



# 2001 Air Quality Report

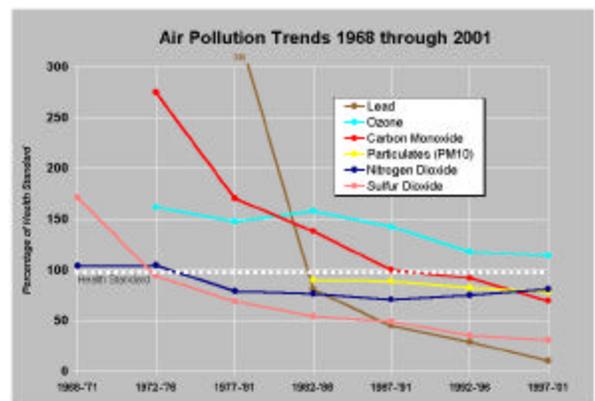
New Jersey Department of Environmental Protection

## SUMMARY

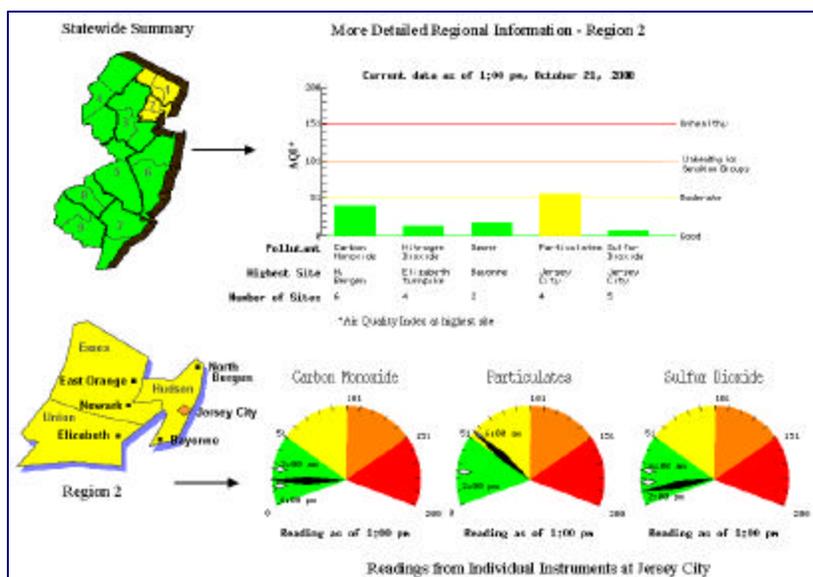
A summary of the New Jersey air quality monitoring data for 2001. Contains information on the Air Quality Index (AQI), concentrations of individual pollutants – carbon monoxide, lead, nitrogen oxides, ozone, particulate matter, and sulfur dioxide. Data on acid precipitation, sulfates, nitrates and other constituents of particulate matter, ozone precursors and toxic air contaminants are also provided.



Air Monitoring Shelter



Air Quality Trends



Air Quality Index



# 2001 Air Quality Report

New Jersey Department of Environmental Protection

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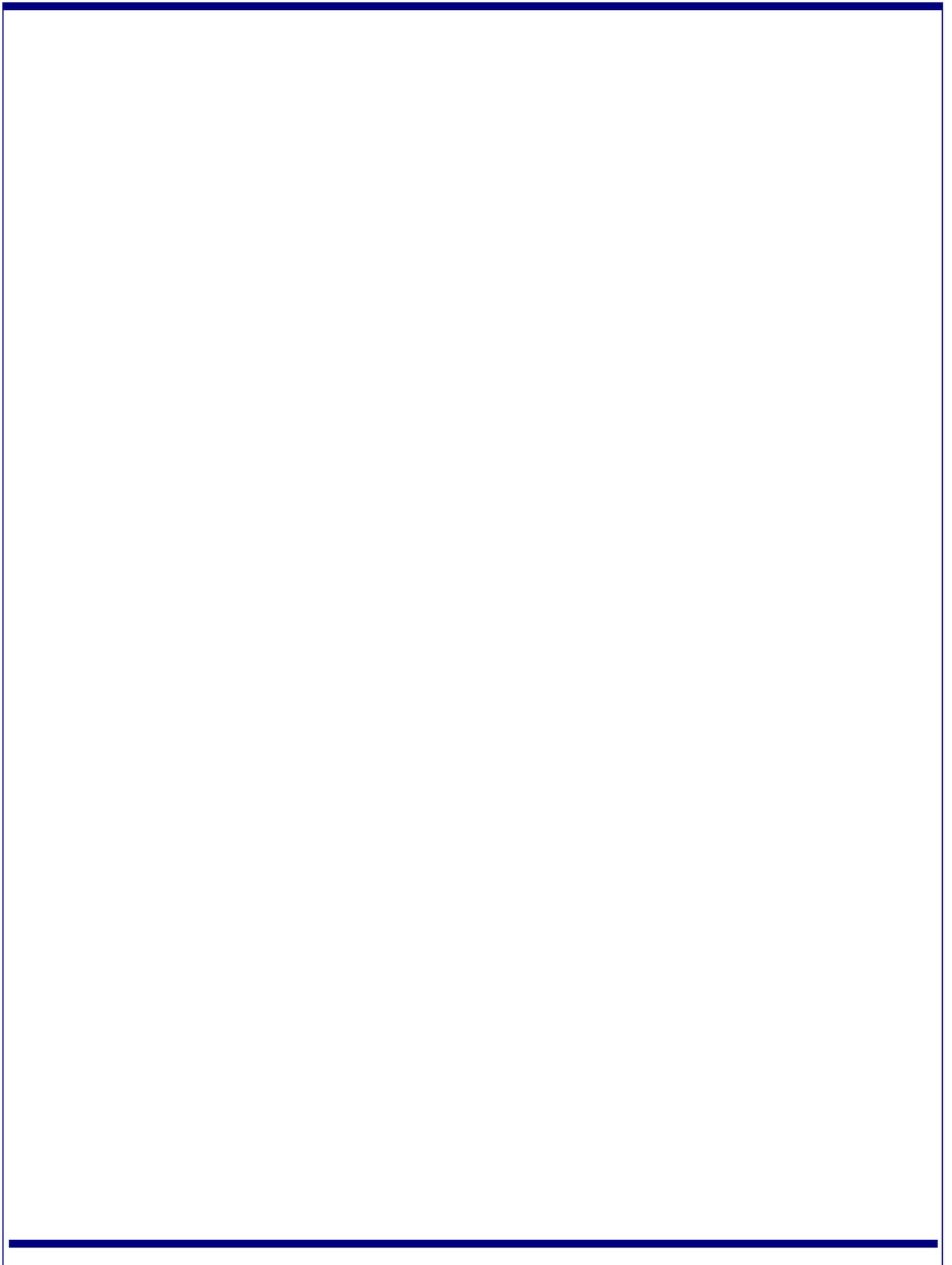
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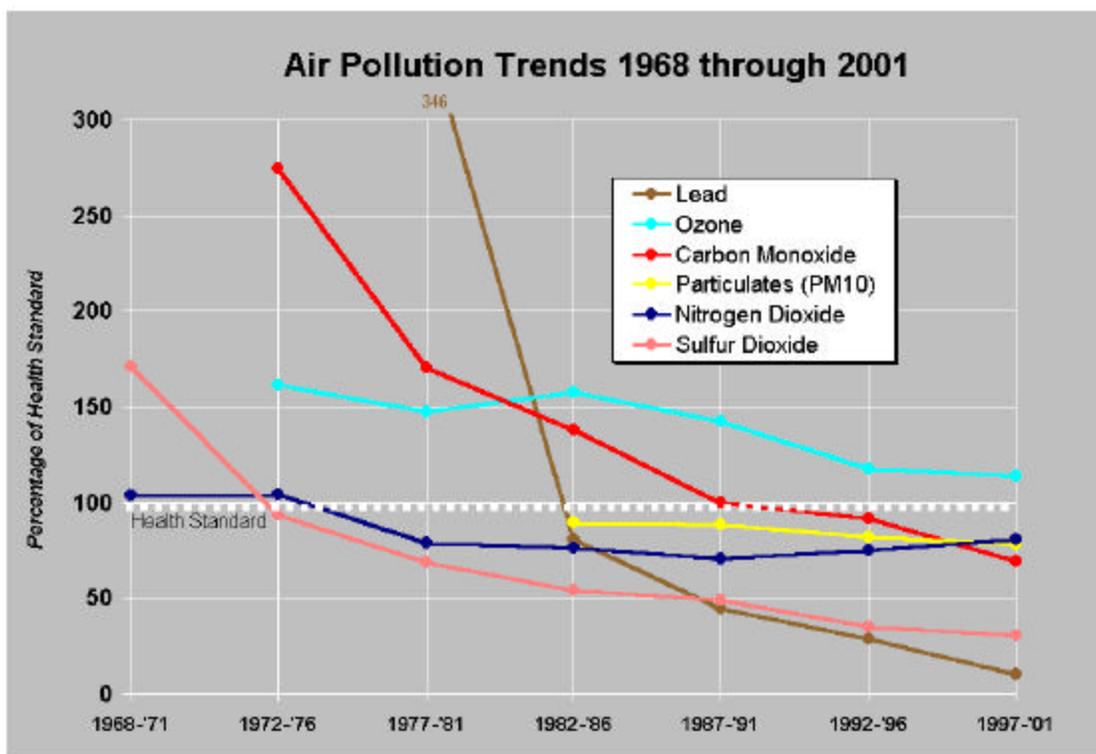


# Introduction

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 PM<sub>2.5</sub>, 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 just beginning and some of the early data from that program is presented in this report.

The format of the Air Quality Report has changed for 2001. The individual sections of the report are intended to be more self contained so that they can be prepared, disseminated and used independent of each other. This was also done so that sections could be made available as they are completed, rather than having to wait for the entire report to be completed and published. While the formatting changes delayed the release of the 2001 report, it is hoped that these changes will make it possible to release the data to the public more quickly in future years.

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

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# 2001 Air Monitoring Network

New Jersey Department of Environmental Protection

## NETWORK SUMMARY

The Bureau of Air Monitoring maintains 47 Ambient Air Monitoring Sites in New Jersey. The Air Monitoring Sites can be divided into two primary networks; the Continuous Monitoring Network and the Manual Sampling Network. The data collected by the program is used to provide the public with information on pollutant levels and are collected in accordance with state and federal regulations. 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 [www.state.nj.us/dep/airmon](http://www.state.nj.us/dep/airmon).



Figure 1: Air Monitoring Trailer located at Rutgers University Ambient Air Monitoring Site



Figure 2: Continuous Monitoring Equipment located within an Air Monitoring Trailer

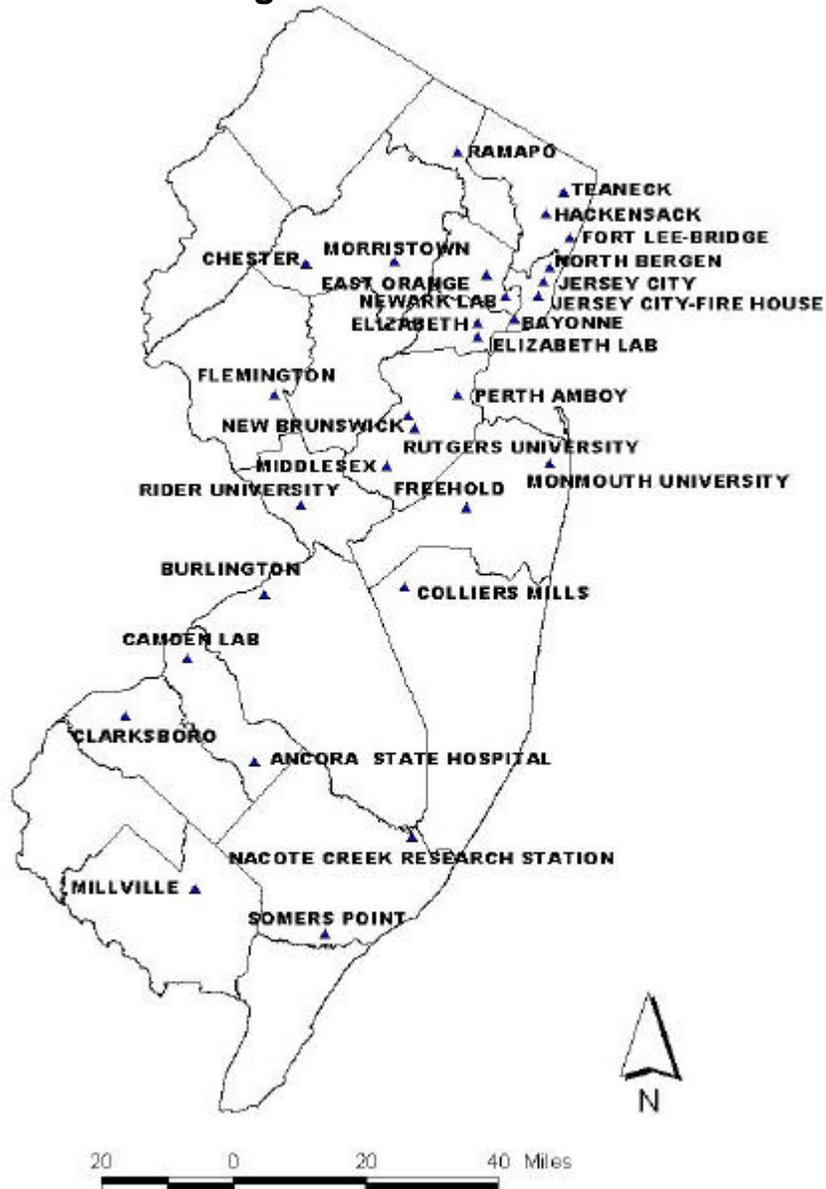


Figure 3: Manual Particulate Samplers located atop an Air Monitoring Trailer

## THE CONTINUOUS MONITORING NETWORK

The Continuous Monitoring Network consists of automated sites which measure carbon monoxide (CO), oxides of nitrogen (NO<sub>x</sub>), ozone (O<sub>3</sub>), sulfur dioxide (SO<sub>2</sub>), 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 4 and the parameters recorded at each site are displayed in Table 1. Many of these locations are also part of the manual monitoring network, which is described later in this section.

**Figure 4**  
**2001 Continuous Network**  
**Monitoring Site Locations**



**Table 1**  
**Continuous Network**  
**Parameters Measured**

**Continuous Parameter Codes**

CO - Carbon Monoxide

NOx - Nitrogen Dioxide and Nitric Oxide

O<sub>3</sub> - Ozone

SO<sub>2</sub> - Sulfur Dioxide

SS - Smoke Shade

TEOM - Continuous PM<sub>2.5</sub> Analyzer

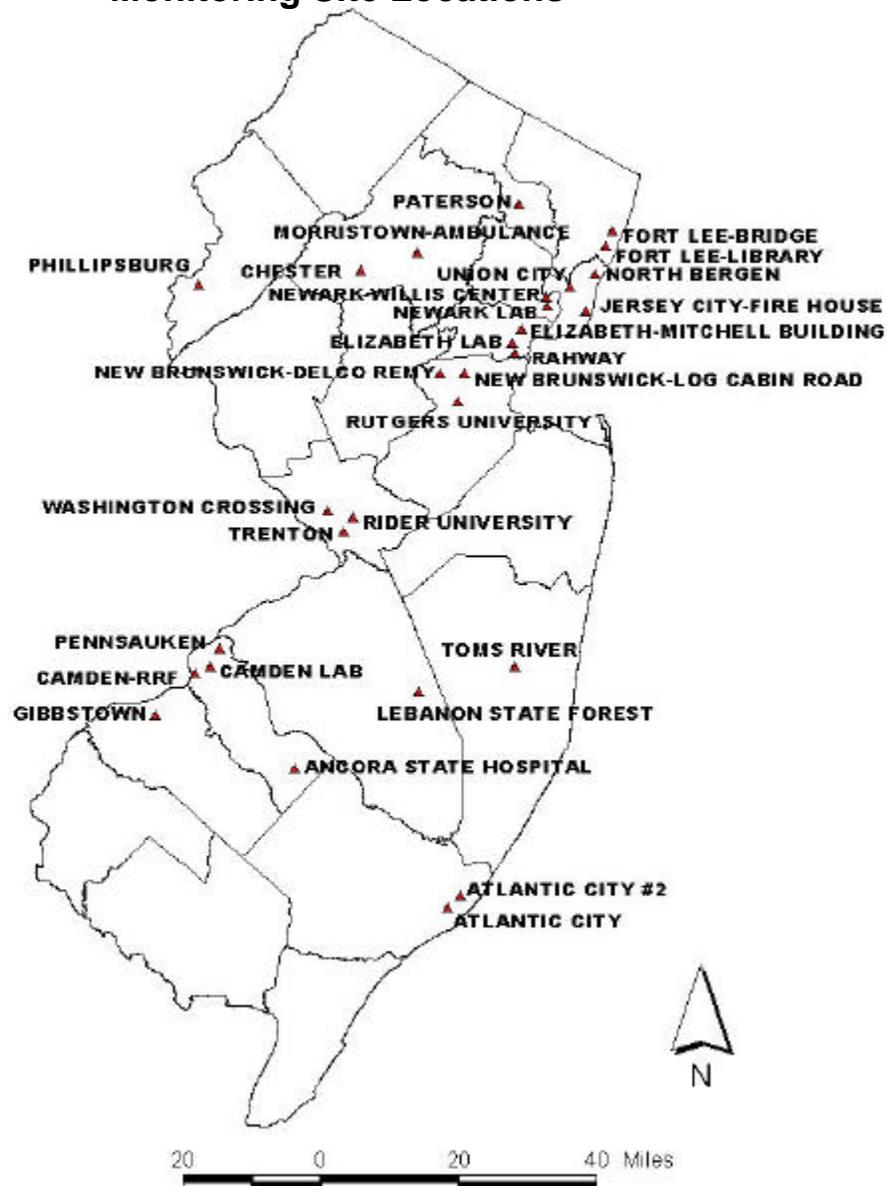
MET - Meteorological Parameters

SITE	CO	NOx	O <sub>3</sub>	SO <sub>2</sub>	SS	TEOM	MET
Ancora State Hospital	X		X	X	X		
Bayonne		X	X	X			
Burlington	X			X	X		
Camden Lab	X	X	X	X	X	X	X
Chester		X	X	X			X
Clarksboro			X	X			
Colliers Mills			X				
East Orange	X	X					X
Elizabeth	X			X	X		
Elizabeth Lab	X	X		X	X	X	X
Flemington			X		X		X
Fort Lee-Bridge	X					X	
Freehold	X				X		
Hackensack	X			X	X		
Jersey City	X			X	X		
Jersey City-Fire House						X	
Middlesex	X						
Millville		X	X	X			
Monmouth University			X				
Morristown	X				X		
Nacote Creek Research Station			X	X			
Newark Lab	X	X	X	X	X	X	
New Brunswick						X	
North Bergen	X						
Perth Amboy	X			X	X		
Ramapo			X				
Rider University		X	X				X
Rutgers University		X	X				X
Somers Point		X		X			
Teaneck		X	X				
<b>TOTAL</b>	<b>15</b>	<b>11</b>	<b>15</b>	<b>15</b>	<b>12</b>	<b>6</b>	<b>7</b>

## MANUAL MONITORING NETWORK

The Manual Monitoring Network does not transmit data in near real-time like 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<sub>2.5</sub>), inhalable particulates (PM<sub>10</sub>), lead (Pb), several parameters associated with atmospheric deposition, pollutants important in the formation of ground level ozone (ozone precursors), and numerous 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 5 and a list of the pollutants measured at each location is shown in Table 2.

**Figure 5**  
**2001 Manual Network**  
**Monitoring Site Locations**



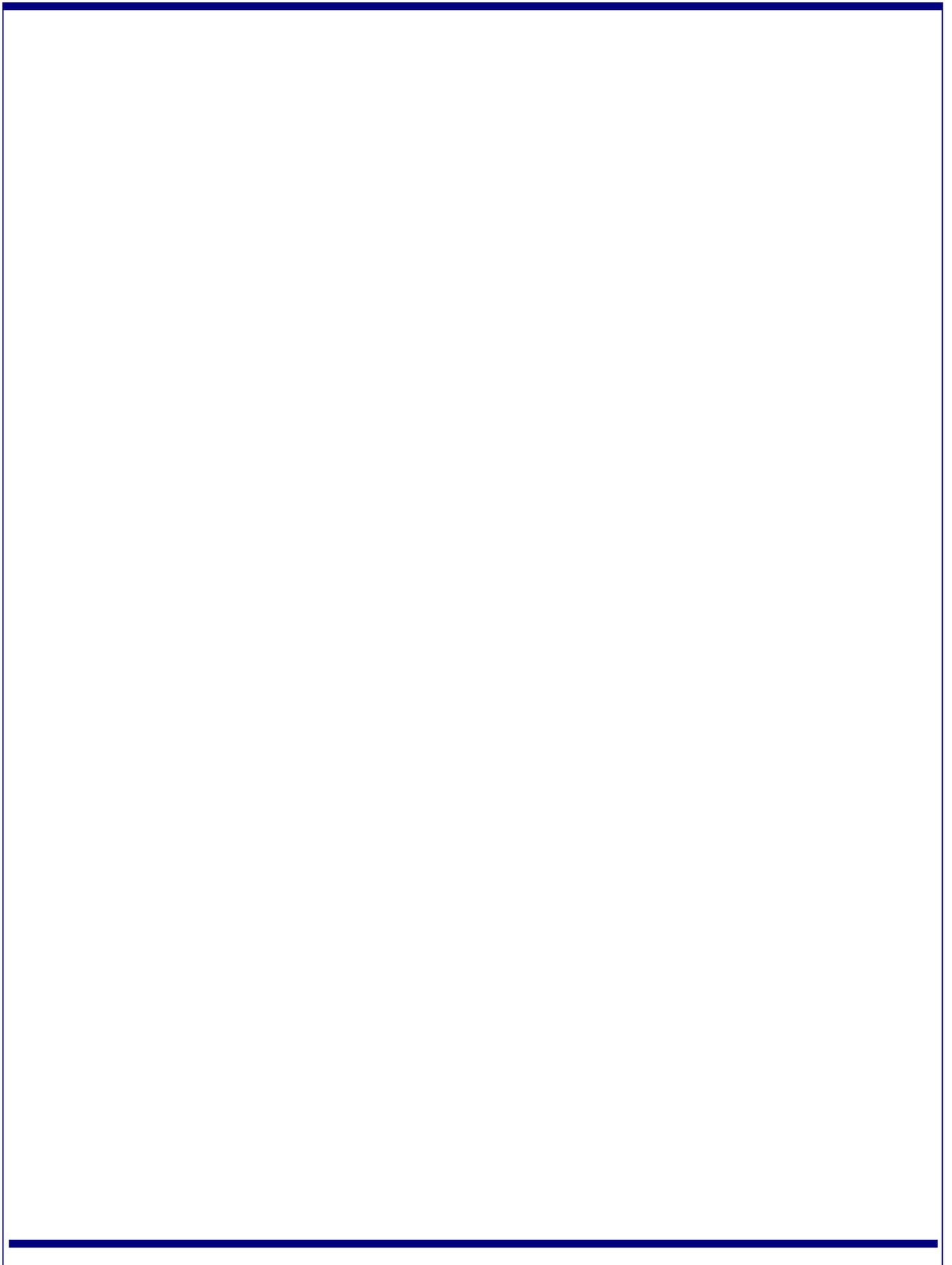


**Table 2  
Manual Network  
Parameters Measured**

**Parameter Codes**

PM2.5	- FRM (Federal Reference Method) Manual PM2.5 Sampler	PAMS	- Photochemical Assessment Monitoring Station (Photo-Chemical Volatile Organic Compounds)
PM10	- FRM Manual PM10 Sampler	CARB	- Carbonyls
PB	- Lead	VOCs	- Volatile Organic Compounds
TSP	- Total Suspended Particulate	SVOCs	- Semi-Volatile Organic Compounds
PM2.5 Spec	- FRM Manual PM2.5 Speciation		

SITE	PM2.5	PM10	PB	TSP	PM2.5 Spec	PAMS	CARB	VOCs	SVOCs	Acid Deposition	
										Dry Deposition	Wet Deposition
Ancora State Hospital											X
Atlantic City		X									
Atlantic City #2	X	X									
Camden Lab	X	X			X	X	X	X	X	X	
Camden-RRF		X									
Chester	X				X		X	X	X		
Elizabeth Lab	X	X			X		X	X	X	X	
Elizabeth-Mitchell Building	X										
Fort Lee-Bridge		X								X	
Fort Lee-Library	X										
Gibbstown	X										
Jersey City-Fire House	X	X									
Lebanon State Forest											X
Morristown-Ambulance	X										
New Brunswick-Log Cabin Road	X				X		X	X	X		
New Brunswick-Delco Remy			X	X							
Newark Lab	X	X									
Newark-Willis Center	X										
Paterson	X										
Pennsauken	X	X	X	X							
Phillipsburg	X										
Rahway	X										
Rider University						X					
Rutgers University						X					
Toms River	X										
Trenton	X	X									
Union City	X										
Washington Crossing	X										X
<b>TOTAL</b>	<b>20</b>	<b>10</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>3</b>





# 2001 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](http://www.epa.gov/airnow/aqibroch).

**Table 1**  
**Air Quality Index**

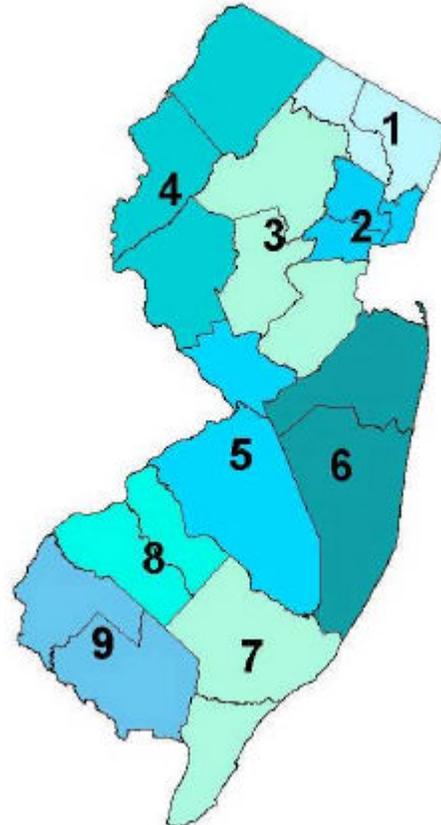
Numerical AQI Rating	Descriptive Rating	AQI Color Code
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151-200	Unhealthy	Red
200-300	Very Unhealthy	Purple

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**



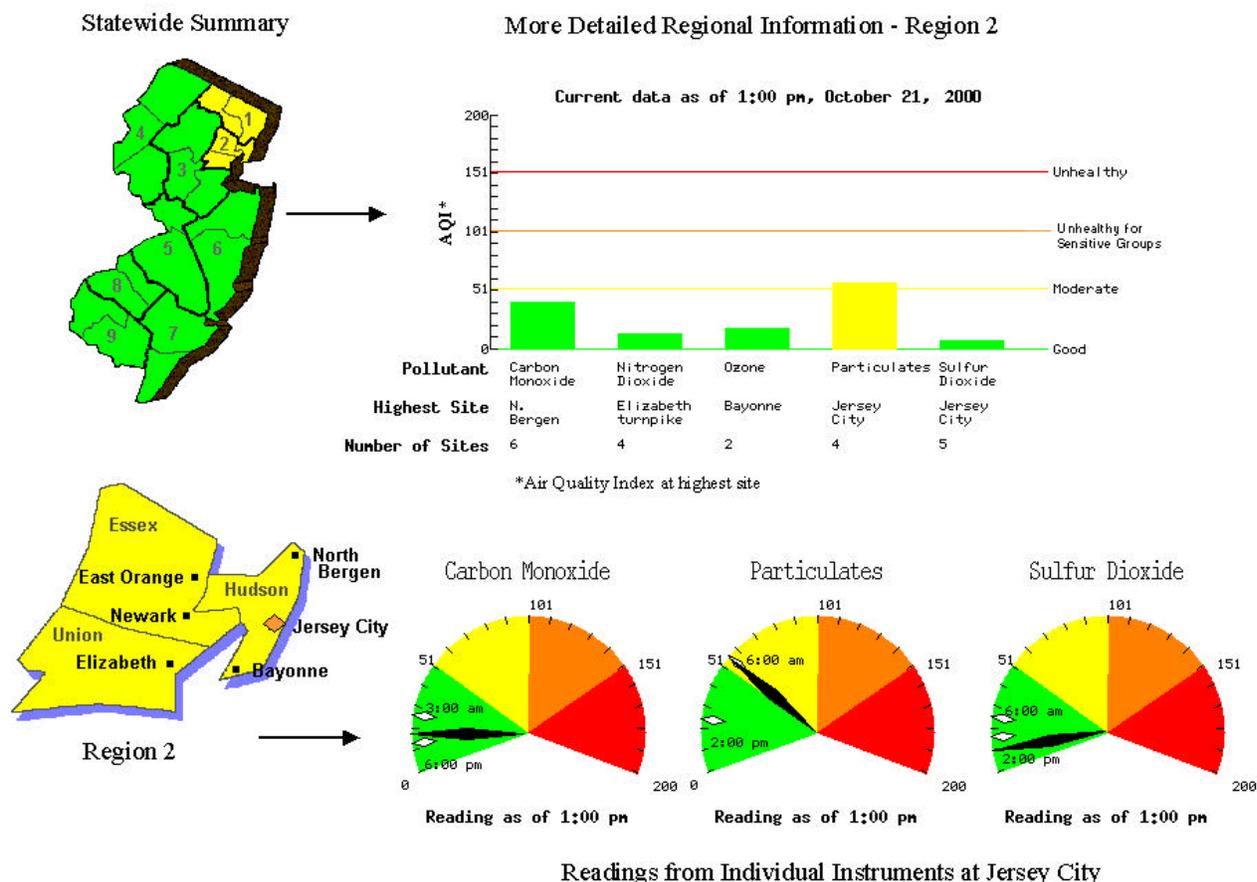
**Table 2**  
**Pollutants Monitored According to Air Quality Index Reporting Region**

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

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

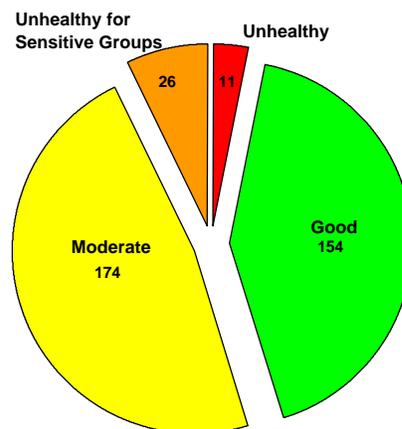
**Figure 2**  
Examples of NJDEP's Air Monitoring Website



**Figure 3**  
Air Quality Summary by Days

## 2001 AQI SUMMARY

A summary of the AQI ratings for New Jersey in 2001 is presented in the pie chart to the right. In 2001 there were 154 "Good" days, 174 were "Moderate", 26 were rated "Unhealthy for Sensitive Groups", 11 were considered "Unhealthy", and none 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.



**Table 3  
Air Quality Index (AQI) Exceedances of 100 During 2001**

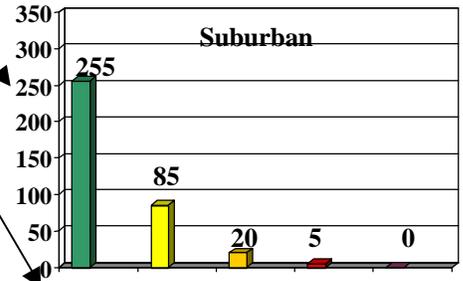
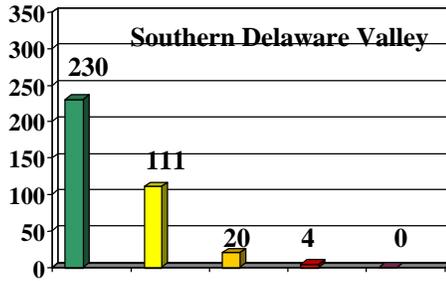
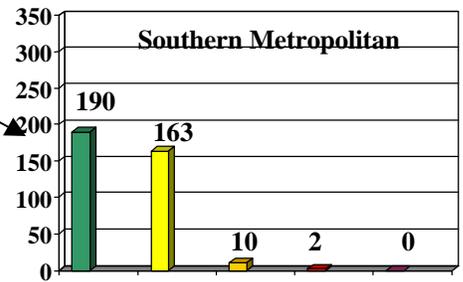
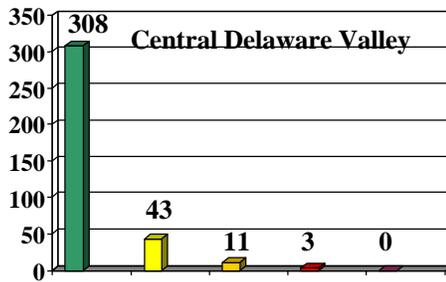
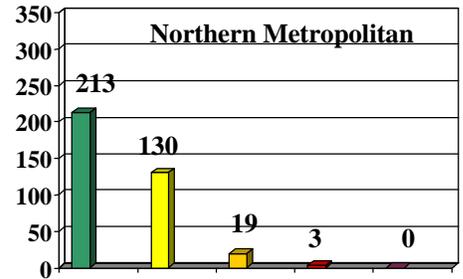
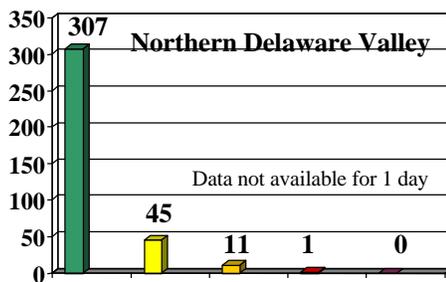
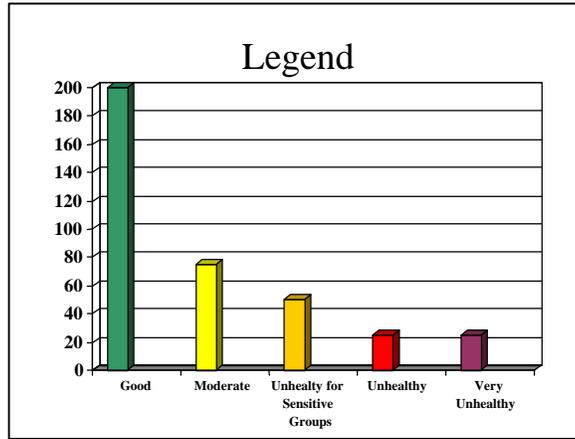
	<u>Ratings</u>		<u>Pollutants</u>
USG	- Unhealthy for Sensitive Groups	PM	- Fine Particle Matter
UH	- Unhealthy	O3	- Ozone
VUH	- Very Unhealthy		

Date	Highest Location	Highest AQI Value	Highest Pollutant	Highest Rating	Pollutant(s) with AQI above 100 *	
May 1	Colliers Mills	106	O <sub>3</sub>	USG	O <sub>3</sub> (1)	
May 2	Colliers Mills	127	O <sub>3</sub>	USG	O <sub>3</sub> (7)	
May 3	Colliers Mills	161	O <sub>3</sub>	UH	O <sub>3</sub> (1)	PM(2)
May 4	Colliers Mills	159	O <sub>3</sub>	UH	O <sub>3</sub> (10)	PM(2)
May 10	Colliers Mills	101	O <sub>3</sub>	USG	O <sub>3</sub> (1)	
May 11	Rutgers University		O <sub>3</sub>	USG	O <sub>3</sub> (9)	
June 11	Fort Lee	110	PM	USG	O <sub>3</sub> (2)	PM(1)
June 12	Ancora S.H.	119	O <sub>3</sub>	USG	O <sub>3</sub> (5)	
June 13	Chester	156	O <sub>3</sub>	UH	O <sub>3</sub> (8)	PM(4)
June 14	Fort Lee	126	PM	USG		PM(3)
June 19	Rutgers University	190	O <sub>3</sub>	UH	O <sub>3</sub> (11)	
June 20	Rutgers Univ./Teaneck	161	O <sub>3</sub>	UH	O <sub>3</sub> (10)	PM(1)
June 26	Ancora S.H.	135	O <sub>3</sub>	USG	O <sub>3</sub> (4)	
June 27	Ancora S.H.	166	O <sub>3</sub>	UH	O <sub>3</sub> (8)	
June 28	Ancora S.H.	156	O <sub>3</sub>	UH	O <sub>3</sub> (8)	PM(3)
June 29	Camden	142	O <sub>3</sub>	USG	O <sub>3</sub> (5)	PM(1)
June 30	Monmouth University	177	O <sub>3</sub>	UH	O <sub>3</sub> (7)	PM(4)
July 10	Millville	129	O <sub>3</sub>	USG	O <sub>3</sub> (4)	
July 17	Millville	150	O <sub>3</sub>	USG	O <sub>3</sub> (7)	
July 21	Colliers Mills	106	O <sub>3</sub>	USG	O <sub>3</sub> (6)	
July 22	Teaneck	104	O <sub>3</sub>	USG	O <sub>3</sub> (1)	
July 23	Rutgers University	127	O <sub>3</sub>	USG	O <sub>3</sub> (2)	
July 25	Teaneck	132	O <sub>3</sub>	USG	O <sub>3</sub> (4)	PM(1)
August 1	Colliers Mills	124	O <sub>3</sub>	USG	O <sub>3</sub> (3)	
August 2	Ramapo/Rutgers Univ.	104	O <sub>3</sub>	USG	O <sub>3</sub> (2)	
August 3	Rutgers University	106	O <sub>3</sub>	USG	O <sub>3</sub> (1)	
August 5	Teaneck	119	O <sub>3</sub>	USG	O <sub>3</sub> (3)	
August 6	Camden	150	O <sub>3</sub>	USG	O <sub>3</sub> (6)	PM(3)
August 7	Colliers Mills	192	O <sub>3</sub>	UH	O <sub>3</sub> (15)	PM(2)
August 8	Millville	161	O <sub>3</sub>	UH	O <sub>3</sub> (9)	PM(1)
August 9	Camden	185	O <sub>3</sub>	UH	O <sub>3</sub> (14)	PM(2)
August 10	Fort Lee	133	PM	USG	O <sub>3</sub> (1)	PM(4)
August 19	Ramapo	109	O <sub>3</sub>	USG	O <sub>3</sub> (4)	
August 23	Fort Lee	108	PM	USG		PM(1)
August 24	Ancora S.H.	101	O <sub>3</sub>	USG	O <sub>3</sub> (1)	
Sept 7	Ramapo	106	O <sub>3</sub>	USG	O <sub>3</sub> (2)	
Sept 19	Camden	101	O <sub>3</sub>	USG	O <sub>3</sub> (1)	

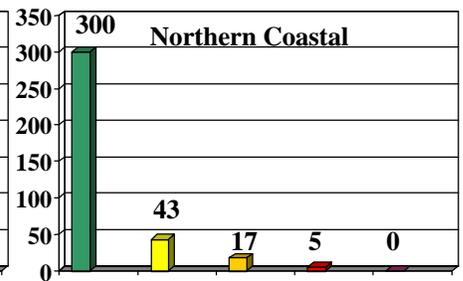
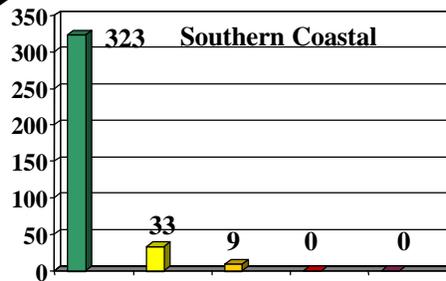
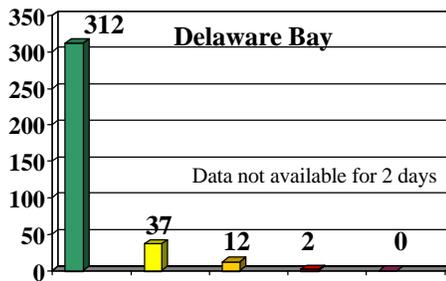
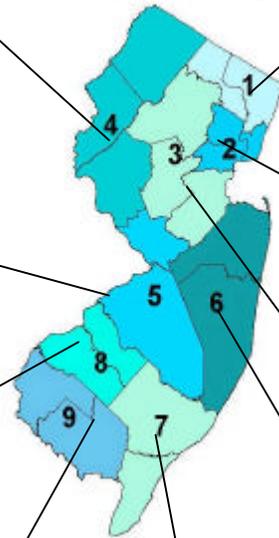
\* Number in parentheses ( ) indicates number of monitoring sites exceeding 100 on given day

Figure 4

2001 Air Quality Index Summary  
 Number of Days by Reporting Region



Air Quality Index Regions



## 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](http://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](http://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](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/](http://www.epa.gov/oar/aqtrnd99/)

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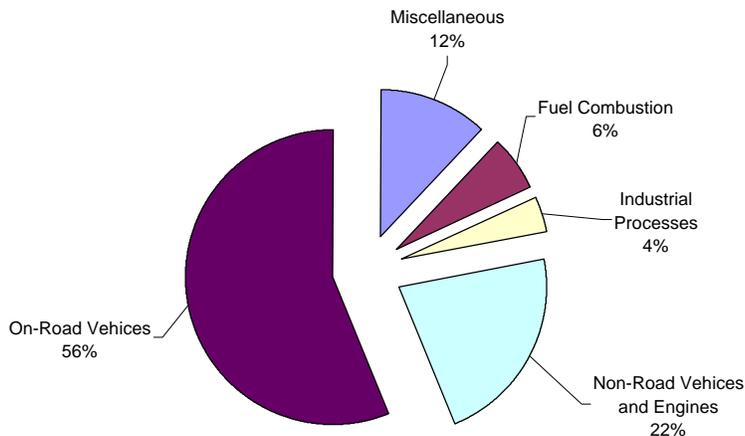




# 2001 Carbon Monoxide Summary

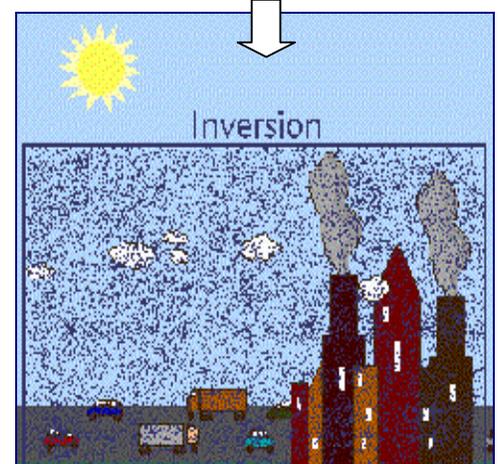
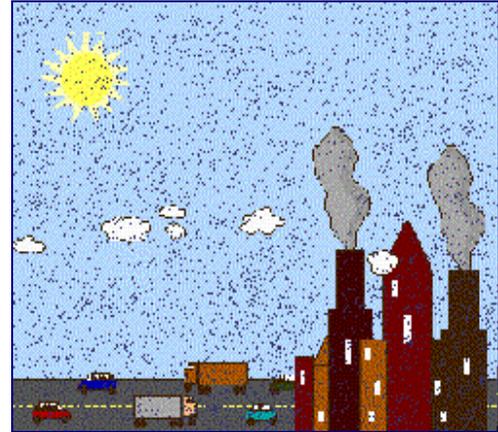
New Jersey Department of Environmental Protection

**Figure 1**  
**CO Emissions by Source Category**



*"How Carbon Monoxide Affects the Way We Live and Breathe" USEPA, November 2000*

**Figure 2: Effect of Atmospheric Inversion on Air Pollution**



## 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 about 56 percent of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions due to heavy traffic congestion. Non-road engines and vehicles, such as construction equipment and boats, contribute about 22 percent of all CO emissions nationwide. 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 above shows the national average contributions of these sources. During the colder months of the year CO levels are typically higher 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).

## HEALTH 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.

## AMBIENT AIR QUALITY STANDARDS FOR CARBON MONOXIDE

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.

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.

## MONITORING LOCATIONS

The state monitored CO levels at 15 locations in 2001. These sites are shown in the map (Figure 3) to the right. The site in Fort Lee did not operate between January 21<sup>st</sup> and April 11<sup>th</sup> due to construction activities near the site. The Newark Lab site was relocated during 2001 and was not operational until August 6<sup>th</sup>. The North Bergen site was also shut down and relocated during 2001, so no data from that location are available prior to November 9<sup>th</sup>.

Table 1

Ambient Air Quality Standards for Carbon Monoxide			
Averaging Period	Type	New Jersey	National
1-Hour	Primary	40 mg/m <sup>3</sup> (35 ppm)	35 ppm
1-Hour	Secondary	40 mg/m <sup>3</sup> (35 ppm)	---
8-Hour	Primary	10 mg/m <sup>3</sup> (9 ppm)	9 ppm
8-Hour	Secondary	10 mg/m <sup>3</sup> (9 ppm)	---

mg/m<sup>3</sup> = Milligrams Per Cubic Meter  
ppm = Part per Million

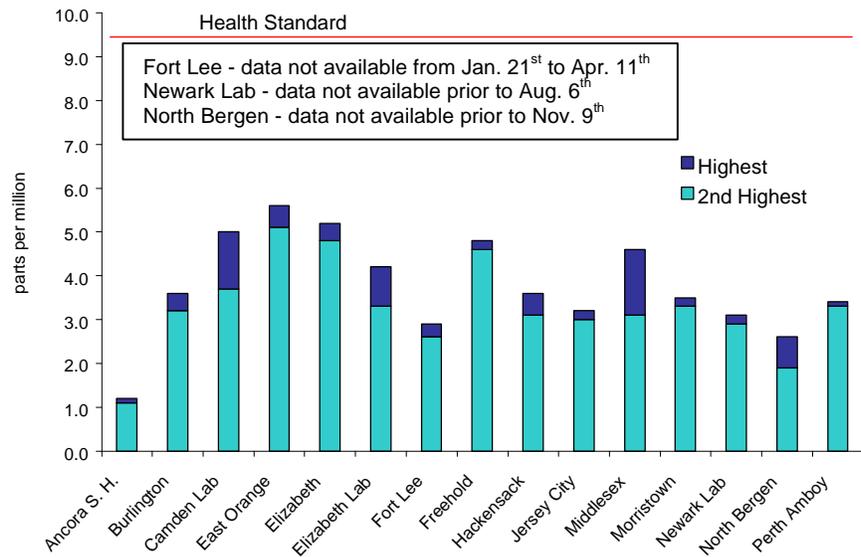
Figure 3  
2001 Carbon Monoxide  
Monitoring Network



## CO LEVELS IN 2001

None of the monitoring sites recorded exceedances of any CO standard during 2001. The maximum one-hour average concentration recorded was 11.6 ppm at the site in East Orange. The highest 8-hour average level recorded was 5.6 ppm, also at the East Orange site. Summaries of the 2001 data are provided in Table 2 and Figure 4.

**Figure 4**  
Highest and 2nd Highest Daily 8-Hour Averages



**Table 2**  
Carbon Monoxide Data - 2001  
Parts Per Million (ppm)

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

Monitoring Sites	Maximum 1-Hour Average	2 <sup>nd</sup> Highest 1-Hour Average	Maximum 8-Hour Average	2 <sup>nd</sup> Highest 8-Hour Average
Ancora S.H.	1.7	1.5	1.2	1.1
Burlington	6.2	4.9	3.6	3.2
Camden Lab	6.1	5.6	5.0	3.7
East Orange	11.6	8.5	5.6	5.1
Elizabeth	6.4	6.1	5.2	4.8
Elizabeth Lab	5.5	5.1	4.2	3.3
Fort Lee <sup>1</sup>	5.2	3.9	2.9	2.6
Freehold	10.0	8.6	4.8	4.6
Hackensack	4.9	4.5	3.6	3.1
Jersey City	5.8	5.1	3.2	3.0
Middlesex	5.0	4.8	4.6	3.1
Morristown	5.8	5.6	3.5	3.3
Newark Lab <sup>2</sup>	5.0	4.7	3.1	2.9
North Bergen <sup>3</sup>	3.1	2.8	2.6	1.9
Perth Amboy	6.0	4.7	3.4	3.3

<sup>1</sup> Data not available from January 21<sup>st</sup> to March 11<sup>th</sup>

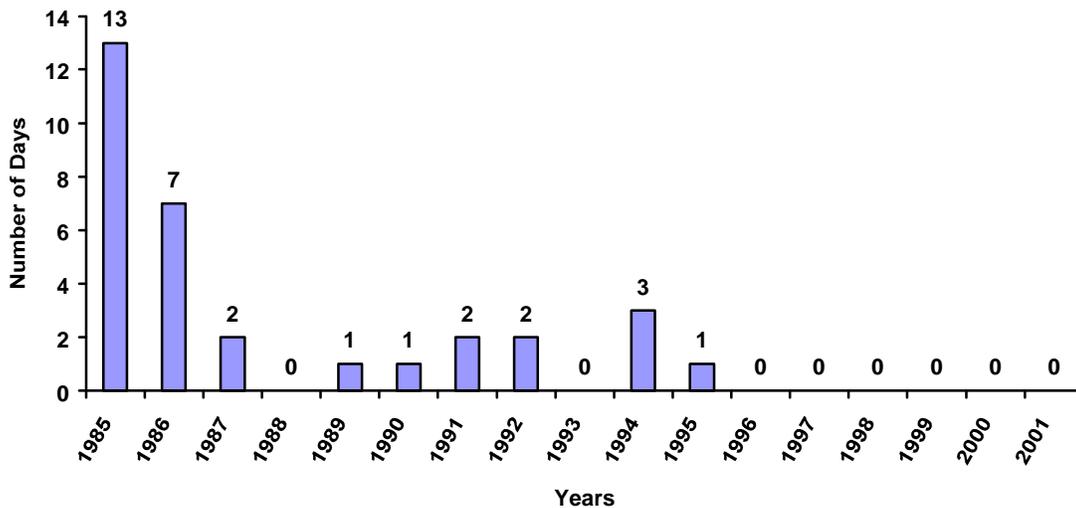
<sup>2</sup> Data not available prior to August 6<sup>th</sup>

<sup>3</sup> Data not available prior to November 9<sup>th</sup>

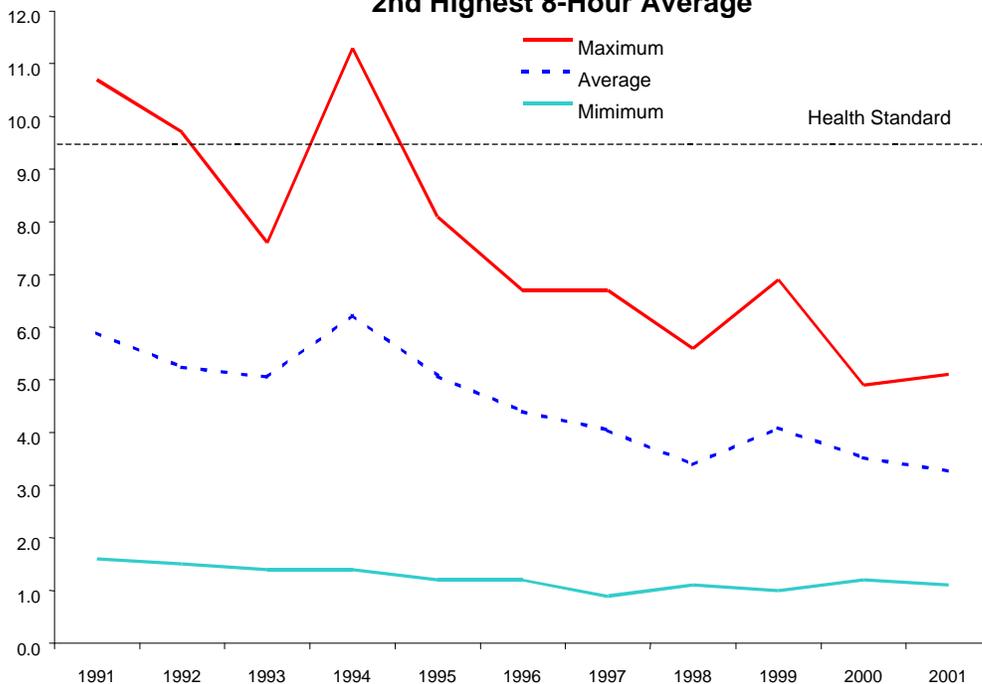
## TRENDS

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 5 below). 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 by the program over the past eleven years is provided in Figure 6. 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 5**  
**Carbon Monoxide**  
**Unhealthy Days 1985-2001**



**Figure 6**  
**Carbon Monoxide Air Quality, 1991 - 2001**  
**2nd Highest 8-Hour Average**



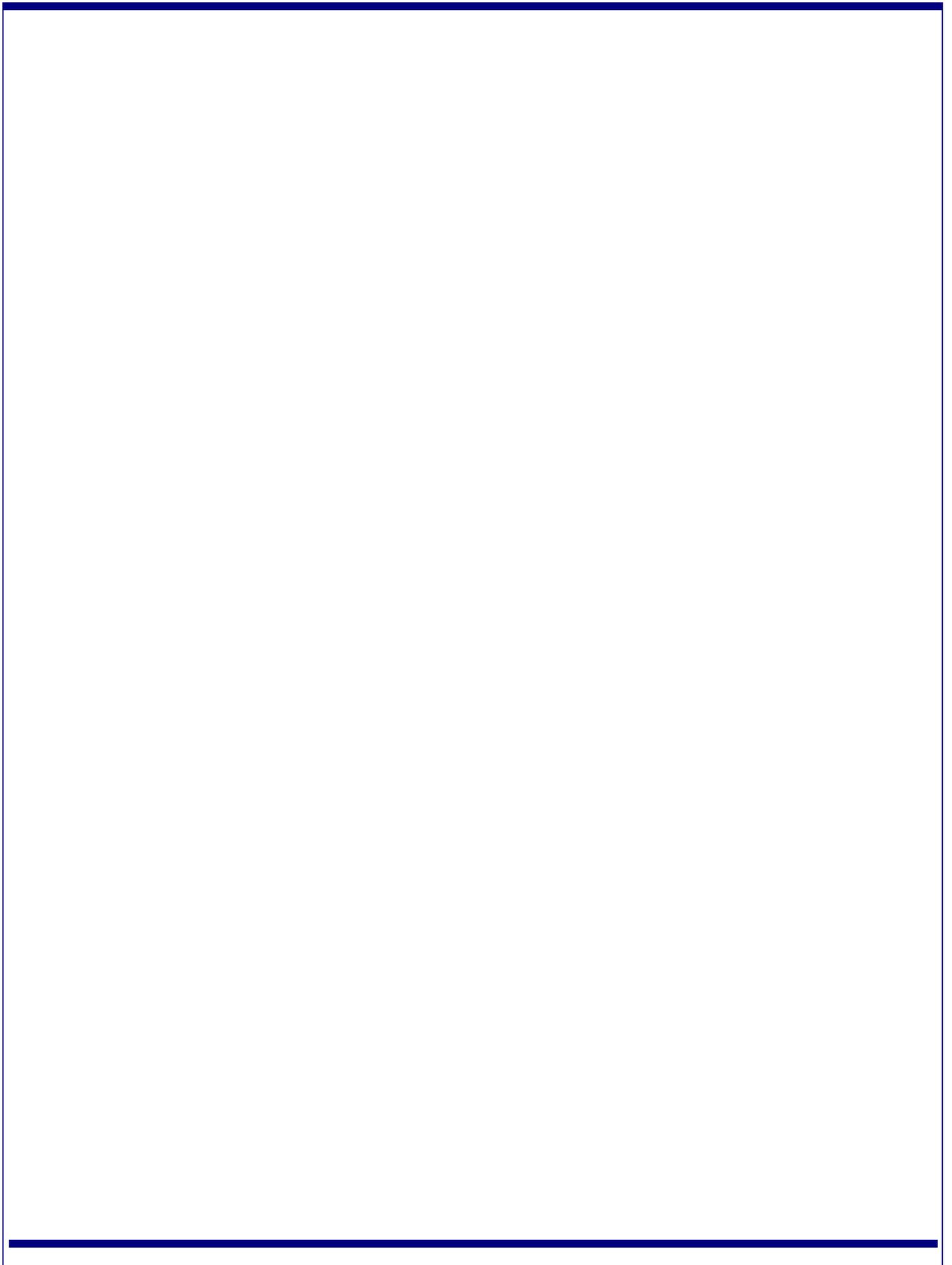
## References

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*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/](http://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/](http://www.epa.gov/oar/aqtrnd00/)



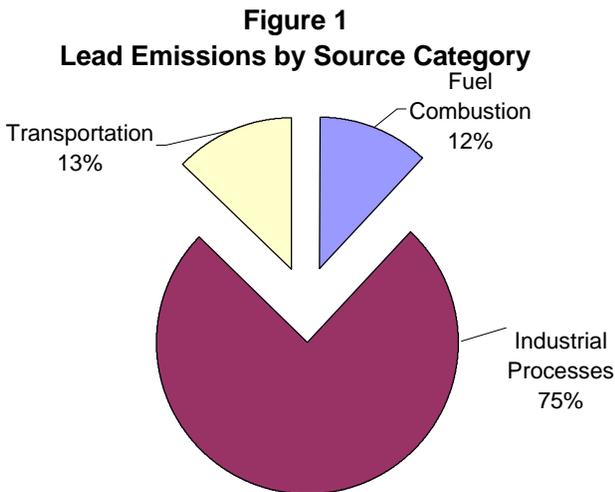


# 2001 Lead Summary

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 like lead smelters. Other industrial sources include lead-acid battery manufacturers and waste incinerators. A pie chart showing the distribution of lead sources nationally is shown below (Figure 1).



Source: USEPA National Air Quality and Emissions Trends Report, 1999

## 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 had 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.

## AMBIENT AIR QUALITY STANDARDS FOR LEAD

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 (ug/m3). The table below shows the National and New Jersey Ambient Air Quality Standards 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.

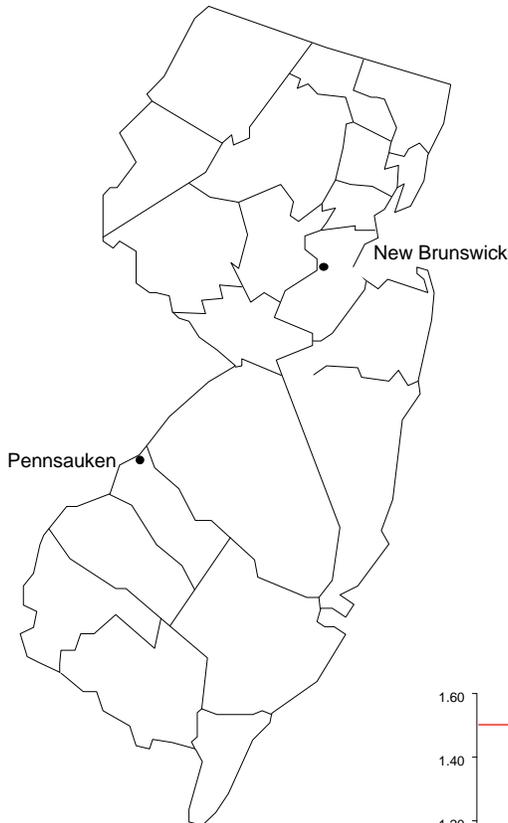
**Table 1**  
**Ambient Air Quality Standards for Lead**  
**Micrograms Per Cubic Meter (ug/m3)**

Period	Type	New Jersey	National
3-Month Arithmetic Means	Primary and Secondary	1.5 ug/m3	
Calendar Quarter Arithmetic Means	Primary and Secondary		1.5 ug/m3

## MONITORING LOCATIONS

The state monitored lead levels at only two locations in 2001. These locations were New Brunswick (near a battery manufacturing plant) and Pennsauken, which is across the river from a former lead smelting operation. These sites are shown in the map below.

**Figure 2**  
**2001 Lead Monitoring Network**



## LEAD LEVELS IN 2001

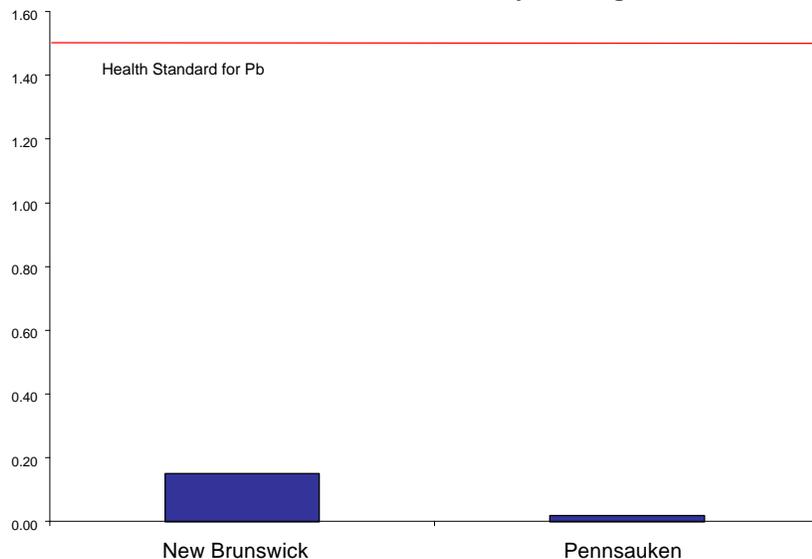
Summaries of the lead levels monitored in 2001 are provided in Table 2 and Figure 3. Neither of the monitoring sites recorded exceedances of the primary or secondary standards during 2001. The maximum 3-month average recorded was 0.230 micrograms per cubic meter (ug/m<sup>3</sup>) at the New Brunswick site. Lead concentrations in recent years have been so low that many of the monitoring sites have been discontinued.

Table 2  
2001 Lead Data  
3-Month and Calendar Quarter (Qtr.) Averages  
Micrograms Per Cubic Meter (ug/m<sup>3</sup>)

Monitoring Site	3-Month Average		Calendar Quarter Average			
	Max.	Month <sup>1</sup>	1 <sup>st</sup> Qtr.	2 <sup>nd</sup> Qtr.	3 <sup>rd</sup> Qtr.	4 <sup>th</sup> Qtr.
New Brunswick	.230	Oct.	.066	.106	.150	.146
Pennsauken	.019	Mar.	.019	.007	.008	.007

<sup>1</sup>The month indicates the last month in the 3-month period

**Figure 3**  
**2001- Lead Concentrations in New Jersey**  
**Maximum Quarterly Averages**

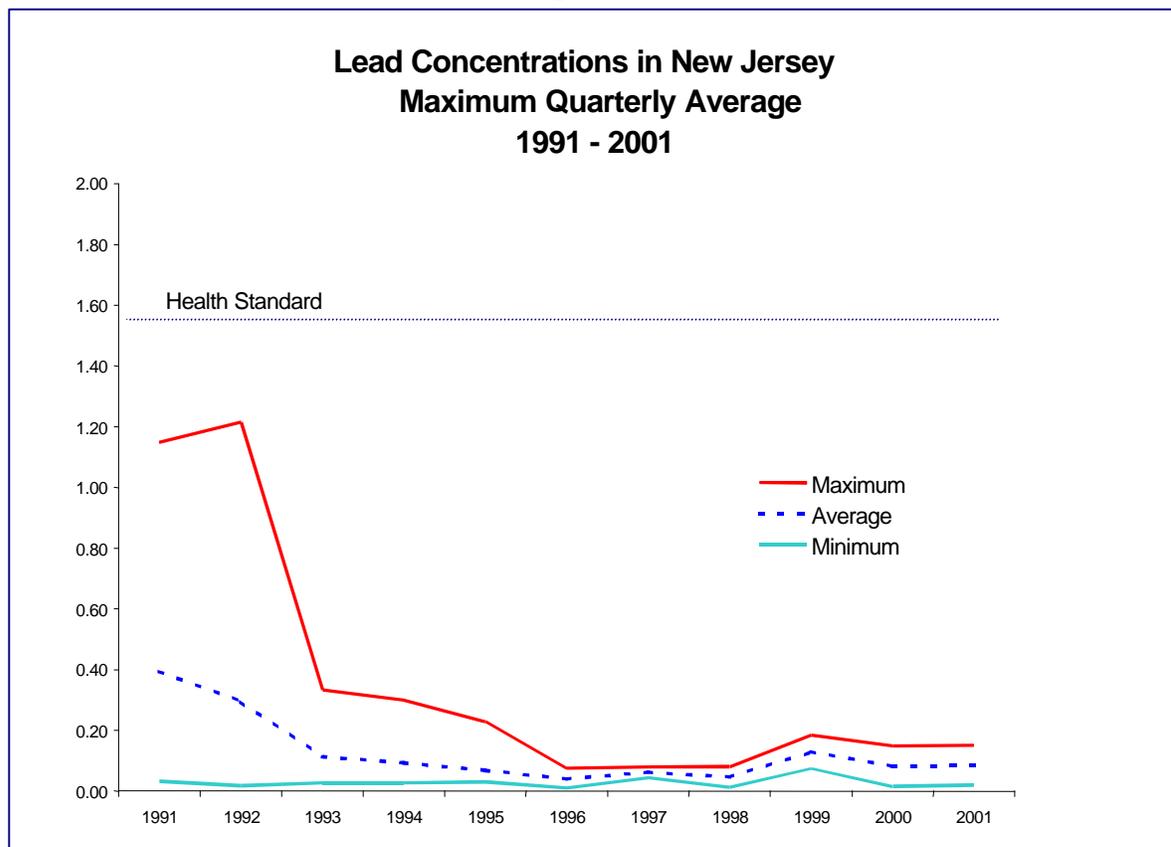




## TRENDS

The phase out of lead in gasoline has resulted in substantial improvements in air quality and levels in New Jersey are now well within the air quality standards. A trend graph showing the maximum, minimum and average concentrations recorded from 1991 to 2001 is provided below. These values were calculated using the maximum quarterly mean concentration recorded at each site each year. Values in more recent years are based on data from very few sites, and the slight increase that appears to have occurred may be due, at least in part, to the shut down of low reading sites. While meeting the national air quality standards for lead is no longer a major environmental issue in New Jersey, levels around specific industrial sources will continue to be monitored, and 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**



## References

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# 2001 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

## NATURE AND SOURCES

Nitrogen Dioxide (NO<sub>2</sub>) is a highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). Nitrogen Oxides (NO<sub>x</sub>), a term that encompasses NO, NO<sub>2</sub>, and other oxides of nitrogen, help to form ozone, particulate matter, haze, and acid rain. Although most NO<sub>x</sub> is emitted as NO, it is readily converted to NO<sub>2</sub> in the atmosphere. The major sources of NO<sub>x</sub> emissions are high-temperature combustion processes, such as those occurring in cars and power plants. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. A pie chart summarizing the major sources of NO<sub>x</sub> is shown below.

## 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. Long-term exposures to NO<sub>2</sub> may increase susceptibility to respiratory infection and may cause permanent damage to the lung.

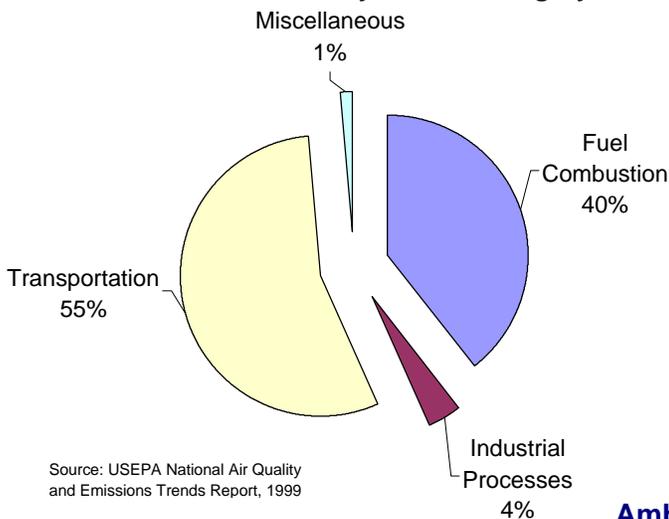
Nitrogen Oxides contribute to a wide range of environmental problems. These include potential changes in the composition of some plants in wetland and terrestrial ecosystems, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, increases in levels of toxins harmful to fish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

## STANDARDS

The National primary (health based) and secondary (welfare based) standards for NO<sub>2</sub> are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey standards are the same except micrograms per cubic meter (ug/m<sup>3</sup>) 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 ug/m<sup>3</sup> that New Jersey uses as a guideline in assessing short-term impacts from specific sources. Table 1 provides a summary of the NO<sub>2</sub> standards.

**Figure 1**

**NO<sub>2</sub> Emissions by Source Category**



**Table 1**

**Ambient Air Quality Standards for Nitrogen Dioxide– 2001**  
Parts Per Million (ppm)  
Micrograms Per Cubic Meter (ug/m<sup>3</sup>)

Period	Type	New Jersey	National	California
12-month average	Primary	100 ug/m <sup>3</sup> (.05 ppm)		
Annual average	Primary		.053 ppm (100 ug/m <sup>3</sup> )	
12-month average	Secondary	100 ug/m <sup>3</sup> (.05 ppm)		
Annual average	Secondary		.053 ppm (100 ug/m <sup>3</sup> )	
1-hour average	Primary			470 ug/m <sup>3</sup> (.25 ppm)

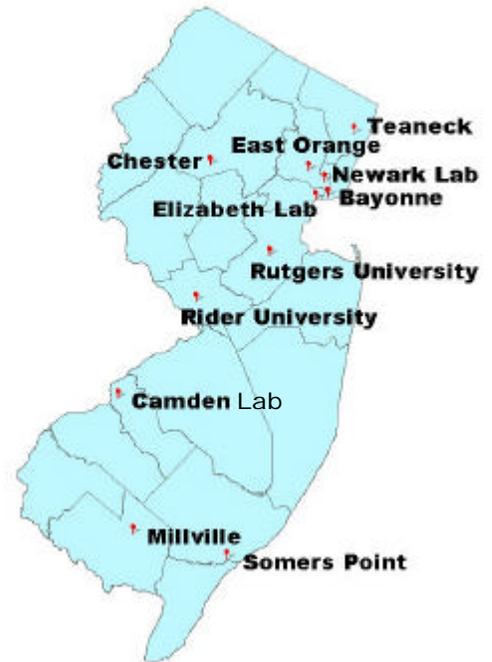
## MONITORING LOCATIONS

The state monitored NO<sub>2</sub> levels at 11 locations in 2001. These sites are shown in the map to the right. The Newark Lab monitoring site had to be relocated because of construction activities. It was put back in operation on August 6<sup>th</sup> of 2001. A valid 2001 annual average could not, therefore, be calculated for that site.

## NO<sub>2</sub> LEVELS IN 2001

None of the monitoring sites recorded exceedances of the primary or secondary NO<sub>2</sub> standards during 2001. 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 Nitric Oxide (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 2001 was 0.051 ppm, also at the Exit 13 site.

**Figure 2**  
**2001 Oxides of Nitrogen**  
**Monitoring Network**



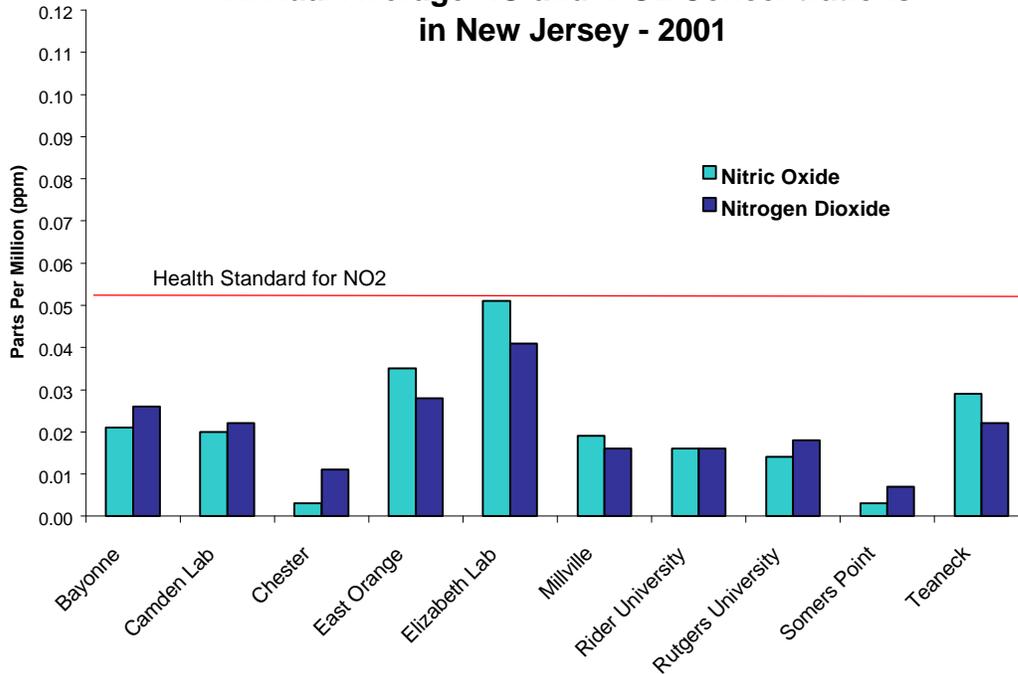
**Table 2**  
**Nitrogen Dioxide & Nitric Oxide Data – 2001**

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 <sup>nd</sup> Highest	Maximum	Calendar year	
Bayonne	.097	.089	.027	.026	.021
Camden Lab	.071	.071	.022	.022	.020
Chester	.059	.059	.011	.011	.003
East Orange	.090	.090	.029	.028	.035
Elizabeth Lab	.142	.141	.041	.040	.051
Millville	.070	.067	.017	.016	.019
Newark Lab <sup>a</sup>	.103	.100	--	--	--
Rider University	.069	.067	.017	.016	.016
Rutgers University	.087	.084	.019	.018	.014
Somers Point	.057	.056	.008	.007	.003
Teaneck	.110	.110	.023	.022	.029

<sup>a</sup> Data not available prior to August 6<sup>th</sup>

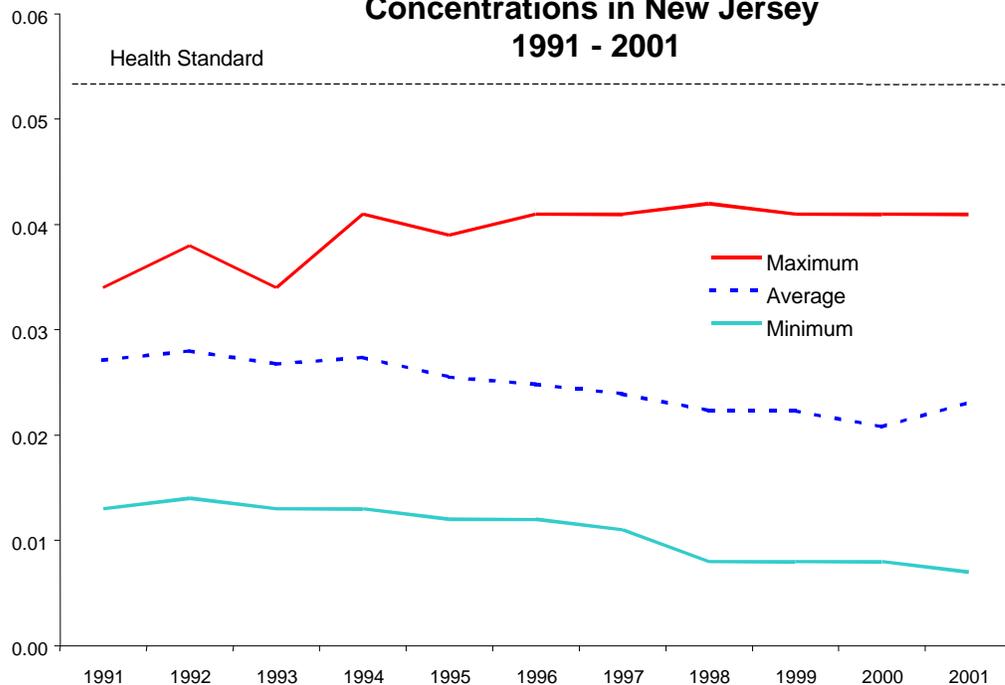
**Figure 3**  
**Annual Average NO and NO<sub>2</sub> Concentrations**  
**in New Jersey - 2001**



## TRENDS

NO<sub>2</sub> concentrations have not posed a significant direct health problem in New Jersey. A graph of NO<sub>2</sub> levels showing the highest, lowest and average annual mean concentrations recorded from 1991 to 2001 is provided below. 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.

**Figure 4**  
**Annual Average Nitrogen Dioxide**  
**Concentrations in New Jersey**  
**1991 - 2001**



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# 2001 Ozone Summary

New Jersey Department of Environmental Protection

## NATURE AND SOURCES

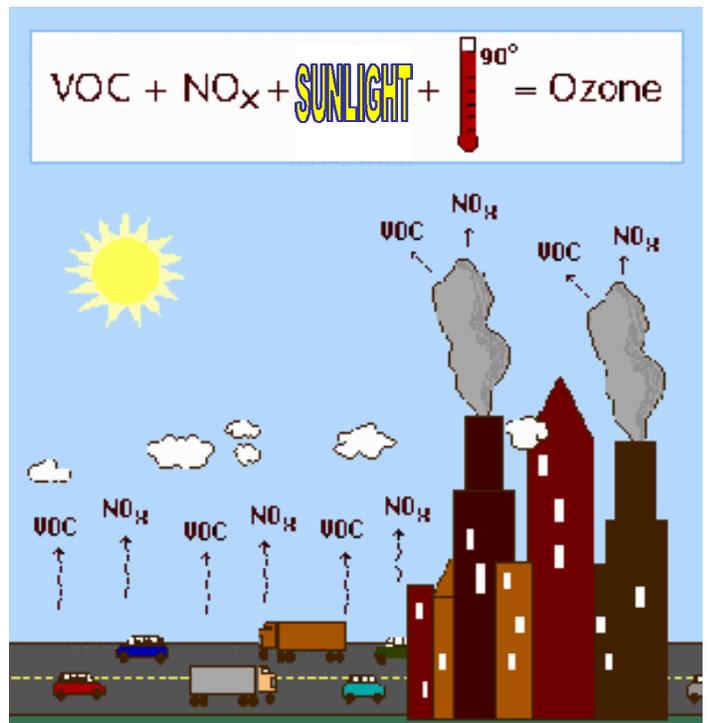
Ozone (O<sub>3</sub>) is a gas consisting of three oxygen atoms. It occurs naturally in the upper atmosphere (stratospheric ozone) where it protects us from harmful ultraviolet rays. However, at ground-level (tropospheric ozone) it is considered an air pollutant and can have serious adverse health effects. Ground-level ozone is created when nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC's) react in the presence of sunlight and heat. NO<sub>x</sub> 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".<sup>1</sup>

## 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.<sup>2</sup>

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, however, 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.



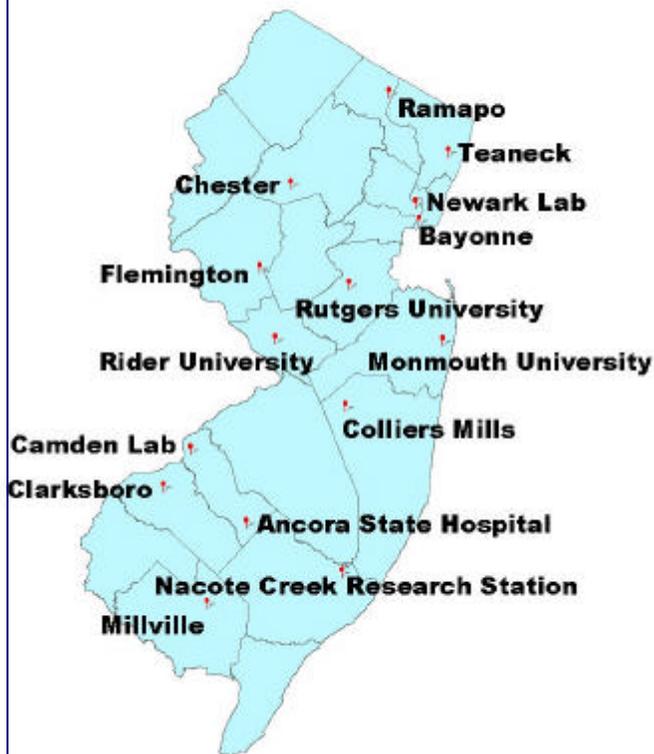
## ENVIRONMENTAL EFFECTS

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.<sup>1</sup>

## OZONE NETWORK

Ozone was monitored at 15 locations in New Jersey during 2001. Of those 15 sites, 12 operated year round and 3 operated only during the ozone season (April 1<sup>st</sup> through October 31<sup>st</sup>). The site in Newark had to be relocated and did not come on-line until August of 2001. Summary statistics for Newark are included in the tables, but this data should not be compared to the other sites, which operated throughout the ozone season.

**Figure 1**  
**2001 Ozone Monitoring Network**



## 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. 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.

<b>Old Ambient Air Quality Standards for Ozone (Prior to July 18,1997)</b>			
Averaging Period	Type	New Jersey	National
1-Hour	Primary	0.12 ppm	0.12 ppm
1-Hour	Secondary	0.08 ppm	0.12 ppm

<b>Current Ambient Air Quality Standards for Ozone (After July 18, 1997)</b>			
Averaging Period	Type	New Jersey	National
8-Hour	Primary	-----	0.08 ppm
8-Hour	Secondary	-----	0.08 ppm

## DESIGN VALUES

The NAAQS 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 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 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 4<sup>th</sup> 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.

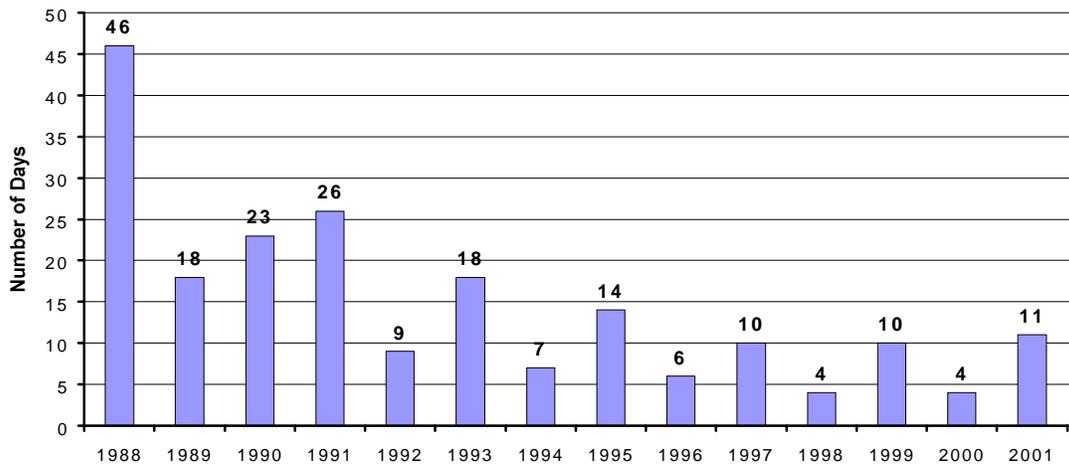


## HOW THE CHANGES TO THE OZONE STANDARDS AFFECT AIR QUALITY RATINGS

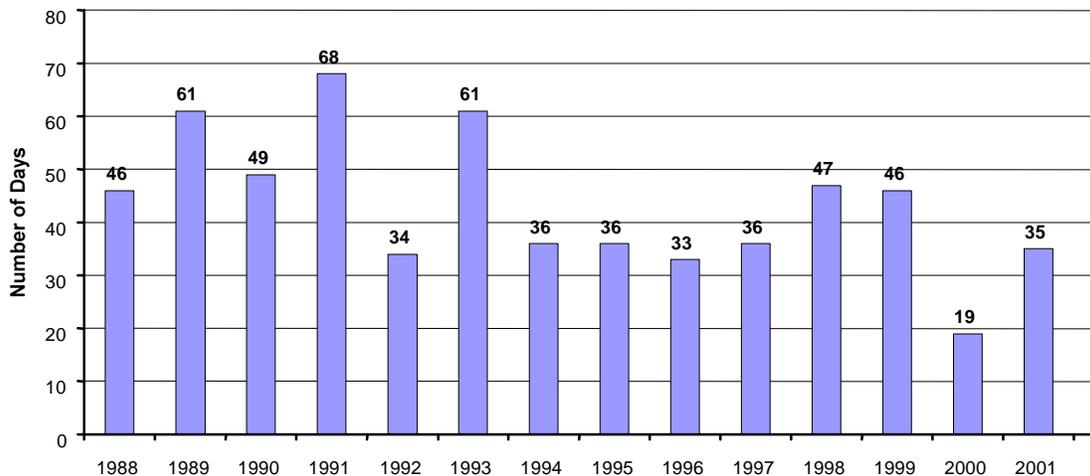
In 2001 there were 11 days on which the old standard was exceeded in New Jersey and 35 days on which the new standard was exceeded. Significant progress was being made towards meeting the old standards (see Figure 2 below). There are fewer days on which that standard is exceeded, and when it is, fewer sites tend to be involved. Also, the maximum levels reached are not as high as they were in the past. The maximum one-hour average concentration recorded in 1988 was 0.218 ppm, compared to a maximum of 0.145 ppm in 2001.

It is apparent, however, that the new standard is significantly more stringent than the old one (compare Figure 2 to Figure 3 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 2**  
**Days on Which the Old Standard (1-hour)**  
**was Exceeded in New Jersey 1988-2001**



**Figure 3**  
**Days on Which the Current Standard (8-hour)**  
**was Exceeded in New Jersey 1988-2001**



## RECAP - OZONE 2001

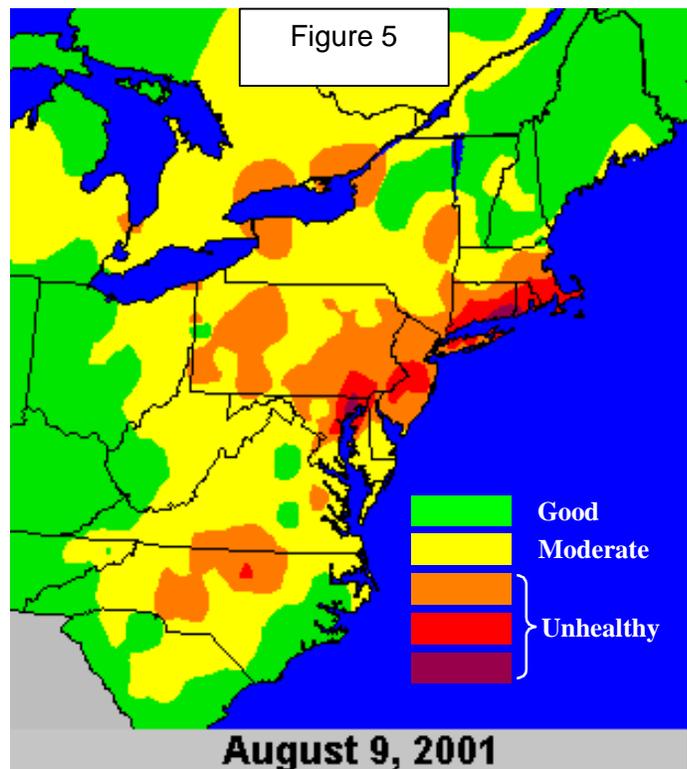
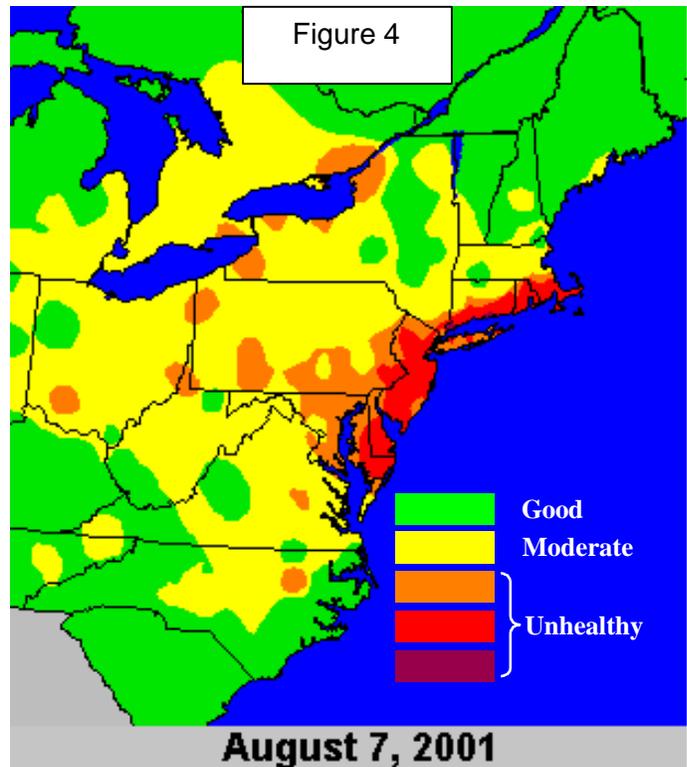
The summer of 2001 was characterized by warmer than normal temperatures (+2.0°F at Philadelphia International Airport) and abnormally dry conditions from July through September. The highest O<sub>3</sub> concentrations were low compared to recent years and seasonal average O<sub>3</sub> was also below normal. This was primarily due to cooler than normal July weather leading to very low O<sub>3</sub> concentrations throughout what is historically the height of the O<sub>3</sub> season.<sup>3</sup>

## MAJOR OZONE EPISODES

There were several major ozone episodes during the 2001 ozone season. One occurred during the first 10 days of August when exceedances of the 8-hour standard were recorded on all days except August 4<sup>th</sup>. On August 7<sup>th</sup> and 9<sup>th</sup> (see Figures 4 and 5) every ozone monitor in the network exceeded the 8-hour standard and the maximum 8-hour concentration of this season (0.121ppm) was recorded at Colliers Mills on August 7<sup>th</sup>.

The maximum 1-hour value of 0.145 ppm was recorded on August 9<sup>th</sup> at Rider University. It was the highest of 6 sites that exceeded the 1-hour standard that day (the most in a single day since July 15, 1997 when 9 sites exceeded the 1-hour standard).

A cold front swept across the region on August 11<sup>th</sup> bringing rain that provided relief from both the intense heat wave and the unhealthy ozone concentrations. This episode was the last significant event of the 2001 ozone season as only a few more scattered exceedances were recorded after August 10<sup>th</sup>.

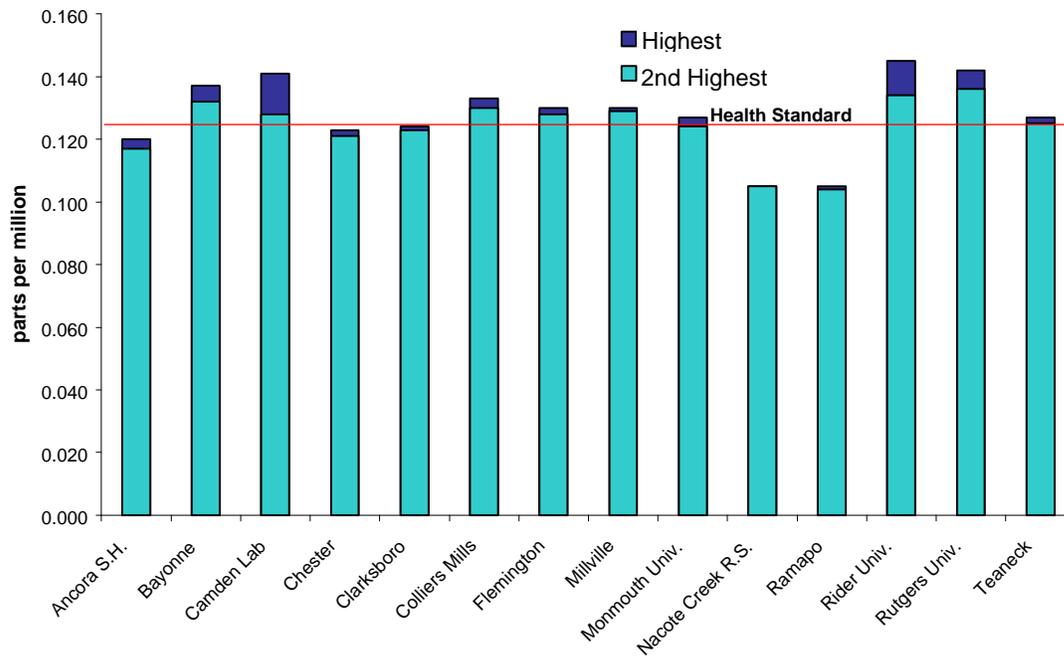


<sup>4</sup>2001 Ozone Map USEPA Archives

## SUMMARY OF 2001 Ozone Data Relative to the OLD 1-HOUR STANDARD

Of the 15 monitoring sites that were operated during the 2001 ozone season, 9 recorded levels above the old 1-hour standard of 0.12 ppm at least once during the year. Eight sites had at least two exceedances and Camden recorded the most exceedances with 5. The highest one-hour concentration was 0.145 ppm at the Rider University site on August 9, 2001. In the 2000 ozone season there were six sites that recorded levels above the standard and the maximum was 0.139 ppm, recorded at both the Clarksboro and Colliers Mills sites.

**Figure 6**  
**Highest and Second Highest Daily 1-Hour Averages**



**Table 1**

Monitoring Site	1-hr Max	2nd Highest 1-hr Max	4th Highest 1-hour Average 1999-2001	# of days with 1-hour Averages above 0.12ppm
Ancora S.H.	0.120	0.117	0.127	0
Bayonne	0.137	0.132	0.137	3
Camden Lab	0.141	0.128	0.128	5
Chester	0.123	0.121	0.119	0
Clarksboro	0.124	0.123	0.124	0
Colliers Mills	0.133	0.130	0.135	4
Flemington	0.130	0.128	0.128	3
Millville	0.130	0.129	0.122	2
Monmouth Univ.	0.127	0.124	0.124	1
Nacote Creek R.S.	0.105	0.105	0.112	0
Newark Lab*	0.116	0.113	---	0
Ramapo	0.105	0.104	0.112	0
Rider University	0.145	0.134	0.145	3
Rutgers University	0.142	0.136	0.142	3
Teaneck	0.127	0.125	0.120	2
Statewide	0.145	0.137		11

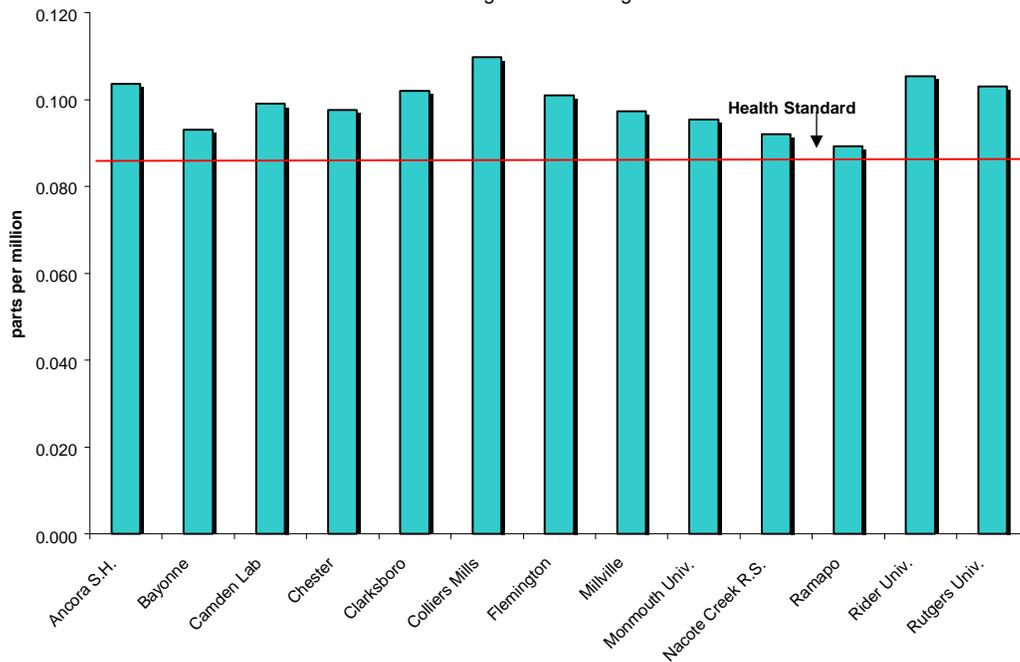
\*Data not available prior to Aug. 6th

## SUMMARY OF 2001 OZONE DATA RELATIVE TO THE NEW 8-HOUR STANDARD

All of the 15 monitoring sites that were operated during the 2001 ozone season recorded levels above the new 8-hour standard of 0.08 ppm. Colliers Mills recorded the most exceedances with 21. The highest eight-hour concentration recorded was 0.121 ppm at the Colliers Mills site on August 7, 2001. All sites recorded levels above the 8-hour standard in 2000 as well, with a maximum concentration of 0.132 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 standard is being violated statewide.

**Figure 7**  
**Ozone Design Values for 1999-2001**

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



**Table 2**

Monitoring Site	1st Highest	2nd Highest	3rd Highest	4 <sup>th</sup> Highest	Avg. of 4th Highest 8-hour Averages 1999-2001	# of days with 8-hour above 0.08ppm
Ancora S.H.	0.112	0.111	0.107	0.104	0.104	17
Bayonne	0.117	0.108	0.103	0.091	0.093	6
Camden Lab	0.118	0.114	0.104	0.104	0.099	19
Chester	0.109	0.109	0.107	0.101	0.098	15
Clarksboro	0.108	0.108	0.098	0.097	0.102	17
Colliers Mills	0.121	0.110	0.109	0.108	0.110	21
Flemington	0.113	0.103	0.103	0.101	0.101	12
Millville	0.110	0.109	0.104	0.102	0.097	14
Monmouth Univ.	0.115	0.112	0.098	0.091	0.095	8
Nacote Creek R.S.	0.101	0.097	0.096	0.096	0.092	9
Newark Lab*	0.109	0.084	0.066	0.066	---	1
Ramapo	0.092	0.092	0.088	0.088	0.089	9
Rider University	0.115	0.106	0.105	0.104	0.105	15
Rutgers University	0.120	0.109	0.107	0.106	0.103	17
Teaneck**	0.116	0.111	0.109	0.097	---	10
Statewide	0.121	0.120	0.118	0.115	0.117	35

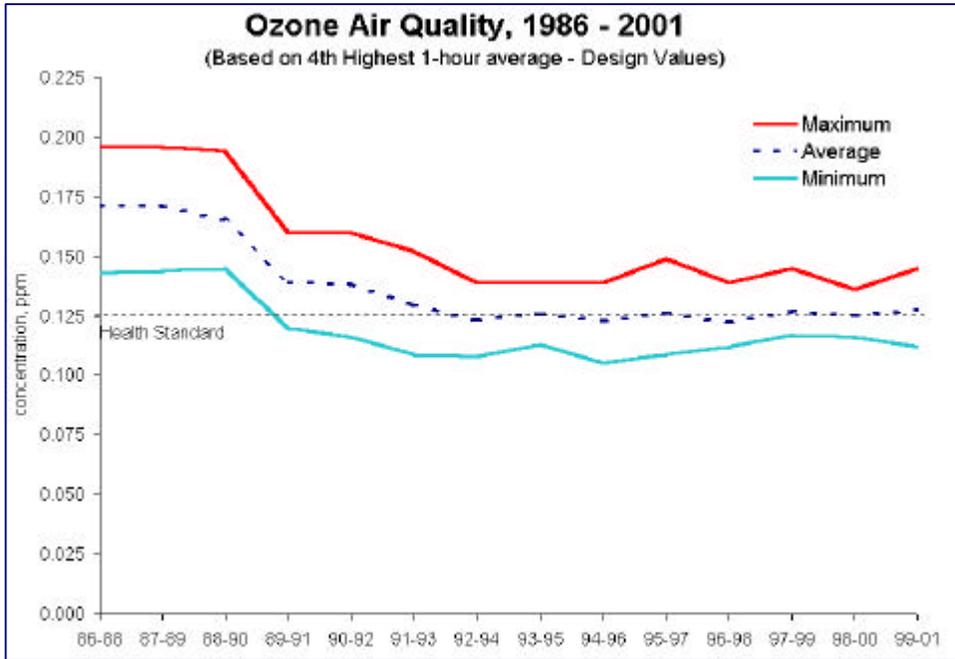
\*Data not available prior to Aug. 6th, 2001

\*\*Data not available prior to 2000 season

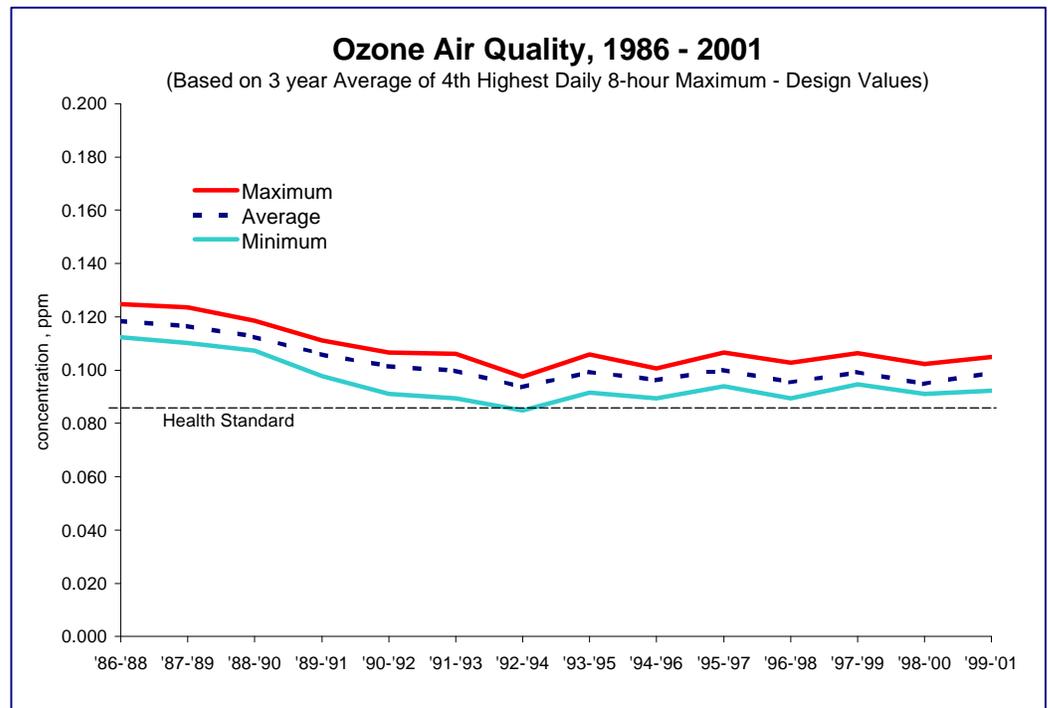
# OZONE TRENDS

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 one-hour concentrations have not exceeded 0.20 ppm since 1988 and the last time levels above 0.18 ppm were recorded was in 1990. 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 NOx. The NOx 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.

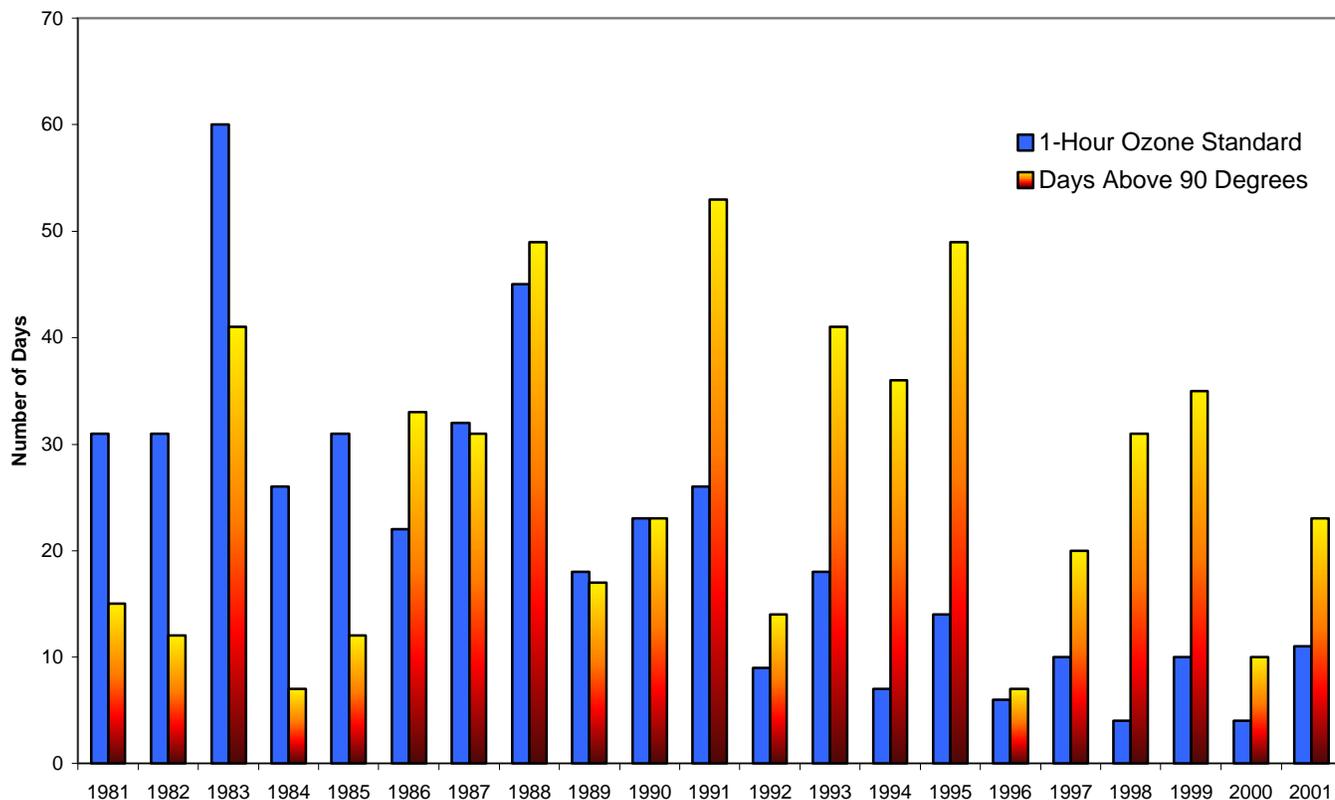
**Figure 8**



**Figure 9**



**Figure 10**  
**Number of Days 1-Hour Ozone Standard Was Exceeded**  
**and Number of Days Above 90 Degrees**  
**New Jersey 1981 - 2001**

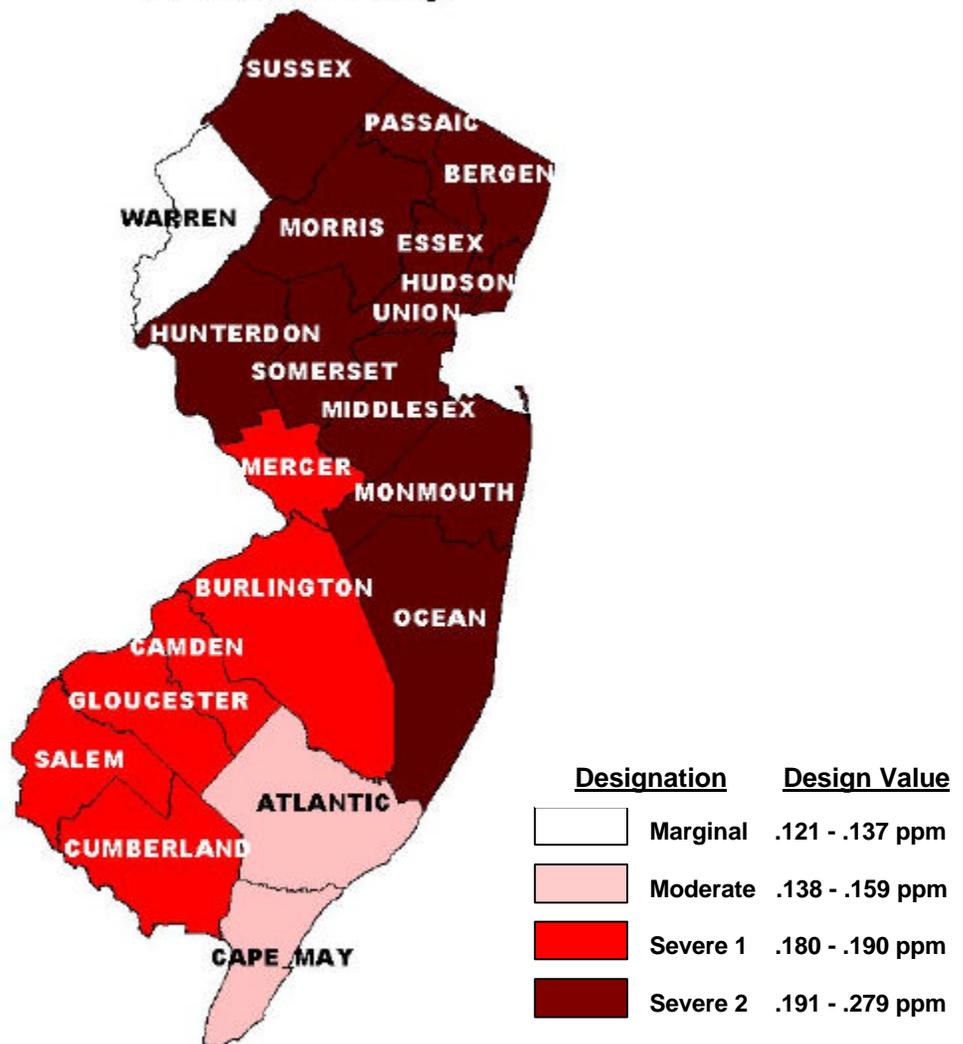


## ACCOUNTING FOR THE INFLUENCE OF WEATHER

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. 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.

**Figure 11**  
**Ozone Non-Attainment Areas**  
**in New Jersey**



## 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.

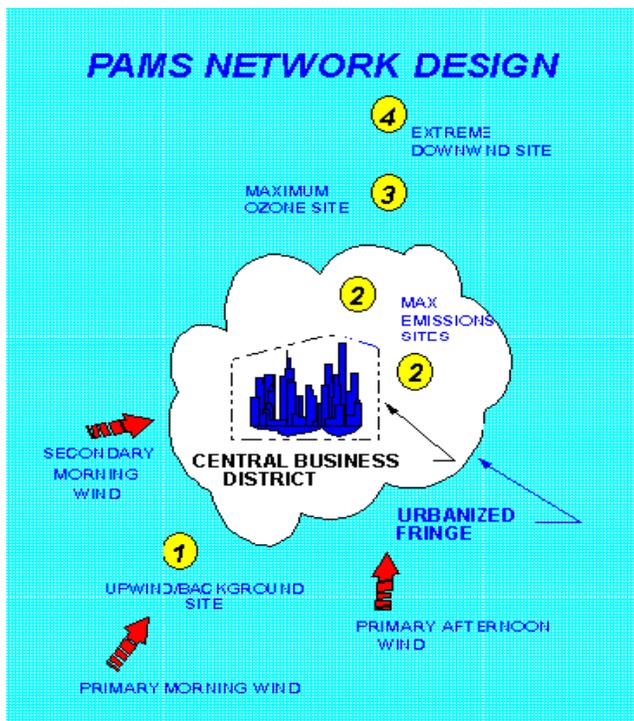
New Jersey is part of four planning areas, the New York, Philadelphia, Atlantic City and Allentown/Bethlehem areas. Their classification with respect to the old 1-hour standard is shown on the map. Now that the new 8-hour average standard for ozone has been upheld by the courts, new designations will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

## PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

Most ground level ozone is the result of oxides of nitrogen (NO<sub>x</sub>) 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 O<sub>3</sub> problem, track VOC and NO<sub>x</sub> emission inventory reductions, assess air quality trends, and make attainment/nonattainment decisions. PAMS monitor both criteria and non-criteria pollutants including ozone (O<sub>3</sub>), oxides of nitrogen (NO<sub>x</sub>), nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), 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 1<sup>st</sup> to August 31<sup>st</sup> each year.

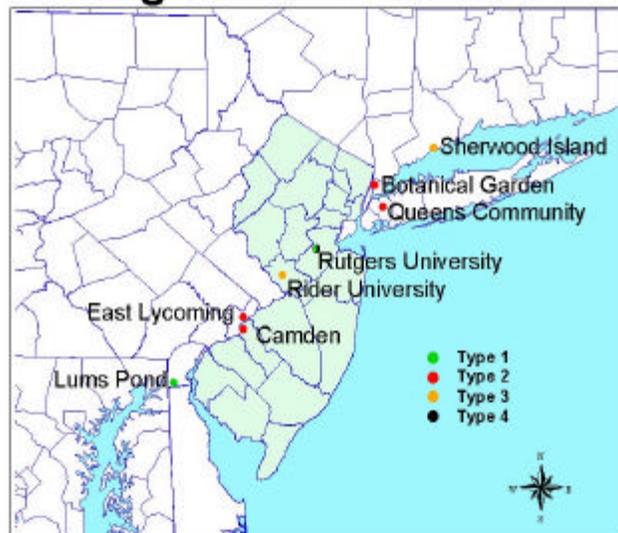
The PAMS network is designed around metropolitan areas where ozone is a significant problem, and each site in the network has a specific purpose as shown in the Figure 12 below. New Jersey is part of the Philadelphia and New York Metropolitan areas and has a total of three PAMS sites. A Type 3 maximum 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 13.

Figure 12



<sup>5</sup> USEPA , PAMS General Information

Figure 13  
Regional PAMS Sites



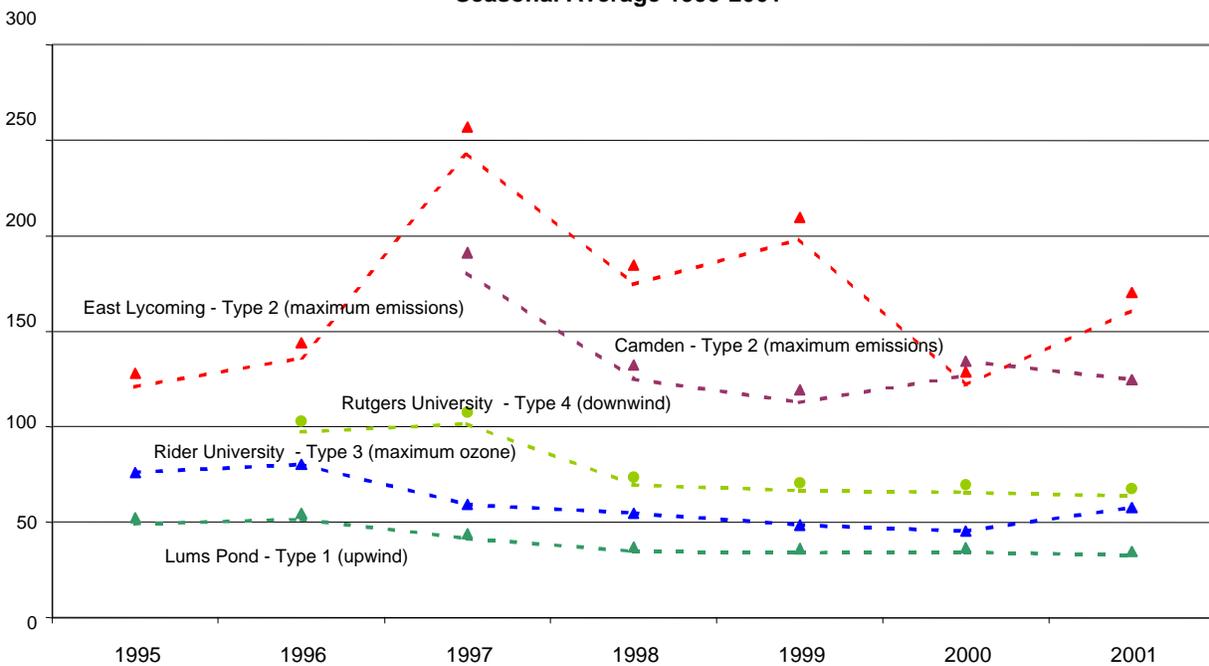
Note: Rutgers University PAMS site is both Type 1 for Philadelphia and Type 4 for New York City.



## PAMS (CONT.)

Figure 14 shows VOC trends for the PAMS sites in the Philadelphia area. In general, for 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 improvements were initially more dramatic, with more level, though still declining concentrations, over the last several years. The maximum emissions -Type 2 sites (Camden and East Lycoming) for this area show a less clear trend, seemingly up and down, and for the East Lycoming site the 2001 levels are actually slightly higher than for the first year measurements were made (1995).

**Figure 14**  
**Philadelphia Region**  
**Total Non-methane Organic Compounds (TMNOC)**  
**Seasonal Average 1995-2001**



## PAMS (cont.)

Figure 15 shows VOC trends for the PAMS sites in the New York City metropolitan area. In general, observations here are similar to those for the Philadelphia area. However, unlike the Type 2 site in the Philadelphia region, the Type 2 sites in the NY area (Queens Community College and the Bronx Botanical Gardens) also show a marked decline over the measurement period, though with more year to year variation than at the other sites.

In conclusion, with the exception of the East Lycoming site, VOC values measured at 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 could account for the reductions. Type 2 sites, though impacted by vehicle emissions, are also affected by urban stationary sources whose 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, isoprene can 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 3 and Table 4.

**Figure 15**  
**New York City Region**  
**Total Non-methane Organic Compounds (TNMOC)**  
**Seasonal Average 1995-2001**

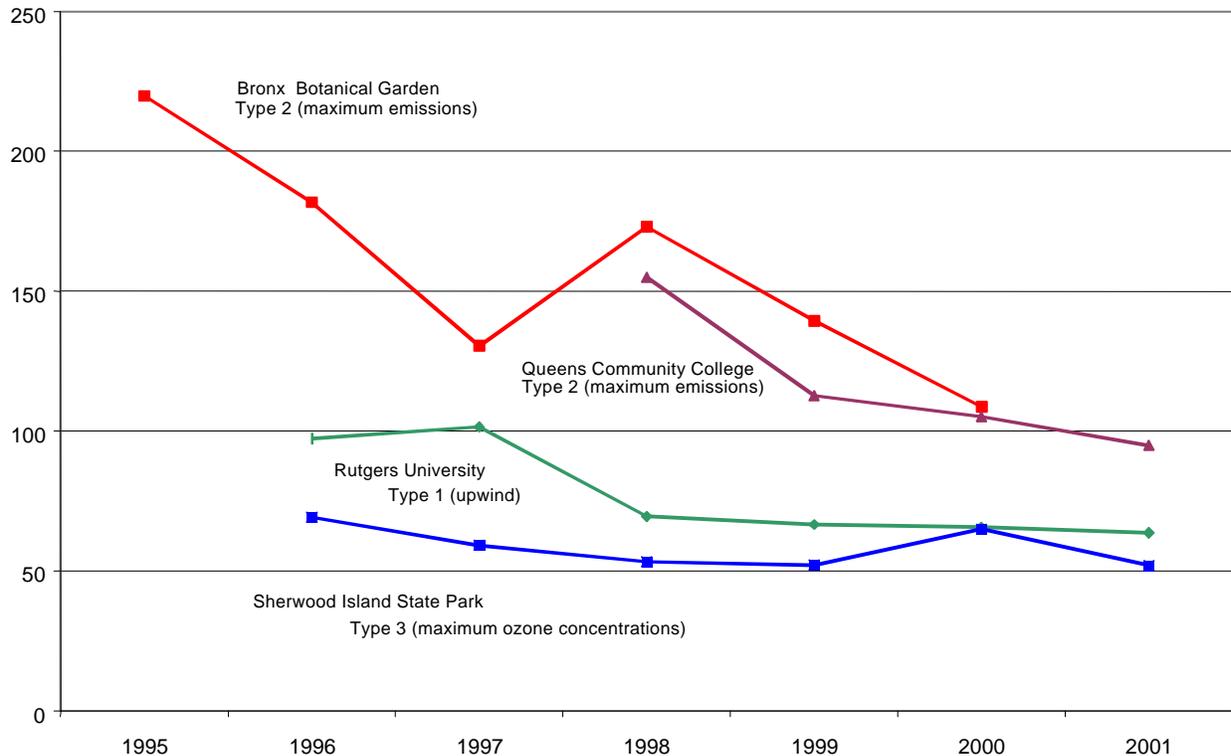


Table 3  
Summary of Photochemical Assessment Monitoring (PAMS) Data  
June, July, and August, 2001

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	9.65	0.42	19.29	0.85	0.63	0.11	1.25	0.23	3.50	0.44	6.99	0.89
Benzene	5.54	0.32	33.25	1.93	0.80	0.14	4.77	0.86	0.70	0.15	4.18	0.91
n-Butane	22.45	1.57	89.80	6.29	6.38	0.42	25.52	1.70	8.75	0.53	35.00	2.10
1-Butene	0.86	0.12	3.43	0.48	0.23	0.04	0.93	0.15	0.44	0.05	1.77	0.21
cis-2-Butene	0.88	0.07	3.51	0.27	0.21	0.02	0.83	0.08	1.15	0.04	4.59	0.14
trans-2-Butene	1.09	0.09	4.36	0.38	0.27	0.04	1.08	0.15	1.25	0.05	4.99	0.19
Cyclohexane	1.70	0.08	10.22	0.47	0.76	0.03	4.56	0.15	0.53	0.04	3.20	0.22
Cyclopentane	1.33	0.07	6.63	0.37	0.28	0.05	1.38	0.26	0.35	0.05	1.77	0.25
n-Decane	0.85	0.05	8.50	0.52	1.14	0.08	11.40	0.77	5.32	0.03	53.24	0.35
m-Diethylbenzene	0.10	0.01	1.03	0.08	0.11	0.01	1.13	0.09	0.23	0.01	2.27	0.09
p-Diethylbenzene	0.20	0.02	2.01	0.16	0.19	0.02	1.91	0.17	0.81	0.01	8.12	0.09
2,2-Dimethylbutane	3.46	0.14	17.31	0.71	0.37	0.04	1.86	0.22	0.45	0.04	2.26	0.18
2,3-Dimethylbutane	1.70	0.19	8.48	0.93	0.39	0.07	1.96	0.37	1.70	0.08	8.50	0.40
2,3-Dimethylpentane	1.92	0.10	13.44	0.67	0.80	0.04	5.60	0.30	1.14	0.05	7.95	0.37
2,4-Dimethylpentane	0.58	0.06	4.06	0.42	0.18	0.02	1.23	0.16	0.93	0.03	6.53	0.24
Ethane	19.51	3.76	39.01	7.53	7.48	2.04	14.95	4.09	16.37	2.98	32.73	5.96
Ethylbenzene	0.94	0.08	7.51	0.65	0.65	0.07	5.16	0.54	0.61	0.06	4.88	0.47
Ethylene (Ethene)	49.61	1.41	99.22	2.82	126.55	0.95	253.09	1.89	11.97	1.56	23.94	3.11
m-Ethyltoluene	0.94	0.07	8.44	0.60	0.47	0.02	4.25	0.22	1.10	0.06	9.94	0.54
o-Ethyltoluene	0.33	0.02	2.94	0.22	0.30	0.01	2.72	0.12	0.33	0.02	2.97	0.15
p-Ethyltoluene	0.34	0.02	3.03	0.17	1.06	0.01	9.54	0.10	0.35	0.02	3.12	0.16
n-Heptane	7.45	0.18	52.17	1.29	2.31	0.06	16.14	0.39	0.76	0.07	5.35	0.46
Hexane	4.79	0.32	28.76	1.90	1.12	0.15	6.72	0.88	1.68	0.15	10.06	0.88
1-Hexene	0.45	0.03	2.69	0.15	0.61	0.02	3.67	0.12	0.16	0.01	0.95	0.06
Isobutane	24.27	1.06	97.09	4.25	3.51	0.30	14.05	1.20	7.58	0.43	30.33	1.73
Isopentane	22.37	1.63	111.84	8.13	4.14	0.60	20.72	2.99	15.15	0.76	75.77	3.80
Isoprene	1.75	0.25	8.76	1.27	6.25	0.32	31.27	1.62	3.74	0.53	18.68	2.63
Isopropylbenzene	1.36	0.06	12.26	0.50	0.20	0.02	1.83	0.17	0.50	0.01	4.48	0.13
Methylcyclohexane	1.82	0.12	12.76	0.81	0.38	0.05	2.64	0.32	0.40	0.05	2.80	0.35
Methylcyclopentane	2.87	0.18	17.21	1.06	0.39	0.06	2.36	0.38	0.90	0.08	5.41	0.48
2-Methylheptane	0.49	0.04	3.89	0.34	0.16	0.02	1.30	0.14	0.25	0.02	2.00	0.17
3-Methylheptane	0.45	0.05	3.56	0.37	0.13	0.02	1.03	0.14	0.20	0.02	1.56	0.20
2-Methylhexane	4.38	0.15	30.63	1.07	1.94	0.06	13.55	0.40	0.51	0.06	3.59	0.44

Table 3 (Continued)  
Summary of Photochemical Assessment Monitoring (PAMS) Data  
June, July, and August, 2001

	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	6.63	0.20	46.44	1.41	2.97	0.08	20.77	0.56	0.61	0.08	4.24	0.55
2-Methylpentane	5.30	0.49	31.79	2.93	0.93	0.15	5.56	0.92	1.93	0.19	11.60	1.12
3-Methylpentane	3.10	0.34	18.59	2.01	1.48	0.10	8.85	0.61	1.22	0.12	7.29	0.74
n-Nonane	0.76	0.05	6.81	0.48	1.72	0.06	15.50	0.55	4.08	0.03	36.72	0.30
n-Octane	0.94	0.08	7.48	0.62	0.27	0.03	2.16	0.25	0.44	0.04	3.52	0.29
n-Pentane	16.85	0.82	84.27	4.12	2.60	0.33	13.01	1.66	5.85	0.40	29.24	2.02
1-Pentene	0.67	0.07	3.34	0.35	0.16	0.03	0.80	0.13	0.60	0.03	2.98	0.17
cis-2-Pentene	0.67	0.04	3.34	0.20	0.14	0.01	0.70	0.05	0.68	0.02	3.40	0.11
trans-2-Pentene	1.23	0.08	6.15	0.40	0.23	0.02	1.17	0.08	1.38	0.04	6.88	0.20
Propane	71.59	3.19	214.78	9.56	10.87	1.36	32.62	4.08	18.67	1.66	56.00	4.98
n-Propylbenzene	0.30	0.02	2.74	0.17	0.20	0.02	1.81	0.15	0.68	0.02	6.13	0.14
Propylene (Propene)	15.79	0.80	47.36	2.40	3.96	0.24	11.88	0.72	3.26	0.39	9.78	1.16
Styrene	0.34	0.02	2.73	0.14	0.43	0.06	3.44	0.52	0.93	0.02	7.46	0.13
Toluene	7.05	0.78	49.35	5.48	2.29	0.35	16.05	2.44	29.65	1.07	207.53	7.46
1,2,3-Trimethylbenzene	0.67	0.06	6.04	0.50	14.82	0.11	133.42	1.01	1.29	0.05	11.61	0.48
1,2,4-Trimethylbenzene	1.06	0.09	9.53	0.77	1.04	0.09	9.37	0.84	1.85	0.06	16.66	0.53
1,3,5-Trimethylbenzene	0.59	0.03	5.35	0.30	0.38	0.03	3.44	0.25	1.14	0.02	10.22	0.22
2,2,4-Trimethylpentane	2.58	0.27	20.63	2.16	0.58	0.10	4.66	0.83	4.21	0.15	33.68	1.23
2,3,4-Trimethylpentane	0.78	0.07	6.24	0.55	0.71	0.03	1.57	0.24	1.07	0.05	8.56	0.39
n-Undecane	0.44	0.03	4.84	0.31	3.47	0.04	38.17	0.44	1.19	0.02	13.12	0.20
m/p-Xylene	2.95	0.26	23.63	2.05	1.52	0.12	12.17	0.93	1.89	0.17	15.10	1.34
o-Xylene	0.90	0.09	7.17	0.75	0.38	0.05	3.07	0.40	0.55	0.06	4.39	0.50

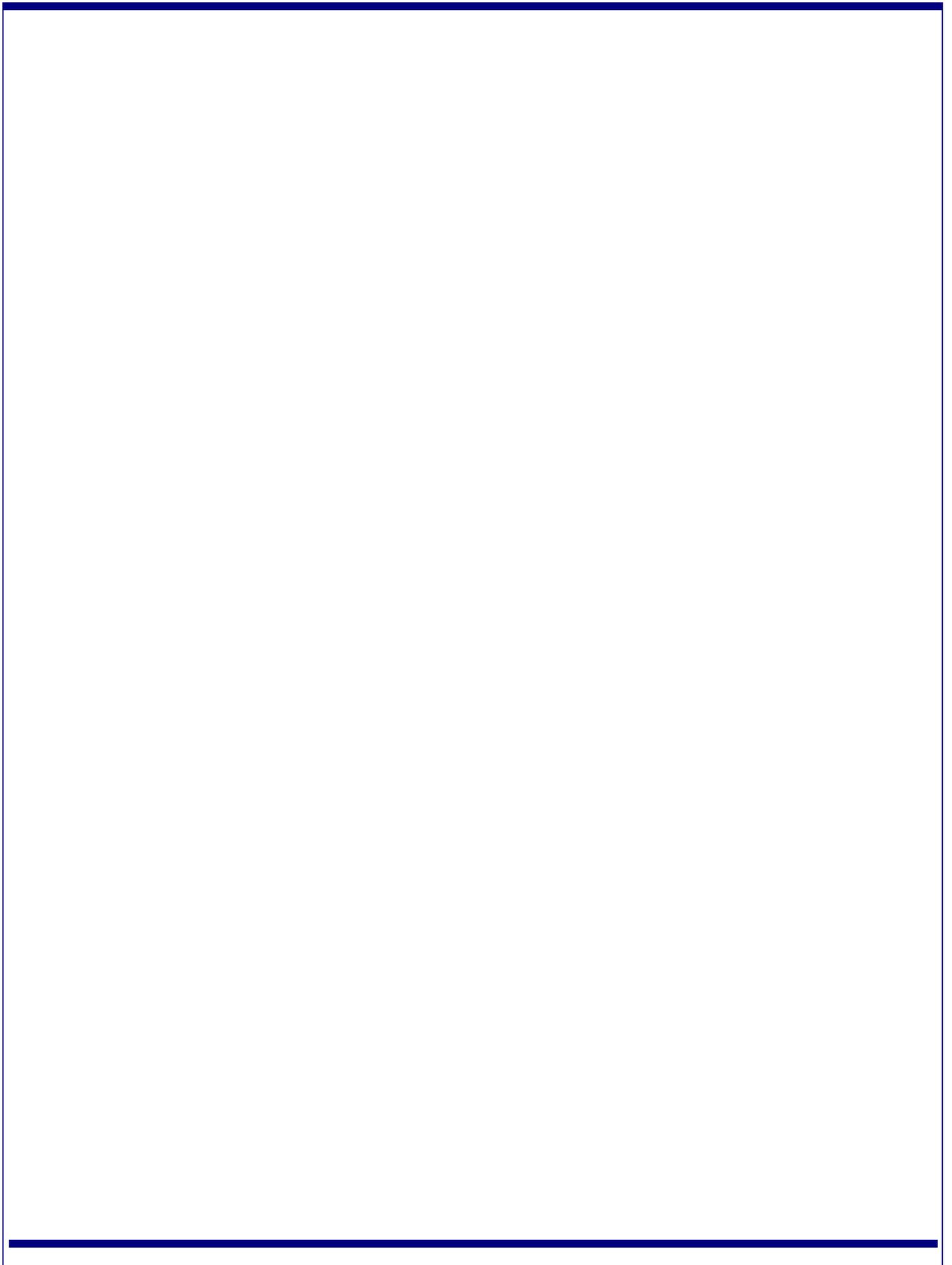
Table 4  
Camden Lab  
PAMS Carbonyls  
June, July, and August, 2001  
Parts Per Billion (Volume)  
30 Sampling Dates (236 Observations)

	# of	Max	Avg		# of	Max	Avg
	Non-Detects*				Non-Detects		
Acetaldehyde	2	4.35	1.33	Formaldehyde	0	9.57	3.61
Acetone	0	9.36	3.75	Hexaldehyde	50	1.36	0.17
Benzaldehyde	15	0.17	0.04	Isovaleraldehyde	235	0.01	0.00
Butyr/Isobutyraldehyde	52	1.62	0.10	Propionaldehyde	63	0.50	0.07
Crotonaldehyde	161	0.62	0.02	Tolualdehyde	58	1.56	0.06
2,5-Dimethylbenzaldehyde	222	0.12	0.00	Valeraldehyde	110	0.13	0.01

\* The number of times, out of a possible 236, that the results were below the detection limits of the method.

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# 2001 Particulate Summary

New Jersey Department of Environmental Protection

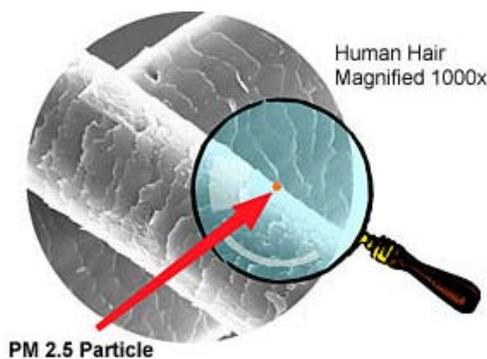
## NATURE AND SOURCES

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. Particulates can be directly emitted, or they can form in the atmosphere from gaseous emissions, such as sulfur dioxide (SO<sub>2</sub>) and oxides of nitrogen (NO<sub>x</sub>).

Particulate matter is generally categorized according to the size of the particles. Total Suspended Particulates (TSP) include all but the largest particles and were the basis for the first health standards for particulate matter. The human respiratory tract will usually trap particles above about 10 microns in diameter before they reach the lungs. Particles smaller than 10 microns (PM<sub>10</sub>) are considered to be inhalable and are generally considered to be more harmful to human health than larger particles.

Particles less than 2.5 microns in diameter are referred to as fine particulate matter or PM<sub>2.5</sub> (See Figure 1). Coarse particles (defined here as particles larger than 2.5 microns) and fine particles have distinctly different sources and health and environmental effects. Coarse particle sources include windblown dust and industrial sources such as grinding operations, while fine particles come from sources such as fuel combustion, power plants, and diesel engines.

**Figure 1**



Graphics Courtesy of the US Department of Energy

## HEALTH EFFECTS

Inhalable particles (PM<sub>10</sub>) and especially fine particles (PM<sub>2.5</sub>) are a health concern because they easily reach the deepest recesses of the lungs. When breathed, these particles can accumulate in the respiratory system and are associated with increased hospital admissions and emergency room visits for heart and lung disease, increased respiratory disease such as asthma, decreased lung function, and even premature death. Groups that appear to be at the greatest risk from particulates include children, the elderly, and individuals with cardiopulmonary disease such as asthma.

## 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](http://www.state.nj.us/dep/airmon)). Airborne particles can also impact vegetation and aquatic ecosystems, and can cause damage to paints and building materials.

**Figure 2**  
**Visibility WebCam**



## STANDARDS

In 1971, EPA set primary (health based) and secondary (welfare based) standards for total suspended particulate matter (TSP). These standards established maximum 24-hour and annual concentrations. 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 ( $\mu\text{g}/\text{m}^3$ ) and the annual geometric mean health standard was set at  $75 \mu\text{g}/\text{m}^3$ . The 24-hour secondary standard was set at  $150 \mu\text{g}/\text{m}^3$ . While EPA did not establish a secondary annual standard for TSP they did set a guideline of  $60 \mu\text{g}/\text{m}^3$  to be used to ensure that the secondary 24-hour standard was being met throughout the year. EPA felt this was necessary because monitoring for TSP was intermittent – generally occurring only once every six days. Although New Jersey still maintains a state standard 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 two stations where TSP samples are taken in order to be analyzed 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). Particles larger than 10 microns are normally filtered out by the upper respiratory tract (nose and throat) and do not reach the lungs. The 24-hour PM10 standard was set at  $150 \mu\text{g}/\text{m}^3$  and the annual standard at  $50 \mu\text{g}/\text{m}^3$  was. The annual standard for PM10 is based on the arithmetic 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 (PM2.5). They kept the existing standards for PM10 as well. Particles smaller than 2.5 microns come from combustion sources or are formed in the atmosphere from gasses. The PM2.5 annual standard concentration was set at  $15 \mu\text{g}/\text{m}^3$  and the 24-hour standard was set at  $65 \mu\text{g}/\text{m}^3$ . Table 1 provides a summary of the Particulate Matter standards.

TABLE 1  
NATIONAL AND NEW JERSEY  
AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE  
MATTER

<u>STANDARD</u>	<u>AVERAGING PERIOD</u>	<u>TYPE</u>	<u>NEW JERSEY</u>	<u>NATIONAL</u>
TOTAL	12-MONTH <sup>‡</sup>	PRIMARY	$75 \mu\text{g}/\text{m}^3$	---
SUSPENDED	24-HOUR	PRIMARY	$260 \mu\text{g}/\text{m}^3$	---
PARTICULATES	12-MONTH <sup>‡</sup>	SECONDARY	$60 \mu\text{g}/\text{m}^3$	---
	24-HOUR	SECONDARY	$150 \mu\text{g}/\text{m}^3$	---
INHALABLE	ANNUAL <sup>†</sup>	Primary	---	$50 \mu\text{g}/\text{m}^3$
PARTICULATES	24-HOUR AVERAGE	Primary	---	$150 \mu\text{g}/\text{m}^3$
FINE	ANNUAL <sup>†</sup>	Primary	---	$15 \mu\text{g}/\text{m}^3$
PARTICULATES	24-HOUR AVERAGE	Primary	---	$65 \mu\text{g}/\text{m}^3$
‡ ANNUAL GEOMETRIC MEAN				
† ANNUAL ARITHMETIC MEAN				



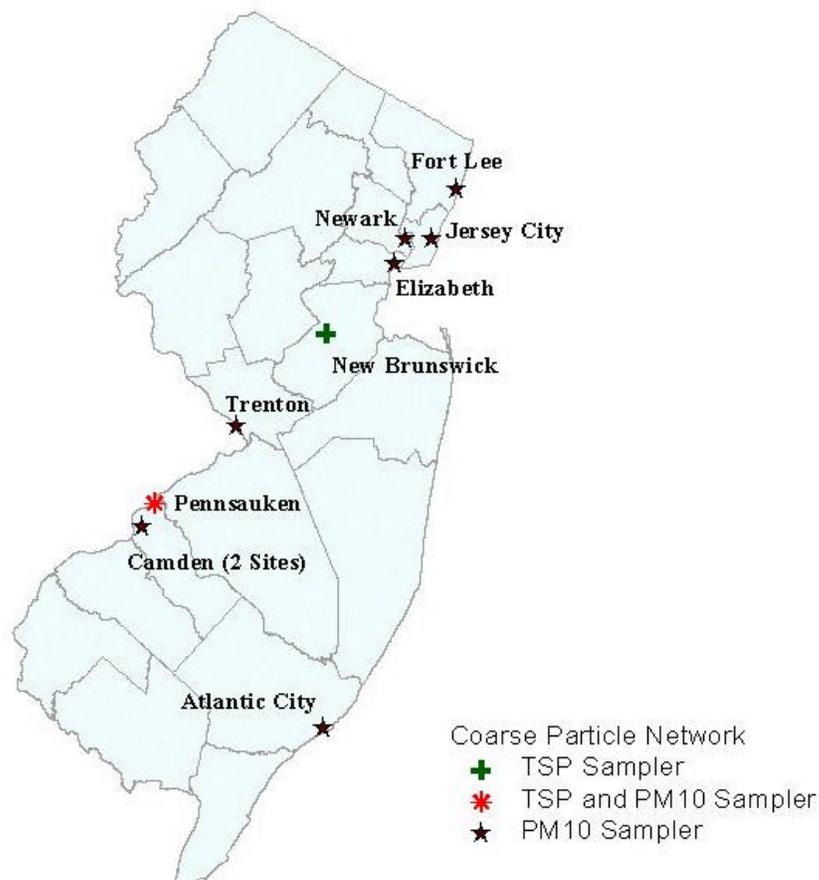
## PARTICULATE MONITORING NETWORK

New Jersey's Particulate Monitoring Network consists of 20 fine particulate monitoring sites, 9 PM10 monitoring sites, 2 TSP monitoring sites, and 12 locations where smoke shade is monitored. Smoke shade is a measure of light transmittance that is used as a surrogate for particle concentrations. As most monitoring methods for particulates require that samples be collected and weighed, data are not available in real time. Smoke shade is a semi-continuous method that is near real-time and is used primarily for estimating particle levels for use in daily air quality index reporting.

### COARSE PARTICLE MONITORING SITES

The coarse particulate monitoring network is composed of PM10 and TSP samplers located at 10 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 3 depicts the coarse particulate monitoring network in New Jersey.

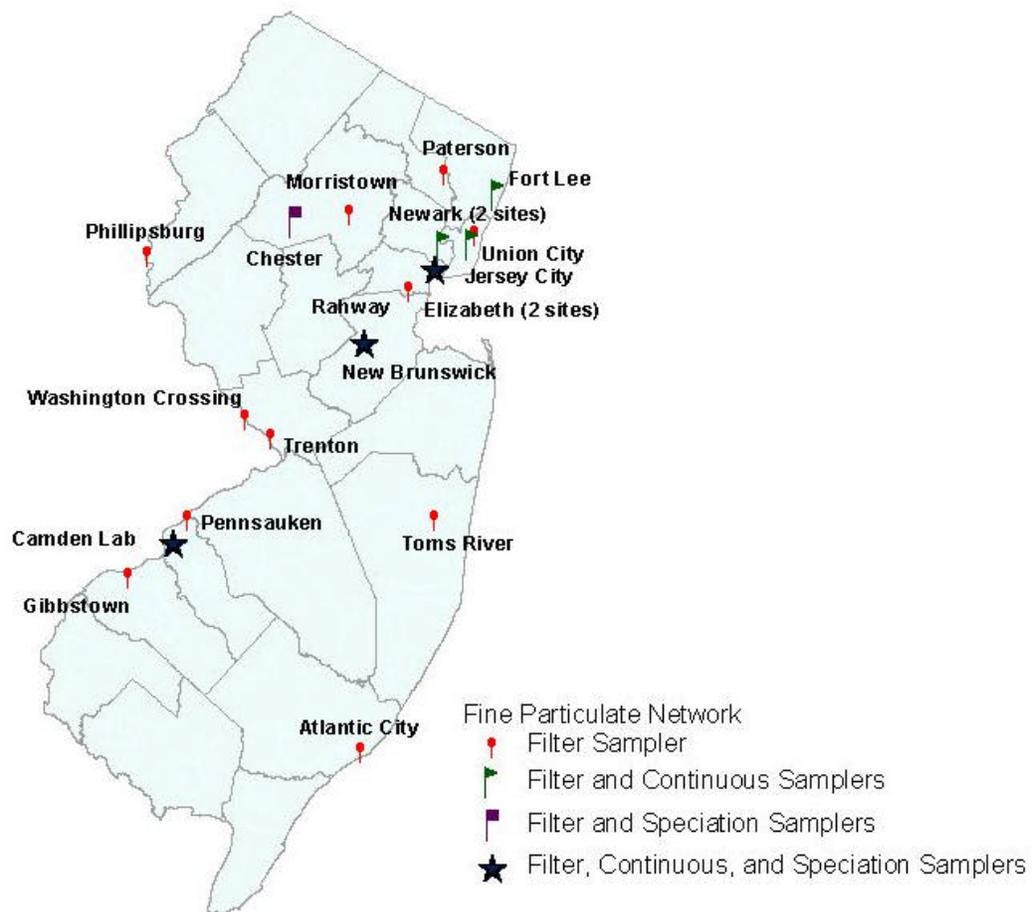
**Figure 3**  
**2001 Coarse Particulate Monitoring Network**



## FINE PARTICLE MONITORING SITES

Each of the 20 fine particulate monitoring sites (Figure 4) has a filter-based sampler, which collects a 24-hour sample on a Teflon filter. At 5 sites, there are also continuous monitors, which record the average 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](http://www.state.nj.us/dep/airmon)). Additionally, fine particulate speciation samplers are located at four sites. Analyses are performed on the samples from these sites to determine the types and amounts of chemicals that make up fine particles.

**Figure 4**  
**2001 Fine Particulate**  
**Monitoring Network**



## SMOKE SHADE MONITORING SITES

In addition to fine and coarse particulate monitoring, smoke shade is also monitored at 12 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 5 below.

**Figure 5  
2001 Smoke Shade  
Monitoring Network**



## 2001 SUMMARY

### MAXIMUM CONCENTRATIONS

In 2001, the maximum daily TSP concentration recorded was  $156 \mu\text{g}/\text{m}^3$  at the site in Pennsauken on June 6<sup>th</sup>. This is well below the state's 24-hour primary air quality standard of  $260 \mu\text{g}/\text{m}^3$ . Pennsauken also recorded the highest annual geometric mean of  $52 \mu\text{g}/\text{m}^3$ , which is below both the state's primary and secondary 12-month standards of 75 and  $60 \mu\text{g}/\text{m}^3$ .

The maximum daily concentration of inhalable particles (PM10) was  $91 \mu\text{g}/\text{m}^3$  recorded at Fort Lee on May 1<sup>st</sup>. The 24-hour National Ambient Air Quality Standard (NAAQS) for PM10 is  $150 \mu\text{g}/\text{m}^3$ . None of the monitoring locations recorded values above the annual NAAQS of  $50 \mu\text{g}/\text{m}^3$  although not all sites had a complete year of data. The highest annual average recorded in 2001 was  $37.4 \mu\text{g}/\text{m}^3$  also at the Fort Lee site.

The maximum daily concentration of fine particles in 2001 was  $52.5 \mu\text{g}/\text{m}^3$  recorded at Union City on June 30<sup>th</sup>. The 24-hour NAAQS for PM2.5 is  $65 \mu\text{g}/\text{m}^3$ . The Elizabeth Lab, Newark Lab, and Union City sites recorded annual concentrations above the  $15 \mu\text{g}/\text{m}^3$  annual NAAQS but by regulation it takes three complete years of data to determine if the standards are being met. The maximum annual average PM2.5 concentration recorded was  $15.8 \mu\text{g}/\text{m}^3$ , recorded at both the Elizabeth Lab and Union City sites.

The daily average maximum smoke shade reading was 1.49 Coefficient of Haze units (COH) recorded at Elizabeth Lab on November 23<sup>rd</sup>. There are no national or state air quality standards for smoke shade, although a 24-hour average of 2.0 COH is used as the basis for rating air quality as unhealthy for sensitive groups in the daily Air Quality Index. See the Air Quality Index section of this report for more information.

### TSP CONCENTRATION SUMMARY

Total Suspended Particulates are no longer routinely measured in the state. However, two sites are still operating, mainly for the purpose of determining the concentration of lead in the atmosphere. For more information, see the 2001 Lead Summary section.

In 2001, the annual geometric mean concentration of TSP was  $29.9 \mu\text{g}/\text{m}^3$  at New Brunswick and  $53.9 \mu\text{g}/\text{m}^3$  at Pennsauken. The maximum 24-hour concentration recorded was  $99 \mu\text{g}/\text{m}^3$  at the New Brunswick site and  $156 \mu\text{g}/\text{m}^3$  at the Pennsauken site. All areas of the state are in attainment for the primary and secondary annual TSP standards of  $75 \mu\text{g}/\text{m}^3$  and  $60 \mu\text{g}/\text{m}^3$  respectively. Neither of the sites surpassed the 24-hour primary standard of  $260 \mu\text{g}/\text{m}^3$ , although Pennsauken did exceed New Jersey's 24-hour secondary standard of  $150 \mu\text{g}/\text{m}^3$  on one occasion. Construction activities adjacent to the Pennsauken site were ongoing during the period when that value was recorded.

TABLE 2  
TSP DATA – 2001

MAX - MAXIMUM

SITE	GEOM. MEAN ( $\mu\text{G}/\text{M}^3$ )	24-HR. MAX ( $\mu\text{G}/\text{M}^3$ )	24-HR. 2 <sup>ND</sup> MAX ( $\mu\text{G}/\text{M}^3$ )
New Brunswick	29.9	99	81
Pennsauken <sup>a</sup>	53.9	156	112

a – No data available November 9 – December 27

## PM10 CONCENTRATION SUMMARY

In 2001, the annual mean concentration of PM10 ranged from 21.7  $\mu\text{g}/\text{m}^3$  in Atlantic City to 37.4  $\mu\text{g}/\text{m}^3$  in Fort Lee. Table 3 and Figure 6 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  $\mu\text{g}/\text{m}^3$ , and no sites surpassed the 24-hour standard of 150  $\mu\text{g}/\text{m}^3$ .

The concentration of Sulfates and Nitrates were also analyzed on some PM10 filters. The results showed that, on average, about 15 percent of PM10 is sulfate and about 2 percent is nitrate. The contributions of sulfate and nitrate to PM10 are significantly less than their contributions to PM2.5. This is because PM10 is predominantly made up of larger particles most of which are directly emitted into the atmosphere. PM2.5 is predominantly a secondary pollutant, forming in the atmosphere from gaseous emissions, such as SO<sub>2</sub> and NO<sub>x</sub>. For more details on the PM10 sulfate and nitrate results, see the section on atmospheric deposition.

TABLE 3  
PM10 DATA – 2001

MAX – MAXIMUM 24-HOUR AVERAGES

SITE	MEAN ( $\mu\text{g}/\text{m}^3$ )	MAX ( $\mu\text{g}/\text{m}^3$ )	2 <sup>ND</sup> MAX ( $\mu\text{g}/\text{m}^3$ )
Atlantic City (Trump) <sup>a</sup>	27.0	55	43
Atlantic City (Bacharach) <sup>a</sup>	21.7	45	41
Camden Lab	25.9	64	61
Camden (Morgan Ave.)	34.5	68	67
Elizabeth	32.2	80	61
Fort Lee <sup>b</sup>	37.4	91	71
Jersey City	29.3	71	85
Newark <sup>c</sup>	24.2	54	53
Pennsauken <sup>d</sup>	29.7	63	61
Trenton	23.5	68	53

a - In Atlantic City, PM10 was sampled at the Trump Plaza from January through August, and on Bacharach Boulevard thereafter.

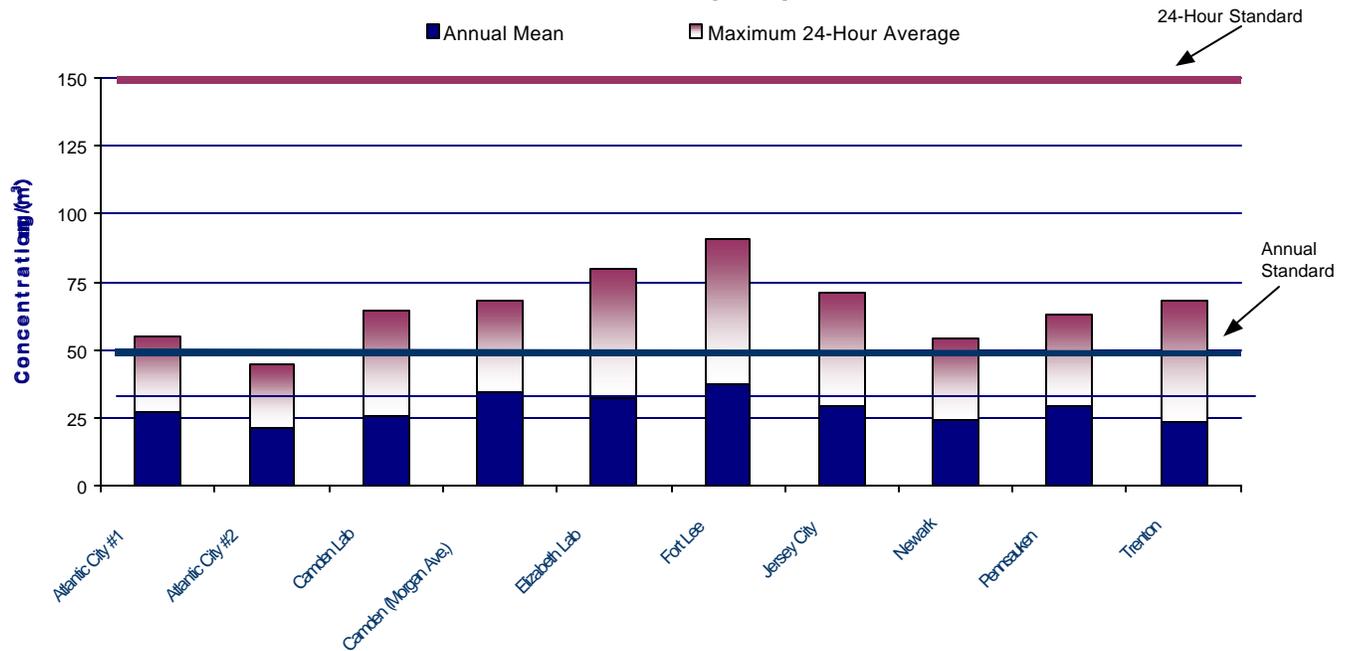
b - No data available January 25 – April 7

c - No data available January 1 – August 17

d - No data available November 9 – December 27

Figure 6

### 2001 Inhalable Particulate (PM10) Concentrations



## PM2.5 CONCENTRATION SUMMARY

Table 4 and Figure 7 show the annual mean, and the 24-hour maximum fine particulate (PM2.5) concentrations recorded in New Jersey in 2001. The annual mean concentration of PM2.5 ranged from 11.8  $\mu\text{g}/\text{m}^3$  in Chester to 15.8  $\mu\text{g}/\text{m}^3$  at the Elizabeth Lab and Union City sites. The highest 24-hour level recorded was 52.5  $\mu\text{g}/\text{m}^3$  at the Union City site.

Three years of data are required to determine compliance with the National Ambient Air Quality Standards (NAAQS) for PM2.5. Based on an initial review of the data, it is apparent that the entire state will meet the 24-hour NAAQS. A number of sites will be very close to the 15  $\mu\text{g}/\text{m}^3$  annual standard. NJDEP will be evaluating all PM2.5 data collected to date in making its final determination as to whether the annual NAAQS are being met.

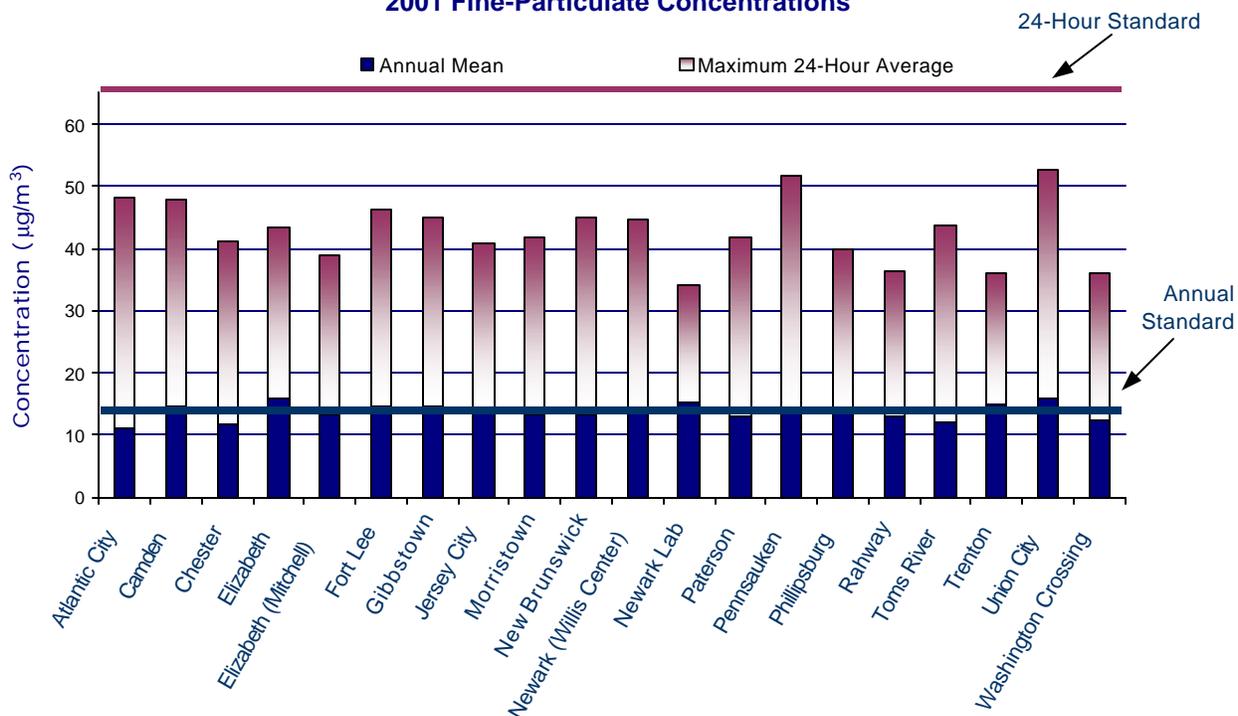
TABLE 4  
PM2.5 DATA – 2001

MAX – MAXIMUM 24-HOUR

SITE	NUMBER OF SAMPLES	MEAN ( $\mu\text{G}/\text{M}^3$ )	MAX ( $\mu\text{G}/\text{M}^3$ )	2 <sup>ND</sup> MAX ( $\mu\text{G}/\text{M}^3$ )
Atlantic City**	45	11.2	48.1	26.3
Camden Lab	122	14.5	47.8	41.2
Chester	84	11.8	41.2	32.2
Elizabeth (Mitchell Bldg.)	92	13.4	39.0	33.8
Elizabeth Lab	286	15.8	43.4	42.4
Fort Lee	96	14.5	46.4	34.4
Gibbstown	100	14.5	45.1	40.8
Jersey City	102	14.1	40.7	37.7
Morristown	83	13.4	41.8	40.5
New Brunswick	93	13.2	45.1	34.1
Newark (Willis Center)	91	13.5	44.5	32.1
Newark Lab**	35	15.3	34.0	30.2
Paterson	84	13.1	41.9	34.2
Pennsauken	94	14.2	51.7	37.8
Phillipsburg	103	13.7	39.7	38.8
Rahway	158	12.8	36.4	35.4
Toms River	87	11.9	43.6	39.8
Trenton	98	14.9	36.0	35.4
Union City	90	15.8	52.5	39.5
Washington Crossing	83	12.2	36.0	29.4

\*\* No data prior to August 6<sup>th</sup>

**Figure 7  
2001 Fine-Particulate Concentrations**



**PM2.5 REAL-TIME MONITORING**

New Jersey's real-time fine PM2.5 monitoring network consists of 5 sites that transmit data once a minute to a central computer in Trenton. The data is then automatically updated on the bureau's website every hour, where it displays the health level that corresponds to the current 24-hour fine particulate concentration. Table 5 provides a summary of the data from these sites and Figure 8 depicts the health level associated with the maximum daily fine particulate concentration recorded in the state each day for the entire year.

Table 5

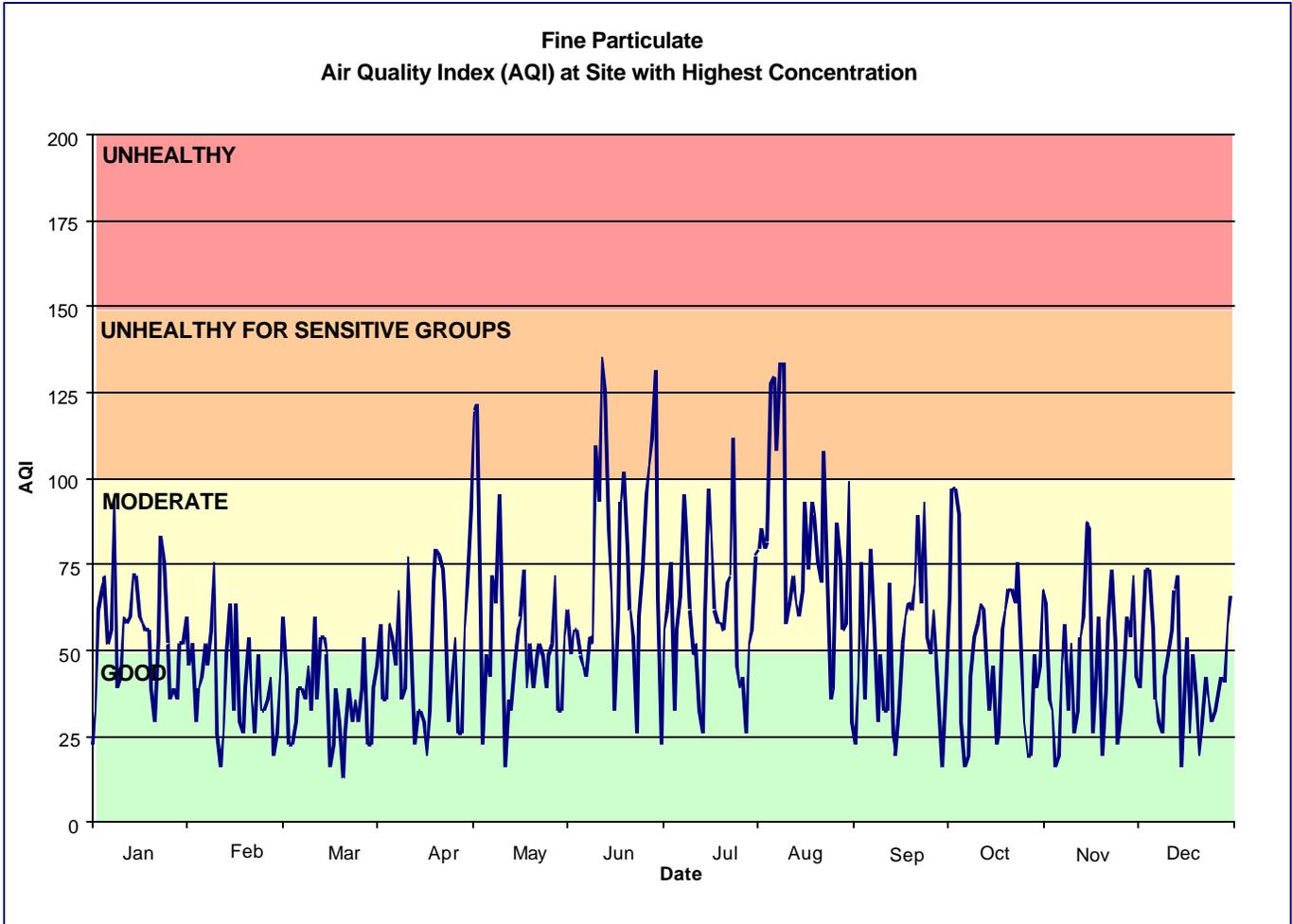
2001 Summary of Continuous PM2.5 Data

Monitoring Site	Annual Arith. Mean	24-Hour Maximum	24-Hour 2nd Highest
Camden Lab	14	57	48
Elizabeth Lab	15	58	53
Fort Lee <sup>a</sup>	--	58	57
Newark Lab <sup>b</sup>	--	34	32
New Brunswick	12	52	48

<sup>a</sup> Data not available from January 21<sup>st</sup> to March 11<sup>th</sup>

<sup>b</sup> Data not available prior to August 6<sup>th</sup>

FIGURE 8

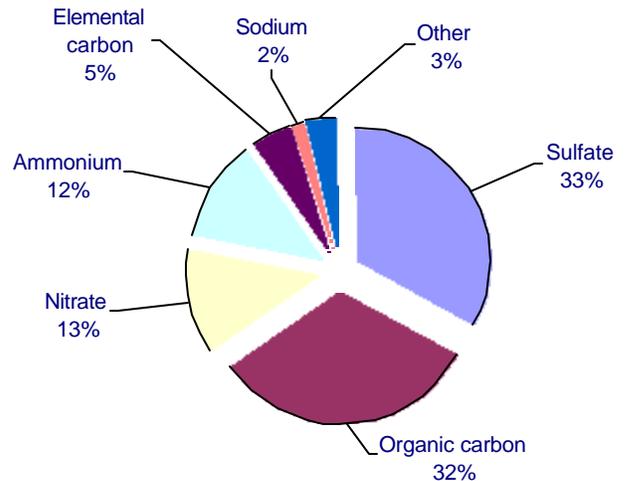


**PM2.5 SPECIATION SUMMARY**

A new project was started in 2001, whereby the fine particulate filters were analyzed in order to determine the chemical composition of the particles. Speciation samplers were placed in Camden, New Brunswick, Chester, and Elizabeth. All of the sites, except New Brunswick, only ran a portion of the year. The results from New Brunswick indicate that approximately 97 percent of fine particles are composed of Sulfate, Organic Carbon, Nitrate, Ammonium, Elemental Carbon, and Sodium (Figure 9).

FIGURE 9

**Components of PM2.5 at New Brunswick in 2001**





## SMOKE SHADE SUMMARY

In 2001, the mean annual concentration of smoke shade ranged from 0.15 Coefficient of Haze units (COH) at Flemington to 0.52 COH at Elizabeth Lab. COH are units of light absorption 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 6 lists the annual mean, daily maximum and second maximum smoke shade levels recorded at the monitoring sites in 2001.

TABLE 6  
Smoke Shade – 2001

Max – Maximum 24-Hour Average

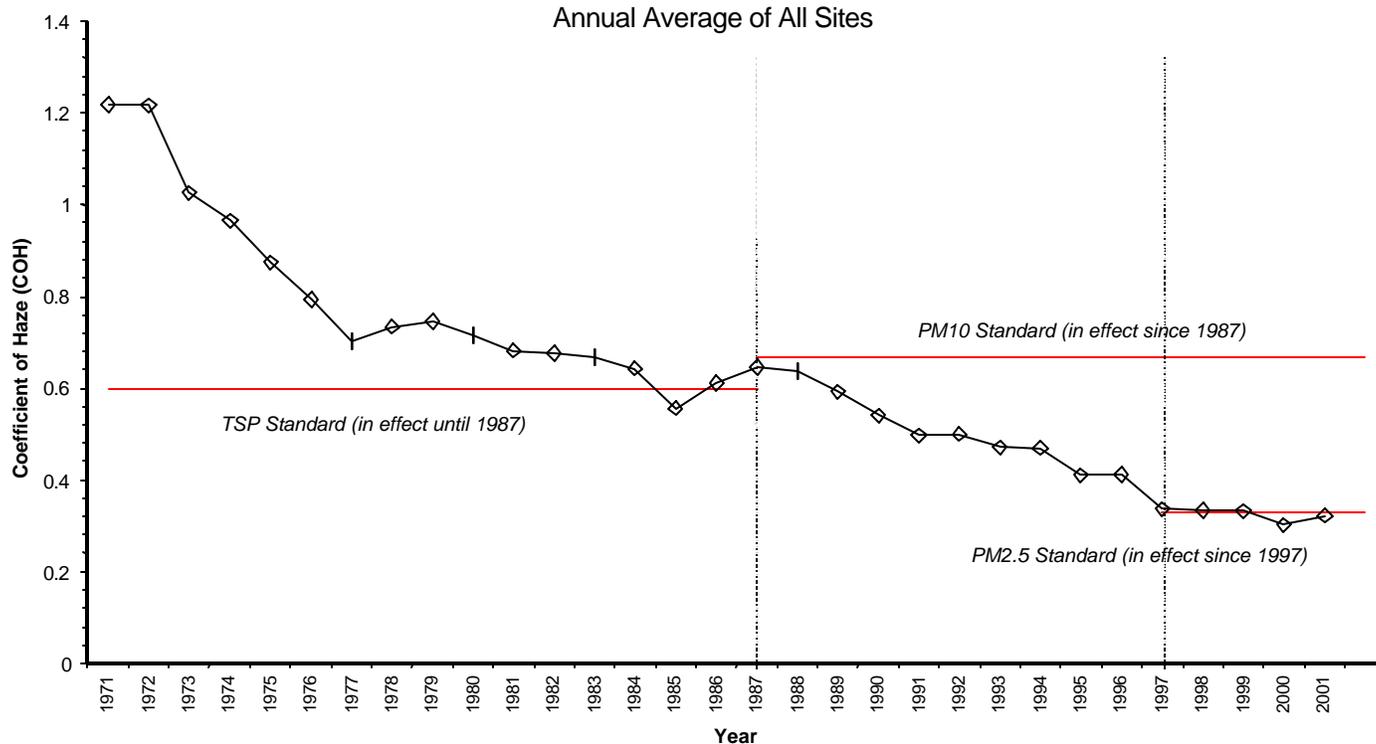
SITE	MEAN (COH)	MAX (COH)	2 <sup>ND</sup> MAX (COH)
Ancora State Hospital	---	0.44	0.39
Burlington	0.21	0.74	0.74
Camden Lab	0.19	0.96	0.86
Elizabeth	0.37	1.37	1.29
Elizabeth Lab	0.52	1.49	1.42
Flemington	0.15	0.50	0.48
Freehold	0.26	0.75	0.65
Hackensack	0.25	0.97	0.80
Jersey City	0.49	1.29	1.24
Morristown	0.27	1.01	0.95
Newark	---	1.18	1.15
Perth Amboy	0.34	1.06	0.99

## 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 12 active sites. The trend graph for smoke shade, shown in Figure 10, 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 PM2.5 health standards. The approximate level of these standards, converted to smoke shade units, are also shown on Figure 10. It can be seen that the new PM2.5 standard is significantly lower than the TSP or PM10 standards and that current levels are very close to this standard. This is consistent with the 2001 summary of fine particle data shown earlier which was based on direct measurements of PM2.5.

**Figure 10**  
**New Jersey Trend in Particulate Levels**  
**1971 - 2001**

Smoke Shade used as a surrogate for particulate matter  
Annual Average of All Sites



## 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](http://www.epa.gov/air/urbanair/pm/index.html)

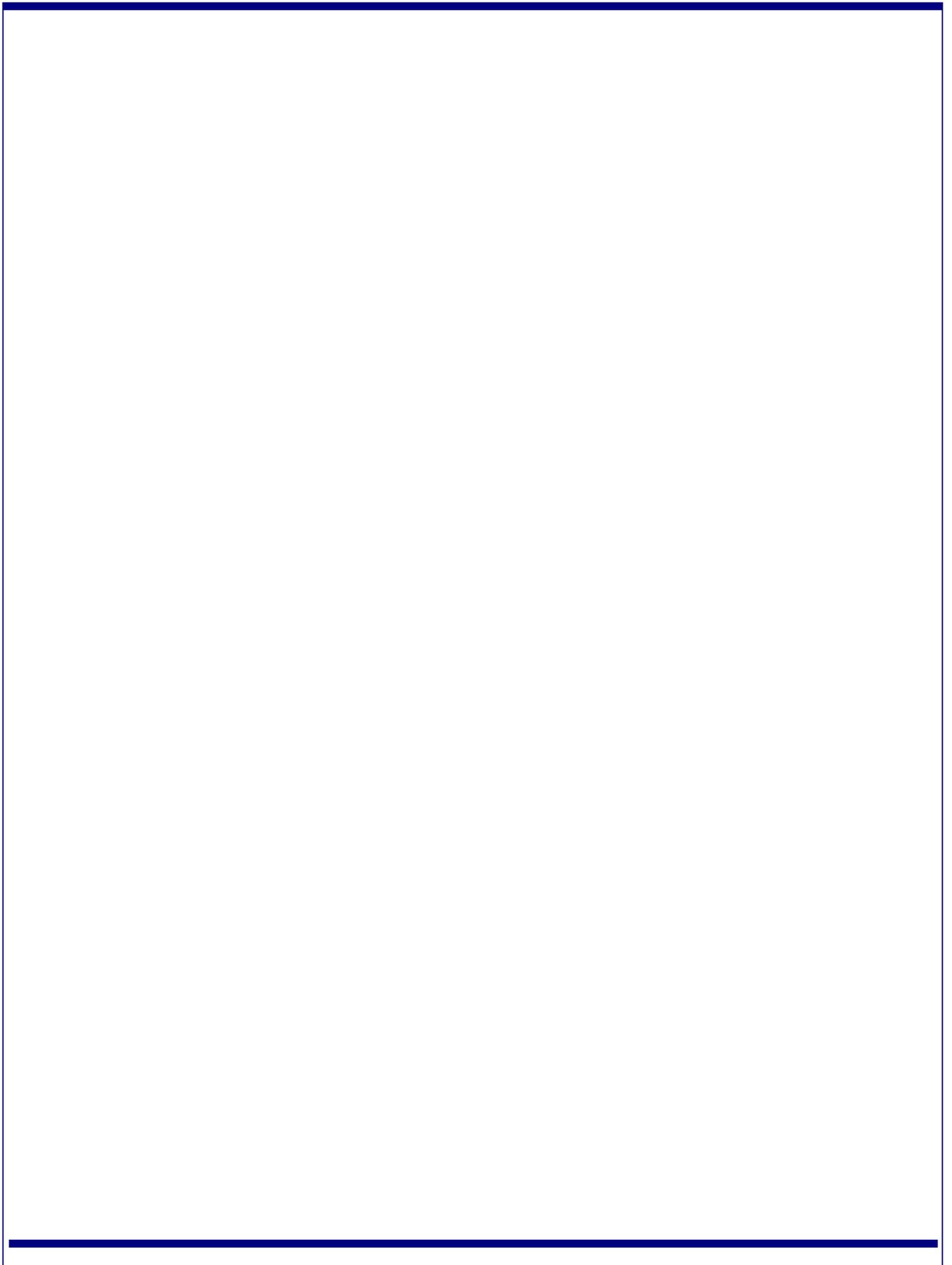
*Air Quality Criteria for Particulate Matter*, USEPA, Office of Research and Development, EPA-600/P-99-002A and B, March 2001

*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/oar/aqtrnd99/](http://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, September 2001, URL: [www.epa.gov/oar/aqtrnd00/](http://www.epa.gov/oar/aqtrnd00/)





# 2001 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

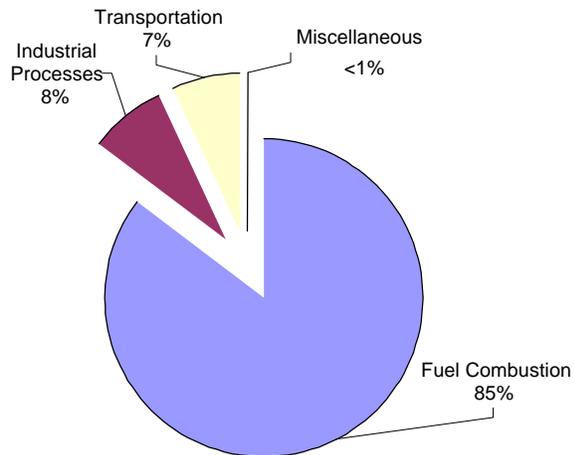
## NATURE AND SOURCES

Sulfur Dioxide (SO<sub>2</sub>) is a heavy, colorless, poisonous gas. Sulfur is found in raw materials such as crude oil, coal, and ore and SO<sub>2</sub> can be formed when fuel containing sulfur is burned, or when gasoline is extracted from oil.

Sulfur Dioxide easily dissolves in water and water vapor to form sulfuric acid. Most of the sulfur dioxide released into the air comes from electric utilities, especially those that burn coal with a high sulfur content. Industrial facilities that derive their products from raw materials such as metallic ore, coal, and crude oil, also release SO<sub>2</sub>. Sulfur dioxide is also found in volcanic gases.

**Figure 1**

**SO<sub>2</sub> Emissions by Source Category**



Source: USEPA National Air Quality and Emissions Trends Report, 1999

## HEALTH AND ENVIRONMENTAL EFFECTS

Sensitive groups for SO<sub>2</sub> include children, the elderly, and people with heart or lung disorders such as asthma. When there are peak levels of SO<sub>2</sub> in the air, people with asthma who are active outdoors may have trouble breathing.

Sulfur Dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people and the environment.

SO<sub>2</sub> is also a big contributor to acid rain, as SO<sub>2</sub> reacts with other substances in the air to form acids, which fall to the earth in rain and snow. Acid rain damages forests and crops, and can make lakes and streams too acidic for fish. Acid rain also speeds up the decay of buildings.

## STANDARDS

There are several health and welfare based standards for sulfur dioxide. There are three National Ambient Air Quality Standards for SO<sub>2</sub>. 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 0.50 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 SO<sub>2</sub>. They are similar to the federal standards but are expressed in micrograms per cubic meter (ug/m<sup>3</sup>) 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 National and New Jersey Ambient Air Quality Standards for SO<sub>2</sub>.

**Table 1**  
**Ambient Air Quality Standards for**  
**Sulfur Dioxide**

<b>Averaging Period</b>	<b>Type</b>	<b>New Jersey</b>	<b>National<sup>a</sup></b>
12-month average	Primary	80 ug/m3 (.03 ppm)	.03 ppm
12-month average	Secondary	60 ug/m3 (.02 ppm)	---
24-hour average	Primary	365 ug/m3 (.14 ppm)	.14 ppm
24-hour average	Secondary	260 ug/m3 (.10 ppm)	---
3-hour average	Secondary	1300 ug/m3 (.5 ppm)	.5 ppm

a – National standards are block averages rather than moving averages

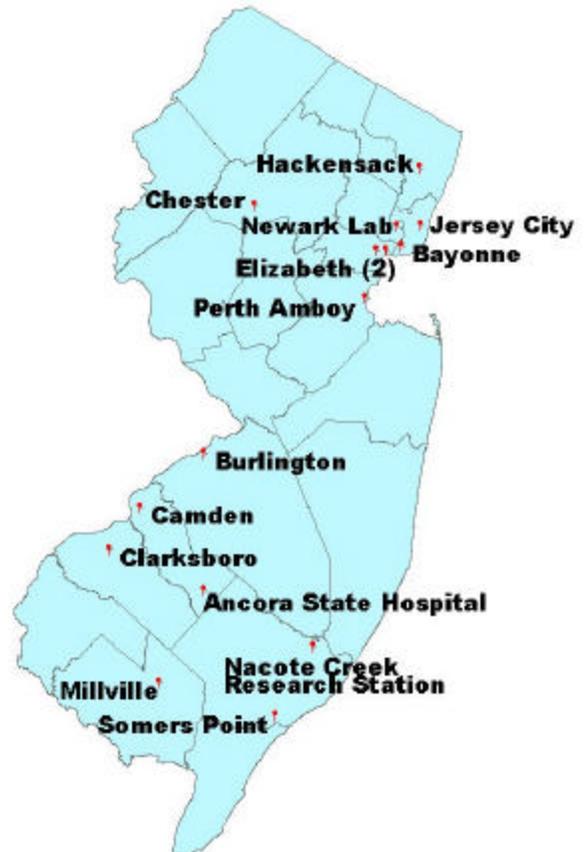
## MONITORING LOCATIONS

The state monitored SO<sub>2</sub> levels at 15 locations in 2001. These sites are shown in the map to the right. The Newark Lab site was relocated during 2001 and was not operational prior to August 6th.

## SO<sub>2</sub> LEVELS IN 2001

None of the monitoring sites recorded exceedances of the primary or secondary SO<sub>2</sub> standards during 2001. The maximum annual average concentration recorded was 0.009 ppm at the Jersey City site. The maximum 24-hour average level recorded was 0.034 ppm which was recorded in Jersey City and Camden Lab. The highest 3-hour average recorded was 0.073 ppm at the site in Newark Lab. Summaries of the 2001 data are provided in Table 2, Table 3 and Figure 3.

**Figure 2**  
**2001 Sulfur Dioxide**  
**Monitoring Network**



**Table 2**  
**Sulfur Dioxide Data – 2001**  
**3-Hour and Annual Averages**  
**Parts Per Million (ppm)**

<b>Monitoring Sites</b>	<b>3-Hour Average<sup>a</sup> Maximum</b>	<b>3-Hour Average<sup>a</sup> 2<sup>nd</sup> Highest</b>	<b>12-Month Average Maximum</b>	<b>12-Month Average Year</b>
Ancora S.H.	.030	.029	.004	.003
Bayonne	.049	.039	.007	.007
Burlington	.035	.034	.005	.005
Camden Lab	.061	.058	.007	.006
Chester	.048	.043	.005	.004
Clarksboro	.041	.041	.006	.005
Elizabeth	.041	.037	.006	.006
Elizabeth Lab	.051	.050	.009	.008
Hackensack	.034	.032	.005	.005
Jersey City	.069	.057	.009	.009
Millville	.047	.033	.005	.005
Nacote Creek R.S.	.021	.020	.003	.003
Newark Lab <sup>b</sup>	.073	.035	----	----
Perth Amboy	.071	.054	.005	.005
Somers Point	.052	.042	.003	.003

a – Based on non-overlapping 3-hour moving averages

b – Data not available prior to August 6<sup>th</sup>

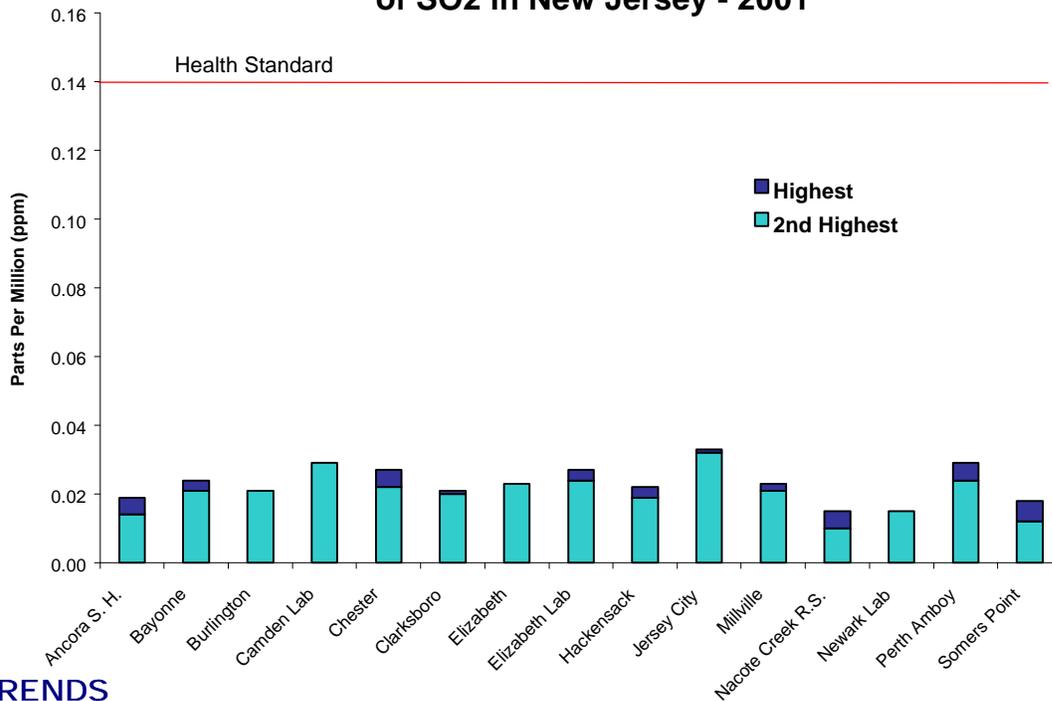
**Table 3**  
**Sulfur Dioxide Data – 2001**  
**24-Hour and Daily Averages**  
**Parts Per Million (ppm)**

<b>Monitoring Sites</b>	<b>24-Hour Average Maximum</b>	<b>24-Hour Average<sup>a</sup> 2<sup>nd</sup> Highest</b>	<b>Daily Average Maximum</b>	<b>Daily Average 2<sup>nd</sup> Highest</b>
Ancora S.H.	.020	.018	.019	.014
Bayonne	.026	.023	.024	.021
Burlington	.025	.022	.021	.021
Camden Lab	.034	.032	.029	.029
Chester	.031	.025	.027	.022
Clarksboro	.027	.022	.021	.020
Elizabeth	.025	.024	.023	.023
Elizabeth Lab	.030	.026	.027	.024
Hackensack	.022	.022	.022	.019
Jersey City	.034	.033	.033	.032
Millville	.029	.022	.023	.021
Nacote Creek R.S.	.016	.012	.015	.010
Newark Lab <sup>b</sup>	.023	.016	.015	.015
Perth Amboy	.030	.025	.029	.024
Somers Point	.020	.015	.018	.012

a – Based on non-overlapping 3-hour moving averages

b – Data not available prior to August 6<sup>th</sup>

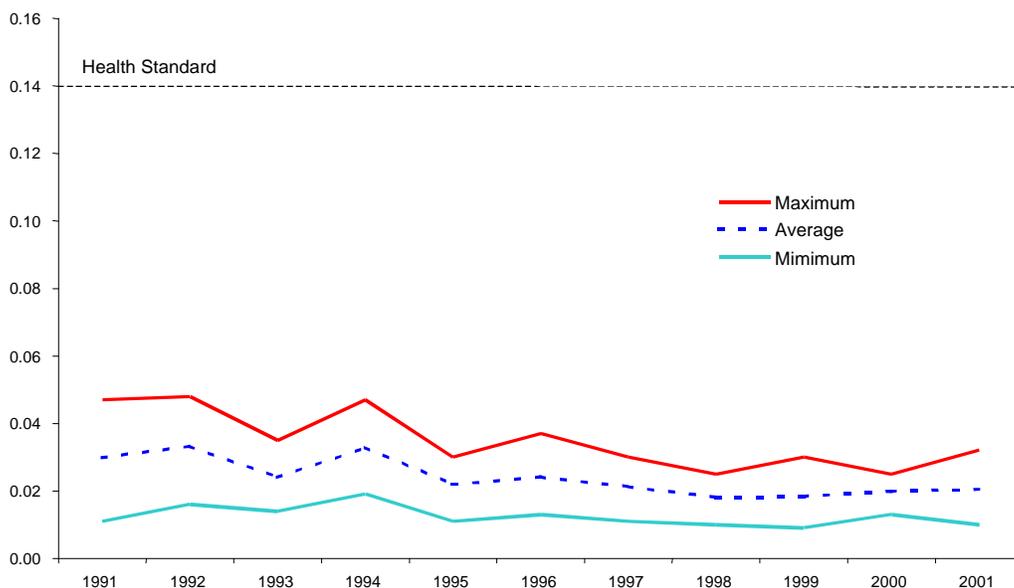
**Figure 3**  
**Highest and 2nd Highest Daily 24-Hour Averages**  
**of SO<sub>2</sub> in New Jersey - 2001**



**TRENDS**

Since the implementation of regulations requiring the use of low sulfur fuels in New Jersey, SO<sub>2</sub> concentrations have improved significantly. The last time an exceedance of any of the National SO<sub>2</sub> standards was recorded in the state was in 1980. A trend graph of SO<sub>2</sub> levels showing the highest, lowest and average 24-hour average concentrations recorded over the past eleven years is shown below. The graph uses the second highest 24-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 4**  
**Sulfur Dioxide Concentrations in New Jersey**  
**1991 - 2001**  
**Second Highest Daily Averages**





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*SO<sub>2</sub> – 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>

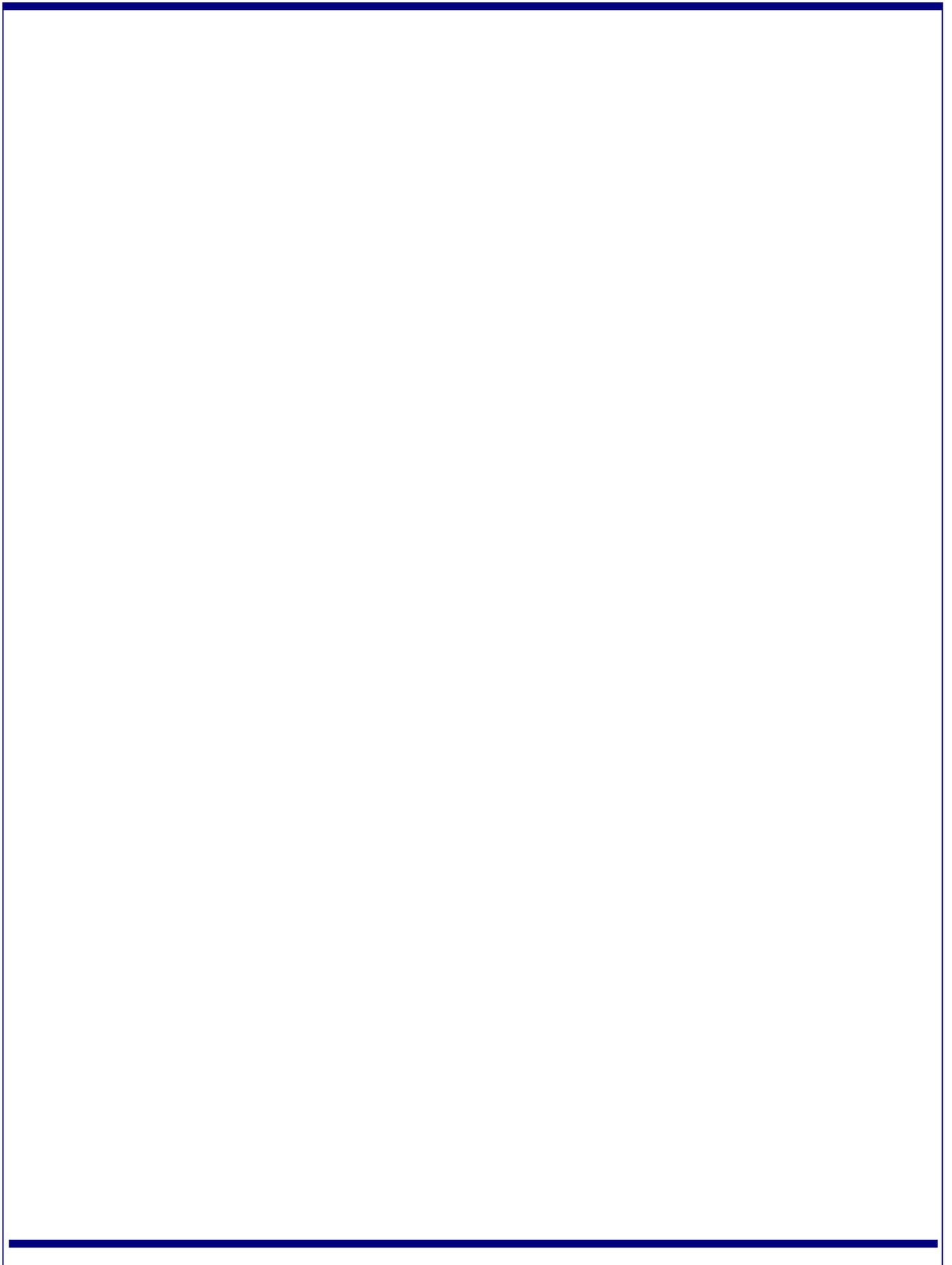
*Toxicological Profile for Sulfur Dioxide*, U.S. Dept. of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, 1998

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# 2001 Air Toxics Summary

New Jersey Department of Environmental Protection

## INTRODUCTION

Air pollutants can be divided into two categories. The six criteria pollutants (ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead), for which the USEPA has set National Ambient Air Quality Standards (NAAQS), and another larger group of pollutants, known as air toxics. The criteria pollutants have been addressed throughout the country using a standard planning process, and have nationally consistent monitoring and reporting requirements. Their control has been the focus of air pollution control efforts for many years, and there is a section on each of these pollutants in this report.

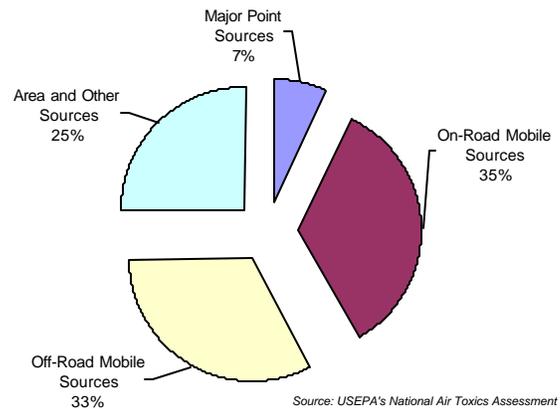
Air toxics are pollutants that can be emitted into the air in quantities that are large enough to cause adverse health effects. These effects cover a wide range of conditions from lung irritation to birth defects to cancer. There are no NAAQS for these pollutants, but in 1990 the U.S. Congress directed the USEPA to begin to address a list of almost 200 air toxics by developing control technology standards. This particular group of air toxics are known as the Hazardous Air Pollutants (HAPS). You can get more information about HAPs at the USEPA Air Toxics Website at [www.epa.gov/ttn/atw](http://www.epa.gov/ttn/atw). The NJDEP also has several web pages dedicated to air toxics. The pages can be accessed at [www.state.nj.us/dep/airmon/airtoxics](http://www.state.nj.us/dep/airmon/airtoxics).

## HEALTH AND ENVIRONMENTAL EFFECTS

People exposed to toxic air pollutants at sufficient concentrations and duration may have an increased chance of getting cancer or experiencing other serious health effects. These health effects can include damage to the immune system, as well as neurological, reproductive (e.g., reduced fertility), developmental, respiratory and other health problems. In addition to breathing air toxics, risks also are associated with the deposition of toxic pollutants onto soils or surface waters, where they are taken up by plants and ingested by animals. Like humans, animals may experience health problems if exposed to sufficient quantities of air toxics over time.

## SOURCES OF AIR TOXICS

**Figure 1**  
**1996 Air Toxics Emissions Estimates for New Jersey**



The USEPA conducted a national assessment of air toxics, originally based on 1990 emission estimates, and later revised the assessment with emissions estimates for 1996. The first effort was called the Cumulative Exposure Project or CEP and the second was termed the National-Scale Air Toxics Assessment (NATA). As part of these assessments, EPA prepared a comprehensive inventory of air toxics emissions for the entire country. The 1996 emissions inventory for New Jersey was briefly reviewed and revised by NJDEP before being finalized. Although there are bound to be some errors in the details of such a massive undertaking as this, a summary of the emissions inventory can give us some indication of what may be the most important sources of air toxic emissions in our state. As can be seen from the pie chart above (Figure 1), which is based on the 1996 estimates, mobile sources are the largest contributors to air toxics emissions in New Jersey. On-road mobile sources account for 35% of the emissions, and off-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) contribute 33%. Area sources represent 25% of the inventory (USEPA refers to this category as "Area and Other")

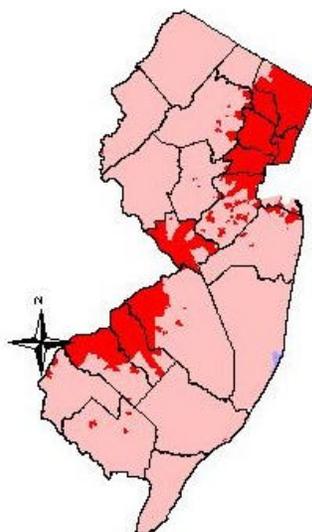
because it includes residential, commercial, and small industrial sources), and major point sources account for the remaining 7% of the inventory. Major point sources are defined by the Clean Air Act as facilities that emit more than 10 tons per year of a single hazardous air pollutant (HAP), or 25 tons per year of all HAPs combined.

## Nature of the Problem

Because of the number and diversity of toxic air pollutants, it is difficult to generalize about them as a class. Most air toxics, however, are associated with basic human activities. This can be seen by looking at the emissions estimates geographically. When the emissions estimates are broken down by county (see Figure 3), it is evident that the areas with higher air toxic emissions are generally those with higher population density. This is directly related to high levels of vehicle use, solvent use, and other population-related types of activities in those counties.

This pattern can also be seen in the estimates of ambient air toxics concentrations. The map above (Figure 2) shows the predicted concentrations of benzene throughout the state. Again the high concentration areas tend to overlap the more densely populated areas of the state. Not all air toxics will follow this pattern as some will tend to be more closely associated with individual point sources, but in general larger populations result in greater emissions of, and exposure to, air toxics.

**Figure 2**



**NATA PREDICTED CONCENTRATIONS IN NEW JERSEY FOR 1996**

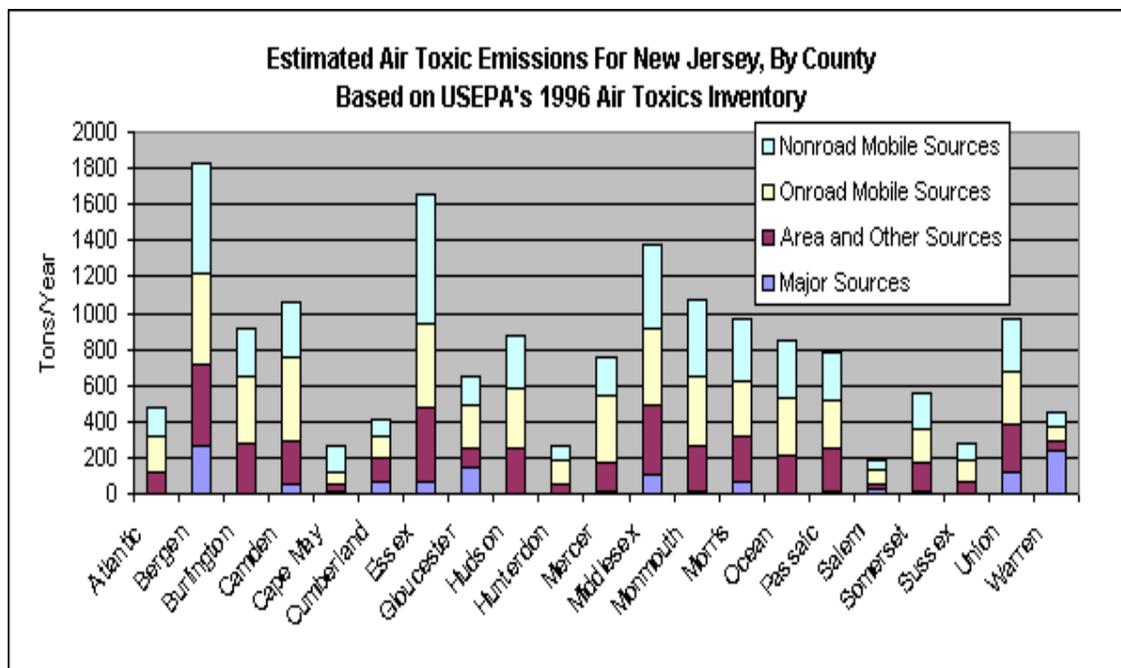
**Benzene**

- 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/m<sup>3</sup>

**Figure 3**



## AIR TOXICS OF CONCERN

Our preliminary analysis of the state and county average air toxics concentrations generated by NATA indicates that 19 of the chemicals were predicted to exceed their health benchmarks in one or more counties in 1996. 18 of these are cancer-causing (carcinogenic) chemicals, and one (acrolein) is not carcinogenic. Predicted concentrations of these 19 pollutants vary around the state, depending on the type of sources that emit them. This is summarized in Table 1 below.

**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
Perchloroethylene	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

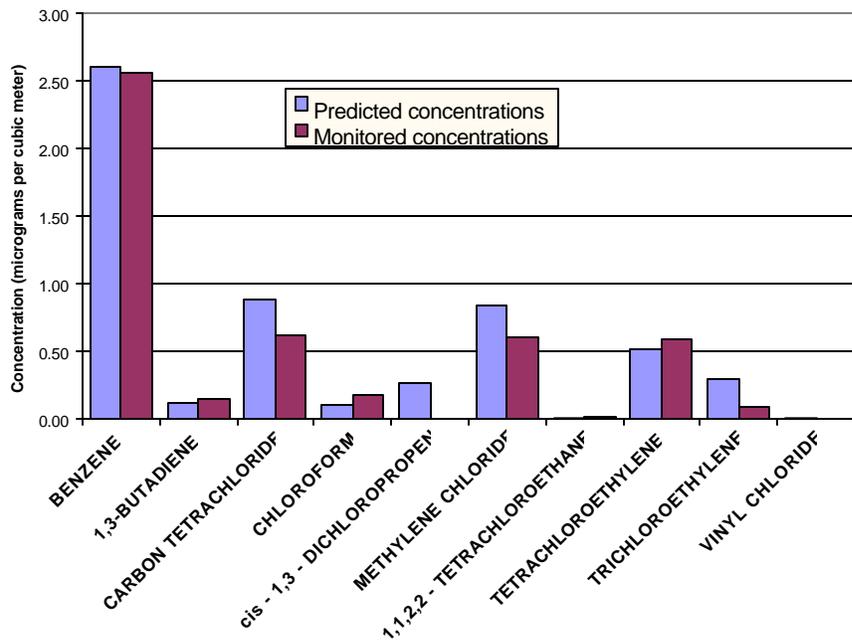
The NJDEP has established 4 comprehensive air toxics monitoring sites. They are located in Camden, Elizabeth, New Brunswick and Chester (see Figure 4). The Camden site has been measuring several toxic volatile organic compounds (VOCs) since 1989. The Elizabeth site began measuring VOCs in 2000, and the New Brunswick and Chester sites became operational in July 2001. In May 2001, analysis for toxic metals began at all 4 sites.

A direct comparison of the concentrations predicted by NATA and actual monitored levels can be made for the Camden site. Camden was operational in 1996, the year on which the NATA estimates are based, and 13 of the compounds evaluated in NATA were measured at the site. The following table compares the predictions and the actual measured concentrations (Table 2). Actual 2001 levels, and the amount they've changed since 1996 are also shown. Of the thirteen air toxics for which data were available, 2 of them fell below detection limits in 1996, so no measured level is reported that year. The comparison of some of the key compounds are shown in the graph to the right (Figure 5). It appears from this analysis that the agreement between predicted and monitored concentrations are remarkably good. (For the majority of these pollutants the predicted and observed values are within a factor of 2 of each other.) For most of the 13 toxics shown, the 2001 levels measured at Camden were substantially lower than the concentrations found in 1996.

**Figure 4  
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  
 $\mu\text{g}/\text{m}^3$  - Micrograms Per Cubic Meter

Pollutant (HAP)	NATA Predicted 1996, $\mu\text{g}/\text{m}^3$	Measured 1996 Level, $\mu\text{g}/\text{m}^3$	Measured 2001 Level, $\mu\text{g}/\text{m}^3$	Percent Change in Measured Levels
Acetaldehyde	1.74	4.53	1.92	-57.6
Acrylonitrile	0.003	NA	0.00**	NA
Benzene	2.61	2.57	1.78	-30.6
1,3-Butadiene	0.12	0.15	0.19	25.9
Carbon Tetrachloride	0.88	0.61	0.60	-2.0
Chloroform	0.10	0.18	0.02	-89.2
cis-1,3-Dichloropropene *	0.26	0.00**	0.00**	NA
Formaldehyde	2.20	14.63	3.37	-77.0
Methylene Chloride	0.83	0.61	0.65	7.5
1,1,2,2-Tetrachloroethane	0.00	0.01	0.00**	NA
Tetrachloroethylene	0.52	0.59	0.36	-39.3
Trichloroethylene	0.29	0.09	0.05	-41.1
Vinyl Chloride *	0.01	0.00**	0.00**	NA

\* Measurements for 1996 and 2001 were below detection limits.

\*\* Measurement fell below detection limits.

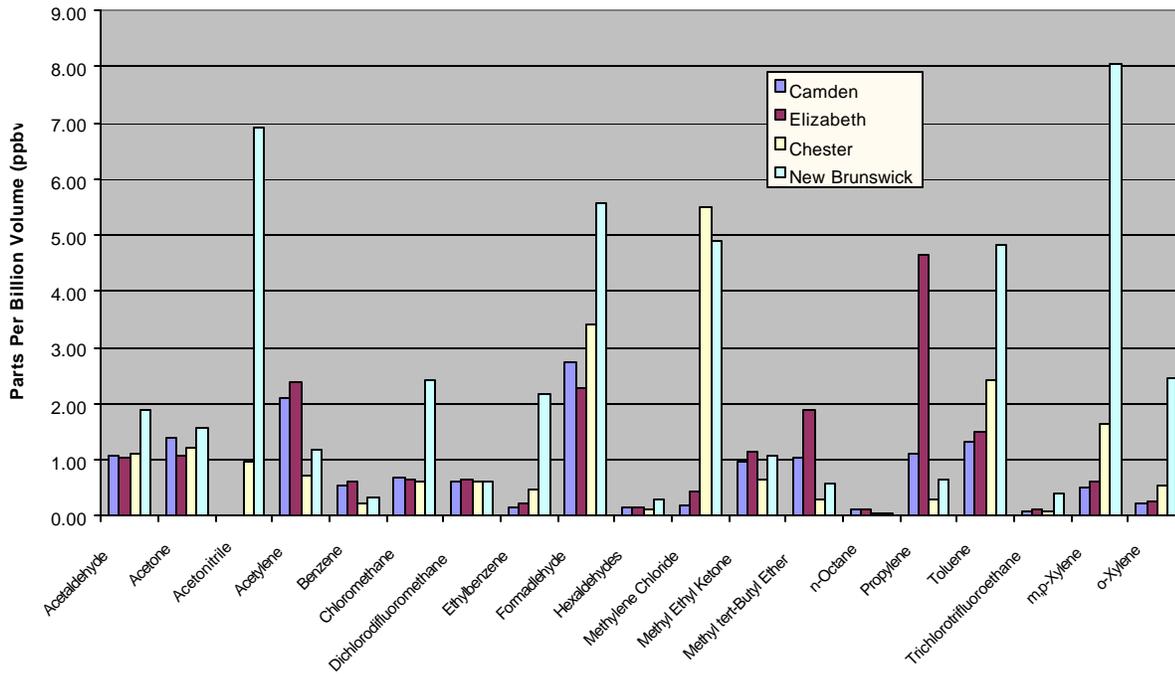
Negative values for percent change mean measured levels went down from 1996 to 2001.

## **AIR TOXICS MONITORING RESULTS FOR 2001**

The results of the air toxics monitoring program for 2001 are shown in Table 3 below. This table shows the average concentration for each air toxic measured at the four New Jersey sites. All values are in part per billion by volume (ppbv). More detailed tables (Tables 4-7) that show additional statistics, detection limit information, health benchmarks when they have been accepted by the NJDEP, and levels in both ppbv and micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) can be found at the end of this section. The ppbv units are more common for monitoring results while  $\mu\text{g}/\text{m}^3$  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. Values reported by the laboratory as “not detected” were averaged in

as zeros. Averages reported where 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 when the results are ranked) are reported along with the mean or 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. Note that the Chester and New Brunswick sites did not begin operation until May of 2001 so their average concentrations may not be strictly comparable to the data from Camden and Elizabeth.

**Figure 6**  
**Selected Toxic Volatile Organics**  
**2001 Annual Averages**  
**New Jersey**



**Table 3**  
**New Jersey Air Toxics Summary – 2001**

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

<b>Pollutant</b>	<b>Camden</b>	<b>Chester</b>	<b>Elizabeth</b>	<b>New Brunswick</b>
Acetaldehyde	1.07	1.15	1.05	1.89
Acetone	1.40	1.27	1.11	1.58
Acetonitrile	0.00	0.97	0.00	6.90
Acetylene	2.11	0.73	2.39	1.19
Acrylonitrile	0.01	0.00	0.00	0.00
tert-Amyl Methyl Ether	0.01	0.00	0.02	0.00
Benzaldehyde	0.06	0.03	0.04	0.06
Benzene	0.56	0.24	0.62	0.32
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	0.02	0.00	0.01	0.01
1,3-Butadiene	0.09	0.00	0.13	0.03
Butyr/Isobutyraldehyde	0.09	0.08	0.08	0.19
Carbon Tetrachloride	0.10	0.09	0.09	0.09
Chlorobenzene	0.00	0.00	0.00	0.00



**Table 3 (Continued)**  
**New Jersey Air Toxics Summary – 2001**

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

<b>Pollutant</b>	<b>Camden</b>	<b>Chester</b>	<b>Elizabeth</b>	<b>New Brunswick</b>
Chloroethane	0.01	0.00	0.00	0.00
Chloroform	0.00	0.00	0.01	0.02
Chloromethane	0.70	0.60	0.65	2.40
Chloromethylbenzene	0.00	0.00	0.00	0.00
Chloroprene	0.00	0.00	0.00	0.00
Crotonaldehyde	0.03	0.04	0.02	0.04
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	0.05	0.00	0.02	0.01
1,1-Dichloroethane	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.00	0.00	0.00	0.00
trans-1,2-Dichloroethylene	0.00	0.00	0.00	0.00
Dichlorodifluoromethane	0.63	0.60	0.66	0.60
1,2-Dichloroethane	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	0.01	0.00	0.01	0.01
Ethyl Acrylate	0.00	0.00	0.00	0.00
Ethylbenzene	0.17	0.47	0.21	2.16
Ethyl tert-Butyl Ether	0.00	0.00	0.00	0.00
Formaldehyde	2.75	3.52	2.31	5.55
Hexachloro-1,3-Butadiene	0.00	0.00	0.00	0.00
Hexaldehydes	0.17	0.14	0.14	0.28
Isovaleraldehyde	0.01	0.00	0.01	0.02
Methylene Chloride	0.19	5.48	0.44	4.90
Methyl Ethyl Ketone	0.98	0.65	1.16	1.09
Methyl Isobutyl Keytone	0.02	0.00	0.03	0.00
Methyl Methacrylate	0.01	0.00	0.00	0.00
Methyl tert-Butyl Ether	1.05	0.29	1.90	0.59
n-Octane	0.12	0.05	0.12	0.04
Propionaldehyde	0.07	0.07	0.09	0.20
Propylene	1.12	0.30	4.64	0.66
Styrene	0.04	0.01	0.03	0.04
1,1,2,2-Tetrachloroethane	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.05	0.01	0.06	0.04
Toluadehydes	0.05	0.03	0.04	0.06
Toluene	1.33	2.43	1.50	4.82
1,2,4-Trichlorobenzene	0.00	0.00	0.00	0.00

**Table 3 (Continued)**  
**New Jersey Air Toxics Summary – 2001**

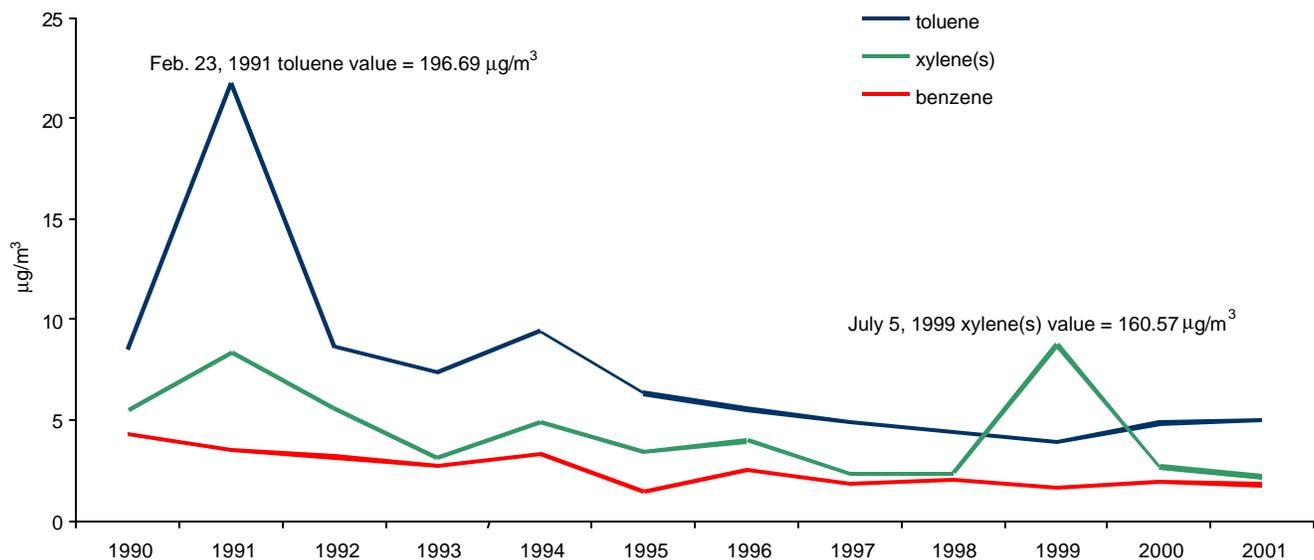
**Annual Average Concentration**  
**ppbv - Parts Per Billion by Volume**

<b>Pollutant</b>	<b>Camden</b>	<b>Chester</b>	<b>Elizabeth</b>	<b>New Brunswick</b>
1,1,1-Trichloroethane	0.04	0.03	0.04	0.04
1,1,2-Trichloroethane	0.00	0.00	0.00	0.00
Trichloroethylene	0.01	0.00	0.02	0.01
Trichlorofluoromethane	0.35	0.33	0.35	0.34
Trichlorotrifluoroethane	0.10	0.10	0.12	0.39
1,2,4-Trimethylbenzene	0.20	0.08	0.22	0.15
1,3,5-Trimethylbenzene	0.07	0.02	0.08	0.05
Valeraldehyde	0.02	0.02	0.02	0.09
Vinyl Chloride	0.00	0.00	0.00	0.00
m,p-Xylene	0.51	1.63	0.60	8.05
o-Xylene	0.23	0.55	0.27	2.45

## TRENDS

The site in Camden is the only monitoring location that has been measuring air toxics for an extended period. The graph below (Figure 7) shows the change in concentrations for three of the most prevalent air toxics (benzene, toluene and xylene) from 1990 to 2001. The graph shows that while average concentrations can vary significantly from year to year, the overall trend is downward. High individual samples may also result in high annual averages in some years. Concentrations of most air toxics have declined significantly over the last ten years. Because air toxics encompass such a large and diverse group of compounds, however, these general trends may not hold for pollutants in all areas of the state.

**Figure 7**  
**Annual Averages for Selected HAPS at Camden**



**Table 4  
Air Toxics Data – 2001  
Camden, New Jersey**

**µg/m<sup>3</sup> – Micrograms Per Cubic Meter  
ppbv – Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
<b>Acetaldehyde</b>	<b>0.005</b>	<b>100%</b>	<b>0.45</b>	<b>1.92</b>	<b>1.07</b>	<b>3.56</b>	<b>0.88</b>
Acetone	0.002	100%	30881	3.31	1.40	4.81	1.22
Acetonitrile	0.25	0%	60	0.00	0.00	0.00	0.00
Acetylene	0.13	100%		2.25	2.11	10.36	1.38
<b>Acrylonitrile</b>	<b>0.21</b>	<b>2%</b>	<b>0.015</b>	<b>0.02</b>	<b>0.01</b>	<b>0.35</b>	<b>0.00</b>
tert-Amyl Methyl Ether	0.12	4%		0.03	0.01	0.22	0.00
Benzaldehyde	0.003	98%		0.26	0.06	0.60	0.04
<b>Benzene</b>	<b>0.04</b>	<b>100%</b>	<b>0.13</b>	<b>1.78</b>	<b>0.56</b>	<b>2.53</b>	<b>0.39</b>
Bromochloromethane	0.12	0%		0.00	0.00	0.00	0.00
Bromodichloromethane	0.06	0%		0.00	0.00	0.00	0.00
Bromoform	0.08	0%	0.909	0.00	0.00	0.00	0.00
Bromomethane	0.09	18%	5	0.08	0.02	0.37	0.00
<b>1,3-Butadiene</b>	<b>0.07</b>	<b>69%</b>	<b>0.0036</b>	<b>0.19</b>	<b>0.09</b>	<b>0.59</b>	<b>0.06</b>
Butyr/Isobutyraldehyde	0.011	91%		0.26	0.09	0.81	0.08
<b>Carbon Tetrachloride</b>	<b>0.08</b>	<b>100%</b>	<b>0.067</b>	<b>0.60</b>	<b>0.10</b>	<b>0.14</b>	<b>0.10</b>
Chlorobenzene	0.06	0%	20	0.00	0.00	0.00	0.00
Chloroethane	0.08	2%	10000	0.02	0.01	0.26	0.00
Chloroform	0.05	9%	0.043	0.02	0.00	0.06	0.00
<b>Chloromethane</b>	<b>0.05</b>	<b>100%</b>	<b>0.556</b>	<b>1.42</b>	<b>0.70</b>	<b>1.11</b>	<b>0.69</b>
Chloromethylbenzene	0.07	0%		0.00	0.00	0.00	0.00
Chloroprene	0.1	0%	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	84%		0.09	0.03	0.20	0.02
Dibromochloromethane	0.08	0%		0.00	0.00	0.00	0.00
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0.00	0.00	0.00
m-Dichlorobenzene	0.05	0%		0.00	0.00	0.00	0.00
o-Dichlorobenzene	0.06	2%	200	0.00	0.00	0.03	0.00
<b>p-Dichlorobenzene</b>	<b>0.09</b>	<b>69%</b>	<b>0.091</b>	<b>0.30</b>	<b>0.05</b>	<b>0.32</b>	<b>0.04</b>
1,1-Dichloroethane	0.08	0%	500	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0%	0.02	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.1	0%		0.00	0.00	0.00	0.00
trans-1,2-Dichloroethylene	0.06	0%		0.00	0.00	0.00	0.00
Dichlorodifluoromethane	0.04	100%	200	3.10	0.63	0.92	0.60
1,2-Dichloroethane	0.06	0%	0.038	0.00	0.00	0.00	0.00
1,2-Dichloropropane	0.07	0%	0.056	0.00	0.00	0.00	0.00
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0.00	0.00	0.00
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0.00	0.00	0.00
Dichlorotetrafluoroethane	0.05	7%		0.01	0.00	0.02	0.00
2,5-Dimethylbenzaldehyde	0.004	34%		0.05	0.01	0.10	0.00
Ethyl Acrylate	0.16	0%	2	0.00	0.00	0.00	0.00

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

**µg/m<sup>3</sup> – Micrograms Per Cubic Meter**  
**ppbv – Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
Ethylbenzene	0.04	100%	1000	0.75	0.17	1.11	0.12
Ethyl tert-Butyl Ether	0.15	0%		0.00	0.00	0.00	0.00
<b>Formaldehyde</b>	<b>0.016</b>	<b>100%</b>	<b>0.77</b>	<b>3.37</b>	<b>2.75</b>	<b>13.86</b>	<b>2.11</b>
Hexachloro-1,3-Butadiene	0.06	0%	0.0455	0.00	0.00	0.00	0.00
Hexaldehydes	0.003	98%		0.68	0.17	0.95	0.03
Isovaleraldehyde	0.004	11%		0.04	0.01	0.18	0.00
Methylene Chloride	0.06	100%	2.1	0.65	0.19	0.66	0.13
Methyl Ethyl Ketone	0.15	93%	1000	2.88	0.98	7.20	0.78
Methyl Isobutyl Keytone	0.15	7%	80	0.07	0.02	0.41	0.00
Methyl Methacrylate	0.18	2%	700	0.04	0.01	0.46	0.00
Methyl tert-Butyl Ether	0.18	98%	3000	3.78	1.05	4.49	0.67
n-Octane	0.06	76%		0.56	0.12	1.15	0.08
Propionaldehyde	0.005	89%		0.16	0.07	0.18	0.06
Propylene	0.05	100%	3000	1.92	1.12	4.79	0.80
Styrene	0.07	47%	1.75	0.16	0.04	0.45	0.00
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0.00	0.00	0.00
<b>Tetrachloroethylene</b>	<b>0.06</b>	<b>67%</b>	<b>0.169</b>	<b>0.36</b>	<b>0.05</b>	<b>0.27</b>	<b>0.04</b>
Toluadehydes	0.009	93%		0.22	0.05	0.20	0.04
Toluene	0.06	100%	400	4.99	1.33	11.20	0.86
1,2,4-Trichlorobenzene	0.06	2%	200	0.02	0.00	0.12	0.00
1,1,1-Trichloroethane	0.06	91%	1000	0.22	0.04	0.13	0.04
1,1,2-Trichloroethane	0.06	0%	0.0625	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	18%	0.5	0.05	0.01	0.11	0.00
Trichlorofluoromethane	0.04	100%	700	1.95	0.35	1.40	0.32
Trichlorotrifluoroethane	0.07	100%		0.80	0.10	0.16	0.10
1,2,4-Trimethylbenzene	0.07	100%		0.97	0.20	1.23	0.14
1,3,5-Trimethylbenzene	0.07	98%		0.34	0.07	0.46	0.05
Valeraldehyde	0.005	73%		0.07	0.02	0.09	0.01
Vinyl Chloride	0.06	0%	0.11	0.00	0.00	0.00	0.00
m,p-Xylene	0.05	100%	700	2.19	0.51	3.21	0.34
o-Xylene	0.05	100%	700	1.00	0.23	1.33	0.16

**Table 5**  
**Air Toxics Data – 2001**  
**Chester, New Jersey**

**µg/m<sup>3</sup> – Micrograms Per Cubic Meter**  
**ppbv – Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
<b>Acetaldehyde</b>	<b>0.005</b>	<b>97%</b>	<b>0.45</b>	<b>2.07</b>	<b>1.15</b>	<b>2.54</b>	<b>1.03</b>
Acetone	0.002	97%	30881	3.02	1.27	2.58	1.19
Acetonitrile	0.25	19%	60	1.62	0.97	16.78	0.00
Acetylene	0.13	100%		0.78	0.73	2.44	0.64
Acrylonitrile	0.21	0%	0.015	0.00	0.00	0.00	0.00
tert-Amyl Methyl Ether	0.12	0%		0.00	0.00	0.00	0.00
Benzaldehyde	0.003	97%		0.13	0.03	0.07	0.03
<b>Benzene</b>	<b>0.04</b>	<b>100%</b>	<b>0.13</b>	<b>0.77</b>	<b>0.24</b>	<b>0.63</b>	<b>0.23</b>
Bromochloromethane	0.12	0%		0.00	0.00	0.00	0.00
Bromodichloromethane	0.06	0%		0.00	0.00	0.00	0.00
Bromoform	0.08	0%	0.909	0.00	0.00	0.00	0.00
Bromomethane	0.09	0%	5	0.00	0.00	0.00	0.00
<b>1,3-Butadiene</b>	<b>0.07</b>	<b>3%</b>	<b>0.0036</b>	<b>0.01</b>	<b>0.00</b>	<b>0.08</b>	<b>0.00</b>
Butyr/Isobutyraldehyde	0.011	94%		0.23	0.08	0.19	0.06
<b>Carbon Tetrachloride</b>	<b>0.08</b>	<b>100%</b>	<b>0.067</b>	<b>0.60</b>	<b>0.09</b>	<b>0.12</b>	<b>0.10</b>
Chlorobenzene	0.06	0%	20	0.00	0.00	0.00	0.00
Chloroethane	0.08	0%	10000	0.00	0.00	0.00	0.00
Chloroform	0.05	6%	0.043	0.01	0.00	0.03	0.00
<b>Chloromethane</b>	<b>0.05</b>	<b>100%</b>	<b>0.556</b>	<b>1.23</b>	<b>0.60</b>	<b>0.76</b>	<b>0.60</b>
Chloromethylbenzene	0.07	0%		0.00	0.00	0.00	0.00
Chloroprene	0.1	0%	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	58%		0.11	0.04	0.50	0.00
Dibromochloromethane	0.08	0%		0.00	0.00	0.00	0.00
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0.00	0.00	0.00
m-Dichlorobenzene	0.05	0%		0.00	0.00	0.00	0.00
o-Dichlorobenzene	0.06	0%	200	0.00	0.00	0.00	0.00
p-Dichlorobenzene	0.09	0%	0.091	0.00	0.00	0.00	0.00
1,1-Dichloroethane	0.08	0%	500	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0%	0.02	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.1	0%		0.00	0.00	0.00	0.00
trans-1,2-Dichloroethylene	0.06	0%		0.00	0.00	0.00	0.00
Dichlorodifluoromethane	0.04	100%	200	2.98	0.60	0.76	0.59
1,2-Dichloroethane	0.06	0%	0.038	0.00	0.00	0.00	0.00
1,2-Dichloropropane	0.07	0%	0.056	0.00	0.00	0.00	0.00
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0.00	0.00	0.00
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0.00	0.00	0.00
Dichlorotetrafluoroethane	0.05	6%		0.00	0.00	0.01	0.00
2,5-Dimethylbenzaldehyde	0.004	16%		0.02	0.00	0.04	0.00
Ethyl Acrylate	0.16	0%	2	0.00	0.00	0.00	0.00

**Table 5 – (Continued)  
Air Toxics Data – 2001  
Chester, New Jersey**

**µg/m<sup>3</sup> - Micrograms Per Cubic Meter  
ppbv - Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
Ethylbenzene	0.04	100%	1000	2.04	0.47	1.09	0.44
Ethyl tert-Butyl Ether	0.15	0%		0.00	0.00	0.00	0.00
<b>Formaldehyde</b>	<b>0.016</b>	<b>100%</b>	<b>0.77</b>	<b>4.32</b>	<b>3.52</b>	<b>8.23</b>	<b>3.33</b>
Hexachloro-1,3-Butadiene	0.06	0%	0.0455	0.00	0.00	0.00	0.00
Hexaldehydes	0.003	100%		0.55	0.14	0.69	0.09
Isovaleraldehyde	0.004	3%		0.00	0.00	0.00	0.00
<b>Methylene Chloride</b>	<b>0.06</b>	<b>100%</b>	<b>2.1</b>	<b>19.03</b>	<b>5.48</b>	<b>22.19</b>	<b>2.36</b>
Methyl Ethyl Ketone	0.15	88%	1000	1.92	0.65	1.51	0.66
Methyl Isobutyl Keytone	0.15	0%	80	0.00	0.00	0.00	0.00
Methyl Methacrylate	0.18	0%	700	0.00	0.00	0.00	0.00
Methyl tert-Butyl Ether	0.18	97%	3000	1.05	0.29	0.57	0.29
n-Octane	0.06	63%		0.23	0.05	0.31	0.04
Propionaldehyde	0.005	94%		0.17	0.07	0.17	0.07
Propylene	0.05	100%	3000	0.52	0.30	0.86	0.29
Styrene	0.07	9%	1.75	0.03	0.01	0.19	0.00
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.06	25%	0.169	0.06	0.01	0.07	0.00
Toluadehydes	0.009	84%		0.13	0.03	0.07	0.03
Toluene	0.06	100%	400	9.15	2.43	17.07	1.43
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.06	81%	1000	0.17	0.03	0.06	0.04
1,1,2-Trichloroethane	0.06	0%	0.0625	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	0%	0.5	0.00	0.00	0.00	0.00
Trichlorofluoromethane	0.04	100%	700	1.87	0.33	0.99	0.30
Trichlorotrifluoroethane	0.07	100%		0.79	0.10	0.15	0.09
1,2,4-Trimethylbenzene	0.07	97%		0.37	0.08	0.28	0.07
1,3,5-Trimethylbenzene	0.07	66%		0.11	0.02	0.15	0.02
Valeraldehyde	0.005	65%		0.06	0.02	0.17	0.01
Vinyl Chloride	0.06	0%	0.11	0.00	0.00	0.00	0.00
m,p-Xylene	0.05	100%	700	7.08	1.63	3.41	1.59
o-Xylene	0.05	100%	700	2.40	0.55	1.14	0.51

**Table 6  
Air Toxics Data – 2001  
Elizabeth, New Jersey**

**µg/m<sup>3</sup> – Micrograms Per Cubic Meter  
ppbv – Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
<b>Acetaldehyde</b>	<b>0.005</b>	<b>98%</b>	<b>0.45</b>	<b>1.89</b>	<b>1.05</b>	<b>2.84</b>	<b>1.00</b>
Acetone	0.002	98%	30881	2.62	1.11	2.41	1.10
Acetonitrile	0.25	0%	60	0.00	0.00	0.00	0.00
Acetylene	0.13	100%		2.55	2.39	7.89	1.98
Acrylonitrile	0.21	0%	0.015	0.00	0.00	0.00	0.00
tert-Amyl Methyl Ether	0.12	13%		0.06	0.02	0.18	0.00
Benzaldehyde	0.003	100%		0.19	0.04	0.14	0.04
<b>Benzene</b>	<b>0.04</b>	<b>100%</b>	<b>0.13</b>	<b>1.97</b>	<b>0.62</b>	<b>1.56</b>	<b>0.55</b>
Bromochloromethane	0.12	0%		0.00	0.00	0.00	0.00
Bromodichloromethane	0.06	0%		0.00	0.00	0.00	0.00
Bromoform	0.08	0%	0.909	0.00	0.00	0.00	0.00
Bromomethane	0.09	6%	5	0.02	0.01	0.11	0.00
<b>1,3-Butadiene</b>	<b>0.07</b>	<b>90%</b>	<b>0.0036</b>	<b>0.28</b>	<b>0.13</b>	<b>0.47</b>	<b>0.13</b>
Butyr/Isobutyraldehyde	0.011	100%		0.24	0.08	0.16	0.08
<b>Carbon Tetrachloride</b>	<b>0.08</b>	<b>100%</b>	<b>0.067</b>	<b>0.56</b>	<b>0.09</b>	<b>0.12</b>	<b>0.09</b>
Chlorobenzene	0.06	0%	20	0.00	0.00	0.00	0.00
Chloroethane	0.08	2%	10000	0.00	0.00	0.09	0.00
Chloroform	0.05	17%	0.043	0.03	0.01	0.06	0.00
<b>Chloromethane</b>	<b>0.05</b>	<b>100%</b>	<b>0.556</b>	<b>1.32</b>	<b>0.65</b>	<b>1.05</b>	<b>0.66</b>
Chloromethylbenzene	0.07	0%		0.00	0.00	0.00	0.00
Chloroprene	0.1	0%	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	74%		0.06	0.02	0.11	0.01
Dibromochloromethane	0.08	0%		0.00	0.00	0.00	0.00
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0.00	0.00	0.00
m-Dichlorobenzene	0.05	0%		0.00	0.00	0.00	0.00
o-Dichlorobenzene	0.06	0%	200	0.00	0.00	0.00	0.00
<b>p-Dichlorobenzene</b>	<b>0.09</b>	<b>52%</b>	<b>0.091</b>	<b>0.13</b>	<b>0.02</b>	<b>0.12</b>	<b>0.01</b>
1,1-Dichloroethane	0.08	0%	500	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0%	0.02	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.1	0%		0.00	0.00	0.00	0.00
trans-1,2-Dichloroethylene	0.06	0%		0.00	0.00	0.00	0.00
Dichlorodifluoromethane	0.04	100%	200	3.28	0.66	1.06	0.65
1,2-Dichloroethane	0.06	0%	0.038	0.00	0.00	0.00	0.00
1,2-Dichloropropane	0.07	0%	0.056	0.00	0.00	0.00	0.00
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0.00	0.00	0.00
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0.00	0.00	0.00
Dichlorotetrafluoroethane	0.05	13%		0.01	0.00	0.02	0.00
2,5-Dimethylbenzaldehyde	0.004	23%		0.03	0.01	0.09	0.00
Ethyl Acrylate	0.16	0%	2	0.00	0.00	0.00	0.00

**Table 6 – (Continued)  
Air Toxics Data – 2001  
Elizabeth, New Jersey**

**µg/m<sup>3</sup> – Micrograms Per Cubic Meter  
ppbv – Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
Ethylbenzene	0.04	100%	1000	0.92	0.21	0.48	0.20
Ethyl tert-Butyl Ether	0.15	0%		0.00	0.00	0.00	0.00
<b>Formaldehyde</b>	<b>0.016</b>	<b>100%</b>	<b>0.77</b>	<b>2.84</b>	<b>2.31</b>	<b>5.75</b>	<b>2.01</b>
Hexachloro-1,3-Butadiene	0.06	0%	0.0455	0.00	0.00	0.00	0.00
Hexaldehydes	0.003	96%		0.57	0.14	0.79	0.03
Isovaleraldehyde	0.004	13%		0.03	0.01	0.15	0.00
Methylene Chloride	0.06	100%	2.1	1.54	0.44	1.92	0.36
Methyl Ethyl Ketone	0.15	96%	1000	3.41	1.16	4.69	1.00
Methyl Isobutyl Keytone	0.15	10%	80	0.13	0.03	0.48	0.00
Methyl Methacrylate	0.18	0%	700	0.00	0.00	0.00	0.00
Methyl tert-Butyl Ether	0.18	96%	3000	6.83	1.90	7.05	1.42
n-Octane	0.06	88%		0.55	0.12	0.31	0.11
Propionaldehyde	0.005	96%		0.21	0.09	0.30	0.07
Propylene	0.05	100%	3000	7.93	4.64	19.18	2.35
Styrene	0.07	56%	1.75	0.12	0.03	0.10	0.03
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0.00	0.00	0.00
<b>Tetrachloroethylene</b>	<b>0.06</b>	<b>67%</b>	<b>0.169</b>	<b>0.40</b>	<b>0.06</b>	<b>0.23</b>	<b>0.05</b>
Toluadehydes	0.009	98%		0.22	0.04	0.13	0.04
Toluene	0.06	100%	400	5.66	1.50	3.68	1.28
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.06	94%	1000	0.22	0.04	0.07	0.04
1,1,2-Trichloroethane	0.06	0%	0.0625	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	29%	0.5	0.09	0.02	0.12	0.00
Trichlorofluoromethane	0.04	98%	700	1.97	0.35	0.86	0.32
Trichlorotrifluoroethane	0.07	100%		0.89	0.12	0.53	0.10
1,2,4-Trimethylbenzene	0.07	98%		1.09	0.22	0.57	0.20
1,3,5-Trimethylbenzene	0.07	98%		0.39	0.08	0.21	0.07
Valeraldehyde	0.005	83%		0.07	0.02	0.11	0.01
Vinyl Chloride	0.06	0%	0.11	0.00	0.00	0.00	0.00
m,p-Xylene	0.05	100%	700	2.59	0.60	1.39	0.56
o-Xylene	0.05	98%	700	1.17	0.27	0.62	0.26



**Table 7**  
**Air Toxics Data – 2001**  
**New Brunswick, New Jersey**

**µg/m<sup>3</sup> – 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 <sup>3</sup>	Mean µg/m <sup>3</sup>	Mean ppbv	Max. ppbv	Median ppbv
<b>Acetaldehyde</b>	<b>0.005</b>	<b>100%</b>	<b>0.45</b>	<b>3.40</b>	<b>1.89</b>	<b>4.31</b>	<b>1.82</b>
Acetone	0.002	100%	30881	3.75	1.58	4.01	1.35
Acetonitrile	0.25	33%	60	11.52	6.90	183.61	0.00
Acetylene	0.13	100%		1.28	1.19	3.71	1.13
Acrylonitrile	0.21	0%	0.015	0.00	0.00	0.00	0.00
tert-Amyl Methyl Ether	0.12	0%		0.00	0.00	0.00	0.00
Benzaldehyde	0.003	97%		0.26	0.06	0.18	0.04
<b>Benzene</b>	<b>0.04</b>	<b>100%</b>	<b>0.13</b>	<b>1.02</b>	<b>0.32</b>	<b>0.67</b>	<b>0.31</b>
Bromochloromethane	0.12	0%		0.00	0.00	0.00	0.00
Bromodichloromethane	0.06	0%		0.00	0.00	0.00	0.00
Bromoform	0.08	0%	0.909	0.00	0.00	0.00	0.00
Bromomethane	0.09	11%	5	0.05	0.01	0.23	0.00
<b>1,3-Butadiene</b>	<b>0.07</b>	<b>50%</b>	<b>0.0036</b>	<b>0.06</b>	<b>0.03</b>	<b>0.13</b>	<b>0.01</b>
Butyr/Isobutyraldehyde	0.011	100%		0.57	0.19	0.38	0.19
<b>Carbon Tetrachloride</b>	<b>0.08</b>	<b>100%</b>	<b>0.067</b>	<b>0.58</b>	<b>0.09</b>	<b>0.12</b>	<b>0.09</b>
Chlorobenzene	0.06	0%	20	0.00	0.00	0.00	0.00
Chloroethane	0.08	0%	10000	0.00	0.00	0.00	0.00
<b>Chloroform</b>	<b>0.05</b>	<b>44%</b>	<b>0.043</b>	<b>0.11</b>	<b>0.02</b>	<b>0.08</b>	<b>0.00</b>
<b>Chloromethane</b>	<b>0.05</b>	<b>100%</b>	<b>0.556</b>	<b>4.90</b>	<b>2.40</b>	<b>66.00</b>	<b>0.59</b>
Chloromethylbenzene	0.07	0%		0.00	0.00	0.00	0.00
Chloroprene	0.1	0%	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	75%		0.11	0.04	0.24	0.01
Dibromochloromethane	0.08	0%		0.00	0.00	0.00	0.00
1,2-Dibromoethane	0.08	0%	0.0045	0.00	0.00	0.00	0.00
m-Dichlorobenzene	0.05	0%		0.00	0.00	0.00	0.00
o-Dichlorobenzene	0.06	0%	200	0.00	0.00	0.00	0.00
p-Dichlorobenzene	0.09	28%	0.091	0.05	0.01	0.05	0.00
1,1-Dichloroethane	0.08	0%	500	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0%	0.02	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.1	3%		0.02	0.00	0.17	0.00
trans-1,2-Dichloroethylene	0.06	0%		0.00	0.00	0.00	0.00
Dichlorodifluoromethane	0.04	100%	200	2.98	0.60	0.84	0.61
1,2-Dichloroethane	0.06	0%	0.038	0.00	0.00	0.00	0.00
1,2-Dichloropropane	0.07	0%	0.056	0.00	0.00	0.00	0.00
cis-1,3-Dichloropropene	0.1	0%	0.25	0.00	0.00	0.00	0.00
trans-1,3-Dichloropropene	0.11	0%	0.25	0.00	0.00	0.00	0.00
Dichlorotetrafluoroethane	0.05	3%		0.00	0.00	0.01	0.00
2,5-Dimethylbenzaldehyde	0.004	25%		0.04	0.01	0.09	0.00
Ethyl Acrylate	0.16	0%	2	0.00	0.00	0.00	0.00

**Table 7 – (Continued)  
Air Toxics Data – 2001  
New Brunswick, New Jersey**

**µg/m<sup>3</sup> – Micrograms Per Cubic Meter  
ppbv – Parts Per Billion by Volume**

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

<b>Pollutant</b>	<b>Detection Limit ppbv</b>	<b>% Detects</b>	<b>Benchmark µg/m<sup>3</sup></b>	<b>Mean µg/m<sup>3</sup></b>	<b>Mean ppbv</b>	<b>Max. ppbv</b>	<b>Median ppbv</b>
Ethylbenzene	0.04	100%	1000	9.37	2.16	8.34	1.68
Ethyl tert-Butyl Ether	0.15	0%		0.00	0.00	0.00	0.00
<b>Formaldehyde</b>	<b>0.016</b>	<b>100%</b>	<b>0.77</b>	<b>6.82</b>	<b>5.55</b>	<b>16.46</b>	<b>4.41</b>
Hexachloro-1,3-Butadiene	0.06	0%	0.0455	0.00	0.00	0.00	0.00
Hexaldehydes	0.003	100%		1.13	0.28	1.17	0.08
Isovaleraldehyde	0.004	39%		0.05	0.02	0.15	0.00
<b>Methylene Chloride</b>	<b>0.06</b>	<b>100%</b>	<b>2.1</b>	<b>17.01</b>	<b>4.90</b>	<b>41.18</b>	<b>1.05</b>
Methyl Ethyl Ketone	0.15	94%	1000	3.20	1.09	3.20	1.13
Methyl Isobutyl Keytone	0.15	3%	80	0.01	0.00	0.07	0.00
Methyl Methacrylate	0.18	0%	700	0.00	0.00	0.00	0.00
Methyl tert-Butyl Ether	0.18	86%	3000	2.13	0.59	1.92	0.46
n-Octane	0.06	56%		0.21	0.04	0.36	0.04
Propionaldehyde	0.005	100%		0.49	0.20	0.43	0.22
Propylene	0.05	100%	3000	1.13	0.66	1.74	0.59
Styrene	0.07	69%	1.75	0.19	0.04	0.11	0.04
1,1,2,2-Tetrachloroethane	0.06	0%	0.017	0.00	0.00	0.00	0.00
<b>Tetrachloroethylene</b>	<b>0.06</b>	<b>56%</b>	<b>0.169</b>	<b>0.26</b>	<b>0.04</b>	<b>0.17</b>	<b>0.03</b>
Toluadehydes	0.009	97%		0.28	0.06	0.32	0.04
Toluene	0.06	100%	400	18.14	4.82	19.37	3.54
1,2,4-Trichlorobenzene	0.06	0%	200	0.00	0.00	0.00	0.00
1,1,1-Trichloroethane	0.06	86%	1000	0.21	0.04	0.20	0.04
1,1,2-Trichloroethane	0.06	0%	0.0625	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	17%	0.5	0.06	0.01	0.13	0.00
Trichlorofluoromethane	0.04	100%	700	1.92	0.34	0.69	0.33
Trichlorotrifluoroethane	0.07	100%		2.97	0.39	10.08	0.10
1,2,4-Trimethylbenzene	0.07	100%		0.72	0.15	0.30	0.14
1,3,5-Trimethylbenzene	0.07	94%		0.25	0.05	0.09	0.05
Valeraldehyde	0.005	100%		0.32	0.09	0.19	0.09
Vinyl Chloride	0.06	0%	0.11	0.00	0.00	0.00	0.00
m,p-Xylene	0.05	100%	700	34.87	8.05	29.55	6.06
o-Xylene	0.05	100%	700	10.61	2.45	8.10	2.18



# 2001 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

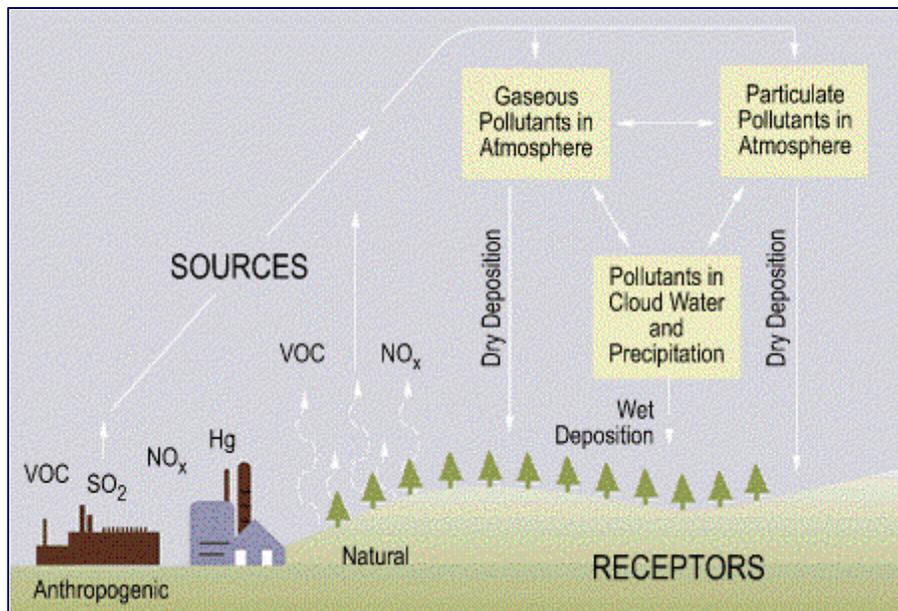
## Nature and Sources

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 absorbed by land or water bodies. Figure 1 below shows the basic mechanisms of deposition and also the major pollutants that are of concern. These include sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), mercury (Hg), and volatile organic compounds (VOCs). SO<sub>2</sub> 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<sub>x</sub> 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. 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

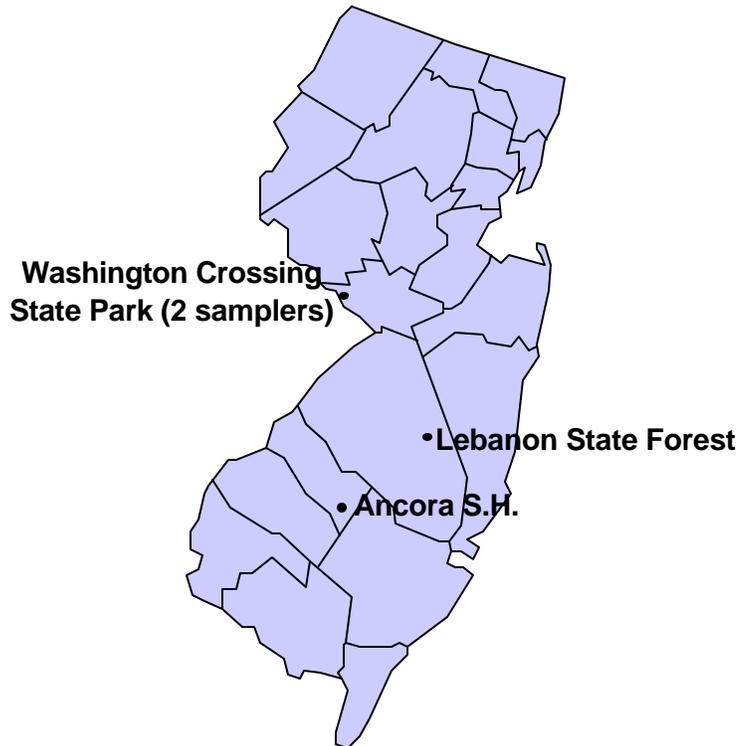
Web Site: <http://www.epa.gov/airmarkets/acidrain/index.html#what>

## MONITORING LOCATIONS

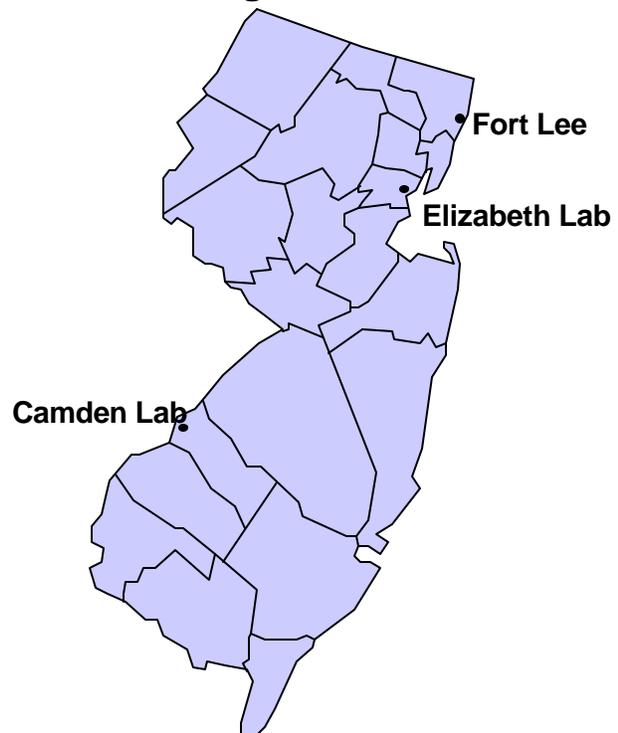
The state monitored wet deposition levels at 3 locations in 2001. These sites are shown in the map to the right. A sample is collected each week from all of the sites and after each significant rain event at the Washington Crossing State Park site. The Washington Crossing site is also part of the National 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 pH of lakes and streams. Nitrates can also add nutrients to water bodies and can eventually lead to eutrophication (excessive growth of plant life).

**Figure 2  
Acid Precipitation Monitoring  
Network - 2001**



**Figure 3  
Sulfates and Nitrates  
Monitoring Network - 2001**



## SUMMARY OF 2001 DATA

A summary of the 2001 wet deposition data is provided in Table 1. The table shows total deposition, 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 4.30. The Ancora State Hospital sampler recorded a mean pH of 4.31 and the Lebanon State Forest sampler recorded a mean pH of 4.41.

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 on 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 PM10 collected.

**Table 1**  
**Acid Precipitation Monitoring Network - 2001**  
**Annual and Seasonal Averages**  
Weighted by Precipitation Amount

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

### Ancora State Hospital – Weekly

	Precip. Inches	PH	Cond. us/cm	Ca <sup>2+</sup> mg/l	Mg <sup>+</sup> mg/l	K <sup>+</sup> mg/l	Na <sup>+</sup> mg/l	NH <sub>4</sub> <sup>-</sup> mg/l	NO <sub>3</sub> <sup>-</sup> mg/l	Cl <sup>-</sup> mg/l	SO <sub>4</sub> <sup>2-</sup> mg/l	PO <sub>4</sub> <sup>3-</sup> mg/l
Winter	9.25	4.52	18.6	0.049	0.026	0.017	0.192	0.163	1.309	0.376	1.294	<MDL
Spring	9.63	4.39	26.9	0.172	0.057	0.044	0.274	0.435	1.799	0.470	2.287	<MDL
Summer	10.05	4.09	47.9	0.183	0.053	0.174	0.141	0.701	2.967	0.399	4.003	<MDL
Fall	4.08	4.53	22.7	0.086	0.058	0.031	0.818	0.249	1.248	1.257	1.438	<MDL
Annual	33.01	4.31	30.4	0.130	0.047	0.075	0.277	0.417	1.950	0.519	2.427	<MDL

### Lebanon State Forest – Weekly

	Precip. Inches	PH	Cond. us/cm	Ca <sup>2+</sup> mg/l	Mg <sup>+</sup> mg/l	K <sup>+</sup> mg/l	Na <sup>+</sup> mg/l	NH <sub>4</sub> <sup>-</sup> mg/l	NO <sub>3</sub> <sup>-</sup> mg/l	Cl <sup>-</sup> mg/l	SO <sub>4</sub> <sup>2-</sup> mg/l	PO <sub>4</sub> <sup>3-</sup> mg/l
Winter	9.50	4.58	17.1	0.047	0.044	0.022	0.345	0.134	1.126	0.650	1.161	<MDL
Spring	10.77	4.51	19.6	0.112	0.036	0.031	0.207	0.269	1.335	0.361	1.558	<MDL
Summer	9.58	4.18	36.2	0.101	0.031	0.022	0.110	0.393	1.856	0.282	2.934	<MDL
Fall	4.56	4.62	15.8	0.067	0.036	0.026	0.227	0.154	1.016	0.416	1.134	<MDL
Annual	34.41	4.41	23.0	0.085	0.037	0.025	0.221	0.251	1.380	0.426	1.775	<MDL

**Table 1 (Continued)**  
**Acid Precipitation Monitoring Network – 2001**  
**Annual and Seasonal Averages**  
 Weighted by Precipitation Amount

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

**Washington Crossing State Park – Weekly**

	Precip. Inches	PH	Cond. us/cm	Ca <sup>2+</sup> mg/l	Mg <sup>+</sup> mg/l	K <sup>+</sup> mg/l	Na <sup>+</sup> mg/l	NH <sub>4</sub> <sup>-</sup> mg/l	NO <sub>3</sub> <sup>-</sup> mg/l	Cl <sup>-</sup> mg/l	SO <sub>4</sub> <sup>2-</sup> mg/l	PO <sub>4</sub> <sup>3-</sup> mg/l
Winter	9.53	4.48	19.3	0.065	0.023	0.008	0.156	0.115	1.267	0.307	1.222	<MDL
Spring	13.70	4.48	20.6	0.115	0.021	0.017	0.102	0.294	1.332	0.200	1.678	<MDL
Summer	11.12	4.05	50.0	0.165	0.029	0.010	0.035	0.535	3.033	0.167	5.067	<MDL
Fall	3.45	4.50	20.9	0.100	0.030	0.014	0.194	0.264	1.594	0.372	1.635	<MDL
Annual	37.80	4.30	29.0	0.112	0.024	0.013	0.109	0.299	1.742	0.237	2.355	<MDL

**Washington Crossing State Park – Event**

	Precip. Inches	PH	Cond. us/cm	Ca <sup>2+</sup> mg/l	Mg <sup>+</sup> mg/l	K <sup>+</sup> mg/l	Na <sup>+</sup> mg/l	NH <sub>4</sub> <sup>-</sup> mg/l	NO <sub>3</sub> <sup>-</sup> mg/l	Cl <sup>-</sup> mg/l	SO <sub>4</sub> <sup>2-</sup> mg/l	PO <sub>4</sub> <sup>3-</sup> mg/l
Winter	10.45	4.43	21.7	0.060	0.021	0.029	0.162	0.165	1.450	0.318	1.435	<MDL
Spring	11.89	4.43	23.8	0.129	0.028	0.031	0.121	0.432	1.602	0.252	1.988	<MDL
Summer	11.49	4.03	52.0	0.169	0.038	0.026	0.089	0.568	2.704	0.273	4.426	<MDL
Fall	3.67	4.47	22.9	0.147	0.047	0.039	0.260	0.330	1.702	0.471	1.675	<MDL
Annual	37.50	4.27	31.8	0.124	0.031	0.030	0.136	0.389	1.907	0.298	2.549	<MDL

**Table 2**  
**Acid Deposition Particulate Matter – 2001**  
 Micrograms per Cubic Meter

N – Number of samples  
 Min – Minimum  
 Max – Maximum

Sampling Location	Site No.	N	Particulates			Sulfates (SO <sub>4</sub> )			Nitrates (NO <sub>3</sub> )			SO <sub>4</sub> & NO <sub>3</sub> % of Particulates
			Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Camden Lab	IP02	59	25.9	4	64	4.92	0.75	24.21	0.38	0.01	1.35	20.5
Elizabeth Lab	IP28	60	32.2	6	80	4.81	0.48	24.28	0.77	0.07	4.72	17.3
Fort Lee	IP14	43	37.4	8	91	4.76	0.47	23.90	0.72	0.10	3.62	14.7

## TRENDS

Figure 3 shows the change in the amount of sulfate ion deposited over the last 12 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 3 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, 1990-2001:**  
**Annual Loading**

