



2002 Air Quality Report

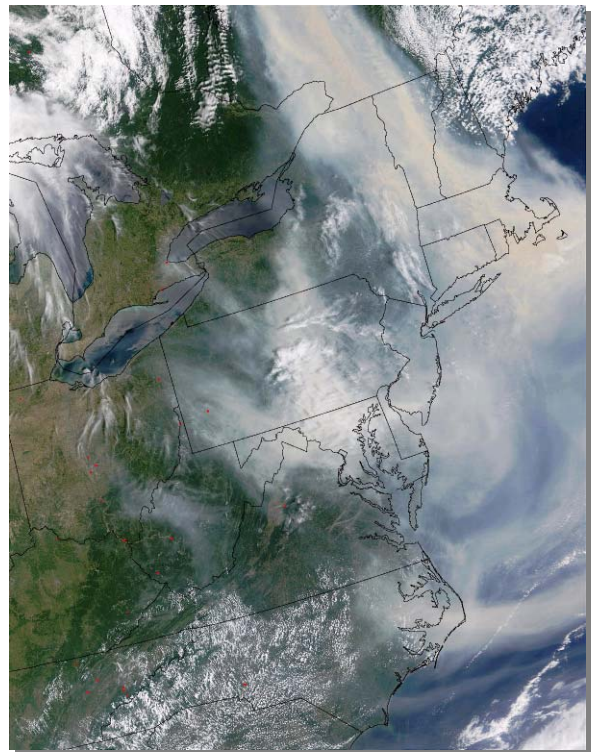
New Jersey Department of Environmental Protection

SUMMARY

A summary of the New Jersey air quality monitoring data for 2002. Contains information on the Air Quality Index (AQI), concentrations of individual pollutants – carbon monoxide, lead, nitrogen oxides, ozone, particulate matter, and sulfur dioxide. Data on acid precipitation, sulfates, nitrates and other constituents of particulate matter, ozone precursors and toxic air contaminants are also provided.



Air Monitoring Shelter



Smoke from Forest Fires Impacts
New Jersey



Visibility Camera in Brigantine National Wildlife Refuge



2002 Air Quality Report

New Jersey Department of Environmental Protection

TABLE OF CONTENTS

	PAGE(S)
INTRODUCTION	
INTRODUCTION	1-2
NETWORK SUMMARY	
NETWORK DESIGN	1
SPATIAL SCALES	1-2
CONTINUOUS NETWORK	2-3
MANUAL NETWORK	4-5
REFERENCES	6
AIR QUALITY INDEX SUMMARY	
WHAT IS THE AIR QUALITY INDEX ?	1-3
2002 AQI SUMMARY	3-5
REFERENCES	6
CARBON MONOXIDE SUMMARY	
NATURE AND SOURCES	1
HEALTH AND ENVIRONMENTAL EFFECTS	1-2
STANDARDS	2
MONITORING LOCATIONS	3
LEVELS IN 2002	3-4
TRENDS	4-5
REFERENCES	6
LEAD SUMMARY	
NATURE AND SOURCES	1
HEALTH AND ENVIRONMENTAL EFFECTS	1
STANDARDS	1
MONITORING LOCATIONS	2
LEVELS IN 2002	2-3
TRENDS	3
REFERENCES	4

NITROGEN DIOXIDE SUMMARY

NATURE AND SOURCES	1
HEALTH AND ENVIRONMENTAL EFFECTS	1
STANDARDS	1-2
MONITORING LOCATIONS	3
LEVELS IN 2002	3
TRENDS	4
TOTAL REACTIVE OXIDES OF NITROGEN	4
REFERENCES	6

OZONE SUMMARY

NATURE AND SOURCES	1
ENVIRONMENTAL EFFECTS	1
HEALTH EFFECTS	2
AMBIENT AIR QUALITY STANDARDS	3
NETWORK	3
DESIGN VALUES	4
HOW CHANGES TO THE OZONE STANDARDS AFFECT AIR QUALITY RATINGS.....	5
MAJOR OZONE EPISODES	6-9
SUMMARY 2002 DATA	
1-HOUR STANDARD	10
8-HOUR STANDARD	11
INFLUENCE OF WEATHER	12
NON-ATTAINMENT AREAS	13
TRENDS	14
REFERENCES	15

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS	1-5
--	-----

PARTICULATE SUMMARY

NATURE AND SOURCES	1
ENVIRONMENTAL EFFECTS	1
HEALTH EFFECTS	2
STANDARDS	2
NETWORK	3
FINE PARTICLE SUMMARY	3-7
FINE PARTICLE SITES	3-4
FINE PARTICLE CONCENTRATION SUMMARY	4-5
PM _{2.5} REAL-TIME MONITORING	6
FINE PARTICLE SPECIATION SUMMARY	7

COARSE PARTICLE SUMMARY	8-9
COARSE PARTICLE MONITORING SITES	8
TSP CONCENTRATION SUMMARY	8
PM ₁₀ CONCENTRATION SUMMARY	8-9
SMOKE SHADE SUMMARY	9-10
SMOKE SHADE MONITORING SITES	9
SMOKE SHADE CONCENTRATION SUMMARY	10
CANADIAN FOREST FIRE EPISODE	10-11
TRENDS	12
REFERENCES	13

SULFUR DIOXIDE SUMMARY

NATURE AND SOURCES	1
HEALTH AND ENVIRONMENTAL EFFECTS	1
STANDARDS	1-2
MONITORING LOCATIONS	3
LEVELS IN 2002	3-4
TRENDS	5
FIVE MINUTE AVERAGE MONITORING	7
REFERENCES	8

AIR TOXICS SUMMARY

INTRODUCTION	1
HEALTH EFFECTS	1
SOURCES	1-2
ESTIMATING EXPOSURE	2-3
MONITORING PROGRAM	4
MONITORING RESULTS FOR 2002	5-16
TRENDS	8
REFERENCES	17

ATMOSPHERIC DEPOSITION SUMMARY

NATURE AND SOURCES	1
MONITORING LOCATIONS	2
SUMMARY OF DATA	3-4
Trends	5

REGIONAL HAZE & VISIBILITY

THE BASICS OF HAZE	1
ANATOMY OF REGIONAL HAZE.....	1
WINTER VS. SUMMER	1
HOW IS HAZE REGULATED?	1

SOURCES	2
ENVIRONMENTAL EFFECTS	3
MONITORING OF HAZE IN NEW JERSEY	4
REFERENCES	5

APPENDIX A – MONITORING SITES

NORTHERN, NEW JERSEY	2-3
CENTRAL, NEW JERSEY	4-5
SOUTHERN, NEW JERSEY	6-7
PARAMETER CODES	8

APPENDIX B – FINE PARTICULATE SPECIATION SUMMERY

FINE PARTICULATE SPECIATION DATA	1-8
--	-----



2002 Air Quality Report

New Jersey Department of Environmental Protection

LIST OF TABLES

	PAGE(S)
NETWORK	
TABLE 1: 2002 - CONTINUOUS AIR MONITORING NETWORK	3
TABLE 2: 2002 - MANUAL AIR MONITORING NETWORK	5
AIR QUALITY INDEX	
TABLE 1: AIR QUALITY INDEX	1
TABLE 2: POLLUTANTS MONITORED ACCORDING TO AIR QUALITY INDEX REPORTING REGION - 2002	2
TABLE 3: AIR QUALITY INDEX EXCEEDANCES OF 100 DURING 2002	4
CARBON MONOXIDE	
TABLE 1: NATIONAL AND NEW JERSEY AMBIENT AIR QUALITY STANDARDS FOR CARBON MONOXIDE	2
TABLE 2: CARBON MONOXIDE DATA – 2002	4
LEAD	
TABLE 1: NATIONAL AND NEW JERSEY AMBIENT AIR QUALITY STANDARDS FOR LEAD	1
TABLE 2: LEAD DATA - 2002	3
NITROGEN DIOXIDE	
TABLE 1: NATIONAL AND NEW JERSEY AIR QUALITY STANDARDS FOR NITROGEN DIOXIDE	2
TABLE 2: NITROGEN DIOXIDE & NITRIC OXIDE DATA – 2002.....	3
OZONE	
TABLE 1: NATIONAL AND NEW JERSEY AMBIENT AIR QUALITY STANDARDS FOR OZONE	1
TABLE 3: OZONE DATA – 2002, 1-HOUR AVERAGE	10
TABLE 4: OZONE DATA – 2002, 8-HOUR AVERAGE	11

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

TABLE 1: SUMMARY OF PHOTOCHEMICAL ASSESSMENT MONITORING DATA	4-5
TABLE 2: CAMDEN LAB – PAMS CARBONYLS	5

PARTICULATE

TABLE 1: NATIONAL AND NEW JERSEY AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER	2
TABLE 2: PM _{2.5} SUMMARY DATA – 2002	5
TABLE 3: 2002 SUMMARY OF CONTINUOUS PM _{2.5} DATA	6
TABLE 4: PM ₁₀ DATA – 2002, 24-HOUR AND ANNUAL AVERAGES	8
TABLE 5: SMOKE SHADE – 2002	10

SULFUR DIOXIDE

TABLE 1: NATIONAL AND NEW JERSEY AMBIENT AIR QUALITY STANDARDS FOR SULFUR DIOXIDE	2
TABLE 2: SULFUR DIOXIDE DATA – 2002, 3-HOUR AND ANNUAL AVERAGES ...	3
TABLE 3: SULFUR DIOXIDE DATA – 2002, 24-HOUR AND DAILY AVERAGES ...	4

AIR TOXICS

TABLE 1: AIR TOXICS OF GREATEST CONCERN IN NEW JERSEY BASED ON 1996 NATIONAL AIR TOXICS ASSESSMENT	3
TABLE 2: COMPARISON OF NATA PREDICTED TO MEASURED LEVELS IN CAMDEN, NJ	5
TABLE 3: NEW JERSEY AIR TOXICS SUMMARY – 2002	6-8
TABLE 4: AIR TOXICS DATA – 2002 CAMDEN, NEW JERSEY	9-10
TABLE 5: AIR TOXICS DATA – 2002 CHESTER, NEW JERSEY	11-12
TABLE 6: AIR TOXICS DATA – 2002 ELIZABETH, NEW JERSEY	13-14
TABLE 7: AIR TOXICS DATA – 2002 NEW BRUNSWICK, NEW JERSEY	15-16

ATMOSPHERIC DEPOSITION

TABLE 1: ACID PRECIPITATION MONITORING NETWORK – 2002, ANNUAL AND SEASONAL AVERAGES	3-4
TABLE 2: ACID DEPOSITION PARTICULATE MATTER – 2002	4

APPENDIX A – 2002 AIR MONITORING SITES

TABLE 1: NORTHERN NEW JERSEY AIR MONITORING SITES	3
TABLE 2: CENTRAL NEW JERSEY AIR MONITORING SITES	5
TABLE 3: SOUTHERN NEW JERSEY AIR MONITORING SITES	7
TABLE 4: PARAMETER CODES	8

APPENDIX B – FINE PARTICULATE SPECIATION SUMMARY – 2002

TABLE 1: FINE PARTICULATE SPECIATION DATA – 2002 CAMDEN, NEW JERSEY	1-2
TABLE 2: FINE PARTICULATE SPECIATION DATA – 2002 CHESTER, NEW JERSEY	3-4
TABLE 3: FINE PARTICULATE SPECIATION DATA – 2002 ELIZABETH LAB, NEW JERSEY	5-6
TABLE 4: FINE PARTICULATE SPECIATION DATA – 2002 NEW BRUNSWICK, NEW JERSEY	7-8



2002 Air Quality Report

New Jersey Department of Environmental Protection

LIST OF FIGURES

	PAGE(S)
NETWORK	
FIGURE 1: AMBIENT AIR MONITORING TRAILER LOCATED AT ELIZABETH LAB ..	1
FIGURE 2: 2002 – CONTINUOUS MONITORING NETWORK	2
FIGURE 3: 2002 – MANUAL MONITORING NETWORK	4
AIR QUALITY INDEX	
FIGURE 1: AIR QUALITY INDEX REGIONS	1
FIGURE 2: EXAMPLES OF NJDEP’S AIR MONITORING WEBSITE	3
FIGURE 3: AIR QUALITY SUMMARY BY DAYS	3
FIGURE 4: 2002 AIR QUALITY INDEX SUMMARY, NUMBER OF DAYS BY REPORTING REGION	5
CARBON MONOXIDE	
FIGURE 1: NATIONAL SUMMARY OF 2002 CO EMISSIONS BY SOURCE CATEGORY	1
FIGURE 2: EFFECTS OF ATMOSPHERIC INVERSION ON AIR POLLUTION	1
FIGURE 3: CARBON MONOXIDE CONCENTRATIONS – NEW JERSEY 1967-1999	2
FIGURE 4: 2002 CARBON MONOXIDE MONITORING NETWORK	3
FIGURE 5: HIGHEST AND 2 ND HIGHEST 8-HOUR AVERAGES OF CARBON MONOXIDE IN NEW JERSEY - 2002	3
FIGURE 6: CARBON MONOXIDE UNHEALTHY DAYS 1985 – 2002	5
FIGURE 7: CARBON MONOXIDE AIR QUALITY, 1975-2002, 2 ND HIGHEST 8-HOUR AVERAGE	5
LEAD	
FIGURE 1: NEW JERSEY’S SUMMARY OF 2002, LEAD EMISSIONS BY SOURCE CATEGORY	1
FIGURE 2: 2002 LEAD MONITORING NETWORK	2
FIGURE 3: LEAD CONCENTRATIONS IN NEW JERSEY MAXIMUM QUARTERLY AVERAGE - 2002	2
FIGURE 4: LEAD CONCENTRATIONS IN NEW JERSEY, 1991-2002, MAXIMUM QUARTERLY AVERAGES	3

NITROGEN DIOXIDE

FIGURE 1:	NATIONAL SUMMARY OF 2002 NO _x BY SOURCE CATEGORY	1
FIGURE 2:	NITROGEN DIOXIDE AND NITRIC OXIDE CONCENTRATION – NEW JERSEY, 1967-1999	2
FIGURE 3:	2002 OXIDES OF NITROGEN MONITORING NETWORK	3
FIGURE 4:	ANNUAL AVERAGE NO AND NO ₂ CONCENTRATIONS IN NEW JERSEY -2002	4
FIGURE 5:	NITROGEN DIOXIDE CONCENTRATIONS IN NEW JERSEY , 1975-2002, 12-MONTH (CALENDAR YEAR) AVERAGE	5

OZONE

FIGURE 1:	GOOD AND BAD OZONE	1
FIGURE 2:	OZONE DAMAGE TO BLACKBERRY BUSH	1
FIGURE 3:	OZONE DAMAGE TO SASSAFRAS TREE	1
FIGURE 4:	AREA OF THE RESPIRATORY TRACT THAT MAY BE AFFECTED BY OZONE	2
FIGURE 5:	2002 OZONE MONITORING NETWORK	3
FIGURE 6:	OZONE AIR QUALITY, 1986-2002 (8-HOUR OZONE STANDARD) ...	4
FIGURE 7:	OZONE AIR QUALITY, 1986-2002 (1-HOUR OZONE STANDARD) ...	4
FIGURE 8:	DAYS ON WHICH THE OLD OZONE STANDARD (1-HOUR) WAS EXCEEDED IN NEW JERSEY 1988-2002	5
FIGURE 9:	DAYS ON WHICH THE CURRENT OZONE STANDARD (8-HOUR) WAS EXCEEDED IN NEW JERSEY 1988-2002	5
FIGURE 10:	MAP OF OZONE LEVELS FOR JUNE 24, 2002	6
FIGURE 11:	SATELLITE VIEW OF SMOKE FROM THE CANADIAN FIRE EVENT.....	7
FIGURE 12:	MAP OF OZONE LEVELS FOR JULY 9, 2004	7
FIGURE 13:	MAP OF OZONE LEVELS FOR AUGUST 13, 2002	8
FIGURE 14:	HIGHEST AND SECOND HIGHEST DAILY 1-HOUR AVERAGES	10
FIGURE 15:	OZONE DESIGN VALUE FOR 2000-2002 (8-HOUR VALUE)	11
FIGURE 16:	NUMBER OF DAYS 1-HOUR OZONE STANDARD WAS EXCEEDED AND NUMBER OF DAYS ABOVE 90 DEGREES, NEW JERSEY 1981-2002	12
FIGURE 17:	OZONE NON-ATTAINMENT AREAS IN NEW JERSEY	13
FIGURE 18:	OZONE CONCENTRATIONS IN NEW JERSEY 1975-2002 SECOND HIGHEST 1-HOUR AVERAGE	14

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

FIGURE 1:	PAMS NETWORK DESIGN	1
FIGURE 2:	REGIONAL PAMS SITES	1
FIGURE 3:	PHILADELPHIA REGION, TOTAL NON-METHANE ORGANIC CARBON SEASONAL AVERAGE 1995-2002	2
FIGURE 4:	NEW YORK CITY REGION, TOTAL NON-METHANE ORGANIC CARBON SEASONAL AVERAGE 1995-2002	3

PARTICULATE

FIGURE 1:	SIZE OF PM _{2.5} PARTICLE COMPARED TO A HUMAN HAIR	1
FIGURE 2:	VISIBILITY WEBCAM	1
FIGURE 3:	2002 PM _{2.5} MONITORING NETWORK	3
FIGURE 4:	2002 FINE PARTICULATE CONCENTRATIONS	4
FIGURE 5:	MAXIMUM DAILY FINE PARTICULATE AIR QUALITY INDEX (AQI)	6
FIGURE 6:	2002 AVERAGE FINE PARTICULATE ANALYTE CONCENTRATIONS ..	7
FIGURE 7:	2002 PM ₁₀ MONITORING NETWORK	8
FIGURE 8:	SUMMARY OF PM ₁₀ CONCENTRATIONS, NEW JERSEY 2002	9
FIGURE 9:	2002 SMOKE SHADE MONITORING NETWORK	9
FIGURE 10:	SPECIATED PM _{2.5} PARTICLES AT CAMDEN LAB NEW JERSEY 7/7/2 (CANDIAN FOREST FIRE)	10
FIGURE 11:	SPECIATED FINE PARTICLES AT CAMDEN LAB NEW JERSEY 2002	10
FIGURE 12:	HOURLY PM _{2.5} DATA FROM FOREST FIRE EPISODE	11
FIGURE 13:	LONG TERM TREND IN PARTICULATE LEVELS 1970-2002	12

SULFUR DIOXIDE

FIGURE 1:	NATIONAL SUMMARY OF 2002 SO ₂ EMISSIONS BY SOURCE CATEGORY	1
FIGURE 2:	SULFUR DIOXIDE CONCENTRATION – NEW JERSEY 1967-1999	2
FIGURE 3:	2002 SULFUR DIOXIDE MONITORING NETWORK	3
FIGURE 4:	HIGHEST AND 2 ND HIGHEST DAILY AVERAGES OF SO ₂ IN NEW JERSEY - 2002	4
FIGURE 5:	SULFUR DIOXIDE CONCENTRATIONS IN NEW JERSEY 1975-2002 SECOND HIGHEST DAILY AVERAGES	5
FIGURE 6:	SULFUR DIOXIDE NON-ATTAINMENT AREAS IN NEW JERSEY	6

AIR TOXICS

FIGURE 1:	1996 AIR TOXICS EMISSIONS ESTIMATES FOR NEW JERSEY	1
FIGURE 2:	ESTIMATED AIR TOXICS EMISSIONS FOR NEW JERSEY, BY COUNTY BASED ON USEPA'S 1996 AIR TOXICS INVENTORY	2
FIGURE 3:	NATA PREDICTED CONCENTRATIONS IN NEW JERSEY FOR 1996 ..	2
FIGURE 4:	2002 AIR TOXICS MONITORING NETWORK	4
FIGURE 5:	AIR TOXICS LEVELS MEASURED IN 1996 AT CAMDEN, NEW JERSEY COMPARED TO NATA PREDICTED LEVELS	4
FIGURE 6:	SELECTED TOXIC VOLATILE ORGANICS 2002 ANNUAL AVERAGES NEW JERSEY	6
FIGURE 7:	ANNUAL AVERAGES FOR SELECTED HAPS AT CAMDEN LAB FROM 1990-2002	8

ATMOSPHERIC DEPOSITION

FIGURE 1: SOURCES OF DEPOSITION	1
FIGURE 2: ACID PRECIPITATION MONITORING NETWORK – 2002	2
FIGURE 3: SULFATE AND NITRATE MONITORING NETWORK – 2002	2
FIGURE 4: TREND IN SULFATE DEPOSITION IN PRECIPITATION AT WASHINGTON CROSSING STATE PARK, NEW JERSEY, 1990-2002: ANNUAL LOADING	5

REGIONAL HAZE & VISIBILITY

FIGURE 1: CONTRIBUTORS TO VISIBILITY IMPAIRMENT	1
FIGURE 2: BRIGANTINE WILDERNESS AREA, SEASONAL ANALYSIS OF VISIBILITY IMPAIRMENT	1
FIGURE 3: COMPOSITION OF FINE PARTICLES IN BRIGANTINE, NJ	2
FIGURE 4: ILLUSTRATES HOW SULFATES AND NITRATES ENTER THE ECOSYSTEM BY WAY OF DEPOSITION	3
FIGURE 5: VISIBILITY CAMERA – NEW JERSEY TRANSIT BUILDING (MANHATTAN SKYLINE – CLEAR DAY)	4
FIGURE 6: VISIBILITY CAMERA – NEW JERSEY TRANSIT BUILDING (MANHATTAN SKYLINE – HAZY DAY)	
FIGURE 7: VISIBILITY CAMERA – BRIGANTINE NATIONAL WILDLIFE REFUGE (CLEAR DAY)	4
FIGURE 8: VISIBILITY CAMERA – BRIGANTINE NATIONAL WILDLIFE REFUGE (HAZY DAY)	4

APPENDIX A – 2002 AIR MONITORING SITES

FIGURE 1: NORTHERN NEW JERSEY AIR MONITORING SITES	2
FIGURE 2: CENTRAL NEW JERSEY AIR MONITORING SITES	4
FIGURE 3: SOUTHERN NEW JERSEY AIR MONITORING SITES	6

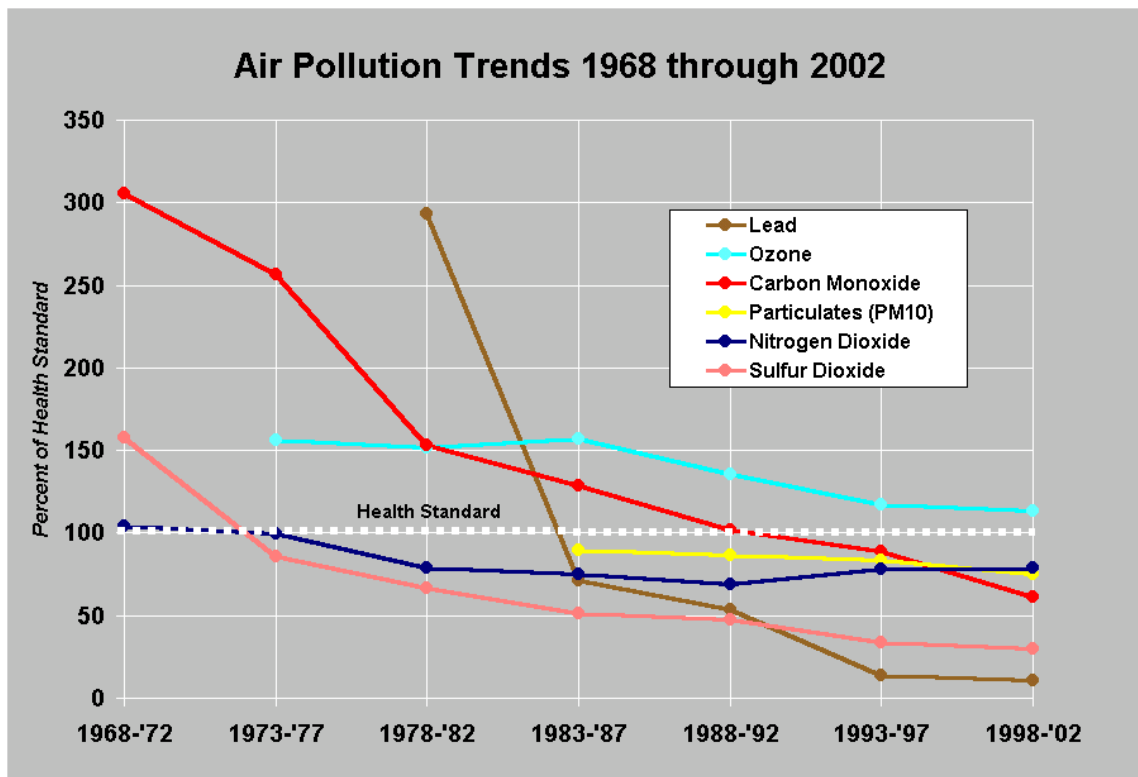


2002 Introduction

New Jersey Department of Environmental Protection

INTRODUCTION

Air Quality in New Jersey has significantly improved since the passage of the Clean Air Act in 1970. As the chart below indicates, New Jersey is now in compliance with all National Ambient Air Quality Standards (NAAQS), except for ozone. These improvements are the result of aggressive pollution control programs implemented in New Jersey as well as regional emission reduction strategies involving other states.



But air quality problems do remain in the state. Ozone continues to be a significant problem in the summer months, and has been found to have serious health effects at lower levels than previously thought. The United States Environmental Protection Agency (USEPA) revised the NAAQS for ozone in 1997 to account for this new health information. Although the standard changes were challenged, the courts eventually upheld them. If the new standards for ozone are to be met, additional emission reduction strategies will have to be implemented.

At the same time the USEPA revised the standards for ozone, they promulgated a new standard for fine particles. Fine particles are defined as particles less than 2.5 micrometers in diameter and are referred to as PM2.5. These small particles have been found to have a greater impact on public health than larger particles, which were the focus of the previous standards. Early data collected on PM2.5 levels in New Jersey presented in this report indicate that fine particles are likely to be a problem in some areas of the state.

In addition to ozone and PM2.5, there is increasing concern about a class of air pollutants termed "air toxics". These pollutants include substances known to cause cancer or other serious health problems. The list of potential air toxics is very large and includes many different types of compounds from heavy metals to toxic volatile organic compounds such as benzene. New Jersey is using the results of an EPA air toxics study and other information to address this complex problem. More comprehensive monitoring of air toxics in New Jersey is being implemented and data from that program is presented in this report.

Questions or comments concerning this report can be made by e-mailing us at bamweb@dep.state.nj.us, by phone at (609) 292-0138 or by writing to us at:

New Jersey Department of Environmental Protection
Bureau of Air Monitoring
P. O. Box 418
Trenton, New Jersey 08625



2002 Network Summary

Department of Environmental Protection

NETWORK DESIGN

In 2002, the Bureau of Air Monitoring maintained 47 Ambient Air Monitoring Sites in New Jersey. These monitoring sites are designed to fulfill the following monitoring objectives for federal and state regulated pollutants: to measure maximum pollutant concentrations, to assess population exposure, to determine the impact of major pollution sources, to measure background levels, to determine the extent of regional pollutant transport, and to measure secondary impacts in rural areas. In addition, monitoring data is provided to various public and media outlets and are used to provide hourly updates on air quality to the Bureau's web page at www.state.nj.us/dep/airmon. The Air Monitoring Sites can be divided into two primary networks: the Continuous Monitoring Network and the Manual Sampling Network.

SPATIAL SCALES

There are many factors and constraints which affect the design of a monitoring network. Most importantly, a network design should consider pollutant characteristics, topographical features, and resource limitations when evaluating whether data collected at a particular site can meet monitoring objectives. To assist in designing an effective air monitoring network, the United States Environmental Protection Agency (USEPA) developed the concept of spatial scales of representativeness. The spatial scales define prospective sites in terms of the area surrounding a monitor where the pollutant concentrations are relatively similar. For each monitoring objective, appropriate spatial scales can be used to identify the general physical location of a suitable monitoring site. The list of various spatial scales are defined below:

Micro-scale (10 – 100m): Monitors that show significant concentration differences from as little as 10 meters or up to 50 meters away from the monitor are classified being



Figure 1: Ambient air monitoring trailer located at the Elizabeth Lab site

Micro-scale monitors. This often occurs when monitors are located right next to low-level emission sources, such as busy roadways, construction sites, and facilities with short stacks. These locations are in areas where the general public is exposed to the concentrations measured.

Middle Scale (100 – 1000m): These monitors show pollutant measurement variations between locations that are approximately 1 kilometer apart. These differences may occur near large industrial areas with many different operations or near large construction sites. Zones of representation for middle scale monitors are often source oriented. Monitoring measurements of this type might be appropriate for the evaluation of short-term exposure to an emission source.

Neighborhood scale (1 – 10km): Neighborhood scale monitors do not show significant differences in pollutant concentrations with spacing of a few kilometers. A particular scale location can represent not only the immediate neighborhood but also neighborhoods of the same type in other parts of the city. Neighborhood scale monitors provide good data for trend analysis studies and compliance with National Ambient Air Quality Standards (NAAQS) because their zone of representation are often found in areas where people commonly reside.

Urban Scale (10 – 100km): Urban scale monitors show consistency among pollutant measurements with monitor separations of at least 10 kilometers. Urban scale sites are usually located at higher elevations and away from highly traveled roads, and industries. These locations are ideal for evaluating concentrations over an entire metropolitan and/or rural area.

Regional scale (100 – 1000km): Regional scale (background monitors) show consistency among measurements for monitor separations of a few hundred kilometers. These monitors are best located in rural areas away from local sources, and at higher elevations. National parks, national wilderness areas, and many state and county parks and reserves are appropriate areas for regional scale sites. Data gathered at this scale location is most useful in assessing pollutant concentrations in a large area and evaluating transport emissions.

THE CONTINUOUS MONITORING NETWORK

The Continuous Monitoring Network consists of automated sites which measure carbon monoxide (CO), oxides of nitrogen (NO_x), ozone (O₃), sulfur dioxide (SO₂), particulate matter, and meteorological data (not all pollutants are measured at all sites). The data is transmitted to a centralized computer system in Trenton, New Jersey, once every minute, thus providing near real-time data. A map showing the location of the continuous monitoring sites is shown in Figure 2 and the parameters recorded at each site are displayed in Table 1 (page 3). Many of these locations are also part of the Manual Monitoring network, which is described in the next section.

Figure 2
2002 – Continuous Monitoring Network

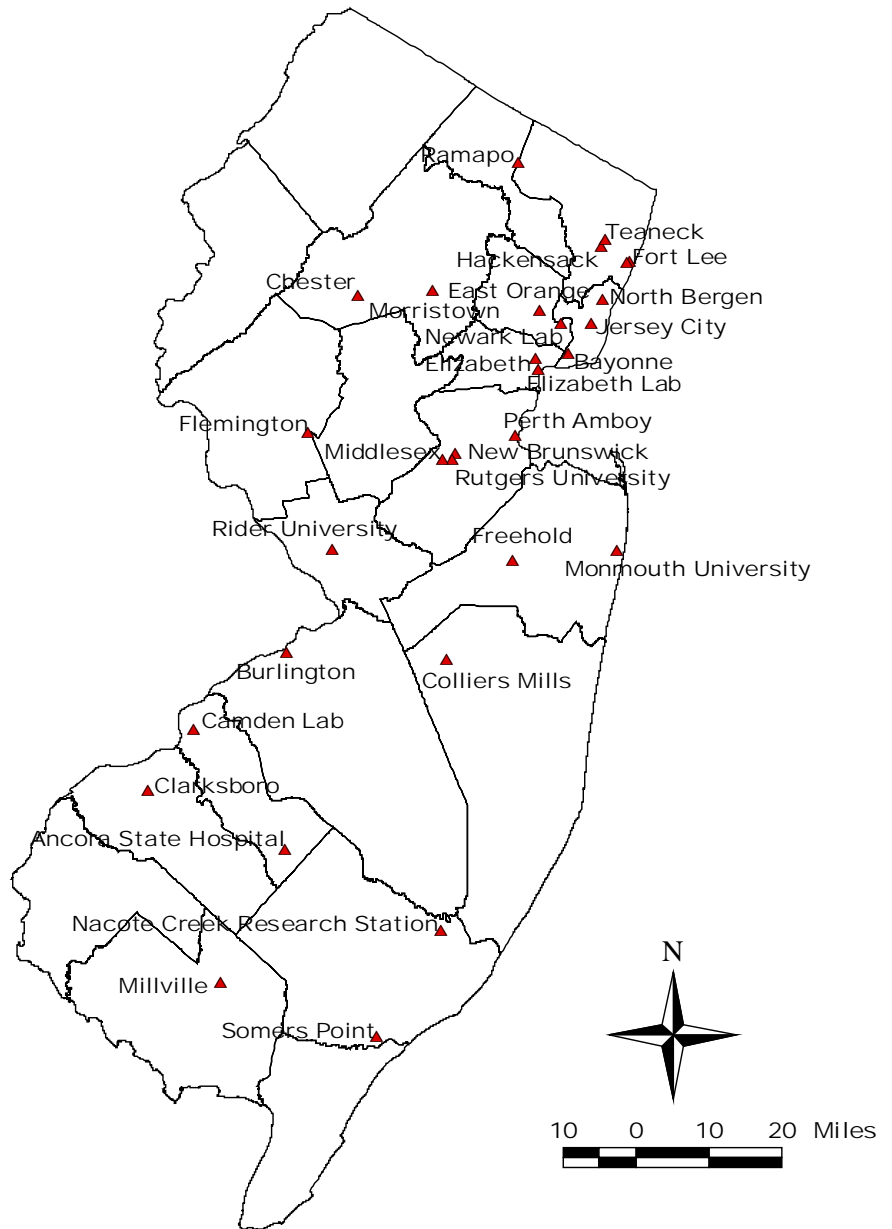


Table 1
2002 - Continuous Air Monitoring Network

Continuous Parameter Codes

- | | | | |
|-----------------------|-------------------------------------|-------------|---|
| CO | - Carbon Monoxide | SS | - Smoke Shade |
| NO_x | - Nitrogen Dioxide and Nitric Oxide | TEOM | - Continuous PM _{2.5} Analyzer |
| O₃ | - Ozone | MET | - Meteorological Parameters |
| SO₂ | - Sulfur Dioxide | | |

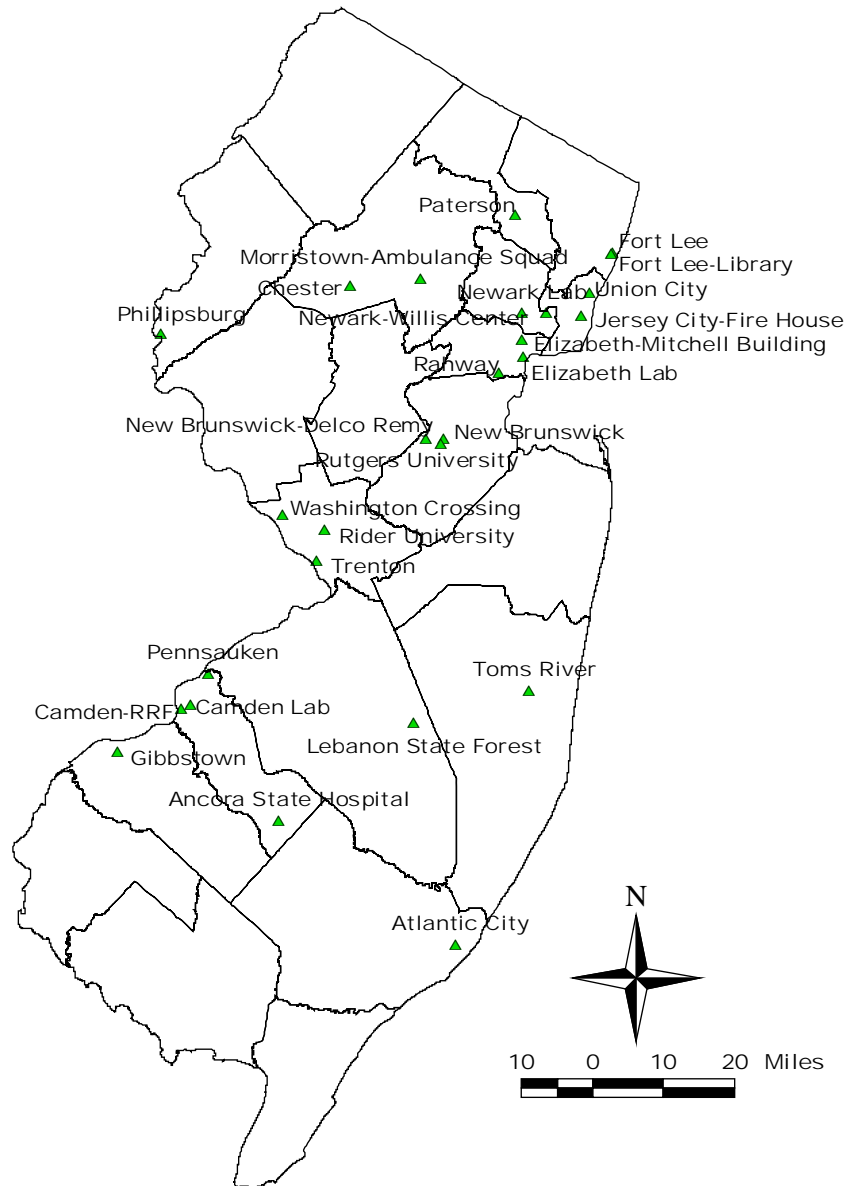
SITE	CO	NO _x	O ₃	SO ₂	SS	TEOM	MET
Ancora State Hospital	U		U	U			
Bayonne		U	N	N			
Burlington	Mi			N	N		
Camden Lab	N	N	U	N	N	N	U
Chester		U	U	U			U
Clarksboro			U	U			
Colliers Mills			U				
East Orange	N	N					U
Elizabeth	Mi			M	N		
Elizabeth Lab	N	N		N	N	N	U
Flemington			U		N		U
Fort Lee	M					M	
Freehold	Mi				N		
Hackensack	N			N	N		
Jersey City	Mi			N	N		
Middlesex	N						
Millville		N	N	N			
Monmouth University			N				
Morristown	Mi				N		
Nacote Creek Research Station			U	U			
Newark Lab	N	N	N	N	N	N	
New Brunswick						N	
North Bergen	Mi						
Perth Amboy	N			N	N		
Ramapo			U				
Rider University		N	N				U
Rutgers University		N	N				U
Somers Point		N		N			
Teaneck		N	N				
TOTAL	15	11	15	15	11	5	7

Spatial Scale codes: Mi - **Micro**, M - **Middle**, N - **Neighborhood**, U - **Urban**, R - **Regional**

MANUAL MONITORING NETWORK

The Manual Monitoring Network does not transmit data in near real-time as does the Continuous Monitoring Network. The manual network consists primarily of equipment that collects samples for subsequent analysis in a laboratory. The network provides data on fine particulates (particles smaller than 2.5 micrometers in diameter or PM_{2.5}), inhalable particulates (PM₁₀), lead (Pb), several parameters associated with atmospheric deposition, pollutants important in the formation of ground level ozone (ozone precursors), and numerous organic compounds that are considered toxic pollutants. Sites that measure ozone precursors are part of the national Photochemical Assessment Monitoring Station (PAMS) program. While some ozone precursors are automatically measured every hour, the data are usually only retrieved once a day. A map of the manual sampling sites is shown in Figure 3 and a list of the pollutants measured at each location is shown in Table 2 (page 5).

Figure 3
2002 – Manual Monitoring Network



**Table 2
2002 - Manual Air Monitoring Network**

Manual Parameter Codes

- | | |
|---|---|
| PM_{2.5} - FRM (Federal Reference Method) Manual PM _{2.5} Sampler | PAMS - Photochemical Assessment Monitoring Station (Ozone Precursors) |
| PM₁₀ - FRM Manual PM ₁₀ Sampler | CARB - Carbonyls |
| Pb - Particulates Analyzed for Lead | VOCs - Volatile Organic Compounds |
| TSP - Total Suspended Particulates | SVOCs - Semi-Volatile Organic Compounds |
| PM_{2.5} Spec - PM _{2.5} Speciation Trends Network Sampler | Acid Deposition - Dry - Nitrates and Sulfates in PM ₁₀
Wet - Acidity (pH scale) in precipitation |

SITE	PM _{2.5}	PM ₁₀	Pb	TSP	PM _{2.5} Spec	PAMS	CARB	VOCs	SVOCs	Acid Deposition	
										Dry	Wet
Ancora State Hospital											U
Atlantic City	N	N									
Camden Lab	N	N			N	N	N	N	N	N	
Camden-RRF		M									
Chester	U				U		U	U	U		
Elizabeth Lab	N	N			N		N	N	N	N	
Elizabeth-Mitchell Building	N										
Fort Lee		M								M	
Fort Lee-Library	N										
Gibbstown	N										
Jersey City-Firehouse	N	N									
Lebanon State Forest											U
Morristown-Ambulance Squad	N										
New Brunswick	N				N		N	N	N		
New Brunswick-Delco Remy			Mi	Mi							
Newark Lab	N	N									
Newark-Willis Center	N										
Paterson	N										
Pennsauken	N										
Phillipsburg	N										
Rahway	N										
Rider University						N					
Rutgers University						N					
Toms River	N										
Trenton	N	N									
Union City	N										
Washington Crossing	N										U
TOTAL	20	8	1	1	4	3	4	4	4	3	3

Spatial Scale codes: Mi - Micro, M - Middle, N - Neighborhood, U - Urban, R - Regional

REFERENCES

Ball, R. J. and G. E. Andersen, *Optimum Site Exposure Criteria for Sulfur Dioxide Monitoring*, EPA-450/3-77-013, The Center for the Environment and Man, Inc., Hartford, CT, Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1977

Ludwig, F. L. and J. H. S. Kealoha, *Selecting Sites for Carbon Monoxide Monitoring*, EPA-450/3-75-077, Stanford Research Institute, Menlo Park, CA. Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1975.

Ludwig, F. L. and E. Shelar, *Site Selection for the Monitoring of Photochemical Air Pollutants*, EPA-450/3-78-013, Stanford Research Institute, Menlo Park, CA, Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1978.

Network Design for State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and Photochemical Assessment Monitoring Stations (PAMS), 40 CFR 58 Appendix D, US Government Printing Office, Washington DC, July 1997.

Pelton, D. J. and R. C. Koch, *Optimum Sampling Exposure Criteria for Lead*, EPA-450/4-84-012, GEOMET Technologies, Inc., Rockville, MD, Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, February 1984.

Watson, J. G., et. al., *Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}* , EPA-454/R-99-022, Desert Research Institute, University and Community College System of Nevada, Reno, NV. Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1997.



2002 Air Quality Index Summary

New Jersey Department of Environmental Protection

WHAT IS THE AIR QUALITY INDEX (AQI)?

The Air Quality Index (AQI) is a national air quality rating system based on the National Ambient Air Quality Standards (NAAQS). Generally, an index value of 100 is equal to the primary, or health based, NAAQS for each pollutant. This allows for a direct comparison of each of the pollutants used in the AQI (carbon monoxide, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide). The AQI rating for a reporting region is equal to the highest rating recorded for any pollutant within that region. In an effort to make the AQI easier to understand, a descriptive rating, and a color code, based on the numerical rating are used (see Table 1).

For more information on the AQI, visit EPA's web site at www.epa.gov/airnow/aqibroch.

Table 1
Air Quality Index

Numerical AQI Rating	Descriptive Rating	AQI Color Code
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151-200	Unhealthy	Red
200-300	Very Unhealthy	Purple

Each weekday morning an air quality summary for the previous day, and a forecast are prepared using the AQI format. These are provided to the Associated Press wire service, the New York Times, and to participating radio and television stations. Each afternoon, an air quality update, which includes the current air quality information and a forecast for the following day, is issued to various newspapers. An extended forecast consisting of the

expected descriptor ratings over the next 72-hour period is also provided for each reporting region on weekdays. A telephone recording of the AQI forecast is taped by 11 a.m., Monday-Friday, and can be heard by dialing **1-800-782-0160**.

For purposes of reporting the AQI, the state is divided into 9 regions (see Figure 1). Table 2 shows the monitoring sites and parameters used in each reporting region to calculate the AQI values.

Figure 1
Air Quality Index Regions

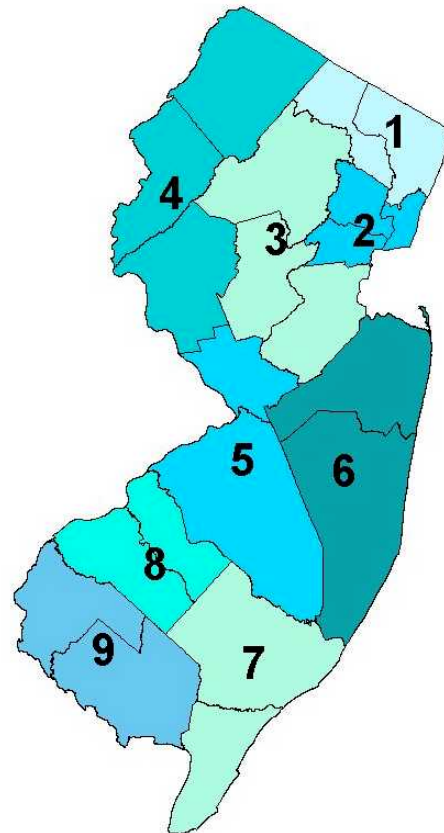


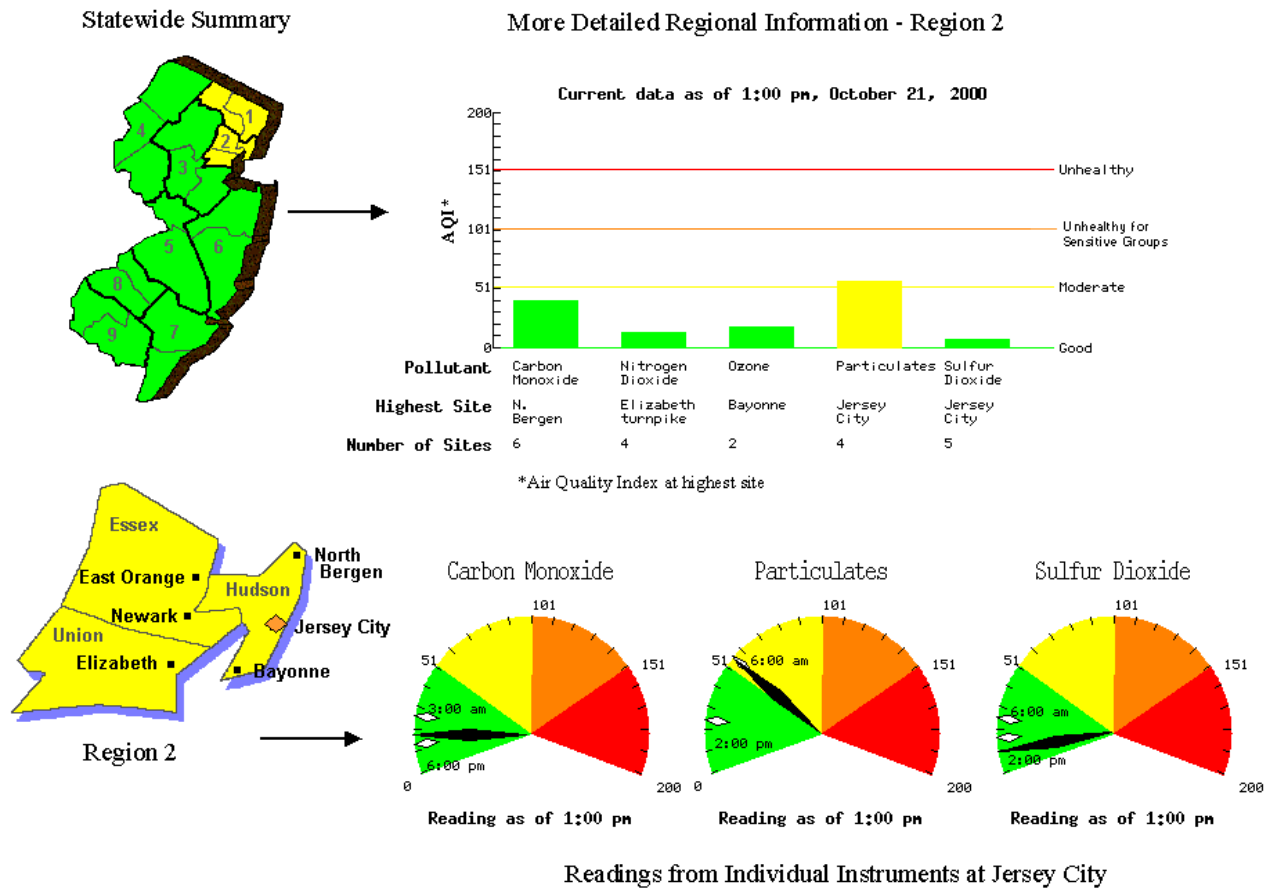
Table 2
Pollutants Monitored According to Air Quality Index Reporting Region - 2002

CO - Carbon Monoxide O₃ - Ozone
SO₂ - Sulfur Dioxide NO₂ - Nitrogen Dioxide
PM - Particulate Matter

Reporting Region	Monitoring Site	CO	SO ₂	PM	O ₃	NO ₂
1. Northern Metropolitan	Fort Lee	X	---	X	---	---
	Hackensack	X	X	X	---	---
	Ramapo	---	---	---	X	---
	Teaneck	---	---	---	X	X
2. Southern Metropolitan	Bayonne	---	X	---	X	X
	East Orange	X	---	---	---	X
	Elizabeth	X	X	X	---	---
	Elizabeth Lab	X	X	X	---	X
	Jersey City	X	X	X	---	---
	Newark Lab	X	X	X	X	X
	North Bergen	X	---	---	---	---
3. Suburban	Chester	---	X	---	X	X
	Middlesex	X	---	---	---	---
	Morristown	X	---	X	---	---
	New Brunswick	---	---	X	---	---
	Perth Amboy	X	X	X	---	---
	Rutgers University	---	---	---	X	X
4. Northern Delaware Valley	Flemington	---	---	X	X	---
5. Central Delaware Valley	Burlington	X	X	X	---	---
	Rider University	---	---	---	X	X
6. Northern Coastal	Colliers Mills	---	---	---	X	---
	Freehold	X	---	X	---	---
	Monmouth University	---	---	---	X	---
7. Southern Coastal	Nacote Creek R. S.	---	X	---	X	---
	Somers Point	---	X	---	---	X
8. Southern Delaware Valley	Ancora State Hospital	X	X	X	X	---
	Camden Lab	X	X	X	X	X
	Clarksboro	---	X	---	X	---
9. Delaware Bay	Millville	---	X	---	X	X

Along with the forecast, cautionary statements are provided for days when the air quality is expected to be unhealthy. A weekday ozone forecast map, introduced during the 1996 ozone season, is televised on New Jersey Network's (NJN) TV News Broadcast. After the ozone season, an air quality forecast map is substituted. A web page was also created in 1996 to show current air quality levels. This page can be accessed at the following internet address: <http://www.state.nj.us/dep/airmon>. Some examples of the air quality information available on our web site are shown below:

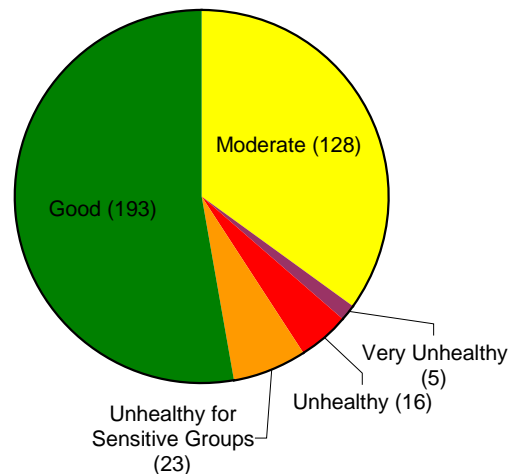
Figure 2
Examples of NJDEP's Air Monitoring Website



2002 AQI SUMMARY

A summary of the AQI ratings for New Jersey in 2002 is presented in the pie chart to the right. In 2002 there were 193 "Good" days, 128 were "Moderate", 23 were rated "Unhealthy for Sensitive Groups", 16 were considered "Unhealthy", and 5 were rated "Very Unhealthy". This indicates that air quality in New Jersey is considered good or moderate most of the time, but that pollution is still bad enough to adversely affect some people on about one day in ten. Table 3 lists the dates when the AQI exceeded the "Unhealthy for Sensitive Groups" threshold at any monitoring location and shows which pollutant(s) were in that range or higher. The map that follows shows the AQI ratings for the year broken down by AQI region.

Figure 3
Air Quality Summary by Days



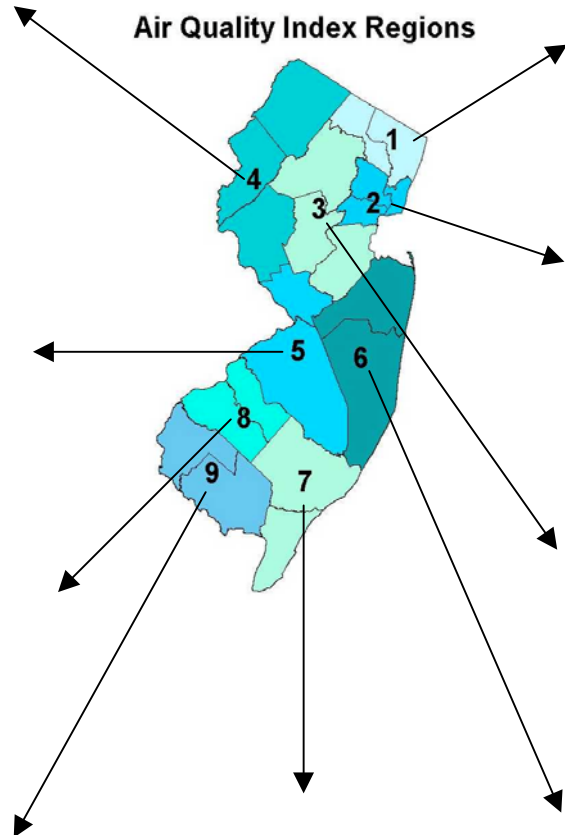
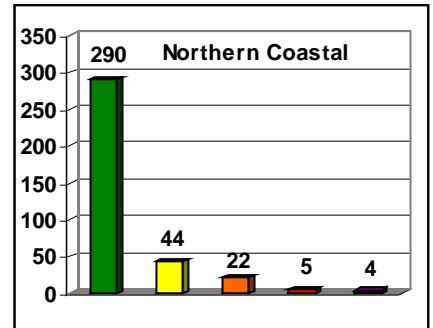
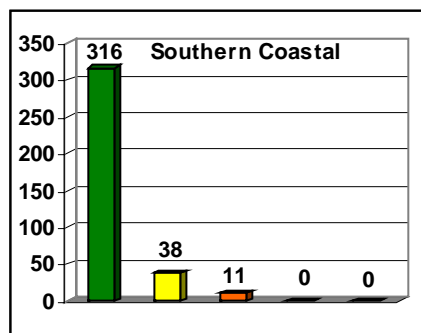
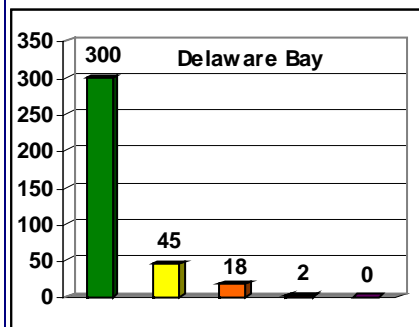
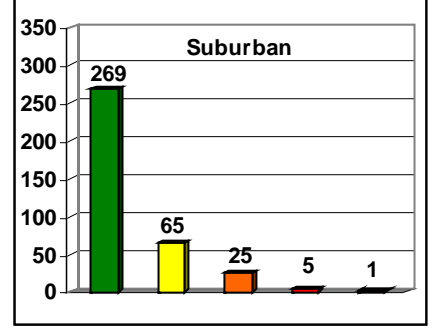
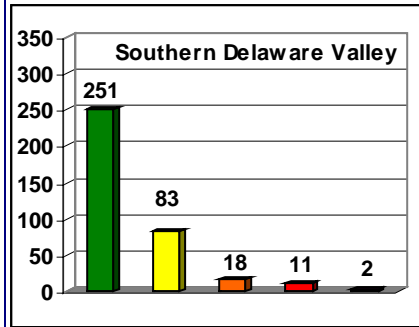
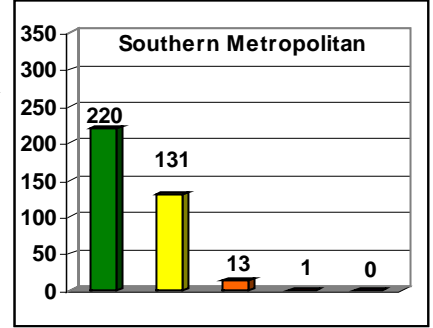
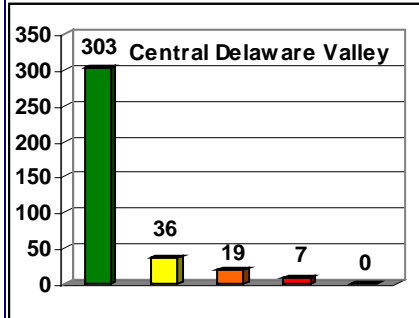
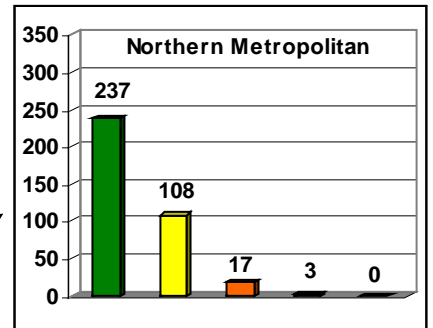
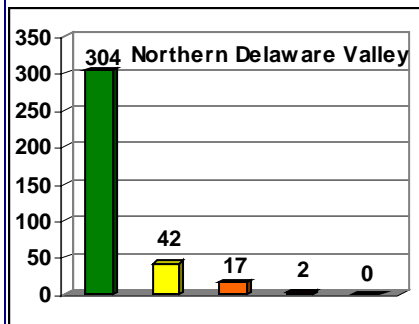
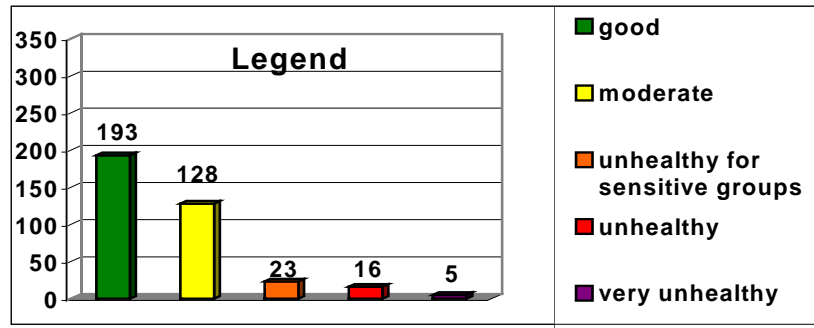
**Table 3
Air Quality Index (AQI) Exceedances of 100 During 2002**

	<u>Ratings</u>		<u>Pollutants</u>
USG	- Unhealthy for Sensitive Groups	PM	- Fine Particle Matter
UH	- Unhealthy	O ₃	- Ozone
VUH	- Very Unhealthy		

Date	Highest Location	Highest AQI Value	Highest Pollutant	Highest Rating	Pollutant(s) with AQI above 100 *	
May 24	Colliers Mills	122	O ₃	USG	O ₃ (7)	
June 05	Chester	119	O ₃	USG	O ₃ (1)	
June 11	Camden Lab	166	O ₃	UH	O ₃ (11)	PM(2)
June 12	Ancora State Hospital	132	O ₃	USG	O ₃ (5)	
June 20	Rutgers University	124	O ₃	USG	O ₃ (5)	
June 21	Flemington	111	O ₃	USG	O ₃ (1)	
June 22	Colliers Mills	156	O ₃	UH	O ₃ (10)	
June 23	Colliers Mills	135	O ₃	USG	O ₃ (9)	
June 24	Ancora State Hospital	150	O ₃	USG	O ₃ (7)	
June 25	Clarksboro	161	O ₃	UH	O ₃ (9)	PM(1)
June 26	Rutgers University	116	O ₃	USG	O ₃ (4)	
"	Elizabeth Lab	116	PM	USG		PM(2)
July 01	Rider University	132	O ₃	USG	O ₃ (10)	
July 02	Colliers Mills	201	O ₃	VUH	O ₃ (12)	PM(3)
July 03	Ancora State Hospital	151	O ₃	UH	O ₃ (7)	
July 07	Camden Lab	169	PM	UH	O ₃ (2)	PM(4)
July 08	Colliers Mills	202	O ₃	VUH	O ₃ (15)	PM(4)
July 09	Colliers Mills	206	O ₃	VUH	O ₃ (15)	PM(4)
July 13	Flemington	101	O ₃	USG	O ₃ (1)	
July 15	Colliers Mills	111	O ₃	USG	O ₃ (2)	
July 17	Colliers Mills	179	O ₃	UH	O ₃ (8)	
July 18	Ancora State Hospital	169	O ₃	UH	O ₃ (14)	PM(3)
July 19	Clarksboro	154	O ₃	UH	O ₃ (9)	PM(3)
July 22	Chester	137	O ₃	USG	O ₃ (7)	
July 23	Teaneck	129	O ₃	USG	O ₃ (5)	
July 28	Rider University	106	O ₃	USG	O ₃ (1)	
July 29	Ancora State Hospital	116	O ₃	USG	O ₃ (3)	PM(1)
July 31	Ancora State Hospital	114	O ₃	USG	O ₃ (2)	
August 01	Colliers Mills	174	O ₃	UH	O ₃ (6)	
August 02	Camden Lab	179	O ₃	UH	O ₃ (12)	
August 03	Camden Lab	129	O ₃	USG	O ₃ (5)	
August 04	Rider University	177	O ₃	UH	O ₃ (8)	
August 05	Ancora State Hospital	124	O ₃	USG	O ₃ (3)	
August 10	Rider University	151	O ₃	UH	O ₃ (8)	
August 11	Rider University	164	O ₃	UH	O ₃ (9)	
August 12	Chester	203	O ₃	VUH	O ₃ (11)	
August 13	Colliers Mills	201	O ₃	VUH	O ₃ (15)	PM(3)
August 17	Monmouth University	127	O ₃	USG	O ₃ (2)	
August 19	Colliers Mills	135	O ₃	USG	O ₃ (4)	
August 22	Chester	104	O ₃	USG	O ₃ (1)	
Sept. 08	Chester	151	O ₃	UH	O ₃ (4)	
Sept. 09	Colliers Mills	137	O ₃	USG	O ₃ (7)	
Sept. 10	Chester	159	O ₃	UH	O ₃ (1)	

* Number in parentheses () indicates number of monitoring sites exceeding 100 on given day

Figure 4
 2002 Air Quality Index Summary
 Number of Days by Reporting Region



References

Air Quality Index, A Guide to Air Quality and Your Health, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 2000, EPA-454/R-00-005, URL: www.epa.gov/airnow/aqi_cl.pdf

Guideline for Reporting of Daily Air Quality - Air Quality Index (AQI), USEPA, Office of Air Quality Planning and Standards, July 1999, EPA-454/R-99-010, URL: www.epa.gov/ttn/oarpg/t1/memoranda/rg701.pdf

Air Quality Index Reporting, Final Rule: Title 40, Part 58, Code of Federal Regulations, August 4, 1999. URL: http://www.epa.gov/ttn/oarpg/t1/fr_notices/airqual.pdf

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/oar/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2001, URL: www.epa.gov/oar/aqtrnd00/



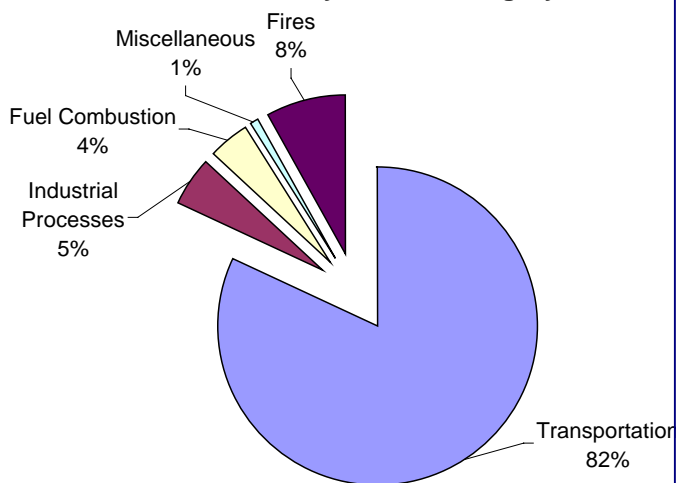
2002 Carbon Monoxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a by-product of motor vehicle exhaust, which contributes over 50 percent of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions, and high CO levels often coincide with morning and afternoon rush hours (Figure 3). Non-road engines and vehicles, such as construction equipment and boats, are also significant sources of CO and overall the transportation sector is responsible for about 82% of all CO emissions nationally. Other sources of CO include industrial processes, fuel combustion in sources such as boilers and incinerators, and natural sources such as forest fires. Figure 1 shows the national average contributions of these sources.

**Figure 1
National Summary of 2002
CO Emissions by Source Category**

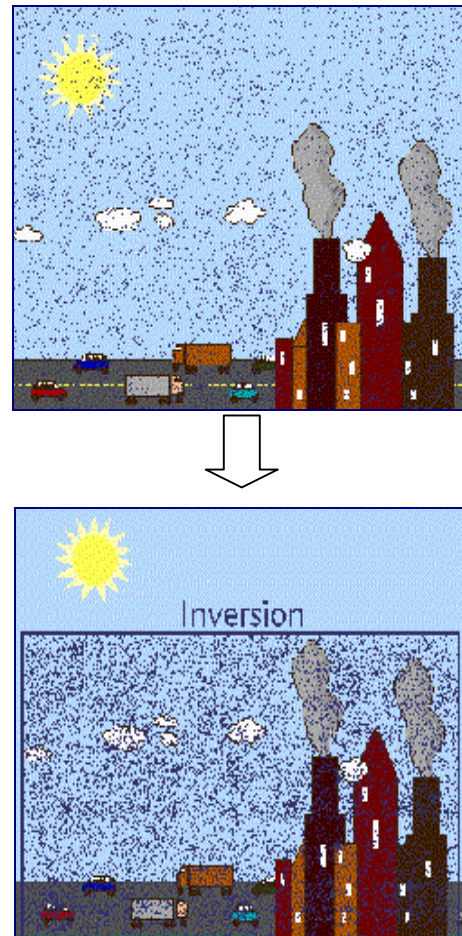


Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

Figure 3 (page 2) also shows that CO levels are typically higher in the winter. This is because motor vehicles do not burn fuel as efficiently when they are cold. Atmospheric inversions are also more frequent during the winter months. Inversions usually occur overnight when cooler air is trapped beneath a layer of warmer air aloft. When this occurs, the

inversion acts like a lid, preventing pollution from mixing in the atmosphere and effectively trapping it close to ground level (see Figure 2).

Figure 2: Effect of Atmospheric Inversion on Air Pollution



HEALTH AND ENVIRONMENTAL EFFECTS

Carbon monoxide enters the bloodstream and reduces the body's ability to distribute oxygen to organs and tissues. The most common symptoms associated with exposure to carbon monoxide are headaches and nausea. The health threat from exposure to CO is most serious for those who suffer from cardiovascular disease. For a person with

heart disease, a single exposure to CO at low levels may cause chest pain and reduce that individual's ability to exercise. Healthy people are also affected, but only at higher levels of exposure. Elevated CO levels are also associated with visual impairment, reduced work capacity, reduced manual dexterity, decreased learning ability, and difficulty in performing complex tasks.

New Jersey state standards for CO are based on different units (milligrams per cubic meter as opposed to parts per million), and our standards are not to be exceeded more than once in any 12-month period. The state has set secondary (welfare based) standards for CO at the same level as the primary standards. The standards are summarized in Table 1.

STANDARDS

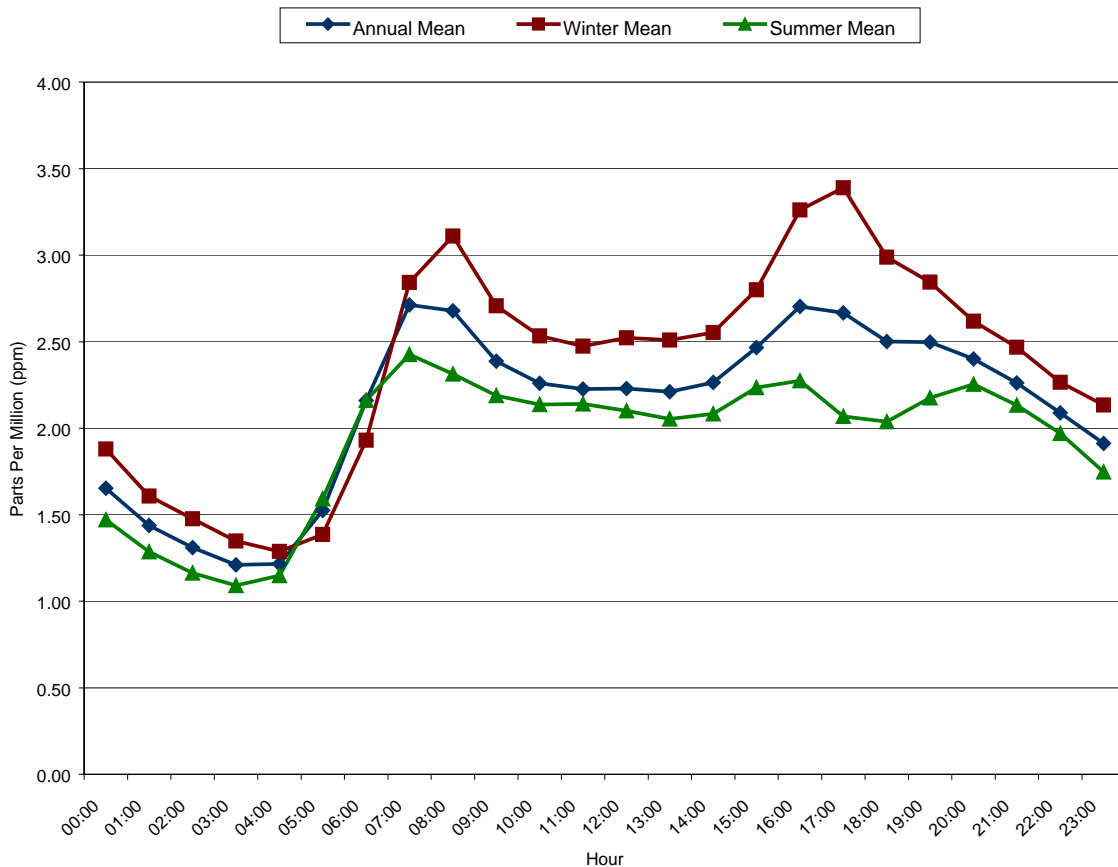
There are currently two national primary, or health based, standards for carbon monoxide. They are set at a one-hour concentration of 35 parts per million (ppm), and an 8-hour average concentration of 9 ppm. These levels are not to be exceeded more than once in any calendar year. There are no national secondary (welfare based) standards for CO at this time.

Table 1
National and New Jersey Ambient Air Quality Standards for Carbon Monoxide

mg/m³ = Milligrams Per Cubic Meter
ppm = Parts per Million

Averaging Period	Type	New Jersey	National
1-Hour	Primary	40 mg/m ³ (35 ppm)	35 ppm
1-Hour	Secondary	40 mg/m ³ (35 ppm)	----
8-Hour	Primary	10 mg/m ³ (9 ppm)	9 ppm
8-Hour	Secondary	10 mg/m ³ (9 ppm)	----

Figure 3
Carbon Monoxide Concentrations – New Jersey
1967-1999
Seasonal and Hourly Variations



MONITORING LOCATIONS

The state monitored CO levels at 15 locations in 2002. These sites are shown in the map in Figure 4. The site in Fort Lee did not operate between June 22nd and September 8th due to site relocation. The Middlesex site was shutdown on January 31st and the North Bergen site was shut down on July 2nd.

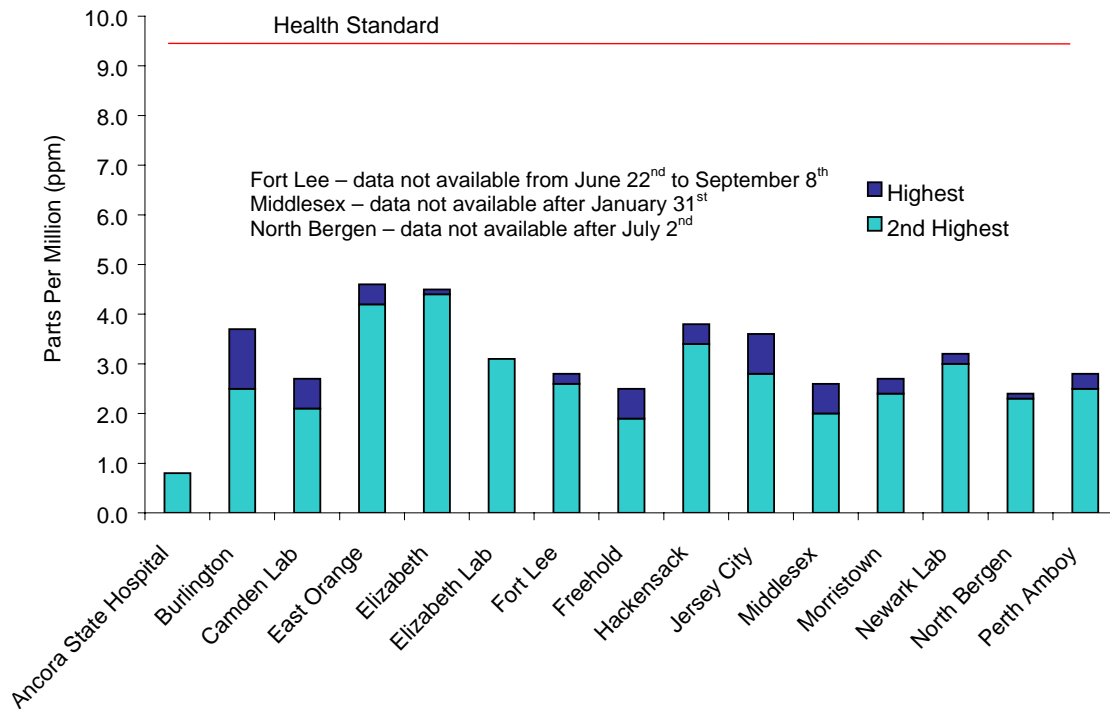
CO LEVELS IN 2002

None of the monitoring sites recorded exceedances of any CO standard during 2002. The maximum one-hour average concentration recorded was 7.6 ppm at the site in Burlington. The highest 8-hour average level recorded was 4.6 ppm, at the East Orange site. Summaries of the 2002 data are provided in Figure 5 and Table 2 (page 4).

Figure 4
2002 Carbon Monoxide
Monitoring Network



Figure 5
Highest and 2nd Highest 8-Hour Averages
of Carbon Monoxide in New Jersey - 2002



**Table 2
Carbon Monoxide Data – 2002
1-Hour and 8-Hour Averages**

1-hour standard = 35 ppm
8-hour standard = 9 ppm

Parts Per Million (ppm)

Monitoring Sites	Maximum 1-Hour Average	2nd Highest 1-Hour Average	Maximum 8-Hour Average	2nd Highest 8-Hour Average
Ancora State Hospital	1.3	1.2	0.8	0.8
Burlington	7.6	7.6	3.7	2.5
Camden Lab	4.5	3.8	2.7	2.1
East Orange	6.0	5.6	4.6	4.2
Elizabeth	6.5	6.4	4.5	4.4
Elizabeth Lab	5.0	4.9	3.1	3.1
Fort Lee ¹	3.5	3.4	2.8	2.6
Freehold	4.5	4.2	2.5	1.9
Hackensack	4.6	4.2	3.8	3.4
Jersey City	4.5	4.4	3.6	2.8
Middlesex ²	3.5	3.3	2.6	2.0
Morristown	5.2	4.9	2.7	2.4
Newark Lab	4.2	4.1	3.2	3.0
North Bergen ³	3.5	3.1	2.4	2.3
Perth Amboy	4.3	3.7	2.8	2.5

¹ Data not available from June 22nd to September 8th

² Data not available after January 31st

³ Data not available after July 2nd

Trends

Carbon monoxide levels have improved dramatically over the past 20 years. The last time the CO standard was exceeded in New Jersey was in January of 1995 (see Figure 6, page 5), and the entire state was officially declared as having attained the CO standard on August 23, 2002. At one time unhealthy levels of CO were recorded on a regular basis – as much as a hundred days a year at some sites. The reduction in CO levels is due primarily to cleaner running cars which are by far the largest source of this pollutant. A trend graph of CO levels showing the maximum, minimum and average 8-hour concentrations recorded since 1975 is provided in Figure 7 (page 5). The graph depicts the second highest 8-hour value recorded, as this is the value that determines if the health standard is being met (one exceedance per site is allowed each year).

Figure 6
Carbon Monoxide
Unhealthy Days 1985-2002

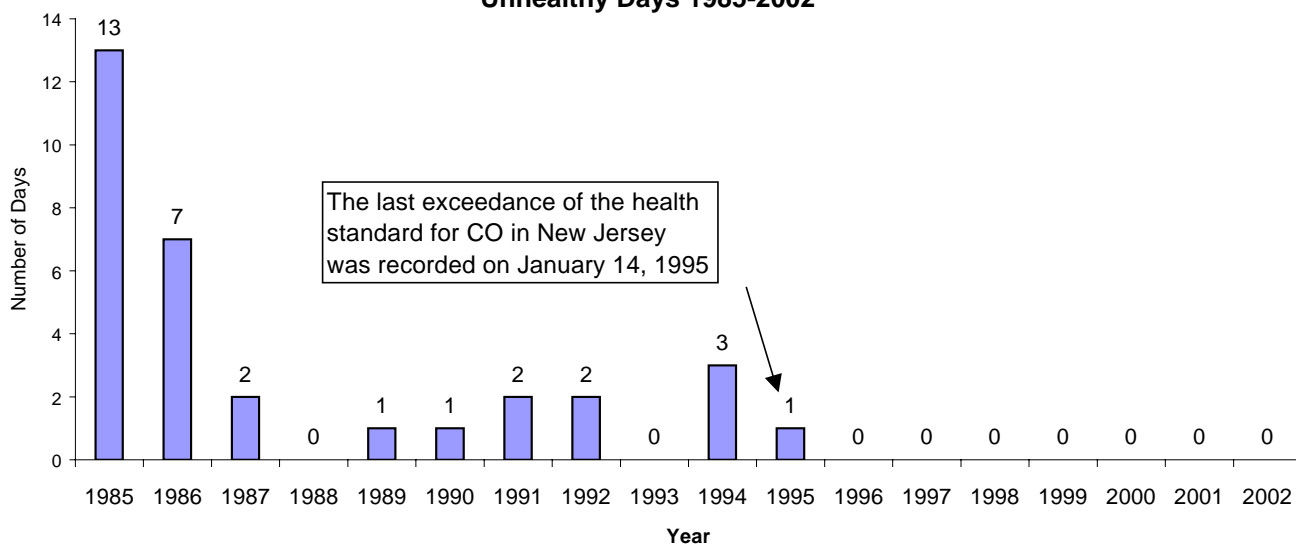
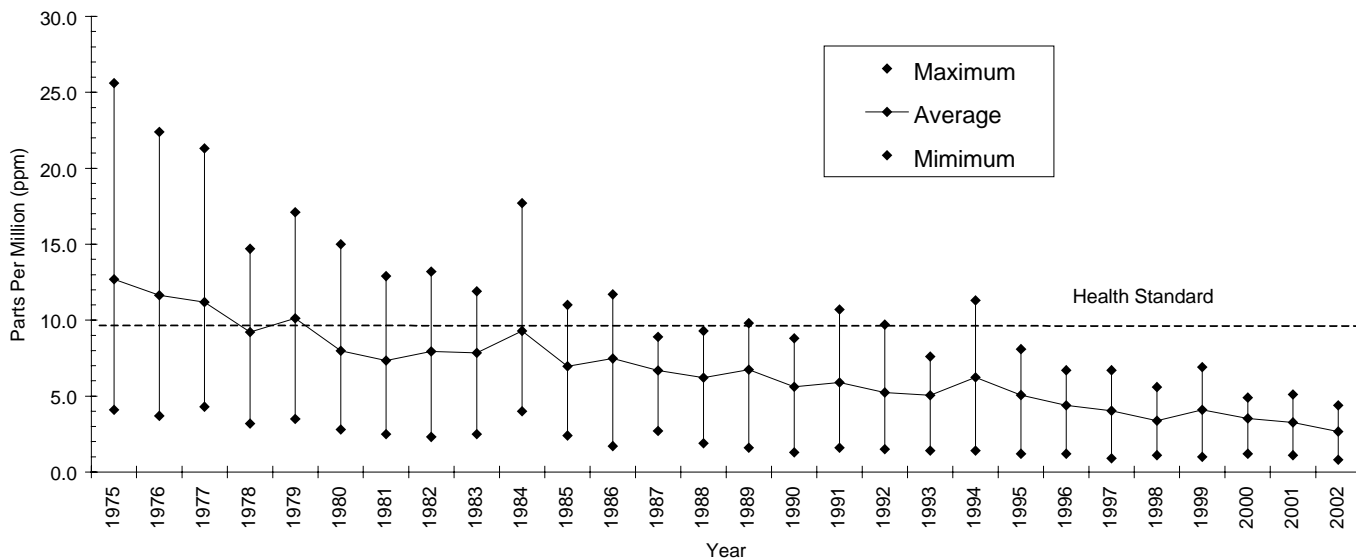


Figure 7
Carbon Monoxide Air Quality, 1975-2002
2nd Highest 8-Hour Average



REFERENCES

CO – How Carbon Monoxide Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC November 2000, URL: <http://www.epa.gov/air/urbanair/co/index.html>

Automobiles and Carbon Monoxide, OMS Fact Sheet, USEPA, January 1993, EPA-400/F-92-005, URL: <http://www.epa.gov/oms/03-co.htm>

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/oar/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, RTP, September 2001, URL: www.epa.gov/oar/aqtrnd00/

Latest Findings on National Air Quality: 2002 Status and Trends, EPA-454/K-03-001, USEPA, Office of Air Quality Planning and Standards, RTP, September 2001, URL: www.epa.gov/airtrends/carbon.html

National Air Quality and Emissions Trend Report, 2003 Special Studies Edition, EPA-454/R-03-005, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2003, URL: <http://www.epa.gov/oar/aqtrnd03/>.

National Primary Ambient Air Quality Standards for Carbon Monoxide, 40 CFR 50.8, US Government Printing Office, Washington DC, July 2001.



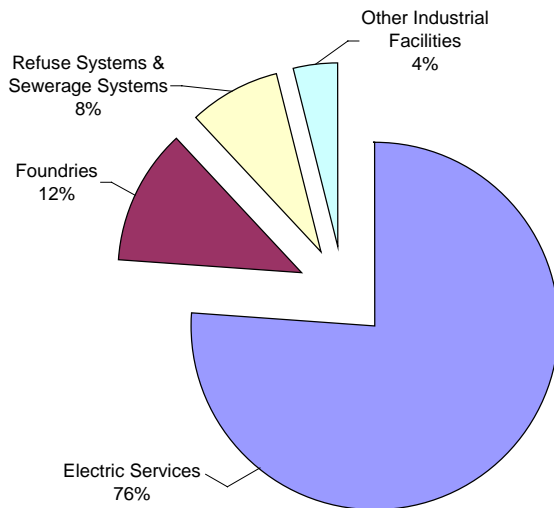
2002 Lead Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Lead (Pb) is a metal that occurs naturally in the environment as well as being produced by a variety of human activities. Historically, the major sources of lead in the air have been motor vehicles and industrial facilities. With the phase out of lead in gasoline, however, the industrial sources now predominate. Because of the reductions in lead emissions from cars and trucks, levels in the air have decreased dramatically. When high levels do occur they are usually near industrial sources. The pie chart below shows the major industrial source of lead in New Jersey. The industrial sources include Electric Services (Energy generating facilities), Foundries (Metal casting facilities), and Refuse and Sewage systems.

Figure 1
New Jersey's Summary of 2002
Lead Emissions by Industrial Category



Source: NJDEP, Air Quality Planning Data 2002

HEALTH AND ENVIRONMENTAL EFFECTS

Lead accumulates in the blood, bones, muscles, and fat. People are mainly exposed to lead by breathing it from the air

or by ingesting food, water, soil, or dust that has been contaminated with lead. Infants and small children are especially sensitive to lead, even at low levels. Lead can damage the kidneys, liver, brain, and nerves and very high exposures can result in mental retardation, behavioral disorders, memory problems, and seizures. Lower levels of lead can damage the brain and nerves in fetuses and young children, resulting in learning disabilities. Lead can also cause high blood pressure and increase the risk of heart disease.

Animals can ingest lead while grazing and may experience health effects similar to those seen in humans. Lead can enter water systems through runoff and from sewage and industrial waste streams. Elevated levels of lead in water can cause reproductive damage in aquatic life and may cause changes in the blood and nerves of fish.

STANDARDS

The primary (health based) and secondary (welfare based) standards for lead are the same. The national standards are set at a maximum quarterly average concentration of 1.5 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). The table below shows the National and New Jersey Ambient Air Quality Standards (NAAQS and NJAAQS) for lead. The difference between the national and state standards is that the national standards are based on calendar quarters (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec) while the state standards are based on concentrations recorded over any three consecutive month period during the year.

Table 1
National and New Jersey Ambient Air Quality Standards for Lead

$\mu\text{g}/\text{m}^3$ = Micrograms Per Cubic Meter

Averaging Period	Type	New Jersey	National
3-Month Arithmetic Means	Primary and Secondary	1.5 $\mu\text{g}/\text{m}^3$	
Calendar Quarter Arithmetic Mean	Primary and Secondary		1.5 $\mu\text{g}/\text{m}^3$

MONITORING LOCATIONS

Lead concentrations in recent years have been so low that many of the monitoring sites have been discontinued. As a result, New Jersey monitored lead at only one location in 2002. This location, near a battery manufacturing plant in New Brunswick, is shown in the map in Figure 2.

LEAD LEVELS IN 2002

A summary of the lead levels monitored in 2002 is shown in Table 2 and Figure 3. No exceedances of the primary or secondary standards were recorded. The maximum 3-month average was 0.116 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), less than a tenth of the health standard.

Figure 2
2002 Lead
Monitoring Network



Figure 3
Lead Concentration in New Jersey
Maximum Quarterly Average
2002

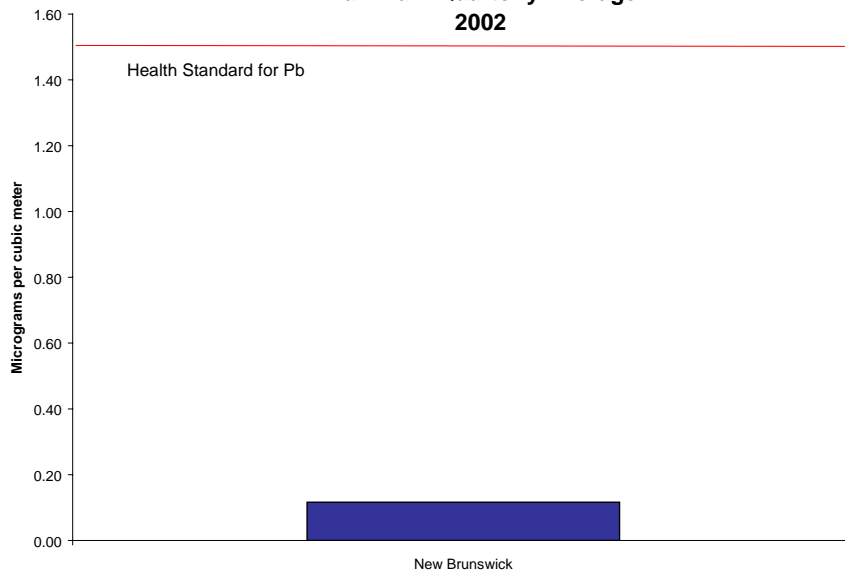


Table 2
Lead Data – 2002
3-Month and Calendar Quarter Averages

$\mu\text{g}/\text{m}^3$ = Micrograms Per Cubic Meter

Monitoring Site	3-Month Average $\mu\text{g}/\text{m}^3$		Calendar Quarter Averages $\mu\text{g}/\text{m}^3$			
	Maximum	Month ¹	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter
New Brunswick	.116	Dec.	.016	.062	.032	.116

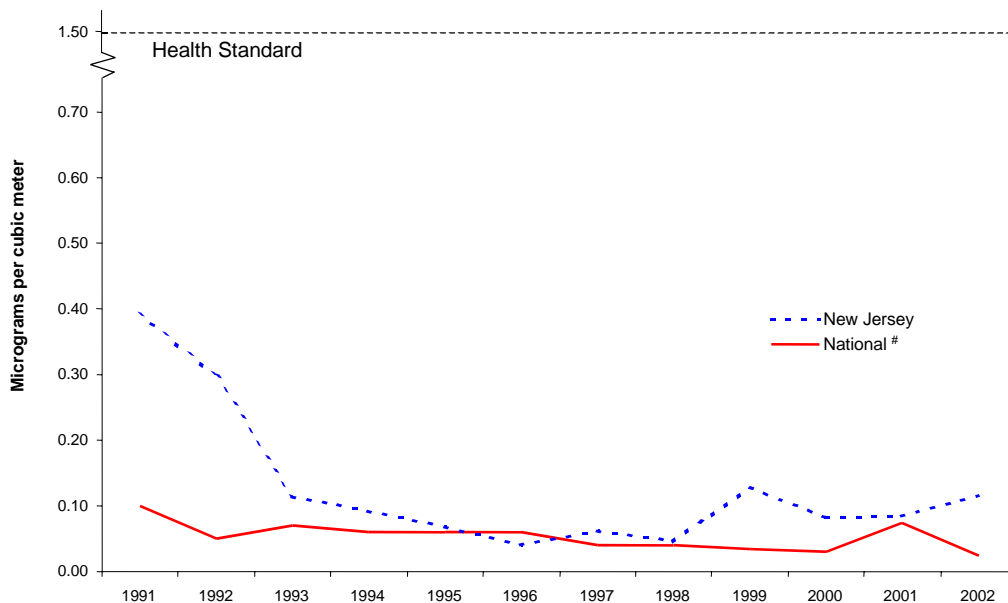
¹ The month indicates the last month in the 3-month period

TRENDS

The phase out of lead in gasoline has resulted in substantial improvements in air quality and lead levels in New Jersey are now well within the air quality standards. Below is a trend graph showing New Jersey's maximum quarterly average concentrations from 1991 to 2002, compared to the national maximum quarterly average concentrations during the same time frame. New Jersey's lead levels decreased by 70% from 1991 to 2002, compared to national lead levels, which decreased by 75% over the same time span. New Jersey values in more recent years are based on data from very few

sites (only one site in 2002). While meeting the NAAQS for lead is no longer a major environmental issue in New Jersey, concern still exists over lead exposure via routes other than direct inhalation. Lead may have accumulated in the soil over time and children playing in such areas may ingest the lead directly.

Figure 4
Lead Concentrations in New Jersey
1991 - 2002
Maximum Quarterly Average



Source: U.S. Environmental Protection Agency, 2002 Air Trends Report

REFERENCES

United States Environmental Protection Agency (USEPA), 2002 Air Trends Report, URL: <http://www.epa.gov/airtrends/lead.html>

New Jersey Department of Environmental Protection (NJDEP), Air Quality Planning, 2002 Lead Emission Inventory Data

Lead – How Lead Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, November 2000, URL: <http://www.epa.gov/air/urbanair/lead/index.html>

Health Assessment of Exposure to Developmental Toxicants, Kimmel, Carole A. , Office of Health and Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, 1987 EPA-600/D-87-210

Health Effects Assessment for Lead, U.S. Environmental Protection Agency, Office of Research and Development, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, 1984 EPA -540/1-86-055

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/oar/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA , Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2001, URL: www.epa.gov/oar/aqtrnd00/



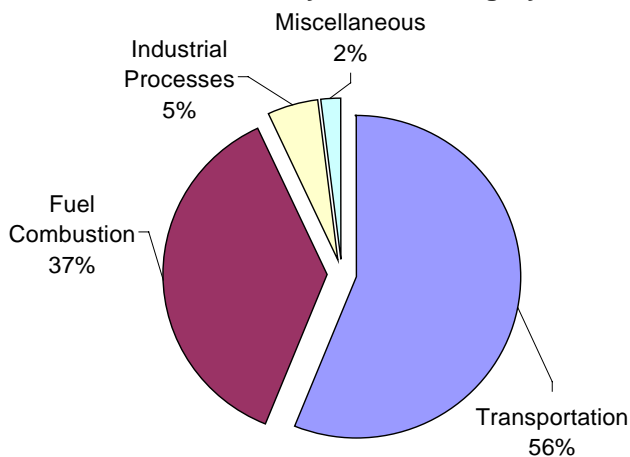
2002 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Nitrogen Dioxide (NO_2) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of Nitric Oxide (NO). When NO_2 reacts with other chemicals in the atmosphere, it can result in the formation of ozone, particulate matter, haze and acid rain. Nitrogen Oxides (NO_x), a mixture of gases which is mostly comprised of NO and NO_2 . These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. A pie chart summarizing the major sources of NO_x is shown in Figure 1. As much of the NO_x in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in the graph in Figure 2 (page 2), which also indicates that concentrations tend to be higher in the winter than the summer. This is due in part to poorer local dispersion conditions caused by light winds and other weather conditions that are more prevalent in the colder months of the year.

Figure 1
National Summary of 2002
 NO_x Emissions by Source Category



Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

HEALTH AND ENVIRONMENTAL EFFECTS

Short-term exposures (less than 3 hours) to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses, and can cause respiratory illnesses, particularly in children ages 5-12. Symptoms of low-level exposure to NO_x include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO_2 may increase susceptibility to respiratory infection and may cause permanent damage to the lung. NO and NO_2 are found in tobacco smoke, so people who smoke or breath in second-hand smoke may be exposed to NO_x . The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that, with the available information, no conclusion can be made as to the carcinogenicity of NO_x to human beings.

Nitrogen Oxides contribute to a wide range of environmental problems. These include potential changes in the composition of some plants in wetland and terrestrial ecosystems, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, increases in levels of toxins harmful to fish and other aquatic life, and visibility impairment.

STANDARDS

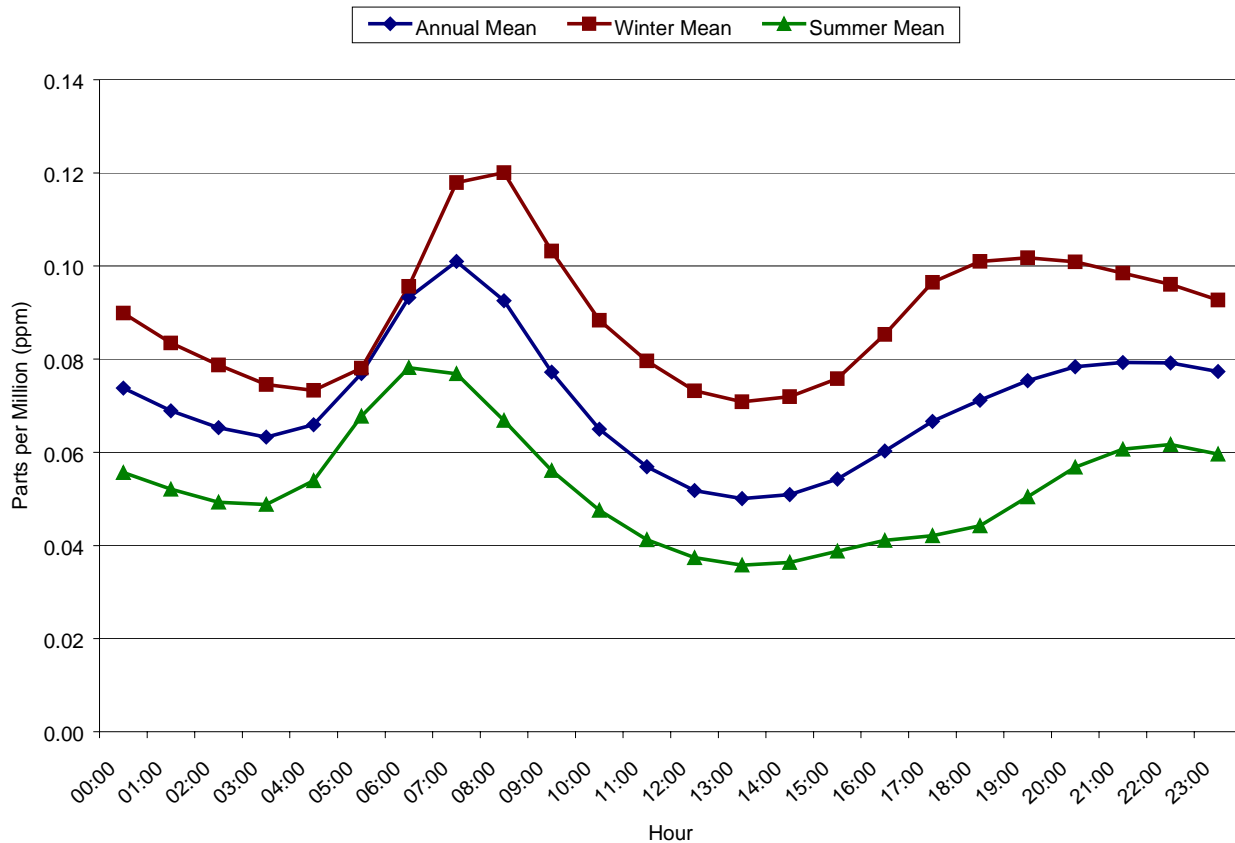
The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) for NO_2 are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) are the standard units, and the state standard applies to any 12-month period, not just the calendar year. The state of California has a one-hour average standard of $470 \mu\text{g}/\text{m}^3$ that New Jersey uses as a guideline in assessing short-term impacts from specific sources. Table 1 (page 2) provides a summary of the NO_2 standards.

Table 1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide

Parts Per Million (ppm)
 Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Averaging Period	Type	New Jersey	National	California
12-month average	Primary	100 $\mu\text{g}/\text{m}^3$ (0.05 ppm)		
Annual average	Primary		0.053 ppm (100 $\mu\text{g}/\text{m}^3$)	
12-month average	Secondary	100 $\mu\text{g}/\text{m}^3$ (0.05 ppm)		
Annual average	Secondary		0.053 ppm (100 $\mu\text{g}/\text{m}^3$)	
1-hour average	Primary			470 $\mu\text{g}/\text{m}^3$ (0.25 ppm)

Figure 2
Nitrogen Dioxide & Nitric Oxide Concentration – New Jersey
1967-1999
Seasonal and Hourly Variation



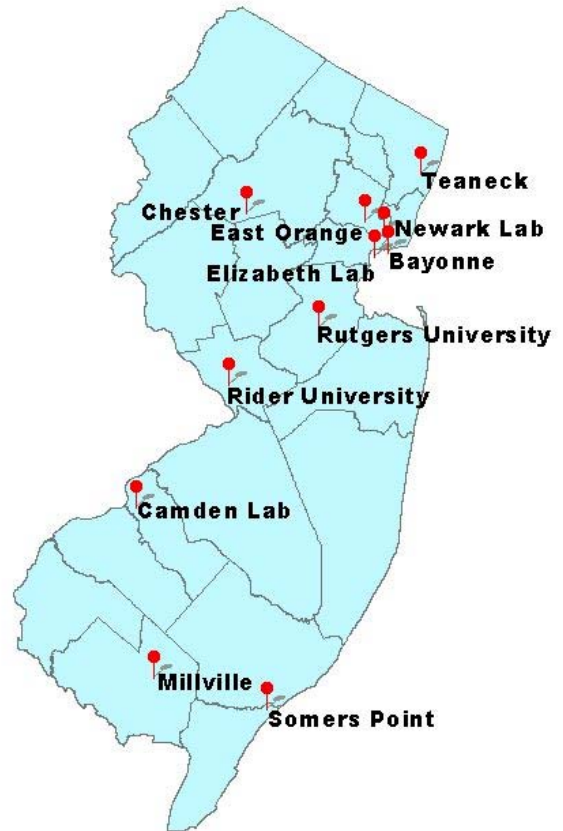
MONITORING LOCATIONS

The state monitored Oxides of Nitrogen levels at 11 locations in 2002. These sites are shown in the map to the right. The Somers Point monitoring station was discontinued on March 6, 2002. A valid 2002 annual average could not be calculated for this site.

NO₂ LEVELS IN 2002

None of the monitoring sites recorded exceedances of the primary or secondary NO₂ NAAQS during 2002. The maximum annual average concentration recorded was 0.040 ppm at Exit 13 of the New Jersey Turnpike in Elizabeth. While national health and welfare standards have not been established for NO, it is considered to be an important pollutant that contributes to the formation of ozone, fine particles and acid rain. The maximum annual average concentration of NO recorded in 2002 was 0.048 ppm, also at the Exit 13 site (see Table 2 and Figure 4, page 4).

**Figure 3
2002 Oxides of Nitrogen
Monitoring Network**



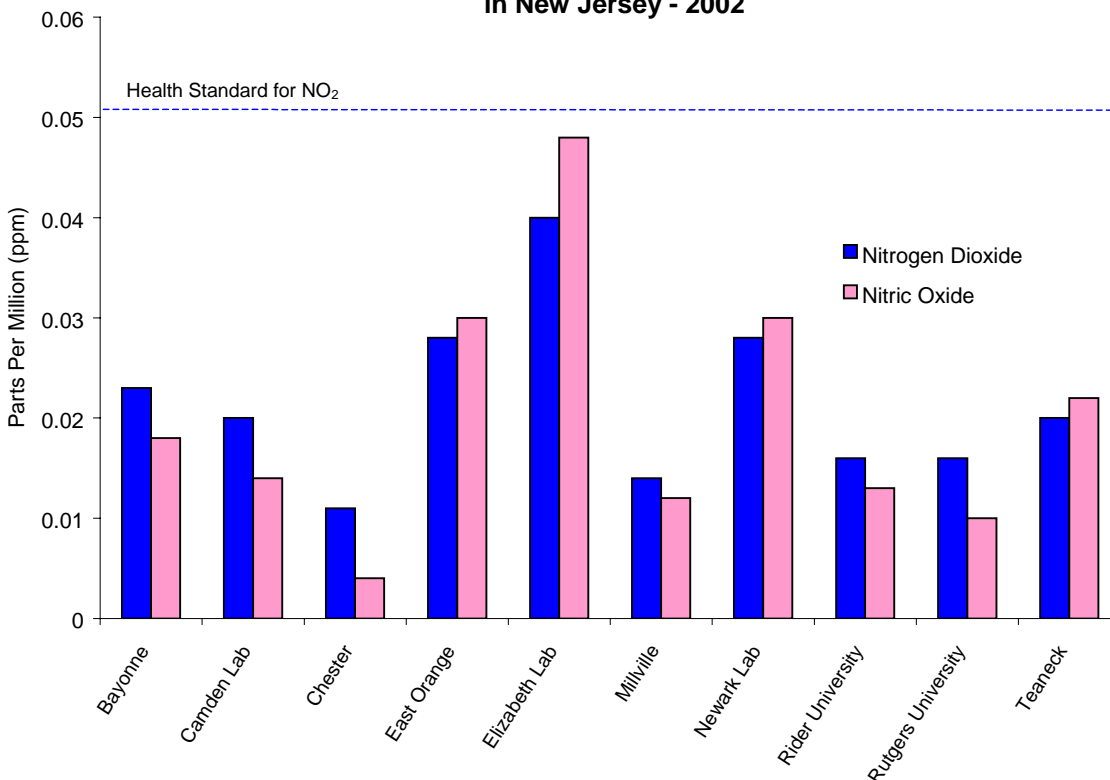
**Table 2
Nitrogen Dioxide & Nitric Oxide Data – 2002**

Parts Per Million (ppm)

Monitoring Site	Nitrogen Dioxide 1-Hour Average (ppm)		Nitrogen Dioxide 12-Month Average (ppm)		Nitric Oxides Annual Average (ppm)
	Maximum	2 nd Highest	Maximum	Calendar year	
Bayonne	.111	.107	.026	.023	.018
Camden Lab	.096	.086	.021	.020	.014
Chester	.056	.056	.011	.011	.004
East Orange	.093	.091	.029	.028	.030
Elizabeth Lab	.129	.129	.041	.040	.048
Millville	.065	.063	.016	.014	.012
Newark Lab	.103	.093	.028	.028	.030
Rider University	.062	.060	.017	.016	.013
Rutgers University	.062	.062	.018	.016	.010
Somers Point ^a	.040	.038	.007	----	----
Teaneck	.086	.084	.022	.020	.022

^a Data not available after March

**Figure 4
Annual Average NO and NO₂ Concentrations
in New Jersey - 2002**



TRENDS

NO₂ concentrations have not posed a significant direct health threat in New Jersey. A graph of NO₂ levels showing the annual mean concentrations recorded from 1975 to 2002 is provided in Figure 5 (page 5). The graph shows the highest, average of all sites, and lowest annual average recorded at any site. Although NO₂ concentrations are well within the NAAQS, there is still a great deal of interest in oxides of nitrogen because of their role in the formation of other pollutants – most notably ozone and fine particles. Both these pollutants are of concern over much of the northeastern United States and efforts to reduce levels of ozone and fine particles are likely to require reductions in NO emissions.

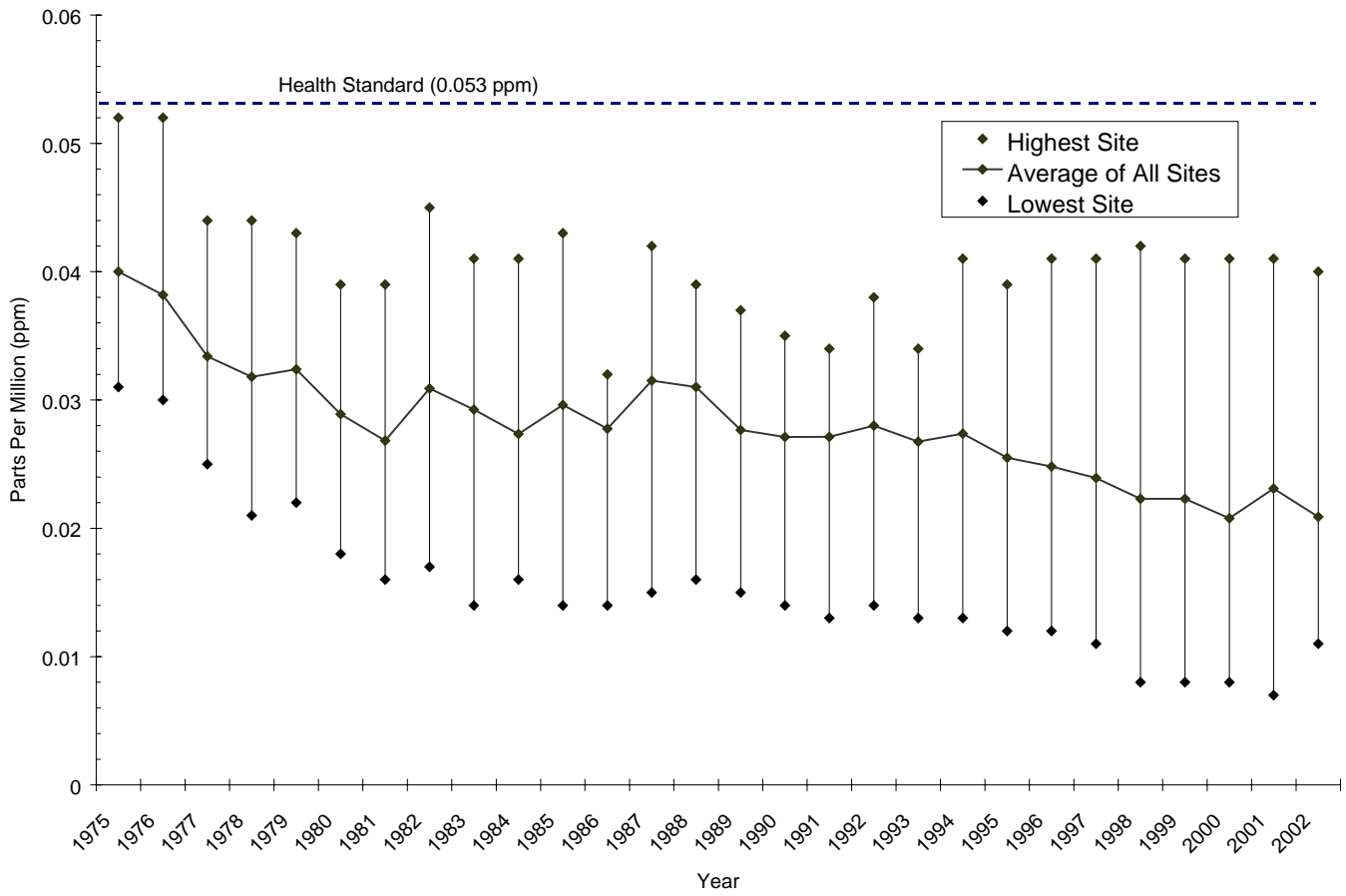
TOTAL REACTIVE OXIDES OF NITROGEN (NO_y)

Although not specifically defined, there is a group of nitroxyl compounds that react in the troposphere and contribute to the formation of ozone. They are termed Total Reactive Oxides of Nitrogen (NO_y). These compounds include NO_x,

peroxyacyl nitrates (RC(O)OONO₂ or PAN), peroxyntoxic acid (HO₂NO₂), nitrous acid (HONO), nitric acid (HNO₃), dinitrogen pentoxide (N₂O₅) and nitrate radicals (XNO₃). NO_y can also be described as the sum of the NO_x and the atmospheric NO_x oxidation products. Although measuring NO_y is not required, NO_y measurements may provide valuable information for evaluating chemical mechanisms in ozone prediction models, indicate NO and NO₂ emission trends, and assist in developing regional control strategies for ozone.

The identification and measurement of individual NO_y compounds is technically difficult and expensive, however, an analyzer that measures total NO_y concentrations is available. The NJDEP began monitoring for NO_y at the Rider University station in March 2002. NO_x and PAMS speciated volatile organic compounds (VOCs) are also measured at this station.

Figure 5
Nitrogen Dioxide Concentrations in New Jersey
1975-2002
12-Month (Calendar Year) Average



REFERENCES

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2001, URL: <http://www.epa.gov/oar/aqtrnd00/>.

National Air Quality and Emissions Trend Report, 2003 Special Studies Edition, EPA-454/R-03-005, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2003, URL: <http://www.epa.gov/oar/aqtrnd03/>.

Meyer, Edwin L., Sennet, Donald H., Cole, Henry S., Richter, Harold G., *Technical Basis for Developing Control Strategies for High Ambient Concentrations of Nitrogen Dioxide*, EPA-450/4-80-017, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1980.

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: <http://www.epa.gov/oar/aqtrnd99/>.

National Primary and Secondary Ambient Air Quality Standards for Nitrogen Dioxide, 40 CFR 50.11, US Government Printing Office, Washington DC, July 2001.

Nitrogen Dioxide and Respiratory Illness in Children, Health Effects Institute, 1994.

NO_x – How Nitrogen Oxides Affect the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1998, URL: <http://www.epa.gov/air/urbanair/nox/index.html>.

The Regional Transport of Ozone, New EPA Rulemaking on Nitrogen Oxide Emissions, EPA-456/F-98-006, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, URL: <http://www.epa.gov/air/noxfacts.pdf>.

Review Of The National Ambient Air Quality Standards For Nitrogen Dioxide Assessment Of Scientific And Technical Information, EPA-452/R-95-005, OAQPS staff paper, USEPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, 1995.

Sittig, M., *Handbook of Toxic and Hazardous Chemicals and Carcinogens Third Edition, Volume 2*, Noyes Publications, Park Ridge, NJ, 1991.

ToxFaQs for Nitrogen Oxides, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, April 2002, URL: <http://www.atsdr.cdc.gov/tfacts175.pdf>.

Utell, Mark J., *Mechanisms of Nitrogen Dioxide Toxicity in Humans*, Health Effects Institute, 1991.



2002 Ozone Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Ozone (O₃) is a gas consisting of three oxygen atoms. It occurs naturally in the upper atmosphere (stratospheric ozone) where it protects us from harmful ultraviolet rays (see Figure 1). However, at ground-level (tropospheric ozone) it is considered an air pollutant and can have serious adverse health effects. Ground-level ozone is created when nitrogen oxides (NO_x) and volatile organic compounds (VOC's) react in the presence of sunlight and heat. NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOC's are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. Ozone and the pollutants that form ozone (precursor pollutants) can also be transported into an area from sources hundreds of miles upwind.

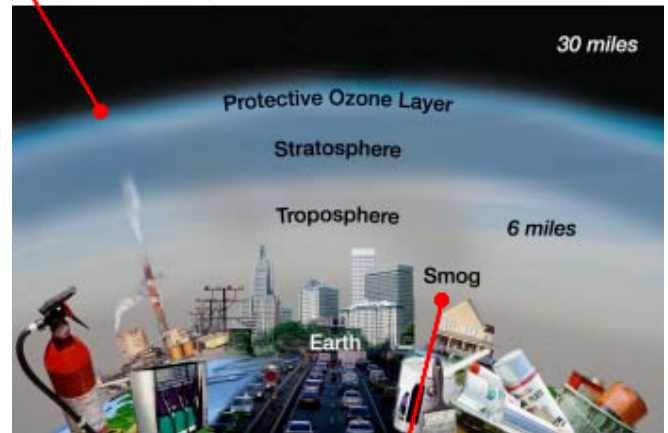
Since ground-level ozone needs sunlight to form, it is mainly a daytime problem during the summer months. Weather patterns have a significant effect on ozone formation and hot, dry summers will result in more ozone than cool, wet ones. In New Jersey, the ozone season runs from April 1st to October 31st, although unhealthy conditions are rare before mid-May or after the first few weeks of September. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the U.S. Environmental Protection Agency (EPA) publication "Ozone: Good Up High, Bad Nearby".

ENVIRONMENTAL EFFECTS

Ground-level ozone damages plant life and is responsible for 500 million dollars in reduced crop production in the United States each year. It interferes with the ability of plants to produce and store food, making them more susceptible to disease, insects, other pollutants, and harsh weather. "Bad" ozone damages the foliage of trees and other plants, sometimes marring the landscape of cities, national parks and forests, and recreation areas. The black areas on the leaves of the blackberry bush and sassafras tree shown in Figure 2 and Figure 3 is damage caused by exposure to ground-level ozone. (Figure 2 and 3 Photos by: Teague Prichard, Wisconsin Department of Natural Resources)

Figure 1: Good and Bad Ozone

Ozone is good up here... Many popular consumer products like air conditioners and refrigerators involve CFCs or halons during either manufacturing or use. Over time, these chemicals damage the earth's protective ozone layer.



Ozone is bad down here... Cars, trucks, power plants and factories all emit air pollution that forms ground-level ozone, a primary component of smog.

Source: EPA

Figure 2: Ozone Damage to Blackberry Bush



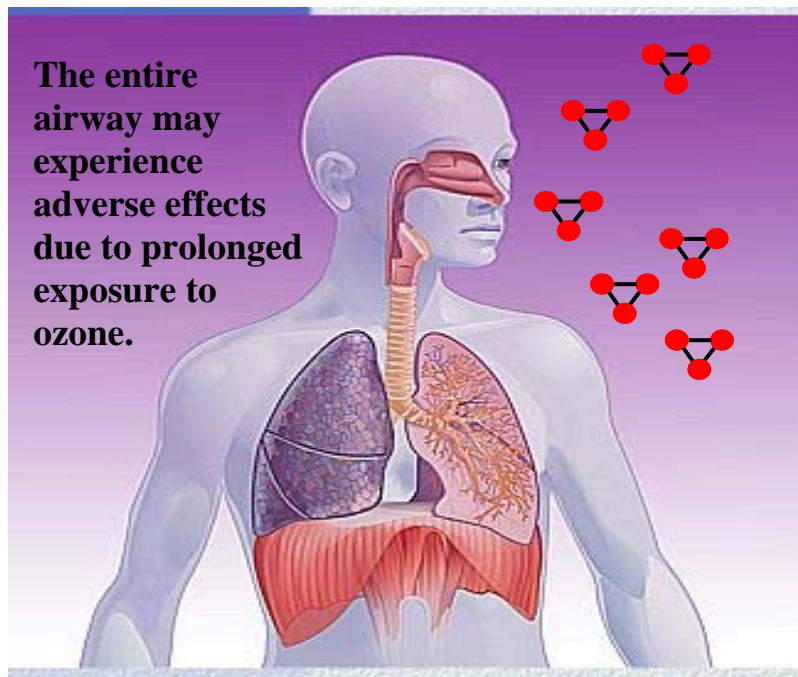
Figure 3: Ozone Damage to Sassafras Tree



HEALTH EFFECTS

Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present in low levels, inhaling it can trigger a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. Ozone also can aggravate other health problems such as bronchitis, heart disease, emphysema, and asthma, and can reduce lung capacity. People with pre-existing respiratory ailments are especially prone to the effects of ozone. For example, asthmatics affected by ozone may have more frequent or severe attacks during periods when ozone levels are high. As shown in Figure 4 ozone can irritate the entire respiratory tract. Children are also at risk for ozone related problems. Their respiratory systems are still developing and they breathe more air per pound of body weight than adults. They are also generally active outdoors during the summer when ozone levels are at their highest. Anyone who spends time outdoors in the summer can be affected and studies have shown that even healthy adults can experience difficulty in breathing when exposed to ozone. Anyone engaged in strenuous outdoor activities, such as jogging, should limit activity to the early morning or late evening hours on days when ozone levels are expected to be high.

Figure 4



Area of the Respiratory Tract that may be Affected by Ozone

AMBIENT AIR QUALITY STANDARDS FOR OZONE

National and state air quality standards have been established for ground-level ozone. There are both primary standards, which are based on health effects, and secondary standards, which are based on welfare effects (e.g. damage to trees, crops and materials). For ground-level ozone, the primary and secondary National Ambient Air Quality Standards (NAAQS) are the same (see Table 1). The ozone NAAQS were revised in 1997 because EPA had determined that the old standard of 0.12 parts per million (ppm) maximum daily one-hour average was not sufficiently protective of public health. They set a revised standard of 0.08 ppm maximum daily eight-hour average. The standard changes were challenged in court but eventually upheld. As many people are accustomed to the old standards, summary information relative to that standard will be provided in this report along with summaries based on the new standard.

OZONE NETWORK

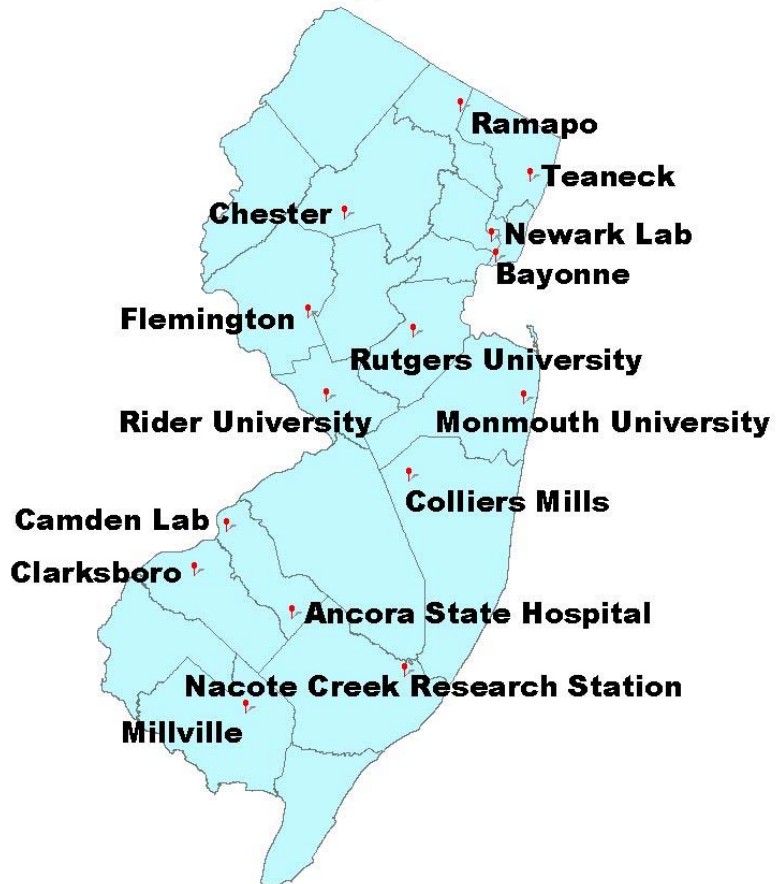
Ozone was monitored at 15 locations in New Jersey during 2002. Of those 15 sites, 12 operated year round and 3 operated only during the ozone season (April 1st through October 31st). The location of the sites are shown in Figure 5.

Table 1
National and New Jersey Ambient Air Quality Standards for Ozone

ppm = Parts per Million

Averaging Period	Type	New Jersey	National
1-Hour	Primary	0.12 ppm	0.12 ppm
1-Hour	Secondary	0.08 ppm	0.12 ppm
8-Hour	Primary	-----	0.08 ppm
8-Hour	Secondary	-----	0.08 ppm

Figure 5
2002 Ozone Monitoring Network



DESIGN VALUES

The NAAQS for ozone are set in such a way that determining whether they are being attained is not based on a single year. For example, an area was considered to be attaining the old 1-hour average standard if the average number of times the standard was exceeded over a three-year period was 1 or less (after correcting for missing data). Thus it was the fourth highest daily maximum 1-hour concentration that occurred over a three-year period that determined if an area would be in attainment. If the fourth highest value was above 0.12 ppm then the average number of exceedances would be greater than 1. The fourth highest value is also known as the design value.

Under the new standard, attainment is determined by taking the average of the 4th highest daily maximum 8-hour average concentration that is recorded each year for three years. This becomes the design value for an area under the new standard. When plans are developed for reducing ozone concentrations, an area must demonstrate that the ozone reduction achieved will be sufficient to ensure the design value will be below the NAAQS, as opposed to ensuring that the standards are never exceeded. This avoids having to develop plans based on extremely rare events.

Figure 6 and 7 show the design value for the 1 and 8-hour standards starting with the 1986-1988 period. Design values are calculated for all ozone sites in the network and the median, maximum and minimum for each year were used in the graphics.

Figure 6

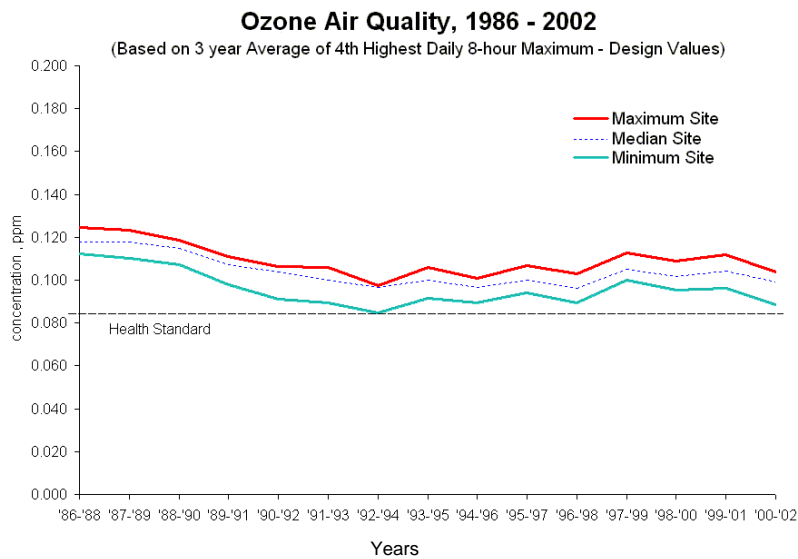
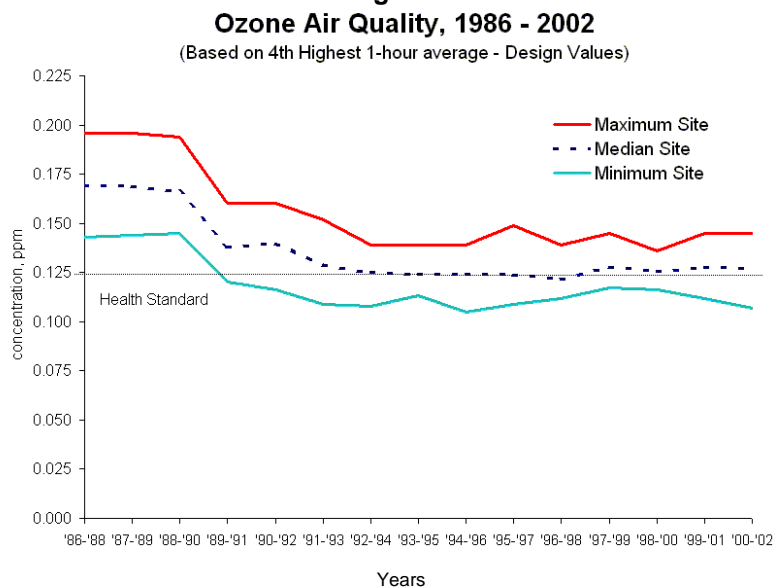


Figure 7



HOW THE CHANGES TO THE OZONE STANDARDS AFFECT AIR QUALITY RATINGS

In 2002 there were 16 days on which the old standard was exceeded in New Jersey and 44 days on which the new standard was exceeded. Significant progress was being made towards meeting the old standards (see Figure 8 below). There are fewer days on which that standard is exceeded, and when it is, fewer sites tend to be involved. Also, the maximum levels reached are not as high as they were in the past. The maximum 1-hour average concentration recorded in 1988 was 0.218 ppm, compared to a maximum of 0.153 ppm in 2002.

It is apparent, however, that the current standard is significantly more stringent than the old one (compare Figure 8 to Figure 9 below). As a result, additional control measures to reduce ozone levels will be needed. These measures will have to be implemented over a wide area and will require the cooperative effort of many states and the federal government if they are to be successful.

Figure 8
Days on which the *Old* Ozone Standard (1-hour) was Exceeded in New Jersey 1988-2002

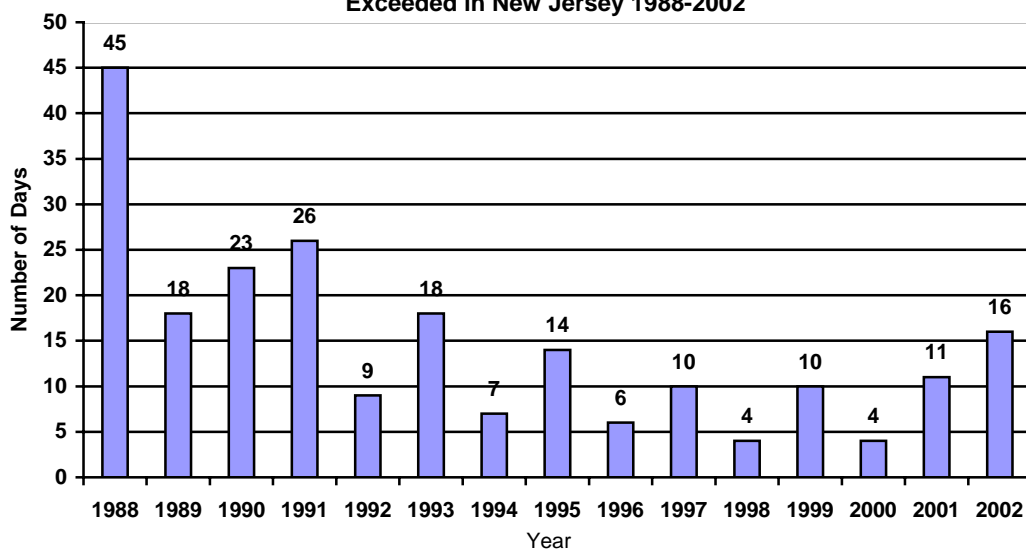
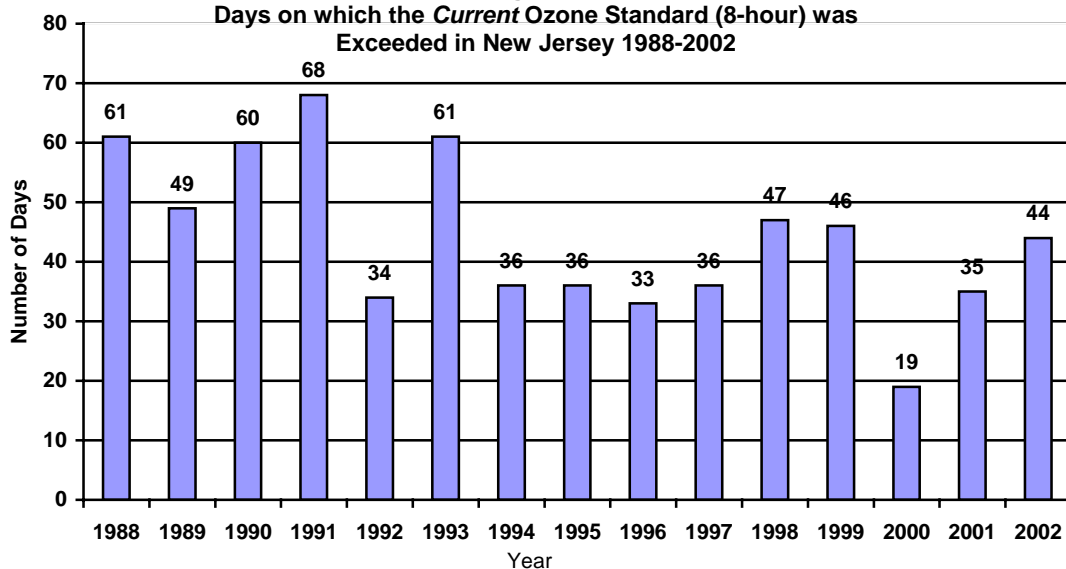


Figure 9
Days on which the *Current* Ozone Standard (8-hour) was Exceeded in New Jersey 1988-2002



MAJOR OZONE EPISODES

June 20 - 26 - This was the longest uninterrupted episode of 2002, resulting in 7 consecutive days on which the 8-hour standard was exceeded.

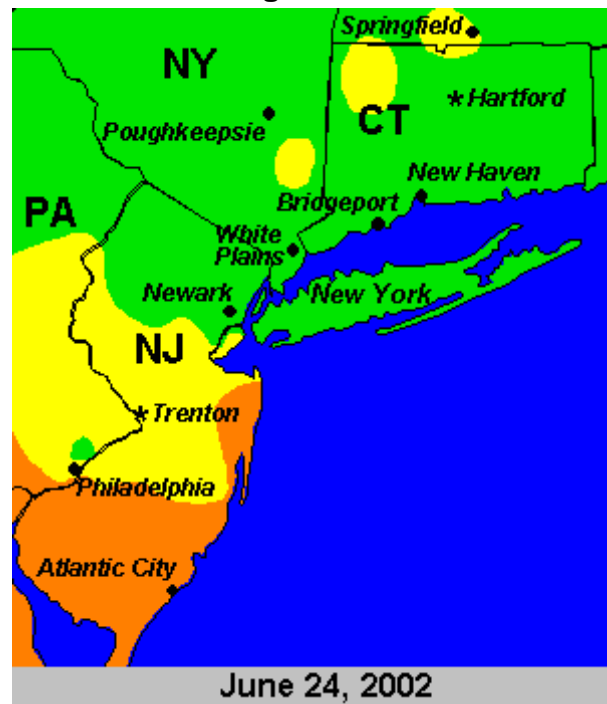
Conditions on June 20th and 21st were not ideal for ozone formation. There was a maritime flow that resulted from high pressure settling off of Maine, and temperatures were in the 80's. Nonetheless, five sites (Rutgers University, Rider University, Flemington, Colliers Mills, and Chester) recorded 8-hour exceedances on the 20th, with the maximum of 0.094ppm occurring at the Rutgers University site. On the 21st, only the Flemington site exceeded the 8-hour standard with a maximum concentration of 0.089ppm. These two days of the episode may have been the result of a stagnant air mass and/or re-circulation. Also, the high-pressure system over Maine originated over the Great Lakes region where it may have picked up more than normal amounts of ozone precursors. When winds shifted around to the southwest on June 22nd, ten sites exceeded the 8-hour standard. The change was brought about by a high-pressure system that settled over southern Delaware. Temperatures began to increase into the upper 80's, and within the next few days of this episode rose to the mid-90's. June 23rd saw nine sites exceed the 8-hour standard, while sites along the eastern portion of the state remained in the moderate range due to the cleaner southern winds coming off the ocean and bay. On June 24th a cold front pushed its way down through northern New Jersey / Central Pennsylvania and a major gradient can be seen throughout the state's ozone concentrations (Figure 10 to right). The site at the Ancora State Hospital recorded an 8-hour exceedance of 0.104ppm while concentrations at the Newark Lab site only reached a maximum 8-hour average of 0.048ppm. On June 25th the frontal boundary reached just

below Interstate Route 195 in central New Jersey in the morning and eventually retreated back north by mid-afternoon. This instability caused a wide variety of ozone values for the day, as the southern portion of the state continued to be under the influence of warm southwest winds, while the northern portion of the state, for several hours was receiving cooler, cleaner maritime air out of the north-northeast. This may explain why Bayonne, Teaneck, and the Newark Lab recorded maximum 8-hour values of 0.054ppm, 0.044ppm, and 0.041ppm respectively, while sites in the southern half of the state recorded 8-hour exceedances as high as 0.109 ppm at Clarksboro and 0.105 ppm at the Camden Lab. All together there were 8 sites throughout the state that exceeded the 8-hour standard. Only the Clarksboro site recorded levels above the 1-hour standard, with a maximum 1-hour value of 0.125 ppm. Temperatures remained warm on the 26th, low to mid 80's, but the episode began to break up as stronger winds blanketed the state and a front finally pushed through taking the stagnant, polluted air mass off to the northeast. The Chester, Flemington, Rider University, and Rutgers University monitoring sites still recorded 8-hour exceedances on the 26th while the remaining sites stayed within the moderate range.

July 7 - 9 - This episode occurred in conjunction with elevated levels of fine particulates that were the result of extensive forest fires in Quebec, Canada. Two of the three days on which all of the state's ozone monitors recorded exceedances occurred during this episode, and although it was not lengthy, it resulted in the highest 1-hour and 8-hour concentrations of the year.

(Analysis abstracted from Dr. Bill Ryan's Summary of 2002 Ozone Season.) The intense fires located in northern Quebec began early July 5th and the first noticeable plumes began moving south. The fires died down over night and by July 6th the first plume had become detached from its source and made its way into northern New York. The flames flared up again on July 6th and a plume began to form over southern Ontario. By mid-afternoon on July 6th the original plume had made its way into southeastern

Figure 10



MAJOR OZONE EPISODES (CONT.)

Pennsylvania and New Jersey. By Sunday a strong cold front moved into the fire regions of northern Quebec and cutoff the southern flowing plume. At this time there were three distinct plumes affecting the northeastern United States. The first plume, by Sunday July 7th, had made its way off the coast of the Carolinas, while the other plumes had drifted through the mid-Atlantic and New England states. A high-pressure system positioned off the Mid-Atlantic States pushed the first plume back northward, where it dissipated onshore impacting New Jersey's southern and eastern regions most directly. This swirling motion can be seen in the satellite picture in Figure 11 and is most noticeable off the southeast coast of New Jersey. Organic compounds in the fire's plume may have enhanced ozone formation during this event.

On July 7th, two of the southern monitors - Millville and the Ancora State Hospital, recorded 8-hour exceedance values of 0.086ppm and 0.097ppm respectively. The other southern site, the Nacote Creek Research Station, recorded a maximum 8-hour concentration of 0.084ppm - just shy of the standard. July 8th was a statewide 8-hour exceedance day. Temperatures were not extremely warm, averaging in the mid to upper 80's and there was a high-pressure system off the Carolina coast pumping southwesterly breezes into the region. The Camden Lab, Clarksboro, and Colliers Mills sites recorded ozone concentrations above the 1-hour standard, and the 0.153 ppm 1-hour value recorded at Colliers Mills was the highest 1-hour value for the entire 2002 season. Colliers Mills also recorded the highest 8-hour value of the day at 0.128 ppm and Clarksboro the second highest with a 0.125 ppm 8-hour value. Similar conditions remained in place on July 9th and there was another statewide exceedance day of the 8-hour standard (see Figure 12). Temperatures were a bit higher on the 9th and most of the state reached the mid-90's. The maximum 8-hour concentration for the 2002 season of 0.138ppm was recorded at Colliers Mills this day, and six sites recorded exceedances of the 1-hour standard - the most for one day in 2002. The passing of a cold front that brought along cloud cover and thunderstorms broke up the episode and there were no recorded exceedances on July 10th.

July 28 - August 5 - This nine-day episode would have been the longest of the year, except for a break that occurred on July 30th when all sites stayed within the moderate range. Although July 30th was still a warm day with temperatures in the mid-90's, a shift in winds to the northwest-brought clean Canadian air to the region throughout the day.

On July 31st the winds continued to arrive from the northwest over most of the state and the shore regions were located on the northeastern most side of the high-pressure system that had settled in Illinois and Indiana, producing winds directly out of the north. Thus, the two sites recording 8-hour exceedances that day were Monmouth University and the Ancora State Hospital, which were receiving winds that were traveling through the metropolitan New York region. The winds produced on the southeast side of the high, which by August 1st had moved into Ontario, is now exposing most of New

Figure 11

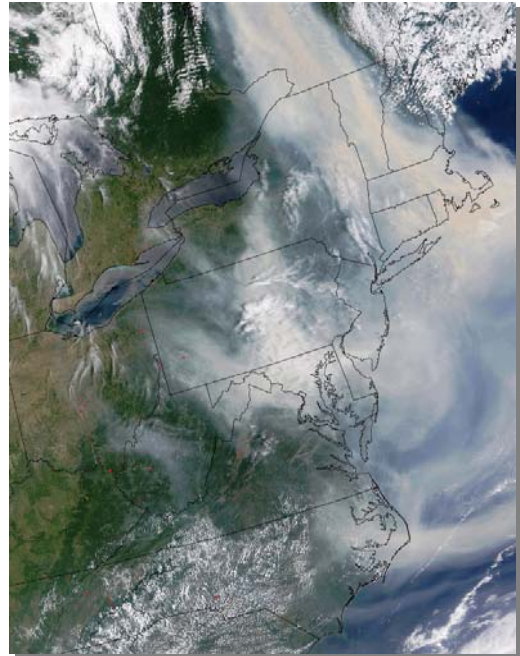
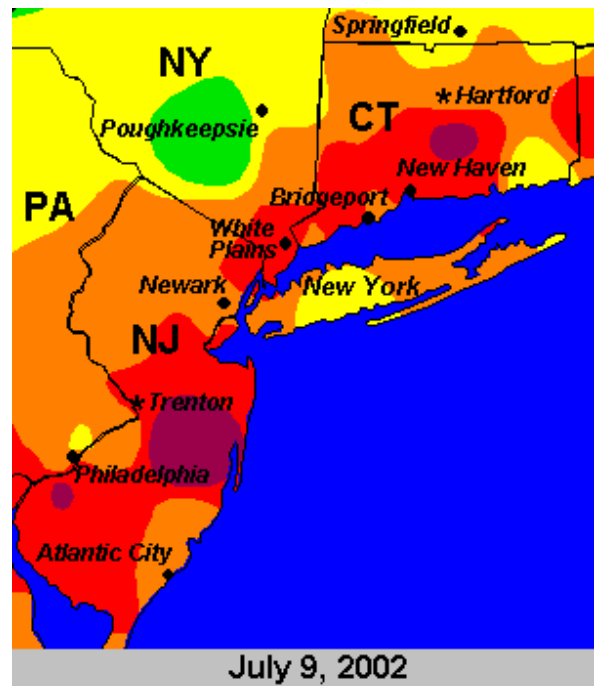


Figure 12



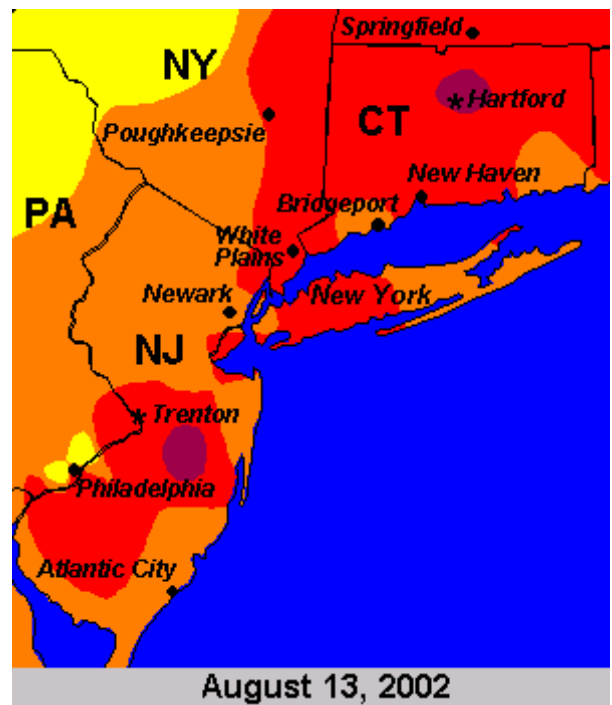
MAJOR OZONE EPISODES (CONT.)

Jersey to metropolitan New York air. Although this is not the traditional setup for producing ozone exceedances it has proven to cause high concentrations in our southern most monitors as the air travels from New York, through the Route 1 corridor on into the southern region of the state. August 1st produced six 8-hour exceedances with Colliers Mills and Millville recording the highest 8-hour values of the day with 0.114ppm and 0.107ppm respectively. Both sites also exceeded the 1-hour standard that day. By August 2nd another high-pressure system settled off of the North Carolina coast and introduced south-southwest winds into New Jersey by mid-morning. So, the dirty air that had moved from northeast to southwest the previous two days was now once again moving back through the region from the opposite direction. This air parcel had become dirtier as it passed over the Baltimore-Washington corridor on its way back up through New Jersey. Add in temperatures in the upper 90's, and 11 sites exceeded the 8-hour standard with the maximum at Camden of 0.116ppm. Camden also recorded a 1-hour exceedance value of 0.133 ppm on August 2nd. The high moved further off the Carolina coast and pushed north, setting up winds from the south across the eastern part of the state, while the high-pressure system located over the Great Lakes influenced the western part of New Jersey. This explains the variations in ozone concentrations for the day with the western sites such as the Camden Lab, Chester, and Flemington recording 8-hour exceedances while the sites under the influence of maritime flow over the Delaware Bay (Ancora State Hospital, Millville, Nacote Creek Research Station) stayed well within the moderate range. Nacote Creek Research Station recorded a maximum 8-hour concentration of just 0.060 ppm while the highest 8-hour maximum value of 0.096ppm was produced at the Camden Lab, as northwesterly winds flowing over the metropolitan Philadelphia region affected that site. August 4th was yet another day of variability across New Jersey as 1-hour exceedances were recorded at the Rider University and Rutgers University sites and nearly at the Camden Lab. These high concentrations were the result of a stationary cold front that stalled northwest of Philadelphia and helped produce 1-hour exceedances all along the I-95 corridor from Washington, D.C. to New York City. August 5th is the last day of the episode and as a result of a passing cold front just three sites in New Jersey exceeded the 8-hour standard, with Clarksboro and Millville just reaching the 0.085ppm standard. The site at the Ancora State Hospital recorded the highest 8-hour value with 0.094 ppm. The cloud cover associated with the passing cold front blanketed the state, leaving just a small clearing in the southern portion of the state, coinciding with the sites that recorded the exceedances for August 5th. The cold front makes its way through the region by August 6th bringing with it strong northerly winds and scattered showers. The maximum 8-hour value for August 6th was 0.037ppm - a significant deviation from the previous week's ozone values.

August 10-14 - This episode produced the 3rd of the statewide exceedance days, where all 15 monitors exceeded the 8-hour standard.

August 12th, 13th, & 14th produced 1-hour exceedances at four sites on each day. On August 10th the episode begins when a high-pressure system over West Virginia produced light southwest winds throughout New Jersey and exceedances along the Route 1 corridor. Rider University recorded a 1-hour exceedance of 0.126 ppm, just above the 1-hour standard. Rutgers University and Flemington recorded the highest ozone concentrations of the eight sites that exceeded the 8-hour standard. The high dropped south into South Carolina and the southwest winds continued across the state on August 11th. Although maximum temperatures barely made it into the 90's, the skies over most of the state were very clear allowing maximum solar intensity. The dew points at Philadelphia International Airport were in the mid-60's on August 11th, unusually low for this time of year. Nine sites across New Jersey exceeded the 8-hour standard, with the maximum concentrations falling along the Route 1 corridor. Rider University recorded the maximum 8-hour value of the day with a 0.110 ppm.

Figure 13



MAJOR OZONE EPISODES (CONT.)

August 12th brought competing high-pressure systems throughout the region. The high that had been influencing the region moved off the coast of Georgia while another high pressure system settled into the West Virginia area. The result was a strong westerly influence compounded by the existing southwest winds. Clear skies and temperatures in the mid 90's produced 8-hour exceedances at 11 sites throughout the state. The two northerly sites that did not exceed the 8-hour standard were Bayonne and the Newark Lab and is mostly likely a result of local NO_x scavenging. The other two sites not exceeding the standard were Monmouth University and the Nacote Creek Research Station, likely resulting from a sea breeze influence. Four sites also exceeded the 1-hour standard; Teaneck, Rider University, the Camden Lab, and Colliers Mills. On August 13th all of the state's monitoring sites recorded exceedances of the 8-hour standard (see Figure 13, page 8). Winds throughout the region were still coming out of the southwest, but were very calm. Temperatures throughout the state were in the mid to upper 90's and clear skies again promoted maximum solar intensity. Four sites exceeded the 1-hour standard; the Camden Lab, Clarksboro, Colliers Mills, and Teaneck as high ozone values were recorded from Raleigh, North Carolina, up into the coastal regions of Maine. August 14th produced four more 1-hour exceedances - the 4th day in a row - and 11 exceedances of the 8-hour standard. This episode begins to unwind as some of the coastal sites receive relief in the form of a sea breeze. The Nacote Creek Research Station, Monmouth University, and Bayonne did not exceed the 8-hour standard on August 14th, while the remainder of the sites still under the southwest flow, produce 8-hour exceedances as high as 0.123ppm at Chester.

This episode ends in a very different manner than the standard high ozone episode. Instead of the passage of a sharp cold front, this episode ends gradually as cleaner air sweeps north, wind speeds increase and the atmosphere steadily destabilizes. On August 15th, concentrations fall across the region as low level flow becomes more southeast and the Bermuda high fills in westward. Cloud cover spreads over the region on August 16th with regional ozone falling further. (Ryan, 2003)

SUMMARY OF 2002 Ozone Data Relative to the 1-HOUR STANDARD

Of the 15 monitoring sites that were operated during the 2002 ozone season, 13 recorded levels above the old 1-hour standard of 0.12 ppm at least once during the year. Seven sites had at least two exceedances while the Camden Lab and Colliers Mills recorded the most exceedances with seven. The highest 1-hour concentration was 0.153 ppm at the Colliers Mills site on July 8, 2002. In the 2001 ozone season there were nine sites that recorded levels above the standard and the maximum was 0.145 ppm, recorded at Rider University.

Figure 14
Highest and Second Highest Daily 1-Hour Averages

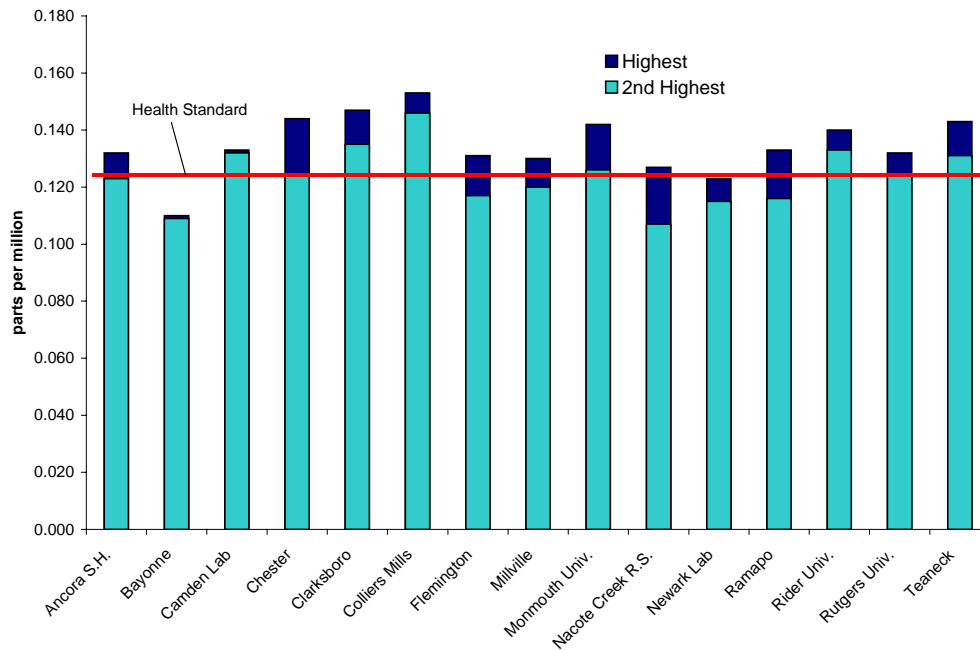


Table 3
Ozone Data – 2002
1-Hour Averages

Monitoring Site	Parts Per Million (ppm)			# of days with 1-hour Averages above 0.12ppm
	1-hr Max	2nd Highest 1-hr Max	1-hour Average Design Value 2000-2002 ¹	
Ancora S.H.	0.132	0.123	0.122	1
Bayonne	0.110	0.109	0.116	0
Camden Lab	0.133	0.132	0.131	7
Chester	0.144	0.124	0.121	2
Clarksboro	0.147	0.135	0.125	6
Colliers Mills	0.153	0.146	0.136	7
Flemington	0.131	0.117	0.128	1
Millville	0.130	0.120	0.127	1
Monmouth Univ.	0.142	0.126	0.126	2
Nacote Creek R.S.	0.127	0.107	0.107	1
Newark Lab	0.123	0.115	0.114	0
Ramapo	0.133	0.116	0.114	1
Rider University	0.140	0.133	0.133	4
Rutgers University	0.132	0.124	0.132	1
Teaneck	0.143	0.131	0.127	4
Statewide	0.153	0.146		16

¹ Design Value calculations exclude data affected by the July 2002 Canadian forest fire episode

SUMMARY OF 2002 OZONE DATA RELATIVE TO THE 8-HOUR STANDARD

All of the 15 monitoring sites that were operated during the 2002 ozone season recorded levels above the new 8-hour standard of 0.08 ppm. Colliers Mills recorded the most exceedances with 30. The highest 8-hour concentration recorded was 0.138 ppm at the Colliers Mills site on July 9, 2002. All sites recorded levels above the 8-hour standard in 2001 as well, with a maximum concentration of 0.121 ppm, recorded at the Colliers Mills site. Design values for the 8-hour standard were also above the standard at all sites, indicating that the ozone standard is being violated throughout New Jersey.

Figure 15
Ozone Design Values for 2000-2002

3 Year Average of the 4th Highest 8-Hour Value

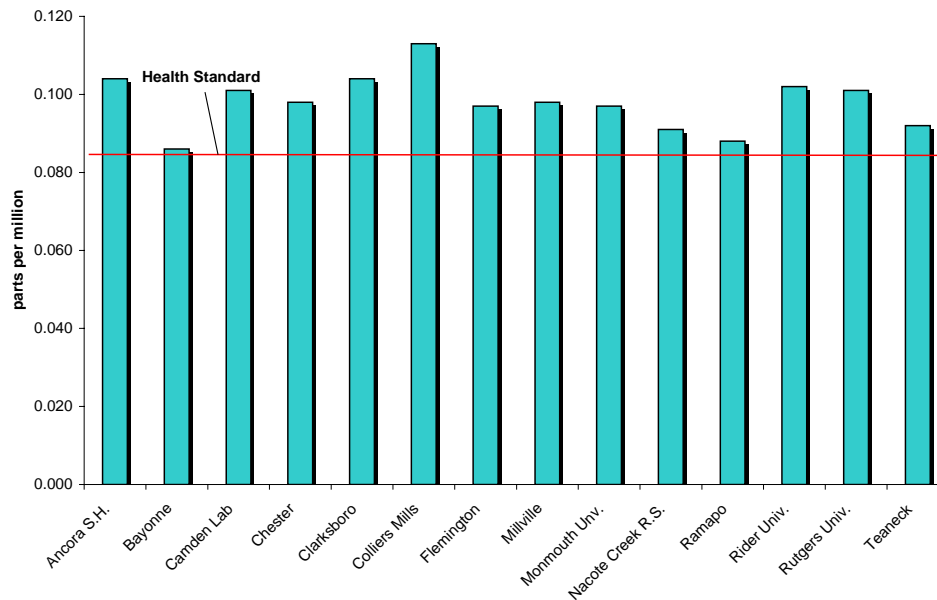


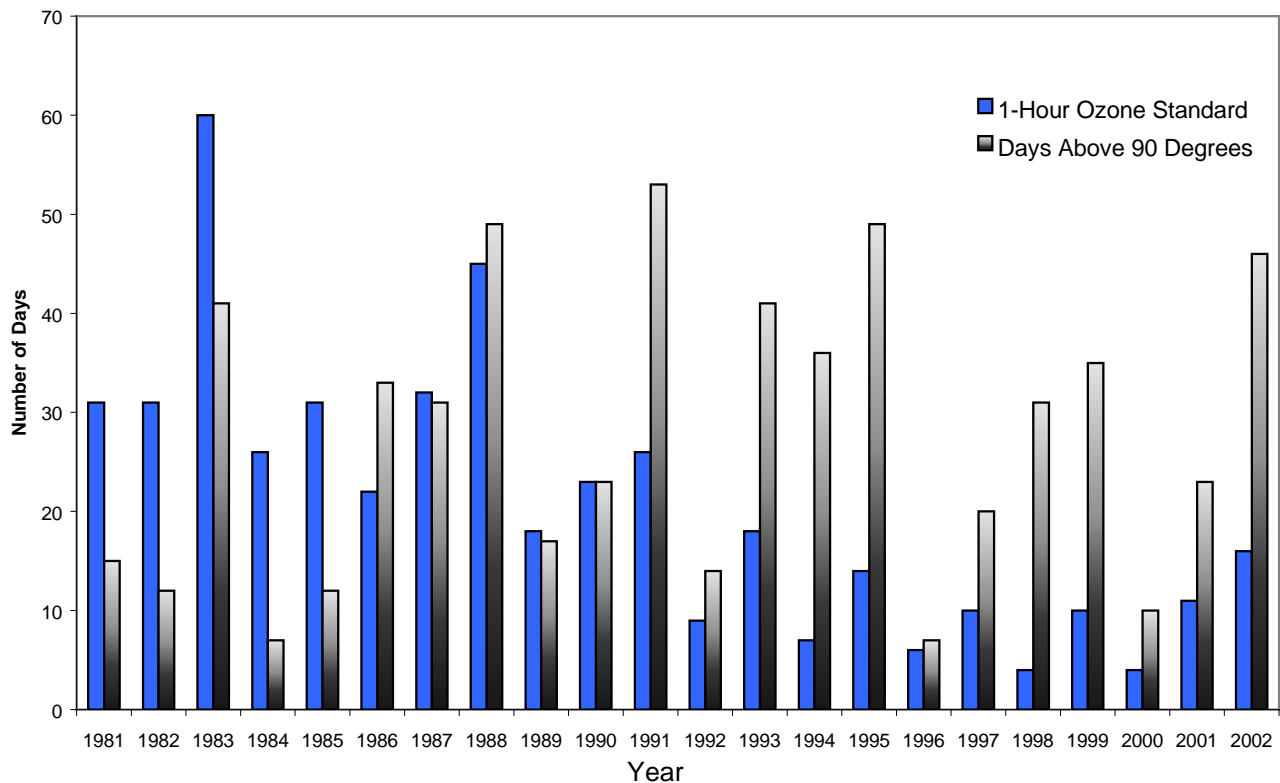
Table 4
Ozone Data – 2002
8-Hour Averages

Monitoring Site	Parts Per Million (ppm)				8-hour Average Design Value 2000-2002 ¹	8-hour standard is 0.08 ppm # of days with 8-hour above 0.08ppm
	1 st Highest	2 nd Highest	3 rd Highest	4 th Highest		
Ancora S.H.	0.118	0.112	0.111	0.106	0.104	27
Bayonne	0.098	0.094	0.093	0.091	0.086	6
Camden Lab	0.116	0.114	0.112	0.112	0.101	19
Chester	0.123	0.108	0.105	0.102	0.098	27
Clarksboro	0.126	0.125	0.115	0.113	0.104	24
Colliers Mills	0.138	0.128	0.125	0.125	0.113	30
Flemington	0.116	0.109	0.101	0.099	0.097	19
Millville	0.109	0.107	0.104	0.102	0.098	20
Monmouth Univ.	0.125	0.114	0.104	0.103	0.097	17
Nacote Creek R.S.	0.102	0.099	0.095	0.093	0.091	11
Newark Lab ²	0.099	0.095	0.095	0.092	-----	8
Ramapo	0.109	0.101	0.097	0.097	0.088	13
Rider University	0.116	0.115	0.110	0.109	0.102	26
Rutgers University	0.115	0.110	0.104	0.104	0.101	26
Teaneck	0.112	0.105	0.104	0.104	0.092	18
Statewide	0.138	0.129	0.128	0.125	0.118	44

¹ Design Value calculations exclude data affected by the July 2002 Canadian forest fire episode

² Data not available prior to Aug. 6, 2001

Figure 16
Number of Days 1-Hour Ozone Standard Was Exceeded
and Number of Days Above 90 Degrees
New Jersey 1981 - 2002



ACCOUNTING FOR THE INFLUENCE OF WEATHER

Trends in ground level ozone are influenced by many factors including weather conditions, transport, growth, and the state of the economy, in addition to changes brought about by regulatory control measures. Of these factors, weather probably has the most profound effect on year to year variations in ozone levels. Several methods have been developed to try to account for the effect of weather on ozone levels so that the change due to emissions could be isolated. While none of these methods are completely successful they do show that over the long term, real reductions in ozone levels have been achieved. A simple way of

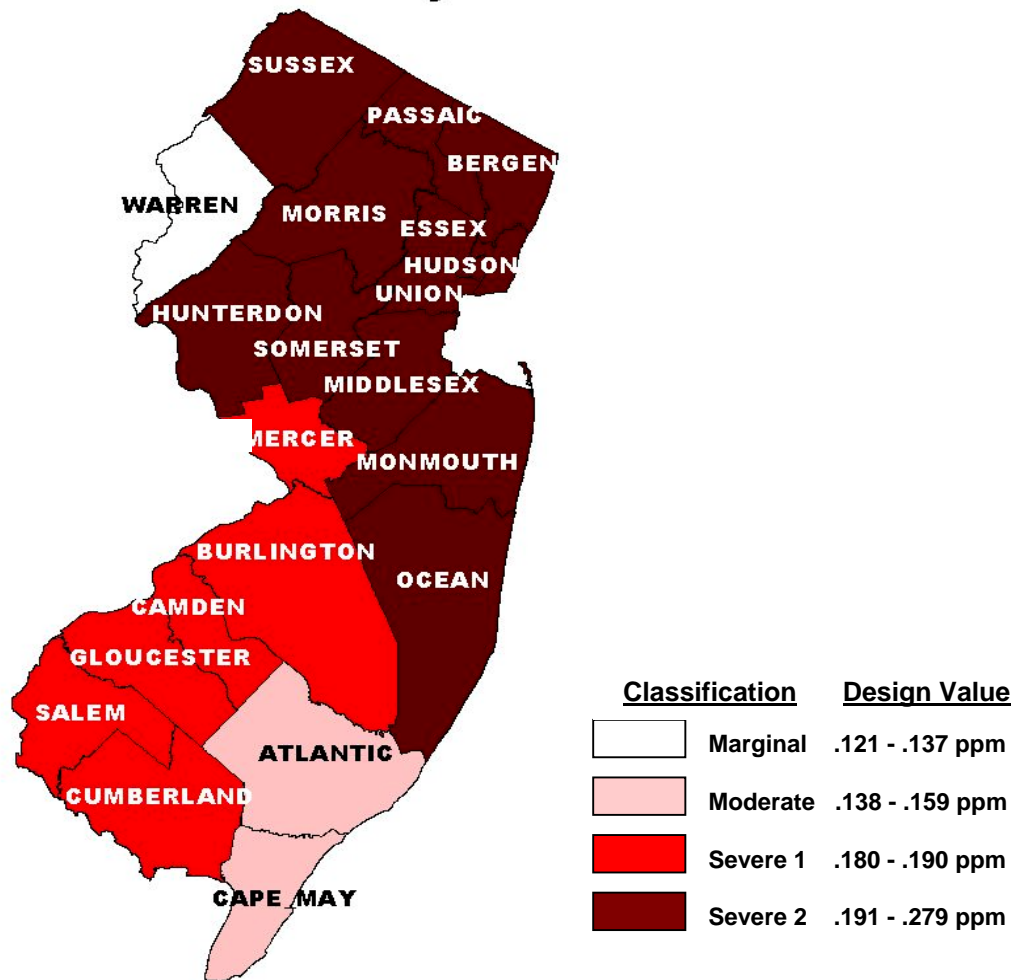
showing the changing effect of weather on ozone is shown above in Figure 16. The number of days each year on which the ambient temperature was 90 degrees or greater is shown next to the number of days the ozone standard was exceeded. In the earliest years shown (1981-1985) there are significantly more days with high ozone than days above 90 degrees. But this pattern gradually changes and for the most recent years there are more "hot" days than "ozone" days. This is an indication that on the days when conditions are suitable for ozone formation, unhealthy levels are being reached less frequently.

OZONE NON-ATTAINMENT AREAS IN NEW JERSEY

The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Areas can also be found to be “unclassifiable” under certain circumstances. The 1990 amendments to the act required that areas be further classified based on the severity of non-attainment. The classifications range from “marginal” to “extreme” and are based on “design values”. The design value is the value that actually determines whether an area meets the standard. For the 1-hour ozone standard for example, the design value is the fourth highest daily maximum 1-hour average concentration recorded over a three year period. Note that these classifications did not take into account the transport of ozone and its precursors and missed the concept of multi-state controls.

New Jersey is part of four planning areas, the New York, Philadelphia, Atlantic City and Allentown/Bethlehem areas. Their classification with respect to the old 1-hour standard is shown on the map in Figure 17. Now that the new 8-hour average standard for ozone has been upheld by the courts, new designations will have to be made.

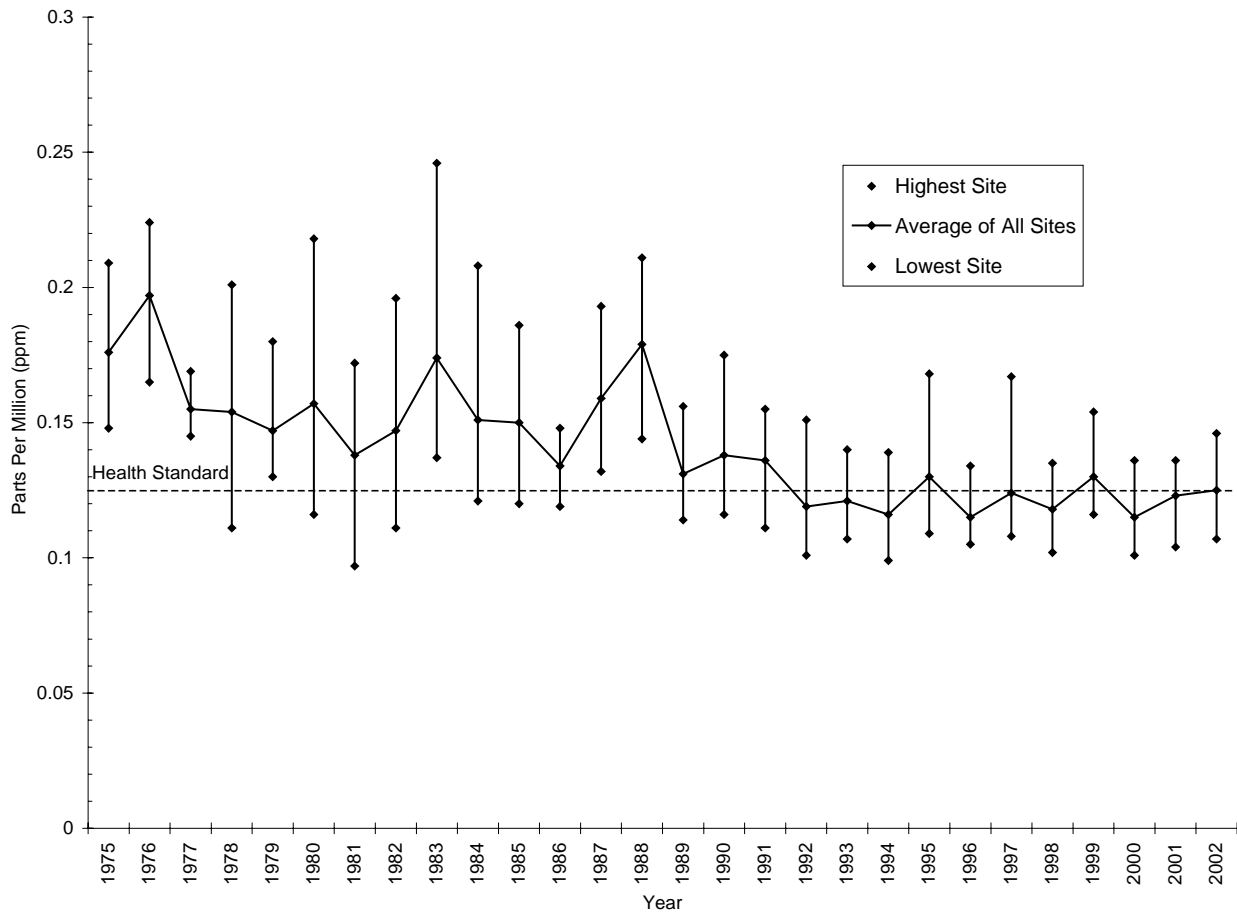
Figure 17
Ozone Non-Attainment Areas
in New Jersey



OZONE TRENDS

The primary focus of efforts to reduce concentrations of ground-level ozone in New Jersey has been on reducing emissions of volatile organic compounds (VOCs). Studies have shown that such an approach should lower peak ozone concentrations, and it does appear to have been effective in achieving that goal. Maximum 1-hour concentrations have not exceeded 0.20 ppm since 1988 and the last time levels above 0.18 ppm were recorded was in 1990 in Figure 18. But improvements may have leveled off in recent years, especially with respect to maximum 8-hour average concentrations. Significant further improvements will require reductions in both VOCs and NO_x. The NO_x reductions will have to be achieved over a very large region of the country because levels in New Jersey are dependent on emissions from upwind sources.

Figure 18
Ozone Concentrations in New Jersey
1975 – 2002
Second Highest 1-Hour Averages



REFERENCES

Ozone: Good Up High, Bad Nearby, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC October 1997, URL: www.epa.gov/oar/oaqps/gooduphigh/

USEPA Fact Sheet: *Health and Environmental Effects of Ground Level Ozone*, USEPA, Office of Air and Radiation, July 1997, URL: www.epa.gov/ttn/oarpg/naaqsf/o3health.html

Ryan, William, *Air Quality Forecast Report Philadelphia Forecast Area 2002*, Pennsylvania State University, Department of Meteorology, University Park, PA, March 2003, URL: http://www.meteo.psu.edu/~wfryan/phl_2002_final_report.htm

USEPA Ozone Map Archives, URL: www.epa.gov/airnow/maparch.html

Enhanced Ozone Monitoring – PAMS General Information, USEPA, 1994, URL: www.epa.gov/air/oaqps/pams/general.html

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/oar/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, RTP, September 2001, URL: www.epa.gov/oar/aqtrnd00/

Smog – Who Does it Hurt?, EPA-452/K-99-001, USEPA, Air and Radiation, Washington, DC, July 1999, URL: www.epa.gov/airnow/health/

Ozone and Your Health, EPA-152/F-99-000, USEPA, Air and Radiation, Washington, DC, September 1999, URL: www.epa.gov/airnow/brochure.html

Air Quality Guide for Ozone, EPA-456/F-002, Air and Radiation, Washington, DC, July 1999, URL: www.epa.gov/airnow/consumer.html



2002 PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

New Jersey Department of Environmental Protection

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

Most ground-level ozone is the result of oxides of nitrogen (NOx) and volatile organic compounds (VOCs) reacting in the presence of sunlight. As a result, it is necessary to measure these ozone forming pollutants, also known as precursor pollutants, to effectively evaluate strategies for reducing ozone levels. The Photochemical Assessment Monitoring Stations (PAMS) network was established for this purpose. Data from the PAMS network is used to better characterize the nature and extent of the O₃ problem, track VOC and NOx emission inventory reductions, assess air quality trends, and make attainment/nonattainment decisions. PAMS monitor both criteria and non-criteria pollutants including ozone (O₃), oxides of nitrogen (NOx), nitric oxide (NO), nitrogen dioxide (NO₂), and specific VOCs, including several carbonyls, that are important in ozone formation. In addition, the measurement of specific weather parameters (e.g. Wind speed/direction, temperature) is required at all PAMS, and upper air weather measurements are required in certain areas. The VOC and carbonyl measurements are only taken during the peak part of the ozone season, from June 1st to August 31st each year.

The PAMS network is designed around metropolitan areas where ozone is a significant problem, and each site in the network has a specific purpose as shown in the Figure 1 below. New Jersey is part of the Philadelphia and New York Metropolitan areas and has a total of three PAMS sites. A Type 3 maximum ozone site for the Philadelphia area is located at Rider University in Mercer County, a Type 2 maximum emissions site is located downwind of the Philadelphia Metropolitan urban area in Camden, and a site at Rutgers University in New Brunswick has been designated both a PAMS Type 1 upwind site for the New York urban area, as well as a Type 4 downwind site for the Philadelphia Metropolitan urban area. An upper air weather monitoring station is also located at the Rutgers University site. All of the PAMS sites for the Philadelphia and New York City areas are shown in Figure 2.

Figure 1

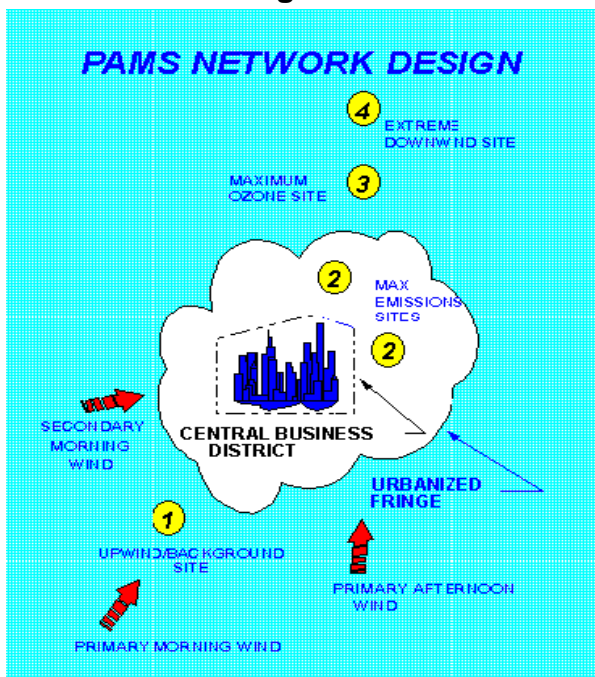


Figure 2

Regional PAMS Sites



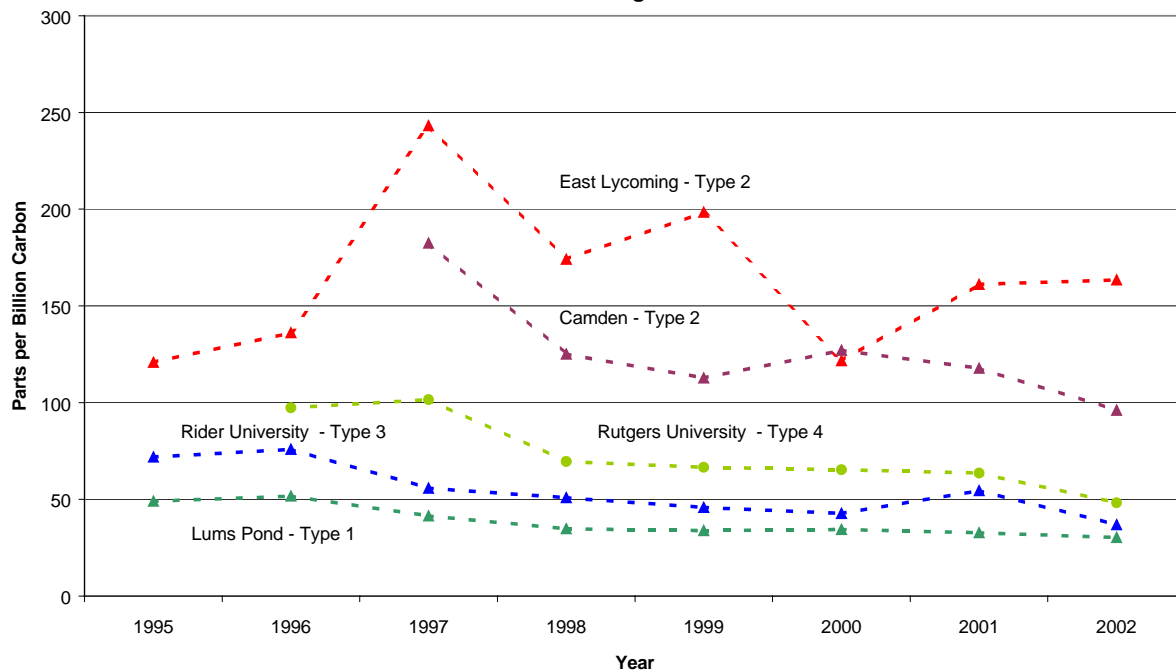
Note: Rutgers University PAMS site is both Type 4 for Philadelphia and Type 1 for New York City.

⁵ USEPA , PAMS General Information

PAMS (CONT.)

The theory behind the locations chosen for these sites is that with regard to ozone precursors, the Type 2 sites should be located so as to be directly impacted by emissions from the urban area. The other sites will show ozone precursor levels that are the result of transport into or out of the urban area. These levels are diminished by chemical reactions and enhanced by inputs from sources along the transport pathway, as well as being affected by local sources near the sites. Figure 3 shows VOC trends for the PAMS sites in the Philadelphia area. Relative levels of precursors are pretty much what might be expected based on the site Type, with levels being lower upwind of the urban area, highest in the urban area, and declining with distance downwind of the urban center. The trends over time show that at Lums Pond (upwind - Type 1), Rider University (maximum ozone concentration - Type 3) and Rutgers University (downwind - Type 4), VOCs have declined over the measurement period. The declines in ozone precursor levels were initially more steep, with more level, though still declining concentrations, over the last several years. The maximum emissions impact, ie., Type 2 sites (Camden and East Lycoming) for this area show a somewhat more complicated trend. For the Camden site, which is located at the site of maximum precursor level based on the second most predominant wind direction, the levels are lower than for the East Lycoming site. The concentrations seem to show a more steady declining trend similar to the other sites already discussed. This might be expected since these are seasonal average values, and over the course of a season this site is not downwind of the urban center as often as is the East Lycoming site. This site would also be expected to show variability more like the non-urban center sites, since the factors that influence the precursor levels at Camden are usually more similar to those sites. The East Lycoming site on the other hand, is located in the predominant downwind direction, and hence when considering average values, will be most impacted by the urban area. Urban areas have many ozone precursor point source emitters, while the other sites, particularly in the summer months, are largely impacted by transportation related sources as well as transport from the urban area. As might be expected then, the East Lycoming data shows the most year to year variation due to the variety of sources that impact it.

Figure 3
Philadelphia Region
Total Non-methane Organic Carbon (TNMOC)
Seasonal Average 1995-2002



PAMS (cont.)

Figure 4 shows VOC trends for the PAMS sites in the New York City metropolitan area. The Queens Community College site ceased operations after the 2001 season. In general, observations here are similar to those for the Philadelphia area. Relative levels of precursors are what might be expected, with the sites most impacted by the urban area having the highest levels. The Bronx Botanical Garden site, located in the most predominant downwind direction, has the highest levels and the greatest variability. The Queens Community College site, located in the second most predominant morning downwind directions, shows lower and less variable precursor levels, much like the Philadelphia region's Camden site. The Rutgers University and Sherwood Island State Park sites show relative levels and trends similar to the Type 1 and Type 3 sites in the Philadelphia region.

In conclusion, VOC values measured at nearly all PAMS sites in the Philadelphia and New York City areas declined during the time period these measurements were made. Changes in gasoline formulation over the period as well as the effect of newer, cleaner vehicles replacing older vehicles in the automotive fleet likely account for at least some of the reductions. Type 2 sites, though impacted by vehicle emissions, are also affected by urban stationary sources whose year to year variability and emission trends over the measurement period are less clear. All sites are also impacted by naturally occurring isoprene, which is emitted by trees. All VOCs are not equal in their contribution to ozone formation and while isoprene levels are generally lower than many other VOCs, its ozone forming potential is one of the highest, and isoprene might account for a significant amount of the ozone forming potential, especially at the non-urban sites. Isoprene levels are thought to be influenced by factors that affect tree health and growth, such as rainfall and severe temperatures.

Summaries of results for all the VOCs and carbonyls measured at the New Jersey PAMS sites are provided in Table 1 and Table 2.

Figure 4
New York City Region
Total Non-methane Organic Carbon (TNMOC)
Seasonal Average 1995-2002

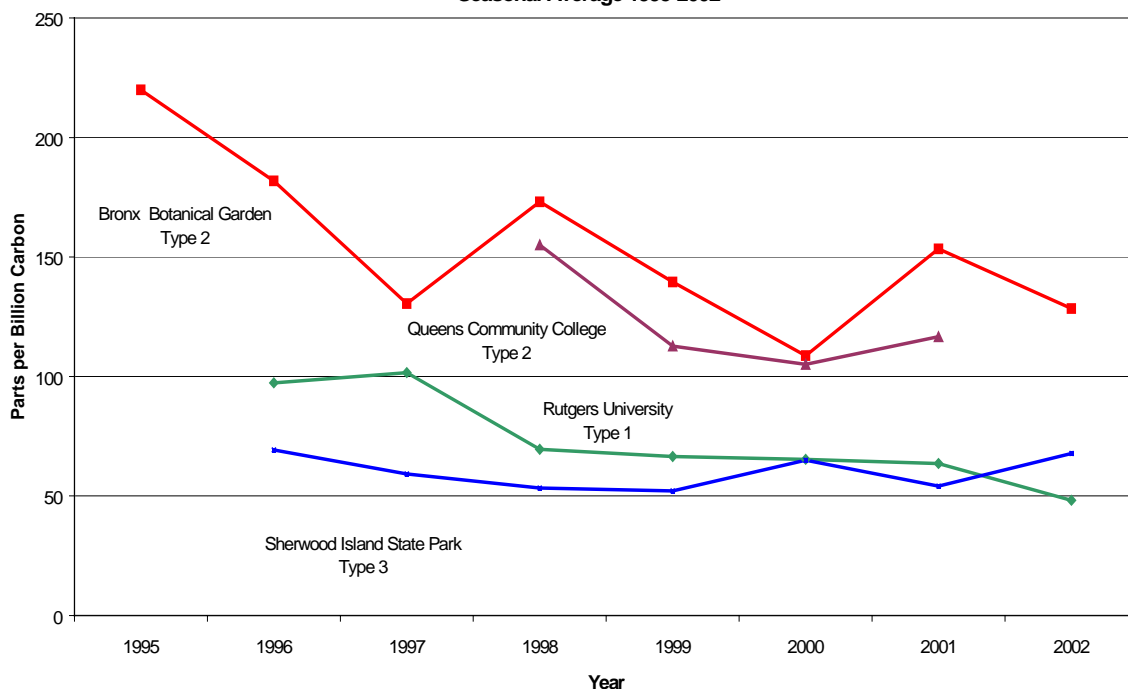


Table 1
Summary of Photochemical Assessment Monitoring (PAMS) Data
June, July, and August, 2002

Parts Per Billion (Volume) – ppbv
Parts Per Billion (Carbon) – ppbC
Max – Maximum Avg - Average

	Camden Lab				Rider University				Rutgers University			
	ppbv		ppbC		ppbv		ppbC		ppbv		ppbC	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
Acetylene	3.26	0.35	6.51	0.71	0.54	0.10	1.07	0.21	7.53	0.45	15.05	0.90
Benzene	2.66	0.27	15.96	1.64	0.73	0.15	4.35	0.88	0.87	0.14	5.22	0.84
n-Butane	63.37	1.51	253.46	6.04	3.66	0.41	14.63	1.62	4.46	0.53	17.84	2.11
1-Butene	1.87	0.12	7.49	0.47	0.13	0.03	0.53	0.13	0.29	0.04	1.16	0.18
cis-2-Butene	1.02	0.10	4.09	0.39	0.10	0.02	0.38	0.08	0.42	0.03	1.69	0.11
trans-2-Butene	1.27	0.10	5.07	0.38	0.11	0.03	0.43	0.10	0.39	0.03	1.56	0.12
Cyclohexane	3.26	0.14	19.57	0.85	0.25	0.04	1.51	0.22	0.20	0.03	1.18	0.20
Cyclopentane	1.76	0.09	8.78	0.46	0.17	0.05	0.84	0.24	0.24	0.04	1.22	0.21
n-Decane	0.55	0.07	5.49	0.66	0.14	0.02	1.44	0.23	0.25	0.03	2.46	0.28
m-Diethylbenzene	0.20	0.03	1.99	0.26	0.10	0.01	0.99	0.13	0.13	0.01	1.30	0.11
p-Diethylbenzene	0.35	0.04	3.45	0.38	0.06	0.01	0.56	0.12	0.10	0.01	0.96	0.14
2,2-Dimethylbutane	2.25	0.14	11.25	0.68	0.15	0.03	0.73	0.17	0.43	0.04	2.15	0.21
2,3-Dimethylbutane	2.10	0.15	10.48	0.77	0.26	0.06	1.32	0.29	0.54	0.07	2.68	0.34
2,3-Dimethylpentane	1.05	0.08	7.34	0.58	0.20	0.04	1.38	0.29	0.22	0.04	1.53	0.26
2,4-Dimethylpentane	1.02	0.07	7.11	0.52	0.12	0.03	0.87	0.23	0.19	0.03	1.33	0.19
Ethane	32.48	3.34	64.95	6.68	6.63	2.01	13.25	4.02	14.94	2.56	29.88	5.12
Ethylbenzene	1.42	0.09	11.38	0.70	1.41	0.04	11.25	0.33	0.43	0.05	3.41	0.36
Ethylene (Ethene)	10.50	1.12	21.00	2.24	1.91	0.35	3.82	0.71	11.29	1.06	22.57	2.12
m-Ethyltoluene	1.19	0.08	10.70	0.68	0.22	0.02	1.98	0.22	0.45	0.05	4.04	0.41
o-Ethyltoluene	0.41	0.04	3.66	0.33	0.05	0.01	0.49	0.12	0.12	0.02	1.04	0.14
p-Ethyltoluene	0.53	0.08	4.81	0.68	0.26	0.04	2.37	0.33	0.21	0.02	1.89	0.15
n-Heptane	1.80	0.13	12.58	0.91	0.34	0.05	2.37	0.36	0.48	0.05	3.36	0.37
Hexane	8.83	0.31	53.00	1.88	0.58	0.12	3.50	0.70	1.75	0.12	10.47	0.70
1-Hexene	0.32	0.04	1.93	0.27	0.40	0.03	2.42	0.15	0.11	0.01	0.63	0.07
Isobutane	33.03	1.05	132.12	4.20	2.24	0.27	8.96	1.09	4.25	0.32	17.01	1.29
Isopentane	39.83	1.55	199.15	7.77	2.92	0.53	14.58	2.66	7.19	0.66	35.97	3.30
Isoprene	2.33	0.20	11.64	0.99	3.50	0.25	17.49	1.27	6.80	0.60	34.00	2.98
Isopropylbenzene	1.11	0.11	9.96	1.01	0.25	0.02	2.25	0.18	0.13	0.01	1.21	0.13
Methylcyclohexane	2.94	0.13	20.60	0.90	0.35	0.04	2.45	0.30	0.40	0.04	2.78	0.28
Methylcyclopentane	3.74	0.18	22.44	1.09	0.34	0.07	2.05	0.41	0.49	0.07	2.95	0.42
2-Methylheptane	0.48	0.05	3.80	0.41	0.11	0.02	0.84	0.14	0.23	0.02	1.84	0.15
3-Methylheptane	0.59	0.05	4.71	0.36	0.12	0.02	0.92	0.16	0.14	0.02	1.10	0.17
2-Methylhexane	1.15	0.12	8.08	0.84	0.25	0.05	1.78	0.36	0.30	0.05	2.13	0.36

Table 1 (Continued)
Summary of Photochemical Assessment Monitoring (PAMS) Data
June, July, and August, 2002

	Camden Lab				Rider University				Rutgers University			
	ppbv		ppbC		ppbv		ppbC		ppbv		ppbC	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
3-Methylhexane	1.26	0.14	8.79	1.00	0.33	0.06	2.32	0.43	0.38	0.06	2.63	0.43
2-Methylpentane	8.33	0.42	49.97	2.49	0.68	0.14	4.09	0.86	1.47	0.17	8.83	1.03
3-Methylpentane	5.46	0.26	32.73	1.56	0.46	0.10	2.73	0.58	0.94	0.11	5.62	0.67
n-Nonane	0.35	0.06	3.17	0.52	0.14	0.02	1.27	0.21	0.28	0.02	2.52	0.22
n-Octane	0.79	0.07	6.33	0.59	0.29	0.03	2.30	0.22	0.28	0.03	2.26	0.24
n-Pentane	32.28	0.80	161.42	4.01	1.69	0.26	8.47	1.29	3.57	0.36	17.84	1.78
1-Pentene	0.40	0.07	2.01	0.34	0.09	0.02	0.45	0.10	0.31	0.03	1.53	0.14
cis-2-Pentene	0.39	0.07	1.94	0.33	0.08	0.02	0.41	0.08	0.32	0.02	1.61	0.11
trans-2-Pentene	0.78	0.09	3.92	0.45	0.13	0.02	0.66	0.11	0.64	0.03	3.20	0.17
Propane	180.02	3.64	540.05	10.93	10.32	1.32	30.97	3.96	10.10	1.57	30.30	4.71
n-Propylbenzene	0.33	0.03	2.98	0.31	0.05	0.01	0.49	0.13	0.10	0.02	0.94	0.14
Propylene (Propene)	16.47	0.83	49.41	2.50	2.27	0.24	6.81	0.72	2.71	0.36	8.12	1.09
Styrene	0.57	0.04	4.56	0.33	0.09	0.02	0.74	0.16	0.08	0.02	0.67	0.15
Toluene	13.81	0.56	96.67	3.94	4.92	0.34	34.41	2.38	13.66	0.73	95.62	5.09
1,2,3-Trimethylbenzene	0.50	0.08	4.49	0.73	0.36	0.04	3.26	0.37	0.39	0.04	3.51	0.35
1,2,4-Trimethylbenzene	1.74	0.08	15.66	0.73	0.21	0.03	1.93	0.31	0.57	0.05	5.10	0.47
1,3,5-Trimethylbenzene	0.76	0.05	6.83	0.46	0.11	0.02	1.02	0.20	0.21	0.03	1.89	0.23
2,2,4-Trimethylpentane	5.94	0.19	47.49	1.53	0.61	0.09	4.87	0.69	0.91	0.11	7.25	0.89
2,3,4-Trimethylpentane	2.53	0.07	20.24	0.55	0.31	0.03	2.50	0.25	0.31	0.04	2.44	0.29
n-Undecane	0.35	0.05	3.89	0.57	0.12	0.02	1.30	0.20	0.17	0.02	1.83	0.21
m/p-Xylene	5.51	0.24	44.04	1.90	4.06	0.11	32.44	0.91	1.45	0.14	11.58	1.13
o-Xylene	1.94	0.10	15.54	0.82	0.89	0.05	7.09	0.37	0.47	0.05	3.78	0.41

Table 2
Camden Lab
PAMS Carbonyls
June, July, and August, 2002
Parts Per Billion (Volume)
28 Sampling Dates (224 Observations)

	# of Detects*	Max	Avg		# of Detects	Max	Avg
Acetaldehyde	224	5.03	1.60	Formaldehyde	224	13.09	4.88
Acetone	224	49.5	7.51	Hexaldehyde	186	0.50	0.07
Benzaldehyde	217	0.31	0.08	Isovaleraldehyde	26	0.04	0.00
Butyr/Isobutyraldehyde	188	1.11	0.22	Propionaldehyde	158	0.47	0.08
Crotonaldehyde	203	1.59	0.07	Tolualdehyde	211	0.20	0.05
2,5-Dimethylbenzaldehyde	4	0.02	0.00	Valeraldehyde	224	0.47	0.06

* The number of samples, out of a possible 224, in which the compound was detected.



2002 Particulate Summary

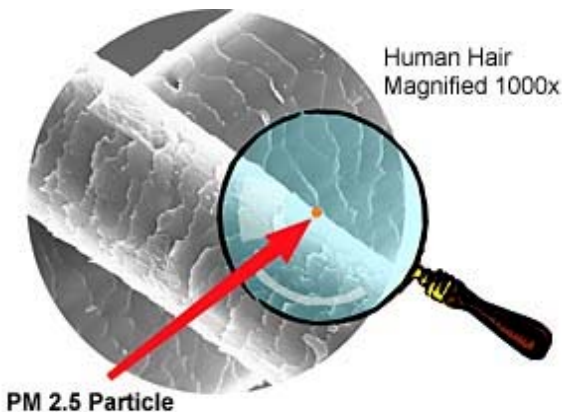
New Jersey Department of Environmental Protection

NATURE AND SOURCES

Particulate air pollution consists of both solid particles and liquid droplets suspended in the atmosphere. Suspended particles can range in size from 70 microns in diameter, approximately the size of a pinhead, to less than 1 micron in diameter. Particles can be directly emitted, or they can form in the atmosphere from gaseous emissions, such as sulfur dioxide (SO₂) and oxides of nitrogen (NO_x). Particles that originate as gases are referred to as secondary particulates.

Particulate matter is generally categorized according to the size of the particles. Coarse particles are defined as particles greater than 2.5 microns in diameter, while particles less than 2.5 microns in diameter are referred to as fine particles (PM_{2.5}) (See Figure 1). Coarse particles are further subdivided into Total Suspended Particulates (TSP), which include all but the largest particles, and PM₁₀, which include particles less than 10 microns in diameter. The human respiratory tract will usually trap particles above about 10 microns in diameter before they reach the lungs. Particles smaller than 10 microns (PM₁₀) are inhalable and are considered to be more harmful to human health than larger particles; fine particles are considered to be even more harmful as they can reach the deep recesses of the lungs.

Figure 1
Size of PM_{2.5} Particle Compared to a Human Hair



Graphics Courtesy of the US Department of Energy

Both fine and coarse particles have anthropogenic, or man-made, as well as natural sources. Anthropogenic sources of coarse particles include industrial processes such as grinding operations, while anthropogenic sources of fine particles include soot from fuel combustion, and secondary particle formation from organic compounds, biomass burning, and emissions of sulfur dioxide (SO₂) and oxides of nitrogen (NO_x). Natural sources of coarse particles include windblown dust, sea salt, and biological debris; and natural sources of fine particles include biogenic gases, which result in the formation of secondary particles.

ENVIRONMENTAL EFFECTS

In addition to health effects, particulate matter is the major cause of reduced visibility in many parts of the United States. Figure 2 provides an example of reduced visibility recorded by our WebCam site in Newark (accessible via the Internet at www.state.nj.us/dep/airmon). Airborne particles can also impact vegetation and aquatic ecosystems, and can cause damage to paints and building materials. More information is provided in the Regional Haze section of this report.

Figure 2
Visibility WebCam



HEALTH EFFECTS

Inhalable particles (PM₁₀) and especially fine particles (PM_{2.5}) are a health concern because they easily reach the deepest recesses of the lungs. Various health problems are associated with both long and short-term exposures. When inhaled, these particles can accumulate in the respiratory system and are associated with increased hospital admissions and emergency room visits for heart and lung conditions, such as asthma, bronchitis, cardiac arrhythmias, heart attacks, and even premature death. Groups that appear to be at the greatest risk from particulates include children, the elderly, and individuals with heart and lung diseases, such as asthma (*US EPA, 2001*).

STANDARDS

In 1971, EPA set primary (health based) and secondary (welfare based) standards for total suspended particulate matter (TSP). These standards, known as the National Ambient Air Quality Standards (NAAQS), were based on maximum 24-hour and annual concentrations (*US EPA, 1997*). The annual standards were based on the geometric mean concentrations over a calendar year, and the 24-hour standards were based on the arithmetic average concentration from midnight to midnight. The primary 24-hour average standard for TSP was set at 260 micrograms per cubic meter (µg/m³) and the annual geometric mean health standard was set at 75 µg/m³. The 24-hour secondary standard was set at 150 µg/m³. While EPA did

not establish a secondary annual standard for TSP they did set a guideline of 60 µg/m³ to be used to ensure that the secondary 24-hour standard was being met throughout the year. Although New Jersey still maintains state standards for TSP, the national standards have been replaced with standards for smaller particles as described below. As a result, monitoring for TSP has largely been discontinued, with the exception of one station, where TSP samples are taken to analyze for lead (Pb). See the Lead Summary section for more details.

In 1987, EPA replaced the TSP standards with standards that focused only on inhalable particles. Inhalable particles are defined as particles less than 10 microns in diameter (PM₁₀). The 24-hour PM₁₀ primary and secondary standards were set at 150 µg/m³, and the annual primary and secondary standards were set at 50 µg/m³. The annual standard for PM₁₀ is based on the arithmetic mean, as opposed to the geometric mean that was used for TSP.

In 1997, EPA promulgated new standards for fine particulates, which it defined as particles less than 2.5 microns in diameter (PM_{2.5}). They kept the existing standards for PM₁₀ as well. The PM_{2.5} annual primary and secondary standards were set at 15 µg/m³ and the 24-hour standard was set at 65 µg/m³. Table 1 provides a summary of the Particulate Matter standards.

**Table 1
National and New Jersey
Ambient Air Quality Standards for Particulate Matter**

Micrograms Per Cubic Meter (µg/m³)

Standard	Averaging Period	Type	New Jersey	National
Total Suspended Particulates (TSP)	12-Month [‡]	Primary	75 µg/m ³	---
	24-Hour	Primary	260 µg/m ³	---
	12-Month [‡]	Secondary	60 µg/m ³	---
	24-Hour	Secondary	150 µg/m ³	---
Inhalable Particulates (PM ₁₀)	Annual [†]	Primary & Secondary	---	50 µg/m ³
	24-Hour Average	Primary & Secondary	---	150 µg/m ³
Fine Particulates (PM _{2.5})	Annual [†]	Primary & Secondary	----	15 µg/m ³
	24-Hour Average	Primary & Secondary	----	65 µg/m ³

[‡] Annual Geometric Mean

[†] Annual Arithmetic Mean

PARTICULATE MONITORING NETWORK

New Jersey's Particulate Monitoring Network consists of 20 fine particulate monitoring sites, 8 PM₁₀ monitoring sites, 1 TSP monitoring site, and 11 sites where smoke shade is monitored.

At some of these sites, samplers that comply with strict EPA specifications are used for collecting data that are submitted to a national database maintained by the EPA. These filter-based samplers, which are approved by the EPA and known as Federal Reference Method (FRM) samplers, collect particles on a filter over a 24-hour period. The filters are subsequently weighed under controlled environmental conditions. The data from the FRM samplers are used by the NJDEP and EPA to determine whether the state, or portions of the state, meet the federal health and welfare particulate standards. Because the FRM samplers do not provide data in real time, the NJDEP employs additional samplers that continuously measure particulate concentrations. These samplers are used by the NJDEP to report current air

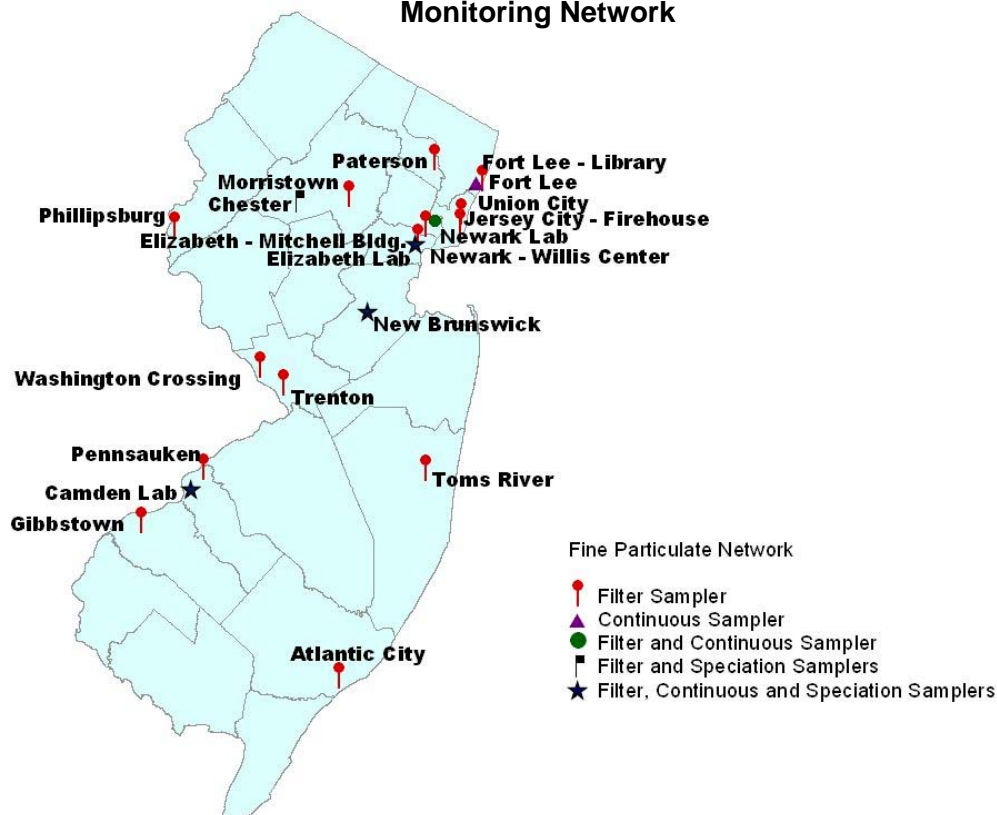
quality to the public through the Air Quality Index (www.state.nj.us/dep/airmon). The NJDEP uses Tapered Element Oscillating Microbalance (TEOM) analyzers and smoke shade instruments for real-time particle reporting. The TEOM analyzers collect a sample of fine particles on an oscillating filter, and determine the concentration based on the change in the frequency at which the filter oscillates. Smoke shade instruments collect a sample of particles on a paper tape for one hour. At the end of each hour the amount of light that will pass through the spot that has formed on the tape is measured, the tape advanced, and the cycle started over. The amount of light transmittance measured is used as an estimate of actual particle concentrations.

FINE PARTICLE SUMMARY

FINE PARTICLE MONITORING SITES

There are 20 monitoring sites in New Jersey where an FRM, collects a PM_{2.5} 24-hour sample (see Figure 3). At 5 sites, continuous particulate monitors measure the

Figure 3
2002 PM_{2.5}
Monitoring Network



concentration of fine particles every minute and transmit the data to the Bureau of Air Monitoring's central computer, where it is made available on the Bureau's Public Website (www.state.nj.us/dep/airmon). Additionally, at four of these locations a separate sampler collects fine particles on three types of filter media which are subsequently analyzed using ion chromatography (IC), X-ray fluorescence (XRF), and Thermal Optical Analysis (TOA) to determine the concentrations of the chemical analytes that constitute the sample.

FINE PARTICLE CONCENTRATION SUMMARY

The annual mean concentration of PM_{2.5} ranged from 11.1 µg/m³ in Chester to 15.1 µg/m³ at Elizabeth Lab. Each site recorded its maximum 24-hour concentration on July 7th during the forest fire episode, with the exception of the Union City and Elizabeth (Mitchell) site, which did not record a reading on that date. During this episode, fine particle concentrations ranged from 66.0 µg/m³ in Washington Crossing State Park to 106.7 µg/m³ in Atlantic City. Due to the rare nature of this event, the concentrations during this

episode were flagged as being affected by an exceptional event, and are not used in the planning process. More information on the forest fire episode is presented later in this section. Excluding this event, maximum 24-hour concentrations ranged from 37.2 µg/m³ at Fort Lee to 59.0 µg/m³ at Elizabeth Lab. Figure 4 and Table 2 depict the mean and maximum concentrations at each site.

Three years of data are required to determine compliance with the NAAQS for PM_{2.5}. NJDEP will be evaluating PM_{2.5} data collected to date in making its final determination as to whether the annual NAAQS are being met.

Figure 4
2002 Fine-Particulate Concentrations

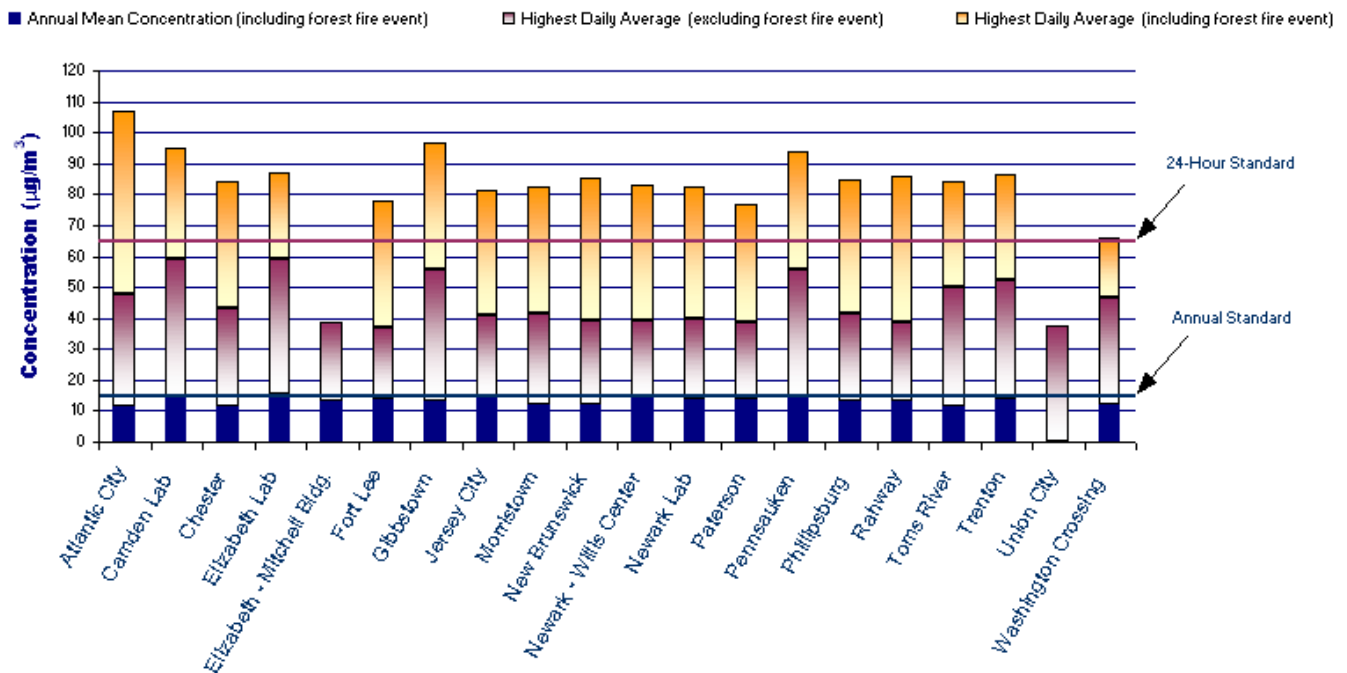


Table 2
PM_{2.5} Summary Data – 2002

Concentration in Micrograms Per Cubic Meter (µg/m³)

Monitoring Site	Number of Samples	Annual Mean [†]	Maximum Daily Average During Forest Fire Episode	Maximum Daily Average Excluding Forest Fire Episode
Atlantic City	114	11.6	106.7	47.7
Camden Lab	114	14.0	95.0	58.9
Chester	114	11.1	83.9	43.5
Elizabeth Lab	330	15.1	86.8	59.0
Elizabeth (Mitchell) ^a	110	13.1	*****	38.4
Fort Lee	119	13.5	77.8	37.2
Gibbstown	109	13.0	96.9	55.8
Jersey City	116	14.9	81.3	41.0
Morristown	115	12.1	82.6	41.5
New Brunswick	103	11.8	85.5	39.3
Newark (Willis Center)	115	14.6	83.1	39.1
Newark Lab	112	13.7	82.4	40.0
Paterson	114	13.4	76.5	38.8
Pennsauken	109	14.6	94.1	55.8
Phillipsburg	117	13.3	84.8	41.3
Rahway	200	13.1	86.0	38.9
Toms River	117	11.5	84.0	50.0
Trenton	106	13.7	86.2	52.2
Union City ^b	21	*****	*****	37.6
Washington Crossing	112	12.0	66.0	46.6

[†] Annual average includes forest fire event

^a Indicates site did not run during the forest fire episode

^b Indicates site did not run during the forest fire episode; and data was unavailable March 15 through December 31

PM_{2.5} REAL-TIME MONITORING

New Jersey's continuous PM_{2.5} monitoring network consists of 5 sites: Camden Lab, Elizabeth Lab, Fort Lee, New Brunswick, and Newark Lab. The data is transmitted once a minute to a central computer in Trenton, where it is averaged and automatically updated on the bureau's website every hour. Table 3 provides a summary of the data from these sites and Figure 5 depicts the health level associated with the maximum daily fine particulate concentration recorded in the state each day for the entire year.

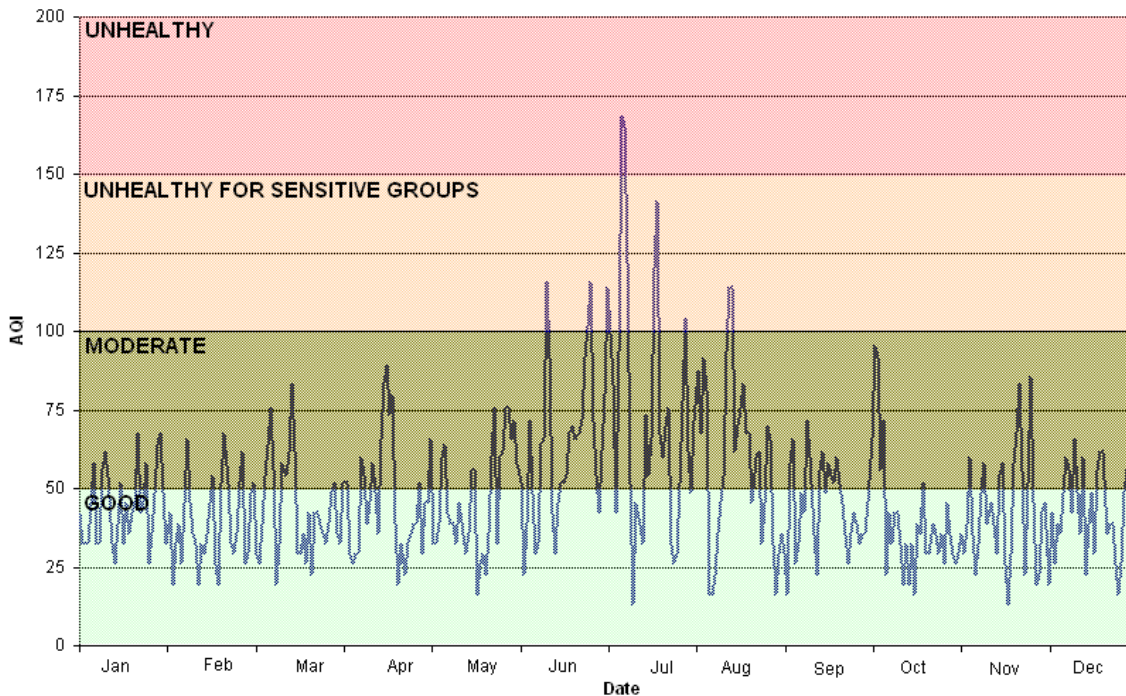
**Table 3
2002 Summary of Continuous PM2.5 Data**

Concentration in Micrograms Per Cubic Meter (µg/m³)

Monitoring Site	Maximum Daily Average	2 nd Highest Daily Average	Annual Mean
Camden Lab	96	90	14
Elizabeth Lab	85	58	15
Fort Lee ^a	48	38	---
Newark Lab	81	52	14
New Brunswick	84	65	12

^a Data unavailable June 30th through August 30th

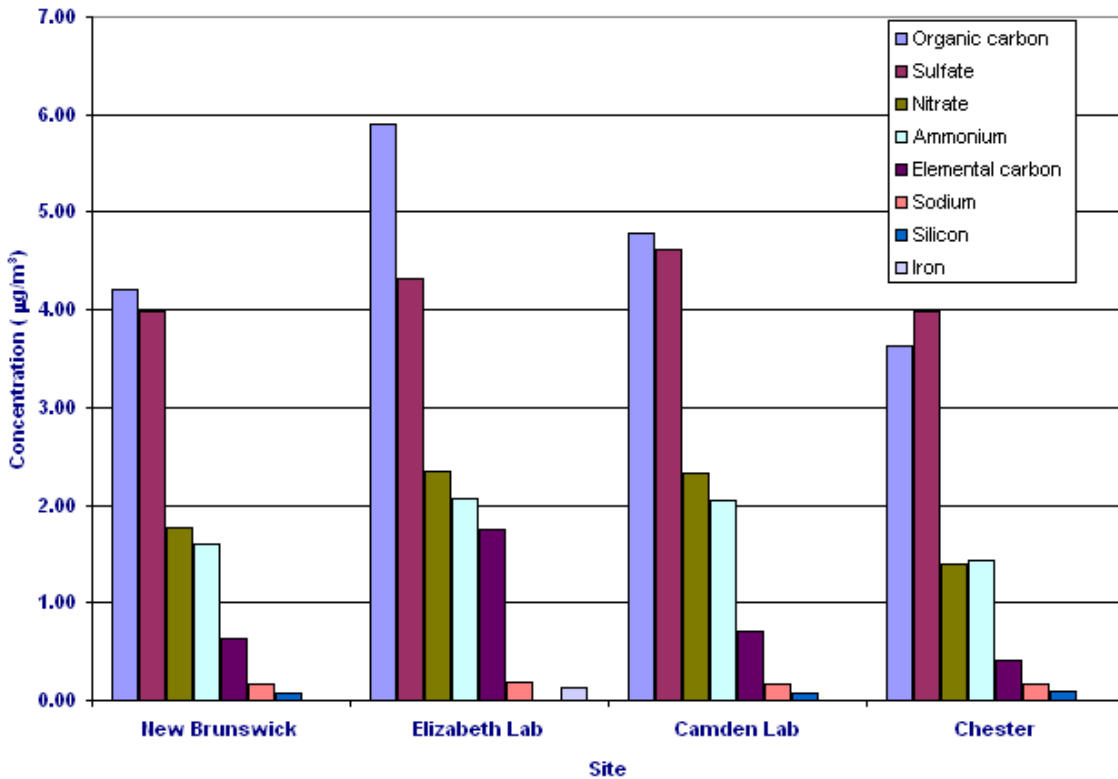
**Figure 5
Maximum Daily Fine Particulate Air Quality Index (AQI)**



FINE PARTICLE SPECIATION SUMMARY

New Jersey's Fine Particulate Speciation Network consists of 4 monitoring sites: Camden Lab, Elizabeth Lab, New Brunswick, and Chester. Samplers run every third day on a schedule concurrent with the FRM sampling network. Of the 55 measured analytes, organic carbon and sulfate combined make up over 60% of the total mass, and nitrate, ammonium, and elemental carbon make up an additional 38% (98% total) of the particulate mass. Figure 6 shows the average concentration of each analyte, with only the eight most prevalent constituents depicted. Appendix B shows the average, maximum, and 2nd highest concentrations for each compound for 2002.

Figure 6
2002 -Average Fine Particle Analyte Concentrations
(Highest 7 Analytes at Each Site)

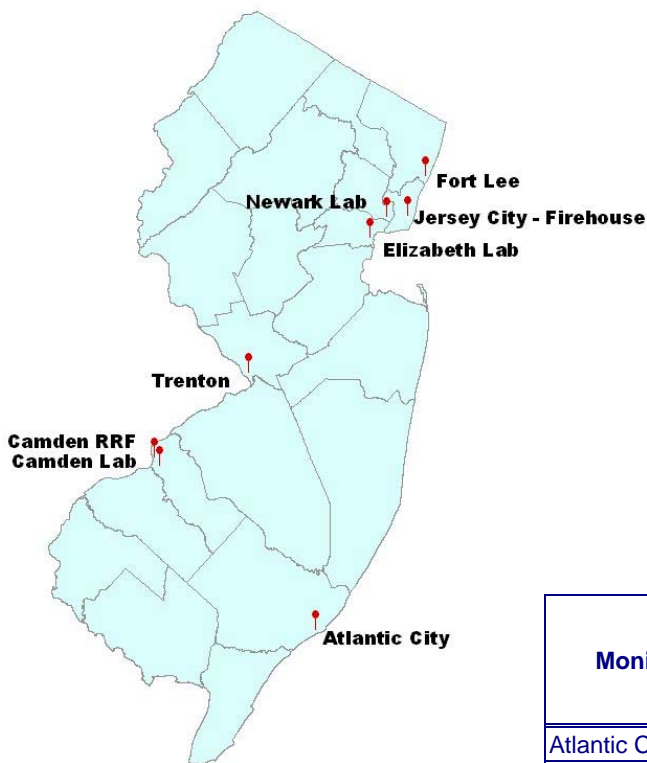


2002 COARSE PARTICLE SUMMARY

COARSE PARTICLE MONITORING SITES

The coarse particulate monitoring network is composed of PM₁₀ sampling sites and TSP sampling sites. Samples are collected on a filter, which is weighed before and after sampling. The amounts of Sulfate and Nitrate are measured on some PM₁₀ samples and Lead is measured on the TSP samples. Figure 7 depicts the PM₁₀ particulate monitoring network in New Jersey.

**Figure 7
2002 PM₁₀
Monitoring Network**



TSP CONCENTRATION SUMMARY

New Jersey currently operates one site, located in New Brunswick, mainly for the purpose of determining the concentration of lead in the atmosphere. For more information, see the 2002 Lead Summary section. In 2002, the annual geometric mean concentration of TSP in New Brunswick was 28.1 µg/m³, and the maximum 24-hour concentration recorded was 139 µg/m³. The site was in attainment for the primary and secondary annual TSP standards of 75 µg/m³ and 60 µg/m³ respectively, and the site did not surpass the 24-hour primary standard of 260 µg/m³ or the 150 µg/m³ secondary standard.

PM₁₀ CONCENTRATION SUMMARY

In 2002, the annual mean concentration of PM₁₀ ranged from 21.4 µg/m³ at Trenton to 36.8 µg/m³ at Camden RRF. Table 4 and Figure 8 show the annual mean and 24-hour maximum PM₁₀ concentrations throughout the state. All areas of the state are in attainment for the annual PM₁₀ standard of 50 µg/m³, and no sites surpassed the 24-hour standard of 150 µg/m³.

**Table 4
PM10 Data-2002
24-Hour and Annual Averages**

Micrograms Per Cubic Meter (µg/m³)
24-Hour Standard = 150 µg/m³
Annual Standard = 50 µg/m³

Monitoring Site	24-Hour Average During Forest Fire	24-Hour Maximum Excluding Forest Fire	Annual Average [†]
Atlantic City	147	66	22.7
Camden Lab ^a	****	73	24.4
Camden RRF #1	149	92	36.8
Elizabeth Lab	114	84	30.2
Fort Lee ^b	****	60	****
Jersey City - Firehouse	110	72	29.2
Newark Lab	98	60	25.0
Trenton	101	70	21.4

[†] Annual average includes forest fire event

^a There was no sample during the forest fire event

^b Data unavailable June 30th through August 30th (no sample during forest fire)

Figure 8
Summary of PM₁₀ Concentrations, New Jersey 2002

■ Annual Mean Concentration (including the fire data) ■ Highest Daily Average (excluding the fire data) □ Highest Daily Average (including the fire data)

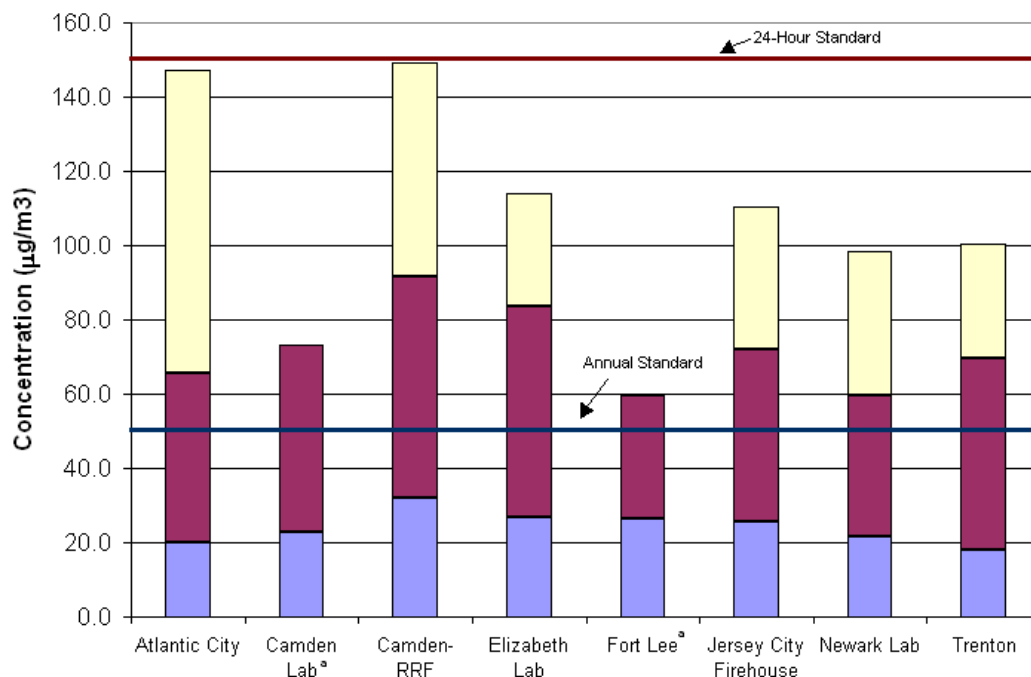


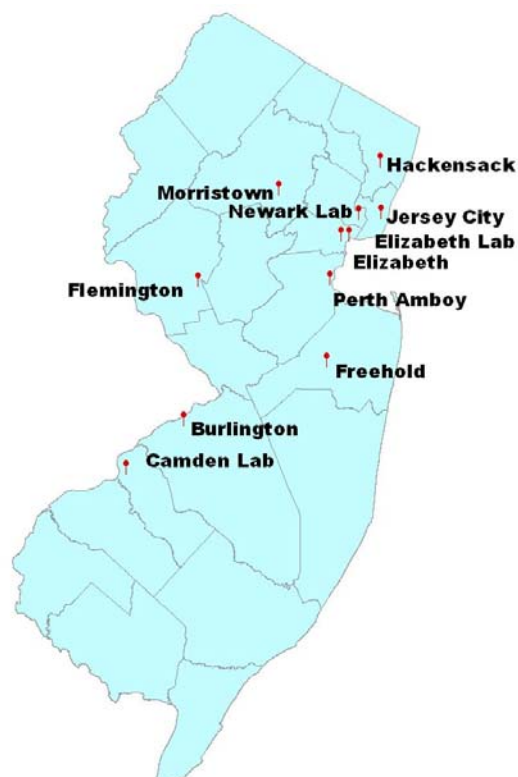
Figure 9
2002 Smoke Shade Monitoring Network

The concentration of Sulfates and Nitrates were also analyzed on some PM₁₀ filters. The results showed that, on average, about 2% percent of PM₁₀ is nitrate and about between 11% and 15% percent is sulfate. The contributions of sulfate and nitrate to PM₁₀ are significantly less than their contributions to PM_{2.5}. This is because PM₁₀ is predominantly made up of larger particles most of which are directly emitted into the atmosphere. PM_{2.5} is predominantly a secondary pollutant, forming in the atmosphere from gaseous emissions, such as SO₂ and NO_x. For more details on the PM₁₀ sulfate and nitrate results, see the section on atmospheric deposition.

SMOKE SHADE SUMMARY

SMOKE SHADE MONITORING SITES

In addition to fine and coarse particulate monitoring, smoke shade is also monitored at 11 stations around the state. Smoke shade, which is an indirect measurement of particles in the atmosphere, has been monitored in New Jersey for over 30 years. Smoke shade is primarily used for the daily reporting of particulate levels in the Air Quality Index. The sites monitoring smoke shade are shown in Figure 9.



SMOKE SHADE CONCENTRATION SUMMARY

In 2002, the annual mean concentration of smoke shade ranged from 0.14 Coefficient of Haze units (COH) at Flemington to 0.64 COH at Elizabeth Lab. COH are units of light transmittance and smoke shade is not a direct measure of particle mass. A 24-hour average level of 2.0 COH is used as a benchmark. Readings above the 2.0 COH benchmark are reported as Unhealthy for Sensitive Groups on the daily Air Quality Index. For more details see the Air Quality Index section of this report. Table 5 lists the maximum and second highest daily average and annual mean smoke shade levels recorded at the monitoring sites in 2002.

**Table 5
Smoke Shade - 2002**

Coefficient of Haze (COHs)

Site	Maximum 24-Hour Average	2nd Highest	Annual Mean
Burlington	0.65	0.61	0.18
Camden Lab ^a	0.77	0.51	----- ^b
Elizabeth	1.41	1.12	0.32
Elizabeth Lab	1.94	1.69	0.64
Flemington	0.72	0.62	0.14
Freehold	0.79	0.63	0.21
Hackensack	0.78	0.73	0.23
Jersey City	1.51	1.32	0.47
Morristown	0.68	0.61	0.21
Newark Lab	1.06	0.91	0.30
Perth Amboy	0.70	0.65	0.23

^a There was no sampling during the forest fire event

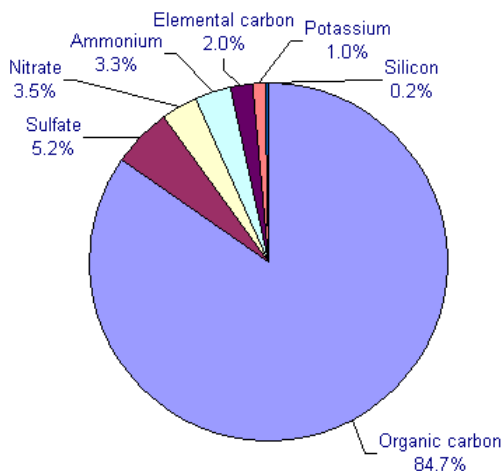
^b Insufficient data

CANADIAN FOREST FIRE EPISODE

A July 2nd lightning storm ignited as many as 85 separate fires in 2 areas southeast of James Bay in Quebec, Canada. The fires were in a region approximately 200-400 miles north of the U.S. border, and destroyed more than 250,000 acres of forest. Ten of the fires burned out of control for days. On July 7th, 2002 northwesterly winds carried the plume of smoke over parts of the Northeast United States, including New Jersey, prompting health advisories. The smoke plume reached as far south as Washington D.C.

During this episode New Jersey recorded its highest PM_{2.5} concentrations on record, with the highest concentrations being reported in the Southern Delaware Valley and Southern Coastal regions. The highest FRM reading was recorded in Atlantic City, which recorded a 24-hour concentration of 106.7 µg/m³. The 1-hour average TEOM levels reached as high as 159 µg/m³ at the Camden Lab. As expected, Organic Carbon was the most prevalent compound, contributing between 86% and 89% of the PM_{2.5} particle mass. Typically organic carbon makes up between 34% and 36% of the total PM_{2.5} particulate mass (Figure 10 & Figure 11).

**Figure 10
Speciated PM_{2.5} Particles at Camden Lab New Jersey 7/7/02
(Canadian forest fire)**



**Figure 11
Speciated Fine Particles at Camden Lab New Jersey 2002**

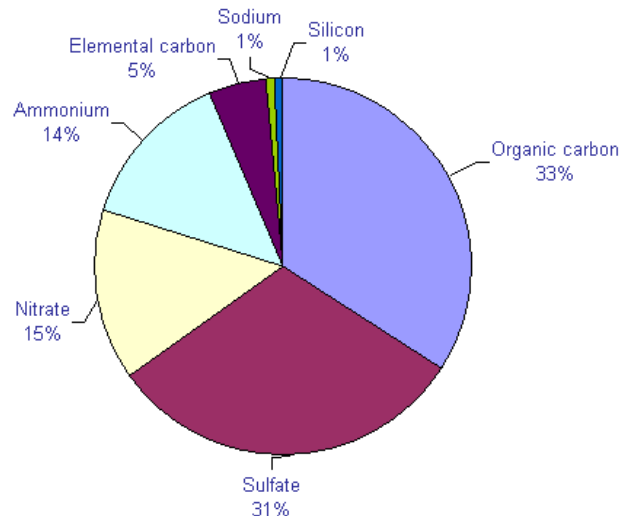
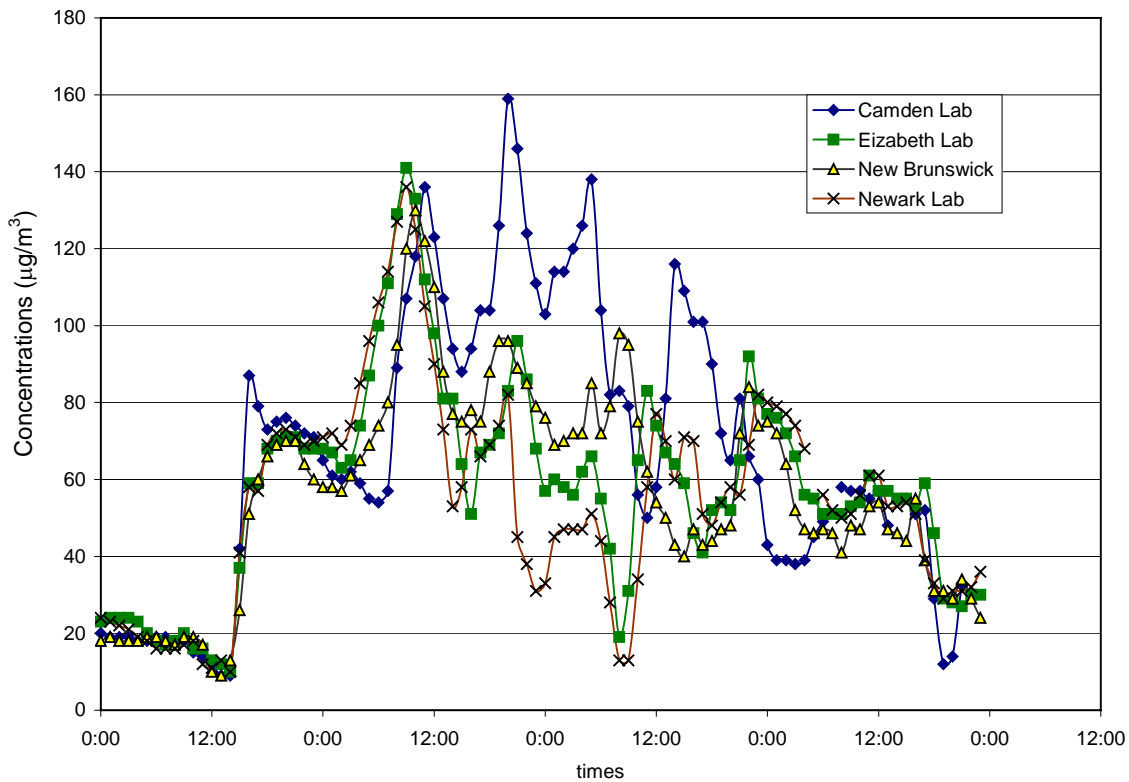


Figure 12 depicts the average hourly particulate concentrations, illustrating the duration and intensity of the particulate concentrations during this episode.

In the southern and central sections of the state fine particle levels remained at an unhealthy level the following day. Camden Lab recorded a 24-hour average TEOM concentration of $90 \mu\text{g}/\text{m}^3$, while New Brunswick recorded a 24-hour average of $65 \mu\text{g}/\text{m}^3$. TEOM readings at Elizabeth Lab and Newark Lab were slightly below $65 \mu\text{g}/\text{m}^3$, the cutoff level for unhealthy particle concentrations. On July 9th, changing winds cleared out the remaining smoke and the particulate levels returned to more normal summertime concentrations.

Figure 12
Hourly PM2.5 Data from Forest Fire Episode
(7/6/02-7/9/02)

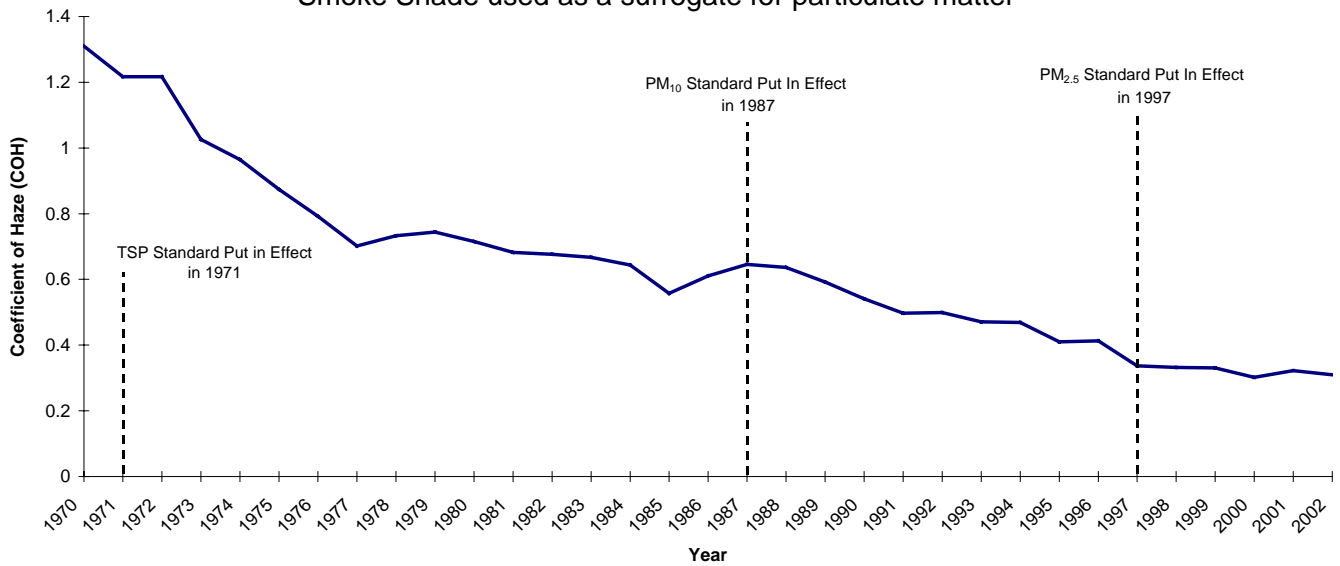


TRENDS IN PARTICULATE CONCENTRATIONS

The longest continuously operating particle monitoring network in the state that is suitable for looking at trends is the smoke shade network. As noted earlier, this monitoring program has been in effect for over thirty years and still has 11 active sites. The trend graph for smoke shade, shown in Figure 13 indicates that particulate levels have steadily declined over the past thirty years. Smoke shade is not a direct measurement of particle mass, but can be related to TSP, PM₁₀ and PM_{2.5} health standards.

Figure 13
Long Term Trend in Particulate Levels
1970 - 2002

Smoke Shade used as a surrogate for particulate matter



REFERENCES

PM – How Particulate Matter Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC November 2000, URL: www.epa.gov/air/urbanair/pm/index.html

Air Quality Criteria for Particulate Matter, USEPA, Office of Research and Development, EPA-600/P-99-002A and B, March 2001

Environmental Health Threats to Children, USEPA, Office of the Administrator, EPA-176/F-96-001, September 1996.

National Ambient Air Quality Standards for Particulate Matter, Final Rule, USEPA, Part 50 of Title 40 of the Code of Federal Regulations, July 1997.

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/airtrends/reports.html

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, September 2001, URL: www.epa.gov/airtrends/reports.html

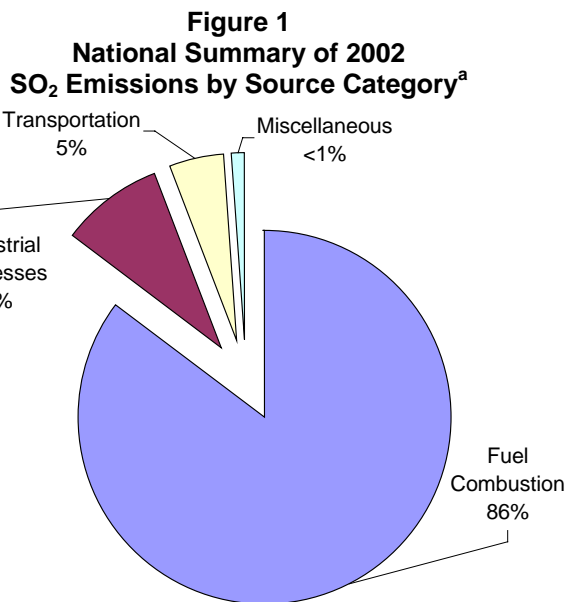


2002 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Sulfur dioxide (SO₂) is a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO₂ gases can be formed when fuel containing sulfur is burned, or when gasoline is extracted from oil. Most of the sulfur dioxide released into the air comes from electric utilities, especially those that burn coal with a high sulfur content. Sulfur is found in raw materials such as crude oil, coal, and ores that contain metals such as aluminum, copper, zinc, lead and iron. Industrial facilities that derive their products from these materials may also release SO₂. A pie chart summarizing the major sources of SO₂ is shown in Figure 1.



^a - sums do not equal 100 due to rounding
Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

SO₂ concentrations in New Jersey are generally higher in the winter than in the summer due to higher emissions from space heating and other sources. This is shown in the chart depicted in Figure 2 (page 2). The chart also shows that SO₂ levels tend to peak in the morning as emissions accumulate prior to being more effectively dispersed when wind speeds increase and atmospheric mixing increases later in the day.

HEALTH AND ENVIRONMENTAL EFFECTS

Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of the action of sulfurous acid that is formed when the highly soluble SO₂ dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO₂ include children, the elderly, and people with heart or lung disorders such as asthma. When SO₂ concentrations in the air become elevated, people belonging to these sensitive groups and those who are active outdoors may have trouble breathing. The International Agency for Research on Cancer (IARC) evaluated SO₂ and based on available information, determined that no conclusion can be made as to the carcinogenicity of SO₂ to human beings.

Sulfur dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people and the environment. Sulfate particles are the major cause of reduced visibility in the eastern United States. SO₂ can also react with other substances in the air to form acids, which fall to the earth in rain and snow. Acid rain damages forests and crops, can make lakes and streams too acidic for fish, and speeds up the decay of building materials and paints.

STANDARDS

There are three National Ambient Air Quality Standards (NAAQS) for SO₂. There is an annual average health standard of 0.030 parts per million (ppm). This is based on a calendar year average of continuously monitored levels. There is also a 24-hour average health based standard of 0.14 ppm which is not to be exceeded more than once a year, and a secondary (welfare based) standard of 0.5 ppm, 3-hour average concentration that is also not to be exceeded more than once per year.

New Jersey has also set state air quality standards for SO₂. They are similar to the federal standards but are expressed in micrograms per cubic meter (µg/m³) instead

of ppm. They are also based on rolling averages rather than block averages. So, for example, the state's primary 12-month standard is based on any twelve-month average recorded during the year, while the federal standard is based solely on the calendar

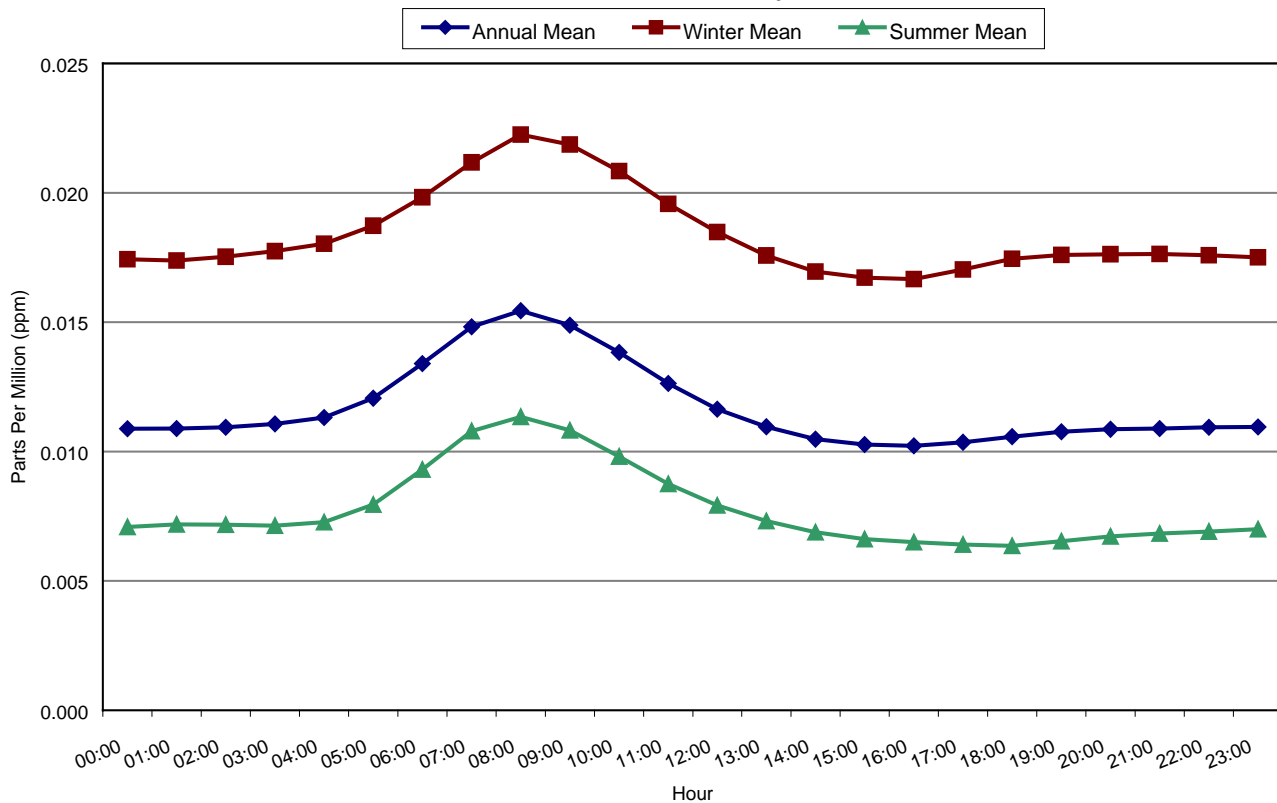
year average. The state also has secondary 12-month, 24-hour, and 3-hour average standards. Table 1 summarizes the NAAQS and the New Jersey Ambient Air Quality Standards (NJAAQS) for SO₂.

Table 1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide

Averaging Period	Type	Parts Per Million (ppm)	
		Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)	
		New Jersey	National ^a
12-month average	Primary	80 $\mu\text{g}/\text{m}^3$ (0.03 ppm)	0.030 ppm
12-month average	Secondary	60 $\mu\text{g}/\text{m}^3$ (0.02 ppm)	---
24-hour average	Primary	365 $\mu\text{g}/\text{m}^3$ (0.14 ppm)	0.14 ppm
24-hour average	Secondary	260 $\mu\text{g}/\text{m}^3$ (0.10 ppm)	---
3-hour average	Secondary	1300 $\mu\text{g}/\text{m}^3$ (0.5 ppm)	0.5 ppm

^a – National standards are block averages rather than moving averages

Figure 2
Sulfur Dioxide Concentration - New Jersey
1967-1999
Seasonal and Hourly Variation



MONITORING LOCATIONS

The state monitored SO₂ levels at 15 locations in 2002. These sites are shown in the map in Figure 3. The Somers Point site was discontinued on March 6, 2002. Consequently, a valid 2002 annual average could not be calculated for this site.

SO₂ LEVELS IN 2002

None of the monitoring sites recorded exceedances of the primary or secondary SO₂ standards during 2002. The maximum annual average concentration recorded was 0.009 ppm at Exit 13 of the New Jersey Turnpike at Elizabeth Lab. The maximum 24-hour average level recorded was 0.037 ppm which was recorded in Jersey City. The highest 3-hour average recorded was 0.092 ppm also at the Exit 13 site at Elizabeth Lab. Summaries of the 2002 data are provided in Table 2, Table 3 (page 4) and Figure 4 (page 4).

**Figure 3
2002 Sulfur Dioxide
Monitoring Network**



**Table 2
Sulfur Dioxide Data – 2002
3-Hour and Annual Averages**

Parts Per Million (ppm)

Monitoring Sites	3-Hour Average Maximum	3-Hour Average 2 nd Highest	12-Month Average Maximum	Average Calendar Year
Ancora State Hospital	0.026	0.025	0.003	0.003
Bayonne	0.046	0.031	0.006	0.006
Burlington	0.038	0.032	0.005	0.004
Camden Lab	0.061	0.044	0.007	0.007
Chester	0.052	0.033	0.004	0.004
Clarksboro	0.041	0.031	0.005	0.005
Elizabeth	0.031	0.030	0.005	0.005
Elizabeth Lab	0.092	0.057	0.009	0.009
Hackensack	0.035	0.030	0.005	0.004
Jersey City	0.052	0.050	0.009	0.007
Millville	0.035	0.030	0.004	0.004
Nacote Creek Research Center	0.022	0.021	0.003	0.003
Newark Lab	0.062	0.049	0.004	0.004
Perth Amboy	0.051	0.039	0.004	0.004
Somers Point ^d	0.063	0.031	0.003	----

^d – Data not available after March 2002

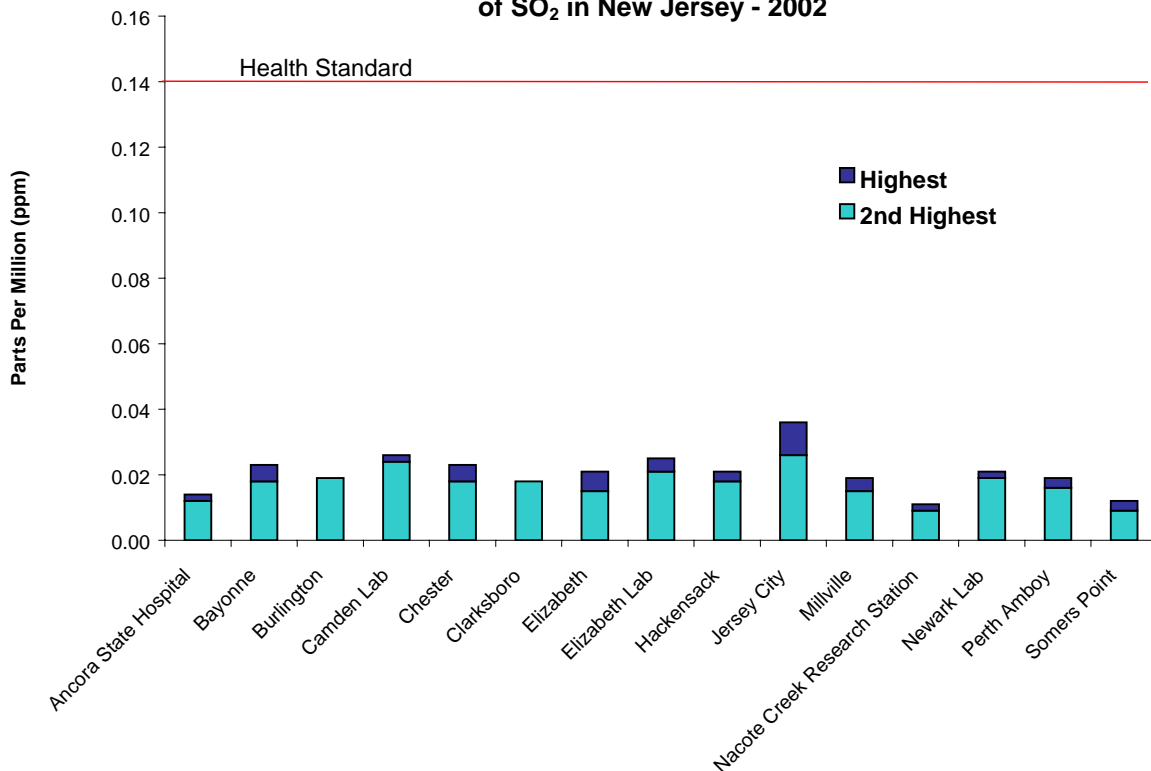
Table 3
Sulfur Dioxide Data – 2002
24-Hour and Daily Averages

Parts Per Million (ppm)

Monitoring Sites	24-Hour Average Maximum	24-Hour Average 2 nd Highest	Daily Average Maximum	Daily Average 2 nd Highest
Ancora State Hospital	0.020	0.014	0.014	0.012
Bayonne	0.023	0.018	0.023	0.018
Burlington	0.026	0.019	0.019	0.019
Camden Lab	0.030	0.028	0.026	0.024
Chester	0.024	0.022	0.023	0.018
Clarksboro	0.028	0.015	0.018	0.018
Elizabeth	0.023	0.017	0.021	0.015
Elizabeth Lab	0.029	0.023	0.025	0.021
Hackensack	0.024	0.020	0.021	0.018
Jersey City	0.037	0.028	0.036	0.026
Millville	0.024	0.016	0.019	0.015
Nacote Creek Research Station	0.012	0.011	0.011	0.009
Newark Lab	0.025	0.022	0.021	0.019
Perth Amboy	0.027	0.017	0.019	0.016
Somers Point ^d	0.013	0.010	0.012	0.009

^d - Data not available after March 2002

Figure 4
Highest and 2nd Highest Daily Averages
of SO₂ in New Jersey - 2002



TRENDS

Since the implementation of regulations requiring the use of low sulfur fuels in New Jersey, SO₂ concentrations have improved significantly. The last time an exceedance of any of the National SO₂ standards was recorded in the state was in 1980. A trend graph of SO₂ levels showing the highest, lowest and average of the daily average concentrations recorded is presented in Figure 5. The graph uses the second highest daily value, as this is the value that determines if the national health standard is being met

(one exceedance per site is allowed each year).

Although there has not been a measured exceedance of the NAAQS in over two decades, there is still a small area of New Jersey that is classified as a non-attainment area for SO₂. This is the result of air quality modeling studies that predicted non-attainment of the standard within a small area of Warren County. The area is shown in the map in Figure 6 (page 6).

Figure 5
Sulfur Dioxide Concentrations in New Jersey
1975-2002
Second Highest Daily Average

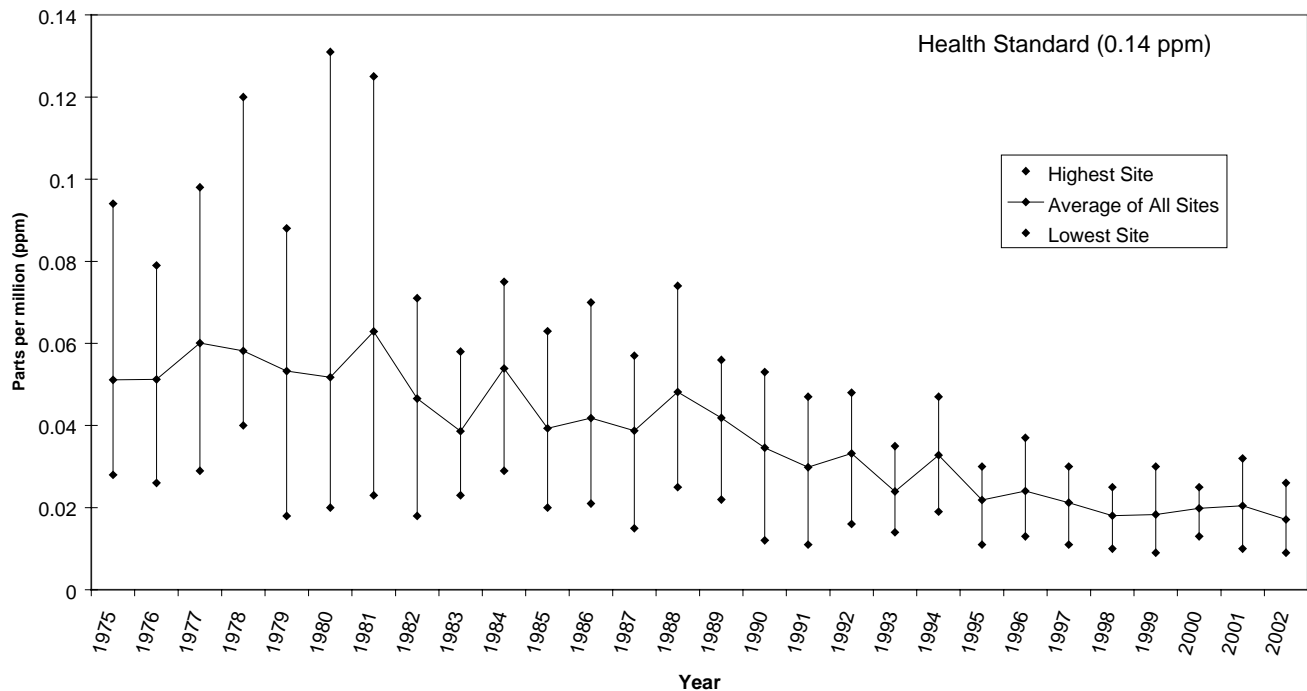
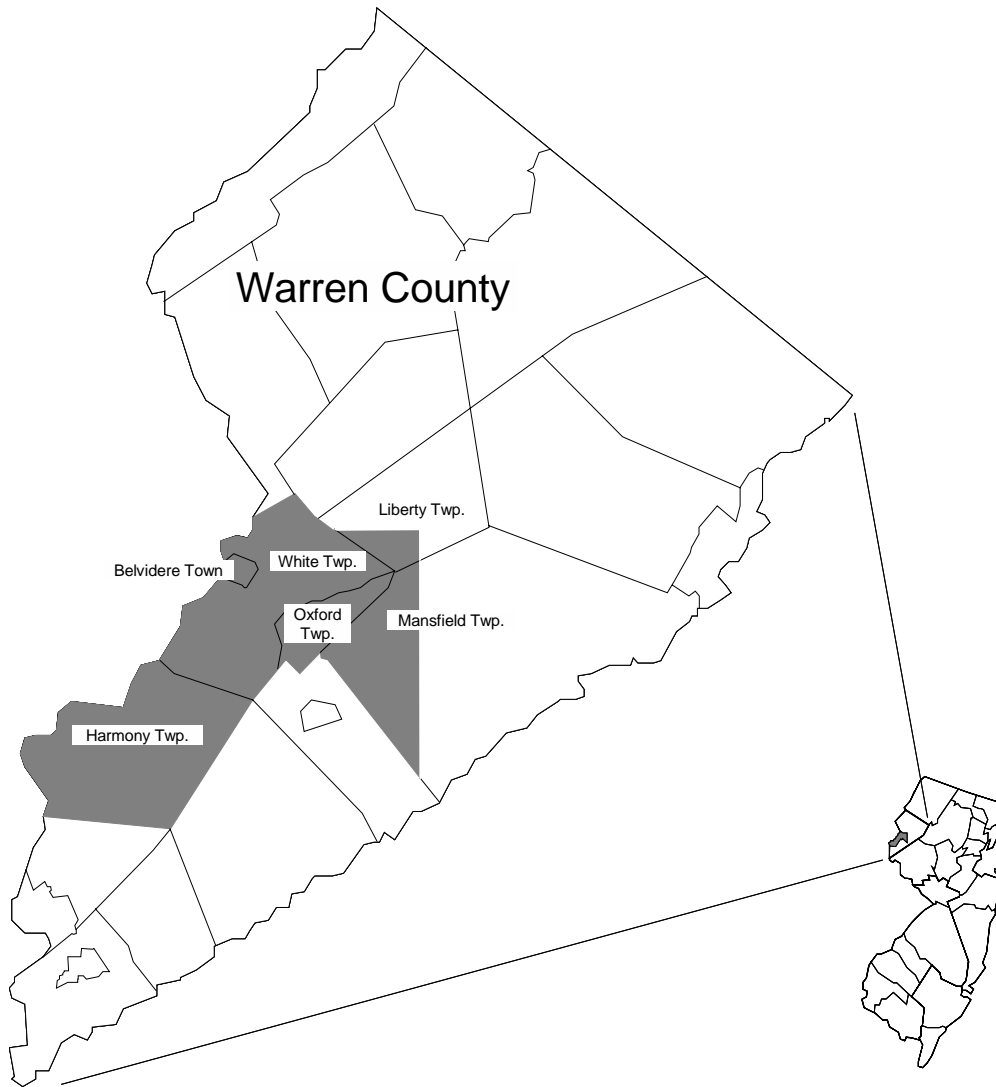


Figure 6
Sulfur Dioxide Non-Attainment Areas* in New Jersey



Legend

- Sulfur Dioxide Nonattainment Area
(includes Belvidere Town; Harmony Township; Oxford Township; White Township; the portion of Liberty Township south of UTM northing 4,255,000 and west of UTM easting 505,000; and the portion of Mansfield Township west of UTM easting 505,000).

*Nonattainment of the National Primary (Health) and Secondary (Welfare) Standards

FIVE MINUTE AVERAGE SO₂ MONITORING

A 1992 court decision compelled the USEPA to review, and if appropriate, revise the NAAQS for SO₂. After soliciting comments from the public and evaluating several options, the USEPA determined that high short-term SO₂ concentrations are a local problem rather than a widespread national concern. The USEPA Administrator decided in May 1996 not to revise the NAAQS for SO₂, but concluded that in some local areas, 5-minute SO₂ concentrations greater than 0.6 ppm pose a health threat to sensitive persons. In January 1997, the USEPA published proposed revisions to the regulations that would establish "concern and intervention levels (IL)." This IL would have a lower range of 0.6 ppm and an upper range of 2.0 ppm of SO₂. These levels are based on a 5-minute SO₂ concentration that is the highest of the 5-minute averages from the 12 possible non-overlapping periods during a clock hour. Under the proposed regulations, the USEPA would leave the responsibility of assessing the health risk and implementing corrective measures to the States. Also, the USEPA recommended that States evaluate the need to monitor 5-minute SO₂ averages around sources based on citizen complaints, the actual emissions of a source, the population in the vicinity of the source, and environmental justice issues.

The USEPA published a draft "Guideline Document for Ambient Monitoring of 5-Minute SO₂ Concentrations" on July 20, 2000. This guidance is intended to assist State and local agencies in determining whether 5-minute SO₂ monitoring should be established in their jurisdictions, and how to redesign an existing SO₂ network to fulfill these additional needs.

In October 2002, an air monitoring project was established in Warren County, New Jersey to evaluate the feasibility of monitoring 5-minute SO₂ concentrations in the vicinity of local point source. This is the first time since the publication of USEPA's draft "Guideline Document for Ambient Monitoring of 5-Minute SO₂ Concentrations" that SO₂ concentrations anywhere in New Jersey are being directly compared to the 5-minute SO₂ guideline IL. Warren County was selected for this study as the Belvidere area of the county is the only SO₂ non-attainment area in the state. The study had broad community involvement in its design and implementation. It is primarily being supported by a local industrial facility as part of a Supplemental Environmental Project (SEP). SEPs

are sometimes part of settlement agreements between the DEP and a regulated facility. They are projects deemed to have an environmental benefit for the community, and are supported by a facility in lieu of, or in addition to, direct monetary penalties. The results of the monitoring study are available on the World Wide Web at www.airgap.com

REFERENCES

Air Quality Criteria for Particulate Matter and Sulfur Oxides (1982): Assessment of New Findings on Sulfur Dioxide Acute Exposure Health Effects in Asthmatic Individuals, Supplement to the Second Addendum (1986), U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Research Triangle Park, NC, 1994.

Draft Guideline Document for Ambient Monitoring of 5-minute SO₂ Concentrations, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 20, 2000.

Horstman, D., Roger, L. J., Kehrl, H. and Hazucha, M., *Airway Sensitivity of Asthmatics to Sulfur Dioxide*, EPA-600/J-86-282, Health Effects Research Lab, Research Triangle Park, NC, Clinical Research Branch, Environmental Monitoring and Services, Inc., Chapel Hill, NC, North Carolina University at Chapel Hill, NC, Prepared for USEPA, Research Triangle Park, NC, 1986.

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2001, URL: <http://www.epa.gov/oar/aqtrnd00/>.

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: <http://www.epa.gov/oar/aqtrnd99/>.

National Air Quality and Emissions Trend Report, 2003 Special Studies Edition, EPA-454/R-03-005, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2003, URL: <http://www.epa.gov/oar/aqtrnd03/>.

National Primary Ambient Air Quality Standards for Sulfur Dioxide, 40 CFR 50.4, US Government Printing Office, Washington DC, July 2001.

National Secondary Ambient Air Quality Standards for Sulfur Dioxide, 40 CFR 50.5, US Government Printing Office, Washington DC, July 2001.

Sittig, M., *Handbook of Toxic and Hazardous Chemicals and Carcinogens Third Edition, Volume 2*, Noyes Publications, Park Ridge, NJ, 1991.

SO₂ – How Sulfur Dioxide Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, November 2000, URL: <http://www.epa.gov/air/urbanair/so2/index.html>.

ToxFaQs for Sulfur Dioxide, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, April 2002, URL: <http://www.atsdr.cdc.gov/tfacts116.pdf>.



2002 Air Toxics Summary

New Jersey Department of Environmental Protection

INTRODUCTION

Air pollutants can be divided into two categories: the criteria pollutants (ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead); and air toxics. The criteria pollutants have been addressed at the national level for many years. The United States Environmental Protection Agency (USEPA) has set National Ambient Air Quality Standards (NAAQS) for them, and they are subject to a standard planning process that includes monitoring, reporting, and control requirements. Each of these pollutants is discussed in its own section of this NJDEP 2002 Air Quality Report.

Air toxics are basically all the other chemicals that can be released into the air and have the potential to cause adverse health effects in humans. These effects cover a wide range of conditions, from lung irritation to birth defects to cancer. There are no NAAQS for these pollutants, but in 1990 the U.S. Congress directed the USEPA to begin to address a list of almost 200 air toxics by developing control technology standards for specific categories of sources that emit them. These air toxics are known as the Clean Air Act Hazardous Air Pollutants (HAPs). You can get more information about HAPs at the USEPA Air Toxics web site at www.epa.gov/ttn/atw. NJDEP also has several web pages dedicated to air toxics. They can be accessed at www.state.nj.us/dep/airmon/airtoxics.

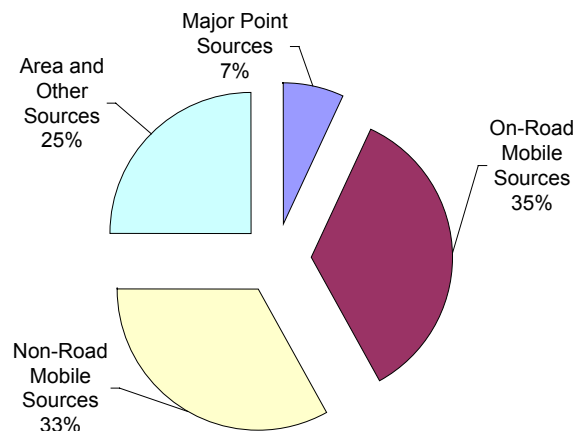
HEALTH EFFECTS

People exposed to significant amounts of air toxics may have an increased chance of getting cancer or experiencing other serious health effects. The noncancer health effects can range from respiratory, neurological, reproductive, developmental, or immune system damage, to irritation and effects on specific organs. In addition to inhalation exposure, there can be risks from the deposition of toxic pollutants onto soils or surface waters. There, they can be taken up by plants and animals which are later consumed by humans.

SOURCES OF AIR TOXICS

A few years ago, USEPA began a national study of air toxics, the National-Scale Air Toxics Assessment (NATA). To determine people's exposure to air toxics around the country, USEPA first prepared a comprehensive inventory of air toxics emissions from all man-made sources in 1996. The 1996 emissions inventory for New Jersey was briefly reviewed and revised by NJDEP before being finalized. Although there are likely to be some errors in the details of such a massive undertaking, the emissions inventory still can give us an indication of the most important sources of air toxic emissions in our state. The pie chart in Figure 1, based on the 1996 NATA emissions estimates, shows that mobile sources are the largest contributors of air toxics emissions in New Jersey.

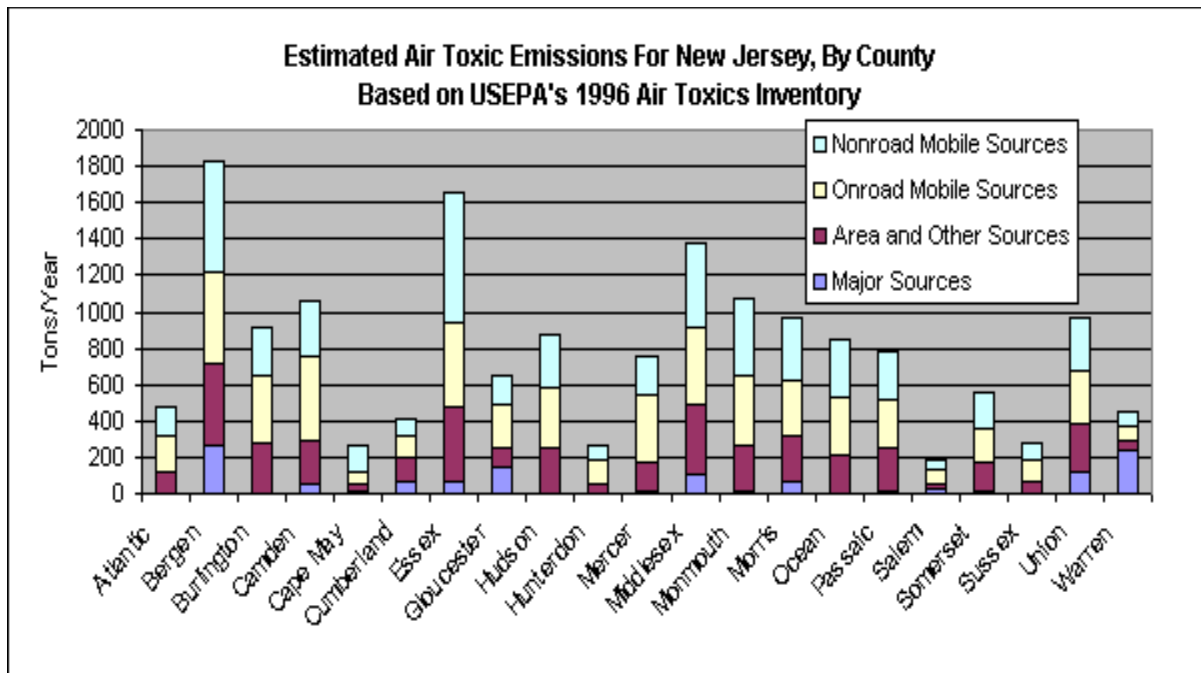
Figure 1
1996 Air Toxics Emissions Estimates for New Jersey



Source: USEPA's National Air Toxics Assessment, 1996

On-road mobile sources (cars and trucks) account for 35% of the emissions, and non-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) contribute 33%. Area sources (residential, commercial, and small industrial sources) represent 25% of

Figure 2



the inventory, and major point sources (such as factories and power plants) account for the remaining 7%.

Air toxics come from many different sources - not only manufacturing, but also other kinds of human activity. When New Jersey's emissions estimates are broken down by county (see Figure 2), it is evident that the areas with the largest air toxic emissions are generally those with the largest populations. This is directly related to high levels of vehicle use, solvent use, heating, and other population-related activities in those counties.

ESTIMATING AIR TOXICS EXPOSURE

The next step in USEPA's NATA project was to use the emissions information in an air dispersion model. The model estimates the concentrations of air toxics that people may be exposed to in different parts of the country. The map in Figure 3 shows the predicted concentrations of benzene throughout New Jersey. The high concentration areas tend to overlap the more densely

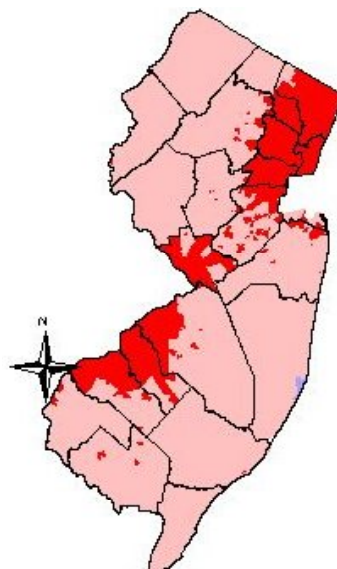


Figure 3

NATA PREDICTED CONCENTRATIONS IN NEW JERSEY FOR 1996

Benzene

- Under 0.5 times benchmark
- 0.5 - 1 times benchmark
- 1 - 5 times benchmark
- 5 - 10 times benchmark
- 10 - 50 times benchmark
- Over 50 times benchmark

Maximum concentration is 4.5 micrograms per cubic meter, or 35 times the health benchmark

Health Benchmark = 0.13ug/m³

populated areas of the state, following the pattern of emissions. Not all air toxics follow this pattern, as some are more closely associated with individual point sources, but in general, larger populations result in greater emissions of, and exposure to, air toxics.

Our preliminary analysis of the state and county average air toxics concentrations generated by NATA indicates that

nineteen chemicals were predicted to exceed their health benchmarks, or level of concern, in one or more counties in 1996. Eighteen of these are considered to be cancer-causing (carcinogenic) chemicals, and one (acrolein) is not. These chemicals are summarized in Table 1.

Estimated air concentrations of these 19 pollutants vary around the state, depending on the type of sources that emit them.

Table 1

Air Toxics of Greatest Concern in New Jersey
Based on 1996 National Air Toxics Assessment

Pollutant of Concern	Extent	Primary Source of Emissions
Benzene	Statewide	Mobile; Background Concentration
1,3-Butadiene	Statewide	On-Road Mobile
Carbon tetrachloride	Statewide	Background Concentration
Chloroform	Statewide	Background Concentration; Point
Diesel particulate matter	Statewide	Off-Road Mobile
Ethylene dibromide	Statewide	Background Concentration
Ethylene dichloride	Statewide	Background Concentration
Formaldehyde	Statewide	Mobile
Acrolein	20 Counties	Mobile
Polycyclic organic matter	20 Counties	Area
Chromium compounds	17 Counties	Area
Acetaldehyde	13 Counties	Mobile
Tetrachloroethylene	11 Counties	Area; Background Concentration
7-PAH	5 Counties	Area
Arsenic compounds	4 Counties	Area; Point
Cadmium compounds	4 Counties	Area
Nickel compounds	4 Counties	Area
Beryllium compounds	1 County	Area
Hydrazine	1 County	Area

AIR TOXICS MONITORING PROGRAM

NJDEP has established four air toxics monitoring sites around the state. They are located in Camden, Elizabeth, New Brunswick and Chester (see Figure 4). The Camden Lab site has been measuring several toxic volatile organic compounds (VOCs) since 1989. The Elizabeth Lab began measuring VOCs in 2000, and the New Brunswick and Chester sites became operational in July 2001. Analysis of toxic metals at all four sites also began in July 2001.

A comparison of the concentrations predicted by NATA and actual monitored levels can be made for the Camden Lab site. In 1996, thirteen of the compounds evaluated in NATA were measured at Camden Lab. Table 2 compares the NATA predictions with the measured concentrations for 1996. Measured 2002 levels, and the percent of change from 1996, are also shown. Of the thirteen air toxics measured, five of them fell below detection limits in 1996, so a concentration of zero or a value under the detection limit is reported for that year. A comparison of some of the key compounds (Figure 5) shows that for most air toxics, the agreement between predicted and monitored concentrations is remarkably good. Acetaldehyde and Formaldehyde do not show a good agreement between predicted and monitored concentrations in 1996; however, measurements in subsequent years of these pollutants are closer in agreement to the 1996 predicted values. For most of the thirteen air toxics in Table 2, the 2002 levels measured at the Camden Lab were substantially lower than the concentrations measured in 1996.

Figure 4
2002 Air Toxics
Monitoring Network

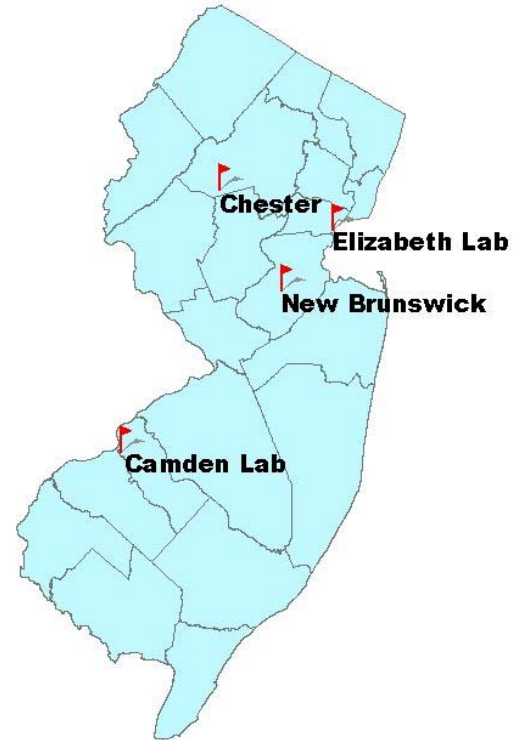


Figure 5
Air Toxics Levels Measured in 1996 at Camden,
New Jersey Compared to NATA Predicted Levels

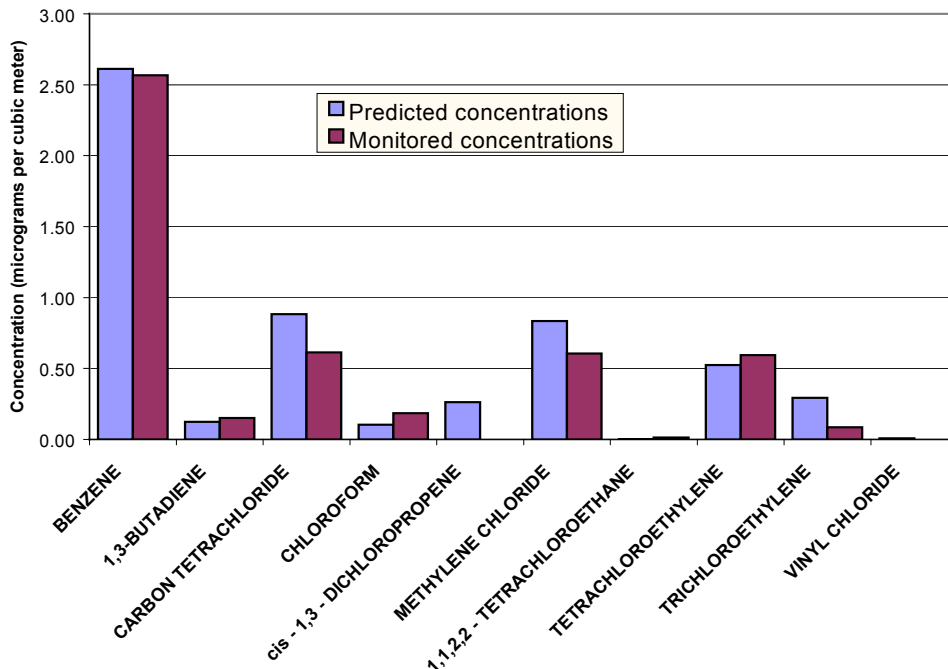


Table 2
Comparison of NATA Predicted to Measured Levels in Camden, NJ

NA – Not Available
µg/m³ - Micrograms Per Cubic Meter

Pollutant (HAP)	NATA Predicted 1996, µg/m ³	Measured 1996 Level, µg/m ³	Measured 2002 Level, µg/m ³	Percent change in measured levels in 1996 & 2002
Acetaldehyde	1.74	4.53	1.19	-73.7%
Acrylonitrile	0.003	NA	0.81	NA
Benzene	2.61	2.57	1.66	-35.4%
1,3-Butadiene	0.12	0.15	0.09**	-40.0%
Carbon Tetrachloride	0.88	0.61	0.50	-18.0%
Chloroform*	0.10	0.18**	0.01**	-94.4%
cis-1,3-Dichloropropene*	0.26	0.00**	0.00**	0.0%
Formaldehyde	2.20	14.63	2.85	-80.5%
Methylene Chloride	0.83	0.61	1.49	144.3%
1,1,2,2-Tetrachloroethane*	0.00	0.01**	0.00**	-100.0%
Tetrachloroethylene	0.52	0.59	0.34**	-42.4%
Trichloroethylene	0.29	0.09**	0.02**	-77.8%
Vinyl Chloride *	0.01	0.00**	0.00**	0.0%

* Measurements for 1996 and 2002 were below detection limits

** Measurement fell below detection limits

Negative values for percent change mean measured levels went down from 1996 to 2002

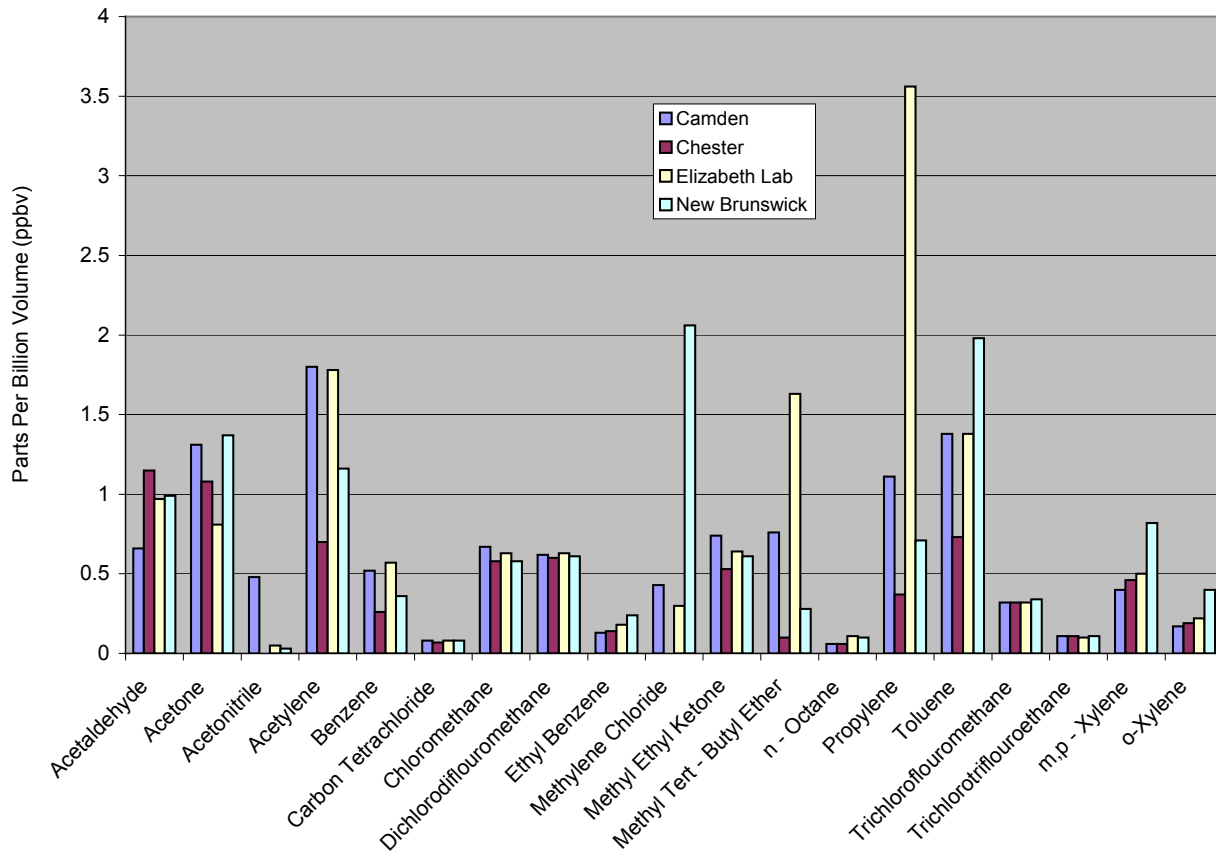
AIR TOXICS MONITORING RESULTS FOR 2002

The results of the air toxics monitoring program for 2002 are shown in Table 3 (page 6). This table shows the average concentration for each air toxic measured at the four New Jersey monitoring sites. All values are in parts per billion by volume (ppbv). More detailed tables (Tables 4-7) that show additional statistics, detection limit information, health benchmarks used by NJDEP, and levels in ppbv and micrograms per cubic meter (µg/m³) can be found at the end of this section. The ppbv units are more common for monitoring results, while µg/m³ units are generally used in modeling and health studies. Note that many of the compounds that were tested were often below the detection limit of the method used. Concentrations below the detection limit, including zero values, were used in the calculation of the annual

average concentrations.

Reported averages for which a significant portion of the data (more than 50%) was below the detection limit should be viewed with extreme caution. Median values (the value of the middle sample value when the results are ranked) are reported along with the mean (average) concentrations because for some compounds only a single or very few high values were recorded. These high values will tend to increase the average concentration significantly but would have less effect on the median value. In such cases, the median value may be a better indicator of long term exposures, on which most of the health benchmarks for air toxics are based. The average concentrations for some of the more prevalent air toxics are graphed in Figure 6 (page 6).

**Figure 6
Selected Toxic Volatile Organics
2002 Annual Averages
New Jersey**



**Table 3
New Jersey Air Toxics Summary – 2002**

**Annual Average Concentration
ppbv – Parts Per Billion by Volume**

Pollutant	Camden Lab	Chester	Elizabeth Lab	New Brunswick
Acetaldehyde	0.66	1.15	0.97	0.99
Acetone	1.31	1.08	0.81	1.37
Acetonitrile	0.48	8.32	0.05	0.41
Acetylene	1.80	0.70	1.78	1.16
Acrylonitrile	0.00	0.00	0.10	0.03
tert-Amyl Methyl Ether	0.01	0.00	0.00	0.00
Benzaldehyde	0.04	0.03	0.04	0.04
Benzene	0.52	0.26	0.57	0.36
Bromochloromethane	0.00	0.00	0.00	0.00
Bromodichloromethane	0.00	0.00	0.00	0.00
Bromoform	0.00	0.00	0.00	0.00
Bromomethane	0.55	0.00	0.00	0.00
1,3-Butadiene	0.04	0.00	0.09	0.02
Butyl/Isobutyraldehyde	0.11	0.14	0.10	0.15
Carbon Tetrachloride	0.08	0.07	0.08	0.08
Chlorobenzene	0.00	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00	0.01

Table 3 (Continued)
New Jersey Air Toxics Summary – 2002

Annual Average Concentration
ppbv – Parts Per Billion by Volume

Pollutant	Camden Lab	Chester	Elizabeth Lab	New Brunswick
Chloroform	0.00	0.00	0.00	0.00
Chloromethane	0.67	0.58	0.63	0.58
Chloromethylbenzene	0.00	0.00	0.00	0.00
Chloroprene	0.00	0.00	0.00	0.00
Crotonaldehyde	0.02	0.01	0.01	0.02
Dibromochloromethane	0.00	0.00	0.00	0.00
1,2-Dibromoethane	0.00	0.00	0.00	0.00
m-Dichlorobenzene	0.00	0.00	0.00	0.00
o-Dichlorobenzene	0.00	0.00	0.00	0.00
p-Dichlorobenzene	0.02	0.00	0.00	0.00
Dichlorodifluoromethane	0.62	0.60	0.63	0.61
1,1-Dichloroethane	0.00	0.00	0.00	0.00
1,2-Dichloroethane	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.01	0.00	0.01	0.00
trans-1,2-Dichloroethylene	0.00	0.00	0.00	0.00
1,2-Dichloropropane	0.00	0.00	0.00	0.00
cis-1,3-Dichloropropene	0.00	0.00	0.00	0.00
trans-1,3-Dichloropropene	0.00	0.00	0.00	0.00
Dichlorotetrafluoroethane	0.00	0.00	0.00	0.00
2,5-Dimethylbenzaldehyde	0.00	0.00	0.00	0.00
Ethyl Acrylate	0.00	0.00	0.00	0.00
Ethylbenzene	0.13	0.14	0.18	0.24
Ethyl tert-Butyl Ether	0.00	0.00	0.00	0.00
Formaldehyde	2.32	3.04	2.04	2.44
Hexachloro-1,3-butadiene	0.00	0.00	0.00	0.00
Hexaldehyde	0.02	0.02	0.02	0.04
Isovaleraldehyde	0.00	0.00	0.00	0.00
Methylene Chloride	0.43	12.27	0.30	2.06
Methyl Ethyl Ketone	0.74	0.53	0.64	0.61
Methyl Isobutyl Ketone	0.03	0.01	0.01	0.00
Methyl Methacrylate	0.00	0.00	0.01	0.00
Methyl tert-Butyl Ether	0.76	0.10	1.63	0.28
n-Octane	0.06	0.06	0.11	0.10
Propionaldehyde	0.04	0.07	0.07	0.07
Propylene	1.11	0.37	3.56	0.71
Styrene	0.01	0.00	0.01	0.01
1,1,2,2 - Tetrachloroethane	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.05	0.01	0.04	0.02
Tolualdehydes	0.03	0.02	0.04	0.03
Toluene	1.38	0.73	1.38	1.98
1,2,4-Trichlorobenzene	0.00	0.00	0.00	0.00
1,1,1 - Trichloroethane	0.01	0.01	0.01	0.01

Table 3 (Continued)
New Jersey Air Toxics Summary – 2002

Annual Average Concentration
ppbv – Parts Per Billion by Volume

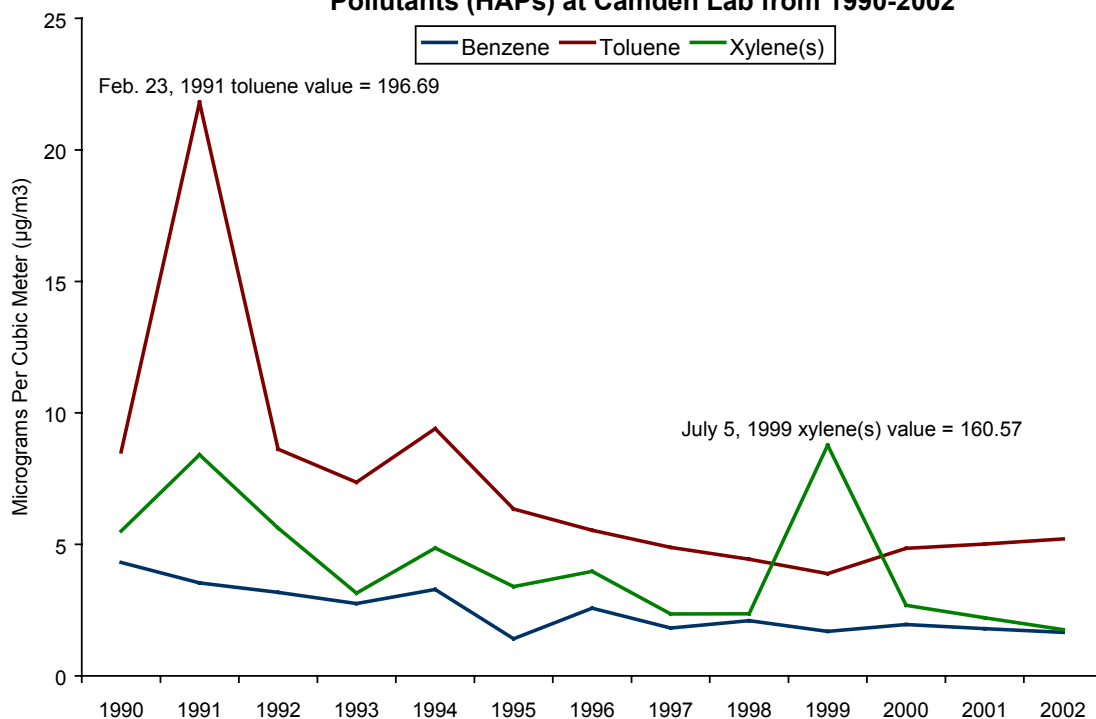
Pollutant	Camden Lab	Chester	Elizabeth Lab	New Brunswick
1,1,2 - Trichloroethane	0.00	0.00	0.00	0.00
Trichloroethylene	0.00	0.00	0.00	0.00
Trichlorofluoromethane	0.32	0.32	0.32	0.34
Trichlorotrifluoroethane	0.11	0.11	0.10	0.11
1,2,4-Trimethylbenzene	0.12	0.04	0.16	0.07
1,3,5-Trimethylbenzene	0.03	0.01	0.05	0.01
Valeraldehyde	0.03	0.01	0.03	0.04
Vinyl Chloride	0.00	0.00	0.00	0.00
m,p - Xylene	0.40	0.46	0.50	0.82
o - Xylene	0.17	0.19	0.22	0.40

TRENDS

The site in Camden Lab is the only monitoring location that has been measuring air toxics for an extended period. The graph in Figure 7 shows the change in concentrations for three of the most prevalent air toxics (benzene, toluene, and xylene) from 1990 to 2002. The graph shows that while average concentrations can vary significantly from year to year, the overall trend is a significant decrease of

concentrations over the last ten years. High individual samples may result in high annual averages in some years, e.g., the annual average for xylene in 1999 would be 2.2 $\mu\text{g}/\text{m}^3$ instead of 6.9 $\mu\text{g}/\text{m}^3$ if the value measured on July 5, 1999 were excluded. Because air toxics comprise such a large and diverse group of compounds, however, these general trends may not hold for other pollutants in different areas of the state.

Figure 7
Annual Averages for Selected Hazardous Air
Pollutants (HAPs) at Camden Lab from 1990-2002



**Table 4
Air Toxics Data – 2002
Camden Lab, New Jersey**

µg/m³ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark µg/m ³	Mean µg/m ³	Mean ppbv	Max. ppbv	Median ppbv
Acetaldehyde	0.01	100%	0.45	1.19	0.66	2.44	0.48
Acetone	0.00	100%	30881	3.11	1.31	9.9	0.69
Acetonitrile	0.25	5%	60	0.81	0.48	23.28	0
Acetylene	0.13	100%		1.91	1.8	8.6	1.38
Acrylonitrile	0.21	2%	0.015	0.01	0	0.16	0
tert-Amyl Methyl Ether	0.12	4%		0.04	0.01	0.68	0
Benzaldehyde	0.00	100%		0.17	0.04	0.15	0.03
Benzene	0.04	100%	0.13	1.66	0.52	2	0.45
Bromochloromethane	0.12	0%		0.00	0	0	0
Bromodichloromethane	0.06	0%		0.00	0	0	0
Bromoform	0.08	0%	0.91	0.00	0	0	0
Bromomethane	0.09	25%	5	2.13	0.55	13.78	0
1,3-Butadiene	0.07	45%	0.033	0.09	0.04	0.5	0
Butyr/Isobutyraldehyde	0.01	94%		0.32	0.11	0.96	0.08
Carbon tetrachloride	0.08	89%	0.067	0.50	0.08	0.21	0
Chlorobenzene	0.06	0%	1000	0.00	0	0	0
Chloroethane	0.08	0%		0.00	0	0	0
Chloroform	0.05	5%	0.043	0.01	0	0.04	0
Chloromethane	0.05	100%	0.56	1.38	0.67	1.11	0.66
Chloromethylbenzene	0.07	0%		0.00	0	0	0
Chloroprene	0.1	0%	7	0.00	0	0	0
Crotonaldehyde	0.01	80%		0.06	0.02	0.36	0.01
Dibromochloromethane	0.08	0%		0.00	0	0	0
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0	0	0
m-Dichlorobenzene	0.05	0%		0.00	0	0	0
o-Dichlorobenzene	0.06	0%	200	0.00	0	0	0
p-Dichlorobenzene	0.09	25%	0.091	0.12	0.02	0.14	0
Dichlorodifluoromethane	0.04	100%	200	3.06	0.62	1.19	0.6
1,1-Dichloroethane	0.08	0%	0.63	0.00	0	0	0
1,2-Dichloroethane	0.06	0%	0.000053	0.00	0	0	0
1,1-Dichloroethene	0.1	0%	200	0.00	0	0	0
cis-1,2-Dichloroethylene	0.1	2%		0.04	0.01	0.29	0
trans-1,2-Dichloroethylene	0.06	0%		0.00	0	0	0
1,2-Dichloropropane	0.07	0%	0.1	0.00	0	0	0
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0	0	0
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0	0	0
Dichlorotetrafluoroethane	0.05	4%		0.01	0	0.04	0
2,5-Dimethylbenzaldehyde	0.00	10%		0.00	0	0.02	0
Ethyl Acrylate	0.16	0%	2	0.00	0	0	0

Table 4 (Continued)
Air Toxics Data - 2001
Camden Lab, New Jersey

$\mu\text{g}/\text{m}^3$ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark $\mu\text{g}/\text{m}^3$	Mean $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Ethylbenzene	0.04	84%		0.56	0.13	0.59	0.12
Ethyl tert-Butyl Ether	0.15	0%		0.00	0	0	0
Formaldehyde	0.02	100%	0.077	2.85	2.32	12.71	1.07
Hexachloro-1,3-butadiene	0.06	0%	0.045	0.00	0	0	0
Hexaldehyde	0.00	94%		0.08	0.02	0.12	0.02
Isovaleraldehyde	0.00	2%		0.00	0	0.13	0
Methylene Chloride	0.06	82%	2.1	1.49	0.43	12.92	0
Methyl Ethyl Ketone	0.15	55%		2.18	0.74	8.82	0.25
Methyl Isobutyl Ketone	0.15	5%	80	0.12	0.03	1.14	0
Methyl Methacrylate	0.18	2%	700	0.01	0	0.09	0
Methyl tert-Butyl Ether	0.18	89%	3.8	2.74	0.76	3.44	0.62
N-Octane	0.06	53%		0.28	0.06	0.27	0.04
Propionaldehyde	0.01	86%		0.09	0.04	0.13	0.02
Propylene	0.05	100%	3000	1.91	1.11	4.18	0.76
Styrene	0.07	25%	1.8	0.04	0.01	0.16	0
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0	0	0
Tetrachloroethylene	0.06	33%	0.17	0.34	0.05	0.92	0
Tolualdehydes	0.009	94%		0.15	0.03	0.13	0.02
Toluene	0.06	100%	400	5.20	1.38	13.64	0.84
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0	0	0
1,1,1-Trichloroethane	0.06	36%	1000	0.05	0.01	0.1	0
1,1,2-Trichloroethane	0.06	0%	0.063	0.00	0	0	0
Trichloroethylene	0.07	4%	0.5	0.02	0	0.12	0
Trichlorofluoromethane	0.04	100%	700	1.80	0.32	1.18	0.3
Trichlorotrifluoroethane	0.07	91%		0.84	0.11	0.28	0
1,2,4-Trimethylbenzene	0.07	87%		0.59	0.12	0.73	0.11
1,3,5-Trimethylbenzene	0.07	47%		0.15	0.03	0.23	0
Valeraldehyde	0.01	98%		0.11	0.03	0.13	0.01
Vinyl chloride	0.06	0%	0.11	0.00	0	0	0
m,p-Xylene	0.05	98%	100	1.74	0.4	1.86	0.31
o-Xylene	0.05	87%	100	0.74	0.17	0.76	0.14

**Table 5
Air Toxics Data – 2002
Chester, New Jersey**

$\mu\text{g}/\text{m}^3$ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark $\mu\text{g}/\text{m}^3$	Mean $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Acetaldehyde	0.01	100%	0.45	2.07	1.15	2.63	1.05
Acetone	0.00	100%	30881	2.56	1.08	1.75	1.09
Acetonitrile	0.25	18%	60	13.96	8.32	264.01	0
Acetylene	0.13	100%		0.74	0.7	1.67	0.64
Acrylonitrile	0.21	0%	0.015	0.00	0	0	0
tert-Amyl Methyl Ether	0.12	0%		0.00	0	0	0
Benzaldehyde	0.00	100%		0.13	0.03	0.19	0.02
Benzene	0.04	100%	0.13	0.83	0.26	0.62	0.25
Bromochloromethane	0.12	0%		0.00	0	0	0
Bromodichloromethane	0.06	0%		0.00	0	0	0
Bromoform	0.08	0%	0.91	0.00	0	0	0
Bromomethane	0.09	2%	5	0.01	0	0.17	0
1,3-Butadiene	0.07	6%	0.033	0.01	0	0.06	0
Butyr/Isobutyraldehyde	0.01	100%		0.41	0.14	0.39	0.13
Carbon tetrachloride	0.08	86%	0.067	0.44	0.07	0.14	0.08
Chlorobenzene	0.06	0%	1000	0.00	0	0	0
Chloroethane	0.08	2%		0.01	0	0.15	0
Chloroform	0.05	6%	0.043	0.01	0	0.03	0
Chloromethane	0.05	100%	0.56	1.20	0.58	1.25	0.58
Chloromethylbenzene	0.07	2%		0.00	0	0.04	0
Chloroprene	0.1	0%	7	0.00	0	0	0
Crotonaldehyde	0.01	69%		0.03	0.01	0.05	0
Dibromochloromethane	0.08	0%		0.00	0	0	0
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0	0	0
m-Dichlorobenzene	0.05	0%		0.00	0	0	0
o-Dichlorobenzene	0.06	0%	200	0.00	0	0	0
p-Dichlorobenzene	0.09	4%	0.091	0.00	0	0.03	0
Dichlorodifluoromethane	0.04	100%	200	2.96	0.6	0.96	0.58
1,1-Dichloroethane	0.08	0%	0.63	0.00	0	0	0
1,2-Dichloroethane	0.06	0%	0.000053	0.00	0	0	0
1,1-Dichloroethene	0.1	0%	200	0.00	0	0	0
cis-1,2-Dichloroethylene	0.1	0%		0.00	0	0	0
trans-1,2-Dichloroethylene	0.06	0%		0.00	0	0	0
1,2-Dichloropropane	0.07	0%	0.1	0.00	0	0	0
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0	0	0
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0	0	0
Dichlorotetrafluoroethane	0.05	4%		0.00	0	0.02	0
2,5-Dimethylbenzaldehyde	0.00	10%		0.00	0	0.01	0
Ethyl Acrylate	0.16	0%	2	0.00	0	0	0

**Table 5 – (Continued)
Air Toxics Data – 2002
Chester, New Jersey**

$\mu\text{g}/\text{m}^3$ - Micrograms Per Cubic Meter
ppbv - Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark $\mu\text{g}/\text{m}^3$	Mean $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Ethylbenzene	0.04	84%		0.61	0.14	0.62	0.12
Ethyl tert-Butyl Ether	0.15	0%		0.00	0	0	0
Formaldehyde	0.02	100%	0.077	3.73	3.04	10.33	2.57
Hexachloro-1,3-butadiene	0.06	0%	0.045	0.00	0	0	0
Hexaldehyde	0.00	100%		0.08	0.02	0.04	0.01
Isovaleraldehyde	0.00	0%		0.00	0	0	0
Methylene Chloride	0.06	80%	2.1	42.59	12.27	215.23	0.38
Methyl Ethyl Ketone	0.15	35%		1.56	0.53	7.22	0
Methyl Isobutyl Ketone	0.15	4%	80	0.04	0.01	0.32	0
Methyl Methacrylate	0.18	0%	700	0.00	0	0	0
Methyl tert-Butyl Ether	0.18	29%	3.8	0.36	0.1	1.07	0
N-Octane	0.06	29%		0.28	0.06	1.92	0
Propionaldehyde	0.01	100%		0.17	0.07	0.23	0.05
Propylene	0.05	100%	3000	0.64	0.37	1.33	0.36
Styrene	0.07	4%	1.8	0.02	0	0.14	0
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0	0	0
Tetrachloroethylene	0.06	16%	0.17	0.07	0.01	0.11	0
Tolualdehydes	0.009	100%		0.10	0.02	0.1	0.02
Toluene	0.06	100%	400	2.75	0.73	3.3	0.61
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0	0	0
1,1,1-Trichloroethane	0.06	33%	1000	0.05	0.01	0.11	0
1,1,2-Trichloroethane	0.06	0%	0.063	0.00	0	0	0
Trichloroethylene	0.07	0%	0.5	0.00	0	0	0
Trichlorofluoromethane	0.04	100%	700	1.80	0.32	0.75	0.3
Trichlorotrifluoroethane	0.07	96%		0.84	0.11	0.21	0.11
1,2,4-Trimethylbenzene	0.07	57%		0.20	0.04	0.17	0.04
1,3,5-Trimethylbenzene	0.07	14%		0.05	0.01	0.06	0
Valeraldehyde	0.01	100%		0.04	0.01	0.08	0.01
Vinyl chloride	0.06	0%	0.11	0.00	0	0	0
m,p-Xylene	0.05	100%	100	2.00	0.46	1.77	0.39
o-Xylene	0.05	88%	100	0.82	0.19	0.75	0.17

**Table 6
Air Toxics Data – 2002
Elizabeth Lab, New Jersey**

$\mu\text{g}/\text{m}^3$ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark $\mu\text{g}/\text{m}^3$	Mean $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Acetaldehyde	0.01	100%	0.45	1.75	0.97	2.66	0.01
Acetone	0.00	100%	30881	1.92	0.81	2.46	0.00
Acetonitrile	0.25	2%	60	0.08	0.05	2.93	0.25
Acetylene	0.13	100%		1.89	1.78	6.24	0.13
Acrylonitrile	0.21	2%	0.015	0.22	0.1	5.73	0.21
tert-Amyl Methyl Ether	0.12	2%		0.01	0	0.13	0.12
Benzaldehyde	0.00	100%		0.17	0.04	0.1	0.00
Benzene	0.04	100%	0.13	1.82	0.57	1.62	0.04
Bromochloromethane	0.12	0%		0.00	0	0	0.12
Bromodichloromethane	0.06	0%		0.00	0	0	0.06
Bromoform	0.08	0%	0.91	0.00	0	0	0.08
Bromomethane	0.09	2%	5	0.01	0	0.13	0.09
1,3-Butadiene	0.07	76%	0.033	0.20	0.09	0.23	0.07
Butyr/Isobutyraldehyde	0.01	100%		0.29	0.1	0.53	0.01
Carbon tetrachloride	0.08	89%	0.067	0.50	0.08	0.22	0.08
Chlorobenzene	0.06	0%	1000	0.00	0	0	0.06
Chloroethane	0.08	0%		0.00	0	0	0.08
Chloroform	0.05	7%	0.043	0.01	0	0.04	0.05
Chloromethane	0.05	100%	0.56	1.30	0.63	1.12	0.05
Chloromethylbenzene	0.07	0%		0.00	0	0	0.07
Chloroprene	0.1	0%	7	0.00	0	0	0.1
Crotonaldehyde	0.01	98%		0.03	0.01	0.1	0.01
Dibromochloromethane	0.08	0%		0.00	0	0	0.08
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0	0	0.08
m-Dichlorobenzene	0.05	0%		0.00	0	0	0.05
o-Dichlorobenzene	0.06	0%	200	0.00	0	0	0.06
p-Dichlorobenzene	0.09	9%	0.091	0.03	0	0.08	0.09
Dichlorodifluoromethane	0.04	100%	200	3.11	0.63	1.09	0.04
1,1-Dichloroethane	0.08	0%	0.63	0.00	0	0	0.08
1,2-Dichloroethane	0.06	0%	0.000053	0.00	0	0	0.06
1,1-Dichloroethene	0.1	0%	200	0.00	0	0	0.1
cis-1,2-Dichloroethylene	0.1	2%		0.04	0.01	0.4	0.1
trans-1,2-Dichloroethylene	0.06	0%		0.00	0	0	0.06
1,2-Dichloropropane	0.07	0%	0.1	0.00	0	0	0.07
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0	0	0.1
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0	0	0.11
Dichlorotetrafluoroethane	0.05	5%		0.00	0	0.01	0.05
2,5-Dimethylbenzaldehyde	0.00	11%		0.00	0	0.05	0.00
Ethyl Acrylate	0.16	0%	2	0.00	0	0	0.16

**Table 6 – (Continued)
Air Toxics Data – 2002
Elizabeth Lab, New Jersey**

$\mu\text{g}/\text{m}^3$ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark $\mu\text{g}/\text{m}^3$	Mean $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Ethylbenzene	0.04	93%		0.78	0.18	0.51	0.04
Ethyl tert-Butyl Ether	0.15	0%		0.00	0	0	0.15
Formaldehyde	0.02	100%	0.077	2.50	2.04	6.37	0.02
Hexachloro-1,3-butadiene	0.06	0%	0.045	0.00	0	0	0.06
Hexaldehyde	0.00	100%		0.08	0.02	0.05	0.00
Isovaleraldehyde	0.00	5%		0.00	0	0.17	0.00
Methylene Chloride	0.06	89%	2.1	1.04	0.3	1.19	0.06
Methyl Ethyl Ketone	0.15	49%		1.88	0.64	3.95	0.15
Methyl Isobutyl Ketone	0.15	7%	80	0.04	0.01	0.36	0.15
Methyl Methacrylate	0.18	4%	700	0.04	0.01	0.42	0.18
Methyl tert-Butyl Ether	0.18	95%	3.8	5.87	1.63	6.5	0.18
N-Octane	0.06	71%		0.51	0.11	1.24	0.06
Propionaldehyde	0.01	96%		0.17	0.07	0.2	0.01
Propylene	0.05	100%	3000	6.12	3.56	19.74	0.05
Styrene	0.07	24%	1.8	0.04	0.01	0.09	0.07
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0	0	0.06
Tetrachloroethylene	0.06	42%	0.17	0.27	0.04	0.28	0.06
Tolualdehydes	0.009	98%		0.20	0.04	0.09	0.009
Toluene	0.06	100%	400	5.20	1.38	5.41	0.06
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0	0	0.06
1,1,1-Trichloroethane	0.06	35%	1000	0.05	0.01	0.11	0.06
1,1,2-Trichloroethane	0.06	0%	0.063	0.00	0	0	0.06
Trichloroethylene	0.07	4%	0.5	0.01	0	0.04	0.07
Trichlorofluoromethane	0.04	100%	700	1.80	0.32	0.6	0.04
Trichlorotrifluoroethane	0.07	89%		0.77	0.1	0.19	0.07
1,2,4-Trimethylbenzene	0.07	89%		0.79	0.16	0.39	0.07
1,3,5-Trimethylbenzene	0.07	58%		0.25	0.05	0.19	0.07
Valeraldehyde	0.01	100%		0.11	0.03	0.2	0.01
Vinyl chloride	0.06	0%	0.11	0.00	0	0	0.06
m,p-Xylene	0.05	100%	100	2.17	0.5	1.42	0.05
o-Xylene	0.05	96%	100	0.95	0.22	0.6	0.05

**Table 7
Air Toxics Data – 2002
New Brunswick, New Jersey**

$\mu\text{g}/\text{m}^3$ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark $\mu\text{g}/\text{m}^3$	Mean $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Acetaldehyde	0.01	100%	0.45	1.78	0.99	2.29	0.9
Acetone	0.00	100%	30881	3.25	1.37	3.43	1.27
Acetonitrile	0.25	13%	60	0.69	0.41	5.29	0
Acetylene	0.13	100%		1.23	1.16	3.08	1.05
Acrylonitrile	0.21	2%	0.015	0.07	0.03	1.38	0
tert-Amyl Methyl Ether	0.12	0%		0.00	0	0	0
Benzaldehyde	0.00	100%		0.17	0.04	0.38	0.03
Benzene	0.04	100%	0.13	1.15	0.36	1.17	0.34
Bromochloromethane	0.12	0%		0.00	0	0	0
Bromodichloromethane	0.06	0%		0.00	0	0	0
Bromoform	0.08	0%	0.91	0.00	0	0	0
Bromomethane	0.09	2%	5	0.01	0	0.13	0
1,3-Butadiene	0.07	27%	0.033	0.04	0.02	0.15	0
Butyr/Isobutyraldehyde	0.01	100%		0.44	0.15	0.27	0.14
Carbon tetrachloride	0.08	92%	0.067	0.50	0.08	0.23	0.08
Chlorobenzene	0.06	0%	1000	0.00	0	0	0
Chloroethane	0.08	2%		0.03	0.01	0.27	0
Chloroform	0.05	10%	0.043	0.02	0	0.09	0
Chloromethane	0.05	98%	0.56	1.20	0.58	1.57	0.56
Chloromethylbenzene	0.07	0%		0.00	0	0	0
Chloroprene	0.1	0%	7	0.00	0	0	0
Crotonaldehyde	0.01	92%		0.06	0.02	0.2	0.01
Dibromochloromethane	0.08	0%		0.00	0	0	0
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0	0	0
m-Dichlorobenzene	0.05	0%		0.00	0	0	0
o-Dichlorobenzene	0.06	0%	200	0.00	0	0	0
p-Dichlorobenzene	0.09	8%	0.091	0.02	0	0.07	0
Dichlorodifluoromethane	0.04	100%	200	3.01	0.61	1.08	0.59
1,1-Dichloroethane	0.08	0%	0.63	0.00	0	0	0
1,2-Dichloroethane	0.06	0%	0.000053	0.00	0	0	0
1,1-Dichloroethene	0.1	0%	200	0.00	0	0	0
cis-1,2-Dichloroethylene	0.1	0%		0.00	0	0	0
trans-1,2-Dichloroethylene	0.06	0%		0.00	0	0	0
1,2-Dichloropropane	0.07	0%	0.1	0.00	0	0	0
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0	0	0
trans-1,3-Dichloropropene	0.11	2%	0.25	0.01	0	0.06	0
Dichlorotetrafluoroethane	0.05	0%		0.00	0	0	0
2,5-Dimethylbenzaldehyde	0.00	11%		0.00	0	0.01	0
Ethyl Acrylate	0.16	0%	2	0.00	0	0	0

**Table 7 – (Continued)
Air Toxics Data – 2002
New Brunswick, New Jersey**

µg/m³ – Micrograms Per Cubic Meter
ppbv – Parts Per Billion by Volume

Compounds in Bold had Annual Mean Concentrations Greater Than Their Accepted Health Benchmark

Pollutant	Detection Limit ppbv	% Detects	Benchmark µg/m ³	Mean µg/m ³	Mean ppbv	Max. ppbv	Median ppbv
Ethylbenzene	0.04	87%		1.04	0.24	0.59	0.21
Ethyl tert-Butyl Ether	0.15	0%		0.00	0	0	0
Formaldehyde	0.02	100%	0.077	2.99	2.44	10.92	1.55
Hexachloro-1,3-butadiene	0.06	0%	0.045	0.00	0	0	0
Hexaldehyde	0.00	96%		0.16	0.04	0.15	0.03
Isovaleraldehyde	0.00	6%		0.00	0	0.03	0
Methylene Chloride	0.06	85%	2.1	7.15	2.06	39.09	0.2
Methyl Ethyl Ketone	0.15	46%		1.79	0.61	4.38	0
Methyl Isobutyl Ketone	0.15	2%	80	0.00	0	0.04	0
Methyl Methacrylate	0.18	0%	700	0.00	0	0	0
Methyl tert-Butyl Ether	0.18	58%	3.8	1.01	0.28	2.43	0.18
N-Octane	0.06	40%		0.47	0.1	1.68	0
Propionaldehyde	0.01	100%		0.17	0.07	0.15	0.07
Propylene	0.05	100%	3000	1.22	0.71	4.29	0.55
Styrene	0.07	17%	1.8	0.04	0.01	0.11	0
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0	0	0
Tetrachloroethylene	0.06	29%	0.17	0.14	0.02	0.24	0
Tolualdehydes	0.009	98%		0.15	0.03	0.12	0.03
Toluene	0.06	100%	400	7.45	1.98	32.85	1.16
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0	0	0
1,1,1-Trichloroethane	0.06	27%	1000	0.05	0.01	0.1	0
1,1,2-Trichloroethane	0.06	0%	0.063	0.00	0	0	0
Trichloroethylene	0.07	4%	0.5	0.02	0	0.1	0
Trichlorofluoromethane	0.04	100%	700	1.91	0.34	1.11	0.3
Trichlorotrifluoroethane	0.07	90%		0.84	0.11	0.27	0.11
1,2,4-Trimethylbenzene	0.07	69%		0.34	0.07	0.31	0.08
1,3,5-Trimethylbenzene	0.07	25%		0.05	0.01	0.12	0
Valeraldehyde	0.01	98%		0.14	0.04	0.28	0.03
Vinyl chloride	0.06	0%	0.11	0.00	0	0	0
m,p-Xylene	0.05	100%	100	3.56	0.82	2.12	0.68
o-Xylene	0.05	96%	100	1.74	0.4	0.97	0.37

REFERENCES

Air Pollution and Health Risk, EPA-450/3-90-022, USEPA, Office of Air and Radiation, Research Triangle Park, NC, March 1991, URL: http://www.epa.gov/ttn/atw/3_90_022.html.

Clean Air Act Amendments of 1990, Title III – Hazardous Air Pollutants, 101st Congress 2nd Session, Report 101-952, US Government Printing Office, Washington DC, October 1990.

Evaluating Exposures to Toxic Air Pollutants: A Citizens Guide, EPA-450/3-90-023, USEPA, Office of Air and Radiation, Research Triangle Park, NC, March 1991, URL: http://www.epa.gov/ttn/atw/3_90_023.

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: <http://www.epa.gov/oar/aqtrnd99>.

National-Scale Air Toxics Assessment for 1996: Estimated Emissions, Concentrations and Risk Technical Fact Sheet, USEPA, Office of Air and Radiation, Research Triangle Park, NC, May 2002, URL: <http://epa.gov/ttn/atw/nata/natafs5-31.pdf>.

Taking Toxics Out of the Air, EPA-452/K-00-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, August 2000, URL: <http://www.epa.gov/oar/oaqps/takingtoxics/airtox.pdf>.

Reference Concentrations for Inhalation, NJDEP, Division of Air Quality, Bureau of Air Quality Evaluation, Trenton, NJ, April 2003, URL: <http://www.state.nj.us/dep/aqpp/downloads/risk/RfCs2003.pdf>.

Reference Concentrations for Short-Term Inhalation Exposure, NJDEP, Division of Air Quality, Bureau of Air Quality Evaluation, Trenton, NJ, April 2003, URL: <http://www.state.nj.us/dep/aqpp/downloads/risk/Acute2003.pdf>.

Unit Risk Factors for Inhalation, NJDEP, Division of Air Quality, Bureau of Air Quality Evaluation, Trenton, NJ, April 2003, URL: <http://www.state.nj.us/dep/aqpp/downloads/risk/URFs2003.pdf>.

1996 National Air Toxics Assessment Results, USEPA, Office of Air and Radiation, Research Triangle Park, NC, September 2002, URL: <http://www.epa.gov/ttn/atw/nata/nsata1.html>.



2002 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

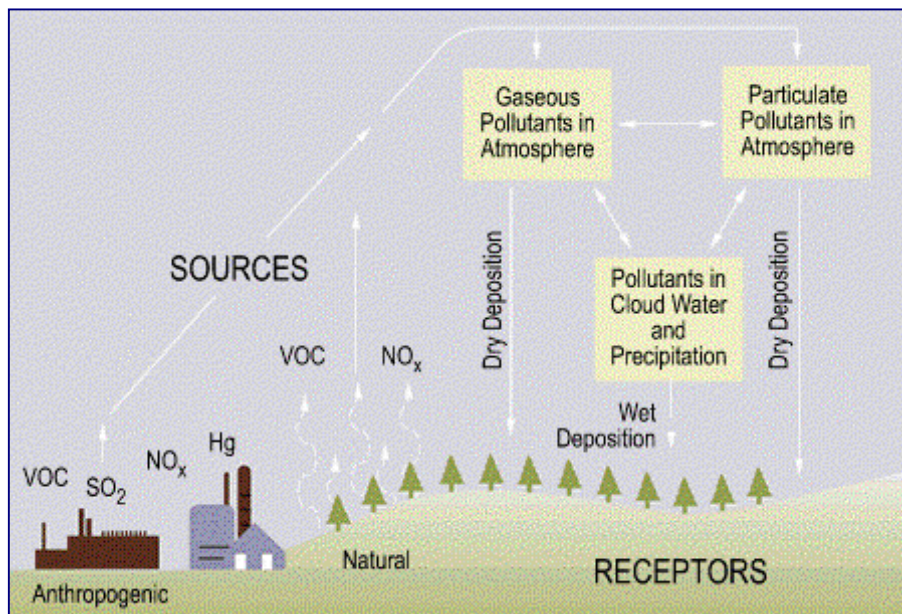
Nature and Sources

Atmospheric deposition refers to pollutants that are deposited on land or water from the air. Deposition is usually the result of pollutants being removed from the atmosphere and deposited by precipitation (wet deposition) or by the settling out of particulates (dry deposition). Dry deposition also includes gaseous pollutants that are deposited to land and water bodies. Figure 1 below shows the basic mechanisms of deposition and also the major pollutants that are of concern. These include sulfur dioxide (SO₂), nitrogen oxides (NO_x), mercury (Hg), and volatile organic compounds (VOCs). SO₂ is a major contributor to acid deposition which can reduce the ability of water bodies to support certain types of fish and other aquatic organisms. NO_x also contributes to the acid deposition problem and can contribute to eutrophication of water bodies as well. Hg will accumulate

in fish by a process known as bio-magnification. Small concentrations of Hg in water are concentrated in smaller organisms. These smaller organisms are in turn consumed by larger ones. As the Hg moves up the food chain, it becomes more and more concentrated. Fish in Hg contaminated water can become contaminated to the point where they are no longer safe for people to eat. For more information on Hg in fish see "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters" which is available at www.state.nj.us/dep/dsr/njmainfish.htm. VOCs are a very diverse group of compounds, some of which are toxic including some known carcinogens.

Atmospheric deposition is the result of pollution from a wide variety of sources and in some cases the pollution can travel great distances before being deposited on the land or water. Some known sources of atmospheric deposition are power plants, motor vehicles, incinerators, and certain industries.

Figure 1



Source: USEPA Clean Air Markets
Web Site: <http://www.epa.gov/acidrain/>

MONITORING LOCATIONS

The state monitored wet deposition levels at 3 locations in 2002. These sites are shown in the map to the right. A sample is collected each week from all of the sites and after each significant rain event at the Washington Crossing State Park site. The Washington Crossing site is also part of the National Atmospheric Deposition Program (NADP) network which is used by the U.S. Environmental Protection Agency to assess national deposition patterns and trends. Each of the sites shown in Figure 2 has a sampler for collecting wet deposition (rain and snow) and a rain gauge for determining precipitation amounts.

In addition to the wet deposition monitoring, dry (particulate) sulfate and nitrate are measured at 3 sites as shown in Figure 3. These measurements are made by analyzing the filters used in the PM₁₀ monitoring network (see section on Particulate Matter). Dry sulfate and nitrate are pollutants which form in the atmosphere and can react with water, creating acids which can affect the acidity (pH) of lakes and streams. Nitrate can also add nutrients to water bodies and can eventually lead to eutrophication (excessive growth of plant life).

Figure 2
Acid Precipitation Monitoring
Network - 2002

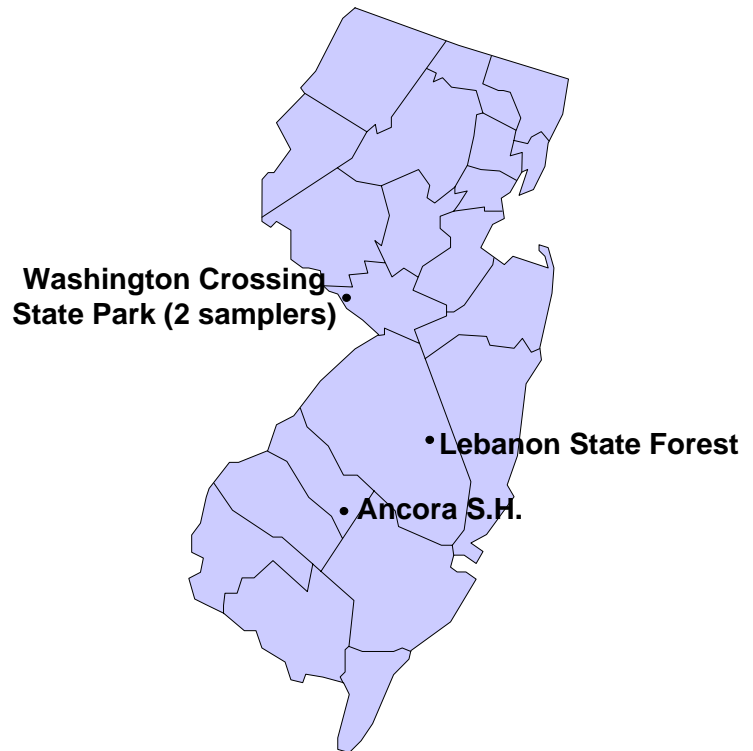
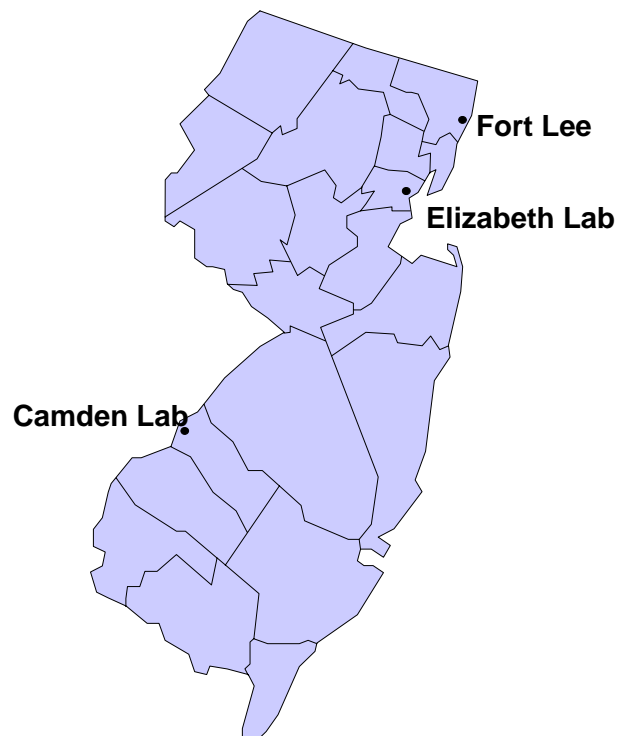


Figure 3
Sulfate and Nitrate
Monitoring Network - 2002



SUMMARY OF 2002 DATA

A summary of the 2002 wet deposition data is provided in Table 1. The table shows total precipitation, pH, conductivity and concentrations of several important ions. When acidity is reported on the pH scale, neutral is considered a 7 with decreasing pH values corresponding to increasing acidity. Normal rainfall has a pH of approximately 5.6 due to the natural presence of carbonic acid in the air. The mean pH value recorded at the Washington Crossing State Park weekly sampler was 4.52. The Ancora State Hospital sampler recorded a mean pH of 4.50 and the Lebanon State Forest sampler recorded a mean pH of 4.53.

Conductivity is a measure of the total density of ions in the water collected. It is used as an indicator of the

total amount of pollution in the sample. Conductivity is the ability of the water to conduct electricity and generally increases as the concentration of ions in water increases.

Concentrations of specific ions considered important because they can affect the chemistry of lakes, streams and other water bodies are also reported for each site. Summaries are provided for each season of the year along with annual averages.

Table 2 shows the concentrations of sulfate and nitrate found in samples of particulate matter collected at three sites. Sulfate and nitrate in particulate form can also significantly affect the acidity and nutrient content of water bodies. These two ions make up, on average, about 17% of the total mass of the particles collected.

Table 1
Acid Precipitation Monitoring Network - 2002
Annual and Seasonal Averages
Weighted by Precipitation Amount

Ca ²⁺	- Calcium	PO ₄ ³⁻	- Phosphate
Mg ⁺	- Magnesium	Cond.	- Specific conductance
K ⁺	- Potassium	us/cm	- MicroSiemens per centimeter
Na ⁺	- Sodium	mg/l	- Milligrams per liter
NH ₄	- Ammonium	<MDL	- Below minimum detection limit
NO ₃ ⁻	- Nitrate	Winter	- January – March
Cl ⁻	- Chloride	Spring	- April – June
SO ₄ ²⁻	- Sulfate	Summer	- July – September
pH	- Acidity	Fall	- October – December

Ancora State Hospital – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	7.01	4.51	21.0	0.126	0.054	0.038	0.316	0.262	1.466	0.564	1.560	<MDL
Spring	13.84	4.39	28.8	0.125	0.054	0.041	0.180	0.532	2.025	0.349	2.408	<MDL
Summer	7.74	4.43	31.8	0.110	0.073	0.028	0.272	0.408	1.578	0.485	2.742	<MDL
Fall	16.41	4.67	14.9	0.056	0.044	0.021	0.227	0.120	0.876	0.407	0.943	<MDL
Annual	45.00	4.50	23.0	0.098	0.054	0.031	0.234	0.318	1.442	0.427	1.798	<MDL

Lebanon State Forest – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	8.79	4.59	18.4	0.099	0.058	0.036	0.383	0.201	1.268	0.661	1.284	<MDL
Spring	12.56	4.52	23.1	0.101	0.048	0.031	0.168	0.433	1.572	0.316	1.896	<MDL
Summer	8.09	4.24	69.8	0.104	0.082	0.038	0.332	0.372	1.720	0.608	2.990	<MDL
Fall	14.23	4.81	11.8	0.053	0.052	0.022	0.314	0.062	0.748	0.548	0.706	<MDL
Annual	43.67	4.53	27.1	0.085	0.058	0.030	0.289	0.254	1.268	0.515	1.582	<MDL

Table 1 (Continued)
Acid Precipitation Monitoring Network – 2002
Annual and Seasonal Averages

Weighted by Precipitation Amount

Ca ²⁺	- Calcium	PO ₄ ³⁻	- Phosphate
Mg ⁺	- Magnesium	Cond.	- Specific conductance
K ⁺	- Potassium	us/cm	- MicroSiemens per centimeter
Na ⁺	- Sodium	mg/l	- Milligrams per liter
NH ₄	- Ammonium	<MDL	- Below minimum detection limit
NO ₃ ⁻	- Nitrate	Winter	- January – March
Cl ⁻	- Chloride	Spring	- April – June
SO ₄ ²⁻	- Sulfate	Summer	- July – September
pH	- Acidity	Fall	- October – December

Washington Crossing State Park – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	7.03	4.61	16.3	0.065	0.020	0.010	0.163	0.147	1.074	0.293	1.133	<MDL
Spring	12.91	4.41	27.8	0.108	0.027	0.023	0.101	0.435	1.860	0.203	2.323	<MDL
Summer	7.07	4.36	29.1	0.084	0.086	0.019	0.091	0.367	1.465	0.206	2.612	<MDL
Fall	15.83	4.72	11.7	0.038	0.011	0.004	0.080	0.097	0.725	0.166	0.796	<MDL
Annual	42.84	4.52	20.2	0.071	0.030	0.013	0.102	0.249	1.238	0.204	1.601	<MDL

Washington Crossing State Park – Event

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	6.45	4.45	21.1	0.123	0.039	0.025	0.208	0.217	1.430	0.377	1.478	<MDL
Spring	13.54	4.43	29.7	0.137	0.054	0.052	0.135	0.533	2.031	0.265	2.407	<MDL
Summer	8.69	4.44	24.4	0.073	0.042	0.028	0.132	0.378	1.310	0.227	2.249	<MDL
Fall	10.50	4.61	16.5	0.075	0.034	0.023	0.109	0.142	1.045	0.237	1.174	<MDL
Annual	39.18	4.48	23.6	0.104	0.044	0.034	0.140	0.344	1.514	0.268	1.897	<MDL

Table 2
Acid Deposition Particulate Matter – 2002
 Micrograms per Cubic Meter

N – Number of samples
 Min – Minimum
 Max – Maximum

Sampling Location	Site No.	N	Particulates			Sulfate (SO ₄)			Nitrate (NO ₃)			SO ₄ & NO ₃ % of Particulates
			Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Camden Lab	IP02	58	24.4	6.0	73.1	4.38	0.72	28.7	0.47	0.02	4.2	19.9
Elizabeth Lab	IP28	55	30.2	9.6	113.8	4.20	1.02	10.2	0.75	0.07	7.0	16.4
Fort Lee	IP14	48	29.0	13.6	59.7	3.29	1.18	16.7	0.84	0.01	5.5	14.2

TRENDS

Figure 4 shows the change in the amount of sulfate ion deposited over the last 13 years at the site in Washington Crossing State Park. The figure shows “wet deposition” only. That is, it does not include dry particulate sulfate that was deposited when no precipitation was occurring. Therefore, the total deposition is higher than what is shown here.

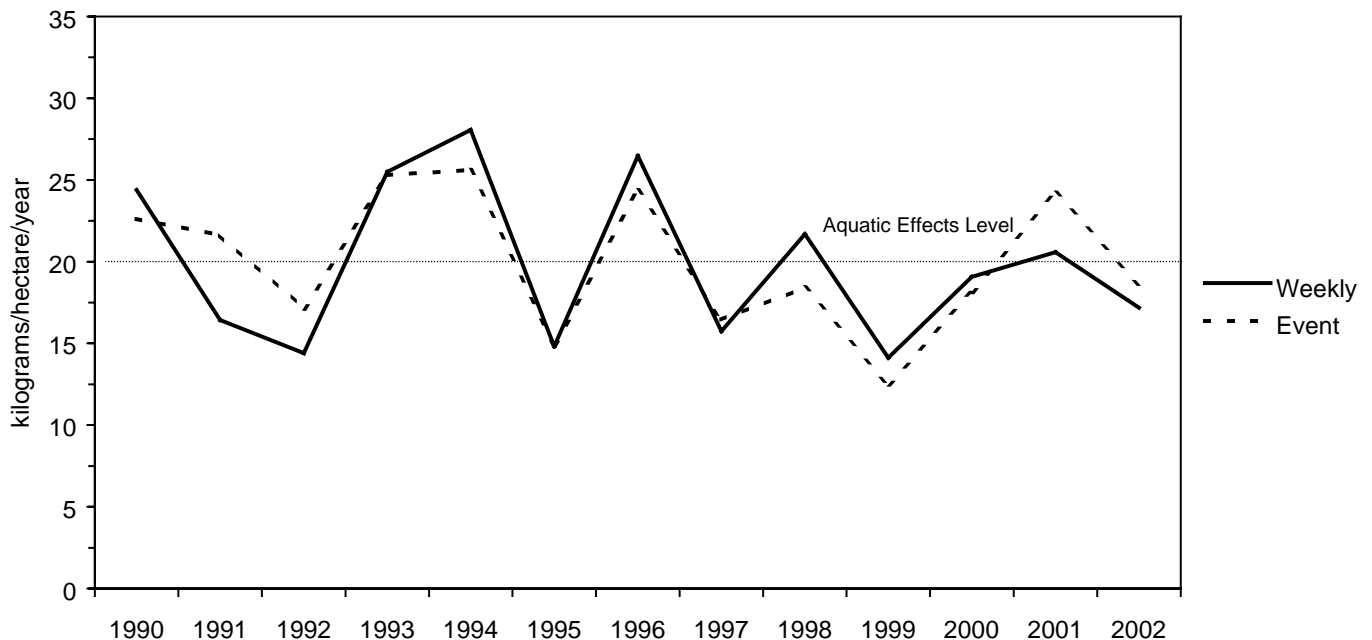
The factors controlling the trend are the sulfate concentrations in air and cloud droplets, and the total amount of precipitation in a given year. For example, in 1991 and 1992, both the sulfate concentrations and the total precipitation were below normal, while they were high in 1993 and 1994. Since the values shown here are

annual totals, they are also sensitive to loss of samples due to contamination or other factors.

Sulfate can alter soil and water chemistry, and a deposition level of 20 kilograms per hectare per year has been generally accepted as the limit above which damage to sensitive natural resources is likely to occur. However, there are no national or New Jersey standards for sulfate deposition.

Sulfate deposition in rain and snow is expressed as mass per unit land area over time. To convert the values shown in Figure 4 to pounds per acre per year, multiply by 0.89 (since one kilogram equals 2.21 pounds and one hectare equals 2.47 acres)

Figure 4
Trend in Sulfate Deposition in Precipitation at
Washington Crossing State Park, New Jersey, 1990-2002:
Annual Loading





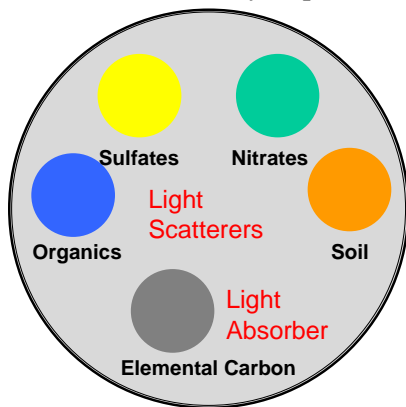
2002 Regional Haze & Visibility

New Jersey Department of Environmental Protection

THE BASICS OF HAZE

Small particles and certain gaseous molecules in the atmosphere cause poor visibility by scattering or absorbing light (see Figure 1). While some visibility impairment occurs even under natural conditions, man made aerosols are the primary cause. When high concentrations of such pollutants are well mixed in the atmosphere, they form a uniform haze that can obscure distant objects. Sometimes haze is the result of pollutants that have been transported considerable distances on the prevailing winds.

Figure 1
Contributors to Visibility Impairment



-From NESCAUM Regional Haze and Visibility in the Northeast and Mid-Atlantic

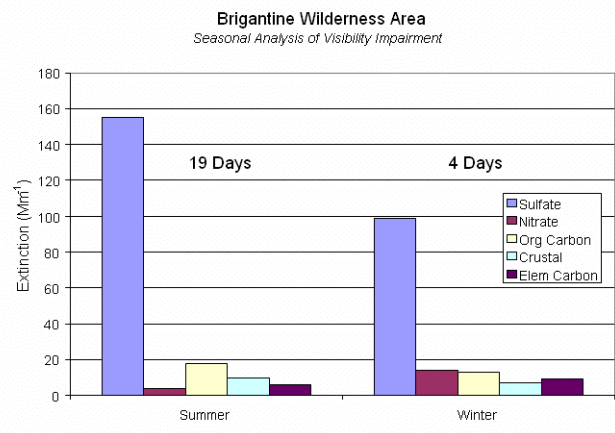
ANATOMY OF REGIONAL HAZE

Data collected over the last decade show that fine particle concentrations, and hence visibility impairment, are highest in the industrialized and densely populated areas of the Northeast and Mid-Atlantic. Sulfate (SO₄) is the primary culprit and typically constitutes 40% of the total fine mass in the region even on clear days. It can account for 60-80% of the total fine mass on very hazy days. Organic carbon usually accounts for the next largest portion of total fine particle mass. It can account for 20-30% on the haziest days. The remainder of the mass is made up primarily of nitrate (NO₃), elemental carbon, and fine soil particles.

WINTER VS. SUMMER

Figure 2 shows the makeup of fine particles collected at the IMPROVE (Interagency Monitoring of Protective Visual Environments) site located north of Atlantic City in the Brigantine Wilderness Area. Evaluations of the data for 1997 & 1998 indicate that visibility was significantly impaired on 19 days in the summer compared to only 4 days in winter. Most visibility impairment is due to sulfate, which can have a greater effect on light extinction (a measure of visibility impairment) than all other types of fine particles combined. Higher sulfate values in the summer can be attributed to the greater photochemical conversion of SO₂ to SO₄ that results from the increased sunlight during the summertime. (Malm, 1999)

Figure 2



HOW IS HAZE REGULATED?

On July 1, 1999, the U.S. Environmental Protection Agency (USEPA) issued a new set of regulations aimed at achieving national visibility goals by 2064. This "regional haze rule" addresses the combined visibility effects of numerous pollution sources over a wide geographic region and how they impact Class I areas. Class I areas as defined by the Clean Air Act, include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks that existed as of August 1977. The Wilderness Area located in the Brigantine National Wildlife Refuge is New Jersey's only Class I area and the only one between Virginia and Maine.

SOURCES OF HAZE CONTRIBUTORS

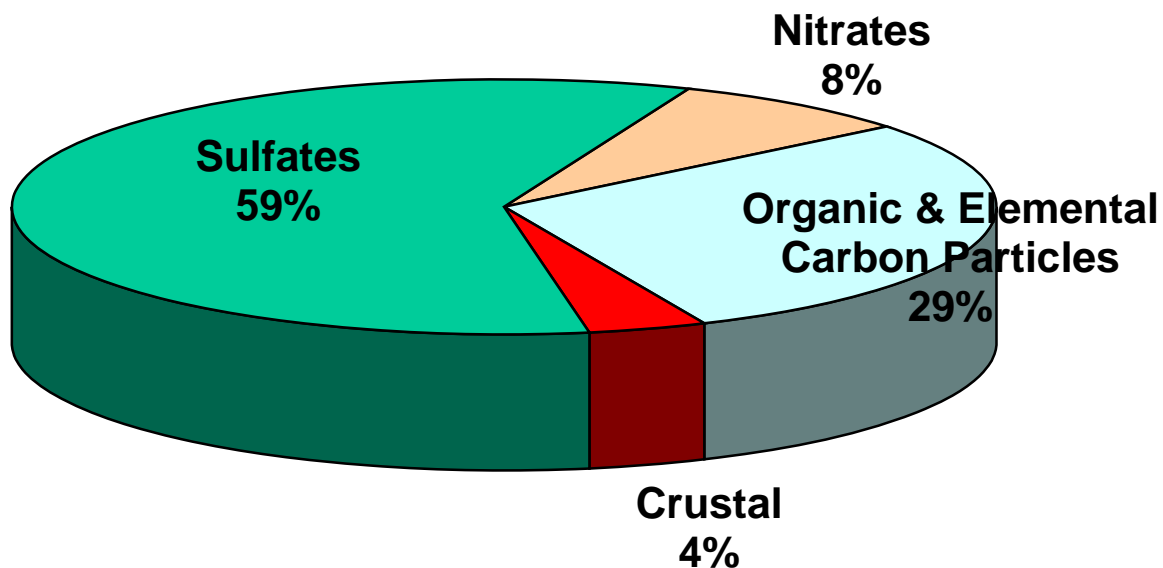
The following categories of air pollutants are the major contributors to haze.

- **Sulfate particles** form in the air from sulfur dioxide gas. Most of this gas is released from coal-burning power plants and other industrial sources, such as smelters, industrial boilers, and oil refineries. Sulfates are the largest contributor to haze in the eastern U.S., due to the large number of coal-fired power plants that affect the region. In humid environments, sulfate particles grow rapidly to a size that is very efficient at scattering light, thereby exacerbating the problem in the East.
- **Organic carbon particles** are emitted directly into the air and are also formed by the reaction of various gaseous hydrocarbons. Sources of direct and indirect organic carbon particles include vehicle exhaust, vehicle refueling, solvent evaporation (e.g., paints), food cooking, and various commercial and industrial sources. Gaseous hydrocarbons are also emitted naturally from trees and from fires, but these sources usually have only a small or short-term effect on overall visibility.
- **Nitrate particles** form in the air from nitrogen oxide gas. This gas is released from virtually all combustion activities, especially those involving cars, trucks, off-road engines (e.g., construction equipment, lawn mowers, and boats), power plants, and other industrial sources. Like sulfates, nitrates scatter more light in humid environments.
- **Elemental carbon particles** are very similar to soot. They are smaller than most other particles and tend to absorb rather than scatter light. The "brown clouds" often seen in winter over urban areas and in mountain valleys can be largely attributed to elemental carbon. These particles are emitted directly into the air from virtually all combustion activities, but are especially prevalent in diesel exhaust and smoke from the burning of wood and wastes.
- **Crustal material** is very similar to dust. It enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, and other surface activities. Whereas other types of particles form from the condensation and growth of microscopic particles and gasses, crustal material results from the crushing and grinding of larger, earth-born material. Because it is difficult to reduce this material to microscopic sizes, crustal material tends to be larger than other particles and tends to fall from the air sooner, contributing less to the overall effect of haze.

source- www.hazecam.net

Figure 3

Composition of Fine Particles in Brigantine, NJ



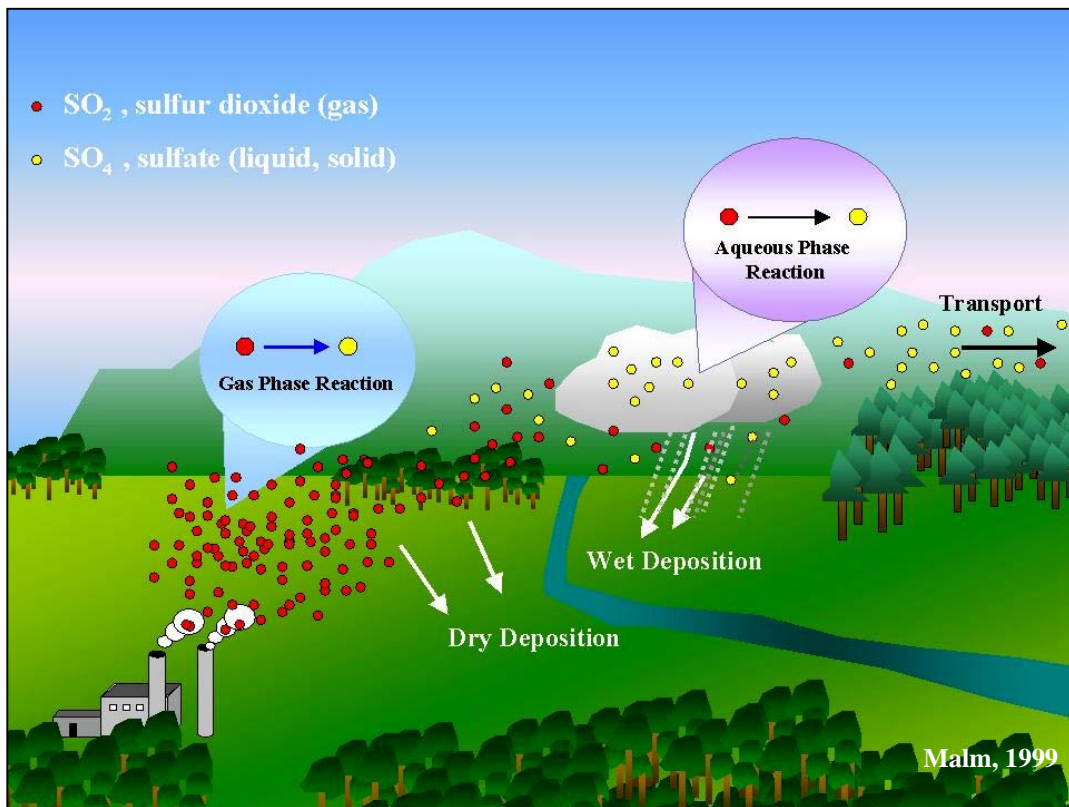
ENVIRONMENTAL EFFECTS

Regional haze is probably most closely associated with its effects on prized vistas such as the Grand Canyon or Acadia National Park. Its impacts may be difficult to quantify but it certainly has a negative overall effect on aesthetics and the outdoors, and how natural areas throughout the nation are enjoyed. But haze also affects urban area and scenes, and can obscure or eclipse the view of an urban skyline (see Figures 4 and 5) or other important urban landmarks such as the Washington Monument .

The pollution that causes regional haze has additional, multifaceted effects on the environment. The most abundant contributors to regional haze, sulfates and nitrates, eventually make their way into the ecosystem through deposition - that is, they are transferred from the air into the water and soils. Too much deposition can have adverse environmental effects, upsetting the delicate balance of the ecosystem. Increased sulfates in the atmosphere leads to acid rain while increased nitrates promote eutrophication of streams and lakes by depleting available oxygen (see section on Atmospheric Deposition).

Figure 4 illustrates how sulfates and nitrates enter the ecosystem by way of deposition.

Figure 4



MONITORING OF HAZE IN NEW JERSEY

Typical visual range in the eastern U.S. is 15 to 30 miles, or about one-third of what it would be without manmade air pollution. In the West, the typical visual range is 60 to 90 miles, or about one-half of the visual range under natural conditions. Haze diminishes the natural visual range. (www.hazecam.net)

Visibility and haze are monitored in two locations in New Jersey; Newark and Brigantine. The monitor in Newark measures the impact of haze on visibility by using a digital camera. The camera is located inside the New Jersey Transit building and is pointed at the New York City skyline. On clear days the entire skyline, as well as each individual building, is easily distinguishable (Figure 5). The Manhattan skyline appears nonexistent when conditions conducive to haze formation are in place (Figure 6).

Visibility Camera – New Jersey Transit Building

Figure 5



Figure 6



The IMPROVE site located within the Brigantine National Wildlife Refuge monitors haze and visibility using several types of instruments. Figure 7 below is an example of a clear day in Brigantine as the Atlantic City skyline is easily distinguishable along the horizon. The example of a hazy day in Brigantine is illustrated below in Figure 8 and not only has the skyline disappeared but the water that was visible in the foreground in the clear picture also seems to have vanished in the haze.

Visibility Camera – Brigantine National Wildlife Refuge

Figure 7



Figure 8



REFERENCES

Malm, *William, C.*, *Introduction to Visibility*, Air Resources Division, National Park Service, Cooperative Institute for Research in the Atmosphere (CIRA), NPS Visibility Program, Colorado State University, Fort Collins, CO, May 1999.

Regional Haze and Visibility in the Northeast and Mid-Atlantic States, Northeast States for Coordinated Air Use Management, January, 2001

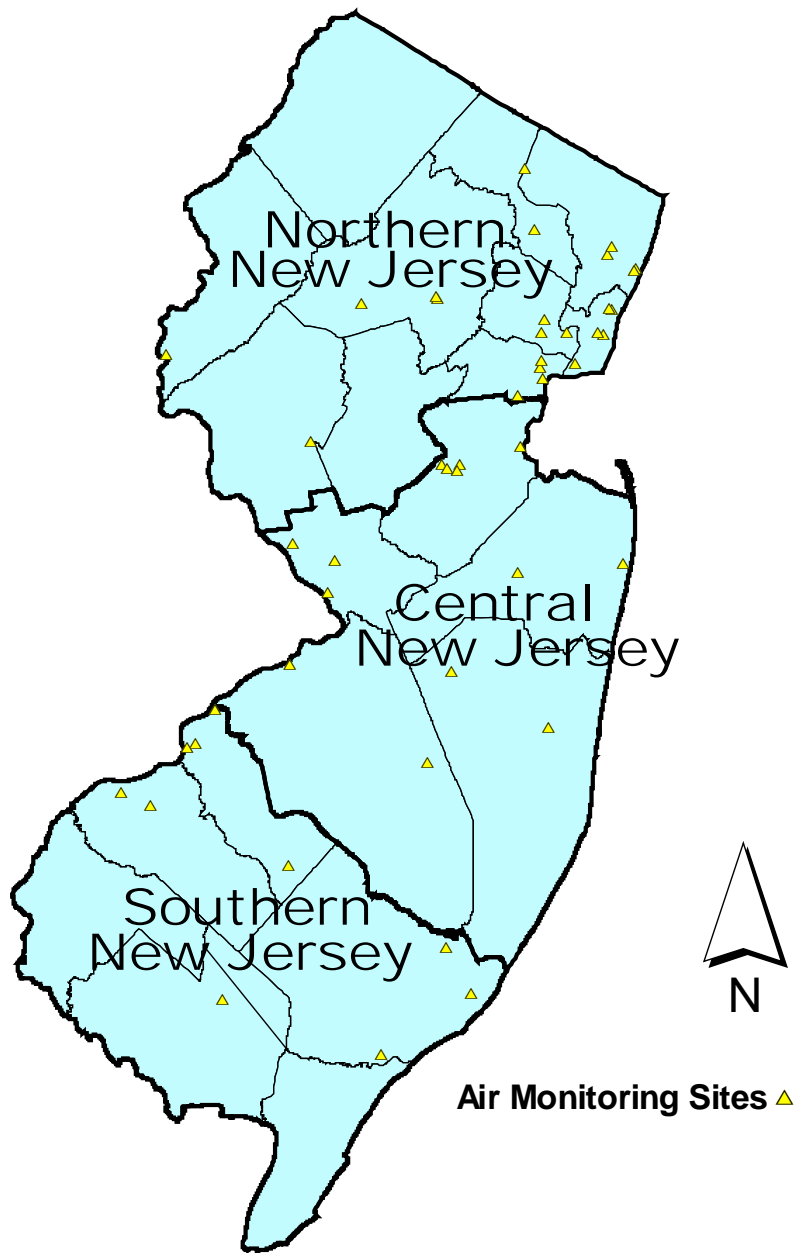
www.hazecam.net



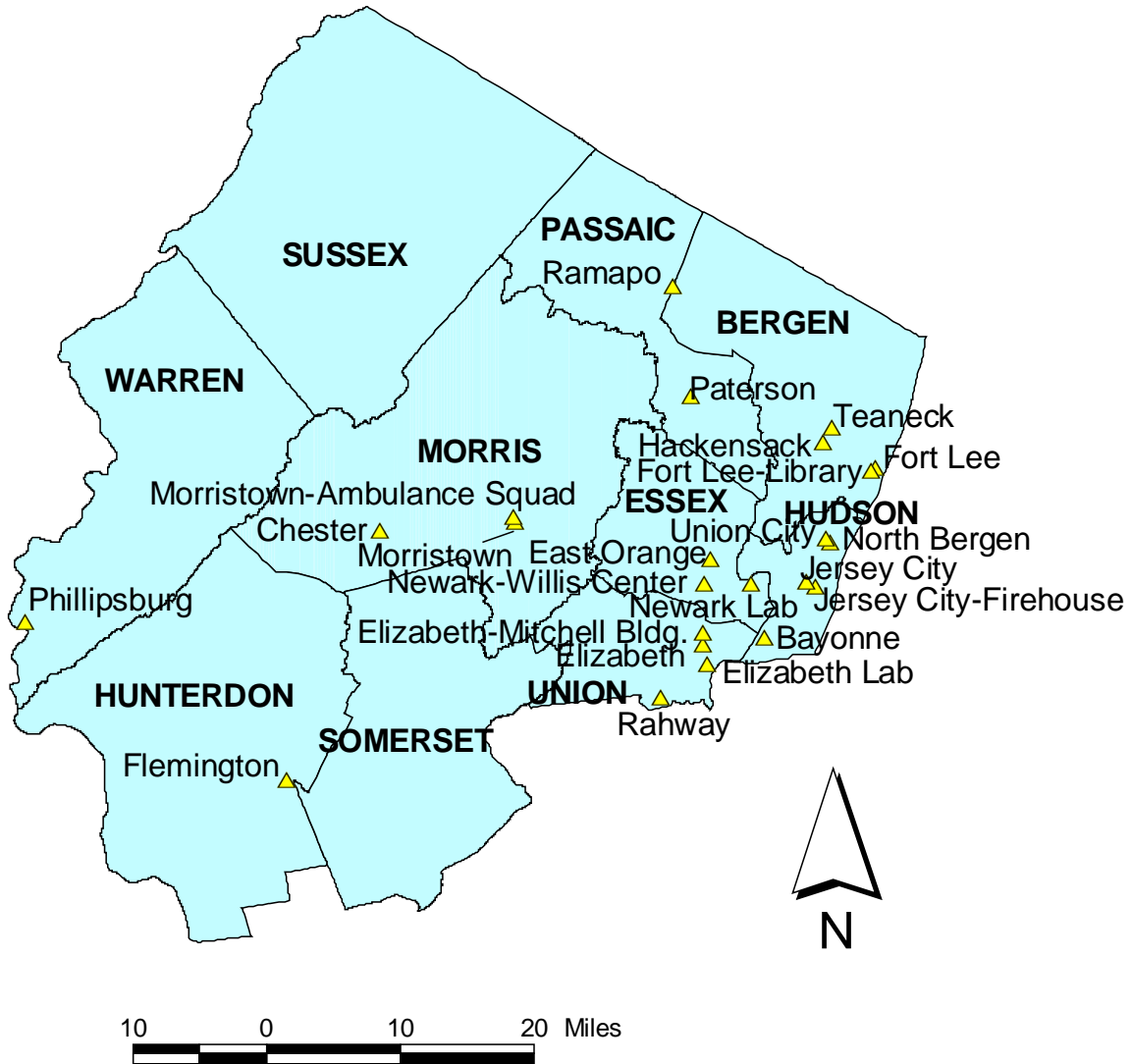
Appendix A

2002 Air Monitoring Sites

New Jersey Department of Environmental Protection



**Figure 1
Northern New Jersey
Air Monitoring Sites**

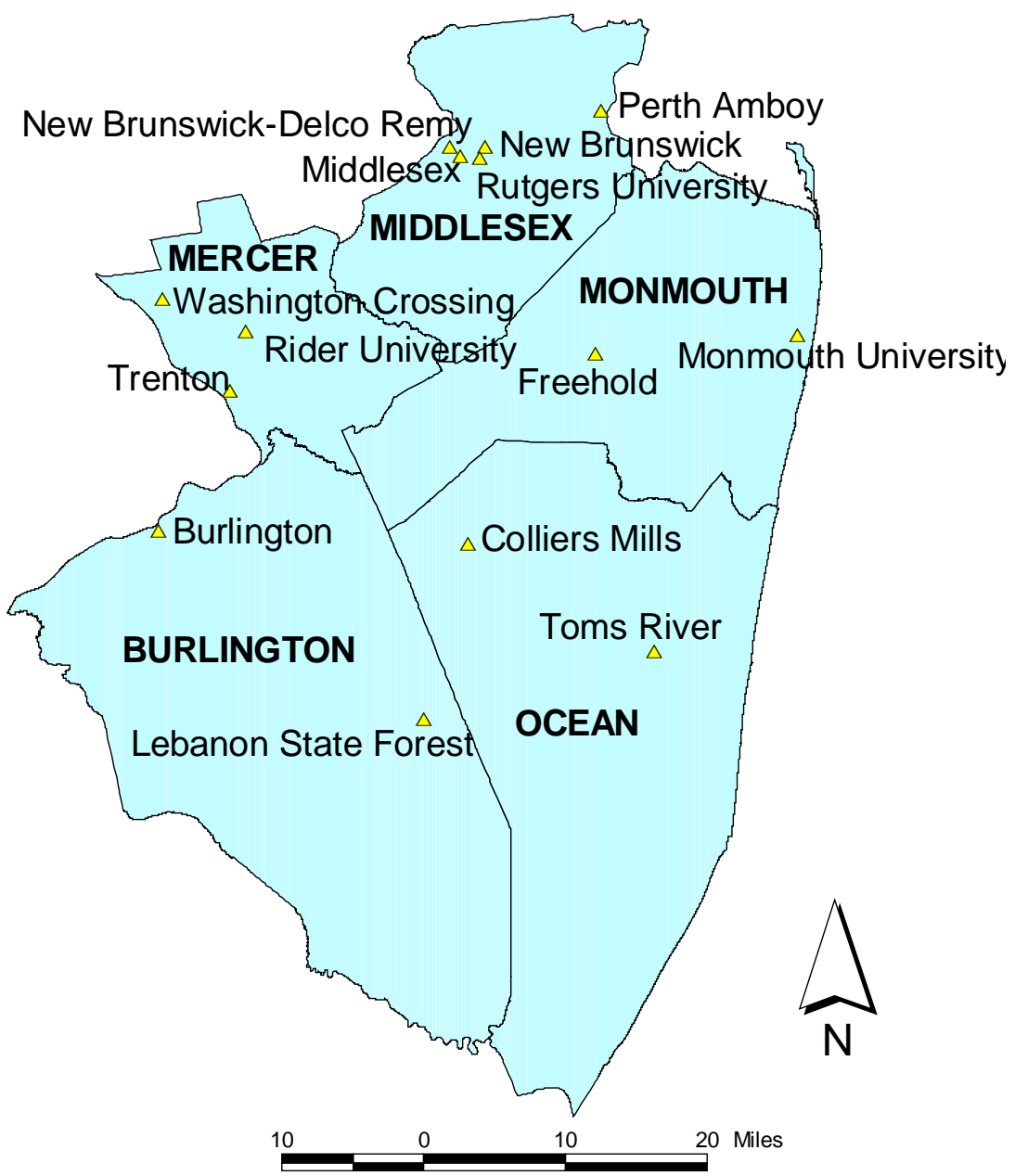


**Table 1
Northern New Jersey Air Monitoring Sites**

County	Monitoring Site	AIRS Codes	Parameter(s) Measured ¹	Coordinates (Degrees-minutes-seconds)		Address
				Latitude	Longitude	
BERGEN	Fort Lee	34 003 0004	CO, TEOM, PM ₁₀ , ACID	40 51 16	73 58 04	Lemoine Avenue Overpass over I-95
	Fort Lee-Library	34 003 0003	PM _{2.5}	40 51 07	73 58 21	Fort Lee Public Library, 320 Main Street
	Hackensack	34 003 5001	CO, SO ₂ , SS	40 51 59	74 02 28	133 River St. near Moore & Mercer Streets
	Teaneck	34 003 0005	NO _x , O ₃	40 53 55	74 01 48	1000 River Road, Fairleigh Dickinson University
ESSEX	East Orange	34 013 1003	CO, NO _x , MET	40 45 22	74 12 13	Engine No. 2, Main Street & Greenwood
	Newark Lab	34 013 0016	CO, NO _x , O ₃ , SO ₂ , SS, TEOM, PM _{2.5} , PM ₁₀	40 43 49	74 08 47	East Ferry & Lexington St.
	Newark-Willis Center	34 013 0015	PM _{2.5}	40 43 49	74 12 46	Mary Willis Cultural Center 447 18 th Ave.
HUDSON	Bayonne	34 017 0006	NO _x , O ₃ , SO ₂	40 40 13	74 07 35	Veterans Park, 25 th St. near Park Road
	Jersey City	34 017 1002	CO, SO ₂ , SS	40 43 54	74 03 60	2828 Kennedy Blvd.
	Jersey City-Firehouse	34 017 1003	PM _{2.5} , PM ₁₀	40 43 32	74 03 09	Firehouse, 355 Newark Ave.
	North Bergen	34 017 5002	CO	40 46 42	74 02 21	8511 Tonnelle Ave.
	Union City	34 017 2002	PM _{2.5}	40 46 25	74 01 53	Health Department, 714 31 st Street
HUNTERDON	Flemington	34 019 0001	O ₃ , SS, MET	40 30 56	74 48 26	Raritan Twp. Sewage Treatment Plant, Three Bridges
MORRIS	Chester	34 027 3001	NO _x , O ₃ , SO ₂ , MET, PM _{2.5} , TOXICS	40 47 16	74 40 34	Bldg. #1, Lucent Tech., Route 513
	Morristown	34 027 0003	CO, SS	40 47 51	74 28 57	11 Washington St.
	Morristown-Ambulance Squad	34 027 0004	PM _{2.5}	40 48 06	74 29 02	Ambulance Squad, 16 Early St.
PASSAIC	Paterson	34 031 0005	PM _{2.5}	40 55 60	74 13 52	Health Department, 176 Broadway Ave.
	Ramapo	34 031 5001	O ₃	41 03 08	74 15 23	Access Road, off Skyline Drive, Wanaque Borough
UNION	Elizabeth	34 039 0003	CO, SO ₂ , SS	40 39 45	74 12 53	7 Broad St.
	Elizabeth Lab	34 039 0004	CO, NO _x , SO ₂ , SS, TEOM, MET, PM _{2.5} , PM ₁₀ , ACID, TOXICS	40 38 29	74 12 30	Interchange 13, NJTP
	Elizabeth-Mitchell Building	34 039 0006	PM _{2.5}	40 40 35	74 12 52	Mitchell Bldg., 500 North Broad Street
	Rahway	34 039 2003	PM _{2.5}	40 36 22	74 16 30	Fire Dept. Bldg., 1300 Main Street
WARREN	Phillipsburg	34 041 0006	PM _{2.5}	40 41 08	75 10 53	Municipal Bldg., 675 Corliss Avenue

¹ See Parameter Codes, Table 4 (page Appendix A-8)

Figure 2
Central New Jersey Air
Monitoring Sites

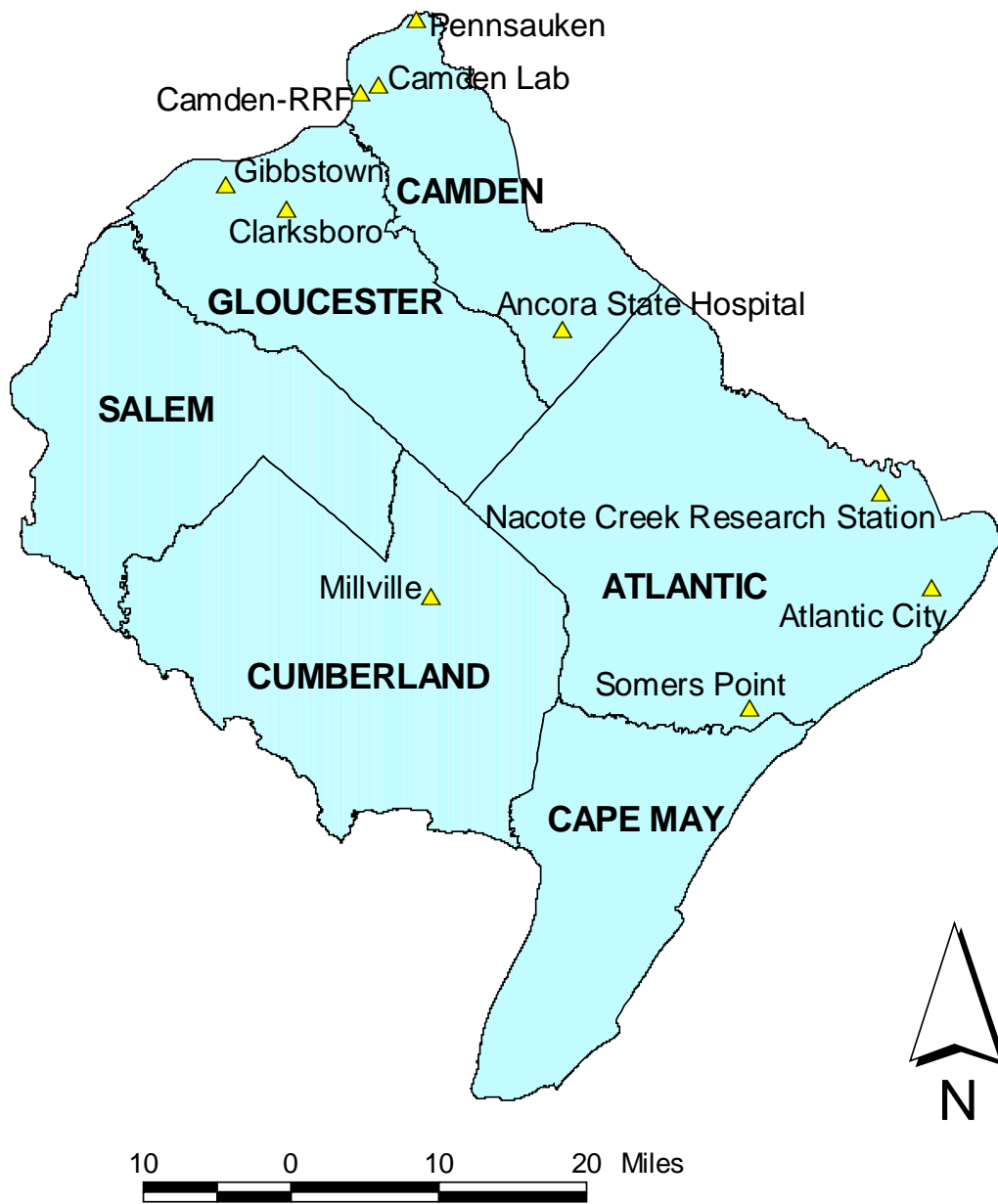


**Table 2
Central New Jersey Air Monitoring Sites**

County	Monitoring Site	AIRS Codes	Parameter(s) Measured ¹	Coordinates (Degrees-minutes-seconds)		Address
				Latitude	Longitude	
BURLINGTON	Burlington	34 005 1001	CO, SO ₂ , SS	40 04 41	74 51 28	1 East Broad Street
	Lebanon State Forest	N/A	ACID	39 53 08	74 30 18	Lebanon State Forest
MERCER	Rider University	34 021 0005	NO _x , O ₃ , PAMS, MET	40 16 59	74 44 34	Athletic Fields, Route 206 South, Lawrenceville
	Trenton	34 021 0008	PM _{2.5} , PM ₁₀	40 13 18	74 45 47	Trenton Library, 120 Academy Street
	Washington Crossing	34 021 8001	PM _{2.5} , ACID	40 18 56	74 51 14	Washington Crossing State Park, off Church Road, Titusville
MIDDLESEX	Middlesex	34 023 8001	CO	40 27 49	74 27 22	Georges Road, west of Route 1 Circle
	New Brunswick	34 023 0006	TEOM, PM _{2.5} , TOXICS	40 28 22	74 25 21	Cook College, Log Cabin Road
	New Brunswick-Delco Remy	34 023 1003	Pb, TSP	40 28 23	74 28 14	12 th Street & Livingston Avenue
	Perth Amboy	34 023 2003	CO, SO ₂ , SS	40 30 32	74 16 06	130 Smith Street, Perth Amboy
	Rutgers University	34 023 0011	NO _x , O ₃ , MET, PAMS	40 27 43	74 25 47	Horticultural Farm #3, off Ryder's Lane, New Brunswick
MONMOUTH	Freehold	34 025 2001	CO, SS	40 15 36	74 16 29	5 West Main Street
	Monmouth University	34 025 0005	O ₃	40 16 40	74 00 18	Edison Science Bldg., West Long Branch
OCEAN	Colliers Mills	34 029 0006	O ₃	40 03 53	74 26 43	Colliers Mills Wildlife Management Area
	Toms River	34 029 2002	PM _{2.5}	39 57 13	74 11 53	Elementary School, 1517 Hooper Avenue

¹ See Parameter Codes, Table 4 (page Appendix A-8)

Figure 3
Southern New Jersey
Air Monitoring Sites



**Table 3
Southern New Jersey Air Monitoring Sites**

County	Monitoring Site	AIRS Codes	Parameter(s) Measured ¹	Coordinates (Degrees-minutes-seconds)		Address
				Latitude	Longitude	
ATLANTIC	Atlantic City	34 001 1006	PM _{2.5} , PM ₁₀	39 25 56	74 23 41	1433 Bacharach Blvd., Atlantic City
	Nacote Creek Research Station	34 001 0005	O ₃ , SO ₂	39 31 32	74 27 34	Brigantine National Wildlife Refuge near Smithville
	Somers Point	34 001 0009	NO _x , SO ₂	39 18 49	74 37 25	Somers Point Marina, Woodland & Harlan Ave.
CAMDEN	Ancora State Hospital	34 007 1001	CO, O ₃ , SO ₂ , ACID	39 41 05	74 51 42	Ancora State Hospital, Winslow Twp.
	Camden Lab	34 007 0003	CO, NO _x , O ₃ , SO ₂ , SS, TEOM, MET, PAMS, PM _{2.5} , ACID, TOXICS	39 55 22	75 05 49	1667 Davis Street, corner of Copewood St.
	Camden-RRF	34 007 0009	PM ₁₀	39 54 54	75 07 10	Camden RRF, Morgan Blvd. & I-676
	Pennsauken	34 007 1007	PM _{2.5}	39 59 19	75 02 60	9800 Zimmerman Ave, near Griffith-Morgan Lane
CUMBERLAND	Millville	34 012 0007	NO _x , O ₃ , SO ₂	39 25 20	75 01 31	Lincoln Avenue & Route 55
GLOUCESTER	Clarksboro	34 015 5001	O ₃ , SO ₂	39 48 02	75 12 46	Clarksboro Shady Lane Rest Home, County House Road
	Gibbstown	34 015 0002	PM _{2.5}	39 49 30	75 17 21	420 Washington Street

¹ See Parameter Codes, Table 4 (page Appendix A-8)

**Table 4
Parameter Codes**

ACID	Acid Deposition	PM _{2.5}	Fine Particles (2.5 Microns or less) collected by a Federally Approved Manual PM _{2.5} Sampler
CO	Carbon Monoxide	TEOM	Continuous PM _{2.5} Analyzer
MET	Meteorological Parameters	SO ₂	Sulfur Dioxide
NO _x	Nitrogen Dioxide and Nitric Oxide	SS	Smoke Shade
O ₃	Ozone	Pb	Lead
PAMS	Photochemical Assessment Monitoring Station	TOXICS	Air Toxics
PM ₁₀	Coarse Particles (10 Microns or less) collected by a Federally Approved Manual PM ₁₀ Sampler	TSP	Total Suspended Particulate



Appendix B

Fine Particulate Speciation Summary- 2002

New Jersey Department of Environmental Protection

Table 1
Fine Particulate Speciation Data – 2002
Camden Lab, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0196	0.4404	0.1571
Ammonium	2.0624	12.1231	6.5005
Antimony	0.0053	0.0522	0.0406
Arsenic	0.0009	0.0054	0.0048
Barium	0.0259	0.0921	0.0851
Bromine	0.0059	0.0757	0.0444
Cadmium	0.0025	0.0149	0.0136
Calcium	0.0368	0.1441	0.1261
Carbonate carbon	0	0	0
Cerium	0.0139	0.1175	0.0921
Cesium	0.0046	0.0416	0.0228
Chlorine	0.0211	1.1224	0.1619
Chromium	0.0026	0.0539	0.0127
Cobalt	0.0002	0.0017	0.0015
Copper	0.0045	0.0290	0.0225
Elemental carbon	0.7309	2.7319	2.4730
Europium	0.0017	0.0232	0.0203
Gallium	0.0003	0.0028	0.002
Gold	0.0019	0.0117	0.0088
Hafnium	0.0025	0.0252	0.0238
Indium	0.0024	0.0204	0.0151
Iridium	0.0017	0.0122	0.0108
Iron	0.0789	0.3581	0.348
Lanthanum	0.0102	0.0756	0.0643
Lead	0.0047	0.0376	0.0216
Magnesium	0.0055	0.1849	0.0591
Manganese	0.0023	0.0072	0.0071
Mercury	0.0013	0.0084	0.0083
Molybdenum	0.0015	0.0112	0.0071
Nickel	0.0036	0.0150	0.0141
Niobium	0.0008	0.0058	0.0042
Nitrate	2.1706	9.3186	8.9148

Table 1 (Continued)
Fine Particulate Speciation Data – 2002
Camden Lab, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Organic carbon	5.0663	49.3815	15.1399
Fine particles	16.0389	95.4053	60.5842
Phosphorus	0.0021	0.0218	0.0161
Potassium	0.0613	0.6379	0.6198
Rubidium	0.0004	0.0028	0.0022
Samarium	0.0008	0.0102	0.0091
Scandium	0.0002	0.0033	0.0021
Selenium	0.0014	0.0057	0.0055
Silicon	0.0931	0.9520	0.4935
Silver	0.0032	0.0153	0.0122
Sodium	0.2045	1.0147	0.9575
Strontium	0.0011	0.0062	0.0043
Sulfate	4.6120	31.5102	17.0436
Sulfur	1.5287	9.3711	5.6812
Tantalum	0.0108	0.0563	0.0492
Terbium	0.0004	0.0088	0.0070
Tin	0.0101	0.0332	0.0291
Titanium	0.0054	0.052	0.0157
Total carbon	5.7972	50.5618	17.8718
Vanadium	0.0062	0.0430	0.0415
Wolfram	0.0040	0.0210	0.0174
Yttrium	0.0004	0.0043	0.0042
Zinc	0.0117	0.0885	0.0429
Zirconium	0.0010	0.0296	0.0054

Table 2
Fine Particulate Speciation Data – 2002
Chester, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0062	0.0829	0.0404
Ammonium	1.5234	6.0980	5.7628
Antimony	0.0071	0.0584	0.0486
Arsenic	0.0010	0.0044	0.0044
Barium	0.0215	0.0873	0.0871
Bromine	0.0029	0.0109	0.0083
Cadmium	0.0030	0.0174	0.0156
Calcium	0.0215	0.0622	0.0543
Carbonate carbon	0	0	0
Cerium	0.0147	0.1280	0.0943
Cesium	0.0045	0.0334	0.0295
Chlorine	0.0056	0.1425	0.0405
Chromium	0.0013	0.0049	0.0043
Cobalt	0.0002	0.0018	0.0012
Copper	0.0049	0.0343	0.0290
Elemental carbon	0.4156	1.0402	0.8696
Europium	0.0007	0.0105	0.0079
Gallium	0.0001	0.0014	0.0014
Gold	0.0012	0.0078	0.0065
Hafnium	0.0034	0.0361	0.0331
Indium	0.0026	0.0127	0.0111
Iridium	0.0013	0.0062	0.0061
Iron	0.0364	0.1043	0.1017
Lanthanum	0.0050	0.0497	0.0487
Lead	0.0027	0.0109	0.0092
Magnesium	0.0046	0.0414	0.0404
Manganese	0.0018	0.0061	0.0050
Mercury	0.0010	0.0050	0.0043
Molybdenum	0.0020	0.0122	0.0119
Nickel	0.0017	0.0116	0.0066
Niobium	0.0006	0.0036	0.0035
Nitrate	1.4652	8.4899	5.8452
Organic carbon	3.8477	42.4958	9.9323
Fine particles	10.3317	31.3502	27.6232
Phosphorus	0.0039	0.1282	0.0201
Potassium	0.0387	0.1271	0.1035
Rubidium	0.0004	0.0047	0.0024
Samarium	0.0006	0.0075	0.0049
Scandium	0.0003	0.0037	0.0028
Selenium	0.0013	0.0058	0.0057

Table 2 (Continued)
Fine Particulate Speciation Data – 2002
Chester, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Silicon	0.0623	0.1827	0.1518
Silver	0.0034	0.0143	0.0111
Sodium	0.1893	0.7246	0.6859
Strontium	0.0007	0.0032	0.0031
Sulfate	4.0093	21.3841	17.8274
Sulfur	1.086	4.9835	3.4005
Tantalum	0.0095	0.051	0.0408
Terbium	0.0003	0.0044	0.0027
Tin	0.0099	0.0381	0.0292
Titanium	0.0041	0.0153	0.0143
Total carbon	4.2633	43.233	10.3099
Vanadium	0.002	0.0137	0.0111
Wolfram	0.0034	0.0226	0.0183
Yttrium	0.0006	0.0049	0.0028
Zinc	0.0078	0.0439	0.0271
Zirconium	0.0008	0.0059	0.0037

Table 3
Fine Particulate Speciation Data – 2002
Elizabeth Lab, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0277	0.5468	0.4555
Ammonium	2.0910	7.5756	7.1794
Antimony	0.0055	0.0627	0.0356
Arsenic	0.0011	0.0051	0.0033
Barium	0.0348	0.0943	0.0923
Bromine	0.0037	0.0172	0.0127
Cadmium	0.0028	0.0261	0.0207
Calcium	0.0435	0.1575	0.1323
Carbonate carbon	0	0	0
Cerium	0.0109	0.1163	0.1088
Cesium	0.0045	0.0365	0.0274
Chlorine	0.0465	0.5961	0.5694
Chromium	0.0033	0.0399	0.0318
Cobalt	0.0003	0.0028	0.0026
Copper	0.0071	0.0269	0.0181
Elemental carbon	1.8226	4.6514	4.0180
Europium	0.0024	0.0206	0.020
Gallium	0.0001	0.0015	0.0012
Gold	0.0020	0.0087	0.0084
Hafnium	0.0033	0.0592	0.0403
Indium	0.0020	0.0256	0.0204
Iridium	0.0015	0.0078	0.0071
Iron	0.1267	0.3848	0.3038
Lanthanum	0.0081	0.0576	0.0462
Lead	0.0047	0.0149	0.0115
Magnesium	0.0095	0.1888	0.1646
Manganese	0.0031	0.0104	0.0097
Mercury	0.0012	0.0072	0.0059
Molybdenum	0.0015	0.0073	0.0069
Nickel	0.0048	0.0297	0.0261
Niobium	0.0006	0.0050	0.0043
Nitrate	2.1984	9.9004	8.4633
Organic carbon	6.0903	46.3731	12.4329
Fine particles	18.1842	85.7084	52.2080
Phosphorus	0.0036	0.0425	0.0269
Potassium	0.0610	0.6606	0.6325
Rubidium	0.0006	0.0029	0.0027
Samarium	0.0011	0.0094	0.0094
Scandium	0.0004	0.0035	0.0023
Selenium	0.0017	0.0097	0.0060

Table 3 (Continued)
Fine Particulate Speciation Data – 2002
Elizabeth Lab, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Silicon	0.1089	1.0478	0.4544
Silver	0.0027	0.0119	0.0106
Sodium	0.2311	0.9496	0.8883
Strontium	0.0013	0.0097	0.0057
Sulfate	4.3530	17.5274	15.8345
Sulfur	1.4142	5.6848	4.8980
Tantalum	0.0081	0.0387	0.0342
Terbium	0.0002	0.0037	0.0029
Tin	0.0093	0.0322	0.0277
Titanium	0.0079	0.0500	0.0234
Total carbon	7.9129	48.0773	15.7961
Vanadium	0.0076	0.0531	0.0439
Wolfram	0.0030	0.0205	0.0171
Yttrium	0.0006	0.0029	0.0028
Zinc	0.0176	0.0602	0.0510
Zirconium	0.0024	0.1116	0.0065

Table 4
Fine Particulate Speciation Data – 2002
New Brunswick, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0172	0.4631	0.2256
Ammonium	1.5808	7.5078	5.0059
Antimony	0.0071	0.0629	0.0586
Arsenic	0.0011	0.0061	0.0046
Barium	0.0306	0.0980	0.0952
Bromine	0.0032	0.0088	0.0087
Cadmium	0.0020	0.0158	0.0100
Calcium	0.0313	0.2295	0.1480
Carbonate carbon	0	0	0
Cerium	0.0163	0.0862	0.0832
Cesium	0.0071	0.0436	0.0365
Chlorine	0.0283	0.7643	0.3416
Chromium	0.0028	0.0500	0.0187
Cobalt	0.0003	0.0020	0.0020
Copper	0.0059	0.0230	0.0211
Elemental carbon	0.6533	2.0387	1.9532
Europium	0.0016	0.0360	0.0228
Gallium	0.0002	0.0029	0.0024
Gold	0.0018	0.0099	0.0093
Hafnium	0.0031	0.0329	0.0317
Indium	0.0021	0.0341	0.0262
Iridium	0.0017	0.0093	0.0078
Iron	0.0784	0.3913	0.3489
Lanthanum	0.0072	0.0736	0.0517
Lead	0.0079	0.1246	0.0404
Magnesium	0.0050	0.0789	0.0600
Manganese	0.0030	0.0254	0.0189
Mercury	0.0012	0.0061	0.0048
Molybdenum	0.0013	0.0090	0.0070
Nickel	0.0027	0.0189	0.0123
Niobium	0.0007	0.0049	0.0041
Nitrate	1.5915	6.8683	6.7106
Organic carbon	6.0903	46.3731	12.4329
Fine particles	18.1842	85.7084	52.2080
Phosphorus	0.0036	0.0425	0.0269
Potassium	0.0610	0.6606	0.6325
Rubidium	0.0006	0.0029	0.0027
Samarium	0.0011	0.0094	0.0094
Scandium	0.0003	0.0031	0.0019
Selenium	0.0012	0.0052	0.0051

Table 4 (Continued)
Fine Particulate Speciation Data – 2002
New Brunswick, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Silicon	0.0819	0.9638	0.3797
Silver	0.0037	0.0143	0.0137
Sodium	0.2086	0.8049	0.7002
Strontium	0.0010	0.0060	0.0051
Sulfate	3.8291	20.3349	14.7554
Sulfur	1.1926	6.3135	4.4472
Tantalum	0.0108	0.0452	0.0450
Terbium	0.0002	0.0045	0.0018
Tin	0.0119	0.0701	0.0508
Titanium	0.0059	0.0433	0.0243
Total carbon	5.1764	47.2367	24.0681
Vanadium	0.0025	0.0083	0.0080
Wolfram	0.0035	0.0237	0.0179
Yttrium	0.0005	0.0030	0.0029
Zinc	0.0175	0.2033	0.1170
Zirconium	0.0009	0.0052	0.0052

