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Research Triangle Park NC 27711

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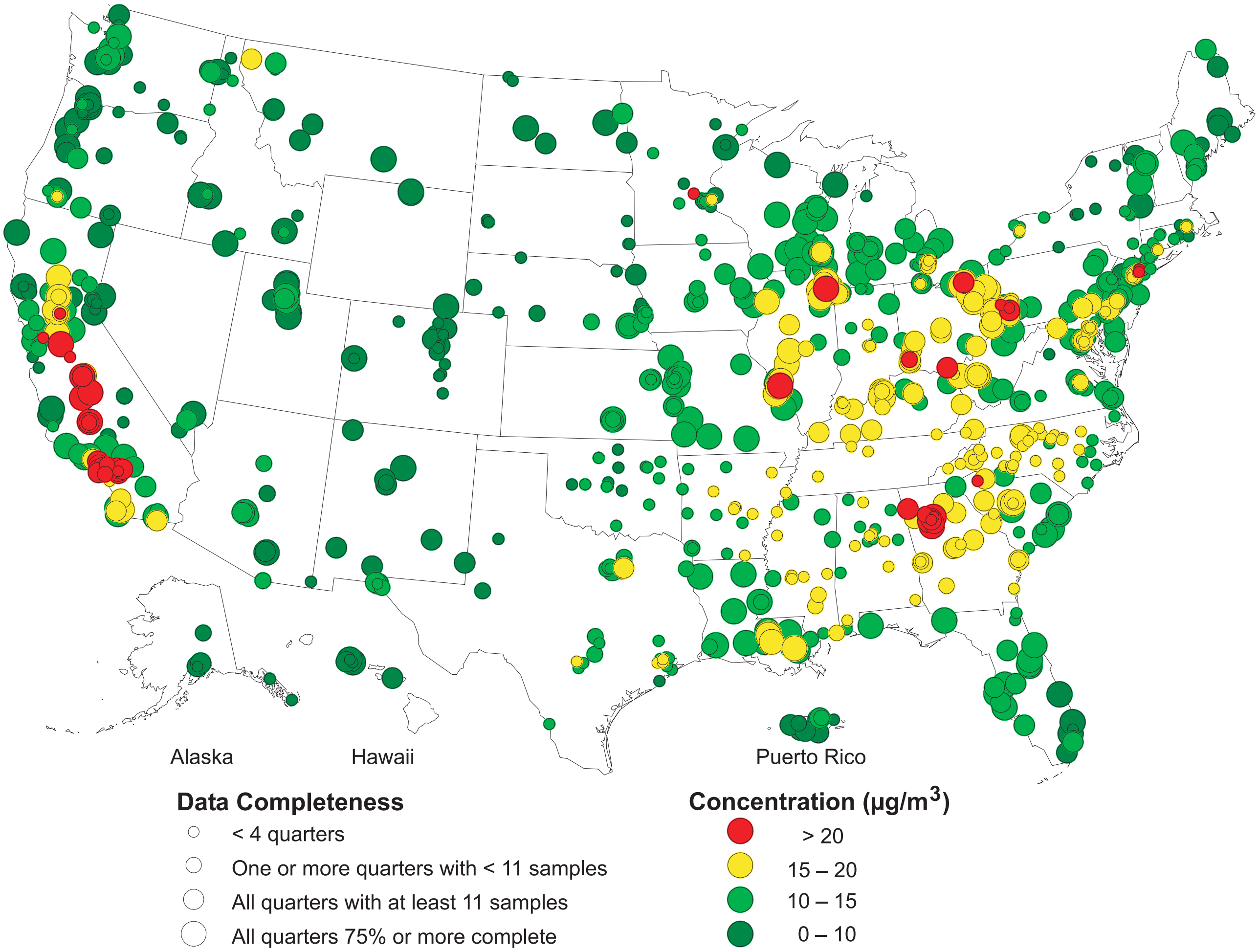
Air

EPA

National Air Quality and Emissions Trends Report, 1999

1999 Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)



Source: US EPA AIRS Data base as of 7/12/00 without data flagged as 1, 2, 3, 4, T, W, Y, or X.

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National Air Quality and Emissions Trends Report, 1999

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions Monitoring and Analysis Division
Air Quality Trends Analysis Group
Research Triangle Park, North Carolina 27711

March 2001

About the Cover

The map on the cover depicts nationwide annual mean $PM_{2.5}$ concentrations from the Federal Reference Method (FRM) monitoring network, as well as information on data completeness. Annual mean concentrations are generally above the level of the 1997 standard of 15 $\mu g/m^3$ in much of the eastern United States and throughout California. Annual mean concentrations above 20 $\mu g/m^3$ are seen in several major metropolitan areas including Pittsburgh, Cleveland, Atlanta, Chicago, and St. Louis and Los Angeles The western Great Plains and mountain regions show notably low annual mean concentrations, most below 10 $\mu g/m^3$.

Data Source: U.S. EPA AIRS Data Base 1/30/01.

Disclaimer

Acknowledgments

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Preface

This is the 27th annual report on air pollution trends in the United States issued by the U.S. Environmental Protection Agency. The report is prepared by the Air Quality Trends Analysis Group (AQTAG) in Research Triangle Park, North Carolina and is directed toward both the technical air pollution audience and other interested parties and individuals.

The report can be accessed via the Internet at **http://www.epa.gov/airtrends/**. AQTAG solicits comments on this report and welcomes suggestions regarding techniques, interpretations, conclusions, or methods of presentation. Comments can be submitted via the website or mailed to:

Attn: Trends Team
AQTAG (MD-14)
U.S. EPA
Research Triangle Park, NC 27711

Readers can access data from the Aerometric Information Retrieval System (AIRS) at **http://www.epa.gov/airsdata/** and real time air pollution data at **http://www.epa.gov/airnow/**.

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Acronyms

AIRS	Aerometric Information Retrieval System
AQRV	Air-Quality Related Values
AIRMoN	Atmospheric Integrated Assessment Monitoring Network
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CARB	California Air Resources Board
CASAC	Clean Air Scientific Advisory Committee
CASTNet	Clean Air Status and Trends Network
CEMs	Continuous Emissions Monitors
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CMSA	Consolidated Metropolitan Statistical Area
DST	Daylight Savings Time
EPA	Environmental Protection Agency
FRM	Federal Reference Method
GDP	Gross Domestic Product
GLM	General Linear Model
HAPs	Hazardous Air Pollutants
IADN	Integrated Atmospheric Deposition Network
I/M	Inspection and Maintenance Programs
IMPROVE	Interagency Monitoring of PROtected Environments
MACT	Maximum Achievable Control Technology
MARAMA	Mid-Atlantic Regional Air Management Association
MDN	Mercury Deposition Network
MSA	Metropolitan Statistical Area
MDL	Minimum Detectable Level
NAAQS	National Ambient Air Quality Standards
NADP/NTN	National Atmospheric Deposition Program/National Trends Network
NAMS	National Air Monitoring Stations
NAPAP	National Acid Precipitation Assessment Program
NARSTO	North American Research Strategy for Tropospheric Ozone
NESCAUM	Northeast States for Coordinated Air Use Management
NLEV	National Low Emission Vehicle
NMOC	Non-Methane Organic Compound
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NPS	National Park Service
NTI	National Toxics Inventory
O_3	Ozone
OTAG	The Ozone Transport Assessment Group
PAHs	Polyaromatic Hydrocarbons
PAMS	Photochemical Assessment Monitoring Stations
PAN	Peroxyacetyl Nitrate
Pb	Lead
PBTs	Persistent and Bioaccumulative Toxics
PCBs	Polychlorinated Biphenyls
PM_{10}	Particulate Matter of 10 micrometers in diameter or less
$PM_{2.5}$	Particulate Matter of 2.5 micrometers in diameter or less
POM	Polycyclic Organic Matter
ppm	Parts Per Million
PSI	Pollutant Standards Index
RFG	Reformulated Gasoline
RVP	Reid Vapor Pressure
SLAMS	State and Local Air Monitoring Stations
SNMOC	Speciated Non-Methane Organic Compound
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
TNMOC	Total Non-Methane Organic Compound
TRI	Toxic Release Inventory
TSP	Total Suspended Particulate
UATMP	Urban Air Toxics Monitoring Program
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds
$\mu g/m^3$	Micrograms Per Cubic Meter

CHAPTER 1

Executive Summary

http://www.epa.gov/oar/aqtrnd99/chapter1.pdf

Criteria pollutants are those pollutants for which the United States Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS). They include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2).

Percent Decrease in National Air Quality Concentrations

1980–1999		1990–1999
57	Carbon Monoxide	36
94	Lead	60
25	Nitrogen Dioxide	10
20	Ozone*	4
—	Particulate Matter (PM_{10})	18
50	Sulfur Dioxide	36

* based on 1-hour level.

Air quality concentrations are based on actual measurements of pollutant concentrations in the air at selected monitoring sites across the country.

Fine particulate matter, or $PM_{2.5}$, are those particles whose aerodynamic diameter is less than or equal to 2.5 micrometers.

Worth Noting:

20-YEAR TRENDS

- National levels of all the criteria pollutants are down.
- Visibility has improved in the East.

10-YEAR TRENDS

$PM_{2.5}$

- In the rural east, sulfates (which comprise approximately 50 percent of $PM_{2.5}$) are down 24 percent over the last 10 years and in 1999 have returned to 1996–1997 levels, after higher levels in 1998.
- At the Class I areas, $PM_{2.5}$ levels, on average, are also back down in 1999.

Visibility

- Overall, the eastern Class I sites do not appear to be getting any worse.
- The eastern Class I sites as an aggregate, showed a 15-percent improvement for the haziest days from 1992–1999. The light extinction due to sulfates reached its lowest level of the 1990s.

Ozone

- While national levels improved in the last 10 years, 1-hour ozone levels in selected regions increased, and 8-hour levels in rural areas increased.

Air Toxics

- Large national emission reductions have been achieved in air toxics (also known as hazardous air pollutants) between the baseline period (1990–1993) and 1996. Improvements come from "major" stationary sources and highway vehicles.

INTRODUCTION

This is the 27th annual report documenting air pollution trends in the United States.[1–25, 27] This document highlights the Environmental Protection Agency's (EPA's) most recent assessment of the nation's air quality, focusing on the 20-year period from 1980–1999. It features comprehensive information for the criteria pollutants and hazardous air pollutants, as well as relevant ambient air pollution information for visibility impairment and acid rain.

Discussions throughout this report are based on the principle that many of the programs designed to reduce ambient concentrations of the criteria pollutants also aid in reducing pollution that contributes to air toxics pollution, visibility impairment, and acid rain. Likewise, requirements under the various air toxics, visibility, and acid rain programs can also help reduce emissions that contribute to ambient concentrations of the criteria pollutants.

CHAPTER 2

CRITERIA POLLUTANTS — NATIONAL TRENDS

EPA tracks trends associated with the criteria pollutant standards. The national and regional air quality trends, along with supporting emissions data, are presented in this chapter. National levels of all criteria pollutants are down over the last 20 years. Over the last 20 years, ozone (O_3) (1-hour and 8-hour) levels nationally have improved considerably. Some parts of the country show increases in levels over the last 10 years, due mainly to increased NO_x emissions and weather conditions favorable to O_3 formation. Rural O_3 levels appear to be increasing in the short term. However, O_3 levels in urban areas where O_3 problems have historically been the most severe have shown marked improvement in response to stringent controls. Over the last 20 years, urban NO_2 concentrations across the country have decreased. All areas of the country that once violated the NAAQS for NO_2 now meet this standard. Since 1988 represents the first complete year of PM_{10} data for most monitors, a 20-year trend is not available. However, the most recent 10-year period (1990–1999) shows that the national average of annual mean PM_{10} concentrations decreased 18 percent. The national composite average of SO_2 annual mean concentrations decreased 36 percent between 1990–1999 with the largest single-year reduction occurring between 1994 and 1995. Nationally carbon monoxide (CO) levels for 1999 are the lowest recorded in the last 20 years and this air quality improvement is consistent across all regions of the country. Presently only six areas of the country have CO levels violating the NAAQS. From 1980–1999, there has been a 94-percent decrease in lead (Pb) emissions with a corresponding 94-percent decrease in maximum quarterly average Pb concentrations at population oriented monitors. There are only six areas in the country in nonattainment for Pb and these are associated with specific point sources.

Summary of MSA Trend Analyses by Pollutant, 1990–1999

	Trend Statistic	Total # MSAs	# MSAs Up	# MSAs Down	# MSAs with No Significant Change
CO	second max 8-hour	138	0	107	31
Lead	max quarterly mean	69	1	44	24
NO_2	arithmetic mean	99	3	41	55
Ozone	fourth max 8-hour	207	25	10	172
Ozone	second daily max 1-hour	207	17	14	176
PM_{10}	90th percentile	216	1	113	102
PM_{10}	weighted annual mean	216	2	126	88
SO_2	arithmetic mean	148	1	86	61
SO_2	second max 24-hour	149	1	82	66

CHAPTER 3

CRITERIA POLLUTANTS — METROPOLITAN AREA TRENDS

Chapter 3 characterizes air quality on a more local level, using three different indicators. First, this chapter lists the 1999 peak air quality concentrations for metropolitan statistical areas (MSAs) . Second, 10-year trends are assessed for each area using a statistical method to measure whether the trend is up or down. The results show that of the 263 areas examined: 1) 214 had downward trends in at least one of the criteria pollutants; 2) 34 had upward trends; 3) 41 areas had no significant trends. A closer look at the

34 areas with upward trends reveals that most were exceeding the level of the 8-hour ozone standard.

The third way in which local air quality is evaluated is by looking at the Air Quality Index (AQI) in the nation's 94 largest metropolitan areas. Ozone accounts for majority of the days with AQI values over 100. Between 1990 and 1999, the total number of days with AQI values greater than 100 decreased 62 percent in southern California but actually rose 25 percent in the remaining major cities across the United States.

CHAPTER 4

CRITERIA POLLUTANTS — OFFICIAL NONATTAINMENT AREAS

Chapter 4 summarizes the current status of nonattainment areas, which are those officially designated areas not meeting the NAAQS for at least one of the six criteria pollutants. As of September 2000, 114 areas are designated nonattainment. These areas are displayed on a map in this chapter. A second map depicts the current ozone nonattainment areas, color-coded to indicate the severity of the ozone problem in each area. The condensed list of nonattainment areas as of September 2000 is presented in Table A-19.

CHAPTER 5

AIR TOXICS

Chapter 5 presents information on Hazardous Air Pollutants (HAPs), commonly called air toxics. These are pollutants known to cause or suspected of causing cancer or other serious human health effects or ecosystem damage. As of the date of this publication, the 1996 National Toxics Inventory (NTI) contains the most complete, up-to-date air toxics emission estimates available for 188 HAPs. For purposes of this report, the information in the NTI has been divided into four overarching source types: 1) large industrial or "major" sources; 2) "area and other sources," which include smaller industrial sources, such as small drycleaners and gasoline stations, as well as natural sources, such as wildfires; 3) "onroad" mobile, including highway vehicles; and 4) "nonroad" mobile sources, like aircraft, locomotives, and lawn mowers. Summaries of the 1996 emissions provide detail that includes contributions of source types to the 188 HAPs, the subset of 33 urban HAPs as well as the recently designated 21 mobile source air toxics.

A comparison of the 1996 NTI to the baseline period (1990–1993) shows that large national emission reductions have been achieved. For 188 HAPs, there is a 23-percent reduction between the baseline and 1996. For the 33 urban HAPs, there is a 30-percent reduction between the baseline and 1996. Improvements come from "major" stationary sources and highway vehicles. Further reductions are expected from both existing programs and planned future efforts.

Although there is currently no national air toxics monitoring network, there are approximately 300 monitoring sites currently producing ambient data on some of the HAPs. Although the sites are not necessarily at locations which represent the highest area-wide concentrations, they can still be used to provide useful information on trends in ambient air toxics. Ambient monitoring results generally reveal downward trends for most pollutants. The most consistent improvements are apparent for benzene and for total suspended lead. From 1994–1999, annual average concentrations for these two HAPs declined 40 and 47 percent respectively. EPA is working together with state and local air monitoring agencies to build upon the existing monitoring sites to develop a national monitoring network.

CHAPTER 6

VISIBILITY TRENDS

The Clean Air Act (CAA) authorizes EPA to protect visibility, or visual air quality, through a number of programs. These programs include the National Visibility Program under sections 169a and 169b of the Act, the Prevention of Significant Deterioration Program for the review of potential impacts from new and modified sources, the secondary National Ambient Air Quality Standards (NAAQS) for PM_{10} and $PM_{2.5}$, and the Acid Rain Program under section 401. The National Visibility Program, established in 1980, requires the protection of visibility in 156 mandatory federal Class I areas across the country (primarily national parks and wilderness areas). The CAA established as a national visibility goal "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory federal Class I areas in which impairment results from man-made air pollution." The Act also calls for state programs to make "reasonable progress" toward the national goal.

The trends analyses presented in this chapter are based on data from the IMPROVE network. There were 34 sites having data adequate for assessing trends between 1990 and 1999. The network recently has been expanded to provide complete coverage of all mandatory federal Class I areas.

Because of the significant regional variations in visibility conditions, the trends are grouped into eastern and western regions, rather than a national aggregate. The trends are presented in terms of the annual average values for the "clearest," "typical," and "haziest" days monitored each year.

The results show that, in general, visibility is worse in the East than in the West. In fact, visibility impairment for the worst days in the West is close to the level of impairment for the best day in the East.

This year's analyses show that the 10 eastern U.S. Class I sites as an aggregate show improvement for the haziest days over the 1992–1999 timeframe primarily due to reduced levels of sulfate. The 26 western U.S. Class I sites as an aggregate show improvement for the clearest 20 percent and middle 20 percent of days over 1990–1999 timeframe.

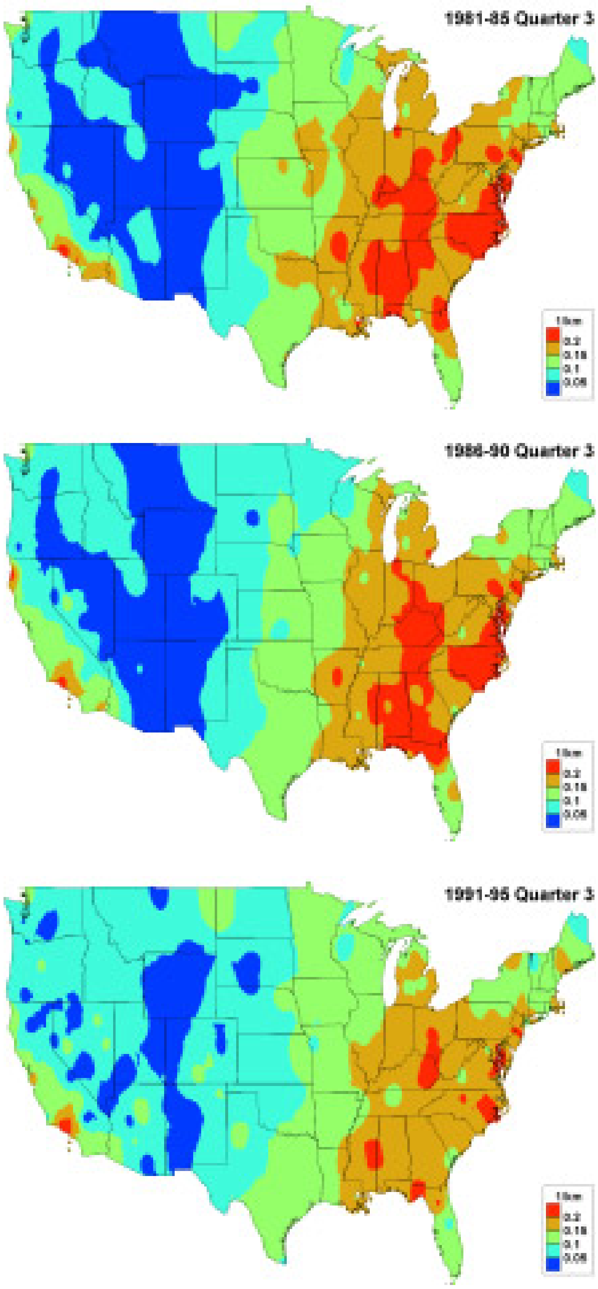
Long-term visibility trends (1990–1999) illustrated in the figures show that summer visibility in the eastern United States improved between 1991–1995. This trend follows overall trends in sulfur dioxides emissions discussed in Chapter 2.

CHAPTER 7

ATMOSPHERIC DEPOSITION OF SULFUR AND NITROGEN COMPOUNDS

Sulfur and nitrogen oxides are emitted into the atmosphere primarily from the burning of fossil fuels. These emissions react in the atmosphere to form compounds that are transported long distances and are subsequently deposited in the form of pollutants such as particulate matter (sulfates, nitrates) and related

Long-term Trends for 75th Percentile Light Extinction Coefficient from Airport Visual Data (July–September)



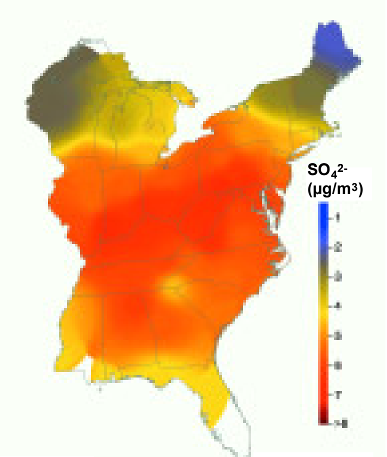
gases (nitrogen dioxide, sulfur dioxide and nitric acid). Nitrogen oxides will also interact with volatile organic compounds to form ozone. The effects of atmospheric deposition include acidification of lakes and streams, nutrient enrichment of coastal waters and large river basins, soil nutrient depletion and decline of sensitive forests, agricultural crop damage, and impacts on ecosystem biodiversity. Toxic pollutants and metals can also be transported and deposited through atmospheric processes.

Both local and long-range emission sources contribute to atmospheric deposition. Total atmospheric deposition is determined using both wet and dry deposition measurements. Wet deposition is the portion dissolved in cloud droplets and is deposited during rain or other forms of precipitation. Dry deposition includes both gas and particle transfer to surfaces during periods of no precipitation. Although the term "acid rain" is widely recognized, the dry deposition portion can range from 20–60 percent of total deposition.

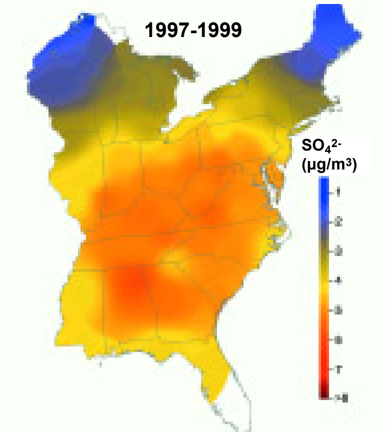
EPA is required by several Congressional and other mandates to assess the effectiveness of air pollution control efforts. These mandates include Title IX of the 1990 Clean Air Act Amendments (the National Acid Precipitation Assessment Program), the Government Performance and Results Act, and the U.S./Canada Air Quality Agreement. One measure of effectiveness of these efforts is whether sustained reductions in the amount of atmospheric deposition over broad geographic regions are occurring. However, permanent changes in SO_2 emissions happen very slowly and atmospheric trends are often obscured by the wide variability of measurements and climate. Numerous years of continuous and consistent data are required to overcome this variability, making long-term monitoring networks especially critical for characterizing deposition levels and identifying relationships among emissions, atmospheric loadings and effects on human health and the environment.

Sulfate concentrations in precipitation have decreased over the past two decades. The reductions were relatively large in the early 1980s followed by more moderate declines until 1995. These reductions in wet sulfates are similar to changes in SO_2 emissions. In 1995 and 1996, however, concentrations of sulfates in precipitation over a large area of the eastern United States exhibited a dramatic and unprecedented reduction. Sulfates in rain have been estimated to be 10–25 percent lower than levels expected with a continuation of 1983–1994 trends. The wet sulfate deposition levels in the 1990–1992 and 1997–1999 time periods, together with the absolute change, are illustrated in the figure. This important reduction in acid precipitation is directly related to the large regional decreases in SO_2 emissions resulting from phase I of the Acid Rain Program (See "Trends in SO_2" in Chapter 2 of this report). The largest reductions in sulfate deposition occurred along the Ohio River Valley and in states to the north and immediately downwind of this region. Nitrogen trends paint a different picture. Nitrate and ammonium deposition derived from National Atmospheric Deposition Program measurement sites reveal 10-year improvement in some areas, including eastern TX, MI, PA and NY. Increased deposition is estimated for the Plains states; and the Western Ohio River and Central Mississippi River Valleys. From ammonium in rain, increases are also noted for eastern NC. However, nitrogen levels for most areas of the county in 1997–1999 were not appreciably different from historical levels.

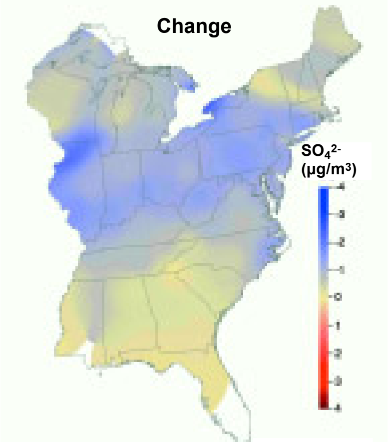
Rural Annual Average Sulfate Concentrations From CASTNet, 1990–1992 vs. 1997–1999



Source: CASTNet



Source: CASTNet



Source: CASTNet

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CHAPTER 2

Criteria Pollutants — National Trends

http://www.epa.gov/oar/aqtrnd99/chapter2.pdf

This chapter presents national and regional trends for each of the pollutants for which the United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS). NAAQS are in place for the following six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). Table 2-1 lists the NAAQS for each pollutant in terms of the level and averaging time of the standard used to evaluate compliance.

There are two types of standards: primary and secondary. Primary standards protect against adverse human health effects, whereas secondary standards protect against welfare effects such as damage to crops, ecosystems, vegetation, buildings, and decreased visibility. There are primary standards for all of the criteria pollutants. Some pollutants (PM and SO_2) have primary standards for both long-term (annual average) and short-term (24 hours or less) averaging times. Short-term standards most directly protect people from adverse health effects associated with peak short-term exposures to air pollution, while long-term standards can protect people from adverse health effects associated with short- and long-term exposures to air pollution.

Table 2-1. NAAQS in effect as of December 2000.

Pollutant	Primary Standard (Health Related)		Secondary Standard (Welfare Related)	
	Type of Average	Standard Level Concentration[a]	Type of Average	Standard Level Concentration
CO	8-hour[b]	9 ppm (10 mg/m^3)	No Secondary Standard	
	1-hour[b]	35 ppm (40 mg/m^3)	No Secondary Standard	
Pb	Maximum Quarterly Average	1.5 μg/m^3	Same as Primary Standard	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 μg/m^3)	Same as Primary Standard	
O_3	Maximum Daily 1-hour Average[c]	0.12 ppm (235 μg/m^3)	Same as Primary Standard	
	4th Maximum Daily[d] 8-hour Average	0.08 ppm (157 μg/m^3)	Same as Primary Standard	
PM_{10}	Annual Arithmetic Mean	50 μg/m^3	Same as Primary Standard	
	24-hour[b]	150 μg/m^3	Same as Primary Standard	
$PM_{2.5}$	Annual Arithmetic Mean[e]	15 μg/m^3	Same as Primary Standard	
	24-hour[f]	65 μg/m^3	Same as Primary Standard	
SO_2	Annual Arithmetic Mean	0.03 ppm (80 μg/m^3)	3-hour[b]	0.50 ppm (1,300 μg/m^3)
	24-hour[b]	0.14 ppm (365 μg/m^3)		

[a] Parenthetical value is an approximately equivalent concentration. (See *40 CFR* Part 50).

[b] The short-term (24-hour) standard of 150 μg/m^3 is not to be exceeded more than once per year on average over three years.

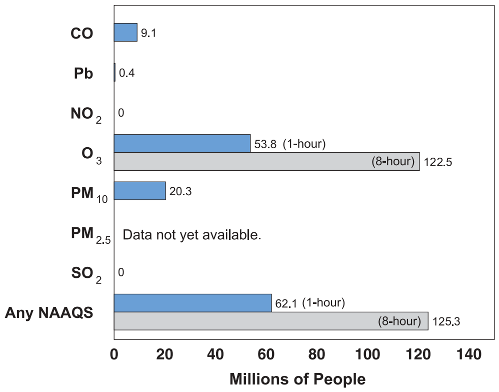
[c] The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one, as determined according to Appendix H of the Ozone NAAQS.

[d] Three-year average of the annual 4th highest daily maximum 8-hour average concentration.

[e] Spatially averaged over designated monitors.

[f] The form is the 98th percentile.

Secondary standards have been established for each criteria pollutant except CO. Secondary standards are identical to the primary standards, with the exception of SO$_2$. Approximately 125 million people in the United states reside in counties that did not meet the primary standard for at least one of the criteria pollutants for the single year 1999.



Number of people living in counties with air quality concentrations above the level of NAAQS in 1999.

On July 18, 1997, EPA revised the ozone and PM NAAQS. The averaging time of the ozone standard changed from a 1-hour average to an 8-hour average to protect against longer exposure periods that are of concern for both human health and welfare. The primary PM standards were revised to change the form of the PM$_{10}$ standards and to add two new PM$_{2.5}$ standards to protect against fine particles.

In May 1999, however, the U.S. Court of Appeals for the D.C. Circuit issued an opinion affecting these revised standards. In particular, the court remanded the ozone standard back to EPA for further consideration. The court also vacated the revised PM$_{10}$ standard and remanded the PM$_{2.5}$ standards back to EPA for further consideration. Following the denial of a petition for a rehearing by the D.C. Circuit, the Justice Department has filed a petition for review before the Supreme Court. Refer to **http://www.epa.gov/airlinks** for up-to-date information concerning actions surrounding the revised standards.

The trends information presented in this chapter is based on two types of data: ambient concentrations and emissions estimates. Ambient concentrations are measurements of pollutant concentrations in the ambient air from monitoring sites across the country. This year's report contains trends data accumulated from 1990–1999 on the criteria pollutants at thousands of monitoring stations located throughout the United states. The trends presented here are derived from the composite average of these direct measurements. The averaging times and air quality statistics used in the trends calculations relate directly to the NAAQS.

The second type of data presented in this chapter are national emissions estimates. These are based largely on engineering calculations of the amounts and kinds of pollutants emitted by automobiles, factories, and other sources over a given period. In addition, some emissions estimates are based on measurements from continuous emissions monitors (CEMs) that have recently been installed at major electric utilities to measure actual emissions. This report incorporates data from CEMs collected between 1994 and 1999 for NO$_x$ and SO$_2$ emissions at major electric utilities. [The emissions data summarized in this chapter and in Appendix A were obtained from the National Emission Inventory data located at **http://www.epa.gov/ttn/chief**. For assistance call INFO CHIEF (919 541-1000).]

Changes in ambient concentrations do not always track changes in national emissions estimates. There are five known reasons for this. First, because most monitors are positioned in urban, population-oriented locales, air quality trends are more likely to track changes in urban emissions rather than changes in total national emissions. Urban emissions are generally dominated by mobile sources, while total emissions in rural areas may be dominated by large stationary sources such as power plants and smelters.

Second, emissions for some pollutants are calculated or measured in a different form than the primary air pollutant. For example, concentrations of ozone are caused by VOC emissions as well as NO$_x$ emissions.

Third, the amount of some pollutants measured at monitoring locations depends on what chemical reactions, if any, occur in the atmosphere during the time it takes the pollutant to travel from its source to the monitoring station.

Fourth, meteorological conditions often control the formation and buildup of pollutants in the ambient air. For example, peak ozone concentrations typically occur during hot, dry, stagnant summertime conditions. CO is predominately a cold weather problem. Also, the amount of rainfall can affect particulate matter levels.

Finally, emission estimates have uncertainties and may not reflect actual emissions. In some cases, estimation methods are not consistent across all 20 years presented in this report.

For a more detailed discussion of the methodology used to compute the trend statistics in this chapter, please refer to Appendix B.

Carbon Monoxide

Air Quality Concentrations

1980–99	57%	decrease
1990–99	36%	decrease
1998–99	3%	decrease

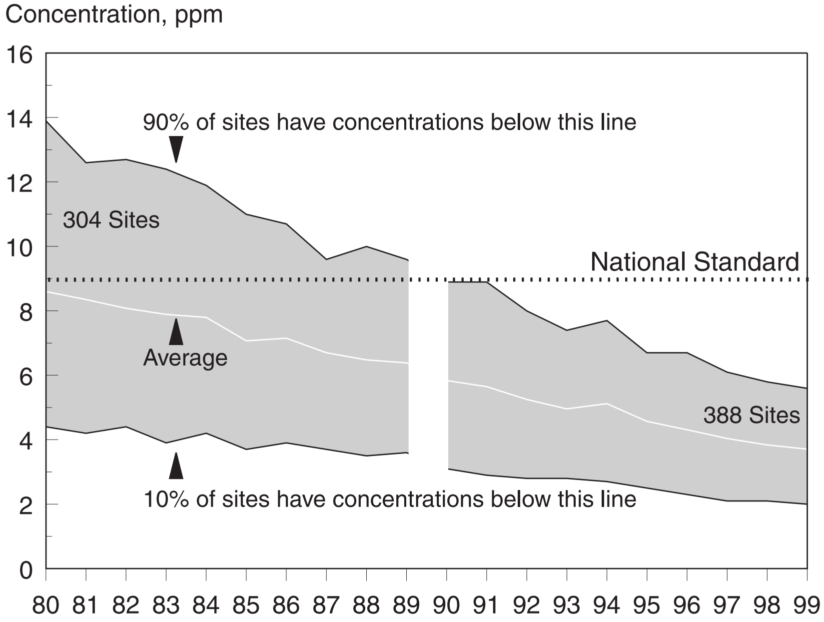
Emissions

1980–99	21%	decrease
1990–99	2%	decrease
1998–99	1%	increase

Worth Noting

- Nationally, carbon monoxide (CO) levels for 1999 are the lowest recorded in last 20 years and this air quality improvement is consistent across all regions of the country.
- Presently, only six areas have CO levels violating the NAAQS (three of these are previous nonattainment areas).
- The National Academy of Sciences is currently initiating a study of persistent CO problem in Fairbanks, Alaska.

Figure 2-1. Trend in 2nd maximum non-overlapping 8-hour average CO concentrations, 1980–1999.



Nature and Sources

Carbon monoxide is a colorless, odorless, and (at much higher levels) poisonous gas, formed when carbon in fuels is not burned completely. It is a product of motor vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide. High concentrations of CO generally occur in areas with heavy traffic congestion. In cities, as much as 95 percent of all CO emissions may emanate from automobile exhaust. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires. Woodstoves, cooking, cigarette smoke, and space heating are sources of CO in indoor environments. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater and nighttime inversion conditions are more frequent.

Health Effects

Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. The health threat from lower levels of CO is most serious for those who suffer from cardiovascular disease, such as angina pectoris. At much higher levels of exposure, CO can be poisonous, and healthy individuals may also be affected. Impairment of cognitive skills, vision and work capacity may occur at elevated CO levels in healthy individuals.

Primary Standards

There are two primary NAAQS for ambient CO: a 1-hour average of 35 ppm, and an 8-hour average of 9 ppm. These concentrations are not to be exceeded more than once per year. There currently are no secondary standards for CO.

National Air Quality Trends

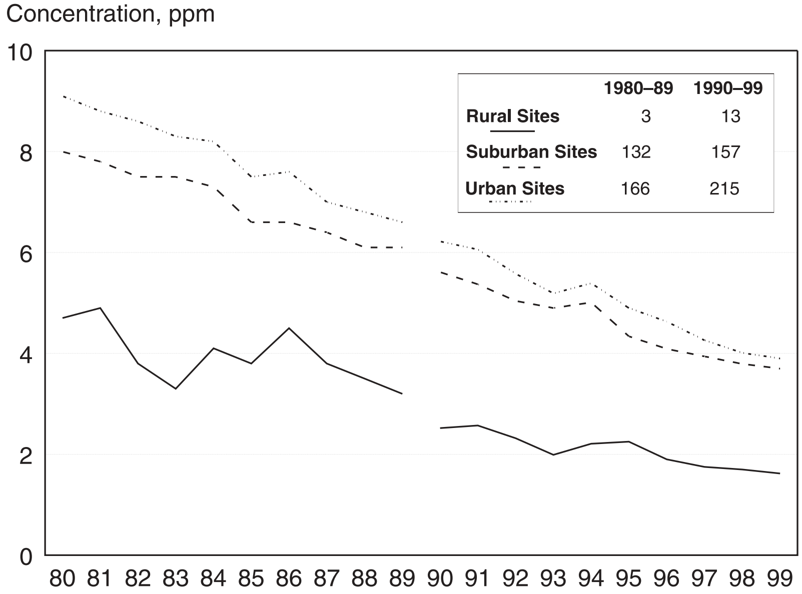
Nationally, CO concentrations have consistently declined over the last 20 years. Figure 2-1 reveals a 57-percent improvement in composite average ambient CO concentrations from 1980 to 1999 and a 36 percent reduction over the last 10 years.[1] Following an upturn in 1994, the nation has experienced year-to-year reductions in peak 8-hour CO concentrations through the remainder of the decade. In fact, the 1999 CO levels are generally the lowest recorded during the past 20 years of monitoring. Exceedances of the 8-hour CO NAAQS (which are simply a count of the number of times the level of the standard is exceeded) have declined 93 percent since 1990.

Long-term reductions in ambient CO concentrations have been measured across all monitoring environments—rural, suburban, and urban sites. Figure 2-2 shows that on average, urban monitoring sites record higher CO concentrations than suburban sites, with the lowest levels found at 16 rural sites. During the past 20 years, the 8-hour CO concentrations decreased 65 percent at 16 rural monitoring sites, 54 percent at 289 suburban sites, and 57 percent at 381 urban sites.

Regional Air Quality Trends

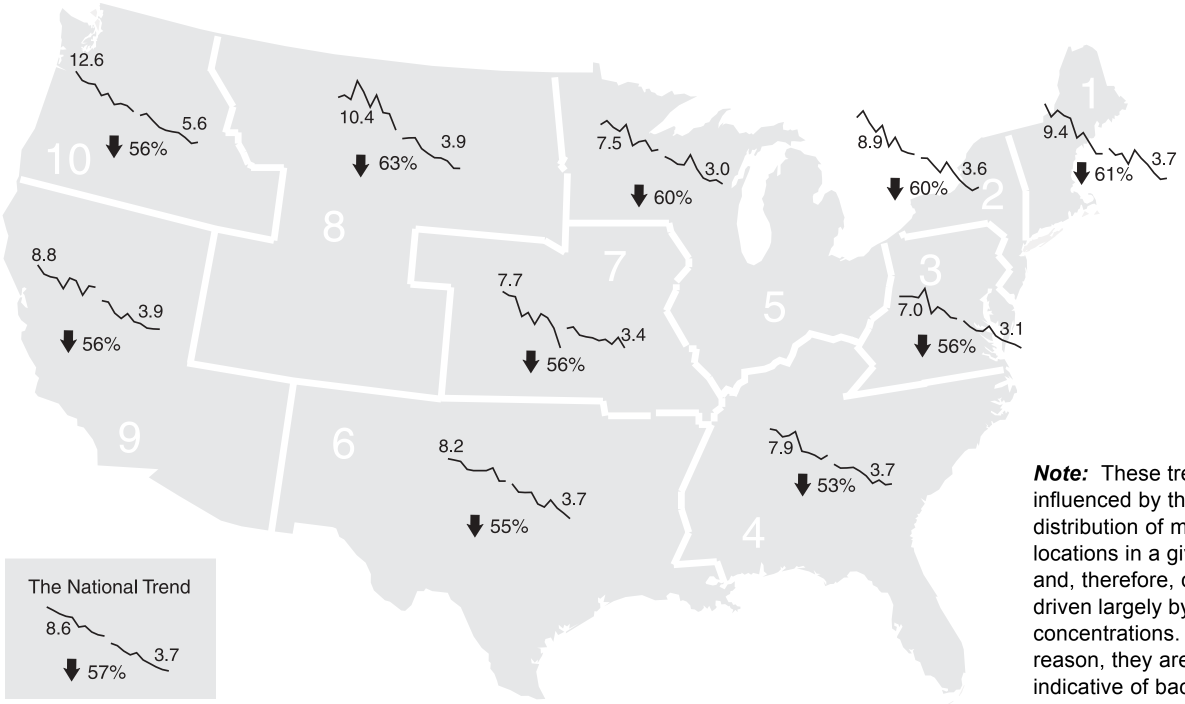
The map in Figure 2-3 shows regional trends in ambient CO concentrations during the past 20 years, 1980–1999. All 10 EPA Regions recorded 20-year improvements in CO levels as measured by the regional composite mean concentrations. Significant 20-year concentration reductions of 50 percent or more are evidenced across the nation except in

Figure 2-2. Trend in 2nd maximum non-overlapping 8-hour average CO concentrations by type of location, 1980–1999.



Note: When the total number of rural, suburban, and urban sites are summed for either the 1980–89 or 1990–99 time periods in Figure 2-2, this number may not equal the total number of sites shown in Figure 2-1for the same time periods. This is due to a few monitoring sites falling outside the definitions of rural, suburban, or urban sites.

Figure 2-3. Trend in CO 2nd maximum non-overlapping 8-hour concentrations by EPA region, 1980–1999.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2.
Concentrations are ppm.

the Midwest where reductions were only slightly smaller.

National Emissions Trends

Figure 2-4 shows that the transportation category, composed of onroad and nonroad sources, accounted for 77 percent of the nation's total CO emissions in 1999. Figure 2-5 presents the broad geographic distributions of 1999 CO emissions based on the tonnage per square mile for each county. This visualization clearly shows that the eastern third of the country and the west coast emitted more CO (on a density basis) than the western two-thirds of the continental United States. National total CO emissions have decreased 21 percent since 1980 as shown in Figure 2-6.[2] Despite a 57-percent increase in vehicle miles traveled (VMT), emissions from onroad vehicles decreased 56

Figure 2-4. CO emissions by source category, 1999.

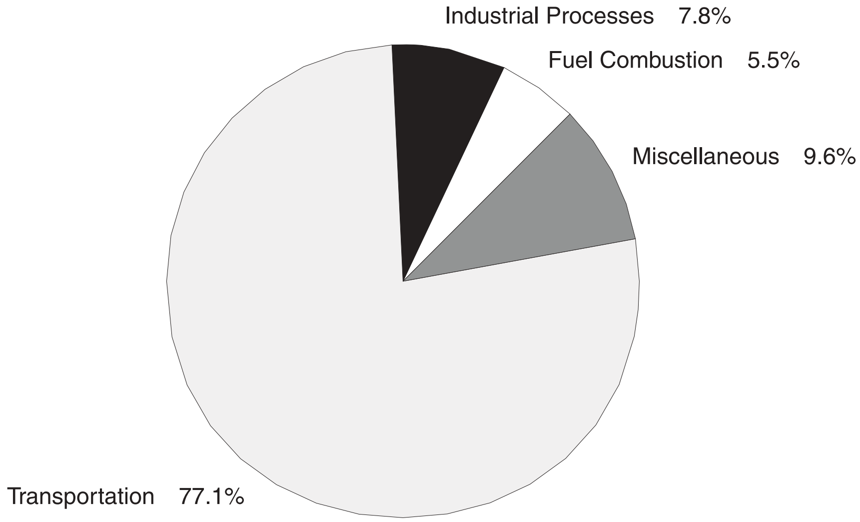
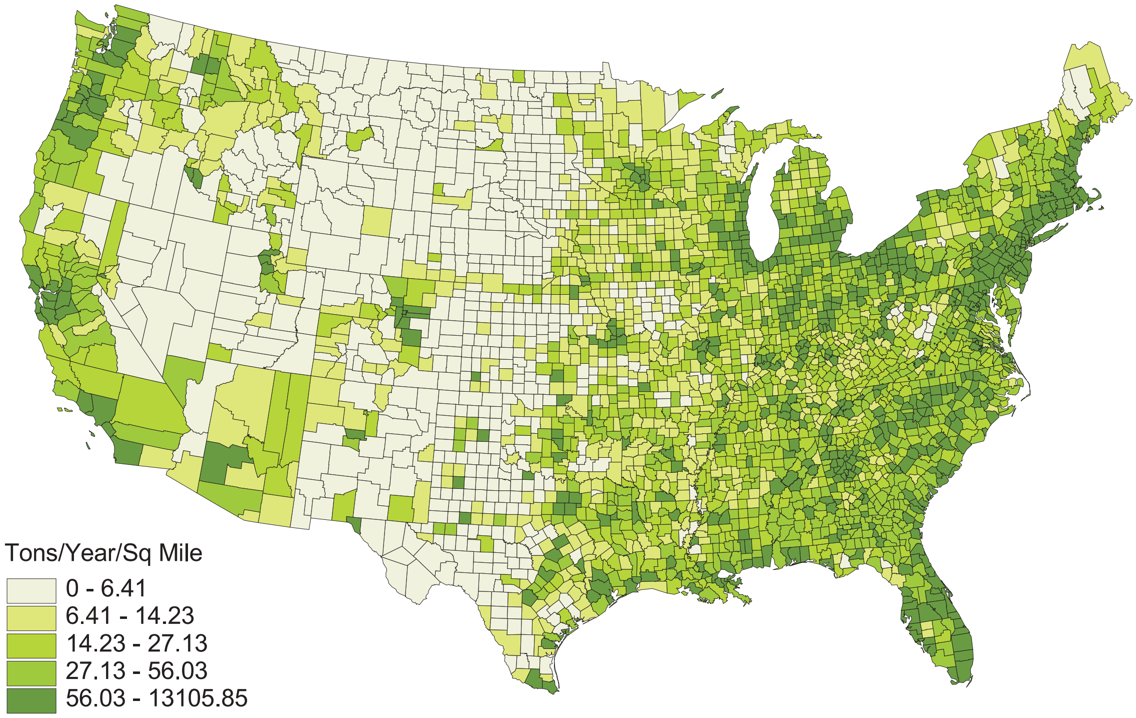


Figure 2-5. Density map of 1999 carbon monoxide emissions, by county.

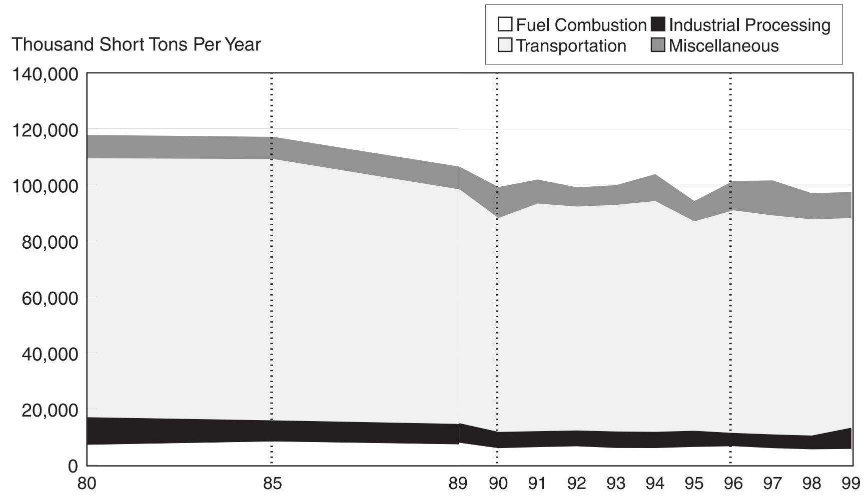


percent during the past 20 years as a result of automotive emissions control programs. However, emissions from all transportation sources have decreased only 23 percent over the same period, primarily due to a 42-percent increase in off-road emissions, which has offset the gains realized in reductions of onroad vehicle emissions.

Table 2-2 lists some of the major milestones in the control of emissions from automobiles starting with the Clean Air Act (CAA) of 1970. At the national level, these measures, which have led to reductions in emissions of CO as well as other pollutants, include establishing national standards for tailpipe emissions, new vehicle technologies, and clean fuels programs. State and local emissions reduction measures include inspection and maintenance (I/M) programs and transportation management programs.

In the area of clean fuels, the 1990 Clean Air Act Amendments (CAAA) require oxygenated gasoline programs in several regions of the country during the winter months. Under the program regulations, a minimum oxygen content (2.7 percent by weight) is required in gasoline to ensure more complete fuel combustion.[3,4] Of the 36 CO nonattainment areas that initially implemented the program in 1992, 17 areas participated in the program during 1999.[5]

Figure 2-6. Trend in national total CO emissions, 1980–1999.[2]



Notes: Emissions data not available for consecutive years 1980–1989.

Emission estimation methods continue to evolve and improve over time. Methods have changed for many significant categories beginning with the years 1985, 1990, and 1996 and consequently are not consistent across all years in this trend period. See Appendix B Emissions Estimates Methodology for additional information.

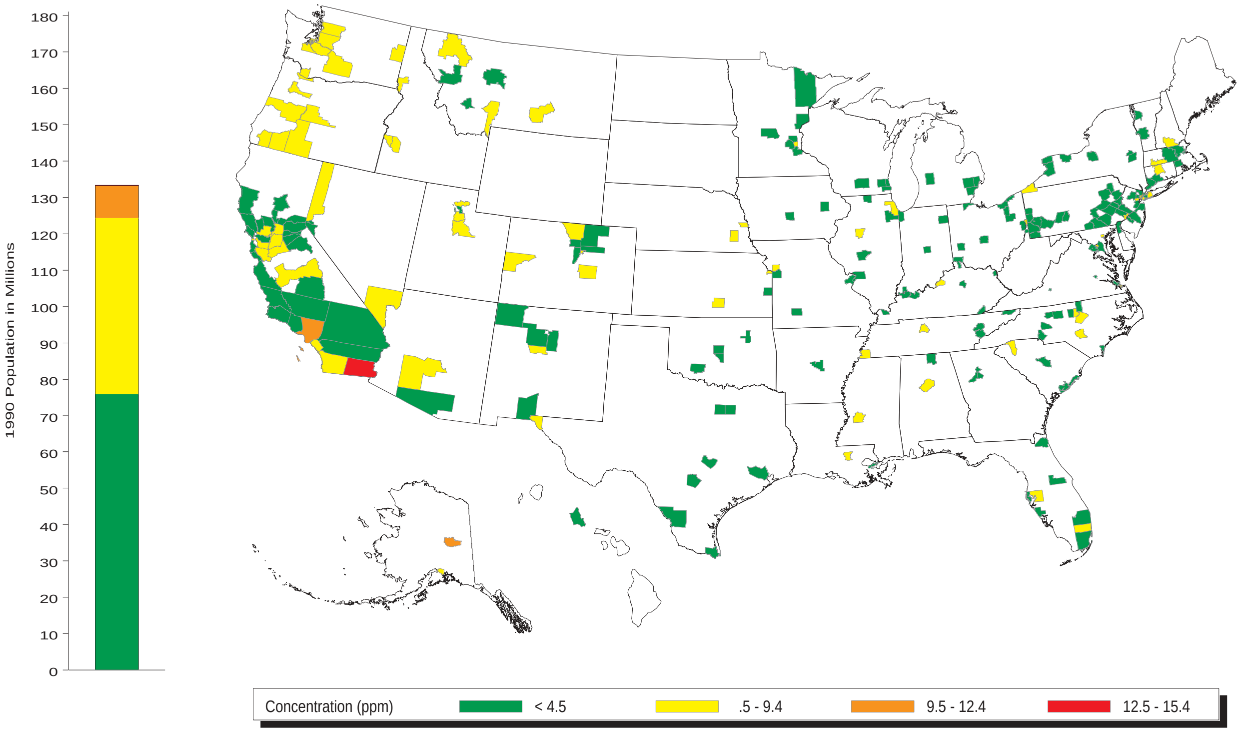
Table 2-2. Milestones in Motor Vehicle Emissions Control

1970	New Clean Air Act sets auto emissions standards.
1971	Charcoal canisters appear to meet evaporative standards.
1973	EGR valves appear to meet NO_x standards.
1974	Fuel economy standards are set.
1975	The first catalytic converters appear for hydrocarbon, CO.
	Unleaded gas appears for use in catalyst equipped cars.
1981	3-way catalysts with on-board computers and O_2 sensors appear.
1983	I/M programs are established in 64 cities.
1989	Fuel volatility limits are set for RVP.
1990	CAAA set new tailpipe standards.
1992	Oxyfuel introduced in cities with high CO levels.
1993	Limits set on sulfur content of diesel fuel.
1994	Phase-in begins of new vehicle standards and technologies.
1995	On-board diagnostic systems in 1996 model year cars.
1995	Phase I Federal Reformulated Gasoline sales begin in worst ozone nonattainment areas.
1998	Sales of 1999 model year California emissions equipped vehicles begin in the Northeast.

Blue Ribbon Panel on Oxygenates in Gasoline

In November 1998, in response to the public concern regarding the detection of MTBE (methyl tertiary butyl ether—one of two fuel oxygenates used in reformulated gasoline to help improve air quality) in water, EPA announced the creation of a blue ribbon panel of leading experts from the public health and scientific communities, automotive fuels industry, water utilities, and local and state governments to review the important issues posed by the use of MTBE and other oxygenates in gasoline. The Panel's final report stated that "the Wintertime Oxyfuel Program continues to provide a means for some areas of the country to come into, or maintain, compliance with the carbon monoxide standard. Los Angeles areas continue to use MTBE in this program. In most areas today, ethanol can, and is, meeting these winter-

Figure 2-7. Highest 2nd maximum non-overlapping 8-hour average CO concentration by county, 1999.



time needs for oxygen without raising fuel volatility concerns given the season of the year. The Panel recommends that the Wintertime Oxyfuel program be continued (a) for as long as it provides a useful compliance and/or maintenance tool for the affected states and metropolitan areas, and (b) assuming that the clarification of state and federal authority described above is enacted to enable states, where necessary, to regulate and/or eliminate the use of gasoline additives that threaten drinking supplies."[6] The Panel's Executive Summary and final report entitled *Achieving Clean Air and Clean Water: The Report of the Blue Ribbon Panel on Oxygenates in Gasoline* can be found on the Panel's homepage at: **http://www.epa.gov/otaq/consumer/fuels/oxypanel/blueribb.htm.**

Additionally, on March 20, 2000, the Clinton Administration, based on the recommendations of the Blue Ribbon Panel, announced a set of legislative principles to address concerns about the continued use of MTBE. The Administration recommended that Congress:

- Amend the CAA to provide the authority to significantly reduce or eliminate the use of MTBE.
- Ensure that air quality gains associated with the use of MTBE are not diminished.
- Replace the existing oxygen requirement contained in the CAA with a renewable fuel standard for all gasoline.

The Administration stated that it believed that the principles would provide an environmentally sound and cost effective approach to addressing the risks posed by the current use of MTBE. Coincident with issuance of the legislative principles, EPA issued an Advance Notice of Proposed Rulemaking under Section 6 of the Toxic Substances Control Act (TSCA) to initiate a regulatory process to address MTBE risks using current authorities in the event that Congress did not act to amend the CAA.[6]

1999 Air Quality Status

The map in Figure 2-7 shows the variations in CO concentrations across the country in 1999. The air quality indicator is the largest annual second maximum 8-hour CO concentration measured at any site in each county. The bar chart to the left of the map displays the number of people living in counties within each concentration range. The colors on the map and bar chart correspond to the colors of the concentration ranges displayed in the map legend. Only four of the 526 monitoring sites reporting ambient CO data to the Aerometric Information Retrieval System (AIRS) failed to meet the CO NAAQS in 1999. These four sites are located in three counties—Los Angeles County, CA; Fairbanks Borough, AK; and Imperial County, CA (Calexico, CA). The site in this latter area is located just north of the border crossing with Mexicali, Mexico. There are 9 million people living in these three counties, compared to the 1998 count of six counties with a total population of 10 million people.

Lead

Air Quality Concentrations		
1980–99	94%	decrease
1990–99	60%	decrease
1998–99		no change

Emissions		
1980–99	94%	decrease
1990–99	16%	decrease
1998–99	4%	increase

Worth Noting

- From 1980–1999, there has been a 94-percent decrease in lead emissions with a corresponding 94-percent decrease in maximum quarterly average lead concentrations at population-oriented monitors.
- Lead emissions are slightly increasing from 1998–1999 even though lead air quality continues its “no-change” status from previous years. Probable cause for the small emissions increase is increased use of aviation fuel, which can still contain large amounts of lead.
- In 1999, only two areas across the country were violating the lead NAAQS, but six are still nonattainment for lead. These areas tend to contain the lead point sources that had one or more source-oriented monitors that violated the NAAQS. These point sources are in Missouri (Doe Run/ Herculeneum plant) and Illinois (Chemetco facility).

Nature and Sources

Twenty-five years ago, automotive sources were the major contributor of lead emissions to the atmosphere. As a result of EPA’s regulatory efforts to reduce the content of lead in gasoline, however, the contribution from the transportation sector, and particularly the automotive sector, has greatly declined. Though aviation fuels still contain relatively large amounts of lead, industrial processes (primarily metals processing) are the major source of lead emissions to the atmosphere today. The highest ambient air concentrations of lead are found in the vicinity of ferrous and nonferrous smelters, battery manufacturers, and other stationary sources of lead emissions.

Health and Environmental Effects

Exposure to lead occurs mainly through inhalation and through ingestion of lead in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues. Lead can also adversely affect the kidneys, liver, nervous system, and other organs. Excessive exposure to lead may cause neurological impairments such as seizures, mental retardation, and/or behavioral disorders. Lead may be a factor in high blood pressure and subsequent heart disease. Additionally, at low doses, fetuses and children may suffer from central nervous system damage. Neurobehavioral changes (i.e., low I.Q.) may result from lead exposure during the child’s first years of life.

Airborne lead can also have adverse impacts on the environment. Wild and domestic grazing animals may ingest lead that has deposited on plant or soil surfaces or that has been absorbed by plants through leaves or roots. At relatively low concentrations (2–10 µg/m^3), lead can inhibit plant growth and result in a shift to more tolerant plant species growing near roadsides and stationary source emissions. See also the Toxics chapter in this report for a discussion of the long-term impact of lead on ecosystem function and stability.

Primary and Secondary Standards

The primary as well as secondary NAAQS for lead is a quarterly average concentration not to exceed 1.5 µg/m^3.

National Air Quality Trends

The statistic used to track ambient lead air quality is the maximum quarterly mean concentration for each year. From 1980–1989, a total of 216 ambient lead monitors met the trends completeness criteria; and a total of 175 ambient lead monitors met the trends data completeness criteria for the 10-year period 1990–1999. Point-source oriented monitoring data were omitted from all ambient trends analysis presented in this section to avoid masking the underlying urban trends.

Figure 2-8 indicates that between 1990 and 1999, maximum quarterly average lead concentrations decreased 60 percent at population-oriented monitors. Between 1998 and 1999, national average lead concentrations (approaching the minimum detectable level) remained unchanged. The effect of the conversion to unleaded gasoline usage in vehicles on ambient lead concentrations is most evident when viewed over a longer period, such as illustrated in Figure 2-8. Between 1980 and 1999, ambient monitor data indicate that concentrations of lead declined 94 percent. This large decline tracks well with overall lead emissions, which also declined 94 percent between 1980 and 1999.

Figure 2-9 looks at urban, rural, and suburban 20-year trends separately. The overall downward trend in lead concentrations can be noted for all locations from 1980–1999. The one slight oddity in Figure 2-9 is the slight upturn in Pb concentration seen at the rural sites in 1995. One of the rural sites in Louisiana (in St. John the Baptist parish) showed a concentration of 5.8 µg/m^3 in December 1995 causing the overall average to increase to 0.411 (up from normal levels of about 0.05 µg/m^3). Region 6 has been consulted regarding this issue and they, in turn, contacted the Louisiana Department of Environmental Quality (LDEQ) to confirm the high lead reading that occurred on December 17, 1995. LDEQ personnel have stated that this is a true reading and that the sampler must have been influenced by lead-rich plumes emitted by the industrial operations that took place at two nearby facilities: Bayou Steel and a recycling business.

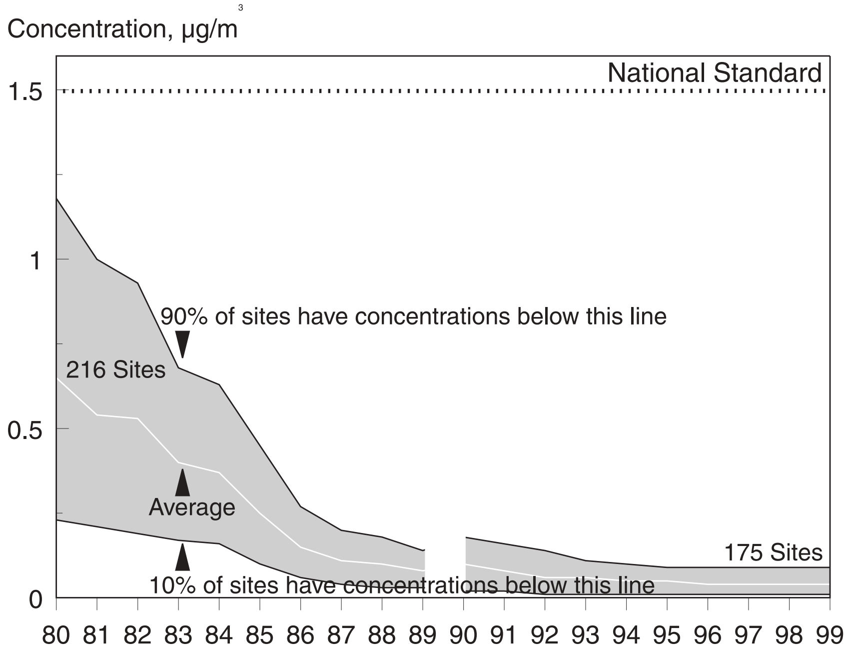
Regional Air Quality Trends

Figure 2-10 segregates the ambient trend analysis by EPA region. Although most regions showed large concentration reductions between 1980 and 1999, there were some intermittent upturns including a rather large upturn in the Region 1 trends plot. Most of these “bumps” in the trends graphs can be attributed to the inherent variability and noise associated with data reported near minimum detectable levels.

National Emission Trends

The lead emission estimates presented are a result of data developed for the National Emission Trends (NET) criteria database. Lead emissions for 1996 were also estimated in the National Toxics Inventory (NTI) and were used in the nationwide disper-

Figure 2-8. Trend in maximum quarterly average Pb concentrations (excluding point-source oriented sites), 1980–1999.



Note: When the total number of rural, suburban, and urban sites are summed for either the 1980–89 or 1990–99 time periods in Figure 2-9, this number may not equal the total number of sites shown in Figure 2-8 for the same time periods. This is due to a few monitoring sites falling outside the definitions of rural, suburban, or urban sites.

Figure 2-9. Pb maximum quarterly mean concentration trends by location (excluding point-source oriented sites), 1980–1999.

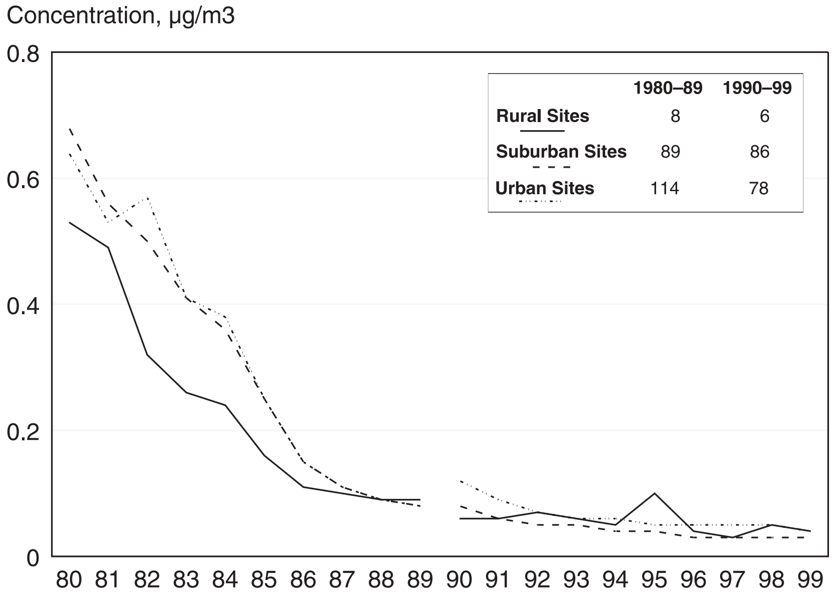
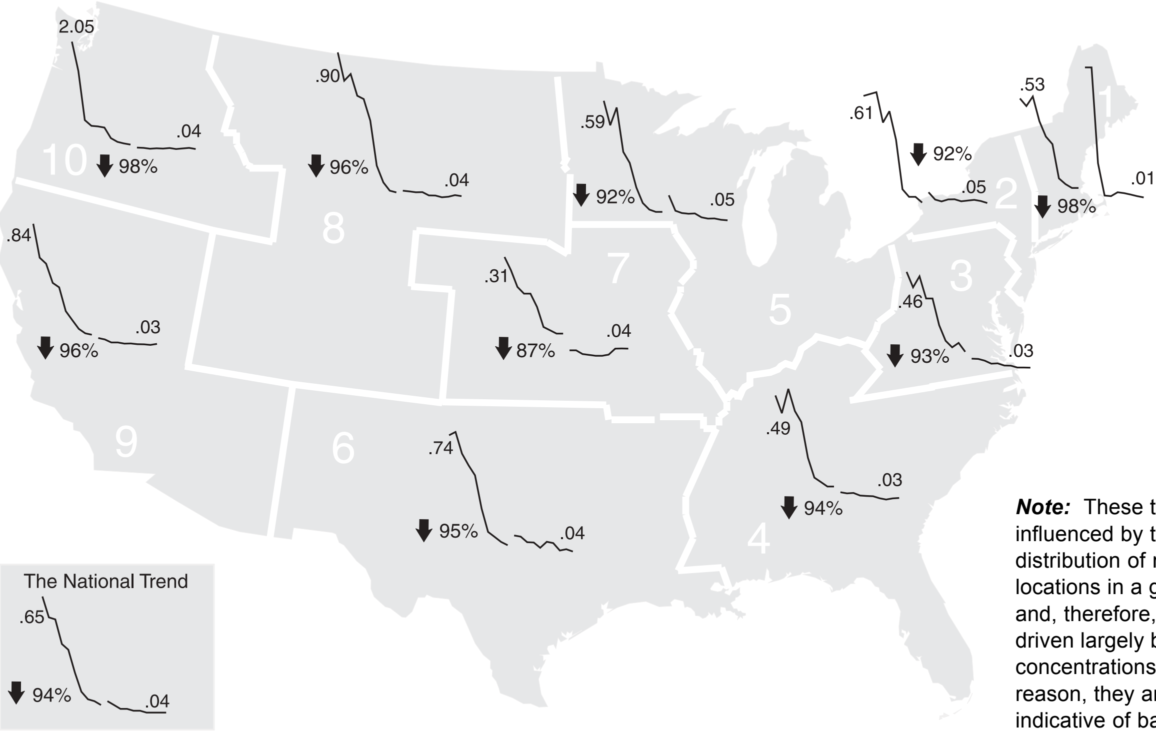


Figure 2-10. Trend in Pb maximum quarterly mean concentration by EPA Region, 1980–1999.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are µg/m^3.

sion modeling as part of EPA's National Air Toxics Assessment (NATA). For 1996, the NTI estimates would be the preferred source for data. In the future, the criteria emissions database (formerly the NET) will be combined with air toxics estimates (formerly in the NTI) in a single data base called the National Emissions Inventory (NEI).

Because of the phase-out of leaded gasoline, lead emissions (and concentrations) decreased sharply during the 1980s and early 1990s. Figure 2-11 indicates that total lead emissions decreased 16 percent between 1990 and 1999. Figure 2-11 also shows that lead emissions decreased 94 percent between 1980 and 1999. The large ambient and emission reductions in lead going from 1980–1990 can be largely attributed to the phasing out of leaded gasoline for automobiles. The magnitude of lead emission reductions after 1990 is a waning result of the phase-out of leaded gasoline use in automotive sources. The 4-percent increase in lead emissions from 1998–1999 is largely attributable to increased use of aviation gasoline. Aviation gasoline is not regulated for lead content and can use significant amounts of lead to comply with octane requirements for aviation fuel.

Figure 2-12 shows that industrial processes were the major source of lead emissions in 1999, accounting for 75 percent of the total. The transportation sector (which includes both onroad and nonroad sources) now accounts for only 13 percent of the total 1999 lead emissions, with most of that coming from aircraft.

1999 Air Quality Status

The large reductions in long-term lead emissions from transportation sources have changed the nature of the ambient lead problem in the United States. Because industrial processes are now responsible for all violations of the lead standard, the lead monitoring strategy now focuses on emission from these point sources. The map in Figure 2-13 shows the lead monitors located in the vicinity of major sources of lead emissions. In 1999, two lead point sources had one or more source-oriented monitors that violated the NAAQS. These two sources are the Chemetco plant in Illinois and the Doe Run (Herculeneum) plant in Missouri. It should be noted that the Franklin smelter in Pennsylvania, which in the past has emitted large amounts of lead, was shut down in 1997. These point sources are ranked in Figure 2-13 according to the site with the greatest maximum quarterly mean. Various enforcement and regulatory actions are being actively pursued by EPA and the states for cleaning up these sources.

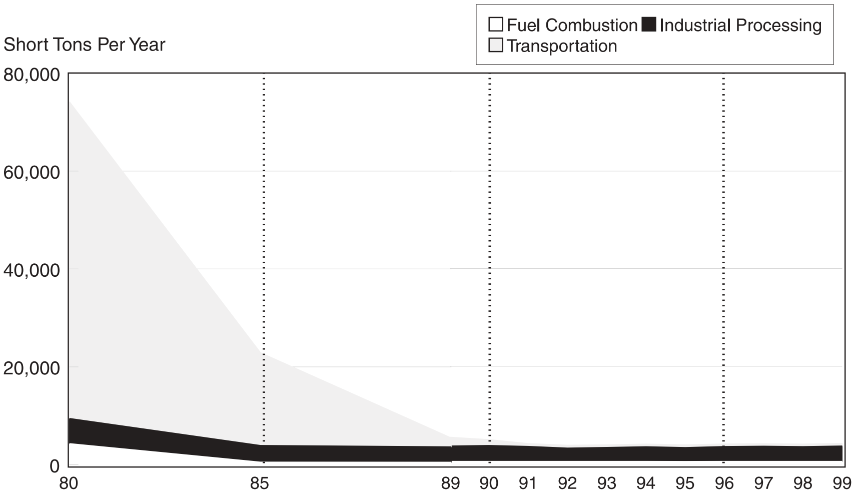
The map in Figure 2-14 shows the highest quarterly mean lead concentration by county in 1999. Two areas, with a total population of approximately 0.42 million, and containing the point sources identified in Figure 2-13, did not meet the lead NAAQS in 1999.

Monitoring Status

Due to the shift in ambient air monitoring focus from mobile-source emissions to stationary point sources of lead air pollution, EPA revised the lead air monitoring regulations by publishing a new rule on January 20, 1999. This action was taken at the direct request of numerous states and local agencies whose onroad mobile-source oriented lead monitors have been reporting peak lead air pollution values that are many times less than the quarterly lead NAAQS of 1.5 µg/m^3 for a number of consecutive years.

The previous regulation required that each urbanized area with a population of 500,000 or more operate at least two lead National Air Monitoring Stations (NAMS). The new rule allows state and local agencies more flexibility. The rule substantially reduces the requirements for measuring lead air pollutant concentrations near major highways,

Figure 2-11. National total Pb emissions trend, 1980–1999.



Notes: Emissions data not available for consecutive years 1980–1989.

Emission estimation methods continue to evolve and improve over time. Methods have changed for many significant categories beginning with the years 1985, 1990, and 1996 and consequently are not consistent across all years in this trend period. See Appendix B Emissions Estimates Methodology for additional information.

Figure 2-12. Pb emissions by source category, 1999.

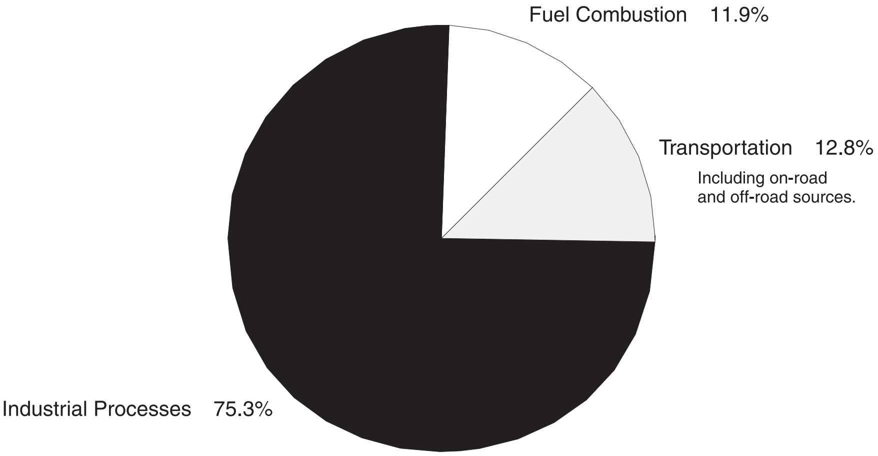
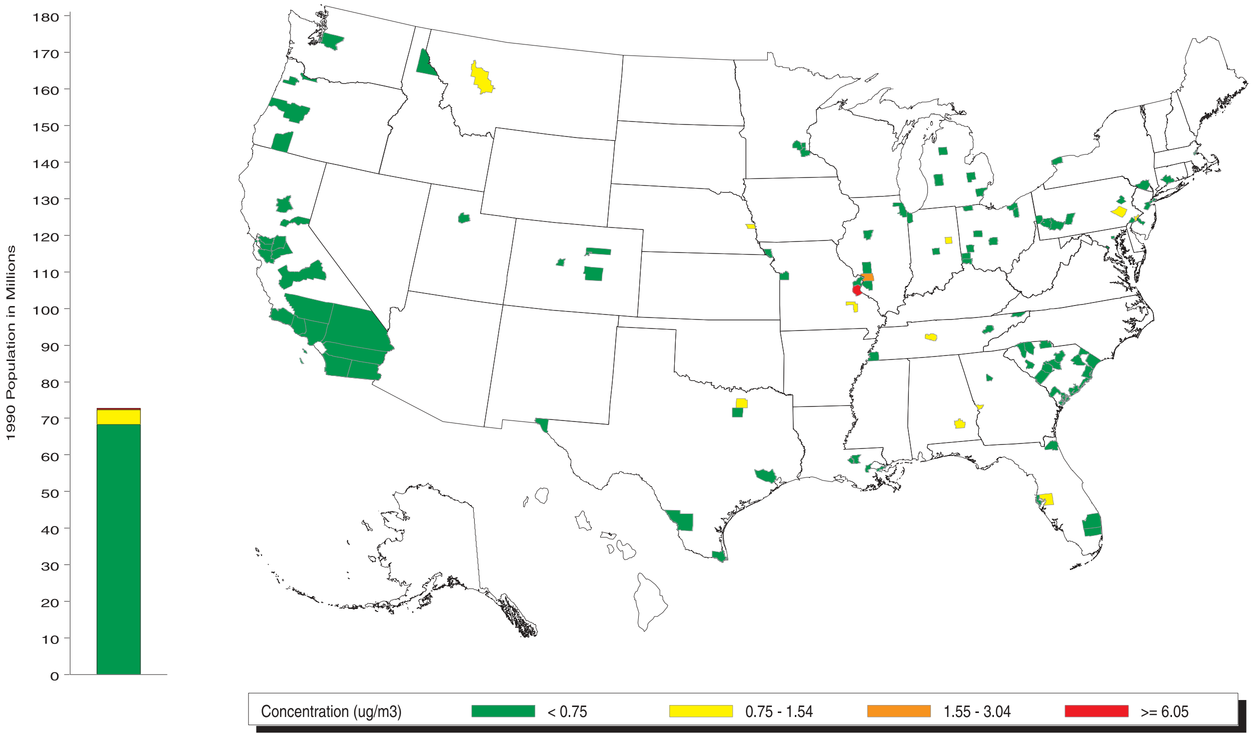


Figure 2-13. Pb maximum quarterly concentration in the vicinity of Pb point sources, 1999.

Rank	ST	Emission Source	Max. Qtr. Avg. (ug/m3)
1	MO	Doe Run (Herculeneum)	6.75
2	IL	Chemetco	2.5

Figure 2-14. Highest Pb maximum quarterly mean by county, 1999.



thus shifting the focus to point sources and their impact on neighboring populations. The regulation also allows states to reduce the number of NAMS from approximately 85 to approximately 15. This reduction will still retain adequate monitoring to ensure attainment of the NAAQS, but it allows efficient refocusing of available monitoring.

Nitrogen Dioxide

Air Quality Concentrations		
1980–99	25%	decrease
1990–99	10%	decrease
1998–99		no change

Emissions		
1980–99	4%	increase
1990–99	5%	increase
1998–99	2%	decrease

Worth Noting

- Over the past 20 years, nitrogen dioxide (NO_2) concentrations across the country have decreased significantly.
- All areas of the country that once violated the national air quality standard for NO_2 now meet that standard.
- The last NO_2 nonattainment area, Los Angeles, was redesignated to attainment in July 1998.

Nature and Sources

Nitrogen dioxide is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Nitrogen oxides (NO_x), the term used to describe the sum of NO, NO_2 and other oxides of nitrogen, play a major role in the formation of ozone in the atmosphere through a complex series of reactions with volatile organic compounds (VOCs). A variety of NO_x compounds and their transformation products occur both naturally and as a result of human activities. Anthropogenic (i.e., man-made) emissions of NO_x account for a large majority of all nitrogen inputs to the environment. The major sources of anthropogenic NO_x emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. Most of NO_x from combustion sources (about 95 percent) is emitted as NO; the remainder is largely NO_2. Because NO is readily converted to NO_2 in the environment, the emissions estimates reported here assume nitrogen oxides are in the NO_2 form. Natural sources of NO_x are lightning, biological and abiological processes in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. Home heaters and gas stoves also produce substantial amounts of NO_2 in indoor settings.

Health and Environmental Effects

Nitrogen dioxide is the most widespread and commonly found nitrogen oxide and is a matter of public health concern. The health effects of most concern associated with short-term exposures (i.e., less than three hours) to NO_2 at or near the ambient NO_2 concentrations seen in the United States, include cough and increased changes in airway responsiveness and pulmonary function in individuals with preexisting respiratory illnesses, as well as increases in respiratory illnesses in children 5–12 years old.[7,8] Evidence suggests that long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause structural alterations in the lungs.

Atmospheric transformation of NO_x can lead to the formation of ozone and nitrogen-bearing particles (e.g., nitrates and nitric acid). As discussed in the ozone and PM sections of this report, exposure to both PM and ozone is associated with adverse health effects.

Nitrogen oxides contribute to a wide range of effects on public welfare and the environment, including global warming and stratospheric ozone depletion. Deposition of nitrogen can lead to fertilization, eutrophication, or acidification of terrestrial, wetland and aquatic (e.g., fresh water bodies, estuaries, and coastal water) systems. These effects can alter competition between existing species, leading to changes in the number and type of species (composition) within a community. For example, eutrophic conditions in aquatic systems can produce explosive algae growth leading to a depletion of oxygen in the water and/or an increase in levels of toxins harmful to fish and other aquatic life.

Primary and Secondary Standards

The level for both the primary and secondary NAAQS for NO_2 is 0.053 ppm annual arithmetic average (mean), not to be exceeded. In this report, the annual arithmetic average (mean) concentration is the metric used to evaluate and track ambient NO_2 air quality trends.

National Air Quality Trends

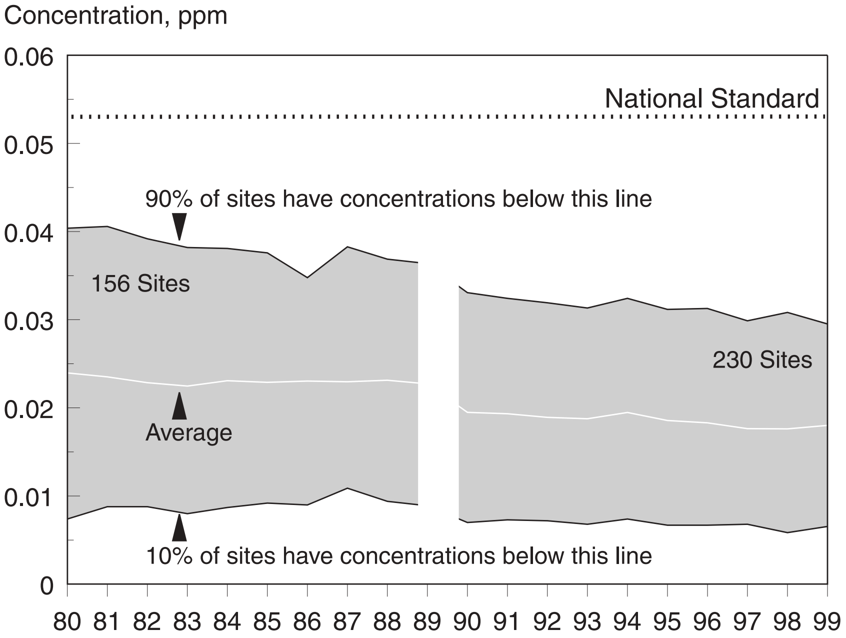
Nationally, annual mean NO_2 concentrations have decreased approximately 25 percent since 1980.[9] As discussed in previous sections of this report, long-term national ambient air quality trends are difficult to assess because few monitoring sites have operated continuously in the same location for 20 years. Figure 2-15 presents 20-year trends in ambient NO_2 concentrations by combining two separate 10-year trends databases, 1980–1989 (156 sites) and 1990–1999 (230 sites). Annual mean NO_2 concentrations declined in the early

1980s, were relatively unchanged during the mid-to-late 1980s, and resumed their decline in the 1990s. Figure 2-15 shows that the national composite annual mean NO_2 concentration in 1999 is 10 percent lower than that recorded in 1990, and is unchanged from the 1998 level. Except for 1994, NO_2 concentrations have decreased, or remained unchanged, each year since 1989.

Figure 2-16 reveals how the trends in annual mean NO_2 concentrations vary among rural, suburban and urban locations. The highest annual mean NO_2 concentrations are typically found in urban areas, with significantly lower annual mean concentrations recorded at rural sites. The 1999 composite mean at 137 urban sites is 24 percent lower than the 1980 level, compared to a 27-percent reduction at 180 suburban sites. At 66 rural sites, the composite mean NO_2 concentration in 1999 is the same as it was in 1980.

Interestingly, at the same time the nation has experienced these significant decreases in NO_2 air quality, nitrogen oxide emissions are increasing, as described in more detail later in this section of the chapter. One possible explanation involves the location of the majority of the nation's NO_2 monitors. Most NO_2 monitoring sites are mobile-source oriented sites in urban areas, and the 20-year decline in ambient NO_2 levels closely tracks the 19-percent reduction in emissions from gasoline powered vehicles over the same time period. However, nitrogen chemistry in the atmosphere is non-linear and, therefore, a change in NO_x emissions may not have a proportional change in ambient concentrations of NO_2. The relationship between emissions and ambient air quality levels is de-

Figure 2-15. Trend in annual NO_2 mean concentrations, 1980–1999.



Note: When the total number of rural, suburban, and urban sites are summed for either the 1980–89 or 1990–99 time periods in Figure 2-16, this number may not equal the total number of sites shown in Figure 2-15 for the same time periods. This is due to a few monitoring sites falling outside the definitions of rural, suburban, or urban sites.

Figure 2-16. Trend in annual mean NO_2 concentrations by type of location, 1980–1999.

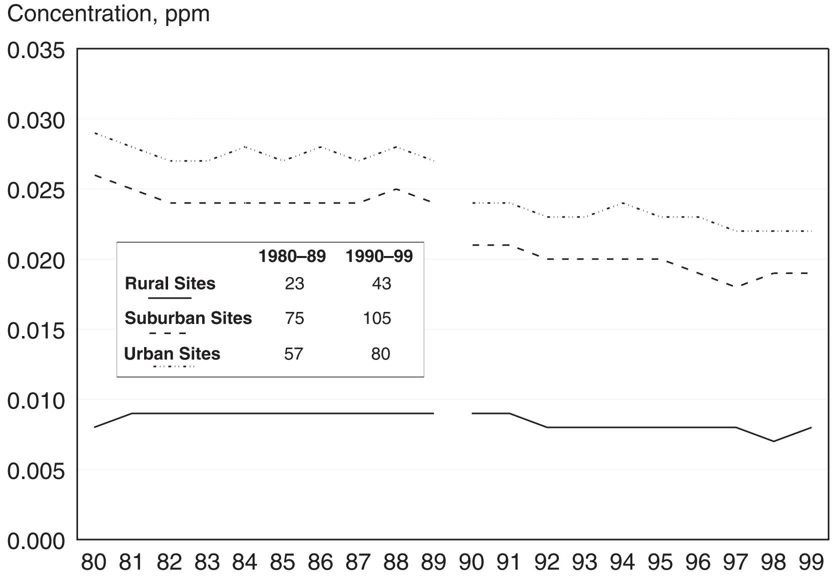
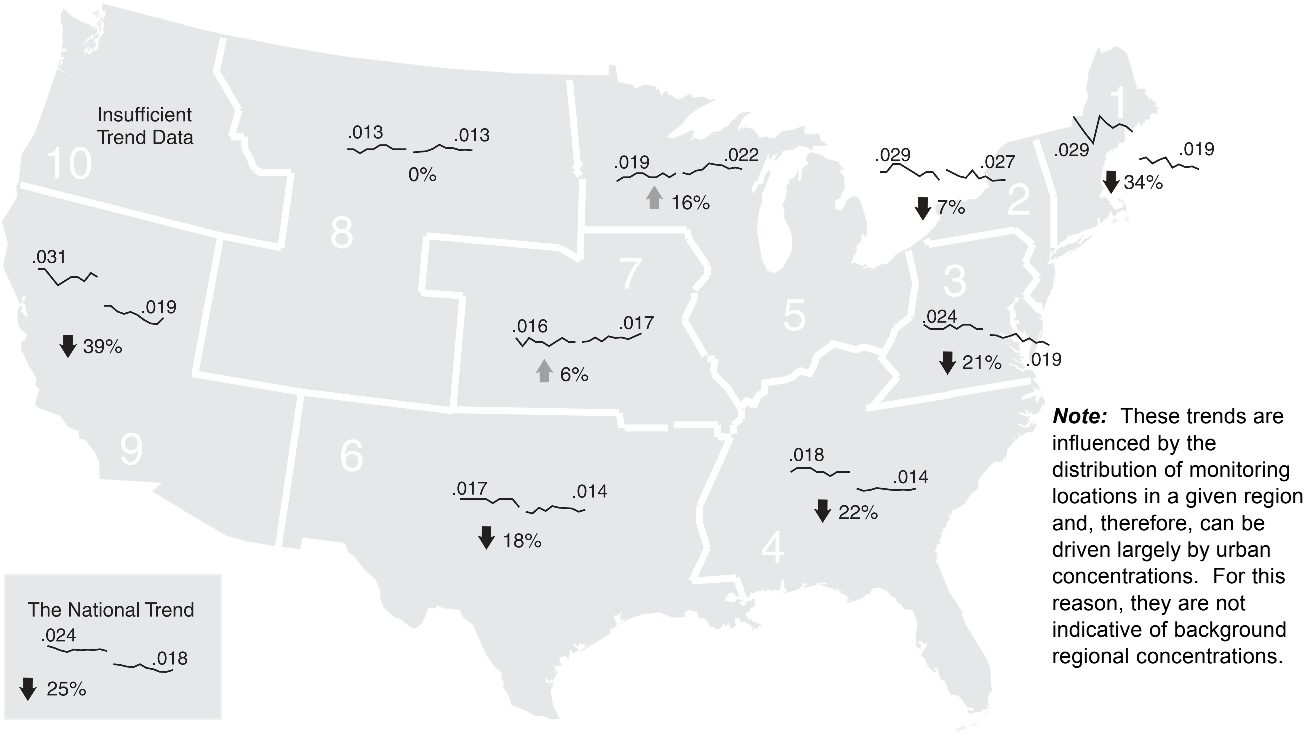


Figure 2-17. Trend in NO_2 maximum quarterly mean concentration by EPA Region, 1980–1999.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

pendent on a number of factors such as concentrations of compounds which react with NO_x emissions (e.g., free radicals and VOCs) as well as the form and concentration of various nitrogen compounds in the area being monitored. For example, an area could experience improving NO_2 air quality in conjunction with increased NO_x emissions, if the emissions are rapidly converted to nitrates, a form of atmospheric nitrogen not detected by the NO_2 monitors. Alternatively, if levels of the compounds which react with NO_x emissions to form ambient NO_2 are declining, increased NO_x emissions may not translate into elevated levels of converted NO_2.

Regional Air Quality Trends

The map in Figure 2-17 provides regional trends in NO_2 concentrations during the past 20 years, 1980–1999 (except Region 10 which does not have any NO_2 trend sites). The trends statistic is the regional composite mean of the NO_2 annual mean concentrations across all sites with at least eight years of ambient measurements. The largest reductions in NO_2 concentrations occurred in the south coast of California and the New England states. Smaller reductions in mean NO_2 concentrations were recorded in the Mid-Atlantic, Southeast, and Southwest. Interestingly, NO_2 concentrations have actually increased in both the North Central and Midwest states. This increase in air quality levels coincides with increases in nitrogen oxide emissions from transportation (both onroad and nonroad) as well as power plants in selected states with NO_2 monitors in these areas.

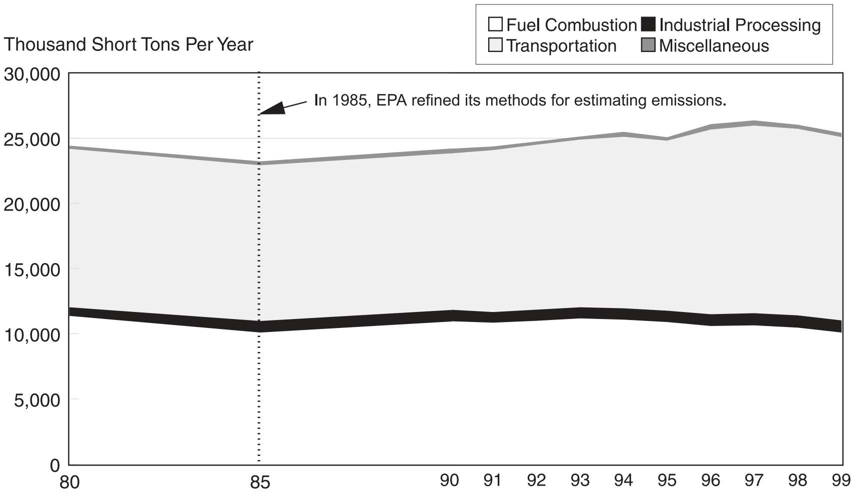
National Emissions Trends

Nationally, emissions of nitrogen oxides have increased over the last 20 years by 4 percent and by 5 percent over the most recent 10-year period from 1990 to 1999. Figure 2-18 shows the temporal trend in NO_x emissions nationwide. These increases are the result of a number of factors, the largest being an increase in nitrogen oxides emissions from transportation sources.

Figure 2-19 indicates that the two primary sources of NO_x emissions are stationary source fuel combustion and transportation. Together, these two sources comprise 95 percent of 1999 total NO_x emissions. Emissions from transportation sources have increased over the last 20 years (16 percent) and during the past 10 years (17 percent). For both light duty gasoline vehicles and light duty gasoline trucks, NO_x emissions peaked in 1994, and then began a steady decrease through 1999. This decrease can be attributed primarily to the implementation of the Tier 1 emission standards which lowered NO_x emissions from new cars and light duty trucks. In contrast, NO_x emissions from heavy duty vehicles, both gasoline and diesel increased significantly over the 10-year period (50 percent for gasoline and 61 percent for diesel). A portion of this increase is due to the increase in VMT for these categories (104 percent for heavy duty gasoline vehicles and 99 percent for heavy duty diesel trucks). In addition, emissions from heavy duty diesel vehicles increased over this period due to the identification of "excess emissions" in many of these vehicles. New emission standards will lead to reductions in emissions from heavy duty vehicles in the future. Further, emissions from off-road vehicles particularly those diesel-fueled have steadily increased over the last 10 years.

Reductions in NO_x emissions from fuel combustion have partially offset the impact of increases in the transportation sector. Emissions from electric utility fuel combustion sources have declined over the 20-year period 1980–1999 (11 percent) and over the 10-year period from 1990–1999 (8 percent). The Acid Deposition Control provisions of the CAA (Title IV) required EPA to establish NO_x annual emission limits for coal-fired electric utility units in two phases resulting in NO_x reductions of approximately 400,000 tons per year during Phase I (1996–1999) and two million

Figure 2-18. Trend in national total NO_x emissions, 1980–1999.



Notes: Emissions data not available for consecutive years 1980–1989.

Emission estimation methods continue to evolve and improve over time. Methods have changed for many significant categories beginning with the years 1985, 1990, and 1996 and consequently are not consistent across all years in this trend period. See Appendix B Emissions Estimates Methodology for additional information.

Figure 2-19. NO_x emissions by source category, 1999.

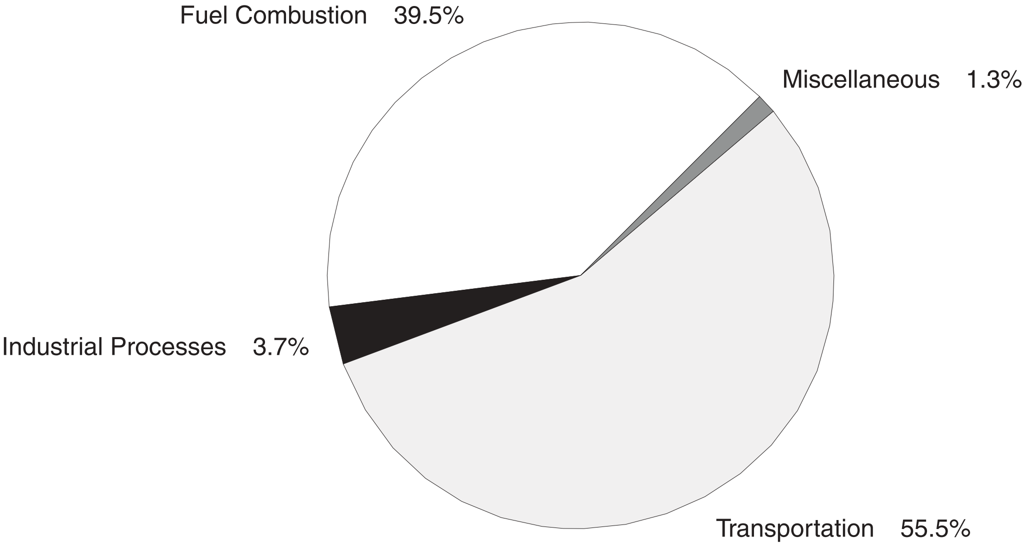
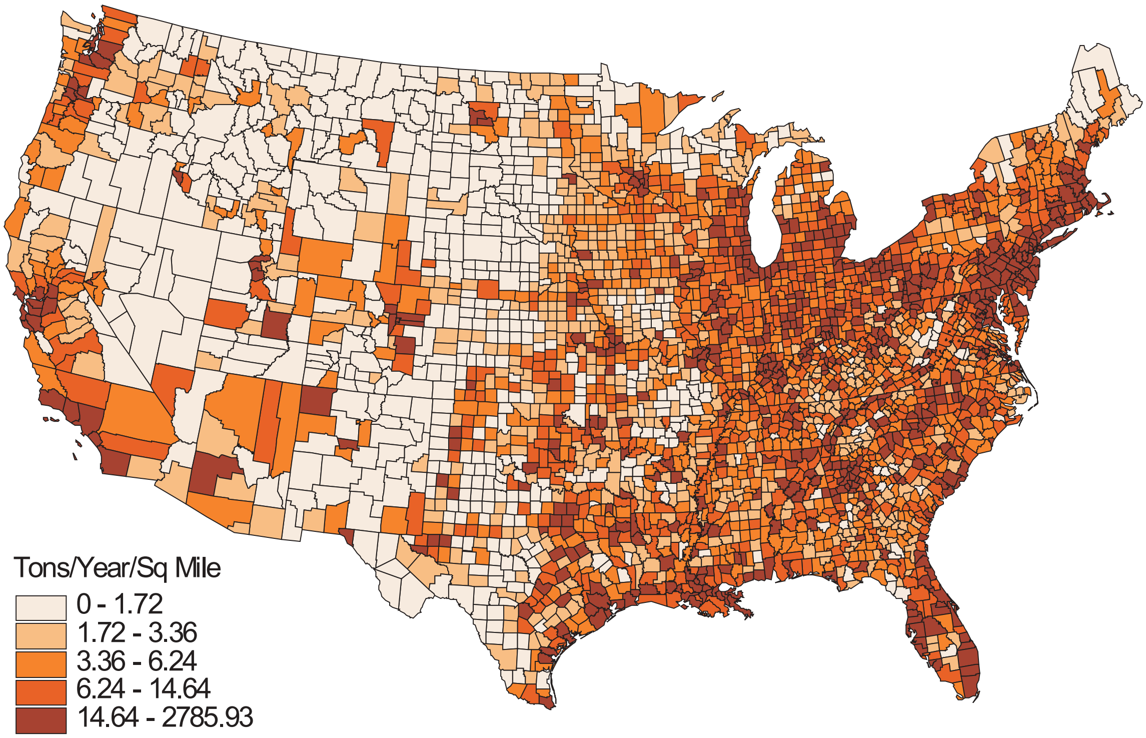


Figure 2-20. Density map of 1999 nitrogen dioxide emissions, by county.



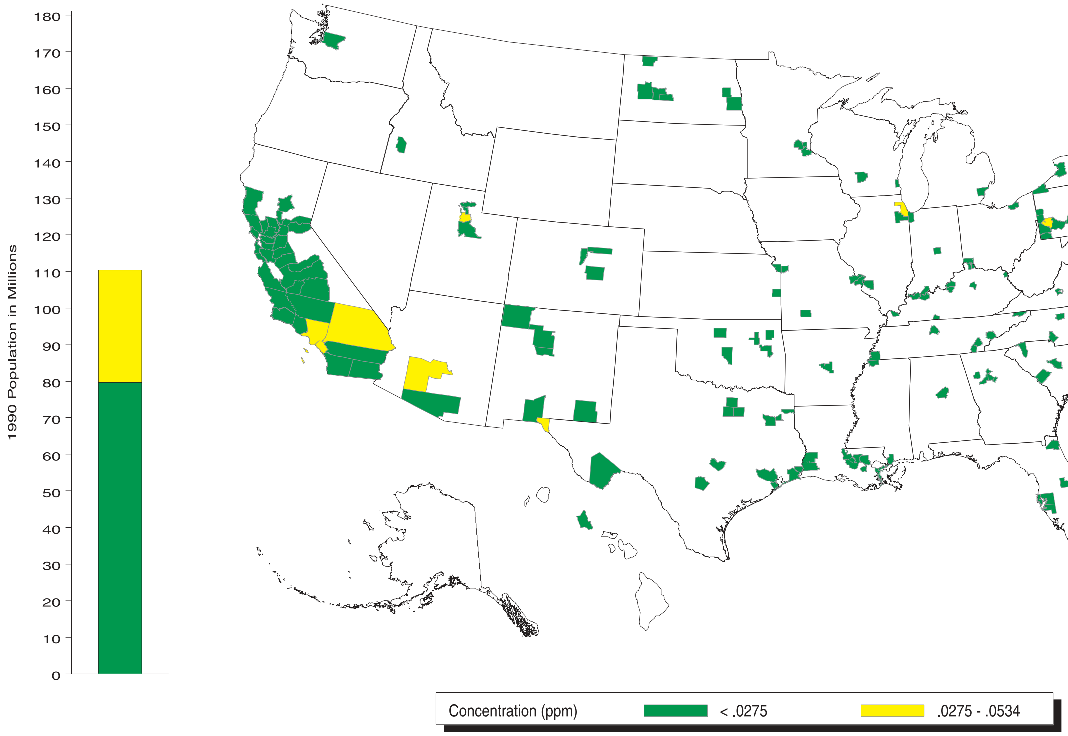
tons per year in Phase II (year 2000 and subsequent years).[10]

Figure 2-20 shows the geographic distribution of 1999 NO_x emissions based on the tonnage per square mile for each county. This map illustrates that the eastern half of the country and the west coast emit more NO_x (on a density basis) than the western half of the continental United States.

1999 Air Quality Status

All monitoring locations across the nation, including Los Angeles, met the NO_2 NAAQS in 1999. This is reflected on the map in Figure 2-21 that displays the highest annual mean NO_2 concentration measured in each county.

Figure 2-21. Highest NO_2 annual mean concentration by county, 1999.



Ozone

Air Quality Concentrations

1980–99	20%	decrease (1-hr)
	12%	decrease (8-hr)
1990–99	4%	decrease (1-hr)
		no change (8-hr)
1989–99	3%	decrease (1-hr)
	1%	decrease (8-hr)

Emissions (Anthropogenic VOCs)

1980–99	31%	decrease
1990–99	14%	decrease
1998–99	3%	decrease

Worth Noting

- Over the last 20 years, ozone (O_3) levels (1-hour and 8-hour) have improved considerably nationwide.
- Rate of improvement, however, appears to have slowed recently.
- Some parts of the country show increases in O_3 levels over the last 10 years, due largely to increased NO_x emissions and weather conditions favorable to O_3 formation.
- Trends for selected urban areas after adjusting for meteorological conditions show slowing progress since the mid-1990s.
- O_3 levels in urban areas, however, where the O_3 problem has historically been the most severe, have shown marked improvement in response to stringent control programs.
- Rural O_3 levels appear to be increasing in the short term.
  - 1-hour levels are higher than those seen in urban areas for the second consecutive year.
  - 8-hour levels increasing nationally over the last 10 years.
  - Trends in 8-hour levels at CASTNet sites up since 1990.
  - 8-hour levels in a number of the nation's national parks are showing significant increases since 1990.

Nature and Sources

Ground level O_3 remains a pervasive pollution problem in the United States. Ozone is readily formed in the atmosphere by the reaction of VOCs and NO_x in the presence of heat and sunlight, which are most abundant in the summer. VOCs are emitted from a variety of sources including: motor vehicles, chemical plants, refineries, factories, consumer and commercial products, other industries, and natural (biogenic) sources. Nitrogen oxides are emitted from motor vehicles, power plants, and other sources of combustion, and natural sources including lightning and biological processes in soil. Changing weather patterns contribute to yearly differences in O_3 concentrations. Ozone and the precursor pollutants that cause O_3 also can be transported into an area from pollution sources located hundreds of miles upwind.

Health and Environmental Effects

Ozone occurs naturally in the stratosphere and provides a protective layer high above the Earth. However, at ground level, it is the prime ingredient of smog. Short-term (1–3 hours) and prolonged (6–8 hours) exposures to ambient O_3 concentrations have been linked to a number of health effects of concern. For example, increased hospital admissions and emergency room visits for respiratory causes have been associated with ambient O_3 exposures.

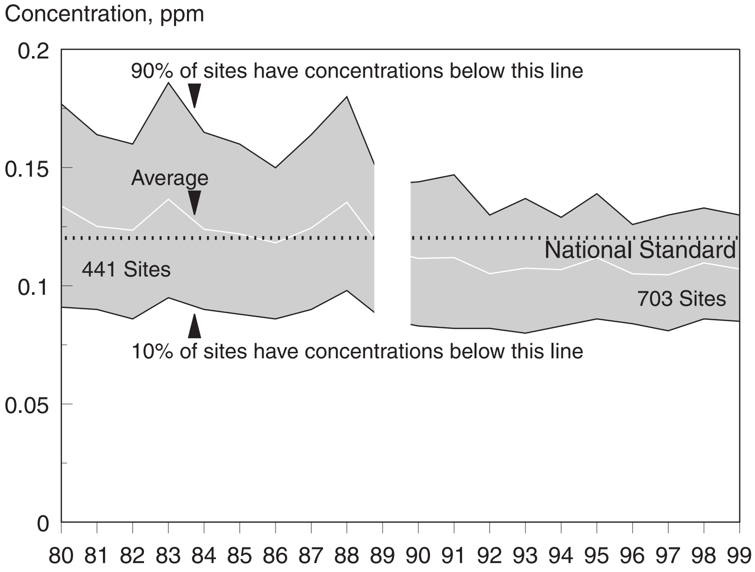
Exposures to O_3 result in lung inflammation, aggravate preexisting respiratory diseases such as asthma, and may make people more susceptible to respiratory infection. Other health effects attributed to short-term and prolonged exposures to O_3, generally while individuals are engaged in moderate or heavy exertion, include significant decreases in lung function and increased respiratory symptoms such as chest pain and cough. Children active outdoors during the summer when O_3 levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include adults who are active outdoors, such as outdoor workers, and individuals with preexisting respiratory disorders such as asthma and chronic obstructive lung disease. Within each of these groups are individuals who are unusually sensitive to O_3. In addition, repeated long-term exposure to O_3 presents the possibility of irreversible changes in the lungs which could lead to premature aging of the lungs and/or chronic respiratory illnesses.

Ozone also affects sensitive vegetation and ecosystems. Specifically, O_3 can lead to reductions in agricultural and commercial forest yields, reduced survivability of sensitive tree seedlings, and increased plant susceptibility to disease, pests, and other environmental stresses such as harsh weather. In long-lived species, these effects may become evident only after several years or even decades. As these species are out-competed by others, long-term effects on forest ecosystems and habitat quality for wildlife and endangered species occurs. Furthermore, O_3 injury to the foliage of trees and other plants can decrease the aesthetic value of ornamental species as well as the natural beauty of our national parks and recreation areas.

Primary and Secondary 1-hour Ozone Standards

In 1979, EPA established 1-hour primary and secondary standards for O_3. The level of the 1-hour primary and secondary O_3 NAAQS is 0.12 ppm daily maximum 1-hour concentration that is not to be exceeded more than once per year on average. To encourage an orderly transition to the revised O_3 standards (promulgated in 1997; see following section for more information), EPA initiated a policy in which the 1-hour standards would no longer apply once an area experienced air quality data meeting the 1-hour standards. In 1998 and early 1999, EPA revoked the 1-hour O_3 NAAQS in 2,942 counties in the United States, leaving 201 counties where the 1-hour standard still applies.[11, 12, 13] However, due to unresolved legal challenges, the Agency is unable to enforce and effectively implement the 8-hour standard. As a result, many areas were without applicable air quality standards adequate to ensure public health and welfare. Therefore, in July 2000, EPA reinstated the 1-hour standard nationwide to alleviate this unanticipated policy outcome and provide protection of public health and welfare.[14]

Figure 2-22. Trend in annual 2nd-highest daily maximum 1-hour, and 4th-highest daily 8-hour O_3 concentrations, 1980–1999.



Primary and Secondary 8-hour Ozone Standards

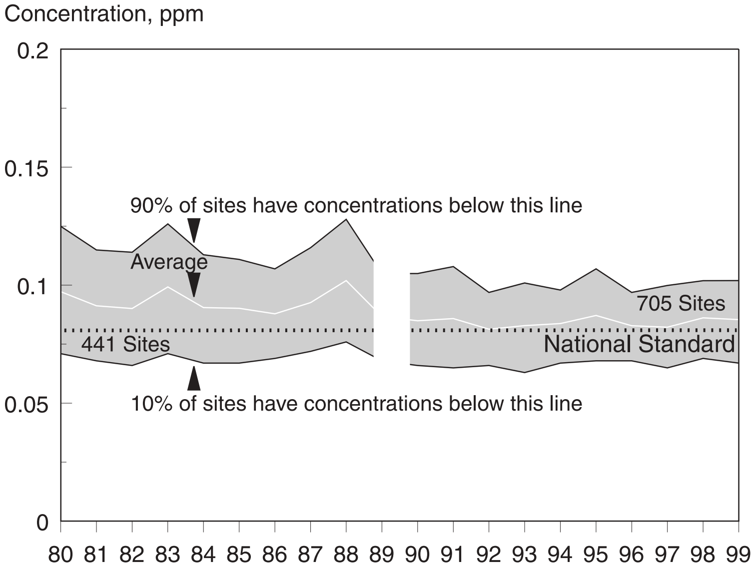
On July 18, 1997, EPA strengthened the O_3 NAAQS based on the latest scientific information showing adverse effects from exposures allowed by the then existing standards. The standard was set in terms of an 8-hour averaging time.[15] Numerous industry and environmental petitioners, including the American Trucking Associations (ATA), challenged the O_3 and the new $PM_{2.5}$ standards in the United States Court of Appeals for the District of Columbia Circuit. On May 14, 1999, a three-judge panel of that court concluded that EPA's interpretation of the Clean Air Act unconstitutionally delegated legislative power to EPA and remanded the standards to EPA. EPA appealed that ruling, and on February 27, 2001, the Supreme Court unanimously upheld the constitutionality of Clean Air Act section 109 and affirmed EPA's ability to set NAAQS based solely on public health and welfare factors, without consideration of costs, which are considered in the implementation of the standards. The court rejected the D.C. Circuit's conclusion that EPA's interpretation of the implementation provisions violated the statute's clear terms, but nevertheless remanded the implementation policy to EPA on the basis that EPA's policy was not a reasonable interpretation of ambiguous statutory language. Because the D.C. Circuit originally remanded, but did not vacate the O_3 and $PM_{2.5}$ standards, they have remained legally effective throughout the ongoing litigation. The case has now been returned to the Court of Appeals, where the remaining issues are to be considered in accordance with the decision of the Supreme Court.

For a variety of reasons, EPA has not yet taken actions to implement either standard. EPA is currently reviewing the results of the litigation and will be conferring with states and other interested parties to determine the approach and schedule for moving forward with implementing the O_3 NAAQS. Refer to **http://www.epa.gov/airlinks** for up-to-date information concerning actions surrounding the revised standards.

Air Quality Trends

Because the 1-hour and 8-hour NAAQS have different averaging times and forms, two different statistics are used in this report to track ambient O_3 air quality trends. For the 1-hour O_3 NAAQS, this report uses the composite mean of the annual second-highest daily maximum

Figure 2-23. Trend in 4th-highest daily 8-hour O_3 concentrations, 1980–1999.



1-hour O_3 concentration as the statistic to evaluate trends. For the 8-hour O_3 NAAQS, the report relies on the annual fourth-highest 8-hour daily maximum O_3 concentration as the statistic of interest to assess trends.

National Air Quality Trends

Figure 2-22 clearly shows that, over the past 20 years, peak 1-hour O_3 concentrations have declined considerably at monitoring sites across the country. From 1980 to 1999, national 1-hour O_3 levels improved 20 percent with 1980, 1983, 1988 and 1995 representing peak years for this pollutant. Because only a few sites have monitored continuously for two decades, the 20-year trends line in Figure 2-22 is composed of two segments—441 sites with complete data during the first 10 years (1980–1989) and 705 sites meeting the data completeness criteria in the most recent 10 years (1990–1999). It is important to interpret such long-term, quantitative ambient O_3 trends carefully given changes in network design, siting criteria, spatial coverage and monitoring instrument calibration procedures during the past two decades. More recently, national 1-hour O_3 levels have continued to improve but the progress has been less rapid evidenced by the 4-percent decrease from 1990–1999.

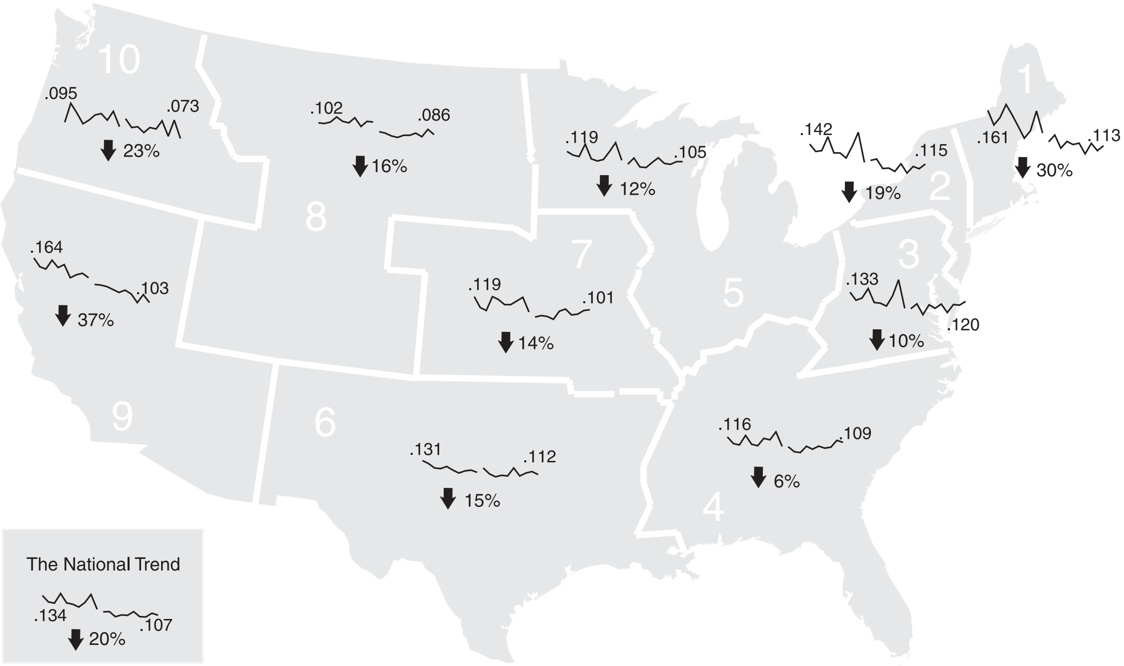
Figure 2-23 shows the national trend in 8-hour O_3 concentrations across the same sites used to estimate the national 1-hour O_3 trends. As was the case with the 1-hour graphic, the 20-year trends line in Figure 2-23 is composed of two segments—441 sites with complete data during the first 10 years (1980–1989) and 705 sites meeting the data completeness criteria in the most recent 10 years (1990–1999). Nationally, 8-hour levels have decreased 12 percent over the last 20 years with even more substantial improvement (18 percent) at higher concentration sites (as shown by the 90th percentile). However, just as is true for the 1-hour levels, the progress in 8-hour O_3 levels over last 10 years has dampened with no change in national levels between 1990 and 1999. The trend in the 8-hour O_3 statistic is similar to the trend in the 1-hour values, although the concentration range is smaller.

Regional Air Quality Trends

The maps in Figures 2-24 and 2-25 examine the trend in 1-hour and 8-hour O_3 concentrations during the past 20 years by geographic region of the country. The O_3 levels (both 1-hour and 8-hour) in all areas have generally followed the pattern of declining trends since 1980 similar to that of the national observations. However, the magnitude of improvement has not been consistent across all Regions. The most pronounced declines in O_3 levels have occurred in the Northeast and West, while the Southeast has evidenced the least improvement. Further, over the last 10 years, O_3 concentrations (both 1-hour and 8-hour) in the Mid-Atlantic, Southeast, Midwest and North Central regions of the country have actually increased. These increases appear to be explained by weather conditions more conducive to O_3 formation (i.e., higher summer temperatures and drier conditions) in 1999 relative to 1990 paired with increased NO_x emissions in many of the affected states (except the Mid-Atlantic region which seems to have been most affected by more conducive meteorological conditions).

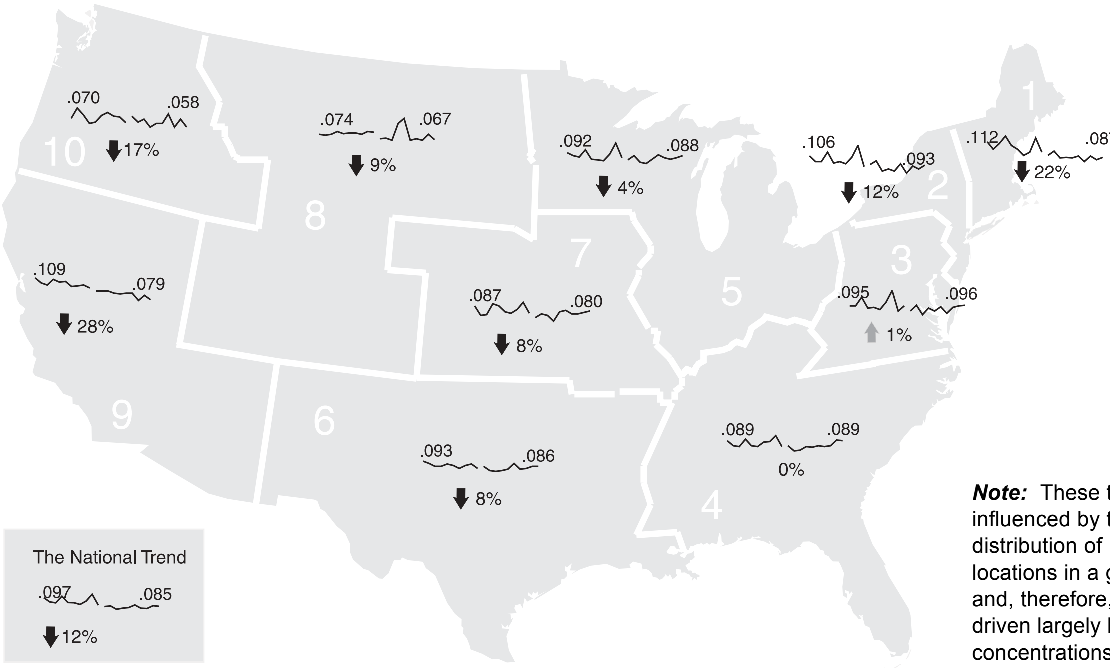
In Figure 2-26, the national 1-hour O_3 trend is disaggregated to show the 20-year change in ambient O_3 concentrations among rural, suburban, and

Figure 2-24. Trend in 2nd highest daily 1-hour O_3 concentration by EPA Region, 1980–1999.



Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

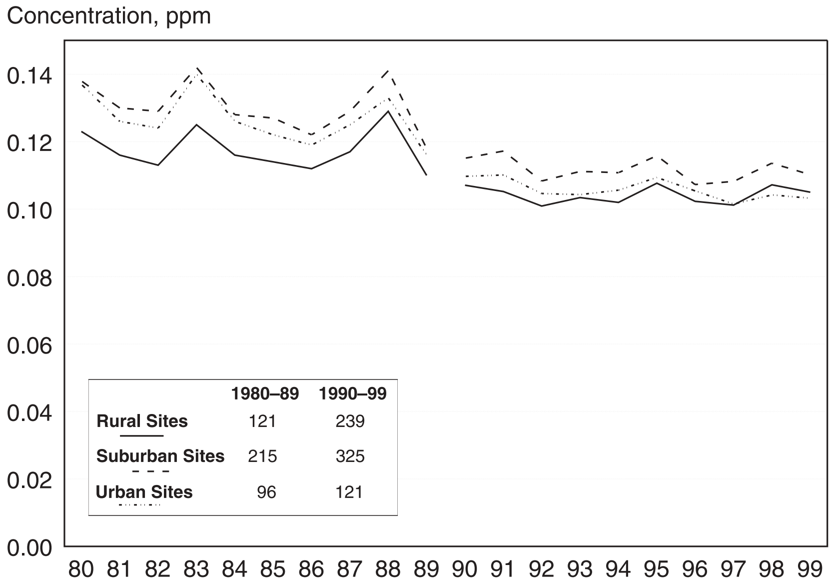
Figure 2-25. Trend in 4th highest daily 8-hour O_3 concentration by EPA Region, 1980–1999.



Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

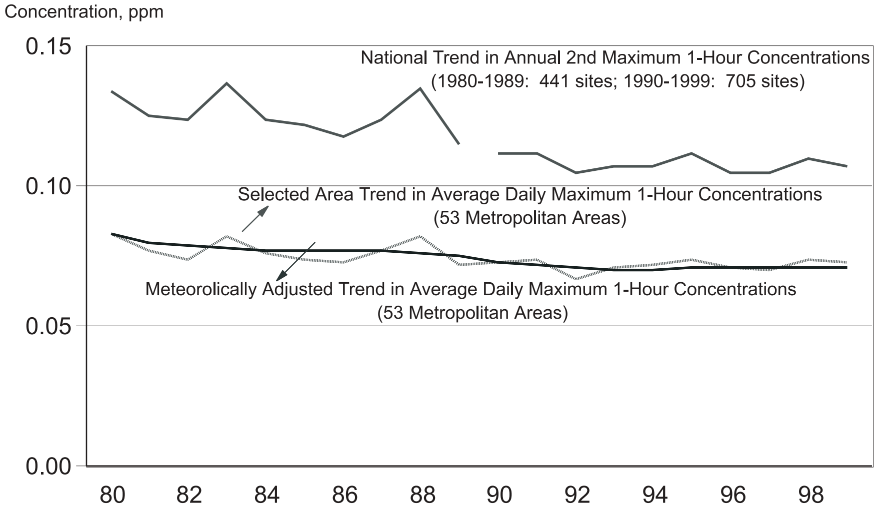
Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Figure 2-26. Trend in annual 2nd-highest daily maximum 1-hour O_3 concentrations by location, 1980–1999.



Note: When the total number of rural, suburban, and urban sites are summed for either the 1980–89 or 1990–99 time periods in Figure 2-26, this number may not equal the total number of sites shown in Figure 2-22 for the same time periods. This is due to a few monitoring sites falling outside the definitions of rural, suburban, or urban sites.

Figure 2-27. Comparison of actual and meteorologically adjusted 1-hour O_3 trends, 1980–1999.



urban monitoring sites. The highest ambient O_3 concentrations are typically found at suburban sites, consistent with the downwind transport of emissions from the urban center. During the past 20 years, O_3 concentrations decreased by 20 percent at 540 suburban sites, and 25 percent at 217 urban sites. However, at 360 rural sites, 1-hour O_3 levels for 1999 are only 14 percent lower than the 1980 level and, for the second consecutive year, are greater than the level observed for urban sites.

Urban Area Air Quality Trends

Figure 2-27 presents the meteorologically-adjusted trend in 1-hour O_3 concentrations for 53 metropolitan areas between 1980 and 1999. Ambient O_3 trends are influenced by year-to-year changes in meteorological conditions, population growth, changes in emissions levels from ongoing control measures as well as the relative levels of O_3 precursors VOCs and NO_x. As discussed in previous *Trends Reports*, EPA uses a statistical model to adjust data on the annual rate of change in O_3 from individual metropolitan areas to account for meteorological impacts, including surface temperature and wind speed.[16] As seen in this figure, after adjusting for meteorological conditions, 1-hour O_3 levels in these selected areas show steady improvement from 1980 through the mid-1990s. The adjusted O_3 levels decreased an average of 1 percent annually through 1994. However, beginning in 1994, the improvement appears to slow. Since the mid-1990s, national 1-hour O_3 levels adjusted to account for variable weather conditions are nearly unchanged.

However, urban areas with the most severe and persistent O_3 problems (i.e., those classified as extreme, severe, and serious O_3 nonattainment areas) show decreases in 1-hour O_3 concentrations between 1990 and 1999 (12 percent) and between 1995 and 1999 (10 percent). These declines, based on data from sites in the areas required to operate the Photochemical Assessment Monitoring Stations (PAMS) network, are consistent with, but more pronounced than, the 4-percent improvement seen nationwide (at the 705 trend sites).[17] Areas with PAMS networks are shown in Figure 2-28. In addition to measuring O_3 levels, PAMS sites include measurements of NO_x, total non-methane organic compounds (TNMOC), a target list of VOC species including several carbonyls, plus surface and upper air meteorology during summer months when weather conditions are most conducive to O_3 formation. Table 2-3 shows

Table 2-3. Summary of Changes in Summer 6-9 a.m. Mean Concentrations of NOx and TNMOC at PAMS Sites

	Total	# of Up	Down	Median Change
1998–99 (all sites)				
NO_x	58	10	11	2%
TNMOC	42	2	14	-8%
1995–99 (all sites)				
NO_x	34	9	9	-6%
TNMOC	17	0	10	-24%
1995–99 (type 2 sites)				
NO_x	17	3	5	-4%
TNMOC	11	0	6	-24%

Note: 1. The numbers shown in the "Up" and "Down" columns refer to the number of sites in which the change in summer 6–9 a.m. mean concentrations between 1995 and 1999 is statistically significant. The total number of sites ("Total") may not equal the sum of the corresponding "Up" and "Down" categories.

2. PAMS type 2 sites are monitoring sites located to detect the maximum downwind ozone precursor emissions impacts.

Figure 2-28. Areas with PAMS networks.

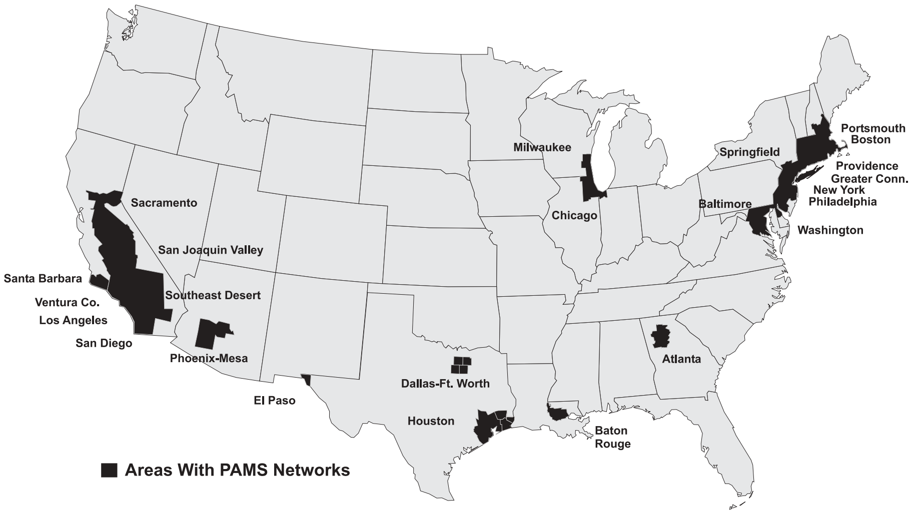
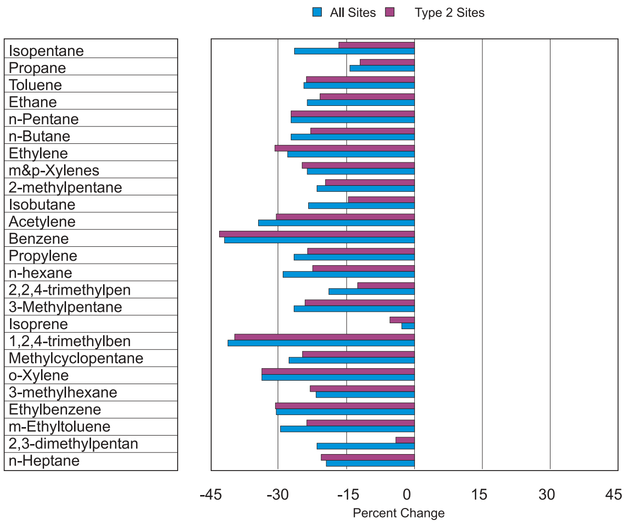


Figure 2-29. A comparison of the median change in summer morning concentrations of the most abundant VOC species measured at all PAMS sites and PAMS type 2 sites from 1995 and 1999.



Number of Sites

All Sites		Type 2 Sites	
Total	Up/Down	Total	Up/Down
19	0/9	11	0/3
21	0/7	12	0/2
21	0/10	12	0/4
21	1/10	12	1/5
20	1/11	12	0/5
21	0/12	12	0/5
21	1/12	12	0/7
19	1/9	12	0/6
21	2/10	12	1/4
21	2/10	12	2/4
21	0/13	12	0/7
21	1/14	12	1/8
21	1/13	12	0/6
21	2/11	12	1/6
21	3/8	12	2/4
20	2/12	12	0/7
21	5/5	12	4/3
21	4/15	12	1/9
21	2/10	12	0/6
21	0/14	12	0/9
21	2/9	12	0/5
21	1/12	12	0/7
18	2/8	10	1/4
21	2/8	12	1/4
21	1/8	12	0/5

Notes: 1. The numbers shown in the "Up" and "Down" columns refer to the number of sites in which the change in summer 6–9 a.m. mean concentrations between 1995 and 1999 is statistically significant. The total number of sites "Total" may not equal the sum of the corresponding "Up" and "Down" categories.

2. Results for formaldehyde and acetaldehyde (both carbonyl compounds) were not included in this analysis because of sampling issues with carbonyl compounds in the PAMS network. EPA is continuing to assess the issues for further comparison of the measurements.

3. Results for acetone and isoprene were not included due to lack of consistency in analytic results.

changes in summer 6:00–9:00 a.m. TNMOC and NO_x concentrations for selected PAMS sites.[18] Morning NO_x concentrations showed a median decline of 6 percent between 1995 and 1999 across 34 PAMS sites, while summer morning TNMOC concentrations registered a median decline of 24 percent across 17 PAMS sites. Figure 2-29 presents the median changes in summer morning concentrations of the most abundant VOC species measured at PAMS sites.[19] All 24 compounds included in this analysis showed declines in median values between 1995 and 1999.

Rural Area Air Quality Trends

Figure 2-30 presents the trend in 8-hour O_3 concentrations for 34 rural sites from the Clean Air Status and Trends Network (CASTNet) for the

Figure 2-30. Trend in 4th-highest daily 8-hour O_3 based on 34 CASTNet sites in the rural eastern United States, 1980–1999.

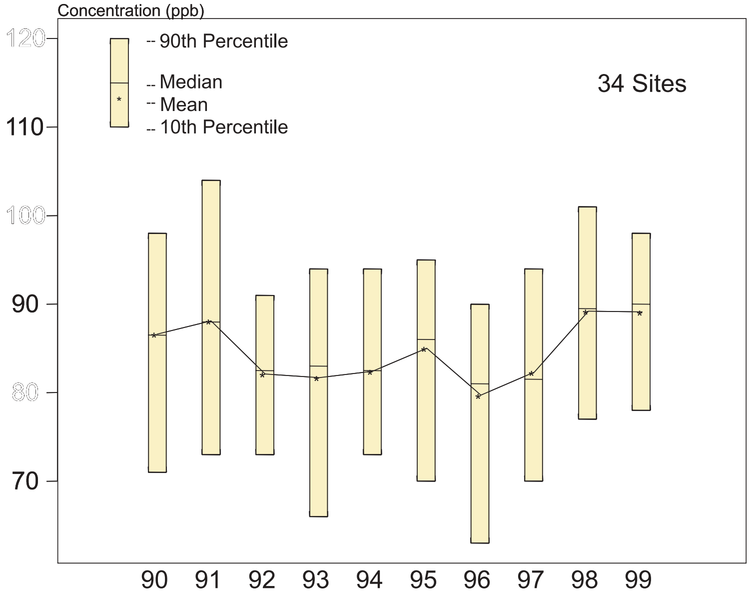


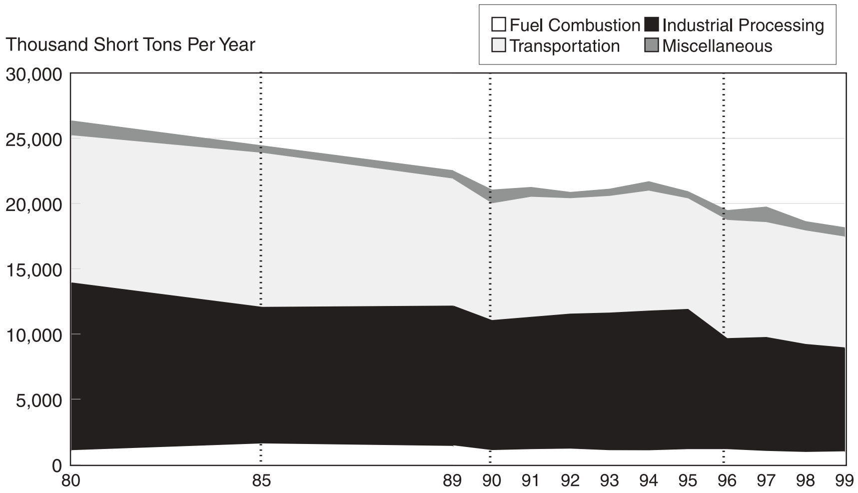
Figure 2-31. Trend in annual 4th-highest daily maximum 8-hour O_3 concentrations in National Parks, 1980–1999.

↑ Indicates a statistically significant upward trend. Otherwise the trend was not statistically significant. Concentrations are ppm.

most recent 10-year period, 1990–1999.[20] The 8-hour O_3 concentrations at these eastern sites, which were the highest during the hot and dry summers of 1991 and 1998, have increased 2 percent over the last 10 years and register no significant change from 1997–1998. This trend in 8-hour O_3 levels at 34 selected sites is mirrored at other rural sites nationwide. Across the nation, rural 8-hour O_3 levels improved 9 percent from 1980–1999, but increased by 2 percent over the last 10 years.[21]

Figure 2-31 further examines patterns in rural O_3 levels by presenting the 10-year trends in the 8-hour O_3 concentrations at seven selected National Park Service (NPS) sites.[22] These sites are located in Class I areas, a special subset of rural environments (all national parks and wilderness areas exceeding 5,000 acres) accorded a higher degree of protection under the CAA provisions for the prevention of significant deterioration. There are more than 26 NPS sites nationally; however, this analysis focuses on the specific sites with sufficient data to evaluate 10-year trends. Over the last 10 years, 8-hour O_3 concentrations in 25 of our national parks increased nearly 8 percent. Nine monitoring sites in eight of these parks experienced statistically significant upward trends in 8-hour O_3 levels: Great Smoky Mountain (TN), Big Bend (TX), Cape Romain (SC), Cowpens (SC), Denali (AK), Everglades (FL), Mammoth Cave (KY), and Voyageurs (MN). For the remaining 17 parks, 8-hour O_3 levels at eight increased only slightly between 1990 and 1999, while seven showed decreasing levels and two were unchanged.

Figure 2-32. Trend in national total anthropogenic VOC emissions, 1980–1999.



Notes: Emissions data not available for consecutive years 1980–1989.

Emission estimation methods continue to evolve and improve over time. Methods have changed for many significant categories beginning with the years 1985, 1990, and 1996 and consequently are not consistent across all years in this trend period. See Appendix B Emissions Estimates Methodology for additional information.

Figure 2-33. Anthropogenic VOC emissions by source category, 1999.

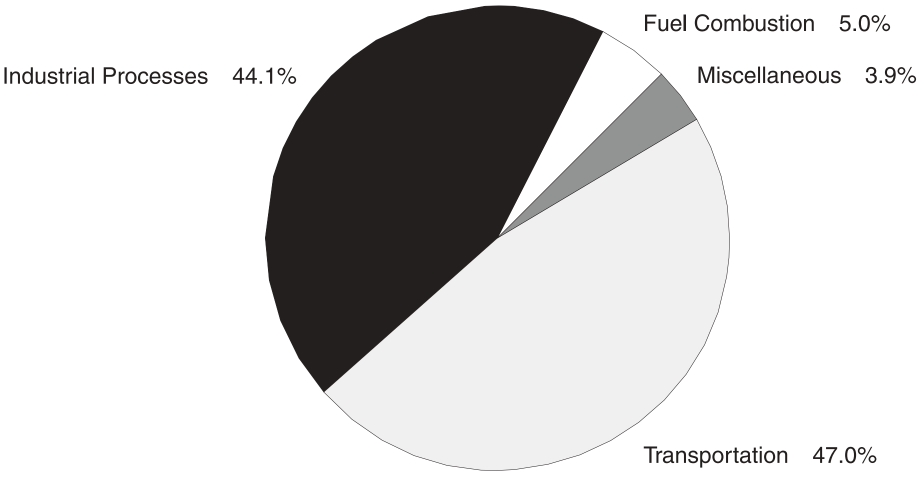


Table 2-4. Biogenic Sources of VOC Emissions By Region

Region	VOC	Source
Southwestern United States	Isoprene	Oak (mostly), citrus, eucalyptus
	Monoterpenes	Pine, citrus, eucalyptus
Northeastern United States	Isoprene	Oak (mostly), spruce
	Monoterpenes	Maple, hickory, pine, spruce, fir, cottonwood

National Emissions Trends

Figure 2-32 shows that national total VOC emissions (which contribute to O_3 formation) from anthropogenic (man-made) sources decreased 31 percent between 1980 and 1999, and 14 percent over the last 10 years. National total NO_x emissions (the other major precursor to O_3 formation) increased 4 percent and 5 percent respectively over the same two periods.

Nationally, the two major sources of VOC emissions are industrial processes (44 percent) and transportation sources (47 percent) as shown in Figure 2-33. Solvent use comprises 60 percent of the industrial process emissions category and 26 percent of total VOC emissions. Industrial VOC emissions have decreased 21 percent since 1990, in part due to the implementation of MACT controls that affect specific chemical and solvent industries. The VOC emissions totals by source category and year are presented in Table A-5 in Appendix A. Recent control measures to reduce transportation sector emissions include regulations to lower fuel volatility and to reduce NO_x and VOC emissions from tailpipes.[23] The effectiveness of these control measures is reflected in a decrease in VOC emissions from highway vehicles. VOC emissions from highway vehicles have declined 18 percent since 1990, while highway vehicle NO_x emissions have increased 19 percent over the same period.

The nonroad methodology for estimating emissions was changed this year with the use of an improved nonroad model for the years 1996 and later. However, this model was not used for the earlier years resulting in a “discontinuity” of about 40 percent for VOC emissions going from 1995–1996.

As required by the CAA, the Federal Reformulated Gasoline Program (RFG) implemented in 1995 has resulted in emissions reductions that exceed those required by law.[24, 25] However, the discovery of MTBE (one of two fuel oxygenates used in reformulated gasoline to help improve air quality) in the water supplies around the country has required examination of the approach used in this program. As previously described in the CO section of this report, in November 1998, EPA announced the creation of a blue ribbon panel of leading experts from the public health and scientific communities, automotive fuels industry, water utilities, and local and state government to review the important issues posed by the use of MTBE and other oxygenates in gasoline. The Panel concluded that RFG provides considerable air quality improvements and benefits for millions of U.S. citizens. However, due to MTBE’s persistence and mobility in water, and its likelihood to contaminate ground and surface water, the Panel recommended that its use in gasoline be substantially reduced.[26] Additionally, on March 20, 2000, the Clinton Administration, based on the recommendations of the Blue Ribbon Panel, announced a set of legislative principles to address concerns about the continued use of MTBE. The Administration recommended that Congress:

- Amend the CAA to provide the authority to significantly reduce or eliminate the use of MTBE.
- Ensure that air quality gains associated with the use of MTBE are not diminished.
- Replace the existing oxygen requirement contained in the CAA with a renewable fuel standard for all gasoline.

In addition to anthropogenic sources of VOC and NO_x, there are natural or biogenic sources of these compounds as well. Table 2-4 shows the different predominant plant species responsible for VOC emissions in different parts of the country for two major biogenic species of concern, isoprene and monoterpenes. Though it is not possible to control the level of these natural emissions, when developing O_3 control strategies, their presence is an important factor to consider. Biogenic NO_x emissions are associated with lightning and biological processes in soil. On a regional basis, biogenic VOC emissions can be greater than anthropogenic VOC emissions. Biogenic NO_x emissions,

Figure 2-34. Density map of 1999 anthropogenic VOC emissions, by county.

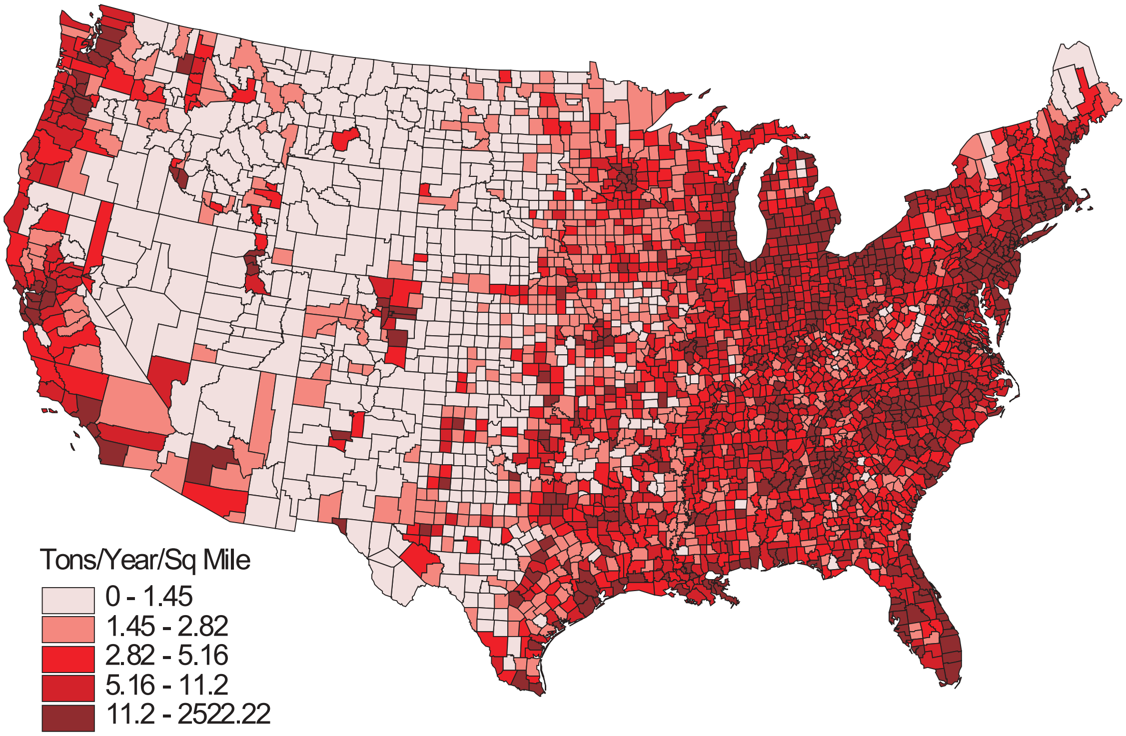


Figure 2-35. Highest second daily maximum 1-hour O_3 concentration by county, 1999.

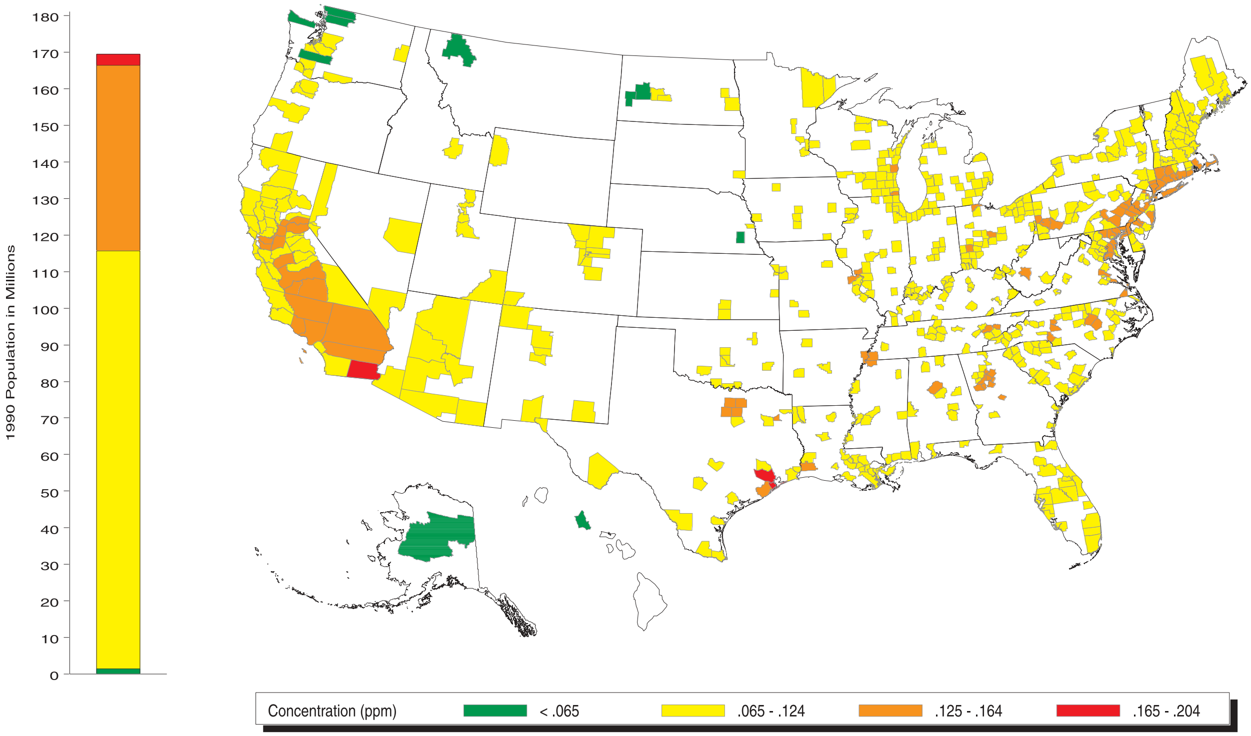
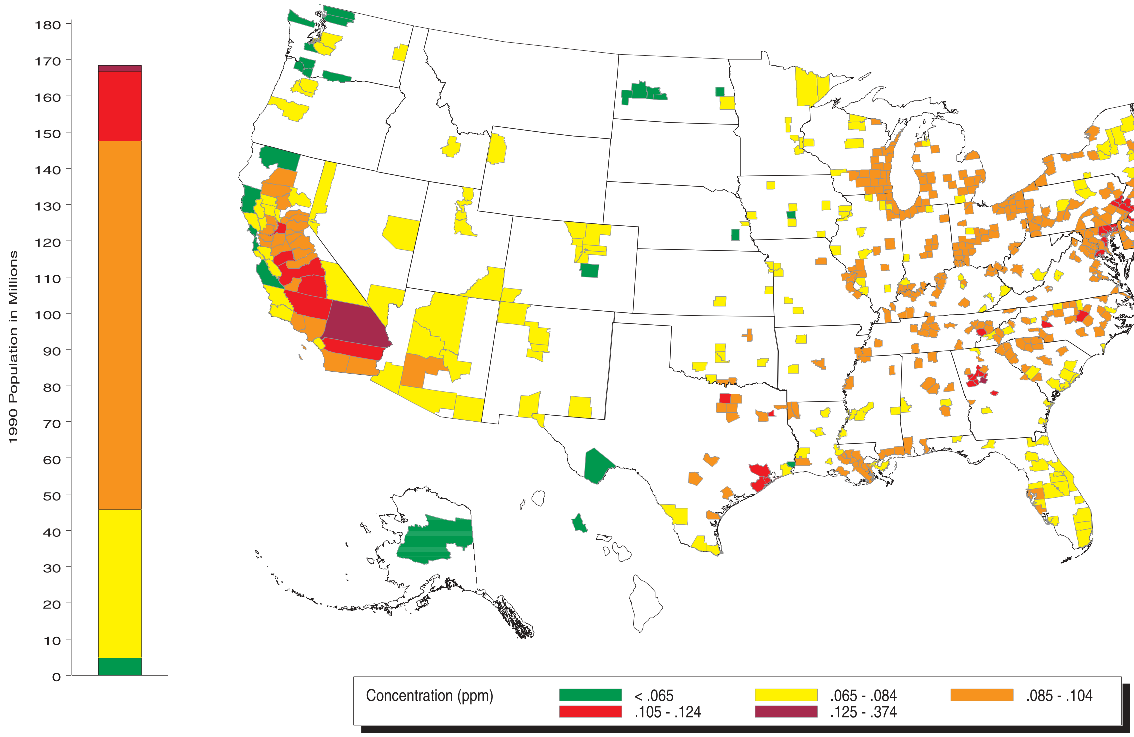


Figure 2-36. Highest fourth daily maximum 8-hour O_3 concentration by county, 1999.



on the other hand, are less than 10 percent of total NO_x emissions.[27]

Figure 2-34 shows the geographic distribution of 1999 VOC emissions based on the tonnage per square mile for each county. This map illustrates that the eastern half of the country and the west coast emit more VOC (on a density basis) than the western half of the continental United States.

Air Quality Status

The map in Figure 2-35 presents second highest daily maximum 1-hour O_3 concentrations by county in 1999. The accompanying bar chart to the left of the map reveals that in 1999 approximately 54 million people lived in 101 counties where O_3 concentrations were above the level of the 1-hour O_3 NAAQS. These numbers represent a slight increase from the totals reported last year (51 million people living in 92 counties) with O_3 concentrations above the level of the O_3 NAAQS in 1998. The map in Figure 2-35 shows large spatial differences, with higher O_3 concentrations typically found in Southern California, the Gulf Coast, and the Northeast and North Central states. Historically, the highest 1-hour concentrations have been found in Los Angeles; however, in 1999, Harris County, TX has the highest second daily maximum value.

Figure 2-36 presents a map of fourth highest daily maximum 8-hour O_3 values by county in 1999 and an accompanying bar chart of the number of people in counties corresponding to various air quality ranges. The map reveals widespread areas with high 8-hour O_3 concentrations (i.e., greater than 0.084 ppm) in much of the eastern half of the country and in California as well as isolated counties in the West. The corresponding bar chart indicates that roughly 123 million people live in counties where fourth highest daily maximum 8-hour O_3 concentrations were greater than 0.084 ppm.

Particulate Matter

PM_{10} Air Quality Concentrations		
1980–99		NA
1990–99	18%	decrease
1998–99	1%	increase

PM_{10} Emissions		
1980–99		NA
1990–99	15%	decrease
1998–99	9%	decrease

$PM_{2.5}$ Air Quality Concentrations	
1980–99	Trend not yet available
1990–99	Trend not yet available
1998–99	Trend not yet available

$PM_{2.5}$ Emissions		
1980–99		NA
1990–99	17%	decrease
1998–99	18%	decrease

Worth Noting:

PM_{10}

- Between 1998 and 1999, annual average PM_{10} concentrations increased nationally for the first time since EPA began tracking PM_{10} trends in 1988. The small increase (1 percent) is largely influenced by increases in the West, particularly in California. PM_{10} concentrations in California were higher than normal from September to December 1999, a period which coincided with major wildfires and particularly dry conditions.
- Beginning in 1998, the number of monitoring sites in the PM_{10} network began to decrease. This follows the PM monitoring strategy published in July 1997 which encourages reducing the number of PM_{10} monitoring sites in areas of low concentrations where the PM_{10} NAAQS are not expected to be violated. In 1999, only 667 sites had data, compared to 887 sites in 1998 and 992 sites in 1997.
- The Franklin Smelter facility, responsible for historically high recorded PM_{10} concentrations in Philadelphia, shut down in August 1997 and dismantled in late 1999. This has brought peak concentrations down below the level of the standard at the nearby monitoring site. In 1998 and 1999, the second maximum was only 61 and 52 µg/m^3, respectively, compared to 264 µg/m^3 in 1997.

$PM_{2.5}$

- The first complete year of $PM_{2.5}$ data (1999) collected by EPA's Federal Reference Method Monitoring network confirms that $PM_{2.5}$ varies regionally. In the East, higher levels extend from the Southeastern to Mid-Atlantic states and west into the Ohio River Valley area. Florida and the Northeast (New York State to Maine) tend to have annual mean concentrations below 15 µg/m^3. California, especially central to southern California, seems to be the only area widespread in the West with annual mean concentrations above 15 µg/m^3.
- Data from the IMPROVE network show that average $PM_{2.5}$ concentrations in the rural east decreased 7 percent from 1998–1999.
- Sulfate concentrations in the rural east decreased 7 percent based on the 10 IMPROVE sites (and 10 percent based on the 34 CASTNet sites) from 1998–1999.
- Organic carbon concentrations in the rural east decreased 4 percent from 1998–1999, and are still up 18 percent from 1997.

Nature and Sources

Particulate matter (PM) is the general term used for a mixture of solid particles and liquid droplets found in the air. PM originates from a variety of sources, including diesel trucks, power plants, wood stoves and industrial processes. The chemical composition and physical properties of these particles vary widely. While individual particles cannot be seen with the naked eye, collectively they can appear as black soot, dust clouds, or haze.

Particles less than or equal to 2.5 micrometers in diameter, or $PM_{2.5}$, are known as "fine" particles. Those larger than 2.5 micrometers but less than or equal to 10 micrometers are known as "coarse" particles. PM_{10} refers to all particles less than or equal to 10 micrometers in diameter.

Fine particles result from fuel combustion (from motor vehicles, power generation, industrial processes), residential fireplaces and wood stoves. Fine particles also can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds.

Coarse particles are generally emitted from sources such as vehicles traveling on unpaved roads, materials handling, and crushing and grinding operations, and windblown dust**.** Fine and coarse particles typically exhibit different behavior in the atmosphere. Coarse particles can settle rapidly from the atmosphere within hours, and their spatial impact is

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Note: The methods used to estimate PM_{10} emissions of some source categories are not consistent in all years over the period between 1980 and 1999. Changes from one method to another make the emissions trend over time appear different than it actually has been. Of particular note is that for 1999 PM_{10} emissions from three source categories of open burning are estimated differently than in previous years and show a substantial increase compared to estimates for prior years. These categories of open burning of residential waste, yard waste, and land clearing waste are included in the "industrial processing" sector of Figures 2-39 and 2-40. The apparent increase in emissions from this sector, and in total PM_{10} emissions, from 1998–1999 is the result of this change in estimation methodology.

typically limited because they tend to fall out of the air in the downwind area near their emission point. Larger coarse particles are not readily transported across urban or broader areas, because they are generally too large to follow air streams and they tend to be removed easily by impaction on surfaces. Smaller-sized coarse particles can have longer lives and longer travel distances, especially in extreme circumstances, such as dust storms.

Because fine particles remain suspended for longer times, typically on the order of days to weeks and travel much father than coarse particles, all else being equal, fine particles are theoretically likely to be more uniformly dispersed at urban and regional scales than coarse particles. Analyses of 1999 $PM_{2.5}$ data from sites in Atlanta, Detroit, Phoenix, and Seattle indicate that $PM_{2.5}$ concentrations tend to be highly correlated among sites within an urban area. In contrast, coarse particles tend to exhibit more localized elevated concentrations near sources.[28]

Health and Environmental Effects

Scientific studies show a link between inhalable PM (alone, or combined with other pollutants in the air) and a series of significant health effects. Inhalable PM includes both fine and coarse particles. Both coarse and fine particles can accumulate in the respiratory system and are associated with numerous adverse health effects. Exposure to coarse particles is primarily associated with the aggravation of respiratory conditions such as asthma. Fine particles are most closely associated with adverse health effects including decreased lung function, increased hospital admissions and emergency room visits, increased respiratory symptoms and disease, and premature death. Sensitive groups that appear to be at greatest risk to such PM effects include the elderly, individuals with cardiopulmonary disease such as asthma or congestive heart disease, and children.

Particulate matter also can also cause adverse impacts to the environment. Fine particles are the major cause of reduced visibility in parts of the United States, including many of our national parks. Other environmental impacts occur when particles deposit onto soils, plants, water, or materials. For example, particles containing nitrogen and sulfur that deposit onto land or water bodies may change the nutrient balance and acidity of those environments so that species composition and buffering capacity change. Particles that are deposited directly onto the leaves of plants can, depending on their chemical composition, corrode leaf surfaces or interfere with plant metabolism. Finally, PM causes soiling and erosion damage to materials, including culturally important objects such as carved monuments and statues.

Primary and Secondary PM Standards

The standards for PM_{10} include both short- and long-term NAAQS. The short-term (24-hour) standard of 150 $\mu g/m^3$ is not to be exceeded more than once per year on average over three years. The long-term standard specifies an expected annual arithmetic mean not to exceed 50 $\mu g/m^3$ averaged over three years.

The standards for $PM_{2.5}$ are set at 15 $\mu g/m^3$ and 65 $\mu g/m^3$, respectively, for the annual and 24-hour standards.[29] These are the primary, or health-based, standards. The secondary, or welfare-based, standards for PM_{10} are identical to the primary standards. The secondary (welfare-based) $PM_{2.5}$ standards were made identical to the primary standards.

Numerous industry and environmental petitioners, including the American Trucking Associations (ATA), challenged the O_3 and PM standards in the United States Court of Appeals for the District of Columbia Circuit. On May 14, 1999, a three-judge panel of that court concluded that EPA's interpretation of the Clean Air Act unconstitutionally delegated legislative power to EPA and remanded the standards to EPA. EPA appealed that ruling, and on February 27, 2001, the Supreme Court unanimously upheld the constitutionality of Clean Air Act section 109 and affirmed EPA's ability to set NAAQS based solely on public health and welfare factors, without consideration of costs, which are considered in the implementation of the standards. The court rejected the D.C. Circuit's conclusion that EPA's interpretation of the implementation provisions violated the statute's clear terms, but nevertheless remanded the implementation policy to EPA on the basis that EPA's policy was not a reasonable interpretation of ambiguous statutory language. Because the D.C. Circuit originally remanded, but did not vacate the O_3 and $PM_{2.5}$ standards, they have remained legally effective throughout the ongoing litigation. The case has now been returned to the Court of Appeals, where the remaining issues are to be considered in accordance with the decision of the Supreme Court.

For a variety of reasons, EPA has not yet taken actions to implement either standard. The litigation over the PM NAAQS has not yet affected EPA or state activities related to these standards. EPA cannot start implementing the 1997 $PM_{2.5}$ standards until EPA and the states have collected three years of monitoring data to determine which areas are not attaining the standards. The fine particle monitoring network has been operational since 1999 and was completed in 2000. In most cases, areas would not be designated "attainment" or "nonattainment" for the $PM_{2.5}$ standards until 2004–2005. Refer to **http://www.epa.gov/airlinks** for up-to-date information concerning actions surrounding the revised standards.

National 10-Year PM_{10} Air Quality Trends

Since 1988 represents the first complete year of PM_{10} data for most monitored locations, a 20-year trend is not available. However, the most recent 10-year period (1990–1999) shows that the national average of annual mean PM_{10} concentrations at 954 monitoring sites decreased 18 percent in Figure 2-37. The downward trend is apparent through 1998. However, between 1998 and 1999, the national average increased 1 percent. This slight increase is largely influenced by increases in the West, particularly in California. PM_{10} concentrations in California were higher than normal from September–December 1999, a period which coincided with major wildfires and particularly dry conditions.

When the sites are grouped as rural, suburban, and urban, as in Figure 2-38, the trend is similar to the national trend. The highest values are generally found at the urban sites, followed closely by the suburban sites. The annual mean is much

Figure 2-37. Trend in annual mean PM_{10} concentrations, 1990–1999.

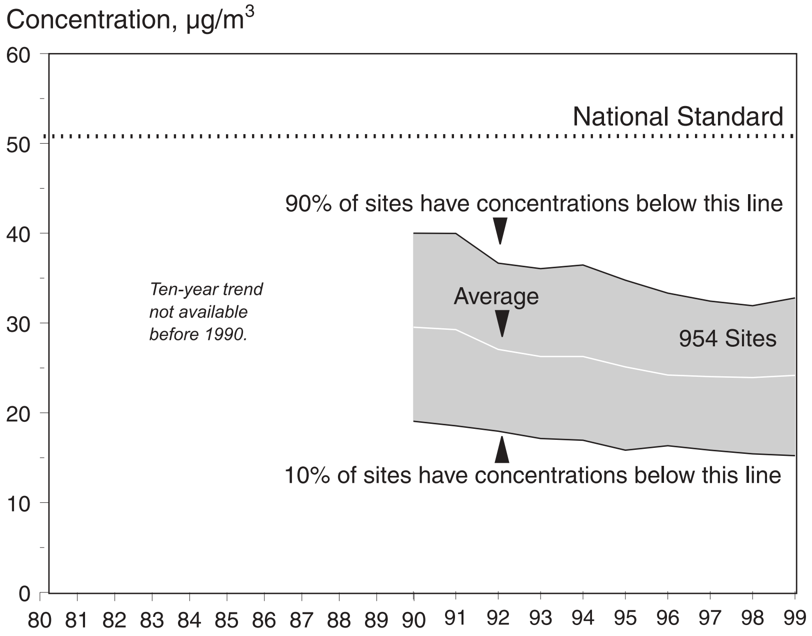


Figure 2-38. PM_{10} annual mean concentration trends by location, 1990–1999.

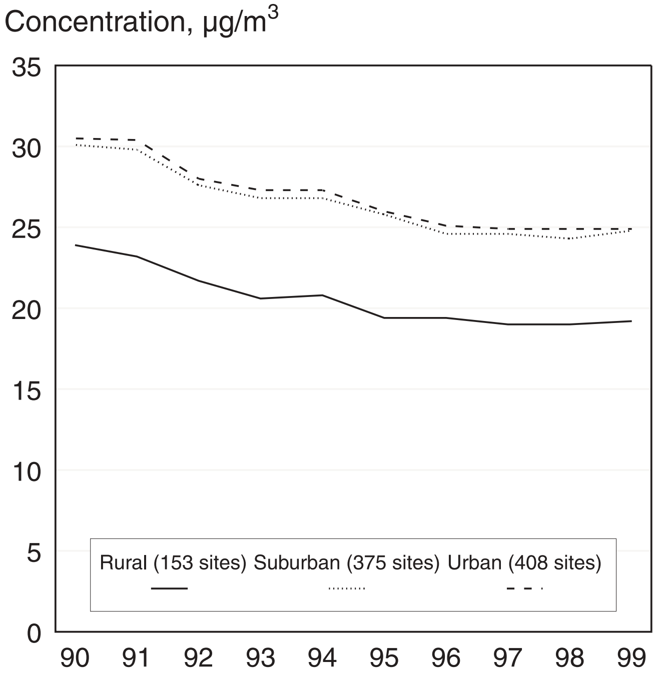
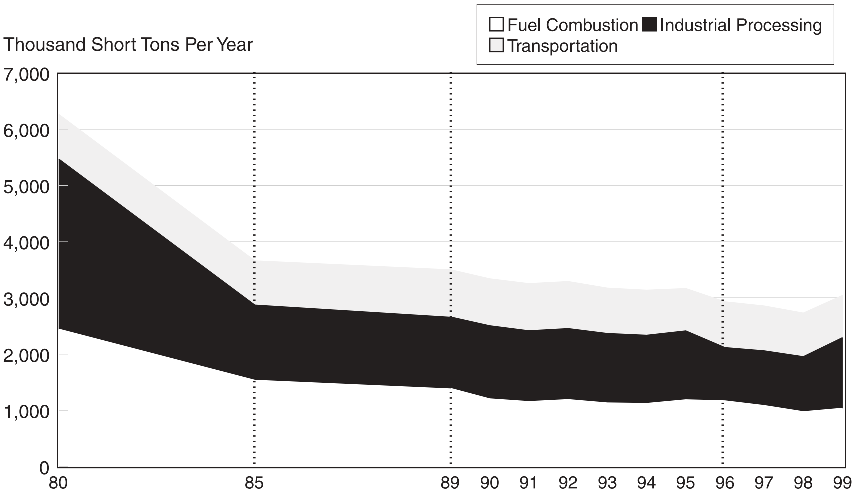


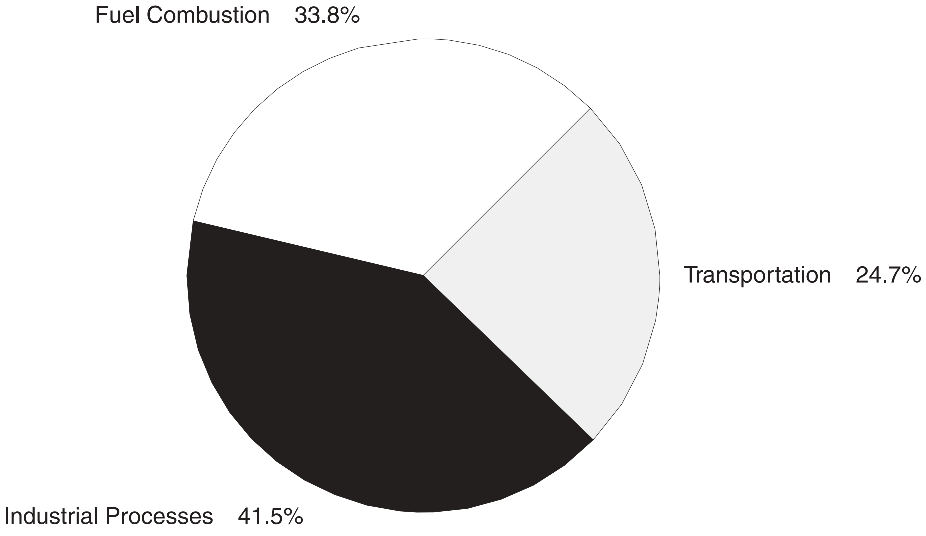
Figure 2-39. National PM_{10} emissions trend, 1980–1999 (traditionally inventoried sources only).



Notes: Emissions data not available for consecutive years 1980–1989.

Emission estimation methods continue to evolve and improve over time. Methods have changed for many significant categories beginning with the years 1985, 1990, and 1996 and consequently are not consistent across all years in this trend period. See Appendix B Emissions Estimates Methodology for additional information.

Figure 2-40. PM_{10} emissions from traditionally inventoried source categories, 1999.



lower at the rural sites, which are generally located away from local sources of PM_{10}.

Beginning in 1998, the number of monitoring sites in the PM_{10} network began to decrease. This follows the PM monitoring strategy published in July 1997 which encourages reducing the number of PM_{10} monitoring sites in areas of low concentrations where the PM_{10} NAAQS are not expected to be violated. Specifically, it calls for eliminating sites not needed for trends or with maximum concentrations less than 60 percent of the NAAQS.[30] In 1999, only 667 sites had data, compared to 887 sites in 1998 and 992 sites in 1997. This decrease in the number of monitors has not affected the calculation of the national trend.

Several factors have played a role in reducing PM_{10} concentrations. Where appropriate, states required emissions from industrial sources and construction activities to be reduced to meet the PM_{10} standards. Measures were also adopted to reduce street dust emissions, including the use of clean anti-skid materials like washed sand, better control of the amount of material used, and removal of the material from the street as soon as the ice and snow melt. Cleaner burning fuels like natural gas and fuel oil have replaced wood and coal as fuels for residential heating, industrial furnaces, and electric utility and industrial boilers.

National PM_{10} Emissions Trends

Nationally, annual estimates of PM_{10} direct emissions decreased 15 percent between 1990 and 1999 (see Table A-6). Direct PM_{10} emissions are generally examined in two separate groups. First there are the emissions from the more traditionally inventoried sources, shown in Figures 2-39 and 2-40. These include fuel combustion, industrial processes, and transportation. Of these, the fuel combustion category saw the largest decrease over the 10-year period (14 percent), with most of the decline attributable to a decrease in emissions from electric utility coal and oil combustion. Emissions from the industrial processes category decreased 3 percent, and emissions from the transportation category decreased 10 percent. The recent upward movement between 1998 and 1999 for industrial processing is attributed to new sources of emissions for open burning (of residential yard wastes and land clearing debris) that had not been characterized previously.

The second group of direct PM_{10} emissions is a combination of miscellaneous and natural sources including agriculture and forestry, wildfires and managed burning, and fugitive dust from paved and unpaved roads. It should be noted that fugitive dust emissions from geogenic wind erosion have been removed from the emissions inventory for all years, since the annual emission estimates based on past methods for this category are not believed to be representative. As Figure 2-41 shows, these miscellaneous and natural sources actually account for a large percentage of the total direct PM_{10} emissions nationwide, although they can be difficult to quantify compared to the traditionally inventoried sources. The trend of emissions in the miscellaneous/natural group may be more uncertain from one year to the next or over several years because these emissions tend to fluctuate a great deal from year to year. It should be noted that a change in methodology occurred between 1995 and 1996 in calculating PM_{10} emissions from unpaved roads. This has led to lower PM_{10} emissions from 1996 through 1999 than would have been predicted using the older methodology.

Figure 2-41. Total PM_{10} emissions by source category, 1999.

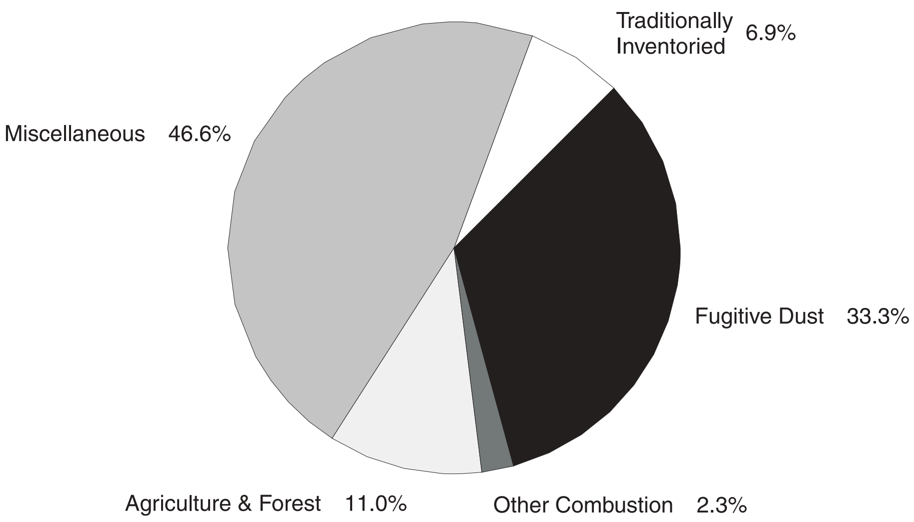


Table A-6 lists PM_{10} emissions estimates for the traditionally inventoried sources for 1990–1999. Miscellaneous and natural source PM_{10} emissions estimates are provided in Table A-7.

Figure 2-42 shows the emission density for PM_{10} in each U.S. county. PM_{10} emission density is the highest in the eastern half of the United States, in large metropolitan areas, areas with a high concentration of agriculture such as the San Joaquin Valley in California and along the Pacific coast. This closely follows patterns in population density. One exception is that open biomass burning is an important source category that is more prevalent in forested areas and in some agricultural areas. Fugitive dust is an important component in arid and agricultural areas.

PM_{10} Regional Air Quality Trends

Figure 2-43 is a map of regional trends for the PM_{10} annual mean from 1990–1999. All 10 EPA regions show decreasing trends over the 10-year period, with declines ranging from 5–33 percent. The largest decreases are generally seen in the western part of the United States. This is significant since PM_{10} concentrations are typically higher in the West. In the western states, programs such as those with residential wood stoves and agricultural practices have helped reduce emissions of PM_{10}. In the eastern United States, the Clean Air Act's Acid Rain Program has contributed to the decrease in PM_{10} emissions. The program has reduced

Figure 2-42. PM_{10} emissions density by county, 1999.

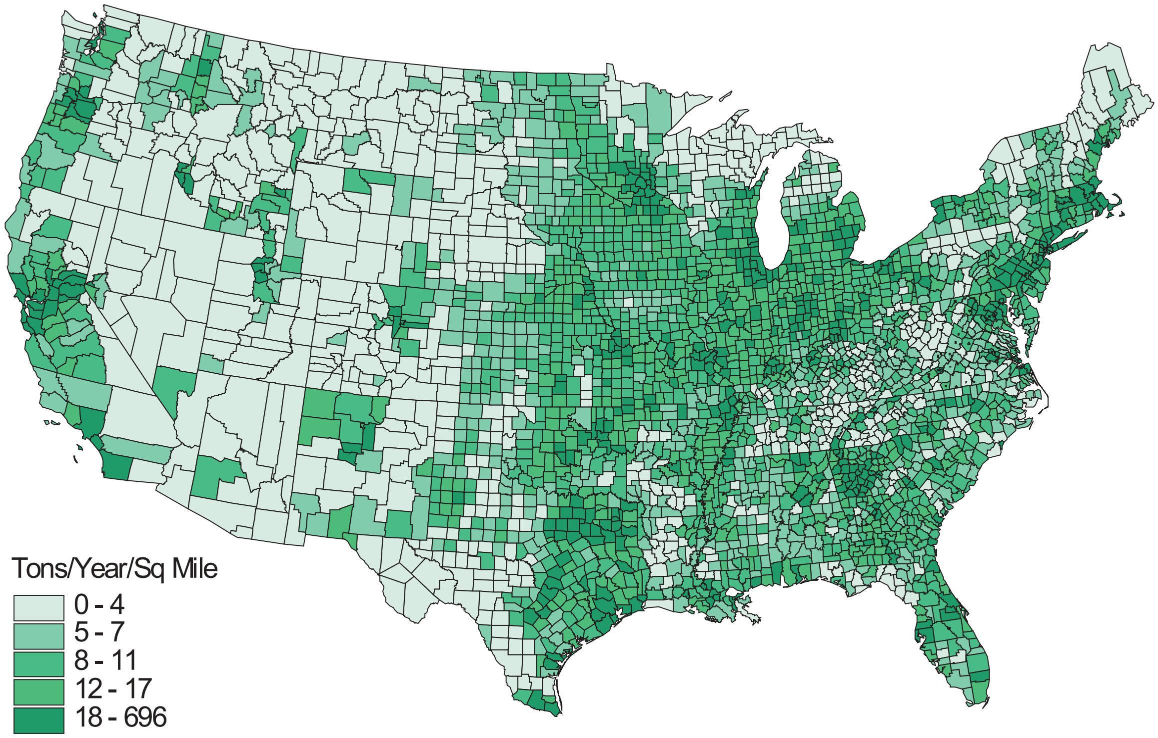
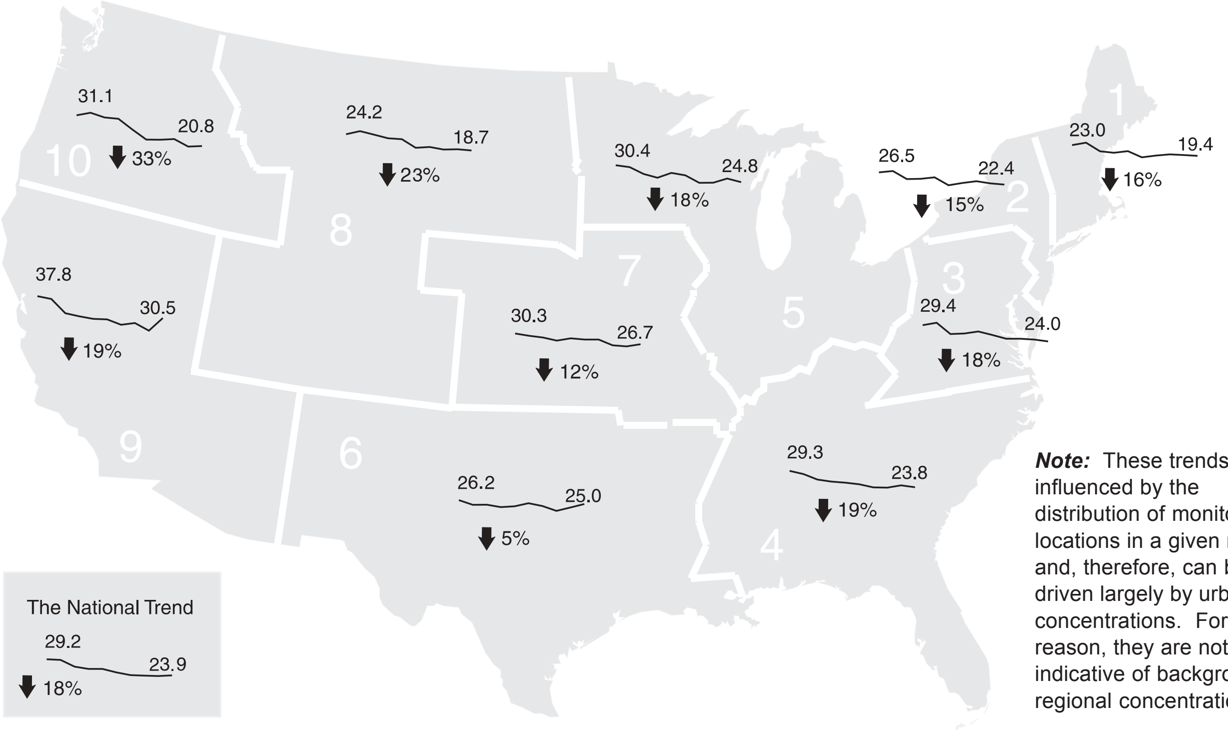


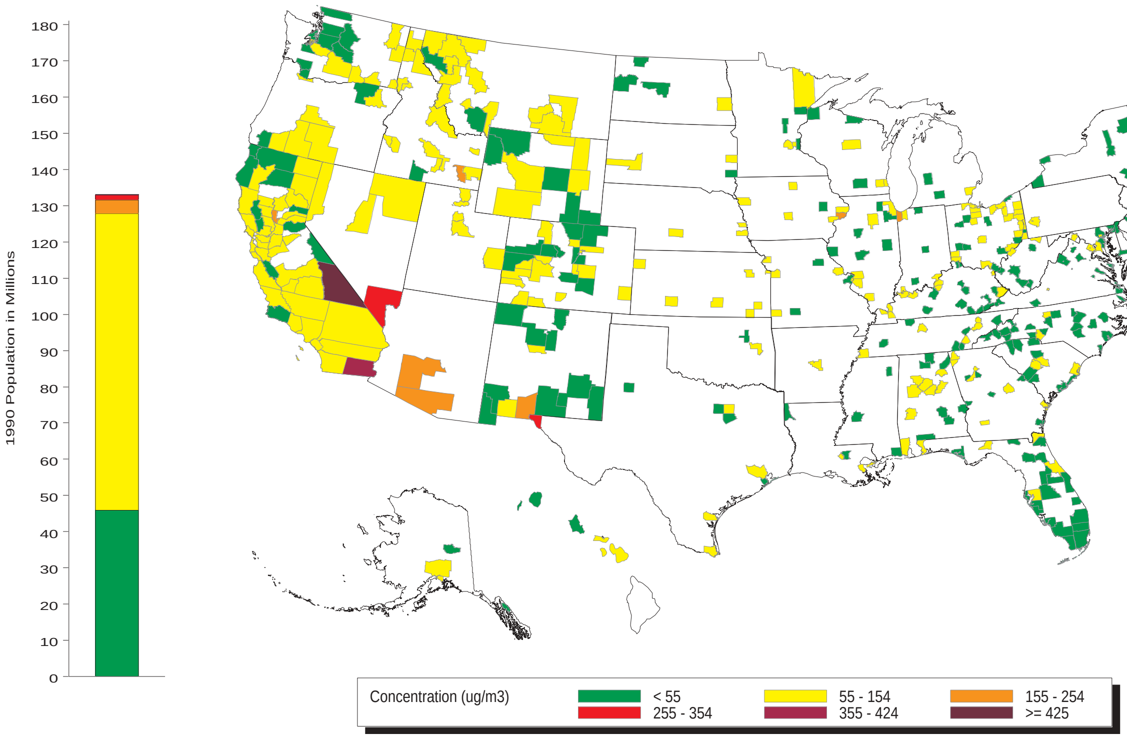
Figure 2-43. Trend in PM_{10} annual mean concentration by EPA region, 1990–1999.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are µg/m3.

Figure 2-44. Highest 2nd maximum 24-hour PM_{10} concentration by county, 1999.



SO_2 and NO_x emissions, both precursors of particulate matter in the atmosphere (see Chapter 7 on Atmospheric Deposition and the SO_2 section in this chapter for more information on the Acid Rain Program).

PM_{10} 1999 Air Quality Status

The map in Figure 2-44 displays the highest second maximum 24-hour PM_{10} concentration in each county for 1999. The largest of these was recorded in Inyo County, California, caused by wind blown dust from a dry lake bed.[31] The bar chart which accompanies the national map shows the number of people living in counties within each concentration range. The colors on the map and bar chart correspond to the colors of the concentration ranges displayed in the map legend. In 1999, approximately 5 million people lived in 11 counties where the highest second maximum 24-hour PM_{10} concentration was above the level of the 24-hour PM_{10} NAAQS. When both the annual and 24-hour PM_{10} standards are considered, there were 20 million people living in 19 counties with PM_{10} concentrations above the NAAQS in 1999. See Chapter 4 for information concerning officially designated PM_{10} nonattainment areas.

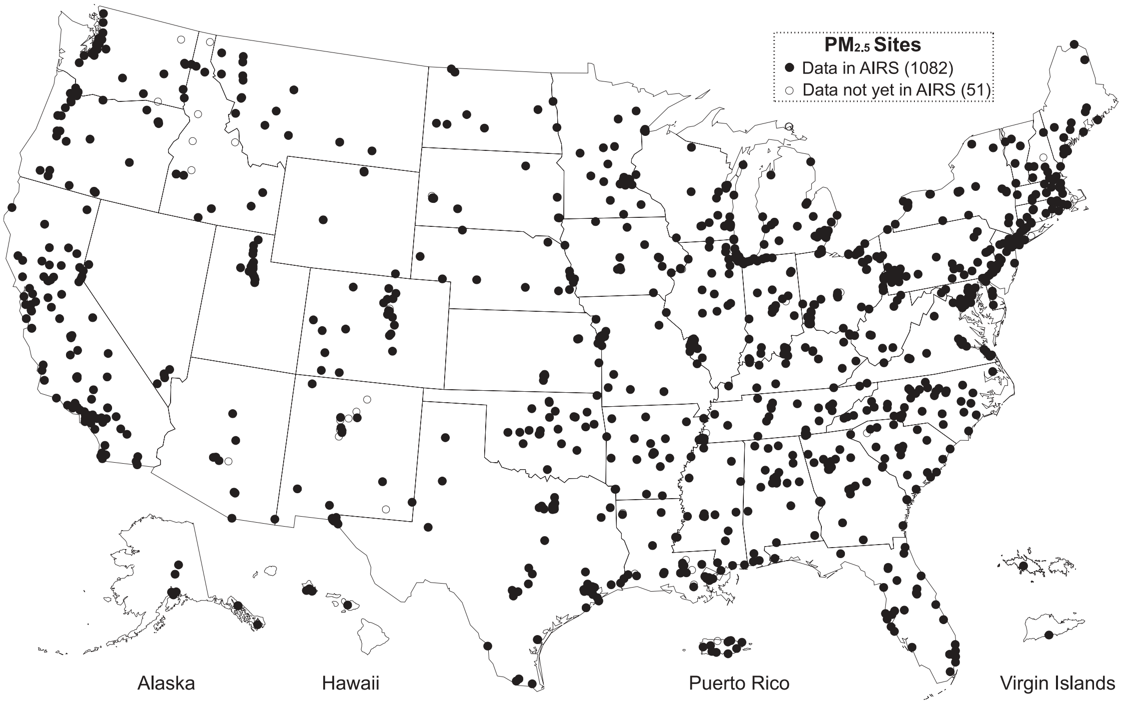
The Franklin Smelter facility, responsible for historically high recorded PM_{10} concentrations in Philadelphia, shut down in August 1997 and dismantled in late 1999.[32] This has brought peak concentrations down below the level of the standard at the nearby monitoring site. In 1998 and 1999, the second maximum was only 61 and 52 µg/m^3, respectively, compared to 264 µg/m^3 in 1997.

Characterizing $PM_{2.5}$ Air Quality

A new monitoring network designed to assess fine PM data with respect to the new $PM_{2.5}$ standards began deployment in early 1999. The status of this network is shown in Figure 2-45. As of February 2001, 1,108 Federal Reference Method (FRM) monitoring sites were operating and 1,044 of them have reported data to EPA's Aerometric Information Retrieval System (AIRS). Analyses of the first complete year of data (1999) collected by this network are summarized in the "FRM Network Results" section.

Data from another network, the IMPROVE network of rural sites, were used to assess the *composition* of and *trends* in ambient $PM_{2.5}$ concen-

Figure 2-45. Status of $PM_{2.5}$ monitor network, as of May 2001.



trations. Since the monitors in the IMPROVE network are non-FRM, the data cannot be used for compliance purposes. Analyses of these data are summarized in the "IMPROVE Network Results" section.

As additional analyses of $PM_{2.5}$ data are completed, they will be published on EPA's $PM_{2.5}$ Data Analysis Web site at **http://www.epa.gov/oar/oaqps/pm25/.**

FRM Network Results

1999 Annual Mean $PM_{2.5}$ Concentrations

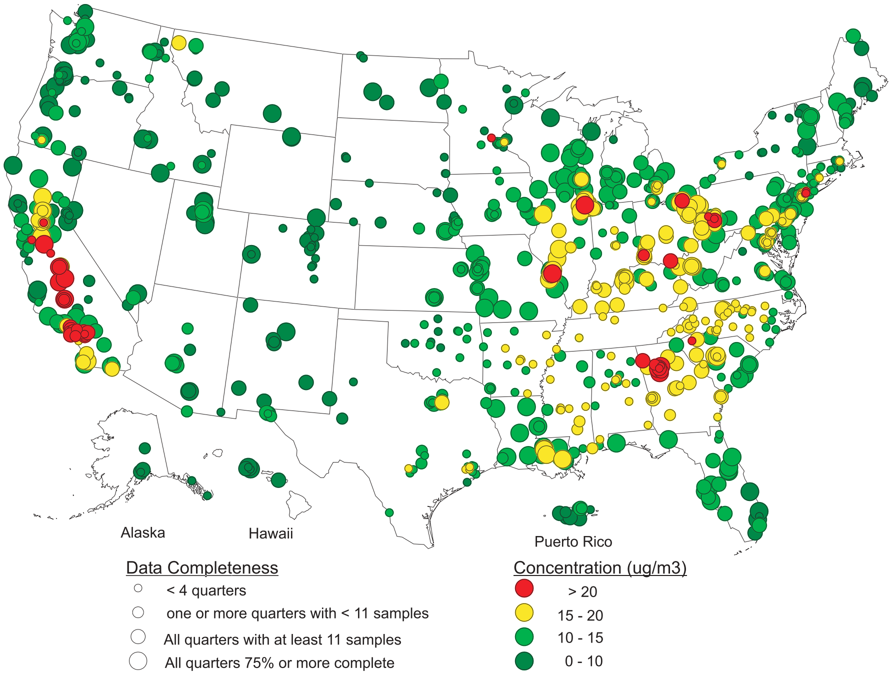
Figure 2-46 depicts nationwide annual mean $PM_{2.5}$ concentrations from the FRM monitoring network. Data completeness is illustrated by the size of the circles on the map, with smaller circles indicating relatively incomplete data for the year. Many locations in the eastern United States and in California were above 15 µg/m^3. Annual mean concentrations were above 20 µg/m^3 in several major urban areas throughout the eastern United States including Pittsburgh, Cleveland, Atlanta, Chicago, and St. Louis. Los Angeles and the central valley of California also had levels above 20 µg/m^3. Sites in the central and western mountain regions of the United States had generally low annual mean concentrations, most below 10 µg/m^3.

1999 24-hour $PM_{2.5}$ Concentrations

Figure 2-47 depicts nationwide 98th percentile 24-hour average $PM_{2.5}$ concentrations from the FRM monitoring network. Concentrations above 65 µg/m^3 are relatively rare in the eastern United States, but more prevalent in California. Values in the 40–65 µg/m^3 range are more common in the eastern United States and the west coast, but relatively rare in the central and western mountain regions.

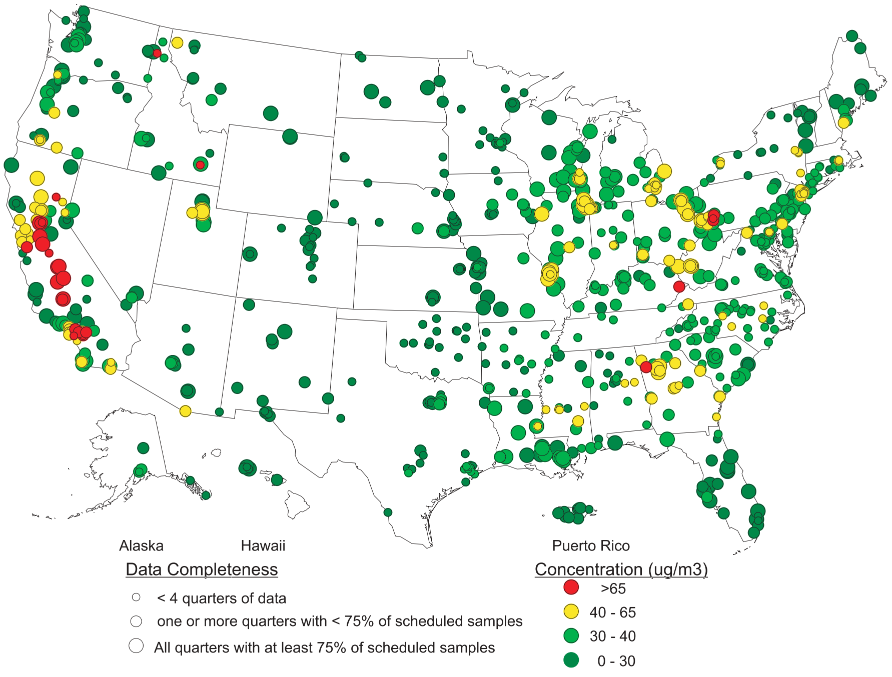
Readers should be cautioned not to draw conclusions regarding the attainment or nonattainment status inferred by a single year of $PM_{2.5}$ monitoring data. EPA regulations in *40 CFR* part 50, Appendix N, require three years of monitoring data and specify certain minimum data completeness requirements for data used to make decisions regarding attainment

Figure 2-46. 1999 annual mean $PM_{2.5}$ concentrations (µg/m^3).



Source: US EPA AIRS Data base as of 7/12/00 without data flagged as 1, 2, 3, 4, T, W, Y, or X

Figure 2-47. 1999 98th percentile 24-hour average $PM_{2.5}$ concentrations (µg/m^3).



Source: US EPA AIRS Data base as of 7/12/00 without data flagged as 1, 2, 3, 4, T, W, Y, or X

Figure 2-48. Urban $PM_{2.5}$ monthly patterns by region, 1999.

Notes: St. Louis and Buffalo = Industrial Midwest; Dallas = Southeast; Rochester = Northeast; Fresno, San Joaquin Valley, and Las Vegas = Southern California.

Hawaii, Alaska, and Puerto Rico are not included in regional summaries.

status. As indicated by the size of the circles on the maps, many sites have relatively incomplete data for 1999 at the time of the data summarization.

Seasonal Patterns in PM Concentrations

Data from the 1999 $PM_{2.5}$ FRM network show distinct seasonal variation in average $PM_{2.5}$ concentrations. The regional summaries in Figure 2-48 (urban) and Figure 2-49 (rural) demonstrate the geographic variability of $PM_{2.5}$ concentrations. The months with peak urban $PM_{2.5}$ concentrations vary by region. The urban areas in the eastern regions all show peaks in the summer months, and the western regions all show peaks in the winter months. The Industrial Midwest shows peaks in June and July, the upper Midwest shows peaks in July and August, and the Southeast shows peaks in August. The Northwest, Southwest, and Southern California all show peaks in January. The

Figure 2-49. Rural $PM_{2.5}$ monthly patterns by region, 1999.

Notes: St. Louis and Buffalo = Industrial Midwest; Dallas = Southeast; Rochester = Northeast; Fresno, San Joaquin Valley, and Las Vegas = Southern California.

Hawaii, Alaska, and Puerto Rico are not included in regional summaries.

Southwest and Southern California show a second peak in November.

Differences between urban and rural locations are apparent from the plots. Southern California urban and rural monitors show different seasonal patterns, with urban winter peaks not present in rural areas. In the Northwest the rural winter peak is not as pronounced as it is in urban areas. In all other regions the urban and rural patterns are very similar.

IMPROVE Network Results

The IMPROVE network was established in 1987 to track visibility impairment in the nation's most pristine areas, like national parks and wilderness areas. For this reason, the data primarily represent rural areas. There are, however, two non-rural sites (in Washington, D.C. and South Lake Tahoe) that use the same monitoring protocol. Data from these and other sites meeting data completeness criteria described in Appendix B, are presented in this section. Figure 2-50 shows the location of these sites by region. (The IMPROVE network is discussed in further detail in Chapter

Figure 2-50. Class I Areas in the IMPROVE Network meeting the data completeness criteria in Appendix B.

6: Visibility Trends. Also, visit **http://vista.cira.colostate.edu/improve/Data/IMPROVE/improve_data.htm** for more information concerning the IMPROVE network.)

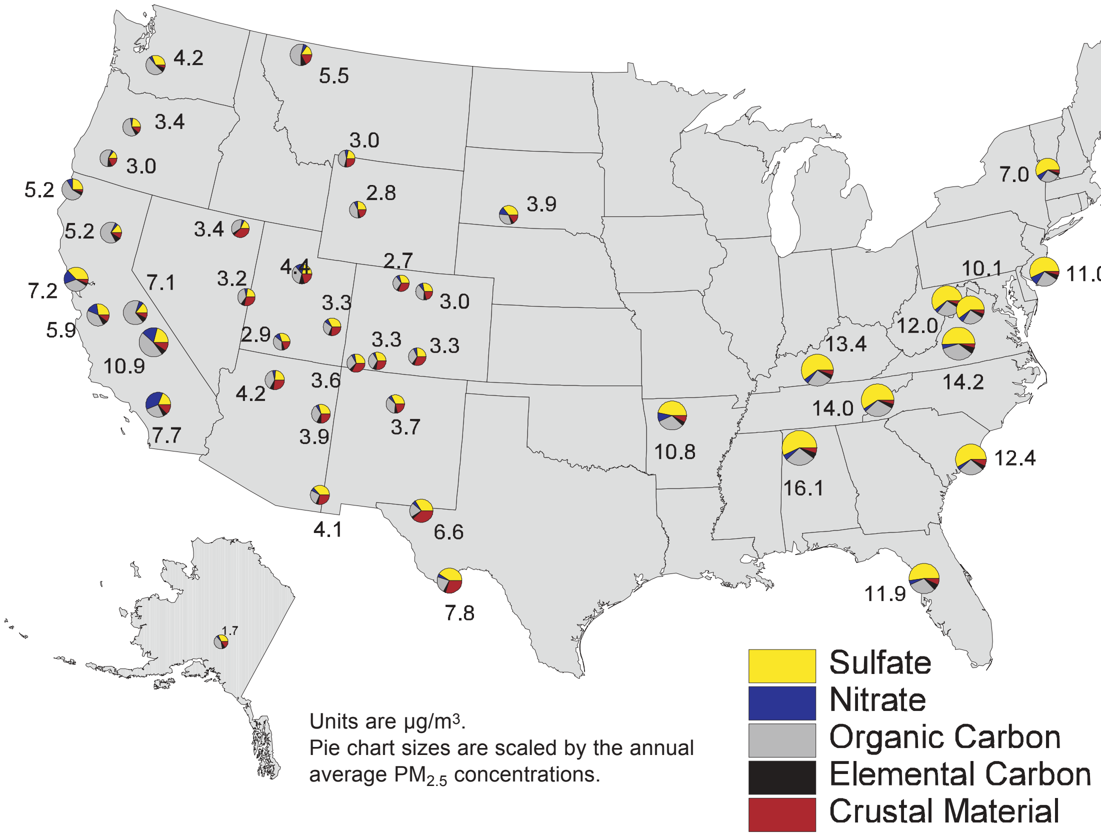
1999 Rural $PM_{2.5}$ Concentrations and Composition

Rural $PM_{2.5}$ concentrations vary regionally, with sites in the East typically having higher annual mean concentrations. Figure 2-51 shows the annual mean $PM_{2.5}$ concentrations in 1999. Much of the East/West difference is attributable to higher sulfate concentrations in the eastern United States. Sulfate concentrations in the eastern sites are 4–5 times greater than those in the western sites. Sulfate concentrations in the East largely result from sulfur dioxide emissions from coal-fired power plants. EPA's Acid Rain Program, which is discussed in more detail in the SO_2 section and in the SO_2 section in Chapter 7, sets restrictions on these power plants.

Within the East, rural $PM_{2.5}$ levels are higher in the Southeastern and mid-Atlantic states (ranging roughly from 10–16 µg/m^3), while the sites in the northeast are between 6–7 µg/m^3. In the West, rural $PM_{2.5}$ levels are generally less than 5 µg/m^3. California, Montana and Texas are the only states in the West with sites above that level.

The chemical composition of $PM_{2.5}$ also varies regionally. Sulfate and organic carbon account for most of the $PM_{2.5}$ concentrations in the East and the West. Sites in the East on average have a higher percentage of sulfate concentrations (56 percent) relative to those in the West (33 per-

Figure 2-51. Annual mean $PM_{2.5}$ concentrations in 1999.



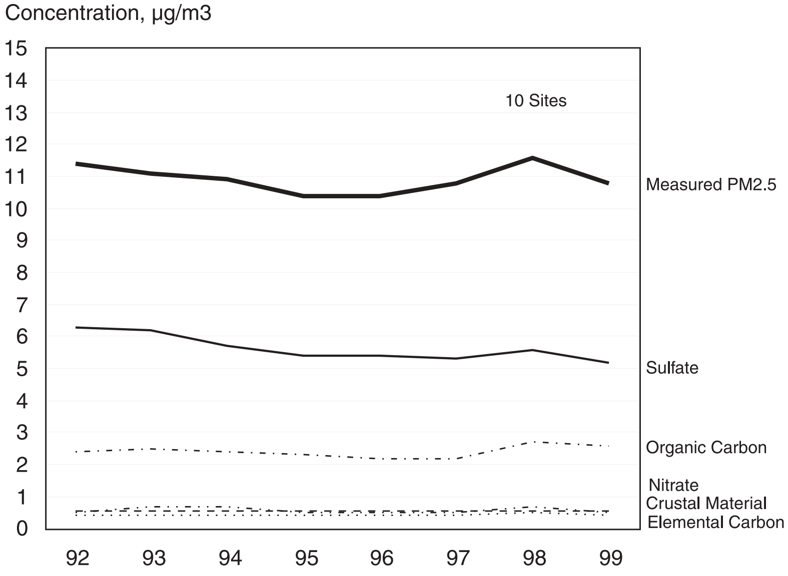
Units are µg/m3.
Pie chart sizes are scaled by the annual average $PM_{2.5}$ concentrations.

cent). Table 2-5 shows the difference in percent contribution of each species for the eastern versus western regions of the United States**.**

Table 2-5. Percent Contribution to $PM_{2.5}$ by Component, 1999

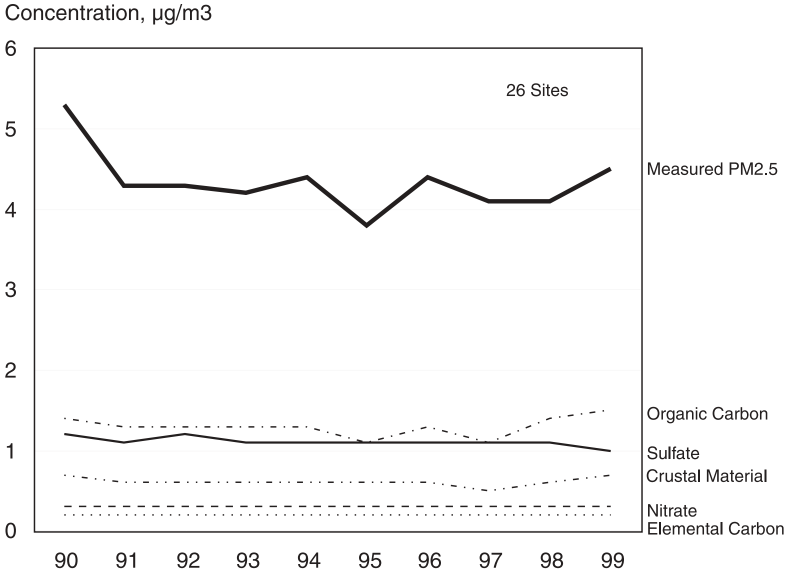
	East (10 sites)	West (26 sites)
Sulfate	56	33
Elemental Carbon	5	6
Organic Carbon	27	36
Nitrate	5	8
Crustal Material	7	17

Figure 2-52. $PM_{2.5}$ concentrations, 1992–1999 at eastern IMPROVE sites meeting trends criteria.



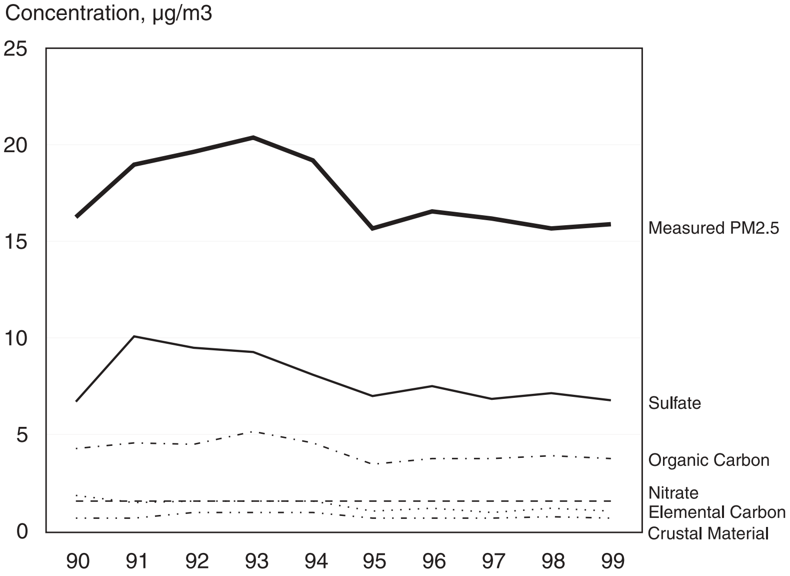
Note: Measured PM2.5 represents the direct mass measurement from the filter. The sum of the component concentrations do not equal this value because they do not account for all measured mass.

Figure 2-53. $PM_{2.5}$ concentrations, 1990–1999 at western IMPROVE sites meeting trends criteria.



Note: Measured PM2.5 represents the direct mass measurement from the filter. The sum of the component concentrations do not equal this value because they do not account for all measured mass.

Figure 2-54. $PM_{2.5}$ concentrations, 1990–1999 at the Washington D.C. IMPROVE site.



Note: Measured PM2.5 represents the direct mass measurement from the filter. The sum of the component concentrations do not equal this value because they do not account for all measured mass.

$PM_{2.5}$ Air Quality Trends in Rural Areas

Because of the significant regional variations in rural $PM_{2.5}$ concentrations, trends are aggregated by eastern and western regions as shown in Figures 2-52 and 2-53. Based on the 10 sites with trend data in the East, average $PM_{2.5}$ concentrations in the rural east decreased 7 percent from 1998–1999. The 1999 level is down 5 percent from the 1992 level, but it is up 4 percent from the 1995 level (the lowest level during the trend period). Sulfate concentrations in the rural east decreased 7 percent from 1998 to 1999. Organic carbon concentrations in the rural east decreased 4 percent from 1998–1999, but are still up 18 percent from 1997 (the lowest level during the trend period).

The average $PM_{2.5}$ concentrations in the West increased 10 percent from 1998–1999. However, the 1999 level is down 15 percent from the 1990 level.

$PM_{2.5}$ Trends in Non-rural Areas

Figure 2-54 shows that annual average $PM_{2.5}$ concentrations at the Washington, D.C. site decreased 2 percent between 1990 and 1999, but increased 1 percent between 1998 and 1999.

Characterizing $PM_{2.5}$ Emissions

To get some idea of the nature of fine PM, some emissions information coupled with ambient data measurements can be examined. EPA is working to improve the $PM_{2.5}$ emission inventory. In the meantime, a general assessment of the emission sources contributing to $PM_{2.5}$ can be obtained by evaluating $PM_{2.5}$ monitoring data in conjunction with emission inventory information. The paragraphs below provide a broad overview of the nationwide concentrations, composition, and sources of

$PM_{2.5}$ based on actual $PM_{2.5}$ measurements and the emission inventory of sources contributing within each composition category.

$PM_{2.5}$ is composed of a mixture of particles directly emitted into the air and particles formed in the air from the chemical transformation of gaseous pollutants. The principal types of secondary particles are ammonium sulfate and ammonium nitrate formed in the air from gaseous emissions of SO_2 and NO_x, reacting with ammonia. The main source of SO_2 is combustion of fossil fuels in boilers and the main sources of NO_x are combustion of fossil fuel in boilers and mobile sources. Some secondary particles are also formed from volatile organic compounds which are emitted from a wide range of combustion and other sources.

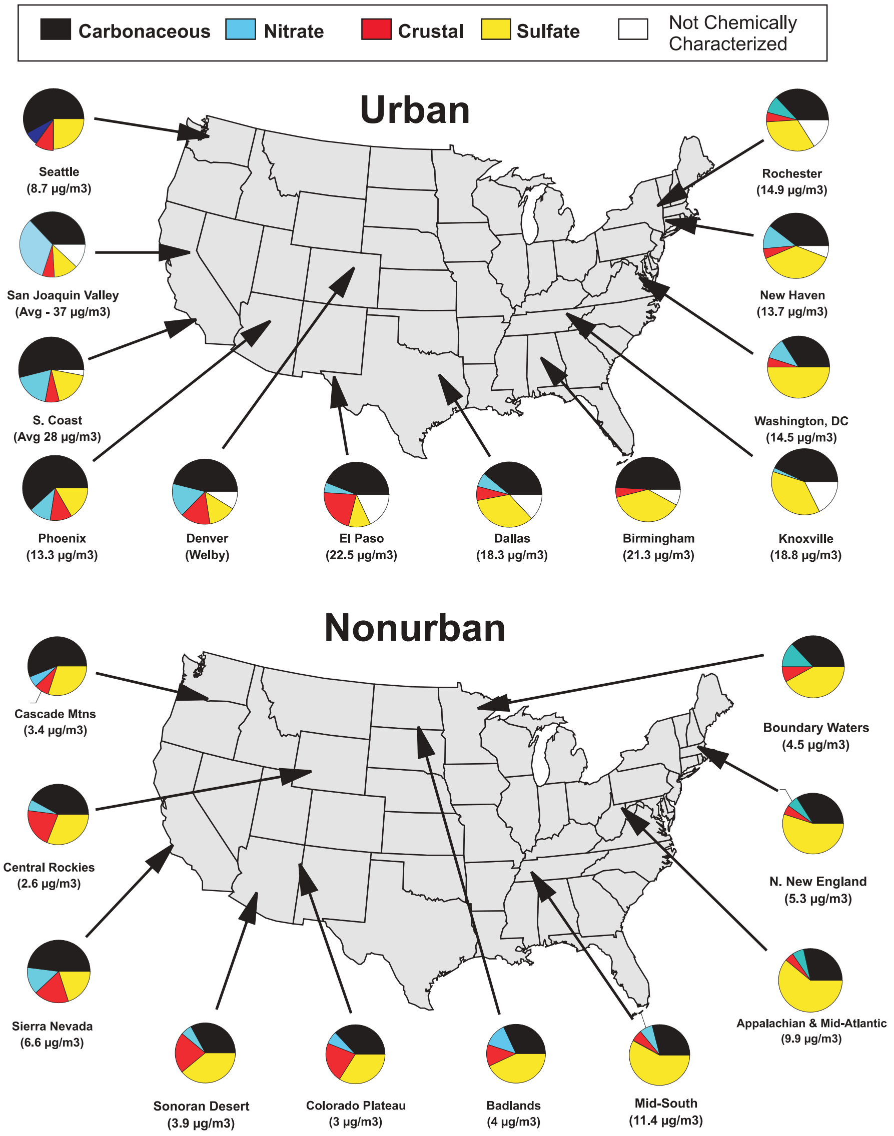
The principle types of directly emitted particles are those that predominantly consist of crustal materials and those consisting of elemental and organic carbonaceous materials resulting from the incomplete combustion of fossil fuels and biomass materials. The main sources of crustal particles are road surface materials, construction activity, and certain agricultural activities. The main sources of combustion-related particles are mobile sources such as diesels, managed and unmanaged biomass burning, residential wood combustion, utility, commercial and industrial boilers. Note however, that crustal particles contain some carbonaceous materials, some combustion process emissions contain crustal materials (e.g., wild and prescribed fires), and even fossil fuels contain fly ash that is chemically similar to soil and thus would be classified as crustal in the compositional analysis of ambient samples reported herein.

Figure 2-55 summarizes information from actual measurements of ambient $PM_{2.5}$. It shows how $PM_{2.5}$ composition varies in both the eastern and western United States. The ambient samples were chemically analyzed to determine the amount of ammonium sulfate and nitrate, crustal material and carbonaceous material. The concentration and composition data are based on at least one year of data from each monitoring location, with the exception of Denver. The data were collected using a variety of non-federal reference methods and should not be used to determine compliance with the $PM_{2.5}$ NAAQS. The composition information represents a range of urban and non urban locations. The published composition data for the East are somewhat limited, but preliminary information from several recently completed urban studies is included. It shows relatively consistent composition of $PM_{2.5}$ across much of the East. The available information consistently shows that $PM_{2.5}$ in the East is dominated by ammonium sulfate on a regional scale and also by carbonaceous particles emitted directly by combustion processes. Regional concentrations of $PM_{2.5}$ are generally higher throughout much of the East, due to the regional influence of ammonium sulfate caused by higher SO_2 emissions throughout much of the East and the ubiquitous nature of combustion processes. (See Chapter 7 for a description of spatial patterns and trends of sulfate air quality.) The regional concentrations of $PM_{2.5}$ are lower in the western United States than in the East and the composition is more variable. The west differs from the East in two important ways. First, non urban $PM_{2.5}$ concentrations are much lower in the West than in the East. This is because the East is blanketed regionally by relatively higher concentrations of ammonium sulfate, whereas regional sulfate concentrations in the West are much lower. Second, several western areas, notably the San Joaquin Valley and the Rubidoux area California's South Coast basin have higher ammonium nitrate concentrations. Nitrate concentrations are also higher in non-urban inland areas of southern California. Such pockets of high nitrate concentrations are not as pronounced in the East. Crustal material is a relatively small constituent of $PM_{2.5}$ in both the West and east, even in arid and agricultural areas such as Phoenix, Arizona and the San Joaquin Valley of California.

Figure 2-56 depicts the link between sources and the composition components of $PM_{2.5}$. EPA has developed a National Emissions Inventory (NEI) inventory for use in analyzing trends in emissions over time, conducting various in house analyses for PM, and for use in regional scale modeling.[33] The NEI covers all 50 states and includes point, area, onroad mobile, nonroad mobile sources and biogenic/geogenic emissions. Point sources are identified individually while county tallies are used for area and mobile source category groups. The inventory includes emissions of SO_2, NO_x, VOC, CO, PM_{10}, $PM_{2.5}$, and NH_3. Of these pollutants, only carbon monoxide is not a contributor to the ambient fine particle burden.

Figure 2-56 provides a link between the sources in the NET inventory and the composition information shown in Figure 2-55. The stacked bar graphs show the relative magnitude of emissions of sulfur dioxide, nitrogen oxides, carbonaceous and crustal-related particles. SO_2 is emitted mostly from the combustion of fossil fuels in boilers operated by electric utilities and industry. Less than 20 percent of SO_2 emissions nationwide are from other sources, mainly industrial processes and mobile sources. NO_x emissions are more evenly divided between stationary source and onroad mobile source fuel combustion, accounting for almost 80 percent of SO_2 emissions. Nonroad mobile sources account for most of the remaining emissions. SO_2 and NO_x combine with ammonia in the atmosphere under certain conditions to form ammonium sulfate and nitrate particles. Animal husbandry, mobile sources, fertilizer application and industrial processes are the main sources of ammonia, with animal husbandry contributing about 80 percent of the emissions. The main sources of carbonaceous particles are biomass and fossil fuel combustion with the open burning of biomass accounting for about one-third of the carbonaceous material emissions. Other important categories are mobile sources, various industrial processes, residential wood stoves and fireplaces, and organic soils and plant materials. Principal mobile sources include both on and off road diesels, gasoline engines, aircraft, railroads, and ships. The main sources of crustal particles are roads, construction and agriculture, but as discussed earlier, some of the crustal materials reported in Figures 2-55 and 2-56 come from combustion emissions. High wind events also can contribute large quantities of crustal materials to the air. However, since wind events are of relatively short duration, they are not included in annual emission estimates such as the NEI. While

Figure 2-55. $PM_{2.5}$ ambient composition.



Notes:

See Appendix B for a full discussion of data sources.

$PM_{2.5}$ mass concentrations are determined using at least 1 year of monitoring at each location using a variety of sampling methods. They should not be used for comparisons to the $PM_{2.5}$ NAAQS.

Figure 2-56. $PM_{2.5}$ emission sources.

Sulfur Dioxide

Ammonium sulfate particles are formed from emissions of gaseous SO_2 (and also SO_3 and sulfuric acid aerosols) emitted mostly from utility and industrial boilers and to a lesser degree from certain industrial processes and mobile sources.

Nitrogen Oxides

Ammonium nitrate particles are formed from emissions of gaseous NO_x emitted mostly from utility and industrial boilers but also from highway and off highway mobile sources and to a lesser degree, biogenic and miscellaneous combustion sources and certain industrial processes.

Ammonia

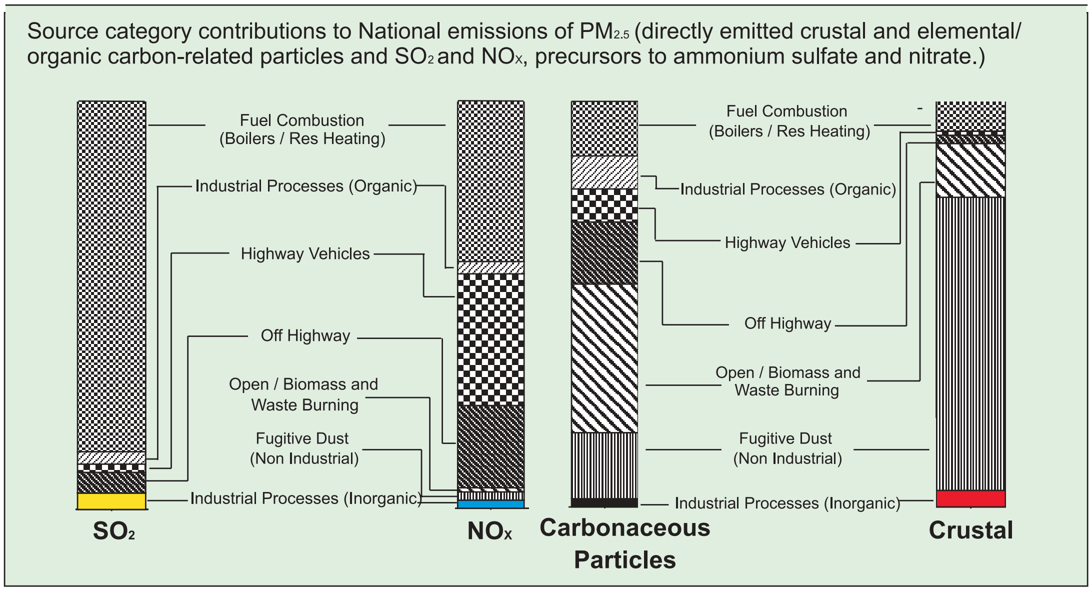
Ammonium sulfate and nitrate particles are formed from emissions of SO_2 and NO_x reacting with gaseous ammonia. Emission sources are animal husbandry, fertilizer manufacturing and application and to a lesser degree from mobile sources, and other combustion and industrial processes.

Carbonaceous Particles

Carbonaceous particles are emitted directly and as condensed liquid droplets from fuel combustion, burning of forests, rangelands and fields; off highway and highway mobile sources (gas and diesel); and certain industrial processes.

Crustal

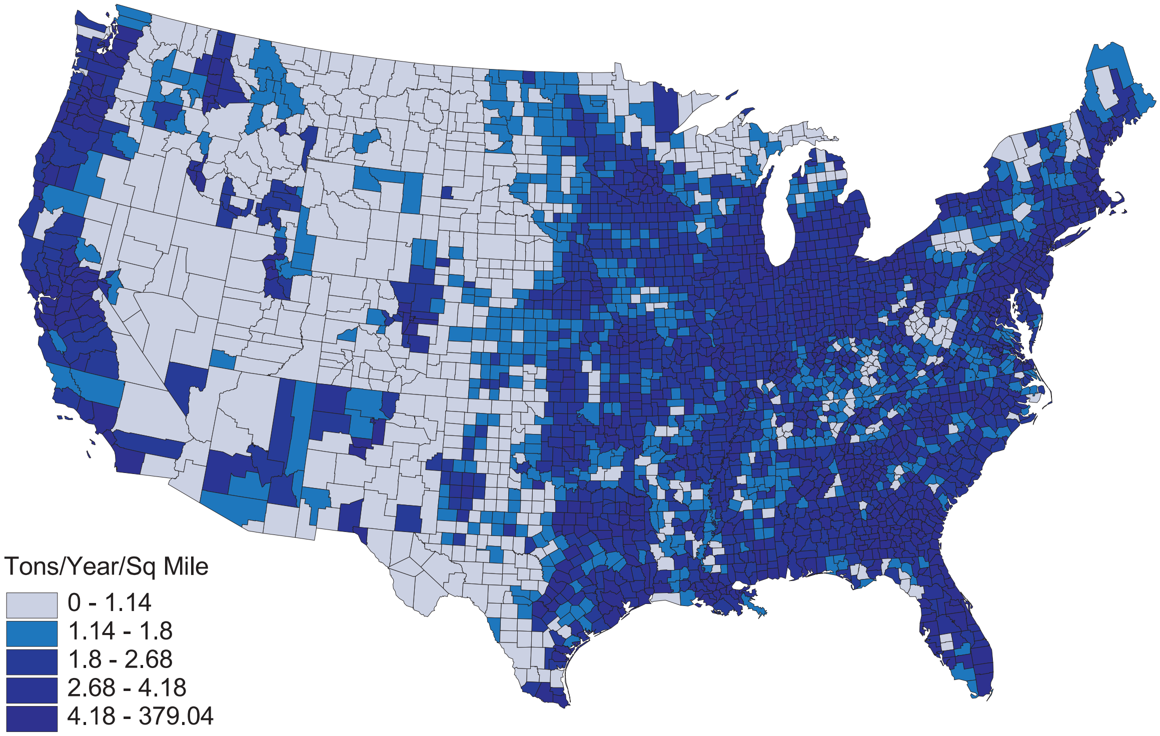
Particles emitted directly from non industrial surface (e.g., paved and unpaved road traffic, construction, agricultural operations, high wind events) and some industrial processes.


Source category contributions to National emissions of $PM_{2.5}$ (directly emitted crustal and elemental/organic carbon-related particles and SO_2 and NO_x, precursors to ammonium sulfate and nitrate.)

Note:

Composition and source contributions vary among urban areas. Also, some carbonaceous material is formed from organic gases reacting in the atmosphere. The magnitude of these "secondary" organics is believed small but more studies are needed by the research community.

Figure 2-57. Direct $PM_{2.5}$ emissions density by county, 1999.



crustal materials are the predominant component of PM_{10}, Figure 2-56 shows that $PM_{2.5}$ is predominantly comprised of secondary particles and directly emitted carbonaceous particles. The composition (and thus the sources) of $PM_{2.5}$ and PM_{10} are markedly different because most of the crustal material particles are larger than 2.5 micrometer aerodynamic diameter while almost all of the secondary particles and directly emitted carbonaceous particles are smaller than 2.5 micrometers.

Used together, Figures 2-55 and 2-56 can give a qualitative feel for the combined influence of specific source types on ambient $PM_{2.5}$ overall (e.g., fuel combustion in boilers, organic and inorganic industrial processes, highway and off highway mobile sources, open burning of waste/ biomass and fugitive dust). For example, Figure 2-56 shows that fuel combustion in boilers contributes significantly to both sulfate and carbonaceous mass. Figure 2-57 shows that both sulfate and carbonaceous particles are found in abundance in $PM_{2.5}$ in the east and that carbonaceous particles are also abundant in the west. Thus, one could conclude that fuel combustion in boilers is a significant contributor to $PM_{2.5}$ in the ambient air. In contrast, one could conclude that fugitive dust sources do not play a particularly important role in ambient air samples of $PM_{2.5}$. It is important to note, however, that PM_{10} crustal particles have been shown to be significant contributors to visibility impairment in the western United States.[34]

National Trends in $PM_{2.5}$ Emissions

Figure 2-57 shows the emission density for $PM_{2.5}$ in each U.S. county. $PM_{2.5}$ emission density is the highest in the eastern half of the United States, in large metropolitan areas, areas with a high concentration of agriculture such as the San Joaquin Valley in California and along the Pacific coast. This closely follows patterns in population density. One exception is that open biomass burning is an important source category that is more prevalent in forested areas and in some agricultural areas. Fugitive dust is a lower fraction of $PM_{2.5}$ emissions than they are for PM_{10}.

Figure 2-58 shows that total direct $PM_{2.5}$ emissions decreased 12 percent between 1990 and 1999, which is a similar 10-year trend to that for PM_{10}. The relative source contribution to $PM_{2.5}$ versus PM_{10} is different, as shown in Figures 2-59 and 2-60. When both traditionally inventoried and miscellaneous categories are considered together, combustion sources account for a higher percentage of total emissions for $PM_{2.5}$ than for PM_{10}.

As discussed earlier, ammonia is important in explaining the formation of sulfate and nitrate. Figure 2-61 is a pie chart showing 1999 NH_3 emissions by source category. It shows that livestock (and to a lesser extent fertilizer application) are the most important NH_3 sources, accounting for 87 percent of total ammonia emissions.

Characterizing Coarse Fraction PM Air Quality

An approximation of course fraction PM can be obtained by subtracting $PM_{2.5}$ from PM_{10} at collocated FRM monitors. Since the protocol for each monitor is not identical, the resulting estimate should be viewed with caution. A more complete and accurate view of $PM_{10-2.5}$ values can be obtained by nationwide deployment of PM_{10} and $PM_{2.5}$ monitors that use an equivalent monitoring protocol. Figure 2-62 shows estimated annual mean $PM_{10-2.5}$ and Figure 2-63 shows the estimated 98th percentile 24-hour average $PM_{10-2.5}$ developed from 1999 FRM monitor data. The limited data show that annual mean concentrations vary widely, with higher concentrations in several areas of the Midwest and southern California. A similar pattern emerges for the estimated 98th percentile 24-hour average

Figure 2-58. National direct $PM_{2.5}$ emissions trend, 1990–1999 (traditionally inventoried sources only).

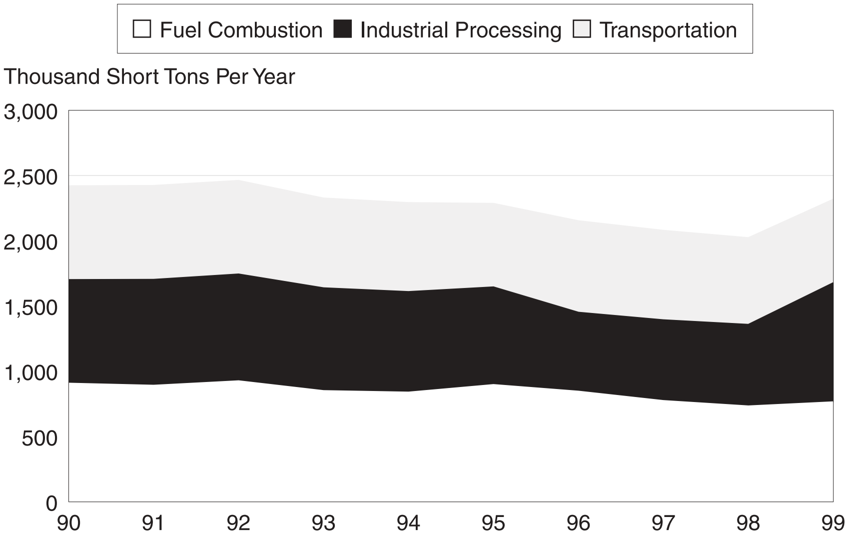
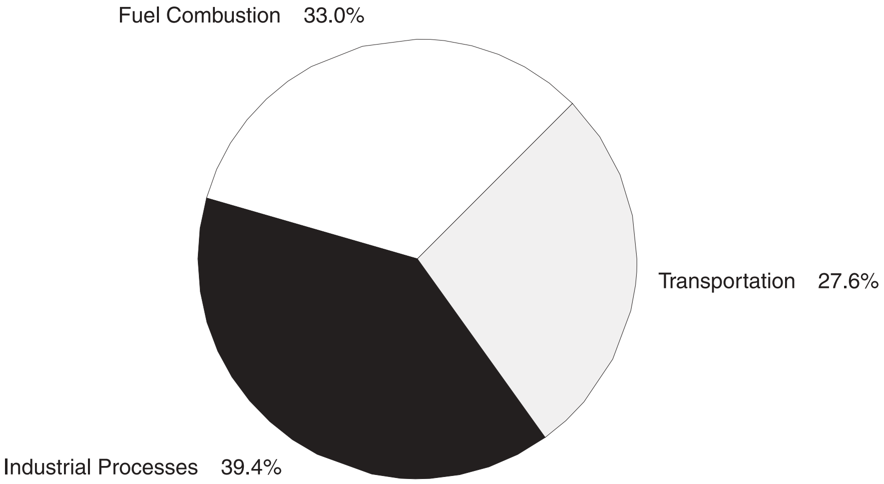


Figure 2-59. Direct $PM_{2.5}$ emissions from traditionally inventoried source categories, 1999.



$PM_{10-2.5}$ concentrations. Though the Southeast data is relatively incomplete, preliminary estimates suggest relatively low $PM_{10-2.5}$ levels throughout that region.

Figure 2-60. Total direct $PM_{2.5}$ emissions by source category, 1999.

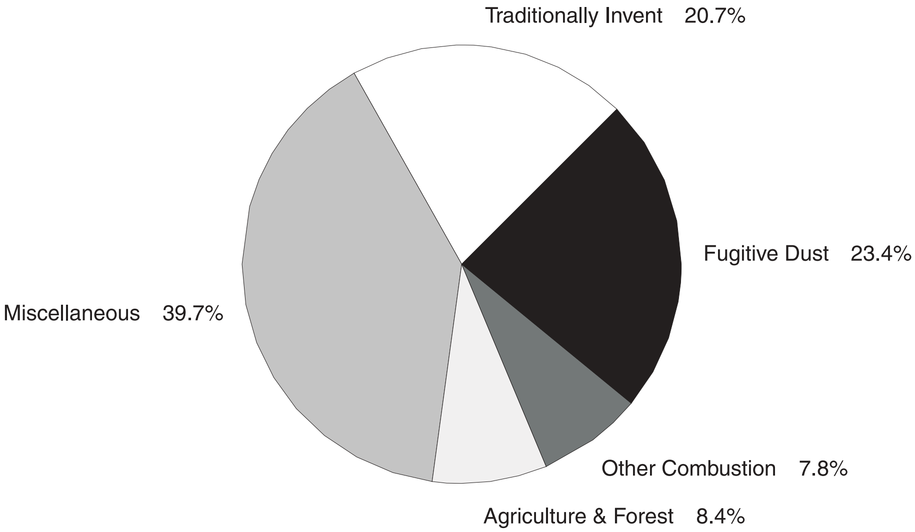


Figure 2-61. National ammonia emissions by principal source categories, 1999.

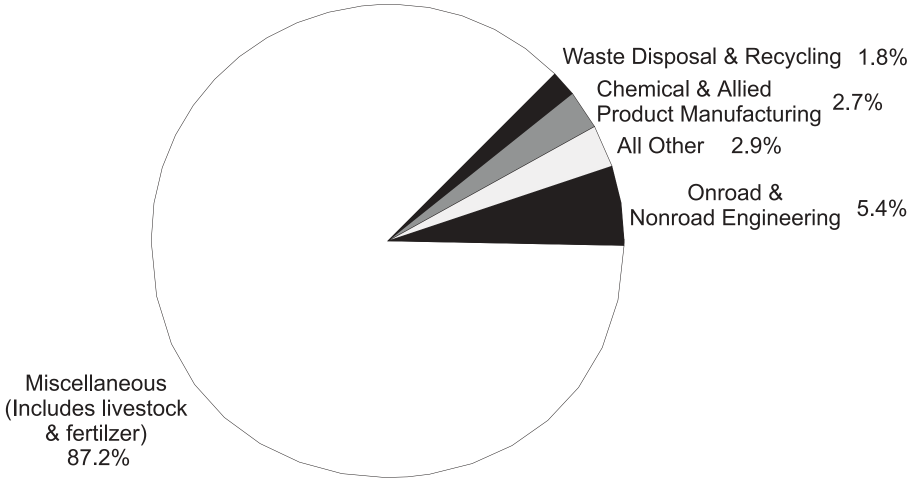


Figure 2-62. Estimated 1999 annual mean $PM_{10-2.5}$.

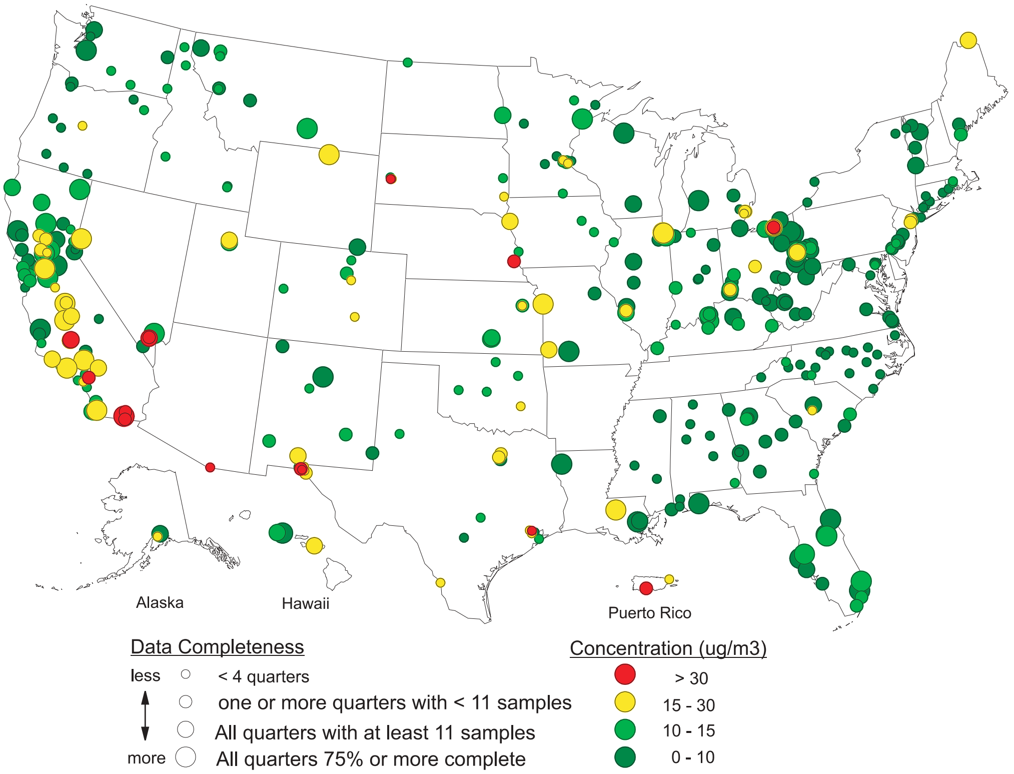
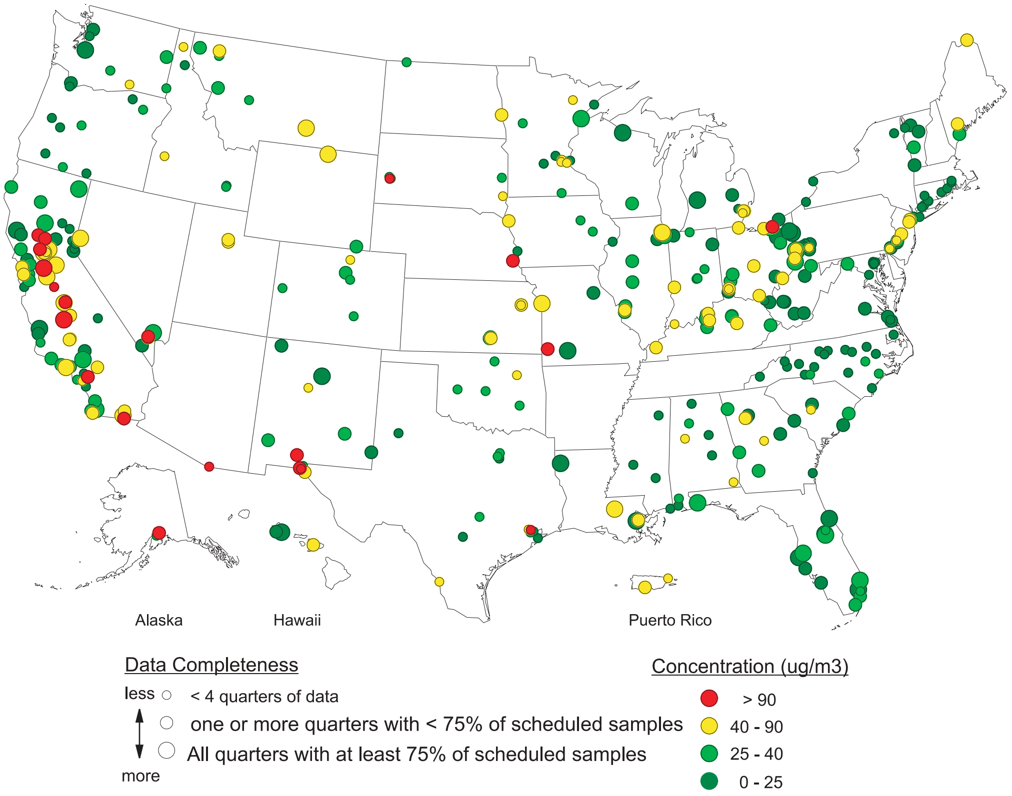


Figure 2-63. Estimated 1999 98th percentile 24-hour average $PM_{10-2.5}$ developed from 1999 FRM monitor data.



Sulfur Dioxide

Air Quality Concentrations	
1980-99	50% decrease
1990-99	36% decrease
1998-99	2% decrease

Emissions	
1980-99	27% decrease
1990-99	20% decrease
1998-99	3% decrease

Worth Noting:

- Steady 20-year improvement has reduced SO_2 ambient concentrations by one-half and emissions by one-third.
- Phase II of the Acid Rain Program was implemented in 2000 and should result in significant new reductions.

Nature and Sources

Sulfur dioxide (SO_2) belongs to the family of sulfur oxide (SO_x) gases. These gases are formed when fuel containing sulfur (mainly coal and oil) is burned, and during metal smelting and other industrial processes. The highest monitored concentrations of SO_2 have been recorded in the vicinity of large industrial facilities.

Health and Environmental Effects

High concentrations of SO_2 can result in temporary breathing impairment for asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels while at moderate exertion may result in reduced lung function that may be accompanied by symptoms such as wheezing, chest tightness, or shortness of breath. Other effects that have been associated with longer-term exposures to high concentrations of SO_2, in conjunction with high levels of PM, include respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease. The subgroups of the population that may be affected under these conditions include individuals with cardiovascular disease or chronic lung disease, as well as children and the elderly.

Additionally, there are a variety of environmental concerns associated with high concentrations of SO_2. Because SO_2, along with NOx, is a major precursor to acidic deposition (acid rain), it contributes to the acidification of soils, lakes and streams and the associated adverse impacts on ecosystems (see Chapter 7, Atmospheric Deposition of Sulfur and Nitrogen Compounds). Sulfur dioxide exposure to vegetation can increase foliar injury, decrease plant growth and yield, and decrease the number and variety of plant species in a given community. Sulfur dioxide also is a major precursor to $PM_{2.5}$ (aerosols), which is of significant concern to human health (as discussed in the particulate matter section of this chapter), as well as a main pollutant that impairs visibility (see Chapter 6, Visibility Trends). Finally, SO_2 can accelerate the corrosion of natural and man-made materials (e.g., concrete and limestone) which are used in buildings and monuments, as well as paper, iron-containing metals, zinc and other protective coatings.

Primary and Secondary Standards

There are both short- and long-term primary NAAQS for SO_2. The short-term (24-hour) standard of 0.14 ppm (365 $\mu g/m^3$) is not to be exceeded more than once per year. The long-term standard specifies an annual arithmetic mean not to exceed 0.030 ppm (80 $\mu g/m^3$). The secondary NAAQS (3-hour) of 0.50 ppm (1,300 $\mu g/m^3$) is not to be exceeded more than once per year. The standards for SO_2 have undergone periodic review, but the science has not warranted a change since they were established in 1972.

National 10-Year Air Quality Trends

The national composite average of SO_2 annual mean concentrations decreased 36 percent between 1990–1999 as shown in Figure 2-64, with the largest single-year reduction (16 percent) occurring between 1994 and 1995.[30] The composite trend has since leveled off, declining only 3 percent from 1998–1999. This same general trend is seen in Figure 2-65, which plots the ambient concentrations grouped by rural, suburban, and urban sites. It shows that the mean concentrations at the urban and suburban sites are consistently higher than those at the rural sites. However, the 1994–1995 reduction in the concentrations at non-rural sites does narrow the gap between the trends. The greater reduction seen in the non-rural sites reflects the fact that the proportion of non-rural sites is greater in the eastern United States, which is where most of the 1994–1995 emissions reductions at electric utilities occurred.[34] The national composite second maximum 24-hour SO_2 annual mean concentrations decreased 38 percent between 1990 and 1999, as shown in Figure 2-64 with the largest single-year reduction (25 percent) occurring between 1994 and 1995. See also Chapter 7, Atmospheric deposition of Sulfur and Nitrogen Compounds. A map of 1999 SO_2

monitor locations may be found in Figure B-6 in Appendix B.

National Emissions Trends

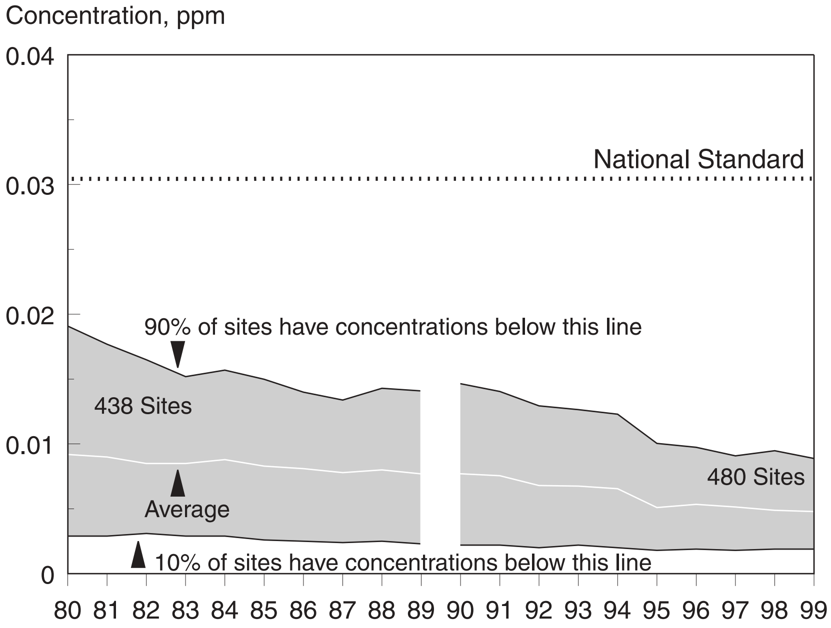
National SO_2 emissions decreased 20 percent between 1990 and 1999, with a sharp decline between 1994 and 1995, similar to the decline in the ambient concentrations. Unlike the air quality trend, however, the emissions trend remains essentially level from 1996–1999, as shown in Figure 2-66. This dramatic reduction in 1995 was caused by implementation of the Acid Rain Program; subsequent year-to-year variations are driven in part by the yearly changes in emissions from the electric utility industry. The electric utility industry accounts for most of the fuel combustion category in Figure 2-67. In particular, the coal-burning power plants have consistently been the largest contributor to SO_2 emissions, as documented in Table A-8 in Appendix A. See also Chapter 7, Atmospheric Deposition of Sulfur and Nitrogen Compounds.

The Acid Rain Program

The substantial national reductions in SO_2 emissions and ambient SO_2 and sulfate concentrations from 1994–1999) are due mainly to Phase I implementation of the Acid Rain Program. Established by EPA under Title IV of the CAAA, the Acid Rain Program's principal goal is to achieve significant reductions in SO_2 and NO_x emissions from electric utilities. Phase I compliance for SO_2 began in 1995 and significantly reduced emissions from the participating utilities.[35] Table 2-6 shows this reduction in terms of units required to participate in Phase I and other units.

Between 1996–1998 total SO_2 emissions from electric utilities have increased slightly, compared to 1995. In

Figure 2-64. Trend in annual mean SO_2 concentrations, 1980–1999.



Note: When the total number of rural, suburban, and urban sites are summed for either the 1980–89 or 1990–99 time periods in Figure 2-26, this number may not equal the total number of sites shown in Figure 2-25 for the same time periods. This is due to a few monitoring sites falling outside the definitions of rural, suburban, or urban sites.

Figure 2-65. Annual mean SO_2 concentration by trend location, 1980–1999.

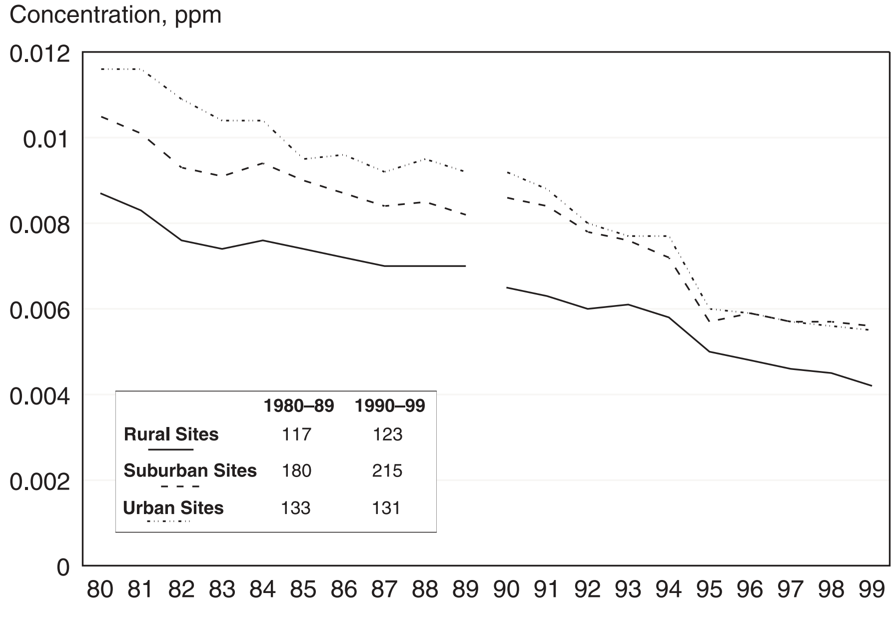
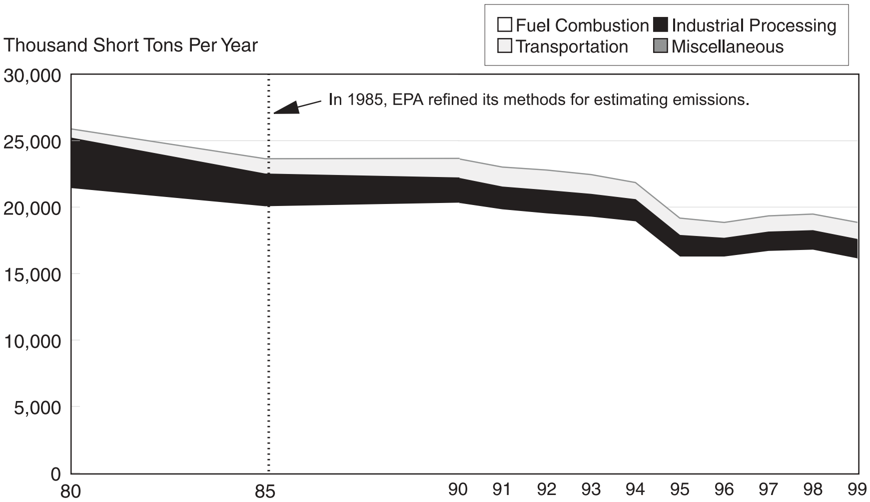
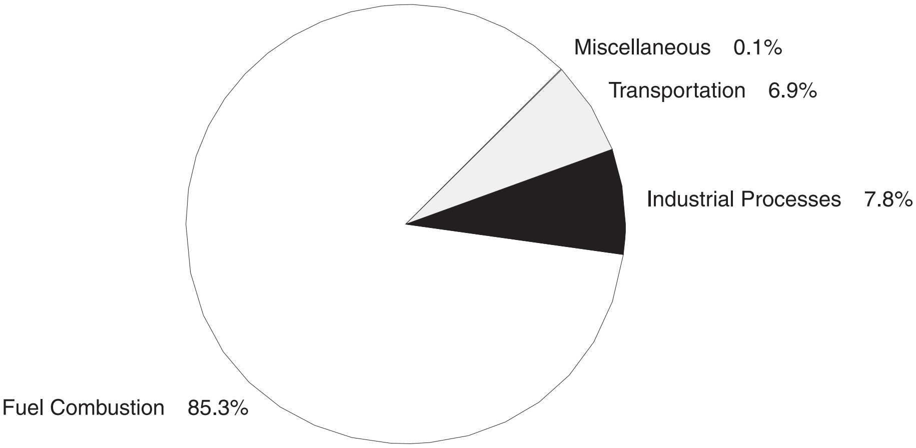


Figure 2-66. National total SO_2 emissions trend, 1980–1999.



In 1985, EPA refined its methods for estimating emissions.

Figure 2-67. SO_2 emissions by source category, 1999.



1999, however, total SO_2 emissions have decreased, matching 1995 levels. Again, Table 2-6 explains this increase in terms of Phase I units and Non-Phase I units. Most Phase I plants over-complied in Phase I (1995–1999), banking their SO_2 allowances for use in Phase II, resulting in significant early reductions. However, some Phase I units did increase their emissions during these years, compared to 1995. Since Phase I units account for only 18 percent of the total 1996–1998 increase, the majority of the increase is attributed to those units not yet participating in the Acid Rain Program until Phase II, which began in 2000. When fully implemented, total SO_2 emissions from electric utilities will be capped at 8.95 million tons per year under the Acid Rain Program. For more information on the Acid Rain Program, visit **http://www.epa.gov/airmarkets**. See also Chapter 7, Atmospheric Deposition of Sulfur and Nitrogen Compounds.

National 20-Year Air Quality Trends

The progress in reducing ambient SO_2 concentrations during the past 20 years is shown in Figure 2-68. While there is a slight disconnect in the trend line between 1989 and 1990 due to the mix of trend sites in each 10-year period, an overall downward trend is evident. The national 1999 composite average SO_2 annual mean concentration is 50 percent lower than 1980. In addition to the previously mentioned effects of the Acid Rain Program, these steady reductions over time were accomplished by installing flue-gas control equipment at coal-fired generating plants, reducing emissions from industrial processing facilities such as smelters and sulfuric acid manufacturing plants, reducing the average sulfur content of fuels burned, and using cleaner fuels in residential and commercial burners.

Regional Air Quality Trends

The map of regional trends in Figure 2-69shows that ambient SO_2 concentrations are generally higher in the eastern United States. The effects of Phase I of the Acid Rain Program are seen most vividly in the northeast. In particular, concentrations fell 20–25 percent between 1994 and 1995 in EPA Regions 1, 2, 3, and 5. These broad regional trends are not surprising since most of the units affected by Phase I of the Acid Rain Program also are located in the east as shown in Figure 2-70 This figure also shows that ambient concentrations have increased slightly between 1995 and 1997 in Regions 3 and 4 where many of the electric utility units not yet affected by the Acid Rain Program are located.

1999 Air Quality Status

The most recent year of ambient data shows that all counties did meet the primary SO_2 short-term standard, according to Figure 2-71.

Table 2-6. Total SO_2 Emissions from Phase I and Non-Phase I Acid Rain Sources: 1990–1999 (million tons).

	1990***	1995	1996	1997	1998	1999
Phase I (Table I) Units*	8.7	4.455	4.765	4.769	4.66	4.348
Non-Phase I Units**	7.03	7.408	7.749	8.209	8.474	8.104
All Electric Utility Units	15.73	11.863	12.514	12.978	13.134	12.452

* does not include substitution, compensating and opt-in units
** includes substitution, compensating, opt-in and Phase II units
*** Acid Rain phased requirements began in 1995

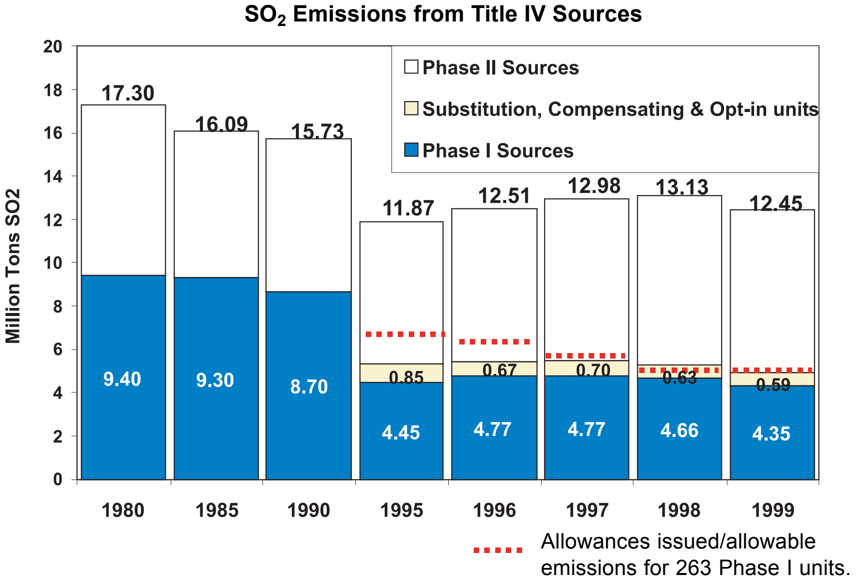


Figure 2-68. Long-term ambient SO_2 trend, 1980–1999.

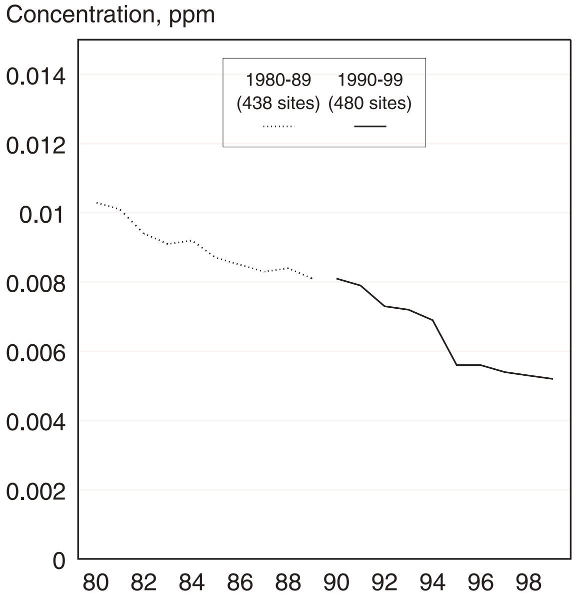
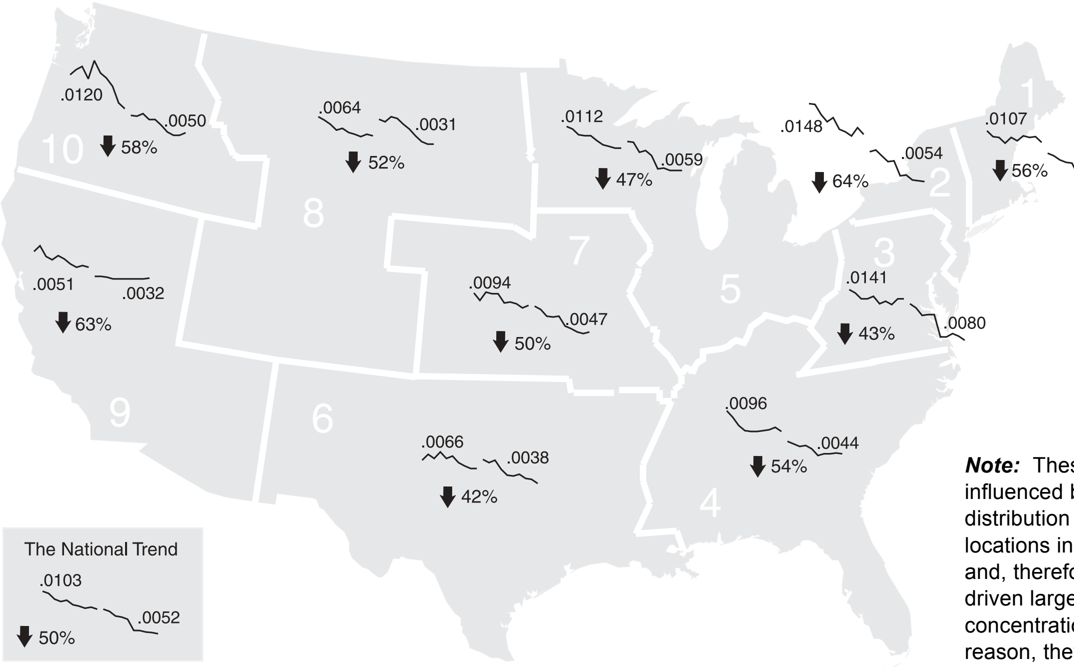


Figure 2-69. Trend in SO_2 annual arithmetic mean concentration by EPA region, 1980–1999.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

Figure 2-70. Plants affected by the Acid Rain Program.

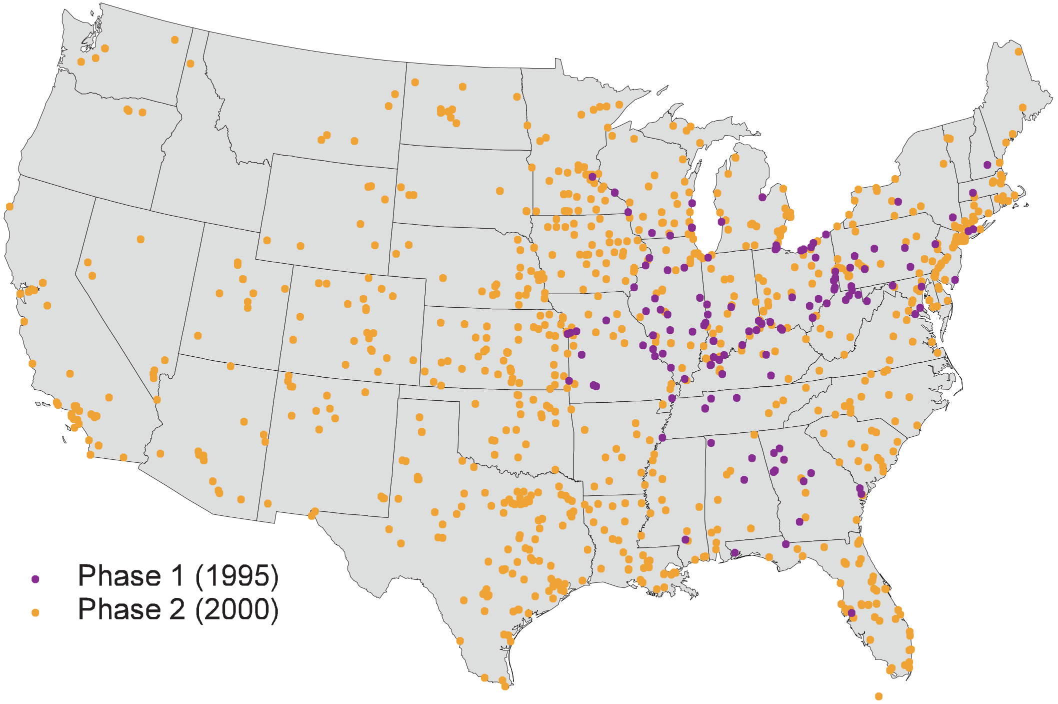
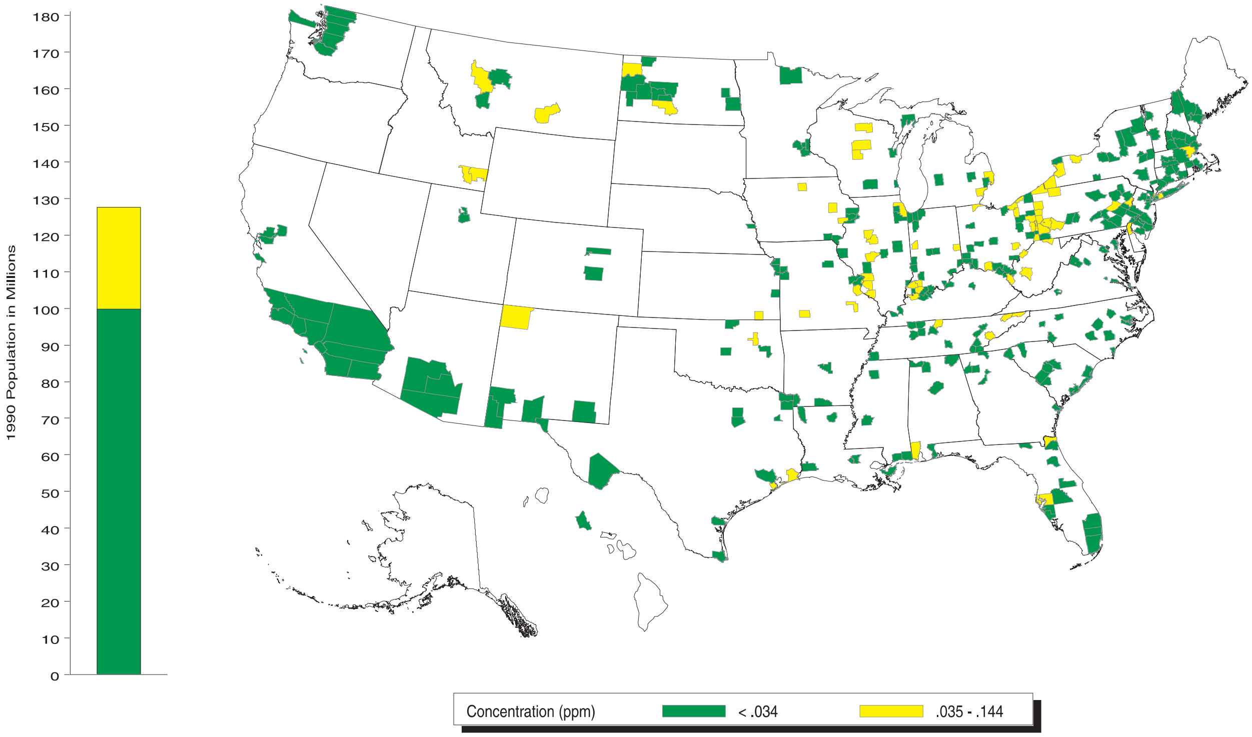


Figure 2-71. Highest 2nd maximum 24-hour SO_2 concentration by county, 1999.



References

1. Note that due to the annual loss and replacement of ambient monitoring sites (e.g., redevelopment, new leases, etc.), too few sites possess a monitoring record sufficient to construct a representative 20-year trend for the nation. Therefore, this report assesses long-term trends by piecing together two separate 10-year trends databases.

2. The methods used to estimate CO emissions of some source categories are not consistent in all years over the period between 1980 and 1999. Changes from one method to another make the emissions trend over time appear different than it actually has been. Of particular note is that for 1999, CO emissions from three source categories of open burning are estimated differently than in previous years and show a substantial increase compared to estimates for prior years. These categories of open burning of residential waste, yard waste, and land clearing waste are included in the ‘industrial processing’ sector of Figure 2-6. The apparent increase in emissions from this sector, and in total CO emissions, from 1998 to 1999 is the result of this change in estimation methodology.

3. *Oxygenated Gasoline Implementation Guidelines*, EPA, Office of Mobile Sources, Washington, D.C., July 27, 1992.

4. *Guidelines for Oxygenated Gasoline Credit Programs and Guidelines on Establishment of Control Periods Under Section 211(m) of the Clean Air Act as Amended*, 57 FR 47853 (October 20, 1992).

5. *Interagency Assessment of Oxygenated Fuels*, National Science and Technology Council, Executive Office of the President, Washington, D.C., June 1997.

6. Section 6 of TSCA gives EPA authority to ban, phase out, limit or control the manufacture of any chemical substance deemed to pose an unreasonable risk to the public or the environment. EPA expects to issue a full proposal to ban or phase down MTBE in early 2001.

7. “National Ambient Air Quality Standards for Nitrogen Dioxide: Final Decision,” *Federal Register*, 61 FR 196, Washington, D.C., October 8, 1996.

8. “Review of the National Ambient Air Quality Standards for Nitrogen Oxides: Assessment of Scientific and Technical Information,” EPA-452/R-95-005, U.S. Environmental Protection Agency, Research Triangle Park, N.C., September 1995.

9. Atmospheric concentrations of NO_2 are determined by indirect photomultiplier measurement of the luminescence produced by a critical reaction of NO with ozone. The measurement of NO_2 is based first on the conversion of NO_2 to NO, and then subsequent detection of NO using this well characterized chemiluminescence technique. This conversion is not specific for NO_2, hence chemiluminescence analyzers are subject to interferences produced by response to other nitrogen containing compounds (e.g., peroxyacetyl nitrate [PAN]) that can be converted to NO). The chemiluminescence technique has been reported to overestimate NO_2 due to these interferences. This is not an issue for compliance since there are no violations of the NO_2 NAAQS. In addition, the interferences are believed to be relatively small in urban areas. The national and regional air quality trends depicted are based primarily on data from monitoring sites in urban locations, and are expected to be reasonable representations of urban NO_2 trends. That is not the case in rural and remote areas, however, where air mass aging could foster greater relative levels of PAN and nitric acid and interfere significantly with the interpretation of NO_2 monitoring data.

10. ˝1998 Compliance Report,” U.S. Environmental Protection Agency, Acid Rain Program, Washington, D.C., August 1999.

11. “Identification of Ozone Areas Attaining the 1-hour Standard and to Which the 1-hour Standard is No Longer Applicable; Final Rule,” *Federal Register*, 63 FR 2804, Washington, D.C., June 5, 1998.

12. “Identification of Additional Ozone Areas Attaining the 1-hour Standard and to Which the 1-hour Standard is No Longer Applicable; Final Rule,” *Federal Register*, 63 FR 39431, Washington, D.C., July 22, 1998.

13. “Identification of Additional Ozone Areas Attaining the 1-hour Standard and to Which the 1-hour Standard is No Longer Applicable; Final Rule,” *Federal Register*, 64 FR 30911, Washington, D.C., June 9, 1999.

14. “Rescinding Findings that the 1-hour Ozone Standard No Longer Applies to Certain Areas; Final Rule,” *Federal Register*, 64 FR 57424, Washington, D.C., November 5, 1999.

15. “National Ambient Air Quality Standards for Ozone; Final Rule,” *Federal Register*, 62 FR 38856, Washington, D.C., July 18, 1997.

16. W.M. Cox and S.H. Chu, “Meteorologically Adjusted Ozone Trends in Urban Areas: A Probabilistic Approach,” *Atmospheric Environment*, Vol. 27B, No. 4, Pergamon Press, Great Britain, 1993.

17. Currently, 24 of the nation’s remaining 31 nonattainment areas for the 1-hour ozone NAAQS are required to operate PAMS sites (“Ambient Air Quality Surveillance: Final Rule,” *Federal Register*, 58FR 8452, Washington, D.C., February 12, 1993). Each PAMS network consists of as many as five monitoring stations, depending on the area’s population. These stations are carefully located according to meteorology, topography, and relative proximity to emissions sources of VOC and NO_x. As of October 1999, there were 83 active designated PAMS sites.

18. “Selected PAMS sites” refers to the inclusion of only those sites with measurements of NO_x or VOCs in both

1995 and 1999. Morning periods for NO_x and VOCs are used because those time frames are generally thought to be an appropriate indicator of anthropogenic emissions.

19. These 24 VOC species are the focus of this analysis because they account for more than 75 percent (by volume) of the VOCs concentrated on in the PAMS program.

20. CASTNet is considered the nation's primary source for atmospheric data to estimate dry acidic deposition and to provide data on rural ozone levels. Used in conjunction with other national monitoring networks, CASTNet is used to determine the effectiveness of national emission control programs. Established in 1987, CASTNet now comprises 79 monitoring stations across the United States. The longest data records are primarily at eastern sites. The majority of the monitoring stations are operated by EPA's Office of Air and Radiation; however, 27 stations are operated by the National Park Service (NPS) in cooperation with EPA. The CASTNet data complement the larger ozone data sets gathered by the State and Local Monitoring (SLAMS) and National Air Monitoring (NAMS) networks with additional rural coverage. A more detailed treatment of CASTNet's atmospheric deposition role and data are provided in Chapter 7: Atmospheric Deposition of Sulfur and Nitrogen Compounds.

21. Similarly, although registering declines in 8-hour ozone levels of 17 and 12 percent respectively over the last 20 years, neither urban nor suburban sites have shown any improvement in ozone concentrations between 1990–1999.

22. This analysis utilizes a non-parametric regression procedure to assess statistical significance a description of which is provided in Chapter 3: Criteria Pollutants – Metropolitan Area Trends.

23. "Volatility Regulations for Gasoline and Alcohol Blends Sold in Calendar Years 1989 and Beyond," *Federal Register*, 54 FR 11868, Washington, D.C., March 22,1989.

24. "Reformulated Gasoline: A Major Step Toward Cleaner Air," EPA-420-B-94-004, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C., September 1994.

25. The Clean Air Act requires that RFG contain 2 percent oxygen by weight. "Requirements for Reformulated Gasoline," *Federal Register*, 59 FR 7716, Washington, D.C., February 16, 1994.

26. The Panel's Executive Summary and final report entitled *"Achieving Clean Air and Clean Water: The Report of the Blue Ribbon Panel on Oxygenates in Gasoline"* can be found at: http://www.epa.gov/oms/consumer/fuels/oxypanel/blueribb.htm

27. *National Air Pollutant Emission Trends, 1900-1998*, EPA-454/R-00-002, U.S. Environmental Protection Agency, Research Triangle Park, NC 2000.

28. 1996 PM Criteria Document, **http://www.epa.gov/ttn/oarpg/t1cd.html**.

29. *National Ambient Air Quality Standards for Particulate Matter: Final Rule,* July 18, 1997. (62 FR 38652), **http://www.epa.gov/ttn/oarpg/t1/fr_notices/pmnaaqs.pdf**.

30. *Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter: Final Rule,* July 18, 1997, **http://www.epa.gov/ttn/oarpg/t1/fr_notices/pm_mon.pdf**.

31. Personal communication with EPA Region 9.

32. Personal communication with EPA Region 3.

33. National Air Pollutant Emissions Trends, 1900-1998, EPA-454/R-00-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, March 2000.

34. IMPROVE, Cooperative Center for Research in the Atmosphere, Colorado State University, Ft. Collins, CO, May 2000.

35. *1997 Compliance Report: Acid Rain Program*, EPA-430-R-98-012, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C., August 1998.

CHAPTER 3

Criteria Pollutants — Metropolitan Area Trends

http://www.epa.gov/oar/aqtrnd99/chapter3.pdf

Worth Noting:

- Out of 263 metropolitan statistical areas, 34 have significant upward trends.
- Of these, trends with values over the level of the air quality standards involved only 8-hour ozone.

This chapter presents status and trends in criteria pollutants for metropolitan statistical areas (MSAs) in the United States. The MSA status and trends give a local picture of air pollution and can reveal regional patterns of trends. Such information can allow one to gauge the air pollution situation where they live, and can be very useful in formulating plans for community based programs.[1] Not all areas in the country are in MSAs, and not all MSAs are included here. A complete list of MSAs and their boundaries can be found in the Statistical Abstract of the United States.[2] The status and trends of metropolitan areas are based on four tables found in Appendix A (A-15 through A-18). Table A-15 gives the 1999 peak statistics for all MSAs, providing the status of that year. Ten-year trends are shown for the 263 MSAs having data that meet the trends requirements explained in Appendix B. Table A-16 lists these MSAs and reports criteria pollutant trends as "upward" or "downward," or "not significant." These categories are based on a statistical test, known as the Theil test, described later in this chapter.

Another way to assess trends in MSAs is to examine Air Quality Index (AQI) values.[3,4,5] The AQI is used to present daily information, on one or more criteria pollutants in an easily understood format, to the public in a timely manner. Tables A-17 and A-18 list the number of days with AQI values greater than 100 for the nation's 94 largest metropolitan areas (population greater than 500,000). Table A-17 lists AQI values based on all pollutants, while Table A-18 lists AQI values based on ozone alone. The tables listing PSI data from previous reports may not agree with the tables in this report because of the new way to calculate the AQI. These changes are presented in more detail later in this chapter.

Not every MSA appears in these tables. Some do not appear because the population is so small or the air quality is so good that AQI reporting is not presently required. There are MSAs with no ongoing air quality monitoring for one or more of the criteria pollutants, because it is not needed. Ambient monitoring for a particular pollutant may not be conducted if there is no problem. In addition, there are also MSAs with too little monitoring data for trends analysis purposes (see Appendix B).

Status: 1999

The air quality status for MSAs can be found in Table A-15.** Table A-15 lists peak statistics for all criteria pollutants measured in an MSA. As discussed above, not all criteria pollutants are measured in all MSAs. This is why data for some MSAs are designated as "ND" (no data) for those pollutants. Examining Table A-15 shows that 163 areas had peak concentrations exceeding standard levels for at least one criteria pollutant. The number of these areas decreased 6 percent over the count from 1998 data (173 areas). These 163 areas contain 58 percent of the U.S. population. Similarly, there were eight areas (with 8 percent of the population) that had peak statistics that exceeded two or more standards. Only one area, Los Angeles, CA (with 4 percent of the U.S. population), had peak statistics from three pollutants that

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**For related information, see Table A-14, peak concentrations for all counties with monitors that reported to the Aerometric Information Retrieval System (AIRS) database.

exceeded the respective standards. There were no areas that violated four or more standards.

Trends Analysis

Table A-16 displays air quality trends for MSAs. The data in this table are average statistics of pollutant concentrations from the subset of ambient monitoring sites that meet the trends criteria explained in Appendix B. A total of 258 MSAs have at least one monitoring site that meets these criteria. As stated previously, not all pollutants are measured in every MSA. From 1990–1999, statistics based on the Standards were calculated for each site and pollutant with available data. Spatial averages were obtained for each of the 263 MSAs by averaging these statistics across all sites in an MSA. This process resulted in one value per MSA per year for each pollutant. Although there are seasonal patterns of high values for some pollutants in some locations, the averages for every MSA and year provide a consistent indicator with which to assess trends.

Since air pollution levels are affected by variations in meteorology, emissions, and day-to-day activities of populations in MSAs, trends in air pollution levels are not always well defined. To assess upward or downward trends, a statistical significance test was applied to these data. An advantage of using the statistical test is the ability to test whether or not the upward or downward trend is real (significant) or just a chance product of year-to-year variation (not significant). Since the underlying pollutant distributions do not meet the usual assumptions required for common significance tests, the test was based upon a nonparametric method commonly referred to as the Theil test.[6,7,8,9] Because linear regression estimates the trend from changes during the entire 10-year period, it is possible to detect an upward or downward trend even when the concentration level of the first year equals the concentration level of the last year.

Table 3-1. Summary of MSA Trend Analyses by Pollutant, 1990–1999

	Trend Statistic	Total # MSAs	# MSAs Up	# MSAs Down	# MSAs with No Significant Change
CO	second max 8-hour	138	0	107	31
Lead	max quarterly mean	69	1	44	24
NO_2	arithmetic mean	99	3	41	55
Ozone	fourth max 8-hour	207	25	10	172
Ozone	second daily max 1-hour	207	17	14	176
PM_{10}	90th percentile	216	1	113	102
PM_{10}	weighted annual mean	216	2	126	88
SO_2	arithmetic mean	148	1	86	61
SO_2	second max 24-hour	149	1	82	66

Table 3-1 summarizes the trend analysis performed on the 263 MSAs. It shows that there were no upward trends in carbon monoxide (CO) for any MSA. Lead, the 90th percentile of PM_{10} and sulfur dioxide had upward trends at only one MSA over the past decade. Further examination of Table A-16 shows that of the 263 MSAs: 1) 214 had downward trends in at least one of the criteria pollutants; 2) 34 had upward trends (of these 34, 26 also had downward trends in other pollutants (leaving 8 MSAs with exclusively upward trends); and 3) 41 MSAs had no significant trends. A closer look at the 34 MSAs with upward trends reveals that most (20) were exceeding the level of the 8-hour ozone standard. For all other pollutants with upward trends in any MSA, the levels observed were well below standard levels. Taken as a whole, these results demonstrate significant improvements in urban air quality over the past decade for the nation.

The Air Quality Index

The AQI provides information on pollutant concentrations for ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Formerly known as the Pollutant Standards Index (PSI), this nationally uniform air quality index is used by state and local agencies for reporting daily air quality to the public. In 1999, EPA updated the AQI to reflect the latest science on air pollution health effects and to make it more appropriate for use in contemporary news media, thereby enhancing the public's understanding of air pollution across the nation. Currently, the AQI may be found in national media such as *USA Today* and on the Weather Channel, as well as local newspapers and broadcasts across the country. It also serves as a basis for community-based programs that encourage the public to take action to reduce air pollution on days when levels are projected to be of concern. An Internet website, AIRNOW (**http://www.epa.gov/airnow**), which presents "real time" air quality data and forecasts of summertime smog levels for most states, uses the AQI to communicate information about air quality. The Index has been adopted by many other countries (e.g., Mexico, Singapore, and Taiwan) and is used around the world to provide the public with information on air pollutants.

AQI values for each of the pollutants are derived from concentrations of that pollutant. The Index is "normalized" across each pollutant so that, generally, an Index value of 100 is set at the level of the short-term, health-based standard for that pollutant. An Index value of 500 is set at the significant harm level, which represents imminent and substantial endangerment to public health.*** The higher the Index value, the greater the level of air pollution and health risk. To make the AQI as easy to understand as possible, EPA has divided the AQI scale into six general categories that correspond to a different level of health concern. Because different groups of people are sensitive to different pollutants, there are pollutant-specific health effects and cautionary statements for each category in the AQI:

- **Good** (AQI values between 0 and 50) Air quality is considered satisfactory and air pollution poses little or no risk.
- **Moderate** (AQI values between 51 and 100) Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of individuals. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
- **Unhealthy for Sensitive Groups** (AQI values between 101 and 150) Certain groups of people are particularly sensitive to the harmful effects of certain air pollutants. This means they are likely to be affected at lower levels than the general public. For example, children and adults who are active outdoors and people with respiratory disease are at greater risk from exposure to ozone, while people with heart disease are at greater risk from carbon monoxide. When the AQI is in this range, members of sensitive groups may experience health effects, but the general public is not likely to be affected.
- **Unhealthy** (AQI values between 151 and 200) Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.
- **Very Unhealthy** (AQI values between 201 and 300) Air quality in this range triggers a health alert, meaning everyone may experience more serious health effects.
- **Hazardous** (AQI values over 300) Air quality in this range triggers health warnings of emergency conditions. The entire population is likely to be affected.

An AQI report will contain an Index value, category name, and the pollutant of concern, and is often featured on local television or radio news programs and in newspapers, especially when values are high. For national consistency and ease of understanding, there are specific colors associated with each category that are required if the AQI is reported using color. Examples of the use of color in Index reporting include the color bars that appear in many newspapers, and the color contours of the ozone Map. The six AQI categories, their respective health effects descriptors, colors, index ranges, and corresponding concentration ranges are listed in Table 3-2. The EPA has also developed an AQI logo (Figure 3-1) to increase the awareness of the AQI in such reports and also to indicate that the AQI is uniform throughout the country.

The AQI integrates information on pollutant concentrations across an entire monitoring network into a single number that represents the worst daily air quality experienced in an urban area. For each of the pollutants, concentrations are converted into Index values between zero and 500. The pollutant with the highest Index value is reported as the AQI for that day. There is a new AQI requirement to report any pollutant with an Index value above 100. In addition, when the AQI is above 100 a pollutant-specific statement indicating what specific groups are most at risk must be reported. For example, when the Index is above 100 for ozone the AQI report will contain the statement "Children and people with asthma are the groups most at risk." The AQI must be reported in all MSAs with air quality problems and populations greater than 350,000 according to the 1990 census. Previously, urbanized areas with populations greater than 200,000 were required to report the Index.

***Based on the short-term standards, Federal Episode Criteria, and Significant Harm Levels, the AQI is computed for PM (particulate matter), SO_2, CO, O_3, and NO_2. Lead is the only criteria pollutant not included in the index because it does not have a short-term standard, a Federal Episode Criteria, or a Significant Harm Level.

Table 3-2. AQI Categories, Colors, and Ranges

Category	AQI	O_3 (ppm) 8-hour	O_3 (ppm) 1-hour	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	CO (ppm)	SO_2 (ppm)	NO_2 (ppm)
Good	0 – 50	0.000 – 0.064	(2)	0.0 - 15.4	0 – 54	0.0 – 4.4	0.000 – 0.034	(3)
Moderate	51 – 100	0.065 – 0.084	(2)	15.5 – 40.4	55 – 154	4.5 – 9.4	0.035 – 0.144	(3)
Unhealthy for Sensitive Groups	101 – 150	0.085 – 0.104	0.125 – 0.164	40.5 – 65.4	155 – 254	9.5 – 12.4	0.145 – 0.224	(3)
Unhealthy	151 – 200	0.105 – 0.124	0.165 – 0.204	65.5 – 150.4	255 – 354	12.5 – 15.4	0.225 – 0.304	(3)
Very unhealthy	201 – 300	0.125 – 0.374	0.205 – 0.404	150.5 – 250.4	355 – 424	15.5 – 30.4	0.305 – 0.604	0.65 – 1.24
Hazardous	301 – 400 401 – 500	(1) (1)	0.405 – 0.504 0.505 – 0.604	250.5 – 350.4 350.5 – 500.4	425 – 504 505 – 604	30.5 – 40.4 40.5 – 50.4	0.605 – 0.804 0.805 – 1.004	1.25 – 1.64 1.65 – 2.04

1. No health effects information for these levels–use 1-hour concentrations.

2. 1-hour concentrations provided for areas where the AQI is based on 1-hour values might be more cautionary.

3. NO_2 has no short-term standard but does have a short-term “alert” level.

Figure 3-1. Air Quality Index logo.

Summary of AQI Analyses

Of the five criteria pollutants used to calculate the AQI, only four (CO, O_3, PM_{10}, and SO_2) generally contribute to the AQI value. Nitrogen dioxide is rarely the highest pollutant measured because it does not have a short-term standard and can only be included when the Index reaches a value of 200 or greater. Ten-year AQI trends are based on daily maximum pollutant concentrations from the subset of ambient monitoring sites that meet the trends requirements in Appendix B.

Since an AQI value greater than 100 indicates that at least one criteria pollutant has reached levels where people in sensitive groups are likely to suffer health effects, the number of days with AQI values greater than 100 provides an indicator of air quality in urban areas. Figure 3-2 shows the trend in the number of days with AQI values greater than 100 summed across the nation’s 94 largest metropolitan areas. This number is expressed as a percentage of the days in the first year (1990). Because of their magnitude, AQI totals for Los Angeles, CA; Riverside, CA; Bakersfield, CA; Ventura CA; Orange County, CA; and San Diego, CA are shown separately as southern California. Plotting these values as a percentage of 1990 values allows two trends of different magnitudes to be compared on the same graph. The long-term air quality improvement in southern California urban areas is evident in this figure. Between 1990 and 1999, the total number of days with AQI values greater than 100 decreased 62 percent in southern California but actually rose 25 percent in the remaining major cities across the United States (see Figure 3-2).

While five criteria pollutants can contribute to the AQI, the index is driven mostly by ozone. AQI estimates depend on the number of pollutants monitored as well as the number of monitoring sites where data are collected. The more pollutants measured and the more sites that are available in an area, the better the estimate of the AQI for a given day. Historically, ozone accounts for the majority of days with AQI values above 100. Soon, $PM_{2.5}$ will also be monitored and reported on a regular basis, which will reduce the percentage of days that ozone is the AQI pollutant. Table A-18 shows the number of days with AQI values greater than 100 that are attributed to ozone alone. Comparing Table A-17 and A-18, the number of days with a AQI above 100 are increasingly due to ozone. In fact, the percentage of days with a AQI above 100 due to ozone have increased from 91 percent in 1990, to 98 percent in 1999 (See Figure 3-3). This increase reveals that ozone increasingly accounts for those days above the 100 level and, therefore, reflects the success in achieving lower CO and PM_{10} concentrations. However, the typical one-in-six day sampling schedule for most PM_{10} sites limits the number of days that PM_{10} can factor into the AQI determination, which may, in some places, account for the predominance of ozone.

Figure 3-2. Number of days with AQI values > 100, as a percentage of 1990 value.

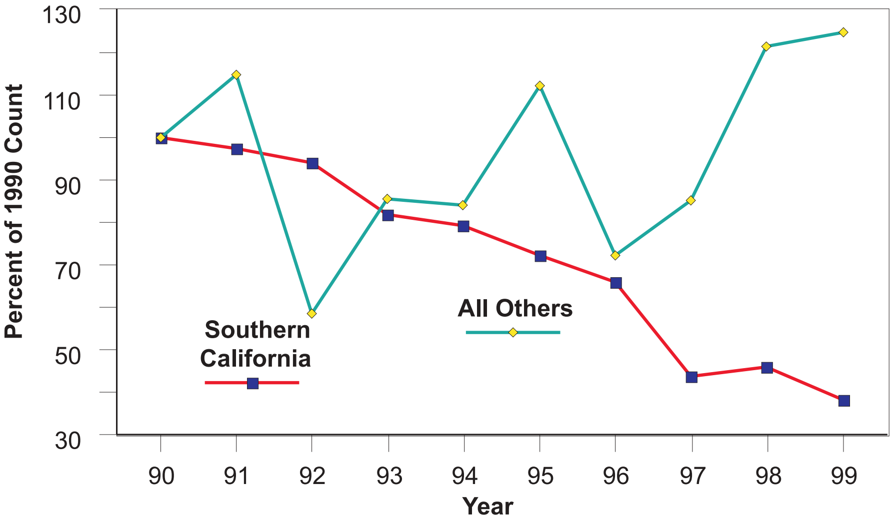
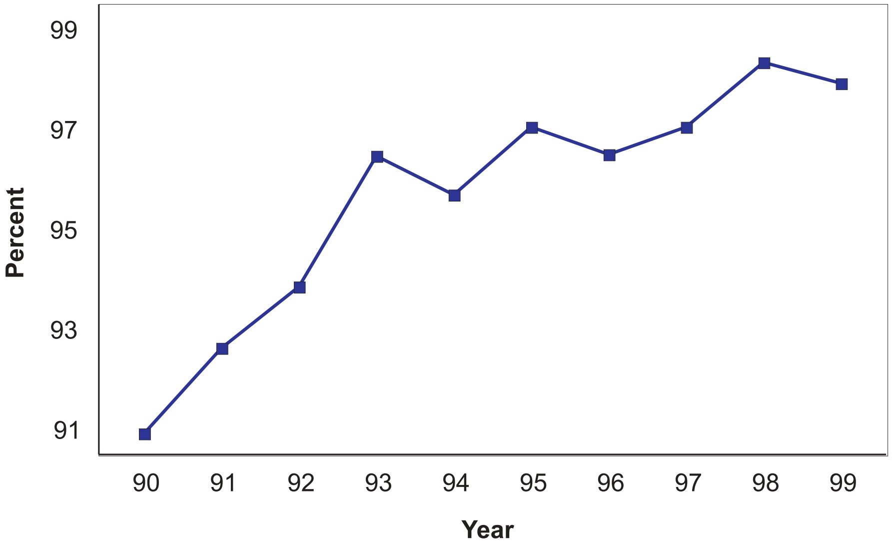


Figure 3-3. Percent of days over 100 due to ozone.



References and Notes

1. Community Based Environmental Protection (CBEP) is a relatively new approach to environmental protection. Traditionally, environmental protection programs have focused on a particular medium or problem (i.e., a "Command and Control" approach to environmental protection). These "Command and Control" programs have been very effective at reducing point source pollution and improving environmental quality for more than two decades. However, some environmental problems, such as non-point source pollution, which may involve several media types and diffuse sources, are less amenable to the "Command and Control" approach. Instead, a solution that seeks to address the various causes of the problems by focusing on the interrelationships between human behavior and pollution in a specific area may be more appropriate. CBEP supplements and complements the traditional environmental protection approach by focusing on the health of an ecosystem and the behavior of humans that live in the ecosystem's boundaries, instead of concentrating on a medium or particular problem. Therefore, CBEP is place-based, and not media or issue-based (see **http://www.epa.gov/ecocommunity/about.htm**).

2. *Statistical Abstracts of the United States, 1999*, U.S. Department of Commerce, U.S. Bureau of the Census.

3. *Air Quality Index, A Guide to Air Quality and Your Health*, EPA-454/R-00-005, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 2000.

4. *Code of Federal Regulations*, 40 CFR Part 58, Appendix G.

5. *Guideline for Reporting of Daily Air Quality—Air Quality Index* (AQI), EPA-454/R-99-010, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1999.

6. *Note:* Although the results are summarized in the report for comparison purposes, the intent of publishing Tables A-16 through A-18 is to present information on a localized basis, to be used on a localized basis (i.e., one MSA at a time). Therefore, no attempt was made to adjust the Type I error to a table-wide basis. All the tests for trends were conducted at the 5-percent significance level. No inference has been made from the tables as a whole.

7. T. Fitz-Simons and D. Mintz, "Assessing Environmental Trends with Nonparametric Regression in the SAS Data Step," American Statistical Association 1995 Winter Conference, Raleigh, NC, January, 1995.

8. Freas, W.P. and E.A. Sieurin, "A Nonparametric Calibration Procedure for Multi-Source Urban Air Pollution Dispersion Models," presented at the Fifth Conference on Probability and Statistics in Atmospheric Sciences, American Meteorological Society, Las Vegas, NV, November 1977.

9. M. Hollander and D.A. Wolfe, *Nonparametric Statistical Methods*, John Wiley and Sons, Inc., New York, NY, 1973.

CHAPTER 4

Criteria Pollutants — Nonattainment Areas

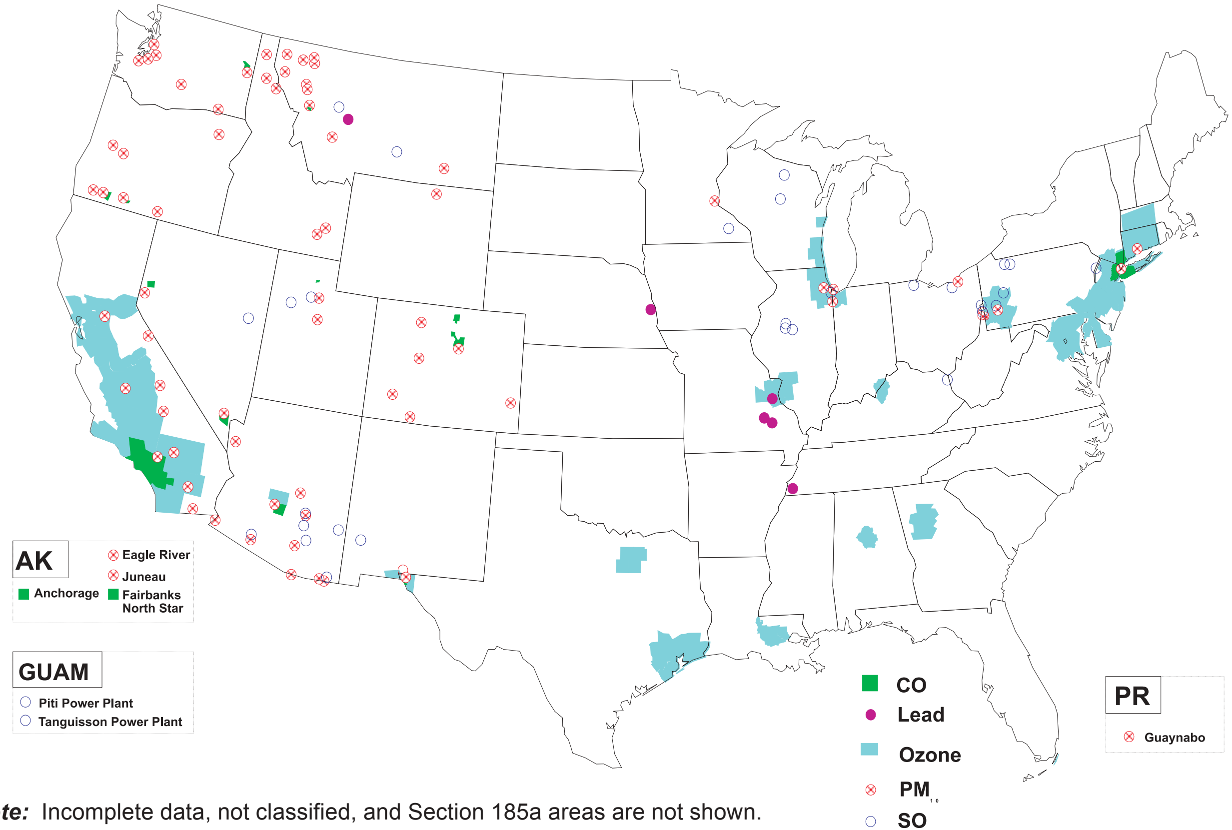
http://www.epa.gov/oar/aqtrnd99/chapter4.pdf

Worth Noting:

- As of September 2000, there were a total of 114 nonattainment areas on the condensed nonattainment list.

This chapter provides general information on geographical regions known as nonattainment areas. When an area does not meet the air quality standard for one of the criteria pollutants the area may be subject to the formal rule-making process which designates the area as nonattainment. The 1990 Clean Air Act Amendments (CAAA) further classify ozone, carbon monoxide, and some particulate matter nonattainment areas based on the magnitude of an area's problem. Nonattainment classifications may be used to specify what air pollution reduction mea-

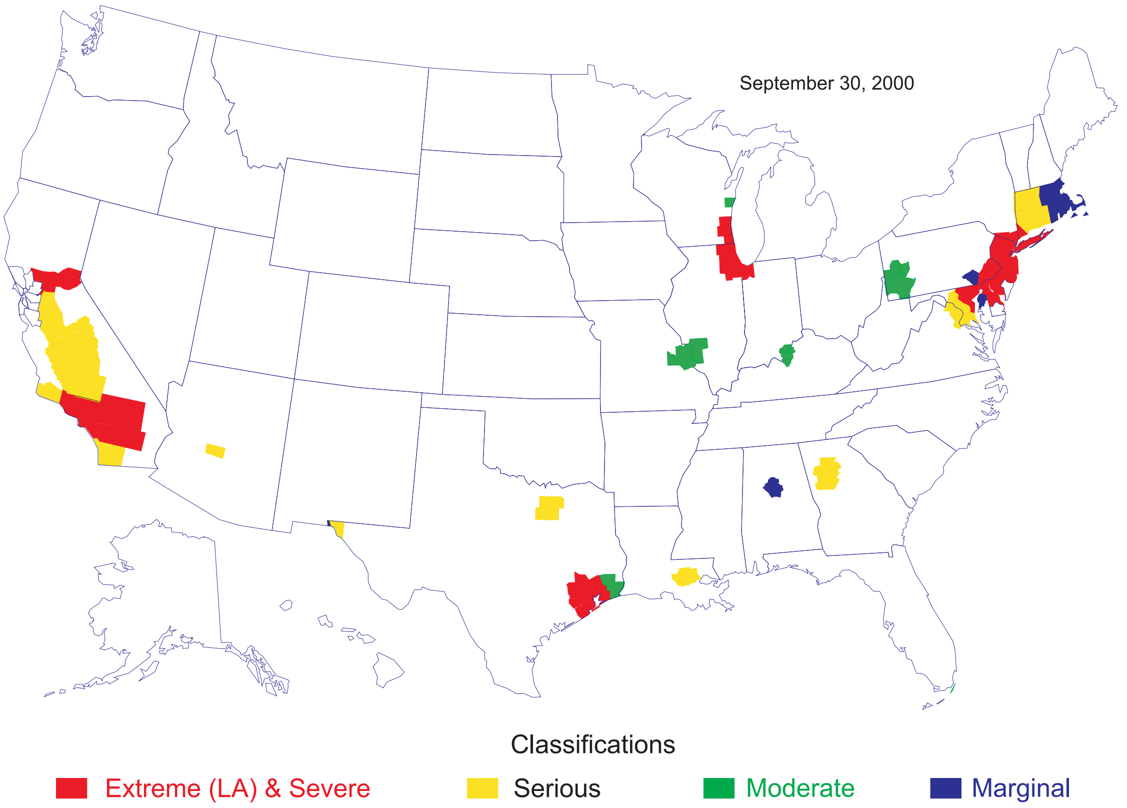
Figure 4-1. Location of nonattainment areas for criteria pollutants, September 2000.



Note: Incomplete data, not classified, and Section 185a areas are not shown.
*Ozone nonattainment areas on map are based on the 1-hour ozone standard.

**PM_{10} nonattainment areas on map are based on the existing PM_{10} standards.

Figure 4-2. Classified ozone nonattainment areas.



Note: San Francisco is classified Other / Sec 185a and nonattainment areas with incomplete data are not included.

sures an area must adopt and when the area must reach attainment. The technical details underlying these classifications are discussed in the *Code of Federal Regulations*, Part 81 (40 CFR 81), see **http://www.epa.gov/epacfr40**.

Figure 4-1 shows the location of the nonattainment areas for each criteria pollutant as of September 2000. Figure 4-2 identifies the classified ozone nonattainment areas by degree of severity. A summary of nonattainment areas can be found in Table A-19 in Appendix A. An area is on the condensed list if the area is designated nonattainment for one or more of the criteria pollutants. Note that Section 185a areas (formerly known as "transitional areas") and incomplete areas are excluded from the counts in Table A-19. Another source of information for areas designated as nonattainment, including Section 185a and incomplete areas, is the *Green Book*. The current *Green Book* is located at **http://www.epa.gov/oar/oaqps/greenbk**.

As of September 2000, there were a total of 114 nonattainment areas on the condensed nonattainment list. The areas on the condensed list are displayed alphabetically by state. There were, as of September 2000, approximately 101 million people living in areas designated as nonattainment for at least one of the criteria pollutants. Areas redesignated between September 1999 and September 2000 are listed in Table 4-1, by pollutant. All redesignations were to attainment.

Table 4-1. Areas Redesignated Between September 1999 and September 2000

SO_2	Coshocton Co., OH; Gallia Co., OH; and Lorain Co., OH
PM_{10}	Canon City, CO
CO	Colorado Springs, CO; Longmont, CO; and Minneapolis-St. Paul, MN
Pb	Collin Co., TX and Marion Co. (Indianapolis), IN
O_3	Cincinnati-Hamilton, OH-KY

CHAPTER 5

Air Toxics

http://www.epa.gov/oar/aqtrnd99/chapter5.pdf

Worth Noting:

- For all 188 HAPs, there is a 23-percent reduction in emissions between the 1990–1993 baseline and 1996. For the 33 urban HAPs, there is a 30-percent reduction in air toxics emissions between baseline and 1996. The majority of these reductions are attributable to two source types with existing regulatory programs: major sources and onroad mobile sources.
- Ambient monitoring results generally reveal downward trends for most monitored HAPs. The most consistent improvements are apparent for benzene which is predominantly emitted by mobile sources; and for total suspended lead. From 1994–1999, annual average concentrations for these two HAPs declined 40 and 47 percent respectively.

Background

Hazardous air pollutants (HAPs), commonly referred to as air toxics or toxic air pollutants are pollutants known to cause or suspected of causing cancer or other serious human health effects or ecosystem damage. The Clean Air Act (CAA) lists 188 HAPs and directs EPA to regulate sources emitting major amounts of these identified pollutants.[1] Examples of HAPs include heavy metals (e.g., mercury and chromium), volatile chemicals (e.g., benzene and perchloroethylene), combustion byproducts (e.g., dioxins) and solvents (e.g., carbon tetrachloride and methylene chloride). In addition, EPA has recently listed diesel particulate matter plus diesel exhaust organic gases as a mobile source air toxic and has addressed diesel exhaust in several regulatory actions. EPA's list of mobile source air toxics also includes 20 other pollutants which are included among the list of 188 HAPs.

Hazardous air pollutants are emitted from literally thousands of sources including large stationary industrial facilities (such as electric power plants), smaller area sources (such as neighborhood dry cleaners), mobile sources (such as automobiles), indoor sources (such as some building materials and cleaning solvents), and other sources (such as wildfires).

Factors such as weather, the terrain (i.e., mountains, plains, valleys), and the chemical and physical properties of a pollutant determine how far it is transported, its concentration at various distances from the source, what kind of physical and chemical changes it undergoes, and whether it will degrade, remain airborne, or deposit to land or water. Some HAPs (such as chromium) remain airborne and contribute to air pollution problems far from the pollution source. Other HAPs (such as mercury) are released into the air and can be deposited to land and water bodies through precipitation, or by settling directly out of the air onto land or water.

Potential Effects of Air Toxics

Human Health

- Cancer
- Birth defects
- Developmental delays
- Reduced immunity
- Difficulty in breathing and respiratory damage
- Headache, dizziness, and nausea

Environmental

- Reproductive effects and developmental delays in wildlife
- Toxicity to aquatic plants and animals
- Accumulation of pollutants in the food chain

Health and Environmental Effects

The degree to which a toxic air pollutant affects a person's health depends on many factors, including the quantity of pollutant the person is exposed to, the duration and frequency of exposures, the toxicity of the pollutant, and the person's state of health and susceptibility. The different health effects that may be caused by HAPs include cancer; neurological, cardiovascular, and respiratory effects; effects on the liver, kidney, immune system, and reproductive system; and effects on fetal and child development. The timing and severity of the effect (e.g., minor or reversible vs. serious, irreversible, and life-threatening) may vary among HAPs and with the exposure circumstances. In some cases effects can be seen immediately; in other cases the resulting effects (e.g., liver damage or cancer) are associated with long-term exposures and may not appear until years after exposure. Roughly half of the 188 HAPs have been classified by EPA as "known," "probable," or "possible" human carcinogens. Known human carcinogens are those that have been demonstrated to cause cancer in humans. Examples include benzene, which has caused leukemia in workers exposed over several years in their workplace air, and arsenic, which has been associated with elevated lung cancer rates in workers at metal smelters. Probable and possible human carcinogens include chemicals that we are less certain cause cancer in people, yet for which laboratory animal testing or limited human data indicate carcinogenic effects. For example, EPA concluded that diesel exhaust is likely to be carcinogenic to humans at environmental levels that the public faces (classifying it as a "probable human carcinogen").[2]

Some HAPs pose particular hazards to people of a certain stage in life (e.g., young children, adolescents, adults, or elderly people). Some HAPs are developmental or reproductive toxicants in humans. This means that exposure before birth or during childhood may interfere with normal development into a healthy adult. Other such exposures may affect the ability to conceive or give birth to a healthy child. Ethylene oxide, for example, has been associated with increased miscarriages in exposed workers and has affected reproductive ability in both male and female laboratory animals.

Some HAPs are of particular concern because they degrade very slowly or not at all, as in the case of metals such as mercury or lead. These persistent HAPs can remain in the environment for a long time and can be transported great distances. Persistent and bioaccumulative HAPs are of particular concern in aquatic ecosystems because the pollutants accumulate in sediments and may biomagnify in tissues of animals at the top of the food chain through consumption or uptake to concentrations many times higher than in the water or air. In this case, exposure to people occurs by eating contaminated food from waters polluted from the deposition of these HAPs. As of July 2000, for example, 40 states and the American Samoa have issued fish consumption advisories for mercury. Thirteen of those states have issued advisories for all water bodies in their state and the other 27 states have issued advisories for more than 1900 specific water bodies.[3]

Hazardous air pollutants can have a variety of environmental impacts in addition to the threats they pose to human health. Like humans, animals can experience health problems if they are exposed to sufficient concentrations of HAPs over time. For example, exposures to PCBs, dioxins, and dibenzo-furans are suspected of causing death and deformities to various bird chicks.[4] These pollutants are also thought to have had adverse impacts on reproduction of lake trout.[5] Mercury is also thought to pose a significant risk to wildlife. Methylmercury levels in fish in numerous waterbodies have been shown to exceed levels associated with adverse effects on birds.[6] These and other observations have led some scientists to conclude that fish-eating birds and mammals occupying a variety of habitats are at risk due to high levels of methylmercury in aquatic food webs.

National Air Toxics Control Program

Since 1990, EPA has made considerable progress in reducing emissions of air toxics through regulatory, voluntary, and other programs. To date, the overall air toxics program has focused on reducing emissions of the 188 air toxics from major stationary sources through the implementation of technology-based emissions standards as specified by Congress in the 1990 CAA Amendments. These actions have resulted in, or are projected to result in, substantial reductions in air toxics emissions. Additionally, actions to address mobile sources under other CAA programs have achieved significant reductions in air toxics emissions (e.g., the phase-out of lead from gasoline). Many motor vehicle and fuel emission control programs of the past have reduced air toxics. Several current EPA programs further reduce air toxics emissions from a wide variety of mobile sources. These include the reformulated gasoline (RFG) program, the national low emission vehicle (NLEV) program, and Tier 2 motor vehicle emission standards and gasoline sulfur control requirements. In addition, EPA has recently issued regulations to address emissions of toxic air pollutants from motor vehicles and their fuels as well as stringent standards for heavy-duty trucks and buses and diesel fuel that will lead to a reduction in emis-

Table 5-1. List of 33 Urban Air Toxics Strategy HAPs

VOCs	Metals (Inorganic Compounds)	Aldehydes (Carbonyl Compounds)	SVOCs & Other HAPs
acrylonitrile	arsenic compounds	acetaldehyde	2,3,7,8-tetrachlorodibenzo-p-dioxin (& congeners & TCDF congeners)
benzene	beryllium and compounds	formaldehyde	coke oven emissions
1,3-butadiene	cadmium compounds	acrolein	hexachlorobenzene
carbon tetrachloride	chromium compounds		hydrazine
chloroform	lead compounds		polycyclic organic matter (POM)
1,2-dibromoethane (ethylene dibromide)	manganese compounds		polychlorinated biphenyls (PCBs)
1,3-dichloropropene	mercury compounds		quinoline
1,2-dichloropropane (propylene dichloride)	nickel compounds		
ethylene dichloride, EDC (1,2-dichlorethane)			
ethylene oxide			
methylene chloride (dichloromethane)			
1,1,2,2,-tetrachloroethane			
tetrachloroethylene (perchloroethylene, PCE)			
trichloroethylene, TCE			
vinyl chloride			

sions of diesel particulate matter by over 90 percent between 1996 and 2020. From 1996 (the year of the most up-to-date emissions inventory estimates) to 2020, the existing proposed mobile source programs are also expected to lower onroad emissions of benzene by 61 percent, formaldehyde by 78 percent, 1,3-butadiene by 60 percent, and acetaldehyde by 73 percent from the 1996 levels. There will also be substantial reductions from other gaseous onroad HAPs and from nonroad mobile sources.

EPA expects, however, that the emission reductions that will result from these actions may only be part of what is necessary to protect public health and the environment from air toxics. In accordance with the 1990 CAA Amendments, EPA has begun to assess the risk remaining (i.e., the residual risk) after implementation of technology-based standards in order to evaluate the need for additional stationary source standards to protect public health and the environment. During 2001, EPA will also begin the process for assessing new standards for nonroad engines such as construction and farm equipment. In addition, after extensive study, EPA determined mercury emissions from power plants pose significant hazards to public health and must be reduced. EPA will propose regulations by 2003 and issue final rules by 2004. By July 2003, EPA will reassess the need for and feasibility of controls for onroad and nonroad sources of air toxics, and propose any additional vehicle and fuel controls that the Agency determines are appropriate. This rulemaking will be finalized by July 2004.

EPA's Integrated Urban Air Toxics strategy identified 33 HAPs which are judged to pose the greatest threat to public health in urban areas.[7] These 33 "urban HAPs" are a subset of EPA's list of 188. Under EPA's urban strategy, the Agency is developing area source regulations that will control those sources responsible for 90 percent of the total emissions of the 33 HAPs in urban areas. The list of the 33 urban HAPs is presented in Table 5-1 and is grouped according to chemical properties (volatile organic compounds (VOCs), metals, aldehydes, and semi-volatile organic compounds [SVOCs]). This grouping is the same breakdown EPA uses for ambient monitoring which is discussed in a subsequent section of this chapter.

In addition to national regulatory efforts, EPA provides leadership and technical and financial assistance for the development of cooperative federal, state, local, and tribal programs to prevent and control air pollution. EPA's risk initiatives include comprehensive local-scale assessments, as well as federal and regional activities associated with air toxics deposition (e.g., the Great Waters program (includes the Great Lakes, Lake Champlain, Chesapeake Bay, and many U.S. coastal estuaries) and Agency initiatives concerning mercury and other persistent and bioaccumulative toxics [PBTs]).

EPA also has an ongoing comprehensive evaluation of air toxics in the United States which is called the National Air Toxics Assessment (NATA). These NATA activities help EPA identify areas of concern, characterize risks, and track progress toward meeting the air toxics program goals to reduce risk to human health and the environment. They include expansion of air toxics monitoring, improving and periodically updating emissions inventories, developing better air toxics emission factors for nonroad sources, improving national- and local-scale modeling, continued research on health effects and exposures to both ambient and indoor air, and improvement of assessment tools.

For indoor air toxics, EPA's program has relied on education and outreach to achieve reductions. EPA's voluntary programs that focus on indoor air pollution have been very successful in reducing indoor air pollution. For example, through EPA's voluntary *Tools for Schools Program*, there have been significant reductions in children's exposure to air toxics in 4,000 schools across the country. EPA is also developing a specific strategy for indoor air toxics that will present an approach to evaluate information, characterize potential indoor exposures and risks, and identify methods to reduce air toxics indoors. Additional information about indoor air toxics activities is available at: **www.epa.gov/iaq/pubs/index.html**.

Examples of Source Types

- **Major sources:** large industrial sources such as chemical plants, oil refineries and steel mills.
- **Area and other sources**: smaller industrial sources such as drycleaners, gas stations and landfills, as well as natural sources like wildfires.
- **Onroad mobile sources:** cars, heavy-duty trucks, buses and other highway vehicles.
- **Nonroad mobile sources:** construction and farm equipment as well as recreational vehicles.

Figure 5-1. National contribution of source types to 1996 NTI emissions for the 188 HAPs.

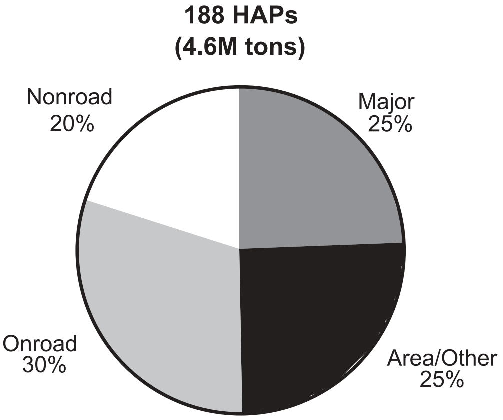
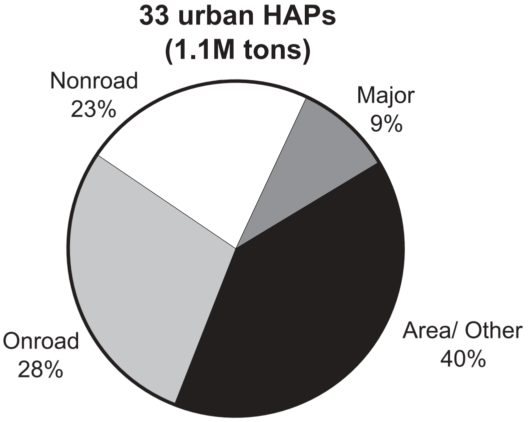


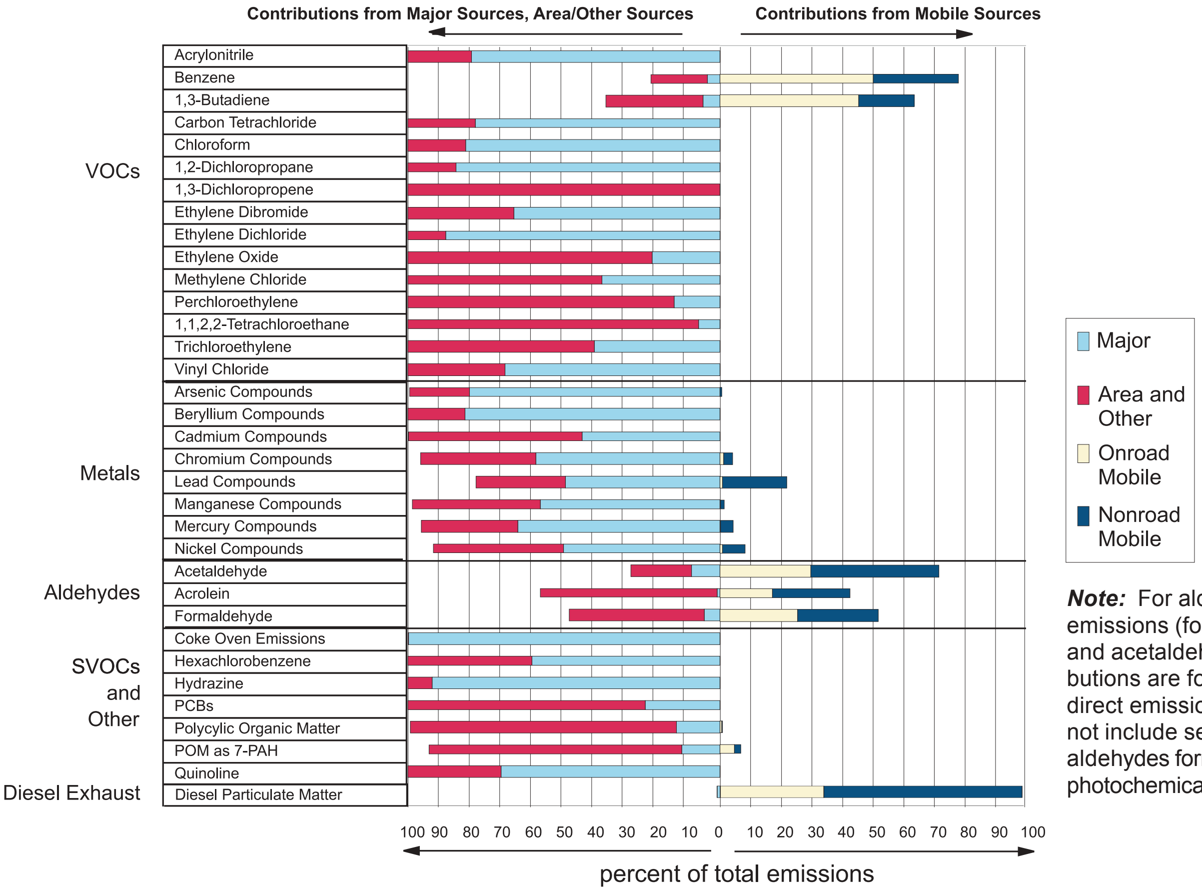
Figure 5-2. National contribution of source types to 1996 NTI emissions for the urban HAPs.



Air Toxics Emissions in 1996

The National Toxics Inventory (NTI) is EPA's compilation of quantitative information concerning the mass of emissions of HAPs emitted into the atmosphere (through smokestacks, tailpipes, vents, etc.) from stationary and mobile sources. The NTI is developed every 3 years. EPA has compiled both a baseline period (1990–1993) as well as 1996 emissions estimates for the 188 HAPs. As of the date of this publication, the 1996 NTI contains the most complete, up-to-date air toxics emissions estimates available. However, EPA has not yet included the 1996 dioxin emissions in the 1996 NTI since they are still under review. Since dioxin emissions are relatively small, its exclusion does not affect the summary information presented for the 188 or the 33 urban HAPs. In addition, these emission summaries do not include diesel particulate matter. For purposes of this report, the information in the NTI has been divided into four overarching source types: 1) large industrial or "major" sources; 2) "area and other sources," which include smaller industrial sources, such as small drycleaners and gasoline stations, as well as natural sources, such as wildfires; 3) "onroad"

Figure 5-3. National contribution by emission source type for individual urban HAPs and diesel particulate matter, 1996.



Note: For aldehyde emissions (formaldehyde and acetaldehyde) contributions are for primary direct emissions and do not include secondary aldehydes formed via photochemical reactions.

mobile, including highway vehicles; and 4) "nonroad" mobile sources, like aircraft, locomotives, and lawn mowers.

Figures 5-1 and 5-2 provide a summary of the national emissions in the 1996 NTI based on source types for the 188 HAPs as well as the 33 urban HAPs, respectively. Note that emissions of the 33 urban HAPs represent roughly a quarter (23 percent) of the 1996 emissions of the 188 HAPs. As shown in Figure 5-1, the national emissions of the 188 HAPs are relatively equally divided between the four types of sources. For the 33 urban HAPs, however, area and other sources are the largest overall contributor (40 percent), while major sources account for less than 10 percent of the nationwide emissions and mobile sources make up the remaining 51 percent.

Figure 5-3 provides the percent of emissions by source type for each of the 33 urban HAPs that have available emissions information (i.e., excluding dioxin). It also contains information on diesel particulate matter. Note that for each bar, the individual contributions total to 100 percent. Also, the center vertical line in the chart is zero so that the mobile source contributions are shown on the right side of the chart for ease of display. The contributions from each source type vary by pollutant. For example, acetaldehyde and benzene have mobile sources as the dominant contributor, hydrazine and coke oven emissions are dominated by major sources, and perchlorethylene is predominantly from area and other sources. Since the other 156 HAPs are not represented here, this graph provides a subset of information on what source types emit which HAPs. For example, nine of the 21 HAPs EPA has identified as mobile source air toxics are not included in Figure 5-3. Table A-21 shows the 21 mobile source air toxics, including diesel particulate matter, and their contributions from mobile sources.

Also, note that Figure 5-3 does not provide any information about the relative magnitude of emissions. For example, benzene and formaldehyde together represent about 64 percent (roughly 32 percent each) of the total emissions of these 32 urban HAPs. Conversely, 23 of the urban HAPs, including lead, chromium, and PCBs each represent less than 1 percent of the total emissions of the 33 urban HAPs.

Figure 5-4 provides additional detail on the source sector emissions from the 1996 NTI to show the relative percentages of sources that are found in urban versus rural areas for all 188 HAPs. Figure 5-5 shows this same breakdown for the 33 urban HAPs subset. For the 188 HAPs, urban sources dominate the emissions for all source types. For the 33 urban HAPs, there is one source type, area and other sources, which has roughly the same percentage contribution of urban and rural sources.

Figure 5-4. Urban/rural splits by source type for the 1996 national emissions of 188 HAPs.

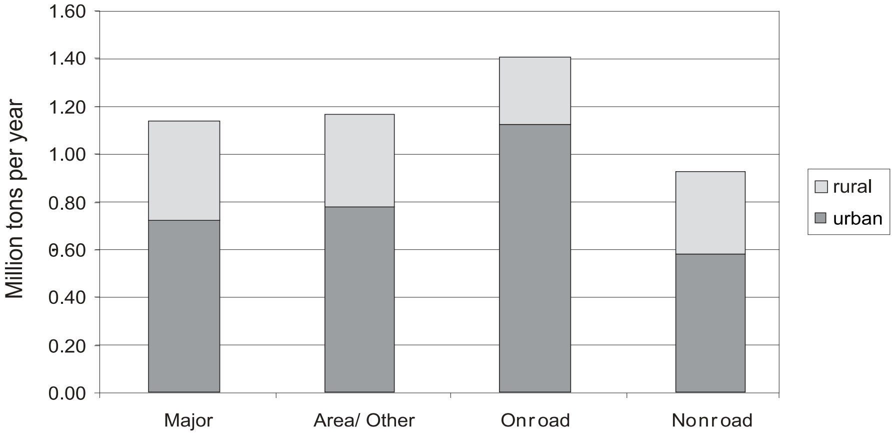
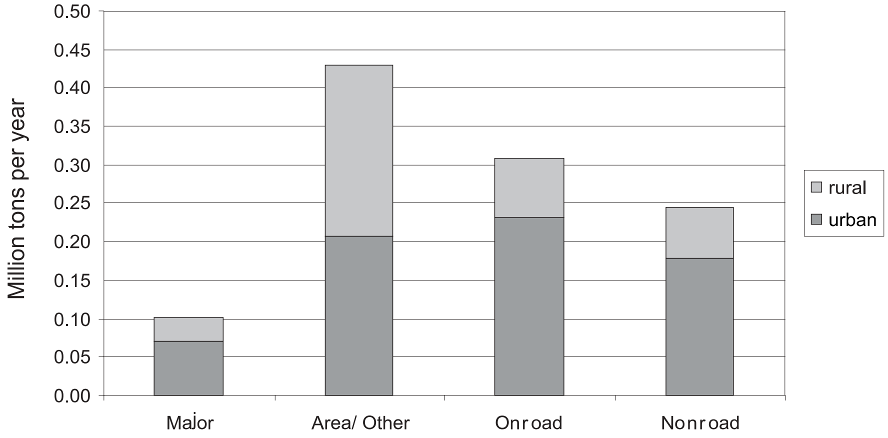


Figure 5-5. Urban/rural splits by source type for the 1996 national emissions of 33 urban HAPs.



Trends in Air Toxics Emissions

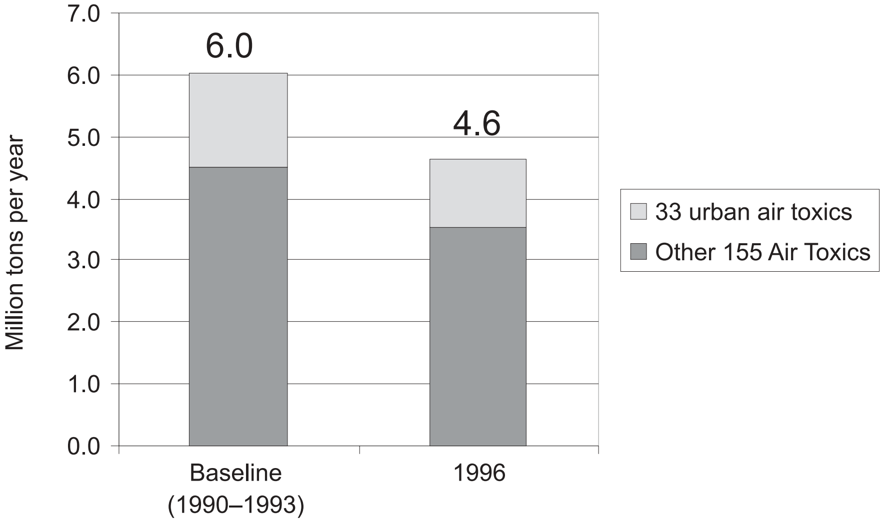
Trends in air toxics emissions are shown in Figure 5-6 based on comparison of a baseline period of NTI emissions data (1990–1993) to the 1996 NTI. The bar for each time period includes both the national total for the 188 HAPs as well as the fraction of the national emissions that are associated with the urban HAPs. For all 188 HAPs, there is a 23-percent reduction between the baseline and 1996. For the 33 urban HAPs, there is a 30-percent reduction between baseline and 1996. The majority of these reductions are attributable to two source types with existing regulatory programs: major sources and onroad mobile sources. For the 188 HAPs, major source emissions (which accounted for 25 percent of the total emissions in 1996) decreased by 58 percent and onroad mobile source emissions (which accounted for 30 percent of the total emission in 1996) decreased by 16 percent. Although differences in how EPA compiled the inventory over time could account for some of the current estimates of changes in emissions, EPA and state regulations, as well as voluntary reductions by industry, have clearly achieved large reductions in overall air toxic emissions.

Ambient Monitoring

Ambient measurements, which provide the concentration of a HAP at a particular monitored location at a point in time, are useful to characterize air quality. These measurements are used to derive trends in HAP concentrations to help evaluate the effectiveness of HAP reduction strategies. They also can provide data to support and evaluate dispersion and deposition models.

Unlike criteria air pollutants, such as carbon monoxide and sulfur dioxide (which have been monitored since the 1970s), there is no national air toxics monitoring system. However, there are approximately 300 monitoring sites currently producing ambient data on

Figure 5-6. Change in national air toxics emissions – baseline (1990–1993) to 1996.



HAPs. These include sites within several states that have long-standing air toxics monitoring programs as well as sites of the Interagency Monitoring of Protected Visual Environments (IMPROVE) visibility network which provides historical information about HAP trace metals in rural areas. The current monitoring sites also include those participating in the Urban Air Toxics Monitoring Program which provides a year's worth of measurements of 39 HAP VOCs and 13 carbonyl compounds.[8] In addition, the Agency's Photochemical Assessment Monitoring Stations (PAMS) program requires routine year-round measurement of VOCs which include nine HAPs: acetaldehyde, benzene, ethylbenzene, formaldehyde, n-hexane, styrene, toluene, xylenes (m/p-xylene, o-xylene) and 2,2,4-trimethlypentane. For a more detailed discussion of the PAMS program, see the ozone section in Chapter 2 of this report. At the present time, the collection of current state and local air toxics monitoring data and PAMS data is limited in its geographic scope and it does not cover many HAPs for most states. In addition the sites are not necessarily at locations which represent the highest area-wide concentrations. Nevertheless, they can still be used to provide useful information on the trends in ambient air toxics at this time.

EPA is working together with state and local air monitoring agencies to build upon these sites to develop a monitoring network with the following objectives: to characterize air toxics problems on a national scale; to provide a means to obtain data on a more localized basis as appropriate and necessary (e.g., to evaluate potential "hot spots" near sources), and to help evaluate air quality models. However, there are a significant number of the 188 HAPs for which EPA does not yet have a monitoring method developed. For this reason, EPA is devoting its resources on building up the air toxics monitoring network by first focusing on the 33 urban HAPs. The states currently have the capability to monitor for 28 of the 33 urban HAPs. As the monitoring network is enhanced, EPA will assist the states to continue to add to both the geographic scope of the monitoring as well as the number of HAPs included. The network will represent an integration of information from many monitoring programs, including existing state and local air toxic monitoring sites; PAMS, and the new urban $PM_{2.5}$ chemical speciation and rural IMPROVE program networks. This new national network will be developed over the next several years.[9]

Trends In Ambient Concentrations

The most widely measured HAP has been lead, which is also a criteria pollutant. Until recently, it has been monitored in most states, both in metropolitan and non-metropolitan areas. Nineteen states have monitored other urban HAPs in their metropolitan areas since 1994. In addition, several VOCs, aldehydes and metals have good data history in metropolitan areas. Most of these monitors, however, are concentrated in a few states, with 36 percent of them in California alone. Nevertheless, these data can be used to provide a preliminary picture of nationwide trends in air toxics. A good history of several trace metal concentrations in rural areas is derived from the IMPROVE program. However, long-term monitoring in rural areas for VOCs and aldehydes has generally been more limited. The locations for the urban and rural monitors with long-term data are shown in Figure 5-7.

Trends derived from these data are separately presented for metropolitan (urban) and non-metropolitan (rural) sites. Table 5-2 presents a national summary of these 6-year trends in ambient air toxics concentrations in metropolitan statistical areas. Among the 33 HAPs on the urban strategy list, 25 pollutants have sufficient historical data for this 6-year trends assessment. These air contaminants include 13 of the 15 urban VOCs, all eight urban HAP trace metals, the three aldehydes and several specific polycyclic aromatic hydrocarbons (PAHs). Also included are styrene and toluene, which are two additional pervasive air toxics whose monitoring sites have good nationwide coverage. The table presents the number of sites with increases and decreases in measured ambient concentrations from 1994–1999. For trace metals, the table includes results representing more than one particulate size fraction. Similarly, trends are shown separately for several individual PAHs which are constituents of polycyclic organic matter (POM). For each of these HAPs with sufficient historical data, the number of sites with statistically significant changes are highlighted. When most individual locations reveal a consistent change (and when many are statistically significant), this is more characteristic of a national trend.

Although these ambient air toxics data are only available for a limited number of metropolitan areas, the results generally reveal downward trends for most monitored HAPs. The most consistent improvements are apparent for benzene which is predominantly emitted by mobile sources; and for total suspended lead. From 1994–1999, annual average concentrations for these two HAPs declined 40 and 47 percent respectively. The majority of ambient concentrations of lead once came from the tail pipe of cars. Since the mid-90s, however, lead has been largely removed from gasoline and almost all of these trace elements now typically emanate from major point sources and aircrafts with piston engines (e.g., small commuter aircraft). The criteria pollutant section in Chapter 2 of this report contains more information about particulate lead. The change in national benzene emissions is attributed to a combination of new car emission standards, use of cleaner fuels in many states as well as stationary source emission reductions. Ambient concentrations of toluene (emitted primarily from mobile sources) also show a consistent decrease over most reporting locations. Similar to benzene, annual average toluene concentrations dropped 48 percent. Other HAPs (including styrene) also reveal air quality improvement, but the downward trends are not significant across large numbers of monitoring locations.

Figure 5-7. Locations for urban and rural air toxics monitors with long-term data.

Number of sites located in an MSA (184): ●
Number of sites not located in an MSA (80): ●

Figure 5-8 presents boxplots of the composite urban trends for six HAPs: benzene, 1,3-butadiene, lead, perchlorethylene, styrene and toluene. These figures depict the concentration distributions among annual averages in metropolitan areas from 1994–1999. The accompanying map displays the number and location of the monitoring “trend” sites. For comparison, the maps also show the number of sites that produced any measurement data during the 6-year period. The average trend lines for benzene, lead and toluene show more improvement in the first few years. The trend for toluene continues through 1999. The benzene trend reveals a small increase between 1998 and 1999.

For the other HAPs in Table 5-2, most urban locations do not reveal predominant or consistent trends among all monitoring areas. In addition, most observed trends for these HAPs are not statistically significant. This is attributed in part to few states with long-term HAP monitoring, to the large year-to-year variability in computed annual average concentrations for some HAPs and the large variety of contributing emission

Table 5-2. National Summary of Ambient HAP Concentration Trends in Metropolitan Areas, 1994–1999

Pollutant Name	Number of Urban Sites by HAP					
	Total	Significant* UP Trend	Non-Significant UP Trend	No Trend	Non-Significant DOWN Trend	Significant* DOWN Trend
Acrylonitrile	4		4			
Benzene	84	**2**	8		52	**22**
1,3-Butadiene	62	**3**	23	5	22	**9**
Carbon tetrachloride	57	**1**	10	6	26	**14**
Chloroform	76	**5**	24	13	34	
1,2-Dibromoethane	26		3	17	3	**3**
1,2-Dichloropropane	30		2	11	16	**1**
Ethylene dichloride	58		5	26	21	**6**
Methylene chloride	74		19	2	39	**14**
1,1,2,2-Tetrachloroethane	11		4	3	4	
Perchloroethylene	76		7	5	50	**14**
Trichloroethylene	66	**2**	17	8	37	**2**
Vinyl chloride	55		2	32	18	**3**
Arsenic (coarse)	9			9		
Arsenic (fine)	8			1	7	
Arsenic (PM$_{10}$)	13		1	2	8	**2**
Arsenic (TSP)	64		8	37	12	**7**
Beryllium (PM$_{10}$)	6			6		
Beryllium (TSP)	25		3	20	2	
Cadmium (PM$_{10}$)	6		3		3	
Cadmium (TSP)	58	**2**	12	10	30	**4**
Chromium (coarse)	9		1		8	
Chromium (fine)	8		1	1	5	**1**
Chromium (PM$_{10}$)	12	**1**	7		4	
Chromium (TSP)	70	**4**	27	9	27	**3**
Chromium VI	19				9	**10**
Lead (coarse)	9				7	**2**
Lead (fine)	8	**1**			6	**1**
Lead (PM$_{10}$)	26	**2**	3	14	5	**2**
Lead (TSP)	241	**8**	52	2	124	**55**
Manganese (coarse)	9		1		7	**1**
Manganese (fine)	8		4		4	
Manganese (PM$_{10}$)	12		1		11	
Manganese (TSP)	63		20	1	34	**8**
Mercury (fine)	8		1	7		
Mercury (PM$_{10}$)	6		3		3	
Mercury (TSP)	22	**1**	16	2	3	
Mercury compounds	2		1		1	
Nickel (coarse)	9		2		5	**2**
Nickel (fine)	8			1	6	**1**
Nickel (PM$_{10}$)	12		3		9	
Nickel (TSP)	69		12	3	39	**15**
Acetaldehyde	18	1	9		7	**1**
Formaldehyde	18	1	12		4	**1**
Acrolein	6	1	2	3		
Benzo(a)pyrene (total PM$_{10}$ & vapor)	18	1	13		4	
Dibenz(a,h)anthracene (total PM$_{10}$ & vapor)	18	3	11		4	
Indeno(1,2,3-cd)pyrene (total PM$_{10}$ & vapor)	18	1	13		4	
Benzo(b)fluoranthene (total PM$_{10}$ & vapor)	18	3	13		2	
Benzo(k)fluoranthene (total PM$_{10}$ & vapor)	18	3	11		4	
Styrene	61		13	5	38	**5**
Toluene	80	1	4		42	**33**

*Statistically significant at the 10-percent level (See Appendix B: Methodology, Air Toxics Methodology section).

Figure 5-8a. National trend in annual average benzene concentrations in metropolitan areas, 1994–1999.

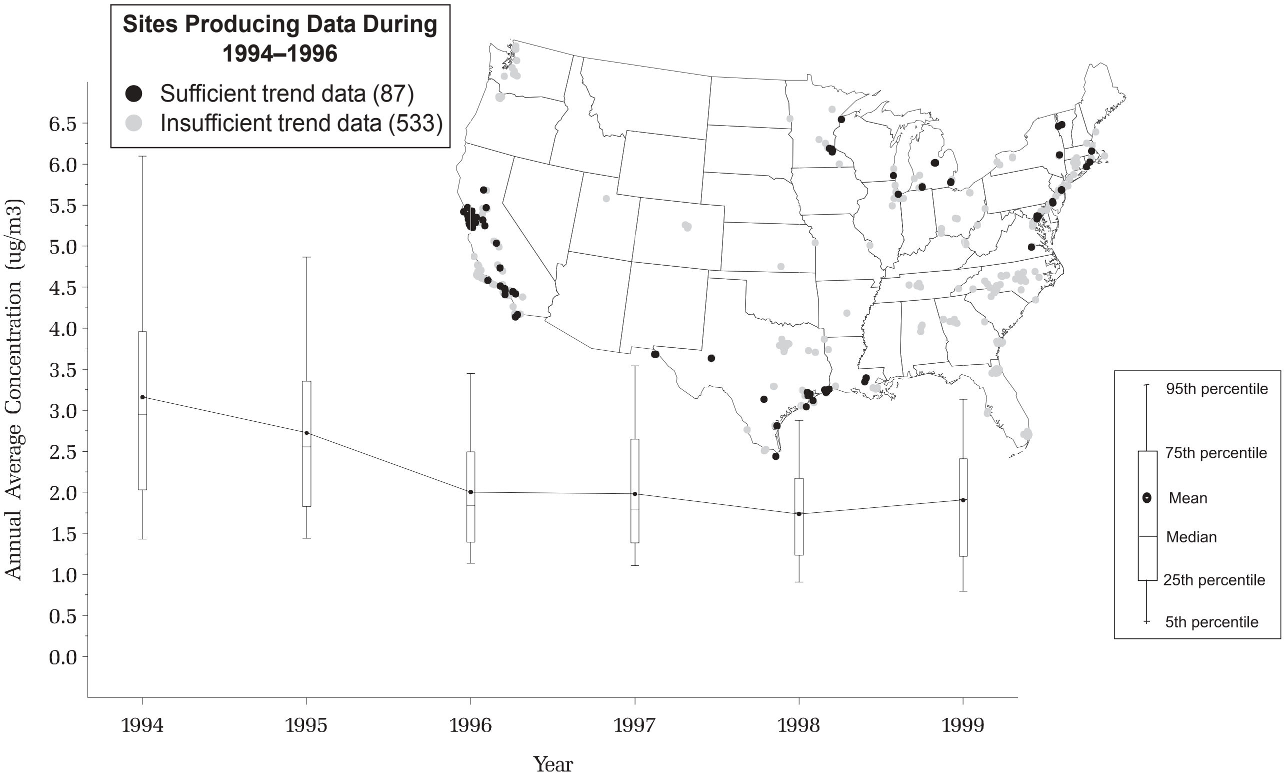


Figure 5-8b. National trend in annual average 1,3-butadiene concentrations in metropolitan areas, 1994–1999.

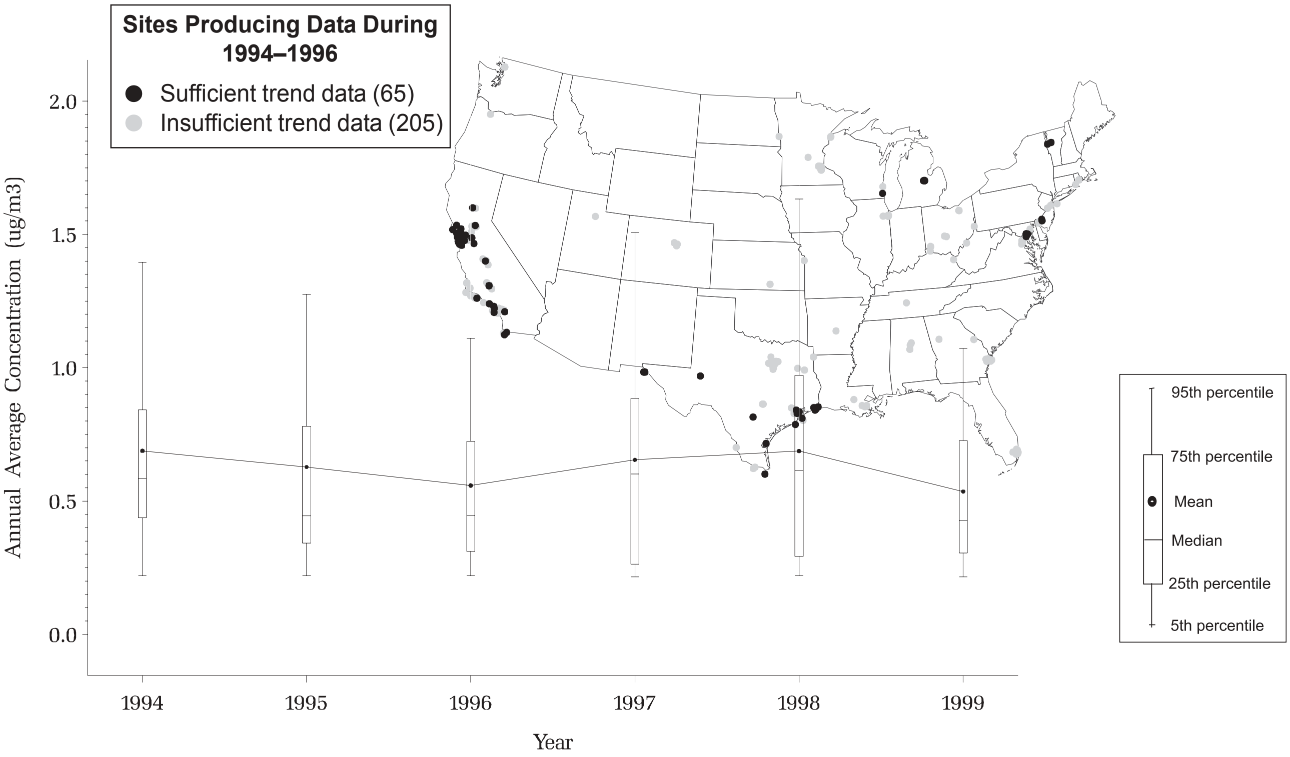


Figure 5-8c. National trend in annual average total suspended lead concentrations in metropolitan areas, 1990–1999.

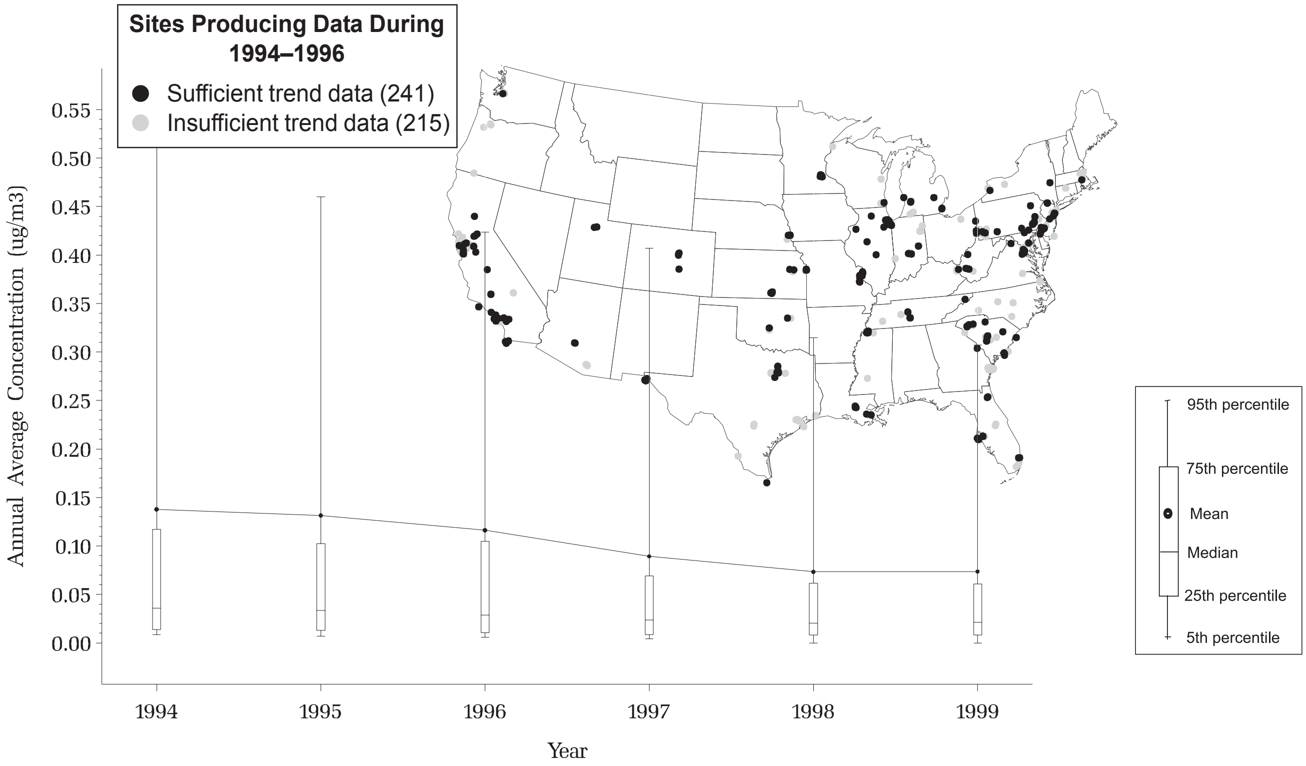


Figure 5-8d. National trend in annual average perchloroethylene concentrations in metropolitan areas, 1990–1999.

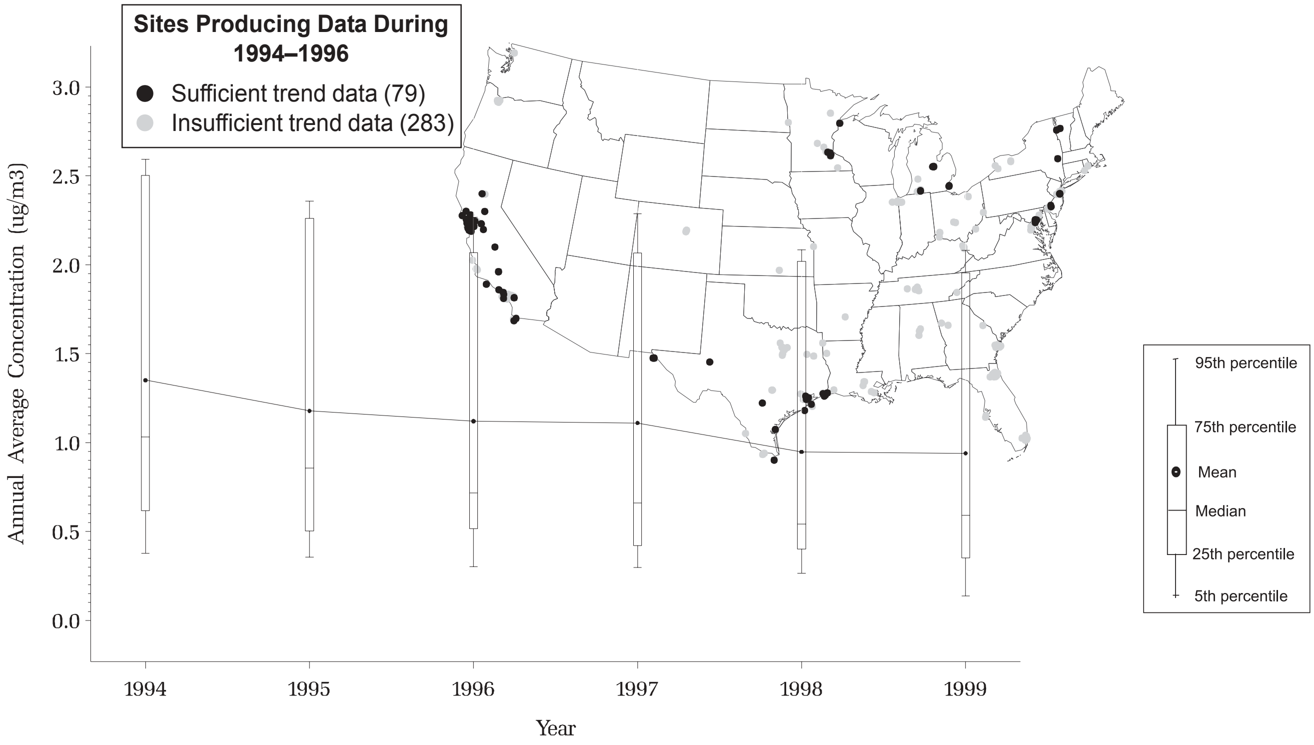


Figure 5-8e. National trend in annual average styrene concentrations in metropolitan areas, 1994–1999.

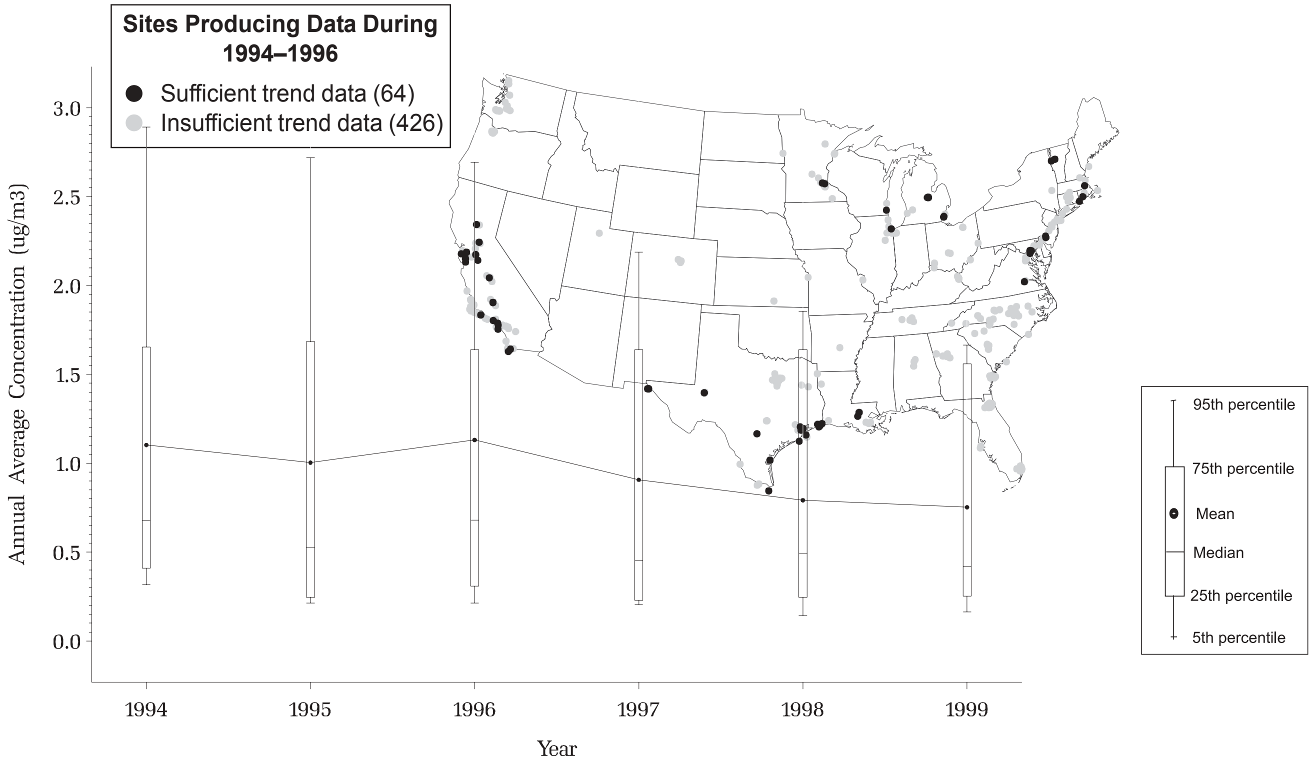
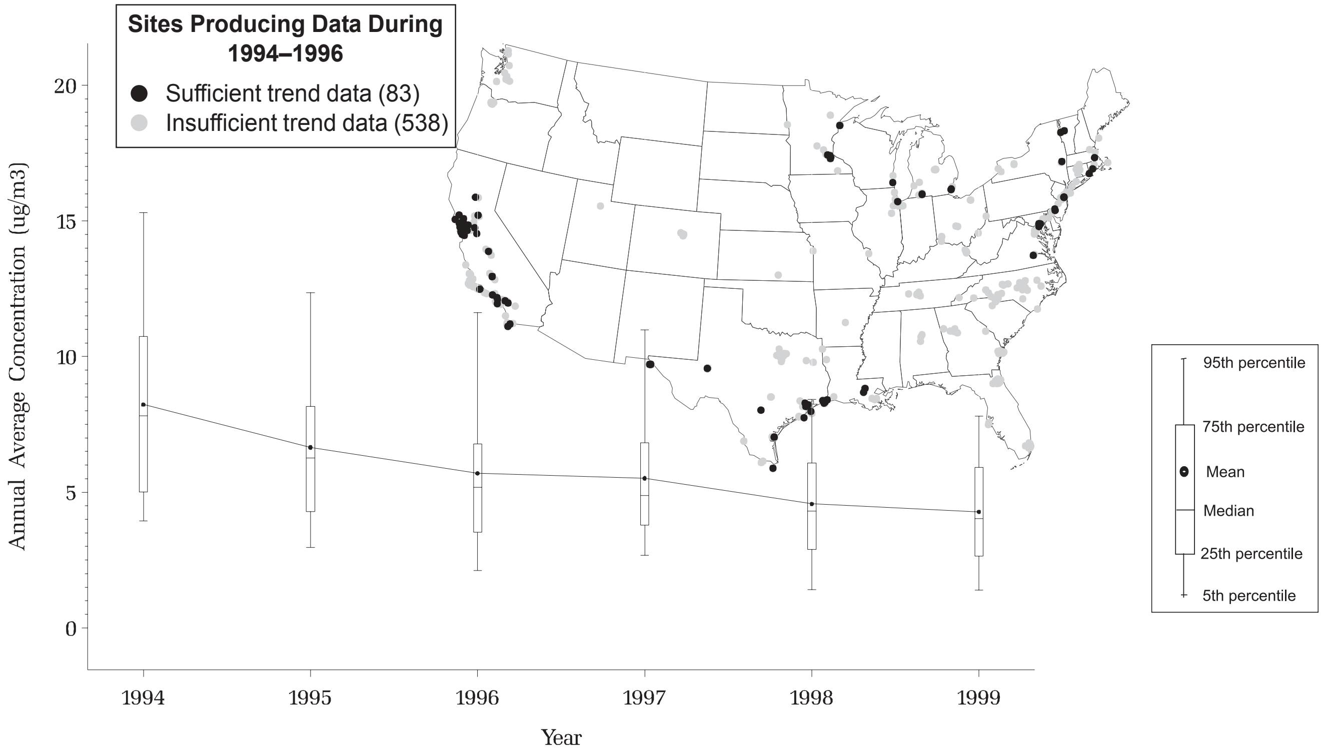


Figure 5-8f. National trend in annual average toluene concentrations in metropolitan areas, 1994–1999.



sources for many of the air toxics. For these pollutants, a national composite trend may not be meaningful at this time. Although the general direction of change is down for most HAPs on the urban list, several states reveal significant 6-year increases at a few locations. The HAPs and some of their influencing sources are: 1,3-butadiene (mobile sources); chromium (power plants, electroplating); lead (smelters and aircraft); and semivolatile particulates (various combustion sources). This list also includes carbon tetrachloride, chloroform, and trichloroethylene whose ambient concentrations are estimated to have relatively high background contributions. Background concentrations are contributions to ambient air toxics concentrations resulting from natural sources, persistence in the environment of past years' emissions and long-range transport from distant source. To illustrate a few of the HAPs without consistent trends among the current set of trend sites, boxplots for 1994–1999 are presented for 1,3-butadiene, styrene, and perchloroethylene. The national trend lines for these HAPs show more year-to year variability, but still appear to show 6-year air quality improvements.

To illustrate the behavior of selected HAPs in a particular region of the country, trends of monitoring sites in California are presented Figure 5-9. The state of California has the largest and longest running air toxics monitoring network. They have over 30 sites with a 10-year history for several VOCs and almost as many for several trace metals. These data allow us to take a look at air toxics trends over a longer period of time. Among the HAPs discussed in this section, notable improvements are seen for benzene, 1,3-butadiene, lead, perchloroethylene, styrene and toluene. The impressive air quality improvement for urban benzene in California is shown in Figure 5-9a. This figure illustrates the large decrease in ambient concentrations which occurred during the early 1990s. Annual average concentrations declined 64 and 35 percent over the 1990–1999 and 1990–1999 periods. Ambient concentrations of perchloroethylene associated with dry cleaners is down 60 and 39 percent respectively (Figure 5-9d). Toluene associated with mobile sources also showed consistent 10-year declines which averaged 53 percent across the state (Figure 5-9f). Besides benzene, another HAP which predominantly comes from mobile sources is 1,3-butadiene. Although site-specific trends for this pollutant were mixed, the composite trend in Figure 5-9b shows an overall 40 percent and 28 percent decline in ambient concentrations for the 10- and 6-year periods.

As was the case nationally, the reductions in ambient concentrations of perchloroethylene are due to better controls on the use of solvents. The California improvements in benzene, 1,3-butadiene and toluene are primarily attributed to the reformulation of gasoline and new-car improvements in terms of emission controls. (For more information about trends in these emissions, see the ozone section in Chapter 2.) For lead in TSP, annual average concentrations in California declined 46 percent over the 10 years, but appear to have leveled off over the most recent years. For additional detail on the derivation of Figures 5-8a to 5-9f, see Appendix B: Methodology.

Ambient air toxics data in rural areas are much more limited, but the results in Table 5-3 also indicate widespread air quality improvement for many monitored HAPs. Significant downward trends are noted among the few rural sites for benzene and several other VOCs. Lead concentrations in rural areas are also down.

While these data are useful to describe general trends and geographic variations in annual average concentrations, they only represent a selected group of monitoring sites. They do not necessarily highlight the range of concentrations or locate air toxics problem areas that exist nationwide. For example, a recent air toxics study conducted in the Los Angeles area has shown that higher concentrations of air toxics generally occur near their emission sources. In particular, concentrations of compounds that are emitted primarily from stationary and area sources tended to be highest within a few kilometers from the source location. More ubiquitous mobile source related compounds such as benzene and 1,3-butadiene were shown to be generally high throughout the South Coast Air Basin. However, the highest concentrations were estimated by air quality models to occur along freeway corridors and junctions. In addition, high levels of mobile source related compounds were estimated near major mobile source activities such as airports and other areas with major industrial activities. Also, annual averages may tend to average out peaks in the monitoring data. The study showed that there were strong seasonal variations to the levels of toxic air contaminants, primarily with those pollutants associated with mobile sources. For example, benzene and butadiene both had seasonal peaks in the late fall and winter

Figure 5-9a. Trend in annual average benzene concentrations for metropolitan sites in California, 1994–1999.

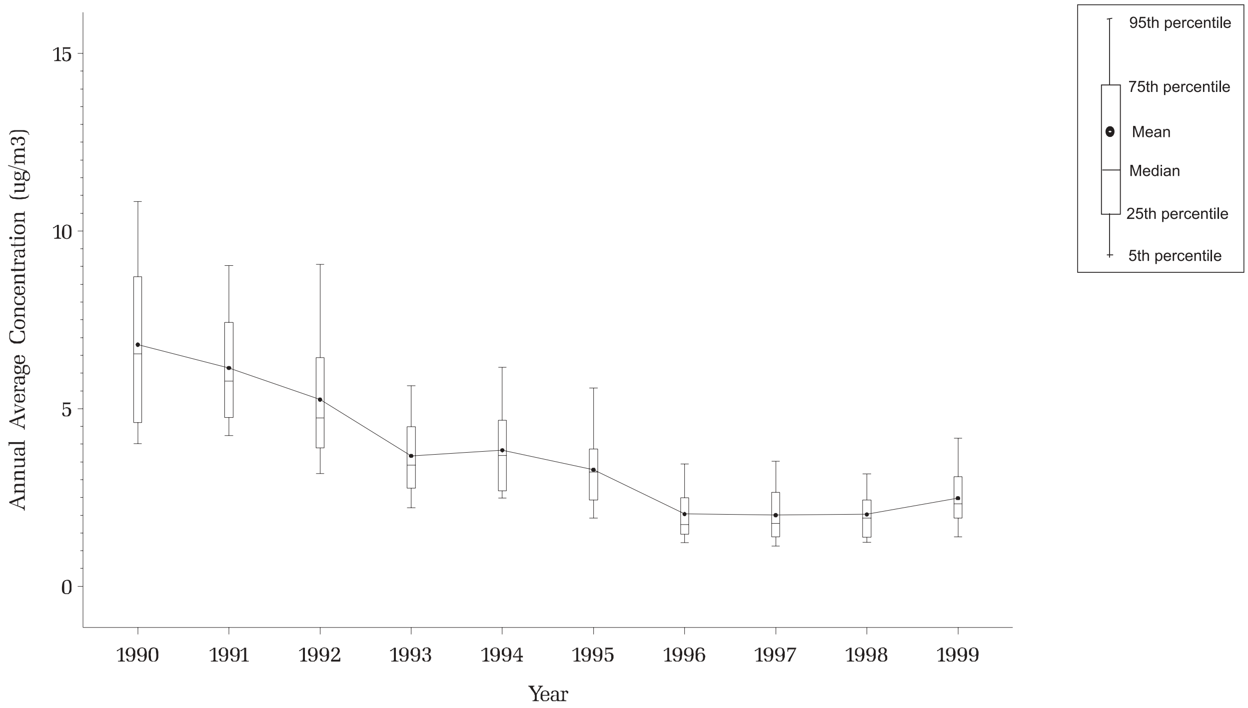


Figure 5-9b. Trend in annual average 1,3-butadiene concentrations for metropolitan sites in California, 1994–1999.

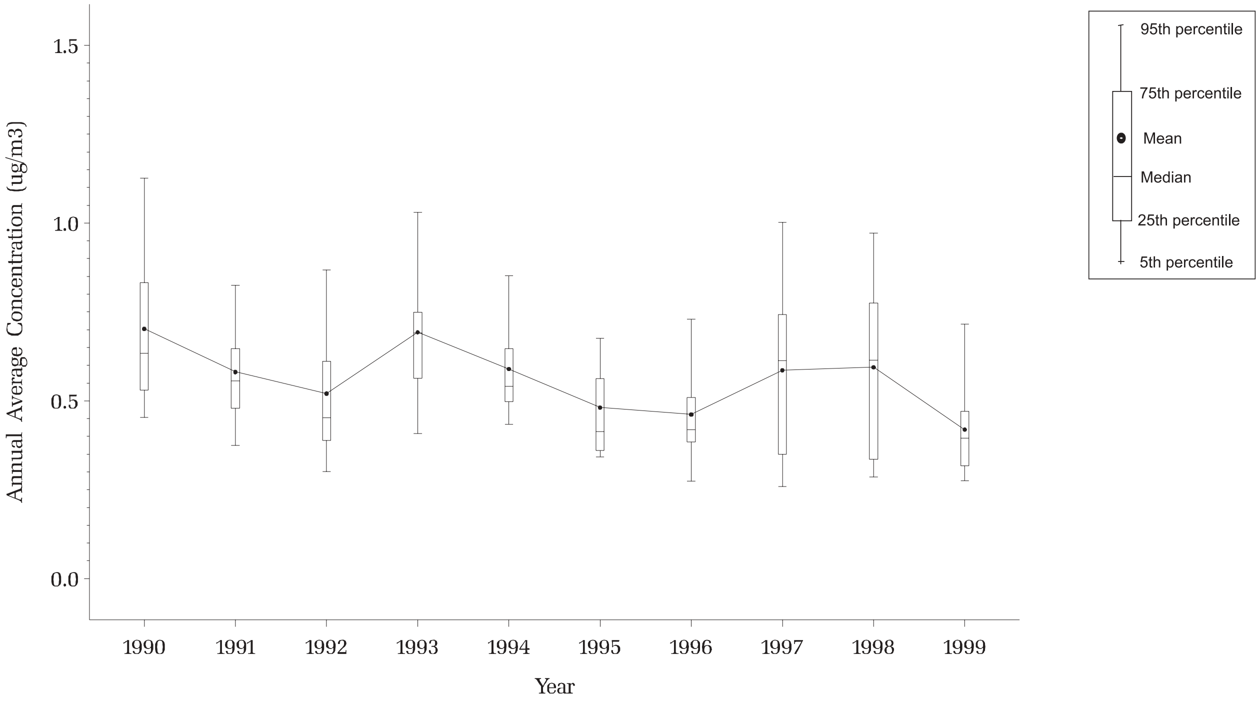


Figure 5-9c. Trend in annual average total suspended lead concentrations for metropolitan sites in California, 1990–1999.

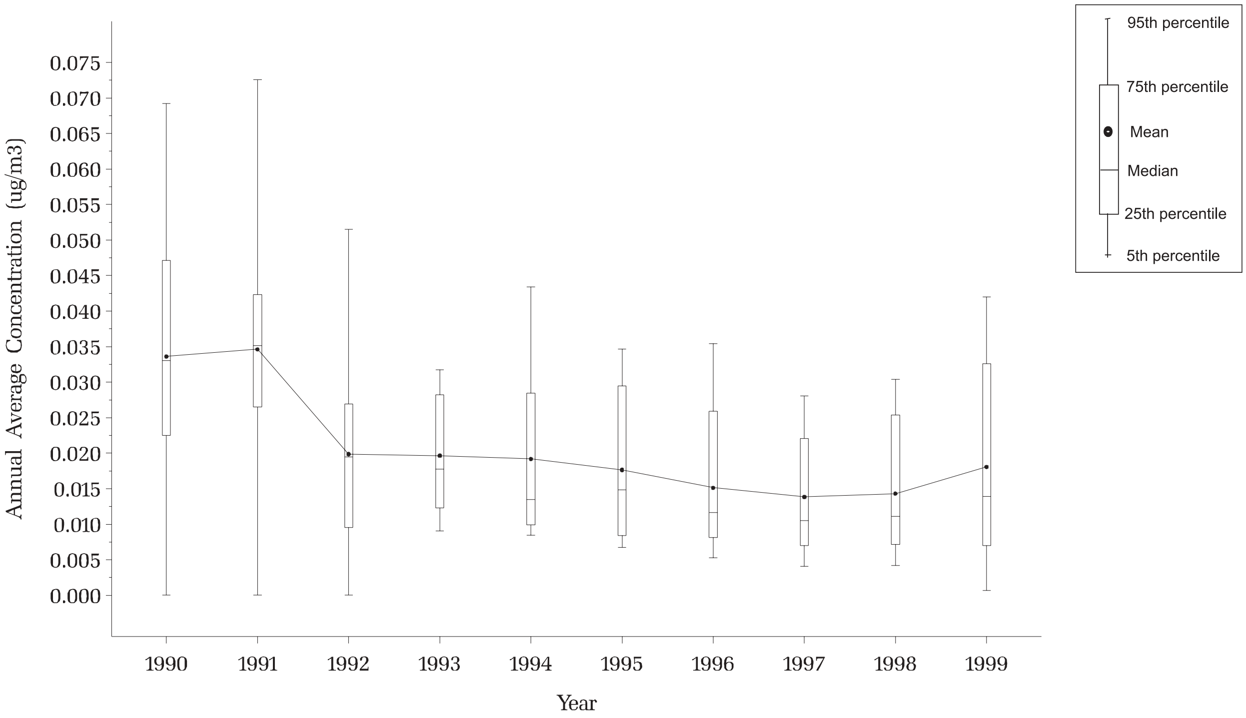


Figure 5-9d. Trend in annual average perchloroethylene concentrations for metropolitan sites in California, 1990–1999.

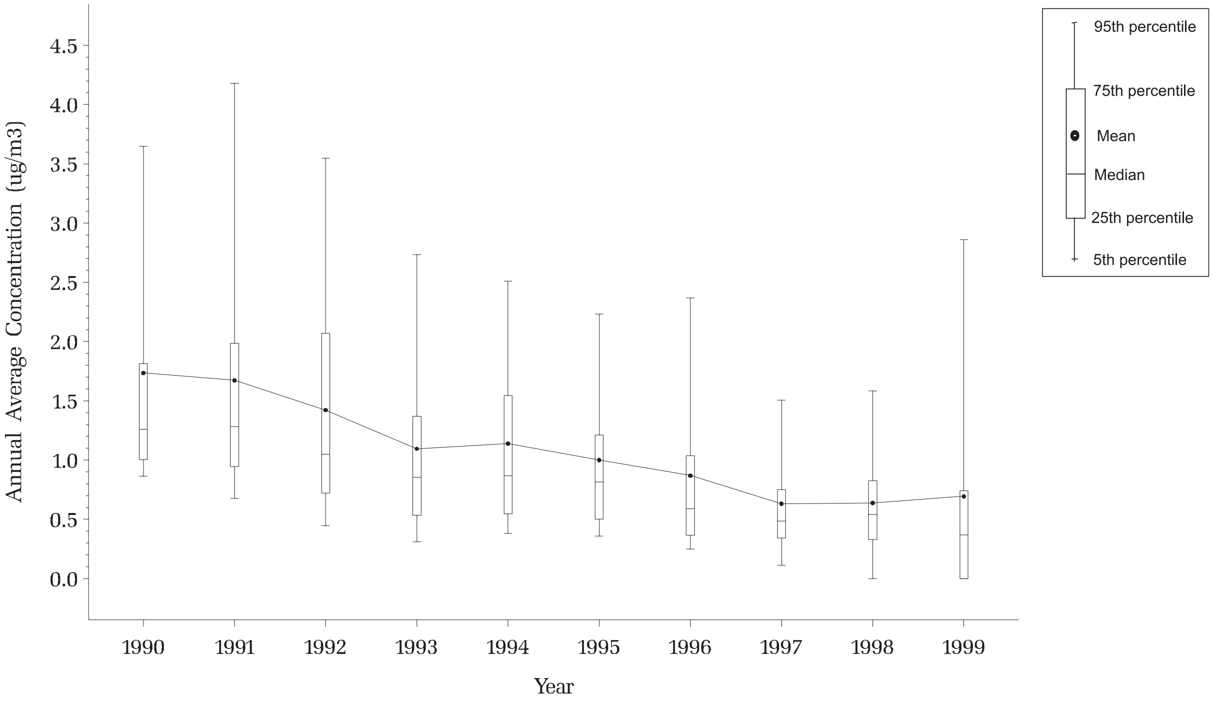


Figure 5-9e. Trend in annual average styrene concentrations for metropolitan sites in California, 1990–1999.

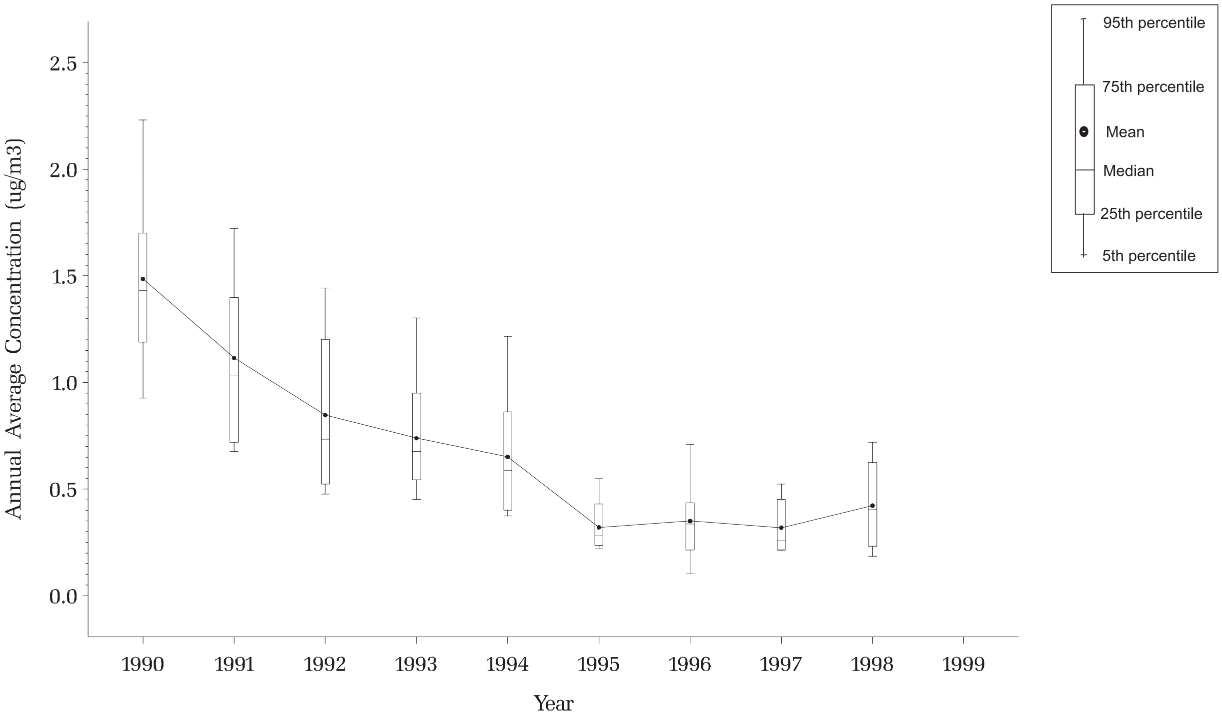


Figure 5-9f. Trend in annual average toluene concentrations for metropolitan sites in California, 1990–1999.

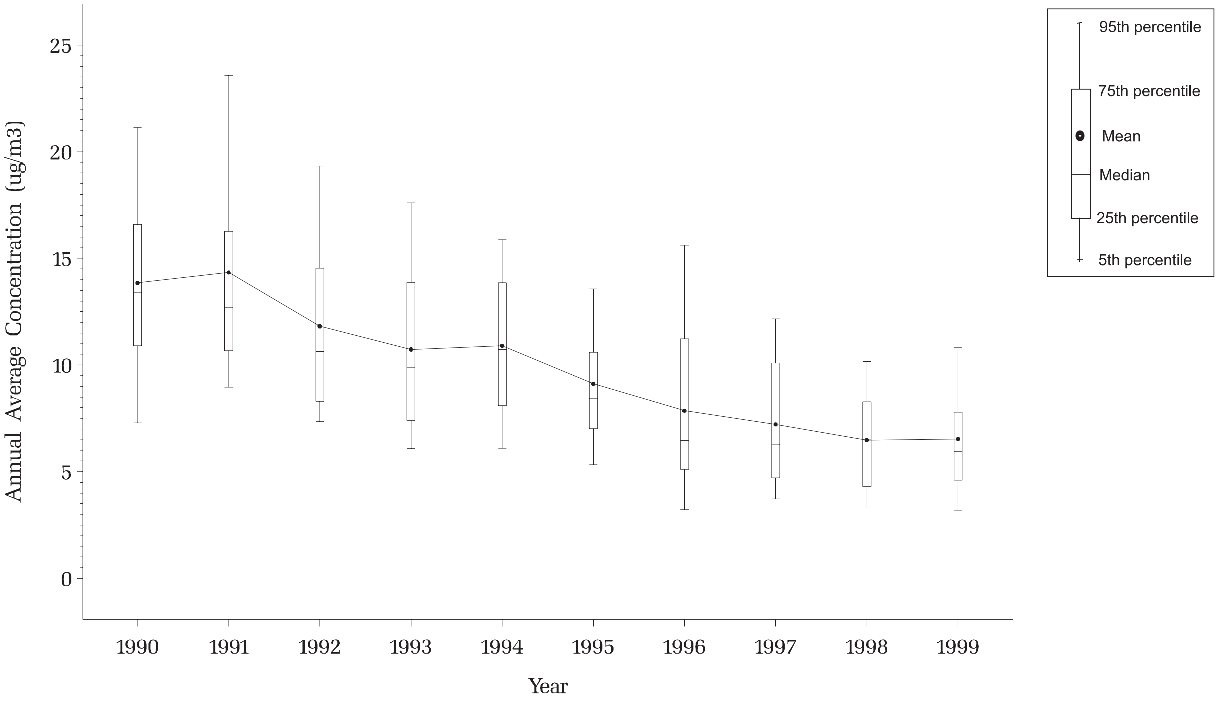


Table 5-3. National Summary of Ambient HAP Concentration Trends in Rural Areas, 1994–1999

	Number of Rural Trend Sites by HAP					
Pollutant Name	**Total**	**Significant* UP Trend**	**Non-Significant UP Trend**	**No Trend**	**Non-Significant DOWN Trend**	**Significant* DOWN Trend**
Benzene	6				6	
1,3-Butadiene	4		1		2	**1**
Carbon tetrachloride	2		2			
Chloroform	4		1		2	**1**
1,2-Dichloropropane	3			2	1	
Ethylene dichloride	3				2	**1**
Methylene chloride	4		1		3	
1,1,2,2-Tetrachloroethane	1				1	
Perchloroethylene	5		1		1	**3**
Trichloroethylene	5			1	3	**1**
Vinyl chloride	4		1	2	1	
Arsenic (coarse)	2		1	1		
Arsenic (fine)	59	**2**	18	1	36	**2**
Arsenic (PM_{10})	6		1	3	1	**1**
Arsenic (TSP)	5			1	2	**2**
Beryllium (PM_{10})	2		1	1		
Beryllium (TSP)	3			3		
Cadmium (PM_{10})	2			1	1	
Cadmium (TSP)	7			4	1	**2**
Chromium (coarse)	2		1		1	
Chromium (fine) *	59	**32**	22	1	4	
Chromium (PM_{10})	6	**1**	2		3	
Chromium (TSP)	8		3	1	4	
Chromium VI	1				1	
Lead (coarse)	2			1	1	
Lead (fine)	59	**3**	32		20	**4**
Lead (PM_{10})	8	**1**	2	2	2	**1**
Lead (TSP)	33		5		16	**12**
Manganese (coarse)	2		1		1	
Manganese (fine)	59	**3**	22		32	**2**
Manganese (PM_{10})	6		2		3	**1**
Manganese (TSP)	7		2		5	
Mercury (fine)	2			1	1	
Mercury (PM_{10})	4		2	1	1	
Mercury (TSP)	1		1			
Nickel (coarse)	2		1		1	
Nickel (fine)	59		12	1	32	**14**
Nickel (PM_{10})	6		1	1	3	**1**
Nickel (TSP)	8			1	6	**1**
Acetaldehyde	3		2		1	
Formaldehyde	4		1		3	
Acrolein	1				1	
Styrene	6		2		3	**1**
Toluene	7		3		3	**1**

*Statistically significant at the 10-percent level (See Appendix B: Methodology, Air Toxics Methodology section).

** The apparent up trends in fine chromium concentrations may be an artifact of the detection limits for these measurements.

months; their lowest levels were observed during the spring and summer months.

National Atmospheric Deposition Program/Mercury Deposition Network

The purpose of the National Atmospheric Deposition Program (NADP) is to address the problem of atmospheric deposition and its effects on agricultural crops, forests, rangelands, surface waters, and other natural resources. NADP began in 1978 as a cooperative program between federal and state agencies, universities, electrical utilities, and other industries to measure atmospheric deposition and determine geographical patterns and trends in wet deposition of sulfate, nitrate, hydrogen ion, ammonium, chloride, calcium, magnesium, and potassium. Wet deposition is atmospheric deposition that occurs when rain, snow, or fog carry gases and particles to the earth's surface.

The Mercury Deposition Network (MDN), which is a component of the NADP, measures mercury levels in wet deposition at over 40 NADP sites located in 16 states and two Canadian provinces. MDN is investigating the importance of atmospheric deposition as a source of mercury in lakes and streams. These MDN data enable researchers to compile a national database of weekly precipitation concentrations to determine seasonal and annual fluxes of mercury in precipitation falling on lakes, wetlands, streams, forested watersheds, and other sensitive ecosystems. As a result, state and federal air regulators can monitor progress in reducing mercury deposition and amend policy decisions accordingly. There are plans to expand the network in the near future, pending availability of new funds. Additional information about the network is available on the Internet at **http://nadp.sws.uiuc.edu/mdn/**.

Data from 1998 indicate that the volume-weighted mean concentration of total mercury in precipitation from 30 sites ranged from 3.8–23.0 ng/L and annual deposition of mercury ranged from 4.0–20.3 µg/m^2. Most of the monitors are in the Great Lake states and eastern United States. While high concentrations in precipitation are found in many regions, the highest estimated deposition is in the southern states. In the eastern United States, average summer mercury concentrations are approximately twice the winter concentrations and average summer deposition values are three times winter values. This can be explained by higher concentrations of mercury in the rain and higher rainfall amounts during the summer.[10]

Integrated Atmospheric Deposition Network

The Integrated Atmospheric Deposition Network (IADN) was established in 1990 by the United States and Canada for conducting air and precipitation monitoring in the Great Lakes Basin. IADN collects data that can be useful in assessing the relative importance of atmospheric deposition to pollutant loadings in the Great Lakes. The first implementation plan, signed in 1990, committed the United States and Canada to work cooperatively towards the initiation of IADN. IADN measures concentrations of target chemicals in rain and snow (wet deposition), airborne particles (dry deposition), and airborne organic vapors.[11] PAHs, PCBs, and organochlorine compounds (which are all Semivolatile Organic Compounds, or SVOCs) are measured in air and precipitation samples in the United States and Canada. SVOCs are measured in both the gaseous and particulate phases in air. Canada also measures trace metals in air and precipitation, as well as $PM_{2.5}$ (particles less than 2.5 microns in diameter) in air.

Under IADN, trends in pollutant concentrations in air and precipitation are assessed and loading estimates of atmospheric deposition and volatilization of pollutants are made every two years. The IADN network currently consists of one master station per Great Lake and 14 satellite stations. Stations are located in remote areas and do not assess urban sources of pollution.

General conclusions based on IADN data include the following:

- Levels in air and precipitation appear stable for current-use pesticides such as endosulphan, but levels for most other pesticides, PCBs, and lead are decreasing.
- Gas absorption appears to be the dominant deposition process for delivering SVOCs, including PCBs and PAHs, to lake surfaces, while wet and dry deposition dominate for the trace elements and higher molecular weight PAHs.
- For some IADN substances, like dieldrin and PCBs, the surface waters are behaving like a source since the amount that is volatilizing from the water is greater than the amount being deposited to the water.
- The lakes are sensitive to the atmospheric concentration of IADN chemicals, and this points out the fragility of these resources given that long-range transport from other regions may be a significant source of toxic pollutants.

- Air trajectory analyses indicate that many SVOCs are potentially originating from outside the Great Lakes basin, whereas trace metals and PAHs may be associated with local sources.

The Second Implementation Plan for IADN (IP2), signed in 1998, outlines goals and plans for IADN for the period 1998–2004. Under this Second Implementation Plan, the IADN will continue surveillance and monitoring activities, related research, and provision of information for intergovernmental commitments and agreements. Additional work to be completed under the Second Implementation Plan is the development of a database for all U.S. and Canadian data. Potential modifications will be discussed in relation to the placement of satellite stations to assess urban inputs and air-water gas exchange, criteria for changes to the IADN chemical list, coordination with other research activities, quality assurance and control of IADN operations, and communication of IADN results.[12]

References

1. This list originally included 189 chemicals. The CAA allows EPA to modify this list if new scientific information becomes available that indicates a change should be made. Using this authority, the Agency modified the list to remove caprolactam in 1996, reducing the list to 188 pollutants (*Hazardous Air Pollutant List; Modification, 61 FR 30816*, June 18, 1996).

2. U.S. EPA. 2000. Draft Health Assessment Document for Diesel Exhaust. July 2000.

3. *Federal Register,* 65 FR 79827.

4. Giesy, J.P., Ludwig, J.P., and Tillitt, D.E. 1994. Deformities in birds of the Great Lakes region: assigning causality. *Environ. Sci. Technol.* 28,128A-136A.

5. Cook, P.M., Zabel, E.W., and Peterson, R.E. 1997. The TCDD toxicity equivalence approach for characterizing risks for early life stage mortality in trout. In: *Chemically Induced Alterations in the Functional Development and Reproduction of Fishes*, pp. 9–27. (Rolland, R., Gilbertson, M., and Peterson R., Eds.). SETAC Press, Pensacola, FL.

6. Scheuhammer, A.M., and Blancher, P.J. 1994. Potential risk to common loons (Gavia immer) from methylmercury exposure in acidified lakes. Hydrobiol. 279,445-455.

7. "National Air Toxics Program: The Integrated Urban Strategy," *Federal Register*, 64 FR 38705, Washington, D.C., July 19, 1999. Available on the Internet at: **http://www.epa.gov/ttn/atw/urban/urbanpg.html**

8. "1997 Urban Air Toxics Monitoring Program (UTAMP)," EPA-454/R-99-036. RTP, NC 27711, January 1999. Available on the Internet at **http://www.epa.gov/ttn/amtic/airtxfil.html**.

9. "Air Toxics Monitoring Concept Paper," U.S Environmental Protection Agency, Office of Air Quality Planning and Standards, RTP, NC, 27711. February 29, 2000. Peer Review Draft. Available on the Internet at: **http://www.epa.gov/ttn/amtic/airtxfil.html**.

10. Sweet, C.W., E. Prestbo, B. Brunette. 1999. Atmospheric wet deposition of mercury in North America. Proceedings of the 92nd Annual Meeting of the Air and Waste Management Association. June 21–23, 1999, St. Louis, MO.

11. The target chemicals include PCBs, pesticides, PAHs and metals. The compounds included as "target chemicals" were selected based on the following criteria: presence on List 1 of Annex 1 of the Great Lakes Water Quality Agreement (substances believed to be toxic and present in the Great Lakes); established or perceived water quality problem; presence on the International Joint Commission's Water Quality Board's list of criteria pollutants; evidence of presence in the atmosphere and an important deposition pathway; and feasibility of measurement in a routine monitoring network.

12. U.S./Canada IADN Scientific Steering Committee. 1998. Technical summary of progress under the integrated atmospheric depositions program 1990–1996.

CHAPTER 6

Visibility Trends

http://www.epa.gov/oar/aqtrnd99/chapter6.pdf

Worth Noting:

The 10 eastern U.S. Class I area trend sites as an aggregate show a 15-percent improvement in aerosol light extinction for the haziest 20 percent of days over the 1992–1999 timeframe, with aerosol light extinction due to sulfates reaching its lowest level of the 1990s. However, visibility on the haziest 20 percent of the days remains significantly impaired with a mean visual range of 23 km for 1999 as compared to 84 km for the clearest days in 1999.

The 26 western U.S. Class I area trend sites as an aggregate show improvement in aerosol light extinction for the clearest 20 percent and middle 20 percent of days over the 1990–1999 timeframe, with a 25-percent and 14-percent improvement, respectively. The conditions for the haziest 20 percent of days degraded between 1997 and 1999 by 17 percent. However, visibility on the haziest 20 percent of the days remains relatively unchanged over the 1990s with the mean visual range for 1999 (80 km) nearly the same as the 1990 level (86 km).

Introduction

The Clean Air Act (CAA) authorizes the United States Environmental Protection Agency (EPA) to protect visibility, or visual air quality, through a number of programs. These programs include the National Visibility Program under sections 169a and 169b of the Act, the Prevention of Significant Deterioration Program for the review of potential impacts from new and modified sources, the secondary National Ambient Air Quality Standards (NAAQS) for PM_{10} and $PM_{2.5}$, and the Acid Rain Program under section 401. Since 1980, EPA issued two sets of regulations to prevent future and remedy existing visibility impairment. In 1980, EPA issued visibility regulations to address adverse impacts from a single source or small group of sources. In 1999, EPA issued regulations to address regional haze, visibility impairment caused by numerous sources located across large geographic areas.

The National Visibility Program requires the protection of visibility in 156 mandatory federal Class I areas across the country (primarily national parks and wilderness areas). The CAA established as a national visibility goal "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory federal Class I areas in which impairment results from man-made air pollution." The Act also calls for state programs to make "reasonable progress" toward the national goal.

In 1987, the Interagency Monitoring of Protected Visual Environments (IMPROVE) visibility network was established as a cooperative effort between EPA, the National Oceanic and Atmospheric Administration, the National Park Service, the U.S. Forest Service, the Bureau of Land Management, the U.S. Fish & Wildlife Service, and state governments. The objectives of the network are to establish current conditions, to track progress toward the national visibility goal by documenting long-term trends, and to provide information for determining the types of pollutants and sources primarily responsible for visibility impairment. Chemical analysis of aerosol measurements provides ambient concentrations and associated light extinction for PM_{10}, $PM_{2.5}$, sulfates, nitrates, organic and elemental carbon, crustal material, and a number of other elements. The IMPROVE program has established protocols for aerosol, optical, and photographic monitoring methods. The IMPROVE network has been expanded from 30 to 110 sites to represent all mandatory federal Class I areas. Together with additional sites which also used the IMPROVE monitoring protocol, the total number of visibility sites now exceeds 130 nationwide. The analyses presented in this chapter are based on data from the IMPROVE network, which can be found on the Internet at: **http://vista.cira.colostate.edu/improve/Data/IMPROVE/improve_data.htm**.

This chapter presents aerosol and light extinction data collected between 1990 and 1999 at 36 Class I areas in the IMPROVE network. Because the CAA calls for the tracking of "reasonable progress" in preventing future impairment and remedying existing impairment, this analysis looks at trends in visibility impairment across the entire range of the visual air quality distribution. States are required to establish goals to improve visibility for the 20 percent worst days and to allow no degradation of the 20 percent best days as discussed later in this chapter. To facilitate this approach, visibility data have been sorted into quintiles, or 20 percent segments, of the overall distribution and average values have been calculated for each quintile. Trends are presented in terms of the haziest ("worst") 20 percent, typical ("middle") 20 percent, and clearest ("best") 20 percent of the annual distribution of data. Figure 6-1 is a map of the 36 Class I areas with seven or more years of IMPROVE monitoring data included in this analysis.

Figure 6-1. IMPROVE sites meeting data completeness requirements for sites operating in 1999.*

*Data does not include IMPROVE sites established in 2000 and 2001.

Nature and Sources of the Problem

Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere. It is most simply described as the haze that obscures the clarity, color, texture, and form of what we see. The same particles linked to serious health and environmental effects (sulfates, nitrates, organic carbon, elemental carbon (commonly called soot), and crustal material) also can significantly affect our ability to see.

Both primary emissions and secondary formation of particles contribute to visibility impairment. Primary particles, such as elemental carbon from diesel and wood combustion, or dust from certain industrial activities or natural sources, are emitted directly into the atmosphere. Secondary particles that are formed in the atmosphere from primary gaseous emissions include sulfate from sulfur dioxide (SO_2) emissions, nitrates from nitrogen oxide (NO_x) emissions, and organic carbon particles formed from condensed hydrocarbon emissions. In the eastern United States, reduced visibility is mainly attributable to secondarily formed particles, particularly those less than a few micrometers in diameter. While secondarily formed particles still account for a significant amount in the West, primary emissions from sources such as woodsmoke generally contribute a larger percentage of the total particulate load than in the East. The only primary gaseous pollutant that directly reduces visibility is nitrogen dioxide (NO_2), which can sometimes be seen in a visible plume from an industrial facility, or in some urban areas with high levels of motor vehicle emissions.

Visibility conditions in Class I and other rural areas vary regionally across the United States. Rural areas in the East generally have higher levels of impairment than most remote sites in the West. Higher eastern levels are generally due to higher regional concentrations of sulfur dioxide and other anthropogenic emissions, higher estimated regional background levels of fine particles, and higher average relative humidity levels. Humidity can significantly increase the effect of pollution on visibility. Some particles, such as sulfates, accumulate water and grow in size becoming more efficient at scattering light. Annual average relative humidity levels are 70–80 percent in the East as compared to 50–60 percent in many parts of the

Figure 6-2. Comparison of the three visibility metrics (extinction, deciview and visual image).

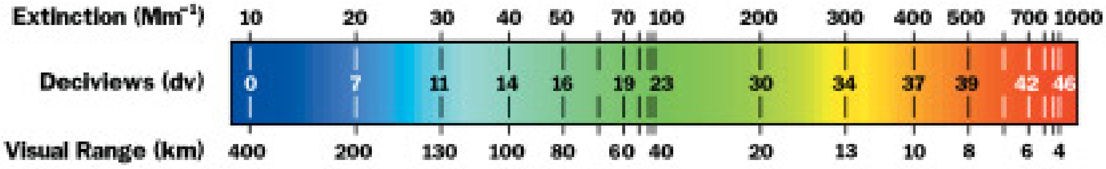
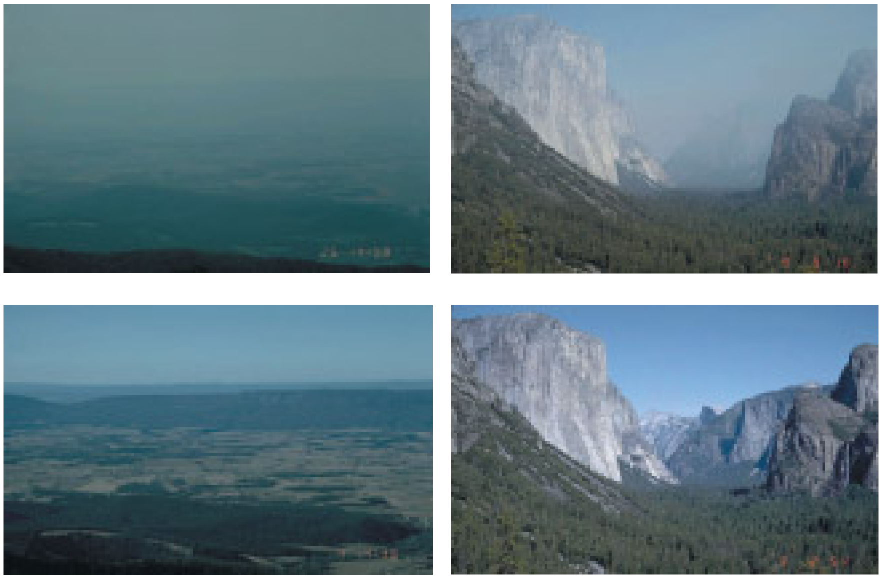


Figure 6-2a. Images of Shenandoah National Park and Yosemite National Park.



Condition:
Bad

Visual Range:
25 km

Deciviews:
28

Condition:
Bad

Visual Range:
16 km

Deciviews:
32

Condition:
Good

Visual Range:
180 km

Deciviews:
8

Condition:
Good

Visual Range:
200 km

Deciviews:
6.5

Shenandoah National Park

Yosemite National Park

West. Poor summer visibility in the eastern United States is primarily the result of high sulfate particle concentrations combined with high humidity levels.

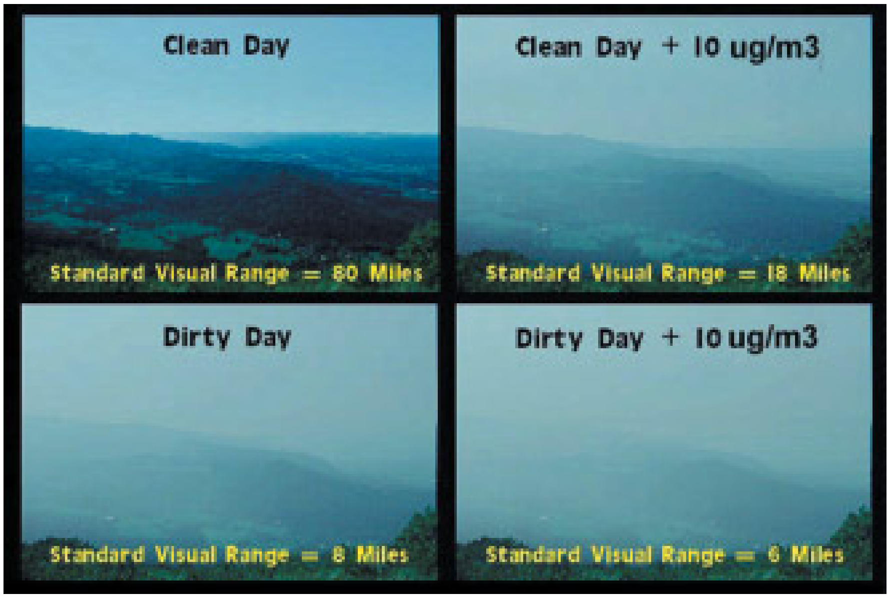
Visibility conditions are commonly expressed in terms of three mathematically related metrics: visual range, light extinction, and deciviews. Figure 6-2 shows the relationship between these three metrics of visibility. Figure 6-2a provides a photographic illustration of very clear and very hazy conditions at Shenandoah National Park in Virginia and Yosemite National Park in California. Visual range is the metric best known by the general public. It is the maximum distance at which one can identify a black object against the horizon, and is typically described in miles or kilometers.

Light extinction, inversely related to visual range, is the sum of light scattering and light absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm^{-1}), with larger values representing poorer visibility. Unlike visual range, the light extinction coefficient allows one to express the relative contribution of one particulate matter (PM) constituent versus another to overall visibility impairment. Using speciated mass measurements collected from the IMPROVE samplers, "reconstructed light extinction" can be calculated by multiplying the aerosol mass for each constituent by its appropriate "dry extinction coefficient," and then summing these values for each constituent. Because sulfates and nitrates become more efficient at scattering light with increasing humidity, these values are also multiplied by a relative humidity adjustment factor.[2] Annual and seasonal light extinction values developed by this approach correlate well with optical measurements of light extinction (by transmissometer) and light scattering (by nephelometer).

The deciview metric was developed because changes in visual range and light extinction are not proportional to human perception of visibility impairment. For example, a 5-mile (8-km) change in visual range can be either very apparent or not perceptible, depending on the base line level of ambient pollution. The deciview metric provides a linear scale for perceived visual changes over the entire range of conditions, from clear to hazy, analogous to the decibel scale for sound. Under many scenic conditions, a change of one deciview is considered to be perceptible by the average person. A deciview of zero represents pristine conditions.

It is important to understand that the same amount of pollution can have dramatically different effects on visibility depending on existing conditions. Most importantly, visibility in cleaner environments is more sensitive to increases in $PM_{2.5}$ particle concentrations than visibility in more polluted areas. This principle is illustrated in Figure 6-3, which characterizes visibility at Shenandoah National Park under a range of conditions.[3] A clear day at Shenandoah can be represented by a visual range of 80 miles (133 km), with conditions approximating naturally-occurring visibility (i.e., without pollution created by human activities). An average day at Shenandoah is represented by a visual range of 18 miles (30 km), and is the result of an additional 10 µg/m³ of fine particles in the atmosphere. The two bottom scenes, with visual ranges of eight and six miles respectively, illustrate that the perceived change in visibility due to an additional 10 µg/m³ of fine particles to an already degraded atmosphere is much less perceptible than adding this amount to a clean atmosphere. Thus, to achieve a given level of perceived visibility improvement, a large reduction in fine particle concentrations is needed in more polluted areas. Conversely, a small amount of pollution in a clean area can dramatically decrease visibility.

Figure 6-3. Shenandoah National Park on clear and hazy days and the effect of adding 10 µg/m³ of fine particles to each.

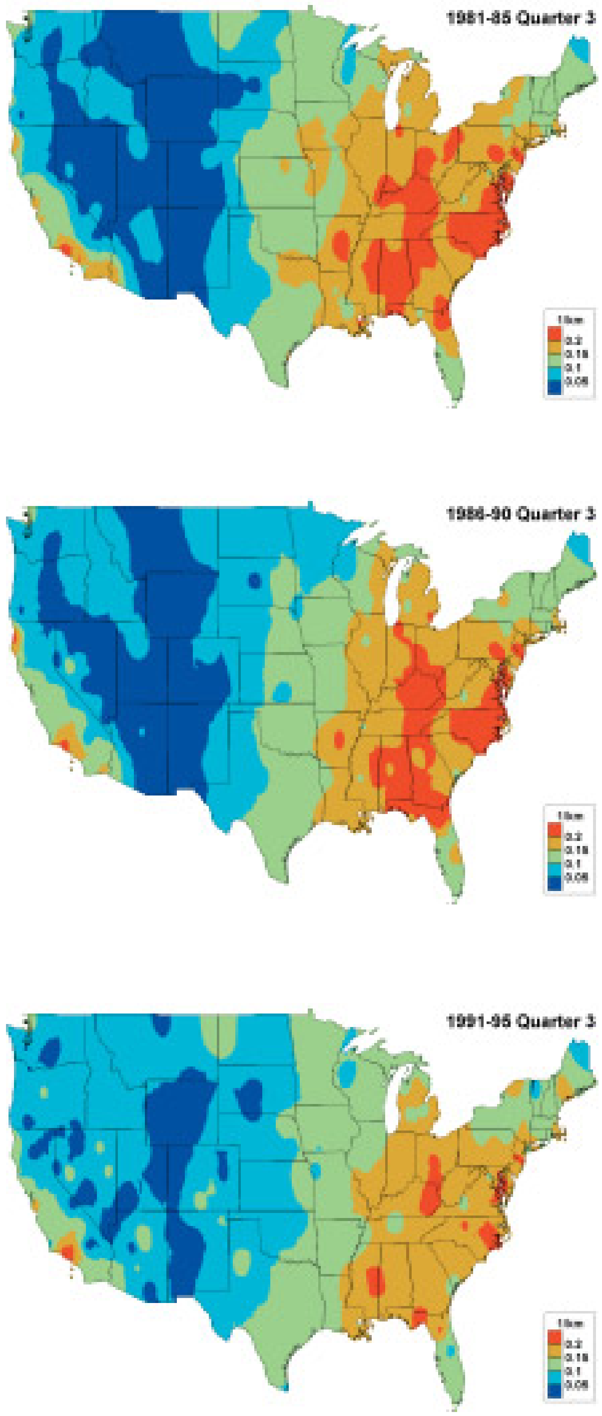


Long-Term Trends (1981–1995)

Visibility impairment is presented here using visual range data collected since 1960 by human observers at 298 monitoring stations located at primarily urban and suburban airports across the country. Trends in visibility impairment can be inferred from these long-term records of visual range. Figure 6-4 describes long-term U.S. visibility impairment trends derived from such data.[4] The maps show the amount of haze during the summer months with each map covering five-year periods, centered at 1983, 1988, and 1993. The dark blue color represents the best visibility, and red represents the worst visibility. Overall, these maps show that summer visibility in the eastern United States improved slightly between 1980 and 1990, and continued to improve between 1991 and 1995. These trends follow overall trends in emissions of sulfur oxides during these periods.

In the early 1990s to the mid 1990s, the National Weather Service gradually switched the method used to collect visibility data presented in Figure 6-4 from human observations to automated sensors. This method change resulted in an incompatibility between the human observation and the automated sensor data. Because

Figure 6-4. Long-term trends for 75th percentile light extinction coefficient from airport visual data (July–September).



of this method change the trends presented using the human observation data in Figure 6-4 end at 1995.

Recent Trends (1990–1999) from IMPROVE Data

Visibility and aerosol light extinction data are presented for 36 sites with at least seven years of fine particle data from 1990–1999 for western sites and from 1992–1999 for eastern sites: 10 are located in the East, and 26 are located in the West, as shown in Figure 6-2. Eastern trends start in 1992 because seven sites were added to the existing three eastern sites in the IMPROVE network, bringing the total number of eastern sites to 10. This is reflected in the eastern Class I area plots, Figure 6-5a and Figure 6-6a to 6-6c, where the trend is based on eight years of data, versus 10 years of data in the western Class I area plots. Because of the significant regional variations in visibility conditions, this chapter does not present aggregate national trends, but instead groups the data into eastern and western regions. As noted earlier, trends in this chapter are presented in terms of the annual average values for the clearest ("best") 20 percent, middle ("typical") 20 percent, and haziest ("worst") 20 percent of the days monitored each year. The goals of the regional haze program are to improve visibility on the haziest days and prevent degradation of visibility on the clearest days. To date, two 24-hour aerosol samples have been taken each week from IMPROVE sites, resulting in a potential for 104 sampling days per year. In 2000, the aerosol sampling schedule was changed to one sample every three days, consistent with the approach used for national $PM_{2.5}$ aerosol monitoring.

In May of 2001, the National Park Service and other participants of the IMPROVE program identified technical concerns about measured nitrate concentrations at all IMPROVE sites prior to June 1996, and about estimates of sulfates, primarily at eastern IMPROVE sites prior to 1995. As a result, the IMPROVE monitoring data used in this year's *National Air Quality and Emissions Trends Report* is interpreted differently to correct the technical concerns. At some affected IMPROVE sites, the adjustments result in a change in the direction or significance of the reported visibility trend. Because of the new usage of the IMPROVE monitoring data, the results presented here are not directly comparable with results presented in previous *Trends* reports. A discussion of the technical concerns, the data usage, and the effect on the nitrate and sulfate data is presented on the IMPROVE website, **http://vista.cira.colostate.edu/IMPROVE/Data/QA_QC/issues.htm**.

Regional Visibility Trends for the Eastern and Western United States

Figures 6-5a and 6-5b illustrate eastern and western trends for visibility impairment in deciviews. The deciview metric used in Figures 6-5a and 6-5b best characterizes perceived changes in visibility impairment. Under many scenic conditions a change in one deciview is considered to be perceptible by the average person. These figures, presented with equivalent scales, demonstrate the regional difference in overall levels of rural visibility impairment. One can see that visibility impairment for the haziest visibility days in the West is close to the same level of impairment as seen for the best days in the East. Figure 6-5a shows that in the East, the haziest visibility days improved by

Figure 6-5a. Visibility* trends for 10 eastern U.S. Class I areas for clearest, middle, and haziest 20 percent days in the distribution, 1992–1999.

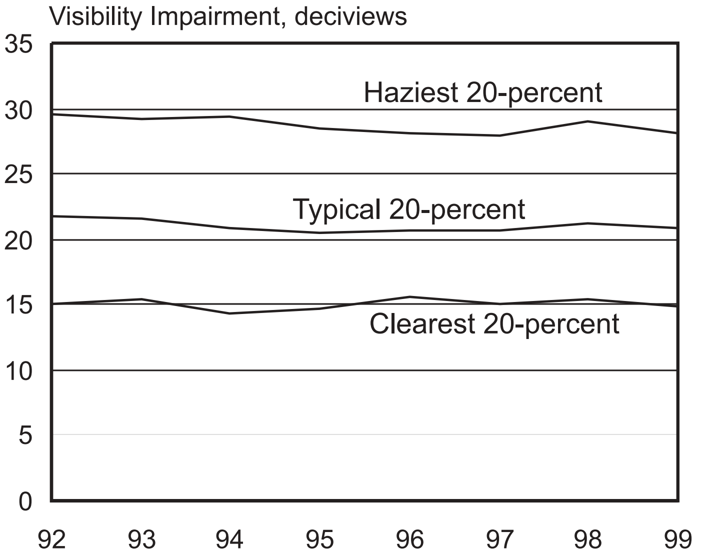
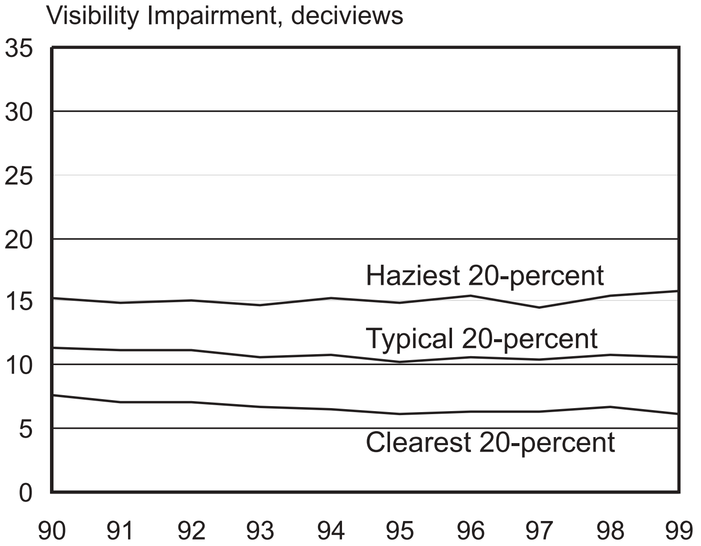


Figure 6-5b. Visibility* trends for 26 western U.S. Class I areas for clearest, middle, and haziest 20 percent days in the distribution, 1992–1999.



* For Figures 6-5a and 6-5b changes in nitrate concentrations were not considered in calculation of deciviews. A constant value based on mean 1997–1999 extinction associated with nitrates was substituted for all years.

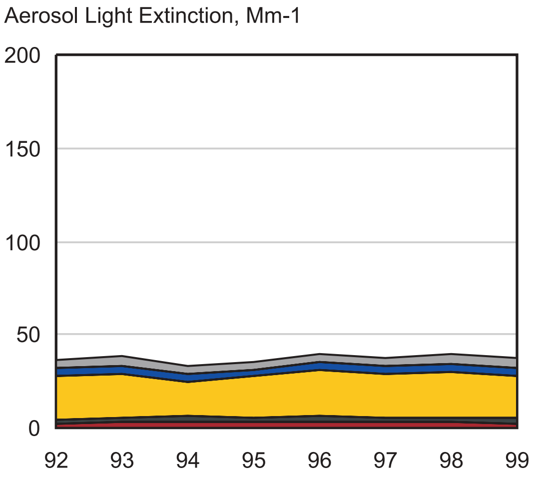
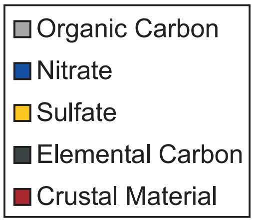


Figure 6-6a. Aerosol light* extinction in 10 eastern Class I areas for the clearest 20 percent of the days in the distribution, 1992–1999.



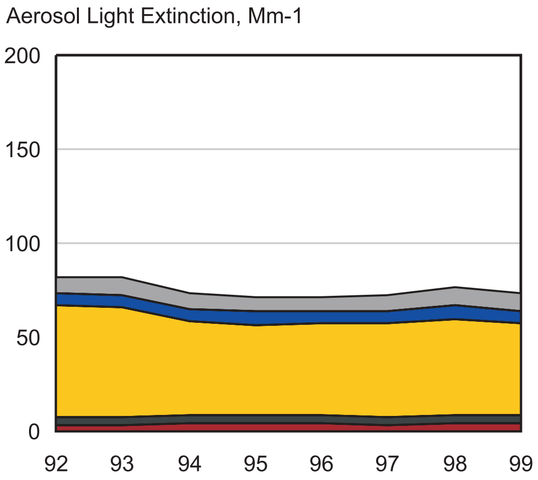


Figure 6-6b. Aerosol light* extinction in 10 eastern Class I areas for the middle 20 percent of the days in the distribution, 1992–1999.

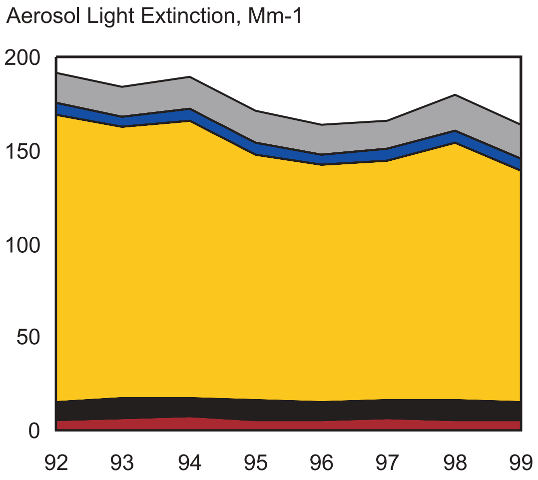


Figure 6-6c. Aerosol light* extinction in 10 eastern Class I areas for the haziest 20 percent of the days in the distribution, 1992–1999.

* For Figures 6-6a to 6-6c changes in nitrate concentrations were not considered in calculation of aerosol light extinction. A constant value based on mean 1997–1999 extinction associated with nitrates was substituted for all years.

1.5 deciviews, or 15 percent in aerosol light extinction, since 1992 based on 10 locations. Over the past two years (1998–1999) impairment on the haziest days in the East show improvement of close to 1 deciview, or 10-percent in aerosol light extinction. However, visibility for the haziest days still remains significantly impaired with a mean visual range of 23 km compared to 84 km for the clearest days in 1999. Visibility impairment in 1999 for the clearest 20 percent of days is approximately equal to 1992 levels of 15 deciviews. The typical days (or middle 20 percent of the distribution) show a 1 deciview improvement, 10 percent in aerosol light extinction, since 1992 for the 10 sites.

In the West, there appears to be visibility improvement for the clearest, and the typical, days as presented in Figure 6-5b for the period 1990–1999. Visibility impairment for the aggregate 26 western sites improved by 1.5 deciviews for the clearest days and 1 deciview for the typical days, or 25 percent and 14 percent in aerosol light extinction, respectively. Visibility impairment for the haziest days in the West degraded between 1997–1999 close to 1.5 deciviews or 17 percent in aerosol light extinction. However, visibility on the haziest 20 percent of days remains relatively unchanged over the 1990s, with the mean visual range for 1999 (80 km) nearly the same as the 1990 level (86 km).

The Components of PM Contributing to Trends in Visibility Impairment

The area plots in Figures 6-6a to 6-6f show the relative contribution to aerosol light extinction by the five principal particulate matter constituents measured by IMPROVE at eastern and western sites for the best, middle, and worst 20 percent days. Note that the scale differs for the eastern and western figures in order to more clearly present the relative contribution of the five components. By understanding the total magnitude of each PM$_{2.5}$ component, the change in aerosol composition over time, and the effect of these components on changing visibility, policymakers can design strategies to address both health and environmental concerns.

In the East, (Figures 6-6a to 6-6c), sulfate is clearly the largest contributor to visibility impairment, ranging from an average of 78–82 percent of each year’s annual aerosol extinction during the haziest days to 56–63 percent on the clearest days. In 1999, eastern aerosol light extinction due to sulfates on the haziest days reached its lowest level of the 1990s with a 19-percent decline over 1992–1999. This decline in sulfates in the eastern United States and the low 1999 level corresponds to the reported regional SO$_2$ emissions trends and lower average sulfate aerosol concentrations discussed in Chapter 7 (Atmospheric Deposition of Sulfur and Nitrogen Compounds). Organic carbon is the next largest contributor to visibility impairment in the East, accounting for 10–14 percent of annual aerosol extinction on the best days and 8–11 percent on the most impaired days. The third largest contributor in the East is nitrate, which also accounts for about 11–13 percent of annual aerosol light extinction on the best days and about 3–4 percent on the haziest days.

In the West, sulfate is also the most significant single contributor to aerosol light extinction on the clearest, typical, and haziest days. Sulfate accounts for 33–41 percent of annual

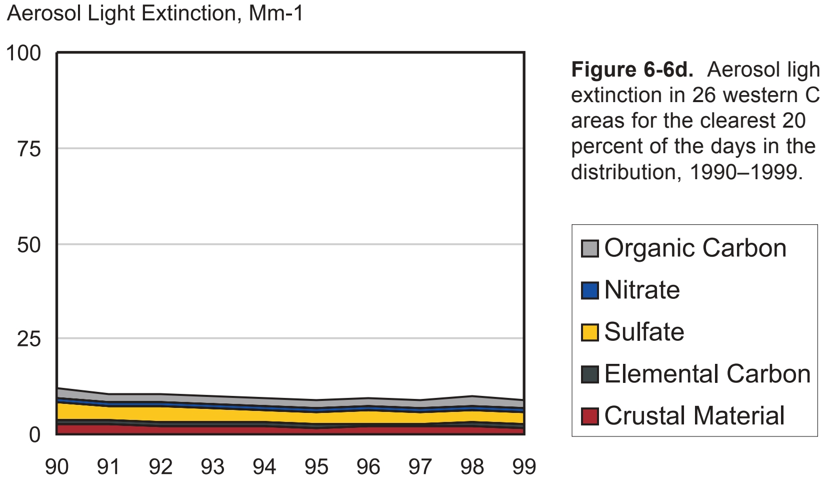


Figure 6-6d. Aerosol light* extinction in 26 western Class I areas for the clearest 20 percent of the days in the distribution, 1990–1999.

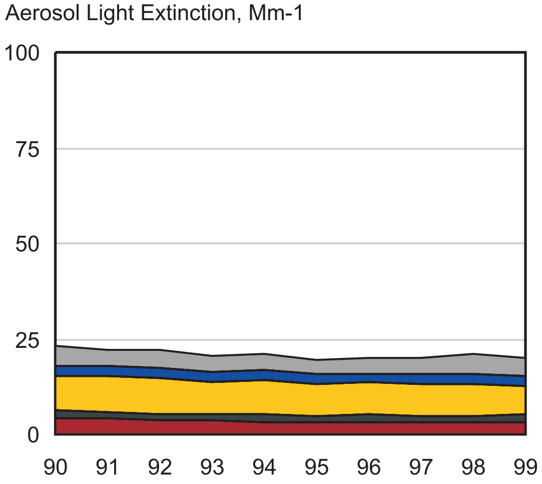


Figure 6-6e. Aerosol light* extinction in 26 western Class I areas for the middle 20 percent of the days in the distribution, 1990–1999.

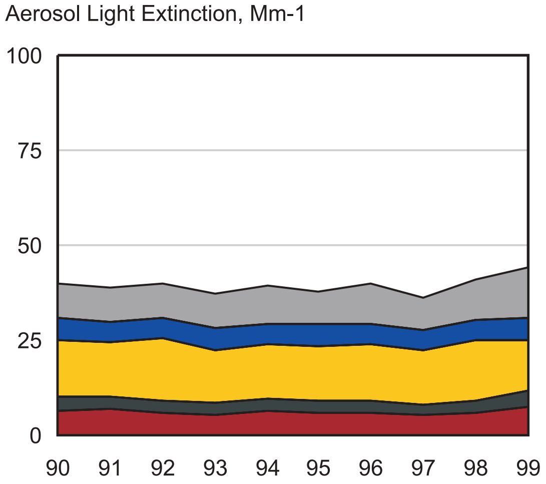
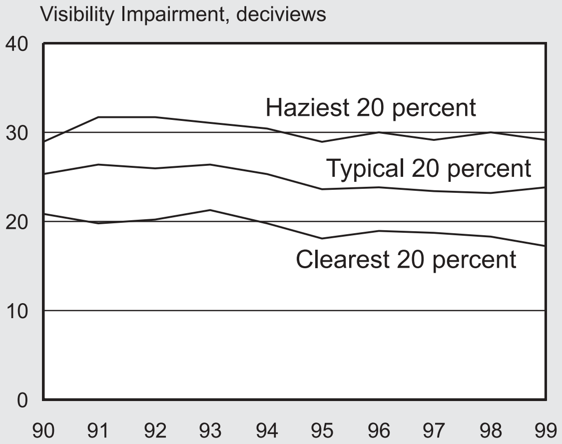


Figure 6-6f. Aerosol light* extinction in 26 western Class I areas for the haziest 20 percent of the days in the distribution, 1990–1999.

* For Figures 6-6d to 6-6f changes in nitrate concentrations were not considered in calculation of aerosol light extinction. A constant value based on mean 1997–1999 extinction associated with nitrates was substituted for all years.

An Urban Perspective – the Washington, D.C. IMPROVE site

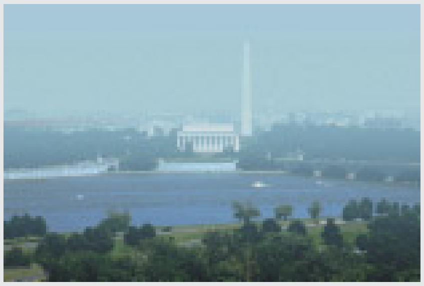
The only urban monitoring site with a long-term data record using the IMPROVE monitoring protocol is located in Washington, D.C. This monitor was one of the first to be deployed in 1988. The figure below illustrates the trend at the Washington, D.C. site for visibility impairment in deciviews from 1990–1999. The decrease of visibility impairment in deciviews seen from 1993–1995 for the clearest, typical, and haziest days is attributable primarily to decreases in sulfate concentrations, although nitrates and organic carbon both had large decreases during the same time period. Nevertheless, conditions of the haziest days are still significantly impaired with an average visual range of only 21 km.



* Changes in nitrate concentrations were not considered in calculation of total light extinction. A constant value based on mean 1997–1999 extinction associated with nitrates was substituted for all years.

The photos below depict a very clear day along with a very hazy day looking across the Potomac River at the Lincoln Memorial and the Washington Monument.

Visual range > 150 km / 9.6 deciviews



Visual range = 8.4 km / 38.4 deciviews

Table 6-1. Summary of Class I Area Trend[1] Analysis

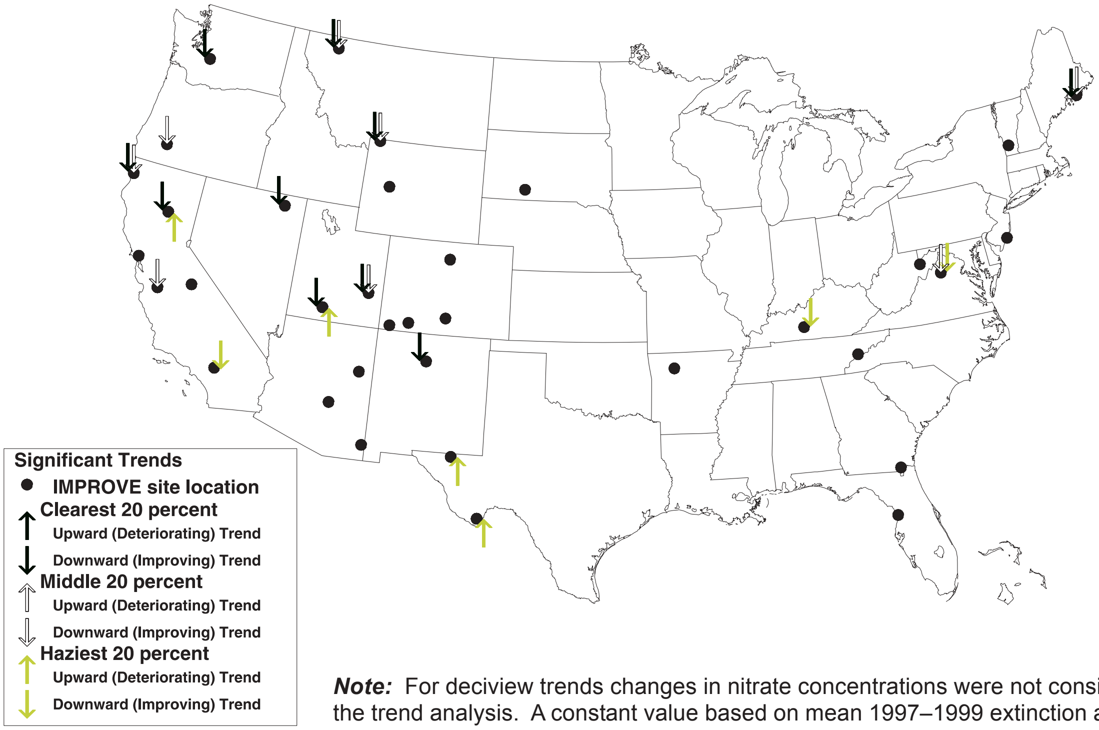
Parameter	Number of Sites With Significant[2] Upward (*Deteriorating*) Trends		Number of Sites With Significant[2] Downward (*Improving*) Trends	
	West	East	West	East
[3]Deciviews, worst 20%	4	0	1	2
[3]Deciviews, middle 20%	0	0	6	2
[3]Deciviews, best 20%	0	0	9	1
Light extinction due to sulfate, worst 20%	4	0	4	2
Light extinction due to sulfate, middle 20%	1	1	6	4
Light extinction due to sulfate, best 20%	0	1	14	0
Light extinction due to organic carbon, worst 20%	2	0	1	0
Light extinction due to organic carbon, middle 20%	0	0	3	0
Light extinction due to organic carbon, best 20%	2	0	5	0

[1] Based on a total of 36 monitored sites with at least 10 years of data in the West and eight years of data in the East: 26 sites in the West, 10 sites in the East.

[2] Statistically significant at the 5-percent level.

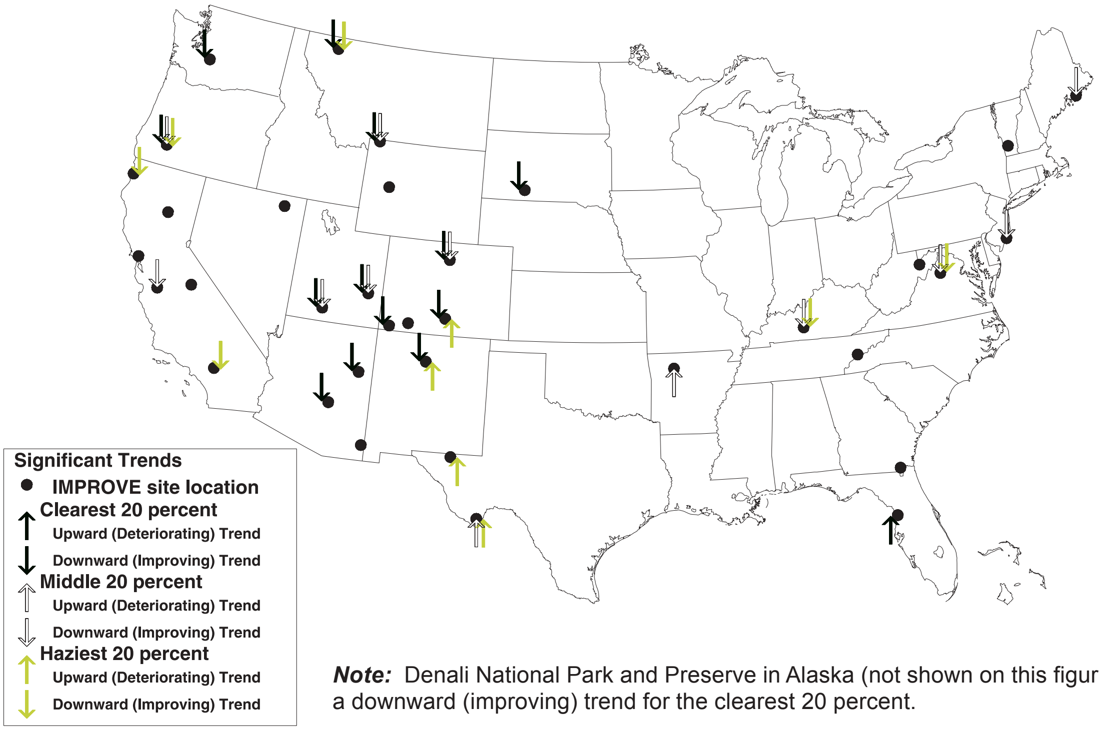
[3] For deciview trends changes in nitrate concentrations were not considered in the trend analysis. A constant value based on mean 1997–1999 extinction associated with nitrates was substituted for all years.

Figure 6-7a. Class I area significant trends in deciviews for the clearest 20 percent, middle 20 percent, and haziest 20 percent days as summarized in Table 6-1.



Note: For deciview trends changes in nitrate concentrations were not considered in the trend analysis. A constant value based on mean 1997–1999 extinction associated with nitrates was substituted for all years.

Figure 6-7b. Class I area significant trends light extinction due to sulfate for the clearest 20 percent, middle 20 percent, and haziest 20 percent days as summarized in Table 6-1.



Note: Denali National Park and Preserve in Alaska (not shown on this figure) showed a downward (improving) trend for the clearest 20 percent.

Figure 6-7c. Class I area significant trends for light extinction due to organic carbon for the clearest 20 percent, middle 20 percent, and haziest 20 percent days as summarized in Table 6-1.

aerosol light extinction on the best days, 39–43 on the typical days, and 31–42 on the haziest days. However, organic carbon (19–30 percent), crustal material (14–26 percent), and nitrates (9–15 percent) play a more significant role (as a percentage of aerosol extinction) in western sites as compared to eastern ones. Since 1990, western visibility (as aggregated across 26 areas) has improved slightly on the best days and typical days. On the haziest days, light extinction generally decreased through 1997, but it increased by 22 percent between 1997–1999. It appears that this increase in light extinction was primarily due to increases in organic carbon and crustal material.

Trends in Specific Class I Areas

IMPROVE data from 36 Class I area monitoring sites[1] were analyzed for upward or downward trends using a nonparametric regression methodology described in Appendix B: Methodology.

Table 6-1 summarizes the trends analysis performed on these 36 sites for total light extinction (expressed in deciviews), light extinction due to sulfates and light extinction due to organic carbon on an area-by-area basis. Figures 6-7a–c show the significant trends for the Class I areas as summarized in Table 6-1. A solid dot indicates the IMPROVE monitoring site location. The arrow is pointing up for a deteriorating trend and down for an improving trend. The different color arrows represent the clearest 20 percent of days, typical (middle) 20 percent of days, and haziest 20 percent of days. As shown in Figure 6-7a several sites with improving trends show improvement in more than one of the three quintiles, especially in the West. Figures 6-7b and 6-7c show the trends associated with aerosol light extinction due to sulfate and organic carbon, respectively. Trends in the individual constituents, like sulfate and organic carbon, often appear earlier than trends for total aerosol light extinction.

Current Visibility Conditions

Current annual average conditions range from about 18–40 miles in the rural east and about 35–90 miles in the rural west. On an annual average basis, natural visibility conditions have been estimated at approximately 80–90 miles in the East and up to 140 miles in the West.[3] Natural visibility varies by region, primarily because of slightly higher estimated background levels of $PM_{2.5}$ in the East, and the more significant effect of relative humidity on particle concentrations in the East than in the West.

Figure 6-8a. Aerosol light extinction in (Mm^{-1}) for the clearest 20 percent days and contribution by individual particulate matter constituents, based on 1997–1999 IMPROVE data.

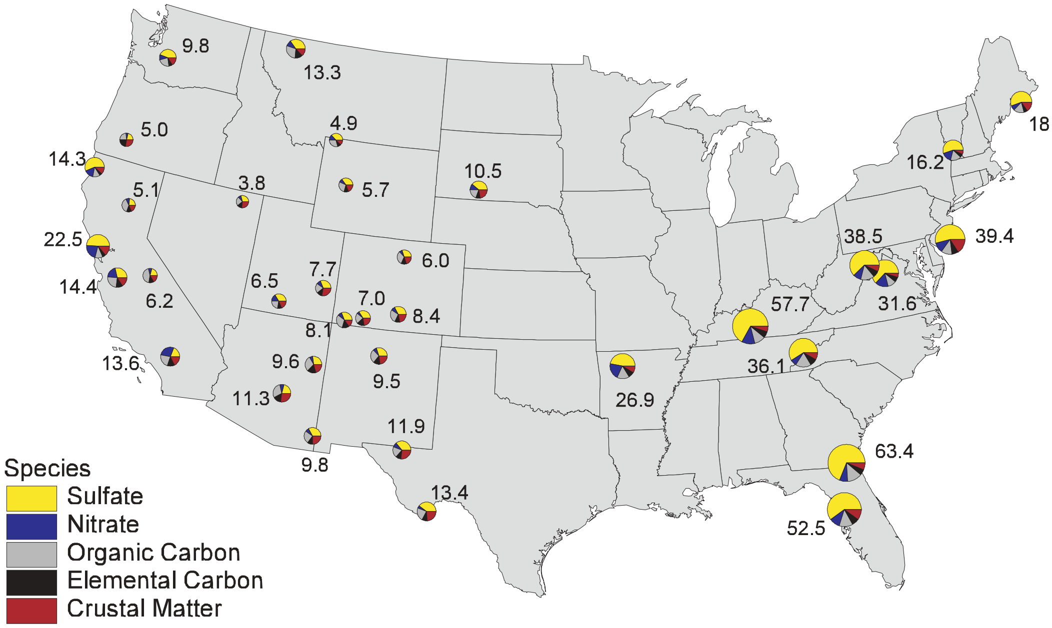


Figure 6-8b. Aerosol light extinction in (Mm^{-1}) for the middle 20 percent days and contribution by individual particulate matter constituents, based on 1997–1999 IMPROVE data.

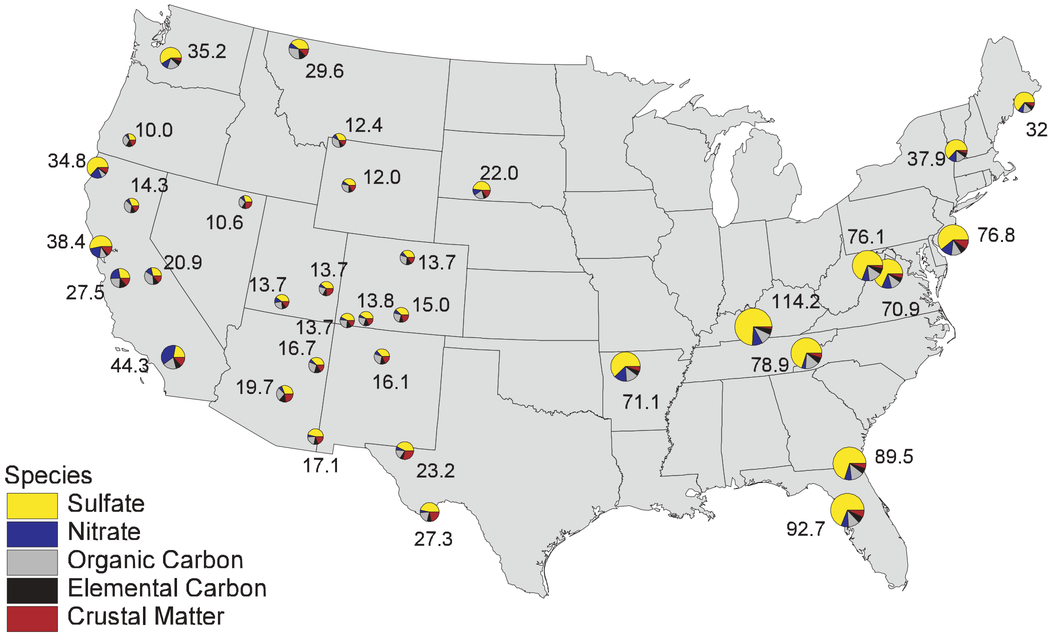
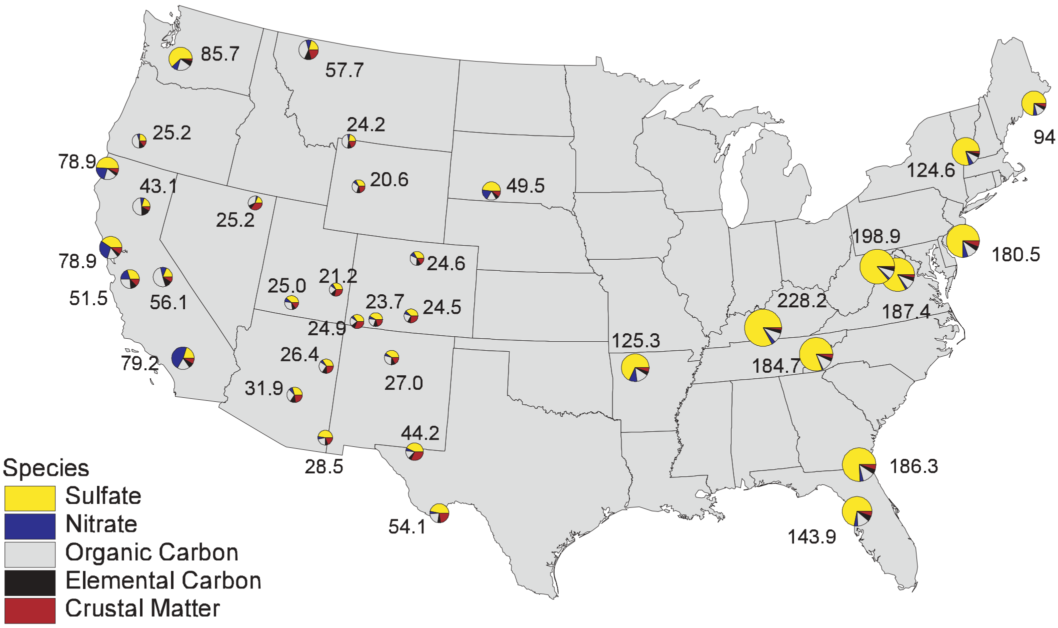


Figure 6-8c. Aerosol light extinction in (Mm^{-1}) for the haziest 20 percent days and contribution by individual particulate matter constituents, based on 1997–1999 IMPROVE data.



Note: For Figures 6-8a to 6-8c changes in nitrate concentrations were not considered in calculation of aerosol light extinction.

Figures 6-8a to 6-9c illustrate regional visibility impairment in terms of reconstructed aerosol light extinction based on measurements at IMPROVE sites between 1997 and 1999. Maps are presented for the clearest, typical, and haziest 20 percent of the distribution. The pie charts show the relative contribution of different particle constituents to visibility impairment. Annual average aerosol light extinction due to these particles is indicated by the value next to each pie and by the size of each pie.[1] Figure 6-8 also shows that visibility impairment is generally greater in the rural east compared to most of the West. As noted earlier, the pies show that, for most rural eastern sites, sulfates account for more than 60 percent of annual average light extinction on the best days and up to 86 percent of annual average light extinction on the haziest days. Sulfate particles play a particularly significant role in the humid summer months due to their ability to take on moisture and become more efficient at scattering light, most notably in the Appalachian, northeast, and mid-south regions. The figures also show that organic carbon and nitrates each account for 10–18 percent and 7–16 percent respectively of aerosol extinction on the clearest days while elemental carbon only contributes 5–8 percent. On the other hand, organic carbon contributes around 11 percent to aerosol light extinction on the haziest days while nitrates and elemental carbon each typically contribute 1–6 percent.

In the rural west, sulfates also play a significant role, typically accounting for about 30–40 percent of aerosol light extinction on the best days and 30–45 percent on the haziest days. In several areas of the West, however, sulfates account for over 50 percent of annual average aerosol extinction, including Mt. Rainier, WA, and Redwood National Park, CA. In contrast, it contributes less than 25 percent in southern California. Organic carbon typically makes up 25–40 percent of aerosol light extinction in the rural west, elemental carbon (absorption) accounts for about 10 percent, and crustal matter (including coarse PM) accounts for about 15–25 percent. Nitrates typically account for less than 10 percent of total light extinction in western locations, except in the southern California region where it accounts for 30-45 percent.

Figures 6-9a to 6-9c illustrate current levels of visibility impairment, in terms of deciviews, for the clearest, typical, and haziest 20 percent days based on IMPROVE data from 1997–1999.[1] Note that the deciview scale is more compressed than the scale for

Figure 6-9a. Current visibility impairment expressed in deciviews for the clearest 20 percent days based on 1997–1999 IMPROVE data.

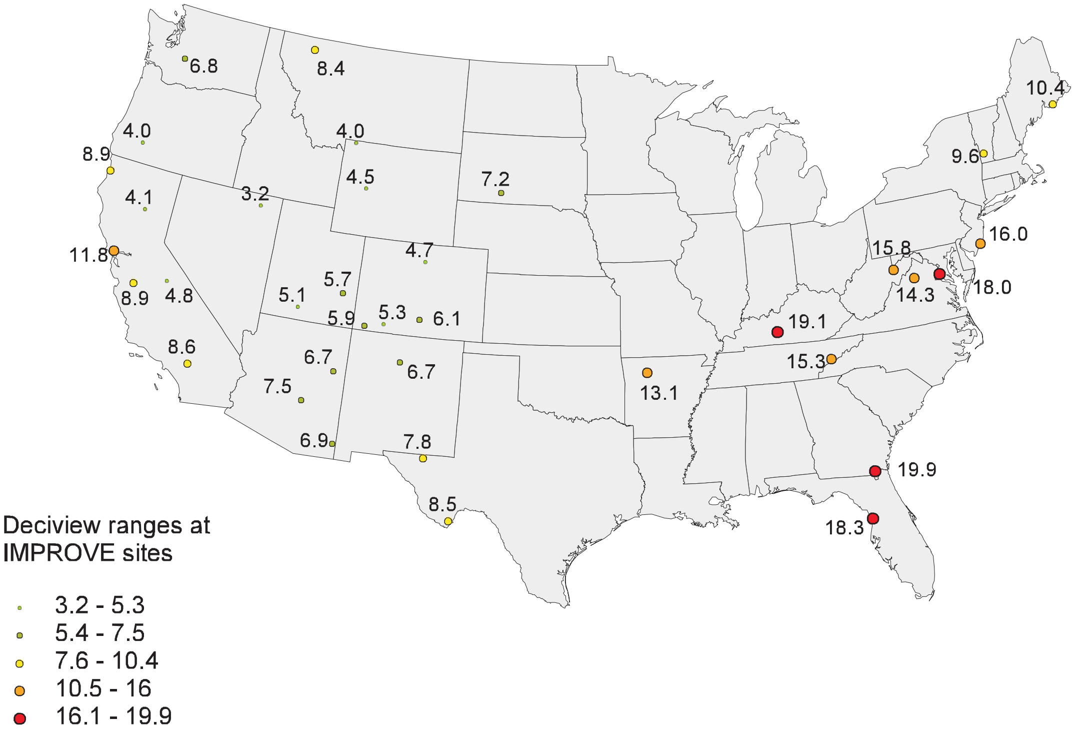


Figure 6-9b. Current visibility impairment expressed in deciviews for the middle 20 percent days based on 1997–1999 IMPROVE data.

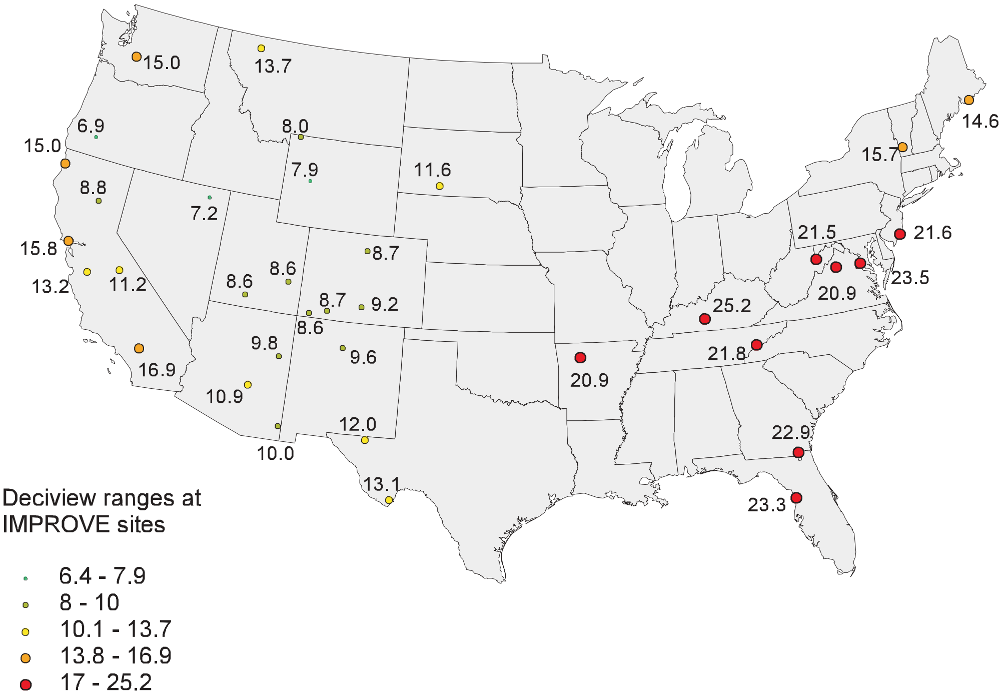
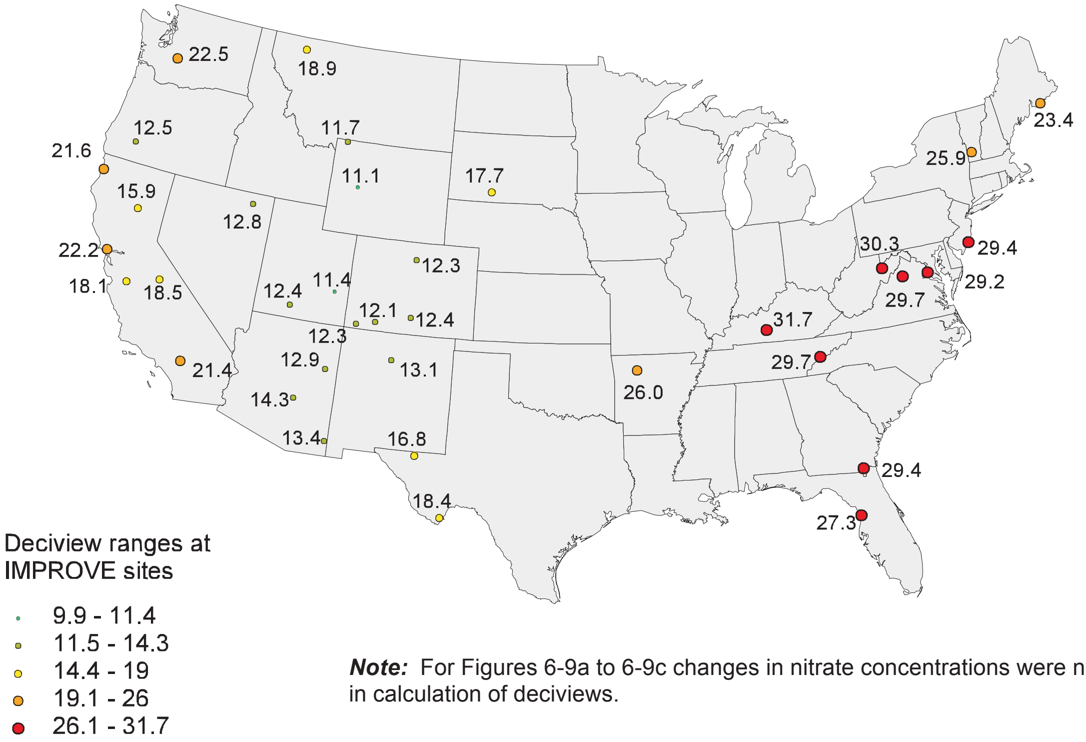


Figure 6-9c. Current visibility impairment expressed in deciviews for the haziest 20 percent days based on 1997–1999 IMPROVE data.



Note: For Figures 6-9a to 6-9c changes in nitrate concentrations were not considered in calculation of deciviews.

visual range or light extinction, with larger values representing greater visibility degradation. Most of the sites in the intermountain west and Colorado Plateau have annual average impairment of 12 deciviews or less, with the worst days ranging up to 17 deciviews. Several other western sites in the northwest and California experience levels on the order of 16–23 deciviews on the haziest 20 percent of days. Many rural locations in the East have annual average values exceeding 21 deciviews, with average visibility levels on the haziest days up to 32 deciviews.

Programs to Improve Visibility

In April of 1999, EPA issued the final regional haze regulation.[5] This regulation addresses visibility impairment in national parks and wilderness areas that is caused by numerous sources located over broad regions. The program lays out a framework within which states can work together to develop implementation plans that are designed to achieve "reasonable progress" toward the national visibility goal of no human-caused impairment in the 156 mandatory Class I federal areas across the country.

States are required to establish goals to improve visibility on the 20 percent worst days and to allow no degradation on the 20 percent best days for each Class I area in the state. In establishing any progress goal, the state must analyze the rate of progress for the next 10–15 year implementation period which, if maintained, would achieve natural visibility conditions by 2064. The state will need to show whether this rate of progress or another rate is more reasonable based on certain factors in the Clean Air Act, including costs and the remaining useful life of affected sources. Along with these goals, the state plans also must include emission reduction measures to meet these goals (in combination with other states' measures), requirements for Best Available Retrofit Technology on certain large existing sources (or an alternative emissions trading program), and visibility monitoring representative of all Class I areas.

State regional haze plans are due in the 2003–2008 timeframe. Because of the common precursors and the regional nature of the PM and regional haze problems, the haze rule includes specific provisions for states that work together in regional planning groups to assess the nature and sources of these problems and to develop coordinated, regional emission reduction strategies. One provision allows nine Grand Canyon Visibility Transport Commission States (Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming) to submit initial plans in 2003 to implement their past recommendations within the framework of the national regional haze program. Another provision allows certain states until 2008 to develop coordinated strategies for regional haze and PM contingent upon participation in regional planning groups. For additional information on the regional haze program, go to EPA's website: **http/www.epa.gov/air/visibility**.

Implementation of the PM and ozone NAAQS in conjunction with a future regional haze program is expected to improve visibility in urban as well as rural areas across the country. Other air quality programs are expected to bring about emissions reductions that will improve visibility in certain regions of the country. The acid rain program will achieve significant regional reductions in the emissions of SO_2, which will reduce sulfate haze particularly in the eastern United States. When implemented, the NO_x State Implementation Plan (SIP) call to reduce emissions from sources of NO_x to reduce formation of ozone should also improve regional visibility conditions to some degree. In addition, visibility impairment in Class I areas should improve as a result of a number of other programs, including mobile source emissions and fuel standards, certain air toxics standards, and implementation of smoke management and woodstove programs to reduce fuel combustion and soot emissions.

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3. Irving, P.M., ed., *Acid Deposition: State of Science and Technology, Volume III, Terrestrial, Materials, Health, and Visibility Effects*, The U.S. National Acid Precipitation Assessment Program, Chapter 24, page 24–76.

4. Schichtel, B.A., J.B. Husar, S.R. Falke, and W.E. Wilson. "Haze Trends of the United States, 1980–1995," *Atmospheric Environment* in press.

5. The final regional haze rule was signed on 4/22/99 and published in the *Federal Register* on 7/1/99 (*64FR35713*).

CHAPTER 7

Atmospheric Deposition of Sulfur and Nitrogen Compounds

http://www.epa.gov/oar/aqtrnd99/chapter7.pdf

Worth Noting:

- 1990's improvements in wet sulfur deposition, rural ambient SO_2, and rural ambient sulfates followed the large reductions in regional emissions in SO_2. Most of the emissions and reductions come from power plants.
  - 10-year changes in the eastern United States: annual average sulfates, -24 percent; annual average SO_2, -32 percent; regional power plant emissions, -25 percent.
  - 2-year changes in the eastern United States: (1998–99): annual average sulfates, -10 percent; annual average SO_2, -4 percent; regional power plant emissions, -6 percent.
- The largest sulfate improvements occur during the third calendar quarter.
  - 10-year changes: quarterly average sulfates, -33 percent.
  - 2-year changes (1998–99): quarterly average sulfates, -17 percent.
- These regional reductions in particle sulfates benefit visibility and $PM_{2.5}$ levels.

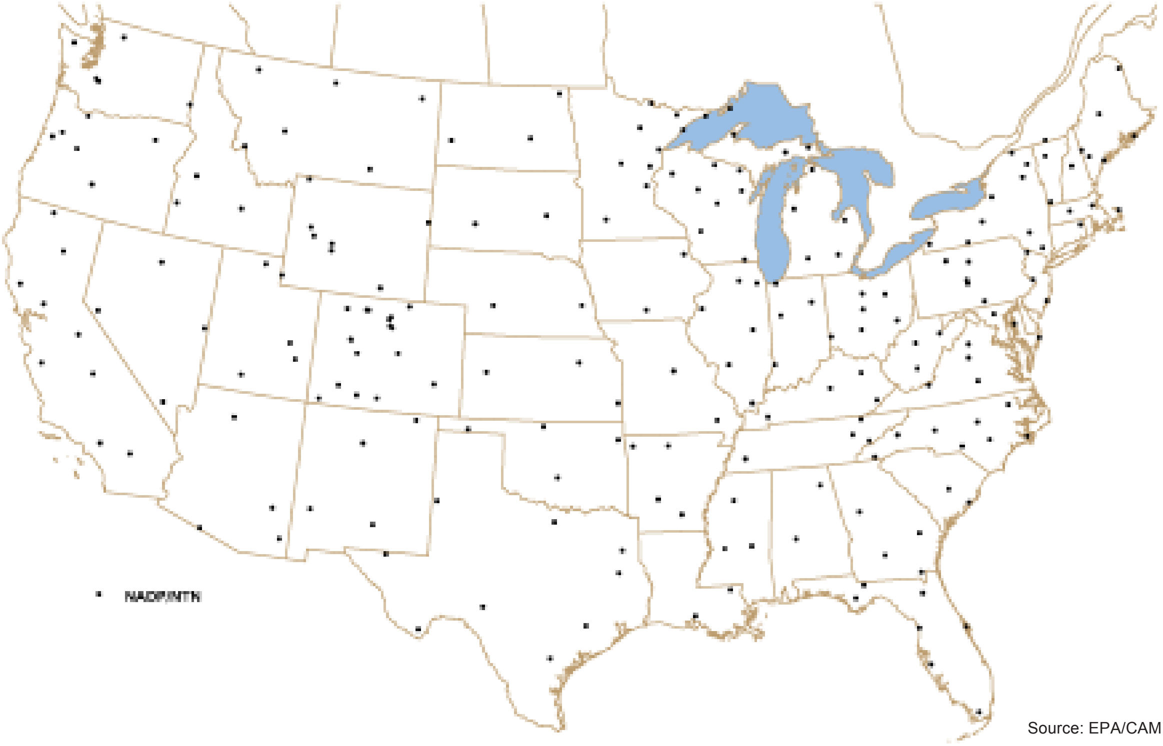
Sulfur and nitrogen oxides are emitted into the atmosphere primarily from the burning of fossil fuels. These emissions react in the atmosphere to form compounds that are transported long distances and are subsequently deposited in the form of pollutants such as particulate matter (sulfates, nitrates) and related gases (nitrogen dioxide, sulfur dioxide and nitric acid). Nitrogen oxides also will interact with volatile organic compounds to form ozone. The effects of atmospheric deposition include acidification of lakes and streams, nutrient enrichment of coastal waters and large river basins, soil nutrient depletion and decline of sensitive forests, agricultural crop damage, and impacts on ecosystem biodiversity. Toxic pollutants and metals also can be transported and deposited through atmospheric processes. (See Chapter 5: Air Toxics.)

Both local and long-range emission sources contribute to atmospheric deposition. Total atmospheric deposition is determined using both wet and dry deposition measurements. Wet deposition is the portion dissolved in cloud droplets and is deposited during rain or other forms of precipitation. Dry deposition includes both gas and particle transfer to surfaces during periods of no precipitation. Although the term "acid rain" is widely recognized, the dry deposition portion can range from 20–60 percent of total deposition.

EPA is required by several Congressional and other mandates to assess the effectiveness of air pollution control efforts. These mandates include Title IX of the Clean Air Act Amendments (the National Acid Precipitation Assessment Program), the Government Performance and Results Act, and the U.S./Canada Air Quality Agreement. One measure of effectiveness of these efforts is whether sustained reductions in the amount of atmospheric deposition over broad geographic regions are occurring. However, changes in the atmosphere happen very slowly and trends are often obscured by the wide variability of measurements and climate. Numerous years of continuous and consistent data are required to overcome this variability, making long-term monitoring networks especially critical for characterizing deposition levels and identifying relationships among emissions, atmospheric loadings and effects on human health and the environment.

For wet and dry deposition, these studies typically include measure-

Figure 7-1. The National Atmospheric Deposition Program/National Trends Network.



Source: EPA/CAMD 04/04/01

ment of concentration levels of key chemical components as well as precipitation amounts. For dry deposition, analyses also must include meteorological measurements that are used to estimate rate of the actual deposition, or "flux." Data representing total deposition loadings (e.g., total sulfate or nitrate) are what many environmental scientists use for integrated ecological assessments.

Primary Atmospheric Deposition Monitoring Networks

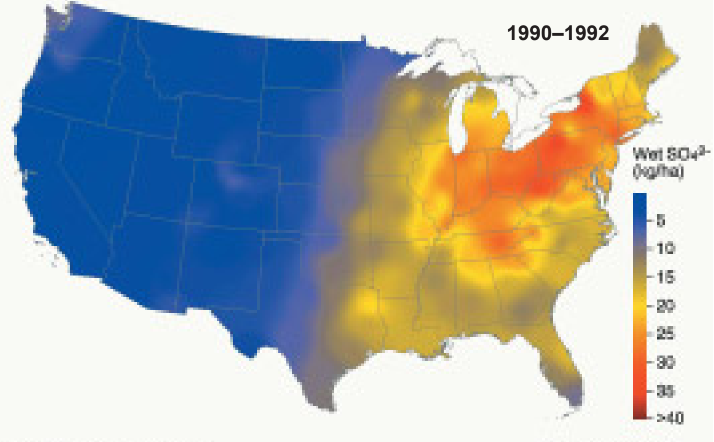
The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) and the Clean Air Status and Trends Network (CASTNet) were developed to monitor wet and dry acid deposition, respectively. Monitoring site locations are predominantly rural by design to assess the relationship between regional pollution and changes in regional patterns in deposition. CASTNet also includes measurements of rural ozone and the chemical constituents of $PM_{2.5}$. Rural monitoring sites of NADP/NTN and CASTNet provide data where sensitive ecosystems are located and provide insight into natural background levels of pollutants where urban influences are minimal. Scientists and policy analysts use these data to evaluate environmental effects, particularly those caused by regional sources of emissions for which long-range transport plays an important role. Measurements from these networks also are important for understanding non-ecological impacts of air pollution such as visibility impairment and damage to materials, particularly those of cultural and historical importance. They also provide important information to support the NAAQS.

National Atmospheric Deposition Network/National Trends Network

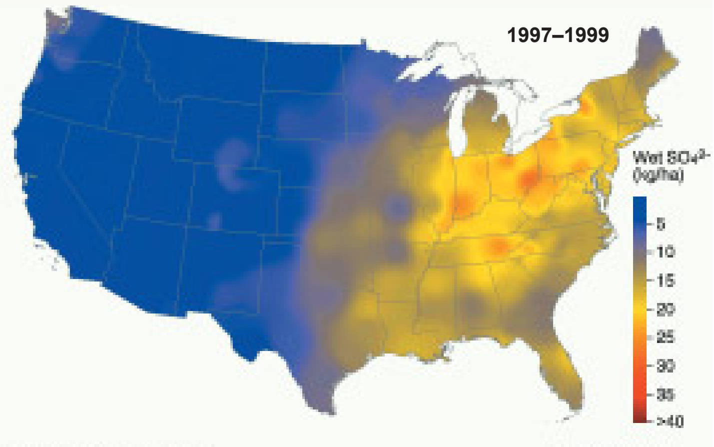
The National Atmospheric Deposition Program/National Trends Network is a cooperative program between federal and state agencies, universities, electric utilities and other industries that has measured precipitation chemistry in the United States since 1978. As one of the world's largest and longest running deposition monitoring networks, it is composed of over 200 sites and is able to determine geographic patterns and trends in precipitation chemistry (see Figure 7-1).

The NADP/NTN analyzes the constituents important in precipitation chemistry, including those affecting rainfall acidity and those that

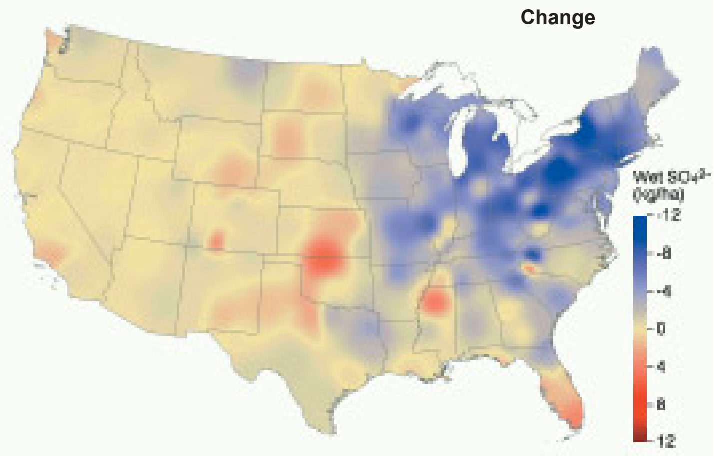
Figure 7-2. Annual mean sulfate deposition from precipitation, 1990–1992 vs. 1997–1999.



Source: CASTNet & NADP/NTN



Source: CASTNet & NADP/NTN



Source: CASTNet & NADP/NTN

may have ecological effects. The Network measures sulfate, nitrate, hydrogen ion (measure of acidity), ammonia, chloride, and base cations (calcium, magnesium, potassium). To ensure comparability of results, laboratory analyses for all samples are conducted by NADP's Central Analytical Lab at the Illinois State Water Survey. A new subnetwork of the NADP, the Mercury Deposition Network (MDN) measures mercury in precipitation. For more information on the MDN, see Chapter 5: Air Toxics.

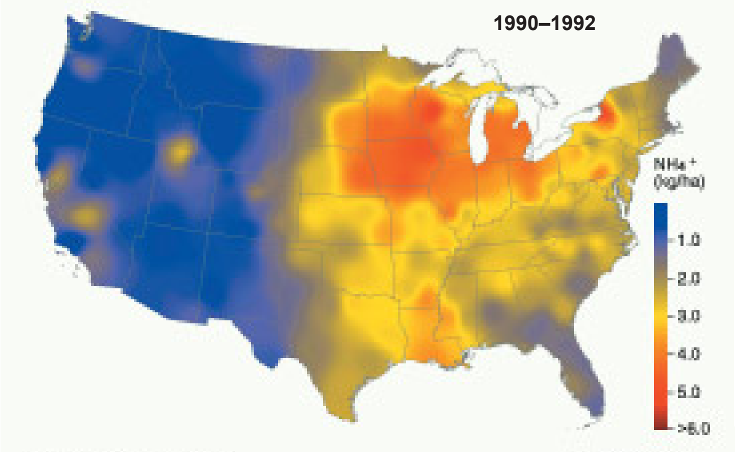
Trends Analyses for Sulfate and Nitrogen Concentrations in Wet Deposition

Sulfate concentrations in precipitation have decreased over the past two decades.[1] The reductions were relatively large in the early 1980s followed by more moderate declines until 1995. These reductions in wet sulfates are similar to changes in SO_2 emissions. In 1995 and 1996, however, concentrations of sulfates in precipitation over a large area of the eastern United States exhibited a dramatic and unprecedented reduction. Sulfates in rain have been estimated to be 10–25 percent lower than levels expected with a continuation of 1983–1994 trends.[2] The wet sulfate deposition levels in the 1990–1992 and 1997–1999 time periods, together with the absolute change are illustrated in Figure 7-2. This important reduction in acid precipitation is directly related to the large regional decreases in SO_2 emissions resulting from phase I of the Acid Rain Program (see "Trends in SO_2" in Chapter 2 of this report). The largest reductions in wet sulfate deposition occurred along the Ohio River Valley and in states to the north and immediately downwind of this region. Nitrogen trends paint a different picture. Nitrate and ammonium deposition derived from NADP/NTN measurement sites reveal 10-year improvement in some areas, including eastern TX, MI, PA and NY. Increased deposition is estimated for the Plains States; and the western Ohio River and Central Mississippi River Valleys. From ammonium in rain, increases are also noted for eastern NC. However, most areas of the country were not appreciably different in either oxidized or reduced 1997–1999 nitrogen from historical levels (see Figures 7-3 and 7-4).

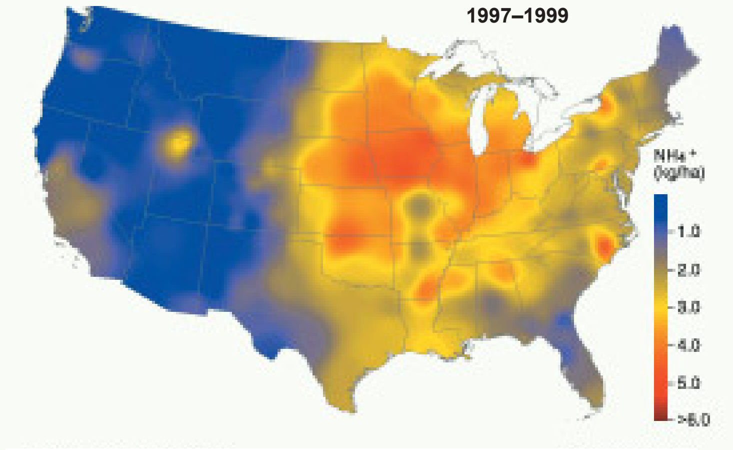
Clean Air Status and Trends Network

The Clean Air Status and Trends Network provides atmospheric data on the dry deposition component of total acid deposition, ground-level ozone and other forms of atmospheric pollution. CASTNet is considered the nation's primary source for atmospheric data to estimate dry acidic deposition and to provide data on rural ozone levels. Used in conjunction with other national monitoring networks, CASTNet is used to determine the effectiveness of national emission control programs. Established in 1987, CASTNet now comprises 79 monitoring stations across the United States. The longest data records are primarily at eastern sites. The majority of the monitoring stations are operated by EPA's Office of Air and Radiation; however, 27 stations are operated by the National Park Service (NPS) in cooperation with EPA. Of the total number of sites, 74 measure dry-deposition, 68 measure ozone, and eight measure aerosols for visibility assessment.

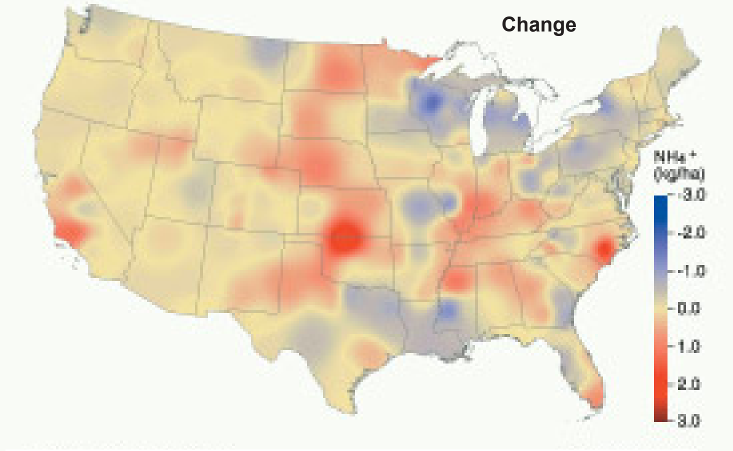
Figure 7-3. Annual mean ammonium deposition from precipitation, 1990–1992 vs. 1997–1999.



Source: CASTNet & NADP/NTN

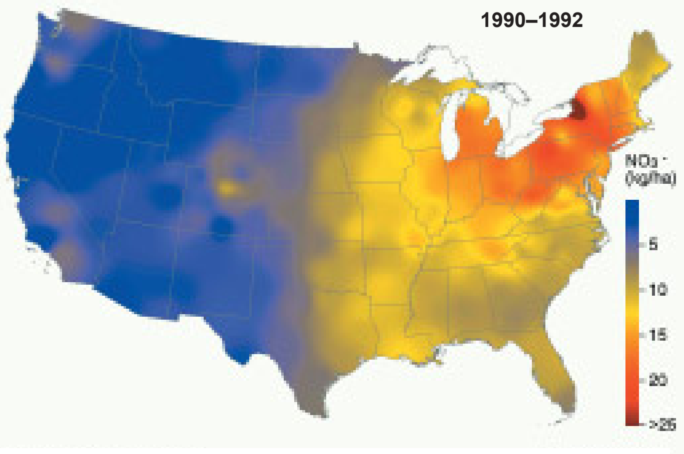


Source: CASTNet & NADP/NTN

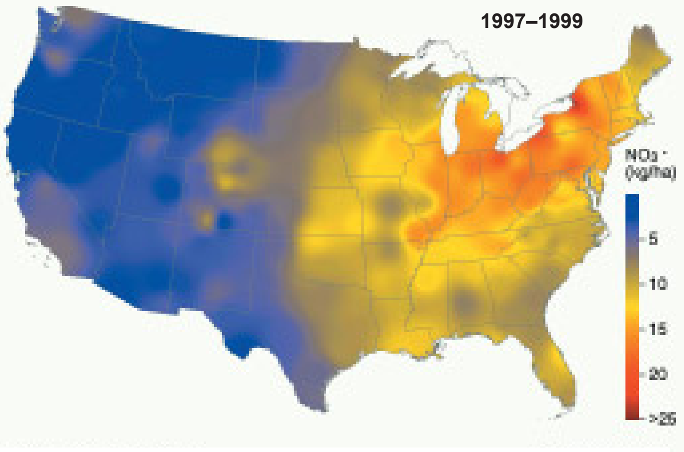


Source: CASTNet & NADP/NTN

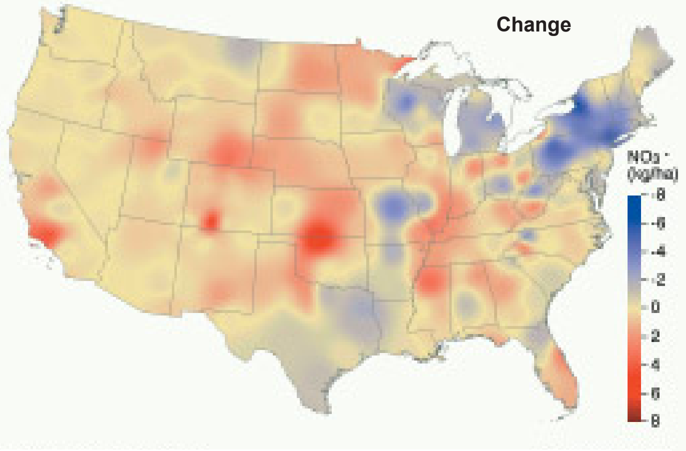
Figure 7-4. Annual mean nitrate deposition from precipitation, 1990–1992 vs. 1997–1999.



Source: CASTNet & NADP/NTN



Source: CASTNet & NADP/NTN



Source: CASTNet & NADP/NTN

Each CASTNet dry deposition station measures:

- Weekly average atmospheric concentrations of sulfate, nitrate, ammonium, sulfur dioxide, and nitric acid (sulfate, nitrate and ammonium generally exist as fine particles).
- Hourly concentrations of ambient ozone levels.
- Meteorological conditions required for calculating dry deposition rates.

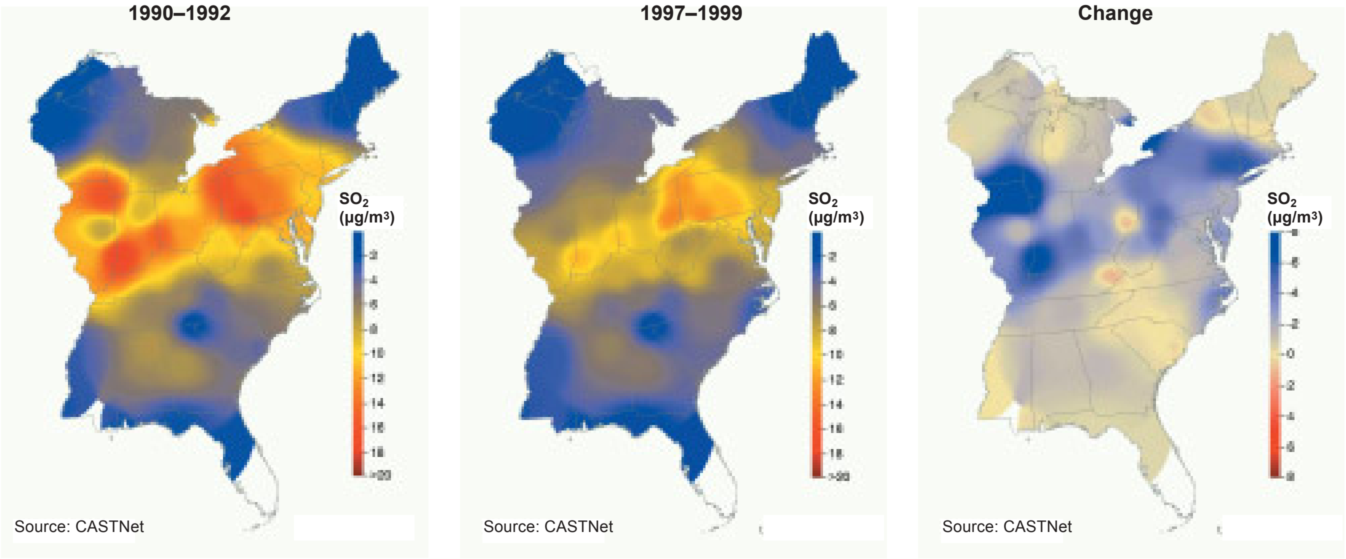
Dry Deposition

Dry deposition rates are calculated using atmospheric concentrations, meteorological data and information on land use, vegetation, and surface conditions. CASTNet complements the database compiled by NADP/NTN. Together, these two long-term databases provide the necessary data to estimate trends and spatial patterns in total atmospheric deposition. NOAA also operates a smaller dry deposition network called Atmospheric Integrated Assessment Monitoring Network (AIRMoN) focused on addressing research issues specifically related to dry deposition measurement.

Concentration Trends Analysis at CASTNet Sites

CASTNet ambient concentration data in the eastern United States were analyzed for the period 1990–1999 for the change in ambient sulfur dioxide, sulfates, total nitrates and ammonium. First, maps are presented for a comparison of 3-year periods at the beginning and end of the 10-year period based on data from all 51 eastern locations in the CASTNet monitoring program. Then data from a subset of 34 eastern CASTNet sites with the most complete historical record are examined for year to year changes from 1990–1999.[3]

Figure 7-5. Rural annual mean SO_2 concentrations from CASTNet, 1990–1992 vs. 1997–1999.



Source: CASTNet

Source: CASTNet

Source: CASTNet

In the early 1990s, ambient SO_2 concentrations in the rural eastern United States were highest in western Pennsylvania, along the Ohio Valley and in the vicinity of Chicago/Gary Indiana. Large improvement in ambient SO_2 air quality can be seen in Figure 7-5 by comparing 1990–1992 with 1997–1999. The largest decreases in concentrations are noted in the vicinity of Chicago and throughout the states bordering the Ohio Valley (IL, IN, OH, PA, KY, WV). The highest SO_2 concentrations in the rural parts of the eastern United States are now concentrated in southwestern PA.

Figure 7-6 shows that sulfate concentrations greater than 5 µg/m³* cover most of the eastern United States in the 1990–1992 period. Regions of concentrations greater than 6 µg/m³ are estimated to cover the Ohio Valley States (IL, IN, OH, KY, WV), Pennsylvania, and the other mid-Atlantic states from New Jersey to Virginia. The highest sulfate concentrations (> 7 µg/m³) were adjacent to the Ohio Valley and in northern Alabama. These are the locations of large electric utilities.

During the late 1990s, ambient average sulfates lowered dramatically. Although there are differences in the measured concentrations among these individual years, both the size of the region with high concentrations as well as the magnitude of those concentrations have decreased.

Based on 34 CASTNet sites with 10 years of measurement data (Figure 7-7), mean rural sulfur dioxide concentrations were reduced by 32 percent and mean rural sulfate levels were reduced by 24 percent. The regional distribution of annual average concentrations is presented as box-plots in Figures 7-8 and 7-9. A 10-percent decrease in mean sulfates and 4-percent decrease in annual mean sulfur dioxide between 1998 and 1999 is also noted. This is a reversal of the 2-year increase previously reported for 1997–1998.

Levels and spatial changes in ambient nitrates in the rural east are shown in Figure 7-10. No significant change is noted in total nitrate concentrations. The trend in average total nitrate concentrations (nitrates plus nitric acid) among the 34 trend sites was level, corresponding to the small change in NO_x emissions during this period. The stable regional average nitrate trend line is not shown. The highest nitrate concentrations in the East are recorded in Ohio, Indiana, and Illinois. As shown in

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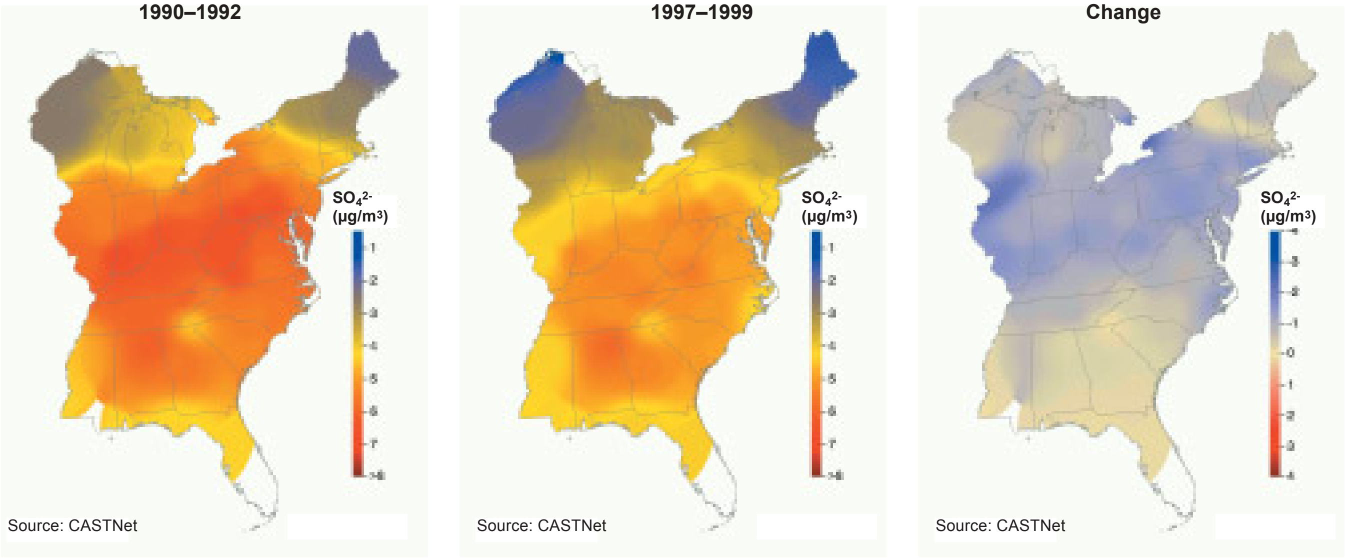
*Sulfate concentrations represent the sulfate ion, SO_4^{-2}, and do not represent the compounds (i.e., ammonium sulfate or ammonium bisulfate) typically associated with this analyte.

Figure 7-6. Rural annual average sulfate concentrations from CASTNet, 1990–1992 vs. 1997–1999.



1990–1992

1997–1999

Change

Source: CASTNet

Source: CASTNet

Source: CASTNet

Figure 7-7. CASTNet and subset of 34 long-term monitoring sites used for 1990–1999 trends analysis.

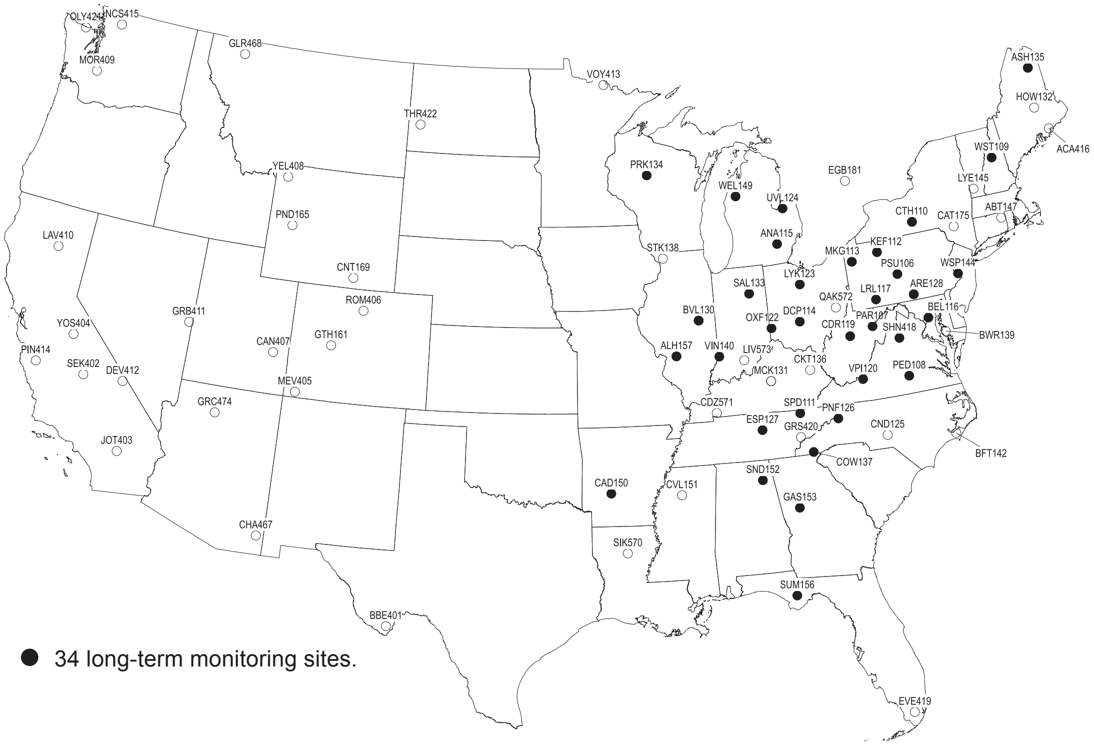


Figure 7-10, the 10-year change in total nitrate concentrations at individual measurement locations has been minimal. The ammonium maps for the eastern United States presented in Figure 7-11 shows that the highest ammonium concentrations are also highest in the midwest. This is due to the association of ammonium concentrations to sulfate and nitrate compounds. Although total nitrates have not substantially changed throughout this region, the 10-year decrease in ambient ammonium in the Ohio Valley and elsewhere appears to be associated with the reduction in sulfate concentrations.

Seasonal Trends in SO_2 Emissions and Related Air Quality

Electric utilities account for 70 percent of the SO_2 emissions in the eastern United States and for 75 percent of the 10-year regional reduction in SO_2 emissions. The trend in ambient sulfates and sulfur dioxide are generally consistent with the change in annual sulfur dioxide emissions from electric utilities in the eastern United States. Figure 7-12 shows that the 24-percent 10-year decline in sulfates and 31-percent decrease in ambient SO_2 correspond to the overall 25-percent decline in power plant SO_2 emissions. In addition, the 1998–1999 decrease in ambient rural sulfates (10 percent) and in ambient rural SO_2 (4 percent) appear to follow the 6-percent decrease in annual regional SO_2 power plant emissions.

For annual average ambient sulfur dioxide, the long-term air quality improvement is more substantial and appears similar to the large drop in regional SO_2 power plant emissions which occurred between 1993 and

Figure 7-8. Trend in ambient sulfates in the rural eastern United States, based on CASTNet monitoring data, 1990–1999.

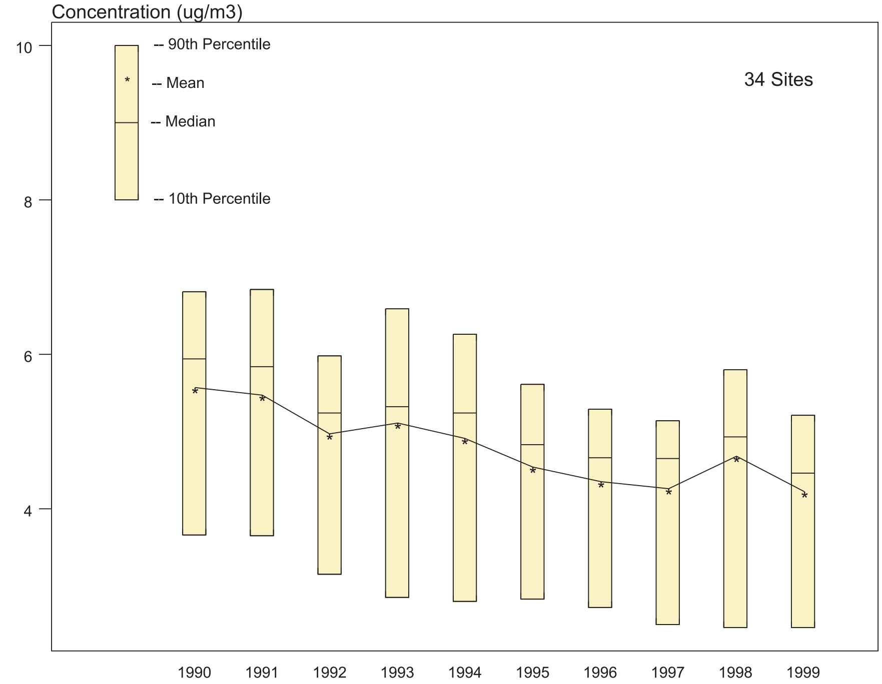


Figure 7-9. Trend in ambient sulfur dioxide in the rural eastern United States, based on CASTNet monitoring data, 1990–1999.

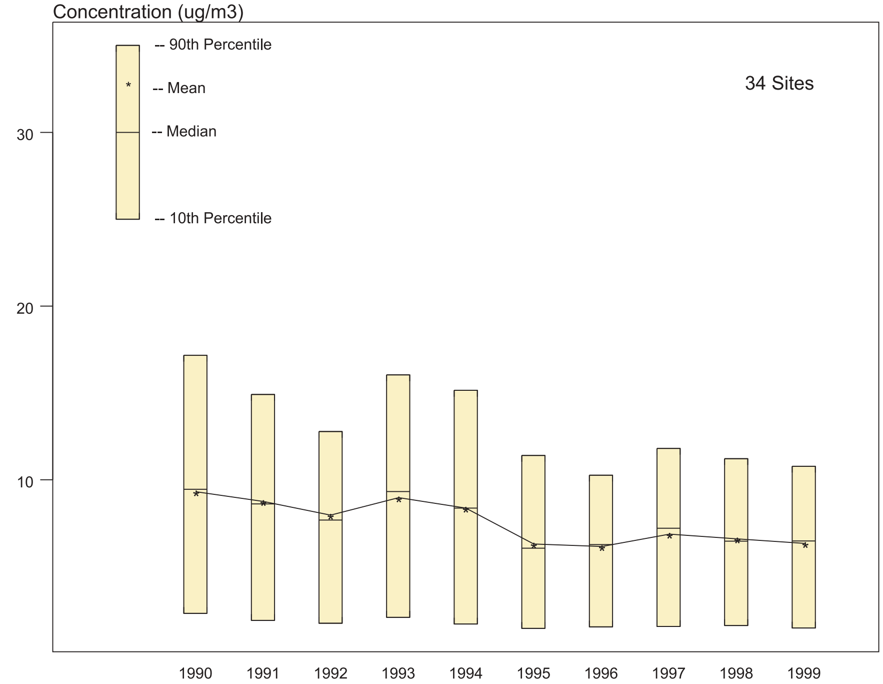
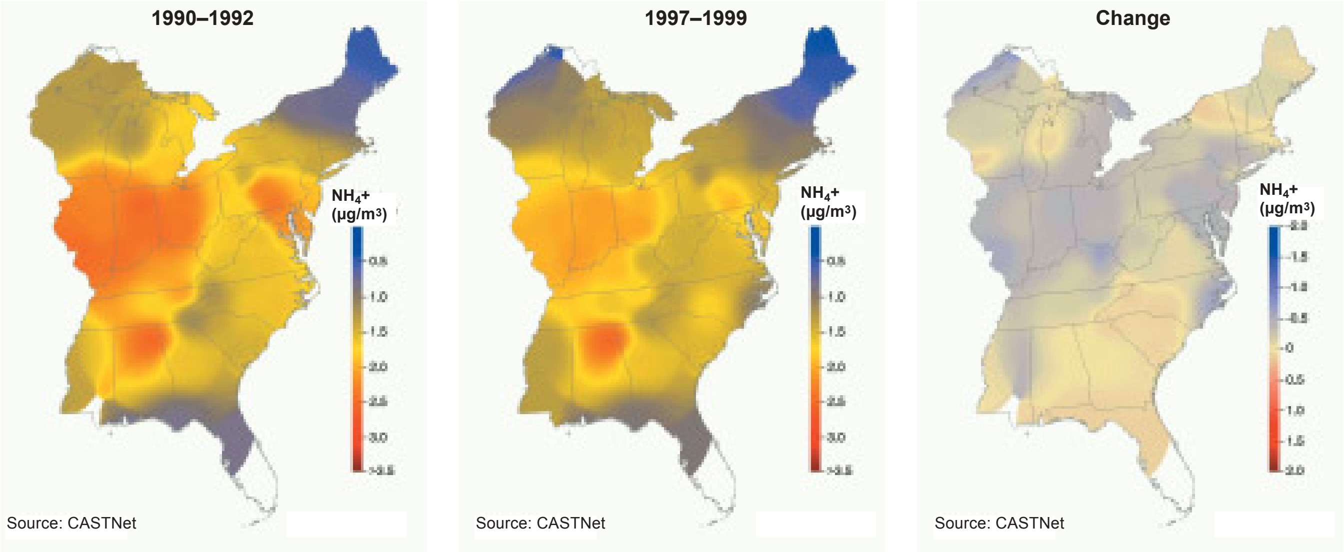


Figure 7-10. Rural annual mean ammonium concentrations from CASTNet, 1990–1992 vs. 1997–1999.

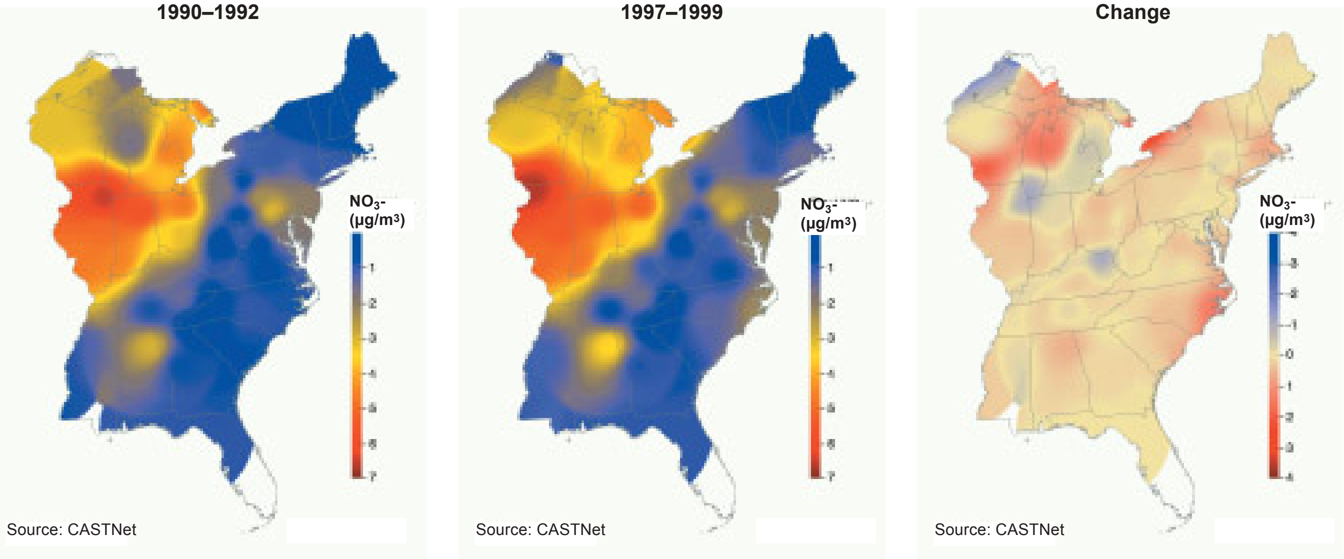


Source: CASTNet

Source: CASTNet

Source: CASTNet

Figure 7-11. Rural annual mean total nitrate concentrations from CASTNet, 1990–1992 vs. 1997–1999.



Source: CASTNet

Source: CASTNet

Source: CASTNet

1995. For sulfates, the composite average ambient concentrations depict a more gradual change.

Figure 7-13 presents the trends in ambient sulfates, ambient sulfur dioxide, and SO_2 emissions by calendar quarter. The largest 10-year decrease in quarterly average ambient sulfates occurred during the 3rd calendar quarter which is the high sulfate "season." This 3-month period with its slow moving air masses, high photochemical activity and high seasonal SO_2 emissions contributes 65–70 percent to the typical annual average concentrations of sulfates.

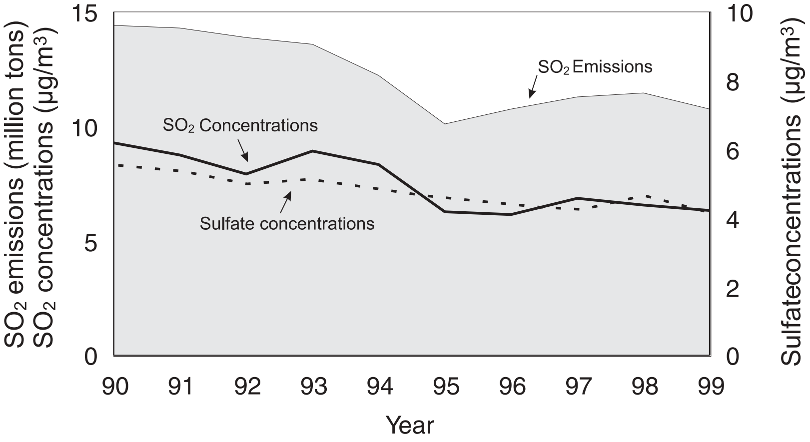
Sulfur dioxide on the other hand depicts its lowest concentration levels during the summer season, but also reveals long term, albeit slightly lower, rural air quality improvement (-25 percent). This contrasts with more significant 10-year changes of -30 percent, -34 percent and -37 percent for the 1st, 2nd, and 4th calendar quarters respectively.

These changes in rural SO_2 match the annual average results presented for urban areas. (See the criteria pollutants section in Chapter 2 for more information about urban ambient SO_2 trends, SO_2 emission trends and the acid rain program. Also see **www.epa.gov/airmarkets/**.)

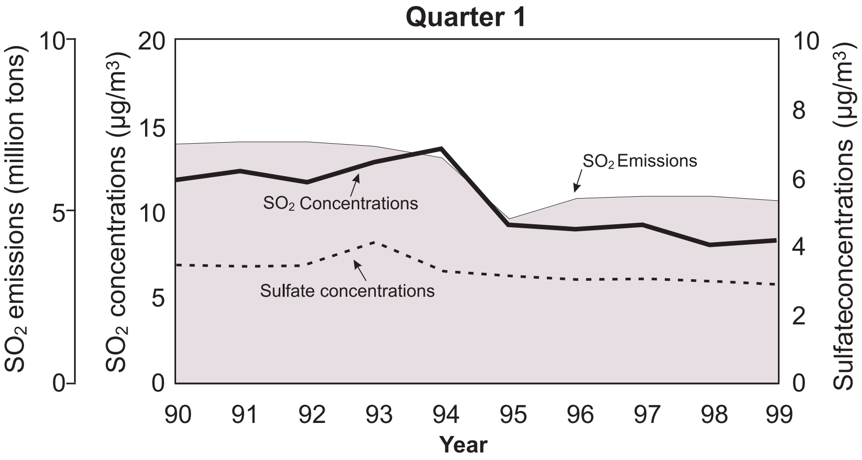
Sulfur and Nitrogen Deposition

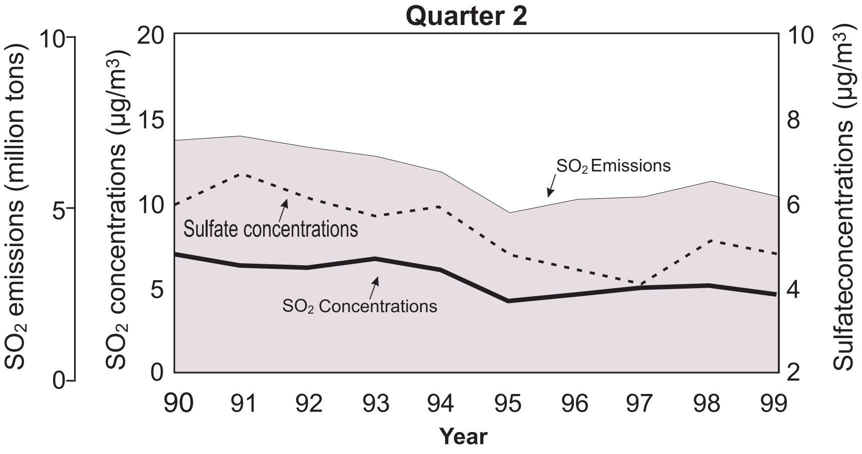
Total deposition of sulfur and nitrogen are derived from concentrations of sulfur and nitrogen species in rain combined with estimated deposition resulting from ambient particles and gases. As described for the spatial patterns in measured concentrations of wet and dry sulfur compounds, the highest deposition of sulfur also is estimated to occur in the eastern

Figure 7-12. Trend in annual mean ambient sulfur dioxide and sulfate concentrations, based on CASTNet monitoring data, and regional SO_2 emissions from electric utilities in rural eastern United States, 1990–1999.

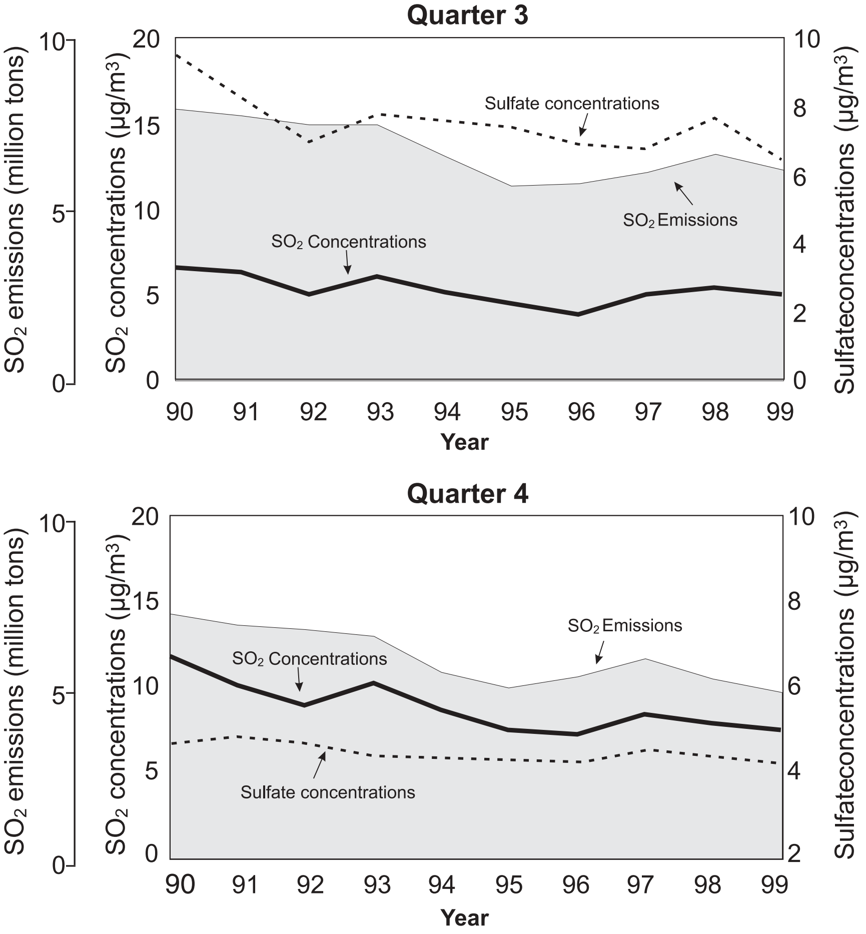


Figures 7-13a. and Figure 7-13b. Trend in annual mean ambient sulfur dioxide and sulfate concentrations, based on CASTNet monitoring data, and regional SO_2 emissions from electric utilities in rural eastern United States by calendar quarter, 1990–1999.





Figures 7-13c. and 7-13d. Trend in annual mean ambient sulfur dioxide and sulfate concentrations, based on CASTNet monitoring data, and regional SO_2 emissions from electric utilities in rural eastern United States by calendar quarter, 1990–1999.



United States. Because of differences in rain, terrain and ground cover there is more spatial variability in estimated deposition than the contributing ambient concentrations. Some of the highest estimated sulfur deposition include areas along and to the East of the Ohio Valley. In these areas, generally at least half (45–65 percent) come from rain. This wet percent ranges from 70–90 percent in the other eastern United States areas with lower sulfur deposition. In all areas of the eastern United States, most of the dry deposition is associated ambient SO_2 gas. In the West, sulfur deposition is much lower. Most western sulfur is deposited in rain, but the other sulfur is more evenly divided between SO_2 gas and sulfate particle (see Figure 7-14).

Nitrogen deposition comes from ammonium and nitrates in rain and ambient particulate concentrations of those species as well as ambient nitric acid. Based on monitoring stations that provide both wet and dry nitrogen measurements, Figure 7-15 shows that large areas of the eastern United States have similarly high values of estimated nitrogen deposition. The estimated deposition at western stations is much lower. For eastern stations, 60–70 percent is estimated to come from rain and most of this is associated with ammonium. Almost all of the remaining 30–40 percent is associated with measured nitric acid. In the West, rain accounts for more of the total deposition. Because dry nitrogen measurements are not available for the middle of the country, total nitrogen deposition cannot be estimated for this region. Data from the NADP, however, suggest that high nitrogen deposition would occur in this region. See Figure 7-3 which shows the high deposition of ammonium from precipitation in the region centered on IA.

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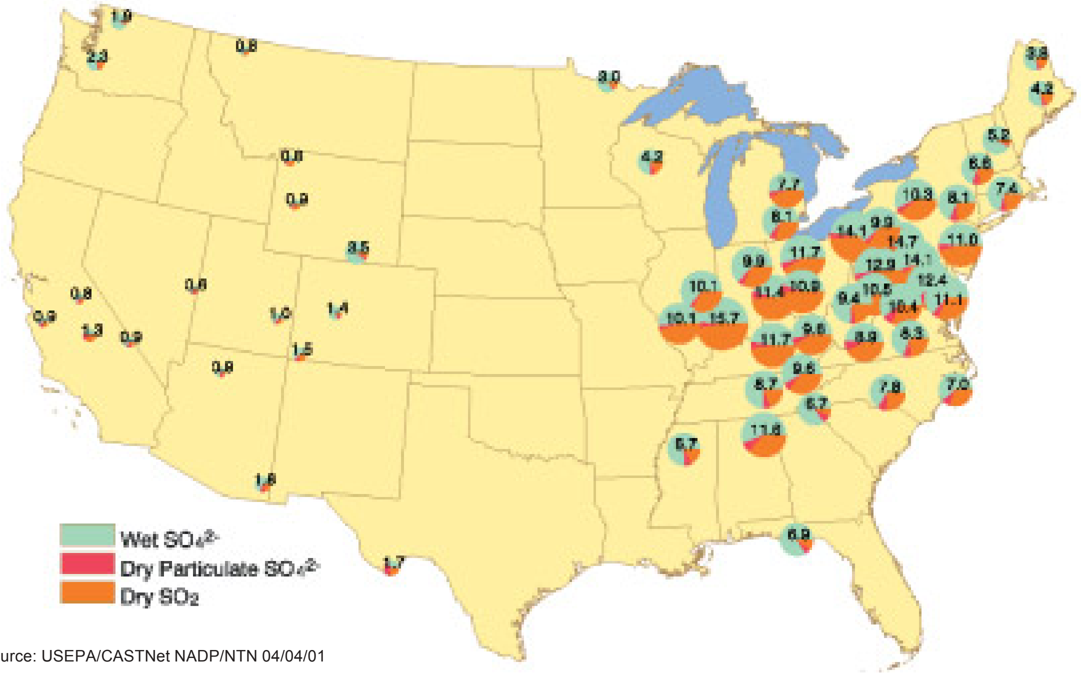
3. Clean Air Status and Trends Network (CASTNet), *1999 Annual Report*. **http://www.epa.gov/castnet/reports.html**.

Figure 7-14. Wet and dry components of sulfur deposition, 1999.



Source: USEPA/CASTNet NADP/NTN 04/04/01

Figure 7-15. Wet and dry components of nitrogen deposition, 1999.

Source: USEPA/CASTNet NADP/NTN

USEPA/CAMD 04/04/01

APPENDIX A

Data Tables

http://www.epa.gov/oar/aqtrnd99/appenda.pdf

Table A-1a. National Air Quality Trends Statistics for Criteria Pollutants, 1980–1989

Statistic	# of Sites	Units	Percentile	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Carbon Monoxide													
2nd Max. 8-hr.	304	ppm	95th	15.6	14.6	14.1	14.1	13.6	12.4	12.1	11.6	11.4	11.1
2nd Max. 8-hr.	304	ppm	90th	13.9	12.6	12.7	12.4	11.9	11.0	10.7	9.6	10.0	9.6
2nd Max. 8-hr.	304	ppm	75th	10.7	10.6	10.0	9.8	9.9	8.9	8.9	8.3	7.8	7.9
2nd Max. 8-hr.	304	ppm	50th	7.9	7.7	7.5	7.3	7.3	6.5	6.8	6.3	6.0	6.0
2nd Max. 8-hr.	304	ppm	25th	5.7	6.0	5.6	5.4	5.2	4.9	5.1	4.7	4.5	4.5
2nd Max. 8-hr.	304	ppm	10th	4.4	4.2	4.4	3.9	4.2	3.7	3.9	3.7	3.5	3.6
2nd Max. 8-hr.	304	ppm	5th	3.8	3.7	3.6	3.4	3.5	3.4	3.3	3.3	3.1	2.9
2nd Max. 8-hr.	304	ppm	Arith. Mean	8.6	8.4	8.1	7.9	7.8	7.1	7.2	6.7	6.5	6.4
Lead													
Max. Qtr. AM	216	µg/m^3	95th	1.63	1.28	1.12	0.87	0.74	0.63	0.36	0.30	0.22	0.21
Max. Qtr. AM	216	µg/m^3	90th	1.18	1.00	0.93	0.68	0.63	0.45	0.27	0.20	0.18	0.14
Max. Qtr. AM	216	µg/m^3	75th	0.70	0.58	0.63	0.50	0.45	0.30	0.17	0.13	0.11	0.10
Max. Qtr. AM	216	µg/m^3	50th	0.50	0.40	0.42	0.36	0.33	0.19	0.12	0.09	0.07	0.06
Max. Qtr. AM	216	µg/m^3	25th	0.35	0.29	0.28	0.24	0.22	0.14	0.08	0.06	0.05	0.04
Max. Qtr. AM	216	µg/m^3	10th	0.23	0.21	0.19	0.17	0.16	0.10	0.06	0.04	0.03	0.03
Max. Qtr. AM	216	µg/m^3	5th	0.19	0.17	0.15	0.14	0.12	0.07	0.05	0.03	0.02	0.02
Max. Qtr. AM	216	µg/m^3	Arith. Mean	0.65	0.54	0.53	0.40	0.37	0.25	0.15	0.11	0.10	0.08
Nitrogen Dioxide													
Arith. Mean	156	ppm	95th	0.051	0.051	0.050	0.046	0.046	0.048	0.050	0.043	0.048	0.045
Arith. Mean	156	ppm	90th	0.040	0.041	0.039	0.038	0.038	0.038	0.035	0.038	0.037	0.036
Arith. Mean	156	ppm	75th	0.029	0.028	0.028	0.027	0.029	0.029	0.028	0.028	0.028	0.028
Arith. Mean	156	ppm	50th	0.023	0.021	0.021	0.021	0.022	0.022	0.022	0.022	0.023	0.022
Arith. Mean	156	ppm	25th	0.016	0.016	0.016	0.016	0.016	0.017	0.016	0.017	0.016	0.016
Arith. Mean	156	ppm	10th	0.007	0.009	0.009	0.008	0.009	0.009	0.009	0.011	0.009	0.009
Arith. Mean	156	ppm	5th	0.003	0.003	0.004	0.003	0.003	0.004	0.004	0.004	0.003	0.003
Arith. Mean	156	ppm	Arith. Mean	0.024	0.024	0.023	0.022	0.023	0.023	0.023	0.023	0.023	0.023
Ozone													
2nd Max. 1-hr.	441	ppm	95th	0.220	0.202	0.196	0.220	0.203	0.190	0.170	0.180	0.200	0.170
2nd Max. 1-hr.	441	ppm	90th	0.177	0.164	0.160	0.186	0.165	0.160	0.150	0.164	0.180	0.143
2nd Max. 1-hr.	441	ppm	75th	0.150	0.140	0.133	0.150	0.138	0.132	0.130	0.140	0.155	0.124
2nd Max. 1-hr.	441	ppm	50th	0.122	0.115	0.115	0.130	0.113	0.112	0.112	0.118	0.130	0.108
2nd Max. 1-hr.	441	ppm	25th	0.105	0.100	0.100	0.110	0.100	0.098	0.098	0.104	0.110	0.099
2nd Max. 1-hr.	441	ppm	10th	0.091	0.090	0.086	0.095	0.090	0.088	0.086	0.090	0.098	0.086
2nd Max. 1-hr.	441	ppm	5th	0.087	0.080	0.080	0.085	0.080	0.078	0.080	0.087	0.088	0.080
2nd Max. 1-hr.	441	ppm	Arith. Mean	0.134	0.125	0.124	0.137	0.124	0.122	0.118	0.124	0.135	0.115
4th Max. 8-hr.	441	ppm	95th	0.142	0.129	0.128	0.145	0.130	0.127	0.120	0.126	0.140	0.120
4th Max. 8-hr.	441	ppm	90th	0.125	0.115	0.114	0.126	0.113	0.111	0.107	0.116	0.128	0.105
4th Max. 8-hr.	441	ppm	75th	0.106	0.101	0.098	0.110	0.099	0.097	0.095	0.102	0.115	0.093
4th Max. 8-hr.	441	ppm	50th	0.093	0.088	0.088	0.096	0.088	0.087	0.085	0.090	0.102	0.084
4th Max. 8-hr.	441	ppm	25th	0.082	0.077	0.076	0.085	0.077	0.077	0.076	0.081	0.087	0.076
4th Max. 8-hr.	441	ppm	10th	0.071	0.068	0.066	0.071	0.067	0.067	0.069	0.072	0.076	0.068
4th Max. 8-hr.	441	ppm	5th	0.065	0.060	0.061	0.063	0.062	0.062	0.062	0.067	0.067	0.063
4th Max. 8-hr.	441	ppm	Arith. Mean	0.097	0.091	0.090	0.099	0.091	0.090	0.088	0.093	0.102	0.087

Table A-1a. National Air Quality Trends Statistics for Criteria Pollutants, 1980–1989 (continued)

Statistic	# of Sites	Units	Percentile	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
PM$_{10}$													
Annual Avg.	—	µg/m^3	95th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	90th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	75th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	50th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	25th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	10th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	5th	—	—	—	—	—	—	—	—	—	—
Annual Avg.	—	µg/m^3	Arith. Mean	—	—	—	—	—	—	—	—	—	—
Sulfur Dioxide													
Arith. Mean	438	ppm	95th	0.0232	0.0223	0.0195	0.0182	0.0184	0.0176	0.0163	0.0162	0.0170	0.0162
Arith. Mean	438	ppm	90th	0.0190	0.0177	0.0164	0.0151	0.0156	0.0150	0.0140	0.0134	0.0143	0.0141
Arith. Mean	438	ppm	75th	0.0134	0.0133	0.0119	0.0121	0.0122	0.0114	0.0114	0.0111	0.0109	0.0107
Arith. Mean	438	ppm	50th	0.0092	0.0090	0.0085	0.0085	0.0088	0.0083	0.0081	0.0078	0.0080	0.0077
Arith. Mean	438	ppm	25th	0.0057	0.0059	0.0057	0.0056	0.0054	0.0050	0.0050	0.0048	0.0048	0.0047
Arith. Mean	438	ppm	10th	0.0029	0.0029	0.0031	0.0029	0.0029	0.0026	0.0025	0.0024	0.0025	0.0023
Arith. Mean	438	ppm	5th	0.0018	0.0018	0.0016	0.0017	0.0018	0.0019	0.0016	0.0016	0.0019	0.0016
Arith. Mean	438	ppm	Arith. Mean	0.0103	0.0101	0.0094	0.0091	0.0092	0.0087	0.0085	0.0083	0.0084	0.0081
2nd Max. 24-hr.	—	ppm	95th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	90th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	75th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	50th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	25th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	10th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	5th	—	—	—	—	—	—	—	—	—	—
2nd Max. 24-hr.	—	ppm	Arith. Mean	—	—	—	—	—	—	—	—	—	—

Table A-1b. National Air Quality Trends Statistics for Criteria Pollutants, 1990–1999

Statistic	# of Sites	Units	Percentile	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Carbon Monoxide													
2nd Max. 8-hr.	388	ppm	95th	10.5	9.9	8.9	8.4	8.3	7.9	7.7	6.9	7.0	6.5
2nd Max. 8-hr.	388	ppm	90th	8.9	8.9	8.0	7.4	7.7	6.7	6.7	6.1	5.8	5.6
2nd Max. 8-hr.	388	ppm	75th	7.2	7.2	6.6	6.1	6.2	5.7	5.2	5.0	4.7	4.5
2nd Max. 8-hr.	388	ppm	50th	5.5	5.3	5.0	4.8	5.0	4.3	4.0	3.8	3.6	3.6
2nd Max. 8-hr.	388	ppm	25th	4.2	4.0	3.8	3.7	3.9	3.3	3.0	2.9	2.8	2.6
2nd Max. 8-hr.	388	ppm	10th	3.1	2.9	2.8	2.8	2.7	2.5	2.3	2.1	2.1	2.0
2nd Max. 8-hr.	388	ppm	5th	2.5	2.3	2.3	2.2	2.2	2.2	2.0	1.7	1.8	1.6
2nd Max. 8-hr.	388	ppm	Arith. Mean	5.8	5.7	5.3	5.0	5.1	4.6	4.3	4.0	3.8	3.7
Lead													
Max. Qtr. AM	175	µg/m^3	95th	0.40	0.25	0.19	0.18	0.15	0.16	0.14	0.12	0.13	0.10
Max. Qtr. AM	175	µg/m^3	90th	0.18	0.16	0.14	0.11	0.10	0.09	0.09	0.09	0.09	0.08
Max. Qtr. AM	175	µg/m^3	75th	0.09	0.08	0.07	0.07	0.06	0.05	0.05	0.04	0.04	0.05
Max. Qtr. AM	175	µg/m^3	50th	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02
Max. Qtr. AM	175	µg/m^3	25th	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Max. Qtr. AM	175	µg/m^3	10th	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Max. Qtr. AM	175	µg/m^3	5th	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Max. Qtr. AM	175	µg/m^3	Arith. Mean	0.10	0.08	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04
Nitrogen Dioxide													
Arith. Mean	230	ppm	95th	0.039	0.043	0.038	0.037	0.040	0.039	0.037	0.034	0.035	0.035
Arith. Mean	230	ppm	90th	0.033	0.032	0.032	0.031	0.032	0.031	0.031	0.030	0.031	0.030
Arith. Mean	230	ppm	75th	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.022	0.023	0.023
Arith. Mean	230	ppm	50th	0.018	0.018	0.018	0.018	0.019	0.018	0.018	0.017	0.017	0.017
Arith. Mean	230	ppm	25th	0.013	0.012	0.012	0.012	0.013	0.012	0.012	0.012	0.012	0.012
Arith. Mean	230	ppm	10th	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.007
Arith. Mean	230	ppm	5th	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004
Arith. Mean	230	ppm	Arith. Mean	0.020	0.019	0.019	0.019	0.020	0.019	0.018	0.018	0.018	0.018
Ozone													
2nd Max. 1-hr.	703	ppm	95th	0.170	0.170	0.159	0.150	0.147	0.149	0.141	0.142	0.150	0.139
2nd Max. 1-hr.	703	ppm	90th	0.144	0.147	0.130	0.137	0.129	0.139	0.126	0.130	0.133	0.130
2nd Max. 1-hr.	703	ppm	75th	0.120	0.122	0.112	0.120	0.117	0.123	0.114	0.116	0.119	0.118
2nd Max. 1-hr.	703	ppm	50th	0.107	0.107	0.099	0.104	0.104	0.110	0.103	0.103	0.109	0.107
2nd Max. 1-hr.	703	ppm	25th	0.093	0.093	0.090	0.091	0.092	0.098	0.093	0.091	0.097	0.095
2nd Max. 1-hr.	703	ppm	10th	0.083	0.082	0.082	0.080	0.083	0.086	0.084	0.081	0.086	0.085
2nd Max. 1-hr.	703	ppm	5th	0.075	0.076	0.077	0.075	0.077	0.079	0.079	0.075	0.077	0.077
2nd Max. 1-hr.	703	ppm	Arith. Mean	0.112	0.112	0.105	0.108	0.107	0.112	0.105	0.105	0.110	0.107
4th Max. 8-hr.	703	ppm	95th	0.115	0.115	0.107	0.110	0.106	0.112	0.103	0.105	0.110	0.105
4th Max. 8-hr.	703	ppm	90th	0.105	0.108	0.097	0.101	0.098	0.107	0.097	0.100	0.102	0.102
4th Max. 8-hr.	703	ppm	75th	0.093	0.096	0.087	0.090	0.090	0.096	0.090	0.091	0.095	0.095
4th Max. 8-hr.	703	ppm	50th	0.083	0.084	0.079	0.081	0.082	0.088	0.082	0.082	0.087	0.087
4th Max. 8-hr.	703	ppm	25th	0.074	0.073	0.073	0.073	0.074	0.077	0.075	0.073	0.077	0.077
4th Max. 8-hr.	703	ppm	10th	0.066	0.065	0.066	0.063	0.067	0.068	0.068	0.065	0.069	0.067
4th Max. 8-hr.	703	ppm	5th	0.060	0.059	0.061	0.059	0.061	0.062	0.062	0.059	0.060	0.061
4th Max. 8-hr.	***703***	***ppm***	***Arith. Mean***	***0.085***	***0.086***	***0.081***	***0.083***	***0.084***	***0.087***	***0.083***	***0.082***	***0.086***	***0.085***

Table A-1b. National Air Quality Trends Statistics for Criteria Pollutants, 1990–1999 (continued)

Statistic	# of Sites	Units	Percentile	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
PM_{10}													
Annual Avg.	954	µg/m^3	95th	45.9	45.5	41.7	40.5	39.4	38.4	37.4	37.5	35.5	39.7
Annual Avg.	954	µg/m^3	90th	39.6	39.8	36.3	35.8	36.2	34.6	33.0	32.2	31.7	32.7
Annual Avg.	954	µg/m^3	75th	33.9	33.5	30.9	30.1	30.3	29.0	27.6	27.1	27.5	27.6
Annual Avg.	954	µg/m^3	50th	28.1	28.0	25.7	25.2	25.4	24.2	22.9	22.9	23.4	23.0
Annual Avg.	954	µg/m^3	25th	23.2	23.4	22.0	21.0	20.9	19.7	19.3	19.3	19.2	19.1
Annual Avg.	954	µg/m^3	10th	18.8	18.3	17.7	16.9	16.7	15.6	16.1	15.6	15.2	15.0
Annual Avg.	954	µg/m^3	5th	16.1	15.2	14.7	13.5	13.4	12.6	13.2	12.7	12.9	12.9
Annual Avg.	954	µg/m^3	Arith. Mean	29.2	29.0	26.8	26.0	26.0	24.8	24.0	23.8	23.6	23.9
Sulfur Dioxide													
Arith. Mean	480	ppm	95th	0.0176	0.0162	0.0154	0.0154	0.0143	0.0116	0.0113	0.0107	0.0106	0.0103
Arith. Mean	480	ppm	90th	0.0146	0.0140	0.0129	0.0126	0.0123	0.0101	0.0097	0.0091	0.0095	0.0089
Arith. Mean	480	ppm	75th	0.0108	0.0100	0.0095	0.0093	0.0091	0.0074	0.0074	0.0071	0.0070	0.0068
Arith. Mean	480	ppm	50th	0.0077	0.0075	0.0068	0.0067	0.0065	0.0051	0.0053	0.0051	0.0049	0.0048
Arith. Mean	480	ppm	25th	0.0043	0.0044	0.0042	0.0039	0.0037	0.0032	0.0032	0.0031	0.0032	0.0032
Arith. Mean	480	ppm	10th	0.0022	0.0022	0.0020	0.0022	0.0020	0.0018	0.0019	0.0018	0.0019	0.0019
Arith. Mean	480	ppm	5th	0.0014	0.0015	0.0014	0.0015	0.0015	0.0014	0.0014	0.0014	0.0014	0.0014
Arith. Mean	480	ppm	Arith. Mean	0.0081	0.0079	0.0073	0.0072	0.0069	0.0056	0.0056	0.0054	0.0053	0.0052
2nd Max. 24-hr.	481	ppm	95th	0.0870	0.0750	0.0750	0.0720	0.0720	0.0570	0.0600	0.0520	0.0520	0.0520
2nd Max. 24-hr.	481	ppm	90th	0.0660	0.0630	0.0620	0.0590	0.0620	0.0480	0.0470	0.0450	0.0440	0.0410
2nd Max. 24-hr.	481	ppm	75th	0.0480	0.0440	0.0440	0.0420	0.0450	0.0330	0.0330	0.0330	0.0310	0.0290
2nd Max. 24-hr.	481	ppm	50th	0.0330	0.0320	0.0300	0.0280	0.0330	0.0220	0.0230	0.0230	0.0220	0.0210
2nd Max. 24-hr.	481	ppm	25th	0.0200	0.0200	0.0190	0.0190	0.0190	0.0150	0.0150	0.0140	0.0140	0.0140
2nd Max. 24-hr.	481	ppm	10th	0.0100	0.0100	0.0100	0.0100	0.0090	0.0080	0.0090	0.0070	0.0070	0.0070
2nd Max. 24-hr.	481	ppm	5th	0.0060	0.0070	0.0060	0.0060	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
2nd Max. 24-hr.	481	ppm	Arith. Mean	0.0376	0.0350	0.0340	0.0328	0.0343	0.0259	0.0263	0.0251	0.0242	0.0233

Table A-2. National Carbon Monoxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**4,632**	**4,480**	**7,302**	**8,485**	**7,443**	**5,510**	**5,856**	**6,155**	**5,586**	**5,519**	**5,934**	**6,206**	**5,484**	**5,075**	**5,322**
FUEL COMB. ELEC. UTIL.	***237***	***276***	***322***	***291***	***321***	***363***	***349***	***350***	***363***	***370***	***372***	***409***	***423***	***450***	***445***
Coal	106	134	188	207	233	234	234	236	246	247	250	251	257	242	239
Oil	41	69	48	18	26	20	19	15	16	15	10	12	14	19	18
Gas	90	73	85	56	51	51	51	51	49	53	55	79	84	97	94
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8	9	33	33
Internal Combustion	NA	NA	NA	10	11	57	45	47	51	55	58	58	60	60	61
FUEL COMB. INDUSTRIAL	***770***	***763***	***750***	***670***	***672***	***879***	***920***	***955***	***1,043***	***1,041***	***1,056***	***1,191***	***1,163***	***1,151***	***1,178***
Coal	100	67	58	86	87	105	101	102	101	100	98	110	109	106	109
Oil	44	49	35	47	46	74	60	64	66	66	71	54	52	51	52
Gas	462	463	418	257	271	226	284	300	322	337	345	340	339	336	342
Other	164	184	239	167	173	279	267	264	286	287	297	349	333	334	341
Internal Combustion	NA	NA	NA	113	96	195	208	227	268	251	245	337	330	324	334
FUEL COMB. OTHER	***3,625***	***3,441***	***6,230***	***7,525***	***6,450***	***4,269***	***4,587***	***4,849***	***4,181***	***4,108***	***4,506***	***4,606***	***3,898***	***3,474***	***3,699***
Commercial/Institutional Coal	12	17	13	14	15	14	14	15	15	15	15	14	14	15	15
Commercial/Institutional Oil	27	23	21	18	17	18	17	18	18	18	19	19	20	16	16
Commercial/Institutional Gas	24	25	26	42	49	44	44	51	53	54	54	64	65	63	69
Misc. Fuel Comb. (Except Residential)	NA	NA	NA	57	55	149	141	141	143	147	145	46	48	49	50
Residential Wood	2,932	3,114	5,992	7,232	6,161	3,781	4,090	4,332	3,679	3,607	3,999	4,207	3,499	3,089	3,300
fireplaces	*2,932*	*3,114*	*5,992*	*7,232*	*6,161*	*3,781*	*4,090*	*4,332*	*3,679*	*3,607*	*3,999*	*3,579*	*2,891*	*2,518*	*2,699*
woodstoves	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*304*	*293*	*276*	*290*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*325*	*314*	*296*	*312*
Residential Other	630	262	178	162	153	262	281	292	274	268	273	255	252	242	249
Industrial Processes	**16,899**	**10,770**	**9,250**	**7,215**	**7,013**	**5,852**	**5,740**	**5,683**	**5,898**	**5,839**	**5,790**	**4,759**	**4,932**	**4,955**	**7,590**
CHEMICAL & ALLIED PRODUCT MFG	***3,397***	***2,204***	***2,151***	***1,845***	***1,925***	***1,183***	***1,127***	***1,112***	***1,093***	***1,171***	***1,223***	***1,053***	***1,071***	***1,081***	***1,081***
Organic Chemical Mfg	340	483	543	251	285	149	128	131	132	130	127	90	91	92	93
ethylene dichloride	*11*	*12*	*17*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
maleic anhydride	*73*	*147*	*103*	*16*	*16*	*3*	*3*	*4*	*4*	*4*	*4*	*0*	*0*	*0*	*0*
cyclohexanol	*36*	*39*	*37*	*5*	*6*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*
other	*220*	*286*	*386*	*230*	*264*	*146*	*125*	*127*	*128*	*125*	*123*	*89*	*90*	*92*	*92*
Inorganic Chemical Mfg	190	153	191	89	95	133	129	130	131	135	134	120	121	123	125
pigments; TiO2 chloride proc.: reactor	*18*	*22*	*34*	*77*	*84*	*119*	*119*	*119*	*119*	*119*	*119*	*117*	*118*	*120*	*122*
other	*172*	*131*	*157*	*12*	*12*	*14*	*11*	*12*	*13*	*16*	*15*	*3*	*3*	*3*	*3*
Polymer & Resin Mfg	NA	NA	NA	19	18	3	6	5	5	5	5	5	5	5	5
Agricultural Chemical Mfg	NA	NA	NA	16	17	44	19	19	18	17	17	12	13	13	13
Paint, Varnish, Lacquer, Enamel Mfg	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	1
Other Chemical Mfg	2,866	1,567	1,417	1,471	1,510	854	844	827	805	885	939	826	841	847	845
carbon black mfg	*2,866*	*1,567*	*1,417*	*1,078*	*1,112*	*798*	*756*	*736*	*715*	*793*	*845*	*796*	*811*	*818*	*815*
carbon black furnace: fugitives	*NA*	*NA*	*NA*	*155*	*180*	*17*	*54*	*57*	*60*	*63*	*65*	*4*	*4*	*4*	*4*
other	*NA*	*NA*	*NA*	*238*	*219*	*39*	*35*	*34*	*30*	*30*	*29*	*26*	*26*	*26*	*26*
METALS PROCESSING	***3,644***	***2,496***	***2,246***	***2,223***	***2,132***	***2,640***	***2,571***	***2,496***	***2,536***	***2,475***	***2,380***	***1,604***	***1,709***	***1,702***	***1,678***
Nonferrous Metals Processing	652	636	842	694	677	436	438	432	423	421	424	459	475	465	454
aluminum anode baking	*326*	*318*	*421*	*41*	*41*	*41*	*47*	*41*	*41*	*41*	*41*	*22*	*23*	*23*	*23*
prebake aluminum cell	*326*	*318*	*421*	*257*	*254*	*260*	*260*	*260*	*260*	*260*	*260*	*277*	*288*	*281*	*274*
other	*NA*	*NA*	*NA*	*396*	*382*	*135*	*131*	*131*	*122*	*120*	*123*	*160*	*164*	*160*	*157*

Table A-2. National Carbon Monoxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (cont.)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Ferrous Metals Processing	2,991	1,859	1,404	1,523	1,449	2,163	2,108	2,038	2,089	2,029	1,930	1,101	1,189	1,193	1,181
basic oxygen furnace	*440*	*125*	*80*	*694*	*662*	*594*	*731*	*767*	*768*	*677*	*561*	*268*	*296*	*301*	*301*
carbon steel electric arc furnace	*181*	*204*	*280*	*19*	*18*	*45*	*54*	*49*	*58*	*61*	*65*	*60*	*65*	*66*	*65*
coke oven charging	*62*	*53*	*43*	*9*	*9*	*14*	*16*	*17*	*7*	*7*	*8*	*4*	*4*	*4*	*4*
gray iron cupola	*1,203*	*649*	*340*	*302*	*280*	*124*	*118*	*114*	*121*	*128*	*120*	*111*	*115*	*111*	*106*
iron ore sinter plant windbox	*1,025*	*759*	*600*	*304*	*293*	*211*	*211*	*211*	*211*	*211*	*211*	*46*	*50*	*50*	*50*
other	*81*	*70*	*61*	*194*	*187*	*1,174*	*979*	*880*	*924*	*945*	*966*	*612*	*659*	*661*	*654*
Metals Processing NEC	NA	NA	NA	6	6	40	25	26	25	25	25	44	46	44	43
PETROLEUM & RELATED INDUSTRIES	***2,179***	***2,211***	***1,723***	***462***	***436***	***333***	***345***	***371***	***371***	***338***	***348***	***354***	***367***	***366***	***366***
Oil & Gas Production	NA	NA	NA	11	8	38	18	21	22	35	34	27	27	27	27
Petroleum Refineries & Related Ind.	2,168	2,211	1,723	449	427	291	324	345	344	299	309	319	332	331	332
fcc units	*1,820*	*2,032*	*1,680*	*403*	*390*	*284*	*315*	*333*	*328*	*286*	*299*	*308*	*320*	*319*	*320*
other	*348*	*179*	*44*	*46*	*37*	*7*	*9*	*13*	*17*	*13*	*10*	*11*	*12*	*12*	*12*
Asphalt Manufacturing	11	NA	NA	2	2	3	4	5	5	5	5	8	8	8	7
OTHER INDUSTRIAL PROCESSES	***620***	***630***	***830***	***694***	***716***	***537***	***548***	***544***	***594***	***600***	***624***	***561***	***582***	***590***	***599***
Agriculture, Food, & Kindred Products	NA	NA	NA	0	0	3	3	3	3	2	6	4	4	4	4
Textiles, Leather, & Apparel Products	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Pub. Prod.	610	602	798	627	655	473	461	449	453	461	484	356	370	378	388
sulfate pulping: rec. furnace/evaporator	*NA*	*NA*	*NA*	*475*	*497*	*370*	*360*	*348*	*350*	*355*	*370*	*274*	*285*	*291*	*299*
sulfate (kraft) pulping: lime kiln	*610*	*602*	*798*	*140*	*146*	*87*	*81*	*75*	*78*	*76*	*82*	*50*	*52*	*53*	*55*
other	*NA*	*NA*	*NA*	*12*	*13*	*16*	*21*	*25*	*24*	*30*	*32*	*32*	*33*	*34*	*34*
Rubber & Miscellaneous Plastic Prod.	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Products	10	27	32	43	43	54	77	85	131	131	127	180	186	186	185
Machinery Products	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
Electronic Equipment	NA	NA	NA	18	12	2	2	2	2	2	2	0	0	0	0
Transportation Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	NA	NA	NA	6	5	5	5	6	4	4	4	19	19	20	20
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***2***	***2***	***5***	***5***	***5***	***5***	***5***	***6***	***1***	***2***	***2***	***2***
Degreasing	NA	NA	NA	1	1	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Dry Cleaning	NA	NA	NA	NA	NA	0	0	0	0	1	1	0	0	0	0
Surface Coating	NA	NA	NA	0	1	0	1	1	1	1	1	1	1	1	1
Other Industrial	NA	NA	NA	0	0	4	4	4	4	4	4	0	0	0	0
Nonindustrial	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Solvent Utilization NEC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***49***	***55***	***76***	***28***	***17***	***51***	***24***	***25***	***70***	***71***	***72***	***72***
Bulk Terminals & Plants	NA	NA	NA	0	0	0	2	0	4	4	4	0	0	0	0
Petroleum & Petroleum Prod. Storage	NA	NA	NA	0	0	0	12	0	32	4	4	0	0	0	0
Petroleum & Petroleum Prod. Trans.	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0
Organic Chemical Storage	NA	NA	NA	42	49	74	13	13	13	13	13	68	69	70	70
Organic Chemical Transport	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	6	5	1	1	3	2	3	3	1	1	1	1

Table A-2. National Carbon Monoxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (cont.)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WASTE DISPOSAL & RECYCLING	***7,059***	***3,230***	***2,300***	***1,941***	***1,747***	***1,079***	***1,116***	***1,138***	***1,248***	***1,225***	***1,185***	***1,116***	***1,130***	***1,142***	***3,792***
Incineration	2,979	1,764	1,246	958	876	372	392	404	497	467	432	403	408	412	416
conical wood burner	*1,431*	*579*	*228*	*17*	*19*	*6*	*7*	*6*	*6*	*6*	*6*	*2*	*2*	*2*	*2*
municipal incinerator	*333*	*23*	*13*	*34*	*35*	*16*	*17*	*15*	*14*	*14*	*15*	*7*	*7*	*8*	*8*
industrial	*NA*	*NA*	NA	*9*	*9*	*9*	*10*	*10*	*87*	*48*	*10*	*9*	*10*	*10*	*10*
commmercial/institutional	*108*	*68*	*60*	*32*	*39*	*19*	*20*	*21*	*21*	*21*	*21*	*22*	*23*	*24*	*24*
residential	*1,107*	*1,094*	*945*	*865*	*773*	*294*	*312*	*324*	*340*	*347*	*351*	*330*	*333*	*337*	*339*
other	*NA*	*NA*	*NA*	*2*	*2*	*27*	*26*	*28*	*29*	*30*	*29*	*32*	*32*	*33*	*33*
Open Burning	4,080	1,466	1,054	982	870	706	722	731	749	755	750	706	715	723	3,369
industrial	*1,932*	*1,254*	*1,007*	*20*	*21*	*14*	*14*	*15*	*15*	*15*	*15*	*15*	*16*	*16*	*0*
commmercial/institutional	*2,148*	*212*	*47*	*4*	*5*	*46*	*48*	*50*	*52*	*54*	*52*	*84*	*88*	*90*	*0*
residential	*NA*	*NA*	NA	*958*	*845*	*509*	*516*	*523*	*529*	*533*	*536*	*506*	*510*	*515*	*422*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*137*	*144*	*144*	*153*	*153*	*147*	*101*	*101*	*102*	*2,947*
POTW	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	1	1	2	2	2	2	6	6	6	6
Other	NA	NA	NA	0	0	0	0	0	1	1	1	0	0	0	0
Transportation	**100,004**	**96,243**	**92,538**	**93,386**	**83,829**	**76,635**	**81,583**	**80,235**	**81,224**	**82,699**	**75,035**	**79,795**	**78,509**	**77,478**	**75,151**
ON-ROAD VEHICLES	***88,034***	***83,134***	***78,049***	***77,387***	***66,050***	***58,444***	***62,999***	***61,236***	***61,833***	***62,903***	***54,811***	***54,388***	***53,315***	***52,360***	***49,989***
Light-Duty Gas Vehicles & Motorcycles	64,031	59,281	53,561	49,451	42,234	34,996	35,680	33,761	33,185	33,317	29,787	29,163	28,639	28,420	27,382
light-duty gas vehicles	*63,846*	*59,061*	*53,342*	*49,273*	*42,047*	*34,806*	*35,503*	*33,582*	*32,995*	*33,122*	*29,601*	*28,974*	*28,449*	*28,225*	*27,187*
motorcycles	*185*	*220*	*219*	*178*	*187*	*190*	*177*	*179*	*190*	*195*	*187*	*189*	*191*	*195*	*195*
Light-Duty Gas Trucks	16,570	15,767	16,137	18,960	15,940	17,118	20,622	21,536	22,795	22,614	19,434	16,873	16,949	16,948	16,115
light-duty gas trucks 1	*10,102*	*9,611*	10,395	*11,834*	*9,034*	*9,672*	*11,606*	*12,065*	*12,647*	*12,428*	*11,029*	*11,221*	*11,296*	*11,315*	*10,766*
light-duty gas trucks 2	*6,468*	*6,156*	5,742	*7,126*	*6,906*	*7,446*	*9,016*	*9,471*	*10,148*	*10,186*	*8,405*	*5,652*	*5,652*	*5,634*	*5,349*
Heavy-Duty Gas Vehicles	6,712	7,140	7,189	7,716	6,506	5,029	5,369	4,586	4,483	5,523	4,103	6,260	5,549	4,782	4,262
Diesels	721	945	1,161	1,261	1,369	1,301	1,327	1,353	1,370	1,449	1,487	2,093	2,178	2,210	2,230
heavy-duty diesel vehicles	*721*	*915*	*1,139*	*1,235*	*1,336*	*1,233*	*1,292*	*1,317*	*1,333*	*1,411*	*1,447*	*2,074*	*2,162*	*2,197*	*2,217*
light-duty diesel trucks	*NA*	*NA*	*4*	*4*	*6*	*46*	*8*	*9*	*10*	*10*	*10*	*7*	*6*	*5*	*5*
light-duty diesel vehicles	*NA*	*30*	*19*	*22*	*28*	*22*	*27*	*27*	*28*	*29*	*29*	*12*	*10*	*8*	*8*
NON-ROAD ENGINES AND VEHICLES	***11,970***	***13,109***	***14,489***	***15,999***	***17,779***	***18,191***	***18,585***	***18,999***	***19,391***	***19,796***	***20,224***	***25,407***	***25,194***	***25,118***	***25,162***
Non-Road Gasoline	10,946	11,754	12,760	13,659	15,021	15,394	15,738	16,081	16,424	16,765	17,112	22,012	21,773	21,657	21,717
recreational	*268*	*283*	*299*	*312*	*321*	*355*	*361*	*366*	*371*	*374*	*382*	*1,376*	*1,359*	*1,355*	*1,357*
construction	*358*	*393*	*527*	*603*	*603*	*603*	*602*	*602*	*602*	*602*	*602*	*723*	*688*	*674*	*667*
industrial	*535*	*586*	*709*	*807*	*740*	*723*	*707*	*690*	*674*	*657*	*640*	*864*	*823*	*793*	*767*
lawn & garden	*5,899*	*6,324*	*6,764*	*7,166*	*8,023*	*8,237*	*8,451*	*8,665*	*8,880*	*9,094*	*9,308*	*11,330*	*11,243*	*11,073*	*11,063*
farm	*202*	*267*	*338*	*372*	*407*	*416*	*424*	*433*	*442*	*450*	*459*	*340*	*343*	*346*	*349*
light commercial	*1,905*	*1,997*	*2,095*	*2,263*	*2,754*	*2,877*	*3,000*	*3,123*	*3,246*	*3,369*	*3,491*	*3,992*	*4,061*	*4,138*	*4,187*
logging	*10*	*23*	*28*	*31*	*47*	*50*	*54*	*58*	*62*	*66*	*69*	*1,160*	*1,012*	*1,016*	*1,067*
airport service	*6*	*8*	*9*	*10*	*10*	*10*	*10*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*
railway maintenance	*NA*	*NA*	*NA*	*5*	*6*	*6*	*6*	*6*	*6*	*6*	*7*	*7*	*7*	*7*	*6*
recreational marine vessels	*1,763*	*1,873*	*1,990*	*2,090*	*2,112*	*2,117*	*2,122*	*2,128*	*2,133*	*2,138*	*2,144*	*2,211*	*2,228*	*2,244*	*2,247*

Table A-2. National Carbon Monoxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (cont.)

Source Category	**1970**	**1975**	**1980**	**1985**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Non-Road Diesel	430	650	829	900	1,062	1,098	1,134	1,169	1,204	1,238	1,269	1,386	1,377	1,352	1,302
recreational	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*5*	*5*	*5*	*5*
construction	*254*	*362*	*479*	*534*	*637*	*662*	*688*	*714*	*739*	*763*	*785*	*878*	*869*	*846*	*802*
industrial	*88*	*69*	*83*	*105*	*121*	*124*	*127*	*130*	*134*	*138*	*142*	*149*	*151*	*151*	*151*
lawn & garden	*6*	*12*	*13*	*14*	*26*	*29*	*32*	*34*	*37*	*39*	*42*	*47*	*50*	*53*	*53*
farm	*16*	*138*	*174*	*142*	*163*	*166*	*168*	*170*	*172*	*174*	*175*	*165*	*163*	*161*	*156*
light commercial	*20*	*27*	*28*	*34*	*44*	*46*	*48*	*49*	*51*	*52*	*54*	*62*	*64*	*67*	*72*
logging	*43*	*38*	*49*	*61*	*58*	*58*	*58*	*57*	*57*	*56*	*55*	*63*	*58*	*52*	*46*
airport service	*1*	*1*	*1*	*2*	*3*	*4*	*4*	*5*	*5*	*5*	*6*	*7*	*7*	*8*	*8*
railway maintenance	*UA*	*UA*	*UA*	*1*	*2*	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*
recreational marine vessels	*UA*	*UA*	*UA*	*3*	*4*	*4*	*4*	*4*	*4*	*4*	*5*	*7*	*7*	*7*	*7*
Aircraft	506	600	743	831	955	904	888	901	905	915	942	949	958	995	1,002
Marine Vessels	23	28	62	73	98	129	136	132	126	127	127	132	135	137	138
coal	*2*	*2*	*4*	*5*	*7*	*4*	*4*	*4*	*4*	*5*	*4*	*4*	*4*	*4*	*5*
diesel	*21*	*25*	*57*	*67*	*90*	*80*	*83*	*79*	*75*	*76*	*77*	*127*	*129*	*130*	*131*
residual oil	*0*	*0*	*1*	*1*	*2*	*11*	*11*	*12*	*12*	*12*	*10*	*0*	*0*	*0*	*0*
gasoline	*NA*	*NA*	*NA*	*NA*	*NA*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*31*	*36*	*35*	*33*	*33*	*34*	*0*	*0*	*0*	*0*
Railroads	65	77	96	106	121	121	120	125	120	114	114	117	121	120	119
Non-Road Other	0	0	0	430	522	545	568	591	614	637	660	810	831	858	883
liquified petroleum gas	*NA*	*NA*	*NA*	*288*	*376*	*398*	*420*	*442*	*464*	*486*	*508*	*704*	*724*	*749*	*773*
compressed natural gas	*NA*	*NA*	*NA*	*142*	*146*	*147*	*148*	*149*	*150*	*151*	*152*	*106*	*108*	*109*	*111*
Miscellaneous	**7,909**	**5,263**	**8,344**	**7,927**	**8,153**	**11,122**	**8,618**	**6,934**	**7,082**	**9,656**	**7,298**	**10,534**	**12,534**	**9,364**	**9,378**
Agriculture & Forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Other Combustion	7,909	5,263	8,344	7,927	8,153	11,122	8,618	6,934	7,082	9,656	7,298	10,534	12,534	9,364	9,378
structural fires	*101*	*258*	*217*	*242*	*242*	*78*	*80*	*81*	*82*	*83*	*84*	*80*	*78*	*79*	*85*
agricultural fires	*873*	*539*	*501*	*396*	*571*	*415*	*413*	*421*	*415*	*441*	*465*	*454*	*464*	*471*	*479*
slash/prescribed burning	*1,146*	*2,268*	*2,226*	*4,332*	*4,332*	*4,668*	*4,666*	*4,729*	*4,966*	*4,990*	*5,252*	*5,402*	*5,769*	*6,152*	*6,152*
forest wildfires	*5,620*	*2,165*	*5,396*	*2,957*	*3,009*	*5,928*	*3,430*	*1,674*	*1,586*	*4,114*	*1,469*	*4,574*	*6,200*	*2,638*	*2,638*
other	*169*	*34*	*4*	*NA*	*NA*	*32*	*28*	*30*	*34*	*28*	*28*	*22*	*23*	*23*	*24*
Health Services	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	0	0	0
Cooling Towers	NA	NA	NA	NA	NA	NA	0	0	NA	0	0	0	0	0	0
Fugitive Dust	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
TOTAL ALL SOURCES	**129,444**	**116,757**	**117,434**	**117,013**	**106,439**	**99,119**	**101,797**	**99,007**	**99,791**	**103,713**	**94,058**	**101,294**	**101,459**	**96,872**	**97,441**

Note: Some columns may not sum to totals due to rounding.

Table A-3. National Lead Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (short tons)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**10,616**	**10,347**	**4,299**	**515**	**505**	**500**	**495**	**491**	**497**	**496**	**490**	**492**	**493**	**494**	**501**
FUEL COMB. ELEC. UTIL.	***327***	***230***	***129***	***64***	***67***	***64***	***61***	***59***	***62***	***62***	***57***	***61***	***64***	***69***	***72***
Coal	300	189	95	51	46	46	46	47	50	50	50	53	54	55	56
bituminous	*181*	*114*	*57*	*31*	*28*	*28*	*28*	*28*	*30*	*30*	*30*	*32*	*33*	*33*	*34*
subbituminous	*89*	*56*	*28*	*15*	*14*	*14*	*14*	*14*	*15*	*15*	*15*	*16*	*16*	*16*	*17*
anthracite & lignite	*30*	*19*	*9*	*5*	*4*	*4*	*4*	*4*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
Oil	28	41	34	13	21	18	15	12	12	12	7	8	10	14	16
residual	*27*	*40*	*34*	*13*	*21*	*18*	*15*	*12*	*12*	*12*	*7*	*8*	*10*	*14*	*16*
distillate	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
FUEL COMB. INDUSTRIAL	***237***	***75***	***60***	***30***	***18***	***18***	***18***	***18***	***19***	***19***	***18***	***16***	***16***	***15***	***17***
Coal	218	60	45	22	14	14	15	14	14	14	14	13	14	13	13
bituminous	*146*	*40*	*31*	*15*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*9*	*9*	*9*	*9*
subbituminous	*45*	*12*	*10*	*5*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
anthracite & lignite	*27*	*7*	*4*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Oil	19	16	14	8	4	3	3	4	5	5	4	3	2	2	3
residual	*17*	*14*	*14*	*7*	*3*	*3*	*2*	*3*	*4*	*4*	*3*	*2*	*2*	*1*	*3*
distillate	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
FUEL COMB. OTHER	***10,052***	***10,042***	***4,111***	***421***	***420***	***418***	***416***	***414***	***416***	***415***	***415***	***415***	***413***	***410***	***412***
Commercial/Institutional Coal	1	16	12	6	4	4	3	4	4	3	4	5	5	4	4
bituminous	*1*	*6*	*6*	*4*	*3*	*3*	*2*	*2*	*2*	*2*	*2*	*3*	*3*	*2*	*2*
subbituminous	*NA*	*2*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
anthracite, lignite	*NA*	*7*	*4*	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*1*	*1*	*1*
Commercial/Institutional Oil	4	11	10	4	4	4	4	4	4	4	3	3	2	2	3
residual	*3*	*10*	*9*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*1*	*3*
distillate	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*1*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*
Misc. Fuel Comb. (Except Residential)	10,000	10,000	4,080	400	400	400	400	400	400	400	400	400	400	400	400
Residential Other	47	16	9	11	12	10	9	7	8	8	8	7	6	5	5
Inustrial Processes	**28,554**	**12,976**	**5,148**	**3,402**	**3,161**	**3,278**	**3,081**	**2,736**	**2,872**	**3,007**	**2,875**	**3,061**	**3,121**	**3,045**	**3,162**
CHEMICAL & ALLIED PRODUCT MFG	***103***	***120***	***104***	***118***	***136***	***136***	***132***	***93***	***92***	***96***	***163***	***167***	***188***	***194***	***218***
Inorganic Chemical Mfg	103	120	104	118	136	136	132	93	92	96	163	167	188	194	218
lead oxide and pigments	*103*	*120*	*104*	*118*	*136*	*136*	*132*	*93*	*92*	*96*	*163*	*167*	*188*	*194*	*218*
METALS PROCESSING	***24,224***	***9,923***	***3,026***	***2,097***	***2,088***	***2,170***	***1,974***	***1,774***	***1,900***	***2,027***	***2,049***	***2,055***	***2,081***	***1,991***	***2,078***
Nonferrous Metals Processing	15,869	7,192	1,826	1,376	1,337	1,409	1,258	1,112	1,210	1,287	1,337	1,333	1,342	1,259	1,329
primary lead production	*12,134*	*5,640*	*1,075*	*874*	*715*	*728*	*623*	*550*	*637*	*633*	*674*	*588*	*619*	*608*	*623*
primary copper production	*242*	*171*	*20*	*19*	*19*	*19*	*19*	*20*	*21*	*22*	*21*	*22*	*24*	*25*	*25*
primary zinc production	*1,019*	*224*	*24*	*16*	*9*	*9*	*11*	*11*	*13*	*12*	*12*	*13*	*13*	*12*	*12*
secondary lead production	*1,894*	*821*	*481*	*288*	*433*	*449*	*414*	*336*	*341*	*405*	*432*	*514*	*484*	*413*	*465*
secondary copper production	*374*	*200*	*116*	*70*	*37*	*75*	*65*	*73*	*70*	*76*	*79*	*76*	*82*	*78*	*81*
lead battery manufacture	*41*	*49*	*50*	*65*	*74*	*78*	*77*	*77*	*81*	*94*	*102*	*103*	*107*	*110*	*117*
lead cable coating	*127*	*55*	*37*	*43*	*50*	*50*	*48*	*44*	*47*	*44*	*16*	*16*	*14*	*13*	*4*
other	*38*	*32*	*24*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

Table A-3. National Lead Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (short tons) (continued)

Source Category	**1970**	**1975**	**1980**	**1985**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Ferrous Metals Processing	7,395	2,196	911	577	582	576	517	461	496	540	528	529	538	536	555
coke manufacturing	*11*	*8*	*6*	*3*	*4*	*4*	*3*	*3*	*2*	*0*	*0*	*0*	*0*	*0*	*0*
ferroalloy production	*219*	*104*	*13*	*7*	*20*	*18*	*14*	*14*	*12*	*13*	*8*	*8*	*8*	*7*	*6*
iron production	*266*	*93*	*38*	*21*	*19*	*18*	*16*	*17*	*18*	*18*	*19*	*18*	*18*	*18*	*18*
steel production	*3,125*	*1,082*	*481*	*209*	*138*	*138*	*145*	*139*	*145*	*160*	*159*	*160*	*165*	*168*	*173*
gray iron production	*3,773*	*910*	*373*	*336*	*401*	*397*	*339*	*288*	*319*	*349*	*342*	*343*	*348*	*343*	*357*
Metals Processing NEC	960	535	289	144	170	185	199	202	194	200	184	193	201	196	195
metal mining	*353*	*268*	*207*	*141*	*169*	*184*	*198*	*201*	*193*	*199*	*183*	*192*	*200*	*195*	*194*
other	*606*	*268*	*82*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
OTHER INDUSTRIAL PROCESSES	***2,028***	***1,337***	***808***	***316***	***173***	***169***	***167***	***56***	***55***	***54***	***59***	***51***	***54***	***54***	***53***
Mineral Products	540	217	93	43	23	26	24	26	27	28	29	29	30	30	31
cement manufacturing	*540*	*217*	*93*	*43*	*23*	*26*	*24*	*26*	*27*	*28*	*29*	*29*	*30*	*30*	*31*
Miscellaneous Industrial Processes	1,488	1,120	715	273	150	143	143	30	28	26	30	22	25	23	22
WASTE DISPOSAL & RECYCLING	***2,200***	***1,595***	***1,210***	***871***	***765***	***804***	***808***	***812***	***825***	***830***	***604***	***788***	***798***	***806***	***813***
Incineration	2,200	1,595	1,210	871	765	804	808	812	825	830	604	788	798	806	813
municipal waste	*581*	*396*	*161*	*79*	*45*	*67*	*70*	*68*	*69*	*68*	*70*	*76*	*76*	*76*	*77*
other	*1,619*	*1,199*	*1,049*	*792*	*720*	*738*	*738*	*744*	*756*	*762*	*534*	*712*	*722*	*729*	*736*
Transportation	**181,698**	**136,336**	**64,706**	**18,973**	**1,802**	**1,197**	**592**	**584**	**547**	**544**	**564**	**525**	**523**	**518**	**536**
ON-ROAD VEHICLES	***171,961***	***130,206***	***60,501***	***18,052***	***982***	***421***	***18***	***18***	***19***	***19***	***19***	***19***	***20***	***21***	***22***
Light-Duty Gas Vehicles & Motorcycles	142,918	106,868	47,184	13,637	733	314	13	14	14	14	14	12	13	14	14
Light-Duty Gas Trucks	22,683	19,440	11,671	4,061	232	100	4	4	5	5	5	7	7	7	7
Heavy-Duty Gas Vehicles	6,361	3,898	1,646	354	16	7	0	0	0	0	0	0	0	1	1
NON-ROAD ENGINES AND VEHICLES	***9,737***	***6,130***	***4,205***	***921***	***820***	***776***	***574***	***565***	***529***	***525***	***544***	***505***	***503***	***497***	***515***
Non-Road Gasoline	8,340	5,012	3,320	229	166	158	0	0	0	0	0	0	0	0	0
Aircraft	1,397	1,118	885	692	655	619	574	565	528	525	544	505	503	497	515
TOTAL ALL SOURCES	**220,869**	**159,659**	**74,153**	**22,890**	**5,468**	**4,975**	**4,169**	**3,810**	**3,916**	**4,047**	**3,929**	**4,077**	**4,137**	**4,057**	**4,199**

Note: Some columns may not sum to totals due to rounding.

Table A-4. National Nitrogen Oxides Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**10,061**	**10,486**	**11,320**	**10,048**	**10,537**	**10,895**	**10,779**	**10,928**	**11,111**	**11,015**	**10,827**	**10,523**	**10,576**	**10,396**	**10,026**
FUEL COMB. ELEC. UTIL.	***4,900***	***5,694***	***7,024***	***6,127***	***6,593***	***6,663***	***6,519***	***6,504***	***6,651***	***6,565***	***6,384***	***6,141***	***6,279***	***6,231***	***5,715***
Coal	3,888	4,828	6,123	5,240	5,676	5,642	5,559	5,579	5,744	5,636	5,579	5,574	5,644	5,436	4,935
bituminous	*2,112*	*2,590*	*3,439*	*4,378*	*4,595*	*4,532*	*4,435*	*4,456*	*4,403*	*4,207*	*3,830*	*3,776*	*3,828*	*3,635*	*3,229*
subbituminous	*1,041*	*1,276*	*1,694*	*668*	*837*	*857*	*874*	*868*	*1,087*	*1,167*	*1,475*	*1,570*	*1,591*	*1,575*	*1,504*
anthracite & lignite	*344*	*414*	*542*	*194*	*245*	*254*	*250*	*255*	*255*	*262*	*273*	*229*	*225*	*226*	*202*
other	*391*	*548*	*447*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*
Oil	1,012	866	901	193	285	221	212	170	180	163	96	118	145	223	202
residual	*40*	*101*	*39*	*178*	*268*	*207*	*198*	*158*	*166*	*149*	*94*	*116*	*142*	*220*	*199*
distillate	*972*	*765*	*862*	*15*	*17*	*14*	*14*	*13*	*14*	*14*	*2*	*2*	*2*	*3*	*3*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*
Gas	NA	NA	NA	646	582	565	580	579	551	591	562	285	319	381	385
natural	*NA*	*NA*	*NA*	*646*	*582*	*565*	*580*	*579*	*551*	*591*	*562*	*273*	*306*	*363*	*367*
process	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*12*	*13*	*19*	*18*
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	7	27	26
Internal Combustion	NA	NA	NA	48	49	235	168	175	176	175	148	158	165	164	167
FUEL COMB. INDUSTRIAL	***4,325***	***4,007***	***3,555***	***3,209***	***3,209***	***3,035***	***2,979***	***3,071***	***3,151***	***3,147***	***3,144***	***3,157***	***3,102***	***3,051***	***3,136***
Coal	771	520	444	608	615	585	570	574	589	602	597	543	537	524	542
bituminous	*532*	*359*	*306*	*430*	*446*	*399*	*387*	*405*	*413*	*420*	*412*	*369*	*364*	*357*	*370*
subbituminous	*164*	*111*	*94*	*14*	*14*	*18*	*20*	*21*	*28*	*38*	*46*	*46*	*46*	*44*	*46*
anthracite & lignite	*75*	*51*	*44*	*33*	*30*	*26*	*26*	*26*	*26*	*27*	*26*	*19*	*19*	*18*	*18*
other	*NA*	*NA*	*NA*	*131*	*124*	*141*	*137*	*122*	*122*	*117*	*112*	*109*	*108*	*105*	*108*
Oil	332	354	286	309	294	265	237	244	245	241	247	225	216	209	214
residual	*228*	*186*	*179*	*191*	*176*	*180*	*146*	*154*	*153*	*149*	*156*	*141*	*130*	*126*	*129*
distillate	*104*	*112*	*63*	*89*	*88*	*71*	*73*	*73*	*75*	*76*	*73*	*73*	*74*	*72*	*73*
other	*NA*	*56*	*44*	*29*	*29*	*14*	*18*	*17*	*17*	*17*	*17*	*11*	*12*	*11*	*11*
Gas	3,060	2,983	2,619	1,520	1,625	1,182	1,250	1,301	1,330	1,333	1,324	1,205	1,189	1,175	1,202
natural	*3,053*	*2,837*	*2,469*	*1,282*	*1,405*	*967*	*1,025*	*1,068*	*1,095*	*1,103*	*1,102*	*993*	*970*	*958*	*985*
process	*8*	*5*	*5*	*227*	*209*	*211*	*222*	*230*	*233*	*228*	*220*	*210*	*216*	*215*	*214*
other	*NA*	*140*	*145*	*11*	*10*	*3*	*3*	*3*	*2*	*2*	*2*	*3*	*3*	*3*	*3*
Other	162	149	205	118	120	131	129	126	124	124	123	120	115	115	118
wood/bark waste	*102*	*108*	*138*	*89*	*92*	*89*	*82*	*82*	*83*	*83*	*84*	*83*	*79*	*80*	*82*
liquid waste	*NA*	*NA*	*NA*	*12*	*12*	*8*	*11*	*10*	*11*	*11*	*11*	*9*	*8*	*8*	*8*
other	*60*	*41*	*67*	*17*	*16*	*34*	*36*	*34*	*30*	*30*	*28*	*29*	*28*	*27*	*28*
Internal Combustion	NA	NA	NA	655	556	874	793	825	863	846	854	1,064	1,045	1,028	1,059
FUEL COMB. OTHER	***836***	***785***	***741***	***712***	***736***	***1,196***	***1,281***	***1,353***	***1,308***	***1,303***	***1,298***	***1,225***	***1,195***	***1,114***	***1,175***
Commercial/Institutional Coal	23	33	25	37	38	40	36	38	40	40	38	34	35	37	37
Commercial/Institutional Oil	210	176	155	106	106	97	88	93	93	95	103	96	97	80	80
Commercial/Institutional Gas	120	125	131	145	159	200	210	225	232	237	231	247	252	243	266
Misc. Fuel Comb. (Except Residential)	NA	NA	NA	11	11	34	32	28	31	31	30	27	28	29	28
Residential Wood	44	39	74	88	75	46	50	53	45	44	49	51	43	38	40
Residential Other	439	412	356	326	347	780	865	916	867	857	847	770	740	688	723
distillate oil	*118*	*113*	*85*	*75*	*78*	*209*	*211*	*210*	*210*	*210*	*210*	*193*	*188*	*172*	*175*
natural gas	*242*	*246*	*238*	*248*	*267*	*449*	*469*	*489*	*513*	*516*	*519*	*470*	*437*	*400*	*433*
other	*79*	*54*	*33*	*3*	*3*	*121*	*185*	*218*	*144*	*131*	*118*	*108*	*114*	*117*	*116*

Table A-4. National Nitrogen Oxides Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Industrial Processes	**1,215**	**697**	**666**	**891**	**852**	**892**	**816**	**857**	**861**	**878**	**873**	**903**	**939**	**950**	**942**
CHEMICAL & ALLIED PRODUCT MFG	***271***	***221***	***213***	***262***	***273***	***168***	***165***	***163***	***155***	***160***	***158***	***125***	***127***	***129***	***131***
Organic Chemical Mfg	70	53	54	37	42	18	22	22	19	20	20	21	21	21	21
Inorganic Chemical Mfg	201	168	159	22	18	12	12	10	5	6	7	6	6	6	6
Polymer & Resin Mfg	NA	NA	NA	22	23	6	6	6	5	5	4	3	3	3	3
Agricultural Chemical Mfg	NA	NA	NA	143	152	80	77	76	74	76	74	50	51	52	53
Paint, Varnish, Lacquer, Enamel Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Other Chemical Mfg	NA	NA	NA	38	39	52	48	50	51	54	54	45	46	47	47
METALS PROCESSING	***77***	***73***	***65***	***87***	***83***	***97***	***76***	***81***	***83***	***91***	***98***	***83***	***88***	***88***	***88***
Nonferrous Metals Processing	NA	NA	NA	16	15	14	15	13	12	12	12	11	12	12	12
Ferrous Metals Processing	77	73	65	58	54	78	56	62	67	75	83	66	71	71	70
Metals Processing NEC	NA	NA	NA	13	14	6	5	6	4	4	4	6	6	6	6
PETROLEUM & RELATED INDUSTRIES	***240***	***63***	***72***	***124***	***97***	***153***	***121***	***148***	***123***	***117***	***110***	***139***	***143***	***143***	***143***
Oil & Gas Production	NA	NA	NA	69	47	104	65	68	70	63	58	86	88	88	88
Petroleum Refineries & Related Ind.	240	63	72	55	49	47	52	76	49	49	48	47	48	48	48
Asphalt Manufacturing	NA	NA	NA	1	1	3	4	4	5	5	5	7	7	7	7
OTHER INDUSTRIAL PROCESSES	***187***	***182***	***205***	***327***	***311***	***378***	***352***	***361***	***370***	***389***	***399***	***438***	***460***	***467***	***470***
Agriculture, Food, & Kindred Products	NA	NA	NA	5	5	3	3	3	4	3	6	5	5	5	5
Textiles, Leather, & Apparel Products	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
Wood, Pulp & Paper, & Pub. Prod.	18	18	24	73	77	91	88	86	86	89	89	86	89	91	93
Rubber & Miscellaneous Plastic Prod.	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Products	169	164	181	239	220	270	249	259	267	281	287	331	350	355	356
cement mfg	*97*	*89*	*98*	*137*	*124*	*151*	*131*	*139*	*143*	*150*	*153*	*200*	*212*	*214*	*213*
glass mfg	*48*	*53*	*60*	*48*	*45*	*59*	*59*	*61*	*64*	*66*	*67*	*69*	*74*	*76*	*78*
other	*24*	*23*	*23*	*54*	*51*	*61*	*59*	*60*	*60*	*64*	*66*	*62*	*64*	*65*	*65*
Machinery Products	NA	NA	NA	2	2	3	2	2	3	6	7	2	3	3	3
Electronic Equipment	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	NA	NA	NA	8	7	10	10	10	9	9	10	12	12	12	12
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***2***	***3***	***1***	***2***	***3***	***3***	***3***	***3***	***2***	***3***	***3***	***3***
Degreasing	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	1	1	1	1	1	1	1	1	1
Dry Cleaning	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Surface Coating	NA	NA	NA	2	2	1	2	2	2	2	2	2	2	2	2
Other Industrial	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Nonindustrial	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Solvent Utilization NEC	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***2***	***2***	***3***	***6***	***5***	***5***	***5***	***6***	***15***	***16***	***16***	***16***
Bulk Terminals & Plants	NA	NA	NA	NA	NA	0	1	1	1	1	1	2	2	2	2
Petroleum & Petroleum Prod. Storage	NA	NA	NA	1	1	2	2	0	0	0	0	7	8	8	8
Petroleum & Petroleum Prod. Trans.	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0
Organic Chemical Storage	NA	NA	NA	1	1	0	2	3	3	3	4	4	4	4	4
Organic Chemical Transport	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	0	1	0	0	0	0	0	1	2	2	2	2

Table A-4. National Nitrogen Oxides Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WASTE DISPOSAL & RECYCLING	***440***	***159***	***111***	***87***	***84***	***91***	***95***	***96***	***123***	***114***	***99***	***101***	***102***	***104***	***91***
Incineration	110	56	37	27	31	49	51	51	74	65	53	56	56	57	58
Open Burning	330	103	74	59	52	42	43	43	44	44	44	42	42	43	30
POTW	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	1	1	1	1	2	2	2	2
Other	NA	NA	NA	0	0	0	1	1	4	3	1	1	1	1	1
Transportation	**9,322**	**11,284**	**12,150**	**11,948**	**12,210**	**12,014**	**12,457**	**12,692**	**12,902**	**13,191**	**13,085**	**14,211**	**14,436**	**14,355**	**14,105**
ON-ROAD VEHICLES	***7,390***	***8,645***	***8,621***	***8,089***	***7,682***	***7,210***	***7,557***	***7,759***	***7,960***	***8,176***	***7,956***	***8,793***	***8,924***	***8,816***	***8,590***
Light-Duty Gas Vehicles & Motorcycles	4,158	4,725	4,421	3,806	3,494	3,013	3,069	3,098	3,117	3,173	3,043	3,006	2,996	2,933	2,859
light-duty gas vehicles	*4,156*	*4,722*	*4,416*	*3,797*	*3,483*	*3,002*	*3,058*	*3,086*	*3,105*	*3,161*	*3,031*	*2,994*	*2,983*	*2,920*	*2,846*
motorcycles	*2*	*3*	*5*	*9*	*11*	*11*	*11*	*12*	*12*	*13*	*12*	*12*	*12*	*12*	*13*
Light-Duty Gas Trucks	1,278	1,461	1,408	1,530	1,386	1,552	1,839	2,004	2,131	2,160	1,991	1,709	1,742	1,703	1,638
light-duty gas trucks 1	*725*	*819*	*864*	*926*	*803*	*901*	*1,074*	*1,171*	*1,242*	*1,251*	*1,183*	*1,166*	*1,185*	*1,157*	*1,110*
light-duty gas trucks 2	*553*	*642*	*544*	*603*	*584*	*651*	*766*	*833*	*888*	*909*	*809*	*543*	*557*	*546*	*529*
Heavy-Duty Gas Vehicles	278	319	300	330	343	306	321	309	316	351	330	518	505	467	459
Diesels	1,676	2,141	2,493	2,423	2,458	2,340	2,328	2,347	2,397	2,492	2,591	3,560	3,680	3,713	3,635
heavy-duty diesel vehicles	*1,676*	*2,118*	*2,463*	*2,389*	*2,416*	*2,248*	*2,284*	*2,302*	*2,351*	*2,446*	*2,544*	*3,538*	*3,662*	*3,698*	*3,620*
light-duty diesel trucks	*NA*	*NA*	*5*	*6*	*7*	*63*	*11*	*11*	*12*	*12*	*13*	*8*	*7*	*6*	*6*
light-duty diesel vehicles	*NA*	*23*	*25*	*28*	*35*	*28*	*33*	*33*	*33*	*34*	*34*	*14*	*11*	*9*	*8*
NON-ROAD ENGINES AND VEHICLES	***1,931***	***2,638***	***3,529***	***3,859***	***4,528***	***4,804***	***4,900***	***4,934***	***4,942***	***5,015***	***5,128***	***5,418***	***5,512***	***5,539***	***5,515***
Non-Road Gasoline	85	92	101	108	114	120	121	123	124	126	127	142	160	176	187
recreational	*1*	*1*	*1*	*1*	*1*	*6*	*6*	*6*	*6*	*6*	*6*	*7*	*8*	*8*	*8*
construction	*2*	*3*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*5*	*6*	*6*
industrial	*10*	*10*	*13*	*14*	*13*	*12*	*12*	*12*	*11*	*11*	*11*	*14*	*14*	*14*	*13*
lawn & garden	*26*	*28*	*29*	*31*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*51*	*61*	*71*	*78*
farm	*3*	*3*	*5*	*5*	*5*	*6*	*6*	*6*	*6*	*6*	*6*	*4*	*4*	*4*	*4*
light commercial	*10*	*10*	*11*	*12*	*14*	*15*	*16*	*16*	*17*	*18*	*18*	*22*	*27*	*31*	*34*
logging	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*4*	*5*	*5*
airport service	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
railway maintenance	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
recreational marine vessels	*34*	*36*	*38*	*40*	*41*	*41*	*41*	*41*	*41*	*41*	*41*	*37*	*37*	*37*	*37*
Non-Road Diesel	1,109	1,666	2,125	2,155	2,472	2,513	2,552	2,595	2,640	2,687	2,739	2,746	2,760	2,751	2,707
recreational	*0*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*5*	*5*	*5*	*5*
construction	*436*	*639*	*843*	*943*	*1,083*	*1,102*	*1,120*	*1,138*	*1,156*	*1,174*	*1,198*	*1,267*	*1,273*	*1,267*	*1,247*
industrial	*217*	*160*	*193*	*244*	*270*	*268*	*265*	*265*	*268*	*270*	*274*	*240*	*242*	*241*	*237*
lawn & garden	*9*	*18*	*19*	*22*	*40*	*45*	*50*	*54*	*59*	*64*	*69*	*70*	*76*	*81*	*83*
farm	*350*	*728*	*926*	*755*	*877*	*898*	*917*	*936*	*953*	*970*	*987*	*935*	*934*	*926*	*906*
light commercial	*31*	*43*	*44*	*54*	*72*	*77*	*82*	*87*	*91*	*96*	*101*	*109*	*114*	*119*	*123*
logging	*65*	*74*	*94*	*118*	*101*	*94*	*88*	*82*	*79*	*77*	*75*	*79*	*73*	*67*	*61*
airport service	*2*	*2*	*2*	*3*	*6*	*7*	*7*	*8*	*8*	*9*	*9*	*10*	*10*	*10*	*10*
railway maintenance	*UA*	*UA*	*UA*	*2*	*3*	*3*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
recreational marine vessels	*UA*	*UA*	*UA*	*13*	*16*	*17*	*17*	*18*	*19*	*19*	*20*	*28*	*29*	*30*	*31*
Aircraft	72	85	106	119	138	158	155	156	156	161	165	167	168	174	175

Table A-4. National Nitrogen Oxides Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	**1970**	**1975**	**1980**	**1985**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Marine Vessels	171	207	467	557	747	943	995	961	917	929	936	970	985	996	1,007
coal	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
diesel	*144*	*175*	*396*	*469*	*628*	*630*	*649*	*621*	*593*	*604*	*615*	*960*	*974*	*984*	*995*
residual oil	*26*	*31*	*71*	*87*	*118*	*114*	*115*	*116*	*114*	*115*	*105*	*0*	*0*	*0*	*0*
gasoline	*NA*	*NA*	*NA*	*NA*	*NA*	*10*	*10*	*9*	*9*	*9*	*10*	*10*	*10*	*11*	*12*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*190*	*221*	*214*	*201*	*201*	*206*	*0*	*0*	*0*	*0*
Railroads	495	589	731	808	923	929	929	946	945	947	990	1,183	1,222	1,215	1,204
Non-Road Other	0	0	0	112	135	141	147	153	159	165	171	210	218	227	235
liquified petroleum gas	*NA*	*NA*	*NA*	*75*	*98*	*103*	*109*	*115*	*120*	*126*	*132*	*183*	*190*	*199*	*206*
compressed natural gas	*NA*	*NA*	*NA*	*37*	*38*	*38*	*38*	*39*	*39*	*39*	*39*	*27*	*28*	*28*	*29*
Miscellaneous	**330**	**165**	**248**	**310**	**293**	**369**	**286**	**255**	**241**	**390**	**267**	**416**	**402**	**319**	**320**
Agriculture and Forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
agricultural livestock	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*
Other Combustion	330	165	248	310	293	368	285	253	240	388	265	416	402	319	320
Health Services	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Cooling Towers	NA	NA	NA	NA	NA	NA	NA	0	NA	0	0	0	0	0	0
Fugitive Dust	NA	NA	NA	NA	NA	1	1	1	1	1	1	0	0	0	0
TOTAL ALL SOURCES	**20,928**	**22,632**	**24,384**	**23,198**	**23,893**	**24,170**	**24,338**	**24,732**	**25,116**	**25,474**	**25,051**	**26,053**	**26,352**	**26,020**	**25,393**

Note: Some columns may not sum to totals due to rounding.

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**722**	**660**	**1,050**	**1,570**	**1,372**	**1,005**	**1,075**	**1,114**	**993**	**989**	**1,073**	**1,072**	**935**	**858**	**904**
FUEL COMB. ELEC. UTIL.	***30***	***40***	***45***	***32***	***37***	***47***	***44***	***44***	***45***	***45***	***44***	***50***	***52***	***56***	***56***
Coal	18	22	31	24	27	27	27	27	29	29	29	28	29	29	29
Oil	7	14	9	5	7	6	5	4	4	4	3	3	4	5	5
Gas	5	4	5	2	2	2	2	2	2	2	2	8	8	10	9
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1	1
Internal Combustion	NA	NA	NA	1	1	12	10	10	10	10	10	10	11	11	11
FUEL COMB. INDUSTRIAL	***150***	***150***	***157***	***134***	***134***	***182***	***196***	***187***	***186***	***196***	***206***	***179***	***175***	***174***	***178***
Coal	4	3	3	7	7	7	6	7	6	8	6	7	7	7	7
Oil	4	5	3	17	16	12	11	12	12	12	12	9	8	8	8
Gas	77	71	62	57	61	58	60	52	51	63	73	59	59	59	60
Other	65	71	89	35	36	51	51	49	51	50	50	35	34	34	35
Internal Combustion	NA	NA	NA	18	15	54	68	66	66	64	65	69	68	67	69
FUEL COMB. OTHER	***541***	***470***	***848***	***1,403***	***1,200***	***776***	***835***	***884***	***762***	***748***	***823***	***843***	***708***	***628***	***670***
Commercial/Institutional Coal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Commercial/Institutional Oil	4	3	3	4	4	3	3	3	3	3	3	3	3	3	3
Commercial/Institutional Gas	6	7	7	6	7	8	8	10	11	11	11	14	14	13	15
Misc. Fuel Comb. (Except Residential)	NA	NA	NA	4	4	8	8	8	9	9	8	9	9	9	10
Residential Wood	460	420	809	1,372	1,169	718	776	822	698	684	759	779	645	569	608
fireplaces	*460*	*420*	*809*	*1,372*	*1,169*	*718*	*776*	*822*	*698*	*684*	*759*	*680*	*549*	*478*	*512*
woodstoves	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*41*	*39*	*37*	*39*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*59*	*57*	*54*	*57*
Residential Other	70	38	28	16	15	38	39	40	40	40	41	36	35	33	34
Inudstrial Processes	**14,310**	**12,081**	**12,861**	**10,474**	**10,755**	**10,000**	**10,178**	**10,380**	**10,578**	**10,738**	**10,780**	**8,540**	**8,761**	**8,304**	**7,996**
CHEMICAL & ALLIED PRODUCT MFG	***1,341***	***1,351***	***1,595***	***881***	***980***	***634***	***710***	***715***	***701***	***691***	***660***	***387***	***388***	***394***	***395***
Organic Chemical Mfg	629	751	884	349	387	192	216	211	215	217	210	131	133	136	138
ethylene oxide mfg	*8*	*9*	*10*	*2*	*2*	*0*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*
phenol mfg	*NA*	*NA*	*NA*	*0*	*0*	*4*	*4*	*4*	*4*	*4*	*2*	*2*	*2*	*2*	*2*
terephthalic acid mfg	*29*	*46*	*60*	*24*	*27*	*20*	*23*	*17*	*19*	*21*	*17*	*11*	*11*	*11*	*11*
ethylene mfg	*70*	*79*	*111*	*28*	*33*	*9*	*11*	*10*	*10*	*9*	*10*	*5*	*5*	*5*	*5*
charcoal mfg	*48*	*29*	*40*	*37*	*45*	*33*	*33*	*33*	*33*	*34*	*33*	*30*	*31*	*31*	*32*
socmi reactor	*81*	*96*	*118*	*43*	*49*	*26*	*30*	*30*	*32*	*33*	*33*	*27*	*28*	*28*	*29*
socmi distillation	*NA*	*NA*	*NA*	*7*	*7*	*8*	*9*	*8*	*8*	*8*	*8*	*4*	*4*	*4*	*4*
socmi air oxidation processes	*NA*	*NA*	*NA*	*0*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*
socmi fugitives	*194*	*235*	*254*	*179*	*193*	*61*	*67*	*69*	*70*	*70*	*70*	*40*	*41*	*42*	*42*
other	*199*	*257*	*291*	*27*	*30*	*29*	*38*	*37*	*36*	*35*	*34*	*12*	*12*	*12*	*12*
Inorganic Chemical Mfg	65	78	93	3	3	2	3	3	2	2	3	3	3	3	3
Polymer & Resin Mfg	271	299	384	343	389	242	268	283	269	257	222	128	124	126	124
polypropylene mfg	*0*	*0*	*1*	*12*	*13*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
polyethylene mfg	*17*	*18*	*22*	*51*	*57*	*39*	*44*	*45*	*46*	*46*	*35*	*16*	*17*	*17*	*17*
polystyrene resins	*10*	*11*	*15*	*6*	*7*	*4*	*5*	*5*	*5*	*5*	*5*	*5*	*3*	*3*	*3*
synthetic fiber	*112*	*149*	*199*	*217*	*250*	*144*	*161*	*173*	*157*	*143*	*142*	*78*	*80*	*82*	*83*
styrene/butadiene rubber	*77*	*68*	*70*	*45*	*50*	*15*	*15*	*16*	*17*	*18*	*16*	*11*	*7*	*7*	*7*
other	*55*	*54*	*77*	*12*	*13*	*37*	*41*	*42*	*42*	*43*	*22*	*16*	*16*	*16*	*13*
Agricultural Chemical Mfg	NA	NA	NA	11	12	6	7	8	7	6	5	8	8	8	8

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Paint, Varnish, Lacquer, Enamel Mfg	61	66	65	8	8	14	16	17	18	17	18	7	8	8	8
paint & varnish mfg	*61*	*66*	*65*	*8*	*8*	*13*	*15*	*16*	*16*	*16*	*16*	*6*	*6*	*6*	*6*
other	*NA*	*NA*	*NA*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*
Pharmaceutical Mfg	40	55	77	43	48	20	21	24	23	24	38	7	7	7	8
Other Chemical Mfg	275	102	92	125	132	158	179	169	166	168	164	104	105	106	107
carbon black mfg	*275*	*102*	*92*	*26*	*26*	*9*	*17*	*16*	*16*	*21*	*24*	*27*	*28*	*28*	*28*
printing ink mfg	*NA*	*NA*	*NA*	*2*	*3*	*1*	*1*	*1*	*1*	*2*	*2*	*1*	*1*	*1*	*1*
fugitives unclassified	*NA*	*NA*	*NA*	*12*	*12*	*23*	*23*	*21*	*20*	*27*	*30*	*13*	*13*	*13*	*13*
carbon black furnace: fugitives	*NA*	*NA*	*NA*	*4*	*5*	*0*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*
other	*NA*	*NA*	*NA*	*81*	*87*	*125*	*136*	*129*	*127*	*117*	*107*	*63*	*64*	*64*	*65*
METALS PROCESSING	***394***	***336***	***273***	***76***	***74***	***122***	***123***	***124***	***124***	***126***	***125***	***73***	***78***	***78***	***77***
Nonferrous Metals Processing	NA	NA	NA	18	19	18	19	17	18	20	21	19	20	20	20
Ferrous Metals Processing	394	336	273	57	54	98	99	100	98	97	96	44	47	47	46
coke oven door & topside leaks	*216*	*187*	*152*	*12*	*12*	*19*	*22*	*27*	*27*	*26*	*26*	*5*	*6*	*6*	*6*
coke oven by-product plants	*NA*	*NA*	*NA*	*3*	*3*	*7*	*9*	*9*	*9*	*9*	*9*	*5*	*5*	*5*	*5*
other	*177*	*149*	*121*	*41*	*39*	*71*	*68*	*63*	*62*	*62*	*61*	*35*	*37*	*36*	*36*
Metals Processing NEC	NA	NA	NA	1	1	7	6	8	8	8	8	10	11	11	10
PETROLEUM & RELATED INDUSTRIES	***1,194***	***1,342***	***1,440***	***703***	***639***	***612***	***640***	***632***	***649***	***647***	***642***	***477***	***487***	***485***	***424***
Oil & Gas Production	411	378	379	107	68	301	301	297	310	305	299	271	274	272	271
Petroleum Refineries & Related Ind.	773	951	1,045	592	568	308	337	332	336	339	339	201	208	208	149
vaccuum distillation	*24*	*31*	*32*	*15*	*13*	*7*	*7*	*7*	*7*	*7*	*6*	*3*	*3*	*3*	*3*
cracking units	*27*	*27*	*21*	*34*	*31*	*15*	*17*	*16*	*15*	*16*	*16*	*16*	*16*	*16*	*16*
process unit turnarounds	*NA*	*NA*	*NA*	*15*	*13*	*11*	*11*	*11*	*11*	*10*	*12*	*2*	*2*	*2*	*2*
petroleum refinery fugitives	*NA*	*NA*	*NA*	*76*	*65*	*99*	*105*	*103*	*109*	*109*	*111*	*84*	*87*	*86*	*27*
other	*721*	*893*	*992*	*454*	*446*	*177*	*196*	*195*	*194*	*198*	*194*	*97*	*101*	*101*	*101*
Asphalt Manufacturing	11	13	16	3	3	3	3	3	3	3	4	5	5	5	4
OTHER INDUSTRIAL PROCESSES	***270***	***235***	***237***	***390***	***403***	***401***	***391***	***414***	***442***	***438***	***450***	***422***	***438***	***443***	***449***
Agriculture, Food, & Kindred Products	208	182	191	169	175	138	130	127	146	145	147	104	108	109	111
vegetable oil mfg	*59*	*61*	*81*	*46*	*49*	*16*	*18*	*19*	*19*	*16*	*16*	*1*	*1*	*1*	*1*
whiskey fermentation: aging	*105*	*77*	*64*	*24*	*23*	*24*	*16*	*12*	*24*	*24*	*25*	*15*	*16*	*16*	*16*
bakeries	*45*	*44*	*46*	*51*	*51*	*43*	*44*	*44*	*46*	*46*	*47*	*41*	*42*	*42*	*43*
other	*NA*	*NA*	*NA*	*49*	*52*	*55*	*52*	*51*	*58*	*58*	*60*	*47*	*49*	*50*	*51*
Textiles, Leather, & Apparel Products	NA	NA	NA	10	10	20	18	19	19	19	19	10	10	10	10
Wood, Pulp & Paper, & Publishing Prod.	NA	NA	NA	42	44	96	92	101	112	105	122	154	160	164	167
Rubber & Miscellaneous Plastic Prod.	60	51	44	41	46	58	59	64	62	61	60	49	51	52	52
rubber tire mfg	*60*	*51*	*44*	*10*	*11*	*5*	*5*	*5*	*5*	*6*	*6*	*6*	*6*	*6*	*6*
green tire spray	*NA*	*NA*	*NA*	*5*	*6*	*3*	*4*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*2*
other	*NA*	*NA*	*NA*	*26*	*29*	*50*	*50*	*55*	*53*	*52*	*51*	*41*	*43*	*44*	*44*
Mineral Products	2	2	2	15	14	18	17	27	28	30	31	31	32	32	32
Machinery Products	NA	NA	NA	4	4	7	8	10	8	11	11	11	12	12	12
Electronic Equipment	NA	NA	NA	0	0	2	2	3	3	3	2	1	1	1	1
Transportation Equipment	NA	NA	NA	1	0	2	2	2	3	3	2	3	4	4	4
Construction	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	NA	NA	NA	108	109	59	62	62	62	62	57	58	60	60	61

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SOLVENT UTILIZATION	***7,174***	***5,651***	***6,584***	***5,699***	***5,964***	***5,750***	***5,782***	***5,901***	***6,016***	***6,162***	***6,183***	***5,474***	***5,621***	***5,149***	***4,825***
Degreasing	707	448	513	756	757	744	718	737	753	775	789	602	624	372	371
open top	NA	NA	NA	28	29	18	25	26	26	27	24	8	8	4	4
conveyorized	NA	NA	NA	5	4	5	6	6	6	6	5	4	5	2	2
cold cleaning	NA	NA	NA	31	35	30	23	24	24	22	23	22	23	10	11
other	707	448	513	691	689	691	664	680	697	719	737	567	588	356	354
Graphic Arts	319	254	373	317	363	274	301	308	322	333	339	287	293	300	293
letterpress	NA	NA	NA	2	2	4	8	8	8	8	8	6	6	6	6
flexographic	NA	NA	NA	18	20	20	24	26	26	25	24	19	19	20	15
lithographic	NA	NA	NA	4	4	14	17	18	21	22	20	12	12	13	13
gravure	NA	NA	NA	131	150	75	82	81	87	93	91	50	51	52	44
other	319	254	373	162	187	162	171	175	180	185	196	200	205	210	214
Dry Cleaning	263	229	320	169	212	215	218	224	225	228	230	154	163	166	168
perchloroethylene	NA	NA	NA	85	107	110	112	115	116	117	118	58	61	63	63
petroleum solvent	NA	NA	NA	84	105	104	106	109	110	111	112	89	94	96	97
other	263	229	320	0	0	0	0	0	0	0	1	7	8	8	8
Surface Coating	3,570	2,977	3,685	2,549	2,635	2,523	2,521	2,577	2,632	2,716	2,681	2,373	2,456	2,193	2,136
industrial adhesives	52	41	55	381	375	390	374	386	400	419	410	351	366	147	148
fabrics	161	177	186	34	35	14	14	16	16	15	15	10	10	10	10
paper	652	548	626	106	114	75	64	61	59	59	52	48	49	50	51
large appliances	49	43	36	22	18	21	20	20	21	22	21	23	24	23	22
magnet wire	7	6	5	0	0	1	1	1	1	1	1	2	2	2	2
autos & light trucks	165	204	165	85	87	92	90	93	92	96	96	94	100	102	106
metal cans	49	57	73	97	95	94	91	93	96	98	102	99	106	109	113
metal coil	18	19	21	50	50	45	49	47	49	48	47	45	47	48	49
wood furniture	211	231	231	132	140	158	154	159	171	185	179	175	185	127	130
metal furniture	35	42	52	41	44	48	47	49	52	56	53	52	54	56	58
flatwood products	64	76	82	4	4	9	10	10	11	12	13	16	17	17	18
plastic parts	17	18	25	11	11	27	22	23	22	22	18	15	16	16	16
large ships	21	20	20	15	15	15	14	15	15	15	13	17	18	18	19
aircraft	1	1	2	27	34	7	7	7	7	7	6	11	11	12	5
misc. metal parts	NA	NA	NA	14	14	59	87	90	92	93	92	38	40	40	40
steel drums	NA	NA	NA	NA	NA	3	3	3	3	4	4	4	4	4	4
architectural	442	407	477	473	500	495	500	505	510	515	522	480	485	487	483
traffic markings	NA	NA	NA	100	106	105	106	107	108	109	111	93	94	94	93
maintenance coatings	108	125	106	79	80	79	76	78	81	85	84	80	83	84	85
railroad	5	7	9	4	3	3	3	3	3	4	4	3	3	3	4
auto refinishing	83	143	186	111	132	130	132	137	140	144	142	161	163	163	104
machinery	39	51	62	37	28	28	26	26	27	27	25	25	25	22	20
electronic & other electrical	NA	NA	NA	79	79	78	75	77	80	85	85	78	82	82	82
general	79	61	52	146	154	121	127	129	133	140	138	100	105	106	107
miscellaneous	942	392	799	104	103	32	37	42	39	38	35	30	31	32	32
thinning solvents	NA	NA	NA	90	96	96	97	100	94	96	99	51	53	54	54
other	372	309	415	306	317	297	295	302	310	321	314	273	280	282	282

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Other Industrial	640	499	690	125	131	94	98	102	102	99	96	106	110	111	113
miscellaneous	*39*	*30*	*44*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
rubber & plastics mfg	*309*	*245*	*327*	*25*	*29*	*28*	*28*	*28*	*29*	*31*	*31*	*38*	*40*	*40*	*40*
other	*292*	*224*	*319*	*100*	*102*	*66*	*71*	*74*	*73*	*68*	*64*	*68*	*70*	*71*	*72*
Nonindustrial	1,674	1,243	1,002	1,783	1,867	1,900	1,925	1,952	1,982	2,011	2,048	1,949	1,973	2,004	1,743
cutback asphalt	*1,045*	*723*	*323*	*191*	*199*	*199*	*202*	*207*	*214*	*221*	*227*	*135*	*140*	*144*	*147*
other asphalt	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*43*	*44*	*45*	*46*
pesticide application	*241*	*195*	*241*	*212*	*260*	*258*	*264*	*272*	*280*	*289*	*299*	*388*	*393*	*408*	*412*
adhesives	*NA*	*NA*	*NA*	*345*	*353*	*361*	*365*	*368*	*372*	*375*	*380*	*301*	*304*	*307*	*250*
consumer solvents	*NA*	*NA*	*NA*	*1,035*	*1,056*	*1,083*	*1,095*	*1,105*	*1,116*	*1,126*	*1,142*	*1,076*	*1,085*	*1,095*	*883*
other	*387*	*325*	*437*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*6*	*6*	*6*	*5*
Other	NA	NA	NA	NA	NA	0	NA	NA	0	0	0	3	3	3	2
STORAGE & TRANSPORT	***1,954***	***2,181***	***1,975***	***1,747***	***1,753***	***1,495***	***1,532***	***1,583***	***1,600***	***1,629***	***1,652***	***1,289***	***1,327***	***1,327***	***1,240***
Bulk Terminals & Plants	599	668	517	606	651	359	369	384	395	403	406	208	215	214	203
fixed roof	*14*	*15*	*12*	*14*	*15*	*9*	*11*	*12*	*13*	*16*	*16*	*6*	*6*	*6*	*6*
floating roof	*45*	*50*	*39*	*46*	*50*	*26*	*29*	*30*	*34*	*29*	*19*	*11*	*11*	*11*	*11*
variable vapor space	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*
efr with seals	*NA*	*NA*	*NA*	*NA*	*NA*	*2*	*3*	*3*	*4*	*4*	*3*	*2*	*2*	*2*	*2*
ifr with seals	*NA*	*NA*	*NA*	*NA*	*NA*	*2*	*2*	*3*	*5*	*3*	*3*	*3*	*3*	*3*	*3*
underground tanks	*NA*	*0*	*0*	*0*	*0*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
area source: gasoline	*509*	*569*	*440*	*512*	*553*	*282*	*281*	*292*	*292*	*305*	*322*	*163*	*167*	*167*	*157*
other	*30*	*33*	*26*	*32*	*33*	*36*	*40*	*42*	*44*	*43*	*41*	*21*	*22*	*22*	*22*
Petroleum & Petroleum Product Stor.	300	315	306	223	210	157	195	204	205	194	191	181	187	187	108
fixed roof gasoline	*47*	*52*	*43*	*26*	*23*	*13*	*17*	*17*	*16*	*16*	*16*	*14*	*14*	*14*	*1*
fixed roof crude	*135*	*141*	*148*	*26*	*21*	*21*	*25*	*26*	*28*	*24*	*21*	*25*	*26*	*25*	*10*
floating roof gasoline	*49*	*54*	*45*	*27*	*24*	*15*	*25*	*24*	*24*	*22*	*22*	*16*	*16*	*16*	*11*
floating roof crude	*32*	*34*	*36*	*5*	*5*	*2*	*7*	*7*	*8*	*6*	*6*	*5*	*6*	*6*	*2*
efr / seal gasoline	*3*	*4*	*3*	*2*	*2*	*7*	*11*	*13*	*14*	*14*	*15*	*9*	*9*	*9*	*9*
efr / seal crude	*1*	*2*	*2*	*0*	*0*	*3*	*3*	*3*	*3*	*3*	*2*	*3*	*3*	*4*	*3*
ifr / seal gasoline	*1*	*2*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*
ifr / seal crude	*2*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
variable vapor space gasoline	*3*	*3*	*3*	*1*	*2*	*1*	*2*	*5*	*6*	*3*	*0*	*0*	*0*	*0*	*0*
area source: crude	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*25*	*22*	*23*	*133*	*132*	*92*	*102*	*106*	*103*	*103*	*106*	*104*	*108*	*108*	*68*
Petroleum & Petroleum Product Trans.t	92	84	61	126	125	151	146	149	142	139	134	115	119	119	120
gasoline loading: normal / splash	*3*	*2*	*0*	*3*	*3*	*3*	*2*	*2*	*2*	*3*	*2*	*3*	*3*	*3*	*3*
gasoline loading: balanced / submerged	*20*	*13*	*2*	*21*	*22*	*15*	*17*	*15*	*13*	*11*	*10*	*7*	*7*	*7*	*7*
gasoline loading: normal / submerged	*39*	*26*	*3*	*41*	*42*	*26*	*25*	*26*	*24*	*25*	*23*	*13*	*14*	*13*	*14*
gasoline loading: clean / submerged	*2*	*1*	*0*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
marine vessel loading: gasoline & crude	*26*	*38*	*50*	*24*	*22*	*31*	*30*	*30*	*29*	*28*	*29*	*31*	*32*	*33*	*34*
other	*2*	*4*	*6*	*35*	*35*	*76*	*73*	*75*	*73*	*72*	*70*	*61*	*62*	*62*	*62*
Service Stations: Stage I	416	481	461	207	223	300	295	303	309	322	334	310	318	318	320
Service Stations: Stage II	521	602	583	485	441	433	430	442	449	467	484	399	410	410	412
Service Stations: Breathing & Emptying	NA	NA	NA	49	52	52	51	52	53	55	57	43	45	45	45
Organic Chemical Storage	26	31	46	34	36	30	35	38	39	39	37	26	26	27	25
Organic Chemical Transport	NA	NA	NA	17	15	10	8	8	7	7	7	5	5	5	5
Inorganic Chemical Storage	NA	NA	NA	0	0	0	1	1	1	1	1	1	1	1	1
Inorganic Chemical Transport	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	0	0	2	2	2	1	1	1	1	1	1	1
Bulk Materials Transport	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WASTE DISPOSAL & RECYCLING	***1,984***	***984***	***758***	***979***	***941***	***986***	***999***	***1,010***	***1,046***	***1,046***	***1,067***	***418***	***422***	***428***	***586***
Incineration	548	453	366	64	59	48	50	51	76	65	54	50	50	51	51
Open Burning	1,424	517	372	309	274	196	200	203	207	208	208	195	198	200	356
industrial	*NA*	*NA*	*NA*	*6*	*6*	*4*	*4*	*4*	*5*	*5*	*5*	*5*	*5*	*5*	*0*
commmercial/institutional	*NA*	*NA*	*NA*	*1*	*2*	*9*	*9*	*10*	*10*	*10*	*10*	*18*	*19*	*19*	*0*
residential	*NA*	*NA*	*NA*	*302*	*266*	*165*	*167*	*169*	*171*	*172*	*173*	*163*	*165*	*166*	*149*
other	*1,424*	*517*	*372*	*NA*	*NA*	*19*	*20*	*20*	*21*	*21*	*20*	*9*	*10*	*10*	*207*
POTW	NA	NA	NA	10	11	49	47	48	50	52	51	48	48	49	50
Industrial Waste Water	NA	NA	NA	1	2	14	18	19	19	19	16	19	20	20	21
TSDF	NA	NA	NA	594	595	589	591	589	588	587	628	41	41	42	42
Landfills	NA	NA	NA	0	0	64	66	69	74	80	75	35	35	36	36
Other	11	14	20	0	0	26	28	31	33	35	36	29	29	30	30
Transportation	**14,849**	**12,623**	**11,291**	**11,818**	**9,744**	**8,988**	**9,240**	**8,882**	**8,973**	**9,235**	**8,515**	**9,099**	**8,844**	**8,738**	**8,529**
ON-ROAD VEHICLES	***12,972***	***10,545***	***8,979***	***9,376***	***7,192***	***6,443***	***6,660***	***6,289***	***6,348***	***6,563***	***5,816***	***5,541***	***5,438***	***5,439***	***5,297***
Light-Duty Gas Vehicles & Motorcycles	9,193	7,248	5,907	5,864	4,462	3,692	3,608	3,288	3,232	3,332	3,029	2,911	2,878	2,935	2,911
light-duty gas vehicles	*9,133*	*7,177*	*5,843*	*5,810*	*4,412*	*3,635*	*3,571*	*3,256*	*3,198*	*3,295*	*2,991*	*2,875*	*2,842*	*2,895*	*2,870*
motorcycles	*60*	*71*	*64*	*54*	*50*	*56*	*36*	*33*	*34*	*37*	*38*	*36*	*36*	*39*	*42*
Light-Duty Gas Trucks	2,770	2,289	2,059	2,425	1,867	2,016	2,318	2,347	2,471	2,488	2,135	1,786	1,789	1,788	1,722
light-duty gas trucks 1	*1,564*	*1,251*	*1,229*	*1,437*	*1,018*	*1,103*	*1,245*	*1,255*	*1,313*	*1,307*	*1,172*	*1,157*	*1,164*	*1,171*	*1,132*
light-duty gas trucks 2	*1,206*	*1,038*	*830*	*988*	*849*	*912*	*1,073*	*1,092*	*1,157*	*1,181*	*963*	*629*	*624*	*617*	*589*
Heavy-Duty Gas Vehicles	743	657	611	716	517	405	416	335	327	414	325	488	439	400	375
Diesels	266	351	402	370	346	331	318	318	318	330	326	356	332	316	289
heavy-duty diesel vehicles	*266*	*335*	*392*	*360*	*332*	*298*	*303*	*302*	*302*	*313*	*309*	*348*	*325*	*311*	*284*
light-duty diesel trucks	*NA*	*NA*	*2*	*2*	*3*	*24*	*4*	*5*	*5*	*5*	*5*	*4*	*3*	*3*	*2*
light-duty diesel vehicles	*NA*	*15*	*8*	*8*	*11*	*9*	*11*	*11*	*11*	*12*	*12*	*5*	*4*	*3*	*3*
NON-ROAD ENGINES AND VEHICLES	***1,878***	***2,078***	***2,312***	***2,442***	***2,552***	***2,545***	***2,581***	***2,594***	***2,624***	***2,672***	***2,699***	***3,558***	***3,406***	***3,299***	***3,232***
Non-Road Gasoline	1,564	1,669	1,787	1,886	1,907	1,889	1,920	1,925	1,957	1,991	2,021	2,888	2,738	2,637	2,593
recreational	*138*	*145*	*151*	*156*	*160*	*128*	*130*	*132*	*133*	*135*	*138*	*189*	*186*	*185*	*185*
construction	*27*	*29*	*39*	*45*	*44*	*44*	*44*	*44*	*44*	*44*	*44*	*68*	*59*	*54*	*51*
industrial	*25*	*27*	*33*	*37*	*33*	*33*	*32*	*31*	*30*	*29*	*28*	*42*	*34*	*32*	*30*
lawn & garden	*511*	*547*	*583*	*616*	*682*	*700*	*718*	*734*	*752*	*771*	*789*	*1,047*	*971*	*888*	*845*
farm	*10*	*14*	*17*	*19*	*20*	*20*	*21*	*21*	*21*	*22*	*22*	*17*	*17*	*16*	*15*
light commercial	*115*	*121*	*127*	*137*	*164*	*171*	*179*	*185*	*192*	*200*	*207*	*233*	*204*	*182*	*172*
logging	*2*	*4*	*5*	*5*	*8*	*9*	*9*	*10*	*11*	*11*	*12*	*372*	*344*	*351*	*369*
airport service	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*
railway maintenance	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
recreational marine vessels	*736*	*782*	*830*	*869*	*793*	*784*	*787*	*768*	*772*	*778*	*779*	*917*	*924*	*929*	*924*
Non-Road Diesel	187	257	327	332	384	390	397	403	408	414	420	412	406	395	372
recreational	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
construction	*94*	*103*	*135*	*151*	*176*	*181*	*185*	*190*	*194*	*199*	*204*	*207*	*205*	*198*	*185*
industrial	*38*	*23*	*28*	*36*	*40*	*40*	*41*	*41*	*42*	*42*	*43*	*41*	*41*	*41*	*39*
lawn & garden	*3*	*4*	*4*	*5*	*9*	*10*	*11*	*12*	*13*	*14*	*14*	*15*	*16*	*17*	*17*
farm	*39*	*109*	*138*	*113*	*127*	*126*	*126*	*125*	*124*	*123*	*121*	*107*	*104*	*101*	*94*
light commercial	*7*	*8*	*8*	*10*	*13*	*13*	*14*	*14*	*15*	*16*	*16*	*18*	*19*	*20*	*20*
logging	*6*	*9*	*11*	*14*	*14*	*14*	*15*	*15*	*15*	*14*	*14*	*15*	*13*	*10*	*8*
airport service	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
railway maintenance	*UA*	*UA*	*UA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
recreational marine vessels	*UA*	*UA*	*UA*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*4*	*4*	*5*	*5*

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	**1970**	**1975**	**1980**	**1985**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Aircraft	97	116	146	165	190	180	177	179	176	176	178	177	178	183	183
Marine Vessels	7	8	19	22	30	32	34	33	32	43	32	33	33	34	34
coal	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*1*
diesel	*6*	*8*	*17*	*20*	*27*	*21*	*22*	*21*	*20*	*27*	*20*	*32*	*32*	*32*	*33*
residual oil	*0*	*1*	*1*	*1*	*2*	*3*	*3*	*3*	*3*	*4*	*3*	*0*	*0*	*0*	*0*
gasoline	*NA*	*NA*	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*7*	*8*	*8*	*8*	*11*	*8*	*0*	*0*	*0*	*0*
Railroads	22	27	33	37	42	52	52	54	52	49	49	48	50	50	49
Non-Road Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
liquified petroleum gas	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
compressed natural gas	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Miscellaneous	**1,101**	**716**	**1,134**	**566**	**642**	**1,059**	**756**	**486**	**556**	**720**	**551**	**753**	**1,192**	**714**	**716**
Agriculture & Forestry	NA	NA	NA	NA	NA	5	6	6	6	6	7	7	7	7	8
Other Combustion	1,101	716	1,134	565	641	1,049	743	474	544	707	537	740	1,179	700	702
structural fires	*19*	*47*	*40*	*44*	*44*	*14*	*14*	*15*	*15*	*15*	*15*	*14*	*14*	*15*	*15*
agricultural fires	*131*	*75*	*70*	*55*	*79*	*48*	*48*	*49*	*48*	*51*	*54*	*51*	*52*	*52*	*53*
slash/prescribed burning	*147*	*290*	*285*	*182*	*182*	*234*	*239*	*243*	*266*	*259*	*293*	*277*	*293*	*311*	*311*
forest wildfires	*770*	*297*	*739*	*283*	*335*	*749*	*439*	*164*	*212*	*379*	*171*	*395*	*817*	*319*	*319*
other	*34*	*7*	*1*	*NA*	*NA*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Catastrophic/Accidental Releases	NA	NA	NA	NA	NA	4	4	4	4	4	4	4	5	5	5
Health Services	NA	NA	NA	0	1	1	0	1	1	1	1	0	1	1	1
Cooling Towers	NA	NA	NA	NA	NA	0	2	2	1	2	2	1	1	1	1
Fugitive Dust	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
TOTAL AVAILABLE SOURCES	**30,982**	**26,079**	**26,336**	**24,428**	**22,513**	**21,053**	**21,249**	**20,862**	**21,099**	**21,683**	**20,918**	**19,464**	**19,732**	**18,614**	**18,145**

Note: Some columns may not sum to totals due to rounding.

Table A-6. National PM $_{10}$ Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**2872**	**2247**	**2445**	**1,536**	**1,382**	**1,196**	**1,147**	**1,183**	**1,124**	**1,113**	**1,179**	**1,160**	**1,076**	**996**	**1,029**
FUEL COMB. ELEC. UTIL.	***1,775***	***1,191***	***879***	***280***	***271***	***295***	***257***	***257***	***279***	***273***	***268***	***289***	***294***	***229***	***225***
Coal	1,680	1,091	796	268	255	265	232	234	253	246	244	264	268	197	194
bituminous	*1,041*	*661*	*483*	*217*	*193*	*188*	*169*	*167*	*185*	*181*	*174*	*195*	*196*	*134*	*131*
subbituminous	*513*	*326*	*238*	*35*	*39*	*37*	*39*	*43*	*46*	*44*	*48*	*51*	*51*	*47*	*46*
anthracite & lignite	*126*	*104*	*75*	*16*	*22*	*41*	*23*	*23*	*22*	*21*	*21*	*19*	*21*	*17*	*17*
other	*NA*	*NA*	*NA*	*0*	*0*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*
Oil	89	93	76	8	12	9	10	7	9	8	5	6	7	5	5
residual	*85*	*87*	*74*	*8*	*11*	*9*	*10*	*7*	*9*	*8*	*5*	*6*	*7*	*5*	*5*
distillate	*3*	*6*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Gas	7	6	7	1	1	1	1	0	1	1	1	1	1	1	1
Other	0	0	0	0	0	0	0	0	0	0	0	1	1	7	7
Internal Combustion	NA	NA	NA	3	3	20	15	16	17	17	18	17	18	18	19
FUEL COMB. INDUSTRIAL	***641***	***564***	***679***	***247***	***243***	***270***	***233***	***243***	***257***	***270***	***302***	***239***	***233***	***230***	***236***
Coal	83	23	18	71	70	84	72	74	71	70	70	73	73	71	74
bituminous	*52*	*14*	*12*	*48*	*49*	*59*	*48*	*53*	*51*	*49*	*49*	*43*	*43*	*42*	*44*
subbituminous	*16*	*4*	*4*	*1*	*1*	*5*	*3*	*3*	*3*	*5*	*5*	*5*	*5*	*5*	*5*
anthracite & lignite	*15*	*4*	*2*	*7*	*6*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*NA*	*NA*	*NA*	*15*	*14*	*19*	*19*	*17*	*16*	*16*	*15*	*24*	*23*	*23*	*23*
Oil	89	69	67	52	48	52	44	45	45	44	49	46	43	42	43
residual	*83*	*62*	*63*	*43*	*39*	*44*	*36*	*37*	*38*	*37*	*42*	*38*	*35*	*34*	*35*
distillate	*6*	*7*	*4*	*5*	*5*	*6*	*6*	*6*	*6*	*6*	*6*	*7*	*7*	*7*	*7*
other	*0*	*0*	*0*	*4*	*4*	*2*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Gas	27	25	23	47	44	41	34	40	43	43	45	42	42	42	43
natural	*24*	*22*	*20*	*24*	*24*	*30*	*24*	*26*	*29*	*30*	*30*	*28*	*27*	*27*	*28*
process	*4*	*3*	*3*	*22*	*20*	*11*	*10*	*13*	*13*	*14*	*15*	*14*	*15*	*15*	*14*
other	*NA*	*NA*	*NA*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other	441	447	571	75	78	87	72	74	86	74	73	61	58	59	60
wood/bark waste	*415*	*444*	*566*	*67*	*71*	*80*	*67*	*67*	*71*	*68*	*68*	*54*	*51*	*52*	*53*
liquid waste	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*26*	*3*	*5*	*6*	*6*	*6*	*5*	*6*	*14*	*6*	*5*	*7*	*6*	*6*	*6*
Internal Combustion	NA	NA	NA	3	3	6	10	11	12	38	64	17	17	16	17
FUEL COMB. OTHER	***455***	***492***	***887***	***1,009***	***869***	***631***	***657***	***683***	***588***	***570***	***610***	***632***	***549***	***537***	***568***
Commercial/Institutional Coal	13	10	8	13	13	15	14	15	15	15	16	16	16	17	17
Commercial/Institutional Oil	52	34	30	12	13	13	11	12	11	12	12	12	12	10	9
Commercial/Institutional Gas	4	4	4	4	5	5	6	6	6	7	6	8	8	7	8
Misc. Fuel Comb. (Except Residential)	NA	NA	NA	3	3	79	73	73	72	73	73	72	76	79	81
Residential Wood	384	407	818	959	817	501	535	558	464	446	484	503	415	403	431
fireplaces	*384*	*407*	*818*	*959*	*817*	*501*	*535*	*558*	*464*	*446*	*484*	*429*	*344*	*335*	*359*
woodstoves	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*38*	*36*	*34*	*36*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*37*	*35*	*33*	*35*
Residential Other	3	37	27	18	18	18	18	18	18	18	18	23	22	21	22

Table A-6. National PM$_{10}$ Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Inudstrial Processes	**8,668**	**4,075**	**3,026**	**1339**	**1276**	**1306**	**1264**	**1269**	**1240**	**1219**	**1231**	**951**	**977**	**983**	**1263**
CHEMICAL & ALLIED PRODUCT MFG	***235***	***127***	***148***	***58***	***63***	***77***	***68***	***71***	***66***	***76***	***67***	***63***	***64***	***65***	***66***
Organic Chemical Mfg	43	21	19	19	22	26	28	28	28	29	29	29	29	30	30
Inorganic Chemical Mfg	61	31	25	7	8	19	4	5	5	5	5	4	4	4	4
Polymer & Resin Mfg	NA	NA	NA	4	5	5	4	5	4	4	4	3	3	3	3
Agricultural Chemical Mfg	46	38	61	9	10	11	11	11	11	10	10	8	9	9	9
Paint, Varnish, Lacquer, Enamel Mfg	NA	NA	NA	0	0	1	1	1	1	1	1	1	1	1	1
Pharmaceutical Mfg	NA	NA	NA	0	0	1	0	0	0	0	0	0	0	0	0
Other Chemical Mfg	86	37	42	18	18	14	20	20	18	27	18	19	19	19	19
METALS PROCESSING	***1,316***	***825***	***622***	***220***	***211***	***214***	***251***	***250***	***181***	***184***	***212***	***144***	***151***	***150***	***147***
Nonferrous Metals Processing	593	229	130	46	45	50	46	47	40	39	41	34	35	35	35
copper	*343*	*66*	*32*	*3*	*3*	*14*	*14*	*15*	*12*	*11*	*12*	*6*	*6*	*6*	*6*
lead	*53*	*31*	*18*	*4*	*3*	*3*	*2*	*2*	*2*	*2*	*3*	*2*	*2*	*2*	*2*
zinc	*20*	*11*	*3*	*3*	*3*	*6*	*6*	*6*	*1*	*2*	*2*	*2*	*2*	*2*	*2*
other	*177*	*121*	*77*	*36*	*36*	*27*	*23*	*23*	*25*	*25*	*25*	*24*	*25*	*25*	*25*
Ferrous Metals Processing	198	275	322	164	156	155	123	115	121	125	149	91	96	95	93
primary	*31*	*198*	*271*	*136*	*129*	*128*	*99*	*92*	*97*	*100*	*123*	*64*	*68*	*68*	*67*
secondary	*167*	*77*	*51*	*26*	*26*	*25*	*24*	*23*	*24*	*25*	*26*	*27*	*28*	*27*	*26*
other	*NA*	*NA*	*NA*	*2*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Metals Processing NEC	525	321	170	10	10	9	82	88	20	20	22	19	20	20	19
PETROLEUM & RELATED INDUSTRIES	***286***	***179***	***138***	***63***	***58***	***55***	***43***	***43***	***38***	***38***	***40***	***29***	***30***	***30***	***29***
Oil & Gas Production	NA	NA	NA	0	0	2	2	2	2	2	2	1	1	1	1
Petroleum Refineries & Related Ind.	69	56	41	28	24	20	20	21	20	19	20	17	17	17	17
fluid catalytic cracking units	*69*	*56*	*41*	*24*	*21*	*17*	*17*	*18*	*17*	*16*	*18*	*12*	*12*	*12*	*12*
other	*NA*	*NA*	*NA*	*4*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*5*	*5*	*5*	*5*
Asphalt Manufacturing	217	123	97	35	34	33	21	20	17	17	18	12	12	11	11
OTHER INDUSTRIAL PROCESSES	***5,832***	***2,572***	***1,846***	***611***	***591***	***583***	***520***	***506***	***501***	***495***	***511***	***325***	***336***	***338***	***343***
Agriculture, Food, & Kindred Products	485	429	402	68	72	73	80	69	73	73	80	59	61	59	61
country elevators	*257*	*247*	*258*	*7*	*9*	*9*	*10*	*10*	*10*	*9*	*9*	*5*	*5*	*5*	*5*
terminal elevators	*147*	*111*	*86*	*6*	*6*	*6*	*7*	*8*	*8*	*7*	*7*	*2*	*2*	*2*	*2*
feed mills	*5*	*3*	*3*	*6*	*7*	*7*	*4*	*5*	*5*	*5*	*5*	*3*	*3*	*3*	*3*
soybean mills	*25*	*27*	*22*	*13*	*14*	*14*	*15*	*11*	*12*	*12*	*12*	*7*	*7*	*7*	*7*
wheat mills	*5*	*1*	*1*	*3*	*3*	*3*	*4*	*4*	*4*	*4*	*4*	*2*	*2*	*2*	*2*
other grain mills	*9*	*8*	*6*	*7*	*8*	*8*	*6*	*5*	*6*	*6*	*7*	*5*	*5*	*5*	*5*
other	*38*	*32*	*26*	*25*	*25*	*25*	*34*	*26*	*28*	*30*	*37*	*36*	*37*	*34*	*36*
Textiles, Leather, & Apparel Products	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
Wood, Pulp & Paper, & Pub. Prod.	727	274	183	101	106	105	81	79	78	76	81	75	77	79	80
sulfate (kraft) pulping	*668*	*228*	*142*	*71*	*74*	*73*	*53*	*50*	*49*	*50*	*53*	*38*	*40*	*40*	*41*
other	*59*	*46*	*41*	*30*	*33*	*32*	*27*	*29*	*29*	*26*	*28*	*37*	*38*	*39*	*39*
Rubber & Miscellaneous Plastic Prod.	NA	NA	NA	3	4	4	4	4	3	3	3	4	4	4	4
Mineral Products	4,620	1,869	1,261	401	374	367	320	318	316	313	317	160	166	167	168
cement mfg	*1,731*	*703*	*417*	*213*	*193*	*190*	*147*	*145*	*140*	*139*	*140*	*23*	*24*	*25*	*24*
surface mining	*134*	*111*	*127*	*20*	*15*	*15*	*14*	*15*	*17*	*17*	*17*	*16*	*17*	*17*	*17*
stone quarrying/processing	*957*	*508*	*421*	*52*	*54*	*54*	*59*	*60*	*60*	*58*	*58*	*23*	*24*	*24*	*24*
other	*1,798*	*547*	*296*	*116*	*111*	*108*	*99*	*98*	*99*	*100*	*102*	*97*	*101*	*102*	*103*
Machinery Products	NA	NA	NA	8	9	9	8	9	7	7	7	5	5	5	5
Electronic Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
Transportation Equipment	NA	NA	NA	2	2	2	2	2	0	0	0	0	0	0	0
Construction	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	NA	NA	NA	28	23	23	25	24	22	22	23	21	21	21	22

Table A-6. National PM $_{10}$ Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***2***	***2***	***4***	***5***	***5***	***6***	***6***	***6***	***6***	***6***	***6***	***6***
Degreasing	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
Dry Cleaning	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Surface Coating	NA	NA	NA	2	2	3	4	4	5	5	5	4	5	5	5
Other Industrial	NA	NA	NA	0	0	1	1	1	1	1	1	0	0	0	0
Nonindustrial	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Solvent Utilization NEC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***107***	***101***	***102***	***101***	***117***	***114***	***106***	***109***	***81***	***83***	***84***	***85***
Bulk Terminals & Plants	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Petroleum & Petroleum Prod. Storage	NA	NA	NA	0	0	0	1	1	1	0	0	1	1	1	1
Petroleum & Petroleum Prod. Trans.	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0
Organic Chemical Storage	NA	NA	NA	1	1	1	1	1	1	1	1	1	1	1	1
Organic Chemical Transport	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	1	1	1	1	1	1	0	0	1	1
Inorganic Chemical Transport	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	105	99	100	99	115	111	104	107	78	80	81	82
storage	*NA*	*NA*	*NA*	*33*	*31*	*31*	*27*	*30*	*32*	*31*	*30*	*26*	*26*	*27*	*27*
transfer	*NA*	*NA*	*NA*	*72*	*67*	*69*	*71*	*85*	*79*	*73*	*76*	*51*	*53*	*54*	*54*
combined	*NA*	*NA*	*NA*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*
Bulk Materials Transport	NA	NA	NA	0	0	1	0	0	0	0	0	0	0	0	0
WASTE DISPOSAL & RECYCLING	***999***	***371***	***273***	***278***	***251***	***271***	***276***	***278***	***334***	***313***	***287***	***303***	***307***	***310***	***587***
Incineration	229	95	75	52	50	65	66	65	119	96	69	89	90	91	92
residential	*51*	*49*	*42*	*39*	*35*	*39*	*41*	*43*	*44*	*45*	*45*	*62*	*63*	*63*	*63*
other	*178*	*46*	*32*	*13*	*15*	*26*	*25*	*23*	*74*	*52*	*25*	*26*	*27*	*28*	*28*
Open Burning	770	276	198	225	200	206	209	211	214	216	217	211	214	216	492
residential	*770*	*276*	*198*	*221*	*195*	*195*	*197*	*199*	*202*	*203*	*204*	*194*	*195*	*197*	*188*
other	*NA*	*NA*	*NA*	*4*	*5*	*11*	*12*	*12*	*13*	*13*	*13*	*18*	*18*	*19*	*303*
POTW	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	0	0	NA	0	0	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	1	1	1	0	3	3	3	3
Other	NA	NA	NA	0	0	0	0	0	0	1	1	1	1	1	1
Transportation	**786**	**786**	**786**	**786**	**844**	**838**	**842**	**839**	**810**	**804**	**756**	**818**	**801**	**779**	**753**
ON-ROAD VEHICLES	***443***	***471***	***397***	***363***	***367***	***349***	***353***	***349***	***327***	***324***	***300***	***345***	***331***	***312***	***295***
Light-Duty Gas Vehicles & Motorcycles	225	207	120	77	65	57	56	55	55	55	55	56	57	58	59
light-duty gas vehicles	*224*	*206*	*119*	*77*	*64*	*57*	*55*	*54*	*55*	*54*	*55*	*56*	*56*	*58*	*58*
motorcycles	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Light-Duty Gas Trucks	70	72	55	43	34	37	44	47	46	46	41	35	36	36	36
light-duty gas trucks 1	*41*	*39*	*25*	*19*	*16*	*18*	*21*	*22*	*22*	*22*	*23*	*23*	*24*	*24*	*25*
light-duty gas trucks 2	*29*	*34*	*29*	*24*	*19*	*19*	*23*	*25*	*24*	*24*	*19*	*12*	*12*	*12*	*11*
Heavy-Duty Gas Vehicles	13	15	15	14	11	10	10	9	10	10	9	14	13	12	12
Diesels	136	177	208	229	257	245	243	238	215	213	194	239	225	206	189
heavy-duty diesel vehicles	*136*	*166*	*194*	*219*	*247*	*225*	*233*	*228*	*206*	*204*	*185*	*235*	*221*	*203*	*186*
light-duty diesel trucks	*NA*	*NA*	*2*	*1*	*2*	*13*	*2*	*3*	*2*	*2*	*2*	*2*	*1*	*1*	*1*
light-duty diesel vehicles	*NA*	*10*	*12*	*8*	*9*	*7*	*8*	*8*	*7*	*7*	*7*	*3*	*2*	*2*	*1*

Table A-6. National PM_{10} Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NON-ROAD ENGINES AND VEHICLES	**220**	**310**	**398**	**424**	**477**	**489**	**489**	**490**	**483**	**480**	**456**	***473***	***470***	***467***	***458***
Non-Road Gasoline	12	39	42	44	46	47	47	48	48	48	49	86	87	88	89
recreational	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
construction	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*
industrial	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
lawn & garden	*8*	*8*	*9*	*9*	*10*	*11*	*11*	*11*	*12*	*12*	*12*	*21*	*21*	*20*	*20*
farm	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
light commercial	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
logging	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*19*	*20*	*22*	*23*
airport service	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
railway maintenance	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
recreational marine vessels (other)	*UA*	*26*	*28*	*29*	*30*	*30*	*30*	*30*	*30*	*30*	*30*	*38*	*38*	*39*	*39*
Non-Road Diesel	154	204	263	272	302	301	299	297	296	296	296	273	268	263	253
recreational	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
construction	*75*	*92*	*123*	*134*	*149*	*149*	*148*	*147*	*147*	*146*	*146*	*142*	*139*	*135*	*128*
industrial	*36*	*23*	*27*	*35*	*38*	*38*	*37*	*37*	*38*	*38*	*38*	*33*	*33*	*33*	*33*
lawn & garden	*3*	*3*	*4*	*4*	*8*	*8*	*9*	*10*	*11*	*11*	*12*	*11*	*11*	*12*	*12*
farm	*16*	*66*	*85*	*70*	*78*	*78*	*77*	*76*	*75*	*74*	*73*	*62*	*59*	*57*	*54*
light commercial	*6*	*7*	*7*	*9*	*11*	*12*	*12*	*12*	*13*	*13*	*14*	*13*	*14*	*14*	*15*
logging	*17*	*12*	*16*	*19*	*15*	*13*	*11*	*10*	*9*	*9*	*8*	*8*	*7*	*7*	*6*
airport service	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
railway maintenance	*NA*	*UA*	*UA*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
recreational marine vessels	*NA*	*UA*	*UA*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*2*
Aircraft	21	26	33	37	43	44	44	45	43	41	40	40	39	39	38
Marine Vessels	9	10	23	28	38	44	46	45	43	44	43	44	44	45	46
coal	*1*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
diesel	*5*	*6*	*15*	*17*	*23*	*27*	*28*	*27*	*26*	*26*	*26*	*40*	*41*	*41*	*42*
residual oil	*3*	*3*	*7*	*9*	*12*	*14*	*14*	*14*	*14*	*14*	*13*	*0*	*0*	*0*	*0*
gasoline	*NA*	*NA*	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Railroads	25	30	37	41	47	53	53	54	52	50	27	29	30	30	30
Non-Road Other	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2
liquified petroleum gas	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
compressed natural gas	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
TOTAL ALL SOURCES	**12,325**	**7,108**	**6,258**	**3,662**	**3,502**	**3,340**	**3,253**	**3,292**	**3,174**	**3,136**	**3,165**	**2,929**	**2,854**	**2,758**	**3,045**

Note: Some columns may not sum to totals due to rounding.

Table A-7. Miscellaneous and Natural PM_{10} Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons)

Source Category	**1970**	**1975**	**1980**	**1985**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Miscellaneous	**839**	**569**	**852**	**37,736**	**37,461**	**24,541**	**24,233**	**23,958**	**24,328**	**25,620**	**22,765**	**21,761**	**23,046**	**23,282**	**20,634**
Agriculture & Forestry	NA	NA	NA	7,108	7,320	5,292	5,234	5,017	4,575	4,845	4,902	4,911	4,952	4,951	4,888
agricultural crops	*NA*	*NA*	*NA*	*6,833*	*6,923*	4,745	4,684	4,464	4,016	4,281	4,334	*4,330*	*4,373*	*4,366*	*4,298*
agricultural livestock	*NA*	*NA*	*NA*	*275*	*396*	547	550	553	558	564	569	*581*	*579*	*585*	*590*
Other Combustion	839	569	852	894	912	1,181	924	770	801	1,053	850	1,152	1,300	1,005	1,007
wildfires	*385*	*206*	*514*	*308*	*300*	*601*	*332*	*171*	*152*	*424*	*145*	*502*	*599*	*261*	*261*
managed burning	*390*	*325*	*315*	*527*	*553*	*558*	*569*	*576*	*625*	*606*	*680*	*631*	*680*	*723*	*725*
other	*64*	*37*	*23*	*59*	*59*	*22*	*23*	*23*	*23*	*24*	*24*	*20*	*21*	*21*	*21*
Cooling Towers	NA	NA	NA	NA	NA	0	0	0	0	0	1	3	3	3	3
Fugitive Dust	NA	NA	NA	29,734	29,229	18,068	18,075	18,170	18,953	19,722	17,012	15,695	16,791	17,324	14,736
unpaved roads	*NA*	*NA*	*NA*	*11,644*	*11,798*	*11,234*	*11,206*	*10,918*	*11,430*	*11,370*	*10,362*	*9,071*	*9,461*	*9,327*	*9,360*
paved roads	*NA*	*NA*	*NA*	*5,080*	*5,769*	*2,248*	*2,399*	*2,423*	*2,462*	*2,538*	*2,409*	*2,400*	*2,595*	*2,663*	*2,728*
construction	*NA*	*NA*	*NA*	*12,670*	*11,269*	*4,249*	*4,092*	*4,460*	*4,651*	*5,245*	*3,654*	*3,578*	*4,022*	*4,545*	*1,956*
other	*NA*	*NA*	*NA*	*339*	*392*	*336*	*377*	*369*	*409*	*569*	*586*	*645*	*713*	*788*	*692*
TOTAL ALL SOURCES	**839**	**569**	**852**	**37,736**	**37,461**	**24,541**	**24,233**	**23,958**	**24,328**	**25,620**	**22,765**	**21,761**	**23,046**	**23,282**	**20,634**

Table A-8. National Sulfur Dioxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	23,456	22,661	21,391	20,021	19,924	20,290	19,796	19,493	19,245	18,887	16,230	16,234	16,651	16,746	16,091
FUEL COMB. ELEC. UTIL.	17,398	18,268	17,469	16,272	16,215	15,909	15,784	15,416	15,189	14,889	12,080	12,730	13,195	13,416	12,698
Coal	15,799	16,756	16,073	15,630	15,404	15,220	15,087	14,824	14,527	14,313	11,603	12,206	12,615	12,470	11,856
bituminous	9,574	10,161	NA	14,029	13,579	13,371	13,215	12,914	12,212	11,841	8,609	8,998	9,517	9,357	8,806
subbituminous	4,716	5,005	NA	1,292	1,422	1,415	1,381	1,455	1,796	1,988	2,345	2,632	2,490	2,486	2,427
anthracite & lignite	1,509	1,590	NA	309	404	434	491	455	519	484	649	576	608	627	623
Oil	1,598	1,511	1,395	612	779	639	652	546	612	522	413	460	514	762	657
residual	1,578	1,462	NA	604	765	629	642	537	601	512	408	454	509	756	651
distillate	20	49	NA	8	14	10	10	9	10	10	5	6	5	6	6
Gas	1	1	1	1	1	1	1	1	1	1	9	7	6	6	12
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	4	121	115
Internal Combustion	NA	NA	NA	30	30	49	45	46	49	53	55	53	56	57	58
FUEL COMB. INDUSTRIAL	4,568	3,310	2,951	3,169	3,086	3,550	3,256	3,292	3,284	3,218	3,357	2,863	2,805	2,742	2,805
Coal	3,129	1,870	1,527	1,818	1,840	1,914	1,805	1,783	1,763	1,740	1,728	1,321	1,306	1,274	1,317
bituminous	2,171	1,297	1,058	1,347	1,384	1,050	949	1,005	991	988	1,003	885	877	858	890
subbituminous	669	399	326	28	29	50	53	60	67	77	81	63	63	61	64
anthracite & lignite	289	174	144	90	79	67	68	67	68	68	68	61	60	57	57
other	NA	NA	NA	353	348	746	735	650	636	606	576	312	306	298	306
Oil	1,229	1,139	1,065	862	812	927	779	801	809	777	912	807	764	738	757
residual	956	825	851	671	625	687	550	591	597	564	701	626	578	559	574
distillate	98	144	85	111	107	198	190	191	193	193	191	158	161	156	159
other	175	171	129	80	80	42	39	20	20	20	20	23	25	23	24
Gas	140	263	299	397	346	543	516	552	555	542	548	575	582	578	576
Other	70	38	60	86	82	158	142	140	140	141	147	140	134	133	135
Internal Combustion	NA	NA	NA	7	6	9	14	16	17	19	23	20	19	19	20
FUEL COMB. OTHER	1,490	1,082	971	579	624	831	755	784	772	780	793	641	651	588	588
Commercial/Institutional Coal	109	147	110	158	169	212	184	190	193	192	200	179	184	196	196
Commercial/Institutional Oil	883	638	637	239	274	425	376	396	381	391	397	308	314	250	246
Commercial/Institutional Gas	1	1	1	2	2	7	7	7	8	8	8	10	10	10	11
Misc. Fuel Comb. (Except Residential)	NA	NA	NA	1	1	6	6	6	6	6	5	6	6	6	6
Residential Wood	6	7	13	13	11	7	7	8	6	6	7	7	6	5	6
Residential Other	492	290	211	167	167	175	176	177	178	177	176	131	130	121	123
distillate oil	212	196	157	128	132	137	141	144	145	145	144	108	106	97	98
bituminous/subbituminous coal	260	76	43	29	27	30	26	26	25	25	24	17	18	18	18
other	20	18	11	10	8	9	8	8	8	8	8	6	6	6	6
Industrial Processes	7,101	4,728	3,807	2,467	2,010	1,900	1,721	1,758	1,723	1,676	1,637	1,417	1,467	1,471	1,465
CHEMICAL & ALLIED PRODUCT MFG	591	367	280	456	440	297	280	278	269	275	286	255	259	261	262
Organic Chemical Mfg	NA	NA	NA	16	17	10	9	9	9	8	8	4	4	4	4
Inorganic Chemical Mfg	591	358	271	354	334	214	208	203	191	194	199	173	176	178	179
sulfur compounds	591	358	271	346	326	211	205	199	187	189	195	171	174	176	177
other	NA	NA	NA	8	8	2	3	4	4	4	4	2	2	2	2
Polymer & Resin Mfg	NA	NA	NA	7	7	1	1	1	1	1	0	1	1	1	1
Agricultural Chemical Mfg	NA	NA	NA	4	4	5	4	4	4	4	5	1	1	1	1
Paint, Varnish, Lacquer, Enamel Mfg	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Other Chemical Mfg	NA	8	10	76	77	67	57	60	64	68	74	76	76	77	76

Table A-8. National Sulfur Dioxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
METALS PROCESSING	***4,775***	***2,849***	***1,842***	***1,042***	***695***	***726***	***612***	***615***	***603***	***562***	***530***	***390***	***407***	***405***	***401***
Nonferrous Metals Processing	4,060	2,165	1,279	853	513	517	435	438	431	391	361	267	276	274	272
copper	*3,507*	*1,946*	*1,080*	*655*	*327*	*323*	*234*	*247*	*250*	*206*	*177*	*93*	*99*	*98*	*97*
lead	*77*	*34*	*34*	*121*	*113*	*129*	*135*	*131*	*122*	*128*	*126*	*112*	*113*	*114*	*114*
aluminum	*80*	*72*	*95*	*62*	*60*	*60*	*61*	*55*	*53*	*51*	*53*	*57*	*59*	*57*	*56*
other	*396*	*113*	*71*	*14*	*13*	*4*	*5*	*5*	*6*	*6*	*6*	*5*	*5*	*5*	*5*
Ferrous Metals Processing	715	684	562	172	165	186	159	158	153	153	151	107	114	114	113
Metals Processing NEC	NA	NA	NA	18	17	22	18	18	19	19	18	17	17	17	17
PETROLEUM & RELATED INDUSTRIES	***881***	***727***	***734***	***505***	***429***	***430***	***378***	***416***	***383***	***379***	***369***	***335***	***344***	***342***	***341***
Oil & Gas Production	111	173	157	204	156	122	98	93	98	95	89	90	90	90	90
natural gas	*111*	*173*	*157*	*202*	*155*	*120*	*96*	*92*	*96*	*93*	*88*	*89*	*90*	*89*	*89*
other	*NA*	*NA*	*NA*	*2*	*1*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*1*
Petroleum Refineries & Related Ind.	770	554	577	300	272	304	274	315	278	276	271	238	246	245	244
fluid catalytic cracking units	*480*	*318*	*330*	*212*	*195*	*183*	*182*	*185*	*183*	*188*	*188*	*157*	*163*	*162*	*162*
other	*290*	*236*	*247*	*88*	*77*	*121*	*92*	*130*	*95*	*88*	*83*	*81*	*83*	*83*	*82*
Asphalt Manufacturing	NA	NA	NA	1	1	4	7	7	7	8	9	8	8	8	7
OTHER INDUSTRIAL PROCESSES	***846***	***740***	***918***	***425***	***405***	***399***	***396***	***396***	***392***	***398***	***403***	***390***	***409***	***415***	***418***
Agriculture, Food, & Kindred Products	NA	NA	NA	3	3	3	3	3	3	3	3	4	4	4	5
Textiles, Leather, & Apparel Products	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Publ. Prod.	169	168	223	131	136	116	123	119	113	109	114	101	105	107	109
Rubber & Miscellaneous Plastic Prod.	NA	NA	NA	1	1	0	0	0	0	0	0	1	1	1	1
Mineral Products	677	571	694	286	261	275	267	270	272	282	282	270	285	288	288
cement mfg	*618*	*511*	*630*	*192*	*172*	*181*	*165*	*168*	*170*	*167*	*171*	*171*	*181*	*183*	*183*
other	*59*	*60*	*64*	*95*	*89*	*94*	*102*	*102*	*102*	*114*	*111*	*99*	*103*	*105*	*106*
Machinery Products	NA	NA	NA	0	0	0	0	1	0	1	1	0	0	0	0
Electronic Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	NA	NA	NA	3	3	5	3	3	3	3	4	13	13	14	14
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***1***	***1***	***0***	***0***	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***
Degreasing	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Dry Cleaning	NA	NA	NA	NA	NA	NA	NA	0	NA	0	0	0	0	0	0
Surface Coating	NA	NA	NA	1	1	0	0	0	0	0	0	0	0	0	0
Other Industrial	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***4***	***5***	***7***	***10***	***9***	***5***	***2***	***2***	***5***	***5***	***5***	***5***
Bulk Terminals & Plants	NA	NA	NA	NA	NA	0	1	1	0	0	0	1	1	1	1
Petroleum & Petroleum Prod. Storage	NA	NA	NA	0	0	5	7	0	0	0	0	0	0	0	0
Petroleum & Petroleum Prod.t Trans.	NA	NA	NA	1	1	0	0	0	0	0	0	1	1	2	2
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0
Organic Chemical Storage	NA	NA	NA	1	1	0	0	0	0	0	0	0	0	0	0
Organic Chemical Transport	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Transport	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	1	2	1	1	7	4	1	1	2	2	2	2

Table A-8. National Sulfur Dioxide Emissions Estimates, 1970, 1975, 1980, 1985, 1989–1999 (thousand short tons) (continued)

Source Category	1970	1975	1980	1985	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WASTE DISPOSAL & RECYCLING	***8***	***46***	***33***	***34***	***36***	***42***	***44***	***44***	***71***	***60***	***47***	***41***	***42***	***42***	***37***
Incineration	4	29	21	25	28	32	32	32	51	42	35	29	29	30	30
industrial	*NA*	*NA*	*NA*	*10*	*10*	*5*	*4*	*5*	*25*	*17*	*8*	*6*	*6*	*7*	*7*
other	*4*	*29*	*21*	*15*	*18*	*26*	*28*	*27*	*26*	*26*	*27*	*22*	*23*	*23*	*24*
Open Burning	4	17	12	9	8	11	11	11	11	11	11	11	11	11	5
industrial	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*4*	*17*	*12*	*8*	*7*	*10*	*10*	*11*	*11*	*11*	*11*	*11*	*11*	*11*	*5*
POTW	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
industrial	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other	NA	NA	NA	0	0	0	1	1	8	6	0	0	0	0	0
Transportation	**494**	**602**	**697**	**1,159**	**1,349**	**1,476**	**1,517**	**1,553**	**1,497**	**1,297**	**1,311**	**1,192**	**1,230**	**1,262**	**1,299**
ON-ROAD VEHICLES	***411***	***503***	***521***	***522***	***570***	***560***	***573***	***586***	***526***	***307***	***311***	***343***	***353***	***358***	***363***
Light-Duty Gas Vehicles & Motorcycles	132	158	159	146	145	129	126	125	124	125	126	128	131	134	137
light-duty gas vehicles	*132*	*158*	*158*	*145*	*145*	*128*	*126*	*125*	*124*	*124*	*126*	*128*	*130*	*134*	*136*
motorcycles	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Light-Duty Gas Trucks	40	48	50	55	58	69	81	87	90	92	93	85	89	90	91
light-duty gas trucks 1	*26*	*32*	*33*	*36*	*38*	*45*	*52*	*56*	*58*	*59*	*60*	*62*	*65*	*66*	*68*
light-duty gas trucks 2	*13*	*16*	*16*	*19*	*21*	*24*	*29*	*31*	*32*	*32*	*32*	*22*	*23*	*24*	*24*
Heavy-Duty Gas Vehicles	8	9	10	11	11	10	10	10	11	12	11	18	18	17	17
Diesels	231	288	303	311	356	352	356	364	300	79	82	112	117	117	118
NON-ROAD ENGINES AND VEHICLES	***83***	***99***	***175***	***637***	***779***	***916***	***944***	***968***	***972***	***990***	***999***	***849***	***877***	***904***	***936***
Non-Road Gasoline	NA	NA	NA	20	22	22	22	22	23	23	23	28	28	28	28
Non-Road Diesel	NA	NA	NA	407	488	509	529	549	570	590	610	459	474	490	507
Aircraft	4	4	6	6	7	11	11	11	11	11	11	11	11	12	12
Marine Vessels	43	52	117	143	193	251	259	258	249	252	239	237	245	256	273
Railroads	36	43	53	59	67	122	120	125	117	113	113	111	115	114	113
Non-Road Other	NA	NA	NA	1	2	2	2	2	2	2	2	3	3	3	3
Miscellaneous	**110**	**20**	**11**	**11**	**11**	**12**	**11**	**10**	**10**	**15**	**10**	**16**	**15**	**12**	**12**
Agriculture & Forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Other Combustion	110	20	11	11	11	12	11	9	9	15	10	16	15	12	12
Fugitive Dust	NA	NA	NA	NA	NA	0	0	0	1	0	0	0	0	0	0
TOTAL ALL SOURCES	**31,161**	**28,011**	**25,905**	**23,658**	**23,293**	**23,678**	**23,045**	**22,813**	**22,474**	**21,875**	**19,188**	**18,859**	**19,363**	**19,491**	**18,867**

Note: Some columns may not sum to totals due to rounding.

Table A-9. National PM $_{2.5}$ Emissions Estimates, 1990–1999 (thousand short tons)

Source Category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**909**	**893**	**927**	**852**	**841**	**898**	**848**	**776**	**735**	**766**	
FUEL COMB. ELEC. UTIL.		***121***	***105***	***106***	***112***	***108***	***107***	***157***	***161***	***130***	***128***
Coal		97	85	87	90	86	86	133	135	103	102
bituminous		*59*	*53*	*53*	*57*	*54*	*52*	*88*	*89*	*62*	*61*
subbituminous		*14*	*16*	*18*	*18*	*17*	*20*	*32*	*31*	*30*	*30*
anthracite & lignite		*23*	*16*	*16*	*15*	*15*	*15*	*13*	*15*	*11*	*11*
Oil		5	5	4	5	5	3	5	6	4	4
Gas		NA	NA	NA	NA	NA	NA	1	1	1	1
Other		0	0	0	0	0	0	0	0	3	3
Internal Combustion		20	15	16	17	17	18	17	18	18	19
FUEL COMB. INDUSTRIAL		***177***	***151***	***159***	***172***	***183***	***203***	***153***	***149***	***147***	***151***
Coal		29	23	25	24	25	25	23	23	23	24
bituminous		*23*	*18*	*20*	*20*	*19*	*19*	*18*	*18*	*18*	*18*
subbituminous		*2*	*1*	*1*	*2*	*3*	*3*	*3*	*3*	*3*	*3*
anthracite & lignite		*1*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*
other		*3*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*2*	*2*
Oil		31	26	26	27	26	28	26	24	24	24
residual		*26*	*22*	*22*	*23*	*22*	*24*	*22*	*20*	*19*	*20*
distillate		*4*	*3*	*3*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
other		*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*	*0*	*0*
Gas		39	34	39	41	42	44	39	39	38	39
natural		*29*	*23*	*26*	*28*	*29*	*29*	*25*	*25*	*25*	*25*
process		*11*	*10*	*13*	*13*	*14*	*15*	*13*	*14*	*14*	*14*
other		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other		73	58	59	69	60	59	50	48	48	49
wood/bark waste		*68*	*55*	*54*	*58*	*55*	*55*	*44*	*42*	*42*	*43*
liquid waste		*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*
other		*4*	*3*	*4*	*10*	*4*	*3*	*6*	*5*	*5*	*5*
Internal Combustion		5	10	10	11	29	48	15	15	15	15
FUEL COMB. OTHER		***611***	***638***	***662***	***568***	***550***	***589***	***538***	***466***	***458***	***487***
Commercial/Institutional Coal		6	6	6	6	6	6	7	7	7	7
Commercial/Institutional Oil		5	5	5	5	5	5	5	5	4	4
Commercial/Institutional Gas		5	5	6	6	6	6	7	7	7	7
Misc. Fuel Comb. (Except Residential)		78	73	72	72	72	73	72	75	78	81
Residential Wood		501	535	558	464	446	484	433	358	349	374
fireplaces		501	535	558	464	446	484	*418*	*344*	*335*	*359*
woodstoves		NA	NA	NA	NA	NA	NA	*15*	*14*	*13*	*14*
Residential Other		15	15	15	15	15	15	15	14	13	14
Industrial Processes	**794**	**812**	**819**	**788**	**771**	**749**	**605**	**619**	**625**	**913**	
CHEMICAL & ALLIED PRODUCT MFG		***47***	***43***	***45***	***41***	***49***	***42***	***39***	***39***	***40***	***40***
Organic Chemical Mfg		10	10	11	10	11	11	12	12	12	12
Inorganic Chemical Mfg		12	3	4	4	4	3	3	3	3	3
Polymer & Resin Mfg		4	3	4	3	3	3	2	2	2	2
Agricultural Chemical Mfg		8	8	8	8	8	8	5	6	6	6
Paint, Varnish, Lacquer, Enamel Mfg		0	0	0	0	0	0	0	0	0	0
Pharmaceutical Mfg		0	0	0	0	0	0	0	0	0	0
Other Chemical Mfg		13	17	17	15	23	16	16	16	17	17

Table A-9. National $PM_{2.5}$ Emissions Estimates, 1990–1999 (thousand short tons) (continued)

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
METALS PROCESSING	***157***	***197***	***198***	***125***	***125***	***134***	***100***	***105***	***105***	***103***
Non-Ferrous Metals Processing	31	29	29	25	25	25	22	23	23	23
copper	*9*	*9*	*9*	*8*	*8*	*8*	*4*	*5*	*4*	*4*
lead	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
zinc	*5*	*5*	*5*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*14*	*13*	*13*	*14*	*14*	*14*	*15*	*15*	*15*	*15*
Ferrous Metals Processing	121	89	83	86	86	92	65	69	68	67
primary	*103*	*72*	*66*	*68*	*68*	*74*	*47*	*50*	*50*	*50*
secondary	*17*	*16*	*16*	*17*	*18*	*19*	*18*	*18*	*18*	*17*
other	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Metals Processing NEC	5	80	85	14	14	16	13	14	14	14
PETROLEUM & RELATED INDUSTRIES	***27***	***24***	***24***	***22***	***22***	***22***	***17***	***17***	***17***	***17***
Oil & Gas Production	2	2	2	2	2	2	1	1	1	1
Petroleum Refineries & Related Industries	13	14	14	13	13	13	12	12	12	12
fluid catalytic cracking units	*11*	*12*	*12*	*11*	*11*	*11*	*7*	*8*	*8*	*8*
other	*2*	*2*	*2*	*2*	*2*	*2*	*4*	*4*	*4*	*4*
Asphalt Manufacturing	12	9	8	7	7	8	4	4	4	4
OTHER INDUSTRIAL PROCESSES	***284***	***264***	***259***	***260***	***256***	***256***	***180***	***186***	***189***	***191***
Agriculture, Food, & Kindred Products	39	46	40	44	43	40	20	21	21	22
country elevators	*6*	*6*	*7*	*6*	*6*	*6*	*1*	*1*	*1*	*1*
terminal elevators	*3*	*3*	*4*	*5*	*4*	*4*	*0*	*0*	*0*	*0*
feed mills	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*
soybean mills	*5*	*4*	*4*	*5*	*5*	*5*	*3*	*3*	*3*	*3*
wheat mills	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other grain mills	*4*	*3*	*3*	*3*	*3*	*3*	*2*	*3*	*3*	*3*
other	*17*	*26*	*19*	*21*	*22*	*20*	*14*	*14*	*14*	*14*
Textiles, Leather, & Apparel Products	0	0	0	0	0	0	0	1	0	0
Wood, Pulp & Paper, & Publishing Products	77	61	59	59	57	60	52	53	55	56
sulfate (kraft) pulping	*57*	*40*	*38*	*38*	*38*	*40*	*31*	*32*	*32*	*33*
other	*21*	*21*	*21*	*21*	*19*	*20*	*21*	*22*	*22*	*23*
Rubber & Miscellaneous Plastic Products	3	3	3	3	3	3	2	2	2	2
Mineral Products	144	134	135	136	133	134	88	92	93	93
cement mfg	*54*	*40*	*39*	*38*	*38*	*38*	*11*	*11*	*11*	*11*
surface mining	*6*	*6*	*7*	*7*	*7*	*6*	*7*	*7*	*7*	*7*
stone quarrying/processing	*24*	*28*	*28*	*28*	*26*	*26*	*9*	*9*	*9*	*9*
other	*61*	*60*	*61*	*62*	*63*	*63*	*61*	*64*	*65*	*66*
Machinery Products	3	3	3	3	3	3	2	2	2	2
Electronic Equipment	0	0	0	0	0	0	1	1	1	1
Transportation Equipment	1	1	1	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	16	16	17	15	16	16	14	14	15	15
SOLVENT UTILIZATION	***4***	***4***	***5***	***6***	***6***	***5***	***5***	***5***	***5***	***6***
Degreasing	0	0	0	0	0	0	0	0	0	0
Graphic Arts	0	0	0	0	0	0	1	1	1	1
Dry Cleaning	0	0	0	0	0	0	0	0	0	0
Surface Coating	3	3	4	4	4	4	4	4	4	4
Other Industrial	1	1	1	1	1	1	0	0	0	0
Nonindustrial	NA	NA	NA	NA	NA	NA	0	0	0	0
Solvent Utilization NEC	NA	NA	NA	NA	NA	NA	0	0	0	0

Table A-9. National PM $_{2.5}$ Emissions Estimates, 1990–1999 (thousand short tons) (continued)

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
STORAGE & TRANSPORT	***42***	***42***	***50***	***46***	***43***	***42***	***30***	***31***	***31***	***31***
Bulk Terminals & Plants	0	0	0	0	0	0	0	0	0	0
Petroleum & Petroleum Product Storage	0	1	1	1	0	0	0	0	0	0
Petroleum & Petroleum Product Transport	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage II	0	0	0	0	0	0	0	0	0	0
Organic Chemical Storage	0	0	0	0	0	0	1	1	1	1
Organic Chemical Transport	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Transport	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	41	41	48	44	41	41	28	29	29	30
storage	*13*	*11*	*12*	*13*	*13*	*12*	*11*	*11*	*11*	*11*
transfer	*28*	*29*	*36*	*31*	*28*	*29*	*17*	*18*	*18*	*18*
combined	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*NA*	*0*	*0*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*
Bulk Materials Transport	0	0	0	0	0	0	0	0	0	0
WASTE DISPOSAL & RECYCLING	***234***	***238***	***239***	***288***	***271***	***247***	***234***	***236***	***238***	***525***
Incineration	46	47	46	93	73	50	45	46	46	47
residential	*27*	*28*	*30*	*31*	*31*	*31*	*30*	*30*	*30*	*31*
other	*19*	*18*	*16*	*62*	*42*	*19*	*15*	*15*	*16*	*16*
Open Burning	187	190	192	195	196	197	186	188	190	476
residential	*177*	*179*	*181*	*183*	*184*	*185*	*176*	*177*	*179*	*173*
other	*10*	*11*	*11*	*11*	*12*	*11*	*10*	*11*	*11*	*303*
POTW	0	0	0	0	0	0	0	0	0	0
Industrial Waste Water	0	0	0	0	0	0	0	0	0	0
TSDF	0	0	0	0	0	0	0	0	0	0
Landfills	0	0	1	1	1	0	2	2	2	2
Other	0	0	0	0	1	0	0	0	0	0
Transportation 719	**720**	**717**	**688**	**682**	**640**	**701**	**686**	**665**	**640**	
ON-ROAD VEHICLES	***286***	***288***	***284***	***261***	***258***	***237***	***276***	***263***	***246***	***229***
Light-Duty Gas Vehicles & Motorcycles	34	33	32	32	32	32	32	33	34	34
ldgv	*34*	*33*	*32*	*32*	*32*	*32*	*32*	*33*	*33*	*34*
motorcycles	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Light-Duty Gas Trucks	24	28	30	30	29	26	22	22	22	22
ldgt1	*12*	*13*	*14*	*14*	*14*	*14*	*14*	*15*	*15*	*15*
ldgt2	*13*	*15*	*16*	*16*	*15*	*12*	*8*	*8*	*7*	*7*
Heavy-Duty Gas Vehicles	6	6	6	7	7	6	9	9	8	8
Diesels	221	220	216	192	190	173	212	199	181	166
hddv	*204*	*211*	*207*	*184*	*182*	*165*	*208*	*196*	*179*	*164*
lddt	*12*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*
lddv	*6*	*7*	*7*	*6*	*6*	*6*	*2*	*2*	*1*	*1*
NON-ROAD ENGINES AND VEHICLES	***432***	***432***	***433***	***427***	***424***	***403***	***425***	***423***	***419***	***411***
Non-Road Gasoline	43	43	43	44	44	45	79	80	81	82
recreational	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
construction	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*
industrial	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
lawn & garden	*10*	*10*	*10*	*11*	*11*	*11*	*19*	*19*	*19*	*19*
farm	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
light commercial	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*

Table A-9. National PM $_{2.5}$ Emissions Estimates, 1990–1999 (thousand short tons) (continued)

Source Category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NON-ROAD ENGINES AND VEHICLES (cont.)											
logging		0	0	0	0	0	0	17	19	20	21
airport service		0	0	0	0	0	0	0	0	0	0
railway maintenance		0	0	0	0	0	0	0	0	0	0
recreational marine vessels		27	27	27	28	28	28	35	35	36	36
Non-Road Diesel		277	275	273	273	272	272	251	247	242	233
recreational		1	1	1	1	1	1	1	1	1	1
construction		137	136	136	135	134	134	130	128	124	118
industrial		35	34	34	35	35	35	30	30	30	30
lawn & garden		8	8	9	10	11	11	10	10	11	11
farm		71	71	70	69	68	67	57	55	53	50
light commercial		11	11	11	12	12	13	12	13	13	14
logging		12	10	9	8	8	8	8	7	6	5
airport service		1	1	1	1	1	1	1	1	1	1
railway maintenance		1	1	1	1	1	1	1	1	1	0
recreational marine vessels		1	1	1	1	1	1	2	2	2	2
Aircraft		31	31	32	30	29	28	28	27	27	27
Marine Vessels		32	34	33	31	32	31	39	39	40	40
coal		1	1	1	1	1	1	1	1	1	1
diesel		25	26	25	24	24	24	37	38	38	38
residual oil		6	6	6	6	6	6	0	0	0	0
gasoline		0	0	0	0	0	0	0	0	0	0
Railroads		49	48	50	48	46	25	27	28	28	27
Non-Road Other		1	1	1	1	1	1	2	2	2	2
liquified petroleum gas		1	1	1	1	1	1	1	1	1	1
compressed natural gas		0	0	0	0	0	0	0	0	0	0
Miscellaneous	**5,234**	**5,004**	**4,854**	**4,926**	**5,360**	**4,725**	**4755**	**5186**	**5040**	**4454**	
Agriculture & Forestry		1,031	1,019	976	887	941	952	953	961	961	948
agricultural crops		949	937	893	803	856	867	866	875	873	860
agricultural livestock		82	83	83	84	85	85	87	87	88	89
Other Combustion		1,037	807	666	693	913	734	946	1139	871	872
wildfires		538	299	151	137	372	130	386	538	233	233
managed burning		479	488	494	535	519	583	542	582	619	620
other		20	20	21	21	21	22	18	19	19	19
Cooling Towers		0	0	0	0	0	1	2	2	3	3
Fugitive Dust		3,166	3,177	3,212	3,346	3,506	3,037	2853	3084	3206	2631
unpaved roads		1,687	1,684	1,642	1,718	1,709	1,559	1366	1427	1406	1411
paved roads		562	600	606	616	634	585	600	649	666	682
construction		850	818	892	930	1,049	777	750	857	968	391
other		67	75	73	81	113	117	136	150	165	146
TOTAL ALL SOURCES		**7,655**	**7,430**	**7,317**	**7,254**	**7,654**	**7,012**	**6,909**	**7,267**	**7,065**	**6,773**

Note: Some columns may not sum to totals due to rounding.

Table A-10. National Ammonia Emissions Estimates, 1990–1999 (thousand short tons)

Source Category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fuel Combustion	**25**	**25**	**25**	**26**	**26**	**26**	**47**	**47**	**47**	**48**	
FUEL COMB. ELEC. UTIL.		***0***	***0***	***0***	***0***	***0***	***0***	***6***	***6***	***8***	***7***
Coal		NA	NA	NA	NA	NA	NA	0	0	0	0
Oil		NA	NA	NA	NA	NA	NA	2	2	3	3
Gas		NA	NA	NA	NA	NA	NA	4	4	4	4
Other		NA	NA	NA	NA	NA	0	0	0	0	
Internal Combustion		0	0	0	0	0	0	0	0	0	0
FUEL COMB. INDUSTRIAL		***17***	***17***	***17***	***18***	***18***	***18***	***34***	***34***	***33***	***34***
Coal		0	0	0	0	0	0	0	0	0	0
Oil		4	4	4	4	4	4	4	4	4	4
Gas		13	13	13	14	14	13	25	25	25	25
Other		0	0	0	0	0	0	0	0	0	0
Internal Combustion		0	0	0	0	0	0	5	5	5	5
FUEL COMB. OTHER		***8***	***8***	***8***	***8***	***8***	***8***	***7***	***7***	***6***	***7***
Commercial/Institutional Coal		0	0	0	0	0	0	0	0	0	0
Commercial/Institutional Oil		2	2	2	2	2	2	2	2	2	2
Commercial/Institutional Gas		1	1	1	1	1	1	1	1	1	1
Misc. Fuel Comb. (Except Residential)		NA	NA	NA	NA	NA	NA	0	0	0	0
Residential Other		5	5	5	5	5	5	5	5	4	4
Industrial Processes	**351**	**355**	**359**	**364**	**364**	**365**	**271**	**277**	**284**	**289**	
CHEMICAL & ALLIED PRODUCT MFG		***183***	***183***	***183***	***183***	***183***	***183***	***123***	***125***	***130***	***133***
Organic Chemical Mfg		NA	NA	NA	NA	NA	NA	0	0	0	0
Inorganic Chemical Mfg		NA	NA	NA	NA	NA	NA	0	0	0	0
Polymer & Resin Mfg		NA	NA	NA	NA	NA	NA	0	0	0	0
Agricultural Chemicals		183	183	183	183	183	183	109	111	115	118
ammonium nitrate/urea mfg.		*111*	*111*	*111*	*111*	*111*	*111*	*41*	*42*	*43*	*44*
other		*71*	*71*	*71*	*71*	*71*	*71*	*68*	*70*	*72*	*73*
Other Chemical Mfg		NA	NA	NA	NA	NA	NA	13	14	14	15
METALS PROCESSING		***6***	***6***	***6***	***6***	***6***	***6***	***4***	***5***	***5***	***5***
Non-Ferrous Metals Processing		0	0	0	0	0	0	0	0	0	0
Ferrous Metals Processing		6	6	6	6	6	6	4	5	5	5
Metals Processing NEC		0	0	0	0	0	0	0	0	0	0
PETROLEUM & RELATED INDUSTRIES		***43***	***43***	***43***	***43***	***43***	***43***	***16***	***17***	***17***	***17***
Oil & Gas Production		0	0	0	0	0	0	0	0	0	0
Petroleum Refineries & Related Industries		43	43	43	43	43	43	16	17	17	17
catalytic cracking		*43*	*43*	*43*	*43*	*43*	*43*	*16*	*17*	*17*	*17*
other		0	0	0	0	0	0	*0*	*0*	*0*	*0*
OTHER INDUSTRIAL PROCESSES		***38***	***38***	***39***	***39***	***40***	***40***	***43***	***45***	***45***	***45***
Agriculture, Food, & Kindred Products		2	2	3	3	2	2	4	4	4	4
Textiles, Leather, & Apparel Products		NA	NA	NA	NA	NA	NA	0	0	0	0
Wood, Pulp & Paper, & Publishing Products		NA	NA	NA	NA	NA	NA	1	1	1	1
Rubber & Miscellaneous Plastic Products		NA	NA	NA	NA	NA	NA	0	0	0	0
Mineral Products		0	0	0	0	0	0	0	0	0	0
Machinery Products		NA	NA	NA	NA	NA	NA	0	0	0	0
Electronic Equipment		NA	NA	NA	NA	NA	NA	0	0	0	0
Miscellaneous Industrial Processes		35	35	36	37	38	38	39	40	40	40

Table A-10. National Ammonia Emissions Estimates, 1990–1999 (thousand short tons) (continued)

Source Category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SOLVENT UTILIZATION		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Degreasing		NA	NA	NA	NA	NA	NA	0	0	0	0
Graphic Arts		NA	NA	NA	NA	NA	NA	0	0	0	0
Dry Cleaning		NA	NA	NA	NA	NA	NA	0	0	0	0
Surface Coating		NA	NA	NA	NA	NA	NA	0	0	0	0
Other Industrial		NA	NA	NA	NA	NA	NA	0	0	0	0
STORAGE & TRANSPORT		***0***	***0***	***0***	***0***	***0***	***0***	***1***	***1***	***1***	***1***
Bulk Terminals & Plants		NA	NA	NA	NA	NA	NA	0	0	0	0
Petroleum & Petroleum Product Storage		NA	NA	NA	NA	NA	NA	1	1	1	1
Petroleum & Petroleum Product Transport		NA	NA	NA	NA	NA	NA	0	0	0	0
Organic Chemical Storage		NA	NA	NA	NA	NA	NA	0	0	0	0
Inorganic Chemical Storage		NA	NA	NA	NA	NA	NA	0	0	0	0
Bulk Materials Storage		0	0	0	0	0	0	0	0	0	0
WASTE DISPOSAL & RECYCLING		***82***	***86***	***89***	***93***	***93***	***93***	***84***	***84***	***86***	***88***
Incineration		NA	NA	NA	NA	NA	NA	0	0	0	0
Open Burning		NA	NA	NA	NA	NA	NA	0	0	0	0
POTW		82	86	89	93	93	93	84	84	86	87
wastewater treatment		*82*	*86*	*89*	*93*	*93*	*93*	*84*	*84*	*86*	*87*
other		*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*
Industrial Waste Water		NA	NA	NA	NA	NA	NA	0	0	0	0
TSDF		NA	NA	NA	NA	NA	NA	0	0	0	0
Landfills		NA	NA	NA	NA	NA	NA	0	0	0	0
Other		NA	NA	NA	NA	NA	NA	0	0	0	0
Transportation	**194**	**205**	**214**	**224**	**239**	**258**	**238**	**267**	**262**	**270**	
ON-ROAD VEHICLES		***188***	***198***	***208***	***218***	***233***	***252***	***229***	***258***	***252***	***260***
Light-Duty Gas Vehicles & Motorcycles		149	151	155	159	168	180	157	168	169	174
Light-Duty Gas Trucks		38	46	52	58	63	70	63	80	72	76
Heavy-Duty Gas Vehicles		0	0	1	1	1	1	4	4	4	4
Diesels		0	0	0	0	0	0	6	6	6	6
NON-ROAD ENGINES AND VEHICLES		***6***	***7***	***7***	***7***	***7***	***7***	***9***	***9***	***10***	***10***
Non-Road Gasoline		1	1	1	1	1	1	1	1	1	1
Non-Road Diesel		2	3	3	3	3	3	3	3	3	3
Aircraft		NA	NA	NA	NA	NA	NA	3	3	4	4
Marine Vessels		1	1	1	1	1	1	1	1	1	1
Railroads		2	2	2	2	2	2	1	1	1	1
NATURAL SOURCES		***30***	***29***	***28***	***29***	***30***	***31***	***32***	***33***	***34***	***35***
Biogenic		30	29	28	29	30	31	32	33	34	35
Miscellaneous	**3,727**	**3,770**	**3,814**	**3,869**	**3,924**	**3,979**	**4,106**	**4,163**	**4,258**	**4,322**	
Agriculture & Forestry		3,727	3,770	3,814	3,869	3,924	3,979	4,106	4,163	4,258	4,322
livestock agriculture		*3,307*	*3,324*	*3,341*	*3,370*	*3,399*	*3,427*	*3,457*	*3,485*	*3,520*	*3,552*
fertilizer application		*420*	*446*	*473*	*499*	*525*	*551*	*649*	*678*	*739*	*769*
Fugitive Dust		0	0	0	0	0	0	0	0	0	0
TOTAL ALL SOURCES		**4,327**	**4,383**	**4,440**	**4,512**	**4,583**	**4,658**	**4,694**	**4,787**	**4,885**	**4,964**

Note: Some columns may not sum to totals due to rounding.

Table A-11. National Long-Term Air Quality Trends, 1980–1999

Year	CO 2nd Max. 8-hr ppm	Pb Max. Qtr. µg/m³	NO_2 Arith. Mean ppm	Ozone 2nd Max. 1-hr ppm	PM_{10} Wtd. Arith. Mean µg/m³	SO_2 Arith. Mean ppm
1980–89	***(304 sites)***	***(216 sites)***	***(156 sites)***	***(441 sites)***	**—**	***(438 sites)***
1980	8.6	0.65	0.024	0.134	—	0.0103
1981	8.4	0.54	0.024	0.125	—	0.0101
1982	8.1	0.53	0.023	0.124	—	0.0094
1983	7.9	0.40	0.022	0.137	—	0.0091
1984	7.8	0.37	0.023	0.124	—	0.0092
1985	7.1	0.25	0.023	0.122	—	0.0087
1986	7.2	0.15	0.023	0.118	—	0.0085
1987	6.7	0.11	0.023	0.124	—	0.0083
1988	6.5	0.10	0.023	0.135	—	0.0084
1989	6.4	0.08	0.023	0.115	—	0.0081
1990–99	***(388 sites)***	***(175 sites)***	***(230 sites)***	***(703 sites)***	***(954 sites)***	***(480 sites)***
1990	5.8	0.10	0.020	0.112	29.2	0.0081
1991	5.7	0.08	0.019	0.112	29.0	0.0079
1992	5.3	0.06	0.019	0.105	26.8	0.0073
1993	5.0	0.06	0.019	0.108	26.0	0.0072
1994	5.1	0.05	0.020	0.107	26.0	0.0069
1995	4.6	0.05	0.019	0.112	24.8	0.0056
1996	4.3	0.04	0.018	0.105	24.0	0.0056
1997	4.0	0.04	0.018	0.105	23.8	0.0054
1998	3.8	0.04	0.018	0.110	23.6	0.0053
1999	3.7	0.04	0.018	0.107	23.9	0.0052

Table A-12a. National Air Quality Trends by Monitoring Location, 1980–1989

Statistic	# of Sites	Units	Location	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Carbon Monoxide													
2nd Max. 8-hr.	3	ppm	Rural	4.7	4.9	3.8	3.3	4.1	3.8	4.5	3.8	3.5	3.2
2nd Max. 8-hr.	132	ppm	Suburban	8.0	7.8	7.5	7.5	7.3	6.6	6.6	6.4	6.1	6.1
2nd Max. 8-hr.	166	ppm	Urban	9.1	8.8	8.6	8.3	8.2	7.5	7.6	7.0	6.8	6.6
Lead													
Max. Qtr.	8	µg/m^3	Rural	0.53	0.49	0.32	0.26	0.24	0.16	0.11	0.10	0.09	0.09
Max. Qtr.	89	µg/m^3	Suburban	0.68	0.56	0.50	0.41	0.36	0.25	0.15	0.11	0.09	0.08
Max. Qtr.	114	µg/m^3	Urban	0.64	0.53	0.57	0.41	0.38	0.25	0.15	0.11	0.09	0.08
Nitrogen Dioxide													
Arith. Mean	23	ppm	Rural	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Arith. Mean	75	ppm	Suburban	0.026	0.025	0.024	0.024	0.024	0.024	0.024	0.024	0.025	0.024
Arith. Mean	57	ppm	Urban	0.029	0.028	0.027	0.027	0.028	0.027	0.028	0.027	0.028	0.027
Ozone													
2nd Max. 1-hr.	121	ppm	Rural	0.123	0.116	0.113	0.125	0.116	0.114	0.112	0.117	0.129	0.110
2nd Max. 1-hr.	215	ppm	Suburban	0.138	0.130	0.129	0.142	0.128	0.127	0.122	0.129	0.141	0.118
2nd Max. 1-hr.	96	ppm	Urban	0.137	0.126	0.124	0.140	0.126	0.122	0.119	0.125	0.133	0.116
PM_{10}*													
Wtd. Arith. Mean	—	µg/m^3	Rural	—	—	—	—	—	—	—	—	—	—
Wtd. Arith. Mean	—	µg/m^3	Suburban	—	—	—	—	—	—	—	—	—	—
Wtd. Arith. Mean	—	µg/m^3	Urban	—	—	—	—	—	—	—	—	—	—
Sulfur Dioxide													
Arith. Mean	117	ppm	Rural	0.0087	0.0083	0.0076	0.0074	0.0076	0.0074	0.0072	0.0070	0.0070	0.0070
Arith. Mean	180	ppm	Suburban	0.0105	0.0101	0.0093	0.0091	0.0094	0.0090	0.0087	0.0084	0.0085	0.0082
Arith. Mean	133	ppm	Urban	0.0116	0.0116	0.0109	0.0104	0.0104	0.0095	0.0096	0.0092	0.0095	0.0092

* PM_{10} trend data is not available for this 10-year period.

Table A-12b. National Air Quality Trends by Monitoring Location, 1990–1999

Statistic	# of Sites	Units	Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Carbon Monoxide													
2nd Max. 8-hr.	13	ppm	Rural	2.5	2.6	2.3	2.0	2.2	2.3	1.9	1.8	1.7	1.6
2nd Max. 8-hr.	157	ppm	Suburban	5.6	5.4	5.0	4.9	5.0	4.3	4.1	3.9	3.8	3.7
2nd Max. 8-hr.	215	ppm	Urban	6.2	6.1	5.6	5.2	5.4	4.9	4.6	4.3	4.0	3.9
Lead													
Max. Qtr.	6	µg/m^3	Rural	0.06	0.06	0.07	0.06	0.05	0.1	0.04	0.03	0.05	0.04
Max. Qtr.	86	µg/m^3	Suburban	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03
Max. Qtr.	78	µg/m^3	Urban	0.12	0.09	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.04
Nitrogen Dioxide													
Arith. Mean	43	ppm	Rural	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.008
Arith. Mean	105	ppm	Suburban	0.021	0.021	0.020	0.020	0.020	0.020	0.019	0.018	0.019	0.019
Arith. Mean	80	ppm	Urban	0.024	0.024	0.023	0.023	0.024	0.023	0.023	0.022	0.022	0.022
Ozone													
2nd Max. 1-hr.	239	ppm	Rural	0.107	0.105	0.101	0.103	0.102	0.108	0.102	0.101	0.107	0.105
2nd Max. 1-hr.	325	ppm	Suburban	0.115	0.117	0.108	0.111	0.111	0.116	0.107	0.108	0.114	0.110
2nd Max. 1-hr.	121	ppm	Urban	0.110	0.110	0.105	0.104	0.106	0.109	0.105	0.102	0.104	0.103
PM_{10}													
Wtd. Arith. Mean	153	µg/m^3	Rural	23.9	23.2	21.7	20.6	20.8	19.4	19.4	19.0	19.0	19.2
Wtd. Arith. Mean	375	µg/m^3	Suburban	30.1	29.8	27.6	26.8	26.8	25.8	24.6	24.6	24.3	24.8
Wtd. Arith. Mean	408	µg/m^3	Urban	30.5	30.4	28.0	27.3	27.3	26.0	25.1	24.9	24.9	24.9
Sulfur Dioxide													
Arith. Mean	123	ppm	Rural	0.0065	0.0063	0.0060	0.0061	0.0058	0.0050	0.0048	0.0046	0.0045	0.0042
Arith. Mean	215	ppm	Suburban	0.0086	0.0084	0.0078	0.0076	0.0072	0.0057	0.0059	0.0057	0.0057	0.0056
Arith. Mean	131	ppm	Urban	0.0092	0.0088	0.0080	0.0077	0.0077	0.0060	0.0059	0.0057	0.0056	0.0055

Table A-13a. National Air Quality Trends Statistics by EPA Region, 1980–1989

	Statistic	# of Sites	Units	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Region 1													
CO	2nd Max. 8-hr.	10	ppm	9.4	8.4	8.9	8.5	8.3	6.8	7.2	6.4	5.6	5.6
Pb	Max. Qtr.	15	µg/m^3	0.53	0.49	0.54	0.41	0.33	0.29	0.11	0.08	0.06	0.06
NO_2	Arith. Mean	4	ppm	0.032	0.030	0.028	0.026	0.032	0.031	0.029	0.030	0.030	0.028
O_3	2nd Max. 1-hr.	21	ppm	0.161	0.141	0.151	0.169	0.155	0.139	0.123	0.133	0.160	0.130
O_3	4th Max. 8-hr.	21	ppm	0.112	0.100	0.109	0.121	0.106	0.100	0.090	0.095	0.118	0.095
PM_{10}*	Wtd. Arith. Mean	—	µg/m^3	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	46	ppm	0.0107	0.0100	0.0099	0.0092	0.0099	0.0095	0.0101	0.0099	0.0100	0.0093
Region 2													
CO	2nd Max. 8-hr.	22	ppm	8.9	9.4	8.5	7.8	8.3	6.7	7.4	6.4	6.2	6.1
Pb	Max. Qtr.	7	µg/m^3	0.61	0.62	0.63	0.47	0.53	0.38	0.12	0.08	0.08	0.05
NO_2	Arith. Mean	7	ppm	0.029	0.029	0.031	0.031	0.030	0.029	0.028	0.029	0.029	0.027
O_3	2nd Max. 1-hr.	25	ppm	0.142	0.132	0.133	0.152	0.130	0.130	0.123	0.139	0.158	0.117
O_3	4th Max. 8-hr.	25	ppm	0.106	0.098	0.098	0.111	0.096	0.098	0.095	0.104	0.120	0.091
PM_{10}*	Wtd. Arith. Mean	—	µg/m^3	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	31	ppm	0.0148	0.0147	0.0135	0.0126	0.0131	0.0117	0.0114	0.0109	0.0119	0.0111
Region 3													
CO	2nd Max. 8-hr.	38	ppm	7.0	7.0	7.0	6.9	7.6	5.7	6.2	5.9	5.4	5.3
Pb	Max. Qtr.	29	µg/m^3	0.46	0.39	0.44	0.34	0.34	0.22	0.15	0.12	0.14	0.10
NO_2	Arith. Mean	36	ppm	0.024	0.023	0.023	0.023	0.024	0.023	0.024	0.024	0.023	0.023
O_3	2nd Max. 1-hr.	62	ppm	0.133	0.122	0.125	0.138	0.119	0.118	0.114	0.128	0.150	0.111
O_3	4th Max. 8-hr.	62	ppm	0.102	0.095	0.095	0.107	0.092	0.093	0.090	0.100	0.116	0.088
PM_{10}*	Wtd. Arith. Mean	—	µg/m^3	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	54	ppm	0.0141	0.0137	0.0130	0.0130	0.0133	0.0124	0.0127	0.0123	0.0130	0.0130
Region 4													
CO	2nd Max. 8-hr.	47	ppm	7.9	7.8	7.3	7.4	7.7	6.2	6.1	5.9	5.6	5.9
Pb	Max. Qtr.	39	µg/m^3	0.49	0.41	0.52	0.42	0.37	0.21	0.12	0.10	0.08	0.08
NO_2	Arith. Mean	8	ppm	0.018	0.019	0.019	0.019	0.018	0.018	0.017	0.018	0.018	0.018
O_3	2nd Max. 1-hr.	71	ppm	0.116	0.107	0.105	0.118	0.106	0.104	0.114	0.112	0.123	0.103
O_3	4th Max. 8-hr.	71	ppm	0.089	0.082	0.081	0.091	0.082	0.081	0.087	0.088	0.096	0.081
PM_{10}*	Wtd. Arith. Mean	—	µg/m^3	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	63	ppm	0.0096	0.0088	0.0078	0.0072	0.0071	0.0071	0.0072	0.0073	0.0076	0.0071
Region 5													
CO	2nd Max. 8-hr.	39	ppm	7.5	7.8	7.3	7.0	7.5	5.9	6.2	6.3	5.5	5.6
Pb	Max. Qtr.	48	µg/m^3	0.59	0.48	0.56	0.36	0.31	0.20	0.13	0.10	0.09	0.09
NO_2	Arith. Mean	17	ppm	0.019	0.020	0.020	0.021	0.021	0.020	0.020	0.021	0.020	0.021
O_3	2nd Max. 1-hr.	90	ppm	0.119	0.114	0.112	0.129	0.109	0.106	0.108	0.119	0.131	0.107
O_3	4th Max. 8-hr.	90	ppm	0.092	0.088	0.086	0.096	0.083	0.082	0.081	0.090	0.105	0.085
PM_{10}*	Wtd. Arith. Mean	—	µg/m^3	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	126	ppm	0.0112	0.0109	0.0102	0.0101	0.0101	0.0095	0.0090	0.0088	0.0086	0.0086

* PM_{10} trend data is not available for this 10-year period.

Table A-13a. National Air Quality Trends Statistics by EPA Region, 1980–1989 (continued)

	Statistic	# of Sites	Units	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Region 6													
CO	2nd Max. 8-hr.	24	ppm	8.2	8.1	8.0	7.4	7.3	7.3	7.3	7.5	6.5	6.5
Pb	Max. Qtr.	16	$\mu g/m^3$	0.74	0.76	0.63	0.56	0.50	0.30	0.16	0.13	0.10	0.08
NO_2	Arith. Mean	12	ppm	0.017	0.017	0.017	0.017	0.017	0.016	0.017	0.017	0.017	0.015
O_3	2nd Max. 1-hr.	34	ppm	0.131	0.127	0.121	0.120	0.123	0.118	0.114	0.117	0.118	0.113
O_3	4th Max. 8-hr.	34	ppm	0.093	0.090	0.086	0.086	0.089	0.087	0.083	0.087	0.089	0.083
PM_{10}*	Wtd. Arith. Mean	—	$\mu g/m^3$	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	29	ppm	0.0066	0.0073	0.0068	0.0076	0.0068	0.0071	0.0063	0.0059	0.0056	0.0056
Region 7													
CO	2nd Max. 8-hr.	13	ppm	7.7	7.4	7.3	5.8	6.1	5.2	6.0	5.7	4.9	5.3
Pb	Max. Qtr.	14	$\mu g/m^3$	0.31	0.27	0.22	0.20	0.20	0.16	0.10	0.09	0.08	0.08
NO_2	Arith. Mean	8	ppm	0.016	0.014	0.016	0.015	0.015	0.014	0.015	0.016	0.015	0.015
O_3	2nd Max. 1-hr.	20	ppm	0.119	0.104	0.100	0.119	0.115	0.108	0.108	0.113	0.118	0.098
O_3	4th Max. 8-hr.	20	ppm	0.087	0.074	0.075	0.090	0.087	0.079	0.077	0.082	0.092	0.077
PM_{10}*	Wtd. Arith. Mean	—	$\mu g/m^3$	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	17	ppm	0.0094	0.0085	0.0095	0.0093	0.0093	0.0082	0.0083	0.0081	0.0076	0.0079
Region 8													
CO	2nd Max. 8-hr.	12	ppm	10.4	10.6	10.2	11.9	10.9	9.5	10.6	9.0	8.9	7.4
Pb	Max. Qtr.	5	$\mu g/m^3$	0.90	0.73	0.77	0.64	0.62	0.49	0.22	0.12	0.07	0.06
NO_2	Arith. Mean	14	ppm	0.013	0.013	0.012	0.013	0.013	0.014	0.014	0.013	0.013	0.013
O_3	2nd Max. 1-hr.	13	ppm	0.102	0.101	0.103	0.110	0.104	0.102	0.109	0.097	0.104	0.103
O_3	4th Max. 8-hr.	13	ppm	0.074	0.073	0.074	0.078	0.075	0.076	0.076	0.074	0.078	0.077
PM_{10}*	Wtd. Arith. Mean	—	$\mu g/m^3$	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	20	ppm	0.0064	0.0060	0.0055	0.0048	0.0050	0.0045	0.0043	0.0040	0.0043	0.0041
Region 9													
CO	2nd Max. 8-hr.	72	ppm	8.8	8.1	7.9	7.8	7.0	7.8	7.6	6.5	7.2	7.1
Pb	Max. Qtr.	38	$\mu g/m^3$	0.84	0.61	0.57	0.44	0.41	0.25	0.19	0.13	0.10	0.09
NO_2	Arith. Mean	50	ppm	0.031	0.031	0.029	0.027	0.028	0.029	0.029	0.028	0.030	0.029
O_3	2nd Max. 1-hr.	99	ppm	0.164	0.152	0.149	0.161	0.151	0.155	0.137	0.141	0.143	0.137
O_3	4th Max. 8-hr.	99	ppm	0.109	0.102	0.099	0.107	0.103	0.104	0.097	0.098	0.099	0.095
PM_{10}*	Wtd. Arith. Mean	—	$\mu g/m^3$	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	47	ppm	0.0051	0.0058	0.0045	0.0041	0.0046	0.0042	0.0036	0.0032	0.0034	0.0032
Region 10													
CO	2nd Max. 8-hr.	27	ppm	12.6	11.7	11.4	11.3	10.2	10.4	9.3	9.4	9.2	8.6
Pb	Max. Qtr.	8	$\mu g/m^3$	2.05	1.50	0.58	0.47	0.46	0.44	0.24	0.17	0.14	0.12
NO_2	Arith. Mean	—	ppm	—	—	—	—	—	—	—	—	—	—
O_3	2nd Max. 1-hr.	6	ppm	0.095	0.121	0.108	0.093	0.098	0.105	0.107	0.098	0.110	0.089
O_3	4th Max. 8-hr.	6	ppm	0.070	0.084	0.075	0.063	0.065	0.074	0.078	0.073	0.072	0.064
PM_{10}*	Wtd. Arith. Mean	—	$\mu g/m^3$	—	—	—	—	—	—	—	—	—	—
SO_2	Arith. Mean	5	ppm	0.0120	0.0126	0.0130	0.0115	0.0137	0.0122	0.0116	0.0106	0.0086	0.0079

* PM_{10} trend data is not available for this 10-year period.

Table A-13b. National Air Quality Trends Statistics by EPA Region, 1990–1999

	Statistic	# of Sites	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Region 1													
CO	2nd Max. 8-hr.	18	ppm	6.0	5.5	5.6	4.8	5.9	5.3	4.8	4.1	3.7	3.7
Pb	Max. Qtr.	1	µg/m^3	0.69	0.69	0.19	0.02	0.02	0.04	0.03	0.03	0.02	0.01
NO_2	Arith. Mean	14	ppm	0.022	0.022	0.021	0.022	0.022	0.020	0.020	0.020	0.020	0.019
O_3	2nd Max. 1-hr.	42	ppm	0.118	0.127	0.110	0.119	0.114	0.116	0.102	0.116	0.106	0.113
O_3	4th Max. 8-hr.	42	ppm	0.090	0.097	0.086	0.087	0.086	0.089	0.080	0.089	0.083	0.087
PM_{10}	Wtd. Arith. Mean	69	µg/m^3	23.0	23.8	20.9	20.4	20.9	18.9	19.5	19.9	19.7	19.4
SO_2	Arith. Mean	47	ppm	0.0080	0.0077	0.0072	0.0069	0.0068	0.0053	0.0052	0.0050	0.0050	0.0047
Region 2													
CO	2nd Max. 8-hr.	28	ppm	5.8	5.8	5.3	4.7	5.5	4.8	4.2	3.7	3.4	3.6
Pb	Max. Qtr.	4	µg/m^3	0.10	0.07	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.05
NO_2	Arith. Mean	12	ppm	0.030	0.029	0.028	0.028	0.029	0.027	0.028	0.027	0.027	0.027
O_3	2nd Max. 1-hr.	39	ppm	0.120	0.122	0.109	0.109	0.105	0.115	0.103	0.111	0.108	0.115
O_3	4th Max. 8-hr.	39	ppm	0.094	0.099	0.085	0.088	0.085	0.095	0.082	0.092	0.088	0.093
PM_{10}	Wtd. Arith. Mean	65	µg/m^3	26.5	26.9	24.3	24.4	24.8	22.2	22.9	23.5	22.8	22.4
SO_2	Arith. Mean	43	ppm	0.0090	0.0092	0.0085	0.0078	0.0079	0.0061	0.0062	0.0056	0.0055	0.0054
Region 3													
CO	2nd Max. 8-hr.	41	ppm	5.2	4.7	4.4	4.4	4.7	4.0	3.7	3.5	3.4	3.1
Pb	Max. Qtr.	25	µg/m^3	0.07	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.03
NO_2	Arith. Mean	35	ppm	0.022	0.021	0.021	0.021	0.022	0.020	0.021	0.020	0.020	0.019
O_3	2nd Max. 1-hr.	74	ppm	0.110	0.117	0.102	0.116	0.111	0.117	0.105	0.116	0.115	0.120
O_3	4th Max. 8-hr.	74	ppm	0.088	0.096	0.083	0.092	0.088	0.094	0.085	0.093	0.095	0.096
PM_{10}	Wtd. Arith. Mean	71	µg/m^3	29.4	30.2	26.5	26.6	27.3	26.1	24.9	24.9	24.7	24.0
SO_2	Arith. Mean	76	ppm	0.0124	0.0119	0.0110	0.0111	0.0111	0.0084	0.0084	0.0088	0.0085	0.0080
Region 4													
CO	2nd Max. 8-hr.	61	ppm	5.2	4.9	4.9	5.0	4.7	4.3	3.8	4.0	3.7	3.7
Pb	Max. Qtr.	25	µg/m^3	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.03
NO_2	Arith. Mean	29	ppm	0.014	0.013	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
O_3	2nd Max. 1-hr.	131	ppm	0.103	0.096	0.095	0.103	0.099	0.104	0.101	0.102	0.111	0.109
O_3	4th Max. 8-hr.	131	ppm	0.082	0.075	0.076	0.081	0.080	0.082	0.081	0.082	0.090	0.089
PM_{10}	Wtd. Arith. Mean	146	µg/m^3	29.3	28.2	26.4	25.7	25.4	24.8	23.8	23.7	24.4	23.8
SO_2	Arith. Mean	76	ppm	0.0059	0.0056	0.0053	0.0054	0.0050	0.0042	0.0044	0.0044	0.0045	0.0044
Region 5													
CO	2nd Max. 8-hr.	43	ppm	5.1	4.8	4.5	4.4	5.2	4.1	3.4	3.2	3.3	3.0
Pb	Max. Qtr.	44	µg/m^3	0.16	0.10	0.08	0.08	0.08	0.07	0.06	0.06	0.05	0.05
NO_2	Arith. Mean	13	ppm	0.021	0.021	0.022	0.022	0.023	0.023	0.023	0.022	0.022	0.022
O_3	2nd Max. 1-hr.	135	ppm	0.102	0.110	0.098	0.097	0.104	0.110	0.103	0.101	0.105	0.105
O_3	4th Max. 8-hr.	135	ppm	0.082	0.088	0.079	0.077	0.083	0.089	0.085	0.083	0.085	0.088
PM_{10}	Wtd. Arith. Mean	165	µg/m^3	30.4	29.7	27.5	26.2	27.8	27.0	24.5	24.6	26.0	24.8
SO_2	Arith. Mean	111	ppm	0.0094	0.0093	0.0081	0.0083	0.0077	0.0061	0.0062	0.0059	0.0059	0.0059

Table A-13b. National Air Quality Trends Statistics by EPA Region, 1990–1999 (continued)

	Statistic	# of Sites	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Region 6													
CO	2nd Max. 8-hr.	29	ppm	6.3	5.7	5.6	5.6	4.8	4.5	5.1	4.5	4.1	3.7
Pb	Max. Qtr.	17	µg/m^3	0.14	0.13	0.10	0.10	0.07	0.10	0.09	0.05	0.06	0.04
NO_2	Arith. Mean	24	ppm	0.014	0.014	0.015	0.014	0.015	0.015	0.015	0.015	0.014	0.014
O_3	2nd Max. 1-hr.	71	ppm	0.121	0.113	0.109	0.111	0.110	0.121	0.110	0.114	0.116	0.112
O_3	4th Max. 8-hr.	71	ppm	0.086	0.080	0.079	0.080	0.082	0.090	0.082	0.083	0.086	0.086
PM_{10}	Wtd. Arith. Mean	86	µg/m^3	26.3	24.7	24.7	24.0	24.2	25.2	24.3	22.7	23.8	25.0
SO_2	Arith. Mean	27	ppm	0.0067	0.0063	0.0066	0.0055	0.0048	0.0047	0.0049	0.0044	0.0043	0.0038
Region 7													
CO	2nd Max. 8-hr.	22	ppm	4.9	5.0	4.4	4.3	4.2	4.0	4.1	3.7	4.2	3.4
Pb	Max. Qtr.	19	µg/m^3	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.03	0.04	0.04
NO_2	Arith. Mean	12	ppm	0.015	0.015	0.016	0.015	0.016	0.016	0.016	0.016	0.016	0.017
O_3	2nd Max. 1-hr.	29	ppm	0.091	0.093	0.092	0.088	0.099	0.102	0.094	0.095	0.100	0.101
O_3	4th Max. 8-hr.	29	ppm	0.071	0.076	0.074	0.066	0.079	0.081	0.076	0.076	0.078	0.080
PM_{10}	Wtd. Arith. Mean	50	µg/m^3	30.3	29.6	29.0	27.9	28.7	28.3	28.3	26.4	26.1	26.7
SO_2	Arith. Mean	28	ppm	0.0078	0.0074	0.0066	0.0065	0.0066	0.0054	0.0051	0.0047	0.0045	0.0047
Region 8													
CO	2nd Max. 8-hr.	22	ppm	6.6	6.7	6.7	5.7	5.3	4.9	4.9	4.6	3.9	3.9
Pb	Max. Qtr.	8	µg/m^3	0.07	0.07	0.06	0.06	0.04	0.04	0.03	0.03	0.04	0.04
NO_2	Arith. Mean	12	ppm	0.012	0.012	0.013	0.013	0.014	0.013	0.013	0.013	0.013	0.013
O_3	2nd Max. 1-hr.	19	ppm	0.090	0.088	0.084	0.082	0.085	0.085	0.088	0.083	0.093	0.086
O_3	4th Max. 8-hr.	19	ppm	0.068	0.069	0.066	0.089	0.096	0.066	0.068	0.066	0.074	0.067
PM_{10}	Wtd. Arith. Mean	112	µg/m^3	24.2	25.2	24.0	22.8	22.4	19.6	19.9	19.0	19.1	18.7
SO_2	Arith. Mean	27	ppm	0.0061	0.0058	0.0064	0.0062	0.0055	0.0049	0.0041	0.0034	0.0031	0.0031
Region 9													
CO	2nd Max. 8-hr.	97	ppm	6.1	6.0	5.1	4.7	5.1	4.5	4.3	4.0	3.9	3.9
Pb	Max. Qtr.	27	µg/m^3	0.07	0.06	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.03
NO_2	Arith. Mean	79	ppm	0.022	0.022	0.021	0.020	0.021	0.020	0.019	0.018	0.018	0.019
O_3	2nd Max. 1-hr.	152	ppm	0.128	0.127	0.125	0.121	0.117	0.120	0.115	0.103	0.114	0.103
O_3	4th Max. 8-hr.	152	ppm	0.091	0.091	0.091	0.088	0.087	0.088	0.088	0.078	0.085	0.079
PM_{10}	Wtd. Arith. Mean	120	µg/m^3	37.8	36.8	32.1	31.1	30.2	30.1	28.3	28.8	26.3	30.5
SO_2	Arith. Mean	36	ppm	0.0021	0.0021	0.0020	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0019
Region 10													
CO	2nd Max. 8-hr.	27	ppm	8.2	8.4	7.7	7.1	6.8	6.6	6.5	6.1	5.5	5.6
Pb	Max. Qtr.	5	µg/m^3	0.06	0.06	0.04	0.05	0.05	0.05	0.04	0.05	0.06	0.04
NO_2	Arith. Mean	—	ppm	—	—	—	—	—	—	—	—	—	—
O_3	2nd Max. 1-hr.	14	ppm	0.100	0.088	0.089	0.081	0.088	0.086	0.097	0.076	0.098	0.073
O_3	4th Max. 8-hr.	14	ppm	0.073	0.065	0.069	0.058	0.063	0.063	0.076	0.058	0.069	0.058
PM_{10}	Wtd. Arith. Mean	70	µg/m^3	31.1	31.9	30.4	29.9	26.4	23.0	23.0	23.2	20.7	20.8
SO_2	Arith. Mean	9	ppm	0.0071	0.0070	0.0073	0.0066	0.0066	0.0059	0.0051	0.0047	0.0047	0.0050

Table A-14. Maximum Air Quality Concentrations by County, 1999

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM ($\mu g/m^3$)	PM$_{10}$ 2nd Max ($\mu g/m^3$)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
AL	CALHOUN CO	116,034	ND	ND	ND	ND	ND	ND	IN	ND	ND
AL	CLAY CO	13,252	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
AL	COLBERT CO	51,666	ND	ND	ND	ND	ND	ND	IN	0.003	0.017
AL	DE KALB CO	54,651	ND	ND	ND	ND	ND	24	48	ND	ND
AL	ELMORE CO	49,210	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
AL	ESCAMBIA CO	35,518	ND	ND	ND	ND	ND	25	53	ND	ND
AL	ETOWAH CO	99,840	ND	ND	ND	ND	ND	30	66	ND	ND
AL	FRANKLIN CO	27,814	ND	ND	ND	ND	ND	ND	IN	ND	ND
AL	HOUSTON CO	81,331	ND	ND	ND	ND	ND	IN	IN	ND	ND
AL	JACKSON CO	47,796	ND	ND	ND	ND	ND	ND	ND	0.005	0.026
AL	JEFFERSON CO	651,525	5	ND	ND	0.13	0.09	IN	108	IN	0.026
AL	LAWRENCE CO	31,513	ND	ND	ND	0.10	0.09	ND	ND	0.002	0.011
AL	LIMESTONE CO	54,135	ND	ND	ND	ND	ND	ND	IN	ND	ND
AL	MADISON CO	238,912	4	ND	ND	0.11	0.09	24*	54*	ND	ND
AL	MARENGO CO	23,084	ND	ND	ND	ND	ND	29	55	ND	ND
AL	MOBILE CO	378,643	ND	ND	ND	0.12	0.09	25	84	0.008	0.041
AL	MONTGOMERY CO	209,085	ND	ND	ND	0.11	0.09	24	48	ND	ND
AL	MORGAN CO	100,043	ND	ND	ND	ND	ND	IN	43	ND	ND
AL	PIKE CO	27,595	ND	0.83	ND	ND	ND	23	40	ND	ND
AL	RUSSELL CO	46,860	ND	ND	ND	ND	ND	IN	49	ND	ND
AL	SHELBY CO	99,358	ND	ND	0.010	0.12	0.10	28	57	ND	ND
AL	SUMTER CO	16,174	ND	ND	ND	0.09	0.07	ND	ND	ND	ND
AL	TALLADEGA CO	74,107	ND	ND	ND	ND	ND	26	59	ND	ND
AL	TUSCALOOSA CO	150,522	ND	ND	ND	ND	ND	28	61	ND	ND
AL	WALKER CO	67,670	ND	ND	ND	ND	ND	25	56	ND	ND
AK	ANCHORAGE BOROUGH	226,338	8	ND	ND	ND	ND	19*	73*	ND	ND
AK	FAIRBANKS NORTH STAR BOROUGH	77,720	10	ND	ND	ND	ND	IN	51	ND	ND
AK	JUNEAU BOROUGH	26,751	ND	ND	ND	ND	ND	IN	27	ND	ND
AK	MATANUSKA-SUSITNA BOROUGH	39,683	ND	ND	ND	ND	ND	16	149	ND	ND
AK	YUKON-KOYUKUK CA	8,478	ND	ND	ND	0.06	0.05	ND	ND	ND	ND
AZ	COCHISE CO	97,624	ND	ND	ND	0.08	0.07	IN	IN*	ND	ND
AZ	COCONINO CO	96,591	ND	ND	ND	0.09	0.08	IN	IN	ND	ND
AZ	GILA CO	40,216	ND	ND	ND	0.09	0.08	IN	IN	ND	ND
AZ	GRAHAM CO	26,554	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AZ	MARICOPA CO	2,122,101	8	ND	0.041	0.12	0.09	60	219	0.003	0.014
AZ	NAVAJO CO	77,658	ND	ND	ND	ND	ND	IN	IN	ND	ND
AZ	PIMA CO	666,880	4	ND	0.019	0.09	0.07	49*	207*	0.002	0.005
AZ	PINAL CO	116,379	ND	ND	ND	ND	ND	ND	ND	IN	0.018
AZ	SANTA CRUZ CO	29,676	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AZ	YAVAPAI CO	107,714	ND	ND	ND	0.09	0.08	IN	IN	ND	ND
AZ	YUMA CO	106,895	ND	ND	ND	0.09	0.08	IN	IN*	ND	ND
AR	ARKANSAS CO	21,653	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	ASHLEY CO	24,319	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	CRAIGHEAD CO	68,956	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	CRITTENDEN CO	49,939	ND	ND	ND	0.13	0.10	IN	IN*	ND	ND
AR	GARLAND CO	73,397	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	JEFFERSON CO	85,487	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	MARION CO	12,001	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	MILLER CO	38,467	ND	ND	ND	ND	ND	IN	IN*	IN	0.019
AR	MONTGOMERY CO	7,841	ND	ND	ND	0.09	0.07	ND	ND	ND	ND
AR	NEWTON CO	7,666	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
AR	OUACHITA CO	30,574	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	PHILLIPS CO	28,838	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	POLK CO	17,347	ND	ND	ND	ND	ND	IN	IN	ND	ND
AR	POPE CO	45,883	ND	ND	ND	ND	ND	IN	IN*	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
AR	PULASKI CO	349,660	4	ND	0.011	0.11	0.09	32*	70*	0.002	0.005
AR	SEBASTIAN CO	99,590	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	UNION CO	46,719	ND	ND	ND	ND	ND	IN	IN*	0.005	0.022
AR	WASHINGTON CO	113,409	ND	ND	ND	ND	ND	IN	IN*	ND	ND
AR	WHITE CO	54,676	ND	ND	ND	ND	ND	IN	IN*	ND	ND
CA	ALAMEDA CO	1,279,182	5	0.00	0.022	0.14	0.09	26*	94*	ND	ND
CA	AMADOR CO	30,039	1	ND	ND	0.12	0.10	ND	ND	ND	ND
CA	BUTTE CO	182,120	4	0.00	0.015	0.11	0.09	29*	139*	ND	ND
CA	CALAVERAS CO	31,998	1	ND	ND	0.12	0.10	21*	64*	ND	ND
CA	COLUSA CO	16,275	ND	ND	ND	0.09	0.08	30	138	ND	ND
CA	CONTRA COSTA CO	803,732	3	0.00	0.018	0.13	0.09	26*	89*	0.003	0.020
CA	DEL NORTE CO	23,460	ND	ND	ND	ND	ND	18	39	ND	ND
CA	EL DORADO CO	125,995	2	ND	0.011	0.14	0.10	21*	42*	ND	ND
CA	FRESNO CO	667,490	8	0.00	0.024	0.15	0.11	47*	130*	ND	ND
CA	GLENN CO	24,798	ND	ND	ND	0.10	0.08	26	121	ND	ND
CA	HUMBOLDT CO	119,118	ND	ND	ND	ND	ND	19*	51*	ND	ND
CA	IMPERIAL CO	109,303	14	0.00	0.018	0.17	0.09	85	369	0.003	0.013
CA	INYO CO	18,281	ND	ND	ND	0.09	0.08	51*	1918*	ND	ND
CA	KERN CO	543,477	4	0.00	0.025	0.14	0.11	61*	142*	IN	0.006
CA	KINGS CO	101,469	ND	ND	0.016	0.13	0.10	54	146	ND	ND
CA	LAKE CO	50,631	ND	ND	ND	0.09	0.07	IN	28	ND	ND
CA	LASSEN CO	27,598	ND	ND	ND	ND	ND	IN	96	ND	ND
CA	LOS ANGELES CO	8,863,164	11	0.09	0.051	0.14	0.10	56	119	0.005	0.019
CA	MADERA CO	88,090	ND	ND	0.014	0.10	0.09	ND	ND	ND	ND
CA	MARIN CO	230,096	3	ND	0.018	0.10	0.06	22*	66*	ND	ND
CA	MARIPOSA CO	14,302	ND	ND	ND	0.11	0.10	IN	IN	ND	ND
CA	MENDOCINO CO	80,345	4	ND	0.010	0.08	0.06	25*	67*	ND	ND
CA	MERCED CO	178,403	ND	ND	0.012	0.13	0.11	IN	IN	ND	ND
CA	MODOC CO	9,678	ND	ND	ND	ND	ND	26	73	ND	ND
CA	MONO CO	9,956	ND	ND	ND	ND	ND	IN	33	ND	ND
CA	MONTEREY CO	355,660	2	ND	0.010	0.08	0.06	29	76	ND	ND
CA	NAPA CO	110,765	3	ND	0.014	0.11	0.08	19*	54*	ND	ND
CA	NEVADA CO	78,510	ND	ND	ND	0.11	0.09	25	78	ND	ND
CA	ORANGE CO	2,410,556	6	ND	0.035	0.11	0.08	37	73	0.002	0.005
CA	PLACER CO	172,796	2	0.00	0.012	0.13	0.10	27*	92*	ND	ND
CA	PLUMAS CO	19,739	ND	ND	ND	0.08	0.07	27*	103*	ND	ND
CA	RIVERSIDE CO	1,170,413	4	0.05	0.025	0.14	0.12	72	134	0.002	0.009
CA	SACRAMENTO CO	1,041,219	6	ND	0.021	0.14	0.11	34*	143*	0.004	0.012
CA	SAN BENITO CO	36,697	ND	ND	ND	0.11	0.08	23*	53*	ND	ND
CA	SAN BERNARDINO CO	1,418,380	4	0.05	0.039	0.16	0.13	60	108	0.002	0.009
CA	SAN DIEGO CO	2,498,016	5	0.00	0.026	0.11	0.09	52	114	0.003	0.016
CA	SAN FRANCISCO CO	723,959	5	0.00	0.021	0.07	0.05	27*	70*	0.002	0.006
CA	SAN JOAQUIN CO	480,628	6	0.00	0.024	0.13	0.09	37*	123*	ND	ND
CA	SAN LUIS OBISPO CO	217,162	3	ND	0.013	0.09	0.08	27	82	0.005	0.027
CA	SAN MATEO CO	649,623	4	ND	0.019	0.08	0.05	27*	75*	ND	ND
CA	SANTA BARBARA CO	369,608	4	0.00	0.022	0.10	0.08	29*	54*	0.002	0.003
CA	SANTA CLARA CO	1,497,577	6	0.00	0.026	0.12	0.08	29*	94*	ND	ND
CA	SANTA CRUZ CO	229,734	1	ND	0.005	0.08	0.07	32*	75*	0.001	0.002
CA	SHASTA CO	147,036	ND	ND	ND	0.11	0.09	IN	42	ND	ND
CA	SIERRA CO	3,318	ND	ND	ND	ND	ND	25	53	ND	ND
CA	SISKIYOU CO	43,531	ND	ND	ND	0.07	0.06	17	47	ND	ND
CA	SOLANO CO	340,421	5	ND	0.014	0.12	0.09	20*	64*	0.002	0.006
CA	SONOMA CO	388,222	3	ND	0.014	0.10	0.08	19*	65*	ND	ND
CA	STANISLAUS CO	370,522	6	0.00	0.022	0.11	0.09	43	137	ND	ND
CA	SUTTER CO	64,415	4	ND	0.014	0.11	0.08	39*	156*	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM ($\mu g/m^3$)	PM_{10} 2nd Max ($\mu g/m^3$)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
CA	TEHAMA CO	49,625	ND	ND	ND	0.11	0.10	IN	IN	ND	ND
CA	TRINITY CO	13,063	ND	ND	ND	ND	ND	IN	78	ND	ND
CA	TULARE CO	311,921	4	ND	0.021	0.13	0.11	56*	137*	ND	ND
CA	TUOLUMNE CO	48,456	3	ND	ND	0.11	0.10	ND	ND	ND	ND
CA	VENTURA CO	669,016	3	0.00	0.022	0.13	0.10	32*	63*	0.002	0.005
CA	YOLO CO	141,092	1	ND	0.012	0.12	0.09	33	144	ND	ND
CO	ADAMS CO	265,038	4	0.08	0.020	0.09	0.07	37*	142*	0.003	0.012
CO	ALAMOSA CO	13,617	ND	ND	ND	ND	ND	IN	129	ND	ND
CO	ARAPAHOE CO	391,511	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
CO	ARCHULETA CO	5,345	ND	ND	ND	ND	ND	IN	82	ND	ND
CO	BOULDER CO	225,339	4	ND	ND	0.10	0.08	IN	56	ND	ND
CO	DELTA CO	20,980	ND	ND	ND	ND	ND	26*	57*	ND	ND
CO	DENVER CO	467,610	5	0.02	IN	0.09	0.07	29*	83*	IN	0.014
CO	DOUGLAS CO	60,391	ND	ND	ND	0.09	0.08	IN	24	ND	ND
CO	EAGLE CO	21,928	ND	ND	ND	ND	ND	IN	36	ND	ND
CO	EL PASO CO	397,014	5	0.01	0.019	0.08	0.06	23*	80*	0.004	0.020
CO	FREMONT CO	32,273	ND	ND	ND	ND	ND	15*	41*	ND	ND
CO	GARFIELD CO	29,974	ND	ND	ND	ND	ND	IN	51	ND	ND
CO	GUNNISON CO	10,273	ND	ND	ND	ND	ND	30	111	ND	ND
CO	JEFFERSON CO	438,430	4	ND	0.010	0.11	0.08	14*	35*	ND	ND
CO	LAKE CO	6,007	ND	0.02	ND	ND	ND	ND	ND	ND	ND
CO	LA PLATA CO	32,284	ND	ND	ND	ND	ND	36	98	ND	ND
CO	LARIMER CO	186,136	5	ND	ND	0.09	0.07	16*	36*	ND	ND
CO	MESA CO	93,145	5	ND	ND	ND	ND	20	52	ND	ND
CO	MONTEZUMA CO	18,672	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
CO	MONTROSE CO	24,423	ND	ND	ND	ND	ND	IN	88	ND	ND
CO	PITKIN CO	12,661	ND	ND	ND	ND	ND	31	73	ND	ND
CO	PROWERS CO	13,347	ND	ND	ND	ND	ND	29*	145*	ND	ND
CO	PUEBLO CO	123,051	ND	ND	ND	ND	ND	IN	51	ND	ND
CO	ROUTT CO	14,088	ND	ND	ND	ND	ND	IN	109	ND	ND
CO	SAN MIGUEL CO	3,653	ND	ND	ND	ND	ND	IN	66	ND	ND
CO	SUMMIT CO	12,881	ND	ND	ND	ND	ND	18*	54*	ND	ND
CO	TELLER CO	12,468	ND	ND	ND	ND	ND	IN	93	ND	ND
CO	WELD CO	131,821	3	ND	ND	0.09	0.07	18*	47*	ND	ND
CT	FAIRFIELD CO	827,645	4	ND	0.018	0.15	0.11	29*	49*	0.006	0.026
CT	HARTFORD CO	851,783	6	ND	0.018	0.13	0.09	18	81	0.004	0.019
CT	LITCHFIELD CO	174,092	ND	ND	ND	0.13	0.10	16*	41*	ND	ND
CT	MIDDLESEX CO	143,196	ND	ND	ND	0.16	0.11	ND	ND	ND	ND
CT	NEW HAVEN CO	804,219	3	0.01	0.026	0.15	0.11	27*	76*	0.007	0.027
CT	NEW LONDON CO	254,957	ND	ND	ND	0.13	0.10	17	36	IN	0.008
CT	TOLLAND CO	128,699	ND	ND	IN	0.12	0.09	ND	ND	IN	0.009
CT	WINDHAM CO	102,525	ND	ND	ND	ND	ND	ND	IN	ND	ND
DE	KENT CO	110,993	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
DE	NEW CASTLE CO	441,946	3	ND	0.018	0.14	0.10	24*	49*	0.008	0.049
DE	SUSSEX CO	113,229	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
DC	WASHINGTON	606,900	6	0.03	0.024	0.13	0.10	IN	IN	0.008	0.020
FL	ALACHUA CO	181,596	ND	ND	ND	0.10	0.08	22*	39*	ND	ND
FL	BAKER CO	18,486	ND	ND	ND	0.08	0.08	ND	ND	ND	ND
FL	BAY CO	126,994	ND	ND	ND	ND	ND	IN	50	ND	ND
FL	BREVARD CO	398,978	ND	ND	ND	0.09	0.08	20*	53*	ND	ND
FL	BROWARD CO	1,255,488	5	0.02	0.011	0.10	0.08	19*	34*	0.003	0.015
FL	COLLIER CO	152,099	ND	ND	ND	ND	ND	17	30	ND	ND
FL	DADE CO	1,937,094	4	ND	0.017	0.11	0.08	25*	45*	0.001	0.003
FL	DUVAL CO	672,971	4	0.02	0.016	0.10	0.08	28	53	0.004	0.020
FL	ESCAMBIA CO	262,798	ND	ND	IN	0.11	0.09	24*	57*	0.004	0.029

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM ($\mu g/m^3$)	PM_{10} 2nd Max ($\mu g/m^3$)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
FL	GULF CO	11,504	ND	ND	ND	ND	ND	IN	IN	ND	ND
FL	HAMILTON CO	10,930	ND	ND	ND	ND	ND	25*	40*	0.004	0.013
FL	HILLSBOROUGH CO	834,054	5	1.02	0.010	0.12	0.09	35	81	0.008	0.060
FL	HOLMES CO	15,778	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
FL	LAKE CO	152,104	ND	ND	ND	ND	ND	19	49	ND	ND
FL	LEE CO	335,113	ND	ND	ND	0.10	0.08	19	32	ND	ND
FL	LEON CO	192,493	ND	ND	ND	0.09	0.08	19	55	ND	ND
FL	MANATEE CO	211,707	ND	ND	0.007	0.11	0.08	24	42	0.004	0.017
FL	MARION CO	194,833	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
FL	MONROE CO	78,024	ND	ND	ND	ND	ND	15	30	ND	ND
FL	NASSAU CO	43,941	ND	ND	ND	ND	ND	28*	59*	0.004	0.036
FL	ORANGE CO	677,491	3	ND	0.012	0.10	0.08	27*	45*	0.002	0.007
FL	OSCEOLA CO	107,728	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
FL	PALM BEACH CO	863,518	3	0.00	0.013	0.10	0.08	20*	33*	0.002	0.013
FL	PASCO CO	281,131	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
FL	PINELLAS CO	851,659	3	0.01	0.016	0.11	0.09	25*	49*	0.007	0.038
FL	POLK CO	405,382	ND	ND	ND	0.10	0.08	22	50	0.007	0.019
FL	PUTNAM CO	65,070	ND	ND	ND	ND	ND	25*	45*	0.003	0.015
FL	ST LUCIE CO	150,171	ND	ND	0.010	0.08	0.07	20	39	ND	ND
FL	SARASOTA CO	277,776	3	ND	ND	0.11	0.09	20*	42*	0.002	0.011
FL	SEMINOLE CO	287,529	ND	ND	ND	0.10	0.08	IN	IN	ND	ND
FL	VOLUSIA CO	370,712	ND	ND	ND	0.09	0.08	21*	57*	ND	ND
GA	BARTOW CO	55,911	ND	ND	ND	ND	ND	ND	ND	0.003	0.012
GA	BIBB CO	149,967	ND	ND	ND	0.13	0.11	IN	53	ND	ND
GA	CHATHAM CO	216,935	ND	ND	ND	0.11	0.08	27	59	0.003	0.018
GA	CHATTOOGA CO	22,242	ND	ND	ND	ND	ND	22	59	ND	ND
GA	CHEROKEE CO	90,204	ND	ND	ND	0.10	IN	ND	ND	ND	ND
GA	COBB CO	447,745	ND	ND	ND	0.11	ND	ND	ND	ND	ND
GA	COWETA CO	53,853	ND	ND	ND	0.13	0.11	ND	ND	ND	ND
GA	DAWSON CO	9,429	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
GA	DE KALB CO	545,837	4	0.05	0.020	0.15	0.11	23	44	ND	ND
GA	DOUGHERTY CO	96,311	ND	ND	ND	ND	ND	26	60	ND	ND
GA	DOUGLAS CO	71,120	ND	ND	ND	0.12	0.11	IN	47	ND	ND
GA	FANNIN CO	15,992	ND	ND	ND	0.10	0.08	ND	ND	0.004	0.018
GA	FAYETTE CO	62,415	ND	ND	ND	0.13	0.11	ND	ND	ND	ND
GA	FLOYD CO	81,251	ND	ND	ND	ND	ND	IN	IN	0.003	0.021
GA	FULTON CO	648,951	3	ND	0.024	0.16	0.12	35	72	0.005	0.023
GA	GLYNN CO	62,496	ND	ND	ND	0.09	0.08	26	45	ND	ND
GA	GWINNETT CO	352,910	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
GA	HENRY CO	58,741	ND	ND	ND	0.15	0.13	ND	ND	ND	ND
GA	MUSCOGEE CO	179,278	ND	1.04	ND	0.11	0.10	24	45	ND	ND
GA	PAULDING CO	41,611	ND	ND	0.007	0.12	0.10	ND	ND	ND	ND
GA	RICHMOND CO	189,719	ND	ND	ND	0.11	0.09	IN	49	ND	ND
GA	ROCKDALE CO	54,091	ND	ND	0.007	0.16	0.12	ND	ND	ND	ND
GA	SPALDING CO	54,457	ND	ND	ND	ND	ND	IN	IN	ND	ND
GA	SUMTER CO	30,228	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
GA	WALKER CO	58,340	ND	ND	ND	ND	ND	26	57	ND	ND
GA	WASHINGTON CO	19,112	ND	ND	ND	ND	ND	27	59	ND	ND
HI	HONOLULU CO	836,231	2	ND	0.004	0.05	0.05	15	41	0.001	0.004
HI	KAUAI CO	51,177	ND	ND	ND	ND	ND	IN	26	ND	ND
HI	MAUI CO	100,374	ND	ND	ND	ND	ND	22	97	ND	ND
ID	ADA CO	205,775	5	ND	0.021	ND	ND	31	106	ND	ND
ID	BANNOCK CO	66,026	ND	ND	IN	ND	ND	30*	176*	0.007	0.046
ID	BLAINE CO	13,552	ND	ND	ND	ND	ND	26*	59*	ND	ND
ID	BONNER CO	26,622	ND	ND	ND	ND	ND	21	64	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m^3)	PM_{10} 2nd Max (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
ID	BONNEVILLE CO	72,207	ND	ND	ND	ND	ND	IN	IN	ND	ND
ID	BUTTE CO	2,918	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
ID	CANYON CO	90,076	6	ND	ND	ND	ND	36*	101*	ND	ND
ID	CARIBOU CO	6,963	ND	ND	ND	ND	ND	25*	78*	0.004	0.047
ID	KOOTENAI CO	69,795	ND	ND	ND	ND	ND	22*	97*	ND	ND
ID	LEMHI CO	6,899	ND	ND	ND	ND	ND	37*	95*	ND	ND
ID	LEWIS CO	3,516	ND	ND	ND	ND	ND	IN	72	ND	ND
ID	MADISON CO	23,674	ND	ND	ND	ND	ND	26*	74*	ND	ND
ID	MINIDOKA CO	19,361	ND	ND	ND	ND	ND	25*	63*	ND	ND
ID	NEZ PERCE CO	33,754	5	ND	ND	ND	ND	31*	65*	ND	ND
ID	SHOSHONE CO	13,931	ND	0.05	ND	ND	ND	19	75	ND	ND
ID	TWIN FALLS CO	53,580	ND	ND	ND	ND	ND	24*	54*	ND	ND
IL	ADAMS CO	66,090	ND	ND	ND	0.09	0.08	21	46	0.005	0.033
IL	CHAMPAIGN CO	173,025	ND	ND	ND	0.11	0.09	23	47	0.002	0.010
IL	COOK CO	5,105,067	5	0.06	0.032	0.11	0.10	40	120	0.009	0.044
IL	DU PAGE CO	781,666	ND	ND	ND	0.09	0.08	ND	IN	0.004	0.019
IL	EFFINGHAM CO	31,704	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
IL	HAMILTON CO	8,499	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
IL	JACKSON CO	61,067	ND	ND	ND	ND	ND	22	55	ND	ND
IL	JERSEY CO	20,539	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
IL	KANE CO	317,471	ND	ND	ND	0.09	0.08	IN	42	ND	ND
IL	LAKE CO	516,418	ND	ND	IN	0.11	0.09	ND	ND	ND	ND
IL	LA SALLE CO	106,913	ND	ND	ND	ND	ND	28	149	ND	ND
IL	MC HENRY CO	183,241	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
IL	MACON CO	117,206	ND	ND	ND	0.10	0.09	ND	IN	0.006	0.027
IL	MACOUPIN CO	47,679	ND	0.03	ND	0.10	0.09	ND	IN	0.003	0.012
IL	MADISON CO	249,238	2	2.50	ND	0.12	0.09	44	120	0.009	0.059
IL	PEORIA CO	182,827	5	0.02	ND	0.10	0.08	23	52	0.007	0.036
IL	RANDOLPH CO	34,583	ND	ND	ND	0.10	0.08	ND	ND	0.005	0.065
IL	ROCK ISLAND CO	148,723	ND	ND	ND	0.09	0.07	ND	IN	0.003	0.010
IL	ST CLAIR CO	262,852	ND	0.09	0.019	0.11	0.08	32	79	0.008	0.036
IL	SANGAMON CO	178,386	2	ND	ND	0.10	0.08	20	45	0.006	0.059
IL	TAZEWELL CO	123,692	ND	ND	ND	ND	ND	ND	IN	0.005	0.035
IL	WABASH CO	13,111	ND	ND	ND	ND	ND	ND	ND	IN	0.032
IL	WILL CO	357,313	1	ND	0.010	0.10	0.09	23	52	0.005	0.023
IL	WINNEBAGO CO	252,913	4	ND	ND	0.09	0.08	ND	IN	ND	ND
IN	ALLEN CO	300,836	3	ND	ND	0.10	0.09	IN	IN	ND	ND
IN	CLARK CO	87,777	ND	ND	ND	0.11	0.09	IN	57	ND	ND
IN	DAVIESS CO	27,533	ND	ND	ND	ND	ND	ND	ND	IN	0.030
IN	DEARBORN CO	38,835	ND	ND	ND	ND	ND	ND	ND	0.008	0.030
IN	DE KALB CO	35,324	ND	ND	ND	ND	ND	IN	IN	ND	ND
IN	DELAWARE CO	119,659	ND	0.76	ND	ND	ND	ND	ND	ND	ND
IN	DUBOIS CO	36,616	ND	ND	ND	ND	ND	26*	54*	ND	ND
IN	ELKHART CO	156,198	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
IN	FLOYD CO	64,404	ND	ND	ND	0.12	0.09	ND	ND	0.007	0.032
IN	FOUNTAIN CO	17,808	ND	ND	ND	ND	ND	ND	ND	IN	0.049
IN	GIBSON CO	31,913	ND	ND	IN	0.10	0.08	ND	ND	IN	0.057
IN	HAMILTON CO	108,936	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
IN	HANCOCK CO	45,527	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
IN	HENDRICKS CO	75,717	IN	ND	IN	ND	ND	IN	IN	IN	0.014
IN	JASPER CO	24,960	ND	ND	ND	ND	ND	IN	IN	0.003	0.015
IN	JEFFERSON CO	29,797	ND	ND	ND	ND	ND	ND	ND	0.007	0.023
IN	JOHNSON CO	88,109	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
IN	LAKE CO	475,594	3	0.08	0.019	0.11	0.10	35	166	0.007	0.032
IN	LA PORTE CO	107,066	ND	ND	ND	0.11	0.09	ND	IN	0.004	0.014

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (μg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (μg/m^3)	PM_{10} 2nd Max (μg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
IN	MADISON CO	130,669	ND	ND	ND	0.11	0.09	IN	IN	ND	ND
IN	MARION CO	797,159	3	0.12	0.018	0.11	0.10	27*	53*	0.007	0.024
IN	MORGAN CO	55,920	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
IN	PERRY CO	19,107	ND	ND	ND	0.12	0.09	IN	IN	IN	0.029
IN	PIKE CO	12,509	ND	ND	ND	ND	ND	ND	ND	IN	0.037
IN	PORTER CO	128,932	ND	ND	ND	0.12	0.10	26	79	0.005	0.020
IN	POSEY CO	25,968	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
IN	ST JOSEPH CO	247,052	ND	ND	IN	0.11	0.09	IN	49	ND	ND
IN	SPENCER CO	19,490	ND	ND	0.008	ND	ND	ND	IN	0.008	0.028
IN	SULLIVAN CO	18,993	ND	ND	ND	ND	ND	ND	ND	IN	0.019
IN	VANDERBURGH CO	165,058	4	ND	IN	0.11	0.10	26	60	0.007	0.022
IN	VERMILLION CO	16,773	ND	ND	ND	ND	ND	ND	IN	ND	ND
IN	VIGO CO	106,107	ND	ND	ND	0.09	0.08	IN	IN	0.006	0.025
IN	WARRICK CO	44,920	ND	ND	ND	0.11	0.10	ND	ND	IN	0.087
IN	WAYNE CO	71,951	ND	ND	ND	ND	ND	ND	ND	0.006	0.041
IA	BLACK HAWK CO	123,798	ND	ND	ND	ND	ND	IN	IN	ND	ND
IA	CERRO GORDO CO	46,733	ND	ND	ND	ND	ND	38	149	0.006	0.123
IA	CLINTON CO	51,040	ND	ND	ND	0.10	0.08	26	78	0.004	0.021
IA	DELAWARE CO	18,035	ND	ND	ND	ND	ND	IN	IN	ND	ND
IA	HARRISON CO	14,730	ND	ND	ND	0.09	0.07	ND	ND	ND	ND
IA	LEE CO	38,687	ND	ND	ND	ND	ND	ND	ND	0.002	0.020
IA	LINN CO	168,767	2	ND	ND	0.10	0.08	IN	54	0.005	0.071
IA	MUSCATINE CO	39,907	ND	ND	ND	ND	ND	IN	67	0.010	0.129
IA	PALO ALTO CO	10,669	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
IA	POLK CO	327,140	4	ND	ND	0.07	0.06	IN	76	ND	ND
IA	POTTAWATTAMIE CO	82,628	ND	ND	ND	ND	ND	IN	IN	ND	ND
IA	SCOTT CO	150,979	ND	ND	ND	0.10	0.08	44	177	0.004	0.014
IA	STORY CO	74,252	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
IA	VAN BUREN CO	7,676	ND	ND	ND	0.09	0.08	ND	ND	0.002	0.011
IA	WARREN CO	36,033	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
IA	WOODBURY CO	98,276	ND	ND	ND	ND	ND	28	73	ND	ND
KS	CLOUD CO	11,023	ND	ND	ND	ND	ND	ND	IN	ND	ND
KS	FORD CO	27,463	ND	ND	ND	ND	ND	31	89	ND	ND
KS	GREELEY CO	1,774	ND	ND	ND	ND	ND	ND	IN	ND	ND
KS	JOHNSON CO	355,054	ND	ND	ND	ND	ND	ND	IN	ND	ND
KS	KEARNEY CO	4,027	ND	ND	ND	ND	ND	ND	IN	ND	ND
KS	LINN CO	8,254	1	ND	0.004	0.10	0.08	ND	ND	0.002	0.007
KS	MONTGOMERY CO	38,816	ND	ND	ND	ND	ND	26	68	0.007	0.046
KS	MORTON CO	3,480	ND	ND	ND	ND	ND	ND	IN	ND	ND
KS	NEOSHO CO	17,035	ND	ND	ND	ND	ND	35	98	ND	ND
KS	PAWNEE CO	7,555	ND	ND	ND	ND	ND	ND	IN	ND	ND
KS	SEDGWICK CO	403,662	5	ND	ND	0.10	0.08	31	86	ND	ND
KS	SHAWNEE CO	160,976	ND	ND	ND	ND	ND	25	74	ND	ND
KS	SHERMAN CO	6,926	ND	ND	ND	ND	ND	31	120	ND	ND
KS	SUMNER CO	25,841	IN	ND	ND	0.10	IN	ND	ND	ND	ND
KS	WYANDOTTE CO	161,993	5	ND	IN	0.09	0.08	40	118	IN	0.016
KY	BELL CO	31,506	2	ND	ND	0.11	0.08	IN	48	ND	ND
KY	BOONE CO	57,589	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
KY	BOYD CO	51,150	1	ND	0.016	0.12	0.09	39	89	0.008	0.024
KY	BULLITT CO	47,567	ND	ND	0.014	0.11	0.09	25	56	ND	ND
KY	CAMPBELL CO	83,866	ND	ND	0.017	0.10	0.09	26	46	0.006	0.025
KY	CARTER CO	24,340	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
KY	CHRISTIAN CO	68,941	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
KY	DAVIESS CO	87,189	1	ND	0.011	0.10	0.09	25	63	0.006	0.024
KY	EDMONSON CO	10,357	ND	ND	ND	0.12	0.10	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m^3)	PM_{10} 2nd Max (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
KY	FAYETTE CO	225,366	2	ND	0.013	0.11	0.09	23	54	0.008	0.020
KY	FLOYD CO	43,586	ND	ND	ND	ND	ND	23	47	ND	ND
KY	GRAVES CO	33,550	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
KY	GREENUP CO	36,742	ND	ND	ND	0.12	0.10	ND	ND	0.006	0.026
KY	HANCOCK CO	7,864	ND	ND	ND	0.11	0.09	ND	ND	0.006	0.031
KY	HARDIN CO	89,240	ND	ND	ND	0.11	0.09	IN	39	ND	ND
KY	HARLAN CO	36,574	ND	ND	ND	ND	ND	IN	44	ND	ND
KY	HENDERSON CO	43,044	2	ND	0.016	0.11	0.10	24	59	0.007	0.056
KY	JEFFERSON CO	664,937	5	ND	0.014	0.12	0.10	28	60	0.007	0.027
KY	JESSAMINE CO	30,508	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
KY	KENTON CO	142,031	3	ND	0.017	0.11	0.09	20	52	ND	ND
KY	LAWRENCE CO	13,998	ND	ND	ND	ND	ND	IN	IN	ND	ND
KY	LIVINGSTON CO	9,062	ND	ND	ND	0.12	0.10	IN	61	0.005	0.024
KY	MC CRACKEN CO	62,879	2	ND	0.011	0.11	0.09	15	58	0.005	0.027
KY	MC LEAN CO	9,628	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
KY	MADISON CO	57,508	ND	ND	ND	ND	ND	IN	46	ND	ND
KY	MARSHALL CO	27,205	ND	ND	ND	ND	ND	IN	61	ND	ND
KY	OLDHAM CO	33,263	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
KY	PERRY CO	30,283	ND	ND	ND	0.10	0.07	24	45	ND	ND
KY	PIKE CO	72,583	ND	ND	ND	0.10	0.08	30	57	ND	ND
KY	PULASKI CO	49,489	ND	ND	ND	0.10	0.10	IN	45	ND	ND
KY	SCOTT CO	23,867	ND	ND	ND	0.11	0.08	ND	ND	ND	ND
KY	SIMPSON CO	15,145	ND	ND	0.009	0.12	0.10	ND	ND	ND	ND
KY	TRIGG CO	10,361	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
KY	WARREN CO	76,673	ND	ND	ND	ND	ND	21	45	ND	ND
KY	WHITLEY CO	33,326	ND	ND	ND	ND	ND	IN	48	ND	ND
LA	ASCENSION PAR	58,214	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
LA	BEAUREGARD PAR	30,083	ND	ND	0.007	0.10	0.08	ND	ND	ND	ND
LA	BOSSIER PAR	86,088	ND	ND	ND	0.11	0.09	ND	ND	0.002	0.006
LA	CADDO PAR	248,253	ND	ND	ND	0.10	0.09	22*	41*	ND	ND
LA	CALCASIEU PAR	168,134	ND	ND	0.005	0.13	0.09	ND	ND	0.004	0.015
LA	EAST BATON ROUGE PAR	380,105	5	0.06	0.019	0.12	0.10	IN	50	0.005	0.025
LA	GRANT PAR	17,526	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
LA	IBERVILLE PAR	31,049	ND	ND	0.009	0.12	0.09	ND	ND	ND	ND
LA	JEFFERSON PAR	448,306	ND	ND	0.011	0.11	0.09	ND	ND	ND	ND
LA	LAFAYETTE PAR	164,762	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
LA	LAFOURCHE PAR	85,860	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
LA	LIVINGSTON PAR	70,526	ND	ND	0.005	0.11	0.09	ND	ND	ND	ND
LA	ORLEANS PAR	496,938	3	0.03	0.022	0.09	0.08	25*	55*	ND	ND
LA	OUACHITA PAR	142,191	ND	ND	ND	0.10	0.08	ND	ND	0.003	0.010
LA	POINTE COUPEE PAR	22,540	ND	ND	0.009	0.11	0.08	ND	ND	ND	ND
LA	ST BERNARD PAR	66,631	ND	ND	ND	0.10	0.08	ND	ND	0.005	0.023
LA	ST CHARLES PAR	42,437	ND	ND	ND	0.11	0.09	27	60	ND	ND
LA	ST JAMES PAR	20,879	ND	ND	0.012	0.12	0.09	ND	ND	ND	ND
LA	ST JOHN THE BAPTIST PAR	39,996	ND	0.08	ND	0.11	0.09	ND	ND	ND	ND
LA	ST MARY PAR	58,086	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
LA	WEST BATON ROUGE PAR	19,419	ND	0.02	0.015	0.11	0.09	34	79	0.006	0.019
ME	ANDROSCOGGIN CO	105,259	ND	ND	ND	ND	ND	IN	45	0.004	0.016
ME	AROOSTOOK CO	86,936	ND	ND	ND	ND	ND	31	91	ND	ND
ME	CUMBERLAND CO	243,135	ND	ND	ND	0.11	0.08	23	61	0.005	0.014
ME	FRANKLIN CO	29,008	ND	ND	ND	ND	ND	IN	27	ND	ND
ME	HANCOCK CO	46,948	ND	ND	IN	0.12	0.09	ND	IN	ND	ND
ME	KENNEBEC CO	115,904	ND	ND	ND	0.10	0.08	IN	76	ND	ND
ME	KNOX CO	36,310	ND	ND	ND	0.11	0.08	IN	47	ND	ND
ME	OXFORD CO	52,602	ND	ND	ND	0.08	0.06	IN	45	0.003	0.015

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
ME	PENOBSCOT CO	146,601	ND	ND	ND	0.09	0.08	17*	32*	ND	ND
ME	PISCATAQUIS CO	18,653	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
ME	SAGADAHOC CO	33,535	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
ME	YORK CO	164,587	ND	ND	IN	0.12	0.09	ND	ND	ND	ND
MD	ALLEGANY CO	74,946	ND	ND	ND	ND	ND	ND	IN	ND	ND
MD	ANNE ARUNDEL CO	427,239	ND	ND	IN	0.14	0.11	25	53	0.006	0.020
MD	BALTIMORE CO	692,134	ND	ND	0.020	0.14	0.11	15	29	ND	ND
MD	CALVERT CO	51,372	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
MD	CARROLL CO	123,372	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
MD	CECIL CO	71,347	ND	ND	ND	0.15	0.11	14	32	ND	ND
MD	CHARLES CO	101,154	ND	ND	ND	0.13	0.11	ND	ND	ND	ND
MD	FREDERICK CO	150,208	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
MD	GARRETT CO	28,138	ND	ND	ND	ND	ND	ND	IN	ND	ND
MD	HARFORD CO	182,132	ND	ND	IN	0.15	0.11	ND	ND	ND	ND
MD	KENT CO	17,842	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
MD	MONTGOMERY CO	757,027	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
MD	PRINCE GEORGES CO	729,268	4	ND	ND	0.13	0.10	24	58	ND	ND
MD	WASHINGTON CO	121,393	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
MD	WICOMICO CO	74,339	ND	ND	ND	ND	ND	12	31	ND	ND
MD	BALTIMORE	736,014	5	0.00	0.024	0.12	0.09	30*	61*	ND	ND
MA	BARNSTABLE CO	186,605	ND	ND	IN	0.13	0.10	ND	ND	ND	ND
MA	BERKSHIRE CO	139,352	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
MA	BRISTOL CO	506,325	ND	ND	IN	0.13	0.10	ND	IN	0.004	0.021
MA	ESSEX CO	670,080	ND	ND	0.013	0.12	0.09	ND	IN	0.005	0.021
MA	HAMPDEN CO	456,310	6	ND	0.022	0.11	0.09	30	66	0.005	0.024
MA	HAMPSHIRE CO	146,568	ND	ND	0.007	0.11	0.09	14	42	0.005	0.017
MA	MIDDLESEX CO	1,398,468	4	ND	ND	0.11	0.09	ND	IN	0.007	0.040
MA	NORFOLK CO	616,087	ND	ND	ND	ND	ND	ND	IN	ND	ND
MA	SUFFOLK CO	663,906	4	0.03	0.030	0.11	0.09	30	65	0.007	0.026
MA	WORCESTER CO	709,705	3	ND	0.020	0.11	0.09	IN	65	0.004	0.013
MI	ALLEGAN CO	90,509	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
MI	BENZIE CO	12,200	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
MI	BERRIEN CO	161,378	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
MI	CALHOUN CO	135,982	ND	ND	ND	ND	ND	IN	50	ND	ND
MI	CASS CO	49,477	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
MI	CLINTON CO	57,883	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
MI	DELTA CO	37,780	ND	ND	ND	ND	ND	ND	ND	0.002	0.010
MI	GENESEE CO	430,459	ND	0.01	ND	0.11	0.10	IN	IN	0.003	0.011
MI	GRAND TRAVERSE CO	64,273	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
MI	HURON CO	34,951	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
MI	INGHAM CO	281,912	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
MI	KALAMAZOO CO	223,411	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
MI	KENT CO	500,631	4	0.00	ND	0.11	0.09	21	54	0.001	0.006
MI	LENAWEE CO	91,476	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
MI	MACOMB CO	717,400	3	ND	ND	0.12	0.10	ND	ND	0.002	0.012
MI	MASON CO	25,537	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
MI	MISSAUKEE CO	12,147	ND	0.00	ND	0.10	0.09	ND	ND	ND	ND
MI	MUSKEGON CO	158,983	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
MI	OAKLAND CO	1,083,592	3	ND	ND	0.11	0.09	ND	ND	ND	ND
MI	ONTONAGON CO	8,854	ND	ND	ND	ND	ND	IN	IN	ND	ND
MI	OTTAWA CO	187,768	ND	ND	ND	0.11	0.09	IN	IN	ND	ND
MI	ST CLAIR CO	145,607	ND	ND	ND	0.12	0.09	ND	ND	0.008	0.048
MI	WASHTENAW CO	282,937	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
MI	WAYNE CO	2,111,687	4	0.10	0.018	0.11	0.09	36	126	0.009	0.053
MN	ANOKA CO	243,641	2	ND	ND	0.09	0.07	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m^3)	PM_{10} 2nd Max (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
MN	BELTRAMI CO	34,384	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	CARLTON CO	29,259	ND	ND	ND	ND	ND	IN	32	ND	ND
MN	CLAY CO	50,422	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	DAKOTA CO	275,227	1	0.47	0.014	0.08	0.07	ND	ND	0.003	0.013
MN	FREEBORN CO	33,060	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	HENNEPIN CO	1,032,431	3	0.01	0.022	ND	ND	30	70	0.004	0.030
MN	KOOCHICHING CO	16,299	ND	ND	ND	ND	ND	ND	ND	0.001	0.003
MN	LAKE CO	10,415	ND	ND	ND	0.08	0.07	IN	IN	ND	ND
MN	MC LEOD CO	32,030	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	MILLE LACS CO	18,670	ND	ND	ND	0.10	0.08	IN	26	ND	ND
MN	OLMSTED CO	106,470	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	OTTER TAIL CO	50,714	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	PINE CO	21,264	1	ND	ND	ND	ND	ND	ND	ND	ND
MN	RAMSEY CO	485,765	5	0.01	0.016	ND	ND	35	88	0.002	0.007
MN	ST LOUIS CO	198,213	2	ND	ND	0.08	0.07	25	71	ND	ND
MN	STEARNS CO	118,791	3	ND	ND	ND	ND	IN	IN	ND	ND
MN	SWIFT CO	10,724	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	WASHINGTON CO	145,896	ND	ND	ND	0.09	0.08	23	49	0.003	0.017
MN	WINONA CO	47,828	ND	ND	ND	ND	ND	IN	IN	ND	ND
MN	WRIGHT CO	68,710	ND	ND	ND	ND	ND	IN	IN	ND	ND
MS	ADAMS CO	35,356	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
MS	BOLIVAR CO	41,875	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
MS	COAHOMA CO	31,665	ND	ND	ND	ND	ND	IN	IN	ND	ND
MS	DE SOTO CO	67,910	ND	ND	0.012	0.13	0.09	ND	ND	ND	ND
MS	HANCOCK CO	31,760	ND	ND	0.006	0.11	0.09	ND	ND	ND	ND
MS	HARRISON CO	165,365	ND	ND	ND	0.11	0.10	ND	ND	0.003	0.024
MS	HINDS CO	254,441	5	ND	ND	0.11	0.08	25	53	0.002	0.007
MS	JACKSON CO	115,243	ND	ND	ND	0.11	0.09	IN	38	0.003	0.016
MS	JONES CO	62,031	ND	ND	ND	ND	ND	IN	IN	ND	ND
MS	LAUDERDALE CO	75,555	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
MS	LEE CO	65,581	ND	ND	ND	0.11	0.09	16	34	ND	ND
MS	MADISON CO	53,794	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
MS	PANOLA CO	29,996	ND	ND	IN	ND	ND	IN	IN	IN	0.004
MS	WARREN CO	47,880	ND	ND	ND	0.09	0.07	ND	IN	ND	ND
MS	WASHINGTON CO	67,935	ND	ND	ND	ND	ND	IN	IN	ND	ND
MO	AUDRAIN CO	23,599	ND	ND	ND	ND	ND	ND	IN	ND	ND
MO	BUCHANAN CO	83,083	ND	ND	ND	ND	ND	IN	99	0.003	0.013
MO	CEDAR CO	12,093	ND	ND	IN	0.09	0.08	ND	ND	ND	ND
MO	CLAY CO	153,411	5	ND	0.015	0.11	0.08	ND	ND	0.002	0.011
MO	GREENE CO	207,949	3	ND	0.013	0.10	0.08	18*	34*	0.004	0.039
MO	HOLT CO	6,034	ND	0.28	ND	ND	ND	ND	ND	ND	ND
MO	IRON CO	10,726	ND	1.24	ND	ND	ND	ND	ND	0.009	0.083
MO	JACKSON CO	633,232	4	0.01	ND	0.12	0.08	28	56	0.003	0.009
MO	JASPER CO	90,465	ND	ND	ND	ND	ND	34	105	ND	ND
MO	JEFFERSON CO	171,380	ND	6.75	ND	0.12	0.10	ND	IN	0.008	0.045
MO	LINCOLN CO	28,892	ND	ND	ND	ND	ND	IN	61	ND	ND
MO	MONROE CO	9,104	ND	ND	ND	0.11	0.09	13*	34*	0.004	0.011
MO	PLATTE CO	57,867	ND	ND	0.011	0.09	0.08	ND	ND	0.002	0.008
MO	ST CHARLES CO	212,907	ND	ND	0.012	0.13	0.10	ND	ND	0.005	0.016
MO	STE GENEVIEVE CO	16,037	ND	ND	IN	0.11	0.10	ND	ND	ND	ND
MO	ST LOUIS CO	993,529	3	0.02	0.024	0.12	0.10	18	33	0.007	0.021
MO	ST LOUIS	396,685	4	ND	0.027	0.12	0.09	36	92	0.009	0.037
MT	BIG HORN CO	11,337	ND	ND	ND	ND	ND	29*	77*	ND	ND
MT	BROADWATER CO	3,318	ND	ND	ND	ND	ND	ND	IN	ND	ND
MT	CASCADE CO	77,691	4	ND	ND	ND	ND	ND	ND	0.003	0.011

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m^3)	PM_{10} 2nd Max (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
MT	FLATHEAD CO	59,218	5	ND	ND	0.06	IN	29*	96*	ND	ND
MT	GALLATIN CO	50,463	5	ND	ND	ND	ND	IN	62	ND	ND
MT	GLACIER CO	12,121	ND	ND	ND	ND	ND	26	69	ND	ND
MT	JEFFERSON CO	7,939	ND	ND	ND	ND	ND	IN	IN	0.004	0.029
MT	LAKE CO	21,041	ND	ND	ND	ND	ND	21	118	ND	ND
MT	LEWIS AND CLARK CO	47,495	ND	1.12	ND	ND	ND	25	125	0.006	0.036
MT	LINCOLN CO	17,481	ND	ND	ND	ND	ND	26	74	ND	ND
MT	MADISON CO	5,989	ND	ND	ND	ND	ND	6*	19*	ND	ND
MT	MISSOULA CO	78,687	4	ND	ND	ND	ND	20*	56*	ND	ND
MT	PARK CO	14,562	ND	ND	ND	ND	ND	IN	IN*	ND	ND
MT	PHILLIPS CO	5,163	ND	ND	ND	ND	ND	ND	IN	ND	ND
MT	RAVALLI CO	25,010	ND	ND	ND	ND	ND	21*	67*	ND	ND
MT	ROOSEVELT CO	10,999	ND	ND	ND	ND	ND	IN	IN	ND	ND
MT	ROSEBUD CO	10,505	ND	ND	ND	ND	ND	32	107	ND	ND
MT	SANDERS CO	8,669	ND	ND	ND	ND	ND	IN	53	ND	ND
MT	SILVER BOW CO	33,941	4	ND	ND	ND	ND	21	62	ND	ND
MT	STILLWATER CO	6,536	ND	ND	ND	ND	ND	IN	IN	ND	ND
MT	YELLOWSTONE CO	113,419	6	ND	ND	ND	ND	21	69	0.007	0.037
NE	CASS CO	21,318	ND	ND	ND	ND	ND	38	131	ND	ND
NE	DAWSON CO	19,940	ND	ND	ND	ND	ND	34	116	ND	ND
NE	DOUGLAS CO	416,444	9	0.81	ND	0.09	0.08	43	102	0.001	0.006
NE	LANCASTER CO	213,641	6	ND	ND	0.06	0.05	ND	ND	ND	ND
NV	CHURCHILL CO	17,938	ND	ND	ND	ND	ND	ND	IN	ND	ND
NV	CLARK CO	741,459	8	ND	ND	0.10	0.08	56	281	ND	ND
NV	DOUGLAS CO	27,637	2	ND	ND	0.09	0.07	IN	IN	ND	ND
NV	ELKO CO	33,530	ND	ND	ND	ND	ND	29	93	ND	ND
NV	LANDER CO	6,266	ND	ND	ND	ND	ND	24	120	ND	ND
NV	PERSHING CO	4,336	ND	ND	ND	ND	ND	ND	IN	ND	ND
NV	WASHOE CO	254,667	7	ND	IN	0.10	0.08	57*	120*	ND	ND
NV	WHITE PINE CO	9,264	ND	ND	ND	0.08	0.07	ND	IN	ND	ND
NV	CARSON CITY	40,443	4	ND	ND	0.08	0.07	ND	IN	ND	ND
NH	BELKNAP CO	49,216	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
NH	CARROLL CO	35,410	ND	ND	ND	0.09	0.07	ND	ND	ND	ND
NH	CHESHIRE CO	70,121	ND	ND	ND	0.11	0.08	22	49	0.005	0.022
NH	COOS CO	34,828	ND	ND	ND	0.10	IN	29	63	0.004	0.034
NH	GRAFTON CO	74,929	ND	ND	ND	0.09	0.07	ND	ND	ND	ND
NH	HILLSBOROUGH CO	336,073	5	ND	IN	0.10	0.09	17	41	0.005	0.025
NH	MERRIMACK CO	120,005	ND	ND	ND	0.09	0.07	17	39	0.004	0.028
NH	ROCKINGHAM CO	245,845	ND	ND	0.010	0.12	0.09	16	34	0.004	0.019
NH	STRAFFORD CO	104,233	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
NH	SULLIVAN CO	38,592	ND	ND	ND	0.10	0.08	16	46	0.003	0.015
NJ	ATLANTIC CO	224,327	ND	ND	ND	0.12	0.10	22	46	0.003	0.009
NJ	BERGEN CO	825,380	4	ND	ND	ND	ND	34	75	0.005	0.020
NJ	BURLINGTON CO	395,066	4	ND	ND	ND	ND	ND	ND	0.004	0.018
NJ	CAMDEN CO	502,824	4	0.08	0.022	0.13	0.11	22	51	0.006	0.023
NJ	CUMBERLAND CO	138,053	ND	ND	ND	0.12	0.10	ND	ND	0.003	0.012
NJ	ESSEX CO	778,206	4	ND	0.033	0.12	0.10	IN	66	0.007	0.022
NJ	GLOUCESTER CO	230,082	ND	ND	ND	0.13	0.10	ND	IN	0.005	0.020
NJ	HUDSON CO	553,099	6	ND	0.026	0.14	0.11	35	56	0.008	0.030
NJ	HUNTERDON CO	107,776	ND	ND	ND	0.13	0.11	ND	ND	ND	ND
NJ	MERCER CO	325,824	ND	ND	0.017	0.15	0.11	21	48	ND	ND
NJ	MIDDLESEX CO	671,780	3	0.18	0.019	0.15	0.11	ND	ND	0.005	0.016
NJ	MONMOUTH CO	553,124	3	ND	ND	0.12	0.10	ND	ND	ND	ND
NJ	MORRIS CO	421,353	4	ND	0.011	0.12	0.10	ND	ND	0.004	0.020
NJ	OCEAN CO	433,203	ND	ND	ND	0.14	0.11	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
NJ	PASSAIC CO	453,060	ND	ND	ND	0.13	0.10	ND	IN	ND	ND
NJ	UNION CO	493,819	7	ND	0.042	ND	ND	33	67	0.007	0.023
NJ	WARREN CO	91,607	ND	ND	ND	ND	ND	ND	IN	ND	ND
NM	BERNALILLO CO	480,577	5	ND	0.016	0.10	0.08	35*	123*	ND	ND
NM	CHAVES CO	57,849	ND	ND	ND	ND	ND	19	33	ND	ND
NM	DONA ANA CO	135,510	4	ND	0.012	0.10	0.08	47*	200*	0.001	0.008
NM	EDDY CO	48,605	ND	ND	0.006	0.08	0.07	ND	ND	0.001	0.007
NM	GRANT CO	27,676	ND	ND	ND	ND	ND	23*	51*	0.003	0.030
NM	HIDALGO CO	5,958	ND	ND	ND	ND	ND	IN	53	0.003	0.025
NM	LEA CO	55,765	ND	ND	ND	ND	ND	18*	31*	ND	ND
NM	LUNA CO	18,110	ND	ND	ND	ND	ND	25*	112*	ND	ND
NM	OTERO CO	51,928	ND	ND	ND	ND	ND	IN	45	ND	ND
NM	SANDOVAL CO	63,319	1	ND	0.010	0.09	0.08	20*	46*	ND	ND
NM	SAN JUAN CO	91,605	2	ND	0.012	0.08	0.07	18*	37*	0.010	0.038
NM	SANTA FE CO	98,928	2	ND	ND	ND	ND	14*	31*	ND	ND
NM	TAOS CO	23,118	ND	ND	ND	ND	ND	IN	38	ND	ND
NM	VALENCIA CO	45,235	ND	ND	ND	0.09	0.07	ND	ND	ND	ND
NY	ALBANY CO	292,594	1	ND	IN	0.11	0.08	ND	ND	0.003	0.016
NY	BRONX CO	1,203,789	4	ND	0.033	0.14	0.10	IN	IN	0.011	0.041
NY	CHAUTAUQUA CO	141,895	ND	ND	ND	0.10	0.09	14	40	0.008	0.060
NY	CHEMUNG CO	95,195	ND	ND	ND	0.09	0.08	ND	ND	0.003	0.015
NY	DUTCHESS CO	259,462	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
NY	ERIE CO	968,532	2	ND	0.022	0.10	0.09	ND	ND	0.010	0.052
NY	ESSEX CO	37,152	ND	ND	ND	0.10	0.08	10	40	0.002	0.007
NY	HAMILTON CO	5,279	ND	ND	ND	0.09	0.08	ND	ND	0.002	0.006
NY	HERKIMER CO	65,797	ND	ND	ND	0.09	0.07	IN	46	0.001	0.007
NY	JEFFERSON CO	110,943	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
NY	KINGS CO	2,300,664	5	0.10	ND	ND	ND	IN	46	0.009	0.030
NY	MADISON CO	69,120	ND	ND	ND	0.09	0.08	ND	ND	0.002	0.015
NY	MONROE CO	713,968	3	ND	ND	0.10	0.09	ND	ND	0.007	0.041
NY	NASSAU CO	1,287,348	5	ND	0.024	ND	ND	16	41	0.006	0.038
NY	NEW YORK CO	1,487,536	5	ND	0.041	0.12	0.08	IN	45	0.013	0.045
NY	NIAGARA CO	220,756	3	0.02	ND	0.10	0.09	IN	48	0.005	0.020
NY	ONEIDA CO	250,836	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
NY	ONONDAGA CO	468,973	3	ND	ND	0.10	0.09	ND	ND	0.002	0.012
NY	ORANGE CO	307,647	ND	0.20	ND	0.12	0.09	ND	ND	ND	ND
NY	PUTNAM CO	83,941	ND	ND	ND	0.13	0.10	ND	ND	0.003	0.010
NY	QUEENS CO	1,951,598	3	ND	0.029	0.13	0.09	ND	ND	0.007	0.028
NY	RENSSELAER CO	154,429	ND	ND	ND	ND	ND	ND	ND	0.002	0.011
NY	RICHMOND CO	378,977	ND	0.02	ND	0.15	0.11	IN	43	0.006	0.022
NY	SARATOGA CO	181,276	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NY	SCHENECTADY CO	149,285	4	ND	ND	0.11	0.08	ND	ND	0.003	0.013
NY	SUFFOLK CO	1,321,864	ND	ND	ND	0.13	0.11	ND	ND	0.007	0.025
NY	ULSTER CO	165,304	ND	ND	ND	0.10	0.08	IN	41	0.002	0.010
NY	WAYNE CO	89,123	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
NY	WESTCHESTER CO	874,866	ND	ND	ND	0.14	0.11	ND	ND	ND	ND
NC	ALEXANDER CO	27,544	ND	ND	ND	0.11	0.08	ND	ND	0.005	0.007
NC	AVERY CO	14,867	ND	ND	ND	0.09	IN	ND	ND	ND	ND
NC	BEAUFORT CO	42,283	ND	ND	ND	ND	ND	ND	ND	0.006	0.015
NC	BUNCOMBE CO	174,821	ND	ND	ND	0.10	0.08	22*	44*	ND	ND
NC	CABARRUS CO	98,935	ND	ND	ND	ND	ND	IN	45	ND	ND
NC	CALDWELL CO	70,709	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
NC	CAMDEN CO	5,904	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	CASWELL CO	20,693	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	CATAWBA CO	118,412	ND	ND	ND	ND	ND	26*	51*	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM ($\mu g/m^3$)	PM_{10} 2nd Max ($\mu g/m^3$)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
NC	CHATHAM CO	38,759	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	CUMBERLAND CO	274,566	5	ND	ND	0.12	0.10	25*	43*	0.005	0.007
NC	DAVIDSON CO	126,677	ND	ND	ND	ND	ND	25*	46*	ND	ND
NC	DAVIE CO	27,859	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
NC	DUPLIN CO	39,995	ND	ND	ND	0.10	0.09	ND	ND	0.005	0.007
NC	DURHAM CO	181,835	5	ND	ND	0.11	0.09	23*	47*	ND	ND
NC	EDGECOMBE CO	56,558	ND	ND	ND	0.10	0.09	IN	IN	0.005	0.007
NC	FORSYTH CO	265,878	4	ND	0.016	0.12	0.10	23	58	0.005	0.020
NC	FRANKLIN CO	36,414	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	GASTON CO	175,093	ND	ND	ND	ND	ND	23	43	ND	ND
NC	GRANVILLE CO	38,345	1	ND	ND	0.09	0.08	ND	ND	ND	ND
NC	GUILFORD CO	347,420	3	ND	ND	0.11	0.10	25*	48*	ND	ND
NC	HARNETT CO	67,822	ND	ND	ND	ND	ND	26*	47*	ND	ND
NC	HAYWOOD CO	46,942	ND	ND	ND	0.11	0.10	25*	42*	ND	ND
NC	HENDERSON CO	69,285	ND	ND	ND	ND	ND	24*	44*	ND	ND
NC	JACKSON CO	26,846	ND	ND	ND	0.09	0.09	ND	ND	ND	ND
NC	JOHNSTON CO	81,306	ND	ND	ND	0.13	0.10	ND	ND	0.005	0.009
NC	LENOIR CO	57,274	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	LINCOLN CO	50,319	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	MC DOWELL CO	35,681	ND	ND	ND	ND	ND	24	40	ND	ND
NC	MARTIN CO	25,078	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
NC	MECKLENBURG CO	511,433	4	ND	0.018	0.13	0.10	31*	61*	0.004	0.013
NC	MITCHELL CO	14,433	ND	ND	ND	ND	ND	29*	49*	ND	ND
NC	NEW HANOVER CO	120,284	4	ND	ND	0.08	0.07	IN	45	0.007	0.027
NC	NORTHAMPTON CO	20,798	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
NC	ONSLOW CO	149,838	ND	ND	ND	ND	ND	IN	45	ND	ND
NC	ORANGE CO	93,851	4	ND	ND	ND	ND	ND	ND	ND	ND
NC	PASQUOTANK CO	31,298	ND	ND	ND	ND	ND	IN	43	ND	ND
NC	PERSON CO	30,180	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
NC	PITT CO	107,924	ND	ND	ND	0.11	0.09	IN	43	ND	ND
NC	ROCKINGHAM CO	86,064	ND	ND	ND	0.11	0.08	ND	ND	ND	ND
NC	ROWAN CO	110,605	1	ND	ND	0.13	0.11	ND	ND	ND	ND
NC	SWAIN CO	11,268	ND	ND	ND	0.09	0.08	21	41	ND	ND
NC	UNION CO	84,211	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
NC	WAKE CO	423,380	5	ND	ND	0.13	0.11	21*	49*	ND	ND
NC	WAYNE CO	104,666	ND	ND	ND	ND	ND	20	48	ND	ND
NC	YANCEY CO	15,419	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
ND	BILLINGS CO	1,108	ND	ND	ND	0.06	0.06	ND	ND	0.001	0.004
ND	BURKE CO	3,002	ND	ND	0.003	ND	ND	17	45	0.002	0.010
ND	BURLEIGH CO	60,131	ND	ND	ND	ND	ND	ND	IN	ND	ND
ND	CASS CO	102,874	ND	ND	0.007	0.07	0.07	21	65	0.001	0.003
ND	DUNN CO	4,005	ND	ND	0.003	0.06	0.06	ND	ND	0.001	0.005
ND	GRAND FORKS CO	70,683	ND	ND	ND	ND	ND	ND	IN	ND	ND
ND	MC KENZIE CO	6,383	ND	ND	ND	ND	ND	6	17	0.001	0.010
ND	MC LEAN CO	10,457	ND	ND	ND	ND	ND	7	17	0.002	0.009
ND	MERCER CO	9,808	ND	ND	0.004	0.07	0.06	ND	IN	0.003	0.016
ND	MORTON CO	23,700	ND	ND	ND	ND	ND	ND	ND	0.006	0.071
ND	OLIVER CO	2,381	ND	ND	0.003	0.08	0.06	ND	ND	0.002	0.014
ND	STARK CO	22,832	ND	ND	ND	ND	ND	ND	IN	ND	ND
ND	STEELE CO	2,420	ND	ND	0.003	0.07	0.06	ND	IN	0.001	0.004
ND	WILLIAMS CO	21,129	ND	ND	ND	ND	ND	ND	IN	0.003	0.064
OH	ADAMS CO	25,371	ND	ND	ND	ND	ND	ND	ND	0.008	0.056
OH	ALLEN CO	109,755	ND	ND	ND	0.11	0.09	17	32	0.003	0.013
OH	ASHTABULA CO	99,821	ND	ND	ND	0.10	0.09	ND	ND	0.005	0.019
OH	ATHENS CO	59,549	ND	ND	ND	ND	ND	20	38	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM ($\mu g/m^3$)	PM$_{10}$ 2nd Max ($\mu g/m^3$)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
OH	BELMONT CO	71,074	ND	ND	ND	ND	ND	26	69	IN	0.030
OH	BUTLER CO	291,479	ND	0.01	ND	0.12	0.10	31	85	0.007	0.024
OH	CLARK CO	147,548	ND	ND	ND	0.11	0.09	ND	ND	0.004	0.017
OH	CLERMONT CO	150,187	ND	ND	ND	0.12	0.09	ND	ND	0.005	0.020
OH	CLINTON CO	35,415	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
OH	COLUMBIANA CO	108,276	ND	ND	ND	ND	ND	IN	135	IN	0.039
OH	CUYAHOGA CO	1,412,140	4	0.15	0.025	0.10	0.09	42	106	0.009	0.036
OH	DELAWARE CO	66,929	ND	ND	ND	0.14	0.10	ND	ND	ND	ND
OH	ERIE CO	76,779	ND	ND	ND	ND	ND	IN	IN	ND	ND
OH	FRANKLIN CO	961,437	3	0.05	ND	0.11	0.10	27	86	0.004	0.015
OH	FULTON CO	38,498	ND	0.26	ND	ND	ND	ND	ND	ND	ND
OH	GEAUGA CO	81,129	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
OH	GREENE CO	136,731	ND	ND	ND	0.10	0.09	18	39	ND	ND
OH	HAMILTON CO	866,228	3	0.01	0.022	0.12	0.09	31	60	0.006	0.028
OH	HANCOCK CO	65,536	ND	ND	ND	ND	ND	IN	31	ND	ND
OH	JEFFERSON CO	80,298	3	ND	ND	0.11	0.09	34	75	0.011	0.059
OH	KNOX CO	47,473	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OH	LAKE CO	215,499	1	ND	ND	0.12	0.10	20	50	0.011	0.062
OH	LAWRENCE CO	61,834	ND	ND	ND	0.12	0.10	27	52	0.005	0.025
OH	LICKING CO	128,300	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OH	LOGAN CO	42,310	ND	0.23	ND	0.10	0.08	ND	ND	ND	ND
OH	LORAIN CO	271,126	ND	ND	ND	0.12	0.09	29	76	0.006	0.027
OH	LUCAS CO	462,361	3	ND	ND	0.13	0.09	23	58	0.004	0.052
OH	MADISON CO	37,068	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OH	MAHONING CO	264,806	ND	ND	ND	0.11	0.09	26	63	0.008	0.029
OH	MEDINA CO	122,354	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OH	MEIGS CO	22,987	ND	ND	ND	ND	ND	ND	ND	0.006	0.034
OH	MIAMI CO	93,182	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OH	MONROE CO	15,497	ND	ND	ND	ND	ND	25	52	ND	ND
OH	MONTGOMERY CO	573,809	3	0.01	ND	0.13	0.10	24	53	0.005	0.018
OH	MORGAN CO	14,194	ND	ND	ND	ND	ND	ND	ND	0.006	0.038
OH	OTTAWA CO	40,029	ND	ND	ND	ND	ND	25	62	ND	ND
OH	PORTAGE CO	142,585	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
OH	PREBLE CO	40,113	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
OH	RICHLAND CO	126,137	ND	ND	ND	ND	ND	23	53	ND	ND
OH	SANDUSKY CO	61,963	ND	ND	ND	ND	ND	26	69	ND	ND
OH	SCIOTO CO	80,327	ND	ND	ND	ND	ND	32	64	0.007	0.032
OH	SENECA CO	59,733	ND	ND	ND	ND	ND	IN	69	ND	ND
OH	STARK CO	367,585	2	ND	ND	0.11	0.09	24	57	0.007	0.028
OH	SUMMIT CO	514,990	3	0.01	ND	0.11	0.10	23	69	0.011	0.065
OH	TRUMBULL CO	227,813	ND	ND	ND	0.11	0.10	22	59	ND	ND
OH	TUSCARAWAS CO	84,090	ND	ND	ND	ND	ND	ND	ND	0.006	0.028
OH	UNION CO	31,969	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OH	WARREN CO	113,909	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
OH	WASHINGTON CO	62,254	ND	ND	ND	0.12	0.10	28	72	ND	ND
OH	WOOD CO	113,269	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
OH	WYANDOT CO	22,254	ND	ND	ND	ND	ND	22	63	ND	ND
OK	CLEVELAND CO	174,253	2	ND	0.012	0.09	0.08	ND	IN	ND	ND
OK	COMANCHE CO	111,486	2	ND	ND	0.09	0.08	ND	IN	ND	ND
OK	CUSTER CO	26,897	ND	ND	ND	ND	ND	ND	IN	ND	ND
OK	GARFIELD CO	56,735	ND	ND	0.008	ND	ND	ND	IN	ND	ND
OK	JEFFERSON CO	7,010	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
OK	KAY CO	48,056	ND	ND	ND	ND	ND	IN	IN*	0.004	0.019
OK	LATIMER CO	10,333	ND	ND	ND	0.10	0.07	ND	ND	ND	ND
OK	LOVE CO	8,157	ND	ND	ND	0.11	0.09	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
OK	MC CLAIN CO	22,795	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
OK	MARSHALL CO	10,829	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
OK	MAYES CO	33,366	ND	ND	0.007	ND	ND	ND	IN	ND	ND
OK	MUSKOGEE CO	68,078	ND	ND	0.008	ND	ND	32*	88*	0.003	0.017
OK	OKLAHOMA CO	599,611	4	ND	0.014	0.10	0.08	IN	IN*	0.004	0.009
OK	PITTSBURG CO	40,581	ND	ND	ND	ND	ND	ND	IN	ND	ND
OK	TULSA CO	503,341	4	ND	0.017	0.12	0.09	22*	44*	0.011	0.083
OR	CLACKAMAS CO	278,850	ND	ND	ND	0.09	0.07	IN	IN	ND	ND
OR	COLUMBIA CO	37,557	ND	ND	ND	0.07	0.05	ND	ND	ND	ND
OR	DESCHUTES CO	74,958	5	ND	ND	ND	ND	IN	75	ND	ND
OR	JACKSON CO	146,389	6	0.00	ND	0.08	IN	IN	93	ND	ND
OR	JOSEPHINE CO	62,649	5	ND	ND	ND	ND	IN	39	ND	ND
OR	KLAMATH CO	57,702	5	ND	ND	ND	ND	IN	82	ND	ND
OR	LAKE CO	7,186	ND	ND	ND	ND	ND	IN	94	ND	ND
OR	LANE CO	282,912	5	0.02	ND	0.08	0.07	IN	IN*	ND	ND
OR	MARION CO	228,483	6	ND	ND	0.08	0.07	ND	ND	ND	ND
OR	MULTNOMAH CO	583,887	6	0.00	IN	ND	ND	IN	63	ND	ND
OR	UMATILLA CO	59,249	ND	ND	ND	ND	ND	IN	53	ND	ND
OR	UNION CO	23,598	ND	ND	ND	ND	ND	IN	89	ND	ND
OR	YAMHILL CO	65,551	ND	0.18	ND	ND	ND	ND	ND	ND	ND
PA	ADAMS CO	78,274	1	ND	0.005	ND	ND	ND	ND	ND	ND
PA	ALLEGHENY CO	1,336,449	4	0.06	0.029	0.13	0.10	37	121	0.012	0.089
PA	ARMSTRONG CO	73,478	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
PA	BEAVER CO	186,093	2	0.08	0.019	0.13	0.10	IN	IN	0.015	0.070
PA	BERKS CO	336,523	3	0.84	0.021	0.13	0.10	IN	IN*	0.008	0.027
PA	BLAIR CO	130,542	2	ND	0.013	0.11	0.09	IN	IN*	0.007	0.030
PA	BUCKS CO	541,174	4	ND	0.018	0.15	0.11	IN	IN*	0.005	0.020
PA	CAMBRIA CO	163,029	3	0.09	0.015	0.11	0.09	IN	IN	0.009	0.025
PA	CARBON CO	56,846	ND	0.07	ND	ND	ND	ND	ND	ND	ND
PA	CENTRE CO	123,786	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
PA	CHESTER CO	376,396	ND	ND	ND	ND	ND	ND	IN	ND	ND
PA	CLEARFIELD CO	78,097	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
PA	DAUPHIN CO	237,813	4	ND	0.018	0.13	0.10	IN	IN*	0.005	0.021
PA	DELAWARE CO	547,651	ND	0.05	0.017	0.13	0.10	IN	IN*	0.010	0.034
PA	ERIE CO	275,572	6	ND	0.015	0.11	0.10	IN	IN*	0.010	0.043
PA	FRANKLIN CO	121,082	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
PA	GREENE CO	39,550	2	ND	0.003	0.12	0.10	ND	ND	0.009	0.022
PA	LACKAWANNA CO	219,039	2	ND	0.014	0.12	0.10	IN	IN	0.005	0.021
PA	LANCASTER CO	422,822	2	ND	0.015	0.13	0.10	IN	IN	0.005	0.021
PA	LAWRENCE CO	96,246	3	ND	0.020	0.11	0.09	IN	IN*	0.008	0.035
PA	LEHIGH CO	291,130	3	ND	0.015	0.13	0.11	IN	IN*	0.007	0.030
PA	LUZERNE CO	328,149	3	ND	0.015	0.11	0.09	IN	IN	0.007	0.023
PA	LYCOMING CO	118,710	ND	ND	ND	0.09	0.08	IN	IN	0.005	0.021
PA	MERCER CO	121,003	ND	ND	ND	0.11	0.09	ND	IN	0.007	0.039
PA	MONROE CO	95,709	0	ND	ND	0.12	0.10	ND	ND	0.003	0.006
PA	MONTGOMERY CO	678,111	2	ND	0.016	0.13	0.10	IN	IN*	0.006	0.020
PA	NORTHAMPTON CO	247,105	3	ND	0.017	0.13	0.11	IN	IN	0.009	0.037
PA	PERRY CO	41,172	ND	ND	0.006	0.11	0.09	ND	IN	0.003	0.012
PA	PHILADELPHIA CO	1,585,577	5	0.84	0.032	0.12	0.10	IN	IN	0.006	0.028
PA	SCHUYLKILL CO	152,585	2	ND	ND	ND	ND	ND	ND	0.007	0.038
PA	TIOGA CO	41,126	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
PA	WARREN CO	45,050	ND	ND	ND	ND	ND	ND	ND	0.015	0.097
PA	WASHINGTON CO	204,584	2	ND	0.016	0.12	0.10	IN	IN	0.010	0.036
PA	WESTMORELAND CO	370,321	2	0.04	0.018	0.13	0.10	IN	IN	0.011	0.037
PA	YORK CO	339,574	2	ND	0.019	0.12	0.09	IN	IN	0.007	0.019

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
RI	KENT CO	161,135	ND	ND	IN	0.12	0.09	14	37	ND	ND
RI	PROVIDENCE CO	596,270	4	ND	0.024	0.11	0.08	29	61	0.007	0.026
RI	WASHINGTON CO	110,006	ND	ND	ND	0.13	0.09	ND	ND	ND	ND
SC	ABBEVILLE CO	23,862	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
SC	AIKEN CO	120,940	ND	0.00	0.005	0.11	0.08	IN	44	IN	0.007
SC	ANDERSON CO	145,196	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
SC	BARNWELL CO	20,293	ND	ND	IN	0.10	0.09	19*	43*	0.002	0.004
SC	BEAUFORT CO	86,425	ND	0.00	ND	ND	ND	ND	ND	ND	ND
SC	BERKELEY CO	128,776	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
SC	CHARLESTON CO	295,039	4	0.01	0.010	0.10	0.08	21	47	0.002	0.011
SC	CHEROKEE CO	44,506	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
SC	CHESTER CO	32,170	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
SC	COLLETON CO	34,377	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
SC	DARLINGTON CO	61,851	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
SC	DILLON CO	29,114	ND	0.01	ND	ND	ND	ND	ND	ND	ND
SC	EDGEFIELD CO	18,375	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
SC	FAIRFIELD CO	22,295	ND	ND	ND	ND	ND	24*	45*	ND	ND
SC	FLORENCE CO	114,344	ND	0.01	ND	ND	ND	ND	ND	ND	ND
SC	GEORGETOWN CO	46,302	ND	0.02	ND	ND	ND	32	77	IN	0.015
SC	GREENVILLE CO	320,167	5	0.01	0.017	ND	ND	IN	52	0.003	0.009
SC	GREENWOOD CO	59,567	ND	0.02	ND	ND	ND	ND	ND	ND	ND
SC	HAMPTON CO	18,191	ND	0.01	ND	ND	ND	ND	ND	ND	ND
SC	HORRY CO	144,053	ND	0.01	ND	ND	ND	ND	ND	ND	ND
SC	KERSHAW CO	43,599	ND	0.01	ND	ND	ND	ND	ND	ND	ND
SC	LEXINGTON CO	167,611	ND	0.04	ND	ND	ND	IN	148	0.004	0.017
SC	OCONEE CO	57,494	ND	ND	ND	0.10	0.09	ND	ND	0.002	0.006
SC	PICKENS CO	93,894	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
SC	RICHLAND CO	285,720	4	0.01	0.014	0.12	0.09	24*	122*	0.003	0.010
SC	SPARTANBURG CO	226,800	ND	0.01	ND	0.12	0.10	26	46	ND	ND
SC	UNION CO	30,337	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
SC	WILLIAMSBURG CO	36,815	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
SC	YORK CO	131,497	ND	0.02	ND	0.11	0.09	26	49	ND	ND
SD	BROOKINGS CO	25,207	ND	ND	ND	ND	ND	24	71	ND	ND
SD	MINNEHAHA CO	123,809	ND	ND	ND	0.07	IN	22*	44*	ND	ND
SD	PENNINGTON CO	81,343	ND	ND	ND	ND	ND	31*	108*	ND	ND
TN	ANDERSON CO	68,250	ND	ND	ND	0.12	0.09	ND	ND	0.004	0.028
TN	BLOUNT CO	85,969	1	ND	0.003	0.12	0.11	ND	IN	0.009	0.056
TN	BRADLEY CO	73,712	ND	ND	0.015	ND	ND	28*	52*	0.008	0.034
TN	COFFEE CO	40,339	ND	ND	IN	ND	ND	ND	ND	IN	0.005
TN	DAVIDSON CO	510,784	5	ND	0.019	0.12	0.10	32	75	0.005	0.022
TN	DICKSON CO	35,061	ND	ND	IN	0.11	0.10	ND	IN	0.003	0.011
TN	GREENE CO	55,853	ND	ND	ND	ND	ND	IN	50	ND	ND
TN	HAMBLEN CO	50,480	ND	ND	ND	ND	ND	ND	IN	ND	ND
TN	HAMILTON CO	285,536	ND	ND	ND	0.12	0.10	29	49	ND	ND
TN	HAWKINS CO	44,565	ND	ND	ND	ND	ND	ND	ND	0.008	0.044
TN	HAYWOOD CO	19,437	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
TN	HUMPHREYS CO	15,795	ND	ND	ND	ND	ND	ND	ND	0.004	0.026
TN	JEFFERSON CO	33,016	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
TN	KNOX CO	335,749	4	0.00	ND	0.13	0.10	30	61	ND	ND
TN	LAWRENCE CO	35,303	ND	ND	ND	0.12	0.10	ND	IN	ND	ND
TN	MC MINN CO	42,383	ND	ND	0.016	ND	ND	39*	69*	0.008	0.027
TN	MADISON CO	77,982	ND	ND	ND	ND	ND	IN	43	ND	ND
TN	MAURY CO	54,812	ND	ND	ND	ND	ND	ND	IN	ND	ND
TN	MONTGOMERY CO	100,498	ND	ND	ND	ND	ND	23	39	0.005	0.016
TN	POLK CO	13,643	ND	ND	ND	ND	ND	ND	ND	0.007	0.021

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
TN	PUTNAM CO	51,373	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
TN	ROANE CO	47,227	ND	ND	IN	0.12	0.09	26	44	0.003	0.019
TN	RUTHERFORD CO	118,570	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
TN	SEVIER CO	51,043	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
TN	SHELBY CO	826,330	5	0.65	0.025	0.13	0.10	27	64	0.006	0.028
TN	STEWART CO	9,479	ND	ND	ND	ND	ND	ND	ND	0.003	0.011
TN	SULLIVAN CO	143,596	3	0.12	0.016	0.11	0.09	ND	IN	0.010	0.039
TN	SUMNER CO	103,281	IN	ND	IN	0.12	0.10	ND	IN	0.004	0.035
TN	UNION CO	13,694	ND	ND	ND	ND	ND	43	148	ND	ND
TN	WASHINGTON CO	92,315	ND	ND	ND	ND	ND	ND	IN	ND	ND
TN	WILLIAMSON CO	81,021	ND	1.02	ND	0.11	0.10	ND	ND	ND	ND
TN	WILSON CO	67,675	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
TX	BEXAR CO	1,185,394	4	ND	0.025	0.11	0.09	IN	IN*	ND	ND
TX	BOWIE CO	81,665	ND	ND	ND	ND	ND	ND	ND	IN	0.007
TX	BRAZORIA CO	191,707	ND	ND	ND	0.16	0.11	ND	ND	ND	ND
TX	BREWSTER CO	8,681	ND	ND	0.000	0.08	0.06	ND	ND	0.001	0.001
TX	CAMERON CO	260,120	3	0.01	ND	0.08	0.07	22*	59*	0.002	0.004
TX	CASS CO	29,982	ND	ND	ND	ND	ND	ND	ND	IN	0.008
TX	COLLIN CO	264,036	ND	0.82	ND	0.14	0.10	IN	IN*	ND	ND
TX	DALLAS CO	1,852,810	3	0.00	0.021	0.13	0.10	32*	61*	0.002	0.007
TX	DENTON CO	273,525	ND	ND	0.008	0.14	0.11	ND	ND	ND	ND
TX	ELLIS CO	85,167	ND	ND	ND	0.12	0.10	25*	52*	0.004	0.033
TX	EL PASO CO	591,610	8	0.15	0.028	0.11	0.07	63	303	0.003	0.016
TX	GALVESTON CO	217,399	ND	ND	0.005	0.18	0.12	23*	43*	0.007	0.040
TX	GREGG CO	104,948	ND	ND	0.007	0.13	0.11	ND	ND	0.002	0.011
TX	HARRIS CO	2,818,199	4	0.02	0.024	0.20	0.12	45*	116*	0.005	0.019
TX	HIDALGO CO	383,545	ND	ND	ND	0.09	0.08	ND	IN	ND	ND
TX	JEFFERSON CO	239,397	ND	ND	0.011	0.10	0.08	ND	ND	0.007	0.051
TX	LUBBOCK CO	222,636	ND	ND	ND	ND	ND	18*	42*	ND	ND
TX	MARION CO	9,984	ND	ND	0.005	0.12	0.09	ND	ND	ND	ND
TX	MONTGOMERY CO	182,201	ND	ND	IN	0.12	ND	ND	ND	ND	ND
TX	NUECES CO	291,145	ND	ND	ND	0.10	0.09	35*	88*	0.002	0.019
TX	ORANGE CO	80,509	ND	ND	0.009	0.09	0.06	ND	ND	ND	ND
TX	SMITH CO	151,309	ND	ND	0.007	0.12	0.10	ND	ND	ND	ND
TX	TARRANT CO	1,170,103	3	ND	0.017	0.15	0.10	22*	44*	ND	ND
TX	TRAVIS CO	576,407	1	ND	0.006	0.11	0.10	IN	IN	ND	ND
TX	VICTORIA CO	74,361	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
TX	WEBB CO	133,239	4	0.02	ND	0.08	0.07	IN	IN	ND	ND
UT	CACHE CO	70,183	IN	ND	ND	0.08	0.07	IN	65	ND	ND
UT	DAVIS CO	187,941	3	ND	0.020	0.11	0.08	ND	ND	0.002	0.006
UT	GRAND CO	6,620	ND	ND	ND	ND	ND	IN	57	ND	ND
UT	SALT LAKE CO	725,956	6	0.08	0.028	0.11	0.08	46*	113*	0.004	0.010
UT	SAN JUAN CO	12,621	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
UT	UTAH CO	263,590	6	ND	0.024	0.11	0.08	33*	91*	ND	ND
UT	WASHINGTON CO	48,560	ND	ND	ND	ND	ND	ND	IN	ND	ND
UT	WEBER CO	158,330	6	ND	0.026	0.10	0.07	29*	70*	ND	ND
VT	BENNINGTON CO	35,845	ND	ND	ND	0.11	0.08	ND	ND	ND	ND
VT	CHITTENDEN CO	131,761	2	ND	0.017	0.09	0.08	ND	IN	0.002	0.008
VT	RUTLAND CO	62,142	2	ND	0.012	ND	ND	ND	IN	0.005	0.022
VT	WASHINGTON CO	54,928	ND	ND	ND	ND	ND	ND	IN	ND	ND
VA	ARLINGTON CO	170,936	4	ND	0.025	0.13	0.10	ND	ND	ND	ND
VA	CAROLINE CO	19,217	ND	ND	IN	0.11	0.09	ND	ND	ND	ND
VA	CARROLL CO	26,594	ND	ND	ND	ND	ND	19	39	ND	ND
VA	CHARLES CITY CO	6,282	ND	ND	0.011	0.13	0.10	ND	ND	0.005	0.017
VA	CHESTERFIELD CO	209,274	ND	ND	ND	0.12	0.09	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
VA	CULPEPER CO	27,791	ND	ND	ND	ND	ND	18	40	ND	ND
VA	FAIRFAX CO	818,584	3	ND	0.023	0.12	0.10	20	56	0.009	0.026
VA	FAUQUIER CO	48,741	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
VA	FREDERICK CO	45,723	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
VA	HANOVER CO	63,306	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
VA	HENRICO CO	217,881	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
VA	KING WILLIAM CO	10,913	ND	ND	ND	ND	ND	18	45	ND	ND
VA	LOUDOUN CO	86,129	ND	ND	0.014	0.11	0.09	ND	ND	ND	ND
VA	MADISON CO	11,949	ND	ND	ND	0.11	0.09	ND	ND	IN	0.010
VA	NORTHUMBERLAND CO	10,524	ND	ND	ND	ND	ND	19	53	ND	ND
VA	PAGE CO	21,690	ND	ND	ND	0.09	0.09	ND	ND	ND	ND
VA	PRINCE WILLIAM CO	215,686	ND	ND	0.012	0.11	0.09	IN	IN	ND	ND
VA	ROANOKE CO	79,332	ND	ND	0.012	0.11	0.09	ND	ND	0.003	0.010
VA	ROCKBRIDGE CO	18,350	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
VA	ROCKINGHAM CO	57,482	ND	ND	ND	ND	ND	25	41	0.003	0.013
VA	STAFFORD CO	61,236	ND	ND	ND	0.12	0.09	ND	ND	ND	ND
VA	TAZEWELL CO	45,960	ND	ND	ND	ND	ND	IN	IN	ND	ND
VA	WARREN CO	26,142	ND	ND	ND	ND	ND	20	40	ND	ND
VA	WISE CO	39,573	ND	ND	ND	ND	ND	21	39	ND	ND
VA	WYTHE CO	25,466	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
VA	ALEXANDRIA	111,183	4	ND	0.025	0.12	0.10	ND	ND	0.005	0.024
VA	CHARLOTTESVILLE	40,341	ND	ND	ND	ND	ND	IN	37	ND	ND
VA	CHESAPEAKE	151,976	ND	ND	ND	ND	ND	IN	44	ND	ND
VA	FREDERICKSBURG	19,027	ND	ND	ND	ND	ND	18	37	ND	ND
VA	HAMPTON	133,793	3	ND	ND	0.14	0.10	19	50	0.004	0.014
VA	NEWPORT NEWS	170,045	2	ND	ND	ND	ND	ND	ND	ND	ND
VA	NORFOLK	261,229	5	ND	0.017	ND	ND	19	46	0.007	0.022
VA	RICHMOND	203,056	2	ND	0.020	ND	ND	19	36	0.005	0.017
VA	ROANOKE	96,397	4	ND	ND	ND	ND	IN	64	ND	ND
VA	SUFFOLK	52,141	ND	ND	ND	0.13	0.09	ND	ND	ND	ND
VA	WINCHESTER	21,947	ND	ND	ND	ND	ND	22	46	ND	ND
WA	ASOTIN CO	17,605	ND	ND	ND	ND	ND	31	82	ND	ND
WA	BENTON CO	112,560	ND	ND	ND	ND	ND	IN	86	ND	ND
WA	CHELAN CO	52,250	ND	ND	ND	ND	ND	IN	44	ND	ND
WA	CLALLAM CO	56,464	ND	ND	ND	0.05	0.04	ND	IN	0.002	0.007
WA	CLARK CO	238,053	7	ND	ND	0.07	0.06	16*	34*	ND	ND
WA	COWLITZ CO	82,119	ND	ND	ND	0.07	0.05	20*	38*	ND	ND
WA	KING CO	1,507,319	6	0.05	0.019	0.09	0.07	IN	50	IN	0.018
WA	KITSAP CO	189,731	ND	ND	ND	ND	ND	15*	34*	ND	ND
WA	KITTITAS CO	26,725	ND	ND	ND	ND	ND	IN	46	ND	ND
WA	KLICKITAT CO	16,616	ND	ND	ND	0.08	0.06	ND	ND	ND	ND
WA	LEWIS CO	59,358	ND	ND	ND	0.06	IN	ND	ND	ND	ND
WA	PIERCE CO	586,203	7	ND	ND	0.09	0.07	17*	56*	IN	0.020
WA	SKAGIT CO	79,555	ND	ND	ND	0.06	0.05	ND	ND	IN	0.025
WA	SNOHOMISH CO	465,642	5	ND	ND	ND	ND	16*	35*	IN	0.011
WA	SPOKANE CO	361,364	6	ND	ND	0.07	0.07	26*	86*	ND	ND
WA	STEVENS CO	30,948	ND	ND	ND	ND	ND	IN	60	ND	ND
WA	THURSTON CO	161,238	5	ND	ND	0.08	0.06	IN	35	ND	ND
WA	WALLA WALLA CO	48,439	ND	ND	ND	ND	ND	40*	92*	ND	ND
WA	WHATCOM CO	127,780	ND	ND	ND	0.06	0.05	14	26	IN	0.016
WA	YAKIMA CO	188,823	5	ND	ND	ND	ND	25*	82*	ND	ND
WV	BERKELEY CO	59,253	ND	ND	ND	ND	ND	22	57	ND	ND
WV	BROOKE CO	26,992	ND	ND	ND	ND	ND	28	61	0.012	0.065
WV	CABELL CO	96,827	ND	ND	ND	0.12	0.10	IN	45	0.005	0.019
WV	FAYETTE CO	47,952	ND	ND	ND	ND	ND	IN	IN	ND	ND

Table A-14. Maximum Air Quality Concentrations by County, 1999 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m³)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m³)	PM_{10} 2nd Max (µg/m³)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
WV	GREENBRIER CO	34,693	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
WV	HANCOCK CO	35,233	5	ND	ND	0.11	0.09	31	98	0.016	0.065
WV	HARRISON CO	69,371	ND	ND	ND	ND	ND	18	45	ND	ND
WV	KANAWHA CO	207,619	IN	ND	ND	0.13	0.10	IN	45	0.010	0.046
WV	MARSHALL CO	37,356	ND	ND	ND	ND	ND	IN	59	0.015	0.060
WV	MONONGALIA CO	75,509	ND	ND	ND	ND	ND	21	58	0.010	0.049
WV	OHIO CO	50,871	3	ND	ND	0.10	0.09	25	50	0.010	0.034
WV	PUTNAM CO	42,835	ND	ND	ND	ND	ND	IN	IN	ND	ND
WV	RALEIGH CO	76,819	ND	ND	ND	ND	ND	IN	39	ND	ND
WV	SUMMERS CO	14,204	ND	ND	ND	ND	ND	IN	37	ND	ND
WV	WAYNE CO	41,636	ND	ND	IN	ND	ND	IN	IN	0.009	0.042
WV	WOOD CO	86,915	ND	ND	ND	0.12	0.10	25	63	0.013	0.058
WI	BROWN CO	194,594	ND	ND	ND	0.10	0.09	ND	ND	0.003	0.011
WI	COLUMBIA CO	45,088	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
WI	DANE CO	367,085	2	ND	ND	0.10	0.09	21*	49*	IN	0.008
WI	DODGE CO	76,559	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
WI	DOOR CO	25,690	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
WI	DOUGLAS CO	41,758	ND	ND	ND	ND	ND	19	44	ND	ND
WI	FLORENCE CO	4,590	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
WI	FOND DU LAC CO	90,083	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
WI	JEFFERSON CO	67,783	ND	ND	ND	0.11	0.10	ND	ND	ND	ND
WI	KENOSHA CO	128,181	ND	ND	ND	0.13	0.10	ND	ND	ND	ND
WI	KEWAUNEE CO	18,878	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
WI	MANITOWOC CO	80,421	ND	ND	ND	0.12	0.10	ND	ND	ND	ND
WI	MARATHON CO	115,400	ND	ND	ND	0.10	0.08	IN	64	0.003	0.040
WI	MILWAUKEE CO	959,275	2	ND	0.022	0.12	0.10	27	60	0.004	0.024
WI	ONEIDA CO	31,679	ND	ND	ND	0.09	0.08	ND	ND	0.006	0.065
WI	OUTAGAMIE CO	140,510	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
WI	OZAUKEE CO	72,831	ND	ND	IN	0.12	0.10	ND	ND	ND	ND
WI	POLK CO	34,773	IN	ND	ND	ND	ND	ND	ND	ND	ND
WI	RACINE CO	175,034	3	ND	ND	0.11	0.09	ND	ND	ND	ND
WI	ROCK CO	139,510	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
WI	ST CROIX CO	50,251	ND	ND	ND	0.08	0.07	ND	ND	ND	ND
WI	SAUK CO	46,975	ND	ND	0.004	0.10	0.09	ND	ND	ND	ND
WI	SHEBOYGAN CO	103,877	ND	ND	ND	0.13	0.09	ND	ND	ND	ND
WI	VERNON CO	25,617	ND	ND	ND	0.08	0.08	IN	IN	ND	ND
WI	VILAS CO	17,707	ND	ND	ND	0.09	0.08	11*	45*	ND	ND
WI	WALWORTH CO	75,000	ND	ND	ND	0.11	0.09	ND	ND	ND	ND
WI	WASHINGTON CO	95,328	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
WI	WAUKESHA CO	304,715	2	ND	ND	0.11	0.10	23	57	ND	ND
WI	WINNEBAGO CO	140,320	ND	ND	ND	0.10	0.09	ND	ND	ND	ND
WI	WOOD CO	73,605	ND	ND	ND	ND	ND	ND	ND	0.003	0.042
WY	ALBANY CO	30,797	ND	ND	ND	ND	ND	IN	50	ND	ND
WY	CAMPBELL CO	29,370	ND	ND	ND	ND	ND	39	132	ND	ND
WY	CARBON CO	16,659	ND	ND	ND	ND	ND	ND	IN	ND	ND
WY	CONVERSE CO	11,128	ND	ND	ND	ND	ND	28	78	ND	ND
WY	FREMONT CO	33,662	ND	ND	ND	ND	ND	IN	63	ND	ND
WY	LARAMIE CO	73,142	ND	ND	ND	ND	ND	15	30	ND	ND
WY	LINCOLN CO	12,625	ND	ND	ND	ND	ND	IN	IN	ND	ND
WY	NATRONA CO	61,226	ND	ND	ND	ND	ND	IN	52	ND	ND
WY	PARK CO	23,178	ND	ND	ND	ND	ND	IN	40	ND	ND
WY	SHERIDAN CO	23,562	ND	ND	ND	ND	ND	31*	117*	ND	ND
WY	SWEETWATER CO	38,823	ND	ND	ND	ND	ND	25*	72*	ND	ND
WY	TETON CO	11,172	ND	ND	ND	0.08	0.07	IN	39	ND	ND
PR	BARCELONETA CO	18,942	ND	ND	ND	ND	ND	IN	49	IN	0.014

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m^3)	PM_{10} 2nd Max (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
PR	BAYAMON CO	196,206	ND	ND	ND	ND	ND	IN	55	0.003	0.021
PR	CAROLINA CO	165,954	ND	ND	ND	ND	ND	IN	IN	ND	ND
PR	CATANO CO	26,243	ND	ND	IN	0.08	0.05	IN	IN	IN	0.017
PR	FAJARDO CO	32,087	ND	ND	ND	ND	ND	IN	73	ND	ND
PR	GUAYAMA CO	40,183	ND	ND	ND	ND	ND	27	61	ND	ND
PR	GUAYNABO CO	80,742	ND	ND	ND	ND	ND	38	84	ND	ND
PR	HUMACAO CO	46,134	ND	ND	ND	ND	ND	IN	60	ND	ND
PR	MANATI CO	36,562	ND	ND	ND	ND	ND	25	58	ND	ND
PR	PONCE CO	189,046	ND	ND	ND	ND	ND	39	86	ND	ND
PR	RIO GRANDE CO	34,283	ND	ND	ND	ND	ND	IN	IN	ND	ND
PR	SAN JUAN CO	434,849	8	0.02	ND	ND	ND	IN	60	ND	ND

CO – Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb – Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 µg/m3)*
NO_2 – Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 (1-hr) – Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
O_3 (8-hr) – Highest fourth daily maximum 8-hour concentration *(Applicable NAAQS is 0.08 ppm)*
PM_{10} – Highest weighted annual mean concentration *(Applicable NAAQS is 50 µg/m3)*
– Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 µg/m3)*
SO_2 – Highest annual mean concentration *(Applicable NAAQS is 0.03 ppm)*
– Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*
ND – Indicates data not available
IN – Indicates insufficient data to calculate summary statistic
Wtd – Weighted
AM – Annual mean
µg/m^3 – Units are micrograms per cubic meter
PPM – Units are parts per million

Data from exceptional events not included.

(*) – These PM_{10} statistics were converted from local temperature and pressure to standard temperature and pressure to ensure all PM_{10} data in this table reflect standard conditions.

Note: The reader is cautioned that this summary is not adequate in itself to numerically rank MSAs according to their air quality. The monitoring data represent the quality of air in the vicinity of the monitoring site but may not necessarily represent urban-wide air quality.

Table A-15. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1999

Metropolitan Statistical Area	**1990 Population**	**CO 8-hr (ppm)**	**Pb QMax (μg/m^3)**	**NO_2 AM (ppm)**	**O_3 1-hr (ppm)**	**O_3 8-hr (ppm)**	**PM_{10} Wtd AM (μg/m^3)**	**PM_{10} 2nd Max (μg/m^3)**	**SO_2 AM (ppm)**	**SO_2 24-hr (ppm)**
AKRON, OH	657,575	3	0.01	ND	0.12	**0.10**	23	69	0.011	0.065
ALBANY, GA	112,561	ND	ND	ND	ND	ND	26	60	ND	ND
ALBANY-SCHENECTADY-TROY, NY	861,424	4	ND	IN	0.11	**0.09**	ND	ND	0.003	0.016
ALBUQUERQUE, NM	589,131	5	ND	0.016	0.10	**0.08**	35*	123*	ND	ND
ALLENTOWN-BETHLEHEM-EASTON, PA	595,081	3	0.07	0.017	**0.13**	**0.11**	ND	36*	0.009	0.037
ALTOONA, PA	130,542	2	ND	0.013	0.11	**0.09**	ND	ND	0.007	0.030
ANCHORAGE, AK	226,338	8	ND	ND	ND	ND	15	73	ND	ND
ANN ARBOR, MI	490,058	ND	ND	ND	0.11	**0.09**	ND	ND	ND	ND
APPLETON-OSHKOSH-NEENAH, WI	315,121	ND	ND	ND	0.11	**0.09**	ND	ND	ND	ND
ASHEVILLE, NC	191,774	ND	ND	ND	0.10	0.08	21	41	ND	ND
ATLANTA, GA	2,959,950	4	0.05	0.024	**0.16**	**0.13**	35	72	0.005	0.023
ATLANTIC-CAPE MAY, NJ	319,416	ND	ND	ND	0.12	**0.10**	22	46	0.003	0.009
AUGUSTA-AIKEN, GA-SC	415,184	ND	0.00	0.005	0.11	**0.09**	IN	49	IN	IN
AUSTIN-SAN MARCOS, TX	846,227	1	ND	0.006	0.11	**0.10**	ND	ND	ND	ND
BAKERSFIELD, CA	543,477	4	0.00	0.025	**0.14**	**0.11**	**59**	141	IN	IN
BALTIMORE, MD	2,382,172	5	0.00	0.024	**0.15**	**0.11**	29	61	0.006	0.020
BANGOR, ME	91,629	ND	ND	ND	0.09	0.08	17	32	ND	ND
BATON ROUGE, LA	528,264	5	0.06[a]	0.019	0.12	**0.10**	34	78	0.006	0.025
BEAUMONT-PORT ARTHUR, TX	361,226	ND	ND	0.011	0.10	0.08	ND	ND	0.007	0.051
BELLINGHAM, WA	127,780	ND	ND	ND	0.06	0.05	14	26	IN	IN
BENTON HARBOR, MI	161,378	ND	ND	ND	0.11	**0.10**	ND	ND	ND	ND
BERGEN-PASSAIC, NJ	1,278,440	4	ND	ND	**0.13**	**0.10**	34	73	0.005	0.020
BILLINGS, MT	113,419	6	ND	ND	ND	ND	21	69	0.007	0.037
BILOXI-GULFPORT-PASCAGOULA, MS	312,368	ND	ND	0.006	0.11	**0.10**	IN	38	0.003	0.024
BIRMINGHAM, AL	840,140	5	ND	0.010	**0.13**	**0.10**	28	108	IN	IN
BISMARCK, ND	83,831	ND	ND	ND	ND	ND	ND	ND	0.006	0.071
BOISE CITY, ID	295,851	6	ND	0.021	ND	ND	36	101	ND	ND
BOSTON, MA-NH	3,227,707	4	0.03	0.030	0.12	**0.09**	30	65	0.007	0.040
BOULDER-LONGMONT, CO	225,339	4	ND	ND	0.10	0.08	IN	56	ND	ND
BRAZORIA, TX	191,707	ND	ND	ND	**0.16**	**0.11**	ND	ND	ND	ND
BREMERTON, WA	189,731	ND	ND	ND	ND	ND	15	33	ND	ND
BRIDGEPORT, CT	443,722	3	ND	0.018	**0.14**	**0.11**	19	41	0.006	0.023
BROCKTON, MA	236,409	ND	ND	IN	0.10	0.08	ND	ND	ND	ND
BROWNSVILLE-HARLINGEN-SAN BENITO, TX	260,120	3	0.01	ND	0.08	0.07	22*	59*	0.002	0.004
BUFFALO-NIAGARA FALLS, NY	1,189,288	3	0.02	0.022	0.10	**0.09**	IN	48	0.010	0.052
BURLINGTON, VT	151,506	2	ND	0.017	ND	ND	ND	ND	0.002	0.008
CANTON-MASSILLON, OH	394,106	2	ND	ND	0.11	**0.09**	24	57	0.007	0.028
CASPER, WY	61,226	ND	ND	ND	ND	ND	IN	52	ND	ND
CEDAR RAPIDS, IA	168,767	2	ND	ND	0.10	0.08	IN	54	0.005	0.071
CHAMPAIGN-URBANA, IL	173,025	ND	ND	ND	0.11	**0.09**	23	47	0.002	0.010
CHARLESTON-NORTH CHARLESTON, SC	506,875	4	0.01	0.010	0.10	0.08	21	47	0.002	0.011
CHARLESTON, WV	250,454	IN	ND	ND	**0.13**	**0.10**	IN	45	0.010	0.046
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	1,162,093	4	0.02	0.018	**0.13**	**0.11**	30	60	0.004	0.013
CHARLOTTESVILLE, VA	131,107	ND	ND	ND	ND	ND	IN	37	ND	ND
CHATTANOOGA, TN-GA	424,347	ND	ND	ND	0.12	**0.10**	29	57	ND	ND
CHEYENNE, WY	73,142	ND	ND	ND	ND	ND	15	30	ND	ND
CHICAGO, IL	7,410,858	5	0.06	0.032	0.11	**0.10**	40	120	0.009	0.044
CHICO-PARADISE, CA	182,120	4	0.00	0.015	0.11	**0.09**	29	139	ND	ND
CINCINNATI, OH-KY-IN	1,526,092	3	0.01	0.022	0.12	**0.10**	31	60	0.008	0.030
CLARKSVILLE-HOPKINSVILLE, TN-KY	169,439	ND	ND	ND	0.12	**0.09**	23	39	0.005	0.016
CLEVELAND-LORAIN-ELYRIA, OH	2,202,069	4	0.15[b]	0.025	0.12	**0.10**	42	106	0.011	0.062
COLORADO SPRINGS, CO	397,014	5	0.01	0.019	0.08	0.06	22	80	0.004	0.020
COLUMBIA, SC	453,331	4	0.04	0.014	0.12	**0.09**	24	148	0.004	0.017

Table A-15. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1999 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
COLUMBUS, GA-AL	260,860	ND	1.04[c]	ND	0.11	**0.10**	24	49	ND	ND
COLUMBUS, OH	1,345,450	3	0.05[d]	ND	**0.14**	**0.10**	27	86	0.004	0.015
CORPUS CHRISTI, TX	349,894	ND	ND	ND	0.10	**0.09**	35*	88*	0.002	0.019
DALLAS, TX	2,676,248	3	0.82[e]	0.021	**0.14**	**0.11**	32*	61*	0.004	0.033
DANBURY, CT	193,597	ND	ND	ND	**0.15**	**0.11**	ND	ND	0.004	0.024
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL	350,861	ND	ND	ND	0.10	0.08	44	**177**	0.004	0.014
DAYTON-SPRINGFIELD, OH	951,270	3	0.01	ND	**0.13**	**0.10**	24	53	0.005	0.018
DAYTONA BEACH, FL	399,413	ND	ND	ND	0.09	0.08	21	56	ND	ND
DECATUR, AL	131,556	ND	ND	ND	0.10	**0.09**	IN	43	0.002	0.011
DECATUR, IL	117,206	ND	ND	ND	0.10	**0.09**	ND	ND	0.006	0.027
DENVER, CO	1,622,980	5	0.08	0.02	0.11	0.08	37	141	0.003	0.012
DES MOINES, IA	392,928	4	ND	ND	0.08	0.07	IN	76	ND	ND
DETROIT, MI	4,266,654	4	0.10	0.018	0.12	**0.10**	36	126	0.009	0.053
DOTHAN, AL	130,964	ND	ND	ND	ND	ND	IN	IN	ND	ND
DOVER, DE	110,993	ND	ND	ND	0.12	**0.10**	ND	ND	ND	ND
DULUTH-SUPERIOR, MN-WI	239,971	2	ND	ND	0.08	0.07	25	71	ND	ND
DUTCHESS COUNTY, NY	259,462	ND	ND	ND	0.12	**0.09**	ND	ND	ND	ND
EL PASO, TX	591,610	8	0.15	0.028	0.11	0.07	**63**	129	0.003	0.016
ELKHART-GOSHEN, IN	156,198	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
ELMIRA, NY	95,195	ND	ND	ND	0.09	0.08	ND	ND	0.003	0.015
ENID, OK	56,735	ND	ND	0.008	ND	ND	ND	ND	ND	ND
ERIE, PA	275,572	6	ND	0.015	0.11	**0.10**	ND	54*	0.010	0.043
EUGENE-SPRINGFIELD, OR	282,912	5	0.02	ND	0.08	0.07	ND	ND	ND	ND
EVANSVILLE-HENDERSON, IN-KY	278,990	4	ND	0.016	0.11	**0.10**	26	60	0.007	0.056
FARGO-MOORHEAD, ND-MN	153,296	ND	ND	0.007	0.07	0.07	21	65	0.001	0.003
FAYETTEVILLE, NC	274,566	5	ND	ND	0.12	**0.10**	24	42	0.005	0.007
FLAGSTAFF, AZ-UT	101,760	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
FLINT, MI	430,459	ND	0.01	ND	0.11	**0.10**	IN	IN	0.003	0.011
FLORENCE, AL	131,327	ND	ND	ND	ND	ND	ND	ND	0.003	0.017
FLORENCE, SC	114,344	ND	0.01	ND	ND	ND	ND	ND	ND	ND
FORT COLLINS-LOVELAND, CO	186,136	5	ND	ND	0.09	0.07	16	36	ND	ND
FORT LAUDERDALE, FL	1,255,488	5	0.02	0.011	0.10	0.08	19	33	0.003	0.015
FORT MYERS-CAPE CORAL, FL	335,113	ND	ND	ND	0.10	0.08	19	32	ND	ND
FORT PIERCE-PORT ST. LUCIE, FL	251,071	ND	ND	0.010	0.08	0.07	20	39	ND	ND
FORT WAYNE, IN	456,281	3	ND	ND	0.10	**0.09**	IN	IN	ND	ND
FORT WORTH-ARLINGTON, TX	1,361,034	3	ND	0.017	**0.15**	**0.10**	22*	44*	ND	ND
FRESNO, CA	755,580	8	0.00	0.024	**0.15**	**0.11**	47	130	ND	ND
GADSDEN, AL	99,840	ND	ND	ND	ND	ND	30	66	ND	ND
GAINESVILLE, FL	181,596	ND	ND	ND	0.10	0.08	21	38	ND	ND
GALVESTON-TEXAS CITY, TX	217,399	ND	ND	0.005	**0.18**	**0.12**	23*	43*	0.007	0.040
GARY, IN	604,526	3	0.08	0.019	0.12	**0.10**	35	**166**	0.007	0.032
GOLDSBORO, NC	104,666	ND	ND	ND	ND	ND	20	48	ND	ND
GRAND JUNCTION, CO	93,145	5	ND	ND	ND	ND	20	52	ND	ND
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	937,891	4	0.00	ND	0.12	**0.10**	21	54	0.001	0.006
GREAT FALLS, MT	77,691	4	ND	ND	ND	ND	ND	ND	0.003	0.011
GREELEY, CO	131,821	3	ND	ND	0.09	0.07	18	47	ND	ND
GREEN BAY, WI	194,594	ND	ND	ND	0.10	**0.09**	ND	ND	0.003	0.011
GREENSBORO—WINSTON-SALEM—HIGH POINT	1,050,304	4	ND	0.016	**0.13**	**0.10**	25	57	0.005	0.020
GREENVILLE, NC	107,924	ND	ND	ND	0.11	**0.09**	IN	43	ND	ND
GREENVILLE-SPARTANBURG-ANDERSON, SC	830,563	5	0.01	0.017	0.12	**0.10**	26	52	0.003	0.009
HAGERSTOWN, MD	121,393	ND	ND	ND	0.11	**0.09**	ND	ND	ND	ND
HAMILTON-MIDDLETOWN, OH	291,479	ND	0.01	ND	0.12	**0.10**	31	85	0.007	0.024

Table A-15. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1999 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM ($\mu g/m^3$)	PM$_{10}$ 2nd Max ($\mu g/m^3$)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
HARRISBURG-LEBANON-CARLISLE, PA	587,986	4	ND	0.018	**0.13**	**0.10**	ND	ND	0.005	0.021
HARTFORD, CT	1,157,585	6	ND	0.018	**0.16**	**0.11**	18	81	0.004	0.019
HICKORY-MORGANTON-LENOIR, NC	292,409	ND	ND	ND	0.12	**0.09**	25	49	0.005	0.007
HONOLULU, HI	836,231	2	ND	0.004	0.05	0.05	15	41	0.001	0.004
HOUMA, LA	182,842	ND	ND	ND	0.12	**0.09**	ND	ND	ND	ND
HOUSTON, TX	3,322,025	4	0.02	0.024	**0.20**	**0.12**	45*	116*	0.005	0.019
HUNTINGTON-ASHLAND, WV-KY-OH	312,529	1	ND	0.016	0.12	**0.10**	39	89	0.009	0.026
HUNTSVILLE, AL	293,047	4	ND	ND	0.11	**0.09**	24	52	ND	ND
INDIANAPOLIS, IN	1,380,491	3	0.12[f]	0.018	0.11	**0.10**	27	53	0.007	0.024
JACKSON, MS	395,396	5	ND	ND	0.11	0.08	25	53	0.002	0.007
JACKSON, TN	90,801	ND	ND	ND	ND	ND	IN	43	ND	ND
JACKSONVILLE, FL	906,727	4	0.02	0.016	0.10	0.08	28	59	0.004	0.036
JACKSONVILLE, NC	149,838	ND	ND	ND	ND	ND	IN	45	ND	ND
JAMESTOWN, NY	141,895	ND	ND	ND	0.10	**0.09**	14	40	0.008	0.060
JANESVILLE-BELOIT, WI	139,510	ND	ND	ND	0.11	**0.09**	ND	ND	ND	ND
JERSEY CITY, NJ	553,099	6	ND	0.026	**0.14**	**0.11**	35	56	0.008	0.030
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA	436,047	3	0.12	0.016	0.11	**0.09**	ND	ND	0.010	0.044
JOHNSTOWN, PA	241,247	3	0.09	0.015	0.11	**0.09**	ND	ND	0.009	0.025
JOPLIN, MO	134,910	ND	ND	ND	ND	ND	34	105	ND	ND
KALAMAZOO-BATTLE CREEK, MI	429,453	ND	ND	ND	0.10	**0.09**	IN	50	ND	ND
KANSAS CITY, MO-KS	1,582,875	5	0.01	0.015	0.12	0.08	40	118	0.003	0.011
KENOSHA, WI	128,181	ND	ND	ND	**0.13**	**0.10**	ND	ND	ND	ND
KNOXVILLE, TN	585,960	4	0.00	0.003	**0.13**	**0.11**	43	148	0.009	0.056
LAFAYETTE, LA	344,853	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
LAKE CHARLES, LA	168,134	ND	ND	0.005	**0.13**	**0.09**	ND	ND	0.004	0.015
LAKELAND-WINTER HAVEN, FL	405,382	ND	ND	ND	0.10	0.08	22	50	0.007	0.019
LANCASTER, PA	422,822	2	ND	0.015	**0.13**	**0.10**	ND	ND	0.005	0.021
LANSING-EAST LANSING, MI	432,674	ND	ND	ND	0.10	**0.09**	ND	ND	ND	ND
LAREDO, TX	133,239	4	0.02	ND	0.08	0.07	ND	ND	ND	ND
LAS CRUCES, NM	135,510	4	ND	0.012	0.10	0.08	45	88	0.001	0.008
LAS VEGAS, NV-AZ	852,737	8	ND	ND	0.10	0.08	**56**	**281**	ND	ND
LAWRENCE, MA-NH	353,232	ND	ND	ND	0.09	0.07	ND	ND	0.005	0.021
LAWTON, OK	111,486	2	ND	ND	0.09	0.08	ND	ND	ND	ND
LEWISTON-AUBURN, ME	93,679	ND	ND	ND	ND	ND	IN	45	0.004	0.016
LEXINGTON, KY	405,936	2	ND	0.013	0.11	**0.09**	23	54	0.008	0.020
LIMA, OH	154,340	ND	ND	ND	0.11	**0.09**	17	32	0.003	0.013
LINCOLN, NE	213,641	6	ND	ND	0.06	0.05	ND	ND	ND	ND
LITTLE ROCK-NORTH LITTLE ROCK, AR	513,117	4	ND	0.011	0.11	**0.09**	32*	70*	0.002	0.005
LONGVIEW-MARSHALL, TX	193,801	ND	ND	0.007	**0.13**	**0.11**	ND	ND	0.002	0.011
LOS ANGELES-LONG BEACH, CA	8,863,164	**11**	0.09	0.051	**0.14**	**0.10**	**56**	119	0.005	0.019
LOUISVILLE, KY-IN	948,829	5	ND	0.014	0.12	**0.10**	28	60	0.007	0.032
LOWELL, MA-NH	280,578	4	ND	ND	ND	ND	ND	ND	ND	ND
LUBBOCK, TX	222,636	ND	ND	ND	ND	ND	18*	42*	ND	ND
MACON, GA	290,909	ND	ND	ND	**0.13**	**0.11**	IN	53	ND	ND
MADISON, WI	367,085	2	ND	ND	0.10	**0.09**	21	48	IN	IN
MANCHESTER, NH	50,000	ND	ND	IN	ND	ND	16	41	IN	IN
MANSFIELD, OH	174,007	ND	ND	ND	ND	ND	23	53	ND	ND
MCALLEN-EDINBURG-MISSION, TX	383,545	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
MEDFORD-ASHLAND, OR	146,389	6	0.00	ND	0.08	IN	IN	93	ND	ND
MELBOURNE-TITUSVILLE-PALM BAY, FL	398,978	ND	ND	ND	0.09	0.08	19	52	ND	ND
MEMPHIS, TN-AR-MS	1,007,306	5	0.65[g]	0.025	**0.13**	**0.10**	27	64	0.006	0.028
MERCED, CA	178,403	ND	ND	0.012	**0.13**	**0.11**	IN	IN	ND	ND
MIAMI, FL	1,937,094	4	ND	0.017	0.11	0.08	24	44	0.001	0.003

Table A-15. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1999 (continued)

Metropolitan Statistical Area	**1990 Population**	**CO 8-hr (ppm)**	**Pb QMax (µg/m^3)**	**NO$_2$ AM (ppm)**	**O$_3$ 1-hr (ppm)**	**O$_3$ 8-hr (ppm)**	**PM$_{10}$ Wtd AM (µg/m^3)**	**PM$_{10}$ 2nd Max (µg/m^3)**	**SO$_2$ AM (ppm)**	**SO$_2$ 24-hr (ppm)**
MIDDLESEX-SOMERSET-HUNTERDON, NJ	1,019,835	3	0.18[h]	0.019	**0.15**	**0.11**	ND	ND	0.005	0.016
MILWAUKEE-WAUKESHA, WI	1,432,149	2	ND	0.022	0.12	**0.10**	27	60	0.004	0.024
MINNEAPOLIS-ST. PAUL, MN-WI	2,538,834	5	0.47[i]	0.022	0.09	0.08	35	88	0.004	0.030
MOBILE, AL	476,923	ND	ND	ND	0.12	**0.09**	25	84	0.008	0.041
MODESTO, CA	370,522	6	0.00	0.022	0.11	**0.09**	43	137	ND	ND
MONMOUTH-OCEAN, NJ	986,327	3	ND	ND	**0.14**	**0.11**	ND	ND	ND	ND
MONROE, LA	142,191	ND	ND	ND	0.10	0.08	ND	ND	0.003	0.010
MONTGOMERY, AL	292,517	ND	ND	ND	0.11	**0.09**	24	48	ND	ND
MUNCIE, IN	119,659	ND	0.76[j]	ND	ND	ND	ND	ND	ND	ND
MYRTLE BEACH, SC	144,053	ND	0.01	ND	ND	ND	ND	ND	ND	ND
NAPLES, FL	152,099	ND	ND	ND	ND	ND	17	30	ND	ND
NASHUA, NH	168,233	5	ND	IN	0.10	**0.09**	17	40	0.005	0.016
NASHVILLE, TN	985,026	5	1.02[k]	0.019	0.12	**0.10**	32	74	0.005	0.035
NASSAU-SUFFOLK, NY	2,609,212	5	ND	0.024	**0.13**	**0.11**	16	41	0.007	0.038
NEW BEDFORD, MA	175,641	ND	ND	ND	**0.13**	**0.10**	ND	ND	ND	ND
NEW HAVEN-MERIDEN, CT	530,180	3	ND	0.026	**0.15**	**0.11**	20	76	0.007	0.027
NEW LONDON-NORWICH, CT-RI	290,734	ND	ND	ND	**0.13**	**0.10**	17	36	IN	IN
NEW ORLEANS, LA	1,285,270	3	0.08	0.022	0.12	**0.09**	27	60	0.005	0.023
NEW YORK, NY	8,546,846	5	0.10	0.041	**0.15**	**0.11**	IN	46	0.013	0.045
NEWARK, NJ	1,915,928	7	ND	0.042	0.12	**0.10**	33	67	0.007	0.023
NEWBURGH, NY-PA	335,613	ND	0.20[l]	ND	0.12	**0.09**	ND	ND	ND	ND
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS,V	1,443,244	5	ND	0.017	**0.14**	**0.10**	19	50	0.007	0.022
OAKLAND, CA	2,082,914	5	0.00	0.022	**0.14**	**0.09**	26	94	0.003	0.020
OCALA, FL	194,833	ND	ND	ND	0.10	0.08	ND	ND	ND	ND
OKLAHOMA CITY, OK	958,839	4	ND	0.014	0.10	0.08	ND	ND	0.004	0.009
OLYMPIA, WA	161,238	5	ND	ND	0.08	0.06	IN	35	ND	ND
OMAHA, NE-IA	639,580	9	0.81[m]	ND	0.09	0.08	43	131	0.001	0.003
ORANGE COUNTY, CA	2,410,556	6	ND	0.035	0.11	0.08	37	73	0.002	0.005
ORLANDO, FL	1,224,852	3	ND	0.012	0.10	0.08	26	49	0.002	0.007
OWENSBORO, KY	87,189	1	ND	0.011	0.10	**0.09**	25	63	0.006	0.024
PANAMA CITY, FL	126,994	ND	ND	ND	ND	ND	IN	50	ND	ND
PARKERSBURG-MARIETTA, WV-OH	149,169	ND	ND	ND	0.12	**0.10**	28	72	0.013	0.058
PENSACOLA, FL	344,406	ND	ND	IN	0.11	**0.09**	23	56	0.004	0.029
PEORIA-PEKIN, IL	339,172	5	0.02	ND	0.10	0.08	23	52	0.007	0.036
PHILADELPHIA, PA-NJ	4,922,175	5	0.84[n]	0.032	**0.15**	**0.11**	22	59*	0.010	0.034
PHOENIX-MESA, AZ	2,238,480	8	ND	0.041	0.12	0.09	**60**	**219**	0.003	0.012
PITTSBURGH, PA	2,384,811	4	0.08	0.029	**0.13**	**0.10**	37	121	0.015	0.089
PITTSFIELD, MA	88,695	ND	ND	ND	0.09	0.08	ND	ND	ND	ND
POCATELLO, ID	66,026	ND	ND	IN	ND	ND	30	**168**	0.007	0.046
PONCE, PR	3,442,660	ND	ND	ND	ND	ND	39	86	ND	ND
PORTLAND, ME	221,095	ND	ND	ND	0.11	0.08	23	61	0.005	0.014
PORTLAND-VANCOUVER, OR-WA	1,515,452	7	0.18	IN	0.09	0.07	16	63	ND	ND
PORTSMOUTH-ROCHESTER, NH-ME	223,271	ND	ND	0.010	0.12	**0.09**	16	34	0.004	0.019
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	1,134,350	4	ND	0.024	**0.13**	**0.09**	29	61	0.007	0.026
PROVO-OREM, UT	263,590	6	ND	0.024	0.11	0.08	32	91	ND	ND
PUEBLO, CO	123,051	ND	ND	ND	ND	ND	IN	51	ND	ND
RACINE, WI	175,034	3	ND	ND	0.11	**0.09**	ND	ND	ND	ND
RALEIGH-DURHAM-CHAPEL HILL, NC	855,545	5	ND	ND	**0.13**	**0.11**	23	49	0.005	0.009
RAPID CITY, SD	81,343	ND	ND	ND	ND	ND	28	108	ND	ND
READING, PA	336,523	3	0.84[o]	0.021	**0.13**	**0.10**	ND	55*	0.008	0.027
REDDING, CA	147,036	ND	ND	ND	0.11	**0.09**	IN	42	ND	ND
RENO, NV	254,667	7	ND	IN	0.10	0.08	**55**	116	ND	ND
RICHLAND-KENNEWICK-PASCO, WA	150,033	ND	ND	ND	ND	ND	IN	86	ND	ND

Table A-15. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1999 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM ($\mu g/m^3$)	PM_{10} 2nd Max ($\mu g/m^3$)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
RICHMOND-PETERSBURG, VA	865,640	2	ND	0.02	**0.13**	**0.10**	19	36	0.005	0.017
RIVERSIDE-SAN BERNARDINO, CA	2,588,793	4	0.05	0.039	**0.16**	**0.13**	**72**	134	0.002	0.009
ROANOKE, VA	224,477	4	ND	0.012	0.11	**0.09**	IN	64	0.003	0.010
ROCHESTER, MN	106,470	ND	ND	ND	ND	ND	IN	IN	ND	ND
ROCHESTER, NY	1,062,470	3	ND	ND	0.10	**0.09**	ND	ND	0.007	0.041
ROCKFORD, IL	329,676	4	ND	ND	0.09	0.08	ND	ND	ND	ND
ROCKY MOUNT, NC	133,235	ND	ND	ND	0.10	**0.09**	IN	IN	0.005	0.007
SACRAMENTO, CA	1,340,010	6	0.00	0.021	**0.14**	**0.11**	33	143	0.004	0.012
ST. CLOUD, MN	190,921	3	ND	ND	ND	ND	IN	IN	ND	ND
ST. JOSEPH, MO	83,083	ND	ND	ND	ND	ND	IN	99	0.003	0.013
ST. LOUIS, MO-IL	1,836,302	4	**6.75**[p]	0.027	**0.13**	**0.10**	44	117	0.009	0.059
SALEM, OR	278,024	6	ND	ND	0.08	0.07	ND	ND	ND	ND
SALINAS, CA	355,660	2	ND	0.010	0.08	0.06	29	76	ND	ND
SALT LAKE CITY-OGDEN, UT	1,072,227	6	0.08	0.028	0.11	0.08	45	113	0.004	0.010
SAN ANTONIO, TX	1,324,749	4	ND	0.025	0.11	**0.09**	ND	46*	ND	ND
SAN DIEGO, CA	2,498,016	5	0.00	0.026	0.11	**0.09**	**52**	112	0.003	0.016
SAN FRANCISCO, CA	1,603,678	5	0.00	0.021	0.10	0.06	26	69	0.002	0.006
SAN JOSE, CA	1,497,577	6	0.00	0.026	0.12	0.08	29	94	ND	ND
SAN JUAN-BAYAMON, PR	1,836,302	8	0.02	IN	0.08	0.05	38	84	0.003	0.015
SAN LUIS OBISPO-ATASCADERO-PASO ROBLE	217,162	3	ND	0.013	0.09	0.08	27	82	0.005	0.027
SANTA BARBARA-SANTA MARIA-LOMPOC, CA	369,608	4	0.00	0.022	0.10	0.08	29	54	0.002	0.003
SANTA CRUZ-WATSONVILLE, CA	229,734	1	ND	0.005	0.08	0.07	31	75	0.001	0.002
SANTA FE, NM	117,043	2	ND	ND	ND	ND	13	31	ND	ND
SANTA ROSA, CA	388,222	3	ND	0.014	0.10	0.08	18	64	ND	ND
SARASOTA-BRADENTON, FL	489,483	3	ND	0.007	0.11	**0.09**	24	42	0.004	0.017
SAVANNAH, GA	258,060	ND	ND	ND	0.11	0.08	27	59	0.003	0.018
SCRANTON—WILKES-BARRE—HAZLETON, PA	638,466	3	ND	0.015	0.12	**0.10**	ND	ND	0.007	0.023
SEATTLE-BELLEVUE-EVERETT, WA	2,033,156	6	0.05[q]	0.019	0.09	0.07	16	50	IN	IN
SHARON, PA	121,003	ND	ND	ND	0.11	**0.09**	ND	ND	0.007	0.039
SHEBOYGAN, WI	103,877	ND	ND	ND	**0.13**	**0.09**	ND	ND	ND	ND
SHREVEPORT-BOSSIER CITY, LA	376,330	ND	ND	ND	0.11	**0.09**	IN	41	0.002	0.006
SIOUX CITY, IA-NE	115,018	ND	ND	ND	ND	ND	28	73	ND	ND
SIOUX FALLS, SD	139,236	ND	ND	ND	0.07	IN	22	44	ND	ND
SOUTH BEND, IN	247,052	ND	ND	IN	0.11	**0.09**	IN	49	ND	ND
SPOKANE, WA	361,364	6	ND	ND	0.07	0.07	26	86	ND	ND
SPRINGFIELD, IL	189,550	2	ND	ND	0.10	0.08	20	45	0.006	0.059
SPRINGFIELD, MO	264,346	3	ND	0.013	0.10	0.08	18	34	0.004	0.039
SPRINGFIELD, MA	587,884	6	ND	0.022	0.11	**0.09**	30	66	0.005	0.024
STAMFORD-NORWALK, CT	329,935	4	ND	ND	**0.14**	**0.11**	29	49	0.006	0.026
STATE COLLEGE, PA	123,786	ND	ND	ND	0.10	**0.09**	ND	ND	ND	ND
STEUBENVILLE-WEIRTON, OH-WV	142,523	5	ND	ND	0.11	**0.09**	34	98	0.016	0.065
STOCKTON-LODI, CA	480,628	6	0.00	0.024	**0.13**	**0.09**	36	123	ND	ND
SYRACUSE, NY	742,177	3	ND	ND	0.10	**0.09**	ND	ND	0.002	0.015
TACOMA, WA	586,203	7	ND	ND	0.09	0.07	17	56	IN	IN
TALLAHASSEE, FL	233,598	ND	ND	ND	0.09	0.08	19	55	ND	ND
TAMPA-ST. PETERSBURG-CLEARWATER, FL	2,067,959	5	1.02[r]	0.016	0.12	**0.09**	35	81	0.008	0.060
TERRE HAUTE, IN	147,585	ND	ND	ND	0.09	0.08	IN	IN	0.006	0.025
TEXARKANA, TX-TEXARKANA, AR	120,132	ND	ND	ND	ND	ND	ND	ND	IN	IN
TOLEDO, OH	614,128	3	0.26	ND	**0.13**	**0.09**	23	58	0.004	0.018
TOPEKA, KS	160,976	ND	ND	ND	ND	ND	25	74	ND	ND
TRENTON, NJ	325,824	ND	ND	0.017	**0.15**	**0.11**	21	48	ND	ND
TUSCON, AZ	666,880	4	ND	0.019	0.09	0.07	48	**207**	0.002	0.005

Table A-15. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1999 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m³)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m³)	PM_{10} 2nd Max (µg/m³)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
TULSA, OK	708,954	4	ND	0.017	0.12	**0.09**	22*	65*	0.011	0.083
TUSCALOOSA, AL	150,522	ND	ND	ND	ND	ND	28	61	ND	ND
TYLER, TX	151,309	ND	ND	0.007	0.12	**0.10**	ND	ND	ND	ND
UTICA-ROME, NY	316,633	ND	ND	ND	0.09	0.08	IN	46	0.001	0.007
VALLEJO-FAIRFIELD-NAPA, CA	451,186	5	ND	0.014	0.12	**0.09**	20	62	0.002	0.006
VENTURA, CA	669,016	3	0.00	0.022	**0.13**	**0.10**	31	63	0.002	0.005
VICTORIA, TX	74,361	ND	ND	ND	0.10	**0.09**	ND	ND	ND	ND
VINELAND-MILLVILLE-BRIDGETON, NJ	138,053	ND	ND	ND	0.12	**0.10**	ND	ND	0.003	0.012
VISALIA-TULARE-PORTERVILLE, CA	311,921	4	ND	0.021	**0.13**	**0.11**	**55**	137	ND	ND
WASHINGTON, DC-MD-VA-WV	4,223,485	6	0.03	0.025	**0.13**	**0.11**	24	57	0.009	0.026
WATERBURY, CT	221,629	ND	0.01	ND	ND	ND	20	47	0.005	0.020
WATERLOO-CEDAR FALLS, IA	123,798	ND	ND	ND	ND	ND	IN	IN	ND	ND
WAUSAU, WI	115,400	ND	ND	ND	0.10	0.08	IN	64	0.003	0.040
WEST PALM BEACH-BOCA RATON, FL	863,518	3	0.00	0.013	0.10	0.08	20	33	0.002	0.013
WHEELING, WV-OH	159,301	3	ND	ND	0.10	**0.09**	26	69	0.015	0.060
WICHITA, KS	485,270	5	ND	ND	0.10	0.08	31	86	ND	ND
WILLIAMSPORT, PA	118,710	ND	ND	ND	0.09	0.08	ND	ND	0.005	0.021
WILMINGTON-NEWARK, DE-MD	513,293	3	ND	0.018	**0.15**	**0.11**	24*	49*	0.008	0.049
WILMINGTON, NC	171,269	4	ND	ND	0.08	0.07	IN	45	0.007	0.027
WORCESTER, MA-CT	478,384	3	ND	0.020	0.11	**0.09**	IN	65	0.004	0.013
YAKIMA, WA	188,823	5	ND	ND	ND	ND	25	82	ND	ND
YOLO, CA	141,092	1	ND	0.012	0.12	**0.09**	33	144	ND	ND
YORK, PA	339,574	2	ND	0.019	0.12	**0.09**	ND	ND	0.007	0.019
YOUNGSTOWN-WARREN, OH	600,859	ND	ND	ND	0.11	**0.10**	26	135	0.008	0.029
YUBA CITY, CA	122,643	4	ND	0.014	0.11	0.08	38	**156**	ND	ND
YUMA, AZ	106,895	ND	ND	ND	0.09	0.08	ND	ND	ND	ND

CO – Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb – Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 µg/m³)*
NO_2 – Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 (1-hr) – Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
O_3 (8-hr) – Highest fourth daily maximum 8-hour concentration *(Applicable NAAQS is 0.08 ppm)*
PM_{10} – Highest weighted annual mean concentration *(Applicable NAAQS is 50 µg/m³)*
– Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 µg/m³)*
SO_2 – Highest annual mean concentration *(Applicable NAAQS is 0.03 ppm)*
– Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*
ND – Indicates data not available
IN – Indicates insufficient data to calculate summary statistic
Wtd – Weighted
AM – Annual mean
µg/m³ – Units are micrograms per cubic meter
PPM – Units are parts per million

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AKRON, OH														
	CO	2nd max 8-hour	Down	1	5.7	3.3	4.1	3.1	5.3	3.3	3.4	3.2	2.6	2.5
	O_3	4th max 8-hour	NS	2	0.09	0.101	0.087	0.093	0.086	0.092	0.091	0.087	0.097	0.097
		2nd daily max 1-hour	NS	2	0.111	0.12	0.108	0.108	0.1	0.117	0.105	0.103	0.112	0.115
	PM_{10}	90th percentile	Down	1	49	51	44	49	51	48	35	39	39	39
		weighted annual mean	Down	1	25.9	28.4	27.1	25	27.6	26.1	24.7	23.8	23.8	23.8
	SO_2	arithmetic mean	Down	1	0.015	0.015	0.013	0.015	0.012	0.009	0.01	0.012	0.01	0.011
		2nd max 24-hour	NS	1	0.061	0.051	0.064	0.056	0.042	0.046	0.042	0.072	0.044	0.065
ALBANY-SCHENECTADY-TROY, NY														
	CO	2nd max 8-hour	Down	1	6.2	5.4	4.7	3.8	5.2	4.3	3.7	4.5	4.4	4.2
	Pb	max quarterly mean	Down	1	0.133	0.037	0.033	0.033	0.043	0.041	0.032	0.031	0.032	0.032
	O_3	4th max 8-hour	NS	3	0.084	0.084	0.086	0.081	0.077	0.079	0.074	0.079	0.075	0.085
		2nd daily max 1-hour	NS	3	0.105	0.099	0.098	0.099	0.1	0.101	0.094	0.097	0.096	0.106
	PM_{10}	90th percentile	NS	5	36.4	35.6	33.6	34.2	40	31.8	28.8	32	36	36
		weighted annual mean	NS	5	20.98	21.3	21.46	19.74	21.4	18.22	19.08	19.52	19.64	19.64
	SO_2	arithmetic mean	Down	1	0.006	0.007	0.006	0.006	0.006	0.005	0.005	0.004	0.003	0.003
		2nd max 24-hour	Down	1	0.028	0.03	0.022	0.026	0.027	0.016	0.021	0.017	0.013	0.013
ALBUQUERQUE, NM														
	CO	2nd max 8-hour	Down	6	5.967	5.433	5.017	5.117	4.933	4.983	4.333	3.7	3.667	4.067
	NO_2	arithmetic mean	NS	1	0.018	0.004	0.021	0.024	0.023	0.018	0.022	0.019	0.016	0.016
	O_3	4th max 8-hour	NS	7	0.069	0.065	0.066	0.063	0.067	0.065	0.068	0.066	0.07	0.071
		2nd daily max 1-hour	NS	7	0.088	0.084	0.086	0.081	0.083	0.083	0.084	0.082	0.086	0.09
	PM_{10}	90th percentile	Down	8	38.875	37.125	33.75	35.5	35.5	39.375	37.5	32.625	32	31.75
		weighted annual mean	Down	8	23.95	22.488	22.788	23.45	22.25	23.75	23.925	20.788	20.575	20.538
ALEXANDRIA, LA														
	PM_{10}	90th percentile	Down	1	38	37	40	36	38	37	27	32	32	32
		weighted annual mean	NS	1	22.8	21.9	24.7	21.3	23.2	21.4	18.6	23.2	23.2	23.2
ALLENTOWN-BETHLEHEM-EASTON, PA														
	CO	2nd max 8-hour	Down	1	5.8	6.5	3.9	3.5	4.7	4.8	3.2	2.7	2.9	3.2
	Pb	max quarterly mean	Down	1	0.4	0.461	0.283	0.181	0.131	0.074	0.083	0.093	0.12	0.071
	NO_2	arithmetic mean	NS	1	0.017	0.018	0.018	0.02	0.021	0.018	0.018	0.016	0.016	0.015
	O_3	4th max 8-hour	NS	2	0.093	0.101	0.081	0.084	0.082	0.094	0.089	0.097	0.092	0.102
		2nd daily max 1-hour	NS	2	0.11	0.119	0.096	0.107	0.105	0.109	0.107	0.116	0.109	0.12
	SO_2	arithmetic mean	NS	2	0.008	0.008	0.007	0.006	0.008	0.006	0.006	0.009	0.009	0.007
		2nd max 24-hour	NS	2	0.037	0.037	0.032	0.029	0.047	0.027	0.028	0.029	0.032	0.034
ALTOONA, PA														
	CO	2nd max 8-hour	NS	1	1.7	1.7	2.8	2	2.4	1.7	1.9	1.5	1.2	1.6
	NO_2	arithmetic mean	Down	1	0.015	0.015	0.014	0.015	0.015	0.013	0.013	0.014	0.013	0.013
	O_3	4th max 8-hour	NS	1	0.081	0.092	0.079	0.086	0.092	0.091	0.083	0.096	0.098	0.091
		2nd daily max 1-hour	up	1	0.097	0.106	0.095	0.1	0.106	0.112	0.101	0.114	0.114	0.111
	SO_2	arithmetic mean	Down	1	0.011	0.011	0.009	0.009	0.01	0.008	0.008	0.01	0.008	0.007
		2nd max 24-hour	Down	1	0.062	0.044	0.046	0.052	0.058	0.037	0.033	0.046	0.032	0.03
ANCHORAGE, AK														
	PM_{10}	90th percentile	Down	3	63.333	57.333	61.333	55.333	50.333	50.667	48	51.333	37.333	32.667
		weighted annual mean	Down	3	30.933	29.633	31.267	27.567	26.6	26.033	24.8	24.5	20.067	21.2
ANNISTON, AL														
	PM_{10}	90th percentile	NS	1	46	46	37	38	40	40	27	42	41	41
		weighted annual mean	NS	1	28	29.2	24.6	25	23.7	22.8	18.7	23.1	26	26
ASHEVILLE, NC														
	O_3	4th max 8-hour	up	1	0.073	0.063	0.064	0.066	0.069	0.076	0.074	0.075	0.09	0.084
		2nd daily max 1-hour	up	1	0.091	0.079	0.083	0.079	0.084	0.085	0.084	0.09	0.114	0.099
	PM_{10}	90th percentile	NS	1	41	41	40	43	30	28	29	38	36	36
		weighted annual mean	Down	1	25.1	24	22.8	22.3	19	18.4	18.8	20.7	20.1	20.5
ATLANTA, GA														
	CO	2nd max 8-hour	Down	1	5.4	6.5	5.1	4.9	5.3	4.5	3.7	4.3	4.1	4.1
	NO_2	arithmetic mean	NS	2	0.021	0.02	0.02	0.02	0.018	0.017	0.021	0.02	0.021	0.022
	O_3	4th max 8-hour	NS	3	0.107	0.093	0.091	0.112	0.093	0.112	0.103	0.102	0.117	0.12
		2nd daily max 1-hour	NS	3	0.137	0.124	0.127	0.148	0.12	0.143	0.129	0.132	0.144	0.152
	PM_{10}	90th percentile	NS	3	68.333	53.333	45.667	47	43.333	45.333	41	48.667	49.667	46
		weighted annual mean	Down	3	38.9	32.067	28.067	28.567	26.867	28.267	26.8	27.967	28.067	26.833
	SO_2	arithmetic mean	Down	3	0.006	0.006	0.006	0.006	0.004	0.004	0.004	0.004	0.003	0.003
		2nd max 24-hour	Down	3	0.025	0.029	0.026	0.032	0.022	0.018	0.019	0.021	0.016	0.017
ATLANTIC-CAPE MAY, NJ														
	O_3	4th max 8-hour	NS	1	0.109	0.111	0.094	0.093	0.083	0.1	0.095	0.106	0.091	0.095
		2nd daily max 1-hour	NS	1	0.157	0.136	0.119	0.115	0.099	0.116	0.108	0.131	0.118	0.118
	SO_2	arithmetic mean	Down	1	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
		2nd max 24-hour	NS	1	0.012	0.011	0.016	0.014	0.019	0.011	0.014	0.011	0.01	0.009
AUGUSTA-AIKEN, GA-SC														
	Pb	max quarterly mean	Down	1	0.017	0.013	0.011	0.01	0.009	0.007	0.004	0.008	0.019	0.002
	O_3	4th max 8-hour	NS	3	0.085	0.072	0.074	0.084	0.08	0.079	0.083	0.084	0.096	0.087
		2nd daily max 1-hour	NS	3	0.103	0.095	0.09	0.101	0.093	0.1	0.099	0.105	0.116	0.106
	PM_{10}	90th percentile	NS	1	36	35	32	35	35	29	29	31	38	35
		weighted annual mean	NS	1	22.2	22.7	21.9	22.1	21.3	18.7	18.7	21.4	22.4	21.1
	SO_2	arithmetic mean	NS	1	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
		2nd max 24-hour	Down	1	0.009	0.01	0.009	0.009	0.008	0.009	0.007	0.008	0.007	0.007

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AUSTIN-SAN MARCOS, TX													
O_3	4th max 8-hour	NS	1	0.088	0.083	0.081	0.08	0.085	0.089	0.08	0.075	0.088	0.087
	2nd daily max 1-hour	NS	1	0.11	0.1	0.099	0.091	0.102	0.105	0.098	0.089	0.115	0.102
BAKERSFIELD, CA													
NO_2	arithmetic mean	Down	4	0.017	0.017	0.016	0.015	0.015	0.013	0.013	0.013	0.013	0.014
O_3	4th max 8-hour	NS	5	0.103	0.105	0.099	0.105	0.104	0.109	0.113	0.096	0.114	0.105
	2nd daily max 1-hour	NS	5	0.13	0.13	0.122	0.128	0.13	0.13	0.138	0.118	0.134	0.122
PM_{10}	90th percentile	Down	4	89.25	90.5	61.75	60	47.25	62	47	45	45.5	55.5
	weighted annual mean	Down	4	47.15	53.775	38.4	33.188	30.1	32.825	28.425	27.9	25.175	29.925
BALTIMORE, MD													
CO	2nd max 8-hour	Down	3	7.1	6.367	5.5	5.433	5.833	4.667	3.633	4.6	4.133	4.567
Pb	max quarterly mean	Down	1	0.058	0.036	0.043	0.035	0.032	0.029	0.027	0.005	0.005	0.005
NO_2	arithmetic mean	Down	1	0.034	0.033	0.031	0.033	0.032	0.026	0.027	0.026	0.026	0.024
O_3	4th max 8-hour	NS	7	0.098	0.108	0.092	0.106	0.096	0.104	0.091	0.105	0.098	0.106
	2nd daily max 1-hour	NS	7	0.126	0.136	0.117	0.132	0.128	0.137	0.119	0.137	0.123	0.138
PM_{10}	90th percentile	Down	5	51.8	57.6	47	50.6	53.4	47.8	43.4	46.4	47.8	45
	weighted annual mean	Down	5	32.72	35.64	30.26	29.44	30.46	28.78	27.1	28.12	28.56	28.02
SO_2	arithmetic mean	Down	2	0.008	0.009	0.009	0.008	0.009	0.006	0.007	0.008	0.007	0.007
	2nd max 24-hour	Down	2	0.03	0.03	0.027	0.026	0.03	0.022	0.026	0.025	0.021	0.02
BANGOR, ME													
PM_{10}	90th percentile	NS	1	33	41	32	34	35	32	27	33	34	24
	weighted annual mean	Down	1	20.5	25.1	21.9	22.2	21.9	20	18.8	21.1	17.5	16.7
BATON ROUGE, LA													
Pb	max quarterly mean	NS	3	0.051	0.03	0.104	0.027	0.038	0.049	0.032	0.041	0.045	0.043
NO_2	arithmetic mean	NS	2	0.01	0.01	0.01	0.01	0.011	0.01	0.01	0.01	0.01	0.01
O_3	4th max 8-hour	NS	3	0.107	0.093	0.084	0.08	0.082	0.093	0.088	0.086	0.091	0.093
	2nd daily max 1-hour	NS	3	0.154	0.132	0.107	0.111	0.115	0.123	0.114	0.119	0.127	0.115
PM_{10}	90th percentile	NS	2	42.5	48.5	37	34.5	40.5	37.5	34.5	43.5	45.25	47
	weighted annual mean	NS	2	28.15	27.6	26.7	22.2	26.3	24.35	24.45	27.35	29.025	30.7
SO_2	arithmetic mean	NS	1	0.005	0.009	0.008	0.006	0.008	0.006	0.006	0.006	0.007	0.006
	2nd max 24-hour	NS	1	0.022	0.036	0.033	0.021	0.025	0.034	0.024	0.027	0.036	0.019
BEAUMONT-PORT ARTHUR, TX													
NO_2	arithmetic mean	NS	2	0.009	0.01	0.011	0.009	0.01	0.01	0.01	0.01	0.008	0.01
O_3	4th max 8-hour	NS	3	0.087	0.097	0.094	0.088	0.08	0.098	0.082	0.092	0.085	0.072
	2nd daily max 1-hour	NS	3	0.12	0.13	0.13	0.115	0.113	0.134	0.117	0.137	0.117	0.099
SO_2	arithmetic mean	Down	2	0.009	0.008	0.006	0.006	0.006	0.005	0.005	0.006	0.005	0.005
	2nd max 24-hour	Down	2	0.042	0.059	0.044	0.047	0.039	0.025	0.041	0.037	0.033	0.032
BELLINGHAM, WA													
O_3	4th max 8-hour	NS	1	0.061	0.058	0.056	0.058	0.059	0.054	0.062	0.052	0.056	0.05
	2nd daily max 1-hour	Down	1	0.082	0.073	0.069	0.08	0.082	0.079	0.078	0.07	0.07	0.062
SO_2	arithmetic mean	NS	1	0.007	0.006	0.007	0.006	0.007	0.006	0.005	0.005	0.005	0.007
	2nd max 24-hour	Down	1	0.028	0.021	0.022	0.017	0.019	0.018	0.013	0.012	0.015	0.016
BERGEN-PASSAIC, NJ													
CO	2nd max 8-hour	Down	2	6.8	6.6	4.45	5.15	6.15	4.9	3.75	4.85	3.7	4.1
NO_2	arithmetic mean	Down	1	0.031	0.031	0.03	0.029	0.031	0.029	0.028	0.028	0.028	0.028
O_3	4th max 8-hour	NS	1	0.096	0.1	0.075	0.082	0.088	0.104	0.083	0.096	0.096	0.096
	2nd daily max 1-hour	NS	1	0.129	0.137	0.104	0.111	0.114	0.122	0.106	0.12	0.12	0.12
PM_{10}	90th percentile	Down	3	59	61.667	50.333	51	57.333	49.333	47.667	48.833	46	44
	weighted annual mean	Down	3	36.933	39.333	32.967	31.167	35.167	30.633	30.533	31.183	28.5	26.9
SO_2	arithmetic mean	Down	2	0.01	0.01	0.009	0.008	0.007	0.005	0.006	0.005	0.005	0.005
	2nd max 24-hour	Down	2	0.041	0.035	0.04	0.026	0.037	0.027	0.022	0.021	0.021	0.022
BILLINGS, MT													
SO_2	arithmetic mean	Down	4	0.016	0.016	0.02	0.021	0.015	0.013	0.009	0.007	0.006	0.005
	2nd max 24-hour	Down	4	0.066	0.069	0.081	0.104	0.066	0.059	0.056	0.032	0.025	0.022
BILOXI-GULFPORT-PASCAGOULA, MS													
O_3	4th max 8-hour	NS	1	0.079	0.079	0.087	0.076	0.093	0.087	0.076	0.078	0.089	0.091
	2nd daily max 1-hour	NS	1	0.115	0.115	0.108	0.098	0.117	0.111	0.104	0.092	0.108	0.107
SO_2	arithmetic mean	Down	1	0.007	0.006	0.006	0.004	0.003	0.003	0.003	0.002	0.003	0.003
	2nd max 24-hour	NS	1	0.037	0.034	0.02	0.029	0.022	0.024	0.043	0.025	0.022	0.024
BIRMINGHAM, AL													
CO	2nd max 8-hour	Down	2	6.8	7	7.45	7.3	6.7	6.55	5.3	6	4.4	4.55
O_3	4th max 8-hour	NS	6	0.093	0.075	0.083	0.082	0.077	0.096	0.093	0.083	0.097	0.09
	2nd daily max 1-hour	NS	6	0.119	0.1	0.108	0.11	0.097	0.125	0.128	0.11	0.121	0.121
PM_{10}	90th percentile	Down	5	58.2	55.2	45.2	43.2	38.8	41.8	38.8	47.2	40.4	36.8
	weighted annual mean	Down	5	34.64	31.88	28.78	27.34	25.24	26.48	24.62	26.1	27.34	24.82
SO_2	arithmetic mean	NS	1	0.008	0.007	0.007	0.009	0.007	0.006	0.004	0.006	0.007	0.007
	2nd max 24-hour	NS	1	0.025	0.02	0.027	0.05	0.037	0.016	0.015	0.018	0.032	0.026
BOISE CITY, ID													
PM_{10}	90th percentile	Down	4	53.5	68	55.75	62	59.5	50	48.5	44.75	39.75	48.25
	weighted annual mean	Down	4	29.275	33.675	33.2	35.45	34.025	29.65	28.175	28.025	22.65	26.05

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BOSTON, MA-NH													
CO	2nd max 8-hour	Down	4	5.6	4.05	4.725	3.95	4.85	3.55	3.6	3.775	2.875	3.425
NO_2	arithmetic mean	Down	3	0.029	0.031	0.029	0.03	0.03	0.027	0.028	0.026	0.027	0.026
O_3	4th max 8-hour	NS	4	0.08	0.093	0.088	0.085	0.084	0.086	0.073	0.082	0.085	0.083
	2nd daily max 1-hour	NS	4	0.101	0.126	0.109	0.113	0.109	0.108	0.092	0.102	0.101	0.102
PM_{10}	90th percentile	NS	8	41.375	40	36.125	36	39.25	35.125	40.25	34.75	41.875	38.375
	weighted annual mean	NS	8	25.913	24.775	22.775	22.325	23.05	21.938	23.625	22.013	24.413	24.2
SO_2	arithmetic mean	Down	10	0.009	0.009	0.009	0.009	0.008	0.006	0.006	0.006	0.006	0.006
	2nd max 24-hour	Down	10	0.038	0.03	0.037	0.031	0.032	0.024	0.025	0.03	0.023	0.025
BOULDER-LONGMONT, CO													
CO	2nd max 8-hour	Down	2	5.7	5.7	5.85	5.25	4.45	4.2	4	4.35	3.4	2.9
O_3	4th max 8-hour	NS	1	0.074	0.077	0.07	0.073	0.071	0.072	0.072	0.071	0.08	0.08
	2nd daily max 1-hour	NS	1	0.096	0.102	0.092	0.096	0.091	0.095	0.092	0.092	0.1	0.1
PM_{10}	90th percentile	Down	2	39	43.5	34.5	43.5	28.5	27	27	24	26	26.5
	weighted annual mean	Down	2	22.9	23.2	22.6	24.25	18.95	16.2	17.2	16.6	16.9	18.15
BRAZORIA, TX													
O_3	4th max 8-hour	NS	1	0.1	0.091	0.097	0.092	0.085	0.113	0.079	0.085	0.09	0.112
	2nd daily max 1-hour	NS	1	0.15	0.13	0.129	0.132	0.112	0.148	0.11	0.137	0.111	0.161
BREMERTON, WA													
PM_{10}	90th percentile	Down	1	41	41	41	47	36	33	24	27	21	23
	weighted annual mean	Down	1	22.6	22.6	22.6	23.4	19.7	20.6	16.9	17.3	12.9	15
BRIDGEPORT, CT													
CO	2nd max 8-hour	Down	1	5	5.5	4.7	3.7	5.8	4.9	3	4	2.8	3.2
NO_2	arithmetic mean	Down	1	0.026	0.025	0.024	0.024	0.026	0.024	0.024	0.023	0.023	0.023
O_3	4th max 8-hour	NS	2	0.098	0.108	0.084	0.098	0.088	0.101	0.088	0.096	0.093	0.093
	2nd daily max 1-hour	NS	2	0.145	0.147	0.119	0.157	0.152	0.131	0.114	0.132	0.132	0.135
PM_{10}	90th percentile	Down	1	41	49	37	43	44	37	32	34	33	30
	weighted annual mean	Down	1	25.2	27.7	22.4	20.8	25.7	21.8	20.6	21.4	20.8	19.4
SO_2	arithmetic mean	Down	1	0.013	0.012	0.011	0.01	0.01	0.007	0.006	0.007	0.007	0.006
	2nd max 24-hour	Down	1	0.05	0.044	0.04	0.035	0.049	0.028	0.023	0.031	0.024	0.023
BROWNSVILLE-HARLINGEN-SAN BENITO, TX													
PM_{10}	90th percentile	NS	1	36	36	36	45	36	35	28	36	36	36
	weighted annual mean	Down	1	21.7	23.9	23.7	22.4	22.5	21.4	18.9	20.6	20.6	20.6
BUFFALO-NIAGARA FALLS, NY													
CO	2nd max 8-hour	Down	3	3.367	3.1	4.633	3.433	3.2	2.567	2.933	2.167	2.167	1.833
Pb	max quarterly mean	NS	1	0.029	0.031	0.034	0.047	0.046	0.033	0.034	0.042	0.036	0.036
NO_2	arithmetic mean	NS	2	0.02	0.018	0.018	0.017	0.019	0.019	0.019	0.018	0.017	0.019
O_3	4th max 8-hour	NS	2	0.089	0.094	0.08	0.077	0.082	0.088	0.077	0.077	0.092	0.089
	2nd daily max 1-hour	NS	2	0.106	0.106	0.109	0.089	0.092	0.103	0.095	0.091	0.106	0.101
PM_{10}	90th percentile	NS	11	35.364	49	33.364	34.545	34	34.364	29	33.909	38.364	38.364
	weighted annual mean	NS	11	19.391	24.845	21.236	19.145	18.664	18.364	19.127	18.7	19.845	19.845
SO_2	arithmetic mean	Down	4	0.011	0.012	0.011	0.01	0.01	0.008	0.007	0.007	0.007	0.007
	2nd max 24-hour	Down	4	0.054	0.062	0.058	0.042	0.039	0.04	0.035	0.041	0.029	0.03
BURLINGTON, VT													
CO	2nd max 8-hour	Down	1	4.6	3.8	3.9	3.9	3.9	2.5	3.3	2	2.4	1.5
NO_2	arithmetic mean	NS	1	0.018	0.017	0.016	0.017	0.017	0.017	0.017	0.017	0.018	0.017
PM_{10}	90th percentile	Down	2	37.5	36.5	38.5	36	34.5	34.5	29	29.5	29.5	29.5
	weighted annual mean	Down	2	24.25	23.2	22.7	20.5	21.1	20.1	20.3	20.05	20.6	20.6
SO_2	arithmetic mean	Down	1	0.008	0.008	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002
	2nd max 24-hour	Down	1	0.021	0.022	0.013	0.011	0.013	0.006	0.014	0.012	0.008	0.008
CANTON-MASSILLON, OH													
O_3	4th max 8-hour	NS	4	0.086	0.089	0.081	0.091	0.084	0.091	0.086	0.083	0.096	0.09
	2nd daily max 1-hour	NS	4	0.103	0.106	0.094	0.105	0.097	0.11	0.096	0.097	0.113	0.104
PM_{10}	90th percentile	Down	2	52	50	45	45	50	51.5	35.5	44	43	36
	weighted annual mean	Down	2	29.55	31.2	27.65	26.25	28.45	28.75	25	25.6	25.05	23.45
SO_2	arithmetic mean	Down	1	0.011	0.01	0.01	0.01	0.009	0.006	0.006	0.007	0.007	0.007
	2nd max 24-hour	Down	1	0.036	0.037	0.04	0.046	0.052	0.033	0.032	0.025	0.029	0.028
CASPER, WY													
PM_{10}	90th percentile	Down	1	38	38	38	27	34	32	33	29	31	29
	weighted annual mean	NS	1	21.3	21.3	21.3	17.7	17.3	19.4	19.1	15.7	17.2	19.7
CEDAR RAPIDS, IA													
CO	2nd max 8-hour	NS	1	3.5	4.1	4.9	3.2	4.2	2.6	7.8	2.4	2.5	2
O_3	4th max 8-hour	NS	1	0.054	0.065	0.071	0.058	0.063	0.065	0.061	0.06	0.059	0.059
	2nd daily max 1-hour	NS	1	0.065	0.081	0.081	0.067	0.07	0.075	0.073	0.071	0.068	0.068
PM_{10}	90th percentile	NS	2	41.5	43.5	43.5	34	34	39	36	40.5	39.5	30.5
	weighted annual mean	NS	2	27.3	28.45	26.1	21.55	22.8	23.55	23.55	24.25	25.35	22.2
SO_2	arithmetic mean	NS	2	0.004	0.004	0.005	0.003	0.003	0.003	0.002	0.003	0.003	0.003
	2nd max 24-hour	Down	2	0.031	0.025	0.024	0.017	0.016	0.013	0.011	0.012	0.01	0.016

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CHAMPAIGN-URBANA, IL														
	O_3	4th max 8-hour	up	1	0.076	0.072	0.071	0.066	0.083	0.084	0.085	0.076	0.083	0.094
		2nd daily max 1-hour	up	1	0.087	0.08	0.085	0.074	0.094	0.095	0.094	0.088	0.105	0.108
	PM_{10}	90th percentile	Down	1	46	47	47	41	44	44	31	35	39	35
		weighted annual mean	NS	1	28.2	30.4	31.4	22	24.9	22.3	19.2	22.5	24.3	22.7
	SO_2	arithmetic mean	Down	1	0.004	0.005	0.004	0.004	0.004	0.003	0.003	0.004	0.003	0.002
		2nd max 24-hour	NS	1	0.03	0.038	0.018	0.015	0.024	0.011	0.013	0.018	0.019	0.01
CHARLESTON-NORTH CHARLESTON, SC														
	CO	2nd max 8-hour	NS	1	4.7	4.9	5.2	5.8	4	6.4	4.7	3.9	2.9	4
	Pb	max quarterly mean	NS	1	0.039	0.039	0.01	0.007	0.012	0.01	0.01	0.011	0.026	0.008
	NO_2	arithmetic mean	Down	2	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007
	O_3	4th max 8-hour	up	3	0.071	0.068	0.071	0.075	0.073	0.071	0.074	0.072	0.08	0.082
		2nd daily max 1-hour	NS	3	0.089	0.085	0.09	0.1	0.088	0.089	0.097	0.089	0.097	0.099
	PM_{10}	90th percentile	Down	4	44	40	35.5	35.75	33.5	29	29.5	29.25	36.75	30
		weighted annual mean	Down	4	20.175	18.5	17.05	16.1	15.35	13.875	14.2	14.375	15.425	14.25
	SO_2	arithmetic mean	Down	2	0.002	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002
		2nd max 24-hour	Down	2	0.016	0.017	0.021	0.014	0.021	0.012	0.014	0.014	0.01	0.009
CHARLESTON, WV														
	CO	2nd max 8-hour	Down	1	2.8	3.05	3.3	2.2	3.5	2.4	2.3	1.9	2	2
	Pb	max quarterly mean	Down	3	0.035	0.022	0.027	0.018	0.026	0.02	0.016	0.01	0.01	0.01
	O_3	4th max 8-hour	NS	1	0.079	0.09	0.055	0.063	0.075	0.091	0.078	0.075	0.091	0.104
		2nd daily max 1-hour	NS	1	0.118	0.119	0.067	0.075	0.099	0.111	0.104	0.103	0.115	0.13
	PM_{10}	90th percentile	Down	1	58	47	44	52	49	40	41	32	35	37
		weighted annual mean	Down	1	36	29.3	27.6	29.2	28.1	26	24	21.1	21.4	21.9
	SO_2	arithmetic mean	NS	2	0.012	0.009	0.009	0.009	0.01	0.007	0.008	0.009	0.009	0.009
		2nd max 24-hour	NS	2	0.056	0.036	0.032	0.034	0.037	0.023	0.031	0.031	0.031	0.036
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC														
	CO	2nd max 8-hour	Down	5	7.06	6.3	6	5.56	5.78	4.68	4.36	4.84	4.2	3.82
	Pb	max quarterly mean	NS	1	0.038	0.014	0.077	0.015	0.032	0.012	0.009	0.007	0.021	0.019
	NO_2	arithmetic mean	NS	1	0.017	0.016	0.016	0.017	0.016	0.016	0.016	0.018	0.018	0.018
	O_3	4th max 8-hour	up	3	0.095	0.091	0.085	0.097	0.089	0.092	0.099	0.1	0.105	0.102
		2nd daily max 1-hour	NS	3	0.117	0.115	0.104	0.13	0.111	0.113	0.126	0.117	0.13	0.125
	PM_{10}	90th percentile	NS	4	47.75	47.5	46	41	42	40	41.5	41.75	47	42.25
		weighted annual mean	Down	4	31.3	29.875	29.375	27.35	27.875	26.425	28.225	27.4	28.125	26.775
CHARLOTTESVILLE, VA														
	PM_{10}	90th percentile	NS	1	44	47	32	40	33	41	35	36	33	32
		weighted annual mean	Down	1	26.9	28.4	21.6	23.7	21.5	22.5	21.3	20.9	22.7	19.9
CHATTANOOGA, TN-GA														
	O_3	4th max 8-hour	NS	2	0.092	0.08	0.079	0.088	0.088	0.09	0.088	0.088	0.1	0.096
		2nd daily max 1-hour	NS	2	0.116	0.098	0.094	0.104	0.114	0.108	0.113	0.107	0.129	0.117
	PM_{10}	90th percentile	Down	2	61	63	51.5	51.5	50.5	49	52.5	45	45	42.5
		weighted annual mean	Down	2	37.85	37.65	34.45	31.75	32.7	32.05	32.3	27.2	27.95	27.85
CHEYENNE, WY														
	PM_{10}	90th percentile	Down	1	30	30	25	24	28	26	25	20	22	23
		weighted annual mean	Down	1	19.4	19.4	16.6	15.5	17.8	14.6	15.1	12.9	13.9	14.9
CHICAGO, IL														
	CO	2nd max 8-hour	Down	6	4.817	4.183	4.533	4.85	6.283	3.633	3.383	3.45	3.55	3.417
	Pb	max quarterly mean	Down	9	0.072	0.056	0.065	0.063	0.054	0.054	0.044	0.04	0.04	0.034
	NO_2	arithmetic mean	NS	5	0.022	0.022	0.025	0.026	0.028	0.028	0.028	0.028	0.027	0.027
	O_3	4th max 8-hour	NS	17	0.071	0.084	0.075	0.068	0.075	0.088	0.076	0.079	0.074	0.083
		2nd daily max 1-hour	NS	17	0.092	0.113	0.102	0.085	0.097	0.114	0.095	0.098	0.094	0.098
	PM_{10}	90th percentile	NS	13	60.154	50.538	53.538	50.846	56.231	55.308	45.077	45.769	50.308	51.615
		weighted annual mean	NS	13	35.1	32.777	32.577	31.238	35.123	32.315	29.6	29.631	32.554	32.077
	SO_2	arithmetic mean	Down	9	0.007	0.009	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.006
		2nd max 24-hour	NS	9	0.039	0.042	0.029	0.032	0.033	0.024	0.022	0.024	0.025	0.027
CHICO-PARADISE, CA														
	CO	2nd max 8-hour	NS	1	3.9	5.6	4.6	3.9	4.1	3.5	3.4	3.5	3.8	4
	NO_2	arithmetic mean	NS	1	0.015	0.016	0.016	0.016	0.015	0.014	0.013	0.013	0.013	0.015
	O_3	4th max 8-hour	NS	1	0.078	0.073	0.077	0.076	0.082	0.076	0.074	0.066	0.078	0.087
		2nd daily max 1-hour	NS	1	0.12	0.09	0.09	0.09	0.097	0.091	0.096	0.074	0.103	0.11
	PM_{10}	90th percentile	Down	1	67	67	67	60	55	52	40	40	37	50
		weighted annual mean	NS	1	28	28	28	27.2	33.3	26.3	25	25.9	22.3	28.6
CINCINNATI, OH-KY-IN														
	CO	2nd max 8-hour	Down	3	4.233	4.2	4.467	4.667	4.267	3.4	2.933	2.733	3.167	2.633
	NO_2	arithmetic mean	NS	2	0.022	0.022	0.021	0.022	0.022	0.021	0.022	0.023	0.022	0.019
	O_3	4th max 8-hour	NS	6	0.088	0.092	0.074	0.081	0.091	0.093	0.088	0.085	0.088	0.089
		2nd daily max 1-hour	NS	6	0.107	0.112	0.09	0.102	0.112	0.114	0.107	0.11	0.114	0.108
	PM_{10}	90th percentile	Down	7	64	57.143	49	58.286	50.714	54.429	42.429	49.286	46.357	43.714
		weighted annual mean	Down	7	36.043	32.086	30.129	30.543	30.4	31.3	27.914	28.886	28.236	26.671
	SO_2	arithmetic mean	Down	4	0.012	0.012	0.011	0.011	0.009	0.006	0.009	0.009	0.009	0.008
		2nd max 24-hour	Down	4	0.054	0.044	0.045	0.044	0.044	0.025	0.035	0.037	0.038	0.033

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CLARKSVILLE-HOPKINSVILLE, TN-KY													
SO_2	arithmetic mean	NS	1	0.007	0.006	0.009	0.01	0.007	0.006	0.006	0.005	0.006	0.005
	2nd max 24-hour	Down	1	0.038	0.029	0.036	0.058	0.037	0.019	0.023	0.026	0.02	0.016
CLEVELAND-LORAIN-ELYRIA, OH													
CO	2nd max 8-hour	NS	3	5.3	5.433	5.5	4.267	6.767	6.033	5.867	4.667	4.5	3.567
O_3	4th max 8-hour	NS	6	0.084	0.09	0.083	0.088	0.085	0.09	0.088	0.085	0.093	0.089
	2nd daily max 1-hour	NS	6	0.105	0.111	0.103	0.106	0.105	0.108	0.106	0.101	0.113	0.109
PM_{10}	90th percentile	NS	10	54	57.3	48.2	50.9	52	53.4	44.5	46	48	49.1
	weighted annual mean	NS	10	32.09	33.17	29.25	27.97	32.31	31.09	29.24	28.72	30.04	28.52
SO_2	arithmetic mean	Down	8	0.01	0.01	0.009	0.009	0.008	0.006	0.007	0.006	0.006	0.006
	2nd max 24-hour	NS	8	0.041	0.04	0.039	0.041	0.043	0.025	0.03	0.03	0.027	0.031
COLORADO SPRINGS, CO													
CO	2nd max 8-hour	Down	4	5.2	4.825	4.4	4.1	3.625	4.05	3.625	3.8	3.125	3.425
Pb	max quarterly mean	Down	1	0.027	0.026	0.016	0.015	0.016	0.012	0.007	0.007	0.012	0.01
NO_2	arithmetic mean	NS	3	0.016	0.016	0.016	0.015	0.017	0.017	0.016	0.015	0.015	0.014
O_3	4th max 8-hour	Down	1	0.06	0.065	0.059	0.055	0.055	0.056	0.059	0.054	0.054	0.054
	2nd daily max 1-hour	Down	1	0.073	0.081	0.068	0.064	0.066	0.07	0.072	0.063	0.063	0.063
PM_{10}	90th percentile	Down	9	34.667	39.444	33	36.222	34	31	30.889	28.222	31	28
	weighted annual mean	Down	9	22.056	24.322	21.722	22.056	20.678	19	19.211	18.022	19.322	18.022
SO_2	arithmetic mean	NS	3	0.003	0.003	0.004	0.003	0.004	0.004	0.003	0.003	0.003	0.003
	2nd max 24-hour	NS	3	0.011	0.011	0.013	0.011	0.018	0.015	0.01	0.007	0.009	0.014
COLUMBIA, SC													
CO	2nd max 8-hour	Down	1	5.8	6	6.3	5.6	4.7	4	3.4	2.9	3.7	3.7
Pb	max quarterly mean	Down	3	0.034	0.043	0.031	0.017	0.015	0.011	0.01	0.009	0.011	0.009
NO_2	arithmetic mean	NS	1	0.013	0.009	0.011	0.013	0.011	0.013	0.013	0.011	0.014	0.014
O_3	4th max 8-hour	NS	3	0.092	0.071	0.075	0.082	0.077	0.079	0.077	0.078	0.091	0.089
	2nd daily max 1-hour	NS	3	0.114	0.095	0.095	0.106	0.095	0.101	0.095	0.101	0.112	0.112
PM_{10}	90th percentile	Down	7	57.143	55.571	51.286	50.571	46.786	43.286	42.714	46.143	52.429	48.714
	weighted annual mean	Down	7	21.571	19.157	20.071	18.7	17.5	14.014	15.829	16.343	17.286	16.171
SO_2	arithmetic mean	NS	4	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003
	2nd max 24-hour	NS	4	0.012	0.013	0.013	0.011	0.011	0.008	0.013	0.012	0.011	0.011
COLUMBUS, GA-AL													
O_3	4th max 8-hour	up	2	0.073	0.07	0.079	0.077	0.076	0.085	0.082	0.081	0.09	0.093
	2nd daily max 1-hour	up	2	0.099	0.093	0.095	0.096	0.101	0.106	0.094	0.096	0.111	0.109
PM_{10}	90th percentile	NS	1	46	40	43	37	44	44	33	39	45	40
	weighted annual mean	NS	1	28.6	26.9	25.8	25.4	26.5	28.2	22.2	26.4	30.1	26.5
COLUMBUS, OH													
CO	2nd max 8-hour	Down	3	4.133	4.767	4.933	3.933	4.467	3.833	2.467	2.433	3	2.367
O_3	4th max 8-hour	NS	3	0.087	0.095	0.079	0.084	0.087	0.089	0.09	0.087	0.095	0.094
	2nd daily max 1-hour	NS	3	0.112	0.114	0.093	0.1	0.102	0.11	0.107	0.101	0.111	0.111
PM_{10}	90th percentile	NS	2	57.5	52.5	43.5	48	46.5	51.5	36	52	51	48.5
	weighted annual mean	NS	2	30.7	29.65	26.15	26.65	26.65	29.15	24.45	27.35	30.25	27.9
SO_2	arithmetic mean	Down	1	0.008	0.007	0.006	0.007	0.007	0.004	0.004	0.004	0.005	0.004
	2nd max 24-hour	Down	1	0.038	0.033	0.03	0.034	0.041	0.019	0.021	0.025	0.019	0.015
CORPUS CHRISTI, TX													
O_3	4th max 8-hour	NS	2	0.081	0.073	0.079	0.081	0.079	0.089	0.08	0.074	0.079	0.085
	2nd daily max 1-hour	NS	2	0.1	0.105	0.094	0.116	0.106	0.119	0.101	0.092	0.102	0.1
PM_{10}	90th percentile	NS	1	43	45	41	51	48	47	37	50	50	50
	weighted annual mean	NS	1	29.8	32.9	29.9	30.6	31.3	31.1	25.1	30.5	30.5	30.5
SO_2	arithmetic mean	NS	2	0.002	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002
	2nd max 24-hour	NS	2	0.013	0.027	0.018	0.024	0.012	0.016	0.013	0.012	0.017	0.01
CUMBERLAND, MD-WV													
SO_2	arithmetic mean	NS	1	0.01	0.009	0.006	0.008	0.01	0.005	0.003	0.006	0.006	0.006
	2nd max 24-hour	NS	1	0.031	0.028	0.024	0.027	0.037	0.015	0.019	0.02	0.02	0.02
DALLAS, TX													
CO	2nd max 8-hour	NS	1	4.7	3.8	5.6	5.4	5.3	5.9	5.5	3.7	2.7	2.7
Pb	max quarterly mean	Down	9	0.215	0.163	0.178	0.187	0.114	0.129	0.08	0.07	0.075	0.086
NO_2	arithmetic mean	up	1	0.012	0.013	0.015	0.014	0.016	0.019	0.019	0.018	0.016	0.016
O_3	4th max 8-hour	NS	3	0.095	0.071	0.089	0.096	0.092	0.109	0.094	0.093	0.094	0.102
	2nd daily max 1-hour	NS	3	0.137	0.11	0.124	0.129	0.118	0.137	0.115	0.124	0.114	0.13
PM_{10}	90th percentile	NS	5	43.2	39.4	39.8	41	41.2	48.8	49.4	41.4	41.4	41.4
	weighted annual mean	NS	5	27.88	26.12	26.26	26.88	26.24	30.3	30.12	26.3	26.3	26.3
DANBURY, CT													
O_3	4th max 8-hour	NS	1	0.105	0.101	0.082	0.096	0.093	0.093	0.081	0.105	0.092	0.106
	2nd daily max 1-hour	NS	1	0.149	0.136	0.121	0.14	0.125	0.134	0.11	0.138	0.115	0.151
PM_{10}	90th percentile	Down	1	38	44	38	40	37	34	36	35	30	30
	weighted annual mean	Down	1	22.1	25.6	22.4	18.9	26	22	21.6	21.3	20.2	20.2
SO_2	arithmetic mean	Down	1	0.007	0.008	0.007	0.006	0.006	0.004	0.005	0.005	0.004	0.004
	2nd max 24-hour	Down	1	0.033	0.032	0.027	0.024	0.037	0.02	0.02	0.024	0.02	0.024

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL													
Pb	max quarterly mean	NS	1	0.031	0.013	0.019	0.016	0.015	0.013	0.019	0.015	0.014	0.014
O_3	4th max 8-hour	NS	2	0.067	0.08	0.076	0.067	0.073	0.077	0.076	0.069	0.072	0.076
	2nd daily max 1-hour	NS	2	0.084	0.092	0.096	0.082	0.087	0.093	0.086	0.084	0.092	0.093
PM_{10}	90th percentile	NS	5	59.4	55.4	59.8	50.6	59.333	63.867	58.2	57.2	58	58.6
	weighted annual mean	NS	5	35.26	34.48	33.68	30.76	36.867	38.553	33.92	33.84	33.32	33.4
SO_2	arithmetic mean	Down	3	0.005	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003
	2nd max 24-hour	Down	3	0.022	0.02	0.019	0.018	0.023	0.017	0.016	0.015	0.013	0.012
DAYTON-SPRINGFIELD, OH													
CO	2nd max 8-hour	Down	2	3.2	3.45	3.6	3.55	3.35	2.95	2.35	2.95	2.8	2.25
O_3	4th max 8-hour	NS	3	0.091	0.094	0.077	0.087	0.091	0.091	0.097	0.089	0.096	0.093
	2nd daily max 1-hour	NS	3	0.114	0.111	0.097	0.109	0.114	0.116	0.113	0.107	0.117	0.116
PM_{10}	90th percentile	NS	3	47.667	43.333	41	45.667	39.667	43.667	38	41	42.333	43
	weighted annual mean	Down	3	26.033	28.2	25.233	24.6	24.433	25.633	22.733	24	24.633	23.8
SO_2	arithmetic mean	NS	2	0.006	0.005	0.005	0.006	0.006	0.004	0.005	0.005	0.005	0.005
	2nd max 24-hour	NS	2	0.023	0.022	0.02	0.032	0.032	0.016	0.027	0.027	0.019	0.018
DAYTONA BEACH, FL													
O_3	4th max 8-hour	NS	2	0.073	0.073	0.073	0.074	0.072	0.068	0.066	0.072	0.079	0.075
	2nd daily max 1-hour	NS	2	0.082	0.082	0.082	0.094	0.084	0.083	0.079	0.086	0.094	0.087
PM_{10}	90th percentile	NS	1	29	29	29	32	28	34	28	28	30	26
	weighted annual mean	NS	1	19.2	19.2	19.2	19.6	20.2	20.9	20.2	19.3	20	18.6
DECATUR, AL													
O_3	4th max 8-hour	up	1	0.069	0.069	0.069	0.08	0.077	0.083	0.086	0.076	0.085	0.092
	2nd daily max 1-hour	up	1	0.08	0.08	0.08	0.091	0.092	0.098	0.096	0.09	0.102	0.103
PM_{10}	90th percentile	NS	1	42	54	41	44	35	40	32	41	41	41
	weighted annual mean	NS	1	24.7	28.1	24.9	24.8	22.4	25	20.5	22.5	24.5	24.5
DECATUR, IL													
Pb	max quarterly mean	NS	1	0.026	0.031	0.03	0.026	0.046	0.028	0.023	0.027	0.024	0.024
O_3	4th max 8-hour	NS	1	0.076	0.087	0.078	0.065	0.079	0.08	0.094	0.077	0.078	0.087
	2nd daily max 1-hour	NS	1	0.088	0.095	0.086	0.077	0.095	0.097	0.1	0.087	0.094	0.102
PM_{10}	90th percentile	NS	1	56	54	63	46	53	56	43	41	49	49
	weighted annual mean	NS	1	33.9	36.3	38.4	27.5	28.9	29.5	27.9	27.1	31.5	31.5
SO_2	arithmetic mean	NS	1	0.008	0.007	0.005	0.006	0.007	0.005	0.005	0.006	0.005	0.006
	2nd max 24-hour	Down	1	0.06	0.039	0.023	0.025	0.03	0.024	0.022	0.021	0.02	0.027
DENVER, CO													
CO	2nd max 8-hour	Down	6	7.217	7	8.3	6.6	6.1	5.567	4.833	4.733	3.883	4.05
Pb	max quarterly mean	Down	4	0.072	0.07	0.071	0.074	0.048	0.048	0.037	0.024	0.045	0.04
NO_2	arithmetic mean	NS	1	0.024	0.024	0.024	0.021	0.028	0.023	0.022	0.023	0.023	0.02
O_3	4th max 8-hour	NS	6	0.072	0.072	0.068	0.067	0.069	0.067	0.07	0.067	0.08	0.069
	2nd daily max 1-hour	NS	6	0.101	0.094	0.092	0.087	0.09	0.09	0.092	0.086	0.1	0.089
PM_{10}	90th percentile	Down	12	44.333	46.667	41.167	52.667	43.417	35.583	35.833	39.833	38.833	36.917
	weighted annual mean	NS	12	23.35	23.833	23.575	25.858	22.183	19.025	19.783	20.242	20.292	19.892
SO_2	arithmetic mean	Down	2	0.006	0.006	0.007	0.006	0.006	0.004	0.005	0.005	0.004	0.004
	2nd max 24-hour	NS	2	0.02	0.026	0.038	0.025	0.025	0.016	0.02	0.021	0.018	0.018
DES MOINES, IA													
CO	2nd max 8-hour	NS	3	4.567	4.6	3.933	4.533	3.933	3.967	3.2	2.967	5.733	2.767
O_3	4th max 8-hour	NS	1	0.037	0.033	0.071	0.041	0.052	0.071	0.064	0.063	0.056	0.059
	2nd daily max 1-hour	NS	1	0.06	0.048	0.079	0.08	0.073	0.081	0.082	0.075	0.065	0.069
PM_{10}	90th percentile	NS	3	56	48	55.333	49	52.333	54	53	58.667	44.667	48.667
	weighted annual mean	NS	3	32.133	28.533	28	28.7	30.067	29.867	31.3	32.133	25.967	25.6
DETROIT, MI													
CO	2nd max 8-hour	Down	5	4.12	4.5	4.08	4.26	5.8	4.3	3.74	3.04	2.98	3.08
NO_2	arithmetic mean	NS	2	0.021	0.02	0.02	0.021	0.022	0.02	0.021	0.02	0.021	0.021
O_3	4th max 8-hour	NS	8	0.084	0.094	0.078	0.079	0.089	0.087	0.084	0.084	0.089	0.089
	2nd daily max 1-hour	NS	8	0.101	0.119	0.098	0.104	0.124	0.117	0.1	0.108	0.11	0.11
PM_{10}	90th percentile	NS	6	64.167	59	46.5	55.333	60.667	58.833	49.5	45	53	52.167
	weighted annual mean	NS	6	36.333	33.467	28.15	32.8	37.65	34.517	30.933	27.733	29.467	29.933
SO_2	arithmetic mean	Down	10	0.01	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.007	0.006
	2nd max 24-hour	NS	10	0.038	0.033	0.03	0.03	0.032	0.03	0.034	0.028	0.032	0.031
DOTHAN, AL													
PM_{10}	90th percentile	NS	1	64	44	43	52	47	46	36	45	41	43
	weighted annual mean	NS	1	30.6	27.6	24.7	26.4	27.8	28.1	22.3	24.9	27.3	28.8
DULUTH-SUPERIOR, MN-WI													
CO	2nd max 8-hour	NS	1	4.4	5.2	4	4.1	4.3	4.5	4.5	3.2	3.7	2.3
PM_{10}	90th percentile	Down	6	40.833	37.167	33.667	31.5	30.5	32	31.5	30.833	30.333	35.333
	weighted annual mean	NS	6	22.433	23.133	20.417	18.9	18.733	18.817	19.117	18.483	19.65	20.567
DUTCHESS COUNTY, NY													
O_3	4th max 8-hour	NS	1	0.101	0.101	0.092	0.099	0.087	0.093	0.089	0.089	0.089	0.093
	2nd daily max 1-hour	NS	1	0.126	0.126	0.112	0.139	0.117	0.115	0.109	0.111	0.108	0.12

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
EL PASO, TX													
CO	2nd max 8-hour	Down	6	10.033	8.55	7.533	7.383	6.167	6.3	7.767	6.35	6.083	4.633
Pb	max quarterly mean	Down	4	0.267	0.274	0.187	0.179	0.117	0.135	0.203	0.092	0.112	0.1
NO_2	arithmetic mean	NS	2	0.022	0.023	0.026	0.026	0.029	0.029	0.029	0.027	0.025	0.023
O_3	4th max 8-hour	NS	4	0.076	0.068	0.073	0.068	0.081	0.078	0.078	0.07	0.077	0.062
	2nd daily max 1-hour	Down	4	0.121	0.119	0.119	0.108	0.127	0.117	0.118	0.113	0.11	0.088
PM_{10}	90th percentile	NS	8	62.625	52.75	49.75	42.875	47.375	50.75	50.5	44.875	44.25	56.25
	weighted annual mean	NS	8	32.475	27.8	27.725	24.488	24.863	27.813	26.588	22.775	23.45	29.313
SO_2	arithmetic mean	Down	2	0.011	0.009	0.012	0.009	0.007	0.008	0.008	0.007	0.006	0.004
	2nd max 24-hour	Down	2	0.057	0.047	0.055	0.056	0.028	0.044	0.035	0.026	0.022	0.017
ELKHART-GOSHEN, IN													
O_3	4th max 8-hour	NS	1	0.078	0.078	0.078	0.078	0.083	0.09	0.091	0.089	0.082	0.077
	2nd daily max 1-hour	NS	1	0.092	0.092	0.092	0.09	0.095	0.102	0.115	0.108	0.106	0.085
ELMIRA, NY													
O_3	4th max 8-hour	NS	1	0.079	0.091	0.066	0.08	0.074	0.076	0.072	0.073	0.082	0.082
	2nd daily max 1-hour	NS	1	0.096	0.101	0.085	0.09	0.084	0.088	0.088	0.081	0.094	0.092
SO_2	arithmetic mean	Down	1	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003
	2nd max 24-hour	Down	1	0.021	0.022	0.021	0.019	0.023	0.014	0.016	0.015	0.011	0.015
ERIE, PA													
NO_2	arithmetic mean	NS	1	0.015	0.013	0.014	0.014	0.015	0.015	0.015	0.015	0.014	0.015
O_3	4th max 8-hour	NS	1	0.084	0.091	0.084	0.081	0.09	0.088	0.083	0.087	0.098	0.096
	2nd daily max 1-hour	NS	1	0.1	0.113	0.098	0.107	0.101	0.105	0.1	0.103	0.122	0.112
SO_2	arithmetic mean	NS	1	0.014	0.01	0.011	0.011	0.01	0.009	0.011	0.009	0.01	0.01
	2nd max 24-hour	NS	1	0.057	0.044	0.056	0.072	0.076	0.05	0.066	0.035	0.068	0.043
EUGENE-SPRINGFIELD, OR													
CO	2nd max 8-hour	NS	2	4.9	5.2	6.2	5.3	5.85	5.2	5.15	4.95	4.25	4.45
O_3	4th max 8-hour	NS	2	0.068	0.069	0.074	0.054	0.069	0.062	0.086	0.058	0.076	0.062
	2nd daily max 1-hour	NS	2	0.09	0.091	0.095	0.077	0.086	0.082	0.108	0.072	0.098	0.076
PM_{10}	90th percentile	Down	5	55.6	65	55.8	62.6	45.6	43.6	37.4	36.8	33.8	33.8
	weighted annual mean	Down	5	28.4	31.86	28.48	28.68	24.58	22.86	19.94	20.98	18.14	18.14
EVANSVILLE-HENDERSON, IN-KY													
CO	2nd max 8-hour	NS	2	3.7	3.45	3.6	4.35	4.05	3.2	3.05	3.65	3.05	3.1
NO_2	arithmetic mean	Down	1	0.018	0.021	0.018	0.017	0.018	0.017	0.017	0.016	0.018	0.016
O_3	4th max 8-hour	NS	6	0.086	0.087	0.076	0.082	0.092	0.092	0.089	0.088	0.088	0.091
	2nd daily max 1-hour	NS	6	0.103	0.104	0.091	0.103	0.108	0.112	0.105	0.103	0.111	0.109
PM_{10}	90th percentile	NS	4	49.75	47	48.5	49.25	50.75	52	40	43.5	43.5	43.75
	weighted annual mean	Down	4	30.85	32.25	29.175	29.1	31.425	30.775	25.225	26.15	27.425	25.775
SO_2	arithmetic mean	Down	5	0.014	0.013	0.012	0.012	0.012	0.009	0.01	0.01	0.011	0.008
	2nd max 24-hour	Down	5	0.066	0.064	0.071	0.055	0.049	0.043	0.052	0.052	0.05	0.046
FAYETTEVILLE, NC													
O_3	4th max 8-hour	NS	1	0.087	0.078	0.079	0.093	0.084	0.081	0.086	0.085	0.093	0.1
	2nd daily max 1-hour	NS	1	0.1	0.101	0.092	0.115	0.098	0.1	0.099	0.098	0.112	0.12
PM_{10}	90th percentile	NS	1	50	45	39	41	40	35	39	41	41	39
	weighted annual mean	Down	1	31.4	26.9	26.2	27.3	25.1	23.3	25.3	24.8	26.5	24.4
FAYETTEVILLE-SPRINGDALE-ROGERS, AR													
PM_{10}	90th percentile	NS	1	38	38	30	39	40	36	36	31	31	31
	weighted annual mean	NS	1	23.2	23.6	21.5	23.9	24.8	24.2	22.5	20.4	20.4	20.4
FLAGSTAFF, AZ-UT													
O_3	4th max 8-hour	NS	1	0.072	0.073	0.074	0.066	0.073	0.069	0.073	0.072	0.072	0.076
	2nd daily max 1-hour	NS	1	0.082	0.079	0.079	0.07	0.081	0.075	0.082	0.076	0.076	0.086
FLINT, MI													
O_3	4th max 8-hour	up	2	0.076	0.08	0.07	0.07	0.075	0.081	0.087	0.083	0.089	0.092
	2nd daily max 1-hour	NS	2	0.095	0.099	0.091	0.105	0.089	0.094	0.106	0.097	0.109	0.109
SO_2	2nd max 24-hour	NS	1	0.014	0.014	0.014	0.017	0.017	0.016	0.012	0.012	0.014	0.011
FLORENCE, AL													
PM_{10}	90th percentile	NS	1	39	41	34	37	34	37	29	32	35	35
	weighted annual mean	NS	1	23.5	23.7	21.3	22.6	20.1	22	17.8	18.7	22.2	22.2
SO_2	arithmetic mean	Down	1	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
	2nd max 24-hour	Down	1	0.027	0.025	0.019	0.022	0.022	0.018	0.019	0.02	0.019	0.017
FORT COLLINS-LOVELAND, CO													
CO	2nd max 8-hour	Down	1	7	9.8	6.9	6.6	6	5.2	5.1	5.2	4.1	5.1
O_3	4th max 8-hour	NS	2	0.066	0.074	0.069	0.068	0.072	0.072	0.069	0.07	0.076	0.069
	2nd daily max 1-hour	NS	2	0.083	0.09	0.091	0.091	0.095	0.089	0.092	0.088	0.092	0.085
PM_{10}	90th percentile	Down	1	39	50	35	36	34	41	33	24	26	26
	weighted annual mean	Down	1	23.4	25.1	22.6	22.4	21.6	22.3	20.4	15.7	16.2	16

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
FORT LAUDERDALE, FL													
CO	2nd max 8-hour	Down	6	4.333	4.467	4.567	3.95	4.05	4.333	3.417	3.483	2.7	3.417
Pb	max quarterly mean	up	1	0.013	0.021	0.037	0.027	0.029	0.019	0.047	0.037	0.037	0.037
NO_2	arithmetic mean	NS	1	0.009	0.009	0.009	0.01	0.009	0.011	0.01	0.01	0.01	0.011
O_3	4th max 8-hour	NS	3	0.07	0.063	0.077	0.078	0.07	0.065	0.065	0.07	0.074	0.071
	2nd daily max 1-hour	NS	3	0.092	0.093	0.098	0.098	0.092	0.093	0.094	0.089	0.095	0.097
PM_{10}	90th percentile	NS	5	26	26	26	28.2	22	22.2	24	23	29	21.4
	weighted annual mean	NS	5	17.78	17.78	17.78	18.34	16.22	15.34	16.26	16.28	18.68	15.84
SO_2	arithmetic mean	up	1	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003
	2nd max 24-hour	up	1	0.006	0.006	0.006	0.011	0.013	0.008	0.008	0.011	0.017	0.015
FORT MYERS-CAPE CORAL, FL													
O_3	4th max 8-hour	NS	1	0.069	0.064	0.073	0.069	0.076	0.066	0.062	0.067	0.092	0.077
	2nd daily max 1-hour	NS	1	0.08	0.082	0.082	0.078	0.09	0.086	0.072	0.076	0.109	0.096
FORT SMITH, AR-OK													
PM_{10}	90th percentile	NS	1	38	37	36	39	38	44	36	39	39	39
	weighted annual mean	NS	1	25.7	24.7	23.5	24.9	23.8	25.7	25.3	22.3	22.3	22.3
FORT WAYNE, IN													
O_3	4th max 8-hour	NS	2	0.086	0.088	0.088	0.081	0.094	0.094	0.091	0.087	0.089	0.089
	2nd daily max 1-hour	NS	2	0.094	0.1	0.095	0.093	0.113	0.109	0.1	0.095	0.103	0.1
PM_{10}	90th percentile	Down	1	53	44	38	36	43	44	28	28	39	31
	weighted annual mean	NS	1	27.2	27.2	22.7	22.9	23.5	23.9	17.2	19.6	23.7	17
FORT WORTH-ARLINGTON, TX													
CO	2nd max 8-hour	Down	1	3.6	3.4	3.8	3.5	2.7	3.3	2.8	2.8	2.5	2.6
NO_2	arithmetic mean	NS	1	0.012	0.014	0.015	0.013	0.017	0.017	0.015	0.016	0.013	0.017
O_3	4th max 8-hour	NS	2	0.099	0.108	0.084	0.093	0.101	0.104	0.094	0.092	0.099	0.102
	2nd daily max 1-hour	NS	2	0.135	0.145	0.122	0.113	0.133	0.141	0.129	0.123	0.126	0.145
PM_{10}	90th percentile	NS	2	40	32	29	32	32.5	36	39	30	30	30
	weighted annual mean	NS	2	23.65	21.55	19.85	19.7	19.55	22.45	22.95	19.75	19.75	19.75
FRESNO, CA													
CO	2nd max 8-hour	Down	4	5.725	6.125	4.575	4.175	4.925	4.225	4.15	3.5	3.5	3.4
Pb	max quarterly mean	Down	1	0.065	0.037	0.035	0.025	0.02	0.015	0.008	0.011	0.013	0.013
NO_2	arithmetic mean	Down	4	0.021	0.021	0.02	0.021	0.02	0.02	0.019	0.018	0.018	0.021
O_3	4th max 8-hour	NS	5	0.1	0.105	0.105	0.106	0.096	0.103	0.108	0.102	0.116	0.103
	2nd daily max 1-hour	NS	5	0.138	0.146	0.142	0.14	0.128	0.134	0.142	0.128	0.154	0.132
PM_{10}	90th percentile	NS	5	106.6	100.4	72.6	85.6	63	80	59.2	76.8	61.8	81.2
	weighted annual mean	Down	5	54.96	53.76	45.22	43.18	40.24	41.04	35.14	40.38	34.42	42.38
GADSDEN, AL													
PM_{10}	90th percentile	NS	2	54.5	56	52	57.5	46	42.5	35.5	47	50	46.5
	weighted annual mean	Down	2	32.8	32.2	31.35	33.2	30.3	29.6	23.4	26.25	30.95	28.25
GALVESTON-TEXAS CITY, TX													
O_3	4th max 8-hour	NS	1	0.09	0.091	0.067	0.114	0.088	0.14	0.08	0.097	0.095	0.108
	2nd daily max 1-hour	NS	1	0.15	0.15	0.097	0.176	0.125	0.198	0.107	0.175	0.146	0.172
PM_{10}	90th percentile	NS	2	43.5	37.5	36.5	42	39	45.5	31	38	38	38
	weighted annual mean	NS	2	25.7	22.3	23.2	23.15	24.15	27.8	21.1	23.25	23.25	23.25
SO_2	arithmetic mean	NS	1	0.007	0.007	0.005	0.005	0.006	0.006	0.014	0.006	0.004	0.007
	2nd max 24-hour	NS	1	0.063	0.05	0.039	0.056	0.052	0.089	0.067	0.053	0.039	0.04
GARY, IN													
CO	2nd max 8-hour	NS	2	4.15	4.05	4.35	4.7	5.55	3.85	3.25	3.65	3.85	3.8
Pb	max quarterly mean	NS	3	0.21	0.098	0.1	0.074	0.181	0.093	0.127	0.088	0.085	0.103
O_3	4th max 8-hour	NS	2	0.08	0.086	0.084	0.072	0.084	0.101	0.095	0.093	0.086	0.098
	2nd daily max 1-hour	NS	2	0.097	0.11	0.118	0.087	0.111	0.122	0.121	0.116	0.117	0.115
PM_{10}	90th percentile	Down	7	50.571	43.429	42.286	38.571	41.571	40.857	32.286	31.429	35.429	29.857
	weighted annual mean	Down	7	32.443	28.329	25.4	22.886	25.414	24.129	20.4	20.993	22.571	20.486
SO_2	arithmetic mean	Down	4	0.01	0.008	0.008	0.008	0.007	0.005	0.005	0.006	0.006	0.005
	2nd max 24-hour	Down	4	0.052	0.029	0.031	0.034	0.034	0.024	0.025	0.026	0.03	0.021
GOLDSBORO, NC													
PM_{10}	90th percentile	NS	1	46	46	36	36	33	30	33	36	34	34
	weighted annual mean	Down	1	26.8	26.8	24.3	23.8	21	20.2	22.6	23.1	21.9	21.9
GRAND JUNCTION, CO													
CO	2nd max 8-hour	Down	1	6.7	6.7	6.7	6.1	6	5.4	5.8	5.4	5.3	4.7
PM_{10}	90th percentile	Down	4	39.5	49.25	41.5	32.5	36	30.75	30.25	29.5	30.5	33
	weighted annual mean	Down	4	18.925	20.95	18.45	17.35	17.15	15.2	14.875	14.5	15.3	15.325
GRAND RAPIDS-MUSKEGON-HOLLAND, MI													
CO	2nd max 8-hour	NS	1	3.5	4	3.2	3.2	4	4.6	3.3	2.4	2.9	3.5
Pb	max quarterly mean	Down	3	0.023	0.016	0.019	0.014	0.013	0.01	0.012	0.012	0.012	0.012
O_3	4th max 8-hour	NS	4	0.101	0.099	0.082	0.082	0.086	0.098	0.089	0.083	0.086	0.092
	2nd daily max 1-hour	NS	4	0.129	0.13	0.108	0.099	0.11	0.122	0.122	0.103	0.105	0.108
PM_{10}	90th percentile	Down	2	55	40.5	54	39	46	40	34.5	32	37.5	36
	weighted annual mean	Down	2	30	25.65	34.8	21.7	26.85	20.95	20.25	18.65	21.25	18.9
SO_2	arithmetic mean	Down	1	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.001
	2nd max 24-hour	Down	1	0.012	0.014	0.015	0.012	0.013	0.011	0.011	0.008	0.008	0.006

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
GREAT FALLS, MT													
CO	2nd max 8-hour	NS	1	5.6	6.6	5.8	6.9	4.8	6.2	5.4	6.4	4.5	3.5
PM_{10}	90th percentile	Down	1	39	44	40	40	34	30	35	32	32	32
	weighted annual mean	Down	1	23.7	21.1	21.4	21.4	20.8	17.9	19.1	20.3	20.3	20.3
GREELEY, CO													
CO	2nd max 8-hour	Down	1	7.1	7.8	7.5	5.8	5.2	5.3	7	4.8	4.4	3.4
O_3	4th max 8-hour	NS	1	0.076	0.077	0.064	0.063	0.071	0.072	0.07	0.069	0.075	0.069
	2nd daily max 1-hour	NS	1	0.109	0.096	0.084	0.087	0.087	0.093	0.097	0.095	0.102	0.092
PM_{10}	90th percentile	Down	1	43	51	43	39	37	34	30	30	30	29
	weighted annual mean	Down	1	24.7	25.9	25.4	22.6	23.1	19.9	17.7	17.8	16.5	17.5
GREEN BAY, WI													
SO_2	arithmetic mean	Down	1	0.005	0.005	0.004	0.003	0.003	0.004	0.003	0.003	0.003	0.003
	2nd max 24-hour	Down	1	0.02	0.042	0.021	0.018	0.015	0.017	0.011	0.017	0.011	0.011
GREENSBORO—WINSTON-SALEM—HIGH POINT, N													
CO	2nd max 8-hour	Down	1	6.8	6.6	5.7	5.5	6	6.2	4.3	4.7	5.4	3.6
NO_2	arithmetic mean	NS	1	0.017	0.016	0.015	0.017	0.017	0.016	0.016	0.017	0.017	0.016
O_3	4th max 8-hour	up	2	0.091	0.084	0.08	0.091	0.087	0.088	0.088	0.088	0.096	0.096
	2nd daily max 1-hour	NS	2	0.112	0.102	0.1	0.118	0.108	0.11	0.114	0.11	0.119	0.112
PM_{10}	90th percentile	Down	3	49.333	47.667	41	44.667	35.333	39	35.333	36.667	38.667	37.667
	weighted annual mean	Down	3	30.967	30.9	26.9	27.4	24.8	25.9	24.033	23.933	24.4	23.767
SO_2	arithmetic mean	NS	1	0.008	0.007	0.006	0.006	0.007	0.007	0.007	0.007	0.006	0.005
	2nd max 24-hour	NS	1	0.023	0.027	0.019	0.022	0.021	0.025	0.026	0.023	0.023	0.02
GREENVILLE, NC													
O_3	4th max 8-hour	NS	1	0.082	0.082	0.078	0.091	0.077	0.082	0.086	0.097	0.089	0.093
	2nd daily max 1-hour	up	1	0.091	0.091	0.095	0.108	0.086	0.098	0.097	0.122	0.109	0.109
GREENVILLE-SPARTANBURG-ANDERSON, SC													
Pb	max quarterly mean	Down	3	0.04	0.035	0.018	0.022	0.019	0.016	0.009	0.01	0.015	0.011
NO_2	arithmetic mean	Down	1	0.019	0.019	0.019	0.018	0.018	0.017	0.016	0.017	0.017	0.017
O_3	4th max 8-hour	up	4	0.075	0.079	0.079	0.087	0.082	0.087	0.085	0.087	0.098	0.097
	2nd daily max 1-hour	up	4	0.094	0.098	0.094	0.113	0.099	0.112	0.105	0.102	0.116	0.115
SO_2	arithmetic mean	NS	1	0.002	0.003	0.003	0.003	0.003	0.001	0.002	0.003	0.003	0.003
	2nd max 24-hour	NS	1	0.011	0.017	0.013	0.012	0.016	0.007	0.012	0.014	0.015	0.009
HAMILTON-MIDDLETOWN, OH													
O_3	4th max 8-hour	NS	2	0.099	0.094	0.071	0.091	0.091	0.092	0.093	0.09	0.091	0.096
	2nd daily max 1-hour	NS	2	0.122	0.111	0.097	0.121	0.113	0.127	0.111	0.111	0.114	0.118
PM_{10}	90th percentile	NS	4	59.5	61.25	50.75	62.75	53.25	57.75	44.5	53.75	53.25	49.75
	weighted annual mean	NS	4	34.275	35.55	30.075	31.125	30.375	33.8	29.325	30.425	30.45	28.25
SO_2	arithmetic mean	Down	2	0.01	0.009	0.007	0.008	0.008	0.005	0.007	0.007	0.006	0.006
	2nd max 24-hour	Down	2	0.037	0.04	0.033	0.035	0.038	0.019	0.025	0.034	0.021	0.023
HARRISBURG-LEBANON-CARLISLE, PA													
Pb	max quarterly mean	NS	1	0.039	0.039	0.039	0.041	0.041	0.041	0.04	0.039	0.036	0.036
NO_2	arithmetic mean	NS	2	0.013	0.014	0.013	0.011	0.015	0.014	0.015	0.013	0.012	0.012
O_3	4th max 8-hour	NS	3	0.091	0.096	0.077	0.094	0.089	0.086	0.08	0.089	0.092	0.096
	2nd daily max 1-hour	NS	3	0.11	0.109	0.093	0.113	0.115	0.105	0.097	0.11	0.112	0.115
PM_{10}	90th percentile	NS	1	35	39	27	30	44	32	31	33	33	33
	weighted annual mean	NS	1	18.5	22	17.8	20.7	22.3	20.7	18.8	21.9	21.9	21.9
SO_2	arithmetic mean	Down	2	0.005	0.006	0.005	0.006	0.007	0.005	0.005	0.005	0.005	0.004
	2nd max 24-hour	NS	2	0.021	0.021	0.022	0.021	0.035	0.017	0.021	0.022	0.017	0.017
HARTFORD, CT													
CO	2nd max 8-hour	Down	2	6.45	6.1	6.05	5.55	6.35	5.75	4.975	4.8	5.4	4.35
NO_2	arithmetic mean	NS	1	0.019	0.02	0.017	0.018	0.02	0.017	0.016	0.018	0.02	0.018
O_3	4th max 8-hour	Down	3	0.103	0.108	0.093	0.1	0.099	0.097	0.082	0.099	0.09	0.097
	2nd daily max 1-hour	NS	3	0.149	0.157	0.123	0.146	0.133	0.134	0.098	0.143	0.12	0.138
PM_{10}	90th percentile	Down	6	34.667	38.167	33.667	30.833	34.667	28.5	30	33.167	31	29.833
	weighted annual mean	NS	6	19.9	23	19.917	17.783	20.017	16.417	17.383	18.45	17.983	17.417
SO_2	arithmetic mean	Down	4	0.007	0.007	0.006	0.005	0.006	0.004	0.004	0.004	0.004	0.004
	2nd max 24-hour	Down	4	0.03	0.03	0.027	0.019	0.027	0.019	0.018	0.021	0.019	0.019
HONOLULU, HI													
CO	2nd max 8-hour	Down	4	1.95	1.775	1.875	2	1.85	1.7	1.575	1.525	1.45	1.2
O_3	4th max 8-hour	NS	1	0.034	0.041	0.047	0.049	0.052	0.051	0.041	0.047	0.049	0.048
	2nd daily max 1-hour	NS	1	0.053	0.05	0.059	0.055	0.055	0.056	0.047	0.053	0.056	0.054
PM_{10}	90th percentile	NS	3	21.667	22.333	21.333	21	23	21	22.667	19	21.667	21
	weighted annual mean	NS	3	10.167	10.533	10.567	11.167	12.167	10.5	11.467	11.633	12.2	10.067
SO_2	arithmetic mean	NS	3	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.001
	2nd max 24-hour	NS	3	0.006	0.006	0.006	0.009	0.006	0.005	0.007	0.005	0.007	0.003
HOUMA, LA													
O_3	4th max 8-hour	NS	1	0.083	0.076	0.07	0.075	0.086	0.101	0.075	0.079	0.089	0.087
	2nd daily max 1-hour	NS	1	0.115	0.097	0.091	0.096	0.103	0.141	0.094	0.103	0.11	0.115

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HOUSTON, TX													
CO	2nd max 8-hour	Down	4	6.775	6.025	6.775	5.6	4.9	4.025	5.25	4.275	3.8	3.35
NO_2	arithmetic mean	Down	4	0.023	0.022	0.022	0.019	0.021	0.021	0.02	0.021	0.019	0.02
O_3	4th max 8-hour	NS	9	0.116	0.098	0.102	0.095	0.097	0.114	0.097	0.107	0.109	0.102
	2nd daily max 1-hour	NS	9	0.192	0.167	0.162	0.161	0.147	0.168	0.154	0.171	0.174	0.159
PM_{10}	90th percentile	Down	5	50.2	48.2	48	50.4	50.2	48	39	47.8	47.8	47.8
	weighted annual mean	Down	5	31.4	31.4	30.22	30.36	30.96	29.54	26	29.42	29.42	29.42
SO_2	arithmetic mean	Down	5	0.005	0.006	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003
	2nd max 24-hour	Down	5	0.025	0.027	0.024	0.022	0.02	0.025	0.023	0.017	0.018	0.015
HUNTINGTON-ASHLAND, WV-KY-OH													
Pb	max quarterly mean	NS	1	0.048	0.028	0.033	0.022	0.03	0.036	0.049	0.023	0.023	0.023
O_3	4th max 8-hour	NS	3	0.093	0.096	0.078	0.09	0.092	0.089	0.077	0.081	0.097	0.094
	2nd daily max 1-hour	NS	3	0.114	0.131	0.097	0.11	0.126	0.117	0.097	0.112	0.127	0.116
PM_{10}	90th percentile	Down	5	53.8	50.4	46	52.2	51.6	48.2	39	45.2	44	47
	weighted annual mean	Down	5	33.82	32.44	29.18	28.46	30.68	29.86	26.46	28.4	26.48	27.9
SO_2	arithmetic mean	Down	8	0.012	0.012	0.01	0.011	0.01	0.009	0.008	0.008	0.008	0.008
	2nd max 24-hour	Down	8	0.07	0.05	0.043	0.052	0.049	0.034	0.028	0.031	0.033	0.03
HUNTSVILLE, AL													
CO	2nd max 8-hour	NS	1	4.2	4.1	4.2	4	3.5	3.6	3	3.1	3.3	4.3
O_3	4th max 8-hour	NS	1	0.079	0.082	0.087	0.087	0.075	0.08	0.081	0.086	0.092	0.093
	2nd daily max 1-hour	NS	1	0.087	0.106	0.114	0.112	0.107	0.102	0.096	0.096	0.118	0.106
PM_{10}	90th percentile	Down	3	47.333	49.333	43	40	35.5	34.333	31.333	37.333	34.667	35.667
	weighted annual mean	Down	3	29.5	27.3	25.967	23.6	22.667	22.567	20.767	20.8	22.033	22.867
INDIANAPOLIS, IN													
CO	2nd max 8-hour	Down	2	3.95	5.15	3.5	4	3.45	3.85	2.75	3.15	2.65	2.4
Pb	max quarterly mean	Down	4	1.11	0.738	0.596	0.654	1.003	0.299	0.073	0.054	0.059	0.095
NO_2	arithmetic mean	NS	1	0.018	0.018	0.018	0.018	0.019	0.02	0.018	0.015	0.019	0.018
O_3	4th max 8-hour	up	6	0.085	0.086	0.082	0.083	0.093	0.094	0.096	0.088	0.094	0.094
	2nd daily max 1-hour	NS	6	0.102	0.1	0.094	0.098	0.11	0.111	0.116	0.104	0.113	0.107
PM_{10}	90th percentile	Down	13	54.308	49.077	43	51.231	46.462	46.077	34.308	36.308	38.923	37
	weighted annual mean	Down	13	32.8	30.562	27.608	27.677	28.254	28.115	22.508	22.523	23.9	21.838
SO_2	arithmetic mean	Down	6	0.009	0.008	0.007	0.008	0.007	0.005	0.005	0.005	0.005	0.005
	2nd max 24-hour	Down	6	0.033	0.03	0.028	0.037	0.038	0.021	0.024	0.023	0.021	0.02
JACKSON, MS													
CO	2nd max 8-hour	NS	1	4.3	4.3	4.3	6.2	5.1	4.4	4.8	3.8	3.7	5
O_3	4th max 8-hour	up	2	0.08	0.072	0.071	0.073	0.073	0.076	0.077	0.077	0.084	0.083
	2nd daily max 1-hour	up	2	0.1	0.085	0.083	0.089	0.086	0.09	0.093	0.095	0.105	0.103
PM_{10}	90th percentile	Down	1	44	44	43	38	32	34	34	36	32	32
	weighted annual mean	Down	1	25.7	25.7	27	23.3	20.9	22.8	21.5	24	19.9	19.9
SO_2	arithmetic mean	NS	1	0.005	0.005	0.005	0.003	0.002	0.002	0.002	0.002	0.002	0.002
	2nd max 24-hour	Down	1	0.013	0.013	0.013	0.01	0.008	0.007	0.008	0.007	0.008	0.007
JACKSON, TN													
PM_{10}	90th percentile	NS	2	44	39	41	37	31.5	42.5	33.5	34	34	34
	weighted annual mean	Down	2	27.7	26.9	27.4	23.35	22.6	25.1	22.1	22.55	23.3	23.3
JACKSONVILLE, FL													
CO	2nd max 8-hour	Down	4	4.05	3.6	4.15	4.075	3.85	3.6	3.075	2.5	2.675	3.375
Pb	max quarterly mean	Down	2	0.038	0.025	0.024	0.048	0.02	0.028	0.022	0.017	0.018	0.018
NO_2	arithmetic mean	NS	1	0.015	0.014	0.014	0.015	0.014	0.016	0.015	0.014	0.015	0.016
O_3	4th max 8-hour	NS	2	0.081	0.072	0.079	0.081	0.074	0.074	0.075	0.08	0.082	0.079
	2nd daily max 1-hour	NS	2	0.11	0.089	0.102	0.11	0.099	0.112	0.091	0.101	0.101	0.099
PM_{10}	90th percentile	NS	2	45	46.5	41.5	38.5	39.5	39	34.5	38.5	43	41.5
	weighted annual mean	NS	2	33.75	33.15	27	27.6	26.55	25.9	25.25	25.5	29	28.2
SO_2	arithmetic mean	NS	6	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	2nd max 24-hour	Down	6	0.034	0.022	0.022	0.026	0.031	0.018	0.019	0.016	0.021	0.019
JACKSONVILLE, NC													
PM_{10}	90th percentile	NS	1	39	39	35	35	28	29	32	32	37	37
	weighted annual mean	NS	1	23.9	23.9	22.9	22.9	20.4	19.8	21.9	20.2	22.1	22.1
JAMESTOWN, NY													
O_3	4th max 8-hour	up	1	0.076	0.076	0.083	0.081	0.08	0.089	0.081	0.087	0.095	0.087
	2nd daily max 1-hour	NS	1	0.098	0.098	0.098	0.104	0.094	0.104	0.097	0.105	0.111	0.101
PM_{10}	90th percentile	NS	2	38.5	38.5	29	31.5	32.5	30	27.5	33.5	37	35.5
	weighted annual mean	NS	2	20.5	20.5	17.75	16.15	15.8	16.4	16.6	16.85	18.7	17.3
SO_2	arithmetic mean	Down	2	0.01	0.01	0.009	0.009	0.008	0.007	0.007	0.006	0.006	0.006
	2nd max 24-hour	Down	2	0.047	0.039	0.039	0.041	0.053	0.039	0.033	0.029	0.026	0.03
JANESVILLE-BELOIT, WI													
O_3	4th max 8-hour	NS	1	0.076	0.076	0.076	0.063	0.076	0.083	0.082	0.075	0.077	0.08
	2nd daily max 1-hour	NS	1	0.091	0.091	0.091	0.083	0.092	0.095	0.101	0.088	0.087	0.095

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
JERSEY CITY, NJ														
	CO	2nd max 8-hour	Down	2	8.45	8.6	7.85	6.6	8.3	7.15	5.8	5.5	4.85	5
	NO_2	arithmetic mean	Down	1	0.03	0.028	0.028	0.027	0.026	0.026	0.027	0.026	0.027	0.026
	O_3	4th max 8-hour	NS	1	0.106	0.115	0.092	0.103	0.095	0.104	0.087	0.105	0.089	0.106
		2nd daily max 1-hour	NS	1	0.175	0.136	0.112	0.131	0.118	0.125	0.12	0.119	0.118	0.139
	PM_{10}	90th percentile	Down	2	51.5	55	44.5	46.5	56.5	42	43	42.5	36	36.5
		weighted annual mean	Down	2	31.2	32.35	26.8	29.05	34	26.5	28.35	26.75	22.85	23.3
	SO_2	arithmetic mean	Down	2	0.013	0.012	0.01	0.009	0.009	0.007	0.008	0.008	0.007	0.007
		2nd max 24-hour	Down	2	0.043	0.035	0.041	0.03	0.036	0.026	0.027	0.025	0.022	0.024
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA														
	CO	2nd max 8-hour	NS	1	3.4	3.3	3	6.5	3.4	3	3	3.5	3.4	2.8
	NO_2	arithmetic mean	Down	1	0.019	0.019	0.018	0.017	0.017	0.018	0.018	0.018	0.017	0.016
	O_3	4th max 8-hour	NS	1	0.1	0.078	0.082	0.088	0.083	0.091	0.083	0.082	0.096	0.086
		2nd daily max 1-hour	NS	1	0.117	0.115	0.103	0.125	0.103	0.114	0.099	0.111	0.115	0.106
	PM_{10}	90th percentile	Down	1	44	48	38	46	38	40	37	37	30	30
		weighted annual mean	Down	1	29.3	30.5	24.9	25.2	25	24.7	22.7	20.8	20.7	20.7
	SO_2	arithmetic mean	NS	3	0.009	0.009	0.009	0.008	0.009	0.008	0.009	0.009	0.009	0.009
		2nd max 24-hour	NS	3	0.044	0.044	0.039	0.042	0.045	0.039	0.044	0.05	0.043	0.038
JOHNSTOWN, PA														
	CO	2nd max 8-hour	Down	1	3.7	4.8	4.4	4.2	4.1	3.5	4.8	2.7	3.1	2.8
	NO_2	arithmetic mean	Down	1	0.018	0.019	0.018	0.017	0.018	0.015	0.018	0.016	0.015	0.015
	O_3	4th max 8-hour	NS	1	0.08	0.096	0.074	0.083	0.083	0.09	0.083	0.092	0.098	0.09
		2nd daily max 1-hour	NS	1	0.103	0.113	0.089	0.099	0.094	0.101	0.098	0.104	0.124	0.107
	SO_2	arithmetic mean	Down	1	0.014	0.015	0.013	0.015	0.014	0.012	0.011	0.009	0.008	0.009
		2nd max 24-hour	Down	1	0.046	0.043	0.052	0.049	0.08	0.042	0.034	0.03	0.027	0.025
JONESBORO, AR														
	PM_{10}	90th percentile	NS	1	47	47	41	46	50	50	42	40	40	40
		weighted annual mean	Down	1	26.8	26.7	25.3	25.2	28	27.6	25.6	23.7	23.7	23.7
KALAMAZOO-BATTLE CREEK, MI														
	PM_{10}	90th percentile	NS	1	58	56	42	39	44	50	33	38	47	44
		weighted annual mean	Down	1	28.1	29.3	27.1	24	25.9	26	22	22.6	26.7	22.5
KANSAS CITY, MO-KS														
	CO	2nd max 8-hour	NS	3	4.433	4	3.9	4.167	4.333	3.333	3.2	3.233	3.7	3.733
	Pb	max quarterly mean	NS	5	0.03	0.027	0.023	0.02	0.017	0.018	0.028	0.1	0.1	0.1
	NO_2	arithmetic mean	NS	3	0.011	0.01	0.01	0.009	0.01	0.01	0.012	0.01	0.012	0.012
	O_3	4th max 8-hour	up	6	0.073	0.079	0.075	0.074	0.079	0.09	0.08	0.086	0.087	0.081
		2nd daily max 1-hour	up	6	0.097	0.1	0.094	0.097	0.097	0.119	0.101	0.107	0.117	0.106
	PM_{10}	90th percentile	NS	7	51	51.286	47.143	48.143	46.714	43.714	56.429	39.714	44.143	50
		weighted annual mean	NS	7	31.343	31.614	30.186	30.186	29.886	24.429	33	26.143	27.114	28.657
	SO_2	arithmetic mean	NS	5	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.003	0.003
		2nd max 24-hour	NS	5	0.022	0.017	0.016	0.02	0.025	0.018	0.024	0.013	0.01	0.011
KENOSHA, WI														
	O_3	4th max 8-hour	NS	2	0.084	0.108	0.085	0.085	0.088	0.103	0.084	0.087	0.09	0.097
		2nd daily max 1-hour	NS	2	0.106	0.135	0.112	0.114	0.119	0.119	0.13	0.111	0.121	0.121
KNOXVILLE, TN														
	CO	2nd max 8-hour	Down	1	5.1	4.5	4.5	4.6	4.3	4.1	3.3	4.8	3.9	3.8
	O_3	4th max 8-hour	up	5	0.092	0.083	0.081	0.09	0.088	0.094	0.091	0.093	0.104	0.1
		2nd daily max 1-hour	up	5	0.11	0.101	0.096	0.11	0.109	0.116	0.108	0.113	0.124	0.122
	PM_{10}	90th percentile	Down	8	52.5	52.25	46.75	48.375	48.75	48.75	48.75	44	41.25	40.75
		weighted annual mean	Down	8	31.963	34.225	30.45	30.15	31.725	31.188	30.513	26.438	26.075	26.925
	SO_2	arithmetic mean	NS	3	0.006	0.006	0.006	0.006	0.006	0.007	0.006	0.006	0.005	0.005
		2nd max 24-hour	NS	3	0.03	0.034	0.034	0.037	0.034	0.034	0.037	0.033	0.028	0.035
LAKE CHARLES, LA														
	O_3	4th max 8-hour	NS	1	0.085	0.087	0.073	0.077	0.075	0.084	0.077	0.085	0.09	0.073
		2nd daily max 1-hour	NS	1	0.11	0.121	0.105	0.103	0.095	0.113	0.092	0.114	0.123	0.085
LAKELAND-WINTER HAVEN, FL														
	O_3	4th max 8-hour	NS	2	0.072	0.072	0.072	0.082	0.072	0.073	0.07	0.078	0.087	0.078
		2nd daily max 1-hour	NS	2	0.095	0.095	0.095	0.103	0.088	0.089	0.089	0.101	0.104	0.097
	SO_2	arithmetic mean	NS	2	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.006	0.005
		2nd max 24-hour	NS	2	0.018	0.015	0.015	0.019	0.016	0.013	0.019	0.016	0.022	0.016
LANCASTER, PA														
	CO	2nd max 8-hour	NS	1	3.4	2.6	2.6	3	3.8	2.4	2.6	3.3	1.9	2.1
	Pb	max quarterly mean	NS	1	0.058	0.043	0.038	0.038	0.042	0.04	0.041	0.041	0.04	0.04
	NO_2	arithmetic mean	NS	1	0.017	0.018	0.015	0.015	0.019	0.016	0.017	0.016	0.015	0.015
	O_3	4th max 8-hour	NS	1	0.087	0.099	0.086	0.095	0.093	0.102	0.085	0.102	0.101	0.102
		2nd daily max 1-hour	NS	1	0.101	0.119	0.106	0.118	0.111	0.124	0.101	0.133	0.119	0.127
	PM_{10}	90th percentile	NS	1	52	45	41	54	61	55	46	50	50	50
		weighted annual mean	up	1	30.6	29.6	27	30.6	37.5	33.1	30.9	33.6	33.6	33.6
	SO_2	arithmetic mean	NS	1	0.006	0.006	0.006	0.007	0.006	0.006	0.005	0.007	0.006	0.005
		2nd max 24-hour	NS	1	0.028	0.023	0.023	0.026	0.03	0.018	0.021	0.023	0.02	0.021

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
LANSING-EAST LANSING, MI														
	O_3	4th max 8-hour	NS	2	0.08	0.083	0.08	0.079	0.079	0.082	0.076	0.078	0.08	0.088
		2nd daily max 1-hour	NS	2	0.095	0.11	0.091	0.096	0.093	0.096	0.087	0.088	0.1	0.1
LAS CRUCES, NM														
	CO	2nd max 8-hour	Down	1	6.3	6.5	4.9	8.7	5	4.4	4.3	4.8	4.2	3.8
	Pb	max quarterly mean	Down	2	0.167	0.147	0.126	0.117	0.054	0.086	0.071	0.075	0.075	0.075
	O_3	4th max 8-hour	NS	3	0.07	0.071	0.07	0.073	0.074	0.074	0.075	0.067	0.072	0.074
		2nd daily max 1-hour	NS	3	0.098	0.096	0.099	0.107	0.104	0.105	0.104	0.09	0.1	0.092
	PM_{10}	90th percentile	NS	3	60	52	56.667	47	55	55.333	50.333	43.333	42	57.667
		weighted annual mean	NS	3	35.233	31.167	31.467	29.767	32.6	34.267	33.3	26.8	26.767	34.833
	SO_2	arithmetic mean	Down	2	0.011	0.01	0.009	0.006	0.004	0.004	0.004	0.003	0.003	0.001
		2nd max 24-hour	Down	2	0.056	0.055	0.052	0.055	0.023	0.021	0.03	0.014	0.012	0.005
LAS VEGAS, NV-AZ														
	CO	2nd max 8-hour	Down	1	7.7	6.9	6.1	7.2	6.9	6.4	6.6	5.5	6.2	5.6
	O_3	4th max 8-hour	NS	3	0.073	0.065	0.076	0.075	0.077	0.073	0.08	0.074	0.077	0.073
		2nd daily max 1-hour	Down	3	0.101	0.09	0.093	0.096	0.091	0.088	0.094	0.088	0.087	0.086
	PM_{10}	90th percentile	NS	1	127	88	76	75	67	77	82	90	84	78
		weighted annual mean	NS	1	69	58.8	48.3	43.1	47.4	46.7	52.5	59.7	52.4	45.1
LAWRENCE, MA-NH														
	O_3	4th max 8-hour	NS	1	0.073	0.086	0.074	0.076	0.082	0.069	0.079	0.078	0.076	0.068
		2nd daily max 1-hour	NS	1	0.091	0.119	0.086	0.1	0.101	0.081	0.092	0.097	0.096	0.09
	PM_{10}	90th percentile	NS	1	32	30	32	36	32	24	22	25	28	28
		weighted annual mean	Down	1	20.6	18.3	19.1	18.3	15.9	13.4	14.3	14.8	15.2	15.2
	SO_2	arithmetic mean	Down	2	0.008	0.007	0.008	0.008	0.006	0.006	0.005	0.005	0.006	0.005
		2nd max 24-hour	Down	2	0.029	0.026	0.027	0.026	0.027	0.025	0.019	0.02	0.021	0.021
LAWTON, OK														
	PM_{10}	90th percentile	NS	1	51	43	41	35	43	44	44	48	48	48
		weighted annual mean	NS	1	29.9	27.1	25.5	27	27.7	25.3	27.8	26.2	26.2	26.2
LEWISTON-AUBURN, ME														
	PM_{10}	90th percentile	Down	1	41	50	43	49	35	37	31	35	31	31
		weighted annual mean	Down	1	24.7	28.5	24	24.3	20.2	19.8	20	20.6	18.2	18.6
	SO_2	arithmetic mean	Down	1	0.007	0.006	0.005	0.007	0.006	0.004	0.004	0.004	0.004	0.004
		2nd max 24-hour	Down	1	0.027	0.023	0.02	0.025	0.025	0.02	0.018	0.017	0.019	0.016
LEXINGTON, KY														
	CO	2nd max 8-hour	NS	1	3.7	4.9	3.8	6.5	4.2	3	3.1	5.2	5.2	5.2
	NO_2	arithmetic mean	Down	1	0.017	0.016	0.016	0.017	0.016	0.017	0.014	0.014	0.011	0.013
	O_3	4th max 8-hour	NS	3	0.078	0.074	0.065	0.079	0.088	0.085	0.079	0.079	0.087	0.087
		2nd daily max 1-hour	up	3	0.097	0.088	0.08	0.099	0.104	0.103	0.088	0.096	0.105	0.107
	PM_{10}	90th percentile	Down	3	48.333	46.333	40	42	45.667	40.333	39	37.333	39.333	40
		weighted annual mean	Down	3	29.4	29.133	24.9	24.033	27.933	24.7	24.033	22.433	23.333	23.033
	SO_2	arithmetic mean	NS	1	0.006	0.008	0.007	0.007	0.008	0.006	0.006	0.006	0.006	0.008
		2nd max 24-hour	NS	1	0.02	0.025	0.03	0.026	0.037	0.016	0.02	0.016	0.023	0.02
LIMA, OH														
	O_3	4th max 8-hour	NS	1	0.084	0.09	0.082	0.09	0.089	0.092	0.092	0.083	0.089	0.093
		2nd daily max 1-hour	NS	1	0.096	0.102	0.1	0.099	0.102	0.106	0.11	0.091	0.102	0.107
	SO_2	arithmetic mean	Down	1	0.005	0.006	0.004	0.005	0.004	0.003	0.003	0.003	0.003	0.003
		2nd max 24-hour	Down	1	0.026	0.021	0.02	0.023	0.036	0.015	0.015	0.016	0.017	0.013
LINCOLN, NE														
	CO	2nd max 8-hour	NS	2	6.15	7.4	4.45	4.25	3.95	4.85	3.35	5	4.25	4.1
	O_3	4th max 8-hour	NS	1	0.057	0.06	0.067	0.049	0.062	0.06	0.054	0.054	0.058	0.053
		2nd daily max 1-hour	NS	1	0.067	0.067	0.074	0.057	0.075	0.07	0.06	0.061	0.068	0.062
	PM_{10}	90th percentile	NS	2	49	52.5	42	38	45.5	44.5	44	38.5	40	40
		weighted annual mean	NS	2	28.65	29.85	25.2	26.05	27.8	24.75	28.15	24.25	26.1	26.1
LITTLE ROCK-NORTH LITTLE ROCK, AR														
	NO_2	arithmetic mean	NS	1	0.009	0.009	0.012	0.009	0.011	0.011	0.011	0.01	0.011	0.011
	O_3	4th max 8-hour	NS	2	0.08	0.078	0.076	0.076	0.076	0.086	0.077	0.077	0.078	0.083
		2nd daily max 1-hour	NS	2	0.099	0.098	0.089	0.096	0.09	0.106	0.096	0.099	0.097	0.104
	PM_{10}	90th percentile	NS	4	48.75	42.5	47.25	44.25	46.5	50	40.5	42.25	42.25	42.25
		weighted annual mean	Down	4	28.5	25.1	27.9	26.925	27.225	29.225	26.2	24.525	24.525	24.525
	SO_2	arithmetic mean	Down	1	0.003	0.003	0.005	0.006	0.003	0.002	0.002	0.002	0.002	0.002
		2nd max 24-hour	Down	1	0.014	0.012	0.012	0.017	0.009	0.008	0.009	0.006	0.006	0.005
LONGVIEW-MARSHALL, TX														
	O_3	4th max 8-hour	up	1	0.088	0.081	0.079	0.093	0.081	0.102	0.082	0.091	0.104	0.105
		2nd daily max 1-hour	NS	1	0.13	0.11	0.101	0.114	0.104	0.145	0.106	0.124	0.129	0.134
LOS ANGELES-LONG BEACH, CA														
	CO	2nd max 8-hour	Down	13	8.962	8.8	7.815	6.808	8.015	7.469	6.846	6.562	6.069	5.8
	Pb	max quarterly mean	Down	6	0.093	0.102	0.079	0.064	0.061	0.049	0.046	0.052	0.038	0.061
	NO_2	arithmetic mean	Down	13	0.041	0.041	0.038	0.036	0.039	0.038	0.035	0.033	0.033	0.035
	O_3	4th max 8-hour	Down	14	0.119	0.125	0.129	0.117	0.113	0.105	0.101	0.091	0.098	0.077
		2nd daily max 1-hour	Down	14	0.185	0.194	0.2	0.174	0.169	0.152	0.142	0.124	0.147	0.111
	PM_{10}	90th percentile	Down	9	78	79.556	64.111	65.333	59.111	63.556	60.667	56.556	54.778	60.333
		weighted annual mean	Down	9	48.667	52.522	41.078	40.467	39.144	39.156	37.967	38.556	33.411	39.1
	SO_2	arithmetic mean	Down	4	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003
		2nd max 24-hour	NS	4	0.012	0.013	0.015	0.011	0.008	0.008	0.008	0.007	0.009	0.01

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
LOUISVILLE, KY-IN													
CO	2nd max 8-hour	Down	4	5.85	5.85	5.15	5.35	5.875	4.4	3.9	4.95	4.375	3.925
NO_2	arithmetic mean	NS	1	0.012	0.012	0.012	0.013	0.014	0.012	0.013	0.013	0.012	0.014
O_3	4th max 8-hour	up	5	0.079	0.086	0.071	0.091	0.092	0.09	0.087	0.089	0.096	0.094
	2nd daily max 1-hour	NS	5	0.107	0.108	0.091	0.123	0.116	0.116	0.109	0.12	0.121	0.112
PM_{10}	90th percentile	Down	6	54.667	49.833	47.5	50.833	47	46.167	43.667	48.167	41.833	42.5
	weighted annual mean	Down	6	32.767	32.25	30.3	29.117	30.283	28.65	26.483	28.717	26.333	25
SO_2	arithmetic mean	Down	4	0.01	0.01	0.009	0.01	0.01	0.008	0.007	0.007	0.007	0.008
	2nd max 24-hour	Down	4	0.041	0.037	0.034	0.035	0.04	0.028	0.031	0.031	0.033	0.026
LOWELL, MA-NH													
CO	2nd max 8-hour	Down	1	7.3	5.8	5.9	5.1	6.5	7.8	4.5	3.6	3.4	4.2
LUBBOCK, TX													
PM_{10}	90th percentile	Down	1	36	39	34	30	33	34	34	27	27	27
	weighted annual mean	Down	1	23.8	25.3	22.1	19.9	23	20.8	21.7	16.6	16.6	16.6
LYNCHBURG, VA													
PM_{10}	90th percentile	NS	1	43	41	39	44	33	49	36	37	33	33
	weighted annual mean	Down	1	24.3	27.5	23.5	25.5	23.2	23.8	22.5	23	20.8	20.8
MADISON, WI													
O_3	4th max 8-hour	NS	1	0.079	0.079	0.079	0.066	0.071	0.08	0.079	0.079	0.076	0.085
	2nd daily max 1-hour	NS	1	0.094	0.094	0.094	0.079	0.082	0.1	0.094	0.088	0.089	0.098
PM_{10}	90th percentile	NS	2	37	38	35	36.5	32.5	42	30.5	33.5	36.5	37
	weighted annual mean	NS	2	22.95	23.75	22	20.15	21.3	22.15	20.05	20.15	23.35	20.55
MANCHESTER, NH													
PM_{10}	90th percentile	Down	2	33.5	37.5	31	36.5	33.5	26	28	28.5	26.5	27
	weighted annual mean	Down	2	19.55	19.9	18.2	17.95	15.25	14.25	16	18.55	15.05	15.6
MANSFIELD, OH													
PM_{10}	90th percentile	NS	1	42	40	39	44	49	42	40	39	41	39
	weighted annual mean	Down	1	27.1	26.7	26.4	27.7	29.2	24.7	24.3	23.3	23.8	22.6
MEDFORD-ASHLAND, OR													
CO	2nd max 8-hour	Down	1	8.2	8.1	6.4	6.9	6.2	5.3	6.4	5.7	5.2	5.7
O_3	4th max 8-hour	NS	1	0.081	0.081	0.081	0.066	0.068	0.071	0.075	0.063	0.085	0.065
	2nd daily max 1-hour	NS	1	0.112	0.112	0.112	0.082	0.087	0.091	0.101	0.074	0.117	0.077
PM_{10}	90th percentile	Down	4	66.75	62.25	51.75	52.5	46.75	36	35	36.25	32.5	46.75
	weighted annual mean	Down	4	35.35	34.35	30.675	29.725	27.95	21.75	20.975	22.775	20.925	23.575
MELBOURNE-TITUSVILLE-PALM BAY, FL													
O_3	4th max 8-hour	NS	2	0.074	0.068	0.075	0.073	0.073	0.066	0.068	0.073	0.081	0.074
	2nd daily max 1-hour	NS	2	0.084	0.085	0.084	0.087	0.088	0.08	0.087	0.086	0.092	0.087
PM_{10}	90th percentile	NS	2	29.5	29.5	29.5	27	23.5	23	25	27.5	32	27
	weighted annual mean	NS	2	16.55	16.55	16.55	17.65	16.5	15.15	16.85	17.6	18.2	17.6
MEMPHIS, TN-AR-MS													
CO	2nd max 8-hour	Down	5	7.46	6.14	7.66	7.64	7.28	5.96	5.28	4.96	4.86	4.68
Pb	max quarterly mean	NS	4	1.041	0.785	1.003	1.045	1.033	0.646	1.044	0.593	0.933	0.249
NO_2	arithmetic mean	up	1	0.023	0.024	0.026	0.026	0.027	0.027	0.024	0.028	0.029	0.025
O_3	4th max 8-hour	up	4	0.088	0.085	0.08	0.084	0.085	0.095	0.094	0.087	0.093	0.097
	2nd daily max 1-hour	up	4	0.113	0.108	0.102	0.108	0.108	0.125	0.124	0.118	0.116	0.127
PM_{10}	90th percentile	Down	2	50	45	43.5	49	43	44.5	40	43.5	40.5	40
	weighted annual mean	Down	2	30.6	26.95	28.4	28.5	26.65	27.45	27.45	26	24.65	24.35
SO_2	arithmetic mean	Down	1	0.009	0.008	0.009	0.007	0.005	0.005	0.004	0.004	0.004	0.004
	2nd max 24-hour	Down	1	0.027	0.024	0.03	0.031	0.025	0.019	0.012	0.012	0.012	0.012
MERCED, CA													
NO_2	arithmetic mean	Down	1	0.015	0.015	0.015	0.015	0.013	0.012	0.012	0.013	0.011	0.012
O_3	4th max 8-hour	NS	1	0.102	0.102	0.102	0.096	0.097	0.107	0.102	0.074	0.112	0.105
	2nd daily max 1-hour	NS	1	0.12	0.12	0.12	0.12	0.119	0.13	0.124	0.09	0.14	0.125
MIAMI, FL													
CO	2nd max 8-hour	Down	2	5.95	7.2	6.2	5.25	4.4	4.9	4.45	3.8	3.1	3.95
NO_2	arithmetic mean	NS	2	0.011	0.011	0.011	0.012	0.01	0.011	0.011	0.012	0.011	0.012
O_3	4th max 8-hour	NS	4	0.067	0.06	0.071	0.075	0.07	0.07	0.069	0.072	0.08	0.074
	2nd daily max 1-hour	NS	4	0.098	0.091	0.095	0.101	0.093	0.094	0.092	0.098	0.099	0.101
PM_{10}	90th percentile	Down	4	38	38	39.5	36.25	34.75	33.75	38.25	30.25	35.25	31.75
	weighted annual mean	Down	4	27	25.725	25.95	26.85	25.075	25.05	25.7	23	25.75	23.1
SO_2	arithmetic mean	NS	1	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001
	2nd max 24-hour	NS	1	0.003	0.003	0.005	0.004	0.004	0.004	0.005	0.004	0.004	0.003
MIDDLESEX-SOMERSET-HUNTERDON, NJ													
CO	2nd max 8-hour	Down	1	5.4	4.2	3.9	3.7	4.3	5.3	3.3	3.8	3	3.2
Pb	max quarterly mean	NS	1	0.302	1.148	1.215	0.333	0.123	0.067	0.061	0.079	0.08	0.182
O_3	4th max 8-hour	NS	1	0.11	0.109	0.094	0.102	0.094	0.102	0.089	0.103	0.096	0.109
	2nd daily max 1-hour	NS	1	0.136	0.122	0.119	0.118	0.112	0.115	0.108	0.12	0.118	0.133
SO_2	arithmetic mean	Down	1	0.007	0.007	0.006	0.005	0.005	0.004	0.005	0.005	0.005	0.005
	2nd max 24-hour	Down	1	0.032	0.025	0.026	0.018	0.028	0.018	0.024	0.019	0.018	0.016

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MILWAUKEE-WAUKESHA, WI													
CO	2nd max 8-hour	Down	5	4.48	3.72	3.24	4.04	4.5	3.04	1.9	1.98	2.08	1.94
Pb	max quarterly mean	Down	1	0.081	0.055	0.047	0.035	0.032	0.048	0.032	0.03	0.03	0.03
NO$_2$	arithmetic mean	Down	1	0.019	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016
O$_3$	4th max 8-hour	NS	8	0.084	0.094	0.078	0.076	0.081	0.096	0.083	0.083	0.082	0.091
	2nd daily max 1-hour	NS	8	0.113	0.136	0.096	0.097	0.117	0.114	0.105	0.117	0.109	0.111
PM$_{10}$	90th percentile	Down	4	57.25	48.75	41	44.5	42.25	49	37.5	38.25	41.25	40.5
	weighted annual mean	Down	4	33.2	29.3	25.775	26.1	27.525	26.55	25	24.275	26.85	24.05
SO$_2$	arithmetic mean	NS	1	0.006	0.005	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004
	2nd max 24-hour	NS	1	0.04	0.029	0.023	0.018	0.032	0.025	0.028	0.028	0.022	0.024
MINNEAPOLIS-ST. PAUL, MN-WI													
CO	2nd max 8-hour	Down	3	6.533	7.167	5.867	5.233	6.4	5.967	5.133	4.5	4.933	4.033
Pb	max quarterly mean	Down	4	0.588	0.246	0.197	0.093	0.052	0.181	0.092	0.072	0.05	0.127
NO$_2$	arithmetic mean	NS	1	0.017	0.016	0.016	0.018	0.019	0.017	0.019	0.017	0.018	0.016
O$_3$	4th max 8-hour	NS	4	0.068	0.07	0.074	0.058	0.07	0.076	0.068	0.073	0.071	0.073
	2nd daily max 1-hour	NS	4	0.087	0.081	0.086	0.074	0.08	0.101	0.086	0.085	0.089	0.083
PM$_{10}$	90th percentile	NS	7	43.429	42.286	37.286	34.571	35.286	39.571	35.857	34.286	39.429	39.429
	weighted annual mean	NS	7	27.871	26.443	22.843	22.057	21.829	22.886	22.6	22.271	23.843	24.257
SO$_2$	arithmetic mean	Down	6	0.004	0.005	0.004	0.003	0.003	0.003	0.003	0.003	0.002	0.002
	2nd max 24-hour	Down	6	0.025	0.027	0.025	0.02	0.017	0.015	0.016	0.015	0.013	0.014
MOBILE, AL													
O$_3$	4th max 8-hour	NS	2	0.081	0.054	0.075	0.071	0.071	0.077	0.077	0.076	0.088	0.082
	2nd daily max 1-hour	NS	2	0.105	0.075	0.098	0.09	0.088	0.108	0.102	0.107	0.107	0.107
PM$_{10}$	90th percentile	Down	4	49.5	48.5	51.25	51.25	51	42.75	39.75	44.5	46.75	38
	weighted annual mean	Down	4	30.65	31.85	33.7	32.4	31.4	28.8	24.6	26.35	29.975	24.5
SO$_2$	arithmetic mean	NS	1	0.008	0.009	0.01	0.01	0.011	0.009	0.009	0.008	0.009	0.008
	2nd max 24-hour	NS	1	0.038	0.05	0.054	0.066	0.052	0.053	0.07	0.049	0.073	0.041
MODESTO, CA													
CO	2nd max 8-hour	Down	2	7.3	6.75	5	4.65	5.1	4.2	4.3	3.7	4.3	4.85
Pb	max quarterly mean	Down	1	0.036	0.036	0.019	0.018	0.019	0.012	0.01	0.011	0.011	0.011
NO$_2$	arithmetic mean	Down	2	0.023	0.023	0.021	0.02	0.02	0.019	0.019	0.019	0.019	0.02
O$_3$	4th max 8-hour	NS	2	0.096	0.091	0.089	0.093	0.09	0.099	0.096	0.086	0.103	0.089
	2nd daily max 1-hour	NS	2	0.115	0.11	0.11	0.12	0.112	0.125	0.124	0.11	0.14	0.109
PM$_{10}$	90th percentile	Down	2	85	101	68.5	72	54	68	40.5	47.5	37.5	37.5
	weighted annual mean	Down	2	43.85	48.4	39.45	40.15	37	34.3	28.35	29.6	22.55	22.55
MONMOUTH-OCEAN, NJ													
CO	2nd max 8-hour	Down	2	5.7	5.45	4.65	5.3	4.9	3.75	4.4	3.65	3	3.3
O$_3$	4th max 8-hour	NS	2	0.098	0.101	0.09	0.099	0.092	0.115	0.095	0.104	0.099	0.1
	2nd daily max 1-hour	NS	2	0.134	0.14	0.133	0.129	0.117	0.148	0.121	0.141	0.132	0.127
MONTGOMERY, AL													
O$_3$	4th max 8-hour	NS	1	0.078	0.067	0.076	0.085	0.078	0.088	0.076	0.07	0.091	0.077
	2nd daily max 1-hour	NS	1	0.097	0.088	0.095	0.113	0.101	0.102	0.102	0.087	0.116	0.096
PM$_{10}$	90th percentile	NS	1	41	44	39	34	36	43	37	40	39	38
	weighted annual mean	NS	1	26.9	25.8	24.2	22.8	25	26.1	22.5	23.9	27.8	23.9
MYRTLE BEACH, SC													
Pb	max quarterly mean	NS	1	0.013	0.013	0.011	0.007	0.005	0.007	0.003	0.006	0.01	0.009
NASHUA, NH													
CO	2nd max 8-hour	Down	2	7.05	6.85	6.8	5.15	7.45	6.75	7.7	4.65	4.45	4.4
NO$_2$	arithmetic mean	NS	1	0.016	0.016	0.015	0.016	0.015	0.014	0.019	0.016	0.015	0.015
O$_3$	4th max 8-hour	NS	2	0.08	0.089	0.084	0.085	0.081	0.083	0.083	0.088	0.073	0.076
	2nd daily max 1-hour	NS	2	0.096	0.103	0.098	0.113	0.099	0.102	0.101	0.109	0.089	0.089
PM$_{10}$	90th percentile	Down	3	32	34	29	27.667	31	25	28.667	29	27.333	26.333
	weighted annual mean	Down	3	17.7	19.067	16.867	16.033	14.133	13.467	15.733	17.267	15.667	15.533
SO$_2$	arithmetic mean	NS	3	0.007	0.005	0.006	0.006	0.006	0.005	0.005	0.006	0.005	0.005
	2nd max 24-hour	Down	3	0.036	0.024	0.025	0.022	0.028	0.023	0.021	0.025	0.019	0.019
NASHVILLE, TN													
CO	2nd max 8-hour	Down	3	5.933	5	5.533	6.4	5.433	4.833	3.867	4.733	4.367	4.433
Pb	max quarterly mean	Down	5	1.257	1.064	0.989	0.887	0.933	1.784	0.574	0.633	0.74	0.502
NO$_2$	arithmetic mean	NS	1	0.012	0.01	0.014	0.012	0.02	0.014	0.012	0.012	0.011	0.019
O$_3$	4th max 8-hour	up	6	0.089	0.08	0.075	0.079	0.083	0.086	0.087	0.09	0.091	0.095
	2nd daily max 1-hour	up	6	0.113	0.099	0.098	0.104	0.103	0.103	0.108	0.112	0.113	0.119
PM$_{10}$	90th percentile	Down	6	56.833	51.667	47.833	47.167	51	50	43.167	46.667	44.833	44
	weighted annual mean	Down	6	36.367	34.75	30.55	30.95	30.217	30.733	28.383	28.183	28.067	27.217
SO$_2$	arithmetic mean	Down	2	0.013	0.012	0.008	0.01	0.007	0.005	0.006	0.006	0.005	0.004
	2nd max 24-hour	NS	2	0.08	0.078	0.028	0.063	0.041	0.025	0.049	0.059	0.035	0.029
NASSAU-SUFFOLK, NY													
CO	2nd max 8-hour	Down	1	7.2	6.6	5.6	5.6	5.4	5	4.9	4.7	4	4.5
NO$_2$	arithmetic mean	Down	1	0.028	0.029	0.026	0.026	0.028	0.025	0.026	0.025	0.022	0.024
O$_3$	4th max 8-hour	NS	2	0.1	0.1	0.09	0.097	0.09	0.109	0.089	0.102	0.093	0.099
	2nd daily max 1-hour	NS	2	0.132	0.147	0.123	0.13	0.121	0.141	0.118	0.133	0.126	0.13
PM$_{10}$	90th percentile	Down	2	53.5	53.5	38	41.5	38.5	32.5	28.5	33.5	30	28
	weighted annual mean	Down	2	26.85	26.85	22.25	23.05	22.65	19.1	18.05	20.25	18.4	17.3
SO$_2$	arithmetic mean	Down	2	0.009	0.009	0.008	0.008	0.007	0.005	0.007	0.006	0.006	0.007
	2nd max 24-hour	Down	2	0.045	0.039	0.039	0.033	0.037	0.03	0.028	0.029	0.028	0.032

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NEW BEDFORD, MA													
O_3	4th max 8-hour	NS	1	0.099	0.101	0.087	0.073	0.077	0.107	0.092	0.092	0.083	0.098
	2nd daily max 1-hour	NS	1	0.126	0.132	0.109	0.088	0.096	0.138	0.118	0.123	0.101	0.125
PM_{10}	90th percentile	NS	1	34	35	29	24	37	21	27	29	25	25
	weighted annual mean	Down	1	23	20.4	17.4	16.8	19.1	14.3	16.1	17.8	16	16
NEW HAVEN-MERIDEN, CT													
NO_2	arithmetic mean	NS	1	0.027	0.028	0.025	0.027	0.03	0.025	0.026	0.024	0.027	0.026
O_3	4th max 8-hour	NS	2	0.1	0.116	0.084	0.094	0.088	0.105	0.085	0.099	0.088	0.098
	2nd daily max 1-hour	NS	2	0.129	0.161	0.115	0.137	0.137	0.144	0.113	0.136	0.124	0.136
PM_{10}	90th percentile	Down	6	48.833	57.667	46	51.167	51.833	40.5	36.167	35.667	36.167	37
	weighted annual mean	Down	6	30.033	33.483	26.733	28.583	29.067	23.617	22.217	22.567	23.117	22.8
SO_2	arithmetic mean	Down	2	0.01	0.01	0.009	0.008	0.008	0.006	0.006	0.005	0.005	0.006
	2nd max 24-hour	Down	2	0.045	0.055	0.042	0.038	0.049	0.031	0.027	0.028	0.028	0.026
NEW LONDON-NORWICH, CT-RI													
O_3	4th max 8-hour	NS	1	0.105	0.107	0.088	0.099	0.093	0.101	0.095	0.104	0.083	0.096
	2nd daily max 1-hour	NS	1	0.158	0.135	0.12	0.126	0.118	0.14	0.121	0.15	0.116	0.127
PM_{10}	90th percentile	Down	2	34.5	40	32	30.5	38.5	28.5	30.5	28.5	27.5	25
	weighted annual mean	Down	2	20.65	23.55	19.75	18.25	22.1	17.2	18.8	18.3	17.35	16.1
SO_2	arithmetic mean	Down	1	0.008	0.007	0.006	0.006	0.005	0.005	0.005	0.004	0.004	0.004
	2nd max 24-hour	Down	1	0.029	0.027	0.025	0.019	0.029	0.017	0.016	0.022	0.018	0.018
NEW ORLEANS, LA													
CO	2nd max 8-hour	Down	2	4.85	4.15	5.35	5.1	4.6	3.55	3.95	3.25	3.15	3.2
Pb	max quarterly mean	NS	1	0.049	0.049	0.049	0.073	0.12	0.411	0.093	0.053	0.114	0.077
NO_2	arithmetic mean	NS	2	0.016	0.015	0.017	0.016	0.015	0.016	0.015	0.014	0.016	0.017
O_3	4th max 8-hour	up	6	0.079	0.072	0.077	0.079	0.082	0.083	0.08	0.078	0.081	0.085
	2nd daily max 1-hour	NS	6	0.104	0.1	0.101	0.104	0.11	0.11	0.103	0.1	0.108	0.105
PM_{10}	90th percentile	Down	1	44	48	39	42	40	37	31	36	36	36
	weighted annual mean	NS	1	27.2	26.3	26.6	24.7	25.3	24.3	22.3	25.2	25.2	25.2
SO_2	arithmetic mean	NS	1	0.003	0.005	0.005	0.006	0.008	0.007	0.006	0.005	0.004	0.005
	2nd max 24-hour	NS	1	0.013	0.028	0.019	0.025	0.027	0.022	0.035	0.017	0.026	0.023
NEW YORK, NY													
CO	2nd max 8-hour	Down	5	7.1	6.7	6.1	5.26	5.94	6.52	4.56	3.64	3.72	4.12
Pb	max quarterly mean	NS	1	0.164	0.124	0.106	0.163	0.14	0.124	0.156	0.155	0.137	0.095
NO_2	arithmetic mean	Down	2	0.043	0.043	0.037	0.04	0.042	0.039	0.039	0.038	0.038	0.037
O_3	4th max 8-hour	NS	5	0.098	0.105	0.078	0.087	0.092	0.096	0.088	0.103	0.09	0.101
	2nd daily max 1-hour	NS	5	0.13	0.141	0.116	0.115	0.12	0.122	0.117	0.131	0.116	0.134
PM_{10}	90th percentile	NS	12	51.917	46.167	40.5	41	46.583	40.583	39.583	40.833	41.417	40.417
	weighted annual mean	Down	12	30.6	29.225	26.25	25.433	27.925	25.325	26.133	25.933	25.125	23.85
SO_2	arithmetic mean	Down	7	0.014	0.014	0.013	0.012	0.013	0.01	0.01	0.009	0.008	0.009
	2nd max 24-hour	Down	7	0.054	0.048	0.051	0.039	0.054	0.038	0.04	0.033	0.03	0.032
NEWARK, NJ													
CO	2nd max 8-hour	Down	3	7.1	8.333	5.633	4.933	7.667	6.033	5.067	4.6	3.667	4.867
NO_2	arithmetic mean	NS	4	0.029	0.028	0.03	0.028	0.03	0.028	0.029	0.028	0.029	0.029
O_3	4th max 8-hour	NS	2	0.096	0.105	0.085	0.092	0.09	0.105	0.087	0.097	0.092	0.1
	2nd daily max 1-hour	NS	2	0.127	0.125	0.105	0.115	0.114	0.12	0.115	0.11	0.116	0.121
PM_{10}	90th percentile	NS	3	55	52.333	44	52	57.333	46	48.667	48.667	44.667	47.333
	weighted annual mean	NS	3	30.633	29.9	28.733	30.133	34.567	27.833	31.4	30.933	27.8	29.6
SO_2	arithmetic mean	Down	4	0.01	0.01	0.009	0.007	0.008	0.006	0.006	0.006	0.006	0.006
	2nd max 24-hour	Down	4	0.04	0.035	0.04	0.025	0.033	0.025	0.027	0.023	0.021	0.021
NEWBURGH, NY-PA													
Pb	max quarterly mean	Down	2	1.01	0.655	0.577	0.344	0.081	0.079	0.059	0.198	0.1	0.198
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS,VA-N													
CO	2nd max 8-hour	NS	3	4.533	5.133	4.333	4.967	5.367	4.267	4.3	4.033	4.633	3.767
NO_2	arithmetic mean	NS	1	0.019	0.02	0.02	0.021	0.019	0.018	0.018	0.019	0.019	0.017
O_3	4th max 8-hour	NS	3	0.085	0.083	0.086	0.094	0.081	0.083	0.077	0.092	0.088	0.094
	2nd daily max 1-hour	NS	3	0.104	0.103	0.125	0.119	0.101	0.105	0.094	0.111	0.103	0.125
PM_{10}	90th percentile	NS	2	37.5	43	36	41	30.5	34	33	35.5	36	33.5
	weighted annual mean	NS	2	24.5	25.15	21.6	23.45	19.8	19.7	20.8	21.6	21.85	20.45
SO_2	arithmetic mean	Down	2	0.007	0.007	0.006	0.007	0.007	0.006	0.006	0.006	0.006	0.006
	2nd max 24-hour	Down	2	0.025	0.022	0.024	0.026	0.024	0.022	0.022	0.025	0.02	0.018
OAKLAND, CA													
CO	2nd max 8-hour	Down	5	4.92	4.98	4.14	3.54	3.72	2.82	2.96	3	2.98	3.2
Pb	max quarterly mean	Down	2	0.073	0.061	0.022	0.024	0.017	0.028	0.012	0.008	0.008	0.008
NO_2	arithmetic mean	Down	2	0.021	0.022	0.02	0.02	0.02	0.019	0.018	0.017	0.018	0.019
O_3	4th max 8-hour	NS	7	0.062	0.065	0.067	0.069	0.065	0.082	0.073	0.06	0.069	0.073
	2nd daily max 1-hour	NS	7	0.097	0.1	0.097	0.106	0.099	0.133	0.107	0.094	0.104	0.106
PM_{10}	90th percentile	Down	3	58.667	64.667	41.333	39	38	36.667	34.667	32.667	28.667	32.667
	weighted annual mean	Down	3	32.267	34.1	26.767	23.733	23.8	21.167	21.967	21.733	19.033	21.267
SO_2	arithmetic mean	NS	3	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	2nd max 24-hour	NS	3	0.011	0.01	0.009	0.01	0.007	0.007	0.007	0.008	0.009	0.013

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
OKLAHOMA CITY, OK														
	CO	2nd max 8-hour	Down	2	4.5	3.9	4.3	5.15	4.25	3.8	3.95	4	3.35	3.35
	Pb	max quarterly mean	Down	1	0.036	0.039	0.029	0.017	0.013	0.017	0.008	0.001	0.001	0.001
	NO$_2$	arithmetic mean	NS	3	0.012	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.012	0.012
	O$_3$	4th max 8-hour	up	4	0.075	0.078	0.073	0.071	0.078	0.085	0.078	0.08	0.086	0.081
		2nd daily max 1-hour	NS	4	0.098	0.099	0.093	0.092	0.093	0.11	0.094	0.098	0.107	0.092
	PM$_{10}$	90th percentile	NS	4	36	34.5	34	34.25	33.75	37.5	39	38.5	38.5	38.5
		weighted annual mean	NS	4	21.525	22.2	21.65	20.875	21.05	21.425	24.225	21.85	21.85	21.85
OLYMPIA, WA														
	PM$_{10}$	90th percentile	Down	1	44	43	42	49	30	35	30	36	22	25
		weighted annual mean	Down	1	23.6	25	23.8	23.8	17.4	17.2	15.6	16.4	14.2	14.4
OMAHA, NE-IA														
	CO	2nd max 8-hour	NS	2	5.15	5.8	5.9	5.3	3.95	5.5	4.85	4.2	5.3	5.75
	Pb	max quarterly mean	NS	6	0.841	0.752	1.329	1.29	1.684	1.032	1.003	0.348	0.046	0.101
	O$_3$	4th max 8-hour	NS	3	0.06	0.064	0.063	0.05	0.06	0.063	0.056	0.062	0.064	0.072
		2nd daily max 1-hour	NS	3	0.069	0.077	0.076	0.059	0.073	0.077	0.068	0.072	0.077	0.088
	PM$_{10}$	90th percentile	NS	7	63.286	58.571	62.429	47.857	51.857	51.857	49.143	51.571	60.429	71
		weighted annual mean	NS	7	37.157	36.357	35.529	31	32.957	29.586	32.7	32.714	34.486	39.029
ORANGE COUNTY, CA														
	CO	2nd max 8-hour	Down	4	8.275	6.95	7.475	5.8	7.325	5.725	5.75	4.775	5	4.65
	NO$_2$	arithmetic mean	Down	3	0.039	0.038	0.034	0.032	0.034	0.033	0.029	0.028	0.029	0.029
	O$_3$	4th max 8-hour	Down	4	0.106	0.099	0.105	0.094	0.097	0.084	0.082	0.073	0.084	0.069
		2nd daily max 1-hour	Down	4	0.173	0.18	0.17	0.15	0.155	0.12	0.12	0.108	0.138	0.111
	PM$_{10}$	90th percentile	NS	2	75	67.5	53	57	53.5	68	46.5	50	52	69
		weighted annual mean	NS	2	45.45	41.25	37.2	36.3	35.6	40.55	32.65	37	33.3	40.5
	SO$_2$	arithmetic mean	NS	1	0.002	0.002	0.002	0.002	0.002	0.003	0.001	0.001	0.002	0.002
		2nd max 24-hour	Down	1	0.008	0.007	0.008	0.006	0.005	0.005	0.004	0.006	0.005	0.005
ORLANDO, FL														
	CO	2nd max 8-hour	Down	2	4.45	3.55	3.85	3.8	3.6	3.3	3.25	3.55	2.95	2.75
	NO$_2$	arithmetic mean	NS	1	0.012	0.012	0.011	0.012	0.011	0.01	0.013	0.013	0.011	0.012
	O$_3$	4th max 8-hour	NS	3	0.081	0.07	0.081	0.081	0.079	0.075	0.074	0.078	0.087	0.081
		2nd daily max 1-hour	NS	3	0.112	0.093	0.1	0.098	0.098	0.097	0.097	0.1	0.106	0.1
	PM$_{10}$	90th percentile	NS	5	35.2	33.8	34.6	31.2	29.4	30	31.8	30.8	34.4	32.4
		weighted annual mean	NS	5	24.5	24.56	22.8	21.68	21.08	20.14	21.36	21.84	22.98	22.22
	SO$_2$	arithmetic mean	NS	1	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
		2nd max 24-hour	NS	1	0.011	0.007	0.007	0.011	0.012	0.006	0.008	0.006	0.007	0.007
OWENSBORO, KY														
	NO$_2$	arithmetic mean	NS	1	0.011	0.011	0.012	0.012	0.012	0.013	0.011	0.012	0.013	0.011
	O$_3$	4th max 8-hour	NS	1	0.086	0.075	0.075	0.081	0.092	0.088	0.086	0.087	0.086	0.09
		2nd daily max 1-hour	NS	1	0.11	0.09	0.085	0.106	0.107	0.109	0.107	0.108	0.11	0.102
	PM$_{10}$	90th percentile	NS	3	45.333	44.667	45	44.667	44.667	48.333	41.333	42	43.333	43
		weighted annual mean	Down	3	29.033	29.233	26.7	25.1	28.7	27	24.167	24.267	24.633	24.3
	SO$_2$	arithmetic mean	Down	1	0.009	0.009	0.009	0.009	0.009	0.007	0.007	0.007	0.007	0.006
		2nd max 24-hour	Down	1	0.038	0.044	0.053	0.05	0.035	0.028	0.02	0.027	0.023	0.024
PARKERSBURG-MARIETTA, WV-OH														
	Pb	max quarterly mean	NS	1	0.019	0.015	0.024	0.017	0.014	0.019	0.023	0.011	0.011	0.011
	O$_3$	4th max 8-hour	NS	2	0.084	0.102	0.08	0.092	0.095	0.097	0.088	0.085	0.093	0.096
		2nd daily max 1-hour	NS	2	0.113	0.12	0.156	0.114	0.113	0.117	0.107	0.106	0.113	0.121
	PM$_{10}$	90th percentile	NS	1	46	46	46	51	51	40	34	39	44	36
		weighted annual mean	Down	1	27.2	27.2	27.2	29.2	27.3	25.3	22.7	23.1	23.1	20.5
	SO$_2$	arithmetic mean	NS	1	0.014	0.014	0.014	0.014	0.017	0.01	0.01	0.01	0.013	0.013
		2nd max 24-hour	NS	1	0.064	0.06	0.059	0.065	0.084	0.041	0.046	0.052	0.089	0.058
PENSACOLA, FL														
	O$_3$	4th max 8-hour	NS	2	0.088	0.075	0.087	0.08	0.085	0.083	0.079	0.085	0.095	0.084
		2nd daily max 1-hour	NS	2	0.112	0.103	0.104	0.102	0.108	0.117	0.098	0.11	0.121	0.102
	SO$_2$	arithmetic mean	Down	2	0.008	0.007	0.008	0.006	0.005	0.003	0.004	0.004	0.004	0.004
		2nd max 24-hour	Down	2	0.074	0.063	0.063	0.047	0.045	0.023	0.024	0.031	0.023	0.024
PEORIA-PEKIN, IL														
	CO	2nd max 8-hour	Down	1	7.4	6.3	7.2	7.3	5.7	5.6	4.6	4.7	5.8	4.6
	Pb	max quarterly mean	Down	1	0.035	0.021	0.024	0.032	0.019	0.026	0.024	0.019	0.017	0.017
	O$_3$	4th max 8-hour	NS	2	0.071	0.079	0.075	0.064	0.075	0.082	0.081	0.072	0.076	0.082
		2nd daily max 1-hour	NS	2	0.084	0.096	0.09	0.079	0.089	0.094	0.089	0.086	0.085	0.098
	PM$_{10}$	90th percentile	Down	2	45	42.5	44.5	36.5	40.5	40	33.5	40	40.5	39.5
		weighted annual mean	NS	2	27.45	26.35	28.25	21.55	23.3	21.55	22.35	26.45	25.9	24.65
	SO$_2$	arithmetic mean	NS	2	0.007	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006
		2nd max 24-hour	Down	2	0.055	0.065	0.043	0.039	0.05	0.084	0.045	0.042	0.041	0.036

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
PHILADELPHIA, PA-NJ													
CO	2nd max 8-hour	Down	9	4.933	4.578	4.722	4.689	5.222	4.089	4.189	3.322	3.1	3.422
Pb	max quarterly mean	NS	10	0.535	0.354	0.563	0.856	0.537	0.694	0.921	0.769	0.273	0.475
NO_2	arithmetic mean	NS	7	0.025	0.025	0.025	0.025	0.026	0.025	0.026	0.025	0.025	0.023
O_3	4th max 8-hour	NS	8	0.103	0.109	0.09	0.099	0.091	0.106	0.093	0.103	0.097	0.101
	2nd daily max 1-hour	NS	8	0.132	0.135	0.113	0.127	0.117	0.13	0.12	0.125	0.118	0.127
PM_{10}	90th percentile	Down	7	54.143	56.714	44	50.143	55.714	51.286	46.857	50.571	45.429	42.429
	weighted annual mean	Down	7	31.286	33.9	28.629	29.543	32.714	29.914	29.471	29.471	27.329	24.557
SO_2	arithmetic mean	Down	13	0.01	0.009	0.008	0.008	0.009	0.007	0.007	0.007	0.006	0.006
	2nd max 24-hour	Down	13	0.039	0.034	0.034	0.031	0.04	0.028	0.026	0.027	0.024	0.023
PHOENIX-MESA, AZ													
CO	2nd max 8-hour	Down	8	6.65	6.225	6.463	5.988	6.263	6.15	5.65	5.1	5.3	5.113
Pb	max quarterly mean	Down	2	0.085	0.105	0.058	0.054	0.047	0.059	0.044	0.023	0.023	0.023
O_3	4th max 8-hour	NS	8	0.079	0.074	0.081	0.081	0.08	0.087	0.086	0.08	0.081	0.081
	2nd daily max 1-hour	NS	8	0.109	0.101	0.113	0.111	0.111	0.119	0.109	0.102	0.104	0.105
PM_{10}	90th percentile	NS	8	67	66.375	63.125	60.875	62	64.875	61.375	69.875	63.063	70.875
	weighted annual mean	NS	8	42.925	43.05	40.4	41.138	40.213	41.275	41.288	46.075	37.794	44.213
SO_2	arithmetic mean	NS	1	0.003	0.005	0.004	0.003	0.003	0.002	0.003	0.004	0.004	0.003
	2nd max 24-hour	NS	1	0.011	0.013	0.01	0.009	0.009	0.008	0.017	0.009	0.011	0.012
PINE BLUFF, AR													
PM_{10}	90th percentile	up	1	39	30	38	39	39	56	39	41	41	41
	weighted annual mean	up	1	20.9	19.1	21.9	23.4	24.7	26.4	23.3	24.5	24.5	24.5
PITTSBURGH, PA													
CO	2nd max 8-hour	Down	5	5.56	4.26	4.8	3.76	4.26	3.82	3.26	2.52	2.56	2.4
Pb	max quarterly mean	Down	4	0.088	0.087	0.067	0.066	0.084	0.061	0.042	0.049	0.044	0.046
NO_2	arithmetic mean	Down	5	0.023	0.023	0.022	0.022	0.023	0.021	0.021	0.02	0.022	0.021
O_3	4th max 8-hour	NS	8	0.081	0.092	0.074	0.088	0.093	0.099	0.089	0.093	0.097	0.092
	2nd daily max 1-hour	up	8	0.1	0.11	0.091	0.11	0.114	0.123	0.105	0.117	0.114	0.121
PM_{10}	90th percentile	Down	19	60.842	59.211	54.605	54.368	62.263	54.579	48.947	51.105	48.368	48.632
	weighted annual mean	Down	19	20.174	20.132	18.121	17.489	19.495	17.105	16.521	16.737	16.174	16.174
SO_2	arithmetic mean	Down	16	0.016	0.015	0.015	0.015	0.015	0.011	0.011	0.011	0.011	0.01
	2nd max 24-hour	Down	16	0.071	0.058	0.072	0.061	0.073	0.044	0.043	0.046	0.042	0.037
PITTSFIELD, MA													
O_3	4th max 8-hour	Down	1	0.092	0.092	0.087	0.083	0.074	0.072	0.081	0.078	0.071	0.075
	2nd daily max 1-hour	NS	1	0.105	0.103	0.109	0.112	0.085	0.086	0.108	0.087	0.078	0.092
POCATELLO, ID													
PM_{10}	90th percentile	Down	4	54	61	61.5	54.75	49.25	40.5	44.25	37.25	35.75	41
	weighted annual mean	Down	4	32.825	34.15	41.675	36.975	29.45	23.85	25.125	23.125	22.4	23.9
PONCE, PR													
PM_{10}	90th percentile	NS	1	47	47	49	53	38	33	35	47	51	51
	weighted annual mean	NS	1	29.7	29.7	29.4	29.9	26.8	24.1	24.3	28.7	27.5	27.5
PORTLAND, ME													
O_3	4th max 8-hour	NS	1	0.092	0.109	0.097	0.089	0.088	0.096	0.083	0.103	0.089	0.076
	2nd daily max 1-hour	NS	1	0.125	0.141	0.118	0.112	0.122	0.116	0.1	0.13	0.12	0.105
PM_{10}	90th percentile	NS	2	39	43.5	38	44	42.5	50	36	42.5	38.5	32.5
	weighted annual mean	NS	2	25.05	26.15	23.45	25.2	23.8	27.5	23.75	26.05	22.55	20.65
SO_2	arithmetic mean	Down	1	0.01	0.009	0.008	0.009	0.008	0.006	0.005	0.005	0.005	0.005
	2nd max 24-hour	NS	1	0.034	0.032	0.029	0.032	0.043	0.022	0.021	0.023	0.025	0.025
PORTLAND-VANCOUVER, OR-WA													
CO	2nd max 8-hour	Down	2	8.45	9.1	6.95	6.3	7	5.65	6.05	5.35	5.05	6.1
O_3	4th max 8-hour	NS	4	0.082	0.064	0.073	0.058	0.064	0.066	0.085	0.056	0.069	0.057
	2nd daily max 1-hour	NS	4	0.116	0.095	0.097	0.087	0.087	0.097	0.115	0.081	0.106	0.079
PM_{10}	90th percentile	Down	6	42	43.333	39.167	42.5	36.833	31.333	33	31.833	30.5	31.833
	weighted annual mean	Down	6	25.1	25.633	22.683	24.85	22.75	19.583	20.067	21.367	18.833	18.617
PORTSMOUTH-ROCHESTER, NH-ME													
NO_2	arithmetic mean	Down	1	0.015	0.015	0.013	0.014	0.013	0.012	0.013	0.013	0.012	0.01
O_3	4th max 8-hour	NS	2	0.081	0.101	0.087	0.089	0.092	0.092	0.083	0.096	0.085	0.087
	2nd daily max 1-hour	NS	2	0.111	0.141	0.112	0.107	0.113	0.124	0.103	0.129	0.113	0.117
PM_{10}	90th percentile	Down	2	33	35.5	31.5	29.5	27	26	26.5	29	25.5	27
	weighted annual mean	Down	2	19.8	19.45	18.9	18.2	14.2	14.9	16.3	17.05	15.85	15.75
SO_2	arithmetic mean	Down	1	0.007	0.007	0.006	0.006	0.006	0.004	0.004	0.004	0.004	0.004
	2nd max 24-hour	Down	1	0.025	0.021	0.027	0.019	0.022	0.017	0.015	0.018	0.016	0.019
PROVIDENCE-FALL RIVER-WARWICK, RI-MA													
CO	2nd max 8-hour	Down	1	7.3	7.4	6.3	5.4	6.7	7	4.4	5.6	4.7	3.9
NO_2	arithmetic mean	NS	1	0.024	0.025	0.023	0.022	0.022	0.022	0.025	0.025	0.025	0.024
O_3	4th max 8-hour	NS	2	0.095	0.104	0.083	0.086	0.087	0.098	0.074	0.092	0.086	0.088
	2nd daily max 1-hour	NS	2	0.131	0.138	0.114	0.109	0.118	0.127	0.1	0.112	0.109	0.116
PM_{10}	90th percentile	Down	3	44.333	48	40	43	49	37.667	40.667	38.333	36.333	36.333
	weighted annual mean	Down	3	29.167	29.833	24.433	26.433	28.867	23.867	26.7	25.467	22.933	23.767
SO_2	arithmetic mean	Down	3	0.01	0.01	0.009	0.008	0.008	0.005	0.006	0.006	0.006	0.005
	2nd max 24-hour	Down	3	0.037	0.036	0.042	0.033	0.033	0.023	0.028	0.029	0.027	0.026

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
PROVO-OREM, UT													
NO_2	arithmetic mean	NS	1	0.019	0.019	0.019	0.026	0.024	0.023	0.024	0.023	0.024	0.024
O_3	4th max 8-hour	NS	1	0.07	0.067	0.071	0.068	0.069	0.068	0.078	0.07	0.083	0.073
	2nd daily max 1-hour	NS	1	0.093	0.084	0.089	0.084	0.084	0.083	0.097	0.08	0.102	0.096
PM_{10}	90th percentile	Down	3	54.667	90.667	68.333	70.667	55.667	49.333	57.333	50	46.667	51.667
	weighted annual mean	Down	3	32.2	42.433	37	38.233	33.7	29	33.7	29.967	27.467	29.7
PUEBLO, CO													
PM_{10}	90th percentile	Down	1	43	46	46	38	45	45	42	41	33	33
	weighted annual mean	Down	1	26.3	29.7	26.3	26.1	29.6	26.2	25.8	26.8	21.7	21.7
RACINE, WI													
CO	2nd max 8-hour	Down	1	5.5	5.7	4.9	4.1	4.3	4.3	3	3.1	3	2.7
O_3	4th max 8-hour	NS	1	0.086	0.099	0.08	0.08	0.088	0.096	0.083	0.098	0.084	0.093
	2nd daily max 1-hour	NS	1	0.11	0.135	0.102	0.103	0.114	0.113	0.129	0.117	0.124	0.114
RALEIGH-DURHAM-CHAPEL HILL, NC													
CO	2nd max 8-hour	Down	2	7.15	7.2	6.45	6.25	6.3	6	5.5	6.75	5.3	5.05
O_3	4th max 8-hour	NS	1	0.093	0.085	0.082	0.095	0.083	0.081	0.082	0.097	0.099	0.108
	2nd daily max 1-hour	NS	1	0.12	0.107	0.099	0.113	0.107	0.096	0.093	0.112	0.124	0.134
PM_{10}	90th percentile	NS	2	44.5	40.5	35.5	39	31	33.5	39	39	40	36.5
	weighted annual mean	NS	2	28.6	25.55	24	24.75	21.8	23.3	25.1	24.6	24.4	22.15
RAPID CITY, SD													
PM_{10}	90th percentile	Down	3	50.667	52.333	47.667	45	55.333	45.333	42.667	51.667	42.333	38
	weighted annual mean	NS	3	30.367	31.233	28.8	26.233	32.733	26.667	27.1	29.8	26.7	23.833
READING, PA													
CO	2nd max 8-hour	Down	1	6.4	4.6	4.6	3.8	5.4	3.9	3.4	3	3	3
Pb	max quarterly mean	Down	12	0.59	0.64	0.558	0.47	0.485	0.343	0.327	0.368	0.412	0.48
NO_2	arithmetic mean	NS	1	0.022	0.022	0.02	0.021	0.023	0.021	0.022	0.021	0.021	0.021
O_3	4th max 8-hour	NS	2	0.092	0.104	0.086	0.088	0.084	0.093	0.086	0.092	0.091	0.101
	2nd daily max 1-hour	NS	2	0.111	0.121	0.099	0.108	0.104	0.112	0.105	0.115	0.105	0.126
SO_2	arithmetic mean	NS	2	0.01	0.01	0.009	0.009	0.011	0.009	0.009	0.009	0.009	0.009
	2nd max 24-hour	Down	2	0.035	0.034	0.033	0.033	0.04	0.033	0.036	0.03	0.024	0.026
REDDING, CA													
O_3	4th max 8-hour	NS	1	0.078	0.066	0.069	0.064	0.078	0.074	0.073	0.067	0.078	0.084
	2nd daily max 1-hour	NS	1	0.092	0.077	0.08	0.072	0.09	0.089	0.083	0.079	0.089	0.108
PM_{10}	90th percentile	Down	1	42	56	45	37	39	34	32	30	30	35
	weighted annual mean	Down	1	25	28.7	24.6	20.1	24.4	19.6	18.7	16.9	17.6	20
RENO, NV													
CO	2nd max 8-hour	NS	5	7.02	7.48	5.86	4.98	5.96	4.38	5.16	5.02	4.72	5.34
O_3	4th max 8-hour	NS	4	0.074	0.07	0.07	0.062	0.07	0.07	0.072	0.065	0.072	0.071
	2nd daily max 1-hour	NS	4	0.107	0.09	0.084	0.085	0.086	0.082	0.09	0.077	0.087	0.087
PM_{10}	90th percentile	Down	6	92	72.833	63.5	71.333	65.333	51.667	51.5	52.167	53.5	53.667
	weighted annual mean	Down	6	43.75	35.833	36.3	40.25	36.3	31.567	29.35	31.733	30.717	34.517
RICHMOND-PETERSBURG, VA													
CO	2nd max 8-hour	NS	2	4.4	3.65	2.5	3.9	3.4	2.55	2.85	3.2	2.8	2.9
NO_2	arithmetic mean	Down	1	0.023	0.024	0.023	0.024	0.024	0.022	0.022	0.021	0.021	0.021
O_3	4th max 8-hour	NS	4	0.083	0.085	0.086	0.098	0.085	0.09	0.083	0.097	0.095	0.097
	2nd daily max 1-hour	NS	4	0.109	0.109	0.115	0.124	0.11	0.115	0.103	0.12	0.12	0.126
PM_{10}	90th percentile	NS	3	39.667	45	35.667	42.667	33	38.333	37	37	37.333	33.667
	weighted annual mean	Down	3	24.867	26.233	22	23.267	20.5	23.2	23.733	22.433	21.867	20.267
SO_2	arithmetic mean	NS	2	0.006	0.006	0.005	0.007	0.006	0.005	0.006	0.005	0.005	0.005
	2nd max 24-hour	NS	2	0.027	0.024	0.022	0.028	0.023	0.02	0.025	0.021	0.022	0.021
RIVERSIDE-SAN BERNARDINO, CA													
CO	2nd max 8-hour	Down	6	4.683	5.667	4.017	3.9	3.833	3.75	3.233	3.4	3.167	2.85
Pb	max quarterly mean	NS	4	0.051	0.056	0.033	0.038	0.037	0.04	0.038	0.04	0.039	0.047
NO_2	arithmetic mean	Down	8	0.028	0.029	0.027	0.028	0.028	0.028	0.026	0.024	0.023	0.025
O_3	4th max 8-hour	Down	15	0.145	0.148	0.141	0.134	0.135	0.126	0.122	0.102	0.124	0.101
	2nd daily max 1-hour	Down	15	0.214	0.207	0.197	0.181	0.186	0.177	0.166	0.147	0.166	0.128
PM_{10}	90th percentile	Down	11	90.818	83.727	70.591	72.909	65.273	68.318	62	60.636	60.909	65.364
	weighted annual mean	Down	11	57.955	53.918	44.5	43.545	42.191	42.532	40.245	39.4	37.091	43.473
SO_2	arithmetic mean	NS	4	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002
	2nd max 24-hour	NS	4	0.007	0.008	0.009	0.007	0.004	0.005	0.004	0.004	0.007	0.007
ROANOKE, VA													
NO_2	arithmetic mean	NS	1	0.013	0.014	0.013	0.014	0.013	0.013	0.013	0.013	0.014	0.012
O_3	4th max 8-hour	up	1	0.075	0.077	0.072	0.084	0.084	0.079	0.073	0.084	0.099	0.089
	2nd daily max 1-hour	NS	1	0.086	0.1	0.089	0.103	0.102	0.093	0.084	0.102	0.126	0.105
PM_{10}	90th percentile	NS	2	58	50.5	47.5	56	55	54	58	51.5	48.5	48.5
	weighted annual mean	Down	2	36.45	32.5	31.65	34.85	35.55	34.35	33.05	29.85	29.2	29.9
SO_2	arithmetic mean	NS	1	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003
	2nd max 24-hour	Down	1	0.018	0.019	0.016	0.018	0.011	0.01	0.014	0.013	0.009	0.01
ROCHESTER, MN													
PM_{10}	90th percentile	Down	1	48	37	37	31	33	32	34	31	31	31
	weighted annual mean	NS	1	27.7	22.7	21.2	20.4	20.8	20.2	19.4	20	21.2	21.2

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
ROCHESTER, NY													
CO	2nd max 8-hour	NS	2	3.45	3.25	3.5	3.15	4.5	3.15	3.7	1.9	2.7	2.5
O_3	4th max 8-hour	NS	2	0.087	0.098	0.076	0.078	0.079	0.093	0.069	0.085	0.081	0.089
	2nd daily max 1-hour	NS	2	0.108	0.111	0.09	0.094	0.094	0.107	0.085	0.099	0.096	0.099
PM_{10}	90th percentile	NS	2	37.5	48.5	37.5	39.5	33	37	35	33	36	36
	weighted annual mean	Down	2	21.3	25.85	22.4	22.8	20.05	20.8	21.45	19.9	19.8	19.8
SO_2	arithmetic mean	Down	2	0.012	0.011	0.011	0.01	0.011	0.01	0.009	0.008	0.009	0.006
	2nd max 24-hour	NS	2	0.04	0.043	0.039	0.041	0.043	0.038	0.033	0.038	0.053	0.03
ROCKFORD, IL													
CO	2nd max 8-hour	Down	1	6.5	5.1	4.6	4.3	4	4.5	3.2	3.7	3.6	3.8
Pb	max quarterly mean	NS	1	0.085	0.044	0.059	0.034	0.039	0.027	0.049	0.029	0.043	0.043
O_3	4th max 8-hour	NS	2	0.068	0.077	0.082	0.067	0.079	0.085	0.078	0.072	0.072	0.08
	2nd daily max 1-hour	NS	2	0.085	0.091	0.093	0.077	0.102	0.101	0.089	0.082	0.084	0.09
PM_{10}	90th percentile	NS	1	45	35	31	26	36	39	29	42	39	39
	weighted annual mean	NS	1	25.2	22.2	21.4	16.3	18.8	18.9	17.6	25.6	24.1	24.1
SACRAMENTO, CA													
CO	2nd max 8-hour	Down	7	7.786	7.2	5.486	5.657	5.471	4.586	4.271	3.929	3.957	3.986
Pb	max quarterly mean	Down	2	0.105	0.04	0.022	0.049	0.019	0.021	0.014	0.012	0.009	0.009
NO_2	arithmetic mean	Down	3	0.02	0.017	0.018	0.018	0.016	0.017	0.017	0.015	0.016	0.017
O_3	4th max 8-hour	NS	8	0.093	0.095	0.094	0.09	0.091	0.097	0.094	0.081	0.094	0.091
	2nd daily max 1-hour	NS	8	0.13	0.128	0.124	0.116	0.113	0.128	0.116	0.101	0.126	0.117
PM_{10}	90th percentile	Down	3	54.333	54.333	42	38	37.667	47	33.667	31.333	31.333	45
	weighted annual mean	Down	3	31.233	31.233	27.633	22.667	23.8	22.9	20	20.167	18.8	23.967
SO_2	arithmetic mean	NS	2	0.004	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.003
	2nd max 24-hour	NS	2	0.011	0.011	0.01	0.004	0.005	0.005	0.004	0.005	0.01	0.008
ST. JOSEPH, MO													
PM_{10}	90th percentile	Down	1	71	79	70	56	62	67	52	57	47	47
	weighted annual mean	Down	1	40.2	44	38.6	31.5	33.7	33.3	32.4	31.4	25.8	25.8
ST. LOUIS, MO-IL													
CO	2nd max 8-hour	Down	8	4.25	4.313	3.45	3.538	3.763	3.313	3.425	3.238	3.4	2.513
Pb	max quarterly mean	Down	13	0.76	0.68	0.697	0.573	0.66	0.677	0.671	0.535	0.433	0.482
NO_2	arithmetic mean	NS	9	0.018	0.018	0.019	0.018	0.019	0.019	0.019	0.018	0.019	0.02
O_3	4th max 8-hour	NS	16	0.081	0.086	0.08	0.074	0.09	0.09	0.084	0.083	0.085	0.089
	2nd daily max 1-hour	NS	16	0.108	0.108	0.1	0.108	0.117	0.116	0.108	0.108	0.112	0.115
PM_{10}	90th percentile	NS	15	54.467	48.2	50.533	46.333	49.533	51.467	42.533	44.8	48.6	43.733
	weighted annual mean	Down	15	32.96	31.807	32.047	28.187	31.12	30.773	27.327	27.553	30.033	27.007
SO_2	arithmetic mean	Down	16	0.011	0.01	0.009	0.009	0.009	0.008	0.008	0.007	0.006	0.006
	2nd max 24-hour	Down	16	0.042	0.041	0.038	0.04	0.04	0.037	0.038	0.034	0.034	0.029
SALINAS, CA													
CO	2nd max 8-hour	Down	1	2.5	2.1	2.3	2.1	2	1.7	2.4	1.7	1.9	1.6
NO_2	arithmetic mean	Down	1	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.01	0.01	0.01
O_3	4th max 8-hour	NS	4	0.062	0.062	0.061	0.065	0.057	0.057	0.063	0.056	0.056	0.059
	2nd daily max 1-hour	Down	4	0.08	0.078	0.075	0.083	0.08	0.071	0.079	0.071	0.07	0.071
PM_{10}	90th percentile	NS	2	40	37	33.5	33	29	37.75	35	32	30.5	34.5
	weighted annual mean	NS	2	23.45	23.9	21.45	19.7	18.15	19	19	20.85	17.35	21.3
SALT LAKE CITY-OGDEN, UT													
CO	2nd max 8-hour	Down	1	6.8	7.5	6.5	6.4	5.9	4.5	6.2	5.4	4.9	5
Pb	max quarterly mean	NS	2	0.083	0.079	0.049	0.07	0.049	0.051	0.028	0.07	0.063	0.057
NO_2	arithmetic mean	NS	2	0.019	0.02	0.02	0.024	0.023	0.022	0.023	0.022	0.022	0.023
O_3	4th max 8-hour	NS	2	0.08	0.079	0.074	0.079	0.081	0.083	0.085	0.077	0.094	0.08
	2nd daily max 1-hour	NS	2	0.113	0.108	0.097	0.104	0.109	0.115	0.114	0.102	0.122	0.107
PM_{10}	90th percentile	Down	6	56.333	89	73.667	68.333	52.5	49.333	61	49	45.667	54.667
	weighted annual mean	Down	6	33.267	41.183	35.85	36.717	32.033	28.867	33.167	28.95	26.717	30.117
SO_2	arithmetic mean	Down	3	0.009	0.01	0.009	0.007	0.004	0.003	0.003	0.003	0.003	0.003
	2nd max 24-hour	Down	3	0.039	0.051	0.046	0.043	0.013	0.013	0.014	0.008	0.008	0.008
SAN ANTONIO, TX													
CO	2nd max 8-hour	Down	1	5.2	5.2	5.2	5	3.3	4.3	4.5	4.4	4.6	4.2
O_3	4th max 8-hour	NS	2	0.084	0.08	0.072	0.081	0.088	0.092	0.081	0.083	0.082	0.083
	2nd daily max 1-hour	NS	2	0.1	0.105	0.096	0.11	0.105	0.117	0.118	0.102	0.1	0.101
PM_{10}	90th percentile	Down	1	47	42	46	38	39	35	28	32	32	32
	weighted annual mean	Down	1	28.3	29.1	28.6	22.7	23.4	22	19.7	20.7	20.7	20.7
SAN DIEGO, CA													
CO	2nd max 8-hour	Down	8	5.588	5.25	4.95	4.413	4.738	4.213	4.288	3.838	3.525	3.713
Pb	max quarterly mean	Down	3	0.094	0.044	0.03	0.033	0.016	0.025	0.019	0.019	0.013	0.013
NO_2	arithmetic mean	Down	7	0.025	0.025	0.024	0.02	0.021	0.021	0.019	0.019	0.018	0.021
O_3	4th max 8-hour	Down	9	0.105	0.099	0.094	0.09	0.082	0.082	0.083	0.078	0.079	0.071
	2nd daily max 1-hour	Down	9	0.154	0.147	0.139	0.132	0.109	0.116	0.104	0.112	0.106	0.097
PM_{10}	90th percentile	Down	3	54.333	54	44	46	42	46	38	38	36	40.667
	weighted annual mean	Down	3	34.233	37.133	31.5	30.033	30.667	32.167	27.7	26.8	22.867	28
SO_2	arithmetic mean	NS	3	0.004	0.003	0.004	0.002	0.003	0.003	0.004	0.003	0.003	0.003
	2nd max 24-hour	NS	3	0.015	0.017	0.017	0.009	0.013	0.012	0.015	0.012	0.011	0.012

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SAN FRANCISCO, CA													
CO	2nd max 8-hour	Down	4	5.7	6.15	4.825	4.6	4.25	3.65	3.9	3.35	3.5	3.625
Pb	max quarterly mean	Down	1	0.044	0.04	0.02	0.026	0.019	0.027	0.014	0.02	0.013	0.013
NO_2	arithmetic mean	Down	1	0.021	0.024	0.022	0.024	0.022	0.021	0.022	0.02	0.02	0.021
O_3	4th max 8-hour	NS	3	0.044	0.046	0.045	0.048	0.049	0.061	0.055	0.048	0.045	0.052
	2nd daily max 1-hour	NS	3	0.06	0.063	0.063	0.083	0.072	0.094	0.082	0.074	0.063	0.082
PM_{10}	90th percentile	Down	1	59	66	56	39	47	34	32	33	34	36
	weighted annual mean	Down	1	28.3	32.1	28.5	26.5	24.8	21	21.1	23.9	22.4	24.5
SO_2	arithmetic mean	NS	1	0.002	0.002	0.003	0.002	0.001	0.002	0.002	0.002	0.002	0.002
	2nd max 24-hour	NS	1	0.01	0.013	0.012	0.01	0.005	0.005	0.007	0.006	0.006	0.006
SAN JOSE, CA													
CO	2nd max 8-hour	Down	2	10.75	10.15	7.25	6.4	7.35	5.6	5.65	5.35	6.05	6
Pb	max quarterly mean	Down	2	0.075	0.037	0.029	0.023	0.017	0.016	0.013	0.011	0.013	0.013
O_3	4th max 8-hour	NS	4	0.071	0.073	0.07	0.073	0.067	0.083	0.081	0.062	0.073	0.072
	2nd daily max 1-hour	NS	4	0.105	0.11	0.108	0.105	0.096	0.118	0.109	0.084	0.111	0.11
PM_{10}	90th percentile	Down	4	72	63.75	54.75	45.5	46.75	38.5	30.75	31.75	33	36.5
	weighted annual mean	Down	4	35.75	33.775	29.7	25.825	26.275	21.5	20.75	22.475	20.95	22.625
SAN JUAN-BAYAMON, PR													
CO	2nd max 8-hour	Down	2	5.3	5.25	5.3	4.45	4.8	4.85	3.95	3.9	3.75	3.5
PM_{10}	90th percentile	NS	7	59.286	47.143	44.429	54.429	45.429	36.714	39.286	50.286	47.429	50.143
	weighted annual mean	NS	7	33.429	29.157	27.714	31.443	28.886	25.071	26.486	30.4	28.043	28.729
SO_2	arithmetic mean	Down	2	0.007	0.01	0.009	0.008	0.008	0.006	0.005	0.004	0.003	0.004
	2nd max 24-hour	Down	2	0.056	0.062	0.069	0.038	0.048	0.039	0.021	0.017	0.013	0.018
SAN LUIS OBISPO-ATASCADERO-PASO ROBLES,C													
CO	2nd max 8-hour	Down	1	3.9	3.3	3	3.1	3.1	2.4	2.3	2.3	2	2.9
NO_2	arithmetic mean	Down	3	0.013	0.013	0.012	0.012	0.012	0.011	0.011	0.011	0.01	0.011
O_3	4th max 8-hour	NS	5	0.069	0.066	0.065	0.064	0.064	0.064	0.069	0.062	0.067	0.065
	2nd daily max 1-hour	NS	5	0.086	0.084	0.082	0.081	0.078	0.081	0.086	0.073	0.081	0.08
PM_{10}	90th percentile	Down	3	38	39.667	32	41.667	33	35.667	31.667	30.333	23.333	27.333
	weighted annual mean	Down	3	23.133	24.367	21.233	22.4	21.167	21.2	18.333	19.967	15.433	17.333
SO_2	arithmetic mean	NS	1	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001
	2nd max 24-hour	NS	1	0.006	0.005	0.004	0.004	0.005	0.004	0.004	0.004	0.004	0.004
SANTA BARBARA-SANTA MARIA-LOMPOC, CA													
CO	2nd max 8-hour	Down	4	2.35	2.325	2.25	2.15	2.5	2.1	1.85	1.625	1.675	1.675
Pb	max quarterly mean	Down	1	0.032	0.027	0.012	0.015	0.01	0.009	0.007	0.008	0.008	0.008
NO_2	arithmetic mean	Down	15	0.007	0.007	0.007	0.006	0.007	0.006	0.006	0.006	0.006	0.006
O_3	4th max 8-hour	Down	16	0.079	0.074	0.079	0.076	0.073	0.074	0.079	0.069	0.064	0.064
	2nd daily max 1-hour	Down	16	0.105	0.103	0.104	0.099	0.095	0.101	0.107	0.087	0.087	0.082
PM_{10}	90th percentile	NS	10	35.3	35.7	32.3	37.8	35.6	33.1	33.1	34.7	33.3	32.6
	weighted annual mean	NS	10	23.17	22.17	21.5	22.58	22.96	21.71	20.96	22.5	21.12	21.59
SO_2	arithmetic mean	NS	11	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	2nd max 24-hour	Down	11	0.003	0.003	0.003	0.004	0.003	0.004	0.003	0.002	0.002	0.002
SANTA CRUZ-WATSONVILLE, CA													
CO	2nd max 8-hour	Down	1	1	1	1	1	1.2	0.8	0.7	0.7	0.8	0.7
NO_2	arithmetic mean	Down	1	0.008	0.01	0.007	0.006	0.006	0.005	0.005	0.004	0.004	0.005
O_3	4th max 8-hour	NS	1	0.06	0.055	0.061	0.061	0.053	0.051	0.049	0.051	0.049	0.06
	2nd daily max 1-hour	NS	1	0.07	0.07	0.07	0.07	0.068	0.06	0.069	0.063	0.055	0.072
SO_2	arithmetic mean	NS	1	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.001
	2nd max 24-hour	NS	1	0.003	0.002	0.006	0.006	0.006	0.008	0.003	0.002	0.003	0.002
SANTA FE, NM													
CO	2nd max 8-hour	Down	1	3.5	3.9	3.7	3.4	2.7	2.3	2.2	2.1	2	1.7
PM_{10}	90th percentile	Down	2	23.5	21.5	23	22.5	21	18.5	21	19.5	20	18.5
	weighted annual mean	Down	2	16.6	14.35	16.15	14.85	13.75	12.75	13.95	13.55	13.6	12.85
SANTA ROSA, CA													
CO	2nd max 8-hour	Down	1	4.3	3.8	3.5	3.8	3.2	2.4	3	3.1	3	3.3
NO_2	arithmetic mean	NS	1	0.015	0.015	0.016	0.016	0.015	0.015	0.014	0.013	0.015	0.014
O_3	4th max 8-hour	up	2	0.056	0.059	0.057	0.061	0.06	0.065	0.062	0.064	0.063	0.072
	2nd daily max 1-hour	up	2	0.075	0.08	0.075	0.085	0.085	0.089	0.08	0.089	0.084	0.096
PM_{10}	90th percentile	Down	3	37.333	46	33	33.667	28.333	28.667	26.667	23	23.333	28.667
	weighted annual mean	Down	3	20.067	23.433	18.4	19.133	17.9	15.7	15.667	14.933	13.967	17.2
SARASOTA-BRADENTON, FL													
CO	2nd max 8-hour	NS	1	6.2	6.9	5.6	6.5	5.3	5.9	5.1	5.3	5.6	5.6
O_3	4th max 8-hour	NS	3	0.077	0.074	0.077	0.075	0.079	0.077	0.073	0.077	0.084	0.085
	2nd daily max 1-hour	NS	4	0.096	0.095	0.092	0.097	0.095	0.095	0.092	0.101	0.119	0.114
PM_{10}	90th percentile	Down	3	42.667	42.333	41.333	38.667	35	33.667	28.667	29.667	31.333	32.667
	weighted annual mean	Down	3	27.967	25.1	26.533	26.533	22.867	21.367	20.033	20.533	20.967	20.9
SO_2	arithmetic mean	Down	1	0.002	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002
	2nd max 24-hour	NS	1	0.016	0.035	0.021	0.018	0.017	0.01	0.018	0.009	0.019	0.019
SAVANNAH, GA													
SO_2	arithmetic mean	NS	1	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.003	0.003	0.003
	2nd max 24-hour	NS	1	0.008	0.009	0.008	0.011	0.015	0.013	0.019	0.013	0.01	0.01

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SCRANTON—WILKES-BARRE—HAZLETON, PA													
CO	2nd max 8-hour	Down	2	4.5	4.15	3.75	2.9	3.55	2.8	3.8	3.05	2.5	2.15
NO_2	arithmetic mean	Down	2	0.018	0.017	0.016	0.018	0.018	0.016	0.018	0.016	0.015	0.015
O_3	4th max 8-hour	NS	4	0.091	0.098	0.081	0.088	0.081	0.088	0.081	0.087	0.087	0.092
	2nd daily max 1-hour	NS	4	0.106	0.118	0.095	0.11	0.098	0.105	0.103	0.101	0.103	0.109
PM_{10}	90th percentile	Down	3	46	48.667	40.667	45.667	49	45	37.667	39	39	39
	weighted annual mean	NS	3	25.367	28.933	25.067	26.233	28.433	25.467	23.533	25.7	25.7	25.7
SO_2	arithmetic mean	Down	2	0.01	0.009	0.008	0.007	0.007	0.005	0.006	0.007	0.006	0.006
	2nd max 24-hour	Down	2	0.049	0.039	0.033	0.026	0.035	0.036	0.028	0.029	0.024	0.022
SEATTLE-BELLEVUE-EVERETT, WA													
CO	2nd max 8-hour	Down	6	7.617	7.7	7.783	5.783	5.683	5.55	5.333	5.6	4.65	4.717
Pb	max quarterly mean	NS	1	0.641	0.561	0.4	0.368	0.607	0.513	0.658	0.874	2.033	0.046
O_3	4th max 8-hour	NS	2	0.088	0.074	0.078	0.066	0.064	0.067	0.082	0.065	0.071	0.06
	2nd daily max 1-hour	NS	2	0.127	0.105	0.098	0.098	0.12	0.093	0.108	0.084	0.12	0.078
PM_{10}	90th percentile	Down	8	48.75	49.75	47.875	50.125	38.25	37	32	36.75	31.625	30
	weighted annual mean	Down	8	28.55	29.3	28.838	27.613	22.513	21.725	20.288	22.025	18.675	18.888
SO_2	arithmetic mean	Down	2	0.008	0.008	0.008	0.008	0.006	0.005	0.004	0.004	0.005	0.005
	2nd max 24-hour	Down	2	0.023	0.023	0.02	0.02	0.022	0.017	0.017	0.011	0.013	0.015
SHARON, PA													
Pb	max quarterly mean	Down	1	0.087	0.087	0.073	0.047	0.054	0.049	0.067	0.044	0.042	0.042
O_3	4th max 8-hour	NS	1	0.087	0.093	0.088	0.083	0.09	0.095	0.09	0.092	0.106	0.091
	2nd daily max 1-hour	NS	1	0.103	0.107	0.1	0.105	0.111	0.113	0.103	0.111	0.121	0.108
PM_{10}	90th percentile	Down	1	52	59	42	47	51	49	37	42	42	42
	weighted annual mean	NS	1	29.9	36	26.6	28.1	29.8	27.7	29	28.2	28.2	28.2
SO_2	arithmetic mean	Down	1	0.01	0.009	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007
	2nd max 24-hour	NS	1	0.036	0.032	0.03	0.029	0.047	0.032	0.029	0.032	0.029	0.039
SHREVEPORT-BOSSIER CITY, LA													
O_3	4th max 8-hour	NS	2	0.088	0.081	0.083	0.088	0.08	0.081	0.079	0.084	0.089	0.091
	2nd daily max 1-hour	NS	2	0.112	0.1	0.1	0.113	0.094	0.097	0.098	0.101	0.109	0.104
PM_{10}	90th percentile	NS	1	33	48	36	37	36	43	29	35	35	35
	weighted annual mean	NS	1	23.3	28.4	23.8	21.8	23.6	23.7	21.9	22.5	22.5	22.5
SO_2	arithmetic mean	NS	1	0.002	0.002	0.004	0.004	0.002	0.001	0.002	0.002	0.002	0.002
	2nd max 24-hour	NS	1	0.006	0.009	0.013	0.011	0.008	0.004	0.004	0.007	0.01	0.006
SIOUX CITY, IA-NE													
PM_{10}	90th percentile	NS	1	46	51	45	40	38	55	72	54	45	48
	weighted annual mean	NS	1	27.7	27.9	25.4	22.5	23.3	26.4	32.5	28.3	28	27.9
SIOUX FALLS, SD													
PM_{10}	90th percentile	NS	2	41.5	39.5	39.5	27.5	38.5	39.5	31.5	35	35	35.5
	weighted annual mean	NS	2	23.2	22.6	22.8	17	22.7	21.65	20.55	21.2	21.6	21.6
SOUTH BEND, IN													
O_3	4th max 8-hour	NS	3	0.082	0.086	0.081	0.076	0.086	0.094	0.09	0.089	0.091	0.088
	2nd daily max 1-hour	up	3	0.097	0.1	0.094	0.09	0.099	0.112	0.107	0.11	0.115	0.102
PM_{10}	90th percentile	Down	2	52.5	49	38	36	39	42	34.5	29.5	36.5	34
	weighted annual mean	Down	2	30.8	29.65	23.05	23.75	27.1	21.7	20.1	17.2	20.65	20.3
SPOKANE, WA													
CO	2nd max 8-hour	Down	3	9.1	9.333	8.133	8	6.4	6.933	6.833	5.133	5.133	4.567
O_3	4th max 8-hour	up	1	0.057	0.061	0.063	0.06	0.068	0.065	0.067	0.068	0.07	0.065
	2nd daily max 1-hour	NS	1	0.071	0.077	0.083	0.069	0.085	0.08	0.079	0.083	0.082	0.073
PM_{10}	90th percentile	Down	4	62.5	58.5	57	60.75	52	44	43.5	40.75	43	41.75
	weighted annual mean	Down	4	37.125	33.1	34.125	32.15	30.375	24.45	26.65	24.45	24.525	23.7
SPRINGFIELD, IL													
CO	2nd max 8-hour	Down	1	4.4	4.3	4.5	3.9	3.1	3.2	3	2.1	1.9	2.4
O_3	4th max 8-hour	Down	1	0.081	0.083	0.077	0.081	0.081	0.08	0.079	0.071	0.078	0.075
	2nd daily max 1-hour	NS	1	0.098	0.102	0.091	0.106	0.101	0.1	0.098	0.085	0.093	0.099
SO_2	arithmetic mean	NS	1	0.007	0.008	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.006
	2nd max 24-hour	NS	1	0.054	0.048	0.043	0.04	0.05	0.062	0.061	0.043	0.061	0.059
SPRINGFIELD, MO													
CO	2nd max 8-hour	Down	1	7.2	6.9	6.2	5.3	5.9	4.1	3.3	4.6	4	3.1
NO_2	arithmetic mean	up	1	0.008	0.008	0.01	0.011	0.013	0.012	0.011	0.011	0.012	0.013
O_3	4th max 8-hour	up	2	0.058	0.063	0.058	0.069	0.072	0.079	0.074	0.066	0.071	0.078
	2nd daily max 1-hour	up	2	0.075	0.073	0.085	0.075	0.093	0.098	0.086	0.08	0.09	0.094
PM_{10}	90th percentile	NS	3	36.333	27.333	30	29.667	28	27.667	26	24	30.667	30.333
	weighted annual mean	NS	3	21.6	18.233	18.933	17.4	17.4	16.633	17.9	15.7	17.967	17.967
SO_2	arithmetic mean	NS	2	0.006	0.003	0.004	0.006	0.008	0.003	0.005	0.002	0.004	0.004
	2nd max 24-hour	NS	2	0.057	0.033	0.034	0.04	0.067	0.021	0.044	0.022	0.021	0.021
SPRINGFIELD, MA													
CO	2nd max 8-hour	NS	2	6.7	6.3	7.1	6.1	7.5	7.9	7.1	5.1	4.1	4.8
NO_2	arithmetic mean	Down	2	0.018	0.017	0.016	0.016	0.019	0.015	0.016	0.015	0.013	0.014
O_3	4th max 8-hour	NS	4	0.093	0.097	0.09	0.095	0.093	0.092	0.083	0.094	0.087	0.087
	2nd daily max 1-hour	NS	4	0.121	0.126	0.117	0.129	0.125	0.124	0.104	0.122	0.109	0.108
PM_{10}	90th percentile	NS	5	39.2	42.2	34.4	39.6	40.4	36.2	35.4	34.2	38.8	38.4
	weighted annual mean	NS	5	23.06	23.4	21.5	22.2	24.44	20.7	22.22	22.08	21.28	23.4
SO_2	arithmetic mean	Down	3	0.008	0.008	0.007	0.006	0.006	0.005	0.005	0.005	0.005	0.005
	2nd max 24-hour	Down	3	0.033	0.031	0.034	0.023	0.048	0.023	0.024	0.021	0.02	0.02

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
STAMFORD-NORWALK, CT														
	CO	2nd max 8-hour	Down	1	6.3	6	5.5	5.2	6.2	5.4	4.1	5.1	3.8	3.8
	O_3	4th max 8-hour	NS	1	0.108	0.11	0.082	0.101	0.107	0.102	0.093	0.101	0.089	0.107
		2nd daily max 1-hour	NS	1	0.144	0.147	0.111	0.145	0.155	0.136	0.121	0.142	0.113	0.143
	PM_{10}	90th percentile	NS	3	48.667	51	36.667	35	50	41.333	39.333	39.333	35.333	36.667
		weighted annual mean	NS	3	30.1	32	24.067	23.3	28.133	24.733	24.5	25.733	23.833	24.2
	SO_2	arithmetic mean	Down	1	0.005	0.006	0.005	0.005	0.006	0.004	0.005	0.004	0.004	0.004
		2nd max 24-hour	NS	1	0.024	0.025	0.022	0.02	0.028	0.023	0.019	0.025	0.025	0.025
STEUBENVILLE-WEIRTON, OH-WV														
	CO	2nd max 8-hour	Down	3	11.467	9.267	6.933	7.233	8.667	5.867	5	4.8	6.7	3.033
	Pb	max quarterly mean	Down	2	0.065	0.083	0.148	0.067	0.082	0.055	0.05	0.029	0.029	0.029
	NO_2	arithmetic mean	NS	1	0.02	0.021	0.019	0.017	0.02	0.02	0.02	0.017	0.017	0.017
	O_3	4th max 8-hour	NS	2	0.075	0.091	0.076	0.081	0.083	0.094	0.08	0.081	0.083	0.085
		2nd daily max 1-hour	NS	2	0.092	0.114	0.089	0.101	0.103	0.112	0.097	0.093	0.094	0.098
	PM_{10}	90th percentile	Down	9	67.778	69.556	63.889	62.111	65.667	60.556	55.222	48.667	53.778	49
		weighted annual mean	Down	9	24.544	26.6	23.822	22.778	23.133	22.756	21.133	18.3	19.322	19.133
	SO_2	arithmetic mean	Down	7	0.024	0.022	0.018	0.019	0.017	0.011	0.011	0.011	0.011	0.011
		2nd max 24-hour	NS	7	0.085	0.08	0.076	0.083	0.088	0.047	0.048	0.051	0.047	0.05
STOCKTON-LODI, CA														
	CO	2nd max 8-hour	Down	2	10.85	9.65	5.85	5.8	6.95	4.8	6	3.65	5.25	5.25
	Pb	max quarterly mean	Down	1	0.042	0.039	0.024	0.026	0.016	0.015	0.023	0.014	0.014	0.014
	NO_2	arithmetic mean	NS	1	0.026	0.025	0.024	0.024	0.024	0.022	0.023	0.022	0.023	0.024
	O_3	4th max 8-hour	NS	2	0.086	0.087	0.085	0.083	0.086	0.087	0.079	0.073	0.085	0.083
		2nd daily max 1-hour	NS	2	0.115	0.11	0.11	0.11	0.12	0.125	0.101	0.094	0.108	0.12
	PM_{10}	90th percentile	Down	2	75.5	93.5	60	74.5	59	51	37.5	45.5	54.5	59.5
		weighted annual mean	Down	2	45.25	48.6	39.35	36.35	35	31.25	26.05	28.7	28.05	31.7
SYRACUSE, NY														
	CO	2nd max 8-hour	Down	1	6.8	8.4	7.5	5.6	6.5	3.3	3.9	4	3	3.1
	O_3	4th max 8-hour	NS	2	0.092	0.092	0.083	0.083	0.077	0.086	0.073	0.077	0.082	0.084
		2nd daily max 1-hour	Down	2	0.103	0.103	0.096	0.097	0.095	0.1	0.085	0.096	0.093	0.092
	PM_{10}	90th percentile	NS	2	48.5	50.5	46.5	41	40.5	35.5	32	38	42	42
		weighted annual mean	NS	2	28.05	29.25	27.25	24.05	22.05	21	22.05	21.65	24.15	24.15
	SO_2	arithmetic mean	NS	2	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002
		2nd max 24-hour	NS	2	0.014	0.014	0.012	0.018	0.02	0.016	0.014	0.017	0.01	0.014
TACOMA, WA														
	CO	2nd max 8-hour	NS	1	8	8.7	8.9	5.9	6	6.3	6.3	6.8	5.8	6.6
	O_3	4th max 8-hour	NS	1	0.087	0.077	0.081	0.068	0.073	0.074	0.077	0.066	0.085	0.065
		2nd daily max 1-hour	NS	1	0.127	0.094	0.097	0.1	0.112	0.089	0.097	0.083	0.126	0.079
	PM_{10}	90th percentile	Down	4	55.75	52.25	54.5	50.75	39.75	38.5	40.25	45	32.75	32.75
		weighted annual mean	Down	4	30.575	31.025	32.6	28.025	23.125	22.7	21.95	23.35	18.65	19.7
	SO_2	arithmetic mean	Down	2	0.008	0.008	0.009	0.009	0.007	0.006	0.006	0.006	0.006	0.005
		2nd max 24-hour	Down	2	0.026	0.023	0.03	0.025	0.021	0.02	0.024	0.023	0.019	0.019
TAMPA-ST. PETERSBURG-CLEARWATER, FL														
	CO	2nd max 8-hour	Down	6	3.817	2.85	2.867	2.583	2.2	2.75	2.533	2.4	2.467	2.5
	Pb	max quarterly mean	Down	3	0.763	0.756	0.45	0.23	0.296	0.254	0.246	0.214	0.175	0.343
	NO_2	arithmetic mean	NS	2	0.013	0.012	0.011	0.011	0.01	0.011	0.011	0.011	0.011	0.013
	O_3	4th max 8-hour	up	7	0.08	0.07	0.074	0.071	0.075	0.074	0.074	0.08	0.089	0.084
		2nd daily max 1-hour	NS	7	0.106	0.097	0.094	0.091	0.093	0.096	0.098	0.099	0.111	0.108
	PM_{10}	90th percentile	NS	5	40.2	41.4	41.6	39	39	38	40.4	42.6	40.4	42.6
		weighted annual mean	NS	5	27.26	27.74	26.72	27.52	25.96	25.28	26.86	27.44	27.4	26.46
	SO_2	arithmetic mean	NS	8	0.006	0.005	0.005	0.005	0.005	0.004	0.005	0.005	0.005	0.005
		2nd max 24-hour	Down	8	0.03	0.029	0.027	0.029	0.031	0.025	0.024	0.026	0.027	0.023
TERRE HAUTE, IN														
	O_3	4th max 8-hour	NS	1	0.087	0.088	0.069	0.074	0.094	0.085	0.098	0.083	0.084	0.082
		2nd daily max 1-hour	NS	1	0.105	0.1	0.081	0.088	0.106	0.099	0.112	0.096	0.099	0.093
	PM_{10}	90th percentile	Down	5	54.8	50	43.4	45	40.2	48.2	36.6	39	37.8	38.2
		weighted annual mean	Down	5	32.82	29.58	26.08	25.48	25.14	26.86	22.24	23.12	23.36	23
	SO_2	arithmetic mean	NS	2	0.011	0.011	0.007	0.009	0.01	0.007	0.009	0.006	0.007	0.008
		2nd max 24-hour	Down	2	0.038	0.037	0.033	0.039	0.039	0.029	0.033	0.023	0.027	0.029
TEXARKANA, TX-TEXARKANA, AR														
	PM_{10}	90th percentile	NS	1	36	39	37	35	36	45	39	34	34	34
		weighted annual mean	NS	1	24.3	22.4	23.3	21.9	22.9	25.7	23.4	22.4	22.4	22.4
TOLEDO, OH														
	O_3	4th max 8-hour	NS	3	0.085	0.086	0.079	0.083	0.088	0.088	0.09	0.083	0.083	0.083
		2nd daily max 1-hour	NS	3	0.1	0.108	0.091	0.108	0.109	0.107	0.108	0.099	0.1	0.109
	SO_2	arithmetic mean	NS	2	0.006	0.006	0.006	0.007	0.007	0.004	0.004	0.004	0.004	0.007
		2nd max 24-hour	NS	2	0.033	0.022	0.029	0.028	0.047	0.025	0.032	0.019	0.019	0.035
TOPEKA, KS														
	Pb	max quarterly mean	Down	3	0.012	0.011	0.009	0.009	0.008	0.009	0.009	0.008	0.008	0.008
	PM_{10}	90th percentile	NS	1	58	39	47	40	46	54	41	44	44	44
		weighted annual mean	NS	1	32.5	25.5	28.3	27.1	29.2	34.1	27.1	28	28	28

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TRENTON, NJ													
O_3	4th max 8-hour	NS	1	0.105	0.122	0.11	0.102	0.103	0.107	0.09	0.106	0.095	0.113
	2nd daily max 1-hour	Down	1	0.142	0.153	0.151	0.135	0.14	0.132	0.121	0.126	0.113	0.149
PM_{10}	90th percentile	Down	1	51	50	43	43	52	38	40	40	35	36
	weighted annual mean	Down	1	29.2	31.1	25.6	26.6	29.1	23.9	26.7	27	23.9	20.6
TUSCON, AZ													
CO	2nd max 8-hour	Down	4	4.55	4.5	4.725	4.638	4.575	4.375	4.075	3.7	3.325	3.1
NO_2	arithmetic mean	NS	1	0.019	0.018	0.016	0.018	0.019	0.019	0.018	0.018	0.017	0.018
O_3	4th max 8-hour	NS	5	0.073	0.072	0.07	0.075	0.073	0.077	0.073	0.071	0.071	0.069
	2nd daily max 1-hour	NS	5	0.093	0.084	0.087	0.09	0.088	0.094	0.086	0.085	0.088	0.084
PM_{10}	90th percentile	NS	10	49.8	38.8	36.4	32.8	32.7	40.9	36.1	38.3	39.4	49.3
	weighted annual mean	NS	10	32.55	25.91	24.05	22.26	22.12	26.22	25.35	25.79	25.88	31.3
SO_2	arithmetic mean	NS	1	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.002
	2nd max 24-hour	Down	1	0.007	0.007	0.006	0.005	0.004	0.004	0.004	0.004	0.004	0.005
TULSA, OK													
CO	2nd max 8-hour	NS	2	4.7	4.6	5.1	3.85	3.85	3.35	5.25	5.65	3.9	3.3
Pb	max quarterly mean	Down	1	0.108	0.214	0.102	0.203	0.098	0.091	0.114	0.015	0.015	0.015
NO_2	arithmetic mean	NS	2	0.011	0.013	0.013	0.013	0.013	0.01	0.012	0.012	0.012	0.014
O_3	4th max 8-hour	NS	3	0.09	0.086	0.077	0.075	0.086	0.095	0.086	0.08	0.089	0.088
	2nd daily max 1-hour	NS	3	0.116	0.111	0.095	0.108	0.111	0.119	0.11	0.106	0.11	0.112
PM_{10}	90th percentile	NS	5	42	41.4	38.6	40	42	44.2	40	37.8	37.8	37.8
	weighted annual mean	NS	5	23.9	25.02	23.52	25.9	25.58	26.24	26.22	24.18	24.18	24.18
SO_2	arithmetic mean	NS	1	0.012	0.01	0.011	0.006	0.004	0.008	0.008	0.008	0.01	0.008
	2nd max 24-hour	NS	1	0.056	0.047	0.053	0.026	0.025	0.034	0.042	0.028	0.034	0.051
TUSCALOOSA, AL													
PM_{10}	90th percentile	NS	1	61	47	38	43	41	48	41	41	44	51
	weighted annual mean	NS	1	31.8	27.5	26	26	25.9	27.4	26.2	25.2	28.3	28.1
UTICA-ROME, NY													
O_3	4th max 8-hour	NS	2	0.08	0.082	0.078	0.067	0.072	0.077	0.063	0.073	0.073	0.076
	2nd daily max 1-hour	NS	2	0.097	0.096	0.092	0.085	0.085	0.092	0.075	0.085	0.088	0.087
PM_{10}	90th percentile	Down	2	35	35	32	30	28.5	26	27.5	26	29.5	29.5
	weighted annual mean	NS	2	20.65	20.65	18.9	16.3	16.25	15.05	15.95	15.1	16.6	16.35
SO_2	arithmetic mean	NS	1	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001
	2nd max 24-hour	NS	1	0.006	0.006	0.006	0.012	0.012	0.008	0.009	0.006	0.005	0.007
VALLEJO-FAIRFIELD-NAPA, CA													
CO	2nd max 8-hour	Down	2	6.85	6.6	5.55	5.55	5.2	4.2	4.15	4.4	4.2	4.15
O_3	4th max 8-hour	NS	3	0.067	0.067	0.065	0.071	0.068	0.079	0.074	0.06	0.071	0.078
	2nd daily max 1-hour	NS	3	0.093	0.103	0.093	0.1	0.096	0.108	0.104	0.082	0.106	0.108
PM_{10}	90th percentile	Down	1	53	69	48	36	32	32	25	22	33	40
	weighted annual mean	Down	1	26.6	40.6	24.4	22.5	21.2	19	17.3	16.1	17.2	19.6
VENTURA, CA													
CO	2nd max 8-hour	Down	2	3.25	3.05	2.3	2.45	2.75	3.15	2.35	2.35	2.25	1.9
Pb	max quarterly mean	Down	1	0.02	0.032	0.014	0.01	0.01	0.01	0.008	0.008	0.006	0.006
NO_2	arithmetic mean	Down	4	0.016	0.015	0.014	0.014	0.014	0.014	0.013	0.012	0.011	0.013
O_3	4th max 8-hour	Down	6	0.098	0.104	0.099	0.089	0.095	0.095	0.099	0.085	0.087	0.079
	2nd daily max 1-hour	Down	6	0.128	0.136	0.128	0.123	0.126	0.126	0.127	0.11	0.116	0.099
PM_{10}	90th percentile	Down	5	55.8	55.6	48.6	46.8	46.6	48.6	43.8	48.2	40.6	47.6
	weighted annual mean	Down	5	34.44	35.9	31.2	27.36	30.02	28.12	27.52	30.22	23.24	29.28
VICTORIA, TX													
O_3	4th max 8-hour	NS	1	0.058	0.086	0.078	0.081	0.075	0.087	0.071	0.078	0.073	0.086
	2nd daily max 1-hour	NS	1	0.099	0.099	0.099	0.098	0.094	0.104	0.087	0.092	0.093	0.102
VINELAND-MILLVILLE-BRIDGETON, NJ													
O_3	4th max 8-hour	NS	1	0.11	0.107	0.087	0.103	0.086	0.091	0.086	0.104	0.098	0.096
	2nd daily max 1-hour	NS	1	0.125	0.124	0.103	0.121	0.102	0.126	0.105	0.115	0.117	0.117
SO_2	arithmetic mean	Down	1	0.007	0.007	0.006	0.006	0.005	0.004	0.005	0.004	0.004	0.003
	2nd max 24-hour	Down	1	0.024	0.023	0.021	0.019	0.032	0.016	0.016	0.018	0.012	0.012
VISALIA-TULARE-PORTERVILLE, CA													
CO	2nd max 8-hour	Down	1	5	5.3	4.3	3.5	4	4.2	3.9	3.5	3.6	3.9
NO_2	arithmetic mean	NS	1	0.021	0.022	0.02	0.023	0.023	0.023	0.018	0.019	0.017	0.021
O_3	4th max 8-hour	NS	2	0.099	0.098	0.1	0.107	0.108	0.1	0.104	0.096	0.102	0.099
	2nd daily max 1-hour	NS	2	0.116	0.116	0.125	0.138	0.137	0.118	0.131	0.114	0.13	0.116
PM_{10}	90th percentile	Down	2	128.5	106.5	82.5	89.5	62.5	72	70	63	63.5	82.5
	weighted annual mean	Down	2	68.5	61	50.75	48.7	42.1	44.3	40.25	40.4	38.3	45.8
WASHINGTON, DC-MD-VA-WV													
CO	2nd max 8-hour	Down	8	4.7	4.6	4.088	4.675	4.15	4.163	3.725	3.788	3.113	3.3
Pb	max quarterly mean	Down	5	0.049	0.032	0.019	0.019	0.019	0.021	0.013	0.01	0.013	0.013
NO_2	arithmetic mean	Down	7	0.024	0.024	0.024	0.024	0.023	0.021	0.021	0.021	0.022	0.021
O_3	4th max 8-hour	NS	13	0.089	0.097	0.086	0.096	0.088	0.095	0.083	0.091	0.099	0.096
	2nd daily max 1-hour	NS	13	0.114	0.122	0.107	0.12	0.116	0.12	0.106	0.116	0.119	0.118
PM_{10}	90th percentile	Down	14	40.857	40.214	36.286	37.214	38.786	36.214	33.5	33.071	35.5	34.286
	weighted annual mean	Down	14	25.45	25.55	23.086	22.35	21.236	21.707	20.336	20.207	20.893	20.614
SO_2	arithmetic mean	Down	5	0.007	0.007	0.008	0.008	0.007	0.006	0.007	0.007	0.007	0.007
	2nd max 24-hour	NS	5	0.026	0.026	0.029	0.026	0.029	0.019	0.031	0.022	0.02	0.02

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WATERBURY, CT														
	PM_{10}	90th percentile	Down	2	56.5	48.5	43.5	44.5	43	40	46.5	37.5	32.5	32
		weighted annual mean	Down	2	34	29.7	23.15	23.55	26.15	24.1	25.95	23.65	22	19.7
	SO_2	arithmetic mean	Down	1	0.01	0.009	0.007	0.006	0.007	0.005	0.005	0.005	0.006	0.005
		2nd max 24-hour	Down	1	0.042	0.038	0.029	0.021	0.03	0.019	0.022	0.02	0.021	0.02
WATERLOO-CEDAR FALLS, IA														
	PM_{10}	90th percentile	Down	1	57	57	63	48	45	52	48	47	47	44
		weighted annual mean	Down	1	34.7	34.7	34.3	31.2	28.7	35.5	31.8	31.3	29.9	24.1
WAUSAU, WI														
	O_3	4th max 8-hour	NS	1	0.081	0.081	0.081	0.06	0.064	0.075	0.07	0.069	0.077	0.084
		2nd daily max 1-hour	NS	1	0.086	0.086	0.086	0.081	0.077	0.088	0.079	0.08	0.098	0.095
	SO_2	arithmetic mean	Down	1	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.002	0.003	0.003
		2nd max 24-hour	NS	1	0.03	0.03	0.024	0.039	0.024	0.022	0.015	0.013	0.031	0.04
WEST PALM BEACH-BOCA RATON, FL														
	CO	2nd max 8-hour	NS	1	2.7	3.1	3.7	3.1	2.8	2.8	2.5	3.6	2.5	2.8
	NO_2	arithmetic mean	NS	1	0.014	0.012	0.011	0.013	0.012	0.012	0.012	0.012	0.012	0.013
	O_3	4th max 8-hour	NS	2	0.066	0.062	0.048	0.077	0.071	0.064	0.064	0.064	0.077	0.061
		2nd daily max 1-hour	NS	2	0.092	0.081	0.067	0.117	0.084	0.082	0.088	0.082	0.096	0.08
	PM_{10}	90th percentile	NS	2	27	27.5	30	29	24.5	24.5	27.5	29	31	29
		weighted annual mean	NS	2	18.95	18.45	19.9	18.85	18.1	17.6	18.45	19.8	20.35	19.6
	SO_2	arithmetic mean	Down	1	0.002	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.001	0.002
		2nd max 24-hour	NS	1	0.007	0.012	0.01	0.028	0.016	0.019	0.014	0.013	0.004	0.013
WHEELING, WV-OH														
	CO	2nd max 8-hour	Down	1	7.1	5.6	5.6	4.1	4.6	5	3.5	3.1	3.5	3
	O_3	4th max 8-hour	NS	1	0.08	0.089	0.075	0.077	0.078	0.089	0.087	0.082	0.087	0.088
		2nd daily max 1-hour	NS	1	0.111	0.108	0.096	0.11	0.095	0.104	0.105	0.11	0.104	0.1
	PM_{10}	90th percentile	Down	2	50	52.5	51.5	51	49	45.5	42	40.5	46	46.5
		weighted annual mean	Down	2	29.5	30.65	30.4	29.35	27.7	28.25	27.6	23.75	24.9	25.65
	SO_2	arithmetic mean	Down	3	0.02	0.02	0.018	0.018	0.015	0.01	0.011	0.01	0.011	0.01
		2nd max 24-hour	Down	3	0.064	0.074	0.077	0.075	0.065	0.055	0.058	0.043	0.045	0.042
WICHITA, KS														
	CO	2nd max 8-hour	Down	3	5.933	5.917	5.633	5	4.933	5.233	5.8	4.8	4.833	4.167
	Pb	max quarterly mean	Down	5	0.017	0.02	0.012	0.014	0.008	0.01	0.011	0.009	0.009	0.009
	O_3	4th max 8-hour	NS	2	0.079	0.076	0.067	0.06	0.07	0.073	0.071	0.079	0.081	0.078
		2nd daily max 1-hour	NS	2	0.095	0.09	0.078	0.075	0.085	0.095	0.093	0.093	0.096	0.093
	PM_{10}	90th percentile	NS	4	48.75	51	52.5	55.5	49.75	50.75	42.5	40	40.5	49.25
		weighted annual mean	Down	4	27.7	31.35	32.25	31.425	26.4	27.1	24.85	22.45	24.2	25.7
WILLIAMSPORT, PA														
	O_3	4th max 8-hour	NS	1	0.071	0.081	0.073	0.075	0.069	0.073	0.07	0.076	0.073	0.075
		2nd daily max 1-hour	NS	1	0.088	0.101	0.092	0.088	0.079	0.091	0.082	0.086	0.097	0.087
	PM_{10}	90th percentile	NS	1	50	60	36	47	52	49	36	40	40	40
		weighted annual mean	NS	1	26	30.7	23.8	23.9	27.8	27.6	25.1	25.6	25.6	25.6
	SO_2	arithmetic mean	NS	1	0.006	0.007	0.007	0.006	0.006	0.006	0.006	0.008	0.005	0.005
		2nd max 24-hour	NS	1	0.025	0.025	0.029	0.025	0.042	0.027	0.028	0.028	0.021	0.021
WILMINGTON-NEWARK, DE-MD														
	CO	2nd max 8-hour	NS	1	5.4	4	4.1	3.8	4.3	4.6	3.6	4.5	3.1	3.1
	NO_2	arithmetic mean	NS	1	0.017	0.017	0.017	0.019	0.019	0.017	0.019	0.018	0.016	0.018
	O_3	4th max 8-hour	NS	3	0.098	0.1	0.094	0.101	0.094	0.112	0.088	0.104	0.095	0.102
		2nd daily max 1-hour	NS	3	0.123	0.121	0.118	0.141	0.119	0.142	0.111	0.136	0.122	0.139
	PM_{10}	90th percentile	Down	2	47.5	44.75	39	42.5	52	44.5	41.5	42.5	40.5	38.5
		weighted annual mean	Down	2	30.05	27.65	24.45	24.8	29.45	27.8	25.4	25.4	24	22.95
	SO_2	arithmetic mean	Down	3	0.014	0.013	0.014	0.013	0.012	0.011	0.01	0.008	0.008	0.007
		2nd max 24-hour	Down	3	0.053	0.046	0.054	0.047	0.048	0.057	0.045	0.041	0.032	0.035
WORCESTER, MA-CT														
	CO	2nd max 8-hour	Down	1	6	7.2	8	6.1	5.9	4.2	5.3	3.4	3.5	3.3
	NO_2	arithmetic mean	Down	1	0.022	0.023	0.024	0.028	0.025	0.021	0.019	0.019	0.019	0.02
	O_3	4th max 8-hour	NS	1	0.097	0.097	0.097	0.092	0.097	0.096	0.074	0.092	0.097	0.093
		2nd daily max 1-hour	Down	1	0.125	0.125	0.125	0.155	0.125	0.118	0.091	0.106	0.124	0.113
	PM_{10}	90th percentile	Down	2	41	37.667	34.333	37	36	31.5	33.5	31.5	32.5	36
		weighted annual mean	NS	2	22.95	21.267	19.583	19.5	19.9	19.45	20.25	19.55	19.2	20.5
	SO_2	arithmetic mean	Down	1	0.008	0.009	0.007	0.007	0.008	0.006	0.005	0.004	0.005	0.004
		2nd max 24-hour	Down	1	0.034	0.029	0.033	0.025	0.024	0.023	0.021	0.021	0.017	0.013
YAKIMA, WA														
	PM_{10}	90th percentile	Down	2	61.5	80.5	59.5	63	54.5	45.5	58.5	59	42.5	38.5
		weighted annual mean	Down	2	33.1	40.15	32.45	34.85	29.1	23.55	30.375	31.6	25.75	22.4
YOLO, CA														
	O_3	4th max 8-hour	NS	1	0.082	0.073	0.085	0.076	0.076	0.083	0.087	0.068	0.087	0.088
		2nd daily max 1-hour	NS	1	0.1	0.105	0.11	0.09	0.097	0.108	0.113	0.092	0.109	0.115
	PM_{10}	90th percentile	Down	1	81	81	63	62	46	61	40	37	42	65
		weighted annual mean	Down	1	46.4	46.4	34.7	29.2	29.8	30.1	24.3	24.6	21.7	30.6

Table A-16. Metropolitan Statistical Area Air Quality Trends, 1990–1999 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
YORK, PA													
CO	2nd max 8-hour	Down	1	4.4	3.7	3.6	3.3	3.9	2.7	2.8	3.4	2.4	2.4
Pb	max quarterly mean	NS	1	0.051	0.051	0.046	0.044	0.042	0.04	0.065	0.044	0.049	0.049
NO_2	arithmetic mean	Down	1	0.022	0.021	0.02	0.022	0.024	0.021	0.021	0.019	0.019	0.019
O_3	4th max 8-hour	NS	1	0.097	0.1	0.079	0.09	0.082	0.086	0.081	0.094	0.095	0.094
	2nd daily max 1-hour	NS	1	0.121	0.114	0.101	0.112	0.115	0.097	0.098	0.109	0.112	0.121
PM_{10}	90th percentile	NS	1	56	60	44	52	51	56	46	49	49	49
	weighted annual mean	NS	1	29.7	32.2	27	30.5	31.7	29.7	28.4	31.2	31.2	31.2
SO_2	arithmetic mean	NS	1	0.007	0.008	0.007	0.008	0.009	0.006	0.007	0.009	0.008	0.007
	2nd max 24-hour	NS	1	0.023	0.02	0.034	0.032	0.041	0.02	0.022	0.026	0.023	0.019
YOUNGSTOWN-WARREN, OH													
O_3	4th max 8-hour	NS	3	0.09	0.096	0.092	0.085	0.083	0.096	0.09	0.089	0.099	0.094
	2nd daily max 1-hour	NS	3	0.105	0.111	0.106	0.106	0.096	0.11	0.104	0.105	0.115	0.108
PM_{10}	90th percentile	Down	9	53	54.889	48.556	49.333	49	48.222	39.333	42.778	46.667	44
	weighted annual mean	Down	9	31.267	33.022	28.544	27.389	29.033	28.089	26.011	25.389	27.267	25.867
SO_2	arithmetic mean	Down	2	0.016	0.016	0.013	0.011	0.011	0.01	0.009	0.008	0.008	0.008
	2nd max 24-hour	Down	2	0.053	0.048	0.056	0.064	0.051	0.038	0.044	0.037	0.03	0.034
YUBA CITY, CA													
CO	2nd max 8-hour	Down	1	5.8	5.8	5.8	5	5.6	4.1	4.1	3.9	3.9	4.2
NO_2	arithmetic mean	Down	1	0.017	0.017	0.017	0.018	0.016	0.014	0.012	0.014	0.013	0.014
O_3	4th max 8-hour	NS	2	0.076	0.079	0.088	0.081	0.082	0.087	0.086	0.073	0.087	0.084
	2nd daily max 1-hour	NS	2	0.1	0.1	0.11	0.11	0.099	0.107	0.105	0.093	0.103	0.105
PM_{10}	90th percentile	NS	1	60	73	57	59	51	68	50	48	44	68
	weighted annual mean	Down	1	38.5	38.5	34.3	30.4	34.1	32.5	29.2	28.6	23.1	38.4

CO = Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb = Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 µg/m3)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 (1-hr) = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
O_3 (8-hr) = Highest fourth daily maximum 8-hour concentration *(Applicable NAAQS is 0.08 ppm)*
PM_{10} = Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 µg/m3)*
SO_2 = Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*
ppm = Units are parts per million
µg/m^3 = Units are micrograms per cubic meter

Table A-17. Number of Days with AQI Values Greater Than 100 at Trend Sites, 1990–1999, and All Sites in 1999

Metropolitan Statistical Area	# of Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total # of Sites	AQI > 100 1999
AKRON, OH	5	9	30	8	10	8	12	11	6	14	20	6	20
ALBANY-SCHENECTADY-TROY, NY	10	4	9	5	5	6	3	4	3	2	6	10	6
ALBUQUERQUE, NM	21	8	5	0	0	1	0	0	0	0	1	21	2
ALLENTOWN-BETHLEHEM-EASTON, PA	5	10	14	3	6	3	9	6	13	18	20	9	23
ATLANTA, GA	10	42	23	20	36	15	35	25	31	50	61	18	69
AUSTIN-SAN MARCOS, TX	1	4	3	1	2	4	10	0	0	5	8	3	19
BAKERSFIELD, CA	8	99	113	100	97	98	105	109	55	76	88	14	94
BALTIMORE, MD	17	29	50	23	48	41	36	28	30	51	40	20	40
BATON ROUGE, LA	7	28	11	5	6	7	15	7	8	14	17	10	26
BERGEN-PASSAIC, NJ	7	8	11	2	3	5	11	3	5	0	0	7	0
BIRMINGHAM, AL	14	28	5	12	10	6	32	15	8	23	27	14	27
BOSTON, MA-NH	24	7	13	9	6	10	8	2	8	7	5	24	9
BUFFALO-NIAGARA FALLS, NY	20	7	9	3	1	4	6	3	1	13	8	20	8
CHARLESTON-NORTH CHARLESTON, SC	9	1	2	0	2	2	1	3	3	3	5	9	5
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	12	31	12	11	23	9	13	18	26	48	34	24	42
CHICAGO, IL	45	4	22	4	3	8	21	6	9	7	12	51	12
CINCINNATI, OH-KY-IN	19	12	19	1	6	16	19	10	11	14	12	23	27
CLEVELAND-LORAIN-ELYRIA, OH	27	10	23	11	13	23	24	18	11	20	18	40	23
COLUMBUS, OH	9	4	17	5	7	10	15	16	8	19	20	12	25
DALLAS, TX	9	24	2	12	14	27	36	12	20	28	23	9	35
DAYTON-SPRINGFIELD, OH	10	13	12	2	11	14	11	18	9	19	19	13	20
DENVER, CO	22	9	6	11	3	1	2	0	0	5	1	28	5
DETROIT, MI	29	11	28	8	5	11	14	13	12	17	15	29	15
EL PASO, TX	19	19	7	10	7	11	8	7	4	6	6	24	7
FORT LAUDERDALE, FL	15	1	0	2	4	1	1	1	0	1	1	18	1
FORT WORTH-ARLINGTON, TX	5	16	20	7	9	31	28	14	14	17	19	5	19
FRESNO, CA	12	62	83	69	59	55	61	70	75	67	81	15	83
GARY, IN	15	2	8	5	0	6	17	11	12	9	10	18	12
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	8	10	26	6	3	12	17	7	8	13	20	9	21
GREENSBORO—WINSTON-SALEM—HIGH POINT, NC	9	12	5	2	20	7	6	6	13	25	20	15	29
GREENVILLE-SPARTANBURG-ANDERSON, SC	5	2	3	5	9	5	8	7	10	28	19	7	19
HARRISBURG-LEBANON-CARLISLE, PA	6	10	21	1	15	12	13	3	9	22	17	6	17
HARTFORD, CT	15	13	23	15	14	18	14	5	16	10	18	15	18
HONOLULU, HI	10	0	0	0	0	0	0	0	0	0	0	14	0
HOUSTON, TX	23	51	36	32	28	38	66	26	47	38	50	23	54
INDIANAPOLIS, IN	27	9	12	7	9	22	19	13	12	19	21	32	26
JACKSONVILLE, FL	14	3	0	2	3	2	1	1	4	10	3	14	3
JERSEY CITY, NJ	7	15	26	11	19	17	18	5	9	7	17	7	17
KANSAS CITY, MO-KS	21	2	11	1	4	10	22	10	18	15	5	21	5
KNOXVILLE, TN	15	23	10	7	25	16	24	20	36	54	59	18	62
LAS VEGAS, NV-AZ	5	4	0	1	2	2	0	2	0	0	0	26	7
LITTLE ROCK-NORTH LITTLE ROCK, AR	7	1	3	0	2	2	7	1	1	2	6	7	6
LOS ANGELES-LONG BEACH, CA	38	173	168	175	134	139	113	94	60	56	27	38	27
LOUISVILLE, KY-IN	20	10	15	2	23	27	22	11	14	27	40	26	44
MEMPHIS, TN-AR-MS	12	24	9	14	15	10	21	19	17	27	36	14	36
MIAMI, FL	12	1	1	3	6	1	2	1	3	8	5	12	5
MIDDLESEX-SOMERSET-HUNTERDON, NJ	3	24	24	8	13	9	16	8	18	21	23	5	26
MILWAUKEE-WAUKESHA, WI	18	8	24	3	4	9	14	5	4	10	13	22	18

Table A-17. Number of Days with AQI Values Greater Than 100 at Trend Sites, 1990–1999, and All Sites in 1999 (continued)

Metropolitan Statistical Area	# of Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total # of Sites	AQI > 100 1999
MINNEAPOLIS-ST. PAUL, MN-WI	20	4	2	1	0	2	5	0	0	1	0	36	0
MONMOUTH-OCEAN, NJ	4	21	20	11	24	13	20	17	21	31	27	4	27
NASHVILLE, TN	16	29	12	6	18	21	26	22	20	30	33	21	45
NASSAU-SUFFOLK, NY	7	20	25	7	17	15	10	8	12	11	18	7	18
NEW HAVEN-MERIDEN, CT	9	17	29	10	17	14	14	8	19	10	16	9	16
NEW ORLEANS, LA	10	6	2	5	6	8	20	8	7	7	18	10	18
NEW YORK, NY	29	36	49	10	19	21	19	15	23	17	24	30	27
NEWARK, NJ	12	23	35	10	13	13	20	12	13	23	21	12	21
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS,VA-NC	10	8	7	8	19	6	6	4	17	15	16	12	16
OAKLAND, CA	18	4	4	3	4	3	12	11	0	11	5	29	6
OKLAHOMA CITY, OK	10	4	4	2	2	5	13	2	4	7	6	10	6
OMAHA, NE-IA	9	1	0	0	1	1	1	1	0	5	5	12	5
ORANGE COUNTY, CA	11	45	35	35	25	15	9	9	3	6	1	12	1
ORLANDO, FL	11	4	1	4	4	3	1	1	4	11	4	13	4
PHILADELPHIA, PA-NJ	36	39	49	24	51	26	30	22	32	37	32	44	32
PHOENIX-MESA, AZ	25	12	11	13	16	10	22	17	12	17	12	51	37
PITTSBURGH, PA	42	19	21	9	13	19	25	11	21	39	23	42	26
PONCE, PR	1	0	0	0	0	0	0	0	0	0	0	1	0
PORTLAND-VANCOUVER, OR-WA	15	11	9	6	0	2	2	6	0	3	2	15	2
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	9	13	20	5	7	7	11	4	10	4	7	12	13
RALEIGH-DURHAM-CHAPEL HILL, NC	5	15	5	0	11	2	1	1	13	21	26	17	29
RICHMOND-PETERSBURG, VA	11	6	18	8	30	13	19	5	21	28	25	11	25
RIVERSIDE-SAN BERNARDINO, CA	36	159	154	174	168	149	124	119	105	95	93	47	97
ROCHESTER, NY	8	5	16	2	0	1	6	0	6	4	9	8	9
SACRAMENTO, CA	20	61	46	51	20	36	41	42	15	27	38	33	48
ST. LOUIS, MO-IL	55	23	32	15	9	32	34	20	15	23	29	55	29
SALT LAKE CITY-OGDEN, UT	13	5	20	9	5	12	4	8	1	12	2	24	5
SAN ANTONIO, TX	4	4	3	1	3	4	18	3	3	6	9	4	9
SAN DIEGO, CA	23	96	67	66	58	46	48	31	14	33	16	27	17
SAN FRANCISCO, CA	9	0	0	0	0	0	2	0	0	0	0	11	0
SAN JOSE, CA	8	7	11	3	4	2	10	7	0	5	2	9	4
SAN JUAN-BAYAMON, PR	11	0	0	0	0	0	0	1	2	1	1	21	3
SCRANTON–WILKES-BARRE–HAZLETON, PA	11	9	17	3	10	7	12	4	11	7	12	11	12
SEATTLE-BELLEVUE-EVERETT, WA	17	9	4	3	0	3	0	6	1	3	1	24	1
SPRINGFIELD, MA	13	13	15	12	13	12	9	5	10	7	10	13	10
SYRACUSE, NY	7	1	12	2	4	1	5	0	2	3	4	7	4
TACOMA, WA	8	5	1	2	0	2	0	1	0	4	0	9	0
TAMPA-ST. PETERSBURG-CLEARWATER, FL	26	6	1	2	1	3	2	3	4	11	9	40	9
TOLEDO, OH	5	3	6	2	7	9	9	11	4	5	4	6	9
TUSCON, AZ	20	1	0	1	1	0	3	0	1	0	2	21	2
TULSA, OK	11	16	12	1	4	12	21	14	7	9	14	11	14
VENTURA, CA	12	70	87	54	43	63	66	62	45	29	22	15	23
WASHINGTON, DC-MD-VA-WV	40	25	48	14	52	20	29	18	29	47	39	42	39
WEST PALM BEACH-BOCA RATON, FL	6	0	0	0	3	0	0	0	0	2	1	7	1
WILMINGTON-NEWARK, DE-MD	9	9	12	12	29	24	27	13	21	24	21	10	21
YOUNGSTOWN-WARREN, OH	14	3	14	10	10	5	12	8	10	22	12	15	13

Table A-18. (Ozone only) Number of Days with AQI Values Greater Than 100 at Trend Sites, 1990–1999, and All Sites in 1999

Metropolitan Statistical Area	# of Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total # of Sites	AQI > 100 1999
AKRON, OH	2	9	30	8	10	8	12	11	6	14	20	2	20
ALBANY-SCHENECTADY-TROY, NY	3	4	9	5	5	6	3	4	3	2	6	3	6
ALBUQUERQUE, NM	7	2	0	0	0	1	0	0	0	0	1	9	2
ALLENTOWN-BETHLEHEM-EASTON, PA	2	10	14	3	6	3	9	6	13	18	20	3	23
ATLANTA, GA	3	42	23	20	36	15	35	25	31	50	61	7	69
AUSTIN-SAN MARCOS, TX	1	4	3	1	2	4	10	0	0	5	8	2	19
BAKERSFIELD, CA	5	95	107	100	97	98	104	109	55	75	87	6	92
BALTIMORE, MD	7	28	50	23	48	40	36	28	30	51	40	8	40
BATON ROUGE, LA	3	28	11	5	5	7	15	7	8	14	17	7	26
BERGEN-PASSAIC, NJ	1	8	11	2	3	5	11	3	5	0	0	1	0
BIRMINGHAM, AL	6	28	5	12	10	6	32	15	8	23	27	6	27
BOSTON, MA-NH	4	7	13	9	6	10	8	2	8	7	5	4	9
BUFFALO-NIAGARA FALLS, NY	2	7	9	3	1	4	6	3	1	13	8	2	8
CHARLESTON-NORTH CHARLESTON, SC	3	1	1	0	2	2	1	3	3	3	5	3	5
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	3	29	12	11	23	9	13	18	26	48	34	7	42
CHICAGO, IL	17	3	22	4	3	7	21	6	9	7	12	22	12
CINCINNATI, OH-KY-IN	6	12	19	1	6	16	19	10	11	14	12	7	27
CLEVELAND-LORAIN-ELYRIA, OH	6	10	23	10	12	22	21	17	11	19	17	9	22
COLUMBUS, OH	3	4	17	5	7	10	15	16	8	19	20	5	25
DALLAS, TX	3	24	2	12	14	27	36	12	20	28	23	5	35
DAYTON-SPRINGFIELD, OH	3	13	12	2	11	14	11	18	9	19	19	5	20
DENVER, CO	6	4	0	4	0	0	0	0	0	5	0	8	3
DETROIT, MI	8	11	28	7	5	11	12	12	12	17	14	8	14
EL PASO, TX	4	6	1	3	3	7	7	2	1	6	1	4	1
FORT LAUDERDALE, FL	3	1	0	2	4	1	1	1	0	1	1	3	1
FORT WORTH-ARLINGTON, TX	2	16	20	7	9	31	28	14	14	17	19	2	19
FRESNO, CA	5	56	81	69	59	55	61	70	75	67	81	7	83
GARY, IN	2	2	8	5	0	6	17	11	11	9	10	4	12
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	4	10	26	6	3	12	17	7	8	13	20	4	21
GREENSBORO—WINSTON-SALEM—HIGH POINT, NC	2	12	5	2	20	7	6	6	13	25	20	6	29
GREENVILLE-SPARTANBURG-ANDERSON, SC	4	2	3	5	9	5	8	7	10	28	19	4	19
HARRISBURG-LEBANON-CARLISLE, PA	3	10	21	1	15	12	13	3	9	22	17	3	17
HARTFORD, CT	3	13	21	14	14	18	13	5	16	10	18	3	18
HONOLULU, HI	1	0	0	0	0	0	0	0	0	0	0	1	0
HOUSTON, TX	9	51	36	32	28	38	66	26	47	38	50	11	54
INDIANAPOLIS, IN	6	9	11	6	9	22	19	13	12	19	21	9	26
JACKSONVILLE, FL	2	3	0	2	3	2	1	1	4	10	3	2	3
JERSEY CITY, NJ	1	15	25	9	19	12	16	5	9	7	17	1	17
KANSAS CITY, MO-KS	6	2	11	1	3	10	22	9	18	15	5	6	5
KNOXVILLE, TN	5	23	10	7	25	16	24	20	36	54	59	7	62
LAS VEGAS, NV-AZ	3	2	0	1	2	2	0	2	0	0	0	4	0
LITTLE ROCK-NORTH LITTLE ROCK, AR	2	1	3	0	2	2	7	1	1	2	6	2	6
LOS ANGELES-LONG BEACH, CA	14	130	126	140	112	117	97	74	45	46	19	14	19
LOUISVILLE, KY-IN	5	10	15	2	22	27	22	11	14	27	40	7	44
MEMPHIS, TN-AR-MS	4	22	9	13	13	10	21	18	17	27	36	4	36
MIAMI, FL	4	1	1	3	6	1	2	1	3	8	5	4	5
MIDDLESEX-SOMERSET-HUNTERDON, NJ	1	24	24	8	13	9	16	8	18	21	23	2	26
MILWAUKEE-WAUKESHA, WI	8	8	24	3	4	9	14	5	4	10	12	9	17

Table A-18. (Ozone only) Number of Days with AQI Values Greater Than 100 at Trend Sites, 1990–1999, and All Sites in 1999 (continued)

Metropolitan Statistical Area	# of Trend Sites	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total # of Sites	AQI > 100 1999
MINNEAPOLIS-ST. PAUL, MN-WI	4	1	0	1	0	0	3	0	0	1	0	5	0
MONMOUTH-OCEAN, NJ	2	21	20	11	24	13	20	17	21	31	27	2	27
NASHVILLE, TN	6	29	12	6	18	21	26	22	20	30	33	8	45
NASSAU-SUFFOLK, NY	2	20	25	7	17	15	10	8	12	11	18	2	18
NEW HAVEN-MERIDEN, CT	2	15	28	10	13	13	14	8	19	10	16	2	16
NEW ORLEANS, LA	6	6	2	5	6	8	20	8	7	7	18	6	18
NEW YORK, NY	5	33	47	10	19	21	18	15	23	17	24	8	27
NEWARK, NJ	2	22	32	10	13	12	20	12	13	23	21	2	21
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS,VA-NC	3	8	7	8	19	6	6	4	17	15	16	3	16
OAKLAND, CA	7	4	3	3	4	3	12	11	0	11	5	9	6
OKLAHOMA CITY, OK	4	4	4	2	2	5	13	2	4	7	6	4	6
OMAHA, NE-IA	3	1	0	0	0	0	0	0	0	0	2	3	2
ORANGE COUNTY, CA	4	38	35	35	25	15	8	9	3	6	1	4	1
ORLANDO, FL	3	4	1	4	4	3	1	1	4	11	4	4	4
PHILADELPHIA, PA-NJ	8	39	49	24	51	25	30	22	32	37	32	10	32
PHOENIX-MESA, AZ	8	7	7	11	16	7	19	17	10	17	12	18	27
PITTSBURGH, PA	8	11	20	8	13	19	24	11	20	39	23	12	26
PONCE, PR	0	0	0	0	0	0	0	0	0	0	0	0	0
PORTLAND-VANCOUVER, OR-WA	4	8	3	6	0	1	2	6	0	3	0	4	0
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	2	13	20	5	7	7	11	4	10	4	7	3	13
RALEIGH-DURHAM-CHAPEL HILL, NC	1	15	5	0	11	2	1	1	13	21	26	8	29
RICHMOND-PETERSBURG, VA	4	6	18	8	30	13	19	5	21	28	25	4	25
RIVERSIDE-SAN BERNARDINO, CA	15	153	152	172	167	148	119	116	102	94	93	18	97
ROCHESTER, NY	2	5	16	2	0	1	6	0	6	4	9	2	9
SACRAMENTO, CA	8	42	36	50	20	36	41	42	15	27	38	13	48
ST. LOUIS, MO-IL	16	23	32	15	9	31	34	20	14	23	29	16	29
SALT LAKE CITY-OGDEN, UT	2	5	3	0	2	4	4	6	1	12	2	7	5
SAN ANTONIO, TX	2	4	3	1	3	4	18	3	3	6	9	2	9
SAN DIEGO, CA	9	96	67	66	58	46	48	31	14	33	16	10	17
SAN FRANCISCO, CA	3	0	0	0	0	0	2	0	0	0	0	3	0
SAN JOSE, CA	4	4	5	3	4	2	10	7	0	5	2	6	4
SAN JUAN-BAYAMON, PR	0	0	0	0	0	0	0	0	0	0	0	1	0
SCRANTON–WILKES-BARRE–HAZLETON, PA	4	9	17	3	10	7	12	4	11	7	12	4	12
SEATTLE-BELLEVUE-EVERETT, WA	2	7	3	3	0	3	0	6	1	3	1	3	1
SPRINGFIELD, MA	4	13	15	12	13	12	9	4	10	7	10	4	10
SYRACUSE, NY	2	0	12	2	4	1	5	0	2	3	4	2	4
TACOMA, WA	1	4	0	2	0	2	0	1	0	4	0	2	0
TAMPA-ST. PETERSBURG-CLEARWATER, FL	7	6	1	2	1	3	2	3	4	11	9	7	9
TOLEDO, OH	3	3	6	2	7	9	9	11	4	5	4	3	9
TUSCON, AZ	5	1	0	1	1	0	3	0	1	0	1	6	1
TULSA, OK	3	16	12	1	4	12	21	14	7	9	14	3	14
VENTURA, CA	6	70	87	54	43	63	66	62	44	29	22	7	23
WASHINGTON, DC-MD-VA-WV	13	25	48	14	52	20	29	18	29	47	39	17	39
WEST PALM BEACH-BOCA RATON, FL	2	0	0	0	3	0	0	0	0	2	1	2	1
WILMINGTON-NEWARK, DE-MD	3	9	12	12	29	24	27	13	21	24	21	4	21
YOUNGSTOWN-WARREN, OH	3	3	14	10	10	5	12	8	10	22	12	3	12

Table A-19. Condensed Nonattainment Areas List(a)

			Pollutant(c)						Population (x 1000) (d)					
State		Area Name(b)	O_3	CO	SO_2	PM_{10}	Pb	NO_2	O_3	CO	SO_2	PM_{10}	Pb	All
1	AK	Anchorage	.	1	.	1	.	.		222	.	170	.	222
2	AK	Fairbanks	.	1	.	.	.	.	.	30	.	.	.	30
3	AK	Juneau	.	.	.	1	.	.	.	.	.	12	.	12
4	AL	Birmingham	1	.	.	.	.	.	751	.	.	.	.	751
5	AZ	Ajo	.	.	1	1	.	.	.	.	6	6	.	6
6	AZ	Bullhead City	.	.	.	1	.	.	.	.	.	5	.	5
7	AZ	Douglas	.	.	1	1	.	.	.	.	13	13	.	13
8	AZ	Miami-Hayden	.	.	2	1	.	.	.	.	3	3	.	3
9	AZ	Morenci	.	.	1	.	.	.	.	.	8	.	.	8
10	AZ	Nogales	.	.	.	1	.	.	.	.	.	19	.	19
11	AZ	Paul Spur	.	.	.	1	.	.	.	.	.	1	.	1
12	AZ	Payson	.	.	.	1	.	.	.	.	.	8	.	8
13	AZ	Phoenix	1	1	.	1	.	.	2,092	2,006	.	2,122	.	2,122
14	AZ	Rillito	.	.	.	1	.	.	.	.	.	0	.	0
15	AZ	San Manuel	.	.	1	.	.	.	.	.	5	.	.	5
16	AZ	Yuma	.	.	.	1	.	.	.	.	.	54	.	54
17	CA	Imperial Valley	.	.	.	1	.	.	.	.	.	92	.	92
18	CA	Los Angeles-South Coast Air Basin	1	1	.	1	.	.	13,000	13,000	.	13,000	.	13,000
19	CA	Mono Basin (in Mono Co.)	.	.	.	1	.	.	.	.	.	0	.	0
20	CA	Owens Valley	.	.	.	1	.	.	.	.	.	18	.	18
21	CA	Sacramento Metro	1	.	.	1	.	.	1,639	.	.	1,041	.	1,639
22	CA	San Diego	1	.	.	.	.	.	2,498	.	.	.	.	2,498
23	CA	San Francisco-Oakland-San Jose	1	.	.	.	.	.	5,815	.	.	.	.	5,815
24	CA	San Joaquin Valley	1	.	.	1	.	.	2,742	.	.	2,742	.	2,742
25	CA	Santa Barbara-Santa Maria-Lompoc	1	.	.	.	.	.	370	.	.	.	.	370
26	CA	Searles Valley	.	.	.	1	.	.	.	.	.	30	.	30
27	CA	Southeast Desert Modified AQMA	1	.	.	2	.	.	384	.	.	349	.	384
28	CA	Ventura Co.	1	.	.	.	.	.	669	.	.	.	.	669
29	CO	Aspen	.	.	.	1	.	.	.	.	.	5	.	5
30	CO	Denver-Boulder	.	1	.	1	.	.	.	1,800	.	1,836	.	1,836
31	CO	Fort Collins	.	1	.	.	.	.	.	106	.	.	.	106
32	CO	Lamar	.	.	.	1	.	.	.	.	.	8	.	8
33	CO	Pagosa Springs	.	.	.	1	.	.	.	.	.	1	.	1
34	CO	Steamboat Springs	.	.	.	1	.	.	.	.	.	6	.	6
35	CO	Telluride	.	.	.	1	.	.	.	.	.	1	.	1
36	CT	Greater Connecticut	1	.	.	1	.	.	2,470		.	126	.	2,470
37	DC-MD-VA	Washington	1	.	.	.	.	.	3,923	.	.	.	.	3,923
38	GA	Atlanta	1	.	.	.	.	.	2,653	.	.	.	.	2,653
39	GU	Piti Power Plant	.	.	1	.	.	.	.	.	0	.	.	0
40	GU	Tanguisson Power Plant	.	.	1	.	.	.	.	.	0	.	.	0
41	ID	Bonner Co.(Sandpoint)	.	.	.	1	.	.	.	.	.	26	.	26
42	ID	Fort Hall I.R.	.	.	.	1	.	.	.	.	.	1	.	1
43	ID	Portneuf Valley	.	.	.	1	.	.	.	.	.	74	.	74
44	ID	Shoshone Co.	.	.	.	2	.	.	.	.	.	13	.	13
45	IL-IN	Chicago-Gary-Lake County	1	.	1	3	.	.	7,887	.	475	625	.	7,887
46	KY	Boyd Co. (Ashland)		.	1	.	.	.	.	.	51	.	.	51
47	KY-IN	Louisville	1	.	.	.	.	.	834	.	.	.	.	834
48	LA	Baton Rouge	1	.	.	.	.	.	559	.	.	.	.	559
49	MA	Springfield (W. Mass)	1	.	.	.	.	.	812	.	.	.	.	812
50	MD	Baltimore	1	.	.	.	.	.	2,348	.	.	.	.	2,348
51	MD	Kent and Queen Anne Cos.	1	.	.	.	.	.	52	.	.	.	.	52

Table A-19. Condensed Nonattainment Areas List(a) (continued)

			Pollutant(c)						Population (x 1000) (d)					
	State	Area Name(b)	O_3	CO	SO_2	PM_{10}	Pb	NO_2	O_3	CO	SO_2	PM_{10}	Pb	All
52	MN	Minneapolis-St. Paul	.	.	.	1	.	.	.	.	.	272	.	272
53	MN	Olmsted Co. (Rochester)	.	.	1	.	.	.	.	.	71	.	.	71
54	MO	Dent	.	.	.	.	1	.	.	.	.	.	3	3
55	MO	Liberty-Arcadia	.	.	.	.	1	.	.	.	.	.	2	2
56	MO-IL	St. Louis	1	.	.	.	1	.	2,390	.	.		2	2,390
57	MT	Butte	.	.	.	1	.	.	.	.	.	33	.	33
58	MT	Columbia Falls	.	.	.	1	.	.	.	.	.	3	.	3
59	MT	Kalispell	.	.	.	1	.	.	.	.	.	12	.	12
60	MT	Lame Deer	.	.	.	1	.	.	.	.	.	1	.	1
61	MT	Lewis & Clark (E. Helena)	.	.	1	.	1	.	.	.	2	.	2	2
62	MT	Libby	.	.	.	1	.	.	.	.	.	3	.	3
63	MT	Missoula	.	1	.	1	.	.	.	43	.	43	.	43
64	MT	Polson	.	.	.	1	.	.	.	.	.	3	.	3
65	MT	Ronan	.	.	.	1	.	.	.	.	.	2	.	2
66	MT	Thompson Falls	.	.	.	1	.	.	.	.	.	1	.	1
67	MT	Whitefish	.	.	.	1	.	.	.	.	.	3	.	3
68	MT	Yellowstone Co. (Laurel)	.	.	1	.	.	.	.	.	5	.	.	5
69	NE	Douglas Co. (Omaha)	.	.	.	.	1	.	.	.	.	.	1	1
70	NM	Anthony	.	.	.	1	.	.	.	.	.	2	.	2
71	NM	Grant Co.	.	.	1	.	.	.	.	.	28	.	.	28
72	NM	Sunland Park	1	.	.	.	.	.	8	.	.	.	.	8
73	NV	Central Steptoe Valley	.	.	1	.	.	.	.	.	2	.	.	2
74	NV	Las Vegas	.	1	.	1	.	.	.	258	.	741	.	741
75	NV	Reno	.	1	.	1	.	.	.	134	.	254	.	254
76	NY-NJ-CT	New York-N. New Jersey-Long Island	1	1	.	1	.	.	17,943	12,338	.	1,488	.	17,943
77	OH	Cleveland-Akron-Lorain	.	.	1	1	.	.	.	.	1,412	1,412	.	1,412
78	OH	Jefferson Co. (Steubenville)	.	.	.	1	.	.	.	.	.	4	.	4
79	OH	Lucas Co. (Toledo)		.	1	.	.	.	.	.	462	.	.	462
80	OR	Grants Pass	.	1	.	1	.	.	.	17	.	17	.	17
81	OR	Klamath Falls	.	1	.	1	.	.	.	18	.	18	.	18
82	OR	LaGrande	.	.	.	1	.	.	.	.	.	12	.	12
83	OR	Lakeview	.	.	.	1	.	.	.	.	.	3	.	3
84	OR	Medford	.	1	.	1	.	.	.	62	.	63	.	63
85	OR	Oakridge	.	.	.	1	.	.	.	.	.	3	.	3
86	OR	Springfield-Eugene	.	.	.	1	.	.	.	.	.	157	.	157
87	PA	Lancaster	1	.	.	.	.	.	423	.	.	.	.	423
88	PA	Pittsburgh-Beaver Valley	1	.	2	1	.	.	2,468	.	446	75	.	2,468
89	PA	Warren Co	.	.	2	.	.	.	.	.	22	.	.	22
90	PA-DE-NJ-MD	Philadelphia-Wilmington-Trenton	1	.	.	.	.	.	6,010	.		.	.	6,010
91	PA-NJ	Allentown-Bethlehem	.	.	1	.	.	.	.	.	91	.	.	91
92	PR	Guaynabo Co.	.	.	.	1	.	.	.	.	.	85	.	85
93	TN	Shelby Co. (Memphis)	.	.	.	.	1	.	.	.	.	.	826	826
94	TX	Beaumont-Port Arthur	1	.	.	.	.	.	361	.	.	.	.	361
95	TX	Dallas-Fort Worth	1	.	.	.	.	.	3,561	.	.	.		3,561
96	TX	El Paso	1	1	.	1	.	.	592	54	.	515	.	592
97	TX	Houston-Galveston-Brazoria	1	.	.	.	.	.	3,731	.	.	.	.	3,731
98	UT	Ogden	.	1	.	1	.	.	.	63	.	63	.	63
99	UT	Salt Lake City	.	.	1	1	.	.	.	.	725	725	.	725
100	UT	Tooele Co.	.	.	1	.	.	.	.	.	26	.	.	26
101	UT	Utah Co. (Provo)	.	1	.	1	.	.	.	85	.	263	.	263
102	WA	Olympia-Tumwater-Lacey	.	.	.	1	.	.	.	.	.	63	.	63

Table A-19. Condensed Nonattainment Areas List(a) (continued)

			Pollutant(c)						Population (x 1000) (d)					
	State	**Area Name(b)**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**NO_2**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**All**
103	WA	Seattle-Tacoma	.	.	.	3	.	.	.	.	.	730	.	730
104	WA	Spokane	.	1	.	1	.	.	.	279	.	177	.	279
105	WA	Wallula	.	.	.	1	.	.	.	.	.	47	.	47
106	WA	Yakima	.	.	.	1	.	.	.	.	.	54	.	54
107	WI	Manitowoc Co.	1	.	.	.	.	.	80	.	.	.	.	80
108	WI	Marathon Co. (Wausau)	.	.	1	.	.	.	.	.	115	.	.	115
109	WI	Milwaukee-Racine	1	.	.	.	.	.	1,735	.	.	.	.	1,735
110	WI	Oneida Co. (Rhinelander)	.	.	1	.	.	.	.	.	31	.	.	31
111	WV	Follansbee	.	.	.	1	.	.	.	.	.	3	.	3
112	WV	New Manchester Gr. (in Hancock Co)	.	.	1	.	.	.	.	.	10	.	.	10
113	WV	Wier.-Butler-Clay (in Hancock Co)	.	.	1	1	.	.	.	.	25	22	.	25
114	WY	Sheridan	.	.	.	1	.	.	.	.	.	13	.	13
			31	17	28	76	6	0	90,800	30,515	4,034	29,792	836	100,593

Notes:

(a) This is a simplified listing of Classified Nonattainment areas. Unclassified and Section 185a nonattainment areas are not included. In certain cases, footnotes are used to clarify the areas involved. For example, the lead nonattainment area listed within the Dallas-Fort Worth ozone nonattainment area is in Frisco, Texas, which is not in Dallas county, but is within the designated boundaries of the ozone nonattainment area. Readers interested in more detailed information should use the official *Federal Register* citation (40 CFR 81).

(b) Names of nonattainment areas are listed alphabetically within each state. The largest city determines which state is listed first in the case of multiple-city nonattainment areas. When a larger nonattainment area, such as ozone, contains 1 or more smaller nonattainment areas, such as PM_{10} or lead, the common name for the larger nonattainment area is used. Note that several smaller nonattainment areas may be inside one larger nonattainment area, as is the case in Figure A-1. For the purpose of this table, these are considered one nonattainment area and are listed on one line. Occasionally, two nonattainment areas may only partially overlap, as in Figure A-2. These are counted as two distinct nonattainment areas and are listed on separate lines.

(c) The number of nonattainment areas for each of the criteria pollutants is listed.

(d) Population figures were obtained from 1990 census data. For nonattainment areas defined as only partial counties, population figures for just the nonattainment area were used when these were available. Otherwise, whole county population figures were used. When a larger nonattainment area encompasses a smaller one, double-counting the population in the “All” column is avoided by only counting the population of the larger nonattainment area.

(e) Lead nonattainment area is a portion of Franklin township, Marion county, Indiana.

(f) Sulfur dioxide nonattainment area is a portion of Boyd county.

(g) Lead nonattainment area is Herculaneum, Missouri in Jefferson county.

(h) Lead nonattainment area is a portion of Lewis and Clark county, Montana.

(i) Ozone nonattainment area is a portion of Dona Ana county, New Mexico.

(j) Lead nonattainment area is a portion of Shelby county, Tennessee.

(k) Lead nonattainment area is Frisco, Texas, in Collin county.

Figure A-1. (Multiple NA areas within a larger NA area) Two SO_2 areas inside the Pittsburgh–Beaver Valley ozone NA. Counted as one NA area.

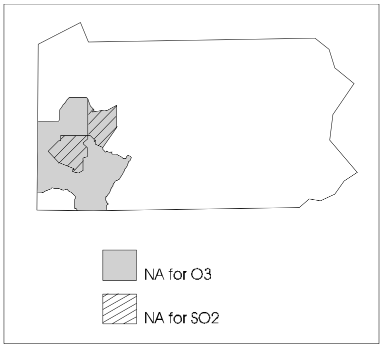


Figure A-2. (Overlapping NA areas) Searles Valley PM_{10} NA partially overlaps the San Joaquin Valley ozone NA. Counted as two NA areas.

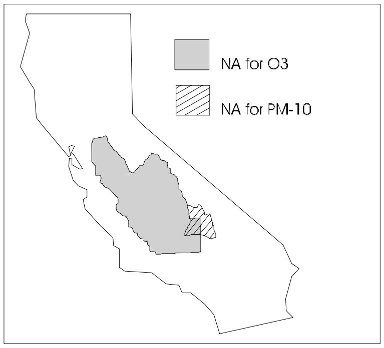


Table A-20. Trend in 8-hr ozone concentrations (ppm) exceedances at National Park and National Monument sites, 1990–1999

National Park	Trend	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Acadia NP	NS	0.089	0.095	0.080	0.080	0.075	0.092	0.073	0.077	0.088	0.092
		4	7	1	3	0	5	2	1	4	5
Big Bend NP	UP	nd	0.057	0.061	0.063	0.069	0.065	0.073	0.063	0.070	0.064
		nd	0	0	0	0	0	0	0	0	0
Brigantine	NS	0.109	0.111	0.094	0.093	0.083	0.100	0.095	0.106	0.091	0.095
		17	34	8	13	2	10	13	18	22	19
Cape Cod NS	NS	0.097	0.111	0.096	0.088	0.088	0.105	0.096	0.100	0.084	0.101
		9	16	6	4	4	9	8	17	2	12
Cape Romain	UP	nd	0.060	0.072	0.069	0.067	0.075	0.071	0.082	0.076	0.080
		nd	0	0	0	0	1	1	3	0	2
Chiricahua NM	NS	0.069	0.071	0.065	0.068	0.071	0.059	0.072	0.065	0.067	0.072
		0	0	0	0	0	0	0	0	0	0
Congaree Swamp	UP	nd	0.059	0.067	0.063	0.064	0.076	0.074	0.065	0.081	0.080
		nd	0	0	0	0	1	0	0	0	0
Cowpens NB	UP	0.074	0.078	0.086	0.082	0.083	0.084	0.080	0.091	0.096	0.094
		0	1	4	3	2	3	2	6	15	7
Denali NP	UP	0.048	0.049	0.050	0.048	0.049	0.053	0.053	0.051	0.054	0.054
		0	0	0	0	0	0	0	0	0	0
Everglades NP	NS	0.060	0.060	0.061	0.064	0.064	0.058	0.063	0.066	0.072	0.067
		0	0	0	0	0	0	0	0	0	0
Glacier NP	NS	0.050	0.051	0.051	0.044	0.055	nd	0.057	0.04	0.053	0.048
		0	0	0	0	0	nd	0	0	0	0
Grand Canyon NP	NS	0.072	0.073	0.074	0.066	0.073	nd	0.073	0.072	0.072	0.076
		0	0	0	0	0	nd	0	0	0	0
Great Smoky Mtn	UP	0.092	0.079	0.088	0.088	0.093	0.099	0.088	0.098	0.110	0.106
		5	2	5	4	10	11	8	19	35	25
Great Smoky Mtn	UP	0.087	0.082	0.075	0.089	0.088	0.093	0.092	0.095	0.106	0.101
		4	1	0	7	6	12	12	20	34	26
Lassen Volcanic	NS	0.078	0.066	0.069	0.064	0.078	0.074	0.073	0.067	0.078	0.084
		1	0	0	0	1	0	1	0	1	2
Mammoth Cave NP	NS	0.083	0.078	0.073	0.072	0.075	0.088	0.082	0.078	0.092	0.098
		2	0	0	0	1	5	2	3	12	13
Olympic NP	NS	0.046	0.043	0.046	0.042	0.042	0.049	0.046	0.045	0.041	0.043
		0	0	0	0	0	0	0	0	0	0
Pinnacles NM	NS	0.083	0.084	0.084	0.060	0.078	0.083	0.094	0.076	0.088	0.082
		3	3	3	0	0	3	9	1	5	0
Rocky Mountain	UP	0.057	0.076	0.071	0.071	0.076	0.076	0.072	0.070	0.080	0.074
		0	0	0	1	0	0	0	0	1	1
Saguaro NM	NS	0.075	0.073	0.074	0.082	0.080	0.083	0.076	0.079	0.077	0.069
		0	0	1	1	0	2	0	0	0	1
Sequoia/Kings C	NS	0.096	0.097	0.102	0.106	0.106	0.095	0.105	0.097	0.094	0.097
		27	34	50	48	58	18	50	26	27	23
Shenandoah NP	UP	0.086	0.083	0.077	0.083	0.083	0.087	0.081	0.089	0.107	0.093
		4	3	1	2	2	7	1	6	22	15
Theodore Roosevelt	NS	0.062	0.060	0.057	0.055	0.057	0.058	0.059	0.071	0.056	0.058
		0	0	0	0	0	0	0	0	0	0
Yosemite NP	NS	0.094	0.080	0.084	0.078	0.077	0.084	0.081	nd	nd	nd
		19	1	3	0	0	2	1	nd	nd	nd
Yellowstone	NS	0.054	0.057	0.063	0.053	0.061	0.060	0.061	0.061	0.066	0.077
		0	0	0	0	0	0	0	0	0	0

Notes:

1. The trends statistic is the annual fourth highest daily maximum 8-hour ozone concentration (ppm). The number of exceedances of the level of the 8-hour ozone NAAQS is shown below the concentration value.
2. “nd” indicates no data available for that year.
3. “inc” indicates less than 90 days of monitoring data available for that year.
4. “NS” indicates no statistically significant trend (at the 0.05 level).
5. “UP” indicates a statistically significant upward trend in ozone concentrations.

Table A-21. Onroad and Nonroad Emissions of 21 Mobile Source Air Toxics, 1996

	Onroad		Nonroad		Mobile Sources	
Compound	**Tons**	**Percent of Total National Emissions**	**Tons**	**Percent of Total National Emissions**	**Tons**	**Percent of Total National Emissions**
1,3-Butadiene*	23,500	42%	9,900	18%	33,400	60%
Acetaldehyde*	28,700	29%	40,800	41%	69,500	70%
Acrolein*	5,000	16%	7,400	23%	12,400	39%
Arsenic Compounds*	0.25	0.06%	2.01	0.51%	2.26	0.57%
Benzene*	168,200	48%	98,700	28%	266,900	76%
Chromium Compounds*	14	1.2%	35	3%	49	4.2%
Dioxins/Furans* [1]	NA	NA	NA	NA	NA	NA
Ethylbenzene	80,800	47%	62,200	37%	143,000	84%
Formaldehyde*	83,000	24%	86,400	25%	169,400	49%
Lead Compounds*	19	0.8%	546	21.8%	565	22.6%
Manganese Compounds*	5.8	0.2%	35.5	1.3%	41.3	1.5%
Mercury Compounds*	0.2	0.1%	6.6	4.1%	6.8	4.2%
MTBE	65,100	47%	53,900	39%	119,000	86%
n-Hexane	63,300	26%	43,600	18%	106,600	44%
Naphthalene[2]	NA	NA	NA	NA	NA	NA
Nickel Compounds*	10.7	0.9%	92.8	7.6%	103.5	8.5%
POM (as sum of 7 PAH)*	42.0	4%	19.3	2%	61.3	6%
Styrene	16,300	33%	3,500	7%	19,800	40%
Toluene	549,900	51%	252,200	23%	802,100	74%
Xylene	311,000	43%	258,400	36%	569,400	79%
Diesel Particulate Matter	182,000	34%	341,000	65%	523,000	99%

*On the urban HAPs list for the Integrated Urban Air Toxics Strategy

[1] Dioxin/Furans emission estimates are still under review

[2] Naphthalene emission estimates are currently included in POM. This will be corrected in the 1999 NTI.

APPENDIX B

Methodology

http://www.epa.gov/oar/aqtrnd99/appendb.pdf

AIRS Methodology

The ambient air quality data presented in Chapters 2 and 3 of this report are based on data retrieved from AIRS on July 20, 2000. These are direct measurements of pollutant concentrations at monitoring stations operated by state and local governments throughout the nation. The monitoring stations are generally located in larger urban areas. EPA and other federal agencies also operate some air quality monitoring sites on a temporary basis as a part of air pollution research studies. The national monitoring network conforms to uniform criteria for monitor siting, instrumentation, and quality assurance.[1,2]

Emission estimation methods used for historical years prior to 1985 are considered "top-down approaches," e.g., pollutant emissions were estimated by using national average emission characterization techniques (for NO_x, VOC, CO, Pb, and PM_{10}). Emission estimates for the years 1985–present represent an evolution in methods for significant categories resulting in a "bottom-up approach" including data submitted directly by state/local agencies (for all criteria pollutants, $PM_{2.5}$ and NH_3).

In 1999, 4,184 monitoring sites reported air quality data for one or more of the six NAAQS pollutants to AIRS, as seen in Table B-1. The geographic locations of these monitoring sites are displayed in Figures B-1 to B-6. The sites are identified as National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations (SLAMS), or "other." NAMS were established to ensure a long-term national network for urban area-oriented ambient monitoring and to provide a systematic, consistent data base for air quality comparisons and trends analysis. SLAMS allow state or local governments to develop networks tailored for their immediate monitoring needs. "Other" monitors may be Special Purpose Monitors, industrial monitors, tribal monitors, etc.

Table B-1. Number of Ambient Monitors Reporting Data to AIRS

Pollutant	# of Sites Reporting Data to AIRS in 1999	# of Trend Sites 1990–1999
CO	531	388
Pb	265	175
NO_2	424	230
O_3	1,086	703
PM_{10}	1,214	954
SO_2	637	480
Total	4,184	2,930

Air quality monitoring sites are selected as national trends sites if they have complete data for at least eight of the 10 years between 1990 and 1999. The annual data completeness criteria are specific to each pollutant and measurement methodology. Table B-1 displays the number of sites meeting the 10-year trend completeness criteria. Because of the annual turnover of monitoring sites, the use of a moving 10-year window maximizes the number of sites available for trends and yields a data base that is consistent with the current monitoring network.

The air quality data are divided into two major groupings: daily (24-hour) measurements and continuous (1-hour) measurements. The daily measurements are obtained from monitoring instruments that produce one measurement per 24-hour period and typically operate on a systematic sampling schedule of once every six days, or 61 samples per year. Such instruments are used to measure PM_{10} and lead. More frequent sampling of PM_{10} (every other day or every day) also is common. Only PM_{10} weighted (for each quarter to account for seasonality) annual arithmetic means that meet the AIRS annual summary criteria are selected as valid means for trends purposes.[3] Beginning in 1998, some sites began reporting PM_{10} data based on local conditions, instead of

Figure B-1. Carbon monoxide monitoring network, 1999.

Figure B-2. Lead monitoring network, 1999.

Figure B-3. Nitrogen dioxide monitoring network, 1999.

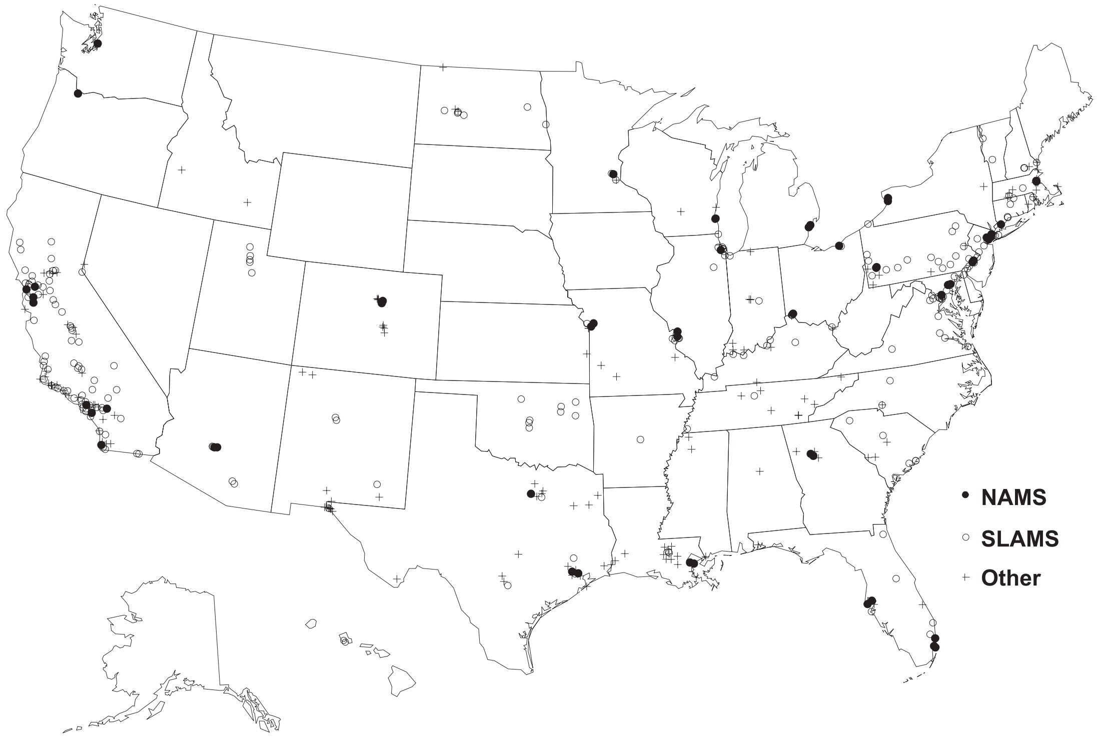


Figure B-4. Ozone monitoring network, 1999.

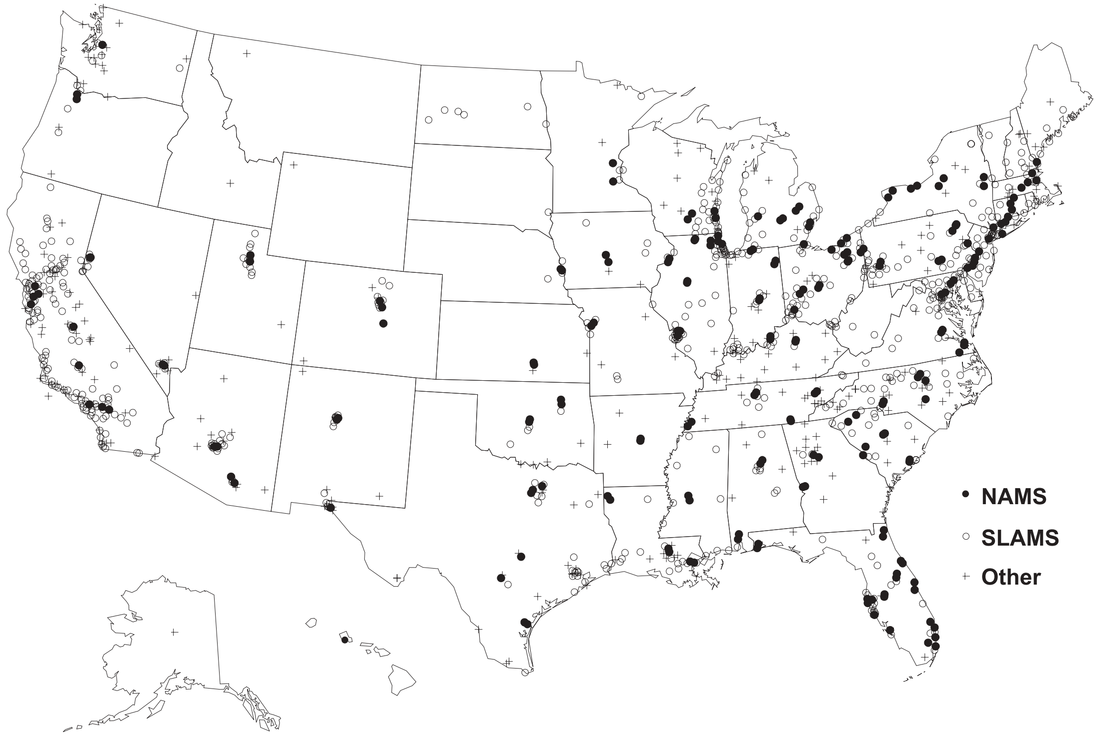


Figure B-5. PM_{10} monitoring network, 1999.

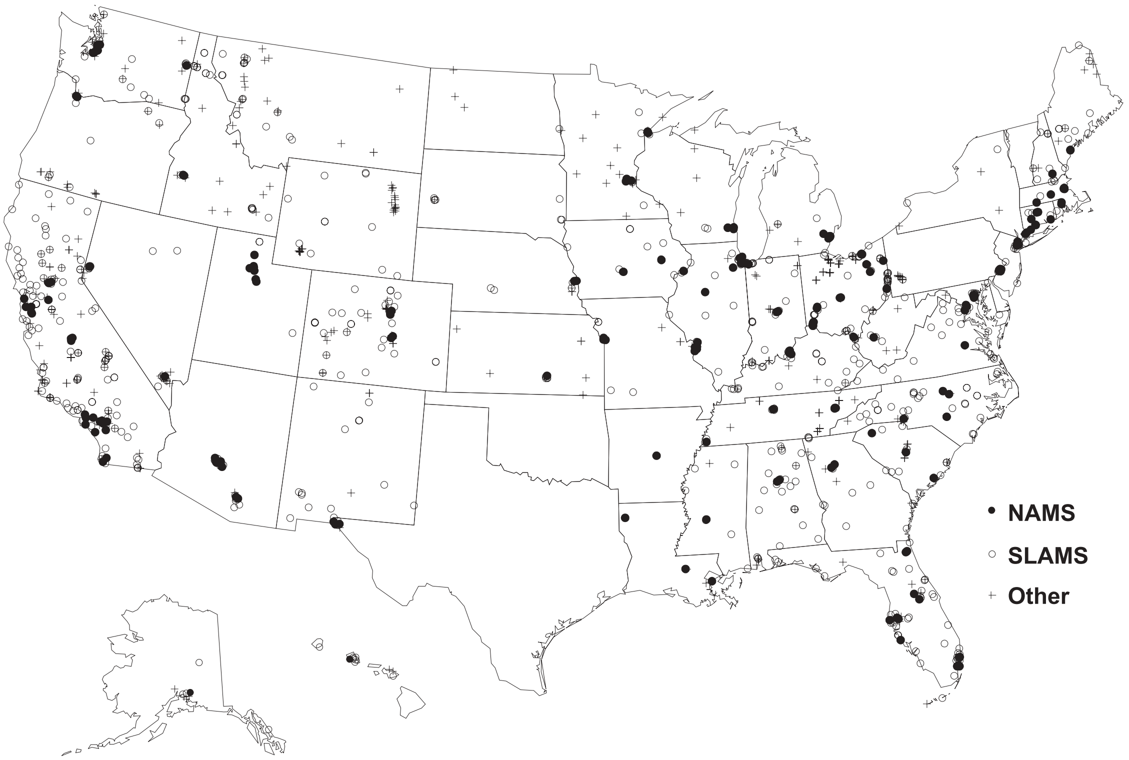


Figure B-6. Sulfur dioxide monitoring network, 1999.

standard, or "reference," conditions. For these sites, PM_{10} statistics were converted from local conditions to standard conditions to ensure all PM_{10} data in this report are consistent and reflect standard conditions.[4] Only lead sites with at least six samples per quarter in three of the four calendar quarters qualify as trends sites. Monthly composite lead data are used if at least two monthly samples are available for at least three of the four calendar quarters.

Monitoring instruments that operate continuously produce a measurement every hour for a possible total of 8,760 hourly measurements in a year. For hourly data, only annual averages based on at least 4,380 hourly observations are considered as trends statistics. The SO_2 standard-related daily statistics require at least 183 daily values to be included in the analysis. Ozone sites meet the annual trends data completeness requirement if they have at least 50 percent of the daily data available for the ozone season, which varies by state, but typically runs from May through September.[5]

Air Quality Trend Statistics

The air quality statistics presented in this report relate to the pollutant-specific NAAQS and comply with the recommendations of the Intra-Agency Task Force on Air Quality Indicators.[6] A composite average of each trend statistic is used in the graphical presentations throughout this report. All sites were weighted equally in calculating the composite average trend statistic. Missing annual summary statistics for the second through ninth years for a site are estimated by linear interpolation from the surrounding years. Missing end points are replaced with the nearest valid year of data. The resulting data sets are statistically balanced, allowing simple statistical procedures and graphics to be easily applied. This procedure is conservative since end-point rates of change are dampened by the interpolated estimates.

Emissions Estimates Methodology

Trends are presented for annual nationwide emissions of CO, lead, NO_x, VOC, PM_{10} , and SO_2. These trends are estimates of the amount and kinds of pollution being emitted by automobiles, factories, and other sources based upon best available engineering calculations. Because of recent changes in the methodology used to obtain these emissions estimates the estimates have been recomputed for each year. Thus, comparisons of the estimates for a given year in this report to the same year in previous reports may not be appropriate.

The emissions estimates presented in this report reflect several major changes in methodologies that were instituted mainly in 1996. First, state-derived emissions estimates were included primarily for nonutility point and area sources. Also, 1985–1994 NO_x emission rates derived from test data from the Acid Rain Division, U.S. EPA, were utilized. The MOBILE5b model was run instead of MOBILE5a for the years 1995 through 1999. For 1985–1999, the Office of Transportation and Air Quality, U.S. EPA, provided new estimates from the beta version of the nonroad model for most nonroad diesel and gasoline equipment categories. Finally, additional improvements were made to the particulate matter fugitive dust categories.

In addition to the changes in methodology affecting most source categories and pollutants, other changes were made to the emissions for specific pollutants, source categories, and/or individual sources. Activity data and correction parameters for agricultural crops and paved roads were included. A change in methodology occurred starting in 1996 for calculating PM_{10} emissions from unpaved roads and in 1999 for calculating emissions from construction. This has led to lower PM_{10} emissions than would have been predicted using the previous methods. The development of new emission estimation methodologies have added emissions for open burning of residential yard waste and land-clearing debris burning. Starting in 1999, these estimates contributed to a significant increase in industrial category emissions for CO, PM_{10} and $PM_{2.5}$ between 1998 and 1999. State-supplied MOBILE model inputs for 1990, 1995, and 1996 were used, as well as state-supplied VMT data for 1990. In addition, there were VMT methodology changes starting in 1995 that affected the allocation of state or metropolitan area VMT to counties. Rule effectiveness from pre-1990 chemical and allied product emissions was removed. Lead content of unleaded and leaded gasoline for the onroad and nonroad engine lead emission estimates was revised, and Alaska and Hawaii nonutility point and area source emissions from several sources were added. Also, this report incorporates data from CEMs collected between 1994 and 1999 for NO_x and SO_2 emissions at major electric utilities.

Figure B-7. Class I Areas in the IMPROVE Network meeting data completeness criteria.

All of these changes are part of a broad effort to update and improve emissions estimates. Additional emissions estimates and a more detailed description of the estimation methodology are available from EPA's Emission Factor and Inventory Group.

IMPROVE Methodology

Data collected from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network is summarized in Chapters 2 ($PM_{2.5}$ section) and 6 of this report. The completeness criteria and averaging method used to summarize the IMPROVE data are slightly different from those used for the criteria pollutants. (Data handling guidance is currently being developed for the IMPROVE network. Future summaries will be based on this guidance.) The source data sets were obtained from Dr. James Sisler of Colorado State University.

The annual average statistics in these files were used to assess trends in this report. The IMPROVE data are not reported in terms of a calendar year. The IMPROVE year runs from March to February of the following year. It follows that the four seasons are: March to May (spring), June to August (summer), September to November (autumn), and December to the following February (winter). The network samplers monitor on Wednesdays and Saturdays throughout the year, yielding 104 samples per year and 26 samples per season. To be included in this analysis, sites were required to have data at least 50 percent of the scheduled samples (13 days) for every calendar quarter.

IMPROVE monitoring sites are selected as trends sites if they have complete data for at least eight of the 10 years between 1990 and 1999 or (six of eight years for those who began monitoring in 1992). A year is valid only if there are at least 13 samples (50 percent complete) per season for both measured and reconstructed $PM_{2.5}$. The same linear interpolation applied to the criteria pollutants is applied here. The IMPROVE sites meeting the data completeness criteria are shown in Figure B-7.

For consistency, the same sites are used in both the $PM_{2.5}$ section and the Visibility chapter. The exceptions are Washington D.C. and South Lake Tahoe, which are not included in the visibility trends analysis because they are urban sites.

Air Toxics Methodology

Database

The 1990–1999 ambient air quality data presented in Chapter 5 of this report are based on air toxics data retrieved from AIRS in July, 2000, data retrieved from the IMPROVE network <**ftp://alta_vista.cira.colostate.edu/DATA/IMPROVE/**> in June, 2000, and data voluntarily submitted to EPA by state and local monitoring agencies and received by June 30, 2000. For more details about the database, see Rosenbaum *et al*, 1999.[7] All statistical summaries are based on annual average concentrations. Measurements for hazardous air pollutants (HAPs) are frequently reported as non-detectable concentrations. To calculate annual average concentrations, one-half of the actual or plausible detection limit is used to substitute values for non-detects (or if the reported value is zero). The plausible detection limit, used for cases where the MDL is missing, is the lowest of the measured concentrations and MDLs for the given monitor and HAP.

Separate summaries are presented for sites in an MSA/PMSA, excluding the (primarily rural) sites from the IMPROVE network, and for other sites. Areas (one or more counties) are either assigned to a MSA, to a CMSA (consolidated MSA) consisting of two or more PMSAs (primary MSAs), or are just assigned to a county. Each non-IMPROVE site in an MSA or CMSA was assigned either to its MSA or PMSA. Some analyses allocated MSA/PMSAs to states. If the MSA/PMSA crosses state boundaries, the state containing the largest portion of that MSA/PMSA was used.

Completeness

All calculations are based on the average of calculated or measured 24-hour values. For each HAP, a series of completeness rules are applied sequentially starting with using the raw hourly data to determine daily completeness. Multiple records for the same HAP, monitoring site, day, and time period are averaged together. A day is complete if the total number of hours monitored for that day is 18 or more (i.e., 75 percent of 24 hours). For example, 18 hourly averages, three 6-hour averages, or three 8-hour averages will satisfy the daily completeness criteria. Once daily completeness is satisfied, quarterly completeness is determined. Calendar quarters are 1. (Late winter) January–March, 2. (Early summer) April–June, 3. (Late summer) July–September, 4. (Early winter) October–December. A calendar quarter is complete if it has 75 percent or more complete days out of the expected number of daily samples for that quarter, and if there are at least five complete days in the quarter. To determine the expected number of daily samples, the most frequently occurring sampling interval (days from one sample to the next sample) was used; in cases of ties, the minimum sampling interval was applied. A calendar year is complete if both the summer and winter six month seasons have at least one complete quarter, i.e., if a) quarter 1 or quarter 4 or both quarters 1 and 4 are complete, and b) quarter 2 or quarter 3 or both quarters 2 and 3 are complete.

In some cases, co-located samples for the same HAP and location were collected. For AIRS data, co-located monitors are identified by having the same 9-digit AIRS ID number but a different POC number. The higher POC numbers are generally used for quality assurance monitoring data that are not as complete as the primary sampling data. Therefore, if multiple AIRS monitors at the same location meet the above completeness requirements, then only the data from the monitor with the lowest POC number was used for these analyses. For data not reported to AIRS, co-located monitors can have very different monitor identifiers. If multiple monitors at the same latitude and longitude location for a given sampling program and HAP meet the completeness requirements, then only the data from the monitor with the highest monitoring frequency was used for these analyses. In case of tied highest monitoring frequencies, the monitor with the most daily average records (from complete quarters in the trend period) was used.

National Analyses

Based on the available years of monitoring data across the nation, the national analyses were restricted to the six-year period 1994–1999. A site was included for a particular HAP if, and only if, there were four or more complete years for that period.

California Analyses

A similar, but longer term trend analysis was performed on metropolitan sites located only in California using 1990–1999 data. A site was included for a given HAP if there was at least one period of five years or longer such that a) at least 75 percent of those years are complete, and b) the period ends in 1997 or later. Only the data from the most recent of the longest such periods was used.

Trend Analysis

Annual averages for years with four complete quarters were computed by averaging the four quarterly averages. If a year had one or more missing or incomplete quarters, then those missing or incomplete quarterly averages were filled in (if possible) using the General Linear Model (GLM) fill-in methodology described below and the annual average was computed by first averaging the quarterly averages (actual or filled-in) for a season and then averaging across the two seasons.[8] Filled-in quarterly averages were used for incomplete quarters even if there was some data for that quarter. Data from incomplete quarters was not used in the analyses. Sometimes, the filled in quarterly average can be negative and occasionally this leads to a negative annual average. To deal with this case, negative or zero filled-in quarterly averages were used to compute the annual average (this avoids biasing the results), but any resulting negative annual averages were reset to zero. In the summary analyses, averages across multiple sites were computed as trimmed means rather than simple arithmetic means in order to reduce the influence of the most extreme monitor averages on the trend line. If there were nine sites or less, then no trimming was performed, so the trimmed mean is the arithmetic mean of all the site averages. If there were between 10 and 40 sites, inclusive, the trimmed mean is the arithmetic mean of all the site averages except for the highest and lowest averages. If there were 41 sites or more, the trimmed mean is the arithmetic mean of all the site averages except for the highest 2.5 percent and the lowest 2.5 percent of the averages. The reported numbers of sites and percentiles are based on all sites meeting the completeness criteria, i.e., including the sites that were excluded for the trimmed mean calculation.

The overall slope (trend) was estimated non-parametrically as the median of the ratios of the difference in the annual average to the difference in calendar year, for all pairs of calendar years. The significance level of the trend was computed using the associated non-parametric Theil test, based on the number of pairs of years where the annual averages increased. The p-values are calculated for a two-sided test for whether or not the annual averages have a trend (which may be increasing or decreasing). The trend is reported as “Significant Up Trend” or “Significant Down Trend” if the corresponding one-sided test is significant at the five percent significance level; otherwise the result is reported as “Non-significant Up Trend,” “no trend,” or “Non-significant Down Trend.”

For the tables summarizing the annual average trends by monitor, the GLM fill-in method was not used. Instead, those monitor annual averages were computed by averaging all complete daily averages for each complete quarter, then averaging the complete quarterly averages for each season, and then, finally, averaging over the two seasons. All other analyses used the filled-in quarterly averages as described above.

GLM Fill-in Methodology

The general linear model (GLM) fill-in methodology and software used to fill in missing quarterly averages was based on the report by Cohen and Pollack (1990),[9] which can be consulted for more details. The method was modified to apply to the sequence of quarterly averages (24 values for the six year 1994–1999 period) instead of five annual means. The method was also modified to use a fitted statistical model with six year effects and four quarterly adjustments, instead of having 24 independent year/quarter effects. In other words, the fitted model assumes that the seasonal (quarterly) variation is the same for every site and year. Initially, each site is allocated to a region, which for these analyses was the MSA/PMSA for sites within an MSA or PMSA, or else was the county. Suppose that for each of the four quarters there is at least one site in the region with complete data for that quarter in at least one year. Suppose also that for each of the six years there is at least one site in the region with complete data for at least one quarter in that year. If these two conditions apply, then the missing quarterly averages for all sites in that region are computed by fitting a general linear model such that the expected value for a given site and quarter q is the sum of the site average, a yearly adjustment term, and a quarterly adjustment term. The yearly adjustment term is the fixed effect of the y’th year, 1 <= y <= 6, assumed to be the same value for all sites in the region. The quarterly adjustment term is the fixed effect of the q’th quarter, 1 <= q <= 4, assumed to be the same value for all sites in the region and all years. If a region does not meet these two conditions, then the region is expanded to become a larger, augmented region with some site data for every quarter, and some site data for every year, and the GLM approach is applied to the augmented region. Candidates for the augmented region are selected by finding the nearest site(s) in the same state that have complete data for the missing quarter(s) and year(s). The selected augmented region is the region giving the lowest mean square error for the GLM model.

Although the GLM methodology filled in most missing quarters, there were some states, HAPs and years that had no complete quarters for any site in the state, and in those cases the missing quarters were not filled in by the GLM approach (which restricts the augmented regions to sites in the same state). For the national analyses of distributions across sites in different states, the missing site-years were then filled in using the same EPA extrapolation and interpolation method used elsewhere in the Trends report: If the site annual average for 1994 was missing, it was filled in with the 1995 annual average; if the 1995 annual average was also missing, then the 1994 and 1995 annual averages were filled in with the 1996 annual average. If the site annual average for 1999 was missing, it was filled in with the 1998 annual average; if the 1998 annual average was also missing, then the 1999 and 1998 annual averages were filled in with the 1997 annual average. Otherwise, any missing annual averages were filled in using simple linear interpolation from the two surrounding annual averages.

References

1. Clean Air Act Amendments of 1990, U.S. Code, volume 42, section 7403 (c)(2), 1990.

2. Ambient Air Quality Surveillance, 44 CFR 27558, May 10, 1979.

3. Aerometric Information Retrieval System (AIRS), Volume 2, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, October, 1993.

4. Falke, S. and Husar, R. (1998) Correction of Particulate Matter Concentrations to Reference Temperature and Pressure Conditions, Paper Number 98-A920, Air & Waste Management Association Annual Meeting, San Diego, CA, June 1998.

5. Ambient Air Quality Surveillance, 51 FR 9597, March 19, 1986.

6. U.S. Environmental Protection Agency Intra-Agency Task Force Report on Air Quality Indicators, EPA-450/4-81-015, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, February 1981.

7. Rosenbaum, A. S., Stiefer, M. P., and Iwamiya, R. K. November, 1999. *Air Toxics Data Archive and AIRS Combined Dataset: Contents Summary Report*. SYSAPP-99/26d. Systems Applications International, San Rafael, CA.

8. In all cases analyzed, four non-missing quarterly means were available after applying the GLM method, so that the resulting annual mean is the arithmetic mean of the four quarterly averages.

9. Cohen, J.P. and A. K. Pollack. 1990. *General Linear Models Approach to Estimating National Air Quality Trends Assuming Different Regional Trends.* SYSAPP-90/102. Systems Applications International, San Rafael, CA.

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Errata for:

National Air Quality and Emissions Trends Report, 1999

Revised January 14, 2002

Page ii:	Change date in “Data Source: U.S. EPA AIRS Data Base 1/30/01” to “7/12/00.”
Page 21, Figure 2-13:	Add new legend to map.
Page 44, Figure 2-41:	Figure re-plotted using the major categories within the Miscellaneous category (instead of ”Miscellaneous”).
Page 52, Figure 2-51:	Replaced with new map.
Page 59, Figure 2-60:	Figure re-plotted using the major categories within Miscellaneous (instead of Miscellaneous).
Page 237	Notes added on “Data Sources for Figure 2-55.”

About the Cover

The map on the cover depicts nationwide annual mean $PM_{2.5}$ concentrations from the Federal Reference Method (FRM) monitoring network, as well as information on data completeness. Annual mean concentrations are generally above the level of the 1997 standard of 15 $\mu g/m^3$ in much of the eastern United States and throughout California. Annual mean concentrations above 20 $\mu g/m^3$ are seen in several major metropolitan areas including Pittsburgh, Cleveland, Atlanta, Chicago, and St. Louis and Los Angeles The western Great Plains and mountain regions show notably low annual mean concentrations, most below 10 $\mu g/m^3$.

Data Source: U.S. EPA AIRS Data Base 7/12/00.

Disclaimer

This report has been reviewed and approved for publication by the U.S. Environmental Protection Agency's Office of Air Quality Planning and Standards. Mention of trade names or commercial products are not intended to constitute endorsement or recommendation for use.

Acknowledgments

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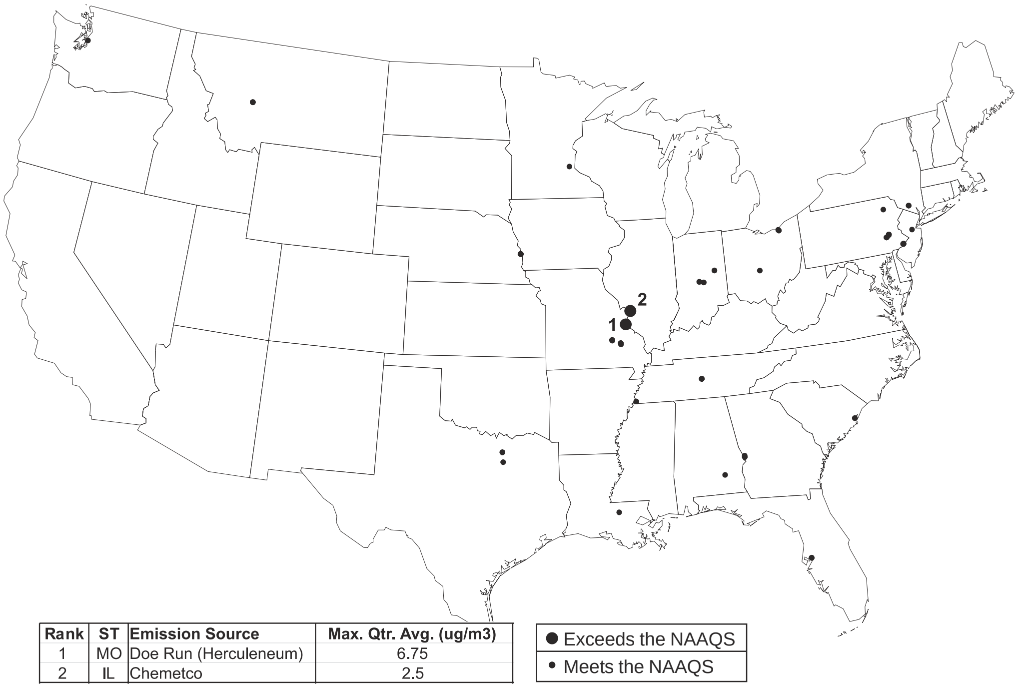
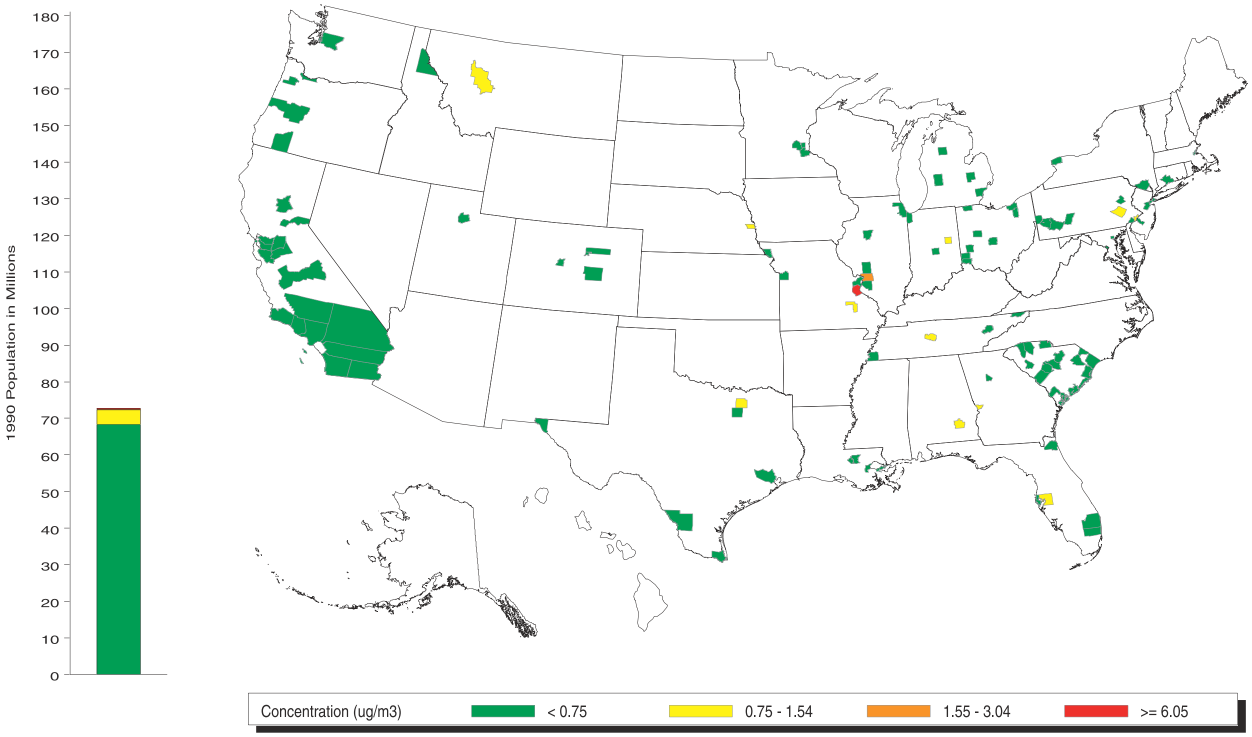
Figure 2-13. Pb maximum quarterly concentration in the vicinity of Pb point sources, 1999.



Rank	ST	Emission Source	Max. Qtr. Avg. (ug/m3)
1	MO	Doe Run (Herculeneum)	6.75
2	IL	Chemetco	2.5

Figure 2-14. Highest Pb maximum quarterly mean by county, 1999.



ried sources, shown in Figures 2-39 and 2-40. These include fuel combustion, industrial processes, and transportation. Of these, the fuel combustion category saw the largest decrease over the 10-year period (14 percent), with most of the decline attributable to a decrease in emissions from electric utility coal and oil combustion. Emissions from the industrial processes category decreased 3 percent, and emissions from the transportation category decreased 10 percent. The recent upward movement between 1998 and 1999 for industrial processing is attributed to new sources of emissions for open burning (of residential yard wastes and land clearing debris) that had not been characterized previously.

The second group of direct PM_{10} emissions is a combination of miscellaneous and natural sources including agriculture and forestry, wildfires and managed burning, and fugitive dust from paved and unpaved roads. It should be noted that fugitive dust emissions from geogenic wind erosion have been removed from the emissions inventory for all years, since the annual emission estimates based on past methods for this category are not believed to be representative. As Figure 2-41 shows, these miscellaneous and natural sources actually account for a large percentage of the total direct PM_{10} emissions nationwide, although they can be difficult to quantify compared to the traditionally inventoried sources. The trend of emissions in the miscellaneous/natural group may be more uncertain from one year to the next or over several years because these emissions tend to fluctuate a great deal from year to year. It should be noted that a change in methodology occurred between 1995 and 1996 in calculating PM_{10} emissions from unpaved roads. This has led to lower PM_{10} emissions from 1996 through 1999 than would have been predicted using the older methodology.

Figure 2-41. Total PM_{10} emissions by source category, 1999.

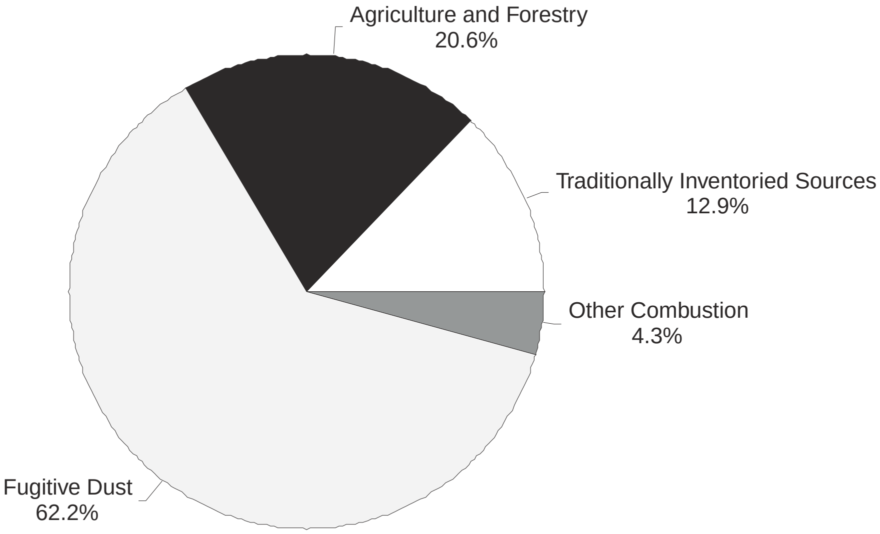


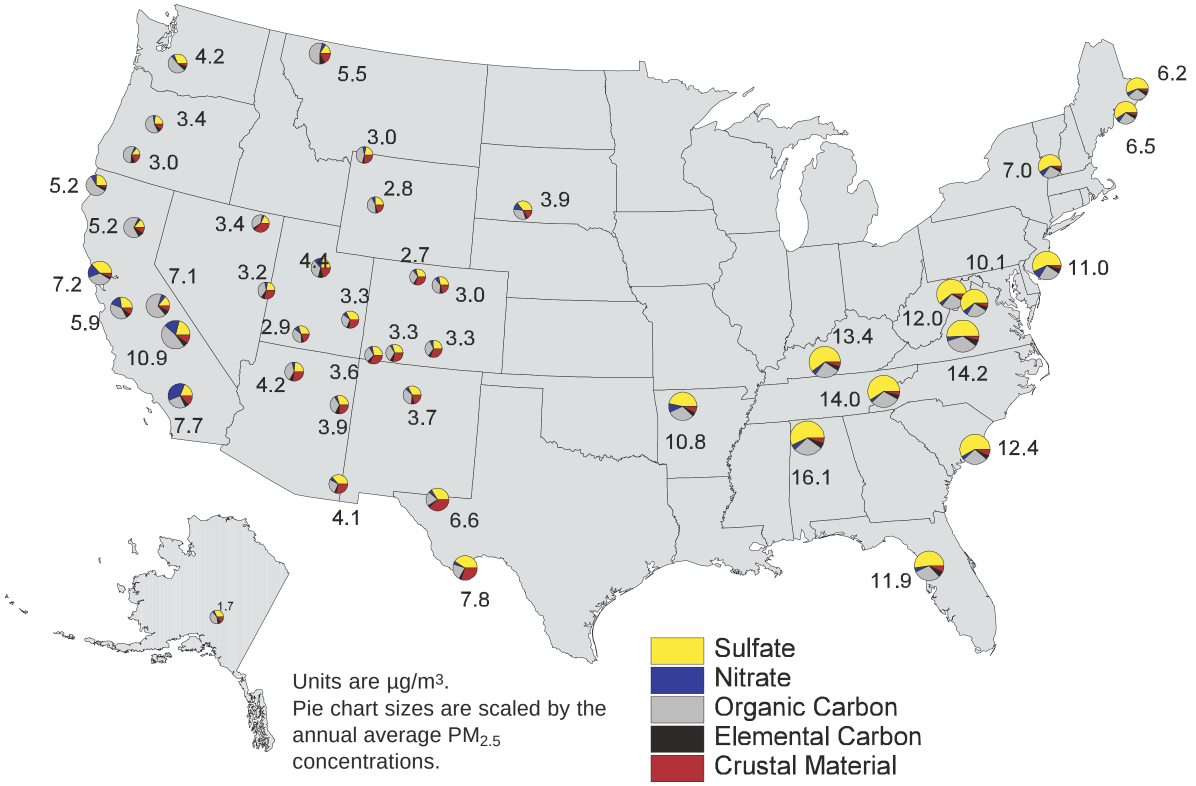
Table A-6 lists PM_{10} emissions estimates for the traditionally inventoried sources for 1990–1999. Miscellaneous and natural source PM_{10} emissions estimates are provided in Table A-7**.**

Figure 2-42 shows the emission density for PM_{10} in each U.S. county. PM_{10} emission density is the highest in the eastern half of the United States, in large metropolitan areas, areas with a high concentration of agriculture such as the San Joaquin Valley in California and along the Pacific coast. This closely follows patterns in population density. One exception is that open biomass burning is an important source category that is more prevalent in forested areas and in some agricultural areas. Fugitive dust is an important component in arid and agricultural areas.

PM_{10} Regional Air Quality Trends

Figure 2-43 is a map of regional trends for the PM_{10} annual mean from 1990–1999. All 10 EPA regions show decreasing trends over the 10-year period, with declines ranging from 5–33 percent. The largest decreases are generally seen in the western part of the United States. This is significant since PM_{10} concentrations are typically higher in the West. In the western states, programs such as those with residential wood stoves and agricultural practices have helped reduce emissions of PM_{10}. In the eastern United States, the Clean Air Act's Acid Rain Program has contributed to the decrease in PM_{10} emissions. The program has reduced

Figure 2-51. Annual mean $PM_{2.5}$ concentrations in 1999.



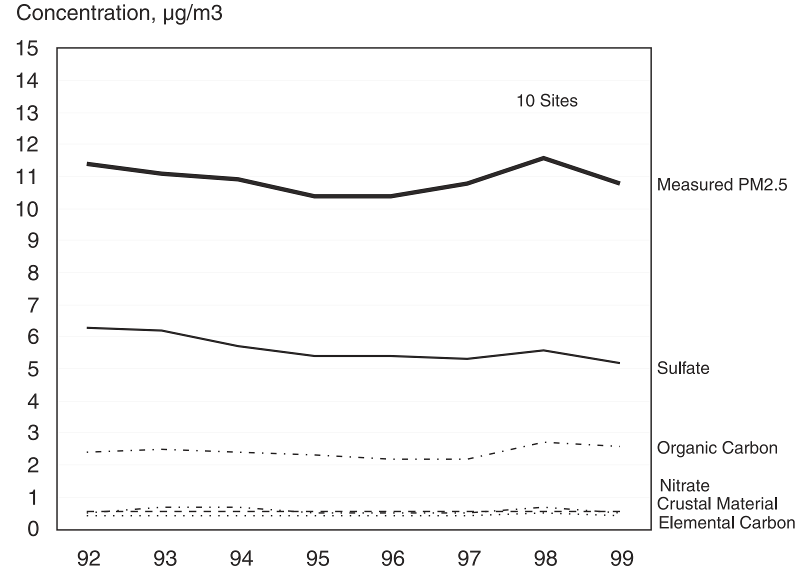
Units are µg/m3.
Pie chart sizes are scaled by the annual average $PM_{2.5}$ concentrations.

cent). Table 2-5 shows the difference in percent contribution of each species for the eastern versus western regions of the United States.

Table 2-5. Percent Contribution to $PM_{2.5}$ by Component, 1999

	East (10 sites)	West (26 sites)
Sulfate	56	33
Elemental Carbon	5	6
Organic Carbon	27	36
Nitrate	5	8
Crustal Material	7	17

Figure 2-52. $PM_{2.5}$ concentrations, 1992–1999 at eastern IMPROVE sites meeting trends criteria.



Note: Measured PM2.5 represents the direct mass measurement from the filter. The sum of the component concentrations do not equal this value because they do not account for all measured mass.

$PM_{10-2.5}$ concentrations. Though the Southeast data is relatively incomplete, preliminary estimates suggest relatively low $PM_{10-2.5}$ levels throughout that region.

Figure 2-60. Total direct $PM_{2.5}$ emissions by source category, 1999.

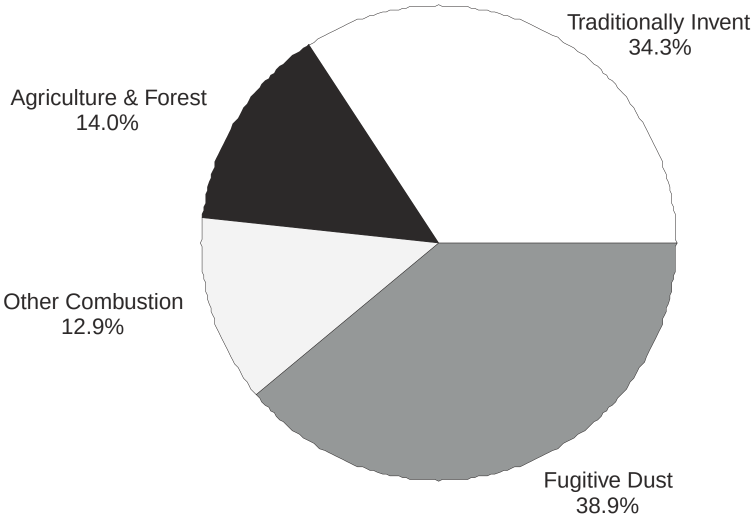
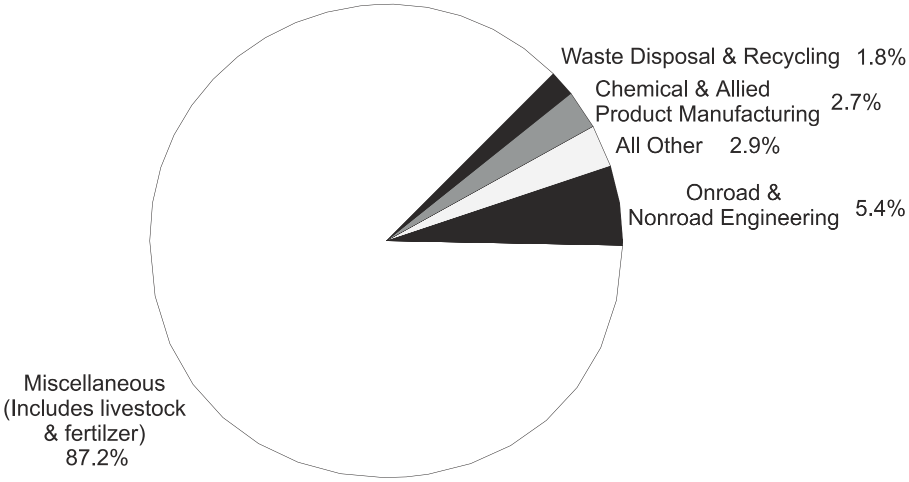


Figure 2-61. National ammonia emissions by principal source categories, 1999.



the 1997 annual average. Otherwise, any missing annual averages were filled in using simple linear interpolation from the two surrounding annual averages.

Notes on Data Sources for Figure 2-55

Composition and concentration data for all non urban locations were obtained from the Interagency Monitoring of Protected Visual Environments (IMPROVE). Washington, D.C. and Seattle data were also obtained from IMPROVE [Reference: IMPROVE, Cooperative Center for Research in the Atmosphere, Colorado State University, Ft. Collins, CO, May 2000]. and the Rochester data are based on a study conducted for NESCAUM. [Reference: Salmon, Lynn and Glen R. Cass, October, 1997, Progress Report to NESCAUM: Determination of Fine Particle Contraction and Chemical Composition in the Northeastern United States, 1995, California Institute of Technology, Pasadena, CA 91125.] The South Coast information is adapted from data collected in the South Coast area since 1982. [Reference: Christoforou, C.S., Lynn G. Salmon, Michael P. Hannigan, Paul A. Soloman and Glen R. Cass, Trends in Fine Particle Concentration and Chemical Composition. Journal of Air and Waste Management Association, Pittsburgh, PA. January 2000.] The Phoenix data is from a report by ENSR, “Plots and Tables to Characterize Particulate Matter in Phoenix, Arizona,” prepared for the Arizona Department of Environmental Quality, ENSR Document 0493-018-8, November 1999. The San Joaquin data are from Desert Research Institute [Reference: PM_{10} and $PM_{2.5}$ Variations in Time and Space, Desert Research Institute, Reno, NV, October 1995.]. Knoxville data was provided by the Tennessee Valley Authority. [Reference: (a) Tanner, R. (Tennessee Valley Authority) Personal Communication with T.G. Pace, January, 1998.] The El Paso and Dallas data were reported as a part of the Texas $PM_{2.5}$ Sampling and Analysis Study, Desert Research Institute, December, 1998. The Denver data was collected under the Northern Front Range Air Quality Study (NFRAQS). [Reference: NFRAQS Final Report, Desert Research Institute, Reno NV, June 1998. Note that this compositional data is the average of winter and summer sampling seasons; thus, no annual average is reported. The New Haven data was provided to Scott Mathias in a personal communication from John Graham, Connecticut Department of Environmental Protection, Bureau of Air Management August 16, 2000.

Non urban data are based on averages of several monitoring locations in the region. Urban data are mainly based on only one location in each area and may not represent the entire urban area. The exceptions to this are the South Coast and San Joaquin Valley areas of California where multiple locations are averaged together. In the South Coast basin, Rubidoux recorded the highest average $PM_{2.5}$ and nitrate concentrations. Additional information on the composition of $PM_{2.5}$ within these areas of California is discussed further in Christoforou (above) and DRI [Reference: PM_{10} and $PM_{2.5}$ Variations in Time and Space, Desert Research Institute, Reno, NV, October 1995.]

References

1. Clean Air Act Amendments of 1990, U.S. Code, volume 42, section 7403 (c)(2), 1990.

2. Ambient Air Quality Surveillance, 44 CFR 27558, May 10, 1979.

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7. Rosenbaum, A. S., Stiefer, M. P., and Iwamiya, R. K. November, 1999. *Air Toxics Data Archive and AIRS Combined Dataset: Contents Summary Report*. SYSAPP-99/26d. Systems Applications International, San Rafael, CA.

8. In all cases analyzed, four non-missing quarterly means were available after applying the GLM method, so that the resulting annual mean is the arithmetic mean of the four quarterly averages.

9. Cohen, J.P. and A. K. Pollack. 1990. *General Linear Models Approach to Estimating National Air Quality Trends Assuming Different Regional Trends.* SYSAPP-90/102. Systems Applications International, San Rafael, CA.