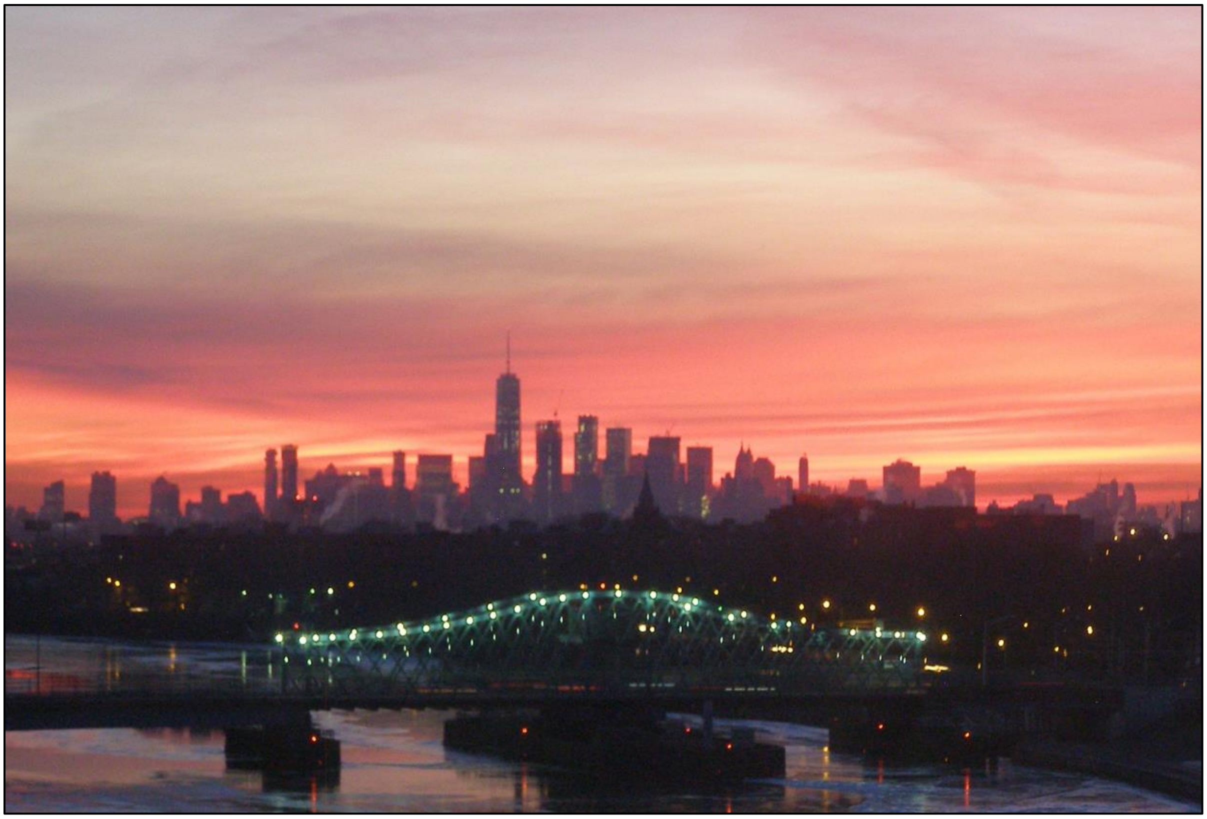
2019 New Jersey Air Quality Report

New Jersey Department of Environmental Protection



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https://nj.gov/dep/airmon/

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STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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Cover photo: Newark Hazecam

EXECUTIVE SUMMARY

This report presents the New Jersey Department of Environmental Protection (NJDEP) air quality monitoring data for 2019, collected from NJDEP's extensive air monitoring network. The state of New Jersey has been monitoring air quality since 1965. During that time, as a result of state, regional and national air pollution reduction efforts, pollution levels have improved significantly.

This report includes detailed chapters for ozone, sulfur dioxide, nitrogen dioxide, particulate matter, and carbon monoxide. These are the criteria pollutants, that is, those for which NAAQS (or criteria) have been set. Other measurements made at our air monitoring stations include air toxics, chemical components of airborne fine particles ("particulate species"), and meteorology.

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 2019, and lists the days on which the AQI was over 100 (meaning the NAAQS were exceeded). Fourteen days were classified as "Unhealthy for Sensitive Groups" in 2019, because their numerical AQI ratings were greater than 100. Twelve of the exceedance days were because of ozone, and one each for nitrogen dioxide and fine particulate matter ($PM_{2.5}$).

Figures 1-1 through 1-6 below illustrate the downward trends in concentrations of criteria pollutants in New Jersey over the past few decades by graphing the statewide design values for each pollutant. A design value is the actual statistic that is compared to a NAAQS. If this value exceeds the NAAQS at any site in the state, the state is determined to be in nonattainment. Design values for each of the criteria pollutants are described in detail in each pollutant-specific chapter of this report.

New Jersey is getting close to meeting the ozone NAAQS (Figure 1-1), and will continue to implement control strategies to reduce ambient concentrations. Because ozone is formed in the presence of sunlight and high temperatures, the highest levels occur in the summer months. Ozone 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 (effective in 2016).

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 the earliest ambient air quality standards. Even though in 2019 there was one day on which the 24-hour $PM_{2.5}$ NAAQS was exceeded, monitoring data in New Jersey shows a steady decline in overall $PM_{2.5}$ levels, which are now in compliance with the NAAQS (Figure 1-2).

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 (Figure 1-3), although there was one exceedance of the 1-hour standard in 2019, most likely caused by a truck idling near the monitoring site.

The sharp increase and subsequent decrease in sulfur dioxide (SO_2) concentrations in New Jersey shown in Figure 1-4 are attributable to a coal-burning facility across the Delaware River in Pennsylvania. NJDEP established the Columbia 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 been meeting the standard.

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 1-5).

Air concentrations of lead have dropped dramatically since a standard was established in 1978. The phase-out of leaded gasoline and removal of lead from paint and other products have had a measurable impact. The last exceedances of the NAAQS were in the early 1980s (Figure 1-6).

In 2019 the Bureau of Air Monitoring revamped its website, which can be found at https://nj.gov/dep/airmon. The table and map of current air quality readings are now easier to find, as well as annual reports, trend graphs, and other information.

Figure 1-1
Ozone Design Value Trend in New Jersey, 1997-2019
3-Year Average of 4th-Highest Daily Maximum 8-Hour Average Concentrations
Parts per Million (ppm)

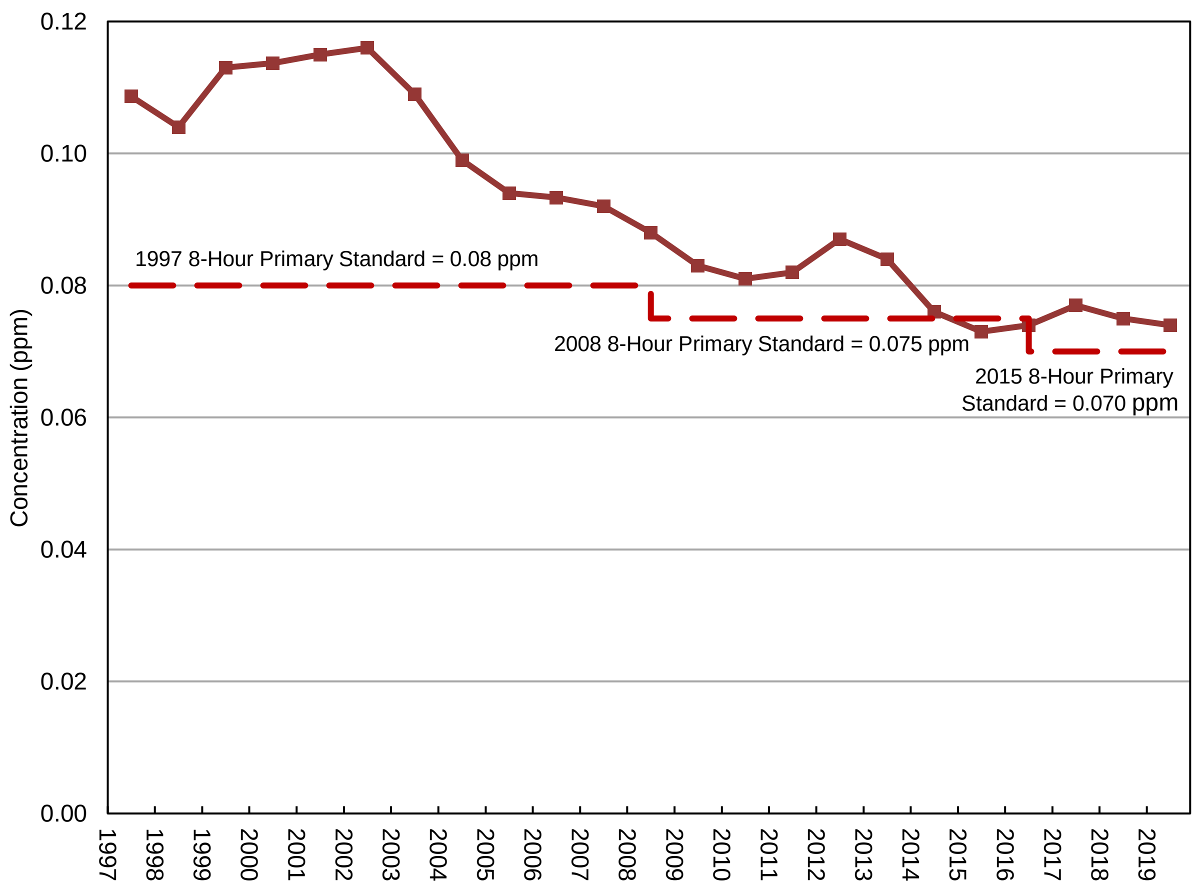


Figure 1-2
Fine Particulate ($PM_{2.5}$) Design Value Trend in New Jersey, 2001-2019
3-Year Average Annual Average Concentrations
Micrograms per Cubic Meter (µg/m³)

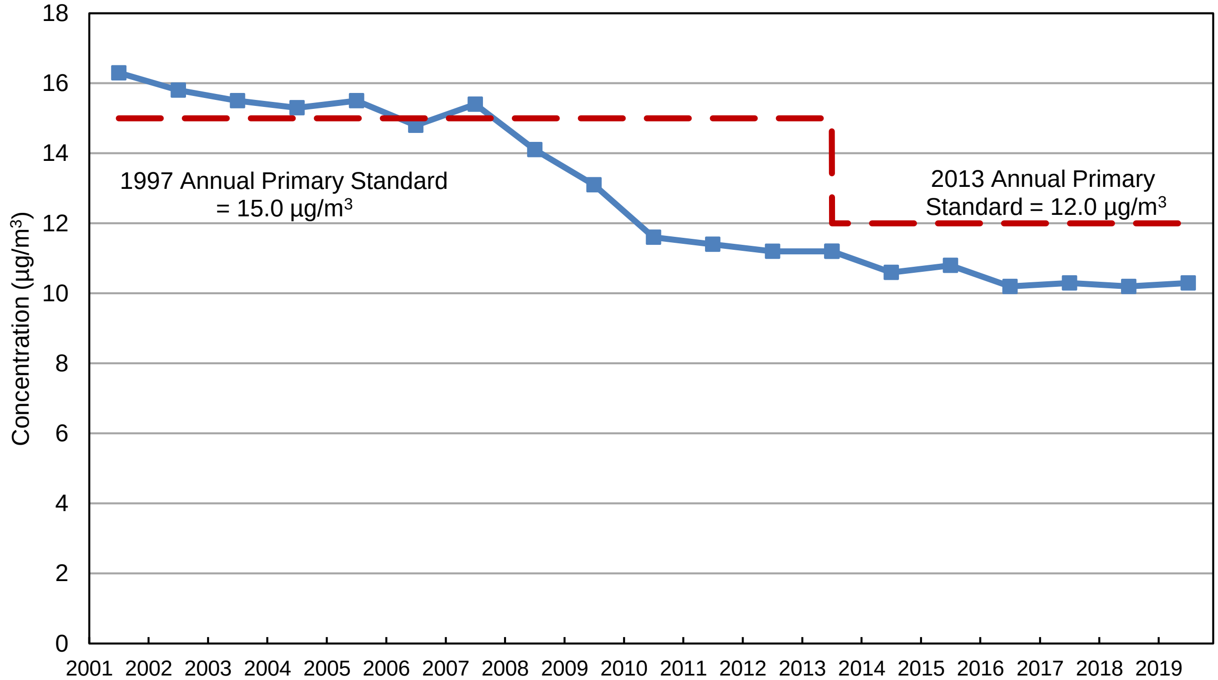


Figure 1-3
Nitrogen Dioxide (NO_2) Design Value Trend in New Jersey, 2000-2019
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average Concentration
Parts per Billion (ppm)

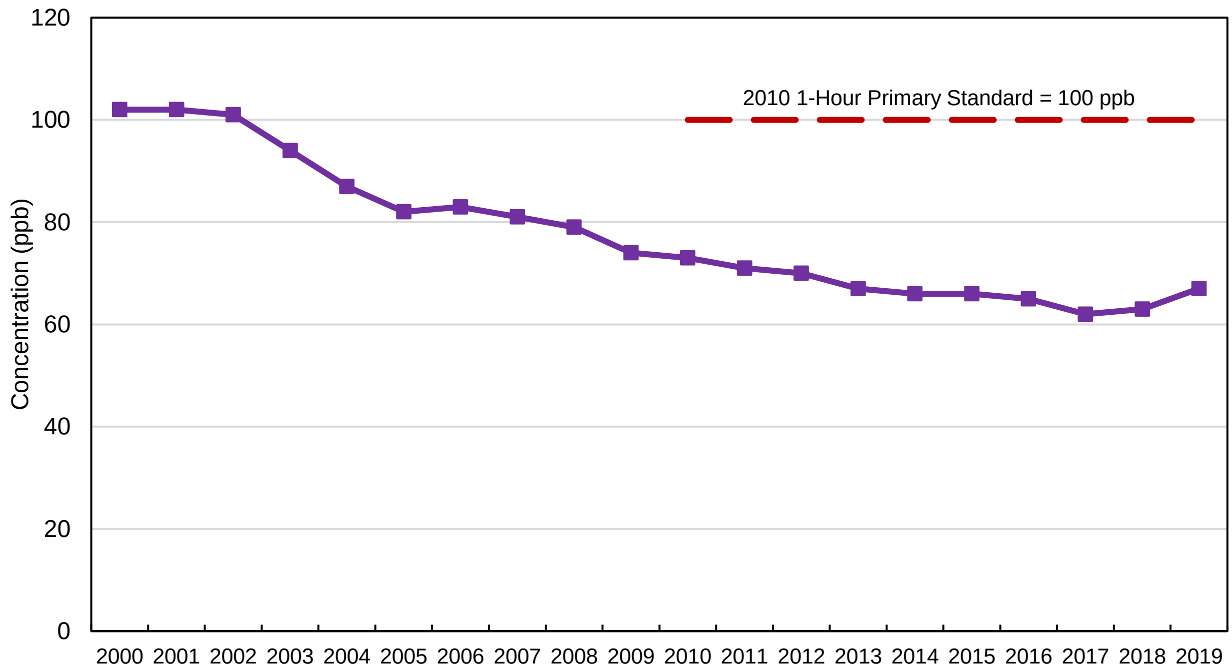


Figure 1-4
Sulfur Dioxide (SO_2) Design Value Trend in New Jersey, 2000-2019
3-Year Average of the 99th-Percentile of Daily Maximum 1-Hour Average Concentrations
in Parts per Billion (ppm)

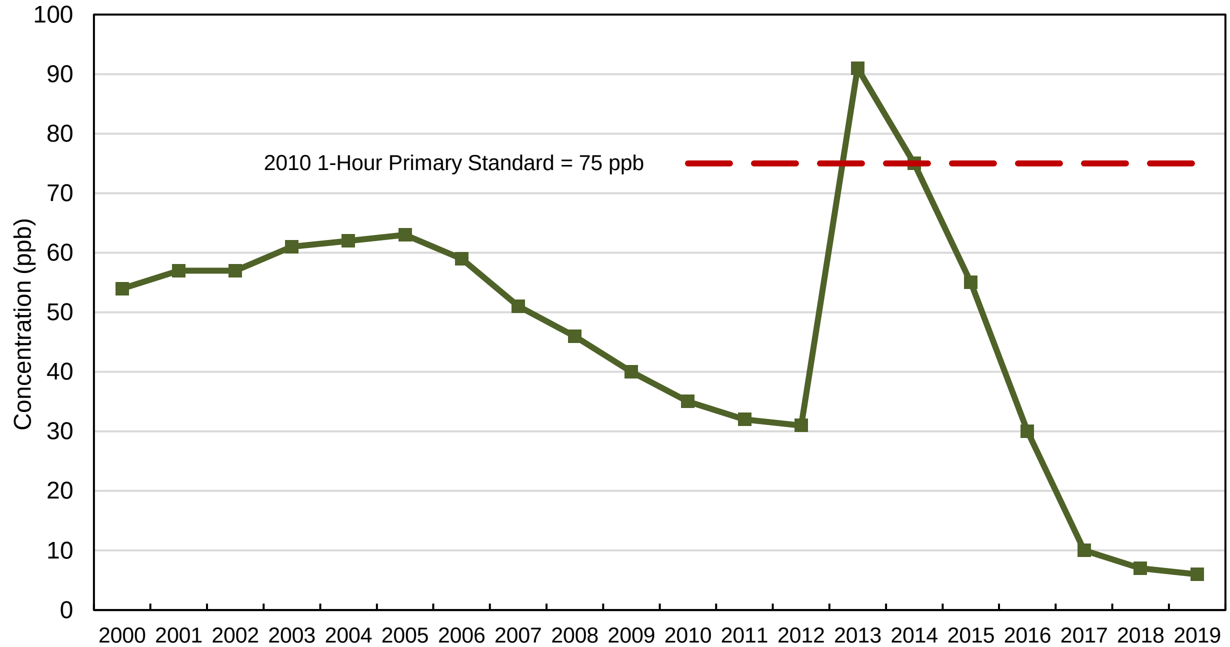


Figure 1-5
Carbon Monoxide (CO) Design Value Trend in New Jersey, 1990-2019
2nd-Highest 8-Hour Average Concentration
Parts per Million (ppm)

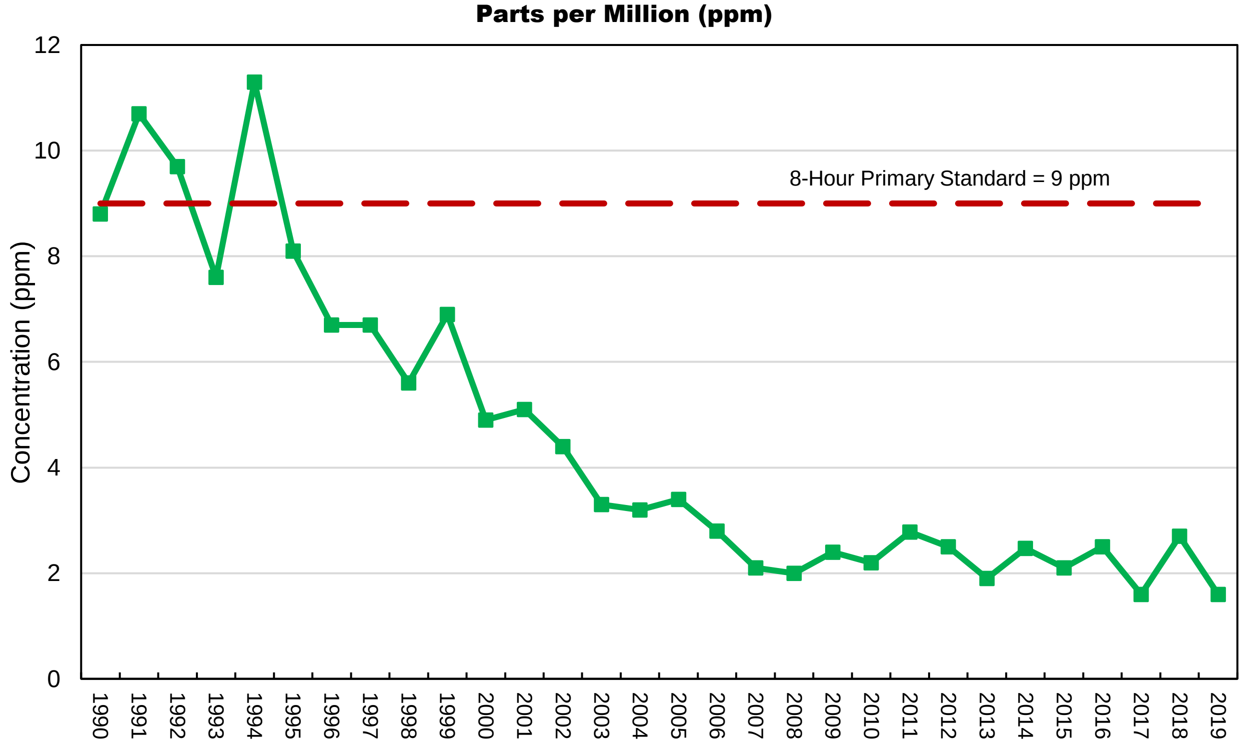
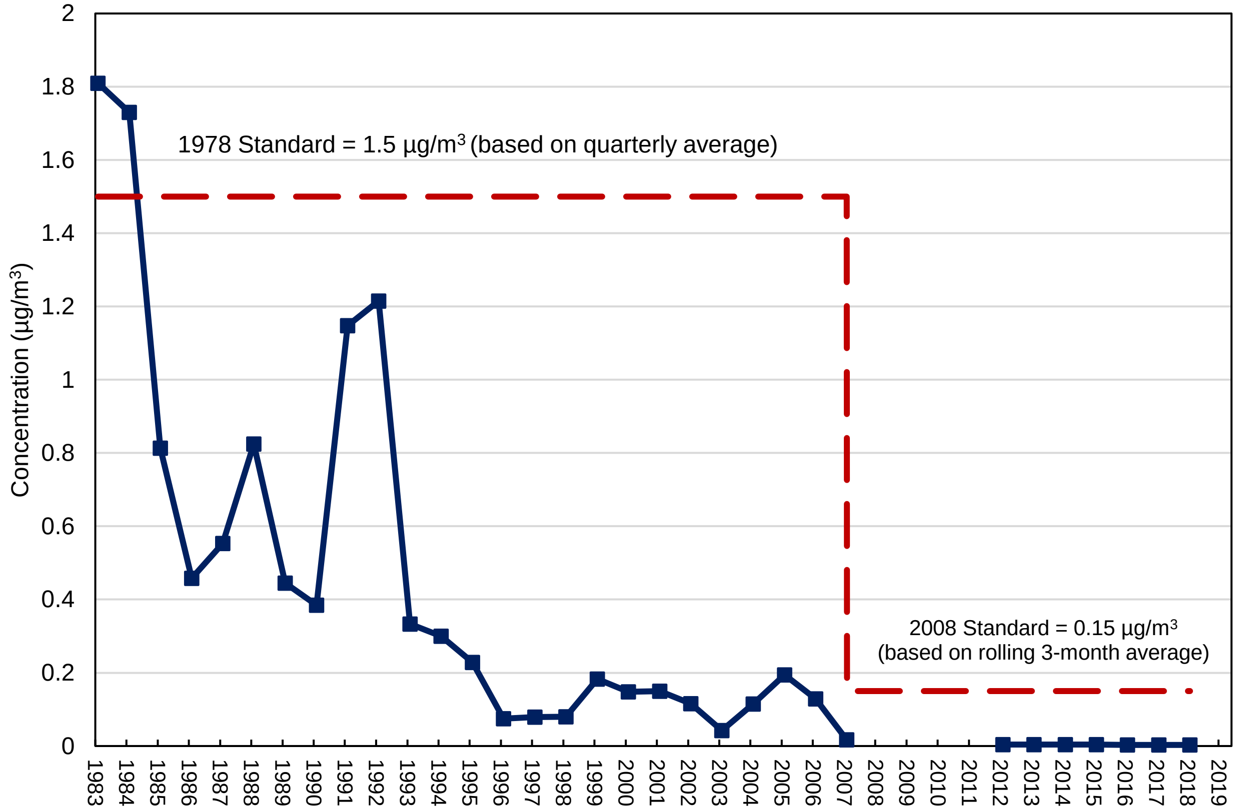


Figure 1-6
Lead Design Value Trend in New Jersey, 1983-2019
Highest 3-Month Average
Micrograms per Cubic Meter (µg/m³)



2019 Air Monitoring Network

New Jersey Department of Environmental Protection

Network Description

Figure 2-1
Filter-Based $PM_{2.5}$ Sampler in Trenton

In 2019, the New Jersey Department of Environmental Protection (NJDEP) Bureau of Air Monitoring (BAM) operated 32 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: ozone (O_3), particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and lead (Pb). 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, NO_2, SO_2 and CO 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 (https://nj.gov/dep/airmon) 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 and PM_{10} concentrations. NJDEP is gradually replacing many of its filter-based $PM_{2.5}$ samplers with real-time samplers, so as to report the current air quality from those sites to the website, and to reduce the manpower and time needed to obtain the data. In 2019 the filter-based sampler at Rahway was shut down, leaving the continuous monitor to measure $PM_{2.5}$, and the Columbia filter-based monitor became a quality assurance/quality control monitor for the real-time one.

In New Jersey, USEPA's National Core Multipollutant Monitoring Network (NCore) is represented by the Newark Firehouse monitoring station. NCore is a program that integrates several advanced measurement systems for gaseous pollutants, particles, and meteorology. This includes total reactive nitrogen, NO_y.

As part of the 2010 revisions to the NO_2 NAAQS, monitoring agencies were required to set up "near road" NO_2 and other monitors in larger urban areas with high vehicular traffic, within 50 meters of a major roadway. This location would measure the relative worst-case population exposures that could occur in the near-road environment, where peak hourly NO_2 concentrations were expected to occur. The Fort Lee Near Road monitoring station was established to comply with the new requirements.

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.

The Rutgers University monitoring site is part of USEPA's Photochemical Assessment Monitoring Station (PAMS) Program. PAMS 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. NO_y is required to be measured here, as well as various meteorological parameters.

Other non-criteria pollutants monitored by BAM include some commonly emitted by motor vehicles and other combustion sources: benzene, toluene, ethylbenzene, xylenes (measured with a "BTEX" analyzer), and black carbon (measured with an aethalometer).

Figure 2-2
Brigantine Air Monitoring Station

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.

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 precipitation samples and ship them to a national laboratory for analysis of acids, nutrients, and base cations.

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, rain, and solar radiation.

Figure 2-1 shows a filter-based manual $PM_{2.5}$ sampler located at the Trenton Free Public Library in Mercer County. Figure 2-2 shows the Brigantine monitoring station in Atlantic County.

The locations of all the monitoring stations that operated in 2019 are displayed 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 2019

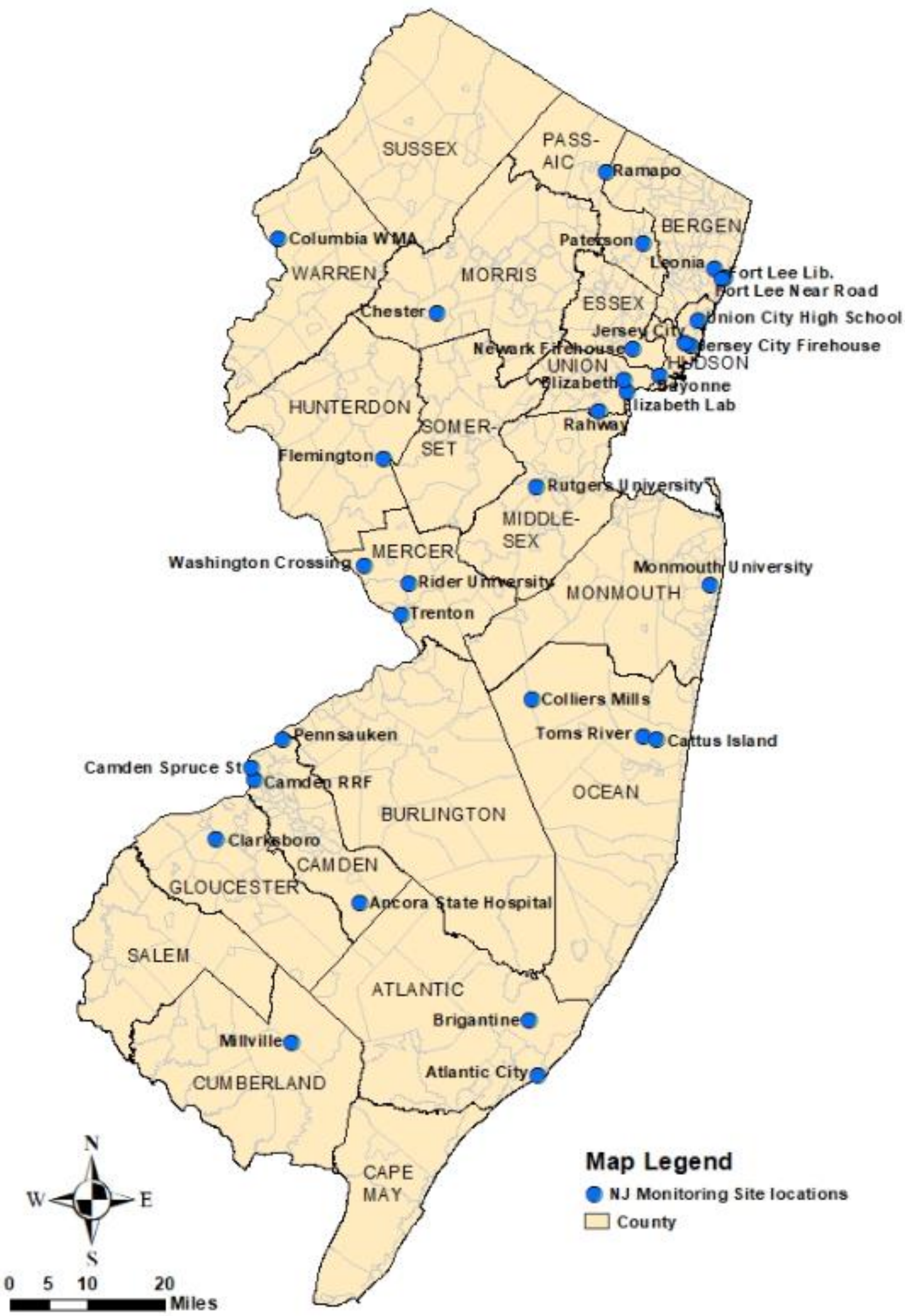


Table 2-1
2019 New Jersey Air Monitoring Network Summary

	Monitoring Station \ Monitoring Parameter	CO	NO_2	NOy	O_3	SO_2	$PM_{2.5}$ (Filter-based)	Real-Time $PM_{2.5}$	Visibility	PM_{10}	Lead	$PM_{2.5}$-Speciation	O_3 Precursors (PAMS)	Toxics	BTEX & Black Carbon	Acid Deposition	Mercury	Meteorological*	Rain	Solar Radiation
1	Ancora State Hospital				X															
2	Atlantic City						X													
3	Bayonne		X		X	X									X			X	X	
4	Brigantine				X	X	X	X	X							X				
5	Camden RRF									X										
6	Camden Spruce Street	X	X		X	X	X	X				X		X	X			X	X	
7	Cattus Island															X				
8	Chester		X		X	X	X					X		X						
9	Clarksboro				X		X													
10	Colliers Mills				X															
11	Columbia		X		X	X		X										X	X	
12	Elizabeth	X				X														
13	Elizabeth Lab	X	X			X	X	X				X		X	X		X	X	X	
14	Flemington				X			X										X	X	
15	Fort Lee Library						X													
16	Fort Lee Near Road	X	X					X							X			X	X	
17	Jersey City	X	X			X														
18	Jersey City Firehouse						X	X		X										
19	Leonia				X															
20	Millville		X		X			X												
21	Monmouth University				X															
22	Newark Firehouse	X	X	X	X	X	X	X		X	X	X			X			X	X	X
23	Paterson						X													
24	Pennsauken						X													
25	Rahway							X												
26	Ramapo				X															
27	Rider University				X			X										X		
28	Rutgers University		X	X	X		X	X				X	X	X			X	X		
29	Toms River						X													
30	Trenton						X													
31	Union City High School						X													
32	Washington Crossing															X				
	TOTAL	6	10	2	16	9	15	12	1	3	1	5	1	4	5	3	2	8	7	1

X - Parameter measured in 2019.
NO_2 includes NO and usually NO_x.
* Meteorological parameters include temperature, relative humidity, barometric pressure, wind direction & wind speed.

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2019 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 recently revised air monitoring webpage (https://nj.gov/dep/airmon).

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/m³) 24-hour	(ppm) 8-hour	(ppb) 1-hour	(ppb) 1-hour
Good	0-50	0.000-0.054	0.0-12.0	0.0-4.4	0-35	0-53
Moderate	51-100	0.055-0.070	12.1-35.4	4.5-9.4	36-75	54-100
Unhealthy for Sensitive Groups	101-150	0.071-0.085	35.5-55.4	9.5-12.4	76-185	101-.360
Unhealthy	151- 200	0.086-0.105	55.5-150.4	12.5-15.4	186-304	361-649
Very Unhealthy	201-300	0.106-0.200	150.5-250.4	15.5-30.4	305-604	605-1249
Hazardous	301-500	>0.200	250.5-500.4	30.5-1004	605-1004	1250-2049

Pollutants:
O_3 – Ozone
$PM_{2.5}$ – Fine particulate matter
CO – Carbon monoxide
SO_2 – Sulfur dioxide
NO_2 – Nitrogen dioxide

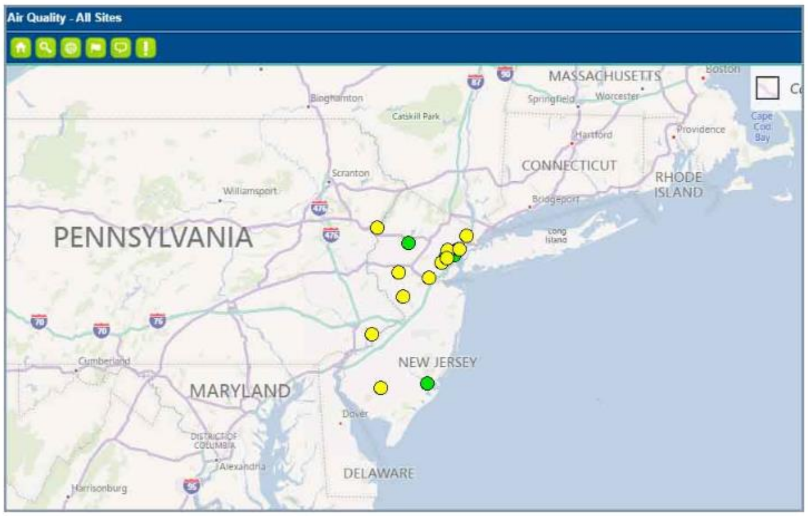
Units:
ppm – parts per million
µg/m³ – micrograms per cubic meter
ppb – parts per billion

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, tables, annual trends and other air quality information are also available on the NJDEP air monitoring web site, as shown in Figure 3-1 below.

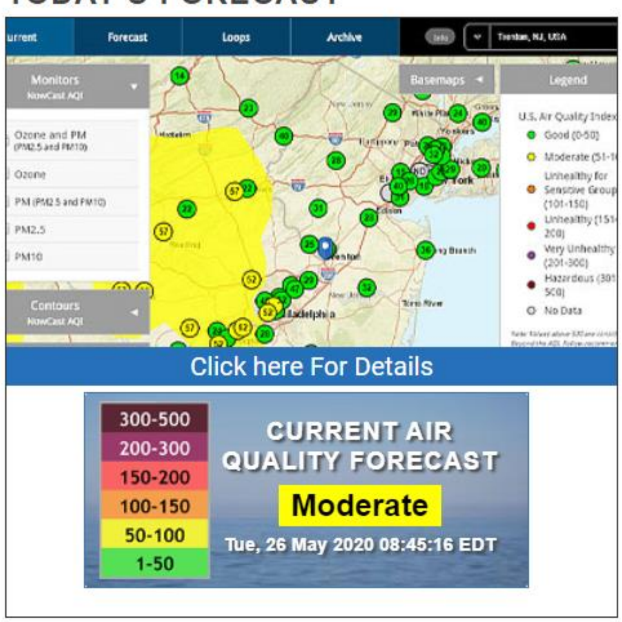
Figure 3-1
Examples of Information Available on NJDEP's Air Monitoring Website
https://nj.gov/dep/airmon

Current Air Quality

MAP OF THE LATEST DATA



TODAY'S FORECAST



2019 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.

There is also an ozone monitor at Washington Crossing State Park that is managed by USEPA. Although it is not officially part of the NJDEP network, its data is included in determining exceedances in New Jersey.

Table 3-4
Pollutants Monitored at Each Air Quality Index Monitoring Site in New Jersey in 2019

	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 2019 AQI ratings for New Jersey is displayed in the pie chart in Figure 3-2 below. In 2019, there were 162 "Good" days, 190 were "Moderate," and 13 were "Unhealthy for Sensitive Groups." This indicates that in 2019 air quality in New Jersey was good on 44% of days, and moderate on 52% of days. However, air pollution was still bad enough on 4% of days to potentially affect sensitive people.

Figure 3-2
2019 Air Quality Summary by Days

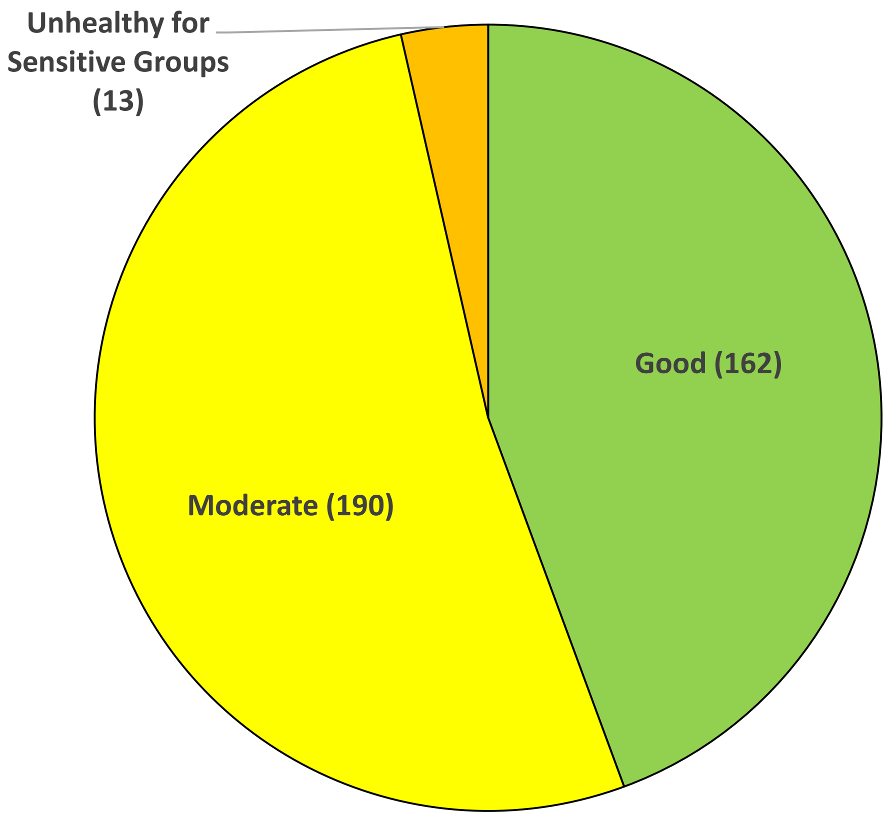


Figure 3-3 shows the distribution of AQI days since 2000. It should be noted that AQI ranges change whenever a NAAQS for a specific pollutant is revised. So even though improvement in AQI days appears to be somewhat erratic, to see how things really have improved, refer to the concentration trend graphs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

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

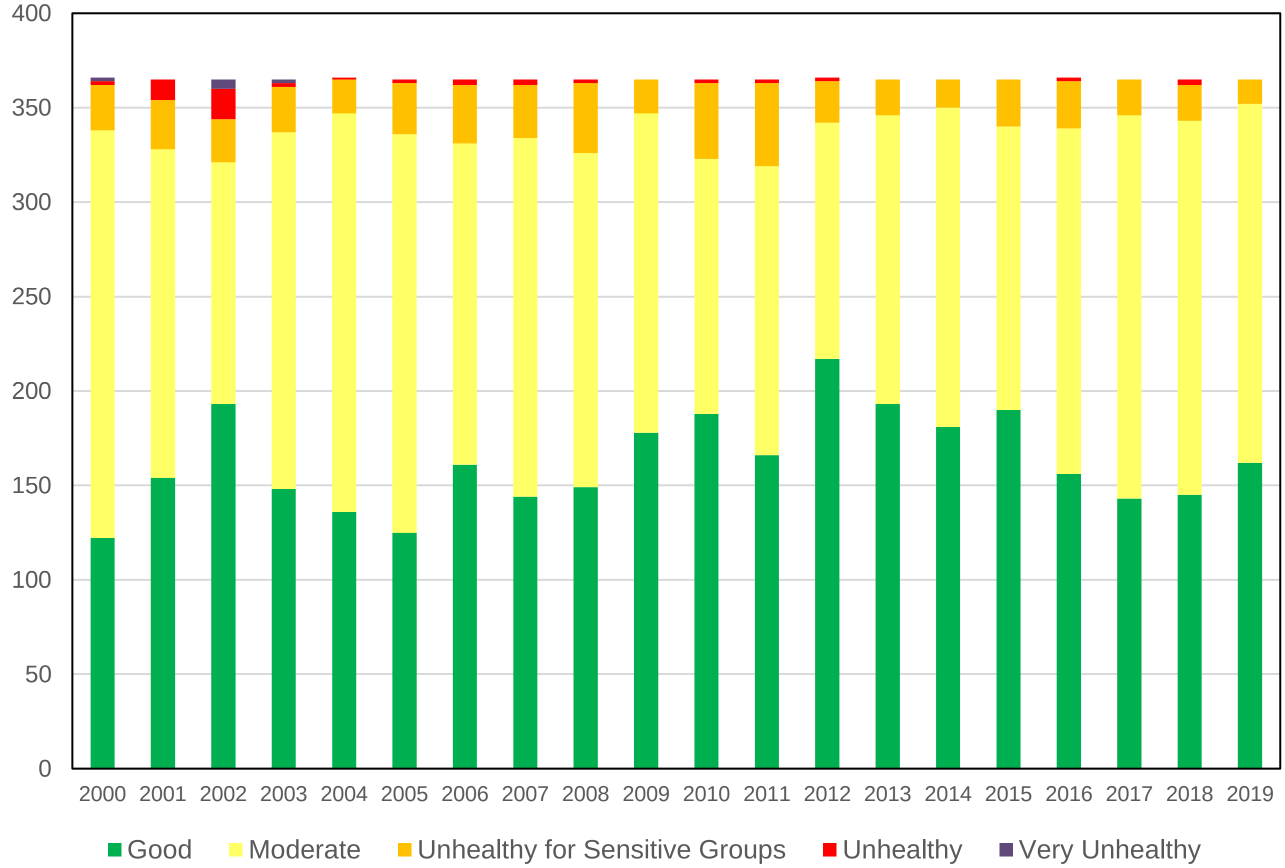


Table 3-5 is a summary of the days when the AQI reached or exceeded the "Unhealthy for Sensitive Groups" ("USG") threshold at any monitoring location in New Jersey in 2019. Table 3-6 lists the individual exceedance dates and shows the specific pollutants and their locations and concentrations. The nitrogen dioxide exceedance is attributed to vehicles idling near the Fort Lee Near Road monitoring station.

Table 3-5
2019 Total Number of NAAQS Exceedance Days in New Jersey

Pollutant	Exceedances
Nitrogen Dioxide	1
Ozone	12
$PM_{2.5}$	1

Table 3-6
AQI "Unhealthy" or "USG" Days in New Jersey During 2019

Day	Date	Monitor Location	Pollutant	Concen-tration	Units	Rating	AQI Value
1	2/3/19	Columbia	$PM_{2.5}$	36.5	µg/m^3	USG	103
2	2/27/19	Fort Lee Near Road	NO_2	109	ppb	USG	103
3	6/5/19	Washington Crossing*	O_3	0.071	ppm	USG	101
4	6/26/19	Ancora	O_3	0.071	ppm	USG	101
5	6/27/19	Ancora	O_3	0.072	ppm	USG	105
		Millville	O_3	0.072	ppm	USG	105
6	6/28/19	Brigantine	O_3	0.072	ppm	USG	105
		Camden Spruce St	O_3	0.071	ppm	USG	101
		Flemington	O_3	0.073	ppm	USG	108
		Leonia	O_3	0.085	ppm	USG	150
		Millville	O_3	0.071	ppm	USG	101
		Rutgers	O_3	0.072	ppm	USG	105
7	7/2/19	Ancora	O_3	0.074	ppm	USG	112
		Camden Spruce St	O_3	0.078	ppm	USG	126
		Clarksboro	O_3	0.080	ppm	USG	133
		Colliers Mills	O_3	0.085	ppm	USG	150
		Millville	O_3	0.072	ppm	USG	105
8	7/4/19	Leonia	O_3	0.071	ppm	USG	101
		Ramapo	O_3	0.077	ppm	USG	122
9	7/10/19	Rutgers	O_3	0.074	ppm	USG	112
10	7/16/19	Rutgers	O_3	0.075	ppm	USG	115
11	7/26/19	Leonia	O_3	0.073	ppm	USG	108
12	7/27/19	Camden Spruce St	O_3	0.077	ppm	USG	122
13	7/29/19	Colliers Mills	O_3	0.074	ppm	USG	112
14	7/30/19	Leonia	O_3	0.072	ppm	USG	105

Rating
USG = Unhealthy for sensitive groups

Pollutants
NO_2 –Nitrogen dioxide
O_3 – Ozone
$PM_{2.5}$ – Fine particles

Units
ppb – parts per billion
ppm – parts per million
µg/m^3 - micrograms per cubic meter

*The Washington Crossing air monitoring station is operated by USEPA. Although it is not part of NJDEP's network, the site's data is included in determining exceedances in New Jersey.

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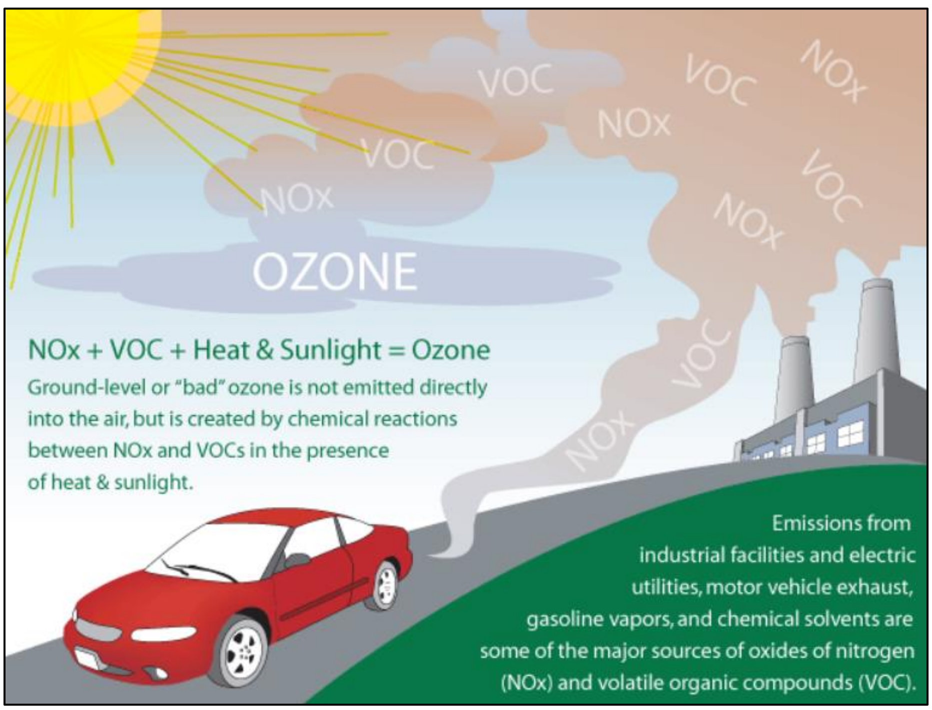
2019 Ozone Summary

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. 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 4-1). 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.

Figure 4-1
Ozone Formation

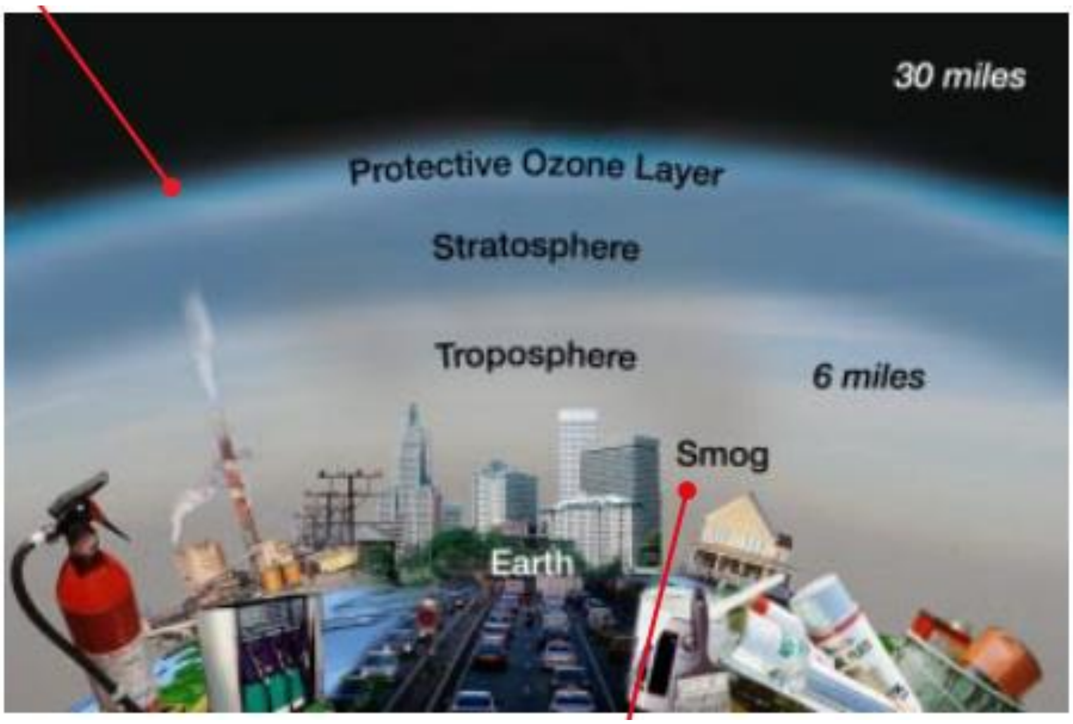


https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics#wwh

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 Figure 4-2, and the USEPA publication, "Good Up High, Bad Nearby – What is Ozone?"

Figure 4-2. 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.

https://www3.epa.gov/airnow/gooduphigh/ozone.pdf

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.

Figure 4-3
Leaf Damage Caused by Ozone

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 brown areas on the leaf shown in Figure 4-3 are damage caused by exposure to ground-level ozone.

For more information see:
https://www.ars.usda.gov/southeast-area/raleigh-nc/plant-science-research/docs/climate-changeair-quality-laboratory/ozone-effects-on-plants/

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). The USEPA must periodically review the NAAQS to determine if they are sufficiently protective of public health based on the latest studies. Initially, the ozone NAAQS was an hourly average of 0.12 ppm, established in 1979. It has since been revoked by USEPA, although New Jersey still uses it as a primary state standard. In 1997, the 0.08 parts per million (ppm) ozone NAAQS was promulgated, based on the maximum 8-hour average daily concentration. It was changed to 0.075 ppm in 2008. In October 2015 the 8-hour ozone NAAQS was lowered once again, to 0.070 ppm, effective in 2016.

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)

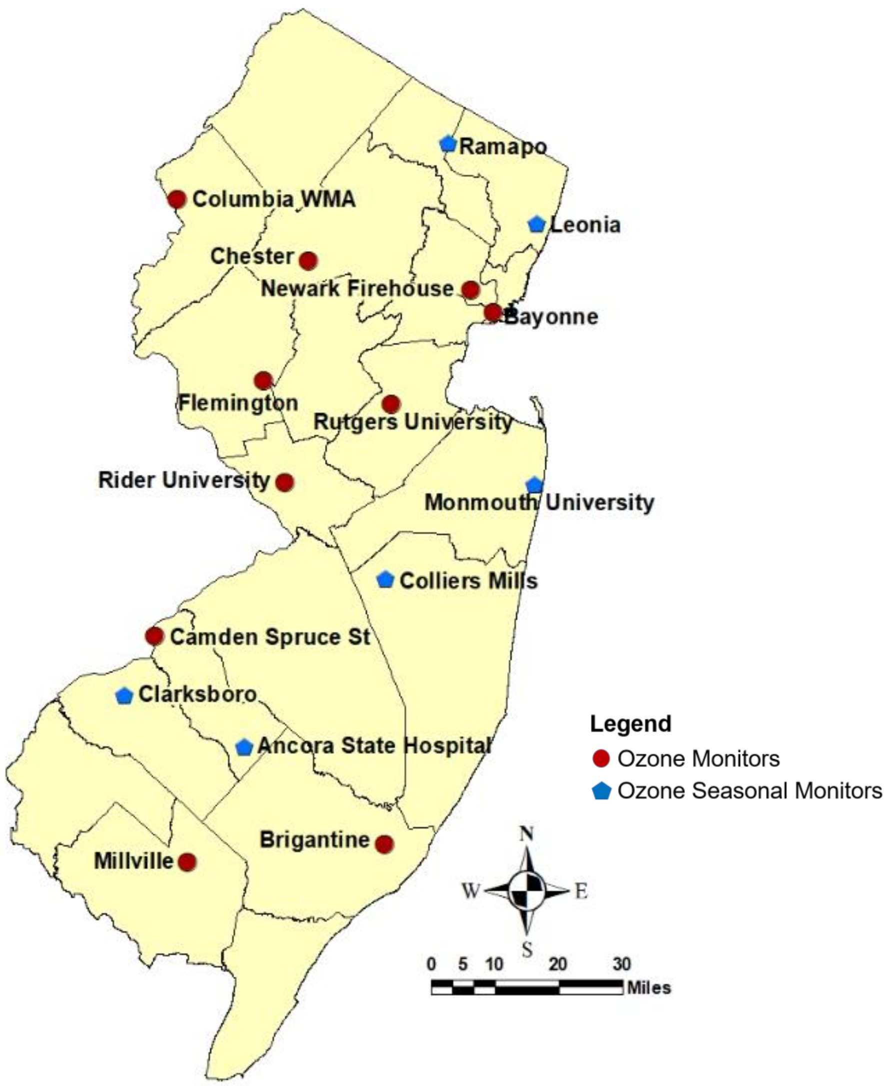
Averaging Period	Type	National	New Jersey
1-Hour	Primary	---	0.12 ppm
8-Hours	Primary & secondary	0.070 ppm	---

OZONE MONITORING NETWORK

The New Jersey Department of Environmental Protection operated 16 monitoring stations in New Jersey during 2019 (see Figure 4-4). Of those 16 sites, ten operate year-round and six operate only during the ozone season, which is March 1st through October 31st. Bayonne, Brigantine, Camden Spruce Street, Chester, Columbia, 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. It can be obtained from USEPA at https://www.epa.gov/outdoor-air-quality-data.

Figure 4-4
2019 Ozone Monitoring Network



OZONE LEVELS IN 2019

During the 2019 ozone season, 10 of the 16 New Jersey monitoring sites recorded levels above the 8-hour standard of 0.070 ppm at least once. There were twelve (12) days, between June 5 and July 30, on which the standard was exceeded somewhere in the state (including one day, June 5, on which only USEPA's Washington Crossing site went over). See the Air Quality Index section for details.

Table 4-2 presents the USEPA-verified 2019 New Jersey ozone data. Of the 16 monitoring sites that operated during the 2019 ozone season, none recorded levels above the New Jersey 1-hour standard of 0.12 ppm. The highest daily 1-hour concentration was 0.102 ppm, recorded at Leonia on June 28. The last time the 1-hour standard was exceeded in New Jersey was in 2018. Figure 4-5 shows the one-hour data for each site.

The highest daily maximum 8-hour average concentration was 0.085, at Leonia on June 28 and Colliers Mills on July 2. Ten sites (plus Washington Crossing) exceeded the 8-hour standard (0.070 ppm) at least once (Ancora, Brigantine, Camden Spruce Street, Clarksboro, Colliers Mills, Flemington, Leonia, Millville, Ramapo, and Rutgers University). Leonia had the most exceedances, with four, and was also the only site to go above the design value (4^{th}-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 2017-2019 period. Figure 4-8 gives a count of the number of exceedance days at each New Jersey monitoring site.

Table 4-2
2019 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	2017-2019 Average of 4th-Highest Daily Max.
Ancora	0.085	0.074	0.067	0.067
Bayonne	0.095	0.067	0.065	0.070
Brigantine	0.079	0.072	0.059	0.061
Camden Spruce St.	0.085	0.078	0.070	0.073
Chester	0.074	0.066	0.062	0.068
Clarksboro	0.091	0.080	0.068	0.072
Colliers Mills	0.091	0.085	0.068	0.072
Columbia	0.073	0.062	0.058	0.063
Flemington	0.087	0.073	0.066	0.070
Leonia	0.102	0.085	0.071	0.074
Millville	0.081	0.072	0.068	0.064
Monmouth University	0.076	0.070	0.067	0.065
Newark Firehouse	0.092	0.070	0.065	0.066
Ramapo	0.097	0.077	0.064	0.066
Rider University	0.082	0.070	0.066	0.070
Rutgers University	0.085	0.075	0.070	0.073

Figure 4-5
2019 Ozone Concentrations in New Jersey
1-Hour Daily Maximum Concentrations
Parts per Million (ppm)

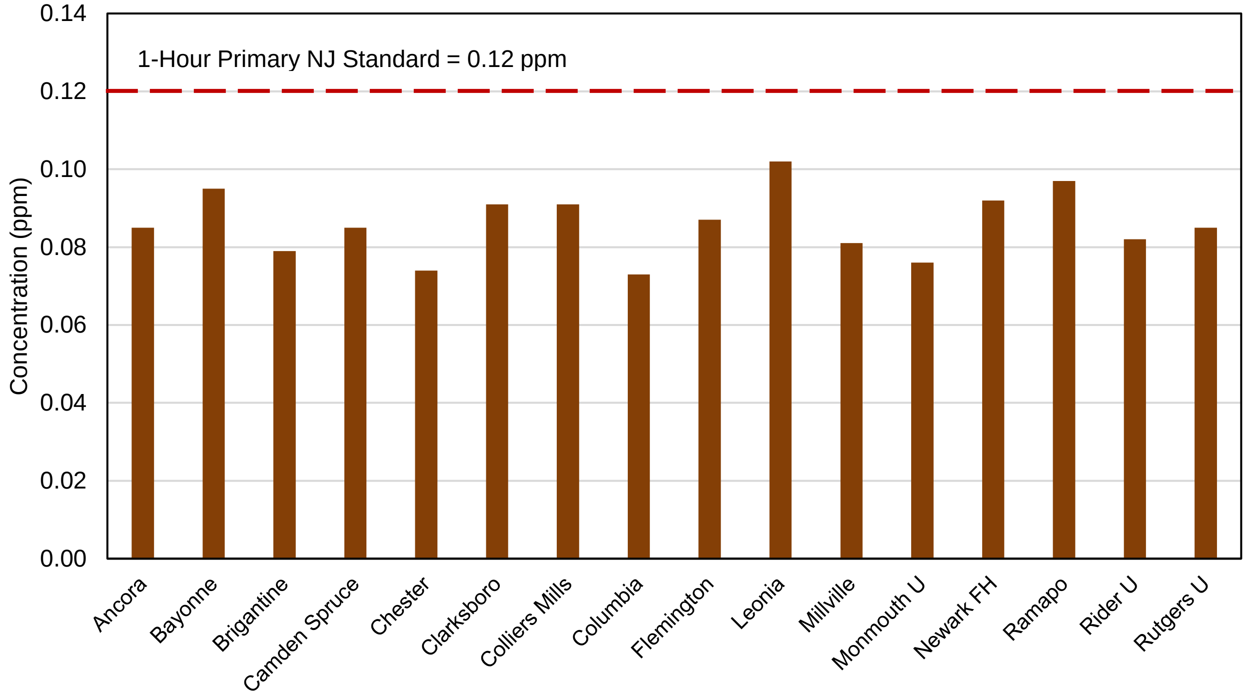


Figure 4-6
2019 Ozone Concentrations in New Jersey
8-Hour Daily Maximum Concentrations
Parts per Million (ppm)

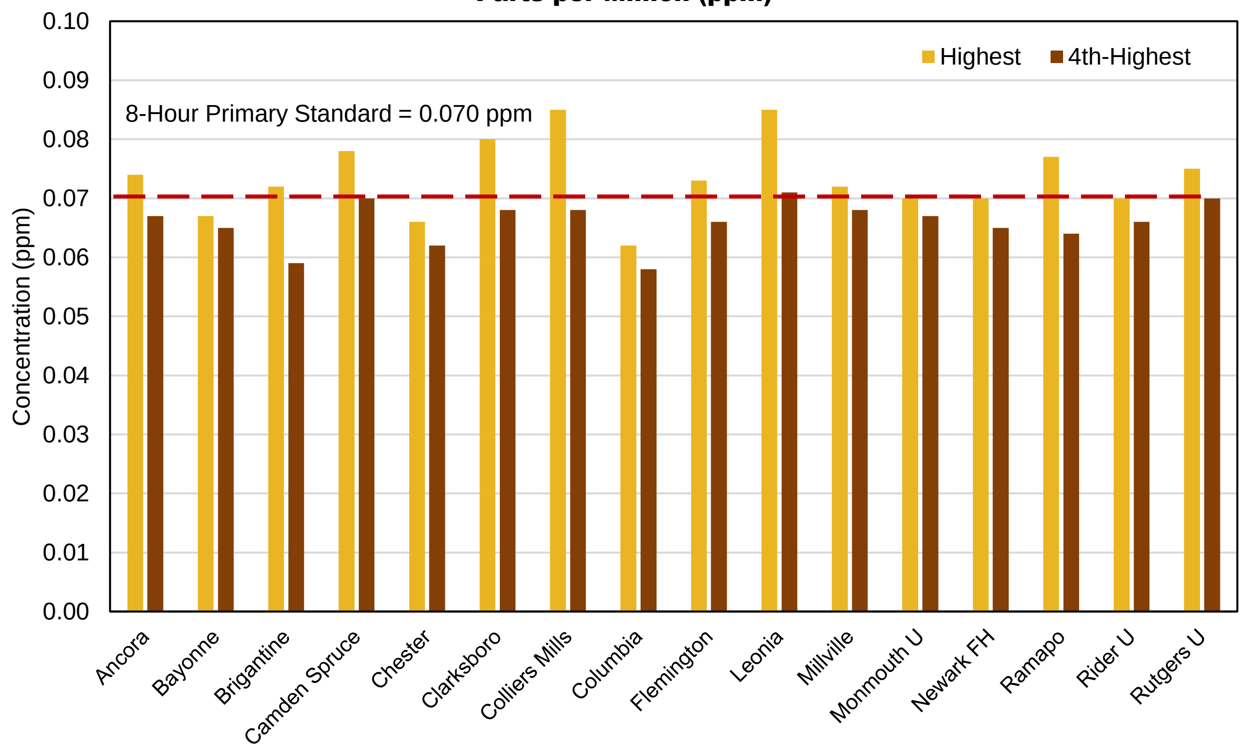


Figure 4-7
New Jersey Ozone Design Values for 2017-2019
3-Year Average of the 4th-Highest Daily Maximum 8-Hour Average
Parts per Million (ppm)

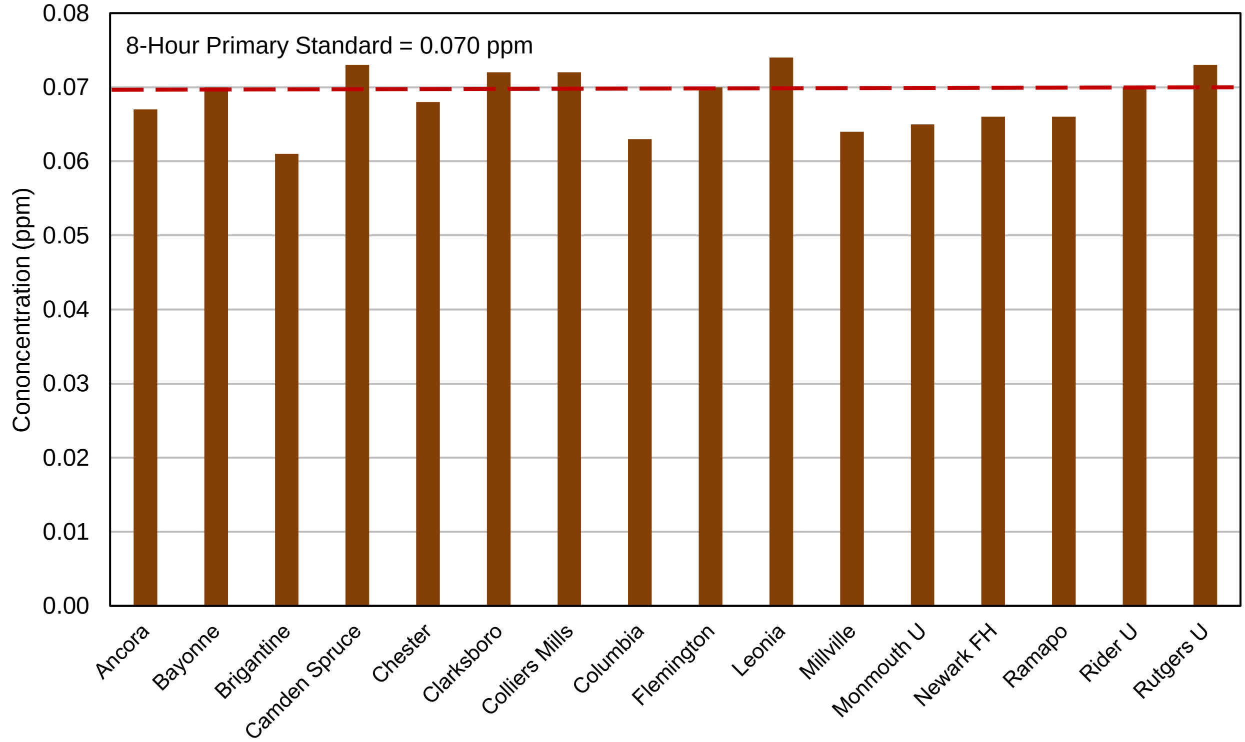
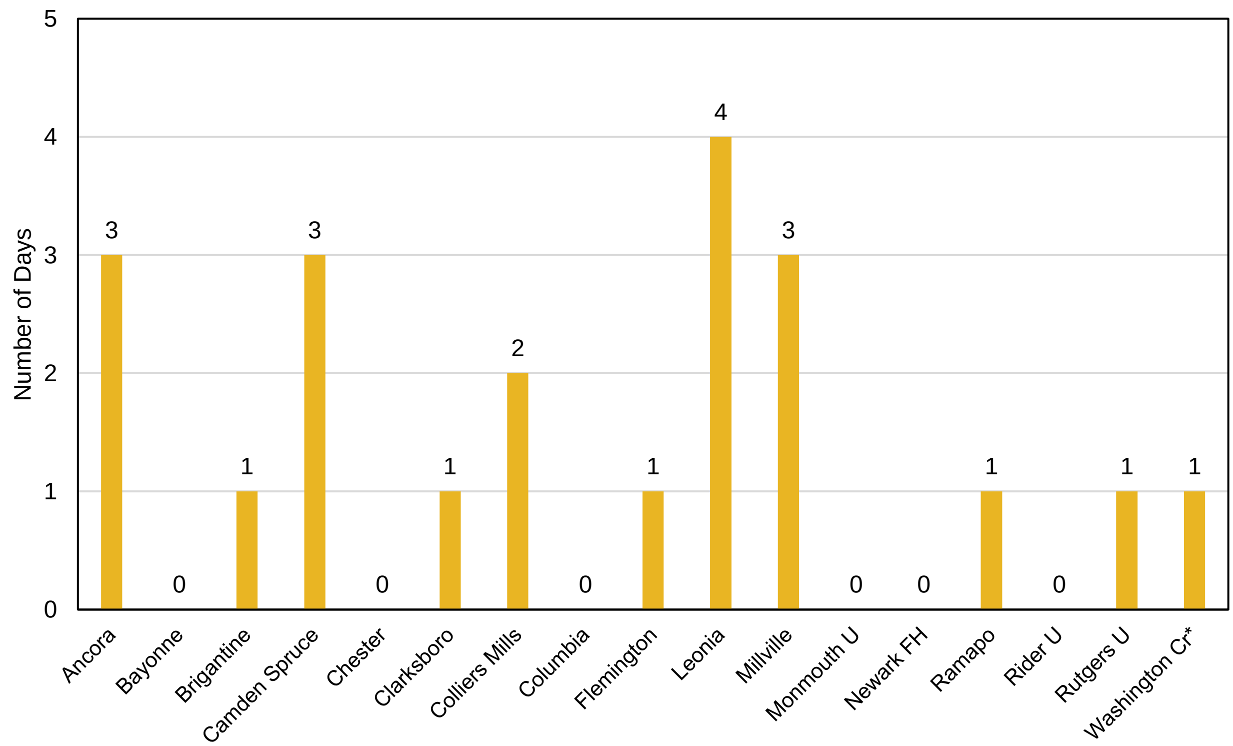


Figure 4-8
Number of Exceedance Days of the 8-Hour O_3 NAAQS in 2019 at NJ's Monitors



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, emissions reductions have resulted in a relatively steady decrease in ozone levels in New Jersey. However, it will take some new initiatives for the state to further decrease ozone concentrations in order to meet the lower 2015 standard. The chart in Figure 4-9 shows the fourth-highest statewide 8-hour maximum average concentration recorded each year since 1997. In 2019, this value was 0.071 ppm, measured at Leonia. The 2019 design value, which is the three-year average of the 4th-highest maximum daily 8-hour concentrations at any site statewide, was 0.074 ppm, as shown in Figure 4-10. This exceeds the 0.070 ppm NAAQS.

Figure 4-9
Ozone Trend in New Jersey, 1997-2019
4th-Highest Daily Maximum 8-Hour Averages
Parts per Million (ppm)

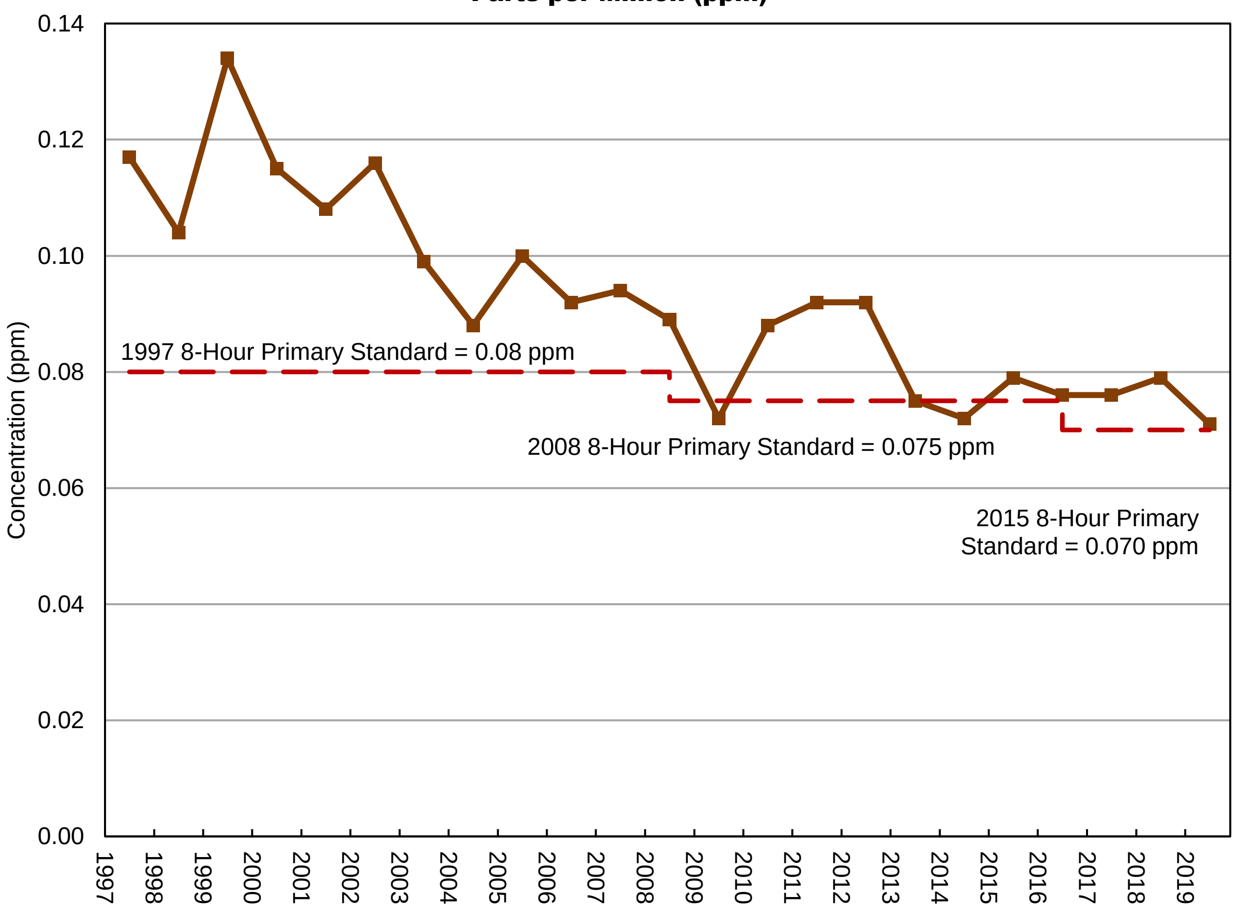
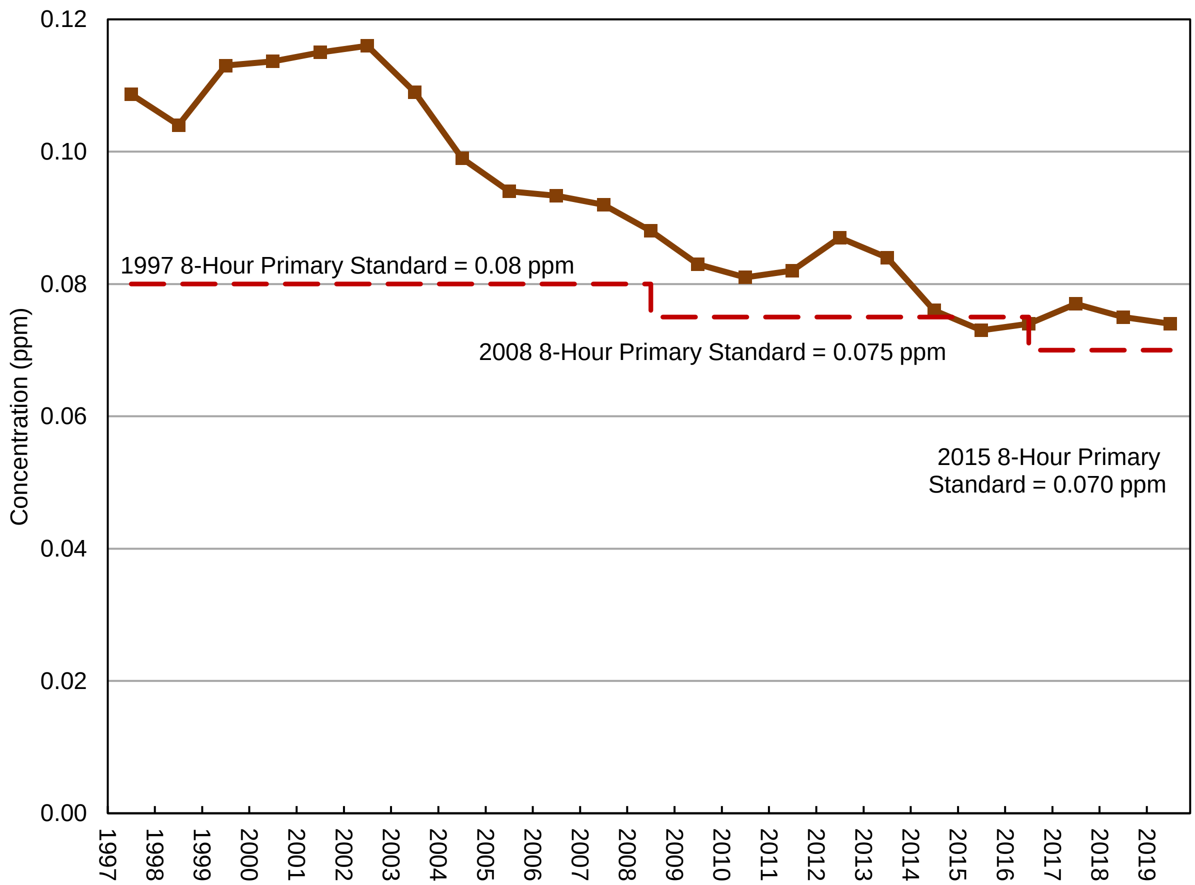


Figure 4-10
Ozone Design Value Trend in New Jersey, 1997-2019
3-Year Average of 4th-Highest Daily Maximum
8-Hour Average Concentration
Parts per Million (ppm)

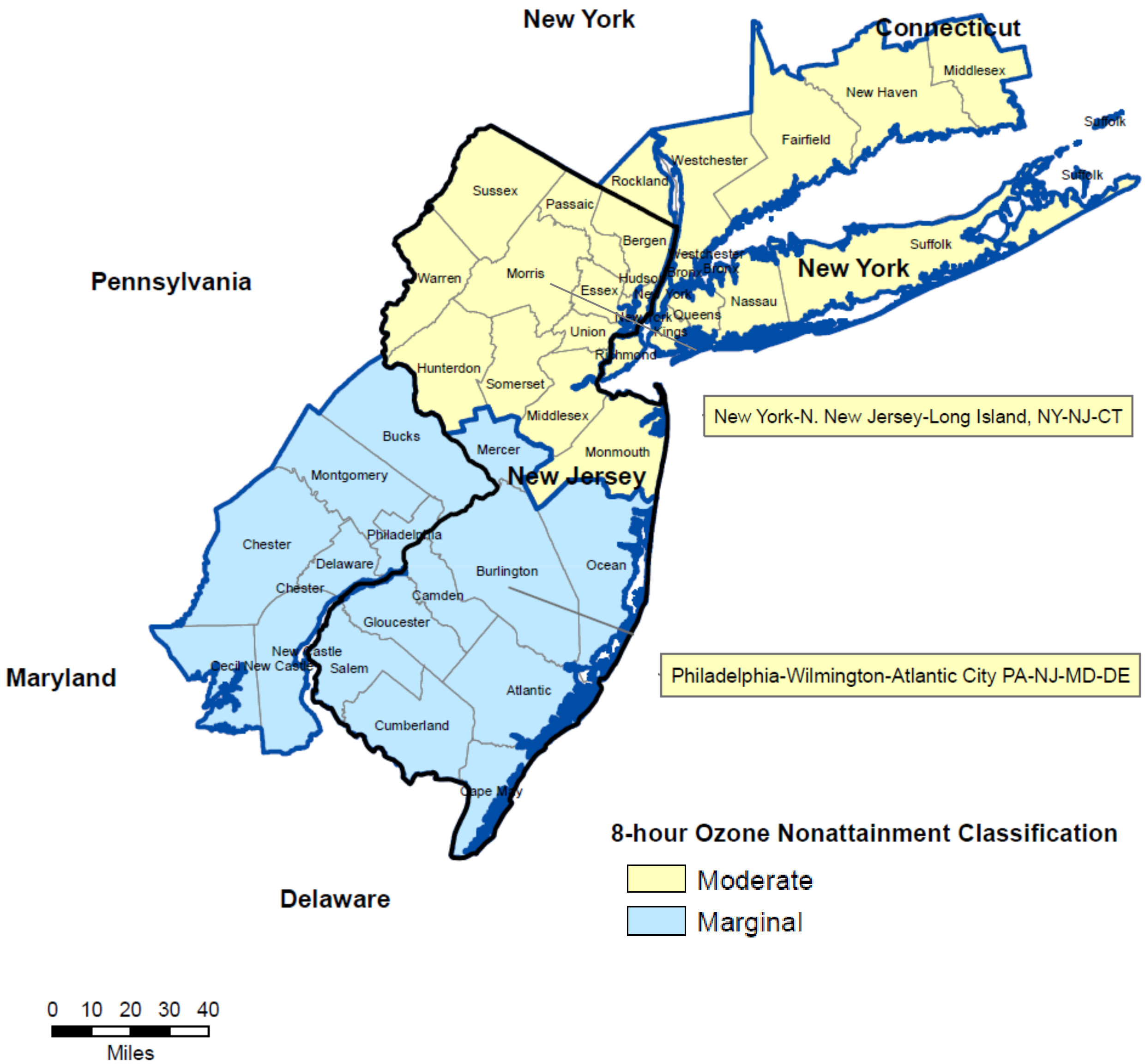


Ozone Nonattainment Areas in New Jersey

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.

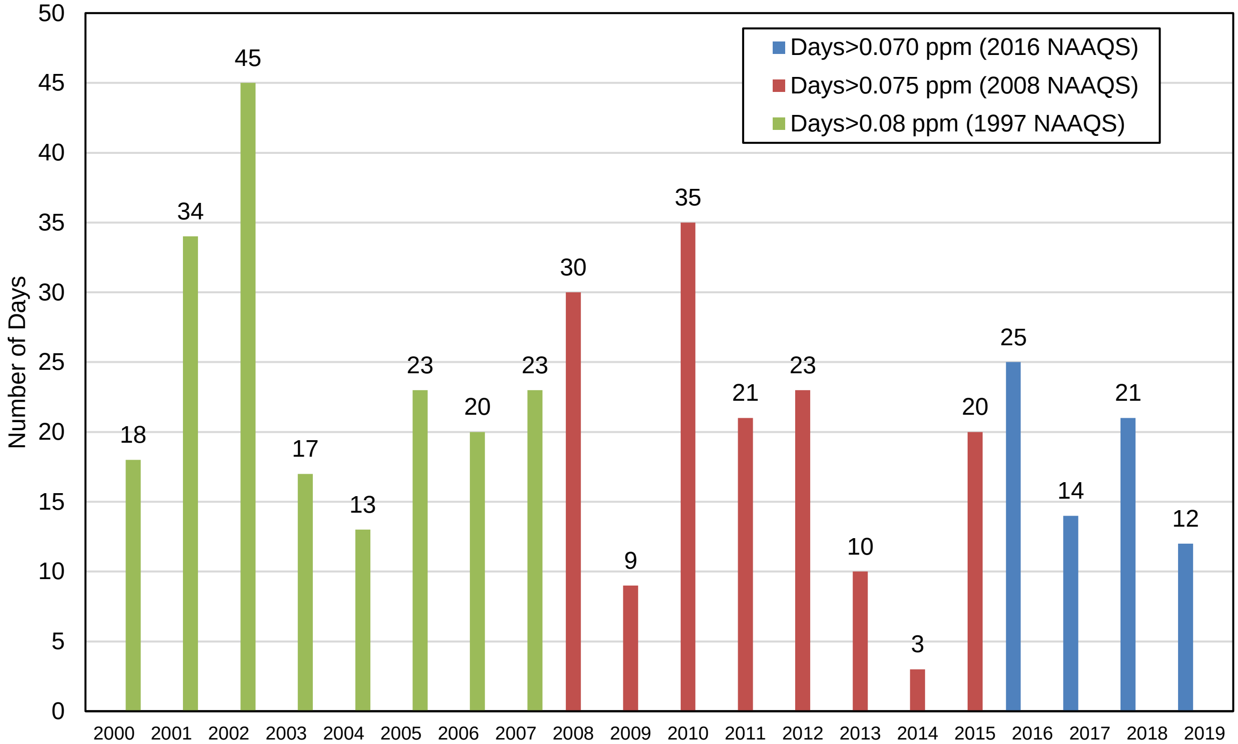
The state of New Jersey has been in nonattainment for the ozone NAAQS with the northern part of the state classified as being “moderate” and the southern part of the state classified as being “marginal.” New Jersey’s current classification with respect to the 2015 8-hour standard is shown in Figure 4-11. Figure 4-12 shows the total number of exceedance days in New Jersey since 2000, relative to the applicable NAAQS at the time.

Figure 4-11
New Jersey 8-Hour Ozone Nonattainment Areas



Source: https://www3.epa.gov/airquality/greenbook/map/nj8_2015.pdf

Figure 4-12
Number of Days on Which the Ozone NAAQS was Exceeded, 2000-2019



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2019 Particulate Matter Summary

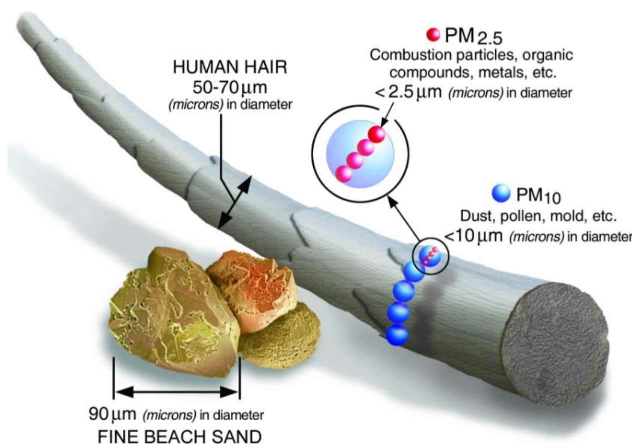
New Jersey Department of Environmental Protection

SOURCES

Particulate air pollution is a complex mixture of organic and inorganic substances in the atmosphere, occurring 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}. "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 shows an example of reduced visibility, in this case due to meteorological conditions, recorded by the visibility camera at the Brigantine NJ Camnet site in Atlantic County (www.hazecam.net). 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 $\mu g/m^3$, and an annual standard was set at 50 $\mu g/m^3$ (it was revoked in 2010). In 1997, 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 2019 consisted of twenty $PM_{2.5}$ 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.

Fifteen $PM_{2.5}$ 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.

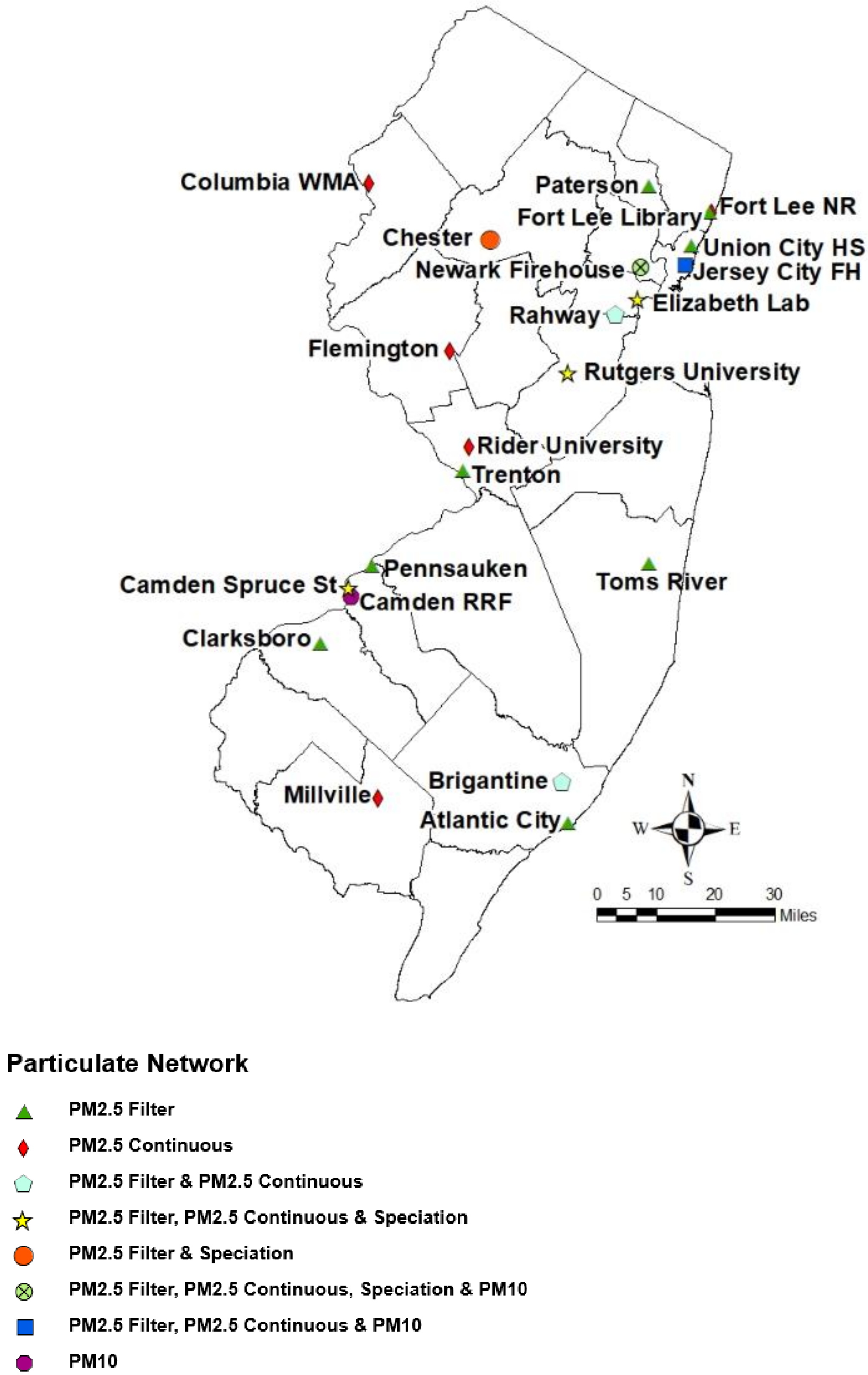
In order to provide real-time hourly data to the public (through the Air Quality Index at www.njaqinow.net), NJDEP has also been using particulate monitors that operate continuously. Twelve sites in New Jersey use Beta Attenuation Monitors (BAM), which measure the loss of intensity (attenuation) of beta 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. In 2019 at the Columbia site, the filter-based sampler was designated a quality control/quality assurance collocated instrument and the continuous sampler became the primary sampler.

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.

Figure 5-3
2019 Particulate Monitoring Network



FINE PARTICLE ($PM_{2.5}$) LEVELS IN 2019

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

In 2019, none of the filter-based FRM $PM_{2.5}$ monitoring sites were in violation of either the annual NAAQS of 12.0 $\mu g/m^3$ or the 24-hour NAAQS of 35 $\mu g/m^3$. The annual mean concentrations of $PM_{2.5}$ measured at the fifteen FRM samplers ranged from 5.57 $\mu g/m^3$ at the Chester monitoring site to 9.17 $\mu g/m^3$ at the Camden Spruce Street station. The highest 24-hour concentrations ranged from 18.4 $\mu g/m^3$ at Chester to 33.0 $\mu g/m^3$ at Trenton Library. Table 5-2 shows the 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 eleven sites (Atlantic City, Brigantine, Camden Spruce Street, Chester, Clarksboro, Fort Lee Library, Newark Firehouse, Paterson, Pennsauken, Rutgers University, and Union City High School) take a sample every third day. At the Columbia monitoring station, the continuous $PM_{2.5}$ sampler was designated as the primary monitor for the site, and the filter-based $PM_{2.5}$ sampler became a secondary (co-located) monitor. USEPA uses data from co-located monitors only for quality assurance, not for determining compliance with the NAAQS, so that data is not included in this report.

Table 5-2
2019 $PM_{2.5}$ 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	115	6.53	21.4	16.8
Brigantine	114	6.97	20.2	14.2
Camden Spruce Street	112	9.17	30.2	24.1
Chester	113	5.57	18.4	13.4
Clarksboro	118	7.15	29.5	21.5
Elizabeth Lab	357	8.77	32.1	23.7
Fort Lee Library	118	7.15	19.9	18.6
Jersey City Firehouse	350	7.65	28.7	22.5
Newark Firehouse	117	7.87	23.1	19.9
Paterson	113	7.69	25.7	19.5
Pennsauken	117	6.71	30.8	21.1
Rutgers University	112	6.76	24.9	23.1
Toms River	345	6.22	23.1	15.7
Trenton Library	313	7.68	33.0	20.7
Union City High School	112	7.88	21.7	20.2

Figure 5-4
2019 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)

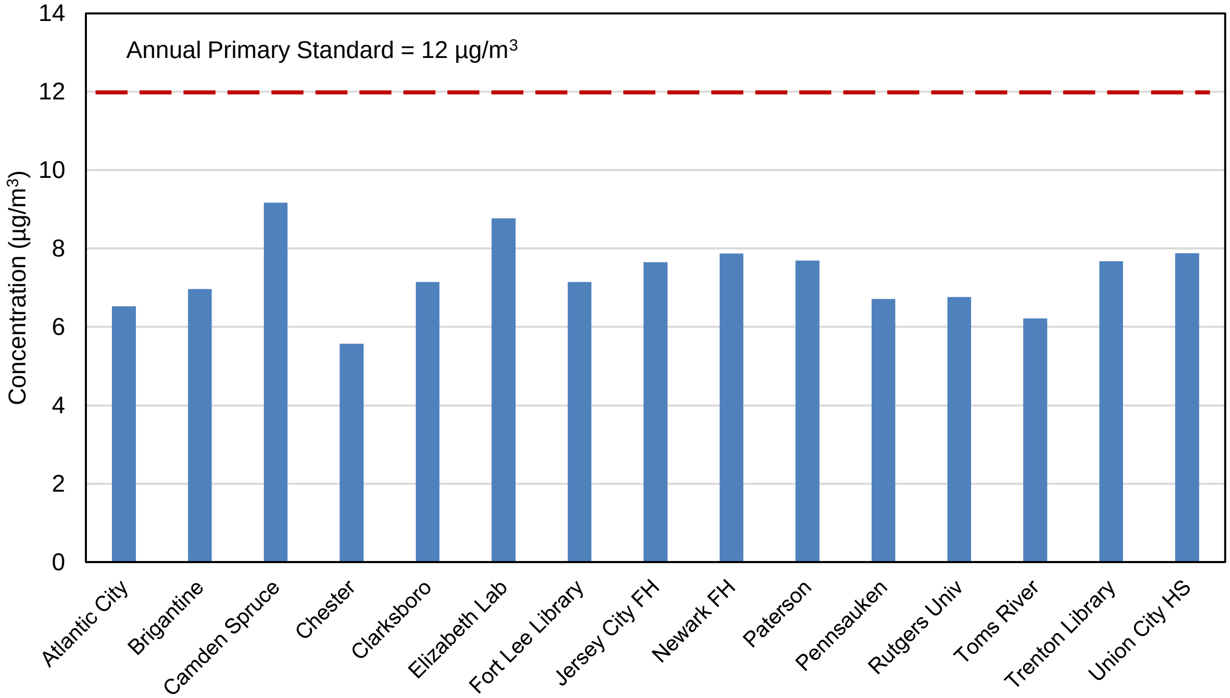
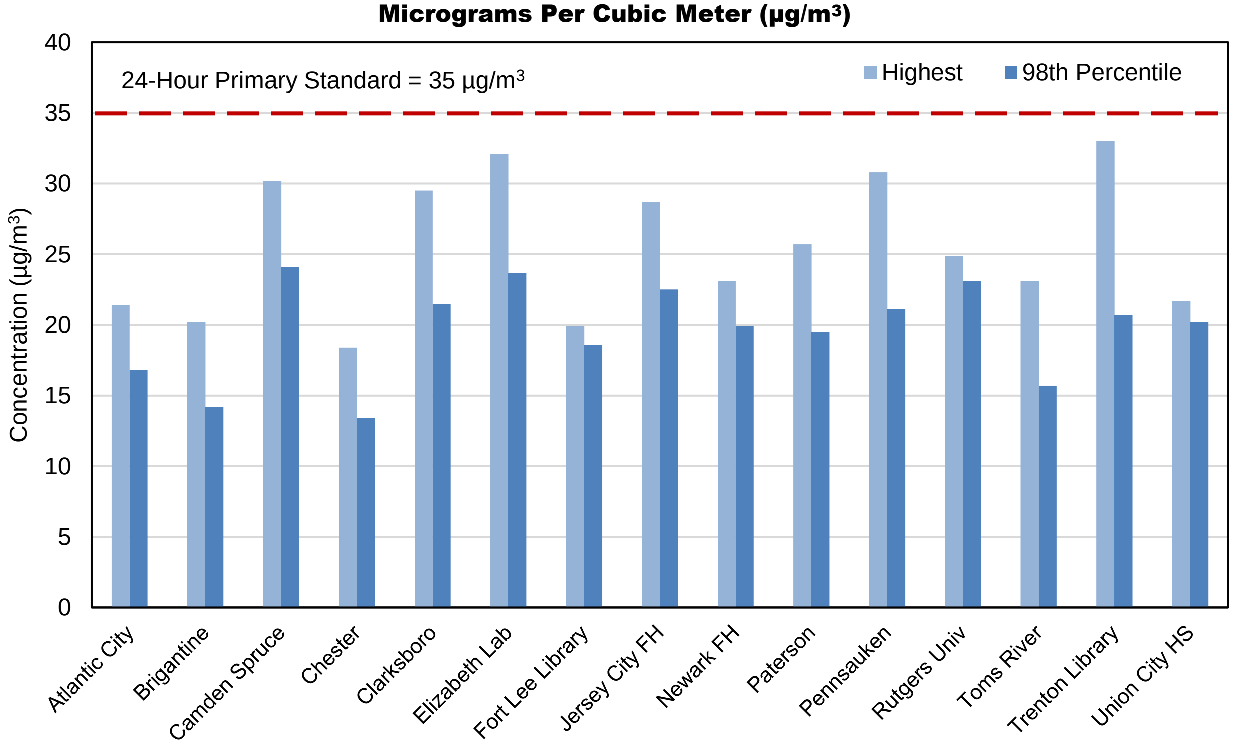


Figure 5-5
2019 $PM_{2.5}$ Concentrations in New Jersey
24-Hour Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)



$PM_{2.5}$ 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 https://nj.gov/dep/airmon. Table 5-3 presents the annual mean, highest 24-hour, and 98th percentile 24-hour values from these sites for 2019. Figures 5-6 and 5-7 show the same data in graphs. In 2019 there were no exceedances of the 12.0 $\mu g/m^3$ annual standard. There was one exceedance of the 24-hour standard at Columbia on 2/3/2019, with a concentration of 36.5 $\mu g/m^3$. The 24-hour NAAQS specifies that decimal values less than 5 be rounded down, so the 35.3 $\mu g/m^3$ highest value at the Elizabeth Lab monitoring station technically does not exceed 35 $\mu g/m^3$.

Table 5-3
2019 $PM_{2.5}$ 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	6.97	21.3	15.8
Camden Spruce Street	10.22	33	26.8
Columbia	7.38	36.5	19.1
Elizabeth Lab	9.93	35.3	22.5
Flemington	7.78	26.5	19.2
Fort Lee Near Road	10.98	31.8	23
Jersey City Firehouse	8.88	31.4	24.8
Millville	7.8	26.5	18.7
Newark Firehouse	8.97	29.4	21.7
Rahway	6.94	24.9	18.7
Rider University	7.57	26.4	17.4
Rutgers University	7.88	25.4	17.1

Figure 5-6
2019 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages from Continuous Monitors
Micrograms Per Cubic Meter (µg/m³)

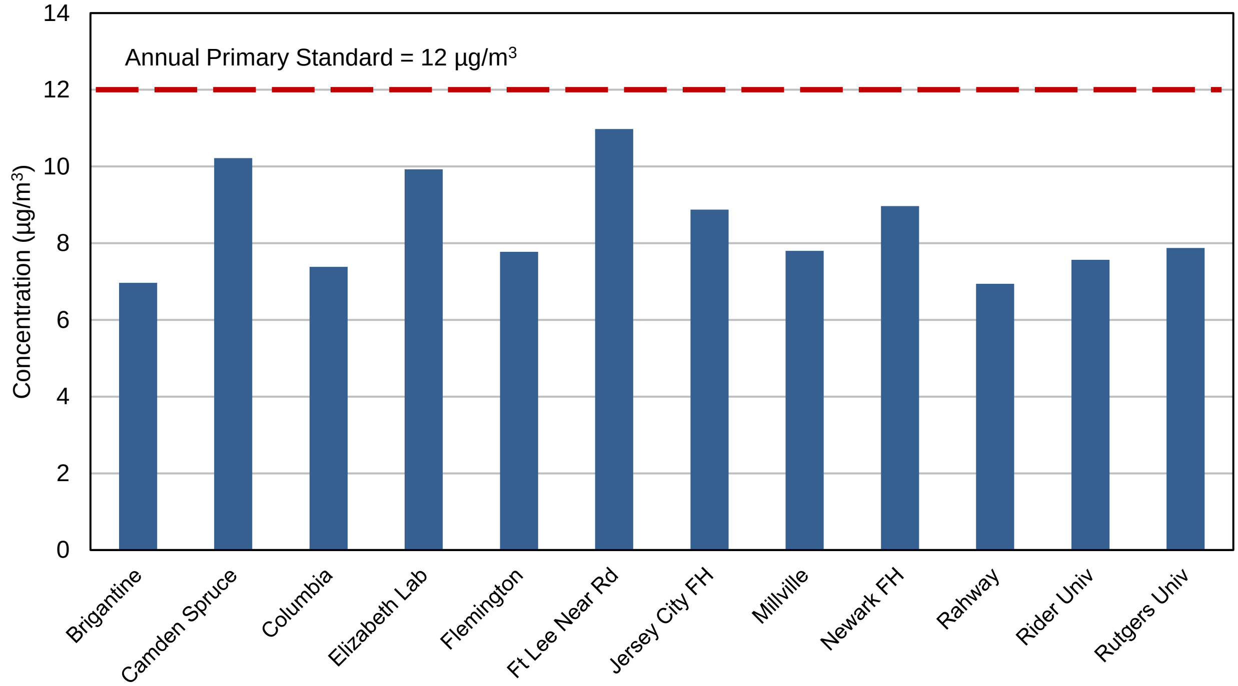
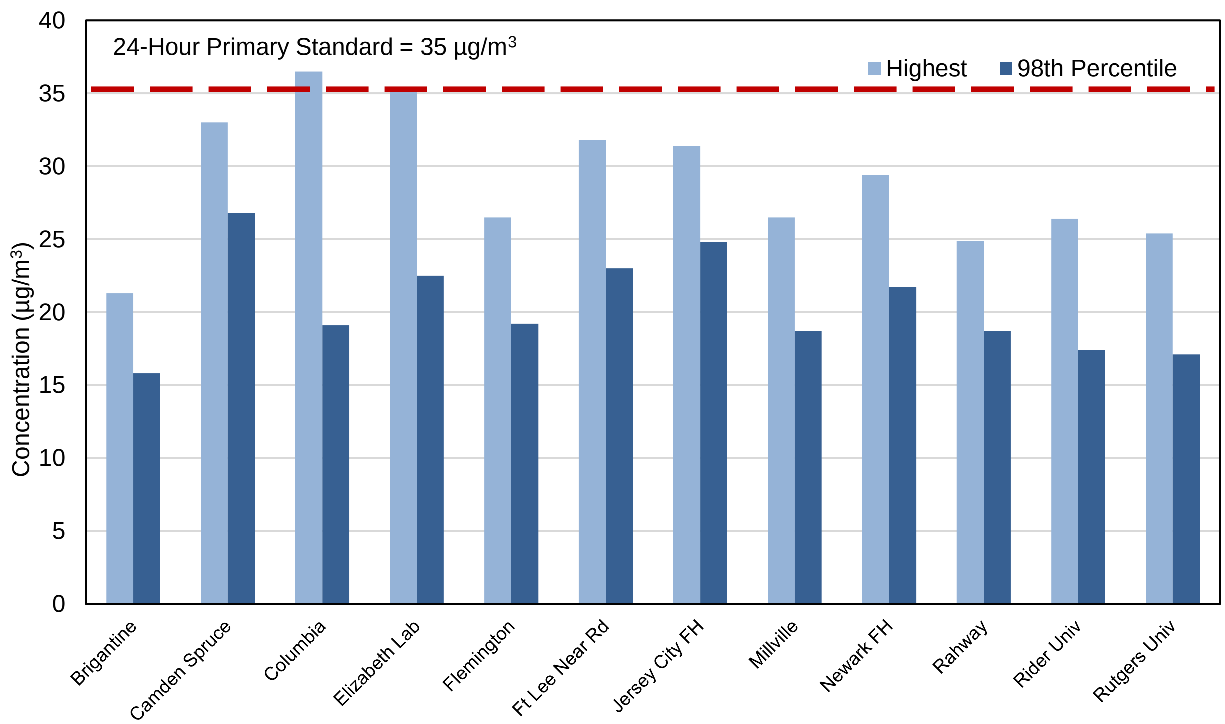


Figure 5-7
2019 $PM_{2.5}$ Concentrations in New Jersey
24-Hour Averages from Continuous Monitors
Micrograms Per Cubic Meter (µg/m³)



$PM_{2.5}$ 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 calculated 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 takes precedence, and FEM data is added in for periods when there is no FRM data.

Although Clarksboro and Millville do not have complete data sets for 2017-2019, their USEPA design value estimates are included here, marked with an asterisk.

All of New Jersey's $PM_{2.5}$ monitoring sites were below the annual and 24-hour design values in 2019.

Table 5-4
New Jersey $PM_{2.5}$ Design Values for 2017-2019
3-Year Average of the Annual Average Concentrations
& 98th Percentile 24-Hour Average Concentrations
Micrograms Per Cubic Meter (µg/m^3)

Monitoring Site	3-Year (2017-2019) Average	
	Annual	98th Percentile 24-Hour
Atlantic City	6.6	16
Brigantine	6.6	15
Camden Spruce Street	10.2	25
Chester	5.8	14
Clarksboro*	7.4	20
Columbia	7.6	19
Elizabeth Lab	9.1	22
Flemington	7.9	19
Fort Lee Library	7.3	18
Fort Lee Near Road	10.3	23
Jersey City Firehouse	8.1	20
Millville*	8.1	18
Newark Firehouse	8.4	20
Paterson	7.7	19
Pennsauken	7.1	19
Rahway	7.4	19
Rider University	7.8	17
Rutgers University	8.1	18
Toms River	6.4	16
Trenton Library	7.4	19
Union City High School	7.8	19

*3-year data set is incomplete per USEPA requirements.

Figure 5-8
New Jersey $PM_{2.5}$ Design Values for 2017-2019
3-Year Average of the Annual Average Concentrations
Micrograms Per Cubic Meter (µg/m³)

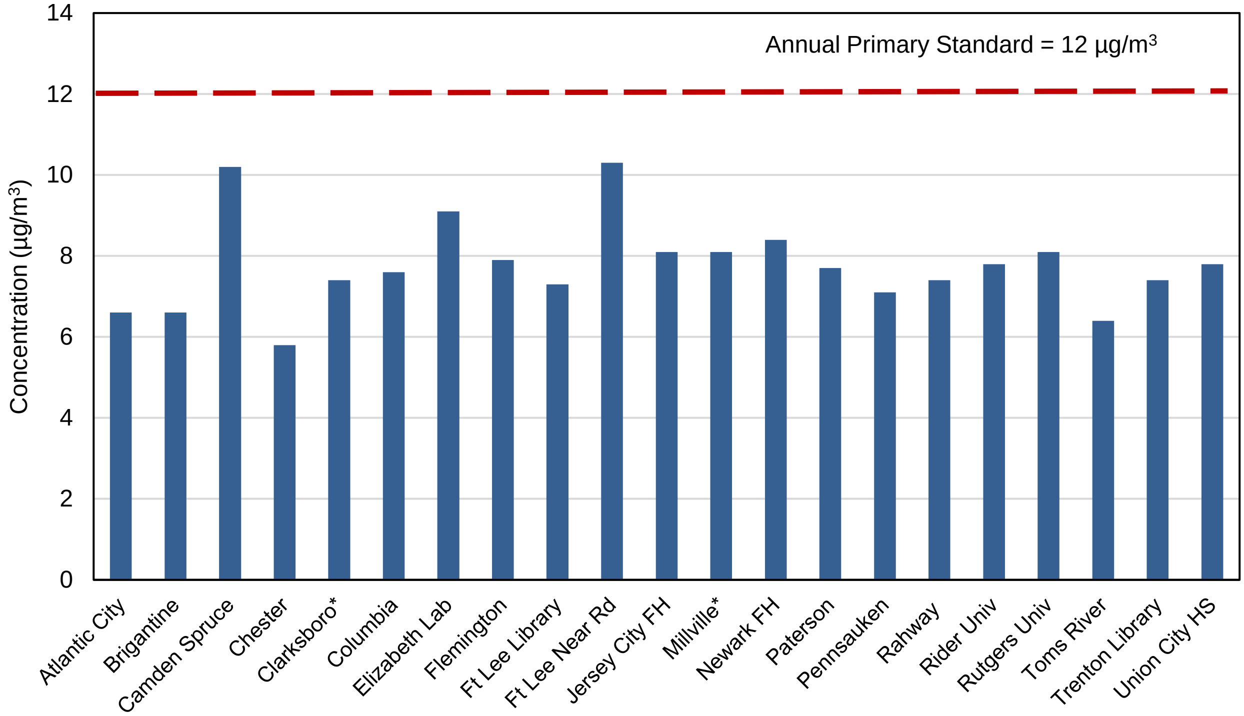
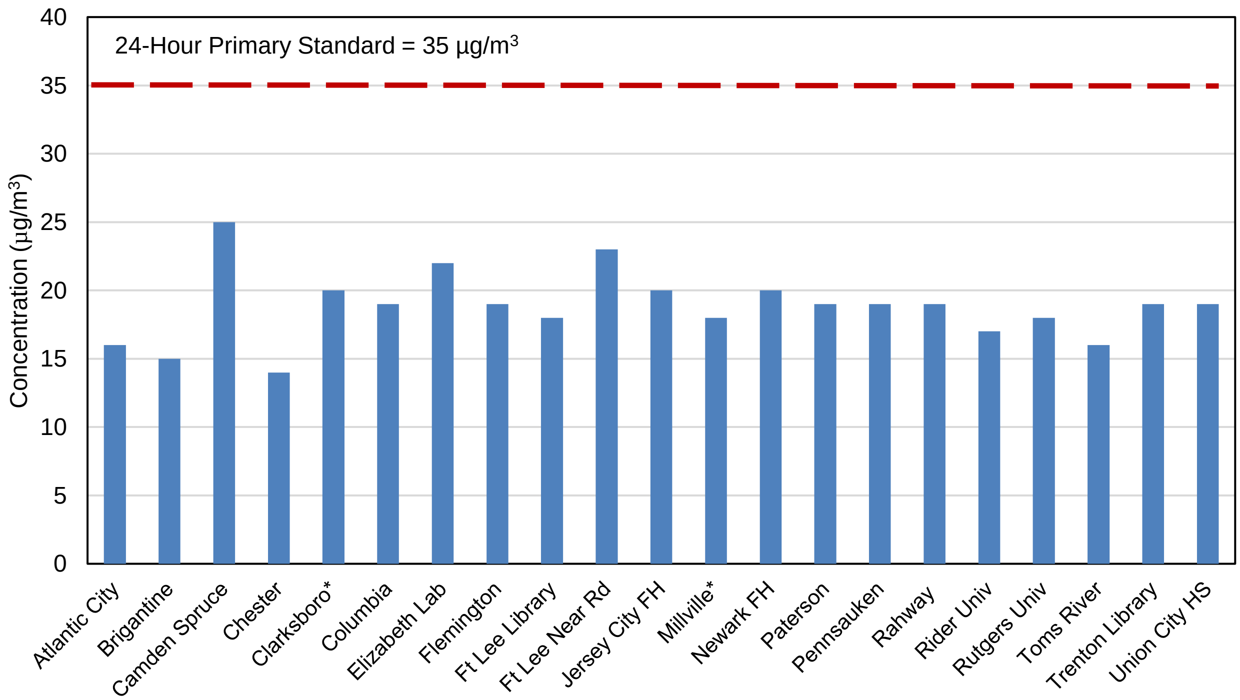


Figure 5-9
New Jersey $PM_{2.5}$ Design Values for 2017-2019
3-Year Average of the 98th Percentile of the 24-Hour Average Concentrations
Micrograms Per Cubic Meter (µg/m³)



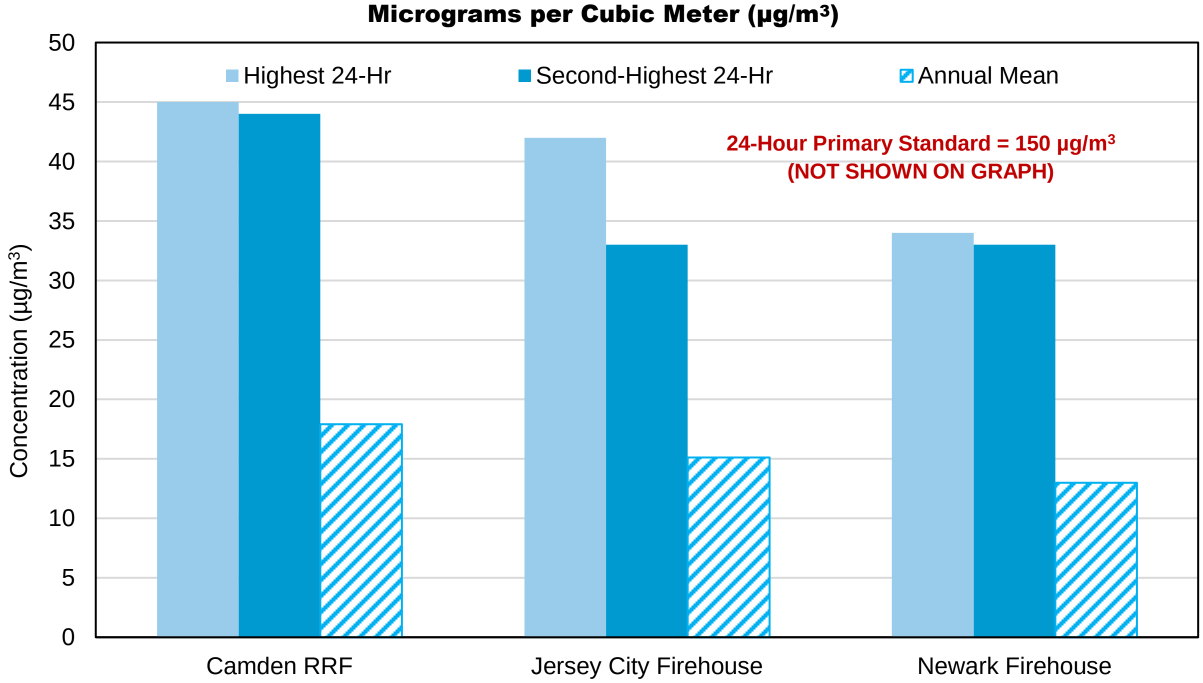
Inhalable Particulate (PM_{10}) Levels in 2019

Table 5-5 shows 2019 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/m³, as can be seen in Figure 5-10. The standard is based on the second-highest 24-hour value.

Table 5-5
2019 PM_{10} Concentrations in New Jersey
24-Hour and Annual Averages
Micrograms Per Cubic Meter (µg/m³)

Monitoring Site	Number of Samples	Annual Average	24-Hour Average	
			Highest	Second-Highest
Camden RRF	57	17.9	45	44
Jersey City Firehouse	60	15.1	42	33
Newark Firehouse	108	13.0	34	33

Figure 5-10
2019 PM_{10} Concentrations in New Jersey
Maximum 24-Hour Averages & Annual Mean
Micrograms per Cubic Meter (µg/m³)



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, 2001-2019

3-Year Average of the Annual Average Concentrations

Micrograms per Cubic Meter (µg/m³)

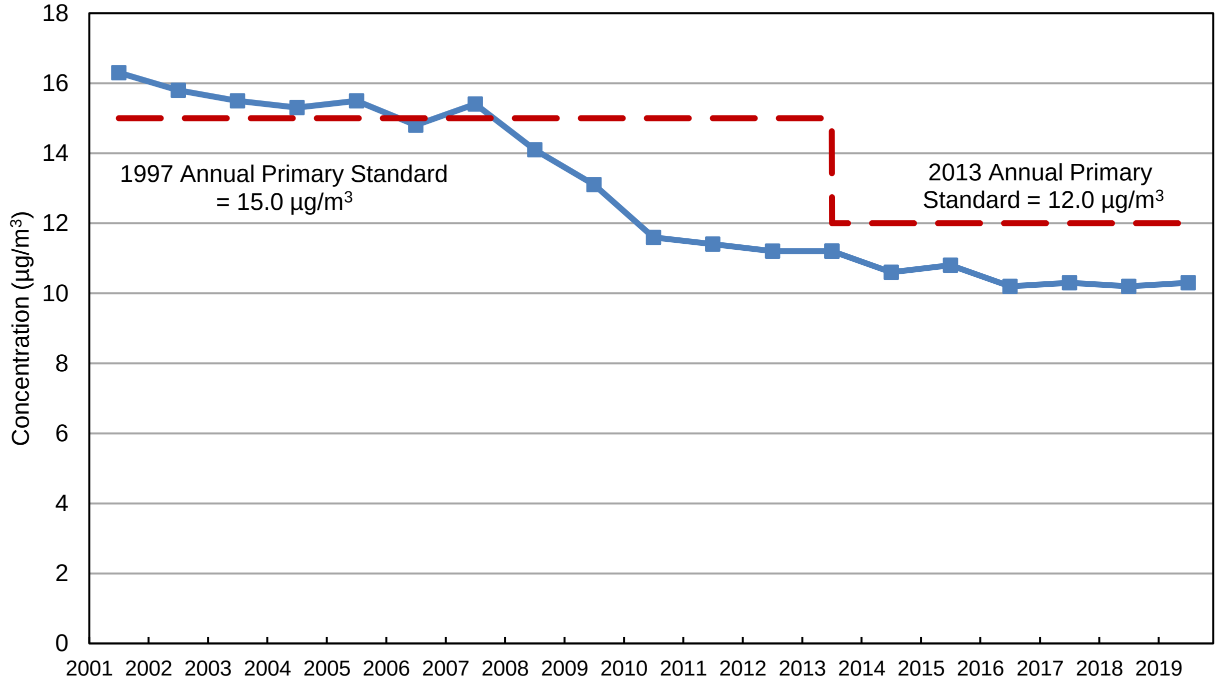
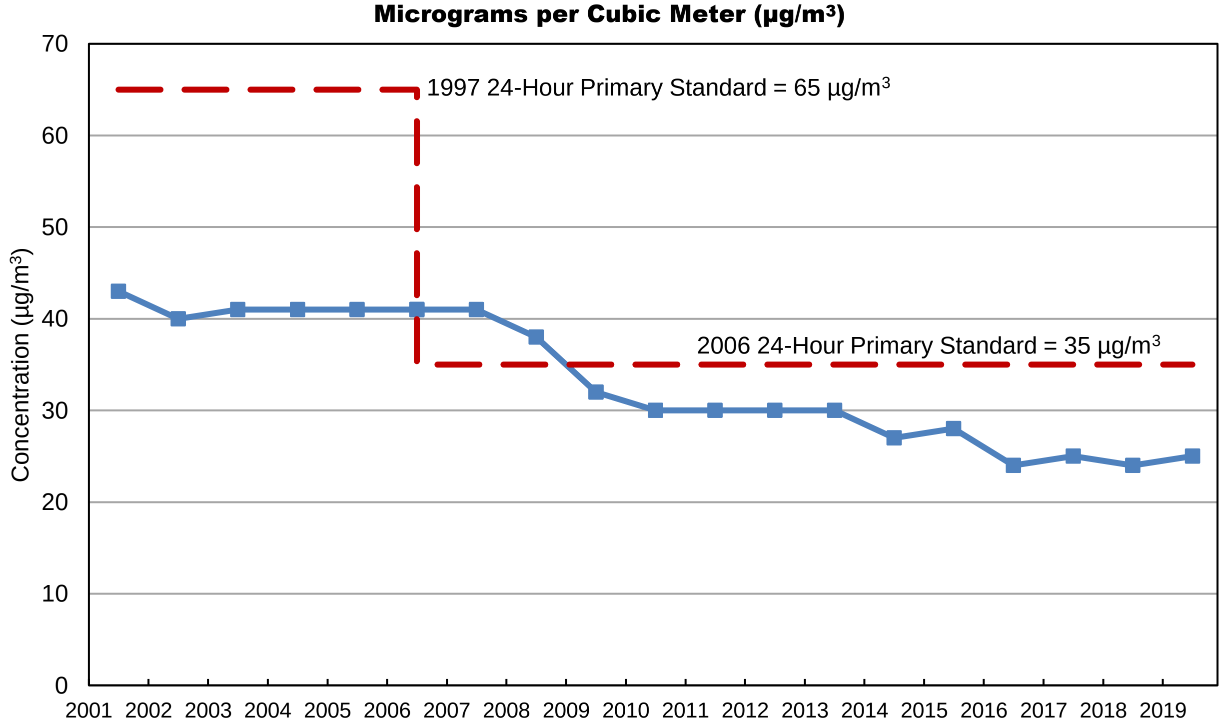


Figure 5-12

$PM_{2.5}$ Design Value Trend in New Jersey, 2001-2019

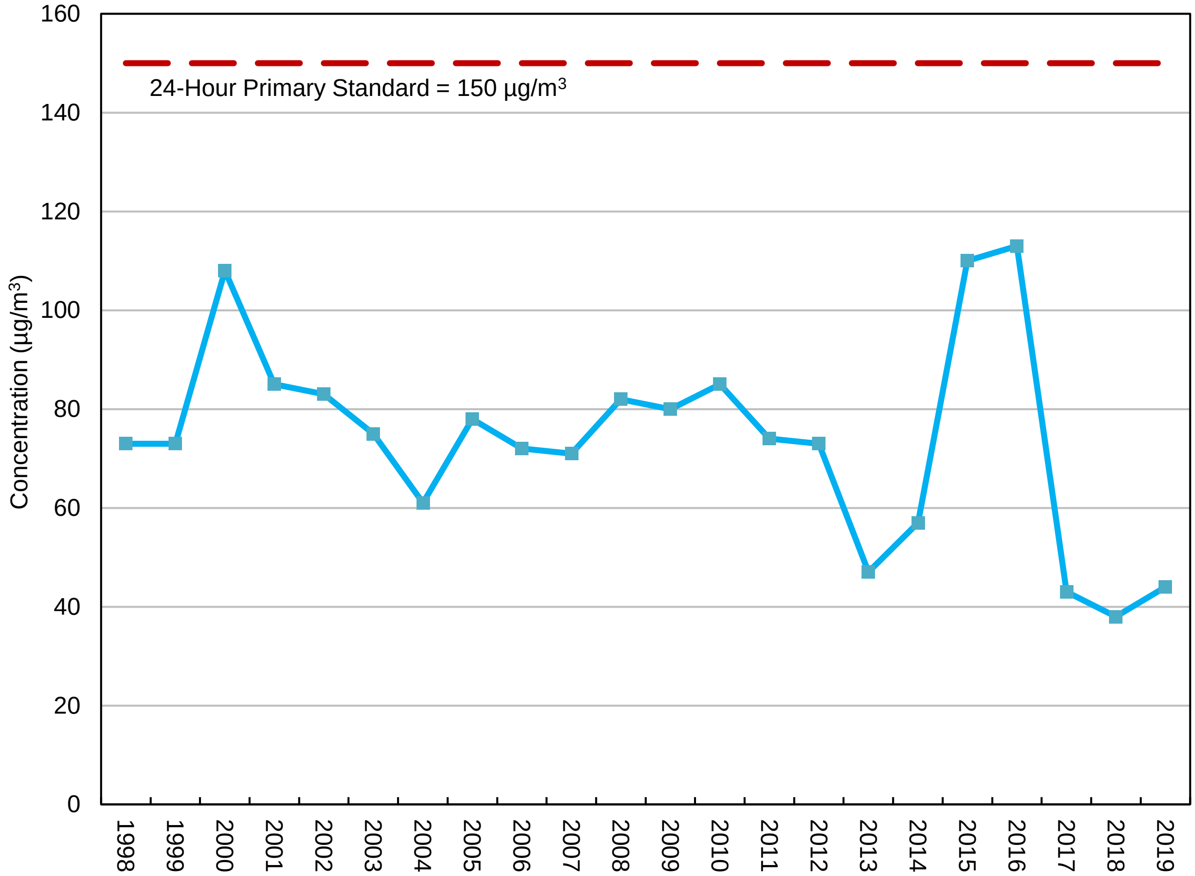
3-Year Average of the 98th Percentile 24-Hour Average Concentrations

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 reconstruction.

Figure 5-13
PM_{10} Design Value Trend in New Jersey, 1998-2019
2nd-Highest 24-Hour Average Concentrations
Micrograms per Cubic Meter (µg/m³)



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2019 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 (NO_x). 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 NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. 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 NO_x in New Jersey in 2017 is shown in Figure 6-1.

Figure 6-1
2017 New Jersey NO_x Estimated Annual Emissions

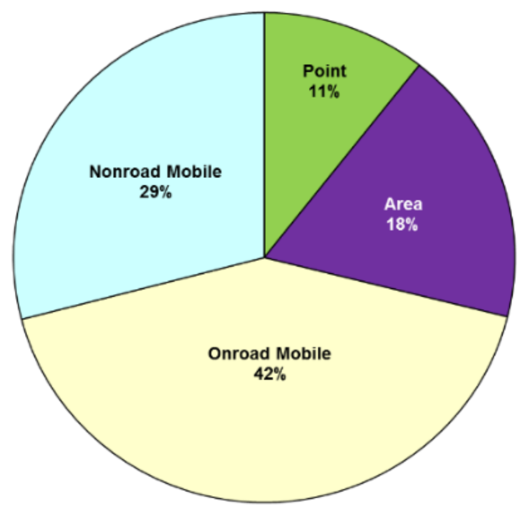
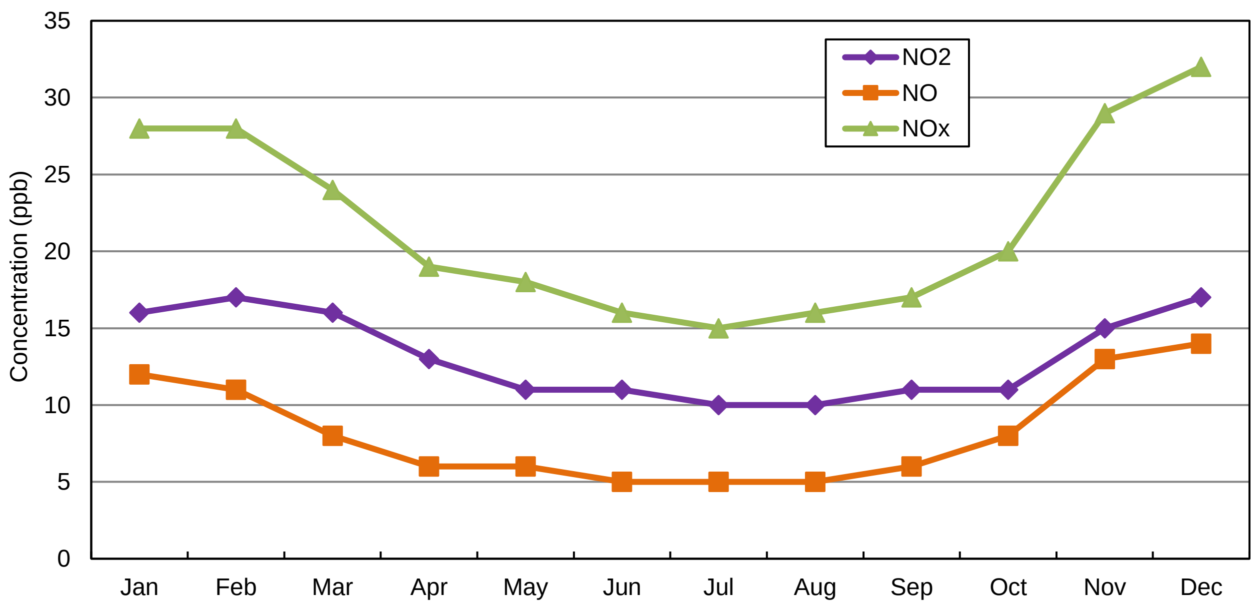


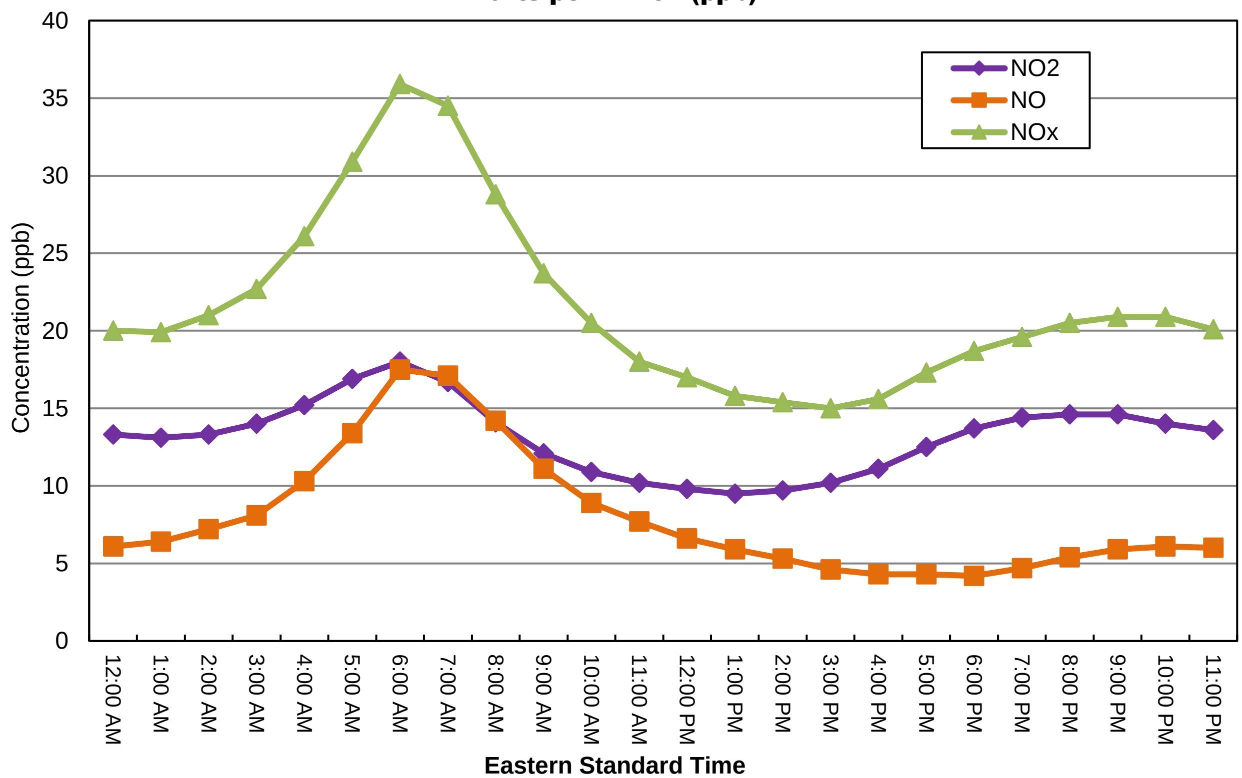
Figure 6-2 shows that NO_x concentrations tend to be higher in the winter than in the summer. This is due in part to heating of buildings, and to weather conditions that are more prevalent in the colder months of the year, such as lighter winds that result in poorer local dispersion conditions.

Figure 6-2
2019 Nitrogen Oxides Concentrations in New Jersey
Average Monthly Variation
Parts per Billion (ppb)



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

Figure 6-3
2019 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 room visits and hospital admissions for respiratory issues, especially asthma. Individuals who spend time on or near major roadways can experience elevated 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 and secondary. Primary standards protect public health, including 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 ($\mu g/m^3$) 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 ($\mu g/m^3$)

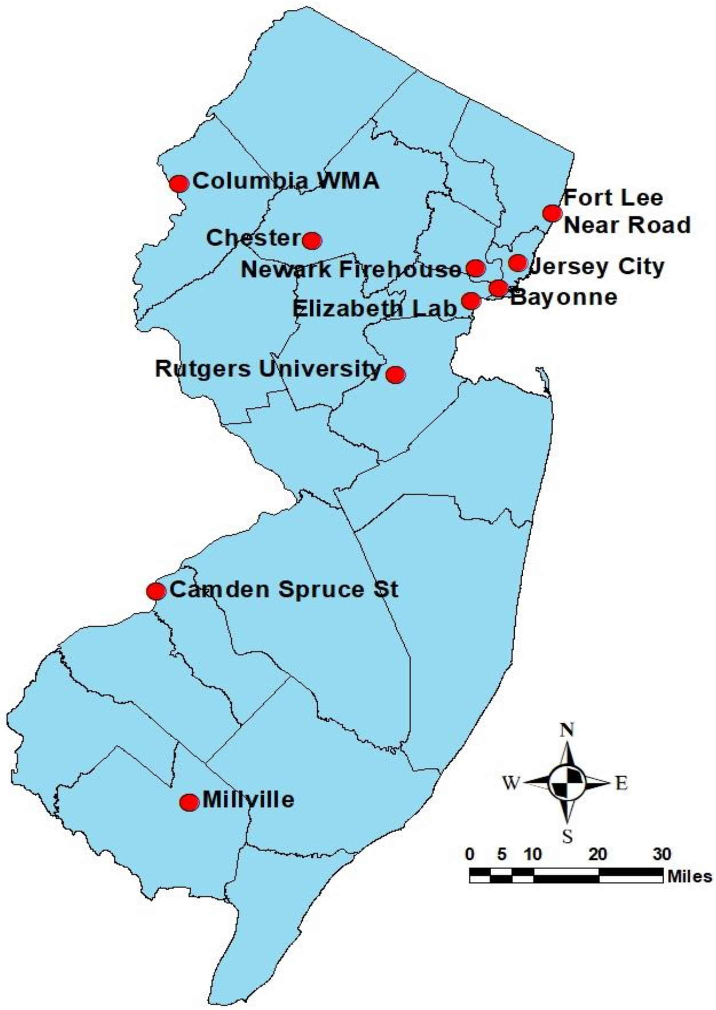
Averaging Period	Type	National	New Jersey
1-Hour	Primary	100 ppb (0.100 ppm)	---
Annual	Primary & secondary	53 ppb (0.053 ppm)	---
12-Month	Primary & secondary	---	100 $\mu g/m^3$ (0.053 ppm)

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 98^{th}-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 98^{th}-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 98^{th}-percentile values is the design value.

NO_2 Monitoring Network

NJDEP measured NO_2 levels at ten locations in 2019. 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. These sites also measure NO and NOx, except for Rutgers. Rutgers is part of the Photochemical Assessment Monitoring Stations (PAMS) Program, and is required to measure total reactive nitrogen (NO_y) as well as NO_2 and NO (but not NO_x). In March the NO_2-NO-NO_x instrument at Rutgers was replaced with a NO_y-NO monitor as well as a separate NO_2 monitor. NO_y is also measured at Newark Firehouse, as required for an NCore Mulitpollutant Monitoring Network site.

Figure 6-4
2019 Nitrogen Dioxide Monitoring Network



NO_2 Levels In 2019

There was one exceedance of a NO_2 NAAQS in 2019. The Fort Lee Near Road monitoring station had a daily maximum 1-hour concentration of 110 ppb on February 27 (see Table 6-2 and Figure 6-5). This is much higher than the next-highest 1-hour value (83 ppb at Jersey City), and is attributed to vehicles idling near the site.

The 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 2017-2019 design value for each site is given in Table 6-2 and Figure 6-6. The site with the highest design value for 2017-2019 was Fort Lee Near Road, with 67 ppb.

Table 6-2
2019 Nitrogen Dioxide Concentrations in New Jersey
1-Hour Averages
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)		
	Daily Maximum	98th-Percentile	2017-2019 98th-%ile 3-Yr Avg
Bayonne	71	58	57
Camden Spruce St.	62	45	45
Chester	36	26	30
Columbia	68	43	43
Elizabeth Trailer	74	62	61
Fort Lee Near Road	110	66	67
Jersey City	83	56	56
Millville	38	35	33
Newark Firehouse	70	61	56
Rutgers University	55	45	43

Figure 6-5
2019 Nitrogen Dioxide Concentrations in New Jersey
Daily Maximum 1-Hour Values
Parts per Billion (ppb)

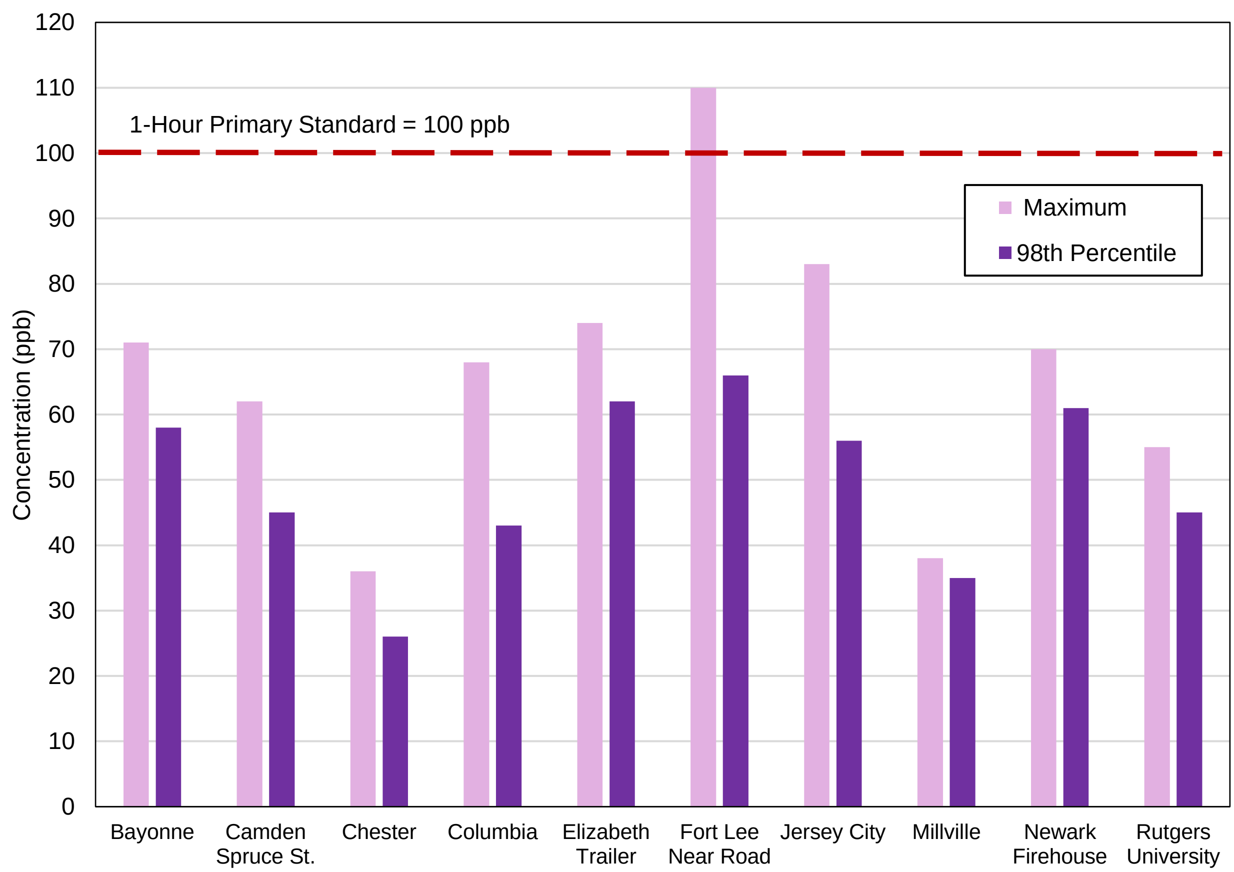
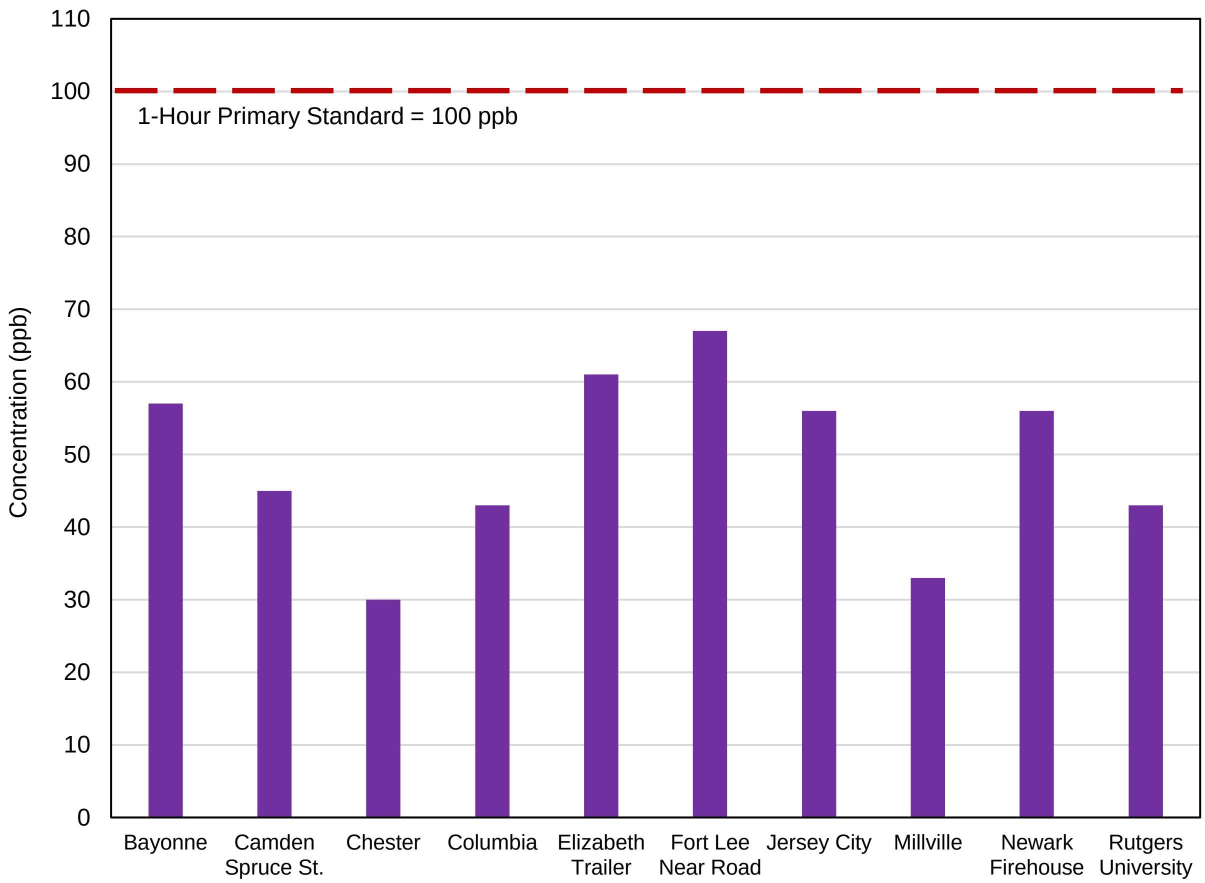


Figure 6-6
2019 Nitrogen Dioxide Design Values in New Jersey
3-Year Average of the 98th-Percentile Daily Maximum 1-Hour Concentrations (2017-2019)
Parts per Billion (ppb)



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 6-3 and Figure 6-7, the highest calendar-year average of 21 ppb occurred at the Jersey City monitoring station on J.F.Kennedy Boulevard near Journal Square. The highest running 12-month average NO_2 concentration of 21 ppb was also measured at the Jersey City site. These values are well below the standards.

Table 6-3
2019 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	16	16
Camden Spruce Street	11	11
Chester	3	3
Columbia	11	11
Elizabeth Lab	20	20
Fort Lee Near Road	17	17
Jersey City	21	21
Millville	6	6
Newark Firehouse	16	16
Rutgers University	9	9

Figure 6-7
2019 Nitrogen Dioxide Design Values in New Jersey
Annual (12-Month) Average Concentrations
Parts per Billion (ppb)

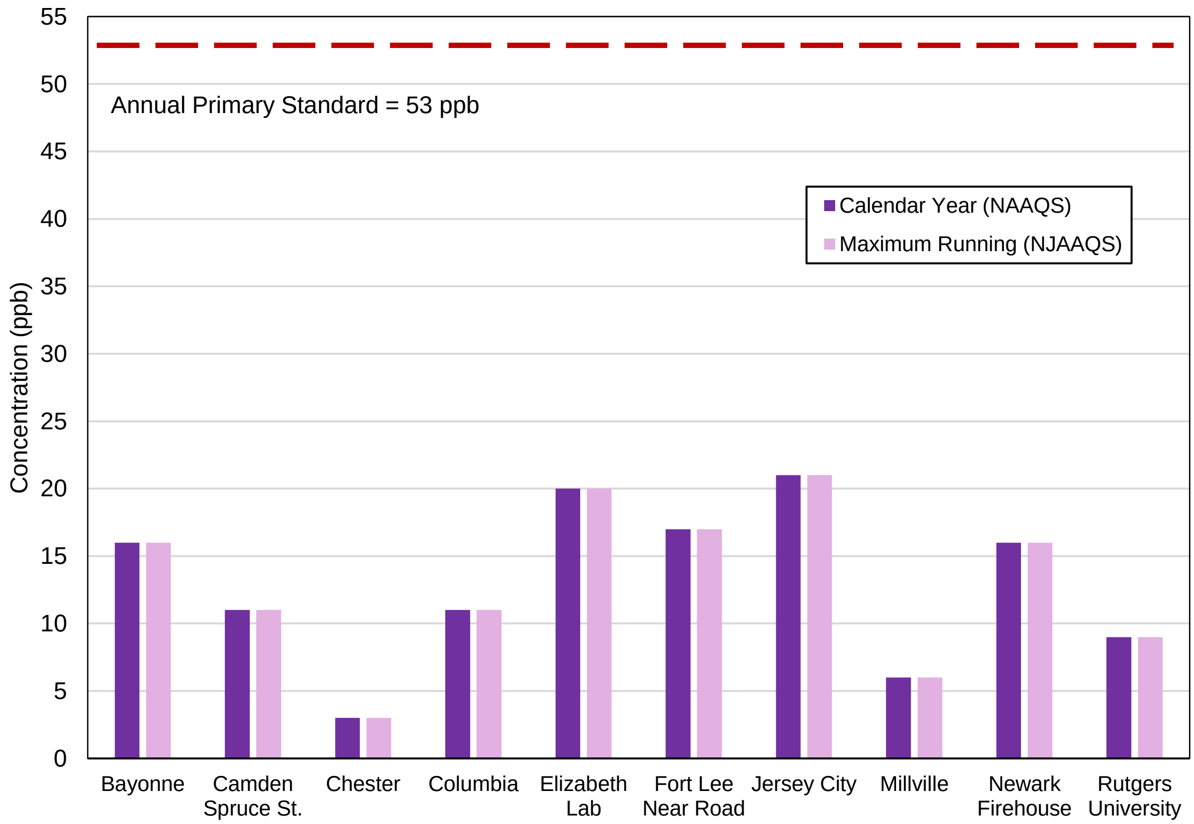
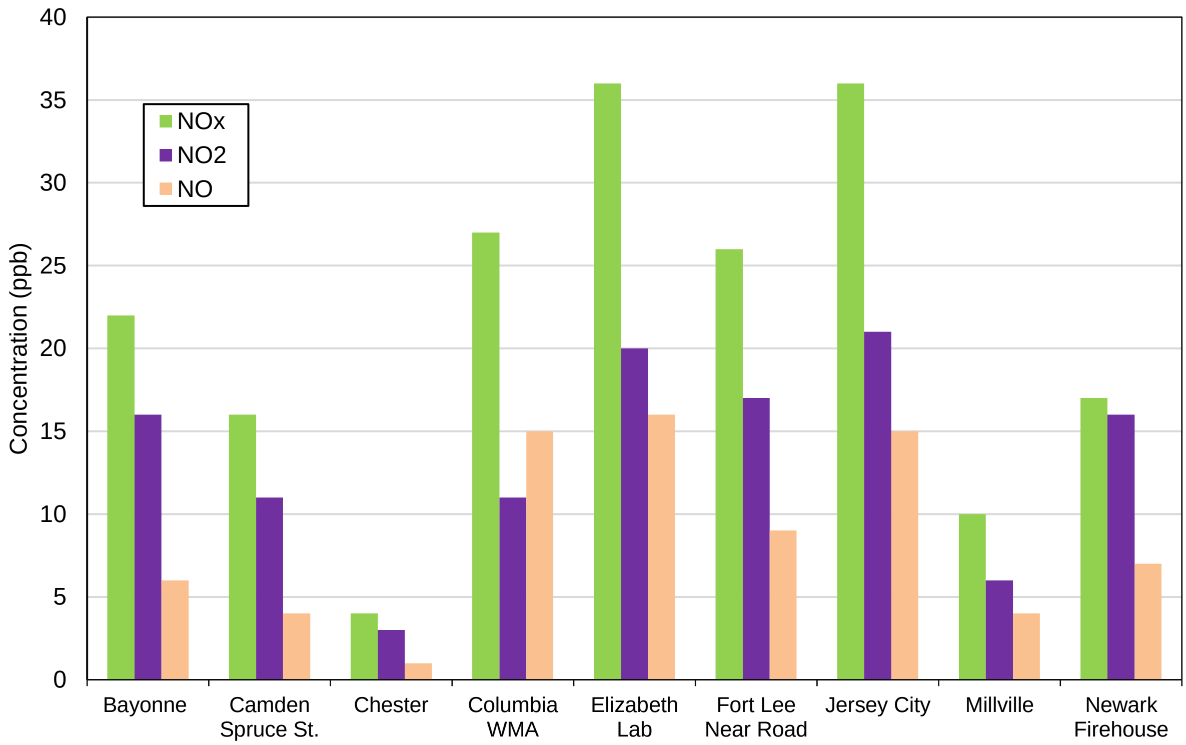


Figure 6-8 shows the calendar-year annual average concentrations of NO_2, NO and NO_x at each New Jersey monitoring site. Even though there are no ambient air standards for NO and NO_x, the stations that measure NO_2 concentrations also measure them (except for Rutgers, which measures NO_y instead). NO_x 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 Columbia monitoring site is an exception to this, with annual average levels of NO higher than NO_2. The monitor is about 100 feet from 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 6-8
2019 Nitrogen Oxides Concentrations in New Jersey
Calendar-Year Annual Averages
Parts per Billion (ppb)



Note: The Rutgers University site discontinued NO_x air sampling in March 2019.

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 6-9 shows the highest statewide annual average concentrations recorded from 1990 to 2019. 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 NO_x emissions.

Figure 6-9
Nitrogen Dioxide Concentrations in New Jersey, 1990-2019
Highest Annual (Calendar Year) Averages
Parts per Billion (ppb)

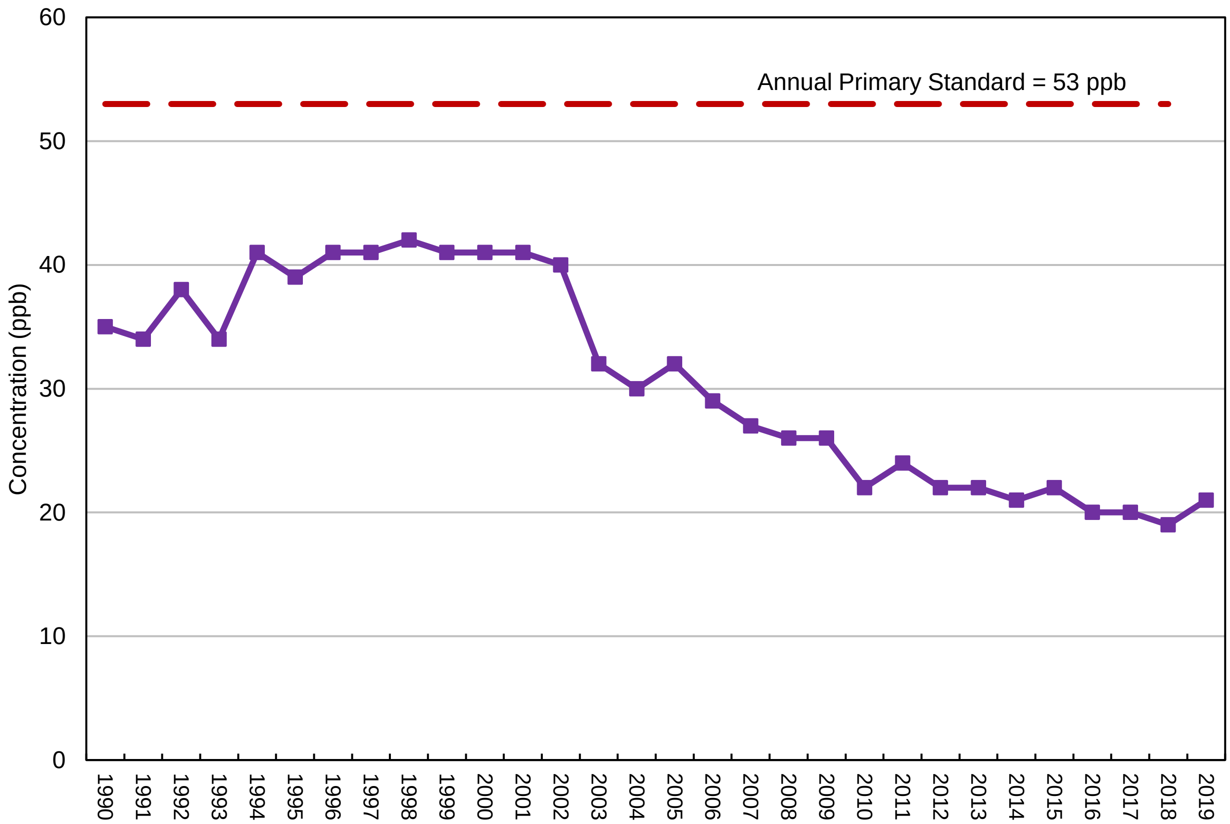


Figure 6-10 shows the statewide highest 98th-percentile values of the daily maximum one-hour concentrations of NO_2 for the years 2000 to 2019 in New Jersey. Even though in 2019 the highest 1-hour New Jersey value exceeded the NAAQS of 100 ppb (at Fort Lee Near Road), the 98th-percentile value was below that at 66 ppb.

Figure 6-11 shows the New Jersey design values for the 1-hour NAAQS for the years 2000-2019. The design value, which officially 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 in 2010.

Figure 6-10
Nitrogen Dioxide Concentrations in New Jersey, 2000-2019
98th-Percentile of the Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)

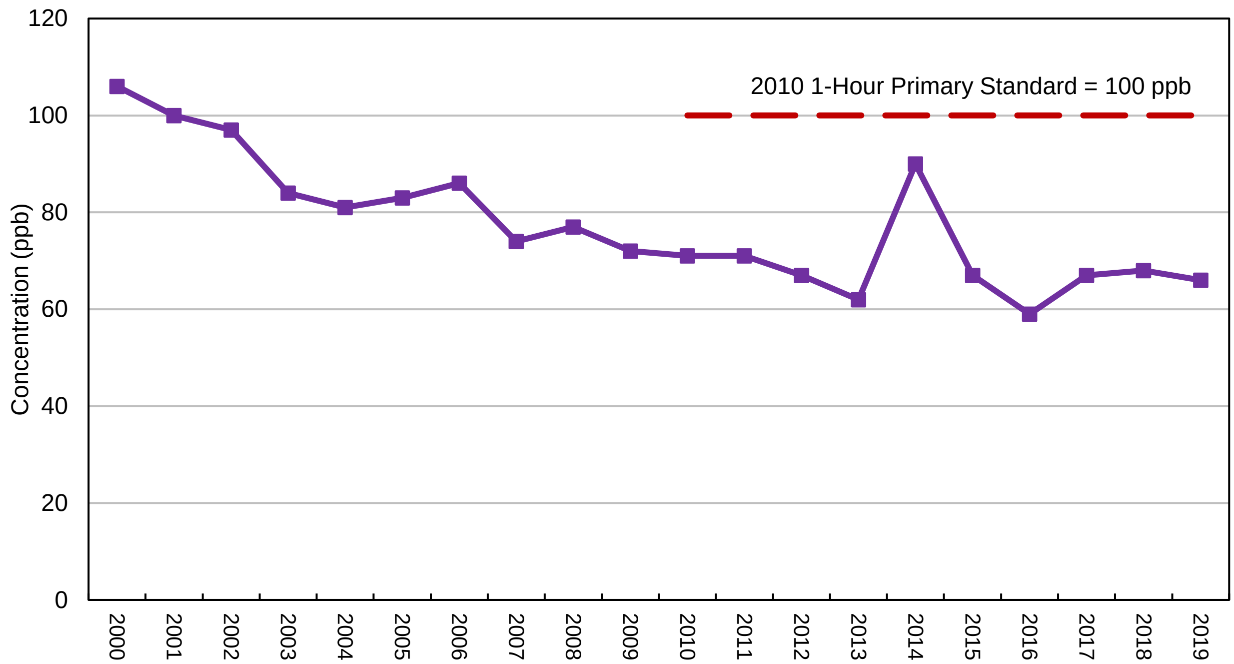
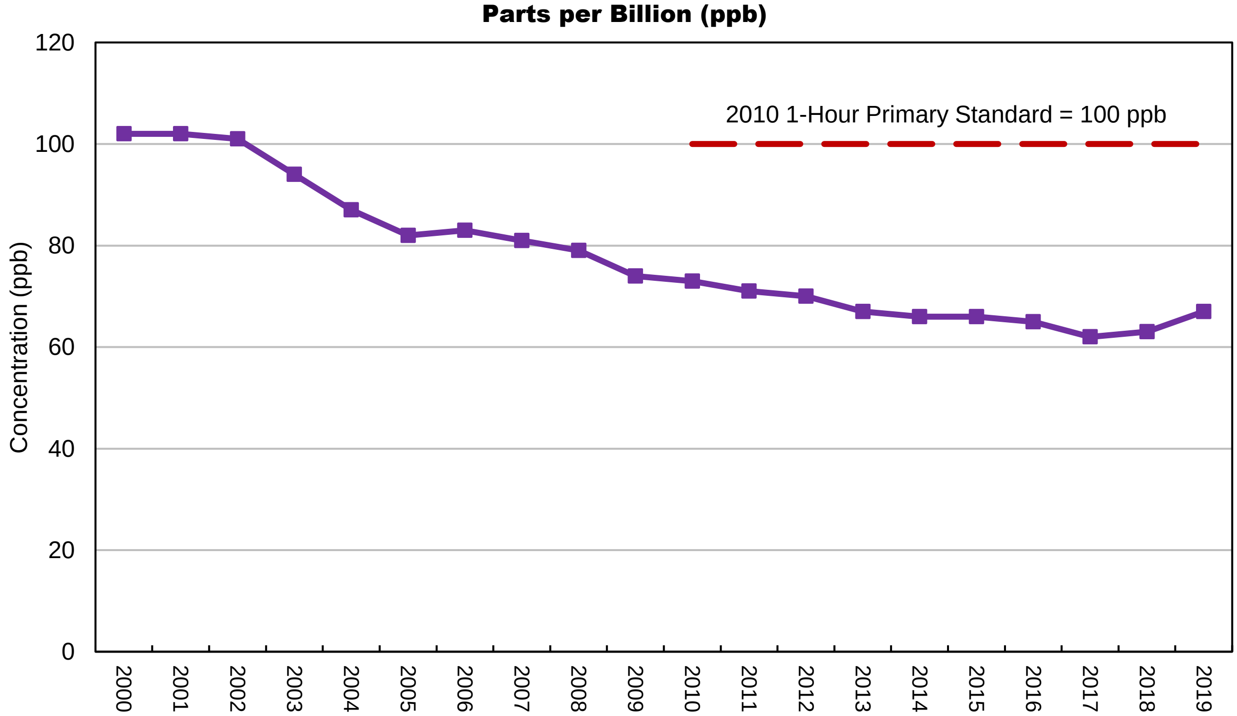


Figure 6-11
Nitrogen Dioxide Design Value Trend in New Jersey, 2000-2019
3-Year Average of the 98th-Percentile Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)



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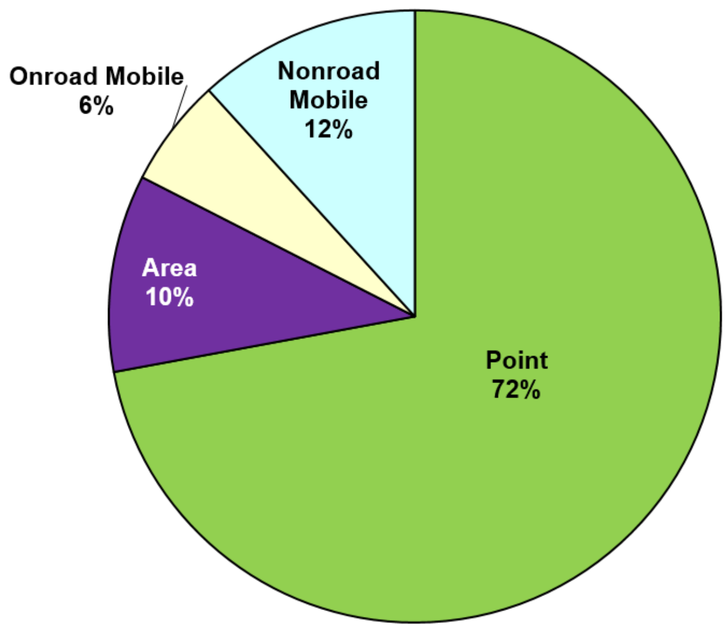
2019 Sulfur Dioxide Summary

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 Estimated
SO_2 Annual Emissions



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. Compliance with the secondary standard is based on the second-highest 3-hour average concentration.

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 ($\mu g/m^3$)

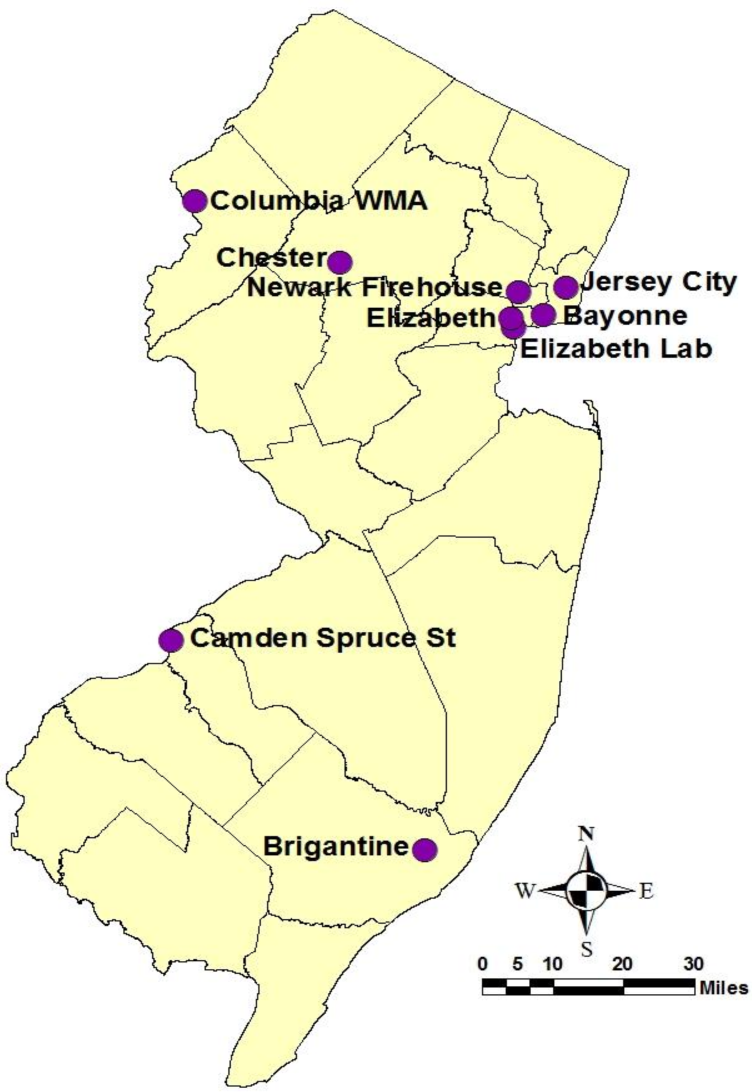
Averaging Period	Type	National	New Jersey[a]
1–hour[b]	Primary	75 ppb	---
3–hours[c]	Secondary	0.5 ppm[d]	1300 $\mu g/m^3$ (0.5 ppm)
24–hours[c]	Primary	---	365 $\mu g/m^3$ (0.14 ppm)
24–hours[c]	Secondary	---	260 $\mu g/m^3$ (0.10 ppm)
12–months	Primary	---	80 $\mu g/m^3$ (0.03 ppm)
12–months	Secondary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

[a] Based on running averages, over any 12 consecutive months.
[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] Not to be exceeded more than once in a year.
[d] Based on successive non-overlapping blocks, beginning at midnight each day.

SO_2 MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) monitored SO_2 levels at nine sites in 2019. The monitoring stations are Bayonne, Brigantine, Camden Spruce Street, Chester, Columbia, Elizabeth, Elizabeth Lab, Jersey City, and Newark Firehouse. Their locations are shown in Figure 7-2.

Figure 7-2
2019 Sulfur Dioxide
Monitoring Network



SO_2 LEVELS IN 2019

In 2019, 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 and second-highest 1-hour values (17.3 and 6.6 ppb) and the highest 99th percentile value of 6.3 ppb. The highest design value, the 3-year average of the 99th-percentile of the daily maximum 1-hour SO_2 concentrations, was also at Camden Spruce Street, with a value of 6 ppb.

Three-hour averages for all sites were well below the national and New Jersey 3-hour secondary standards of 0.5 ppm. The NAAQS is based on successive non-overlapping 3-hour blocks, while the NJAAQS uses running 3-hour averages (although the second-highest value can't overlap the highest value). The highest block average of 0.009 ppm was measured at Camden Spruce Street, while the highest running average of 0.010 ppm was recorded at Newark Firehouse. The second-highest 3-hour averages, both block and running, were 0.005 ppm, also recorded at Camden. Results are shown in Table 7-3 and Figure 7-5.

No monitoring sites had exceedances of the New Jersey 24-hour (0.14 ppm) or 12-month (0.03 ppm) SO_2 standards during 2019. The highest 24-hour average concentration was 0.004 ppm, measured at the Jersey City station. Jersey City and Elizabeth both had a second-highest value of 0.003 ppm. The highest 12-month running average concentration of 0.0008 ppm was recorded at the Elizabeth site. See Tables 7-4 and 7-5, and Figures 7-6 and 7-7 for data for the other monitoring sites.

Table 7-2
2019 Sulfur Dioxide Concentrations in New Jersey
Daily Maximum and 99th Percentile 1-Hour Averages
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)			2017-2019 Design Value[a]
	Highest Daily Maximum	2nd-Highest Daily Maximum	99th Percentile Daily Maximum	
Bayonne	9.4	5.6	4.9	5
Brigantine	1.7	1.4	1.2	2
Camden Spruce St.	17.3	6.6	6.3	6
Chester	16.6	5.8	3.3	3
Columbia	6.7	5.9	5.8	5
Elizabeth	4.8	4.2	3.7	4
Elizabeth Lab	15.7	4.7	3.9	5
Jersey City	6.3	4.8	4	5
Newark Firehouse	12.1	3.9	2.4	3

[a] 3-Year (2017-2019) average of the 99th percentile 1-hour daily maximum concentrations.

Figure 7-3
2019 Sulfur Dioxide Concentrations in New Jersey
1-Hour Averages
Parts per Billion (ppb)

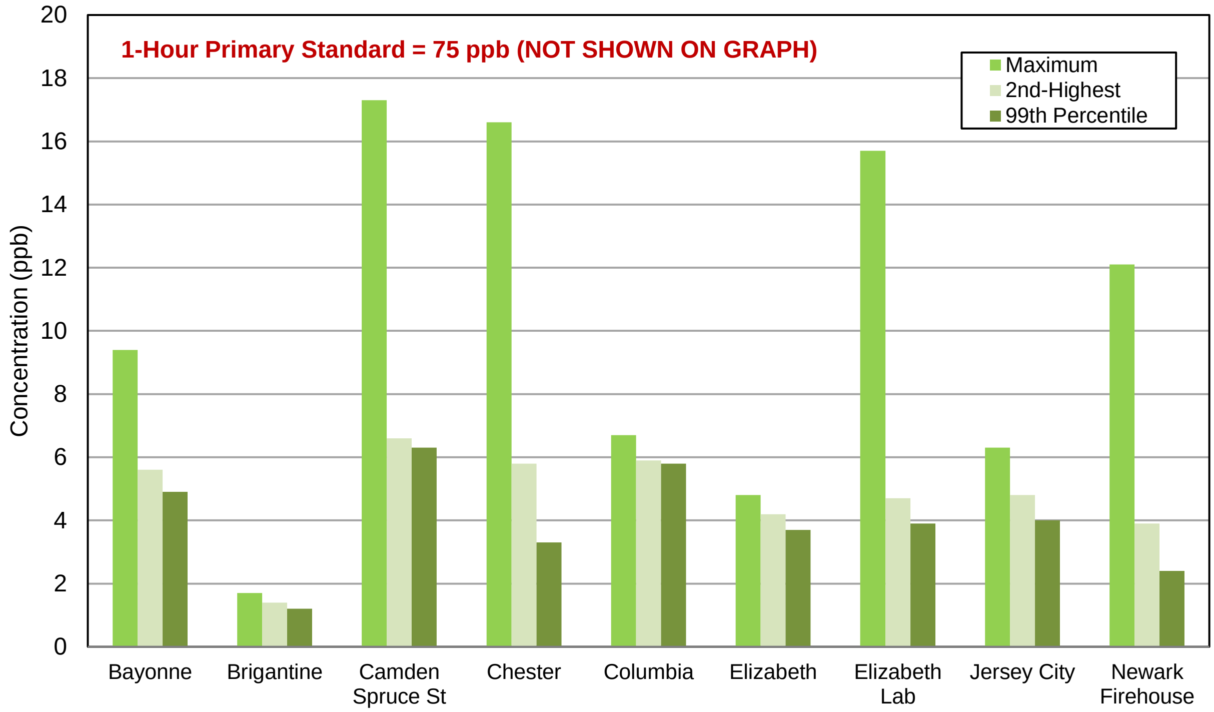


Figure 7-4
New Jersey Sulfur Dioxide Design Values for 2017-2019
3-Year Average of the 99th Percentile of the 1-Hour Daily Maximum Concentrations
Parts per Billion (ppb)

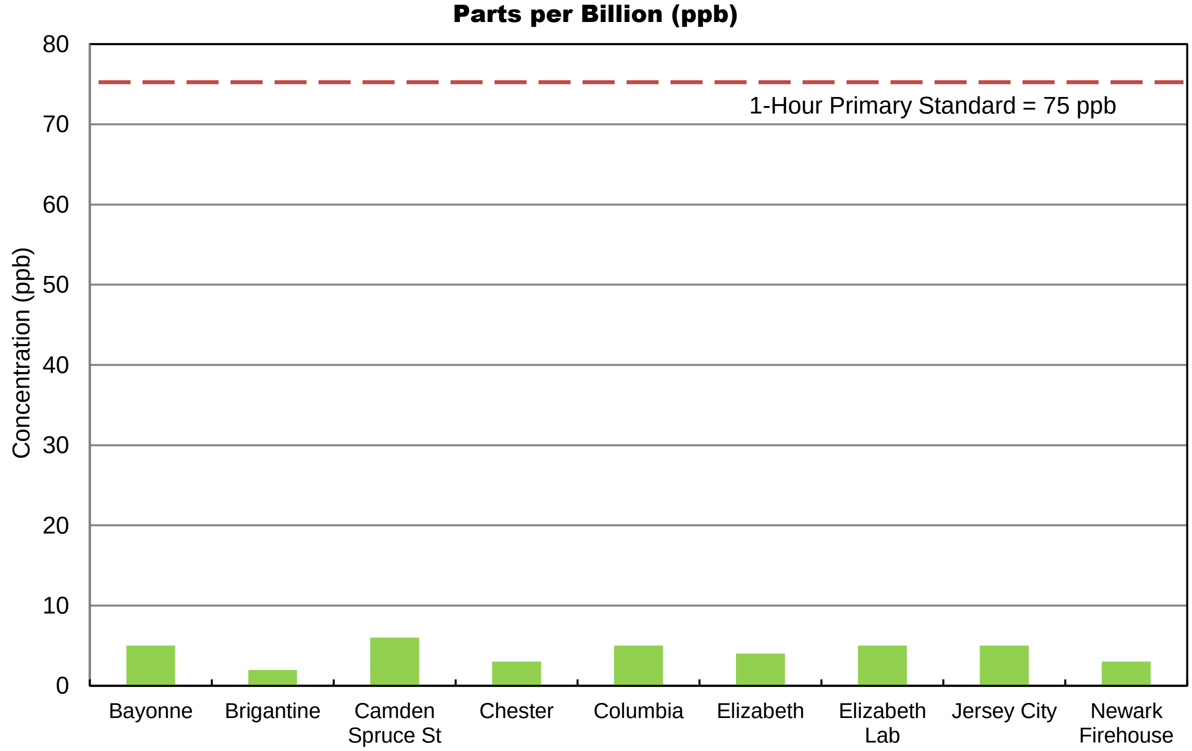


Table 7-3
2019 Sulfur Dioxide Concentrations in New Jersey
3-Hour Averages
Parts per Million (ppm)

Monitoring Site	3-Hour Average Concentrations			
	Block[a]		Running[b]	
	Maximum	2nd-Highest	Maximum	2nd-Highest*
Bayonne	0.007	0.004	0.007	0.004
Brigantine	0.001	0.001	0.001	0.001
Camden Spruce	0.009	0.005	0.009	0.005
Chester	0.008	0.003	0.008	0.004
Columbia	0.004	0.004	0.004	0.004
Elizabeth	0.004	0.004	0.004	0.004
Elizabeth Trailer	0.006	0.003	0.006	0.003
Jersey City	0.006	0.004	0.006	0.004
Newark Firehouse	0.006	0.004	0.010	0.003

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

Figure 7-5
2019 Sulfur Dioxide Concentrations in New Jersey
2nd Highest 3-Hour Averages
Parts per Million (ppm)

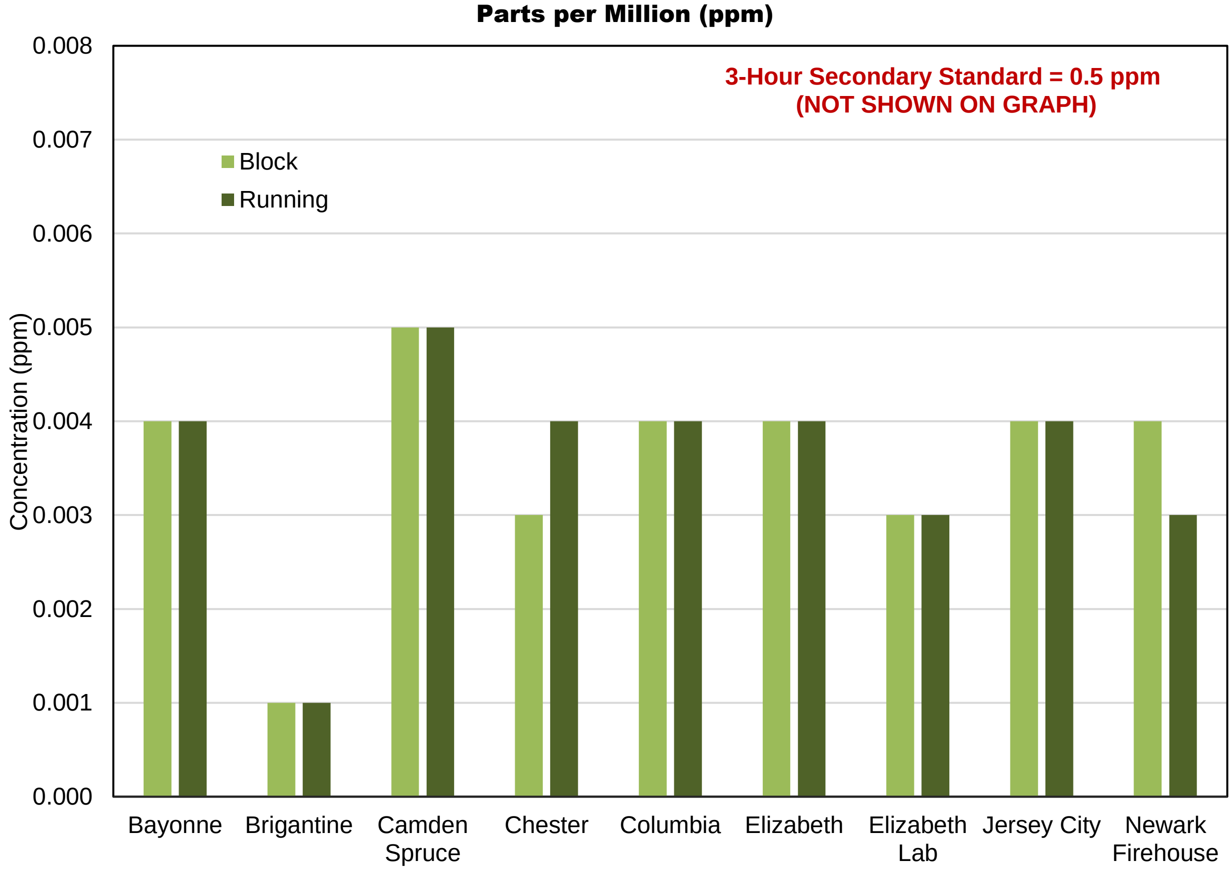


Table 7-4
2019 Sulfur Dioxide Concentrations in New Jersey
24-Hour Running Averages
Parts per Million (ppm)

Monitoring Site	24-Hour Running Average	
	Maximum	2nd Highest (Non-overlapping)
Bayonne	0.001	0.001
Brigantine	0.001	0.001
Camden Spruce St.	0.003	0.002
Chester	0.002	0.001
Columbia	0.002	0.002
Elizabeth	0.003	0.003
Elizabeth Lab	0.002	0.002
Jersey City	0.004	0.003
Newark Firehouse	0.001	0.001

Figure 7-6
2019 Sulfur Dioxide Concentrations in New Jersey
Highest 24-Hour Running Averages
Parts per Million (ppm)

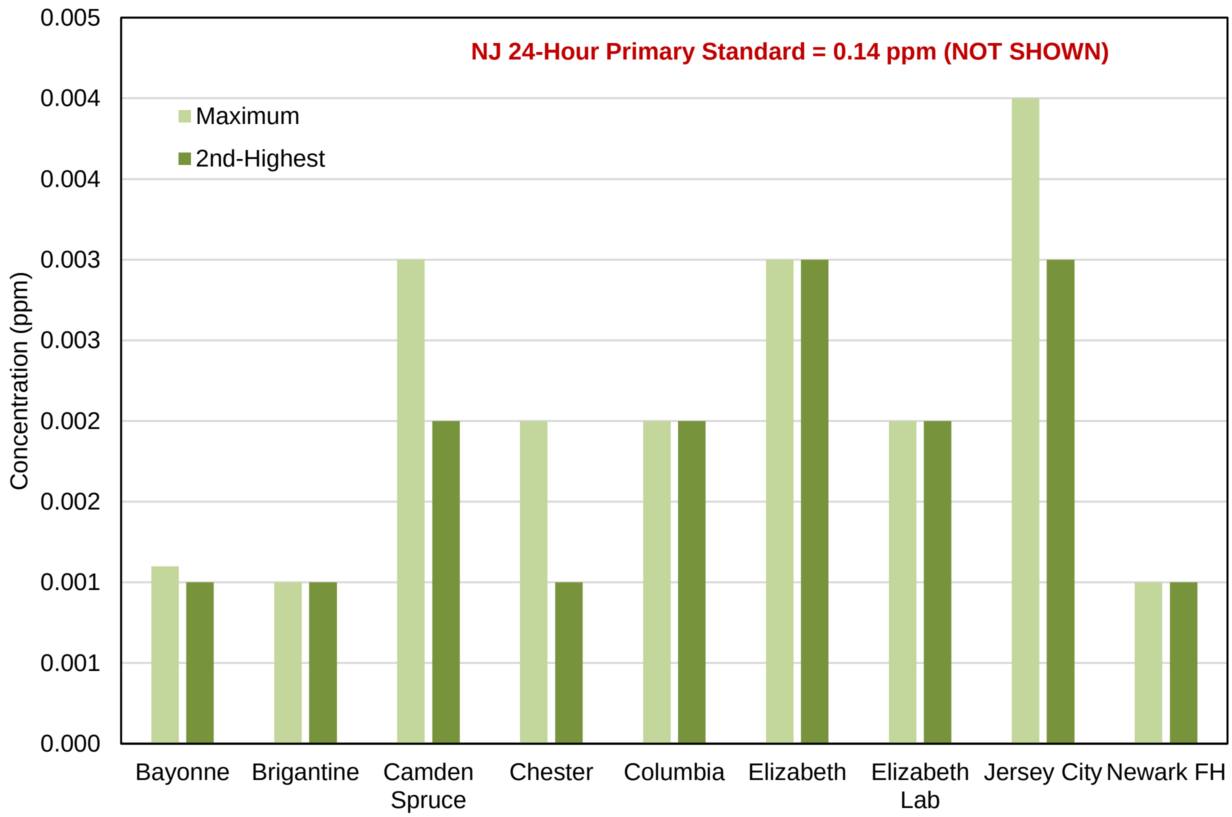
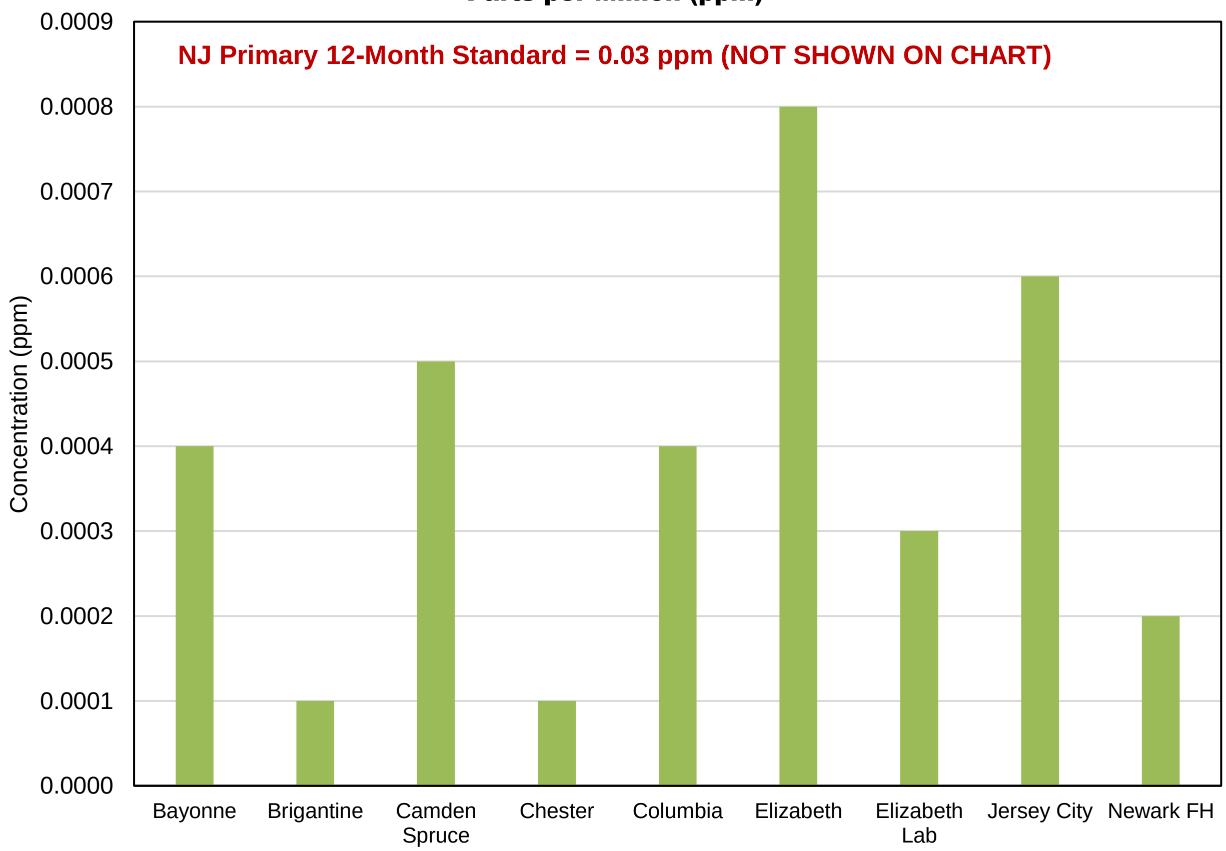


Table 7-5
2019 Sulfur Dioxide Concentrations in New Jersey
Maximum 12-Month Running Averages
Parts per Million (ppm)

Monitoring Site	Maximum 12-Month Running Average
Bayonne	0.0004
Brigantine	0.0001
Camden Spruce St.	0.0005
Chester	0.0001
Columbia	0.0004
Elizabeth	0.0008
Elizabeth Lab	0.0003
Jersey City	0.0006
Newark Firehouse	0.0002

Figure 7-7
2019 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, 1975-2019
2nd-Highest 24-Hour Average Concentrations
Parts per Billion (ppb)

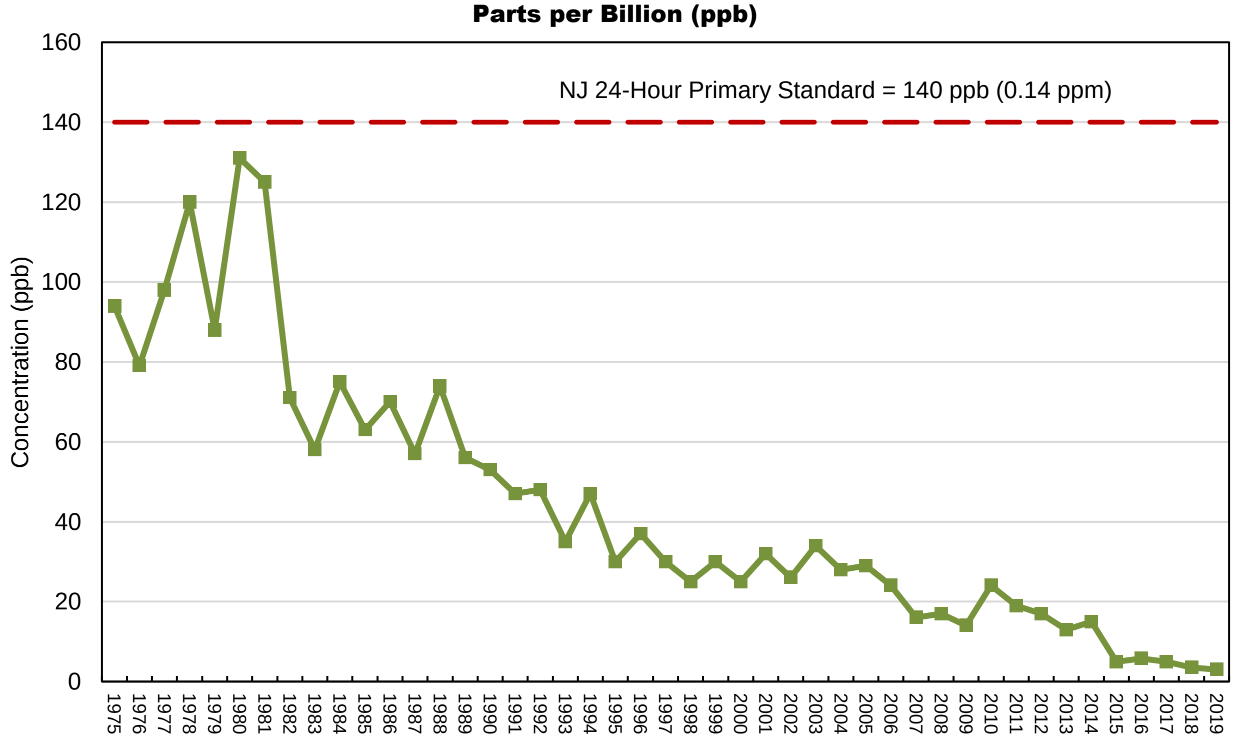


Figure 7-9
Sulfur Dioxide Trend in New Jersey, 2000-2019
99th Percentile of the Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)

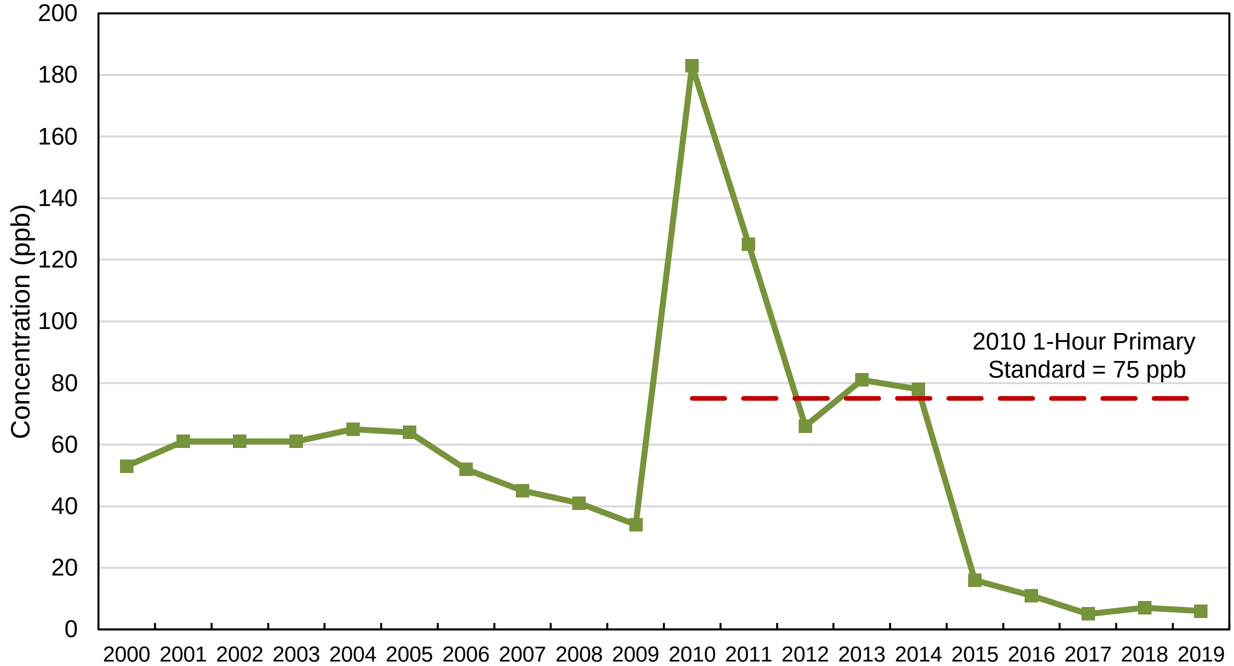
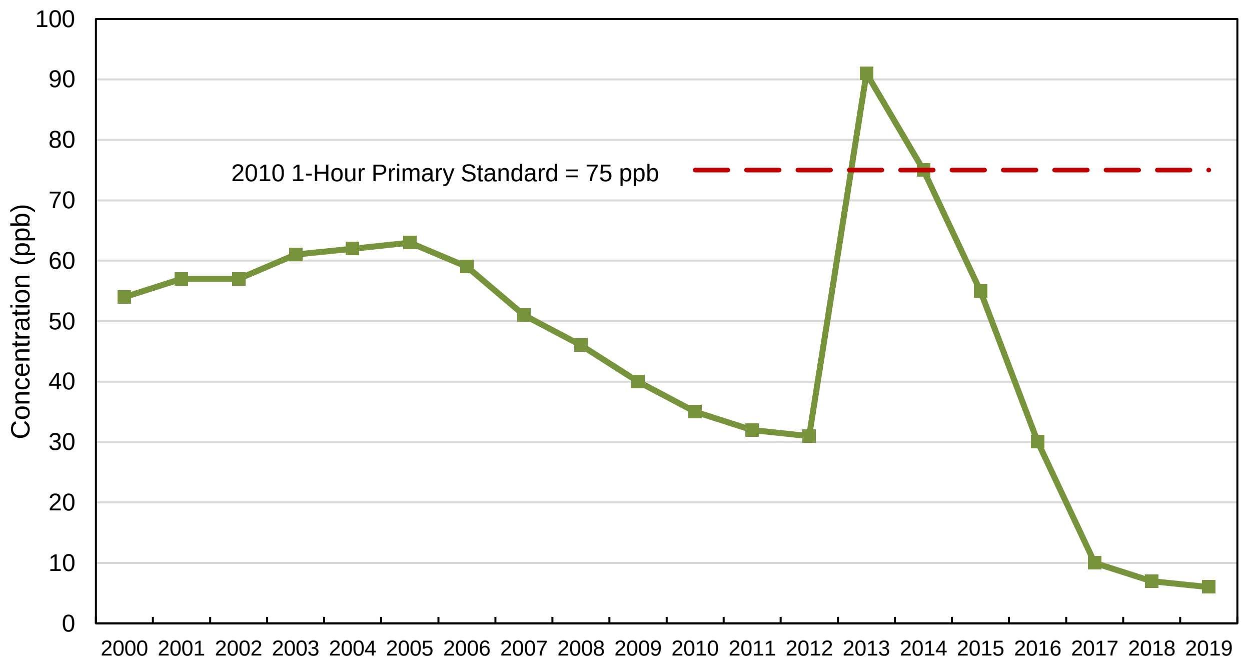


Figure 7-10
Sulfur Dioxide Design Value Trend in New Jersey, 2000-2019
3-Year Average of the 99th Percentile Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)



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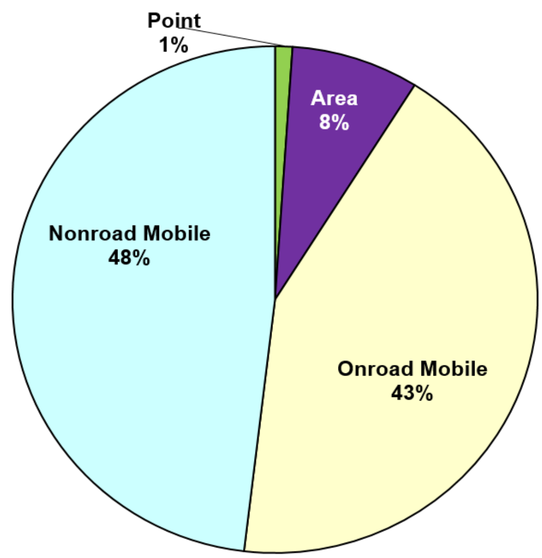
2019 Carbon Monoxide Summary

New Jersey Department of Environmental Protection

Sources

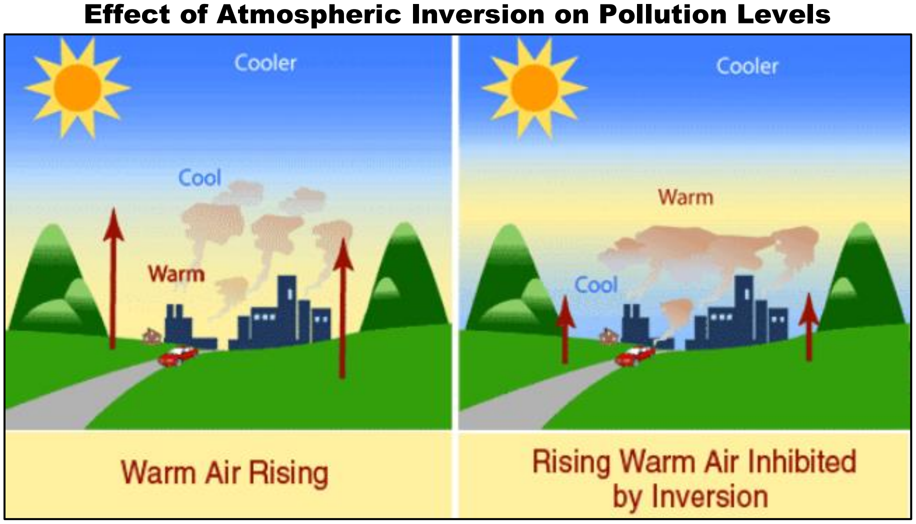
Carbon monoxide (CO) is a colorless, odorless gas formed when carbon in fuels is not burned completely. The main source of outdoor CO is exhaust from internal combustion engines, primarily on-road vehicles, as well as non-road vehicles, generators, construction equipment, boats and other types of mobile sources. Fifty percent 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 source categories of CO in New Jersey in 2017 is shown in Figure 8-1.

Figure 8-1
2017 New Jersey Estimated CO Annual Emissions



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 8-2
Effect of Atmospheric Inversion on Pollution Levels



https://www.epa.gov/pmcourse/what-particle-pollution

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
2019 Carbon Monoxide Concentrations in New Jersey
Monthly Variation
Parts per Million (ppm)

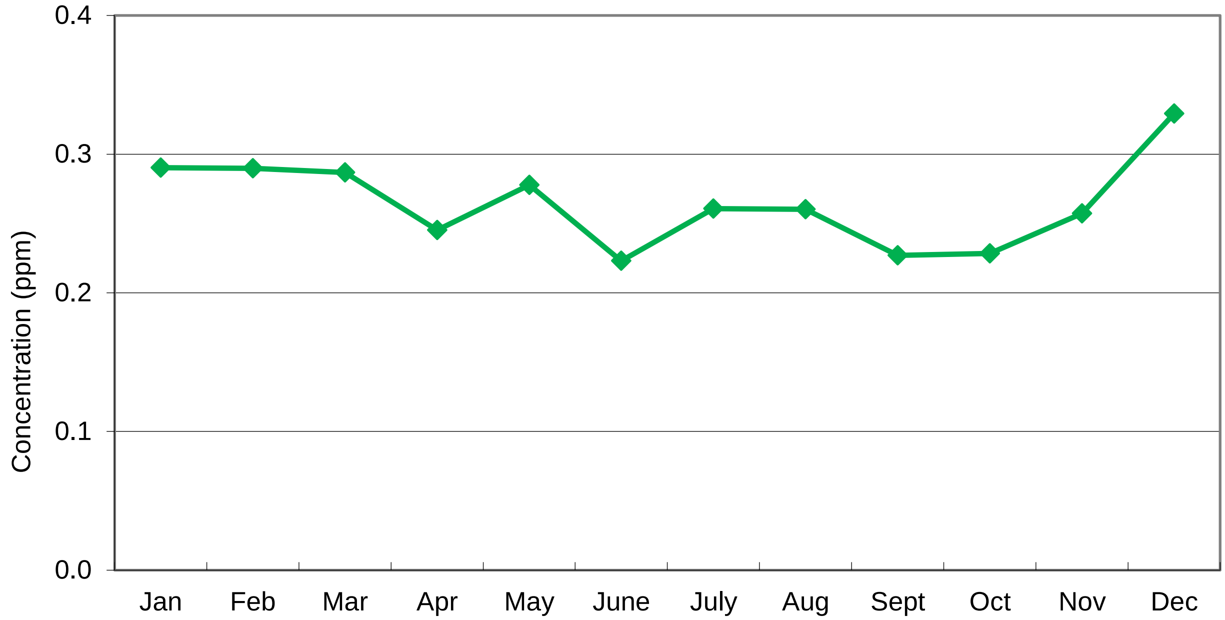
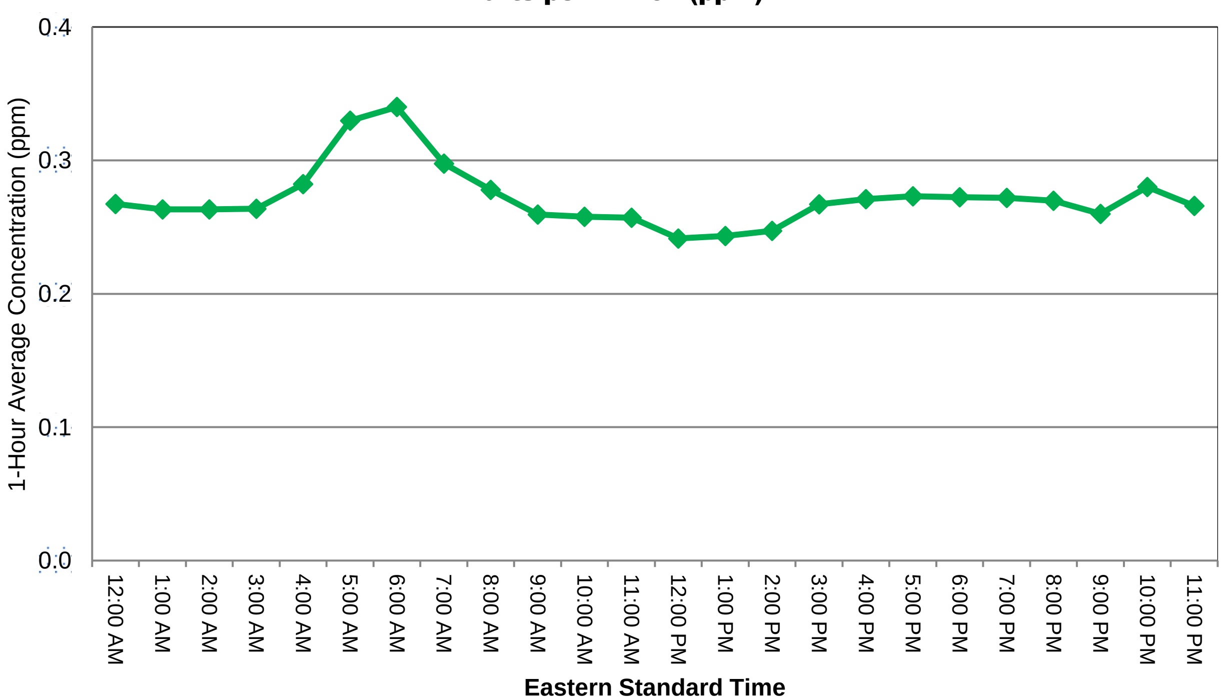


Figure 8-4
2019 Carbon Monoxide Concentrations in New Jersey
Hourly Variation
Parts per Million (ppm)



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 (also known as 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 values, or the actual statistical values that determine compliance with the NAAQS, are the second-highest 1-hour and 8-hour values 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)

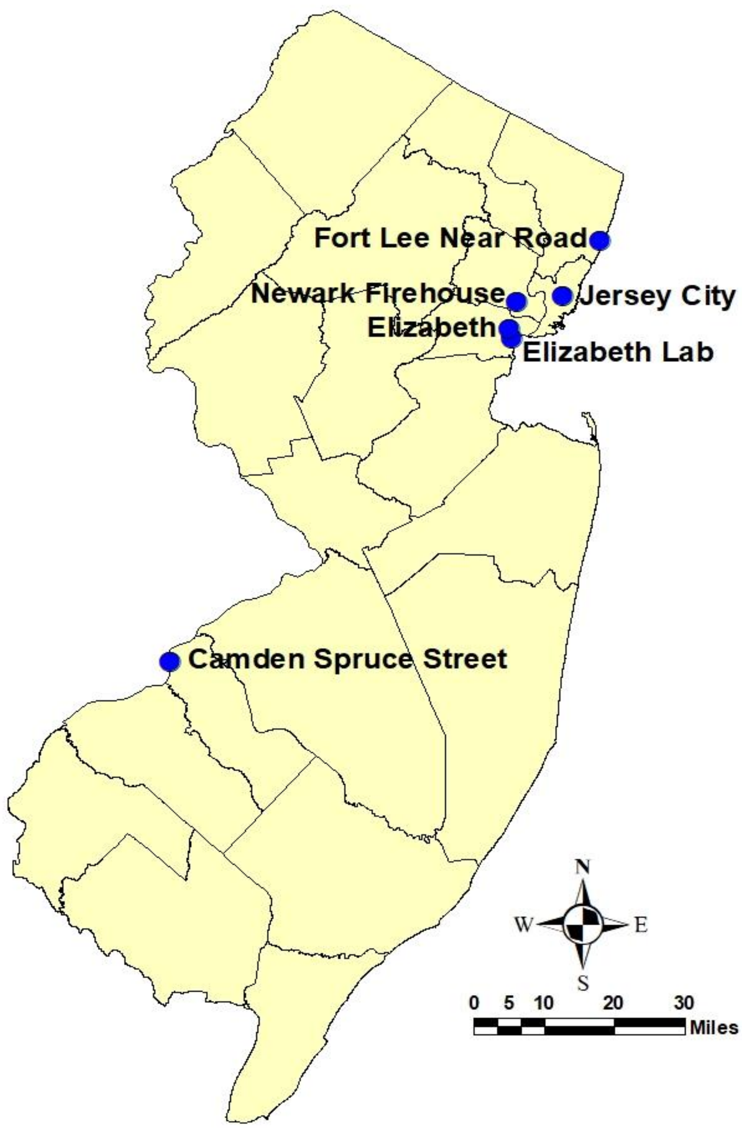
Averaging Period	Type	National [a]	New Jersey [b]
1-Hour	Primary	35 ppm	40 mg/m^3 (35 ppm)
1-Hour	Secondary	----	40 mg/m^3 (35 ppm)
8-Hours	Primary	9 ppm	10 mg/m^3 (9 ppm)
8-Hours	Secondary	----	10 mg/m^3 (9 ppm)

[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) had six CO monitors operating in 2019. The locations 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 thousandth of a ppm (0.000 ppm). The other stations are Camden Spruce Street, Elizabeth, Elizabeth Lab, Fort Lee Near Road, and Jersey City.

Figure 8-5
2019 Carbon Monoxide Monitoring Network



CO LEVELS IN 2019

There were no exceedances of any CO standards at any of the New Jersey monitoring sites during 2019. The maximum 1-hour average CO concentration recorded in 2019 was 3.2 ppm, at the Jersey City station. The highest 8-hour average CO concentration recorded was 1.9 ppm, at the Elizabeth station. Summaries of the 2019 data are provided in Table 8-2, and Figures 8-6 and 8-7.

Table 8-2
2019 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.	1.7	1.7	1.5	1.2
Elizabeth	2.5	2.2	1.9	1.6
Elizabeth Lab	2.1	1.6	1.3	1.3
Fort Lee Near Rd.	1.3	1.3	0.9	0.9
Jersey City	3.2	2.1	1.2	1.2
Newark Firehouse	2.379	2.254	1.7	1.6

*Non-overlapping 8-hour periods

Figure 8-6
2019 Carbon Monoxide Concentrations in New Jersey
1-Hour Averages
Parts per Million (ppm)

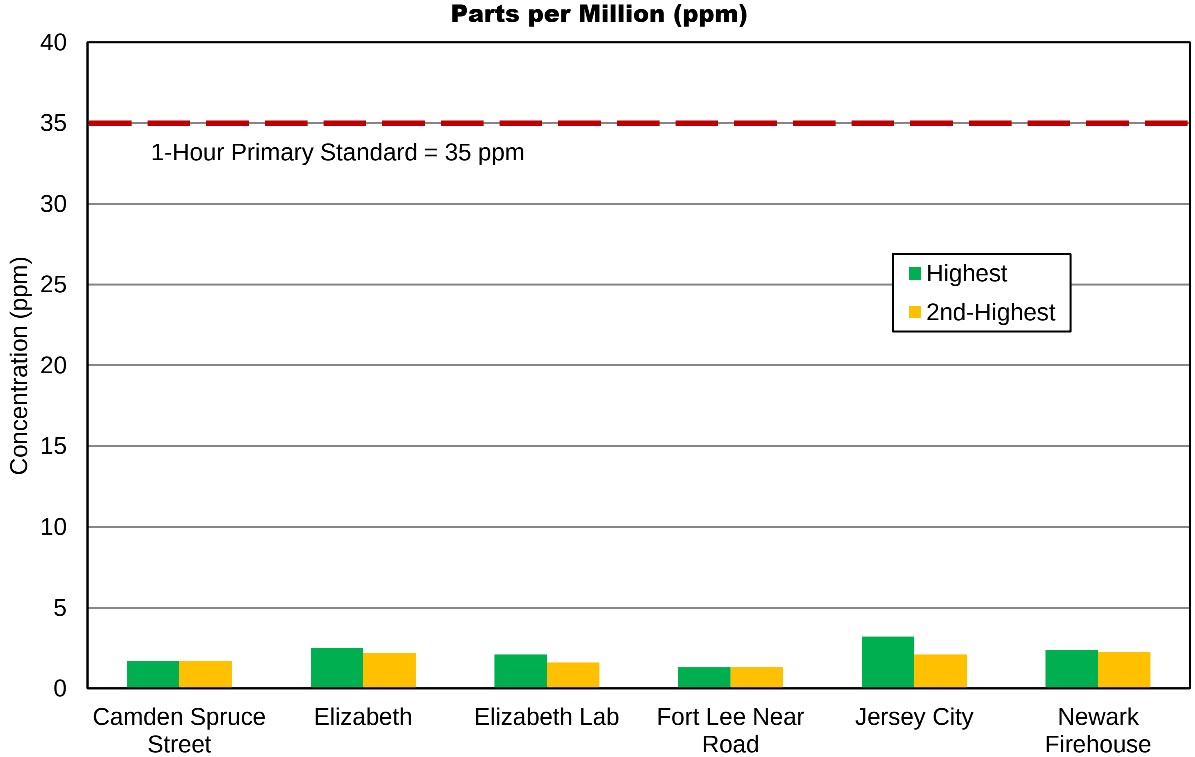
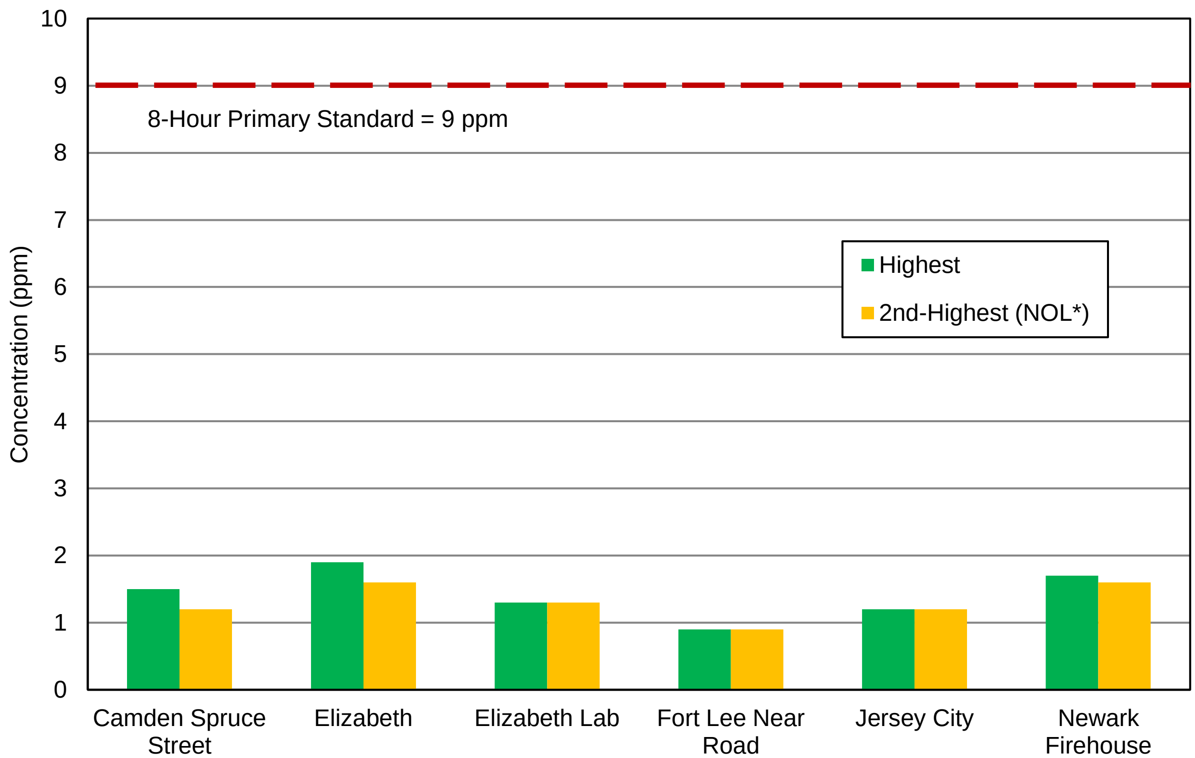


Figure 8-7
2019 Carbon Monoxide Concentrations in New Jersey
8-Hour Averages
Parts per Million (ppm)



*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, 1990-2019
2nd Highest 1-Hour Average Concentrations
Parts per Million (ppm)

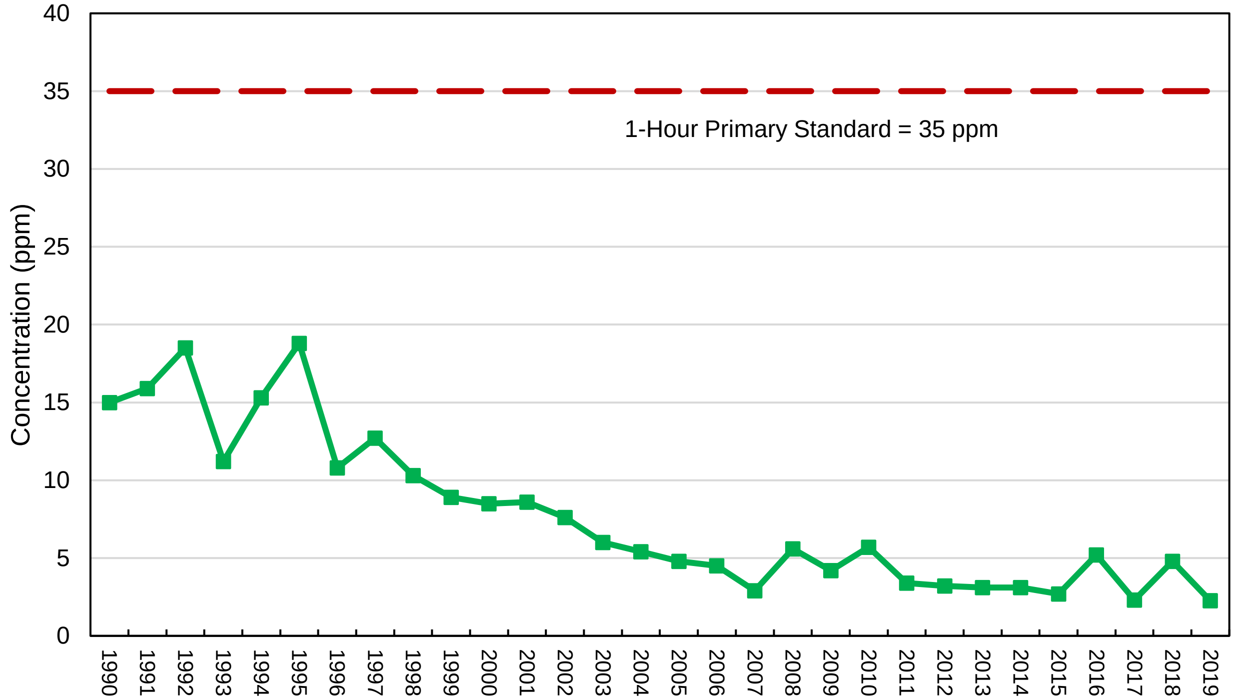
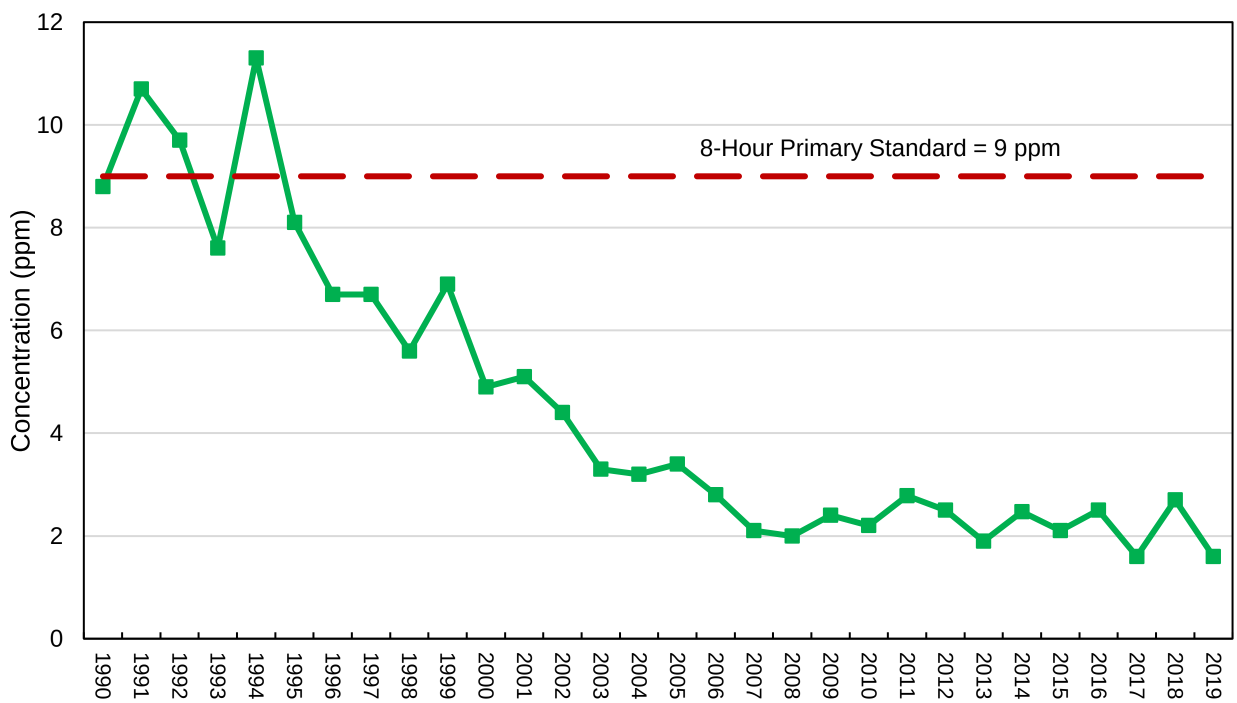


Figure 8-8
Carbon Monoxide Design Value Trend in New Jersey, 1990-2019
2nd Highest 8-Hour Average Concentrations
Parts per Million (ppm)



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2019 Lead Summary

New Jersey Department of Environmental Protection

Sources

Lead is a criteria pollutant as well as a Hazardous Air Pollutant listed under the 1990 Clean Air Act. It is one of the first known and most widely studied environmental and occupational toxins.

Lead was once commonly used in paint and gasoline, and is still used in batteries, solder, pipes, pottery, roofing materials and some cosmetics. Since 1980, there has been a 99% decrease in the average lead air concentration nationwide. A phase-out of lead additive in gasoline began in the mid-1970s. It is still used in aviation fuel in some smaller aircraft, accounting for about 74% of the estimated 9 tons emitted in New Jersey in 2014. New Jersey no longer has any significant industrial sources of lead.

Health Effects

Lead that is emitted into the air can be inhaled, or ingested after it settles (this is actually the main route of human exposure to airborne lead). There is no level of lead exposure that is considered safe. The main target for lead toxicity is the nervous system, both in adults and children. However, children's developing brains are the most vulnerable to the effects of lead, leading to lifelong effects, even after exposure ceases. The brain damage caused by lead exposure can result in learning disabilities and delinquent behavior, impacting IQ and academic achievement. Lead can also damage red blood cells and weaken the immune system. Other effects in adults include increased blood pressure, cardiovascular disease, and decreased kidney function. In addition, lead is classified as a "probable human carcinogen."

Ambient Air quality Standards

A NAAQS for lead was first promulgated in 1978. A value of 1.5 µg/m^3 was established as both the primary and secondary standard. It was based on an average for each calendar quarter, and was not to be exceeded. The New Jersey AAQS was based on a rolling three-month average. Thirty years later, in 2008, the NAAQS was lowered tenfold to 0.15 µg/m^3, also averaged over a rolling three-month period, and not to be exceeded.

A rolling three-month average considers each of the 12 three-month periods associated with a given year, not just the four calendar quarters within that year. The old NAAQS required lead to be sampled as total suspended particulate (TSP). In New Jersey, lead is now measured as PM_{10}.

Table 9-1
National Ambient Air Quality Standards for Lead
Micrograms Per Cubic Meter (µg/m^3)

Averaging Period	Type	Level
3 Months (Rolling)	Primary & Secondary	0.15 µg/m^3

Lead Air Levels in 2019

In the 1980s NJDEP had more than 20 lead monitors around the state, including a few specifically located near lead-emitting facilities, such as a battery manufacturer in New Brunswick and a paint factory in Newark. By 2008, after years of decreasing measurements, all of New Jersey's lead monitors were shut down. In 2012, a lead monitor was installed at the Newark Firehouse monitoring station in accordance with new NAAQS requirements. Figure 9-1 presents all of the data from the Newark site since it started operating. Table 9-1 shows the rolling three-month averages for 2019.

Figure 9-1
Lead Concentrations at Newark Firehouse in New Jersey, 2012-2019
24-Hour Averages
Micrograms per Cubic Meter (µg/m³)

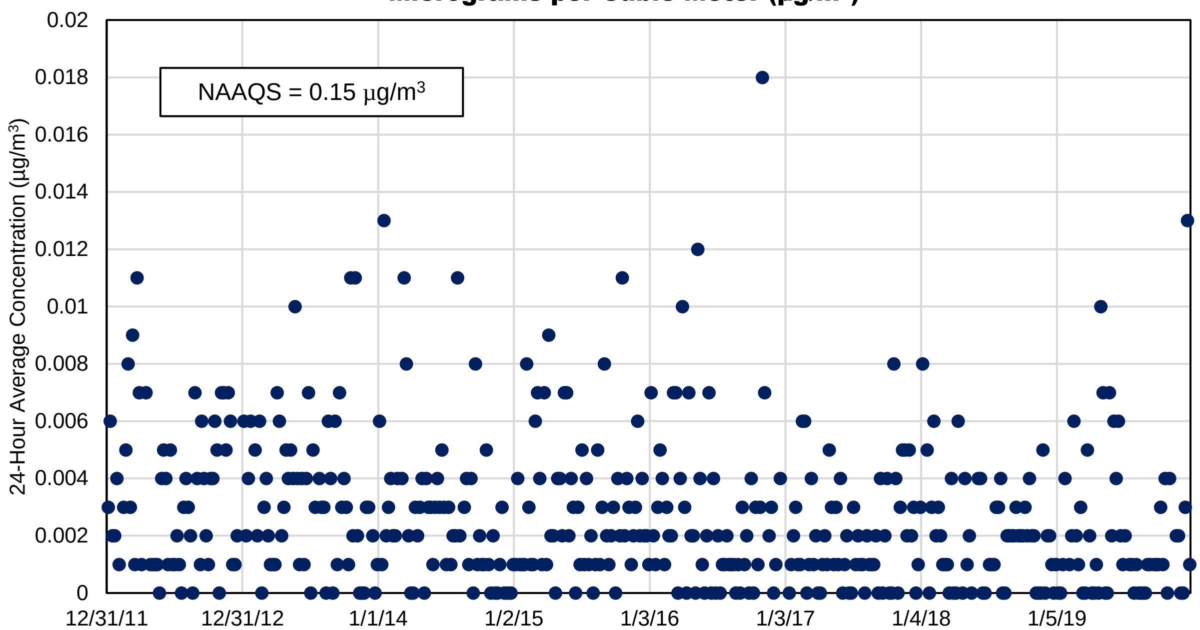


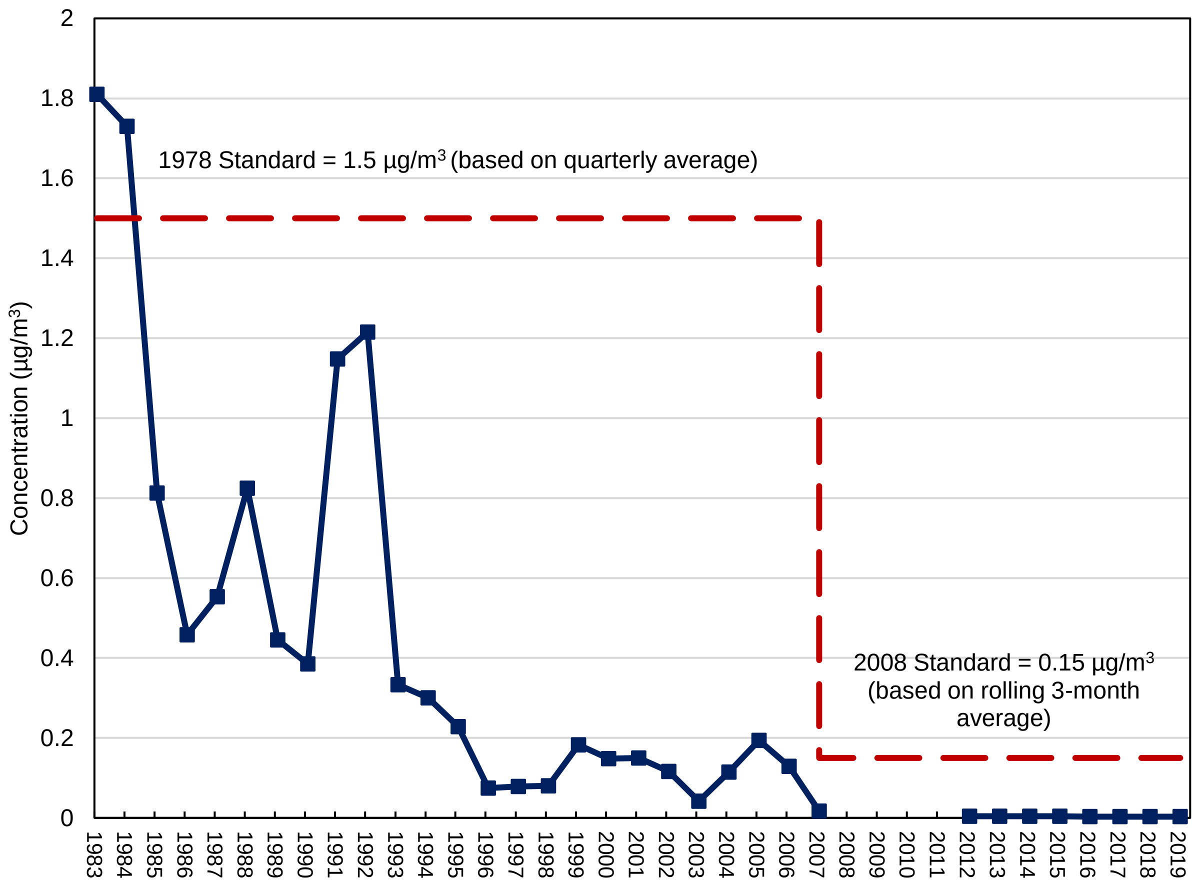
Table 9-1
2019 Lead Concentrations in New Jersey
3-Month Rolling Averages
Micrograms per Cubic Meter (µg/m³)

3-Month Period	3-Month Average
November-January	0.001
December-February	0.002
January-March	0.002
February-April	0.002
March-May	0.002
April-June	0.003
May-July	0.003
June-August	0.002
July-September	0.001
August-October	0.001
September-November	0.002
October-December	0.003

LEAD AIR TREND

The last exceedances of the NAAQS were in 1983 and 1984 (as shown in Figure 9-2), and the last exceedance of the NJAAQS was in 1992 (based on a rolling 3-month average; not shown in the graph). Since then, air concentrations of lead in New Jersey have dropped considerably. The highest annual 3-month rolling average concentrations at Newark Firehouse since 2012 have ranged from 0.003 to 0.004 µg/m³.

Figure 9-2
Lead Design Value Trend in New Jersey, 1983-2019
Highest 3-Month Average
Micrograms per Cubic Meter (µg/m³)



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2019 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 states and local or tribal jurisdictions are required to plan and implement a process to bring and keep levels below the NAAQS, using monitoring, reporting, and control measures. Each of these pollutants is discussed in its own section (Sections 4 through 9) of this New Jersey Department of Environmental Protection (NJDEP) 2019 Air Quality Report.

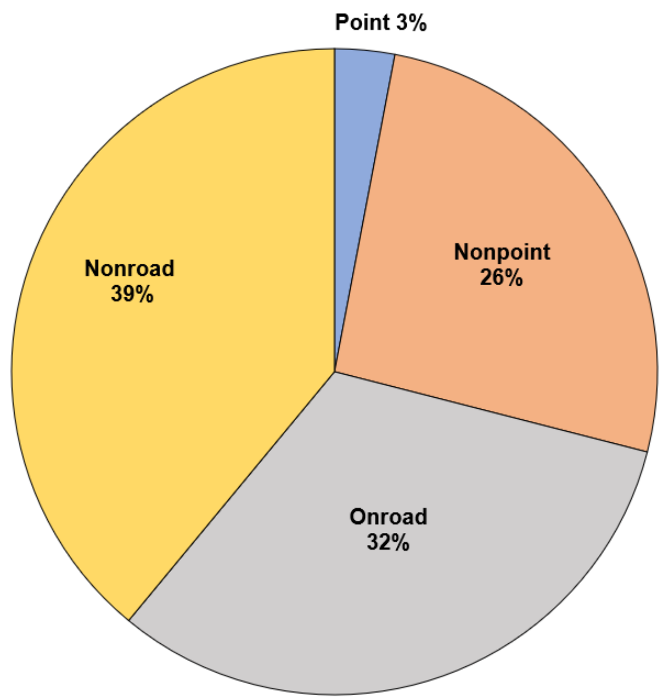
Air toxics are all the other chemicals released into the air that have the potential to cause adverse health effects in humans. These effects cover a wide range of conditions, from lung irritation to birth defects to cancer. There are no NAAQS for these pollutants, but in 1990 the U.S. Congress directed the USEPA to begin addressing a list of 187 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 health risk from air toxics around the country. The pie chart in Figure 10-1, taken from the most recent available NEI (for 2014), 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

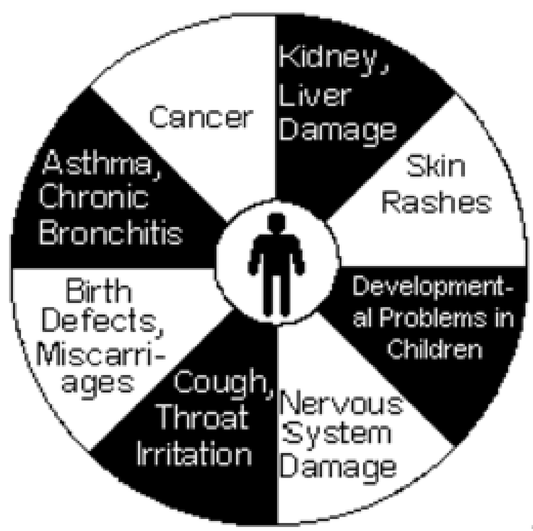


https://www.nj.gov/dep/airtoxics/sourceso14.htm

HEALTH EFFECTS

People exposed to air toxics in significant amounts or for significant periods 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.

Figure 10-2
Potential Effects of Air Toxics

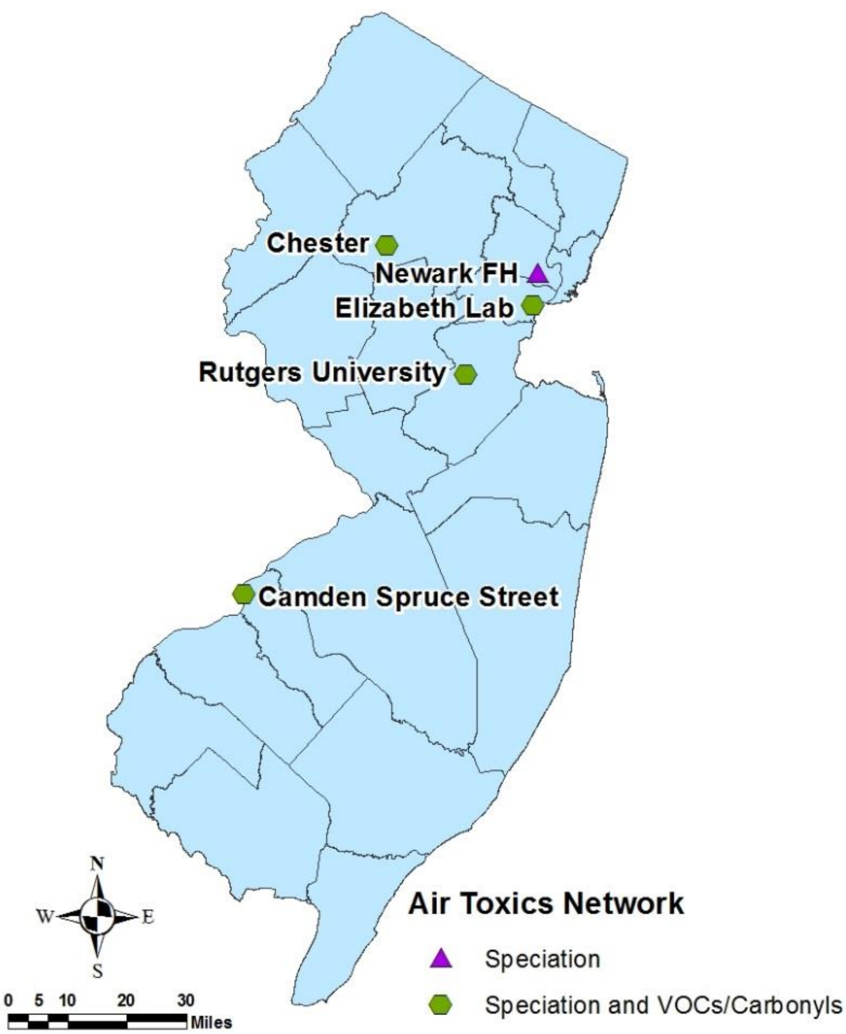


Source: www3.epa.gov/ttn/atw/3_90_024.html

MONITORING LOCATIONS

In 2019 NJDEP had four air toxics monitoring sites that measured 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 Rutgers University in East Brunswick. Toxic metals data are collected at the same four monitoring stations, plus Newark Firehouse.

Figure 10-3
2019 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 situated on Rutgers University 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 this 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 in July 2001 toxics monitoring began at the Chester and New Brunswick monitoring stations. In 2016 the New Brunswick VOC monitor was moved to the Rutgers University monitoring site, 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 2019

2019 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 10-4 through 10-7, including concentrations in parts per billion by volume (ppbv), additional statistics, and risk estimates. 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.

Detection limit information and health benchmarks used by NJDEP can be found in Table 10-9. A number of compounds were mostly below the detection limit of the lab analysis method used. However, this does not mean they are not present in the air below the detection limit level. For chemicals detected in less than 50% of the samples, there is significant uncertainty in the calculated averages. Median values (the value of the middle sample when the results are ranked) are reported in Tables 10-4 through 10-7 along with the mean (average) concentrations, because for some compounds only a single value or a few very high values were recorded. These high values could skew 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.

Table 10-1
2019 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	2.7040	1.1524	2.0617	1.9440
2	Acetone			67-64-1	2.8067	1.8891	2.5410	2.4192
3	Acetonitrile		*	75-05-8	0.3105	0.4096	0.8403	0.6298
4	Acetylene			74-86-2	0.6663	0.3680	0.8070	0.5279
5	Acrolein		*	107-02-8	0.7847	0.7593	0.7308	0.8465
6	Acrylonitrile		*	107-13-1	_0.0022_	_0.0017_	ND	_0.0010_
7	tert-Amyl Methyl Ether			994-05-8	ND	ND	ND	_0.0006_
8	Benzaldehyde			100-52-7	0.3219	0.0740	0.1115	0.1006
9	Benzene		*	71-43-2	0.8100	0.3385	0.6976	0.4539
10	Bromochloromethane			74-97-5	ND	ND	_0.0003_	ND
11	Bromodichloromethane			75-27-4	_0.0028_	_0.0014_	_0.0036_	_0.0037_
12	Bromoform		*	75-25-2	_0.0087_	_0.0049_	_0.0108_	_0.0086_
13	Bromomethane	Methyl bromide	*	74-83-9	0.4870	0.0273	0.0294	0.0290
14	1,3-Butadiene		*	106-99-0	0.0567	0.0122	0.0749	0.0337
15	Butyraldehyde			123-72-8	0.3940	0.1653	0.2886	0.2495
16	Carbon Disulfide		*	75-15-0	0.0755	0.0472	0.0572	0.0473
17	Carbon Tetrachloride		*	56-23-5	0.5984	0.5902	0.5976	0.5988
18	Chlorobenzene		*	108-90-7	_0.0080_	_0.0017_	_0.0060_	_0.0031_
19	Chloroethane	Ethyl chloride	*	75-00-3	0.0307	_0.0157_	0.0186	0.0464
20	Chloroform		*	67-66-3	0.1285	0.1044	0.1403	0.1332
21	Chloromethane	Methyl chloride	*	74-87-3	1.1360	1.0970	1.1195	1.1109
22	Chloroprene	2-Chloro-1,3-butadiene	*	126-99-8	ND	ND	ND	ND
23	Crotonaldehyde			123-73-9	0.2072	0.2555	0.2862	0.1692
24	Dibromochloromethane	Chlorodibromomethane		124-48-1	_0.0028_	_0.0007_	_0.0027_	_0.0022_
25	1,2-Dibromoethane	Ethylene dibromide	*	106-93-4	ND	ND	_0.0003_	ND
26	m-Dichlorobenzene	1,3-Dichlorobenzene		541-73-1	_0.0010_	_0.0005_	_0.0009_	_0.0003_
27	o-Dichlorobenzene	1,2-Dichlorobenzene		95-50-1	_0.0018_	_0.0012_	_0.0012_	_0.0013_
28	p-Dichlorobenzene	1,4-Dichlorobenzene	*	106-46-7	0.0489	_0.0099_	0.0339	_0.0182_
29	Dichlorodifluoromethane			75-71-8	2.4352	2.3175	2.3451	2.3278
30	1,1-Dichloroethane	Ethylidene dichloride	*	75-34-3	_0.0025_	_0_	_0.0022_	_0.0005_
31	1,2-Dichloroethane	Ethylene dichloride	*	107-06-2	0.0864	0.0735	0.0860	0.0786
32	1,1-Dichloroethylene	Vinylidene chloride	*	75-35-4	_0.0041_	_0.0012_	_0.0013_	_0.0012_
33	cis-1,2-Dichloroethylene	cis-1,2-Dichloroethene		156-59-2	ND	ND	ND	_0.0001_
34	trans-1,2-Dichloroethylene	trans-1,2-Dichloroethene		156-60-5	_0.0112_	_0.0027_	_0.0077_	_0.0060_
35	Dichloromethane	Methylene chloride	*	75-09-2	0.6431	1.1363	3.3766	0.6355
36	1,2-Dichloropropane	Propylene dichloride	*	78-87-5	_0.0023_	_0.0007_	_0.0010_	_0.0016_

Continued

- _Values in **italics** indicate averages based on less than 50% of samples above the detection limit._
- **ND** (“not detected”) indicates that all samples were below the detection limit.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

Table 10-1 (continued)
2019 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-Dichloropropylene	cis-1,3-Dichloropropene	*	10061-01-5	ND	ND	ND	ND
38	trans-1,3-Dichloropropylene	trans-1,3-Dichloropropene	*	10061-02-6	ND	ND	ND	ND
39	Dichlorotetrafluoroethane	Freon 114		76-14-2	0.1156	0.1148	0.1166	0.1159
40	Ethyl Acrylate		*	140-88-5	*0.0014*	*0.0010*	ND	*0.0015*
41	Ethylbenzene		*	100-41-4	0.3017	0.0695	0.2595	0.1351
42	Ethyl tert-Butyl Ether	tert-Butyl ethyl ether		637-92-3	*0.0005*	*0.0051*	*0.0002*	0.0458
43	Formaldehyde		*	50-00-0	2.8514	2.2930	3.4649	1.8037
44	Hexachlorobutadiene	Hexachloro-1,3-butadiene	*	87-68-3	*0.0066*	*0.0071*	*0.0057*	*0.0085*
45	Hexaldehyde	Hexanaldehyde		66-25-1	0.2154	0.1121	0.2237	0.1800
46	Methyl Ethyl Ketone	MEK, 2-Butanone		78-93-3	0.4181	0.2916	0.4207	0.4770
47	Methyl Isobutyl Ketone	MIBK	*	108-10-1	0.1522	0.0826	0.1390	0.1226
48	Methyl Methacrylate		*	80-62-6	0.0398	*0.0012*	0.0354	*0.0082*
49	Methyl tert-Butyl Ether	MTBE	*	1634-04-4	*0.0008*	*0.0004*	ND	*0.0031*
50	n-Octane			111-65-9	0.2591	0.0854	0.3285	0.1033
51	Propionaldehyde		*	123-38-6	0.4250	0.2214	0.4149	0.3223
52	Propylene			115-07-1	0.8131	0.3064	1.2329	0.4814
53	Styrene		*	100-42-5	0.3577	*0.0123*	0.0651	0.0398
54	1,1,2,2-Tetrachloroethane		*	79-34-5	*0.0027*	*0.0044*	*0.0020*	*0.0052*
55	Tetrachloroethylene	Perchloroethylene	*	127-18-4	0.1495	0.0565	0.1354	0.0894
56	Toluene		*	108-88-3	2.0892	0.4205	1.6450	0.7368
57	1,2,4-Trichlorobenzene		*	120-82-1	*0.0100*	*0.0096*	*0.0079*	*0.0126*
58	1,1,1-Trichloroethane	Methyl chloroform	*	71-55-6	*0.0103*	*0.0065*	0.0126	0.0117
59	1,1,2-Trichloroethane		*	79-00-5	*0.0088*	*0.0003*	*0.0004*	*0.0009*
60	Trichloroethylene		*	79-01-6	0.0435	*0.0113*	0.0224	0.0171
61	Trichlorofluoromethane			75-69-4	1.8637	1.2008	1.2335	1.2255
62	Trichlorotrifluoroethane	1,1,2-Trichloro-1,2,2-trifluoroethane		76-13-1	0.5912	0.5868	0.5864	0.5896
63	1,2,4-Trimethylbenzene			95-63-6	0.3726	0.0502	0.2572	0.1010
64	1,3,5-Trimethylbenzene			108-67-8	0.1102	0.0108	0.0786	0.0268
65	Valeraldehyde			110-62-3	0.1301	0.0432	0.1114	0.0939
66	Vinyl chloride		*	75-01-4	0.0105	*0.0013*	*0.0007*	*0.0017*
67	m,p-Xylene		*	108-38-3 106-42-3	0.9107	0.1357	0.7272	0.2947
68	o-Xylene		*	95-47-6	0.4139	0.0772	0.3177	0.1429

- *Values in **italics** are averages based on less than 50% of samples detected.*
- **ND** ("not detected") indicates that all samples were below the detection limit.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

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 animal or human health studies. For carcinogens, which are 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). Because of a lack of toxicity studies, not all air toxics have health benchmarks. Health benchmarks used to evaluate the VOCs and carbonyls monitored in New Jersey are listed in Table 10-9. Health benchmarks for specific toxic metals and elements are shown in Table 10-3.

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.

Air toxics with risk ratios greater than one for at least one monitoring site are summarized in Table 10-2. Acrolein and formaldehyde showed the highest risk statewide. Other pollutants above health benchmarks at all four sites were acetaldehyde, benzene, carbon tetrachloride, chloroform, chloromethane (methyl chloride), and 1,2-dichloroethane (ethylene dichloride). 1,3-butadiene was over the health benchmark at Camden and Elizabeth.

Table 10-2
Monitored Air Toxics with Risk Ratios Greater Than One in 2019

Pollutant		CAS No.	Annual Average Risk Ratio			
			Camden	Chester	Elizabeth	Rutgers
1	Acetaldehyde	75-07-0	6	3	5	4
2	Acrolein	107-02-8	39	38	37	42
3	Benzene	71-43-2	6	3	5	3
4	1,3-Butadiene	106-99-0	1.7	0.4	2.3	1.0
5	Carbon Tetrachloride	56-23-5	4	3	4	4
6	Chloroform	67-66-3	3	2	3	3
7	Chloromethane	74-87-3	2	2	2	2
8	1,2-Dichloroethane	107-06-2	2	2	2	2
9	Formaldehyde	50-00-0	37	30	45	23

- Risk ratio = air concentration (annual average)/health benchmark

Table 10-3 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 10-3
2019 Summary of Toxic Metals and Elements Monitored in New Jersey
Annual Average Concentrations
Micrograms per Cubic Meter (μg/m^3)

Pollutant	HAP	Camden	Chester	Elizabeth	Newark	Rutgers	Health Benchmark (μg/m^3)
Antimony	*	*0*	*0.002*	0.003	0.0026	0.002	*0.2*
Arsenic	*	*0.000003*	*0.000004*	0.00001	*0.000004*	0.00001	0.00023
Cadmium	*	*0.002*	*0.0005*	0.0019	0.0025	0.0019	0.00024
Chlorine	*	0.1562	0.0046	0.0113	0.0245	0.0087	*0.2*
Chromium[a]	*	0.004	0.0017	0.0027	0.0019	0.0028	0.000083
Cobalt	*	*0*	*0.0002*	*0*	*0*	*0*	0.00011
Lead	*	0.0039	0.0017	0.0016	0.0025	0.0021	0.083
Manganese	*	0.0025	*0*	0.002	0.0016	0.0013	*0.05*
Nickel[b]	*	0.0015	0.0005	0.0012	0.0008	0.0011	0.0021
Phosphorus	*	0.0006	0.00004	0.0005	0.0004	0.0002	*0.07*
Selenium	*	*0.0008*	0.0003	0.0004	0.0004	0.0004	*20*
Silicon		0.0503	0.0168	0.0472	0.0487	0.0328	*3*
Vanadium		*0.002*	*0.0001*	*0.0001*	*0.0002*	*0.0001*	*0.1*

- Annual average values in ***italics*** had fewer than 50% of samples detectable, so the means are highly uncertain.
- HAP = Hazardous air pollutant listed in the Clean Air Act.
- Health benchmarks in italics have a noncancer endpoint. See section below on "Estimating Health Risk" for more information.

a) 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.
b) 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.

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 10-11 present data for some of the VOCs that have been measured for a number of years at levels of concern (above their health benchmarks). 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 10-11 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 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 probably 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 laboratory 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-Dichloroethane (also known as ethylene dichloride) (Figure 10-10) 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 laboratory detection limit, resulting in over 90% of samples having detectable levels. 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.

Formaldehyde (Figure 10-11) 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 high outdoor levels are mostly the result of secondary formation. In 2014, concentrations at the New Brunswick site were consistently higher than at the other monitors, although levels subsequently dropped to the range of the other monitoring sites.

Figure 10-4
ACETALDEHYDE – New Jersey Monitored Concentrations

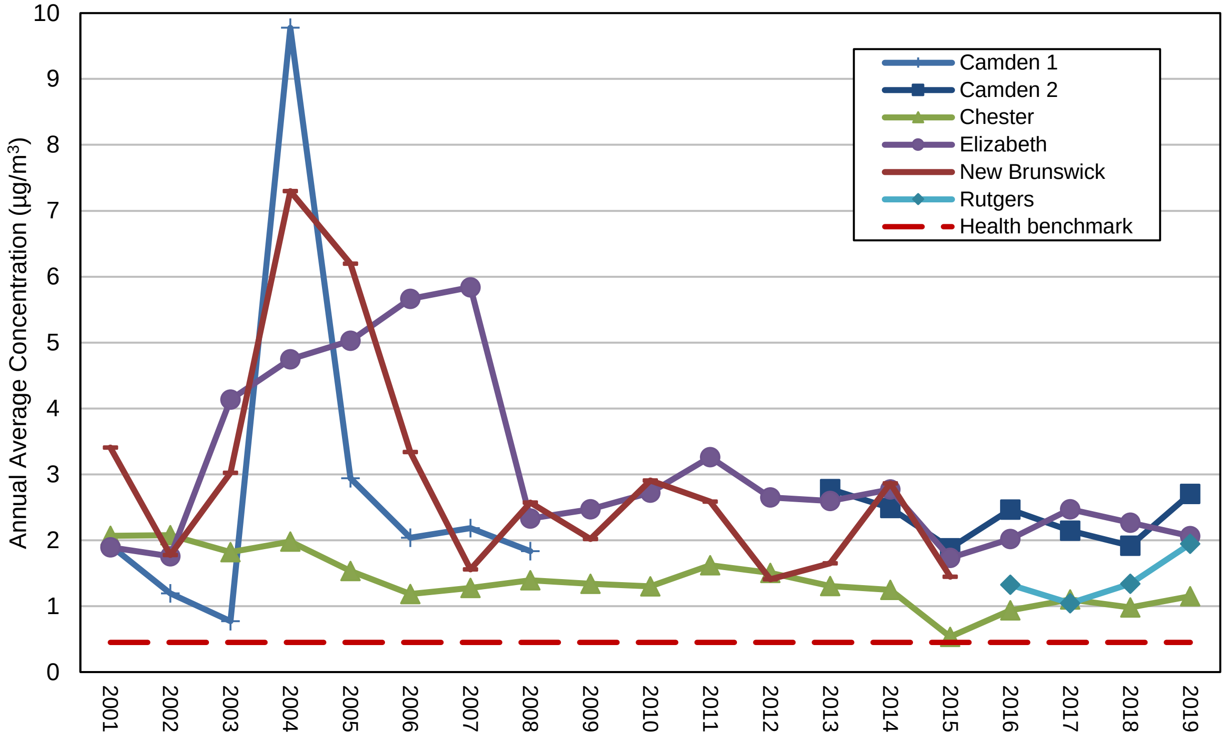


Figure 10-5
BENZENE – New Jersey Monitored Concentrations

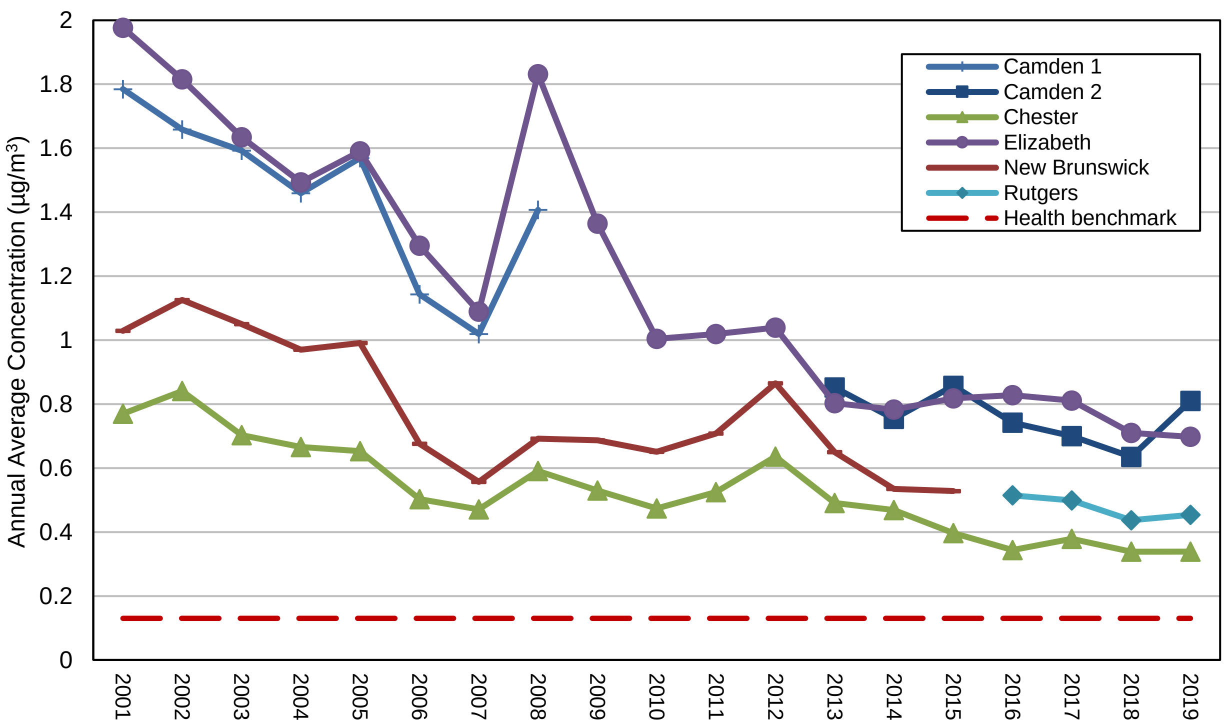


Figure 10-6
1,3-BUTADIENE – New Jersey Monitored Concentrations

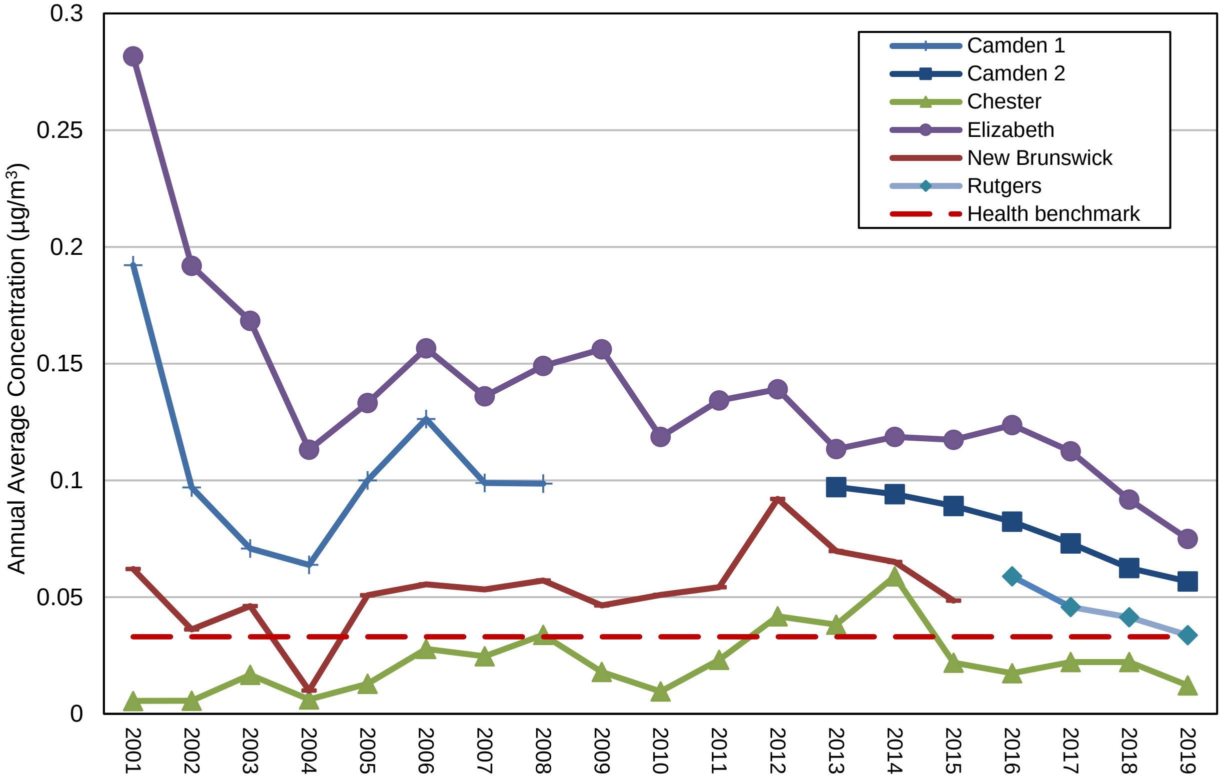


Figure 10-7
CARBON TETRACHLORIDE – New Jersey Monitored Concentrations

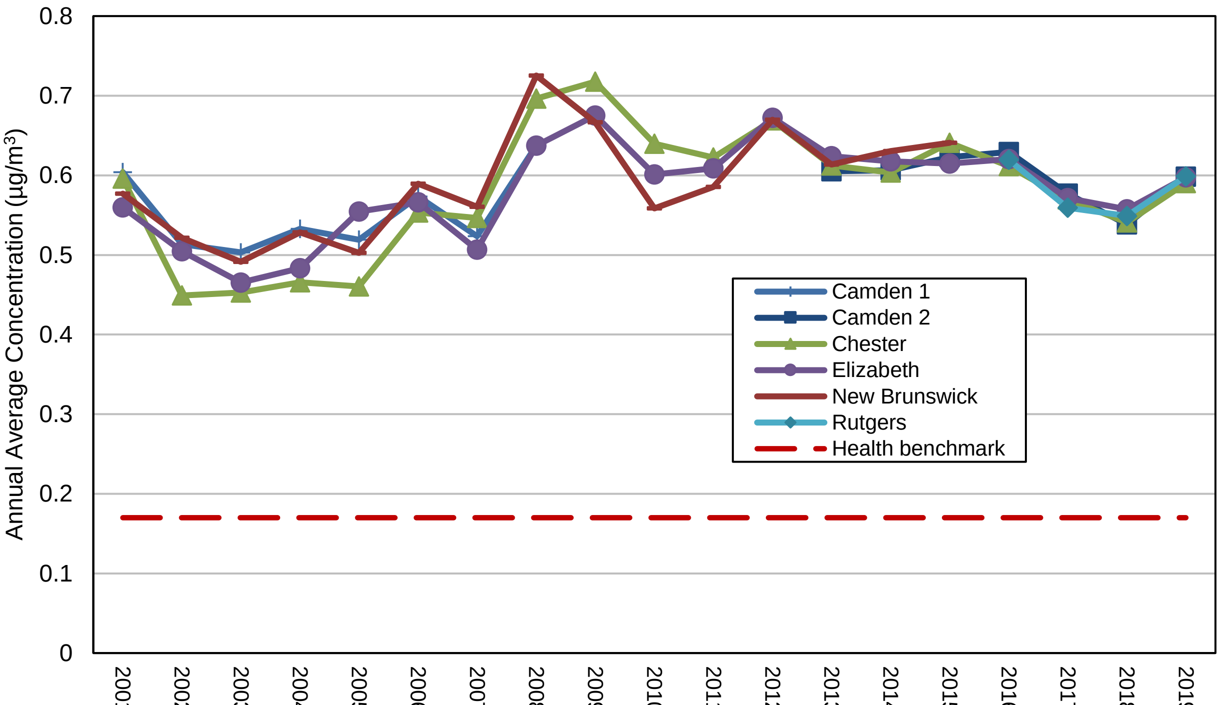


Figure 10-8
CHLOROFORM – New Jersey Monitored Concentrations

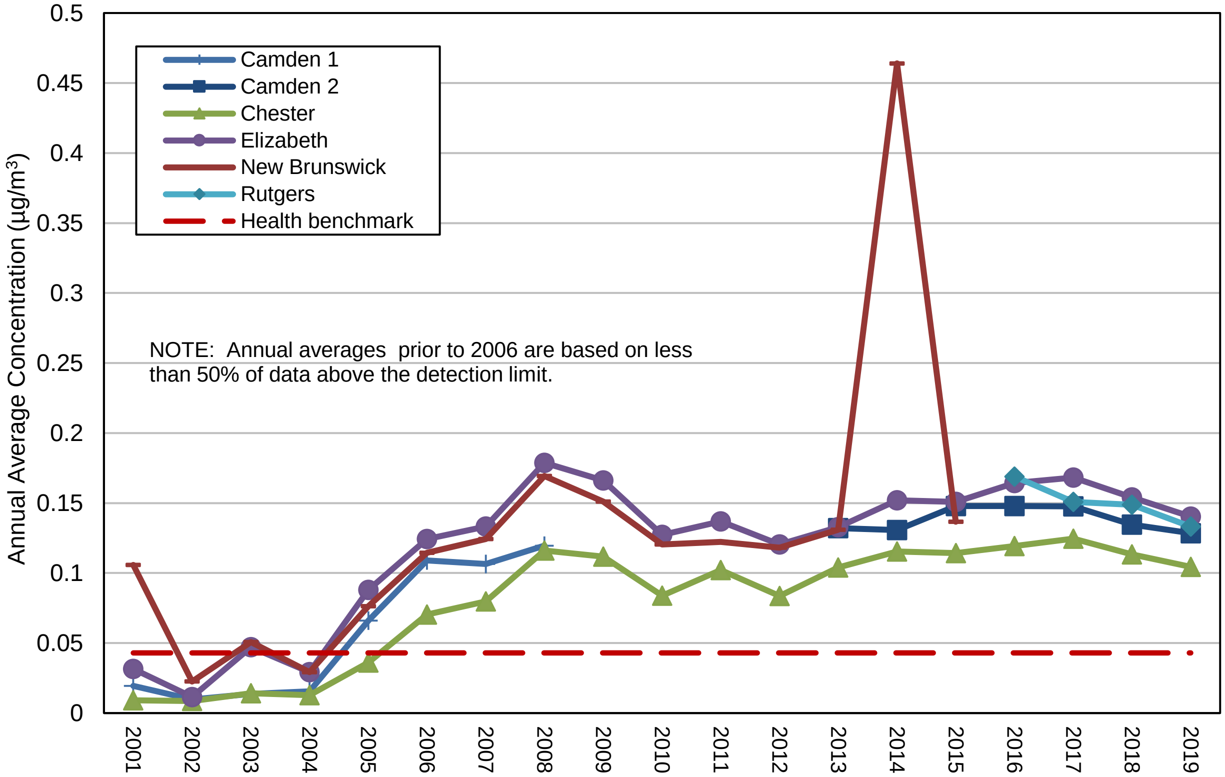


Figure 10-9
CHLOROMETHANE (Methyl Chloride) – New Jersey Monitored Concentrations

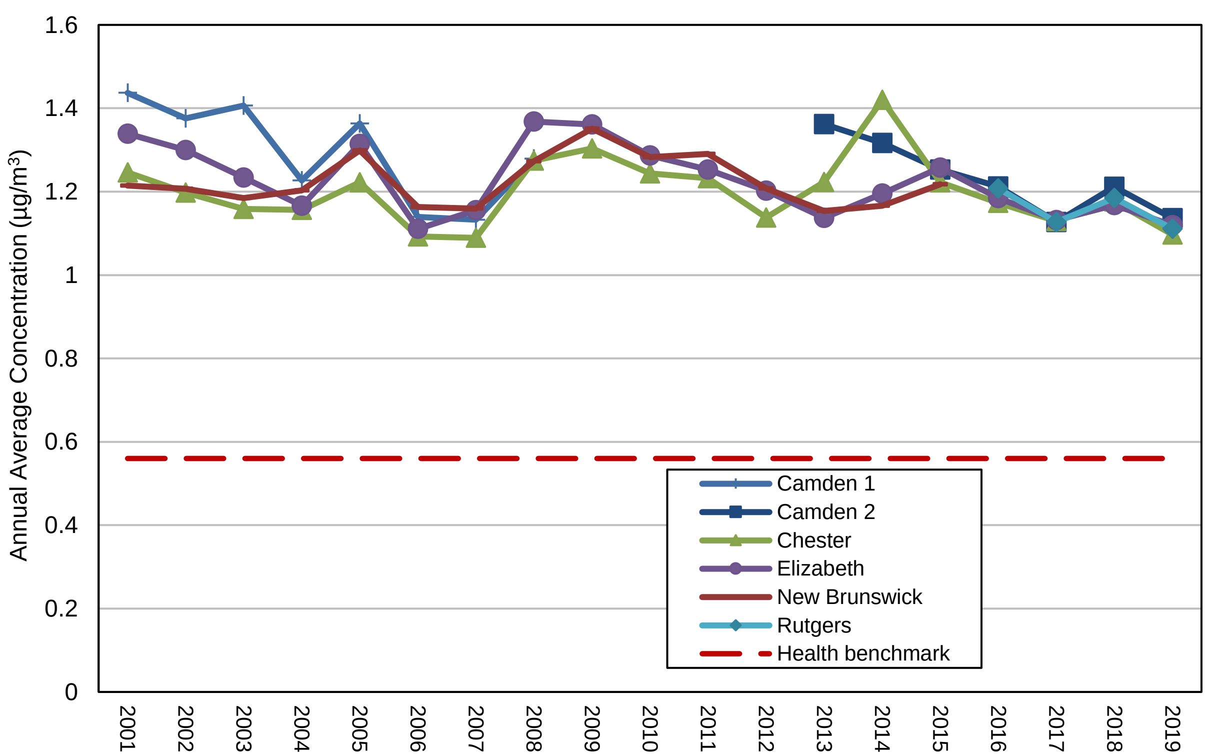


Figure 10-10

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

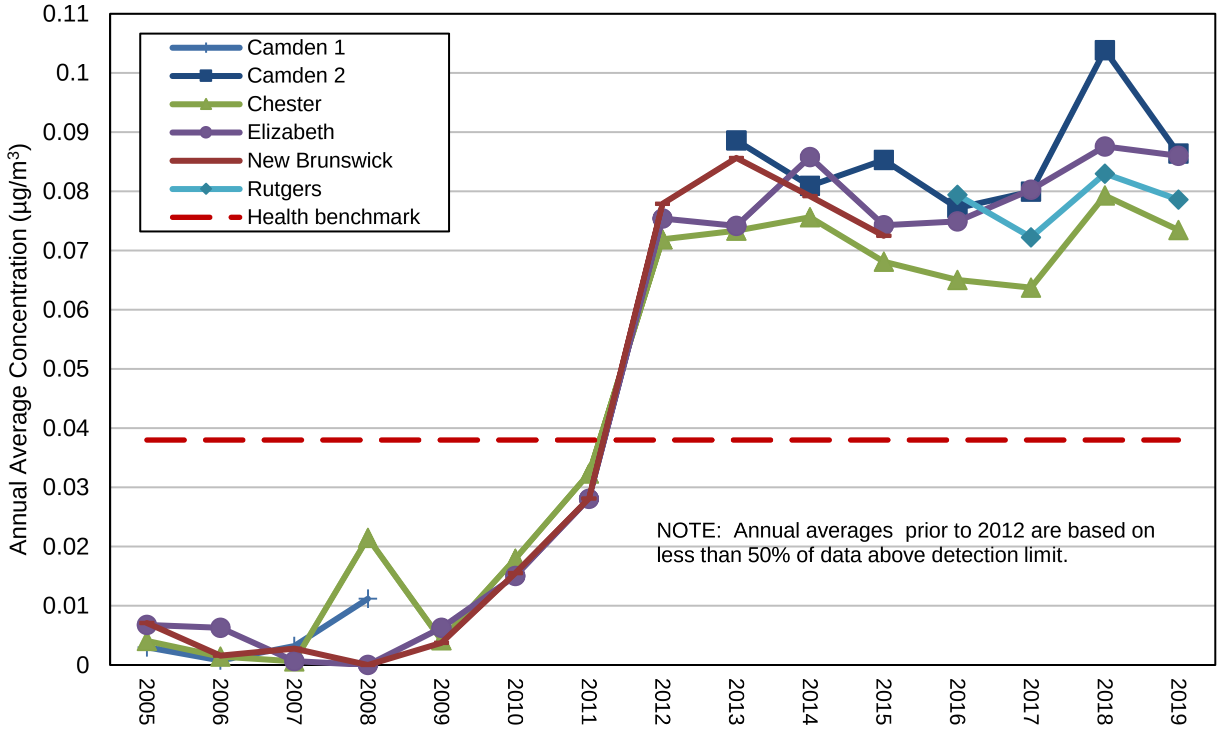


Figure 10-11

FORMALDEHYDE – New Jersey Monitored Concentrations

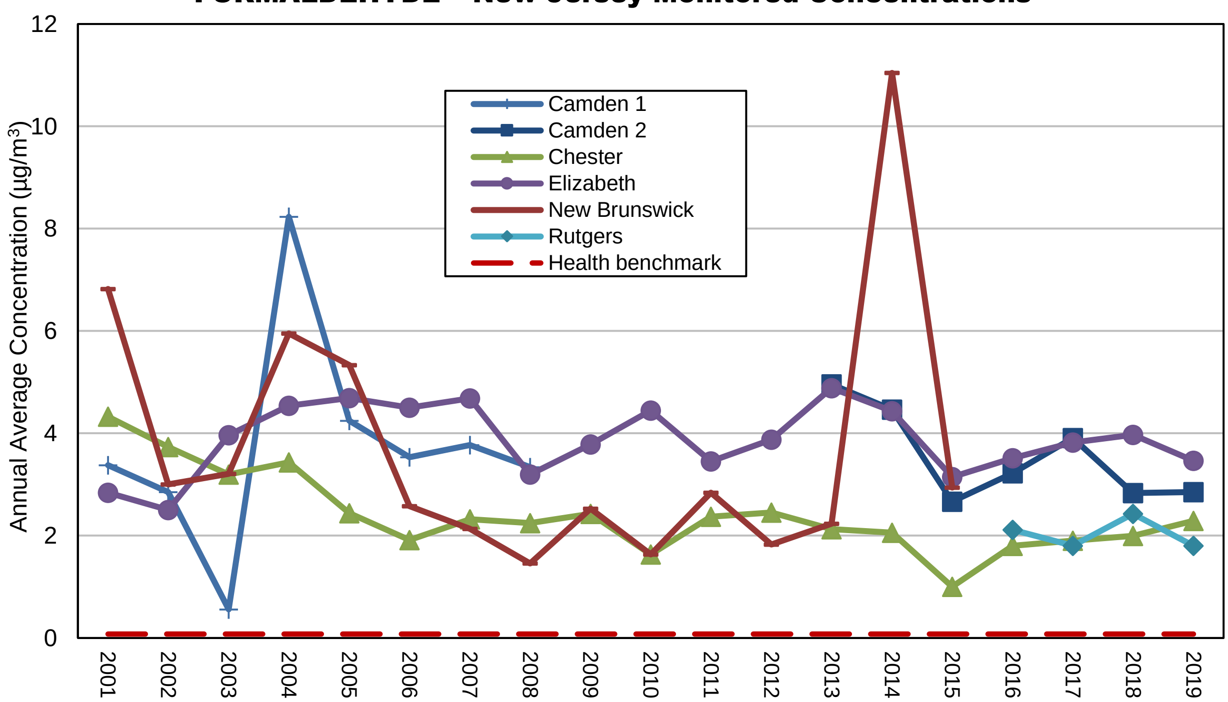


Table 10-4
CAMDEN SPRUCE STREET – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			µg/m^3				
1	Acetaldehyde	1.5007	1.3400	4.2800	2.7040	2.4144	7.7115	100	**6**
2	Acetone	1.1816	0.9885	4.3200	2.8067	2.3481	10.2620	100	*0.0001*
3	Acetonitrile	0.1849	0.1600	0.7370	0.3105	0.2686	1.2374	100	*0.01*
4	Acetylene	0.6261	0.4205	3.3400	0.6663	0.4475	3.5545	100	
5	Acrolein	0.3422	0.3110	0.7640	0.7847	0.7131	1.7518	100	***39***
6	Acrylonitrile	*0.0010*	0	0.0616	*0.0022*	0	0.1337	2	0.1
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.0742	0.0580	0.2050	0.3219	0.2517	0.8898	100	
9	Benzene	0.2535	0.2025	0.8620	0.8100	0.6469	2.7538	100	**6**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0.00041*	0	0.0085	*0.0028*	0	0.0570	8	0.1
12	Bromoform	*0.0008*	0	0.006	*0.0087*	0	0.0620	35	0.01
13	Bromomethane	0.1254	0.0108	5.5800	0.4870	0.0419	21.6696	92	*0.1*
14	1,3-Butadiene	0.0256	0.0205	0.1030	0.0567	0.0454	0.2279	97	**1.7**
15	Butyraldehyde	0.1336	0.1220	0.3030	0.3940	0.3598	0.8936	100	
16	Carbon Disulfide	0.0243	0.0201	0.0893	0.0755	0.0626	0.2781	98	*0.0001*
17	Carbon Tetrachloride	0.0951	0.0951	0.1290	0.5984	0.5981	0.8117	100	**4**
18	Chlorobenzene	*0.0017*	0	0.0296	*0.0080*	0	0.1363	31	*0.00001*
19	Chloroethane	0.0116	0.0117	0.0494	0.0307	0.0307	0.1304	68	*0.000003*
20	Chloroform	0.0263	0.0242	0.0467	0.1285	0.1182	0.2280	100	**3**
21	Chloromethane	0.5501	0.5570	0.7410	1.1360	1.1502	1.5302	100	**2**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.0723	0.0329	0.5240	0.2072	0.0943	1.5022	100	
24	Dibromochloromethane	*0.0003*	0	0.0025	*0.0028*	0	0.0248	26	0.08
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.0002*	0	0.0065	*0.0010*	0	0.0391	8	
27	o-Dichlorobenzene	*0.0003*	0	0.0022	*0.0018*	0	0.0132	26	0.00001
28	p-Dichlorobenzene	0.0081	0.0066	0.0495	0.0489	0.0397	0.2976	56	*0.5*
29	Dichlorodifluoromethane	0.4924	0.4955	0.8170	2.4352	2.4505	4.0406	100	*0.02*
30	1,1-Dichloroethane	0.0006	0	0.0087	*0.0025*	0	0.0352	15	0.004
31	1,2-Dichloroethane	0.0213	0.0226	0.0452	0.0864	0.0915	0.1829	94	**2**
32	1,1-Dichloroethylene	*0.0010*	0	0.0135	*0.0041*	0	0.0535	13	*0.00002*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	*0.00282*	0	0.0326	*0.0112*	0	0.1293	44	
35	Dichloromethane	0.1851	0.1340	1.1000	0.6431	0.4655	3.8214	100	0.01
36	1,2-Dichloropropane	*0.0005*	0	0.0091	*0.0023*	0	0.0421	10	0.02
37	cis-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
38	trans-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
39	Dichlorotetrafluoroethane	0.0165	0.0166	0.0208	0.1156	0.1157	0.1454	100	
40	Ethyl Acrylate	*0.0003*	0	0.0209	*0.0014*	0	0.0856	2	*0.0002*
41	Ethylbenzene	0.0695	0.0481	0.3480	0.3017	0.2088	1.5110	100	0.8
42	Ethyl tert-Butyl Ether	*0.0001*	0	0.0033	*0.0005*	0	0.0138	5	
43	Formaldehyde	2.3218	1.9500	5.7900	2.8514	2.3947	7.1105	100	**37**
44	Hexachlorobutadiene	*0.0006*	0	0.0026	*0.0066*	0	0.0277	32	0.1
45	Hexaldehyde	0.0526	0.0492	0.1410	0.2154	0.2013	0.5776	100	

Continued

Table 10-4 (continued)
CAMDEN SPRUCE STREET – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			µg/m³				
46	Methyl Ethyl Ketone	0.1420	0.1270	0.4210	0.4181	0.3740	1.2398	100	*0.0001*
47	Methyl Isobutyl Ketone	0.0372	0.0326	0.1130	0.1522	0.1333	0.4629	97	*0.00005*
48	Methyl Methacrylate	0.0113	0.0065	0.1010	0.0398	0.0227	0.3556	65	*0.0001*
49	Methyl tert-Butyl Ether	*0.0002*	0	0.0093	*0.0008*	0	0.0335	3	0.0002
50	n-Octane	0.0555	0.0402	0.2800	0.2591	0.1876	1.3080	100	
51	Propionaldehyde	0.1789	0.1670	0.3810	0.4250	0.3967	0.9050	100	*0.05*
52	Propylene	0.4724	0.3655	1.5800	0.8131	0.6290	2.7193	100	*0.0003*
53	Styrene	0.0840	0.0477	0.7070	0.3577	0.2032	3.0113	97	0.2
54	1,1,2,2-Tetrachloroethane	*0.0004*	0	0.0054	*0.0027*	0	0.0371	13	0.2
55	Tetrachloroethylene	0.0220	0.0186	0.0751	0.1495	0.1262	0.5094	98	0.9
56	Toluene	0.5544	0.3605	2.7900	2.0892	1.3584	10.5130	100	*0.0006*
57	1,2,4-Trichlorobenzene	*0.0013*	0	0.0064	*0.0100*	0	0.0475	34	*0.005*
58	1,1,1-Trichloroethane	*0.0019*	0	0.0090	*0.0103*	0	0.0491	48	*0.00001*
59	1,1,2-Trichloroethane	*0.0016*	0	0.0235	*0.0088*	0	0.1282	23	0.1
60	Trichloroethylene	0.0081	0.00475	0.0750	0.0435	0.0255	0.4031	66	0.2
61	Trichlorofluoromethane	0.3317	0.2420	1.5500	1.8637	1.3598	8.7092	100	*0.003*
62	Trichlorotrifluoroethane	0.0771	0.0759	0.1060	0.5912	0.5813	0.8123	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.0758	0.0472	0.5100	0.3726	0.2320	2.5070	97	*0.006*
64	1,3,5-Trimethylbenzene	0.0224	0.0147	0.1460	0.1102	0.0723	0.7177	95	*0.002*
65	Valeraldehyde	0.0369	0.0325	0.0889	0.1301	0.1145	0.3132	100	
66	Vinyl Chloride	0.0041	0.0005	0.0643	0.0105	0.0013	0.1644	50	0.1
67	m,p-Xylene	0.2097	0.1315	1.5000	0.9107	0.5710	6.5129	100	*0.009*
68	o-Xylene	0.0953	0.0627	0.5860	0.4139	0.2720	2.5444	100	*0.004*

- Concentrations in *italics* are arithmetic means (averages) based on less than 50% of the samples above the detection limit.
- 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.
- Annual mean **risk ratios** in *italics* are based on noncancer effects.
- A risk ratio for a pollutant is calculated by dividing the annual mean air concentration by the long-term health benchmark. If the annual mean is 0, then the risk ratio is not calculated. See Table 10-9 for chemical-specific health benchmarks.

Table 10-5
CHESTER – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			$\mu g/m^3$				
1	Acetaldehyde	0.6396	0.5200	1.5900	1.1524	0.9369	2.8648	100	**3**
2	Acetone	0.7953	0.7740	2.4600	1.8891	1.8386	5.8436	100	*0.0001*
3	Acetonitrile	0.2440	0.2250	0.7710	0.4096	0.3778	1.2945	100	*0.01*
4	Acetylene	0.3458	0.2730	1.3100	0.3680	0.2905	1.3941	100	
5	Acrolein	0.3312	0.3120	0.9420	0.7593	0.7154	2.1600	100	***38***
6	Acrylonitrile	*0.0008*	0	0.0451	*0.0017*	0	0.0979	2	0.1
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.0171	0.0136	0.0761	0.0740	0.0590	0.3303	97	
9	Benzene	0.1060	0.0971	0.2360	0.3385	0.3102	0.7539	100	**3**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0.0002*	0	0.0022	*0.0014*	0	0.0147	14	0.1
12	Bromoform	*0.0005*	0	0.0032	*0.0049*	0	0.0331	27	0.01
13	Bromomethane	0.0070	0.0077	0.0178	0.0273	0.0299	0.0691	82	*0.01*
14	1,3-Butadiene	0.0055	0.0042	0.0274	0.0122	0.0092	0.0606	61	0.4
15	Butyraldehyde	0.0561	0.0433	0.1870	0.1653	0.1275	0.5515	100	
16	Carbon Disulfide	0.0152	0.0103	0.1910	0.0472	0.0321	0.5948	98	*0.0001*
17	Carbon Tetrachloride	0.0938	0.0959	0.1850	0.5902	0.6034	1.1640	100	**3**
18	Chlorobenzene	*0.0004*	0	0.0099	*0.0017*	0	0.0456	13	*0.000002*
19	Chloroethane	*0.0060*	0	0.0584	*0.0157*	0	0.1541	36	*0.000002*
20	Chloroform	0.0214	0.0199	0.0459	0.1044	0.0972	0.2241	100	**2**
21	Chloromethane	0.5313	0.5265	0.7330	1.0970	1.0872	1.5137	100	**2**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.0891	0.0169	0.5580	0.2555	0.0483	1.5996	96	
24	Dibromochloromethane	*0.0001*	0	0.0019	*0.0007*	0	0.0189	7	0.02
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.0001*	0	0.0009	*0.0005*	0	0.0054	14	
27	o-Dichlorobenzene	*0.0002*	0	0.0013	*0.0012*	0	0.0078	23	0.00001
28	p-Dichlorobenzene	*0.0016*	0	0.0192	*0.0099*	0	0.1154	41	*0.1*
29	Dichlorodifluoromethane	0.4686	0.477	0.5830	2.3175	2.3591	2.8833	100	*0.02*
30	1,1-Dichloroethane	*0*	0	0	*0*	0	0	0	
31	1,2-Dichloroethane	0.0182	0.0182	0.0288	0.0735	0.0735	0.1166	98	**2**
32	1,1-Dichloroethylene	*0.0003*	0	0.0043	*0.0012*	0	0.0171	14	*0.00001*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	*0.0007*	0	0.0048	*0.0027*	0	0.0190	25	
35	Dichloromethane	0.3271	0.1250	6.0700	1.1363	0.4343	21.0874	100	0.01
36	1,2-Dichloropropane	*0.0002*	0	0.0046	*0.0007*	0	0.0213	4	0.01
37	cis-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
38	trans-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
39	Dichlorotetrafluoroethane	0.0164	0.0168	0.0208	0.1148	0.1171	0.1454	100	
40	Ethyl Acrylate	*0.0002*	0	0.0088	*0.0010*	0	0.0360	4	*0.0001*
41	Ethylbenzene	0.0160	0.0149	0.0463	0.0695	0.0645	0.2010	100	0.2
42	Ethyl tert-Butyl Ether	*0.0012*	0	0.0104	*0.0051*	0	0.0435	20	
43	Formaldehyde	1.8671	1.2100	8.9100	2.2930	1.4860	10.9421	100	**30**
44	Hexachlorobutadiene	*0.0007*	0	0.0026	*0.0071*	0	0.0277	34	0.2
45	Hexaldehyde	0.0274	0.0164	0.1440	0.1121	0.0672	0.5899	92	

Continued

Table 10-5 (continued)
CHESTER – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			µg/m³				
46	Methyl Ethyl Ketone	0.0990	0.0828	0.2690	0.2916	0.2438	0.7921	100	*0.0001*
47	Methyl Isobutyl Ketone	0.0202	0.0183	0.0961	0.0826	0.0750	0.3937	95	*0.00003*
48	Methyl Methacrylate	*0.0003*	0	0.0040	*0.0012*	0	0.0141	11	*0.000002*
49	Methyl tert-Butyl Ether	*0.0001*	0	0.0055	*0.0004*	0	0.0198	2	0.0001
50	n-Octane	0.0183	0.0162	0.0563	0.0854	0.0757	0.2630	98	
51	Propionaldehyde	0.0932	0.0832	0.2040	0.2214	0.1976	0.4846	100	*0.03*
52	Propylene	0.1780	0.1525	0.8060	0.3064	0.2625	1.3872	100	*0.0001*
53	Styrene	*0.0029*	0	0.0479	*0.0123*	0	0.2040	45	0.01
54	1,1,2,2-Tetrachloroethane	*0.0006*	0	0.0079	*0.0044*	0	0.0542	18	0.3
55	Tetrachloroethylene	0.0083	0.0077	0.0268	0.0565	0.0522	0.1818	82	0.4
56	Toluene	0.1116	0.0974	0.3450	0.4205	0.3668	1.3000	100	*0.0001*
57	1,2,4-Trichlorobenzene	*0.0013*	0	0.0069	*0.0096*	0	0.0512	34	*0.005*
58	1,1,1-Trichloroethane	*0.0012*	0	0.0051	*0.0065*	0	0.0278	41	*0.00001*
59	1,1,2-Trichloroethane	*0.0001*	0	0.0017	*0.0003*	0	0.0093	4	0.005
60	Trichloroethylene	*0.0021*	0	0.0109	*0.0113*	0	0.0586	41	0.1
61	Trichlorofluoromethane	0.2137	0.2130	0.2700	1.2008	1.1968	1.5171	100	*0.002*
62	Trichlorotrifluoroethane	0.0766	0.0762	0.0992	0.5868	0.5840	0.7602	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.0102	0.0085	0.0381	0.0502	0.0418	0.1873	88	*0.001*
64	1,3,5-Trimethylbenzene	0.0022	0.0018	0.0116	0.0108	0.0088	0.0570	55	*0.0002*
65	Valeraldehyde	0.0123	0.0116	0.0376	0.0432	0.0409	0.1325	76	
66	Vinyl Chloride	*0.0005*	0	0.0145	*0.0013*	0	0.0371	13	0.01
67	m,p-Xylene	0.0312	0.0251	0.1020	0.1357	0.1088	0.4429	98	*0.001*
68	o-Xylene	0.0178	0.0159	0.0494	0.0772	0.0688	0.2145	100	*0.001*

- Concentrations in *italics* are arithmetic means (averages) based on less than 50% of the samples above the detection limit.
- 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.
- Annual mean **risk ratios** in *italics* are based on noncancer effects.
- A risk ratio for a pollutant is calculated by dividing the annual mean air concentration by the long-term health benchmark. If the annual mean is 0, then the risk ratio is not calculated. See Table 10-9 for chemical-specific health benchmarks.

Table 10-6
ELIZABETH – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			µg/m^3				
1	Acetaldehyde	1.1443	0.9690	2.4000	2.0617	1.7459	4.3242	100	**5**
2	Acetone	1.0697	0.9310	3.6500	2.5410	2.2115	8.6704	100	*0.0001*
3	Acetonitrile	0.5005	0.1960	6.8200	0.8403	0.3291	11.4503	100	*0.01*
4	Acetylene	0.7583	0.5705	4.2900	0.8070	0.6071	4.5655	100	
5	Acrolein	0.3187	0.3150	0.7460	0.7308	0.7223	1.7106	100	***37***
6	Acrylonitrile	*0*	0	0	*0*	0	0	0	
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.0257	0.0229	0.0954	0.1115	0.0992	0.4141	100	
9	Benzene	0.2184	0.1870	0.5930	0.6976	0.5974	1.8944	100	**5**
10	Bromochloromethane	*0.0001*	0	0.0036	*0.0003*	0	0.0191	2	*0.00001*
11	Bromodichloromethane	*0.0005*	0	0.0072	*0.0036*	0	0.0482	10	0.1
12	Bromoform	*0.0010*	0	0.0072	*0.0108*	0	0.0744	34	0.01
13	Bromomethane	0.0076	0.0084	0.0147	0.0294	0.0326	0.0571	81	*0.01*
14	1,3-Butadiene	0.0339	0.0267	0.1240	0.0749	0.0591	0.2743	100	**2.3**
15	Butyraldehyde	0.0978	0.0846	0.2910	0.2886	0.2495	0.8582	100	
16	Carbon Disulfide	0.0184	0.0147	0.1120	0.0572	0.0458	0.3488	100	*0.0001*
17	Carbon Tetrachloride	0.0950	0.0964	0.1550	0.5976	0.6066	0.9753	100	**4**
18	Chlorobenzene	*0.0013*	0	0.0110	*0.0060*	0	0.0506	25	*0.00001*
19	Chloroethane	0.0070	0	0.0424	0.0186	0	0.1119	41	*0.000002*
20	Chloroform	0.0287	0.0245	0.0544	0.1403	0.1196	0.2656	100	**3**
21	Chloromethane	0.5421	0.5430	0.6880	1.1195	1.1213	1.4207	100	**2**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.0998	0.0316	0.6610	0.2862	0.0906	1.8949	100	
24	Dibromochloromethane	*0.0003*	0	0.0041	*0.0027*	0	0.0407	20	0.07
25	1,2-Dibromoethane	*0.00004*	0	0.0024	*0.0003*	0	0.0184	2	0.2
26	m-Dichlorobenzene	*0.0002*	0	0.0034	*0.0009*	0	0.0204	7	
27	o-Dichlorobenzene	*0.0002*	0	0.0022	*0.0012*	0	0.0132	17	0.00001
28	p-Dichlorobenzene	0.0056	0.0033	0.0290	0.0339	0.0198	0.1744	51	*0.4*
29	Dichlorodifluoromethane	0.4742	0.479	0.5740	2.3451	2.3689	2.8388	100	*0.02*
30	1,1-Dichloroethane	*0.0005*	0	0.0314	*0.0022*	0	0.1271	2	0.003
31	1,2-Dichloroethane	0.0212	0.0217	0.0377	0.0860	0.0878	0.1526	100	**2**
32	1,1-Dichloroethylene	*0.0003*	0	0.0059	*0.0013*	0	0.0234	12	*0.00001*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	*0.0019*	0	0.0162	*0.0077*	0	0.0642	36	
35	Dichloromethane	0.9720	0.1620	46.0000	3.3766	0.5628	159.8053	100	0.04
36	1,2-Dichloropropane	*0.0002*	0	0.0051	*0.0010*	0	0.0236	5	0.01
37	cis-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
38	trans-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
39	Dichlorotetrafluoroethane	0.0167	0.0166	0.0227	0.1166	0.1160	0.1587	100	
40	Ethyl Acrylate	*0*	0	0	*0*	0	0	0	
41	Ethylbenzene	0.0598	0.0526	0.1880	0.2595	0.2284	0.8163	100	0.6
42	Ethyl tert-Butyl Ether	*0.0001*	0	0.0035	*0.0002*	0	0.0146	2	
43	Formaldehyde	2.8215	2.4400	9.8000	3.4649	2.9965	12.0350	100	**45**
44	Hexachlorobutadiene	*0.0005*	0	0.0027	*0.0057*	0	0.028796	29	0.1
45	Hexaldehyde	0.0546	0.0372	0.4380	0.2237	0.1522	1.7943	100	

Continued

Table 10-6 (continued)
ELIZABETH – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			$\mu g/m^3$				
46	Methyl Ethyl Ketone	0.1429	0.1120	0.4870	0.4207	0.3298	1.4341	100	*0.0001*
47	Methyl Isobutyl Ketone	0.0339	0.0327	0.0809	0.1390	0.1340	0.3314	91	*0.00005*
48	Methyl Methacrylate	0.0101	0.0086	0.0477	0.0354	0.0303	0.1680	66	*0.00005*
49	Methyl tert-Butyl Ether	*0*	0	0	*0*	0	0	0	
50	n-Octane	0.0703	0.0542	0.3350	0.3285	0.2532	1.5650	100	
51	Propionaldehyde	0.1747	0.1440	0.4660	0.4149	0.3421	1.1070	100	*0.05*
52	Propylene	0.7164	0.4460	4.0700	1.2329	0.7676	7.0047	100	*0.0004*
53	Styrene	0.0153	0.0108	0.0854	0.0651	0.0460	0.3637	86	0.04
54	1,1,2,2-Tetrachloroethane	*0.0003*	0	0.0034	*0.0020*	0	0.0233	12	0.1
55	Tetrachloroethylene	0.0200	0.0149	0.0519	0.1354	0.1011	0.3520	98	0.8
56	Toluene	0.4366	0.374	1.2900	1.6450	1.4093	4.8608	100	*0.0004*
57	1,2,4-Trichlorobenzene	*0.0011*	0	0.0061	*0.0079*	0	0.0453	31	*0.004*
58	1,1,1-Trichloroethane	0.0023	0.0025	0.0100	0.0126	0.0136	0.0546	54	*0.00001*
59	1,1,2-Trichloroethane	*0.0001*	0	0.0014	*0.0004*	0	0.0076	5	0.01
60	Trichloroethylene	0.0042	0.0025	0.0153	0.0224	0.0134	0.0822	53	0.1
61	Trichlorofluoromethane	0.2195	0.2180	0.2710	1.2335	1.2249	1.5227	100	*0.002*
62	Trichlorotrifluoroethane	0.0765	0.0754	0.0937	0.5864	0.5778	0.7181	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.0523	0.0465	0.1780	0.2572	0.2286	0.8750	100	*0.004*
64	1,3,5-Trimethylbenzene	0.0160	0.0138	0.0661	0.0786	0.0678	0.3249	98	*0.001*
65	Valeraldehyde	0.0316	0.0274	0.2190	0.1114	0.0963	0.7715	97	
66	Vinyl Chloride	*0.0003*	0	0.0033	*0.0007*	0	0.0084	17	0.01
67	m,p-Xylene	0.1675	0.1450	0.5840	0.7272	0.6296	2.5357	100	*0.007*
68	o-Xylene	0.0732	0.0621	0.2460	0.3177	0.2696	1.0681	100	*0.003*

- Concentrations in *italics* are arithmetic means (averages) based on less than 50% of the samples above the detection limit.
- 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.
- Annual mean **risk ratios** in *italics* are based on noncancer effects.
- A risk ratio for a pollutant is calculated by dividing the annual mean air concentration by the long-term health benchmark. If the annual mean is 0, then the risk ratio is not calculated. See Table 10-9 for chemical-specific health benchmarks.

Table 10-7
RUTGERS – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			µg/m^3				
1	Acetaldehyde	1.0789	1.0150	2.5400	1.9440	1.8288	4.5765	100	**4**
2	Acetone	1.0184	0.9870	2.7900	2.4192	2.3446	6.6275	98	*0.0001*
3	Acetonitrile	0.3751	0.1700	3.7900	0.6298	0.2854	6.3632	100	*0.01*
4	Acetylene	0.4960	0.4030	1.7400	0.5279	0.4289	1.8517	100	
5	Acrolein	0.3692	0.3315	0.8120	0.8465	0.7601	1.8619	100	***42***
6	Acrylonitrile	*0.0005*	0	0.0272	*0.0010*	0	0.0590	2	0.1
7	tert-Amyl Methyl Ether	*0.0001*	0	0.0054	*0.0006*	0	0.0226	3	
8	Benzaldehyde	0.0232	0.0144	0.1660	0.1006	0.062502	0.7205	90	
9	Benzene	0.1421	0.1185	0.5290	0.4539	0.3786	1.6900	100	**3**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0.0005*	0	0.0061	*0.0037*	0	0.0409	19	0.1
12	Bromoform	*0.0008*	0	0.0041	*0.0086*	0	0.0424	36	0.01
13	Bromomethane	0.0075	0.0087	0.0145	0.0290	0.0336	0.0563	83	*0.01*
14	1,3-Butadiene	0.0152	0.0120	0.0573	0.0337	0.0264	0.1268	88	1.0
15	Butyraldehyde	0.0846	0.0699	0.3260	0.2495	0.2061	0.9614	100	
16	Carbon Disulfide	0.0152	0.0107	0.0708	0.0473	0.0332	0.2205	97	*0.0001*
17	Carbon Tetrachloride	0.0952	0.0976	0.1520	0.5988	0.6141	0.9564	100	**4**
18	Chlorobenzene	*0.0007*	0	0.0102	*0.0031*	0	0.0470	22	*0.000003*
19	Chloroethane	0.0176	0.0084	0.1230	0.0464	0.0222	0.3246	57	*0.000005*
20	Chloroform	0.0273	0.0238	0.0633	0.1332	0.1162	0.3091	100	**3**
21	Chloromethane	0.5379	0.5380	0.6950	1.1109	1.1110	1.4352	100	**2**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.0590	0.0223	0.4190	0.1692	0.0639	1.2011	96	
24	Dibromochloromethane	*0.0002*	0	0.0064	*0.0022*	0	0.0635	16	0.06
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.00005*	0	0.0010	*0.0003*	0	0.0060	5	
27	o-Dichlorobenzene	*0.0002*	0	0.0016	*0.0013*	0	0.0096	22	0.00001
28	p-Dichlorobenzene	*0.0030*	0	0.0151	*0.0182*	0	0.0908	47	*0.2*
29	Dichlorodifluoromethane	0.4707	0.4785	0.5780	2.3278	2.3665	2.8586	100	*0.02*
30	1,1-Dichloroethane	*0.0001*	0	0.0070	*0.0005*	0	0.0283	2	0.001
31	1,2-Dichloroethane	0.0194	0.0201	0.0319	0.0786	0.0814	0.1291	97	**2**
32	1,1-Dichloroethylene	*0.0003*	0	0.0082	*0.0012*	0	0.0325	12	*0.00001*
33	cis-1,2-Dichloroethylene	*0.00002*	0	0.0010	*0.0001*	0	0.0040	2	
34	trans-1,2-Dichloroethylene	*0.0015*	0	0.0073	*0.0060*	0	0.0289	41	
35	Dichloromethane	0.1829	0.1385	0.5160	0.6355	0.4812	1.7926	100	0.01
36	1,2-Dichloropropane	*0.0003*	0	0.0122	*0.0016*	0	0.0564	5	0.02
37	cis-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
38	trans-1,3-Dichloropropylene	*0*	0	0	*0*	0	0	0	
39	Dichlorotetrafluoroethane	0.0166	0.0165	0.0206	0.1159	0.115346	0.1440	100	
40	Ethyl Acrylate	*0.0004*	0	0.0128	*0.0015*	0	0.0524	3	*0.0002*
41	Ethylbenzene	0.0311	0.0270	0.0843	0.1351	0.1172	0.3660	100	0.3
42	Ethyl tert-Butyl Ether	0.0110	0.0090	0.1400	0.0458	0.0374	0.5851	93	
43	Formaldehyde	1.4688	1.1050	8.3800	1.8037	1.3570	10.2912	100	**23**
44	Hexachlorobutadiene	*0.0008*	0	0.0105	*0.0085*	0	0.1120	34	0.2
45	Hexaldehyde	0.0439	0.0198	0.5640	0.1800	0.0809	2.3104	97	

Continued

Table 10-7 (continued)
RUTGERS – 2019 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			µg/m^3				
46	Methyl Ethyl Ketone	0.1620	0.1275	1.2700	0.4770	0.3755	3.7399	100	*0.0001*
47	Methyl Isobutyl Ketone	0.0299	0.0251	0.2570	0.1226	0.1028	1.0528	98	*0.00004*
48	Methyl Methacrylate	*0.0023*	0	0.0230	*0.0082*	0	0.0810	36	*0.00001*
49	Methyl tert-Butyl Ether	*0.0009*	0	0.0108	*0.0031*	0	0.0389	12	0.001
50	n-Octane	0.0221	0.0199	0.0576	0.1033	0.0930	0.2691	100	
51	Propionaldehyde	0.1357	0.1100	0.6140	0.3223	0.2613	1.4585	100	*0.04*
52	Propylene	0.2797	0.2510	1.2000	0.4814	0.4320	2.0653	100	*0.0002*
53	Styrene	0.0093	0.0090	0.0554	0.0398	0.0383	0.2360	78	0.02
54	1,1,2,2-Tetrachloroethane	*0.0008*	0	0.0106	*0.0052*	0	0.073	21	0.3
55	Tetrachloroethylene	0.0132	0.0104	0.0606	0.0894	0.0702	0.4111	97	0.6
56	Toluene	0.1955	0.1530	0.7670	0.7368	0.5765	2.8901	100	*0.0002*
57	1,2,4-Trichlorobenzene	*0.0017*	0	0.0399	*0.0126*	0	0.2961	29	*0.006*
58	1,1,1-Trichloroethane	0.0021	0.0010	0.0120	0.0117	0.0055	0.0655	50	*0.00001*
59	1,1,2-Trichloroethane	*0.0002*	0	0.0066	*0.0009*	0	0.0360	5	0.01
60	Trichloroethylene	0.0032	0.0020	0.0141	0.0171	0.0107	0.0758	52	0.1
61	Trichlorofluoromethane	0.2181	0.2165	0.2690	1.2255	1.2165	1.5115	100	*0.002*
62	Trichlorotrifluoroethane	0.0769	0.0757	0.0983	0.5896	0.5801	0.7533	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.0205	0.0164	0.0627	0.1010	0.0804	0.3082	97	*0.002*
64	1,3,5-Trimethylbenzene	0.0055	0.0049	0.0185	0.0268	0.0241	0.0909	81	*0.0004*
65	Valeraldehyde	0.0266	0.0172	0.1750	0.0939	0.0606	0.6165	89	
66	Vinyl Chloride	*0.0007*	0	0.0077	*0.0017*	0	0.0197	22	0.02
67	m,p-Xylene	0.0679	0.0537	0.2300	0.2947	0.2332	0.9986	100	*0.003*
68	o-Xylene	0.0329	0.0283	0.0981	0.1429	0.1227	0.4259	100	*0.001*

- Concentrations in *italics* are arithmetic means (averages) based on less than 50% of the samples above the detection limit.
- 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.
- Annual mean **risk ratios** in *italics* are based on noncancer effects.
- A risk ratio for a pollutant is calculated by dividing the annual mean air concentration by the long-term health benchmark. If the annual mean is 0, then the risk ratio is not calculated. See Table 10-9 for chemical-specific health benchmarks.

In 2019, samples of the chemicals in Table 10-8 were never detected at the monitoring location specified. However, these pollutants may be present in the air at levels the lab cannot measure. Chemical-specific average detection limits can be found in Table 10-9.

Table 10-8
Air Toxics with 100% Non-Detects in 2019

Pollutant		CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acrylonitrile	107-13-1			X	
2	Tert-Amyl Ethyl Ether	994-05-8	X	X	X	
3	Bromochloromethane	74-97-5	X	X		X
4	Chloroprene	126-99-8	X	X	X	X
5	1,2-Dibromoethane	106-93-4	X	X		X
6	cis-1,2-Dichloroethylene	156-59-2	X	X	X	
7	cis-1,3-Dichloropropylene	10061-01-5	X	X	X	X
8	trans-1,3-Dichloropropylene	10061-02-6	X	X	X	X
9	Ethyl Acrylate	140-88-5			X	
10	Methyl tert-Butyl Ether	1634-04-4			X	

Table 10-9
Air Toxics Detection Limits and Health Benchmarks

	Pollutant	CAS No.	Detection Limit (ppbv)	Detection Limit (µg/m^3)	Health Bench-mark (µg/m^3)
1	Acetaldehyde	75-07-0	0.018	0.0324	0.45
2	Acetone	67-64-1	0.201	0.4775	*31000*
3	Acetonitrile	75-05-8	0.0746	0.1252	*60*
4	Acetylene	74-86-2	0.11	0.1171	
5	Acrolein	107-02-8	0.144	0.3302	*0.02*
6	Acrylonitrile	107-13-1	0.0219	0.0475	0.015
7	tert-Amyl Methyl Ether	994-05-8	0.0101	0.0422	
8	Benzaldehyde	100-52-7	0.0017	0.0074	
9	Benzene	71-43-2	0.0099	0.0316	0.13
10	Bromochloromethane	74-97-5	0.0102	0.0540	*40*
11	Bromodichloromethane	75-27-4	0.0111	0.0744	0.027
12	Bromoform	75-25-2	0.014	0.1447	0.91
13	Bromomethane	74-83-9	0.0099	0.0384	*5*
14	1,3-Butadiene	106-99-0	0.011	0.0243	0.033
15	Butyraldehyde	123-72-8	0.0174	0.0513	
16	Carbon Disulfide	75-15-0	0.0415	0.1292	*700*
17	Carbon Tetrachloride	56-23-5	0.0109	0.0686	0.17
18	Chlorobenzene	108-90-7	0.0102	0.0470	*1000*
19	Chloroethane	75-00-3	0.0161	0.0425	*10000*
20	Chloroform	67-66-3	0.0083	0.0405	0.043
21	Chloromethane	74-87-3	0.0344	0.0710	0.56
22	Chloroprene	126-99-8	0.0222	0.0804	0.002
23	Crotonaldehyde	123-73-9	0.00331	0.0095	
24	Dibromochloromethane	124-48-1	0.0124	0.1231	0.037
25	1,2-Dibromoethane	106-93-4	0.0132	0.1014	0.0017
26	m-Dichlorobenzene	541-73-1	0.0236	0.1419	
27	o-Dichlorobenzene	95-50-1	0.0278	0.1672	200
28	p-Dichlorobenzene	106-46-7	0.0242	0.1455	*0.091*
29	Dichlorodifluoromethane	75-71-8	0.0371	0.1835	*100*
30	1,1-Dichloroethane	75-34-3	0.0073	0.0295	0.63
31	1,2-Dichloroethane	107-06-2	0.0086	0.0348	0.038
32	1,1-Dichloroethylene	75-35-4	0.0124	0.0492	*200*
33	cis-1,2-Dichloroethylene	156-59-2	0.0336	0.1332	
34	trans-1,2-Dichloroethylene	156-60-5	0.0116	0.0460	
35	Dichloromethane	75-09-2	0.0512	0.1779	77
36	1,2-Dichloropropane	78-87-5	0.0111	0.0513	0.1
37	cis-1,3-Dichloropropylene	10061-01-5	0.0099	0.0449	0.25
38	trans-1,3-Dichloropropylene	10061-02-6	0.0138	0.0626	0.25
39	Dichlorotetrafluoroethane	76-14-2	0.0103	0.0720	
40	Ethyl Acrylate	140-88-5	0.0145	0.0594	*8*
41	Ethylbenzene	100-41-4	0.0178	0.0773	0.40
42	Ethyl tert-Butyl Ether	637-92-3	0.0074	0.0309	
43	Formaldehyde	50-00-0	0.0411	0.0505	0.077
44	Hexachlorobutadiene	87-68-3	0.0727	0.7754	0.045
45	Hexaldehyde	66-25-1	0.00286	0.0117	

Continued

Table 10-9 (continued)

Air Toxics Detection Limits and Health Benchmarks

	Pollutant	CAS No.	Detection Limit (ppbv)	Detection Limit (μg/m³)	Health Bench-mark (μg/m³)
46	Methyl Ethyl Ketone	78-93-3	0.101	0.2974	*5000*
47	Methyl Isobutyl Ketone	108-10-1	0.0102	0.0418	*3000*
48	Methyl Methacrylate	80-62-6	0.075	0.2641	*700*
49	Methyl tert-Butyl Ether	1634-04-4	0.0198	0.0714	3.8
50	n-Octane	111-65-9	0.0233	0.1088	
51	Propionaldehyde	123-38-6	0.0275	0.0653	*8*
52	Propylene	115-07-1	0.141	0.2427	*3000*
53	Styrene	100-42-5	0.0151	0.0643	1.8
54	1,1,2,2-Tetrachloroethane	79-34-5	0.0165	0.1133	0.017
55	Tetrachloroethylene	127-18-4	0.0144	0.0977	0.16
56	Toluene	108-88-3	0.0182	0.0686	*3760*
57	1,2,4-Trichlorobenzene	120-82-1	0.141	1.0465	*2*
58	1,1,1-Trichloroethane	71-55-6	0.0149	0.0813	*1000*
59	1,1,2-Trichloroethane	79-00-5	0.0114	0.0622	0.063
60	Trichloroethylene	79-01-6	0.0123	0.0661	0.2
61	Trichlorofluoromethane	75-69-4	0.0166	0.0933	*700*
62	Trichlorotrifluoroethane	76-13-1	0.0098	0.0751	*30000*
63	1,2,4-Trimethylbenzene	95-63-6	0.033	0.1622	*60*
64	1,3,5-Trimethylbenzene	108-67-8	0.0114	0.0560	*60*
65	Valeraldehyde	110-62-3	0.00322	0.0113	
66	Vinyl chloride	75-01-4	0.0102	0.0261	0.11
67	m,p-Xylene	108-38-3 106-42-3	0.0325	0.1411	*100*
68	o-Xylene	95-47-6	0.0225	0.0977	*100*

- **Detection limits** from ERG analytic lab, Morrisville, NC.
- **Health benchmark** - the chemical-specific air concentration above which there may be human health concerns. Not available for all chemicals.
- 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 noncarcinogen, 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.
- Health benchmarks in *italics* are based on noncancer effects.
- Health benchmarks are from *Toxicity Values for Inhalation Exposure*, NJDEP Bureau of Evaluation & Planning, June 2020. https://www.state.nj.us/dep/aqpp/downloads/risk/ToxAll2020.pdf

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2019 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 predicting pollutant concentrations for comparison 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 eight 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

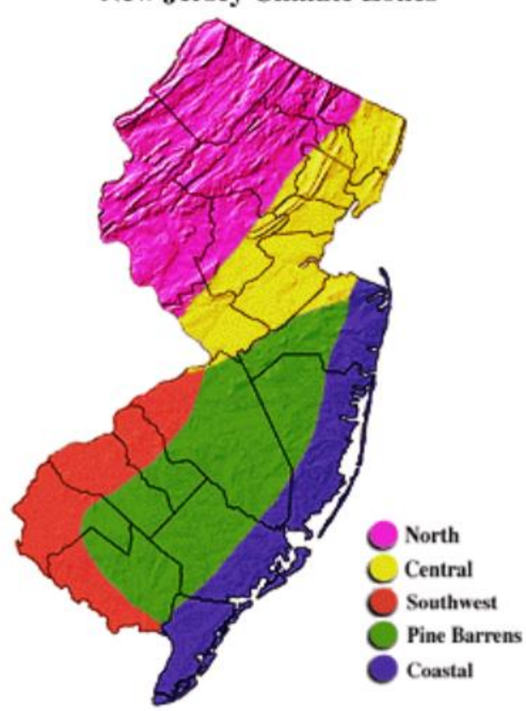
Although New Jersey is one of the smallest states in the country, with a land area of 7,836 square miles, it has five distinct climate zones, which are classified as the Northern, Central, Pine Barrens, Southwest, and Coastal Zones. The topography of the different zones, their distance from the Atlantic Ocean, and the prevailing atmospheric flow patterns affecting them produce distinct variations in the daily weather. This accounts for different results at our air monitoring stations. The climate zones are shown in Figure 11-1.

According to the Office of New Jersey State Climatologist, 2019 was the 10th warmest year on record since 1895 (tied with 2002), with an average temperature of 54.3˚F.

2019 statewide annual precipitation averaged 51.93 inches, making it the 17th-wettest year in 125 years.

Figure 11-1

New Jersey Climate Zones



https://climate.rutgers.edu/stateclim/?section=njcp&target=NJCoverview

2019 Monitoring Locations & Results

NJDEP collected meteorological data at nine stations in its air monitoring network in 2019. However, at the Newark Firehouse monitoring station, communication problems with the meteorological instrument (not including solar radiation) resulted in only about six weeks of data. Data collection from the Rutgers University site was added in August, although there are still some issues to work out. Table 11-1 lists the parameters monitored at each station, and Figure 11-2 is a map of the 2019 meteorological monitoring network. In Tables 11-2 through 11-6, the 2019 meteorological data is summarized for temperature, rain, solar radiation, relative humidity, and barometric pressure. Figure 11-3 presents the average temperature for each monitoring site along with the most recent statewide 30-year and 2019 averages. Figure 11-4 shows the monthly rainfall at each site, compared to the most recent statewide 30-year and 2019 average total precipitation. The instrument that measures precipitation at most of our sites uses sound rather than a collection bucket, which could result in an underestimate, especially for light showers or snow.

Figures 11-5 through 11-11 present annual wind roses for Bayonne, Camden Spruce Street, Columbia, Elizabeth Lab, Flemington, Fort Lee Near Road, and Rider University, respectively. A wind rose shows, in a circular format, 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 11-1
2019 New Jersey Meteorological Monitoring Network
Parameter Summary

Site Name	Temperature	Relative Humidity	Wind Speed	Wind Direction	Barometric Pressure	Rain	Solar Radiation
Bayonne	X	X	X	X	X	X	
Camden Spruce Street	X	X	X	X	X	X	
Columbia	X	X	X	X	X	X	
Elizabeth Lab	X	X	X	X	X	X	
Flemington	X	X	X	X	X	X	
Fort Lee Near Road	X	X	X	X	X	X	
Newark Firehouse	X*	X*	X*	X*	X*	X*	X
Rider University	X	X	X	X	X	X*	
Rutgers University	X*	X*	X*	X*	X*	X*	X*

*Data available for part of year only:

- Newark Firehouse -Temperature, relative humidity, wind speed, wind direction, barometric pressure and rain data were only available for 4/2-6/30/2019.
- Rutgers University – Data collection began August 2019.

Figure 11-2
2019 Meteorological Monitoring Network

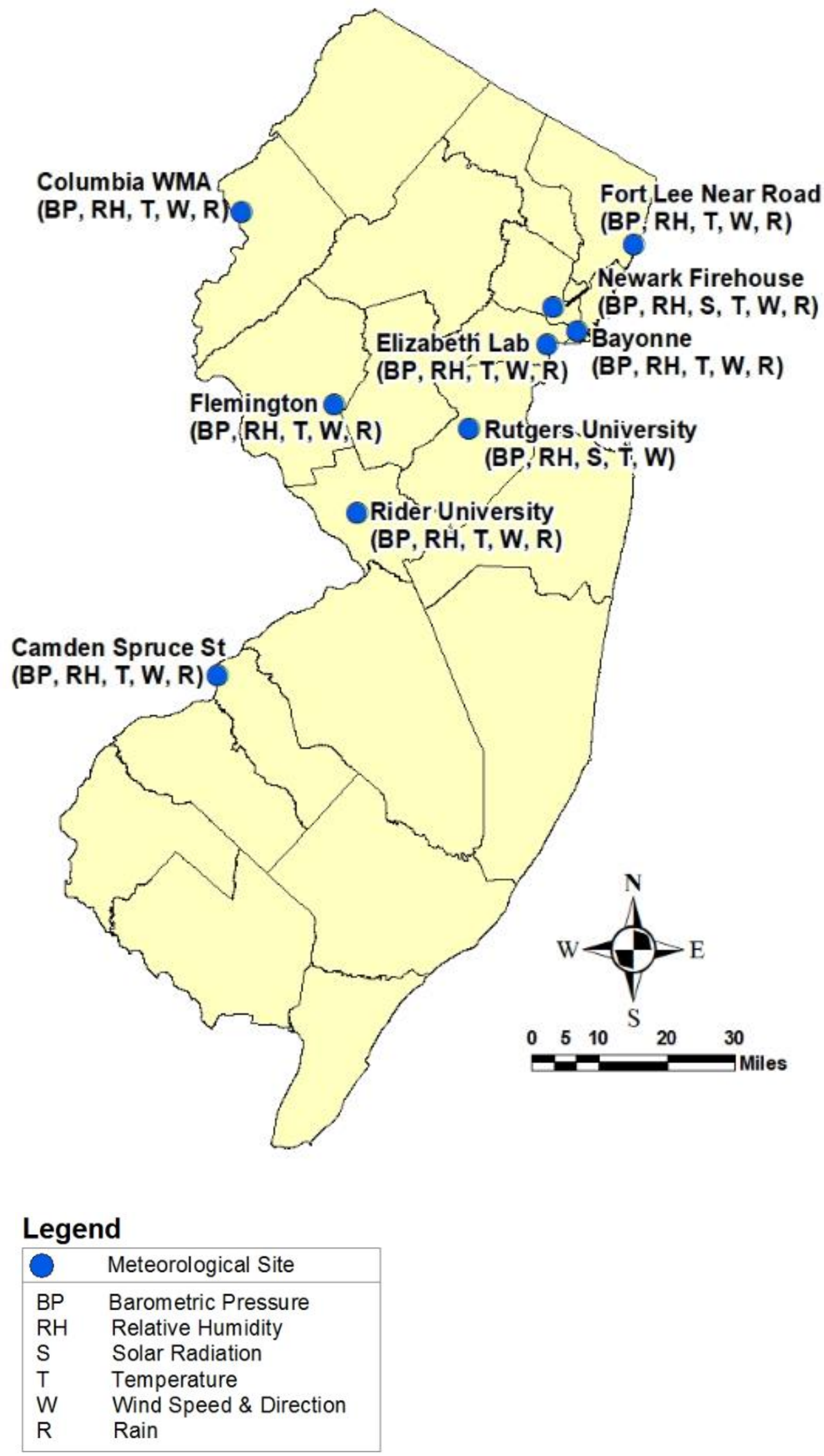


Table 11-2
2019 Temperature Data (in Degrees Fahrenheit) from NJ's Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	Mean	32	34	40	53	61	71	79	74	69	59	43	37	54
	Minimum	3	11	18	33	42	54	66	61	52	43	24	16	3
	Maximum	59	62	71	78	84	91	95	90	89	89	59	55	95
Camden Spruce St	Mean	33	36	42	58	65	74	80	76	71	61	44	39	57
	Minimum	6	13	20	32	45	56	66	61	55	44	25	20	6
	Maximum	60	67	74	80	88	93	98	92	90	92	66	58	98
Columbia	Mean	27	30	37	52	60	67	74	69	63	54	37	32	50
	Minimum	-3	-6	6	23	38	44	58	51	41	34	19	12	-6
	Maximum	56	61	72	75	84	88	93	87	87	88	59	57	93
Elizabeth Trailer	Mean	32	35	40	54	61	71	79	74	69	59	42	37	54
	Minimum	2	10	16	32	42	51	64	60	52	39	22	15	2
	Maximum	58	65	74	79	87	91	97	91	90	93	62	58	97
Flemington	Mean	29	32	38	53	60	68	76	72	66	56	38	34	52
	Minimum	0	3	6	22	37	41	59	52	40	30	17	15	0
	Maximum	59	64	73	77	86	89	95	90	89	91	61	55	95
Fort Lee Near Road	Mean	30	33	39	52	60	70	78	74	68	58	41	37	53
	Minimum	0	9	16	31	40	53	63	59	51	42	22	20	0
	Maximum	57	63	70	76	87	91	97	91	88	90	60	55	97
Newark Firehouse	Mean	ND	ND	ND	57	61	ND	ND	ND	ND	ND	ND	ND	*
	Minimum	ND	ND	ND	40	41	ND	ND	ND	ND	ND	ND	ND	*
	Maximum	ND	ND	ND	77	86	ND	ND	ND	ND	ND	ND	ND	*
Rider University	Mean	30	33	39	54	62	69	76	73	66	57	39	35	53
	Minimum	2	5	14	26	38	43	60	55	43	33	19	15	2
	Maximum	60	65	75	79	85	91	96	91	88	91	61	57	96
Rutgers University	Mean	ND	ND	ND	ND	ND	ND	ND	73	68	58	40	36	*
	Minimum	ND	ND	ND	ND	ND	ND	ND	57	45	35	20	15	*
	Maximum	ND	ND	ND	ND	ND	ND	ND	90	88	92	62	57	*

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

Figure 11-3
2019 Average Temperatures at NJDEP Air Monitoring Sites Compared to the Statewide 30-Year Average

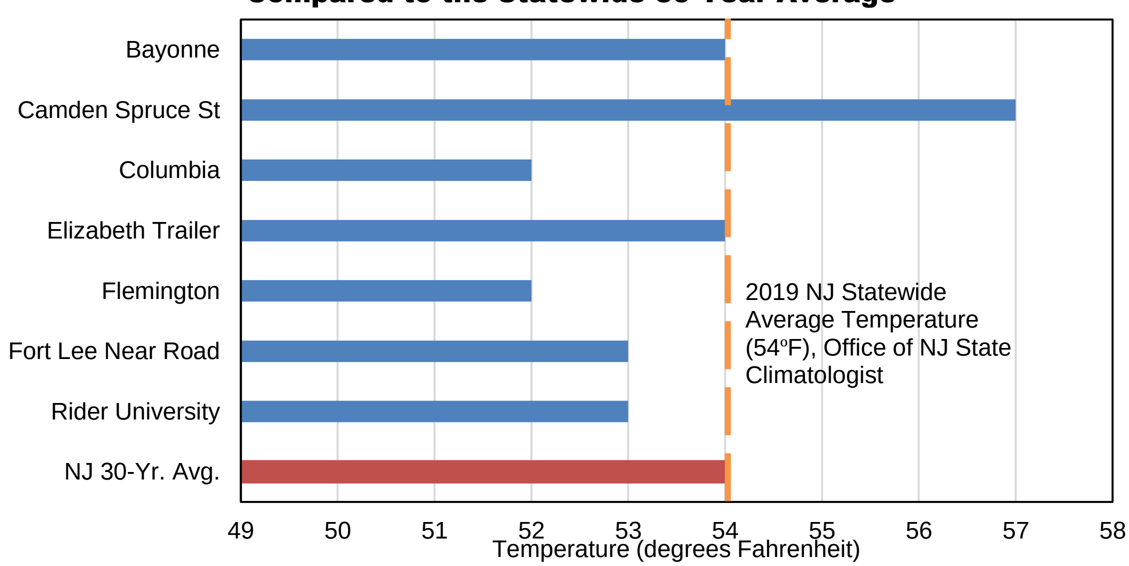
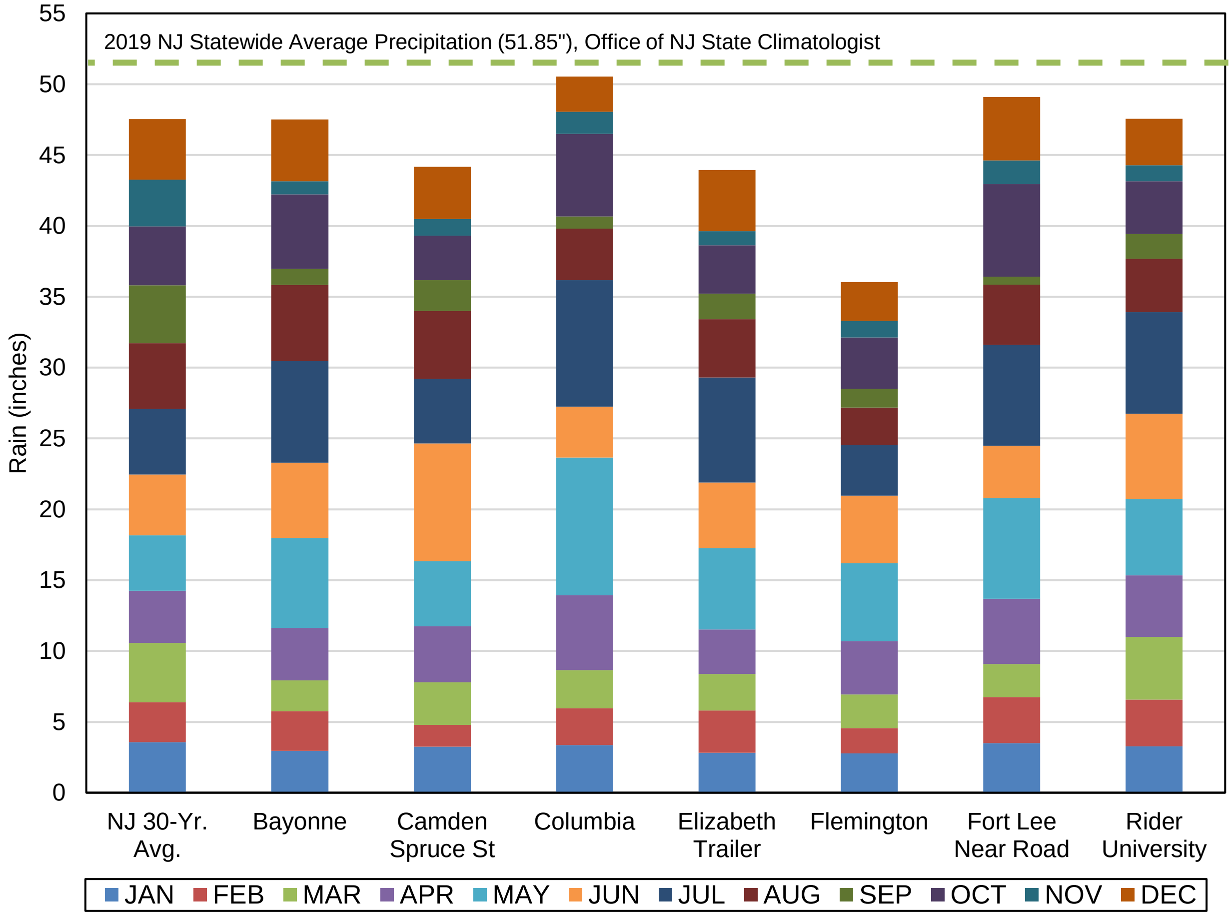


Table 11-3
2019 Rain Totals (Inches) from NJ's Air Monitoring Sites

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Bayonne	2.95	2.81	2.17	3.70	6.35	5.31	7.16	5.39	1.12	5.28	0.93	4.36	47.52
Camden Spruce St	3.25	1.54	3.01	3.95	4.58	8.31	4.58	4.77	2.17	3.15	1.19	3.68	44.18
Columbia	3.35	2.60	2.71	5.28	9.71	3.59	8.92	3.65	0.85	5.84	1.56	2.49	50.55
Elizabeth Trailer	2.81	2.99	2.57	3.14	5.74	4.64	7.40	4.12	1.82	3.42	0.99	4.30	43.94
Flemington	2.78	1.78	2.38	3.78	5.49	4.78	3.59	2.62	1.32	3.63	1.18	2.74	36.05
Fort Lee Near Road	3.51	3.25	2.33	4.61	7.10	3.70	7.11	4.25	0.58	6.52	1.68	4.47	49.10
Rider University	3.26	3.31	4.42	4.34	5.38	6.03	7.15	3.79	1.74	3.72	1.13	3.28	47.56

Figure 11-4
2019 Total Rainfall at NJDEP Air Monitoring Sites
Compared to the Statewide 30-Year Average



NOTE: Newark Firehouse and Rutgers University are not included because of incomplete data.

Table 11-4
2019 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	0.10	0.15	0.23	0.27	0.30	0.36	0.37	0.33	0.26	0.15	0.12	0.07	0.22
	Maximum	0.76	0.99	1.21	1.34	1.42	1.53	1.42	1.35	1.21	1.04	0.82	0.62	1.53

*Rutgers not included because of incomplete data.

Table 11-5
2019 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	56	57	52	57	64	59	60	62	60	64	55	65	59
	Minimum	27	28	17	20	22	26	28	27	24	27	15	32	15
	Maximum	88	88	88	87	88	90	89	87	86	89	87	89	90
Camden Spruce St	Mean	53	56	48	51	61	55	59	60	59	62	52	62	56
	Minimum	25	24	14	17	22	22	26	26	24	26	18	30	14
	Maximum	89	88	87	89	89	88	89	90	88	89	87	89	90
Columbia	Mean	60	61	55	60	72	70	75	76	75	75	63	73	68
	Minimum	26	28	14	15	27	27	36	35	31	22	16	29	14
	Maximum	92	91	90	92	92	92	93	93	93	93	92	92	93
Elizabeth Trailer	Mean	52	54	49	56	64	57	59	63	59	63	52	63	58
	Minimum	25	25	12	15	20	20	27	24	21	22	16	27	12
	Maximum	90	89	88	89	89	91	90	88	88	90	88	89	91
Flemington	Mean	60	61	56	60	71	68	70	70	68	69	60	71	65
	Minimum	27	30	15	18	26	28	36	33	31	30	25	38	15
	Maximum	93	92	92	92	92	93	90	90	88	91	86	89	93
Fort Lee Near Road	Mean	54	55	51	57	64	57	58	61	59	64	53	65	58
	Minimum	27	27	15	15	20	20	27	30	23	26	14	31	14
	Maximum	91	90	89	91	90	92	89	88	87	90	89	90	92
Newark Firehouse	Mean	ND	ND	ND	59	62	ND	ND	ND	ND	ND	ND	ND	*
	Minimum	ND	ND	ND	14	20	ND	ND	ND	ND	ND	ND	ND	*
	Maximum	ND	ND	ND	88	88	ND	ND	ND	ND	ND	ND	ND	*
Rider University	Mean	59	60	54	60	70	66	70	71	71	73	62	70	65
	Minimum	26	28	15	18	27	29	32	31	28	27	18	33	15
	Maximum	93	91	90	92	93	93	93	93	93	92	90	91	93

ND = no data (including all of Rutgers 2019 relative humidity data)
*Not able to determine an annual statistic because of missing data.

Table 11-6
2019 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	30.04	30.11	30.08	29.97	29.93	29.89	29.93	29.94	30.07	30.03	30.04	30.03	30.01
Camden Spruce St	30.06	30.13	30.09	29.97	29.93	29.9	29.94	29.94	30.07	30.03	30.05	30.04	30.01
Columbia	29.51	29.59	29.56	29.46	29.43	29.41	29.45	29.46	29.58	29.53	29.52	29.51	29.50
Elizabeth Trailer	30.03	30.1	30.07	29.96	29.92	29.88	29.92	29.93	30.06	30.02	30.03	30.02	30.00
Flemington	29.89	29.98	29.93	29.81	29.78	29.75	29.79	29.8	29.92	29.88	29.89	29.88	29.86
Fort Lee Near Road	29.7	29.78	29.75	29.66	29.63	29.59	29.63	29.64	29.76	29.72	29.71	29.7	29.69
Newark Firehouse	ND	ND	ND	29.79	29.82	ND	ND	ND	ND	ND	ND	ND	*
Rider University	29.94	30.02	29.99	29.86	29.83	29.8	29.83	29.84	29.97	29.93	29.95	29.93	29.91
Rutgers University	ND	ND	ND	ND	ND	ND	ND	29.88	30	29.97	29.98	29.98	*

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

Wind Roses - Distribution of Wind Speed & Wind Direction

Figure 11-5. 2019 Wind Rose for Bayonne

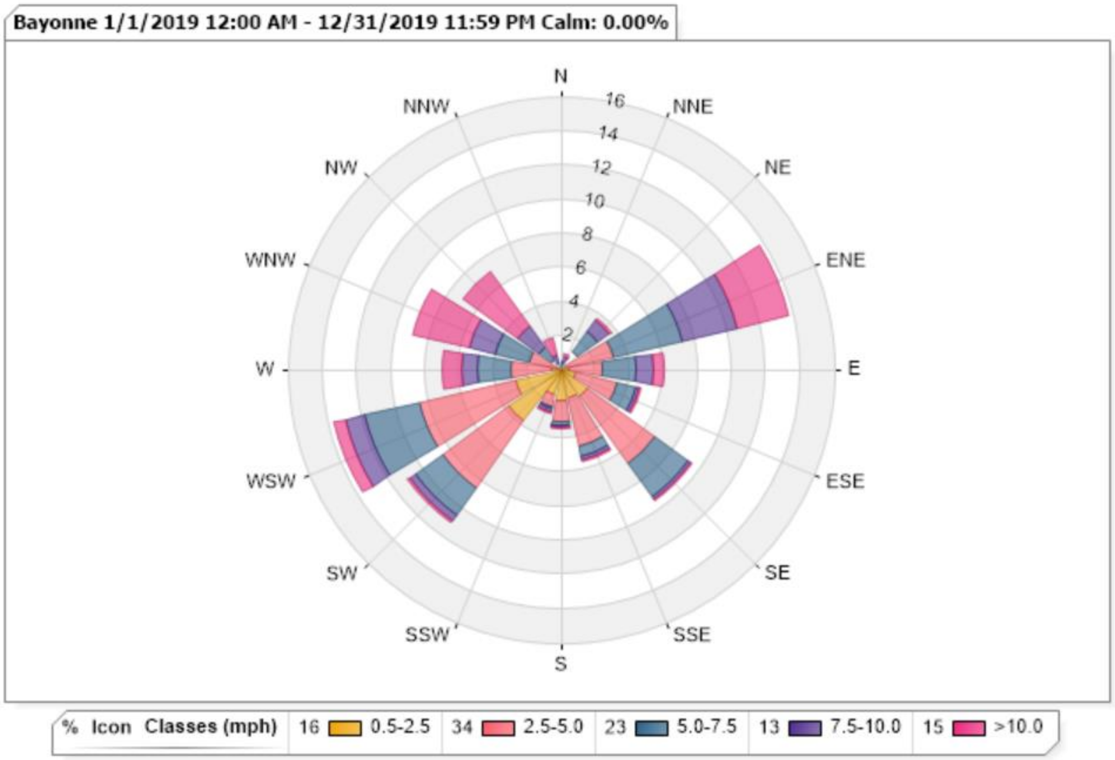


Figure 11-6. 2019 Wind Rose for Camden Spruce Street

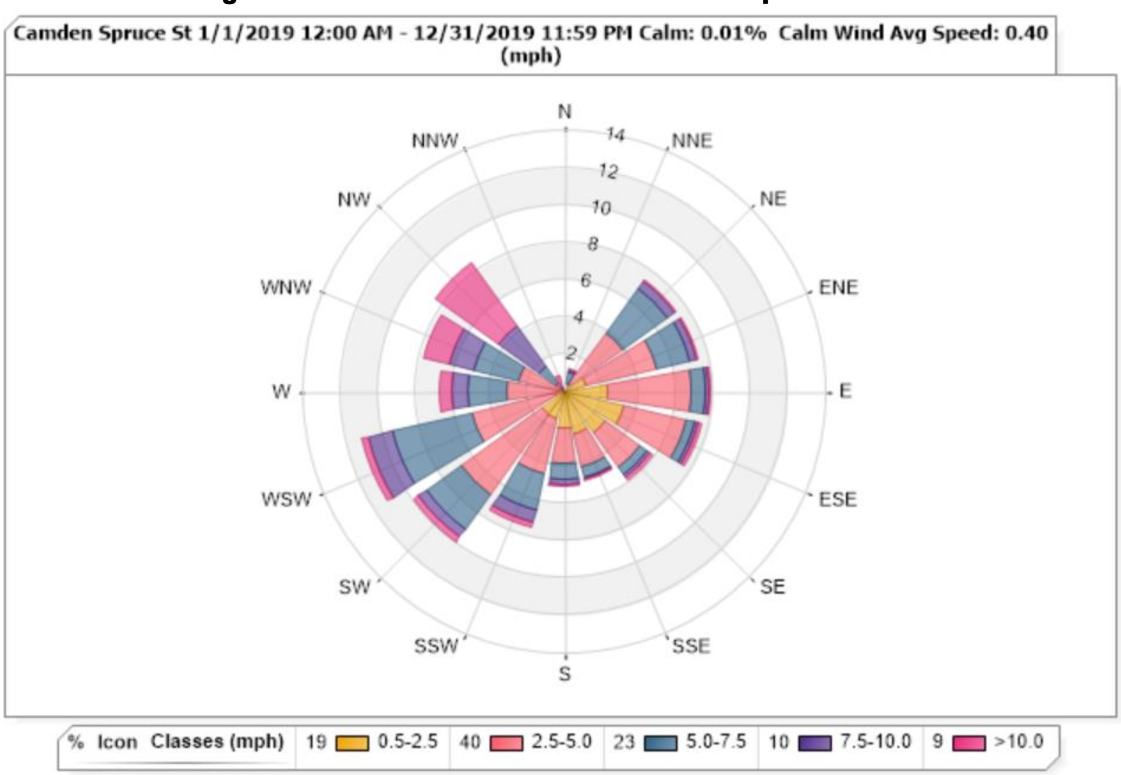


Figure 11-7. 2019 Wind Rose for Columbia

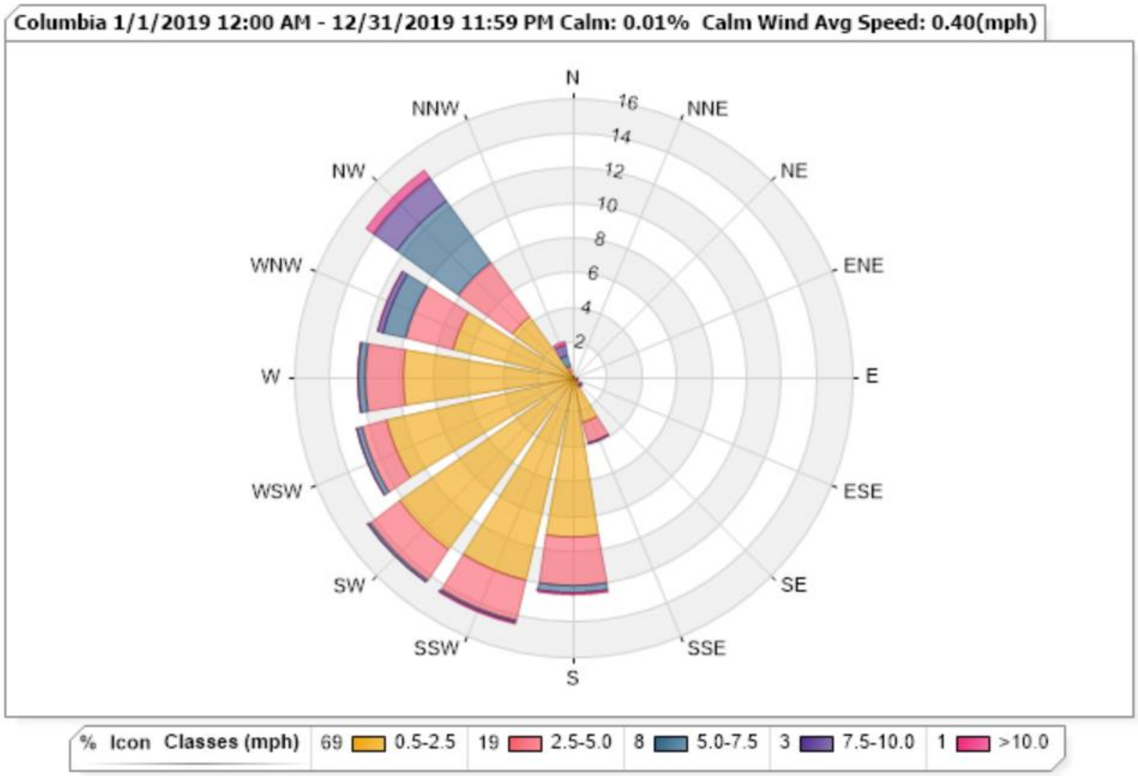


Figure 11-8. 2019 Wind Rose for Elizabeth Lab

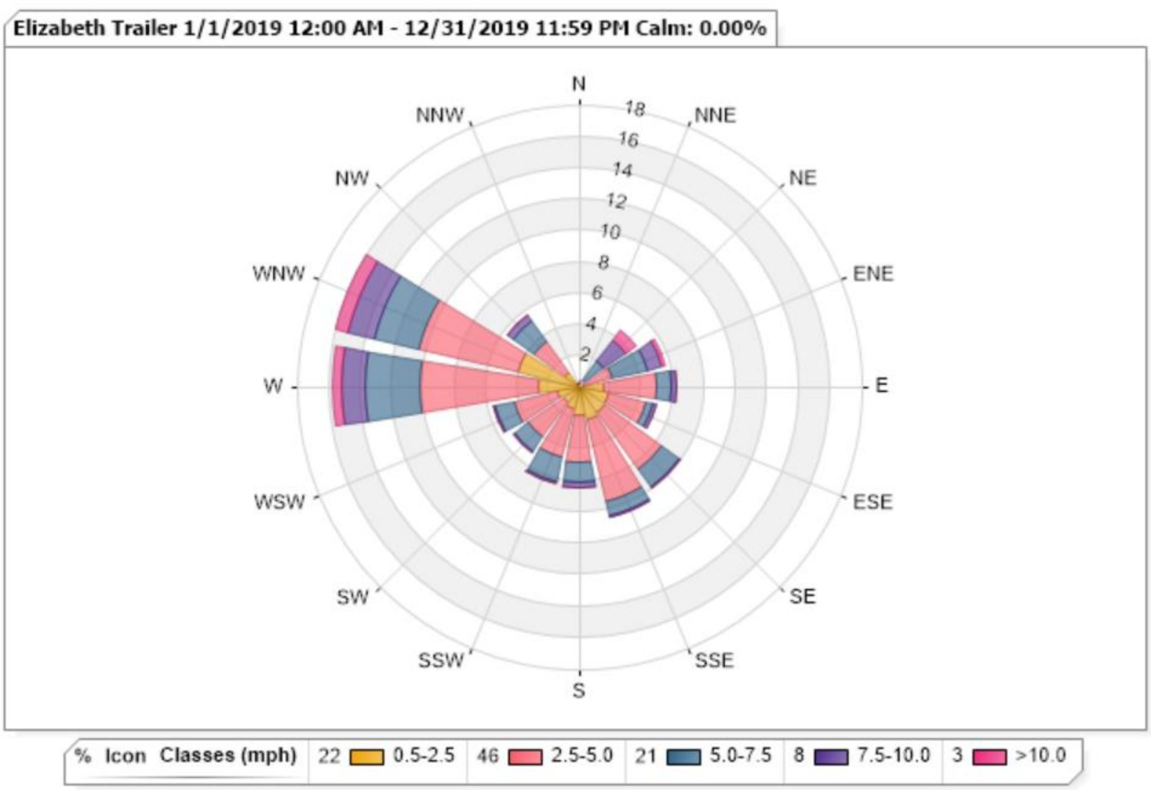


Figure 11-9. 2019 Wind Rose for Flemington

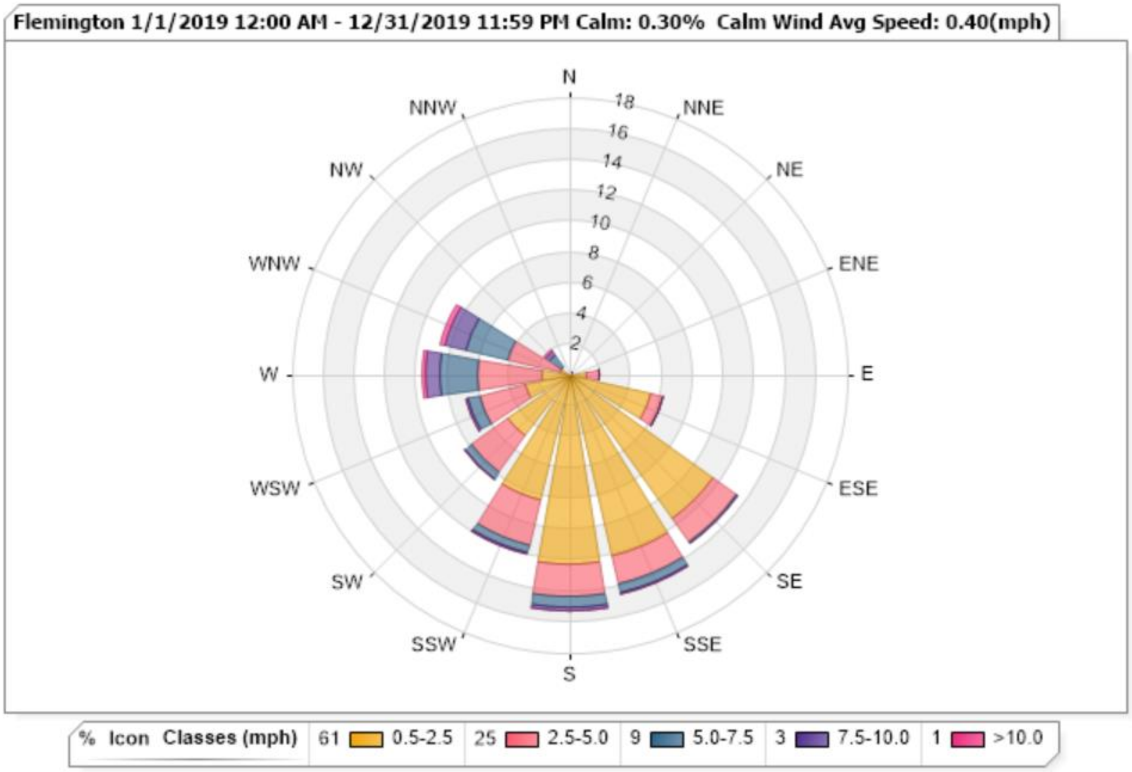


Figure 11-10. 2019 Wind Rose for Fort Lee Near Road

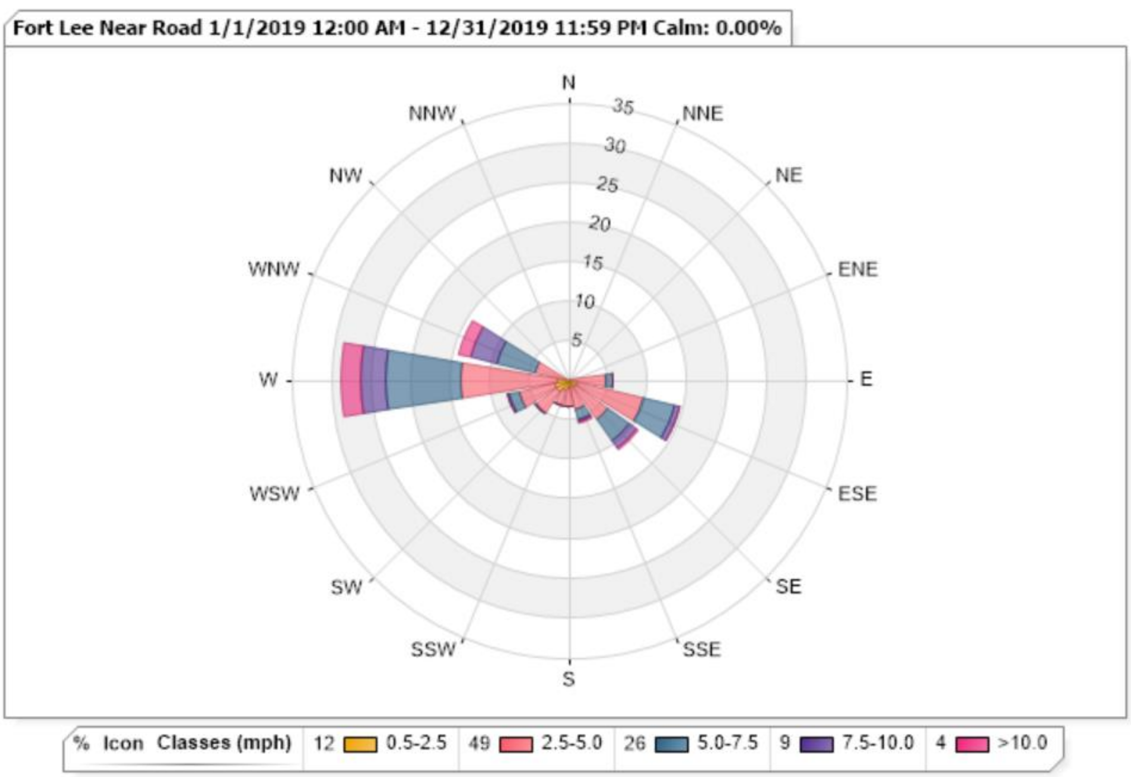
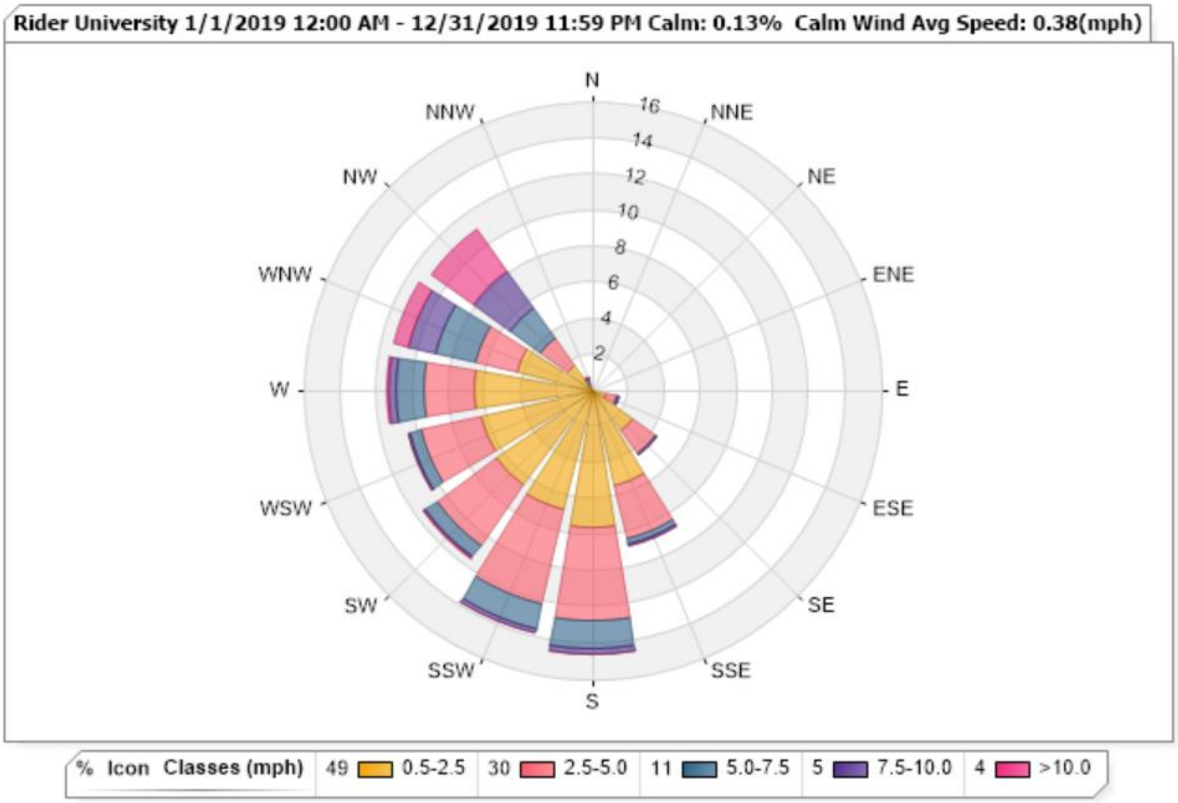


Figure 11-11. 2018 Wind Rose for Rider University



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Appendix A
2019 Air Monitoring Sites

New Jersey Department of Environmental Protection

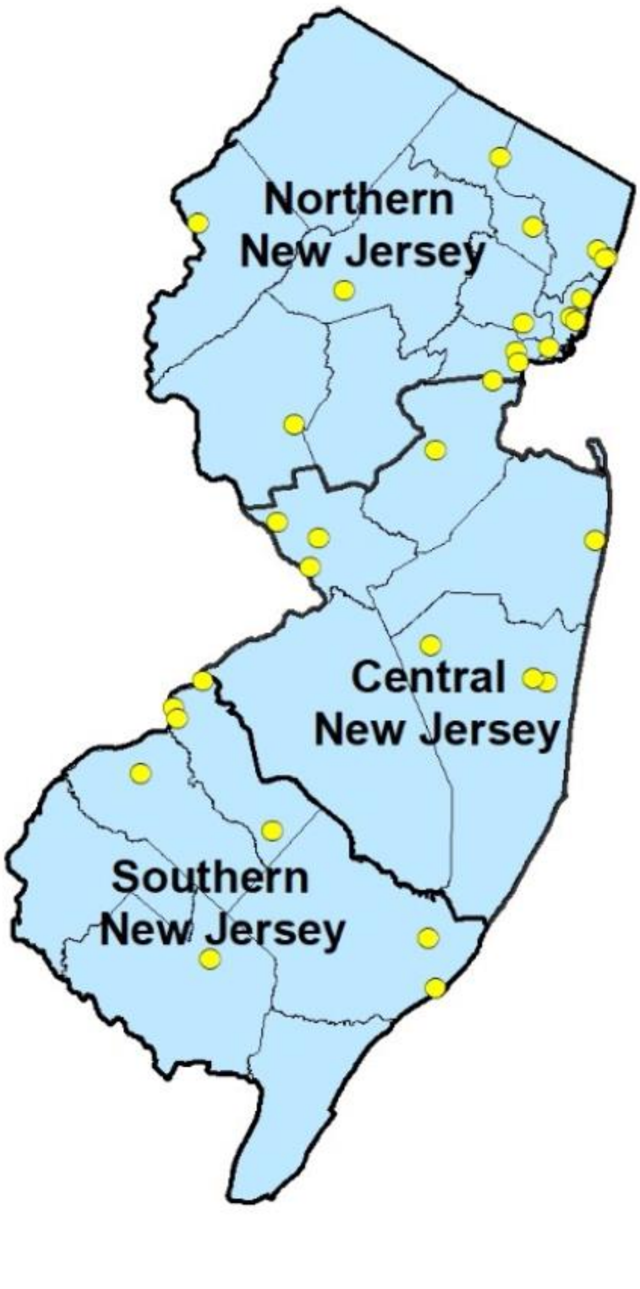

Figure A-1
2019 Northern New Jersey
Air Monitoring Sites

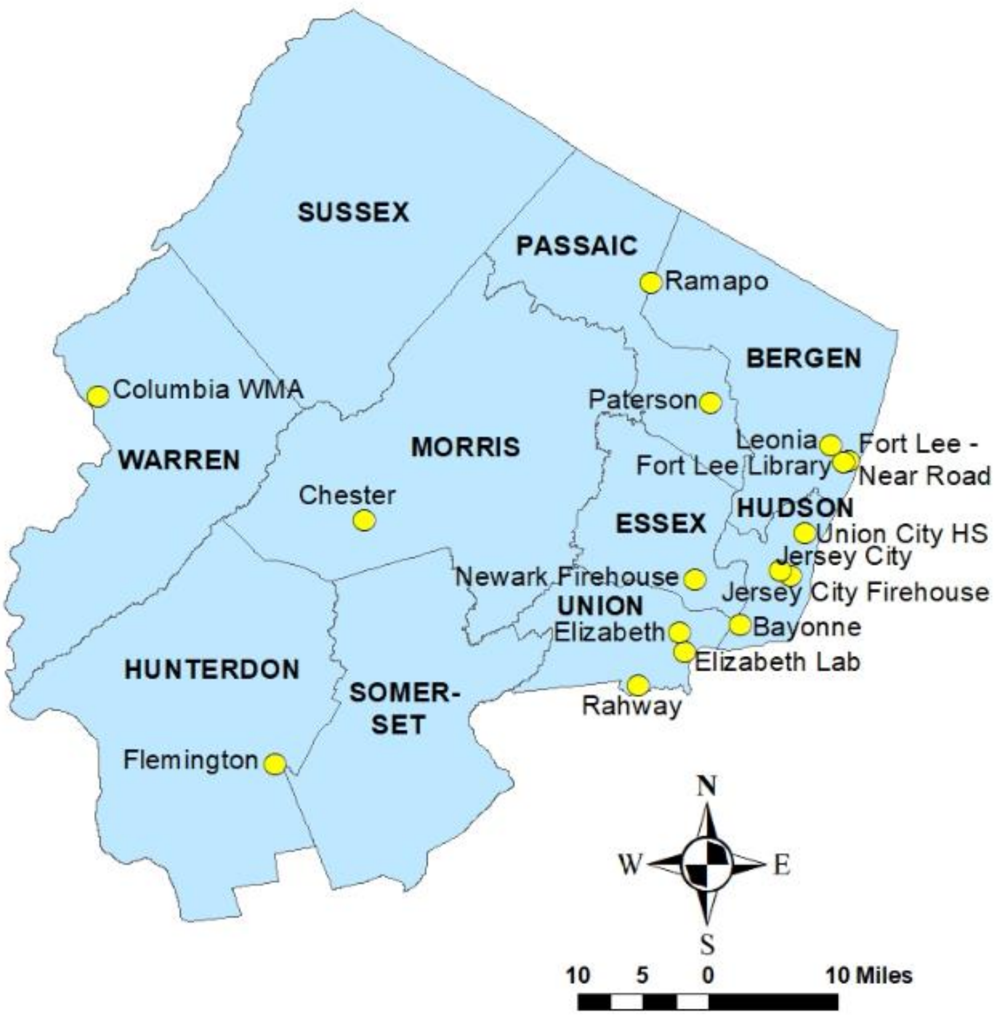

Table A-1
2019 Northern New Jersey Air Monitoring Sites

County	Monitoring Site	AQS 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 N. Central Rd.
	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	40.720989	-74.192892	360 Clinton Avenue
HUDSON	Bayonne	34 017 0006	NO_X, O_3, SO_2, BTEX, BC, Met	40.670250	-74.126081	Veterans Park, 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	Jersey City Fire Dept. Engine 5/Ladder 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	Department of Public Works Bldg. #1, 50 North Road
PASSAIC	Paterson	34 031 0005	$PM_{2.5}$	40.918381	-74.168092	Paterson Board of Health, 176 Broadway
	Ramapo	34 031 5001	O_3	41.058617	-74.255544	Ramapo Station Fire Tower, Ramapo Park 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	New Jersey Turnpike Interchange 13 Toll Plaza
	Rahway	34 039 2003	Beta	40.603943	-74.276174	Rahway Fire Department, 1300 Main Street
WARREN	Columbia	34 041 0007	NO_X, O_3, SO_2, 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
2019 Central New Jersey
Air Monitoring Sites

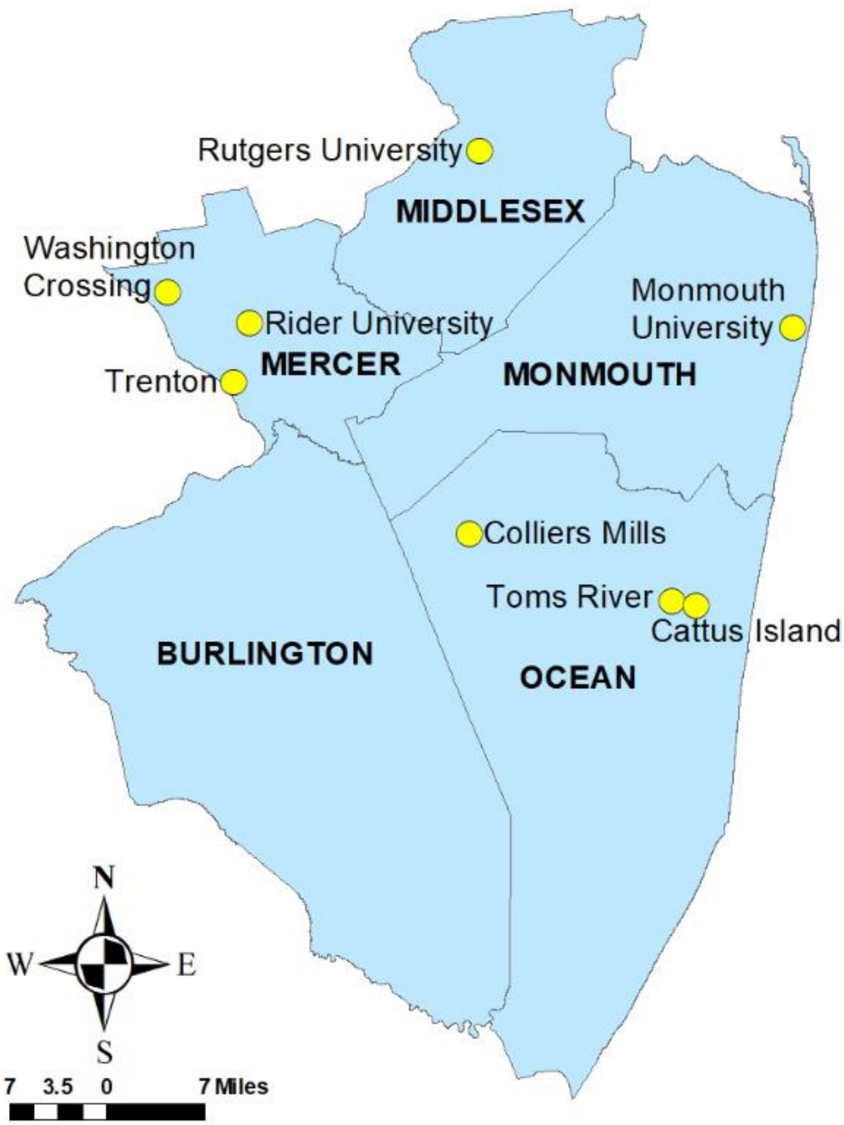

Table A-2
2019 Central New Jersey Air Monitoring Sites

County	Monitoring Site	AQS 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	Athletic Fields, off of 2083 Lawrenceville Rd, Lawrence Twp.
	Trenton Library	34 021 0008	$PM_{2.5}$	40.222411	-74.763167	120 Academy Street
	Washington Crossing	N/A	ACID	40.315359	-74.853613	Washington Crossing State Park, Philips Farm Group Area, 1239 Bear Tavern Rd.,Titusville
MIDDLESEX	Rutgers University	34 023 0011	NO_2, NO, NO_y, O_3, PAMS, Beta, $PM_{2.5}$, Toxics, Spec, Hg, Met	40.462182	-74.429439	Vegetable Farm 3, 67 Ryders Lane, East Brunswick
MONMOUTH	Monmouth University	34 025 0005	O_3	40.277647	-74.005100	Edison Science Hall, off of 400 Cedar Avenue, West Long Branch
OCEAN	Cattus Island	N/A	ACID	39.989636	-74.134132	Cattus Island County Park behind Administrative Office, end of Bandon Road, Toms River
	Colliers Mills	34 029 0006	O_3	40.064830	-74.444050	JPTD Training Center, south of Success Rd., east of 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).

FIGURE A-3
2019 SOUTHERN NEW JERSEY
AIR MONITORING SITES

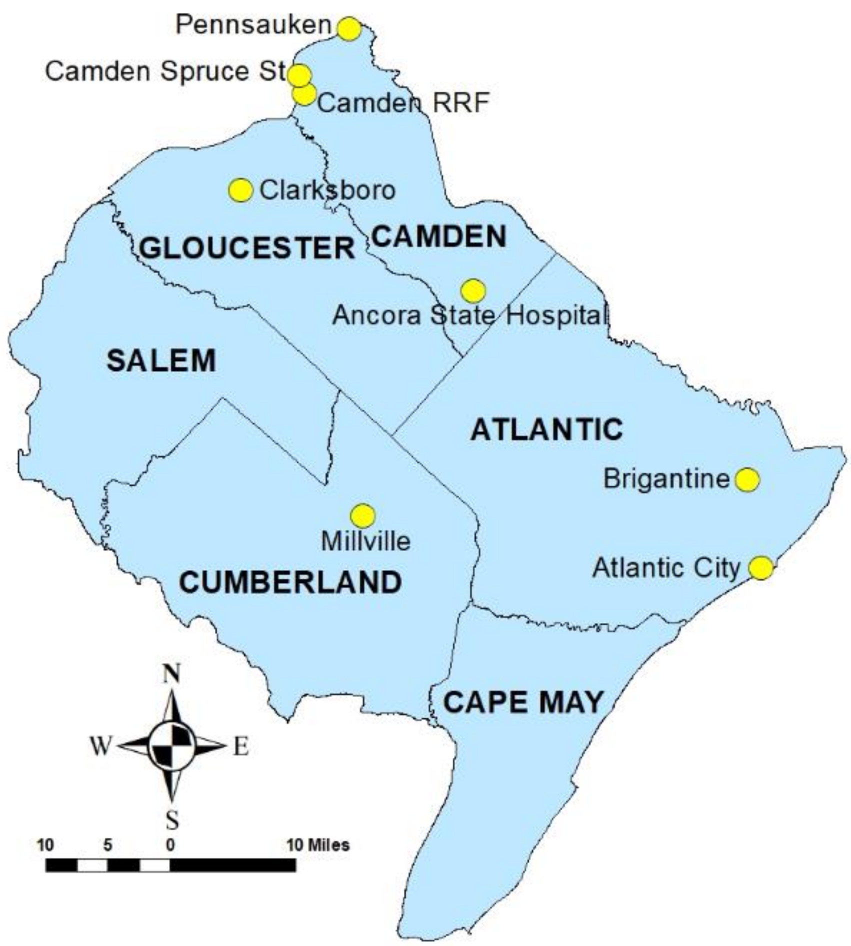

Table A-3
2019 Southern New Jersey Air Monitoring Sites

County	Monitoring Site	AQS 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	266-298 Spruce Street
	Pennsauken	34 007 1007	$PM_{2.5}$	39.989036	-75.050008	Camden Water Inc., 8999 Zimmerman Ave.
CUMBERLAND	Millville	34 011 0007	NO_X, O_3, Beta	39.422273	-75.025204	Behind 4401 S. Main Road
GLOUCESTER	Clarksboro	34 015 0002	O_3, $PM_{2.5}$	39.800339	-75.212119	Shady Lane Nursing Home, 256 County House Road

[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
SO_2	Sulfur dioxide
Spec	Speciated fine particles (2.5 microns or less)
Toxics	Air toxics
Visibility	Measured by nephelometer

Appendix B: 2019
Fine Particulate Speciation Summary

New Jersey Department of Environmental Protection

Table B-1
2019 Fine Particulate Speciation Concentrations
CAMDEN SPRUCE STREET NJ
Micrograms per Cubic Meter (µg/m^3)

Species		Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.0282	0.2094	79
2	Ammonium Ion	0.5792	3.2567	100
3	Antimony	*0*	0.0265	48
4	Arsenic	*0.000003*	0.0001	47
5	Barium	0.0054	0.0629	52
6	Bromine	*0.0006*	0.0102	33
7	Cadmium	0.0020	0.0262	59
8	Calcium	0.0465	0.2118	100
9	Carbon, Elemental	0.9783	4.3498	100
10	Carbon, Organic	2.5727	7.9262	100
11	Cerium	*0.0025*	0.0711	47
12	Cesium	0.0031	0.0377	55
13	Chloride	0.5744	4.3839	100
14	Chlorine	0.1562	2.8886	98
15	Chromium	0.0040	0.0276	84
16	Cobalt	*0*	0.0042	34
17	Copper	0.0039	0.0162	90
18	Indium	*0.0004*	0.0231	45
19	Iron	0.1421	0.7291	100
20	Lead	0.0039	0.0165	67
21	Magnesium	0.0224	0.1514	64
22	Manganese	0.0025	0.0149	78
23	Nickel	0.0015	0.0105	81
24	Nitrate	1.3593	12.6346	100
25	Phosphorus	0.0006	0.0050	97
26	Potassium	0.1247	0.9668	100
27	Potassium Ion	0.1080	1.0405	100
28	Rubidium	*0*	0.0033	48
29	Selenium	0.0008	0.0059	74
30	Silicon	0.0503	0.2151	97
31	Silver	0.0026	0.0178	66
32	Sodium	0.1296	1.0242	91
33	Sodium Ion	0.1110	0.8718	98
34	Strontium	0.0005	0.0061	59
35	Sulfate	1.0460	3.8275	100
36	Sulfur	0.3679	1.4329	100
37	Tin	0.0072	0.0890	72
38	Titanium	0.0030	0.0091	86
39	Vanadium	*0.0002*	0.0015	29
40	Zinc	0.0312	0.1921	100
41	Zirconium	0.0020	0.0246	53

Table B-2
2019 Fine Particulate Speciation Concentrations
CHESTER NJ
Micrograms per Cubic Meter (µg/m^3)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.0087	0.1130	61
2	Ammonium Ion	0.2917	1.2847	98
3	Antimony	*0.0020*	0.0256	47
4	Arsenic	*0.000004*	0.0001	44
5	Barium	0.0041	0.0504	51
6	Bromine	*0.0002*	0.0024	14
7	Cadmium	*0.0005*	0.0332	47
8	Calcium	0.0112	0.0399	96
9	Carbon, Elemental	0.3762	0.9902	100
10	Carbon, Organic	1.6783	5.5453	100
11	Cerium	*0*	0.0461	40
12	Cesium	0.0021	0.0402	51
13	Chloride	0.0399	0.1511	98
14	Chlorine	0.0046	0.1051	60
15	Chromium	0.0017	0.0092	70
16	Cobalt	0.0002	0.0039	54
17	Copper	0.0052	0.0231	84
18	Indium	*0.0001*	0.0179	46
19	Iron	0.0254	0.0646	100
20	Lead	0.0017	0.0166	60
21	Magnesium	0.0168	0.1185	54
22	Manganese	*0*	0.0065	39
23	Nickel	0.0005	0.0028	67
24	Nitrate	0.8498	7.7547	100
25	Phosphorus	0.0000	0.0011	88
26	Potassium	0.0318	0.1066	100
27	Potassium Ion	0.0237	0.1073	97
28	Rubidium	0.0003	0.0039	54
29	Selenium	0.0003	0.0049	51
30	Silicon	0.0168	0.0832	72
31	Silver	0.0019	0.0222	54
32	Sodium	0.0383	0.1592	70
33	Sodium Ion	0.0236	0.1155	93
34	Strontium	0.0002	0.0033	53
35	Sulfate	0.7823	2.9565	100
36	Sulfur	0.2681	1.1674	100
37	Tin	0.0018	0.0329	54
38	Titanium	0.0013	0.0075	72
39	Vanadium	*0.0001*	0.0014	21
40	Zinc	0.0084	0.0355	100
41	Zirconium	*0.0003*	0.0206	44

Table B-3
2019 Fine Particulate Speciation Concentrations
ELIZABETH LAB NJ
Micrograms per Cubic Meter (µg/m^3)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.0140	0.1150	65
2	Ammonium Ion	0.5167	3.1142	100
3	Antimony	0.0030	0.0353	55
4	Arsenic	0.00001	0.0001	50
5	Barium	0.0101	0.0534	67
6	Bromine	*0.0005*	0.0069	40
7	Cadmium	0.0019	0.0292	55
8	Calcium	0.0310	0.0944	100
9	Carbon, Elemental	1.2872	3.6837	100
10	Carbon, Organic	2.2726	11.0271	100
11	Cerium	*0.0006*	0.0778	44
12	Cesium	0.0025	0.0399	60
13	Chloride	0.1313	0.8342	99
14	Chlorine	0.0113	0.1504	90
15	Chromium	0.0027	0.0310	77
16	Cobalt	*0*	0.0027	32
17	Copper	0.0055	0.0165	98
18	Indium	0.0024	0.0375	60
19	Iron	0.1298	0.3244	100
20	Lead	0.0016	0.0155	60
21	Magnesium	0.0219	0.1654	61
22	Manganese	0.0020	0.0119	74
23	Nickel	0.0012	0.0096	85
24	Nitrate	1.4134	8.8462	100
25	Phosphorus	0.0005	0.0133	93
26	Potassium	0.0433	0.2356	100
27	Potassium Ion	0.0312	0.2128	100
28	Rubidium	0.0004	0.0071	52
29	Selenium	0.0004	0.0036	57
30	Silicon	0.0472	0.2442	93
31	Silver	0.0013	0.0221	60
32	Sodium	0.0730	0.8017	78
33	Sodium Ion	0.0713	0.6029	98
34	Strontium	0.0011	0.0111	68
35	Sulfate	1.0221	3.5955	100
36	Sulfur	0.3607	1.3804	100
37	Tin	0.0028	0.0304	61
38	Titanium	0.0048	0.0173	92
39	Vanadium	*0.0001*	0.0023	24
40	Zinc	0.0136	0.0556	100
41	Zirconium	0.0027	0.0259	64

Table B-4
2019 Fine Particulate Speciation Data
NEWARK FIREHOUSE NJ
Concentrations in Micrograms per Cubic Meter (µg/m³)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.0160	0.1241	64
2	Ammonium Ion	0.4663	2.4740	100
3	Antimony	0.0026	0.0313	60
4	Arsenic	*0.000004*	0.0001	45
5	Barium	0.0106	0.0486	69
6	Bromine	*0.0004*	0.0060	26
7	Cadmium	0.0025	0.0222	54
8	Calcium	0.0327	0.1387	100
9	Carbon, Elemental	0.7592	2.8782	100
10	Carbon, Organic	2.1861	7.1868	100
11	Cerium	0.0033	0.0771	52
12	Cesium	0.0041	0.0541	60
13	Chloride	0.1260	0.9063	100
14	Chlorine	0.0245	1.2556	86
15	Chromium	0.0019	0.0127	77
16	Cobalt	*0*	0.0025	32
17	Copper	0.0059	0.0397	92
18	Indium	0.0018	0.0293	53
19	Iron	0.0871	0.4721	100
20	Lead	0.0025	0.0155	72
21	Magnesium	0.0204	0.1157	65
22	Manganese	0.0016	0.0178	73
23	Nickel	0.0008	0.0047	73
24	Nitrate	1.4151	7.5485	100
25	Phosphorus	0.0004	0.0084	92
26	Potassium	0.0462	0.3234	100
27	Potassium Ion	0.0335	0.3145	100
28	Rubidium	0.0001	0.0044	50
29	Selenium	0.0004	0.0058	60
30	Silicon	0.0487	0.2256	91
31	Silver	0.0023	0.0329	60
32	Sodium	0.0720	1.0695	75
33	Sodium Ion	0.0731	0.6462	99
34	Strontium	0.0016	0.0695	67
35	Sulfate	0.9195	3.3328	100
36	Sulfur	0.3241	1.3505	100
37	Tin	0.0021	0.0327	58
38	Titanium	0.0045	0.0633	91
39	Vanadium	0.0002	0.0017	24
40	Zinc	0.0137	0.0710	100
41	Zirconium	0.0039	0.0234	68

Table B-5
2019 Fine Particulate Speciation Data
RUTGERS UNIVERSITY NJ
Concentrations in Micrograms per Cubic Meter (µg/m^3)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.0122	0.1273	63
2	Ammonium Ion	0.3935	3.3002	100
3	Antimony	0.0020	0.0261	57
4	Arsenic	0.0000	0.0001	51
5	Barium	0.0057	0.0612	57
6	Bromine	0.0003	0.0059	17
7	Cadmium	0.0019	0.0241	57
8	Calcium	0.0171	0.0551	100
9	Carbon, Elemental	0.5666	3.1113	100
10	Carbon, Organic	1.9737	6.3987	100
11	Cerium	0.0028	0.0927	53
12	Cesium	0.0046	0.0460	63
13	Chloride	0.0960	1.3289	100
14	Chlorine	0.0087	0.2851	72
15	Chromium	0.0028	0.0368	72
16	Cobalt	*0*	0.0030	38
17	Copper	0.0029	0.0160	82
18	Indium	0.0027	0.0378	59
19	Iron	0.0515	0.1544	100
20	Lead	0.0021	0.0161	64
21	Magnesium	0.0158	0.1339	60
22	Manganese	0.0013	0.0140	69
23	Nickel	0.0011	0.0089	84
24	Nitrate	1.1523	9.9298	100
25	Phosphorus	0.0002	0.0058	91
26	Potassium	0.0417	0.3092	100
27	Potassium Ion	0.0321	0.2911	99
28	Rubidium	0.0004	0.0055	53
29	Selenium	0.0004	0.0042	59
30	Silicon	0.0328	0.2583	90
31	Silver	0.0023	0.0318	63
32	Sodium	0.0591	0.4854	75
33	Sodium Ion	0.0592	0.8092	99
34	Strontium	0.0003	0.0068	54
35	Sulfate	0.8932	3.3734	100
36	Sulfur	0.3077	1.2321	100
37	Tin	0.0021	0.0391	55
38	Titanium	0.0025	0.0122	80
39	Vanadium	*0.0001*	0.0016	19
40	Zinc	0.0108	0.0478	100
41	Zirconium	0.0020	0.0264	58

*Annual averages in italics are arithmetic means calculated with fewer than 50% of the samples above zero.

Chemical Speciation Network information can be found at https://www.epa.gov/amtic/chemical-speciation-network-csn.

Table B-6. 2019 Average Minimum Detection Limits (MDL) (µg/m^3)

	Species	MDL (µg/m^3)
1	Aluminum	0.032
2	Ammonium	0.005
3	Antimony	0.039
4	Arsenic	0.002
5	Barium	0.08
6	Bromine	0.005
7	Cadmium	0.016
8	Calcium	0.018
9	Carbon, Elemental	0.018
10	Carbon, Organic	0.138
11	Cerium	0.095
12	Cesium	0.054
13	Chloride	0.036
14	Chlorine	0.005
15	Chromium	0.003
16	Cobalt	0.003
17	Copper	0.011
18	Indium	0.038
19	Iron	0.018
20	Lead	0.012
21	Magnesium	0.043
22	Manganese	0.006
23	Nickel	0.002
24	Nitrate	0.035
25	Phosphorus	0.002
26	Potassium	0.005
27	Potassium Ion	0.061
28	Rubidium	0.009
29	Selenium	0.005
30	Silicon	0.016
31	Silver	0.016
32	Sodium	0.089
33	Sodium Ion	0.026
34	Strontium	0.007
35	Sulfate	0.025
36	Sulfur	0.004
37	Tin	0.049
38	Titanium	0.003
39	Vanadium	0.001
40	Zinc	0.003
41	Zirconium	0.036

Detection limit information from: Chemical Speciation Network (CSN) Annual Quality Report, prepared by Air Quality Research Center, University of California, Davis, 1/27/2020. https://airquality.ucdavis.edu/sites/g/files/dgvnsk1671/files/inline-files/CSN_2018AnnualReport_01.27.2020_srsedit.pdf