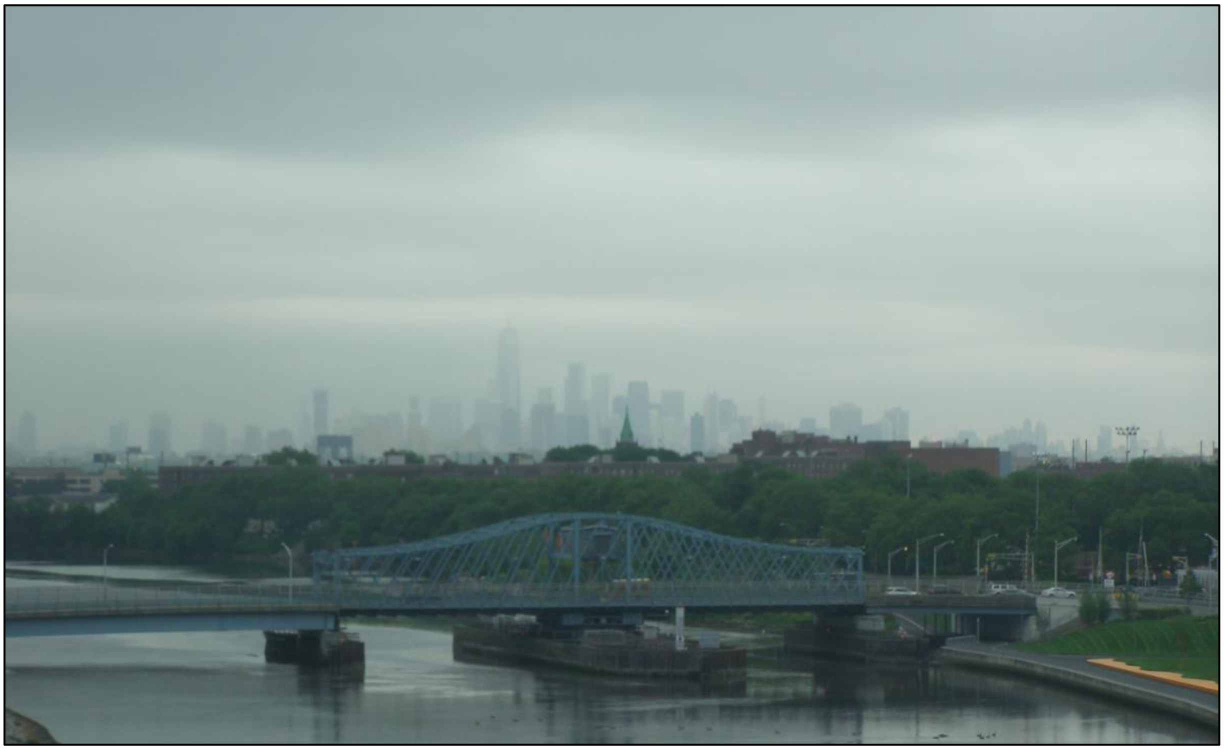
2017

New Jersey Air Quality Report

New Jersey Department of Environmental Protection



October 30, 2018

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Cover photo: Newark/New York City HazeCam, http://www.hazecam.net/camsite.aspx?site=newark, 5/31/2018.

EXECUTIVE SUMMARY

This report summarizes the New Jersey Department of Environmental Protection (NJDEP) air quality monitoring data for 2017, collected from NJDEP's extensive air monitoring network. The state of New Jersey has been monitoring air quality since 1965. During that time pollution levels have improved significantly, as a result of state, regional and national air pollution reduction efforts.

The chapter on the Air Quality Index (AQI), a national air quality rating system based on the National Ambient Air Quality Standards (NAAQS), describes the overall quality of New Jersey's air in 2017, and lists the days on which the AQI was over 100 (and NAAQS were exceeded). Nineteen days were classified as "Unhealthy for Sensitive Groups" in 2017, because their numerical AQI ratings were greater than 100. No days were classified as "Unhealthy" (AQI ratings greater than 150).

This report also includes detailed chapters for ozone, sulfur dioxide, nitrogen dioxide, particulate matter, and carbon monoxide. These are the criteria pollutants, those for which NAAQS have been set. Other information collected at our air monitoring stations includes meteorology, air toxics, and particulate species.

Figures 1-1 through 1-5 below illustrate the downward trends in concentrations of criteria pollutants in New Jersey over the past few decades.

New Jersey is getting close to meeting the ozone NAAQS, and will continue to implement emission control strategies while pursuing emissions reductions, including in upwind states that affect New Jersey's air. Because ozone is formed in the presence of sunlight and high temperatures, it can reach significant levels in the summer months. It also has been found to have serious health effects at lower levels than previously thought. In response, the United States Environmental Protection Agency (USEPA) periodically revises and lowers the NAAQS. USEPA lowered the ozone standard to 0.070 ppm in 2015.

The sharp increase and subsequent decrease in sulfur dioxide (SO_2) concentrations in New Jersey shown in Figure 1-2 are attributable to a coal-burning facility across the Delaware River in Pennsylvania. NJDEP established the Columbia Wildlife Management Area monitoring station in 2010 to determine the facility's impact on New Jersey's air quality. Exceedances of the SO_2 NAAQS were recorded that same year. Since the plant ceased operations under a court agreement, SO_2 levels in New Jersey have again achieved the standard.

Nitrogen dioxide (NO_2) is a reactive gas emitted primarily from motor vehicles. It is known to cause serious health problems, especially for sensitive individuals such as children, the elderly, and people with asthma. New Jersey has long been in compliance with the NAAQS for NO_2.

Particulate air pollution less than 2.5 micrometers in diameter is referred to as fine particulate or $PM_{2.5}$. These small particles can be inhaled deep into the lungs, and are known to have a greater impact on public health than larger particles, which were the focus of previous ambient air quality standards. Monitoring data in New Jersey shows a steady decline in $PM_{2.5}$ levels that are now in compliance with the NAAQS.

Outdoor concentrations of carbon monoxide can affect people with cardiovascular problems. Levels in New Jersey have been below the NAAQS for over twenty years.

Figure 1-1
Ozone Design Value* Trend in New Jersey, 1997-2017
*3-Year Average of 4th-Highest Daily Maximum 8-Hour Average Concentrations in Parts per Million (ppm)

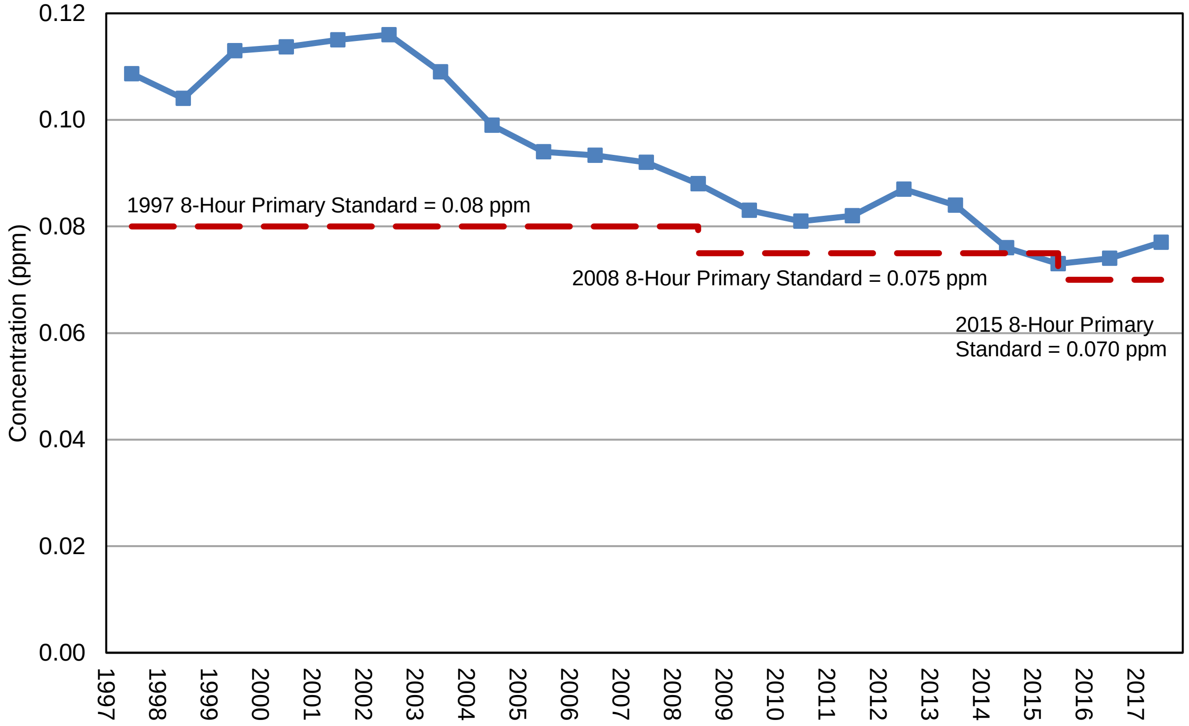


Figure 1-2
Sulfur Dioxide (SO_2) Design Value* Trend in New Jersey, 2000-2017
*3-Year Average of the 99th-Percentile of Daily Maximum 1-Hour Average Concentrations in Parts per Million (ppm)

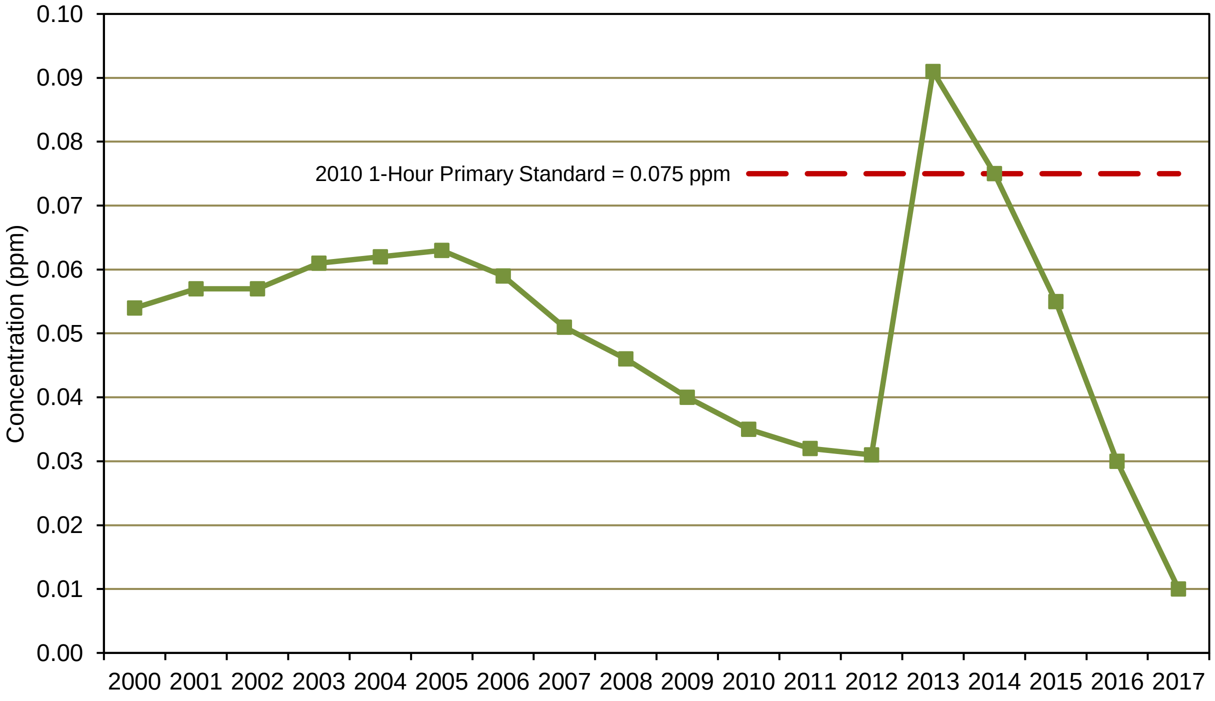


Figure 1-3

Nitrogen Dioxide (NO_2) Design Value* Trend in New Jersey, 2000-2017

***3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average Concentration in Parts per Million (ppm)**

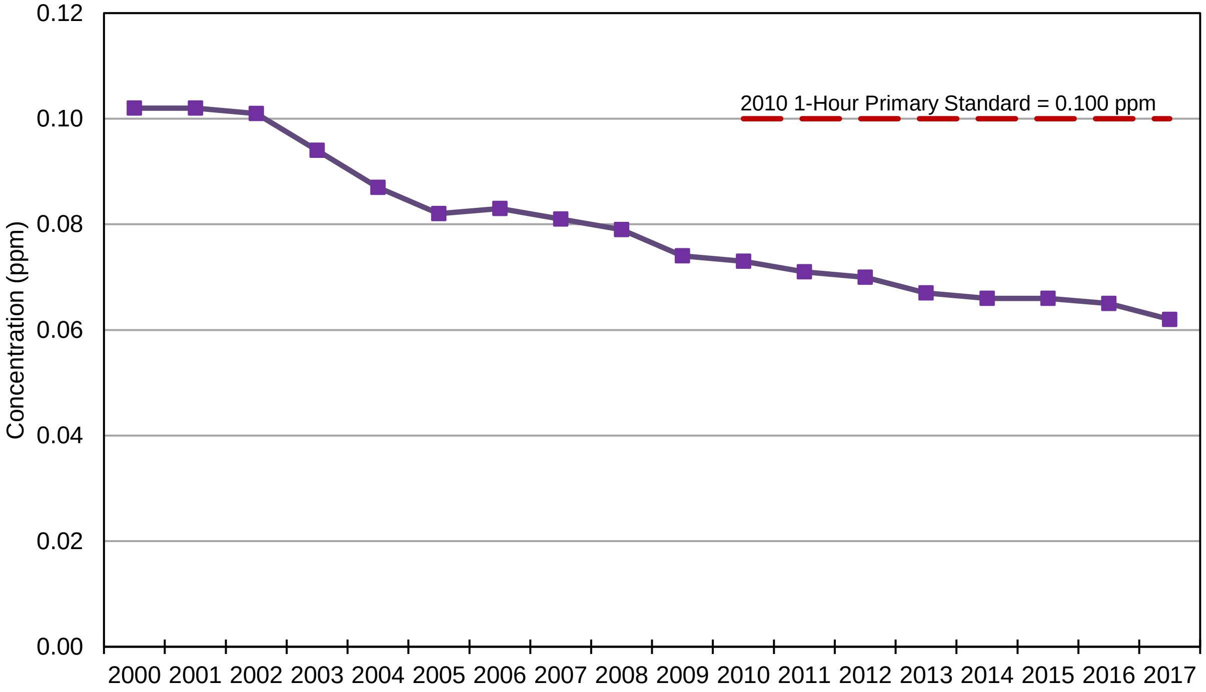


Figure 1-4

Fine Particulate ($PM_{2.5}$) 24-Hour Design Value* Trend in New Jersey, 2001-2017

***3-Year Average of the 98th-Percentile 24-Hour Average Concentrations in Micrograms per Cubic Meter (µg/m³)**

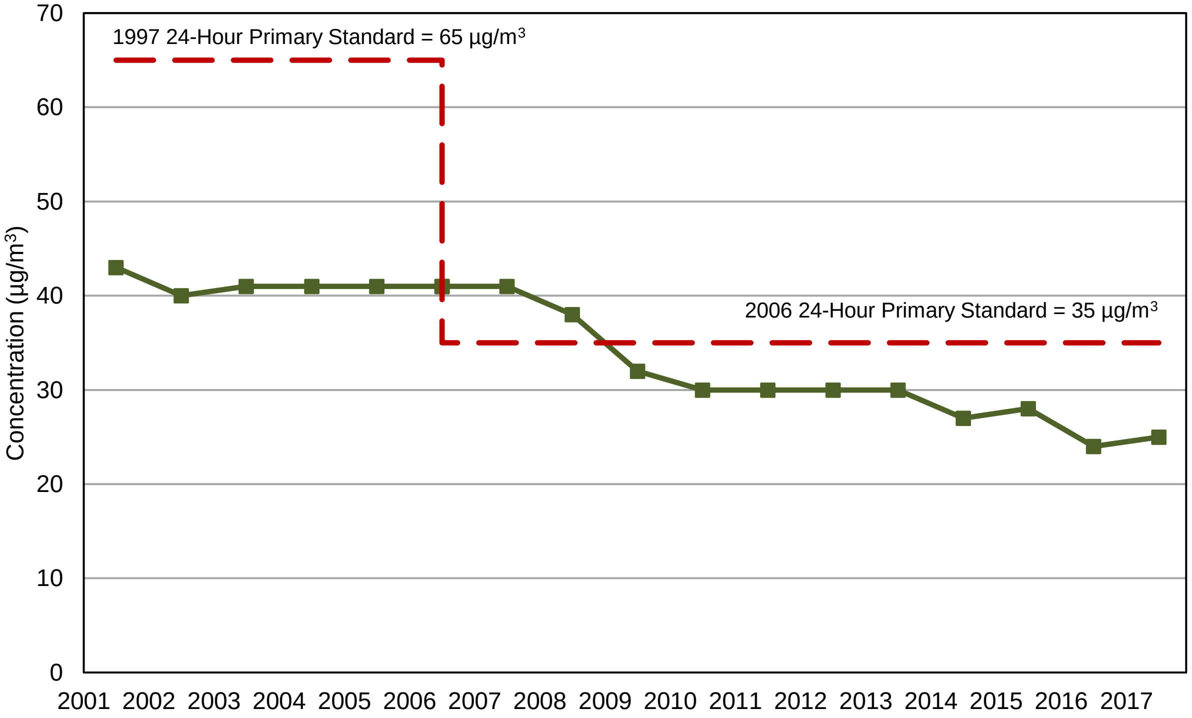
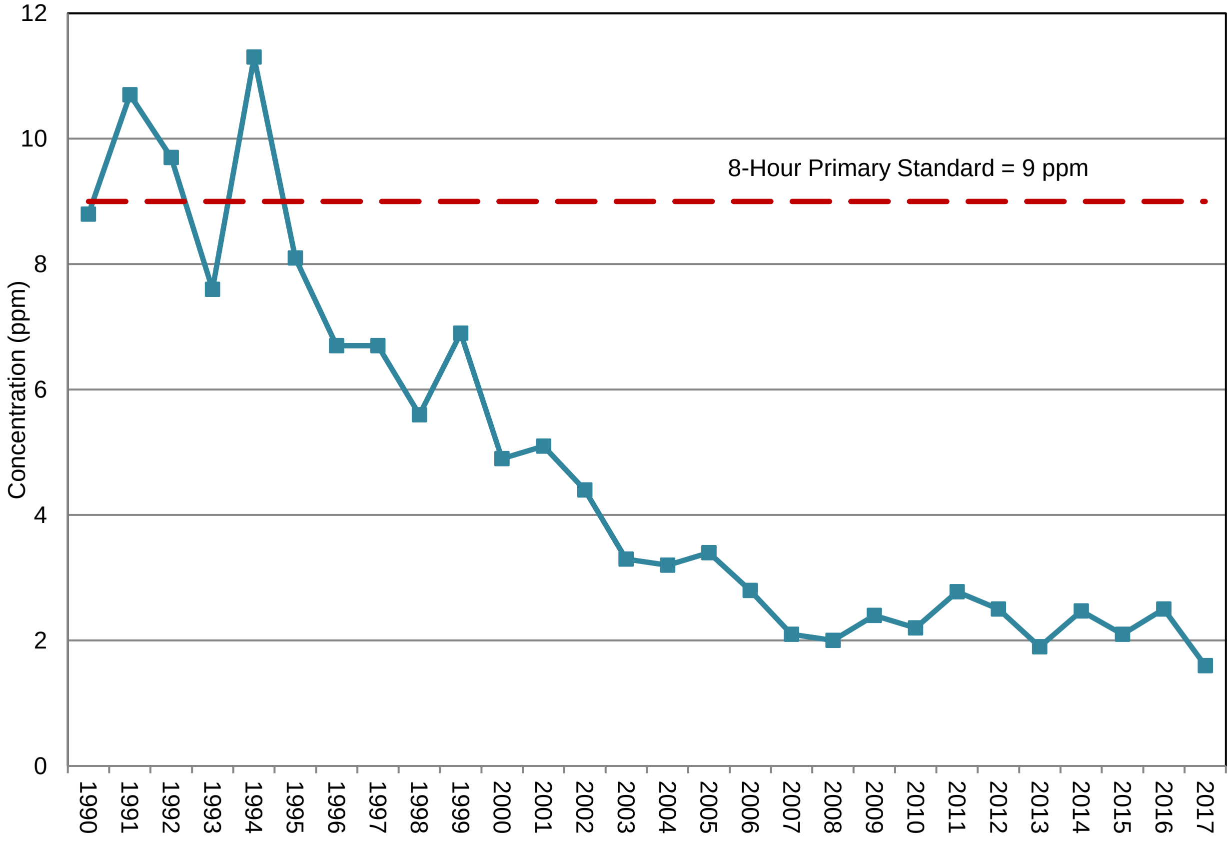


Figure 1-5
Carbon Monoxide (CO) Design Value* Trend in New Jersey, 1990-2017
*2nd-Highest 8-Hour Average Concentration
in Parts per Million (ppm)



2017 Air Monitoring Network

New Jersey Department of Environmental Protection

NETWORK DESCRIPTION

In 2017, the New Jersey Department of Environmental Protection (NJDEP) Bureau of Air Monitoring (BAM) operated 33 ambient air monitoring stations. The monitoring stations vary in the number and type of monitors operating at each site. New Jersey's air monitoring program is primarily focused on the measurement of pollutants for which National Ambient Air Quality Standards (NAAQS) have been established, also known as criteria pollutants. Criteria pollutant monitoring is regulated by the United States Environmental Protection Agency (USEPA), which prescribes the design and siting of the monitoring networks, the acceptable monitoring methods, and the minimum quality assurance activities. Only data which meet USEPA requirements can be used to determine compliance with the NAAQS. There are six criteria air pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). Because particulate matter encompasses such a wide range of contaminants, there are separate NAAQS for two different size fractions of particles. There are NAAQS for fine particles, less than 2.5 microns in size, also referred to as $PM_{2.5}$ (1 micron = one millionth of a meter), and another NAAQS for inhalable particles, less than 10 microns in size, referred to as PM_{10}.

In New Jersey, O_3, CO, NO_2, and SO_2 are measured using USEPA-approved real-time monitoring methods, and data for these pollutants are continuously transmitted to a central data acquisition system. Once an hour, the Bureau of Air Monitoring posts this air quality data to its website (www.njaqinow.net) and to the USEPA's Air Now website (www.airnow.gov). Data is subsequently reviewed and certified, and is available from USEPA's Air Quality Database at https://www.epa.gov/outdoor-air-quality-data.

$PM_{2.5}$ is measured with both 24-hour filter-based samplers and real-time continuous monitors. Filters must be installed and removed manually, and brought to the BAM lab to be weighed and analyzed. A filter-based sampler is also used to determine lead, PM_{10}, and PM_{coarse} concentrations (PM larger than 2.5 microns and smaller than 10 microns).

Figure 2-1
Ramapo Air Monitoring Station

In addition to monitoring criteria pollutants, the NJDEP also measures “non-criteria pollutants,” or pollutants that do not have health-based National Ambient Air Quality Standards. Certain non-criteria pollutants are grouped together by their purpose or collection method. USEPA’s Photochemical Assessment Monitoring Station (PAMS) program, for example, measures non-criteria pollutants that are important in the formation of ozone. Since most ozone is not directly emitted from sources but forms in the atmosphere when volatile organic compounds and oxides of nitrogen react in the presence of sunlight, it is important to know the levels of these “precursor” pollutants.

Other non-criteria pollutants monitored by BAM include some that are commonly emitted by motor vehicles and other combustion sources: Benzene, toluene, ethylbenzene, ortho-xylene, meta-xylene, para-xylene (measured with a “BTEX” analyzer), and black carbon (measured with an aethalometer).

Five sites in the monitoring network collect samples of $PM_{2.5}$ that are analyzed to determine the chemical makeup of the particles. These are part of USEPA’s Chemical Speciation Network (CSN). This data is used in helping to identify the primary sources of particles, and in assessing potential health effects.

Figure 2-2
USEPA-Approved $PM_{2.5}$ Sampler in Jersey City

Volatile organic compounds (VOCs) are collected and analyzed at four monitoring sites. These non-criteria pollutants are classified as “air toxics,” pollutants that have potential health effects but for which NAAQS have not been established. They can be carcinogenic or have other serious health effects, and are very diverse in their chemical composition.

Two sites, Cattus Island and Washington Crossing, are part of the National Atmospheric Deposition Network. BAM staff collect the samples and ship them to a national laboratory for analysis of acids, nutrients, and base cations in precipitation.

A number of sites within the air monitoring network also take measurements of meteorological parameters, such as temperature, relative humidity, barometric pressure, wind speed, wind direction, precipitation, and solar radiation.

Figure 2-1 shows the seasonal ozone monitoring station at Ramapo Mountain State Forest in Passaic County. Figure 2-2 shows a USEPA-approved manual $PM_{2.5}$ sampler located at the Jersey City Firehouse on Newark Avenue.

The locations of all the monitoring stations that operated in 2017 are shown on the map in Figure 2-3. Table 2-1 lists the parameters that were measured at each site. More details about the monitoring stations can be found in Appendix A.

Figure 2-3
New Jersey Air Monitoring Sites in 2017

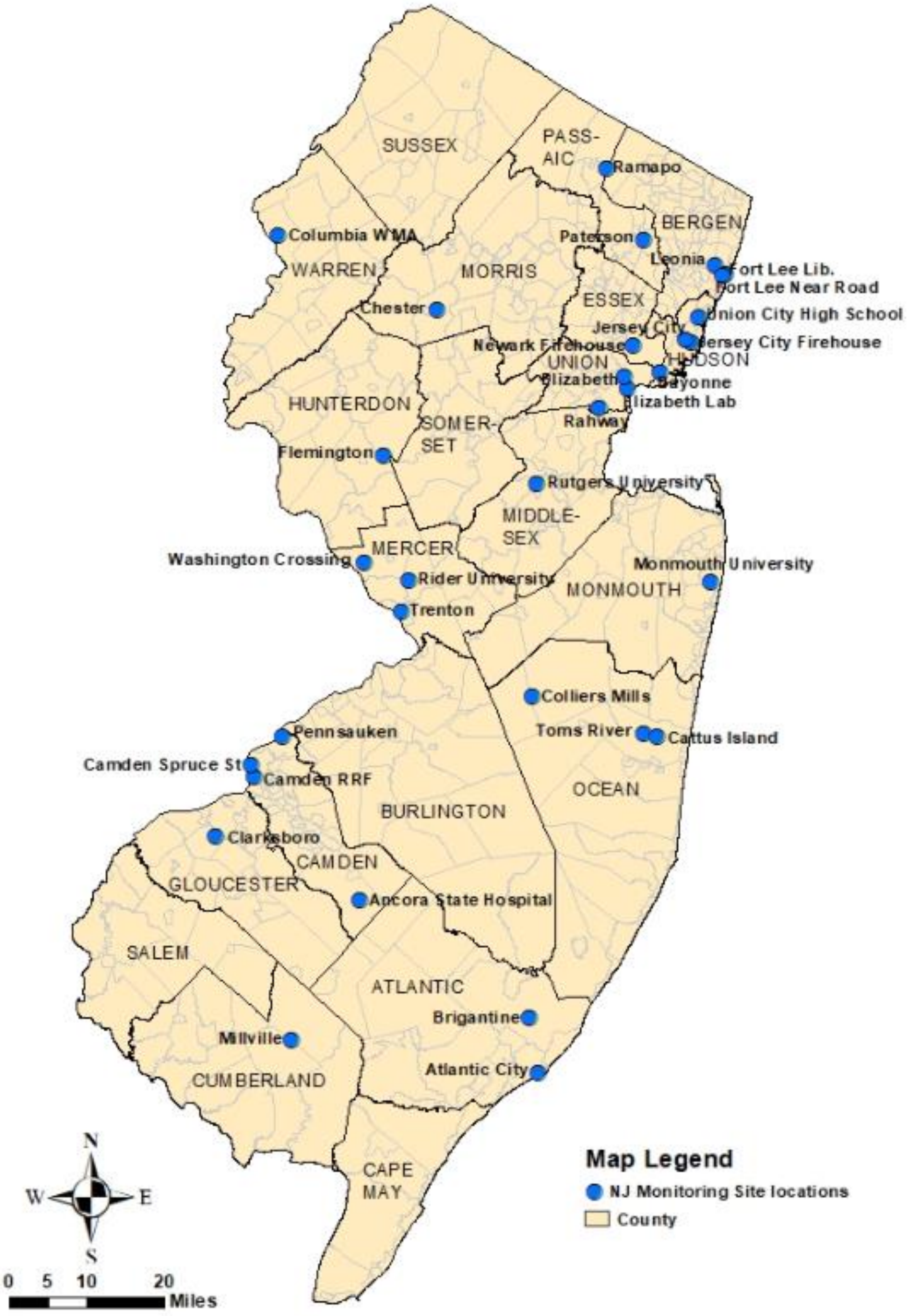


Table 2-1
2017 New Jersey Air Monitoring Network Summary

	Monitoring Parameter Monitoring Station	CO	NO_x	NOy	O_3	SO_2	Smoke Shade	$PM_{2.5}$	Real-Time $PM_{2.5}$ TEOM	Real-Time $PM_{2.5}$ Beta	Visibility	PM_{10}	Lead/PM_{coarse}	$PM_{2.5}$-Speciation	O_3 Precursors (PAMS)	Toxics	BTEX/ Black Carbon	Acid Deposition	Mercury	Meteorological#	Rain	Solar Radiation
1	Ancora State Hospital				1																	
2	Atlantic City							1														
3	Bayonne		1		1	1											1			1	1	
4	Brigantine				1	1		1		1	1							1				
5	Camden RRF											1										
6	Camden Spruce Street	1	1		1	1		2		1				1		1	1			1	1	
7	Cattus Island																	1				
8	Chester		1		1	1		1						1		1						
9	Clarksboro				1			1a														
10	Colliers Mills				1																	
11	Columbia		1		1	1		1		1										1	1	
12	Elizabeth	1				1	1															
13	Elizabeth Lab	1	1			1	1	2		1				1		1	1		1	1	1	
14	Flemington				1					1										1	1	
15	Fort Lee Library							1														
16	Fort Lee Near Road	1	1							1							1			1	1	
17	Gibbstown *							1b														
18	Jersey City	1	1			1	1															
19	Jersey City Firehouse							2		1		2										
20	Leonia				1																	
21	Millville		1		1					1												
22	Monmouth University				1																	
23	Newark Firehouse	1	1	1	1	1		1		1		1	1	1			1			1	1	1
24	Paterson							1														
25	Pennsauken							1														
26	Rahway							1	1													
27	Ramapo				1																	
28	Rider University				1					1										1		
29	Rutgers University		1		1			1		1				2	1	1			1			
30	Toms River							1														
31	Trenton							1														
32	Union City High School**							1														
33	Washington Crossing																	1				
	TOTAL	6	10	1	16	9	0	20	1	11	1	4	1	6	1	4	5	3	2	8	7	1

Meteorological parameters include temperature, relative humidity, barometric pressure, wind direction & wind speed.
* Monitoring site shut down in 2017
1 - Parameter measured in 2017
2 - Collocated parameter measured in 2017
a - Monitor started up in 2017
b - Monitor shut down in 2017

CHANGES TO THE NETWORK IN 2017

The only change to New Jersey's monitoring network in 2017 was the shutdown of the Gibbstown station in August because of construction activity at the site. The filter-based $PM_{2.5}$ sampler was relocated to the Clarksboro monitoring station.

Table 2-2
2016 Network Changes (by Date)

Monitoring Site	Parameter(s)	Action	Date
Clarksboro	$PM_{2.5}$ FRM	Moved from Gibbstown	8/8/2017
Gibbstown	$PM_{2.5}$ FRM	Site shut down	8/8/2017

$PM_{2.5}$ FRM is a federal reference method filter-based manual sampler for measuring 24-hour samples of inhalable particulate.

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2017 Air Quality Index

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). An index value of 100 is equal to the primary, or health-based, NAAQS for each pollutant. This allows for a comparison of each of the pollutants used in the AQI. These pollutants are ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Although air concentrations of pollutants have been dropping over the past few years, the U.S. Environmental Protection Agency (USEPA) periodically reviews the NAAQS to make sure that they are protective of public health, and adjusts them accordingly in response to new research. The latest NAAQS revision, for ozone, occurred in October 2015.

Every morning an air pollution forecast for the current and following day is prepared by the New Jersey Department of Environmental Protection (NJDEP) using the AQI format. The forecast is provided to USEPA and is disseminated through the Enviroflash system to subscribers who sign up to receive air quality forecast and alert emails or texts (www.enviroflash.info). Anyone can view the forecast and current air quality conditions at USEPA's AirNow website (www.airnow.gov) or at NJDEP's air monitoring webpage (www.njaqinow.net/).

In an effort to make the AQI easier to understand, a color code and descriptive interpretation are assigned to the numerical ratings (see Table 3-1). Table 3-2 contains suggested actions to take to protect public health for different AQI levels. For more information on the AQI, visit EPA's web site at www.airnow.gov.

Table 3-1
Air Quality Index Levels and Associated Health Impacts

AQI Level of Health Concern	Numerical Value	Meaning	Color Code
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.	**Green**
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	**Yellow**
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	**Orange**
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.	**Red**
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.	**Purple**
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.	**Maroon**

Table 3-2
AQI Suggested Actions to Protect Health

Air Quality Index Level	AQI Value Actions to Protect Your Health
Good (1-50)	None
Moderate (51-100)	Unusually sensitive individuals should consider limiting prolonged outdoor exertion.
Unhealthy for Sensitive Groups (101-150)	Children, active adults, and people with respiratory disease such as asthma should limit prolonged outdoor exertion.
Unhealthy (151-200)	Children, active adults, and people with respiratory disease such as asthma should avoid prolonged outdoor exertion: Everyone else should limit prolonged outdoor exertion.
Very Unhealthy (201-300)	Children, active adults, and people with respiratory disease such as asthma should avoid outdoor exertion. Everyone else should limit outdoor exertion.
Hazardous (301-500)	Everyone should avoid all physical activity outdoors.

Table 3-3 shows the pollutant-specific ranges for the AQI categories. These are set according to the corresponding NAAQS.

Table 3-3
AQI Pollutant-Specific Ranges

Category	AQI Level	O_3	$PM_{2.5}$	CO	SO_2	NO_2
		(ppm) 8-hour	(µg/m^3) 24-hour	(ppm) 8-hour	(ppm) 1-hour	(ppm) 1-hour
Good	0-50	0.000-0.054	0.0-12.0	0.0-4.4	0-0.035	0-0.053
Moderate	51-100	0.055-0.070	12.1-35.4	4.5-9.4	0.036-0.075	0.054-0.100
Unhealthy for Sensitive Groups	101-150	0.071-0.085	35.5-55.4	9.5-12.4	0.076-0.185	0.101- 0.360
Unhealthy	151- 200	0.086-0.105	55.5-150.4	12.5-15.4	0.186-0.304	0.361-0.649
Very Unhealthy	201-300	0.106-0.200	150.5-250.4	15.5-30.4	0.305-0.604	0.605-1.249
Hazardous	301-500	>0.200	250.5-500.4	30.5-1004	0.605-1.004	1.250-2.049

Pollutants:

O_3 – Ozone

$PM_{2.5}$ – Fine particulate matter

CO – Carbon monoxide

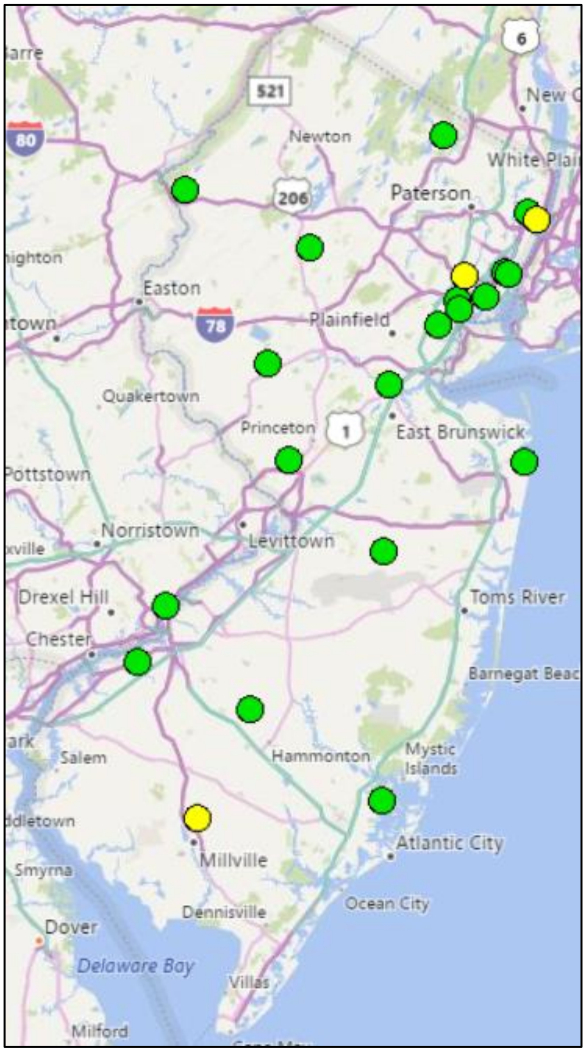
SO_2 – Sulfur dioxide

NO_2 – Nitrogen dioxide

On days when the air quality is expected to reach the “Unhealthy for Sensitive Groups” range or above, cautionary statements similar to those in Tables 3-1 and 3-2 are provided as part of the forecast. These air quality alerts are issued through Enviroflash emails, are displayed on the AirNow and NJDEP air monitoring websites, and can also be viewed on the National Weather Service page for the Philadelphia/Mount Holly area (http://airquality.weather.gov/). Maps, charts, site photos, and other air quality information are also available on the NJDEP air monitoring web site, as shown in Figure 3-1 below.

Figure 3-1
Examples of Information Available on NJDEP’s Air Monitoring Website
www.njaqinow.net

Current Air Quality



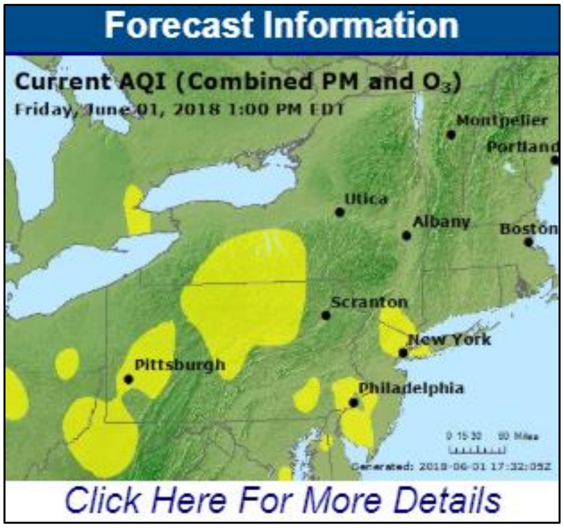
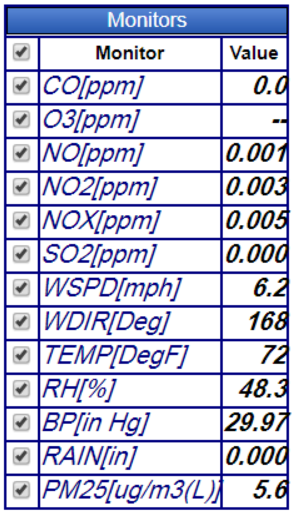
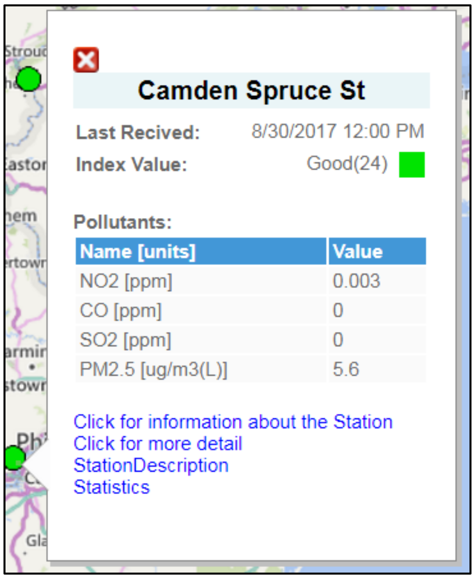


Figure 3-1 (continued)
Examples of Information Available on NJDEP's Air Monitoring Website



Monitors

☑	Monitor	Value
☑	*CO[ppm]*	***0.0***
☑	*O3[ppm]*	***--***
☑	*NO[ppm]*	***0.001***
☑	*NO2[ppm]*	***0.003***
☑	*NOX[ppm]*	***0.005***
☑	*SO2[ppm]*	***0.000***
☑	*WSPD[mph]*	***6.2***
☑	*WDIR[Deg]*	***168***
☑	*TEMP[DegF]*	***72***
☑	*RH[%]*	***48.3***
☑	*BP[in Hg]*	***29.97***
☑	*RAIN[in]*	***0.000***
☑	*PM25[ug/m3(L)]*	***5.6***



☒

Camden Spruce St

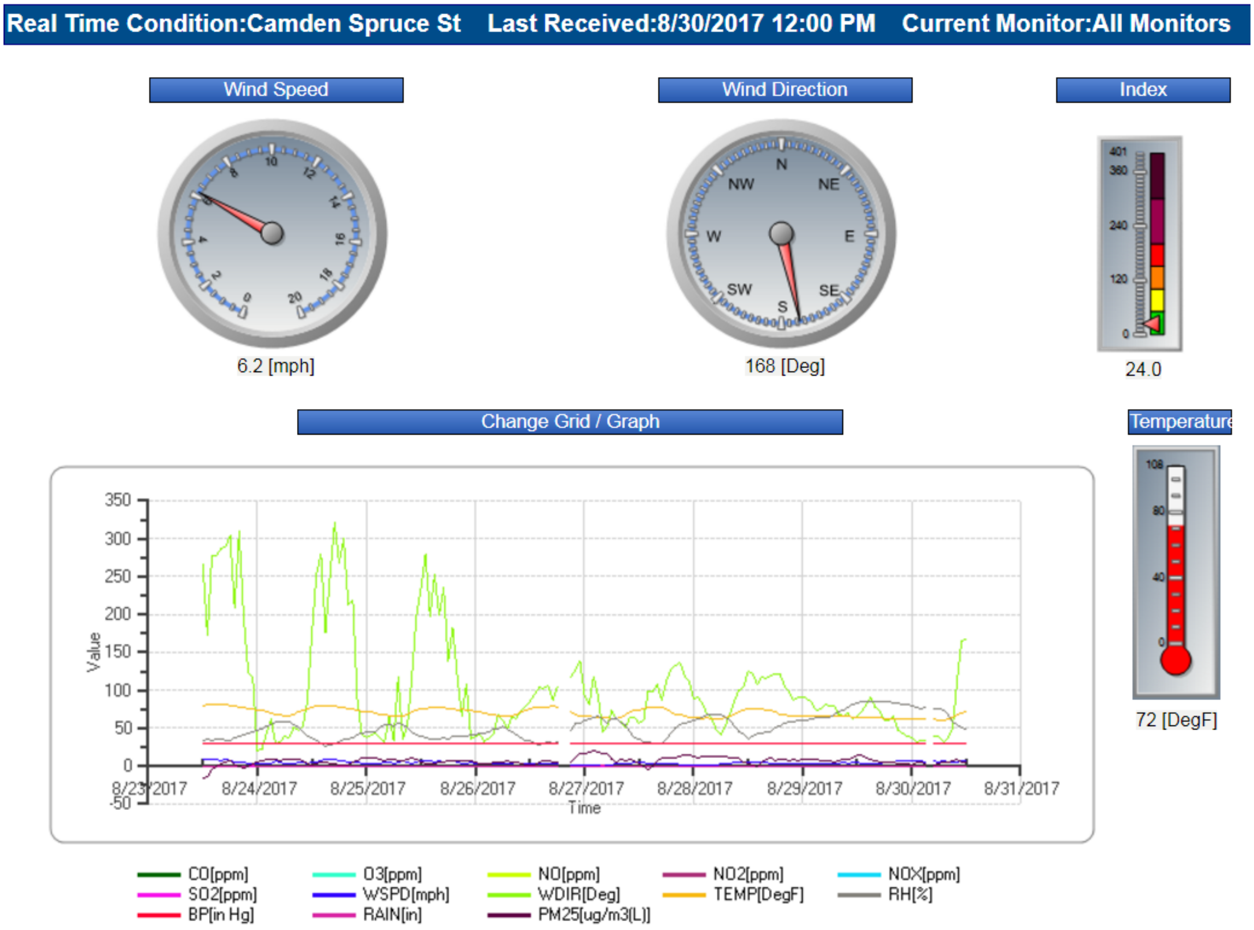
Last Recived: 8/30/2017 12:00 PM

Index Value: Good(24) 🟩

Pollutants:

Name [units]	Value
NO2 [ppm]	0.003
CO [ppm]	0
SO2 [ppm]	0
PM2.5 [ug/m3(L)]	5.6

Click for information about the Station
Click for more detail
StationDescription
Statistics



Real Time Condition:Camden Spruce St Last Received:8/30/2017 12:00 PM Current Monitor:All Monitors

2017 AQI SUMMARY

Not all of New Jersey's monitoring sites have 365 days of reported air quality index values. Certain ozone monitors only operate during "ozone season," from March through October. Also, not all monitoring sites measure all pollutants. Table 3-4 shows which pollutants are used to determine the daily AQI at different monitoring stations.

Table 3-4
Pollutants Monitored at Each Air Quality Index Monitoring Site in New Jersey in 2017

	Monitoring Site	Ozone	Particulate Matter	Carbon Monoxide	Sulfur Dioxide	Nitrogen Dioxide
1	Ancora State Hospital	√ (s)				
2	Bayonne	√			√	√
3	Brigantine	√	√		√	
4	Camden Spruce St.	√	√	√	√	√
5	Chester	√			√	√
6	Clarksboro	√ (s)				
7	Colliers Mills	√ (s)				
8	Columbia WMA	√	√		√	√
9	Elizabeth			√	√	
10	Elizabeth Lab		√	√	√	√
11	Flemington	√	√			
12	Fort Lee Near Road		√	√		√
13	Jersey City			√	√	√
14	Jersey City Firehouse		√			
15	Leonia	√ (s)				
16	Millville	√	√			√
17	Monmouth University	√ (s)				
18	Newark Firehouse	√	√	√	√	√
19	Rahway		√			
20	Ramapo	√ (s)				
21	Rider University	√	√			
22	Rutgers University	√	√			√

(s) – Seasonal operation only (March 1 through October 31)

A summary of the AQI ratings for New Jersey in 2017 is presented in the pie chart in Figure 3-2 below. In 2017, there were 143 "Good" days, 203 were "Moderate," and 19 were rated "Unhealthy for Sensitive Groups." There were no days rated "Unhealthy" or "Very Unhealthy." This indicates that air quality in New Jersey is mostly good or moderate, but that air pollution was still bad enough in 2017 to adversely affect sensitive people about 5% of the time. However, this is an improvement from the previous year, when 26 days were unhealthy for sensitive groups and there were two "Unhealthy" days.

Figure 3-2
2017 Air Quality Summary by Days

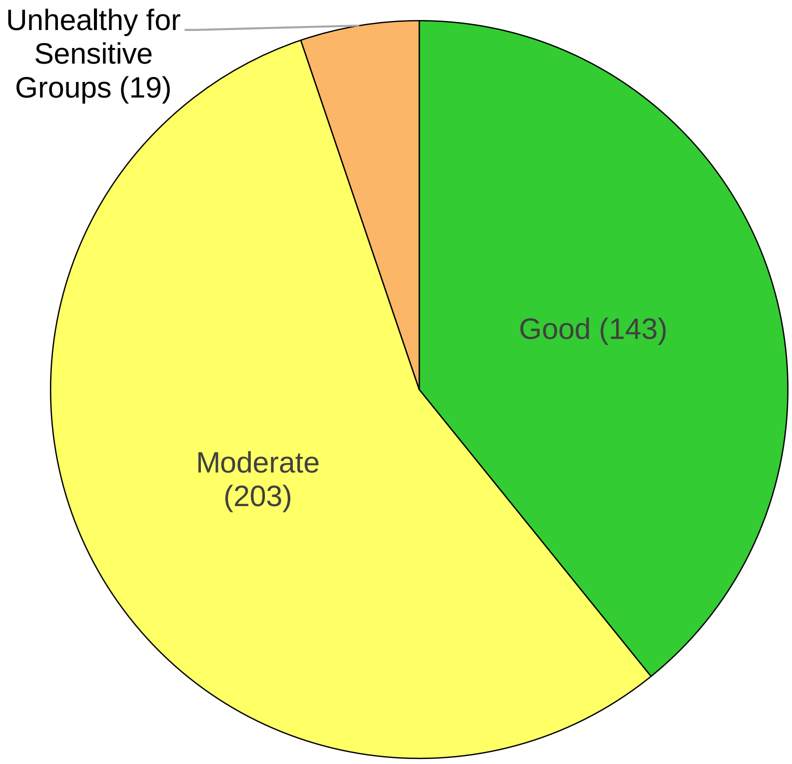


Table 5 lists the dates when the AQI reached the "Unhealthy for Sensitive Groups" threshold at any monitoring location, and shows the responsible pollutants and their concentrations. Fourteen out of the nineteen "USG" days are the result of high ozone levels during warm-weather periods.

Table 3-5
AQI "Unhealthy" or "USG" Days in New Jersey During 2017

Day	Date	Monitor Location	Pollutant	Concen-tration	Units	AQI Rating	AQI Value
1	1/28/17	Camden Spruce St.	$PM_{2.5}$	36.2	$\mu g/m^3$	USG	103
2	2/1/17	Camden Spruce St.	$PM_{2.5}$	37.7	$\mu g/m^3$	USG	106
3	3/9/17	Camden Spruce St.	$PM_{2.5}$	40.6	$\mu g/m^3$	USG	114
4	4/11/17	Chester	O_3	0.075	ppm	USG	115
		Flemington	O_3	0.077	ppm	USG	122
		Ramapo	O_3	0.074	ppm	USG	112
		Rutgers University	O_3	0.071	ppm	USG	101
		Washington Crossing*	O_3	0.071	ppm	USG	101
5	5/17/17	Camden Spruce St.	O_3	0.077	ppm	USG	122
		Chester	O_3	0.072	ppm	USG	105
		Clarksboro	O_3	0.071	ppm	USG	101
		Columbia	O_3	0.071	ppm	USG	101
		Flemington	O_3	0.072	ppm	USG	105
		Leonia	O_3	0.074	ppm	USG	112
		Rider University	O_3	0.077	ppm	USG	122
		Rutgers University	O_3	0.080	ppm	USG	133
		Washington Crossing*	O_3	0.073	ppm	USG	108
6	5/18/17	Camden Spruce St.	O_3	0.083	ppm	USG	143
		Clarksboro	O_3	0.076	ppm	USG	119
		Flemington	O_3	0.072	ppm	USG	105
		Leonia	O_3	0.074	ppm	USG	112
		Rider University	O_3	0.080	ppm	USG	133
		Rutgers University	O_3	0.075	ppm	USG	115
		Washington Crossing*	O_3	0.071	ppm	USG	101
7	6/10/17	Camden Spruce St.	O_3	0.076	ppm	USG	119
		Leonia	O_3	0.074	ppm	USG	112
8	6/11/17	Camden Spruce St.	O_3	0.071	ppm	USG	101
9	6/12/17	Bayonne	O_3	0.074	ppm	USG	112
		Camden Spruce St.	O_3	0.074	ppm	USG	112
		Chester	O_3	0.072	ppm	USG	105
		Clarksboro	O_3	0.073	ppm	USG	108
		Colliers Mills	O_3	0.080	ppm	USG	133
		Flemington	O_3	0.073	ppm	USG	108
		Leonia	O_3	0.082	ppm	USG	140
		Monmouth University	O_3	0.071	ppm	USG	101
		Newark Firehouse	O_3	0.071	ppm	USG	101
		Rutgers University	O_3	0.072	ppm	USG	105

Continued on next page.

Table 3-5 (continued)
AQI "Unhealthy" or "USG" Days in New Jersey During 2017

Day	Date	Monitor Location	Pollutant	Concen-tration	Units	AQI Rating	AQI Value
10	6/13/17	Ancora	O_3	0.071	ppm	USG	101
		Camden Spruce St.	O_3	0.079	ppm	USG	129
		Clarksboro	O_3	0.078	ppm	USG	126
		Colliers Mills	O_3	0.079	ppm	USG	129
		Leonia	O_3	0.074	ppm	USG	112
11	6/22/17	Camden Spruce St.	O_3	0.076	ppm	USG	119
		Leonia	O_3	0.071	ppm	USG	101
		Rider University	O_3	0.076	ppm	USG	119
		Rutgers University	O_3	0.076	ppm	USG	119
		Washington Crossing*	O_3	0.071	ppm	USG	101
12	6/30/17	Leonia	O_3	0.079	ppm	USG	129
13	7/19/17	Camden Spruce St.	O_3	0.072	ppm	USG	105
		Clarksboro	O_3	0.076	ppm	USG	119
		Colliers Mills	O_3	0.074	ppm	USG	112
14	7/20/17	Ancora	O_3	0.073	ppm	USG	108
		Clarksboro	O_3	0.071	ppm	USG	101
		Colliers Mills	O_3	0.077	ppm	USG	122
15	7/22/17	Bayonne	O_3	0.075	ppm	USG	115
		Camden Spruce St.	O_3	0.076	ppm	USG	119
16	8/1/17	Bayonne	O_3	0.072	ppm	USG	105
17	9/24/17	Rutgers University	O_3	0.078	ppm	USG	126
18	12/4/17	Elizabeth Lab	$PM_{2.5}$	35.6	µg/m^3	USG	101
19	12/10/17	Camden Spruce St.	$PM_{2.5}$	44.2	µg/m^3	USG	122

Rating
USG – Unhealthy for sensitive groups

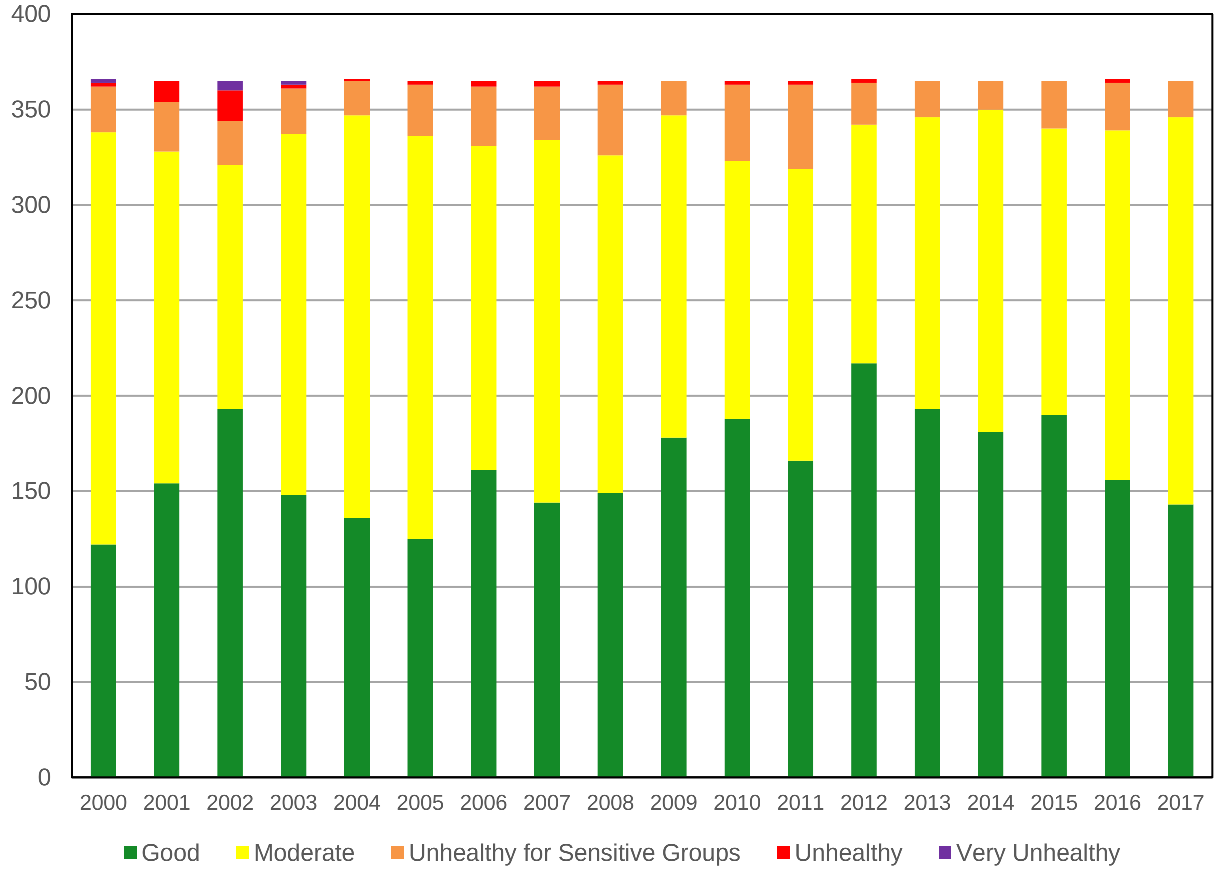
Pollutants	Units
$PM_{2.5}$ – Fine particulate matter	µg/m^3 – micrograms per cubic meter
O_3 – Ozone	ppm – parts per million

* Washington Crossing air monitoring station is operated by USEPA. The site's data is included in determining exceedances in New Jersey.

Figure 3-3 shows the distribution of AQI days since 2000. It should be noted that AQI ranges change whenever a NAAQS is revised (so far, always to be more stringent) for a specific pollutant. So even though improvement in AQI days appears to be somewhat erratic, to see how things really have improved, refer to the concentration trend graphs in the individual criteria pollutant reports.

Of all the criteria pollutants, ozone is predominantly responsible for AQI days above the moderate range in New Jersey.

Figure 3-3
Number of Days in Each AQI Category Since 2000



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2017 Ozone Summary

New Jersey Department of Environmental Protection

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 4-1). 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 (VOCs) react in the presence of sunlight (see Figure 4-2). NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOCs are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. The pollutants that form ozone, referred to as "precursor" pollutants, and ozone itself 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 problem in the daytime during the summer months. The U.S. Environmental Protection Agency (USEPA) requires New Jersey to monitor ozone from March 1st to October 31st, the so-called "ozone season." Weather patterns have a significant effect on ozone formation, and hot dry summers will result in more ozone than cool wet ones. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the USEPA publication, "Good Up High, Bad Nearby – What is Ozone?"

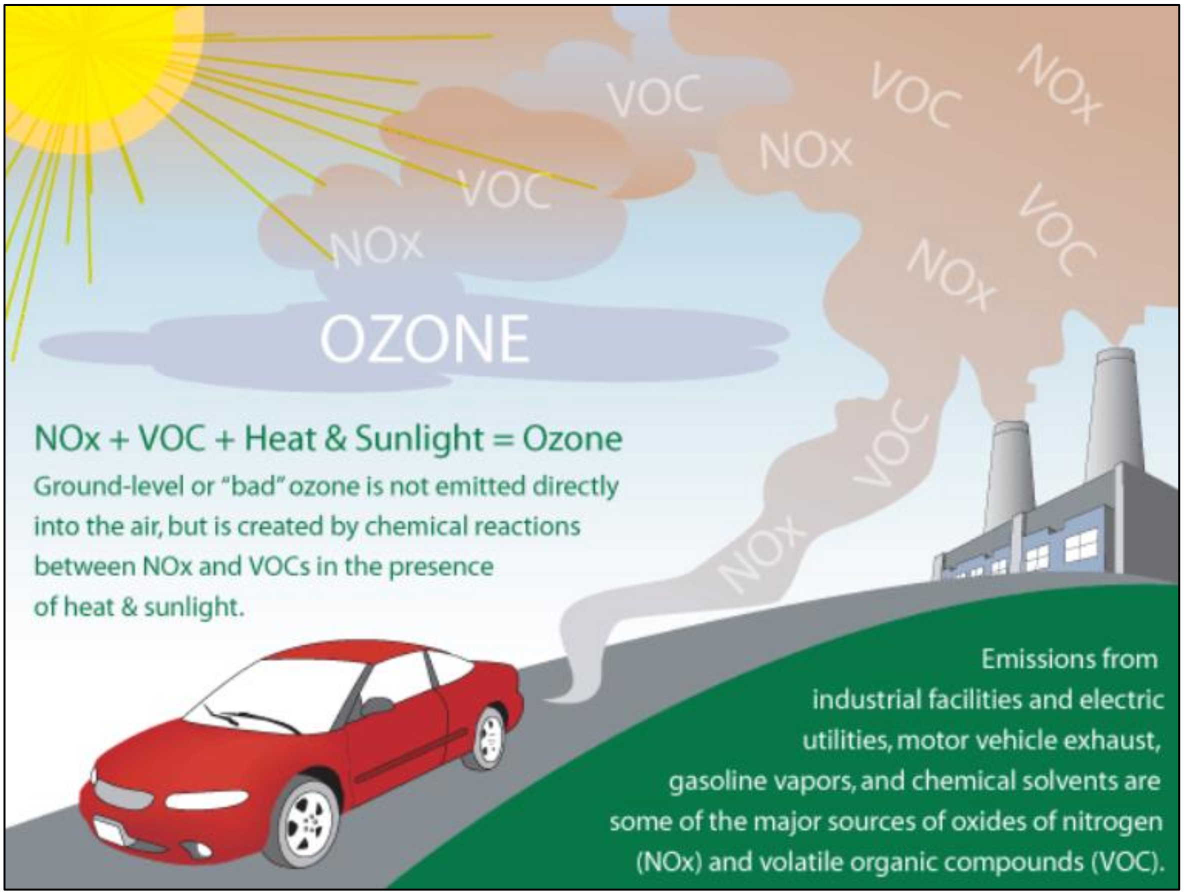
Figure 4-1. Good and Bad Ozone

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: USEPA AirNow

Figure 4-2
Ozone Formation



Source: USEPA. https://airnow.gov/index.cfm?action=aqibasics.ozone

HEALTH AND ENVIRONMENTAL EFFECTS

Ozone can irritate the entire respiratory tract. Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present at 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 medical conditions 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. Children are at special risk for ozone-related problems. They breathe more air per pound of body weight than adults, and ozone can impact the development of their immature respiratory systems. They tend to be active outdoors during the summer when ozone levels are at their highest. Anyone who spends time outdoors in the summer can be affected, and studies have shown that even healthy adults can experience difficulty in breathing when exposed to ozone. Anyone engaged in strenuous outdoor activities, such as jogging, should limit activity to the early morning or late evening hours on days when ozone levels are expected to be high.

Ground-level ozone damages plant life and is responsible for 500 million dollars in reduced crop production in the United States each year. It interferes with the ability of plants to produce and store food, making them more susceptible to harsh weather, disease, insects, and other pollutants. It 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 tulip poplar leaf shown in Figure 4-3 are damage caused by exposure to ground-level ozone.

Figure 4-3
Leaf Damage Caused by Ozone

https://www.epa.gov/sites/production/files/styles/large/public/2015-06/tulippoplarleafdamage.jpg

AMBIENT AIR QUALITY STANDARDS

National and state air quality standards for ground-level ozone were first promulgated in 1971. There are both primary standards, which are set to provide public health protection (including protecting the health of sensitive populations such as asthmatics, children, and the elderly), and secondary standards, which are based on welfare effects (such as 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 4-1). USEPA must periodically review the NAAQS to determine if they are sufficiently protective of public health based on the latest studies. In 1997, the 0.08 parts per million (ppm) 8-hour average daily maximum ozone NAAQS was changed to 0.075 ppm. In October 2015 the 8-hour ozone NAAQS was lowered once again, to 0.070 ppm, effective in 2016. New Jersey also has a primary 1-hour standard of 0.12 ppm.

Compliance with a NAAQS is based on meeting the design value, the actual statistic that determines whether the standard is being met. For ozone, calculating the design value is a two-step process using data from the most recent three years. The first step involves determining the fourth-highest daily maximum 8-hour average concentration for each monitoring site in the state for each of the three years. The values for each site are then used to calculate a three-year average. If this value exceeds the NAAQS at any site in the state, the state is determined to be in nonattainment.

Table 4-1
National and New Jersey Ambient Air Quality Standards for Ozone
Parts per Million (ppm)

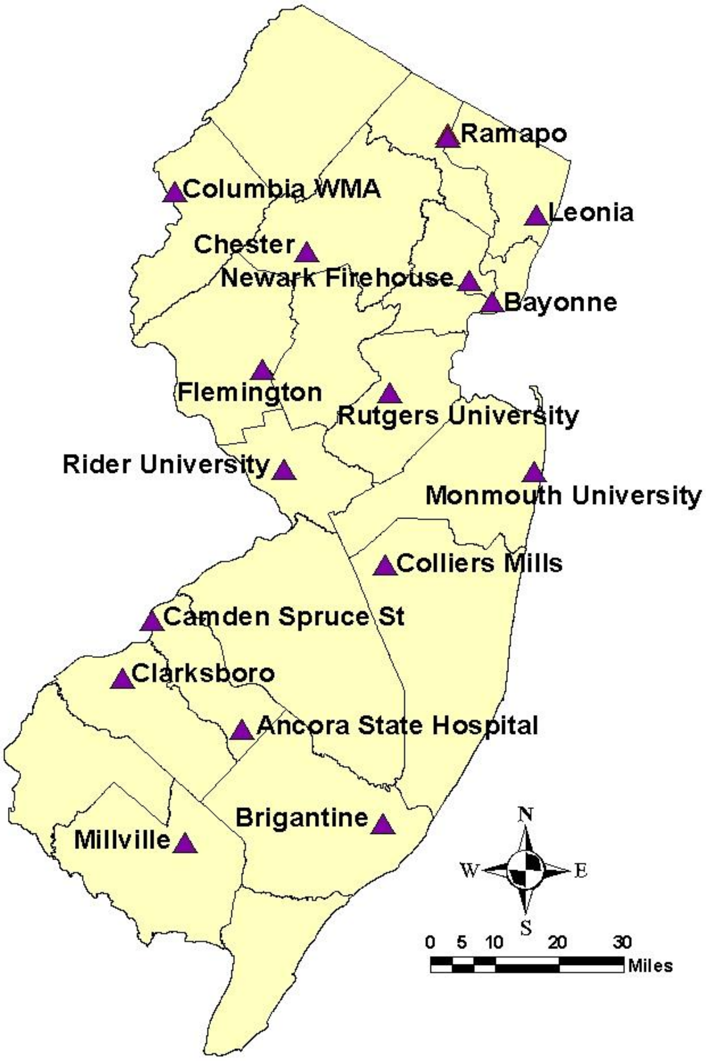
Averaging Period	Type	National	New Jersey
1-Hour	Primary	---	0.12 ppm
8-Hours	Primary & secondary	0.070 ppm	---

OZONE MONITORING NETWORK

Ozone was measured at 16 monitoring stations in New Jersey during 2017 (see Figure 4-4). Of those 16 sites, ten operate year-round and six operate only during the ozone season, which was March 1st through October 31st. Bayonne, Brigantine, Camden Spruce Street, Chester, Columbia Wildlife Management Area (WMA), Flemington, Millville, Newark Firehouse, Rider University and Rutgers University operate year-round. Ancora, Clarksboro, Colliers Mills, Leonia, Monmouth University, and Ramapo sites operate only during the ozone season.

There is an ozone monitor at Washington Crossing State Park in Mercer County which is maintained and operated by USEPA. Data from the site is also used in determining New Jersey's NAAQS compliance status, although it is not presented here.

Figure 4-4
2017 Ozone Monitoring Network



OZONE LEVELS IN 2017

During the 2017 ozone season, all 16 New Jersey monitoring sites recorded levels above the 8-hour standard of 0.070 ppm. There were fourteen (14) days, between April 11 and September 24, on which the standard was exceeded somewhere in the state.

Table 4-2 presents all the USEPA-approved 2017 New Jersey ozone data. Of the 16 monitoring sites that operated during the 2017 ozone season, none recorded levels above the old (since-revoked) 1-hour standard of 0.12 ppm. The highest daily 1-hour concentration was 0.104 ppm, recorded at Leonia on June 30th. The last time the 1-hour standard was exceeded in New Jersey was in 2010. Figure 4-5 shows the one-hour data for each site.

The highest daily maximum 8-hour average concentration was 0.083 at Camden Spruce Street on May 18th. Seven sites in New Jersey (Camden Spruce Street, Chester, Clarksboro, Colliers Mills, Flemington, Leonia, and Rutgers University) were above the design value (4th-highest 8-hour daily maximum >0.070 ppm). Figure 4-6 presents each site's 8-hour daily maximum average values, and Figure 4-7 shows the 3-year average 8-hour design value for the 2015-2017 period.

Table 4-2
2017 Ozone Concentrations in New Jersey
Parts per Million (ppm)

Monitoring Site	1-Hour Daily Maximum	8-Hour Averages		
		Highest Daily Maximum	4th-Highest Daily Maximum	2015-2017 Average of 4th-Highest Daily Max.
Ancora	0.079	0.073	0.068	0.068
Bayonne	0.092	0.075	0.067	0.070
Brigantine	0.076	0.067	0.063	0.064
Camden Spruce St.	0.093	0.083	0.076	0.077
Chester	0.080	0.075	0.070	0.074
Clarksboro	0.089	0.078	0.073	0.069
Colliers Mills	0.086	0.080	0.074	0.073
Columbia	0.075	0.071	0.064	0.065
Flemington	0.086	0.077	0.072	0.072
Leonia	0.104	0.082	0.074	0.074
Millville	0.072	0.065	0.063	0.066
Monmouth University	0.074	0.071	0.060	0.068
Newark Firehouse	0.079	0.071	0.064	0.068
Ramapo	0.080	0.074	0.066	0.068
Rider University	0.093	0.080	0.069	0.071
Rutgers University	0.090	0.080	0.075	0.075

Figure 4-5
2017 Ozone Concentrations in New Jersey
1-Hour Daily Maximum Concentrations
Parts per Million (ppm)

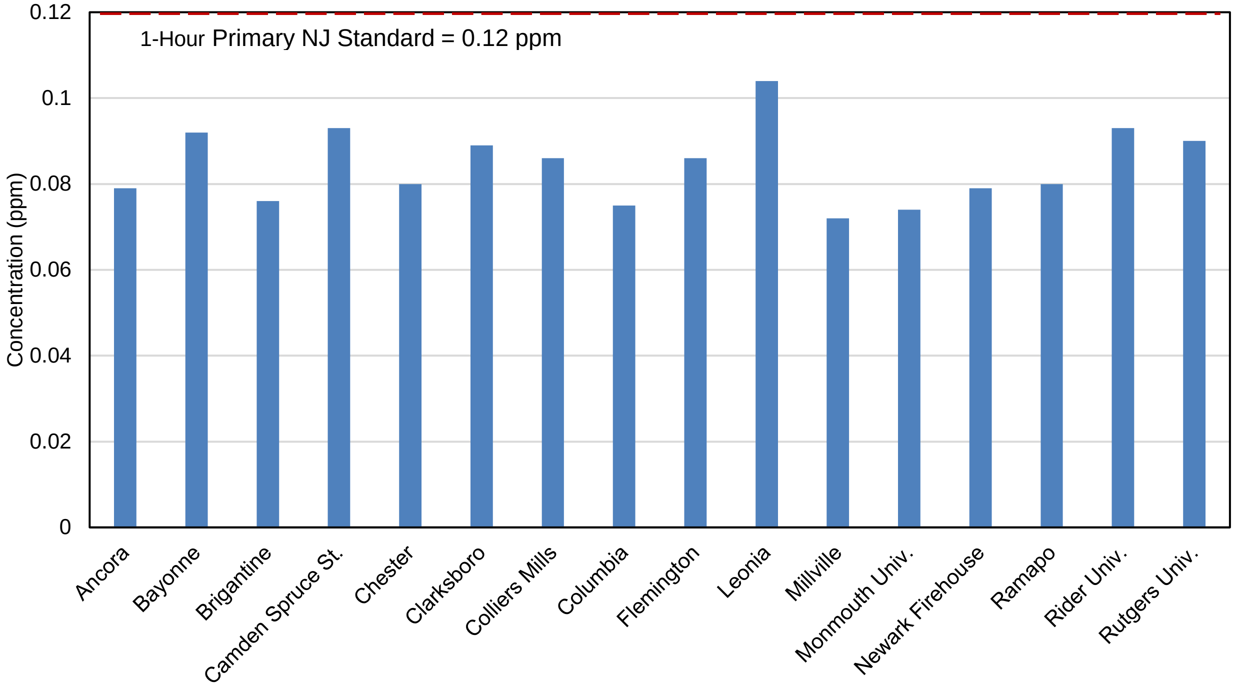


Figure 4-6
2017 Ozone Concentrations in New Jersey
8-Hour Daily Maximum Concentrations
Parts per Million (ppm)

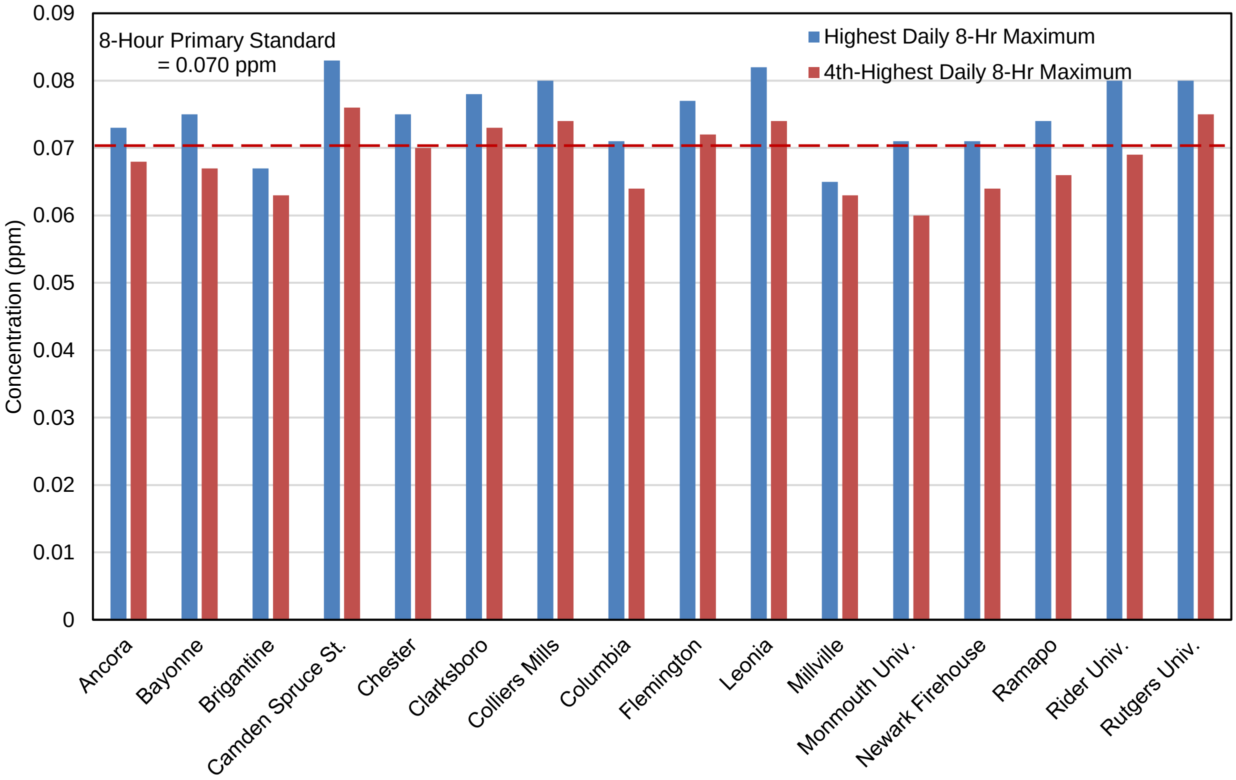
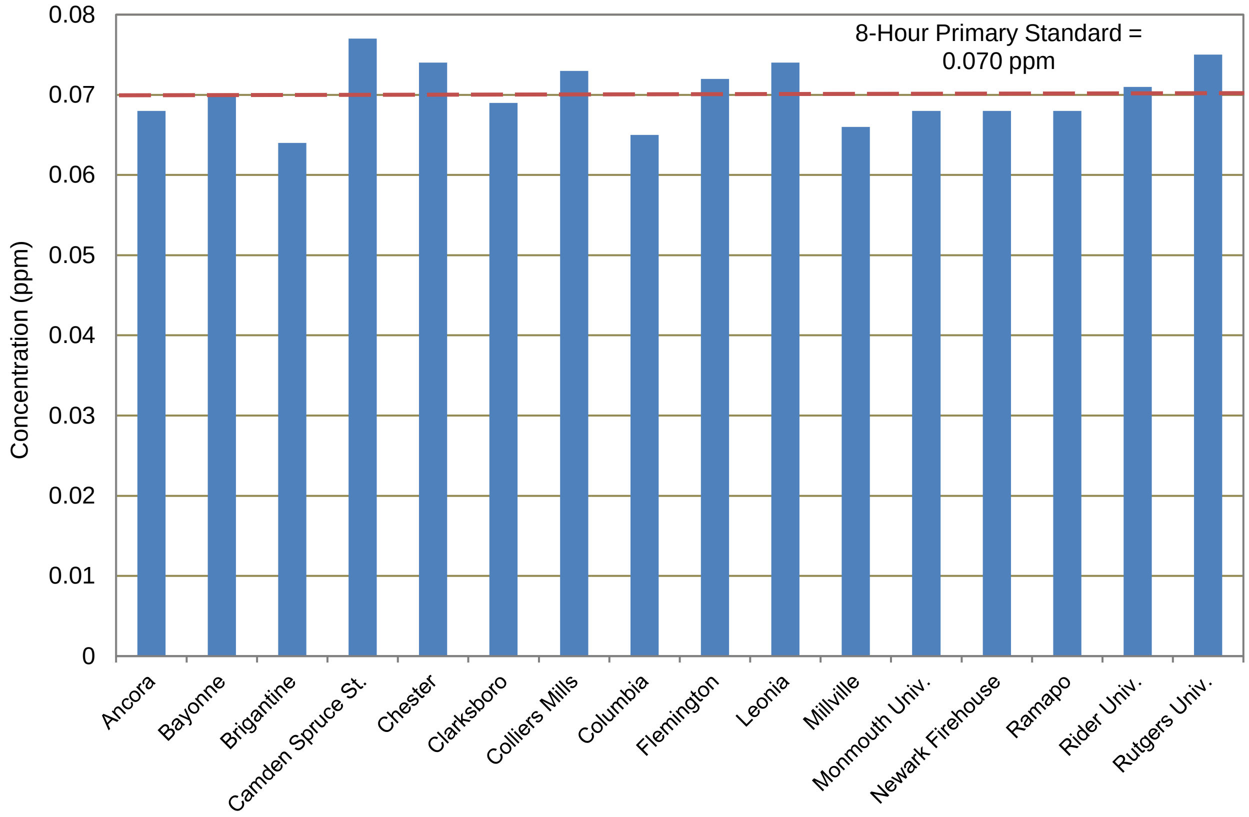


Figure 4-7
New Jersey Ozone Design Values for 2015-2017
3-Year Average of the 4th-Highest Daily Maximum 8-Hour Average
Parts per Million (ppm)



OZONE TRENDS

Studies have shown that in order to lower ground-level ozone concentrations, emissions of VOCs and NOx must be reduced. Over the past couple of decades, this effort has resulted in a relatively steady decrease in ozone levels in New Jersey. The chart in Figure 4-8 shows the fourth-highest statewide 8-hour maximum average concentration recorded each year since 1997. In 2017, this value was 0.076 ppm (measured at Camden Spruce Street). In 2017, the design value, which is the three-year average of the 4th-highest maximum daily 8-hour concentration at any site statewide, was 0.077 ppm, as shown in Figure 4-9. This exceeds the 0.070 ppm NAAQS. Ozone levels in New Jersey are greatly impacted by emissions from upwind sources in other states, so the effort to reduce VOC and NOx emissions need to be implemented in regions beyond our state borders.

Figure 4-8
Ozone Concentrations in New Jersey, 1997-2017
Statewide 4th-Highest Daily Maximum 8-Hour Averages
Parts per Million (ppm)

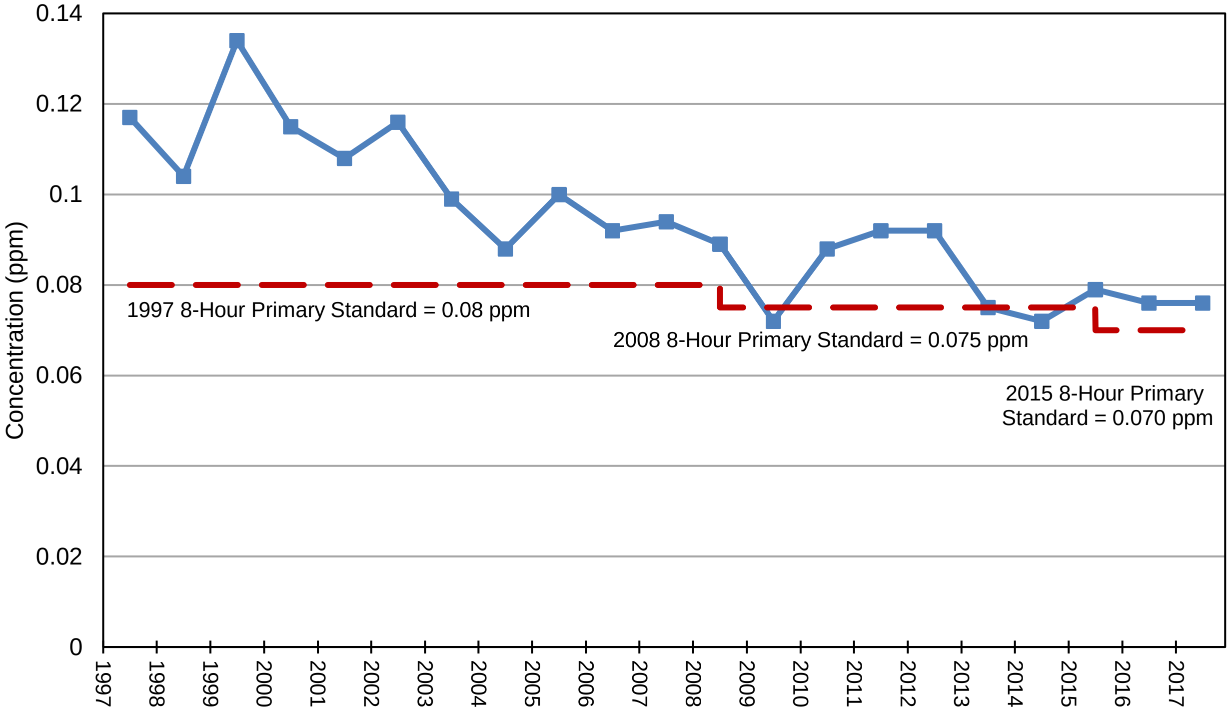
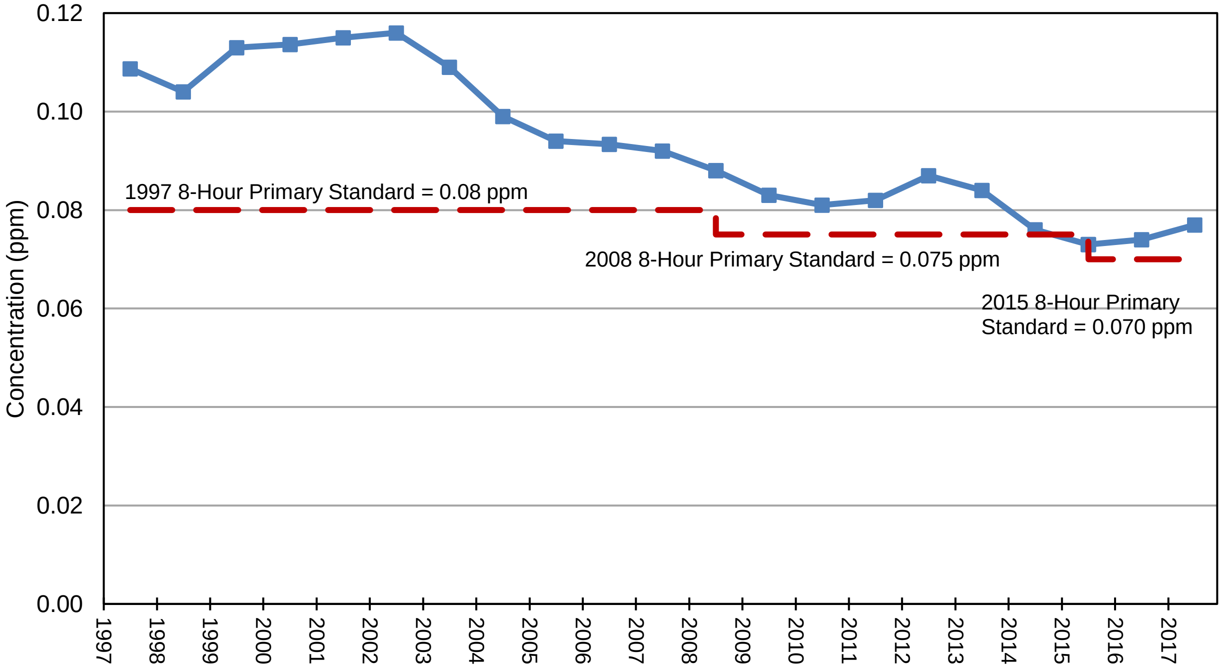


Figure 4-9
Ozone Design Values in New Jersey, 1997-2017
Statewide 3-Year Average of 4th-Highest Daily Maximum 8-Hour Average Concentration
Parts per Million (ppm)

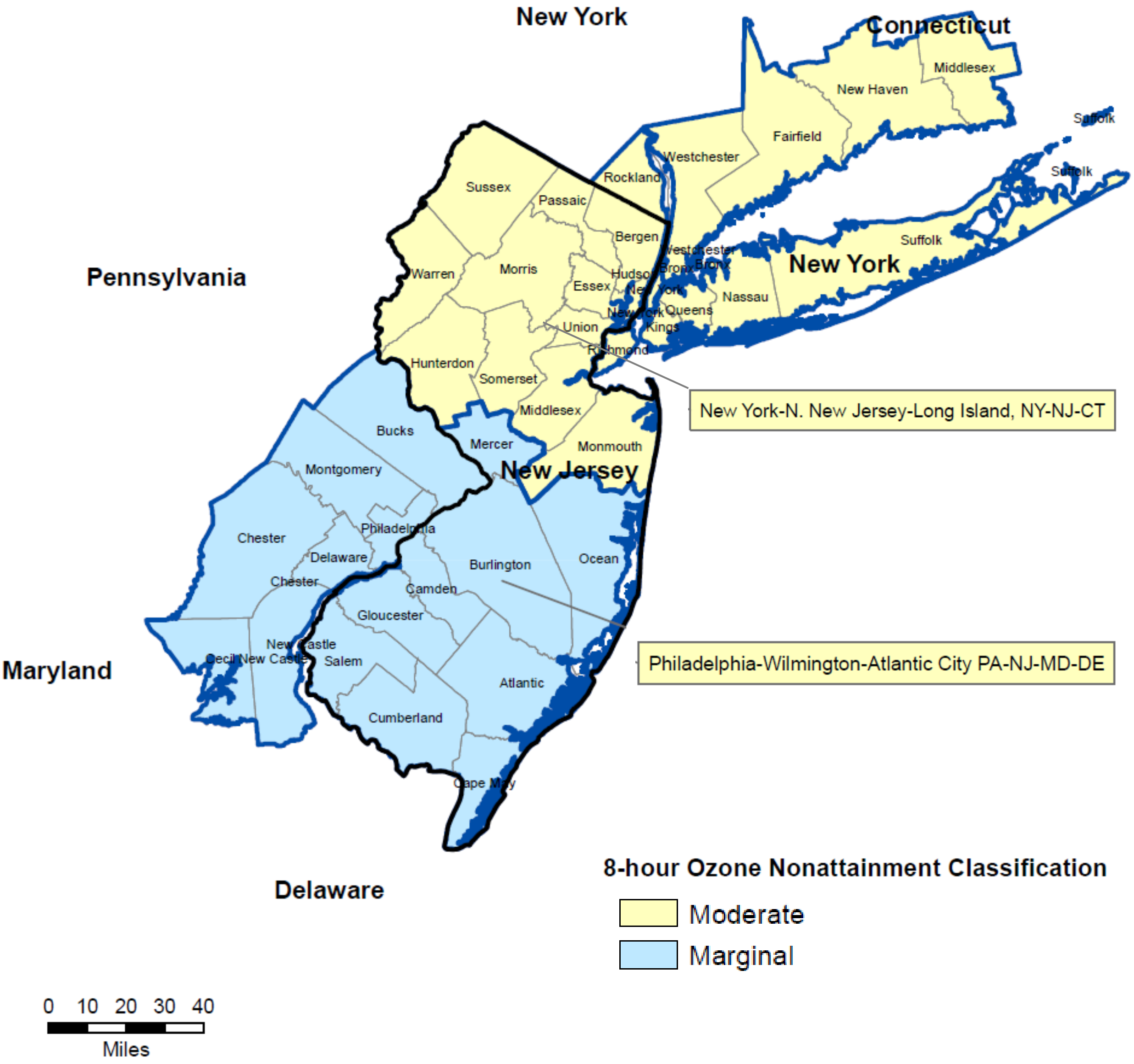


OZONE NONATTAINMENT AREAS IN NEW JERSEY

The Clean Air Act requires that all areas of the country be evaluated for attainment or nonattainment for each of the NAAQS. The 1990 amendments to the Clean Air Act required that areas be further classified based on the severity of nonattainment. The classifications range from “marginal” to “extreme” and are based on the design values that determine whether an area meets the standard.

The state of New Jersey has been in nonattainment for the ozone NAAQS with the northern part of the state classified as being “moderate” and the southern part of the state classified as being “marginal.” New Jersey’s current classification with respect to the 2008 8-hour standard is shown in Figure 4-10.

Figure 4-10
New Jersey 8-Hour Ozone Nonattainment Areas



Source: www3.epa.gov/airquality/greenbook/map/nj8_2008.pdf

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2017 Particulate Matter Summary

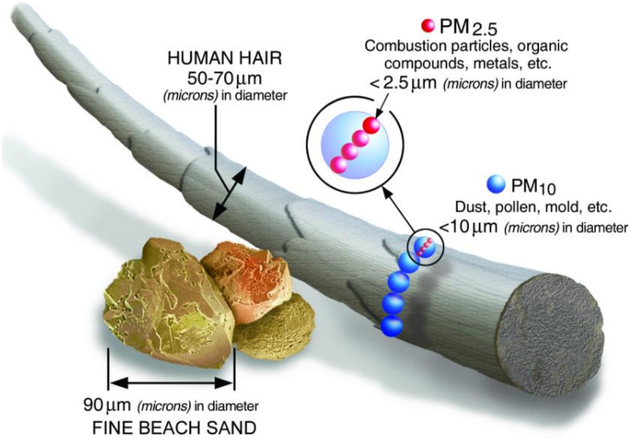
New Jersey Department of Environmental Protection

SOURCES

Particulate air pollution is a complex mixture of organic and inorganic substances in the atmosphere, present as either liquids or solids. Particulates may be as large as 70 microns in diameter or smaller than 1 micron in diameter. Most particulates are small enough that individual particles are undetected by the human eye. Particulates may travel hundreds of miles from their original sources, suspended in the atmosphere, before falling to the ground.

Particulate pollution is categorized by size, measured in microns (one millionth of a meter, also known as a micrometer). Particulates with diameters of 2.5 microns or less are considered "fine particulate matter," referred to as $PM_{2.5}$ (Figure 5-1). Particulates with diameters of 10 microns or less are "inhalable particulate matter," and are referred to as PM_{10}. "Coarse particulate matter" is between 2.5 and 10 microns in size (PM_{coarse}). "Total suspended particulate" (TSP) refers to all suspended particulates, including the largest ones.

Figure 5-1
Size Comparisons for PM Particles



USEPA. www.epa.gov/pm-pollution

Particulates can occur naturally or can be man-made. Examples of naturally-occurring particles are windblown dust and sea salt. Man-made particulates, which come from sources such as fossil fuel combustion and industrial processes, can be categorized as either primary particulates or secondary particulates. Primary particulates are directly emitted from their sources, while secondary particulates form in the atmosphere through reactions of gaseous emissions.

HEALTH AND ENVIRONMENTAL EFFECTS

The size of particles is directly linked to their potential for causing health problems. Fine particles ($PM_{2.5}$) pose the greatest health risk. They can get deep into the lungs and some may even get into the bloodstream. Exposure to these particles can affect a person's lungs and heart. They can lead to premature death in people with heart or lung disease, can cause heart attacks, decrease lung function, and aggravate asthma. PM_{10} is of less concern, although it is inhalable and can irritate a person's eyes, nose, and throat.

Particulates of all sizes have an impact on the environment. PM is the major cause of reduced visibility in many parts of the United States. Figure 5-2a provides an example of reduced visibility due to particulate pollution, recorded by the Camnet visibility camera at Brigantine (www.hazecam.net) which focuses on the Atlantic City skyline. Figure 5-2b is an example of a day with low particulate pollution and good visibility. Airborne particles can also impact vegetation and aquatic ecosystems, and can cause damage to paints and building materials.

Figure 5-2a.

Figure 5-2b.

AMBIENT AIR QUALITY STANDARDS

The U.S. Environmental Protection Agency (USEPA) first established National Ambient Air Quality Standards (NAAQS) for particulate matter in 1971. It set primary (health-based) and secondary (welfare-based) standards for total suspended particulate (TSP), which included PM up to about 25 to 45 micrometers. Over the years, new health data shifted the focus toward smaller and smaller particles. In 1987, USEPA replaced the TSP standards with standards for PM_{10}. The 24-hour PM_{10} primary and secondary standards were set at 150 $\mu g/m^3$. Ten years later, USEPA began regulating $PM_{2.5}$. The annual $PM_{2.5}$ primary and secondary standards were set at 15.0 $\mu g/m^3$ until 2013, when the primary annual standard was lowered to 12.0 $\mu g/m^3$. A 24-hour $PM_{2.5}$ standard of 65 $\mu g/m^3$.was promulgated in 1997, then lowered in 2006 to 35 $\mu g/m^3$. Table 5-1 provides a summary of the current particulate matter standards.

Compliance with the standards is determined by calculating a statistic called the design value. For the annual $PM_{2.5}$ NAAQS, the design value is the highest statewide 3-year average of each site's annual average concentrations. For the 24-hour NAAQS, the 98th percentile of the 24-hour concentrations for each monitoring site must be averaged for the three most recent years. The highest site's value is the state's design value. For PM_{10}, the design value is the second-highest 24-hour average concentration in a given year.

Table 5-1
National Ambient Air Quality Standards for Particulate Matter

Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Averaging Period	Type	Level
Fine Particulate ($PM_{2.5}$)	Annual	Primary	12.0 $\mu g/m^3$
	Annual	Secondary	15.0 $\mu g/m^3$
	24-Hours	Primary & Secondary	35 $\mu g/m^3$
Inhalable Particulate (PM_{10})	24-Hours	Primary & Secondary	150 $\mu g/m^3$

PARTICULATE MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) particulate monitoring network in 2017 consisted of twenty-two $PM_{2.5}$ monitoring sites and three PM_{10} monitoring sites. Criteria pollutant monitors must meet strict USEPA requirements in order to determine compliance with the NAAQS. NJDEP uses three different methods to measure particulate.

Eighteen $PM_{2.5}$ sites and the three PM_{10} sites use filter-based samplers, which pull a predetermined amount of air through $PM_{2.5}$ or PM_{10} size-selective inlets for a 24-hour period. The filters are weighed before and after sampling under controlled environmental conditions to determine the concentration of the captured particles. This filter-based method has for years been designated as the Federal Reference Method (FRM) for particulate matter compliance determination.

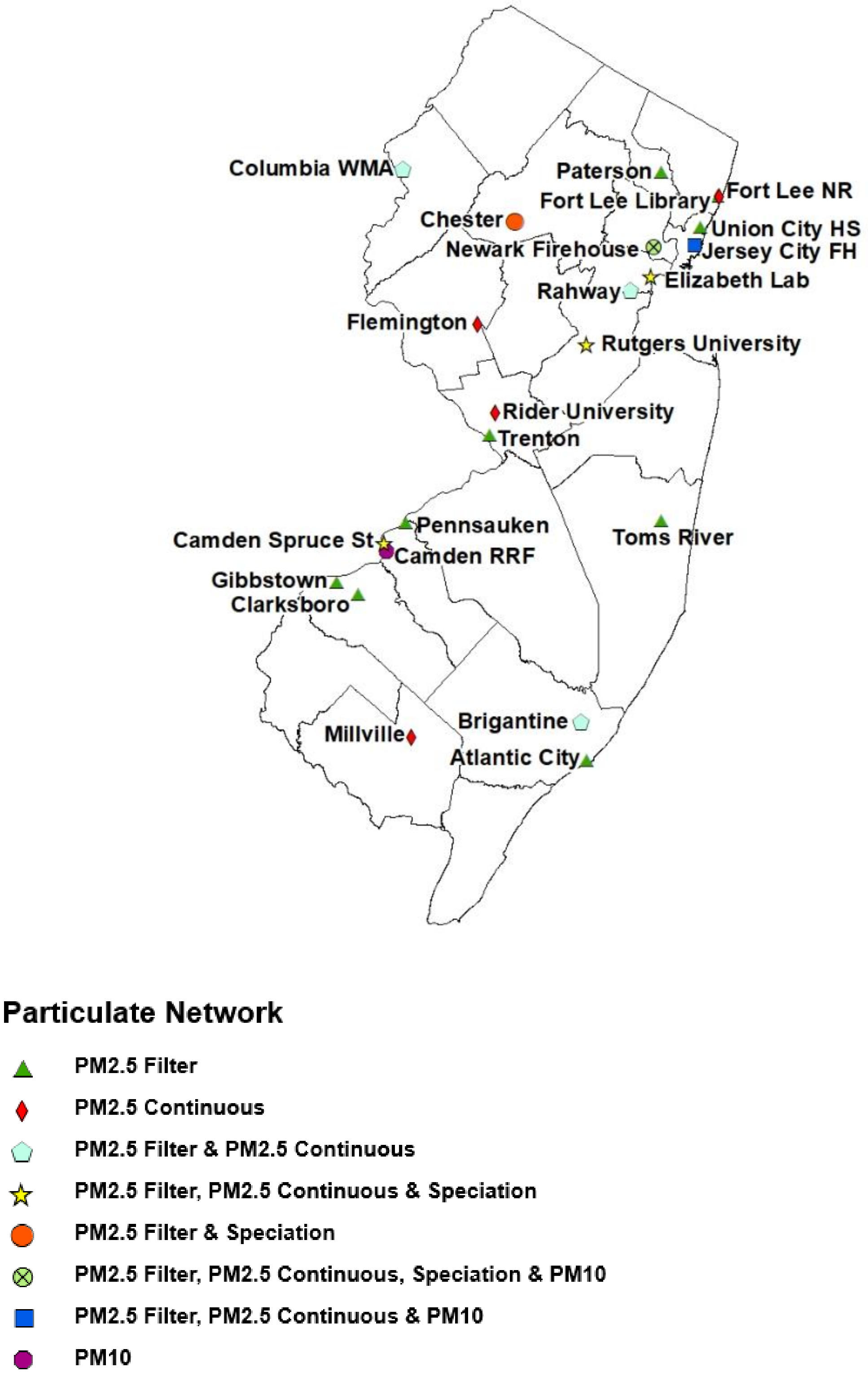
In order to provide real-time hourly data to the public (through the Air Quality Index at www.njaqinow.net), NJDEP has also been using particulate monitors that operate continuously. Eleven sites in New Jersey use Beta Attenuation Monitors (BAM), which measure the loss of intensity (attenuation) of beta particles due to absorption by $PM_{2.5}$ particles collected on a filter tape. These monitors are classified by USEPA as Federal Equivalent Methods (FEM) for $PM_{2.5}$, and can be used to determine compliance with the NAAQS. One site, Rahway, uses a Tapered Element Oscillating Microbalance (TEOM) analyzer, which is not a Federal Equivalent Method (FEM). TEOM analyzers collect a sample of $PM_{2.5}$ on an oscillating filter and determine the concentration based on the change in the frequency at which the filter oscillates. This instrument will be replaced with an FEM monitor in 2018.

At one time, the NJDEP PM_{10} monitoring network consisted of more than twenty sampling sites. Due to many years of low concentrations and the shift in emphasis to $PM_{2.5}$ monitoring, the network has been reduced to only three sites, the Camden Resource Recovery Facility (RRF), Jersey City Firehouse, and Newark Firehouse. PM_{10} samples are taken once every six days at Camden and Jersey City, and every three days at Newark.

Five monitoring stations are part of the national Chemical Speciation Network (CSN). They use a separate 24-hour filter-based $PM_{2.5}$ sampler to determine the concentrations of the chemical analytes that make up the particle sample. The sample is collected on three types of filter media which are subsequently analyzed using ion chromatography (IC), X-ray fluorescence (XRF), and Thermal Optical Transmittance (TOT). CSN monitoring takes place at the Camden Spruce Street, Chester, Elizabeth Lab, Newark Firehouse and Rutgers University monitoring stations. CSN data can be found in Appendix B of the Air Quality Summaries.

Figure 5-3 shows the locations of all the particulate monitors in New Jersey. Because of proposed construction at the Gibbstown monitoring station, in August of 2017 the it was shut down and the $PM_{2.5}$ monitor was moved to Clarksboro.

Figure 5-3
2017 Particulate Monitoring Network



FINE PARTICLE ($PM_{2.5}$) LEVELS IN 2017

$PM_{2.5}$ LEVELS FOR FILTER-BASED FRM MONITORS

The annual mean concentrations of $PM_{2.5}$ measured by the eighteen filter-based FRM samplers ranged from 5.85 $\mu g/m^3$ at the Brigantine monitoring site to 9.58 $\mu g/m^3$ at the Elizabeth Lab station. The highest 24-hour concentrations ranged from 18.0 $\mu g/m^3$ at Chester to 30.4 $\mu g/m^3$ at Toms River. Table 5-2 shows the 2017 annual mean, highest and 98th percentile 24-hour concentrations, as well as the number of valid samples collected. The data is also shown graphically in Figures 5-4 and 5-5. Four sites (Elizabeth Lab, Jersey City Firehouse, Toms River and Trenton) operate every day. The other fourteen sites (Atlantic City, Brigantine, Camden Spruce Street, Chester, Clarksboro, Columbia, Fort Lee Library, Gibbstown, Newark Firehouse, Paterson, Pennsauken, Rahway, Rutgers University, and Union City High School) take a sample every third day. In 2017, no FRM sites were in violation of either the annual NAAQS of 12.0 $\mu g/m^3$ or the 24-hour NAAQS of 35 $\mu g/m^3$.

Table 5-2
2017 $PM_{2.5}$ Concentrations in New Jersey
Annual and 24-Hour Averages (FRM)
Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	Number of Samples	Annual Average	24-Hour Average	
			Highest	98th%-ile
Atlantic City	113	6.93	23.3	17.6
Brigantine	115	5.85	18.5	13.5
Camden Spruce Street	112	9.31	28.1	22.5
Chester	116	5.90	18.0	13.6
Clarksboro*	50	7.95	21.7	21.7
Columbia	106	8.19	23.6	18.3
Elizabeth Lab	336	9.58	29.1	20.8
Fort Lee Library	118	7.30	18.8	16.3
Gibbstown*	63	7.27	18.8	17.4
Jersey City Firehouse	349	8.14	23.3	18.5
Newark Firehouse	110	7.57	19.1	15.3
Paterson	117	7.76	20.3	17.7
Pennsauken	118	7.91	19.8	18.2
Rahway	112	7.76	21.3	17.2
Rutgers University	120	6.84	18.3	17.5
Toms River	320	6.74	30.4	16.4
Trenton Library	345	7.53	23.7	18.0
Union City High School	118	7.81	20.7	17.8

*In August 2017 the PM2.5 sampler from Gibbstown was moved to Clarksboro. Neither site collected enough data to calculate a valid annual mean concentration.

Figure 5-4
2017 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)

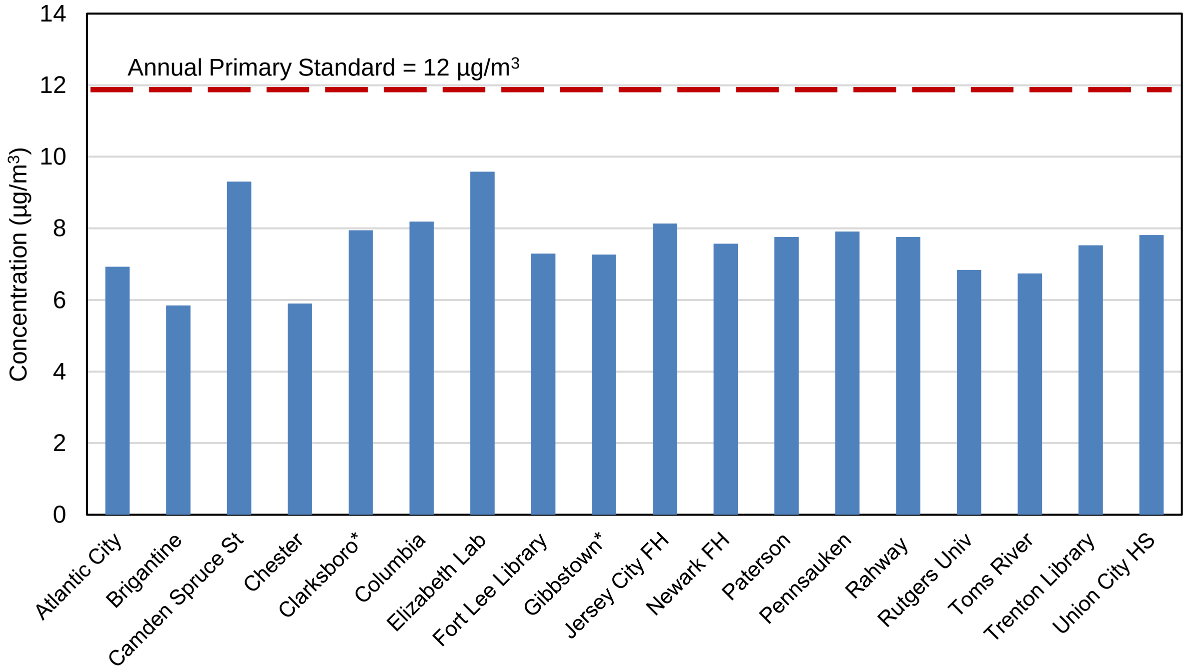
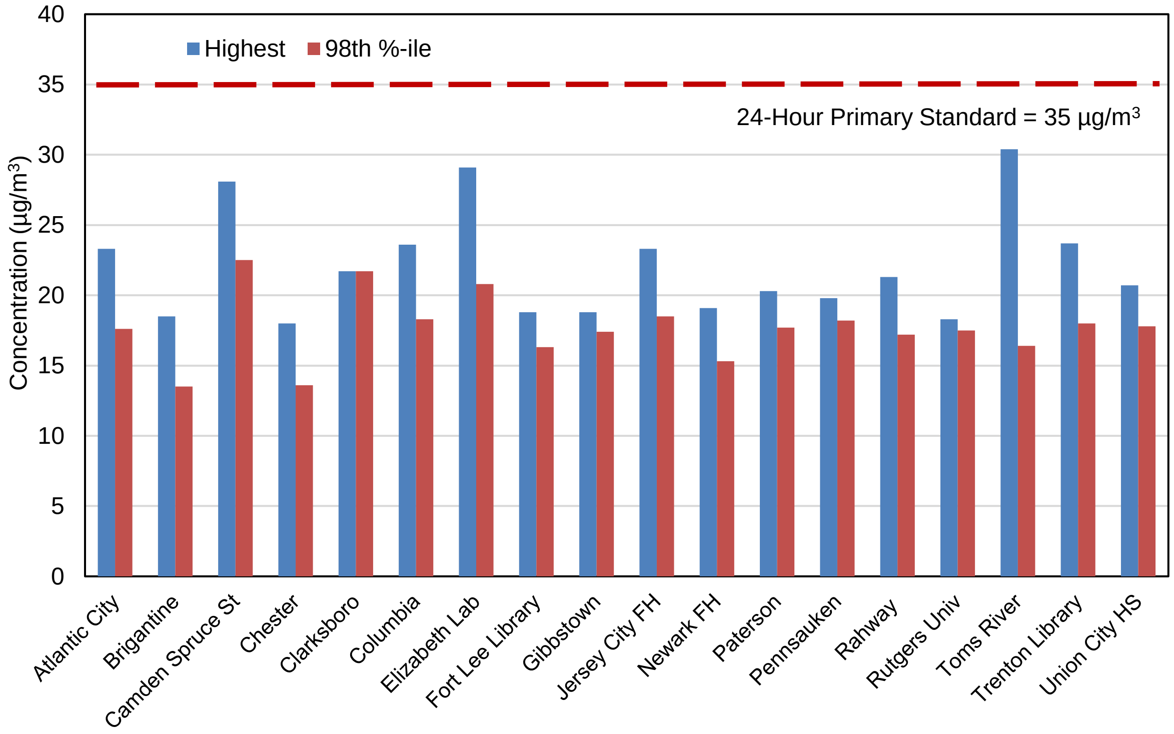


Figure 5-5
2017 $PM_{2.5}$ Concentrations in New Jersey
24-Hour Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)



$PM_{2.5}$ LEVELS FOR CONTINUOUS FEM MONITORS

New Jersey's continuous $PM_{2.5}$ monitoring network consists of twelve sites: Brigantine, Camden Spruce Street, Columbia, Elizabeth Lab, Flemington, Fort Lee Near Road, Jersey City Firehouse, Millville, Newark Firehouse, Rahway, Rider University, and Rutgers University. One-minute readings are transmitted to a central computer in Trenton, where they are averaged every hour and automatically updated on the NJDEP website at www.njaqinow.net. Table 5-3 presents the annual mean, highest 24-hour, and 98th percentile 24-hour values from these sites for 2017. Figures 5-6 and 5-7 show the same data in graphs. In 2017 there were four exceedances of the 24-hour standard at Camden Spruce St. and one at the Elizabeth Lab (see the Air Quality Index Summary for details). However, the 24-hour 98th percentile values, 27.7 $\mu g/m^3$ at Camden and 22.1 $\mu g/m^3$ at Elizabeth Lab, which are used to determine compliance with the NAAQS, were below primary standard of 35 $\mu g/m^3$.

Table 5-3
2017 $PM_{2.5}$ Concentrations in New Jersey
Annual and 24-Hour Averages (Continuous Monitors)
Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	Annual Average	24-Hour Average	
		Highest	98th%-ile
Brigantine	7.81	18.0	15.7
Camden Spruce Street	11.87	44.2	27.7
Columbia	8.19	31.6	19.6
Elizabeth Lab	10.29	35.6	22.1
Flemington	8.04	25.8	17.5
Fort Lee Near Road	8.88	25.9	18.2
Jersey City Firehouse	10.27	25.1	20.9
Millville	7.89	21.8	16.5
Newark Firehouse	8.59	24.7	19.2
Rahway	8.10	18.7	16.4
Rider University	8.08	26.0	17.2
Rutgers University	8.33	26.2	18.8

Figure 5-6

2017 $PM_{2.5}$ Concentrations in New Jersey

Annual Averages from Continuous Monitors

Micrograms Per Cubic Meter (µg/m³)

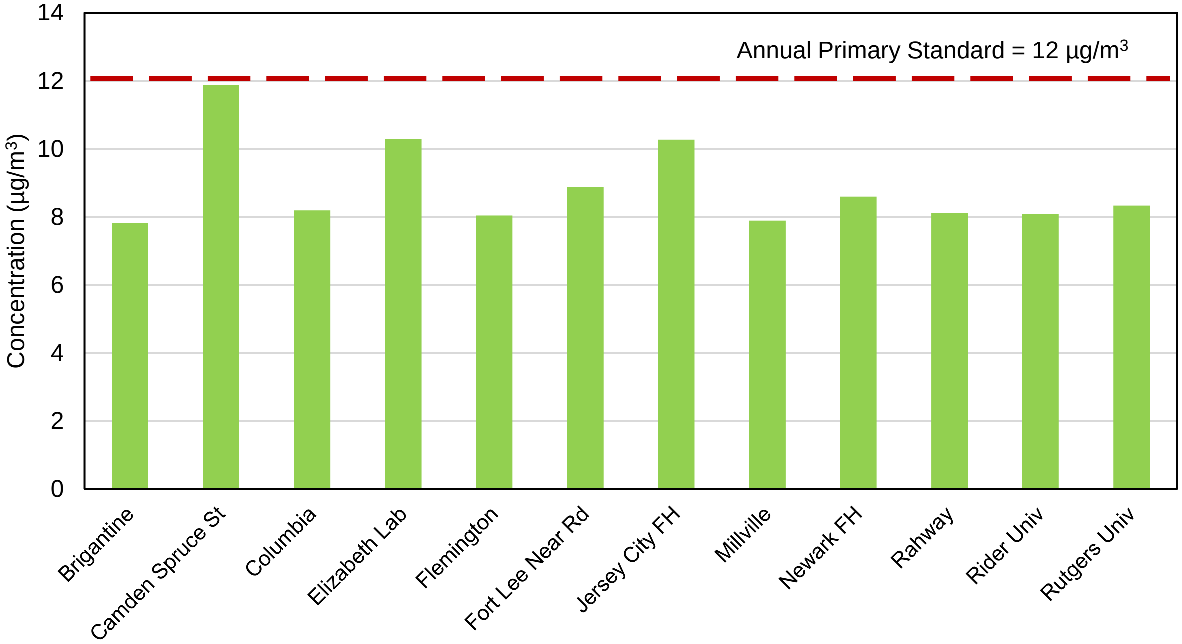
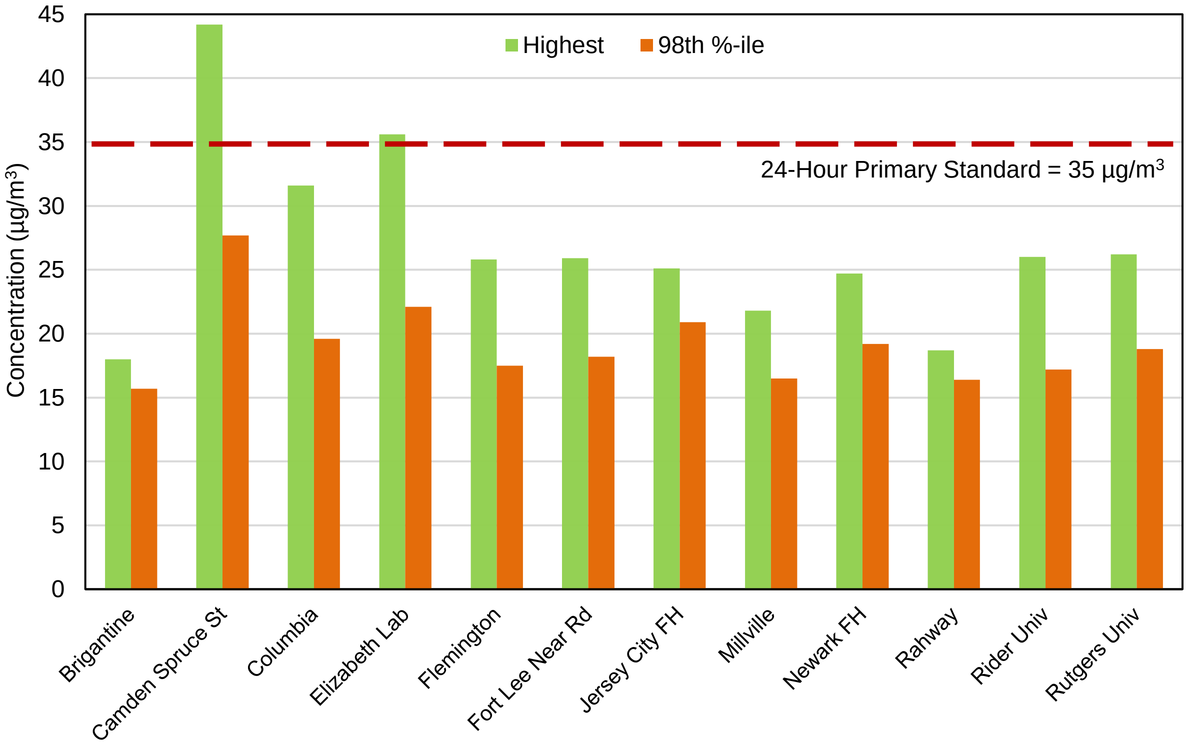


Figure 5-7

2017 $PM_{2.5}$ Concentrations in New Jersey

24-Hour Averages from Continuous Monitors

Micrograms Per Cubic Meter (µg/m³)



PM$_{2.5}$ DESIGN VALUES

Table 5-4 and Figures 5-8 and 5-9 show the PM$_{2.5}$ design values for each of the New Jersey monitors, as determined by USEPA. Some sites have both a filter-based FRM monitor and a continuous FEM monitor. At sites with both, the data from the FRM monitor usually takes precedence, and FEM data is added in for periods when there is no FRM data.

Seven sites do not have complete three-year data sets, but their USEPA design value estimates are included here anyway (marked with an asterisk). As mentioned before, Gibbstown was shut down mid-2017 and its monitor moved to Clarksboro. Flemington, Millville, Rider University, Rutgers University, and Union City High School are missing some or all 2015 PM$_{2.5}$ data.

Table 5-4
New Jersey PM$_{2.5}$ Design Values for 2015-2017
3-Year Average of the Annual Average Concentrations
& 98th Percentile 24-Hour Average Concentrations
Micrograms Per Cubic Meter (µg/m³)

Monitoring Site	3-Year (2015-2017) Average	
	Annual	98th %-ile 24-Hour
Atlantic City	7.3	16
Brigantine	6.8	15
Camden Spruce Street	10.3	25
Chester	6.4	16
Clarksboro*	7.9	22
Columbia	8.6	22
Elizabeth Lab	9.7	23
Flemington*	8.3	17
Fort Lee Library	8.5	21
Fort Lee Near Road	10.1	22
Gibbstown*	7.8	18
Jersey City Firehouse	8.4	21
Millville*	7.9	17
Newark Firehouse	8.6	20
Paterson	8.0	19
Pennsauken	8.3	19
Rahway	8.2	20
Rider University*	8.3	17
Rutgers University*	8.3	19
Toms River	6.9	18
Trenton Library	7.7	20
Union City High School*	8.2	18

*3-year data set is incomplete.

Figure 5-8
New Jersey $PM_{2.5}$ Design Values for 2015-2017
3-Year Average of the Annual Average Concentrations
Micrograms Per Cubic Meter (µg/m³)

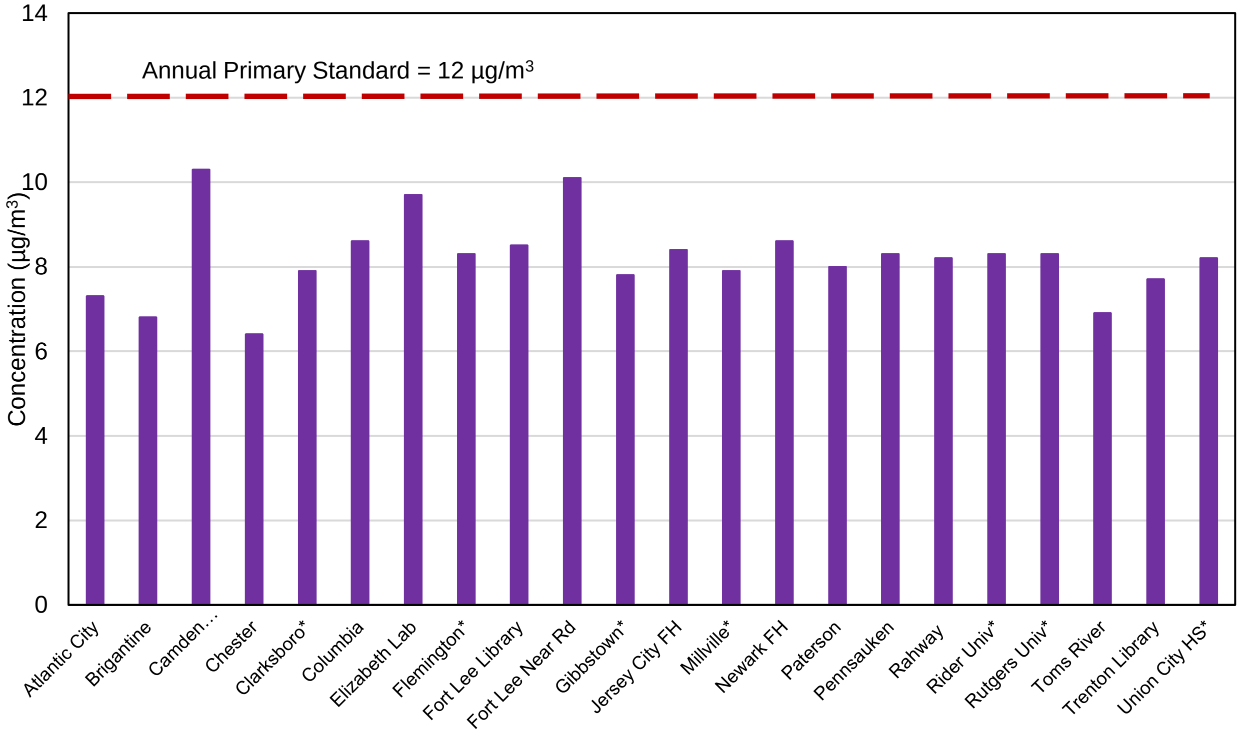
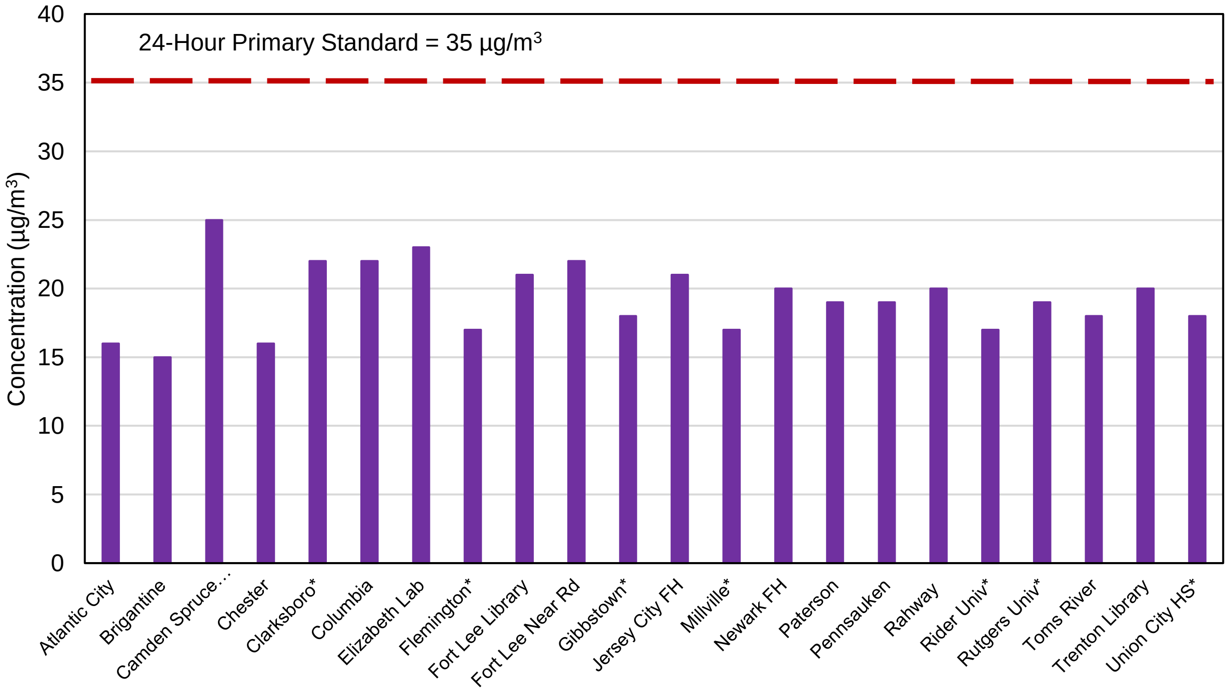


Figure 5-9
New Jersey $PM_{2.5}$ Design Values for 2015-2017
3-Year Average of the 98th Percentile of the 24-Hour Average Concentrations
Micrograms Per Cubic Meter (µg/m³)



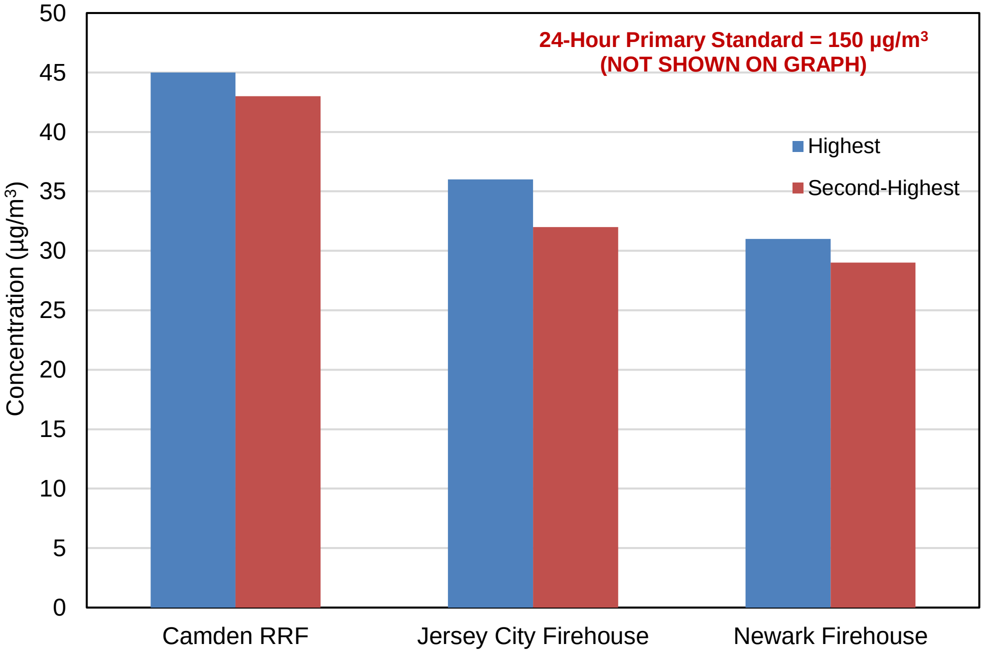
INHALABLE PARTICULATE (PM_{10}) LEVELS IN 2017

Table 5-5 shows 2017 values for each of the New Jersey PM_{10} monitors. The highest and second-highest 24-hour concentrations, as well as the annual average, are presented. All areas of the state are in attainment for the 24-hour standard of 150 µg/m^3, as can be seen in Figure 5-10. The standard is based on the second-highest 24-hour value. In 2017, the highest PM_{10} values were measured at the Camden RRF site.

Table 5-5
2017 PM_{10} Concentrations in New Jersey
24-Hour and Annual Averages
Micrograms Per Cubic Meter (µg/m^3)

Monitoring Site	Number of Samples	Annual Average	24-Hour Average	
			Highest	Second-Highest
Camden RRF	56	20.1	45	43
Jersey City Firehouse	56	15.4	36	32
Newark Firehouse	117	13.9	31	29

Figure 5-10
2017 PM_{10} Concentrations in New Jersey
Maximum 24-Hour Averages
Micrograms per Cubic Meter (µg/m^3)



PARTICULATE TRENDS

The $PM_{2.5}$ monitoring network in New Jersey has been in place since 1999. Figures 5-11 and 5-12 show the trend in the design values (3-year averages) since 2001, as well as changes to the NAAQS. Years of data show a noticeable decline in fine particulate concentrations.

Figure 5-11
$PM_{2.5}$ Design Value Trend in New Jersey, 2001-2017
3-Year Average of the Annual Average Concentrations
Micrograms per Cubic Meter (µg/m³)

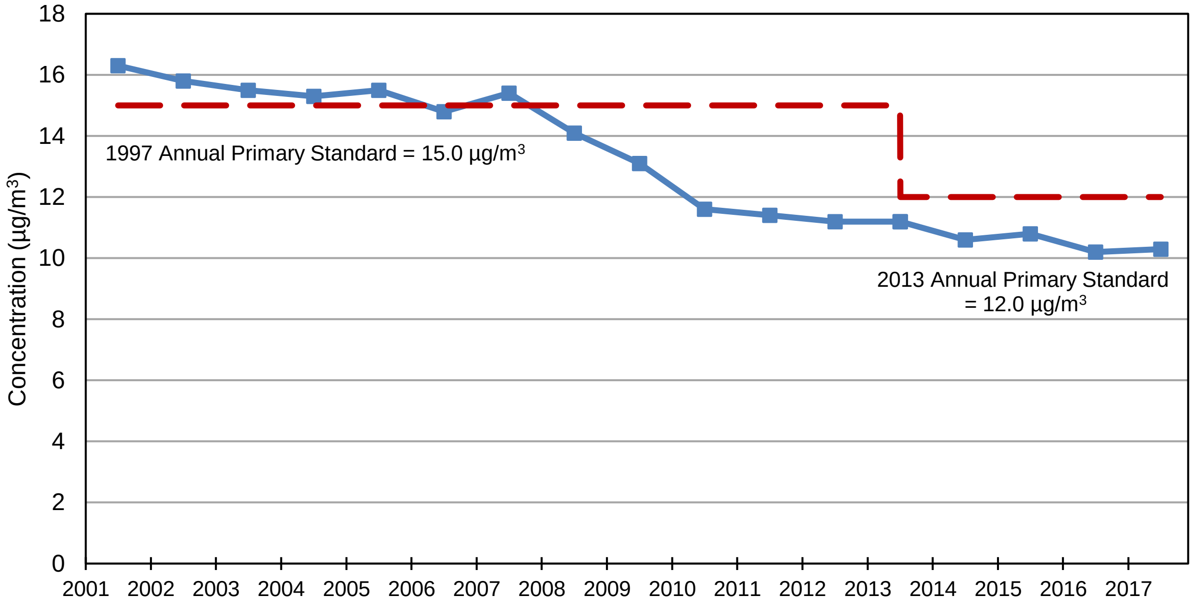
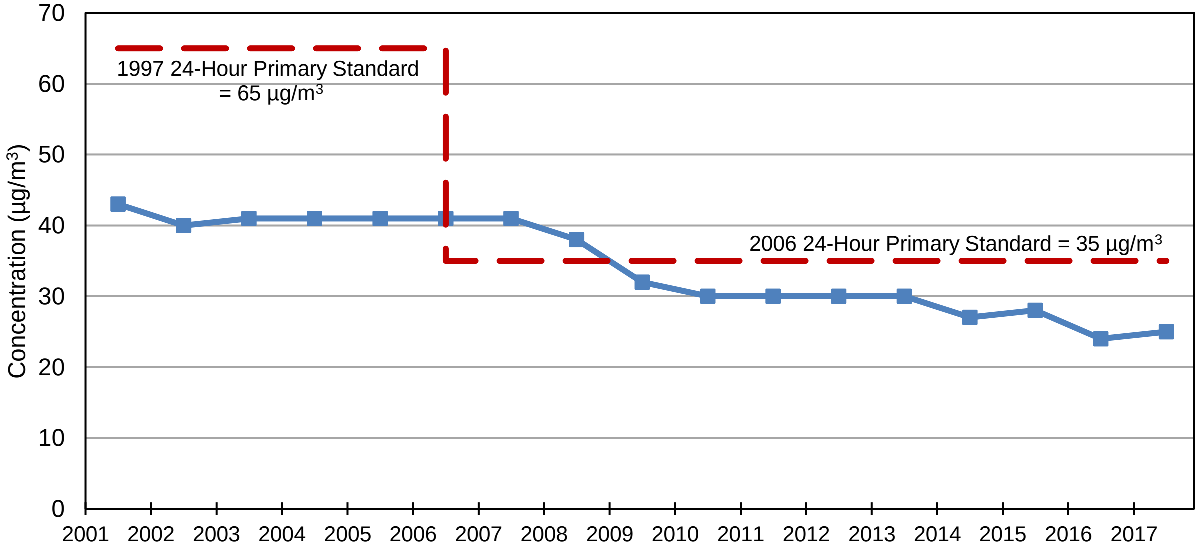
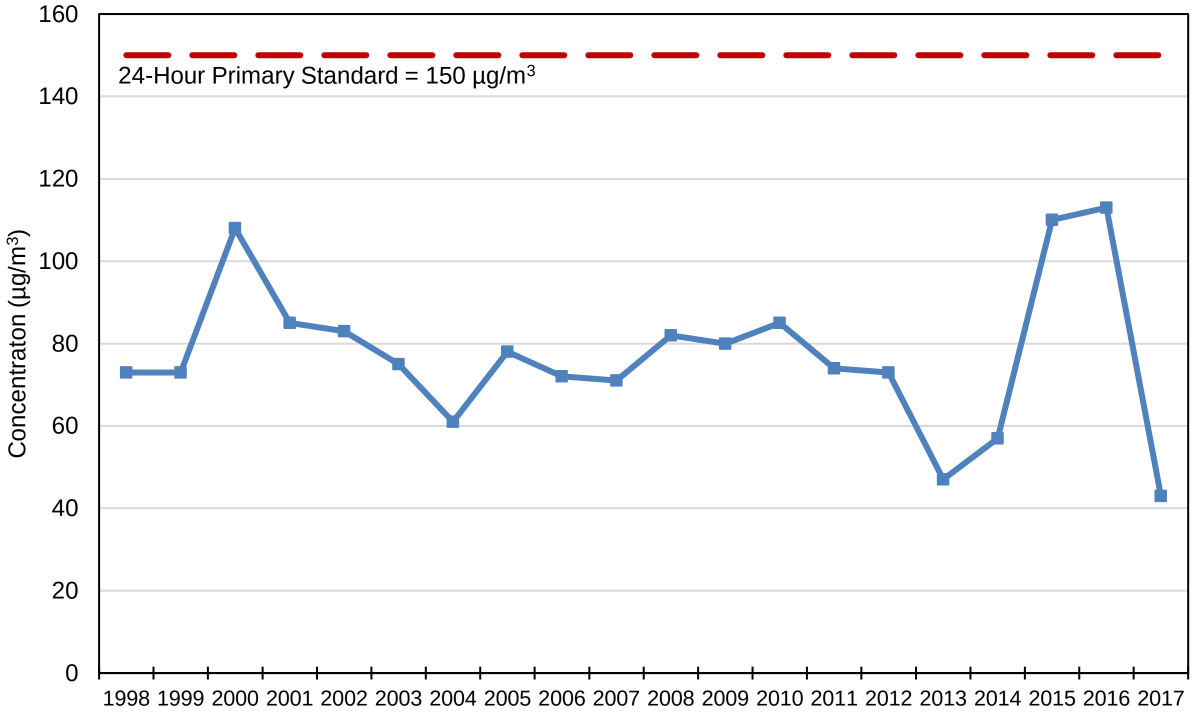


Figure 5-12
$PM_{2.5}$ Design Value Trend in New Jersey, 2001-2017
3-Year Average of the 98th Percentile 24-Hour Average Concentrations
Micrograms per Cubic Meter (µg/m³)



The PM_{10} design value trend is shown in Figure 5-13. The increase in concentration in 2015 and 2016 occurred at the Camden Spruce Street monitor, during a period of major road construction.

Figure 5-13
PM_{10} Design Value Trend in New Jersey, 1998-2017
2nd-Highest 24-Hour Average Concentrations
Micrograms per Cubic Meter (µg/m³)



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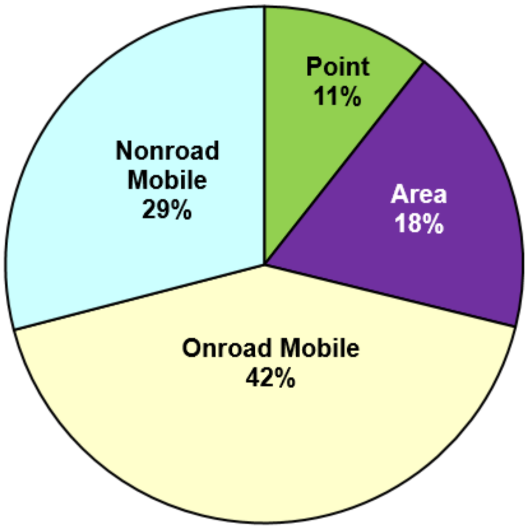
2017 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

SOURCES

Nitrogen dioxide (NO_2) is a reddish-brown highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). NO_2 is used by regulatory agencies as the indicator for the group of gases known as nitrogen oxides (NOx). These gases are emitted from motor vehicle exhaust, combustion of coal, oil or natural gas, and industrial processes such as welding, electroplating, and dynamite blasting. Although most NOx is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. When NO_2 reacts with other chemicals it can form ozone, particulate matter, and other pollutant compounds. A pie chart summarizing the major sources of NOx in New Jersey in 2017 is shown in Figure 6-1.

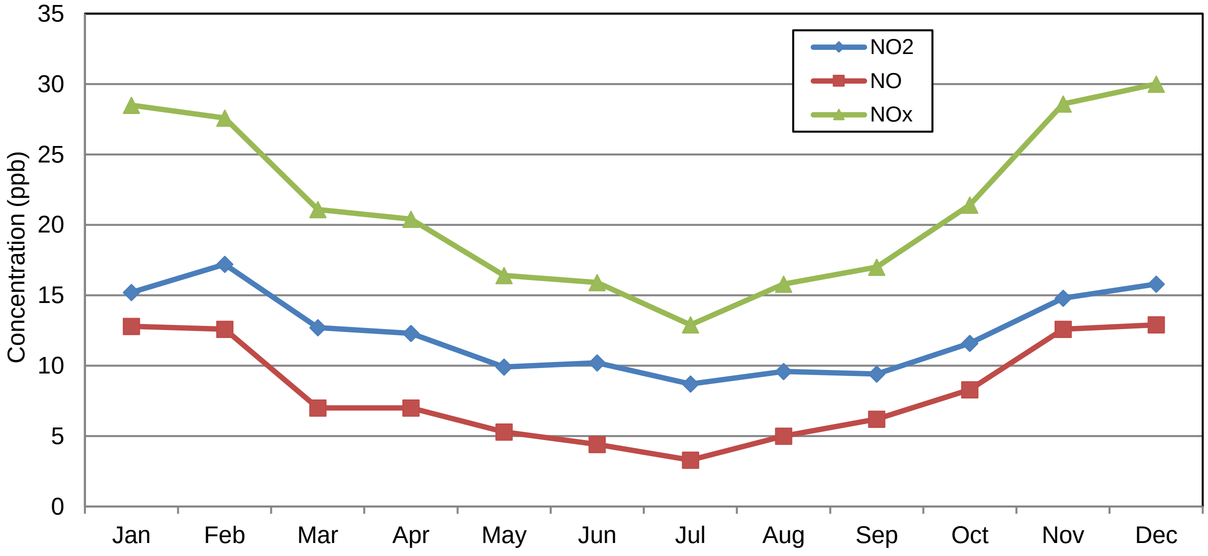
Figure 6-1
2017 New Jersey NOx Projected Emissions



Inventory Source: MARAMA 2017 BETA2

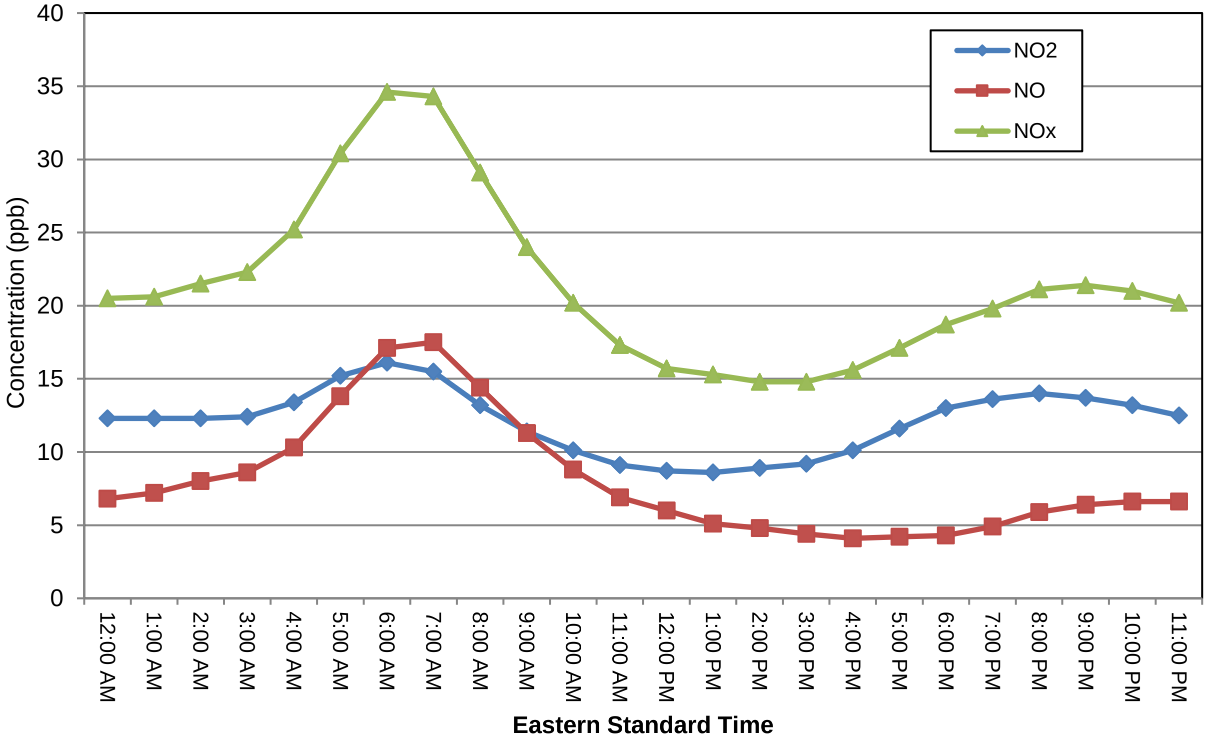
Figure 6-2 shows that NOx concentrations tend to be higher in the winter than in the summer. This is due in part to building heating, and to weather conditions that are more prevalent in the colder months of the year, such as lighter winds that result in poorer local dispersion conditions.

Figure 6-2
2017 Nitrogen Oxides Concentrations in New Jersey
Average Monthly Variation
Parts per Billion (ppb)



Because much of the NOx in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in Figure 6-3.

Figure 6-3
2017 Nitrogen Oxides Concentrations in New Jersey
1-Hour Average Hourly Variation
Parts per Billion (ppb)



HEALTH AND ENVIRONMENTAL EFFECTS

Short-term exposures to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses and cause respiratory illnesses in children, people with asthma, and the elderly. Symptoms of low-level exposure to NO and NO_2 include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO_2 may increase susceptibility to respiratory infection and may cause permanent damage to the lung. Studies show a connection between breathing elevated short-term NO_2 concentrations and increases in hospital emergency department visits and hospital admissions for respiratory issues, especially asthma. Individuals who spend time on or near major roadways can experience high short-term NO_2 exposures.

Nitrogen oxides contribute to a wide range of environmental problems. Chemical reactions in the air form both ozone and particulate matter. Nitrate particles make the air hazy and impair visibility, and contribute to nutrient pollution in coastal waters, resulting in eutrophication. NO_2 also reacts with water and oxygen to form nitric acid, a component of acid rain, which causes acidification of freshwater bodies and harms sensitive ecosystems such as lakes and forests.

AMBIENT AIR QUALITY STANDARDS

There are two types of National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (USEPA). Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. A 1-hour primary standard for NO_2 of 100 parts per billion (ppb) was promulgated in 2010. The primary and secondary annual NAAQS for NO_2 are the same, a calendar year average concentration of 53 ppb. The annual New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS, except that micrograms per cubic meter (µg/m^3) are the standard units and the averaging time is any 12-month period (a running average) instead of a calendar year. Table 6-1 presents a summary of the NO_2 standards.

Table 6-1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)
Parts per Billion (ppb)
Parts per Million (ppm)
Micrograms per Cubic Meter (µg/m^3)

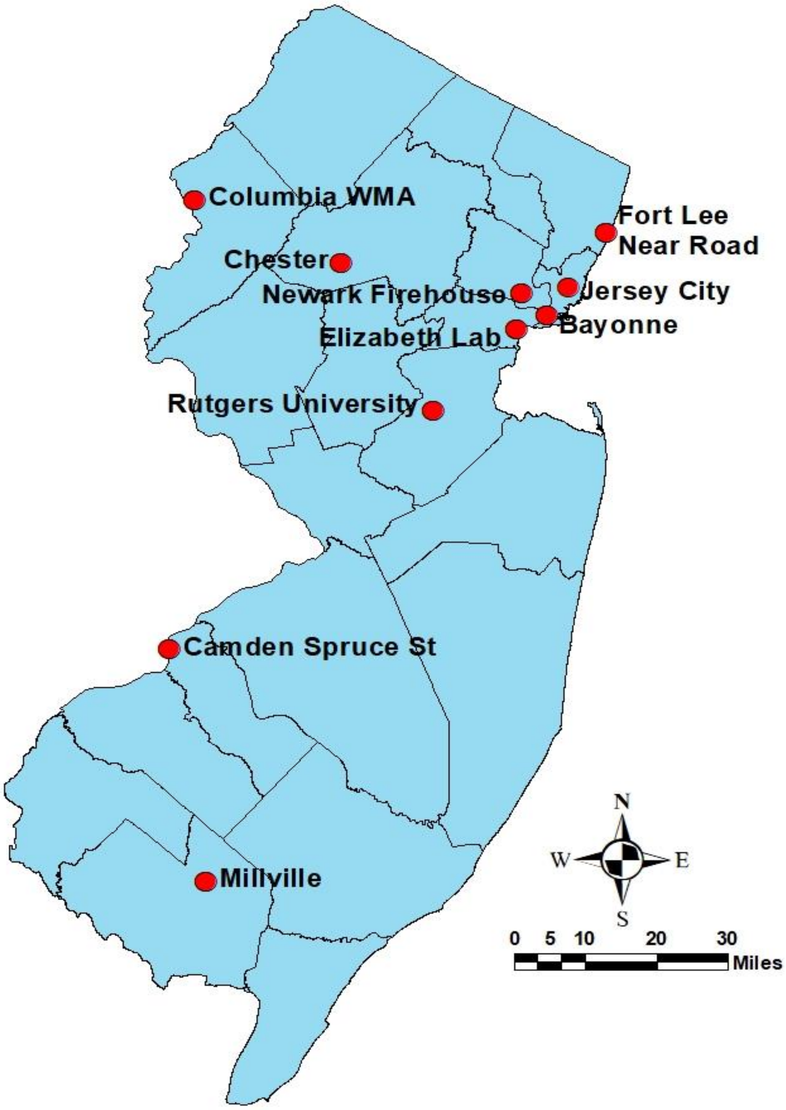
Averaging Period	Type	National	New Jersey
1-Hour	Primary	100 ppb (0.100 ppm)	---
Annual	Primary & secondary	53 ppb (0.053 ppm)	---
12-Month	Primary & secondary	---	100 µg/m^3 (0.053 ppm)

A state or other designated area is in compliance with a NAAQS when it meets the design value. For the annual standard, the annual average is the design value. However, for the 1-hour NO_2 standard, the NAAQS is met when the 3-year average of the 98th percentile of the daily maximum 1-hour NO_2 concentrations is less than 100 ppb. This statistic is calculated by first obtaining the maximum 1-hour average NO_2 concentrations for each day at each monitor. Then the 98th percentile value of the daily maximum NO_2 concentrations must be determined for the current year, and for each of the previous two years. Finally, the average of these three annual 98th-percentile values is the design value.

NO_2 MONITORING NETWORK

NJDEP monitored NO_2 levels at ten locations in 2017. The monitoring stations are Bayonne, Camden Spruce Street, Chester, Columbia, Elizabeth Lab, Fort Lee Near Road, Jersey City, Millville, Newark Firehouse, and Rutgers University. These sites are shown in Figure 6-4.

Figure 6-4
2017 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2017

None of New Jersey's monitoring sites exceeded the 1-hour or annual NO_2 ambient air standards in 2017. Fort Lee Near Road had the highest daily maximum 1-hour concentration at 92 ppb (see Table 6-2 and Figure 6-5). The 2017 98th-percentile values for each monitoring station are also shown in Table 6-2 and Figure 6-5. The design value for NO_2, which determines whether or not there is a violation of the NAAQS, is actually the 3-year average of the 98th-percentile of the 1-hour daily maximum concentrations. The 2015-2017 design value for each site is given in Table 6-2 and Figure 6-7. The site with the highest design value for 2015-2017 was Fort Lee Near Road, with 63 ppb, although the 2015 data does not meet USEPA completeness criteria. The design values for Jersey City, Millville, and Rutgers University stations also have incomplete data for the three-year period (see Table 6-2 footnotes).

Table 6-2
2017 Nitrogen Dioxide Concentrations in New Jersey
1-Hour Averages
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)		
	Daily Maximum	98th Percentile	2015-2017 98th-%ile 3-Yr Avg
Bayonne	77	56	57
Camden Spruce St.	53	46	50
Chester	38	33	31
Columbia	52	44	48
Elizabeth Trailer	79	59	62
Fort Lee Near Road*	92	67	63
Jersey City*	70	53	52
Millville*	45	33	33
Newark Firehouse	75	56	57
Rutgers University*	53	41	43

*The following sites do not have three complete years of data for 2015 to 2017, and do not meet the design value criteria for NO_2:

- Fort Lee Near Road began operating in 2014, but data for 2015 was incomplete.
- Jersey City began operating January 2016.
- Millville was temporarily shut down February 2016 to June 2016.
- Rutgers University was temporarily shut down for site renovations April 2015 to June 2015.

Figure 6-5
2017 Nitrogen Dioxide Concentrations in New Jersey
Daily Maximum 1-Hour Values
Parts per Billion (ppb)

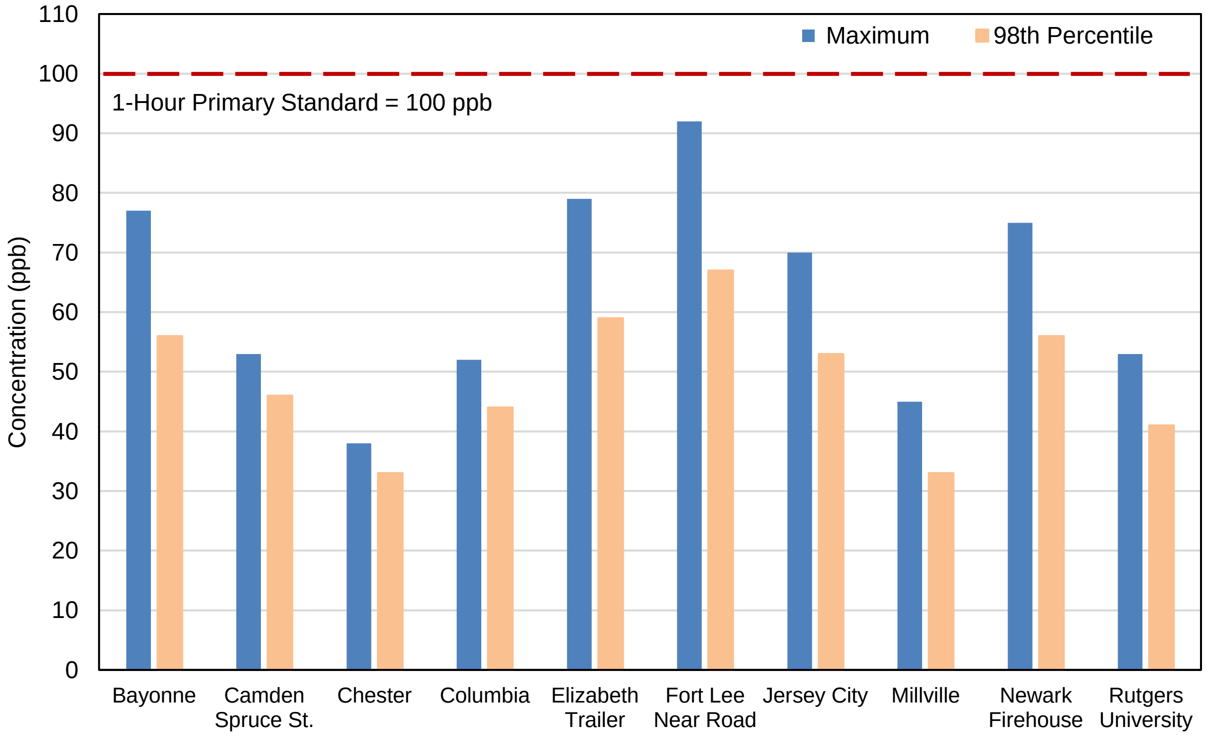
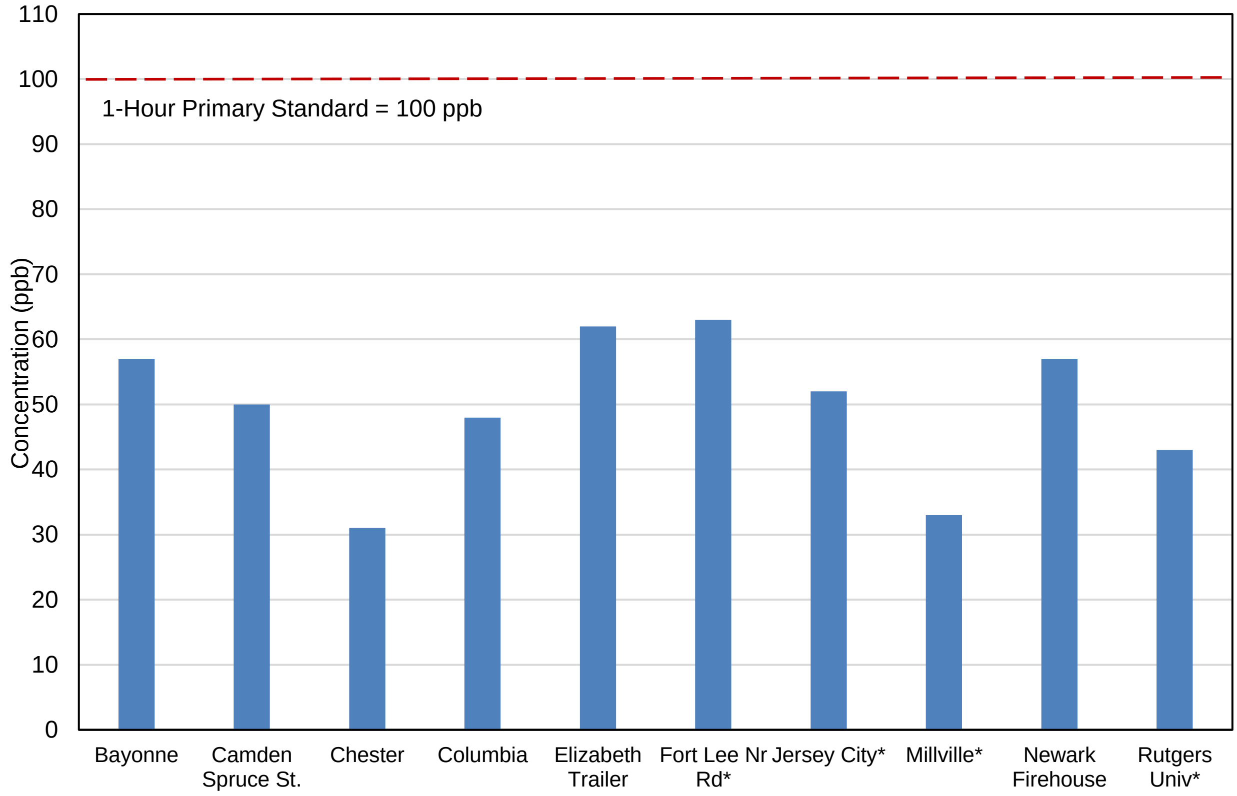


Figure 6-7
2017 Nitrogen Dioxide Design Values in New Jersey
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Concentrations (2015-2017)
Parts per Billion (ppb)



***Note:** 2015-2017 data for Fort Lee Near Road, Jersey City, Millville, and Rutgers University sites are incomplete and do not meet design value requirements. See Table 6-2 for details.

In order to meet the annual NAAQS for NO_2, the calendar-year average (January 1 to December 31) must be less than or equal to 53 ppb, rounded to no more than one decimal place. The NJAAQS is also 53 ppb, but it is compared to the maximum running 12-month average (of any twelve consecutive months in the year). As shown in Table 6-2 and Figure 6-8, the highest calendar-year average of 20 ppb occurred at the Jersey City monitoring station, located on J.F.Kennedy Boulevard near Journal Square. The highest running 12-month average NO_2 concentration, also 20 ppb, was measured at both the Elizabeth Lab site, located at Exit 13 of the New Jersey Turnpike, and the Jersey City site. These values are well below the standards.

Table 6-2
2017 Nitrogen Dioxide Concentrations in New Jersey
Annual (12-Month) Averages
Parts per Billion (ppb)

Monitoring Site	12-Month Average (ppb)	
	Calendar Year	Maximum Running
Bayonne	15	16
Camden Spruce Street	12	12
Chester	3	3
Columbia	10	10
Elizabeth Lab	19	20
Fort Lee Near Road	18	18
Jersey City	20	20
Millville	6	6
Newark Firehouse	15	15
Rutgers University	8	8

Figure 6-8
2017 Nitrogen Dioxide Design Values in New Jersey
Annual (12-Month) Average Concentrations
Parts per Billion (ppb)

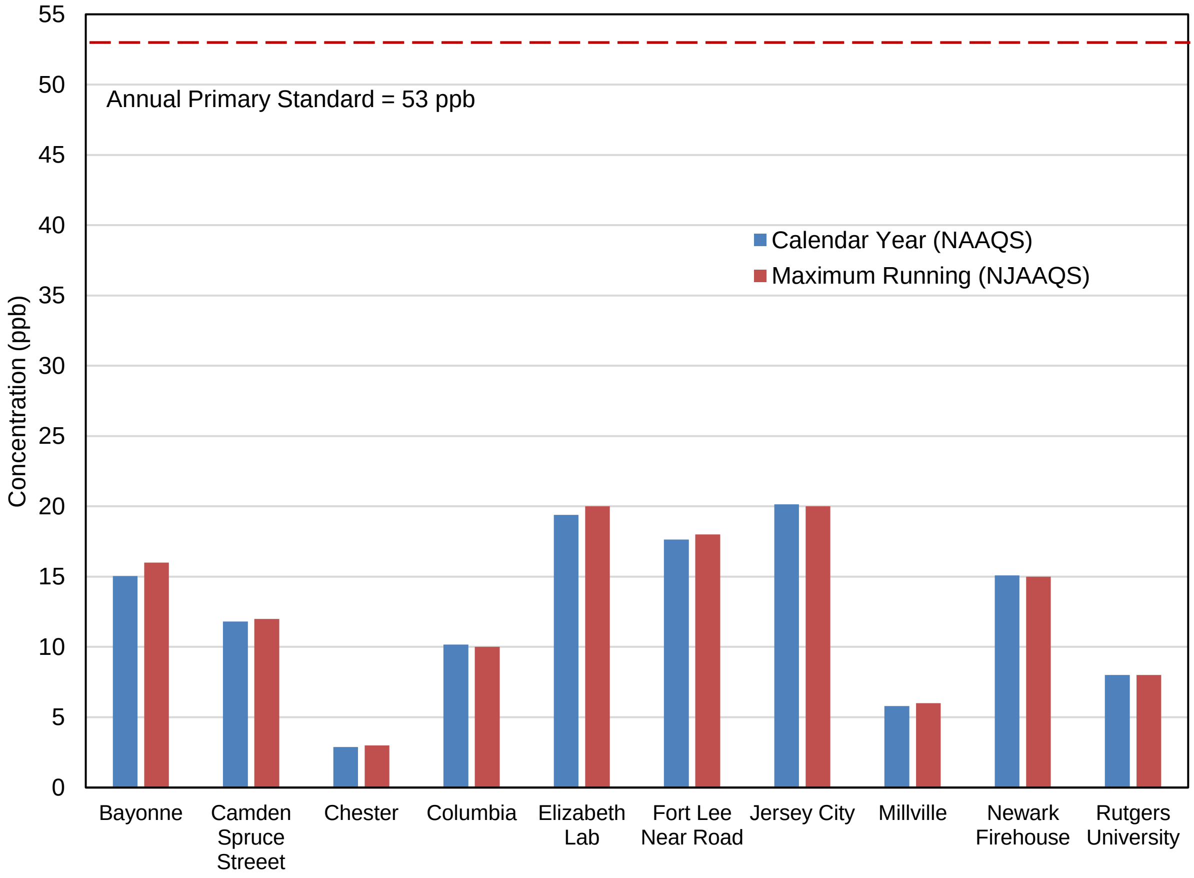
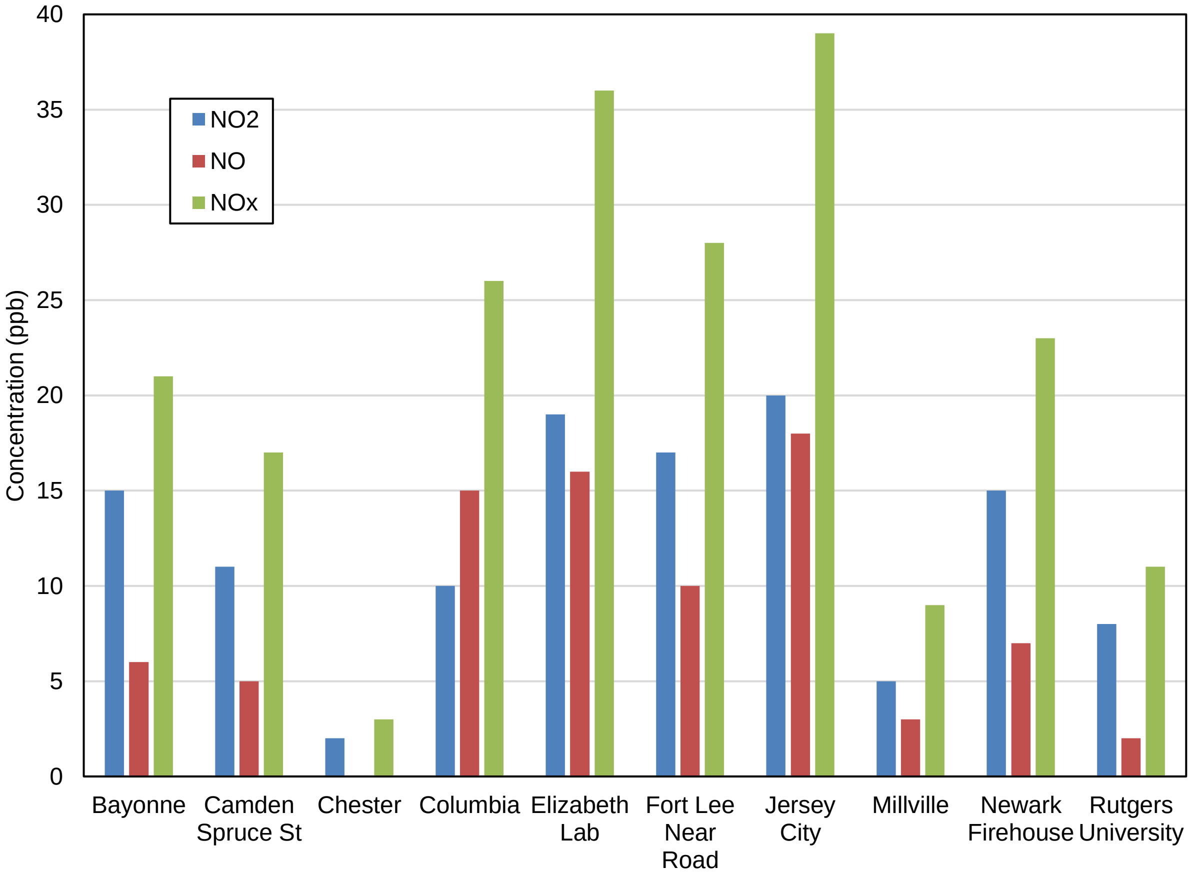


Figure 6-9 shows the calendar-year annual average concentrations of NO_2, NO and NOx at each New Jersey monitoring site. The stations that measure NO_2 concentrations also measure NO and NOx, even though there are no ambient air standards for them. NOx levels are approximately (not exactly) the sum of the NO_2 and NO concentrations. The concentration of NO tends to be lower than NO_2, because it quickly reacts with other air pollutants (particularly ozone) after it is emitted from a source, and converts to NO_2. The higher NO concentration at the Columbia monitor is believed to result from its proximity to Interstate Highway 80. The road is a significant source of NO emissions from vehicles, but the expected conversion of NO to NO_2 is probably hindered by the area's relatively low levels of other pollutants.

Figure 6-9
2017 Nitrogen Oxides Concentrations in New Jersey
Calendar-Year Annual Averages
Parts per Billion (ppb)



Note: The annual average concentration of NO at Chester was 0 ppb.

NO_2 TRENDS

Routine monitoring for NO_2 in New Jersey began in 1966. The last year in which the annual average NO_2 concentration exceeded the NAAQS was 1974. The graph of NO_2 levels in Figure 6-10 shows the highest statewide annual average concentrations recorded from 1990 to 2017. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of concern about the role of nitrogen oxides in the formation of other pollutants, most notably ozone and fine particles. Both of these pollutants still occasionally reach problematic levels in the northeastern United States. Efforts to reduce levels of ozone and fine particles are likely to require continued reductions in NOx emissions.

Figure 6-11 shows the highest 98th percentile values of the daily maximum one-hour concentrations of NO_2 for the years 2000 to 2017 in New Jersey. The 1-hour NAAQS of 100 ppb has not been exceeded since it was promulgated in 2010.

Figure 6-12 shows the New Jersey design values for the 1-hour NAAQS for the years 2000-2017. The design value, which determines compliance with the 1-hour NO_2 NAAQS, is the highest 3-year average of the 98th percentile values of the daily maximum one-hour concentrations at each New Jersey monitoring site. New Jersey has not violated the 1-hour NAAQS since it was implemented.

Figure 6-10
Nitrogen Dioxide Concentrations in New Jersey, 1990-2017
Highest Annual (Calendar Year) Averages
Parts per billion (ppb)

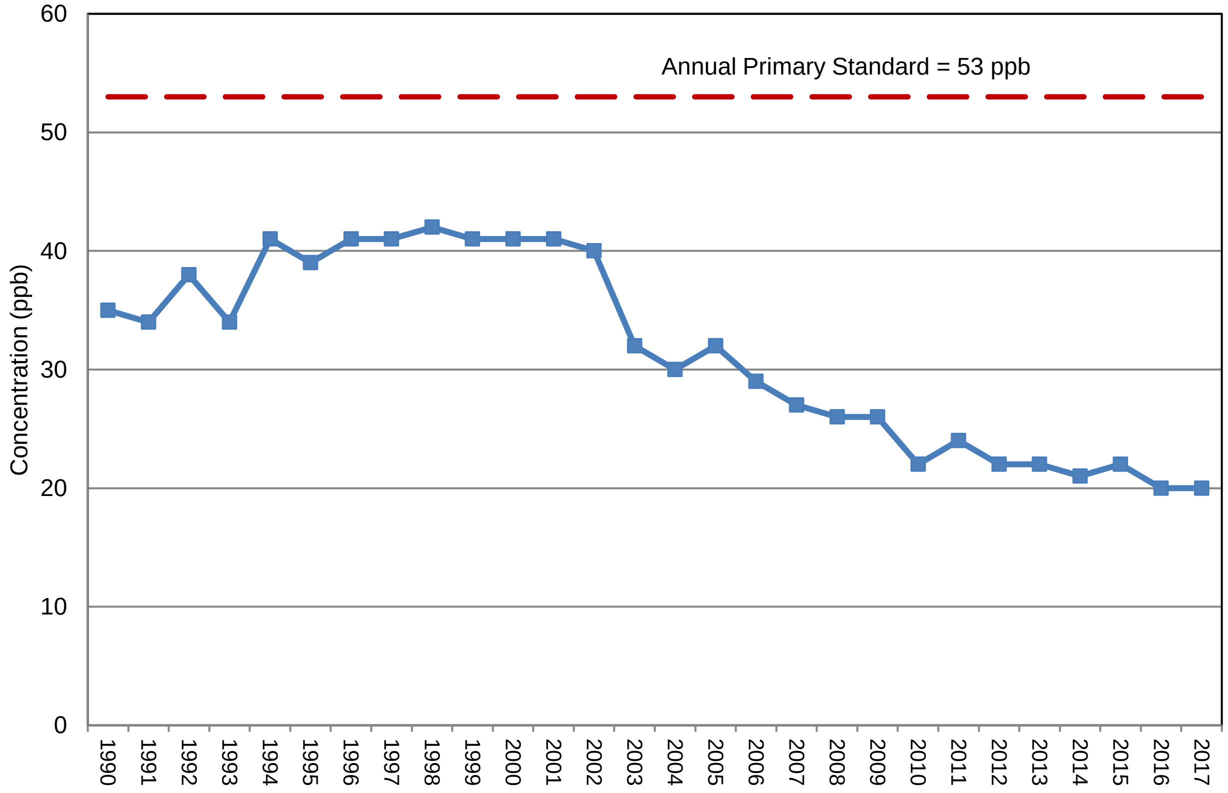


Figure 6-11
Nitrogen Dioxide Concentrations in New Jersey, 2000-2017
98^{th}-Percentile of the Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)

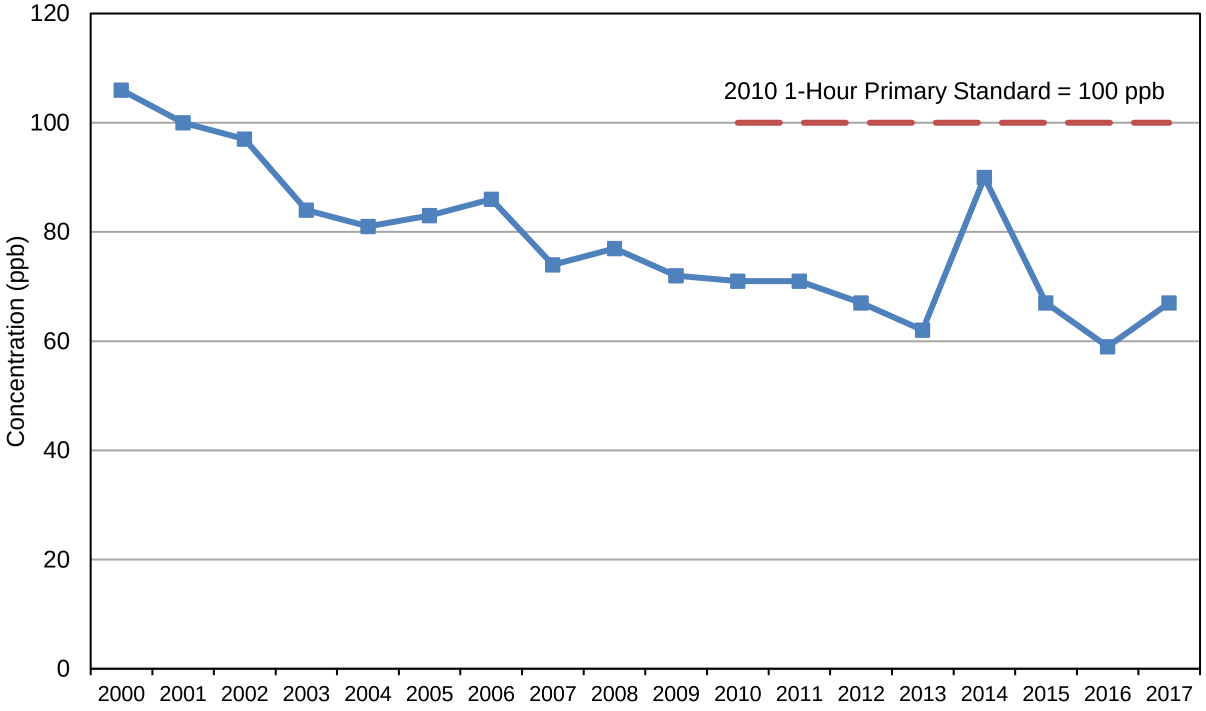
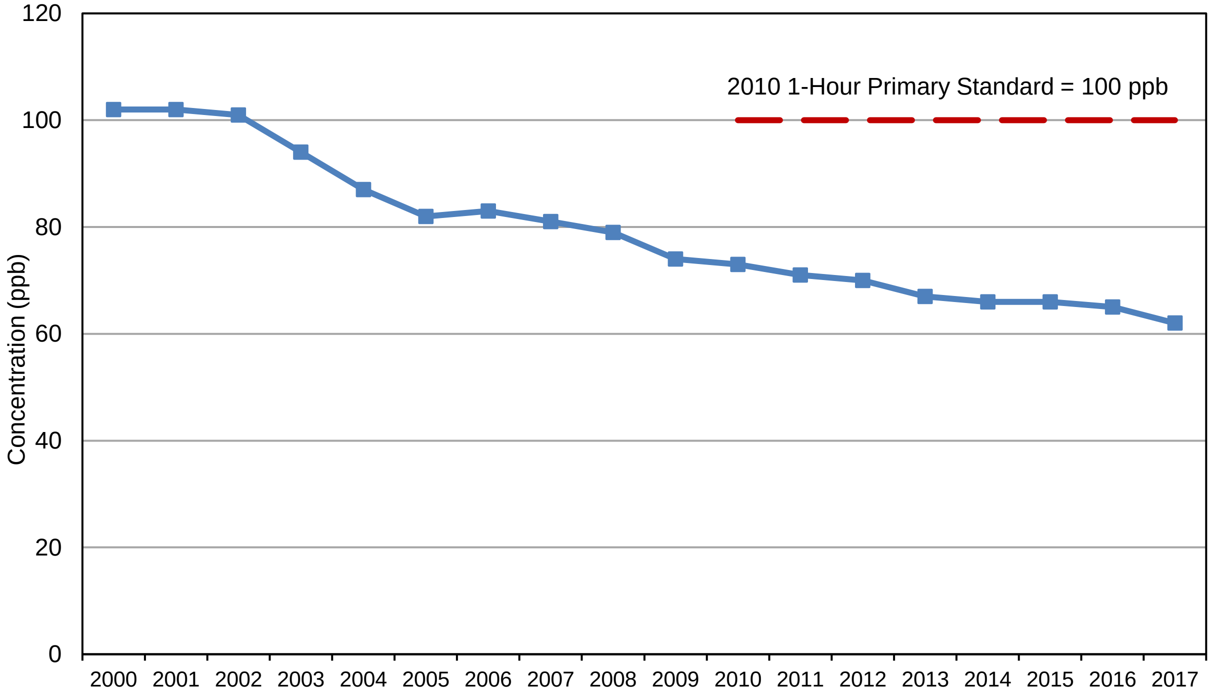


Figure 6-12
Nitrogen Dioxide Design Value Trend in New Jersey, 2000-2017
3-Year Average of the 98^{th} Percentile Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)



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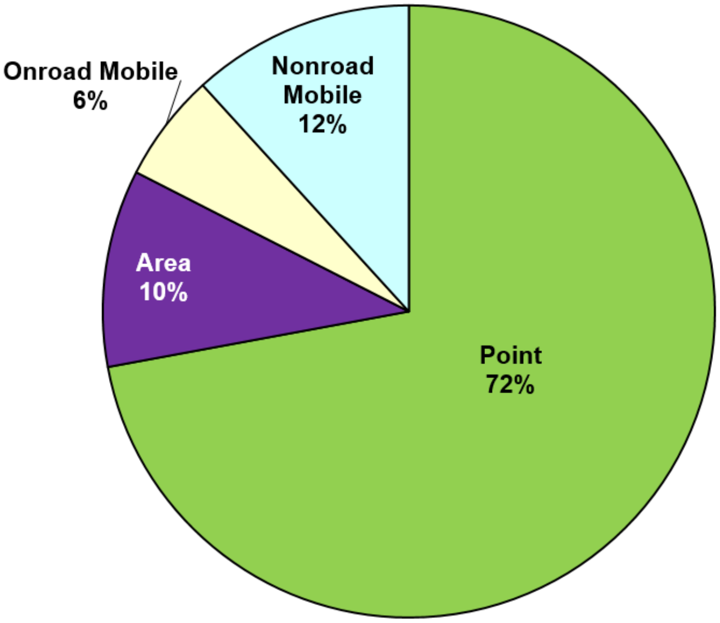
2017 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

SOURCES

Sulfur dioxide (SO_2) is a heavy, colorless gas with a suffocating odor, that easily dissolves in water to form sulfuric acid. SO_2 gases are formed when fuels containing sulfur (coal, oil, and gasoline) are burned, or when gasoline is extracted from oil. Most of the sulfur dioxide released into the air comes from fuel combustion in electric utilities, especially those that burn coal with a high sulfur content. Sulfur is found in raw materials such as crude oil, coal, and ores that contain metals. Industrial facilities that derive their products from these materials may also release SO_2. The pie chart in Figure 7-1 summarizes the primary sources of SO_2 in New Jersey in 2017.

Figure 7-1
2017 New Jersey SO_2 Projected Emissions



Inventory Source: MARAMA 2017 BETA2

HEALTH AND ENVIRONMENTAL EFFECTS

Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of sulfurous acid forming when the highly soluble SO_2 gas dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO_2 include children, the elderly, and people with heart or lung disorders such as asthma. When SO_2 concentrations in the air become elevated, people in these sensitive groups and those who are active outdoors may have trouble breathing.

Sulfur dioxide reacts with other gases and particles in the air to form sulfates, which also can be harmful to people and the environment. Sulfate particles are the major cause of reduced visibility in the eastern United States. SO_2 forms acids that fall to the earth in rain and snow. Better known as acid rain, this acidic precipitation can damage forests and crops, can make lakes and streams too acidic for fish, and can speed up the decay of building materials and paints.

AMBIENT AIR QUALITY STANDARDS

The current National Ambient Air Quality Standards (NAAQS) for SO_2 are shown in Table 7-1. Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. In June 2010 the United States Environmental Protection Agency (USEPA) established a new primary 1-hour NAAQS for SO_2 at a level of 75 parts per billion (ppb). At the same time, the old 24-hour and annual average NAAQS were revoked, and the 3-hour secondary NAAQS was retained. Compliance with the 1-hour standard is determined by calculating the 99th percentile of 1-hour daily maximum concentrations for each monitoring site in the state each year, and then averaging each site's values for the three most recent years. This statistic is called the design value.

Table 7-1 also shows New Jersey's ambient air quality standards (NJAAQS) for SO_2, which are based on the older NAAQS. NJAAQS for SO_2 are expressed in micrograms per cubic meter ($\mu g/m^3$) as well as ppm, and are calculated using running averages (consecutive 3-hour, 24-hour and 12 month averages) rather than calendar year or non-overlapping block averages. The secondary 3-hour New Jersey standard is the same as the NAAQS, except that New Jersey uses a running average.

Table 7-1

National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide (SO_2)

Parts per Billion (ppb)

Parts per Million (ppm)

Micrograms per Cubic Meter ($\mu g/m^3$)

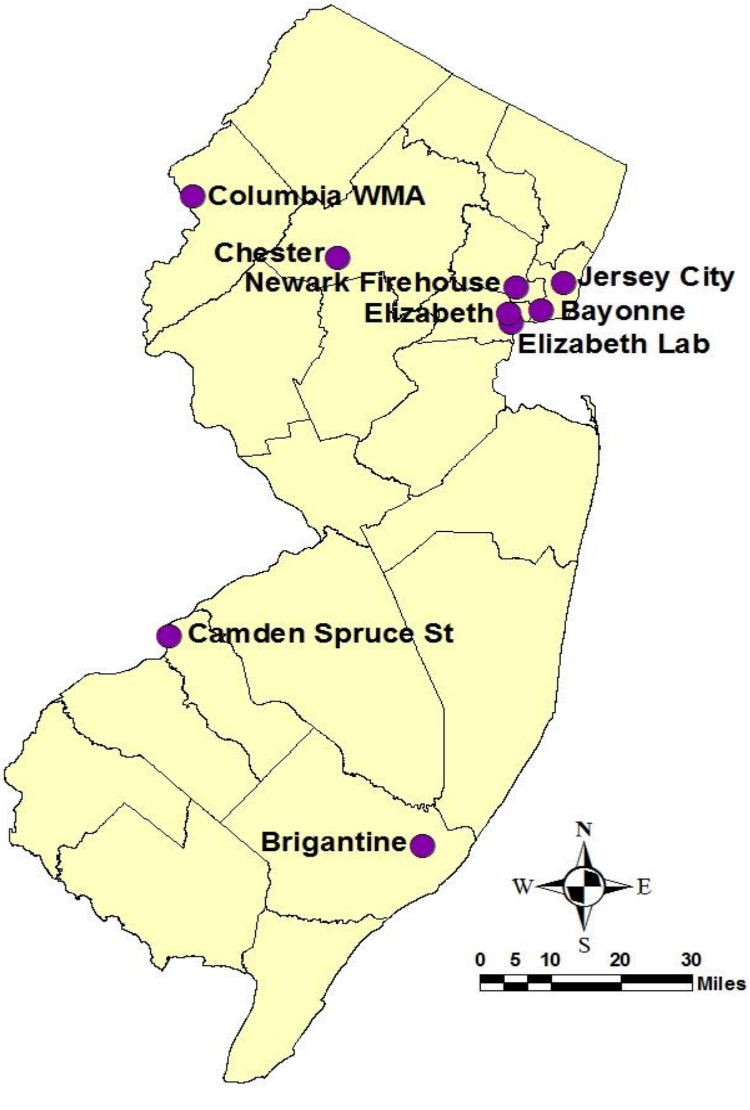
Averaging Period	Type	National	New Jersey[a]
1–hour[b]	Primary	75 ppb	---
3–hours	Secondary	0.5 ppm[c]	1300 $\mu g/m^3$ (0.5 ppm)
24–hours[d]	Primary	---	365 $\mu g/m^3$ (0.14 ppm)
24–hours[d]	Secondary	---	260 $\mu g/m^3$ (0.10 ppm)
12–months	Primary	---	80 $\mu g/m^3$ (0.03 ppm)
12–months	Secondary	---	60 $\mu g/m^3$ (0.02 ppm)

[a] Based on running averages, over any 12 consecutive months in a year.
[b] To meet this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour averages at each monitor within the state must not exceed 75 ppb.
[c] Based on successive non-overlapping blocks, beginning at midnight each day.
[d] Not to be exceeded more than once in a year.

SO_2 MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) monitored SO_2 levels at nine locations in 2017. These sites are shown in Figure 7-2. Two sites, Brigantine and Newark Firehouse, measure SO_2 concentrations at trace levels, down to a ten-thousandth part per million (0.0000 ppm). The other sites measure SO_2 concentrations to the thousandth of a part per million (0.000 ppm).

Figure 7-2
2017 Sulfur Dioxide
Monitoring Network



SO_2 LEVELS IN 2017

In 2017, there were no exceedances of the 1-hour NAAQS of 75 ppb. See Table 7-2 and Figures 7-3 and 7-4. Camden Spruce Street had the highest 1-hour value of 10 ppb. However, the highest 99th percentile value of 5 ppb was recorded at Jersey City. The highest design value, the 3-year average of the 99th-percentile of the daily maximum 1-hour SO_2 concentrations, was 10 ppb at Camden Spruce Street. This is the result of some very high values recorded at the Camden site in 2016, including two exceedances of the NAAQS, possibly due to port activity on the Delaware River.

There were no exceedances of the 3-hour secondary standard of 0.5 ppm. The highest value of 0.007 ppm, recorded at Jersey City, was the same when calculated using non-overlapping 3-hour blocks, as required by the NAAQS, or when calculated using running 3-hour averages, as specified by the NJAAQS. Results are shown in Table 7-3 and Figure 7-5.

No monitoring sites had exceedances of the 24-hour or 12-month New Jersey SO_2 standards during 2017. The highest and second-highest 24-hour average concentrations were 0.005 and 0.004 ppm, measured at the Jersey City monitoring station. The highest 12-month running average concentration of 0.00069 ppm was also recorded at Jersey City. See Tables 7-4 and 7-5, and Figures 7-6 and 7-7 for data for the other monitoring sites.

Table 7-2
2017 Sulfur Dioxide Concentrations in New Jersey
Daily Maximum and 99th Percentile 1-Hour Averages
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)			2015-2017 Design Value[a]
	Highest Daily Maximum	2nd-Highest Daily Maximum	99th Percentile Daily Maximum	
Bayonne	8	6	4	4
Brigantine	4.6	4.1	3.1	4
Camden Spruce St.	10	5	4	10
Chester	5	5	3	5
Columbia	5	5	4	6
Elizabeth	4	4	4	4
Elizabeth Lab	9	6	3	8
Jersey City	8	7	5	4
Newark Firehouse	8	6.9	2.5	4

[a] 3-Year (2015-2017) average of the 99th percentile 1-hour daily maximum concentrations.

Figure 7-3
2017 Sulfur Dioxide Concentrations in New Jersey
1-Hour Averages
Parts per Billion (ppb)

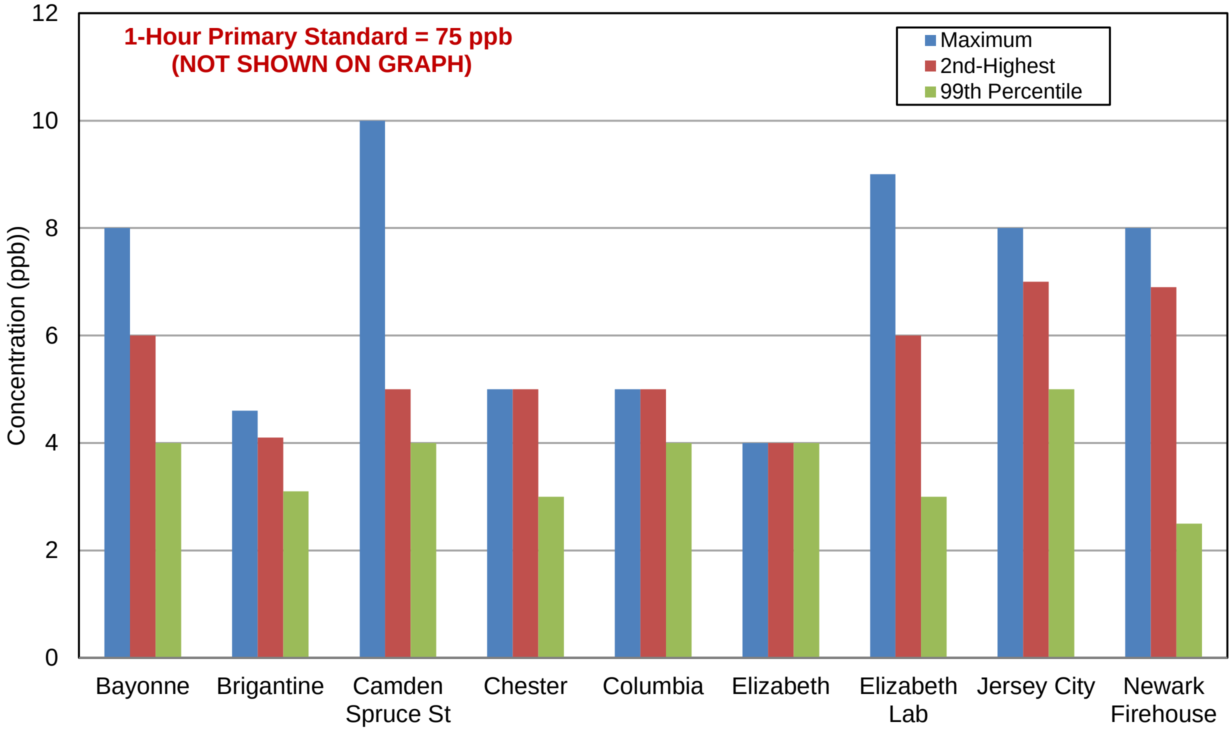


Figure 7-4
New Jersey Sulfur Dioxide Design Values for 2015-2017
3-Year Average of the 99th Percentile of the 1-Hour Daily Maximum Concentrations
Parts per Billion (ppb)

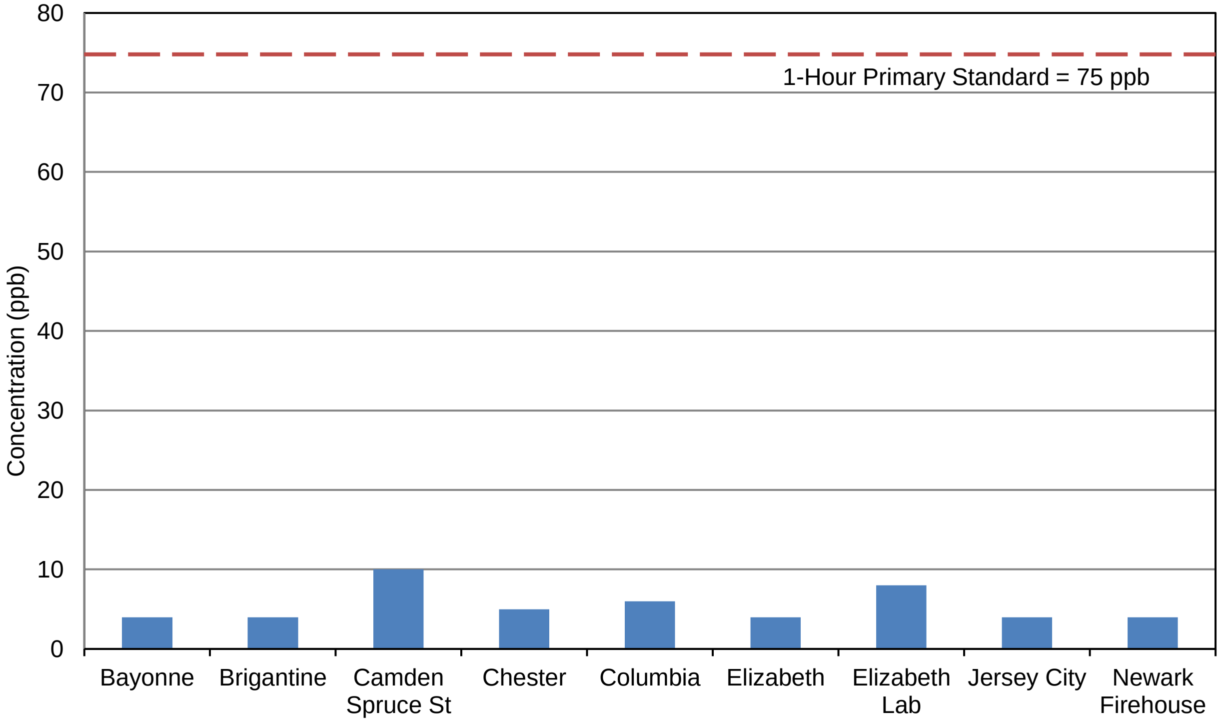


Table 7-3
2017 Sulfur Dioxide Concentrations in New Jersey
3-Hour Averages
Parts per Million (ppm)

Monitoring Site	3-Hour Average Concentrations			
	Block[a]		Running[b]	
	Maximum	2nd-Highest	Maximum	2nd-Highest*
Bayonne	0.003	0.003	0.004	0.003
Brigantine	0.0021	0.002	0.0022	0.0021
Camden Spruce	0.002	0.002	0.003	0.003
Chester	0.004	0.002	0.004	0.002
Columbia	0.003	0.003	0.004	0.003
Elizabeth	0.003	0.003	0.003	0.003
Elizabeth Trailer	0.005	0.003	0.005	0.004
Jersey City	0.007	0.006	0.007	0.007
Newark Firehouse	0.0045	0.0026	0.0045	0.0026

[a] NAAQS
[b] NJAAQS
*Non-overlapping

Figure 7-5
2017 Sulfur Dioxide Concentrations in New Jersey
2nd Highest 3-Hour Averages
Parts per Million (ppm)

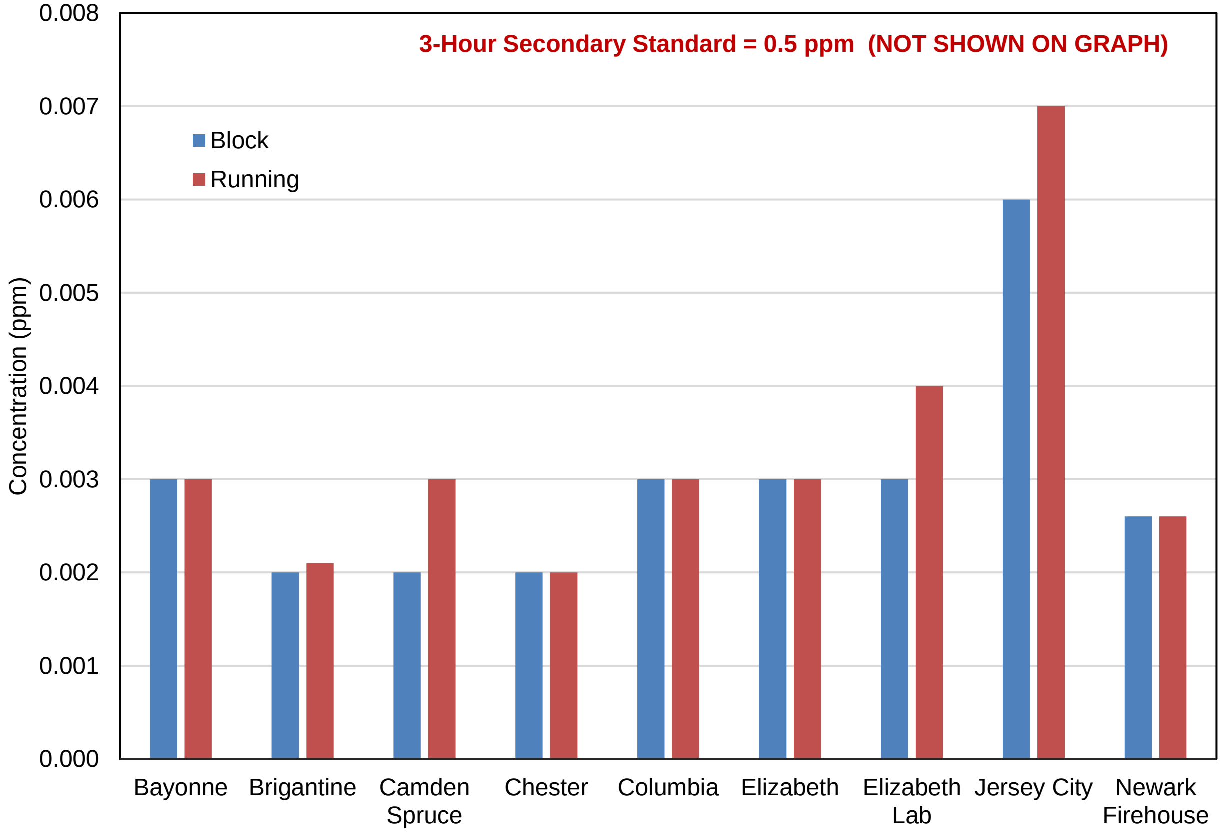


Table 7-4
2017 Sulfur Dioxide Concentrations in New Jersey
24-Hour Averages
Parts per Million (ppm)

Monitoring Site	24-Hour Running Average	
	Maximum	2nd Highest (Non-overlapping)
Bayonne	0.001	0
Brigantine	0.0009	0.0008
Camden Spruce St.	0.001	0.001
Chester	0.001	0.001
Columbia	0.002	0.002
Elizabeth	0.002	0.002
Elizabeth Lab	0.001	0.001
Jersey City	0.005	0.004
Newark Firehouse	0.0012	0.001

Figure 7-6
2016 Sulfur Dioxide Concentrations in New Jersey
2nd-Highest 24-Hour Averages
Parts per Million (ppm)

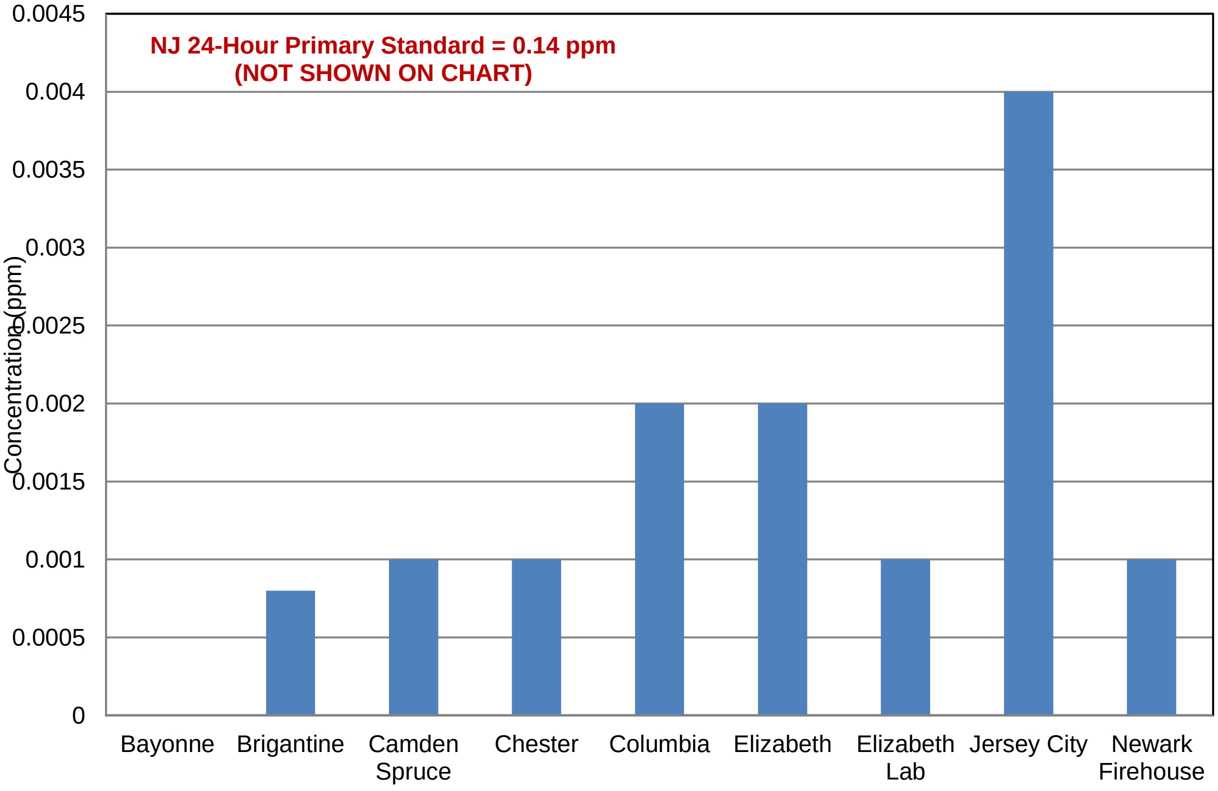
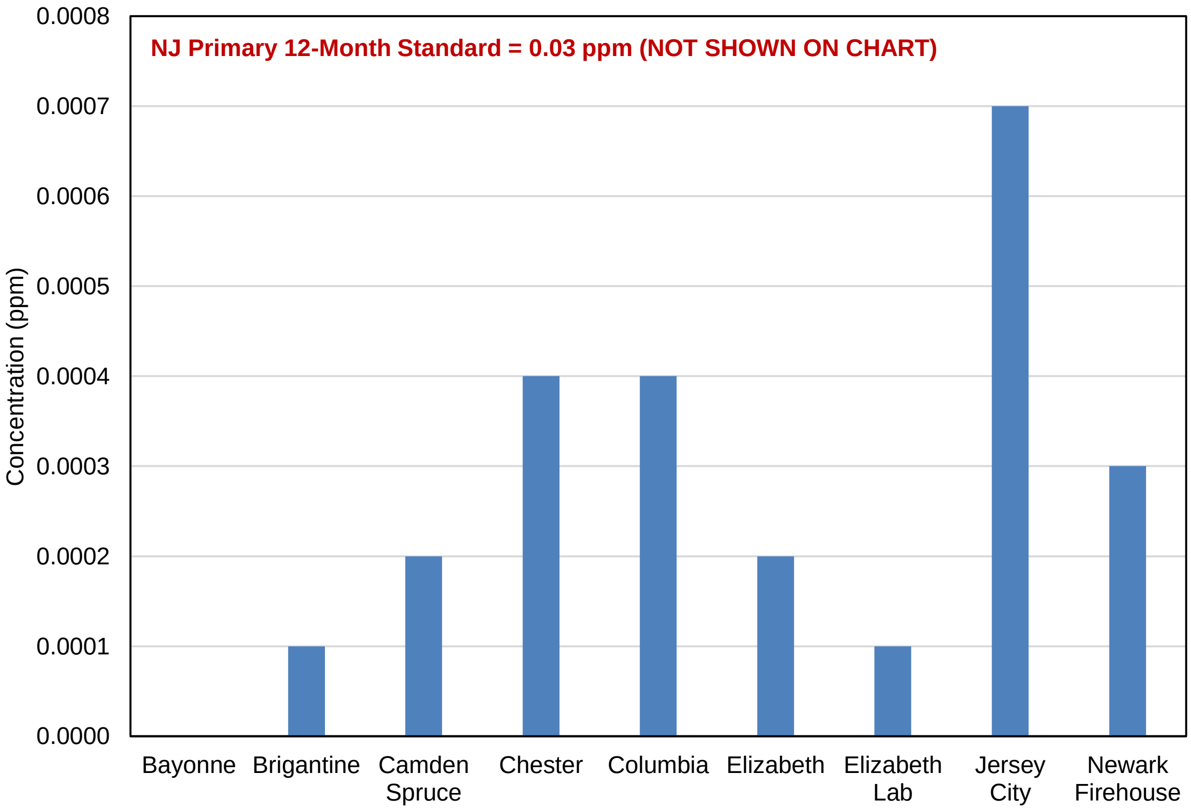


Table 7-5
2017 Sulfur Dioxide Concentrations in New Jersey
Maximum 12-Month Running Averages
Parts per Million (ppm)

Monitoring Site	Maximum 12-Month Running Average
Bayonne	0.0000
Brigantine	0.0001
Camden Spruce St.	0.0002
Chester	0.0004
Columbia	0.0004
Elizabeth	0.0002
Elizabeth Lab	0.0001
Jersey City	0.0007
Newark Firehouse	0.0003

Figure 7-7
2017 Sulfur Dioxide Concentrations in New Jersey
Maximum 12-Month Running Averages
Parts per Million (ppm)



SO_2 TRENDS

Sulfur dioxide concentrations across the country have decreased significantly since the first NAAQS were set in 1971. Figure 7-8 shows the second-highest daily average concentrations of SO_2 recorded in New Jersey each year since 1975. Nationwide efforts to reduce ambient sulfur levels have focused on sulfur in fuels. Regulations passed in 2000 reduced the sulfur content of gasoline by up to 90 percent, and enabled the use of new emission control technologies in cars, sport utility vehicles (SUVs), minivans, vans and pick-up trucks (beginning with model year 2004). Even more stringent gasoline and emissions controls for sulfur went into effect in 2017. And in New Jersey, limits on sulfur in commercial fuel oil were implemented beginning in 2014.

A coal-burning power plant across the Delaware River in Pennsylvania had for many years been suspected of causing high SO_2 levels in New Jersey. Air dispersion modeling carried out by NJDEP showed that the facility was causing likely violations of the SO_2 NAAQS. New Jersey petitioned the USEPA under Section 126 of the Clean Air Act to take action against the Portland Power Plant. In support of the petition, NJDEP established an SO_2 monitoring station at the Columbia Wildlife Management Area in Knowlton Township, Warren County, in September 2010. The dramatic increase in the monitored 99th percentile 1-hour SO_2 concentration in 2010 (shown in Figure 7-9) is attributable to measurements taken at the Columbia site. In October 2011, USEPA finalized a rule to grant New Jersey's petition. This final rule required the Portland Power Plant to reduce its SO_2 emissions such that the plant's contribution to predicted air quality standard violations would be lowered within one year, and completely eliminated within three years. The power plant stopped operating in mid-2014. Recent monitoring data has shown that Warren County and its vicinity are now able to meet the 1-hour SO_2 NAAQS.

Figure 7-10 shows the trend in the design value, the value that determines compliance with the NAAQS. The design value for the 1-hour NAAQS is the 3-year average of the 99th percentile of the daily maximum 1-hour concentrations of SO_2 at each site. The values presented are the highest statewide for a given year.

Figure 7-8
Sulfur Dioxide Trend in New Jersey, 1975-2017
2nd-Highest 24-Hour Average Concentrations
Parts per Million (ppm)

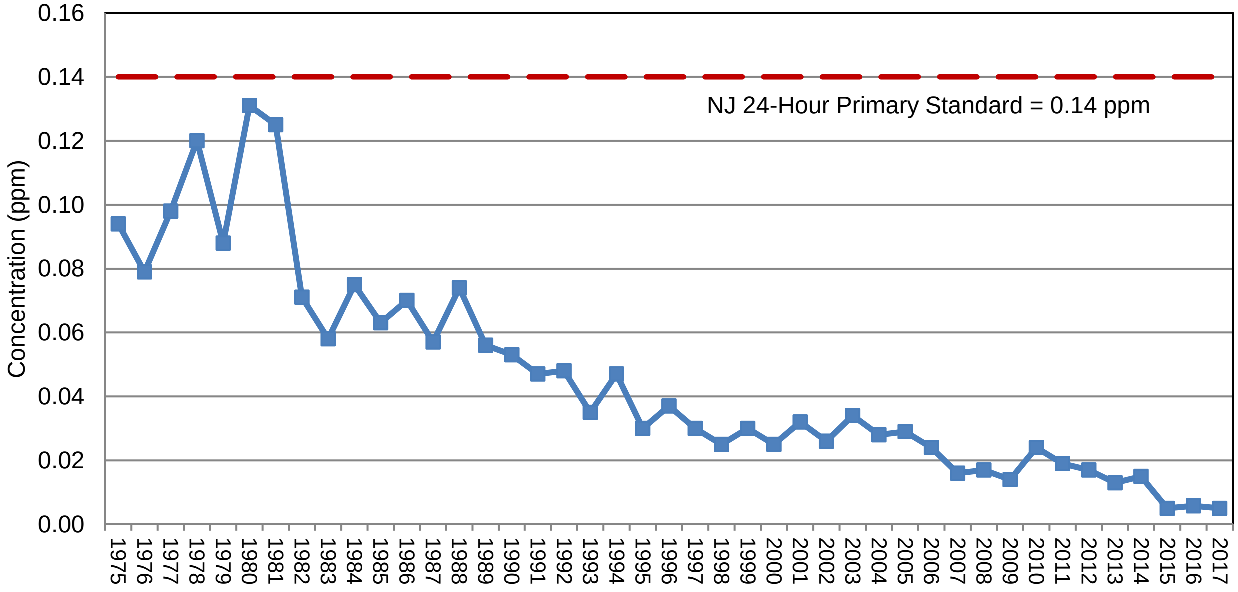


Figure 7-9

Sulfur Dioxide Trend in New Jersey, 2000-2017

99th Percentile of the Daily Maximum 1-Hour Concentrations

Parts per Million (ppm)

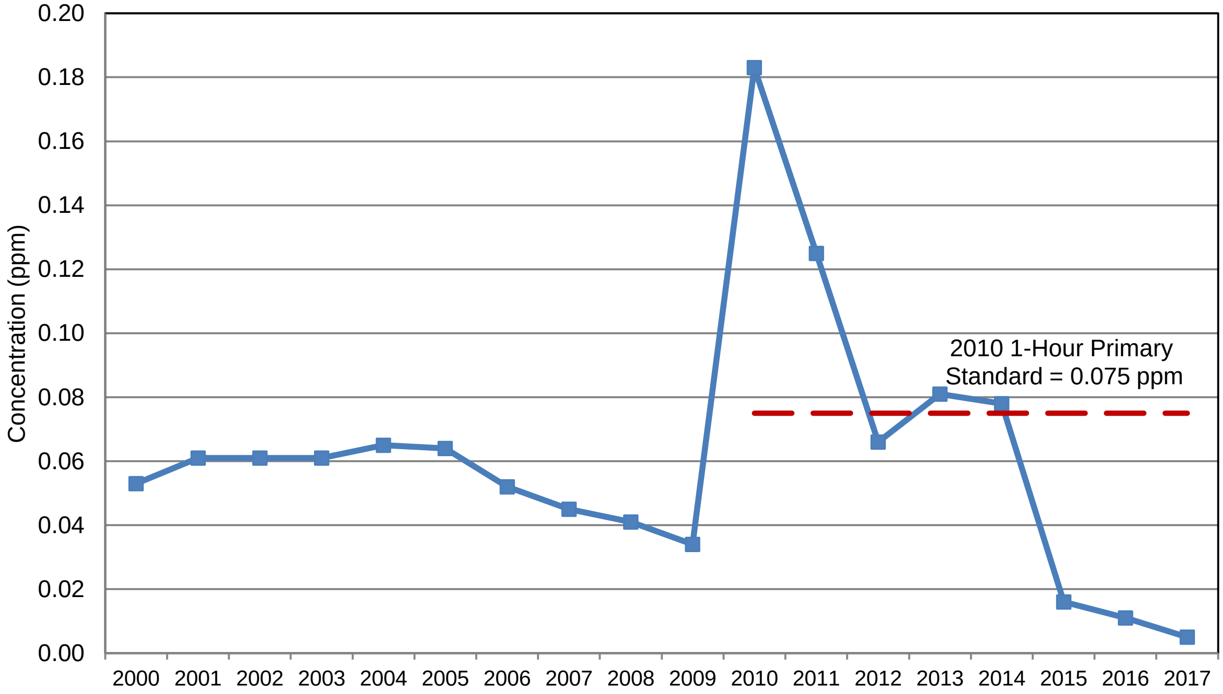
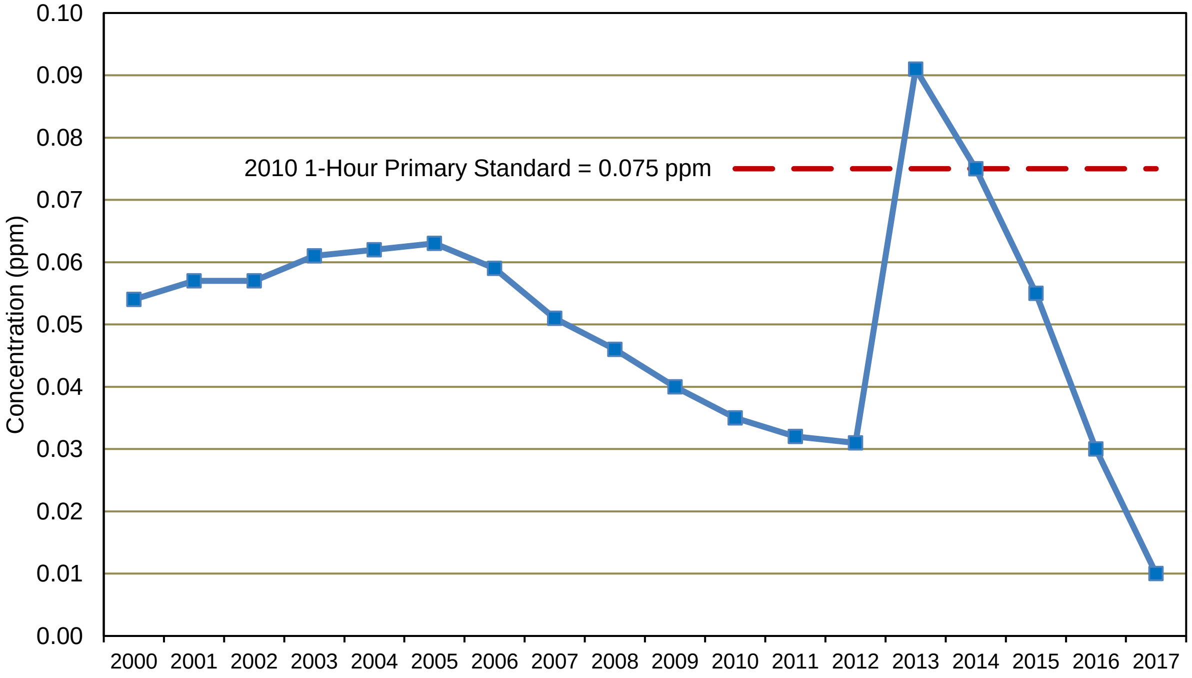


Figure 7-10

Sulfur Dioxide Design Value Trend in New Jersey, 2000-2017

3-Year Average of the 99th Percentile Daily Maximum 1-Hour Concentrations

Parts per Million (ppm)



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2017 Carbon Monoxide Summary

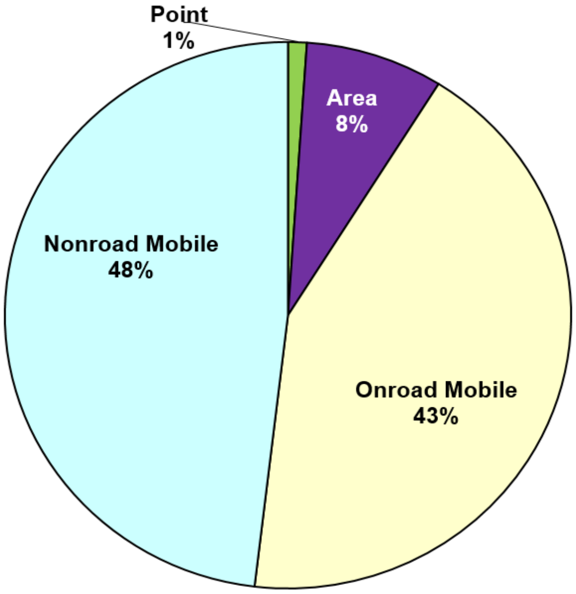
New Jersey Department of Environmental Protection

SOURCES

Carbon monoxide (CO) is a colorless, odorless gas formed when carbon in fuels is not burned completely. The main source of outdoor CO is exhaust from internal combustion engines, primarily on-road vehicles, as well as non-road vehicles, generators, construction equipment, boats and other types of mobile sources. 50% of all CO emissions nationwide are attributable to mobile sources, and over 90% in New Jersey. Significant amounts of CO are also emitted from fuel combustion in boilers and incinerators, natural sources such as forest fires, and various industrial processes. A pie chart estimating the contribution of different categories of CO sources in New Jersey in 2017 is shown in Figure 8-1.

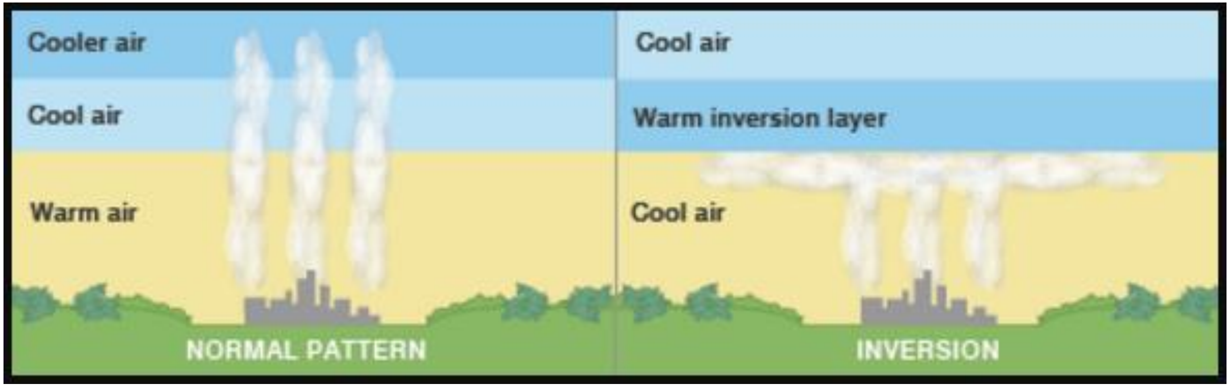
Outdoor concentrations of CO can rise during atmospheric inversions. This phenomenon occurs when cooler air is trapped beneath a layer of warmer air, which often occurs overnight. The inversion acts like a lid, preventing pollution from mixing in the atmosphere and effectively trapping it close to the ground (see Figure 8-2). This can allow CO to accumulate at ground-level.

Figure 8-1
2017 New Jersey 2017 Carbon Monoxide Projected Emissions



Inventory Source: MARAMA 2017 BETA2

Figure 8-2
Effect of Atmospheric Inversion on Pollution Levels



https://kisialevelgeography.files.wordpress.com/2014/06/44875197_thermal_inversion466x135.gif

Figure 8-3 shows that CO concentrations are slightly higher in the winter, probably because inversions are more frequent during the winter months. Also, high CO levels often coincide with morning and afternoon rush hours. This diurnal variation is displayed in Figure 8-4.

Figure 8-3
2017 Carbon Monoxide Concentrations in New Jersey
Monthly Variation
Parts per Million (ppm)

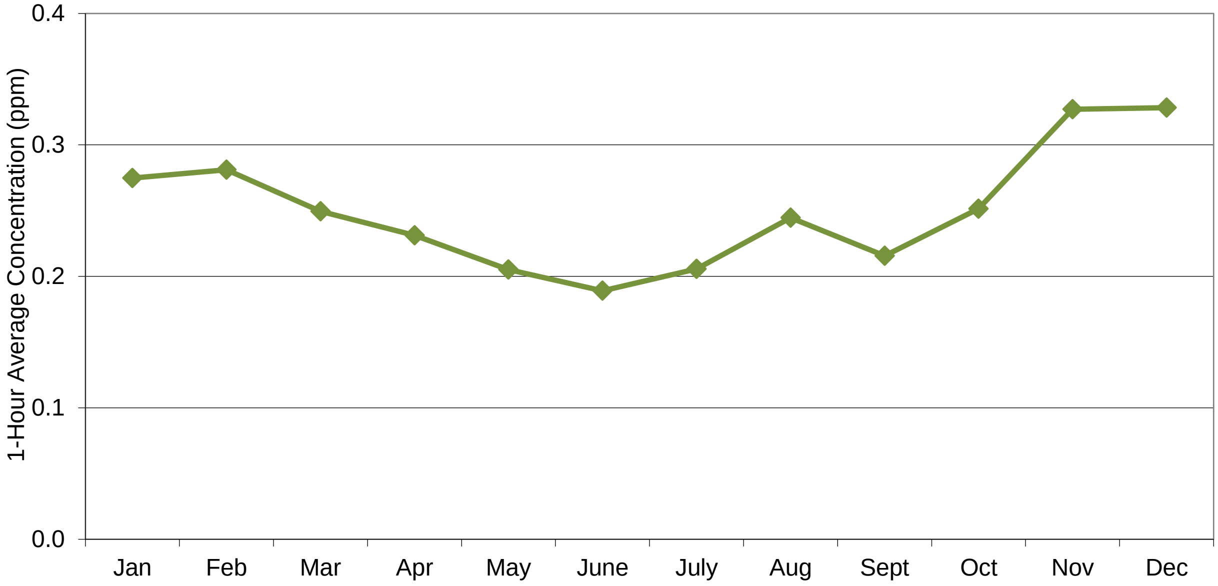
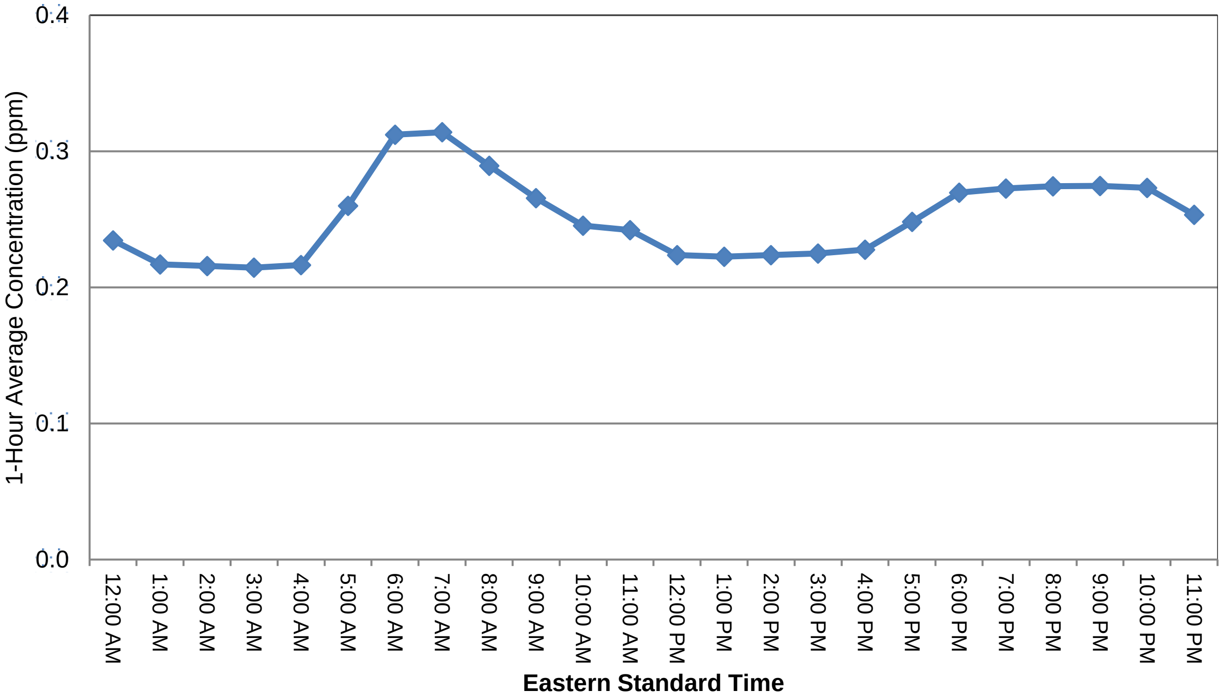


Figure 8-4
2017 Carbon Monoxide Concentrations in New Jersey
Hourly Variation
Parts per Million (ppm)



HEALTH EFFECTS

Carbon monoxide reduces the oxygen-carrying capacity of blood, therefore reducing the distribution of oxygen to organs like the heart and brain. The most common symptoms of exposure to high concentrations of carbon monoxide are headaches and nausea. Exposure to extremely high concentrations, usually resulting from combustion exhaust accumulating in enclosed indoor spaces, can be life-threatening. Such high levels of CO are not likely to occur outdoors. The health threat from exposure to outdoor 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 reduce that individual's ability to exercise and may cause chest pain (angina).

AMBIENT AIR QUALITY STANDARDS

National Ambient Air Quality Standards (NAAQS) are established for the entire U.S. Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. For carbon monoxide, there are currently two primary, or health-based, NAAQS: a 1-hour standard of 35 parts per million (ppm), and an 8-hour standard of 9 ppm. These levels are not to be exceeded more than once in any calendar year. Therefore, the design value, or the actual statistical value that determines compliance with the NAAQS, is the second-highest 1-hour and 8-hour value in a given year. There are no national secondary, or welfare-based, standards for CO at this time. New Jersey also has standards for CO, and they are equivalent to the NAAQS even though they have different units (milligrams per cubic meter as opposed to parts per million). Also, the 8-hour state standard is based on a running average, not to be exceeded more than once in a 12-month period. The state has set secondary standards for CO at the same level as the primary standards. The standards are all summarized in Table 8-1.

Table 8-1
National and New Jersey Ambient Air Quality Standards for Carbon Monoxide
Parts per Million (ppm)
Milligrams per Cubic Meter (mg/m3)

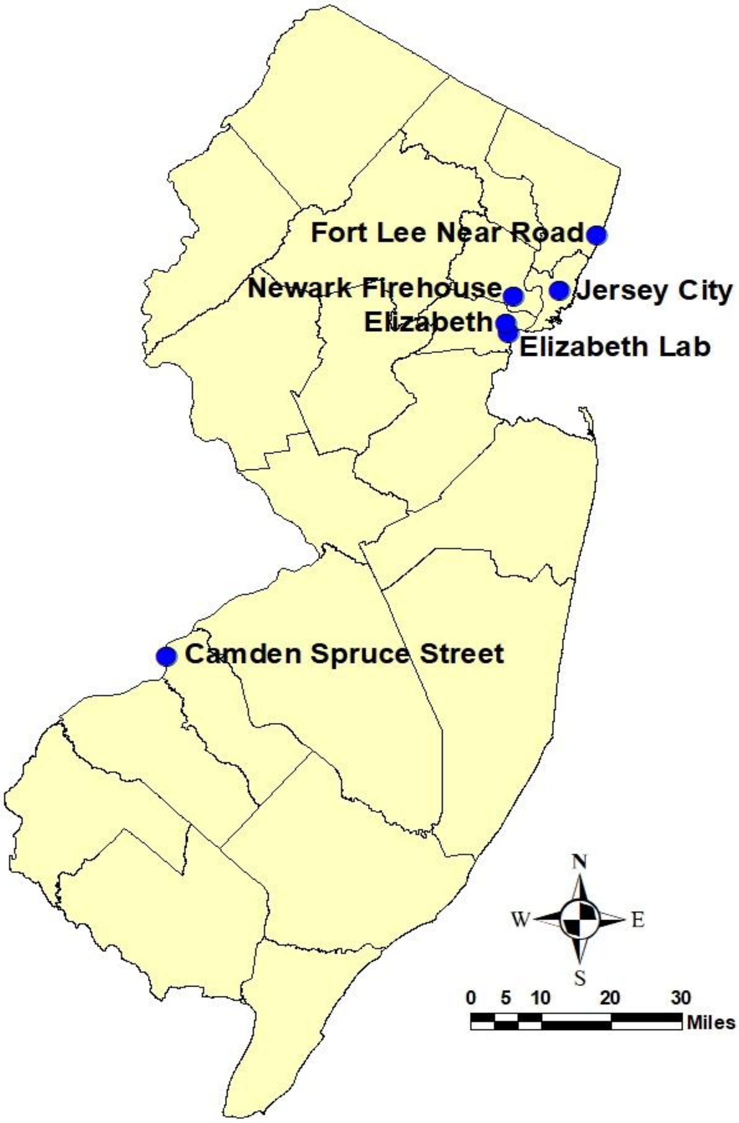
Averaging Period	Type	National [a]	New Jersey [b]
1-Hour	Primary	35 ppm	40 mg/m^3 (35 ppm)
1-Hour	Secondary	----	40 mg/m^3 (35 ppm)
8-Hours	Primary	9 ppm	10 mg/m^3 (9 ppm)
8-Hours	Secondary	----	10 mg/m^3 (9 ppm)

[a] Not to be exceeded more than once in a calendar year.
[b] Not to be exceeded more than once in any consecutive 12-month period.

CO MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) operated six CO monitoring stations in 2017. These sites are shown in the map in Figure 8-5. The Newark Firehouse station is part of the U.S. Environmental Protection Agency's (USEPA) National Core Multipollutant Monitoring Network (NCore). It measures and reports CO concentrations at trace levels, down to a hundredth of a ppm (0.00 ppm). The other stations are Camden Spruce Street, Elizabeth, Elizabeth Lab, Fort Lee Near Road, and Jersey City.

Figure 8-5
2017 Carbon Monoxide Monitoring Network



CO LEVELS IN 2017

There were no exceedances of any CO standards at any of the New Jersey monitoring sites during 2017. The maximum 1-hour average CO concentration recorded in 2017 was 2.4 ppm, at the Elizabeth station. The highest 8-hour average CO concentration recorded was 1.8 ppm, at the Camden Spruce Street, Elizabeth, and Elizabeth Lab stations. Summaries of the 2017 data are provided in Table 8-2, and Figures 8-6 and 8-7.

Table 8-2
2017 Carbon Monoxide Concentrations in New Jersey
1-Hour and 8-Hour Averages
Parts per Million (ppm)

Monitoring Site	1-Hour Average Concentrations		8-Hour Average Concentrations	
	Highest	2nd-Highest	Highest	2nd-Highest*
Camden Spruce St.	2.2	2.0	1.8	1.4
Elizabeth	2.4	2.3	1.8	1.6
Elizabeth Lab	2.1	1.9	1.8	1.3
Fort Lee Near Rd.	1.3	1.2	1.0	0.9
Jersey City	2.0	1.7	1.1	1.1
Newark Firehouse	2.33	2.17	1.4	1.4

*Non-overlapping 8-hour periods

Figure 8-6
2017 Carbon Monoxide Concentrations in New Jersey
1-Hour Averages
Parts per Million (ppm)

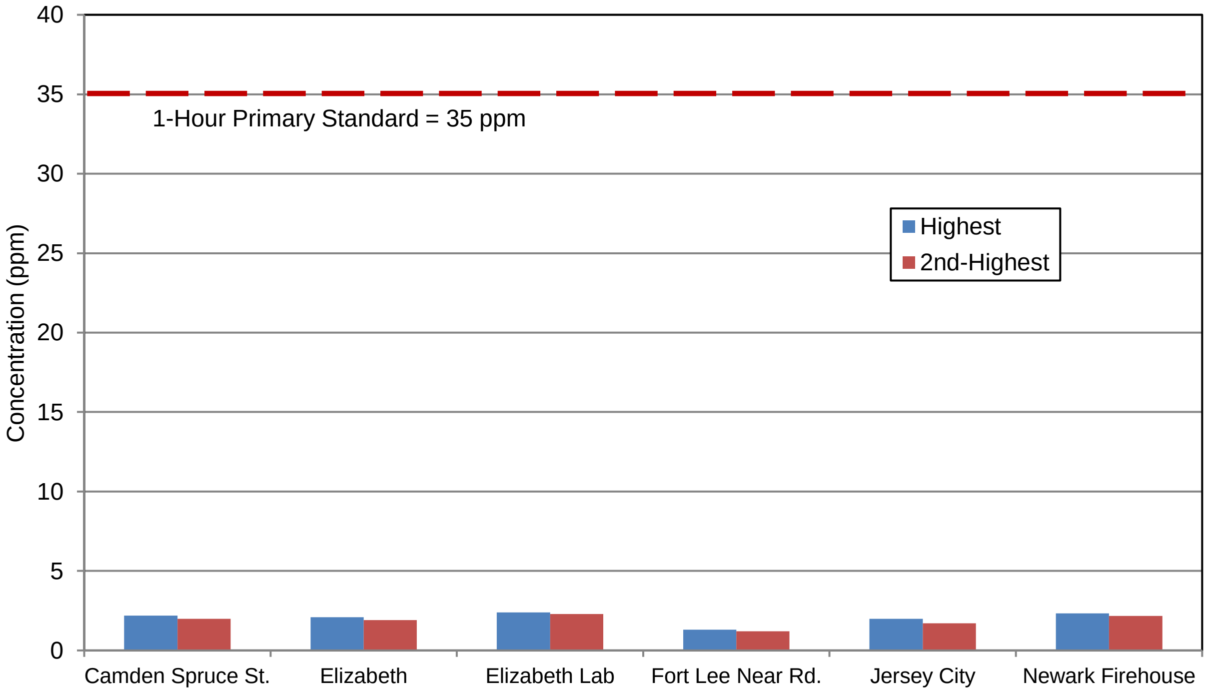
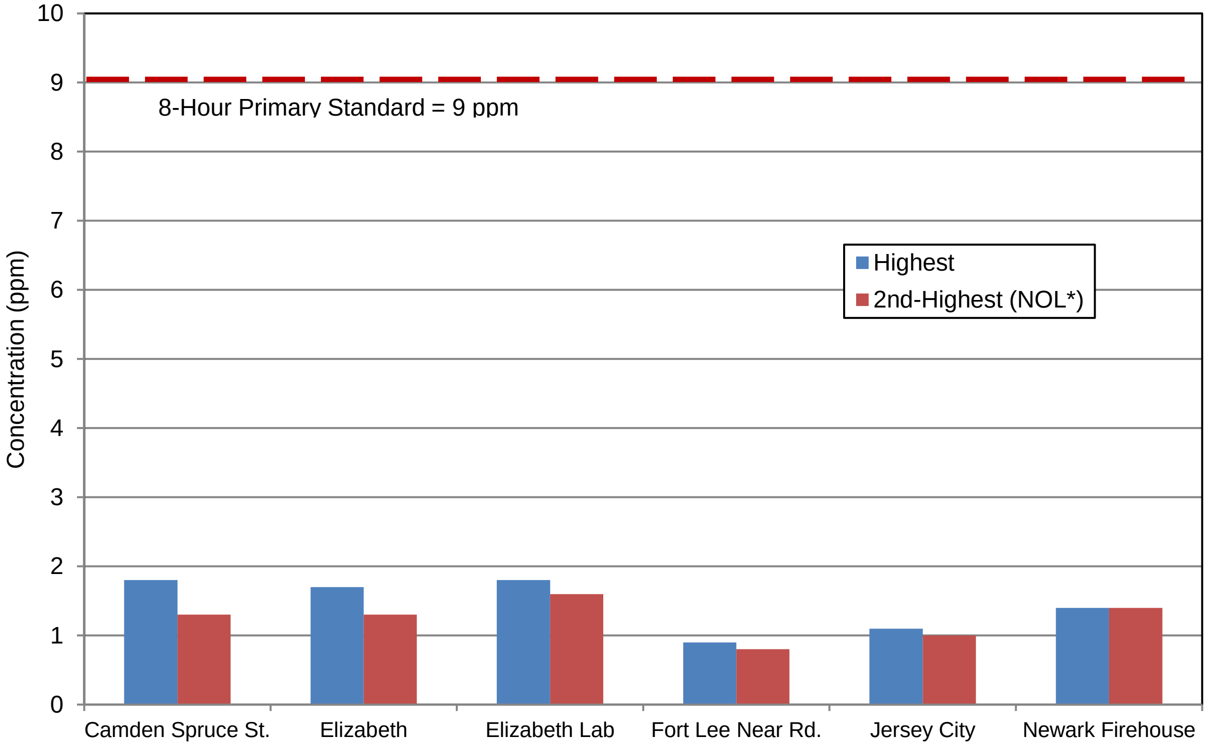


Figure 8-7
2017 Carbon Monoxide Concentrations in New Jersey
8-Hour Averages
Parts per Million (ppm)



*Non-overlapping 8-hour periods

CO TRENDS

Carbon monoxide levels in outdoor air have improved dramatically over the past two-and-a-half decades. Figures 8-8 and 8-9 present the trends in CO levels since 1990. The graphs actually show the second-highest 1-hour and 8-hour values recorded, because those are the design values that determine if the NAAQS are being met (one exceedance per site is allowed each year). The entire state was officially declared to have attained the CO standards as of August 23, 2002. Years ago, unhealthy levels of CO were recorded on a regular basis. The reduction in CO levels is due primarily to cleaner-running cars and other vehicles, which are by far the largest source of this pollutant outdoors. The last violation of the 8-hour NAAQS was in 1994.

Figure 8-8
Carbon Monoxide Design Value Trend in New Jersey, 1990-2017
Statewide 2nd-Highest 1-Hour Average Concentrations
Parts per Million (ppm)

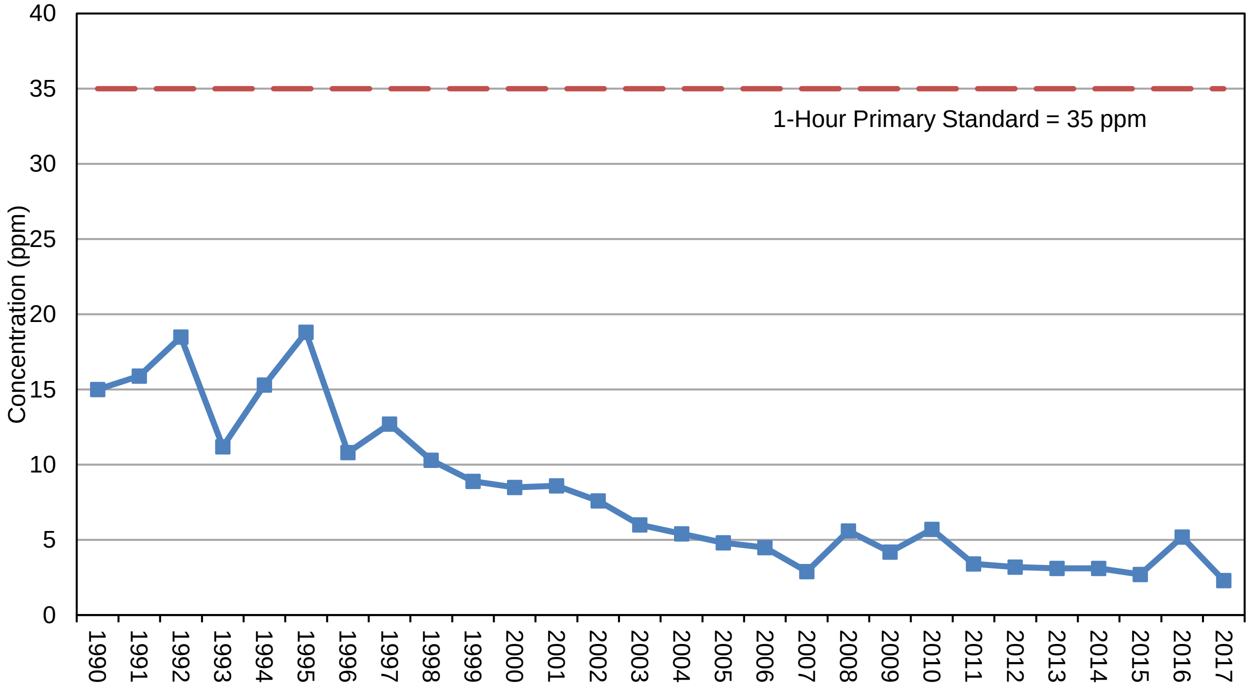
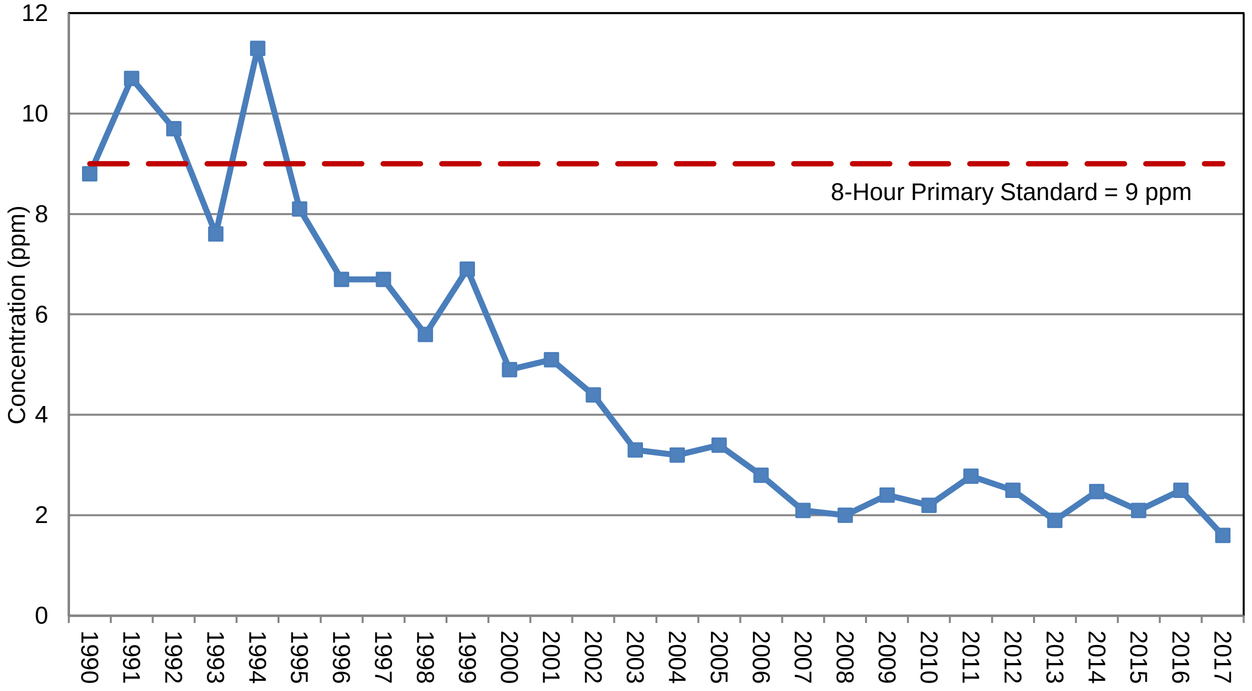


Figure 8-8
Carbon Monoxide Design Value Trend in New Jersey, 1990-2017
Statewide 2nd Highest 8-Hour Average Concentrations
Parts per Million (ppm)



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2017 Meteorology Summary

New Jersey Department of Environmental Protection

AIR POLLUTION AND METEOROLOGY

Meteorology plays an important role in the distribution of pollution throughout the troposphere, the layer of the atmosphere closest to the earth's surface. Atmospheric processes such as wind speed and wind direction affect the transport and dispersion of air pollution. Precipitation, solar radiation, and other weather phenomena influence chemical reactions and atmospheric transformations. By studying meteorological and air pollution data together, scientists and mathematicians have developed reasonably accurate models for predicting the fate of pollutants as they go through the stages of transport, dispersion, transformation, and removal. Air pollution models can assist in comparing predicted pollutant concentrations to National Ambient Air Quality Standards (NAAQS), in determining the impacts of new and existing air pollution sources, and in designing ambient air monitoring networks.

The New Jersey Department of Environmental Protection (NJDEP) Bureau of Air Monitoring collects meteorological data at a number of its air monitoring stations. This data can be used by planners in preparing State Implementation Plans (SIPs) to reduce pollutant emissions; by engineers to design or evaluate air pollution permit applications; and by scientists to site air monitoring stations.

CLIMATOLOGY IN NEW JERSEY

New Jersey is located about halfway between the Equator and the North Pole, on the eastern coast of the United States. Its geographic location results in the state being influenced by different air streams at different times (wet, dry, hot, cold), making for daily weather that is highly variable.

Although New Jersey is one of the smallest states in the Union, with a land area of 7,836 square miles, it has five distinct climate zones, which are classified as the Northern, Central, Pine Barrens, Southwest, and Coastal Zones. The topography of the different zones, their distance from the Atlantic Ocean, and the prevailing atmospheric flow patterns affecting them produce distinct variations in the daily weather. These climate zones are shown in Figure 9-1.

Figure 9-1

New Jersey Climate Zones

Source: Office of the New Jersey State Climatologist

MONITORING LOCATIONS

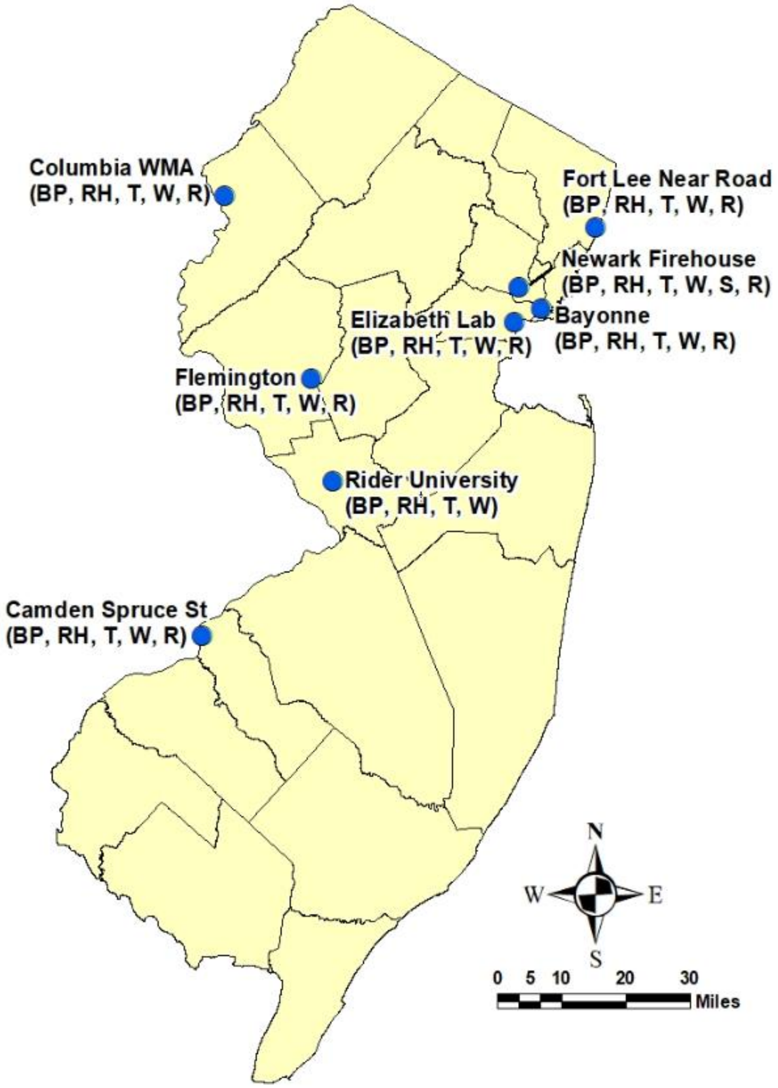
NJDEP collected meteorological data at eight stations in its monitoring network in 2017. Not all meteorological parameters were measured at each site. Table 9-1 lists the parameters monitored at each station, and Figure 9-2 is a map of the 2017 meteorological monitoring network. In Tables 9-2 through 9-6, the 2017 meteorological data is summarized for temperature, rain, relative humidity, solar radiation, and barometric pressure. Figure 9-3 presents the average temperature for each monitoring site compared with the statewide 30-year average. Figure 9-4 shows the monthly precipitation at each site, as well as the statewide 30-year average.

Figures 9-5 through 9-13 show annual wind roses for Bayonne, Camden Spruce Street, Columbia, Elizabeth Lab, Flemington, Fort Lee Near Road, Newark Firehouse, and Rider University, respectively. Presented in a circular format, a wind rose shows the frequency of winds blowing *from* a specific direction for a specified period. The length of each "spoke" around the circle is related to the frequency that the wind blows from a particular direction per unit time. Each concentric circle represents a different frequency, starting with zero at the center and increasing frequencies at the outer circles. Each spoke is broken down into color-coded bands that show wind speed ranges.

Table 9-1
2017 New Jersey Meteorological Monitoring Network
Parameter Summary

	Site Name	Temperature	Relative Humidity	Wind Speed	Wind Direction	Barometric Pressure	Solar Radiation	Rain
1	Bayonne	X	X	X	X	X		X
2	Camden Spruce Street	X	X	X	X	X		X
3	Columbia	X	X	X	X	X		X
4	Elizabeth Lab	X	X	X	X	X		X
5	Flemington	X	X	X	X	X		X
6	Fort Lee Near Road	X	X	X	X	X		X
7	Newark Firehouse	X	X	X	X	X	X	X
8	Rider University	X	X	X	X	X		

Figure 9-2
2017 Meteorological Monitoring Network



Legend

●	Meteorological Site
BP	Barometric Pressure
RH	Relative Humidity
S	Solar Radiation
T	Temperature
W	Wind Speed & Direction
R	Rain

Table 9-2
2017 Temperature Data (in Degrees Fahrenheit)
from NJ's Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	Mean	37	39	38	54	60	71	75	73	69	62	46	34	55
	Minimum	16	20	14	37	45	52	61	61	54	43	25	10	10
	Maximum	62	70	69	80	89	91	92	90	89	81	73	60	92
Camden Spruce St	Mean	37	43	41	59	62	74	78	74	70	63	47	35	57
	Minimum	16	23	16	39	44	53	64	61	54	43	24	11	11
	Maximum	65	73	73	86	92	96	95	91	91	82	74	62	96
Columbia	Mean	32	36	35	54	57	67	71	67	63	56	40	29	51
	Minimum	7	17	10	30	36	44	52	48	42	34	18	5	5
	Maximum	54	72	63	83	90	92	89	87	89	80	72	54	92
Elizabeth Lab	Mean	36	40	38	56	60	72	76	73	69	62	46	34	55
	Minimum	12	18	13	37	43	52	62	60	53	40	23	8	8
	Maximum	66	73	72	86	93	95	94	91	89	83	73	63	95
Flemington	Mean	34	38	36	54	58	69	73	69	65	58	41	31	52
	Minimum	4	17	13	29	34	44	53	50	43	32	20	7	4
	Maximum	63	72	70	83	91	94	92	89	90	82	73	61	94
Fort Lee Near Road	Mean	35	38	36	52	62	71	75	72	68	62	44	32	54
	Minimum	12	17	12	35	43	50	59	59	52	40	22	7	7
	Maximum	63	66	68	84	92	95	93	89	87	80	72	58	95
Newark Firehouse	Mean	36	39	37	55	60	71	75	72	68	61	45	33	54
	Minimum	13	18	13	36	43	51	60	60	52	41	23	9	9
	Maximum	65	70	70	83	92	93	92	89	90	82	73	61	93
Rider University	Mean	35	39	38	55	59	69	74	70	66	58	44	32	53
	Minimum	3	17	12	30	37	46	55	52	44	35	21	6	3
	Maximum	64	72	72	84	90	93	92	89	89	82	74	63	93

Figure 9-3
2017 Average Temperatures at NJDEP Air Monitoring Sites Compared to the Statewide 30-Year Average

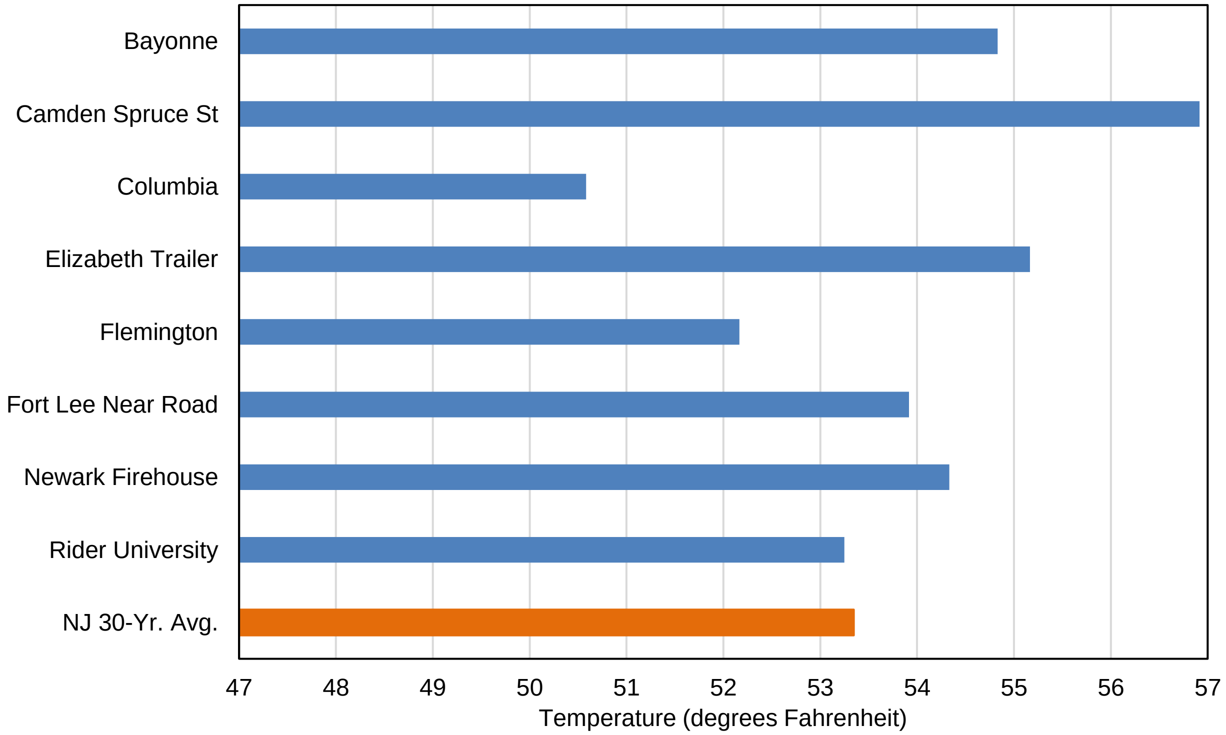
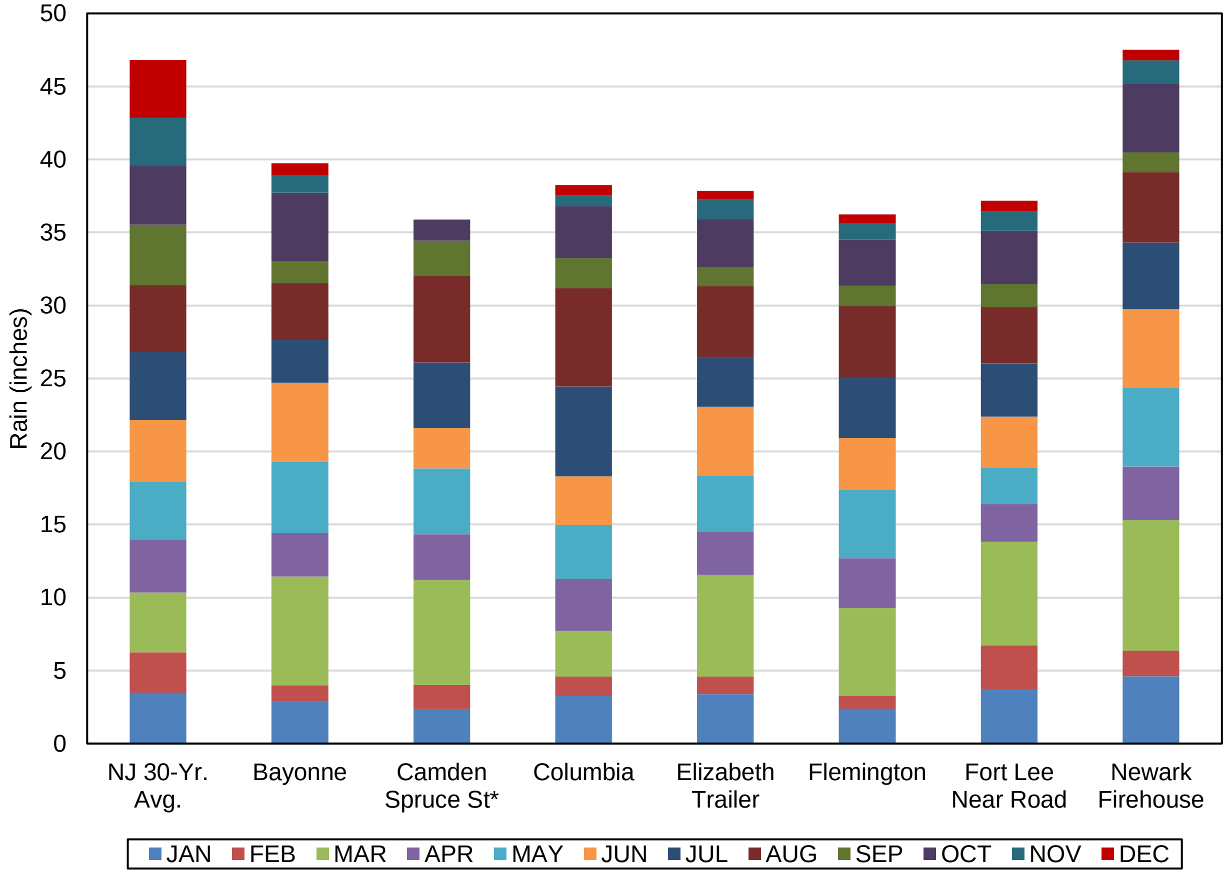


Table 9-3
2017 Rain Data (Inches) from NJ's Air Monitoring Sites

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Bayonne	2.88	1.10	7.45	2.98	4.88	5.43	2.93	3.89	1.49	4.69	1.18	0.84	39.74
Camden Spruce St.	2.37	1.64	7.21	3.11	4.52	2.76	4.48	5.94	2.40	1.46	ND	ND	*
Columbia	3.25	1.33	3.12	3.55	3.70	3.35	6.15	6.73	2.09	3.53	0.77	0.68	38.24
Elizabeth Lab	3.38	1.21	6.96	2.93	3.85	4.73	3.35	4.92	1.29	3.29	1.38	0.56	37.84
Flemington	2.39	0.88	5.99	3.43	4.69	3.53	4.18	4.86	1.40	3.15	1.09	0.64	36.23
Fort Lee Near Road	3.69	3.03	7.09	2.57	2.47	3.54	3.63	3.88	1.56	3.67	1.34	0.70	37.17
Newark Firehouse	4.61	1.74	8.95	3.68	5.36	5.44	4.53	4.82	1.36	4.72	1.59	0.71	47.51

ND = no data
*Not able to determine an annual statistic because of missing data.

Figure 9-4
2017 Total Rainfall at NJDEP Air Monitoring Sites Compared to the Statewide 30-Year Average



*Camden Spruce Street has no rain data for November and December.

Table 9-4
2017 Relative Humidity Data (%) from NJ’s Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	Mean	65	57	52	60	61	58	61	61	63	63	59	58	60
	Minimum	33	25	17	23	24	25	29	26	28	21	25	35	17
	Maximum	89	89	89	90	89	90	89	88	88	88	88	88	90
Camden Spruce St	Mean	59	50	49	54	58	54	61	59	60	62	56	53	56
	Minimum	26	22	15	16	20	22	27	27	24	23	21	24	15
	Maximum	89	90	89	89	90	88	90	90	90	90	90	88	90
Columbia	Mean	68	59	55	61	67	69	75	77	76	73	66	62	67
	Minimum	30	17	13	19	24	24	33	37	28	23	21	32	13
	Maximum	91	90	91	91	91	91	92	92	92	93	91	91	93
Elizabeth Lab	Mean	63	55	49	58	61	56	61	62	62	63	57	55	59
	Minimum	26	17	13	16	23	20	27	26	22	18	20	27	13
	Maximum	91	91	91	91	91	92	91	91	90	91	89	89	92
Flemington	Mean	68	59	54	61	67	65	71	73	73	71	66	62	66
	Minimum	30	19	13	17	26	23	30	35	30	19	24	29	13
	Maximum	91	92	91	92	92	93	93	93	93	92	92	92	93
Fort Lee Near Road	Mean	63	55	50	56	62	55	60	60	62	62	57	57	58
	Minimum	28	17	13	19	23	21	29	30	22	20	22	30	13
	Maximum	91	91	91	91	92	92	91	90	91	91	91	90	92
Newark Firehouse	Mean	63	54	49	58	61	57	61	61	62	61	57	54	58
	Minimum	28	17	13	16	25	21	28	28	22	18	21	27	13
	Maximum	91	91	91	91	92	92	91	91	89	91	89	88	92
Rider University	Mean	70	59	57	65	70	68	74	74	74	75	67	62	68
	Minimum	33	20	15	18	29	26	36	34	34	21	25	28	15
	Maximum	96	96	95	95	95	96	95	95	95	95	94	94	96

Table 9-5
2017 Solar Radiation Data (in Langleys) from NJ’s Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Newark Firehouse	Mean	0.08	0.15	0.21	0.25	0.29	0.36	0.34	0.31	0.25	0.17	0.12	0.08	0.22
	Maximum	0.74	0.97	1.19	1.29	1.37	1.43	1.43	1.39	1.28	1.05	0.76	0.64	1.43

Table 9-6
2017 Average Barometric Pressure Data (in inches of Hg) from NJ’s Air Monitoring Sites

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	29.94	29.91	30.09	29.99	29.87	29.9	29.93	30	29.99	30.07	30.09	30.04	29.99
Camden Spruce St	30.02	29.93	30.11	29.98	29.87	29.91	29.93	30	29.99	30.07	30.1	30.06	30.00
Columbia	29.46	29.4	29.57	29.48	29.37	29.41	29.45	29.52	29.51	29.57	29.57	29.52	29.49
Elizabeth Lab	29.97	29.91	30.08	29.97	29.86	29.89	29.92	29.99	29.98	30.06	30.07	30.03	29.98
Flemington	29.83	29.77	29.96	29.84	29.72	29.75	29.79	29.85	29.85	29.92	29.94	29.9	29.84
Fort Lee Near Road	29.65	29.59	29.76	29.68	29.58	29.59	29.63	29.69	29.68	29.75	29.76	29.71	29.67
Newark Firehouse	29.87	29.8	29.98	29.88	29.76	29.79	29.83	29.89	29.88	29.97	29.98	29.93	29.88
Rider University	29.88	29.82	29.97	29.88	29.76	29.8	29.83	29.9	29.89	29.97	30.01	29.95	29.89

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Wind Roses - Distribution of Wind Speed & Wind Direction

Figure 9-5. 2017 Wind Rose for Bayonne

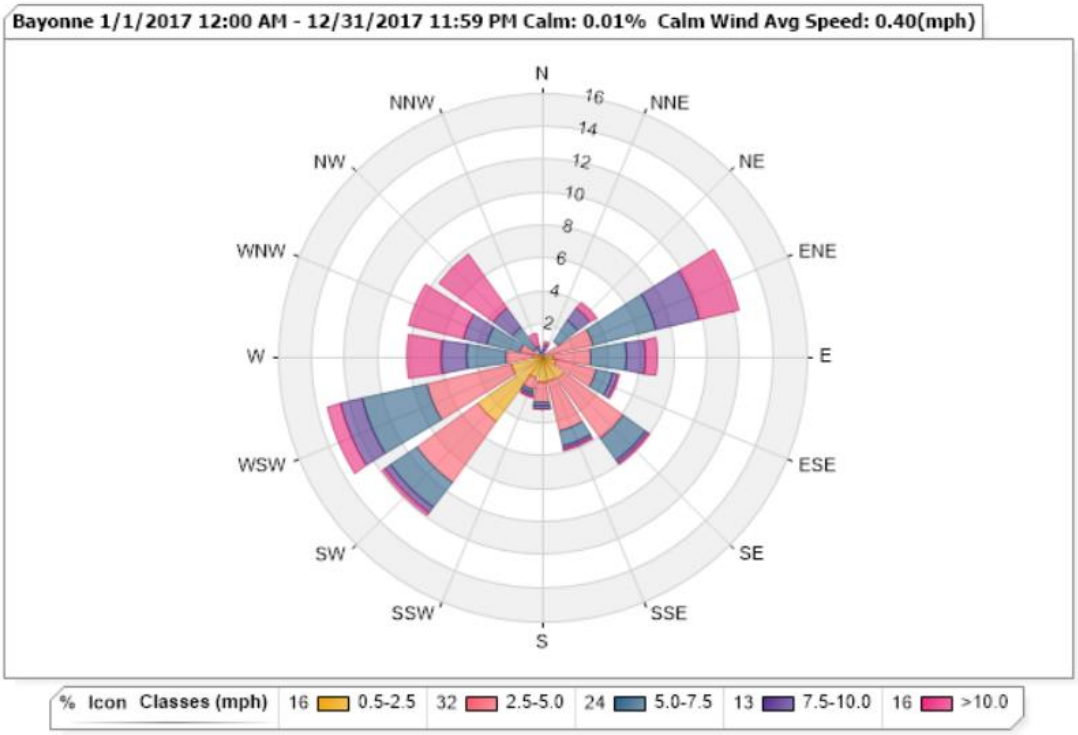


Figure 9-6. 2017 Wind Rose for Camden Spruce Street

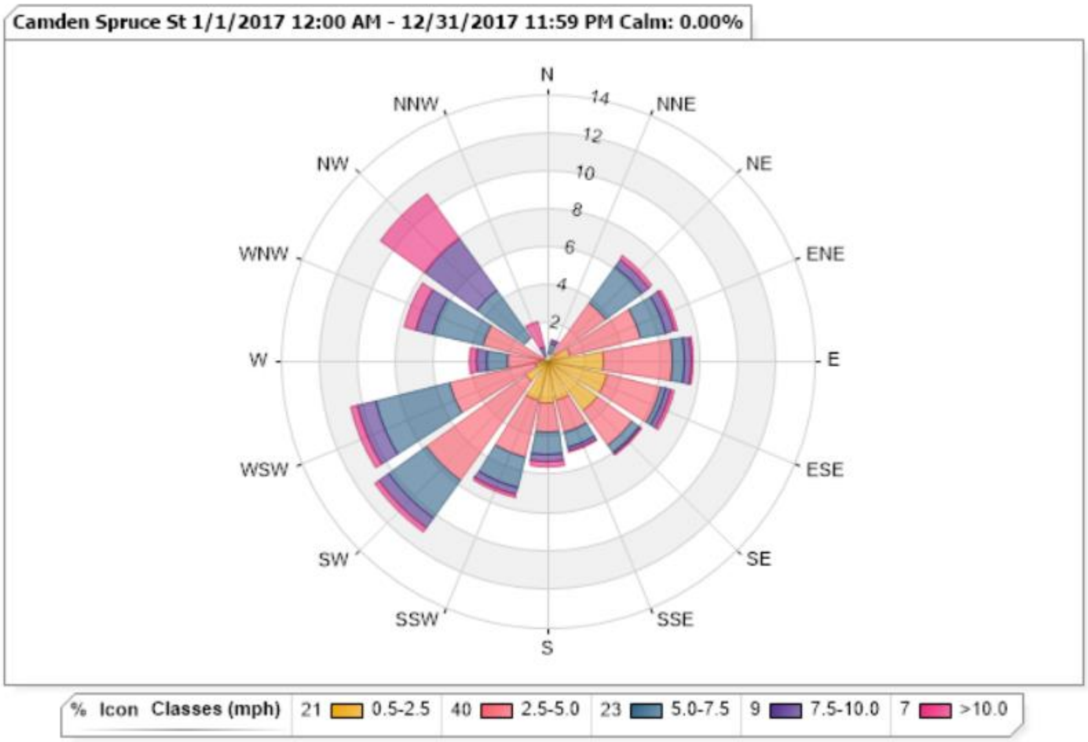


Figure 9-7. 2017 Wind Rose for Columbia

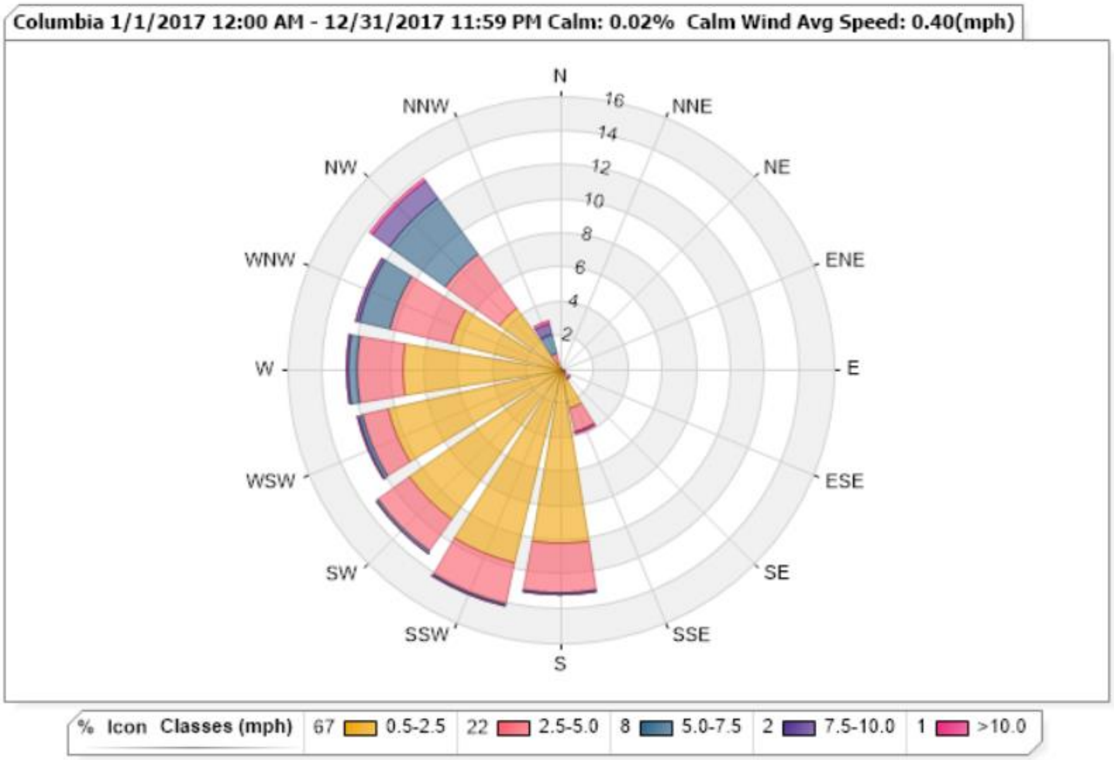


Figure 9-8. 2017 Wind Rose for Elizabeth Lab

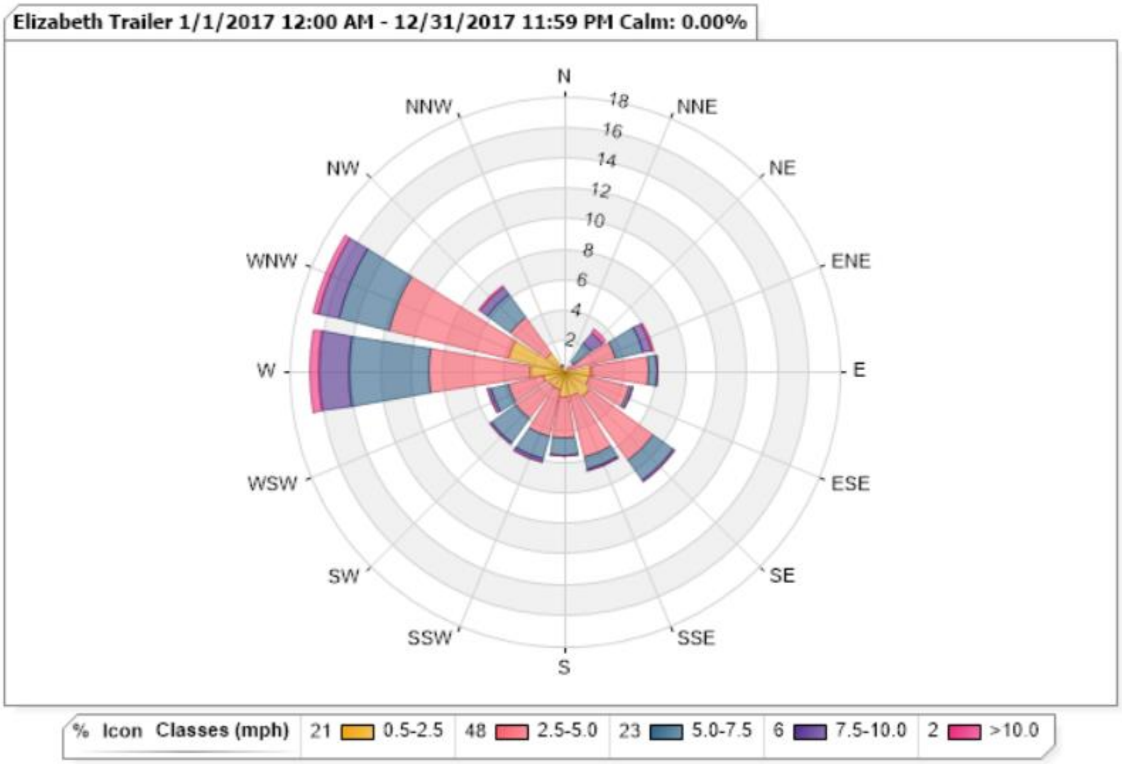


Figure 9-9. 2017 Wind Rose for Flemington

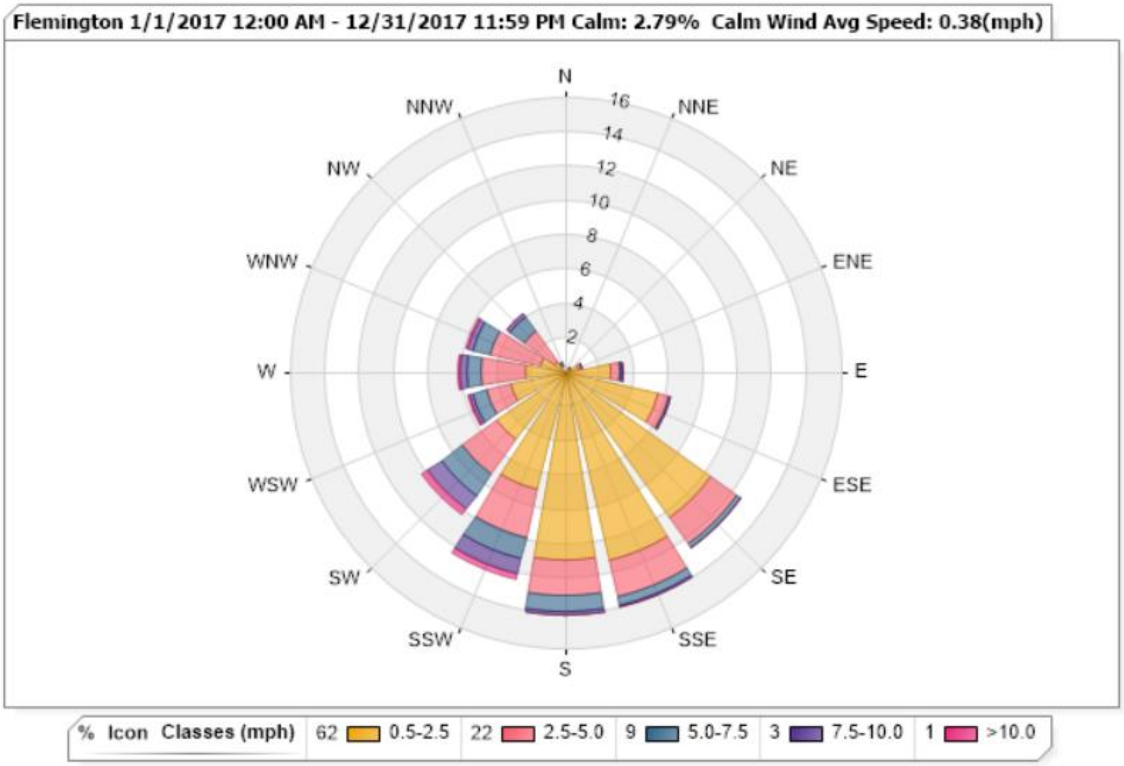


Figure 9-10. 2017 Wind Rose for Fort Lee Near Road

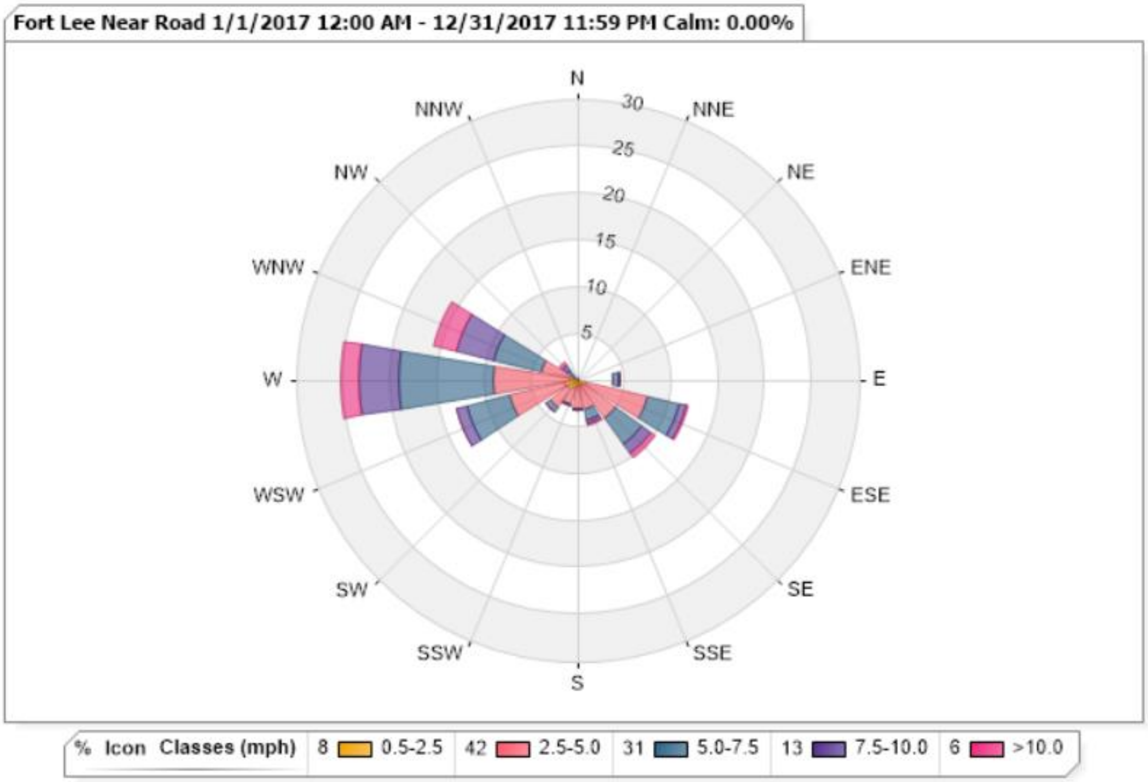


Figure 9-11. 2017 Wind Rose for Newark Firehouse

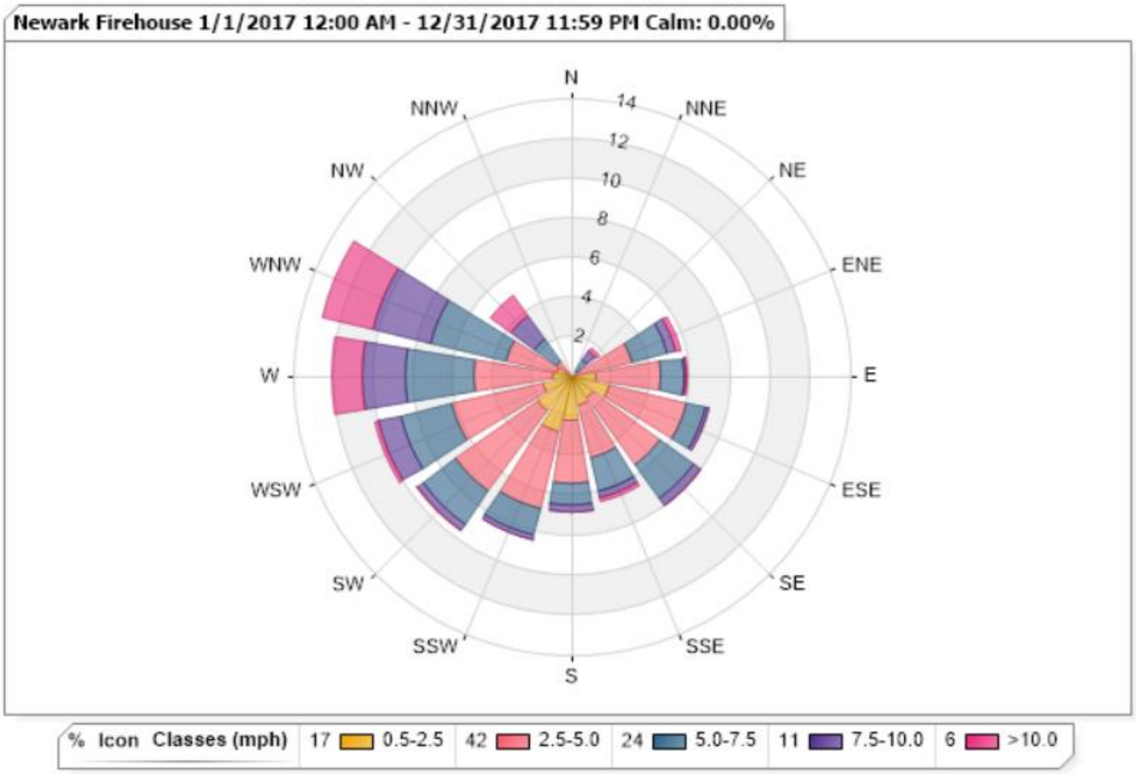
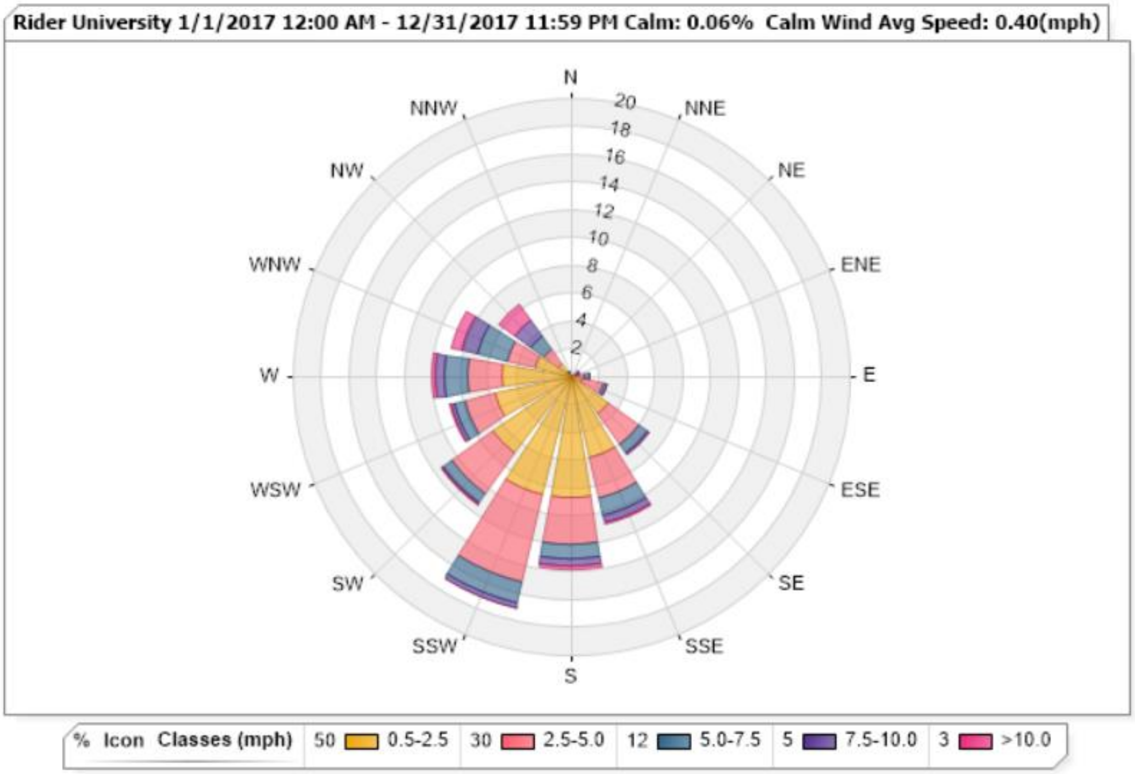


Figure 9-12. 2017 Wind Rose for Rider University



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2017 Air Toxics Summary

New Jersey Department of Environmental Protection

INTRODUCTION

Air pollutants can be generally divided into two categories: 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 since the 1970s. 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 New Jersey Department of Environmental Protection (NJDEP) 2016 Air Quality Report.

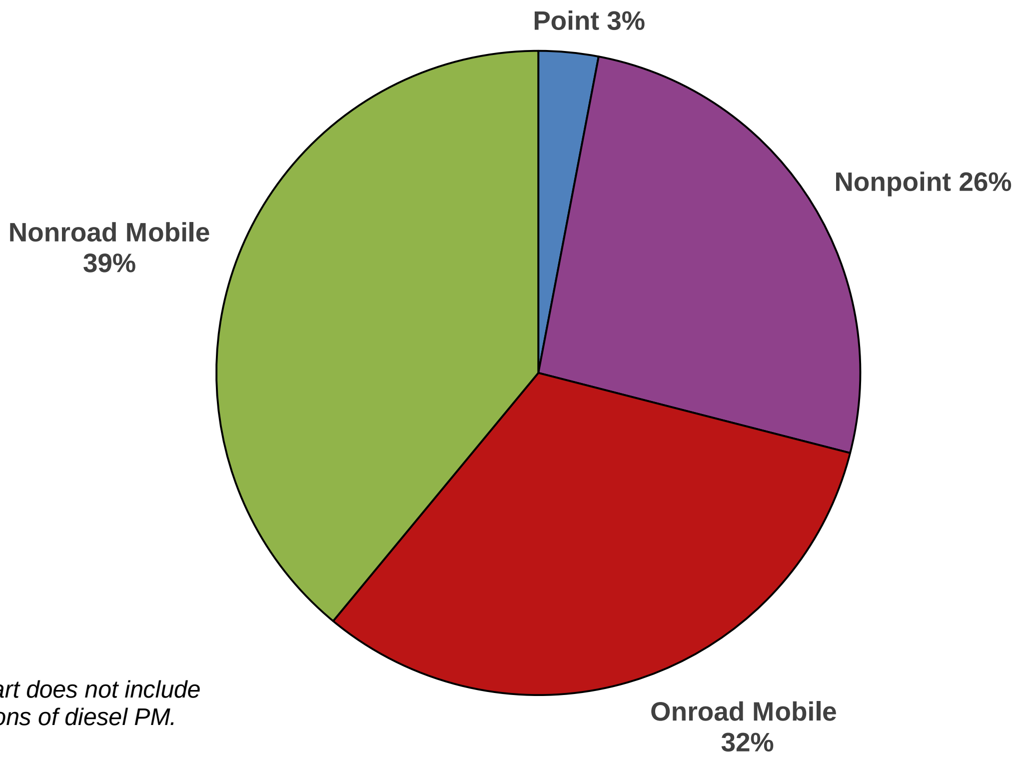
Air toxics are basically all the other chemicals released into the air that have the potential to cause adverse health effects in humans. These effects cover a wide range of conditions, from lung irritation to birth defects to cancer. There are no NAAQS for these pollutants, but in 1990 the U.S. Congress directed the USEPA to begin addressing a list of almost 200 air toxics by developing control technology standards for specific types 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.nj.gov/dep/airtoxics.

SOURCES OF AIR TOXICS

USEPA compiles a National Emissions Inventory (NEI) every three years. In addition to criteria pollutants and criteria precursors, it also collects information on emissions of hazardous air pollutants. This data is then used for the National-Scale Air Toxics Assessment (NATA), which combines emissions data and complex dispersion and exposure models to estimate the public's exposure to air toxics around the country. The pie chart in Figure 10-1, taken from the 2014 NEI, shows that mobile sources are the largest contributors of air toxics emissions in New Jersey. More information can be found at www.epa.gov/national-air-toxics-assessment.

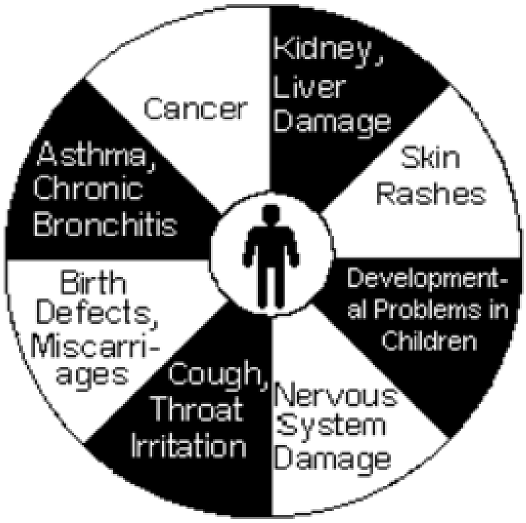
In New Jersey, on-road mobile sources (cars and trucks) account for 32% of the air toxics emissions, and non-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) contribute an additional 39%. Nonpoint sources (residential, commercial, and small industrial sources) represent 26% of the inventory, and point sources (such as factories and power plants) account for the remaining 3%.

Figure 10-1
2014 Air Toxics Emissions Source Estimates for New Jersey



Pie chart does not include emissions of diesel PM.

Figure 10-2
Potential Effects of Air Toxics



Source: www3.epa.gov/ttn/atw/3_90_024.html

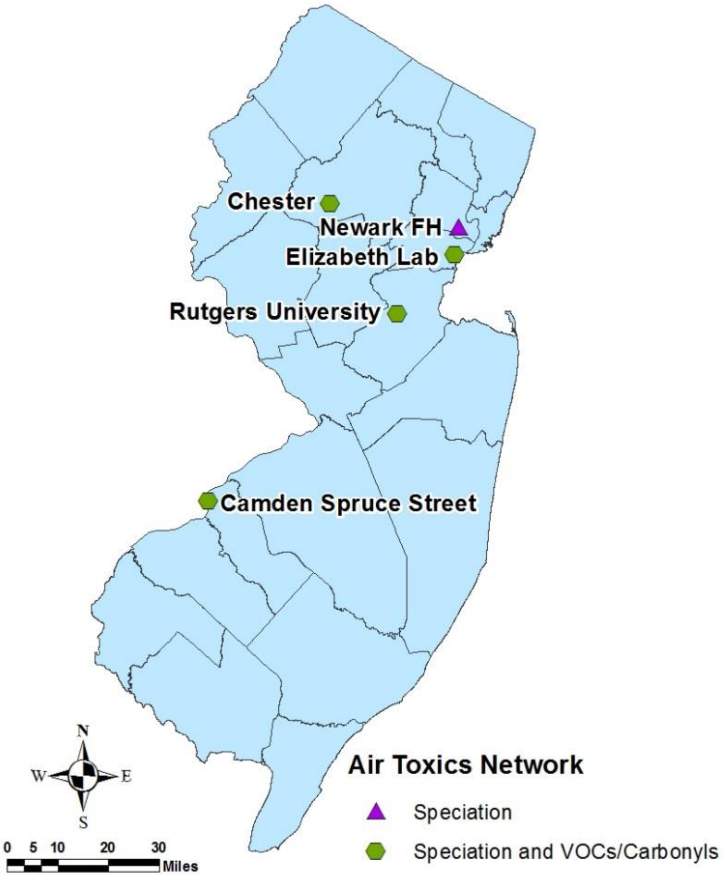
HEALTH EFFECTS

People exposed to significant amounts of air toxics may have an increased chance of developing cancer or experiencing other serious health effects. The noncancer health effects can range from respiratory, neurological, reproductive, developmental, or immune system damage, to irritation and effects on specific organs (see Figure 10-2). In addition to inhalation exposure, there can be risks from the deposition of toxic pollutants onto soil or surface water. There, they can be taken up by humans directly, or by consuming exposed plants and animals.

MONITORING LOCATIONS

In 2017 NJDEP had four air toxics monitoring sites that measure volatile organic compounds (VOCs) and carbonyls (a subset of VOCs that includes formaldehyde, acetaldehyde and other related compounds). As shown in Figure 10-3, the monitors are located at Camden Spruce Street, Chester, Elizabeth Lab, and at Rutgers University in East Brunswick. Toxic metals data are collected at the same four monitoring stations, plus Newark Firehouse.

Figure 10-3
2017 Air Toxics Monitoring Network



The Chester monitoring site is in rural Morris County, away from known sources, and serves as kind of a “background” monitor. The Rutgers University monitoring station is in a suburban setting on Rutgers agricultural lands in East Brunswick. The Elizabeth Lab monitoring station sits next to the Exit 13 tollbooths on the New Jersey Turnpike. The Camden Spruce Street monitoring station is located in an industrial urban setting. The Newark Firehouse monitoring station is in an urban residential area. More information about the air monitoring sites can be found in the Air Monitoring Network section and Appendix A of the annual Air Quality Report.

New Jersey's VOC monitors are part of the Urban Air Toxics Monitoring Program (UATMP), sponsored by the USEPA. A 24-hour integrated air sample is collected in a canister every six days, and then sent to the USEPA contract laboratory (ERG, located in North Carolina) to be analyzed for VOCs and carbonyls. A previous monitoring site in Camden (officially called the Camden Lab site) had been measuring toxic VOCs for the UATMP since 1989. It was shut down in 2008 when NJDEP lost access to the location. A new monitoring station, the Camden Spruce Street monitoring site, became operational in 2013. The Elizabeth Lab site began measuring VOCs in 2000, and the New Brunswick and Chester sites started in July 2001. In 2016 the New Brunswick VOC monitor was replaced by one at a new station at Rutgers University, less than a mile away.

Analysis of some toxic metals and other elements also began in 2001, at Camden, Chester, Elizabeth Lab and New Brunswick, as part of USEPA's Chemical Speciation Network (CSN). The Newark Firehouse site was added in 2010, and the New Brunswick CSN monitor was moved to Rutgers University in 2016. The CSN was established to characterize the metals, ions and carbon constituents of $PM_{2.5}$. Filters are collected every three or six days and sent to a national lab for analysis.

NEW JERSEY AIR TOXICS MONITORING RESULTS FOR 2017

2017 annual average concentrations of VOCs and carbonyls for the four New Jersey monitoring sites are shown in Table 10-1. All values are in micrograms per cubic meter ($\mu g/m^3$). More detail can be found in Tables 10-5 through 10-8, including additional statistics, detection limit information, health benchmarks used by NJDEP, risk ratios, and concentrations in parts per billion by volume (ppbv). The ppbv units are more common in air monitoring, while $\mu g/m^3$ units are generally used in air dispersion modeling and health studies.

A number of compounds that were analyzed were mostly below the detection limit of the method used (see Table 10-9). However, this does not mean they are not present in the air below the detection limit level. For chemicals with less than 50% of the samples above the detection limit, there is significant uncertainty in the calculated averages. Median values (the value of the middle sample value when the results are ranked) are reported in Tables 10-5 through 10-8 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 concentrations, but would have less effect on the median value. In such cases, the median value may be a better indicator of long-term exposure concentrations.

For acrolein, USEPA has determined that the methods used to collect and analyze it in ambient air are not producing reliable results. More information is available at http://archive.epa.gov/schoolair/web/html/acrolein.html. Although we are including the 2017 New Jersey acrolein data in this report, the concentrations are highly uncertain.

Table 10-2 presents the annual average concentrations of toxic metals and elements, along with their health benchmarks (see the "Estimating Health Risk" section below for an explanation). No risk ratios were calculated, because most of the chemicals were below the detection limit and the resulting average concentrations are highly uncertain. Additional data from the CSN monitors can be found in Appendix B (Fine Particulate Speciation Summary) of the annual Air Quality Report.

Table 10-1
2017 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey

Annual Average Concentrations
Micrograms per Cubic Meter (μg/m³)

	Pollutant	Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acetaldehyde		*	75-07-0	2.145	1.100	*2.471*	1.045
2	Acetone			67-64-1	2.694	1.820	*2.430*	2.199
3	Acetonitrile		*	75-05-8	3.837	1.181	*0.565*	0.384
4	Acetylene			74-86-2	0.758	0.436	*0.988*	0.612
5	Acrolein[a]		*	107-02-8	0.810	0.862	*0.976*	0.893
6	Acrylonitrile		*	107-13-1	ND	*0.001*	ND	ND
7	tert-Amyl Methyl Ether			994-05-8	*0.002*	*0.002*	*0.003*	*0.003*
8	Benzaldehyde			100-52-7	0.281	0.071	*0.124*	0.080
9	Benzene		*	71-43-2	0.700	0.378	*0.811*	0.498
10	Bromochloromethane			74-97-5	*0.029*	*0.032*	*0.025*	*0.025*
11	Bromodichloromethane			75-27-4	*0.008*	*0.005*	*0.009*	*0.007*
12	Bromoform		*	75-25-2	*0.013*	*0.005*	*0.014*	*0.013*
13	Bromomethane	Methyl bromide	*	74-83-9	0.691	0.052	*0.055*	0.050
14	1,3-Butadiene		*	106-99-0	0.073	0.022	*0.112*	0.046
15	Butyraldehyde			123-72-8	0.353	0.168	*0.312*	0.166
16	Carbon Disulfide		*	75-15-0	0.062	0.036	*0.047*	ND
17	Carbon Tetrachloride		*	56-23-5	0.577	0.570	*0.571*	0.559
18	Chlorobenzene		*	108-90-7	*0.012*	*0.010*	*0.016*	*0.010*
19	Chloroethane	Ethyl chloride	*	75-00-3	*0.027*	*0.026*	*0.027*	*0.051*
20	Chloroform		*	67-66-3	0.148	0.125	*0.168*	0.151
21	Chloromethane	Methyl chloride	*	74-87-3	1.127	1.130	*1.132*	1.127
22	Chloroprene	2-Chloro-1,3-butadiene	*	126-99-8	*0.002*	*0.001*	*0.002*	*0.002*
23	Crotonaldehyde			123-73-9	0.325	0.247	*0.280*	0.209
24	Dibromochloromethane	Chlorodibromomethane		124-48-1	*0.025*	*0.021*	*0.030*	*0.023*
25	1,2-Dibromoethane	Ethylene dibromide	*	106-93-4	*0.005*	*0.005*	*0.007*	*0.008*
26	m-Dichlorobenzene	1,3-Dichlorobenzene		541-73-1	*0.003*	*0.001*	*0.005*	*0.004*
27	o-Dichlorobenzene	1,2-Dichlorobenzene		95-50-1	*0.005*	*0.002*	*0.006*	*0.004*
28	p-Dichlorobenzene	1,4-Dichlorobenzene	*	106-46-7	0.042	*0.007*	*0.042*	*0.018*
29	Dichlorodifluoromethane			75-71-8	2.598	2.482	*2.460*	2.459
30	1,1-Dichloroethane	Ethylidene dichloride	*	75-34-3	*0.004*	*0.005*	*0.009*	*0.005*
31	1,2-Dichloroethane	Ethylene dichloride	*	107-06-2	0.080	0.064	*0.080*	0.072
32	1,1-Dichloroethylene	Vinylidene chloride	*	75-35-4	*0.004*	*0.004*	*0.006*	*0.004*
33	cis-1,2-Dichloroethylene	cis-1,2-Dichloroethene		156-59-2	ND	ND	ND	ND
34	trans-1,2-Dichloroethylene	trans-1,2-Dichloroethene		156-60-5	0.010	0.002	0.008	0.005
35	Dichloromethane	Methylene chloride	*	75-09-2	0.419	0.338	0.537	0.430
36	1,2-Dichloropropane	Propylene dichloride	*	78-87-5	0.003	0.004	0.003	0.002

- *Values in **italics** indicate averages based on less than 50% of samples above the detection limit.*
- **ND** indicates that all samples were below the detection limit.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

[a] Acrolein concentrations are highly uncertain because of problems with collection and analysis methods.

Table 10-1 (continued)
2017 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey

Annual Average Concentrations
Micrograms per Cubic Meter (μg/m³)

Pollutant		Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	Rutgers
37	cis-1,3-Dichloropropene	cis-1,3-Dichloropropylene	*	542-75-6	*0.002*	*0.002*	*0.003*	*0.002*
38	trans-1,3-Dichloropropene	trans-1,3-Dichloropropylene	*	542-75-6	ND	ND	ND	*0.001*
39	Dichlorotetrafluoroethane	Freon 114		76-14-2	0.136	0.136	*0.138*	0.134
40	2,5-Dimethylbenzaldehyde			5799-94-2	ND	ND	ND	ND
41	Ethyl Acrylate		*	140-88-5	ND	ND	*0.0004*	ND
42	Ethyl tert-Butyl Ether	tert-Butyl ethyl ether		637-92-3	*0.010*	*0.012*	*0.076*	0.065
43	Ethylbenzene		*	100-41-4	0.556	0.313	*0.561*	0.442
44	Formaldehyde		*	50-00-0	3.909	1.901	*3.821*	1.803
45	Hexachloro-1,3-butadiene	Hexachlorobutadiene	*	87-68-3	*0.022*	*0.014*	*0.029*	*0.021*
46	Hexaldehyde	Hexanaldehyde		66-25-1	0.189	0.055	*0.136*	0.081
47	Isovaleraldehyde			590-86-3	ND	ND	ND	ND
48	Methyl Ethyl Ketone	MEK		78-93-3	0.502	0.304	*0.462*	0.364
49	Methyl Isobutyl Ketone	MIBK	*	108-10-1	0.196	0.102	*0.188*	0.124
50	Methyl Methacrylate		*	80-62-6	*0.024*	*0.006*	*0.041*	*0.014*
51	Methyl tert-Butyl Ether	MTBE	*	1634-04-4	*0.011*	*0.005*	*0.025*	*0.019*
52	n-Octane			111-65-9	0.281	0.092	*0.367*	0.132
53	Propionaldehyde		*	123-38-6	0.395	0.237	*0.407*	0.219
54	Propylene			115-07-1	0.815	0.349	*2.968*	0.531
55	Styrene		*	100-42-5	1.070	0.073	*0.143*	0.126
56	1,1,2,2-Tetrachloroethane		*	79-34-5	*0.004*	*0.004*	*0.010*	*0.007*
57	Tetrachloroethylene	Perchloroethylene	*	127-18-4	0.144	0.071	*0.179*	0.103
58	Tolualdehydes				0.158	0.090	*0.126*	0.115
59	Toluene		*	108-88-3	2.766	0.604	*1.843*	0.916
60	1,2,4-Trichlorobenzene		*	102-82-1	*0.005*	*0.004*	*0.006*	*0.008*
61	1,1,1-Trichloroethane	Methyl chloroform	*	71-55-6	0.026	*0.016*	*0.028*	0.022
62	1,1,2-Trichloroethane		*	79-00-5	*0.002*	ND	*0.004*	*0.002*
63	Trichloroethylene		*	79-01-6	*0.058*	*0.009*	*0.024*	*0.011*
64	Trichlorofluoromethane			75-69-4	2.163	1.324	*1.332*	1.319
65	Trichlorotrifluoroethane	1,1,2-Trichloro-1,2,2-trifluoroethane		76-13-1	0.605	0.600	*0.604*	*0.013*
66	1,2,4-Trimethylbenzene			95-63-6	0.482	0.110	*0.385*	0.175
67	1,3,5-Trimethylbenzene			108-67-8	0.161	0.044	*0.131*	0.067
68	Valeraldehyde			110-62-3	0.133	0.057	*0.115*	0.053
69	Vinyl chloride		*	75-01-4	*0.011*	*0.006*	*0.008*	*0.006*
70	m,p-Xylene		*	1330-20-7	0.954	0.181	*0.914*	0.432
71	o-Xylene		*	95-47-6	0.627	0.320	*0.612*	0.421

- *Values in **italics** indicate averages based on less than 50% of samples above the detection limit.*
- **ND** indicates that all samples were below the detection limit.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

Table 10-2
2017 Summary of Toxic Metals and Elements Monitored in New Jersey

Annual Average Concentrations[a]
Micrograms per Cubic Meter ($\mu g/m^3$)

Pollutant	HAP[b]	Camden	Chester	Elizabeth	Newark	Rutgers	Health Benchmark ($\mu g/m^3$)[c]
Antimony	*	0.032	0.006	0.002	0.003	0.0002	
Arsenic	*	0.0004	0.0002	0.0001	0.0004	0.0002	*0.00023*
Cadmium	*	0.001	0.002	0.0001	0.001	0	*0.00024*
Chlorine	*	0.297	0.001	0.008	0.014	0.005	0.2
Chromium[d]	*	0.003	0.003	0.004	0.005	0.005	*0.000083*
Cobalt	*	0.00001	0.0001	0	0	0	*0.00011*
Lead	*	0.004	0.002	0.002	0.001	0.002	*0.083*
Manganese	*	0.002	0.0003	0.002	0.001	0.001	0.05
Nickel[e]	*	0.002	0.001	0.001	0.002	0.002	*0.0021*
Phosphorus	*	0.0004	0.0003	0.001	0.001	0.0003	0.07
Selenium	*	0.0003	0.001	0.001	0.0002	0.001	20
Silicon		0.058	0.030	0.087	0.077	0.043	3
Vanadium		0.0004	0.0004	0.0002	0.0002	0.0003	0.1

[a] Most samples were below detection limits, so the annual averages are highly uncertain.

[b] HAP = Hazardous air pollutant listed in the Clean Air Act.

[c] Health benchmarks in italics have a cancer endpoint. See section below on "Estimating Health Risk" for more information.

[d] Chromium's health benchmark is based on carcinogenicity of hexavalent chromium (Cr+6). It is not known how much of the chromium measured by the monitor is hexavalent.

[e] Nickel's health benchmark is based on specific nickel compounds. It is not known how much of the nickel measured by the monitor is in that form.

ESTIMATING HEALTH RISK

The effects on human health resulting from exposure to specific air toxics can be estimated by using chemical-specific **health benchmarks**. These are based on toxicity values developed by the USEPA and other agencies, using chemical-specific animal or human health studies. For carcinogens, chemicals suspected of causing cancer, the health benchmark is 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 a noncarcinogen is the air concentration at which no adverse health effect is expected to occur, even if a person is exposed to that concentration on a daily basis for a lifetime (this is also known as a reference concentration). Not all air toxics have health benchmarks, because of a lack of toxicity studies. Available health benchmarks for the VOCs and carbonyls monitored in New Jersey are listed in Tables 10-5 through 10-8.

If ambient air concentrations exceed health benchmarks, regulatory agencies can focus their efforts on reducing emissions or exposure to those chemicals. Dividing the air concentration of a chemical by its health benchmark gives us a number referred to as a **risk ratio**. If the risk ratio is less than one, the air concentration should not pose a health risk. If it is greater than one, it may be of concern. The risk ratio also indicates how much higher or lower the estimated air concentration is compared to the health benchmark.

The pollutants with risk ratios greater than one for at least one monitoring site are summarized in Table 10-3. Table 10-4 shows the different types of sources that contribute to the levels of those pollutants in the air. Formaldehyde showed the highest risk at all four monitoring sites. Risk ratios for formaldehyde at Camden and Elizabeth were double those at Chester and Rutgers.

Other pollutants above health benchmarks at all four sites were acetaldehyde, benzene, carbon tetrachloride, chloroform, chloromethane (methyl chloride), and 1,2-dichloroethane (ethylene dichloride). 1,2-Dibromoethane had a risk ratio above one at all sites as well, but most of the samples were below the detection limit. 1,3-Butadiene and ethylbenzene were above the health benchmark at all sites except Chester. Tetrachloroethylene was barely over the health benchmark at Elizabeth. To summarize, the Elizabeth Lab site had eleven pollutants with annual average concentrations that exceeded their health benchmarks, Camden and Rutgers had ten, and Chester had eight.

Although the mean concentrations of **acrolein** exceeded the health benchmark at all sites (see Tables 10-5 through 10-8), risk ratios were not calculated because of problems with the sampling and analysis method, as previously mentioned. 50% of ambient acrolein in New Jersey is attributed to mobile sources, 27% to nonpoint sources, 21% to secondary formation, and 2% to point sources.

Table 10-3
Monitored Toxic Air Pollutants with Risk Ratios Greater Than One in NJ for 2017

Pollutant		CAS No.	Risk Ratio			
			Camden	Chester	Elizabeth	Rutgers
1	Acetaldehyde	75-07-0	5	2	5	2
2	Benzene	71-43-2	5	3	6	4
3	1,3-Butadiene	106-99-0	2		3	1.4
4	Carbon Tetrachloride	56-23-5	9	9	9	8
5	Chloroform	67-66-3	3	3	4	4
6	Chloromethane	74-87-3	2	2	2	2
7	*1,2-Dibromoethane*	106-93-4	3	3	4	5
8	1,2-Dichloroethane	107-06-2	2	1.7	2	1.9
9	Ethylbenzene	100-41-4	1.4		1.4	1.1
10	Formaldehyde	50-00-0	51	25	50	23
11	Tetrachloroethylene	127-18-4			1.1	

NOTE: Values in italics are based on less than 50% of samples above the detection limit.

Table 10-4
Sources of Air Toxics with Risk Ratios >1 in NJ

Pollutant	% Contribution from						
	Point Sources	Nonpoint Sources	On-Road Mobile Sources	Nonroad Mobile Sources	Back-ground[a]	Secondary Formation[b]	Bio-genics[c]
Acetaldehyde	0.1%	5%	7%	2%	0%	74%	11%
Benzene	1.5%	29%	50%	20%	0%	0%	0%
1,3-Butadiene	0.1%	21%	59%	19%	0%	0%	0%
Carbon Tetrachloride	0.002%	0.01%	0%	0%	100%	0%	0%
Chloroform	69%	31%	0%	0%	0%	0%	0%
Chloromethane	27%	73%	0%	0%	0%	0%	0%
1,2-Dibromoethane	100%	0.02%	0%	0%	0%	0%	0%
1,2-Dichloroethane	7%	93%	0%	0%	0%	0%	0%
Ethylbenzene	1.6%	8%	66%	24%	0%	0%	0%
Formaldehyde	0.8%	7%	6%	4%	0%	73%	9%
Tetrachloroethylene	6%	94%	0%	0%	0%	0%	0%

[a] Background concentrations are levels of pollutants that would be found in in the air in a given year even if there had been no recent human-caused emissions, because of persistence in the environment of past years' emissions and long-range transport from distant sources.

[b] Secondary formation occurs when some volatile organic compounds (VOCs) react chemically in the air with other emitted compounds (usually oxides of nitrogen).

[c] Biogenic emissions are those directly emitted from trees, plants and soil microbes (excludes secondary formation).

TRENDS AND COMPARISONS

Monitoring of air toxics in New Jersey has been going on since a UATMP site was established in Camden in 1989. Sampling and analysis methods continue to evolve, most notably with improvements in the ability to detect chemicals at lower concentrations. Figures 10-4 through 10-15 present data for some of the VOCs that have been sampled over the past decade. As mentioned previously, the first toxics monitoring site in Camden (Camden Lab) was shut down in 2008. It is identified in Figures 10-4 through 10-15 as "Camden 1." The new Camden site (Camden Spruce Street), located about two miles from the old site, is designated "Camden 2" in the trend graphs. The New Brunswick monitoring station was shut down in 2016, and most of the monitors were moved less than a mile to the Rutgers University site.

According to USEPA's National Air Toxics Assessment (NATA), **acetaldehyde** concentrations in New Jersey (Figure 10-4) are primarily influenced by secondary formation, a process in which chemicals in the air react with each other and are transformed into other chemicals. Mobile sources also contribute to ambient levels. In 2003, no data was collected in Camden after September, which could have had an influence on the low annual average for that year. In 2004, high levels of acetaldehyde were measured over a number of weeks at both Camden and New Brunswick.

Figures 10-5 and 10-6 show a general decrease in **benzene** and **1,3-butadiene** concentrations over the past decade. Over 50% of New Jersey's ambient benzene and 1,3-butadiene comes from on-road mobile sources, and about 20% comes from non-road mobile sources.

Carbon tetrachloride (Figure 10-7) was once used widely as a degreaser, household cleaner, propellant, refrigerant, and fumigant. It has been phased out of most production and use because of its toxicity and its ability to deplete stratospheric ozone. However, about 100 tons are still emitted annually by industry in the U.S., although no emissions have been reported in New Jersey for years. It degrades slowly in the environment, so it can be transported from other areas, and levels in the air can remain relatively steady for a long time.

Some of the increase in **chloroform** concentrations shown in Figure 10-8 is believed to be from improvements in the detection limit. The high annual average concentration for New Brunswick in 2014 is attributable to a period of high values in May and June. Point and nonpoint sources (related to waste disposal) are the major contributors to ambient chloroform levels in New Jersey. Chloroform can be formed in small amounts by chlorination of water. It breaks down slowly in ambient air.

As seen in Figure 10-9, **chloromethane** (also known as methyl chloride) levels have remained relatively stable from year to year, and all the sites show similar levels. It was once commonly used as a refrigerant and in the chemical industry, but was phased out because of its toxicity. According to the USEPA's 2014 National Emissions Inventory, about 73% of the chloromethane in New Jersey's air is from nonpoint sources, primarily waste disposal, while 27% is from point sources.

1,2-Dibromoethane (or ethylene dibromide) (Figure 10-10) is currently used as a pesticide in the treatment of felled logs for bark beetles and termites, and control of wax moths in beehives. It was once used as an additive to leaded gasoline and as a soil and grain fumigant, but those uses have been banned by USEPA. Most of the monitoring results fall below the detection limit, so the data in the graph is fairly uncertain.

1,2-Dichloroethane (also called ethylene dichloride) (Figure 10-11) is primarily used in the production of chemicals, as a solvent, dispersant and wetting and penetrating agent. The increase in concentrations after 2011 is related to an improvement in the detection limit, resulting in over 90% of samples having detectable levels of 1,2-dichloroethane. The most recent National Emissions Inventory estimates that 93% of 1,2-dichloroethane in New Jersey's air is from point sources, and 7% from nonpoint sources.

About 90% of **ethylbenzene** is emitted from mobile sources. Improvements in mobile source emissions controls have contributed to the downward trend in air concentrations. 2001 data for Chester and New Brunswick have been omitted from the graph because of technical problems encountered when sampling began that year (Figure 10-12).

Formaldehyde (Figure 10-13) is a ubiquitous pollutant that is often found at higher concentrations indoors rather than outdoors because of its use in many consumer goods. It is used in the production of fertilizer, paper, plywood, urea-formaldehyde resins, and many other products. In New Jersey the primary emitters of formaldehyde are mobile sources, although secondary formation contributes the most to high outdoor levels. In 2014, concentrations at the New Brunswick site were consistently higher than at the other monitors, although they dropped in 2015.

The annual average **styrene** concentration at the Camden Spruce Street monitor dropped below the health benchmark in 2017, although levels are still higher than at the other New Jersey monitors (see Figure 10-14). NJDEP has not been able to find the source of the styrene in Camden. Styrene used in the production of polystyrene plastics and resins, but a significant amount also comes from vehicles.

Tetrachloroethylene (commonly known as perchloroethylene) (Figure 10-15) is widely used as an industrial solvent and in dry cleaning. It is a common contaminant of hazardous waste sites because of a tendency to dispose of it improperly. In recent years, production and demand for it by industry and dry cleaners has been declining.

Figure 10-4
ACETALDEHYDE – New Jersey Monitored Concentrations

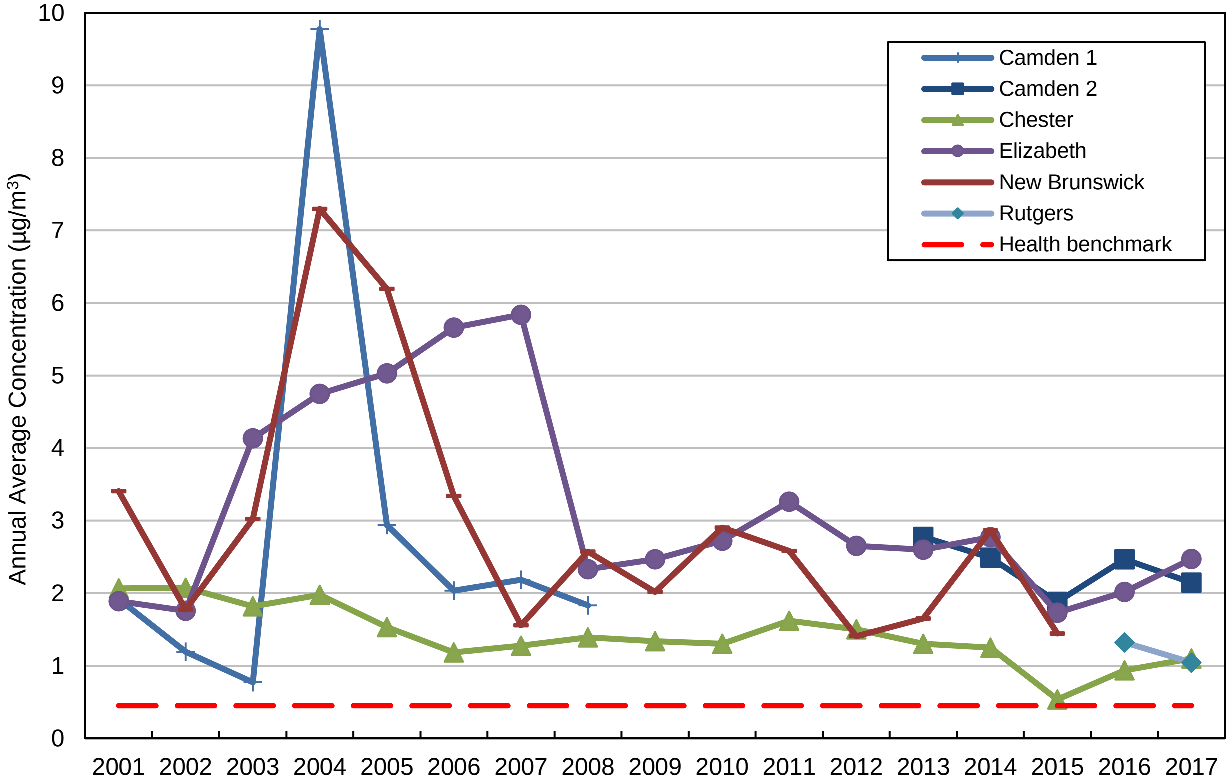


Figure 10-5
BENZENE – New Jersey Monitored Concentrations

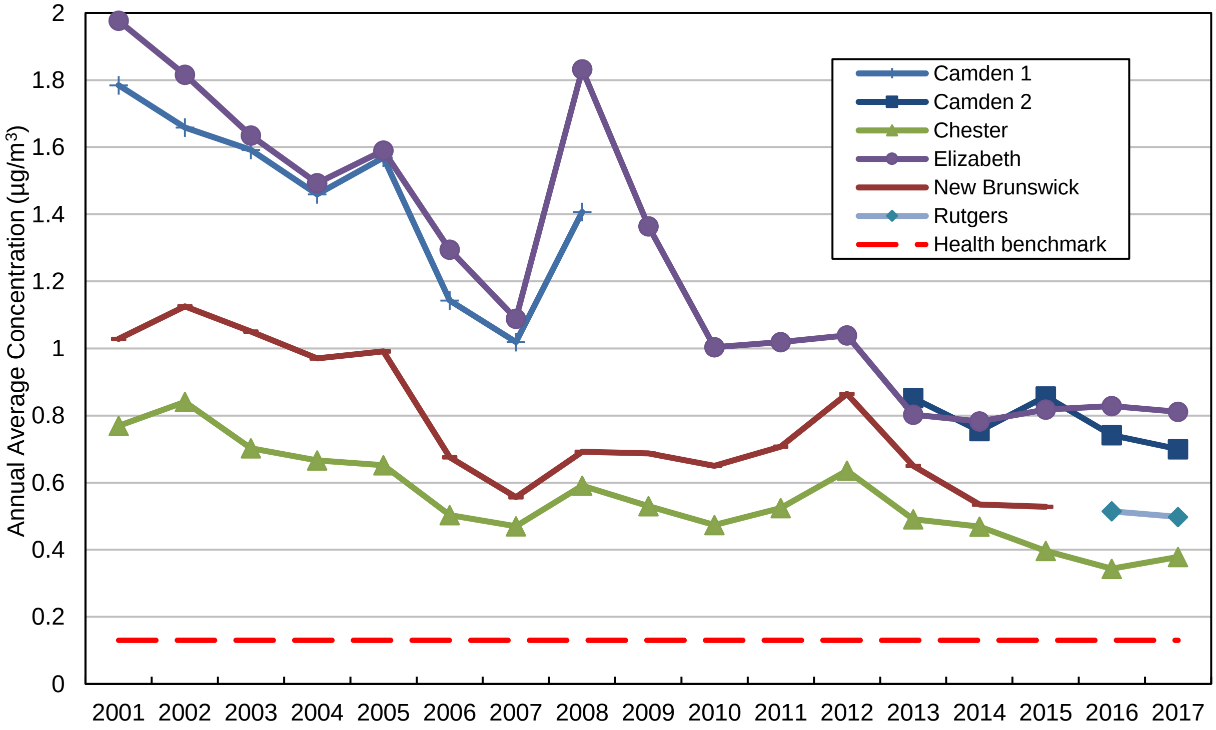


Figure 10-6
1,3-BUTADIENE – New Jersey Monitored Concentrations

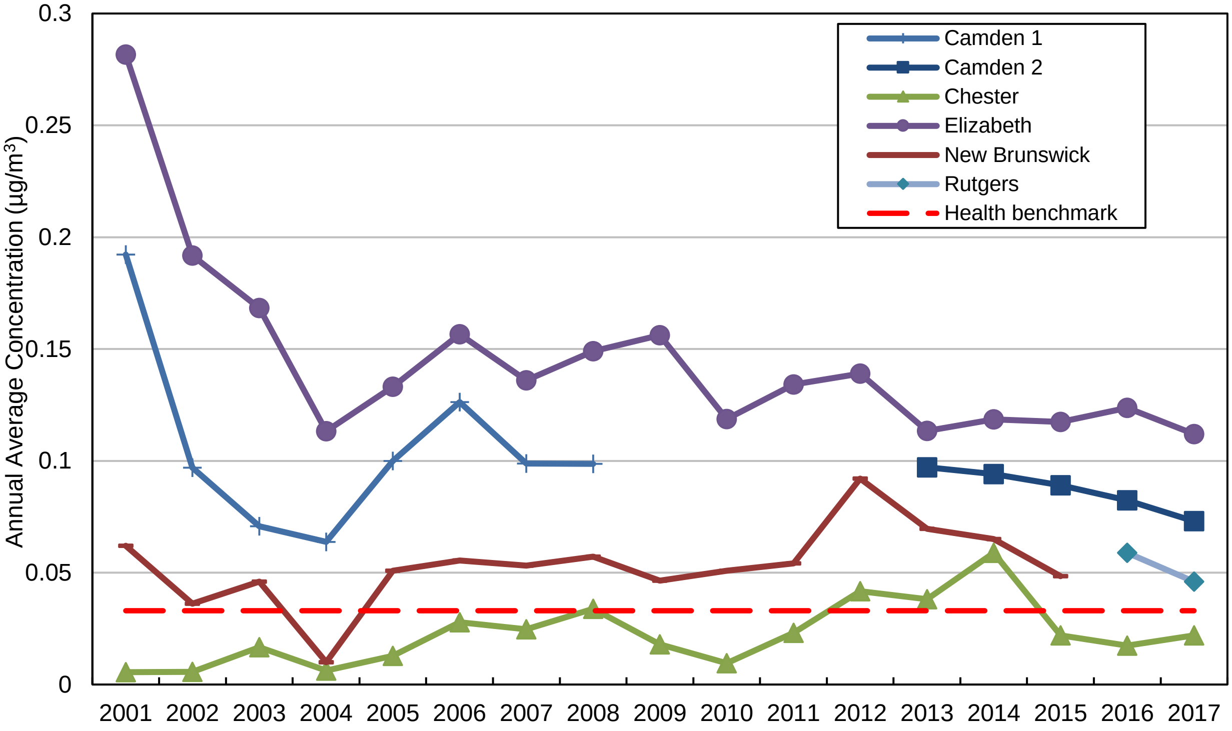


Figure 10-7
CARBON TETRACHLORIDE – New Jersey Monitored Concentrations

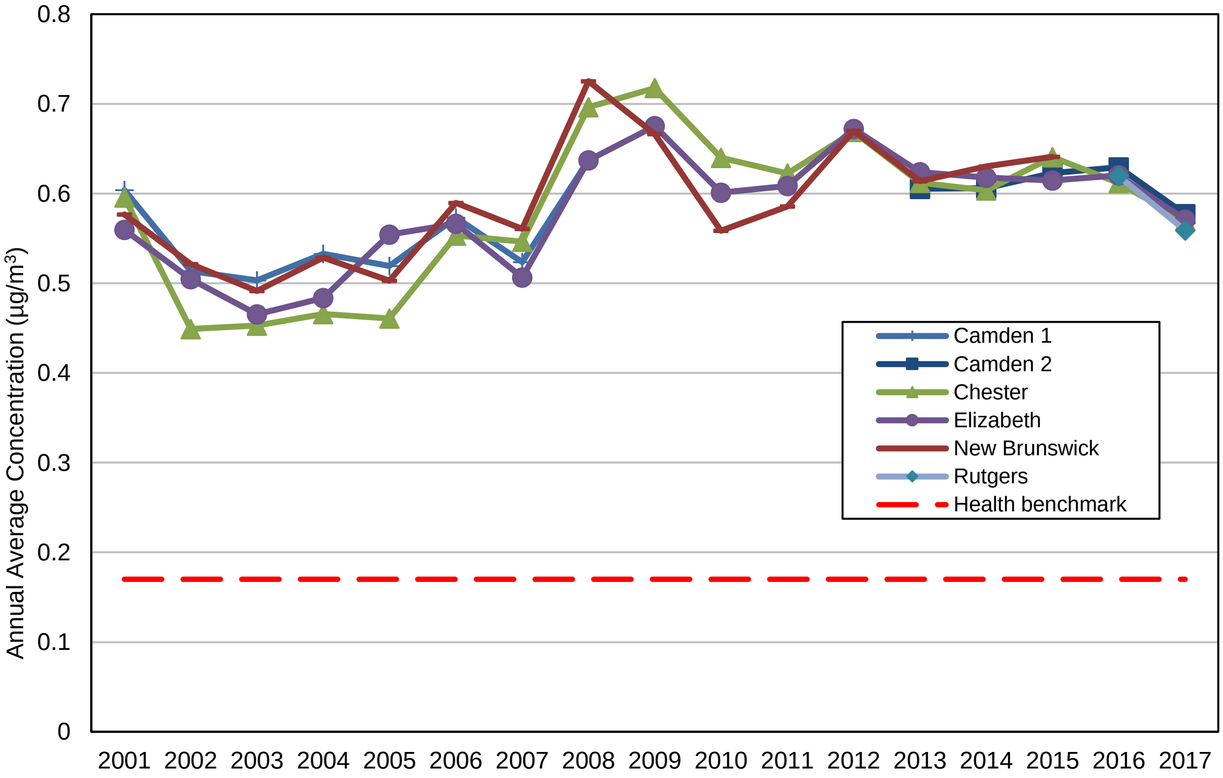


Figure 10-8
CHLOROFORM – New Jersey Monitored Concentrations

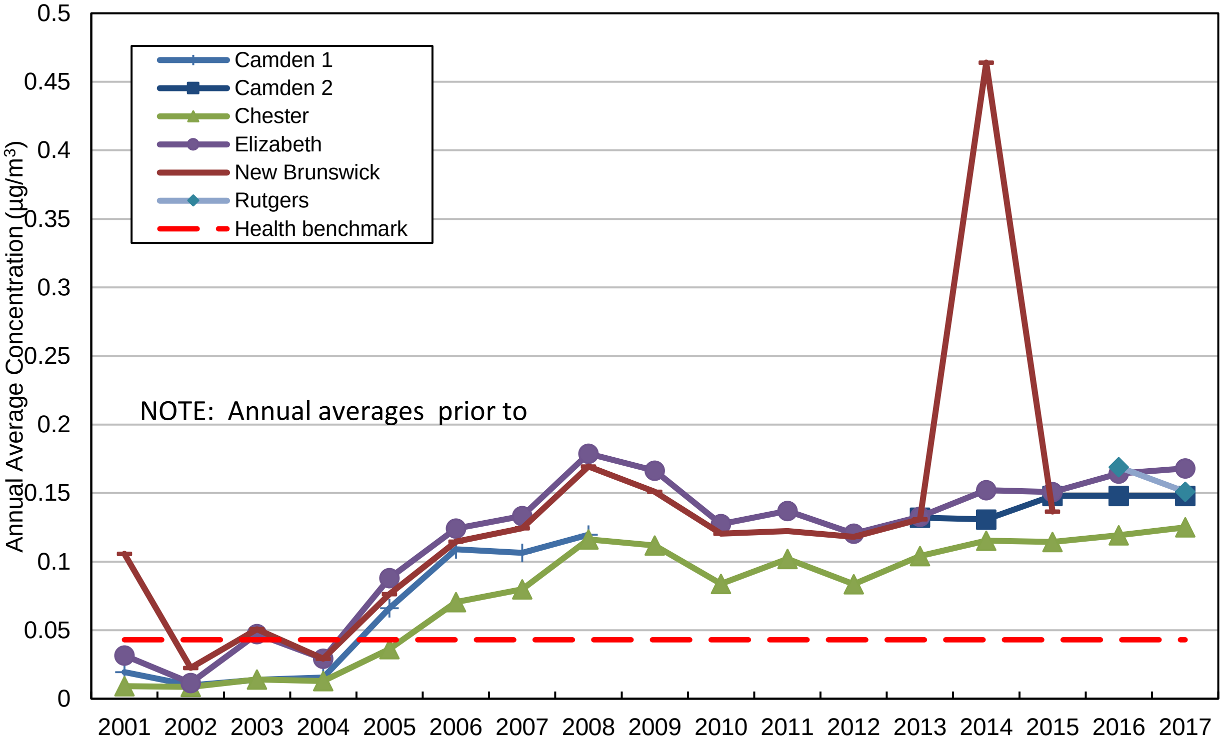


Figure 10-9
CHLOROMETHANE (Methyl Chloride) – New Jersey Monitored Concentrations

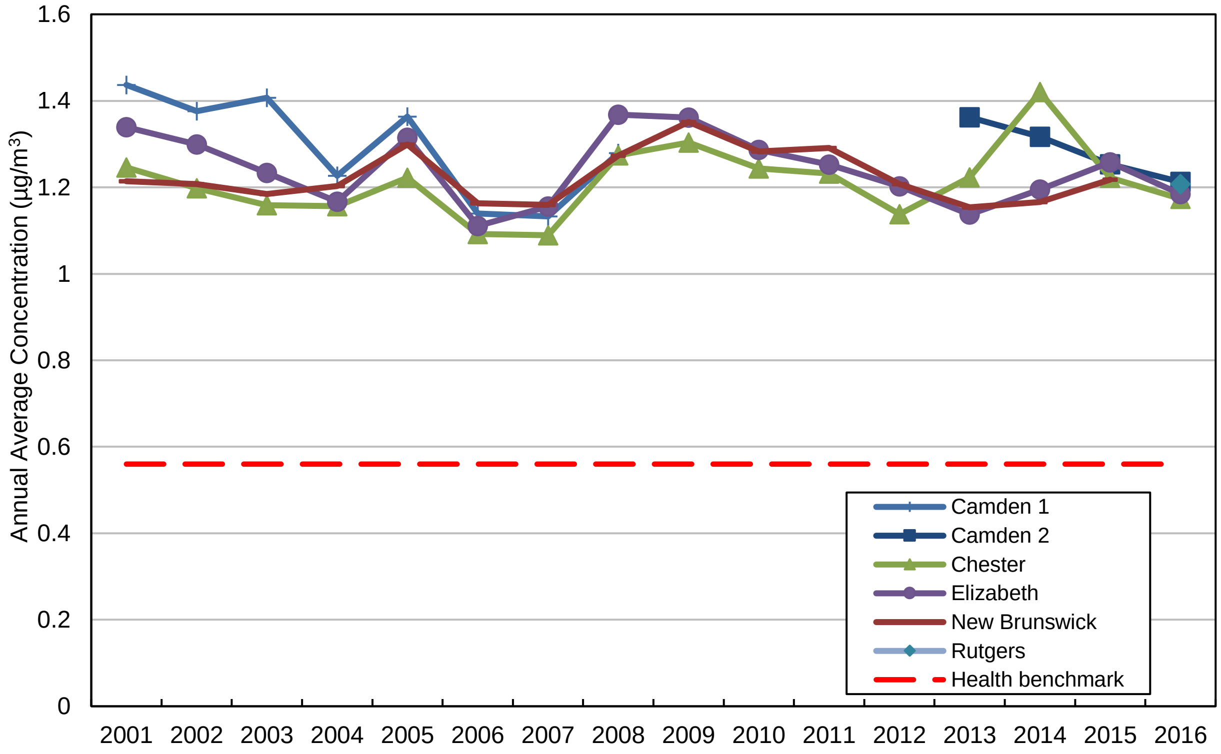


Figure 10-10
1,2-DIBROMOETHANE (Ethylene Dibromide) – New Jersey Monitored Concentrations

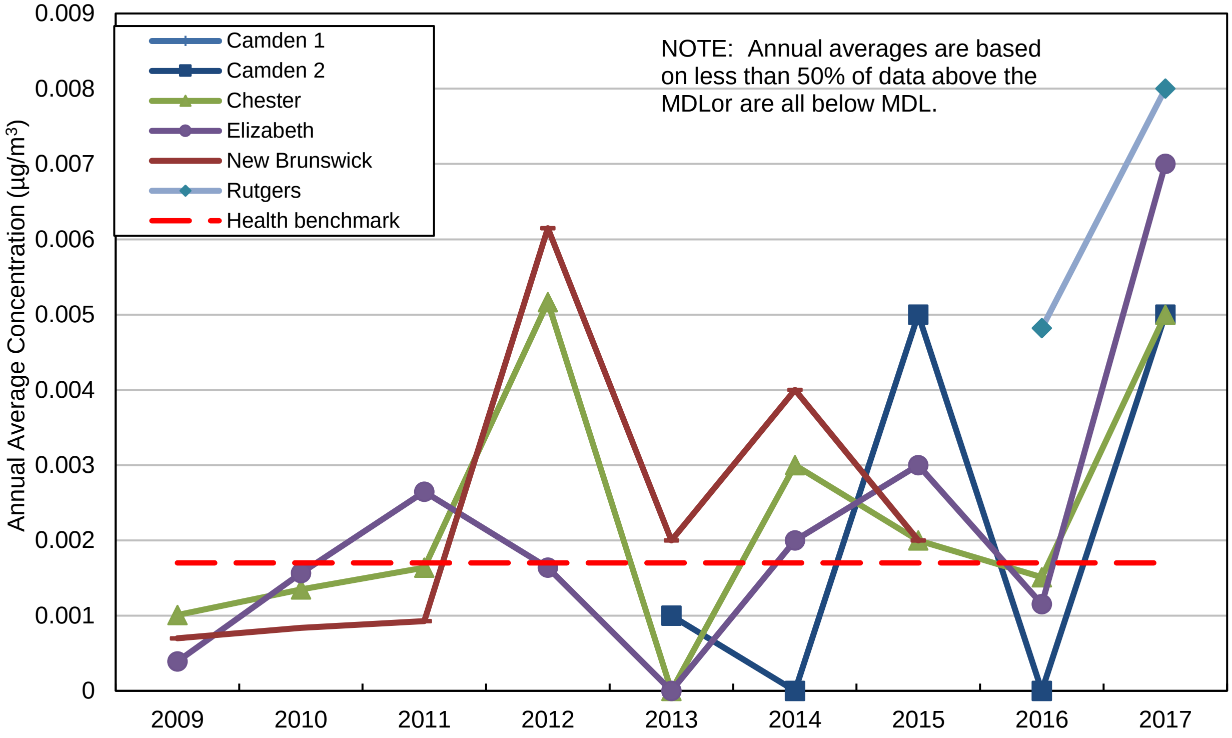


Figure 10-11
1,2-DICHLOROETHANE (Ethylene Dichloride) – New Jersey Monitored Concentrations

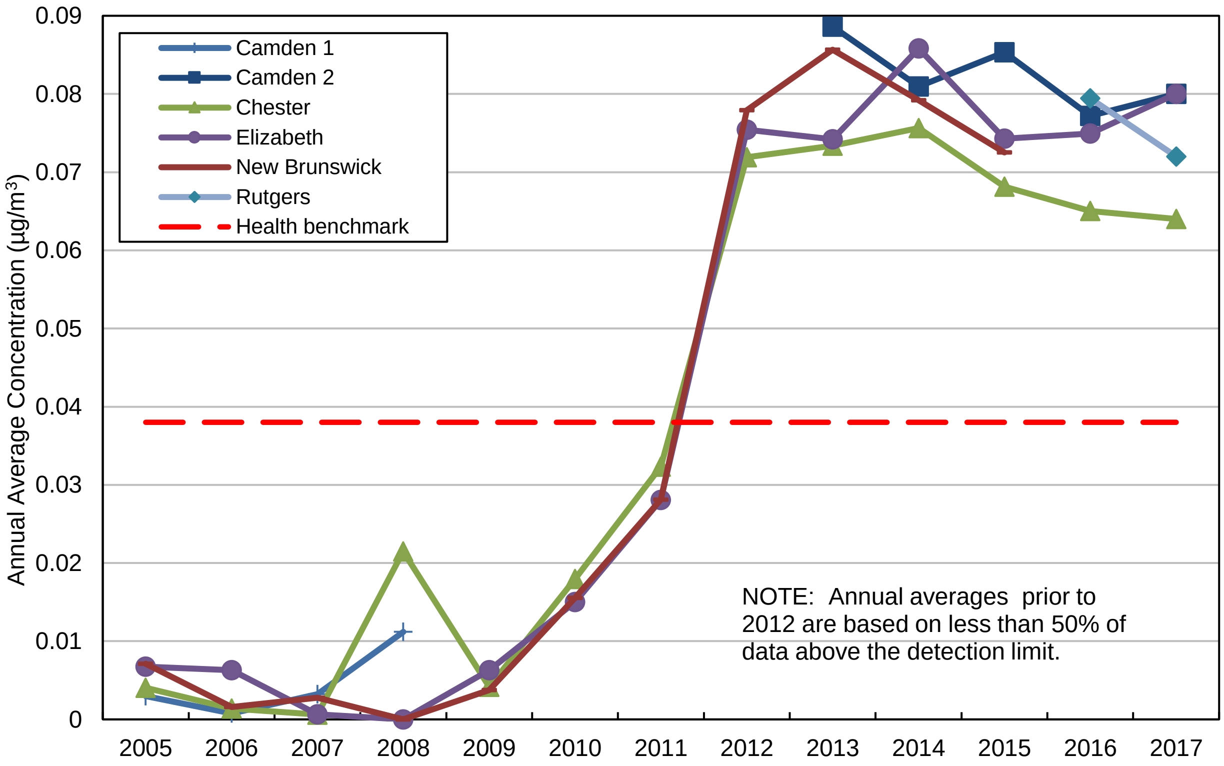


Figure 10-12
ETHYLBENZENE – New Jersey Monitored Concentrations

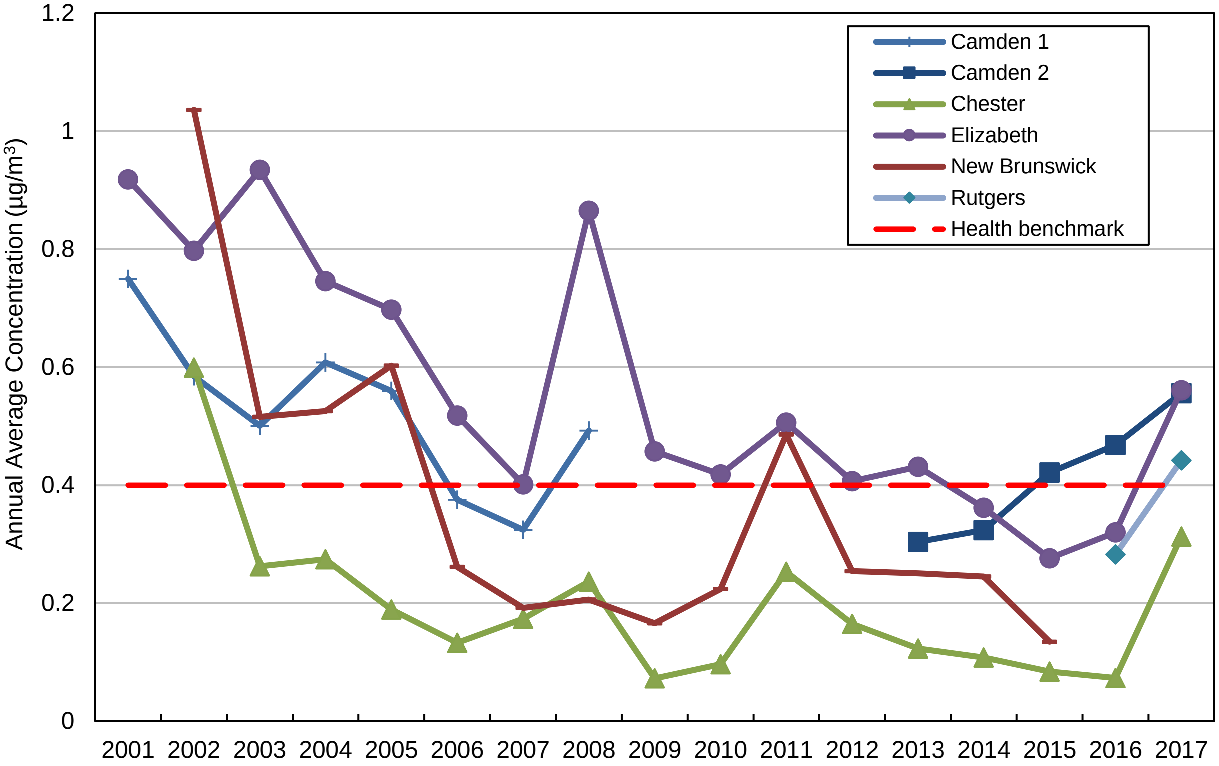


Figure 10-13
FORMALDEHYDE – New Jersey Monitored Concentrations

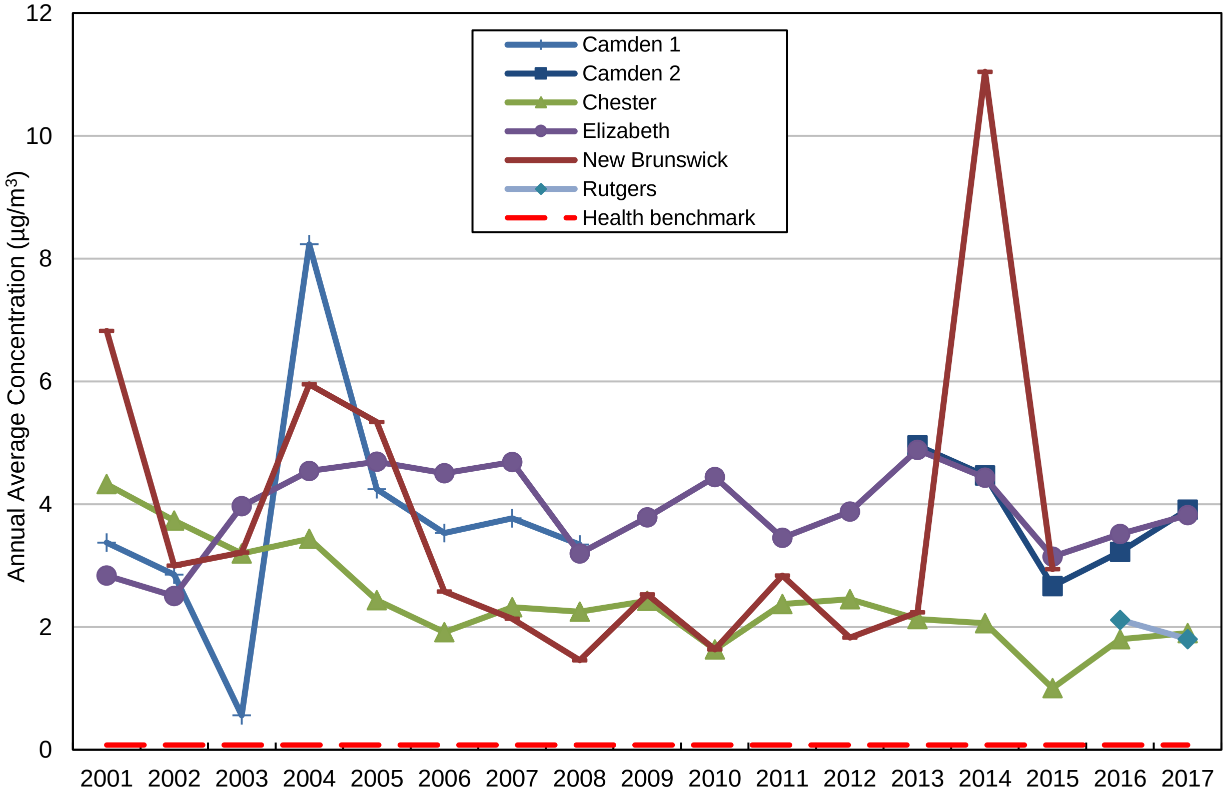


Figure 10-14
STYRENE – New Jersey Monitored Concentrations

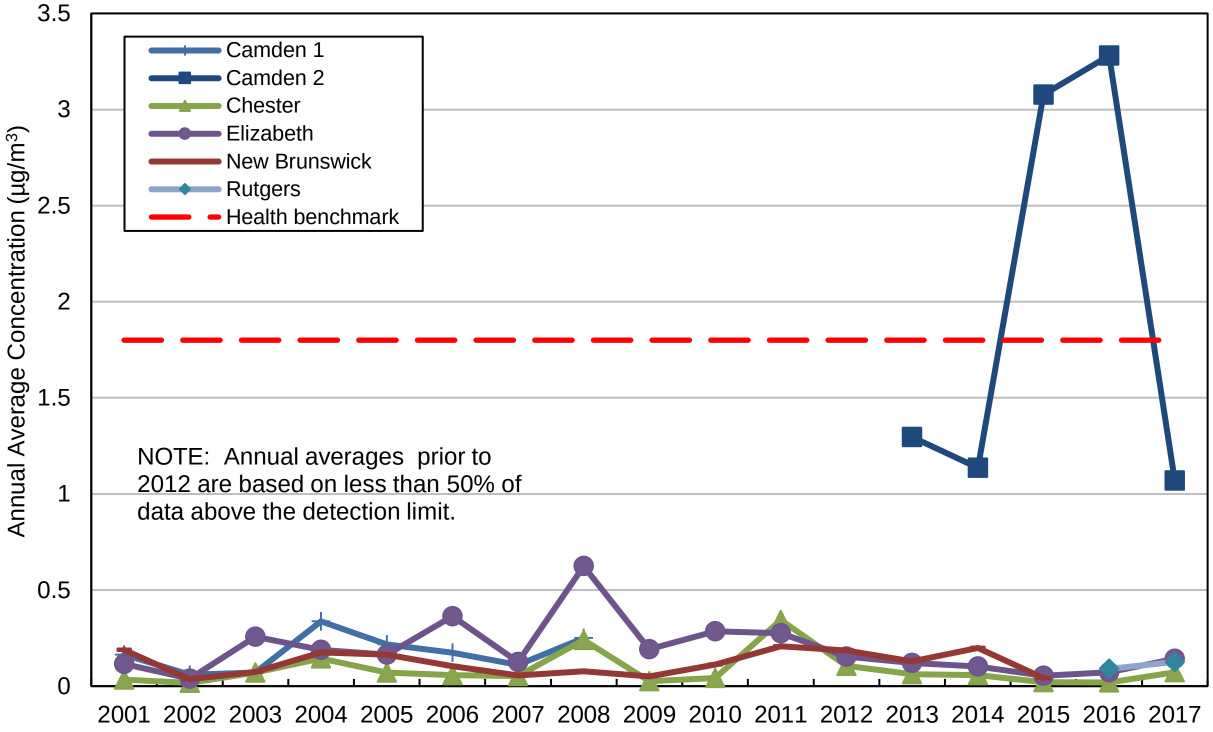


Figure 10-15
TETRACHLOROETHYLENE – New Jersey Monitored Concentrations

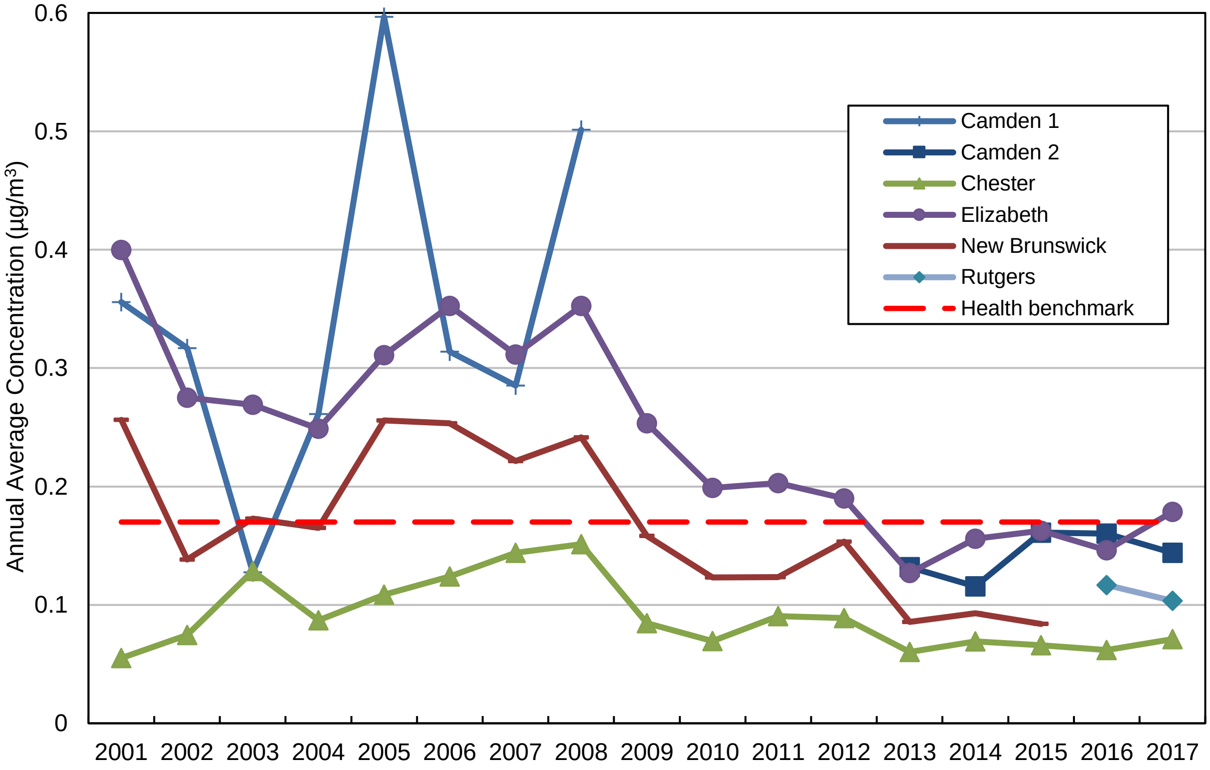


Table 10-5

CAMDEN SPRUCE STREET - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[,d]	24-Hour Maximum ($\mu g/m^3$)	Health Bench-mark ($\mu g/m^3$)[e]	Annual Mean Risk Ratio[f]	Detection Limit ($\mu g/m^3$)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	1.191	1.090	2.930	2.145	1.964	5.279	0.45	**5**	0.005	100
Acetone	67-64-1	1.134	0.914	2.790	2.694	2.171	6.627	31000	0.0001	0.014	100
Acetonitrile	75-05-8	2.285	0.192	94.400	3.837	0.322	158.502	60	0.1	0.020	100
Acetylene	74-86-2	0.712	0.495	3.020	0.758	0.527	3.216			0.033	100
Acrolein[g]	107-02-8	0.353	0.327	0.908	0.810	0.750	2.082	0.02	40	0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015	0	0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.0004*	0	0.007	*0.002*	0	0.029			0.033	7
Benzaldehyde	100-52-7	0.065	0.038	0.347	0.281	0.163	1.506			0.074	100
Benzene	71-43-2	0.219	0.203	0.479	0.700	0.647	1.530	0.13	**5**	0.010	100
Bromochloromethane	74-97-5	*0.005*	0	0.045	*0.029*	0	0.238			0.206	15
Bromodichloromethane	75-27-4	*0.001*	0	0.011	*0.008*	0	0.074			0.101	15
Bromoform	75-25-2	*0.001*	0	0.014	*0.013*	0	0.145	0.91	0.01	0.186	15
Bromomethane	74-83-9	0.178	0.017	6.150	0.691	0.064	23.880	5	0.1	0.066	96
1,3-Butadiene	106-99-0	0.033	0.026	0.122	0.073	0.058	0.270	0.033	**2**	0.031	96
Butyraldehyde	123-72-8	0.120	0.114	0.224	0.353	0.336	0.661			0.027	100
Carbon Disulfide	75-15-0	0.020	0.017	0.095	0.062	0.053	0.296	700	0.0001	0.009	100
Carbon Tetrachloride	56-23-5	0.092	0.093	0.114	0.577	0.582	0.717	0.067	**9**	0.075	100
Chlorobenzene	108-90-7	*0.003*	0	0.013	*0.012*	0	0.060	1000	0.00001	0.046	30
Chloroethane	75-00-3	*0.010*	0	0.038	*0.027*	0	0.100	10000	0.000003	0.047	46
Chloroform	67-66-3	0.030	0.030	0.056	0.148	0.146	0.273	0.043	**3**	0.044	100
Chloromethane	74-87-3	0.546	0.541	0.683	1.127	1.116	1.410	0.56	**2**	0.033	100
Chloroprene	126-99-8	*0.0004*	0	0.012	*0.002*	0	0.043	7	0.0002	0.040	6
Crotonaldehyde	123-73-9	0.114	0.048	0.501	0.325	0.138	1.436			0.049	100
Dibromochloromethane	594-18-3	*0.003*	0	0.013	*0.025*	0	0.111			0.051	44
1,2-Dibromoethane	106-93-4	*0.001*	0	0.013	*0.005*	0	0.100	0.0017	**3**	0.138	7
m-Dichlorobenzene	541-73-1	*0.001*	0	0.011	*0.003*	0	0.066			0.168	7
o-Dichlorobenzene	95-50-1	*0.001*	0	0.012	*0.005*	0	0.072	200	0.00002	0.144	9
p-Dichlorobenzene	106-46-7	0.007	0.009	0.030	0.042	0.051	0.180	0.091	0.5	0.156	52
Dichlorodifluoromethane	75-71-8	0.525	0.518	0.740	2.598	2.562	3.660	200	0.01	0.064	100
1,1-Dichloroethane	75-34-3	*0.001*	0	0.013	*0.004*	0	0.053	0.63	0.01	0.061	9
1,2-Dichloroethane	107-06-2	0.020	0.019	0.046	0.080	0.077	0.186	0.038	**2**	0.053	98
1,1-Dichloroethene	75-35-4	*0.001*	0	0.010	*0.004*	0	0.040	200	0.00002	0.032	15
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.003*	0	0.027	*0.010*	0	0.107			0.048	20
Dichloromethane	75-09-2	0.121	0.113	0.380	0.419	0.391	1.320	2.1	0.2	0.028	100

[a] See page 10-25 for footnotes.

Table 10-5 (continued)

CAMDEN SPRUCE STREET - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m^3)[c,d]	Annual Median (µg/m^3)[,d]	24-Hour Maximum (µg/m^3)	Health Bench-mark (µg/m^3)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m^3)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.001*	0	0.014	*0.003*	0	0.065	0.1	0.03	0.079	6
cis-1,3-Dichloropropene	542-75-6	*0.0004*	0	0.011	*0.002*	0	0.050			0.064	4
trans-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.020	0.018	0.030	0.136	0.126	0.210			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	ND	ND	ND	ND	ND	ND			0.011	0
Ethyl Acrylate	140-88-5	ND	ND	ND	ND	ND	ND	2	0	0.033	0
Ethyl tert-Butyl Ether	637-92-3	*0.002*	0	0.012	*0.010*	0	0.050			0.046	31
Ethylbenzene	100-41-4	0.128	0.120	0.348	0.556	0.521	1.511	0.40	**1.4**	0.035	100
Formaldehyde	50-00-0	3.183	2.520	9.440	3.909	3.095	11.593	0.077	**51**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.012	*0.022*	0	0.128	0.045	0.5	0.117	28
Hexaldehyde	66-25-1	0.046	0.035	0.146	0.189	0.143	0.598			0.139	100
Isovaleraldehyde	590-86-3	ND	ND	ND	ND	ND	ND			0.007	0
Methyl Ethyl Ketone	78-93-3	0.170	0.142	0.495	0.502	0.419	1.459	5000	0.0001	0.074	100
Methyl Isobutyl Ketone	108-10-1	0.048	0.043	0.307	0.196	0.174	1.258	3000	0.0001	0.057	93
Methyl Methacrylate	80-62-6	*0.006*	0	0.058	*0.024*	0	0.237	700	0.00003	0.115	33
Methyl tert-Butyl Ether	1634-04-4	*0.003*	0	0.042	*0.011*	0	0.151	3.8	0.003	0.050	22
n-Octane	111-65-9	0.060	0.041	0.241	0.281	0.192	1.126			0.079	100
Propionaldehyde	123-38-6	0.166	0.141	0.382	0.395	0.335	0.907	8	0.05	0.007	100
Propylene	115-07-1	0.474	0.382	1.460	0.815	0.657	2.513	3000	0.0003	0.055	100
Styrene	100-42-5	0.251	0.074	2.700	1.070	0.315	11.501	1.8	0.6	0.068	98
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.012	*0.004*	0	0.082	0.017	0.2	0.124	7
Tetrachloroethylene	127-18-4	0.021	0.019	0.048	0.144	0.129	0.326	0.17	0.8	0.095	98
Tolualdehydes		0.032	0.023	0.130	0.158	0.113	0.639			0.020	98
Toluene	108-88-3	0.734	0.469	6.980	2.766	1.767	26.304	5000	0.001	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.001*	0	0.014	*0.005*	0	0.104	4	0.001	0.371	6
1,1,1-Trichloroethane	71-55-6	0.005	0.005	0.013	0.026	0.027	0.071	1000	0.00003	0.071	63
1,1,2-Trichloroethane	79-00-5	*0.0003*	0	0.010	*0.002*	0	0.055	0.063	0.03	0.093	4
Trichloroethylene	79-01-6	*0.011*	0	0.076	*0.058*	0	0.408	0.5	0.1	0.091	44
Trichlorofluoromethane	75-69-4	0.385	0.268	1.560	2.163	1.506	8.765	700	0.003	0.045	100
Trichlorotrifluoroethane	76-13-1	0.079	0.080	0.096	0.605	0.609	0.736	30000	0.00002	0.069	100
1,2,4-Trimethylbenzene	95-63-6	0.098	0.073	0.461	0.482	0.356	2.266			0.103	100
1,3,5-Trimethylbenzene	108-67-8	0.033	0.026	0.140	0.161	0.128	0.688			0.103	100
Valeraldehyde	110-62-3	0.038	0.037	0.084	0.133	0.130	0.296			0.007	100
Vinyl chloride	75-01-4	*0.004*	0	0.032	*0.011*	0	0.082	0.11	0.1	0.020	37
m,p-Xylene	1330-20-7	0.220	0.155	0.850	0.954	0.673	3.691	100	0.01	0.017	100
o-Xylene	95-47-6	0.144	0.124	0.423	0.627	0.536	1.837	100	0.01	0.069	100

[a] See page 10-25 for footnotes.

Table 10-6
CHESTER - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m^3)[c,d]	Annual Median (µg/m^3)[,d]	24-Hour Maximum (µg/m^3)	Health Bench-mark (µg/m^3)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m^3)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	0.611	0.602	1.760	1.100	1.084	3.171	0.45	**2**	0.005	100
Acetone	67-64-1	0.766	0.703	1.640	1.820	1.670	3.896	31000	0.0001	0.014	100
Acetonitrile	75-05-8	0.703	0.198	13.200	1.181	0.332	22.163	60	0.02	0.020	100
Acetylene	74-86-2	0.409	0.308	2.010	0.436	0.328	2.141			0.033	100
Acrolein[g]	107-02-8	0.376	0.340	0.906	0.862	0.780	2.077	0.02	43	0.046	100
Acrylonitrile	107-13-1	*0.001*	0	0.037	*0.001*	0	0.080	0.015	0.1	0.065	2
tert-Amyl Methyl Ether	994-05-8	*0.000*	0	0.008	*0.002*	0	0.033			0.033	7
Benzaldehyde	100-52-7	0.016	0.016	0.037	0.071	0.069	0.161			0.074	98
Benzene	71-43-2	0.118	0.103	0.260	0.378	0.329	0.831	0.13	**3**	0.010	100
Bromochloromethane	74-97-5	*0.006*	0	0.050	*0.032*	0	0.265			0.206	16
Bromodichloromethane	75-27-4	*0.001*	0	0.011	*0.005*	0	0.074			0.101	9
Bromoform	75-25-2	*0.0004*	0	0.010	*0.005*	0	0.103	0.91	0.01	0.186	5
Bromomethane	74-83-9	0.013	0.011	0.083	0.052	0.043	0.322	5	0.01	0.066	86
1,3-Butadiene	106-99-0	0.010	0.007	0.048	0.022	0.015	0.106	0.033	0.7	0.031	61
Butyraldehyde	123-72-8	0.057	0.055	0.115	0.168	0.162	0.339			0.027	100
Carbon Disulfide	75-15-0	0.011	0.010	0.037	0.036	0.031	0.115	700	0.0001	0.009	100
Carbon Tetrachloride	56-23-5	0.091	0.091	0.113	0.570	0.573	0.711	0.067	**9**	0.075	100
Chlorobenzene	108-90-7	*0.002*	0	0.011	*0.010*	0	0.051	1000	0.00001	0.046	27
Chloroethane	75-00-3	*0.010*	0	0.042	*0.026*	0	0.111	10000	0.000003	0.047	45
Chloroform	67-66-3	0.026	0.024	0.039	0.125	0.117	0.190	0.043	**3**	0.044	100
Chloromethane	74-87-3	0.547	0.546	0.695	1.130	1.127	1.435	0.56	**2**	0.033	100
Chloroprene	126-99-8	*0.0004*	0	0.010	*0.001*	0	0.036	7	0.0002	0.040	4
Crotonaldehyde	123-73-9	0.086	0.022	0.515	0.247	0.062	1.476			0.049	96
Dibromochloromethane	594-18-3	*0.002*	0	0.011	*0.021*	0	0.094			0.051	38
1,2-Dibromoethane	106-93-4	*0.001*	0	0.012	*0.005*	0	0.092	0.0017	**3**	0.138	7
m-Dichlorobenzene	541-73-1	*0.0001*	0	0.007	*0.001*	0	0.042			0.168	2
o-Dichlorobenzene	95-50-1	*0.0003*	0	0.008	*0.002*	0	0.048	200	0.00001	0.144	4
p-Dichlorobenzene	106-46-7	*0.001*	0	0.016	*0.007*	0	0.096	0.091	0.1	0.156	9
Dichlorodifluoromethane	75-71-8	0.502	0.508	0.605	2.482	2.512	2.992	200	0.01	0.064	100
1,1-Dichloroethane	75-34-3	*0.001*	0	0.011	*0.005*	0	0.045	0.63	0.01	0.061	13
1,2-Dichloroethane	107-06-2	0.016	0.017	0.024	0.064	0.067	0.097	0.038	**1.7**	0.053	93
1,1-Dichloroethene	75-35-4	*0.001*	0	0.009	*0.004*	0	0.036	200	0.00002	0.032	14
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.0004*	0	0.009	*0.002*	0	0.036			0.048	5
Dichloromethane	75-09-2	0.097	0.095	0.160	0.338	0.330	0.556	2.1	0.2	0.028	100

[a] See page 10-25 for footnotes.

Table 10-6 (continued)

CHESTER - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[,d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.001*	0	0.013	*0.004*	0	0.060	0.1	0.04	0.079	7
cis-1,3-Dichloropropene	542-75-6	*0.0004*	0	0.012	*0.002*	0	0.054			0.064	4
trans-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.019	0.018	0.034	0.136	0.126	0.238			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	ND	ND	ND	ND	ND	ND			0.011	0
Ethyl Acrylate	140-88-5	ND	ND	ND	ND	ND	ND	2	0	0.033	0
Ethyl tert-Butyl Ether	637-92-3	*0.003*	0	0.013	*0.012*	0	0.054			0.046	36
Ethylbenzene	100-41-4	0.072	0.080	0.127	0.313	0.345	0.551	0.40	0.8	0.035	100
Formaldehyde	50-00-0	1.548	1.340	5.830	1.901	1.646	7.160	0.077	**25**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.001*	0	0.009	*0.014*	0	0.096	0.045	0.3	0.117	18
Hexaldehyde	66-25-1	0.013	0.012	0.051	0.055	0.049	0.209			0.139	89
Isovaleraldehyde	590-86-3	ND	ND	ND	ND	ND	ND			0.007	0
Methyl Ethyl Ketone	78-93-3	0.103	0.090	0.247	0.304	0.265	0.728	5000	0.0001	0.074	100
Methyl Isobutyl Ketone	108-10-1	0.025	0.024	0.060	0.102	0.098	0.246	3000	0.00003	0.057	95
Methyl Methacrylate	80-62-6	*0.002*	0	0.013	*0.006*	0	0.053	700	0.00001	0.115	20
Methyl tert-Butyl Ether	1634-04-4	*0.001*	0	0.010	*0.005*	0	0.036	3.8	0.001	0.050	16
n-Octane	111-65-9	0.020	0.017	0.075	0.092	0.079	0.350			0.079	96
Propionaldehyde	123-38-6	0.100	0.092	0.240	0.237	0.219	0.570	8	0.03	0.007	100
Propylene	115-07-1	0.203	0.181	0.556	0.349	0.311	0.957	3000	0.0001	0.055	100
Styrene	100-42-5	0.017	0.018	0.040	0.073	0.075	0.170	1.8	0.04	0.068	86
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.010	*0.004*	0	0.069	0.017	0.2	0.124	7
Tetrachloroethylene	127-18-4	0.010	0.011	0.026	0.071	0.075	0.176	0.17	0.4	0.095	82
Tolualdehydes		0.018	0.015	0.058	0.090	0.074	0.285			0.020	85
Toluene	108-88-3	0.160	0.140	0.516	0.604	0.528	1.945	5000	0.0001	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.001*	0	0.016	*0.004*	0	0.119	4	0.001	0.371	4
1,1,1-Trichloroethane	71-55-6	*0.003*	0	0.011	*0.016*	0	0.060	1000	0.00002	0.071	43
1,1,2-Trichloroethane	79-00-5	ND	ND	ND	ND	ND	ND	0.063	0	0.093	0
Trichloroethylene	79-01-6	*0.002*	0	0.015	*0.009*	0	0.081	0.5	0.02	0.091	16
Trichlorofluoromethane	75-69-4	0.236	0.235	0.295	1.324	1.320	1.657	700	0.002	0.045	100
Trichlorotrifluoroethane	76-13-1	0.078	0.078	0.092	0.600	0.598	0.705	30000	0.00002	0.069	100
1,2,4-Trimethylbenzene	95-63-6	0.022	0.017	0.228	0.110	0.084	1.121			0.103	98
1,3,5-Trimethylbenzene	108-67-8	0.009	0.007	0.061	0.044	0.034	0.300			0.103	89
Valeraldehyde	110-62-3	0.016	0.015	0.044	0.057	0.053	0.155			0.007	93
Vinyl chloride	75-01-4	*0.002*	0	0.016	*0.006*	0	0.041	0.11	0.1	0.020	30
m,p-Xylene	1330-20-7	0.042	0.033	0.115	0.181	0.141	0.499	100	0.002	0.017	100
o-Xylene	95-47-6	0.074	0.083	0.130	0.320	0.358	0.565	100	0.003	0.069	100

[a] See page 10-25 for footnotes.

Table 10-7
ELIZABETH LAB - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m^3)[c,d]	Annual Median (µg/m^3)[,d]	24-Hour Maximum (µg/m^3)	Health Bench-mark (µg/m^3)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m^3)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	1.372	1.010	13.300	2.471	1.820	23.963	0.45	**5**	0.005	100
Acetone	67-64-1	1.023	0.925	4.140	2.430	2.197	9.834	31000	0.0001	0.014	100
Acetonitrile	75-05-8	0.336	0.216	1.580	0.565	0.363	2.653	60	0.01	0.020	100
Acetylene	74-86-2	0.928	0.669	5.010	0.988	0.712	5.335			0.033	100
Acrolein[g]	107-02-8	0.426	0.394	0.900	0.976	0.902	2.064	0.02	49	0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015	0	0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.001*	0	0.009	*0.003*	0	0.038			0.033	11
Benzaldehyde	100-52-7	0.029	0.027	0.074	0.124	0.117	0.321			0.074	100
Benzene	71-43-2	0.254	0.214	1.090	0.811	0.684	3.482	0.13	**6**	0.010	100
Bromochloromethane	74-97-5	*0.005*	0	0.043	*0.025*	0	0.228			0.206	13
Bromodichloromethane	75-27-4	*0.001*	0	0.011	*0.009*	0	0.074			0.101	16
Bromoform	75-25-2	*0.001*	0	0.013	*0.014*	0	0.134	0.91	0.02	0.186	15
Bromomethane	74-83-9	0.014	0.013	0.044	0.055	0.050	0.171	5	0.01	0.066	93
1,3-Butadiene	106-99-0	0.051	0.045	0.180	0.112	0.100	0.398	0.033	**3**	0.031	98
Butyraldehyde	123-72-8	0.106	0.098	0.243	0.312	0.289	0.717			0.027	100
Carbon Disulfide	75-15-0	0.015	0.013	0.046	0.047	0.040	0.143	700	0.0001	0.009	100
Carbon Tetrachloride	56-23-5	0.091	0.091	0.118	0.571	0.573	0.742	0.067	**9**	0.075	100
Chlorobenzene	108-90-7	*0.003*	0	0.031	*0.016*	0	0.143	1000	0.00002	0.046	34
Chloroethane	75-00-3	*0.010*	0	0.071	*0.027*	0	0.187	10000	0.000003	0.047	39
Chloroform	67-66-3	0.034	0.034	0.059	0.168	0.166	0.288	0.043	**4**	0.044	100
Chloromethane	74-87-3	0.548	0.549	0.677	1.132	1.134	1.398	0.56	**2**	0.033	100
Chloroprene	126-99-8	*0.0005*	0	0.012	*0.002*	0	0.043	7	0.0002	0.040	5
Crotonaldehyde	123-73-9	0.098	0.047	0.452	0.280	0.135	1.296			0.049	100
Dibromochloromethane	594-18-3	0.004	0.002	0.013	0.030	0.017	0.111			0.051	51
1,2-Dibromoethane	106-93-4	*0.001*	0	0.010	*0.007*	0	0.077	0.0017	**4**	0.138	10
m-Dichlorobenzene	541-73-1	*0.001*	0	0.010	*0.005*	0	0.060			0.168	11
o-Dichlorobenzene	95-50-1	*0.001*	0	0.011	*0.006*	0	0.066	200	0.00003	0.144	11
p-Dichlorobenzene	106-46-7	*0.007*	0	0.034	*0.042*	0	0.204	0.091	0.5	0.156	49
Dichlorodifluoromethane	75-71-8	0.497	0.503	0.652	2.460	2.487	3.224	200	0.01	0.064	100
1,1-Dichloroethane	75-34-3	*0.002*	0	0.015	*0.009*	0	0.061	0.63	0.01	0.061	21
1,2-Dichloroethane	107-06-2	0.020	0.020	0.048	0.080	0.081	0.194	0.038	**2**	0.053	97
1,1-Dichloroethene	75-35-4	*0.002*	0	0.010	*0.006*	0	0.040	200	0.00003	0.032	18
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.002*	0	0.023	*0.008*	0	0.091			0.048	16
Dichloromethane	75-09-2	0.155	0.134	0.612	0.537	0.465	2.126	2.1	0.3	0.028	100

[a] See page 10-25 for footnotes.

Table 10-7 (continued)

ELIZABETH LAB - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[,d]	24-Hour Maximum ($\mu g/m^3$)	Health Bench-mark ($\mu g/m^3$)[e]	Annual Mean Risk Ratio[f]	Detection Limit ($\mu g/m^3$)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.0006*	0	0.014	*0.003*	0	0.065	0.1	0.03	0.079	5
cis-1,3-Dichloropropene	542-75-6	*0.0006*	0	0.012	*0.003*	0	0.054			0.064	7
trans-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.020	0.019	0.029	0.138	0.133	0.203			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	ND	ND	ND	ND	ND	ND			0.011	0
Ethyl Acrylate	140-88-5	*0.0001*	0	0.006	*0.0004*	0	0.025	2	0.0002	0.033	2
Ethyl tert-Butyl Ether	637-92-3	0.018	0.016	0.088	0.076	0.067	0.368			0.046	95
Ethylbenzene	100-41-4	0.129	0.132	0.398	0.561	0.573	1.728	0.40	**1.4**	0.035	100
Formaldehyde	50-00-0	3.112	2.430	13.400	3.821	2.984	16.456	0.077	**50**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.003*	0	0.011	*0.029*	0	0.117	0.045	0.6	0.117	34
Hexaldehyde	66-25-1	0.033	0.031	0.077	0.136	0.127	0.315			0.139	100
Isovaleraldehyde	590-86-3	ND	ND	ND	ND	ND	ND			0.007	0
Methyl Ethyl Ketone	78-93-3	0.157	0.133	0.534	0.462	0.392	1.574	5000	0.0001	0.074	100
Methyl Isobutyl Ketone	108-10-1	0.046	0.046	0.120	0.188	0.188	0.492	3000	0.0001	0.057	95
Methyl Methacrylate	80-62-6	*0.010*	0	0.127	*0.041*	0	0.520	700	0.0001	0.115	39
Methyl tert-Butyl Ether	1634-04-4	*0.007*	0	0.057	*0.025*	0	0.206	3.8	0.01	0.050	48
n-Octane	111-65-9	0.079	0.064	0.648	0.367	0.299	3.027			0.079	100
Propionaldehyde	123-38-6	0.171	0.147	0.465	0.407	0.349	1.105	8	0.1	0.007	100
Propylene	115-07-1	1.725	0.791	9.760	2.968	1.361	16.798	3000	0.001	0.055	100
Styrene	100-42-5	0.034	0.033	0.076	0.143	0.141	0.324	1.8	0.1	0.068	97
1,1,2,2-Tetrachloroethane	79-34-5	*0.002*	0	0.012	*0.010*	0	0.082	0.017	0.6	0.124	18
Tetrachloroethylene	127-18-4	0.026	0.020	0.081	0.179	0.136	0.549	0.17	**1.1**	0.095	98
Tolualdehydes		0.026	0.019	0.074	0.126	0.091	0.364			0.020	98
Toluene	108-88-3	0.489	0.415	2.340	1.843	1.564	8.818	5000	0.0004	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.001*	0	0.015	*0.006*	0	0.111	4	0.002	0.371	7
1,1,1-Trichloroethane	71-55-6	0.005	0.006	0.014	0.028	0.033	0.076	1000	0.00003	0.071	69
1,1,2-Trichloroethane	79-00-5	*0.001*	0	0.011	*0.004*	0	0.060	0.063	0.1	0.093	8
Trichloroethylene	79-01-6	*0.005*	0	0.018	*0.024*	0	0.097	0.5	0.05	0.091	38
Trichlorofluoromethane	75-69-4	0.237	0.240	0.303	1.332	1.348	1.702	700	0.002	0.045	100
Trichlorotrifluoroethane	76-13-1	0.079	0.079	0.110	0.604	0.605	0.843	30000	0.00002	0.069	100
1,2,4-Trimethylbenzene	95-63-6	0.078	0.073	0.289	0.385	0.359	1.421			0.103	100
1,3,5-Trimethylbenzene	108-67-8	0.027	0.027	0.082	0.131	0.133	0.403			0.103	100
Valeraldehyde	110-62-3	0.033	0.029	0.084	0.115	0.102	0.296			0.007	100
Vinyl chloride	75-01-4	*0.003*	0	0.015	*0.008*	0	0.038	0.11	0.1	0.020	31
m,p-Xylene	1330-20-7	0.211	0.189	1.150	0.914	0.821	4.994	100	0.01	0.017	100
o-Xylene	95-47-6	0.141	0.138	0.480	0.612	0.599	2.084	100	0.01	0.069	100

[a] See page 10-25 for footnotes.

Table 10-8

RUTGERS UNIVERSITY - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[,d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	0.580	0.557	1.360	1.045	1.004	2.450	0.45	**2**	0.005	100
Acetone	67-64-1	0.926	0.898	2.690	2.199	2.132	6.390	31000	0.0001	0.014	100
Acetonitrile	75-05-8	0.229	0.214	0.743	0.384	0.359	1.248	60	0.01	0.020	100
Acetylene	74-86-2	0.574	0.391	3.390	0.612	0.416	3.610			0.033	100
Acrolein[g]	107-02-8	0.389	0.349	0.981	0.893	0.800	2.249	0.02	45	0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015	0	0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.001*	0	0.010	*0.003*	0	0.042			0.033	10
Benzaldehyde	100-52-7	0.019	0.018	0.035	0.080	0.078	0.152			0.074	100
Benzene	71-43-2	0.156	0.135	0.667	0.498	0.431	2.131	0.13	**4**	0.010	100
Bromochloromethane	74-97-5	*0.005*	0	0.045	*0.025*	0	0.238			0.206	15
Bromodichloromethane	75-27-4	*0.001*	0	0.012	*0.007*	0	0.080			0.101	12
Bromoform	75-25-2	*0.001*	0	0.012	*0.013*	0	0.124	0.91	0.01	0.186	15
Bromomethane	74-83-9	0.013	0.012	0.033	0.050	0.047	0.128	5	0.01	0.066	90
1,3-Butadiene	106-99-0	0.021	0.018	0.126	0.046	0.040	0.279	0.033	**1.4**	0.031	82
Butyraldehyde	123-72-8	0.056	0.053	0.133	0.166	0.156	0.392			0.027	100
Carbon Disulfide	75-15-0	ND	ND	ND	ND	ND	ND	700	0	0.009	0
Carbon Tetrachloride	56-23-5	0.089	0.091	0.117	0.559	0.569	0.736	0.067	**8**	0.075	100
Chlorobenzene	108-90-7	*0.002*	0	0.013	*0.010*	0	0.060	1000	0.00001	0.046	25
Chloroethane	75-00-3	*0.019*	0	0.223	*0.051*	0	0.588	10000	0.00001	0.047	48
Chloroform	67-66-3	0.031	0.029	0.058	0.151	0.139	0.283	0.043	**4**	0.044	100
Chloromethane	74-87-3	0.546	0.535	0.684	1.127	1.104	1.412	0.56	**2**	0.033	100
Chloroprene	126-99-8	*0.000*	0	0.011	*0.002*	0	0.040	7	0.000	0.040	5
Crotonaldehyde	123-73-9	0.073	0.032	0.421	0.209	0.092	1.207			0.049	100
Dibromochloromethane	594-18-3	*0.003*	0	0.012	*0.023*	0	0.102			0.051	43
1,2-Dibromoethane	106-93-4	*0.001*	0	0.013	*0.008*	0	0.100	0.0017	**5**	0.138	10
m-Dichlorobenzene	541-73-1	*0.001*	0	0.010	*0.004*	0	0.060			0.168	8
o-Dichlorobenzene	95-50-1	*0.001*	0	0.010	*0.004*	0	0.060	200	0.00002	0.144	8
p-Dichlorobenzene	106-46-7	*0.003*	0	0.026	*0.018*	0	0.156	0.091	0.2	0.156	23
Dichlorodifluoromethane	75-71-8	0.497	0.502	0.612	2.459	2.480	3.027	200	0.01	0.064	100
1,1-Dichloroethane	75-34-3	*0.001*	0	0.012	*0.005*	0	0.049	0.63	0.01	0.061	12
1,2-Dichloroethane	107-06-2	0.018	0.018	0.026	0.072	0.073	0.105	0.038	**1.9**	0.053	98
1,1-Dichloroethene	75-35-4	*0.001*	0	0.010	*0.004*	0	0.040	200	0.00002	0.032	15
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.001*	0	0.018	*0.005*	0	0.071			0.048	12
Dichloromethane	75-09-2	0.124	0.109	0.702	0.430	0.377	2.439	2.1	0.2	0.028	100

[a] See page 10-25 for footnotes.

Table 10-8 (continued)

RUTGERS UNIVERSITY - 2017 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Maximum (µg/m³)	Health Benchmark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.000*	0	0.015	*0.002*	0	0.069	0.1	0.02	0.079	3
cis-1,3-Dichloropropene	542-75-6	*0.000*	0	0.014	*0.002*	0	0.064			0.064	3
trans-1,3-Dichloropropene	542-75-6	*0.000*	0	0.018	*0.001*	0	0.082			0.095	2
Dichlorotetrafluoroethane	76-14-2	0.019	0.018	0.028	0.134	0.126	0.196			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	ND	ND	ND	ND	ND	ND			0.011	0
Ethyl Acrylate	140-88-5	ND	ND	ND	ND	ND	ND	2	0	0.033	0
Ethyl tert-Butyl Ether	637-92-3	0.016	0.016	0.036	0.065	0.067	0.150			0.046	97
Ethylbenzene	100-41-4	0.102	0.108	0.209	0.442	0.469	0.908	0.40	**1.1**	0.035	100
Formaldehyde	50-00-0	1.469	1.285	4.570	1.803	1.578	5.612	0.077	**24**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.010	*0.021*	0	0.107	0.045	0.5	0.117	25
Hexaldehyde	66-25-1	0.020	0.019	0.072	0.081	0.078	0.295			0.139	98
Isovaleraldehyde	590-86-3	ND	ND	ND	ND	ND	ND			0.007	0
Methyl Ethyl Ketone	78-93-3	0.124	0.107	0.316	0.364	0.314	0.931	5000	0.0001	0.074	100
Methyl Isobutyl Ketone	108-10-1	0.030	0.029	0.110	0.124	0.117	0.451	3000	0.00004	0.057	95
Methyl Methacrylate	80-62-6	*0.003*	0	0.020	*0.014*	0	0.082	700	0.00002	0.115	30
Methyl tert-Butyl Ether	1634-04-4	*0.005*	0	0.021	*0.019*	0	0.076	3.8	0.01	0.050	43
n-Octane	111-65-9	0.028	0.026	0.070	0.132	0.121	0.327			0.079	100
Propionaldehyde	123-38-6	0.092	0.086	0.241	0.219	0.203	0.572	8	0.03	0.007	100
Propylene	115-07-1	0.308	0.291	1.190	0.531	0.501	2.048	3000	0.0002	0.055	100
Styrene	100-42-5	0.030	0.027	0.089	0.126	0.115	0.379	1.8	0.1	0.068	97
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.010	*0.007*	0	0.069	0.017	0.4	0.124	13
Tetrachloroethylene	127-18-4	0.015	0.013	0.039	0.103	0.085	0.265	0.17	0.6	0.095	93
Tolualdehydes		0.023	0.021	0.060	0.115	0.103	0.295			0.020	94
Toluene	108-88-3	0.243	0.213	0.795	0.916	0.801	2.996	5000	0.0002	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.001*	0	0.017	*0.008*	0	0.126	4	0.002	0.371	8
1,1,1-Trichloroethane	71-55-6	0.004	0.004	0.013	0.022	0.022	0.071	1000	0.00002	0.071	60
1,1,2-Trichloroethane	79-00-5	*0.000*	0	0.011	*0.002*	0	0.060	0.063	0.03	0.093	3
Trichloroethylene	79-01-6	*0.002*	0	0.014	*0.011*	0	0.075	0.5	0.02	0.091	18
Trichlorofluoromethane	75-69-4	0.235	0.236	0.284	1.319	1.323	1.596	700	0.002	0.045	100
Trichlorotrifluoroethane	76-13-1	*0.002*	0	0.100	*0.013*	0	0.766	30000	0.0000004	0.069	2
1,2,4-Trimethylbenzene	95-63-6	0.036	0.033	0.094	0.175	0.162	0.462			0.103	100
1,3,5-Trimethylbenzene	108-67-8	0.014	0.012	0.038	0.067	0.059	0.187			0.103	97
Valeraldehyde	110-62-3	0.015	0.014	0.043	0.053	0.049	0.151			0.007	97
Vinyl chloride	75-01-4	*0.002*	0	0.015	*0.006*	0	0.038	0.11	0.1	0.020	28
m,p-Xylene	1330-20-7	0.099	0.084	0.291	0.432	0.365	1.264	100	0.004	0.017	100
o-Xylene	95-47-6	0.097	0.106	0.184	0.421	0.460	0.799	100	0.004	0.069	100

[a] See page 10-25 for footnotes.

Footnotes for Tables 10-5 through 10-8

[b] Analytes in bold text had annual means above the long-term health benchmark.

[c] Numbers in italics are arithmetic means (or averages) based on less than 50% of the samples above the detection limit.

[d] 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.

[e] A health 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. These toxicity values are not available for all chemicals. For more information, go to www.nj.gov/dep/aqpp/risk.html.

[f] A risk ratio for a chemical is a comparison of the annual mean air concentration to the long-term health benchmark. If the annual mean is 0, then the annual mean risk ratio is not calculated.

[g] Acrolein concentrations are highly uncertain because of problems with collection and analysis methods.

ND indicates that all samples were below the detection limit.

Table 10-9
Analytes with 100% Non-Detects in 2017

Pollutant		CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acrylonitrile	107-13-1	X		X	X
2	Carbon Disulfide	75-15-0				X
3	cis-1,2-Dichloroethylene	156-59-2	X	X	X	X
4	trans-1,3-Dichloropropene	542-75-6	X	X	X	
5	2,5-Dimethylbenzaldehyde	5799-94-2	X	X	X	X
6	Ethyl Acrylate	140-88-5	X	X		X
7	Isovaleraldehyde	590-86-3	X	X	X	X
8	1,1,2-Trichloroethane	79-00-5		X		

In 2017, samples of the chemicals in Table 10-9 were never above the detection limit at the specified monitoring location. However, these pollutants may be present in the air below the detection limit level. Chemical-specific detection limits can be found in Tables 10-5 through 10-8.

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Appendix A
2017 Air Monitoring Sites

New Jersey Department of Environmental Protection

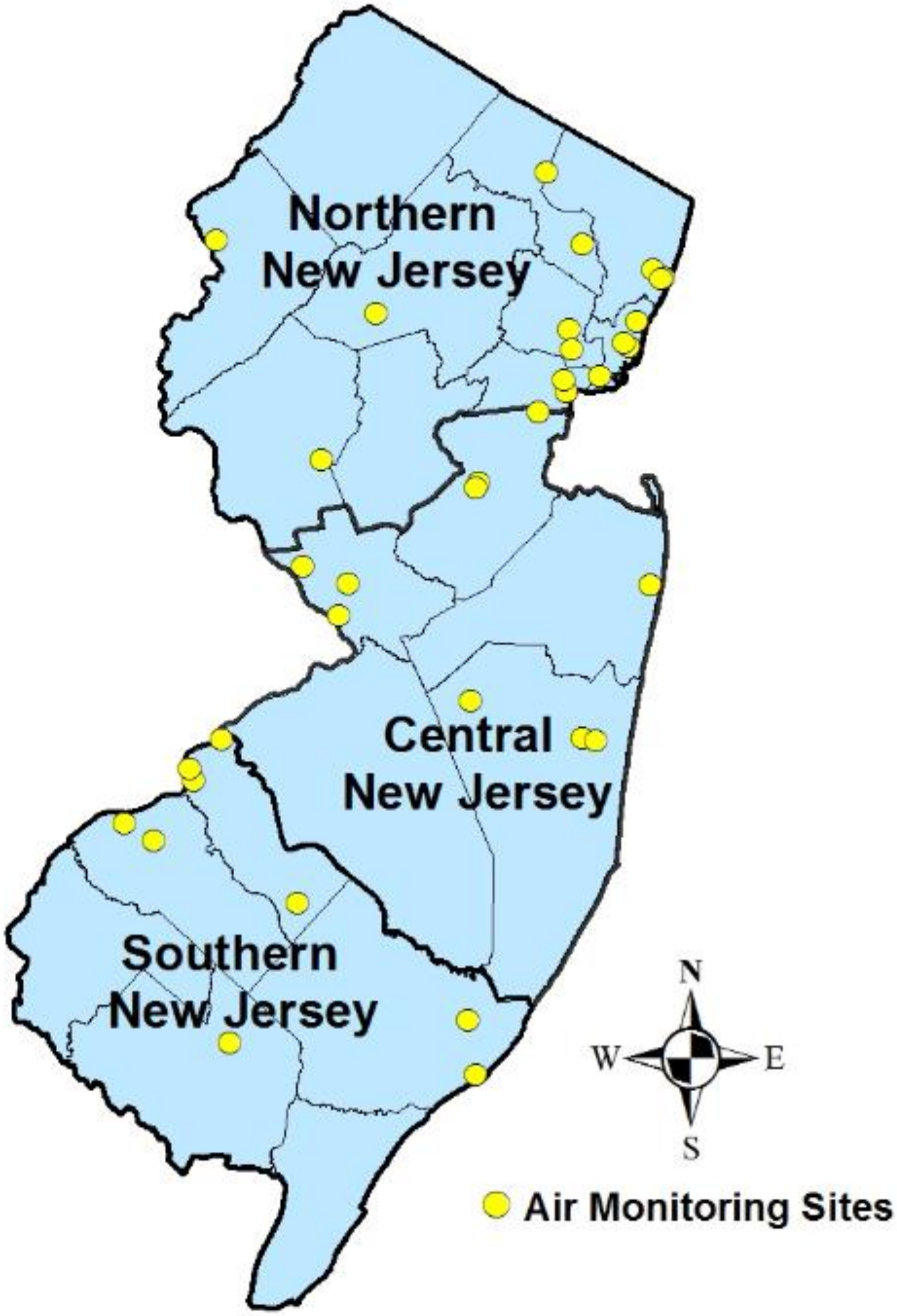

FIGURE A-1
2017 NORTHERN NEW JERSEY
AIR MONITORING SITES

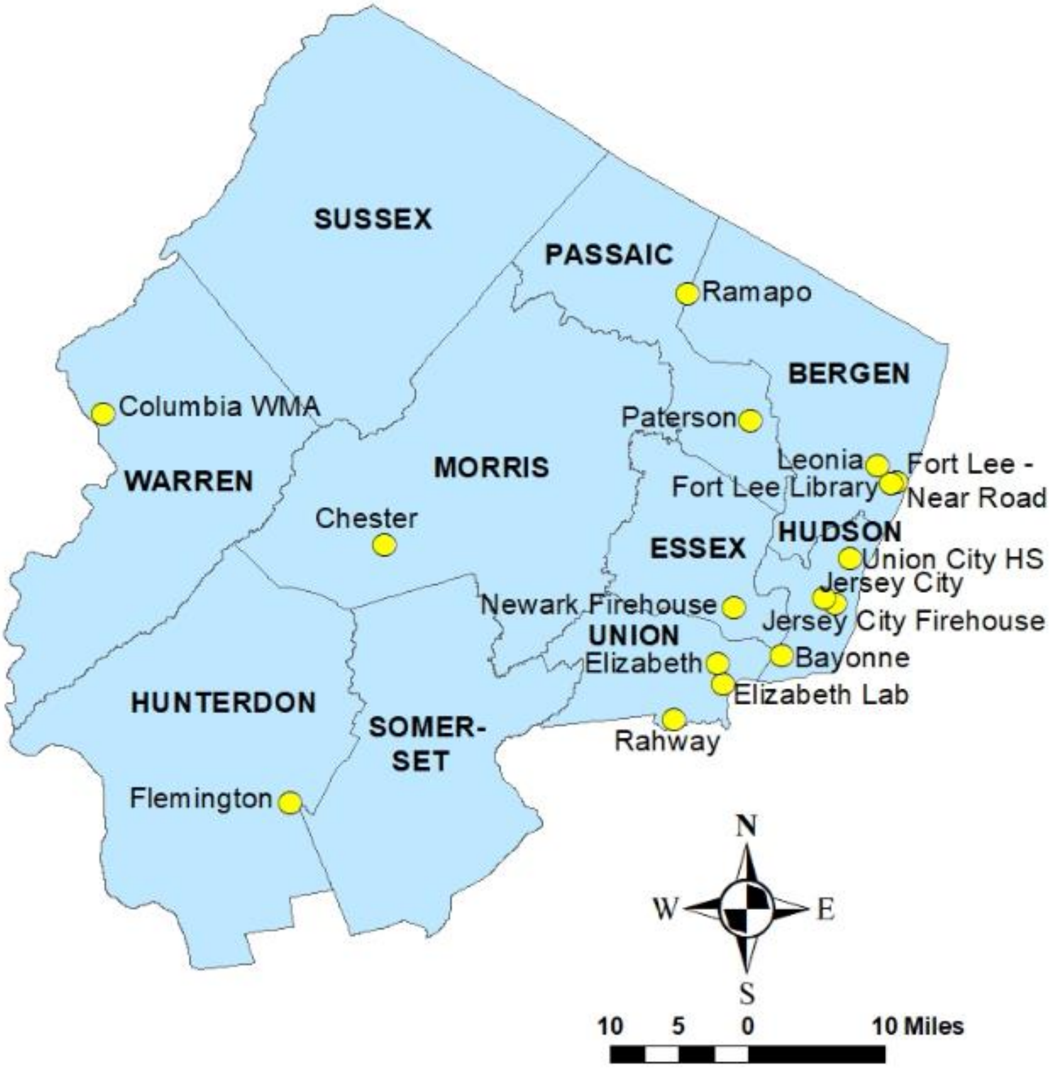

Table A-1
2017 Northern New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
BERGEN	Fort Lee Library	34 003 0003	PM$_{2.5}$	40.852256	-73.973314	320 Main Street
	Fort Lee Near Road	34 003 0010	CO, NO$_x$, Beta, BTEX, BC, Met	40.853550	-73.966180	2047 Central Ave.
	Leonia	34 003 0006	O$_3$	40.870436	-73.991994	Overpeck Park, 40 Fort Lee Road
ESSEX	Newark Firehouse	34 013 0003	CO, O$_3$, SO$_2$, PM$_{2.5}$, Spec, NOy, NO$_X$, BTEX, Pb, Beta, BC, Met, PM$_{coarse}$	40.720989	-74.192892	Engine 10, 360 Clinton Avenue
HUDSON	Bayonne	34 017 0006	NO$_X$, O$_3$, SO$_2$, BTEX, BC, Met	40.670250	-74.126081	Park Rd at end of W. 25th St.
	Jersey City	34 017 1002	CO, NO$_x$, SO$_2$	40.731645	-74.066308	2828 John F. Kennedy Boulevard
	Jersey City Firehouse	34 017 1003	PM$_{2.5}$, PM$_{10}$, Beta	40.725454	-74.052290	Engine 6, 355 Newark Avenue
	Union City High School	34 017 0008	PM$_{2.5}$	40.770908	-74.036218	2500 John F. Kennedy Blvd.
HUNTERDON	Flemington	34 019 0001	O$_3$, Met, Beta	40.515262	-74.806671	Raritan Twp. Municipal Utilities Authority, 365 Old York Road
MORRIS	Chester	34 027 3001	NO$_X$, O$_3$, SO$_2$, PM$_{2.5}$, Toxics, Spec	40.787628	-74.676301	Bldg. #1, Department of Public Works, (DPW), 50 North Road
PASSAIC	Paterson	34 031 0005	PM$_{2.5}$	40.918381	-74.168092	Health Department, 176 Broadway
	Ramapo	34 031 5001	O$_3$	41.058617	-74.255544	Ramapo Mountain State Forest, Access Road, off Skyline Drive, Wanaque
UNION	Elizabeth	34 039 0003	CO, SO$_2$	40.662493	-74.214800	7 Broad Street
	Elizabeth Lab	34 039 0004	CO, NO$_X$, SO$_2$, Met, PM$_{2.5}$, Toxics, Hg, Spec, BTEX, BC, Beta	40.641440	-74.208365	Interchange 13 Toll Plaza, New Jersey Turnpike
	Rahway	34 039 2003	PM$_{2.5}$, TEOM	40.603943	-74.276174	Fire Dept. Headquarters, 1300 Main Street
WARREN	Columbia WMA	34 041 0007	NO$_X$, O$_3$, SO$_2$, PM$_{2.5}$, Met, Beta	40.924580	-75.067815	Columbia Wildlife Management Area, 105 Delaware Road, Knowlton Twp.

[1] See abbreviations and acronyms in Table A-4 (page A-8).

FIGURE A-2
2017 CENTRAL NEW JERSEY
AIR MONITORING SITES

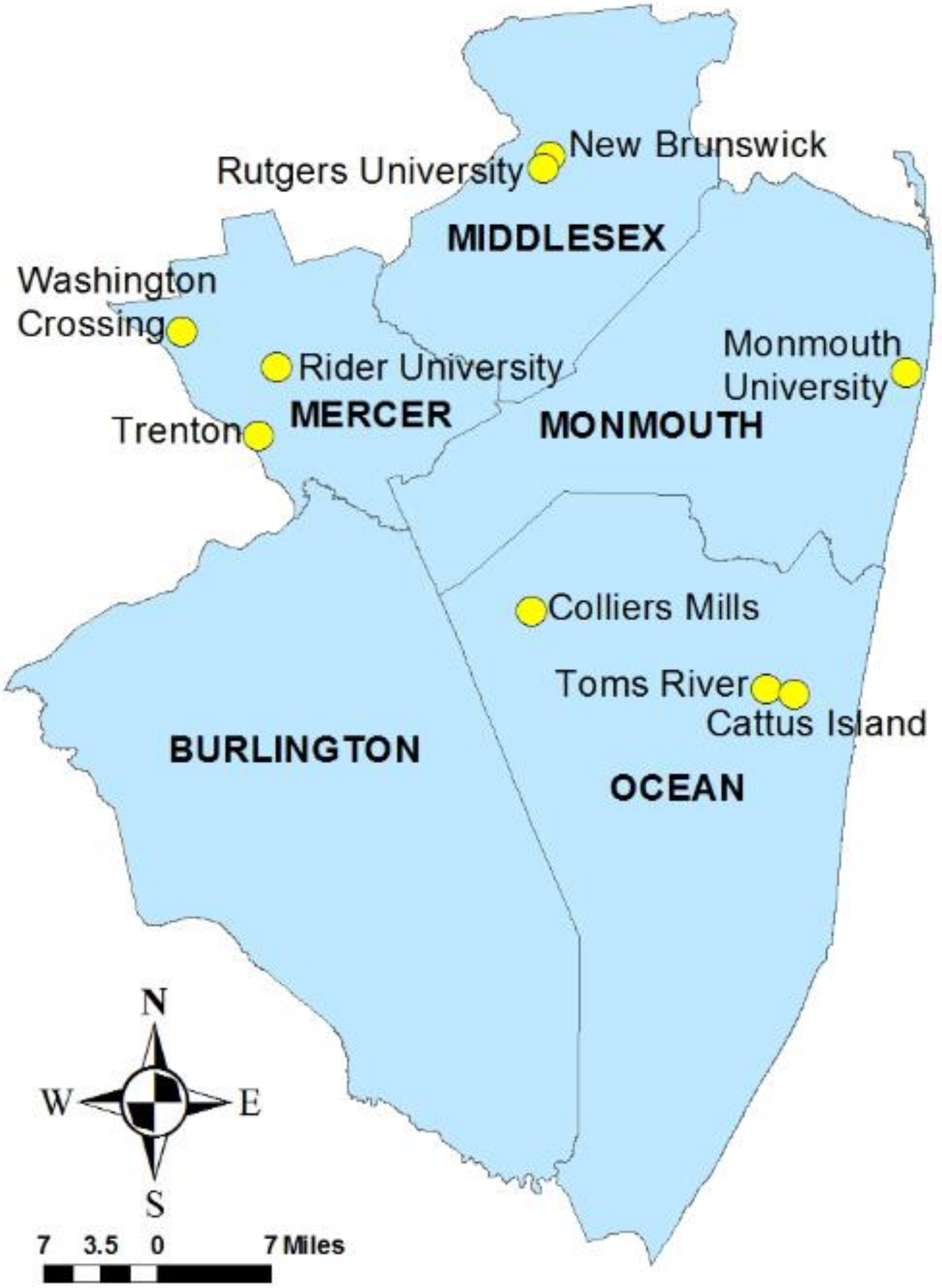

Table A-2
2017 Central New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
MERCER	Rider University	34 021 0005	O_3, Met, Beta	40.283092	-74.742644	2083 Lawrenceville Rd, Athletic Fields, Lawrence Twp.
	Trenton	34 021 0008	$PM_{2.5}$	40.222411	-74.763167	Trenton Public Library, 120 Academy Street
	Washington Crossing	N/A	ACID	40.315359	-74.853613	1240 Bear Tavern Road, Washington Crossing State Park, Titusville
MIDDLESEX	Rutgers University	34 023 0011	NO_X, O_3, Met[2], PAMS, Beta, $PM_{2.5}$, Toxics, Spec, Hg	40.462182	-74.429439	Horticultural Farm #3, 67 Ryders Lane, East Brunswick
MONMOUTH	Monmouth University	34 025 0005	O_3	40.277647	-74.005100	Edison Science Bldg., 400 Cedar Avenue, West Long Branch
OCEAN	Cattus Island	N/A	ACID	39.989636	-74.134132	Cattus Island County Park, end of Bandon Road, Toms River
	Colliers Mills	34 029 0006	O_3	40.064830	-74.444050	Colliers Mills Wildlife Management Area, Success Rd. near Hawkin Rd., Jackson Twp.
	Toms River	34 029 2002	$PM_{2.5}$	39.994908	-74.170447	Hooper Avenue Elementary School, 1517 Hooper Avenue

[1] See abbreviations and acronyms in Table A-4 (page A-8).
[2] Meteorological measurements at the site are collected by Rutgers University.

FIGURE A-3
2017 SOUTHERN NEW JERSEY
AIR MONITORING SITES

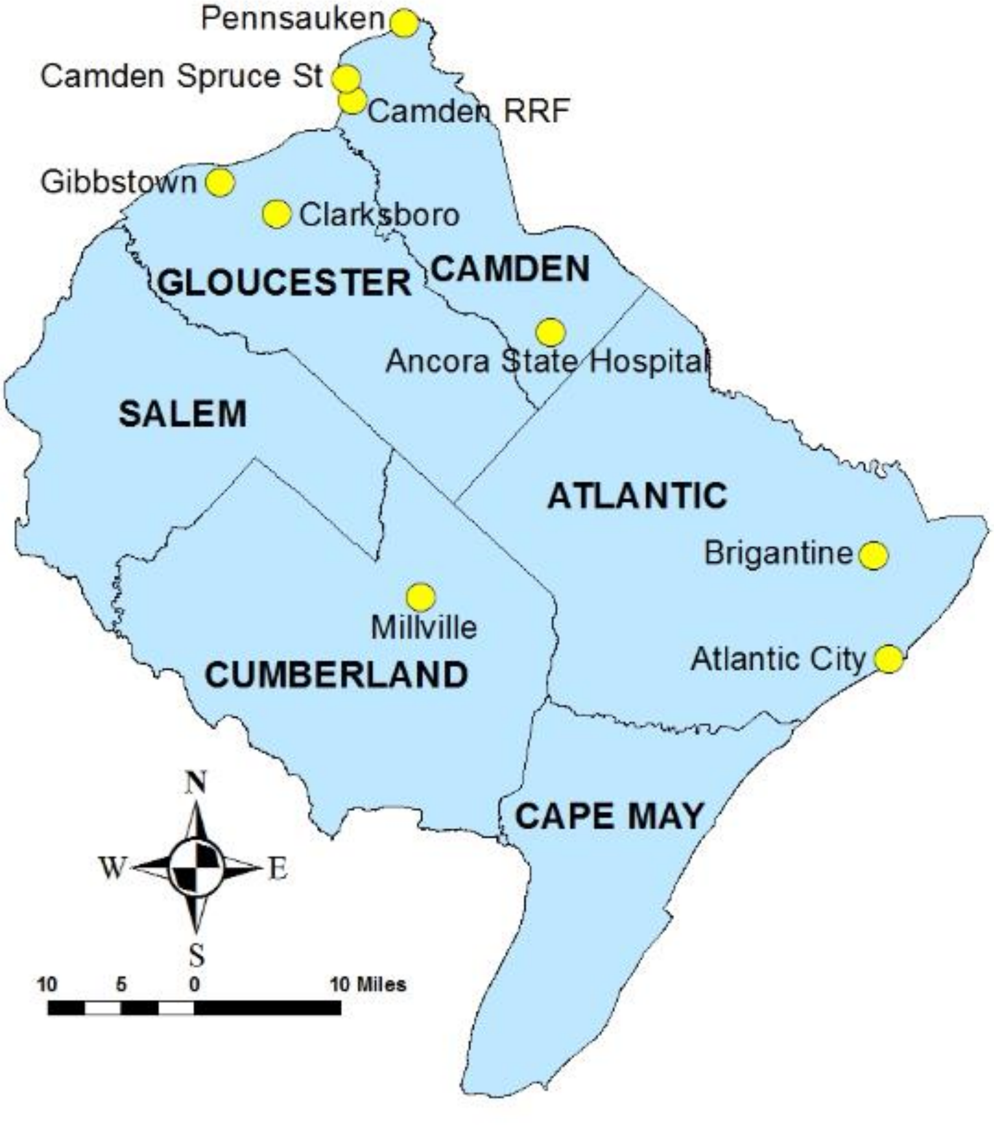

Table A-3
2017 Southern New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
ATLANTIC	Atlantic City	34 001 1006	$PM_{2.5}$	39.363260	-74.431000	Atlantic Cape Community College, 1535 Bacharach Boulevard
	Brigantine	34 001 0006	Visibility, O_3, SO_2, Beta, $PM_{2.5}$, ACID[2]	39.464872	-74.448736	Edwin B. Forsythe National Wildlife Refuge Visitor Center, 800 Great Creek Road, Galloway
CAMDEN	Ancora State Hospital	34 007 1001	O_3	39.684250	-74.861491	301 Spring Garden Road, Hammonton
	Camden RRF	34 007 0009	PM_{10}	39.912431	-75.116864	600 Morgan Street
	Camden Spruce Street	34 007 0002	CO, NO_X, O_3, SO_2, $PM_{2.5}$, Spec, BTEX, BC, Toxics, Met, Beta	39.934446	-75.125291	226-298 Spruce Street
	Pennsauken	34 007 1007	$PM_{2.5}$	39.989036	-75.050008	Morris-Delair Water Treatment Plant, 8999 Zimmerman Ave.
CUMBERLAND	Millville	34 011 0007	NO_X, O_3, Beta	39.422273	-75.025204	Next to 4425 South Main Road
GLOUCESTER	Clarksboro	34 015 0002	O_3, $PM_{2.5}$	39.800339	-75.212119	Shady Lane Complex, 256 County House Road
	Gibbstown	34 015 0004	$PM_{2.5}$	39.830837	-75.284682	Municipal Maintenance Yard, 61 North School Street

[1] See abbreviations and acronyms in Table A-4 (page A-8).

[2] United States Fish and Wildlife Service-Air Quality Branch (USFWS-AQB) is responsible for sample collection.

Table A-4
Abbreviations & Acronyms

ACID	Acid Deposition
BC	Black carbon measured by aethalometer
Beta	Real-time $PM_{2.5}$ analyzer
BTEX	Measures benzene, toluene, ethylbenzene and xylenes
CO	Carbon monoxide
Hg	Mercury
Met	Meteorological parameters
NO_X	Nitrogen dioxide and nitric oxide
NOy	Total reactive oxides of nitrogen
O_3	Ozone
PAMS	Photochemical Assessment Monitoring Station, measures ozone precursors
Pb	Lead
$PM_{2.5}$	Fine particles (2.5 microns or less) collected by a Federal Reference Method $PM_{2.5}$ sampler
PM_{10}	Coarse particles (10 microns or less) collected by a Federal Reference Method PM_{10} sampler
PM_{coarse}	Difference between PM_{10} and $PM_{2.5}$ measurements
SO_2	Sulfur dioxide
Spec	Speciated fine particles (2.5 microns or less)
TEOM	Real-time $PM_{2.5}$ analyzer
Toxics	Air toxics
Visibility	Measured by nephelometer

Appendix B: 2017
Fine Particulate Speciation Summary

New Jersey Department of Environmental Protection

Table 1
2017 Fine Particulate Speciation Concentrations
CAMDEN SPRUCE STREET NJ
Micrograms per Cubic Meter (µg/m^3)

Pollutant		Annual Average	Maximum Daily Average
1	Aluminum	0.032	0.176
2	Ammonium Ion	0.454	3.112
3	Antimony	0.004	0.049
4	Arsenic	0.0004	0.006
5	Barium	0.004	0.090
6	Bromine	0.003	0.014
7	Cadmium	0.001	0.024
8	Calcium	0.083	0.925
9	Carbon, Elemental	0.651	2.101
10	Carbon, Organic	2.273	6.072
11	Cerium	0.004	0.090
12	Cesium	0.004	0.061
13	Chlorine	0.297	8.496
14	Chromium	0.005	0.077
15	Cobalt	0.00001	0.004
16	Copper	0.006	0.023
17	Indium	0.001	0.028
18	Iron	0.136	0.968
19	Lead	0.004	0.028
20	Magnesium	0.011	0.140
21	Manganese	0.002	0.009
22	Nickel	0.002	0.022
23	Nitrate	0.888	5.513
24	Phosphorus	0.0004	0.007
25	Potassium	0.107	0.718
26	Potassium Ion	0.071	0.717
27	Rubidium	0.001	0.010
28	Selenium	0.0003	0.006
29	Silicon	0.058	0.287
30	Silver	0.003	0.020
31	Sodium	0.091	0.673
32	Sodium Ion	0.132	1.914
33	Strontium	0.001	0.005
34	Sulfate	1.071	6.177
35	Sulfur	0.380	1.570
36	Tin	0	0.058
37	Titanium	0.003	0.011
38	Vanadium	0.0004	0.003
39	Zinc	0.026	0.133
40	Zirconium	0.001	0.044

Table 2
2017 Fine Particulate Speciation Concentrations
CHESTER NJ

Micrograms per Cubic Meter ($\mu g/m^3$)

Pollutant		Annual Average	Maximum Daily Average
1	Aluminum	0.017	0.175
2	Ammonium Ion	0.206	1.346
3	Antimony	0.006	0.062
4	Arsenic	0.0002	0.006
5	Barium	0.003	0.069
6	Bromine	0.001	0.006
7	Cadmium	0.002	0.032
8	Calcium	0.023	0.095
9	Carbon, Elemental	0.269	0.896
10	Carbon, Organic	1.505	4.493
11	Cerium	0.004	0.090
12	Cesium	0	0.059
13	Chlorine	0.001	0.071
14	Chromium	0.003	0.020
15	Cobalt	0.0001	0.003
16	Copper	0.004	0.017
17	Indium	0.001	0.013
18	Iron	0.034	0.156
19	Lead	0.002	0.013
20	Magnesium	0.001	0.052
21	Manganese	0.0003	0.004
22	Nickel	0.001	0.005
23	Nitrate	0.631	3.485
24	Phosphorus	0.0003	0.004
25	Potassium	0.041	0.176
26	Potassium Ion	0.015	0.064
27	Rubidium	0.0003	0.007
28	Selenium	0.0005	0.004
29	Silicon	0.030	0.209
30	Silver	0.001	0.025
31	Sodium	0.035	0.369
32	Sodium Ion	0.029	0.228
33	Strontium	0.0005	0.005
34	Sulfate	0.763	2.198
35	Sulfur	0.283	0.909
36	Tin	0.003	0.048
37	Titanium	0.002	0.013
38	Vanadium	0.0004	0.002
39	Zinc	0.007	0.033
40	Zirconium	0.002	0.045

Table 3
2017 Fine Particulate Speciation Concentrations
ELIZABETH LAB NJ
Micrograms per Cubic Meter (µg/m^3)

Pollutant		Annual Average	Maximum Daily Average
1	Aluminum	0.039	0.396
2	Ammonium Ion	0.304	2.229
3	Antimony	0.002	0.045
4	Arsenic	0.0001	0.006
5	Barium	0.012	0.108
6	Bromine	0.002	0.015
7	Cadmium	0.0001	0.016
8	Calcium	0.052	0.269
9	Carbon, Elemental	1.024	2.784
10	Carbon, Organic	2.374	6.268
11	Cerium	0.001	0.140
12	Cesium	0.002	0.062
13	Chlorine	0.008	0.132
14	Chromium	0.004	0.061
15	Cobalt	0	0.002
16	Copper	0.008	0.028
17	Indium	0	0.024
18	Iron	0.149	0.562
19	Lead	0.002	0.018
20	Magnesium	0.015	0.175
21	Manganese	0.002	0.014
22	Nickel	0.001	0.015
23	Nitrate	1.030	6.597
24	Phosphorus	0.001	0.010
25	Potassium	0.058	0.380
26	Potassium Ion	0.026	0.470
27	Rubidium	0	0.008
28	Selenium	0.001	0.006
29	Silicon	0.087	0.730
30	Silver	0.002	0.018
31	Sodium	0.051	0.450
32	Sodium Ion	0.065	1.042
33	Strontium	0.001	0.012
34	Sulfate	0.922	2.815
35	Sulfur	0.356	1.068
36	Tin	0.002	0.040
37	Titanium	0.006	0.029
38	Vanadium	0.0002	0.004
39	Zinc	0.014	0.036
40	Zirconium	0.002	0.036

Table 4
2017 Fine Particulate Speciation Data
NEWARK FIREHOUSE NJ

Concentrations in Micrograms per Cubic Meter (µg/m^3)

Pollutant		Annual Average	Maximum Daily Average
1	Aluminum	0.030	0.749
2	Ammonium Ion	0.270	1.641
3	Antimony	0.003	0.051
4	Arsenic	0.0004	0.010
5	Barium	0.009	0.083
6	Bromine	0.002	0.009
7	Cadmium	0.001	0.025
8	Calcium	0.047	0.325
9	Carbon, Elemental	0.640	1.937
10	Carbon, Organic	2.276	6.387
11	Cerium	0.009	0.112
12	Cesium	0.004	0.056
13	Chlorine	0.014	0.509
14	Chromium	0.005	0.325
15	Cobalt	0	0.008
16	Copper	0.008	0.049
17	Indium	0.0004	0.037
18	Iron	0.112	1.202
19	Lead	0.001	0.021
20	Magnesium	0.014	0.083
21	Manganese	0.001	0.013
22	Nickel	0.002	0.114
23	Nitrate	1.029	6.226
24	Phosphorus	0.001	0.008
25	Potassium	0.056	0.375
26	Potassium Ion	0.024	0.321
27	Rubidium	0.0002	0.010
28	Selenium	0.0002	0.005
29	Silicon	0.077	1.388
30	Silver	0.001	0.028
31	Sodium	0.066	0.739
32	Sodium Ion	0.060	0.641
33	Strontium	0.001	0.010
34	Sulfate	0.805	2.130
35	Sulfur	0.323	0.899
36	Tin	0.001	0.046
37	Titanium	0.005	0.038
38	Vanadium	0.0002	0.002
39	Zinc	0.014	0.077
40	Zirconium	0.004	0.040

Table 5
2017 Fine Particulate Speciation Data
RUTGERS UNIVERSITY NJ

Concentrations in Micrograms per Cubic Meter (µg/m^3)

Pollutant		Annual Average	Maximum Daily Average
1	Aluminum	0.021	0.489
2	Ammonium Ion	0.202	1.774
3	Antimony	0.0002	0.044
4	Arsenic	0.0002	0.004
5	Barium	0.008	0.080
6	Bromine	0.001	0.008
7	Cadmium	0	0.018
8	Calcium	0.024	0.120
9	Carbon, Elemental	0.477	1.867
10	Carbon, Organic	2.039	7.700
11	Cerium	0.004	0.114
12	Cesium	0.003	0.086
13	Chlorine	0.005	0.301
14	Chromium	0.005	0.073
15	Cobalt	0	0.005
16	Copper	0.005	0.017
17	Indium	0	0.022
18	Iron	0.062	0.292
19	Lead	0.002	0.025
20	Magnesium	0.012	0.135
21	Manganese	0.001	0.012
22	Nickel	0.002	0.024
23	Nitrate	0.772	5.616
24	Phosphorus	0.0003	0.003
25	Potassium	0.048	0.307
26	Potassium Ion	0.021	0.311
27	Rubidium	0	0.005
28	Selenium	0.001	0.006
29	Silicon	0.043	0.920
30	Silver	0.002	0.026
31	Sodium	0.044	0.398
32	Sodium Ion	0.049	0.334
33	Strontium	0.001	0.011
34	Sulfate	0.745	2.177
35	Sulfur	0.296	0.864
36	Tin	0.003	0.051
37	Titanium	0.003	0.030
38	Vanadium	0.0003	0.004
39	Zinc	0.008	0.023
40	Zirconium	0.002	0.045