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Research Triangle Park NC 27711

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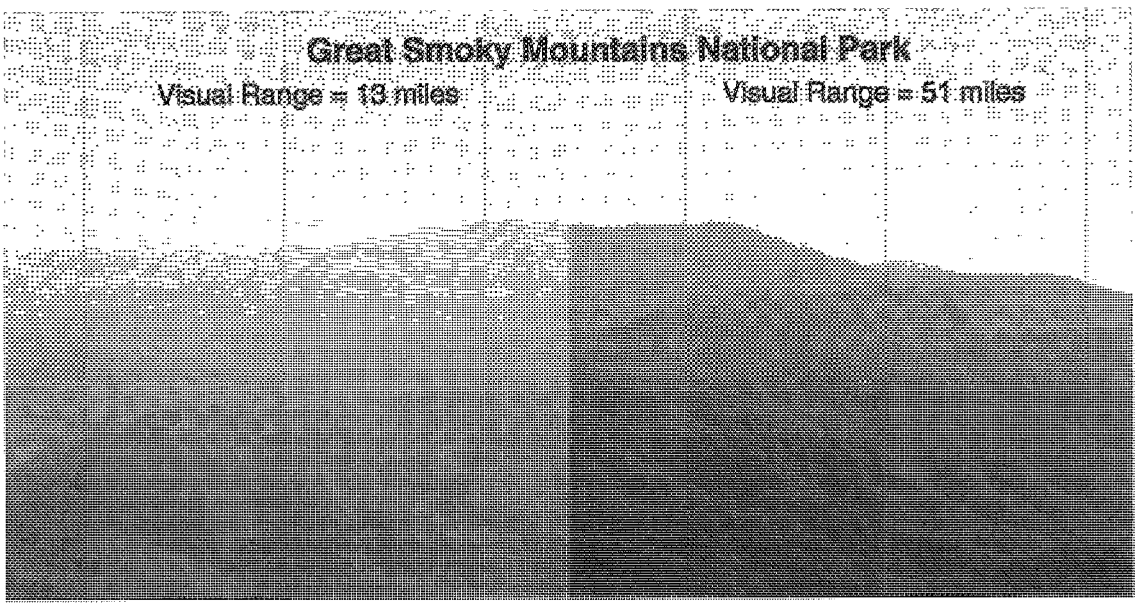
National Air Quality and Emissions Trends Report, 1996



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National Air Quality and Emissions Trends Report, 1996

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

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About the Cover

The cover provides a visual air quality comparison of the average best and worst visibility days at Great Smoky Mountain National Park from 1992 to 1995. The image was generated using software called WinHaze. WinHaze, developed by Air Resource Specialists of Fort Collins, Colorado, uses visual range parameters to degrade a pristine image, thus simulating what a scene would look like with the given visibility parameters. Images such as these are helpful in defining and communicating the visibility problem and assessing any progress made. Additional information on visibility can be found in Chapter 3 of this report.

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.

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The Trends Team would like to acknowledge Kate Ramoth of GeoLogics Corporation for assistance with layout, tables, graphics, and technical editing; the parties who reviewed this report prior to publication for their comments; and the following individuals for their extensive contributions in a variety of areas: Dr. John Ackermann, John Bachmann, Angela Bandemehr, Desmond Bailey, Dr. Jane Caldwell, Rich Cook, William Cox, Rich Damberg, Barbara Driscoll, Kathy Kaufmann, Mary Manners, Dr. Karen Martin, Melissa McCullough, Dr. Dave McKee, David Misenheimer, Dr. Diedre Murphy, Sharon Nizich, Anne Pope, Kelly Rimer, Dr. Mary Ross, Dr. Roy Smith, Greg Stella, Lori Stewart, and Dr. Al Wehe.

Preface

This is the twenty-fourth 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, complete with graphics and data tables, can be accessed via the Internet at http://www.epa.gov/oar/aqtrnd96/. 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

For additional air quality data, readers can access the Aerometric Information Retrieval System's (AIRS) executive software at http://www.epa.gov/oar/airs/aewin.

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Acronyms

AIRS	Aerometric Information Retrieval System
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CARB	California Air Resources Board
CASAC	Clean Air Scientific Advisory Committee
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
GDP	Gross Domestic Product
HAPs	Hazardous Air Pollutants
IMPROVE	Interagency Monitoring of PROtected Environments
MACT	Maximum Achievable Control Technology
MARAMA	Mid-Atlantic Regional Air Management Association
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Stations
NARSTO	North American Research Strategy for Tropospheric Ozone
NESCAUM	Northeast States for Coordinated Air Use Management
NMOC	Non-Methane Organic Compound
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NTI	National Toxics Inventory
O_3	Ozone
OTAG	The Ozone Transport Assessment Group
PAHs	Polyaromatic Hydrocarbons
PAMS	Photochemical Assessment Monitoring Stations
Pb	Lead
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
SLAMS	State and Local Air Monitoring Stations
SNMOC	Speciated Non-Methane Organic Compound
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
TRI	Toxic Release Inventory
TSP	Total Suspended Particulate
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds

Chapter 1

Executive Summary

THIS IS THE twenty-fourth annual report documenting air pollution trends in the United States.[1–23] While in recent years this report has widened its scope to include air pollution topics such as acid rain, visibility, and air toxics, its focus remains on those pollutants for which the United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS). The Clean Air Act (CAA) requires EPA to periodically review and, if appropriate, revise ambient air quality standards to protect public health and welfare. Primary standards are designed to protect public health, including sensitive populations such as children and the elderly, while secondary standards protect public welfare, such as the effects of air pollution on vegetation, materials, and visibility. There are six criteria pollutants with primary standards: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2).

In July 1997, EPA revised the ozone and particulate matter standards following a lengthy scientific review process. Prior to this time, the PM standard applied to particles whose aerodynamic size is less than or equal to 10 micrometers, or PM_{10}. The NAAQS revision strengthened protection against particles in the smaller part of that range by adding an indicator for $PM_{2.5}$ (those whose aerodynamic size is less than or equal to 2.5 micrometers). The combination of the PM_{10} and $PM_{2.5}$ indicators will provide protection against a wide array of particles.

Since this report deals with data for and prior to 1996, the trend data for ozone and PM_{10} are compared to the pre-existing NAAQS. However, the new standards for both ozone and particulate matter are discussed in detail in special sections in Chapter 2.

Overview and Highlights

The criteria pollutant analyses emphasized in Chapter 2 focus on national trends in air quality concentrations and emissions for the criteria pollutants. Air quality concentrations are based on actual direct measurements of pollutant concentrations in the air at selected monitoring sites across the country. Emissions are calculated estimates of the total tonnage of these pollutants, or their precursors, released into the air annually. Emissions estimates are derived from many factors, including the level of industrial activity, technology changes, fuel consumption, vehicle miles traveled (VMT), and other activities that affect air pollution. In 1994, EPA began incorporating direct emissions measurements of sulfur dioxide and nitrogen oxides (NO_x) for the electric utility industry. Additional emissions information is contained in the companion report, *National Air Pollutant Emission Trends, 1900–1996*.[24]

Table 1-1 summarizes the 10-year percent changes in national air quality concentrations and emissions.

Table 1-1. Percent Change in National Air Quality Concentrations and Emissions, 1987–1996

	Air Quality Concentration % Change 1987–1996	Emissions % Change 1987–1996
Carbon Monoxide	-37%	-18%
Lead	-75%	-50%
Nitrogen Dioxide	-10%	+3% (NO_x)
Ozone	-15%	-18% (VOC)
PM_{10}*	-25%	-12%⁺
Sulfur Dioxide	-37%	-14%

*Based on 1988 to 1996 data.
⁺Includes only directly emitted particles. Secondary PM formed from SOx, NOx, and other gases comprise a significant fraction of ambient PM.

The above table shows that air quality has continued to improve during the past 10 years for all six pollutants. Nationally, the 1996 air quality levels are the best on record for all six criteria pollutants. In fact, all the years in the 1990s have had better air quality than all the years in the 1980s, showing a steady trend of improvement.

Emissions of all criteria pollutants have improved as well, with the exception of NO_x. In October 1997, EPA proposed a rule that will significantly reduce regional emissions of NO_x and, in turn, reduce the regional transport of ozone. This rule is discussed further in the Ozone section of Chapter 2.

Chapter 3 presents trends in visibility for 29 national parks and wilderness areas in the Interagency Monitoring of PROtected Environments (IMPROVE) visibility monitoring network. Data collected at these areas show that visibility, in the form of average aerosol light extinction, has improved 10 percent in the eastern United States and 20 percent in the western United States between 1988 and 1995. When the haziest days are considered, however, visibility worsened in the East and improved in the West. Specifically, aerosol light extinction for the haziest visibility days worsened in the East by 6 percent but improved in the West by 12 percent.

Chapter 4 highlights the Photochemical Assessment Monitoring Stations (PAMS) program, which is an intensive monitoring network set up to increase our knowledge of the underlying causes of ozone pollution and potential control strategies. PAMS monitoring sites are located in all ozone nonattainment areas classified as serious, severe, or extreme. The 21 affected areas collect measurements of ozone, NO_x, and volatile organic compounds (VOCs), as well as surface and upper air meteorology. For a second consecutive year, the majority of PAMS sites show significant reductions in key ozone precursors. However, the 1995 to 1996 reductions in benzene and other mobile-related VOC concentrations were not quite as large as those between 1994 and 1995. More detailed information on the PAMS program can be found on the Internet at http://www.epa.gov/oar/oaqps/pams.

Chapter 5 presents information on air toxics, another set of pollutants regulated under the CAA which are known to cause, or may cause, adverse health effects or ecosystem damage. The Office of Air Quality Planning and Standards' (OAQPS) National Toxics Inventory (NTI) estimates that 3.7 million tons of air toxics are released to the air annually. This is the second year EPA has reported air toxics emissions based on the NTI. Data from the Toxic Release Inventory (TRI) were used as the foundation of this inventory. The development of the NTI represents a significant improvement in characterization of air toxics because the NTI shows that mobile and area sources, which are not included in TRI, account for approximately 75 percent of hazardous air pollutant emissions. This chapter reports analyses of PAMS data indicating the usefulness of this network for assessing the toxic air quality issue.

Chapter 6 summarizes the current status of nonattainment areas, which are those areas not meeting the NAAQS for at least one of the six criteria pollutants. Under the Clean Air Act Amendments (CAAA) of 1990, there were 274 areas designated nonattainment for at least one ambient standard. As of September 1997, 158 areas are still designated nonattainment, with particulate matter having the largest number (79), and ozone the second largest number (59) of areas. Note that in future years the nonattainment area list will reflect areas not meeting the new ozone and particulate matter standards. The current nonattainment areas for each criteria pollutant are displayed on one map in this chapter, while a second map depicts ozone nonattainment areas alone, color-coded to indicate the severity of the ozone problem in each area. The condensed list of nonattainment areas as of September 1997 is presented in Table A-13. This table is also on the Internet at http://www.epa.gov/airs/nonattn.html and is updated as areas are redesignated.

Chapter 7 characterizes air quality on a more local level, using three different indicators. First, this chapter lists peak air quality concentrations for 1996 for each Metropolitan Statistical Area (MSA). Second, 10-year trends are assessed for each MSA using a statistical method to measure whether the trend is up or down significantly. The results show that 13 MSAs have a statistically significant upward trend in ambient concentrations for at least one criteria pollutant, while 217 MSAs have a statistically significant downward trend for at least one criteria pollutant. The third way in which local air quality is evaluated is by looking at the Pollutant Standards Index (PSI) in the nation's largest MSAs. The PSI analysis shows that between 1987 and 1996 the total number of "unhealthful" days decreased 51 percent in the Los Angeles basin (which includes the Los Angeles and Riverside MSAs) and 75 percent in the remaining major cities across the United States.

Finally, Appendix A provides expanded tables of the air quality concentrations and emissions data described throughout this report. Appendix B summarizes the methodology which is the basis for the trends analyses in Chapter 2, and also provides maps of the current monitoring network for each criteria pollutant.

Improvement in the Face of Economic Growth

National reductions in air quality concentrations and emissions continue to occur in the face of economic growth. Since 1970, total U.S. population increased 29 percent, vehicle miles traveled increased 121 percent, and the gross domestic product (GDP) increased 104 percent (see Figure 1-1).[25,26,27] During that same period, notable reductions in air quality concentrations and emissions took place. Aggregate criteria pollutant emissions decreased 32 percent (see Figure 1-1). When examined individually, emissions for all criteria pollutants except NO_x decreased between 1970 and 1996 (see Table 1-2), the greatest improvement being a 98-percent decrease in

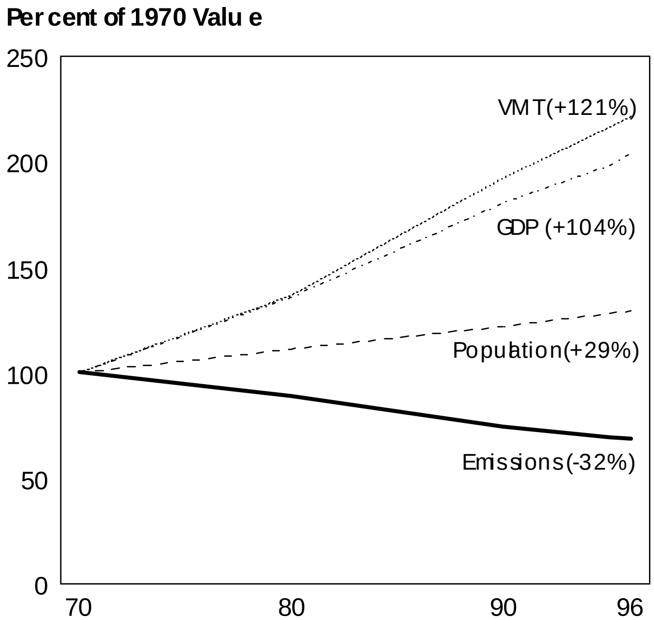


Figure 1-1. Total U.S. population, vehicle miles traveled, U.S. gross domestic product, and aggregate emissions, 1970–1996.

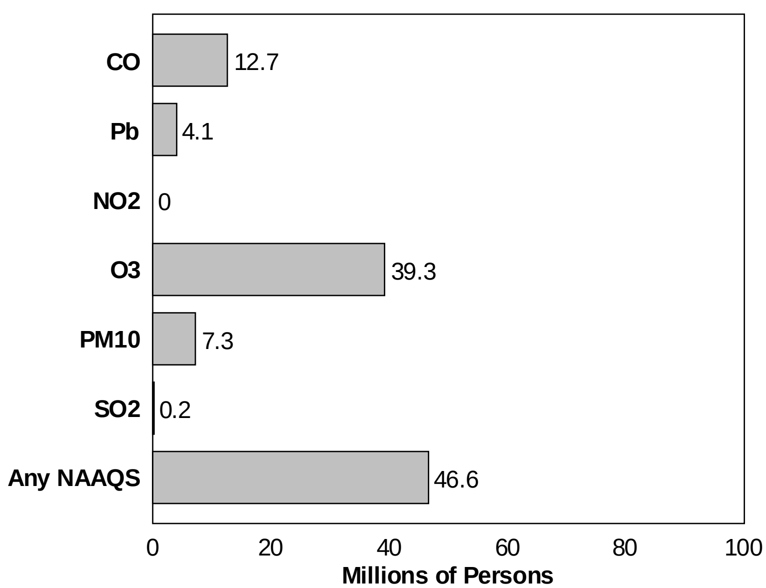


Figure 1-2. Number of people living in counties with air quality concentrations above the level of the NAAQS in 1996.

lead emissions. Though air quality trends are not available back to 1970, in most cases they are available for the past 20 years. Reductions in air quality concentrations between 1977 and 1996 are impressive with CO, lead, and SO_2 decreasing by more than half. Because of evolving monitoring networks, these long-term changes in air quality concentrations are not as certain as long-term changes in emissions, but they do provide an accurate indication of the general trend in air quality.

Table 1-2. Long-term Percent Change in National Air Quality Concentrations and Emissions

	Air Quality Concentration % Change 1977–1996	Emissions % Change 1970–1996
Carbon Monoxide	-61%	-31%
Lead	-97%	-98%
Nitrogen Dioxide	-27%	+8% (NO_x)
Ozone	-30%	-38% (VOC)
PM_{10}	Data Not Available	-73%⁺
Sulfur Dioxide	-58%	-39%

⁺Includes only directly emitted particles. Secondary PM formed from SOx, NOx, and other gases comprise a significant fraction of ambient PM.

These air quality improvements are a direct result of EPA working with states, industry, and other partners to effectively establish and implement clean air laws and regulations.

The Need for Continued Progress

While progress has been made, it is important not to lose sight of the magnitude of the air pollution problem that still remains. Based upon monitoring data submitted to EPA's data base, approximately 46 million people in the United States reside in counties that did not meet the air quality standard for at least one of the NAAQS pollutants for the single year 1996, as noted in Figure 1-2.[28,29] And in 1997, EPA revised two criteria pollutant standards that were not protective enough.

After conducting one of the most extensive NAAQS reviews ever, EPA concluded that the existing standards for ozone and particulate matter were not adequately protective of public health. For ozone, several hour exposures at levels below the pre-existing standard were found to cause significant health effects, including aggravation of asthma, breathing and respiratory problems, loss of lung function, and possible long-term lung damage and lowered immunity to disease. For particulate matter, concentrations below those allowed by the previous standard were associated with significant effects including premature death, increased hospital admissions, and increaesd respiratory symptoms and disease. The scientific review concluded that additional standards should be set for fine particles, or $PM_{2.5}$. On July 16, 1997, EPA Administrator Carol Browner approved new, more protective standards for ozone and particulate matter. These standards, each year, will prevent approximately 15,000 premature deaths, 350,000 cases of aggravated asthma, and 1 million cases of significantly decreased lung function in children. EPA has developed a flexible, commonsense, and cost-effective implementation plan to achieve these standards, providing for both cleaner air and continued national economic progress. The notices and support documents for the new NAAQS are on the Internet at http://www.epa.gov/airlinks.

References

1. *The National Air Monitoring Program: Air Quality and Emissions Trends—Annual Report*, EPA-450/1-73-001a and b, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, July 1973.
2. *Monitoring and Air Quality Trends Report, 1972*, EPA-450/1-73-004, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 1973.
3. *Monitoring and Air Quality Trends Report, 1973*, EPA-450/1-74-007, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1974.
4. *Monitoring and Air Quality Trends Report, 1974*, EPA-450/1-76-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1976.
5. *National Air Quality and Emissions Trends Report, 1975*, EPA-450/1-76-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, November 1976.
6. *National Air Quality and Emissions Trends Report, 1976*, EPA-450/1-77-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 1977.
7. *National Air Quality and Emissions Trends Report, 1977*, EPA-450/2-78-052, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 1978.
8. *1980 Ambient Assessment—Air Portion*, EPA-450/4-81-014, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 1978.
9. *National Air Quality and Emissions Trends Report, 1981*, EPA-450/4-83-011, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, April 1983.
10. *National Air Quality and Emissions Trends Report, 1982*, EPA-450/4-84-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, March 1984.
11. *National Air Quality and Emissions Trends Report, 1983*, EPA-450/4-84-029, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, April 1985.
12. *National Air Quality and Emissions Trends Report, 1984*, EPA-450/4-86-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1986.
13. *National Air Quality and Emissions Trends Report, 1985*, EPA-450/4-87-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1987.
14. *National Air Quality and Emissions Trends Report, 1986*, EPA-450/4-88-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1988.
15. *National Air Quality and Emissions Trends Report, 1987*, EPA-450/4-89-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, March 1989.
16. *National Air Quality and Emissions Trends Report, 1988*, EPA-450/4-90-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, March 1990.
17. *National Air Quality and Emissions Trends Report, 1989*, EPA-450/4-91-003, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1991.

18. *National Air Quality and Emissions Trends Report, 1990*, EPA-450/4-91-023, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, November 1991.

19. *National Air Quality and Emissions Trends Report, 1991*, EPA-450/R-92-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1992.

20. *National Air Quality and Emissions Trends Report, 1992*, EPA-454/R-93-031, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1993.

21. *National Air Quality and Emissions Trends Report, 1993*, EPA-454/R-94-026, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1994.

22. *National Air Quality and Emissions Trends Report, 1994,* EPA-454/R-95-014, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1995.

23. *National Air Quality and Emissions Trends Report, 1995*, EPA-454/R-96-005, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1996.

24. *National Air Pollutant Emission Trends, 1900–1996*, EPA-454/R-97-011, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 1997.

25. *Statistical Abstract of the United States, 1996*, U.S. Department of Commerce, U.S. Bureau of the Census.

26. Personal Communication with E.H. Pechan & Associates on VMT Development, Springfield, VA, August 18, 1997.

27. The Bureau of Economic Analysis, Department of Commerce, website at http://www.bea.doc.gov/bea/.

28. The population estimates in Figure 1-2 are based upon only a single year of data, 1996, and only consider counties with monitoring data for each pollutant. They are intended to provide a relative measure of the extent of the problem for each pollutant in 1996. An individual living in a county that had a measured concentration above the level the NAAQS may not actually be exposed to unhealthy air.

29. The number of people living in formally designated nonattainment areas as of September 1997 was approximately 120 million. These population estimates differ because formal nonattainment designations are based on multiple years of data rather than a single year and generally do not follow county boundaries. For a pollutant such as ozone, nonattainment areas typically compose the entire metropolitan area, which may include additional counties that do not contain monitors.

Chapter 2

Air Quality Trends

THIS CHAPTER PRESENTS national air quality trends for each of the pollutants for which EPA has established NAAQS. NAAQS are in place for the following six criteria pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter whose aerodynamic size is less than or equal to 10 microns, and sulfur dioxide. Table 2-1 lists the NAAQS for each pollutant in terms of the level of the standard, the associated averaging time, and the form of the statistic used to evaluate compliance. ***Just recently, the NAAQS for ozone and for particulate matter were revised. Since these revisions did not take place until 1997, they were not included in Table 2-1, which covers the NAAQS in effect in 1996. The revised standards, however, are discussed in detail within this chapter in special sections entitled "The New Ozone Standards" and "The New Particulate Matter Standards."***

There are two types of standards: primary and secondary. Primary standards protect against adverse health effects, whereas secondary standards protect against welfare effects such as damage to crops, vegetation, buildings, and decreased visibility. There are primary standards for all of the criteria pollutants, and some pollutants (PM_{10} 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 any adverse health effects associated with peak short-term exposures to air pollution, while long-term standards can protect

Table 2-1. NAAQS in Effect in 1996

Pollutant	Primary (Health Related)		Secondary (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	
PM_{10}	Annual Arithmetic Mean[d]	50 µg/m^3	Same as Primary Standard	
	24-hour[d]	150 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.

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

[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] Particulate standards use PM_{10} as the indicator pollutant. The annual standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 µg/m^3; the 24-hour standard is attained when the expected number of days per calendar year above 150 µg/m^3 is equal to or less than one, as determined according to Appendix K of the PM NAAQS.

people from adverse health effects associated with short- and long-term exposures to air pollution. There are secondary standards for each criteria pollutant except CO. Secondary standards are identical to the primary standard with the exception of SO_2.

This chapter emphasizes the most recent 10 years of air pollution trends, from 1987 to 1996. Trends over a 15- or 20-year time frame are presented when possible; however, the limited amount of data available in the earliest years of monitoring make them suitable only for examining the general behavior of ambient concentrations. In addition, one-year changes in ambient concentrations are presented. These must also be interpreted with a bit of caution, as they can be heavily influenced by meteorological conditions.

Most of 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 data accumulated on the criteria pollutants between 1987 and 1996 at 4,858 monitoring stations located in urban, suburban, and some rural areas. The trends presented here are derived from the composite average of these direct measurements (see Table A-10). 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 report is emissions estimates. These are based on engineering calculations of the amounts and kinds of pollutants emitted by automobiles, factories, and other sources over a given period. There are also monitors known as 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 1996 for NO_x and SO_2 emissions at major electric utilities.

Changes in ambient concentrations do not always track changes in emissions estimates. There are four 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 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 VOCs emissions of 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.

Finally, 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; and the amount of rainfall can affect particulate matter levels and the frequency of forest fires.

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

Carbon Monoxide

- **Air Quality Concentrations**

1987–96	37%	decrease
1995–96	7%	decrease

- **Emissions**

1987–96	18%	decrease
1995–96	1%	decrease

Nature and Sources

Carbon monoxide is a colorless, odorless, and at higher levels, a 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. 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 CO is most serious for those who suffer from cardiovascular disease. At higher levels of exposure, healthy individuals are also affected. Visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks are all associated with exposure to elevated CO levels.

Primary Standards

There are two primary NAAQS for ambient CO, a 1-hour average of 35 parts per million (ppm) and an 8-hour average of 9 ppm. These concentrations are not to be exceeded more than once per year. Secondary standards have not been established for CO.

Trends

The consistent downward trend in concentrations and emissions of CO is clear, with long-term improvements continuing between 1987 and 1996. Figure 2-1 shows that national average CO concentrations decreased 37 percent during the past 10 years as measured by the composite average of the annual second highest 8-hour concentration. These reductions in ambient CO levels occurred despite a 28-percent increase in VMT. Nationally, the composite average of exceedances of the CO NAAQS declined 92 percent since 1987. The large difference between the rate of change in concentrations and the percentage change in exceedances is due to the nature of the exceedance statistic (which is simply a count of a pass / fail indicator). There are only a few monitoring sites currently recording exceedances of the level of the standard.

National total CO emissions have decreased 18 percent since 1987 as illustrated in Figure 2-2. As expected, the national CO air quality decrease of 37 percent from the urban CO monitoring network, which is primarily mobile-source oriented, more closely tracks the estimated 26 percent reduction in highway vehicle emissions. Figure 2-3 shows that transportation sources now account for 79 percent of the nation's total CO emissions.

The CO air quality improvement occurred across all monitoring environments—urban, suburban and rural

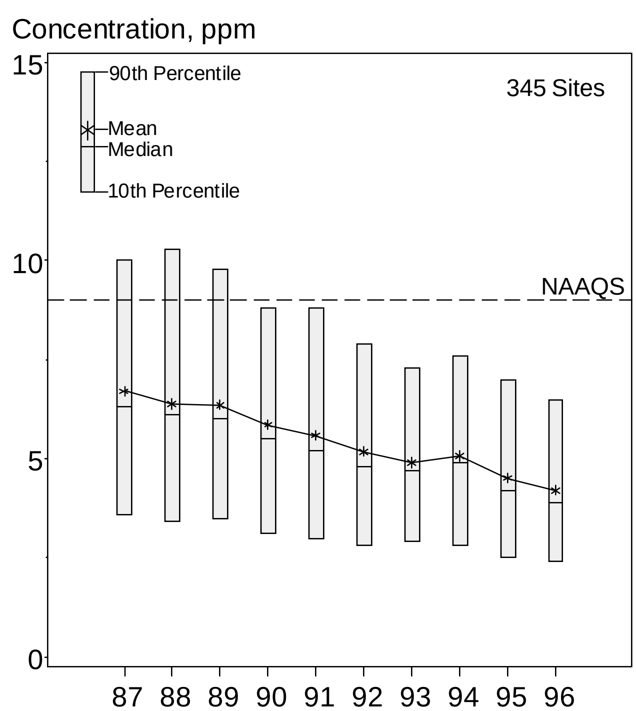


Figure 2-1. Trend in second maximum non-overlapping 8-hour average CO concentrations, 1987–1996.

monitoring sites. As expected, Figure 2-4 shows, that urban monitoring sites record higher CO concentrations on average, than suburban sites, with the lowest levels found at 10 rural CO sites. During the past 10 years, composite mean CO 8-hour concentrations decreased 37 percent at 190 urban sites, 37 percent at 142 suburban locations, and 48 percent at the 10 rural monitoring sites.

Between 1995 and 1996, national composite average CO concentrations decreased 7 percent. Eight of the 10 EPA Regions located throughout the country experienced declines in composite mean ambient CO levels between 1995 and 1996, while monitoring sites in Regions 6 and 10 recorded small increases in composite average concentrations. Nationally, the 1996 composite average ambient concentration is the lowest level recorded during the past 20 years of monitoring. Total CO emissions decreased 1 percent since 1995, with CO emissions from highway vehicles recording a 2-percent decline since last year. These improvements in highway vehicle emissions occurred despite the 2-percent increase in VMT since last year.

To reduce tail pipe emissions of CO and to help attain the national standard for CO, the 1990 Clean Air Act Amendments (CAAA) require oxygenated gasoline programs in several regions 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.[1,2] Of the 36 nonattainment areas that initially implemented the program in 1992, 25 areas continue to use oxygenated fuels. The White House Office of Science and Technology Policy (OSTP) review of the oxygenated fuels program, *Interagency Assessment of Oxygenated Fuels,*[3]

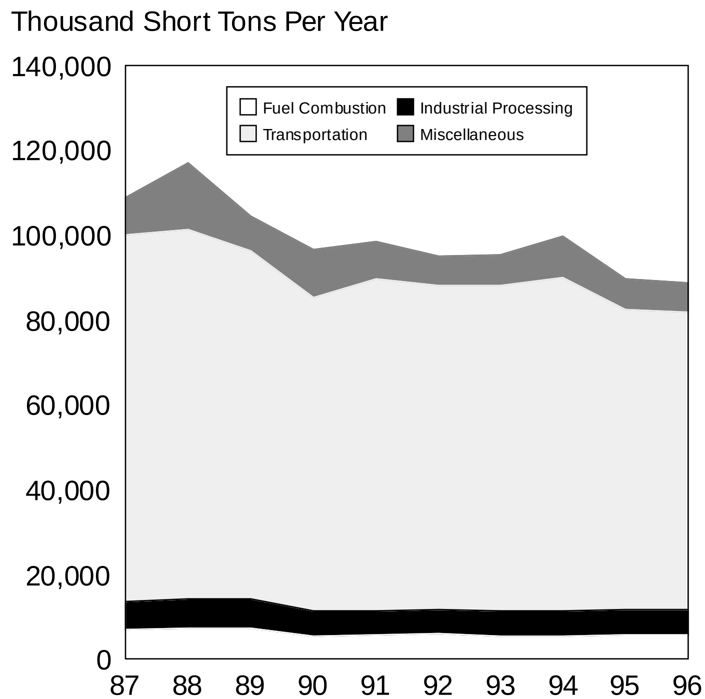


Figure 2-2. National total CO emissions trend, 1987–1996.

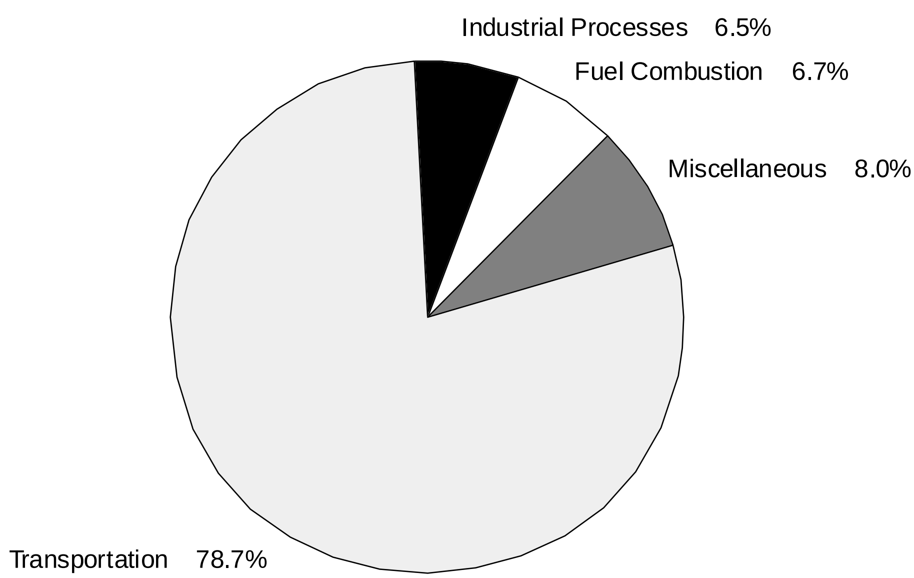


Figure 2-3. CO emissions by source category, 1996.

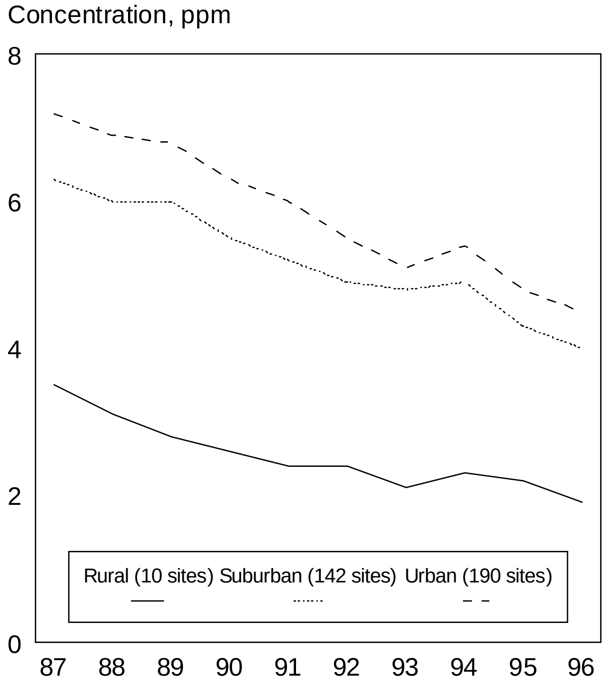


Figure 2-4. CO second maximum 8-hour concentration trends by location, 1987–1996.

stated that analyses of ambient CO measurements in some cities with winter oxygenated gasoline programs showed reductions of about 10 percent. In a regression analysis that expanded on a recent EPA study, the estimated oxyfuel effect was an average total reduction in ambient CO concentrations of 14 percent overall for the eight winter seasons from 1986 through 1994.[4,5]

The map in Figure 2-5 shows the variations in CO concentrations across the country in 1996. The air quality indicator is the highest annual second maximum 8-hour concentration measured 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. In 1996, seven counties (with a total population

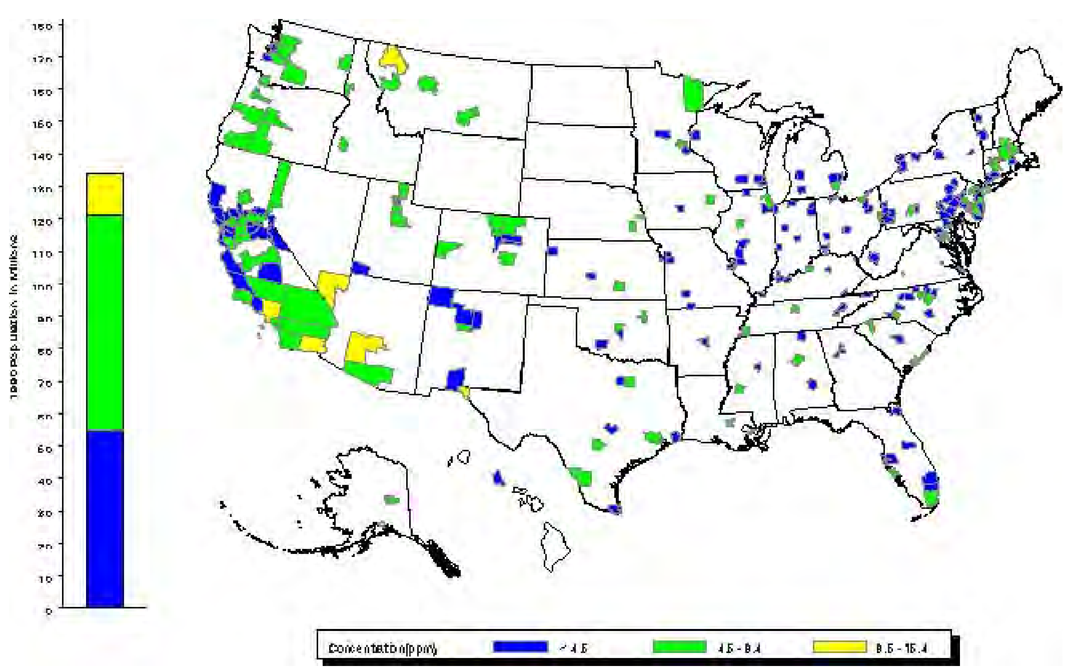


Figure 2-5. Highest CO second maximum 8-hour concentration by county, 1996.

of approximately 13 million people) had second maximum 8-hour concentrations greater than 9 ppm. These totals are up slightly from 1995 totals of six counties and 12 million people.

Figure 2-6 illustrates the improvement in ambient CO air quality during the past 20 years. Although there are differences in the mix of trend sites for the two periods (168 vs. 345 sites), there is evidence of a consistent decline in CO concentrations during the past 20 years.

The CO ambient trends plotting points and emissions totals by source category are listed in Tables A-1 and A-2. The plotting points for the 20-year trend charts are listed in Table A-9.

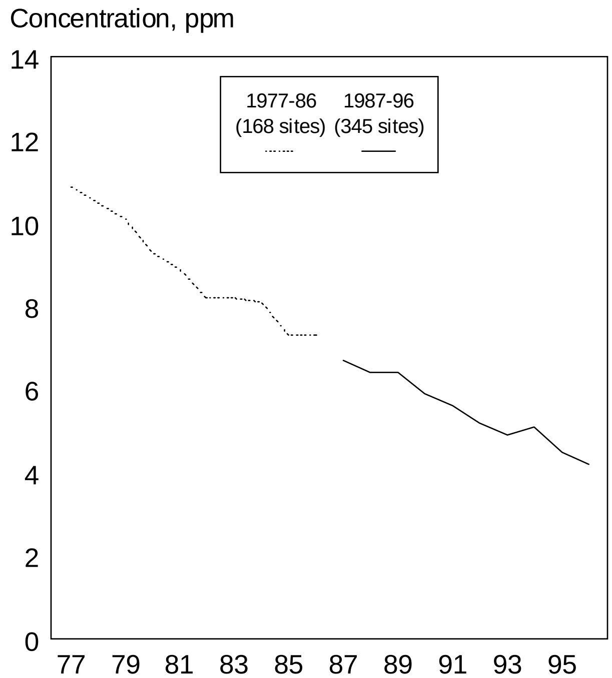


Figure 2-6. Long-term ambient CO trend, 1977–1996.

Lead

- **Air Quality Concentrations**

1987–96	75%	decrease
1995–96	no	change

- **Emissions**

1987–96	50%	decrease
1995–96	2%	decrease

Nature and Sources

In the past, 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, the contribution from the transportation sector has declined over the past decade. Today, metals processing is the major source of lead emissions to the atmosphere. The highest concentrations of lead are found in the vicinity of nonferrous and ferrous smelters, battery manufacturers, and other stationary sources of lead emissions.

Health and Other Effects

Exposure to lead occurs mainly through the inhalation of air and the ingestion of lead in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues. Because it is not readily excreted, 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. Even at low doses, lead exposure is associated with changes in fundamental enzymatic, energy transfer, and homeostatic mechanisms in the body. At low doses, fetuses and children often suffer from central nervous system damage. Recent studies also show that lead may be a factor in high blood pressure and subsequent heart disease. Lead can also be deposited on the leaves of plants, presenting a hazard to grazing animals. Animals do not appear to be more susceptible to adverse effects from lead than humans however, nor do adverse effects in animals occur at lower levels of exposure than comparable effects in humans. For these reasons, the secondary standard for lead is identical to the primary standard.

Primary and Secondary Standards

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

Trends

Figure 2-7 indicates that between 1987 and 1996 maximum quarterly average lead concentrations decreased 75 percent at population-oriented monitors. Figure 2-8 shows that total lead emissions decreased 50 percent. These reductions are a direct result of the phase-out of leaded gasoline. Table A-3, which lists lead emissions by major source category, shows that on-road vehicles accounted for 95 percent of the 10-year lead emissions decline. Note that previously published lead emissions estimates have been recently revised significantly downwards for the on-road vehicle category.

Air quality trends segregated by location (rural, suburban, and urban) are provided in Figure 2-9. All three location types show similar declines over the past 10 years.

The effect of the conversion to unleaded gasoline usage on ambient lead concentrations is even more impressive when viewed over a longer period, as illustrated in Figure 2-10. Between 1977 and 1996, ambient concentrations of lead declined 97 percent. This large decline tracks well with the emissions trend, which shows a decline of 98 percent between 1970 and 1996. Between

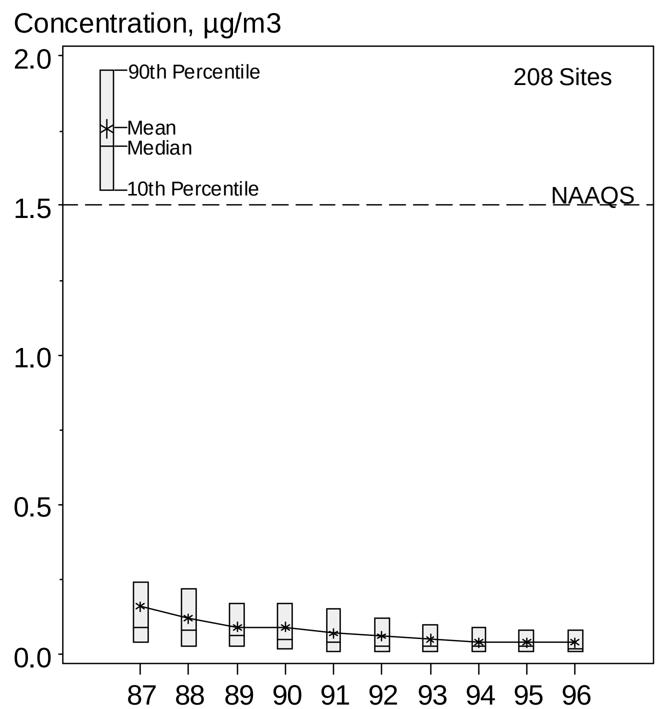


Figure 2-7. Trend in maximum quarterly average Pb concentrations (excluding source-oriented sites), 1987–1996.

1995 and 1996, national average lead concentrations (approaching the minimum detectable level) remained unchanged, while lead emissions estimates showed a 2-percent decline.

The large reductions in long-term lead emissions from transportation sources has changed the nature of the ambient lead problem in the United States. As Figure 2-11 shows, industrial processes were the major source of lead emissions in 1996, accounting for 73 percent of the total. The transportation sector (on-road and non-road sources) now accounts for only 15 percent of total 1996 lead emissions; on-road vehicles account for less than one half of a percent. Because industrial processes are now responsible for all violations of the lead standard, the lead monitoring strategy now focuses on these emissions point sources. The map in Figure 2-12 shows the lead monitors oriented in the vicinity of major sources of lead emissions. In 1996, eight lead point sources had one or more source-oriented monitors that exceeded the NAAQS. These eight sources are ranked in Figure 2-12 according to the site with greatest maximum quarterly mean. Various enforcement and regulatory actions are being actively pursued by EPA and the states for these sources.

The map in Figure 2-13 shows the highest quarterly mean lead concentration by county in 1996. Eight counties, with a total population of 4.7 million and containing the point sources identified in Figure 2-12, did not meet the lead NAAQS in 1996. Note that the point-source oriented monitoring data were excluded from trends analyses presented in Figures 2-7 and 2-9 so as not to mask the underlying urban trends.

In an effort to reduce unnecessary monitoring requirements and allow

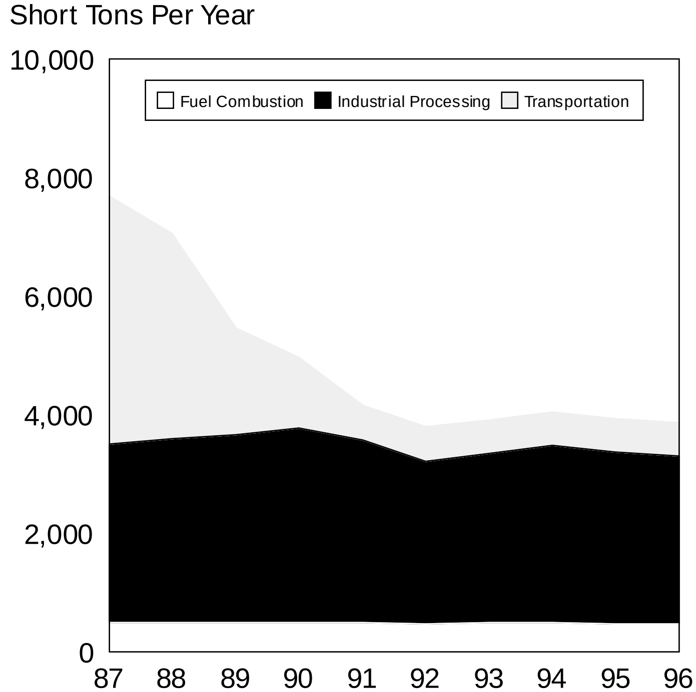


Figure 2-8. National total Pb emissions trend, 1987–1996.

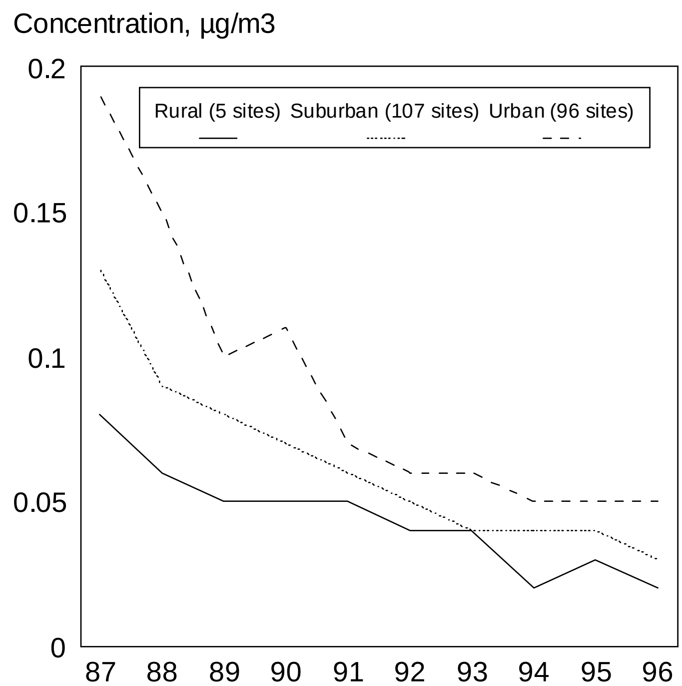


Figure 2-9. Pb maximum quarterly mean concentration trends by location (excluding source-oriented sites), 1987–1996.

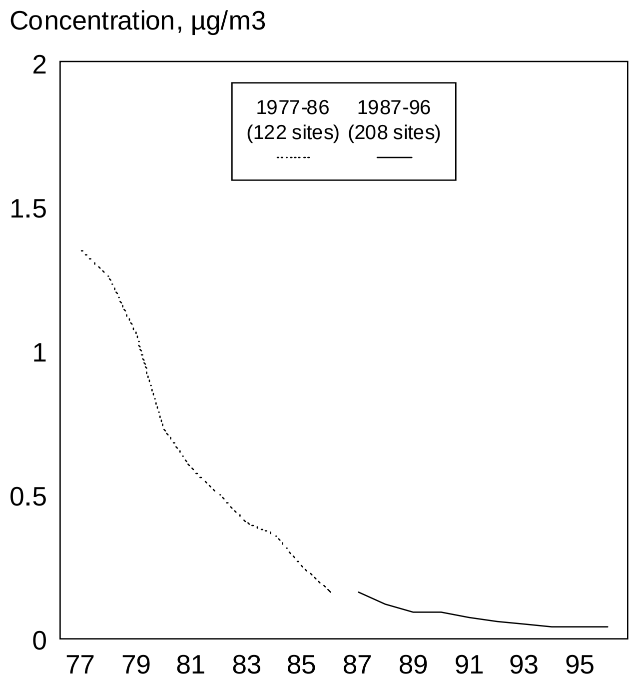


Figure 2-10. Long-term ambient Pb trend, 1977–1996.

diverted savings to be utilized for new monitoring requirements, EPA has decided to significantly reduce the mobile-source oriented lead monitoring requirement. Previously, regulations required that each urbanized area with a population of 500,000 or more operate at least two lead National Air Monitoring Stations (NAMS); there are approximately 85 NAMS in operation and reporting data for 1996. With the new lead monitoring rule proposed in September 1997, NAMS monitoring will only be required in the largest metropolitan area in each of the 10 EPA Regions, and also in each populated area (either a MSA/CMSA, town, or county) where lead violations have been measured.

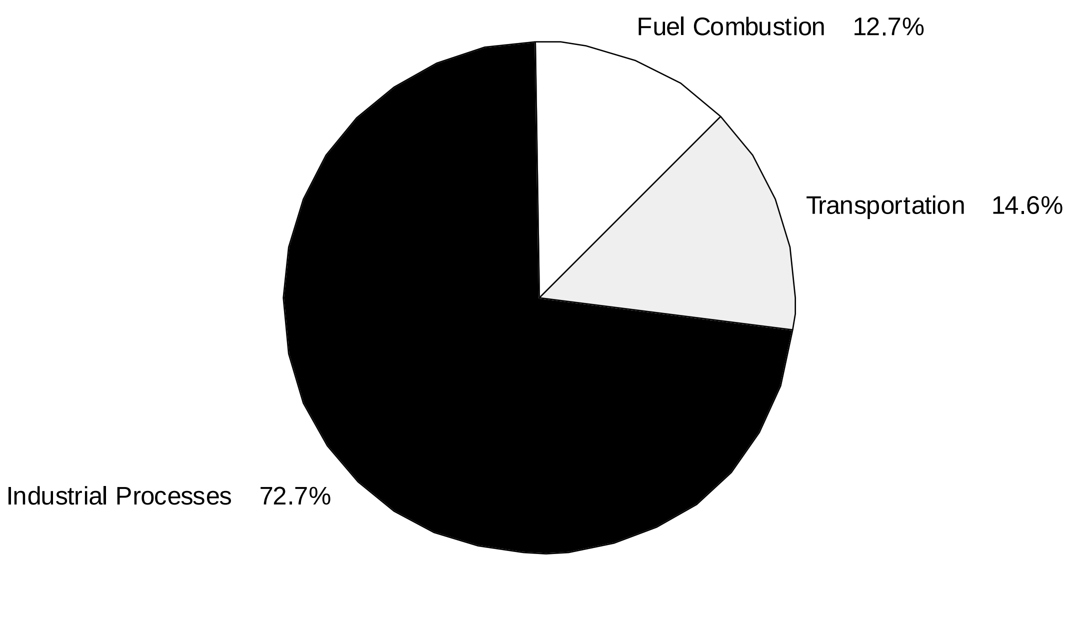
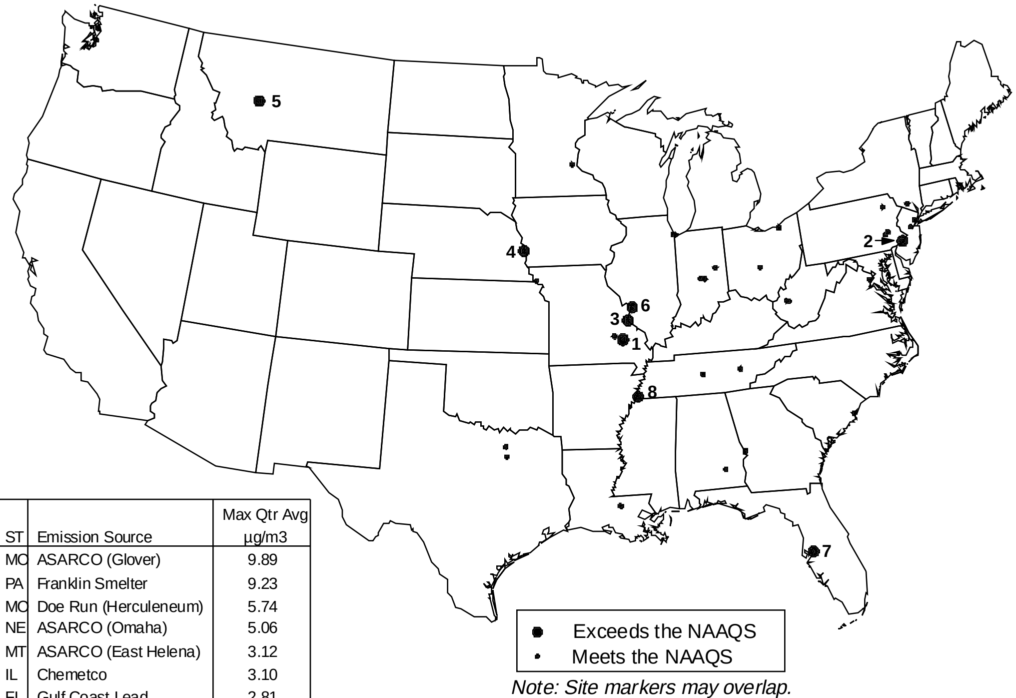


Figure 2-11. Pb emissions by source category, 1996.



Rank	ST	Emission Source	Max Qtr Avg µg/m3
1	MO	ASARCO (Glover)	9.89
2	PA	Franklin Smelter	9.23
3	MO	Doe Run (Herculeneum)	5.74
4	NE	ASARCO (Omaha)	5.06
5	MT	ASARCO (East Helena)	3.12
6	IL	Chemetco	3.10
7	FL	Gulf Coast Lead	2.81
8	TN	Refined Metals	2.81

Figure 2-12. Pb maximum quarterly concentration in the vicinity of Pb point sources, 1996.

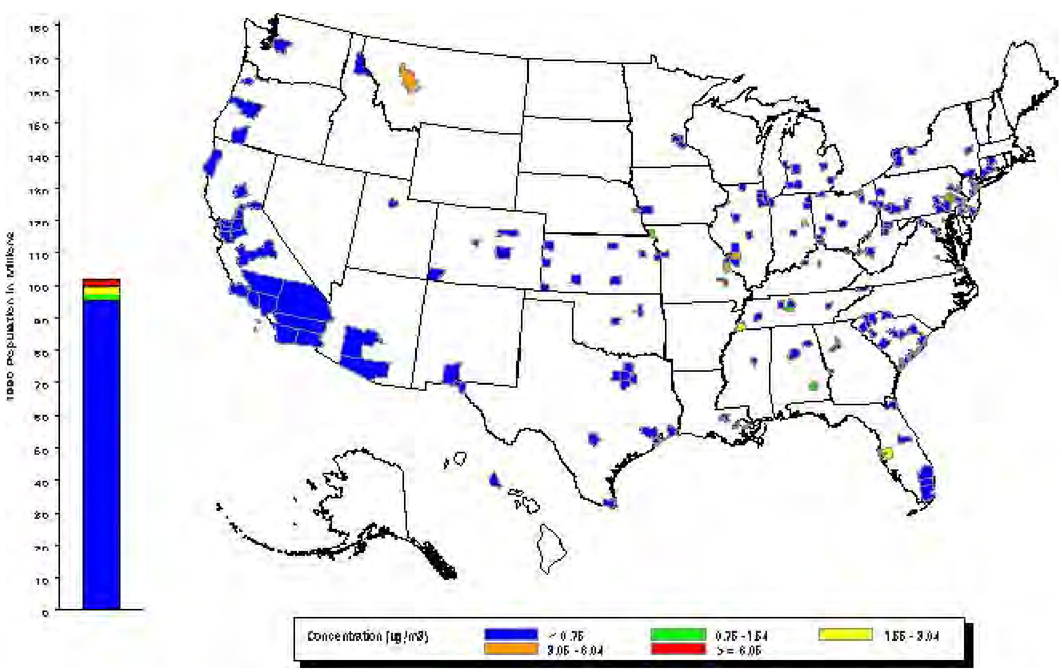


Figure 2-13. Highest Pb maximum quarterly mean by county, 1996.

Nitrogen Dioxide

- **Air Quality Concentrations**

1987–96	10%	decrease
1995–96		no change

- **Emissions**

1987–96	3%	increase
1995–96	2%	decrease

Nature and Sources

Nitrogen dioxide is a light brown gas that can become an important component of urban haze. Nitrogen oxides usually enter the air as the result of high-temperature combustion processes, such as those occurring in automobiles and power plants. NO_2 plays an important role in the atmospheric reactions that generate ozone. Home heaters and gas stoves also produce substantial amounts of NO_2.

Health and Other Effects

Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations higher than those normally found in the ambient air may cause increased incidence of acute respiratory disease in children.

Nitrogen oxides are an important precursor to both ozone and acidic precipitation (acid rain) and can affect both terrestrial and aquatic ecosystems. The regional transport and deposition of nitrogenous compounds arising from emissions of NO_x is a potentially significant contributor to such environmental effects as the growth of algae and subsequent unhealthy or toxic conditions for fish in the Chesapeake Bay and other estuaries. In some parts of the western United States, NO_x have a significant impact on particulate matter concentrations.

Primary and Secondary Standards

The ambient NO_2 primary and secondary NAAQS are an annual mean concentration not to exceed 0.053 ppm.

Trends

The trend in annual mean NO_2 concentrations measured at 214 sites across the country between 1987 and 1996 is shown in Figure 2-14. The trend shows a 10-percent decrease in the national composite mean. However, the trend in total NO_x emissions during the same period shows a 3-percent increase, as shown in Figure 2-15. Since most NO_2 monitors are located in urban, population-oriented areas, the trend in ambient concentrations is more representative of the highway vehicle NO_x emissions, which decreased 6 percent between 1987 and 1996.

The increase in total NO_x emissions is due, in large part, to emissions from coal-fired electric utilities. NO_x emissions from these utilities account for roughly one quarter of all NO_x emissions. Between 1987 and 1996, emissions from these sources rose 3 percent. In October 1997, EPA proposed a rule that will reduce regional emissions of NO_x. Utilities and large utility point sources are the most likely sources for these emissions reductions. See the ozone section, beginning on page 27, for more information concerning this rule.

The two primary sources of NO_x emissions are fuel combustion and transportation. Together these two sources made up 95 percent of 1996 total NO_x emissions. Table A-4 provides a listing of NO_x emissions by major source category.

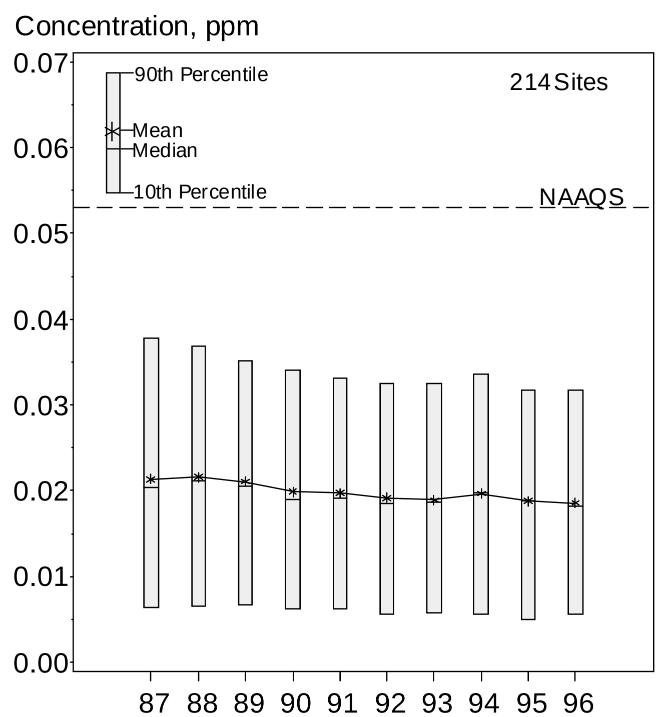


Figure 2-14. Trend in annual NO_2 concentrations, 1987–1996.

Title IV (Acid Deposition Control) of the CAA specifies that between 1980 and 2010, total annual NO_x emissions will be reduced by approximately 10 percent (2 million tons). In 1996, NO_x emissions were reduced 33 percent from 1990 levels at participating utilities. It is important to note, however, that these participating utilities made up only three percent of total national NO_x emissions in 1996. Further, emissions from these participating utilities only made 12 percent of NO_x emissions from electric utilities in 1996. EPA's rule to reduce the regional transport of ozone will help to achieve important additional reductions in emissions of NO_x.

Although higher ambient NO_2 levels are typically observed in urban areas, Figure 2-17 shows that the ambient NO_2 air quality trends are similar across monitoring locations. Additionally, 1996 is the fifth consecutive year that all monitoring locations across the nation, including Los Angeles, met the national NO_2 air quality standard (see Figure 2-18). Twenty-year trends in ambient NO_2 concentrations show an overall decrease of approximately 27 percent (see Figure 2-19).

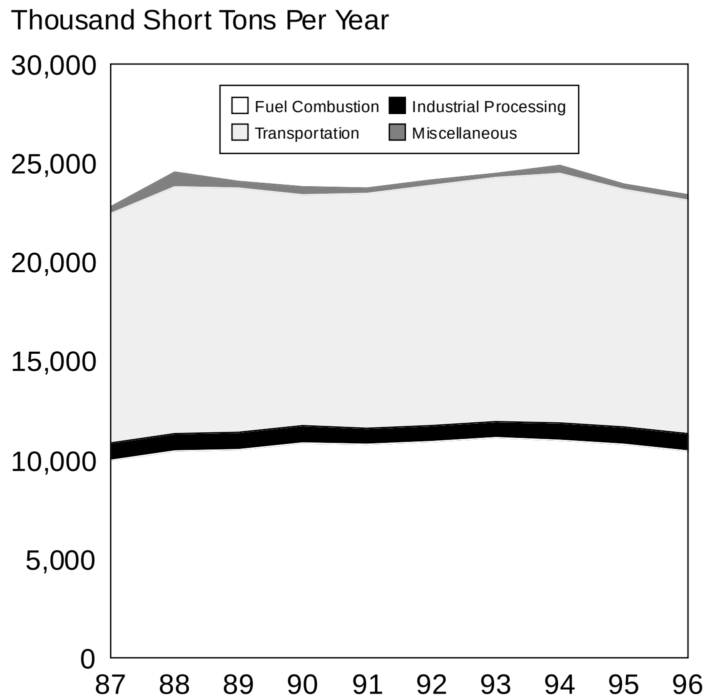


Figure 2-15. National total NO_x emissions trend, 1987–1996.

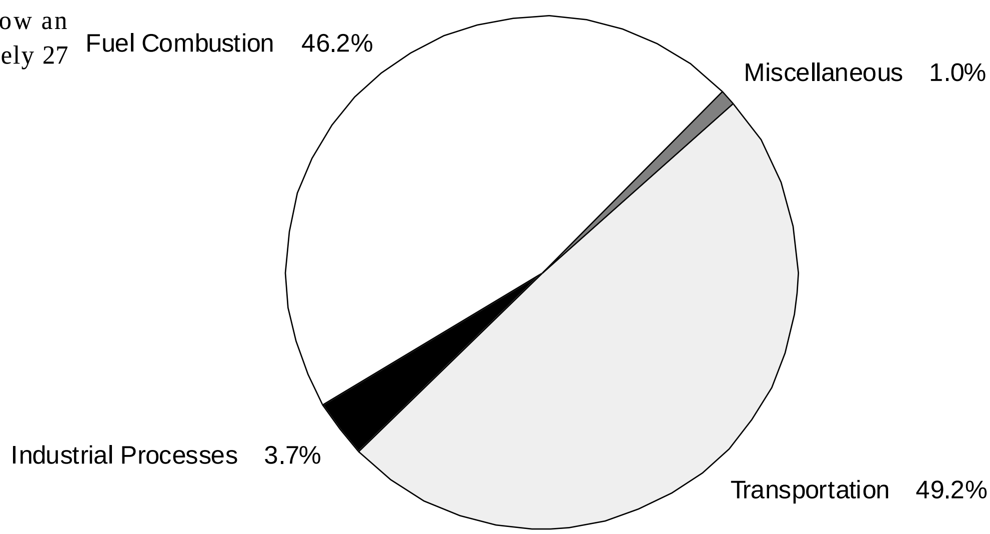


Figure 2-16. NO_x emissions by source category, 1996.

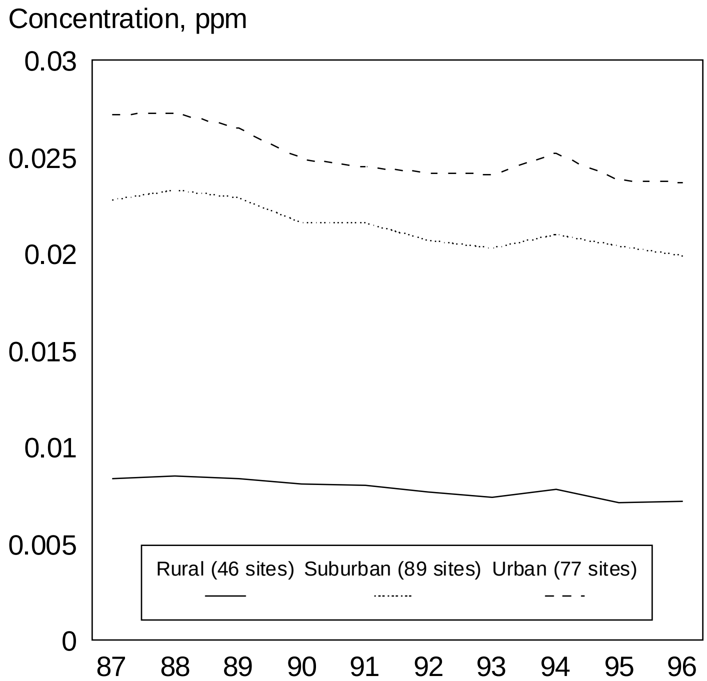


Figure 2-17. NO_2 annual mean concentration trend by location, 1987–1996.

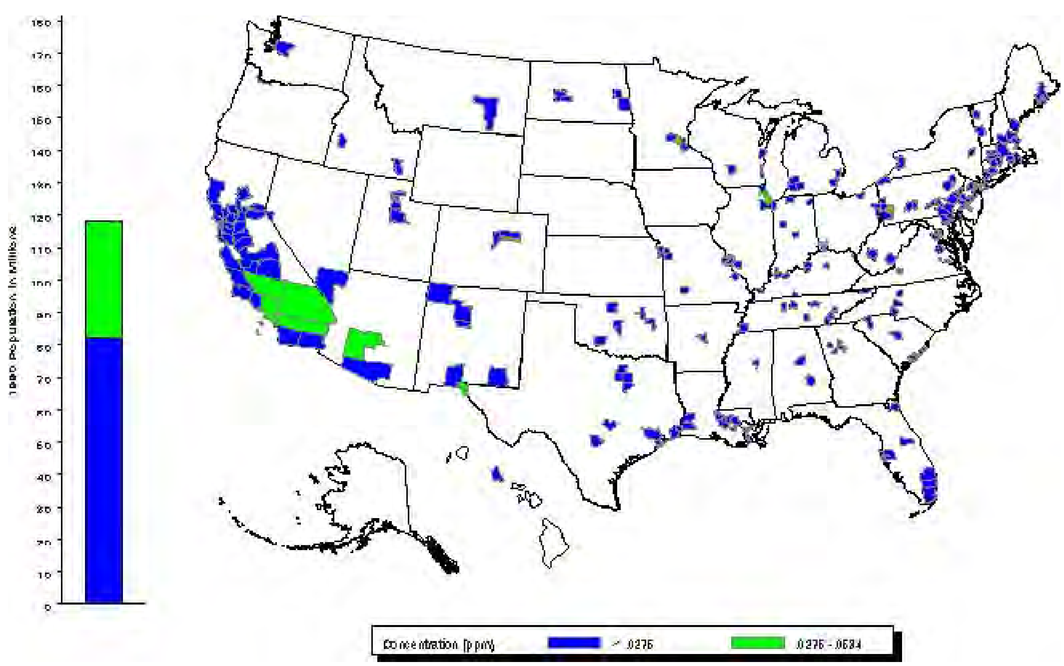


Figure 2-18. Highest NO_2 annual mean concentration by county, 1996.

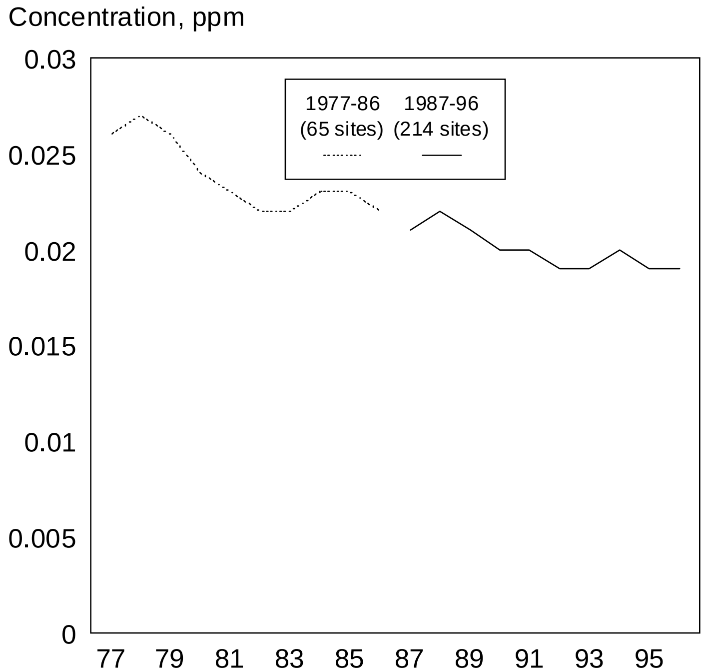


Figure 2-19. Long-term ambient NO_2 trend, 1977–1996.

Ozone

- **Air Quality Concentrations (1 hour)**

1987–96	15%	decrease
1995–96	6%	decrease

- **Emissions**

1987–96	18%	decrease
1995–96	7%	decrease

Nature and Sources

Ground level ozone (the primary constituent of smog) has remained a pervasive pollution problem throughout the United States. Ozone is not emitted directly into the air but is formed by the reaction of VOCs and NO_x in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually during hot summer weather. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. NO_x is emitted from motor vehicles, power plants, and other sources of combustion. Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Ozone and the precursor pollutants that cause ozone also can be transported into an area from pollution sources found hundreds of miles upwind.

Health and Other Effects

Ozone occurs naturally in the stratosphere and provides a protective layer high above the earth. At ground-level, however, it is the prime ingredient of smog. Short-term exposures (1 to 3 hours) to ambient ozone concentrations have been linked to increased hospital admissions and emergency room visits for respiratory causes. Repeated exposures to ozone can make people more susceptible to respiratory infection and lung inflammation, and can aggravate preexisting respiratory diseases such as asthma. Other health effects attributed to short-term exposures to ozone, 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 ozone levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include outdoor workers, individuals with preexisting respiratory disease such as asthma and chronic obstructive lung disease, and individuals who are unusually responsive to ozone. Recent studies have attributed these same health effects to prolonged exposures (6 to 8 hours) to relatively low ozone levels during periods of moderate exertion. In addition, long-term exposures to ozone present the possibility of irreversible changes in the lungs which could lead to premature aging of the lungs and/or chronic respiratory illnesses.

The recently completed review of the ozone standard also highlighted concerns associated with ozone effects on vegetation for which the 1-hour ozone standard did not provide adequate protection. These effects include reduction in agricultural and commercial forest yields, reduced growth and decreased survivability of tree seedlings, increased tree and plant susceptibility to disease, pests, and other environmental stresses, and potential long-term effects on forests and ecosystems. Because ground-level ozone interferes with the ability of the plant to produce and store food, plants become more susceptible to disease, insect attack, harsh weather and other environmental stresses. In long-lived species, these effects may only become evident after several years or even decades. Ozone also damages the foliage of trees and other plants, decreasing the natural beauty of our national parks and recreation areas, and reducing the quality of the habitat for wildlife, including endangered species.

The Ozone Transport Assessment Group

Through a 2-year effort known as the Ozone Transport Assessment Group (OTAG), EPA worked in partnership with state and local government agencies in the 37 easternmost states, industry, and academia to address ozone transport. Based on OTAG's extensive analysis of ozone transport, on October 10, 1997 EPA proposed a rule to reduce the regional transport of ozone. This rule sets a budget for emissions of NO_x for 22 states east of the Mississippi and the District of Columbia and will significantly reduce the transport of NO_x and ozone. EPA plans to finalize the rule in September 1998. More detailed information on the OTAG process and details on information generated by the OTAG workgroups are available on the OTAG web page at http://www.epa.gov/ttn/otag.

Primary and Secondary 1-hour Standards

In 1979, EPA established 1-hour primary and secondary standards for ozone. The level of the 1-hour primary NAAQS is 0.12 ppm daily maximum 1-hour ozone concentration that is not to be exceeded more than once per year on average. The secondary standard was set identical to the primary standard.

The New Primary and Secondary 8-hour Ozone Standards

On July 18, 1997, EPA replaced the previous 1-hour primary standard (health-based) with a new 8-hour standard to protect against longer exposure periods that are of concern at ozone concentrations below the level of the previous 1-hour standard.[6] The secondary standard (welfare-based) was set identical to the 8-hour primary standard. EPA also announced that it will expand the rural ozone monitoring network to focus on ozone-related vegetation research. Although the following trends discussion focuses on the 1-hour NAAQS in place in 1996, a description of the new 8-hour ozone NAAQS and some preliminary 8-hour trends results immediately follows. Subsequent reports will feature trends and status for daily maximum 8-hour concentrations.

Trends

Ambient ozone trends are influenced by year-to-year changes in meteorological conditions, population growth, VOC to NO_x ratios, and by changes in emissions from ongoing control measures. Unlike the hot, dry meteorological conditions in 1995 that were highly conducive to peak ozone formation, the summer of 1996 in most of the central and eastern United States was wet and cool, while excessive heat, and minimal precipitation affected the west.[7] As shown in Figure 2-20, frequent cloudiness and precipitation often kept highs below 90°F across areas to the north and east of the central Great Plains, in dramatic contrast to the excessive heat that periodically covered these regions during the summer of 1995. Figure 2-21 reveals that the 1996 composite national average daily maximum 1-hour ozone concentration is 15 percent lower than the 1987 level. Nationally, the 1996 composite mean concentration is 6 percent lower than 1995 and tied with 1992 as the lowest composite mean during this 10-year period. The highest national composite mean level was recorded in 1988. Since

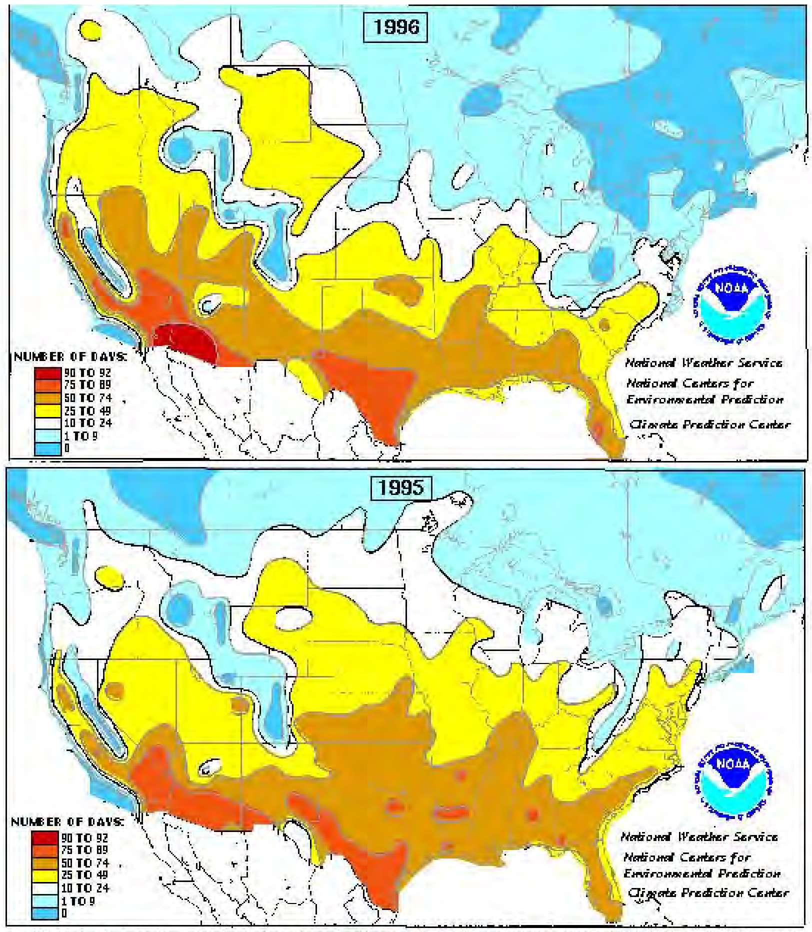


FIGURE 1. *The number of days during Summer (June - August) with highs ≥ 90°F, 1996 (top) vs. 1995 (bottom). Only stations with reports for at least 91 days during the 92-day period were included in the analyses. Sharp gradients near major coastlines and in regions of irregular terrain may be under-represented. Mexican areas were not analyzed due to the sparseness of reliable data. This summer, hot days were unusually frequent in western North America while few instances of 90°F+ heat occurred across the northeastern quarter of the United States and southeastern Canada. These conditions are nearly the opposite of those observed during Summer 1995, when heat and humidity were commonplace in the East and cooler than normal conditions dominated the West.*

Figure 2-20. Number of summer days, June–August with temperatures ≥90°, 1995 vs. 1996.

1987, the composite mean of the number of exceedances of the ozone NAAQS has declined 73 percent. Nationally, the composite average estimated exceedance rate declined 37 percent between 1995 and 1996. Significant reductions in ozone concentrations were seen in the Northeast, North Central, Southwest and the California coastal regions.

The reductions in ozone levels described above, however, do not affect all environments equally. Although the general pattern of ozone trends across rural, suburban, and urban environments are similar, the magnitudes of the reductions differ. Figure 2-22 shows the trends in composite mean second daily maximum 1-hour concentrations for all three monitor settings. The highest concentration levels are typically found at suburban sites. During the past 10 years, the composite mean at 276 suburban sites and at 113 urban sites recorded the same 16 percent reduction in ozone composite mean con-

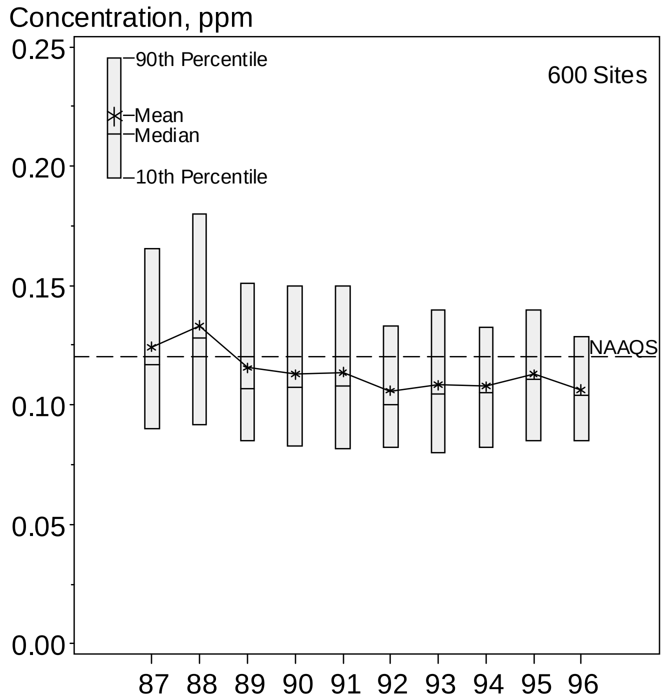


Figure 2-21. Trend in annual second daily maximum 1-hour O_3 concentrations, 1987–1996.

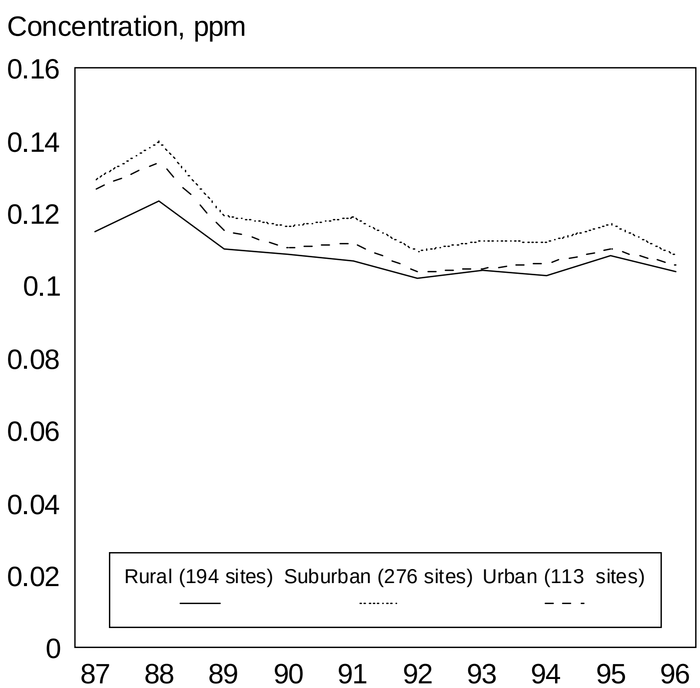


Figure 2-22. O_3 second daily maximum 1-hour concentration trends by location, 1987–1996.

centrations. Since 1987, ozone levels declined 10 percent at 194 sites in rural locations.

As noted in a study by the National Academy of Science, and in previous *Trends Reports*, ozone trends are affected by changing meteorological conditions that are conducive to ozone formation.[8,9] EPA has developed a statistical model that attempts to account for meteorological effects and helps to normalize the resulting trend estimates across years.[10] The model, based on the Weibull probability distribution, includes a trend component that adjusts the annual rate of change in ozone for concurrent impacts of meteorological conditions, including surface temperature and wind speed. Figure 2-23 shows the results from application of the model in 41 major urban areas. While the raw data trends reflect the year-to-year variability in ozone conducive conditions, the meteorologically adjusted ozone composite trend provides a better indicator of ozone trends due to emissions trends. For these 41 metropolitan areas, the adjusted trend shows continued improvement with an average decrease of about 1 percent per year since 1987.

The map in Figure 2-24 presents the highest second daily maximum 1-hour concentration by county in 1996. The accompanying bar chart to the left of the map reveals that in 1996 approximately 39 million people lived in 52 counties where the second daily maximum 1-hour concentration was above the level of the ozone NAAQS. These numbers represent a significant improvement from the 70 million people (living in 108 counties) with ozone concentrations above the level of the ozone NAAQS in 1995. As noted previously, differences in meteorological conditions between 1995 and 1996, are likely responsible for much of this decline.

The population totals for 1996 are similar to those recorded in 1994. Nationally, peak 1-hour ozone levels show large spatial differences. Los Angeles has the highest number of exceedances of the ozone NAAQS, followed by Houston and metropolitan areas in California and the northeast United States.

Long-term, quantitative ambient ozone trends are difficult to estimate due to changes in network design, siting criteria, spatial coverage and monitoring instrument calibration procedures over the past two decades. For example, in Figure 2-25, the shaded area in the late 1970s shows the period corresponding to the old calibration procedure where concentration levels are less certain. Figure 2-25 contrasts the 1977–1986 composite trend line based on 238 sites with the current 1987–1996 composite trend

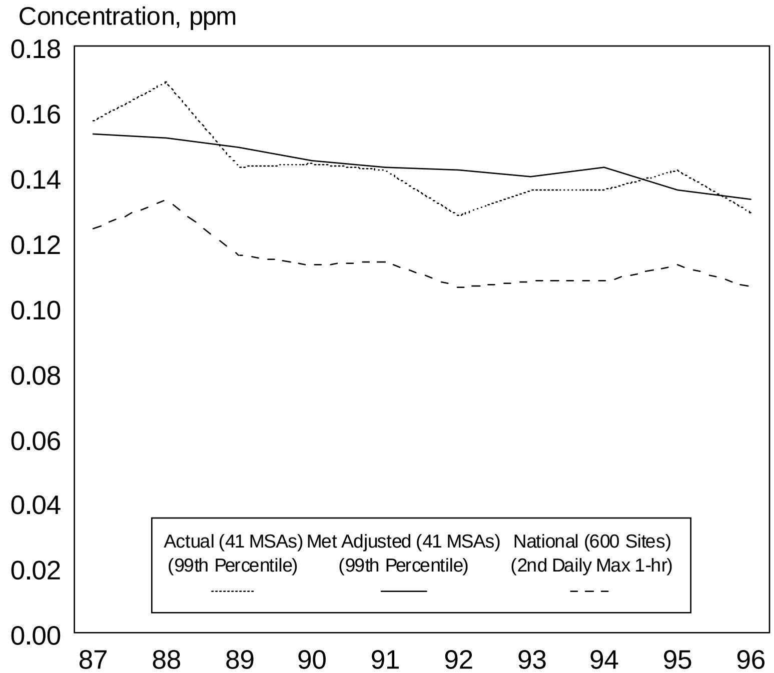


Figure 2-23. Comparison of actual and meteorologically adjusted ozone trends, 1987–1996 (composite average of 99th percentile 1-hr daily max concentration).

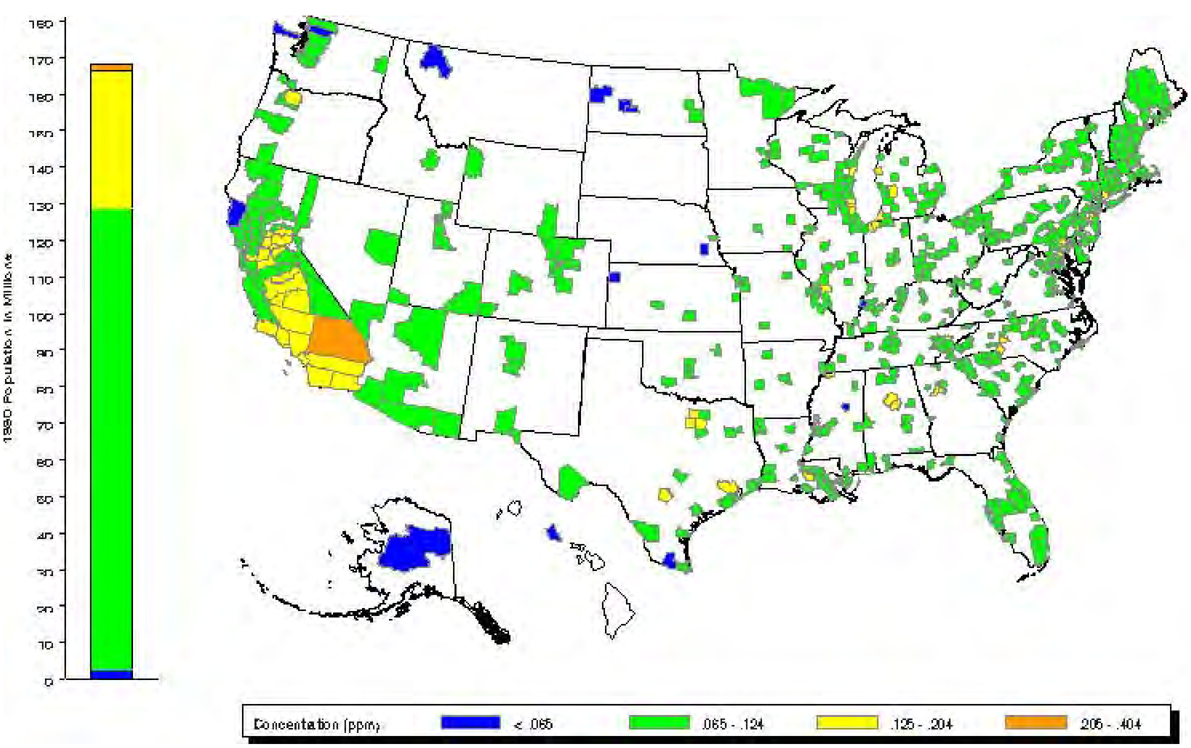


Figure 2-24. Highest O_3 second daily maximum concentration by county, 1996.

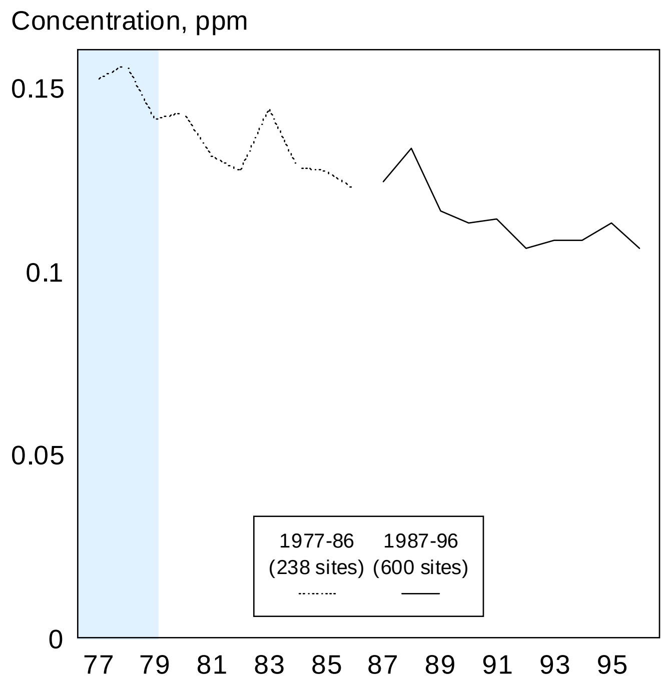


Figure 2-25. Long-term trend in second daily maximum 1-hour O_3 concentrations, 1977–1996.

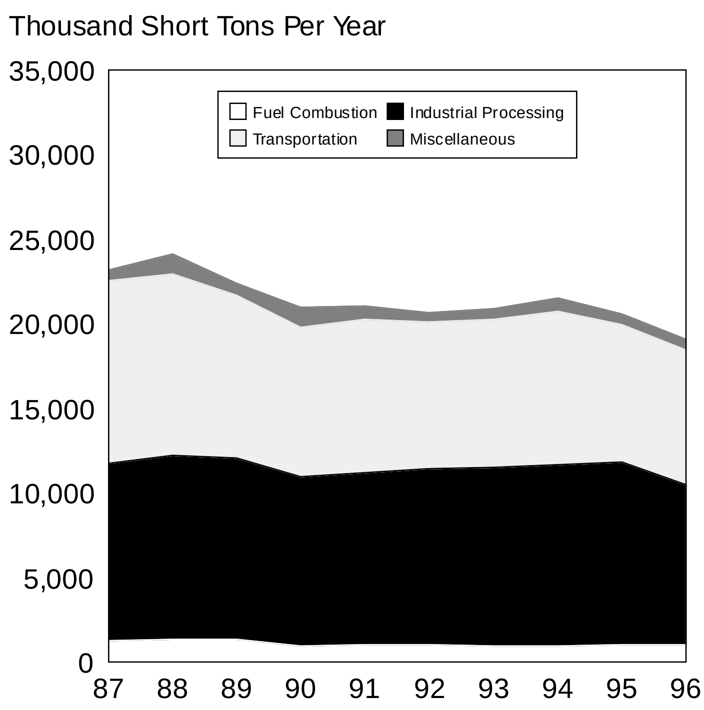


Figure 2-26. National total VOC emissions trend, 1987–1996.

line for the 600 trend sites, revealing about a 30-percent decline in ozone concentrations during the past 20 years. Although the overall trend is downward, short-term upturns corresponding to ozone-conducive meteorology are evident.

Figure 2-26 shows that national total VOC emissions (which contribute to ozone formation) decreased 18 percent between 1987 and 1996. National total NO_x emissions (the other major precursor to ozone formation) increased 5 percent between 1987 and 1996. Recent control measures to reduce emissions include regulations to lower fuel volatility and to reduce NO_x and VOC emissions from tailpipes.[11] The effectiveness of these control measures is reflected in the 26-percent decrease in VOC emissions from transportation sources. VOC emissions from highway vehicles have declined 35 percent since 1987, while highway vehicle NO_x emissions have declined 7 percent since their peak level in 1994. Nationally, the two major sources of VOC emissions are industrial processes (50 percent) and transportation sources (42 percent) as shown in Figure 2-27 and in Table A-5. Solvent use comprises 66 percent of the industrial process emissions category and 33 percent of total VOC emissions.

To further understand the air quality problems in metropolitan areas, the CAA called for improved monitoring of ozone and its precursors (VOC and NO_x). PAMS are found in all ozone nonattainment areas classified as serious, severe, or extreme. The 21 affected areas collect measurements of ozone, NO_x (NO, NO_2, and total NO_x), and many VOCs, as well as surface and upper air meteorological data. Between 1995 and 1996, a majority of the PAMS sites showed decreases in the concentrations of key ozone-forming VOCs.

For a more detailed discussion of the PAMS program and VOC reductions, see Chapter 4, "PAMS: Enhanced Ozone and Precursor Monitoring."

As required by the CAA, a cleaner burning fuel known as reformulated gasoline has been sold since January 1, 1995 in those areas of the country with the worst ozone or smog problems. RFG is formulated to reduce automotive emissions of ozone-forming pollutants and toxic chemicals—it is estimated to reduce both VOC and toxic emissions by more than 15 percent. RFG sold during the summer ozone season has lower volatility than most conventional gasoline.[12] The RFG program is mandated year-round in 10 areas of the country (Los Angeles, San Diego, Hartford, New York, Philadelphia, Chicago, Baltimore, Houston, Milwaukee, and Sacramento). Besides these required areas, several other parts of the country exceeding the ozone standard have voluntarily entered the RFG program.[13] For a more detailed discussion of the VOC reductions that have been achieved since the start of the RFG program, see Chapter 4.

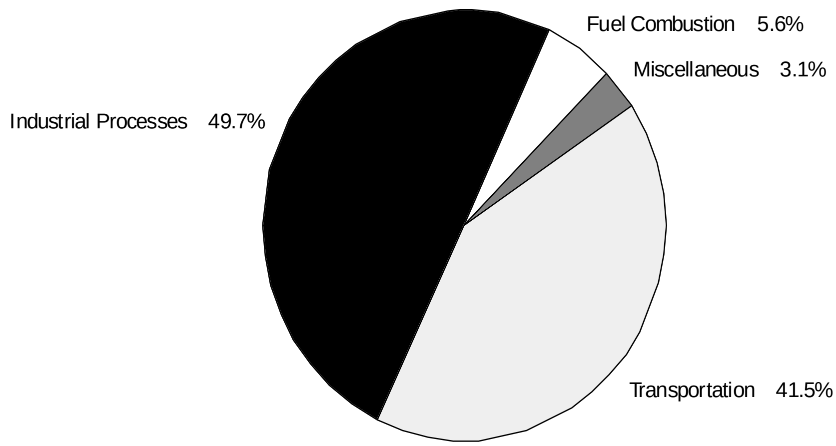


Figure 2-27. VOC emissions by source category, 1996.

The New 8-hour Ozone Standards

ON JULY 18, 1997, EPA announced revisions to the NAAQS for ground-level ozone, the primary constituent of smog. After a lengthy scientific review process, including extensive external scientific review, and public review and comment, the EPA Administrator determined that the previous 1-hour ozone standard should be replaced with a new 8-hour standard to protect both public health and the environment. Many new health studies show that health effects occur at levels lower than the previous standard and that exposure times longer than one hour (as reflected in the previous standard) are of concern.

The ozone primary and secondary standards, when last revised in 1979, were set at 0.12 ppm for one hour and was expressed as a "one-expected-exceedance" form. As the Clean Air Scientific Advisory Committee (CASAC) unanimously recommended, EPA changed the ozone standard averaging time to eight hours. EPA also changed the form of the primary standard, consistent with CASAC recommendations, from an expected-exceedance form to a concentration-based form because it relates more directly to ozone concentrations associated with health effects. It also avoids exceedances, regardless of magnitude, from being counted equally in the attainment tests. The new 8-hour primary standard was set at 0.08 ppm for the 3-year average of the annual 4th-highest daily maximum 8-hour ozone concentrations. The previous secondary standard (to protect the environment, i.e., agricultural crops, national parks, and forests) was replaced with a standard identical to the new primary standard.

Based on the most recent health studies, prolonged exposures (6 to 8 hours) to relatively low ozone levels during periods of moderate exertion can result in significant decreases in lung function, increased respiratory symptoms such as chest pain and cough, increased susceptibility to respiratory infection and lung inflammation, and aggravation of preexisting respiratory diseases such as asthma. Exposures to ambient ozone concentrations have also been linked to increased hospital admissions and emergency room visits for respiratory causes. Children active outdoors during the summertime when ozone levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include outdoor workers, individuals with preexisting respiratory disease such as asthma and chronic obstructive lung disease, and individuals who are unusually responsive to ozone. In addition, long-term exposures to ozone present the possibility of irreversible changes in the lungs which could lead to premature aging of the lungs and / or chronic respiratory illness.

In setting the 8-hour standard at 0.08 ppm, the EPA Administrator recognized that since there is no discernible threshold below which no adverse health effects occur, no level would eliminate all risk. Thus, a zero-risk standard is not possible, nor is it required by the Clean Air Act. The selected 0.08 ppm level is based on the judgment that at this level, public health will be protected with an adequate margin of safety.

The scientific review also highlighted concerns associated with ozone effects on vegetation for which the previous ozone standard did not provide adequate protection. These effects include reduction in agricultural and commercial forest yields; reduced growth and decreased survivability of tree seedlings; increased tree and plant susceptibility to disease, pests, and other environmental stresses; and potential long-term effects on forests and ecosystems. Many studies suggested that the degree of ozone damage to plants depends as much on the total seasonal cumulative ozone dose the plant receives as it does on the magnitude of any one particular acute ozone episode. Thus, during this current ozone NAAQS review, discussions on possible forms for a new secondary standard included a seasonal, cumulative index. Although a separate seasonal secondary standard was not set at this time, EPA believes attainment of the new 8-hour primary standard will substantially protect vegetation. EPA is committed to enhancing rural ozone monitoring, working in conjunction with other federal agencies, and considering long-term cumulative effects of ozone on plants as additional information becomes available.

The averaging times and air quality statistics used to track national air quality trends relate directly to the form of the respective national ambient air quality standard. For the 1-hour ozone standard, the solid line in Figure 2-28 shows the trend in the composite average of the annual second daily maximum 1-hour ozone concentrations. For the new 8-hour ozone standard, the dashed line shows the trend in the composite average of the annual fourth highest daily maximum 8-hour ozone concentrations. Between 1987 and 1996, the composite average of the 1-hour daily maximum ozone concentrations declined 15 percent, while the composite average of 8-hour fourth highest daily maximum concentrations decreased by 11 percent. The 1997 *Trends Report* will mark the transition to the 8-hour standard for tracking air quality status and trends.

The new 8-hour standard became effective on September 16, 1997, while the 1-hour standard will remain in effect in an area until EPA determines that the area has met the 1-hour standard.

A copy of the Federal Register Notice (62FR 38856) for the new standard can be downloaded from EPA's homepage on the Internet. The address is: http://www.epa.gov/ttn/oarpg/rules.html.

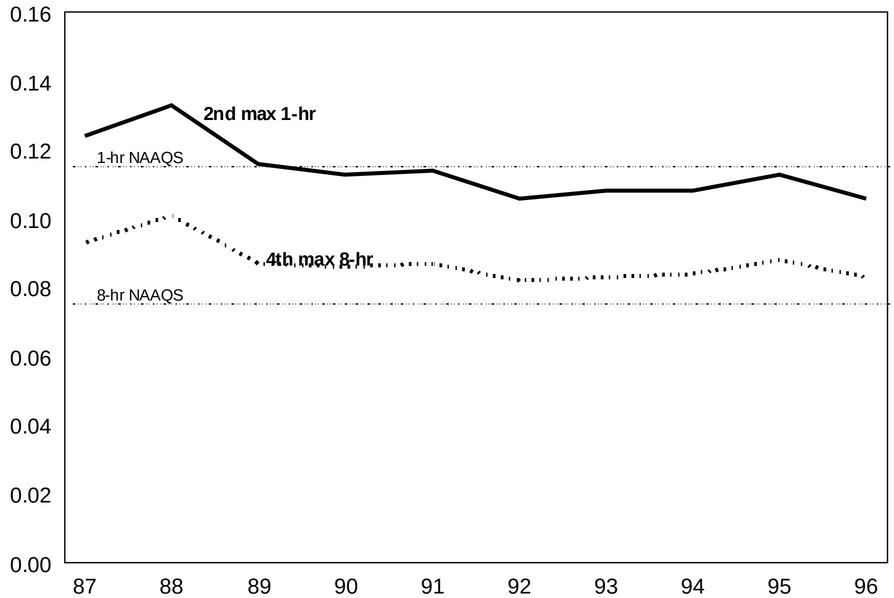


Figure 2-28. Trend in 2nd max 1-hr vs. 4th max 8-hr ozone concentrations, 1987–1996.

Determining Compliance with the New 8-hour Ozone Standards

The Standards

The level of the national 8-hour primary and secondary ambient air quality standards for ozone is 0.08 ppm, daily maximum 8-hour average. The 8-hour air quality standards are met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. (Computational details are specified in Appendix I to Part 50.10 of Title 40 of the *Code of Federal Regulations*.)

The Attainment Test

As shown in Example 1, the primary and secondary standards are met at this monitoring site because the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone

Example 1. Ambient monitoring site attaining the primary and secondary O_3 standards.

Year	Percent Valid Days	Highest Daily Max 8-hour Conc. (ppm)	2nd Highest Daily Max 8-hour Conc. (ppm)	3rd Highest Daily Max 8-hour Conc. (ppm)	4th Highest Daily Max 8-hour Conc. (ppm)
1993	100 percent	0.092	0.091	0.090	0.088
1994	96 percent	0.090	0.089	0.086	0.084
1995	98 percent	0.087	0.085	0.083	0.080
Average	**98 percent**				**0.084**

Example 2. Ambient monitoring site failing to meet the primary and secondary O_3 standards.

Year	Percent Valid Days	Highest Daily Max 8-hour Conc. (ppm)	2nd Highest Daily Max 8-hour Conc. (ppm)	3rd Highest Daily Max 8-hour Conc. (ppm)	4th Highest Daily Max 8-hour Conc. (ppm)
1993	96 percent	0.105	0.103	0.103	0.102
1994	74 percent	0.090	0.085	0.082	0.080
1995	98 percent	0.103	0.101	0.101	0.097
Average	**89 percent**				**0.093**

concentrations (0.084 ppm) is less than or equal to 0.08 ppm. The data completeness requirement is also met because the average percent of days with valid ambient monitoring data is greater than 90 percent, and no single year has less than 75 percent data completeness.

Example 2 shows that the primary and secondary standards are not met at this monitoring site because the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations (0.093 ppm) is greater than 0.08 ppm. The ozone concentration data for 1994 is used in these computations even though the data capture is less than 75 percent, because the average fourth-highest daily maximum 8-hour average concentration is greater than 0.08 ppm.

The Design Value

The air quality design value at a monitoring site is defined as the concentration that when reduced to the level of the standard ensures that the site meets the standard. For a concentration-based standard, the air quality design value is simply the standard-related test statistic. Thus, for the primary and secondary ozone standards, the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is also the air quality design value for the site.

Particulate Matter

- **Air Quality Concentrations (PM_{10})**
  - 1988–96 25% decrease
  - 1995–96 4% decrease
- **Emissions (PM_{10})**
  - 1988–96 12% decrease
  - 1995–96 no change

Nature and Sources

Particulate matter is the general term used for a mixture of solid particles and liquid droplets found in the air. These particles, which come in a wide range of sizes, originate from many different stationary and mobile sources as well as from natural sources. They may be emitted directly by a source or formed in the atmosphere by the transformation of gaseous emissions. Their chemical and physical compositions vary depending on location, time of year, and meteorology.

Health and Other Effects

Scientific studies show a link between particulate matter (alone, or combined with other pollutants in the air) and a series of significant health effects. These health effects include premature death, increased hospital admissions and emergency room visits, increased respiratory symptoms and disease, and decreased lung function, and alterations in lung tissue and structure and in respiratory tract defense mechanisms. Sensitive groups that appear to be at greater risk to such effects include the elderly, individuals with cardiopulmonary disease such as asthma, and children. In addition to health problems, particulate matter is the major cause of reduced visibility in many parts of the United States. Airborne particles also can cause soiling and damage to materials.

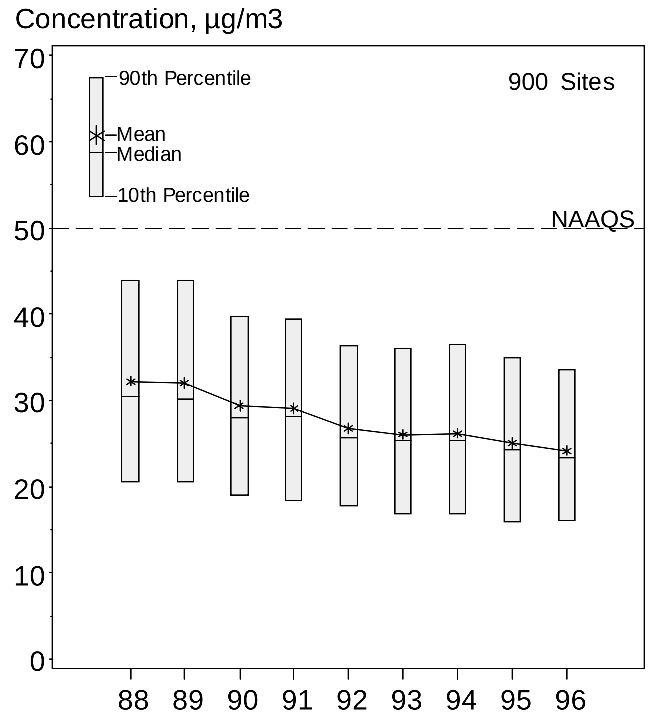


Figure 2-29. Trend in annual mean PM_{10} concentrations, 1988-1996.

Primary and Secondary PM_{10} Standards

There are both short- and long-term PM_{10} NAAQS. The long-term standard specifies an expected annual arithmetic mean not to exceed 50 µg / m^3 averaged over three years. 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. Together, these make up the primary, or health-based, PM_{10} standards. The secondary, or welfare-based, standards for PM_{10} are identical to the primary standards.

The New PM Standards

The original standard for particulate matter was a Total Suspended Particulate (TSP) standard, established in 1971. In 1987, EPA replaced the TSP standard with a PM_{10} standard to focus on smaller particles of aerodynamic diameter less than or equal to 10 micrometers. These smaller particles caused the greatest health concern because of their ability to penetrate into sensitive regions of the respiratory tract. The most recent review of the particulate matter standards concluded that still more protection from adverse health effects was needed. On July 18, 1997 EPA revised the particulate matter standards by adding new standards for $PM_{2.5}$ (particles of aerodynamic diameter less than or equal to 2.5 micrometers) and by adjusting the form of the PM_{10} 24-hour standard.[14] Additional details for the revised standards are provided in the next section, "The New Particulate Matter Standards." The trends discussion of this section will focus on the PM_{10} standards that were in place when the 1987–1996 data presented in this report were collected.

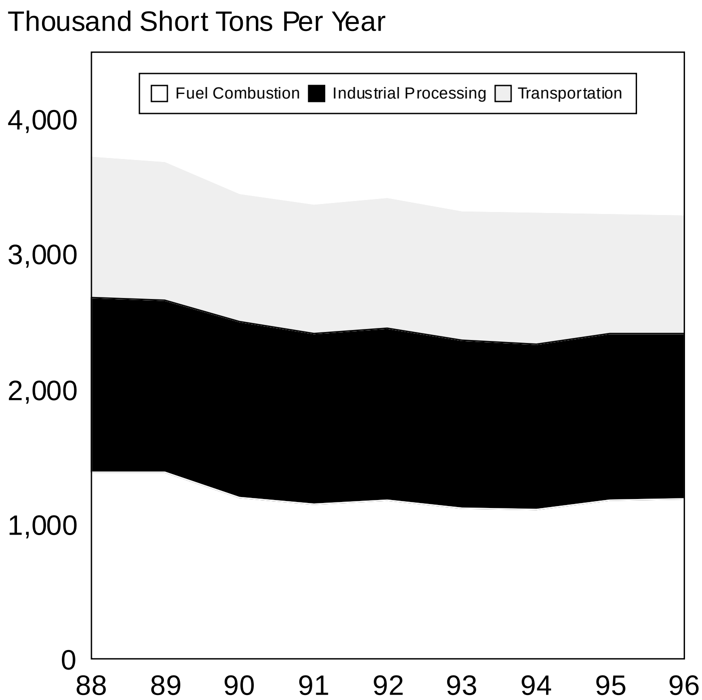


Figure 2-30. National PM_{10} emissions trend, 1988–1996 (traditionally inventoried sources only).

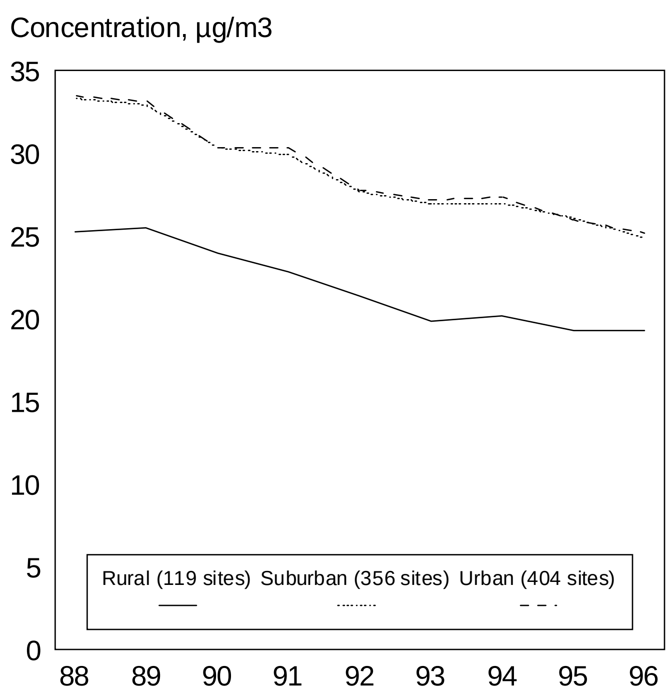


Figure 2-31. PM_{10} annual mean concentration trends by location, 1988–1996.

Trends

The first complete year of PM_{10} trends data for most monitors is 1988, so the trends in this section begin there. Figure 2-29 shows a 25-percent decrease in annual mean PM_{10} concentrations measured at monitoring sites across the country between 1988 and 1996. The change in direct emissions of PM_{10}, which are based on engineering estimates, is shown in Figure 2-30. For the same time period (1988–1996), direct emissions decreased 12 percent, while emissions of SO_2, a major precursor of fine particulate matter, decreased by about the same amount. The 1-year change between 1995 and 1996 showed a 4-percent decrease in annual mean PM_{10} concentrations, while PM_{10} emissions remained about the same.

As shown in Figure 2-31, urban and suburban sites have similar trends and comparable average concentrations. The trends at rural sites are consistent with these urban and suburban patterns, although the composite mean level is significantly lower.

Direct PM_{10} emissions are generally examined in two separate groups. The first is the more traditionally inventoried sources, including fuel combustion, industrial processes, and transportation, as shown in Figure 2-32. The second group is a combination of miscellaneous and natural sources including agriculture and forestry, wildfires and managed burning, fugitive dust from paved and unpaved roads, and wind erosion. As Figure 2-33 shows, these miscellaneous and natural sources actually account for almost 90 percent of the total direct PM_{10} emissions nationwide, although they can be difficult to quantify compared to the traditionally inventoried sources. The emissions trend for the traditionally inventoried sources shows a 12-percent decrease since 1988. Because the emissions in the miscellaneous / natural group tend to fluctuate a great deal from year to year, the trend from one year to the next or over several years may not be particularly meaningful. Table A-6 lists PM_{10} emissions estimates for the traditionally inventoried sources for 1987–1996. Miscellaneous and natural source PM_{10} emissions estimates are provided in Table A-7.

The map in Figure 2-34 displays the highest second maximum 24-hour PM_{10} concentration by county in 1996. Three counties had a monitor with a very high 24-hour PM_{10} second maximum concentration. The highest was recorded in Howell County, Missouri at a monitor adjacent to a charcoal kiln facility. The next highest was a monitor in Imperial County, California at a site just 1 / 4 mile from the border with Mexico. The third highest second maximum concentration was recorded at the Franklin Smelter in Philadelphia. The bar chart which accompanies the national map shows that in 1996, approximately 5 million people lived in 11 counties where the second highest maximum 24-hour PM_{10} concentration was above the level of the 24-hour PM_{10} NAAQS. When both the annual and 24-hour standards are considered, there were 7 million people living in 15 counties with PM_{10} concentrations above the PM_{10} NAAQS in 1996.

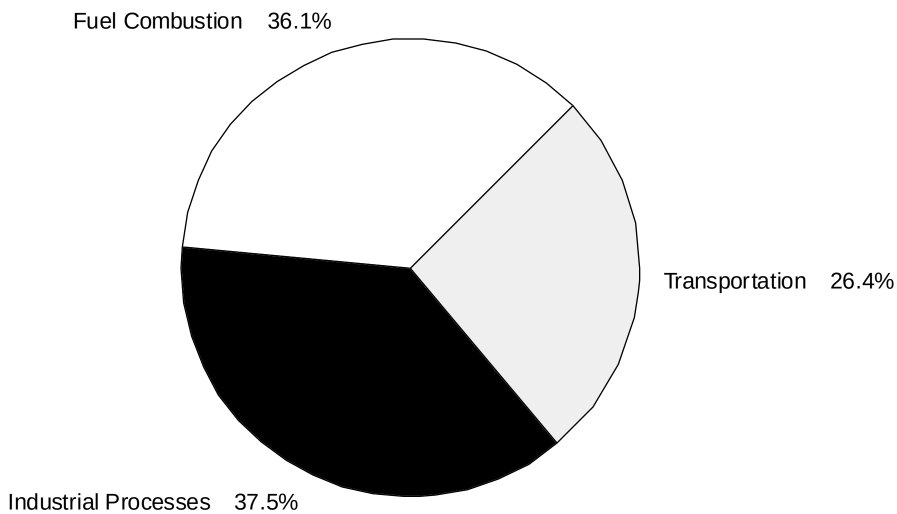


Figure 2-32. PM_{10} emissions from traditionally inventoried source categories, 1996.

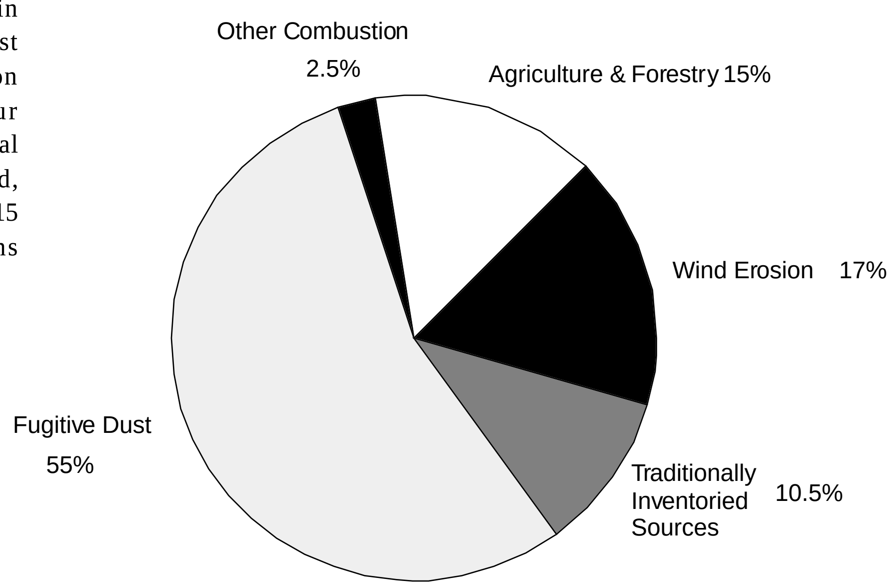


Figure 2-33. Total PM_{10} emissions by source category, 1996.

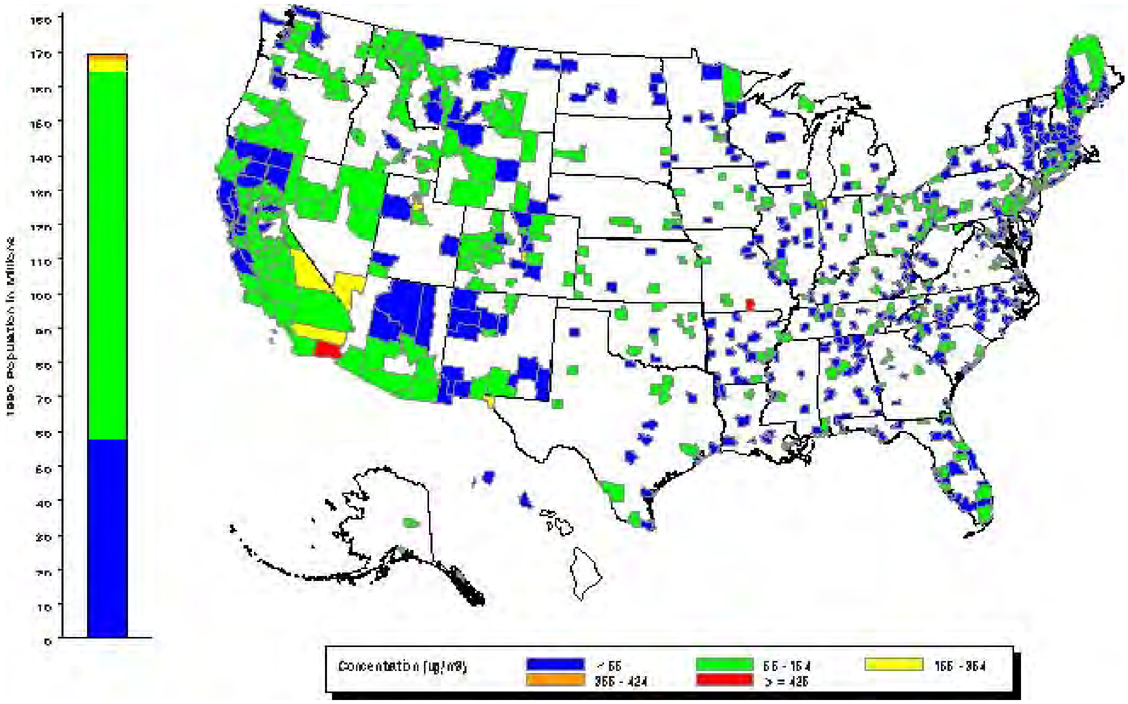


Figure 2-34. Highest second maximum 24-hour PM_{10} concentration by county, 1996.

The New Particulate Matter Standards

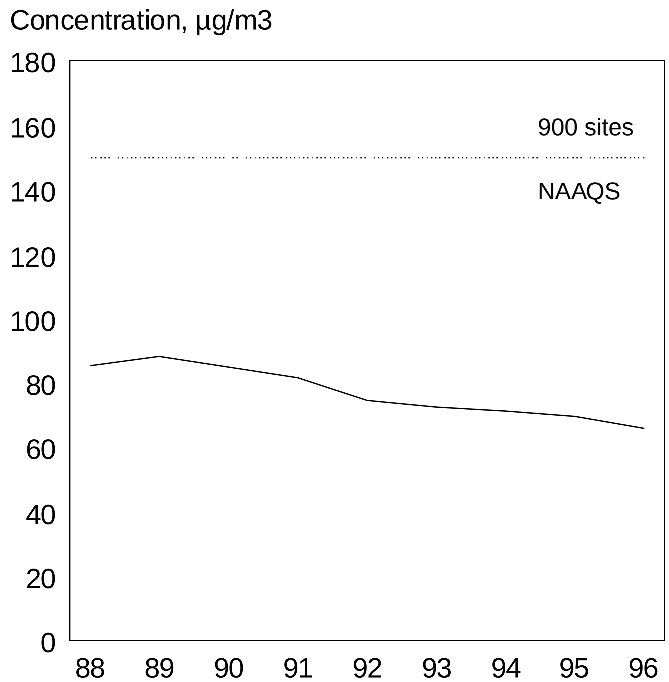


Figure 2-35. PM_{10} trend in the average 99th percentile PM_{10} concentration, 1988–1996.

Revisions to the particulate matter standards were announced July 18, 1997. The review of hundreds of peer-reviewed scientific studies, published since the original PM_{10} standards were established, provided evidence that significant health effects are associated with exposures to ambient levels of fine particles allowed by the PM_{10} standards. Consistent with the advice given by CASAC, the EPA Administrator determined that adding new standards was necessary to protect the health of the public and the environment.

The primary (health-based) standards were revised to add two new $PM_{2.5}$ standards, set at 15µg / m^3 and 65 µg / m^3, respectively, for the annual and 24-hour standards, and to change the form of the 24-hour PM_{10} standard. In setting these levels, the EPA Administrator recognized that since there is no discernible threshold below which no adverse health effects occur, no level would eliminate all risk. Therefore, a zero-risk standard is not possible, nor is it required by the CAA. The selected levels are based on the judgement that public health will be protected with an adequate margin of safety. The secondary (welfare-based) standards were revised by making them identical to the primary standards. In conjunction with the Regional Haze Program, the secondary standards will protect against major PM welfare effects, such as visibility impairment, soiling, and materials damage.

$PM_{2.5}$ consists of those particles that are less than 2.5 micrometers in diameter. They are also referred to as “fine” particles, while those between 2.5 and 10 micrometers are known as “coarse” particles. Fine particles result from fuel combustion from motor vehicles, power generation, and industrial facilities, as well as from residential fireplaces and wood stoves. Fine particles can also be formed in the atmosphere by the transformation of gaseous emissions such as SO_2, NO_x, and VOCs. Coarse particles are generally emitted from sources such as vehicles traveling on unpaved roads, materials handling, and crushing and grinding operations, as well as windblown dust.

Both coarse and fine particles can accumulate in the respiratory system and are associated with numerous health effects. Exposure to coarse fraction particles is primarily associated with the aggravation of respiratory conditions such as asthma. Fine particles are most closely associated with such health effects as premature death, increased hospital admissions and emergency room visits, increased respiratory symptoms and disease, and decreased lung function. Sensitive groups that appear to be at greatest risk to such effects include the elderly, individuals with cardiopulmonary disease such as asthma, and children.

The form of the 24-hour PM_{10} standard changed from the one-expected-exceedance form to a concentration-based 99th percentile form, averaged over three years. EPA changed the form of the 24-hour PM_{10} standard from an expected-exceedance form to a concentration-based form because the new form relates more directly to PM concentrations associated with health effects. The concentration-based form also avoids exceedances, regardless of size, from being counted equally in attainment tests. The method for computing the 99th percentile for comparison to the 24-hour standard is found in the *Code of Federal Regulations* (40 CFR Part

50, Appendix N) and is described briefly in the pages that follow.

Figure 2-35 shows a trend of the average 99th percentile for 900 sites across the country. The 99th percentile shown in the trend is computed by the Aerometric Information Retrieval System (AIRS), so it differs slightly from the data handling procedures found in the Code of Federal Regulations (CFR). The data displayed in the figure also differ from the regulatory data handling procedures in that only one year of data are presented, whereas an actual comparison to the standards is always based on an average of three years of data. The trend data show a 23-percent increase in average 99th percentile concentration between 1988 and 1996.

The form of the 24-hour $PM_{2.5}$ standard is also a percentile form, although it is a 98th percentile. Like PM_{10}, it is averaged over three years. The form of the annual standard for $PM_{2.5}$ is a 3-year average of the annual arithmetic mean, just as for the PM_{10} standard. However, unlike PM_{10}, compliance with the $PM_{2.5}$ annual standard may be judged from single or multiple community-oriented monitors reflective of a community-based spatial average. A spatial average is more closely linked to the underlying health effects information. A trend of $PM_{2.5}$ data is not presented here because there are not enough monitors in place at this time to portray an accurate national trend. The network of monitors required for the new $PM_{2.5}$ standard will be phased in over the next three to four years.

A copy of the Federal Register Notice for the new PM standard (62FR 38652) can be downloaded from EPA's homepage on the Internet. The address is http://www.epa.gov/ttn/oarpg/rules.html.

Determining Compliance With the New PM Standards

Appendix N to 40 CFR Part 50 contains the data handling regulations for the new particulate matter standards. Some of those requirements are illustrated in the examples provided here, but Appendix N includes additional details, requirements, and examples (including examples for spatial averaging and for data which do not meet data completeness requirements).

The levels, forms, and rounding conventions of the particulate matter standards can be summarized as follows:

Annual PM_{10} Standard

Level: 50 µg/m³

Form: At each site, calculate the annual mean from 4 quarterly means. Average the annual means for 3 years.

Rounding: 50.4 rounds to 50
50.5 rounds to 51 (first value above the standard).

24-Hour PM_{10} Standard

Level: 150 µg/m³

Form: At each site, calculate the 99th percentile for the year. Average the 99th percentiles for 3 years.

Rounding: 154 rounds to 150
155 rounds to 160 (first value above the standard).

Annual $PM_{2.5}$ Standard

Level: 15.0 µg/m³

Form: At each site, calculate the annual mean from 4 quarterly means. If spatial averaging is used, average the annual means of the designated monitors in the area to get an annual spatial mean. Then average the annual spatial means for 3 years.

Rounding: 15.04 rounds to 15.0
15.05 rounds to 15.1 (first value above the standard).

24-Hour $PM_{2.5}$ Standard

Level: 65 µg/m³

Form: At each site, calculate the 98th percentile for the year. Average the 98th percentiles for 3 years.

Rounding: 65.4 rounds to 65
65.5 rounds to 66 (first value above the standard).

Sample Calculation of the 3-Year Average Annual Mean for PM_{10}

Assume data completeness requirements have been met for this example. At each site, average all the 24-hour measurements in a quarter to find the quarterly mean. Then average the 4 quarterly means to find the annual mean. In this example, the 4 quarterly means for the first year are 43.23, 54.72, 50.96, and 60.77 µg/m³. Find the annual mean for the first year.

$$\frac{43.23 + 54.72 + 50.96 + 60.77}{4} = 52.42\ \mu g/m^3$$

Similarly, the annual means for the second and third year are calculated to be 82.17 and 63.23 µg/m³. Find the 3-year average annual mean.

$$\frac{52.42 + 82.17 + 63.23}{3} = 65.94\ \mu g/m^3$$

Round 65.94 to 66 µg/m³ before comparing to the standard. *This example does not meet the PM_{10} annual standard.*

Sample Calculation of the 3-Year Average 99th Percentile for PM_{10}

Assume for this example that the data completeness requirements have been met. At each site, sort all values collected in a year from lowest to highest. Number their rankings as in the following table:

Year 1

Rank	Value (µg/m³)
1	85
2	87
3	88
—	—
108	120
109	128
110	130

Year 2

Rank	Value (µg/m³)
1	90
2	93
3	97
—	—
96	143
97	148
98	150

Year 3

Rank	Value (µg/m³)
1	40
2	48
3	52
—	—
98	140
99	144
100	147

In this example, the site collected 110 out of a possible 121 samples in Year 1; 98 out of 121 in Year 2; and 100 out of 121 in Year 3. Calculate the 99th percentile for each year.

$$0.99 \times 110 = 108.9$$

$$0.99 \times 98 = 97.02$$

$$0.99 \times 100 = 99$$

Take the integer part of the product and add 1 to find which ranking corresponds to the 99th percentile.

$$108 + 1 = 109$$

$$97 + 1 = 98$$

$$99 + 1 = 100$$

Find the value which corresponds to the ranking using the table above.

109 corresponds to 128 µg/m³

98 corresponds to 150 µg/m³

100 corresponds to 147 µg/m³

Find the 3-year average of the 99th percentiles.

$$\frac{128 + 150 + 147}{3} = 141.66667 \ \mu g/m^3$$

Round 141.66667 to 140 µg / m³ before comparing to the standard. *This example meets the PM_{10} 24-hour standard.*

Sample Calculation of the 3-Year Average of the Spatially Averaged Annual Means for $PM_{2.5}$

Assume data completeness requirements have been met for this example. Given an area designated for spatial averaging and three monitors designated for spatial averaging within the area, first average all the 24-hour measurements in each quarter at each site to find the 4 quarterly means. Then calculate the annual mean from the 4 quarterly means. If, for this example, the 4 quarterly means for first site for the first year are 11.6, 12.4, 15.1, and 12.1 µg / m³, find the annual mean for this site and year.

$$\frac{11.6 + 12.4 + 15.1 + 12.1}{4} = 12.8 \ \mu g/m^3$$

Similarly, the annual means for the other sites and the other years can be calculated. The results appear in the following table.

	Annual Means (µg/m³)		
	Site 1	Site 2	Site 3
Year 1	12.8	14.2	13.6
Year 2	13.0	13.5	12.9
Year 3	15.2	14.8	17.1

For Year 1, find the annual spatial mean of the designated monitors in the area.

$$\frac{12.8 + 14.2 + 13.6}{3} = 13.533333 \ \mu g/m^3$$

Similarly, the annual spatial means for Year 2 and Year 3 are calculated to be 13.13 and 15.7 µg / m³. Find the 3-year average annual spatial mean.

$$\frac{13.533333 + 13.13 + 15.7}{3} = 14.121111 \ \mu g/m^3$$

Round 14.121111 to 14.1 µg / m³ before comparing to the standard. *This example meets the $PM_{2.5}$ annual standard.*

Sample Calculation of the 3-Year Average 98th Percentile for $PM_{2.5}$

Assume for this example that the data completeness requirements have been met. At each site, sort all values collected in a year from lowest to highest. Number their rankings as in the following table:

Year 1

Rank	Value (µg/m³)
—	—
275	57.9
276	59.0
277	62.2
—	—

Year 2

Rank	Value (µg/m³)
—	—
296	54.3
297	57.1
298	63.0
—	—

Year 3

Rank	Value (µg/m³)
—	—
290	66.0
291	68.4

292	69.8
—	—

In this example, the site collected 281 samples out of possible 365 samples in Year 1; 304 out of 365 in Year 2; and 296 out of 365 in Year 3. Calculate the 98th percentile for each year.

0.98 x 281 = 275.38

0.98 x 304 = 297.92

0.98 x 296 = 290.07

Take the integer part of the product and add 1 to find which ranking corresponds to the 98th percentile.

275 + 1 = 276

297 + 1 = 298

290 + 1 = 291

Find the value which corresponds to the ranking using the table above.

276 corresponds to 59.0 µg/m³

298 corresponds to 63.0 µg/m³

291 corresponds to 68.4 µg/m³

Find the 3-year average of the 98th percentiles.

$$\frac{59.0 + 63.0 + 68.4}{3} = 63.466667 \ \mu g/m^3$$

Round 63.466667 to 63 µg/m³ before comparing to the standard. *This example meets the $PM_{2.5}$ 24-hour standard.*

Sulfur Dioxide

- **Air Quality Concentrations**

1987–96	37%	decrease
1995–96		no change

- **Emissions**

1987–96	14%	decrease
1995–96	3%	increase

Nature and Sources

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

Health and Other Effects

The major health concerns associated with exposure to high concentrations of SO_2 include effects on breathing, respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease. Major subgroups of the population that are most sensitive to SO_2 include asthmatics and individuals with cardiovascular disease or chronic lung disease, as well as children and the elderly.

Together, SO_2 and NO_x are the major precursors to acidic deposition (acid rain), which is associated with the acidification of lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility. SO_2 is a major precursor to $PM_{2.5}$, which, as discussed in the previous section (beginning on page 34), is of significant concern to health as well as a main pollutant that impairs visibility.

Primary and Secondary Standards

There are two primary NAAQS for SO_2 that address these health concerns: an annual mean concentration of 0.030 ppm (80 µg/m^3) not to be exceeded, and a 24-hour daily concentration of 0.14 ppm (365 µg/m^3) not to be exceeded more than once per year.

The secondary SO_2 NAAQS is a 3-hour average concentration of 0.50 ppm (1,300 µg/m^3) not to be exceeded more than once per year.

Trends

The map in Figure 2-36 displays the highest second maximum 24-hour SO_2 concentration by county in 1996. Only

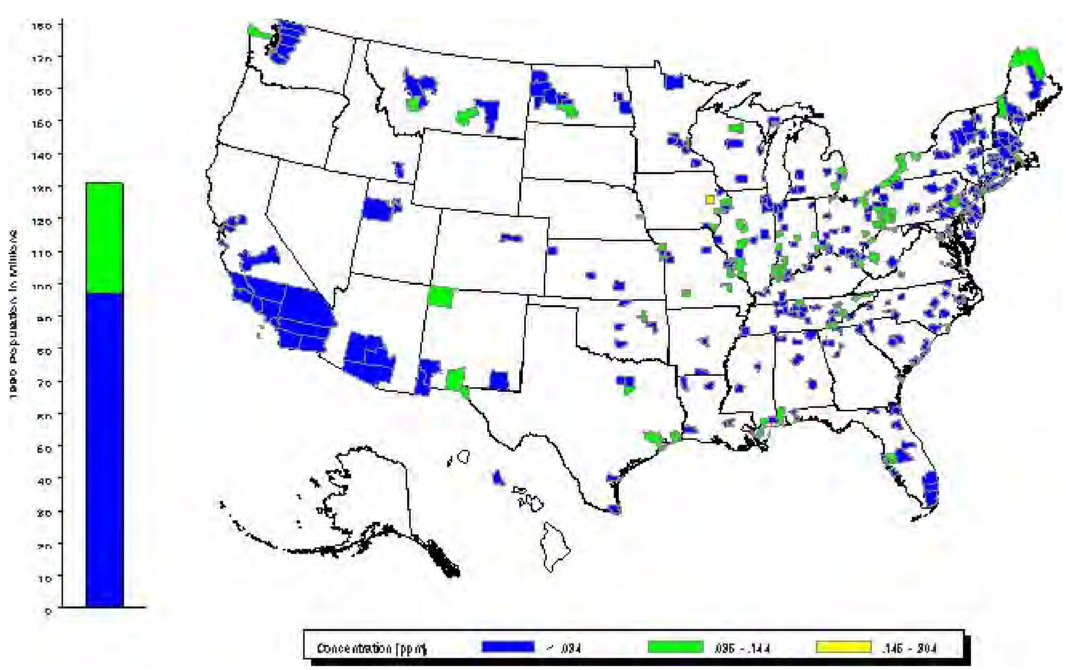


Figure 2-36. Highest second maximum 24-hour SO_2 concentration by county, 1996.

one county, Linn County, Iowa, containing a major SO_2 point source, failed to meet the ambient SO_2 NAAQS in 1996.

The national composite average of SO_2 annual mean concentrations decreased 37 percent between 1987 and 1996 (see Figure 2-37), while SO_2 emissions decreased 12 percent (see Figure 2-38). Between 1995 and 1996, there was no change in the national composite average of SO_2 annual mean concentrations, while SO_2 emissions increased 3 percent.

Historically, networks are positioned in population-oriented locales. As seen in Figure 2-39, eighty-eight percent of total national SO_2 emissions, however, result from fuel combustion sources that tend to be located in less populated areas. Thus, it is important to emphasize that current SO_2 problems in the United States are caused by point sources that are usually identified by modeling rather than routine ambient monitoring. Figure 2-40 reveals that composite annual mean concentrations at sites in suburban and urban locations decreased 38 and 41 percent, respectively, while ambient levels decreased 29 percent at rural sites.

The progress in reducing ambient SO_2 concentrations during the past 20 years is shown in Figure 2-41. This reduction was 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.

Established by EPA under Title IV of the CAA, the Acid Rain Program's principal goal is to achieve significant reductions in SO_2 and NO_x emissions.

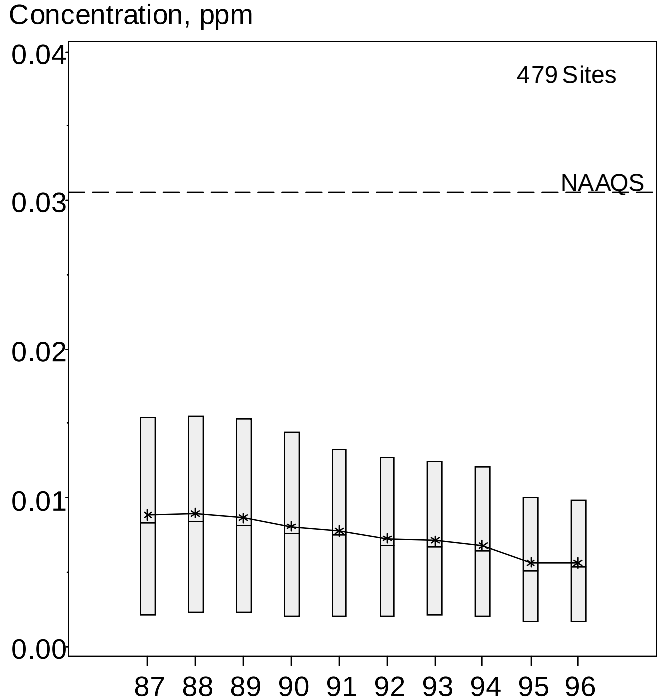


Figure 2-37. Trend in annual mean SO_2 concentrations, 1987–1996.

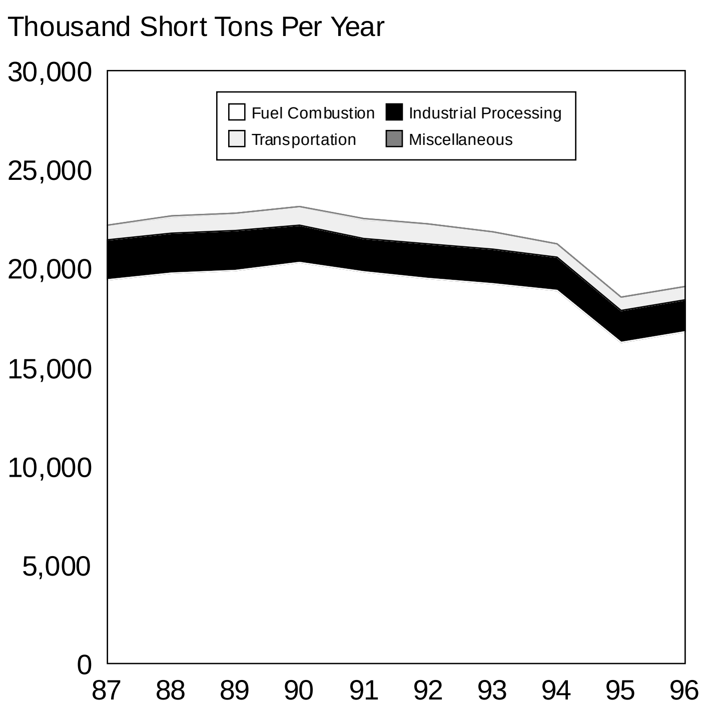


Figure 2-38. National total SO_2 emissions trend, 1987–1996.

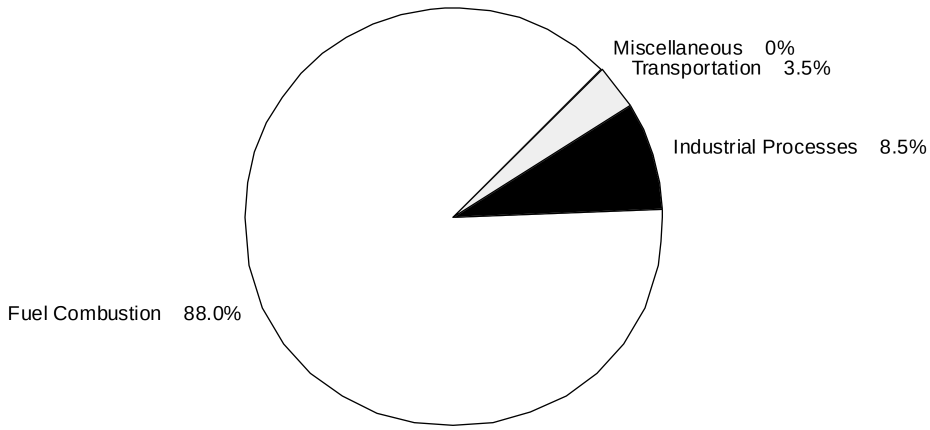


Figure 2-39. SO_2 emissions by source category, 1996.

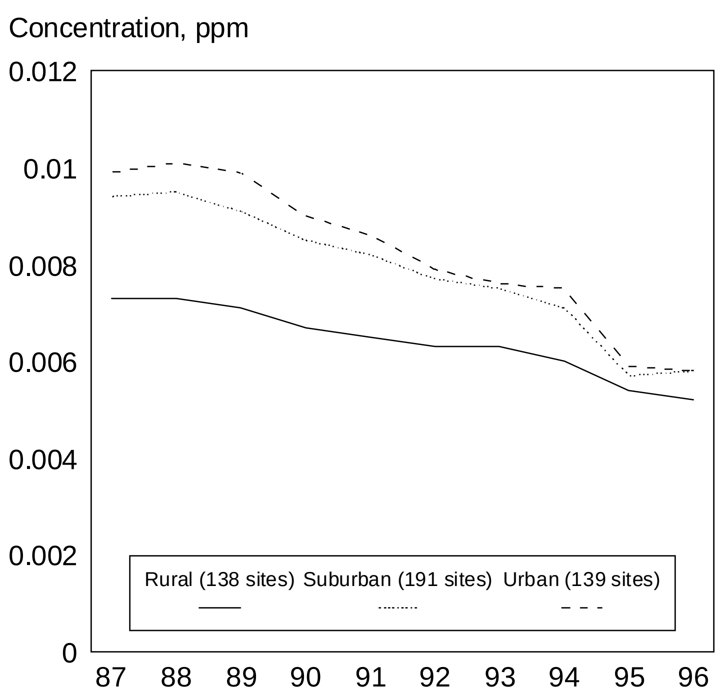


Figure 2-40. SO_2 annual mean concentration trend by location, 1987–1996.

Phase I of EPA's Acid Rain Program reduced SO_2 emissions at participating utilities from 10.9 million tons in 1980 to 5.3 million tons in 1995. This level was 39 percent below 8.7 million tons, the allowable emissions level for 1995 required by the CAAA. In 1996, SO_2 emissions at the participating utilities rose to 5.4 million tons, an increase of approximately 100,000 tons from 1995. This is still 35 percent below the 1996 allowable level of 8.3 million tons. Review of the largest emission increases between 1995 and 1996 reveals that increased utilization seems to be at least a contributing factor, if not the sole factor, for most of the increases. At several units, for example, the rise occurred due to increased utilization coupled with the use of higher sulfur coal in response to the market providing this coal (and allowances) less expensively. Another case reflects a utilization increase coupled with scrubber difficulties, resulting in lower removal efficiencies than in 1995. A final case where a substantial increase in emissions occurred is due solely to a utilization increase; the unit underwent an extended outage in 1995, but operated throughout 1996.[15] For more information, visit the Acid Rain Program Home Page at http://www.epa.gov/acidrain.

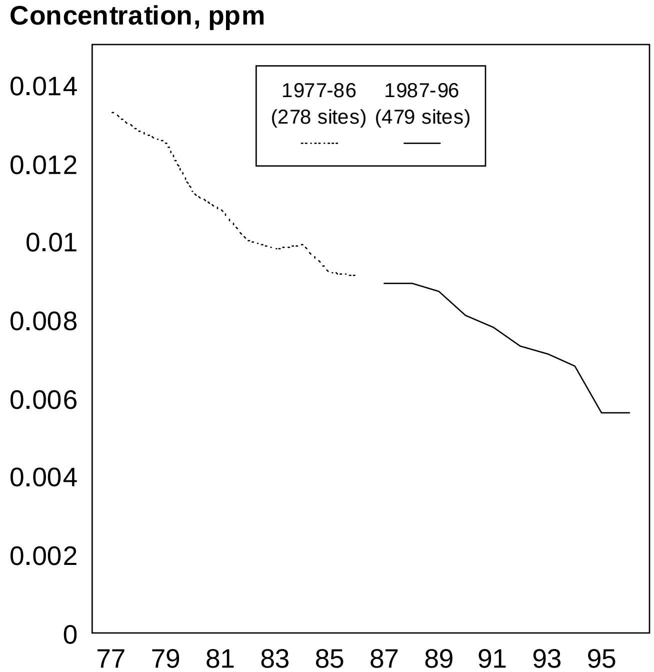


Figure 2-41. Long-term ambient SO_2 trend, 1977–1996.

References

1. *Oxygenated Gasoline Implementation Guidelines*, EPA, Office of Mobile Sources, Washington, DC, July 27, 1992.
2. *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).
3. *Interagency Assessment of Oxygenated Fuels*, National Science and Technology Council, Executive Office of the President, Washington, DC, June 1997.
4. G. Whitten, J. Cohen, and A. Kuklin, *Regression Modeling of Oxyfuel Effects on Ambient CO Concentrations: Final Report*, SYSAPP-96/78, prepared for the Renewable Fuels Association and Oxygenated Fuels Association by System Applications International, Inc., San Rafael, CA, January 1997.
5. Cook, J.R., P. Enns, and M.S. Sklar, *Regression Analysis of Ambient CO Data from Oxyfuel and Nonoxyfuel Areas*, Paper No. 97-RP139.02, Air and Waste Management Association 90th Annual Meeting, Toronto, Ontario, June 1997.
6. *National Ambient Air Quality Standards for Ozone: Final Rule*. 62 FR 38856, July 18, 1997.
7. National Weather Service, National Climate Prediction Center WebPage, September 1996 Report.
8. *Rethinking the Ozone Problem in Urban and Regional Air Pollution*, National Research Council, National Academy Press, Washington, DC, December 1991.
9. *National Air Quality and Emissions Trends Report, 1993*, EPA-454/R-94-026, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, October 1994.
10. 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.
11. *Volatility Regulations for Gasoline and Alcohol Blends Sold in Calendar Years 1989 and Beyond*, 54 FR 11868, March 22, 1989.
12. *Reformulated Gasoline: A Major Step Toward Cleaner Air.* EPA-420-B-94-004, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, DC, September 1994.
13. *Requirements for Reformulated Gasoline*. 59 FR 7716, February 16, 1994.
14. *National Ambient Air Quality Standards for Particulate Matter: Final Rule*, July 18, 1997.
15. *1996 Compliance Report Acid Rain Program*, EPA-430-R-97-025, U.S. Environmental Protection Agency, Office of Air and Radiation, Acid Rain Program Information 401 M Street, SW, Mail Code 6204J, Washington, DC 20460, June 1997.

Chapter 3

Visibility Trends

Introduction

The CAA requires 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, and the secondary NAAQS for PM_{10} and $PM_{2.5}$. 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 manmade air pollution." The Act also calls for state programs to make "reasonable progress" toward the national goal.

In 1987, the IMPROVE visibility monitoring network was established as a cooperative effort between EPA, National Park Service, U.S. Forest Service, Bureau of Land Management, 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, soil dust, and a number of other elements. The IMPROVE program has established protocols for aerosol, optical, and photographic monitoring methods, and these methods are employed at more than 70 Class I sites. The analyses presented in this chapter are based on data from the IMPROVE network which can be found on the Internet at ftp://alta_vista.cira.colostate.edu/IMPROVE.

This chapter evaluates data collected from 1988–1995 at 30 Class I areas in the IMPROVE network. To assess progress in preventing future impairment and remedying existing impairment, the chapter in some cases presents trends of the average "best," "worst," and "average" 20 percent of the data under consideration (i.e., "best" is the average of the 20 percent lowest values, also referred to as the 10^{th} percentile. Likewise, the terms, "worst" and "average" refer to an average of the upper 20 percent range—80 percent to 100 percent, and middle 20 percent range 40–60 percent, recorded annually). Figure 3-1 provides a visual illustration that contrasts visual air quality from the average best and worst conditions at Acadia, Great Smoky Mountains, and Grand Canyon national parks.[1]

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 soil dust) can also significantly affect our ability to see.

Both primary releases and secondary formation of particles contribute to visibility impairment. Primary particles, such as dust from roads and agricultural operations or elemental carbon from diesel and wood combustion, are emitted directly into the atmosphere. Secondary particles formed in the atmosphere from primary gaseous emissions include sulfate formed from sulfur dioxide emissions, nitrates from nitrogen oxide emissions, and organic carbon particles formed from 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 dominate in the West, primary emissions from sources such as woodsmoke 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.

In general, visibility conditions in rural Class I 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 concentrations of anthropogenic pollution, higher estimated 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 the West. Poor summer visibility in the eastern United States is primarily the result of high sulfate concentrations combined with high humidity levels.

Visibility conditions are commonly expressed in terms of three mathematically related metrics: visual range, light extinction, and deciviews. Visual range 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. The IMPROVE network measures two parameters, light extinction using transmissometers, and light scattering using nephelometers. From these two parameters other parameters

Acadia National Park
Visual Range = 16 miles Visual Range = 71 miles

Great Smoky Mountains National Park
Visual Range = 13 miles Visual Range = 51 miles

Grand Canyon National Park
Visual Range = 60 miles Visual Range = 124 miles

Figure 3-1. Range of best and worst conditions at Acadia, Great Smoky Mountains, and Grand Canyon national parks, 1992–1995.

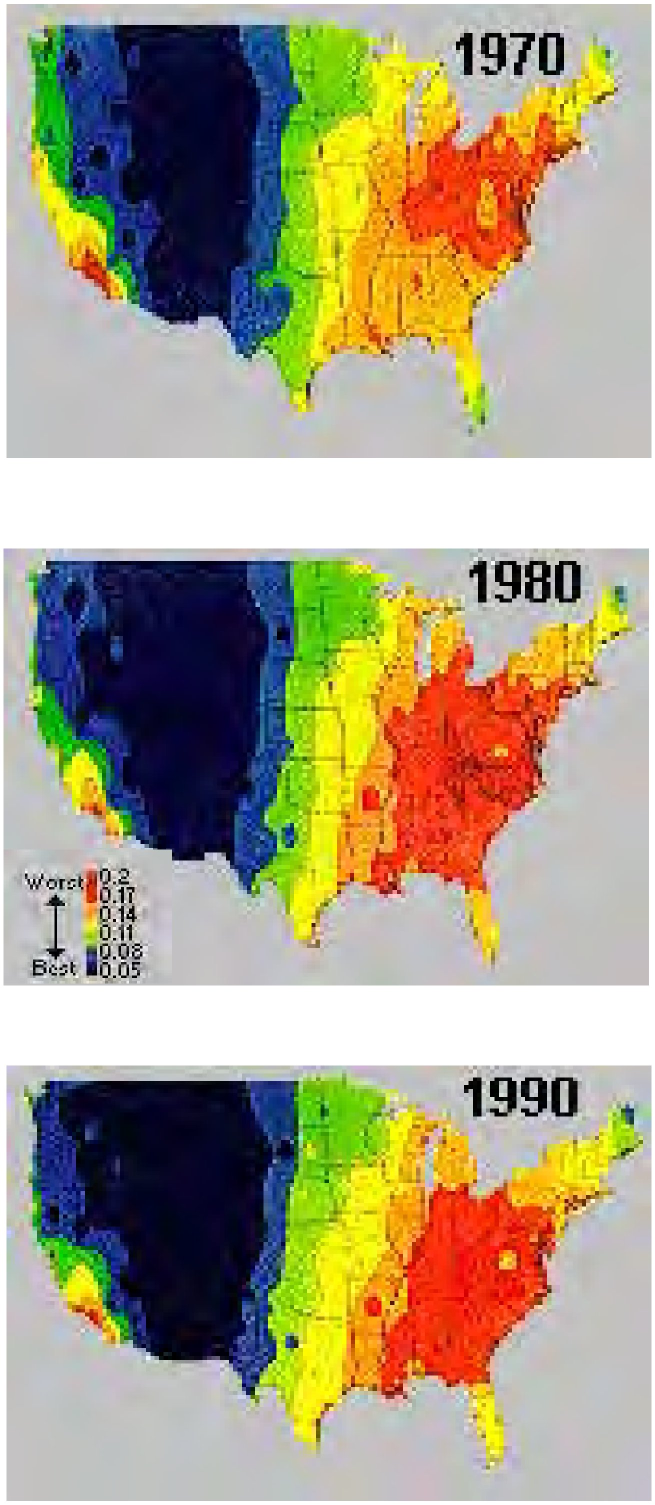


Figure 3-2. Long-term trend for 75th percentile light extinction coefficient from airport visual data (July–September).

such as visual range or deciviews may be calculated.

Equal changes in visual range and light extinction are not proportional to human perception, however. For example, a 5-mile change in visual range can be either very apparent or not perceptible, depending on the base line level of ambient pollution (see Figure 3-1). 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 perceptible by the average person. A deciview of zero represents pristine conditions.

Long-Term Trends

Visibility impairment has been analyzed using visual range data collected since 1960 at 280 monitoring stations located at airports across the country. Trends in visibility impairment can be inferred from these long-term records of visual range. Figure 3-2 describes long-term U.S. visibility impairment trends derived from such data.[2] The maps show the amount of haze during the summer months of 1970, 1980, and 1990. The dark blue color represents the best visibility, and red represents the worst visibility. Overall, these maps show that summer visibility impairment in the eastern United States increased greatly between 1970 and 1980, and decreased slightly between 1980 and 1990. These trends follow overall trends in emissions of sulfur oxides during these periods.

Recent Trends in Rural Areas: 1988–1995

Aerosol and light extinction data have been collected for eight consecutive years (1988–1995) at 30 sites in the IMPROVE network (see Figure 3-3). Of

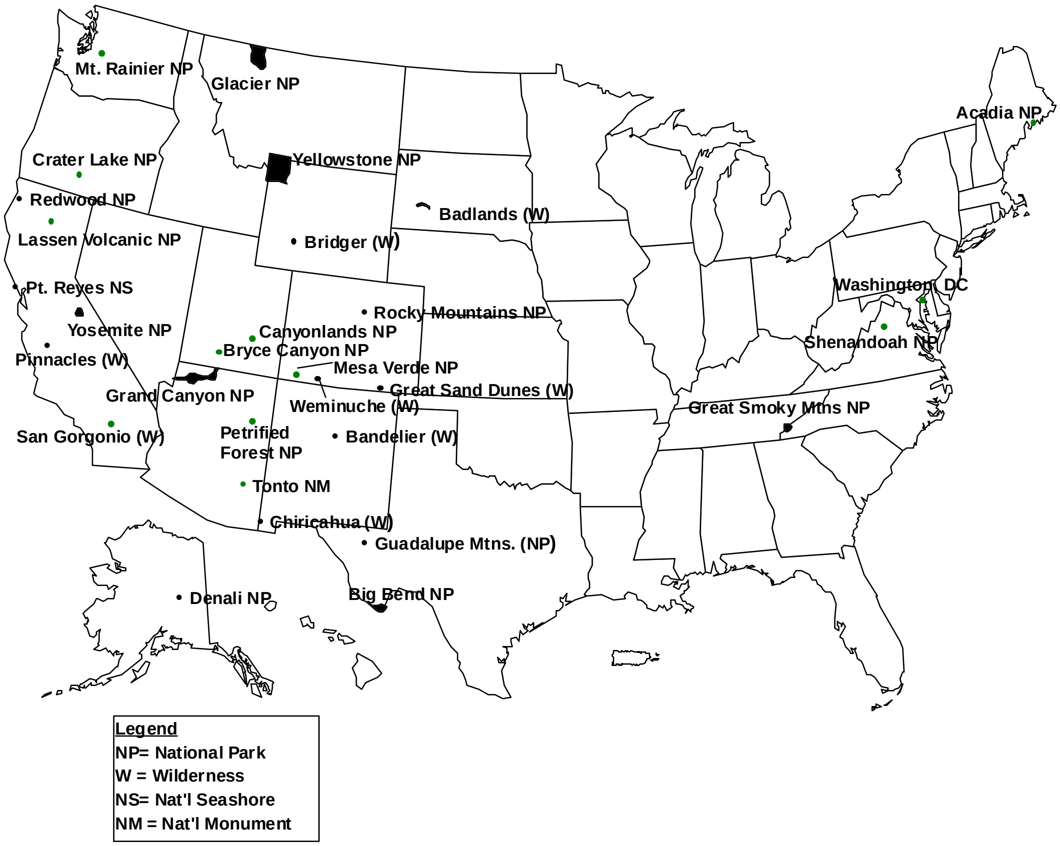


Figure 3-3. IMPROVE visibility monitoring network 30 sites with data for the period 1988–present.

these 30 sites, Washington, DC is the only urban location. The remaining 29 represent rural Class I areas: three are located in the East (Acadia National Park, Maine; Shenandoah National Park, Virginia; and Great Smoky Mountains National Park, Tennessee), and 26 are located in the West. Because of the significant regional variations in visibility conditions, this section does not look at aggregate national trends, but groups existing sites into eastern and western regions. As noted earlier, the values representing the "best" and "worst" days are presented in addition to median values. For the purposes of this report, these terms correspond to the 10th, 50th and 90th percentiles.

Regional Trends

Figures 3-4a and 3-4b illustrate eastern and western trends for total light extinction. These figures indicate that, in general, aerosol light extinction for the best days (10th percentile) and median days (50th percentile) showed downward trends over the eight-year period for both eastern and western regions, indicating overall improvement in visibility. Reductions of light extinction between 1988 and 1995 for the best and median days ranged from 9–20 percent in the east and 10–30 percent in the West. The East showed a degradation of visibility with a 6-percent increase in light extinction for the worst days (90^{th} percentile), whereas western sites, on the other hand, showed general improvement.

Figures 3-5 and 3-6 show eastern and western trends in light extinction due to sulfate and light extinction due to organic carbon. Light extinction due to organic carbon dropped significantly between 1988 and 1995 for the 10th, 50th, and 90th percentile values in both the eastern (24–47 percent) and western regions (30–52 percent). Sulfate light extinction, on the other hand, was much more variable in both regions. Seasonal averages for light extinction due to sulfate over the 1988–1995 time period generally increased in the summer. In the East, light extinction due to sulfate in 1995 shows a 21-percent increase from 1988 levels for the worst visibility days, but median sulfate extinction shows a 7-percent improvement for the same period, with lowest levels occurring in 1994 and 1995. In the West, it appears that sulfate extinction increased between 6–9 percent between 1988 and 1995 for the median and worst visibility days, although gradual improvements are seen after levels peaked in 1992. Note that the vertical scales for Figures 3-3 to 3-6 have been altered to better view trends, since light extinction due to sulfate is much greater in the East.

Figures 3-7a and 3-7b show the relative contribution to median (50th percentile) eastern and western aerosol light extinction, respectively, for the five principal constituents measured at IMPROVE sites. These graphs illustrate that sulfate, organic carbon, and elemental carbon are the largest contributors to aerosol light extinction, with sulfate playing a larger role in the East and West. Nationally, light extinction from sulfate, nitrate, and soil dust appear to have remained fairly constant over the eight-year period, while organic carbon and elemental carbon appear to be declining.

Class I Area Trends. IMPROVE data from 30 Class I area monitoring sites in place from 1988–1995 were analyzed using a nonparametric regression methodology described in Chapter 7, Metropolitan Area Trends. Trends are reported in Table A-12 according to their significance, upward or downward, or as not significant.

Table 3-1 summarizes the trends analysis performed on these 30 sites for total light extinction (expressed in deciviews), light extinction due to sulfate, and light extinction due to organic carbon. Because of the importance of tracking progress in the entire distribution of visibility conditions, trends in the 10th, 50th, and 90th percentile values were analyzed. No sites were found to have statistically significant upward trends for any of the parameters evaluated. Several sites, however, did have positive slopes for various parameters, indicating some degree of an upward trend.

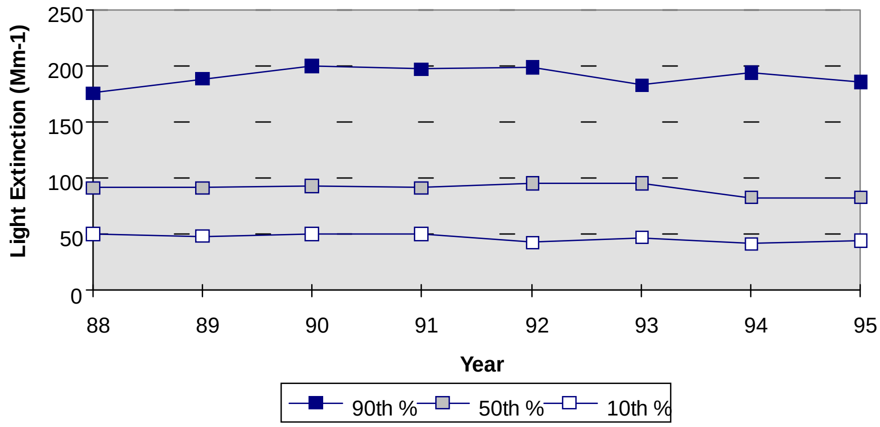


Figure 3-4a. Total light extinction trends for eastern Class I areas.

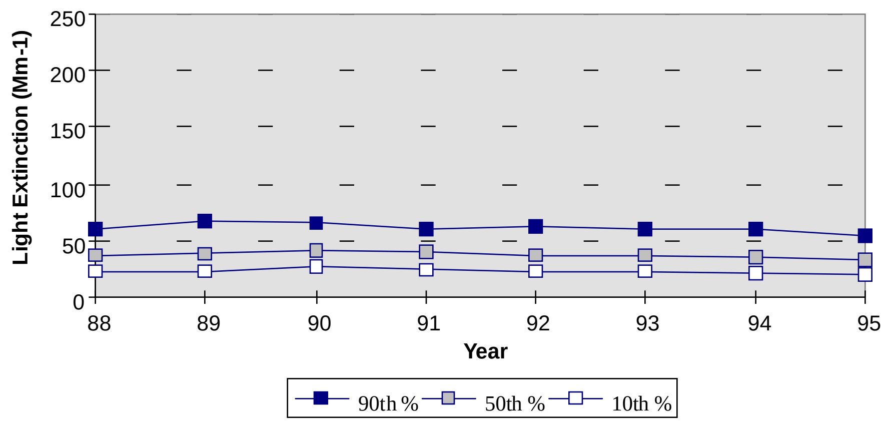


Figure 3-4b. Total light extinction trends for western Class I areas.

On an annual average basis, about one-third have significant downward trends in deciviews. Only one site had a downward trend for sulfate, whereas close to 20 of the 30 sites have a downward trend for organic carbon.

Fewer sites were found to have significant trends in hazy day conditions than for the cleanest days. Only five sites showed significant downward trends in deciviews for the haziest days, whereas one-third to two-thirds of the sites showed significant trends for the cleanest days. Many more sites had significant downward trends in organic carbon light extinction than for sulfate light extinction.

Although the nonparametric analysis described above does not reveal any sites with significant upward trends in visibility impairment, a review of annual data plotted for each site shows several sites that should be monitored closely for gradual upward trends for either the best, median, or worst days. Table 3-2 lists those sites which may be of potential concern.

Current Conditions

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 higher estimated background levels of $PM_{2.5}$ particles in the East, and the more significant effect of relative humidity on particle concentrations in the East than in the West. Current annual average conditions range from about 18–40 miles in the rural East and about 35–90 miles in the rural West.

Figure 3-8 illustrates annual average visibility impairment in terms of light extinction captured at IMPROVE sites between 1992 and 1995. The pie charts show the relative contribution of different particle constituents to visibility impairment. Annual average total light extinction due to these particles is indicated by the value next to each pie and by the size of each pie.[4]

Figure 3-8 also shows that visibility impairment is generally greater in the rural East compared to most of the West. In the rural East, sulfates account for about 50–70 percent of annual average light extinction. Sulfate plays a particularly significant role in the humid summer months, most notably in the Appalachian, northeast, and mid-south regions. Nitrates and organic and elemental carbon all account for between 10–15 percent of total light extinction in most Eastern locations.

In the rural West, sulfates also play a significant role, accounting for about 25–40 percent of total light extinction in most regions. Sulfates, however, account for over 50 percent of annual average light extinction in the Cascades of Oregon. Organic carbon typically is responsible for 15–35 percent of total light extinction in the rural West, elemental carbon (absorption) accounts

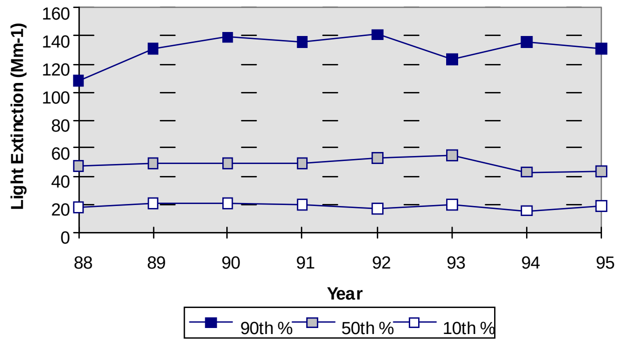


Figure 3-5a. Light extinction due to sulfate in eastern Class I areas.

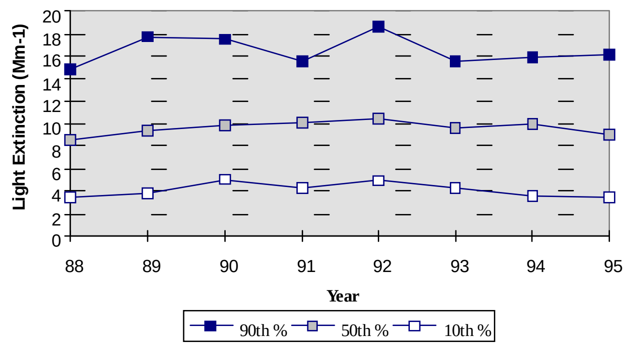


Figure 3-5b. Light extinction due to sulfate in western Class I areas.

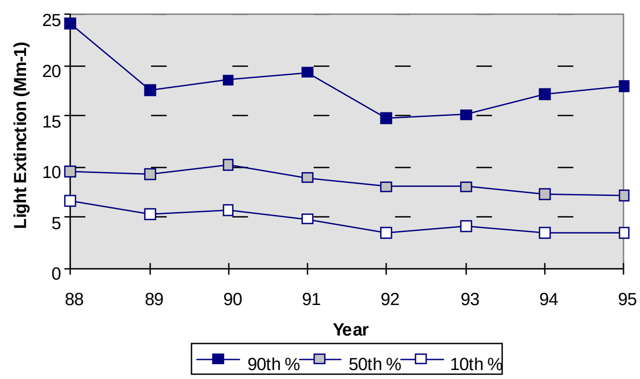


Figure 3-6a. Light extinction due to organic carbon in eastern Class I areas.

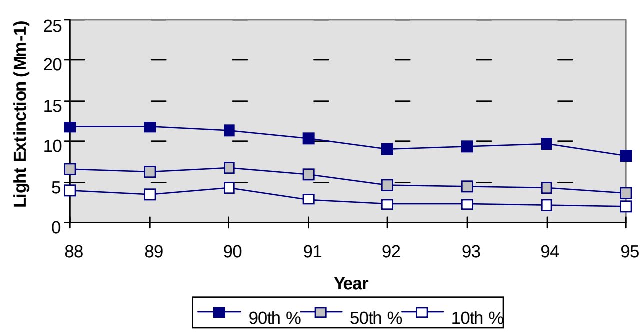


Figure 3-6b. Light extinction due to organic carbon in western Class I areas.

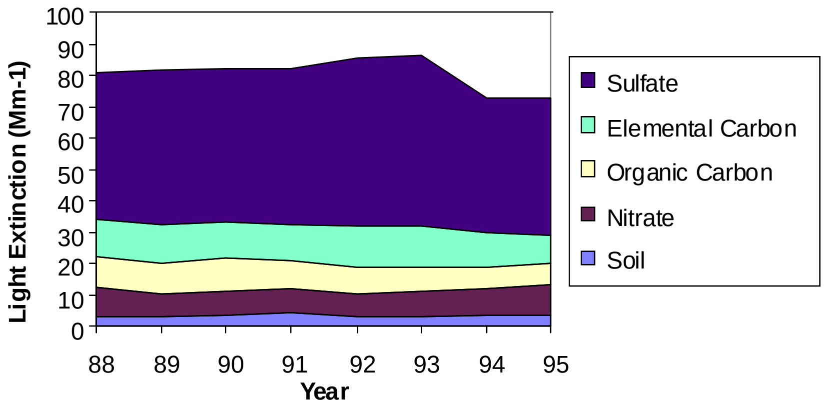


Figure 3-7a. Average aerosol light extinction in eastern Class I areas.

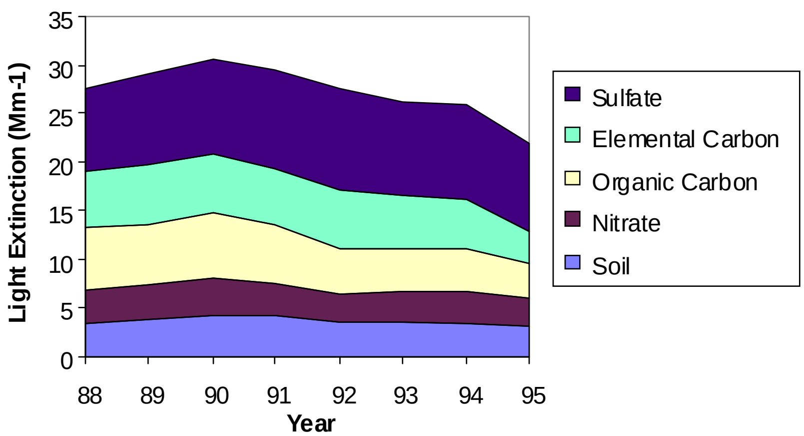


Figure 3-7b. Average aerosol light extinction in western Class I areas.

for about 15–25 percent, and soil dust (coarse PM) accounts for about 10–20 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 almost 40 percent.

Figure 3-9 also illustrates annual average visibility impairment from IMPROVE data for 1992–1995, expressed in deciviews.[4] Note that the deciview scale is more compressed than the scale for 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 impairment of 12 deciviews or less, whereas many rural locations in the East have values exceeding 23 deciviews.

One key to understanding visibility effects is understanding 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 3-10, which characterizes visibility at Shenandoah National Park under a range of conditions.[5] A clear day at Shenandoah can be represented by a visual range of 80 miles, 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, and is the result of an additional 10μg / m^3 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 10μg / m^3 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 larger 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.

Programs to Improve Visibility

In the recent review of the particulate matter NAAQS, EPA concluded that the most appropriate way of addressing visibility effects associated with PM was to establish secondary standards for PM equivalent to the suite of primary standards in conjunction with establishment of a new regional haze program. In July 1997, EPA proposed a new regional haze program to address visibility impairment in national parks and wilderness areas caused by numerous sources located over broad regions. The proposed program takes into consideration recommendations from the National Academy of Sciences, the Grand Canyon Visibility Transport Commission, and a Federal Advisory Committee on Ozone, Particulate Matter, and Regional Haze Implementation

Programs. The proposal lays out a framework within which states are to conduct regional planning and develop implementation plans which are to achieve “reasonable progress” toward the national visibility goal of no human-caused impairment. Because of the common precursors and the regional nature of the ozone, PM, and regional haze problems, EPA is developing these implementation programs together to integrate future planning and control strategy efforts to the greatest extent possible. Implementation of the NAAQS in conjunction with a future regional haze program is anticipated to improve visibility in urban and rural areas across the country.

Other air quality programs are expected to lead to emissions reductions that will improve visibility in certain regions of the country. The Acid Rain program is designed to achieve significant reductions in sulfur oxide emissions, which is expected to reduce sulfate haze particularly in the eastern United States. Additional control programs on sources of nitrogen oxides to reduce formation of ozone can also improve regional visibility conditions. In addition, the NAAQS, mobile source, and woodstove programs to reduce fuel combustion and soot emissions can benefit areas adversely impacted by visibility impairment due to sources of organic and elemental carbon.

Table 3-1. Summary of Class I Area Trend Analysis

PARAMETER	Sites with Significant Downward Trend	Sites with Significant Upward Trend
Deciviews, average days	8	0
Deciviews, clean days	11	0
Deciviews, hazy days	5	0
Extinction due to sulfate, average days	1	0
Extinction due to sulfate, clean days	1	0
Extinction due to sulfate, hazy days	0	0
Extinction due to organic carbon, average days	26	0
Extinction due to organic carbon, clean days	27	0
Extinction due to organic carbon, hazy days	12	0

Table 3-2. IMPROVE Sites With Potential Upward Trends

Best Days (10th Percentile)	Median Days (50th Percentile)	Worst Days (90th Percentile)
Weminuche	Crater Lake	Acadia
	Great Smoky Mountains	Badlands
	Mount Rainier	Big Bend
	Washington, DC	Chiricahua
	Yosemite	Crater Lake
		Glacier
		Great Smoky Mountains
		Point Reyes
		Shenandoah
		Washington

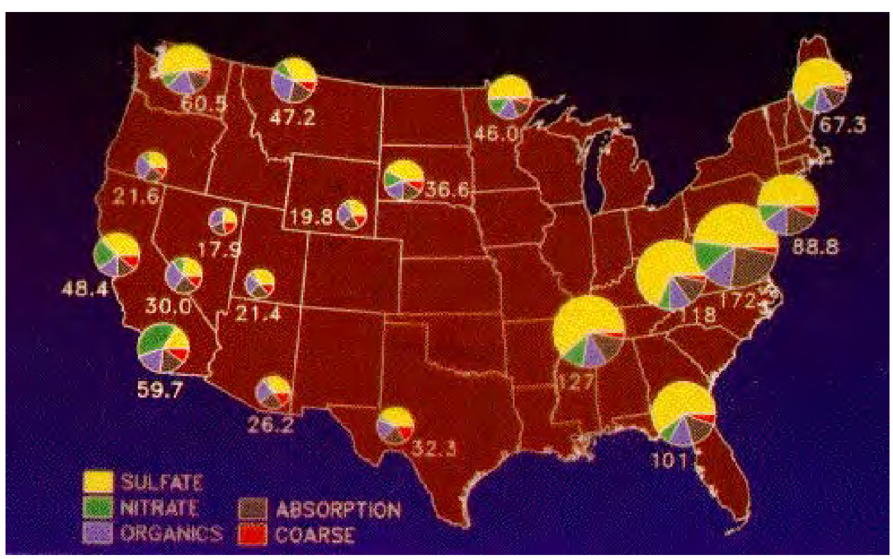


Figure 3-8. Annual average light extinction (Mm^{-1}), 1992–1995 IMPROVE data.

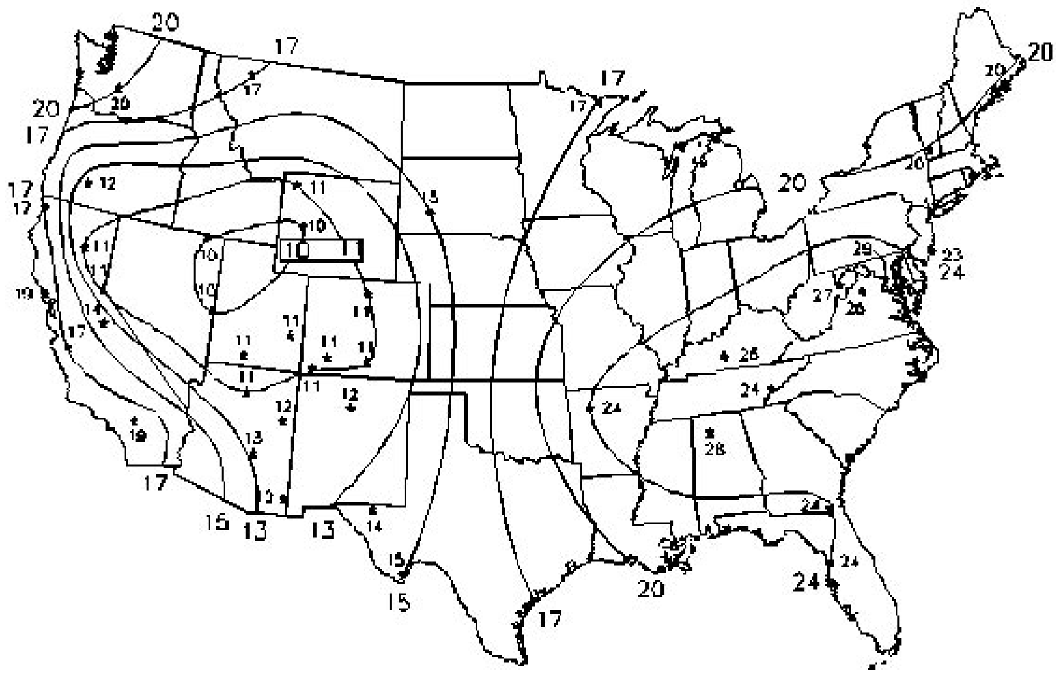


Figure 3-9. Annual average visibility impairment in deciviews relative to pristine conditions of deciviews = 0, 1992–1995 IMPROVE data.

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

References

1. Images were created with WinHaze Software, John Molenar, Air Resource Specialists, Inc., Fort Collins, Colorado 80525.

2. R.B. Husar, J.B. Elkins, W.E. Wilson, "U.S. Visibility Trends, 1906–1992," Air and Waste Management Association 87th Annual Meeting and Exhibition, Cincinnati, OH, 1994.

3. Irving, Patricia M., e.d., *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. Sisler, J. *Spatial and Seasonal Patterns and Long-Term Variability of the Composition of the Haze in the United States: An Analysis of Data from the IMPROVE Network*. Colorado State University, Cooperative Institute for Research in the Atmosphere. Fort Collins, CO., 1996.

5. Cooperative Institute for Research in the Atmosphere (CIRA), Colorado State University, Fort Collins, CO.

Chapter 4

PAMS: Enhanced Ozone & Precursor Monitoring

Background

Of the six criteria pollutants, ozone is the most pervasive. The most prevalent photochemical oxidant and an important contributor to "smog," ozone is unique among the criteria pollutants because it is not emitted directly into the air. Instead, it results from complex chemical reactions in the atmosphere between VOCs and NO_x in the presence of sunlight. There are thousands of sources of VOCs and NO_x located across the country. To track and control ozone, EPA must create an understanding of not only the pollutant itself, but the chemicals, reactions, and conditions that contribute to its formation as well.

Section 182(c)(1) of the CAA called for improved monitoring of ozone and its precursors, VOC and NO_x, to obtain more comprehensive and representative data on ozone air pollution. Responding to this requirement, EPA promulgated regulations to initiate the Photochemical Assessment Monitoring Stations (PAMS) program in February 1993. The PAMS program requires the establishment of an enhanced monitoring network in all ozone nonattainment areas classified as serious, severe, or extreme. The 21 affected ozone areas listed in Table 4-1 have a total population of 78 million. Although only encompassing 18 percent of the total number of original ozone nonattainment areas, PAMS areas account for 79 percent of the total number of nonattainment area ozone exceedance days, as seen in Figure 4-1.

Network Requirements

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. Each PAMS network generally consists of four different monitoring sites (Types 1, 2, 3, and 4) designed to fulfill unique data collection objectives.

- The Type 1 sites are located upwind of the metropolitan area to measure ozone and precursors being transported into the area.
- The Type 2 sites are referred to as maximum precursor emissions impact sites. As the name implies, they are designed to collect data on the type and magnitude of ozone precursor emissions emanating from the metropolitan area. Type 2 sites are typically located immediately downwind of the central business district and operate according to a more intensive monitoring schedule than other PAMS stations. Type 2 sites also measure a greater array of precursors than other PAMS sites and are suited for the evaluation of

Table 4-1. Metropolitan Areas Requiring PAMS

EXTREME	
1.	Los Angeles-South Coast Air Basin, CA[1]
SEVERE	
2.	Baltimore, MD
3.	Chicago-Gary-Lake County (IL), IL-IN-WI[2]
4.	Houston-Galveston-Brazoria, TX
5.	Milwaukee-Racine, WI[2]
6.	New York-New Jersey-Long Island, NY-NJ-CT
7.	Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD
8.	Sacramento, CA
9.	SE Desert Modified AQMA, CA[1]
10.	Ventura County, CA
SERIOUS	
11.	Atlanta, GA
12.	Baton Rouge, LA
13.	Boston-Lawrence-Worchester, MA-NH
14.	Greater Connecticut, CT
15.	El Paso, TX
16.	Portsmouth-Dover-Rochester, NH-E
17.	Providence-Pawtucket-Fall River, I-MA
18.	San Diego, CA
19.	San Joaquin Valley, CA
20.	Springfield, MA
21.	Washington, DC-MD-VA

1. Los Angeles-South Coast and SE Desert Modified AQMA are combined into one PAMS area referred to as South Coast / SEDAB.
2. Chicago and Milwaukee are combined into one PAMS area referred to as Lake Michigan.

urban air toxics. For larger nonattainment areas, a second Type 2 site is required in the second-most predominant wind direction.

- The Type 3 stations are intended to measure maximum ozone concentrations and are sited farther downwind of the urban area than the Type 2 sites.
- The Type 4 PAMS sites are located downwind of the nonattainment area to assess ozone and precursor levels exiting the area and potentially contributing to the ozone problem in other areas.

In addition to the surface monitoring sites described above, each PAMS area also is required to monitor upper air meteorology at one representative site. Regulations allow a 5-year transition or phase-in schedule for the program at a rate of at least one station per area per year. The first official year of implementation for PAMS was 1994. As of September 1997, there were 75 operating PAMS sites.

Monitoring Requirements

The data collected at the PAMS sites include measurements of ozone, NO_x, a target list of VOCs (including several carbonyls, see Table 4-2), plus surface and upper air meteorology. Most PAMS sites measure 56 target hydrocarbons on an hourly or 3-hour basis during the PAMS monitoring season. The Type 2 sites also collect data on three carbonyl compounds (formaldehyde, acetaldehyde, and acetone). Included in the monitored VOC species are 10 compounds classified as hazardous air pollutants (HAPs). The PAMS program is the only federally mandated initiative that requires routine monitoring of HAPs; for more information on HAPs see Chapter 5, "Air Toxics." All PAMS stations measure ozone,

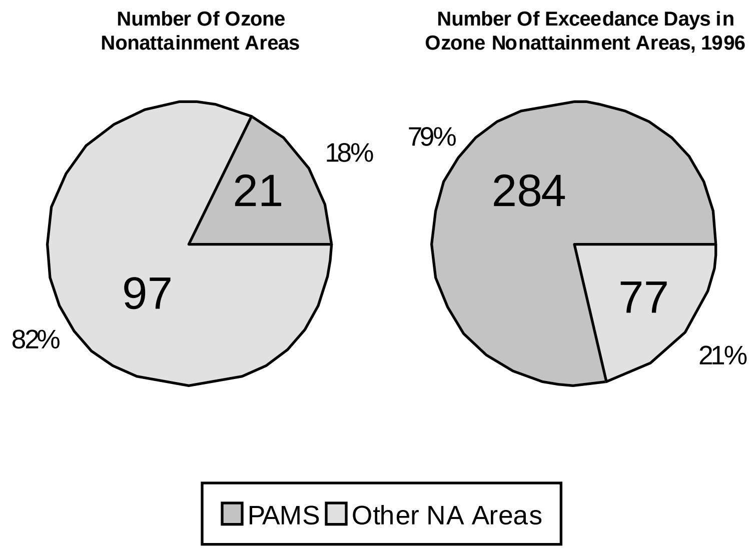


Figure 4-1. PAMS percent of total number of ozone nonattainment areas and 1996 ozone exceedance days (total number of original classified and section 185a ozone nonattainment areas = 118; total number of 1996 exceedance days in original nonattainment areas = 361.)

Table 4-2. PAMS Target List of VOCs

Hydrocarbons		
Ethylene	2,3-Dimethylbutane	3-Methylheptane
Acetylene	2-Methylpentane	n-Octane
Ethane	3-Methylpentane	*Ethylbenzene
Propylene	2-Methyl-1-Pentene	*m&p-Xylenes
Propane	*n-Hexane	*Styrene
Isobutane	Methylcyclopentane	*o-Xylene
1-Butene	2,4-Dimethylpentane	n-Nonane
n-Butane	*Benzene	Isopropylbenzene
t-2-Butene	Cyclohexane	n-Propylbenzene
c-2-Butene	2-Methylhexane	m-Ethyltoluene
Isopentane	2,3-Dimethylpentane	p-Ethyltoluene
1-Pentene	3-Methylhexane	1,3,5-Trimethylbenzene
n-Pentane	*2,2,4-Trimethylpentane	o-Ethyltoluene
Isoprene	n-Heptane	1,2,4-Trimethylbenzene
t-2-Pentene	Methylcyclohexane	n-Decane
c-2-Pentene	2,3,4-Trimethylpentane	1,2,3-Trimethylbenzene
2,2-Dimethylbutane	*Toluene	m-Diethylbenzene
Cyclopentane	2-Methylheptane	p-Diethylbenzene
		n-Undecane
Carbonyls		
*Formaldehyde	Acetone	*Acetaldehyde
	*Hazardous Air Pollutants	

NO_x, and surface meteorological parameters on an hourly basis. In general, the PAMS monitoring season spans the three summer months when weather conditions are most conducive for ozone formation. EPA allows states flexibility in network design and sampling plans in recognition of the fact that each PAMS area has its own unique characteristics and demands.

Program Objectives

EPA believes that data gathered by PAMS will greatly enhance the ability of state and local air pollution control agencies to effectively evaluate ozone nonattainment conditions and identify cost-effective control strategies. The Agency also anticipates that the measurements will be of substantial value in verifying ozone precursor emissions inventories and in corroborating estimates of area-wide emissions reductions. The data will be used by states to evaluate, adjust, and provide input to the photochemical grid models used to develop ozone control strategies, as well as demonstrate their success. PAMS will provide information to evaluate population risk exposure, expand the data base available to confirm attainment/nonattainment decisions, and develop ozone and ozone precursor trends.

EPA is extremely committed to the analysis and interpretation of PAMS data. Federal grant funds are allocated annually to state, local, and consolidated environmental agencies for data characterization and analysis. Extensive in-house PAMS analyses are also being performed at EPA. There are a number of tools and techniques available for PAMS analysis; EPA continues to develope and refine these tools as well as coordinate workshops and training. A new PAMS web site (http://www.epa.gov/oar/oaqps/pams) has been introduced to help disseminate PAMS analysis-related information as well as general program material.

VOC Characterization

As previously mentioned, each PAMS area has its own unique characteristics. Although the mix of VOC emission point sources affecting PAMS areas vary significantly by area, there are some mobile and area VOC emission sources that are common to all. These sources produce similarities in the overall composition of VOC in the ambient area. Table 4-3 shows 1996 composite rankings for 45 reporting sites of 6–9 am mean concentrations (in parts per billion Carbon [ppbC]) of the PAMS VOC target list. Morning hours are generally considered an appropriate indicator for VOC emissions since emission source activity is high and photochemical reactivity and mixing heights are still low. On average, the top 10 compounds at each site accounted for about 65 percent of the total targeted ppbC.

Though all the PAMS-targeted VOCs (as well as additional reactive sources of carbon) contribute to the formation of ozone, each VOC reacts at a different rate and with different reaction mechanisms. Ozone yield for a VOC depends significantly on the conditions within the polluted atmosphere in which it reacts, such as VOC to NO_x ratio, VOC composition, and sunlight intensity. Although faster reacting VOCs may produce more ozone in a shorter time period than do slower reacting ones (under similar conditions), the ozone yields may be more comparable when viewed over a longer time span. How this affects a particular locality would depend on weather patterns and the possibility of stagnant air masses developing. Since 1977, EPA's reactivity policy has been to define as VOCs subject to air pollution regulation all organic compounds which participate in atmospheric photochemical reactions, except certain compounds that EPA has defined as having negligible reactivity. These negligibly reactive compounds are not considered to be VOC for regulatory purposes. Two PAMS target compounds, ethane and acetone, are in this group. With the exception of the negligibly reactive compounds, all VOCs are required to be controlled equally. An alternative approach to ozone forming potential was developed by Dr. William Carter of the University of California. In 1994, Carter published a set of "ozone forming potential" factors known as the Maximum Incremental Reactivity (MIR) scale.[1] Carter's MIR factors were derived by adjusting the NO_x concentration in the base case scenario to yield the highest incremental reactivity for each evaluated VOC; the factors also were based on ozone yields produced per single day of sunlight exposure. Carter's MIR technique was adapted by the State of California in setting automotive emissions standards. Applying Carter's MIR factors to the means used in Table 4-3 changes the relative ranking and conditional importance of the PAMS target list. The overall top 10 reactivity-weighted compounds (using Carter's MIR factors) at operating PAMS sites in 1996 were: formaldehyde; ethylene; m&p-xylenes; propylene; toluene; isopentane; acetaldehyde; 1,2,4-trimethylbenzene o-xylene; and isoprene. These 10 compounds accounted for approximately 70 percent of the total PAMS targeted ozone-forming potential.

Trends

Between 1995 and 1996, the number of ozone NAAQS exceedance days in PAMS areas declined 26 percent; be-

Table 4-3. PAMS Targeted VOCs Ranked by Mean 6–9 am Concentration, Summer 1996

Parameter	AIRS Code	Rank	# of Sites Reporting
Propane	43204	1	49
Isopentane	43221	2	51
Ethane	43202	3	49
Toluene	45202	4	53
n-Butane	43212	5	53
n-Pentane	43220	6	53
Ethylene	43203	7	49
Formaldehyde	43502	8	22
Acetone	43551	9	21
m&p-Xylenes	45109	10	53
Benzene	45201	11	53
2-Methylpentane	43285	12	53
Acetylene	43206	13	49
Isobutane	43214	14	52
2,2,4-Trimethylpentane	43250	15	53
Isoprene	43243	16	53
n-Hexane	43231	17	53
Propylene	43205	18	49
3-Methylpentane	43230	19	53
Acetaldehyde	43503	20	22
1,2,4-Trimethylbenzene	45208	21	53
o-Xylene	45204	22	53
3-Methylhexane	43249	23	53
Ethylbenzene	45203	24	53
Methylcyclopentane	43262	25	53
1,2,3-Trimethylbenzene	45225	26	44
2,3-Dimethylbutane	43284	27	53
2-Methylhexane	43263	28	53
n-Heptane	43232	29	53
2,3-Dimethylpentanane	43291	30	53
n-Undecane	43954	31	51
n-Decane	43238	32	51
m-Ethyltoluene	45212	33	46
2,3,4-Trimethylpentane	43252	34	53
Methylcyclohexane	43261	35	53
1-Butene	43280	36	50
p-Ethyltoluene	45213	37	46
Cyclopentane	43242	38	51
n-Octane	43233	39	53
2,4-Dimethylpentane	43247	40	53
1-Pentene	43224	41	53
Styrene	45220	42	53
2,2-Dimethylbutane	43244	43	53
1,3,5-Trimethylbenzene	45207	44	53
Cyclohexane	43248	45	53
n-Nonane	43235	46	53
o-Ethyltoluene	45211	47	46
t-2-Pentene	43226	48	50
3-Methylheptane	43253	49	53
n-Propylbenzene	45209	50	53
2-Methylheptane	43960	51	53
2-Methyl-1-Pentene	43246	52	52
p-Diethylbenzene	45219	53	44
t-2-Butene	43216	54	50
m-Diethylbenzene	45218	55	44
c-2-Butene	43217	56	50
c-2-Pentene	43227	57	50

tween 1994 and 1996 the number dropped by 21 percent. Table 4-4 shows the counts by individual area. Average summer daily ozone maxima declined 8 percent between 1995 and 1996 and 3 percent between 1994 and 1996. A summary of the 2-year and 3-year changes for ozone, selected VOCs, and NO_x is shown in Table 4-5. Meteorologically adjusted ozone trends have been steadily declining across the United States in the past 10 years as seen in Figure 2-21 of Chapter 2.[2] Meteorological-adjusted ozone concentrations appear to be declining faster in the PAMS areas than elsewhere, especially in the last two years. Of the 41 MSAs evaluated with the referenced EPA adjustment technique ("Cox-Chu"), 18 of the MSAs correspond fairly well to PAMS areas. In Figure 4-3, data for those 18 areas are contrasted with the 23 non-PAMS areas. Meteorologically adjusted ozone concentrations are, most likely, declining as a result of VOC emissions controls.

For the second consecutive year, many PAMS sites showed significant reductions in total VOC and "key" ozone precursors. (Although a certain amount of caution should be exercised in using relative VOC reactivity rankings, this section does focus somewhat on the top 10 reactivity-weighted compounds mentioned in the previous section as computed using Carter's MIR technique. Space limitations of this report prohibit inclusion of a more comprehensive summary.) Ambient levels of total VOC declined by around 15 percent between 1995 and 1996 (16 percent for "All Reported Hours" and 14 percent for "6:00–9:00 am"). This change corroborates well with emissions inventory data. Aggregate VOC emissions inventory estimates for the 21 PAMS nonattainment areas showed a drop of 12 percent between 1995 and

Table 4-4. Number of Ozone NAAQS Exceedance Days, by PAMS Area

Area	1994	1995	1996
Los Angeles-South Coast Air Basin, CA	118	98	85
Baltimore, MD	10	13	4
Baton Rouge, LA	4	11	4
Chicago-Gary-Lake County (IL), IL-IN-WI	2	4	5
Houston-Galveston-Brazoria, TX	24	48	26
Milwaukee-Racine, WI	3	5	2
New York-New Jersey-Long Island, NY-NJ-CT	11	16	9
Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD	8	11	5
San Diego, CA	9	12	2
SE Desert Modified AQMA, CA	81	43	45
Ventura County, CA	17	23	17
Atlanta, GA	3	13	7
Boston-Lawrence-Worchester, MA-NH	3	5	2
Greater Connecticut, CT	5	10	2
El Paso, TX	6	4	2
Portsmouth-Dover-Rochester, NH-ME	1	3	0
Providence-Pawtucket-Fall River, RI-MA	1	4	0
Sacramento, CA	6	11	11
San Joaquin Valley, CA	43	42	56
Springfield, MA	3	2	0
Washington, DC-MD-VA	4	6	1
Total PAMS Areas	**362**	**384**	**285**
Total All Ozone Nonattainment Areas[1]	**439**	**557**	**361**

[1]Original classified, unclassified, and section 185a ozone nonattainment areas.

1996. Of the 11 evaluated VOCs, only m&p-xylenes had a median site percent change increase between 1995 and 1996 ("All Reported Hours" and "6:00–9:00 am"); the median percent changes showed declines for all other parameters. Benzene, another VOC though not a major ozone precursor, is also highlighted in Table 4-5 as a follow-on to last year's analysis which showed a significant 1994–1995 reduction in benzene and other mobile-related VOC concentrations as a possible result of federally mandated RFG. Federally mandated RFG was implemented in most PAMS areas at the beginning of 1995. The 1995–1996 reductions in benzene and other mobile-related VOC concentrations were not quite as large as those seen from 1994 to 1995. Average benzene concentrations declined by a median 38 percent in 1995—the first year of the RFG program—as compared to an 8-percent reduction in 1996. This smaller reduction in 1996 was not only expected since RFG was in place in both 1995 and 1996, but it supports the supposition that RFG contributed to the significant emission reductions between 1994–1995. The Office of Mobile Sources (OMS) is currently sponsoring an analysis of PAMS data to help verify the contribution of RFG to the large emissions reductions in 1995. For more information on benzene, see Chapter 5.

Between 1994 and 1996, the number of sites with significant declines outnumber the sites showing increases for all 11 highlighted VOCs. Like ozone, annual variations in VOC concentrations can result from changes in meteorological conditions. Nationwide, the summer of 1996 was cooler than the summer of 1994 and wetter than the summer of 1995, especially in some of the regions where many PAMS sites are located (e.g., Northeast and the South).[3] Hot and dry conditions are more conducive for photochemistry and thus, secondary production of VOCs, than are cool and wet conditions. Ambient concentrations of isoprene, a VOC of predominantly biogenic origin, are particularly sensitive to meteorological factors. Some of the VOC reductions seen between 1994 and 1996 and between 1995 and 1996 may, therefore, be explained by differing meteorological conditions. However, the large reductions seen since 1994 are too large to be credible without some human intervention (i.e., anthropogenic emissions reductions). The NO_x concentration changes were fairly mixed over the three years evaluated. Between 1995 and 1996, reporting PAMS sites showed a median increase of 3 percent in daily concentrations and a 1-percent increase in 6–9 am levels. Between 1994 and 1996, NO_x concentrations declined 6 percent.

NO_x Versus VOC

Although the highlighted VOCs (minus benzene) shown in Table 4-5 have the highest (MIR method) ozone-forming potential overall at reporting PAMS sites, a blanket reduction in these compounds may not necessarily reduce ozone levels. Sometimes NO_x reductions as opposed to VOC reductions will contribute more to reducing ozone concentrations. Ozone concentrations are sensitive to shifts in the relative abundance of VOC and NO_x. In addition to local factors of influence (area emissions of VOCs and NO_x, and meteorological conditions), ozone concentrations can be significantly impacted by incoming transported ozone and ozone precursors. This is especially true in the northeastern United States where nonattainment areas lie in close proximity to each other. The PAMS networks are designed with the ability of quantifying the incoming and outgoing transport (i.e., Type 1 and Type 4 sites). The Ozone Transport Assessment Group (OTAG) identified areas that "contribute significantly" to ozone problems in downwind areas. On October 10, 1997 EPA proposed a rule to significantly reduce the transport of NO_x and ozone. For an expanded discussion of the proposed rule, see the Ozone section of Chapter 2.

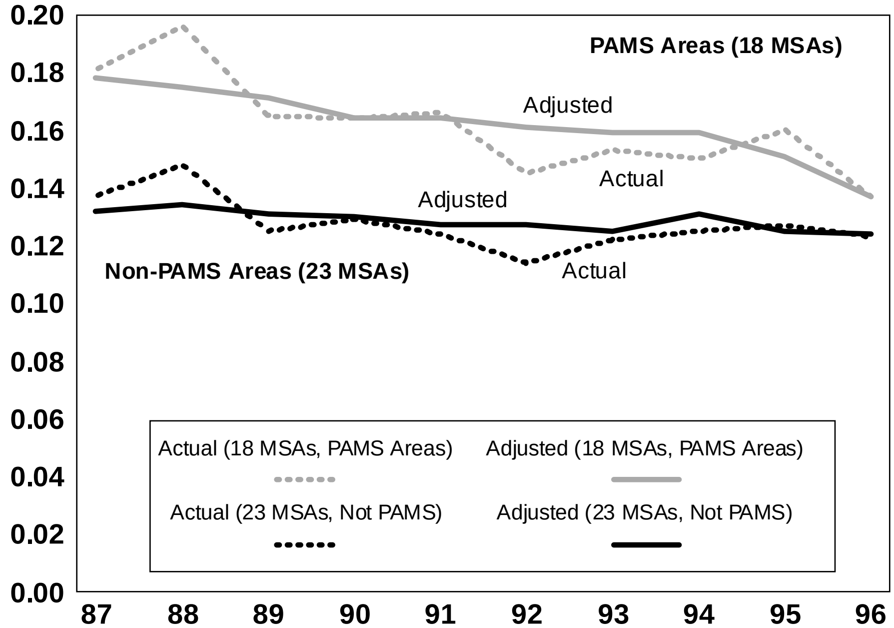


Figure 4-2. Comparison of actual and meteorologically adjusted ozone trends—PAMS metropolitan areas versus non-PAMS areas, 1987–1996 (composite average of 99th percentile 1-hr. daily max. conc.)

Summary

The PAMS networks produce a myriad of information invaluable to the development and evaluation of ozone control strategies and programs. A few examples include: VOC to NO_x ratios helpful for deciding what type of controls to seek; upper air and surface meteorological data capable of identifying transport trajectories; inter-species (benzene / toluene, xylene / toluene) components sufficient to quantify airmass aging; inputs to statistical models (regression and neural network analysis) capable of forecasting high ozone concentrations and identifying vital VOC species; and continuous speciated detail useful for corroborating inventories and validating photochemical models (for detailed discussion of these topics, see the Data Analysis Support section of the PAMS web site). Further, the networks will provide long-term perspectives on changes in atmospheric concentrations of ozone and its precursors, provide information to evaluate population exposure, and most importantly, deliver a more complete understanding of the complex problem of ozone so that we can continue to develop strategies to reduce ozone concentrations and thereby protect public health and welfare.

References

1 W.P.L Carter (1994), *Development of Ozone Reactivity Scales for Volatile Organic Compounds*, J. Air & Waste Manage. Assoc. 44:881-899.

2. 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.

3. D.T. Bailey, "Summer 1997 in Perspective," http://www.epa.gov/oar/oaqps/pams/summer97.pdf, 1997.

Table 4-5. Summary of Changes in Summer Mean Concentrations for Ozone, NO_x, and Selected VOCs, 1995–1996 and 1994–1996

2-Year Change, 1995 to 1996

Parameter	All Reported Hours: # of Sites Total	#Up	#Down	Median Change	6:00 to 9:00 am: # of Sites Total	#Up	#Down	Median Change
Ozone (44201)—Avg. Daily Max.	66	3	30	-8%	—	—	—	—
Oxides of Nitrogen (42603)	51	24	18	3%	51	18	17	1%
Total NMOC (43102)	32	9	16	-16%	32	6	14	-14%
Ethylene (43203)	39	13	12	-4%	39	11	10	-2%
Propylene (43205)	39	10	16	-1%	39	10	13	-2%
Isopentane (43221)	36	9	10	-1%	36	8	5	-3%
Isoprene (43243)	39	8	22	-22%	39	4	15	-15%
Formaldehyde (43502)	18	1	13	-28%	18	2	10	-26%
Acetaldehyde (43503)	18	4	10	-10%	18	3	9	-16%
M&P-Xylenes (45109)	38	15	8	9%	38	12	6	2%
Toluene (45202)	39	12	12	0%	39	8	7	-4%
O-Xylene (45204)	39	12	17	-8%	39	10	13	-3%
1,2,4-Trimethylbenzene (45208)	38	10	22	-31%	38	8	17	-23%
Benzene (45201)	39	11	15	-8%	39	8	10	-5%

3-Year Change, 1994 to 1996

Parameter	All Reported Hours: # of Sites Total	#Up	#Down	Median Change	6:00 to 9:00 am: # of Sites Total	#Up	#Down	Median Change
Ozone (44201)—Avg. Daily Max.	54	9	19	-3%	—	—	—	—
Oxides of Nitrogen (42603)	34	12	19	-6%	33	8	13	-6%
Total NMOC (43102)	16	3	11	-28%	15	0	9	-29%
Ethylene (43203)	19	2	13	-26%	16	1	11	-26%
Propylene (43205)	18	2	10	-21%	15	2	7	-8%
Isopentane (43221)	19	1	11	-21%	16	1	10	-28%
Isoprene (43243)	17	4	10	-16%	14	2	8	-28%
Formaldehyde (43502)	7	1	5	-26%	6	0	5	-29%
Acetaldehyde (43503)	7	1	6	-35%	6	1	5	-40%
M&P-Xylenes (45109)	18	2	12	-18%	16	0	11	-34%
Toluene (45202)	19	1	14	-26%	16	0	11	-31%
O-Xylene (45204)	19	2	14	-29%	16	0	13	-34%
1,2,4-Trimethylbenzene (45208)	16	2	10	-35%	14	2	9	-38%
Benzene (45201)	19	2	17	-42%	16	0	13	-44%

1. Note that the terms “#Up” and “#Down” refer to the number of sites in which the change in summer mean concentrations between 1994 and 1995, or 1994 and 1996, is a statistically significant increase or decrease (as determined by a t-test with a significance level of .05). The total number of sites (“Total”) may not necessarily equal the sum of the corresponding “#Up” and “#Down” categories.

2. Data qualifications

   a) Because states are permitted, with EPA consent, to customize their network sampling plans, the “all hours reported” means may not encompass all hours of the day or may encompass different hours from year to year and, therefore, may not be comparable. Annual approved network sampling plans are posted on the PAMS web site. Changes in sampling equipment and / or methods may also contribute to differences in yearly means. Data shown in the “Median Change” column are the medians of the individual site percent changes in summer means for all reporting (“Total”) sites. [Summer means were computed for every sites that reported both years. The year-to-year percent change in these summer means were arrayed by magnitude. The middle value is the “Median Change.”]

   b) Although data submitted to EPA’s Aerometric Information and Retrieval System (AIRS) follow quality assurance procedures, EPA recognizes the complexity of the VOC monitoring and analysis systems and realizes that errors may exist in the database. In general, VOC data quality has been improving over the lifetime of PAMS data.

   c) Measurements of carbonyl compounds (formaldehyde and acetaldehyde) have recently come under enhanced scrutiny at EPA. Development of a carbonyl field audit program is being planned for PAMS in order to help determine the overall quality of carbonyl measurements made for the program. Currently, the National Performance Audit Program (NPAP) does an excellent job in determining the analytical accuracy but an assessment of the field sampling component is also needed.

Chapter 5

Air Toxics

Background

Hazardous air pollutants (HAPs), commonly referred to as air toxics or toxic air pollutants, are pollutants that cause, or may cause, adverse health effects or ecosystem damage. The CAA lists 188 pollutants or chemical groups as hazardous air pollutants in section 112 (b)(1) and targets sources emitting them for regulation.[1] Examples of air toxics include heavy metals like mercury and chromium; organic chemicals like benzene, 1,3-butadiene, perchloroethylene (PERC), dioxins, and polycyclic organic matter (POM); and pesticides such as chlordane and toxaphene.

HAPs are emitted from literally thousands of sources including stationary (large industrial facilities such as utilities and smaller, area sources like neighborhood dry cleaners) as well as mobile sources (automobiles). Adverse effects to human health and the environment due to HAPs can result from exposure to air toxics from individual facilities, exposure to mixtures of pollutants found in urban settings, or exposure to pollutants emitted from distant sources that are transported through the atmosphere over regional, national or even global air sheds. Exposures to HAPs can be either short-term or long-term in nature. In some cases, effects can be seen immediately, such as those rare instances in which there is a catastrophic release of a lethal pollutant, or when a respiratory irritant is regularly released in sufficient levels to cause immediate effects. In other cases, the resulting effects may be experienced from long-term exposure (e.g., from mercury), over a period of several months or years.

In addition to breathing air contaminated with air toxics, people can also be exposed to some HAPs through other, less direct pathways such as through the ingestion of food from contaminated waters. Some air toxics bio-accumulate in body tissues, resulting in predators building up large concentrations from consuming contaminated prey, thereby magnifying up the food chain (i.e., each level accumulates the toxics and passes the burden along to the next level of the food web.) Presently, over 2,100 U.S. water bodies are currently under fish consumption advisories, representing approximately 15 percent of the nation's total lake acreage, and 5 percent of the nation's river miles. In addition, the Great Lakes and a large portion of the U.S. coastal areas are also under fish consumption advisories. Mercury, polychlorinated biphenyls (PCBs), chlordane, dioxins, and dichlorodiphenyltrichloroethane (DDT) and its degradation products: dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD), were responsible for almost 95 percent of all fish consumption advisories in effect in 1996.[2]

Health and Ecological Effects

Compared to information for the criteria pollutants previously described in other chapters, the information concerning potential health effects of the HAPs (and their ambient concentrations) is relatively incomplete. Most of the information on potential health effects of these pollutants is derived from experimental animal data. Enough evidence exists, however, to conclude that air toxics may pose a risk of harmful effects to public health and the environment. Potential health effects resulting from exposure to HAPs include leukemia and other cancers; reproductive and developmental effects such as impaired development in newborns and young children, inability to complete a pregnancy and decreased fertility; and damage to the pulmonary system. Of the 188 HAPs referenced previously, almost 60 percent are classified by EPA as known, probable or possible carcinogens. Nearly 30 percent of the HAPs have some evidence of reproductive or developmental effects (mostly in experimental animal data); about 13 percent are suspected endocrine disruptors; and approximately 60 percent may effect the central nervous system (CNS) and / or create other adverse effects such as irritation of the lungs. The extent to which these effects actually occur in the population depends on a number of factors, including the level and duration of the exposure to the pollutant(s).

Toxic air pollutants can have a number of environmental impacts in addition to the threats they pose to human health. Animals, like humans, may experience health problems if they breathe sufficient concentrations of HAPs over time. Little quantitative information currently exists, however, describing the nature and scope of the effects of air toxics on non-human species. One of the more documented ecological concerns associated with toxic air pollutants is the potential for some to damage aquatic ecosystems. In some cases, deposited air pollutants can be significant contributors to overall pollutant loadings entering water bodies. For the Great Lakes, international workshops have examined the importance of deposition of air toxics, relative to other loadings. While data are presently insufficient for quantitative estimates comparing air deposition and other loading pathways (especially for persistent chemicals which continue to move among air, water, and sediments), deposition of air toxics to the Great Lakes is considered potentially significant and continues to be investigated under a binational monitoring network.[3] A number of studies suggest that deposited air toxics contribute to deleterious effects such as birth defects, reproductive failures, developmental disorders, disease, and premature death in fish and wildlife species native to the Great Lakes. Persistent air toxics are of particular concern in these aquatic ecosystems, as levels bio-accumulate in animals at the top of the food chain resulting in exposure many times higher than that indicated from the water or air.

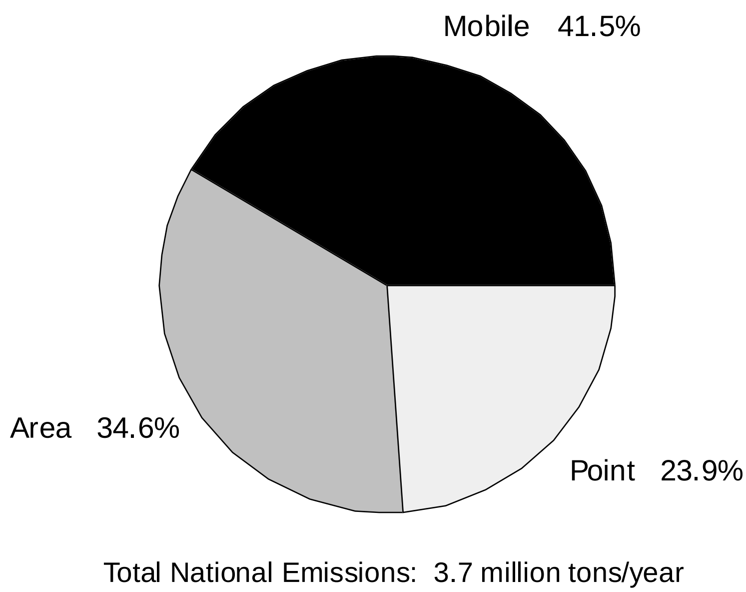


Figure 5-1. Total national HAP emissions by source type, 1993.

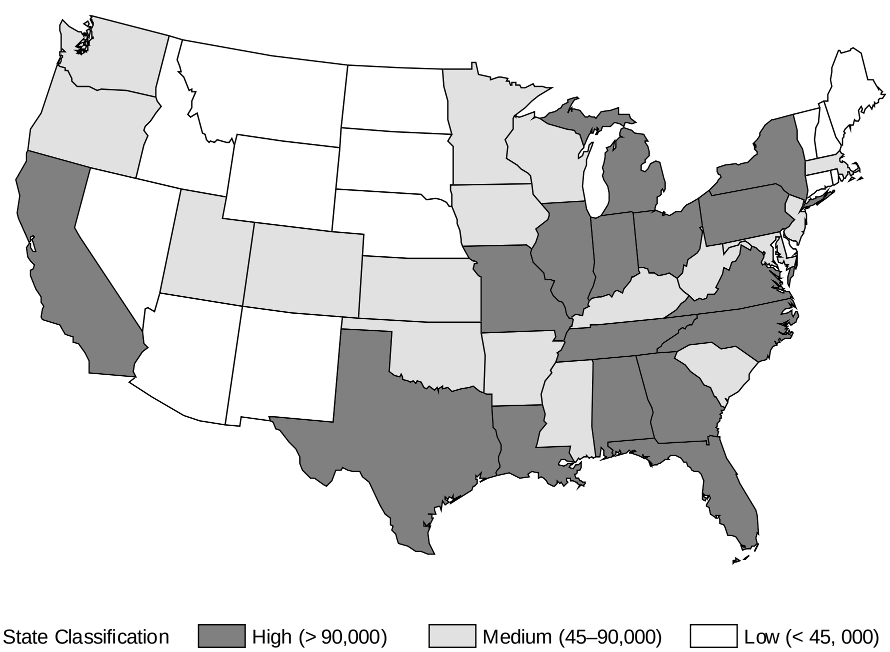


Figure 5-2. HAP emissions by state, 1993 (tons/year).

Table 5-1. Top 20 Sources of 1993 Toxic Emissions of Hazardous Air Pollutants

Rank	Source Category	Emissions(tpy)	Major HAPs by mass/category
1.	Mobile Sources: On-Road Vehicles	1,389,111	Acetaldehyde, Benzene, 1,3-Butadiene, Formaldehyde, Toluene, Xylenes
2.	Consumer & Commercial Product Solvent Use	414,096	Methanol, Methyl chloroform, Toluene, Xylenes
3.	Open burning: Forests and Wildfires	207,663	Acetaldehyde, Acrolein, Benzene, 1,3-Butadiene, Formaldehyde, Toluene, Xylenes[4]
4.	Glycol Dehydrators (Oil and Gas Production)	206,065	Benzene, Toluene, Xylenes
5.	Mobile Sources: Non-Road Vehicles & Equip.	145,866	Acetaldehyde, Benzene, 1,3-Butadiene, Formaldehyde
6.	Open Burning: Prescribed Burnings	134,149	Acetaldehyde, Acrolein, Benzene, Formaldehyde[4]
7.	Residential Boilers: Wood/Wood Residue	98,646	Acetaldehyde, Benzene, POM Combustion[5]
8.	Dry Cleaning: Perchloroethylene	95,700	Perchloroethylene
9.	Organic Chemical Manufacturing	91,419	Benzene, Ethylene glycol, Hydrogen chloride, Methanol, Methyl chloride, Toluene
10.	Pulp and Paper Production	88,579	Acetaldehyde, Benzene, Carbon tetrachloride, Formaldehyde, Hydrochloric acid, Methanol, Methylene chloride
11.	Halogenate Solvent Cleaning (Degreasing)	61,374	Methyl chloroform, Methylene chloride, Perchloroethylene, Trichlo-roethylene
12.	Primary Nonferrous Metals Production	37,980	Chlorine, Hydrogen chloride, Metals
13.	Cellulosic Man-Made Fibers	37,605	Carbon disulfide, Hydrogen chloride
14.	Petroleum Refining (All Processes)	27,115	Benzene, Hydrochloric acid, Toluene, Xylenes
15.	Municipal Waste Combustion	24,777	Formaldehyde, Hydrogen chloride, Manganese, Mercury, Lead
16.	Motor Vehicles (Surface Coating)	23,081	Methyl chloroform, Toluene, Xylenes
17.	Gasoline Distribution Stage II	21,512	Benzene, Glycol ethers, Naphthalene, Toluene
18.	Utility Boilers: Coal Combustion	21,404	Hydrogen fluoride, Manganese, Methylene chloride, Selenium[6]
19.	Plastics Materials and Resins Manufacturing	20,830	Methanol, Methylene chloride, Styrene, Vinyl acetate
20.	Flexible Polyurethane Foam Production	19,550	Methylene chloride

Emissions Data

There are approximately 3.7 million tons of air toxics released to the air each year according to OAQPS' NTI. Air toxics are emitted from all types of manmade sources, including large industrial sources, small stationary sources, and mobile sources. As shown in Figure 5-1, the NTI estimates of the area source (sources of HAPs emitting less than 10 tons per year of an individual HAP or 25 tons per year of aggregate emissions of HAPs each) and mobile source contributions to the national emissions of HAPs are approximately 35 and 41 percent respectively.

As part of the characterization of sources of HAPs nationwide, a listing of the sources emitting the greatest quantities of HAPs is presented in Table 5-1 for the 1993 inventory. These sources do not necessarily represent those which pose greatest risk. HAP emissions are not equivalent to risks posed by exposure to these compounds because some of the HAPs are more toxic than others, and actual exposures will vary by site-specific conditions such as stack height, topography, wind speed and direction, and receptor location. The data in Table 5-1, however, do provide an indication of the variety of sources and HAPs which are emitted from such sources in relatively large quantities.

Table 5-1 also shows the major contributing HAPs for each of the top 20 source categories. The 20 sources listed in Table 5-1 accounted for 87 percent of total emissions of the 188 HAPs for the year 1993. The first two source categories, on-road motor vehicles (a mobile source category) and consumer / commercial solvent use (an area source category) account for approximately 47 percent of the 188 HAPs emitted annually. Figure 5-2 is presented to illustrate the geographic distribution of emissions of HAPs by mass. This figure shows total emissions of HAPs for each state and does not necessarily imply relative health risk by exposure to HAPs by state. The categorization of pollutant emissions as high, medium, and low provides a rough sense of the distribution of emissions. In addition, some states may show relatively high emissions as a result of very large emissions from a few facilities or show relatively large emissions as a result from many very small point sources.

The NTI, which is currently being updated, includes emissions information for 188 HAPs from 913 point-, area-, and mobile-source categories. TRI data were used as the foundation of this inventory. The TRI data, however, are significantly limited in several key aspects as a tool for comprehensively characterizing the scope of the air toxics issue. For example, TRI does not include estimates of air toxics emissions from mobile and area sources.[7] The NTI suggests that the TRI data alone represent less than half of the total emissions from the point source category. Therefore, the NTI has incorporated other data to create a more complete inventory.

Data from OAQPS studies, such as the Mercury Report,[8] and 112c(6) and 112(k) inventory reports, and data collected during development of Maximum Achievable Control Technology (MACT) Standards under section 112(d), supplement the TRI data in the NTI. In addition, state and local data such as the California Air Resource Board's (CARB) Hot Spots Inventory, Houston Inventory, and the Arizona HAP Study were incorporated in the 1993 NTI. The use of non-TRI data from other sources is particularly important for providing estimates of area- and mobile-source contributions to total HAP emissions. Note that development of the NTI is continuing and that additional information concerning emissions from sources regulated under the MACT program will be added, as well as additional state and local emissions data submitted as part of Title V operating permit surveys of the Act.

Table 5-2. Summary of Changes in Mean Concentration for HAPs Measured as a Part of the PAMS Program (24-hour measurements), 1994–1996*

HAP	1994 to 1995 # Sites	1994 to 1995 # Up	1994 to 1995 # Down	1995 to 1996 # Sites	1995 to 1996 # Up	1995 to 1996 # Down
Acetaldehyde	0	n/a	n/a	2	0	0
Benzene	7	0	4	5	1	2
Ethyl benzene	8	0	2	5	0	2
Formaldehyde	0	n/a	n/a	2	0	0
Hexane	5	2	0	4	0	0
Toluene	8	0	5	5	0	1
Styrene	7	0	1	5	1	2
m/p-Xylene	8	0	4	5	0	0
o-Xylene	7	0	1	5	0	1
2,2,4-Trimethylpentane	4	1	1	5	0	3

* Note that the terms "#Up" and "#Down" refer to the number of sites in which the change in annual mean concentration between 1994 and 1995, or 1995 and 1996, is a statistically significantly increase or decrease. The total number of sites (# sites) may not necessarily equal the sum of the corresponding "#Up" and "#Down" categories.

Table 5-3. Comparison of Loading Estimates for the Great Lakes

Chemical	Year	Superior (kg/yr)	Michigan (kg/yr)	Huron (kg/yr)	Erie (kg/yr)	Ontario (kg/yr)
PCBs (wet/dry)	1988	550	400	400	180	140
	1992	160	110	110	53	42
	1994	85	69	180	37	64
DDT (wet/dry)	1988	90	64	65	33	26
	1992	34	25	25	12	10
	1994	17	32	37	46	16
B(a)P	1988	69	180	180	81	62
	1992	120	84	84	39	31
	1994	200	250	na	240	120
Pb (wet/dry)	1988	230,000	540,000	400,000	230,000	220,000
	1992	67,000	26,000	10,000	97,000	48,000
	1994	51,000	72,000	100,000	65,000	45,000

Ambient Air Quality Data

Presently, there is no national ambient air quality monitoring network designed to perform routine measurements of air toxics levels. Therefore, ambient data for individual air toxic pollutants is limited (both spatially and temporally) in comparison to the data available from the long-term, nationwide monitoring for the six criteria pollutants. EPA has several efforts underway which, although less optimal than a comprehensive and routine HAPs network, will provide some information useful to assessing the toxics issue.

The Agency's PAMS collect data on concentrations of ozone and its precursors in 21 areas across the nation classified as serious, severe or extreme nonattainment areas for ozone. Because several ozone precursors are also air toxics, ambient data collected from PAMS sites can be used for limited evaluations of toxics problems in selected urban areas as well as assessment of the tropospheric ozone formation. Despite some limitations, the PAMS sites will provide consistent, long-term measurements of selected toxics in major metropolitan areas. The PAMS program requires routine measurement of 10 HAPs: acetaldehyde, benzene, ethyl benzene, formaldehyde, hexane, styrene, toluene, m / p-xylene, o-xylene and 2,2,4-trimethlypentane.

Preliminary analysis of measurements of selected HAPs in PAMS areas indicate that concentrations of certain toxic VOCs in those areas appear to be declining. Table 5-2 shows 2-year comparisons for 24-hour measurements for nine air toxics measured at PAMS sites for the periods 1994–1995 and 1995–1996.[9] The only pollutant with more sites significantly increasing (at the 5-percent level) than those significantly decreasing (at the 5-percent level) for either time period, is hexane between 1994 and 1995. For a more detailed discussion of the PAMS program, see Chapter 4 of this report.

In addition to the PAMS program, EPA continues to administer and support voluntary programs through which states may collect ambient air quality measurements for suites of toxics. These programs include the Urban Air Toxics Monitoring Program (UATMP), as well as the Non-Methane Organic Compound (NMOC) and Speciated Non-Methane Organic Compound (SNMOC) monitoring programs. The UATMP is the "participatory" program dedicated to toxics monitoring which involves measurements of 37 VOCs and 13 carbonyl compounds.[10] In the current programs, five states are participating and operating 15 ambient measurement sites for toxics.[11]

Further, the Integrated Atmospheric Deposition Network (IADN), a joint U.S. / Canada measurement program, was initiated in 1990 to assess the relative importance of atmospheric deposition to the Great Lakes, and to provide information about sources of these pollutants.[12] The network consists of master (research-grade) stations on each lake, with additional satellite stations. There are two master stations in Canada and three in the United States that were chosen to be representative of regional deposition patterns. In addition to precipitation rates, temperature, relative humidity, wind speed and direction, and solar radiation collected at each site, concentrations of target chemicals are measured in rain and snow (wet deposition), airborne particles (dry deposition), and airborne organic vapors.[13]

The results of a comparison of deposition estimates from studies performed in 1988, 1992, and 1994 are presented in Table 5-3. Since the earlier estimates were based on sparse and uncertain data, these results are difficult to interpret definitively. The most consistent trend, however, is the reduction in 1994 lead deposition versus 1988 values for all the lakes, which is not surprising given the ban of leaded gas in the United States. Estimates of wet and dry deposition of PCBs to the lakes for 1994 show a decline compared to past estimates.[14] In addition, measurements of ambient air quality levels of PCBs at surface sites near Lake Superior appear to have remained constant over time compared to ambient levels near Lakes Erie and Michigan which have indeed declined. These downward trends in ambient air quality concentrations support estimations of an atmospheric half-life for PCBs of approximately six years which corresponds well to PCB half-lives seen in other environmental media.[15] The loading of one of the most toxic polynuclear aromatic hydrocarbons (PAH) yet characterized, benzo(a)pyrene (B(a)P), to the lakes seems to have increased; however, this is probably due to an underestimation of B(a)P in the 1992 studies.[16] Finally, the 1994 results show that DDT wet and dry deposition declined between 1988 and 1992, but rose slightly for all lakes except Superior in 1994.[17]

Concurrent with these monitoring efforts, EPA has recently initiated a program to identify, compile and catalogue all previously collected monitoring data for air toxics which is not now centrally archived. This effort is focusing presently on the compilation of measurements previously made by state and local agencies. These data will contribute to the development of an expanded and enhanced information infrastructure for air toxics.[18] All data completed as a result of this effort will be made universally accessible to all interested programs and analysts.

In addition, the Agency is also sponsoring a related project to develop environmental indicators based on air quality monitoring data, emissions data, modeling data, and administrative / programmatic data that can effectively demonstrate the extent and severity of the air toxics problem, and any progress made toward solving it in future years through regulatory or voluntary programs. Indicators will be included that consider population exposure and health risk, as well as ambient concentrations and emissions. Such indicators will be used to make geographic comparisons and assess temporal trends in subsequent trends reports.[19]

Air Toxics Control Program

The Regulatory Response

In 1990, Congress amended section 112 of the CAA by adding a new approach to the regulation of HAPs. This new approach first requires the development of technology-based emissions standards for the major sources of the 188 HAPs under section 112(d). The overall approach is to use available control technologies or changes in work practice to get emission reductions for as many of the listed HAPs as possible, regardless of the HAP's inherent toxicity and potential risk. This technology-based standards program is commonly referred to as the MACT program. Although there is no health test in this phase, it is intended that effective MACT standards will reduce a majority of the HAP emissions and potential risks. Under Section 112(d)(6), the MACT standards are subject to periodic review and potential revision.

In addition, the CAAA calls for an evaluation of the health and environmental risks remaining after technology-based standards have been set (i.e., residual risks) and requires more stringent regulation if certain risk criteria are not met. Specifically, its focus is to achieve a level of protection that provides the public health with an "ample margin of safety" while also ensuring that residual emissions do not result in "adverse environmental effects."

Under the Urban Area Source Program, EPA is identifying at least 30 HAPs that are of particular concern when emitted in urban areas, especially from area sources. EPA currently is developing a plan to reduce emissions of such chemicals by regulating sources that account for 90 percent of the emissions and to reduce cancer incidence by 75 percent.

The CAAA also require EPA to conduct specific studies to evaluate other potential human health and ecological problems and to determine if regulation is necessary. The Agency is currently conducting studies of the atmospheric deposition to the Great Lakes and coastal waters,[20] the electric utility industry, and mercury. Updates for these studies are highlighted at the end of this chapter. EPA also is required under section 112(c)(6) of the CAA to identify sources of seven specific pollutants and to regulate sources accounting for 90 percent of the emissions of each.[21]

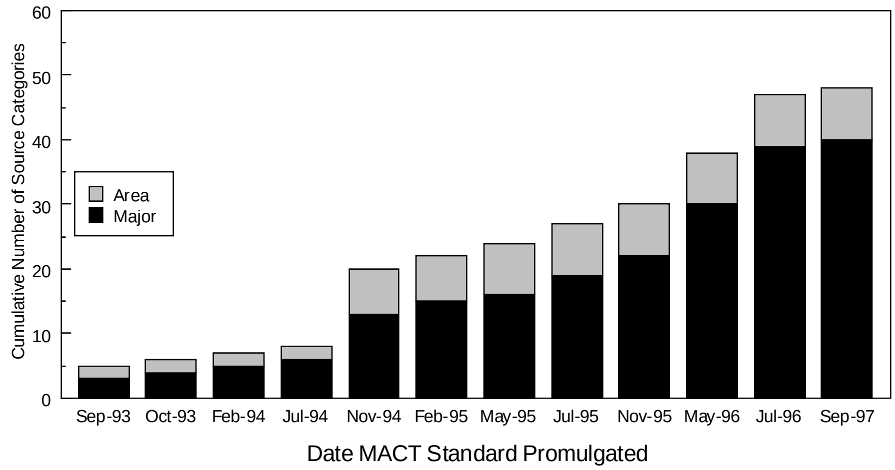


Figure 5-3. MACT source categories.

The air toxics program and the NAAQS program complement each other. Many air toxics are emitted in the form of particles or as VOCs which can be ozone precursors. Control efforts to meet the NAAQS for ozone and PM_{10} also reduce air toxic emissions. Furthermore, as air pollution control strategies for automobiles become more stringent, air toxic emissions from vehicles also are reduced. Requirements under the air toxics program can also significantly reduce emissions of some of the six NAAQS pollutants. For example, EPA's final air toxics rule for organic chemical manufacturing is expected to reduce VOC emissions by nearly 1 million tons annually.

The CAA recognizes that not all problems are national problems or have a single solution. National emission standards must be promulgated to decrease the emissions of as many HAPs as possible from major sources, but authority is also provided to look at smaller scale problems such as the urban environment or the deposition to water bodies in order to address specific concerns. The Act also recognizes the need to focus or rank efforts to meet specific needs, such as a concern for a class of toxic and persistent HAPs. There are mechanisms for increasing partnerships among EPA, states, and local programs in order to address problems specific to these regional and local environments.

Air Toxics Regulation and Implementation Status

The CAA greatly expanded the number of industries affected by national air toxic emissions controls. Large industrial complexes (major sources) such as chemical plants, oil refineries, marine tank vessel loading, aerospace manufacturers, steel mills, and a number of surface coating operations are some of the industries being controlled for toxic air pollution. Where warranted, smaller sources (area sources) of toxic air pollution such as dry cleaning operations, solvent cleaning, commercial sterilizers, secondary lead smelters, and chrome plating also are affected. EPA estimates that over the next 10 years the air toxics program will reduce emissions by 1.5 million tons per year.[22]

The emissions reductions are beginning to be realized for many industries. As many as 16 major- and eight area-source categories have begun to take some action toward complying with the controls required by the 2- and 4-year regulations. The extent of this compliance depends on the requirements of the regulations and actions taken by the industries to meet these requirements.

Emissions Reductions Through the MACT Program

The regulation of air toxics emissions through the process outlined in section 112 of the CAA, referred to as MACT regulations, is beginning to achieve significant emissions reductions of HAPs as well as criteria pollutants. As Figure 5-3 shows, as of September 1997 MACT standards have been promulgated for 48 source categories, representing all MACT standards in the 2- and 4-year groups plus one standard in the 7-year group. Sources are required to comply with these standards within three years of the effective date of the regulation, with some exceptions. Just recently to comply with section 112(s), EPA released a report to Congress describing the status of the HAP program under the CAA. EPA estimates that the 2- and 4-year standards will reduce HAP emissions by approximately 980,000 tons / year when fully implemented.[22] Concurrent control of particulate matter and VOC as ozone precursors by MACT standards, is estimated to reduce approximately 1,810,000 tons per year in combined emissions, a reduction that would not have occurred through other more conventional regulatory programs for these specific pollutants.

In addition, EPA has promulgated regulations on municipal waste combustors and hospital / medical / infectious waste incinerators under section 129 of the CAA which will significantly reduce emissions of the listed section 129 pollutants from these sources. These pollutants include particulate matter, sulfur dioxide, hydrogen chloride, oxides of nitrogen, carbon monoxide, lead, mercury, dioxins and dibenzofurans. For example, mercury emissions from municipal waste combustors are estimated to be reduced in the year 2000 by about 98 percent from 1990 levels. Mercury emissions from hospital / medical / infectious waste incinerators are estimated to be reduced by 93–95 percent, from 1995 levels, when the regulations become fully effective.

Residual Risk

To determine whether “post-MACT” risks are acceptable, Congress added a human health risk and adverse environmental effects-based “needs test” in the second regulatory phase. In this phase, referred to as “residual risk” standard setting, EPA is required to promulgate additional standards for those source categories that are emitting HAPs at levels that present an unacceptable risk to the public or the environment. Congress directed that such residual risk standards should “provide an ample margin of safety to protect public health.” Non-cancer human health risks and adverse environmental effects will also be considered in setting residual risk standards. Using a risk management framework, EPA will determine whether technology-based emission standards sufficiently protect human health.

EPA is required by section 112(f)(1) of the Act to provide a report to Congress describing the methodology of approaches assessing these residual risks, the public health significance of any remaining risks, and technical and economic issues associated with controlling the risks. The report is currently scheduled for publication in 1999.

Special Studies/Programs

As mentioned previously, the CAA requires EPA to conduct special studies to assess the magnitude and effects of air toxics focusing on specific sources, receptors, and pollutants. Summaries of the main efforts follow.

The Great Waters Program

Section 112(m) of the CAA requires the Agency to study and report to Congress every two years on the extent of atmospheric deposition of HAPs and other pollutants to the Great Lakes, the Chesapeake Bay, Lake Champlain, and coastal waters, and the need for new regulations to protect these water bodies. The pollutants of concern to this effort include nitrogen compounds, mercury, and pesticides in addition to other persistent, bioaccumulating HAPs. This program coordinates with extensive research programs to provide new understanding of the complicated issue of atmospheric deposition of air pollution to water bodies. New scientific findings will be incorporated into each required biennial report to Congress and appropriate regulatory recommendations will be made based on those findings. This statute provides the authority to introduce new regulations or influence those under development in order to prevent adverse effects from these pollutants to human health and the environment.

The Mercury Study

The Mercury Study is a comprehensive study of mercury emissions from anthropogenic sources in the United States, an assessment of the public health and ecological effects of such emissions, an analysis of technologies to control mercury emissions, and the costs of such control. The study is mandated by section 112(n)(1)(B) of the CAA because mercury is, as an element, eternally persistent as well as being bioaccumulative and the cause of fish consumption advisories in more than 39 states. A number of observations can be made regarding trends in mercury use and emissions. The overall use of mercury by industrial and manufacturing source categories has significantly declined. Industrial use of mercury declined by nearly 75 percent between 1988 and 1995. Much of this decline can be attributed to the elimination of mercury as a paint additive and the phase-out of mercury in household batteries. Reducing mercury in manufactured products is important because emissions of mercury are most likely to occur when these products are broken or discarded. Based on trends in mercury use, EPA predicts that manufacturing use of mercury will continue to decline. Chlorine production from mercury cell chlor-alkali plants will continue to account for most of the use in, and emissions from, the manufacturing sector. This industry has pledged, however, to voluntarily reduce mercury use by 50 percent by 2006. Secondary production of mercury may increase as more recycling facilities begin operations to recover mercury from discarded products and wastes. A significant decrease will occur in mercury emissions from municipal waste combustors and medical waste incinerators when the final regulations promulgated by EPA for these source categories are fully implemented. Emissions from both categories will decline by at least 90 percent

Table 5-4. List of Potential 112(k) HAPs

CAS Number	Name	CAS Number	Name
79345	1,1,2,2-Tetrachloroethane	75092	Methylene chloride (dichloromethane)
140885	Ethyl acrylate	71432	Benzene
79005	1,1,2-trichloroethane	101688	Methylene diphenyl diisocyanate (MDI)
106934	Ethylene dibromide (dibromoethane)		Beryllium compounds
78875	1,2-Dichloropropane (propylene dichloride)		Nickel compounds
75218	Ethylene oxide	117817	Bis(2-ethylhexyl)phthalate (DEHP) Polycyclic organic matter
106990	1,3-Butadiene		Cadmium compounds
107062	Ethylene dichloride (1,2-dichloroethane)	91225	Quinoline
542756	1,3-Dichloropropene	56235	Carbon tetrachloride
50000	Formaldehyde	100425	Styrene
106467	1,4-dichlorobenzene	67663	Chloroform
302012	Hydrazine	127184	Tetrachloroethylene (perchloroethylene)
75070	Acetaldehyde		Chromium compounds
	Lead compounds	79016	Trichloroethylene
107028	Acrolein		Coke oven emissions
	Manganese compounds	75014	Vinyl chloride
79061	Acrylamide		Dioxins/furans
	Mercury compounds	75354	Vinylidene chloride (1,1-Dichloroethylene)
107131	Acrylonitrile		
74873	Methyl chloride (chloromethane)		
	Arsenic compounds		

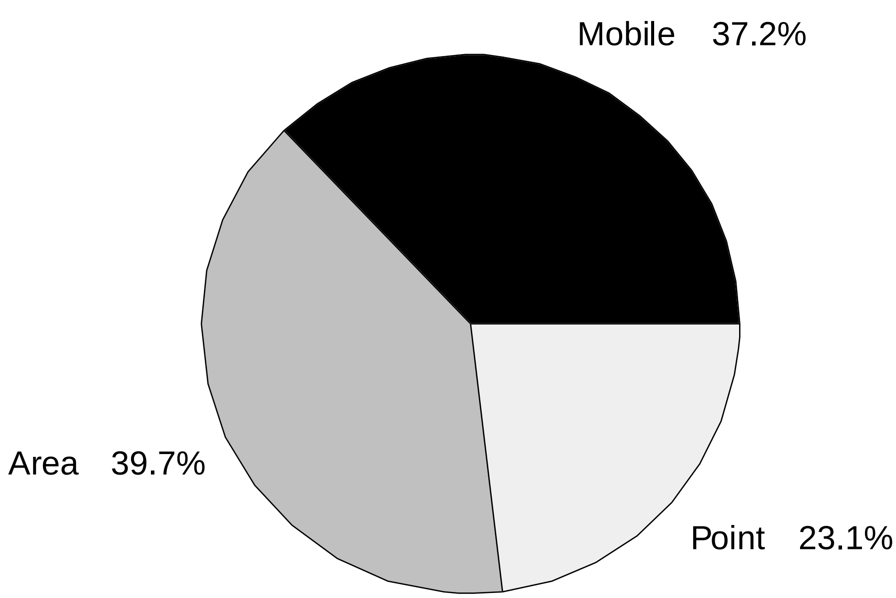


Figure 5-4. Emissions of 40 potential section 112(k) HAPs by source type (tons/year).

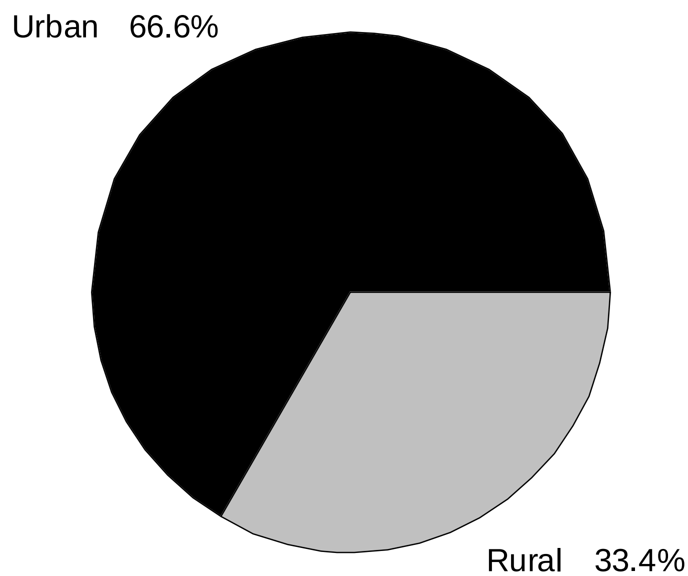


Figure 5-5. Emissions of 40 potential section 112(k) HAPs by urban and rural classification (tons/year).

from 1995 levels; to roughly 6 tons per year from municipal waste combustors and 1 ton per year from medical waste incinerators. In addition, EPA has proposed mercury emission limits for hazardous waste combustors. Based on 1995 estimates, coal-fired utility boilers are the largest remaining source category at 52 tons per year. Future mercury emissions from utility boilers depend on a number of factors including the nation's energy needs, fuel choices, industry restructuring and other requirements under the CAA (e.g., the Acid Rain Program). A recent EPA analysis also predicted mercury emissions will decline at least 11 tons per year as a result of implementation of the ambient standards for fine particulate matter. International efforts to reduce greenhouse gases will also reduce mercury emissions. The Mercury Study Report to Congress was completed in December 1997.

The Specific Pollutants Strategy

Section 112(c)(6) of the CAA requires EPA to identify sources of alkylated lead compounds, POM, mercury, hexachlorobenzene, PCBs, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and 2,3,7,8-tetrachlorodibenzofuran, and then to subject sources accounting for not less than 90 percent of the aggregate emissions of each pollutant to standards.[22] Standards must be developed by EPA for sources of these HAPs that are not subject to current standards. In order to meet the requirements of section 112(c)(6), EPA compiled national inventories of sources and emissions of each of the seven HAPs.[23]

The Urban Area Source Program

Sections 112(c)(3) and 112(k) of the CAA require EPA to identify categories and subcategories of area sources of HAPs in urban areas that pose a threat to human health. Specifically, EPA must identify at least 30 HAPs that present the greatest threat to urban populations, and assure that sources accounting for 90 percent or more of the aggregate emissions of these 30 HAPs are subject to regulation. In addition, a national strategy must be developed to reduce cancer incidence attributable to these pollutants by at least 75 percent. In order to address the requirements of sections 112(c)(3) and 112(k), EPA compiled draft air emissions inventories of 40 potential urban HAPs, as seen in Table 5-4.[24]

Figures 5-4 and 5-5 present summary data from the draft urban air emissions inventory. Figure 5-4 indicates that: area sources account for 40 percent of emissions of the 40 potential urban HAPs, mobile sources account for 37 percent, and point (major) sources account for 23 percent. Figure 5-5 shows that urban emissions of the 40 potential HAPs account for 67 percent, and rural emissions account for 33 percent of the 40 potential HAPs.

It is important to note that emissions estimates do not necessarily reflect potential health risk from exposure to these HAPs. Further analyses will be performed in conjunction with the development of the urban air toxics strategy. The development of the inventories for the potential urban pollutants, however, is a critical element in the regulatory strategy to reduce emissions of HAPs from area sources in urban geographic areas.

The Utility Air Toxics Study

As mandated by section 112(n)(1)(A) of the CAA, the Agency is studying HAP emissions from fossil fuel-fired (coal, oil, and gas) electric utilities and the associated hazards to public health. A draft utility report identifies 67 HAPs in the emissions database. The report predicts that over the next two decades there will be roughly a 30-percent increase in HAP emissions from coal-fired utilities and roughly a 50-percent decline in HAP emissions from oil-fired utilities. These projections are primarily based on anticipated energy demands and changes in fuel usage but also account for other factors such as expected controls.

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. "Update: Listing of Fish and Wildlife Advisories," announcing the availability of the 1996 update for the database: Listing of Fish and Wildlife Advisories (LFWA); U.S. EPA Fact Sheet, EPA-823-97-007, June 1997.

3. Hillery, B.R., Hoff, R.M., and Hites, R.A. 1997. "Atmospheric contaminant deposition to the Great Lakes determined from the Integrated Atmospheric Deposition Network." Chapter 15 in *Atmospheric Deposition of Contaminants to the Great Lakes and Coastal Waters*. 1997, Joel E. Baker, Editor. SETAC Press. (Society of Environmental Toxicology and Chemistry.)

4. POM is also a constituent of emissions of this source category, although not a major contributor to emissions on a mass basis.

5. One of the HAPs that is emitted from residential wood combustion is POM, which is a class of hundreds of compounds of varying toxicity. POM is defined in the NTI as the sum of 16 PAH compounds to provide a workable definition of the more toxic components of the class.

6. Mercury and hydrochloric acid are also constituents of emissions of this source category, although not major contributors to emissions on a mass basis.

7. In addition to the absence of emissions estimates for area and mobile source categories, there are other significant limitations in the TRI's portrayal of overall HAP emissions. First, facilities with Standard Industrial Classification (SIC) codes outside the range of 20 to 39 (the manufacturing SICs) are not required to report. Therefore, HAP emissions from facilities such as mining operations, electric utilities, and oil and gas production operations are not represented in the TRI. Further, TRI data are self-reported by the emitting facilities, and TRI does not require facilities to perform any actual monitoring or testing to develop their reported estimates. Consequently, the accuracy of the reported data may vary from facility to facility and from year to year. Finally, the original TRI list only required reporting for 173 of the 188 HAPs identified in the CAA.

8. Mercury Report to Congress, SAB review Draft. Volume II. An Inventory of Anthropogenic Mercury Emissions in the United States. EPA-452/R-96-001b.

9. Summaries of the health effects associated with the compounds included in this analysis are provided below:

   Acetaldehyde: The primary effects on humans, reported from short-term exposure to low to moderate levels of acetaldehyde, are irritation of eyes, skin, and respiratory tract. Short-term exposure effects on animals also include slowed respiration and elevated blood pressure. Effects on humans from long-term acetaldehyde exposure resemble those of alcoholism. Long-term exposures of animals have resulted in changes in respiratory tract tissues, as well as growth retardation, anemia, and kidney effects. While no information is available on acetaldehyde effects on human reproduction or development, both such effects have been observed in animal tests. Based on evidence of tumors in animals, EPA has classified acetaldehyde as a probable human carcinogen of relatively low carcinogenic hazard.

   Benzene: Reported effects on humans, from short-term exposure to low to moderate benzene levels, include drowsiness, dizziness, headache, and unconsciousness as well as eye, skin and respiratory tract irritation. Effects on both humans and animals from long-term benzene exposure include blood and immune system disorders. Reproductive effects have been reported for women exposed to high benzene levels and adverse effects on the developing fetus have been observed in animal tests. Changes in human chromosome number and structure have been reported under certain exposures. EPA has classified benzene as a known human carcinogen of medium carcinogenic hazard.

   Formaldehyde: Reported effects on humans, from short-term and long-term exposure to formaldehyde, are mainly irritation of eyes, nose, throat, and, at higher levels, the respiratory tract. Long-term exposures of animals have also resulted in damage to respiratory tract tissues. Although

little information is available on developmental effects to humans, animal tests do not indicate effects on fetal development. EPA has classified formaldehyde as a probable human carcinogen of medium carcinogenic hazard based on sufficient animal and limited human evidence.

Toluene: Effects on the CNS of humans and animals have been reported, from short-term exposure to low to moderate levels of toluene, and include dysfunction, fatigue, sleepiness, headaches, and nausea. Short-term exposure effects also include cardiovascular symptoms in humans and depression of the immune system in animals. CNS effects are also observed in long-term exposures of humans and animals. Additional long-term exposure effects include irritation of eyes, throat and respiratory tract in humans and changes in respiratory tract tissue of animals. Repeated toluene exposure has been observed to adversely affect the developing fetus in humans and animals. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider toluene classifiable as to human carcinogenicity.

Xylenes: Reported effects on humans, from short-term exposure to high levels of xylenes, include irritation of eyes, nose, and throat, difficulty breathing, impairment of the CNS and gastrointestinal effects. Similar effects have been reported in animals in addition to effects on the kidney. Human effects from long-term exposure to xylenes are to the CNS, respiratory and cardiovascular systems, blood, and kidney. Long-term animal exposures to high levels of xylenes have shown effects on the liver. Effects on the developing fetus have been observed in animal studies. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider xylenes classifiable as to human carcinogenicity.

Ethyl benzene: Effects reported, from short-term exposures of humans to high levels of ethyl benzene, include dizziness, depression of the CNS, eye, mucous membrane, nose and respiratory tract irritation, and difficulty breathing. In short-term exposures of laboratory animals, additional effects on the liver, kidney and pulmonary system have also been reported. Long-term exposures of animals have demonstrated effects on blood cells, the liver and kidneys. Effects on fetal development have also been observed in animal exposures. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider ethyl benzene classifiable as to human carcinogenicity.

Styrene: Exposure to styrene vapors can cause irritation of eyes, nose, throat and respiratory tract in humans. Effects on the CNS of humans including dizziness, fatigue, sleepiness, headaches, nausea, and effects on intellectual function and memory have also been reported from long-term exposure to styrene. Long-term exposures of animals have demonstrated effects on the CNS, liver and kidney as well as eye and nasal irritation. Although the available information for humans is inconclusive, animal tests do not indicate effects on reproduction or fetal development. The carcinogenicity of styrene is currently under review by EPA. When absorbed into the human body, styrene is metabolized into styrene oxide, a direct acting mutagen that causes cancer in test animals.

Hexane: Reported effects on humans, from short-term exposure to high levels of hexane, include irritation of eyes, mucous membranes, throat and skin, as well as impairment of the CNS including dizziness, giddiness, headaches, and slight nausea. Long-term human exposure from inhalation is associated with a slowing of peripheral nerve signal conduction which causes numbness in the extremities and muscular weakness, as well as changes to the retina which causes blurred vision. Animal exposures to hexane have resulted in damage to nasal, respiratory tract, lung and peripheral nerve tissues, as well as effects on the CNS. No information is available on hexane effects on human reproduction or development. Limited laboratory animal data indicate a potential for testicular damage in adults, while several animal studies show no effect on fetal development. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider hexane classifiable as to human carcinogenicity.

2,2,4-Trimethylpentane: Little information is available on the effects of 2,2,4-trimethylpentane overexposure in humans. Laboratory animals exposed to high levels for short periods have developed irritation, fluid build-up and bleeding in the lungs, as well as depression of CNS function. Kidney and liver effects have been reported from long-term animal exposures. No information is available on the potential for reproductive or developmental effects or on the carcinogenic potential of 2,2,4-trimethylpentane.

10. Twenty-eight of the 37 VOCs, and four of the 13 carbonyls measured as a part of the UATMP are defined as HAPs in section 112(b)(1) of the CAA.

11. The following states are presently participating in the UATMP: Arkansas, Louisiana, New Jersey, Texas, and Vermont.

12. The IADN fulfills legislative mandates in Canada and the United States that address the monitoring of air toxics. An international Great Lakes deposition network is mandated by Annex 15 of the *Great Lakes Water Quality Agreement between the United States and Canada*. In the United States, the CAA requires a Great Lakes deposition network.

13. 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.

14. Hornbuckle, K.C., Jeremaison, J.D., Sweet, C.W., Eisenreich, S., “Seasonal Variations in Air-Water Exchange

of Polychlorinated Biphenyls in Lake Superior", J. Environ. Sci. Technol. 1994, 28, 1491-1501.

15. Hillery, B.R., Basu I., Sweet, C.W., Hites, R.A., *Temporal and Spatial Trends in a Long-Term Study of Gas-Phase PCB Concentrations near the Great Lakes*, Environ. Sci. Technol. 1997, 31, 1811-1816.

16. Hoff, R.M., Strachan, W.M.J., Sweet, C.W., D.F. Gatz, Harlin, K., Shackleton, M., Cussion, S., Chan, C.H., Brice, K.A., Shroeder, W.H., Bidleman, T.F., Atmospheric Deposition of Toxic Chemicals to the Great Lakes: A Review of Data Through 1994, Atmos. Environ., 1996, 30, 3505-3527.

17. Hillery, B.R., Hoff, R.M., Hites, R. Atmospheric Contaminant Deposition to the Great Lakes Determined from the International Atmospheric Deposition Network, In Atmospheric Deposition of Contaminants to the Great Lakes and Coastal Water, Baker, J.E., ed., Society for Environmental Toxicology and Chemistry, 1997.

18. Interest in participation in this voluntary effort and / or requests for further information about this data cataloguing effort should be directed to James Hemby, Office of Air Quality Planning and Standards, Mail Drop 14, Research Triangle Park, North Carolina 27711; 919-541-5459; and hemby.james@epamail.epa.gov.

19. The scheduled completion date for this project is September 1998; however, interim products will be released as completed. Additional information on this project is also available through James Hemby. Please see address and phone number above.

20. Section 112 (m) is commonly referred to as the "Great Waters" program.

21. These compounds, known as the section 112(c)(6) specific pollutants, are alkylated lead compounds, polycyclic organic matter, hexachlorobenzene, mercury, polychlorinated biphenyls, 2,3,7,8-tetrachlorodibenzofurans, and 2,3,7,8-tetrachlorodibenzo-p-dioxin.

22. Second Report to Congress on the Status of the Hazardous Air Pollutant Program Under the CAA, Draft. EPA-453 / R-96-015. October 1997.

23. The final inventory report is available at the following Internet address: www.epa.gov/ttn/uatw/112cfac.html.

24. The draft inventory report is available at the following Internet address: www.epa.gov/ttn/uatw/112kfac.html.

Chapter 6

Nonattainment Areas

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, it may be subject to the formal rule-making process which designates it as nonattainment. The 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 measures 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).

Figure 6-1 shows the location of the nonattainment areas for each criteria pollutant. Figure 6-2 identifies the ozone nonattainment areas by degree of severity. A summary of nonattain-

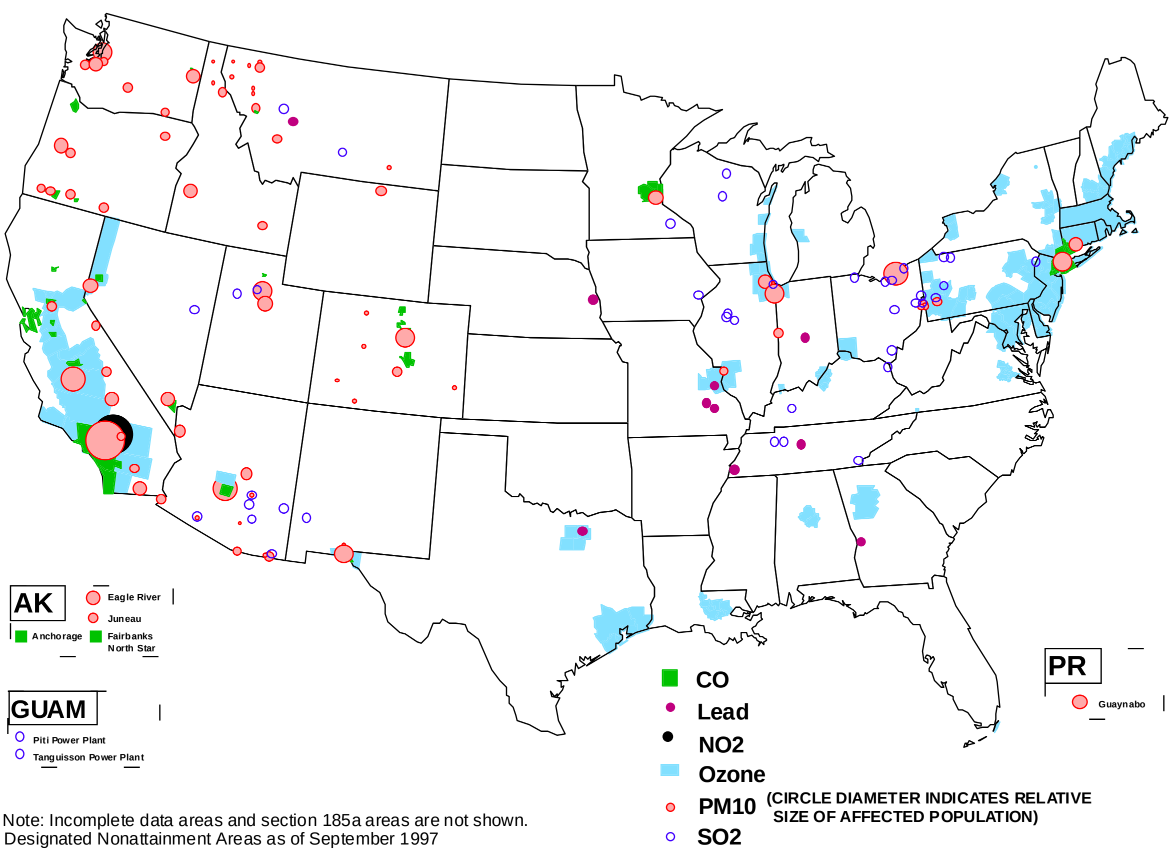


Figure 6-1. Location of nonattainment areas for criteria pollutants.

ment areas can be found in Table A-13 in Appendix A. This condensed list is also located on the Internet at http://www.epa.gov/airs/nonattn.html and is updated as areas are redesignated. Note that Section 185a areas (formerly known as "transitional areas") and incomplete areas are excluded from the counts in Table A-13. For information on these areas see the *EPA Green Book* site located at http://www.epa.gov/oar/oaqps/greenbk.

As of September 1997, there were a total of 158 nonattainment areas on the condensed nonattainment list. The areas on the condensed list are displayed alphabetically by state. There are approximately 119 million people living in areas currently designated as nonattainment.

Areas redesignated to attainment between September 1996 and September 1997 are listed below by pollutant.

Ozone

- Nashville, TN
- Seattle-Tacoma, WA
- Monterey Bay, CA
- Hancock and Waldo Co's, ME
- Lake Charles, LA
- Portland-Vancouver, OR-WA
- Norfolk-VA Beach-Newport News, VA
- Salt Lake and Davis Co's, UT
- Reading, PA

CO

- Seattle-Tacoma, WA
- Vancouver, WA

PM_{10}

- Oglesby, IL
- Detroit (Wayne Co), MI

SO_2

- Marion Co, IN
- LaPorte Co, IN
- Wayne Co, IN
- Vigo Co, IN
- Millinocket, ME

Nitrogen dioxide and lead counts remained the same since September 1996.

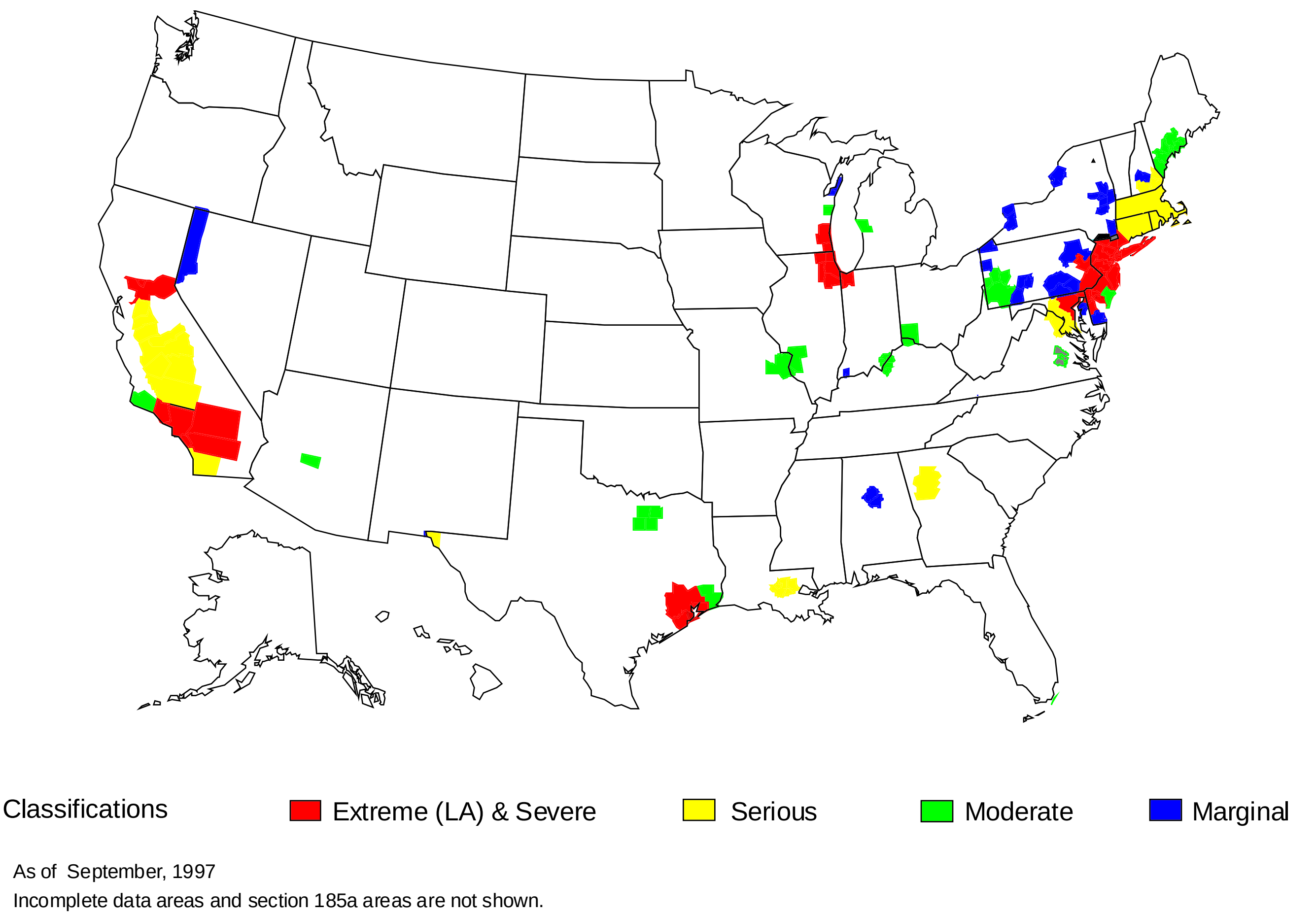


Figure 6-2. Classified ozone nonattainment areas.

Chapter 7

Metropolitan Area Trends

WHILE MOST OF this report discusses air quality trends on a national scale, there is interest in information about local air quality. This chapter presents status and trends in criteria pollutants for MSAs in the United States. A complete list of MSAs and their boundaries can be found in the *Statistical Abstract of the United States*.[1] The status and trends of metropolitan areas are based on four tables found in Appendix A (A-14 through A-17). Table A-14 gives the 1996 peak statistics for all MSAs, providing the status of the most recent year. Ten-year trends are shown for the 258 MSAs having data that met the trends criteria explained in Appendix B. Table A-15 lists these MSAs and reports criteria pollutant trends as "upward" or "downward," or "not significant." These rankings are based on a statistical test, known as the Theil test, which is described later in this chapter. Another way to assess trends in MSAs is to examine PSI values.[2,3] The PSI is used to combine daily information on one or more criteria pollutants into an easily understood format, which can then be presented to the public in a timely manner. Tables A-16 and A-17 list the number of days with PSI values greater than 100 (unhealthful) for the nation's 94 largest metropolitan areas (population greater than 500,000). Table A-16 lists PSI values based on all pollutants while Table A-17 lists PSI values based on ozone alone.

All MSAs do not appear in these tables because of the availability of data or the size of the MSA. There are MSAs with no ongoing air pollution monitoring because these areas do not have pollution problems. The same is true for certain combinations of MSAs and pollutants. There are also MSAs with so little information that the criteria for trends analysis are not met (see Appendix B). Finally, there are MSAs that do not meet size criteria for certain tables and, therefore, are not included.

Status: 1996

The air quality status for MSAs can be found in Table A-14 (for related information, see Table A-11—peak concentrations for all counties with monitors that reported to the AIRS data base). Table A-14 lists peak statistics for all criteria pollutants measured in an MSA. Since certain areas are not considered to have a problem with all criteria pollutants, all criteria pollutants are not measured in all MSAs and, therefore, are designated as "ND" (no data) for those pollutants. Examining Table A-14 shows that 45 areas had peak concentrations from at least one criteria pollutant exceeding standard levels. These areas represent 27 percent of the U.S. population. Similarly, there were 10 areas representing 10 percent of the population that had peak statistics that exceeded two or more standards. Only one area, (Philadelphia, PA) representing 2 percent of the U.S. population, had peak statistics from three pollutants that exceeded the respective standards. High values for two pollutants, PM_{10} and lead, are due to one localized industrial source. There were no areas, however, that violated four or more standards. In fact, 1996 was the fifth year in a row that there were no violations of the NO_2 standards in the United States.

Trends Analysis

Air quality trends for MSAs are examined in Table A-15. The data in this table are based on pollutant concentrations from the subset of ambient monitoring sites that meet the same trends criteria explained in Appendix B. A total of 258 MSAs had at least one monitoring site that met these criteria. As stated previously, not all pollutants are measured in every MSA.

From 1987 to 1996, statistics based on the NAAQS were calculated for each site and pollutant with available data. Spatial averages were obtained for each of the 258 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 aspects of certain pollutants and, therefore, seasonality in monitoring intensity among MSAs, the averages for every MSA and year provide a consistent value with which to assess trends.

To assess upward or downward trends, a linear regression was applied to these data. Since the underlying pollutant distributions do not meet the usual assumptions required for common least squares regression, the regression analysis was based upon a nonparametric method commonly referred to as the Theil test.[4,5,6] 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. Because this method uses a median estimator, it is not influenced by single extreme values. 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. Another advantage of using the regression analysis 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).

Table 7-1 summarizes the trend analysis performed on the 258 MSAs. It shows that there were no upward trends in CO, lead, and PM_{10} (annual mean) at any of the MSAs over the past decade. Of the 258 MSAs, 217 had downward trends in at least one of the criteria pollutants, and only 13 had upward trends. A closer look at these 13 MSAs reveals that all are well below the NAAQS for the respective pollutant, meaning that their upward trends are not immediately in danger of violating the NAAQS (in fact, none of these areas are classified as nonattainment for a NAAQS). These results demonstrate significant improvements in urban air quality over the past decade.

Table 7-1. Summary of MSA Trend Analysis, by Pollutant

		Total # MSAs	# MSAs Up	# MSAs Down	# MSAs with No Significant Change
CO	Second Max, 8-hour	140	0	99	41
Lead	Max Quarterly Mean	95	0	76	19
NO_2	Arithmetic Mean	90	2	50	38
Ozone	Second Daily Max, 1-hour	192	1	51	140
PM_{10}	Second Max, 24-hour	216	6	96	114
PM_{10}	Weighted Annual Mean	216	0	153	63
SO_2	Arithmetic Mean	143	4	98	41
SO_2	Second Max, 24-hour	143	4	79	60

The Pollutant Standards Index

PSI values are derived from pollutant concentrations. They are reported daily in all metropolitan areas of the United States with populations exceeding 200,000, and are used to report air quality over large urban areas. The PSI is reported as a value between zero and 500 or a descriptive word (e.g., "unhealthful") and is featured on local TV or radio news programs and in newspapers.

Based on their short-term NAAQS, Federal Episode Criteria,[7] and Significant Harm Levels,[8] the PSI is computed for PM_{10}, 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 NAAQS, a Federal Episode Criteria, or a Significant Harm Level. Since the PSI is a tool used to communicate pollution concerns to a wide audience, there are also colors linked to the general descriptors of air quality. The five PSI color categories and their respective health effects descriptors are listed in Table 7-2.

The PSI integrates information on criteria 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 criteria pollutants, concentrations are converted into an index value between zero and 500. The pollutant with the highest index value is reported as the PSI for that day. Therefore, the PSI does not take into account the possible adverse effects associated with combinations of pollutants (i.e., synergism).[2,3]

A PSI value of 100 corresponds to the standard established under the CAA. A PSI value greater than 100 indicates that at least one criteria pollutant (with the exception of NO_2) exceeded the level of the NAAQS, therefore designating air quality to be in the unhealthful range on that day. Relatively high PSI values activate public health warnings. For example, a PSI of 200 initiates a First Stage Alert at which time sensitive populations (e.g., the elderly and persons with respiratory illnesses) are advised to remain indoors and reduce physical activity. A PSI of 300 initiates a Second Stage Alert at which time the general public is advised to avoid outdoor activity.

Summary of PSI Analyses

Of the five criteria pollutants used to calculate the PSI, CO, O_3, PM_{10}, and SO_2 generally contribute to the PSI value. Nitrogen dioxide is rarely the

Table 7-2. Pollutant Standards Index Values with Pollutant Concentration, Health Descriptors, and PSI Colors

INDEX VALUE	AIR QUALITY LEVEL	POLLUTANT LEVELS PM-10 (24-hour) ug/m^3	SO$_2$ (24-hour) ug/m^3	CO (8-hour) ppm	O$_3$ (1-hour) ppm	NO$_2$ (1-hour) ppm	HEALTH EFFECT DESCRIPTOR	PSI COLORS
500	SIGNIFICANT HARM	600	2,620	50	0.6	2.0		
400	EMERGENCY	500	2,100	40	0.5	1.6	HAZARDOUS	RED
300	WARNING	420	1,600	30	0.4	1.2		
							VERY UNHEALTHFUL	ORANGE
200	ALERT	350	800	15	0.2	0.6		
							UNHEALTHFUL	YELLOW
100	NAAQS	150	365	9	0.12	a		
							MODERATE	GREEN
50	50% OF NAAQS	50	80[b]	4.5	0.06	a		
							GOOD	BLUE
0		0	0	0	0	a		

[a] No index values reported at concentration levels below those specified by "Alert Level" criteria.
[b] Annual primary NAAQS.

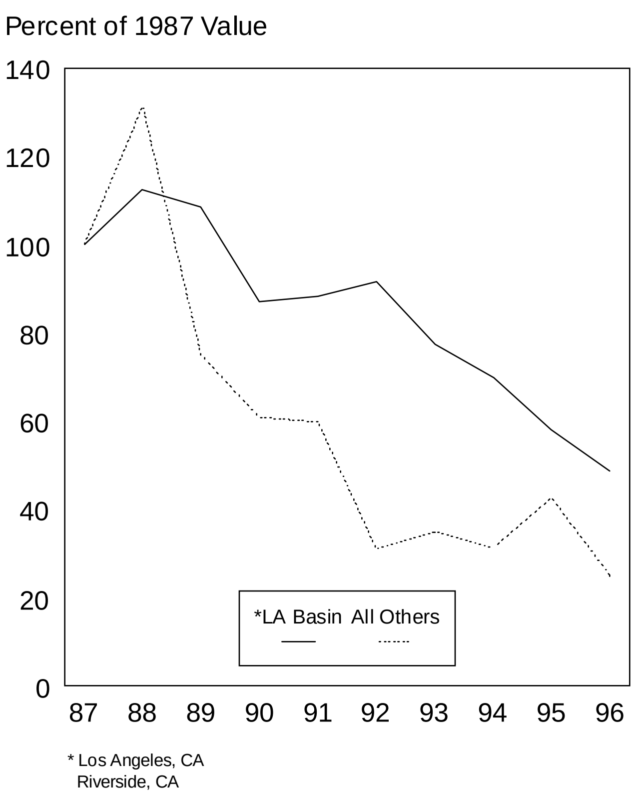


Figure 7-1. Number of days with PSI values > 100, as a percentage of 1987 value.

highest pollutant measured because it does not have a short-term NAAQS and can only be included when concentrations exceed one of the Federal Episode Criteria or Significant Harm Levels. Ten-year PSI trends are based on daily maximum pollutant concentrations from the subset of ambient monitoring sites that meet the trends criteria in Appendix B.

Since a PSI value greater than 100 indicates that the level of the NAAQS for at least one criteria pollutant has been exceeded on a given day, the number of days with PSI values greater than 100 provides an indicator of air quality in urban areas. Figure 7-1 shows the trend in the number of days with PSI values greater than 100 summed across the nation's 94 largest metropolitan areas as a percentage of the 1987 value. Because of their magnitude, PSI totals for Los Angeles, CA and Riverside, CA are shown separately as the LA Basin. Plotting these values as a percentage of 1987 values, allows two trends of different magnitudes to be compared on the same graph. The long-term air quality improvement in urban areas is evident in this figure. Between 1987 and 1996, the total number of days with PSI values greater than 100 decreased 51 percent in the Los Angeles Basin and 75 percent in the remaining major cities across the United States.

PSI 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 sites that are available in an area, the better the estimate of the maximum PSI for a given day. Ozone accounts for the majority of days with PSI values above 100, but is collected at only a small number of sites in each area. Table A-18 shows that the percentage of days with PSI values greater than 100 that could be attributed to ozone alone has increased from 78 percent in 1987 to 89 percent in 1996. This increase reveals that ozone increasingly accounts for those days above the 100 level and 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 PSI determination.

The PSI is currently undergoing revision to reflect the changes in the ozone and PM NAAQS. These revisions will be proposed in the Spring of 1998 and should be finalized by the end of 1998. Concurrently, the Federal Episode Criteria and Significant Harm Levels for ozone and PM are being revised to reflect the health effects data that motivated the revisions to the ozone and PM NAAQS.

References

1. *Statistical Abstracts of the United States, 1997*, U.S. Department of Commerce, U.S. Bureau of the Census.
2. Measuring Air Quality, The Pollutant Standards Index, EPA-451 / K-94-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, February 1994.
3. *Code of Federal Regulations*, 40 CFR Part 58, Appendix G.
4. 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.
5. 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.
6. M. Hollander and D.A. Wolfe, *Nonparametric Statistical Methods*, John Wiley and Sons, Inc., New York, NY, 1973.
7. *Code of Federal Regulations*, 40 CFR Part 51, Appendix L.
8. *Code of Federal Regulations*, 40 CFR Part 51, section 51.151.

Appendix A

Data Tables

Table A-1. National Air Quality Trends Statistics for Criteria Pollutants, 1987–1996

Statistic	Units	# of Sites	Percentile	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Carbon Monoxide													
2nd Max. 8hr.	PPM	345	95th	11.9	11.2	11.1	10.6	9.9	8.6	8.1	8.1	7.7	7.3
"	"	"	90th	10.0	10.3	9.8	8.8	8.8	7.9	7.3	7.6	7.0	6.5
"	"	"	75th	8.3	7.8	7.8	7.1	6.9	6.4	5.8	6.2	5.5	5.1
"	"	"	50th	6.3	6.1	6.0	5.5	5.2	4.8	4.7	4.9	4.2	3.9
"	"	"	25th	4.7	4.3	4.4	4.2	3.9	3.7	3.6	3.8	3.2	3.0
"	"	"	10th	3.6	3.4	3.5	3.1	3.0	2.8	2.9	2.8	2.5	2.4
"	"	"	5th	3.0	3.0	2.8	2.6	2.4	2.5	2.3	2.3	2.3	2.1
"	"	"	Arith. Mean	6.7	6.4	6.4	5.9	5.6	5.2	4.9	5.1	4.5	4.2
Lead													
Max. Qtr.	$\mu g/m^3$	208	95th	0.41	0.37	0.27	0.26	0.19	0.17	0.16	0.13	0.11	0.12
"	"	"	90th	0.24	0.22	0.17	0.17	0.15	0.12	0.10	0.09	0.08	0.08
"	"	"	75th	0.14	0.13	0.11	0.09	0.07	0.06	0.06	0.05	0.05	0.04
"	"	"	50th	0.09	0.08	0.06	0.05	0.04	0.03	0.03	0.03	0.03	0.02
"	"	"	25th	0.06	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.01	0.01
"	"	"	10th	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
"	"	"	5th	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
"	"	"	Arith. Mean	0.16	0.12	0.09	0.09	0.07	0.06	0.05	0.04	0.04	0.04
Nitrogen Dioxide													
Arith. Mean	PPM	214	95th	0.043	0.046	0.043	0.041	0.043	0.039	0.037	0.041	0.039	0.038
"	"	"	90th	0.038	0.037	0.035	0.034	0.033	0.033	0.033	0.034	0.032	0.032
"	"	"	75th	0.027	0.027	0.027	0.026	0.025	0.024	0.025	0.025	0.024	0.024
"	"	"	50th	0.020	0.021	0.020	0.019	0.019	0.019	0.019	0.020	0.019	0.018
"	"	"	25th	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.012
"	"	"	10th	0.006	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.006
"	"	"	5th	0.004	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004
"	"	"	Arith. Mean	0.021	0.022	0.021	0.020	0.020	0.019	0.019	0.020	0.019	0.019
Ozone													
2nd Max. 1hr.	PPM	600	95th	0.183	0.202	0.190	0.177	0.175	0.160	0.160	0.154	0.158	0.145
"	"	"	90th	0.166	0.180	0.151	0.150	0.150	0.133	0.140	0.133	0.140	0.129
"	"	"	75th	0.140	0.151	0.125	0.121	0.124	0.113	0.120	0.118	0.124	0.115
"	"	"	50th	0.117	0.128	0.107	0.108	0.108	0.100	0.105	0.105	0.111	0.104
"	"	"	25th	0.102	0.109	0.096	0.095	0.095	0.090	0.092	0.093	0.099	0.094
"	"	"	10th	0.090	0.092	0.085	0.083	0.082	0.082	0.080	0.082	0.085	0.085
"	"	"	5th	0.083	0.083	0.080	0.074	0.075	0.076	0.074	0.075	0.077	0.079
"	"	"	Arith. Mean	0.124	0.133	0.116	0.113	0.114	0.106	0.108	0.108	0.113	0.106

Table A-1. National Air Quality Trends Statistics for Criteria Pollutants, 1987–1996 (continued)

Statistic	Units	# of Sites	Percentile	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
PM_{10}													
Annual Avg.	µg/m^3	900	95th	—	52.5	52.7	46.2	46.1	42.1	41.5	40.0	39.6	38.4
"	"	"	90th	—	44.0	43.9	39.7	39.5	36.4	36.0	36.6	35.0	33.6
"	"	"	75th	—	37.6	36.8	34.2	33.4	31.0	30.1	30.5	29.3	27.9
"	"	"	50th	—	30.5	30.1	28.0	28.2	25.6	25.4	25.4	24.3	23.3
"	"	"	25th	—	25.8	25.6	23.4	23.5	21.9	21.0	21.1	20.0	19.4
"	"	"	10th	—	20.6	20.6	19.1	18.5	17.9	16.8	16.8	15.9	16.0
"	"	"	5th	—	17.5	17.4	16.4	15.1	13.9	13.4	13.1	12.7	13.2
"	"	"	Arith. Mean	—	32.2	32.0	29.4	29.1	26.8	26.0	26.2	25.1	24.2
Sulfur Dioxide													
Arith. Mean	PPM	479	95th	0.0183	0.0195	0.0182	0.0165	0.0160	0.0153	0.0146	0.0137	0.0115	0.0113
"	"	"	90th	0.0154	0.0155	0.0153	0.0144	0.0132	0.0127	0.0124	0.0121	0.0100	0.0098
"	"	"	75th	0.0116	0.0116	0.0114	0.0105	0.0099	0.0095	0.0092	0.0089	0.0073	0.0074
"	"	"	50th	0.0083	0.0084	0.0081	0.0076	0.0075	0.0068	0.0067	0.0064	0.0051	0.0053
"	"	"	25th	0.0053	0.0053	0.0050	0.0045	0.0046	0.0043	0.0040	0.0037	0.0033	0.0033
"	"	"	10th	0.0021	0.0023	0.0023	0.0020	0.0020	0.0020	0.0021	0.0020	0.0017	0.0017
"	"	"	5th	0.0013	0.0016	0.0016	0.0014	0.0015	0.0013	0.0014	0.0015	0.0014	0.0014
"	"	"	Arith. Mean	0.0089	0.0089	0.0087	0.0081	0.0078	0.0073	0.0071	0.0068	0.0056	0.0056
2nd Max. 24hr.	PPM	480	95th	0.0915	0.0920	0.0935	0.0810	0.0710	0.0710	0.0680	0.0710	0.0570	0.0590
"	"	"	90th	0.0725	0.0720	0.0760	0.0650	0.0600	0.0590	0.0580	0.0590	0.0470	0.0465
"	"	"	75th	0.0530	0.0560	0.0530	0.0500	0.0455	0.0443	0.0420	0.0440	0.0330	0.0340
"	"	"	50th	0.0390	0.0400	0.0390	0.0340	0.0320	0.0310	0.0285	0.0320	0.0220	0.0235
"	"	"	25th	0.0245	0.0260	0.0240	0.0215	0.0210	0.0190	0.0190	0.0190	0.0160	0.0160
"	"	"	10th	0.0100	0.0125	0.0120	0.0100	0.0100	0.0100	0.0100	0.0080	0.0080	0.0085
"	"	"	5th	0.0055	0.0065	0.0065	0.0050	0.0060	0.0045	0.0050	0.0050	0.0040	0.0040
"	"	"	Arith. Mean	0.0420	0.0439	0.0420	0.0380	0.0347	0.0335	0.0326	0.0335	0.0259	0.0268

Table A-2. National Carbon Monoxide Emissions Estimates, 1987–1996 (thousand short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FUEL COMBUSTION	***6,967***	***7,379***	***7,449***	***5,510***	***5,856***	***6,155***	***5,586***	***5,519***	***5,934***	***5,962***
Electric Utilities	*307*	*320*	*327*	*363*	*349*	*350*	*363*	*370*	*372*	*377*
coal	223	236	239	234	234	236	246	247	250	263
oil	20	25	26	20	19	15	16	15	10	11
gas	53	48	51	51	51	51	49	53	55	44
internal combustion	10	11	11	57	45	47	51	55	58	59
Industrial	*649*	*669*	*672*	*879*	*920*	*955*	*1,043*	*1,041*	*1,056*	*1,072*
coal	85	87	87	105	101	102	101	100	98	99
oil	46	46	46	74	60	64	66	66	71	72
gas	252	265	271	226	284	300	322	337	345	348
other	171	173	173	279	267	264	286	287	297	305
internal combustion	96	98	96	195	208	227	268	251	245	247
Other	*6,011*	*6,390*	*6,450*	*4,269*	*4,587*	*4,849*	*4,181*	*4,108*	*4,506*	*4,513*
residential wood	5,719	6,086	6,161	3,781	4,090	4,332	3,679	3,607	3,999	3,993
other	292	303	288	488	497	517	502	502	506	520
INDUSTRIAL PROCESSES	***6,851***	***7,034***	***7,013***	***5,852***	***5,740***	***5,683***	***5,898***	***5,839***	***5,790***	***5,817***
Chemical & Allied Processing	*1,798*	*1,917*	*1,925*	*1,183*	*1,127*	*1,112*	*1,093*	*1,171*	*1,223*	*1,223*
Metals Processing	*1,984*	*2,101*	*2,132*	*2,640*	*2,571*	*2,496*	*2,536*	*2,475*	*2,380*	*2,378*
Petroleum & Related Industries	*455*	*441*	*436*	*333*	*345*	*371*	*371*	*338*	*348*	*348*
Other Industrial Processes	*713*	*711*	*716*	*537*	*548*	*544*	*594*	*600*	*624*	*635*
Solvent Utilization	*2*	*2*	*2*	*5*	*5*	*5*	*5*	*5*	*6*	*6*
Storage & Transport	*50*	*56*	*55*	*76*	*28*	*17*	*51*	*24*	*25*	*25*
Waste Disposal & Recycling	*1,850*	*1,806*	*1,747*	*1,079*	*1,116*	*1,138*	*1,248*	*1,225*	*1,185*	*1,203*
TRANSPORTATION	***86,209***	***86,861***	***81,832***	***73,965***	***78,114***	***76,233***	***76,794***	***78,706***	***70,947***	***69,946***
On-Road Vehicles	*71,250*	*71,081*	*66,050*	*57,848*	*62,074*	*59,859*	*60,202*	*61,833*	*54,106*	*52,944*
Non-Road Sources	*14,959*	*15,780*	*15,781*	*16,117*	*16,040*	*16,374*	*16,592*	*16,873*	*16,841*	*17,002*
MISCELLANEOUS	***8,852***	***15,895***	***8,153***	**11,208**	**8,751**	**7,052**	**7,013**	**9,614**	**7,050**	**7,099**
Structural Fires	*242*	*242*	*242*	*164*	*166*	*168*	*169*	*170*	*171*	*172*
Agricultural Fires	*483*	*612*	*571*	*415*	*413*	*421*	*415*	*441*	*465*	*475*
Prescribed Burning	*4,332*	*4,332*	*4,332*	*4,668*	*4,713*	*4,760*	*4,810*	*4,860*	*4,916*	*4,955*
Forest Wildfires	*3,795*	*10,709*	*3,009*	*5,928*	*3,430*	*1,674*	*1,586*	*4,114*	*1,469*	*1,469*
Other	*NA*	*NA*	*NA*	*32*	*28*	*30*	*34*	*28*	*28*	*27*
TOTAL ALL SOURCES	**108,879**	**117,169**	**104,447**	**96,535**	**98,461**	**95,123**	**95,291**	**99,677**	**89,721**	**88,822**

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

Table A-3. National Lead Emissions Estimates, 1987–1996 (short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FUEL COMBUSTION	***510***	***511***	***505***	***500***	***495***	***491***	***495***	***494***	***487***	***493***
Electric Utilities	*64*	*66*	*67*	*64*	*61*	*59*	*61*	*61*	*57*	*62*
coal	48	46	46	46	46	47	49	49	50	50
oil	16	20	21	18	15	12	12	12	7	12
Industrial	*22*	*19*	*18*	*18*	*18*	*18*	*19*	*18*	*16*	*17*
coal	14	14	14	14	15	14	14	14	14	14
oil	8	5	4	3	3	4	5	4	3	3
Other	*425*	*426*	*420*	*418*	*416*	*414*	*415*	*415*	*414*	*414*
commercial/institutional coal	5	5	4	4	3	4	4	3	3	3
commercial/institutional oil	5	5	4	4	4	4	3	3	3	4
misc. fuel comb. (except res.)	400	400	400	400	400	400	400	400	400	400
residential other	14	16	12	10	9	7	8	8	8	7
INUSTRIAL PROCESSES	***3,004***	***3,090***	***3,161***	***3,278***	***3,081***	***2,734***	***2,869***	***3,005***	***2,892***	***2,812***
Chemical & Allied Processing	*123*	*136*	*136*	*136*	*132*	*93*	*92*	*96*	*144*	*117*
Metals Processing	*1,835*	*1,965*	*2,088*	*2,169*	*1,975*	*1,773*	*1,899*	*2,027*	*2,067*	*2,000*
Other Industrial Processes	*202*	*172*	*173*	*169*	*167*	*56*	*54*	*53*	*59*	*57*
Waste Disposal & Recycling	*844*	*817*	*765*	*804*	*807*	*812*	*824*	*829*	*622*	*638*
TRANSPORTATION	***4,167***	***3,452***	***1,802***	***1,197***	***592***	***584***	***547***	***544***	***564***	***564***
On-Road Vehicles	*3,317*	*2,567*	*982*	*421*	*18*	*18*	*19*	*19*	*19*	*19*
Non-Road Sources	*850*	*885*	*820*	*776*	*574*	*565*	*529*	*525*	*545*	*545*
TOTAL ALL SOURCES	**7,681**	**7,053**	**5,468**	**4,975**	**4,168**	**3,808**	**3,911**	**4,043**	**3,943**	**3,869**

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

Table A-4. National Nitrogen Oxides Emissions Estimates, 1987–1996 (thousand short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FUEL COMBUSTION	***10,014***	***10,472***	***10,537***	***10,895***	***10,779***	***10,928***	***11,111***	***11,015***	***10,827***	***10,494***
Electric Utilities	*6,246*	*6,545*	*6,593*	*6,663*	*6,519*	*6,504*	*6,651*	*6,565*	*6,384*	*6,034*
coal	5,376	5,666	5,676	5,642	5,559	5,579	5,744	5,636	5,579	5,517
oil	217	273	285	221	212	170	180	163	96	96
gas	605	557	582	565	580	579	551	591	562	461
internal combustion	48	50	49	235	168	175	176	175	148	151
Industrial	*3,063*	*3,187*	*3,209*	*3,035*	*2,979*	*3,071*	*3,151*	*3,147*	*3,144*	*3,170*
coal	596	617	615	585	570	574	589	602	597	599
oil	292	296	294	265	237	244	245	241	247	246
gas	1,505	1,584	1,625	1,182	1,250	1,301	1,330	1,333	1,324	1,336
other	119	121	120	131	129	126	124	124	123	125
internal combustion	552	569	556	874	793	825	863	846	854	864
Other	*706*	*740*	*736*	*1,196*	*1,281*	*1,353*	*1,308*	*1,303*	*1,298*	*1,289*
commercial/institutional coal	37	39	38	40	36	38	40	40	38	38
commercial/institutional oil	121	117	106	97	88	93	93	95	103	102
commercial/institutional gas	144	157	159	200	210	225	232	237	231	234
misc. fuel comb. (except res.)	11	11	11	34	32	28	31	31	30	29
residential wood	69	74	75	46	50	53	45	44	49	48
residential other	323	343	347	780	865	916	867	857	847	838
INDUSTRIAL PROCESSES	***841***	***860***	***852***	***892***	***816***	***857***	***861***	***878***	***873***	***880***
Chemical & Allied Processing	*255*	*274*	*273*	*168*	*165*	*163*	*155*	*160*	*158*	*159*
Metals Processing	*75*	*82*	*83*	*97*	*76*	*81*	*83*	*91*	*98*	*98*
Petroleum & Related Industries	*101*	*100*	*97*	*153*	*121*	*148*	*123*	*117*	*110*	*110*
Other Industrial Processes	*320*	*315*	*311*	*378*	*352*	*361*	*370*	*389*	*399*	*403*
Solvent Utilization	*3*	*3*	*3*	*1*	*2*	*3*	*3*	*3*	*3*	*3*
Storage & Transport	*2*	*2*	*2*	*3*	*6*	*5*	*5*	*5*	*6*	*6*
Waste Disposal & Recycling	*85*	*85*	*84*	*91*	*95*	*96*	*123*	*114*	*99*	*100*
TRANSPORTATION	***11,598***	***12,467***	***12,374***	***11,633***	***11,891***	***12,098***	***12,285***	***12,616***	***11,998***	***11,781***
On-Road Vehicles	*7,651*	*7,661*	*7,682*	*7,040*	*7,373*	*7,440*	*7,510*	*7,672*	*7,323*	*7,171*
Non-Road Sources	*3,947*	*4,806*	*4,693*	*4,593*	*4,518*	*4,658*	*4,776*	*4,944*	*4,675*	*4,610*
MISCELLANEOUS	***352***	***727***	***293***	***371***	***286***	***254***	***225***	***383***	***237***	***239***
TOTAL ALL SOURCES	**22,806**	**24,526**	**24,057**	**23,792**	**23,772**	**24,137**	**24,482**	**24,892**	**23,935**	**23,393**

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

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1987–1996 (thousand short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FUEL COMBUSTION	***1,283***	***1,360***	***1,372***	***1,005***	***1,075***	***1,114***	***993***	***989***	***1,073***	***1,075***
Electric Utilities	*35*	*37*	*38*	*47*	*44*	*44*	*45*	*45*	*44*	*45*
coal	25	27	27	27	27	27	29	29	29	31
oil	6	7	7	6	5	4	4	4	3	3
gas	2	2	2	2	2	2	2	2	2	2
internal combustion	1	1	1	12	10	10	10	10	10	10
Industrial	*131*	*136*	*134*	*182*	*196*	*187*	*186*	*196*	*206*	*208*
coal	7	7	7	7	6	7	6	8	6	6
oil	16	16	16	12	11	12	12	12	12	12
gas	57	61	61	58	60	52	51	63	73	73
other	36	36	36	51	51	49	51	50	50	51
internal combustion	15	15	15	54	68	66	66	64	65	66
Other	*1,117*	*1,188*	*1,200*	*776*	*835*	*884*	*762*	*748*	*823*	*822*
residential wood	1,085	1,155	1,169	718	776	822	698	684	759	758
other	32	33	31	58	59	62	64	63	64	64
INDUSTRIAL PROCESSES	***10,535***	***10,854***	***10,755***	***10,000***	***10,178***	***10,380***	***10,578***	***10,738***	***10,780***	***9,482***
Chemical & Allied Processing	*923*	*982*	*980*	*634*	*710*	*715*	*701*	*691*	*660*	*436*
Metals Processing	*70*	*74*	*74*	*122*	*123*	*124*	*124*	*126*	*125*	*70*
Petroleum & Related Industries	*655*	*645*	*639*	*612*	*640*	*632*	*649*	*647*	*642*	*517*
Other Industrial Processes	*394*	*408*	*403*	*401*	*391*	*414*	*442*	*438*	*450*	*439*
Solvent Utilization	*5,743*	*5,945*	*5,964*	*5,750*	*5,782*	*5,901*	*6,016*	*6,162*	*6,183*	*6,273*
Storage & Transport	*1,801*	*1,842*	*1,753*	*1,495*	*1,532*	*1,583*	*1,600*	*1,629*	*1,652*	*1,312*
Waste Disposal & Recycling	*950*	*959*	*941*	*986*	*999*	*1,010*	*1,046*	*1,046*	*1,067*	*433*
TRANSPORTATION	***10,721***	***10,722***	***9,613***	***8,815***	***9,003***	***8,622***	***8,684***	***9,021***	***8,135***	***7,928***
On-Road Vehicles	*8,477*	*8,290*	*7,192*	*6,313*	*6,499*	*6,072*	*6,103*	*6,401*	*5,701*	*5,502*
Non-Road Sources	*2,244*	*2,432*	*2,422*	*2,502*	*2,503*	*2,551*	*2,581*	*2,619*	*2,433*	*2,426*
MISCELLANEOUS	***655***	***1,230***	***642***	***1,164***	***845***	***579***	***641***	***798***	***599***	***601***
Other Combustion	*655*	*1,230*	*641*	*1,064*	*756*	*485*	*535*	*710*	*511*	*516*
structural fires	44	44	44	29	30	30	30	30	31	31
agricultural fires	67	85	79	48	48	49	48	51	54	55
slash/prescribed burning	182	182	182	234	236	239	241	246	252	256
forest wildfires	361	918	335	749	439	164	212	379	171	171
other	NA	NA	NA	3	3	3	3	3	3	3
Other	*0*	*1*	*1*	*100*	*89*	*94*	*105*	*88*	*88*	*85*
TOTAL ALL SOURCES	**23,194**	**24,167**	**22,383**	**20,985**	**21,100**	**20,695**	**20,895**	**21,546**	**20,586**	**19,086**

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

Table A-6. National Particulate Matter (PM_{10}) Emissions Estimates, 1987–1996 (thousand short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FUEL COMBUSTION	***1,335***	***1,384***	***1,386***	***1,196***	***1,147***	***1,183***	***1,124***	***1,113***	***1,179***	***1,186***
Electric Utilities	*284*	*279*	*274*	*295*	*257*	*257*	*279*	*273*	*268*	*282*
coal	271	265	259	265	232	234	253	246	244	258
oil	9	10	11	9	10	7	9	8	5	5
gas	1	1	1	1	1	0	1	1	1	1
internal combustion	3	3	3	20	15	16	17	17	18	18
Industrial	*239*	*244*	*243*	*270*	*233*	*243*	*257*	*270*	*302*	*306*
coal	67	70	70	84	72	74	71	70	70	71
oil	48	48	48	52	44	45	45	44	49	50
gas	44	45	44	41	34	40	43	43	45	45
other	78	79	78	87	72	74	86	74	73	75
internal combustion	3	3	3	6	10	11	12	38	64	65
Other	*812*	*862*	*869*	*631*	*657*	*683*	*588*	*570*	*610*	*598*
residential wood	758	807	817	501	535	558	464	446	484	472
other	54	55	52	130	122	124	124	125	126	126
INUDSTRIAL PROCESSES	***1,288***	***1,294***	***1,276***	***1,306***	***1,264***	***1,269***	***1,240***	***1,219***	***1,231***	***1,232***
Chemical & Allied Processing	*58*	*62*	*63*	*77*	*68*	*71*	*66*	*76*	*67*	*67*
Metals Processing	*194*	*208*	*211*	*214*	*251*	*250*	*181*	*184*	*212*	*211*
Petroleum & Related Industries	*62*	*60*	*58*	*55*	*43*	*43*	*38*	*38*	*40*	*40*
Other Industrial Processes	*606*	*601*	*591*	*583*	*520*	*506*	*501*	*495*	*511*	*510*
Solvent Utilization	*2*	*2*	*2*	*4*	*5*	*5*	*6*	*6*	*6*	*6*
Storage & Transport	*100*	*101*	*101*	*102*	*101*	*117*	*114*	*106*	*109*	*109*
Waste Disposal & Recycling	*265*	*259*	*251*	*271*	*276*	*278*	*334*	*313*	*287*	*290*
TRANSPORTATION	***881***	***1,041***	***1,016***	***934***	***947***	***961***	***954***	***972***	***883***	***869***
On-Road Vehicles	*360*	*369*	*367*	*336*	*349*	*343*	*321*	*320*	*293*	*274*
Non-Road Sources	*520*	*672*	*649*	*598*	*598*	*618*	*633*	*652*	*590*	*595*
TOTAL ALL SOURCES	**3,504**	**3,721**	**3,678**	**3,436**	**3,358**	**3,413**	**3,318**	**3,305**	**3,293**	**3,288**

Table A-7. Miscellaneous and Natural PM_{10} Emissions Estimates, 1987–1996 (thousand short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
MISCELLANEOUS	***37,453***	***39,444***	***37,461***	**24,419**	**24,122**	**23,865**	**24,196**	**25,461**	**22,454**	**22,702**
Agriculture & Forestry	*7,326*	*7,453*	*7,320*	5,146	5,106	4,909	4,475	4,690	4,661	4,708
Other Combustion	*988*	*1,704*	*912*	1,203	941	785	768	1,048	778	783
wildfires	389	1,086	300	601	332	171	152	424	145	145
managed burning	540	559	553	558	563	568	570	578	586	591
other	59	59	59	45	45	46	46	46	46	47
Cooling Towers	*NA*	*NA*	*NA*	0	0	0	0	0	1	1
Fugitive Dust	*29,139*	*30,287*	*29,229*	18,069	18,076	18,171	18,954	19,722	17,013	17,209
wind erosion	0	0	0	1	1	1	1	1	1	1
unpaved roads	11,110	12,379	11,798	11,234	11,206	10,918	11,430	11,370	10,362	10,303
paved roads	5,530	5,900	5,769	2,248	2,399	2,423	2,462	2,538	2,409	2,417
construction	12,121	11,662	11,269	4,249	4,092	4,460	4,651	5,245	3,654	3,950
other	377	346	392	336	377	369	409	569	586	538
NAT. SOURCES (wind erosion)	***1,577***	***18,110***	***12,101***	**2,092**	**2,077**	**2,227**	**509**	**2,160**	**1,146**	**5,316**
TOTAL ALL SOURCES	**39,030**	**57,555**	**49,562**	**26,512**	**26,199**	**26,093**	**24,706**	**27,621**	**23,599**	**28,018**

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

Table A-8. National Sulfur Dioxide Emissions Estimates, 1987–1996 (thousand short tons)

Source Category	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FUEL COMBUSTION	***19,549***	***19,881***	***20,050***	***20,290***	***19,796***	***19,493***	***19,245***	***18,887***	***16,230***	***16,786***
Electric Utilities	*15,819*	*16,110*	*16,340*	*15,909*	*15,784*	*15,416*	*15,189*	*14,889*	*12,080*	*12,604*
coal	15,138	15,344	15,529	15,220	15,087	14,824	14,527	14,313	11,603	12,114
oil	651	15,344	15,529	639	652	546	612	522	413	412
gas	1	1	1	1	1	1	1	1	9	21
internal combustion	29	31	30	49	45	46	49	53	55	57
Industrial	*3,068*	*3,111*	*3,086*	*3,550*	*3,256*	*3,292*	*3,284*	*3,218*	*3,357*	*3,399*
coal	1,817	1,856	1,840	1,914	1,805	1,783	1,763	1,740	1,728	1,762
oil	807	806	812	927	779	801	809	777	912	918
gas	356	360	346	543	516	552	555	542	548	548
other	82	83	82	158	142	140	140	141	147	147
internal combustion	6	6	6	9	14	16	17	19	23	23
Other	*662*	*660*	*624*	*831*	*755*	*784*	*772*	*780*	*793*	*782*
commercial/institutional coal	164	172	169	212	184	190	193	192	200	200
commercial/institutional oil	310	295	274	425	376	396	381	391	397	389
commercial/institutional gas	2	2	2	7	7	7	8	8	8	8
misc. fuel comb. (except res.)	1	1	1	6	6	6	6	6	5	5
residential wood	10	11	11	7	7	8	6	6	7	7
other	175	180	167	175	176	177	178	177	176	173
INDUSTRIAL PROCESSES	***1,976***	***2,052***	***2,010***	***1,900***	***1,721***	***1,758***	***1,723***	***1,676***	***1,637***	***1,644***
Chemical & Allied Processing	*425*	*449*	*440*	*297*	*280*	*278*	*269*	*275*	*286*	*287*
Metals Processing	*648*	*707*	*695*	*726*	*612*	*615*	*603*	*562*	*530*	*530*
Petroleum & Related Industries	*445*	*443*	*429*	*430*	*378*	*416*	*383*	*379*	*369*	*368*
Other Industrial Processes	*418*	*411*	*405*	*399*	*396*	*396*	*392*	*398*	*403*	*409*
Solvent Utilization	*1*	*1*	*1*	*0*	*0*	*1*	*1*	*1*	*1*	*1*
Storage & Transport	*4*	*5*	*5*	*7*	*10*	*9*	*5*	*2*	*2*	*2*
Waste Disposal & Recycling	*35*	*36*	*36*	*42*	*44*	*44*	*71*	*60*	*47*	*48*
TRANSPORTATION	***771***	***806***	***837***	***934***	***969***	***980***	***903***	***685***	***676***	***674***
On-Road Vehicles	*538*	*553*	*570*	*542*	*570*	*578*	*517*	*301*	*304*	*307*
Non-Road Sources	*233*	*253*	*267*	*392*	*399*	*402*	*385*	*384*	*372*	*368*
TOTAL ALL SOURCES	**22,308**	**22,767**	**22,907**	**23,136**	**22,496**	**22,240**	**21,879**	**21,262**	**18,552**	**19,113**

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

Table A-9. National Long-Term Air Quality Trends, 1977–1996

Year	CO 2nd Max. 8hr. ppm	Pb Max. Qtr. µg/m^3	NO_2 Arith. Mean ppm	Ozone 2nd Max. 1hr. ppm	PM_{10} Wtd. Arith. Mean µg/m^3	SO_2 Arith. Mean ppm
1977-86	***(168 sites)***	***(122 sites)***	***(65 sites)***	***(238 sites)***	**—**	***(278 sites)***
1977	10.9	1.35	0.026	0.152	—	0.0133
1978	10.5	1.26	0.027	0.156	—	0.0128
1979	10.1	1.06	0.026	0.141	—	0.0125
1980	9.3	0.73	0.024	0.143	—	0.0112
1981	8.9	0.59	0.023	0.131	—	0.0108
1982	8.2	0.50	0.022	0.127	—	0.0100
1983	8.2	0.40	0.022	0.144	—	0.0098
1984	8.1	0.36	0.023	0.128	—	0.0099
1985	7.3	0.25	0.023	0.127	—	0.0092
1986	7.3	0.16	0.022	0.122	—	0.0091
1987-96	***(345 sites)***	***(208 sites)***	***(214 sites)***	***(600 sites)***	***(900 sites)***	***(479 sites)***
1987	6.7	0.16	0.021	0.124	—	0.0089
1988	6.4	0.12	0.022	0.133	32.2	0.0089
1989	6.4	0.09	0.021	0.116	32.0	0.0087
1990	5.9	0.09	0.020	0.113	29.4	0.0081
1991	5.6	0.07	0.020	0.114	29.1	0.0078
1992	5.2	0.06	0.019	0.106	26.8	0.0073
1993	4.9	0.05	0.019	0.108	26.0	0.0071
1994	5.1	0.04	0.020	0.108	26.2	0.0068
1995	4.5	0.04	0.019	0.113	25.1	0.0056
1996	4.2	0.04	0.019	0.106	24.2	0.0056

Table A-10. National Air Quality Trends Statistics by Monitoring Location, 1987–1996

Statistic	Units	# of Sites	Location	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Carbon Monoxide													
2nd Max. 8hr.	ppm	10	Rural	3.5	3.1	2.8	2.6	2.4	2.4	2.1	2.3	2.2	1.9
"	"	142	Suburban	6.3	6.0	6.0	5.5	5.2	4.9	4.8	4.9	4.3	4.0
"	"	190	Urban	7.2	6.9	6.8	6.3	6.0	5.5	5.1	5.4	4.8	4.5
Lead													
Max. Qtr.	ug/m^3	5	Rural	0.08	0.06	0.05	0.05	0.05	0.04	0.04	0.02	0.03	0.02
"	"	107	Suburban	0.13	0.09	0.08	0.07	0.06	0.05	0.04	0.04	0.04	0.03
"	"	96	Urban	0.19	0.15	0.10	0.11	0.07	0.06	0.06	0.05	0.05	0.05
Nitrogen Dioxide													
Arith. Mean	ppm	46	Rural	0.008	0.009	0.008	0.008	0.008	0.008	0.007	0.008	0.007	0.007
"	"	89	Suburban	0.023	0.023	0.023	0.022	0.022	0.021	0.020	0.021	0.020	0.020
"	"	77	Urban	0.027	0.027	0.027	0.025	0.025	0.024	0.024	0.025	0.024	0.024
Ozone													
2nd Max. 1hr.	ppm	194	Rural	0.115	0.124	0.110	0.109	0.107	0.102	0.104	0.103	0.108	0.104
"	"	276	Suburban	0.129	0.140	0.119	0.116	0.119	0.110	0.112	0.112	0.117	0.108
"	"	113	Urban	0.127	0.134	0.115	0.111	0.112	0.104	0.105	0.106	0.110	0.106
PM_{10}													
Wtd. Arith. Mean	ug/m^3	119	Rural	—	25.3	25.5	23.9	22.8	21.4	19.9	20.2	19.3	19.3
"	"	356	Suburban	—	33.3	32.9	30.3	29.9	27.7	27.0	27.0	26.1	24.9
"	"	404	Urban	—	33.4	33.1	30.4	30.4	27.8	27.2	27.3	26.0	25.2
Sulfur Dioxide													
Arith. Mean	ppm	138	Rural	0.0073	0.0073	0.0071	0.0067	0.0065	0.0063	0.0063	0.0060	0.0054	0.0052
"	"	191	Suburban	0.0094	0.0095	0.0091	0.0085	0.0082	0.0077	0.0075	0.0071	0.0057	0.0058
"	"	139	Urban	0.0099	0.0101	0.0099	0.0090	0.0086	0.0079	0.0076	0.0075	0.0059	0.0058

Table A-11. Maximum Air Quality Concentrations by County, 1996

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
AL	CALHOUN	116,034	.	.	.	.	31	.
AL	CLAY	13,252	.	.	.	0.102	.	.
AL	COLBERT	51,666	.	.	.	.	46	0.019
AL	DE KALB	54,651	.	.	.	.	45	
AL	ELMORE	49,210	.	.	.	0.102	.	.
AL	ESCAMBIA	35,518	.	.	.	.	41	.
AL	ETOWAH	99,840	.	0.26	.	.	50	.
AL	FRANKLIN	27,814	.	.	.	.	45	.
AL	GENEVA	23,647	.	.	.	0.077	.	.
AL	HOUSTON	81,331	.	.	.	.	54	.
AL	JACKSON	47,796	.	.	.	.	33	0.027
AL	JEFFERSON	651,525	5.7	0.13	.	0.141	100	0.015
AL	LAWRENCE	31,513	.	.	.	0.096	.	.
AL	LIMESTONE	54,135	.	.	.	.	43	.
AL	MADISON	238,912	3	.	.	0.102	54	.
AL	MARENGO	23,084	.	.	.	.	52	.
AL	MOBILE	378,643	.	.	.	0.104	91	0.07
AL	MONTGOMERY	209,085	1.5	.	0.01	0.091	39	0.022
AL	MORGAN	100,043	.	.	.	0.114	45	0.001
AL	PIKE	27,595	.	0.79	.	.	45	.
AL	RUSSELL	46,860	.	.	.	.	38	.
AL	SHELBY	99,358	.	.	0.01	0.127	42	.
AL	SUMTER	16,174	.	.	.	0.08	.	.
AL	TALLADEGA	74,107	.	.	.	.	53	.
AL	TUSCALOOSA	150,522	.	.	.	.	58	.
AL	WALKER	67,670	.	.	.	.	46	.
AK	ANCHORAGE BOROUGH	226,338	10.5	.	.	.	133	.
AK	FAIRBANKS NORTH STAR BOROUGH	77,720	8.6	.	.	.		
AK	JUNEAU BOROUGH	26,751	.	.	.	.	79	.
AK	YUKON-KOYUKUK CA	8,478	.	.	.	0.057	.	.
AZ	COCHISE	97,624	.	.	.	0.079	69	.
AZ	COCONINO	96,591	.	.	.	0.082	31	.
AZ	GILA	40,216	.	.	.	.	66	.
AZ	GRAHAM	26,554	.	.	.	.	84	.
AZ	MARICOPA	2,122,101	10	0.05	0.0316	0.122	130	0.017
AZ	NAVAJO	77,658	.	.	.	.	28	.
AZ	PIMA	666,880	5.1	0.05	0.019	0.092	81	0.004
AZ	PINAL	116,379	.	.	.	.	.	0.02
AZ	SANTA CRUZ	29,676	.	.	.	.	88	
AZ	YAVAPAI	107,714	.	.	.	.	22	.
AZ	YUMA	106,895	.	.	.	0.098	59	.
AR	ARKANSAS	21,653	.	.	.	.	70	.
AR	ASHLEY	24,319	.	.	.	.	55	.
AR	CRAIGHEAD	68,956	.	.	.	.	53	.
AR	CRITTENDEN	49,939	.	.	.	0.114	58	.
AR	GARLAND	73,397	.	.	.	.	40	.
AR	JEFFERSON	85,487	.	.	.	.	51	.
AR	MARION	12,001	.	.	.	.	51	.
AR	MILLER	38,467	.	.	.	.	50	.
AR	MONTGOMERY	7,841	.	.	.	0.07	.	.
AR	NEWTON	7,666	.	.	.	0.08	.	.
AR	OUACHITA	30,574	.	.	.	.	45	.
AR	PHILLIPS	28,838	.	.	.	.	64	.
AR	POLK	17,347	.	.	.	.	47	.
AR	POPE	45,883	.	.	.	.	46	.
AR	PULASKI	349,660	3.8	.	0.0108	0.102	52	0.009
AR	SEBASTIAN	99,590	.	.	.	.	47	.
AR	UNION	46,719	.	.	.	.	47	0.023
AR	WASHINGTON	113,409	.	.	.	.	48	.
AR	WHITE	54,676	.	.	.	.	49	.
CA	ALAMEDA	1,279,182	3.8	0	0.0218	0.137	44	.
CA	AMADOR	30,039	1.4	.	.	0.127	.	.
CA	BUTTE	182,120	5.3	0	0.013	0.096	62	.
CA	CALAVERAS	31,998	0.8	.	.	0.13	33	.
CA	COLUSA	16,275	.	.	.	0.101	73	.
CA	CONTRA COSTA	803,732	2.7	0.02	0.0172	0.117	45	
CA	DEL NORTE	23,460	.	.	.	.	40	
CA	EL DORADO	125,995	4.8	.	0.0107	0.13	64	
CA	FRESNO	667,490	6.7	0	0.0214	0.151	101	0.008
CA	GLENN	24,798	.	.	.	0.092	79	.
CA	HUMBOLDT	119,118	.	0	.	.	56	.
CA	IMPERIAL	109,303	14.1	0.05	0.0143	0.143	440	0.013

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (μgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (μgm)	SO_2 24-hr (ppm)
CA	INYO	18,281	.	.	.	0.091	221	.
CA	KERN	543,477	5.6	0	0.029	0.163	110	0.009
CA	KINGS	101,469	.	.	0.0144	0.139	138	.
CA	LAKE	50,631	.	.	.	0.08	20	.
CA	LASSEN	27,598	.	.	.	.	35	.
CA	LOS ANGELES	8,863,164	14.5	0.06	0.0481	0.197	109	
CA	MADERA	88,090	.	.	.	0.128	68	.
CA	MARIN	230,096	3.4	.	0.0181	0.095	47	.
CA	MARIPOSA	14,302	.	.	.	0.11	96	.
CA	MENDOCINO	80,345	2.4	.	0.0125	0.055	49	.
CA	MERCED	178,403	.	.	0.0116	0.124	57	.
CA	MODOC	9,678	.	.	.	.	53	.
CA	MONO	9,956	3	.	.	0.09	81	.
CA	MONTEREY	355,660	2.4	.	0.0105	0.091	40	.
CA	NAPA	110,765	3.8	.	0.0141	0.089	39	.
CA	NEVADA	78,510	.	.	.	0.111	86	.
CA	ORANGE	2,410,556	6.6	.	0.0351	0.144	77	0.004
CA	PLACER	172,796	2.3	0	0.0156	0.131	45	.
CA	PLUMAS	19,739	.	.	.	0.09	61	.
CA	RIVERSIDE	1,170,413	5	0.04	0.0286	0.182	155	0.004
CA	SACRAMENTO	1,041,219	7.1	0.01	0.022	0.138	80	0.005
CA	SAN BENITO	36,697	.	.	.	0.118	35	
CA	SAN BERNARDINO	1,418,380	6.6	0.04	0.0383	0.215	123	
CA	SAN DIEGO	2,498,016	6	0.02	0.0218	0.133	92	
CA	SAN FRANCISCO	723,959	5.1	0.01	0.0215	0.061	59	
CA	SAN JOAQUIN	480,628	6.7	0	0.0232	0.126	61	
CA	SAN LUIS OBISPO	217,162	2.3	.	0.0125	0.109		
CA	SAN MATEO	649,623	3.4	.	0.0196	0.091	45	
CA	SANTA BARBARA	369,608	4.5	0	0.0191	0.13	63	
CA	SANTA CLARA	1,497,577	5.8	0.01	0.0251	0.115	68	
CA	SANTA CRUZ	229,734	0.7	.	0.0054	0.102	69	
CA	SHASTA	147,036	.	.	.	0.11	50	.
CA	SIERRA	3,318	.	.	.	.	114	.
CA	SISKIYOU	43,531	.	.	.	0.07	35	.
CA	SOLANO	340,421	4.5	.	0.0147	0.117	43	0.006
CA	SONOMA	388,222	3	.	0.0139	0.085	39	.
CA	STANISLAUS	370,522	5.6	0	0.0219	0.125	83	.
CA	SUTTER	64,415	4.1	.	0.0123	0.108	69	.
CA	TEHAMA	49,625	.	.	.	0.09	49	.
CA	TRINITY	13,063	.	.	.	.	63	.
CA	TULARE	311,921	3.9	.	0.0182	0.139	87	.
CA	TUOLUMNE	48,456	2.5	.	.	0.117	.	.
CA	VENTURA	669,016	3.3	0	0.0223	0.144	79	0.003
CA	YOLO	141,092	1.3	.	0.0107	0.113	65	.
CO	ADAMS	265,038	3.9	0.05	0.0215	0.089	96	0.015
CO	ALAMOSA	13,617	.	.	.	.	92	.
CO	ARAPAHOE	391,511	2.6	.	0.0316	0.103	.	.
CO	ARCHULETA	5,345	.	.	.	.	85	.
CO	BOULDER	225,339	5.5	.	.	0.092	59	.
CO	DELTA	20,980	.	.	.	.	67	.
CO	DENVER	467,610	7.3	0.05	0.0331	0.092	70	0.024
CO	DOUGLAS	60,391	.	.	.	0.102	26	.
CO	EAGLE	21,928	.	.	.	.	52	.
CO	EL PASO	397,014	5	0.01	.	0.077	76	
CO	FREMONT	32,273	.	.	.	.	37	.
CO	GARFIELD	29,974	.	.	.	.	78	.
CO	GUNNISON	10,273	.	.	.	0.086	91	.
CO	JEFFERSON	438,430	4.3	.	0.009	0.107	39	.
CO	LAKE	6,007	.	0.04	.	.	.	.
CO	LA PLATA	32,284	.	.	.	.	92	
CO	LARIME	186,136	5.1	.	.	0.093	52	.
CO	MESA	93,145	5.8	.	.	.	63	.
CO	MONTEZUMA	18,672	.	0.01	.	0.077	.	.
CO	MONTROSE	24,423	.	.	.	.	60	.
CO	PITKIN	12,661	.	.	.	.	66	.
CO	PROWERS	13,347	.	.	.	.	80	.
CO	PUEBLO	123,051	.	.	.	.	49	.
CO	ROUTT	14,088	.	.	.	.	137	.
CO	SAN MIGUEL	3,653	.	.	.	.	105	
CO	SUMMIT	12,881	.	.	.	.	56	.
CO	TELLER	12,468	.	.	.	.	195	.
CO	WELD	131,821	7	.	.	0.097	56	.

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (μgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (μgm)	SO_2 24-hr (ppm)
CT	FAIRFIELD	827,645	4.1	0.02	0.0235	0.126	65	0.026
CT	HARTFORD	851,783	4.5	0.03	0.0161	0.091	49	0.022
CT	LITCHFIELD	174,092	.	.	.	0.112	50	.
CT	MIDDLESEX	143,196	.	.	.	0.102	38	.
CT	NEW HAVEN	804,219	2.9	0.05	0.026	0.12	109	
CT	NEW LONDON	254,957	.	.	.	0.121	56	
CT	TOLLAND	128,699	.	.	0.006	0.101	.	0.013
CT	WINDHAM	102,525	.	.	.	.	35	.
DE	KENT	110,993	.	.	.	0.11	.	.
DE	NEW CASTLE	441,946	3.6	.	0.019	0.108	81	
DE	SUSSEX	113,229	.	.	.	0.109	50	0.023
DC	WASHINGTON	606,900	4.5	0.02	0.0264	0.11	49	0.025
FL	ALACHUA	181,596	.	.	.	.	44	.
FL	BAY	126,994	.	.	.	.	50	.
FL	BREVARD	398,978	.	.	.	0.087	44	.
FL	BROWARD	1,255,488	4.4	0.05	0.0095	0.103	48	0.008
FL	CALHOUN	11,011	.	.	.	0.08	.	.
FL	COLLIER	152,099	.	.	.	.	45	.
FL	DADE	1,937,094	4.6	0.01	0.016	0.097	62	0.005
FL	DUVAL	672,971	3.8	0.02	0.0149	0.096	53	0.024
FL	ESCAMBIA	262,798	.	.	.	0.098	37	0.033
FL	GULF	11,504	.	.	.	.	47	.
FL	HAMILTON	10,930	.	.	.	.	62	0.019
FL	HILLSBOROUGH	834,054	3.9	2.81	0.0098	0.113	81	0.087
FL	LEE	335,113	.	.	.	0.08	38	.
FL	LEON	192,493	.	.	.	0.087	33	.
FL	MANATEE	211,707	.	.	.	0.091	48	.
FL	MARTIN	100,900	.	.	.	.	42	.
FL	NASSAU	43,941	.	.	.	.	61	0.03
FL	ORANGE	677,491	4.1	0	0.0126	0.104	67	0.008
FL	OSCEOLA	107,728	.	.	.	0.096	.	.
FL	PALM BEACH	863,518	3.6	0	0.012	0.09	56	
FL	PASCO	281,131	.	.	.	0.086	.	.
FL	PINELLAS	851,659	2.8	0	0.0112	0.092	50	0.033
FL	POLK	405,382	.	.	.	0.092	45	0.021
FL	PUTNAM	65,070	.	.	.	.	45	0.019
FL	ST JOHNS	83,829	.	.	.	0.09	.	
FL	ST LUCIE	150,171	.	.	.	0.072	.	
FL	SARASOTA	277,776	5.1	.	.	0.094	73	0.018
FL	SEMINOLE	287,529	.	.	.	0.092	49	.
FL	VOLUSIA	370,712	.	.	.	0.085	63	.
GA	BARTOW	55,911	.	.	.	.	.	0.014
GA	BIBB	149,967	.	.	.	.	34	.
GA	CHATHAM	216,935	.	.	.	0.085	.	0.03
GA	CHATTOOGA	22,242	.	.	.	.	51	.
GA	DE KALB	545,837	3.7	0.02	0.0175	0.13	56	
GA	DOUGHERTY	96,311	.	.	.	.	21	.
GA	ELBERT	18,949	.	.	.	.	48	.
GA	FANNIN	15,992	.	.	.	0.091	.	0.033
GA	FLOYD	81,251	.	.	.	.	.	0.016
GA	FULTON	648,951	3.8	0.03	0.0266	0.137	60	0.022
GA	GLYNN	62,496	.	.	.	0.086	30	.
GA	GWINNETT	352,910	.	.	.	0.109	.	.
GA	MUSCOGEE	179,278	.	0.65	.	0.095	58	.
GA	PAULDING	41,611	.	.	0.0052	0.114	.	.
GA	RICHMOND	189,719	.	.	.	0.099	44	.
GA	ROCKDALE	54,091	.	.	0.0059	0.123	.	.
GA	SPALDING	54,457	.	.	.	.	48	.
GA	WASHINGTON	19,112	.	.	.	.	59	.
HI	HONOLULU	836,231	3	0.03	0.0031	0.047	29	0.009
HI	KAUAI	51,177	.	.	.	.	36	.
ID	ADA	205,775	5	.	0.0228	.	90	.
ID	BANNOCK	66,026	.	.	0.0144	.	89	0.03
ID	BLAINE	13,552	.	.	.	.	52	.
ID	BONNER	26,622	.	.	.	.	78	.
ID	BONNEVILLE	72,207	.	.	.	.	76	.
ID	BUTTE	2,918	.	.	.	0.081	.	.
ID	CANYON	90,076	.	.	.	.	74	.
ID	CARIBOU	6,963	.	.	.	.	72	.
ID	KOOTENAI	69,795	.	.	.	.	76	.
ID	LEMHI	6,899	.	.	.	.	100	.
ID	LEWIS	3,516	.	.	.	.	63	.

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (μgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (μgm)	SO_2 24-hr (ppm)
ID	MADISON	23,674	.	.	.	.	67	.
ID	MINIDOKA	19,361	.	.	.	.	62	.
ID	NEZ PERCE	33,754	5.9	.	.	.	63	
ID	SHOSHONE	13,931	.	0.1	.	.	101	.
ID	TWIN FALLS	53,580	.	.	.	.	64	
IL	ADAMS	66,090	.	.	.	0.099	41	0.03
IL	CHAMPAIGN	173,025	.	.	.	0.094	39	0.013
IL	COLES	51,644	.	.	.	.	44	.
IL	COOK	5,105,067	4.9	0.54	0.032	0.117	122	0.032
IL	DU PAGE	781,666	.	0.05	.	0.087	56	
IL	EFFINGHAM	31,704	.	.	.	0.097	.	
IL	JACKSON	61,067	.	.	.	.	37	.
IL	JERSEY	20,539	.	.	.	0.102	.	.
IL	KANE	317,471	.	.	.	0.096	.	.
IL	LAKE	516,418	.	.	0.008	0.125	.	.
IL	LA SALLE	106,913	.	.	.	.	111	
IL	MC HENRY	183,241	.	.	.	0.094	.	
IL	MACON	117,206	.	0.02	.	0.1	53	0.022
IL	MACOUPIN	47,679	0.7	0.01	.	0.102	39	0.012
IL	MADISON	249,238	2.5	3.1	.	0.127	107	0.102
IL	PEORIA	182,827	4.6	0.02	.	0.091	43	0.047
IL	RANDOLPH	34,583	.	.	.	0.093	89	0.06
IL	ROCK ISLAND	148,723	.	0.02	.	0.081	48	
IL	ST CLAIR	262,852	.	0.11	0.0202	0.089	63	
IL	SANGAMON	178,386	3	.	.	0.098	26	0.061
IL	TAZEWELL	123,692	.	.	.	.	44	0.043
IL	WABASH	13,111	.	.	.	.	.	0.043
IL	WILL	357,313	0.9	0.02	0.009	0.093	47	0.023
IL	WINNEBAGO	252,913	3.2	0.05	.	0.089	36	.
IN	ALLEN	300,836	2.7	0.02	.	0.105	70	.
IN	CLARK	87,777	.	.	.	0.098	54	.
IN	DAVIESS	27,533	.	.	.	.	.	0.05
IN	DEARBORN	38,835	.	.	.	.	.	0.045
IN	DE KALB	35,324	0.7	0	0.0074	0.082	80	
IN	DELAWARE	119,659	.	0.94	.	.	.	.
IN	DUBOIS	36,616	.	.	.	.	52	.
IN	ELKHART	156,198	.	.	.	0.115	.	.
IN	FLOYD	64,404	.	.	.	0.119	.	0.038
IN	FOUNTAIN	17,808	.	.	.	.	.	0.037
IN	GIBSON	31,913	.	.	.	.	.	0.076
IN	HAMILTON	108,936	.	.	.	0.116	.	.
IN	HANCOCK	45,527	.	.	.	0.12	.	.
IN	JASPER	24,960	.	.	.	.	41	0.012
IN	JEFFERSON	29,797	.	.	.	.	.	0.013
IN	KNOX	39,884	.	.	.	0.103	.	.
IN	LAKE	475,594	3.7	0.21	0.0208	0.113	95	0.031
IN	LA PORTE	107,066	.	.	.	0.128	.	
IN	MADISON	130,669	.	.	.	0.121	46	.
IN	MARION	797,159	3.1	0.16	0.0179	0.121	71	0.041
IN	MORGAN	55,920	.	.	.	.	.	0.027
IN	PIKE	12,509	.	.	.	.	.	0.054
IN	PORTER	128,932	.	.	.	0.132	208	0.026
IN	POSEY	25,968	.	.	.	0.064	.	0.04
IN	ST JOSEPH	247,052	2.5	.	0.0155	0.11	45	
IN	SPENCER	19,490	.	.	.	.	.	0.03
IN	SULLIVAN	18,993	.	.	.	.	.	0.022
IN	TIPPECANOE	130,598	1.1	.	0.0126	.	34	0.02
IN	VANDERBURGH	165,058	4.1	.	0.0117	0.105	45	0.04
IN	VERMILLION	16,773	.	.	.	.	44	.
IN	VIGO	106,107	2.6	.	.	0.112	53	0.039
IN	WARRICK	44,920	.	.	.	0.115	.	0.097
IN	WAYNE	71,951	.	.	.	.	.	0.036
IA	BLACK HAWK	123,798	.	.	.	.	59	
IA	CERRO GORDO	46,733	.	.	.	.	151	
IA	CLINTON	51,040	.	.	.	.	78	0.042
IA	DELAWARE	18,035	.	.	.	.	45	.
IA	DUBUQUE	86,403	.	.	.	.	.	0.022
IA	EMMET	11,569	.	.	.	.	39	.
IA	LEE	38,687	.	.	.	.	.	0.045
IA	LINN	168,767	7.8	.	.	0.073	65	0.2
IA	MUSCATINE	39,907	.	.	.	.	72	0.086
IA	POLK	327,140	4	.	.	0.082	130	.

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
IA	POTTAWATTAMIE	82,628	.	0.37	.	.	.	.
IA	SCOTT	150,979	.	.	.	0.09	153	0.024
IA	UNION	12,750	.	.	.	.	49	.
IA	VAN BUREN	7,676	.	.	.	0.082	.	
IA	WOODBURY	98,276	.	.	.	.	95	.
KS	CLOUD	11,023	.	0.01	.	.	48	.
KS	FORD	27,463	.	0.01	.	.	48	.
KS	GREELEY	1,774	.	0.01	.	.	102	.
KS	JOHNSON	355,054	.	0.01	.	.	67	.
KS	KEARNEY	4,027	.	.	.	.	69	.
KS	MIAMI	23,466	.	.	.	0.1	.	.
KS	MORTON	3,480	.	0.01	.	.	81	.
KS	PAWNEE	7,555	0.3	.	.	0.08	.	0.001
KS	SEDGWICK	403,662	6.4	0.02	.	0.095	119	0.007
KS	SHAWNEE	160,976	.	0.01	.	.	58	.
KS	SHERMAN	6,926	0.3	0.01	.	0.05	74	0.001
KS	WYANDOTTE	161,993	2.7	0.07	0.0216	0.106	120	0.057
KY	BELL	31,506	3.5	.	.	0.092	47	.
KY	BOONE	57,589	.	.	.	0.101	.	.
KY	BOYD	51,150	3.7	.	0.013	0.102	86	0.057
KY	BULLITT	47,567	.	.	0.0133	0.11	49	.
KY	CAMPBELL	83,866	.	.	0.0185	0.115	62	0.029
KY	CHRISTIAN	68,941	.	.	.	0.1	39	0.019
KY	DAVIESS	87,189	2.7	.	0.0114	0.107	59	0.02
KY	EDMONSON	10,357	.	.	.	0.107	.	.
KY	FAYETTE	225,366	3.1	.	0.0137	0.096	60	0.02
KY	FLOYD	43,586	.	.	.	.	50	.
KY	GRAVES	33,550	.	.	.	0.086	.	.
KY	GREENUP	36,742	.	0.02	.	0.097	.	0.023
KY	HANCOCK	7,864	.	.	.	0.11	.	0.025
KY	HARDIN	89,240	.	.	.	0.093	49	.
KY	HARLAN	36,574	.	.	.	.	51	.
KY	HENDERSON	43,044	2	.	0.0173	0.108	59	0.041
KY	JEFFERSON	664,937	5.6	0.02	0.0202	0.121	61	0.03
KY	JESSAMINE	30,508	.	.	.	0.082	.	.
KY	KENTON	142,031	3.3	.	0.0192	0.112	56	.
KY	LAWRENCE	13,998	.	.	.	0.082	54	0
KY	LIVINGSTON	9,062	.	.	.	0.105	51	0.021
KY	MC CRACKEN	62,879	3.2	.	0.0116	0.087	61	
KY	MC LEAN	9,628	.	.	.	0.094	.	
KY	MADISON	57,508	.	.	.	.	53	.
KY	MARSHALL	27,205	.	.	.	.	54	.
KY	OLDHAM	33,263	.	.	.	0.109	.	.
KY	PERRY	30,283	.	.	.	0.09	43	.
KY	PIKE	72,583	.	.	.	0.087	37	.
KY	PULASKI	49,489	.	.	.	0.083	55	.
KY	SCOTT	23,867	.	.	.	0.095	.	.
KY	SIMPSON	15,145	.	.	0.0141	0.094	.	.
KY	TRIGG	10,361	.	.	.	0.101	.	.
KY	WARREN	76,673	.	.	.	.	46	.
KY	WHITLEY	33,326	.	.	.	.	44	.
KY	WOODFORD	19,955	.	0.04	.	.	.	.
LA	ASCENSION PARISH	58,214	.	.	.	0.121	.	.
LA	BEAUREGARD PARISH	30,083	.	.	0.0054	0.092	.	.
LA	BOSSIER PARISH	86,088	.	.	.	0.096	44	0.004
LA	CADDO PARISH	248,253	.	.	.	0.1	47	.
LA	CALCASIEU PARISH	168,134	.	.	0.0056	0.101	33	0.018
LA	EAST BATON ROUGE PARISH	380,105	4.7	0.15	0.0208	0.118		
LA	GRANT PARISH	17,526	.	.	.	0.085	.	.
LA	IBERVILLE PARISH	31,049	.	.	0.0105	0.139	42	.
LA	JEFFERSON PARISH	448,306	.	.	0.0118	0.1	.	.
LA	LAFAYETTE PARISH	164,762	.	.	.	0.098	25	.
LA	LAFOURCHE PARISH	85,860	.	.	.	0.094	.	.
LA	LIVINGSTON PARISH	70,526	.	.	0.0051	0.116	.	.
LA	ORLEANS PARISH	496,938	4	0.02	0.0178	0.091	44	.
LA	OUACHITA PARISH	142,191	.	.	.	0.089	76	0.007
LA	POINTE COUPEE PARISH	22,540	.	.	0.0068	0.102	.	
LA	RAPIDES PARISH	131,556	.	.	.	.	42	.
LA	ST BERNARD PARISH	66,631	.	.	.	0.105	.	
LA	ST CHARLES PARISH	42,437	.	.	.	0.102	64	
LA	ST JAMES PARISH	20,879	.	.	0.0133	0.113	.	
LA	ST JOHN THE BAPTIST PARISH	39,996	.	0.09	.			

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (μgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (μgm)	SO_2 24-hr (ppm)
LA	ST MARY PARISH	58,086	.	.	.	0.092	.	
LA	WEST BATON ROUGE PARISH	19,419	.	0.03	0.0153	0.114		
ME	ANDROSCOGGIN	105,259	.	.	.	.	37	0.018
ME	AROOSTOOK	86,936	.	.	.	.	104	0.04
ME	CUMBERLAND	243,135	.	.	.	0.1	61	0.021
ME	FRANKLIN	29,008	.	.	.	.	39	.
ME	HANCOCK	46,948	.	.	0.001	0.1	51	.
ME	KENNEBEC	115,904	.	.	.	0.096	64	.
ME	KNOX	36,310	.	.	.	0.104	39	.
ME	OXFORD	52,602	.	.	.	0.079	41	0.013
ME	PENOBSCOT	146,601	.	.	.	0.082	70	0.02
ME	PISCATAQUIS	18,653	.	.	.	0.07	.	.
ME	SAGADAHOC	33,535	.	.	.	0.108	.	.
ME	SOMERSET	49,767	.	.	.	0.093	26	.
ME	YORK	164,587	.	.	0.0106	0.104	37	.
MD	ALLEGANY	74,946	.	.	.	.	47	0.019
MD	ANNE ARUNDEL	427,239	.	.	.	0.126	44	
MD	BALTIMORE	692,134	3	.	0.019	0.122	44	.
MD	CALVERT	51,372	.	.	.	0.094	.	.
MD	CARROLL	123,372	.	.	.	0.113	.	.
MD	CECIL	71,347	.	.	.	0.119	41	.
MD	CHARLES	101,154	.	.	.	0.099	.	.
MD	GARRETT	28,138	.	.	.	.	61	.
MD	HARFORD	182,132	.	.	0.0092	0.131	.	.
MD	KENT	17,842	.	.	.	0.107	.	.
MD	MONTGOMERY	757,027	3	.	.	0.108	.	.
MD	PRINCE GEORGES	729,268	4.5	.	.	0.116	50	
MD	WICOMICO	74,339	.	.	.	.	34	.
MD	BALTIMORE	736,014	4.2	0.03	0.0269	0.108	75	0.024
MA	BARNSTABLE	186,605	.	.	.	0.124	.	.
MA	BERKSHIRE	139,352	.	.	.	0.108	.	.
MA	BRISTOL	506,325	.	.	0.0075	0.118	44	0.043
MA	ESSEX	670,080	.	.	0.0157	0.105	34	0.027
MA	HAMPDEN	456,310	7.7	.	0.0238	0.108	67	0.028
MA	HAMPSHIRE	146,568	.	.	0.0074	0.11	40	0.017
MA	MIDDLESEX	1,398,468	4.5	.	.	0.102	51	0.032
MA	NORFOLK	616,087	.	.	.	.	55	.
MA	PLYMOUTH	435,276	.	.	.	0.088	.	.
MA	SUFFOLK	663,906	4.7	.	0.031	0.089	80	0.037
MA	WORCESTER	709,705	5.3	.	0.0193	0.091	46	0.021
MI	ALLEGAN	90,509	.	.	0.0091	0.123	.	.
MI	BENZIE	12,200	.	.	.	0.108	.	.
MI	BERRIEN	161,378	.	.	.	0.125	.	.
MI	CALHOUN	135,982	.	.	.	.	57	.
MI	CASS	49,477	.	.	.	0.115	.	.
MI	CLINTON	57,883	.	.	.	0.077	.	.
MI	DELTA	37,780	.	.	.	.	.	0.011
MI	GENESEE	430,459	.	0.01	.	0.113	45	0.012
MI	HURON	34,951	.	.	.	0.098	.	.
MI	INGHAM	281,912	.	.	.	0.096	.	.
MI	KALAMAZOO	223,411	1.5	0.01	0.0114	0.102	33	0.011
MI	KENT	500,631	3.3	0.01	.	0.127	71	0.011
MI	LENAWEE	91,476	.	.	.	0.104	.	.
MI	MACOMB	717,400	2.8	.	0.012	0.108	.	0.022
MI	MARQUETTE	70,887	.	.	.	.	78	.
MI	MASON	25,537	.	.	.	0.128	.	.
MI	MECOSTA	37,308	.	.	.	0.11	.	.
MI	MONROE	133,600	.	.	.	.	45	.
MI	MUSKEGON	158,983	.	0.01	.	0.123	.	.
MI	OAKLAND	1,083,592	2.6	.	.	0.09	.	.
MI	OTTAWA	187,768	.	.	.	0.113	.	.
MI	ROSCOMMON	19,776	.	.	.	0.099	.	.
MI	ST CLAIR	145,607	.	.	.	0.113	.	
MI	VAN BUREN	70,060	.	0.01	0.0083	.	.	
MI	WASHTENAW	282,937	.	.	.	0.099	.	.
MI	WAYNE	2,111,687	6.2	0.04	0.0214	0.098	106	0.079
MN	ANOKA	243,641	.	.	.	0.078	.	.
MN	CARLTON	29,259	.	.	.	.	27	.
MN	DAKOTA	275,227	1.1	0.55	0.0157	0.081	.	0.024
MN	DOUGLAS	28,674	.	.	.	.	6	.
MN	GOODHUE	40,690	.	.	.	.	19	.
MN	HENNEPIN	1,032,431	4.7	0.01	0.0281	.	91	0.013

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
MN	KOOCHICHING	16,299	.	.	.	0.074	22	0.011
MN	LAKE	10,415	.	.	.	0.074	.	.
MN	MORRISON	29,604	.	.	.	.	24	.
MN	OLMSTED	106,470	.	.	.	.	44	0.016
MN	PINE	21,264	.	.	.	.	13	.
MN	PIPESTONE	10,491	.	.	.	.	21	.
MN	RAMSEY	485,765	7.3	0.01	0.0193	.	89	0.01
MN	ST LOUIS	198,213	4.5	.	.	0.074	58	
MN	SHERBURNE	41,945	.	.	.	.	38	0.011
MN	STEARNS	118,791	4	.	.	.	.	.
MN	WASHINGTON	145,896	.	.	.	0.09	48	0.041
MN	WRIGHT	68,710	.	.	0.0083	.	.	0.007
MS	ADAMS	35,356	.	.	.	0.094	.	.
MS	CHOCTAW	9,071	1.2	0.01	0.0043	0.055	14	0.006
MS	COAHOMA	31,665	.	.	.	.	37	.
MS	DE SOTO	67,910	.	.	.	0.145	.	
MS	HANCOCK	31,760	.	.	.	0.104	.	.
MS	HARRISON	165,365	.	.	.	.	.	0.043
MS	HINDS	254,441	4.8	.	.	0.097	55	0.008
MS	JACKSON	115,243	.	.	.	0.101	33	0.017
MS	JONES	62,031	.	.	.	.	44	.
MS	LAUDERDALE	75,555	.	.	.	0.091	.	.
MS	LEE	65,581	.	.	.	0.086	.	.
MS	MADISON	53,794	.	.	.	0.088	.	.
MS	SHARKEY	7,066	.	.	.	0.09	.	.
MS	WARREN	47,880	.	.	.	0.097	40	.
MS	WASHINGTON	67,935	.	.	.	.	39	.
MO	AUDRAIN	23,599	.	.	.	.	40	.
MO	BUCHANAN	83,083	.	.	.	.	126	0.079
MO	CHRISTIAN	32,644	.	.	.	.	148	.
MO	CLAY	153,411	4.4	.	0.0132	0.114	.	0.009
MO	GREENE	207,949	3.3	.	0.0113	0.095	101	0.089
MO	HOLT	6,034	.	0.82	.	.	.	.
MO	HOWELL	31,447	.	.	.	.	1321	.
MO	IRON	10,726	.	9.89	.	.	.	0.084
MO	JACKSON	633,232	3.8	0.01	0.0178	0.094	73	0.033
MO	JEFFERSON	171,380	.	5.74	.	0.113	43	0.078
MO	MARION	27,682	.	.	.	.	34	.
MO	MONROE	9,104	.	.	.	0.098	35	0.01
MO	PLATTE	57,867	.	.	0.0124	0.092	.	0.008
MO	ST CHARLES	212,907	.	.	0.0107	0.122	41	
MO	STE GENEVIEVE	16,037	.	.	0.004	0.122	47	
MO	ST LOUIS	993,529	4.2	0.03	0.0218	0.11	57	
MO	TANEY	25,561	1.1	.	.	.	.	.
MO	ST LOUIS	396,685	6.4	.	0.0248	0.116	85	0.04
MT	BIG HORN	11,337	.	.	.	.	103	
MT	BROADWATER	3,318	.	.	.	.	61	0.014
MT	CASCADE	77,691	5.4	.	.	.	59	0.02
MT	FERGUS	12,083	.	.	.	.	38	.
MT	FLATHEAD	59,218	11.1	.	.	0.064	91	.
MT	GALLATIN	50,463	.	.	.	.	74	.
MT	GLACIER	12,121	.	.	.	.	54	.
MT	JEFFERSON	7,939	.	.	.	.	34	0.055
MT	LAKE	21,041	.	.	.	.	122	.
MT	LEWIS AND CLARK	47,495	.	3.12	.	.		
MT	LINCOLN	17,481	.	.	.	.	94	.
MT	MADISON	5,989	.	.	.	.	30	.
MT	MISSOULA	78,687	5.6	.	.	.	112	.
MT	PARK	14,562	.	.	.	.	48	.
MT	PHILLIPS	5,163	.	.	.	.	30	.
MT	RAVALLI	25,010	.	.	.	.	69	.
MT	ROOSEVELT	10,999	.	.	.	.	53	.
MT	ROSEBUD	10,505	.	.	0.0057	.	120	0.011
MT	SANDERS	8,669	.	.	.	.	109	.
MT	SILVER BOW	33,941	.	.	.	.	90	
MT	STILLWATER	6,536	.	.	.	.	35	.
MT	YELLOWSTONE	113,419	7.1	.	.	.	75	0.099
NE	ADAMS	29,625	.	.	.	.	60	.
NE	BUFFALO	37,447	.	.	.	.	74	.
NE	CASS	21,318	.	.	.	.	145	.
NE	DAWSON	19,940	.	.	.	.	99	.
NE	DOUGLAS	416,444	6.9	5.06	.	0.074	81	0.051

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
NE	LANCASTER	213,641	4.7	.	.	0.06	63	.
NE	OTOE	14,252	.	.	.	.	41	.
NE	SCOTTS BLUFF	36,025	.	.	.	.	51	
NV	CHURCHILL	17,938	.	.	.	.	61	.
NV	CLARK	741,459	10.1	.	0.0271	0.096	328	.
NV	DOUGLAS	27,637	2.1	.	0.0101	0.083	82	.
NV	ELKO	33,530	.	.	.	.	107	.
NV	LANDER	6,266	.	.	.	.	143	.
NV	PERSHING	4,336	.	.	.	.	144	.
NV	WASHOE	254,667	7.6	.	.	0.096	131	.
NV	WHITE PINE	9,264	.	.	.	0.081	55	
NV	CARSON CITY	40,443	.	.	.	.	52	.
NH	BELKNAP	49,216	.	.	.	0.088	.	.
NH	CARROLL	35,410	.	.	.	0.079	.	.
NH	CHESHIRE	70,121	.	.	.	0.091	46	0.024
NH	COOS	34,828	.	.	.	.	61	0.045
NH	GRAFTON	74,929	.	.	.	0.07	.	.
NH	HILLSBOROUGH	336,073	7.6	.	0.0192	0.103	44	0.026
NH	MERRIMACK	120,005	.	.	.	0.095	38	0.033
NH	ROCKINGHAM	245,845	.	.	0.0125	0.107	42	0.015
NH	STRAFFORD	104,233	.	.	.	0.098	38	.
NH	SULLIVAN	38,592	.	.	.	0.09	37	0.017
NJ	ATLANTIC	224,327	3.6	0.01	.	0.108	40	0.014
NJ	BERGEN	825,380	4	.	0.0278	0.106	61	0.026
NJ	BURLINGTON	395,066	4.6	.	.	.	.	0.023
NJ	CAMDEN	502,824	5	0.08	0.0235	0.125	65	0.027
NJ	CUMBERLAND	138,053	.	.	.	0.105	.	0.016
NJ	ESSEX	778,206	3.8	0.07	0.0322	0.115	67	0.027
NJ	GLOUCESTER	230,082	.	.	.	0.118	43	0.024
NJ	HUDSON	553,099	6.7	0.03	0.0272	0.12	83	0.03
NJ	HUNTERDON	107,776	.	.	.	0.108	.	.
NJ	MERCER	325,824	.	.	0.0169	0.121	59	.
NJ	MIDDLESEX	671,780	3.3	0.06	0.0203	0.125	46	0.024
NJ	MONMOUTH	553,124	4.6	.	.	0.123	.	.
NJ	MORRIS	421,353	5.4	.	0.0114	0.114	.	0.023
NJ	OCEAN	433,203	4.2	.	.	0.118	.	.
NJ	PASSAIC	453,060	.	0	.	.	48	.
NJ	SALEM	65,294	.	0.02	.	.	.	.
NJ	UNION	493,819	6	.	0.0412	0.111	60	0.03
NJ	WARREN	91,607	.	.	.	.	53	.
NM	BERNALILLO	480,577	7.1	.	0.022	0.098	94	.
NM	CHAVES	57,849	.	.	.	.	37	.
NM	CIBOLA	23,794	.	.	.	.	18	.
NM	DONA ANA	135,510	4.3	0.07	0.009	0.124	143	
NM	EDDY	48,605	.	.	0.0051	.	.	0.007
NM	GRANT	27,676	.	.	.	.	40	0.02
NM	HIDALGO	5,958	.	.	.	.	35	0.022
NM	LEA	55,765	.	.	.	.	35	.
NM	LUNA	18,110	.	.	.	.	49	.
NM	MC KINLEY	60,686	.	.	.	.	34	
NM	OTERO	51,928	.	.	.	.	70	.
NM	SANDOVAL	63,319	1.4	.	0.0077	0.088	39	.
NM	SAN JUAN	91,605	2.9	.	0.0068	.	31	
NM	SANTA FE	98,928	2.2	.	.	.	33	
NM	TAOS	23,118	.	.	.	.	103	.
NM	VALENCIA	45,235	.	.	.	0.079	.	.
NY	ALBANY	292,594	.	0.03	0.0146	0.105	45	0.025
NY	BRONX	1,203,789	3.3	.	0.0355	0.122	55	0.055
NY	BROOME	212,160	.	.	.	.	34	.
NY	CHAUTAUQUA	141,895	.	.	.	0.097	33	0.039
NY	CHEMUNG	95,195	.	.	.	0.088	24	0.016
NY	DUTCHESS	259,462	.	.	.	0.109	.	.
NY	ERIE	968,532	3.7	0.03	0.0224	0.091	39	0.041
NY	ESSEX	37,152	.	.	.	0.093	25	0.009
NY	GREENE	44,739	.	.	.	.	49	.
NY	HAMILTON	5,279	.	.	.	0.076	.	0.008
NY	HERKIMER	65,797	.	.	.	0.073	30	0.009
NY	JEFFERSON	110,943	.	.	.	0.084	.	.
NY	KINGS	2,300,664	6.1	0.16	0.0347	0.114	57	0.038
NY	MADISON	69,120	.	.	.	0.082	.	0.015
NY	MONROE	713,968	3.9	0.04	.	0.083	54	0.041
NY	NASSAU	1,287,348	4.9	.	0.0258	.	55	0.031

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
NY	NEW YORK	1,487,536	6.3	0.06	0.0422	.	87	
NY	NIAGARA	220,756	2.7	0.02	.	0.099	78	0.048
NY	ONEIDA	250,836	.	.	.	0.076	43	.
NY	ONONDAGA	468,973	3.9	.	.	0.088	61	0.012
NY	ORANGE	307,647	.	0.06	.	0.12	.	.
NY	PUTNAM	83,941	.	.	.	0.122	37	0.015
NY	QUEENS	1,951,598	.	.	.	0.108	.	0.035
NY	RENSSELAER	154,429	.	.	.	.	42	0.011
NY	RICHMOND	378,977	.	0.04	.	0.117	45	0.027
NY	ROCKLAND	265,475	.	.	.	.	50	.
NY	SARATOGA	181,276	.	.	.	0.091	45	.
NY	SCHENECTADY	149,285	3.7	.	.	0.085	48	0.021
NY	STEUBEN	99,088	.	.	.	.	26	.
NY	SUFFOLK	1,321,864	.	.	.	0.12	40	0.025
NY	ULSTER	165,304	.	.	.	0.095	51	0.011
NY	WARREN	59,209	.	.	.	.	40	0.013
NY	WAYNE	89,123	.	.	.	0.086	.	.
NY	WESTCHESTER	874,866	.	.	.	0.115	.	.
NC	ALAMANCE	108,213	.	.	.	.	50	.
NC	ALEXANDER	27,544	.	.	.	0.094	60	0.012
NC	BEAUFORT	42,283	.	.	.	.	33	0.024
NC	BUNCOMBE	174,821	.	.	.	0.084	76	.
NC	CABARRUS	98,935	.	.	.	.	46	.
NC	CARTERET	52,556	.	.	.	0.09	.	.
NC	CASWELL	20,693	0.4	.	.	0.108	.	.
NC	CATAWBA	118,412	.	.	.	.	50	.
NC	CHATHAM	38,759	.	.	.	0.1	37	.
NC	COLUMBUS	49,587	.	.	.	.	.	0.006
NC	CUMBERLAND	274,566	4.1	.	.	0.106	53	0.012
NC	DAVIDSON	126,677	.	.	.	.	49	.
NC	DAVIE	27,859	.	.	.	0.103	.	.
NC	DUPLIN	39,995	.	.	.	0.083	.	0.01
NC	DURHAM	181,835	5.4	.	.	0.103	46	.
NC	EDGECOMBE	56,558	.	.	.	0.091	39	0.01
NC	FORSYTH	265,878	4.3	.	0.0164	0.119	58	0.026
NC	FRANKLIN	36,414	0.8	.	.	0.107	.	.
NC	GASTON	175,093	3.6	.	.	.	52	.
NC	GRANVILLE	38,345	0.7	.	.	0.124	44	.
NC	GUILFORD	347,420	3.8	.	.	0.109	54	.
NC	HALIFAX	55,516	.	.	.	.	51	.
NC	HARNETT	67,822	.	.	.	.	45	.
NC	HAYWOOD	46,942	.	.	.	0.095	49	.
NC	HENDERSON	69,285	.	.	.	.	53	.
NC	JOHNSTON	81,306	.	.	.	0.102	.	0.01
NC	LINCOLN	50,319	.	.	.	0.1	50	0.013
NC	MC DOWELL	35,681	.	.	.	.	59	
NC	MACON	23,499	.	.	.	0.08	.	.
NC	MECKLENBURG	511,433	5.1	.	0.0163	0.13	53	0.015
NC	MITCHELL	14,433	.	.	.	.	59	.
NC	NEW HANOVER	120,284	.	.	.	0.09	46	
NC	NORTHAMPTON	20,798	.	.	.	.	.	0.012
NC	ONSLOW	149,838	.	.	.	.	37	.
NC	ORANGE	93,851	5.1	.	.	.	.	.
NC	PASQUOTANK	31,298	.	.	.	.	33	.
NC	PITT	107,924	.	.	.	0.097	36	.
NC	ROBESON	105,179	.	.	.	.	53	.
NC	ROCKINGHAM	86,064	.	.	.	0.123	.	.
NC	ROWAN	110,605	0.8	.	0.008	0.133	47	.
NC	SWAIN	11,268	.	.	.	0.075	48	0.01
NC	WAKE	423,380	5.6	.	.	0.107	49	.
NC	WATAUGA	36,952	.	.	.	.	46	.
NC	WAYNE	104,666	.	.	.	.	43	.
NC	WILSON	66,061	.	.	.	.	41	.
NC	YANCEY	15,419	.	.	.	0.09	.	0.003
ND	BILLINGS	1,108	.	.	.	.	.	0.007
ND	BURLEIGH	60,131	.	.	.	.	27	.
ND	CASS	102,874	.	.	0.008	0.075	54	0.008
ND	DUNN	4,005	.	.	.	.	.	0.007
ND	GRAND FORKS	70,683	.	.	.	.	53	
ND	MC KENZIE	6,383	.	.	.	0.063	.	
ND	MERCER	9,808	.	.	0.0043	0.062	45	0.033
ND	MORTON	23,700	.	.	.	.	.	0.056

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
ND	OLIVER	2,381	.	.	0.003	0.063	.	0.013
ND	STARK	22,832	.	.	.	.	23	.
ND	STEELE	2,420	.	.	0.0027	0.068	38	0.006
ND	WILLIAMS	21,129	.	.	.	.	23	0.013
OH	ADAMS	25,371	.	.	.	.	.	0.026
OH	ALLEN	109,755	.	.	.	0.11	44	0.015
OH	ASHTABULA	99,821	.	.	.	0.105	.	0.022
OH	ATHENS	59,549	.	.	.	.	47	.
OH	BELMONT	71,074	.	.	.	.	86	0.057
OH	BUTLER	291,479	.	0.05	.	0.115	78	0.026
OH	CLARK	147,548	.	.	.	0.116	.	0.031
OH	CLERMONT	150,187	.	.	.	0.104	.	0.025
OH	CLINTON	35,415	.	.	.	0.118	.	.
OH	COLUMBIANA	108,276	.	0.04	0.0191	.	86	0.057
OH	CUYAHOGA	1,412,140	9.4	1.06	0.0259	0.108	123	0.049
OH	FRANKLIN	961,437	2.7	0.07	.	0.107	66	0.021
OH	FULTON	38,498	.	0.44	.	.	.	.
OH	GREENE	136,731	.	.	.	.	27	.
OH	HAMILTON	866,228	2.8	0.22	0.0285	0.107	72	0.036
OH	HANCOCK	65,536	.	.	.	.	44	.
OH	JEFFERSON	80,298	5.3	.	0.0197	0.094	126	0.055
OH	KNOX	47,473	.	.	.	0.113	.	.
OH	LAKE	215,499	1.9	.	.	0.117	42	0.037
OH	LAWRENCE	61,834	.	.	.	0.123	53	0.018
OH	LICKING	128,300	.	.	.	0.108	20	.
OH	LOGAN	42,310	.	0.26	.	0.097	.	.
OH	LORAIN	271,126	.	.	.	0.099	67	0.032
OH	LUCAS	462,361	2.6	.	.	0.113	69	0.049
OH	MADISON	37,068	.	.	.	0.107	.	.
OH	MAHONING	264,806	.	.	.	0.102	47	0.03
OH	MEDINA	122,354	.	.	.	0.096	.	.
OH	MEIGS	22,987	.	.	.	.	.	0.027
OH	MIAMI	93,182	.	.	.	0.11	.	.
OH	MONROE	15,497	.	.	.	.	66	.
OH	MONTGOMERY	573,809	3	0.05	.	0.112	66	0.022
OH	MORGAN	14,194	.	.	.	.	.	0.057
OH	NOBLE	11,336	.	.	.	.	48	.
OH	OTTAWA	40,029	.	.	.	.	38	.
OH	PORTAGE	142,585	.	.	.	0.107	.	.
OH	PREBLE	40,113	.	.	.	0.111	.	.
OH	RICHLAND	126,137	.	.	.	.	68	.
OH	SANDUSKY	61,963	.	.	.	.	79	.
OH	SCIOTO	80,327	.	.	.	.	60	0.023
OH	SENECA	59,733	.	.	.	.	58	.
OH	STARK	367,585	2.5	.	.	0.097	68	0.032
OH	SUMMIT	514,990	3.4	0.04	.	0.103	73	0.042
OH	TRUMBULL	227,813	.	.	.	0.107	43	.
OH	TUSCARAWAS	84,090	.	.	.	.	.	0.034
OH	WARREN	113,909	.	.	.	0.11	.	.
OH	WASHINGTON	62,254	.	.	.	0.105	78	.
OH	WYANDOT	22,254	.	.	.	.	66	.
OK	CARTER	42,919	.	.	.	.	52	.
OK	CLEVELAND	174,253	2.7	.	0.0132	0.088	56	.
OK	COMANCHE	111,486	1.6	.	0.0087	0.077	56	.
OK	GARFIELD	56,735	.	.	0.0094	.	.	.
OK	GARVIN	26,605	.	.	.	.	.	0.014
OK	KAY	48,056	.	.	.	.	70	0.02
OK	MC CLAIN	22,795	.	.	.	0.089	.	.
OK	MAYES	33,366	.	.	.	.	60	.
OK	MUSKOGEE	68,078	.	.	0.0085	.	91	0.021
OK	OKLAHOMA	599,611	7.9	0.01	0.0139	0.102	54	0.005
OK	TULSA	503,341	6.8	0.11	0.015	0.115	76	0.042
OK	WOODWARD	18,976	.	.	.	.	69	.
OR	CLACKAMAS	278,850	.	.	.	0.133	39	.
OR	COLUMBIA	37,557	.	.	.	0.094	.	.
OR	DESCHUTES	74,958	5.3	.	.	.	123	.
OR	JACKSON	146,389	6.6	0.02	.	0.101	82	.
OR	JOSEPHINE	62,649	6	.	.	.	62	.
OR	KLAMATH	57,702	4.8	.	.	.	86	.
OR	LAKE	7,186	.	.	.	.	68	.
OR	LANE	282,912	5.7	0.02	.	0.111	78	.
OR	MARION	228,483	7.1	.	.	0.117	.	.

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
OR	MULTNOMAH	583,887	6.5	0.02	0.0182	.	70	.
OR	UMATILLA	59,249	.	.	.	.	66	.
OR	UNION	23,598	.	.	.	.	121	.
OR	YAMHILL	65,551	.	0.11	.	.	.	.
PA	ADAMS	78,274	.	.	.	0.099	.	.
PA	ALLEGHENY	1,336,449	4.3	0.07	0.0303	0.113	123	0.07
PA	BEAVER	186,093	2.1	0.06	0.018	0.105	76	0.058
PA	BERKS	336,523	3.4	0.82	0.0219	0.11	66	0.037
PA	BLAIR	130,542	1.9	.	0.0134	0.101	60	0.033
PA	BUCKS	541,174	4.7	.	0.0211	0.12	58	0.028
PA	CAMBRIA	163,029	4.8	0.05	0.0175	0.098	63	0.034
PA	CARBON	56,846	.	0.08	.	.	.	.
PA	CENTRE	123,786	.	.	.	0.089	.	.
PA	CHESTER	376,396	.	.	.	.	69	.
PA	DAUPHIN	237,813	2.3	0.04	0.021	0.104	63	0.022
PA	DELAWARE	547,651	.	0.04	0.0214	0.117	69	0.025
PA	ERIE	275,572	.	.	0.0148	0.1	56	0.066
PA	FRANKLIN	121,082	.	.	.	0.096	.	.
PA	LACKAWANNA	219,039	3.5	.	0.0176	0.113	61	0.033
PA	LANCASTER	422,822	2.6	0.04	0.0172	0.101	69	0.021
PA	LAWRENCE	96,246	3.5	.	0.0237	0.097	91	0.034
PA	LEHIGH	291,130	3.2	.	0.0175	0.114	54	0.035
PA	LUZERNE	328,149	4.1	.	0.0176	0.105	60	0.023
PA	LYCOMING	118,710	.	.	.	0.082	46	0.028
PA	MERCER	121,003	.	0.07	.	0.103	52	0.029
PA	MONTGOMERY	678,111	2.9	0.04	0.0209	0.118	58	0.028
PA	NORTHAMPTON	247,105	3.1	0.04	0.0238	0.11	65	0.033
PA	PERRY	41,172	.	.	0.0083	0.09	39	0.02
PA	PHILADELPHIA	1,585,577	5.6	9.23	0.0339	0.13	356	0.063
PA	SCHUYLKILL	152,585	2.2	.	.	.	.	0.027
PA	WARREN	45,050	.	.	.	.	.	0.032
PA	WASHINGTON	204,584	2.5	.	0.0173	0.103	72	0.035
PA	WESTMORELAND	370,321	.	0.04	.	0.104	43	.
PA	YORK	339,574	2.8	0.07	0.0206	0.098	53	0.022
RI	KENT	161,135	.	.	0.0031	0.107	33	.
RI	PROVIDENCE	596,270	4.4	.	0.0249	0.112	83	0.032
SC	ABBEVILLE	23,862	.	.	.	0.083	.	.
SC	AIKEN	120,940	.	0	.	0.105	41	.
SC	ANDERSON	145,196	.	0.01	.	0.098	54	.
SC	BARNWELL	20,293	.	.	.	0.095	39	.
SC	BEAUFORT	86,425	.	0.01	.	.	.	.
SC	BERKELEY	128,776	.	.	.	0.099	.	.
SC	CHARLESTON	295,039	4.7	0.02	0.0102	0.099	54	0.021
SC	CHEROKEE	44,506	.	.	.	0.103	.	.
SC	CHESTER	32,170	.	.	.	0.095	.	.
SC	DARLINGTON	61,851	.	.	.	0.093	.	.
SC	EDGEFIELD	18,375	.	.	.	0.092	.	.
SC	FAIRFIELD	22,295	.	.	.	.	46	.
SC	FLORENCE	114,344	.	0.01	.	.	.	.
SC	GEORGETOWN	46,302	.	0.02	.	.	94	0.011
SC	GREENVILLE	320,167	4.6	0.01	0.0158	.	77	0.012
SC	GREENWOOD	59,567	.	0.01	.	.	.	.
SC	LEXINGTON	167,611	.	.	.	.	117	0.02
SC	OCONEE	57,494	.	.	.	0.082	.	0.008
SC	PICKENS	93,894	.	.	.	0.11	.	.
SC	RICHLAND	285,720	3.4	0.02	0.0126	0.099	115	0.011
SC	SPARTANBURG	226,800	.	0	.	0.11	50	.
SC	SUMTER	102,637	.	0.01	.	.	.	.
SC	UNION	30,337	.	.	.	0.091	.	.
SC	WILLIAMSBURG	36,815	.	.	.	0.085	.	.
SC	YORK	131,497	.	0.01	.	0.105	49	.
SD	BROOKINGS	25,207	.	.	.	.	64	.
SD	MINNEHAHA	123,809	.	.	.	.	53	.
SD	PENNINGTON	81,343	.	.	.	.	137	.
TN	ANDERSON	68,250	.	.	.	0.102	.	0.035
TN	BENTON	14,524	.	.	.	.	55	.
TN	BLOUNT	85,969	.	.	.	0.102	42	0.058
TN	BRADLEY	73,712	.	.	0.0137	.	42	0.036
TN	COFFEE	40,339	.	.	0.0068	.	32	0.014
TN	DAVIDSON	510,784	5	0.08	0.0119	0.11	66	0.022
TN	DICKSON	35,061	.	0.01	0.0078	.	47	0.006
TN	GILES	25,741	.	.	.	0.104	48	.

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
TN	HAMILTON	285,536	.	.	.	0.114	65	.
TN	HARDIN	22,633	.	.	.	.	.	0.018
TN	HAWKINS	44,565	.	.	.	.	.	0.052
TN	HAYWOOD	19,437	.	.	.	0.1	.	.
IN	HENRY	27,888	.	.	.	.	53	.
TN	HUMPHREYS	15,795	.	.	.	0.102	51	0.02
TN	JEFFERSON	33,016	.	.	.	0.125	.	.
TN	KNOX	335,749	3.3	.	.	0.114	66	.
TN	LOUDON	31,255	0.9	.	0.0141	0.112	43	0.024
TN	MC MINN	42,383	.	.	0.0143	.	60	
TN	MADISON	77,982	.	0.02	.	.	45	.
TN	MAURY	54,812	.	.	.	.	51	.
TN	MONTGOMERY	100,498	.	.	.	.	56	0.023
TN	POLK	13,643	.	.	.	.	.	0.037
TN	PUTNAM	51,373	.	.	0.0065	.	39	0.008
TN	ROANE	47,227	.	0.17	.	.	53	0.021
TN	RUTHERFORD	118,570	.	.	.	0.092	.	0.006
TN	SEVIER	51,043	.	.	.	0.107	.	.
TN	SHELBY	826,330	6.5	2.81	0.0241	0.122	60	0.017
TN	STEWART	9,479	.	.	.	.	.	0.019
TN	SULLIVAN	143,596	3	0.13	0.0176	0.104	67	0.05
TN	SUMNER	103,281	.	.	.	0.119	.	0.076
TN	UNION	13,694	.	.	.	.	78	.
TN	WASHINGTON	92,315	.	.	.	.	48	.
TN	WILLIAMSON	81,021	.	0.9	.	0.106	.	0.005
TN	WILSON	67,675	.	.	.	0.115	.	0.009
TX	BELL	191,088	.	.	.	.	41	.
TX	BEXAR	1,185,394	5	0.02	0.009	0.126	38	.
TX	BRAZORIA	191,707	.	.	.	0.11	.	.
TX	BREWSTER	8,681	.	.	.	0.084	.	.
TX	CAMERON	260,120	2.2	0.02	.	0.077	40	0.004
TX	COLLIN	264,036	.	0.7	.	0.114	65	.
TX	DALLAS	1,852,810	5.5	0.17	0.019	0.135	87	0.008
TX	DENTON	273,525	.	.	0.01	0.131	.	.
TX	ECTOR	118,934	.	.	.	.	59	.
TX	ELLIS	85,167	.	0.27	0.007	0.108	102	0.046
TX	EL PASO	591,610	10.3	0.4	0.0351	0.123	158	
TX	GALVESTON	217,399	.	0.02	0.0051	0.107	52	0.067
TX	GREGG	104,948	.	.	.	0.106	.	.
TX	HARRIS	2,818,199	7	0.02	0.0233	0.18	68	0.046
TX	HIDALGO	383,545	.	.	.	0.063	111	.
TX	JEFFERSON	239,397	2.1	0.02	0.0083	0.117	34	0.044
TX	KAUFMAN	52,220	.	0.03	.	.	.	.
TX	LUBBOCK	222,636	.	.	.	.	85	.
TX	NUECES	291,145	.	.	.	0.103	45	0.015
TX	ORANGE	80,509	.	.	0.0111	0.119	.	.
TX	POTTER	97,874	.	.	.	.	38	.
TX	SMITH	151,309	.	.	.	0.104	30	.
TX	TARRANT	1,170,103	3.2	0.02	0.021	0.131	56	0.011
TX	TRAVIS	576,407	3.2	.	0.0182	0.098	32	.
TX	VICTORIA	74,361	.	.	.	0.087	.	.
TX	WEBB	133,239	5.5	.	.	0.069	103	.
TX	WICHITA	122,378	.	.	.	.	50	.
UT	CACHE	70,183	5.7	.	.	0.083	109	.
UT	DAVIS	187,941	4	.	0.0204	0.114	109	0.013
UT	GRAND	6,620	.	.	.	.	52	.
UT	IRON	20,789	.	.	.	.	38	.
UT	SALT LAKE	725,956	6.9	0.03	0.0253	0.124	157	
UT	SAN JUAN	12,621	.	.	.	0.077	.	
UT	TOOELE	26,601	.	.	.	.	50	0.002
UT	UTAH	263,590	9.1	.	0.0242	0.105	141	.
UT	WASHINGTON	48,560	3.4	.	.	0.086	85	.
UT	WEBER	158,330	7	.	0.0263	0.103	98	.
VT	BENNINGTON	35,845	.	.	.	0.098	41	.
VT	CHITTENDEN	131,761	3.3	.	0.0165	0.075	37	0.014
VT	RUTLAND	62,142	3.6	.	0.0124	.	39	0.032
VT	WASHINGTON	54,928	.	.	.	.	38	.
VT	WINDHAM	41,588	.	.	.	.	41	.
VA	ARLINGTON	170,936	4	.	0.0243	0.112	38	.
VA	CAROLINE	19,217	.	.	0.0073	0.097	.	.
VA	CARROLL	26,594	.	.	.	.	46	.
VA	CHARLES CITY	6,282	.	.	0.0102	0.104	.	

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
VA	CHESTERFIELD	209,274	.	.	.	0.106	69	.
VA	CULPEPER	27,791	.	.	.	.	37	.
VA	FAIRFAX	818,584	4.4	0.02	0.0218	0.116	50	0.04
VA	FAUQUIER	48,741	.	.	.	0.094	.	.
VA	FREDERICK	45,723	.	.	.	0.095	.	.
VA	HANOVER	63,306	.	.	.	0.099	.	.
VA	HENRICO	217,881	.	.	.	0.102	64	.
VA	HENRY	56,942	.	.	.	0.104	.	.
VA	KING WILLIAM	10,913	.	.	.	.	56	
VA	LOUDOUN	86,129	.	.	.	.	56	.
VA	MADISON	11,949	.	.	.	0.093	.	.
VA	NORTHUMBERLAND	10,524	.	.	.	.	45	.
VA	PRINCE WILLIAM	215,686	.	.	0.0113	0.098	36	
VA	ROANOKE	79,332	.	.	0.0128	0.084	.	0.014
VA	SMYTH	32,370	.	.	.	.	40	.
VA	STAFFORD	61,236	.	.	.	0.1	.	.
VA	TAZEWELL	45,960	.	.	.	.	61	.
VA	WARREN	26,142	.	.	.	.	37	.
VA	WISE	39,573	.	.	.	.	61	.
VA	WYTHE	25,466	.	.	.	0.084	.	.
VA	ALEXANDRIA	111,183	3.7	.	0.0263	0.093	57	0.048
VA	BRISTOL	18,426	.	.	.	.	39	.
VA	CHARLOTTESVILLE	40,341	.	.	.	.	39	.
VA	CHESAPEAKE	151,976	.	0.03	.	.	38	.
VA	COVINGTON	6,991	.	.	.	.	47	.
VA	FREDERICKSBURG	19,027	.	.	.	.	38	.
VA	HAMPTON	133,793	.	.	.	0.097	50	0.019
VA	LYNCHBURG	66,049	.	.	.	.	41	.
VA	MARTINSVILLE	16,162	.	.	.	.	49	.
VA	NEWPORT NEWS	170,045	2.8	.	.	.	.	.
VA	NORFOLK	261,229	5.9	.	0.0179	.	36	0.025
VA	RICHMOND	203,056	3.2	0.01	0.0222	.	56	0.027
VA	ROANOKE	96,397	5.9	.	.	.	78	.
VA	SUFFOLK	52,141	.	.	.	0.093	46	.
VA	WINCHESTER	21,947	.	.	.	.	45	.
WA	ASOTIN	17,605	.	.	.	.	75	.
WA	BENTON	112,560	.	.	.	.	82	.
WA	CHELAN	52,250	.	.	.	.	37	.
WA	CLALLAM	56,464	.	.	.	0.058	43	0.085
WA	CLARK	238,053	6.4	.	.	0.108	44	.
WA	COWLITZ	82,119	.	.	.	.	55	.
WA	KING	1,507,319	6.8	0.66	0.0201	0.118	93	0.019
WA	KITSAP	189,731	3.5	.	.	.	41	.
WA	PIERCE	586,203	6.3	.	.	0.097	74	0.028
WA	SKAGIT	79,555	.	.	.	0.064	.	0.031
WA	SNOHOMISH	465,642	4.9	.	.	0.076	80	0.014
WA	SPOKANE	361,364	9	.	.	0.079	110	.
WA	THURSTON	161,238	4	.	.	.	53	.
WA	WALLA WALLA	48,439	.	.	.	.	122	
WA	WHATCOM	127,780	.	.	.	0.078	37	0.013
WA	YAKIMA	188,823	7.4	.	.	.	112	.
WV	BERKELEY	59,253	.	0.01	.	.	.	.
WV	BROOKE	26,992	.	.	.	.	87	0.04
WV	CABELL	96,827	.	0.05	.	0.113	.	0.023
WV	FAYETTE	47,952	.	.	.	.	46	.
WV	GREENBRIER	34,693	.	.	0.0047	0.09	.	0.019
WV	HANCOCK	35,233	6.2	0.04	0.0158	0.099	170	0.066
WV	HARRISON	69,371	.	0.01	.	.	.	.
WV	KANAWHA	207,619	2.3	0.02	0.0197	0.104	50	0.039
WV	MARION	57,249	.	0.03	.	.	.	.
WV	MARSHALL	37,356	.	.	.	.	49	0.072
WV	MONONGALIA	75,509	.	0.01	.	.	57	0.042
WV	OHIO	50,871	3.5	.	.	0.105	48	0.045
WV	PUTNAM	42,835	.	.	.	.	48	.
WV	TUCKER	7,728	.	.	.	0.096	.	.
WV	WAYNE	41,636	.	.	.	.	51	0.035
WV	WOOD	86,915	.	0.02	.	0.108	50	0.046
WI	BROWN	194,594	.	.	.	0.105	.	0.011
WI	COLUMBIA	45,088	.	.	.	0.093	.	.
WI	DANE	367,085	4.1	.	.	0.094	44	0.01
WI	DODGE	76,559	.	.	.	0.092	.	.
WI	DOOR	25,690	.	.	.	0.107	.	.

Table A-11. Maximum Air Quality Concentrations by County, 1996 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} 2nd MAX (µgm)	SO_2 24-hr (ppm)
WI	DOUGLAS	41,758	.	.	.	.	44	.
WI	FLORENCE	4,590	.	.	.	0.081	.	.
WI	FOND DU LAC	90,083	.	.	.	0.096		
WI	JEFFERSON	67,783	.	.	.	0.091	.	.
WI	KENOSHA	128,181	.	.	.	0.141	.	.
WI	KEWAUNEE	18,878	.	.	.	0.097	.	.
WI	MANITOWOC	80,421	.	.	0.0034	0.126	.	.
WI	MARATHON	115,400	.	.	.	0.079	50	0.015
WI	MILWAUKEE	959,275	2.7	0.03	0.021	0.119	52	0.028
WI	ONEIDA	31,679	.	.	.	0.078	.	0.067
WI	OUTAGAMIE	140,510	.	.	.	0.094	.	.
WI	OZAUKEE	72,831	.	.	0.0065	0.11	.	.
WI	POLK	34,773	0.9	.	.	0.08	.	.
WI	RACINE	175,034	3	.	.	0.129	.	.
WI	ROCK	139,510	.	.	.	0.103	.	.
WI	ST CROIX	50,251	.	.	.	0.083	.	
WI	SAUK	46,975	.	.	0.0046	0.082	.	.
WI	SHEBOYGAN	103,877	.	.	.	0.105	.	.
WI	TAYLOR	18,901	.	.	.	0.073	.	.
WI	VERNON	25,617	.	.	.	0.077	30	.
WI	VILAS	17,707	.	.	.	.	30	.
WI	WALWORTH	75,000	.	.	.	0.1	.	.
WI	WASHINGTON	95,328	.	.	.	0.095	.	.
WI	WAUKESHA	304,715	1.5	.	.	0.093	69	.
WI	WINNEBAGO	140,320	.	.	.	0.094	.	.
WY	ALBANY	30,797	.	.	.	0.08	55	.
WY	CAMPBELL	29,370	.	.	.	.	101	.
WY	FREMONT	33,662	.	.	.	.	78	.
WY	LARAMIE	73,142	.	.	.	.	31	.
WY	NATRONA	61,226	.	.	.	.	36	.
WY	PARK	23,178	.	.	.	.	23	.
WY	SHERIDAN	23,562	.	.	.	.	80	.
WY	SWEETWATER	38,823	.	.	.	.	69	.
WY	TETON	11,172	.	.	.	0.072	93	.

CO = Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb = Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 ug/m³)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
PM-10 = Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 ug/m³)*
Data from exceptional events not included.
SO_2 = Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*
WTD = Weighted
AM = Annual mean
UGM = Units are micrograms per cubic meter
PPM = Units are parts per million

Note: The reader is cautioned that this summary is not adequate in itself to numerically rank counties 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-12. Trends From IMPROVE Monitoring Sites, 1988–1995

TOTAL LIGHT EXTINCTION (Mm^{-1})

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Acadia NP	10TH	-.0377*	.0156	36.5	40.9	41.4	38.3	32.1	35.4	30.9	30.8
Badlands (W)	10TH	-.0222	.0543	28.0	25.8	26.4	26.5	27.2	25.8	24.3	21.9
Bandelier (W)	10TH	-.0323	.0894	22.6	26.5	28.2	25.4	23.5	24.2	22.9	18.3
Big Bend NP	10TH	-.0222	.0894	27.4	27.9	29.1	25.9	22.8	26.2	23.5	24.9
Bryce Canyon NP	10TH	-.0311	.0894	19.4	17.9	19.7	20.5	19.6	18.6	16.9	15.2
Bridger (W)	10TH	-.0253	.0543	16.5	17.2	19.3	16.5	17.0	15.4	16.2	13.7
Canyonlands NP	10TH	-.0386	.0543	20.3	22.0	24.6	23.0	20.0	21.0	19.4	16.4
Chiricahua (W)	10TH	-.0167*	.0305	22.7	22.1	23.0	22.3	20.5	21.7	20.4	20.8
Crater Lake NP	10TH	-.0242	.0543	17.9	19.2	19.3	19.2	18.8	16.6	17.3	14.6
Denali NP	10TH	-.0246*	.0071	17.2	16.4	21.5	17.0	15.7	15.2	15.2	14.5
Glacier NP	10TH	-.0169	.2742	29.7	31.3	33.9	35.7	35.1	32.3	27.9	26.4
Grand Canyon NP	10TH	-.0116	.2742	17.9	18.4	22.4	20.6	20.3	18.1	17.0	18.3
Great Sand Dunes (W)	10TH	-.0629*	.0071	23.6	22.2	26.4	24.8	21.2	19.9	18.5	15.8
Great Smoky Mtns NP	10TH	-.0190*	.0305	48.9	51.4	50.2	50.7	46.8	47.6	44.9	45.7
Guadalupe Mtns NP	10TH	-.0171	.1375	27.1	30.2	28.1	23.1	25.3	26.9	23.7	26.0
Lassen Volcanic NP	10TH	-.0311	.0543	17.5	18.8	20.4	16.0	18.5	16.2	16.0	14.9
Mesa Verde NP	10TH	-.0415	.0894	21.6	19.6	25.2	22.6	20.2	19.1	20.2	15.7
Mt. Rainier NP	10TH	-.0305	.2742	24.7	23.4	27.4	27.9	32.7	25.4	21.1	19.0
Petrified Forest NP	10TH	-.0547*	.0305	23.3	28.0	28.4	27.7	24.0	22.2	22.4	19.5
Pinnacles (W)	10TH	-.0389*	.0156	31.9	32.8	41.1	29.5	27.7	31.6	25.7	25.1
Pt. Reyes NS	10TH	-.0257	.1375	32.0	33.7	42.8	35.5	33.0	35.2	31.0	27.8
Redwood NP	10TH	-.0316*	.0071	28.7	26.2	31.1	26.1	27.5	23.7	23.3	23.0
Rocky Mtns NP	10TH	-.0168	.1375	19.8	17.9	19.4	18.1	18.6	18.1	18.4	14.9
San Gorgonio (W)	10TH	-.0265	.1994	23.1	22.0	30.8	21.9	19.8	22.1	18.2	22.5
Shenandoah NP	10TH	-.0150	.1375	63.2	54.5	58.3	60.8	48.7	59.8	48.6	56.1
Tonto NM	10TH	-.0289*	.0156	27.8	27.1	29.8	25.3	25.9	24.1	22.5	24.4
Washington, DC	10TH	-.0021	.4524	88.0	93.3	95.6	92.2	93.4	107.5	91.9	68.9
Weminuche (W)	10TH	0.0016	.5476	17.6	18.4	19.7	20.9	20.6	18.1	20.5	15.4
Yellowstone NP	10TH	-.0550*	.0071	22.8	21.6	24.4	22.2	19.4	16.8	17.1	16.4
Yosemite NP	10TH	-.0060	.1994	18.1	17.1	24.2	17.9	18.8	18.0	16.4	17.7
Acadia NP	50TH	-.0314	.1375	61.0	75.9	65.0	66.4	59.5	61.0	61.5	53.2
Badlands (W)	50TH	-.0170	.0543	43.9	46.1	43.5	45.1	44.4	38.2	40.2	39.7
Bandelier (W)	50TH	-.0466*	.0071	32.9	34.6	35.6	33.7	32.0	30.8	28.9	24.8
Big Bend NP	50TH	-.0069	.1375	42.2	44.9	42.2	41.0	40.9	41.3	42.6	40.3
Bryce Canyon NP	50TH	-.0198	.1375	31.4	31.5	28.8	31.6	28.7	28.8	30.4	24.1
Bridger (W)	50TH	-.0242	.1375	24.5	24.9	27.6	26.1	27.0	22.4	23.6	21.0
Canyonlands NP	50TH	-.0264	.0894	29.7	29.2	34.7	33.2	29.5	29.2	29.3	23.1
Chiricahua (W)	50TH	-.0218*	.0305	34.4	32.8	34.5	32.0	30.1	32.8	31.1	29.1
Crater Lake NP	50TH	0.0065	.4524	24.0	28.1	30.2	32.2	30.4	25.2	31.4	22.4
Denali NP	50TH	-.0366*	.0156	22.5	24.3	27.5	21.1	19.5	19.4	21.0	18.0
Glacier NP	50TH	-.0152	.1994	52.7	51.0	54.0	55.0	54.5	48.6	51.0	44.1
Grand Canyon NP	50TH	-.0287	.0543	27.7	29.5	32.7	30.7	29.2	27.4	27.4	25.3
Great Sand Dunes (W)	50TH	-.0401*	.0156	30.5	33.4	33.1	31.9	30.7	26.4	27.1	23.9
Great Smoky Mtns NP	50TH	0.0105	.4524	86.3	93.1	94.5	85.8	100.2	104.8	76.3	90.7
Guadalupe Mtns NP	50TH	-.0093	.2742	39.7	42.1	45.6	37.6	34.2	37.4	41.0	37.9
Lassen Volcanic NP	50TH	-.0210*	.0305	29.7	29.0	29.3	25.7	27.5	26.7	27.6	24.5
Mesa Verde NP	50TH	-.0176	.1994	29.5	27.2	28.2	30.7	26.7	27.2	29.0	23.6
Mt. Rainier NP	50TH	0.0037	.5476	58.0	54.3	55.0	65.7	69.7	67.8	57.2	48.5

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995 (continued)

TOTAL LIGHT EXTINCTION (Mm^{-1})

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Petrified Forest NP	50TH	-.0416*	.0305	36.1	37.2	40.4	39.2	35.2	31.1	32.6	27.6
Pinnacles (W)	50TH	-.0323	.0894	55.1	58.1	63.5	55.1	52.3	55.5	46.2	47.6
Pt. Reyes NS	50TH	-.0375	.0543	56.8	62.6	68.7	59.6	51.5	53.3	55.2	44.5
Redwood NP	50TH	-.0191	.0894	48.7	52.3	58.5	51.6	50.5	43.5	48.7	46.7
Rocky Mtns NP	50TH	-.0186	.0894	30.5	31.3	31.8	30.2	31.9	27.7	30.1	23.7
San Gorgonio (W)	50TH	-.0178	.1994	65.0	71.3	70.3	73.8	57.5	72.7	62.2	55.9
Shenandoah NP	50TH	-.0126	.1375	125.7	105.6	117.8	124.0	125.6	122.5	109.1	103.8
Tonto NM	50TH	-.0252*	.0305	38.1	42.1	39.3	38.5	39.0	37.4	34.7	34.7
Washington, DC	50TH	0.0059	.2742	121.0	154.8	152.6	175.8	171.9	176.6	155.7	126.8
Weminuche (W)	50TH	-.0168*	.0305	29.0	30.7	29.3	29.8	29.0	27.7	28.6	23.0
Yellowstone NP	50TH	-.0364	.0543	27.8	29.5	31.5	31.7	28.2	26.7	26.1	21.9
Yosemite NP	50TH	-.0003	.5476	35.9	36.4	40.2	40.6	42.1	36.6	33.0	36.1
Acadia NP	90TH	0.0053	.5476	145.7	156.1	131.9	133.7	152.2	153.9	155.8	122.9
Badlands (W)	90TH	0.0081	.4524	68.0	65.3	65.3	67.6	86.8	69.3	74.6	64.8
Bandelier (W)	90TH	-.0119	.4524	41.9	52.2	36.2	40.6	44.9	42.4	43.2	38.2
Big Bend NP	90TH	-.0015	.3598	67.3	70.1	63.5	67.0	61.3	63.9	69.0	66.6
Bryce Canyon NP	90TH	-.0091	.1375	41.1	44.8	38.7	40.1	40.2	41.3	40.0	36.8
Bridger (W)	90TH	-.0170	.0543	37.8	37.5	38.0	36.4	40.3	31.6	35.2	30.7
Canyonlands NP	90TH	-.0394*	.0071	43.1	45.4	45.3	42.9	37.1	39.0	38.3	32.4
Chiricahua (W)	90TH	-.0050	.1994	51.0	45.7	45.9	45.5	45.1	48.0	48.7	44.5
Crater Lake NP	90TH	0.0006	.5476	47.4	52.7	51.0	49.2	48.0	53.6	53.5	41.6
Denali NP	90TH	-.0254	.1994	35.0	34.6	44.1	39.4	30.3	34.8	36.4	29.5
Glacier NP	90TH	-.0089	.3598	73.1	89.6	88.1	90.0	92.9	86.2	85.3	80.6
Grand Canyon NP	90TH	-.0142	.1375	40.0	44.2	44.9	38.3	38.8	39.6	39.6	36.3
Great Sand Dunes (W)	90TH	-.0353	.0894	43.2	48.1	42.7	42.2	36.0	37.4	52.7	34.6
Great Smoky Mtns NP	90TH	0.0113	.3598	154.0	175.9	219.0	194.6	188.5	172.9	185.8	188.6
Guadalupe Mtns NP	90TH	-.0209	.0894	62.8	69.1	58.7	55.2	53.7	55.6	61.9	54.7
Lassen Volcanic NP	90TH	-.0116	.3598	48.5	54.3	43.6	37.2	45.7	46.5	49.1	41.9
Mesa Verde NP	90TH	-.0078	.2742	37.5	41.3	43.7	36.2	34.4	42.9	39.4	36.0
Mt. Rainier NP	90TH	-.0310	.2742	107.1	130.6	165.1	131.0	132.4	113.4	120.9	100.7
Petrified Forest NP	90TH	-.0323*	.0156	48.8	51.4	54.0	47.7	46.3	43.4	41.0	44.2
Pinnacles (W)	90TH	-.0393*	.0305	78.7	97.5	96.5	86.0	87.9	77.3	74.8	74.9
Pt. Reyes NS	90TH	-.0319	.2742	94.8	167.2	126.7	108.1	120.0	159.8	109.4	90.3
Redwood NP	90TH	-.0235	.0894	92.4	98.7	99.6	95.6	98.0	82.4	76.3	86.8
Rocky Mtns NP	90TH	-.0175	.0543	43.7	50.1	46.9	44.0	43.0	44.6	43.6	42.4
San Gorgonio (W)	90TH	-.0334	.0543	128.7	136.0	144.0	129.7	141.8	119.9	116.7	98.5
Shenandoah NP	90TH	0.0091	.3598	227.2	232.3	249.8	263.7	255.2	219.7	240.7	244.7
Tonto NM	90TH	-.0113	.1994	52.8	62.1	48.8	51.6	51.7	54.7	43.9	49.7
Washington, DC	90TH	0.0005	.5476	246.2	235.6	229.1	296.0	307.4	298.6	263.2	225.2
Weminuche (W)	90TH	-.0257*	.0156	39.8	46.2	40.4	40.5	37.4	38.4	36.7	35.7
Yellowstone NP	90TH	-.0358*	.0305	50.7	49.3	47.5	42.7	46.8	38.7	50.1	37.2
Yosemite NP	90TH	-.0088	.3598	73.1	66.0	73.4	63.0	73.4	60.1	65.8	69.6

* Denotes that the slope is significant at the .05 significance level.

NP = National Park
W = Wilderness
NS = National Seashore
NM = National Monument

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995

LIGHT EXTINCTION DUE TO SULFATE (Mm^{-1})

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Acadia NP	10TH	-.0353	.1375	12.5	16.1	17.0	14.7	12.0	13.8	11.0	12.9
Badlands (W)	10TH	0.0187	.3598	4.9	5.5	6.0	6.0	7.8	6.5	5.8	5.2
Bandelier (W)	10TH	-.0200	.3598	2.8	3.7	4.7	4.3	4.7	4.1	3.5	2.5
Big Bend NP	10TH	-.0130	.4524	5.7	6.4	7.0	5.2	5.0	6.5	5.2	6.0
Bryce Canyon NP	10TH	-.0362	.4524	3.0	1.9	2.7	3.2	3.9	3.0	2.3	2.1
Bridger (W)	10TH	0.0000	.5476	1.7	1.8	2.7	2.0	2.9	2.0	2.0	1.6
Canyonlands NP	10TH	-.0629	.3598	3.0	3.1	5.1	3.8	3.9	3.5	3.1	2.0
Chiricahua (W)	10TH	0.0000	.5476	3.4	3.6	4.5	4.2	4.0	4.2	3.4	3.7
Crater Lake NP	10TH	-.0138	.4524	1.7	2.1	2.5	2.0	3.5	2.3	2.0	1.5
Denali NP	10TH	0.0123	.4524	1.6	1.6	2.7	2.1	2.2	1.9	2.1	1.9
Glacier NP	10TH	-.0105	.5476	5.7	8.5	9.6	9.4	11.5	9.0	7.0	7.0
Grand Canyon NP	10TH	0.0000	.5476	2.0	1.9	2.8	2.8	3.6	2.6	1.9	2.3
Great Sand Dunes (W)	10TH	-.0489	.2742	2.9	2.4	4.1	3.5	4.1	3.2	2.8	2.0
Great Smoky Mtns NP	10TH	-.0129	.1994	17.2	21.0	20.7	20.3	18.2	19.2	16.9	19.6
Guadalupe Mtns NP	10TH	0.0060	.5476	5.3	7.1	6.5	4.5	5.7	6.0	5.3	6.9
Lassen Volcanic NP	10TH	0.0000	.4524	1.3	1.6	1.3	0.9	2.5	1.6	1.3	1.4
Mesa Verde NP	10TH	-.0281	.3598	2.6	2.7	5.2	3.5	4.0	3.3	3.1	2.3
Mt. Rainier NP	10TH	-.0353	.2742	5.7	6.3	7.8	7.5	11.7	7.1	4.8	4.0
Petrified Forest NP	10TH	-.0573	.2742	2.7	3.9	4.9	5.1	4.3	3.7	3.2	2.9
Pinnacles (W)	10TH	-.0542	.0543	5.9	5.6	7.3	5.1	4.7	5.9	4.2	4.6
Pt. Reyes NS	10TH	0.0264	.4524	7.1	8.7	15.7	12.8	10.1	12.0	10.9	9.5
Redwood NP	10TH	-.0164	.3598	7.5	5.8	8.5	7.0	9.0	6.3	5.6	7.0
Rocky Mtns NP	10TH	-.0458	.1375	2.1	2.4	2.4	2.2	2.8	2.2	1.8	1.5
San Gorgonio (W)	10TH	0.0205	.3598	1.9	2.0	2.8	2.0	2.3	2.2	1.6	2.4
Shenandoah NP	10TH	-.0058	.3598	26.1	24.7	25.4	26.3	22.6	26.1	19.9	25.5
Tonto NM	10TH	-.0164	.2742	3.3	3.8	5.2	3.6	4.6	3.7	3.2	3.4
Washington, DC	10TH	-.0133	.3598	35.5	34.1	32.9	36.0	39.8	45.7	32.3	29.9
Weminuche (W)	10TH	0.0746	.1994	1.3	1.9	2.4	2.4	3.4	2.4	3.1	1.7
Yellowstone NP	10TH	-.0592*	.0305	3.1	2.5	3.0	2.8	3.0	2.0	2.3	2.0
Yosemite NP	10TH	0.0000	.4524	1.4	1.5	2.7	1.5	2.9	1.8	1.4	1.5
Acadia NP	50TH	-.0491*	.0305	29.5	39.6	35.3	33.3	29.3	30.3	29.4	25.6
Badlands (W)	50TH	0.0092	.2742	11.8	14.1	14.3	14.0	14.7	12.6	14.0	14.3
Bandelier (W)	50TH	0.0000	.5476	6.7	6.6	6.3	6.6	7.3	7.3	6.7	5.0
Big Bend NP	50TH	0.0069	.2742	13.0	12.9	12.9	10.6	12.2	12.9	13.5	13.6
Bryce Canyon NP	50TH	-.0095	.4524	7.8	7.4	6.7	7.6	8.4	7.1	8.8	6.0
Bridger (W)	50TH	0.0000	.5476	3.8	5.0	5.0	4.8	6.0	4.6	5.0	4.6
Canyonlands NP	50TH	-.0432	.1994	6.5	5.7	8.0	7.8	7.0	6.2	6.5	4.6
Chiricahua (W)	50TH	0.0099	.3598	8.5	8.0	8.7	7.2	8.0	10.0	9.5	8.2
Crater Lake NP	50TH	0.0684	.1375	3.7	4.2	4.9	7.0	7.5	5.7	6.1	4.7
Denali NP	50TH	0.0366	.3598	3.2	5.6	7.7	3.8	4.2	4.5	4.7	4.3
Glacier NP	50TH	0.0169	.0543	13.1	14.2	16.0	14.9	18.1	15.1	15.5	15.6
Grand Canyon NP	50TH	-.0021	.5476	5.4	6.1	7.1	6.7	7.1	6.0	6.6	5.7
Great Sand Dunes (W)	50TH	-.0052	.4524	5.9	6.9	6.1	5.9	7.0	6.0	6.7	5.7
Great Smoky Mtns NP	50TH	0.0222	.3598	40.8	50.0	49.7	45.7	57.0	60.5	41.4	49.1
Guadalupe Mtns NP	50TH	0.0107	.3598	10.7	10.6	12.0	10.6	10.8	10.2	13.5	11.9
Lassen Volcanic NP	50TH	0.0217	.1994	4.2	3.8	3.4	2.8	4.6	5.0	4.7	4.3
Mesa Verde NP	50TH	0.0146	.3598	6.1	5.7	6.5	7.4	6.6	6.4	8.4	5.6
Mt. Rainier NP	50TH	0.0183	.3598	24.1	21.1	19.6	32.0	34.0	33.6	25.5	22.7

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995 (continued)

LIGHT EXTINCTION DUE TO SULFATE (Mm^{-1})

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Petrified Forest NP	50TH	-.0258	.2742	6.9	7.7	9.4	9.2	8.5	6.9	8.1	6.0
Pinnacles (W)	50TH	-.0050	.5476	8.3	12.5	14.3	12.5	11.7	11.4	9.1	13.6
Pt. Reyes NS	50TH	-.0101	.2742	18.9	23.3	21.9	22.9	19.6	18.8	22.0	19.1
Redwood NP	50TH	0.0099	.4524	18.2	22.1	24.1	20.8	20.8	15.5	21.4	23.5
Rocky Mtns NP	50TH	-.0100	.3598	6.0	5.9	7.1	6.1	7.1	5.9	6.5	4.8
San Gorgonio (W)	50TH	0.0164	.3598	8.5	7.2	7.2	11.8	9.4	11.5	8.9	8.8
Shenandoah NP	50TH	-.0062	.2742	71.0	58.6	63.1	70.0	73.2	72.7	57.4	56.7
Tonto NM	50TH	0.0021	.5476	6.7	8.2	6.7	8.7	7.8	7.5	8.0	6.9
Washington, DC	50TH	0.0231	.2742	51.3	61.3	54.9	83.0	75.8	79.7	64.7	55.9
Weminuche (W)	50TH	-.0039	.5476	5.9	7.2	6.9	6.2	7.6	6.6	7.4	5.1
Yellowstone NP	50TH	-.0022	.4524	4.4	4.5	4.6	4.9	5.2	4.6	4.4	3.9
Yosemite NP	50TH	0.0390	.0894	5.3	6.1	7.1	7.7	8.5	7.2	6.4	7.6
Acadia NP	90TH	-.0097	.3598	88.6	101.5	79.8	78.2	102.1	97.5	100.2	73.3
Badlands (W)	90TH	0.0166	.3598	19.7	26.2	22.7	24.7	37.4	27.2	22.5	24.0
Bandelier (W)	90TH	0.0337	.1375	9.2	15.2	6.1	8.7	10.9	10.0	11.3	11.6
Big Bend NP	90TH	0.0019	.5476	22.6	21.9	24.2	20.6	24.7	19.9	27.6	21.3
Bryce Canyon NP	90TH	0.0086	.4524	11.0	11.9	10.5	9.3	11.6	9.9	11.0	12.3
Bridger (W)	90TH	-.0155	.1375	7.1	8.6	7.3	7.2	9.5	6.8	6.4	6.9
Canyonlands NP	90TH	-.0229	.0894	9.8	8.8	10.8	7.6	9.4	8.7	8.0	8.4
Chiricahua (W)	90TH	-.0034	.4524	16.0	13.5	12.9	10.4	13.3	14.6	12.5	15.8
Crater Lake NP	90TH	0.0145	.3598	9.2	13.8	10.4	9.6	13.7	13.4	10.7	11.2
Denali NP	90TH	-.0088	.4524	10.8	10.4	13.5	6.5	10.1	6.4	11.6	11.4
Glacier NP	90TH	-.0159	.4524	16.2	23.1	20.0	19.7	25.7	20.9	18.1	18.4
Grand Canyon NP	90TH	-.0061	.4524	9.7	9.4	9.8	8.6	10.1	8.4	10.0	9.0
Great Sand Dunes (W)	90TH	0.0040	.5476	10.6	9.2	7.6	7.0	9.5	9.5	8.2	9.9
Great Smoky Mtns NP	90TH	0.0189	.1994	84.7	120.5	153.0	127.4	129.9	110.7	125.1	134.5
Guadalupe Mtns NP	90TH	-.0155	.3598	20.7	25.0	15.2	18.0	19.5	18.9	19.5	18.3
Lassen Volcanic NP	90TH	0.0227	.3598	8.1	11.0	7.7	4.9	11.1	9.0	10.2	9.6
Mesa Verde NP	90TH	-.0016	.5476	10.1	11.6	10.3	8.3	11.0	10.2	10.1	10.6
Mt. Rainier NP	90TH	-.0201	.2742	45.2	65.9	93.1	65.4	66.6	55.4	63.0	51.2
Petrified Forest NP	90TH	-.0049	.5476	11.5	11.1	11.9	10.2	13.6	10.3	10.2	13.2
Pinnacles (W)	90TH	0.0029	.5476	16.2	18.6	21.3	19.0	20.4	16.1	19.4	18.3
Pt. Reyes NS	90TH	0.0419	.0894	23.5	29.8	29.1	30.9	41.5	28.9	30.3	36.1
Redwood NP	90TH	-.0200	.2742	31.8	42.4	44.3	43.5	42.0	30.9	34.0	37.2
Rocky Mtns NP	90TH	-.0098	.4524	9.2	11.8	9.4	9.5	9.0	10.8	8.0	10.5
San Gorgonio (W)	90TH	-.0300	.0543	17.7	17.1	16.7	16.7	21.1	17.1	14.4	14.2
Shenandoah NP	90TH	0.0170	.1994	151.3	171.3	183.9	200.8	190.9	163.3	180.9	184.9
Tonto NM	90TH	-.0208	.1994	12.3	10.6	11.7	11.7	10.7	9.3	9.9	11.7
Washington, DC	90TH	0.0286	.3598	103.4	107.5	85.4	171.9	170.8	141.8	133.5	117.6
Weminuche (W)	90TH	0.0078	.4524	8.4	12.2	9.8	8.1	10.4	10.8	8.9	10.1
Yellowstone NP	90TH	-.0054	.5476	4.5	6.7	5.7	5.8	6.1	5.0	5.8	5.4
Yosemite NP	90TH	-.0046	.4524	14.2	14.7	12.8	12.8	16.7	14.9	12.6	13.0

* Denotes that the slope is significant at the .05 significance level.
NP = National Park
W = Wilderness
NS = National Seashore
NM = National Monument

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995

LIGHT EXTINCTION DUE TO ORGANIC CARBON (Mm^{-1})

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Acadia NP	10TH	-.1079*	.0156	4.6	4.4	4.9	4.4	2.6	3.4	2.8	2.3
Badlands (W)	10TH	-.1399*	.0009	5.2	4.1	4.3	2.9	2.3	2.3	2.2	2.0
Bandelier (W)	10TH	-.0995*	.0156	4.0	4.2	4.6	3.8	2.7	3.2	2.7	2.0
Big Bend NP	10TH	-.0786*	.0305	4.5	3.7	4.6	2.9	1.9	2.7	2.7	2.6
Bryce Canyon NP	10TH	-.1209*	.0156	2.6	2.7	3.2	2.1	1.5	1.4	1.5	1.3
Bridger (W)	10TH	-.1263	.0894	2.6	2.6	3.5	1.4	0.9	1.1	1.4	1.2
Canyonlands NP	10TH	-.0908*	.0305	2.7	2.8	3.8	2.5	1.4	1.9	1.8	1.6
Chiricahua (W)	10TH	-.1156*	.0305	4.2	3.1	3.4	2.3	1.8	1.8	1.8	2.1
Crater Lake NP	10TH	-.1479*	.0071	2.9	3.5	3.7	1.6	1.6	1.3	1.2	1.1
Denali NP	10TH	-.2124*	.0071	3.3	2.3	3.2	2.5	0.9	1.0	0.9	0.8
Glacier NP	10TH	-.0875*	.0156	6.1	5.2	6.2	5.6	4.0	4.7	3.6	3.6
Grand Canyon NP	10TH	-.1196*	.0305	2.2	2.8	3.7	2.6	1.8	1.6	1.4	1.6
Great Sand Dunes (W)	10TH	-.1621*	.0028	4.3	4.1	5.4	3.7	2.4	2.0	2.1	1.5
Great Smoky Mtns NP	10TH	-.0756*	.0002	7.4	6.7	6.7	5.9	5.0	4.9	4.7	4.4
Guadalupe Mtns NP	10TH	-.1035*	.0071	4.5	4.6	4.2	2.5	2.6	2.7	2.4	2.3
Lassen Volcanic NP	10TH	-.1024*	.0156	3.3	3.4	4.5	2.7	2.2	2.3	2.2	1.6
Mesa Verde NP	10TH	-.1209*	.0071	3.5	2.8	3.4	2.6	1.9	1.4	2.1	1.6
Mt. Rainier NP	10TH	-.0974*	.0305	3.9	3.3	4.1	3.9	3.5	2.9	2.0	2.4
Petrified Forest NP	10TH	-.1108*	.0156	3.5	4.3	4.7	4.2	3.1	2.4	2.8	2.0
Pinnacles (W)	10TH	-.0865*	.0071	4.6	4.6	6.0	3.9	3.0	3.5	3.0	2.7
Pt. Reyes NS	10TH	-.0904*	.0028	3.7	3.5	3.2	3.0	2.4	2.0	2.0	2.1
Redwood NP	10TH	-.1567*	.0028	4.1	3.5	4.5	3.1	2.3	1.8	1.6	1.7
Rocky Mtns NP	10TH	-.1441*	.0071	4.2	2.6	4.0	1.7	2.1	1.5	1.7	1.4
San Gorgonio (W)	10TH	-.1042*	.0305	3.9	2.5	4.9	2.1	1.8	2.3	1.5	1.9
Shenandoah NP	10TH	-.1024*	.0156	8.0	5.1	5.9	4.3	3.1	4.2	3.2	3.8
Tonto NM	10TH	-.0988*	.0028	6.4	4.4	5.0	3.2	3.3	3.1	2.8	2.9
Washington, DC	10TH	-.0403	.0543	10.1	11.4	10.4	9.7	9.3	11.1	9.4	6.0
Weminuche (W)	10TH	-.1479*	.0071	3.6	3.0	3.1	2.1	1.5	1.6	1.7	1.3
Yellowstone NP	10TH	-.1696*	.0071	5.4	3.6	5.6	4.0	2.5	1.9	1.9	1.7
Yosemite NP	10TH	-.1100	.0894	3.4	2.7	5.0	2.2	1.6	2.2	1.5	2.3
Acadia NP	50TH	-.0487*	.0305	6.8	6.8	6.0	6.8	5.5	5.6	5.8	4.7
Badlands (W)	50TH	-.0940*	.0028	6.0	6.2	6.2	5.6	4.1	3.9	3.9	3.4
Bandelier (W)	50TH	-.0955*	.0156	6.6	5.9	6.6	6.9	4.5	4.1	3.6	3.5
Big Bend NP	50TH	-.0719*	.0009	7.2	6.5	6.2	6.0	4.4	4.9	4.8	4.3
Bryce Canyon NP	50TH	-.0916*	.0071	4.9	4.8	4.6	4.4	2.6	2.9	2.8	2.8
Bridger (W)	50TH	-.1305*	.0028	4.9	4.3	5.4	4.2	3.4	2.4	2.8	2.3
Canyonlands NP	50TH	-.1174*	.0305	5.3	4.6	6.0	4.6	2.8	3.2	3.6	2.3
Chiricahua (W)	50TH	-.1162*	.0028	6.6	5.0	5.2	4.7	3.2	3.2	2.6	3.0
Crater Lake NP	50TH	-.1082	.0894	4.8	6.0	7.1	4.9	3.9	2.7	5.6	2.6
Denali NP	50TH	-.1926*	.0028	3.5	3.3	3.6	2.8	1.8	1.2	1.5	1.1
Glacier NP	50TH	-.0597*	.0009	12.7	11.4	11.7	10.8	10.2	9.3	9.7	6.8
Grand Canyon NP	50TH	-.0750*	.0071	4.3	4.1	5.2	4.3	3.0	3.0	2.8	2.6
Great Sand Dunes (W)	50TH	-.1072*	.0028	5.8	5.1	5.7	5.5	3.9	3.0	3.4	2.8
Great Smoky Mtns NP	50TH	-.0445*	.0305	10.8	11.9	12.9	10.4	9.9	10.7	8.1	9.3
Guadalupe Mtns NP	50TH	-.0738*	.0028	6.7	6.0	5.9	5.0	3.3	4.7	4.3	4.0
Lassen Volcanic NP	50TH	-.0978*	.0305	5.0	6.5	7.3	5.5	5.0	3.8	4.0	3.6
Mesa Verde NP	50TH	-.1156*	.0156	7.0	4.1	4.5	4.5	3.0	2.9	3.2	2.5
Mt. Rainier NP	50TH	-.0678*	.0028	9.4	9.4	11.7	9.0	9.0	8.6	7.0	5.5

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995 (continued)

LIGHT EXTINCTION DUE TO ORGANIC CARBON (Mm^{-1})

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Petrified Forest NP	50TH	-.0893*	.0028	6.8	5.3	6.2	6.0	4.5	3.8	4.2	3.5
Pinnacles (W)	50TH	-.0824*	.0071	9.6	9.5	10.1	7.8	7.0	7.8	6.1	5.6
Pt. Reyes NS	50TH	-.1719*	.0156	5.3	6.8	8.1	6.2	4.0	3.0	3.4	2.4
Redwood NP	50TH	-.1247*	.0156	5.6	5.6	7.3	6.0	5.1	4.6	4.0	2.6
Rocky Mtns NP	50TH	-.1371*	.0002	6.1	5.9	5.5	4.8	3.9	3.1	3.7	2.2
San Gorgonio (W)	50TH	-.0527	.1375	10.1	10.0	9.3	11.4	7.0	11.5	7.6	6.1
Shenandoah NP	50TH	-.0524*	.0071	11.1	9.3	11.6	9.7	8.8	7.9	8.1	7.7
Tonto NM	50TH	-.0604*	.0028	7.2	6.5	7.0	5.5	5.8	5.4	4.1	5.1
Washington, DC	50TH	0.0031	.5476	15.8	18.0	16.9	18.5	16.2	19.2	18.0	12.1
Weminuche (W)	50TH	-.1176*	.0009	5.2	4.7	4.5	4.6	3.0	2.7	2.8	2.3
Yellowstone NP	50TH	-.0996*	.0305	5.0	6.3	6.6	5.9	4.4	3.5	4.4	3.1
Yosemite NP	50TH	-.0181	.3598	6.7	7.7	8.2	7.8	7.1	6.4	5.6	7.9
Acadia NP	90TH	-.0291	.1375	17.6	17.2	13.2	16.6	12.1	14.3	14.2	14.4
Badlands (W)	90TH	-.0456	.2742	12.1	8.7	9.8	11.0	6.7	5.6	12.7	8.2
Bandelier (W)	90TH	-.0550*	.0156	9.3	8.8	8.1	8.0	8.9	8.1	6.7	6.0
Big Bend NP	90TH	-.0321	.1375	11.3	13.0	8.2	10.6	6.8	9.9	8.9	9.4
Bryce Canyon NP	90TH	-.0589	.0543	6.8	7.0	6.5	5.7	5.3	7.1	5.5	4.5
Bridger (W)	90TH	-.0674	.0894	9.6	7.0	7.8	6.9	6.9	4.7	8.2	5.4
Canyonlands NP	90TH	-.1195*	.0028	8.7	8.0	7.1	6.3	4.4	4.7	4.1	4.4
Chiricahua (W)	90TH	-.0327	.2742	9.3	6.7	8.0	6.9	7.1	7.3	7.5	6.0
Crater Lake NP	90TH	-.0568	.3598	12.7	11.4	13.6	11.5	6.9	7.9	15.4	8.3
Denali NP	90TH	-.0643	.3598	5.0	4.9	6.6	12.6	2.6	9.1	5.6	2.0
Glacier NP	90TH	-.0034	.4524	19.3	25.2	27.4	23.0	18.9	23.4	25.0	20.0
Grand Canyon NP	90TH	-.0631*	.0028	7.9	7.7	7.8	5.6	5.3	6.9	4.9	4.8
Great Sand Dunes (W)	90TH	-.0951*	.0071	9.2	7.8	6.9	6.5	4.3	4.9	6.1	4.6
Great Smoky Mtns NP	90TH	-.0375	.1994	28.0	17.3	22.1	21.5	15.5	19.7	18.6	19.8
Guadalupe Mtns NP	90TH	-.0752*	.0071	9.2	9.1	7.4	7.8	5.9	6.7	6.8	5.1
Lassen Volcanic NP	90TH	-.0306	.0894	11.1	12.4	10.1	9.4	9.2	10.1	10.6	8.7
Mesa Verde NP	90TH	-.0760	.0543	7.9	7.2	8.0	5.8	3.9	5.6	5.8	4.6
Mt. Rainier NP	90TH	-.0532*	.0305	21.4	23.3	26.0	21.4	22.0	19.4	18.1	15.7
Petrified Forest NP	90TH	-.0958*	.0028	10.4	8.6	8.2	7.3	6.3	6.7	4.9	6.5
Pinnacles (W)	90TH	-.0584*	.0156	13.9	18.6	16.0	14.3	12.3	12.9	11.0	11.8
Pt. Reyes NS	90TH	-.1305	.0543	11.2	19.0	15.4	12.9	9.0	12.9	7.1	7.3
Redwood NP	90TH	-.0590*	.0071	16.7	15.0	13.9	11.4	13.3	12.3	6.7	11.9
Rocky Mtns NP	90TH	-.0751*	.0156	9.5	10.9	9.6	7.6	6.9	6.5	8.7	6.1
San Gorgonio (W)	90TH	-.0594*	.0071	20.5	19.2	17.9	17.1	19.4	15.2	15.6	10.3
Shenandoah NP	90TH	-.0215	.1375	26.9	18.0	20.2	19.8	16.8	11.4	18.9	19.4
Tonto NM	90TH	-.0236	.4524	10.3	15.0	7.7	8.5	9.2	13.9	6.0	10.3
Washington, DC	90TH	-.0032	.5476	31.7	22.8	29.2	28.5	24.8	35.7	30.5	24.8
Weminuche (W)	90TH	-.1003*	.0071	9.0	8.4	7.9	5.7	4.7	4.7	4.8	4.7
Yellowstone NP	90TH	-.0718	.0894	12.7	10.2	10.7	9.3	9.5	7.5	15.6	7.0
Yosemite NP	90TH	0.0534	.3598	22.2	14.5	16.6	16.5	18.4	12.3	21.0	21.9

* Denotes that the slope is significant at the .05 significance level.
NP = National Park
W = Wilderness
NS = National Seashore
NM = National Monument

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995

DECIVIEW

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Acadia NP	10TH	-.0294*	.0305	13.0	14.1	14.2	13.4	11.7	12.6	11.3	11.3
Badlands (W)	10TH	-.0229*	.0305	10.3	9.5	9.7	9.7	10.0	9.5	8.9	7.8
Bandelier (W)	10TH	-.0404	.0894	8.1	9.7	10.4	9.3	8.5	8.9	8.3	6.0
Big Bend NP	10TH	-.0237	.0894	10.1	10.3	10.7	9.5	8.2	9.6	8.6	9.1
Bryce Canyon NP	10TH	-.0592	.0894	6.6	5.8	6.8	7.2	6.7	6.2	5.2	4.2
Bridger (W)	10TH	-.0481	.0543	5.0	5.4	6.6	5.0	5.3	4.3	4.9	3.2
Canyonlands NP	10TH	-.0552	.0543	7.1	7.9	9.0	8.3	6.9	7.4	6.6	4.9
Chiricahua (W)	10TH	-.0210*	.0305	8.2	7.9	8.3	8.0	7.2	7.8	7.1	7.3
Crater Lake NP	10TH	-.0395	.0543	5.8	6.5	6.6	6.5	6.3	5.1	5.5	3.8
Denali NP	10TH	-.0587*	.0071	5.4	5.0	7.6	5.3	4.5	4.2	4.2	3.7
Glacier NP	10TH	-.0163	.2742	10.9	11.4	12.2	12.7	12.5	11.7	10.3	9.7
Grand Canyon NP	10TH	-.0145	.3598	5.8	6.1	8.1	7.2	7.1	5.9	5.3	6.1
Great Sand Dunes (W)	10TH	-.0908*	.0071	8.6	8.0	9.7	9.1	7.5	6.9	6.2	4.6
Great Smoky Mtns NP	10TH	-.0120*	.0305	15.9	16.4	16.1	16.2	15.4	15.6	15.0	15.2
Guadalupe Mtns NP	10TH	-.0168	.1375	10.0	11.1	10.3	8.4	9.3	9.9	8.6	9.6
Lassen Volcanic NP	10TH	-.0585	.0543	5.6	6.3	7.1	4.7	6.1	4.9	4.7	4.0
Mesa Verde NP	10TH	-.0686	.0894	7.7	6.8	9.2	8.1	7.0	6.5	7.0	4.5
Mt. Rainier NP	10TH	-.0400	.2742	9.0	8.5	10.1	10.3	11.9	9.3	7.4	6.4
Petrified Forest NP	10TH	-.0575*	.0305	8.4	10.3	10.4	10.2	8.8	8.0	8.1	6.7
Pinnacles (W)	10TH	-.0405*	.0156	11.6	11.9	14.1	10.8	10.2	11.5	9.4	9.2
Pt. Reyes NS	10TH	-.0221	.1375	11.6	12.2	14.5	12.7	11.9	12.6	11.3	10.2
Redwood NP	10TH	-.0357*	.0156	10.6	9.6	11.4	9.6	10.1	8.6	8.4	8.3
Rocky Mtns NP	10TH	-.0241	.1375	6.8	5.8	6.6	5.9	6.2	6.0	6.1	4.0
San Gorgonio (W)	10TH	-.0373	.1994	8.4	7.9	11.3	7.8	6.8	7.9	6.0	8.1
Shenandoah NP	10TH	-.0085	.1994	18.4	17.0	17.6	18.0	15.8	17.9	15.8	17.2
Tonto NM	10TH	-.0302*	.0156	10.2	10.0	10.9	9.3	9.5	8.8	8.1	8.9
Washington, DC	10TH	-.0004	.4524	21.7	22.3	22.6	22.2	22.3	23.7	22.2	19.3
Weminuche (W)	10TH	0.0051	.5476	5.7	6.1	6.8	7.4	7.2	6.0	7.2	4.3
Yellowstone NP	10TH	-.0848*	.0071	8.3	7.7	8.9	8.0	6.6	5.2	5.4	5.0
Yosemite NP	10TH	-.0115	.2742	5.9	5.4	8.9	5.8	6.3	5.9	4.9	5.7
Acadia NP	50TH	-.0169	.1375	18.1	20.3	18.7	18.9	17.8	18.1	18.2	16.7
Badlands (W)	50TH	-.0130	.0543	14.8	15.3	14.7	15.1	14.9	13.4	13.9	13.8
Bandelier (W)	50TH	-.0386*	.0071	11.9	12.4	12.7	12.2	11.6	11.3	10.6	9.1
Big Bend NP	50TH	-.0049	.1375	14.4	15.0	14.4	14.1	14.1	14.2	14.5	13.9
Bryce Canyon NP	50TH	-.0183	.0543	11.5	11.5	10.6	11.5	10.5	10.6	11.1	8.8
Bridger (W)	50TH	-.0285	.1375	9.0	9.1	10.2	9.6	9.9	8.1	8.6	7.4
Canyonlands NP	50TH	-.0257	.0543	10.9	10.7	12.4	12.0	10.8	10.7	10.7	8.4
Chiricahua (W)	50TH	-.0190*	.0156	12.4	11.9	12.4	11.6	11.0	11.9	11.4	10.7
Crater Lake NP	50TH	0.0033	.5476	8.8	10.3	11.1	11.7	11.1	9.3	11.4	8.1
Denali NP	50TH	-.0517*	.0156	8.1	8.9	10.1	7.5	6.7	6.6	7.4	5.9
Glacier NP	50TH	-.0095	.1994	16.6	16.3	16.9	17.0	17.0	15.8	16.3	14.8
Grand Canyon NP	50TH	-.0269	.0543	10.2	10.8	11.9	11.2	10.7	10.1	10.1	9.3
Great Sand Dunes (W)	50TH	-.0366*	.0156	11.1	12.1	12.0	11.6	11.2	9.7	10.0	8.7
Great Smoky Mtns NP	50TH	0.0051	.4524	21.6	22.3	22.5	21.5	23.0	23.5	20.3	22.1
Guadalupe Mtns NP	50TH	-.0071	.3598	13.8	14.4	15.2	13.2	12.3	13.2	14.1	13.3
Lassen Volcanic NP	50TH	-.0204*	.0305	10.9	10.6	10.8	9.4	10.1	9.8	10.1	9.0
Mesa Verde NP	50TH	-.0169	.1994	10.8	10.0	10.4	11.2	9.8	10.0	10.6	8.6
Mt. Rainier NP	50TH	0.0020	.5476	17.6	16.9	17.0	18.8	19.4	19.1	17.4	15.8

Table A-12. Trends From IMPROVE Monitoring Sites, 1988–1995 (continued)

DECIVIEW

SITE	PERCENTILE	SLOPE	OBSERVED SIGNIFICANCE LEVEL	1988	1989	1990	1991	1992	1993	1994	1995
Petrified Forest NP	50TH	-.0338*	.0305	12.8	13.1	14.0	13.7	12.6	11.4	11.8	10.2
Pinnacles (W)	50TH	-.0194	.0543	17.1	17.6	18.5	17.1	16.5	17.1	15.3	15.6
Pt. Reyes NS	50TH	-.0225	.0543	17.4	18.3	19.3	17.9	16.4	16.7	17.1	14.9
Redwood NP	50TH	-.0123	.0894	15.8	16.5	17.7	16.4	16.2	14.7	15.8	15.4
Rocky Mtns NP	50TH	-.0183	.0894	11.2	11.4	11.6	11.0	11.6	10.2	11.0	8.6
San Gorgonio (W)	50TH	-.0089	.1994	18.7	19.6	19.5	20.0	17.5	19.8	18.3	17.2
Shenandoah NP	50TH	-.0050	.1994	25.3	23.6	24.7	25.2	25.3	25.1	23.9	23.4
Tonto NM	50TH	-.0195*	.0305	13.4	14.4	13.7	13.5	13.6	13.2	12.4	12.4
Washington, DC	50TH	0.0023	.3598	24.9	27.4	27.3	28.7	28.4	28.7	27.5	25.4
Weminuche (W)	50TH	-.0160*	.0305	10.6	11.2	10.8	10.9	10.6	10.2	10.5	8.3
Yellowstone NP	50TH	-.0383	.0543	10.2	10.8	11.5	11.6	10.4	9.8	9.6	7.9
Yosemite NP	50TH	0.0006	.5476	12.8	12.9	13.9	14.0	14.4	13.0	11.9	12.9
Acadia NP	90TH	0.0018	.5476	26.8	27.5	25.8	25.9	27.2	27.3	27.5	25.1
Badlands (W)	90TH	0.0049	.4524	19.2	18.8	18.8	19.1	21.6	19.4	20.1	18.7
Bandelier (W)	90TH	-.0082	.4524	14.3	16.5	12.9	14.0	15.0	14.5	14.6	13.4
Big Bend NP	90TH	-.0012	.3598	19.1	19.5	18.5	19.0	18.1	18.5	19.3	19.0
Bryce Canyon NP	90TH	-.0062	.1994	14.1	15.0	13.5	13.9	13.9	14.2	13.9	13.0
Bridger (W)	90TH	-.0134	.0543	13.3	13.2	13.3	12.9	13.9	11.5	12.6	11.2
Canyonlands NP	90TH	-.0292*	.0156	14.6	15.1	15.1	14.6	13.1	13.6	13.4	11.7
Chiricahua (W)	90TH	-.0033	.1994	16.3	15.2	15.2	15.1	15.1	15.7	15.8	14.9
Crater Lake NP	90TH	0.0008	.5476	15.6	16.6	16.3	15.9	15.7	16.8	16.8	14.2
Denali NP	90TH	-.0205	.2742	12.5	12.4	14.8	13.7	11.1	12.5	12.9	10.8
Glacier NP	90TH	-.0046	.3598	19.9	21.9	21.8	22.0	22.3	21.5	21.4	20.9
Grand Canyon NP	90TH	-.0114	.1375	13.9	14.9	15.0	13.4	13.6	13.8	13.8	12.9
Great Sand Dunes (W)	90TH	-.0273	.0894	14.6	15.7	14.5	14.4	12.8	13.2	16.6	12.4
Great Smoky Mtns NP	90TH	0.0037	.4524	27.3	28.7	30.9	29.7	29.4	28.5	29.2	29.4
Guadalupe Mtns NP	90TH	-.0115	.0894	18.4	19.3	17.7	17.1	16.8	17.2	18.2	17.0
Lassen Volcanic NP	90TH	-.0076	.3598	15.8	16.9	14.7	13.1	15.2	15.4	15.9	14.3
Mesa Verde NP	90TH	-.0058	.2742	13.2	14.2	14.7	12.9	12.4	14.6	13.7	12.8
Mt. Rainier NP	90TH	-.0123	.2742	23.7	25.7	28.0	25.7	25.8	24.3	24.9	23.1
Petrified Forest NP	90TH	-.0213*	.0156	15.8	16.4	16.9	15.6	15.3	14.7	14.1	14.9
Pinnacles (W)	90TH	-.0204*	.0305	20.6	22.8	22.7	21.5	21.7	20.5	20.1	20.1
Pt. Reyes NS	90TH	-.0126	.2742	22.5	28.2	25.4	23.8	24.9	27.7	23.9	22.0
Redwood NP	90TH	-.0107	.0894	22.2	22.9	23.0	22.6	22.8	21.1	20.3	21.6
Rocky Mtns NP	90TH	-.0132	.0543	14.8	16.1	15.5	14.8	14.6	14.9	14.7	14.4
San Gorgonio (W)	90TH	-.0130	.0543	25.6	26.1	26.7	25.6	26.5	24.8	24.6	22.9
Shenandoah NP	90TH	0.0029	.3598	31.2	31.5	32.2	32.7	32.4	30.9	31.8	32.0
Tonto NM	90TH	-.0072	.1994	16.6	18.3	15.8	16.4	16.4	17.0	14.8	16.0
Washington, DC	90TH	0.0001	.5476	32.0	31.6	31.3	33.9	34.3	34.0	32.7	31.1
Weminuche (W)	90TH	-.0190*	.0156	13.8	15.3	14.0	14.0	13.2	13.5	13.0	12.7
Yellowstone NP	90TH	-.0254*	.0305	16.2	16.0	15.6	14.5	15.4	13.5	16.1	13.1
Yosemite NP	90TH	-.0044	.2742	19.9	18.9	19.9	18.4	19.9	17.9	18.8	19.4

* Denotes that the slope is significant at the .05 significance level.
NP = National Park
W = Wilderness
NS = National Seashore
NM = National Monument

Table A-13. Condensed Nonattainment Areas List(a)

			Pollutant(c)						Population(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	.	.	2092	2006	.	2122	.	2122
14	AZ	Rillito	.	.	.	1	.	.	.	.	.	0	.	0
15	AZ	San Manuel	.	.	1	.	.	.	.	.	5	.	.	5
16	AZ	Yuma	.	.	.	1	.	.	.	.	.	54	.	54
17	CA	Chico	.	1	.	.	.	.	.	72	.	.	.	72
18	CA	Imperial Valley	.	.	.	1	.	.	.	.	.	92	.	92
19	CA	Lake Tahoe South Shore	.	1	.	.	.	.	.	30	.	.	.	30
20	CA	Los Angeles-South Coast Air Basin	1	1	.	1	.	1(e)	13000	13000	.	13000	.	13000
21	CA	Mono Basin (in Mono Co.)	.	.	.	1	.	.	.	.	.	0	.	0
22	CA	Owens Valley	.	.	.	1	.	.	.	.	.	18	.	18
23	CA	Sacramento Metro	1	1	.	1	.	.	1639	1097	.	1041	.	1639
24	CA	San Diego	1	1	.	.	.	.	2498	2348	.	.	.	2498
25	CA	San Francisco-Oakland-San Jose	.	1(f)	.	.	.	.	.	3630	.	.	.	3630
26	CA	San Joaquin Valley	1	3	.	1	.	.	2742	946	.	2742	.	2742
27	CA	Santa Barbara-Santa Maria-Lompoc	1	.	.	.	.	.	370	.	.	.	.	370
28	CA	Searles Valley	.	.	.	1	.	.	.	.	.	30	.	30
29	CA	Southeast Desert Modified AQMA	1	.	.	2	.	.	384	.	.	349	.	384
30	CA	Ventura Co.	1	.	.	.	.	.	669	.	.	.	.	669
31	CO	Aspen	.	.	.	1	.	.	.	.	.	5	.	5
32	CO	Canon City	.	.	.	1	.	.	.	.	.	12	.	12
33	CO	Colorado Springs	.	1	.	.	.	.	.	353	.	.	.	353
34	CO	Denver-Boulder	.	1	.	1	.	.	.	1800	.	1836	.	1836
35	CO	Fort Collins	.	1	.	.	.	.	.	106	.	.	.	106
36	CO	Lamar	.	.	.	1	.	.	.	.	.	8	.	8
37	CO	Longmont	.	1	.	.	.	.	.	52	.	.	.	52
38	CO	Pagosa Springs	.	.	.	1	.	.	.	.	.	1	.	1
39	CO	Steamboat Springs	.	.	.	1	.	.	.	.	.	6	.	6
40	CO	Telluride	.	.	.	1	.	.	.	.	.	1	.	1
41	CT	Greater Connecticut	1	.	.	1	.	.	2470		.	126	.	2470
42	DC-MD-VA	Washington	1	.	.	.	.	.	3923	.	.	.	.	3923
43	DE	Sussex Co	1	.	.	.	.	.	113	.	.	.	.	113
44	GA	Atlanta	1	.	.	.	.	.	2653	.	.	.	.	2653
45	GA	Muscogee Co. (Columbus)	.	.	.	.	1	.	.	.	.	.	179	179
46	GU	Piti Power Plant	.	.	1	.	.	.	.	.	0	.	.	0
47	GU	Tanguisson Power Plant	.	.	1	.	.	.	.	.	0	.	.	0
48	IA	Muscatine Co.	.	.	1	.	.	.	.	.	23	.	.	23
49	ID	Boise	.	.	.	1	.	.	.	.	.	125	.	125
50	ID	Bonner Co.(Sandpoint)	.	.	.	1	.	.	.	.	.	26	.	26
51	ID	Pocatello	.	.	.	1	.	.	.	.	.	46	.	46
52	ID	Shoshone Co.	.	.	.	2	.	.	.	.	.	13	.	13
53	IL-IN	Chicago-Gary-Lake County	1	.	1	3	.	.	7887	.	475	625	.	7887
54	IN	Evansville	1	.	.	.	.	.	165	.	.	.	.	165

Table A-13. Condensed Nonattainment Areas List(a) (continued)

	State	Area Name(b)	Pollutant(c) O_3	CO	SO_2	PM_{10}	Pb	NO_2	Population(d) O_3	CO	SO_2	PM_{10}	Pb	All
55	IN	Marion Co. (Indianapolis)	.	.	.	.	1(g)	.	.	.	.	.	16	16
56	IN	Vermillion Co. (Terre Haute)		.	.	1	.	.	.	.	.	17	.	17
57	KY	Boyd Co. (Ashland)		.	1(h)	.	.	.	.	.	51	.	.	51
58	KY	Muhlenberg Co.	.	.	1	.	.	.	.	.	31	.	.	31
59	KY-IN	Louisville	1	.	.	.	.	.	834	.	.	.	.	834
60	LA	Baton Rouge	1	.	.	.	.	.	559	.	.	.	.	559
61	MA	Springfield (W. Mass)	1	.	.	.	.	.	812	.	.	.	.	812
62	MA-NH	Boston-Lawrence-Worcester	1	.	.	.	.	.	5507	.	.	.	.	5507
63	MD	Baltimore	1	.	.	.	.	.	2348	.	.	.	.	2348
64	MD	Kent and Queen Anne Cos.	1	.	.	.	.	.	52	.	.	.	.	52
65	ME	Knox and Lincoln Cos.	1	.	.	.	.	.	67	.	.	.	.	67
66	ME	Lewiston-Auburn	1	.	.	.	.	.	221	.	.	.	.	221
67	ME	Portland	1	.	.	.	.	.	441	.	.	.	.	441
68	MI	Muskegon	1	.	.	.	.	.	159	.	.	.	.	159
69	MN	Minneapolis-St. Paul	.	1	.	1	.	.	.	2310	.	272	.	2310
70	MN	Olmsted Co. (Rochester)	.	.	1	.	.	.	.	.	71	.	.	71
71	MO	Dent	.	.	.	.	1	.	.	.	.	.	2	2
72	MO	Liberty-Arcadia	.	.	.	.	1	.	.	.	.	.	2	2
73	MO-IL	St. Louis	1	.	.	1(i)	1(j)	.	2390	.	.	32	2	2390
74	MT	Butte	.	.	.	1	.	.	.	.	.	33	.	33
75	MT	Columbia Falls	.	.	.	1	.	.	.	.	.	2	.	2
76	MT	Kalispell	.	.	.	1	.	.	.	.	.	11	.	11
77	MT	Lame Deer	.	.	.	1	.	.	.	.	.	0	.	0
78	MT	Lewis & Clark (E. Helena)	.	.	1	.	1(k)	.	.	.	2	.	2	2
79	MT	Libby	.	.	.	1	.	.	.	.	.	2	.	2
80	MT	Missoula	.	1	.	1	.	.	.	43	.	43	.	43
81	MT	Polson	.	.	.	1	.	.	.	.	.	3	.	3
82	MT	Ronan	.	.	.	1	.	.	.	.	.	1	.	1
83	MT	Thompson Falls	.	.	.	1	.	.	.	.	.	1	.	1
84	MT	Whitefish	.	.	.	1	.	.	.	.	.	3	.	3
85	MT	Yellowstone Co. (Laurel)	.	.	1	.	.	.	.	.	5	.	.	5
86	NE	Douglas Co. (Omaha)	.	.	.	.	1	.	.	.	.	.	1	1
87	NH	Manchester	1	.	.	.	.	.	222	.	.	.	.	222
88	NH	Portsmouth-Dover-Rochester	1	.	.	.	.	.	183	.	.	.	.	183
89	NJ	Atlantic City	1	.	.	.	.	.	319	.	.	.	.	319
90	NM	Anthony	.	.	.	1	.	.	.	.	.	1	.	1
91	NM	Grant Co.	.	.	1	.	.	.	.	.	27	.	.	27
92	NM	Sunland Park	1(l)	.	.	.	.	.	8	.	.	.	.	8
93	NV	Central Steptoe Valley	.	.	1	.	.	.	.	.	2	.	.	2
94	NV	Las Vegas	.	1	.	1	.	.	.	258	.	741	.	741
95	NV	Reno	1	1	.	1	.	.	255	134	.	254	.	255
96	NY	Albany-Schenectady-Troy	1	.	.	.	.	.	874	.	.	.	.	874
97	NY	Buffalo-Niagara Falls	1	.	.	.	.	.	1189	.	.	.	.	1189
98	NY	Essex Co. (Whiteface Mtn.)	1	.	.	.	.	.	1	.	.	.	.	1
99	NY	Jefferson Co.	1	.	.	.	.	.	111	.	.	.	.	111
100	NY	Poughkeepsie	1	.	.	.	.	.	259	.	.	.	.	259
101	NY-NJ-CT	New York-N. New Jersey-Long Island	1	1	.	1	.	.	17943	13155	.	1487	.	17943
102	OH	Cleveland-Akron-Lorain	.	.	3	1	.	.	.	.	1898	1412	.	1898
103	OH	Coshocton Co.	.	.	1	.	.	.	.	.	35	.	.	35
104	OH	Gallia Co.	.	.	1	.	.	.	.	.	30	.	.	30
105	OH	Jefferson Co. (Steubenville)	.	.	1	1	.	.	.	.	80	4	.	80
106	OH	Lucas Co. (Toledo)		.	1	.	.	.	.	.	462	.	.	462
107	OH-KY	Cincinnati-Hamilton	1	.	.	.	.	.	1705	.	.	.	.	1705
108	OH-PA	Youngstown-Warren-Sharon	1(m)	.	.	.	.	.	121	.	.	.	.	121
109	OR	Grants Pass	.	1	.	1	.	.	.	17	.	17	.	17
110	OR	Klamath Falls	.	1	.	1	.	.	.	18	.	17	.	18

Table A-13. Condensed Nonattainment Areas List(a) (continued)

	State	Area Name(b)	Pollutant(c) O_3	CO	SO_2	PM_{10}	Pb	NO_2	Population(d) O_3	CO	SO_2	PM_{10}	Pb	All
111	OR	LaGrande	.	.	.	1	.	.	.	.	.	11	.	11
112	OR	Lakeview	.	.	.	1	.	.	.	.	.	2	.	2
113	OR	Medford	.	1	.	1	.	.	.	62	.	63	.	63
114	OR	Oakridge	.	.	.	1	.	.	.	.	.	3	.	3
115	OR	Springfield-Eugene	.	.	.	1	.	.	.	.	.	157	.	157
116	OR-WA	Portland-Vancouver	.	1	.	.	.	.	.	948	.	.	.	948
117	PA	Altoona	1	.	.	.	.	.	131	.	.	.	.	131
118	PA	Erie	1	.	.	.	.	.	276	.	.	.	.	276
119	PA	Harrisburg-Lebanon-Carlisle	1	.	.	.	.	.	588	.	.	.	.	588
120	PA	Johnstown	1	.	.	.	.	.	241	.	.	.	.	241
121	PA	Lancaster	1	.	.	.	.	.	423	.	.	.	.	423
122	PA	Pittsburgh-Beaver Valley	1	.	2	1	.	.	2468	.	446	75	.	2468
123	PA	Scranton-Wilkes-Barre	1	.	.	.	.	.	734	.	.	.	.	734
124	PA	Warren Co	.	.	2	.	.	.	.	.	22	.	.	22
125	PA	York	1	.	.	.	.	.	418	.	.	.	.	418
126	PA-DE-NJ-MD	Philadelphia-Wilmington-Trenton	1	.		.	.	.	.	6010	.	.	.	6010
127	PA-NJ	Allentown-Bethlehem-Easton	1	.	1	.	.	.	687	.	91	.	.	687
128	PR	Guaynabo Co.	.	.	.	1	.	.	.	.	.	85	.	85
129	RI	Providence (all of RI)	1	.	.	.	.	.	1003	.	.	.	.	1003
130	TN	Benton Co.	.	.	1	.	.	.	.	.	14	.	.	14
131	TN	Humphreys Co.	.	.	1	.	.	.	.	.	15	.	.	15
132	TN	Shelby Co. (Memphis)	.	.	.	.	1(n)	.	.	.	.	.	826	826
133	TN	Nashville	.	.	.	.	1(o)	.	.	.	.	.	81	81
134	TN	Polk Co.	.	.	1	.	.	.	.	.	13	.	.	13
135	TX	Beaumont-Port Arthur	1	.	.	.	.	.	361	.	.	.	.	361
136	TX	Dallas-Fort Worth	1	.	.	.	1(p)	.	3561	.	.	.	264	3561
137	TX	El Paso	1	1	.	1	.	.	592	54	.	515	.	592
138	TX	Houston-Galveston-Brazoria	1	.	.	.	.	.	3731	.	.	.	.	3731
139	UT	Ogden	.	1	.	1	.	.	.	63	.	63	.	63
140	UT	Salt Lake City	.	.	1	1	.	.	.	.	725	725	.	725
141	UT	Tooele Co.	.	.	1	.	.	.	.	.	26	.	.	26
142	UT	Utah Co. (Provo)	.	1	.	1	.	.	.	85	.	263	.	263
143	VA	Richmond	1	.	.	.	.	.	738	.	.	.	.	738
144	VA	Smyth Co. (White Top Mtn.)	1	.	.	.	.	.	0	.	.	.	.	0
145	WA	Olympia-Tumwater-Lacey	.	.	.	1	.	.	.	.	.	63	.	63
146	WA	Seattle-Tacoma	.	.	.	3	.	.	.	.	.	730	.	730
147	WA	Spokane	.	1	.	1	.	.	.	279	.	177	.	279
148	WA	Wallula	.	.	.	1	.	.	.	.	.	47	.	47
149	WA	Yakima	.	.	.	1	.	.	.	.	.	54	.	54
150	WI	Door Co.	1	.	.	.	.	.	26	.	.	.	.	26
151	WI	Manitowoc Co.	1	.	.	.	.	.	80	.	.	.	.	80
152	WI	Marathon Co. (Wausau)	.	.	1	.	.	.	.	.	115	.	.	115
153	WI	Milwaukee-Racine	1	.	.	.	.	.	1735	.	.	.	.	1735
154	WI	Oneida Co. (Rhinelander)	.	.	1	.	.	.	.	.	31	.	.	31
155	WV	Follansbee	.	.	.	1	.	.	.	.	.	3	.	3
156	WV	New Manchester Gr. (in Hancock Co)	.	.	1	.	.	.	.	.	10	.	.	10
157	WV	Wier.-Butler-Clay (in Hancock Co)	.	.	1	1	.	.	.	.	25	22	.	25
158	WY	Sheridan	.	.	.	1	.	.	.	.	.	13	.	13
		Total	59	29	38	79	10	1	101,739	43,118	4,760	29,939	1,375	119,424

Table A-13. Condensed Nonattainment Areas List(a) (continued)

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 one 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 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 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 (in 1000s) 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) NO_2 population same as O_3 and CO.

(f) Carbon monoxide nonattainment area includes San Francisco county, and parts of Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma counties.

(g) Lead nonattainment area is a portion of Franklin township, Marion county, Indiana.

(h) Sulfur dioxide nonattainment area is a portion of Boyd county.

(i) PM_{10} nonattainment area is Granite City, Illinois, in Madison county.

(j) Lead nonattainment area is Herculaneum, Missouri in Jefferson county.

(k) Lead nonattainment area is a portion of Lewis and Clark county, Montana.

(l) Ozone nonattainment area is a portion of Dona Ana county, New Mexico.

(m) Youngstown has been redesignated for ozone but not the rest of the MSA and the population has been adjusted accordingly.

(n) Lead nonattainment area is a portion of Shelby county, Tennessee.

(o) Lead nonattainment area is a portion of Williamson county, Tennessee.

(p) Lead nonattainment area is Frisco, Texas, in Collin county.

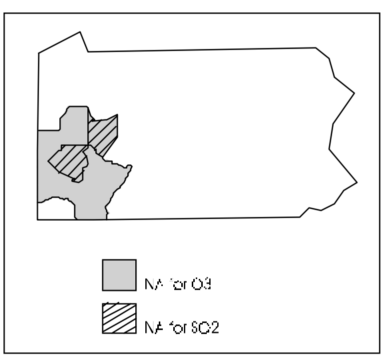


Figure A-1. (Multiple NA areas within a larger NA area) Two SO_2 areas inside the Pittsburgh–Beaver Valley ozone NA. Counted as one NA area.

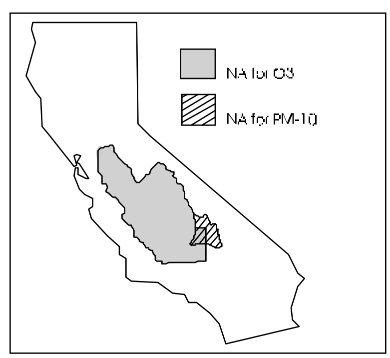


Figure A-2. (Overlapping NA areas) Searles Valley PM_{10} NA partially overlaps the San Joaquin Valley ozone NA. Counted as two NA areas.

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (µgm)	PM_{10} 2nd MAX (µgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
ABILENE, TX	119,655	ND	ND	ND	ND	ND	ND	ND	ND
AGUADILLA, PR	128,172	ND	ND	ND	ND	ND	ND	ND	ND
AKRON, OH	657,575	3	0.04	ND	0.11	25	73	0.010	0.042
ALBANY, GA	112,561	ND	ND	ND	ND	IN	21	ND	ND
ALBANY-SCHENECTADY-TROY, NY	861,424	4	0.03	0.015	0.11	21	48	0.005	0.025
ALBUQUERQUE, NM	589,131	7	ND	0.022	0.10	38	94	ND	ND
ALEXANDRIA, LA	131,556	ND	ND	ND	ND	19	42	ND	ND
ALLENTOWN-BETHLEHEM-EASTON, PA	595,081	3	0.08	0.024	0.11	IN	65	0.010	0.035
ALTOONA, PA	130,542	2	ND	0.013	0.10	22	60	0.008	0.033
AMARILLO, TX	187,547	ND	ND	ND	ND	IN	38	ND	ND
ANCHORAGE, AK	226,338	**11**	ND	ND	ND	34	133	ND	ND
ANN ARBOR, MI	490,058	ND	ND	ND	0.10	ND	ND	ND	ND
ANNISTON, AL	116,034	ND	ND	ND	ND	IN	31	ND	ND
APPLETON-OSHKOSH-NEENAH, WI	315,121	ND	ND	ND	0.09	ND	ND	ND	ND
ARECIBO, PR	155,005	ND	ND	ND	ND	ND	ND	ND	ND
ASHEVILLE, NC	191,774	ND	ND	ND	0.08	25	76	ND	ND
ATHENS, GA	126,262	ND	ND	ND	ND	ND	ND	ND	ND
ATLANTA, GA	2,959,950	4	0.03	0.027	**0.14**	31	60	0.005	0.022
ATLANTIC-CAPE MAY, NJ	319,416	4	0.01	ND	0.11	IN	40	0.003	0.014
AUGUSTA-AIKEN, GA-SC	415,184	ND	0.00	ND	0.11	19	44	ND	ND
AURORA-ELGIN, IL	356,884	ND	ND	ND	ND	ND	ND	ND	ND
AUSTIN-SAN MARCOS, TX	846,227	3	ND	0.018	0.10	20	32	ND	ND
BAKERSFIELD, CA	543,477	6	0.00	0.029	**0.16**	**54**	110	0.003	0.009
BALTIMOREvMD	2,3821,72	4	0.03	0.027	**0.13**	29	75	0.008	0.028
BANGOR, ME	91,629	ND	ND	ND	0.08	19	34	ND	ND
BARNSTABLE-YARMOUTH, MA	134,954	ND	ND	ND	ND	ND	ND	ND	ND
BATON ROUGE, LA	528,264	5	0.15	0.021	0.12	26	51	0.006	0.024
BEAUMONT-PORT ARTHUR, TX	361,226	2	0.02	0.011	0.12	15	34	0.006	0.044
BELLINGHAM, WA	127,780	ND	ND	ND	0.08	15	37	0.005	0.013
BENTON HARBOR, MI	161,378	ND	ND	ND	**0.13**	ND	ND	ND	ND
BERGEN-PASSAIC, NJ	1,278,440	4	0.00	0.028	0.11	37	61	0.007	0.026
BILLINGS, MT	113,419	7	ND	ND	ND	28	75	0.014	0.099
BILOXI-GULFPORT-PASCAGOULA, MS	312,368	ND	ND	ND	0.10	18	33	0.003	0.043
BINGHAMTON, NY	264,497	ND	ND	ND	ND	IN	34	ND	ND
BIRMINGHAM, AL	840,140	6	0.13	0.010	**0.14**	34	100	0.004	0.015
BISMARCK, ND	83,831	ND	ND	ND	ND	12	27	0.007	0.056
BLOOMINGTON, IN	108,978	ND	ND	ND	ND	ND	ND	ND	ND
BLOOMINGTON-NORMAL, IL	129,180	ND	ND	ND	ND	ND	ND	ND	ND
BOISE CITY, ID	295,851	5	ND	IN	ND	36	90	ND	ND
BOSTON, MA-NH	3,227,707	5	ND	0.031	0.11	27	80	0.008	0.037
BOULDER-LONGMONT, CO	225,339	6	ND	ND	0.09	19	59	ND	ND
BRAZORIA, TX	191,707	ND	ND	ND	0.11	ND	ND	ND	ND
BREMERTON, WA	189,731	4	ND	ND	ND	14	41	ND	ND
BRIDGEPORT, CT	443,722	3	0.02	0.024	**0.13**	27	63	0.006	0.023
BROCKTON, MA	236,409	ND	ND	0.008	0.10	ND	ND	ND	ND
BROWNSVILLE-HARLINGEN-SAN BENITO, TX	260,120	2	0.02	ND	0.08	21	40	0.001	0.004
BRYAN-COLLEGE STATION, TX	121,862	ND	ND	ND	ND	ND	ND	ND	ND
BUFFALO-NIAGARA FALLS, NY	1,189,288	4	0.03	0.022	0.10	22	78	0.008	0.048
BURLINGTON, VT	151,506	3	ND	0.017	ND	20	37	0.002	0.014
CAGUAS, PR	279,501	ND	ND	ND	ND	ND	ND	ND	ND
CANTON-MASSILLON, OH	394,106	3	ND	ND	0.10	28	68	0.006	0.032
CASPER, WY	61226	ND	ND	ND	ND	19	36	ND	ND

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (µgm)	PM_{10} 2nd MAX (µgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
CEDAR RAPIDS, IA	168,767	8	ND	ND	0.07	26	65	0.011	**0.200(*)**
CHAMPAIGN-URBANA, IL	173,025	ND	ND	ND	0.09	19	39	0.003	0.013
CHARLESTON-NORTH CHARLESTON, SC	506,875	5	0.02	0.010	0.10	22	54	0.003	0.021
CHARLESTON, WV	250,454	2	0.02	0.020	0.10	25	50	0.010	0.039
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	1,162,093	5	0.01	0.016	**0.13**	28	53	0.005	0.015
CHARLOTTESVILLE, VA	131,107	ND	ND	ND	ND	21	39	ND	ND
CHATTANOOGA, TN-GA	424,347	ND	ND	ND	0.11	33	65	ND	ND
CHEYENNE, WY	73,142	ND	ND	ND	ND	15	31	ND	ND
CHICAGO, IL	7,410,858	5	0.54(a)	0.032	**0.13**	40	122	0.008	0.032
CHICO-PARADISE, CA	182,120	5	0.00	0.013	0.10	25	62	ND	ND
CINCINNATIvOH-KY-IN	1,526,092	3	0.22	0.029	0.12	32	72	0.011	0.045
CLARKSVILLE-HOPKINSVILLE, TN-KY	169,439	ND	ND	ND	0.10	26	56	0.006	0.023
CLEVELAND-LORAIN-ELYRIA, OH	2,202,069	9	1.06(b)	0.026	0.12	41	123	0.011	0.049
COLORADO SPRINGS, CO	397,014	5	0.01	ND	0.08	26	76	ND	ND
COLUMBIA, MO	112,379	ND	ND	ND	ND	ND	ND	ND	ND
COLUMBIA, SC	453,331	3	0.02	0.013	0.10	42	117	0.004	0.020
COLUMBUS, GA-AL	260,860	ND	0.65(c)	ND	0.10	22	58	ND	ND
COLUMBUS, OH	1,345,450	3	0.07	ND	0.11	28	66	0.004	0.021
CORPUS CHRISTI, TX	349,894	ND	ND	ND	0.10	25	45	0.003	0.015
CUMBERLAND, MD-WV	101,643	ND	ND	ND	ND	27	47	0.003	0.019
DALLAS, TX	2,676,248	6	0.70(d)	0.019	**0.14**	**51**	102	0.005	0.046
DANBURY, CT	193,597	ND	ND	ND	0.11	IN	45	0.005	0.020
DANVILLE, VA	108,711	ND	ND	ND	ND	ND	ND	ND	ND
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL	350,861	ND	0.02	ND	0.09	43	153	0.004	0.024
DAYTON-SPRINGFIELD, OH	951,270	3	0.05	ND	0.12	25	66	0.005	0.031
DAYTONA BEACH, FL	399,413	ND	ND	ND	0.09	21	63	ND	ND
DECATUR, AL	131,556	ND	ND	ND	0.11	21	45	IN	0.001
DECATUR, IL	117,206	ND	0.02	ND	0.10	28	53	0.005	0.022
DENVER, CO	1,622,980	7	0.05	0.033	0.11	34	96	0.006	0.024
DES MOINES, IA	392,928	4	ND	ND	0.08	IN	130	ND	ND
DETROIT, MI	4,266,654	6	0.04	0.021	0.11	40	106	0.011	0.079
DOTHAN, AL	130,964	ND	ND	ND	ND	IN	54	ND	ND
DOVER, DE	110,993	ND	ND	ND	0.11	ND	ND	ND	ND
DUBUQUE, IA	86,403	ND	ND	ND	ND	ND	ND	0.003	0.022
DULUTH-SUPERIOR, MN-WI	239,971	5	ND	ND	0.07	21	58	ND	ND
DUTCHESS COUNTY, NY	259,462	ND	ND	ND	0.11	ND	ND	ND	ND
EAU CLAIRE, WI	137,543	ND	ND	ND	ND	ND	ND	ND	ND
EL PASO, TX	591,610	**10**	0.40	0.035	0.12	45	**158**	0.009	0.046
ELKHART-GOSHEN, IN	156,198	ND	ND	ND	0.12	ND	ND	ND	ND
ELMIRA, NY	95,195	ND	ND	ND	0.09	IN	24	0.004	0.016
ENID, OK	56,735	ND	ND	0.009	ND	ND	ND	ND	ND
ERIE, PA	275,572	ND	ND	0.015	0.10	IN	56	0.011	0.066
EUGENE-SPRINGFIELD, OR	282,912	6	0.02	ND	0.11	19	78	ND	ND
EVANSVILLE-HENDERSON, IN-KY	278,990	4	ND	0.017	0.12	26	59	0.018	0.097
FARGO-MOORHEAD, ND-MN	153,296	ND	ND	0.008	0.08	17	54	0.002	0.008
FAYETTEVILLE, NC	274,566	4	ND	ND	0.11	26	53	0.004	0.012
FAYETTEVILLE-SPRINGDALE-ROGERS, AR	259,462	ND	ND	ND	ND	23	48	ND	ND
FITCHBURG-LEOMINSTER, MA	138,165	ND	ND	ND	ND	ND	ND	ND	ND
FLAGSTAFF, AZ-UT	101,760	ND	ND	ND	0.08	IN	31	ND	ND
FLINT, MI	430,459	ND	0.01	ND	0.11	20	45	0.002	0.012
FLORENCE, AL	131,327	ND	ND	ND	ND	18	46	0.003	0.019
FLORENCE, SC	114,344	ND	0.01	ND	ND	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (µgm)	PM_{10} 2nd MAX (µgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
FORT COLLINS-LOVELAND, CO	186,136	5	ND	ND	0.09	IN	52	ND	ND
FORT LAUDERDALE, FL	1,255,488	4	0.05	0.010	0.10	20	48	0.002	0.008
FORT MYERS-CAPE CORAL, FL	335,113	ND	ND	ND	0.08	17	38	ND	ND
FORT PIERCE-PORT ST. LUCIE, FL	251,071	ND	ND	ND	0.07	IN	42	ND	ND
FORT SMITH, AR-OK	175,911	ND	ND	ND	ND	25	47	ND	ND
FORT WALTON BEACH, FL	143,776	ND	ND	ND	ND	ND	ND	ND	ND
FORT WAYNE, IN	456,281	3	0.02	0.007	0.11	35	80	0.003	0.010
FORT WORTH-ARLINGTON, TX	1,361,034	3	0.02	0.021	**0.13**	24	56	0.001	0.011
FRESNO, CA	755,580	7	0.00	0.021	**0.15**	39	101	0.002	0.008
GADSDEN, AL	99,840	ND	0.26	ND	ND	23	50	ND	ND
GAINESVILLE, FL	181,596	ND	ND	ND	ND	19	44	ND	ND
GALVESTON-TEXAS CITY, TX	217,399	ND	0.02	IN	0.11	22	52	0.014	0.067
GARY, IN	604,526	4	0.21(e)	0.021	**0.13**	28	**208**	0.007	0.031
GLENS FALLS, NY	118,539	ND	ND	ND	ND	IN	40	0.002	0.013
GOLDSBORO, NC	104,666	ND	ND	ND	ND	23	43	ND	ND
GRAND FORKS, ND-MN	103,181	ND	ND	ND	ND	IN	53	ND	ND
GRAND JUNCTION, CO	93,145	6	ND	ND	ND	21	63	ND	ND
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	937,891	3	0.01	0.009	**0.13**	22	71	0.002	0.011
GREAT FALLS, MT	77,691	5	ND	ND	ND	19	59	0.004	0.020
GREELEY, CO	131,821	7	ND	ND	0.10	18	56	ND	ND
GREEN BAY, WI	194,594	ND	ND	ND	0.11	ND	ND	0.003	0.011
GREENSBORO—WINSTON-SALEM—HIGH POINT, NC	1,050,304	4	ND	0.016	0.12	28	58	0.007	0.026
GREENVILLE, NC	107,924	ND	ND	ND	0.10	20	36	ND	ND
GREENVILLE-SPARTANBURG-ANDERSON, SC	830,563	5	0.01	0.016	0.11	39	77	0.002	0.012
HAGERSTOWN, MD	121,393	ND	ND	ND	ND	ND	ND	ND	ND
HAMILTON-MIDDLETOWN, OH	291,479	ND	0.05	ND	0.12	32	78	0.007	0.026
HARRISBURG-LEBANON-CARLISLE, PA	587,986	2	0.04	0.021	0.10	23	63	0.006	0.022
HARTFORD, CT	1,157,585	5	0.03	0.016	0.10	21	49	0.006	0.022
HATTIESBURG, MS	98,738	ND	ND	ND	ND	ND	ND	ND	ND
HICKORY-MORGANTON-LENOIR, NC	292,409	ND	ND	ND	0.09	24	60	0.004	0.012
HONOLULU, HI	836,231	3	0.03	0.003	0.05	19	29	0.002	0.009
HOUMA, LA	182,842	ND	ND	ND	0.09	ND	ND	ND	ND
HOUSTON, TX	3,322,025	7	0.02	0.023	**0.18**	40	68	0.006	0.046
HUNTINGTON-ASHLAND, WV-KY-OH	312,529	4	0.05	0.013	0.12	37	86	0.012	0.057
HUNTSVILLE, AL	293,047	3	ND	ND	0.10	22	54	ND	ND
INDIANAPOLIS, IN	1,380,491	3	0.16(f)	0.018	0.12	29	71	0.006	0.041
IOWA CITY, IA	96,119	ND	ND	ND	ND	ND	ND	ND	ND
JACKSON, MI	149,756	ND	ND	ND	ND	ND	ND	ND	ND
JACKSON, MS	395,396	5	ND	ND	0.10	22	55	0.002	0.008
JACKSON, TN	90,801	ND	0.02	ND	ND	22	45	ND	ND
JACKSONVILLE, FL	906,727	4	0.02	0.015	0.10	26	61	0.006	0.030
JACKSONVILLE, NC	149,838	ND	ND	ND	ND	22	37	ND	ND
JAMESTOWN, NY	141,895	ND	ND	ND	0.10	15	33	0.008	0.039
JANESVILLE-BELOIT, WI	139,510	ND	ND	ND	0.10	ND	ND	ND	ND
JERSEY CITY, NJ	553,099	7	0.03	0.027	0.12	43	83	0.009	0.030
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA	436,047	3	0.13	0.018	0.10	28	67	0.012	0.052
JOHNSTOWN, PA	241,247	5	0.05	0.018	0.10	IN	63	0.011	0.034
JONESBORO, AR	68,956	ND	ND	ND	ND	26	53	ND	ND
JOPLIN, MO	134,910	ND	ND	ND	ND	ND	ND	ND	ND
KALAMAZOO-BATTLE CREEK, MI	429,453	2	0.01	0.011	0.10	22	57	0.003	0.011
KANKAKEE, IL	96,255	ND	ND	ND	ND	ND	ND	ND	ND
KANSAS CITY, MO-KS	1,582,875	4	0.07	0.022	0.11	45	120	0.006	0.057

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (μgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (μgm)	PM_{10} 2nd MAX (μgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
KENOSHA, WI	128,181	ND	ND	ND	**0.14**	ND	ND	ND	ND
KILLEEN-TEMPLE, TX	255,301	ND	ND	ND	ND	IN	41	ND	ND
KNOXVILLE, TN	585,960	3	ND	0.014	0.11	36	78	0.009	0.058
KOKOMO, IN	96,946	ND	ND	ND	ND	ND	ND	ND	ND
LA CROSSE, WI-MN	116,401	ND	ND	ND	ND	ND	ND	ND	ND
LAFAYETTE, LA	344,853	ND	ND	ND	0.10	16	25	ND	ND
LAFAYETTE, IN	161,572	1	ND	IN	ND	IN	34	IN	0.020
LAKE CHARLES, LA	168,134	ND	ND	0.006	0.10	IN	33	0.003	0.018
LAKELAND-WINTER HAVEN, FL	405,382	ND	ND	ND	0.09	22	45	0.006	0.021
LANCASTER, PA	422,822	3	0.04	0.017	0.10	31	69	0.005	0.021
LANSING-EAST LANSING, MI	432,674	ND	ND	ND	0.10	ND	ND	ND	ND
LAREDO, TX	133,239	6	ND	ND	0.07	42	103	ND	ND
LAS CRUCES, NM	135,510	4	0.07	0.009	0.12	**56**	143	0.006	0.056
LAS VEGAS, NV-AZ	852,737	**10**	ND	0.027	0.10	IN	**328**	ND	ND
LAWRENCE, KS	81,798	ND	ND	ND	ND	ND	ND	ND	ND
LAWRENCE, MA-NH	353,232	ND	ND	ND	0.09	IN	34	0.005	0.023
LAWTON, OK	111,486	2	ND	IN	0.08	IN	56	ND	ND
LEWISTON-AUBURN, ME	93,679	ND	ND	ND	ND	20	37	0.004	0.018
LEXINGTON, KY	405,936	3	0.04	0.014	0.10	26	60	0.006	0.020
LIMA, OH	154,340	ND	ND	ND	0.11	IN	44	0.003	0.015
LINCOLN, NE	213,641	5	ND	ND	0.06	28	63	ND	ND
LITTLE ROCK-NORTH LITTLE ROCK, AR	513,117	4	ND	0.011	0.10	29	52	0.002	0.009
LONGVIEW-MARSHALL, TX	193,801	ND	ND	ND	0.11	ND	ND	ND	ND
LOS ANGELES-LONG BEACH, CA	8,863,164	**15**	0.06	0.045	**0.20**	45	109	0.004	0.011
LOUISVILLE, KY-IN	948,829	6	0.02	0.020	0.12	28	61	0.009	0.038
LOWELL, MA-NH	280,578	5	ND	ND	ND	ND	ND	ND	ND
LUBBOCK, TX	222,636	ND	ND	ND	ND	22	85	ND	ND
LYNCHBURG, VA	193,928	ND	ND	ND	ND	23	41	ND	ND
MACON, GA	290,909	ND	ND	ND	ND	IN	34	ND	ND
MADISON, WI	367,085	4	ND	ND	0.09	21	44	0.002	0.010
MANCHESTER, NH	50,000	ND	ND	ND	ND	ND	ND	ND	ND
MANSFIELD, OH	174,007	ND	ND	ND	ND	24	68	ND	ND
MAYAGUEZ, PR	237,143	ND	ND	ND	ND	ND	ND	ND	ND
MCALLEN-EDINBURG-MISSION, TX	383,545	ND	ND	ND	0.06	28	111	ND	ND
MEDFORD-ASHLAND, OR	146,389	7	0.02	ND	0.10	29	82	ND	ND
MELBOURNE-TITUSVILLE-PALM BAY, FL	398,978	ND	ND	ND	0.09	18	44	ND	ND
MEMPHIS, TN-AR-MS	1,007,306	7	**2.81(g)**	0.024	**0.15**	29	60	0.004	0.017
MERCED, CA	178,403	ND	ND	0.012	0.12	IN	57	ND	ND
MIAMI, FL	1,937,094	5	0.01	0.016	0.10	28	62	0.002	0.005
MIDDLESEX-SOMERSET-HUNTERDON, NJ	1,019,835	3	0.06	0.020	**0.13**	IN	46	0.005	0.024
MILWAUKEE-WAUKESHA, WI	1,432,149	3	0.03	0.021	0.12	28	69	0.004	0.028
MINNEAPOLIS-ST. PAUL, MN-WI	2,538,834	7	0.55(h)	0.027	0.09	30	91	0.004	0.041
MOBILE, AL	476,923	ND	ND	ND	0.10	28	91	0.009	0.070
MODESTO, CA	370,522	6	0.00	0.022	**0.13**	32	83	ND	ND
MONMOUTH-OCEAN, NJ	986,327	5	ND	ND	0.12	ND	ND	ND	ND
MONROE, LA	142,191	ND	ND	ND	0.09	IN	76	0.003	0.007
MONTGOMERY, AL	292,517	2	ND	0.010	0.10	23	39	0.003	0.022
MUNCIE, IN	119,659	ND	0.94(i)	ND	ND	ND	ND	ND	ND
MYRTLE BEACH, SC	144,053	ND	ND	ND	ND	ND	ND	ND	ND
NAPLES, FL	152,099	ND	ND	ND	ND	16	45	ND	ND
NASHUA, NH	168,233	8	ND	0.019	0.10	17	44	0.007	0.026
NASHVILLE, TN	985,026	5	0.90(j)	0.012	0.12	32	66	0.007	0.076

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (µgm)	PM_{10} 2nd MAX (µgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
NASSAU-SUFFOLK, NY	2,609,212	5	ND	0.026	0.12	21	55	0.008	0.031
NEW BEDFORD, MA	175,641	ND	ND	ND	0.12	16	44	ND	ND
NEW HAVEN-MERIDEN, CT	530,180	3	0.05	0.026	0.12	28	109	0.008	0.031
NEW LONDON-NORWICH, CT-RI	290,734	ND	ND	ND	0.12	19	56	0.005	0.016
NEW ORLEANS, LA	1,285,270	4	0.09	0.018	0.11	31	64	0.006	0.035
NEW YORK, NY	8,546,846	6	0.16	0.042	0.12	41	87	0.015	0.055
NEWARK, NJ	1,915,928	6	0.07	0.041	0.12	34	67	0.007	0.030
NEWBURGH, NY-PA	335,613	ND	0.06	ND	0.12	ND	ND	ND	ND
NORFOLK-VIRGINIA BEACH-NEWPORT, VA	1,443,244	6	0.03	0.018	0.10	21	50	0.007	0.025
OAKLAND, CA	2,082,914	4	0.02	0.022	**0.14**	23	45	0.003	0.011
OCALA, FL	194,833	ND	ND	ND	ND	ND	ND	ND	ND
ODESSA-MIDLAND, TX	255,545	ND	ND	ND	ND	26	59	ND	ND
OKLAHOMA CITY, OK	958,839	8	0.01	0.014	0.10	28	56	IN	0.005
OLYMPIA, WA	161,238	4	ND	ND	ND	IN	53	ND	ND
OMAHA, NE-IA	639,580	7	**5.06(k)**	ND	0.07	42	145	0.004	0.051
ORANGE COUNTY, CA	2,410,556	7	ND	0.035	**0.14**	35	77	0.001	0.004
ORLANDO, FL	1,224,852	4	0.00	0.013	0.10	25	67	0.002	0.008
OWENSBORO, KY	87,189	3	ND	0.011	0.11	23	59	0.007	0.020
PANAMA CITY, FL	126,994	ND	ND	ND	ND	22	50	ND	ND
PARKERSBURG-MARIETTA, WV-OH	149,169	ND	0.02	ND	0.11	23	78	0.010	0.046
PENSACOLA, FL	344,406	ND	ND	ND	0.10	21	37	0.005	0.033
PEORIA-PEKIN, IL	339,172	5	0.02	ND	0.09	24	44	0.008	0.047
PHILADELPHIA, PA-NJ	4,922,175	6	**9.23(l)**	0.034	**0.13**	**70**	**356**	0.010	0.063
PHOENIX-MESA, AZ	2,238,480	**10**	0.05	0.032	0.12	IN	130	0.003	0.020
PINE BLUFF, AR	85,487	ND	ND	ND	ND	23	51	ND	ND
PITTSBURGH, PA	2,384,811	4	0.07	0.030	0.11	41	123	0.015	0.070
PITTSFIELD, MA	88,695	ND	ND	ND	0.11	ND	ND	ND	ND
POCATELLO, ID	66,026	ND	ND	0.014	ND	31	89	0.006	0.030
PONCE, PR	3,442,660	ND	ND	ND	ND	IN	53	ND	ND
PORTLAND, ME	221,095	ND	ND	ND	0.10	27	61	0.005	0.021
PORTLAND-VANCOUVER, OR-WA	1,515,452	7	0.11	IN	**0.13**	27	70	ND	ND
PORTSMOUTH-ROCHESTER, NH-ME	223,271	ND	ND	0.013	0.11	18	42	0.004	0.015
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	1,134,350	4	ND	0.025	0.11	38	83	0.009	0.043
PROVO-OREM, UT	263,590	9	ND	0.024	0.11	37	141	ND	ND
PUEBLO, CO	123,051	ND	ND	ND	ND	IN	49	ND	ND
PUNTA GORDA, FL	110,975	ND	ND	ND	ND	ND	ND	ND	ND
RACINE, WI	175,034	3	ND	ND	**0.13**	ND	ND	ND	ND
RALEIGH-DURHAM-CHAPEL HILL, NC	855,545	6	ND	ND	0.11	26	49	0.003	0.010
RAPID CITY, SD	81,343	ND	ND	ND	ND	37	137	ND	ND
READING, PA	336,523	3	0.82(m)	0.022	0.11	30	66	0.010	0.037
REDDING, CA	147,036	ND	ND	ND	0.11	IN	50	ND	ND
RENO, NV	254,667	8	ND	ND	0.10	45	131	ND	ND
RICHLAND-KENNEWICK-PASCO, WA	150,033	ND	ND	ND	ND	IN	82	ND	ND
RICHMOND-PETERSBURG, VA	865,640	3	0.01	0.022	0.11	26	69	0.006	0.027
RIVERSIDE-SAN BERNARDINO, CA	2,588,793	7	0.04	0.038	**0.22**	**63**	**155**	0.002	0.005
ROANOKE, VA	224,477	6	ND	0.013	0.08	IN	78	0.003	0.014
ROCHESTER, MN	106,470	ND	ND	ND	ND	19	44	0.002	0.016
ROCHESTER, NY	1,062,470	4	0.04	ND	0.09	25	54	0.010	0.041
ROCKFORD, IL	329,676	3	0.05	ND	0.09	18	36	ND	ND
ROCKY MOUNT, NC	133,235	ND	ND	ND	0.09	23	39	0.003	0.010
SACRAMENTO, CA	1,340,010	7	0.01	0.022	**0.14**	27	80	0.002	0.005
SAGINAW-BAY CITY-MIDLAND, MI	399,320	ND	ND	ND	ND	ND	ND	ND	ND

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (μgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (μgm)	PM_{10} 2nd MAX (μgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
ST. CLOUD, MN	190,921	4	ND	ND	ND	ND	ND	ND	ND
ST. JOSEPH, MO	83,083	ND	ND	ND	ND	32	126	0.008	0.079
ST. LOUIS, MO-IL	1,836,302	6	**5.74(n)**	0.025	**0.13**	40	107	0.012	0.102
SALEM, OR	278,024	7	ND	ND	0.12	ND	ND	ND	ND
SALINAS, CA	355,660	2	ND	0.011	0.09	20	40	ND	ND
SALT LAKE CITY-OGDEN, UT	1,072,227	7	0.03	0.026	0.12	47	**157**	0.004	0.021
SAN ANGELO, TX	98,458	ND	ND	ND	ND	ND	ND	ND	ND
SAN ANTONIO, TX	1,324,749	5	0.02	0.009	**0.13**	20	38	ND	ND
SAN DIEGO, CA	2,498,016	6	0.02	0.022	**0.13**	30	92	0.005	0.017
SAN FRANCISCO, CA	1,603,678	5	0.01	0.022	0.10	24	59	0.002	0.007
SAN JOSE, CA	1,497,577	6	0.01	0.025	0.12	25	68	ND	ND
SAN JUAN-BAYAMON, PR	1,836,302	7	ND	ND	ND	34	95	0.006	0.022
SAN LUIS OBISPO-ATASCADERO-PASO ROBLE, CA	217,162	2	ND	0.013	0.11	21	96	0.006	0.029
SANTA BARBARA-SANTA MARIA-LOMPOC, CA	369,608	5	0.00	0.019	**0.13**	29	63	0.001	0.006
SANTA CRUZ-WATSONVILLE, CA	229,734	1	ND	0.005	0.10	33	69	0.002	0.003
SANTA FE, NM	117,043	2	ND	ND	ND	14	33	ND	ND
SANTA ROSA, CA	388,222	3	ND	0.014	0.09	17	39	ND	ND
SARASOTA-BRADENTON, FL	489,483	5	ND	ND	0.09	27	73	0.002	0.018
SAVANNAH, GA	258,060	ND	ND	ND	0.09	ND	ND	0.005	0.030
SCRANTON—WILKES-BARRE—HAZLETON, PA	638,466	4	ND	0.018	0.11	24	61	0.007	0.033
SEATTLE-BELLEVUE-EVERETT, WA	2,033,156	7	0.66(o)	0.020	0.12	24	93	0.006	0.019
SHARON, PA	121,003	ND	0.07	ND	0.10	IN	52	0.007	0.029
SHEBOYGAN, WI	103,877	ND	ND	ND	0.11	ND	ND	ND	ND
SHERMAN-DENISON, TX	95,021	ND	ND	ND	ND	ND	ND	ND	ND
SHREVEPORT-BOSSIER CITY, LA	376,330	ND	ND	ND	0.10	22	47	0.002	0.004
SIOUX CITY, IA-NE	115,018	ND	ND	ND	ND	IN	95	ND	ND
SIOUX FALLS, SD	139,236	ND	ND	ND	ND	19	53	ND	ND
SOUTH BEND, IN	247,052	3	ND	0.011	0.11	20	45	ND	ND
SPOKANE, WA	361,364	9	ND	ND	0.08	32	110	ND	ND
SPRINGFIELD, IL	189,550	3	ND	ND	0.10	IN	26	0.006	0.061
SPRINGFIELD, MO	264,346	3	ND	0.011	0.10	41	148	0.008	0.089
SPRINGFIELD, MA	587,884	8	ND	0.024	0.11	30	67	0.007	0.028
STAMFORD-NORWALK, CT	329,935	4	ND	ND	0.12	32	65	0.005	0.026
STATE COLLEGE, PA	123,786	ND	ND	ND	0.09	ND	ND	ND	ND
STEUBENVILLE-WEIRTON, OH-WV	142,523	6	0.04	0.020	0.10	37	**170**	0.014	0.066
STOCKTON-LODI, CA	480,628	7	0.00	0.023	**0.13**	27	61	ND	ND
SUMTER, SC	102,637	ND	0.01	ND	ND	ND	ND	ND	ND
SYRACUSE, NY	742,177	4	ND	ND	0.09	24	61	0.003	0.015
TACOMA, WA	586,203	6	ND	ND	0.10	22	74	0.006	0.028
TALLAHASSEE, FL	233,598	ND	ND	ND	0.09	IN	33	ND	ND
TAMPA-ST. PETERSBURG-CLEARWATER, FL	2,067,959	4	**2.81(p)**	0.011	0.11	35	81	0.007	0.087
TERRE HAUTE, IN	147,585	3	ND	ND	0.11	27	53	0.012	0.039
TEXARKANA, TX-TEXARKANA, AR	120,132	ND	ND	ND	ND	23	50	ND	ND
TOLEDO, OH	614,128	3	0.44(q)	ND	0.11	23	69	0.005	0.049
TOPEKA, KS	160,976	ND	0.01	ND	ND	21	58	ND	ND
TRENTON, NJ	325,824	ND	ND	0.017	0.12	27	59	ND	ND
TUSCON, AZ	666,880	5	0.05	0.019	0.09	38	81	0.001	0.004
TULSA, OK	708,954	7	0.11	0.015	0.12	IN	76	0.008	0.042
TUSCALOOSA, AL	150,522	ND	ND	ND	ND	IN	58	ND	ND
TYLER, TX	151,309	ND	ND	ND	0.10	IN	30	ND	ND
UTICA-ROME, NY	316,633	ND	ND	ND	0.08	20	43	0.002	0.009
VALLEJO-FAIRFIELD-NAPA, CA	451,186	5	ND	0.015	0.12	20	43	0.002	0.006
VENTURA, CA	669,016	3	0.00	0.022	**0.14**	30	79	0.001	0.003

Table A-14. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1996 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMAX (µgm)	NO_2 AM (ppm)	O_3 2nd MAX (ppm)	PM_{10} WTD AM (µgm)	PM_{10} 2nd MAX (µgm)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
VICTORIA, TX	74,361	ND	ND	ND	0.09	ND	ND	ND	ND
VINELAND-MILLVILLE-BRIDGETON, NJ	138,053	ND	ND	ND	0.11	ND	ND	0.005	0.016
VISALIA-TULARE-PORTERVILLE, CA	311,921	4	ND	0.018	**0.14**	45	87	ND	ND
WACO, TX	189,123	ND	ND	ND	ND	ND	ND	ND	ND
WASHINGTON, DC-MD-VA-WV	4,223,485	5	0.02	0.026	0.12	23	57	0.009	0.048
WATERBURY, CT	221,629	ND	0.04	ND	ND	27	69	0.005	0.022
WATERLOO-CEDAR FALLS, IA	123,798	ND	ND	ND	ND	32	59	ND	ND
WAUSAU, WI	115,400	ND	ND	ND	0.08	25	50	0.003	0.015
WEST PALM BEACH-BOCA RATON, FL	863,518	4	0.00	0.012	0.09	23	56	0.002	0.014
WHEELING, WV-OH	159,301	4	ND	ND	0.11	28	86	0.015	0.072
WICHITA, KS	485,270	6	0.02	ND	0.10	26	119	0.005	0.007
WICHITA FALLS, TX	130,351	ND	ND	ND	ND	19	50	ND	ND
WILLIAMSPORT, PA	118,710	ND	ND	ND	0.08	25	46	0.006	0.028
WILMINGTON-NEWARK, DE-MD	513,293	4	ND	0.019	0.12	32	81	0.011	0.067
WILMINGTON, NC	171,269	ND	ND	ND	0.09	IN	46	0.006	0.036
WORCESTER, MA-CT	478,384	5	ND	0.019	0.09	IN	46	0.005	0.021
YAKIMA, WA	188,823	7	ND	ND	ND	31	112	ND	ND
YOLO, CA	141,092	1	ND	0.011	0.11	28	65	ND	ND
YORK, PA	339,574	3	0.07	0.021	0.10	28	53	0.007	0.022
YOUNGSTOWN-WARREN, OH	600,859	ND	0.04	0.019	0.11	33	86	0.012	0.057
YUBA CITY, CA	122,643	4	ND	0.012	0.11	29	69	ND	ND
YUMA, AZ	106,895	ND	ND	ND	0.10	IN	59	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 ug/m³)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
PM_{10} = Highest weighted annual mean concentration *(Applicable NAAQS is 50 ug/m³)*
Data from exceptional events not included.
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 ug/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
UGM = Units are micrograms per cubic meter
PPM = Units are parts per million
* – Localized impact from electric utility and switching to low sulfur coal per SIP.
(a) – Localized impact from an industrial source in Chicago, IL. Highest population-oriented site in Chicago, IL is 0.06 µg/m³.
(b) – Localized impact from an industrial source in Cleveland, OH. This facility has been shut down. Highest population-oriented site in Cleveland, OH is 0.04 µg/m³.
(c) – Localized impact from an industrial source in Columbus, GA. Highest population-oriented site in Columbus, GA is 0.11 µg/m³.
(d) – Localized impact from an industrial source in Collin Co., TX. Highest population-oriented site in Dallas, TX is 0.17 µg/m³.
(e) – Localized impact from an industrial source in Hammond, IN. Highest population-oriented site in Hammond is 0.04 µg/m³.
(f) – Localized impact from an industrial source in Indianapolis, IN. Highest population-oriented site in Indianapolis, IN is 0.07 µg/m³.
(g) – Localized impact from an industrial source in Memphis, TN. Highest population-oriented site in Memphis, TN is 0.03 µg/m³.
(h) – Localized impact from an industrial source in Eagan, MN. Highest population-oriented site in Minneapolis, MN is 0.01 µg/m³.
(i) – Localized impact from an industrial source in Muncie, IN.
(j) – Localized impact from an industrial source in Williamston, CO., TN. Highest population-oriented site in Nashville, TN is 0.07 µg/m³.
(k) – Localized impact from an industrial source in Omaha, NE. Highest population-oriented site in Omaha, NE is 0.02 µg/m³.
(l) – Localized impact from an industrial source in Philadelphia, PA. Highest population-oriented site in Philadelphia, PA is 0.76 µg/m³.
(m) – Localized impact from an industrial source in Laureldale, PA.
(n) – Localized impact from an industrial source in Herculaneum, MO. Highest population-oriented site in St. Louis, MO is 0.03 µg/m³.
(o) – Localized impact from an industrial source in Seattle.
(p) – Localized impact from an industrial source in Tampa, FL.
(q) – Localized impact from an industrial source in Toledo, OH.

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. Metropolitan Statistical Area Air Quality Trends, 1987–1996

Metropolitan Statistical Area			Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AKRON, OH														
	CO	SECOND MAX 8-HOUR	NS	1	5.1	4.6	5.2	5.7	3.3	4.1	3.1	5.3	3.3	3.4
	LEAD	MAX QUARTERLY MEAN	DOWN	2	0.13	0.07	0.10	0.04	0.06	0.05	0.06	0.06	0.03	0.04
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.13	0.16	0.13	0.11	0.12	0.11	0.11	0.10	0.12	0.11
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	72	72	61	59	57	62	62	63	47
		WEIGHTED ANNUAL MEAN	DOWN	1	—	34	34	26	28	27	25	28	26	25
	SO2	ARITHMETIC MEAN	DOWN	1	0.014	0.015	0.015	0.015	0.015	0.013	0.015	0.012	0.009	0.010
		SECOND MAX 24-HOUR	NS	1	0.045	0.056	0.053	0.061	0.051	0.064	0.056	0.042	0.046	0.042
ALBANY-SCHENECTADY-TROY, NY														
	CO	SECOND MAX 8-HOUR	DOWN	1	7.5	6.2	5.7	6.2	5.4	4.7	3.8	5.2	4.3	3.7
	LEAD	MAX QUARTERLY MEAN	NS	1	0.08	0.05	0.04	0.13	0.04	0.03	0.03	0.04	0.04	0.03
	OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.11	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09
	PM_{10}	SECOND MAX 24-HOUR	NS	2	—	46	46	46	51	54	51	57	49	43
		WEIGHTED ANNUAL MEAN	NS	2	—	22	22	22	22	21	20	22	19	19
	SO2	ARITHMETIC MEAN	DOWN	1	0.007	0.006	0.005	0.006	0.007	0.006	0.006	0.006	0.005	0.005
		SECOND MAX 24-HOUR	NS	1	0.027	0.039	0.022	0.028	0.030	0.022	0.026	0.027	0.016	0.021
ALBUQUERQUE, NM														
	CO	SECOND MAX 8-HOUR	DOWN	5	8.6	6.6	6.6	6.2	5.6	5.1	5.4	5.0	5.2	4.5
	NO2	ARITHMETIC MEAN	NS	1	0.018	0.018	0.019	0.018	0.004	0.021	0.024	0.023	0.018	0.022
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	7	0.09	0.09	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.08
	PM_{10}	SECOND MAX 24-HOUR	NS	9	—	79	75	58	52	46	52	53	58	52
		WEIGHTED ANNUAL MEAN	NS	9	—	37	35	26	23	24	25	24	25	25
ALEXANDRIA, LA														
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	43	43	43	44	48	43	49	45	42
		WEIGHTED ANNUAL MEAN	NS	1	—	23	23	23	22	25	21	23	21	19
ALLENTOWN-BETHLEHEM-EASTON, PA														
	CO	SECOND MAX 8-HOUR	NS	2	4.7	6.8	4.8	5.3	5.3	3.8	3.6	6.6	4.7	3.2
	LEAD	MAX QUARTERLY MEAN	DOWN	2	0.43	0.84	0.44	0.24	0.27	0.18	0.12	0.11	0.06	0.06
	NO2	ARITHMETIC MEAN	NS	1	0.019	0.020	0.020	0.017	0.018	0.018	0.020	0.021	0.018	0.018
	OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.12	0.15	0.10	0.11	0.12	0.10	0.11	0.11	0.11	0.11
	PM_{10}	SECOND MAX 24-HOUR	NS	3	—	65	63	74	62	38	60	64	57	57
		WEIGHTED ANNUAL MEAN	DOWN	3	—	28	28	27	27	20	23	25	24	24
	SO2	ARITHMETIC MEAN	NS	1	0.012	0.012	0.010	0.010	0.008	0.008	0.009	0.010	0.010	0.010
		SECOND MAX 24-HOUR	DOWN	1	0.035	0.049	0.047	0.044	0.033	0.030	0.027	0.042	0.027	0.033
ALTOONA, PA														
	OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.13	0.14	0.10	0.10	0.11	0.10	0.10	0.11	0.11	0.10
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	75	60	53	65	38	62	74	57	57
		WEIGHTED ANNUAL MEAN	NS	1	—	31	25	21	26	21	23	26	25	25
	SO2	ARITHMETIC MEAN	DOWN	1	0.010	0.011	0.011	0.011	0.011	0.009	0.009	0.010	0.008	0.008
		SECOND MAX 24-HOUR	NS	1	0.051	0.051	0.059	0.062	0.044	0.046	0.052	0.058	0.037	0.033
ANCHORAGE, AK														
	PM_{10}	SECOND MAX 24-HOUR	NS	3	—	97	79	107	104	130	102	95	115	89
		WEIGHTED ANNUAL MEAN	NS	3	—	28	26	31	30	31	28	27	26	25
ANN ARBOR, MI														
	OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.13	0.13	0.10	0.09	0.11	0.10	0.10	0.09	0.11	0.10
ANNISTON, AL														
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	64	64	64	78	45	69	44	62	31
		WEIGHTED ANNUAL MEAN	DOWN	1	—	28	28	28	29	25	25	24	23	19
APPLETON-OSHKOSH-NEENAH, WI														
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.10	0.11	0.09	0.08	0.09	0.09	0.07	0.08	0.08	0.08
ASHEVILLE, NC														
	OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.08
	PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	75	53	49	53	41	53	33	38	37
		WEIGHTED ANNUAL MEAN	DOWN	1	—	29	29	25	24	23	22	19	18	19
ATLANTA, GA														
	CO	SECOND MAX 8-HOUR	DOWN	1	5.9	5.3	6.2	5.4	6.5	5.1	4.9	5.3	4.5	3.7
	LEAD	MAX QUARTERLY MEAN	DOWN	2	0.07	0.05	0.04	0.03	0.04	0.03	0.02	0.03	0.05	0.03
	NO2	ARITHMETIC MEAN	DOWN	2	0.024	0.024	0.023	0.021	0.020	0.020	0.020	0.018	0.017	0.021
	OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.16	0.16	0.12	0.14	0.12	0.12	0.15	0.12	0.14	0.13
	PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	87	73	96	78	61	72	61	55	58
		WEIGHTED ANNUAL MEAN	DOWN	2	—	41	37	46	36	31	31	30	31	29
	SO2	ARITHMETIC MEAN	DOWN	2	0.006	0.007	0.007	0.007	0.006	0.006	0.006	0.004	0.004	0.004
		SECOND MAX 24-HOUR	DOWN	2	0.035	0.041	0.043	0.026	0.032	0.028	0.036	0.023	0.018	0.018
ATLANTIC-CAPE MAY, NJ														
	LEAD	MAX QUARTERLY MEAN	NS	1	0.06	0.04	0.07	0.02	0.03	0.02	0.03	0.04	0.03	0.03
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.14	0.15	0.12	0.16	0.14	0.12	0.12	0.10	0.12	0.11
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	82	69	59	71	51	58	56	66	66
		WEIGHTED ANNUAL MEAN	DOWN	1	—	41	37	34	34	31	30	33	32	32
	SO2	ARITHMETIC MEAN	DOWN	1	0.004	0.006	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003
		SECOND MAX 24-HOUR	NS	1	0.016	0.025	0.029	0.012	0.011	0.016	0.014	0.019	0.011	0.014
AUGUSTA-AIKEN, GA-SC														
	LEAD	MAX QUARTERLY MEAN	DOWN	1	0.03	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00
	OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.11	0.09	0.10	0.10	0.09	0.10	0.09	0.11	0.10

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	67	49	53	50	42	51	45	40	41
	WEIGHTED ANNUAL MEAN	DOWN	1	—	27	21	22	23	22	22	21	19	19
AUSTIN-SAN MARCOS, TX													
CO	SECOND MAX 8-HOUR	NS	1	4.2	4.2	4.2	5.9	3.4	3.7	3.0	5.8	3.5	3.2
NO2	ARITHMETIC MEAN	NS	1	0.017	0.017	0.017	0.017	0.016	0.017	0.017	0.018	0.021	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.11	0.11	0.11	0.10	0.09	0.09	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	56	44	43	40	48	51	45	41	31
	WEIGHTED ANNUAL MEAN	DOWN	2	—	26	25	21	24	23	19	20	22	19
BAKERSFIELD, CA													
NO2	ARITHMETIC MEAN	DOWN	3	0.017	0.018	0.017	0.016	0.016	0.015	0.014	0.014	0.012	0.012
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	199	158	165	169	104	96	131	111	64
	WEIGHTED ANNUAL MEAN	DOWN	1	—	74	65	69	70	55	44	40	46	36
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.006	0.004	0.004	0.002	0.003	0.002	0.003	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.016	0.016	0.014	0.011	0.010	0.010	0.010	0.007	0.008	0.009
BALTIMORE, MD													
CO	SECOND MAX 8-HOUR	DOWN	4	7.3	7.7	6.7	6.9	6.1	5.4	5.2	5.5	4.3	3.5
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.09	0.08	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.03
NO2	ARITHMETIC MEAN	DOWN	2	0.031	0.030	0.030	0.029	0.029	0.026	0.027	0.028	0.025	0.025
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.15	0.17	0.12	0.12	0.13	0.12	0.13	0.13	0.14	0.12
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	82	73	69	74	59	63	70	65	57
	WEIGHTED ANNUAL MEAN	DOWN	3	—	36	36	30	35	30	29	30	28	27
SO2	ARITHMETIC MEAN	DOWN	2	0.011	0.012	0.012	0.008	0.009	0.009	0.008	0.009	0.006	0.007
	SECOND MAX 24-HOUR	DOWN	2	0.037	0.038	0.042	0.030	0.030	0.027	0.026	0.030	0.022	0.026
BANGOR, ME													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	58	54	37	48	70	52	59	51	34
	WEIGHTED ANNUAL MEAN	DOWN	1	—	31	26	21	25	22	22	22	20	19
BATON ROUGE, LA													
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.21	0.10	0.09	0.06	0.03	0.03	0.02	0.02	0.04	0.03
NO2	ARITHMETIC MEAN	NS	1	0.019	0.017	0.015	0.014	0.015	0.016	0.012	0.016	0.016	0.015
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.14	0.15	0.14	0.15	0.13	0.11	0.11	0.12	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	54	57	56	62	57	47	54	49	43
	WEIGHTED ANNUAL MEAN	DOWN	2	—	28	28	28	28	27	22	26	24	24
SO2	ARITHMETIC MEAN	NS	1	0.007	0.007	0.007	0.005	0.009	0.008	0.006	0.008	0.006	0.006
	SECOND MAX 24-HOUR	NS	1	0.030	0.029	0.056	0.022	0.036	0.033	0.021	0.025	0.034	0.024
BEAUMONT-PORT ARTHUR, TX													
CO	SECOND MAX 8-HOUR	NS	1	4.0	3.0	2.0	2.3	2.3	2.4	3.3	2.0	1.7	2.1
LEAD	MAX QUARTERLY MEAN	NS	1	0.04	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02
NO2	ARITHMETIC MEAN	UP	1	0.007	0.007	0.007	0.005	0.008	0.009	0.010	0.012	0.010	0.008
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.13	0.15	0.14	0.12	0.13	0.13	0.12	0.11	0.14	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	48	48	48	58	53	56	45	56	34
	WEIGHTED ANNUAL MEAN	DOWN	1	—	23	23	23	26	26	22	20	20	15
SO2	ARITHMETIC MEAN	DOWN	2	0.009	0.008	0.008	0.009	0.008	0.006	0.006	0.006	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	2	0.053	0.046	0.088	0.042	0.059	0.044	0.047	0.039	0.025	0.041
BELLINGHAM, WA													
SO2	ARITHMETIC MEAN	NS	1	0.008	0.005	0.006	0.007	0.006	0.007	0.006	0.007	0.006	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.025	0.026	0.018	0.028	0.021	0.022	0.017	0.019	0.018	0.013
BERGEN-PASSAIC, NJ													
CO	SECOND MAX 8-HOUR	DOWN	2	7.5	6.8	7.5	6.8	6.6	4.5	5.2	6.2	4.9	3.8
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.13	0.09	0.05	0.04	0.03	0.02	0.03	0.08	0.03	0.03
NO2	ARITHMETIC MEAN	DOWN	1	0.036	0.036	0.035	0.031	0.031	0.030	0.029	0.031	0.029	0.028
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.17	0.19	0.12	0.13	0.14	0.10	0.11	0.11	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	83	70	83	79	60	71	91	72	53
	WEIGHTED ANNUAL MEAN	DOWN	3	—	38	35	37	39	33	31	35	31	31
SO2	ARITHMETIC MEAN	DOWN	2	0.010	0.012	0.011	0.010	0.010	0.009	0.008	0.007	0.005	0.006
	SECOND MAX 24-HOUR	DOWN	2	0.037	0.053	0.045	0.041	0.035	0.040	0.026	0.037	0.027	0.022
BILLINGS, MT													
SO2	ARITHMETIC MEAN	DOWN	3	0.022	0.021	0.019	0.016	0.016	0.021	0.022	0.016	0.014	0.010
	SECOND MAX 24-HOUR	DOWN	3	0.107	0.108	0.086	0.070	0.070	0.081	0.104	0.072	0.066	0.065
BILOXI-GULFPORT-PASCAGOULA, MS													
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.006	0.006	0.007	0.006	0.006	0.004	0.003	0.003	0.003
	SECOND MAX 24-HOUR	NS	1	0.022	0.022	0.029	0.037	0.034	0.020	0.029	0.022	0.024	0.043
BIRMINGHAM, AL													
CO	SECOND MAX 8-HOUR	DOWN	4	7.6	7.4	7.4	6.9	7.0	6.6	6.6	6.6	6.2	5.4
LEAD	MAX QUARTERLY MEAN	DOWN	2	1.59	2.51	1.23	0.91	1.34	0.62	0.19	0.09	0.08	0.10
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.12	0.12	0.10	0.12	0.10	0.11	0.11	0.10	0.12	0.13
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	76	62	69	75	54	62	49	54	46
	WEIGHTED ANNUAL MEAN	DOWN	6	—	37	31	35	32	29	27	25	26	25
BISMARCK, ND													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	43	51	84	51	45	45	40	36	36
	WEIGHTED ANNUAL MEAN	NS	1	—	19	21	24	21	21	19	18	20	20
BOISE CITY, ID													
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	92	107	67	129	79	80	90	74	74
	WEIGHTED ANNUAL MEAN	DOWN	3	—	40	42	29	35	34	37	35	30	28

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
BOSTON, MA-NH													
CO	SECOND MAX 8-HOUR	DOWN	3	6.2	5.3	5.2	5.9	4.0	4.5	3.6	4.5	3.5	3.2
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.11	0.16	0.07	0.04	0.03	0.03	0.02	0.01	0.01	0.01
NO2	ARITHMETIC MEAN	DOWN	6	0.029	0.029	0.028	0.027	0.027	0.026	0.027	0.027	0.024	0.025
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	4	0.12	0.15	0.12	0.10	0.13	0.11	0.11	0.11	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	8	—	54	52	53	51	51	51	48	42	54
	WEIGHTED ANNUAL MEAN	DOWN	8	—	27	27	25	24	22	22	22	21	22
SO2	ARITHMETIC MEAN	DOWN	10	0.011	0.012	0.011	0.010	0.009	0.009	0.009	0.008	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	10	0.044	0.050	0.044	0.039	0.031	0.038	0.033	0.033	0.024	0.026
BOULDER-LONGMONT, CO													
CO	SECOND MAX 8-HOUR	DOWN	1	8.7	6.0	6.5	4.8	4.2	5.1	4.1	2.7	3.7	2.5
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.12	0.12	0.11	0.10	0.10	0.09	0.10	0.09	0.10	0.09
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	78	85	70	71	61	73	47	45	45
	WEIGHTED ANNUAL MEAN	DOWN	2	—	28	29	23	23	23	24	19	16	17
BRAZORIA, TX													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.14	0.14	0.15	0.15	0.13	0.13	0.13	0.11	0.15	0.11
BRIDGEPORT, CT													
CO	SECOND MAX 8-HOUR	DOWN	1	5.3	6.5	5.2	5.0	5.5	4.7	3.7	5.8	4.9	3.0
NO2	ARITHMETIC MEAN	DOWN	1	0.027	0.027	0.026	0.026	0.025	0.024	0.024	0.026	0.024	0.024
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.20	0.22	0.16	0.15	0.15	0.12	0.16	0.15	0.13	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	54	48	52	55	45	45	54	51	40
	WEIGHTED ANNUAL MEAN	DOWN	2	—	26	25	23	25	20	19	22	19	19
SO2	ARITHMETIC MEAN	DOWN	2	0.012	0.012	0.012	0.011	0.010	0.010	0.009	0.009	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	2	0.051	0.060	0.047	0.048	0.042	0.037	0.033	0.051	0.031	0.029
BROCKTON, MA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.13	0.13	0.12	0.15	0.11	0.11	0.12	0.13	0.10
BROWNSVILLE-HARLINGEN-SAN BENITO, TX													
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	49	49	49	68	59	67	51	48	39
	WEIGHTED ANNUAL MEAN	NS	2	—	24	24	24	26	27	25	24	23	20
BUFFALO-NIAGARA FALLS, NY													
CO	SECOND MAX 8-HOUR	DOWN	3	4.7	4.1	4.4	3.4	3.1	4.6	3.4	3.2	2.6	2.9
LEAD	MAX QUARTERLY MEAN	NS	2	0.08	0.07	0.04	0.04	0.03	0.03	0.04	0.05	0.04	0.04
NO2	ARITHMETIC MEAN	NS	2	0.022	0.021	0.022	0.020	0.018	0.018	0.017	0.019	0.019	0.019
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.13	0.14	0.10	0.11	0.11	0.11	0.09	0.09	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	12	—	59	57	49	61	52	63	40	44	40
	WEIGHTED ANNUAL MEAN	DOWN	12	—	26	25	20	25	22	19	19	19	20
SO2	ARITHMETIC MEAN	DOWN	4	0.012	0.013	0.012	0.011	0.012	0.011	0.010	0.010	0.008	0.007
	SECOND MAX 24-HOUR	DOWN	4	0.056	0.062	0.051	0.054	0.062	0.058	0.042	0.039	0.040	0.034
BURLINGTON, VT													
CO	SECOND MAX 8-HOUR	NS	1	4.7	3.7	3.7	4.6	3.8	3.9	3.9	3.9	2.5	3.3
NO2	ARITHMETIC MEAN	DOWN	1	0.019	0.019	0.019	0.018	0.017	0.016	0.017	0.017	0.017	0.017
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	38	45	62	53	50	45	47	45	36
	WEIGHTED ANNUAL MEAN	DOWN	2	—	23	25	24	23	23	21	21	20	20
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.007	0.007	0.008	0.008	0.003	0.003	0.003	0.002	0.002
	SECOND MAX 24-HOUR	DOWN	1	0.018	0.027	0.031	0.021	0.022	0.013	0.011	0.013	0.006	0.014
CANTON-MASSILLON, OH													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.12	0.14	0.11	0.10	0.11	0.09	0.10	0.10	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	79	77	65	61	59	63	60	60	57
	WEIGHTED ANNUAL MEAN	DOWN	2	—	34	35	30	31	28	26	28	29	25
SO2	ARITHMETIC MEAN	DOWN	1	0.010	0.011	0.012	0.011	0.010	0.010	0.010	0.009	0.006	0.006
	SECOND MAX 24-HOUR	NS	1	0.045	0.039	0.041	0.036	0.037	0.040	0.046	0.052	0.033	0.032
CEDAR RAPIDS, IA													
CO	SECOND MAX 8-HOUR	NS	1	3.3	4.2	2.9	4.8	4.5	4.2	4.1	3.4	2.5	2.5
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.09	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.07	0.07
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	67	73	71	62	60	47	46	56	63
	WEIGHTED ANNUAL MEAN	DOWN	3	—	35	33	28	29	27	22	23	23	23
SO2	ARITHMETIC MEAN	DOWN	5	0.007	0.006	0.007	0.006	0.006	0.005	0.004	0.004	0.004	0.003
	SECOND MAX 24-HOUR	DOWN	5	0.052	0.047	0.049	0.048	0.040	0.036	0.037	0.029	0.028	0.023
CHAMPAIGN-URBANA, IL													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.10	0.09	0.09	0.08	0.09	0.07	0.09	0.10	0.09
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	70	70	66	61	71	50	50	50	39
	WEIGHTED ANNUAL MEAN	DOWN	1	—	32	32	28	30	31	22	25	22	19
SO2	ARITHMETIC MEAN	DOWN	1	0.005	0.005	0.005	0.004	0.005	0.004	0.004	0.004	0.003	0.003
	SECOND MAX 24-HOUR	NS	1	0.021	0.025	0.025	0.030	0.038	0.018	0.015	0.024	0.011	0.013
CHARLESTON-NORTH CHARLESTON, SC													
CO	SECOND MAX 8-HOUR	NS	1	5.4	7.5	5.9	4.7	4.9	5.2	5.8	4.0	6.4	4.7
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.05	0.03	0.02	0.03	0.04	0.01	0.01	0.01	0.01	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.10	0.11	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	63	55	59	46	46	40	48	40	40
	WEIGHTED ANNUAL MEAN	DOWN	4	—	29	29	27	25	23	22	21	20	20
SO2	ARITHMETIC MEAN	DOWN	1	0.005	0.005	0.005	0.003	0.005	0.005	0.004	0.004	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.042	0.063	0.044	0.027	0.030	0.035	0.025	0.038	0.019	0.021

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CHARLESTON, WV													
CO	SECOND MAX 8-HOUR	NS	1	4.7	2.8	2.9	2.8	3.1	3.3	2.2	3.5	2.4	2.3
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.04	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02
NO2	ARITHMETIC MEAN	DOWN	1	0.025	0.024	0.021	0.020	0.020	0.017	0.018	0.019	0.020	0.020
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.16	0.10	0.12	0.12	0.07	0.08	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	83	88	72	59	50	59	57	53	50
	WEIGHTED ANNUAL MEAN	DOWN	1	—	37	35	36	29	28	29	28	26	24
SO2	ARITHMETIC MEAN	DOWN	2	0.011	0.013	0.014	0.012	0.009	0.009	0.009	0.010	0.007	0.008
	SECOND MAX 24-HOUR	DOWN	2	0.045	0.049	0.062	0.056	0.036	0.031	0.034	0.037	0.023	0.031
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC													
CO	SECOND MAX 8-HOUR	DOWN	5	6.7	6.7	7.0	7.1	6.3	6.0	5.6	5.8	4.7	4.4
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.07	0.07	0.03	0.04	0.01	0.08	0.02	0.03	0.01	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.13	0.16	0.12	0.12	0.12	0.10	0.13	0.11	0.11	0.13
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	68	55	57	57	54	52	47	48	51
	WEIGHTED ANNUAL MEAN	DOWN	2	—	35	34	33	30	30	29	29	26	28
CHARLOTTESVILLE, VA													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	72	64	53	57	37	54	40	53	39
	WEIGHTED ANNUAL MEAN	DOWN	1	—	40	30	27	28	22	24	22	23	21
CHATTANOOGA, TN-GA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.12	0.10	0.12	0.10	0.09	0.10	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	76	67	72	75	72	61	63	58	63
	WEIGHTED ANNUAL MEAN	DOWN	2	—	39	36	38	38	34	32	33	32	32
CHICAGO, IL													
CO	SECOND MAX 8-HOUR	NS	6	4.6	5.0	4.8	5.3	4.3	4.8	4.7	6.5	3.7	3.2
LEAD	MAX QUARTERLY MEAN	DOWN	8	0.10	0.15	0.10	0.08	0.06	0.07	0.06	0.06	0.05	0.04
NO2	ARITHMETIC MEAN	NS	5	0.029	0.030	0.030	0.026	0.025	0.027	0.028	0.031	0.031	0.031
OZONE	SECOND DAILY MAX 1-HOUR	NS	16	0.14	0.14	0.11	0.09	0.11	0.10	0.09	0.10	0.12	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	13	—	91	84	99	78	79	78	92	75	65
	WEIGHTED ANNUAL MEAN	DOWN	13	—	39	39	37	35	34	33	37	34	31
SO2	ARITHMETIC MEAN	DOWN	9	0.008	0.008	0.007	0.006	0.007	0.006	0.006	0.006	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	9	0.036	0.031	0.028	0.024	0.029	0.026	0.028	0.030	0.023	0.022
CHICO-PARADISE, CA													
CO	SECOND MAX 8-HOUR	DOWN	2	5.6	7.2	6.4	6.2	7.4	5.9	4.7	4.6	4.1	4.4
NO2	ARITHMETIC MEAN	DOWN	1	0.017	0.016	0.016	0.015	0.016	0.016	0.016	0.015	0.014	0.013
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.10	0.10	0.12	0.09	0.09	0.09	0.10	0.09	0.10
CINCINNATI, OH-KY-IN													
CO	SECOND MAX 8-HOUR	NS	3	5.0	3.8	4.9	4.2	4.2	4.5	4.7	4.3	3.4	2.9
LEAD	MAX QUARTERLY MEAN	NS	2	0.09	0.13	0.09	0.11	0.06	0.05	0.05	0.04	0.05	0.13
NO2	ARITHMETIC MEAN	DOWN	3	0.027	0.025	0.026	0.024	0.024	0.022	0.023	0.024	0.023	0.023
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.13	0.14	0.11	0.12	0.12	0.09	0.10	0.12	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	7	—	94	94	91	66	60	70	68	69	61
	WEIGHTED ANNUAL MEAN	DOWN	7	—	40	41	36	32	30	31	30	31	28
SO2	ARITHMETIC MEAN	DOWN	6	0.012	0.011	0.012	0.012	0.011	0.010	0.011	0.008	0.007	0.008
	SECOND MAX 24-HOUR	DOWN	6	0.055	0.049	0.052	0.058	0.044	0.044	0.041	0.042	0.029	0.035
CLARKSVILLE-HOPKINSVILLE, TN-KY													
SO2	ARITHMETIC MEAN	NS	1	0.005	0.010	0.007	0.007	0.006	0.009	0.010	0.007	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	1	0.040	0.066	0.042	0.038	0.029	0.036	0.058	0.037	0.019	0.023
CLEVELAND-LORAIN-ELYRIA, OH													
CO	SECOND MAX 8-HOUR	NS	2	6.0	5.7	5.9	4.7	4.7	5.1	4.3	5.3	5.7	3.7
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.31	0.26	0.19	0.32	0.18	0.21	0.21	0.14	0.11	0.06
NO2	ARITHMETIC MEAN	DOWN	1	0.022	0.023	0.025	0.022	0.022	0.021	0.022	0.021	0.021	0.020
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.12	0.14	0.10	0.11	0.11	0.10	0.11	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	7	—	85	93	87	82	79	77	93	97	74
	WEIGHTED ANNUAL MEAN	NS	7	—	42	41	36	38	33	32	39	36	33
SO2	ARITHMETIC MEAN	DOWN	9	0.011	0.011	0.012	0.010	0.010	0.009	0.008	0.008	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	9	0.045	0.044	0.042	0.041	0.039	0.038	0.039	0.040	0.023	0.030
COLORADO SPRINGS, CO													
CO	SECOND MAX 8-HOUR	DOWN	2	8.3	11.5	7.7	6.8	6.5	6.0	5.4	4.6	5.1	4.4
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.08	0.08	0.08	0.07	0.08	0.07	0.06	0.07	0.07	0.07
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	73	74	68	75	65	71	63	53	51
	WEIGHTED ANNUAL MEAN	DOWN	4	—	30	30	25	27	24	27	25	23	23
COLUMBIA, SC													
CO	SECOND MAX 8-HOUR	DOWN	1	7.0	7.4	6.5	5.8	6.0	6.3	5.6	4.7	4.0	3.4
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.09	0.06	0.03	0.03	0.05	0.04	0.02	0.02	0.01	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.13	0.10	0.11	0.10	0.10	0.11	0.10	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	DOWN	5	—	66	57	59	49	54	48	40	41	44
	WEIGHTED ANNUAL MEAN	DOWN	5	—	31	30	29	25	26	25	24	20	23
SO2	ARITHMETIC MEAN	DOWN	1	0.003	0.003	0.003	0.003	0.002	0.002	0.003	0.002	0.001	0.002
	SECOND MAX 24-HOUR	DOWN	1	0.017	0.017	0.012	0.009	0.013	0.013	0.012	0.010	0.005	0.011
COLUMBUS, GA-AL													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.10	0.09	0.10	0.09	0.09	0.10	0.10	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	43	43	63	75	51	50	49	54	38
	WEIGHTED ANNUAL MEAN	NS	1	—	26	26	29	27	26	25	27	28	22

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
COLUMBUS, OH													
CO	SECOND MAX 8-HOUR	DOWN	3	5.4	6.0	5.7	4.1	4.8	4.9	3.9	4.5	3.8	2.5
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.09	0.08	0.08	0.06	0.06	0.06	0.04	0.04	0.04	0.03
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.14	0.11	0.11	0.12	0.09	0.10	0.10	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	69	80	84	64	64	66	64	67	60
	WEIGHTED ANNUAL MEAN	DOWN	3	—	31	34	32	31	27	27	27	29	26
SO2	ARITHMETIC MEAN	DOWN	1	0.009	0.008	0.008	0.008	0.007	0.006	0.007	0.007	0.004	0.004
	SECOND MAX 24-HOUR	NS	1	0.032	0.035	0.038	0.038	0.033	0.030	0.034	0.041	0.019	0.021
CORPUS CHRISTI,TX													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.13	0.10	0.10	0.10	0.11	0.09	0.12	0.11	0.12	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	76	74	63	70	59	74	53	54	40
	WEIGHTED ANNUAL MEAN	NS	2	—	28	30	27	31	29	29	28	28	23
SO2	ARITHMETIC MEAN	NS	2	0.003	0.003	0.003	0.002	0.003	0.003	0.003	0.002	0.002	0.002
	SECOND MAX 24-HOUR	NS	2	0.017	0.025	0.019	0.013	0.027	0.018	0.024	0.012	0.016	0.013
CUMBERLAND, MD-WV													
SO2	ARITHMETIC MEAN	DOWN	1	0.012	0.013	0.011	0.010	0.009	0.006	0.008	0.010	0.005	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.044	0.055	0.049	0.031	0.028	0.024	0.027	0.037	0.015	0.019
DALLAS,TX													
CO	SECOND MAX 8-HOUR	NS	1	4.7	8.0	4.5	4.7	3.8	5.6	5.4	5.3	5.9	5.5
LEAD	MAX QUARTERLY MEAN	DOWN	11	0.25	0.23	0.24	0.21	0.16	0.16	0.16	0.10	0.11	0.07
NO2	ARITHMETIC MEAN	UP	1	0.014	0.014	0.012	0.012	0.013	0.015	0.014	0.016	0.019	0.019
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.13	0.13	0.13	0.14	0.10	0.12	0.13	0.12	0.14	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	5	—	57	58	60	57	54	62	51	66	72
	WEIGHTED ANNUAL MEAN	NS	5	—	29	29	28	26	26	27	26	30	30
DANBURY, CT													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.15	0.20	0.13	0.15	0.14	0.12	0.14	0.13	0.13	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	60	48	44	53	57	46	48	52	45
	WEIGHTED ANNUAL MEAN	NS	1	—	26	25	22	26	22	19	26	22	22
SO2	ARITHMETIC MEAN	DOWN	1	0.008	0.009	0.008	0.007	0.008	0.007	0.006	0.006	0.004	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.035	0.051	0.036	0.033	0.032	0.027	0.024	0.037	0.020	0.020
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL													
LEAD	MAX QUARTERLY MEAN	NS	1	0.03	0.01	0.02	0.03	0.01	0.02	0.02	0.02	0.01	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.11	0.10	0.08	0.09	0.10	0.08	0.09	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	72	75	71	57	59	62	74	78	84
	WEIGHTED ANNUAL MEAN	NS	3	—	33	32	31	30	29	28	32	34	31
SO2	ARITHMETIC MEAN	NS	3	0.004	0.004	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.003
	SECOND MAX 24-HOUR	DOWN	3	0.018	0.023	0.025	0.022	0.020	0.019	0.018	0.023	0.017	0.016
DAYTON-SPRINGFIELD, OH													
CO	SECOND MAX 8-HOUR	DOWN	2	5.0	4.0	4.8	3.2	3.5	3.6	3.6	3.4	3.0	2.4
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.09	0.08	0.06	0.05	0.04	0.04	0.06	0.04	0.05	0.04
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.12	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	74	70	64	53	52	58	56	56	54
	WEIGHTED ANNUAL MEAN	DOWN	4	—	31	30	25	28	25	24	24	25	23
SO2	ARITHMETIC MEAN	DOWN	2	0.006	0.006	0.006	0.006	0.005	0.005	0.006	0.006	0.004	0.005
	SECOND MAX 24-HOUR	NS	2	0.030	0.026	0.031	0.023	0.022	0.020	0.031	0.032	0.016	0.027
DECATUR, AL													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	57	57	57	68	48	60	45	52	44
	WEIGHTED ANNUAL MEAN	NS	1	—	25	25	25	28	25	25	22	25	21
DECATUR, IL													
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.09	0.10	0.07	0.03	0.03	0.03	0.03	0.05	0.03	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.11	0.09	0.09	0.10	0.09	0.08	0.10	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	99	110	101	85	75	64	66	58	53
	WEIGHTED ANNUAL MEAN	DOWN	1	—	40	40	34	36	38	28	29	30	28
SO2	ARITHMETIC MEAN	DOWN	1	0.013	0.015	0.012	0.008	0.007	0.005	0.006	0.007	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.081	0.162	0.108	0.060	0.039	0.023	0.025	0.030	0.024	0.022
DENVER, CO													
CO	SECOND MAX 8-HOUR	DOWN	6	12.1	9.9	7.8	7.2	7.0	8.3	6.6	6.1	5.6	4.8
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.09	0.07	0.05	0.06	0.05	0.06	0.06	0.04	0.05	0.03
NO2	ARITHMETIC MEAN	DOWN	2	0.034	0.033	0.033	0.032	0.032	0.032	0.027	0.032	0.029	0.027
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	5	0.11	0.11	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	10	—	66	79	67	75	71	92	66	54	52
	WEIGHTED ANNUAL MEAN	DOWN	10	—	30	30	28	28	29	32	27	24	24
SO2	ARITHMETIC MEAN	DOWN	2	0.007	0.007	0.006	0.006	0.006	0.007	0.006	0.006	0.004	0.005
	SECOND MAX 24-HOUR	NS	2	0.021	0.022	0.023	0.020	0.026	0.038	0.025	0.025	0.016	0.020
DES MOINES, IA													
CO	SECOND MAX 8-HOUR	NS	3	4.7	3.9	4.4	4.6	4.6	3.9	4.5	3.9	4.0	3.2
OZONE	SECOND DAILY MAX 1-HOUR	UP	2	0.05	0.06	0.06	0.07	0.06	0.08	0.08	0.07	0.08	0.08
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	83	87	89	66	81	77	90	78	89
	WEIGHTED ANNUAL MEAN	NS	3	—	35	33	32	29	28	29	30	30	31
DETROIT, MI													
CO	SECOND MAX 8-HOUR	NS	6	6.6	5.4	6.0	4.5	5.1	4.2	4.5	6.6	4.5	3.9
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.07	0.06	0.06	0.04	0.04	0.03	0.03	0.03	0.03	0.03
NO2	ARITHMETIC MEAN	NS	1	0.023	0.023	0.025	0.024	0.022	0.021	0.022	0.025	0.022	0.020

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
OZONE	SECOND DAILY MAX 1-HOUR	NS	7	0.11	0.14	0.12	0.10	0.12	0.10	0.11	0.12	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	6	—	92	81	78	73	69	82	90	88	65
	WEIGHTED ANNUAL MEAN	NS	6	—	38	39	36	33	28	33	38	35	31
SO2	ARITHMETIC MEAN	DOWN	9	0.010	0.010	0.010	0.010	0.008	0.007	0.007	0.007	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	9	0.040	0.040	0.037	0.038	0.033	0.030	0.030	0.031	0.029	0.035
DOTHAN, AL													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	47	47	70	62	63	59	63	56	54
	WEIGHTED ANNUAL MEAN	NS	1	—	26	26	31	28	25	26	28	28	22
DOVER, DE													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.15	0.17	0.12	0.10	0.10	0.08	0.11	0.10	0.10	0.10
DUBUQUE, IA													
SO2	ARITHMETIC MEAN	NS	1	0.005	0.005	0.005	0.005	0.004	0.004	0.003	0.005	0.006	0.003
	SECOND MAX 24-HOUR	NS	1	0.028	0.052	0.030	0.037	0.028	0.029	0.014	0.037	0.027	0.022
DULUTH-SUPERIOR, MN-WI													
CO	SECOND MAX 8-HOUR	NS	1	8.5	5.1	9.9	4.4	5.2	4.0	4.1	4.3	4.5	4.5
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	68	52	55	51	48	37	41	46	46
	WEIGHTED ANNUAL MEAN	DOWN	6	—	27	26	22	23	20	19	19	19	19
EL PASO, TX													
CO	SECOND MAX 8-HOUR	DOWN	5	10.0	9.1	9.8	10.9	9.1	8.1	8.0	6.6	6.8	8.4
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.32	0.26	0.30	0.27	0.27	0.19	0.18	0.12	0.13	0.20
NO2	ARITHMETIC MEAN	NS	1	0.023	0.021	0.022	0.017	0.019	0.021	0.021	0.023	0.023	0.023
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	3	0.16	0.14	0.13	0.12	0.12	0.12	0.11	0.13	0.11	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	6	—	116	109	104	71	85	58	82	88	84
	WEIGHTED ANNUAL MEAN	DOWN	6	—	47	42	36	30	30	27	28	31	30
SO2	ARITHMETIC MEAN	DOWN	3	0.015	0.014	0.013	0.010	0.010	0.012	0.009	0.007	0.008	0.008
	SECOND MAX 24-HOUR	DOWN	3	0.066	0.059	0.055	0.055	0.047	0.053	0.049	0.029	0.038	0.036
ELMIRA, NY													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.12	0.09	0.10	0.10	0.09	0.09	0.08	0.09	0.09
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.007	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004
	SECOND MAX 24-HOUR	DOWN	1	0.029	0.027	0.026	0.021	0.022	0.021	0.019	0.023	0.014	0.016
ERIE, PA													
CO	SECOND MAX 8-HOUR	DOWN	1	5.3	4.9	4.4	5.1	3.8	3.6	4.4	3.7	3.2	3.2
NO2	ARITHMETIC MEAN	NS	1	0.016	0.016	0.015	0.015	0.013	0.014	0.014	0.015	0.015	0.015
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.15	0.15	0.12	0.10	0.11	0.10	0.11	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	87	73	71	68	56	59	54	94	94
	WEIGHTED ANNUAL MEAN	NS	1	—	35	27	27	29	22	26	29	29	29
SO2	ARITHMETIC MEAN	DOWN	1	0.014	0.014	0.014	0.014	0.010	0.011	0.011	0.010	0.009	0.011
	SECOND MAX 24-HOUR	NS	1	0.050	0.050	0.074	0.057	0.044	0.056	0.072	0.076	0.050	0.066
EUGENE-SPRINGFIELD, OR													
CO	SECOND MAX 8-HOUR	DOWN	1	6.9	7.1	6.0	4.8	5.4	6.0	4.7	5.3	4.7	4.6
LEAD	MAX QUARTERLY MEAN	NS	1	0.08	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.12	0.08	0.09	0.09	0.10	0.08	0.09	0.08	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	102	104	87	117	92	91	85	75	61
	WEIGHTED ANNUAL MEAN	DOWN	4	—	35	31	28	33	29	29	25	23	20
EVANSVILLE-HENDERSON, IN-KY													
CO	SECOND MAX 8-HOUR	NS	1	2.5	3.1	2.3	2.5	2.0	2.3	2.6	2.7	2.7	2.0
NO2	ARITHMETIC MEAN	DOWN	1	0.021	0.022	0.020	0.018	0.021	0.018	0.017	0.018	0.017	0.017
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.11	0.12	0.10	0.10	0.10	0.09	0.10	0.11	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	82	81	79	63	54	68	76	70	46
	WEIGHTED ANNUAL MEAN	DOWN	3	—	38	36	32	34	30	30	33	32	26
SO2	ARITHMETIC MEAN	DOWN	8	0.011	0.012	0.014	0.013	0.013	0.012	0.012	0.012	0.010	0.010
	SECOND MAX 24-HOUR	NS	8	0.060	0.062	0.060	0.062	0.065	0.069	0.051	0.048	0.042	0.047
FARGO-MOORHEAD, ND-MN													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	45	46	63	45	54	39	39	40	40
	WEIGHTED ANNUAL MEAN	NS	1	—	21	21	21	19	21	18	18	20	20
FAYETTEVILLE-SPRINGDALE-ROGERS, AR													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	58	58	59	46	53	58	49	46	48
	WEIGHTED ANNUAL MEAN	NS	1	—	26	26	23	24	22	24	25	24	23
FAYETTEVILLE, NC													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.10	0.10	0.09	0.09	0.09	0.10	0.10	0.10	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	73	52	56	52	44	55	44	38	53
	WEIGHTED ANNUAL MEAN	DOWN	1	—	33	29	31	27	26	27	25	23	26
FLINT, MI													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.13	0.10	0.10	0.10	0.09	0.10	0.09	0.09	0.10
FLORENCE, AL													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	56	56	56	57	40	52	39	49	46
	WEIGHTED ANNUAL MEAN	DOWN	1	—	24	24	24	24	21	23	20	22	18
SO2	ARITHMETIC MEAN	DOWN	1	0.007	0.007	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.071	0.050	0.036	0.027	0.025	0.019	0.022	0.022	0.018	0.019
FORT COLLINS-LOVELAND, CO													
CO	SECOND MAX 8-HOUR	DOWN	1	12.8	11.3	8.3	7.0	9.8	6.9	6.6	6.0	5.2	5.1
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.09	0.10	0.09	0.08	0.09	0.09	0.09	0.10	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	83	59	45	58	39	54	45	47	52
	WEIGHTED ANNUAL MEAN	DOWN	1	—	28	29	23	25	23	22	22	22	20

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
FORT LAUDERDALE, FL													
CO	SECOND MAX 8-HOUR	NS	4	4.3	3.5	4.4	3.4	3.6	4.0	3.6	3.5	3.5	3.0
LEAD	MAX QUARTERLY MEAN	NS	2	0.04	0.04	0.04	0.03	0.02	0.06	0.03	0.03	0.02	0.04
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.12	0.12	0.11	0.10	0.09	0.09	0.10	0.09	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	UP	1	—	42	36	29	42	42	66	50	50	50
	WEIGHTED ANNUAL MEAN	NS	1	—	22	21	17	18	18	19	24	24	24
FORT MYERS-CAPE CORAL, FL													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.10	0.10	0.10	0.08	0.08	0.08	0.08	0.09	0.09	0.07
FORT SMITH, AR-OK													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	46	46	55	47	51	60	44	56	47
	WEIGHTED ANNUAL MEAN	NS	1	—	28	28	26	25	24	25	24	26	25
FORT WAYNE, IN													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.12	0.12	0.09	0.10	0.09	0.10	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	64	64	64	55	45	61	47	53	34
	WEIGHTED ANNUAL MEAN	DOWN	1	—	29	29	27	27	23	23	24	24	17
FORT WORTH-ARLINGTON, TX													
CO	SECOND MAX 8-HOUR	DOWN	2	5.1	5.1	4.8	4.2	3.7	4.0	3.4	3.2	3.2	3.0
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.08	0.05	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02
NO2	ARITHMETIC MEAN	NS	1	0.015	0.014	0.013	0.012	0.014	0.015	0.013	0.017	0.017	0.015
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.13	0.14	0.13	0.14	0.15	0.12	0.11	0.13	0.14	0.13
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	54	50	49	45	51	58	40	52	49
	WEIGHTED ANNUAL MEAN	NS	3	—	25	24	24	23	21	21	20	24	25
SO2	ARITHMETIC MEAN	NS	1	0.002	0.002	0.001	0.002	0.002	0.003	0.001	0.002	0.001	0.001
	SECOND MAX 24-HOUR	NS	1	0.010	0.010	0.007	0.008	0.006	0.013	0.005	0.006	0.004	0.011
FRESNO, CA													
CO	SECOND MAX 8-HOUR	DOWN	2	4.0	5.0	4.8	4.9	5.4	3.9	3.4	4.3	3.5	3.2
NO2	ARITHMETIC MEAN	NS	2	0.017	0.021	0.022	0.021	0.021	0.020	0.020	0.020	0.019	0.019
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.16	0.16	0.14	0.14	0.15	0.14	0.14	0.12	0.13	0.14
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	153	153	153	120	87	114	100	104	72
	WEIGHTED ANNUAL MEAN	DOWN	6	—	53	53	53	52	43	43	39	39	34
GADSDEN, AL													
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	70	52	61	80	59	76	54	62	49
	WEIGHTED ANNUAL MEAN	DOWN	2	—	36	28	33	32	31	33	30	30	23
GALVESTON-TEXAS CITY, TX													
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.04	0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.03	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.13	0.14	0.14	0.15	0.15	0.10	0.18	0.13	0.20	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	54	59	49	43	52	62	47	62	47
	WEIGHTED ANNUAL MEAN	DOWN	3	—	27	28	24	22	24	24	23	25	19
SO2	ARITHMETIC MEAN	NS	1	0.006	0.007	0.008	0.007	0.007	0.005	0.005	0.006	0.006	0.014
	SECOND MAX 24-HOUR	NS	1	0.053	0.049	0.045	0.063	0.050	0.039	0.056	0.052	0.089	0.067
GARY, IN													
CO	SECOND MAX 8-HOUR	NS	1	4.5	4.2	4.0	3.8	4.6	4.2	5.0	4.6	3.7	2.8
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.91	0.47	0.23	0.21	0.11	0.11	0.08	0.17	0.12	0.13
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.13	0.15	0.10	0.10	0.11	0.11	0.09	0.11	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	8	—	91	74	82	68	59	56	57	53	45
	WEIGHTED ANNUAL MEAN	DOWN	8	—	35	33	33	29	26	24	26	25	21
SO2	ARITHMETIC MEAN	DOWN	5	0.011	0.010	0.011	0.010	0.008	0.007	0.007	0.006	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	5	0.041	0.052	0.047	0.048	0.028	0.028	0.032	0.032	0.022	0.023
GLENS FALLS, NY													
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.005	0.004	0.005	0.004	0.004	0.004	0.004	0.003	0.002
	SECOND MAX 24-HOUR	DOWN	1	0.029	0.040	0.023	0.040	0.020	0.017	0.018	0.027	0.011	0.013
GRAND FORKS, ND-MN													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	53	53	104	57	57	38	36	40	28
	WEIGHTED ANNUAL MEAN	DOWN	1	—	24	24	25	20	18	17	16	18	15
GRAND RAPIDS-MUSKEGON-HOLLAND, MI													
CO	SECOND MAX 8-HOUR	NS	1	4.9	4.1	4.5	3.5	4.0	3.2	3.2	4.0	4.6	3.3
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.09	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.13	0.14	0.12	0.12	0.12	0.10	0.09	0.10	0.12	0.13
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	64	60	69	62	122	65	68	52	43
	WEIGHTED ANNUAL MEAN	DOWN	2	—	28	29	30	26	35	22	27	21	20
SO2	ARITHMETIC MEAN	DOWN	1	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002
	SECOND MAX 24-HOUR	DOWN	1	0.017	0.016	0.016	0.012	0.014	0.015	0.012	0.013	0.011	0.011
GREAT FALLS, MT													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	65	65	61	72	53	61	48	52	59
	WEIGHTED ANNUAL MEAN	NS	1	—	20	20	24	21	21	21	21	18	19
GREELEY, CO													
CO	SECOND MAX 8-HOUR	DOWN	1	10.5	9.2	7.3	7.1	7.8	7.5	5.8	5.2	5.3	7.0
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.09	0.10	0.10	0.11	0.10	0.08	0.09	0.09	0.09	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	83	73	66	80	60	99	57	59	56
	WEIGHTED ANNUAL MEAN	DOWN	1	—	40	30	25	26	25	23	23	20	18
GREEN BAY, WI													
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.007	0.006	0.005	0.005	0.004	0.003	0.003	0.004	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.045	0.039	0.024	0.020	0.042	0.021	0.018	0.015	0.017	0.011

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
GREENSBORO—WINSTON-SALEM—HIGH POINT, N													
CO	SECOND MAX 8-HOUR	DOWN	1	9.7	9.7	9.7	6.8	6.6	5.7	5.5	6.0	6.2	4.3
NO2	ARITHMETIC MEAN	NS	1	0.018	0.018	0.016	0.017	0.016	0.015	0.017	0.017	0.016	0.016
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.12	0.14	0.10	0.12	0.10	0.10	0.11	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	5	—	69	66	60	61	51	57	43	57	46
	WEIGHTED ANNUAL MEAN	DOWN	5	—	34	33	32	31	27	28	25	26	25
SO2	ARITHMETIC MEAN	NS	1	0.007	0.007	0.007	0.008	0.007	0.006	0.006	0.007	0.007	0.007
	SECOND MAX 24-HOUR	NS	1	0.028	0.031	0.024	0.023	0.027	0.019	0.022	0.021	0.025	0.026
GREENVILLE-SPARTANBURG-ANDERSON, SC													
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.06	0.06	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.13	0.10	0.09	0.10	0.10	0.11	0.10	0.11	0.11
GREENVILLE, NC													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.12	0.10	0.10	0.09	0.10	0.11	0.09	0.10	0.10
HAMILTON-MIDDLETOWN, OH													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.13	0.11	0.12	0.11	0.10	0.12	0.11	0.13	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	76	76	76	53	50	73	55	77	53
	WEIGHTED ANNUAL MEAN	NS	1	—	27	27	27	33	27	29	27	29	26
SO2	ARITHMETIC MEAN	DOWN	2	0.010	0.010	0.010	0.010	0.009	0.007	0.008	0.008	0.005	0.007
	SECOND MAX 24-HOUR	DOWN	2	0.041	0.041	0.040	0.037	0.040	0.033	0.035	0.038	0.019	0.025
HARRISBURG-LEBANON-CARLISLE, PA													
NO2	ARITHMETIC MEAN	NS	2	0.014	0.014	0.014	0.013	0.014	0.013	0.011	0.015	0.014	0.015
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.12	0.14	0.10	0.11	0.11	0.09	0.11	0.12	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	74	61	52	52	36	62	68	60	50
	WEIGHTED ANNUAL MEAN	NS	2	—	27	25	23	25	21	24	27	25	24
SO2	ARITHMETIC MEAN	NS	2	0.006	0.006	0.006	0.005	0.006	0.005	0.006	0.007	0.005	0.005
	SECOND MAX 24-HOUR	NS	2	0.026	0.024	0.029	0.021	0.021	0.022	0.021	0.035	0.017	0.021
HARTFORD, CT													
CO	SECOND MAX 8-HOUR	DOWN	2	7.5	8.3	6.7	6.7	6.1	6.1	5.6	6.4	5.8	5.3
NO2	ARITHMETIC MEAN	DOWN	1	0.020	0.020	0.020	0.019	0.020	0.017	0.018	0.020	0.017	0.016
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.14	0.17	0.15	0.15	0.16	0.12	0.15	0.13	0.13	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	7	—	51	47	47	52	51	41	50	39	39
	WEIGHTED ANNUAL MEAN	DOWN	7	—	23	23	20	23	20	18	20	16	17
SO2	ARITHMETIC MEAN	DOWN	2	0.008	0.009	0.009	0.008	0.007	0.006	0.005	0.006	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	2	0.040	0.044	0.042	0.034	0.032	0.027	0.020	0.029	0.019	0.019
HONOLULU, HI													
CO	SECOND MAX 8-HOUR	DOWN	2	3.7	3.3	3.4	2.9	2.6	2.8	3.1	3.1	2.5	2.4
LEAD	MAX QUARTERLY MEAN	NS	2	0.02	0.01	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.04	0.03	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.05
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	26	26	34	35	25	23	28	25	26
	WEIGHTED ANNUAL MEAN	NS	1	—	16	16	16	17	17	16	19	15	16
HOUMA, LA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.11	0.11	0.12	0.10	0.09	0.10	0.10	0.14	0.09
HOUSTON, TX													
CO	SECOND MAX 8-HOUR	DOWN	4	6.7	6.5	5.8	6.8	6.0	6.8	5.6	4.9	4.0	5.3
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.06	0.06	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00
NO2	ARITHMETIC MEAN	DOWN	4	0.024	0.023	0.022	0.023	0.022	0.022	0.019	0.021	0.021	0.020
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	10	0.17	0.18	0.18	0.19	0.17	0.16	0.16	0.15	0.17	0.16
PM_{10}	SECOND MAX 24-HOUR	NS	7	—	63	63	65	64	70	68	61	64	49
	WEIGHTED ANNUAL MEAN	DOWN	7	—	33	33	33	32	31	30	31	30	26
SO2	ARITHMETIC MEAN	DOWN	7	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004
	SECOND MAX 24-HOUR	NS	7	0.022	0.027	0.026	0.025	0.025	0.022	0.020	0.018	0.026	0.022
HUNTINGTON-ASHLAND, WV-KY-OH													
CO	SECOND MAX 8-HOUR	NS	1	4.5	3.9	5.5	4.7	4.4	4.1	3.8	5.2	3.8	3.7
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.09	0.13	0.06	0.04	0.04	0.04	0.04	0.03	0.04	0.03
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.14	0.12	0.11	0.12	0.09	0.11	0.13	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	87	85	70	59	62	59	61	61	61
	WEIGHTED ANNUAL MEAN	DOWN	4	—	37	35	35	33	30	29	32	31	28
SO2	ARITHMETIC MEAN	DOWN	7	0.017	0.016	0.014	0.013	0.012	0.010	0.011	0.010	0.009	0.008
	SECOND MAX 24-HOUR	DOWN	7	0.087	0.091	0.080	0.075	0.051	0.044	0.053	0.048	0.036	0.029
HUNTSVILLE, AL													
CO	SECOND MAX 8-HOUR	DOWN	1	5.0	5.0	5.2	4.2	4.1	4.2	4.0	3.5	3.6	3.0
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.13	0.09	0.09	0.11	0.11	0.11	0.11	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	58	58	65	65	50	56	46	49	43
	WEIGHTED ANNUAL MEAN	DOWN	1	—	31	31	30	28	30	23	21	22	21
INDIANAPOLIS, IN													
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.56	0.68	0.53	0.68	0.30	0.26	0.11	0.20	0.06	0.04
OZONE	SECOND DAILY MAX 1-HOUR	NS	5	0.11	0.13	0.11	0.10	0.10	0.09	0.10	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	14	—	72	73	76	63	56	63	63	60	50
	WEIGHTED ANNUAL MEAN	DOWN	14	—	34	36	33	31	28	28	28	28	23
SO2	ARITHMETIC MEAN	DOWN	8	0.011	0.011	0.011	0.009	0.008	0.008	0.009	0.007	0.006	0.005
	SECOND MAX 24-HOUR	DOWN	8	0.046	0.048	0.041	0.036	0.029	0.029	0.038	0.038	0.026	0.026
JACKSON, MS													
LEAD	MAX QUARTERLY MEAN	NS	1	0.12	0.07	0.08	0.07	0.05	0.02	0.02	0.00	0.09	0.09
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.09	0.09	0.08	0.10	0.09	0.08	0.09	0.09	0.09	0.09

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
JACKSON, TN													
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	65	56	60	46	53	56	44	51	43
	WEIGHTED ANNUAL MEAN	DOWN	2	—	32	31	28	27	27	23	23	25	22
JACKSONVILLE, FL													
CO	SECOND MAX 8-HOUR	DOWN	4	5.7	5.6	5.9	4.3	3.8	3.9	4.2	3.7	3.6	3.1
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.12	0.06	0.04	0.04	0.03	0.02	0.05	0.02	0.03	0.02
NO2	ARITHMETIC MEAN	NS	1	0.018	0.019	0.015	0.015	0.014	0.014	0.015	0.014	0.016	0.015
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.11	0.11	0.11	0.09	0.10	0.11	0.10	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	59	59	59	54	47	60	49	53	53
	WEIGHTED ANNUAL MEAN	DOWN	3	—	34	36	34	32	26	27	26	27	24
SO2	ARITHMETIC MEAN	DOWN	5	0.004	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	5	0.038	0.041	0.035	0.037	0.023	0.023	0.025	0.030	0.019	0.020
JAMESTOWN, NY													
SO2	ARITHMETIC MEAN	DOWN	1	0.013	0.014	0.014	0.012	0.013	0.011	0.011	0.010	0.009	0.008
	SECOND MAX 24-HOUR	NS	1	0.066	0.054	0.072	0.065	0.048	0.050	0.049	0.072	0.056	0.039
JERSEY CITY, NJ													
CO	SECOND MAX 8-HOUR	DOWN	1	8.0	7.8	7.3	7.2	7.5	6.0	5.6	5.9	6.2	4.9
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.10	0.11	0.07	0.05	0.06	0.04	0.04	0.03	0.04	0.04
NO2	ARITHMETIC MEAN	DOWN	1	0.031	0.033	0.031	0.030	0.028	0.028	0.027	0.026	0.026	0.027
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.16	0.20	0.12	0.18	0.14	0.11	0.13	0.12	0.13	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	4	—	71	73	74	68	58	67	90	64	56
	WEIGHTED ANNUAL MEAN	NS	4	—	31	32	31	32	26	27	31	25	26
SO2	ARITHMETIC MEAN	DOWN	2	0.012	0.015	0.014	0.013	0.012	0.010	0.009	0.009	0.007	0.008
	SECOND MAX 24-HOUR	DOWN	2	0.041	0.059	0.047	0.043	0.035	0.041	0.030	0.036	0.026	0.027
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA													
CO	SECOND MAX 8-HOUR	DOWN	1	4.8	4.3	3.7	3.4	3.3	3.0	6.5	3.4	3.0	3.0
NO2	ARITHMETIC MEAN	DOWN	1	0.020	0.019	0.019	0.019	0.019	0.018	0.017	0.017	0.018	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.09	0.12	0.11	0.12	0.12	0.10	0.13	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	68	68	59	67	57	73	53	58	53
	WEIGHTED ANNUAL MEAN	DOWN	3	—	31	31	32	32	29	29	28	27	26
SO2	ARITHMETIC MEAN	DOWN	3	0.010	0.011	0.010	0.009	0.009	0.009	0.008	0.009	0.008	0.009
	SECOND MAX 24-HOUR	NS	3	0.046	0.049	0.053	0.044	0.044	0.039	0.042	0.045	0.039	0.044
JOHNSTOWN, PA													
CO	SECOND MAX 8-HOUR	NS	1	5.6	4.3	4.1	3.7	4.8	4.4	4.2	4.1	3.5	4.8
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.52	0.30	0.31	0.16	0.19	0.14	0.06	0.05	0.06	0.06
NO2	ARITHMETIC MEAN	DOWN	1	0.020	0.019	0.019	0.018	0.019	0.018	0.017	0.018	0.015	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.14	0.10	0.10	0.11	0.09	0.10	0.09	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	70	70	58	70	56	63	69	61	61
	WEIGHTED ANNUAL MEAN	DOWN	1	—	33	33	28	33	28	27	29	27	27
SO2	ARITHMETIC MEAN	DOWN	1	0.016	0.017	0.017	0.014	0.015	0.013	0.015	0.014	0.012	0.011
	SECOND MAX 24-HOUR	DOWN	1	0.065	0.054	0.089	0.046	0.043	0.052	0.049	0.080	0.042	0.034
KALAMAZOO-BATTLE CREEK, MI													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	108	73	69	72	57	59	57	55	57
	WEIGHTED ANNUAL MEAN	DOWN	1	—	38	34	28	29	27	24	26	26	22
KANSAS CITY, MO-KS													
CO	SECOND MAX 8-HOUR	DOWN	5	5.4	4.4	4.6	4.4	3.8	3.5	4.1	4.3	3.4	3.3
LEAD	MAX QUARTERLY MEAN	DOWN	5	0.16	0.17	0.06	0.03	0.03	0.02	0.02	0.02	0.02	0.03
NO2	ARITHMETIC MEAN	NS	3	0.013	0.010	0.011	0.011	0.010	0.010	0.009	0.010	0.010	0.012
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.11	0.13	0.10	0.10	0.10	0.09	0.10	0.10	0.12	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	8	—	65	71	67	60	60	61	59	60	72
	WEIGHTED ANNUAL MEAN	NS	8	—	32	33	30	30	29	29	29	24	31
SO2	ARITHMETIC MEAN	NS	5	0.006	0.005	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004
	SECOND MAX 24-HOUR	NS	5	0.026	0.022	0.016	0.022	0.017	0.016	0.020	0.025	0.018	0.024
KENOSHA, WI													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.19	0.19	0.13	0.11	0.14	0.11	0.11	0.12	0.12	0.13
KNOXVILLE, TN													
CO	SECOND MAX 8-HOUR	DOWN	1	6.1	6.1	6.7	5.1	4.5	4.5	4.6	4.3	4.1	3.3
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.10	0.12	0.09	0.11	0.10	0.10	0.11	0.11	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	8	—	64	61	64	63	54	61	56	58	62
	WEIGHTED ANNUAL MEAN	DOWN	8	—	33	32	32	34	30	30	32	31	31
SO2	ARITHMETIC MEAN	UP	2	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	SECOND MAX 24-HOUR	UP	2	0.029	0.032	0.031	0.033	0.039	0.035	0.041	0.042	0.038	0.047
LAKE CHARLES, LA													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.13	0.13	0.12	0.11	0.12	0.11	0.10	0.10	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	44	44	44	52	75	51	46	54	33
	WEIGHTED ANNUAL MEAN	NS	1	—	21	21	21	23	25	22	23	23	18
LAKELAND-WINTER HAVEN, FL													
SO2	ARITHMETIC MEAN	NS	1	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.006
	SECOND MAX 24-HOUR	NS	1	0.019	0.018	0.016	0.022	0.016	0.018	0.019	0.016	0.014	0.021
LANCASTER, PA													
CO	SECOND MAX 8-HOUR	NS	1	3.3	3.4	4.1	3.4	2.6	2.6	3.0	3.8	2.4	2.6
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.09	0.07	0.05	0.06	0.04	0.04	0.04	0.04	0.04	0.04
NO2	ARITHMETIC MEAN	NS	1	0.019	0.020	0.018	0.017	0.018	0.015	0.015	0.019	0.016	0.017
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.13	0.10	0.10	0.12	0.11	0.12	0.11	0.12	0.10

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	59	59	59	51	45	68	117	73	63
	WEIGHTED ANNUAL MEAN	NS	1	—	31	31	31	30	27	31	38	33	31
SO2	ARITHMETIC MEAN	DOWN	1	0.007	0.007	0.007	0.006	0.006	0.006	0.007	0.006	0.006	0.005
	SECOND MAX 24-HOUR	NS	1	0.027	0.028	0.037	0.028	0.023	0.023	0.026	0.030	0.018	0.021
LANSING-EAST LANSING, MI													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.10	0.12	0.10	0.10	0.11	0.09	0.10	0.09	0.10	0.09
LAS CRUCES, NM													
CO	SECOND MAX 8-HOUR	DOWN	2	5.8	5.0	4.5	4.6	5.0	3.8	6.0	4.1	3.7	3.7
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.20	0.18	0.16	0.17	0.15	0.13	0.12	0.05	0.09	0.07
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	140	123	93	86	88	77	91	75	78
	WEIGHTED ANNUAL MEAN	NS	3	—	44	45	35	31	31	30	33	34	33
SO2	ARITHMETIC MEAN	DOWN	2	0.011	0.010	0.010	0.011	0.010	0.009	0.006	0.004	0.004	0.004
	SECOND MAX 24-HOUR	DOWN	2	0.063	0.068	0.061	0.056	0.055	0.052	0.055	0.023	0.021	0.030
LAS VEGAS, NV-AZ													
CO	SECOND MAX 8-HOUR	DOWN	2	9.7	11.1	10.0	10.9	9.5	7.9	8.6	8.8	7.8	8.4
NO2	ARITHMETIC MEAN	DOWN	1	0.028	0.031	0.034	0.037	0.030	0.028	0.029	0.027	0.027	0.027
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	3	0.11	0.11	0.10	0.10	0.09	0.09	0.10	0.09	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	106	155	159	111	89	106	112	102	104
	WEIGHTED ANNUAL MEAN	NS	2	—	50	65	67	60	47	44	47	47	50
LAWRENCE, MA-NH													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.14	0.11	0.10	0.13	0.10	0.11	0.11	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	39	39	39	35	48	46	35	28	34
	WEIGHTED ANNUAL MEAN	DOWN	1	—	21	21	21	18	19	18	16	13	14
SO2	ARITHMETIC MEAN	DOWN	2	0.010	0.008	0.009	0.008	0.007	0.008	0.008	0.006	0.006	0.005
	SECOND MAX 24-HOUR	DOWN	2	0.043	0.031	0.036	0.029	0.026	0.027	0.026	0.027	0.025	0.019
LAWTON, OK													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	82	74	73	54	52	55	51	52	56
	WEIGHTED ANNUAL MEAN	DOWN	1	—	32	32	30	27	26	27	28	25	28
LEWISTON-AUBURN, ME													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	55	55	55	66	58	68	46	46	37
	WEIGHTED ANNUAL MEAN	DOWN	1	—	25	25	25	29	24	24	20	20	20
SO2	ARITHMETIC MEAN	DOWN	1	0.009	0.007	0.008	0.007	0.006	0.005	0.007	0.006	0.004	0.004
	SECOND MAX 24-HOUR	DOWN	1	0.034	0.044	0.035	0.027	0.023	0.020	0.025	0.025	0.020	0.018
LEXINGTON, KY													
CO	SECOND MAX 8-HOUR	DOWN	1	5.8	5.4	5.6	3.7	4.9	3.8	6.5	4.2	3.0	3.1
NO2	ARITHMETIC MEAN	NS	1	0.017	0.018	0.019	0.017	0.016	0.016	0.017	0.016	0.017	0.014
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.12	0.11	0.10	0.09	0.08	0.10	0.10	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	76	76	61	52	52	61	66	65	57
	WEIGHTED ANNUAL MEAN	DOWN	2	—	30	30	28	28	24	25	27	26	24
SO2	ARITHMETIC MEAN	NS	1	0.007	0.007	0.006	0.006	0.008	0.007	0.007	0.008	0.006	0.006
	SECOND MAX 24-HOUR	NS	1	0.031	0.027	0.034	0.020	0.025	0.030	0.026	0.037	0.016	0.020
LIMA, OH													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.006	0.006	0.005	0.006	0.004	0.005	0.004	0.003	0.003
	SECOND MAX 24-HOUR	NS	1	0.030	0.024	0.033	0.026	0.021	0.020	0.023	0.036	0.015	0.015
LINCOLN, NE													
CO	SECOND MAX 8-HOUR	DOWN	2	6.1	6.4	6.1	6.2	7.4	4.5	4.3	4.0	4.9	3.4
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.06	0.08	0.06	0.07	0.07	0.07	0.06	0.08	0.07	0.06
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	57	61	58	66	50	51	49	54	61
	WEIGHTED ANNUAL MEAN	NS	2	—	29	33	29	30	25	26	28	25	28
LITTLE ROCK-NORTH LITTLE ROCK, AR													
NO2	ARITHMETIC MEAN	NS	1	0.009	0.010	0.009	0.009	0.009	0.012	0.009	0.011	0.011	0.011
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.11	0.09	0.10	0.10	0.09	0.10	0.09	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	4	—	63	59	60	53	63	55	57	59	50
	WEIGHTED ANNUAL MEAN	NS	4	—	30	29	29	25	28	27	27	29	26
SO2	ARITHMETIC MEAN	NS	1	0.002	0.002	0.002	0.003	0.003	0.005	0.006	0.003	0.002	0.002
	SECOND MAX 24-HOUR	NS	1	0.006	0.016	0.010	0.014	0.012	0.012	0.017	0.009	0.008	0.009
LONGVIEW-MARSHALL,TX													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.12	0.10	0.13	0.11	0.10	0.11	0.10	0.15	0.11
LOS ANGELES-LONG BEACH, CA													
CO	SECOND MAX 8-HOUR	DOWN	12	9.4	10.5	9.9	9.1	9.0	8.0	6.9	8.3	7.7	7.0
LEAD	MAX QUARTERLY MEAN	DOWN	6	0.15	0.15	0.09	0.09	0.10	0.08	0.06	0.06	0.05	0.05
NO2	ARITHMETIC MEAN	DOWN	12	0.045	0.048	0.046	0.042	0.043	0.040	0.038	0.041	0.039	0.037
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	13	0.22	0.23	0.22	0.19	0.20	0.20	0.18	0.17	0.15	0.14
PM_{10}	SECOND MAX 24-HOUR	DOWN	9	—	121	124	115	120	92	83	82	106	77
	WEIGHTED ANNUAL MEAN	DOWN	9	—	57	57	49	53	41	40	39	39	38
SO2	ARITHMETIC MEAN	DOWN	4	0.005	0.005	0.004	0.003	0.003	0.004	0.003	0.003	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	4	0.015	0.019	0.015	0.012	0.013	0.015	0.011	0.008	0.008	0.008
LOUISVILLE, KY-IN													
CO	SECOND MAX 8-HOUR	DOWN	3	6.8	5.9	6.0	5.9	5.9	4.2	4.6	5.1	3.8	3.3
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.10	0.09	0.05	0.03	0.04	0.04	0.05	0.02	0.06	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.11	0.16	0.11	0.11	0.12	0.09	0.13	0.12	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	84	71	66	61	53	65	63	62	57

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
		WEIGHTED ANNUAL MEAN	DOWN	6	—	38	35	34	33	30	29	30	29	26
	SO2	ARITHMETIC MEAN	NS	4	0.009	0.010	0.010	0.010	0.010	0.009	0.010	0.010	0.008	0.007
		SECOND MAX 24-HOUR	DOWN	4	0.045	0.044	0.055	0.041	0.037	0.034	0.035	0.040	0.028	0.031
LOWELL, MA-NH														
	CO	SECOND MAX 8-HOUR	NS	1	6.4	6.4	5.3	7.3	5.8	5.9	5.1	6.5	7.8	4.5
LUBBOCK, TX														
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	100	94	61	79	58	56	81	76	85
		WEIGHTED ANNUAL MEAN	DOWN	1	—	36	34	24	26	22	20	23	21	22
LYNCHBURG, VA														
	PM_{10}	SECOND MAX 24-HOUR	NS	1	—	64	54	51	53	45	63	40	54	41
		WEIGHTED ANNUAL MEAN	DOWN	1	—	31	30	24	28	24	26	23	24	23
MADISON, WI														
	PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	90	90	54	55	39	43	50	55	34
		WEIGHTED ANNUAL MEAN	DOWN	1	—	34	34	24	25	22	21	22	23	20
MANSFIELD, OH														
	PM_{10}	SECOND MAX 24-HOUR	UP	1	—	56	56	56	62	68	66	58	61	68
		WEIGHTED ANNUAL MEAN	NS	1	—	27	27	27	27	26	28	29	25	24
MEDFORD-ASHLAND, OR														
	CO	SECOND MAX 8-HOUR	DOWN	1	8.8	11.3	11.0	8.2	8.1	6.4	6.9	6.2	5.3	6.4
	LEAD	MAX QUARTERLY MEAN	DOWN	1	0.07	0.05	0.04	0.02	0.03	0.02	0.02	0.02	0.02	0.02
	PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	174	199	123	148	99	91	80	60	65
		WEIGHTED ANNUAL MEAN	DOWN	3	—	54	54	42	40	36	35	33	26	24
MELBOURNE-TITUSVILLE-PALM BAY, FL														
	OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.10	0.10	0.08	0.09	0.08	0.09	0.09	0.08	0.09
MEMPHIS, TN-AR-MS														
	CO	SECOND MAX 8-HOUR	DOWN	5	8.8	6.4	8.2	7.5	6.1	7.7	7.6	7.3	6.0	5.3
	LEAD	MAX QUARTERLY MEAN	DOWN	2	0.18	0.13	0.17	0.10	0.05	0.24	0.11	0.10	0.04	0.03
	NO2	ARITHMETIC MEAN	NS	1	0.034	0.032	0.026	0.023	0.024	0.026	0.026	0.027	0.027	0.024
	OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.12	0.13	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.13
	PM_{10}	SECOND MAX 24-HOUR	NS	2	—	63	65	65	51	57	62	60	59	55
		WEIGHTED ANNUAL MEAN	DOWN	2	—	31	31	31	27	28	29	27	27	27
	SO2	ARITHMETIC MEAN	DOWN	2	0.007	0.006	0.007	0.007	0.007	0.007	0.006	0.005	0.004	0.003
		SECOND MAX 24-HOUR	DOWN	2	0.031	0.029	0.029	0.027	0.025	0.031	0.029	0.025	0.019	0.011
MERCED, CA														
	PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	106	137	153	122	82	119	109	89	57
		WEIGHTED ANNUAL MEAN	DOWN	1	—	52	52	53	52	46	43	39	39	31
MIAMI, FL														
	CO	SECOND MAX 8-HOUR	NS	2	5.9	4.8	7.3	6.0	7.2	6.2	5.3	4.4	4.9	4.5
	LEAD	MAX QUARTERLY MEAN	DOWN	2	0.12	0.05	0.05	0.02	0.02	0.01	0.01	0.01	0.01	0.01
	NO2	ARITHMETIC MEAN	DOWN	2	0.014	0.012	0.013	0.011	0.011	0.011	0.012	0.010	0.011	0.011
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	4	0.12	0.11	0.11	0.10	0.09	0.10	0.10	0.09	0.09	0.09
	PM_{10}	SECOND MAX 24-HOUR	NS	3	—	50	48	48	54	53	87	67	47	58
		WEIGHTED ANNUAL MEAN	DOWN	3	—	28	27	28	26	27	27	26	24	25
	SO2	ARITHMETIC MEAN	UP	1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
		SECOND MAX 24-HOUR	UP	1	0.002	0.002	0.003	0.003	0.003	0.005	0.004	0.004	0.004	0.005
MIDDLESEX-SOMERSET-HUNTERDON, NJ														
	CO	SECOND MAX 8-HOUR	DOWN	1	5.4	5.3	5.4	5.4	4.2	3.9	3.7	4.3	5.3	3.3
	LEAD	MAX QUARTERLY MEAN	NS	1	0.17	0.38	0.38	0.30	1.15	1.22	0.33	0.12	0.07	0.06
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.16	0.19	0.13	0.14	0.13	0.12	0.11	0.12	0.13	0.12
	PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	67	67	60	65	54	60	56	43	46
		WEIGHTED ANNUAL MEAN	DOWN	1	—	34	34	29	30	25	25	27	22	25
	SO2	ARITHMETIC MEAN	DOWN	1	0.011	0.012	0.010	0.007	0.007	0.006	0.005	0.005	0.004	0.005
		SECOND MAX 24-HOUR	DOWN	1	0.035	0.043	0.037	0.032	0.025	0.026	0.018	0.028	0.018	0.024
MILWAUKEE-WAUKESHA, WI														
	CO	SECOND MAX 8-HOUR	NS	5	4.5	4.2	3.9	4.5	3.8	3.3	4.3	4.6	3.0	2.0
	LEAD	MAX QUARTERLY MEAN	DOWN	2	0.13	0.12	0.07	0.08	0.06	0.05	0.04	0.03	0.04	0.03
	NO2	ARITHMETIC MEAN	DOWN	2	0.023	0.023	0.024	0.022	0.021	0.021	0.020	0.021	0.021	0.020
	OZONE	SECOND DAILY MAX 1-HOUR	DOWN	6	0.17	0.15	0.13	0.11	0.14	0.10	0.10	0.12	0.12	0.11
	PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	91	84	78	64	53	61	63	63	53
		WEIGHTED ANNUAL MEAN	DOWN	4	—	32	35	33	29	26	26	28	27	25
	SO2	ARITHMETIC MEAN	DOWN	2	0.005	0.006	0.006	0.006	0.006	0.005	0.003	0.004	0.003	0.004
		SECOND MAX 24-HOUR	NS	2	0.025	0.035	0.030	0.039	0.034	0.026	0.024	0.027	0.023	0.025
MINNEAPOLIS-ST. PAUL, MN-WI														
	CO	SECOND MAX 8-HOUR	DOWN	3	9.5	7.8	10.0	6.0	6.9	5.6	5.3	5.7	6.0	5.3
	LEAD	MAX QUARTERLY MEAN	DOWN	3	0.55	0.55	0.38	0.77	0.31	0.25	0.12	0.07	0.23	0.12
	NO2	ARITHMETIC MEAN	NS	1	0.009	0.009	0.009	0.009	0.008	0.008	0.009	0.009	0.010	0.008
	OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.10	0.11	0.09	0.09	0.08	0.09	0.08	0.08	0.11	0.10
	PM_{10}	SECOND MAX 24-HOUR	DOWN	10	—	66	76	68	60	55	49	56	54	59
		WEIGHTED ANNUAL MEAN	DOWN	10	—	29	29	27	24	21	21	21	22	22
	SO2	ARITHMETIC MEAN	DOWN	7	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002
		SECOND MAX 24-HOUR	DOWN	7	0.017	0.016	0.016	0.015	0.017	0.018	0.014	0.011	0.011	0.012
MOBILE, AL														
	OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.10	0.09	0.10	0.07	0.10	0.09	0.09	0.11	0.10

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	72	62	57	59	69	68	60	53	49
	WEIGHTED ANNUAL MEAN	NS	4	—	35	31	31	32	34	32	31	29	25
SO2	ARITHMETIC MEAN	NS	1	0.009	0.008	0.008	0.008	0.009	0.010	0.010	0.011	0.009	0.009
	SECOND MAX 24-HOUR	NS	1	0.052	0.054	0.064	0.038	0.050	0.054	0.066	0.052	0.053	0.070
MODESTO, CA													
CO	SECOND MAX 8-HOUR	DOWN	1	8.6	9.7	11.8	10.5	9.4	5.9	6.6	6.3	5.4	5.6
NO2	ARITHMETIC MEAN	DOWN	1	0.024	0.027	0.027	0.026	0.024	0.022	0.024	0.023	0.022	0.022
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.14	0.12	0.11	0.12	0.11	0.11	0.11	0.12	0.13	0.13
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	129	129	135	133	81	118	101	90	66
	WEIGHTED ANNUAL MEAN	DOWN	2	—	46	46	44	48	39	40	37	34	28
MONMOUTH-OCEAN, NJ													
CO	SECOND MAX 8-HOUR	DOWN	2	6.1	6.6	6.1	5.7	5.5	4.7	5.3	4.9	3.8	4.4
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.14	0.14	0.14	0.14	0.15	0.14	0.13	0.11	0.15	0.12
MONROE, LA													
PM_{10}	SECOND MAX 24-HOUR	UP	1	—	72	72	72	58	79	81	99	111	76
	WEIGHTED ANNUAL MEAN	NS	1	—	30	30	30	25	28	27	34	36	31
MONTGOMERY, AL													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	40	40	58	60	48	48	45	55	39
	WEIGHTED ANNUAL MEAN	NS	1	—	23	23	27	26	24	23	25	26	23
NASHUA, NH													
CO	SECOND MAX 8-HOUR	NS	2	7.0	5.7	6.2	7.1	6.9	6.8	5.2	7.5	6.8	6.5
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01
NO2	ARITHMETIC MEAN	DOWN	1	0.020	0.024	0.022	0.019	0.016	0.015	0.016	0.015	0.014	0.019
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.09	0.14	0.09	0.10	0.10	0.10	0.11	0.10	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	5	—	52	44	41	50	49	39	38	31	39
	WEIGHTED ANNUAL MEAN	DOWN	5	—	22	22	18	19	17	17	15	14	16
SO2	ARITHMETIC MEAN	DOWN	3	0.008	0.008	0.008	0.007	0.005	0.006	0.006	0.006	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	3	0.041	0.044	0.040	0.036	0.024	0.025	0.022	0.028	0.023	0.021
NASHVILLE, TN													
CO	SECOND MAX 8-HOUR	DOWN	3	6.9	6.5	7.4	5.9	5.0	5.5	6.4	5.4	4.8	3.9
LEAD	MAX QUARTERLY MEAN	NS	4	1.16	1.29	0.66	1.45	1.21	1.05	0.91	0.98	1.93	0.62
NO2	ARITHMETIC MEAN	NS	1	0.012	0.012	0.012	0.012	0.010	0.014	0.012	0.020	0.014	0.012
OZONE	SECOND DAILY MAX 1-HOUR	NS	7	0.11	0.12	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	5	—	76	76	75	71	60	79	65	66	59
	WEIGHTED ANNUAL MEAN	DOWN	5	—	38	37	36	35	31	31	30	31	28
SO2	ARITHMETIC MEAN	DOWN	5	0.007	0.008	0.008	0.008	0.008	0.006	0.007	0.005	0.004	0.005
	SECOND MAX 24-HOUR	NS	6	0.033	0.049	0.057	0.050	0.055	0.030	0.045	0.041	0.030	0.037
NASSAU-SUFFOLK, NY													
CO	SECOND MAX 8-HOUR	DOWN	1	9.9	9.1	6.5	7.2	6.6	5.6	5.6	5.4	5.0	4.9
NO2	ARITHMETIC MEAN	DOWN	1	0.032	0.033	0.029	0.028	0.029	0.026	0.026	0.028	0.025	0.026
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.17	0.16	0.15	0.14	0.18	0.13	0.13	0.13	0.15	0.12
SO2	ARITHMETIC MEAN	DOWN	2	0.009	0.008	0.010	0.009	0.009	0.008	0.008	0.007	0.005	0.007
	SECOND MAX 24-HOUR	DOWN	2	0.038	0.056	0.045	0.045	0.039	0.039	0.033	0.037	0.030	0.028
NEW BEDFORD, MA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.16	0.12	0.13	0.13	0.11	0.09	0.10	0.14	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	39	39	39	51	42	44	49	28	44
	WEIGHTED ANNUAL MEAN	DOWN	1	—	23	23	23	20	17	17	19	14	16
NEW HAVEN-MERIDEN, CT													
NO2	ARITHMETIC MEAN	NS	1	0.028	0.029	0.028	0.027	0.028	0.025	0.027	0.030	0.025	0.026
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.15	0.17	0.15	0.13	0.16	0.12	0.14	0.14	0.14	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	8	—	67	62	71	76	70	69	68	56	55
	WEIGHTED ANNUAL MEAN	DOWN	8	—	30	30	28	32	25	26	27	23	21
SO2	ARITHMETIC MEAN	DOWN	2	0.012	0.015	0.012	0.010	0.010	0.009	0.008	0.008	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	2	0.055	0.071	0.071	0.045	0.055	0.042	0.038	0.049	0.031	0.027
NEW LONDON-NORWICH, CT-RI													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.16	0.15	0.14	0.16	0.14	0.12	0.13	0.12	0.14	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	42	42	48	52	52	40	49	43	50
	WEIGHTED ANNUAL MEAN	DOWN	3	—	22	22	20	23	19	18	22	17	18
SO2	ARITHMETIC MEAN	DOWN	1	0.007	0.009	0.008	0.008	0.007	0.006	0.006	0.005	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.028	0.047	0.027	0.029	0.027	0.025	0.019	0.029	0.017	0.016
NEW ORLEANS, LA													
CO	SECOND MAX 8-HOUR	DOWN	2	6.7	6.1	6.1	4.9	4.2	5.4	5.1	4.6	3.6	4.0
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.10	0.10	0.09	0.05	0.03	0.03	0.02	0.02	0.03	0.02
NO2	ARITHMETIC MEAN	DOWN	2	0.021	0.019	0.017	0.016	0.015	0.017	0.016	0.015	0.016	0.015
OZONE	SECOND DAILY MAX 1-HOUR	NS	5	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	47	58	54	52	52	54	50	50	44
	WEIGHTED ANNUAL MEAN	DOWN	1	—	26	31	27	26	27	25	25	24	22
SO2	ARITHMETIC MEAN	UP	2	0.004	0.004	0.003	0.003	0.004	0.005	0.005	0.005	0.005	0.005
	SECOND MAX 24-HOUR	UP	2	0.016	0.017	0.017	0.013	0.023	0.018	0.019	0.021	0.019	0.025
NEW YORK, NY													
CO	SECOND MAX 8-HOUR	DOWN	4	7.7	8.3	7.9	7.1	6.6	6.0	5.1	5.8	6.5	4.5
LEAD	MAX QUARTERLY MEAN	NS	3	0.11	0.14	0.08	0.09	0.08	0.06	0.09	0.08	0.07	0.08
NO2	ARITHMETIC MEAN	DOWN	1	0.049	0.049	0.049	0.046	0.047	0.036	0.043	0.046	0.042	0.042

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.15	0.18	0.12	0.14	0.15	0.12	0.12	0.12	0.13	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	12	—	68	69	66	61	55	55	69	65	51
	WEIGHTED ANNUAL MEAN	DOWN	12	—	33	34	31	30	27	26	28	26	27
SO2	ARITHMETIC MEAN	DOWN	6	0.015	0.016	0.015	0.014	0.013	0.012	0.011	0.012	0.009	0.009
	SECOND MAX 24-HOUR	DOWN	6	0.054	0.062	0.062	0.055	0.045	0.048	0.038	0.051	0.035	0.037
NEWARK, NJ													
CO	SECOND MAX 8-HOUR	NS	3	7.4	7.3	7.6	7.1	8.3	5.6	4.9	7.7	6.0	5.1
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.55	0.83	0.41	0.39	1.04	0.44	0.23	0.30	0.23	0.23
NO2	ARITHMETIC MEAN	NS	5	0.031	0.031	0.028	0.028	0.027	0.029	0.027	0.029	0.027	0.028
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	3	0.17	0.18	0.12	0.12	0.12	0.11	0.11	0.12	0.12	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	80	74	68	62	55	67	95	69	61
	WEIGHTED ANNUAL MEAN	NS	3	—	35	35	31	30	29	30	35	28	31
SO2	ARITHMETIC MEAN	DOWN	4	0.011	0.012	0.012	0.010	0.010	0.009	0.007	0.008	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	4	0.041	0.050	0.047	0.040	0.035	0.040	0.025	0.033	0.025	0.027
NEWBURGH, NY-PA													
LEAD	MAX QUARTERLY MEAN	DOWN	1	2.46	1.18	1.36	0.54	0.28	0.22	0.28	0.06	0.05	0.06
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS,VA-N													
CO	SECOND MAX 8-HOUR	DOWN	3	6.0	5.5	5.2	4.5	5.1	4.3	5.0	5.4	4.3	4.3
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.10	0.10	0.12	0.18	0.03	0.03	0.03	0.02	0.03	0.03
NO2	ARITHMETIC MEAN	NS	1	0.020	0.020	0.020	0.019	0.020	0.020	0.021	0.019	0.018	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.13	0.10	0.11	0.10	0.13	0.13	0.10	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	53	60	58	56	46	54	41	40	43
	WEIGHTED ANNUAL MEAN	DOWN	4	—	28	27	26	26	23	23	20	21	22
SO2	ARITHMETIC MEAN	DOWN	2	0.007	0.008	0.007	0.007	0.007	0.006	0.007	0.007	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	2	0.032	0.032	0.033	0.025	0.022	0.024	0.026	0.024	0.022	0.022
OAKLAND, CA													
CO	SECOND MAX 8-HOUR	DOWN	6	4.3	4.8	4.9	4.8	4.8	4.0	3.4	3.6	2.7	2.9
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.09	0.15	0.13	0.08	0.10	0.02	0.02	0.02	0.02	0.01
NO2	ARITHMETIC MEAN	DOWN	2	0.022	0.023	0.022	0.021	0.022	0.020	0.020	0.020	0.019	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	7	0.12	0.11	0.10	0.09	0.09	0.09	0.10	0.10	0.13	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	73	82	81	89	58	66	72	47	41
	WEIGHTED ANNUAL MEAN	DOWN	3	—	30	31	30	33	27	25	25	22	22
SO2	ARITHMETIC MEAN	NS	3	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	SECOND MAX 24-HOUR	DOWN	3	0.009	0.009	0.013	0.011	0.010	0.009	0.010	0.007	0.007	0.007
OKLAHOMA CITY, OK													
CO	SECOND MAX 8-HOUR	NS	3	7.5	5.2	6.4	5.4	4.7	4.8	6.1	5.2	5.0	5.1
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.06	0.07	0.05	0.02	0.02	0.01	0.01	0.01	0.01	0.01
NO2	ARITHMETIC MEAN	NS	3	0.014	0.018	0.013	0.012	0.011	0.011	0.011	0.012	0.012	0.012
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.11	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	5	—	54	53	47	45	55	45	42	51	50
	WEIGHTED ANNUAL MEAN	NS	5	—	25	24	23	23	22	21	21	21	24
SO2	ARITHMETIC MEAN	NS	1	0.005	0.010	0.007	0.004	0.002	0.002	0.003	0.004	0.002	0.002
	SECOND MAX 24-HOUR	DOWN	1	0.012	0.041	0.015	0.019	0.005	0.009	0.008	0.007	0.006	0.006
OLYMPIA, WA													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	117	118	86	99	78	78	63	65	53
	WEIGHTED ANNUAL MEAN	DOWN	1	—	35	28	24	25	24	24	17	17	16
OMAHA, NE-IA													
CO	SECOND MAX 8-HOUR	NS	2	5.4	5.5	4.8	5.2	5.8	5.9	5.3	4.0	5.5	4.9
LEAD	MAX QUARTERLY MEAN	NS	5	0.55	0.79	0.67	0.54	0.44	0.69	0.55	0.73	0.49	0.40
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	3	0.08	0.09	0.08	0.07	0.08	0.08	0.06	0.07	0.08	0.07
PM_{10}	SECOND MAX 24-HOUR	DOWN	7	—	96	95	92	78	89	70	81	77	78
	WEIGHTED ANNUAL MEAN	DOWN	7	—	42	42	37	36	36	31	33	30	33
ORANGE COUNTY, CA													
CO	SECOND MAX 8-HOUR	DOWN	3	7.8	8.4	8.7	7.7	6.9	7.2	5.5	7.2	5.9	5.5
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.09	0.09	0.08	0.06	0.06	0.03	0.05	0.04	0.04	0.04
NO2	ARITHMETIC MEAN	DOWN	2	0.040	0.044	0.045	0.046	0.044	0.039	0.037	0.040	0.038	0.033
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	3	0.21	0.22	0.23	0.19	0.19	0.18	0.16	0.17	0.13	0.13
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	96	96	95	97	79	78	83	124	75
	WEIGHTED ANNUAL MEAN	DOWN	2	—	45	45	45	41	37	36	36	41	33
SO2	ARITHMETIC MEAN	NS	1	0.005	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.015	0.014	0.009	0.006	0.012	0.007	0.008	0.007	0.005	0.005
ORLANDO, FL													
CO	SECOND MAX 8-HOUR	DOWN	2	4.7	4.5	4.3	4.5	3.6	3.9	3.8	3.6	3.3	3.3
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.05	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
NO2	ARITHMETIC MEAN	DOWN	1	0.013	0.013	0.013	0.012	0.012	0.011	0.012	0.011	0.010	0.013
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	3	0.11	0.10	0.11	0.11	0.09	0.10	0.10	0.10	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	45	44	46	42	49	39	37	37	55
	WEIGHTED ANNUAL MEAN	DOWN	3	—	28	27	27	27	24	24	23	22	23
SO2	ARITHMETIC MEAN	NS	1	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	SECOND MAX 24-HOUR	NS	1	0.008	0.010	0.006	0.011	0.007	0.007	0.011	0.012	0.006	0.008
OWENSBORO, KY													
CO	SECOND MAX 8-HOUR	NS	1	4.1	6.4	5.9	5.4	3.8	4.5	5.5	3.9	4.2	4.2
NO2	ARITHMETIC MEAN	NS	1	0.015	0.015	0.014	0.011	0.011	0.012	0.012	0.012	0.013	0.011

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.14	0.10	0.11	0.09	0.09	0.11	0.11	0.11	0.11
PM$_{10}$	SECOND MAX 24-HOUR	NS	1	—	80	80	69	55	52	56	90	70	47
	WEIGHTED ANNUAL MEAN	DOWN	1	—	33	33	29	29	27	25	30	29	24
SO2	ARITHMETIC MEAN	NS	1	0.008	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.007	0.007
	SECOND MAX 24-HOUR	NS	1	0.033	0.040	0.053	0.038	0.044	0.053	0.050	0.035	0.028	0.020
PARKERSBURG-MARIETTA, WV-OH													
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.08	0.04	0.04	0.02	0.02	0.02	0.02	0.01	0.02	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.15	0.15	0.12	0.11	0.12	0.10	0.10	0.11	0.12	0.11
SO2	ARITHMETIC MEAN	DOWN	1	0.017	0.015	0.016	0.014	0.014	0.014	0.014	0.017	0.010	0.010
	SECOND MAX 24-HOUR	NS	1	0.070	0.076	0.076	0.064	0.060	0.059	0.065	0.084	0.041	0.046
PENSACOLA, FL													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.10	0.09	0.11	0.10	0.10	0.10	0.11	0.12	0.10
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.006	0.007	0.008	0.006	0.007	0.005	0.004	0.003	0.003
	SECOND MAX 24-HOUR	DOWN	1	0.086	0.071	0.057	0.078	0.056	0.057	0.032	0.039	0.019	0.015
PEORIA-PEKIN, IL													
CO	SECOND MAX 8-HOUR	DOWN	1	7.4	7.9	7.7	7.4	6.3	7.2	7.3	5.7	5.6	4.6
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.08	0.04	0.04	0.04	0.02	0.02	0.03	0.02	0.03	0.02
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.11	0.11	0.10	0.08	0.10	0.09	0.08	0.09	0.09	0.09
PM$_{10}$	SECOND MAX 24-HOUR	DOWN	1	—	57	70	72	48	54	39	45	42	43
	WEIGHTED ANNUAL MEAN	NS	1	—	23	28	27	24	25	20	21	20	21
SO2	ARITHMETIC MEAN	NS	2	0.008	0.009	0.007	0.007	0.008	0.007	0.007	0.007	0.007	0.007
	SECOND MAX 24-HOUR	NS	2	0.058	0.062	0.046	0.055	0.065	0.043	0.039	0.049	0.084	0.045
PHILADELPHIA, PA-NJ													
CO	SECOND MAX 8-HOUR	DOWN	9	6.3	5.4	7.1	4.9	4.6	4.7	4.7	5.2	4.1	4.2
LEAD	MAX QUARTERLY MEAN	NS	10	0.77	0.50	0.38	0.54	0.35	0.56	0.86	0.54	0.69	0.93
NO2	ARITHMETIC MEAN	DOWN	5	0.033	0.031	0.030	0.028	0.028	0.028	0.026	0.028	0.027	0.028
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	8	0.16	0.18	0.13	0.13	0.14	0.11	0.13	0.12	0.13	0.12
PM$_{10}$	SECOND MAX 24-HOUR	DOWN	10	—	75	73	68	73	55	69	71	65	63
	WEIGHTED ANNUAL MEAN	NS	10	—	34	34	31	33	27	29	32	31	30
SO2	ARITHMETIC MEAN	DOWN	10	0.011	0.012	0.011	0.010	0.009	0.008	0.008	0.009	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	10	0.046	0.052	0.045	0.040	0.034	0.034	0.031	0.040	0.026	0.026
PHOENIX-MESA, AZ													
CO	SECOND MAX 8-HOUR	DOWN	9	8.0	7.6	7.4	6.2	5.9	6.0	5.7	5.9	5.8	5.4
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.19	0.16	0.09	0.09	0.11	0.06	0.05	0.05	0.06	0.04
OZONE	SECOND DAILY MAX 1-HOUR	NS	9	0.11	0.11	0.10	0.11	0.10	0.11	0.11	0.11	0.12	0.11
PM$_{10}$	SECOND MAX 24-HOUR	NS	6	—	96	113	85	84	97	79	83	88	81
	WEIGHTED ANNUAL MEAN	DOWN	6	—	48	51	43	44	43	43	42	43	42
SO2	ARITHMETIC MEAN	NS	1	0.001	0.001	0.002	0.003	0.005	0.004	0.003	0.003	0.002	0.003
	SECOND MAX 24-HOUR	NS	1	0.010	0.001	0.006	0.011	0.013	0.010	0.009	0.009	0.008	0.017
PINE BLUFF, AR													
PM$_{10}$	SECOND MAX 24-HOUR	NS	1	—	60	60	47	42	51	55	56	62	51
	WEIGHTED ANNUAL MEAN	NS	1	—	27	27	21	19	22	23	25	26	23
PITTSBURGH, PA													
CO	SECOND MAX 8-HOUR	DOWN	5	5.6	5.1	5.3	5.6	4.3	4.8	3.8	4.3	3.8	3.3
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.12	0.13	0.12	0.09	0.09	0.07	0.07	0.08	0.06	0.04
NO2	ARITHMETIC MEAN	DOWN	5	0.025	0.023	0.023	0.023	0.023	0.022	0.022	0.023	0.021	0.021
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.12	0.13	0.11	0.10	0.11	0.09	0.11	0.11	0.12	0.10
PM$_{10}$	SECOND MAX 24-HOUR	DOWN	14	—	96	89	80	80	75	77	83	72	61
	WEIGHTED ANNUAL MEAN	DOWN	14	—	35	34	32	33	29	29	32	29	28
SO2	ARITHMETIC MEAN	DOWN	12	0.017	0.018	0.018	0.017	0.015	0.015	0.015	0.015	0.011	0.011
	SECOND MAX 24-HOUR	DOWN	12	0.077	0.078	0.075	0.074	0.056	0.068	0.062	0.072	0.047	0.044
PITTSFIELD, MA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.09	0.09	0.09	0.11	0.10	0.11	0.11	0.09	0.09	0.11
PONCE, PR													
PM$_{10}$	SECOND MAX 24-HOUR	DOWN	1	—	96	96	77	58	64	66	64	57	53
	WEIGHTED ANNUAL MEAN	DOWN	1	—	46	46	38	30	29	30	27	24	24
PORTLAND-VANCOUVER, OR-WA													
CO	SECOND MAX 8-HOUR	DOWN	2	10.7	8.9	8.2	8.5	9.1	7.0	6.3	7.0	5.7	6.1
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.17	0.12	0.07	0.06	0.06	0.05	0.06	0.04	0.03	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.10	0.11	0.08	0.12	0.09	0.10	0.09	0.09	0.09	0.12
PM$_{10}$	SECOND MAX 24-HOUR	DOWN	6	—	75	72	61	85	59	66	50	41	48
	WEIGHTED ANNUAL MEAN	DOWN	6	—	28	25	25	26	23	25	23	20	20
SO2	ARITHMETIC MEAN	NS	1	0.006	0.006	0.007	0.006	0.006	0.007	0.006	0.005	0.005	0.005
	SECOND MAX 24-HOUR	NS	1	0.018	0.018	0.023	0.019	0.024	0.017	0.025	0.013	0.013	0.013
PORTLAND, ME													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.14	0.17	0.13	0.13	0.14	0.12	0.11	0.12	0.12	0.10
PM$_{10}$	SECOND MAX 24-HOUR	DOWN	1	—	58	56	42	54	57	48	51	49	37
	WEIGHTED ANNUAL MEAN	DOWN	1	—	24	26	23	25	23	21	21	21	20
SO2	ARITHMETIC MEAN	DOWN	1	0.011	0.010	0.010	0.010	0.009	0.008	0.009	0.008	0.006	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.042	0.044	0.039	0.034	0.032	0.029	0.032	0.043	0.022	0.021
PORTSMOUTH-ROCHESTER, NH-ME													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.14	0.17	0.12	0.11	0.14	0.11	0.11	0.11	0.12	0.10
PM$_{10}$	SECOND MAX 24-HOUR	NS	2	—	51	44	44	49	57	39	37	37	40

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	WEIGHTED ANNUAL MEAN	DOWN	2	—	21	21	20	19	19	18	14	15	16
SO2	ARITHMETIC MEAN	DOWN	1	0.006	0.006	0.008	0.007	0.007	0.006	0.006	0.006	0.004	0.004
	SECOND MAX 24-HOUR	DOWN	1	0.034	0.034	0.029	0.025	0.021	0.027	0.019	0.022	0.017	0.015
PROVIDENCE-FALL RIVER-WARWICK, RI-MA													
CO	SECOND MAX 8-HOUR	NS	1	8.1	7.3	6.2	7.3	7.4	6.3	5.4	6.7	7.0	4.4
NO2	ARITHMETIC MEAN	NS	1	0.024	0.024	0.024	0.024	0.025	0.023	0.022	0.022	0.022	0.025
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.15	0.15	0.12	0.13	0.14	0.11	0.11	0.12	0.13	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	61	60	58	68	52	56	60	63	59
	WEIGHTED ANNUAL MEAN	DOWN	3	—	31	31	29	30	24	26	29	24	27
SO2	ARITHMETIC MEAN	DOWN	5	0.011	0.011	0.010	0.009	0.008	0.009	0.008	0.007	0.005	0.006
	SECOND MAX 24-HOUR	DOWN	5	0.049	0.050	0.043	0.039	0.039	0.044	0.036	0.035	0.022	0.030
PROVO-OREM, UT													
CO	SECOND MAX 8-HOUR	DOWN	1	13.3	11.0	15.8	16.2	11.6	10.0	9.6	9.3	7.1	7.1
NO2	ARITHMETIC MEAN	NS	1	0.024	0.028	0.028	0.025	0.022	0.019	0.026	0.024	0.023	0.024
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.10	0.11	0.11	0.09	0.08	0.09	0.08	0.08	0.08	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	184	222	115	220	202	194	106	94	125
	WEIGHTED ANNUAL MEAN	DOWN	3	—	50	49	32	42	37	38	34	29	34
PUEBLO, CO													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	70	75	52	57	54	51	54	86	49
	WEIGHTED ANNUAL MEAN	DOWN	1	—	35	33	26	30	26	26	30	26	26
RACINE, WI													
CO	SECOND MAX 8-HOUR	DOWN	1	6.7	7.4	6.4	5.5	5.7	4.9	4.1	4.3	4.3	3.0
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.18	0.18	0.14	0.11	0.14	0.10	0.10	0.11	0.11	0.13
RALEIGH-DURHAM-CHAPEL HILL, NC													
CO	SECOND MAX 8-HOUR	DOWN	1	10.9	10.9	10.9	8.7	8.8	7.3	7.2	6.9	6.6	5.6
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.11	0.11	0.11	0.12	0.11	0.10	0.11	0.11	0.10	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	73	60	50	51	46	47	37	48	50
	WEIGHTED ANNUAL MEAN	DOWN	2	—	34	29	29	26	24	25	22	23	25
RAPID CITY, SD													
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	74	68	76	138	80	88	79	75	62
	WEIGHTED ANNUAL MEAN	NS	2	—	29	26	27	28	25	23	29	24	23
READING, PA													
CO	SECOND MAX 8-HOUR	DOWN	1	5.3	5.2	5.0	6.4	4.6	4.6	3.8	5.4	3.9	3.4
LEAD	MAX QUARTERLY MEAN	DOWN	9	0.59	0.49	0.59	0.50	0.53	0.42	0.39	0.33	0.26	0.25
NO2	ARITHMETIC MEAN	DOWN	1	0.025	0.024	0.023	0.022	0.022	0.020	0.021	0.023	0.021	0.022
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.15	0.11	0.11	0.12	0.10	0.11	0.10	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	52	52	61	67	47	55	80	54	54
	WEIGHTED ANNUAL MEAN	NS	1	—	31	31	26	28	23	25	29	26	26
SO2	ARITHMETIC MEAN	DOWN	2	0.012	0.013	0.012	0.010	0.010	0.009	0.009	0.011	0.009	0.009
	SECOND MAX 24-HOUR	DOWN	2	0.043	0.053	0.048	0.038	0.034	0.033	0.033	0.040	0.033	0.036
REDDING, CA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.08	0.08	0.09	0.09	0.08	0.08	0.07	0.09	0.09	0.08
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	66	66	59	74	58	50	54	47	34
	WEIGHTED ANNUAL MEAN	DOWN	1	—	26	26	25	29	25	20	24	20	19
RENO, NV													
CO	SECOND MAX 8-HOUR	DOWN	2	8.6	8.6	9.1	8.3	9.2	7.4	5.8	6.9	5.3	5.9
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	2	0.10	0.10	0.10	0.11	0.09	0.08	0.09	0.09	0.08	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	127	123	135	106	86	92	86	65	72
	WEIGHTED ANNUAL MEAN	DOWN	6	—	44	42	44	36	36	40	36	32	29
RICHLAND-KENNEWICK-PASCO, WA													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	90	175	382	281	85	136	103	103	103
	WEIGHTED ANNUAL MEAN	DOWN	1	—	33	29	40	31	24	28	27	27	27
RICHMOND-PETERSBURG, VA													
CO	SECOND MAX 8-HOUR	DOWN	2	6.0	4.1	4.0	4.4	3.7	2.5	3.9	3.4	2.6	2.9
NO2	ARITHMETIC MEAN	DOWN	1	0.026	0.026	0.025	0.023	0.024	0.023	0.024	0.024	0.022	0.022
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.13	0.14	0.11	0.11	0.11	0.12	0.12	0.11	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	59	54	59	59	44	55	37	53	63
	WEIGHTED ANNUAL MEAN	DOWN	3	—	28	28	25	26	22	23	21	23	24
SO2	ARITHMETIC MEAN	DOWN	1	0.007	0.009	0.009	0.006	0.006	0.005	0.007	0.006	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.031	0.042	0.032	0.034	0.027	0.024	0.023	0.022	0.016	0.027
RIVERSIDE-SAN BERNARDINO, CA													
CO	SECOND MAX 8-HOUR	DOWN	7	4.5	4.7	5.1	4.4	5.1	3.6	3.5	3.5	3.4	2.9
LEAD	MAX QUARTERLY MEAN	DOWN	4	0.08	0.08	0.06	0.05	0.06	0.03	0.04	0.04	0.04	0.04
NO2	ARITHMETIC MEAN	NS	7	0.028	0.030	0.030	0.029	0.029	0.027	0.028	0.028	0.029	0.027
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	16	0.21	0.22	0.22	0.21	0.21	0.19	0.18	0.19	0.18	0.17
PM_{10}	SECOND MAX 24-HOUR	DOWN	10	—	134	208	160	133	100	107	99	115	95
	WEIGHTED ANNUAL MEAN	DOWN	10	—	66	69	62	58	50	49	47	47	45
SO2	ARITHMETIC MEAN	DOWN	4	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001
	SECOND MAX 24-HOUR	DOWN	4	0.007	0.012	0.013	0.006	0.008	0.009	0.006	0.004	0.005	0.004
ROANOKE, VA													
NO2	ARITHMETIC MEAN	DOWN	1	0.016	0.016	0.014	0.013	0.014	0.013	0.014	0.013	0.013	0.013
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.13	0.10	0.09	0.10	0.09	0.10	0.10	0.09	0.08
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	65	65	68	63	64	72	68	74	70

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	WEIGHTED ANNUAL MEAN	NS	2	—	37	35	36	33	32	35	36	34	33
SO2	ARITHMETIC MEAN	DOWN	1	0.004	0.004	0.005	0.004	0.004	0.004	0.004	0.004	0.003	0.003
	SECOND MAX 24-HOUR	NS	1	0.014	0.018	0.022	0.018	0.019	0.016	0.018	0.011	0.010	0.014
ROCHESTER, MN													
CO	SECOND MAX 8-HOUR	DOWN	1	9.0	7.1	6.3	6.1	6.3	5.1	4.9	5.0	4.0	4.0
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	54	64	89	43	44	38	43	49	44
	WEIGHTED ANNUAL MEAN	DOWN	1	—	29	30	28	23	21	20	21	20	19
ROCHESTER, NY													
CO	SECOND MAX 8-HOUR	NS	2	3.8	4.0	3.6	3.5	3.3	3.5	3.2	4.5	3.2	3.7
LEAD	MAX QUARTERLY MEAN	NS	1	0.10	0.09	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.13	0.10	0.11	0.11	0.09	0.09	0.09	0.11	0.08
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	81	60	47	61	49	64	42	47	45
	WEIGHTED ANNUAL MEAN	DOWN	2	—	30	24	21	26	22	23	20	21	21
SO2	ARITHMETIC MEAN	DOWN	2	0.011	0.012	0.013	0.012	0.011	0.011	0.010	0.011	0.010	0.009
	SECOND MAX 24-HOUR	NS	2	0.045	0.038	0.054	0.040	0.043	0.039	0.041	0.043	0.038	0.033
ROCKFORD, IL													
CO	SECOND MAX 8-HOUR	DOWN	1	8.0	8.1	6.6	6.5	5.1	4.6	4.3	4.0	4.5	3.2
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.05	0.13	0.07	0.09	0.04	0.06	0.03	0.04	0.03	0.05
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.09	0.11	0.09	0.09	0.09	0.09	0.08	0.10	0.10	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	37	58	54	55	49	42	44	45	36
	WEIGHTED ANNUAL MEAN	NS	1	—	17	25	25	22	21	16	19	19	18
SACRAMENTO, CA													
CO	SECOND MAX 8-HOUR	DOWN	5	9.5	10.4	9.8	9.6	8.4	6.7	7.2	6.9	5.4	5.4
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.11	0.08	0.07	0.10	0.04	0.02	0.05	0.02	0.02	0.01
NO2	ARITHMETIC MEAN	DOWN	4	0.019	0.019	0.019	0.019	0.017	0.017	0.018	0.015	0.016	0.016
OZONE	SECOND DAILY MAX 1-HOUR	NS	6	0.13	0.14	0.11	0.13	0.14	0.12	0.12	0.11	0.13	0.12
SO2	ARITHMETIC MEAN	DOWN	1	0.010	0.010	0.006	0.006	0.003	0.002	0.001	0.001	0.001	0.001
	SECOND MAX 24-HOUR	DOWN	1	0.020	0.020	0.020	0.010	0.010	0.010	0.003	0.004	0.004	0.003
SAGINAW-BAY CITY-MIDLAND, MI													
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	100	124	71	86	115	51	45	45	45
	WEIGHTED ANNUAL MEAN	DOWN	1	—	31	30	26	30	29	22	22	22	22
SALINAS, CA													
CO	SECOND MAX 8-HOUR	NS	1	2.3	2.3	2.3	2.5	2.1	2.3	2.1	2.0	1.7	2.4
NO2	ARITHMETIC MEAN	DOWN	1	0.013	0.014	0.014	0.012	0.012	0.012	0.012	0.012	0.011	0.011
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.08	0.08	0.10	0.08	0.08	0.07	0.08	0.08	0.07	0.08
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	49	49	49	43	38	55	33	47	40
	WEIGHTED ANNUAL MEAN	DOWN	1	—	25	25	23	23	22	22	20	21	20
SALT LAKE CITY-OGDEN, UT													
CO	SECOND MAX 8-HOUR	DOWN	2	8.7	7.7	7.3	6.9	7.8	7.6	6.5	6.4	5.7	6.5
LEAD	MAX QUARTERLY MEAN	DOWN	3	0.16	0.16	0.13	0.08	0.08	0.05	0.06	0.05	0.05	0.03
NO2	ARITHMETIC MEAN	NS	1	0.024	0.026	0.027	0.019	0.020	0.022	0.025	0.026	0.024	0.026
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.11	0.12	0.13	0.11	0.10	0.09	0.10	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	8	—	136	129	96	151	133	114	94	81	105
	WEIGHTED ANNUAL MEAN	DOWN	8	—	42	43	32	39	35	35	30	28	31
SO2	ARITHMETIC MEAN	DOWN	4	0.008	0.010	0.010	0.008	0.009	0.008	0.007	0.004	0.003	0.003
	SECOND MAX 24-HOUR	NS	4	0.039	0.051	0.079	0.036	0.048	0.051	0.041	0.012	0.012	0.012
SAN ANTONIO, TX													
CO	SECOND MAX 8-HOUR	DOWN	2	6.2	5.7	6.3	5.4	4.6	4.7	5.1	3.5	3.8	4.8
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.11	0.06	0.04	0.07	0.03	0.03	0.03	0.03	0.03	0.02
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.12	0.11	0.10	0.11	0.10	0.11	0.11	0.12	0.12
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	63	57	49	48	48	54	47	41	37
	WEIGHTED ANNUAL MEAN	DOWN	3	—	28	28	25	25	25	23	23	21	19
SAN DIEGO, CA													
CO	SECOND MAX 8-HOUR	DOWN	7	5.8	6.1	6.6	5.8	5.4	5.0	4.5	4.8	4.2	4.2
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.09	0.06	0.04	0.08	0.05	0.03	0.04	0.01	0.02	0.01
NO2	ARITHMETIC MEAN	DOWN	6	0.025	0.028	0.027	0.024	0.024	0.023	0.020	0.021	0.021	0.019
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	8	0.16	0.17	0.16	0.16	0.15	0.14	0.13	0.11	0.12	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	67	75	67	74	52	62	62	72	50
	WEIGHTED ANNUAL MEAN	DOWN	3	—	36	39	34	37	32	30	31	32	28
SO2	ARITHMETIC MEAN	DOWN	2	0.004	0.005	0.005	0.004	0.003	0.004	0.003	0.003	0.003	0.004
	SECOND MAX 24-HOUR	NS	2	0.012	0.014	0.016	0.015	0.018	0.019	0.010	0.014	0.012	0.014
SAN FRANCISCO, CA													
CO	SECOND MAX 8-HOUR	DOWN	4	6.1	6.4	5.9	5.7	6.2	4.8	4.6	4.3	3.7	3.9
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.09	0.10	0.08	0.04	0.04	0.02	0.03	0.02	0.03	0.01
NO2	ARITHMETIC MEAN	DOWN	1	0.024	0.026	0.026	0.021	0.024	0.022	0.024	0.022	0.021	0.022
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.09	0.09	0.08	0.06	0.06	0.06	0.08	0.07	0.09	0.08
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	84	84	93	84	75	72	65	42	45
	WEIGHTED ANNUAL MEAN	DOWN	1	—	33	33	28	32	29	27	25	21	21
SO2	ARITHMETIC MEAN	NS	1	0.002	0.002	0.003	0.002	0.002	0.003	0.002	0.001	0.002	0.002
	SECOND MAX 24-HOUR	NS	1	0.010	0.012	0.015	0.010	0.013	0.012	0.010	0.005	0.005	0.007
SAN JOSE, CA													
CO	SECOND MAX 8-HOUR	DOWN	2	7.2	10.4	11.9	10.8	10.2	7.3	6.4	7.4	5.6	5.7
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.19	0.12	0.12	0.08	0.04	0.03	0.02	0.02	0.02	0.01

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.13	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	115	122	117	102	85	72	76	47	47
	WEIGHTED ANNUAL MEAN	DOWN	4	—	38	39	36	34	30	25	26	22	21
SAN JUAN-BAYAMON, PR													
CO	SECOND MAX 8-HOUR	DOWN	2	5.5	5.4	5.5	5.3	5.3	5.3	4.5	4.8	4.9	4.0
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	79	82	80	70	71	75	70	59	63
	WEIGHTED ANNUAL MEAN	DOWN	6	—	33	34	35	30	28	32	30	26	27
SO2	ARITHMETIC MEAN	UP	2	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.003
	SECOND MAX 24-HOUR	NS	2	0.016	0.023	0.014	0.016	0.015	0.022	0.013	0.015	0.019	0.015
SAN LUIS OBISPO-ATASCADERO-PASO ROBLES,C													
CO	SECOND MAX 8-HOUR	DOWN	1	3.6	4.0	4.7	3.9	3.3	3.0	3.1	3.1	2.4	2.3
NO2	ARITHMETIC MEAN	DOWN	2	0.012	0.012	0.013	0.012	0.012	0.011	0.011	0.011	0.010	0.010
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	5	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	58	58	54	47	41	54	38	49	40
	WEIGHTED ANNUAL MEAN	DOWN	3	—	27	27	25	25	23	23	21	21	19
SO2	ARITHMETIC MEAN	NS	4	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001
	SECOND MAX 24-HOUR	NS	4	0.004	0.006	0.006	0.006	0.007	0.004	0.004	0.005	0.003	0.003
SANTA BARBARA-SANTA MARIA-LOMPOC, CA													
CO	SECOND MAX 8-HOUR	DOWN	4	2.6	2.6	2.8	2.4	2.3	2.3	2.2	2.5	2.1	1.9
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.05	0.05	0.05	0.03	0.03	0.01	0.02	0.01	0.01	0.01
NO2	ARITHMETIC MEAN	DOWN	19	0.008	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	20	0.11	0.11	0.15	0.10	0.10	0.10	0.10	0.09	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	14	—	53	54	49	45	45	51	43	45	42
	WEIGHTED ANNUAL MEAN	DOWN	14	—	26	25	23	22	22	24	23	23	22
SO2	ARITHMETIC MEAN	NS	12	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	SECOND MAX 24-HOUR	NS	12	0.004	0.004	0.003	0.003	0.003	0.003	0.004	0.003	0.003	0.003
SANTA CRUZ-WATSONVILLE, CA													
CO	SECOND MAX 8-HOUR	NS	1	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.2	0.8	0.7
NO2	ARITHMETIC MEAN	DOWN	1	0.006	0.008	0.009	0.008	0.010	0.007	0.006	0.006	0.005	0.005
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.09	0.08	0.08	0.08	0.09	0.07	0.08	0.07	0.07	0.08
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	56	50	47	43	35	49	37	36	39
	WEIGHTED ANNUAL MEAN	DOWN	1	—	30	31	24	24	22	22	22	19	19
SO2	ARITHMETIC MEAN	NS	1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002
	SECOND MAX 24-HOUR	NS	1	0.007	0.007	0.004	0.003	0.002	0.006	0.006	0.006	0.008	0.003
SANTA FE, NM													
CO	SECOND MAX 8-HOUR	DOWN	1	4.3	3.8	3.5	3.5	3.9	3.7	3.4	2.7	2.3	2.2
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	34	40	43	32	36	32	28	28	29
	WEIGHTED ANNUAL MEAN	DOWN	2	—	17	16	17	14	16	15	14	13	14
SANTA ROSA, CA													
CO	SECOND MAX 8-HOUR	DOWN	1	4.1	4.9	5.0	4.3	3.8	3.5	3.8	3.2	2.4	3.0
NO2	ARITHMETIC MEAN	NS	1	0.016	0.016	0.015	0.015	0.015	0.016	0.016	0.015	0.015	0.014
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.10	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.08
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	52	52	51	69	44	45	41	37	34
	WEIGHTED ANNUAL MEAN	DOWN	3	—	23	23	20	23	18	19	18	16	16
SARASOTA-BRADENTON, FL													
CO	SECOND MAX 8-HOUR	NS	1	6.3	6.3	6.3	6.2	6.9	5.6	6.5	5.3	5.9	5.1
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.08	0.10	0.10	0.10	0.10	0.09	0.09	0.10	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	43	43	43	53	72	66	48	37	38
	WEIGHTED ANNUAL MEAN	NS	2	—	24	24	24	24	26	25	22	20	19
SO2	ARITHMETIC MEAN	NS	1	0.002	0.002	0.003	0.002	0.003	0.003	0.003	0.003	0.002	0.002
	SECOND MAX 24-HOUR	NS	1	0.008	0.012	0.017	0.016	0.035	0.021	0.018	0.017	0.010	0.018
SAVANNAH, GA													
SO2	ARITHMETIC MEAN	NS	1	0.002	0.007	0.003	0.002	0.002	0.002	0.003	0.003	0.004	0.004
	SECOND MAX 24-HOUR	NS	1	0.010	0.046	0.013	0.008	0.009	0.008	0.011	0.015	0.013	0.019
SCRANTON—WILKES-BARRE—HAZLETON, PA													
CO	SECOND MAX 8-HOUR	DOWN	2	4.8	4.8	4.1	4.5	4.2	3.8	2.9	3.6	2.8	3.8
NO2	ARITHMETIC MEAN	DOWN	2	0.020	0.018	0.019	0.018	0.017	0.016	0.018	0.018	0.016	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.11	0.13	0.10	0.10	0.12	0.10	0.11	0.10	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	66	58	61	65	45	69	61	64	50
	WEIGHTED ANNUAL MEAN	DOWN	3	—	29	29	25	29	25	26	28	25	24
SO2	ARITHMETIC MEAN	DOWN	2	0.011	0.010	0.009	0.010	0.009	0.008	0.007	0.007	0.005	0.006
	SECOND MAX 24-HOUR	DOWN	2	0.048	0.051	0.047	0.049	0.039	0.033	0.026	0.035	0.036	0.028
SEATTLE-BELLEVUE-EVERETT, WA													
CO	SECOND MAX 8-HOUR	DOWN	5	9.3	9.1	8.5	7.3	7.4	7.5	5.6	5.4	5.4	5.0
LEAD	MAX QUARTERLY MEAN	NS	2	0.29	0.47	0.21	0.35	0.30	0.22	0.20	0.32	0.27	0.34
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.09	0.11	0.08	0.12	0.10	0.09	0.10	0.11	0.09	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	7	—	81	96	83	93	74	75	59	61	56
	WEIGHTED ANNUAL MEAN	DOWN	7	—	31	32	29	30	29	28	23	22	20
SO2	ARITHMETIC MEAN	NS	1	0.007	0.007	0.006	0.009	0.010	0.010	0.009	0.007	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	1	0.022	0.028	0.022	0.026	0.028	0.024	0.022	0.017	0.020	0.019
SHARON, PA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.12	0.14	0.11	0.10	0.11	0.10	0.11	0.11	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	84	88	68	73	58	56	68	72	52

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	WEIGHTED ANNUAL MEAN	DOWN	1	—	37	35	30	36	27	28	30	28	29
SO2	ARITHMETIC MEAN	DOWN	1	0.009	0.011	0.011	0.010	0.009	0.008	0.008	0.008	0.008	0.007
	SECOND MAX 24-HOUR	DOWN	1	0.037	0.054	0.043	0.036	0.032	0.030	0.029	0.047	0.032	0.029
SHREVEPORT-BOSSIER CITY, LA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.11	0.12	0.11	0.10	0.10	0.11	0.09	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	47	47	47	100	44	52	51	52	44
	WEIGHTED ANNUAL MEAN	NS	1	—	23	23	23	28	24	22	24	24	22
SO2	ARITHMETIC MEAN	NS	1	0.003	0.003	0.004	0.002	0.002	0.004	0.004	0.002	0.001	0.002
	SECOND MAX 24-HOUR	NS	1	0.010	0.009	0.023	0.006	0.009	0.013	0.011	0.008	0.004	0.004
SIOUX CITY, IA-NE													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	77	75	69	66	87	44	69	62	95
	WEIGHTED ANNUAL MEAN	NS	1	—	31	28	28	28	25	23	23	26	33
SIOUX FALLS, SD													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	52	54	46	44	43	48	43	50	43
	WEIGHTED ANNUAL MEAN	NS	1	—	22	22	20	19	19	15	22	20	19
SOUTH BEND, IN													
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.10	0.12	0.08	0.09	0.10	0.10	0.09	0.10	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	78	71	89	63	64	59	61	51	44
	WEIGHTED ANNUAL MEAN	DOWN	2	—	29	30	31	30	23	24	27	22	20
SPOKANE, WA													
CO	SECOND MAX 8-HOUR	DOWN	1	19.0	13.8	12.3	11.5	11.0	9.9	9.8	8.1	8.4	9.0
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	137	142	173	93	143	120	85	76	91
	WEIGHTED ANNUAL MEAN	DOWN	4	—	50	46	45	40	40	40	37	31	32
SPRINGFIELD, IL													
CO	SECOND MAX 8-HOUR	DOWN	1	4.6	4.8	4.4	4.4	4.3	4.5	3.9	3.1	3.2	3.0
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.11	0.11	0.10	0.10	0.09	0.11	0.10	0.10	0.10
SO2	ARITHMETIC MEAN	DOWN	1	0.008	0.007	0.007	0.007	0.008	0.006	0.006	0.006	0.006	0.006
	SECOND MAX 24-HOUR	NS	1	0.039	0.074	0.047	0.054	0.048	0.043	0.040	0.050	0.062	0.061
SPRINGFIELD, MA													
CO	SECOND MAX 8-HOUR	NS	2	8.3	7.3	7.3	6.7	6.3	7.1	6.1	7.5	7.9	7.1
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.14	0.09	0.06	0.05	0.03	0.04	0.02	0.01	0.01	0.01
NO2	ARITHMETIC MEAN	DOWN	2	0.018	0.019	0.018	0.018	0.017	0.016	0.016	0.019	0.015	0.016
OZONE	SECOND DAILY MAX 1-HOUR	NS	4	0.12	0.16	0.12	0.12	0.13	0.12	0.13	0.12	0.12	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	4	—	56	49	52	50	56	50	56	43	47
	WEIGHTED ANNUAL MEAN	DOWN	4	—	27	25	22	22	20	20	23	19	20
SO2	ARITHMETIC MEAN	DOWN	6	0.010	0.010	0.009	0.009	0.008	0.007	0.006	0.006	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	6	0.039	0.050	0.033	0.034	0.030	0.030	0.022	0.037	0.025	0.026
SPRINGFIELD, MO													
CO	SECOND MAX 8-HOUR	DOWN	1	7.5	6.9	6.7	7.2	6.9	6.2	5.3	5.9	4.1	3.3
NO2	ARITHMETIC MEAN	NS	1	0.010	0.010	0.010	0.008	0.008	0.010	0.011	0.013	0.012	0.011
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.09	0.09	0.07	0.08	0.07	0.08	0.08	0.09	0.10	0.09
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	43	42	42	33	42	37	38	37	38
	WEIGHTED ANNUAL MEAN	DOWN	3	—	22	22	22	18	19	17	17	17	18
SO2	ARITHMETIC MEAN	NS	2	0.007	0.006	0.006	0.006	0.003	0.004	0.006	0.008	0.003	0.005
	SECOND MAX 24-HOUR	NS	2	0.079	0.057	0.052	0.057	0.033	0.034	0.040	0.067	0.021	0.043
ST. JOSEPH, MO													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	112	100	104	120	89	100	77	101	126
	WEIGHTED ANNUAL MEAN	DOWN	1	—	46	45	40	44	39	32	34	33	32
ST. LOUIS, MO-IL													
CO	SECOND MAX 8-HOUR	DOWN	7	6.2	4.6	4.8	4.0	4.1	3.3	3.3	3.5	3.3	3.3
LEAD	MAX QUARTERLY MEAN	DOWN	12	1.06	1.99	0.81	0.71	0.62	0.64	0.50	0.56	0.57	0.61
NO2	ARITHMETIC MEAN	NS	8	0.021	0.020	0.019	0.018	0.018	0.019	0.018	0.019	0.019	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	16	0.13	0.13	0.11	0.11	0.11	0.10	0.11	0.11	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	15	—	84	84	78	62	67	62	67	64	56
	WEIGHTED ANNUAL MEAN	DOWN	15	—	37	37	33	32	32	28	31	30	27
SO2	ARITHMETIC MEAN	DOWN	15	0.012	0.012	0.012	0.011	0.010	0.009	0.009	0.009	0.008	0.008
	SECOND MAX 24-HOUR	DOWN	15	0.054	0.054	0.056	0.042	0.042	0.039	0.041	0.041	0.037	0.039
STAMFORD-NORWALK, CT													
CO	SECOND MAX 8-HOUR	DOWN	1	6.3	6.9	6.0	6.3	6.0	5.5	5.2	6.2	5.4	4.1
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.17	0.22	0.16	0.14	0.15	0.11	0.15	0.16	0.14	0.12
PM_{10}	SECOND MAX 24-HOUR	NS	4	—	62	59	62	59	48	48	64	51	47
	WEIGHTED ANNUAL MEAN	NS	4	—	30	28	29	31	23	22	27	24	24
SO2	ARITHMETIC MEAN	NS	1	0.005	0.006	0.006	0.005	0.006	0.005	0.005	0.006	0.004	0.005
	SECOND MAX 24-HOUR	NS	1	0.022	0.031	0.029	0.024	0.025	0.022	0.020	0.028	0.023	0.019
STATE COLLEGE, PA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.14	0.10	0.11	0.12	0.10	0.11	0.10	0.11	0.11
STEUBENVILLE-WEIRTON, OH-WV													
CO	SECOND MAX 8-HOUR	DOWN	1	30.3	19.6	13.3	20.5	13.9	6.9	6.6	8.2	5.7	5.3
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.17	0.05	0.09	0.08	0.07	0.14	0.07	0.07	0.06	0.04
NO2	ARITHMETIC MEAN	NS	1	0.020	0.021	0.023	0.020	0.021	0.019	0.017	0.020	0.020	0.020
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.12	0.10	0.09	0.11	0.09	0.10	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	6	—	98	121	95	102	84	93	109	90	88
	WEIGHTED ANNUAL MEAN	DOWN	6	—	41	42	37	40	36	34	35	34	32

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
SO2	ARITHMETIC MEAN	DOWN	5	0.024	0.026	0.026	0.025	0.024	0.019	0.019	0.018	0.012	0.011
	SECOND MAX 24-HOUR	DOWN	5	0.097	0.088	0.092	0.085	0.078	0.076	0.085	0.093	0.049	0.048
STOCKTON-LODI, CA													
CO	SECOND MAX 8-HOUR	NS	2	8.4	9.4	9.0	10.9	9.7	5.9	5.8	7.0	4.8	6.0
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.06	0.06	0.05	0.04	0.04	0.02	0.03	0.02	0.02	0.02
NO2	ARITHMETIC MEAN	DOWN	1	0.025	0.026	0.026	0.026	0.025	0.024	0.024	0.024	0.022	0.023
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.12	0.12	0.11	0.12	0.11	0.11	0.11	0.12	0.13	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	2	—	97	113	118	127	77	100	95	91	55
	WEIGHTED ANNUAL MEAN	DOWN	2	—	42	46	45	49	39	36	35	31	26
SYRACUSE, NY													
CO	SECOND MAX 8-HOUR	DOWN	1	9.4	7.8	9.7	6.8	8.4	7.5	5.6	6.5	3.3	3.9
PM_{10}	SECOND MAX 24-HOUR	DOWN	3	—	66	66	62	74	62	67	59	51	53
	WEIGHTED ANNUAL MEAN	DOWN	3	—	32	32	27	29	27	24	24	23	23
TACOMA, WA													
CO	SECOND MAX 8-HOUR	DOWN	1	10.5	11.6	10.3	8.0	8.7	8.9	5.9	6.0	6.3	6.3
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.10	0.11	0.09	0.13	0.09	0.10	0.10	0.11	0.09	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	4	—	90	106	91	94	89	78	66	67	60
	WEIGHTED ANNUAL MEAN	DOWN	4	—	34	36	32	32	33	30	25	25	24
SO2	ARITHMETIC MEAN	NS	2	0.007	0.007	0.007	0.008	0.008	0.009	0.009	0.007	0.006	0.006
	SECOND MAX 24-HOUR	DOWN	2	0.029	0.029	0.027	0.026	0.023	0.030	0.025	0.021	0.020	0.024
TAMPA-ST. PETERSBURG-CLEARWATER, FL													
CO	SECOND MAX 8-HOUR	DOWN	6	3.7	4.4	3.7	3.8	2.9	2.9	2.6	2.2	2.8	2.5
LEAD	MAX QUARTERLY MEAN	DOWN	2	0.03	0.03	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
NO2	ARITHMETIC MEAN	DOWN	1	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.010	0.012	0.011
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	5	0.12	0.11	0.10	0.11	0.10	0.09	0.09	0.09	0.09	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	52	50	46	48	55	55	59	52	47
	WEIGHTED ANNUAL MEAN	DOWN	3	—	29	29	28	29	26	27	26	25	25
SO2	ARITHMETIC MEAN	DOWN	6	0.006	0.006	0.007	0.006	0.004	0.004	0.004	0.004	0.004	0.004
	SECOND MAX 24-HOUR	DOWN	6	0.028	0.028	0.027	0.026	0.022	0.023	0.023	0.024	0.020	0.022
TERRE HAUTE, IN													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.08	0.11	0.11	0.10	0.08	0.09	0.11	0.10	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	5	—	93	87	88	75	61	63	54	62	47
	WEIGHTED ANNUAL MEAN	DOWN	5	—	34	33	33	30	26	25	25	27	22
SO2	ARITHMETIC MEAN	NS	2	0.009	0.008	0.009	0.011	0.011	0.007	0.009	0.010	0.007	0.009
	SECOND MAX 24-HOUR	NS	2	0.038	0.035	0.043	0.038	0.037	0.033	0.039	0.039	0.029	0.033
TEXARKANA, TX-TEXARKANA, AR													
PM_{10}	SECOND MAX 24-HOUR	UP	1	—	40	40	48	45	50	44	52	55	50
	WEIGHTED ANNUAL MEAN	NS	1	—	26	26	24	22	23	22	23	26	23
TOLEDO, OH													
LEAD	MAX QUARTERLY MEAN	NS	1	0.65	0.54	0.48	0.79	0.48	0.57	0.63	0.70	0.43	0.44
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.11	0.13	0.10	0.10	0.11	0.09	0.11	0.11	0.11	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	64	64	59	60	53	63	58	50	42
	WEIGHTED ANNUAL MEAN	DOWN	1	—	36	36	26	29	28	25	26	25	22
SO2	ARITHMETIC MEAN	DOWN	2	0.009	0.009	0.007	0.006	0.006	0.006	0.007	0.007	0.004	0.004
	SECOND MAX 24-HOUR	NS	2	0.043	0.041	0.040	0.033	0.022	0.029	0.028	0.047	0.025	0.031
TOPEKA, KS													
LEAD	MAX QUARTERLY MEAN	DOWN	5	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	66	66	66	56	58	48	49	65	58
	WEIGHTED ANNUAL MEAN	NS	1	—	40	40	33	26	28	27	29	34	27
TRENTON, NJ													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.16	0.20	0.14	0.14	0.15	0.15	0.14	0.14	0.13	0.12
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	79	66	68	58	49	66	64	45	59
	WEIGHTED ANNUAL MEAN	DOWN	1	—	32	30	29	31	26	27	29	24	27
TULSA, OK													
CO	SECOND MAX 8-HOUR	NS	2	6.3	4.2	5.6	4.7	4.6	5.1	3.9	3.9	3.4	5.3
LEAD	MAX QUARTERLY MEAN	NS	1	0.13	0.13	0.20	0.11	0.21	0.10	0.20	0.10	0.09	0.11
NO2	ARITHMETIC MEAN	NS	2	0.012	0.013	0.014	0.011	0.013	0.013	0.013	0.013	0.010	0.012
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.11	0.12	0.11	0.12	0.11	0.10	0.11	0.11	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	5	—	56	77	61	59	53	61	50	53	60
	WEIGHTED ANNUAL MEAN	NS	5	—	28	28	24	25	24	26	26	26	26
SO2	ARITHMETIC MEAN	NS	2	0.008	0.009	0.006	0.009	0.009	0.009	0.006	0.005	0.007	0.008
	SECOND MAX 24-HOUR	NS	2	0.058	0.045	0.035	0.046	0.052	0.048	0.035	0.031	0.031	0.036
TUSCALOOSA, AL													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	59	59	70	62	45	66	48	63	58
	WEIGHTED ANNUAL MEAN	DOWN	1	—	29	29	32	28	26	26	26	27	26
TUSCON, AZ													
CO	SECOND MAX 8-HOUR	DOWN	3	5.6	6.8	5.7	4.6	4.4	4.6	4.5	4.4	4.3	4.1
NO2	ARITHMETIC MEAN	DOWN	1	0.023	0.023	0.023	0.022	0.024	0.023	0.022	0.021	0.020	0.019
OZONE	SECOND DAILY MAX 1-HOUR	NS	5	0.08	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09
PM_{10}	SECOND MAX 24-HOUR	DOWN	10	—	90	90	87	55	53	44	40	54	47
	WEIGHTED ANNUAL MEAN	DOWN	10	—	37	39	33	25	23	22	21	25	25
UTICA-ROME, NY													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.11	0.12	0.09	0.10	0.10	0.09	0.09	0.09	0.10	0.08

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
VALLEJO-FAIRFIELD-NAPA, CA													
CO	SECOND MAX 8-HOUR	DOWN	2	6.6	7.3	7.4	6.9	6.6	5.6	5.6	5.2	4.2	4.2
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.10	0.10	0.10	0.09	0.10	0.09	0.10	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	1	—	94	94	94	98	69	46	57	51	43
	WEIGHTED ANNUAL MEAN	DOWN	1	—	27	27	27	41	24	23	21	19	17
VENTURA, CA													
CO	SECOND MAX 8-HOUR	DOWN	2	3.9	3.3	3.0	3.3	3.1	2.3	2.5	2.8	3.2	2.4
LEAD	MAX QUARTERLY MEAN	DOWN	1	0.05	0.03	0.04	0.02	0.03	0.01	0.01	0.01	0.01	0.01
NO2	ARITHMETIC MEAN	DOWN	4	0.015	0.016	0.017	0.016	0.015	0.014	0.014	0.014	0.014	0.013
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	6	0.15	0.14	0.15	0.13	0.14	0.13	0.12	0.13	0.13	0.13
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	74	74	83	69	63	55	51	60	52
	WEIGHTED ANNUAL MEAN	DOWN	6	—	38	38	34	35	30	27	29	27	26
VINELAND-MILLVILLE-BRIDGETON, NJ													
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.14	0.15	0.13	0.13	0.12	0.10	0.12	0.10	0.13	0.11
SO2	ARITHMETIC MEAN	DOWN	1	0.007	0.009	0.008	0.007	0.007	0.006	0.006	0.005	0.004	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.038	0.034	0.049	0.024	0.023	0.021	0.019	0.032	0.016	0.016
VISALIA-TULARE-PORTERVILLE, CA													
CO	SECOND MAX 8-HOUR	DOWN	1	5.5	5.6	5.9	5.0	5.3	4.3	3.5	4.0	4.2	3.9
NO2	ARITHMETIC MEAN	NS	1	0.019	0.023	0.021	0.021	0.022	0.020	0.023	0.023	0.023	0.018
OZONE	SECOND DAILY MAX 1-HOUR	NS	3	0.13	0.12	0.13	0.12	0.12	0.12	0.13	0.13	0.12	0.13
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	113	154	173	129	102	99	86	115	81
	WEIGHTED ANNUAL MEAN	DOWN	2	—	60	61	69	61	51	49	42	47	40
WASHINGTON, DC-MD-VA-WV													
CO	SECOND MAX 8-HOUR	DOWN	8	7.4	6.6	6.3	5.2	5.0	4.4	5.0	4.5	4.4	3.9
LEAD	MAX QUARTERLY MEAN	DOWN	5	0.07	0.05	0.05	0.05	0.03	0.02	0.02	0.02	0.02	0.01
NO2	ARITHMETIC MEAN	NS	7	0.027	0.025	0.025	0.027	0.026	0.026	0.026	0.026	0.023	0.023
OZONE	SECOND DAILY MAX 1-HOUR	NS	13	0.13	0.15	0.11	0.11	0.12	0.11	0.12	0.12	0.12	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	9	—	61	65	54	53	42	53	47	50	45
	WEIGHTED ANNUAL MEAN	DOWN	9	—	29	30	26	26	23	22	22	22	21
SO2	ARITHMETIC MEAN	DOWN	4	0.008	0.009	0.010	0.008	0.008	0.008	0.008	0.008	0.007	0.007
	SECOND MAX 24-HOUR	NS	4	0.030	0.030	0.038	0.030	0.029	0.033	0.027	0.031	0.020	0.028
WATERBURY, CT													
PM_{10}	SECOND MAX 24-HOUR	NS	3	—	68	64	75	63	52	52	55	58	62
	WEIGHTED ANNUAL MEAN	NS	3	—	30	31	31	29	23	23	25	24	25
SO2	ARITHMETIC MEAN	DOWN	1	0.009	0.010	0.010	0.010	0.009	0.007	0.006	0.007	0.005	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.038	0.055	0.048	0.042	0.038	0.029	0.021	0.030	0.019	0.022
WEST PALM BEACH-BOCA RATON, FL													
CO	SECOND MAX 8-HOUR	DOWN	1	3.8	4.0	3.7	2.7	3.1	3.7	3.1	2.8	2.8	2.5
NO2	ARITHMETIC MEAN	NS	1	0.012	0.013	0.013	0.014	0.012	0.011	0.013	0.012	0.012	0.012
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.09	0.10	0.11	0.09	0.07	0.07	0.11	0.08	0.08	0.09
PM_{10}	SECOND MAX 24-HOUR	UP	2	—	33	33	33	33	47	43	56	36	52
	WEIGHTED ANNUAL MEAN	NS	2	—	19	19	19	18	20	19	18	18	18
SO2	ARITHMETIC MEAN	NS	1	0.001	0.001	0.003	0.002	0.002	0.003	0.004	0.003	0.002	0.002
	SECOND MAX 24-HOUR	UP	1	0.004	0.004	0.009	0.007	0.012	0.010	0.028	0.016	0.019	0.014
WHEELING, WV-OH													
CO	SECOND MAX 8-HOUR	NS	1	6.0	4.0	5.2	7.1	5.6	5.6	4.1	4.6	5.0	3.5
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.12	0.12	0.11	0.11	0.11	0.10	0.11	0.10	0.10	0.11
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	83	81	77	67	66	73	63	65	58
	WEIGHTED ANNUAL MEAN	DOWN	2	—	34	34	30	31	30	29	28	28	28
SO2	ARITHMETIC MEAN	DOWN	3	0.019	0.021	0.021	0.020	0.020	0.018	0.018	0.015	0.010	0.011
	SECOND MAX 24-HOUR	NS	3	0.069	0.072	0.065	0.064	0.074	0.077	0.075	0.065	0.055	0.058
WICHITA FALLS, TX													
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	56	56	56	55	52	62	73	57	50
	WEIGHTED ANNUAL MEAN	DOWN	1	—	27	27	27	27	23	26	27	20	19
WICHITA, KS													
CO	SECOND MAX 8-HOUR	DOWN	3	7.5	7.0	7.9	5.9	5.9	5.6	5.0	4.9	5.2	5.8
LEAD	MAX QUARTERLY MEAN	DOWN	5	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01
OZONE	SECOND DAILY MAX 1-HOUR	NS	2	0.08	0.10	0.07	0.10	0.09	0.08	0.08	0.09	0.10	0.09
PM_{10}	SECOND MAX 24-HOUR	UP	4	—	62	61	63	68	65	83	64	69	72
	WEIGHTED ANNUAL MEAN	NS	4	—	31	30	28	31	32	31	26	27	25
WILLIAMSPORT, PA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.09	0.12	0.08	0.09	0.10	0.09	0.09	0.08	0.09	0.08
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	62	62	60	67	42	58	61	59	46
	WEIGHTED ANNUAL MEAN	NS	1	—	29	29	26	31	24	24	28	28	25
SO2	ARITHMETIC MEAN	NS	1	0.006	0.009	0.007	0.006	0.007	0.007	0.006	0.006	0.006	0.006
	SECOND MAX 24-HOUR	NS	1	0.026	0.035	0.042	0.025	0.025	0.029	0.025	0.042	0.027	0.028
WILMINGTON-NEWARK, DE-MD													
CO	SECOND MAX 8-HOUR	NS	1	4.9	5.3	4.5	5.4	4.0	4.1	3.8	4.3	4.6	3.6
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.14	0.19	0.12	0.14	0.14	0.12	0.14	0.12	0.14	0.11
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	60	84	91	65	52	67	82	73	66
	WEIGHTED ANNUAL MEAN	NS	1	—	32	42	37	33	28	29	38	37	32
SO2	ARITHMETIC MEAN	DOWN	2	0.014	0.016	0.016	0.013	0.012	0.013	0.013	0.012	0.010	0.009
	SECOND MAX 24-HOUR	DOWN	2	0.047	0.054	0.048	0.043	0.033	0.046	0.041	0.044	0.036	0.035

Note: NS = Not Significant (no significant upward or downward trend).

Table A-15. Metropolitan Statistical Area Air Quality Trends, 1987–1996 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
WORCESTER, MA-CT													
CO	SECOND MAX 8-HOUR	NS	1	7.1	5.6	7.9	6.0	7.2	8.0	6.1	5.9	4.2	5.3
NO2	ARITHMETIC MEAN	DOWN	1	0.034	0.029	0.026	0.022	0.023	0.024	0.028	0.025	0.021	0.019
PM_{10}	SECOND MAX 24-HOUR	DOWN	2	—	62	55	48	47	41	43	43	39	42
	WEIGHTED ANNUAL MEAN	DOWN	2	—	27	26	23	21	20	20	20	19	20
SO2	ARITHMETIC MEAN	DOWN	1	0.009	0.009	0.011	0.008	0.009	0.007	0.007	0.008	0.006	0.005
	SECOND MAX 24-HOUR	DOWN	1	0.038	0.042	0.040	0.034	0.029	0.033	0.025	0.024	0.023	0.021
YAKIMA, WA													
CO	SECOND MAX 8-HOUR	DOWN	1	10.9	8.9	8.7	7.4	9.0	8.8	7.9	8.0	7.1	7.4
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	77	77	77	173	67	90	86	50	99
	WEIGHTED ANNUAL MEAN	NS	1	—	34	34	34	44	32	38	31	24	35
YORK, PA													
CO	SECOND MAX 8-HOUR	DOWN	1	4.8	4.2	4.6	4.4	3.7	3.6	3.3	3.9	2.7	2.8
NO2	ARITHMETIC MEAN	DOWN	1	0.025	0.023	0.022	0.022	0.021	0.020	0.022	0.024	0.021	0.021
OZONE	SECOND DAILY MAX 1-HOUR	DOWN	1	0.12	0.14	0.10	0.12	0.11	0.10	0.11	0.12	0.10	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	81	57	63	69	47	77	80	66	51
	WEIGHTED ANNUAL MEAN	NS	1	—	33	31	30	32	27	31	32	30	28
SO2	ARITHMETIC MEAN	NS	1	0.008	0.007	0.008	0.007	0.008	0.007	0.008	0.009	0.006	0.007
	SECOND MAX 24-HOUR	NS	1	0.032	0.029	0.035	0.023	0.020	0.034	0.032	0.041	0.020	0.022
YOUNGSTOWN-WARREN, OH													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.12	0.11	0.10	0.12	0.10	0.10	0.10	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	DOWN	6	—	87	86	78	82	77	74	78	82	58
	WEIGHTED ANNUAL MEAN	DOWN	6	—	37	36	31	34	31	30	31	30	28
SO2	ARITHMETIC MEAN	DOWN	2	0.012	0.014	0.016	0.016	0.016	0.013	0.011	0.011	0.010	0.009
	SECOND MAX 24-HOUR	NS	2	0.058	0.077	0.043	0.053	0.048	0.056	0.063	0.051	0.038	0.044
YUBA CITY, CA													
OZONE	SECOND DAILY MAX 1-HOUR	NS	1	0.11	0.13	0.09	0.11	0.10	0.11	0.13	0.09	0.11	0.10
PM_{10}	SECOND MAX 24-HOUR	NS	1	—	88	88	88	95	75	69	81	114	69
	WEIGHTED ANNUAL MEAN	DOWN	1	—	39	39	39	39	34	30	34	33	29

CO = Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb = Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 ug/m^3)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
PM_{10} = Highest weighted annual mean concentration *(Applicable NAAQS is 50 ug/m^3)*
Data from exceptional events not included.
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 ug/m^3)*
SO_2 = Highest annual mean concentration *(Applicable NAAQS is 0.03 ppm)*
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*

Note: NS = Not Significant (no significant upward or downward trend).

Table A-16. Number of Days with PSI Values Greater Than 100 at Trend Sites, 1987–1996, and All Sites in 1996

Metropolitan Statistical Area	# of Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total # of Sites	PSI > 100 1996
AKRON, OH	5	5	17	4	2	2	1	0	0	1	0	7	0
ALBANY-SCHENECTADY-TROY, NY	7	0	7	0	0	1	0	0	1	0	0	12	0
ALBUQUERQUE, NM	21	26	8	10	7	5	0	1	1	2	0	26	0
ALLENTOWN-BETHLEHEM-EASTON, PA	9	5	16	0	0	3	0	0	1	0	0	11	0
ATLANTA, GA	8	27	21	3	17	6	5	17	4	19	6	16	12
AUSTIN-SAN MARCOS, TX	5	0	2	1	0	1	0	0	1	0	0	6	0
BAKERSFIELD, CA	6	67	87	76	60	65	32	56	47	49	56	20	59
BALTIMORE, MD	15	28	43	9	12	20	5	14	17	14	3	23	4
BATON ROUGE, LA	6	10	10	9	18	6	2	3	2	7	2	13	4
BERGEN-PASSAIC, NJ	8	14	19	4	4	3	0	0	0	4	0	9	0
BIRMINGHAM, AL	16	10	16	1	7	0	2	5	0	15	5	17	5
BOSTON, MA-NH	24	5	15	4	1	4	1	3	1	1	0	28	0
BUFFALO-NIAGARA FALLS, NY	21	4	18	1	2	0	0	0	0	0	0	21	0
CHARLESTON-NORTH CHARLESTON, SC	9	0	0	0	0	1	1	0	0	0	0	9	0
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	10	10	21	3	6	2	0	4	0	1	3	28	6
CHICAGO, IL	44	17	23	4	3	8	7	1	8	4	3	65	4
CINCINNATI, OH-KY-IN	21	11	21	3	6	7	0	1	4	7	1	23	2
CLEVELAND-LORAIN-ELYRIA, OH	24	6	21	4	2	3	2	2	4	4	1	40	5
COLUMBUS, OH	9	1	4	0	1	3	1	0	0	1	0	13	1
DALLAS, TX	8	10	14	7	8	1	3	5	1	13	2	24	6
DAYTON-SPRINGFIELD, OH	11	3	17	3	1	1	0	3	2	2	1	12	1
DENVER, CO	21	37	19	11	9	7	7	3	2	2	1	32	1
DETROIT, MI	28	9	17	10	3	8	1	2	8	11	3	35	3
EL PASO, TX	17	32	16	33	27	13	17	10	10	4	9	21	10
FORT LAUDERDALE, FL	7	0	3	2	0	0	0	0	0	1	0	19	0
FORT WORTH-ARLINGTON, TX	8	4	11	8	5	9	2	1	8	6	3	8	3
FRESNO, CA	8	49	29	47	29	33	27	28	11	19	31	17	39
GARY, IN	18	8	13	1	3	3	2	0	1	4	3	23	3
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	6	5	10	3	2	2	0	1	1	1	3	9	4
GREENSBORO-WINSTON-SALEM-HIGH POINT, NC	10	0	19	5	2	0	0	2	1	0	2	22	2
GREENVILLE-SPARTANBURG-ANDERSON, SC	2	0	8	0	0	0	1	1	0	0	0	8	1
HARRISBURG-LEBANON-CARLISLE, PA	7	5	13	0	2	0	0	1	2	0	0	7	0
HARTFORD, CT	14	20	27	11	7	14	9	9	10	9	1	15	1
HONOLULU, HI	4	0	0	0	0	0	0	0	0	0	0	13	0
HOUSTON, TX	28	67	61	41	59	42	30	26	29	54	28	33	32
INDIANAPOLIS, IN	27	3	9	2	1	1	1	0	2	2	2	33	5
JACKSONVILLE, FL	14	2	2	0	0	0	0	1	0	2	0	19	0
JERSEY CITY, NJ	8	12	18	2	7	8	1	5	1	2	2	10	2
KANSAS CITY, MO-KS	24	6	4	2	2	2	1	2	0	6	3	28	3
KNOXVILLE, TN	13	0	8	0	5	0	0	2	1	4	1	24	1
LAS VEGAS, NV-AZ	7	7	31	46	22	12	5	8	12	7	3	19	13
LITTLE ROCK-NORTH LITTLE ROCK, AR	7	1	0	0	1	0	0	0	0	1	0	8	0
LOS ANGELES-LONG BEACH, CA	36	201	239	226	180	184	185	146	136	103	88	40	89
LOUISVILLE, KY-IN	17	2	20	3	4	4	0	6	4	4	3	27	4
MEMPHIS, TN-AR-MS	12	10	9	5	6	1	2	4	1	7	7	15	8
MIAMI, FL	10	4	5	4	1	2	0	0	0	0	1	12	1
MIDDLESEX-SOMERSET-HUNTERDON, NJ	5	10	24	8	12	8	3	1	5	1	0	7	3
MILWAUKEE-WAUKESHA, WI	17	13	19	8	2	10	0	0	4	5	1	21	1
MINNEAPOLIS-ST. PAUL, MN-WI	23	14	3	7	3	2	1	0	5	3	1	41	1

Table A-16. Number of Days with PSI Values Greater Than 100 at Trend Sites, 1987–1996, and All Sites in 1996 (continued)

Metropolitan Statistical Area	# of Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total # of Sites	PSI > 100 1996
MONMOUTH-OCEAN, NJ	3	0	0	11	7	9	2	6	0	5	2	4	3
NASHVILLE, TN	20	4	23	4	9	1	1	2	3	2	2	27	2
NASSAU-SUFFOLK, NY	4	15	10	6	7	13	2	4	3	5	2	8	2
NEW HAVEN-MERIDEN, CT	11	20	16	7	10	22	3	11	8	8	2	10	2
NEW ORLEANS, LA	10	5	2	1	0	0	1	2	2	3	0	14	1
NEW YORK, NY	26	44	46	18	18	22	4	6	8	8	4	38	7
NEWARK, NJ	13	24	33	5	8	11	5	2	6	6	2	16	2
NORFOLK-VA BEACH-NEWPORT NEWS,VA-NC	11	5	8	0	0	1	2	4	2	0	0	12	0
OAKLAND, CA	19	14	10	3	5	6	2	3	3	12	11	29	11
OKLAHOMA CITY, OK	13	6	0	2	2	0	0	0	2	3	1	14	1
OMAHA, NE-IA	9	0	1	1	0	0	0	1	1	1	1	13	1
ORANGE COUNTY, CA	9	58	63	66	47	40	43	25	14	6	6	11	6
ORLANDO, FL	9	0	0	1	2	0	1	0	0	0	0	16	0
PHILADELPHIA, PA-NJ	37	35	35	19	14	25	3	21	6	14	5	48	22
PHOENIX-MESA, AZ	25	42	27	30	9	4	10	7	9	13	5	29	10
PITTSBURGH, PA	37	10	20	9	8	4	1	3	2	7	0	55	1
PONCE, PR	1	.	0	0	0	0	0	0	0	0	0	1	0
PORTLAND-VANCOUVER, OR-WA	12	11	8	6	8	9	2	0	2	0	4	17	4
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	11	10	9	2	7	11	2	1	2	5	0	20	0
RALEIGH-DURHAM-CHAPEL HILL, NC	4	3	4	4	2	1	1	0	1	0	0	23	0
RICHMOND-PETERSBURG, VA	10	8	20	1	3	4	3	9	1	4	0	11	0
RIVERSIDE-SAN BERNARDINO, CA	36	171	180	178	144	144	156	142	124	113	94	53	94
ROCHESTER, NY	8	1	5	0	1	0	0	0	0	0	0	9	0
SACRAMENTO, CA	12	52	72	57	41	46	21	11	11	16	12	37	17
ST. LOUIS, MO-IL	53	17	20	13	8	6	3	6	11	14	4	61	4
SALT LAKE CITY-OGDEN, UT	18	7	11	15	2	19	10	3	10	1	3	23	6
SAN ANTONIO, TX	7	2	2	0	1	0	0	0	1	3	2	7	2
SAN DIEGO, CA	20	61	84	91	61	40	37	17	16	14	4	27	4
SAN FRANCISCO, CA	9	1	2	1	0	0	0	0	0	1	0	11	0
SAN JOSE, CA	8	18	16	21	11	11	2	2	0	5	2	11	2
SAN JUAN-BAYAMON, PR	10	2	0	0	0	0	0	0	0	0	1	22	1
SCRANTON-WILKES-BARRE-HAZLETON, PA	10	1	12	1	0	2	0	0	0	0	0	11	0
SEATTLE-BELLEVUE-EVERETT, WA	14	14	20	8	5	2	1	0	0	0	0	21	1
SPRINGFIELD, MA	16	3	19	5	4	5	4	7	3	4	1	13	1
SYRACUSE, NY	4	3	1	2	1	2	0	0	0	0	0	10	0
TACOMA, WA	8	9	9	4	3	1	1	0	1	0	0	9	0
TAMPA-ST. PETERSBURG-CLEARWATER, FL	20	5	1	1	3	0	1	0	0	1	2	35	2
TOLEDO, OH	5	2	6	1	0	1	0	3	1	0	0	8	1
TUSCON, AZ	18	4	6	2	0	0	0	0	0	0	0	29	0
TULSA, OK	12	2	2	2	3	2	1	1	2	4	2	13	2
VENTURA, CA	13	54	83	59	36	49	25	16	24	30	25	18	28
WASHINGTON, DC-MD-VA-WV	34	26	37	8	5	16	2	13	7	8	2	52	2
WEST PALM BEACH-BOCA RATON, FL	5	0	0	0	0	0	0	0	0	0	0	9	0
WILMINGTON-NEWARK, DE-MD	5	16	22	3	4	6	2	3	1	6	0	12	1
YOUNGSTOWN-WARREN, OH	9	0	5	1	0	1	1	0	0	1	0	15	0

Table A-17. (Ozone only) Number of Days with PSI Values Greater Than 100 at Trend Sites, 1987–1996, and All Sites in 1996

Metropolitan Statistical Area	# of Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total # of Sites	PSI > 100 1996
AKRON, OH	2	5	17	4	2	2	1	0	0	1	0	2	0
ALBANY-SCHENECTADY-TROY, NY	3	0	7	0	0	1	0	0	1	0	0	3	0
ALBUQUERQUE, NM	7	1	0	0	0	0	0	0	1	0	0	9	0
ALLENTOWN-BETHLEHEM-EASTON, PA	3	5	15	0	0	3	0	0	0	0	0	3	0
ATLANTA, GA	3	27	21	3	17	6	5	17	4	19	6	6	12
AUSTIN-SAN MARCOS, TX	2	0	2	1	0	1	0	0	1	0	0	2	0
BAKERSFIELD, CA	4	67	83	73	57	62	31	56	47	48	56	8	58
BALTIMORE, MD	6	26	40	8	11	20	5	14	16	14	3	8	4
BATON ROUGE, LA	3	10	10	9	18	6	2	3	2	7	2	7	4
BERGEN-PASSAIC, NJ	1	13	18	2	3	3	0	0	0	4	0	1	0
BIRMINGHAM, AL	6	7	15	1	7	0	2	5	0	15	5	6	5
BOSTON, MA-NH	4	4	15	4	1	4	1	3	1	1	0	6	0
BUFFALO-NIAGARA FALLS, NY	2	4	18	1	1	0	0	0	0	0	0	2	0
CHARLESTON-NORTH CHARLESTON, SC	3	0	0	0	0	0	1	0	0	0	0	3	0
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	3	10	21	2	3	2	0	4	0	1	3	7	6
CHICAGO, IL	16	16	22	3	0	7	3	0	2	4	2	22	3
CINCINNATI, OH-KY-IN	6	11	21	3	6	7	0	1	4	7	1	8	2
CLEVELAND-LORAIN-ELYRIA, OH	6	6	21	1	2	3	1	1	2	1	1	8	2
COLUMBUS, OH	2	1	4	0	1	3	0	0	0	1	0	4	1
DALLAS, TX	2	10	14	7	8	1	3	5	1	13	2	7	6
DAYTON-SPRINGFIELD, OH	3	2	17	3	1	1	0	3	2	2	1	4	1
DENVER, CO	5	5	4	0	2	0	0	0	0	0	0	9	0
DETROIT, MI	7	6	16	10	3	8	0	2	6	9	2	8	2
EL PASO, TX	3	17	6	13	9	7	7	4	6	3	3	4	4
FORT LAUDERDALE, FL	2	0	3	2	0	0	0	0	0	1	0	3	0
FORT WORTH-ARLINGTON, TX	2	4	11	8	5	9	2	1	8	6	3	2	3
FRESNO, CA	3	49	28	45	22	32	27	27	11	19	31	7	39
GARY, IN	4	6	13	0	3	3	2	0	1	4	3	4	3
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	2	5	10	3	2	2	0	1	1	1	3	5	4
GREENSBORO—WINSTON-SALEM—HIGH POINT, NC	3	0	14	0	2	0	0	2	1	0	2	6	2
GREENVILLE-SPARTANBURG-ANDERSON, SC	2	0	8	0	0	0	1	1	0	0	0	4	1
HARRISBURG-LEBANON-CARLISLE, PA	3	5	13	0	2	0	0	1	2	0	0	3	0
HARTFORD, CT	3	10	24	9	7	12	8	9	10	7	1	3	1
HONOLULU, HI	1	0	0	0	0	0	0	0	0	0	0	1	0
HOUSTON, TX	10	66	61	41	59	42	30	26	29	54	28	12	32
INDIANAPOLIS, IN	5	3	9	2	1	0	0	0	2	2	2	7	5
JACKSONVILLE, FL	2	2	2	0	0	0	0	1	0	2	0	3	0
JERSEY CITY, NJ	1	12	18	2	7	8	1	5	1	2	2	1	2
KANSAS CITY, MO-KS	6	5	4	1	2	2	1	1	0	6	2	7	2
KNOXVILLE, TN	4	0	8	0	5	0	0	2	1	4	1	8	1
LAS VEGAS, NV-AZ	3	0	3	1	1	0	0	0	0	0	0	4	0
LITTLE ROCK-NORTH LITTLE ROCK, AR	2	1	0	0	1	0	0	0	0	1	0	2	0
LOS ANGELES-LONG BEACH, CA	13	160	178	154	132	134	143	116	107	84	62	15	63
LOUISVILLE, KY-IN	4	2	20	1	4	4	0	6	4	4	3	7	4
MEMPHIS, TN-AR-MS	3	5	8	2	4	0	0	1	0	7	6	4	7
MIAMI, FL	4	4	5	3	1	2	0	0	0	0	1	4	1
MIDDLESEX-SOMERSET-HUNTERDON, NJ	2	10	24	8	12	8	3	1	5	1	0	2	3
MILWAUKEE-WAUKESHA, WI	6	13	19	8	2	10	0	0	4	5	1	9	1
MINNEAPOLIS-ST. PAUL, MN-WI	3	1	1	0	0	0	0	0	0	0	0	5	0

Table A-17. (Ozone only) Number of Days with PSI Values Greater Than 100 at Trend Sites, 1987–1996, and All Sites in 1996 (continued)

Metropolitan Statistical Area	# of Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total # of Sites	PSI > 100 1996
MONMOUTH-OCEAN, NJ	1	0	0	11	7	9	2	6	0	5	2	2	3
NASHVILLE, TN	7	3	23	2	9	1	1	2	3	2	2	9	2
NASSAU-SUFFOLK, NY	1	11	8	6	7	13	2	4	3	5	2	2	2
NEW HAVEN-MERIDEN, CT	2	17	16	7	8	20	3	7	6	8	2	2	2
NEW ORLEANS, LA	5	5	2	1	0	0	1	2	2	3	0	6	1
NEW YORK, NY	4	16	32	12	13	19	3	6	8	7	4	8	7
NEWARK, NJ	3	23	30	4	7	8	5	2	4	6	2	3	2
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS,VA-NC	2	3	7	0	0	1	2	4	2	0	0	3	0
OAKLAND, CA	7	14	10	3	5	5	2	3	3	12	11	9	11
OKLAHOMA CITY, OK	4	1	0	0	2	0	0	0	0	3	0	4	0
OMAHA, NE-IA	3	0	0	0	0	0	0	0	0	0	0	3	0
ORANGE COUNTY, CA	3	54	53	48	43	40	41	25	14	5	6	4	6
ORLANDO, FL	3	0	0	1	2	0	1	0	0	0	0	4	0
PHILADELPHIA, PA-NJ	8	34	35	17	14	25	3	21	5	14	5	10	5
PHOENIX-MESA, AZ	9	2	4	0	3	0	5	5	4	7	5	10	5
PITTSBURGH, PA	6	5	16	2	0	2	0	3	2	6	0	11	1
PONCE, PR	.	.	0	0	0	0	0	0	0	0	0	.	0
PORTLAND-VANCOUVER, OR-WA	3	2	2	0	4	1	2	0	0	0	4	4	4
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	2	10	8	2	7	11	2	1	2	5	0	3	0
RALEIGH-DURHAM-CHAPEL HILL, NC	1	0	0	0	2	0	0	0	1	0	0	8	0
RICHMOND-PETERSBURG, VA	4	7	20	1	3	4	3	9	1	4	0	4	0
RIVERSIDE-SAN BERNARDINO, CA	16	168	179	169	138	141	154	141	123	107	91	20	91
ROCHESTER, NY	2	1	5	0	1	0	0	0	0	0	0	2	0
SACRAMENTO, CA	6	30	49	18	16	30	20	8	11	16	12	14	17
ST. LOUIS, MO-IL	16	14	20	7	8	6	3	6	11	14	4	17	4
SALT LAKE CITY-OGDEN, UT	4	2	8	7	2	1	0	0	1	1	0	6	3
SAN ANTONIO, TX	2	2	2	0	1	0	0	0	1	3	2	2	2
SAN DIEGO, CA	8	60	80	82	60	40	37	17	16	14	4	9	4
SAN FRANCISCO, CA	3	1	0	0	0	0	0	0	0	1	0	3	0
SAN JOSE, CA	4	18	11	6	2	3	2	2	0	5	2	6	2
SAN JUAN-BAYAMON, PR	.	0	0	0	0	0	0	0	0	0	0	.	0
SCRANTON—WILKES-BARRE—HAZLETON, PA	3	1	12	1	0	2	0	0	0	0	0	4	0
SEATTLE-BELLEVUE-EVERETT, WA	1	0	1	0	2	0	0	0	0	0	0	3	1
SPRINGFIELD, MA	4	2	19	5	4	5	3	7	3	3	0	4	0
SYRACUSE, NY	.	0	0	0	0	0	0	0	0	0	0	2	0
TACOMA, WA	1	0	0	0	2	0	0	0	1	0	0	2	0
TAMPA-ST. PETERSBURG-CLEARWATER, FL	5	5	0	1	3	0	1	0	0	1	2	7	2
TOLEDO, OH	2	2	6	1	0	1	0	3	1	0	0	4	1
TUSCON, AZ	5	0	0	0	0	0	0	0	0	0	0	7	0
TULSA, OK	3	1	2	2	3	2	0	1	2	4	2	3	2
VENTURA, CA	6	54	83	59	36	49	25	16	24	30	25	8	28
WASHINGTON, DC-MD-VA-WV	13	21	35	5	5	16	2	13	7	8	2	18	2
WEST PALM BEACH-BOCA RATON, FL	1	0	0	0	0	0	0	0	0	0	0	2	0
WILMINGTON-NEWARK, DE-MD	1	16	22	3	4	6	2	3	1	6	0	4	1
YOUNGSTOWN-WARREN, OH	1	0	5	1	0	1	0	0	0	1	0	3	0

Table A-18. Total Number of Days with PSI Values Greater Than 100 at Trend Sites—Summary, 1987–1996

Metropolitan Statistical Area	# of Trend Sites	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total # of Sites	PSI > 100 1996
						All Pollutants							
All Trend Sites	1,333	1,565	1,987	1,300	1,050	1,043	712	705	635	725	480	1,921	582
LOS ANGELES–LONG BEACH, CA	36	201	239	226	180	184	185	146	136	103	88	40	89
RIVERSIDE–SAN BERNADINO, CA	36	171	180	178	144	144	156	142	124	113	94	53	94
All Except LA and Riverside	1,261	1,193	1,568	896	726	715	371	417	375	509	298	1,828	399
						Ozone Only							
All Trend Sites	380	1,221	1,696	922	849	877	607	636	545	666	429	534	495
LOS ANGELES–LONG BEACH, CA	13	160	178	154	132	134	143	116	107	84	62	15	63
RIVERSIDE–SAN BERNADINO, CA	16	168	179	169	138	141	154	141	123	107	91	20	91
All Except LA and Riverside	351	893	1,339	599	579	602	310	379	315	475	276	499	341

Appendix B

Methodology

Air Quality Data Base

THE AMBIENT AIR quality data presented in Chapter 2 of this report are based on data retrieved from AIRS on July 3, 1997. 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]

In 1996, 4,858 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 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 1996	# of Trend Sites 1987–1996
CO	554	345
Pb	428	208
NO_2	415	214
O_3	1,037	600
PM_{10}	1,734	900
SO_2	690	479
Total	**4,858**	**2,746**

Air quality monitoring sites are selected as national trends sites if they have complete data for at least eight of the 10 years between 1987 and 1996. 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. For the PM_{10} standard which was established in 1987, the trend analyses are based on sites with data in seven of the nine years between 1988 and 1996. 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) is also 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] 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.[4]

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.[5] 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 endpoint rates of change are dampened by the interpolated estimates.

Emissions Estimates Methodology

Trends are presented for annual nationwide emissions of CO, lead, NO_x, VOCs, 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.

Figure B-1. Carbon monoxide monitoring network, 1996.

Figure B-2. Lead monitoring network, 1996.

Figure B-3. Nitrogen dioxide monitoring network, 1996.

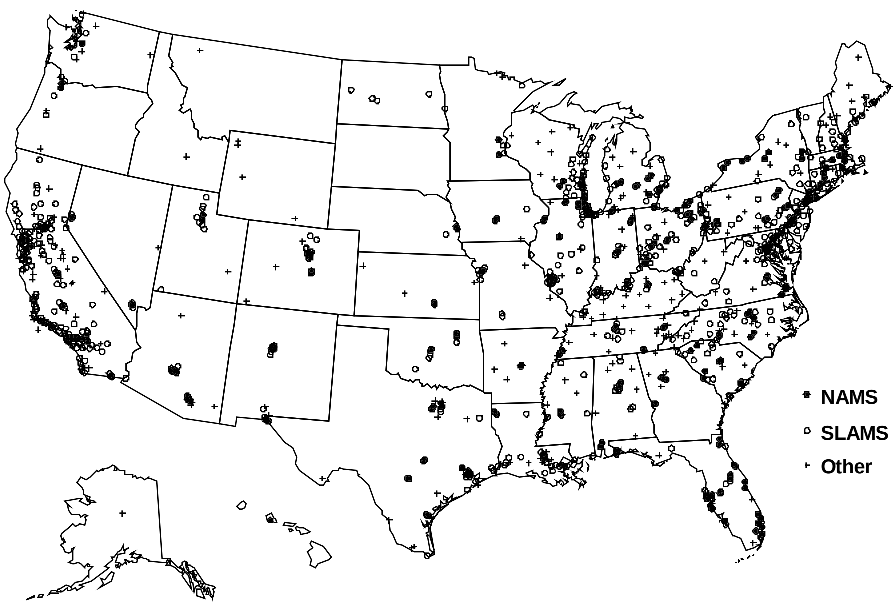


Figure B-4. Ozone monitoring network, 1996.

The emissions estimates presented in this report reflect several major changes in methodologies. 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 1995 and 1996, and state-derived VMT data were applied. The Office of Mobile Sources, U.S. EPA, provided new estimates for non-road diesel, railroad, and spark ignition marine engines, and lead emission estimates from aircraft gasoline consumption were added. Finally, additional improvements were made to the particulate matter fugitive dust categories.

In addition to the changes in methodology affecting most, if not all, 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, construction, and paved roads were included. State-supplied MOBILE model inputs for 1990, 1995, and 1996 were used, as well as state-supplied VMT data for 1990. Rule effectiveness from pre-1990 chemical and allied product emissions was removed. Lead content of unleaded and leaded gasoline for the on-road and non-road 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 1996 for NO_x and SO_2 emissions at major electric utilities.

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 in a companion report, *National Air Pollutant Emission Trends, 1900–1996*.[6]

References

1. *Clean Air Act Ammendments 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. *Ambient Air Quality Surveillance*, 51 FR 9597, March 19, 1986.
5. *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.
6. *National Air Pollutant Emission Trends, 1900–1996*, EPA-454/R-97-011, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1997.

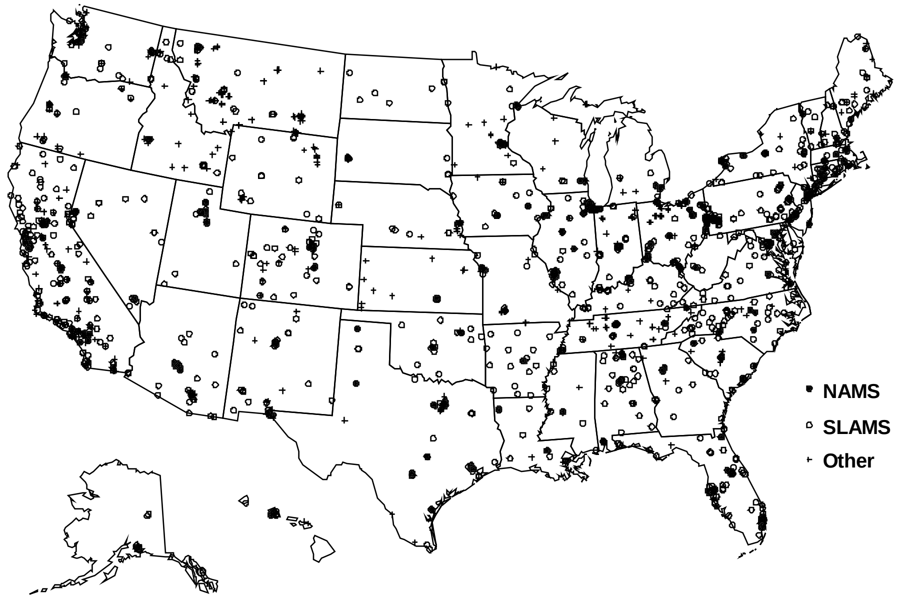


Figure B-5. PM_{10} monitoring network, 1996.

Figure B-6. Sulfur dioxide monitoring network, 1996.