



2003 Air Quality Report

New Jersey Department of Environmental Protection

SUMMARY

A summary of the New Jersey air quality monitoring data for 2003. 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.





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New Jersey Department of Environmental Protection

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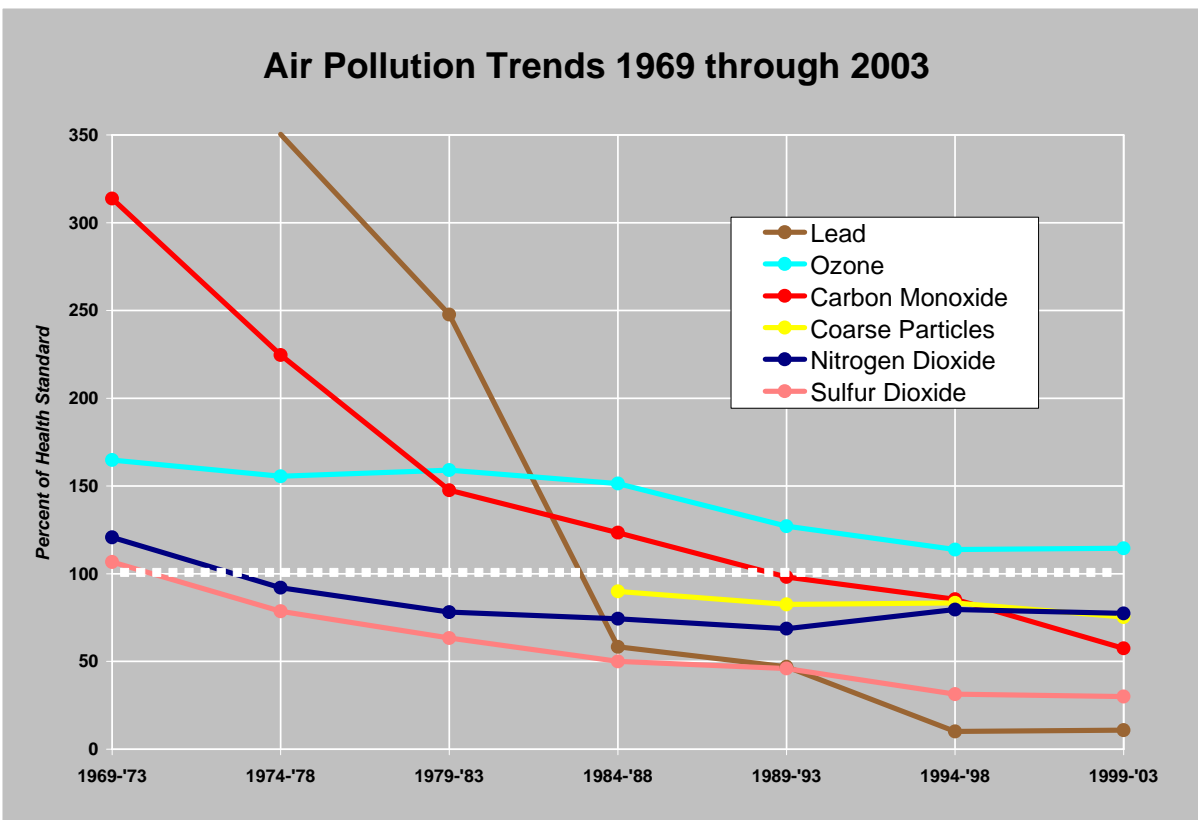


2003 Introduction

New Jersey Department of Environmental Protection

INTRODUCTION

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



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

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

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

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

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2003 Network Summary

New Jersey Department of Environmental Protection

NETWORK DESIGN

In 2003, the Bureau of Air Monitoring maintained 44 Ambient Air Monitoring Sites in New Jersey. These monitoring sites are designed to fulfill the following monitoring objectives for federal and state regulated pollutants: to measure maximum pollutant concentrations, to assess population exposure, to determine the impact of major pollution sources, to measure background levels, to determine the extent of regional pollutant transport, and to measure secondary impacts in rural areas. In addition, monitoring data are provided to various public and media outlets and are used to provide hourly updates on air quality to the Bureau's web page at www.state.nj.us/dep/airmon. The Air Monitoring Sites can be divided into two primary networks: the Continuous Monitoring Network and the Manual Sampling Network.

SPATIAL SCALES

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

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



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

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

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

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

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

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

THE CONTINUOUS MONITORING NETWORK

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

Figure 2
2003 – Continuous Monitoring Network

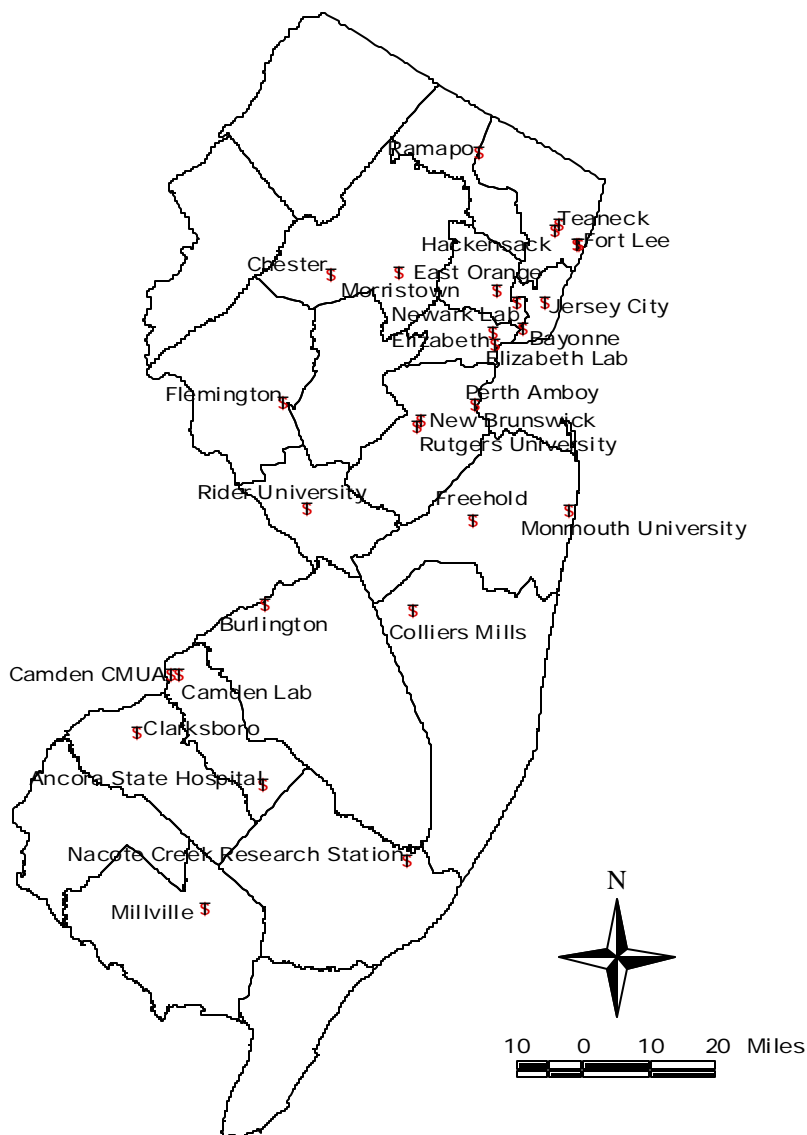


Table 1

2002-03' Continuous Network Changes			
Monitoring Site	Parameter(s)	Action	Date
Camden CMUA	TEOM	Start-up	11/20/03
¹ Camden Lab	CO,NO ₂ ,O ₃ ,SO ₂ , SS,TEOM,MET	Temporary shutdown	09/22/03
Middlesex	CO	Discontinued	01/31/02
² Newark Lab	CO,NO ₂ ,O ₃ ,SO ₂ , SS,TEOM	Temporary shutdown	06/04/03
North Bergen	CO	Discontinued	07/02/02
Somers Point	NO ₂ ,SO ₂	Discontinued	03/05/02

¹ The site was temporarily shutdown to replace the old monitoring shelter. (Photo of new trailer, figure 1)

² The area where the site was located is under redevelopment. The station is in the process of being relocated.

Table 2
2003 – Continuous Air Monitoring Network

Continuous Parameter Codes

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

SITE	CO	NO _x	O ₃	SO ₂	SS	TEOM	MET
Ancora State Hospital	U		U	U			
Bayonne		U	N	N			
Burlington	Mi			N	N		
Camden CMUA						N	
Camden Lab	N	N	U	N	N	N	U
Chester		U	U	U			U
Clarksboro			U	U			
Colliers Mills			U				
East Orange	N	N					U
Elizabeth	Mi			M	N		
Elizabeth Lab	N	N		N	N	N	U
Flemington			U		N		U
Fort Lee	M					M	
Freehold	Mi				N		
Hackensack	N			N	N		
Jersey City	Mi			N	N		
Millville		N	N	N			
Monmouth University			N				
Morristown	Mi				N		
Nacote Creek Research Station			U	U			
Newark Lab	N	N	N	N	N	N	
New Brunswick						N	
Perth Amboy	N			N	N		
Ramapo			U				
Rider University		N	N				U
Rutgers University		N	N				U
Teaneck		N	N				
TOTAL	13	10	15	14	11	6	7

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

MANUAL MONITORING NETWORK

The Manual Monitoring Network does not transmit data in near real-time as does the Continuous Monitoring Network. The manual network consists primarily of equipment that collects samples for subsequent analysis in a laboratory. The network provides data on fine particulates (particles smaller than 2.5 micrometers in diameter or $PM_{2.5}$), inhalable particulates (PM_{10}), lead (Pb), total suspended particulates (TSP), several parameters associated with atmospheric deposition, pollutants important in the formation of ground level ozone (ozone precursors), and numerous organic compounds that are considered toxic pollutants. Sites that measure ozone precursors are part of the national Photochemical Assessment Monitoring Station (PAMS) program. While some ozone precursors are automatically measured every hour, the data are usually only retrieved once a day. Changes to the Manual Network are summarized in Table 3. A map of the manual sampling sites is shown in Figure 3 and a list of the pollutants measured at each location is shown in Table 4 (page 5).

Figure 3
2003 – Manual Monitoring Network

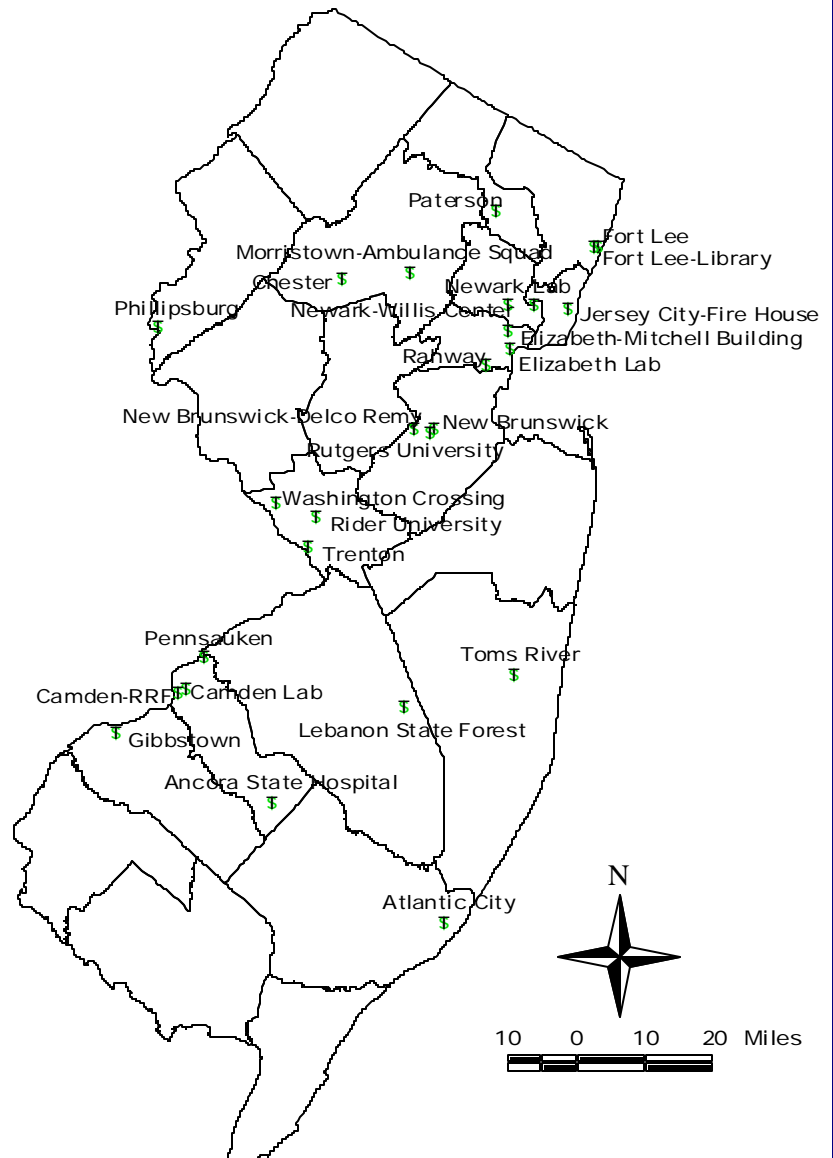


Table 3

2002-03' Manual Network Changes			
Monitoring Site	Parameter(s)	Action	Date
³ Camden Lab	$PM_{2.5}$, PM_{10}	Temporary shutdown	09/12/03
Elizabeth Lab	PM_{10}	Discontinued	12/16/02
⁴ Newark Lab	$PM_{2.5}$, PM_{10}	Temporary shutdown	06/04/03
Union City	$PM_{2.5}$	Discontinued	03/12/02

³ The site was temporarily shutdown to replace the old monitoring shelter. (Photo of new trailer, figure 1)

⁴ The area where the site was located is under redevelopment. The station is in the process of being relocated.

**Table 4
2003 - Manual Air Monitoring Network**

Manual Parameter Codes

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

SITE	PM _{2.5}	PM ₁₀	Pb	TSP	PM _{2.5} Spec	PAMS	CARB	VOCs	Acid Deposition	
									Dry	Wet
Ancora State Hospital										U
Atlantic City	N	N								
Camden Lab	N	N			N	N	N	N	N	
Camden-RRF		M								
Chester	U				U		U	U		
Elizabeth Lab	N				N		N	N		
Elizabeth-Mitchell Building	N									
Fort Lee		M							M	
Fort Lee-Library	N									
Gibbstown	N									
Jersey City-Firehouse	N	N								
Lebanon State Forest										U
Morristown-Ambulance Squad	N									
New Brunswick	N				N		N	N		
New Brunswick-Delco Remy			Mi	Mi						
Newark Lab	N	N								
Newark-Willis Center	N									
Paterson	N									
Pennsauken	N									
Phillipsburg	N									
Rahway	N									
Rider University						N				
Rutgers University						N				
Toms River	N									
Trenton	N	N								
Washington Crossing	N									U
TOTAL	19	7	1	1	4	3	4	4	2	3

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

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2003 Air Quality Index Summary

New Jersey Department of Environmental Protection

WHAT IS THE AIR QUALITY INDEX (AQI)?

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

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

Table 1
Air Quality Index

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

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

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

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

Figure 1
Air Quality Index Regions

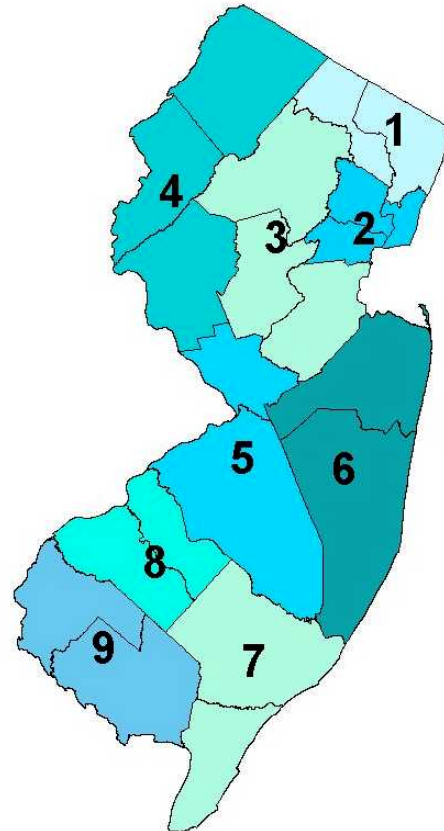


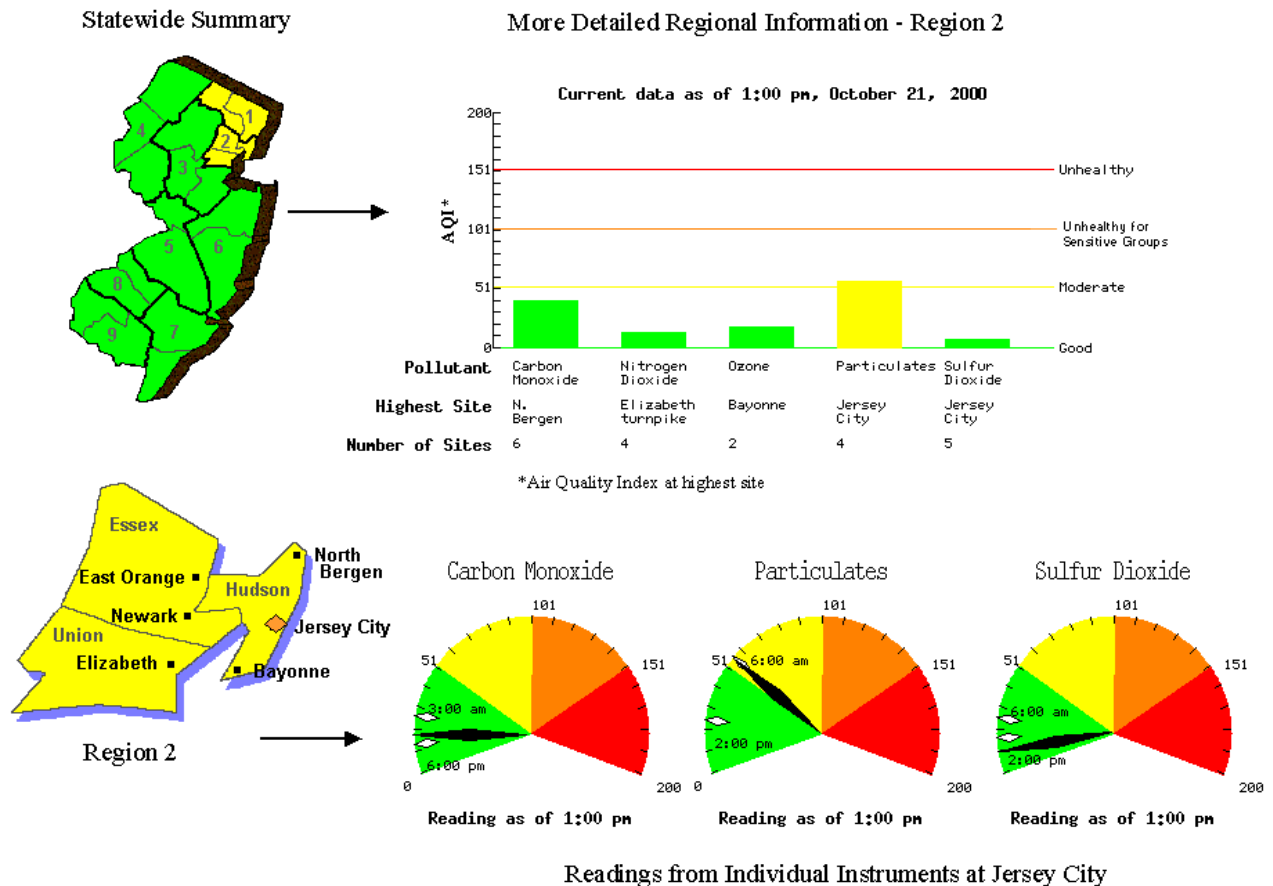
Table 2
Pollutants Monitored According to Air Quality Index Reporting Region - 2003

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

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

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

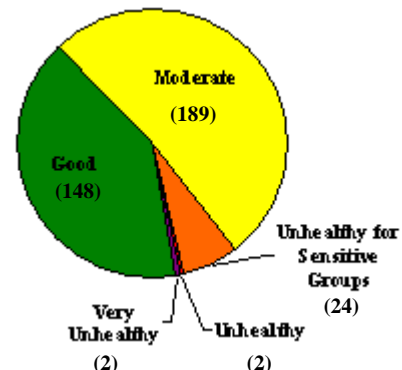
Figure 2
Examples of NJDEP's Air Monitoring Website



2003 AQI SUMMARY

A summary of the AQI ratings for New Jersey in 2003 is presented in the pie chart to the right. In 2003 there were 148 "Good" days, 189 were "Moderate", 24 were rated "Unhealthy for Sensitive Groups", 2 were considered "Unhealthy", and 2 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 thirteen. 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. Figure 4 shows the AQI ratings for the year broken down by AQI region.

Figure 3
Air Quality Summary by Days



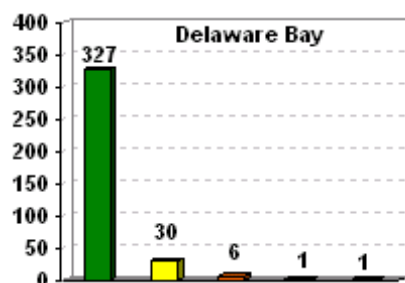
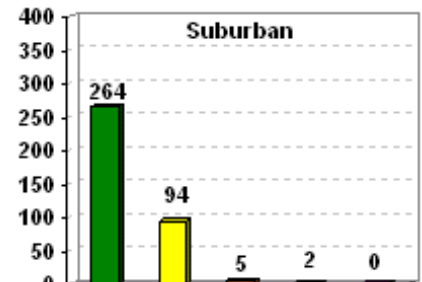
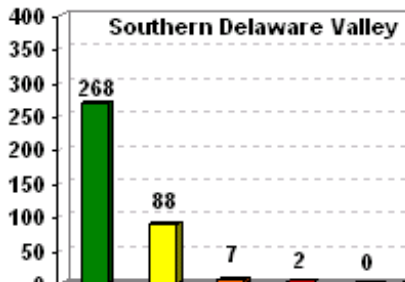
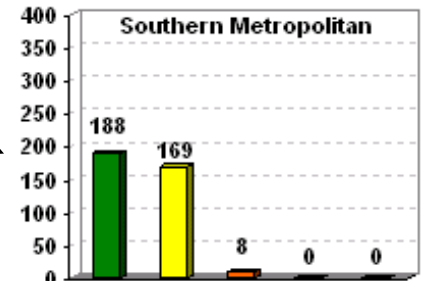
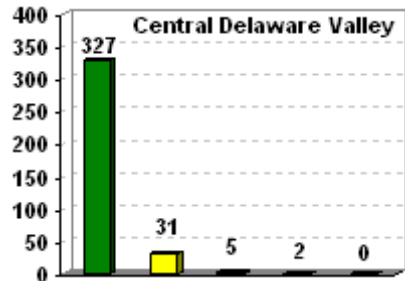
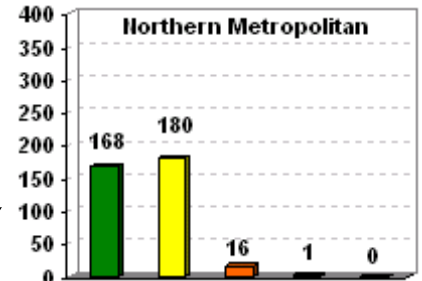
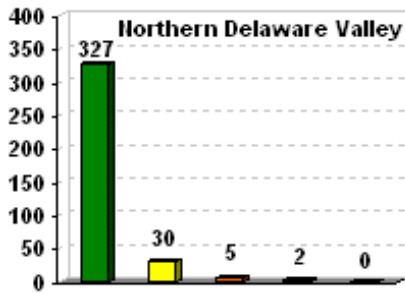
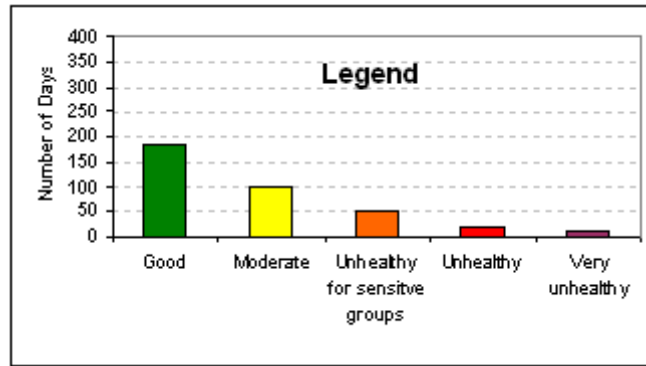
**Table 3
Air Quality Index (AQI) Exceedances of 100 During 2003**

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

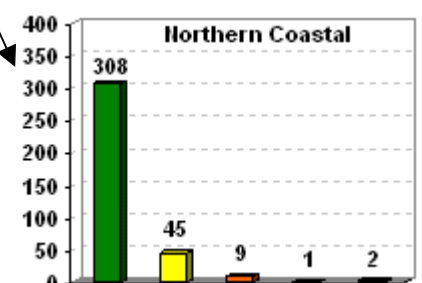
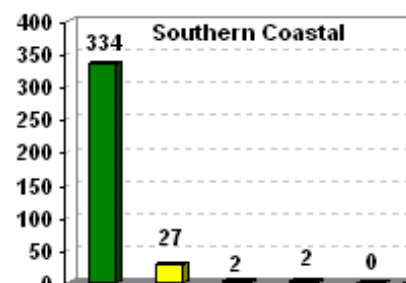
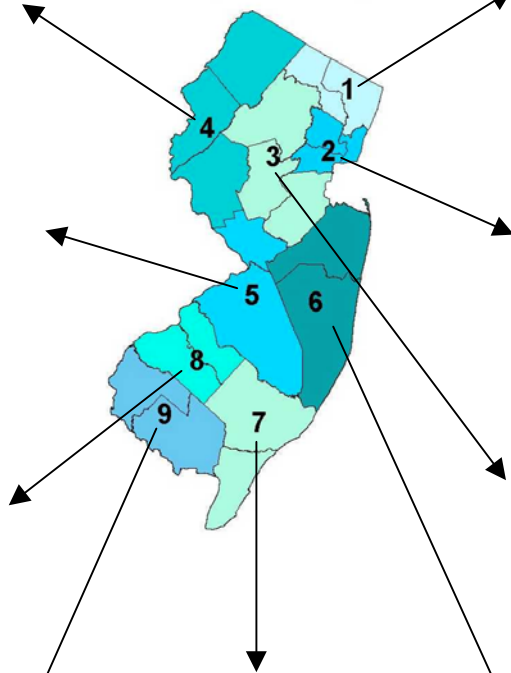
Date	Highest Location	Highest AQI Value	Highest Pollutant	Highest Rating	Pollutant(s) with AQI above 100 *	
April 16	Colliers Mills	109	O ₃	USG	O ₃ (6)	
June 11	Fort Lee	141	PM	USG	O ₃ (1)	PM(1)
June 12	Fort Lee	104	PM	USG		PM(1)
June 19	Fort Lee	118	PM	USG		PM(1)
June 23	Nacote Creek	101	O ₃	USG	O ₃ (1)	
June 24	Monmouth University	169	O ₃	UH	O ₃ (7)	
June 25	Monmouth University	203	O ₃	VUH	O ₃ (13)	
June 26	Ancora S.H.	203	O ₃	VUH	O ₃ (13)	PM(4)
June 27	Fort Lee	154	PM	UH	O ₃ (9)	PM(4)
June 28	Rutgers University	101	O ₃	USG	O ₃ (1)	
June 29	Flemington	104	O ₃	USG	O ₃ (1)	
June 30	Ancora S.H.	114	O ₃	USG	O ₃ (1)	
July 01	Ancora S.H.	104	O ₃	USG	O ₃ (1)	
July 02	Flemington	122	O ₃	USG	O ₃ (5)	
July 04	Ancora S.H. / Clarksboro	132	O ₃	USG	O ₃ (11)	
July 05	Monmouth Univ. / Fort Lee	104	O ₃ /PM	USG	O ₃ (1)	PM(1)
July 15	Ramapo	101	O ₃	USG	O ₃ (1)	
July 27	Colliers Mills	109	O ₃	USG	O ₃ (2)	
August 13	Colliers Mills	114	PM	USG		PM(2)
August 15	Camden Lab	114	O ₃	USG	O ₃ (1)	
August 20	Camden Lab	129	O ₃	USG	O ₃ (1)	
August 21	Rider University	120	PM	USG		PM(1)
August 22	Ancora State Hospital	137	O ₃	USG	O ₃ (3)	PM(3)
August 25	Rider University	104	O ₃	USG	O ₃ (1)	
Oct. 09	Chester	130	PM	USG		PM(2)
Oct. 10	Colliers Mills	108	PM	USG		PM(2)
Nov. 03	Colliers Mills	108	PM	USG		PM(2)
Nov. 17	Chester	114	PM	USG		PM(1)

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

Figure 4
 2003 Air Quality Index Summary
 Number of Days by Reporting Region



Air Quality Index Regions



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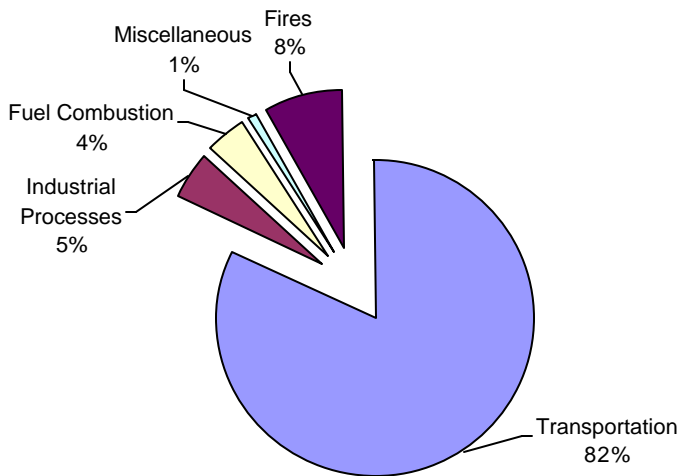
2003 Carbon Monoxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a by-product of motor vehicle exhaust, which contributes over 50 percent of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions, and high CO levels often coincide with morning and afternoon rush hours (Figure 3 on page 2). Non-road engines and vehicles, such as construction equipment and boats, are also significant sources of CO and overall the transportation sector is responsible for about 82% of all CO emissions nationally. Other sources of CO include industrial processes, fuel combustion in sources such as boilers and incinerators, and natural sources such as forest fires. Figure 1 shows the national average contributions of these sources.

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

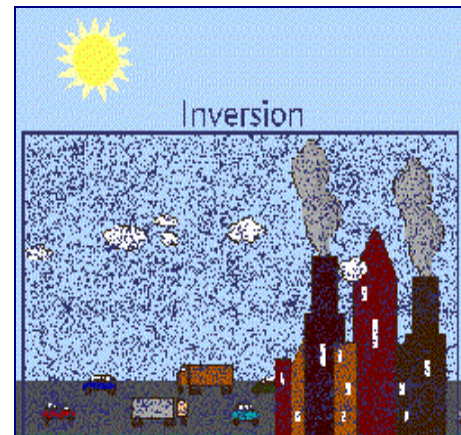
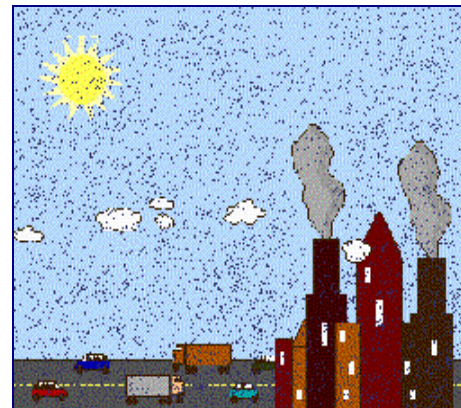


Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

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

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

Figure 2: Effect of Atmospheric Inversion on Air Pollution



HEALTH AND ENVIRONMENTAL EFFECTS

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

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

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

STANDARDS

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

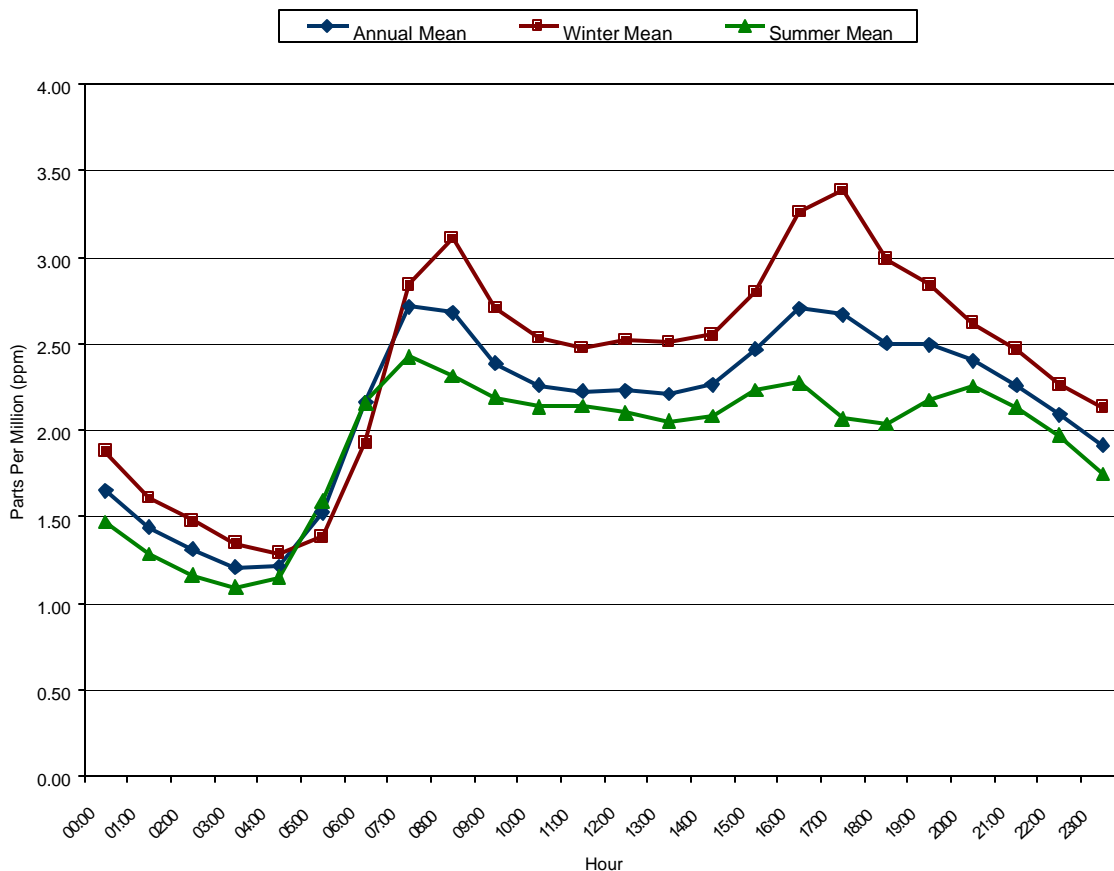
New Jersey state standards for CO are based on different units (milligrams per cubic meter as

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

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

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

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



MONITORING LOCATIONS

The state monitored CO levels at 13 locations in 2003. These sites are shown in the map in Figure 4. The site in Newark was shut down on June 5, 2003 when the location was selected for the construction of a new school building. The site in Camden was shut down on September 22, 2003 for renovations.

CO LEVELS IN 2003

None of the monitoring sites recorded exceedances of any CO standard during 2003. The maximum one-hour average concentration recorded was 9.5 ppm at the site in Hackensack. The highest 8-hour average level recorded was 4.3 ppm, at the East Orange site. Summaries of the 2003 data are provided in Figure 5 and Table 2 (page 4).

Figure 4
2003 Carbon Monoxide
Monitoring Network

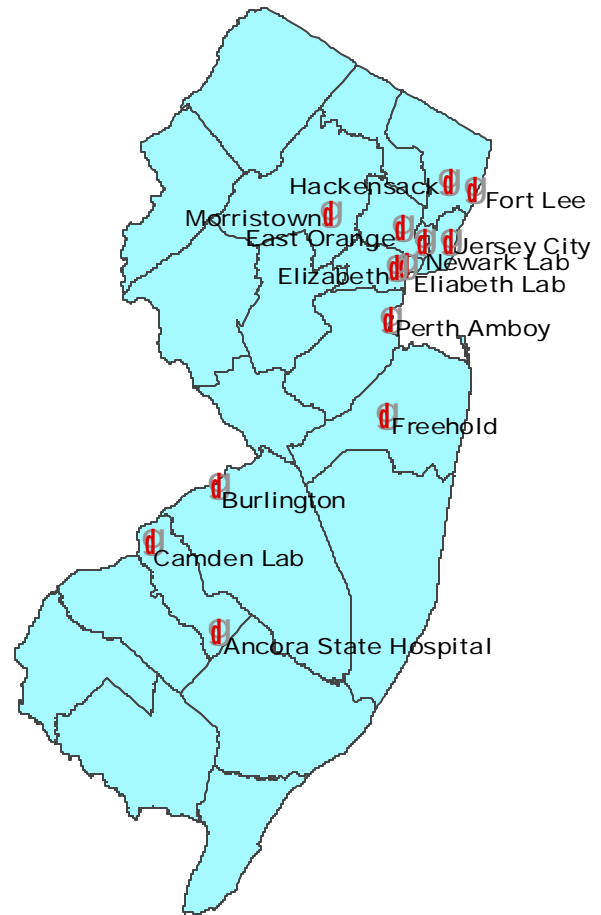
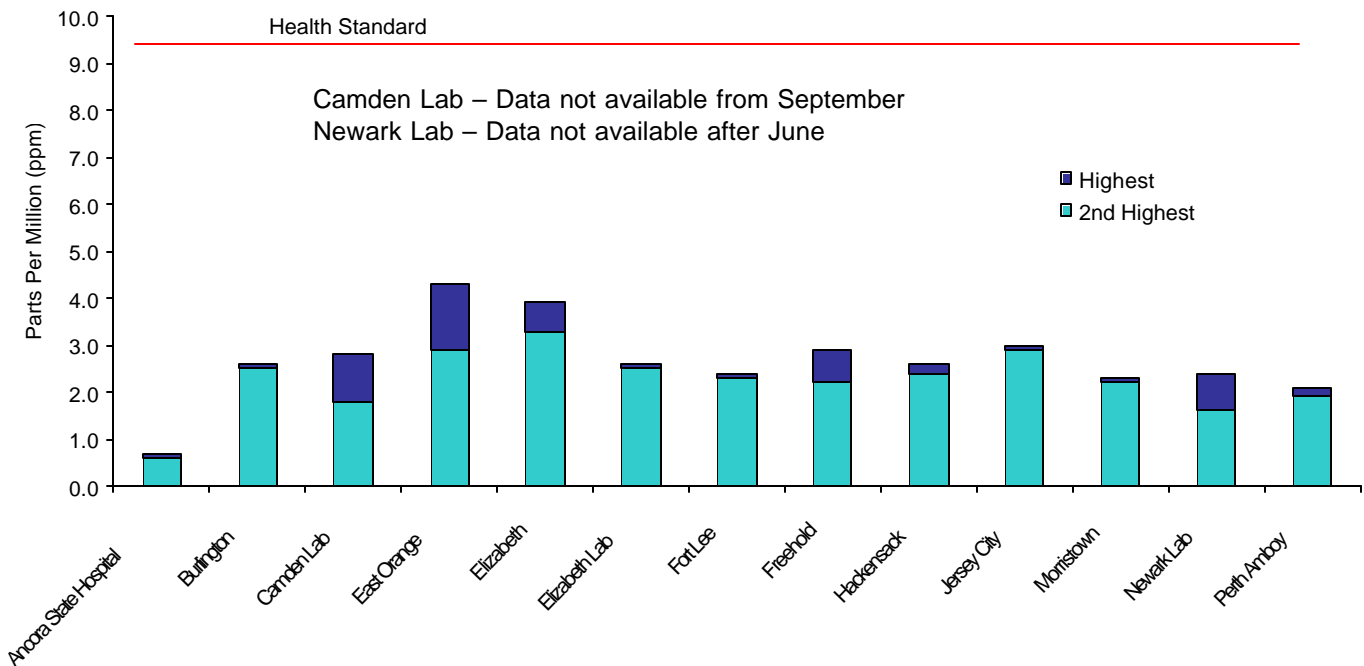


Figure 5
Highest and 2nd Highest 8-Hour Averages
of Carbon Monoxide in New Jersey - 2003



**Table 2
Carbon Monoxide Data – 2003
1-Hour and 8-Hour Averages**

Parts Per Million (ppm)
1-hour standard = 35 ppm
8-hour standard = 9 ppm

Monitoring Sites	Maximum 1-Hour Average	2nd Highest 1-Hour Average	Maximum 8-Hour Average	2nd Highest 8-Hour Average
Ancora State Hospital	1.1	1.1	0.7	0.6
Burlington	5.4	5.3	2.6	2.5
Camden Lab ^a	3.0	2.9	2.8	1.8
East Orange	6.5	5.8	4.3	2.9
Elizabeth	6.4	6.0	3.9	3.3
Elizabeth Lab	3.7	3.5	2.6	2.5
Fort Lee	3.8	2.7	2.4	2.3
Freehold	6.3	6.0	2.9	2.2
Hackensack	9.5	5.2	2.6	2.4
Jersey City	4.6	4.0	3.0	2.9
Morristown	4.5	3.6	2.3	2.2
Newark Lab ^b	3.3	3.0	2.4	1.6
Perth Amboy	3.7	3.7	2.1	1.9

^a Data not available after September

^b Data not available after June

Trends

Carbon monoxide levels have improved dramatically over the past 20 years. The last time the CO standard was exceeded in New Jersey was in January of 1995 (see Figure 6, page 5), and the entire state was officially declared as having attained the CO standard on August 23, 2002. At one time unhealthy levels of CO were recorded on a regular basis – as much as a hundred days a year at some sites. The reduction in CO levels is due primarily to cleaner running cars which are by far the largest source of this pollutant. A trend graph of CO levels showing the maximum, minimum and 2nd highest average 8-hour concentrations recorded since 1975 is provided in Figure 7 (page 5). The graph depicts the second highest 8-hour value recorded, as this is the value that determines if the health standard is being met (one exceedance per site is allowed each year).

Figure 6
Carbon Monoxide
Unhealthy Days 1985-2003

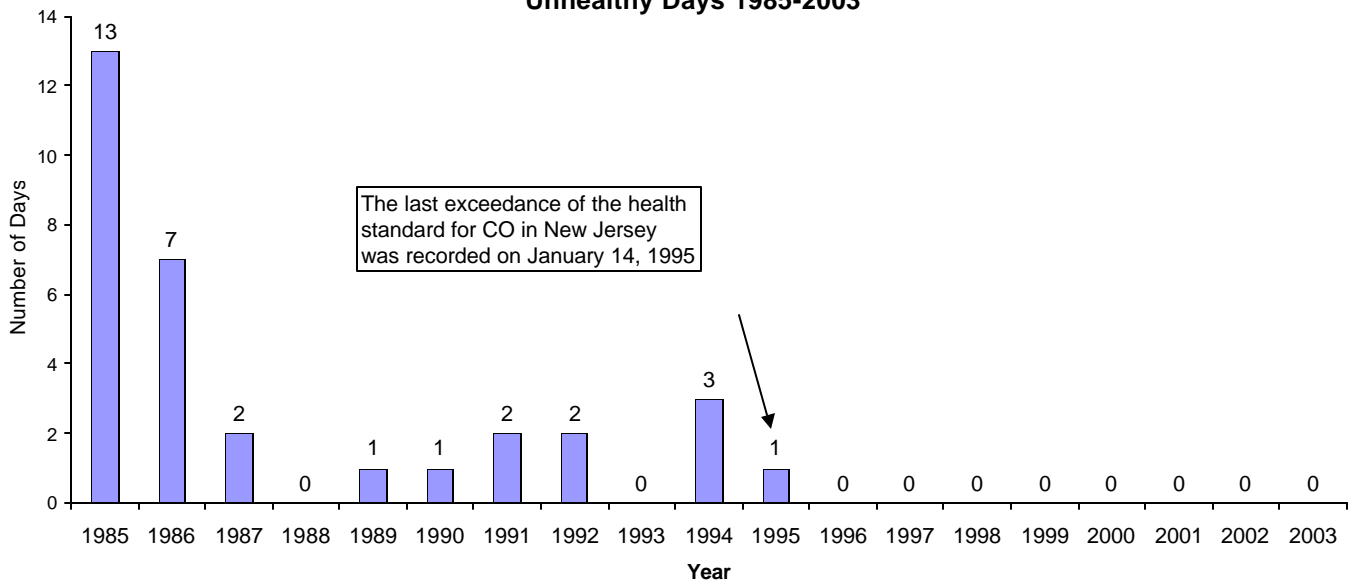
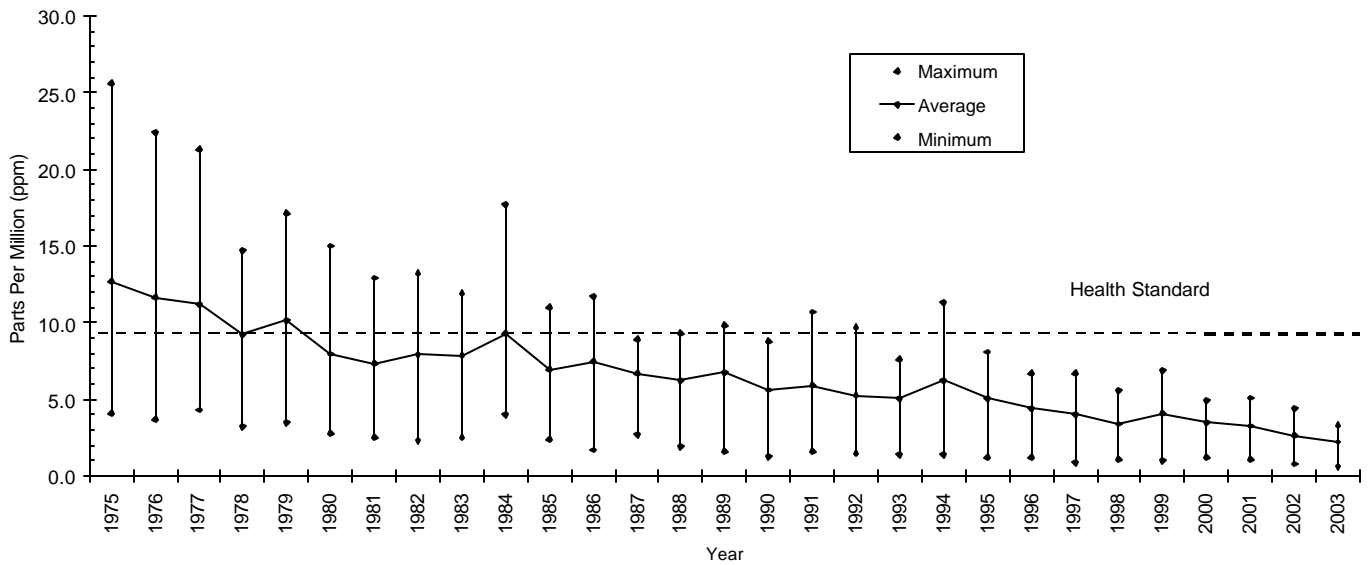


Figure 7
Carbon Monoxide Air Quality, 1975-2003
2nd Highest 8-Hour Average



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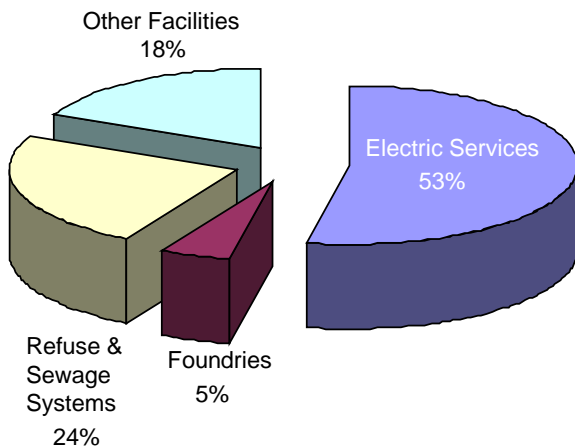
2003 Lead Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

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

Figure 1
New Jersey's Summary of 2003
Lead Emissions by Industrial Category



Source: NJDEP, Air Quality Planning Data 2003

HEALTH AND ENVIRONMENTAL EFFECTS

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

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

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

STANDARDS

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

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

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

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

MONITORING LOCATIONS

Lead concentrations in recent years have been so low that many of the monitoring sites have been discontinued. As a result, New Jersey monitored lead at only one location in 2003. This location, near a battery manufacturing plant in New Brunswick, is shown in the map in Figure 2.

LEAD LEVELS IN 2003

A summary of the lead levels monitored in 2003 is shown in Table 2 and Figure 3. No exceedances of the primary or secondary standards were recorded. The maximum 3-month average was 0.109 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), less than a tenth of the health standard.

Figure 2
2003 Lead
Monitoring Network

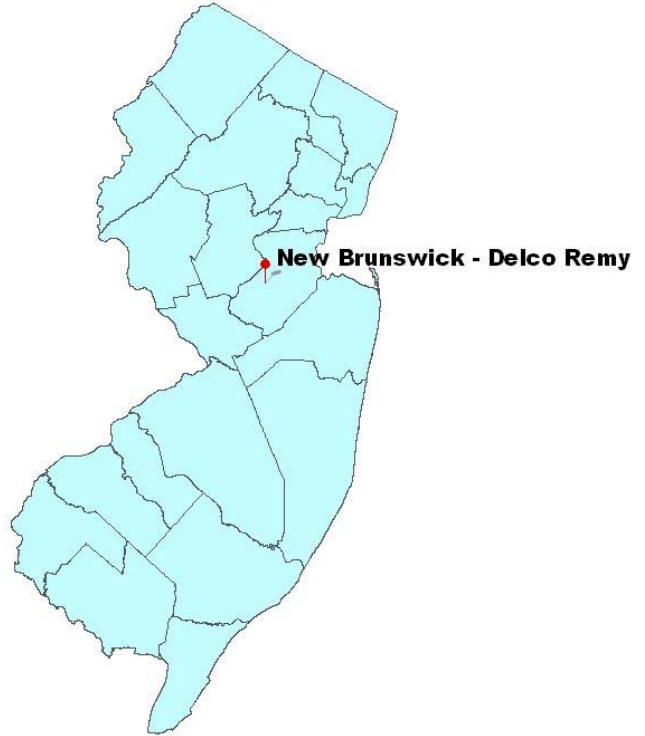
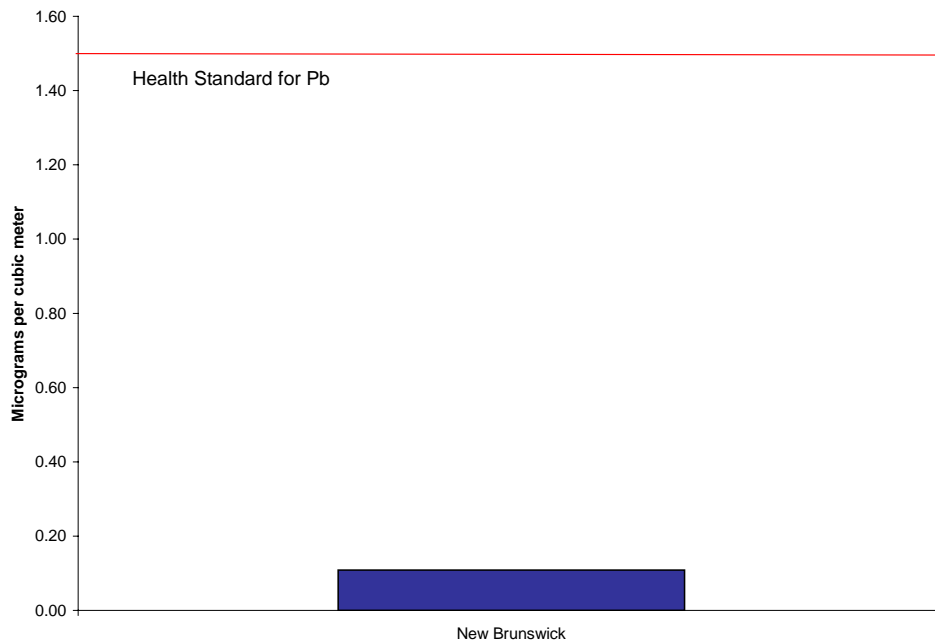


Figure 3

Maximum 3-Month Average Lead Concentrations in New Jersey
2003



**Table 2
Lead Data – 2003
3-Month and Calendar Quarter Averages**

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

Monitoring Site	3-Month Average $\mu\text{g}/\text{m}^3$		Calendar Quarter Averages $\mu\text{g}/\text{m}^3$			
	Maximum	Month ¹	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter
New Brunswick	.109	Jan.	.024	.016	.042	.019

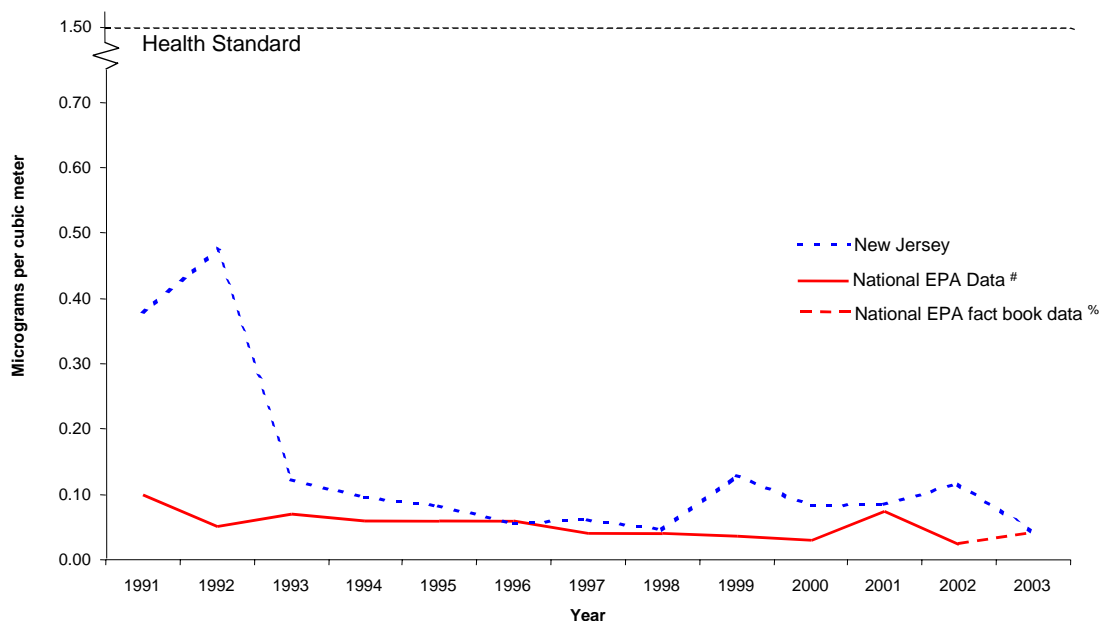
¹ The month indicates the last month in the 3-month period

TRENDS

The phase out of lead in gasoline has resulted in substantial improvements in air quality and lead levels in New Jersey are now well within the air quality standards. Below is a trend graph showing New Jersey's maximum quarterly average concentrations from 1991 to 2003, compared to EPA's 2002 national maximum quarterly average data and it's 2003 national county-wide fact book lead data. New Jersey's lead levels have decreased approximately 90% from 1991 to 2003, and the national trend concentrations have been consistently low over the same time span. New Jersey values in more

recent years are based on data from very few sites (only one site in 2003). While meeting the NAAQS for lead is no longer a major environmental issue in New Jersey, concern still exists over lead exposure via routes other than direct inhalation. Lead may have accumulated in the soil over time and children playing in such areas may ingest the lead directly.

**Figure 4
Lead Concentrations in New Jersey
1991 - 2003
Maximum Quarterly Average**



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

% Source: U.S. Environmental Protection Agency, 2003 Air Trends County Fact Book Report

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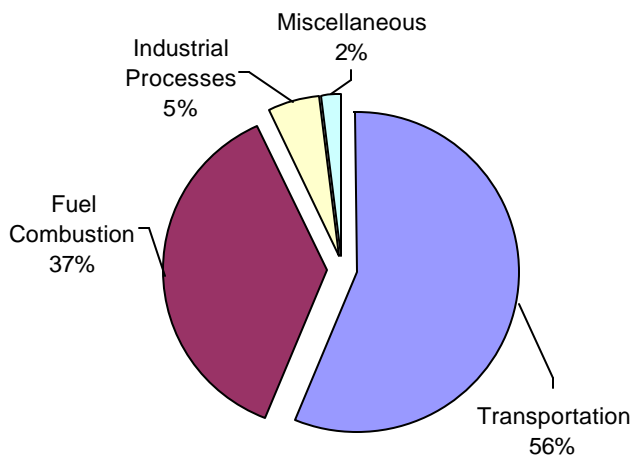
2003 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Nitrogen Dioxide (NO₂) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of Nitric Oxide (NO). When NO₂ reacts with chemicals that are common in the atmosphere in the presence of sunlight, it can result in the formation of ozone, particulate matter, haze and acid rain. Nitrogen Oxides (NO_x) is a mixture of gases which is mostly comprised of NO and NO₂. These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating, and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO₂ in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. A pie chart summarizing the major sources of NO_x is shown below (Figure 1). As much of the NO_x in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in the graph in Figure 2 (page 2), which also indicates that concentrations tend to be higher in the winter than the summer. This is due in part to poorer local dispersion conditions caused by light winds and other weather conditions that are more prevalent in the colder months of the year.

Figure 1
National Summary of 2002
NO_x Emissions by Source Category



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

HEALTH AND ENVIRONMENTAL EFFECTS

Short-term exposures (less than 3 hours) to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses, and can cause respiratory illnesses, particularly in children ages 5-12. Symptoms of low level exposure to NO_x include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO₂ may increase susceptibility to respiratory infection and may cause permanent damage to the lung. NO and NO₂ are found in tobacco smoke, so people who smoke or breathe in second-hand smoke may be exposed to NO_x. The U.S. Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the U.S. Environmental Protection Agency (EPA) have determined that, with the available information, no conclusion can be made as to the carcinogenicity of NO_x to human beings.

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

STANDARDS

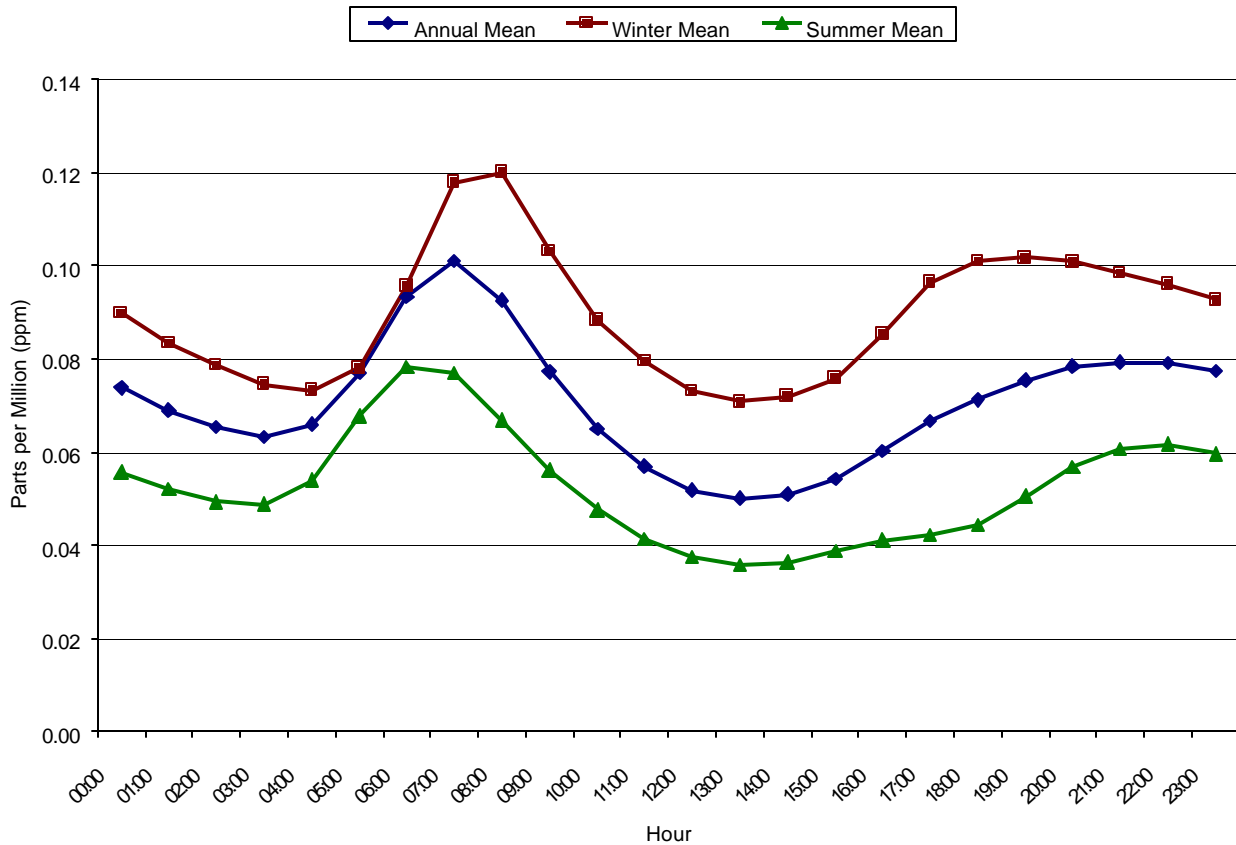
The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) for NO₂ are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except micrograms per cubic meter (µg/m³) 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 µg/m³ that New Jersey uses as a guideline in assessing short-term impacts from specific sources. Table 1 provides a summary of the NO₂ standards.

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

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

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

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



MONITORING LOCATIONS

The state monitored NO₂ levels at 10 locations in 2003. These sites are shown in the map to the right. The Newark Lab monitoring station was discontinued on June 5, 2003 and the Camden Lab monitoring station was temporarily discontinued on September 22. As a result, valid 2003 annual averages could not be calculated for these sites. The Camden Lab monitoring station resumed operation on January 8, 2004, and the DEP is continuing efforts to establish a station to replace the Newark Lab station.

NO₂ LEVELS IN 2003

None of the monitoring sites recorded exceedances of either the National or New Jersey Air Quality Standards for NO₂ during 2003. The maximum annual average concentration recorded was 0.032 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 2003 was 0.050 ppm, also at the Exit 13 site (see Table 2 and Figure 4, page 4),

Figure 3
2003 Oxides of Nitrogen
Monitoring Network

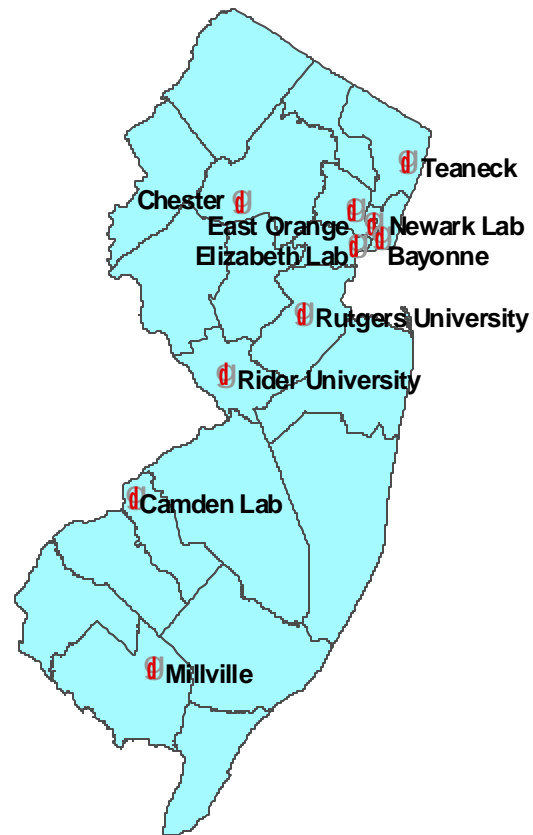


Table 2
Nitrogen Dioxide and Nitric Oxide Data-2003
1-Hour and 12-Month Averages

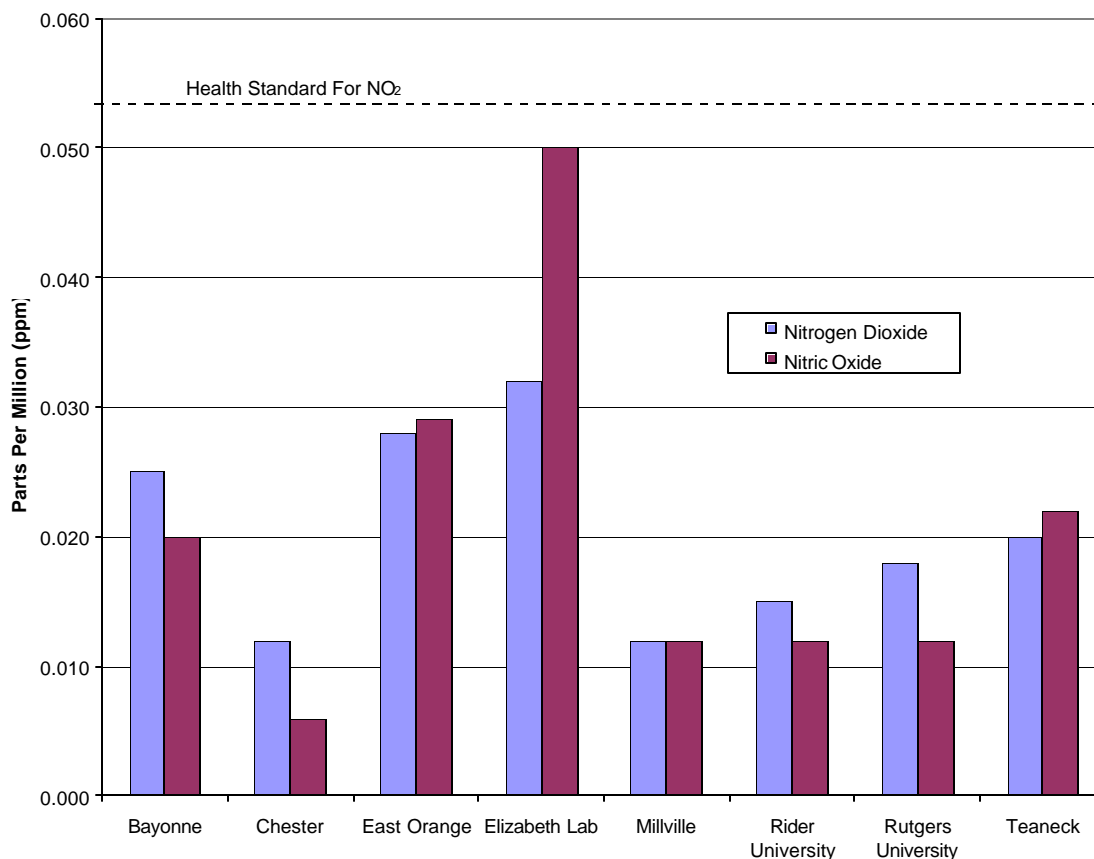
Parts Per Million (ppm)
California 1-Hour Standard = 0.25 ppm
National 12-Month Standard = 0.053 ppm

Monitoring Sites	Nitrogen Dioxide 1-Hour Average (ppm)		Nitrogen Dioxide 12-Month Average (ppm)		Nitric Oxides Annual Average(ppm)
	Maximum	2nd Highest	Maximum	Calendar year	
Bayonne	0.138	0.101	0.026	0.025	0.020
Camden Lab ^a	0.078	0.076	0.022	----	----
Chester	0.058	0.057	0.013	0.012	0.006
East Orange	0.093	0.091	0.028	0.028	0.029
Elizabeth Lab	0.092	0.088	0.039	0.032	0.050
Millville	0.054	0.050	0.014	0.012	0.012
Newark Lab ^b	0.084	0.080	0.029	----	----
Rider University	0.064	0.060	0.017	0.015	0.012
Rutgers University	0.091	0.090	0.018	0.018	0.012
Teaneck	0.124	0.119	0.021	0.020	0.022

^aData not available after September

^bData not available after June

Figure 4
Annual Average NO and NO₂ Concentrations
in New Jersey - 2003



TRENDS

NO₂ concentrations have not posed a significant direct health problem in New Jersey. A graph of NO₂ levels provided in Figure 5 shows the statewide average annual mean concentrations recorded from 1975 to 2003 in the form of a trendline. The graph also includes the levels of the sites that measured the highest annual mean and lowest annual mean in each year as points above and below this trendline. Although NO₂ concentrations are well within the NAAQS, there is still a great deal of interest in oxides of nitrogen because of their role in the formation of other pollutants – most notably ozone and fine particles. Both these pollutants are of concern over much of the northeastern United States and efforts to reduce levels of ozone and fine particles are likely to require reductions in NO emissions.

TOTAL REACTIVE OXIDES OF NITROGEN (NO_y)

Although not specifically defined, there is a broad group of nitroxy compounds in the ambient air that react in the troposphere and contribute to the formation of ozone. These compounds, called Total Reactive Oxides of Nitrogen (NO_y), include nitrogen oxides (NO_x), peroxyacyl nitrates (RC(O)OONO₂ or PAN), peroxy nitric acid (HO₂NO₂), nitrous acid (HONO), nitric acid (HNO₃), dinitrogen pentoxide (N₂O₅) and nitrate radicals (·NO₃). NO_y can also be described as the sum of the nitrogen oxides (NO_x) and the atmospheric NO_x oxidation products. Although measuring NO_y is not required by the federal regulations, it is strongly recommended by the EPA to supplement the data collected by Photochemical Assessment Monitoring Stations (PAMS) Network. NO_y measurements may provide valuable information for evaluating chemical mechanisms in ozone (O₃)

prediction models, indicate NO and NO₂ emission trends, and assist in developing regional control strategies for O₃.

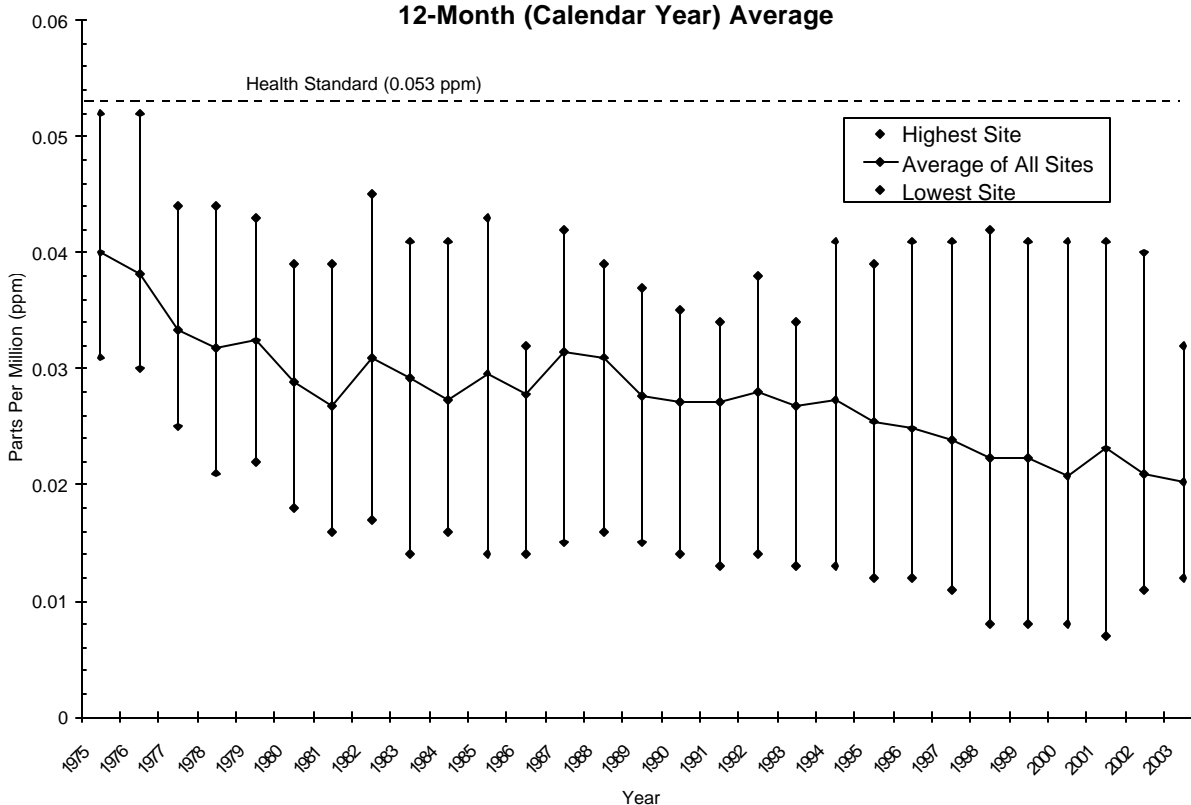
The identification and measurement of individual NO_y compounds is technically difficult and expensive, however, an analyzer that measures total NO_y concentrations is commercially available. The NJDEP began monitoring for NO_y at the Rider University station in March 2002. Nitrogen oxides (NO_x) and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

The monthly average NO_y concentrations for 2003 are presented in Table 3 along with the corresponding NO_x concentrations measured by the NO₂ analyzer at Rider University. The concentrations of NO_y closely match the NO_x concentrations, and both follow a trend where the highest concentrations are in the fall and winter months, and the lowest concentrations are in July and August. Poorer air dispersion conditions that are prevalent in the colder months are the cause for the seasonally higher concentrations of NO_x and NO_y.

Table 3
Nitrogen Oxides (NO_x) and
Total Reactive Oxides of Nitrogen (NO_y) Data
Rider University - 2003
Monthly Average

	Parts Per Million (ppm)	
	NO _x Monthly Average (ppm)	NO _y Monthly Average (ppm)
January	0.032	0.035
February	0.043	0.039
March	0.031	0.032
April	0.022	0.022
May	0.020	0.020
June	0.014	0.014
July	0.014	0.013
August	0.011	0.011
September	0.016	0.015
October	0.031	0.029
November	0.046	0.044
December	0.038	0.036

Figure 5
Nitrogen Dioxide Concentrations in New Jersey
1975-2003
12-Month (Calendar Year) Average



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2003 Ozone Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Ozone (O_3) is a gas consisting of three oxygen atoms. It occurs naturally in the upper atmosphere (stratospheric ozone) where it protects us from harmful ultraviolet rays (see Figure 1). However, at ground-level (tropospheric ozone) it is considered an air pollutant and can have serious adverse health effects. Ground-level ozone is created when nitrogen oxides (NO_x) and volatile organic compounds (VOC's) react in the presence of sunlight and heat. NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOC's are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. Ozone and the pollutants that form ozone (precursor pollutants) can also be transported into an area from sources hundreds of miles upwind.

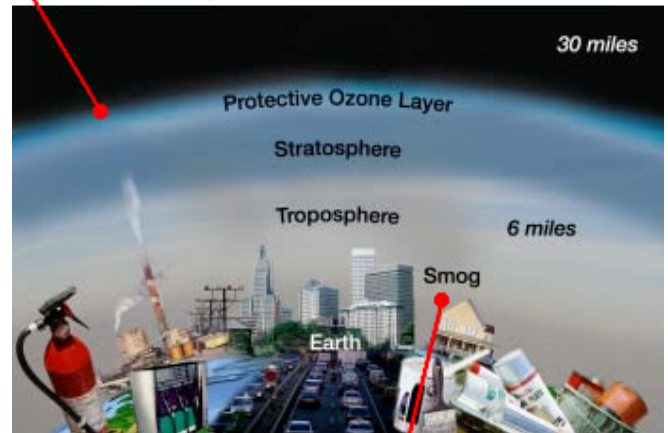
Since ground-level ozone needs sunlight to form, it is mainly a daytime problem during the summer months. Weather patterns have a significant effect on ozone formation and hot, dry summers will result in more ozone than cool, wet ones. In New Jersey, the ozone monitoring season runs from April 1st to October 31st, although unhealthy conditions are not common before mid-May or after the first few weeks of September. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the U.S. Environmental Protection Agency (EPA) publication "Ozone: Good Up High, Bad Nearby".

ENVIRONMENTAL EFFECTS

Ground-level ozone damages plant life and is responsible for 500 million dollars in reduced crop production in the United States each year². It interferes with the ability of plants to produce and store food, making them more susceptible to disease, insects, other pollutants, and harsh weather. "Bad" ozone damages the foliage of trees and other plants, sometimes marring the landscape of cities, national parks and forests, and recreation areas. The black areas on the leaves of the blackberry bush and sassafras tree shown in Figure 2 and Figure 3 is damage caused by exposure to ground-level ozone. (Figure 2 and 3 Photos by: Teague Prichard, Wisconsin Department of Natural Resources)

Figure 1: Good and Bad Ozone

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



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

Source: EPA

Figure 2: Ozone Damage to Blackberry Bush



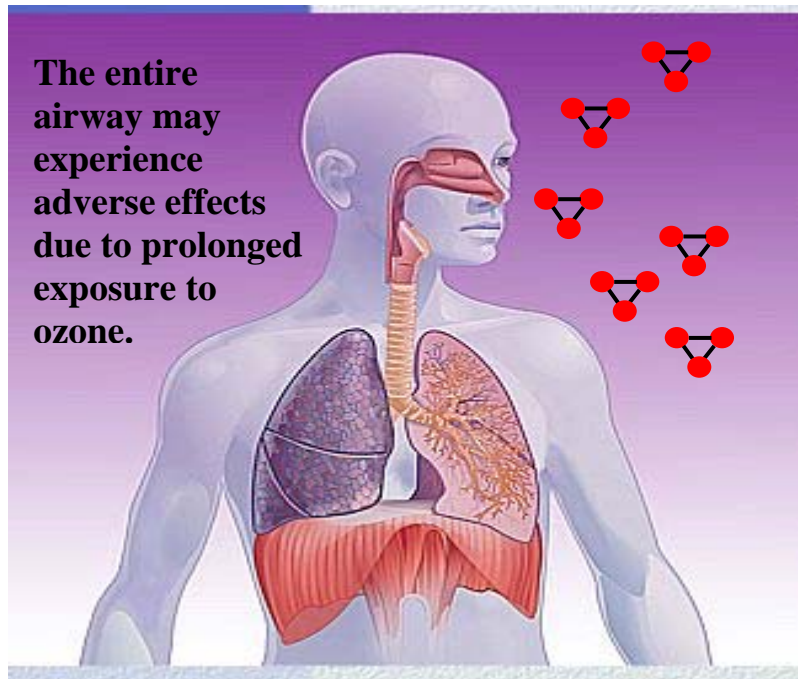
Figure 3: Ozone Damage to Sassafras Tree



HEALTH EFFECTS

Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present in low levels, inhaling it can trigger a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. Ozone also can aggravate other health problems such as bronchitis, heart disease, emphysema, and asthma, and can reduce lung capacity. People with pre-existing respiratory ailments are especially prone to the effects of ozone. For example, asthmatics affected by ozone may have more frequent or severe attacks during periods when ozone levels are high. As shown in Figure 4 ozone can irritate the entire respiratory tract. Children are also at risk for ozone related problems. Their respiratory systems are still developing and they breathe more air per pound of body weight than adults. They are also generally active outdoors during the summer when ozone levels are at their highest. Anyone who spends time outdoors in the summer can be affected and studies have shown that even healthy adults can experience difficulty in breathing when exposed to ozone. Anyone engaged in strenuous outdoor activities, such as jogging, should limit these activities to days when ozone levels are not expected to be high.

Figure 4



Area of the Respiratory Tract that may be Affected by Ozone

AMBIENT AIR QUALITY STANDARDS FOR OZONE

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

OZONE NETWORK

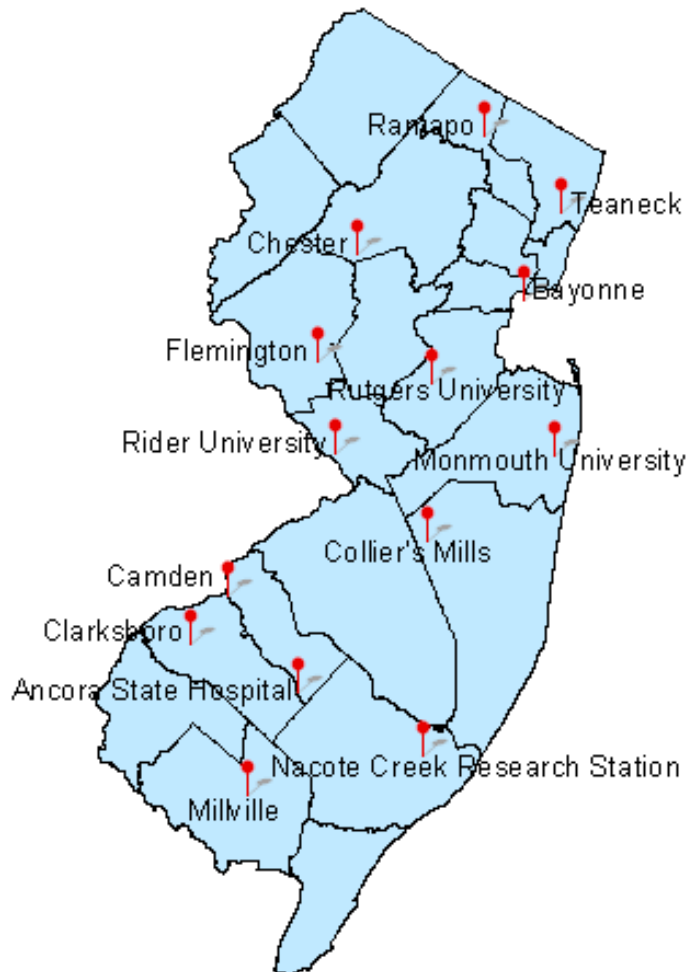
Ozone was monitored at 14 locations in New Jersey during 2003. Of those 14 sites, 11 operated year round and 3 operated only during the ozone monitoring season (April 1st through October 31st). Site locations are shown in Figure 5.

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

ppm = Parts per Million

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

Figure 5
2003 Ozone Monitoring Network



DESIGN VALUES

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

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

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

Figure 6
8-Hour Ozone Air Quality, 1986 - 2003

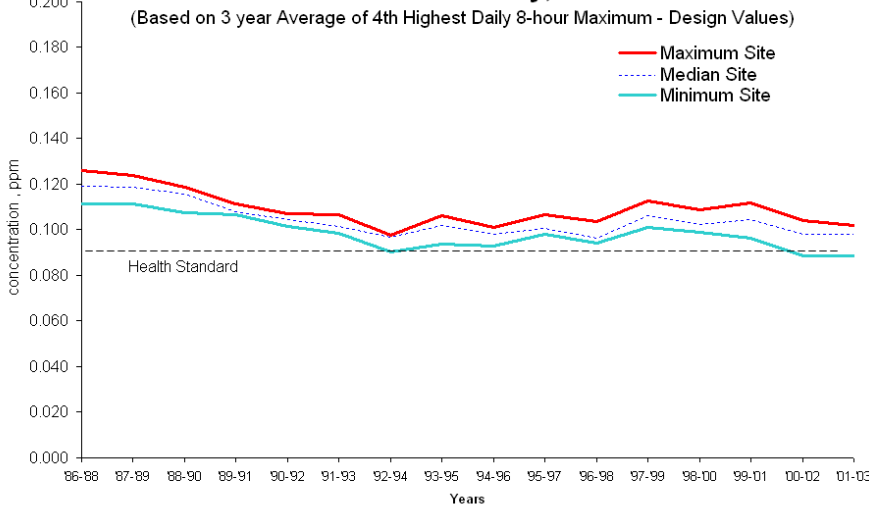
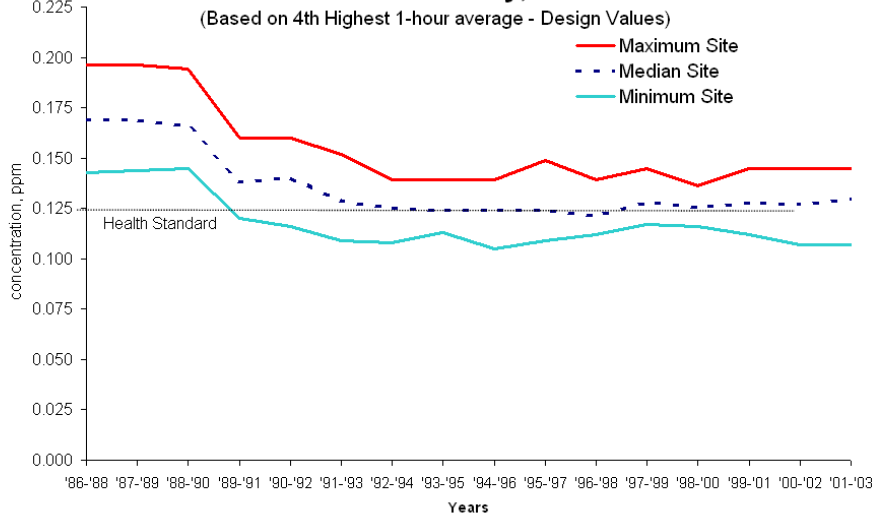


Figure 7
1-Hour Ozone Air Quality, 1986 - 2003



HOW THE CHANGES TO THE OZONE STANDARDS AFFECT AIR QUALITY RATINGS

In 2003 there were 4 days on which the old standard was exceeded in New Jersey and 20 days on which the new standard was exceeded. Significant progress was being made towards meeting the old standards (see Figure 8 below). There are fewer days on which that standard is exceeded, and when it is, fewer sites tend to be involved. Also, the maximum levels reached are not as high as they were in the past. The maximum 1-hour average concentration recorded in 1988 was 0.218 ppm, compared to a maximum of 0.151 ppm in 2003.

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

Figure 8
Days on which the 1-hour Ozone Standard
was Exceeded in New Jersey 1988-2003

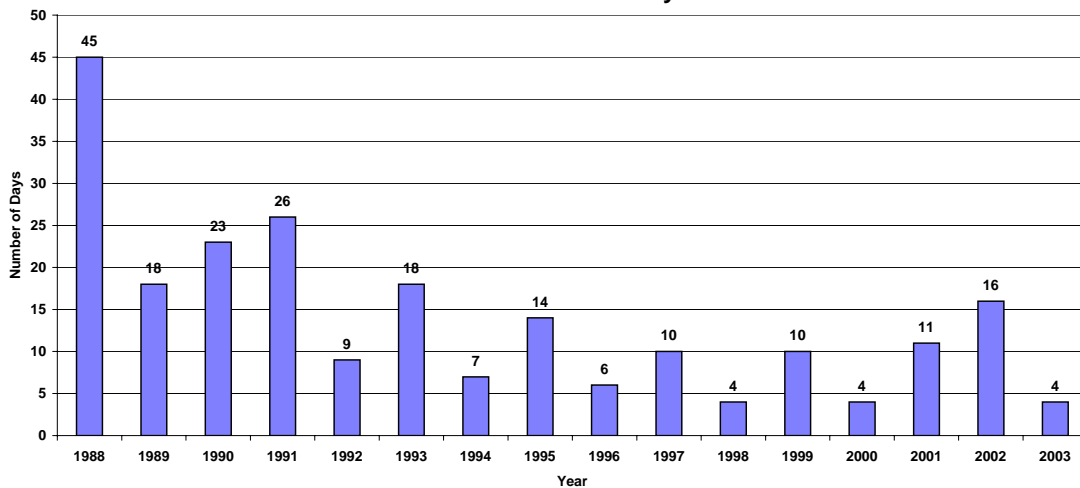
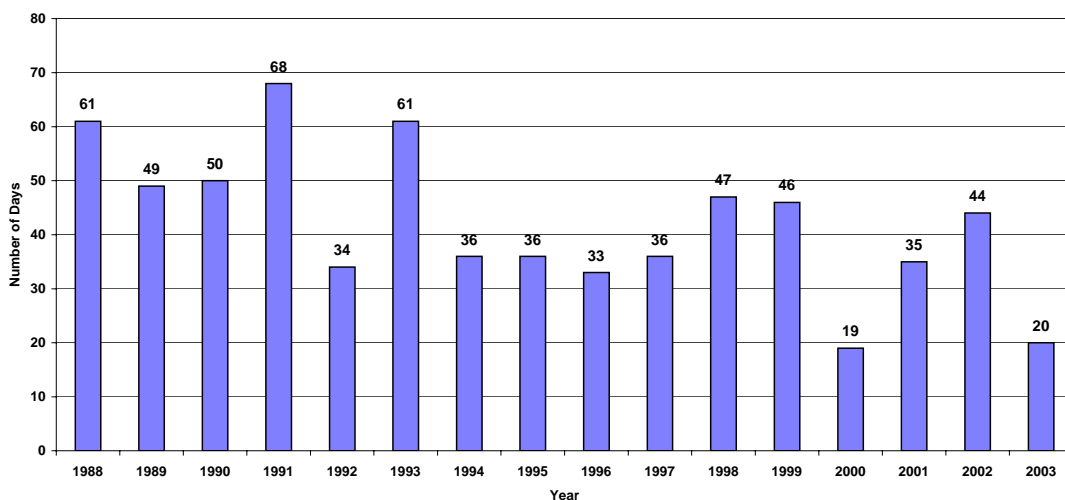


Figure 9
Days on which the 8-hour Ozone Standard
was Exceeded in New Jersey 1988-2003



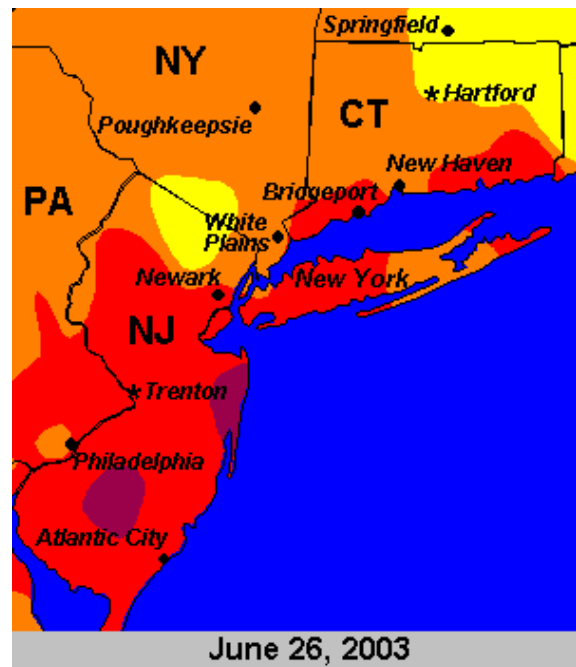
MAJOR OZONE EPISODES

Historically, several ozone episodes occur throughout the New Jersey summer. Some ozone episodes have begun as early as April while others have lasted well into the early days of autumn. The 2003 ozone season seemed as if it would be significant since the first exceedances of the 8-hour standard occurred on April 16th. Six sites throughout the state made it above the 8-hour standard of 0.08 ppm, and although the maximum values weren't much above the standard, April 16th turned out to be one of the most widespread exceedances of the summer. This early start, however, was not a great indicator of the season to come. The remainder of the summer was very clean, in regards to air quality, and only one major ozone episode occurred in the Garden State. Conditions conducive to ozone formation (sunny, warm, west-southwest winds) were almost non-existent as the majority of the summer was blanketed by cloud-cover and only 24 days between May 1st and September 31st were clear (without cloud cover). Precipitation levels were near normal in May, August and September, while June and July accumulations deviated quite significantly. June was very wet and recorded rainfall levels roughly four inches above normal, whereas July was dryer than usual, receiving nearly two and a half inches below normal rain fall. Atypical meteorological conditions played a significant role in low ground level ozone concentrations in 2003. Ground level ozone will remain a problem that requires both local and regional emission reduction strategies to effectively control its presence throughout the summer months.

June 24 – 27 On the 24th a large high pressure system centered in Ohio pushed its way through the region. New Jersey was on the eastern side of this high pressure and therefore began to receive west-northwest winds in the mid morning hours. These winds carried polluted metropolitan Philadelphia air into the southern regions of the state. Southern sites most affected by this plume, such as Ancora S.H., Millville, and Nacote Creek R.S. reported hourly ozone concentrations of 0.088, 0.082, and 0.086 ppm respectively.

Temperatures settled in the mid -90's throughout the state, pushing seven sites above the 8-hour standard. Monmouth University was the highest site that day with a maximum 8-hour value of 0.112 ppm and it also exceeded the 1-hour standard with a maximum of 0.139 ppm. The same high-pressure system stayed in place throughout the 25th, shifting to the south a bit as the day went on. Temperatures stayed in the mid-90's and winds remained light, allowing the long daylight hours maximum opportunity to react with ozone precursors. This southern shift brought westerly winds to the entire state for the remainder of the day causing 13 sites to exceed the 8-hour standard. June 25th was a widespread exceedance day as all but the Ramapo site exceeded the 8-hour standard, and three sites exceeded the 1-hour standard; Ancora S.H., Clarksboro, and Monmouth University. June 26th was the most prolific ozone day of the season. The highest 1-hour value of the 2003 season (0.151 ppm) was recorded at Monmouth University, while a total of six sites exceeded the 1-hour standard. Once again, every site except Ramapo exceeded the 8-hour standard as conditions conducive to ozone formation were in place throughout the region. Temperatures reached 97°, making June 26th the hottest day of the summer, and winds were now from the south-southwest. Similar conditions remained in place throughout the morning hours of the 27th, but by mid afternoon all of New Jersey was receiving brisk winds out of the west-northwest. However, nine sites still exceeded the 8-hour standard with the rural Chester location recording the highest concentration of the day with 0.099 ppm. This wind shift likely kept ozone concentrations in check and brought the only major ozone episode of the year to a close. Only the Rutgers University site exceeded the 8-hour standard on June 28th by barely making it above the standard with an 8-hour maximum concentration of 0.085 ppm.

Figure 10



SUMMARY OF 2003 OZONE DATA RELATIVE TO THE 1-HOUR STANDARD

Of the 14 monitoring sites that were operated during the 2003 ozone season, six recorded levels above the old 1-hour standard of 0.12 ppm at least once during the year. Three sites had at least two exceedances, while Monmouth University recorded the most exceedances with four. The highest 1-hour concentration was 0.151 ppm at the Monmouth University site on June 26, 2003. By comparison, the 2002 ozone season had 13 sites that recorded levels above the standard and the maximum was 0.153 ppm, recorded at Colliers Mills.

Figure 11
Highest and Second Highest Daily 1-Hour Averages

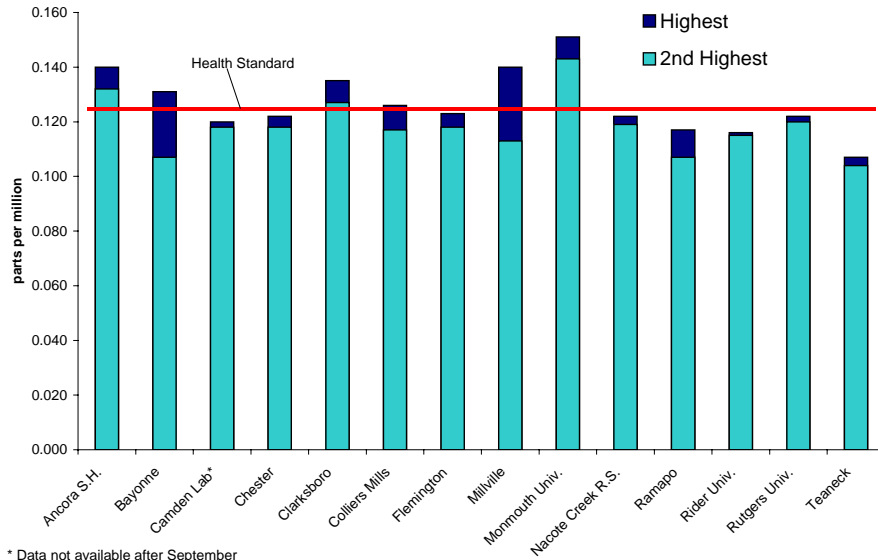


Table 3
Ozone Data – 2003
1-Hour Averages

Monitoring Site	Parts Per Million (ppm)			1-hour standard is 0.12 ppm # of days with 1-hour Averages above 0.12ppm
	1-hr Max	2nd Highest 1-hr Max	4th Highest ^a 1-hour Average 2001-2003	
Ancora S.H.	0.140	0.132	0.122	2
Bayonne	0.131	0.107	0.130	1
Camden Lab ^b	0.120	0.118	0.128	0
Chester	0.122	0.118	0.122	0
Clarksboro	0.135	0.127	0.127	2
Colliers Mills	0.126	0.117	0.134	1
Flemington	0.123	0.118	0.128	0
Millville	0.140	0.113	0.129	1
Monmouth Univ.	0.151	0.143	0.128	4
Nacote Creek R.S.	0.122	0.119	0.107	0
Ramapo	0.117	0.107	0.116	0
Rider University	0.116	0.115	0.133	0
Rutgers University	0.122	0.120	0.132	0
Teaneck	0.107	0.104	0.127	0
Statewide	0.151	0.143	0.145	4

^a Design value calculations exclude data affected by the July 2002 Canadian forest fire episode. See 2002 Air Quality Report for details.

^b Data not available after September

SUMMARY OF 2003 OZONE DATA RELATIVE TO THE 8-HOUR STANDARD

All of the 14 monitoring sites that were operated during the 2003 ozone season recorded levels above the new 8-hour standard of 0.08 ppm. Monmouth University recorded the most exceedances with ten. The highest 8-hour concentration recorded was 0.131 ppm at the Monmouth University site on June 25, 2003. All sites recorded levels above the 8-hour standard in 2002 as well, with a maximum concentration of 0.138 ppm, recorded at the Colliers Mills site. Design values for the 8-hour standard were also above the standard at all sites, indicating that the ozone standard is being violated throughout New Jersey.

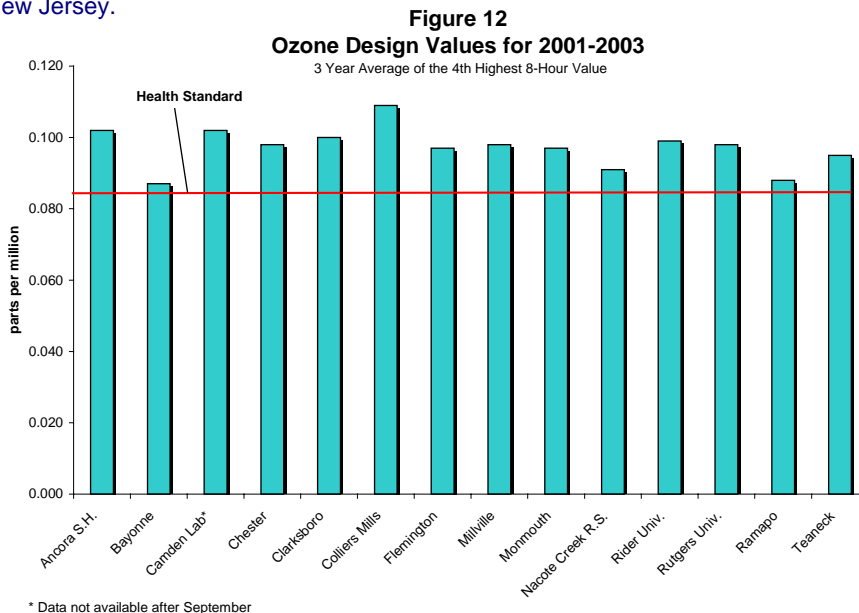


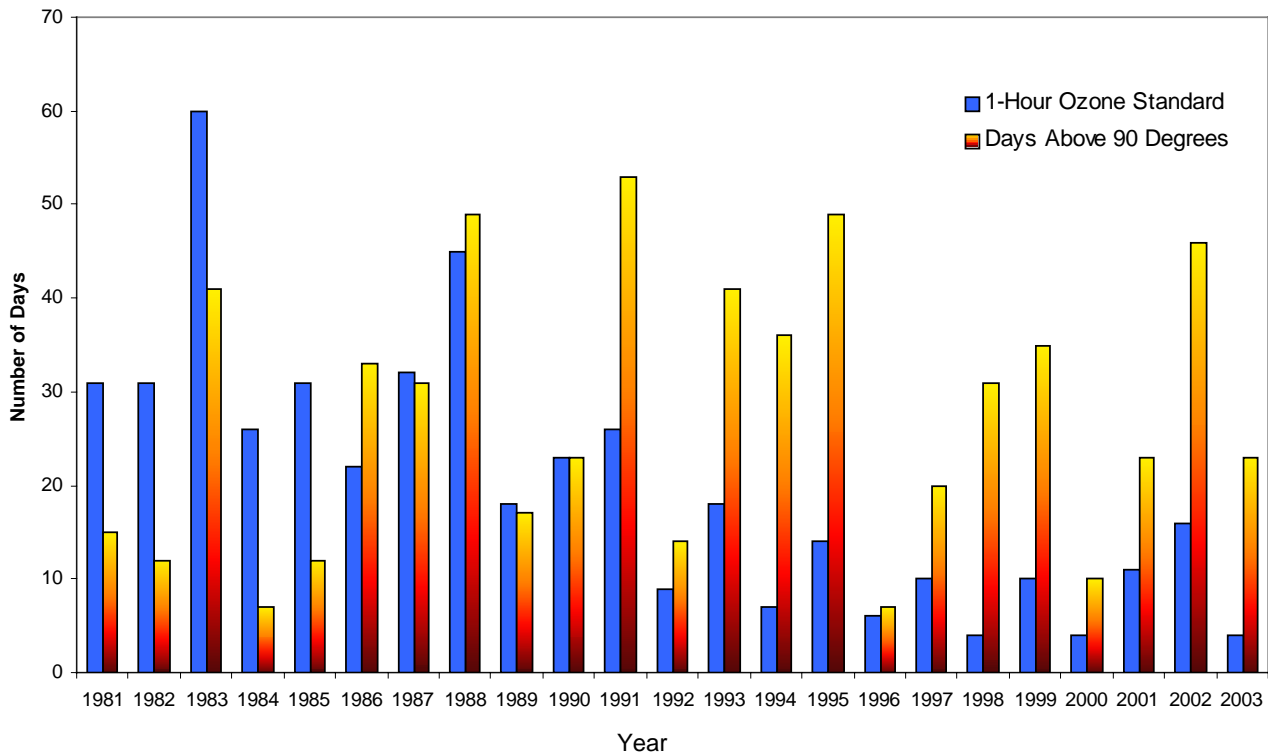
Table 4
Ozone Data – 2003
8-Hour Averages

Monitoring Site	Parts Per Million (ppm)				Avg. of 4 th Highest ^a 8-hour Averages 2001-2003	8-hour standard is 0.08 ppm # of days with 8-hour above 0.08ppm
	1 st Highest	2 nd Highest	3 rd Highest	4 th Highest		
Ancora S.H.	0.131	0.115	0.097	0.096	0.102	9
Bayonne	0.102	0.097	0.082	0.081	0.087	2
Camden Lab ^b	0.108	0.106	0.092	0.090	0.102	4
Chester	0.109	0.108	0.099	0.090	0.098	5
Clarksboro	0.123	0.112	0.097	0.090	0.100	6
Colliers Mills	0.116	0.111	0.096	0.095	0.109	9
Flemington	0.115	0.110	0.093	0.092	0.097	7
Millville	0.120	0.104	0.092	0.092	0.098	6
Monmouth Univ.	0.131	0.128	0.112	0.099	0.097	10
Nacote Creek R.S.	0.110	0.108	0.089	0.085	0.091	4
Ramapo	0.088	0.085	0.082	0.081	0.088	2
Rider University	0.110	0.107	0.094	0.086	0.099	7
Rutgers University	0.117	0.113	0.091	0.086	0.098	5
Teaneck	0.099	0.098	0.090	0.085	0.095	4
Statewide	0.131	0.131	0.112	0.099	0.110	20

^a Design Value calculations exclude data affected by the July 2002 Canadian forest fire episode. See 2002 Air Quality Report for details.

^b Data not available after September

Figure 13
Number of Days 1-Hour Ozone Standard Was Exceeded
and Number of Days Above 90 Degrees
New Jersey 1981 - 2003



ACCOUNTING FOR THE INFLUENCE OF WEATHER

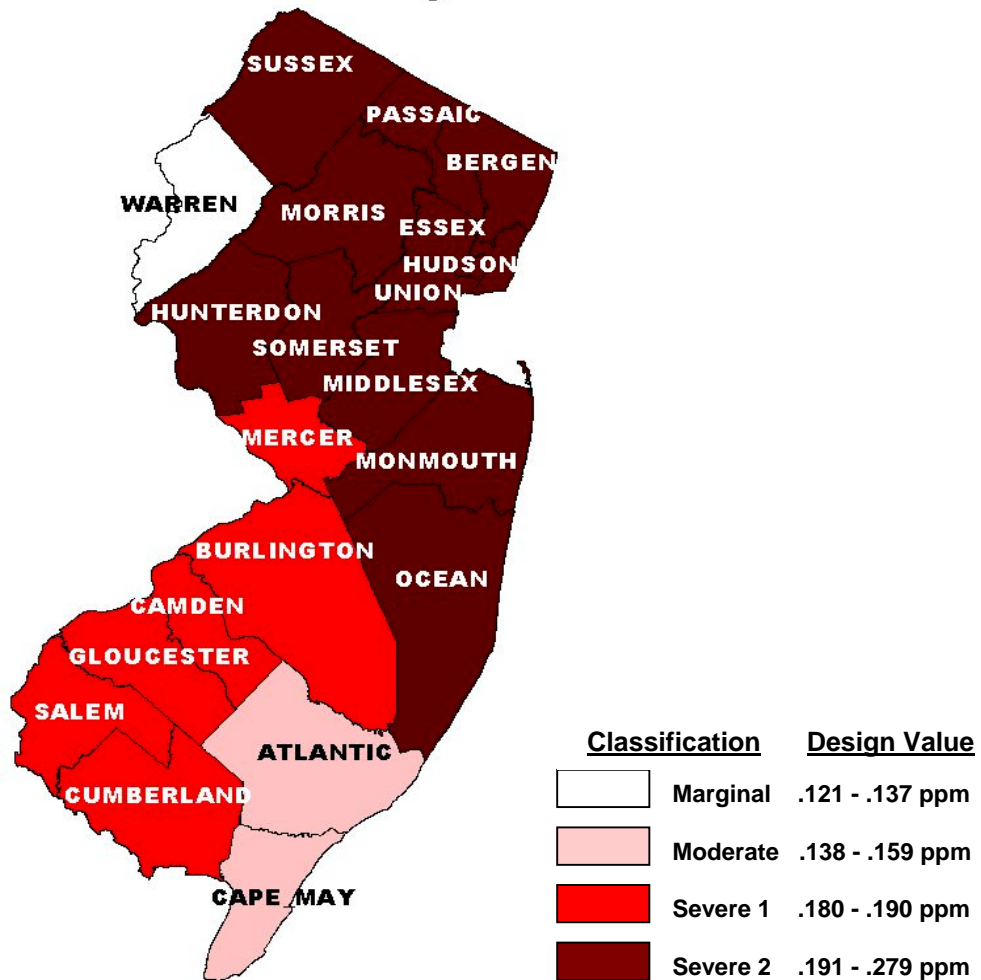
Trends in ground level ozone are influenced by many factors including weather conditions, transport, growth, and the state of the economy, in addition to changes brought about by regulatory control measures. Of these factors, weather probably has the most profound effect on year to year variations in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

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

OZONE NON-ATTAINMENT AREAS IN NEW JERSEY

The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Areas can also be found to be "unclassifiable" under certain circumstances. The 1990 amendments to the act required that areas be further classified based on the severity of non-attainment. The classifications range from "marginal" to "extreme" and are based on "design values". The design value is the value that actually determines whether an area meets the standard. For the 1-hour ozone standard for example, the design value is the fourth highest daily maximum 1-hour average concentration recorded over a three year period. 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 below. Now that the new 8-hour average standard for ozone has been upheld by the courts, new designations will have to be made.

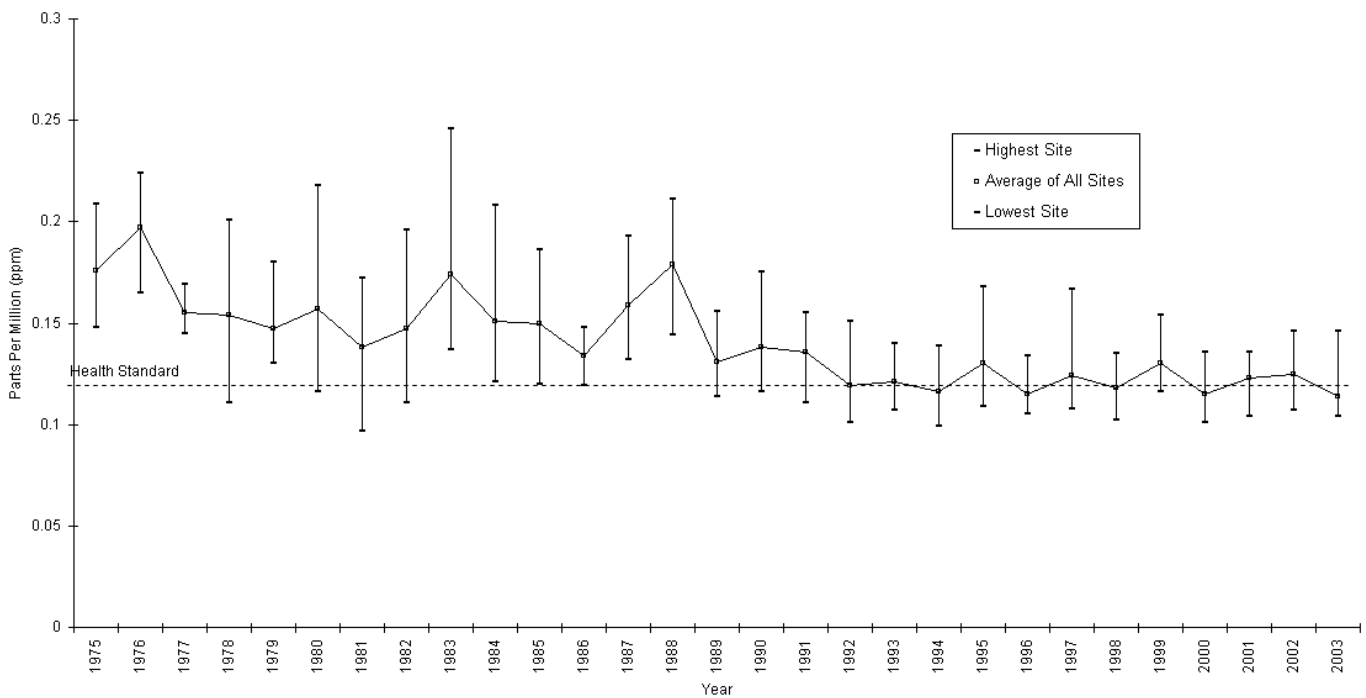
Figure 14
Ozone Non-Attainment Areas
in New Jersey



OZONE TRENDS

The primary focus of efforts to reduce concentrations of ground-level ozone in New Jersey has been on reducing emissions of volatile organic compounds (VOCs). Studies have shown that such an approach should lower peak ozone concentrations, and it does appear to have been effective in achieving that goal. Maximum 1-hour concentrations have not exceeded 0.20 ppm since 1988, and the last time levels above 0.18 ppm were recorded was in 1990. (Figure 15) But improvements may have leveled off in recent years, especially with respect to maximum 8-hour average concentrations. Significant further improvements will require reductions in both VOCs and NO_x. The NO_x reductions will have to be achieved over a very large region of the country, because levels in New Jersey are dependent on emissions from upwind sources.

Figure 15
Ozone Concentrations in New Jersey
1975 – 2003
Second Highest 1-Hour Averages



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2003 PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

New Jersey Department of Environmental Protection

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

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

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

Figure 1

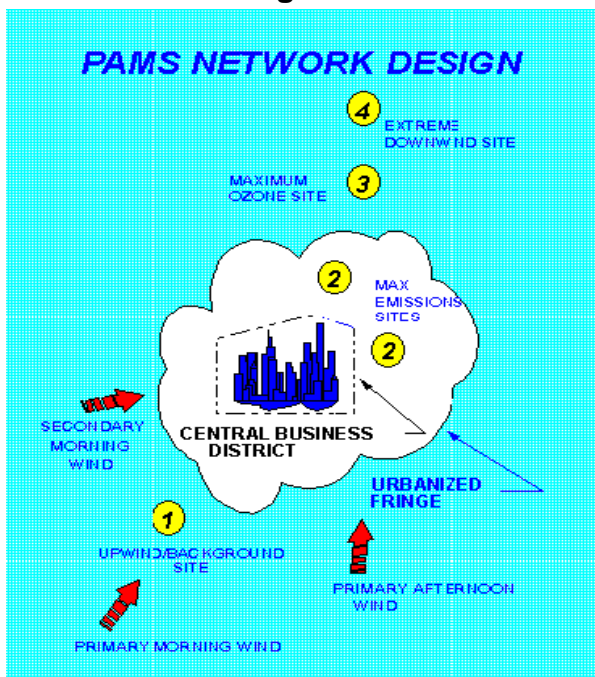


Figure 2

Regional PAMS Sites



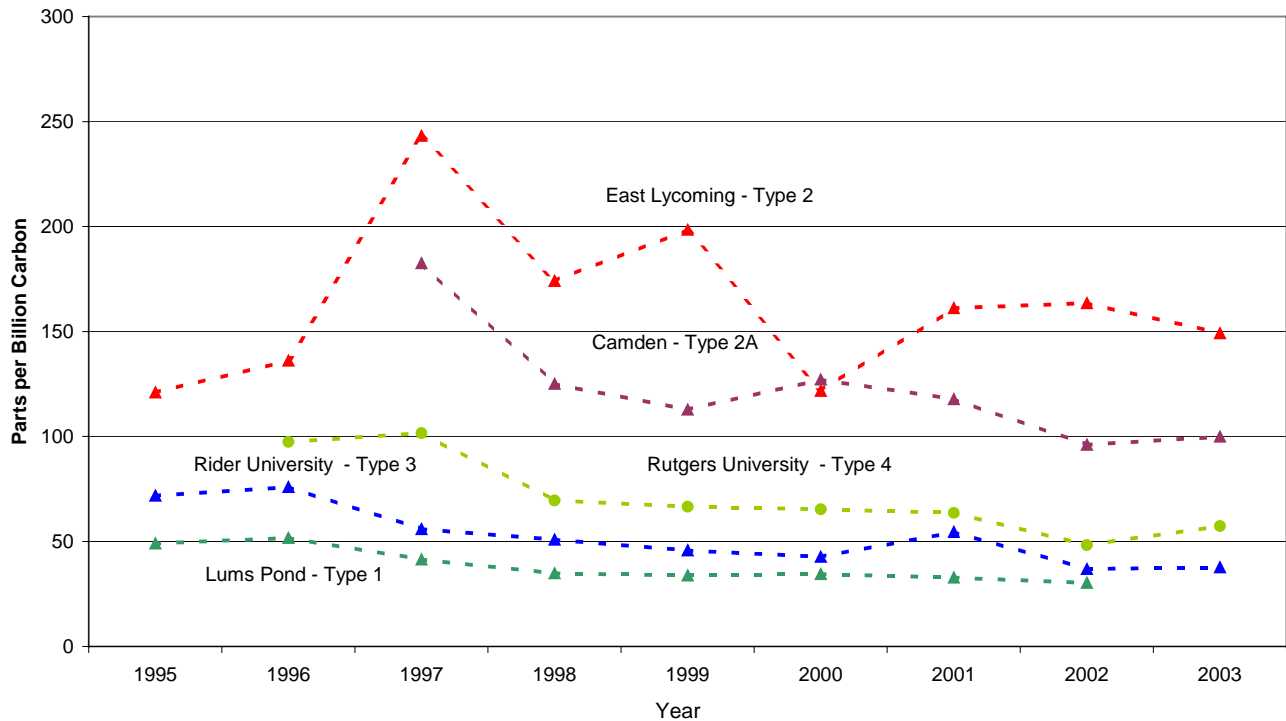
Note: Rutgers University PAMS site is both Type 4 for Philadelphia and Type 1 for New York City.

⁵ USEPA , PAMS General Information

PAMS (CONT.)

Figure 3 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 more variation from year to year, though the trend at both sites is downward since 1997. Operation of the Lums Pond site was discontinued after the 2002 season by Delaware's Department of Natural Resources and Environmental Control (DNREC).

Figure 3
Philadelphia Region
Total Non-methane Organic Carbon (TNMOC)
Seasonal Average 1995-2003



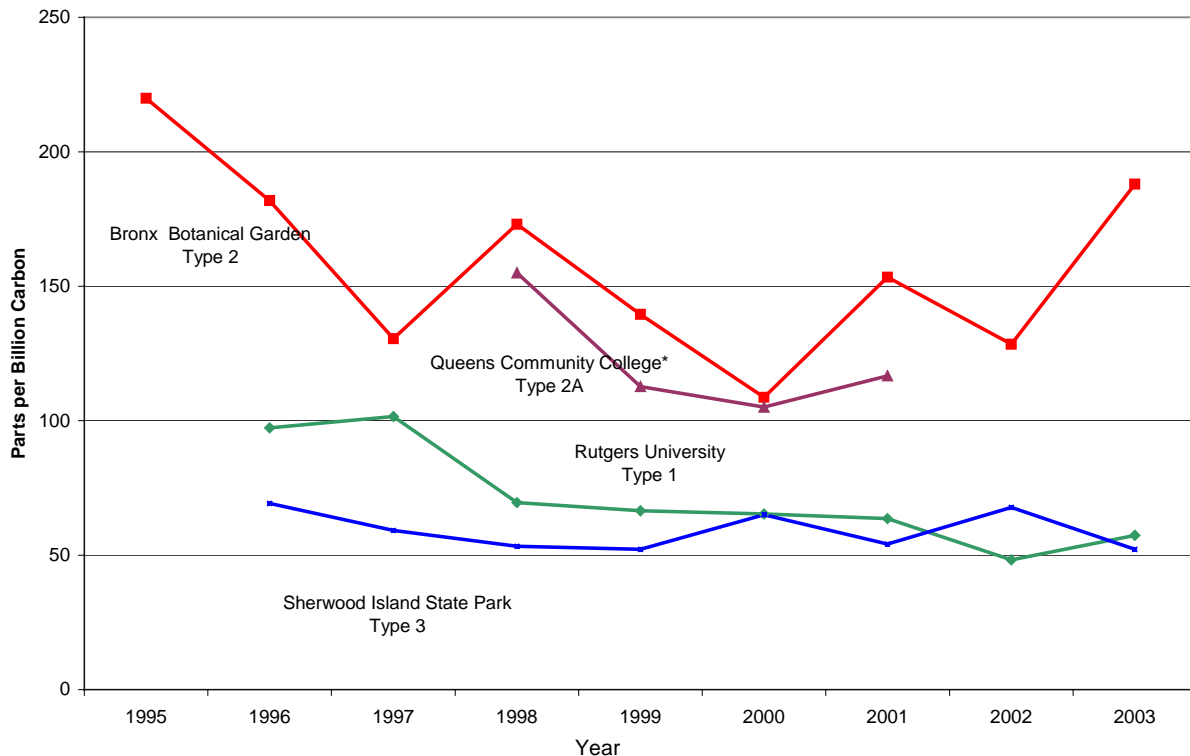
PAMS (cont.)

Figure 4 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. The Type 2 site in the NY area at the Bronx Botanical Gardens shows even more year to year variability than does the Philadelphia Type 2 site at East Lycoming. Operation of the Queens Community College site was discontinued after the 2001 season.

In conclusion, trends for VOC values measured at all PAMS sites in the Philadelphia and New York City areas show a decline over 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, hence these sites seem to show more year to year variability. 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 also highest during the middle of the day, when photochemical conditions are most conducive to ozone formation. Isoprene levels are thought to be influenced by factors that affect tree health and growth, such as rainfall and severe temperatures.

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

Figure 4
New York City Region
Total Non-methane Organic Carbon (TNMOC)
Seasonal Average 1995-2003



* Operations of the Queens Community College site was discontinued after the 2001 season.

Table 1
Summary of Photochemical Assessment Monitoring (PAMS) Data
June, July, and August, 2003

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	5.09	0.39	10.18	0.77	0.62	0.14	1.23	0.28	6.68	0.33	13.36	0.66
Benzene	4.71	0.35	28.25	2.12	0.74	0.15	4.41	0.88	0.77	0.15	4.62	0.88
n-Butane	46.98	1.62	187.93	6.49	22.83	0.42	91.3	1.67	5.90	0.57	23.61	2.27
1-Butene	2.97	0.13	11.86	0.53	0.20	0.03	0.78	0.13	0.77	0.05	3.07	0.19
cis-2-Butene	1.59	0.08	6.35	0.31	0.12	0.02	0.47	0.08	0.54	0.03	2.17	0.12
trans-2-Butene	1.91	0.09	7.62	0.38	0.11	0.02	0.45	0.08	0.54	0.03	2.14	0.12
Cyclohexane	2.49	0.11	14.93	0.65	0.17	0.03	1.00	0.20	0.24	0.04	1.42	0.22
Cyclopentane	1.03	0.10	5.17	0.49	0.23	0.06	1.13	0.28	0.52	0.04	2.61	0.21
n-Decane	4.69	0.06	46.92	0.61	2.13	0.03	21.27	0.27	0.63	0.04	6.31	0.35
m-Diethylbenzene	0.37	0.02	3.7	0.23	0.21	0.02	2.1	0.20	1.23	0.02	12.29	0.15
p-Diethylbenzene	0.49	0.02	4.87	0.25	0.28	0.01	2.81	0.14	0.12	0.02	1.19	0.16
2,2-Dimethylbutane	3.80	0.17	19.01	0.83	0.20	0.04	0.99	0.18	0.97	0.04	4.86	0.22
2,3-Dimethylbutane	1.29	0.15	6.46	0.73	0.25	0.05	1.25	0.27	0.88	0.07	4.39	0.34
2,3-Dimethylpentane	0.50	0.08	3.53	0.55	0.22	0.04	1.51	0.29	0.28	0.04	1.95	0.30
2,4-Dimethylpentane	0.45	0.06	3.17	0.42	0.12	0.03	0.81	0.23	0.21	0.03	1.45	0.24
Ethane	21.54	3.95	43.08	7.90	13.70	2.39	27.39	4.78	43.27	2.87	86.54	5.74
Ethylbenzene	0.66	0.09	5.29	0.70	1.72	0.04	13.72	0.35	0.39	0.05	3.13	0.40
Ethylene (Ethene)	15.24	1.31	30.47	2.63	3.33	0.42	6.66	0.85	19.62	1.16	39.24	2.32
Isomers of Ethyltoluene	4.16	0.13	37.48	1.15	0.77	0.06	6.94	0.53	1.20	0.10	10.72	0.93
n-Heptane	1.43	0.16	10.00	1.11	0.25	0.05	1.77	0.35	0.72	0.06	5.06	0.44
Hexane	4.64	0.34	27.85	2.03	0.63	0.12	3.80	0.69	2.90	0.17	17.37	1.03
1-Hexene	0.75	0.03	4.49	0.18	0.20	0.02	1.19	0.14	0.11	0.02	0.68	0.09
Isobutane	24.74	1.17	98.97	4.67	11.90	0.28	47.59	1.13	3.61	0.36	14.44	1.43
Isopentane	17.71	1.46	88.56	7.30	2.54	0.50	12.70	2.52	13.42	0.68	67.09	3.42
Isoprene	1.43	0.23	7.15	1.17	2.68	0.21	13.42	1.06	4.35	0.59	21.73	2.95
Isopropylbenzene	1.33	0.07	12.01	0.59	0.14	0.02	1.28	0.16	0.08	0.02	0.75	0.14
Methylcyclohexane	2.29	0.12	16.01	0.87	0.27	0.04	1.87	0.27	0.66	0.05	4.61	0.34
Methylcyclopentane	2.39	0.17	14.35	1.03	0.31	0.07	1.84	0.40	0.67	0.08	3.99	0.46
2-Methylheptane	0.43	0.05	3.42	0.39	0.37	0.02	2.93	0.13	0.34	0.02	2.75	0.18
3-Methylheptane	0.46	0.05	3.71	0.36	0.21	0.02	1.71	0.16	0.39	0.02	3.14	0.20
2-Methylhexane	0.86	0.13	6.04	0.90	0.24	0.05	1.71	0.34	0.37	0.06	2.57	0.41

Table 1 (Continued)
Summary of Photochemical Assessment Monitoring (PAMS) Data
June, July, and August, 2003

	Camden Lab				Rider University				Rutgers University			
	ppbv		ppbC		ppbv		ppbC		ppbv		ppbC	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
3-Methylhexane	1.12	0.16	7.83	1.12	0.31	0.06	2.14	0.42	0.42	0.07	2.96	0.49
2-Methylpentane	3.46	0.39	20.76	2.35	0.69	0.14	4.13	0.82	2.25	0.17	13.49	1.03
3-Methylpentane	2.21	0.25	13.27	1.50	0.45	0.09	2.69	0.55	1.38	0.11	8.29	0.67
n-Nonane	2.83	0.06	25.45	0.56	1.11	0.02	10.01	0.22	0.53	0.03	4.79	0.29
n-Octane	0.62	0.08	4.99	0.61	1.04	0.03	8.31	0.20	1.06	0.04	8.47	0.30
n-Pentane	13.89	0.84	69.46	4.20	1.82	0.26	9.11	1.28	4.32	0.37	21.59	1.86
1-Pentene	0.65	0.06	3.23	0.31	0.07	0.02	0.37	0.09	0.36	0.03	1.81	0.15
cis-2-Pentene	0.38	0.04	1.88	0.21	0.06	0.02	0.3	0.08	0.31	0.03	1.55	0.13
trans-2-Pentene	0.63	0.07	3.15	0.34	0.14	0.02	0.69	0.11	0.56	0.04	2.8	0.18
Propane	57.03	3.97	171.1	11.90	20.70	1.35	62.1	4.05	16.70	1.69	50.11	5.08
n-Propylbenzene	0.32	0.03	2.9	0.26	0.16	0.02	1.41	0.14	0.14	0.02	1.23	0.17
Propylene (Propene)	32.20	0.88	96.6	2.64	2.55	0.22	7.64	0.67	4.21	0.34	12.62	1.03
Styrene	0.40	0.04	3.21	0.36	0.30	0.02	2.4	0.18	0.16	0.03	1.28	0.21
Toluene	5.37	0.69	37.59	4.82	33.85	0.35	236.98	2.46	14.13	0.72	98.91	5.04
1,2,3-Trimethylbenzene	1.68	0.05	15.09	0.46	0.73	0.06	6.57	0.52	0.58	0.05	5.23	0.47
1,2,4-Trimethylbenzene	1.79	0.09	16.15	0.79	0.77	0.04	6.96	0.33	0.63	0.06	5.67	0.55
1,3,5-Trimethylbenzene	0.78	0.05	6.99	0.41	0.45	0.03	4.06	0.23	0.27	0.03	2.46	0.24
2,2,4-Trimethylpentane	2.17	0.21	17.35	1.65	0.43	0.08	3.45	0.67	0.82	0.11	6.57	0.92
2,3,4-Trimethylpentane	0.89	0.06	7.09	0.52	0.13	0.03	1.07	0.23	0.28	0.04	2.22	0.31
n-Undecane	2.60	0.04	28.57	0.47	1.79	0.02	19.73	0.22	0.37	0.03	4.07	0.33
m/p-Xylene	2.20	0.24	17.6	1.92	6.29	0.12	50.32	1.00	1.43	0.16	11.42	1.32
o-Xylene	0.78	0.09	6.24	0.75	1.10	0.05	8.8	0.38	0.54	0.06	4.34	0.47

Table 2
Camden Lab
PAMS Carbonyls
June, July, and August, 2003
Parts Per Billion (Volume)
12 Sampling Dates (96 Observations)

	# of Detects*	Max	Avg		# of Detects*	Max	Avg
Acetaldehyde	96	5.70	1.14	Formaldehyde	96	10.02	2.68
Acetone	96	4.87	2.67	Hexaldehyde	52	0.10	0.01
Benzaldehyde	95	0.08	0.03	Isovaleraldehyde	31	0.04	0.01
Butyr/Isobutyraldehyde	61	0.25	0.04	Propionaldehyde	72	0.33	0.05
Crotonaldehyde	94	0.52	0.13	Tolualdehyde	75	0.32	0.04
2,5-Dimethylbenzaldehyde	0	0.00	0.00	Valeraldehyde	93	0.09	0.02

* The number of samples, out of a possible 96, in which the compound was detected.

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2003 Particulate Summary

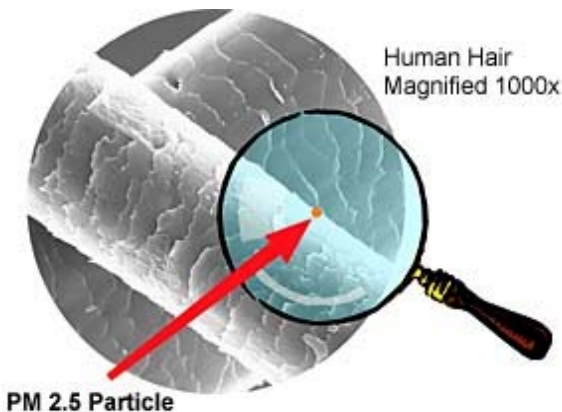
New Jersey Department of Environmental Protection

NATURE AND SOURCES

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

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

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



Graphics Courtesy of the US Department of Energy

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

ENVIRONMENTAL EFFECTS

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

Figure 2
Visibility WebCam



View of New York City Skyline from Newark

HEALTH EFFECTS

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

STANDARDS

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

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

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

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

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

Micrograms Per Cubic Meter (µg/m³)

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

[‡] Annual Geometric Mean

[†] Annual Arithmetic Mean

PARTICULATE MONITORING NETWORK

New Jersey's Particulate Monitoring Network consists of 20 fine particulate monitoring sites, 7 PM₁₀ monitoring sites, 1 TSP monitoring site, and 11 sites where smoke shade is monitored.

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

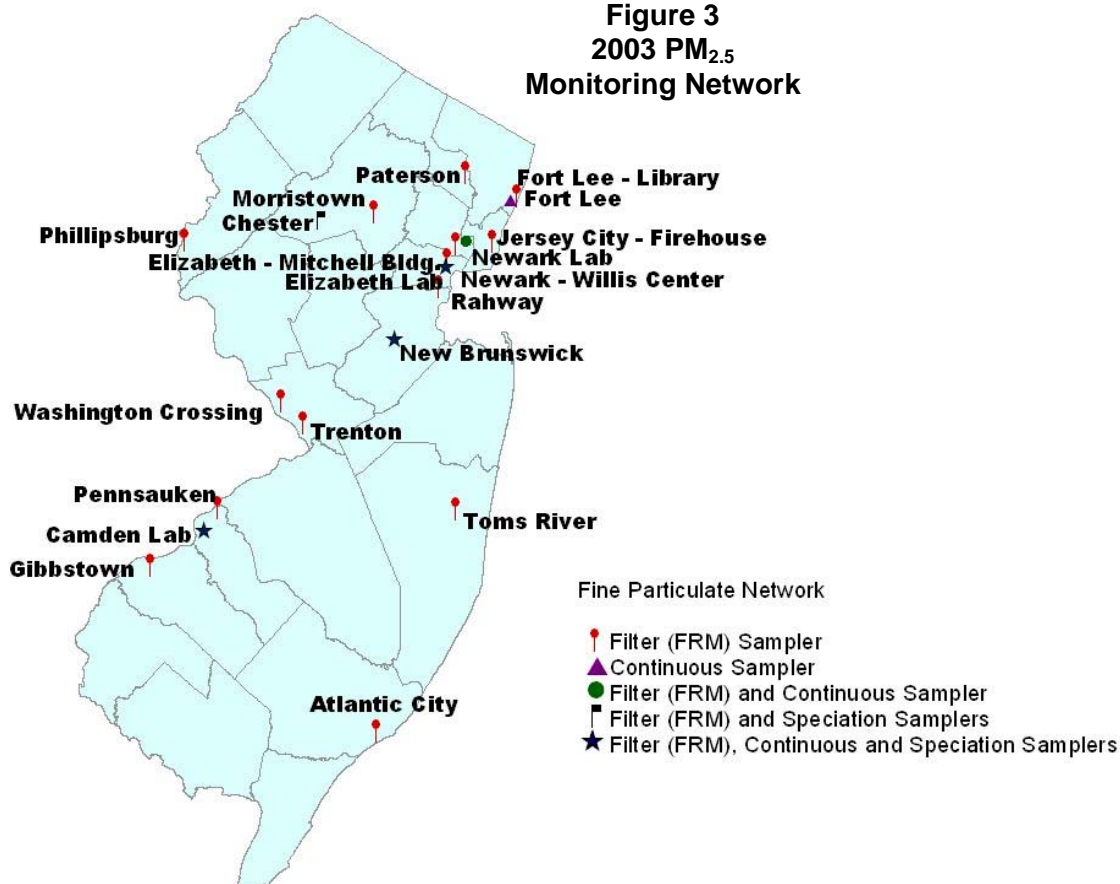
to report current air quality to the public through the Air Quality Index (www.state.nj.us/dep/airmon). The NJDEP uses Tapered Element Oscillating Microbalance (TEOM) analyzers and smoke shade instruments for real-time particle reporting. The TEOM analyzers collect a sample of fine particles on an oscillating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

FINE PARTICLE SUMMARY

FINE PARTICLE MONITORING SITES

There are 19 monitoring sites in New Jersey where a filter-based (FRM) sampler routinely collects PM_{2.5} 24-hour samples (see Figure 3). At 5 sites, continuous

Figure 3
2003 PM_{2.5}
Monitoring Network



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

FINE PARTICLE CONCENTRATION SUMMARY

The annual mean concentration of PM_{2.5} ranged from 10.7 $\mu\text{g}/\text{m}^3$ in Chester to 16.3 $\mu\text{g}/\text{m}^3$ at Camden Lab. The maximum 24-hour concentrations ranged from 35.1 $\mu\text{g}/\text{m}^3$ at Newark Lab to 63.3 $\mu\text{g}/\text{m}^3$ at Phillipsburg.

Camden Lab was not in commission during the final quarter of 2003, and Newark Lab was not in commission during the

final two quarters of the year. Therefore, the data collected from these sites may be somewhat biased. During the first three quarters of the year, Camden Lab has a lower concentration than Elizabeth Lab. However, the annual mean at Elizabeth Lab was 16.0, which was slightly lower than the annual mean of 16.3 at Camden. This can be partially attributed to the low concentrations recorded at Elizabeth Lab during the 4th quarter while Camden was out of commission. And, the maximum daily concentration at most of the sites was reached while Newark Lab was not in commission.

Figure 4 and Table 2 depict the mean and maximum concentrations at each site.

None of the sites exceeded the 24-hour standard of 65 $\mu\text{g}/\text{m}^3$. Three years of data are required to determine compliance with the NAAQS for PM_{2.5}. NJDEP will be evaluating PM_{2.5} data collected to date in making its final determination as to whether the annual NAAQS are being met.

Figure 4
2003 Fine-Particulate Concentrations

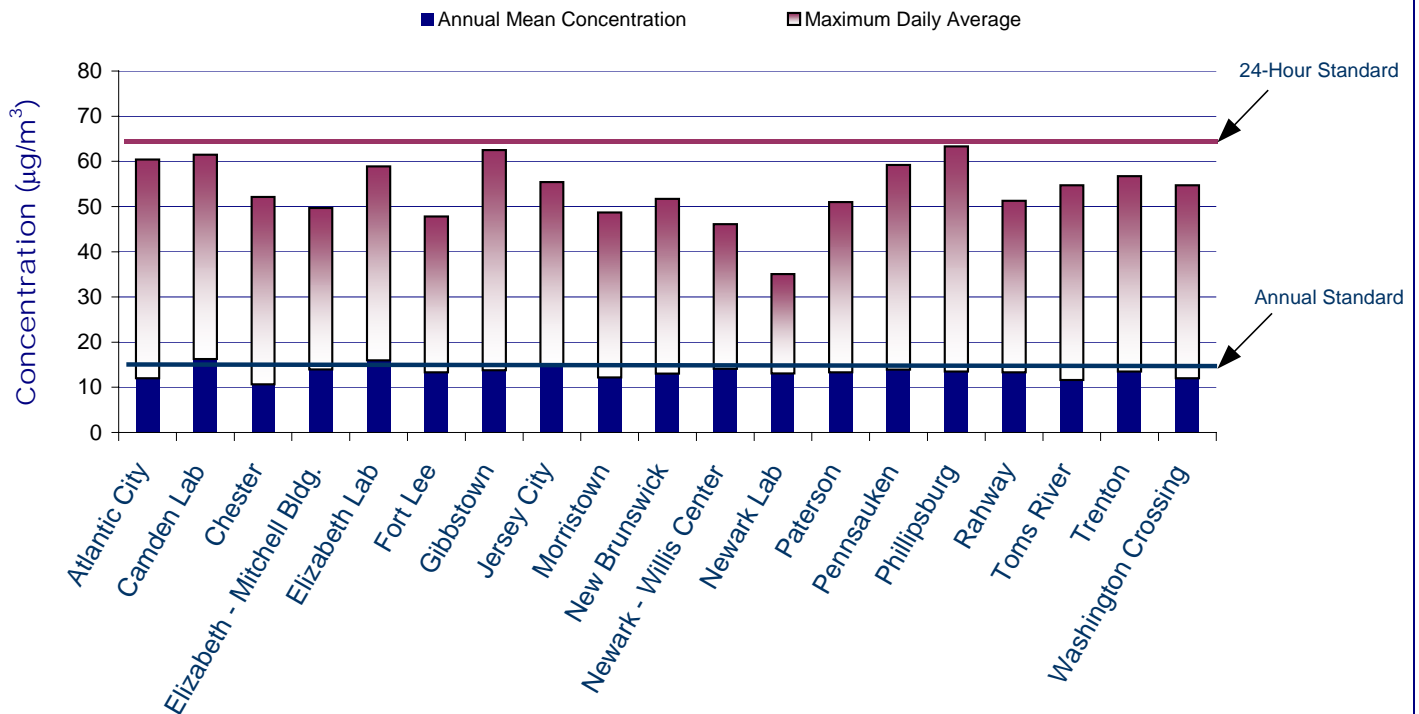


Table 2
PM_{2.5} Summary Data – 2003

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

Monitoring Site	Number of Samples	24-Hour Maximum	Second Highest	Annual Mean
Atlantic City	102	60.4	38.4	12.0 ^a
Camden Lab	78	61.5	43.0	16.3 ^{a, b}
Chester	111	52.1	44.8	10.7
Elizabeth Lab	111	49.7	45.1	16.0
Elizabeth (Mitchell)	316	58.9	49.3	14.0
Fort Lee	109	47.8	43.5	13.3
Gibbstown	112	62.5	35.3	13.8
Jersey City	109	55.4	49.8	14.8
Morristown	109	48.7	45.3	12.2
New Brunswick	111	51.7	45.3	13.0
Newark (Willis Center)	96	46.1	39.8	14.1 ^a
Newark Lab	46	35.1	31.9	13.1 ^{a, c}
Paterson	110	51.0	46.2	13.3
Pennsauken	119	59.2	44.5	13.9 ^a
Phillipsburg	110	63.3	48.8	13.5
Rahway	109	51.3	38.3	13.3
Toms River	112	54.7	42.3	11.6
Trenton	114	56.7	42.3	13.5
Washington Crossing	104	54.7	42.1	12.0 ^a

^a Site did not record 75% valid samples during each quarter

^b Site was out of commission from September through the end of the year

^c Site was out of commission from June through the end of the year

Table 3
2003 Summary of Continuous PM_{2.5} Data

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

Monitoring Site	Maximum Daily Average	2nd Highest Daily Average	Annual Mean
Camden Lab ^a	67	57	--
Elizabeth Lab	61	54	16
Fort Lee	71	61	19
Newark Lab ^b	32	31	--
New Brunswick	60	57	12

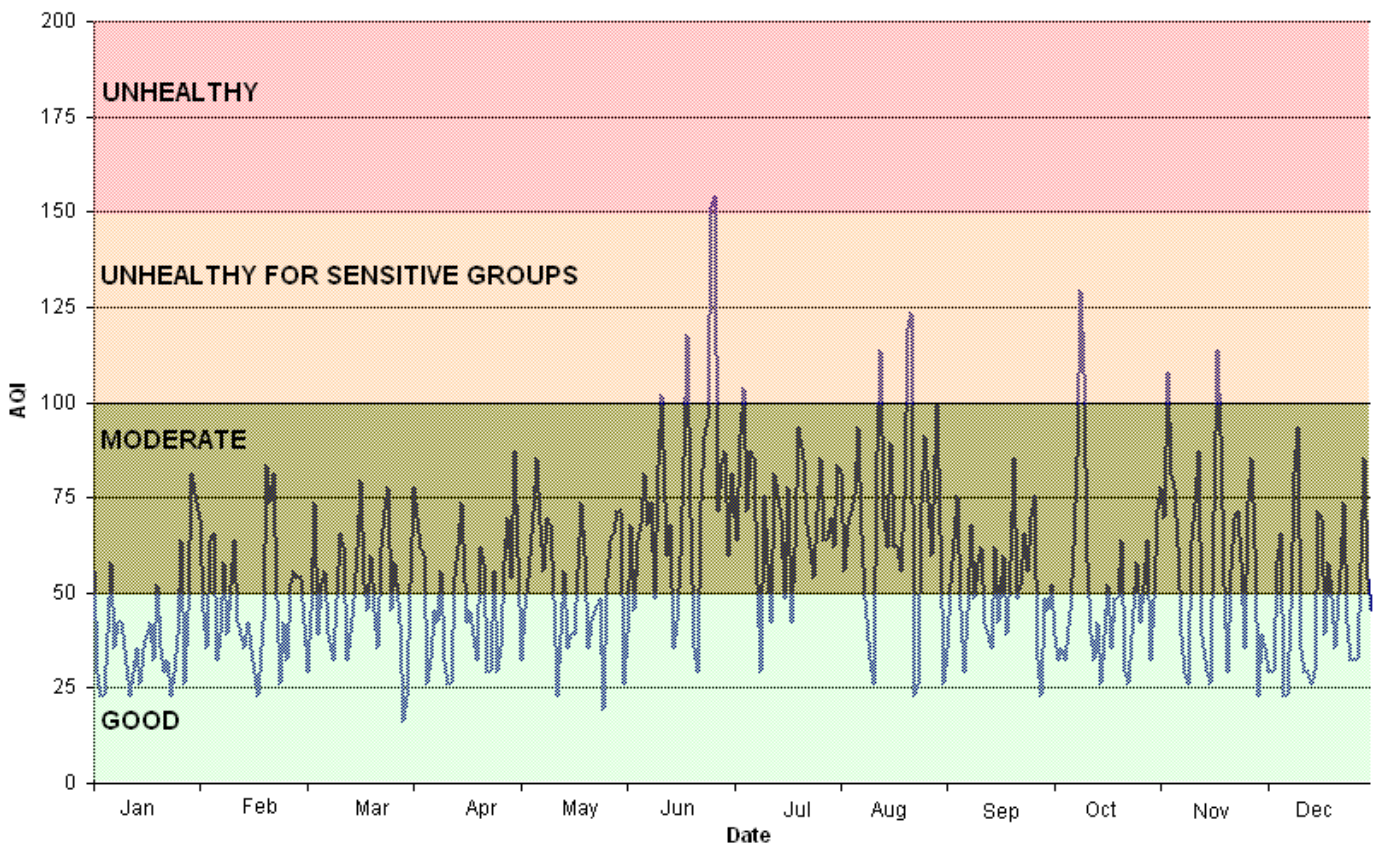
^a Data Not Available after September

^b Data Not Available after June

PM_{2.5} REAL-TIME MONITORING

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

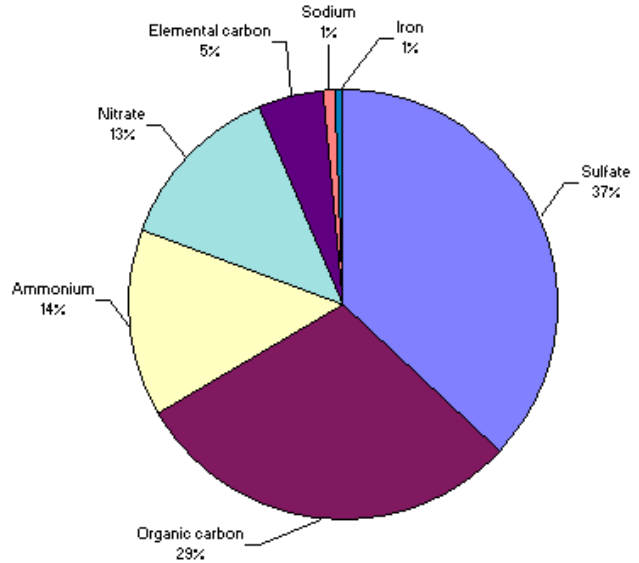
Figure 5
Maximum Daily Fine Particulate Air Quality Index (AQI)



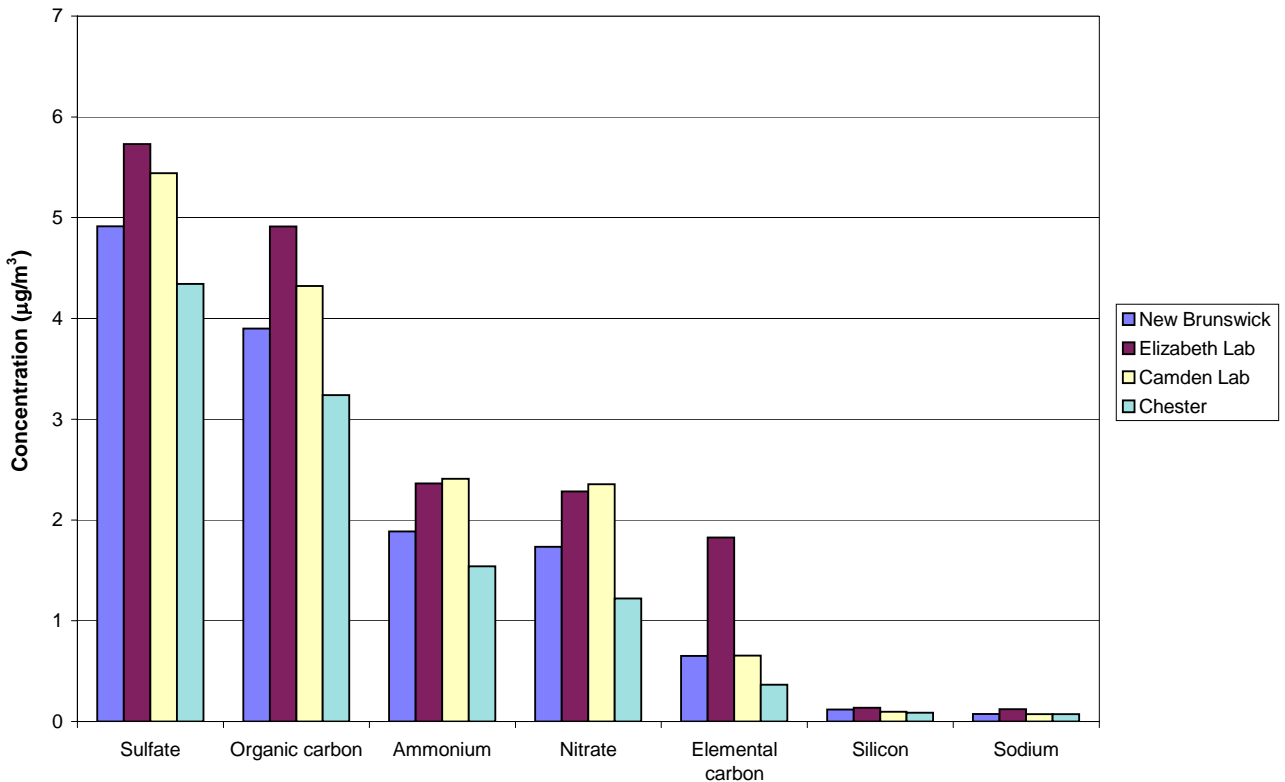
FINE PARTICLE SPECIATION SUMMARY

New Jersey's Fine Particulate Speciation Network consists of 4 monitoring sites: Camden Lab, Elizabeth Lab, New Brunswick, and Chester. Samplers run every third day on a schedule concurrent with the FRM sampling network. Of the 55 measured analytes, organic carbon and sulfate combined make up over 60% of the total mass, and nitrate, ammonium, and elemental carbon make up an additional 38% of the particulate mass. Figure 6 depicts the typical chemical composition of fine particulate matter by showing the average percentage each analyte contributed to the total concentration of fine particles at New Brunswick in 2003. Figure 7 depicts the average concentration of each analyte at all the sites, with only the seven most prevalent constituents depicted. Appendix B shows the average, maximum, and 2nd highest concentrations for each compound for 2003.

**Figure 6
2003 Fine Particulate Analyte Composition
(Highest 7 Analytes at New Brunswick)**



**Figure 7
2003 Fine Particulate Analyte Composition
(Highest 7 Analytes Depicted)**



2003 COARSE PARTICLE SUMMARY

COARSE PARTICLE MONITORING SITES

The coarse particulate monitoring network is composed of PM₁₀ sampling sites and TSP sampling sites. Samples are collected on a filter, which is weighed before and after sampling. The amounts of Sulfate and Nitrate are measured on some PM₁₀ samples and Lead is measured on the TSP samples. Figure 8 depicts the PM₁₀ particulate monitoring network in New Jersey.

Figure 8
2003 PM₁₀
Monitoring Network



TSP CONCENTRATION SUMMARY

New Jersey currently operates one site, located in New Brunswick, mainly for the purpose of determining the concentration of lead in the atmosphere. For more information, see the 2003 Lead Summary section. In 2003, the annual geometric mean concentration of TSP in New Brunswick was 27.6 $\mu\text{g}/\text{m}^3$, and the maximum 24-hour concentration recorded was 74 $\mu\text{g}/\text{m}^3$. The site was 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, and the site did not surpass the 24-hour primary standard of 260 $\mu\text{g}/\text{m}^3$ or the 150 $\mu\text{g}/\text{m}^3$ secondary standard.

PM₁₀ CONCENTRATION SUMMARY

In 2003, the annual mean concentration of PM₁₀ ranged from 21.2 $\mu\text{g}/\text{m}^3$ at Atlantic City to 36.5 $\mu\text{g}/\text{m}^3$ at Fort Lee. Table 4 and Figure 9 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 Sulfate and Nitrate were also analyzed on some PM₁₀ filters. The results showed that, on average, about 2% percent of PM₁₀ is nitrate and 17% percent is sulfate; however, these percentages vary across sites and sampling dates. The contributions of sulfate and nitrate to PM₁₀ are significantly less than their contributions to PM_{2.5}. This is because PM₁₀ is predominantly made up of larger particles most of which are directly emitted into the atmosphere. PM_{2.5} is predominantly a secondary pollutant, forming in the atmosphere from gaseous emissions, such as SO₂ and NO_x. For more details on the PM₁₀ sulfate and nitrate results, see the section on atmospheric deposition.

Table 4
PM₁₀ Data-2003
24-Hour and Annual Averages

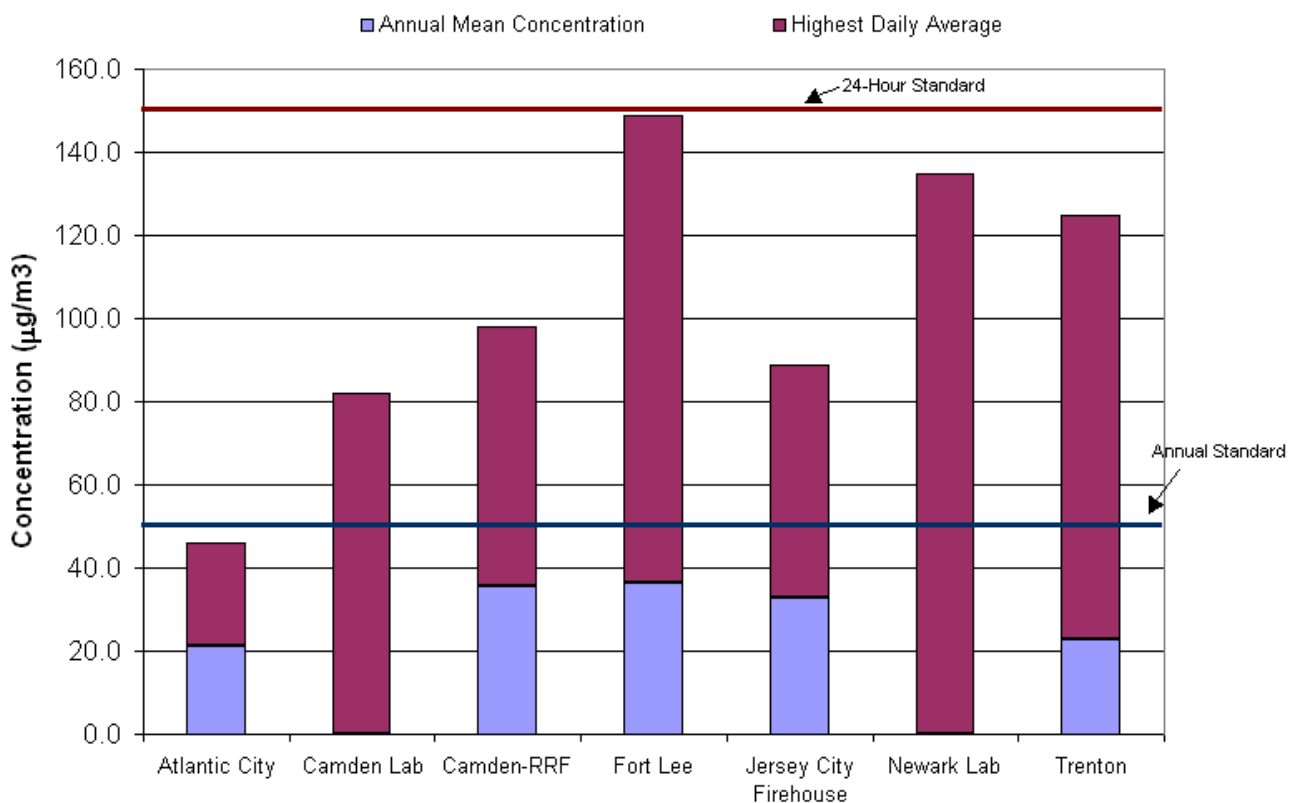
Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)
24-Hour Standard = $150 \mu\text{g}/\text{m}^3$
Annual Standard = $50 \mu\text{g}/\text{m}^3$

Monitoring Site	Number of Samples	24-Hour Maximum	Second Highest	Annual Mean
Atlantic City	56	46	35	21.2
Camden Lab ^a	42	82	52	****
Camden RRF #1	56	98	56	35.5
Fort Lee	58	149	75	36.5
Jersey City - Firehouse	55	89	61	32.1
Newark Lab ^b	23	135	41	****
Trenton	57	125	70	22.7

^a Data Not Available after September

^b Data Not Available after May

Figure 9
Summary of PM₁₀ Concentrations, New Jersey 2003



SMOKE SHADE SUMMARY

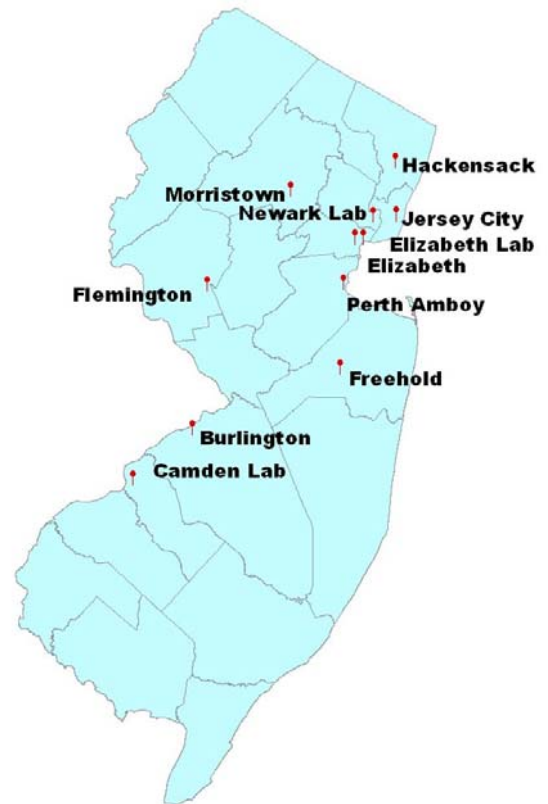
SMOKE SHADE MONITORING SITES

In addition to fine and coarse particulate monitoring, smoke shade is also monitored at 11 stations around the state. Smoke shade, which is an indirect measurement of particles in the atmosphere, has been monitored in New Jersey for over 30 years. Smoke shade is primarily used for the daily reporting of particulate levels in the Air Quality Index. The sites monitoring smoke shade are shown in Figure 10.

SMOKE SHADE CONCENTRATION SUMMARY

In 2003, the annual mean concentration of smoke shade ranged from 0.15 Coefficient of Haze units (COH) at Flemington to 0.54 COH at Elizabeth Lab. COH are units of light transmittance and smoke shade is not a direct measure of particle mass. A 24-hour average level of 2.0 COH is used as a benchmark. Readings above the 2.0 COH benchmark are reported as Unhealthy for Sensitive Groups on the daily Air Quality Index. For more details see the Air Quality Index section of this report. Table 5 lists the maximum and second highest daily average and annual mean smoke shade levels recorded at the monitoring sites in 2003.

**Figure 10
2003 Smoke Shade
Monitoring Network**



**Table 5
Smoke Shade - 2003**

Coefficient of Haze (COHs)
No Standard

Site	Maximum Daily Average	2nd Highest	Annual Mean
Burlington	0.92	0.58	0.17
Camden Lab ^a	0.74	0.55	----
Elizabeth	1.26	1.24	0.43
Elizabeth Lab	1.45	1.24	0.54
Flemington	0.52	0.49	0.15
Freehold	0.69	0.54	0.20
Hackensack	1.00	0.90	0.24
Jersey City	1.40	1.38	0.48
Morristown	1.13	0.80	0.24
Newark Lab ^b	0.84	0.74	----
Perth Amboy	1.28	0.87	0.27

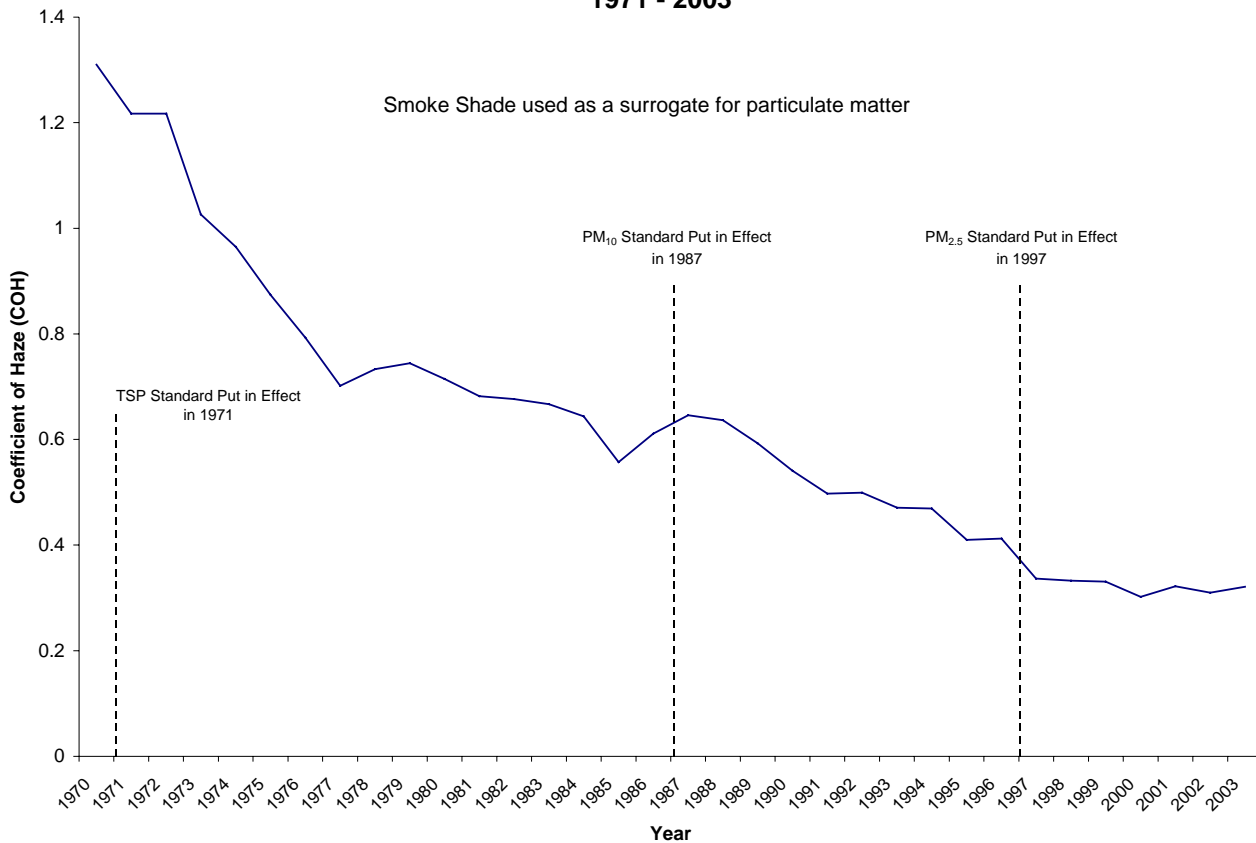
^a Data Not Available after September

^b Data Not Available after June

TRENDS IN PARTICULATE CONCENTRATIONS

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

Figure 11
Long Term Trend in Particulate Levels
1971 - 2003



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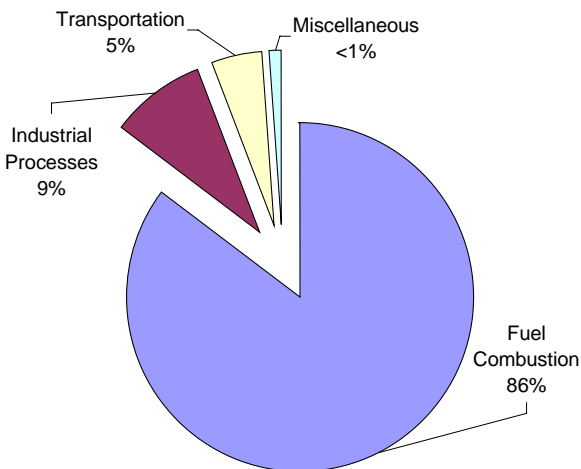
2003 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Sulfur Dioxide (SO₂) is a heavy, colorless gas with a suffocating odor. Sulfur is found in raw materials such as crude oil, coal, and ore that contains metals such as aluminum, copper, zinc, lead and iron. SO₂ gases can be formed when fuel-containing sulfur is burned, or when gasoline is extracted from oil. SO₂ easily dissolves in water 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 SO₂. Sulfur dioxide is also found in volcanic gases. A pie chart summarizing the major sources of SO₂ is shown in Figure 1.

Figure 1
National Summary of 2002
SO₂ Emissions by Source Category^a



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

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

HEALTH AND ENVIRONMENTAL EFFECTS

Sulfur dioxide causes irritation of the mucous membranes, which probably results from the action of sulfurous acid formed when the highly soluble SO₂ dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO₂ include children, the elderly, and people with heart or lung disorders such as asthma. When there are peak levels of SO₂ in the air, people belonging to these sensitive groups and those who are active outdoors may have trouble breathing. The International Agency for Research on Cancer (IARC) has classified sulfur dioxide as Group 3, not classifiable as to human carcinogenicity.

Sulfur Dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people and the environment. SO₂ also contributes to acid rain, as it 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, can make lakes and streams too acidic for fish, and speeds up the decay of building materials and paints. In addition, sulfate particles formed from SO₂ are the major cause of reduced visibility in many parts of the U.S.

STANDARDS

There are several health and welfare based standards for sulfur dioxide. There are three National Ambient Air Quality Standards (NAAQS) for SO₂. There is an annual average health standard of 0.030 parts per million (ppm). This is based on a calendar year average of continuously monitored levels. There is also a 24-hour average health based standard of 0.14 ppm which is not to be exceeded more than once a year, and a secondary (welfare based) standard of 0.50 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 SO₂. They are similar to the federal standards but are expressed in micrograms per cubic meter (µg/m³) instead

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

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

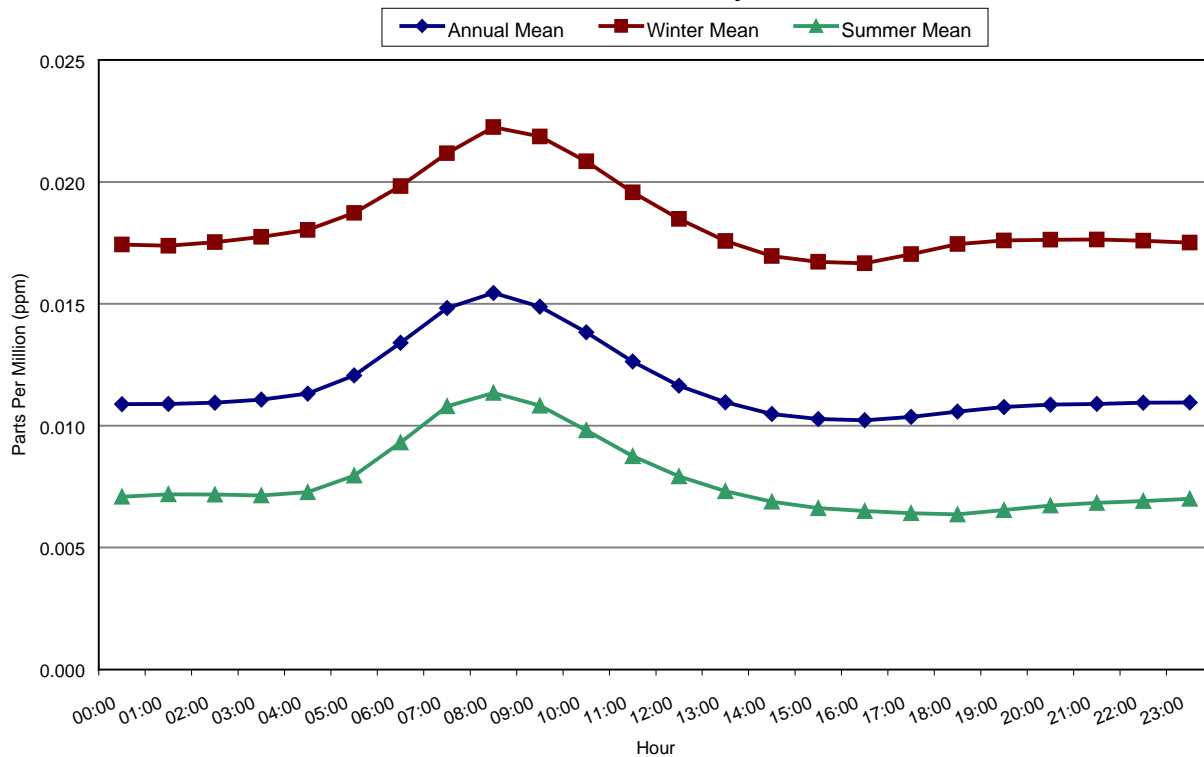
Table 1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide

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

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

^a National standards are block averages rather than moving averages

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



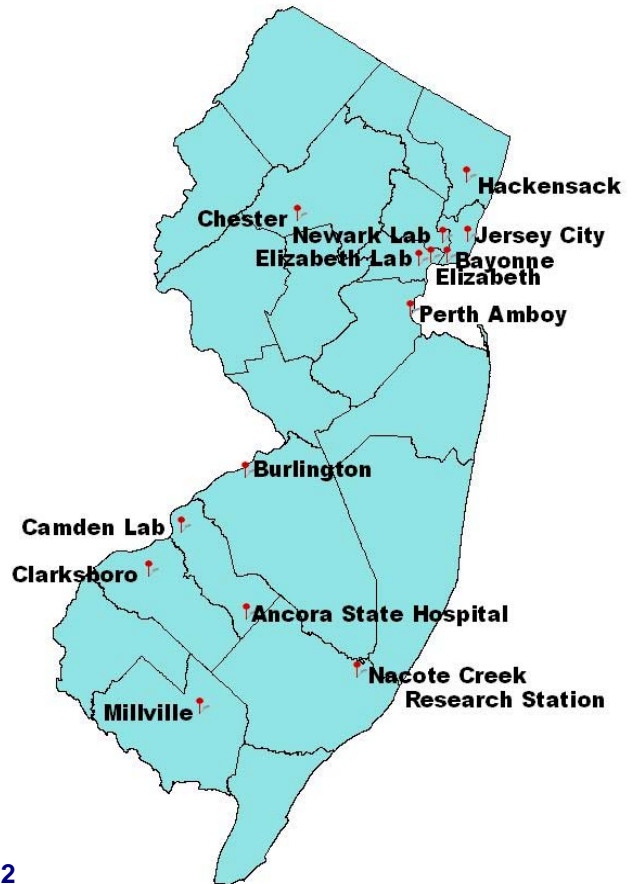
MONITORING LOCATIONS

The state monitored SO₂ levels at 14 locations in 2003. These sites are shown in the map in Figure 3. Newark Lab was discontinued on June 5, 2003 and Camden Lab was temporarily discontinued on September 22, 2003. Therefore, a valid annual average for the calendar year could not be calculated for these sites.

SO₂ LEVELS IN 2003

None of the monitoring sites recorded exceedances of the primary or secondary SO₂ standards during 2003. The maximum annual average concentration recorded was 0.009 ppm at Jersey City. The maximum 24-hour average level recorded was 0.036 ppm, which was recorded in Jersey City. The highest 3-hour average recorded was 0.063 ppm also at Jersey City. Summaries of the 2003 data are provided in Table 2, Table 3 (page 4) and Figure 4 (Page 4).

**Figure 3
2003 Sulfur Dioxide
Monitoring Network**



**Table 2
Sulfur Dioxide Data – 2003
3-Hour and Annual Averages**

Parts Per Million (ppm)
3-Hour Standard = .5 ppm
Annual Standard = .03 ppm

Monitoring Sites	3-Hour Average Maximum	3-Hour Average 2 nd Highest	12-Month Average Maximum	Average Calendar Year
Ancora State Hospital	0.026	0.022	0.004	0.003
Bayonne	0.049	0.041	0.006	0.006
Burlington	0.038	0.032	0.004	0.004
Camden Lab ^a	0.052	0.052	0.008	----
Chester	0.040	0.039	0.004	0.004
Clarksboro	0.035	0.032	0.005	0.004
Elizabeth	0.041	0.040	0.006	0.006
Elizabeth Lab	0.050	0.047	0.009	0.008
Hackensack	0.040	0.039	0.004	0.004
Jersey City	0.063	0.058	0.009	0.009
Millville	0.024	0.022	0.004	0.004
Nacote Creek Research Station	0.025	0.020	0.003	0.003
Newark Lab ^b	0.051	0.045	0.005	----
Perth Amboy	0.042	0.034	0.005	0.005

^aData not available after September

^bData not available after June

Table 3
Sulfur Dioxide Data – 2003
24-Hour and Daily Averages

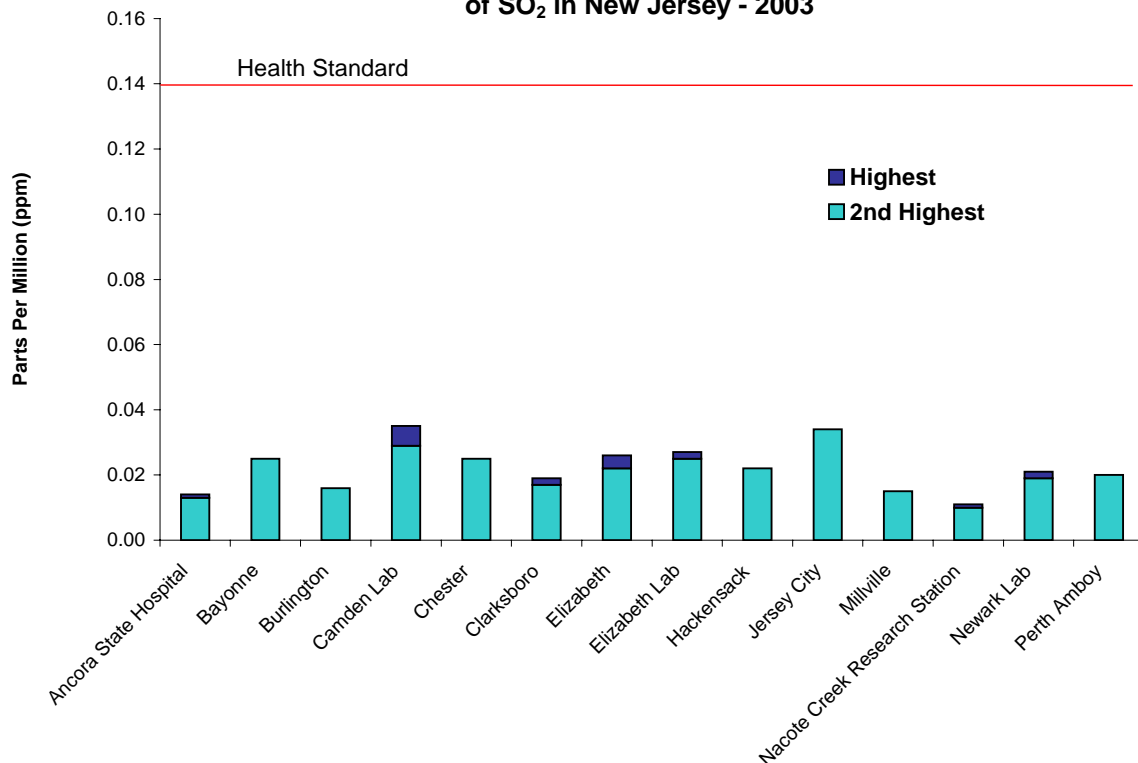
Parts Per Million (ppm)
 24-Hour Standard = .14 ppm

Monitoring Sites	24-Hour Average Maximum	24-Hour Average 2 nd Highest	Daily Average Maximum	Daily Average 2 nd Highest
Ancora State Hospital	0.016	0.012	0.014	0.013
Bayonne	0.025	0.025	0.025	0.025
Burlington	0.020	0.017	0.016	0.016
Camden Lab ^a	0.035	0.031	0.035	0.029
Chester	0.026	0.025	0.025	0.025
Clarksboro	0.021	0.019	0.019	0.017
Elizabeth	0.028	0.023	0.026	0.022
Elizabeth Lab	0.030	0.030	0.027	0.025
Hackensack	0.025	0.023	0.022	0.022
Jersey City	0.036	0.034	0.034	0.034
Millville	0.018	0.015	0.015	0.015
Nacote Creek Research Station	0.011	0.011	0.011	0.010
Newark Lab ^b	0.023	0.021	0.021	0.019
Perth Amboy	0.025	0.024	0.020	0.020

^aData not available after September

^bData not available after June

Figure 4
Highest and 2nd Highest Daily Averages
of SO₂ in New Jersey - 2003



TRENDS

Since the implementation of regulations requiring the use of low sulfur fuels in New Jersey, SO₂ concentrations have improved significantly. The last time an exceedance of any of the National SO₂ standards was recorded in the state was in 1980. A trend graph of SO₂ levels showing the daily average concentrations recorded since 1975 from the highest, average and lowest of all sites is shown in Figure 5 below. The graph uses the second highest daily 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
Sulfur Dioxide Concentrations in New Jersey
1975-2003
Second Highest Daily Average

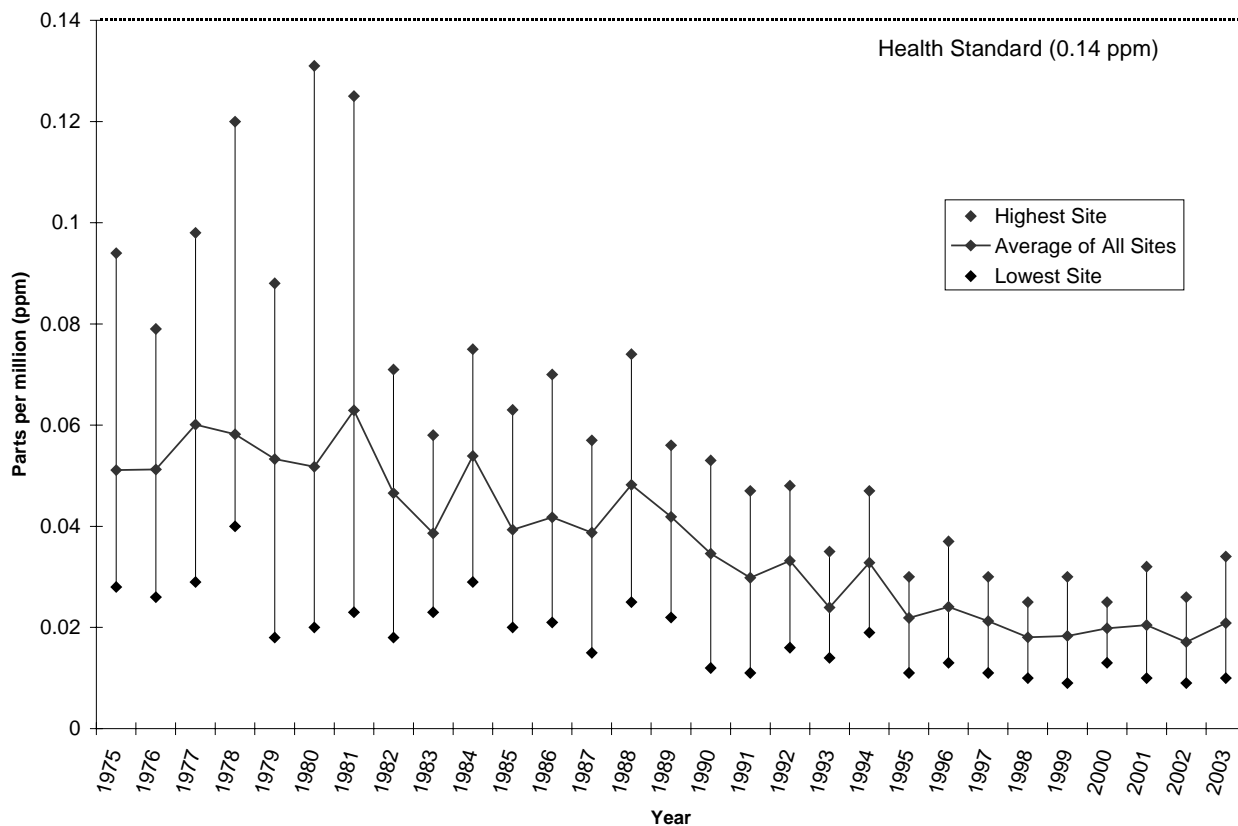
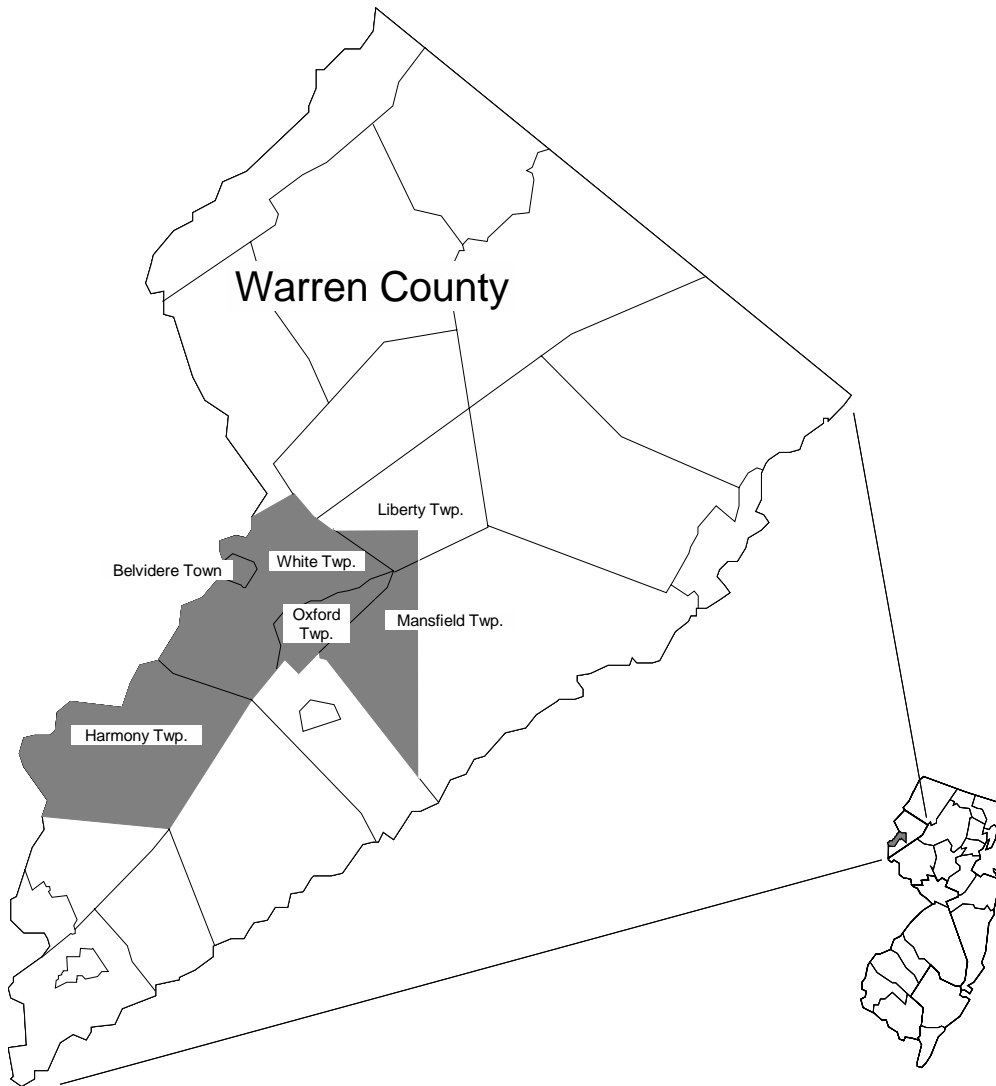


Figure 6
Sulfur Dioxide Non-Attainment Areas* in New Jersey



Legend

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

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

FIVE MINUTE AVERAGE SO₂ MONITORING

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

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

In October 2002, an air monitoring project was established in Warren County, New Jersey to evaluate the feasibility of monitoring 5-minute SO₂ concentrations in the vicinity of a local point source. This is the first time since the publication of USEPA's draft "Guideline Document for Ambient Monitoring of 5-Minute SO₂ Concentrations" that SO₂ concentrations anywhere in New Jersey are being directly compared to the 5-minute SO₂ guideline IL. Warren County was selected for this study as the Belvidere area of the county is the only SO₂ non-attainment area in the state (see Figure 6 - page 6). The study had broad community involvement in its design and implementation. It is primarily being supported by a

local industrial facility as part of a Supplemental Environmental Project (SEP).

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

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2003 Air Toxics Summary

New Jersey Department of Environmental Protection

INTRODUCTION

Air pollutants can be divided into two categories: the criteria pollutants (ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead); and air toxics. The criteria pollutants have been addressed at the national level for many years. The United States Environmental Protection Agency (USEPA) has set National Ambient Air Quality Standards (NAAQS) for them, and they are subject to a standard planning process that includes monitoring, reporting, and control requirements. Each of these pollutants is discussed in its own section of this NJDEP 2003 Air Quality Report.

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

HEALTH EFFECTS

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

The effects on human health resulting from exposure to specific air toxics can be estimated by using chemical-

specific "health benchmarks." These are developed by the USEPA and other agencies by looking at numerous health studies for a chemical. For carcinogens, the health benchmark is set at the concentration of the pollutant that corresponds to a one in a million increase in the risk of getting cancer if a person was to breathe that concentration over his or her entire lifetime. The health benchmark for non-carcinogens is set at a concentration not expected to have any adverse health effects, also known as the reference concentration. Health benchmarks for each of the air toxics are listed in Table 4. If ambient air concentrations exceed the set benchmarks then further action is warranted.

SOURCES OF AIR TOXICS

A few years ago, USEPA began a national study of air toxics, the National-Scale Air Toxics Assessment (NATA). To determine people's exposure to air toxics around the country, USEPA first prepared a comprehensive inventory of air toxics emissions from all man-made sources in 1996. The 1996 emissions inventory for New Jersey was briefly reviewed and revised by NJDEP before being finalized. Although there are likely to be some errors in the details of such a massive undertaking, the emissions inventory still can give us an indication of the most important sources of air toxic emissions in our state. The pie chart in Figure 1 (see page 2), based on the 1996 NATA emissions estimates, shows that mobile sources are the largest contributors of air toxics emissions in New Jersey.

On-road mobile sources (cars, and trucks) account for 35% of the emissions, and off-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) contribute 33%. Area sources (residential, commercial, and small industrial sources) represent 25% of the inventory, and major point sources (such as factories and power plants) account for the remaining 7%.

Air toxics come from so many different sources - not only manufacturing, but also other kinds of human activity. When New Jersey's emissions estimates are broken down by county (see Figure 2) it is evident that the areas with the

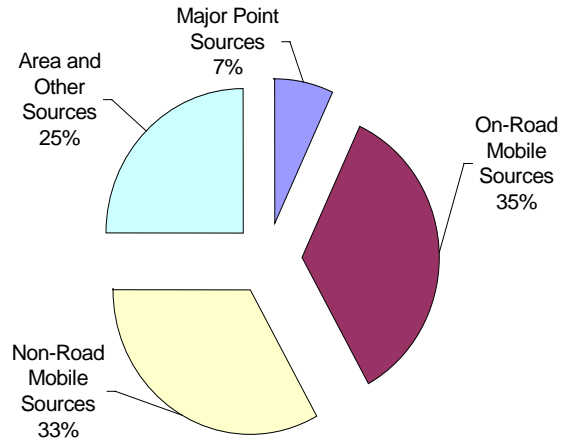
largest air toxic emissions are generally those with the largest populations. This is directly related to high levels of vehicle use, solvent use, heating, and other population-related activities in those counties.

ESTIMATING AIR TOXICS EXPOSURE

The next step in USEPA's NATA project was to use the emissions information in an air dispersion model. The model estimates the concentrations of air toxics that people may be exposed to in different parts of the country. The map in Figure 3 shows the predicted concentrations of benzene throughout New Jersey. The high concentration areas tend to overlap the more densely populated areas of the state, following the pattern of emissions. Not all air toxics follow this pattern, as some are more closely associated with individual point sources, but in general, larger populations result in greater emissions of, and exposure to, air toxics.

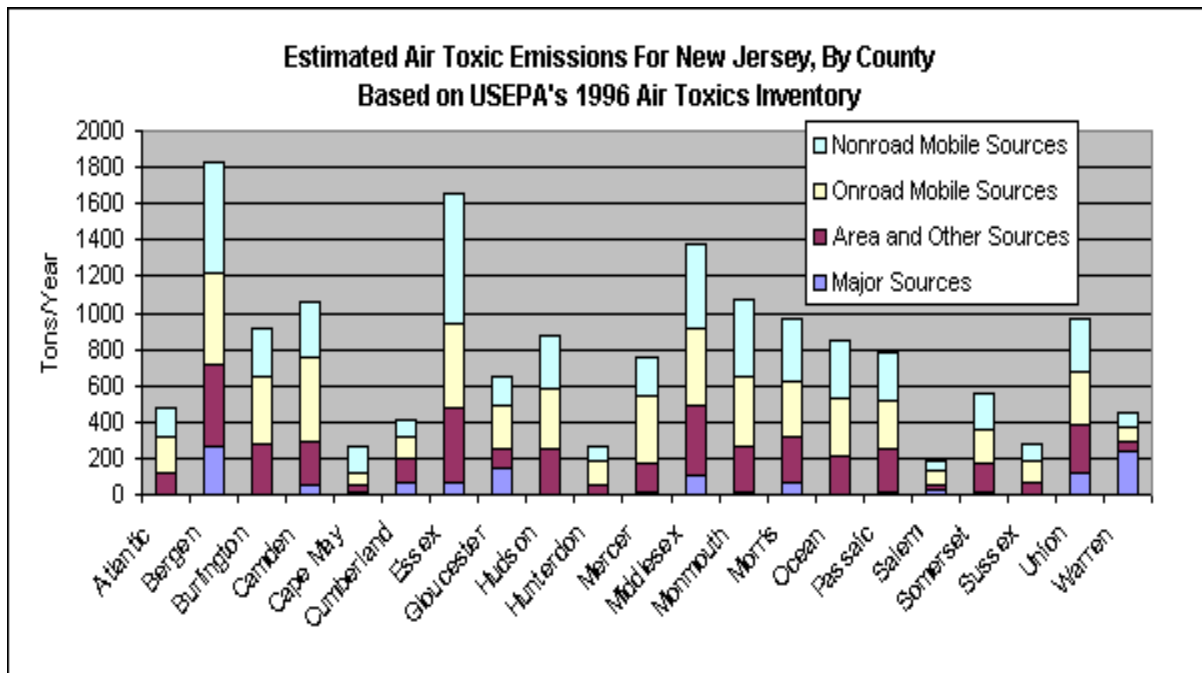
Our preliminary analysis of the state and county

Figure 1
1996 Air Toxics Emissions Estimates for New Jersey



Source: USEPA's National Air Toxics Assessment, 1996

Figure 2



average air toxics concentrations generated by NATA indicates that nineteen chemicals were predicted to exceed their health benchmarks, or level of concern, in one or more counties in 1996. Eighteen of these are considered to be cancer causing (carcinogenic) chemicals, and one (acrolein) is not. Estimated air concentrations of these 19 pollutants vary around the state, depending on the type of sources that emit them. This is summarized in Table 1.

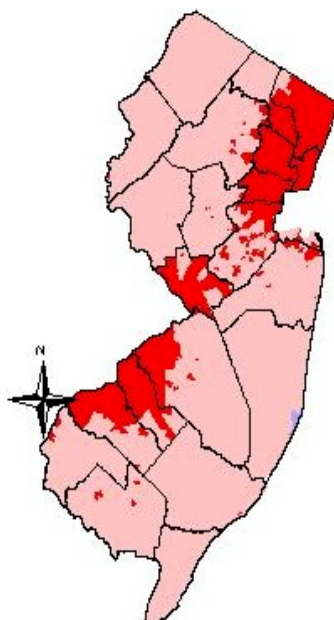
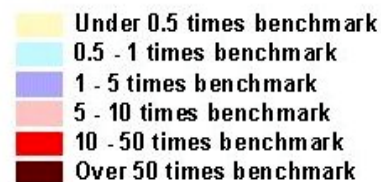


Figure 3
NATA PREDICTED CONCENTRATIONS
IN NEW JERSEY FOR 1996

Benzene



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

Health Benchmark = 0.13ug/m³

Table 1

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

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

AIR TOXICS MONITORING PROGRAM

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

A comparison of the concentrations predicted by NATA and actual monitored levels can be made for the Camden Lab site. In 1996, thirteen of the compounds evaluated in NATA were measured in Camden. Table 2 compares the NATA predictions with the measured concentrations for 1996. Measured 2003 levels, and the percent of change from 1996, are also shown. Of the thirteen air toxics measured, three of them fell below detection limits in 1996, so no concentration can be reported for that year. For the remaining ten compounds, the comparisons are shown in Figure 5. It appears from this analysis that the agreement between predicted and monitored concentrations is remarkably good. Also, for most of the thirteen air toxics in Table 2, the 2003 levels measured at the Camden Lab were substantially lower than the concentrations measured in 1996.

Figure 4
2003 Air Toxics
Monitoring Network

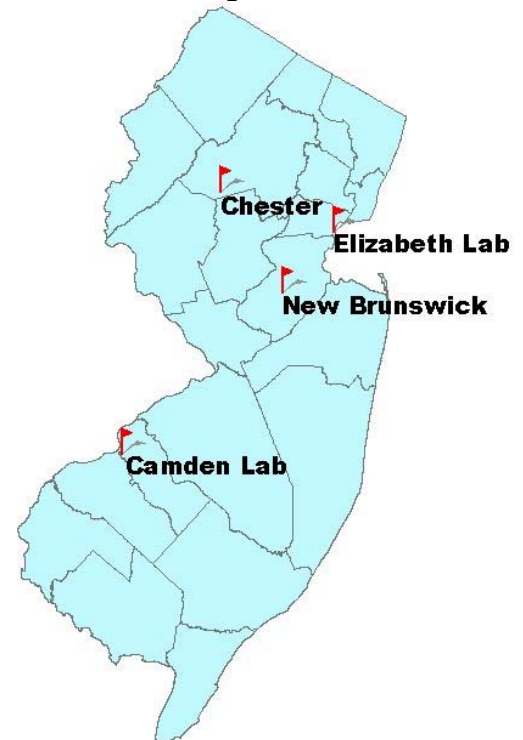


Figure 5
Air Toxics Levels Measured in 1996 at Camden,
New Jersey Compared to NATA Predicted Levels

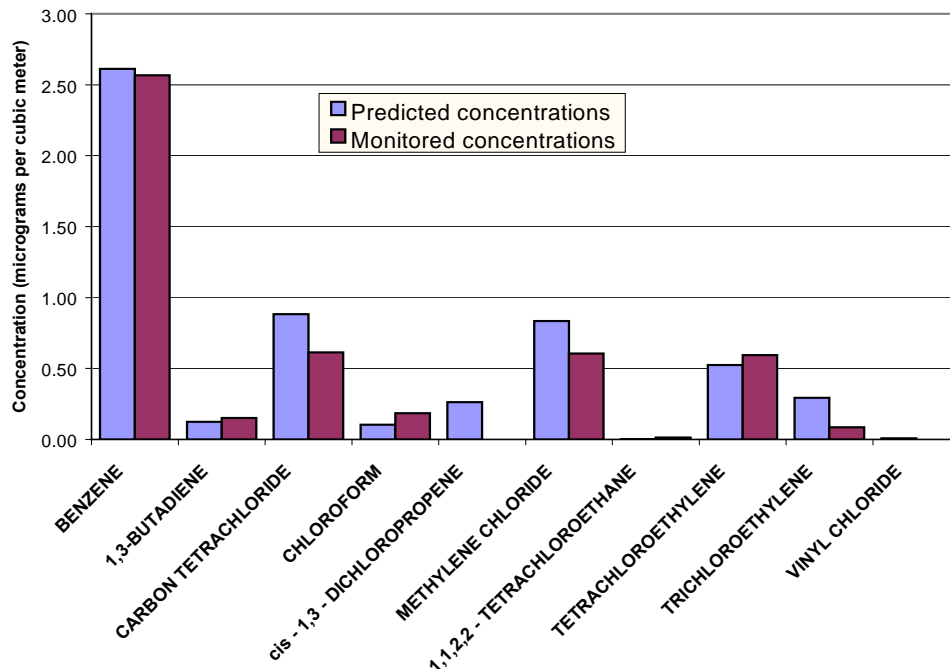


Table 2
Comparison of NATA Predicted to Measured Levels in Camden, NJ

NA – Not Available
 $\mu\text{g}/\text{m}^3$ - 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 2003 Level, $\mu\text{g}/\text{m}^3$	Percent Change in Measured Levels in 1996 and 2003
Acetaldehyde	1.74	4.53	NA	NA
Acrylonitrile	0.003	NA	0.02*	NA
Benzene	2.61	2.57	0.50	-80.5%
1,3-Butadiene	0.12	0.15	0.03*	-80.0%
Carbon Tetrachloride	0.88	0.61	0.08	-86.9%
Chloroform*	0.10	0.18*	0.00*	-100%
cis-1,3-Dichloropropene*	0.26	0.00*	0.00*	0.0%
Formaldehyde	2.20	14.63	NA	NA
Methylene Chloride	0.83	0.61	0.11	-82.0%
1,1,2,2-Tetrachloroethane*	0.00	0.01*	0.00*	-100%
Tetrachloroethylene	0.52	0.59	0.02*	-96.6%
Trichloroethylene	0.29	0.09*	0.00*	-100%
Vinyl Chloride *	0.01	0.00*	0.00*	0.0%

* Measurement fell below detection limits.

Negative values for percent change mean measured levels went down from 1996 to 2003

AIR TOXICS MONITORING RESULTS FOR 2003

The results of the air toxics monitoring program for 2003 are shown in Table 3. This table shows the average concentration for each air toxic measured at the four New Jersey monitoring sites. All values are in parts per billion by volume (ppbv). More detailed tables (Tables 4-7) that show additional statistics, detection limit information, health benchmarks used by NJDEP, and levels in ppbv and micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) 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. Concentrations below the detection limit, including zero values, were used in the calculation of the annual average concentrations.

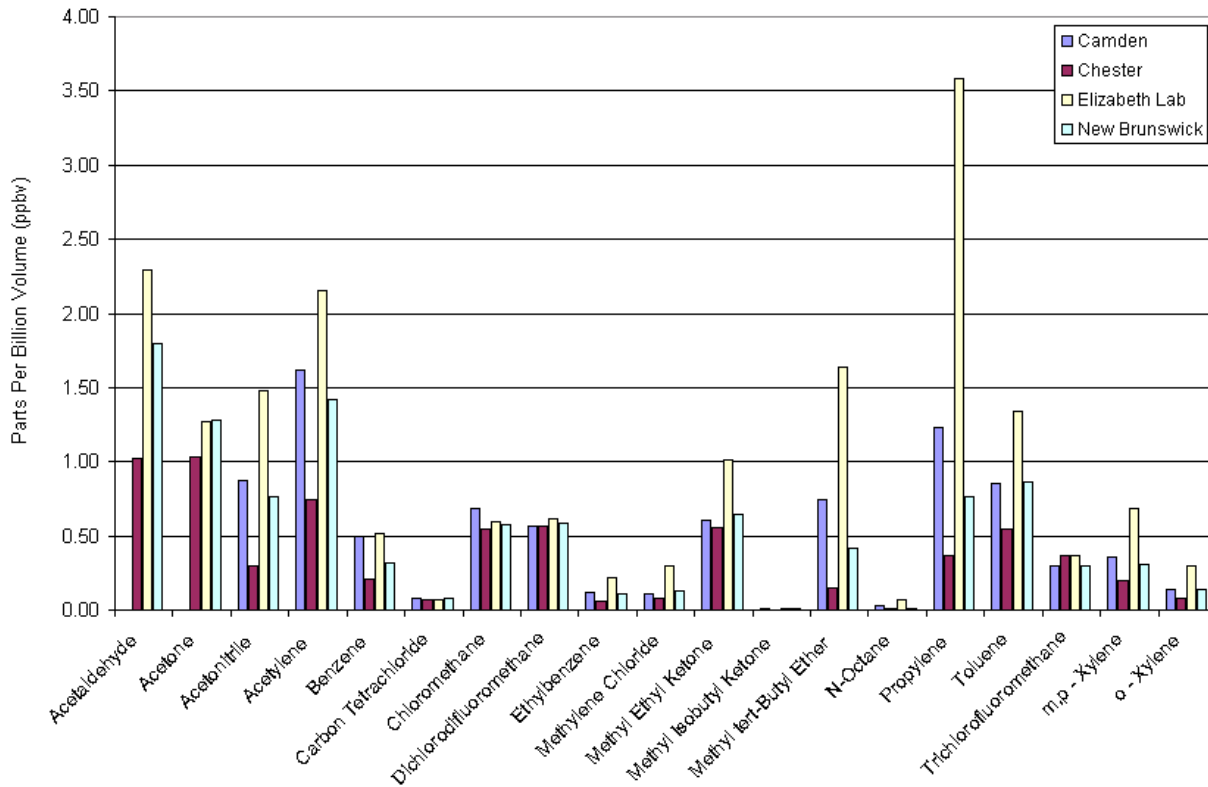
Reported averages for which a significant portion of the data (more than 50%) was below the detection limit should be viewed with extreme caution. Median values (the value of the middle sample value when the results are ranked) are reported along with the mean (average) concentrations because for some compounds only a single or very few high values were recorded. These high values will tend to increase the average concentration significantly but would have less effect on

the median value. In such cases, the median value may be a better indicator of long term exposures, on which most of the health benchmarks for air toxics are based. The average concentrations for some of the more prevalent air toxics are graphed in Figure 6.

The Elizabeth Lab site has the highest concentrations for the majority of the prevalent air toxics and also had the highest number of compounds (nine) with average concentrations that exceeded their health benchmark. New Brunswick also had nine

compounds exceeding health benchmarks. It is also important to note that instrumental malfunction caused unusually low readings for a portion of compounds at Camden from September 2002 through July 2003. This group of compounds are called carbonyls and are noted as not available (NA) in Tables 2-4. The toxic air pollutants that exceeded the health benchmark included acetaldehyde, benzene, carbon tetrachloride, chloromethane, and formaldehyde.

**Figure 6
Selected Toxic Volatile Organics
2003 Annual Averages
New Jersey**



**Table 3
New Jersey Air Toxics Summary – 2003**

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

Pollutant	Camden Lab^a	Chester	Elizabeth Lab	New Brunswick
Acetaldehyde	NA	1.02	2.30	1.80
Acetone	NA	1.04	1.27	1.28
Acetonitrile	0.88	0.30	1.48	0.77
Acetylene	1.61	0.74	2.15	1.42
Acrylonitrile	0.02	0.02	0.01	0.01
tert-Amyl Methyl Ether	0.00	0.00	0.02	0.00
Benzaldehyde	NA	0.03	0.06	0.03
Benzene	0.50	0.21	0.51	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	0.43	0.00	0.00	0.00
1,3-Butadiene	0.03	0.01	0.08	0.02
Butyr/Isobutyraldehyde	NA	0.11	0.18	0.17
Carbon Tetrachloride	0.08	0.07	0.07	0.08
Chlorobenzene	0.00	0.00	0.00	0.00
Chloroethane	0.00	0.00	0.00	0.00
Chloroform	0.00	0.00	0.01	0.01
Chloromethane	0.68	0.55	0.60	0.57
Chloromethylbenzene	0.00	0.00	0.00	0.00
Chloroprene	0.00	0.00	0.00	0.00
Crotonaldehyde	NA	0.07	0.09	0.10
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	0.01	0.00	0.01	0.00
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	0.01
trans - 1,2 - Dichloroethylene	0.00	0.00	0.00	0.00
Dichlorodifluoromethane	0.57	0.57	0.61	0.58
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	NA	0.00	0.01	0.00
Ethyl Acrylate	0.00	0.00	0.00	0.00
Ethylbenzene	0.12	0.06	0.22	0.11
Ethyl tert-Butyl Ether	0.00	0.00	0.00	0.00
Formaldehyde	NA	2.68	3.23	2.82

Table 3 (Continued)
New Jersey Air Toxics Summary – 2003

Annual Average Concentration
ppbv – Parts Per Billion by Volume

Pollutant	Camden Lab^a	Chester	Elizabeth Lab	New Brunswick
Hexachloro-1,3-Butadiene	0	0.00	0.00	0.00
Hexaldehyde	NA	0.02	0.17	0.04
Isovaleraldehyde	NA	0.00	0.00	0.01
Methylene Chloride	0.11	0.08	0.30	0.13
Methyl Ethyl Ketone	0.60	0.56	1.02	0.65
Methyl Isobutyl Ketone	0.01	0.00	0.01	0.01
Methyl Methacrylate	0.00	0.00	0.03	0.00
Methyl tert-Butyl Ether	0.74	0.15	1.64	0.42
N-Octane	0.03	0.01	0.07	0.01
Propionaldehyde	NA	0.08	0.18	0.15
Propylene	1.23	0.37	3.58	0.76
Styrene	0.02	0.02	0.06	0.02
1,1,2,2 - Tetrachloroethane	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.02	0.02	0.04	0.03
Tolualdehydes	NA	0.02	0.06	0.03
Toluene	0.86	0.55	1.34	0.86
1,2,4-Trichlorobenzene	0	0.00	0.00	0.00
1,1,1 - Trichloroethane	0.01	0.01	0.02	0.01
1,1,2 - Trichloroethane	0.00	0.00	0.00	0.00
Trichloroethylene	0.00	0.00	0.02	0.00
Trichlorofluoromethane	0.30	0.36	0.37	0.30
Trichlorotrifluoroethane	0.10	0.09	0.10	0.10
1,2,4-Trimethylbenzene	0.12	0.04	0.17	0.09
1,3,5-Trimethylbenzene	0.03	0.01	0.05	0.02
Valeraldehyde	NA	0.02	0.12	0.05
Vinyl Chloride	0.00	0.00	0.00	0.00
m,p - Xylene	0.35	0.19	0.68	0.30
o - Xylene	0.14	0.08	0.29	0.13

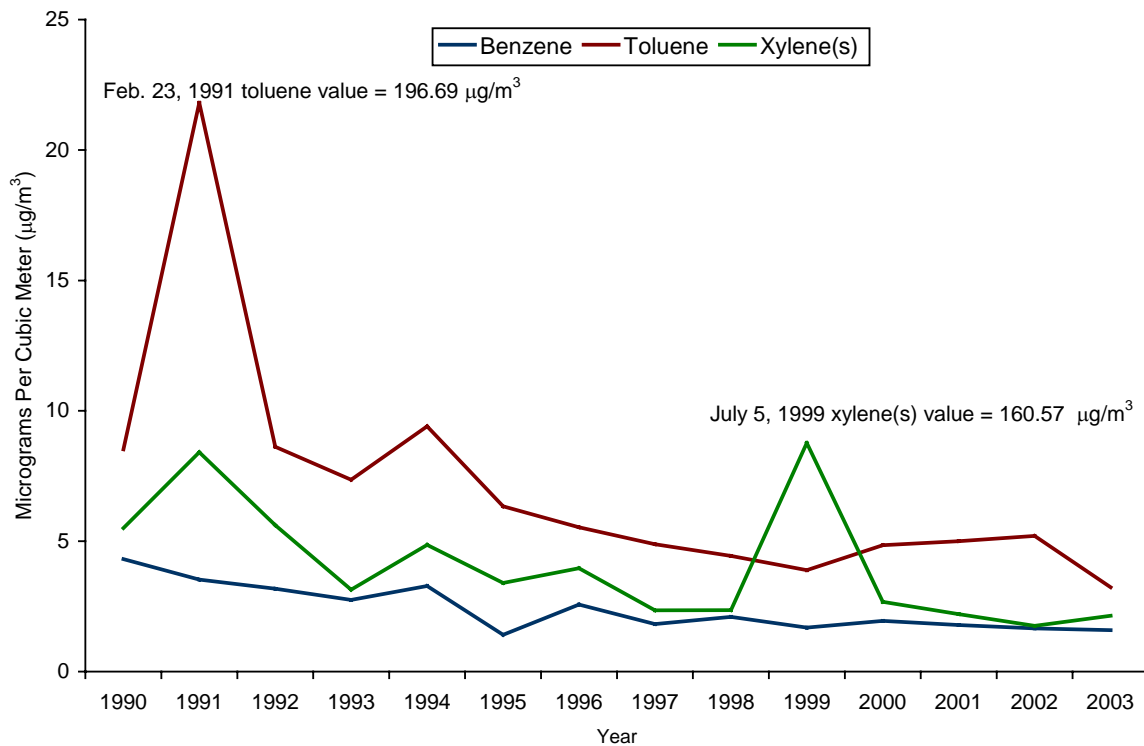
^a Data not available for the 4th quarter of 2003

TRENDS

The site in Camden is the only monitoring location that has been measuring air toxics for an extended period. The graph in Figure 7 shows the change in concentrations for three of the most prevalent air toxics (benzene, toluene, and xylene) from 1990 to 2003. 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 comprise such a large and diverse group of compounds, however, these general trends may not hold for other pollutants in different areas of the state.

Figure 7
Annual Averages for Selected Hazardous Air
Pollutants (HAPs) at Camden Lab from 1990-2003



^aData not available for 4th quarter of 2003

Table 4
Air Toxics Data 2003
January – September
Camden Lab, New Jersey

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. ppbv	Median ppbv
Acetaldehyde	0.005	100	0.45	NA	NA	2.91	NA
Acetone	0.002	100	30881	NA	NA	1.02	NA
Acetonitrile	0.25	24	60	1.47	0.88	8.83	0.00
Acetylene	0.13	100		1.72	1.61	4.65	1.45
Acrylonitrile	0.21	11	0.015	0.05	0.02	0.34	0.00
tert-Amyl Methyl Ether	0.12	3		0.00	0.00	0.03	0.00
Benzaldehyde	0.003	97		NA	NA	0.05	NA
Benzene	0.04	100	0.13	1.59	0.50	1.30	0.43
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	0.91	0.00	0.00	0.00	0.00
Bromomethane	0.09	41	5	1.67	0.43	11.09	0.00
1,3-Butadiene	0.07	35	0.033	0.07	0.03	0.21	0.00
Butyr/Isobutyraldehyde	0.011	100		NA	NA	0.44	NA
Carbon Tetrachloride	0.08	89	0.067	0.50	0.08	0.12	0.09
Chlorobenzene	0.06	0	1000	0.00	0.00	0.00	0.00
Chloroethane	0.08	0		0.00	0.00	0.00	0.00
Chloroform	0.05	11	0.043	0.01	0.00	0.04	0.00
Chloromethane	0.05	100	0.56	1.40	0.68	1.03	0.65
Chloromethylbenzene	0.07	0		0.00	0.00	0.00	0.00
Chloroprene	0.01	3	7	0.00	0.00	0.05	0.00
Crotonaldehyde	0.005	94		NA	NA	0.31	NA
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	22	0.091	0.08	0.01	0.14	0.00
Dichlorodifluoromethane	0.04	100	200	2.25	0.57	0.90	0.57
1,1 – Dichloroethane	0.08	0	0.63	0.00	0.00	0.00	0.00
1,2 – Dichloroethane	0.06	0	0.000053	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0	200	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
1,2 – Dichloropropane	0.07	0	0.1	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	0		0.00	0.00	0.00	0.00
2,5-Dimethylbenzaldehyde	0.004	3		NA	NA	0.00	NA

**Table 4 (Continued)
Air Toxics Data – 2003
January - September
Camden Lab, New Jersey**

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean ppbv	Max. Ppbv	Median Ppbv
Ethyl Acrylate	0.16	0	2	0.00	0.00	0.00	0.00
Ethylbenzene	0.04	89		0.50	0.12	0.29	0.10
Ethyl tert-Butyl Ether	0.15	0		0.00	0.00	0.00	0.00
Formaldehyde	0.016	100	0.077	NA	NA	4.11	NA
Hexachloro-1,3-Butadiene	0.06	0	0.0455	0.00	0.00	0.00	0.00
Hexaldehyde	0.003	100		NA	NA	0.07	NA
Isovaleraldehyde	0.004	3		NA	NA	0.02	NA
Methylene Chloride	0.06	65	2.1	0.39	0.11	0.62	0.09
Methyl Ethyl Ketone	0.15	46		1.77	0.60	6.34	0.00
Methyl Isobutyl Ketone	0.15	11	80	0.04	0.01	0.23	0.00
Methyl Methacrylate	0.18	0	700	0.00	0.00	0.00	0.00
Methyl tert-Butyl Ether	0.18	78	3.8	2.68	0.74	2.41	0.55
N-Octane	0.06	38		0.16	0.03	0.21	0.00
Propionaldehyde	0.005	94		NA	NA	0.18	NA
Propylene	0.05	100	3000	2.12	1.23	4.76	0.83
Styrene	0.07	30	1.8	0.07	0.02	0.12	0.00
1,1,2,2 – Tetrachloroethane	0.06	0	0.017	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.06	30	0.17	0.13	0.02	0.11	0.00
Tolualdehydes	0.009	100		NA	NA	0.08	NA
Toluene	0.06	100	400	3.23	0.86	1.90	0.68
1,2,4-Trichlorobenzene	0.06	0	200	0.00	0.00	0.00	0.00
1,1,1 – Trichloroethane	0.06	35	1000	0.08	0.01	0.19	0.00
1,1,2 – Trichloroethane	0.06	0	0.063	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	8	0.5	0.02	0.00	0.07	0.00
Trichlorofluoromethane	0.04	100	700	1.67	0.30	0.47	0.28
Trichlorotrifluoroethane	0.07	95		0.80	0.10	0.17	0.10
1,2,4-Trimethylbenzene	0.07	92		0.58	0.12	0.31	0.10
1,3,5-Trimethylbenzene	0.07	51		0.15	0.03	0.11	0.02
Valeraldehyde	0.05	94		NA	NA	0.06	NA
Vinyl Chloride	0.06	3	0.11	0.00	0.00	0.06	0.00
m,p - Xylene	0.05	97	100	1.53	0.35	0.87	0.28
o - Xylene	0.05	95	100	0.61	0.14	0.33	0.12

^{1,2,3} See table end notes on Air Toxics page 18

Table 5
Air Toxics Data – 2003
Chester, New Jersey

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean Ppbv	Max. Ppbv	Median ppbv
Acetaldehyde	0.005	100	0.45	1.84	1.02	2.39	0.92
Acetone	0.002	100	30881	2.46	1.04	1.97	1.03
Acetonitrile	0.25	30	60	0.50	0.30	5.11	0.00
Acetylene	0.13	96		0.79	0.74	1.96	0.70
Acrylonitrile	0.21	9	0.015	0.03	0.02	0.33	0.00
tert-Amyl Methyl Ether	0.12	0		0.00	0.00	0.00	0.00
Benzaldehyde	0.003	100		0.12	0.03	0.07	0.02
Benzene	0.04	98	0.13	0.68	0.21	0.45	0.20
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	0.91	0.00	0.00	0.00	0.00
Bromomethane	0.09	4	5	0.00	0.00	0.02	0.00
1,3-Butadiene	0.07	12	0.033	0.02	0.01	0.26	0.00
Butyr/Isobutyraldehyde	0.011	100		0.33	0.11	0.24	0.10
Carbon Tetrachloride	0.08	86	0.067	0.44	0.07	0.15	0.08
Chlorobenzene	0.06	0	1000	0.00	0.00	0.00	0.00
Chloroethane	0.08	4		0.00	0.00	0.02	0.00
Chloroform	0.05	14	0.043	0.01	0.00	0.03	0.00
Chloromethane	0.05	98	0.56	1.14	0.55	0.74	0.57
Chloromethylbenzene	0.07	2		0.01	0.00	0.12	0.00
Chloroprene	0.01	0	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	96		0.20	0.07	0.45	0.05
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	2	0.091	0.00	0.00	0.02	0.00
Dichlorodifluoromethane	0.04	98	200	2.25	0.57	1.19	0.57
1,1 - Dichloroethane	0.08	0	0.63	0.00	0.00	0.00	0.00
1,2 - Dichloroethane	0.06	0	0.000053	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0	200	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	2		0.01	0.00	0.10	0.00
1,2 - Dichloropropane	0.07	0	0.1	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	0		0.00	0.00	0.00	0.00
2,5-Dimethylbenzaldehyde	0.004	2		0.00	0.00	0.01	0.00
Ethyl Acrylate	0.16	0	2	0.00	0.00	0.00	0.00

**Table 5 – (Continued)
Air Toxics Data – 2003
Chester, New Jersey**

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean Ppbv	Max. Ppbv	Median ppbv
Ethylbenzene	0.04	61		0.25	0.06	0.75	0.04
Ethyl tert-Butyl Ether	0.15	0		0.00	0.00	0.00	0.00
Formaldehyde	0.016	100	0.077	3.29	2.68	11.35	2.20
Hexachloro-1,3-Butadiene	0.06	0	0.0455	0.00	0.00	0.00	0.00
Hexaldehyde	0.003	100		0.08	0.02	0.06	0.02
Isovaleraldehyde	0.004	20		0.01	0.00	0.04	0.00
Methylene Chloride	0.06	65	2.1	0.28	0.08	0.48	0.06
Methyl Ethyl Ketone	0.15	54		1.65	0.56	3.84	0.31
Methyl Isobutyl Ketone	0.15	4	80	0.01	0.00	0.14	0.00
Methyl Methacrylate	0.18	2	700	0.02	0.00	0.25	0.00
Methyl tert-Butyl Ether	0.18	61	3.8	0.54	0.15	0.73	0.12
N-Octane	0.06	16		0.06	0.01	0.37	0.00
Propionaldehyde	0.005	100		0.19	0.08	0.21	0.07
Propylene	0.05	96	3000	0.63	0.37	1.18	0.31
Styrene	0.07	18	1.8	0.07	0.02	0.61	0.00
1,1,2,2 - Tetrachloroethane	0.06	0	0.017	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.06	25	0.17	0.13	0.02	0.49	0.00
Tolualdehydes	0.009	98		0.12	0.02	0.06	0.02
Toluene	0.06	100	400	2.06	0.55	10.62	0.30
1,2,4-Trichlorobenzene	0.06	0	200	0.00	0.00	0.00	0.00
1,1,1 - Trichloroethane	0.06	37	1000	0.06	0.01	0.05	0.00
1,1,2 - Trichloroethane	0.06	0	0.063	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	2	0.5	0.00	0.00	0.01	0.00
Trichlorofluoromethane	0.04	98	700	2.03	0.36	3.50	0.28
Trichlorotrifluoroethane	0.07	95		0.69	0.09	0.14	0.10
1,2,4-Trimethylbenzene	0.07	61		0.19	0.04	0.56	0.03
1,3,5-Trimethylbenzene	0.07	26		0.04	0.01	0.21	0.00
Valeraldehyde	0.05	98		0.05	0.02	0.04	0.01
Vinyl Chloride	0.06	0	0.11	0.00	0.00	0.00	0.00
m,p - Xylene	0.05	93	100	0.84	0.19	1.19	0.17
o - Xylene	0.05	75	100	0.35	0.08	0.74	0.07

^{1,2,3} See table end notes on Air Toxics page 18

**Table 6
Air Toxics Data – 2003
Elizabeth Lab, New Jersey**

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean Ppbv	Max. Ppbv	Median ppbv
Acetaldehyde	0.005	100	0.45	4.13	2.30	7.18	1.80
Acetone	0.002	100	30881	3.02	1.27	5.99	0.88
Acetonitrile	0.25	49	60	2.48	1.48	6.34	0.00
Acetylene	0.13	100		2.29	2.15	8.38	1.57
Acrylonitrile	0.21	6	0.015	0.01	0.01	0.13	0.00
tert-Amyl Methyl Ether	0.12	25		0.10	0.02	0.23	0.00
Benzaldehyde	0.003	98		0.27	0.06	0.38	0.05
Benzene	0.04	100	0.13	1.63	0.51	1.31	0.45
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	0.91	0.00	0.00	0.00	0.00
Bromomethane	0.09	11	5	0.02	0.00	0.07	0.00
1,3-Butadiene	0.07	70	0.033	0.17	0.08	0.30	0.07
Butyr/Isobutyraldehyde	0.011	98		0.54	0.18	0.92	0.15
Carbon Tetrachloride	0.08	89	0.067	0.46	0.07	0.12	0.08
Chlorobenzene	0.06	0	1000	0.00	0.00	0.00	0.00
Chloroethane	0.08	2		0.00	0.00	0.05	0.00
Chloroform	0.05	25	0.043	0.05	0.01	0.06	0.00
Chloromethane	0.05	100	0.56	1.23	0.60	0.83	0.61
Chloromethylbenzene	0.07	0		0.00	0.00	0.00	0.00
Chloroprene	0.01	0	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	98		0.25	0.09	0.37	0.06
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	0.01	0.00
p - Dichlorobenzene	0.09	28	0.091	0.07	0.01	0.08	0.00
Dichlorodifluoromethane	0.04	100	200	2.43	0.61	0.77	0.62
1,1 - Dichloroethane	0.08	0	0.63	0.00	0.00	0.00	0.00
1,2 - Dichloroethane	0.06	0	0.000053	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	2	200	0.01	0.00	0.17	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
1,2 - Dichloropropane	0.07	0	0.1	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	0		0.00	0.00	0.00	0.00
2,5-Dimethylbenzaldehyde	0.004	31		0.04	0.01	0.08	0.00
Ethyl Acrylate	0.16	0	2	0.00	0.00	0.00	0.00

**Table 6 – (Continued)
Air Toxics Data – 2003
Elizabeth Lab, New Jersey**

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean Ppbv	Max. Ppbv	Median ppbv
Ethylbenzene	0.04	91		0.93	0.22	0.59	0.20
Ethyl tert-Butyl Ether	0.15	0		0.00	0.00	0.00	0.00
Formaldehyde	0.016	100	0.077	3.96	3.23	7.38	3.22
Hexachloro-1,3-Butadiene	0.06	0	0.0455	0.00	0.00	0.00	0.00
Hexaldehyde	0.003	98		0.69	0.17	2.62	0.04
Isovaleraldehyde	0.004	27		0.01	0.00	0.03	0.00
Methylene Chloride	0.06	94	2.1	1.03	0.30	3.90	0.20
Methyl Ethyl Ketone	0.15	79		2.99	1.02	5.85	0.86
Methyl Isobutyl Ketone	0.15	17	80	0.05	0.01	0.14	0.00
Methyl Methacrylate	0.18	8	700	0.10	0.03	0.53	0.00
Methyl tert-Butyl Ether	0.18	94	3.8	5.90	1.64	6.38	1.31
N-Octane	0.06	60		0.34	0.07	0.63	0.05
Propionaldehyde	0.005	98		0.42	0.18	1.46	0.08
Propylene	0.05	100	3000	6.16	3.58	47.50	1.82
Styrene	0.07	49	1.8	0.26	0.06	1.57	0.00
1,1,2,2 - Tetrachloroethane	0.06	0	0.017	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.06	53	0.17	0.27	0.04	0.32	0.03
Tolualdehydes	0.009	100		0.28	0.06	0.28	0.04
Toluene	0.06	100	400	5.06	1.34	3.78	1.25
1,2,4-Trichlorobenzene	0.06	0	200	0.00	0.00	0.00	0.00
1,1,1 - Trichloroethane	0.06	49	1000	0.09	0.02	0.06	0.00
1,1,2 - Trichloroethane	0.06	0	0.063	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	38	0.5	0.10	0.02	0.27	0.00
Trichlorofluoromethane	0.04	100	700	2.07	0.37	1.03	0.32
Trichlorotrifluoroethane	0.07	91		0.74	0.10	0.22	0.10
1,2,4-Trimethylbenzene	0.07	92		0.81	0.17	0.34	0.16
1,3,5-Trimethylbenzene	0.07	72		0.24	0.05	0.13	0.05
Valeraldehyde	0.05	98		0.41	0.12	1.49	0.04
Vinyl Chloride	0.06	2	0.11	0.00	0.00	0.02	0.00
m,p - Xylene	0.05	100	100	2.96	0.68	2.29	0.62
o - Xylene	0.05	94	100	1.27	0.29	0.82	0.27

^{1,2,3} See table end notes on Air Toxics page 18

Table 7
Air Toxics Data – 2003
New Brunswick, New Jersey

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean Ppbv	Max. Ppbv	Median ppbv
Acetaldehyde	0.005	100	0.45	3.24	1.80	4.43	1.50
Acetone	0.002	100	30881	3.03	1.28	6.15	1.15
Acetonitrile	0.25	48	60	1.29	0.77	8.78	0.00
Acetylene	0.13	100		1.51	1.42	5.57	1.20
Acrylonitrile	0.21	8	0.015	0.03	0.01	0.24	0.00
tert-Amyl Methyl Ether	0.12	4		0.00	0.00	0.03	0.00
Benzaldehyde	0.003	100		0.15	0.03	0.10	0.03
Benzene	0.04	100	0.13	1.02	0.32	0.80	0.29
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	0.91	0.00	0.00	0.00	0.00
Bromomethane	0.09	4	5	0.00	0.00	0.01	0.00
1,3-Butadiene	0.07	32	0.033	0.05	0.02	0.15	0.00
Butyr/Isobutyraldehyde	0.011	100		0.51	0.17	0.46	0.13
Carbon Tetrachloride	0.08	90	0.067	0.49	0.08	0.13	0.08
Chlorobenzene	0.06	0	1000	0.00	0.00	0.00	0.00
Chloroethane	0.08	4		0.01	0.00	0.09	0.00
Chloroform	0.05	28	0.043	0.05	0.01	0.06	0.00
Chloromethane	0.05	100	0.56	1.18	0.57	0.78	0.56
Chloromethylbenzene	0.07	2		0.01	0.00	0.07	0.00
Chloroprene	0.01	0	7	0.00	0.00	0.00	0.00
Crotonaldehyde	0.005	100		0.29	0.10	0.55	0.04
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	10	0.091	0.01	0.00	0.05	0.00
Dichlorodifluoromethane	0.04	100	200	2.31	0.58	0.71	0.60
1,1 - Dichloroethane	0.08	0	0.63	0.00	0.00	0.00	0.00
1,2 - Dichloroethane	0.06	0	0.000053	0.00	0.00	0.00	0.00
1,1-Dichloroethene	0.1	0	200	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethylene	0.1	4		0.05	0.01	0.34	0.00
trans - 1,2 - Dichloroethylene	0.06	0		0.00	0.00	0.00	0.00
1,2 - Dichloropropane	0.07	0	0.1	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	2		0.00	0.00	0.02	0.00
2,5-Dimethylbenzaldehyde	0.004	11		0.01	0.00	0.03	0.00
Ethyl Acrylate	0.16	0	2	0.00	0.00	0.00	0.00

**Table 7 – (Continued)
Air Toxics Data – 2003
New Brunswick, New Jersey**

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

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

Pollutant	Detection Limit ppbv	% Detects	Benchmark ¹ $\mu\text{g}/\text{m}^3$	Mean ^{2,3} $\mu\text{g}/\text{m}^3$	Mean Ppbv	Max. ppbv	Median ppbv
Ethylbenzene	0.04	88		0.48	0.11	0.26	0.12
Ethyl tert-Butyl Ether	0.15	0		0.00	0.00	0.00	0.00
Formaldehyde	0.016	100	0.077	3.46	2.82	12.31	1.75
Hexachloro-1,3-Butadiene	0.06	0	0.0455	0.00	0.00	0.00	0.00
Hexaldehyde	0.003	100		0.16	0.04	0.27	0.02
Isovaleraldehyde	0.004	48		0.03	0.01	0.05	0.00
Methylene Chloride	0.06	82	2.1	0.43	0.13	0.55	0.10
Methyl Ethyl Ketone	0.15	56		1.91	0.65	4.31	0.34
Methyl Isobutyl Ketone	0.15	8	80	0.04	0.01	0.20	0.00
Methyl Methacrylate	0.18	0	700	0.00	0.00	0.00	0.00
Methyl tert-Butyl Ether	0.18	78	3.8	1.51	0.42	1.57	0.38
N-Octane	0.06	20		0.06	0.01	0.15	0.00
Propionaldehyde	0.005	100		0.36	0.15	0.57	0.09
Propylene	0.05	100	3000	1.31	0.76	2.12	0.62
Styrene	0.07	42	1.8	0.06	0.02	0.08	0.00
1,1,2,2 - Tetrachloroethane	0.06	0	0.017	0.00	0.00	0.00	0.00
Tetrachloroethylene	0.06	46	0.17	0.18	0.03	0.19	0.00
Tolualdehydes	0.009	100		0.13	0.03	0.11	0.02
Toluene	0.06	98	400	3.24	0.86	2.61	0.79
1,2,4-Trichlorobenzene	0.06	0	200	0.00	0.00	0.00	0.00
1,1,1 - Trichloroethane	0.06	40	1000	0.08	0.01	0.07	0.00
1,1,2 - Trichloroethane	0.06	0	0.063	0.00	0.00	0.00	0.00
Trichloroethylene	0.07	12	0.5	0.02	0.00	0.06	0.00
Trichlorofluoromethane	0.04	98	700	1.70	0.30	0.59	0.28
Trichlorotrifluoroethane	0.07	96		0.76	0.10	0.38	0.10
1,2,4-Trimethylbenzene	0.07	84		0.44	0.09	0.22	0.09
1,3,5-Trimethylbenzene	0.07	54		0.12	0.02	0.09	0.02
Valeraldehyde	0.05	100		0.18	0.05	0.29	0.03
Vinyl Chloride	0.06	0	0.11	0.00	0.00	0.00	0.00
m,p - Xylene	0.05	98	100	1.32	0.30	0.67	0.29
o - Xylene	0.05	94	100	0.58	0.13	0.30	0.14

^{1,2,3} See table end notes on Air Toxics page 18

END NOTES FOR TABLES 4-7

¹ The Heath Benchmark is defined as the chemical-specific air concentration above which there may be human health concerns. For a carcinogen (cancer-causing chemical), the health benchmark is set at the air concentration that would cause no more than a one in a million increase in the likelihood of getting cancer, even after a lifetime of exposure. For a non-carcinogen, the health benchmark is the maximum air concentration to which exposure is likely to cause no harm, even if that exposure occurs on a daily basis for a lifetime.

² Individual 24-hour pollutant concentrations were reported by the analyzing laboratory in ppbv (parts per billion by volume) and were converted to $\mu\text{g}/\text{m}^3$ using the following formula:

$$\frac{\mu\text{g}}{\text{m}^3} = \frac{(\text{ppbv})(\text{MolecularWeight})}{24.45}$$

where Molecular Weight is the molecular weight of a pollutant in grams, and 24.45 is the molar volume of an ideal gas in liters at the standard temperature of 25°C.

³ For a valid 24-hour sampling event when the analyzing laboratory reports the term “Not Detected” for a particular pollutant, the concentration of 0.0 ppbv is assigned to that pollutant. These zero concentrations were included in the calculation of annual averages and medians for each pollutant regardless of percent detection.

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2003 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

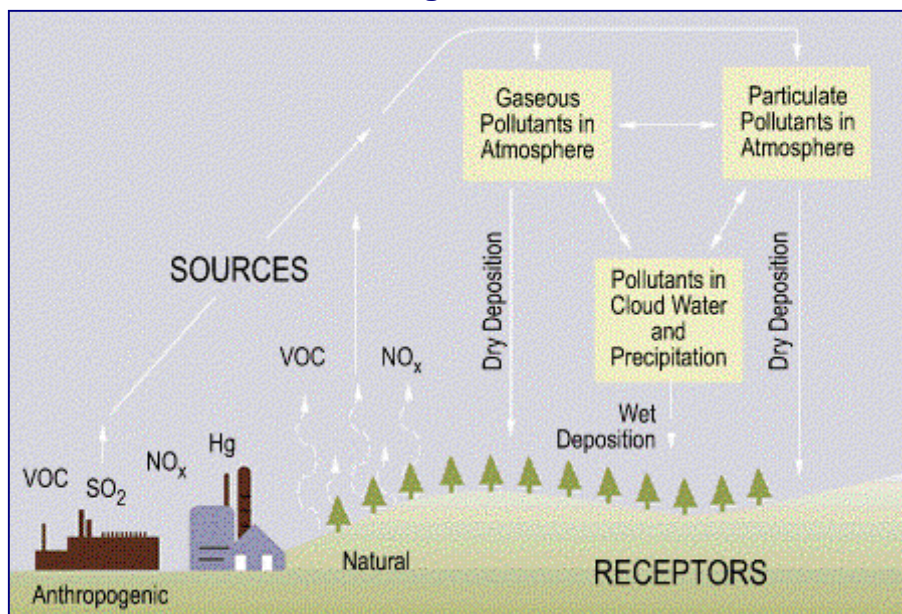
Nature and Sources

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 shows the basic mechanisms of deposition and the major pollutants of concern. These include sulfur dioxide (SO₂), nitrogen oxides (NO_x), mercury (Hg), and volatile organic compounds (VOCs). SO₂ is a major contributor to acid deposition, which can reduce the ability of water bodies to support certain types of fish and other aquatic organisms. NO_x also contributes to the acid deposition problem and can contribute to the 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 concentrated. Fish in Hg contaminated water can become contaminated to the point where they are no longer safe for people to eat. For more information on Hg in fish see "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters" which is available at www.state.nj.us/dep/dsr/njmainfish.htm. VOCs are a very diverse group of compounds, some of which are toxic, including 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 2003. 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 2 sites as shown in Figure 3. These measurements are taken by analyzing filters used in the PM10 monitoring network (see section on Particulate Matter). Dry sulfate and nitrate are pollutants that form in the atmosphere and can react with water, creating acids that affect the pH of lakes and streams. Nitrates also increase nutrient load in water bodies and can eventually lead to eutrophication (excessive growth of plant life).

Figure 2
Acid Precipitation Monitoring
Network - 2003

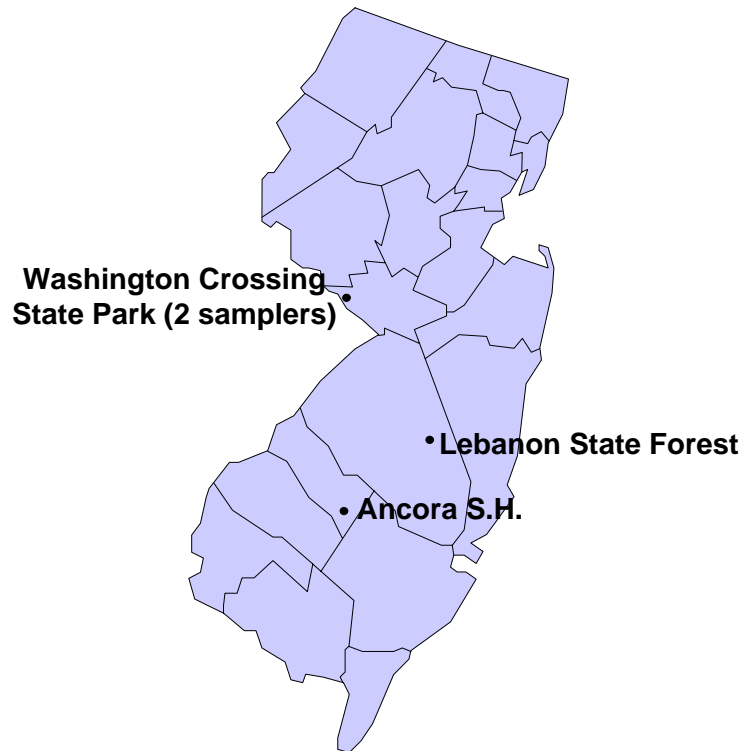
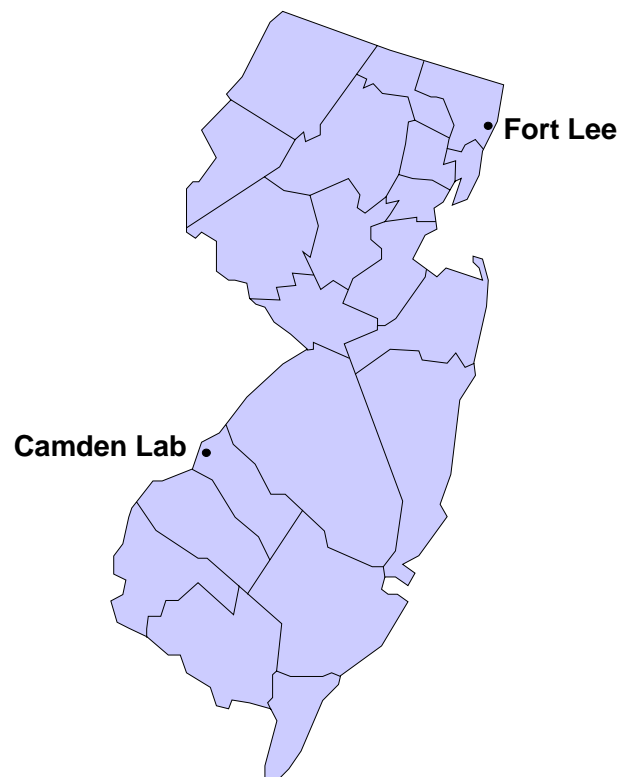


Figure 3
Sulfate and Nitrate
Monitoring Network - 2003



SUMMARY OF 2003 DATA

A summary of the 2003 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 4.53. The Ancora State Hospital sampler recorded a mean pH of 4.48 and the Lebanon State Forest sampler recorded a mean pH of 4.57.

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 two sites. In particulate form, sulfate and nitrate can have significant effects on 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 - 2003
Annual and Seasonal Averages
Weighted by Precipitation Amount

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

Ancora State Hospital – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	10.36	4.49	24.3	0.132	0.071	0.045	0.426	0.213	1.521	0.781	1.954	< MDL
Spring	12.59	4.49	20.7	0.102	0.060	0.041	0.183	0.346	1.366	0.338	1.742	< MDL
Summer	16.09	4.34	29.1	0.099	0.101	0.063	0.596	0.328	1.443	1.077	2.262	< MDL
Fall	13.12	4.69	14.3	0.071	0.061	0.028	0.439	0.134	0.830	0.791	1.085	< MDL
Annual	52.16	4.48	22.4	0.099	0.075	0.045	0.423	0.260	1.286	0.768	1.779	< MDL

Lebanon State Forest – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter*	1.13	4.51	28.1	0.226	0.176	0.075	1.369	0.268	1.229	2.530	1.772	< MDL
Spring	13.40	4.48	18.3	0.091	0.060	0.050	0.231	0.296	1.296	0.382	1.590	< MDL
Summer	14.06	4.52	20.8	0.092	0.092	0.040	0.543	0.273	1.059	0.929	1.637	< MDL
Fall	12.68	4.76	13.2	0.085	0.073	0.039	0.553	0.100	0.810	0.965	0.901	< MDL
Annual	41.27	4.57	17.9	0.093	0.078	0.044	0.467	0.227	1.064	0.807	1.399	< MDL

* Only two weekly samples were available for collection in late March of the 1st Quarter (Winter Quarter).

Table 1 (Continued)
Acid Precipitation Monitoring Network – 2003
Annual and Seasonal Averages
 Weighted by Precipitation Amount

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

Washington Crossing State Park – Weekly

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	9.92	4.69	14.1	0.067	0.026	0.011	0.203	0.092	0.873	0.398	0.968	< MDL
Spring	13.98	4.40	22.4	0.195	0.019	0.022	0.065	0.337	1.500	0.144	1.859	< MDL
Summer	10.98	4.39	24.8	0.096	0.048	0.032	0.308	0.291	1.283	0.600	2.104	< MDL
Fall	17.86	4.71	12.3	0.040	0.028	0.013	0.246	0.103	0.714	0.453	0.911	< MDL
Annual	52.74	4.53	17.9	0.098	0.029	0.019	0.203	0.202	1.071	0.391	1.421	< MDL

Washington Crossing State Park – Event

	Precip. Inches	pH	Cond. us/cm	Ca ²⁺ mg/l	Mg ⁺ mg/l	K ⁺ mg/l	Na ⁺ mg/l	NH ₄ ⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l
Winter	7.74	4.44	22.5	0.103	0.052	0.042	0.306	0.211	1.292	0.561	1.628	< MDL
Spring	10.41	4.31	29.7	0.120	0.055	0.048	0.090	0.446	2.047	0.190	2.390	< MDL
Summer	10.70	4.43	28.3	0.487	0.115	0.162	0.456	0.436	1.612	0.793	3.166	0.156
Fall	17.09	4.66	13.6	0.057	0.035	0.025	0.245	0.109	0.791	0.452	1.045	< MDL
Annual	45.94	4.46	22.2	0.179	0.061	0.065	0.269	0.279	1.351	0.491	1.942	< MDL

Table 2
Acid Deposition Particulate Matter – 2003
 Micrograms per Cubic Meter

N – Number of samples
 Min – Minimum
 Max – Maximum

Sampling Location	Site No.	N	Particulates			Sulfate (SO ₄)			Nitrate (NO ₃)			SO ₄ & NO ₃ % of Particulates
			Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Camden Lab	IP02	42	26.7	4.1	82	5.58	0.80	23.91	0.35	0.01	1.46	22.2
Fort Lee	IP14	58	36.5	8.3	149	4.14	0.97	18.84	0.61	0.05	3.70	13.0

*Camden Lab was off-line after September 2004. Mean concentrations are derived from averaging the sample concentrations obtained before the Site went down in September.

TRENDS

Figure 4 shows the change in the amount of sulfate ion deposited over the last 14 years at the site in Washington Crossing State Park. The figure shows “wet deposition” only. It does not include dry particulate sulfate that was deposited when no precipitation was occurring. Therefore, the total deposition is higher than what is shown here.

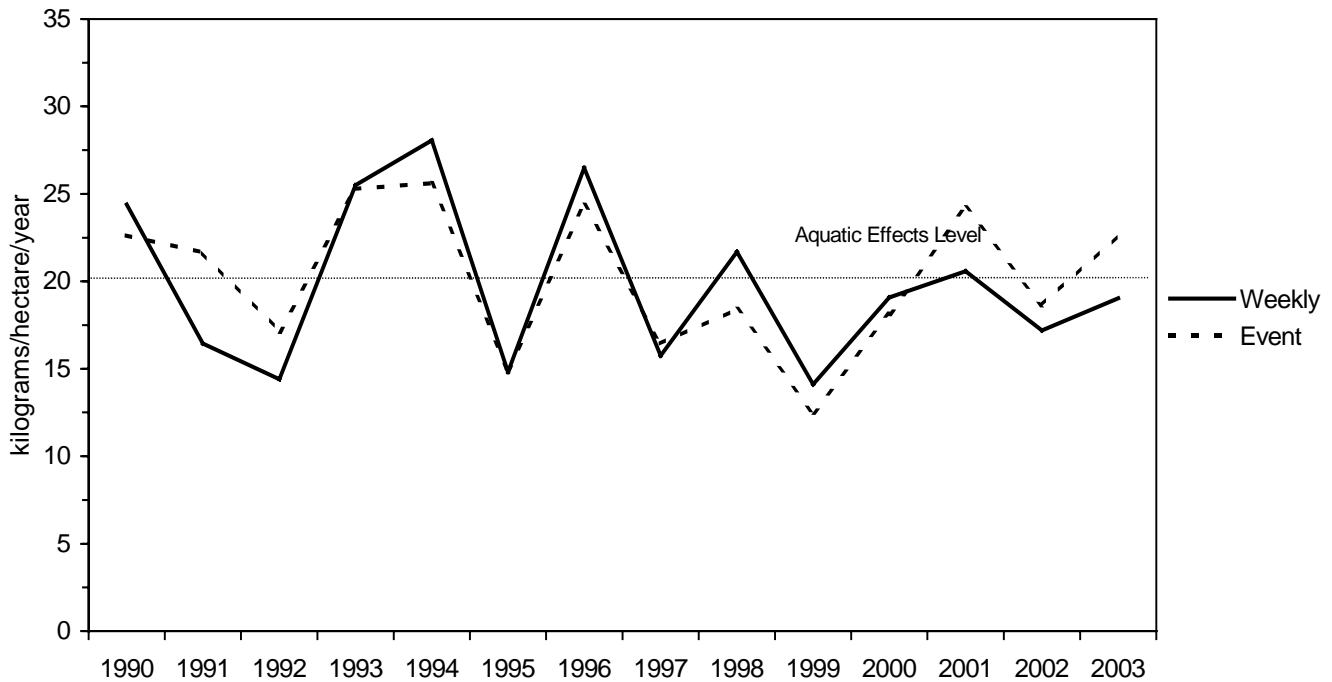
The factors controlling the trend are the sulfate concentrations in air and cloud droplets and the total amount of precipitation in a given year. For example, in 1991 and 1992, both the sulfate concentrations and the total precipitation were below normal, while they were high in 1993 and 1994. Since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

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

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

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

Figure 4
Trend in Sulfate Deposition in Precipitation at
Washington Crossing State Park, New Jersey, 1990-2003:
Annual Loading





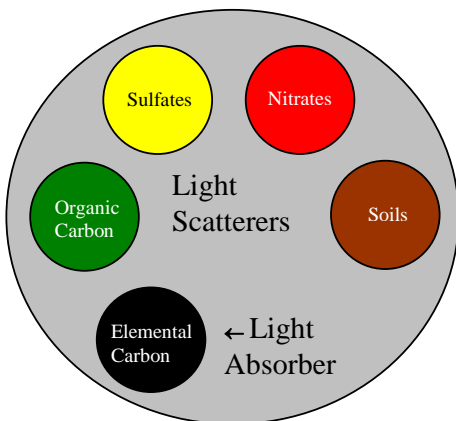
2003 Regional Haze & Visibility

New Jersey Department of Environmental Protection

THE BASICS OF HAZE

Small particles and some gases in the atmosphere can reduce visibility by scattering or absorbing light (see Figure 1). This is sometimes evident by a visible plume from a industrial facility, but when pollutants are well mixed in the atmosphere, they form a more uniform haze. Hazy conditions in New Jersey are primarily the result of fine particles that form in the atmosphere from gases. These are termed "secondary" particulates and are often the result of pollutants that are transported into the area on the prevailing winds.

**Figure 1
Contributors to Visibility Impairment**



ANATOMY OF REGIONAL HAZE

Data collected over the last decade show that visibility impairment is highest in the more industrial and highly populated areas of northeastern United States than in more rural western states. Sulfate (SO₄) is the dominant contributor to fine particle pollution and the resulting haze in this area. It typically accounts for 40% of the total fine mass in the region on clear days and can account for 60-80% of the total fine particle mass on very hazy days. Organic carbon typically accounts for the next largest portion of fine particle mass, about 20-30% on hazy days. The remainder of the mass comes from nitrate (NO₃), elemental carbon and fine soil particles.

PARTICLES AND VISIBILITY

Figure 2 shows the makeup of fine particles collected at the IMPROVE (Interagency Monitoring of Protected Visual Environments) site located north of Atlantic City in the Brigantine Wilderness Area.

The two charts compare the average pollutant composition on the days with the worst visibility to the days with the best visibility. Most visibility impairment is due to sulfate, which can have a greater effect on light extinction (a measure of visibility impairment) than all other types of fine particles combined. Higher sulfate values in the summer can be attributed to the greater photochemical conversion of SO₂ to SO₄ that results from the increased sunlight during the summertime. (Malm, 1999)

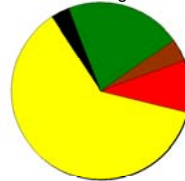
**Figure 2
Composition of Fine Particles on Days With Good Visibility Compared to Days with Poor Visibility
Brigantine,
New Jersey, 2003**

Average Fine Mass Composition on Days with Good Visibility



Ammonium Nitrate	0.49 $\mu\text{g}/\text{m}^3$	13.70%
Ammonium Sulfate	1.84 $\mu\text{g}/\text{m}^3$	51.70%
Elemental Carbon	0.15 $\mu\text{g}/\text{m}^3$	4.20%
Organic Carbon	0.88 $\mu\text{g}/\text{m}^3$	24.70%
Soils	0.21 $\mu\text{g}/\text{m}^3$	5.80%
Total 3.6 $\mu\text{g}/\text{m}^3$		

Average Fine Mass Composition on Days with Poor Visibility



Ammonium Nitrate	2.00 $\mu\text{g}/\text{m}^3$	9.5%
Ammonium Sulfate	13.1 $\mu\text{g}/\text{m}^3$	61.9%
Elemental Carbon	0.73 $\mu\text{g}/\text{m}^3$	3.4%
Organic Carbon	4.44 $\mu\text{g}/\text{m}^3$	21.0%
Soils	0.89 $\mu\text{g}/\text{m}^3$	4.2%
Total 21.1 $\mu\text{g}/\text{m}^3$		

HOW IS HAZE REGULATED?

In 1999, the U.S. Environmental Protection Agency announced a major effort to improve air quality in national parks and wilderness areas aimed at achieving national visibility goals by 2064. The Regional Haze Rule calls for state and federal agencies to work together to improve visibility in 156 National Parks and wilderness areas such as the Grand Canyon, Yosemite, the Great Smokies and Shenandoah. This "regional haze rule" addresses the combined visibility effects of numerous pollution sources over a wide geographic region and how they impact Class I areas. Class I areas as defined by the Clean Air Act, include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks that existed as of August 1977. The Wilderness Area located in the Brigantine National Wildlife Refuge is New Jersey's only Class I area. The rule requires the states, in coordination with the Environmental Protection Agency, the National Park Service, U.S. Fish and Wildlife Service, the U.S. Forest Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. The first State plans for regional haze is due in the 2003-2008 timeframe. Five multi-state regional planning organizations are working together now to develop the technical basis for these plans.

SOURCE OF HAZE CONTRIBUTORS

The following categories of air pollution are the major contributors to haze:

Sulfate particles form in the air from sulfur dioxide gas. Most of this gas is released from coal-burning power plants and other industrial sources, such as smelters, industrial boilers, and oil refineries. Sulfates are the largest contributor to haze in the eastern U.S., due to the large number of coal-fired power plants that affect the region. In humid environments, sulfate particles grow rapidly to a size that is very efficient at scattering light, thereby exacerbating the problem in the East.

Organic carbon particles are emitted directly into the air and are also formed by the reaction of various gaseous hydrocarbons. Sources of direct and indirect organic carbon particles include vehicle exhaust, vehicle refueling, solvent evaporation (e.g., paints), food cooking,

and various commercial and industrial sources. Gaseous hydrocarbons are also emitted naturally from trees and from fires, but these sources usually have only a small or short-term effect on overall visibility.

Nitrate particles form in the air from nitrogen oxide gas. This gas is released from virtually all combustion activities, especially those involving cars, trucks, off-road engines (e.g., construction equipment, lawn mowers, and boats), power plants, and other industrial sources. Like sulfates, nitrates scatter more light in humid environments.

Elemental carbon particles are very similar to soot. They are smaller than most other particles and tend to absorb rather than scatter light. The "brown clouds" often seen in winter over urban areas and in mountain valleys can be largely attributed to elemental carbon. These particles are emitted directly into the air from virtually all combustion activities, but are especially prevalent in diesel exhaust and smoke from the burning of wood and wastes.

Soils are very similar to dust. It enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, and other surface activities. Whereas other types of particles form from the condensation and growth of microscopic particles and gasses, crustal material results from the crushing and grinding of larger, earth-born material. Because it is difficult to reduce this material to microscopic sizes, crustal material tends to be larger than other particles and tends to fall from the air sooner, contributing less to the overall effect of haze.

Source – www.hazecam.net

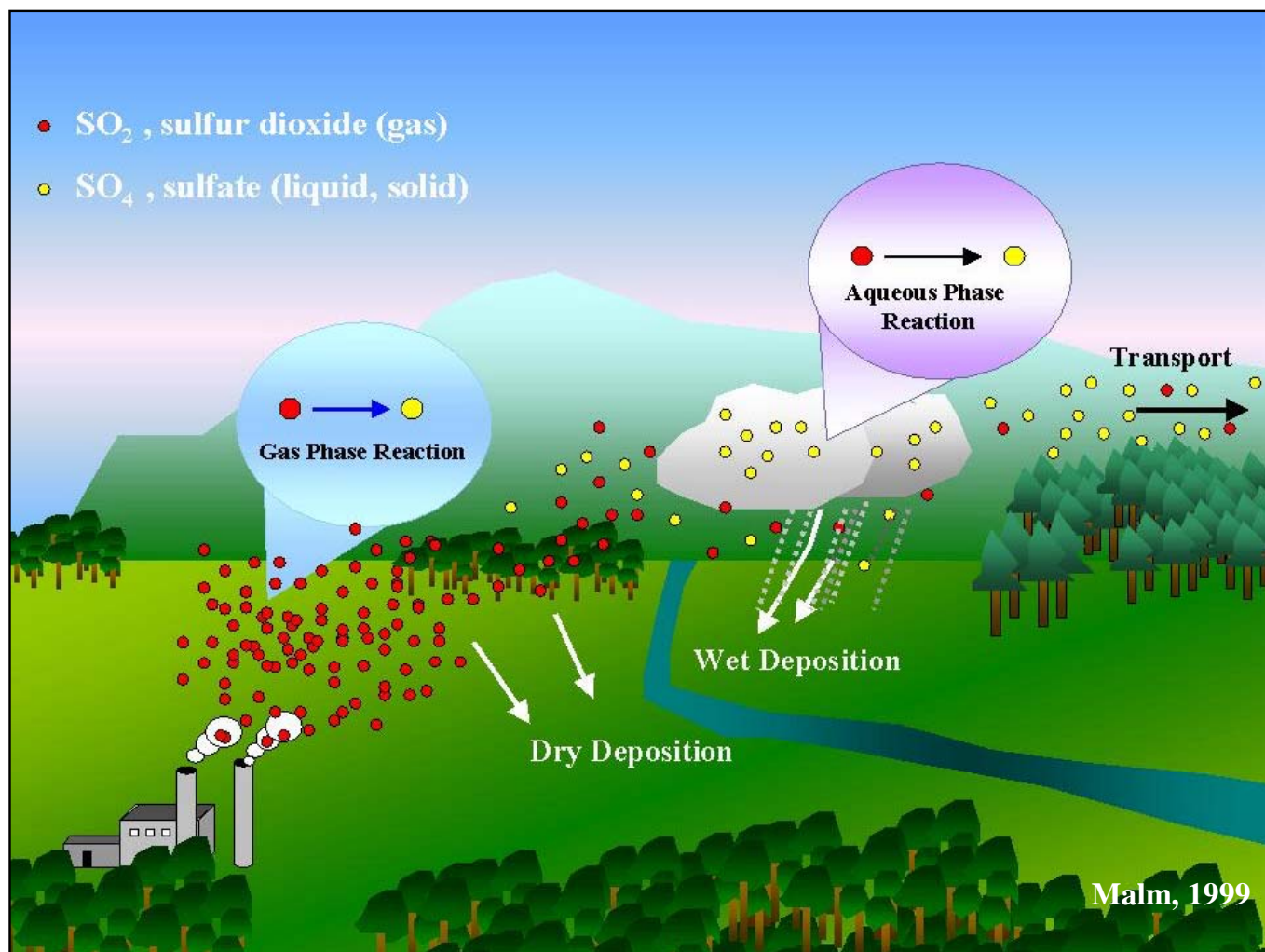
ENVIRONMENTAL EFFECTS

Regional haze is probably most closely associated with its effects on prized vistas such as the Grand Canyon or Acadia National Park. Its impacts may be difficult to quantify but it certainly has a negative overall effect on aesthetics and the outdoors, and how natural areas throughout the nation are enjoyed. But haze also affects urban areas and scenes, and can obscure or eclipse the view of an urban skyline (see Figures 5 and 6) or other important urban landmarks such as the Washington Monument.

The pollution that causes regional haze has additional,

multifaceted effects on the environment. The most abundant contributors to regional haze, sulfates and nitrates, eventually make their way into the ecosystem through deposition - that is, they are transferred from the air into the water and soils (see Figure 4). Too much deposition can have adverse environmental effects, upsetting the delicate balance of the ecosystem. Increased sulfates in the atmosphere leads to acid rain while increased nitrates promote eutrophication of streams and lakes by depleting available oxygen (see section on Atmospheric Deposition).

Figure 4
Illustration of How Sulfates and Nitrates Enter the Ecosystem by way of Deposition



MONITORING OF HAZE IN NEW JERSEY

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

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

Visibility Camera – New Jersey Transit Building

Figure 5



Figure 6



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

Visibility Camera – Brigantine National Wildlife Refuge

Figure 7



Figure 8



REFERENCES

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

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

Vista.cira.colostate.edu/views

www.hazecam.net



Appendix A

2003 Air Monitoring Sites

New Jersey Department of Environmental Protection

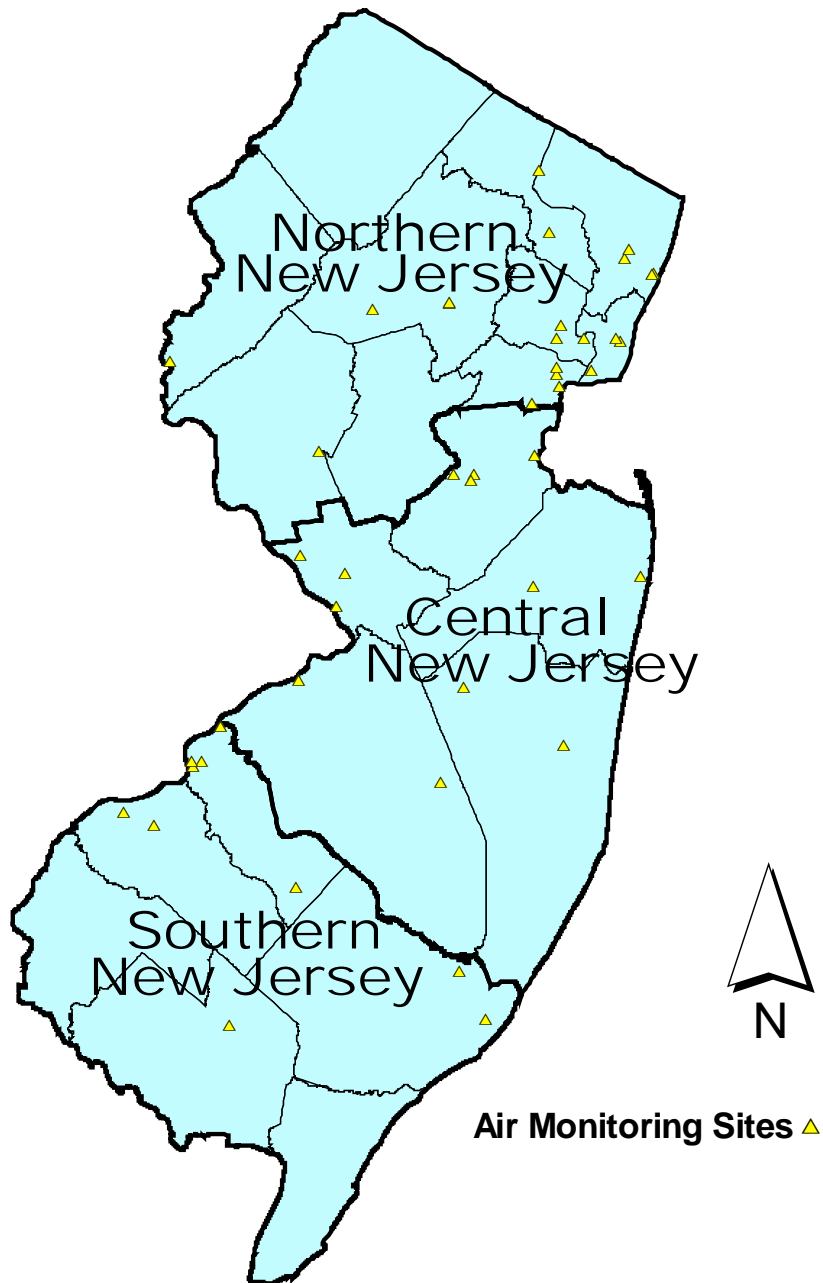
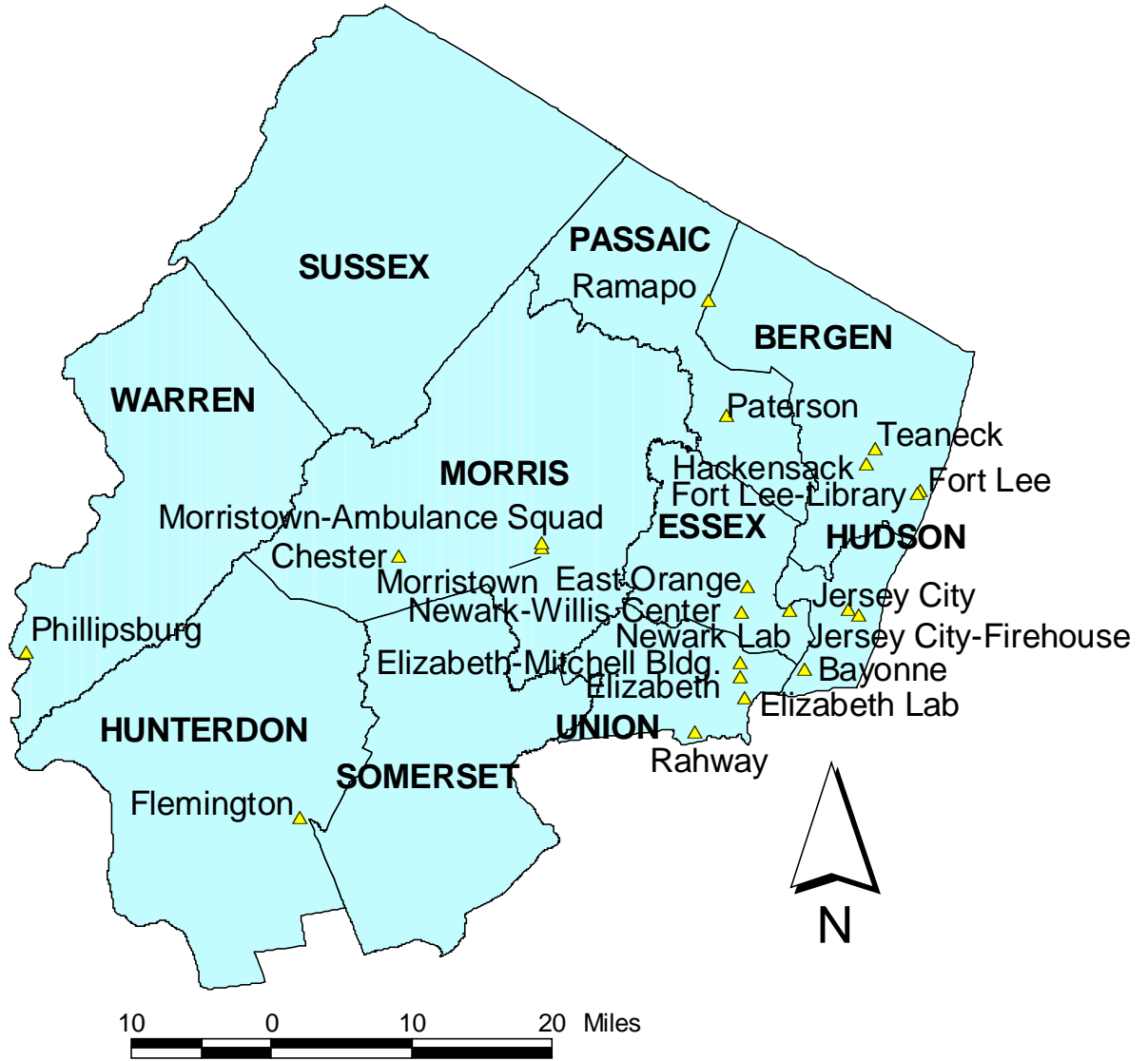


Figure 1
Northern New Jersey
Air Monitoring Sites

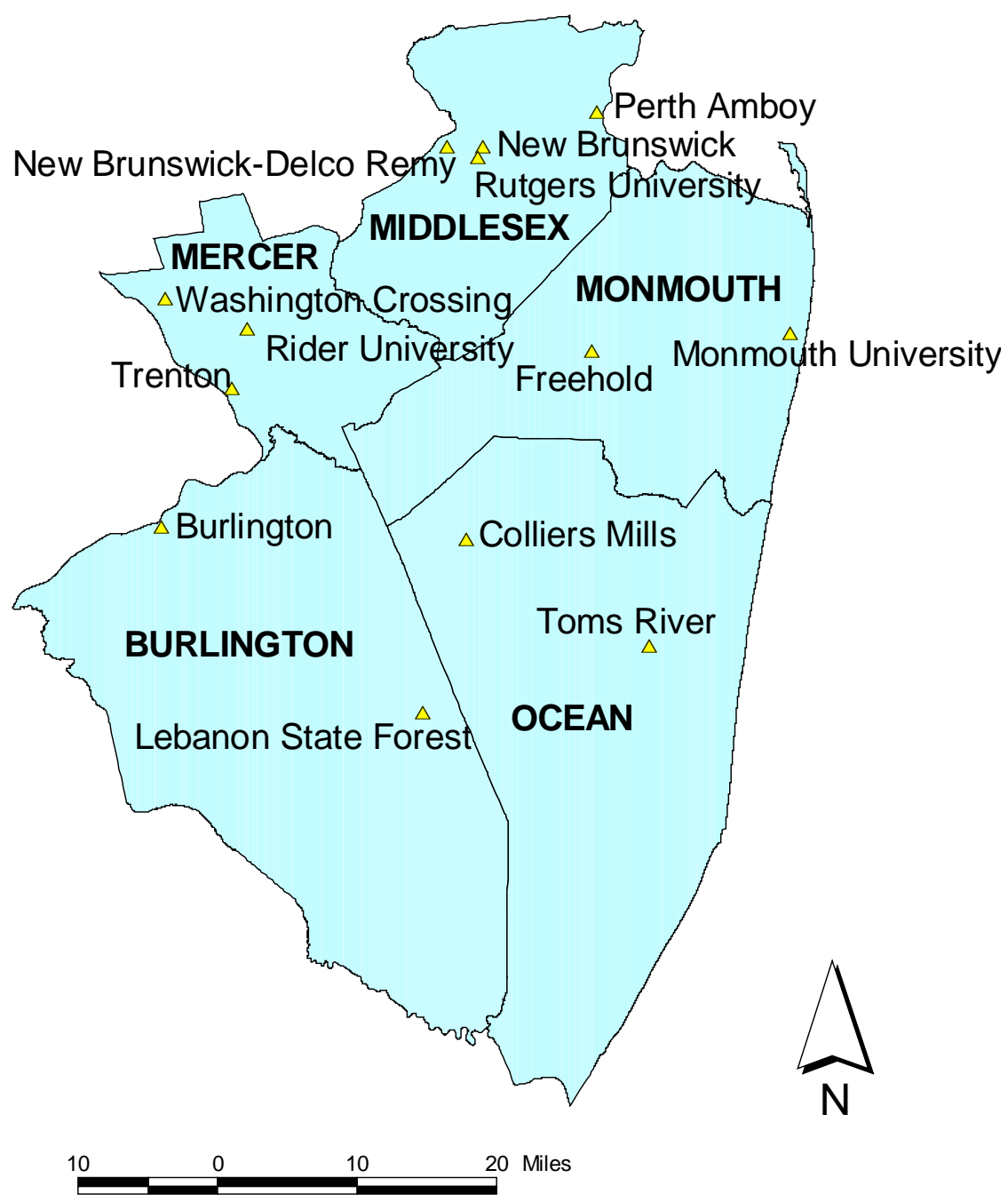


**Table 1
Northern New Jersey Air Monitoring Sites**

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

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

Figure 2
Central New Jersey Air
Monitoring Sites

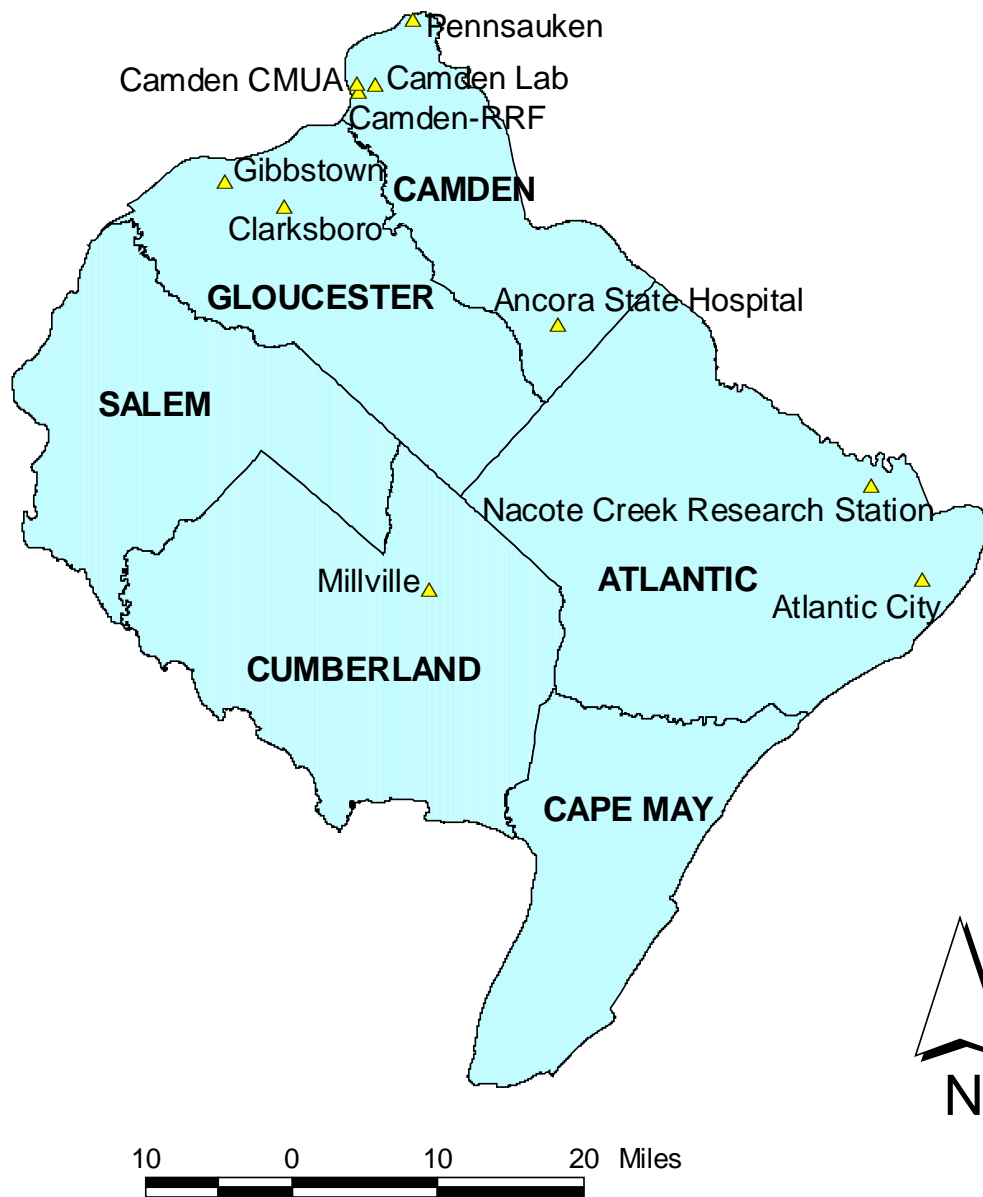


**Table 2
Central New Jersey Air Monitoring Sites**

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

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

Figure 3
Southern New Jersey
Air Monitoring Sites



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

County	Monitoring Site	AIRS Codes	Parameter(s) Measured ¹	Coordinates (Degrees-minutes-seconds)		Address
				Latitude	Longitude	
ATLANTIC	Atlantic City	34 001 1006	PM _{2.5} , PM ₁₀	39 25 56	74 23 41	1433 Bacharach Blvd., Atlantic City
	Nacote Creek Research Station	34 001 0005	O ₃ , SO ₂	39 31 32	74 27 34	Brigantine National Wildlife Refuge near Smithville
CAMDEN	Ancora State Hospital	34 007 1001	CO, O ₃ , SO ₂ , ACID	39 41 05	74 51 42	Ancora State Hospital, Winslow Twp.
	Camden CMUA	N/A	TEOM	39 55 25	75 07 20	1645 Ferry Avenue, Camden County Sewage Treatment Plant
	Camden Lab	34 007 0003	CO, NO _x , O ₃ , SO ₂ , SS, TEOM, MET, PAMS, PM _{2.5} , ACID, TOXICS	39 55 22	75 05 49	1667 Davis Street, corner of Copewood St.
	Camden-RRF	34 007 0009	PM ₁₀	39 54 54	75 07 10	Camden RRF, Morgan Blvd. & I-676
	Pennsauken	34 007 1007	PM _{2.5}	39 59 19	75 02 60	9800 Zimmerman Ave, near Griffith-Morgan Lane
CUMBERLAND	Millville	34 011 0007	NO _x , O ₃ , SO ₂	39 25 20	75 01 31	Lincoln Avenue & Route 55
GLOUCESTER	Clarksboro	34 015 0002	O ₃ , SO ₂	39 48 02	75 12 46	Clarksboro Shady Lane Rest Home, County House Road
	Gibbstown	34 015 5001	PM _{2.5}	39 49 30	75 17 21	420 Washington Street

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

**Table 4
Parameter Codes**

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



Appendix B

Fine Particulate Speciation Summary- 2003

New Jersey Department of Environmental Protection

Table 1
Fine Particulate Speciation Data – 2003
Camden Lab, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0131	0.1135	0.1032
Ammonium	2.4083	10.0741	7.2564
Antimony	0.0050	0.0357	0.0318
Arsenic	0.0013	0.0053	0.0050
Barium	0.0156	0.0829	0.0672
Bromine	0.0034	0.0165	0.0150
Cadmium	0.0018	0.0164	0.0145
Calcium	0.0296	0.0794	0.0678
Cerium	0.0064	0.0655	0.0561
Cesium	0.0046	0.0296	0.0277
Chlorine	0.0146	0.1859	0.0959
Chromium	0.0017	0.0084	0.0075
Cobalt	0.0003	0.0019	0.0018
Copper	0.0043	0.0198	0.0152
Elemental carbon	0.6544	2.5224	1.7056
Europium	0.0017	0.0185	0.0183
Gallium	0.0001	0.0019	0.0013
Gold	0.0017	0.0079	0.0069
Hafnium	0.0027	0.0289	0.0246
Indium	0.0025	0.0226	0.0186
Iridium	0.0012	0.0100	0.0079
Iron	0.0606	0.2353	0.1257
Lanthanum	0.0059	0.0640	0.0460
Lead	0.0039	0.0167	0.0133
Magnesium	0.0060	0.1203	0.0973
Manganese	0.0019	0.0071	0.0071
Mercury	0.0010	0.0055	0.0054
Molybdenum	0.0012	0.0077	0.0075
Nickel	0.0036	0.0172	0.0117
Niobium	0.0005	0.0040	0.0037
Nitrate	2.3551	9.5853	9.4050

Table 1 (Continued)
Fine Particulate Speciation Data – 2003
Camden Lab, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Organic carbon	4.3223	12.4551	10.6937
Phosphorus	0.0009	0.0156	0.0103
Potassium	0.0557	0.7383	0.2126
Rubidium	0.0004	0.0051	0.0030
Samarium	0.0008	0.0129	0.0072
Scandium	0.0003	0.0056	0.0024
Selenium	0.0018	0.0071	0.0053
Silicon	0.0724	0.2944	0.2219
Silver	0.0023	0.0130	0.0121
Sodium	0.1509	0.7295	0.6127
Strontium	0.0012	0.0122	0.0051
Sulfate	5.4420	25.1719	21.5139
Sulfur	1.6878	7.3544	6.6574
Tantalum	0.0018	0.0109	0.0107
Terbium	0.0004	0.0073	0.0047
Tin	0.0052	0.0363	0.0310
Titanium	0.0042	0.0215	0.0113
Total mass	16.4466	61.5781	41.4476
Vanadium	0.0052	0.0407	0.0206
Wolfram	0.0025	0.0111	0.0105
Yttrium	0.0005	0.0035	0.0032
Zinc	0.0101	0.0507	0.0315
Zirconium	0.0010	0.0081	0.0072

Table 2
Fine Particulate Speciation Data – 2003
Chester, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0089	0.0784	0.0529
Ammonium	1.4819	7.7266	5.8562
Antimony	0.0065	0.0428	0.0412
Arsenic	0.0008	0.0058	0.0040
Barium	0.0111	0.0657	0.0622
Bromine	0.0019	0.0071	0.0069
Cadmium	0.0026	0.0256	0.0241
Calcium	0.0176	0.0710	0.0573
Cerium	0.0095	0.1337	0.0884
Cesium	0.0042	0.0418	0.0337
Chlorine	0.0055	0.0398	0.0386
Chromium	0.0021	0.0343	0.0091
Cobalt	0.0002	0.0018	0.0018
Copper	0.0021	0.0108	0.0098
Elemental carbon	0.3596	0.8574	0.8074
Europium	0.0008	0.0111	0.0059
Gallium	0.0003	0.0023	0.0020
Gold	0.0018	0.0103	0.0083
Hafnium	0.0022	0.0256	0.0242
Indium	0.0028	0.0238	0.0229
Iridium	0.0014	0.0140	0.0086
Iron	0.0349	0.1062	0.0903
Lanthanum	0.0049	0.0542	0.0387
Lead	0.0026	0.0133	0.0115
Magnesium	0.0032	0.0946	0.0368
Manganese	0.0013	0.0054	0.0049
Mercury	0.0011	0.0072	0.0057
Molybdenum	0.0011	0.0157	0.0071
Nickel	0.0018	0.0082	0.0074
Niobium	0.0004	0.0047	0.0045
Nitrate	1.1882	4.9301	4.6549
Organic carbon	3.1432	8.2441	7.9788
Phosphorus	0.0006	0.0084	0.0081
Potassium	0.0360	0.4099	0.1227
Rubidium	0.0003	0.0027	0.0025
Samarium	0.0007	0.0108	0.0045
Scandium	0.0002	0.0034	0.0026
Selenium	0.0009	0.0052	0.0040

Table 2 (Continued)
Fine Particulate Speciation Data – 2003
Chester, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Silicon	0.0485	0.2249	0.2122
Silver	0.0028	0.0206	0.0136
Sodium	0.1041	0.6489	0.6211
Strontium	0.0009	0.0051	0.0043
Sulfate	4.1817	23.8837	21.1887
Sulfur	1.2516	7.7064	6.7161
Tantalum	0.0030	0.0201	0.0170
Terbium	0.0004	0.0039	0.0039
Tin	0.0042	0.0365	0.0363
Titanium	0.0030	0.0130	0.0119
Total mass	11.0591	53.3430	43.7023
Vanadium	0.0016	0.0106	0.0083
Wolfram	0.0029	0.0210	0.0159
Yttrium	0.0005	0.0031	0.0028
Zinc	0.0052	0.0300	0.0253
Zirconium	0.0007	0.0127	0.0044

Table 3
Fine Particulate Speciation Data – 2003
Elizabeth Lab, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0167	0.1390	0.1285
Ammonium	2.1994	10.2445	8.0518
Antimony	0.0068	0.0720	0.0465
Arsenic	0.0010	0.0048	0.0045
Barium	0.0141	0.0710	0.0587
Bromine	0.0036	0.0111	0.0100
Cadmium	0.0031	0.0319	0.0310
Calcium	0.0402	0.1376	0.0967
Cerium	0.0062	0.0539	0.0506
Cesium	0.0039	0.0322	0.0312
Chlorine	0.0606	1.0567	0.5884
Chromium	0.0030	0.0283	0.0194
Cobalt	0.0003	0.0032	0.0020
Copper	0.0055	0.0153	0.0140
Elemental carbon	1.7779	5.1038	4.6039
Europium	0.0025	0.0235	0.0207
Gallium	0.0002	0.0024	0.0022
Gold	0.0015	0.0110	0.0092
Hafnium	0.0035	0.0339	0.0294
Indium	0.0032	0.0300	0.0238
Iridium	0.0014	0.0090	0.0089
Iron	0.1310	0.4956	0.3358
Lanthanum	0.0073	0.0771	0.0632
Lead	0.0044	0.0184	0.0140
Magnesium	0.0062	0.0565	0.0557
Manganese	0.0025	0.0269	0.0082
Mercury	0.0009	0.0057	0.0055
Molybdenum	0.0015	0.0110	0.0080
Nickel	0.0053	0.0358	0.0306
Niobium	0.0004	0.0040	0.0028
Nitrate	2.2856	11.9818	11.3399
Organic carbon	5.5986	12.6215	12.4528
Phosphorus	0.0032	0.0961	0.0426
Potassium	0.0481	0.5799	0.1155
Rubidium	0.0003	0.0037	0.0034
Samarium	0.0009	0.0107	0.0098
Scandium	0.0002	0.0035	0.0034
Selenium	0.0013	0.0056	0.0046

Table 3 (Continued)
Fine Particulate Speciation Data – 2003
Elizabeth Lab, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Silicon	0.0813	0.3841	0.3124
Silver	0.0023	0.0120	0.0098
Sodium	0.1797	0.8561	0.7245
Strontium	0.0013	0.0098	0.0075
Sulfate	4.7406	22.4577	20.8302
Sulfur	1.4732	7.2163	5.9842
Tantalum	0.0023	0.0239	0.0199
Terbium	0.0008	0.0175	0.0066
Tin	0.0057	0.0487	0.0326
Titanium	0.0059	0.0191	0.0181
Total mass	17.3692	56.2158	51.0889
Vanadium	0.0070	0.0377	0.0296
Wolfram	0.0022	0.0181	0.0158
Yttrium	0.0004	0.0034	0.0024
Zinc	0.0317	1.6019	0.0582
Zirconium	0.0011	0.0104	0.0067

Table 4
Fine Particulate Speciation Data – 2003
New Brunswick, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.0115	0.1067	0.0844
Ammonium	1.8203	9.1265	7.8466
Antimony	0.0063	0.0515	0.0507
Arsenic	0.0013	0.0076	0.0074
Barium	0.0120	0.0713	0.0653
Bromine	0.0028	0.0094	0.0089
Cadmium	0.0019	0.0214	0.0157
Calcium	0.0262	0.1053	0.0821
Cerium	0.0061	0.0712	0.0575
Cesium	0.0037	0.0329	0.0322
Chlorine	0.0213	0.7891	0.3443
Chromium	0.0030	0.0296	0.0207
Cobalt	0.0003	0.0027	0.0015
Copper	0.0040	0.0150	0.0123
Elemental carbon	0.6409	1.9724	1.8699
Europium	0.0016	0.0220	0.0186
Gallium	0.0002	0.0024	0.0018
Gold	0.0014	0.0088	0.0074
Hafnium	0.0021	0.0383	0.0203
Indium	0.0024	0.0228	0.0169
Iridium	0.0013	0.0071	0.0070
Iron	0.0728	0.2797	0.2157
Lanthanum	0.0066	0.0594	0.0587
Lead	0.0043	0.0263	0.0159
Magnesium	0.0050	0.0624	0.0535
Manganese	0.0023	0.0210	0.0182
Mercury	0.0010	0.0077	0.0058
Molybdenum	0.0012	0.0122	0.0101
Nickel	0.0030	0.0185	0.0144
Niobium	0.0005	0.0054	0.0048
Nitrate	1.6845	9.2520	8.3412
Organic carbon	3.8135	9.5666	8.3752
Phosphorus	0.0011	0.0305	0.0088
Potassium	0.0451	0.6205	0.1391
Rubidium	0.0003	0.0034	0.0021
Samarium	0.0010	0.0153	0.0105
Scandium	0.0002	0.0025	0.0019
Selenium	0.0013	0.0059	0.0059

Table 4 (Continued)
Fine Particulate Speciation Data – 2003
New Brunswick, New Jersey

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

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Silicon	0.0683	0.2781	0.2564
Silver	0.0024	0.0248	0.0115
Sodium	0.1928	2.7805	1.1087
Strontium	0.0009	0.0068	0.0038
Sulfate	4.7360	30.5835	21.6116
Sulfur	1.4063	8.7940	6.1515
Tantalum	0.0024	0.0211	0.0185
Terbium	0.0007	0.0162	0.0053
Tin	0.0043	0.0338	0.0325
Titanium	0.0039	0.0177	0.0122
Total mass	13.9240	59.9897	51.1604
Vanadium	0.0024	0.0145	0.0091
Wolfram	0.0018	0.0119	0.0110
Yttrium	0.0003	0.0033	0.0025
Zinc	0.0131	0.0917	0.0774
Zirconium	0.0008	0.0098	0.0048