2020 New Jersey Air Quality Report

New Jersey Department of Environmental Protection

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

New Jersey Department of Environmental Protection
Bureau of Air Monitoring
Mail Code: 401-02E
P. O. Box 420
Trenton, New Jersey 08625-0420
Contact: bamweb@dep.nj.gov
Telephone: 609-292-0138

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Cover photo: Brigantine Hazecam, 3/12/2021

EXECUTIVE SUMMARY

This report presents the New Jersey Department of Environmental Protection (NJDEP) air quality monitoring data for 2020, 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.

A discussion of the impact of the Coronavirus Disease 2019 (COVID-19) pandemic on air pollution levels can be found below.

What's in the Annual Air Quality Report

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

The chapter on the Air Quality Index (AQI) describes a national air quality rating system based on the NAAQS, and discusses the overall quality of New Jersey's air in 2020. Included is a list of the six days on which the AQI was over 100. This means that the NAAQS were exceeded; the days were classified as "Unhealthy for Sensitive Groups."

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 2020 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).

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 dropped below 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-five 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).

The Bureau of Air Monitoring website can be found at https://nj.gov/dep/airmon. Available information includes a table and map of current air quality readings, the daily air quality forecast, as well as annual reports and trend graphs.

Figure 1-1
Statewide New Jersey Ozone Trend, 1997-2020
3-Year Average of 4th-Highest Daily Maximum 8-Hour Average Concentrations
Parts per Million (ppm)

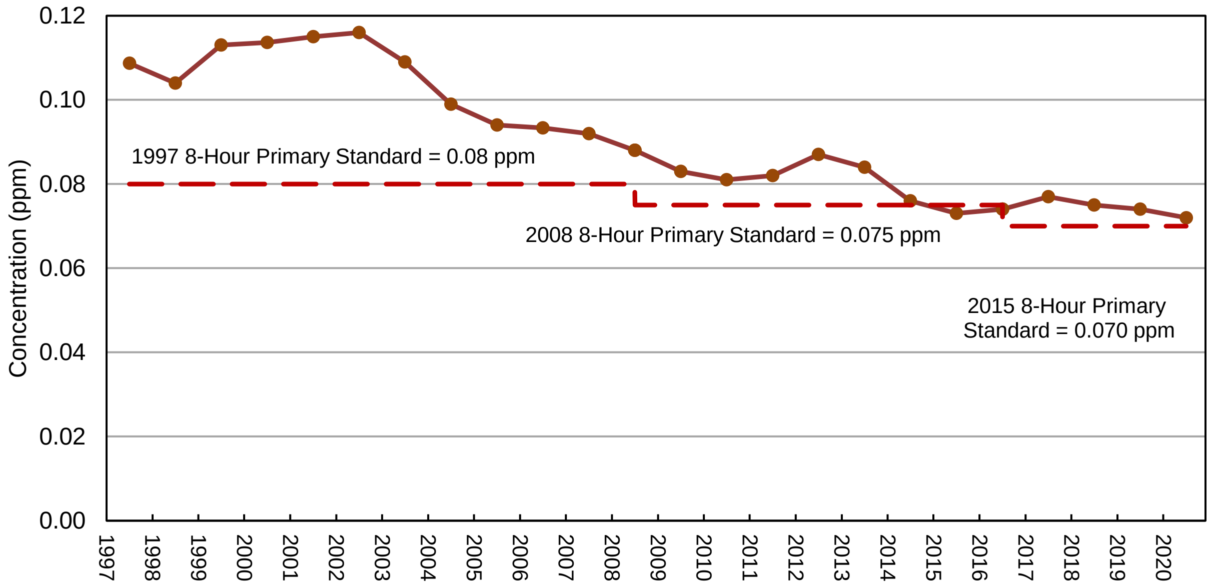


Figure 1-2
Statewide New Jersey Fine Particulate ($PM_{2.5}$) Trend, 2001-2020
3-Year Average of the Highest Annual Average Concentrations
Micrograms per Cubic Meter (µg/m^3)

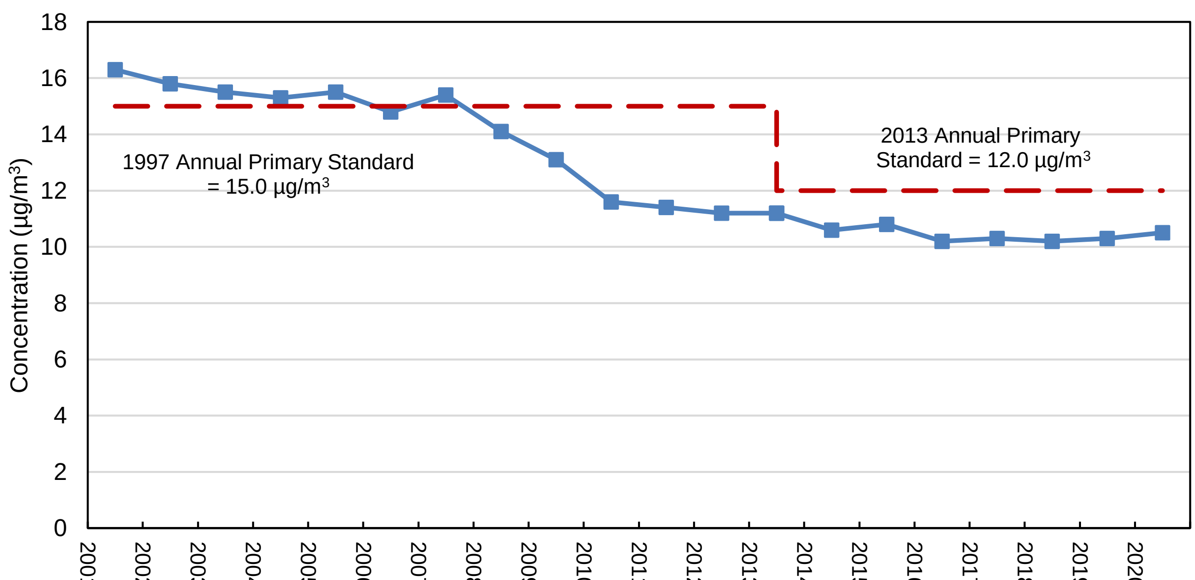


Figure 1-3
Statewide New Jersey Nitrogen Dioxide (NO_2) Trend, 2000-2020
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average Concentrations
Parts per Billion (ppb)

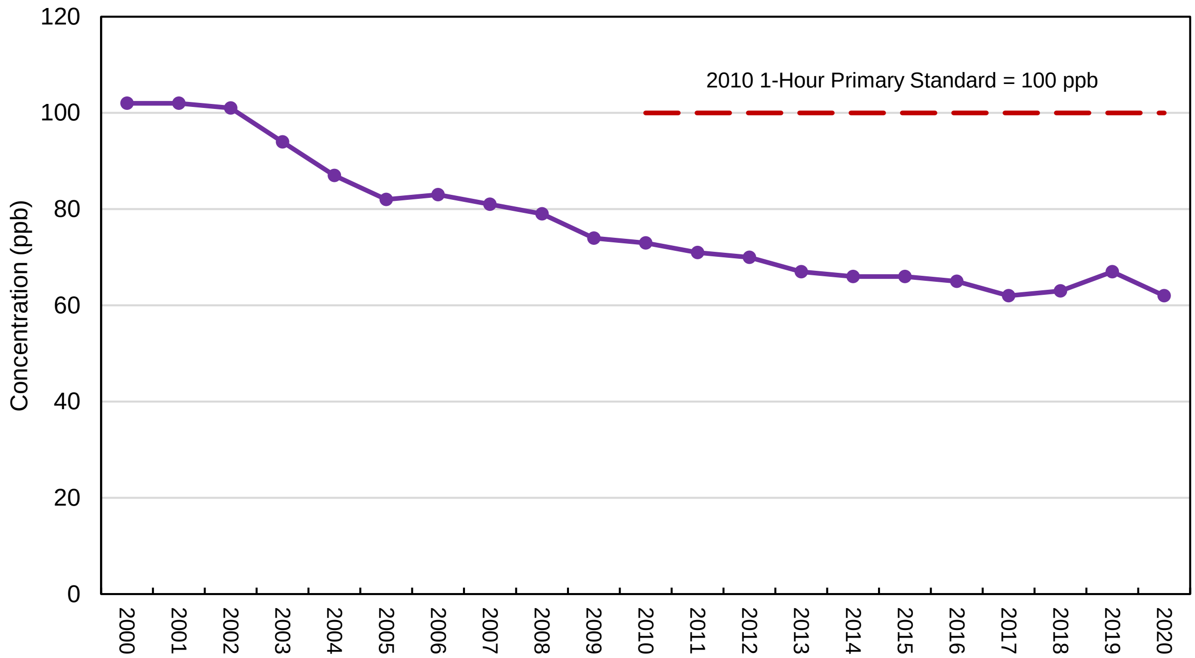


Figure 1-4
Statewide New Jersey Sulfur Dioxide (SO_2) Trend, 2000-2020
3-Year Average of the 99th-Percentile of Daily Maximum 1-Hour Average Concentrations
Parts per Billion (ppb)

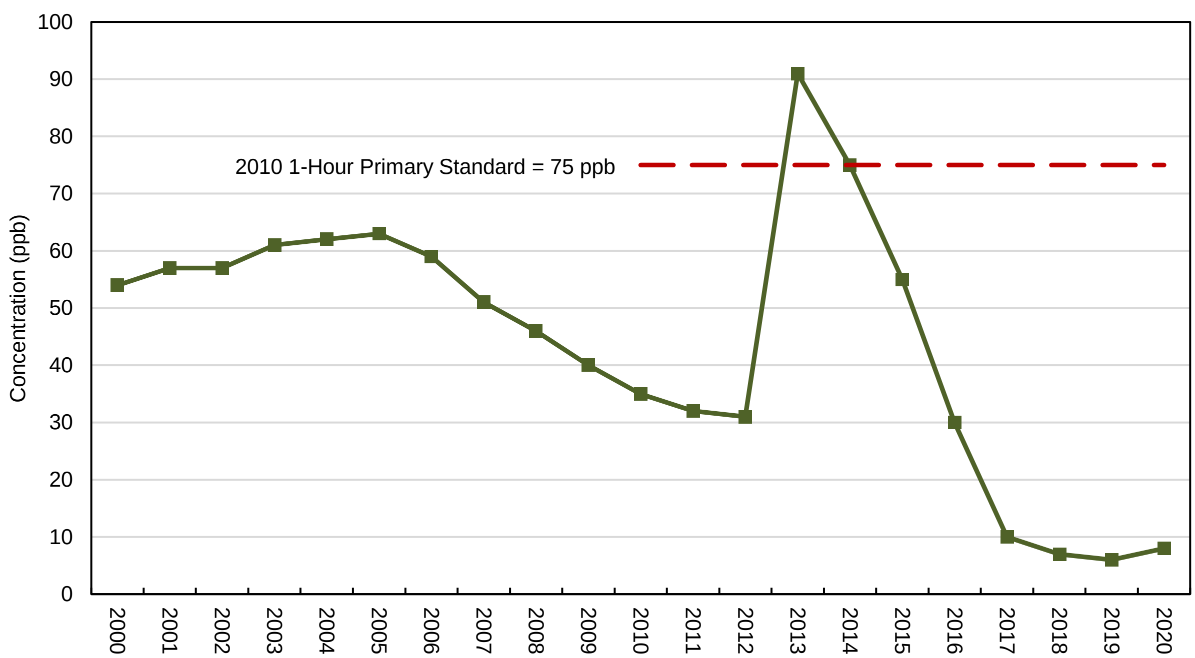


Figure 1-5
Statewide New Jersey Carbon Monoxide (CO) Trend, 1990-2020
2nd-Highest 8-Hour Average Concentrations
Parts per Million (ppm)

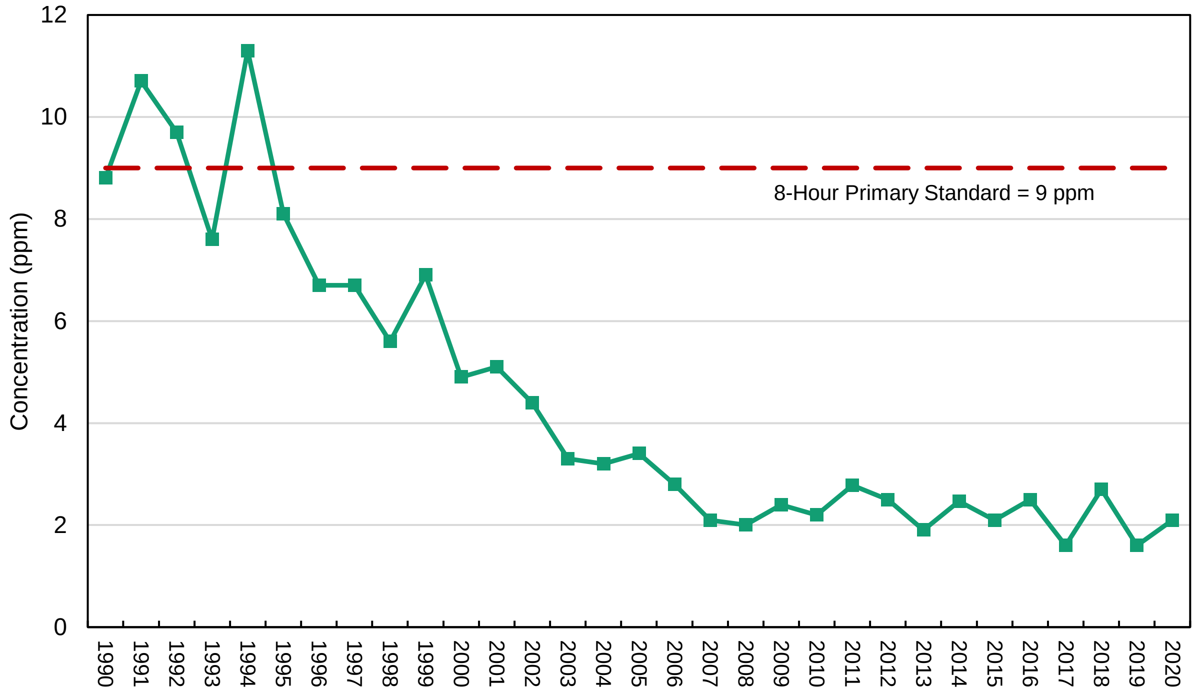
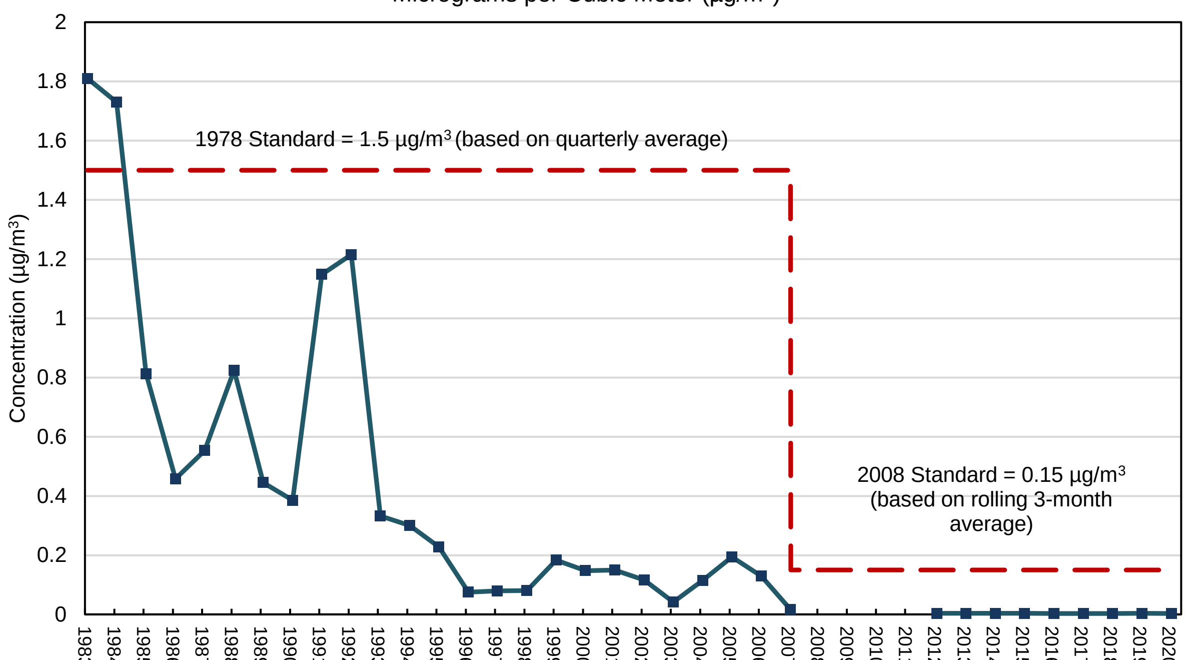


Figure 1-6
Statewide New Jersey Lead Trend, 1983-2020
Highest 3-Month Averages
Micrograms per Cubic Meter (µg/m^3)



2020 and the Impact of COVID-19

Impact on Bureau of Air Monitoring Operations

2020 will be remembered for an outbreak of COVID-19, which disrupted activity around the globe. In mid-March, New Jersey Governor Phil Murphy directed all state government departments to authorize temporary remote work (work-from-home) arrangements for as many employees as possible. The transition began on March 18. It was not a government shutdown, but a way to limit the spread of COVID-19 through social distancing.

The work of the NJDEP Bureau of Air Monitoring (BAM) continued, although there were some interruptions. Field staff serviced their monitoring stations as best they could. Certain sites could not be accessed, such as those at hospitals and health centers, and those at public buildings which were closed, including schools, universities, and libraries. Stations in the northeastern counties that were hardest hit by COVID-19 (Hudson, Bergen, Essex, Union) were completely avoided for the first few months of the outbreak. At those sites, particulate filter and VOC canister samples were rendered invalid because they could not be picked up within the allotted period of time. Some equipment malfunctioned or fell out of quality control specifications, and could not be immediately addressed.

Impact on Air Quality in New Jersey

In addition to authorizing temporary remote work for state employees, the Governor's "Stay at Home" directive ordered the closure of offices, schools, non-essential retail businesses, recreational businesses, and non-essential construction projects. By the end of March 2020, there was a 50% reduction in light duty vehicle traffic volume and a 30% reduction in heavy duty vehicle traffic. Electric power use is estimated to have decreased by 6% to 14% in the New York metropolitan area. A benefit of the shutdown was a reduction in pollutant levels. In 2020, New Jersey only had six days on which NAAQS were exceeded, five days for ozone and one day for $PM_{2.5}$. This is the lowest number of exceedance days since records have been kept in the state. Pollutant reductions at monitors located in the most urban areas of New Jersey are shown below.

Nitrogen oxides (NOx) are the sum of nitric oxide (NO) and nitrogen dioxide (NO_2) and are largely emitted by motor vehicles and power plants. Levels significantly decreased at the Elizabeth Lab and Jersey City monitoring stations from March through June 2020. The Elizabeth Lab station is located at Exit 13 of the New Jersey Turnpike, which has some of the highest average daily traffic counts in New Jersey. The Jersey City station is located at Journal Square, a commercial corridor that is subject to heavy traffic congestion.

Figure 1-7 shows the monthly NOx concentrations for 2020 at the Elizabeth Lab monitoring site compared to 3-year average monthly NOx concentrations for two time periods, 2014-2016 and 2017-2019. The plot of the 2020 data shows a dramatic drop in monthly average NOx concentrations from April through June, before returning to historically average levels from August through December.

Figure 1-8 is the corresponding chart of NOx concentrations at the Jersey City station. It shows a similar drop in monthly NOx concentrations during the same months as the Elizabeth Lab site.

The percent change in the monthly average NOx concentrations in April, May and June 2020 versus corresponding historical values ranged from -25% to -50% at Elizabeth Lab and Jersey City.

Figure 1-7
2020 Average Monthly NOx Concentrations at Elizabeth Lab
Compared to 2014-2016 and 2017-2019
Parts per Million (ppm)

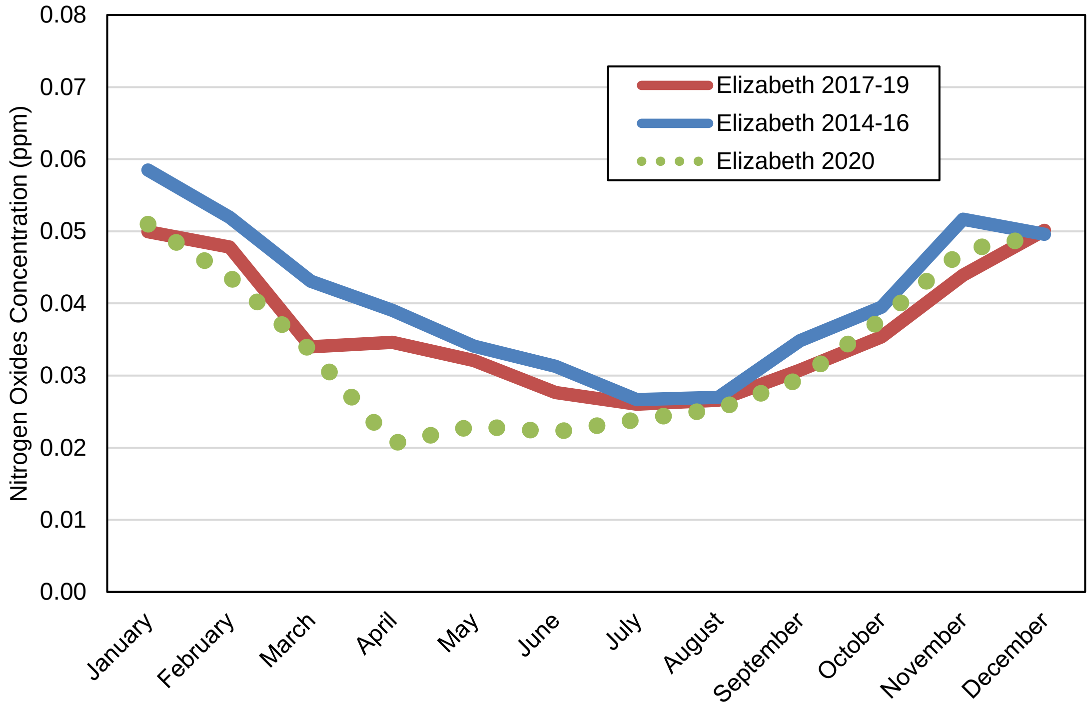
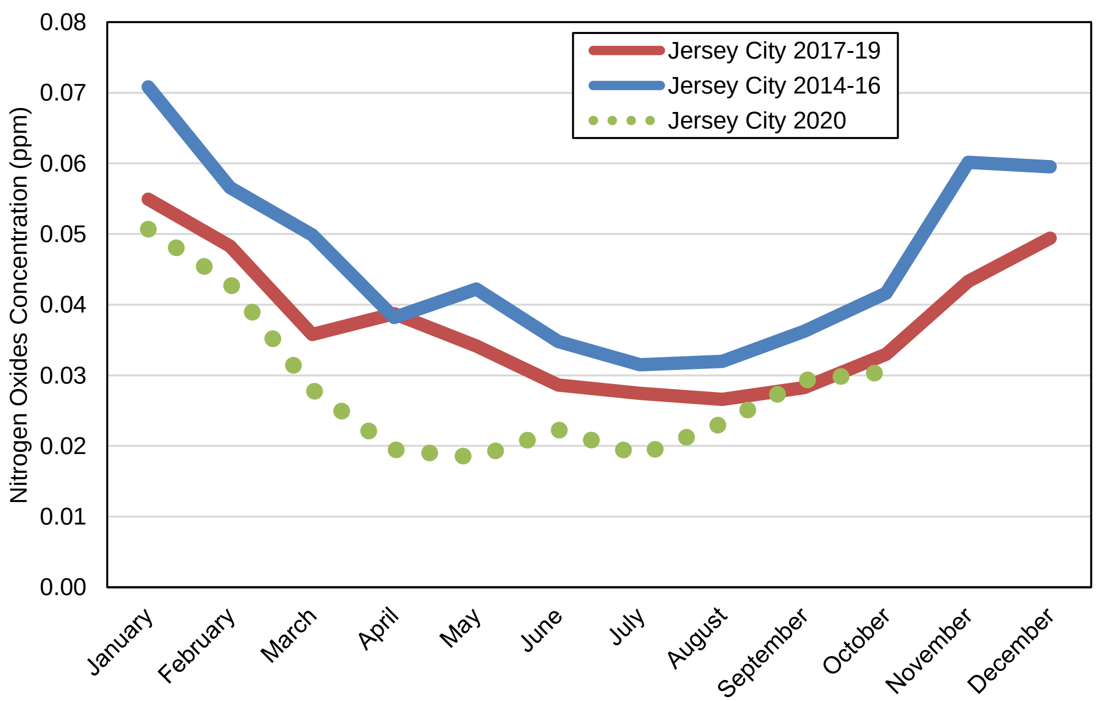


Figure 1-8
2020 Average Monthly NOx Concentrations at Jersey City
Compared to 2014-2016 and 2017-2019
Parts per Million (ppm)



Fine particulate matter ($PM_{2.5}$) concentrations were also affected by the COVID-19 shutdown, as can be seen from the 2020 data for the Elizabeth Lab and Camden Spruce Street monitoring stations. The Camden Spruce Street site is located in an industrial and commercial area of Camden adjacent to Delaware River port facilities.

Figures 1-9 and 1-10 compare the 2020 monthly average $PM_{2.5}$ concentrations at Elizabeth Lab and Camden Spruce Street with the average monthly $PM_{2.5}$ concentrations for two 3-year periods, 2014-2016 and 2017-2019. At Elizabeth Lab (Figure 1-9), the 2020 data shows a reduction in monthly average $PM_{2.5}$ concentrations that begins in January and continues through September, before returning to historically average levels from October through December. The Camden Spruce Street station also shows a sustained drop in monthly $PM_{2.5}$ concentrations from January through October 2020 (Figure 1-10).

The percent change in the monthly average $PM_{2.5}$ concentrations from January to September 2020 versus corresponding historical values ranged from -8% to -38% at the Elizabeth Lab and Camden Spruce Street stations.

Figure 1-9
2020 Average Monthly $PM_{2.5}$ Concentrations at Elizabeth Lab
Compared to 2014-2016 and 2017-2019
Micrograms per Cubic Meter (µg/m³)

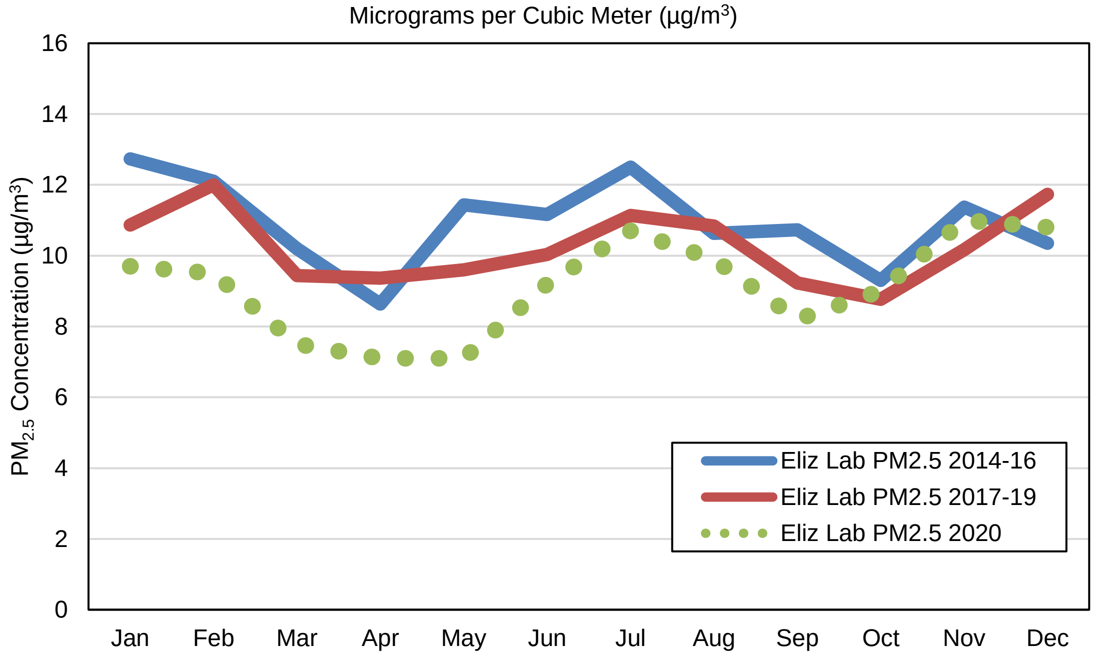
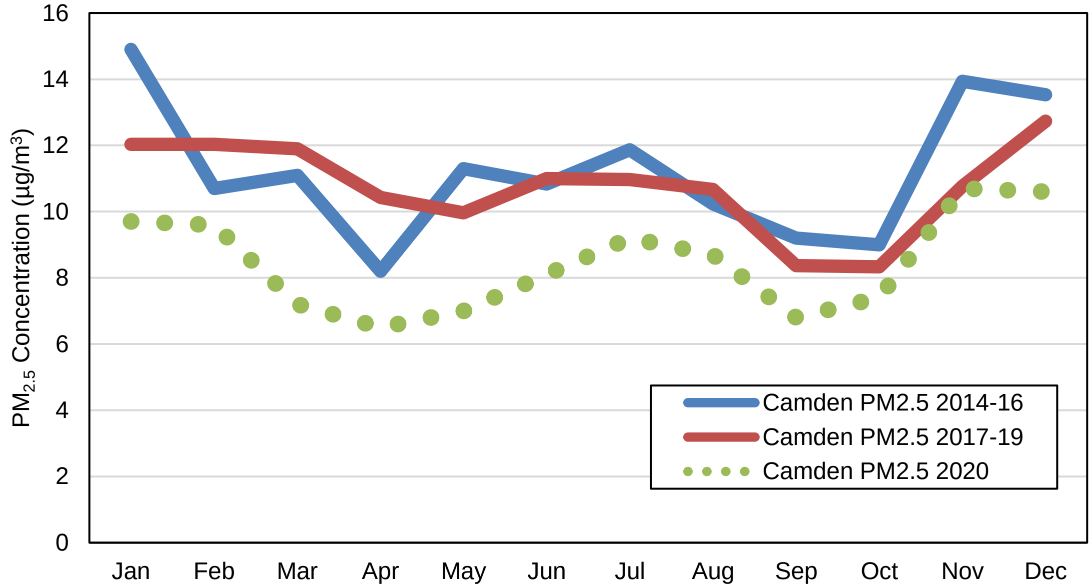
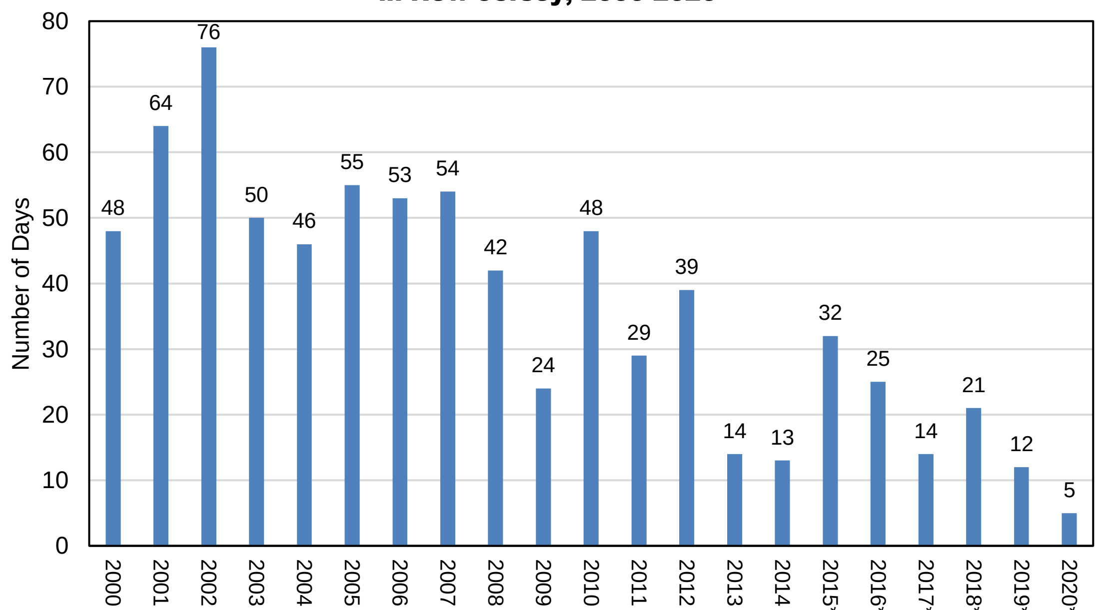


Figure 1-10
2020 Average Monthly $PM_{2.5}$ Concentrations at Camden Spruce Street Compared to 2014-2016 and 2017-2019
Micrograms per Cubic Meter (µg/m^3)



Ozone (O_3). The sharp drop in motor vehicle traffic volume and the limits on commercial activity led to a record low number of days in which ozone concentrations in New Jersey exceeded the 2015 ozone NAAQS of 0.070 parts per million (ppm). While the number of ozone exceedance days has been declining, the five days in 2020 were less than half of the next lowest number, 12 days recorded in 2019. This trend is shown in Figure 1-11.

Figure 1-11
Number of Days on Which Ozone Concentrations Exceeded 0.070 ppm in New Jersey, 2000-2020**



*Includes data from the Washington Crossing USEPA monitoring station.
**0.070 ppm is the 2015 NAAQS.

The decrease in ozone concentrations can be observed by comparing the 2020 monthly averages of the daily maximum 8-hour average concentrations to historical monthly averages for 2017 to 2019. This is shown in Figure 1-12 for the Camden Spruce Street station and in Figure 1-13 for the Rutgers station. During the ozone season from March through October, the average percent difference in monthly average daily maximum 8-hour ozone concentrations in 2020 versus 2017-2019 was -9.5% at Camden Spruce Street and -6.3% at Rutgers.

Figure 1-12
2020 Average Monthly Daily Maximum 8-Hour Ozone Concentrations at Camden Spruce Street Compared to 2017-2019
Parts per Million (ppm)

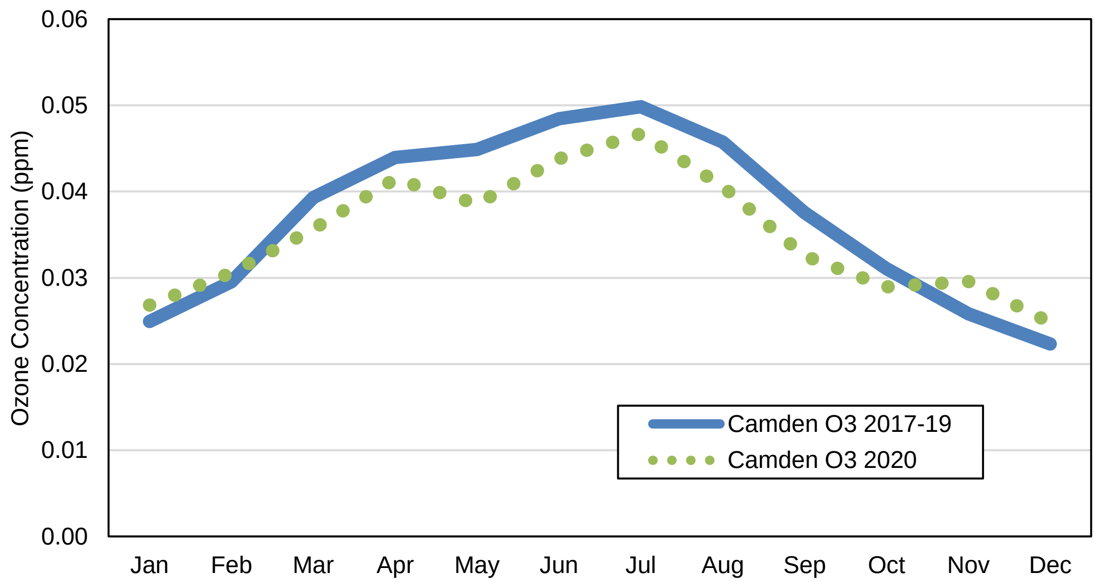
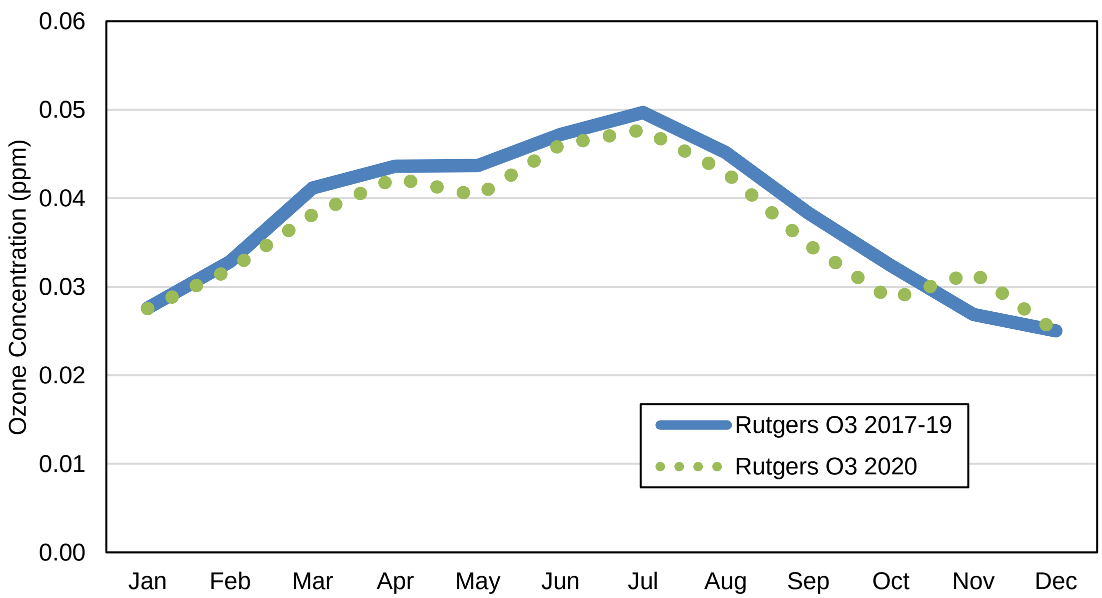


Figure 1-13
2020 Average Monthly Daily Maximum 8-Hour Ozone Concentrations at Rutgers/New Brunswick Compared to 2017-2019
Parts per Million (ppm)



2020 Air Monitoring Network

New Jersey Department of Environmental Protection

Network Description

In 2020, the New Jersey Department of Environmental Protection (NJDEP) Bureau of Air Monitoring (BAM) started the year with 31 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 includes 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}.

Criteria Pollutants

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 that the current air quality from those sites can be reported on the BAM website, and to reduce the manpower and time needed to obtain the data.

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 oxides of nitrogen, NO_y.

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

Other Pollutants

Along with 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. In addition, PAMS requires monitoring of NO_y, 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).

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

Figure 2-1
Columbia Air Monitoring Station

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 the Columbia monitoring station in Warren County. The setup includes a filter-based manual $PM_{2.5}$ sampler, at right, which functions as a secondary or co-located particulate monitor.

Changes to the Network in 2020

Just a few changes were made to New Jersey's air monitoring network in 2020.

$PM_{2.5}$

Fort Lee Library - The filter-based monitor was removed and the site was shut down. There is a continuous $PM_{2.5}$ monitor at the Fort Lee Near Road monitoring station, located 0.38 miles away.

Toms River - A continuous monitor started operating in 2020, with the intention of discontinuing the daily filter-based $PM_{2.5}$ sampling at the site on December 31, 2020.

PM_{10}

Camden Spruce Street **-** A monitor was installed and started up at the beginning of the year.

Camden RRF – The site was shut down after installation of the PM_{10} monitor at Camden Spruce Street, located about 1.6 miles away.

These changes are summarized in Table 2-1.

Table 2-1. New Jersey Air Monitoring Network Changes 2020

Monitoring Site	Parameter(s)	Action	Date
Camden Spruce St	PM_{10}	Installed monitor	1/1/2020
Camden RRF	PM_{10}	Shut down site	3/1/2020
Fort Lee Library	$PM_{2.5}$	Shut down site	1/1/2020
Toms River	$PM_{2.5}$	Installed a continuous monitor	1/1/2020
Toms River	$PM_{2.5}$	Discontinued filter-based monitor	12/31/2020

The locations of all the monitoring stations that operated in 2020 are displayed on the map in Figure 2-2. Table 2-2 lists the parameters that were measured at each site. More information about the monitoring stations can be found in Appendix A.

Figure 2-2
New Jersey Air Monitoring Sites in 2020

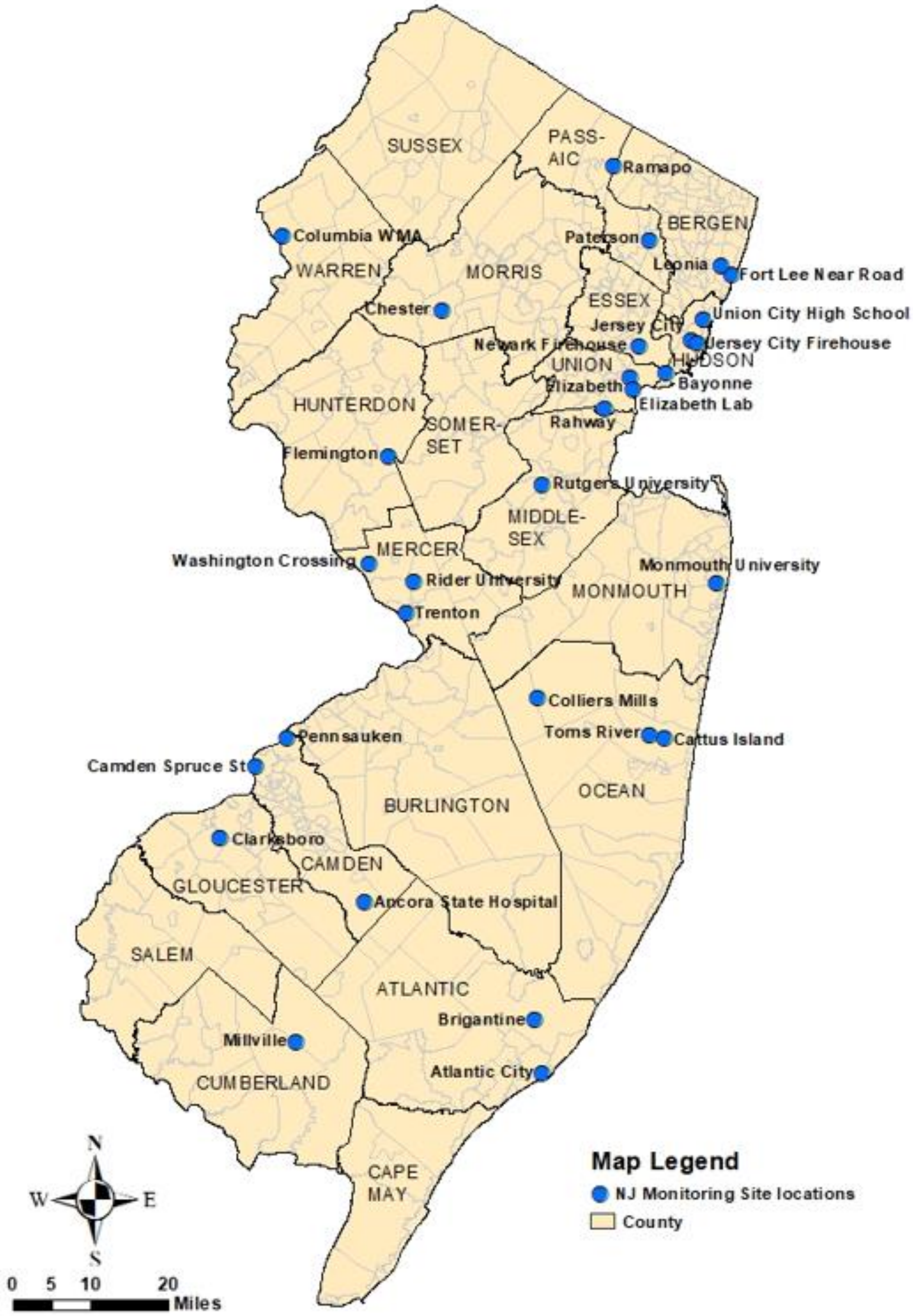


Table 2-2
2020 New Jersey Air Monitoring Network Parameters

	Monitoring Station / Monitoring Parameter	O_3	$PM_{2.5}$ (Filter-based)	Real-Time $PM_{2.5}$	PM_{10}	NO_2	NOy	SO_2	CO	Lead	Toxics	$PM_{2.5}$-Speciation	O_3 Precursors (PAMS)	BTEX & Black Carbon	Visibility	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	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 Near Road			X		X			X					X				X	X	
16	Jersey City					X		X	X											
17	Jersey City Firehouse		X	X	X															
18	Leonia	X																		
19	Millville	X		X		X														
20	Monmouth University	X																		
21	Newark Firehouse	X	X	X	X	X	X	X	X	X		X		X				X	X	X
22	Paterson		X																	
23	Pennsauken		X																	
24	Rahway			X																
25	Ramapo	X																		
26	Rider University	X		X														X	X	
27	Rutgers University	X	X	X		X	X				X	X	X				X	X		X
28	Toms River		X	X																
29	Trenton		X																	
30	Union City High School		X																	
31	Washington Crossing															X				
	TOTAL	16	14	13	4	10	2	9	6	1	4	5	1	5	1	3	2	8	7	2

X - Parameter measured in 2020.
NO_2 usually includes NO and NO_x.
* Meteorological parameters include temperature, relative humidity, barometric pressure, wind direction & wind speed.
** Camden RRF was shut down March 2020.

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2020 Air Quality Index

New Jersey Department of Environmental Protection

What is the Air Quality Index (AQI)?

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

Every morning an air pollution forecast for the current and following day is prepared by the New Jersey Department of Environmental Protection (NJDEP) using the AQI format. The forecast is provided to USEPA and is disseminated through the Enviroflash system to subscribers who sign up to receive air quality forecast and alert emails or texts (www.enviroflash.info). Anyone can view the forecast and current air quality conditions at USEPA's AirNow website (www.airnow.gov) or at NJDEP's air monitoring webpage (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	$PM_{2.5}$	NO_2	SO_2	CO
		(ppm) 8-hour	($\mu g/m^3$) 24-hour	(ppb) 1-hour	(ppb) 1-hour	(ppm) 8-hour
Good	0-50	0.000-0.054	0.0-12.0	0-53	0-35	0.0-4.4
Moderate	51-100	0.055-0.070	12.1-35.4	54-100	36-75	4.5-9.4
Unhealthy for Sensitive Groups	101-150	0.071-0.085	35.5-55.4	101-.360	76-185	9.5-12.4
Unhealthy	151- 200	0.086-0.105	55.5-150.4	361-649	186-304	12.5-15.4
Very Unhealthy	201-300	0.106-0.200	150.5-250.4	605-1249	305-604	15.5-30.4
Hazardous	301-500	>0.200	250.5-500.4	1250-2049	605-1004	30.5-1004

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

Units:
ppm – parts per million
$\mu g/m^3$ – micrograms per cubic meter
ppb – parts per billion

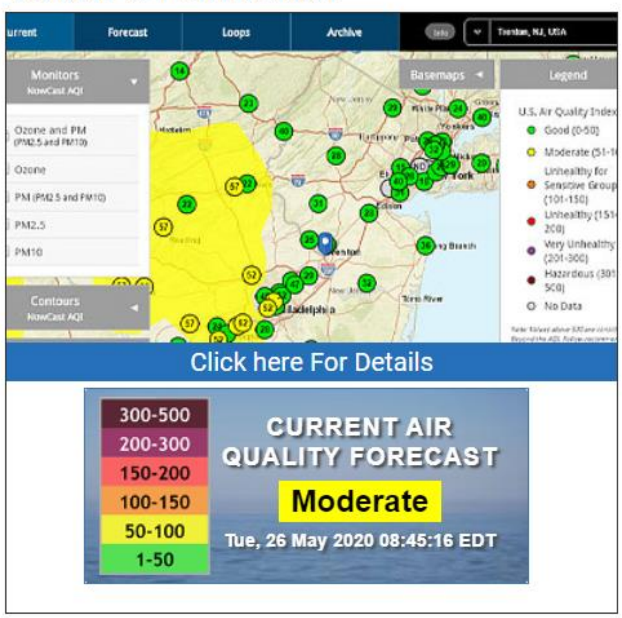
On days when the air quality is expected to reach the "Unhealthy for Sensitive Groups" range or above, cautionary statements similar to those in Tables 3-1 and 3-2 are provided as part of the forecast. These air quality alerts are issued through Enviroflash emails, are displayed on the AirNow and NJDEP 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



2020 New Jersey AQI Summary

Not all of New Jersey's monitoring sites have 365 (or 366) 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 and does not report to the BAM website, 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 2020

	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	√	√		√	√
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	√	√			√
23	Toms River		√			

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

A summary of the 2020 AQI ratings for New Jersey is displayed in the pie chart in Figure 3-2 below. In 2020, there were 219 “Good” days, 141 were “Moderate,” and 6 were “Unhealthy for Sensitive Groups.” This indicates that in 2020 air quality in New Jersey was good on 60% of days, and moderate on 39% of days. Air pollution was still bad enough on almost 2% of days to potentially affect sensitive people, but 2020 had the lowest number of exceedance days since standards were established.

Figure 3-2
2020 Air Quality Summary by Days

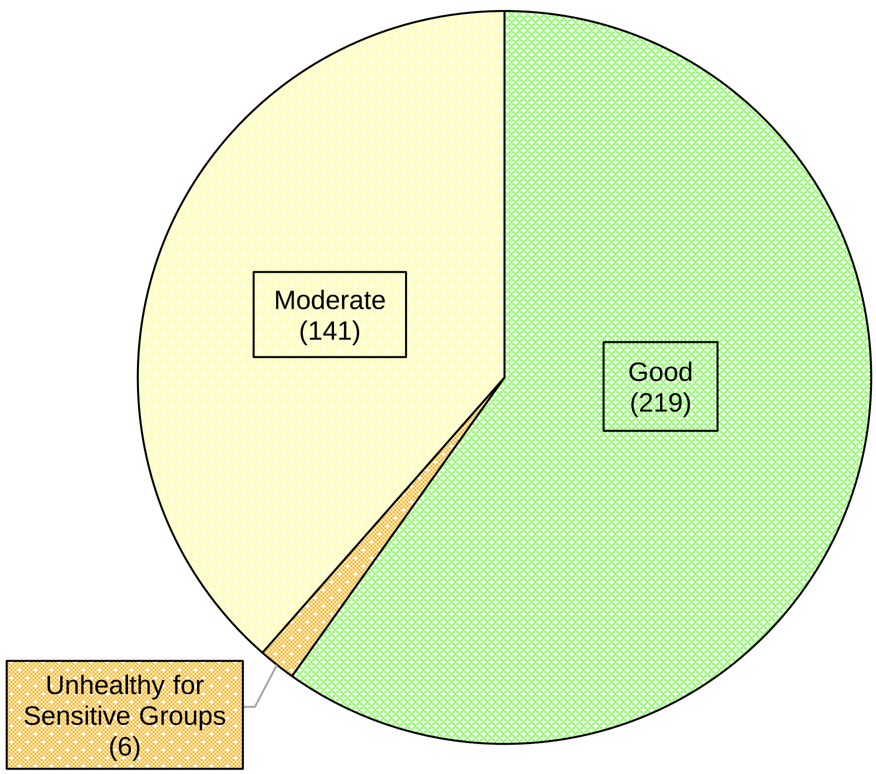


Figure 3-3 shows the distribution of AQI days since 2000. It should be noted that AQI ranges change whenever a NAAQS for a specific pollutant is revised. So even though improvement in AQI days appears to be somewhat erratic, to see how things really have improved, refer to the concentration trend graphs in the individual criteria pollutant reports or in the executive summary. As mentioned above, in 2020 New Jersey had the lowest number of exceedance days since they started being recorded.

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

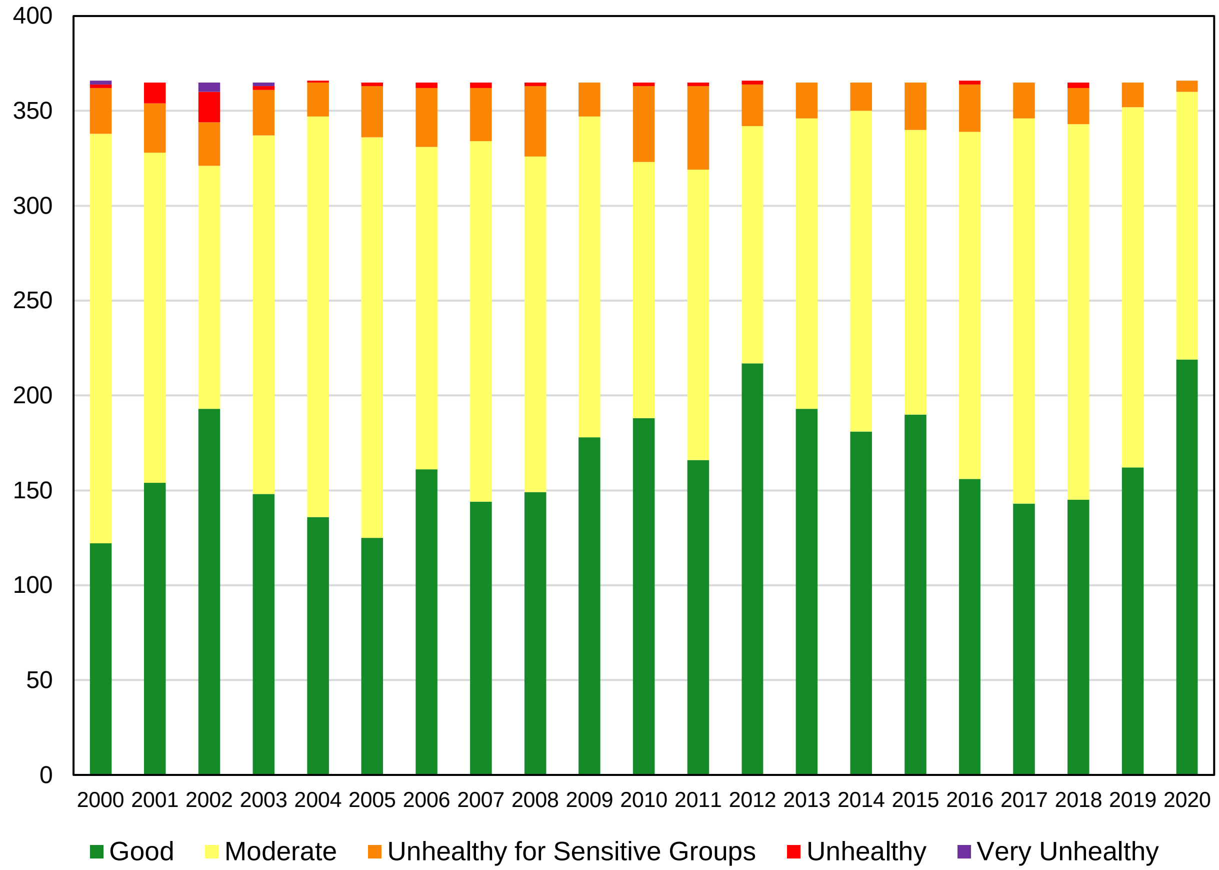


Table 3-5 shows the number of days when the AQI reached or exceeded the "Unhealthy for Sensitive Groups" (USG) threshold at any monitoring location in New Jersey in 2020. Table 3-6 lists the individual exceedance dates and shows the specific pollutants and their locations and concentrations.

Of all the criteria pollutants, ozone is predominantly responsible for AQI days above the moderate range in New Jersey. Exceedances are the result of weather conditions that favor the formation and transport of ozone. Ozone forms when emissions of nitrogen oxides and volatile organic compounds undergo chemical reactions in the presence of sunlight.

The $PM_{2.5}$ exceedance on December 12 is also attributed to weather conditions and emissions. Unseasonably warm temperatures, light and variable winds, and periods of fog or mist resulted in elevated levels of $PM_{2.5}$ throughout much of the region on December 12. Limited atmospheric mixing allowed for emissions from cars, trucks, and industry, as well as from fuel-burning heating devices, to accumulate near the surface, contributing to exceedances in parts of eastern Pennsylvania and northern New Jersey.

Table 3-5
2020 Total Number of NAAQS Exceedance Days in New Jersey

Pollutant	Exceedances
Ozone	5
$PM_{2.5}$	1

Table 3-6
AQI "Unhealthy for Sensitive Groups" (USG) Days in New Jersey During 2020

Day No.	Date	Monitor Location	Pollutant	Concen-tration	Units	AQI Rating	AQI Value
1	6/9/20	Rider University	O_3	0.074	ppm	USG	112
		Rutgers University	O_3	0.074	ppm	USG	112
2	7/6/20	Leonia	O_3	0.073	ppm	USG	108
3	7/21/20	Clarksboro	O_3	0.071	ppm	USG	101
4	7/22/20	Leonia	O_3	0.074	ppm	USG	112
		Rider University	O_3	0.073	ppm	USG	108
5	8/10/20	Leonia	O_3	0.076	ppm	USG	119
		Rider University	O_3	0.071	ppm	USG	101
6	12/12/20	Newark Firehouse	$PM_{2.5}$	46.2	$\mu g/m^3$	USG	127
		Rahway	$PM_{2.5}$	39.5	$\mu g/m^3$	USG	111

Rating
USG = Unhealthy for sensitive groups

Pollutants
O_3 – Ozone
$PM_{2.5}$ – Fine particles

Units
ppm – parts per million
$\mu g/m^3$ - micrograms per cubic meter

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"Appendix G to Part 58 - Uniform Air Quality Index (AQI) and Daily Reporting." Title 40 *Code of Federal Regulations*. https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=3b421c7ca640647158c90279e577c578&mc=true&n=pt40.6.58&r=PART&ty=HTML#ap40.6.58_161.g. Accessed 6/22/2021.

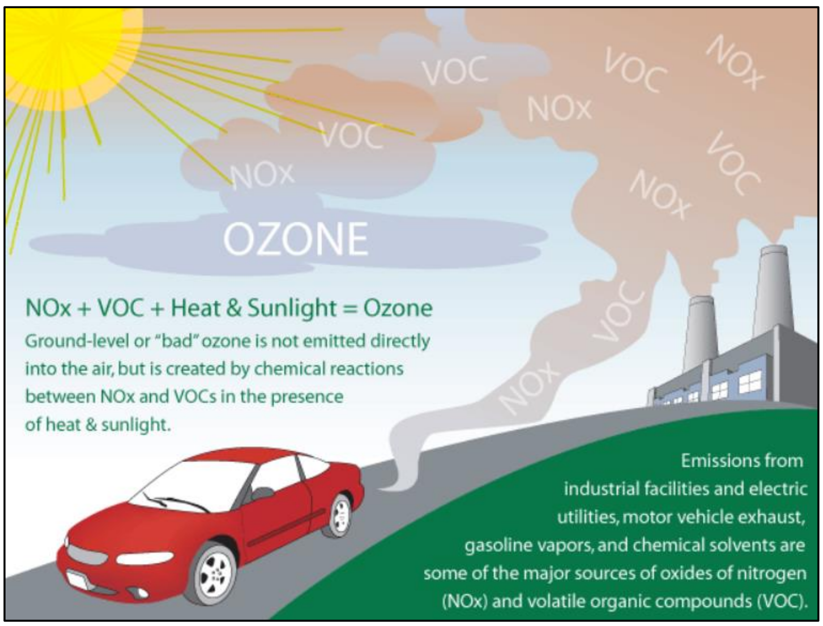
2020 Ozone Summary

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. Figures 4-2 and 4-3 show the effect of sunlight on ambient ozone concentrations. The U.S. Environmental Protection Agency (USEPA) requires New Jersey to monitor ozone from March 1st to October 31st, the so-called "ozone season." However, weather patterns have a significant effect on ozone formation, and hot dry summers will result in higher levels than cool wet ones.

Figure 4-2
2020 Ozone Concentrations in New Jersey
Monthly Variation of 1-Hour Concentrations
Parts per Million (ppm)

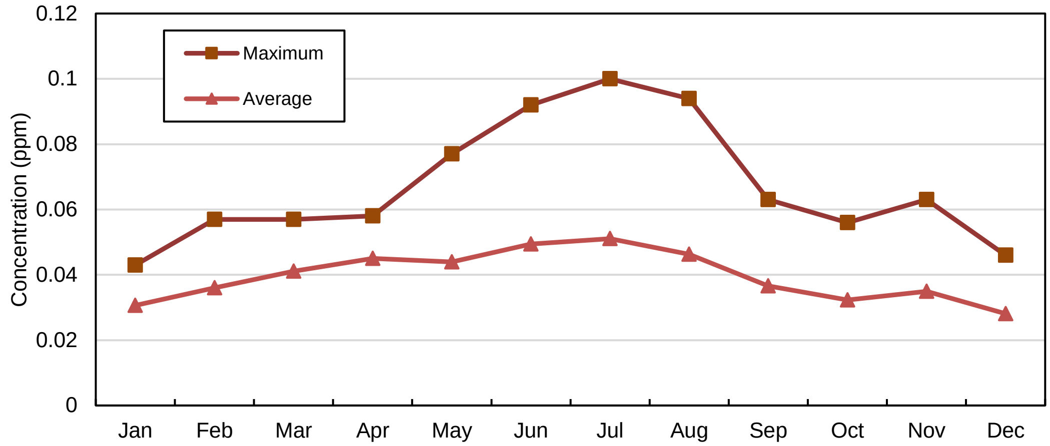


Figure 4-3
2020 Ozone Concentrations in New Jersey
Daily Variation of 1-Hour Concentrations
Parts per Million (ppm)

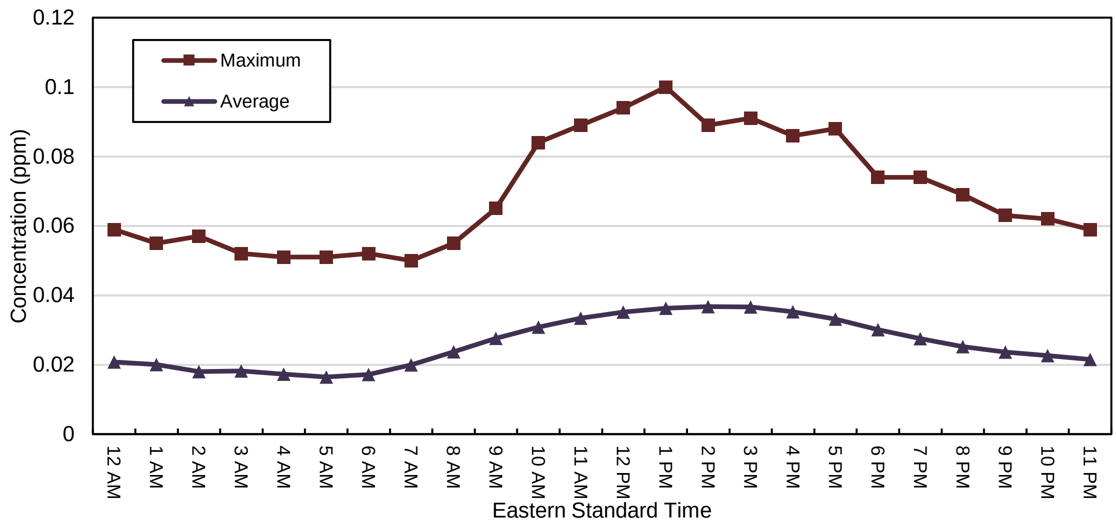
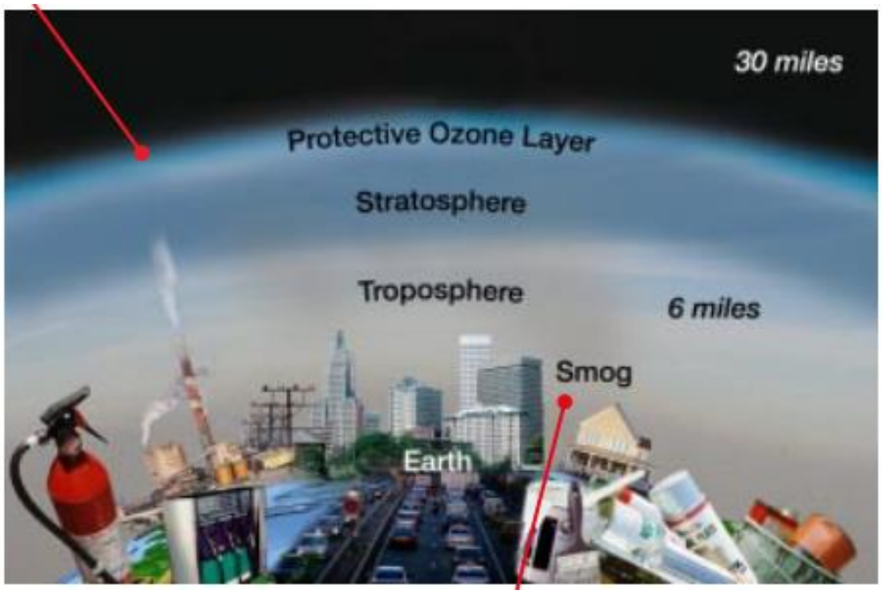


Figure 4-4 explains the difference between ozone in the upper and lower atmosphere. For more information, refer to the USEPA publication, "Good Up High, Bad Nearby – What is Ozone?"

Figure 4-4. 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://www.epa.gov/sites/production/files/documents/gooduphigh.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.

Ground-level ozone damages plant life, and a recent study (see below) estimated that it is responsible for about $1 billion in reduced crop yield in the U.S. 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 yellowed areas on the leaf shown in Figure 4-5 are damage caused by exposure to ground-level ozone.

For more information see: https://coe.northeastern.edu/news/research-reveals-air-pollution-costs-us-estimated-1b-a-year-in-perennial-crop-yield/.

Figure 4-5
Leaf Damage Caused by Ozone

www.epa.gov/ground-level-ozone-pollution/ecosystem-effects-ozone-pollution

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 retains 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)

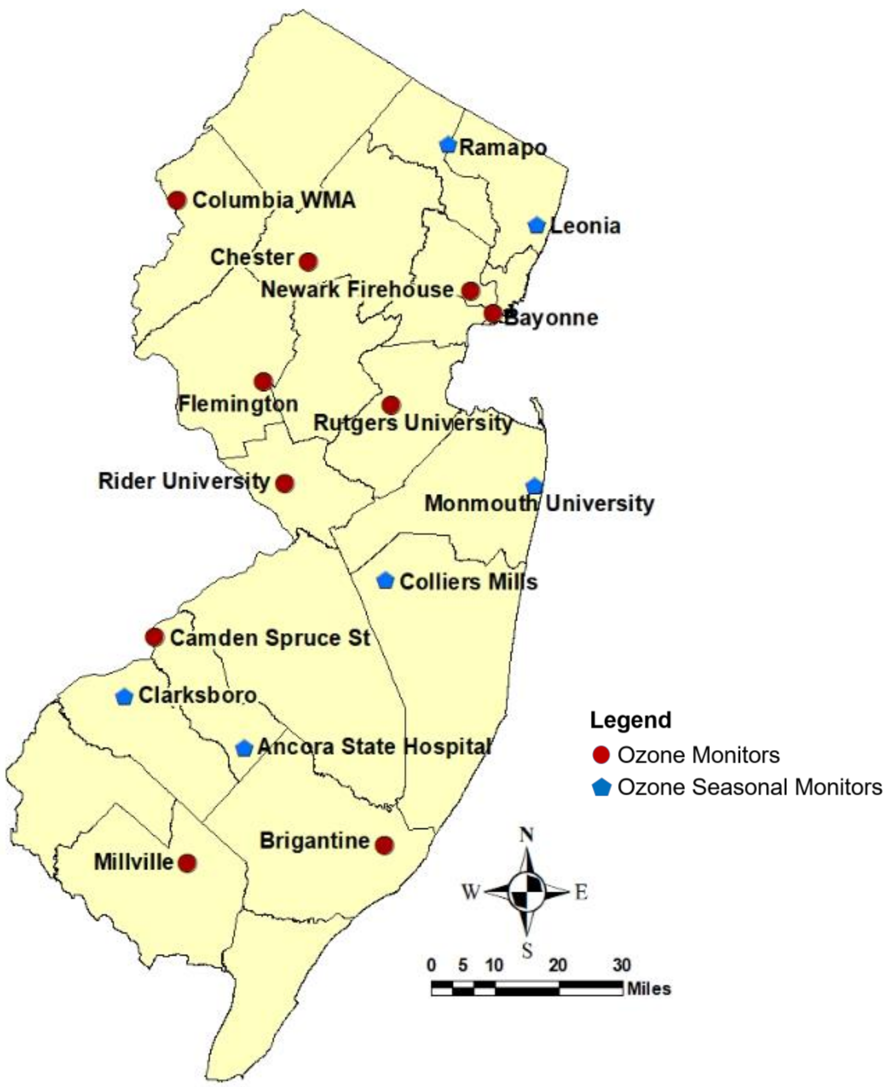
Averaging Period	Type	National Level	New Jersey Level	Design Value
1-Hour	Primary	---	0.12 ppm	Annual 2nd-highest daily maximum
8-Hours	Primary & secondary	0.070 ppm	---	3-year average of the annual 4th-highest daily maximums

OZONE MONITORING NETWORK

The New Jersey Department of Environmental Protection operated 16 monitoring stations in New Jersey during 2020 (see Figure 4-6). 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 4-6
2020 Ozone Monitoring Network



OZONE LEVELS IN 2020

The 2020 ozone season had only five days on which the NAAQS was exceeded, which was unusually low. Only 4 of the 16 New Jersey monitoring sites recorded levels above the 8-hour standard of 0.070 ppm at least once. As shown in Table 4-2, those sites were Clarksboro and Rutgers (once) and Leonia and Rider (three times each). For details, see the Air Quality Index section of this air quality report.

Table 4-2
2020 Exceedances of the O_3 NAAQS

Day	Date	Site	8-Hour Maximum Average Concentration (ppm)
1	6/9/20	Rider University	0.074
		Rutgers University	0.074
2	7/6/20	Leonia	0.073
3	7/21/20	Clarksboro	0.071
4	7/22/20	Leonia	0.074
		Rider University	0.073
5	8/10/20	Leonia	0.076
		Rider University	0.071

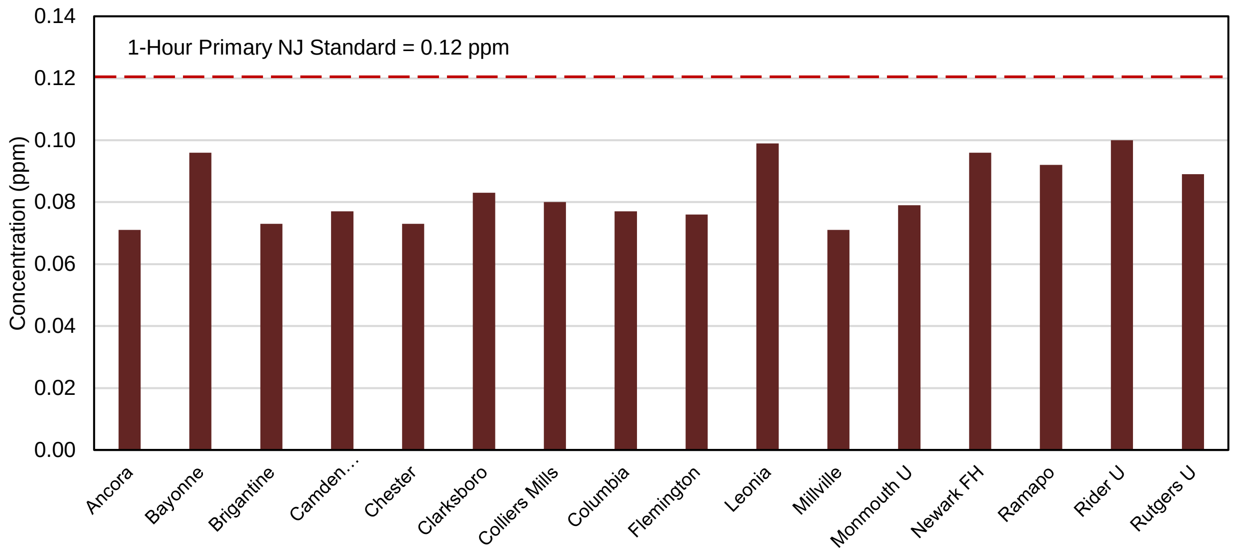
Table 4-3 presents the 2020 ozone data for New Jersey's 16 monitors.

Table 4-3
2020 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	2017-2020 Average of 4th-Highest Daily Max.
Ancora	0.071	0.060	0.059	0.065
Bayonne	0.096	0.067	0.063	0.069
Brigantine	0.073	0.067	0.059	0.060
Camden Spruce St.	0.077	0.066	0.062	0.069
Chester	0.073	0.065	0.060	0.065
Clarksboro	0.083	0.071	0.064	0.070
Colliers Mills	0.080	0.065	0.063	0.068
Columbia	0.077	0.067	0.054	0.060
Flemington	0.076	0.063	0.059	0.066
Leonia	0.099	0.076	0.066	0.072
Millville	0.071	0.061	0.060	0.064
Monmouth University	0.079	0.068	0.062	0.066
Newark Firehouse	0.096	0.067	0.064	0.067
Ramapo	0.092	0.070	0.062	0.065
Rider University	0.100	0.074	0.070	0.071
Rutgers University	0.089	0.074	0.066	0.071

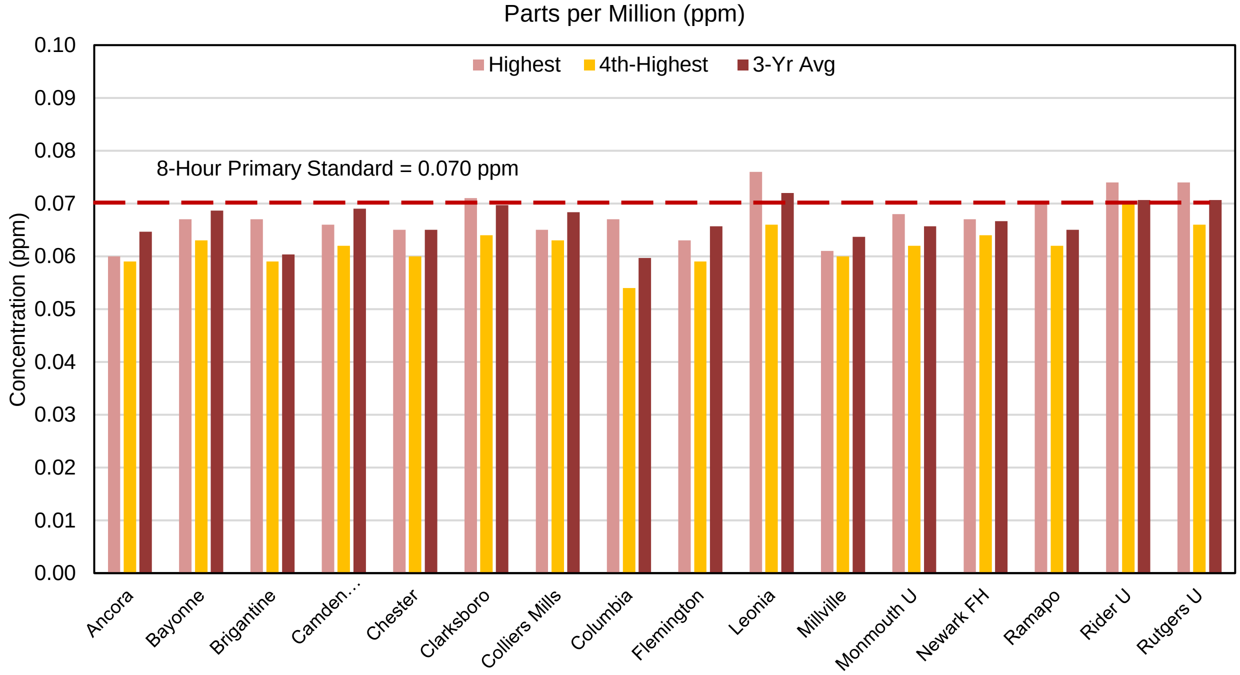
No site recorded levels above the New Jersey 1-hour standard of 0.12 ppm. The highest daily 1-hour concentration was 0.100 ppm, recorded at Rider University on July 22. The last time the 1-hour standard was exceeded in New Jersey was in 2018. Figure 4-7 shows the one-hour data for each site.

Figure 4-7
2020 Ozone Concentrations in New Jersey
1-Hour Daily Maximums
Parts per Million (ppm)



The highest daily maximum 8-hour average concentration was 0.076 ppm, recorded at Leonia on August 10. The 4th-highest 8-hour daily maximum value (0.070 ppm) was measured at Rider. Leonia also exceeded the design value during the 2020 ozone season (3-year average of the 4th-highest 8-hour daily maximum) at 0.072 ppm. Figure 4-8 shows the 8-hour values for each site.

Figure 4-8
2020 Ozone Concentrations in New Jersey
8-Hour Daily Maximums (Highest, 4th-Highest, and 3-Year Average of 4th Highest)
Parts per Million (ppm)



Ozone Trends

Studies have shown that to decrease 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 lowering of ozone levels in New Jersey. The chart in Figure 4-9 shows both the fourth-highest statewide 8-hour maximum daily average concentrations and the ozone design value (which is a 3-year average of these values) recorded each year since 1997. In 2020, Rider University had the maximum fourth-highest 8-hour maximum daily average of 0.070 ppm. The highest statewide 2020 design value was 0.072 ppm, recorded at Leonia. This exceeds the 0.070 ppm NAAQS. Design values can also be found in Table 4-4.

Figure 4-10 shows the total number of exceedance days in New Jersey since 2000.

Figure 4-9
Statewide New Jersey Ozone Trends, 1997-2020
4th-Highest & 3-Year Average of the 4th-Highest Daily Maximum 8-Hour Averages
Parts per Million (ppm)

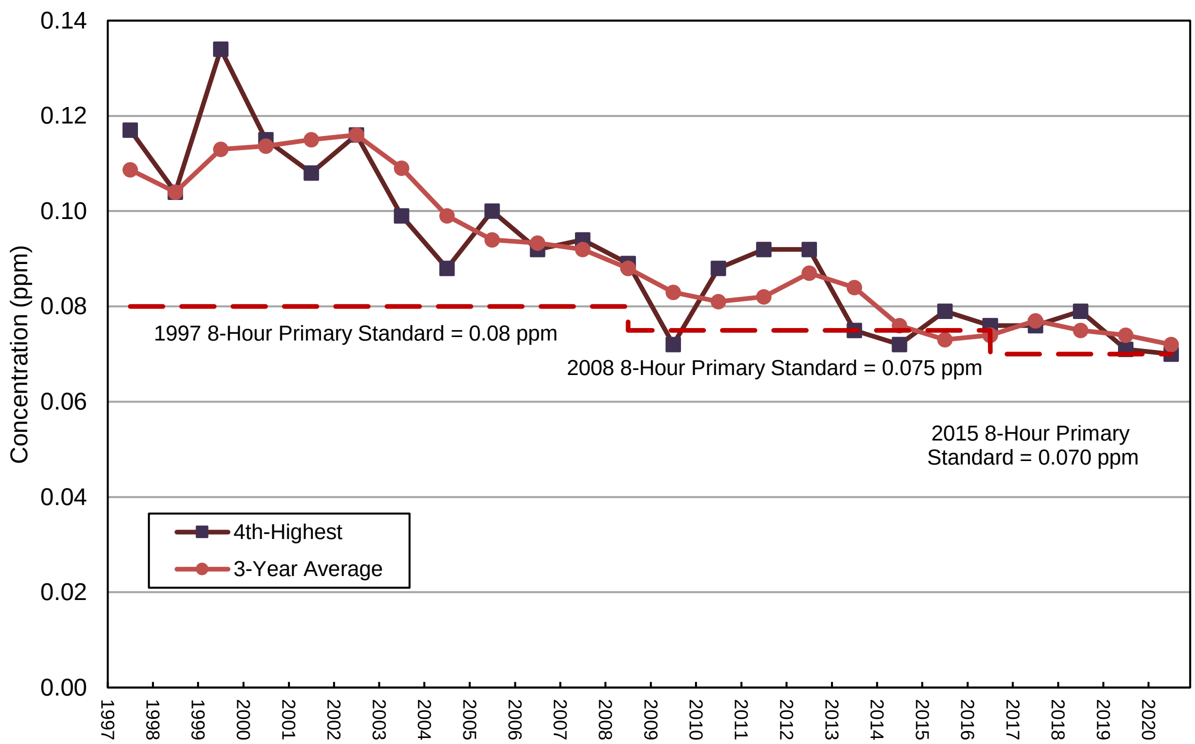
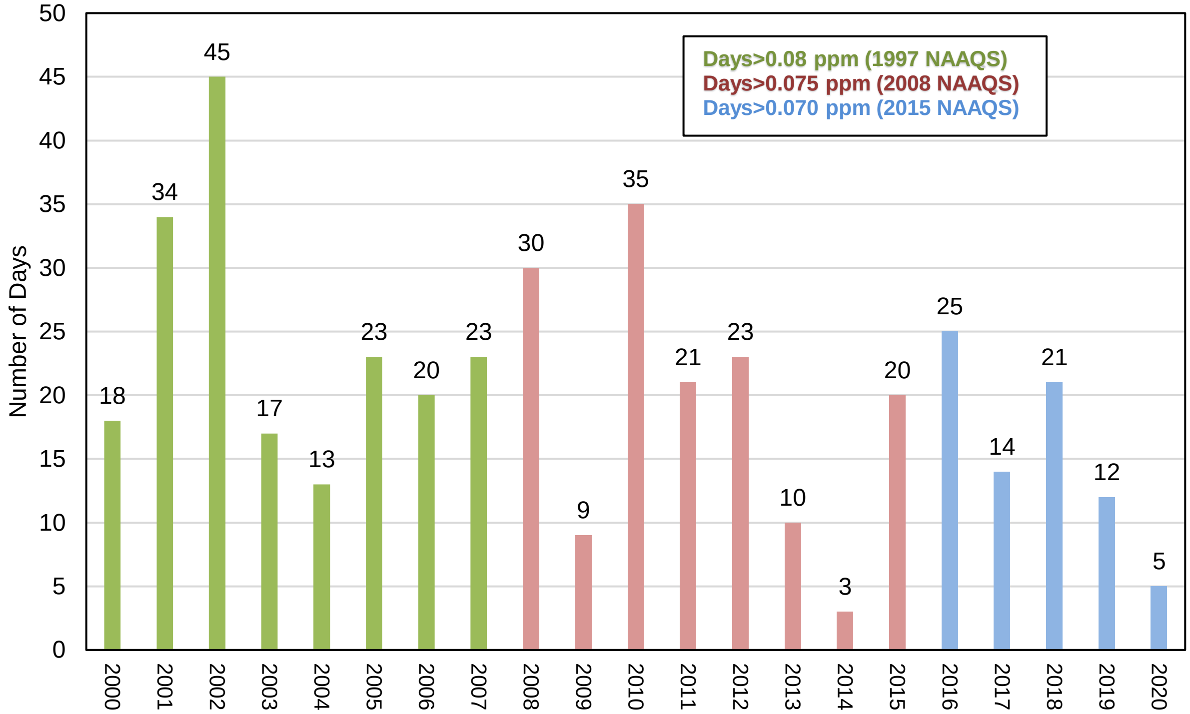


Table 4-4
Statewide New Jersey Ozone Trends, 1997-2020
Daily Maximum 8-Hour Average Concentrations
Parts per Million (ppm)

Year	4th-Highest	3-Year Average of 4th-Highest*
1997	0.117	0.109
1998	0.104	0.104
1999	0.134	0.113
2000	0.115	0.114
2001	0.108	0.115
2002	0.116	0.116
2003	0.099	0.109
2004	0.088	0.099
2005	0.100	0.094
2006	0.092	0.093
2007	0.094	0.092
2008	0.089	0.088
2009	0.072	0.083
2010	0.088	0.081
2011	0.092	0.082
2012	0.092	0.087
2013	0.075	0.084
2014	0.072	0.076
2015	0.079	0.073
2016	0.076	0.074
2017	0.076	0.077
2018	0.079	0.075
2019	0.071	0.074
2020	0.070	0.072

*Design value

Figure 4-10
Number of Days on Which the Ozone NAAQS was Exceeded in New Jersey, 2000-2020

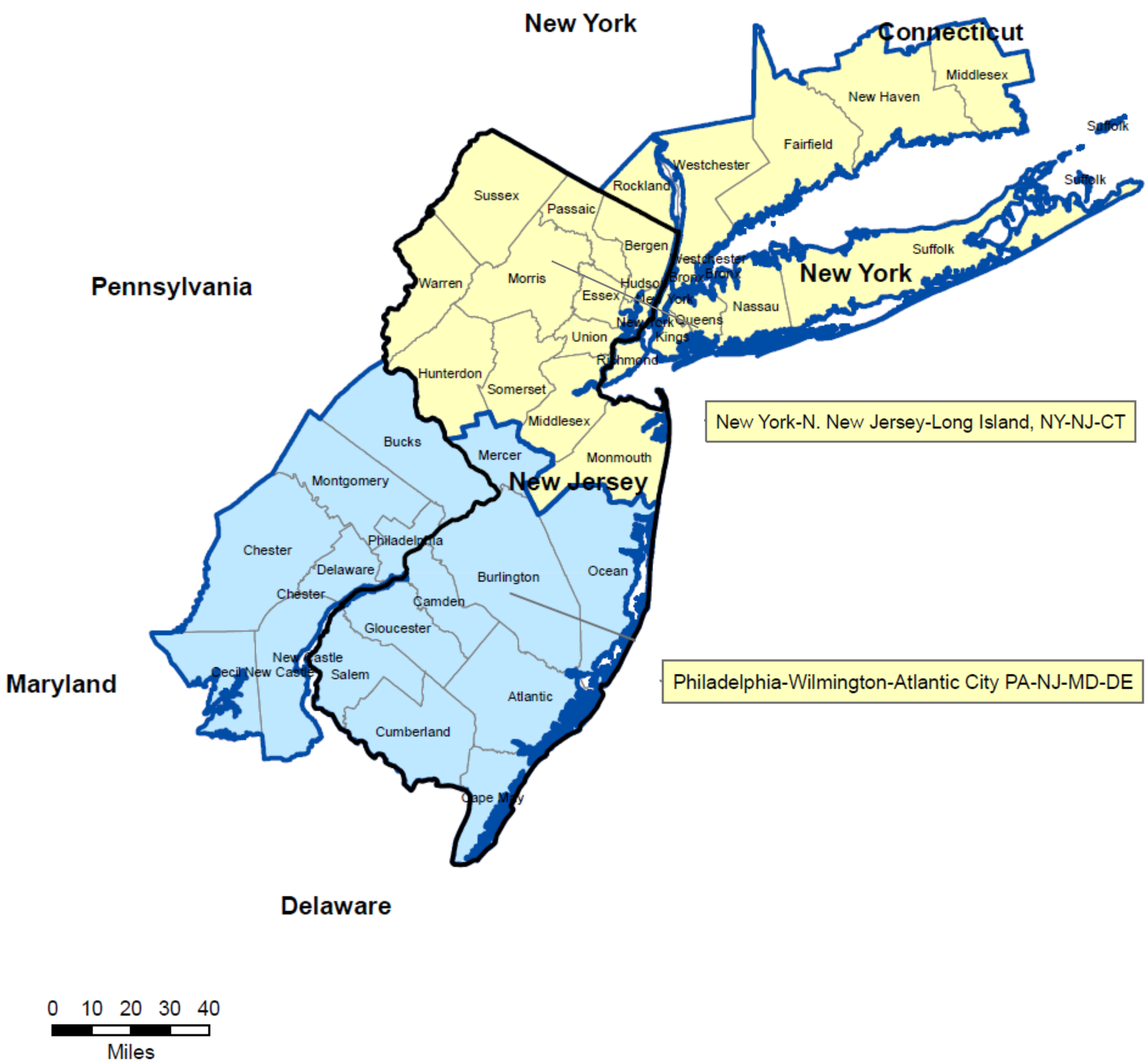


OZONE NONATTAINMENT AREAS IN NEW JERSEY

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 entire state of New Jersey is designated as nonattainment for the ozone NAAQS. New Jersey’s nonattainment areas for the 2008 0.075 ppm and 2015 0.070 ppm 8-hour standards are shown in Figure 4-11. New Jersey’s northern nonattainment area is classified as “moderate” for the 0.08 ppm and 0.07 ppm 8-hour ozone standards and “serious” for the 0.075 ppm 8-hour ozone standard. New Jersey’s southern nonattainment area is classified as “moderate” for the 0.08 ppm 8-hour ozone standard, and “marginal” for the 0.075 ppm and 0.070 ppm 8-hour ozone standards.

Figure 4-11
New Jersey 8-Hour Ozone Nonattainment Areas
0.075 & 0.070 ppm NAAQS



Source: https://www3.epa.gov/airquality/greenbook/nj8_2015.html

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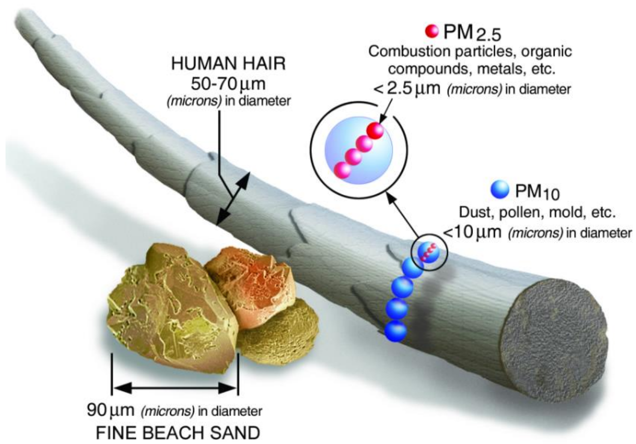
2020 Particulate Matter Summary

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.

Figure 5-1
Size Comparisons for PM Particles



USEPA. www.epa.gov/pm-pollution

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.

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. New Jersey has one Class I area listed under the Regional Haze Program. The program seeks to improve and protect visibility and air quality in specially designated areas such as national parks and wilderness areas. New Jersey's Class I site is the Brigantine wilderness area, located within the Edwin B. Forsythe National Wildlife Refuge. A visibility camera (www.hazecam.net) is located there. Airborne particles can also impact vegetation and aquatic ecosystems, and can cause damage to paints and building materials.

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 µg/m^3, and an annual standard was set at 50 µg/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 µg/m^3 until 2013, when the primary annual standard was lowered to 12.0 µg/m^3. A 24-hour $PM_{2.5}$ standard of 65 µg/m^3.was promulgated in 1997, then lowered in 2006 to 35 µg/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 for a given year.

Table 5-1
National Ambient Air Quality Standards for Particulate Matter
Micrograms Per Cubic Meter (µg/m^3)

Pollutant	Averaging Period	Type	Level	Design Value
Fine Particulate ($PM_{2.5}$)	Annual	Primary	12.0 µg/m^3	3-year average of the annual means
	Annual	Secondary	15.0 µg/m^3	3-year average of the annual means
	24-Hours	Primary & Secondary	35 µg/m^3	3-year average of the annual 98th percentile values
Inhalable Particulate (PM_{10})	24-Hours	Primary & Secondary	150 µg/m^3	2nd-highest annual average over 3 years

PARTICULATE MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) particulate monitoring network in 2020 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.

Fourteen $PM_{2.5}$ 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.

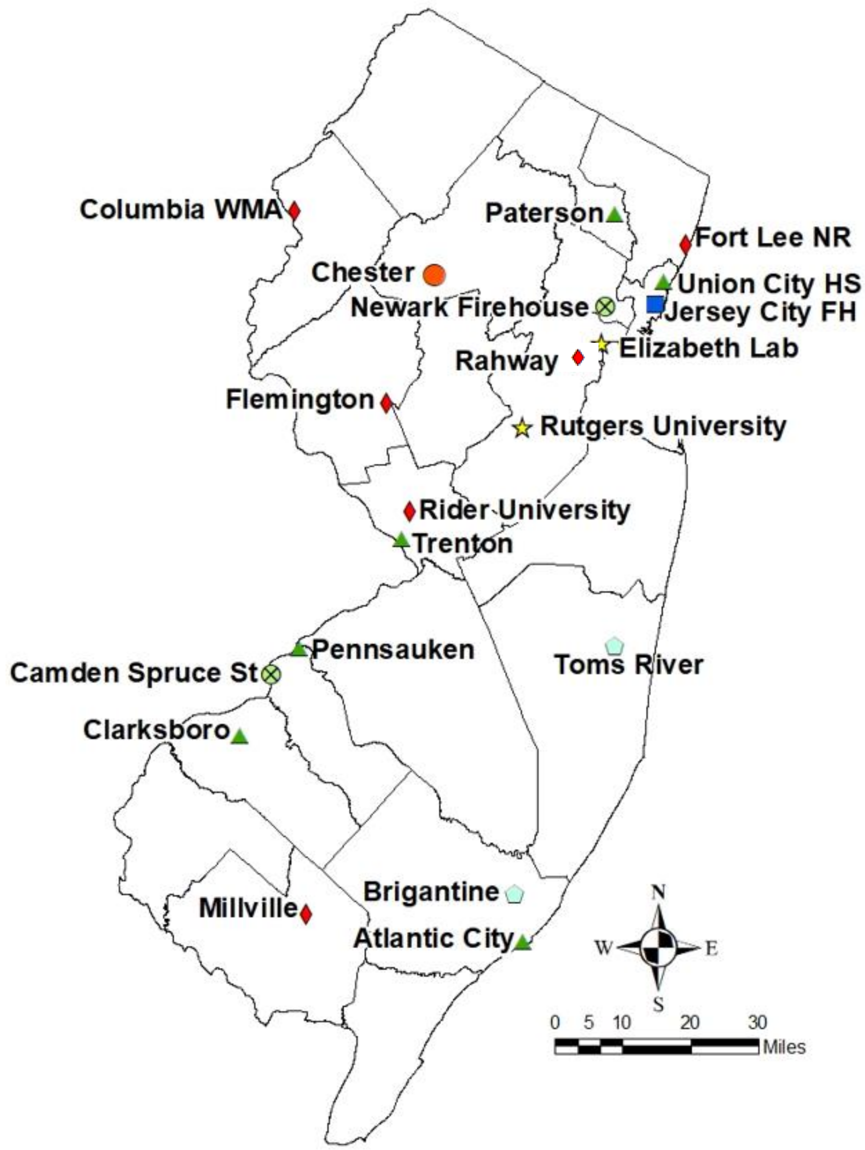
In order to provide real-time hourly data to the public (through the Air Quality Index at www.njaqinow.net), NJDEP has also been using particulate monitors that operate continuously. Thirteen sites in New Jersey use Beta Attenuation Monitors (BAM), which measure the loss of intensity (attenuation) of 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.

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. In 2020 the Camden Spruce Street site replaced the Camden RRF PM_{10} site, which was shut down early in the year for logistical reasons. The other two monitors are at the 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 separate 24-hour filter-based $PM_{2.5}$ samplers to determine the concentrations of the chemical analytes that make up the particles. Teflon filters are analyzed for 33 elements, nylon filters are analyzed for ions, and quartz filters are analyzed for carbon. CSN monitoring takes place at the Camden Spruce Street, Chester, Elizabeth Lab, Newark Firehouse and Rutgers University monitoring stations. New Jersey's 2020 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
2020 Particulate Monitoring Network



- PM2.5 Filter
- PM2.5 Continuous
- PM2.5 Filter & PM2.5 Continuous
- PM2.5 Filter, PM2.5 Continuous & Speciation
- PM2.5 Filter & Speciation
- PM2.5 Filter, PM2.5 Continuous, Speciation & PM10
- PM2.5 Filter, PM2.5 Continuous & PM10

FINE PARTICLE ($PM_{2.5}$) LEVELS IN 2020

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

For the NJDEP air monitoring program, the COVID-19 emergency had the greatest impact on the collection of filter-based PM data. While continuous monitors mostly kept operating, there were periods of time, beginning in March, when filters could not be retrieved and replaced. Some sites collect a sample every day, but most are sampled every third day. Pickups resumed at most monitoring stations in July, but certain sites remained off-limits. The monitors at Atlantic City, Paterson, Trenton and Union City High School are located in buildings that remained inaccessible through the end of the year. In 2020, none of New Jersey's filter-based monitors had enough samples to comply with USEPA's PM sampling validity criteria.

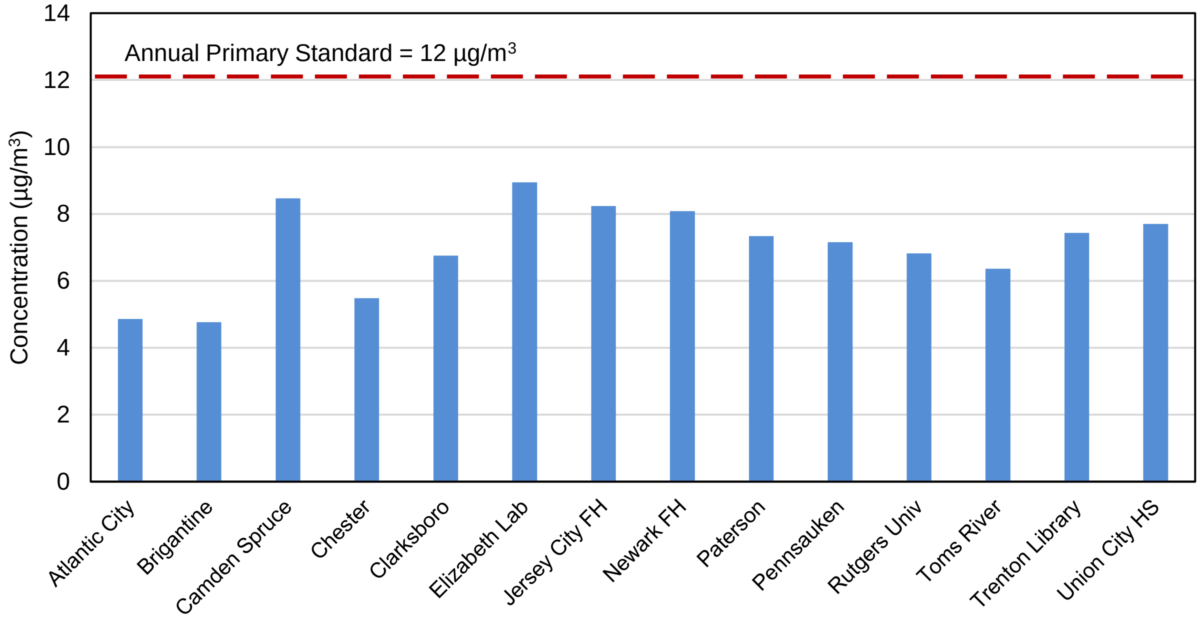
Using the data that was collected in 2020, none of the filter-based $PM_{2.5}$ monitoring sites showed any violations of either the annual NAAQS of 12.0 $\mu g/m^3$ or the 24-hour NAAQS of 35 $\mu g/m^3$. The annual mean concentrations of $PM_{2.5}$ measured at the fourteen filter-based samplers ranged from 4.77 $\mu g/m^3$ at the Brigantine monitoring site to 8.94 $\mu g/m^3$ at the Elizabeth Lab monitoring station. The highest 24-hour concentrations ranged from 8.8 $\mu g/m^3$ at Atlantic City to 34.0 $\mu g/m^3$ at Elizabeth Lab. Table 5-2 shows the annual mean, highest and 98^{th}-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) sample $PM_{2.5}$ every day. The other ten sites (Atlantic City, Brigantine, Camden Spruce Street, Chester, Clarksboro, Newark Firehouse, Paterson, Pennsauken, Rutgers University, and Union City High School) take a sample every third day, and should have about 122 samples per year.

Table 5-2
2020 $PM_{2.5}$ Concentrations in New Jersey
Annual and 24-Hour Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	Number of Samples	Annual Average*	24-Hour Average	
			Highest	98^{th}%-ile
Atlantic City	23	4.86	8.8	8.8
Brigantine	63	4.77	12.7	11.2
Camden Spruce Street	72	8.47	20.6	19.5
Chester	86	5.48	24.2	17.7
Clarksboro	82	6.75	14.2	13.8
Elizabeth Lab	243	8.94	34.0	23.6
Jersey City Firehouse	235	8.24	27.8	25.2
Newark Firehouse	84	8.08	29.5	21.3
Paterson	20	7.34	16.1	16.1
Pennsauken	76	7.16	19.7	17.7
Rutgers University	85	6.82	19.8	15.5
Toms River	263	6.36	20.3	15.2
Trenton Library	145	7.43	25.1	17.8
Union City High School	22	7.70	17.1	17.1

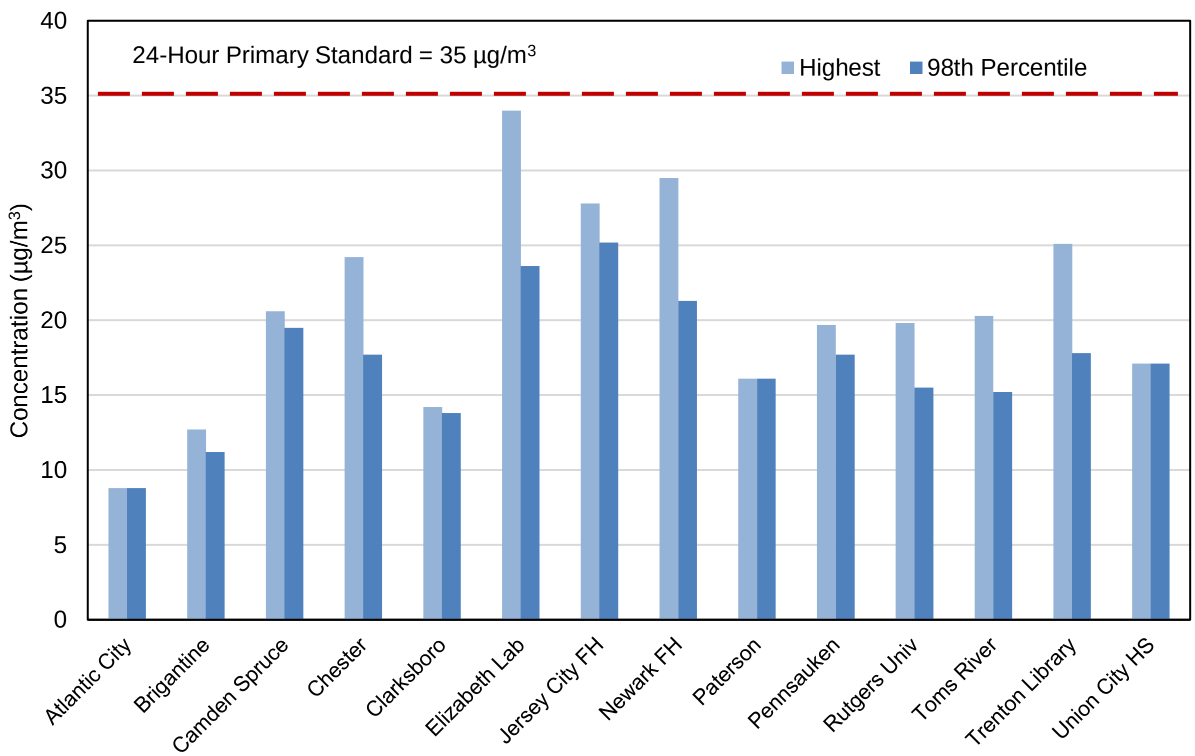
*None of the filter-based annual averages meet USEPA's summary criteria.

Figure 5-4
2020 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages* (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)



*None of the filter-based annual averages meet USEPA's summary criteria.

Figure 5-5
2020 $PM_{2.5}$ Concentrations in New Jersey
24-Hour Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)



$PM_{2.5}$ LEVELS FOR CONTINUOUS MONITORS

New Jersey's 2020 continuous $PM_{2.5}$ monitoring network consisted of thirteen sites: Brigantine, Camden Spruce Street, Columbia, Elizabeth Lab, Flemington, Fort Lee Near Road, Jersey City Firehouse, Millville, Newark Firehouse, Rahway, Rider University, Rutgers University, and Toms River (which was added in early March). 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 2020. Figures 5-6 and 5-7 show the same data in graphs. In 2020 there were no exceedances of the 12.0 $\mu g/m^3$ annual standard. There were two exceedances of the 24-hour standard, at Newark Firehouse and Rahway, both on December 12. See Table 3-6 in the Air Quality Index section of the 2020 New Jersey Air Quality Report for details.

Table 5-3
2020 $PM_{2.5}$ 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	6.99	23.2	15.7
Camden Spruce Street	8.46	27.1	18.9
Columbia	7.21	35.4	18.4
Elizabeth Lab	9.08	31.7	20.7
Flemington	7.36	28.5	17.9
Fort Lee Near Road	9.55	28.4	24.1
Jersey City Firehouse	8.56	27.6	22.9
Millville	8.32	20.2	16.1
Newark Firehouse	8.82	46.2	19.8
Rahway	6.92	39.5	20.8
Rider University	7.18	21.8	16.1
Rutgers University	7.57	29.8	21.2
Toms River	6.36	20.3	17.8

Figure 5-6
2020 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages from Continuous Monitors
Micrograms Per Cubic Meter (µg/m³)

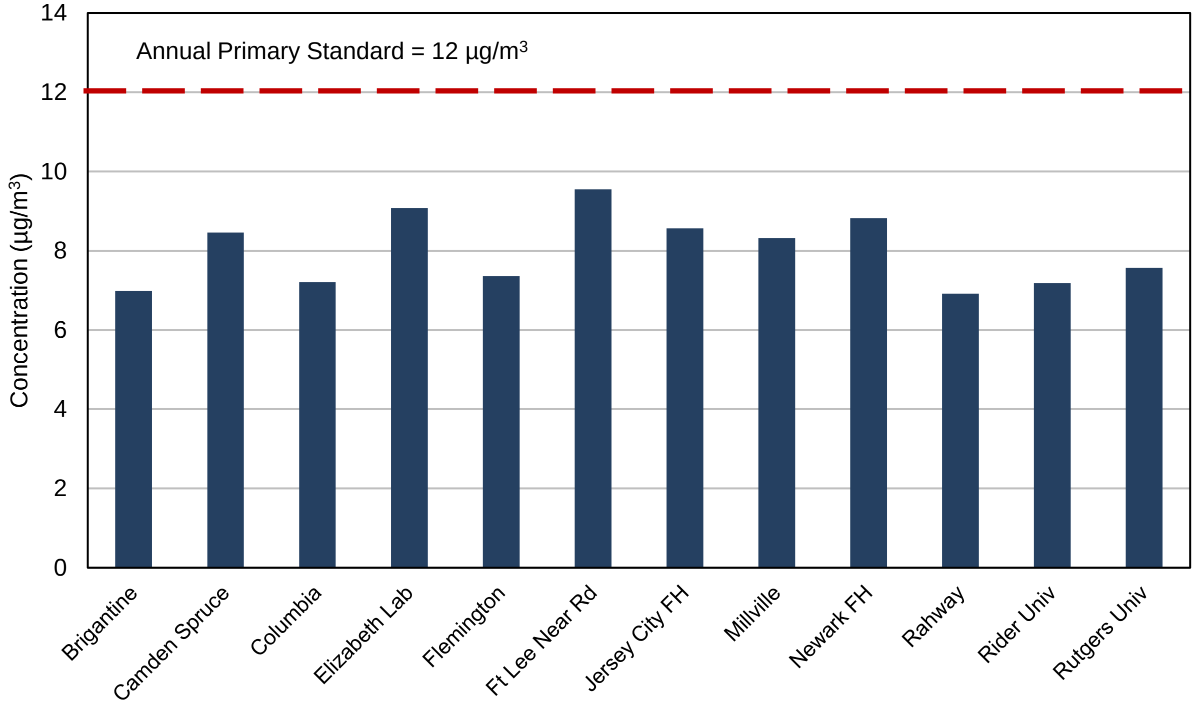
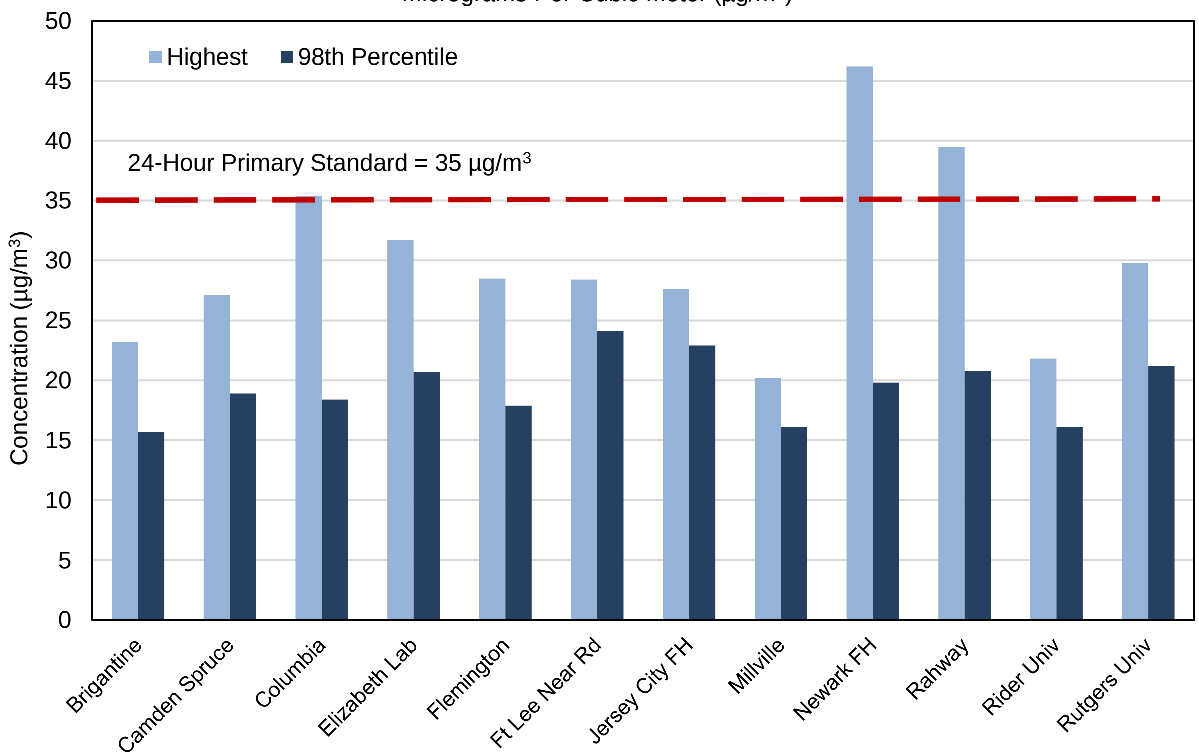


Figure 5-7
2020 $PM_{2.5}$ Concentrations in New Jersey
24-Hour Averages from Continuous Monitors
Micrograms Per Cubic Meter (µg/m³)



2020 $PM_{2.5}$ DESIGN VALUES

For $PM_{2.5}$ monitoring sites that have both a filter-based monitor and a continuous monitor, the data from the filter-based monitor usually takes precedence, and continuous monitor data is added in for periods when there is no filter data.

However, because COVID-19 limited access to some of our sites, only eleven out of twenty $PM_{2.5}$ monitoring stations had a complete set of valid data in 2020. USEPA determines the validity and completeness of a data set, and calculates design values. Sites with incomplete data are determined to have invalid design values, and these are marked with an asterisk in the table and figures below.

Table 5-4 and Figures 5-8 and 5-9 show USEPA's calculated $PM_{2.5}$ 2020 design values for each of the New Jersey monitors. All of New Jersey's $PM_{2.5}$ monitoring sites were below the annual and 24-hour design values in 2020.

Table 5-4
New Jersey $PM_{2.5}$ Design Values for 2018-2020
3-Year Average of the Annual Average Concentrations
& 98th Percentile 24-Hour Average Concentrations
Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	3-Year (2018-2020) Average	
	Annual	98th Percentile 24-Hour
Atlantic City*	5.9	14
Brigantine	6.5	15
Camden Spruce Street	9.4	22
Chester*	5.6	15
Clarksboro*	7.0	17
Columbia	7.3	19
Elizabeth Lab	8.7	22
Flemington	7.7	19
Fort Lee Near Road	10.5	25
Jersey City Firehouse*	7.8	22
Millville	8.3	18
Newark Firehouse	8.5	21
Paterson*	7.6	18
Pennsauken*	6.8	18
Rahway*	7.2	20
Rider University	7.5	17
Rutgers University	7.8	19
Toms River	6.2	16
Trenton Library*	7.4	19
Union City High School*	7.7	19

*2020 data set incomplete; design values deemed invalid by USEPA.

Figure 5-8
New Jersey $PM_{2.5}$ Design Values for 2018-2020
3-Year Average of the Annual Average Concentrations
Micrograms Per Cubic Meter (µg/m³)

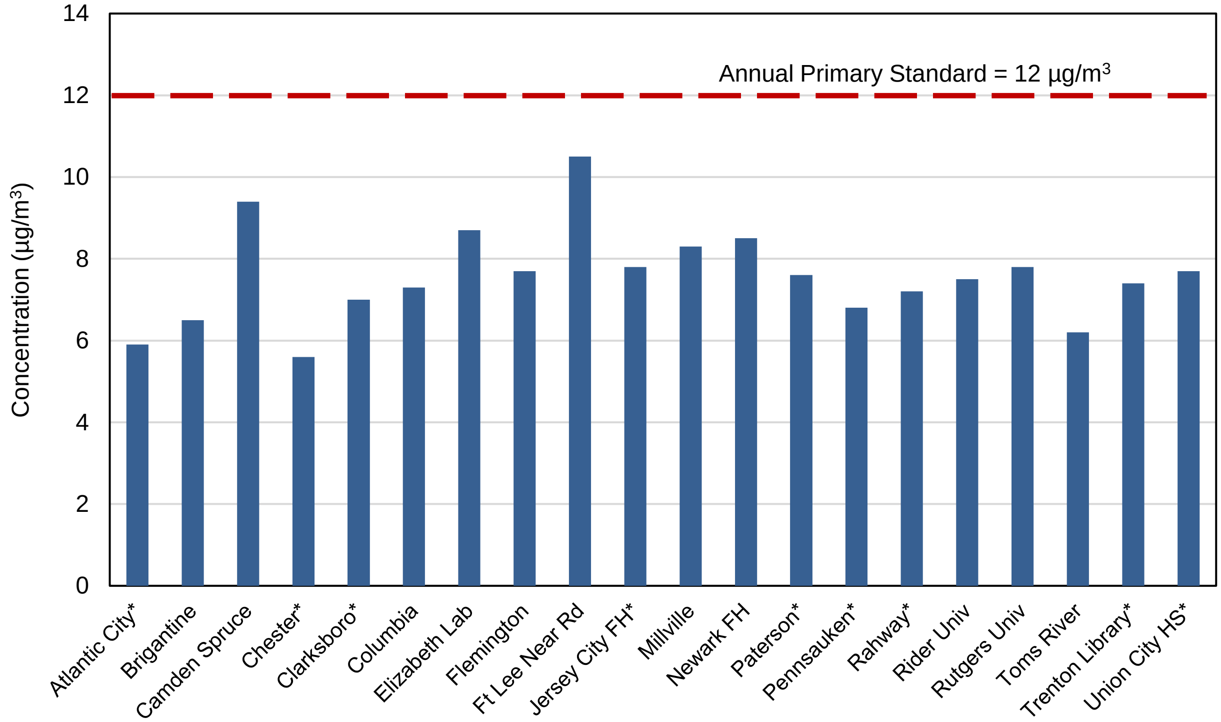
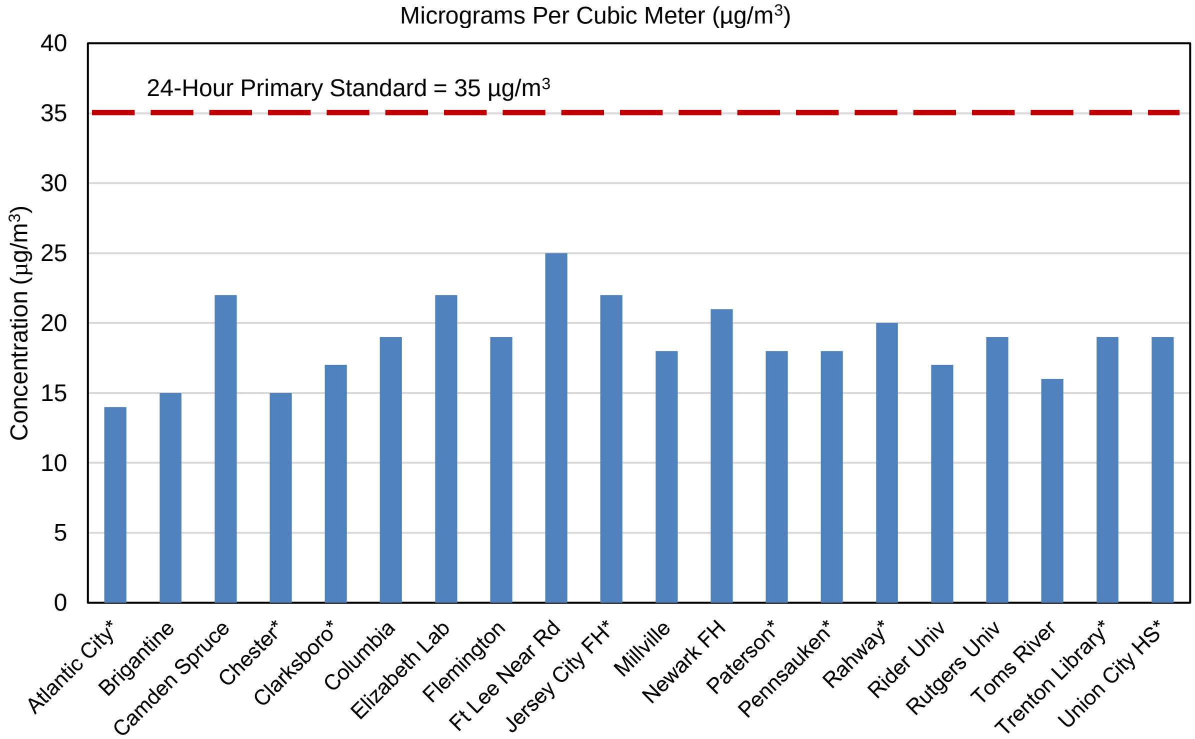


Figure 5-9
New Jersey $PM_{2.5}$ Design Values for 2018-2020
3-Year Average of the 98th Percentile 24-Hour Average Concentrations
Micrograms Per Cubic Meter (µg/m³)



*2020 data set incomplete; design values deemed invalid by USEPA.

Inhalable Particulate (PM_{10}) Levels in 2020

The COVID-19 emergency work-from-home order halted the collection of PM_{10} filter samples from mid-March through early July. Monitors at Camden Spruce Street and the Jersey City Firehouse are scheduled to sample every sixth day, and the Newark Firehouse site samples every third day. The Bureau of Air Monitoring could only collect about 70% of the samples that USEPA requires to meet their summary criteria for calculating annual averages.

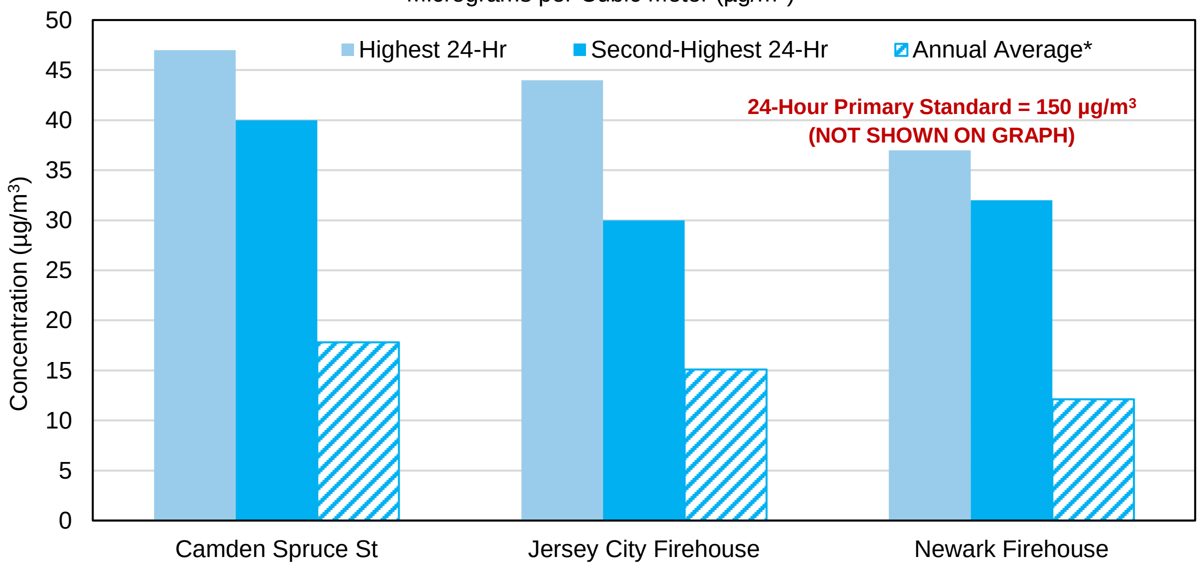
Table 5-5 shows 2020 data for each of the New Jersey PM_{10} monitors. The highest and second-highest 24-hour concentrations are presented, as well as the annual averages calculated by USEPA with the incomplete data set. All areas of the state are in attainment for the 24-hour standard of 150 $\mu g/m^3$, as can be seen in Figure 5-10. The standard is based on the second-highest 24-hour value.

Table 5-5
2020 PM_{10} Concentrations in New Jersey
Annual* and 24-Hour Averages
Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	Number of Samples	Annual Average*	24-Hour Average	
			Highest	Second-Highest
Camden Spruce Street	42	17.8	47	40
Jersey City Firehouse	41	15.1	44	30
Newark Firehouse	76	12.1	37	32

*Annual averages do not meet USEPA's summary criteria.

Figure 5-10
2020 PM_{10} Concentrations in New Jersey
Annual* and 24-Hour Averages
Micrograms per Cubic Meter ($\mu g/m^3$)



Particulate Trends

A $PM_{2.5}$ monitoring network was established in New Jersey in 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
Statewide New Jersey PM2.5 Trends, 2001-2020
Annual Mean & 3-Year Average of the Annual Mean Concentrations
Micrograms per Cubic Meter (µg/m³)

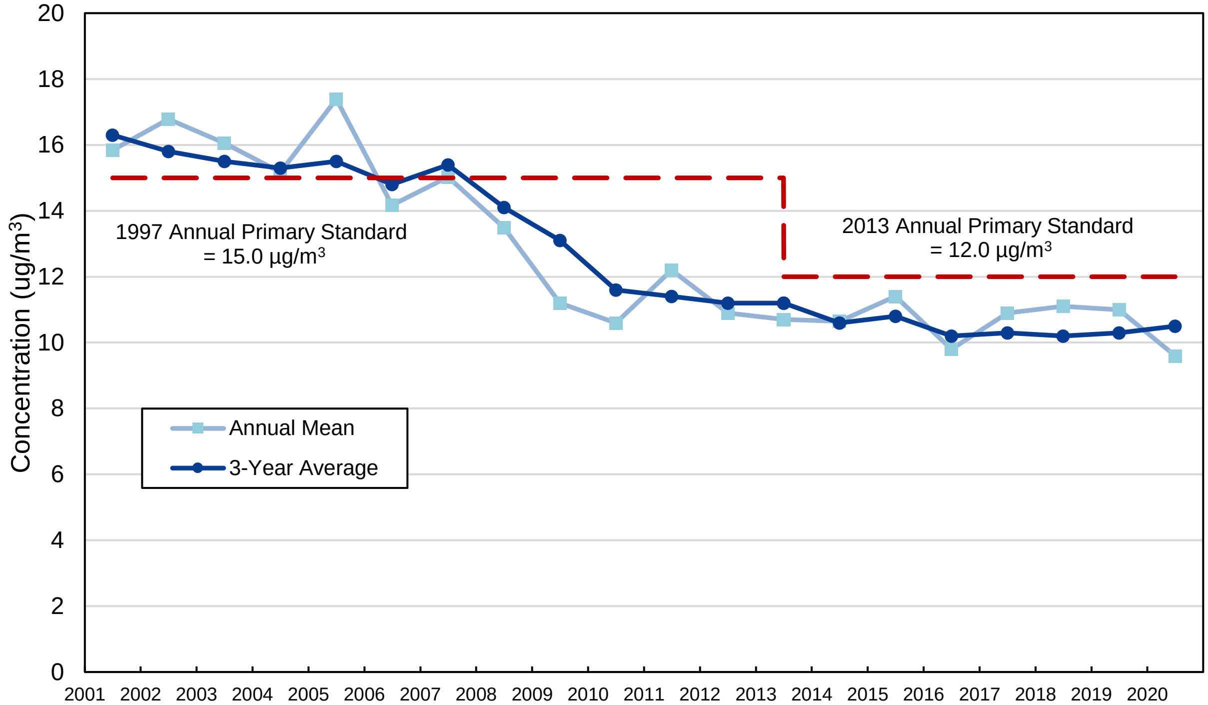
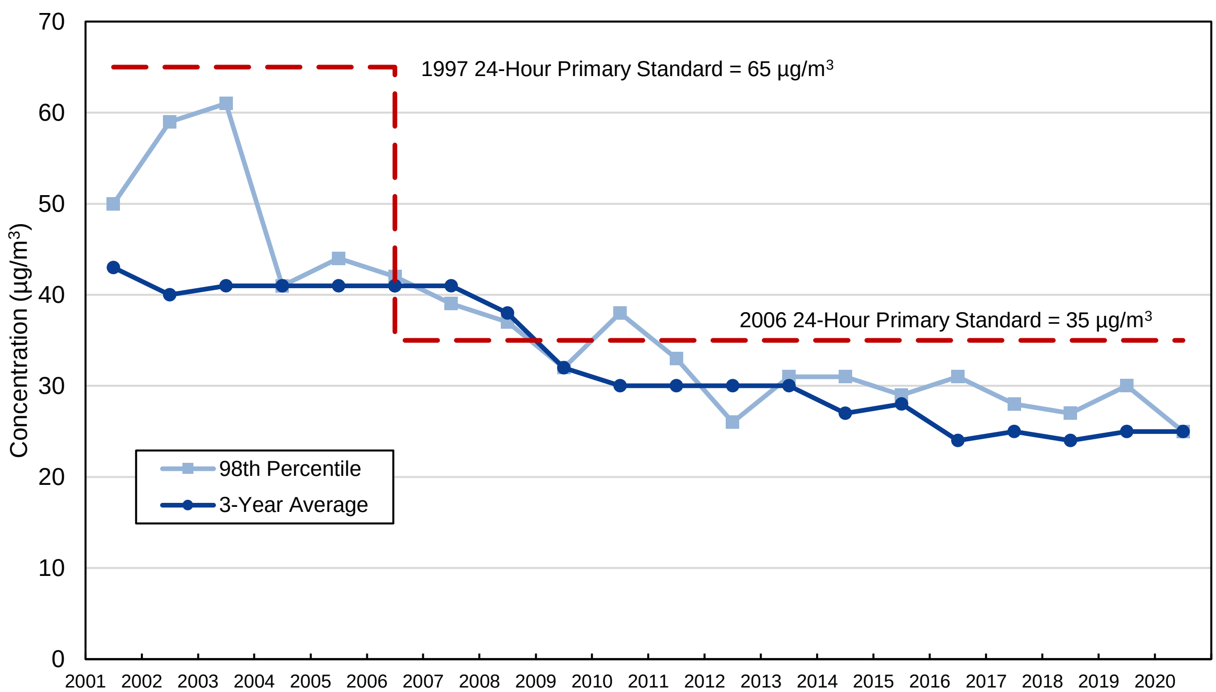


Figure 5-12
Statewide New Jersey PM2.5 Trends, 2001-2020
98th Percentile & 3-Year Average of the 98th Percentile 24-Hour Average Concentrations
Micrograms per Cubic Meter (µg/m³)



The PM_{10} design value trend is shown in Figure 5-13. The increase in concentration in 2015 and 2016 occurred at the Camden RRF monitor at 600 Morgan Street, during a period of major road reconstruction nearby. The Camden RRF site was shut down in early 2020, when a PM_{10} monitor was placed at the Camden Spruce Street station.

Figure 5-13
Statewide New Jersey PM_{10} Trend, 2001-2020
2nd-Highest 24-Hour Average Concentrations
Micrograms per Cubic Meter (µg/m³)

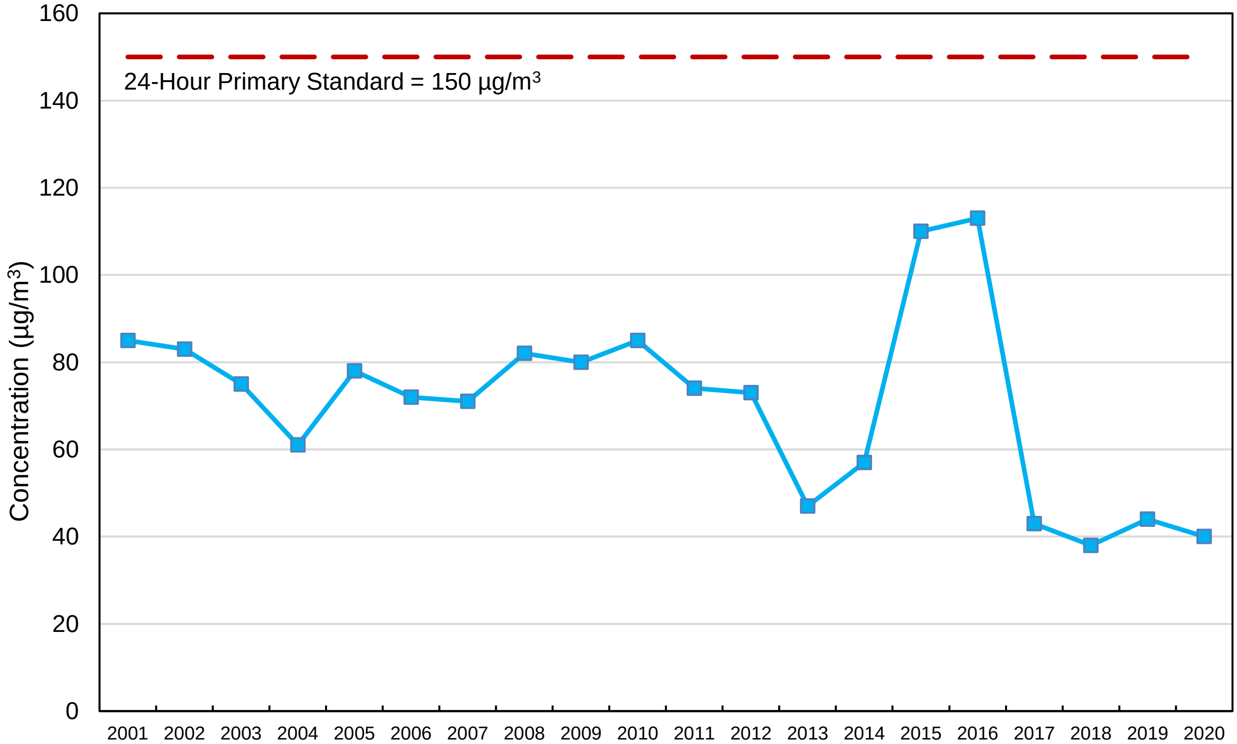


Table 5-6 below presents the trend data displayed in Figures 5-11, 5-12 and 5-13.

Table 5-6
Statewide New Jersey Particulate Matter Trends, 1998-2020
$PM_{2.5}$ & PM_{10} Concentrations
Micrograms per Cubic Meter (µg/m^3)

Year	$PM_{2.5}$				PM_{10}
	Annual		24-Hour		24-Hour
	Mean	3-Year Average*	98th Percentile	3-Year Average*	2nd-Highest*
2001	15.8	16.3	50	43	85
2002	16.8	15.8	59	40	83
2003	16.1	15.5	61	41	75
2004	15.2	15.3	41	41	61
2005	17.4	15.5	44	41	78
2006	14.2	14.8	42	41	72
2007	15.0	15.4	39	41	71
2008	13.5	14.1	37	38	82
2009	11.2	13.1	32	32	80
2010	10.6	11.6	38	30	85
2011	12.2	11.4	33	30	74
2012	10.9	11.2	26	30	73
2013	10.7	11.2	31	30	47
2014	10.6	10.6	31	27	57
2015	11.4	10.8	29	28	110
2016	9.8	10.2	31	24	113
2017	10.9	10.3	28	25	43
2018	11.1	10.2	27	24	38
2019	11.0	10.3	30	25	44
2020	9.6	10.5	25	25	40

*Design value

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2020 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

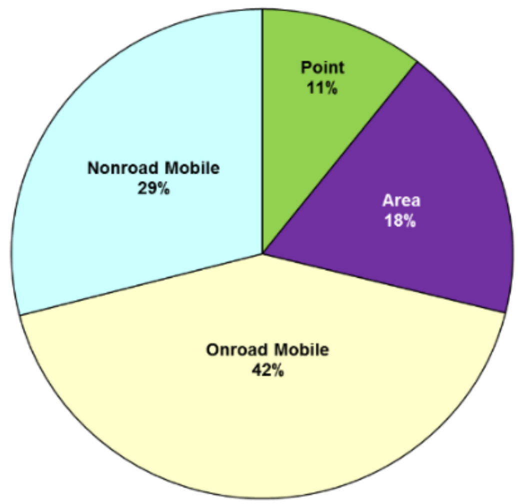
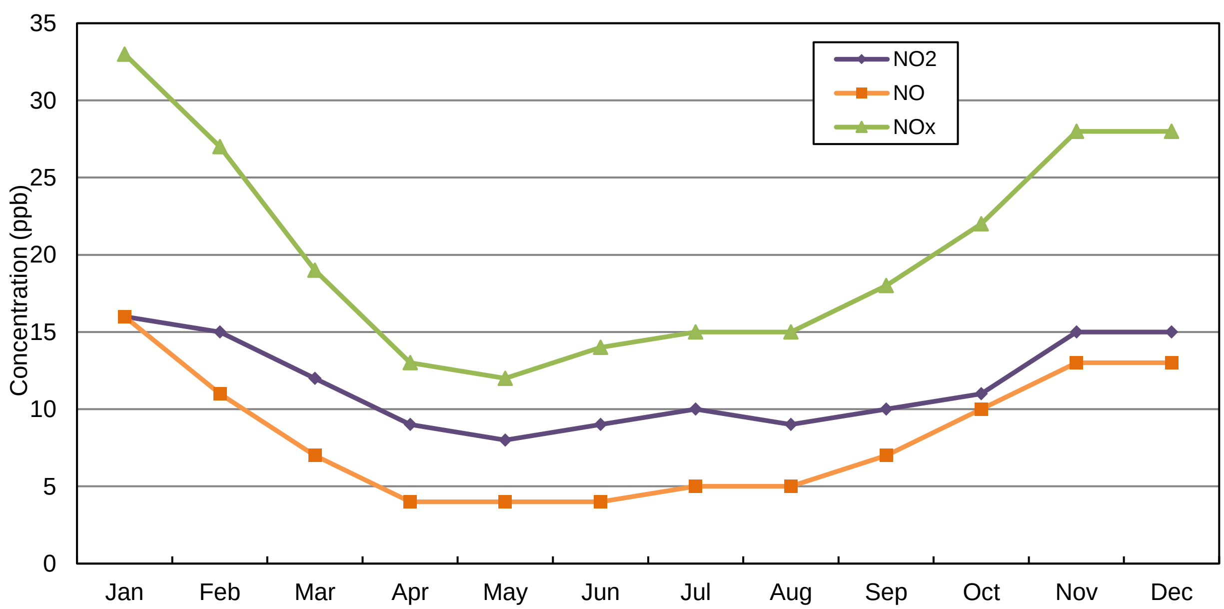


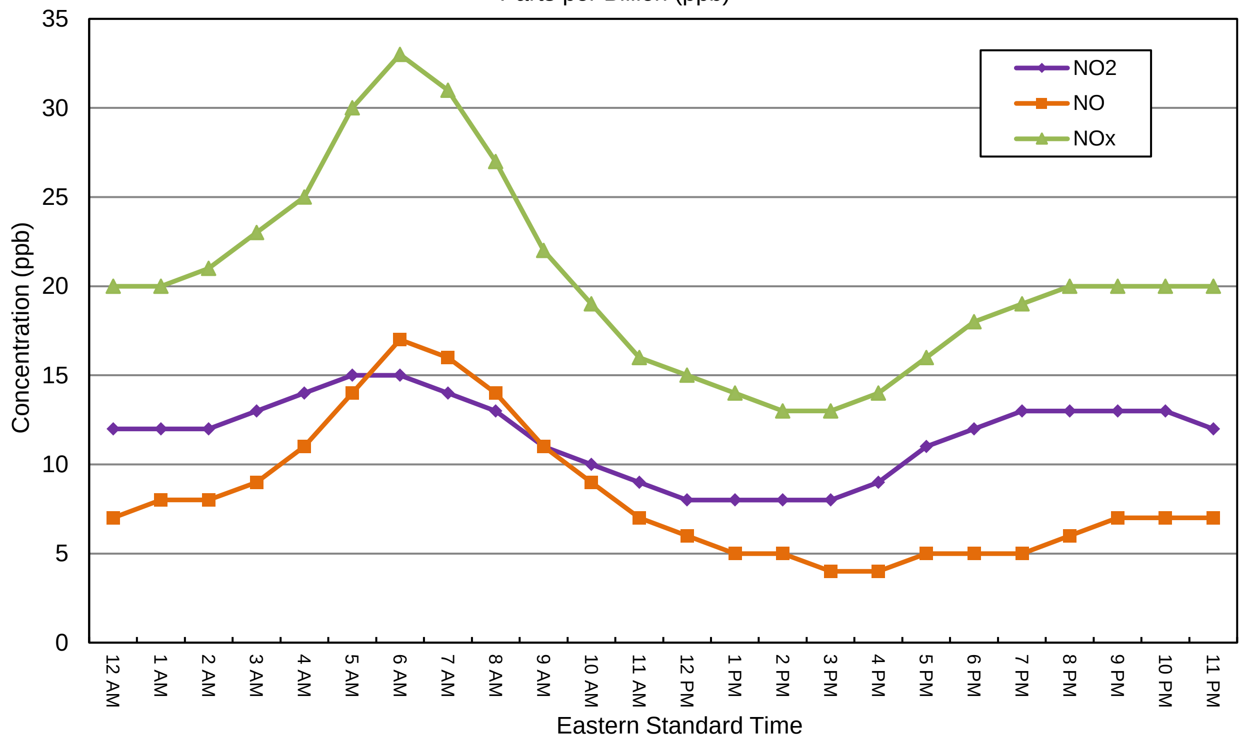
Figure 6-2 shows that NO_x concentrations tend to be higher in the winter than in the summer. This is due in part to heating of buildings, and to weather conditions that are more prevalent in the colder months of the year, such as lighter winds that result in poorer local dispersion conditions.

Figure 6-2
2020 Nitrogen Oxides Concentrations in New Jersey
Monthly Variation of 1-Hour Concentrations
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 was evident even in a year like 2020, when rush hour traffic was generally below normal. This is shown in Figure 6-3.

Figure 6-3
2020 Nitrogen Oxides Concentrations in New Jersey
Daily Variation of 1-Hour Concentrations
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 (NO2)
Parts per Billion (ppb)
Parts per Million (ppm)

Averaging Period	Type	National Level	New Jersey Level	Design Value
1-Hour	Primary	100 ppb	---	3-year average of the annual 98th percentile daily maximums
Annual	Primary & secondary	53 ppb	---	Annual mean
12-Month	Primary & secondary	---	0.05 ppm	Highest 12-month running average

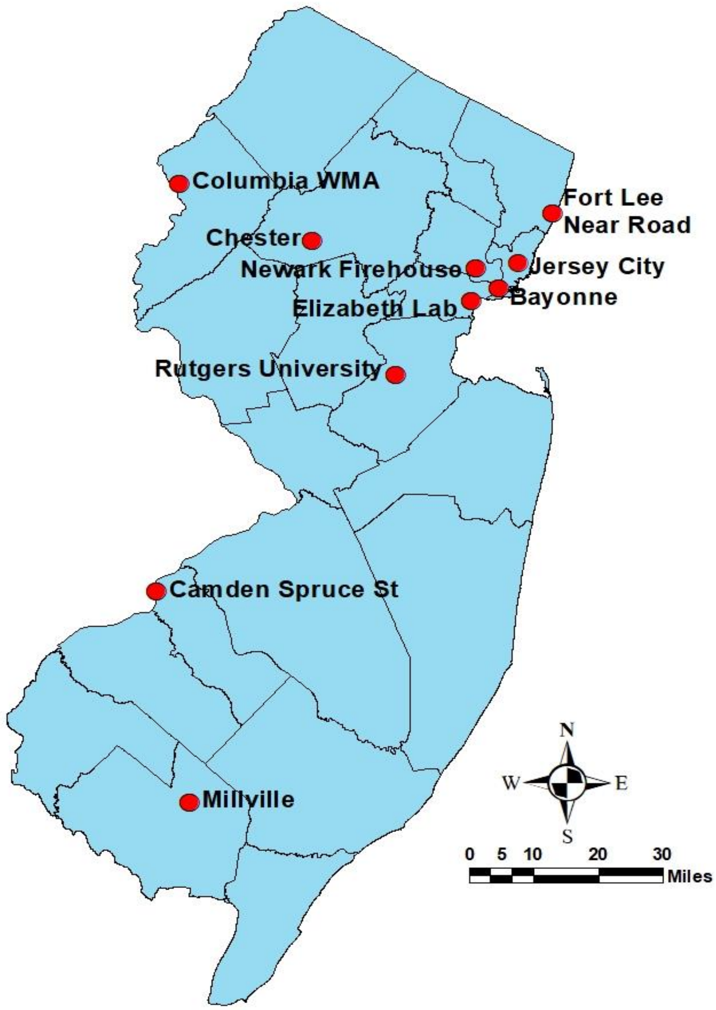
A state or other designated area is in compliance with a NAAQS when it meets the design value. For the annual standard, the annual average is the design value. However, for the 1-hour NO_2 standard, the NAAQS is met when the 3-year average of the 98^{th}-percentile of the daily maximum 1-hour NO_2 concentrations 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 2020. 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 Station (PAMS) Program, and is required to measure total reactive nitrogen (NO_y) as well as NO_2 and NO, but not NO_x. NO_y is also measured at Newark Firehouse, as required for an NCore Mulitpollutant Monitoring Network site.

The Jersey City monitoring station was shut down October 30^{th} through the end of the year because of water damage at the site.

Figure 6-4
2020 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2020

There were no exceedances of any NO_2 NAAQS in 2020.

See Table 6-2 and Figure 6-5 for 1-hour values for all of the monitoring sites. The maximum daily 1-hour average concentration was 92 ppb, recorded at Newark Firehouse. Elizabeth Lab had the highest 1-hour 98th percentile value of 55 ppb. However, the site with the highest design value for 2018-2020 was Fort Lee Near Road, with 62 ppb.

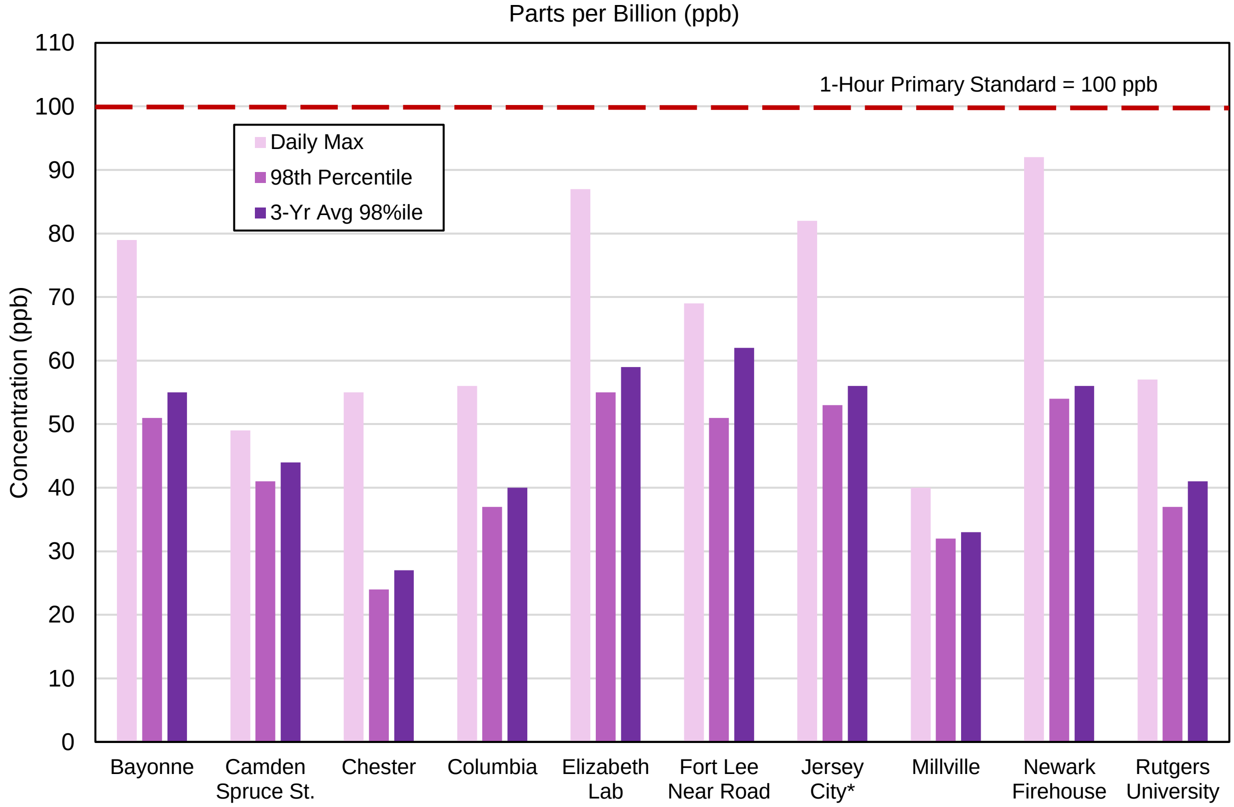
As noted, the Jersey City site had no data after October 30 because of a temporary shutdown.

Table 6-2
2020 Nitrogen Dioxide Concentrations in New Jersey
Maximum, 98th-Percentile, & 3-Year Average of 98th-Percentile Daily 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	79	51	55
Camden Spruce St.	49	41	44
Chester	55	24	27
Columbia	56	37	40
Elizabeth Trailer	87	55	59
Fort Lee Near Road	69	51	62
Jersey City*	82	53	56
Millville	40	32	33
Newark Firehouse	92	54	56
Rutgers University	57	37	41

* Jersey City had no data after October 30 because of a temporary shutdown.

Figure 6-5
2020 Nitrogen Dioxide Concentrations in New Jersey
Maximum, 98th-Percentile, & 3-Year Average of 98th-Percentile Daily 1-Hour Averages
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 6-6, 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. However, the Jersey City dataset is incomplete for the year because of the temporary shutdown of the site after October 30. In any case, these values are well below the standards.

Table 6-3
2020 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	14	16
Camden Spruce Street	10	11
Chester	3	3
Columbia	10	11
Elizabeth Lab	18	20
Fort Lee Near Road	15	17
Jersey City*	17	21
Millville	6	7
Newark Firehouse	14	16
Rutgers University	7	8

* Jersey City had no data from 10/30/2020 to 12/31/2020

Figure 6-6
2020 Nitrogen Dioxide Concentrations in New Jersey
Annual (12-Month) Averages
Parts per Billion (ppb)

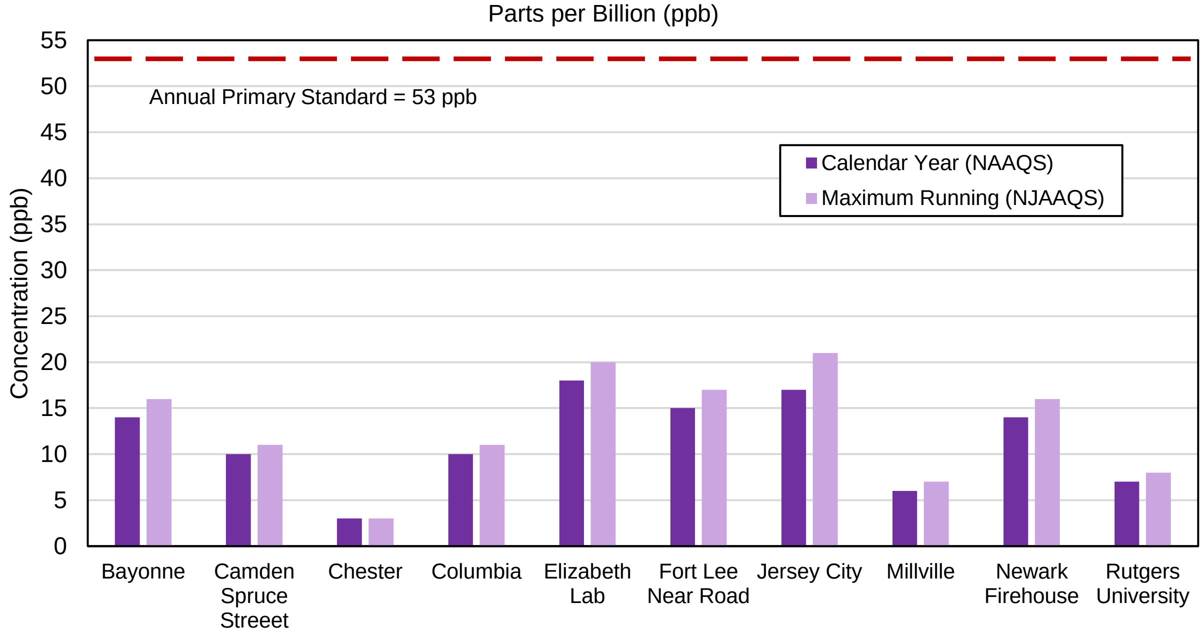
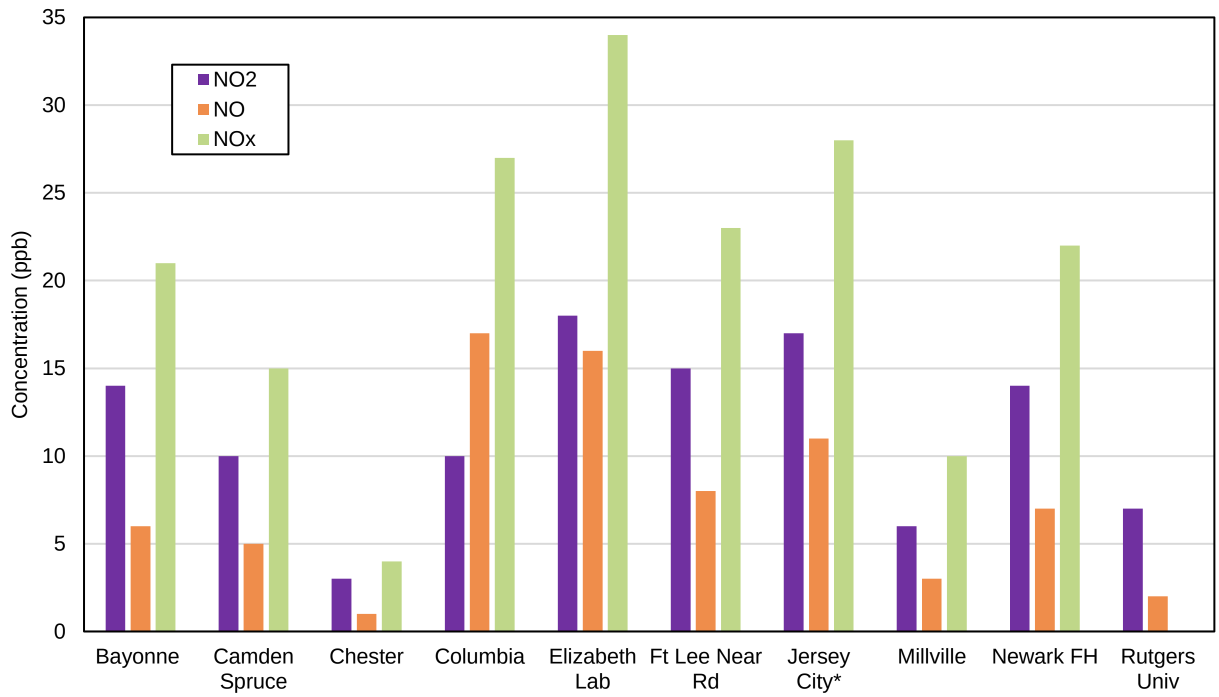


Figure 6-7 and Table 6-4 show the calendar-year annual average concentrations of NO_2, NO and NO_x at each New Jersey monitoring site. Even though there are no ambient air standards for NO and NO_x, the stations that measure NO_2 concentrations also measure them (except for Rutgers, which measures NO_y instead of NO_x). 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 6-7
2020 Nitrogen Oxides Concentrations in New Jersey
Annual Averages
Parts per Billion (ppb)



*The Jersey City site had no data 10/30-12/31/2020.

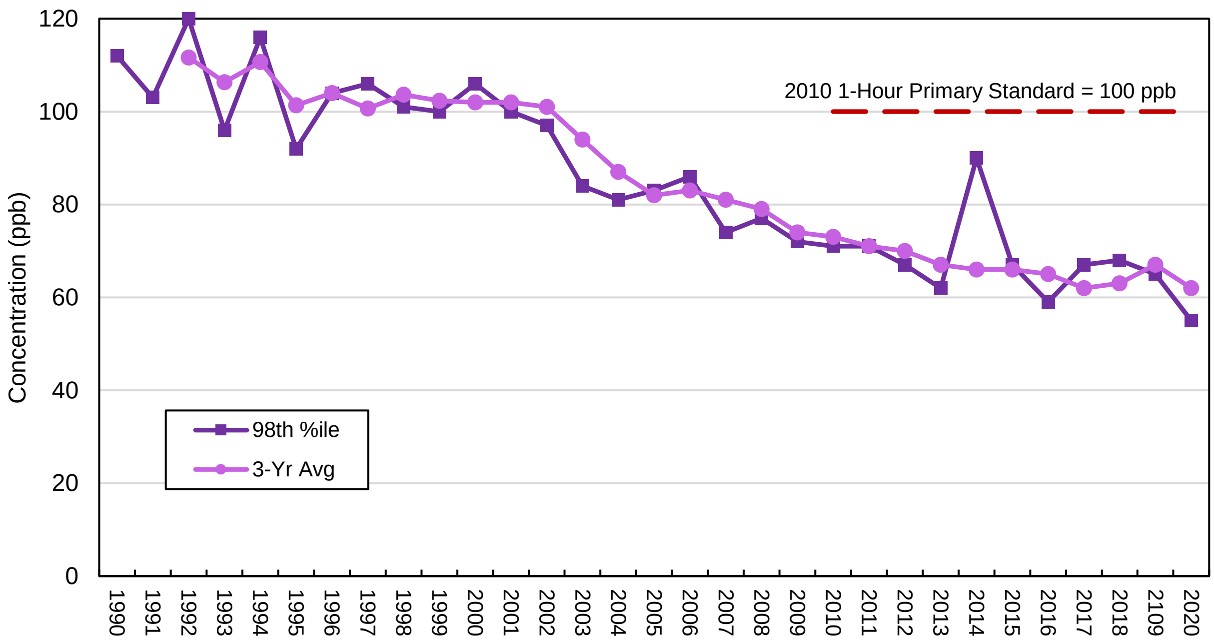
Table 6-4
2020 Nitrogen Oxides Concentrations in New Jersey
Annual Averages
Parts per Billion (ppb)

Site	NO_2	NO	NO_x
Bayonne	14	6	21
Camden Spruce Street	10	5	15
Chester	3	1	4
Columbia	10	17	27
Elizabeth Lab	18	16	34
Fort Lee Near Road	15	8	23
Jersey City*	17	11	28
Millville	6	3	10
Newark Firehouse	14	7	22
Rutgers University	7	2	

NO_2 TRENDS

New Jersey has not violated the 1-hour NAAQS since it was implemented in 2010. Figure 6-8 shows the highest statewide 98th percentile and design values for the 1-hour NAAQS for the years 2000-2020. 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 any New Jersey monitoring site.

Figure 6-8
Statewide New Jersey Nitrogen Dioxide Trends, 1990-2020
98th Percentile & 3-Year Average 98th Percentile Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)



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 2020. 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.

The statewide trend data is also presented in Table 6-5.

Figure 6-9
Statewide New Jersey Nitrogen Dioxide Trend, 1990-2020
Highest Annual (Calendar Year) Average Concentrations
Parts per Billion (ppb)

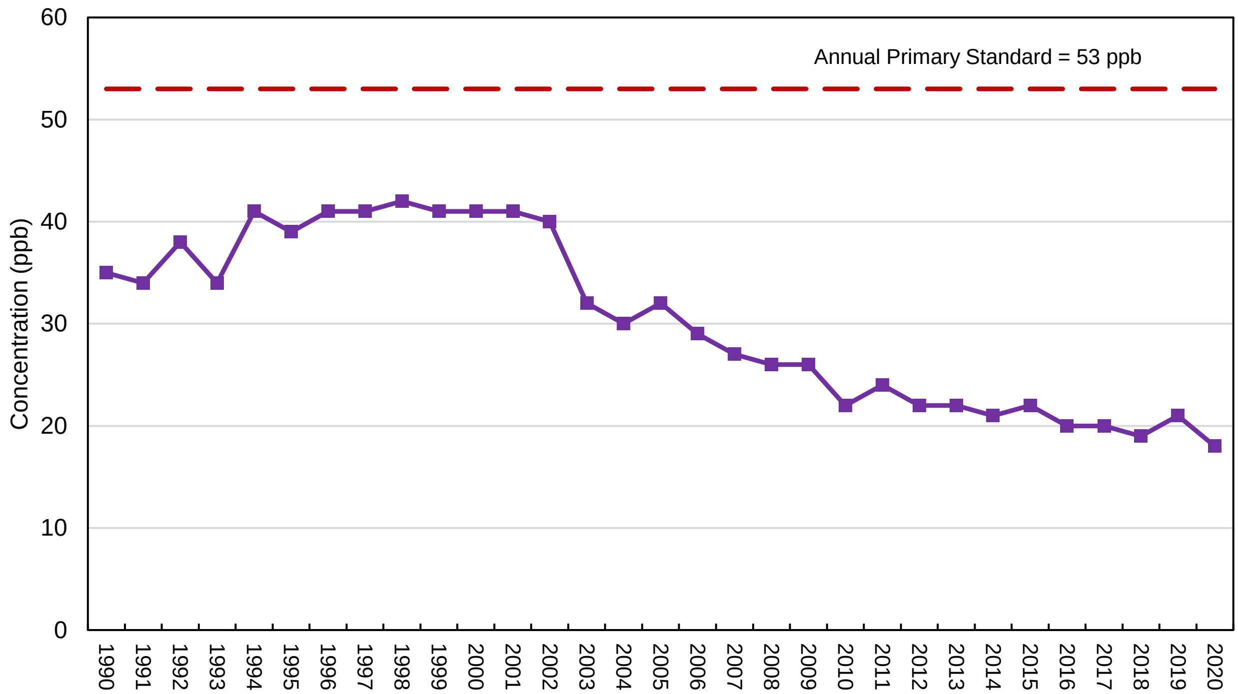


Table 6-5
Statewide New Jersey Nitrogen Dioxide Trends, 1990-2020
1-Hour Daily & 3-Year Average of 98th Percentile Concentrations
Annual Maximum Average Concentrations
Parts per Billion (ppb)

Year	1-Hour Daily		Annual Average*
	98th Percentile	3-Year Average of 98th Percentile*	
1990	112	---	35
1991	103	---	34
1992	120	112	38
1993	96	106	34
1994	116	111	41
1995	92	101	39
1996	104	104	41
1997	106	101	41
1998	101	104	42
1999	100	102	41
2000	106	102	41
2001	100	102	41
2002	97	101	40
2003	84	94	32
2004	81	87	30
2005	83	82	32
2006	86	83	29
2007	74	81	27
2008	77	79	26
2009	72	74	26
2010	71	73	22
2011	71	71	24
2012	67	70	22
2013	62	67	22
2014	90	66	21
2015	67	66	22
2016	59	65	20
2017	67	62	20
2018	68	63	19
2019	65	67	21
2020	55	62	18

*Design value

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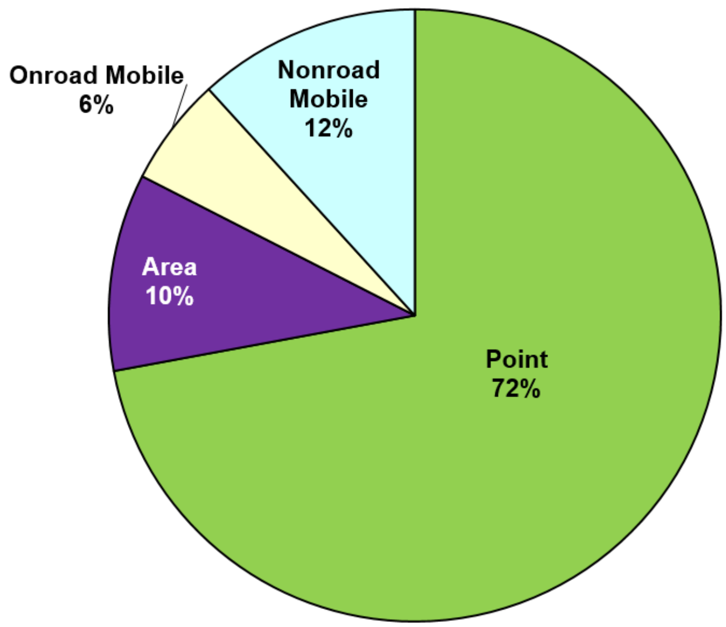
2020 Sulfur Dioxide Summary

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 for a given year.

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 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. Also, the NJAAQS use ppm units instead of ppb.

Table 7-1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide (SO_2)
Parts per Billion (ppb)
Parts per Million (ppm)

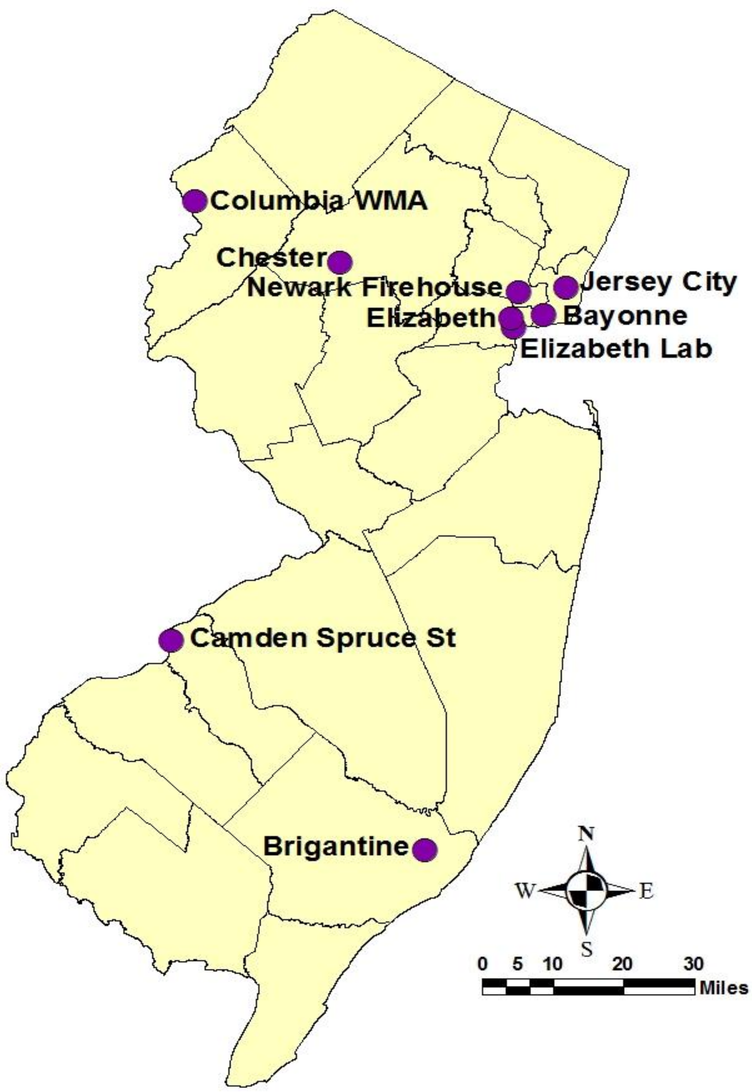
Averaging Period	Type	National Level	New Jersey Level[a]	Design Value
1–hour	Primary	75 ppb	---	3-year average of the annual 99th percentile daily maximums
3–hours	Secondary	0.5 ppm[b]	0.5 ppm	Annual 2nd-highest
24–hours	Primary	---	0.14 ppm	Annual 2nd-highest
24–hours	Secondary	---	0.1 ppm	Annual 2nd-highest
12–months	Primary	---	0.03 ppm	Not to be exceeded
12–months	Secondary	---	0.02 ppm	Not to be exceeded

[a] Based on running averages, over any 12 consecutive months.
[b] 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 2020. 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
2020 Sulfur Dioxide Monitoring Network



SO_2 Levels in 2020

In 2020, the Bureau of Air Monitoring was able to continue the measurement of SO_2 concentrations despite the COVID-19 shutdown that began in March. The only site missing significant amounts of data is Jersey City, which had problems with the SO_2 monitor that started on July 1 and which could not be fixed until September 9. Then a severe storm on October 30 led to water infiltration that caused the entire site to be shut down through the end of the year. When it was operating, the Jersey City site had a couple of periods of anomalously high values (one on January 13, the other on June 7) for which we could find no explanation, and also no reason to invalidate the data. Even so, no ambient air standards were exceeded.

1-hour data is presented in Table 7-2 and Figure 7-3 for comparison with the NAAQS of 75 ppb. Jersey City had by far the highest and second-highest 1-hour values (47.1 and 38.5 ppb) and also the highest 99th percentile value (11.8 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 Jersey City, with a value of 8 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 values were measured at Jersey City. The block averages were 0.0306 and 0.0259 ppm, and the running averages were 0.0341 and 0.0259 ppm. Results are shown in Table 7-3 and Figure 7-4.

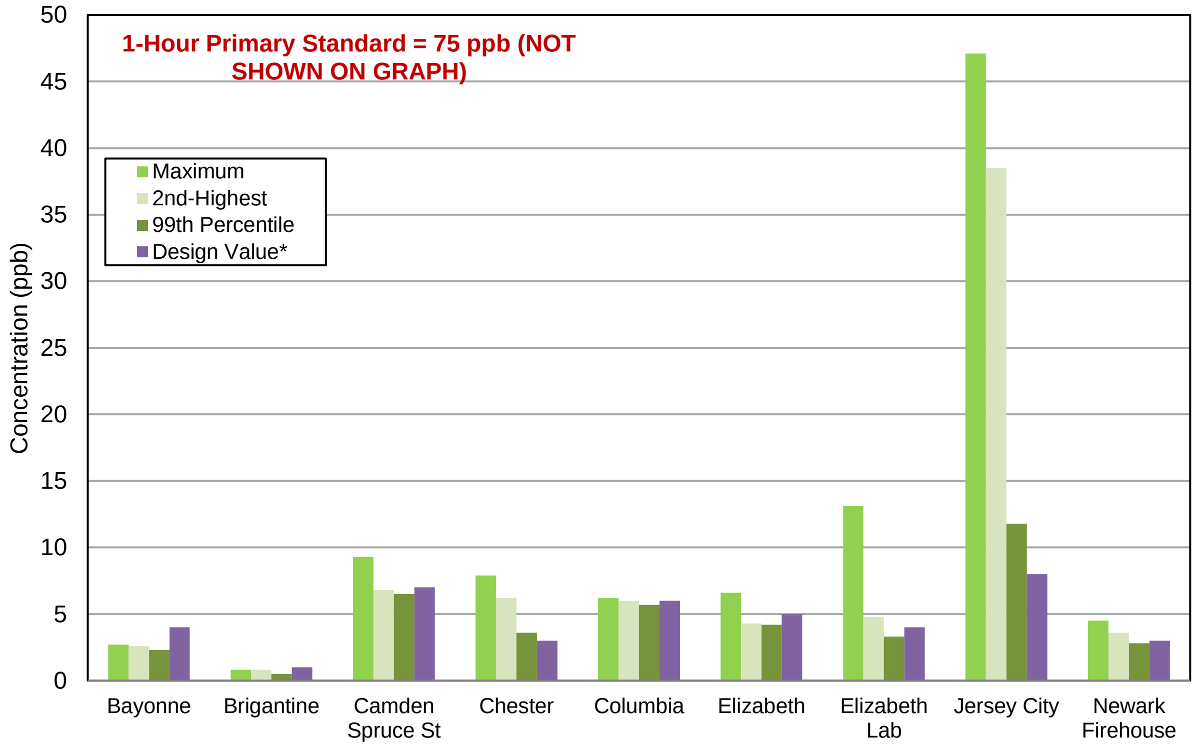
The New Jersey 24-hour ambient air quality standard is 0.14 ppm, and the 12-month standard is 0.03 ppm. In 2020, the highest values were all at the Jersey City site. The highest and second-highest 24-hour average concentrations were 0.0120 ppm and 0.0118 ppm. The highest 12-month running average concentration of was 0.0020 ppm. See Tables 7-4 and 7-5, and Figures 7-5 and 7-6, for data for the other monitoring sites.

Table 7-2
2020 Sulfur Dioxide Concentrations in New Jersey
1-Hour Averages & Design Values
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)			2018-2020 Design Value[a]
	Highest Daily Maximum	2nd-Highest Daily Maximum	99th Percentile Daily Maximum	
Bayonne	2.7	2.6	2.3	4
Brigantine	0.8	0.8	0.5	1
Camden Spruce Street	9.3	6.8	6.5	7
Chester	7.9	6.2	3.6	3
Columbia	6.2	6.0	5.7	6
Elizabeth	6.6	4.3	4.2	5
Elizabeth Lab	13.1	4.8	3.3	4
Jersey City*	47.1	38.5	11.8	8
Newark Firehouse	4.5	3.6	2.8	3

[a] 3-Year (2018-2020) average of the 99th percentile 1-hour daily maximum concentrations.
*The Jersey City monitoring station is missing 36% of its annual data because of problems with the instrument and the temporary shutdown of the site.

Figure 7-3
2020 Sulfur Dioxide Concentrations in New Jersey
1-Hour Averages & Design Values
Parts per Billion (ppb)



Design value = 3-year average of the 99th percentile 1-hour daily maximum concentrations.

Table 7-3
2020 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	0.0020	0.0020	0.0021	0.0020
Brigantine	0.0007	0.0005	0.0007	0.0005
Camden Spruce Street	0.0057	0.0050	0.0057	0.0050
Chester	0.0044	0.0034	0.0077	0.0044
Columbia	0.0047	0.0040	0.0057	0.0043
Elizabeth	0.0094	0.0057	0.0106	0.0043
Elizabeth Trailer	0.0050	0.0040	0.0054	0.0037
Jersey City	0.0306	0.0259	0.0341	0.0259
Newark Firehouse	0.0028	0.0027	0.0036	0.0029

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

Figure 7-4
2020 Sulfur Dioxide Concentrations in New Jersey
2nd Highest 3-Hour Averages
Parts per Million (ppm)

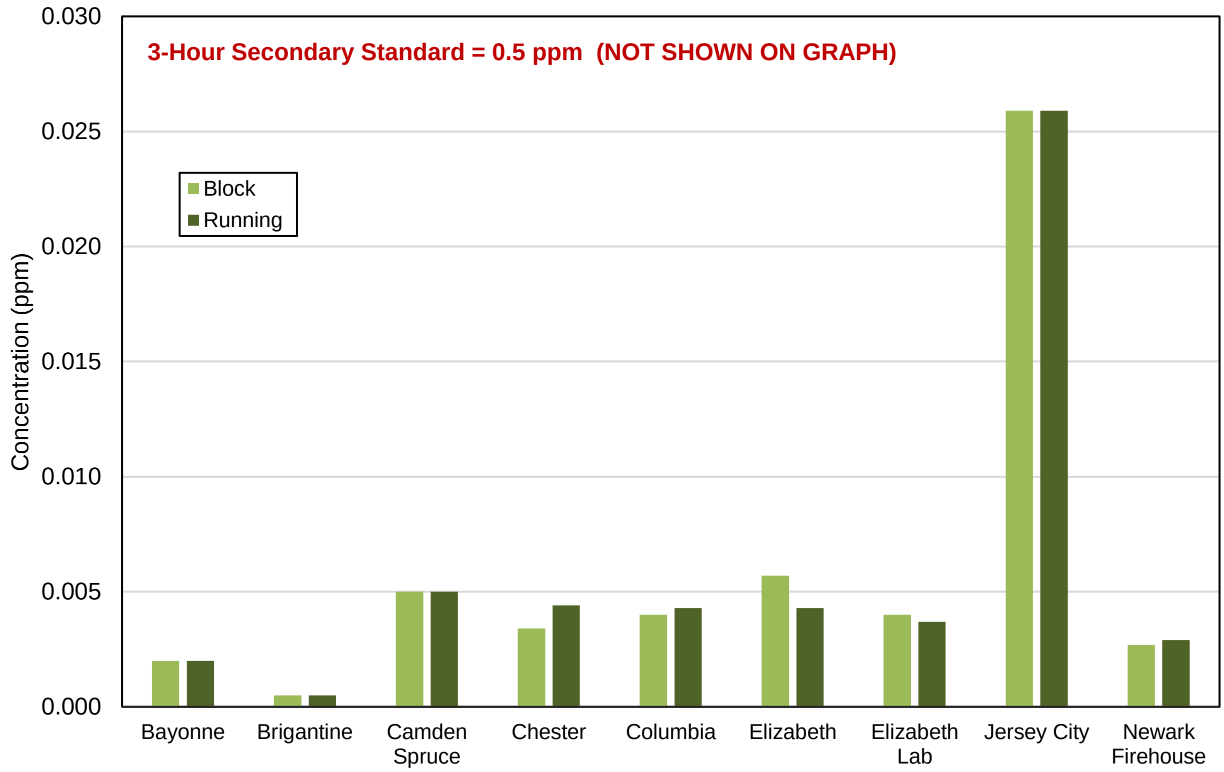


Table 7-4
2020 Sulfur Dioxide Concentrations in New Jersey
24-Hour Running Averages
Parts per Million (ppm)

Monitoring Site	24-Hour Running Average	
	Maximum	2nd Highest (Non-overlapping)
Bayonne	0.0012	0.0012
Brigantine	0.0002	0.0002
Camden Spruce Street	0.0024	0.0023
Chester	0.0023	0.0017
Columbia	0.0023	0.0023
Elizabeth	0.0038	0.0024
Elizabeth Lab	0.0023	0.0021
Jersey City	0.0120	0.0118
Newark Firehouse	0.0020	0.0012

Figure 7-5
2020 Sulfur Dioxide Concentrations in New Jersey
24-Hour Running Averages
Parts per Million (ppm)

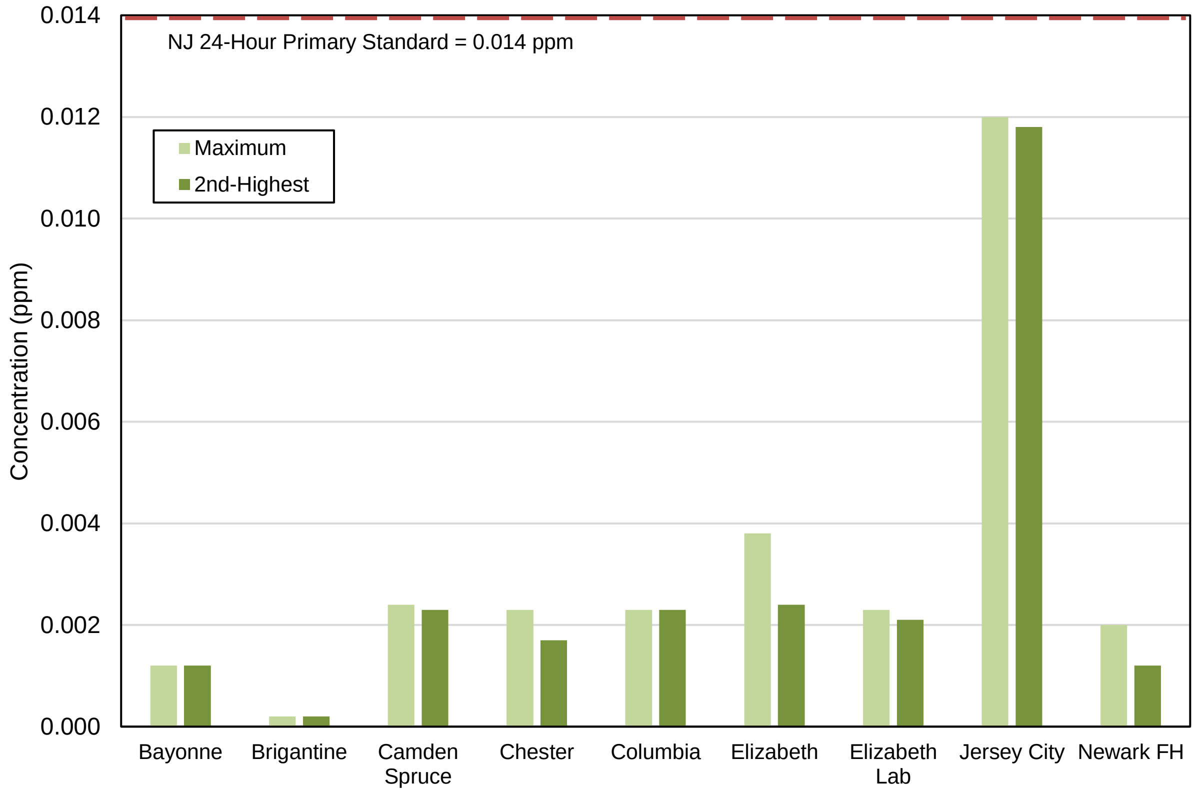
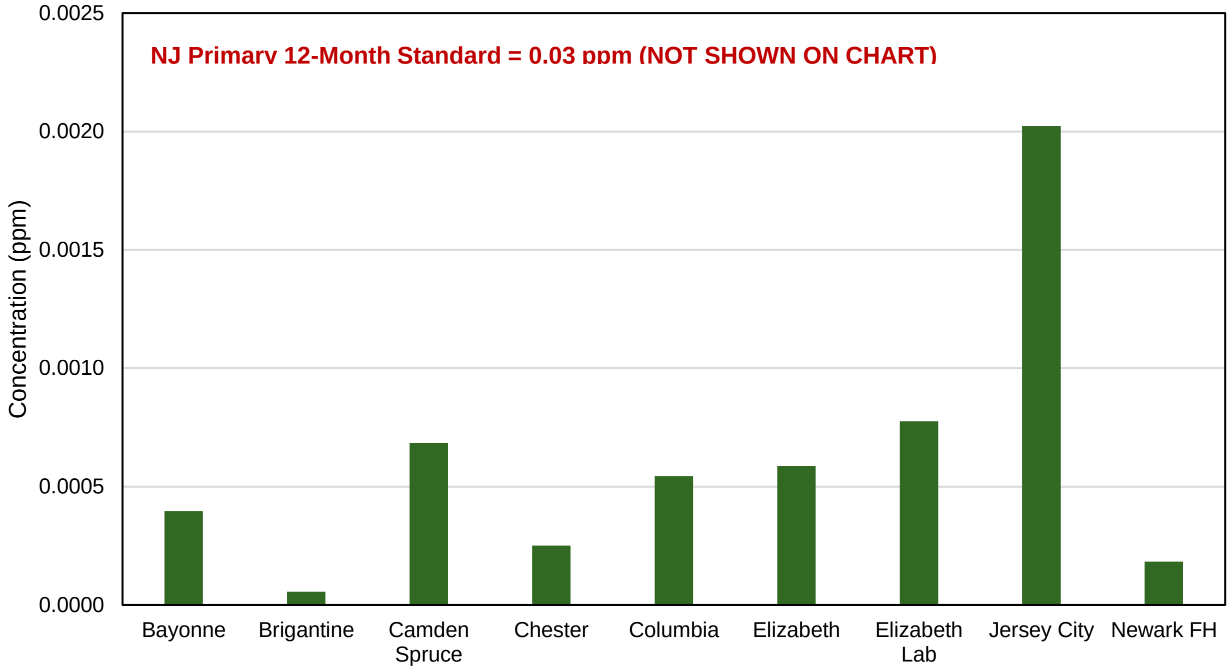


Table 7-5
2020 Sulfur Dioxide Concentrations in New Jersey
Maximum 12-Month Running Averages
Parts per Million (ppm)

Monitoring Site	Maximum 12-Month Running Average
Bayonne	0.0004
Brigantine	0.0001
Camden Spruce Street	0.0007
Chester	0.0003
Columbia	0.0005
Elizabeth	0.0006
Elizabeth Lab	0.0008
Jersey City	0.0020
Newark Firehouse	0.0002

Figure 7-6
2020 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 7-7 shows the second-highest daily average concentrations of SO_2 recorded in New Jersey each year since 1980 (also see Table 7-6). 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 7-8) 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 7-8 also 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 7-7
Statewide New Jersey Sulfur Dioxide Trend, 1980-2020
2nd-Highest 24-Hour Average Concentrations
Parts per Billion (ppb)

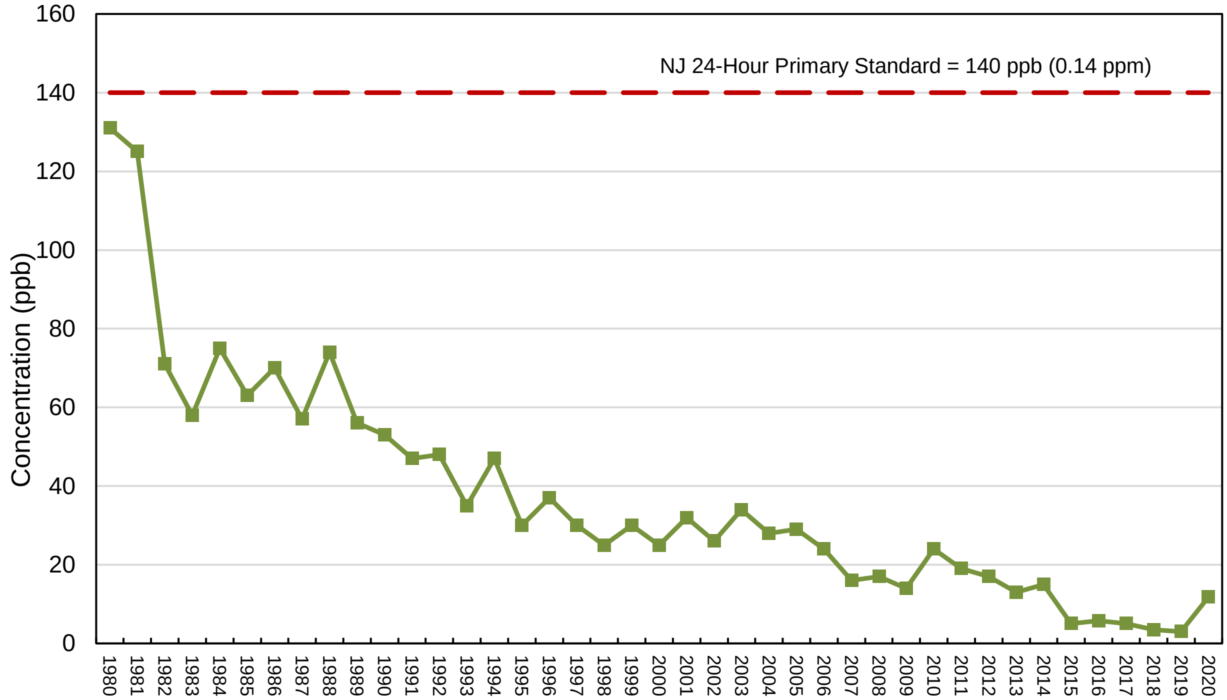


Figure 7-8
Statewide New Jersey Sulfur Dioxide Trends, 1980-2020
99th Percentile & 3-Year Average of the 99th Percentile Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)

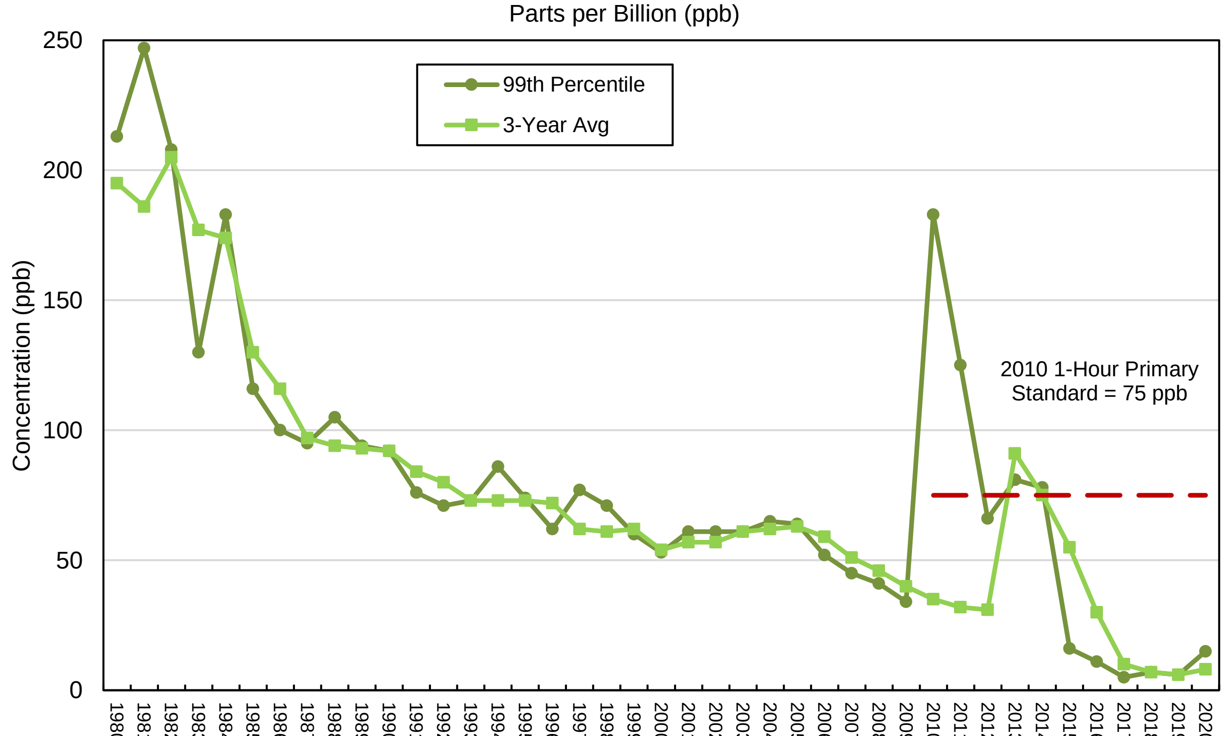


Table 7-6
Statewide New Jersey Sulfur Dioxide Trends
Parts per Billion (ppb)

Year	24-Hour Average	1-Hour Daily Maximum	
	2nd-Highest	99th Percentile	3-Year Average*
1980	131	213	195
1981	125	247	186
1982	71	208	205
1983	58	130	177
1984	75	183	174
1985	63	116	130
1986	70	100	116
1987	57	95	97
1988	74	105	94
1989	56	94	93
1990	53	92	92
1991	47	76	84
1992	48	71	80
1993	35	73	73
1994	47	86	73
1995	30	74	73
1996	37	62	72
1997	30	77	62
1998	25	71	61
1999	30	60	62
2000	25	53	54
2001	32	61	57
2002	26	61	57
2003	34	61	61
2004	28	65	62
2005	29	64	63
2006	24	52	59
2007	16	45	51
2008	17	41	46
2009	14	34	40
2010	24	183	35
2011	19	125	32
2012	17	66	31
2013	13	81	91
2014	15	78	75
2015	5	16	55
2016	5.8	11	30
2017	5	5	10
2018	3.5	7	7
2019	3	6	6
2020	11.8	15	8

*Design value

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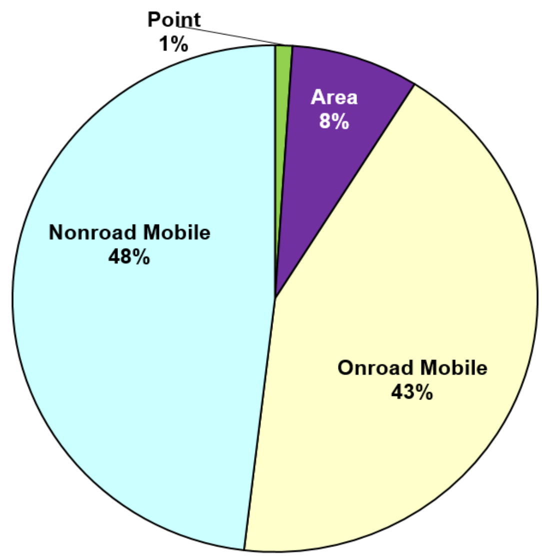
2020 Carbon Monoxide Summary

New Jersey Department of Environmental Protection

SOURCES

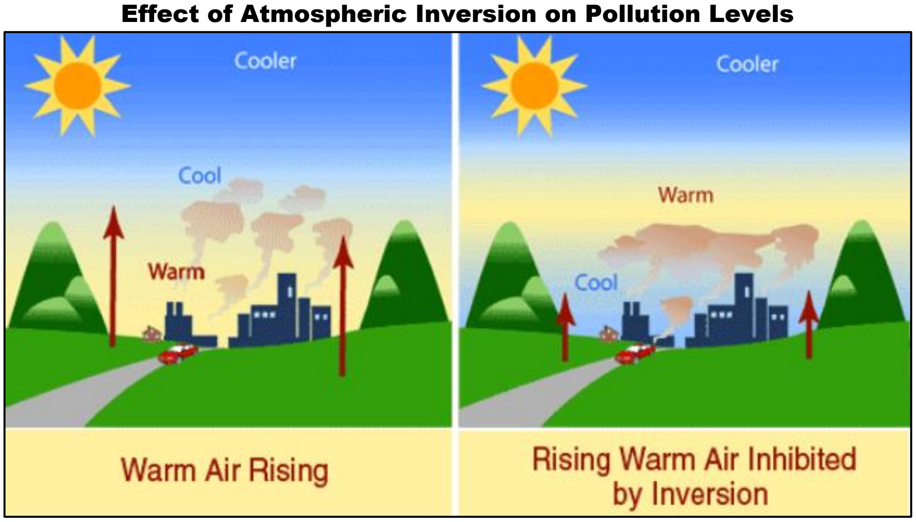
Carbon monoxide (CO) is a colorless, odorless gas formed when carbon in fuels is not burned completely. The main source of outdoor CO is exhaust from internal combustion engines, primarily on-road vehicles, as well as non-road vehicles, generators, construction equipment, boats and other types of mobile 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 (latest estimate available) 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

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. 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.

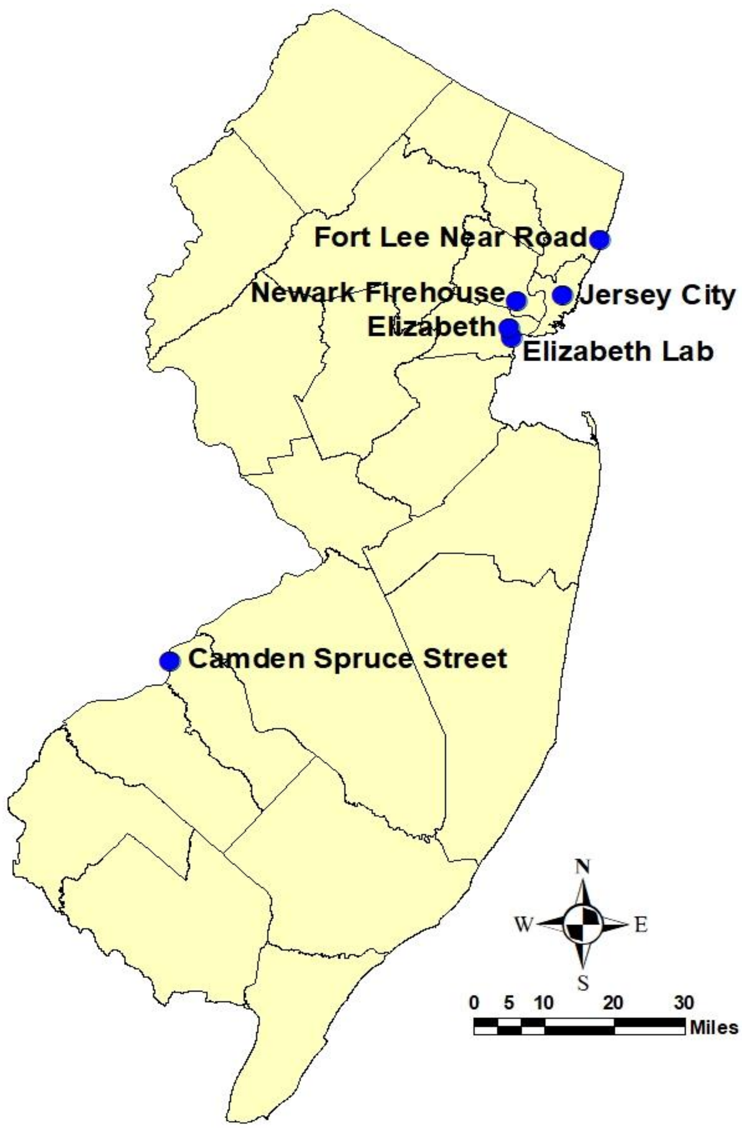
Table 8-1
National and New Jersey Ambient air Quality Standards
for Carbon Monoxide
Parts per Million (ppm)

Averaging Period	Type	National Level	New Jersey Level	Design Value
1-Hour	Primary	35 ppm	35 ppm	Annual 2nd-highest
1-Hour	Secondary	----	35 ppm	2nd-highest 12-month value
8-Hours	Primary	9 ppm	9 ppm	Annual 2nd-highest
8-Hours	Secondary	----	9 ppm	2nd-highest 12-month value

CO MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) has six CO monitors around the state, as shown on the map in Figure 8-3. 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. However, in 2020 the Jersey City station was shut down from October 31 through the end of the year after the site was damaged by water infiltration after a storm.

Figure 8-3
2020 Carbon Monoxide Monitoring Network



CO Levels in 2020

There were no exceedances of any CO standards at any of the New Jersey monitoring sites during 2020. The highest values were all recorded at the Newark Firehouse site. The maximum and 2nd-highest 1-hour average CO concentrations were 3.113 ppm and 2.715 ppm. The highest and 2nd-highest 8-hour average CO concentrations were 2.5 ppm and 2.1 ppm. Summaries of the 2020 data are provided in Table 8-2, and Figures 8-4 and 8-5.

Table 8-2
2020 Carbon Monoxide Concentrations in New Jersey
Parts per Million (ppm)

Monitoring Site	1-Hour Average Concentrations		8-Hour Average Concentrations	
	Highest	2nd-Highest	Highest	2nd-Highest*
Camden Spruce Street	1.6	1.5	1.3	1.0
Elizabeth	2.4	2.3	2.0	1.6
Elizabeth Lab	2.5	2.1	1.6	1.6
Fort Lee Near Road	1.7	1.5	1.2	1.1
Jersey City**	2.8	2.2	2.0	1.9
Newark Firehouse	**3.113**	**2.715**	**2.5**	**2.1**

*Non-overlapping 8-hour periods
**Site was temporarily shut down from 10/31 to 12/31/2020.

Figure 8-4
2020 Carbon Monoxide Concentrations in New Jersey
1-Hour Averages
Parts per Million (ppm)

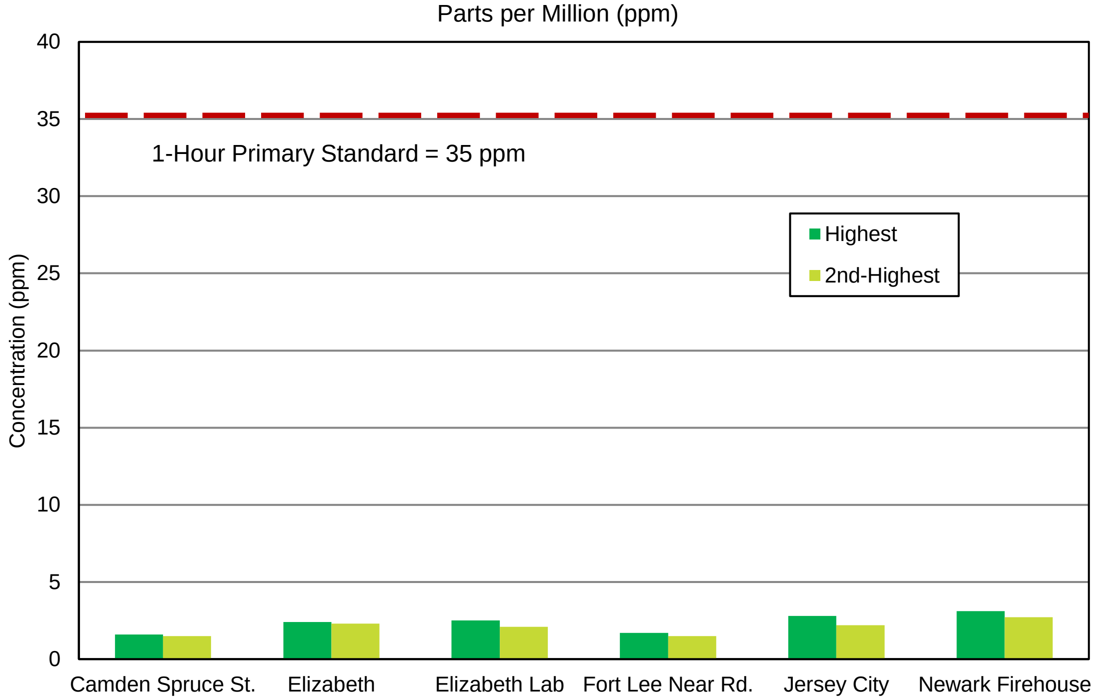
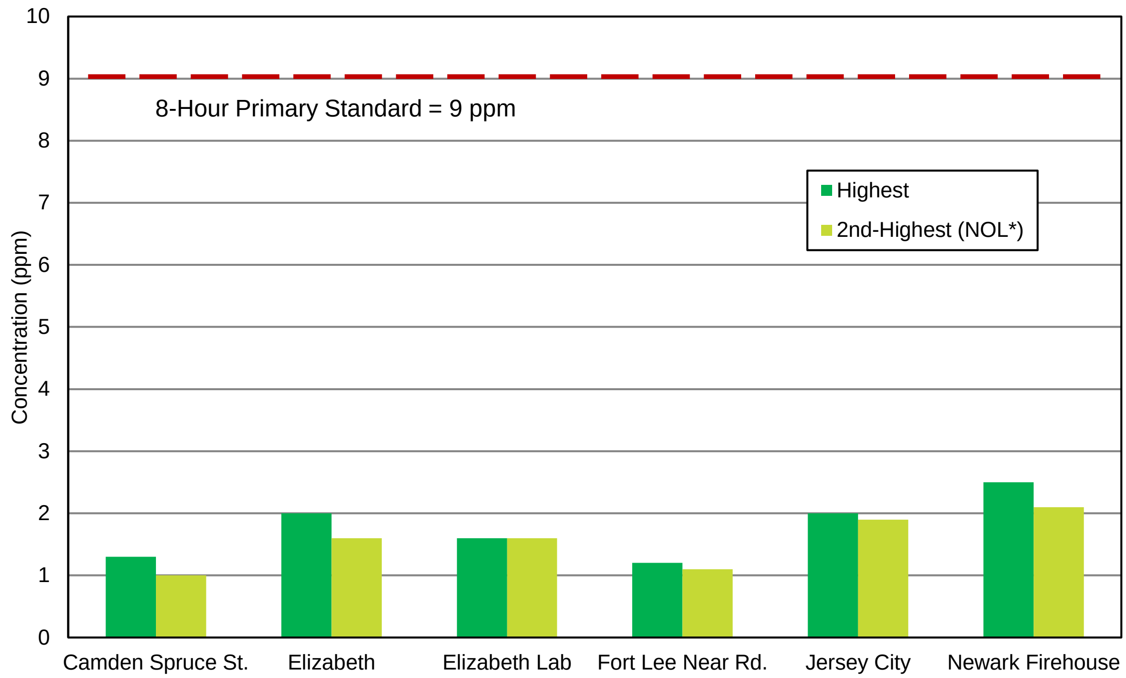


Figure 8-5
2020 Carbon Monoxide Concentrations in New Jersey
8-Hour Averages
Parts per Million (ppm)



*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 8-6 and 8-7 and Table 8-3 present the trends in CO levels since 1990. The graphs and table 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 8-6
Statewide New Jersey Carbon Monoxide Trend, 1990-2020
2nd-Highest 1-Hour Average Concentration
Parts per Million (ppm)

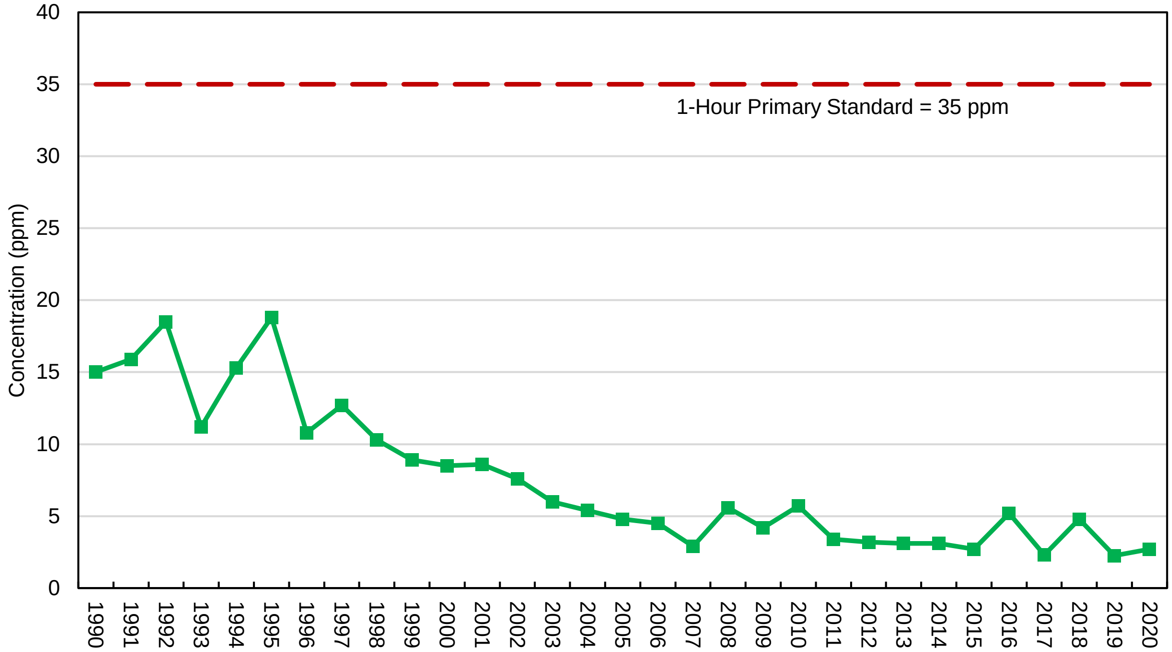


Figure 8-7
Statewide New Jersey Carbon Monoxide Trend, 1990-2020
2nd-Highest 8-Hour Average Concentration
Parts per Million (ppm)

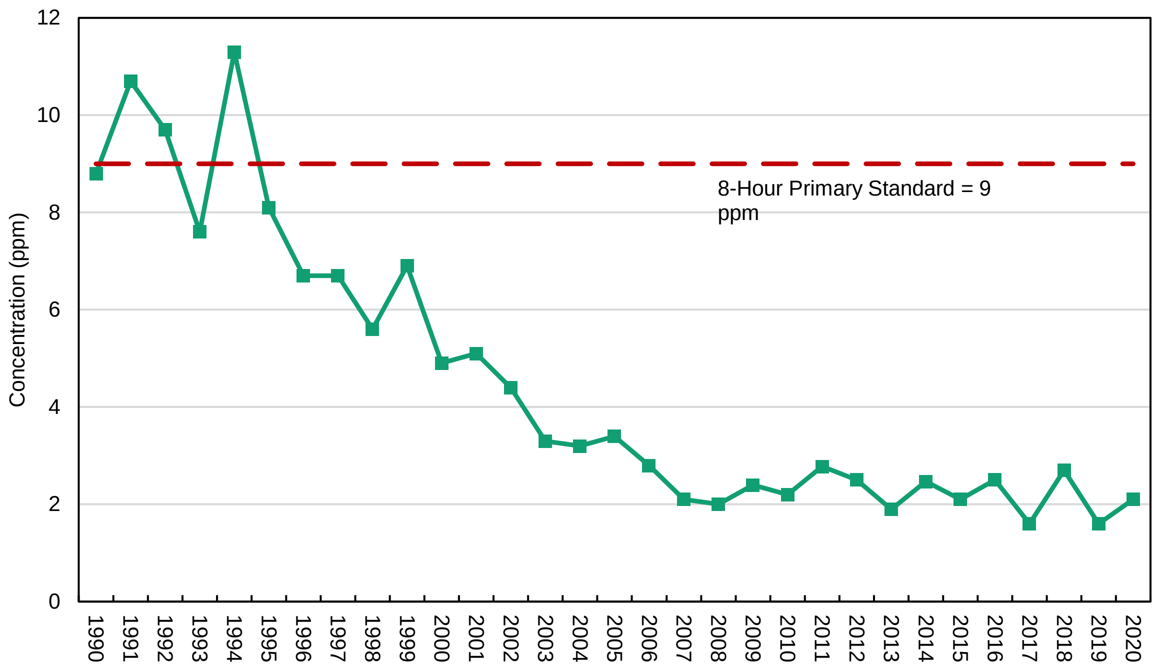


Table 8-3
Statewide New Jersey Carbon Monoxide Trends, 1990-2020
1-Hour and 8-Hour Average Concentrations
Parts per Million (ppm)

Year	2nd-Highest Average Concentrations*	
	1-Hour	8-Hour
1990	15	8.8
1991	15.9	10.7
1992	18.5	9.7
1993	11.2	7.6
1994	15.3	11.3
1995	18.8	8.1
1996	10.8	6.7
1997	12.7	6.7
1998	10.3	5.6
1999	8.9	6.9
2000	8.5	4.9
2001	8.6	5.1
2002	7.6	4.4
2003	6	3.3
2004	5.4	3.2
2005	4.8	3.4
2006	4.5	2.8
2007	2.9	2.1
2008	5.6	2
2009	4.2	2.4
2010	5.7	2.2
2011	3.4	2.8
2012	3.2	2.5
2013	3.1	1.9
2014	3.1	2.5
2015	2.7	2.1
2016	5.2	2.5
2017	2.3	1.6
2018	4.8	2.7
2019	2.3	1.6
2020	2.7	2.1

*Design values

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2020 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, although it is still used in aviation fuel in some smaller aircraft. The most recent USEPA National Emissions Inventory estimates that 4.36 tons of lead were emitted in New Jersey in 2017, mostly from aircraft. 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 (ingestion 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	Design Value
3 Months (Rolling)	Primary & Secondary	0.15 µg/m^3	Not to be exceeded

LEAD AIR LEVELS IN 2020

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 concentrations, all of New Jersey's lead monitors were shut down. In March 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 2020. Because of the 2020 COVID-19 shutdown, no lead samples could be collected between March 4 and July 8.

Figure 9-1
Lead Concentrations at Newark Firehouse in New Jersey, 2012-2020
24-Hour Averages
Micrograms per Cubic Meter (µg/m³)

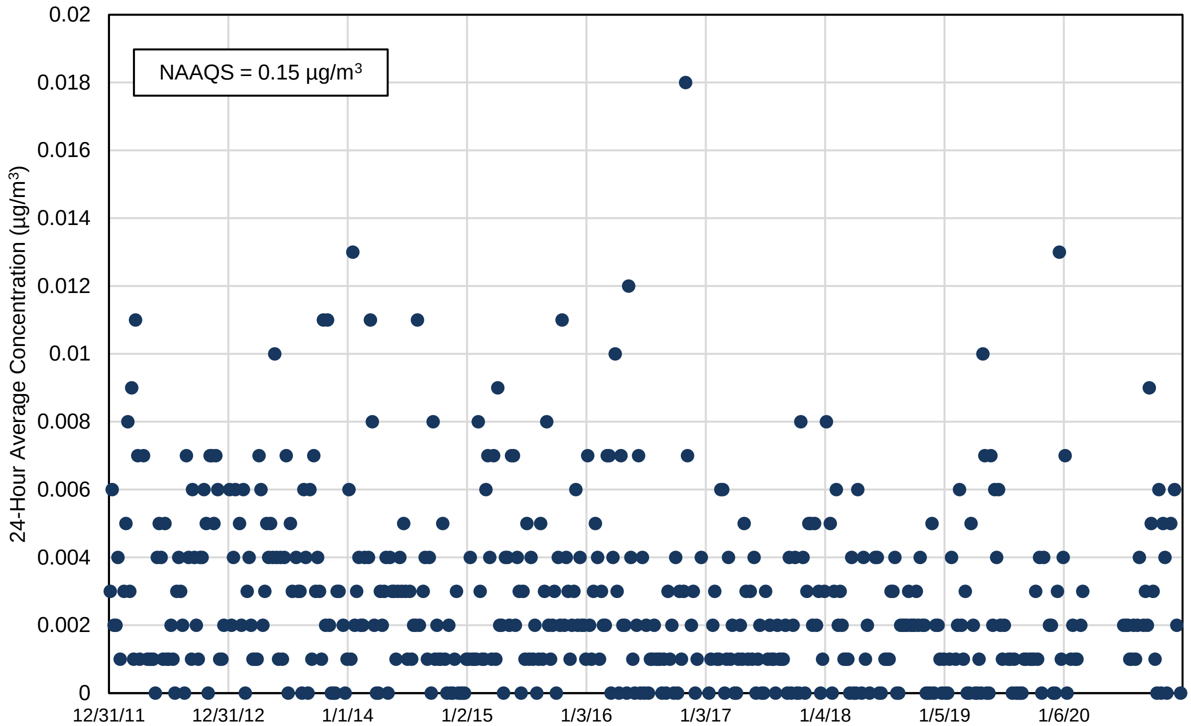


Table 9-1
2020 Lead Concentrations in New Jersey
3-Month Rolling Averages
Micrograms per Cubic Meter (µg/m³)

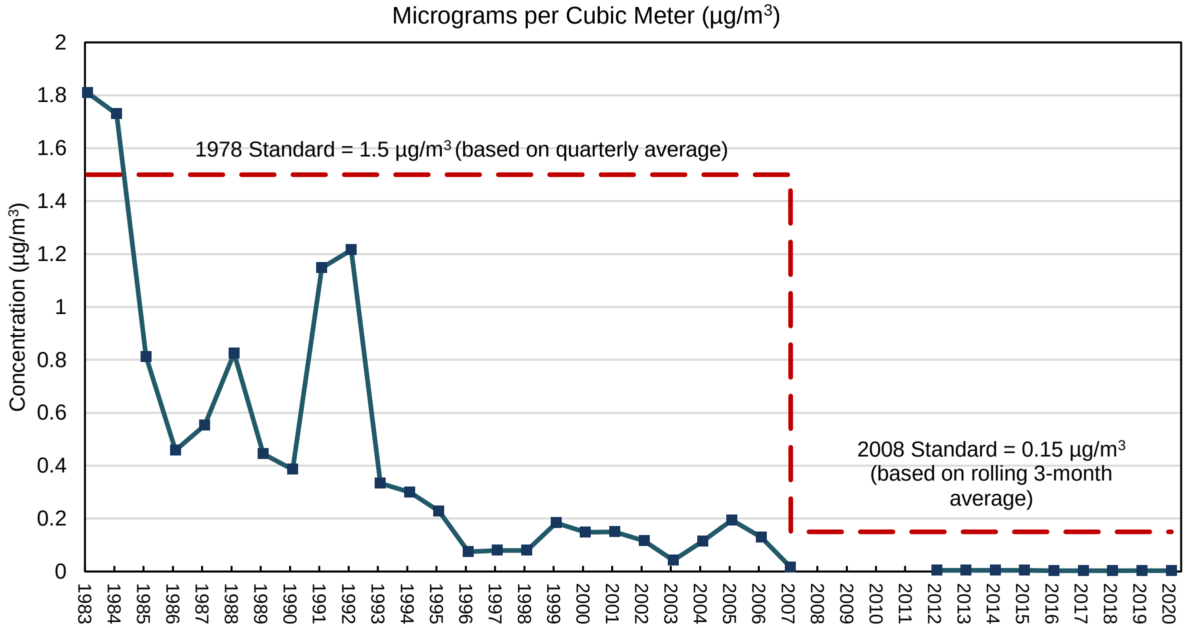
3-Month Period	3-Month Average
November-January	0.003
December-February	0.003
January-March	*
February-April	*
March-May	*
April-June	*
May-July	*
June-August	*
July-September	0.003
August-October	0.003
September-November	0.003
October-December	0.003

*No samples were collected between March 4 and July 8, 2020

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
Statewide New Jersey Lead Trend, 1983-2020
Highest 3-Month Averages
Micrograms per Cubic Meter (µg/m³)



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2020 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.

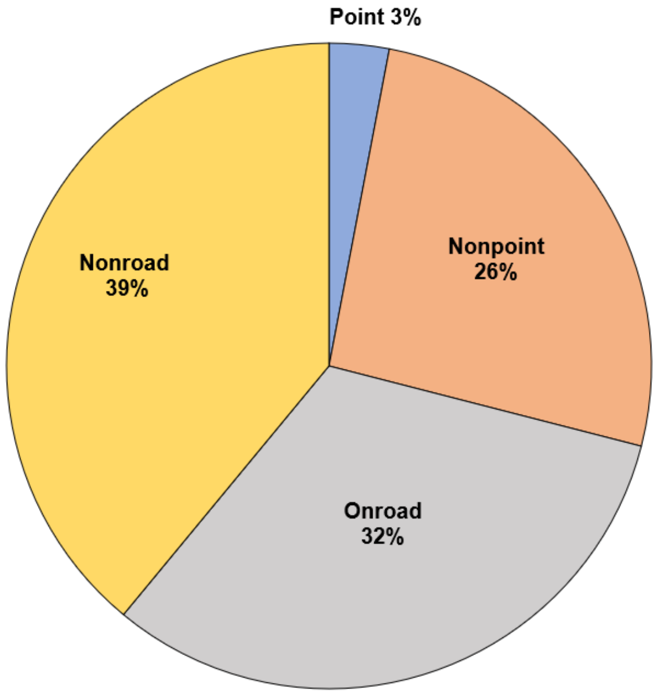
Air toxics are all the other chemicals released into the air that have the potential to cause adverse health effects in humans. These effects cover a wide range of conditions, from lung irritation to birth defects to cancer. There are no NAAQS for these pollutants, but in 1990 the U.S. Congress directed 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

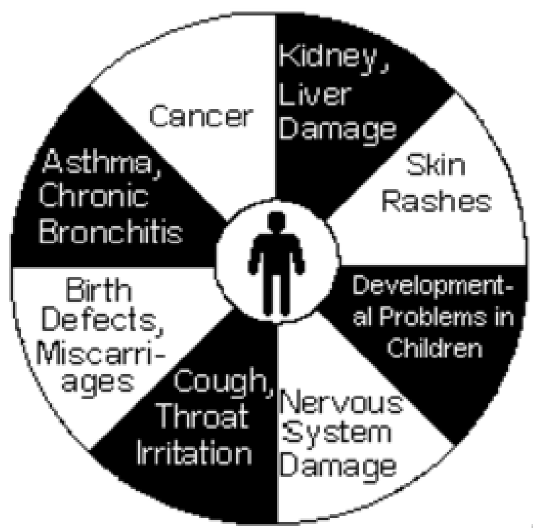


https://www.nj.gov/dep/airtoxics/sourceso14.htm

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

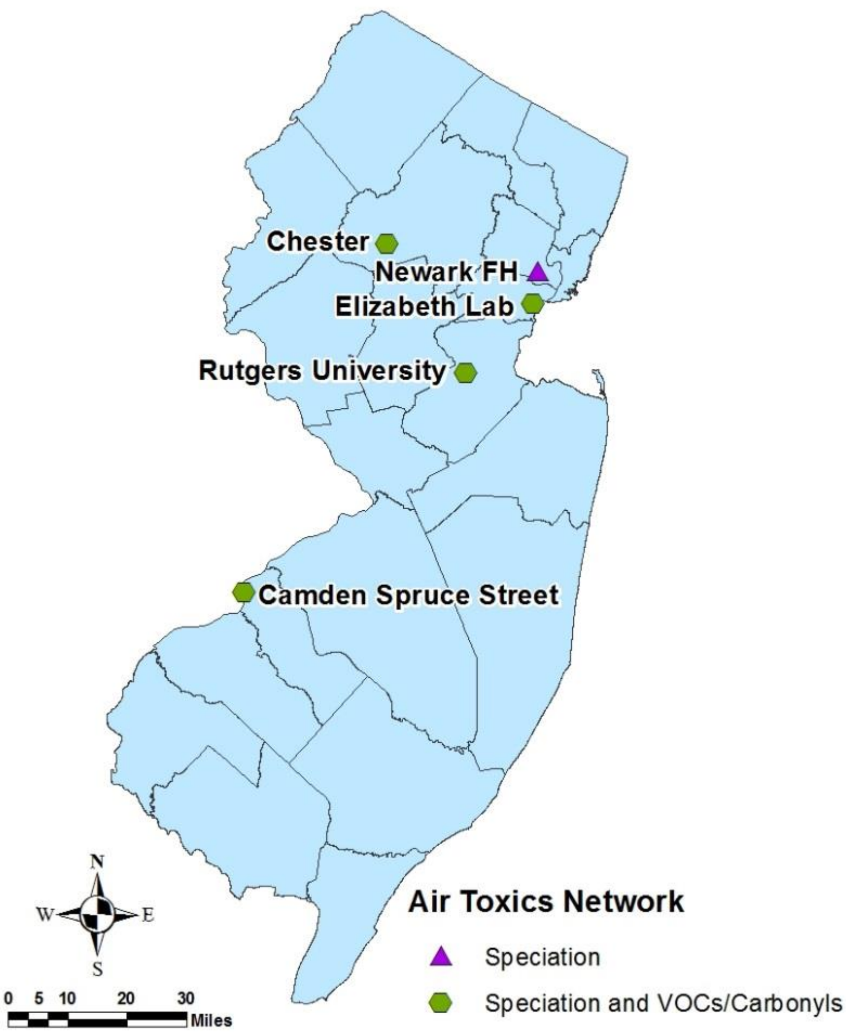


Source: www3.epa.gov/ttn/atw/3_90_024.html

MONITORING LOCATIONS

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

Figure 10-3
2020 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, but 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 fine particulate matter for 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 2020

The worldwide COVID-19 shutdown prevented the pickup, setup and analysis of toxics data between mid-March and mid-August. Samples are normally taken every sixth day, resulting in about 60 data points for a given year. This year we averaged about 34 samples per site.

Summary statistics were done using the data available for 2020. 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 ($\mu g/m^3$). Values in parts per billion by volume (ppbv), as well as other statistics and risk estimates, can be found in Tables 10-4 through 10-7. 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 in the analysis can be found in Table 10-9. A number of compounds were not detected in some of the samples analyzed by the lab. 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 mean 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
2020 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey
Annual Average Concentrations
Micrograms per Cubic Meter ($\mu g/m^3$)

Pollutant		Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acetaldehyde		*	75-07-0	2.720	1.052	1.839	1.097
2	Acetone			67-64-1	3.312	1.812	3.307	2.381
3	Acetonitrile		*	75-05-8	0.238	0.267	0.871	0.377
4	Acetylene			74-86-2	0.459	0.235	0.436	0.399
5	Acrolein		*	107-02-8	0.679	0.534	0.654	0.695
6	Acrylonitrile		*	107-13-1	*0*	*0.001*	*0.0002*	*0.001*
7	tert-Amyl Methyl Ether			994-05-8	*0*	*0*	*0*	*0*
8	Benzaldehyde			100-52-7	0.420	0.064	0.126	0.077
9	Benzene		*	71-43-2	0.978	0.377	0.763	0.511
10	Bromochloromethane			74-97-5	*0*	*0*	*0*	*0*
11	Bromodichloromethane			75-27-4	*0*	*0.0004*	*0*	*0.001*
12	Bromoform		*	75-25-2	0.019	0.012	0.021	0.014
13	Bromomethane	Methyl bromide	*	74-83-9	0.141	0.067	0.031	0.038
14	1,3-Butadiene		*	106-99-0	0.060	0.009	0.068	0.035
15	Butyraldehyde			123-72-8	0.399	0.143	0.297	0.199
16	Carbon Disulfide		*	75-15-0	0.078	0.030	0.117	0.038
17	Carbon Tetrachloride		*	56-23-5	0.561	0.576	0.570	0.530
18	Chlorobenzene		*	108-90-7	*0.009*	*0.001*	*0.006*	*0.004*
19	Chloroethane	Ethyl chloride	*	75-00-3	0.021	0.009	0.020	0.024
20	Chloroform		*	67-66-3	0.125	0.092	0.129	0.131
21	Chloromethane	Methyl chloride	*	74-87-3	0.975	0.920	0.948	0.924
22	Chloroprene	2-Chloro-1,3-butadiene	*	126-99-8	*0*	*0*	*0*	0
23	Crotonaldehyde			123-73-9	0.179	0.181	0.211	0.152
24	Dibromochloromethane	Chlorodibromomethane		124-48-1	*0.004*	*0.001*	0.003	*0.002*
25	1,2-Dibromoethane	Ethylene dibromide	*	106-93-4	*0*	*0*	*0*	*0*
26	m-Dichlorobenzene	1,3-Dichlorobenzene		541-73-1	*0.001*	*0.0003*	*0.0001*	*0.0002*
27	o-Dichlorobenzene	1,2-Dichlorobenzene		95-50-1	*0.002*	*0.001*	*0.009*	*0.0003*
28	p-Dichlorobenzene	1,4-Dichlorobenzene	*	106-46-7	0.077	0.008	0.038	0.033
29	Dichlorodifluoromethane			75-71-8	2.312	2.189	2.189	2.221
30	1,1-Dichloroethane	Ethylidene dichloride	*	75-34-3	*0*	*0*	*0*	*0*
31	1,2-Dichloroethane	Ethylene dichloride	*	107-06-2	0.106	0.070	0.081	0.075
32	1,1-Dichloroethylene	Vinylidene chloride	*	75-35-4	*0.008*	*0.001*	*0.0004*	*0.0004*
33	cis-1,2-Dichloroethylene	cis-1,2-Dichloroethene		156-59-2	*0*	*0*	*0*	*0*
34	trans-1,2-Dichloroethylene	trans-1,2-Dichloroethene		156-60-5	0.015	*0.002*	0.012	0.010
35	Dichloromethane	Methylene chloride	*	75-09-2	0.506	0.398	1.355	0.477
36	1,2-Dichloropropane	Propylene dichloride	*	78-87-5	*0.005*	*0.002*	*0.002*	*0.001*

Continued

- Values in ppbv can be found in Tables 10-4 through 10-7.
- *Values in **italics** indicate that fewer than 50% of samples had detectable levels.*
- **Zero** indicates that there were no samples with reportable levels.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

Table 10-1 (continued)
2020 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey
Annual Average Concentrations
Micrograms per Cubic Meter ($\mu g/m^3$)

	Pollutant	Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	Rutgers
37	cis-1,3-Dichloropropylene	cis-1,3-Dichloropropene	*	10061-01-5	*0*	*0*	*0*	*0*
38	trans-1,3-Dichloropropylene	trans-1,3-Dichloropropene	*	10061-02-6	*0*	*0*	*0*	*0*
39	Dichlorotetrafluoroethane	Freon 114		76-14-2	0.107	0.107	0.107	0.108
40	Ethyl Acrylate		*	140-88-5	*0.003*	*0*	0	*0*
41	Ethylbenzene		*	100-41-4	0.513	0.052	0.224	0.110
42	Ethyl tert-Butyl Ether	tert-Butyl ethyl ether		637-92-3	*0*	0.029	*0.001*	0.037
43	Formaldehyde		*	50-00-0	3.704	1.341	2.935	1.607
44	Hexachlorobutadiene	Hexachloro-1,3-butadiene	*	87-68-3	*0.002*	*0.001*	*0.0004*	*0.0004*
45	Hexaldehyde	Hexanaldehyde		66-25-1	0.183	0.062	0.161	0.082
46	Methyl Ethyl Ketone	MEK, 2-Butanone		78-93-3	0.503	0.257	0.496	0.363
47	Methyl Isobutyl Ketone	MIBK	*	108-10-1	0.182	0.049	0.121	0.066
48	Methyl Methacrylate		*	80-62-6	0.055	*0.003*	0.061	*0.041*
49	Methyl tert-Butyl Ether	MTBE	*	1634-04-4	*0.005*	*0.002*	*0.002*	*0.008*
50	n-Octane			111-65-9	0.320	0.060	0.248	0.086
51	Propionaldehyde		*	123-38-6	0.418	0.217	0.388	0.249
52	Propylene			115-07-1	0.692	0.167	1.751	0.369
53	Styrene		*	100-42-5	0.263	0.016	0.063	0.027
54	1,1,2,2-Tetrachloroethane		*	79-34-5	*0*	*0.001*	*0.002*	*0.0002*
55	Tetrachloroethylene	Perchloroethylene	*	127-18-4	0.148	0.056	0.119	0.076
56	Toluene		*	108-88-3	3.088	0.456	1.554	0.758
57	1,2,4-Trichlorobenzene		*	120-82-1	*0.005*	*0.006*	*0.001*	*0.003*
58	1,1,1-Trichloroethane	Methyl chloroform	*	71-55-6	0.016	0.010	0.015	0.014
59	1,1,2-Trichloroethane		*	79-00-5	*0.005*	*0.0002*	*0.003*	*0.001*
60	Trichloroethylene		*	79-01-6	0.050	0.032	0.046	0.042
61	Trichlorofluoromethane			75-69-4	2.162	1.225	1.232	1.244
62	Trichlorotrifluoroethane	1,1,2-Trichloro-1,2,2-trifluoroethane		76-13-1	0.543	0.541	0.540	0.543
63	1,2,4-Trimethylbenzene			95-63-6	0.571	0.040	0.237	0.106
64	1,3,5-Trimethylbenzene			108-67-8	0.171	0.010	0.069	0.030
65	Valeraldehyde			110-62-3	0.153	0.052	0.114	0.072
66	Vinyl chloride		*	75-01-4	*0.008*	*0.001*	*0.001*	*0.001*
67	m,p-Xylene		*	108-38-3 106-42-3	1.439	0.118	0.639	0.281
68	o-Xylene		*	95-47-6	0.623	0.053	0.275	0.121

- Values in ppbv can be found in Tables 10-4 through 10-7.
- *Values in **italics** indicate that fewer than 50% of samples had detectable levels.*
- **Zero** indicates that there were no samples with reportable levels.
- 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. A **risk ratio** can be used to quantify risk from exposure to specific chemicals, derived by dividing the air concentration of a chemical by its health benchmark. 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 had a risk ratio slightly greater than one at all sites except Chester, and ethylbenzene was slightly greater than one at Camden.

Table 10-2
Monitored Air Toxics with Risk Ratios Greater Than One in 2020

Pollutant		CAS No.	Annual Average Risk Ratio			
			Camden	**Chester**	**Elizabeth**	**Rutgers**
1	Acetaldehyde	75-07-0	6	2	4	2
2	Acrolein	107-02-8	*34*	*27*	*33*	*35*
3	Benzene	71-43-2	8	3	6	4
4	1,3-Butadiene	106-99-0	1.8	0.3	2	1.1
5	Carbon Tetrachloride	56-23-5	3	3	3	3
6	Chloroform	67-66-3	3	2	3	3
7	Chloromethane	74-87-3	1.7	1.6	1.7	1.6
8	1,2-Dichloroethane	107-06-2	3	2	2	2
9	Ethylbenzene	100-41-4	1.3	0.1	0.6	0.3
10	Formaldehyde	50-00-0	48	17	38	21

- Risk ratio = annual average air concentration/health benchmark
- Health benchmarks in italics have a noncancer endpoint. See section below on "Estimating Health Risk" for more information.

Table 10-3 presents annual average concentrations and health benchmarks for certain toxic metals and elements that can be found in fine particles. This fine particulate matter is analyzed through USEPA's Chemical Speciation Network (CSN). No risk ratios were calculated, because most of the chemicals were below the detection limit and so 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
2020 Summary of Toxic Metals and Elements Monitored in New Jersey
Annual Average Concentrations & Health Benchmarks
Micrograms per Cubic Meter ($\mu g/m^3$)

Pollutant	HAP	Camden	Chester	Elizabeth	Newark	Rutgers	Health Benchmark
Antimony	*	0.002	0	*0.001*	*0.001*	*0.001*	*0.2*
Arsenic	*	*0*	*0.00001*	*0.00001*	*0.00001*	*0.00003*	0.00023
Cadmium	*	0.005	0.003	0.003	0.001	0.001	0.00024
Chlorine	*	0.075	0.001	0.012	0.022	0.008	*0.2*
Chromium[a]	*	0.002	0.001	0.002	0.001	0.001	0.000083
Cobalt	*	*0*	*0*	*0*	*0*	*0*	0.00011
Lead	*	0.006	0.001	0.002	0.003	0.002	0.083
Manganese	*	0.004	*0*	0.002	0.002	0.001	*0.05*
Nickel[b]	*	0.001	0.0004	0.001	0.001	0.001	0.0021
Phosphorus	*	0.0004	0.0001	0.001	0.001	0.0002	*0.07*
Selenium	*	0.002	*0*	0.0002	0.0005	*0.0002*	*20*
Silicon		0.057	0.022	0.049	0.058	0.027	*3*
Vanadium		*0.0002*	*0.00002*	*0.0003*	*0.0002*	*0.0002*	*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.

Acrolein is sometimes used as a pesticide and to make other chemicals, but by far most of it is formed in the air from burning fossil fuels (gasoline, oil) and organic matter (including cigarettes). It is not known if it causes cancer, but it can have detrimental effects on the respiratory system. Prior to 2016, there were concerns that the laboratory methods used to measure acrolein were inadequate. The analysis methods have since been improved, and the recent data is presented in Figure 10-5.

Figures 10-6 and 10-7 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 10-8) 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 because it depletes 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 the **chloroform** concentration shown in Figure 10-9 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 10-10, **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 10-11) is primarily used in the production of chemicals, as a solvent, dispersant and wetting and penetrating agent. The increase in concentrations after 2011 is related to an improvement in the 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.

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

Formaldehyde (Figure 10-13) is a ubiquitous pollutant that is often found at higher concentrations indoors rather than outdoors because of its use in many consumer goods. It is used in the production of fertilizer, paper, plywood, urea-formaldehyde resins, and many other products. In New Jersey the primary emitters of formaldehyde are mobile sources, although 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 10-5
ACETALDEHYDE – New Jersey Monitored Concentrations

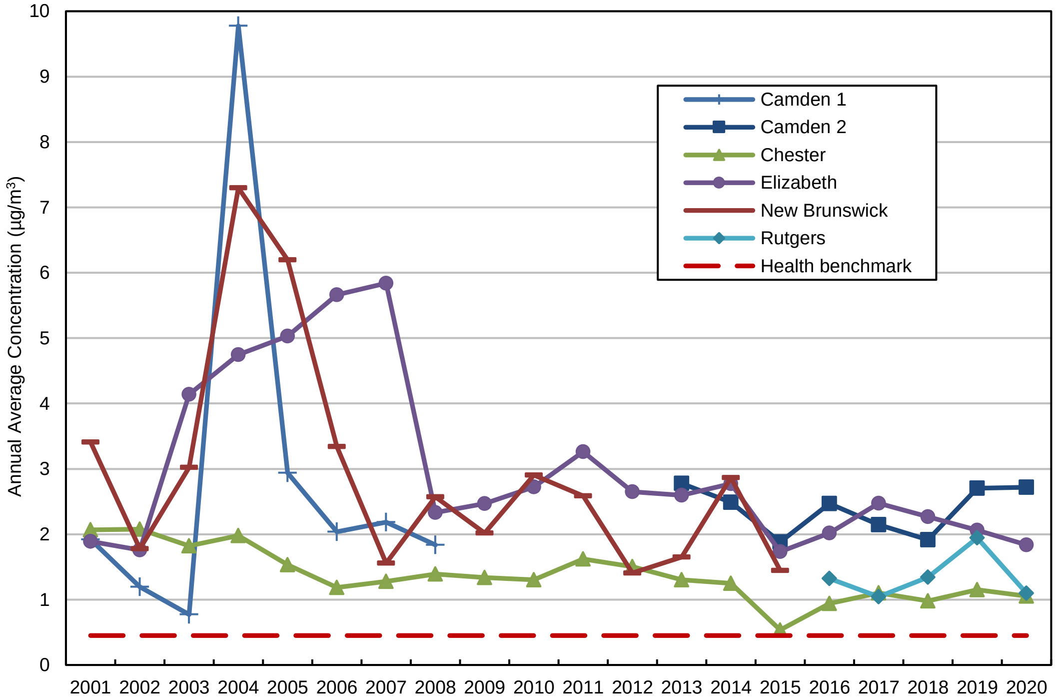


Figure 10-4
ACROLEIN – New Jersey Monitored Concentrations

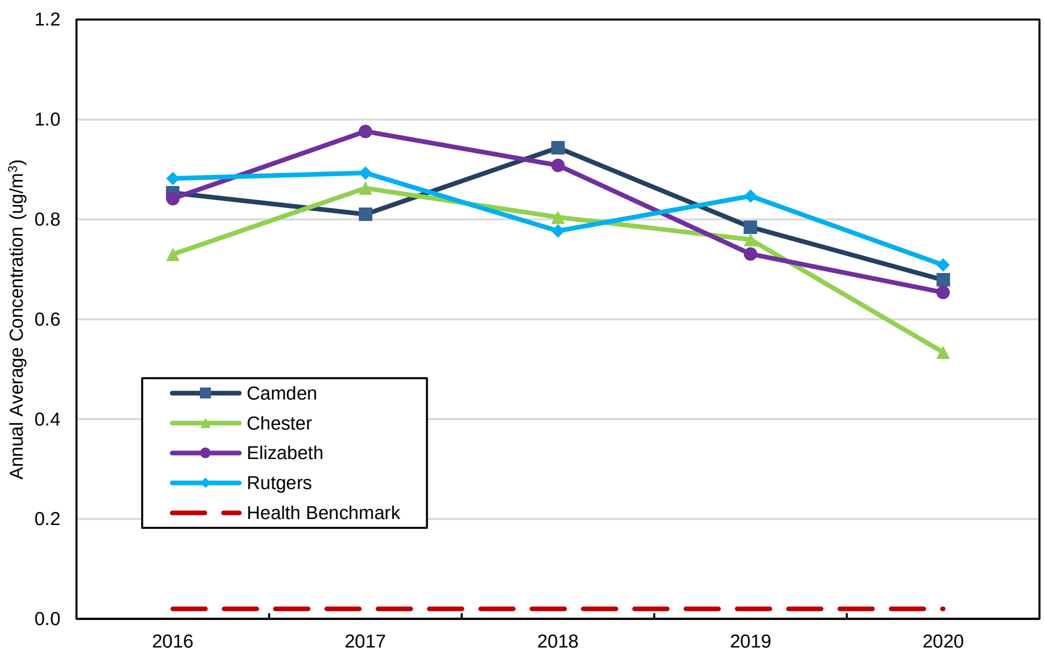


Figure 10-6
BENZENE – New Jersey Monitored Concentrations

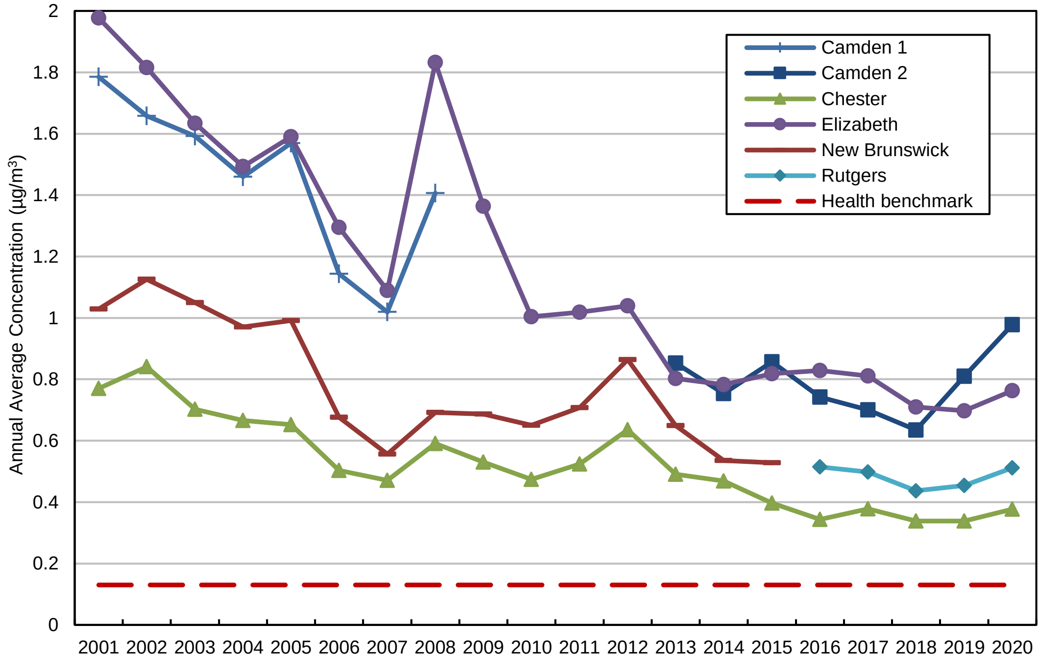


Figure 10-7
1,3-BUTADIENE – New Jersey Monitored Concentrations

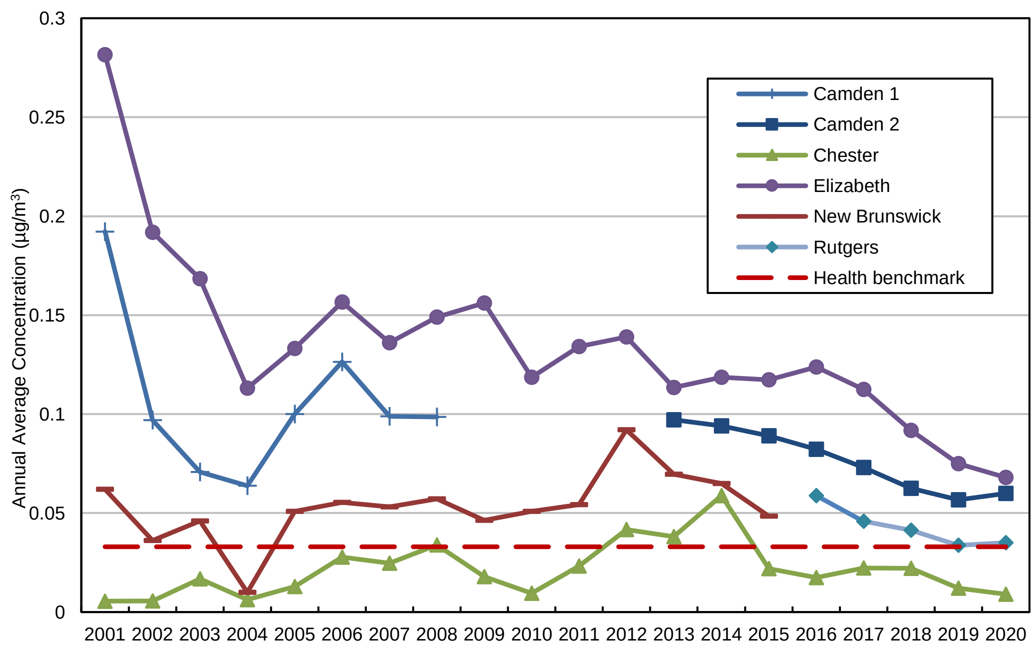


Figure 10-8
CARBON TETRACHLORIDE – New Jersey Monitored Concentrations

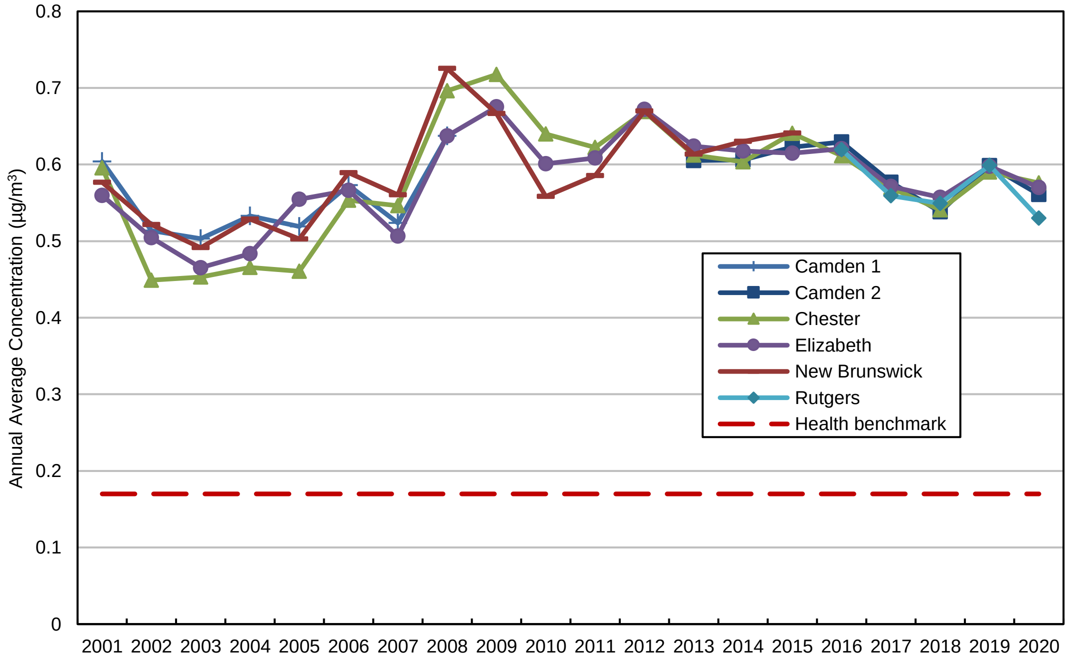


Figure 10-9
CHLOROFORM – New Jersey Monitored Concentrations

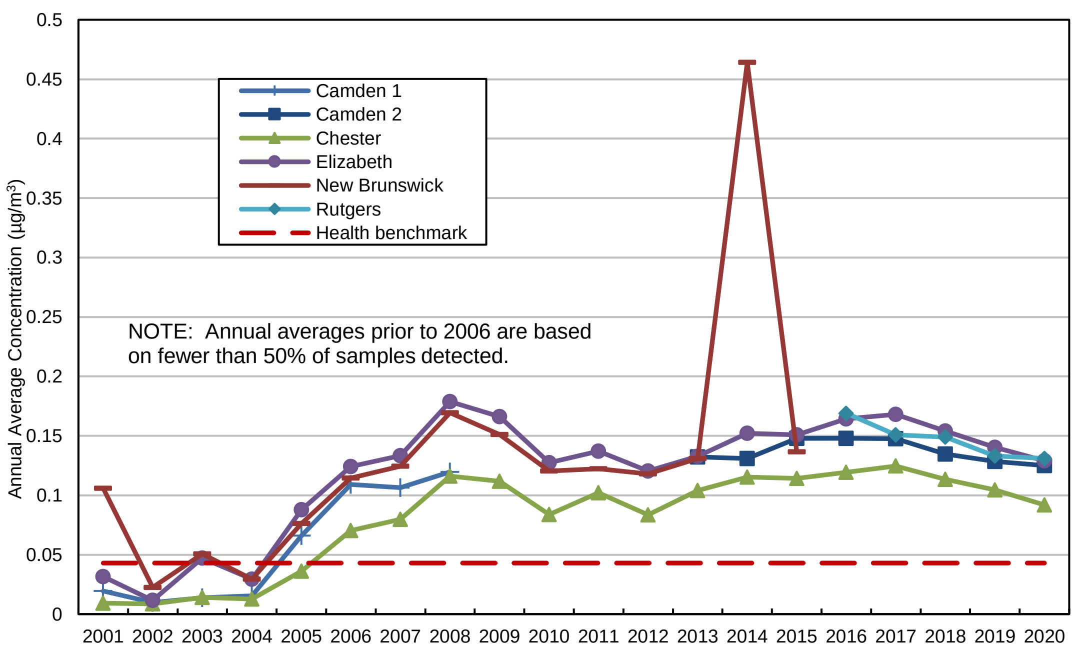


Figure 10-10
CHLOROMETHANE (Methyl Chloride) – New Jersey Monitored Concentrations

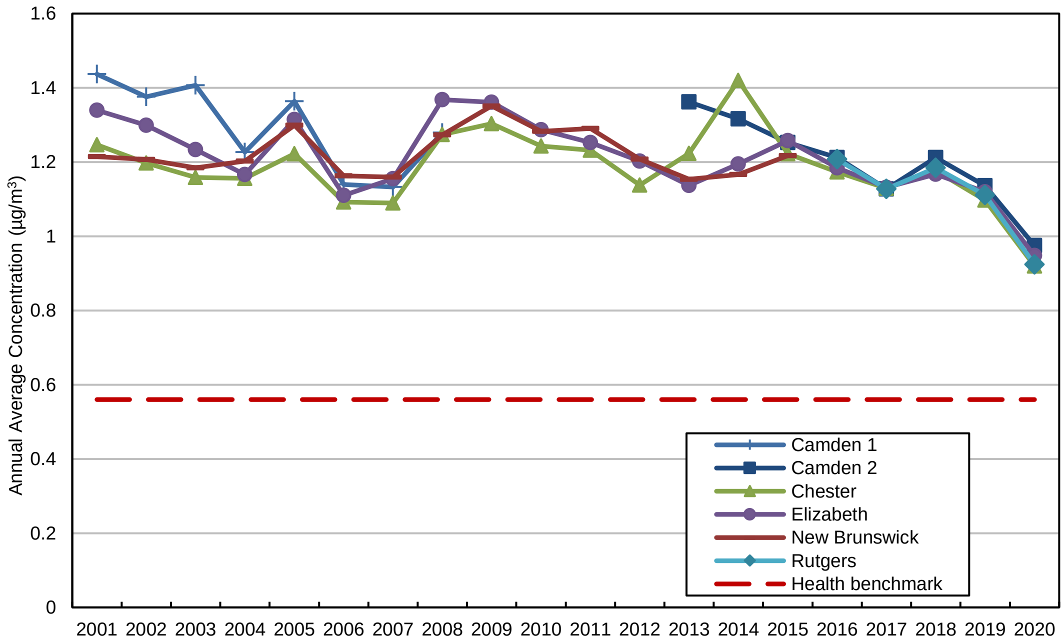


Figure 10-11
1,2-DICHLOROETHANE (Ethylene Dichloride) – New Jersey Monitored Concentrations

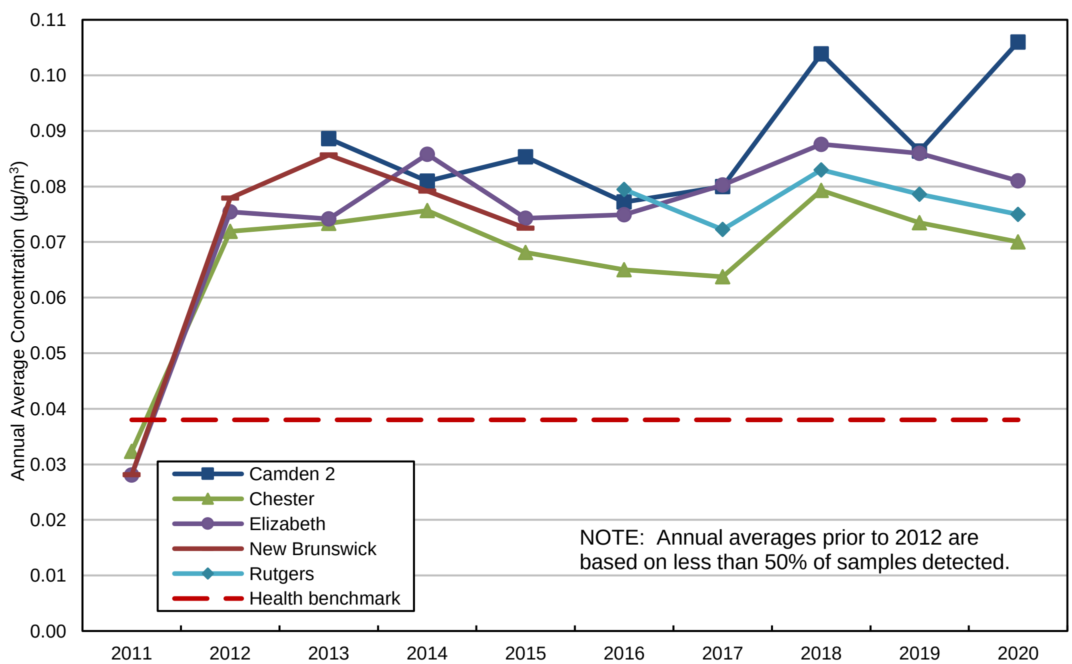


Figure 10-12
ETHYLBENZENE – New Jersey Monitored Concentrations

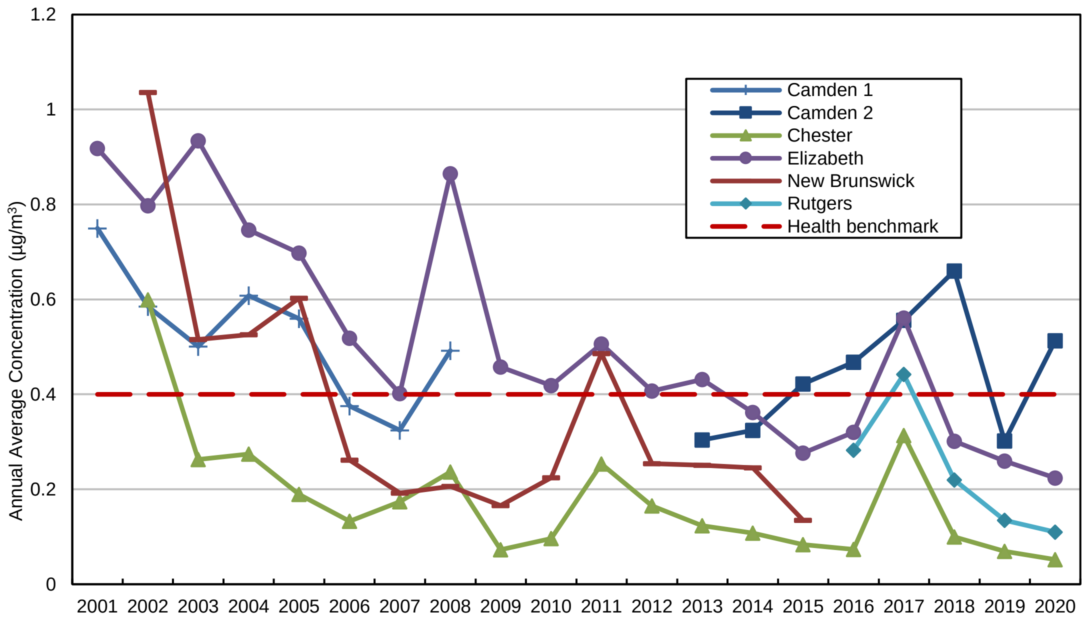


Figure 10-13
FORMALDEHYDE – New Jersey Monitored Concentrations

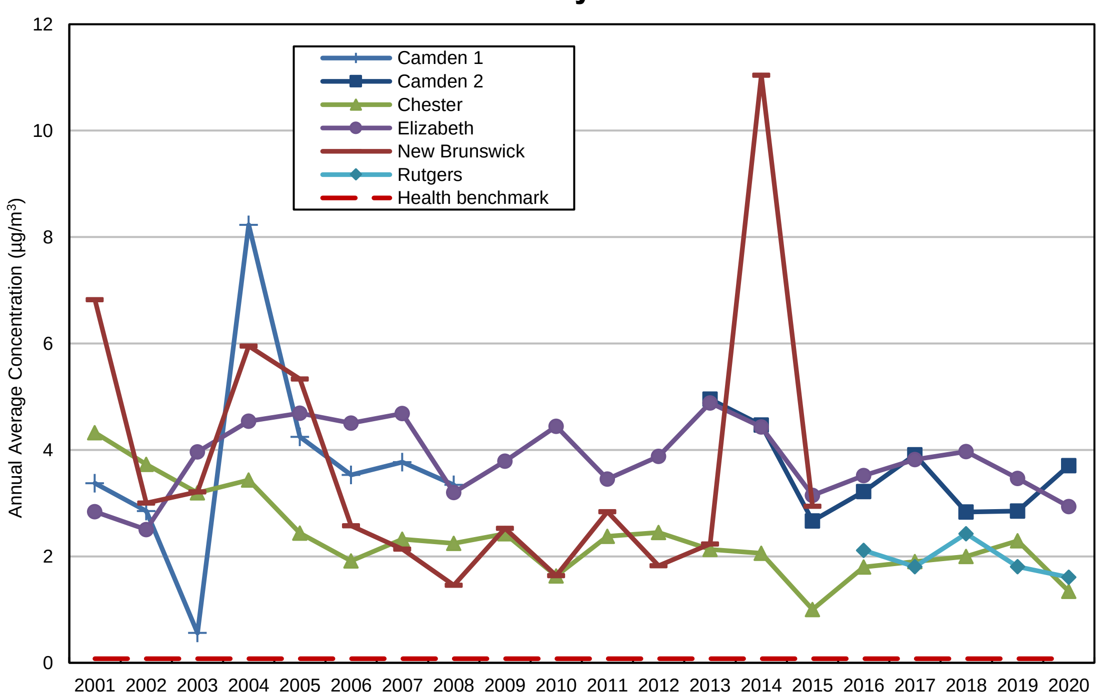


Table 10-4
CAMDEN SPRUCE STREET – 2020 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean	Annual Median	24-Hour Max.	Annual Mean	Annual Median	24-Hour Max.	% Detected	Annual Mean Risk Ratio
		ppbv			μg/m³				
1	Acetaldehyde	1.509	1.470	2.810	2.720	2.649	5.063	100	**6**
2	Acetone	1.394	1.140	3.020	3.312	2.708	7.174	100	*0.0001*
3	Acetonitrile	0.141	0.116	0.400	0.238	0.195	0.672	94	*0.004*
4	Acetylene	0.431	0.301	1.540	0.459	0.320	1.639	100	
5	Acrolein	0.296	0.269	0.624	0.679	0.617	1.431	100	***34***
6	Acrylonitrile	*0*	0	0	*0*	0	0	0	
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.097	0.046	0.298	0.420	0.201	1.293	100	
9	Benzene	0.306	0.236	0.984	0.978	0.754	3.144	100	**8**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0*	0	0	*0*	0	0	0	
12	Bromoform	0.002	0.002	0.018	0.019	0.018	0.184	74	0.02
13	Bromomethane	0.036	0.010	0.353	0.141	0.039	1.371	100	*0.03*
14	1,3-Butadiene	0.027	0.018	0.114	0.060	0.039	0.252	97	**1.8**
15	Butyraldehyde	0.135	0.134	0.276	0.399	0.395	0.814	100	
16	Carbon Disulfide	0.025	0.024	0.071	0.078	0.074	0.221	100	*0.0001*
17	Carbon Tetrachloride	0.089	0.092	0.114	0.561	0.581	0.717	100	**3**
18	Chlorobenzene	*0.002*	0	0.017	*0.009*	0	0.079	40	*0.00001*
19	Chloroethane	0.008	0.006	0.034	0.021	0.015	0.088	69	*0.000002*
20	Chloroform	0.026	0.024	0.049	0.125	0.118	0.238	100	**3**
21	Chloromethane	0.472	0.466	0.587	0.975	0.962	1.212	100	**1.7**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.063	0.035	0.248	0.179	0.101	0.711	100	
24	Dibromochloromethane	*0.0004*	0	0.002	*0.004*	0	0.019	40	0.1
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.0001*	0	0.001	*0.001*	0	0.008	11	
27	o-Dichlorobenzene	*0.0003*	0	0.002	*0.002*	0	0.010	23	*0.00001*
28	p-Dichlorobenzene	0.013	0.009	0.038	0.077	0.054	0.230	97	0.8
29	Dichlorodifluoromethane	0.468	0.451	0.654	2.312	2.230	3.234	100	*0.02*
30	1,1-Dichloroethane	*0*	0	0	*0*	0	0	0	
31	1,2-Dichloroethane	0.026	0.023	0.072	0.106	0.092	0.290	100	**3**
32	1,1-Dichloroethylene	*0.002*	0	0.037	*0.008*	0	0.148	17	*0.00004*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	0.004	0.003	0.023	0.015	0.010	0.090	69	
35	Dichloromethane	0.146	0.115	0.536	0.506	0.400	1.862	100	0.01
36	1,2-Dichloropropane	*0.001*	0	0.027	*0.005*	0	0.126	9	0.05
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	0.015	0.015	0.019	0.107	0.108	0.134	100	
40	Ethyl Acrylate	*0.001*	0	0.022	*0.003*	0	0.088	3	*0.0003*
41	Ethylbenzene	0.118	0.059	0.882	0.513	0.255	3.830	100	**1.3**
42	Ethyl tert-Butyl Ether	*0*	0	0	*0*	0	0	0	
43	Formaldehyde	3.016	2.870	6.870	3.704	3.525	8.437	100	**48**
44	Hexachlorobutadiene	*0.0002*	0	0.006	*0.002*	0	0.062	6	0.05
45	Hexaldehyde	0.045	0.041	0.129	0.183	0.167	0.528	100	

Continued

Table 10-4 (continued)
CAMDEN SPRUCE STREET – 2020 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	0.171	0.142	0.483	0.503	0.417	1.422	100	*0.0001*
47	Methyl Isobutyl Ketone	0.044	0.025	0.192	0.182	0.100	0.787	97	*0.0001*
48	Methyl Methacrylate	0.016	0.009	0.100	0.055	0.032	0.351	77	*0.0001*
49	Methyl tert-Butyl Ether	*0.001*	0	0.016	*0.005*	0	0.059	17	0.001
50	n-Octane	0.069	0.038	0.400	0.320	0.177	1.869	100	
51	Propionaldehyde	0.176	0.166	0.410	0.418	0.394	0.974	100	*0.05*
52	Propylene	0.402	0.245	1.840	0.692	0.422	3.167	100	*0.0002*
53	Styrene	0.062	0.028	0.605	0.263	0.118	2.577	94	0.1
54	1,1,2,2-Tetrachloroethane	*0*	0	0	*0*	0	0	0	
55	Tetrachloroethylene	0.022	0.019	0.082	0.148	0.129	0.558	100	0.9
56	Toluene	0.819	0.487	3.730	3.088	1.835	14.055	100	*0.0008*
57	1,2,4-Trichlorobenzene	*0.001*	0	0.006	*0.005*	0	0.047	29	*0.003*
58	1,1,1-Trichloroethane	0.003	0.003	0.008	0.016	0.016	0.043	80	*0.00002*
59	1,1,2-Trichloroethane	*0.001*	0	0.008	*0.005*	0	0.042	31	0.07
60	Trichloroethylene	0.009	0.009	0.034	0.050	0.047	0.184	89	0.3
61	Trichlorofluoromethane	0.385	0.254	1.180	2.162	1.427	6.630	100	*0.003*
62	Trichlorotrifluoroethane	0.071	0.072	0.082	0.543	0.548	0.630	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.116	0.052	1.010	0.571	0.258	4.965	100	*0.01*
64	1,3,5-Trimethylbenzene	0.035	0.014	0.314	0.171	0.068	1.544	97	*0.003*
65	Valeraldehyde	0.044	0.042	0.094	0.153	0.147	0.331	100	
66	Vinyl Chloride	*0.003*	0	0.029	*0.008*	0	0.075	49	0.08
67	m,p-Xylene	0.331	0.168	2.290	1.439	0.729	9.943	100	*0.01*
68	o-Xylene	0.144	0.080	0.915	0.623	0.347	3.973	100	*0.006*

- Arithmetic means in *italics* had fewer than 50% of samples with detectable concentrations.
- 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 – 2020 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	0.584	0.539	1.190	1.052	0.970	2.144	100	**2**
2	Acetone	0.763	0.719	1.430	1.812	1.708	3.397	100	*0.0001*
3	Acetonitrile	0.159	0.123	0.610	0.267	0.207	1.024	97	*0.004*
4	Acetylene	0.221	0.164	0.587	0.235	0.175	0.625	100	
5	Acrolein	0.233	0.136	0.959	0.534	0.312	2.199	100	***27***
6	Acrylonitrile	*0.0004*	0	0.013	*0.001*	0	0.028	3	0.06
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.015	0.012	0.042	0.064	0.053	0.183	100	
9	Benzene	0.118	0.108	0.283	0.377	0.345	0.904	100	**3**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0.0001*	0	0.002	*0.0004*	0	0.011	3	0.01
12	Bromoform	0.001	0.001	0.005	0.012	0.013	0.047	58	0.01
13	Bromomethane	0.017	0.008	0.296	0.067	0.030	1.149	97	*0.01*
14	1,3-Butadiene	0.004	0.004	0.022	0.009	0.008	0.049	65	0.3
15	Butyraldehyde	0.048	0.047	0.161	0.143	0.138	0.475	100	
16	Carbon Disulfide	0.010	0.008	0.028	0.030	0.025	0.087	100	*0.00004*
17	Carbon Tetrachloride	0.092	0.091	0.121	0.576	0.575	0.761	100	**3**
18	Chlorobenzene	*0.0003*	0	0.002	*0.001*	0	0.010	23	*0.000001*
19	Chloroethane	0.004	0.005	0.013	0.009	0.012	0.035	65	*0.000001*
20	Chloroform	0.019	0.018	0.026	0.092	0.087	0.128	100	**2**
21	Chloromethane	0.446	0.445	0.561	0.920	0.919	1.158	100	**1.6**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.063	0.014	0.378	0.181	0.040	1.084	96	
24	Dibromochloromethane	*0.0001*	0	0.001	*0.001*	0	0.009	16	0.02
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.00005*	0	0.001	*0.0003*	0	0.008	3	
27	o-Dichlorobenzene	*0.0001*	0	0.002	*0.001*	0	0.011	13	*0.000004*
28	p-Dichlorobenzene	0.0014	0.001	0.005	0.008	0.007	0.028	61	0.1
29	Dichlorodifluoromethane	0.4426	0.438	0.532	2.189	2.166	2.631	100	*0.02*
30	1,1-Dichloroethane	*0*	0	0	*0*	0	0	0	
31	1,2-Dichloroethane	0.017	0.017	0.026	0.070	0.068	0.103	100	**2**
32	1,1-Dichloroethylene	*0.0002*	0	0.003	*0.001*	0	0.010	10	*0.000004*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	*0.001*	0	0.005	*0.002*	0	0.019	23	
35	Dichloromethane	0.115	0.089	0.421	0.398	0.310	1.463	100	0.01
36	1,2-Dichloropropane	*0.0004*	0	0.005	*0.002*	0	0.023	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	0.015	0.015	0.019	0.107	0.105	0.132	100	
40	Ethyl Acrylate	*0*	0	0	*0*	0	0	0	
41	Ethylbenzene	0.012	0.011	0.045	0.052	0.046	0.196	100	0.1
42	Ethyl tert-Butyl Ether	0.007	0.007	0.011	0.029	0.031	0.047	90	
43	Formaldehyde	1.092	0.692	3.110	1.341	0.850	3.819	100	**17**
44	Hexachlorobutadiene	*0.0001*	0	0.001	*0.001*	0	0.007	10	0.02
45	Hexaldehyde	0.015	0.010	0.072	0.062	0.042	0.296	100	

Continued

Table 10-5 (continued)
CHESTER – 2020 NJ Air Toxics Monitoring Data

	Pollutant	Annual Mean (ppbv)	Annual Median (ppbv)	24-Hour Max. (ppbv)	Annual Mean (µg/m³)	Annual Median (µg/m³)	24-Hour Max. (µg/m³)	% Detected	Annual Mean Risk Ratio
46	Methyl Ethyl Ketone	0.087	0.079	0.152	0.257	0.232	0.448	100	*0.0001*
47	Methyl Isobutyl Ketone	0.012	0.009	0.027	0.049	0.036	0.111	97	*0.00002*
48	Methyl Methacrylate	*0.001*	0	0.010	*0.003*	0	0.036	16	*0.000004*
49	Methyl tert-Butyl Ether	*0.0005*	0	0.004	*0.002*	0	0.014	13	0.0004
50	n-Octane	0.013	0.010	0.040	0.060	0.048	0.185	100	
51	Propionaldehyde	0.091	0.081	0.174	0.217	0.193	0.413	100	*0.03*
52	Propylene	0.097	0.083	0.279	0.167	0.143	0.480	100	*0.0001*
53	Styrene	0.004	0.002	0.048	0.016	0.008	0.205	65	0.01
54	1,1,2,2-Tetrachloroethane	*0.0002*	0	0.004	*0.001*	0	0.025	6	0.06
55	Tetrachloroethylene	0.008	0.007	0.026	0.056	0.049	0.175	97	0.4
56	Toluene	0.121	0.092	0.504	0.456	0.347	1.899	100	*0.0001*
57	1,2,4-Trichlorobenzene	*0.001*	0	0.009	*0.006*	0	0.067	16	*0.003*
58	1,1,1-Trichloroethane	0.002	0.003	0.004	0.010	0.014	0.021	68	*0.00001*
59	1,1,2-Trichloroethane	*0.00005*	0	0.001	*0.0002*	0	0.008	3	0.004
60	Trichloroethylene	0.006	0.007	0.010	0.032	0.035	0.055	84	0.2
61	Trichlorofluoromethane	0.218	0.210	0.321	1.225	1.180	1.804	100	*0.002*
62	Trichlorotrifluoroethane	0.071	0.071	0.081	0.541	0.543	0.622	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.008	0.007	0.047	0.040	0.032	0.230	100	*0.001*
64	1,3,5-Trimethylbenzene	0.002	0.002	0.016	0.010	0.008	0.077	77	*0.0002*
65	Valeraldehyde	0.015	0.012	0.050	0.052	0.042	0.176	94	
66	Vinyl Chloride	*0.0002*	0	0.003	*0.001*	0	0.008	13	0.006
67	m,p-Xylene	0.027	0.023	0.136	0.118	0.098	0.591	100	*0.001*
68	o-Xylene	0.012	0.011	0.062	0.053	0.046	0.271	100	*0.001*

- Arithmetic means in *italics* had fewer than 50% of samples with detectable concentrations.
- 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 – 2020 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				
1	Acetaldehyde	1.021	0.908	2.090	1.839	1.635	3.766	100	**4**
2	Acetone	1.392	1.220	4.030	3.307	2.898	9.573	100	*0.0001*
3	Acetonitrile	0.519	0.186	3.190	0.871	0.312	5.356	100	*0.01*
4	Acetylene	0.409	0.324	1.800	0.436	0.345	1.916	100	
5	Acrolein	0.285	0.253	0.664	0.654	0.580	1.523	100	***33***
6	Acrylonitrile	*0.0001*	0	0.003	*0.0002*	0	0.006	3	0.01
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.029	0.026	0.069	0.126	0.112	0.299	100	
9	Benzene	0.239	0.215	0.485	0.763	0.687	1.549	100	**6**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0*	0	0	*0*	0	0	0	
12	Bromoform	0.002	0.002	0.006	0.021	0.020	0.057	83	0.02
13	Bromomethane	0.008	0.008	0.011	0.031	0.030	0.042	100	*0.01*
14	1,3-Butadiene	0.031	0.023	0.096	0.068	0.051	0.213	100	**2**
15	Butyraldehyde	0.101	0.093	0.223	0.297	0.275	0.658	100	
16	Carbon Disulfide	0.038	0.033	0.155	0.117	0.104	0.483	100	*0.0002*
17	Carbon Tetrachloride	0.091	0.095	0.115	0.570	0.599	0.724	100	**3**
18	Chlorobenzene	*0.001*	0	0.014	*0.006*	0	0.063	37	*0.00001*
19	Chloroethane	0.008	0.006	0.034	0.020	0.016	0.089	69	*0.000002*
20	Chloroform	0.026	0.024	0.083	0.129	0.115	0.405	100	**3**
21	Chloromethane	0.459	0.454	0.776	0.948	0.938	1.602	100	**1.7**
22	Chloroprene	*0*	0	0	*0*	0	0	0	
23	Crotonaldehyde	0.073	0.033	0.469	0.211	0.094	1.344	100	
24	Dibromochloromethane	0.0003	0	0.002	0.003	0	0.018	37	0.08
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.00002*	0	0.001	*0.0001*	0	0.004	3	
27	o-Dichlorobenzene	*0.002*	0	0.033	*0.009*	0	0.198	31	*0.00005*
28	p-Dichlorobenzene	0.006	0.005	0.021	0.038	0.029	0.129	91	0.4
29	Dichlorodifluoromethane	0.443	0.431	0.566	2.189	2.132	2.799	100	*0.02*
30	1,1-Dichloroethane	*0*	0	0	*0*	0	0	0	
31	1,2-Dichloroethane	0.020	0.020	0.030	0.081	0.081	0.121	100	**2**
32	1,1-Dichloroethylene	*0.0001*	0	0.002	*0.0004*	0	0.009	6	*0.000002*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	0.003	0.003	0.011	0.012	0.010	0.045	71	
35	Dichloromethane	0.390	0.132	8.220	1.355	0.459	28.557	100	0.02
36	1,2-Dichloropropane	*0.0005*	0	0.006	*0.002*	0	0.027	11	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	0.015	0.015	0.019	0.107	0.105	0.136	100	
40	Ethyl Acrylate	0	0	0	0	0	0	0	
41	Ethylbenzene	0.052	0.040	0.145	0.224	0.175	0.630	100	0.6
42	Ethyl tert-Butyl Ether	*0.0003*	0	0.010	*0.001*	0	0.040	3	
43	Formaldehyde	2.390	2.280	4.040	2.935	2.800	4.961	100	**38**
44	Hexachlorobutadiene	*0.00004*	0	0.001	*0.0004*	0	0.015	3	0.01
45	Hexaldehyde	0.039	0.030	0.240	0.161	0.124	0.983	100	

Continued

Table 10-6 (continued)
ELIZABETH – 2020 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	0.168	0.155	0.415	0.496	0.456	1.222	100	*0.0001*
47	Methyl Isobutyl Ketone	0.030	0.027	0.075	0.121	0.110	0.307	93	*0.00004*
48	Methyl Methacrylate	0.017	0.008	0.277	0.061	0.028	0.975	63	*0.0001*
49	Methyl tert-Butyl Ether	*0.001*	0	0.010	*0.002*	0	0.035	9	0.001
50	n-Octane	0.053	0.039	0.210	0.248	0.184	0.981	100	
51	Propionaldehyde	0.163	0.143	0.333	0.388	0.340	0.791	100	*0.05*
52	Propylene	1.017	0.518	3.990	1.751	0.892	6.867	100	*0.0006*
53	Styrene	0.015	0.012	0.079	0.063	0.050	0.335	94	0.03
54	1,1,2,2-Tetrachloroethane	*0.0003*	0	0.007	*0.002*	0	0.050	6	0.1
55	Tetrachloroethylene	0.018	0.012	0.084	0.119	0.081	0.570	100	0.7
56	Toluene	0.412	0.346	0.954	1.554	1.304	3.595	100	*0.0004*
57	1,2,4-Trichlorobenzene	*0.0001*	0	0.002	*0.001*	0	0.015	9	*0.0005*
58	1,1,1-Trichloroethane	0.003	0.003	0.006	0.015	0.016	0.031	80	*0.00002*
59	1,1,2-Trichloroethane	*0.001*	0	0.022	*0.003*	0	0.120	3	0.05
60	Trichloroethylene	0.008	0.008	0.025	0.046	0.041	0.133	94	0.2
61	Trichlorofluoromethane	0.219	0.213	0.274	1.232	1.197	1.540	100	*0.002*
62	Trichlorotrifluoroethane	0.070	0.071	0.089	0.540	0.540	0.679	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.048	0.045	0.201	0.237	0.220	0.988	97	*0.004*
64	1,3,5-Trimethylbenzene	0.014	0.013	0.061	0.069	0.062	0.297	97	*0.001*
65	Valeraldehyde	0.032	0.028	0.119	0.114	0.097	0.419	100	
66	Vinyl Chloride	*0.0004*	0	0.003	*0.001*	0	0.007	26	0.01
67	m,p-Xylene	0.147	0.119	0.452	0.639	0.517	1.963	100	*0.006*
68	o-Xylene	0.063	0.052	0.189	0.275	0.226	0.821	100	*0.003*

- Arithmetic means in *italics* had fewer than 50% of samples with detectable concentrations.
- 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 – 2020 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	0.605	0.576	1.150	1.097	1.038	2.072	100	**2**
2	Acetone	1.006	0.992	2.160	2.381	2.257	5.131	100	*0.0001*
3	Acetonitrile	0.217	0.127	1.190	0.377	0.213	1.998	97	*0.006*
4	Acetylene	0.384	0.286	1.360	0.399	0.304	1.447	100	
5	Acrolein	0.309	0.322	0.629	0.695	0.738	1.442	100	***35***
6	Acrylonitrile	*0.0002*	0	0.008	*0.001*	0	0.018	3	0.04
7	tert-Amyl Methyl Ether	*0*	0	0	*0*	0	0	0	
8	Benzaldehyde	0.018	0.018	0.032	0.077	0.079	0.139	100	
9	Benzene	0.163	0.140	0.332	0.511	0.438	1.061	100	**4**
10	Bromochloromethane	*0*	0	0	*0*	0	0	0	
11	Bromodichloromethane	*0.0002*	0	0.004	*0.001*	0	0.026	9	0.05
12	Bromoform	0.001	0.002	0.005	0.014	0.017	0.047	71	0.02
13	Bromomethane	0.010	0.008	0.079	0.038	0.029	0.306	100	*0.01*
14	1,3-Butadiene	0.016	0.011	0.069	0.035	0.023	0.153	94	**1.1**
15	Butyraldehyde	0.068	0.067	0.169	0.199	0.179	0.498	100	
16	Carbon Disulfide	0.013	0.012	0.022	0.038	0.036	0.064	100	*0.0001*
17	Carbon Tetrachloride	0.083	0.087	0.118	0.530	0.552	0.742	97	**3**
18	Chlorobenzene	*0.001*	0	0.005	*0.004*	0	0.022	32	*0.000004*
19	Chloroethane	0.009	0.005	0.067	0.024	0.014	0.176	62	*0.000002*
20	Chloroform	0.026	0.022	0.066	0.131	0.113	0.321	100	**3**
21	Chloromethane	0.450	0.450	0.612	0.924	0.925	1.264	100	**1.6**
22	Chloroprene	0	0	0	0	0	0	0	
23	Crotonaldehyde	0.051	0.023	0.238	0.152	0.071	0.682	100	
24	Dibromochloromethane	*0.0002*	0	0.001	*0.002*	0	0.013	35	0.06
25	1,2-Dibromoethane	*0*	0	0	*0*	0	0	0	
26	m-Dichlorobenzene	*0.00004*	0	0.001	*0.0002*	0	0.005	6	
27	o-Dichlorobenzene	*0.00005*	0	0.002	*0.0003*	0	0.010	3	*0.000002*
28	p-Dichlorobenzene	0.005	0.004	0.020	0.033	0.023	0.120	85	0.4
29	Dichlorodifluoromethane	0.448	0.441	0.567	2.221	2.179	2.804	100	*0.02*
30	1,1-Dichloroethane	*0*	0	0	*0*	0	0	0	
31	1,2-Dichloroethane	0.019	0.018	0.025	0.075	0.072	0.102	100	**2**
32	1,1-Dichloroethylene	*0.0001*	0	0.002	*0.0004*	0	0.007	6	*0.000002*
33	cis-1,2-Dichloroethylene	*0*	0	0	*0*	0	0	0	
34	trans-1,2-Dichloroethylene	0.002	0.002	0.014	0.010	0.007	0.056	56	
35	Dichloromethane	0.137	0.119	0.336	0.477	0.393	1.167	100	0.01
36	1,2-Dichloropropane	*0.0001*	0	0.004	*0.001*	0	0.018	3	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	0.015	0.015	0.021	0.108	0.106	0.149	100	
40	Ethyl Acrylate	*0*	0	0	*0*	0	0	0	
41	Ethylbenzene	0.026	0.018	0.080	0.110	0.079	0.347	100	0.3
42	Ethyl tert-Butyl Ether	0.009	0.010	0.014	0.037	0.042	0.059	85	
43	Formaldehyde	1.302	1.160	2.880	1.607	1.425	3.537	100	**21**
44	Hexachlorobutadiene	*0.00003*	0	0.001	*0.0004*	0	0.009	6	0.01
45	Hexaldehyde	0.020	0.017	0.047	0.082	0.069	0.194	100	

Continued

Table 10-7 (continued)
RUTGERS – 2020 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	0.127	0.120	0.239	0.363	0.346	0.704	100	*0.0001*
47	Methyl Isobutyl Ketone	0.017	0.016	0.041	0.066	0.064	0.166	87	*0.00002*
48	Methyl Methacrylate	*0.011*	0	0.286	*0.041*	0	1.007	38	*0.0001*
49	Methyl tert-Butyl Ether	*0.002*	0	0.011	*0.008*	0	0.040	35	0.002
50	n-Octane	0.019	0.016	0.044	0.086	0.070	0.204	100	
51	Propionaldehyde	0.103	0.093	0.201	0.249	0.226	0.477	100	*0.03*
52	Propylene	0.217	0.157	1.530	0.369	0.251	2.633	100	*0.0001*
53	Styrene	0.007	0.006	0.024	0.027	0.024	0.103	88	0.02
54	1,1,2,2-Tetrachloroethane	*0.0001*	0	0.003	*0.0002*	0	0.006	3	0.01
55	Tetrachloroethylene	0.011	0.010	0.038	0.076	0.067	0.260	100	0.5
56	Toluene	0.205	0.154	0.480	0.758	0.544	1.809	100	*0.0002*
57	1,2,4-Trichlorobenzene	*0.0004*	0	0.005	*0.003*	0	0.037	18	*0.002*
58	1,1,1-Trichloroethane	0.003	0.003	0.005	0.014	0.016	0.028	76	*0.00001*
59	1,1,2-Trichloroethane	*0.0002*	0	0.005	*0.001*	0	0.011	6	0.01
60	Trichloroethylene	0.008	0.008	0.019	0.042	0.043	0.100	91	0.2
61	Trichlorofluoromethane	0.221	0.213	0.278	1.244	1.200	1.562	100	*0.002*
62	Trichlorotrifluoroethane	0.071	0.071	0.086	0.543	0.546	0.658	100	*0.00002*
63	1,2,4-Trimethylbenzene	0.021	0.014	0.080	0.106	0.068	0.393	100	*0.002*
64	1,3,5-Trimethylbenzene	0.006	0.004	0.023	0.030	0.020	0.115	91	*0.001*
65	Valeraldehyde	0.020	0.017	0.047	0.072	0.062	0.164	100	
66	Vinyl Chloride	*0.0003*	0	0.003	*0.001*	0	0.007	15	0.006
67	m,p-Xylene	0.065	0.048	0.269	0.281	0.188	1.168	100	*0.003*
68	o-Xylene	0.028	0.021	0.102	0.121	0.084	0.443	100	*0.001*

- Arithmetic means in *italics* had fewer than 50% of samples with detectable concentrations.
- 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 2020, 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 2020

Pollutant		CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acrylonitrile	107-13-1	X			
2	Tert-Amyl Ethyl Ether	994-05-8	X	X	X	X
3	Bromochloromethane	74-97-5	X	X		X
4	Bromodichloromethane	75-27-4	X		X	
5	Chloroprene	126-99-8	X	X	X	X
6	1,2-Dibromoethane	106-93-4	X	X		X
7	1,1-Dichloroethane	75-34-3	X	X	X	X
8	cis-1,2-Dichloroethylene	156-59-2	X	X	X	
9	cis-1,3-Dichloropropylene	10061-01-5	X	X	X	X
10	trans-1,3-Dichloropropylene	10061-02-6	X	X	X	X
11	Ethyl Acrylate	140-88-5		X	X	X
12	Ethyl tert-Butyl Ether	637-92-3	X			
13	1,1,2,2-Tetrachloroethane	79-34-5	X			

Table 10-9
2020 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	0.020	0.037	0.45
2	Acetone	67-64-1	0.159	0.378	*31000*
3	Acetonitrile	75-05-8	0.038	0.064	*60*
4	Acetylene	74-86-2	0.258	0.275	
5	Acrolein	107-02-8	0.161	0.369	*0.02*
6	Acrylonitrile	107-13-1	0.011	0.024	0.015
7	tert-Amyl Methyl Ether	994-05-8	0.011	0.046	
8	Benzaldehyde	100-52-7	0.009	0.041	
9	Benzene	71-43-2	0.010	0.033	0.13
10	Bromochloromethane	74-97-5	0.012	0.066	*40*
11	Bromodichloromethane	75-27-4	0.012	0.078	0.027
12	Bromoform	75-25-2	0.020	0.207	0.91
13	Bromomethane	74-83-9	0.019	0.074	*5*
14	1,3-Butadiene	106-99-0	0.012	0.026	0.033
15	Butyraldehyde	123-72-8	0.017	0.050	
16	Carbon Disulfide	75-15-0	0.037	0.116	*700*
17	Carbon Tetrachloride	56-23-5	0.018	0.110	0.17
18	Chlorobenzene	108-90-7	0.011	0.051	*1000*
19	Chloroethane	75-00-3	0.017	0.044	*10000*
20	Chloroform	67-66-3	0.014	0.069	0.043
21	Chloromethane	74-87-3	0.030	0.061	0.56
22	Chloroprene	126-99-8	0.012	0.042	0.002
23	Crotonaldehyde	123-73-9	0.003	0.008	
24	Dibromochloromethane	124-48-1	0.017	0.172	0.037
25	1,2-Dibromoethane	106-93-4	0.014	0.104	0.0017
26	m-Dichlorobenzene	541-73-1	0.008	0.049	
27	o-Dichlorobenzene	95-50-1	0.011	0.067	*200*
28	p-Dichlorobenzene	106-46-7	0.011	0.064	0.091
29	Dichlorodifluoromethane	75-71-8	0.013	0.062	*100*
30	1,1-Dichloroethane	75-34-3	0.011	0.046	0.63
31	1,2-Dichloroethane	107-06-2	0.011	0.043	0.038
32	1,1-Dichloroethylene	75-35-4	0.016	0.063	*200*
33	cis-1,2-Dichloroethylene	156-59-2	0.010	0.039	
34	trans-1,2-Dichloroethylene	156-60-5	0.013	0.050	
35	Dichloromethane	75-09-2	0.017	0.058	77
36	1,2-Dichloropropane	78-87-5	0.014	0.064	0.1
37	cis-1,3-Dichloropropylene	10061-01-5	0.010	0.044	0.25
38	trans-1,3-Dichloropropylene	10061-02-6	0.015	0.068	0.25
39	Dichlorotetrafluoroethane	76-14-2	0.015	0.107	
40	Ethyl Acrylate	140-88-5	0.012	0.050	*8*
41	Ethylbenzene	100-41-4	0.009	0.040	0.40
42	Ethyl tert-Butyl Ether	637-92-3	0.009	0.037	
43	Formaldehyde	50-00-0	0.042	0.051	0.077
44	Hexachlorobutadiene	87-68-3	0.004	0.041	0.045
45	Hexaldehyde	66-25-1	0.002	0.010	

Continued

Table 10-9 (continued)
Air Toxics Detection Limits and Health Benchmarks

	Pollutant	CAS No.	Detection Limit (ppbv)	Detection Limit (µg/m^3)	Health Bench-mark (µg/m^3)
46	Methyl Ethyl Ketone	78-93-3	0.027	0.080	*5000*
47	Methyl Isobutyl Ketone	108-10-1	0.016	0.066	*3000*
48	Methyl Methacrylate	80-62-6	0.052	0.181	*700*
49	Methyl tert-Butyl Ether	1634-04-4	0.011	0.040	3.8
50	n-Octane	111-65-9	0.022	0.103	
51	Propionaldehyde	123-38-6	0.045	0.108	*8*
52	Propylene	115-07-1	0.126	0.217	*3000*
53	Styrene	100-42-5	0.018	0.078	1.8
54	1,1,2,2-Tetrachloroethane	79-34-5	0.017	0.119	0.017
55	Tetrachloroethylene	127-18-4	0.012	0.084	0.16
56	Toluene	108-88-3	0.019	0.070	*3760*
57	1,2,4-Trichlorobenzene	120-82-1	0.034	0.249	*2*
58	1,1,1-Trichloroethane	71-55-6	0.014	0.077	*1000*
59	1,1,2-Trichloroethane	79-00-5	0.009	0.050	0.063
60	Trichloroethylene	79-01-6	0.009	0.048	0.2
61	Trichlorofluoromethane	75-69-4	0.012	0.069	*700*
62	Trichlorotrifluoroethane	76-13-1	0.008	0.045	*30000*
63	1,2,4-Trimethylbenzene	95-63-6	0.006	0.029	*60*
64	1,3,5-Trimethylbenzene	108-67-8	0.004	0.019	*60*
65	Valeraldehyde	110-62-3	0.001	0.004	
66	Vinyl chloride	75-01-4	0.015	0.039	0.11
67	m,p-Xylene	108-38-3 106-42-3	0.009	0.038	*100*
68	o-Xylene	95-47-6	0.015	0.063	*100*

- **Detection limits** are 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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Appendix A

2020 Air Monitoring Sites

New Jersey Department of Environmental Protection

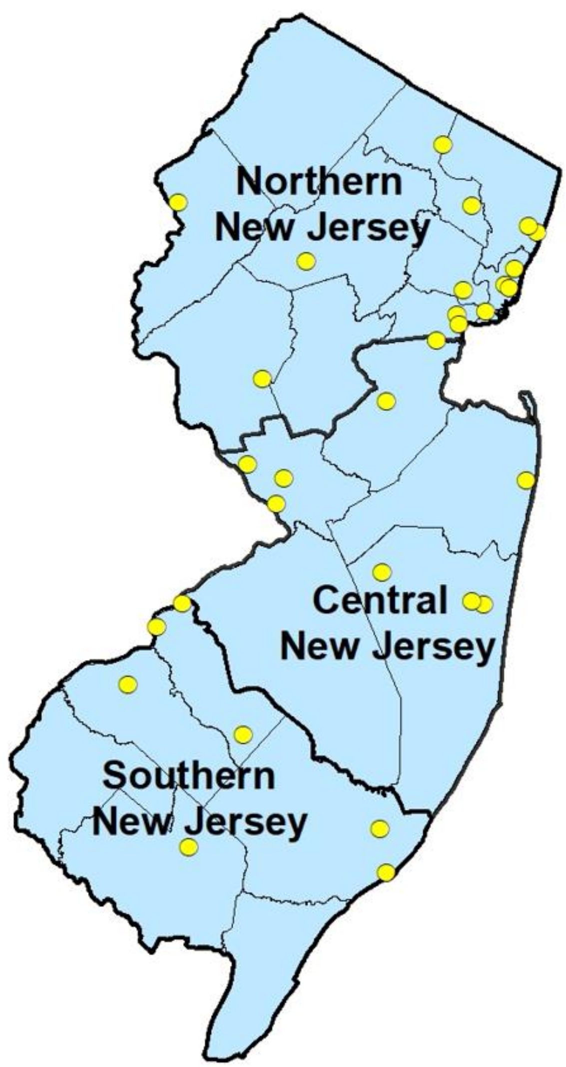

Figure A-1
2020 Northern New Jersey
Air Monitoring Sites

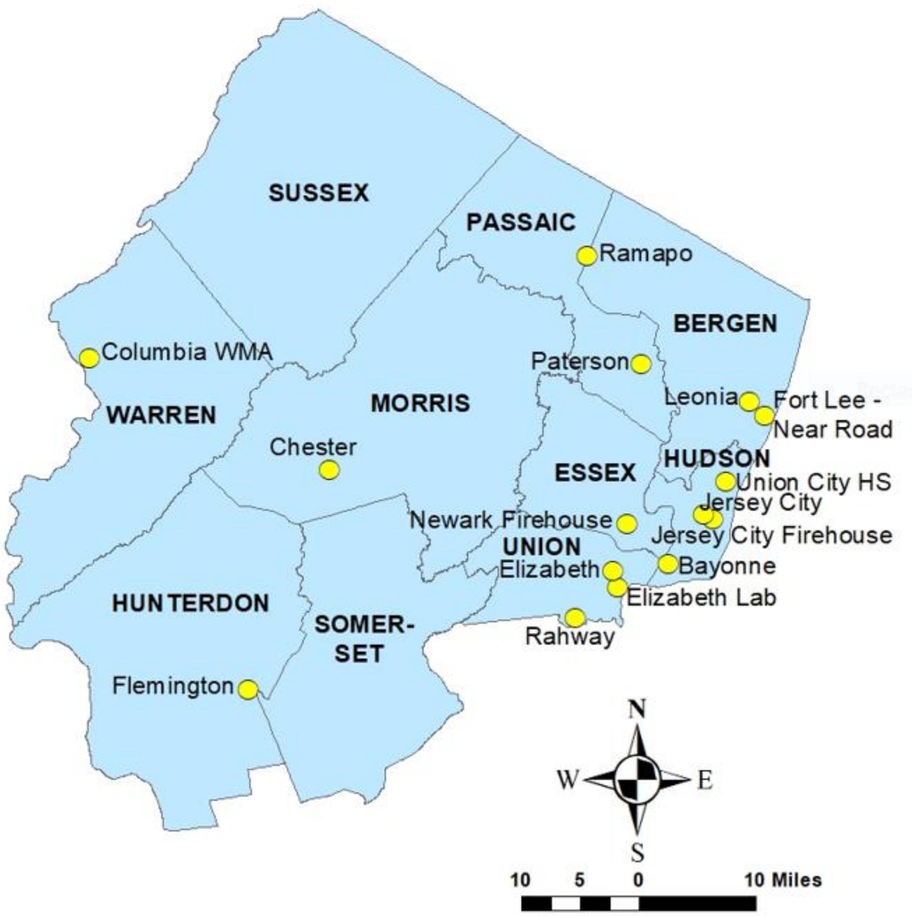

Table A-1
2020 Northern New Jersey Air Monitoring Sites

County	Monitoring Site	AQS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
BERGEN	Fort Lee Near Road	34 003 0010	CO, NO_x, Beta, BTEX, BC, Met	40.853550	-73.966180	Hoyt Ave & Hudson St, south of toll plaza
	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
2020 CENTRAL NEW JERSEY
AIR MONITORING SITES

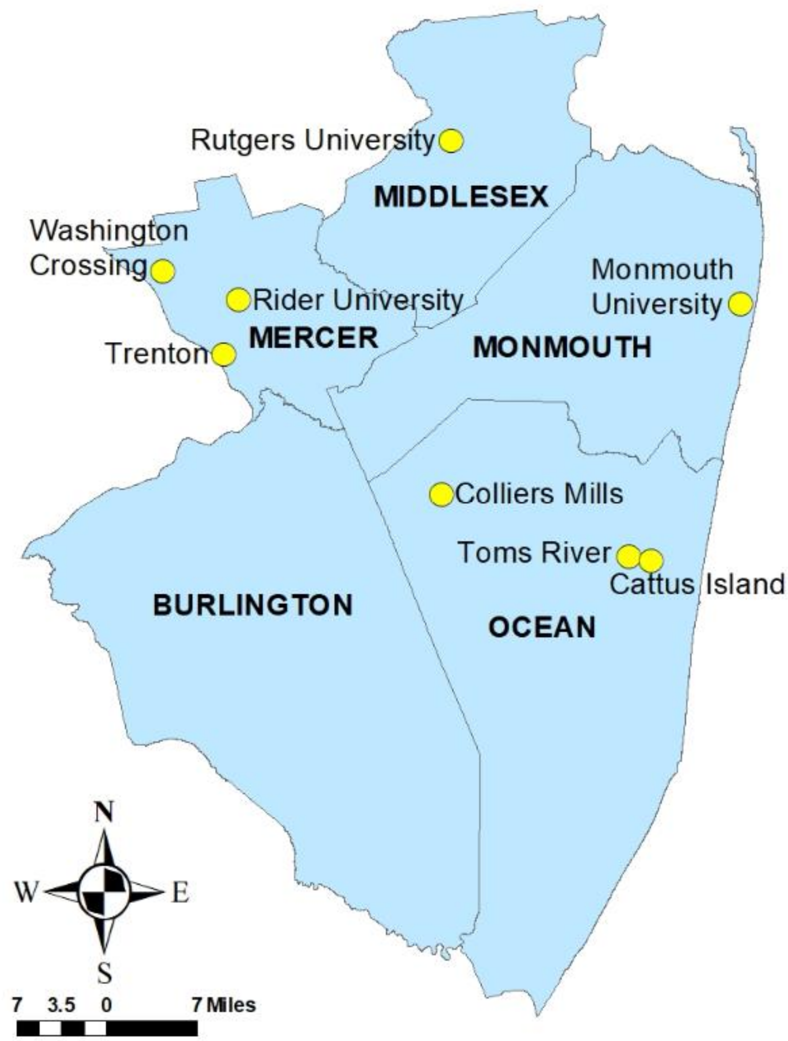

Table A-2
2020 Central New Jersey Air Monitoring Sites

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	Beta, $PM_{2.5}$	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
2020 Southern New Jersey
Air Monitoring Sites

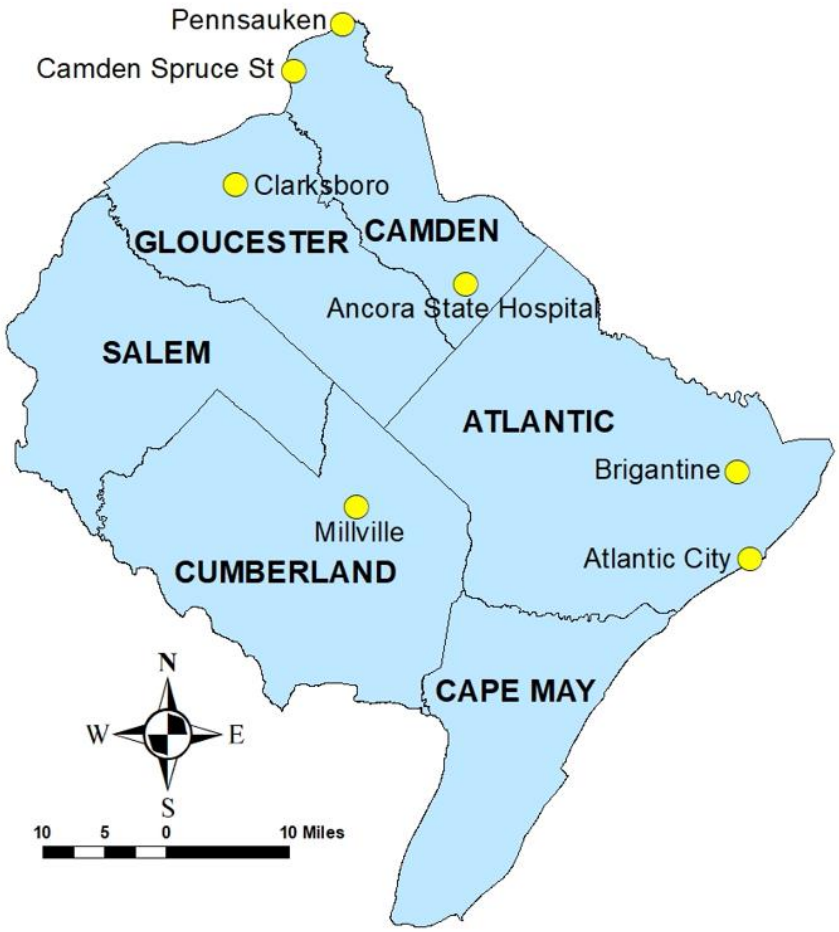

Table A-3
2020 Southern New Jersey Air Monitoring Sites

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 Spruce Street	34 007 0002	CO, NO_X, O_3, SO_2, $PM_{2.5}$, PM_{10}, 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 ACID sample collection.

Table A-4
Abbreviations & Acronyms

ACID	Acid deposition
BC	Black carbon measured by aethalometer
Beta	Real-time $PM_{2.5}$ analyzer
BTEX	Measurement of 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: 2020 Fine Particulate Speciation Summary

New Jersey Department of Environmental Protection

Table B-1
2020 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	0.031	0.113	78
2	Ammonium Ion	0.508	1.857	97
3	Antimony	0.002	0.023	50
4	Arsenic	*0*	0.0003	31
5	Barium	*0.002*	0.053	47
6	Bromine	*0.0005*	0.005	36
7	Cadmium	0.005	0.024	72
8	Calcium	0.051	0.278	100
9	Carbon, Elemental	0.855	2.780	100
10	Carbon, Organic	2.368	4.765	100
11	Cerium	0.007	0.069	58
12	Cesium	*0.0002*	0.032	47
13	Chloride	0.498	3.039	97
14	Chlorine	0.075	1.054	94
15	Chromium	0.002	0.011	83
16	Cobalt	*0*	0.003	33
17	Copper	0.004	0.015	94
18	Indium	0.004	0.039	56
19	Iron	0.136	0.818	100
20	Lead	0.006	0.032	83
21	Magnesium	0.016	0.066	61
22	Manganese	0.004	0.012	81
23	Nickel	0.001	0.002	81
24	Nitrate	1.207	5.199	97
25	Phosphorus	0.0004	0.005	89
26	Potassium	0.092	0.433	97
27	Potassium Ion	0.068	0.357	100
28	Rubidium	*0.0001*	0.003	47
29	Selenium	0.002	0.015	64
30	Silicon	0.057	0.265	92
31	Silver	0.003	0.020	61
32	Sodium	0.077	0.456	97
33	Sodium Ion	0.071	0.322	97
34	Strontium	0.001	0.004	58
35	Sulfate	0.862	2.647	100
36	Sulfur	0.300	0.983	97
37	Tin	0.005	0.029	69
38	Titanium	0.003	0.016	92
39	Vanadium	*0.0002*	0.001	28
40	Zinc	0.030	0.122	97
41	Zirconium	0.002	0.018	56

Table B-2
2020 Fine Particulate Speciation Concentrations
CHESTER NJ
Micrograms per Cubic Meter (µg/m^3)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.007	0.051	56
2	Ammonium Ion	0.263	1.428	100
3	Antimony	0	0.018	50
4	Arsenic	*0.00001*	0.0003	36
5	Barium	*0.001*	0.066	44
6	Bromine	*0.0001*	0.002	19
7	Cadmium	0.003	0.019	61
8	Calcium	0.014	0.036	97
9	Carbon, Elemental	0.233	0.618	100
10	Carbon, Organic	1.569	3.557	100
11	Cerium	0.004	0.059	58
12	Cesium	0.002	0.046	53
13	Chloride	0.030	0.092	97
14	Chlorine	0.001	0.007	64
15	Chromium	0.001	0.006	69
16	Cobalt	*0*	0.002	31
17	Copper	0	0.006	53
18	Indium	*0.001*	0.032	42
19	Iron	0.024	0.051	100
20	Lead	0.001	0.009	61
21	Magnesium	*0.011*	0.077	47
22	Manganese	*0*	0.006	42
23	Nickel	0.0004	0.002	67
24	Nitrate	0.721	4.020	100
25	Phosphorus	0.0001	0.003	72
26	Potassium	0.033	0.075	100
27	Potassium Ion	0.021	0.071	100
28	Rubidium	0.0005	0.004	58
29	Selenium	*0*	0.006	33
30	Silicon	0.022	0.086	78
31	Silver	*0*	0.016	31
32	Sodium	0.035	0.158	92
33	Sodium Ion	0.017	0.077	97
34	Strontium	0.0003	0.005	53
35	Sulfate	0.671	1.692	100
36	Sulfur	0.226	0.603	100
37	Tin	0.003	0.028	58
38	Titanium	0.002	0.007	78
39	Vanadium	*0.00002*	0.0003	11
40	Zinc	0.006	0.030	97
41	Zirconium	*0*	0.014	39

Table B-3
2020 Fine Particulate Speciation Concentrations
ELIZABETH LAB NJ
Micrograms per Cubic Meter (µg/m^3)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.025	0.121	78
2	Ammonium Ion	0.392	1.545	100
3	Antimony	*0.001*	0.023	48
4	Arsenic	*0.00001*	0.0004	47
5	Barium	0.013	0.062	73
6	Bromine	*0.001*	0.013	32
7	Cadmium	0.003	0.028	64
8	Calcium	0.033	0.103	100
9	Carbon, Elemental	0.912	2.474	100
10	Carbon, Organic	2.041	7.949	100
11	Cerium	*0.001*	0.064	45
12	Cesium	*0.003*	0.068	49
13	Chloride	0.133	0.784	99
14	Chlorine	0.012	0.136	86
15	Chromium	0.002	0.019	75
16	Cobalt	*0*	0.003	27
17	Copper	0.005	0.018	84
18	Indium	*0.001*	0.019	45
19	Iron	0.131	0.358	100
20	Lead	0.002	0.017	63
21	Magnesium	0.014	0.082	52
22	Manganese	0.002	0.009	86
23	Nickel	0.001	0.006	79
24	Nitrate	1.199	5.147	100
25	Phosphorus	0.001	0.006	85
26	Potassium	0.044	0.195	100
27	Potassium Ion	0.030	0.204	100
28	Rubidium	*0*	0.005	44
29	Selenium	0.0002	0.004	56
30	Silicon	0.049	0.188	96
31	Silver	0.001	0.024	52
32	Sodium	0.081	0.412	95
33	Sodium Ion	0.066	0.440	100
34	Strontium	0.001	0.006	56
35	Sulfate	0.886	2.127	100
36	Sulfur	0.315	0.893	100
37	Tin	*0.0001*	0.024	42
38	Titanium	0.006	0.015	95
39	Vanadium	*0.0003*	0.009	33
40	Zinc	0.014	0.038	100
41	Zirconium	0.003	0.036	66

Table B-4
2020 Fine Particulate Speciation Concentrations
NEWARK FIREHOUSE NJ
Micrograms per Cubic Meter ($\mu g/m^3$)

Species		Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.104	6.166	79
2	Ammonium Ion	0.407	1.622	100
3	Antimony	*0.001*	0.025	48
4	Arsenic	*0.00001*	0.0003	40
5	Barium	0.009	0.059	63
6	Bromine	*0.0004*	0.004	27
7	Cadmium	0.001	0.020	53
8	Calcium	0.036	0.258	100
9	Carbon, Elemental	0.626	2.567	100
10	Carbon, Organic	2.156	10.026	100
11	Cerium	*0*	0.046	44
12	Cesium	0.005	0.051	60
13	Chloride	0.128	1.419	99
14	Chlorine	0.022	0.705	85
15	Chromium	0.001	0.015	70
16	Cobalt	*0*	0.003	22
17	Copper	0.006	0.038	82
18	Indium	*0.0001*	0.030	43
19	Iron	0.099	0.524	100
20	Lead	0.003	0.020	67
21	Magnesium	0.022	0.505	53
22	Manganese	0.002	0.012	68
23	Nickel	0.001	0.006	70
24	Nitrate	1.328	5.432	100
25	Phosphorus	0.001	0.007	87
26	Potassium	0.049	0.213	100
27	Potassium Ion	0.034	0.218	99
28	Rubidium	0.0001	0.006	52
29	Selenium	0.0005	0.005	52
30	Silicon	0.058	0.704	93
31	Silver	*0*	0.021	44
32	Sodium	0.090	0.899	93
33	Sodium Ion	0.075	0.872	100
34	Strontium	0.0003	0.006	53
35	Sulfate	0.834	1.785	100
36	Sulfur	0.285	0.839	100
37	Tin	*0.001*	0.030	43
38	Titanium	0.006	0.033	93
39	Vanadium	*0.0002*	0.002	27
40	Zinc	0.016	0.052	100
41	Zirconium	*0.002*	0.027	49

Table B-5
2020 Fine Particulate Speciation Concentrations
RUTGERS UNIVERSITY NJ
Micrograms per Cubic Meter (µg/m^3)

	Species	Annual Average*	Maximum Daily Average	% Samples Detected
1	Aluminum	0.014	0.109	71
2	Ammonium Ion	0.242	0.974	100
3	Antimony	*0.001*	0.025	49
4	Arsenic	*0.00003*	0.001	46
5	Barium	0.008	0.078	68
6	Bromine	*0.0002*	0.003	19
7	Cadmium	0.001	0.023	53
8	Calcium	0.018	0.061	100
9	Carbon, Elemental	0.434	1.417	100
10	Carbon, Organic	1.980	7.728	100
11	Cerium	*0*	0.064	43
12	Cesium	*0*	0.042	46
13	Chloride	0.082	1.099	99
14	Chlorine	0.008	0.112	76
15	Chromium	0.001	0.009	70
16	Cobalt	*0*	0.002	36
17	Copper	0.003	0.039	75
18	Indium	*0.0002*	0.027	46
19	Iron	0.049	0.135	100
20	Lead	0.002	0.018	67
21	Magnesium	*0.018*	0.146	49
22	Manganese	0.001	0.012	53
23	Nickel	0.001	0.003	70
24	Nitrate	0.795	4.199	100
25	Phosphorus	0.0002	0.003	82
26	Potassium	0.049	0.642	100
27	Potassium Ion	0.038	0.735	99
28	Rubidium	0.0002	0.006	56
29	Selenium	*0.0002*	0.005	47
30	Silicon	0.027	0.120	89
31	Silver	0.001	0.017	58
32	Sodium	0.066	0.649	94
33	Sodium Ion	0.051	0.691	99
34	Strontium	0.001	0.017	56
35	Sulfate	0.762	2.018	100
36	Sulfur	0.265	0.800	100
37	Tin	0.002	0.023	51
38	Titanium	0.003	0.023	83
39	Vanadium	*0.0002*	0.002	26
40	Zinc	0.012	0.037	100
41	Zirconium	*0.0005*	0.029	47

*Annual averages in italics are calculated with fewer than 50% of samples detected.

USEPA's Chemical Speciation Network was established to characterize the metals, ions and carbon constituents of ambient fine particles. Information can be found at https://www.epa.gov/amtic/chemical-speciation-network-csn.

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

	Species	MDL (µg/m^3)
1	Aluminum	0.032
2	Ammonium Ion	0.007
3	Antimony	0.039
4	Arsenic	0.002
5	Barium	0.08
6	Bromine	0.005
7	Cadmium	0.016
8	Calcium	0.009
9	Carbon, Elemental	0.012
10	Carbon, Organic	0.350
11	Cerium	0.095
12	Cesium	0.054
13	Chloride	0.015
14	Chlorine	0.004
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	0.046
22	Manganese	0.006
23	Nickel	0.002
24	Nitrate	0.039
25	Phosphorus	0.003
26	Potassium	0.006
27	Potassium Ion	0.061
28	Rubidium	0.009
29	Selenium	0.005
30	Silicon	0.018
31	Silver	0.016
32	Sodium	0.092
33	Sodium Ion	0.009
34	Strontium	0.007
35	Sulfate	0.022
36	Sulfur	0.004
37	Tin	0.049
38	Titanium	0.004
39	Vanadium	0.001
40	Zinc	0.003
41	Zirconium	0.036

Most recent detection limit information from: Chemical Speciation Network (CSN) Annual Quality Report, prepared by Air Quality Research Center, University of California, Davis, pp. 29-30, 1/25/2021. https://www.epa.gov/sites/default/files/2021-04/documents/csn_2019annualqualityreport_01.25.2021_draft_sent_to_epa_01.25.2021_508compliant_rev03.11.2021.pdf

Appendix C: Glossary

New Jersey Department of Environmental Protection

GLOSSARY OF AIR MONITORING ABBREVIATIONS AND TERMS

Air Quality Index (AQI) – a national rating system for reporting daily air quality to the public

Air toxics – air pollutants that may cause adverse health effects in humans, but do not have a NAAQS

Ambient air – air in outdoor areas that are accessible to the general public

AQS – Air Quality System, USEPA's nationwide database for air quality data

BAM – NJDEP Bureau of Air Monitoring

CAMNET – a network of real-time cameras established to raise public awareness of the effects of air pollution on visibility.

Canister – a stainless steel container used for collecting an air sample to be analyzed in a lab.

Carcinogen – a chemical which may cause cancer

CO – Carbon monoxide, a criteria pollutant

Continuous monitor – an instrument that collects data around the clock, throughout the year, and transmits the data to a central data acquisition system every minute or hour.

Criteria pollutant – an air pollutant for which a National Ambient Air Quality Standard (NAAQS) has been set (ozone, particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide & lead).

Design value (DV) – a pollutant-specific statistic applied to air monitoring data that determines whether a National Ambient Air Quality Standard is being met or exceeded

Detection limit – lowest quantity of a chemical that can be reliably measured by a laboratory method or sampling instrument

Fine particles – see $PM_{2.5}$

Hazardous Air Pollutant (HAP) – an "air toxic" pollutant that is listed in the 1990 Clean Air Act Amendments and is subject to emissions limits for specific source types.

Health benchmark – a chemical-specific air concentration above which there may be human health concerns

Inhalable particles – see PM_{10}

Lead – see Pb

Manual sampler – an instrument that collects an air sample over a specific time period on a filter, adsorbent cartridge or canister, which is then manually retrieved for analysis.

Median – the middle value in a list of numerical values, sorted in ascending or descending order

NAAQS – National Ambient Air Quality Standard; for specific air pollutants, a concentration allowable in ambient air.

NJDEP – New Jersey Department of Environmental Protection

NO – Nitric oxide

NO_2 – Nitrogen dioxide, a criteria pollutant

NO_x – Oxides of nitrogen

NO_y – Total reactive oxides of nitrogen

O_3 – Ozone, a criteria pollutant

Ozone precursors – a group of volatile organic compounds (VOCs) that affect ozone formation and destruction in the atmosphere; also called PAMS pollutants.

PAMS – Photochemical Assessment Monitoring Station; a site which measures ozone precursors.

Particulate matter (PM)– a complex mix of liquid and/or solid particles in the atmosphere

Pb – Lead, a criteria pollutant and a HAP

$PM_{2.5}$ – Fine particles, 2.5 micrometers in aerodynamic diameter or smaller; a criteria pollutant

PM_{10} – Inhalable particles, 10 micrometers in aerodynamic diameter or smaller; a criteria pollutant

$PM_{2.5}$-Speciation – a group of elements, ionic compounds and carbon compounds that are analyzed from fine particles.

ppb - parts per billion, a concentration measurement usually used for gaseous pollutants

ppm – parts per million, a concentration measurement usually used for gaseous pollutants

Real-time – a system in which data is collected and (almost) immediately presented, usually every hour.

Risk ratio – a chemical-specific air concentration divided by its health benchmark; ratios greater than one may indicate a public health concern

SO_2 – Sulfur dioxide, a criteria pollutant

USEPA - United States Environmental Protection Agency

VOC – Volatile organic compound, a carbon-based chemical compound that is normally gaseous

$\mu g/m^3$ - micrograms per cubic meter, a concentration measurement, usually used for particulate matter and air toxics