



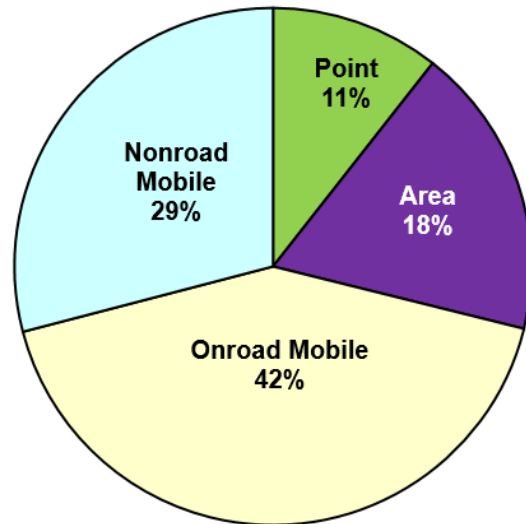
# 2017 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

## SOURCES

Nitrogen dioxide (NO<sub>2</sub>) is a reddish-brown highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). NO<sub>2</sub> is used by regulatory agencies as the indicator for the group of gases known as nitrogen oxides (NO<sub>x</sub>). 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<sub>x</sub> is emitted as NO, it is readily converted to NO<sub>2</sub> in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. When NO<sub>2</sub> reacts with other chemicals it can form ozone, particulate matter, and other pollutant compounds. A pie chart summarizing the major sources of NO<sub>x</sub> in New Jersey in 2017 is shown in Figure 6-1.

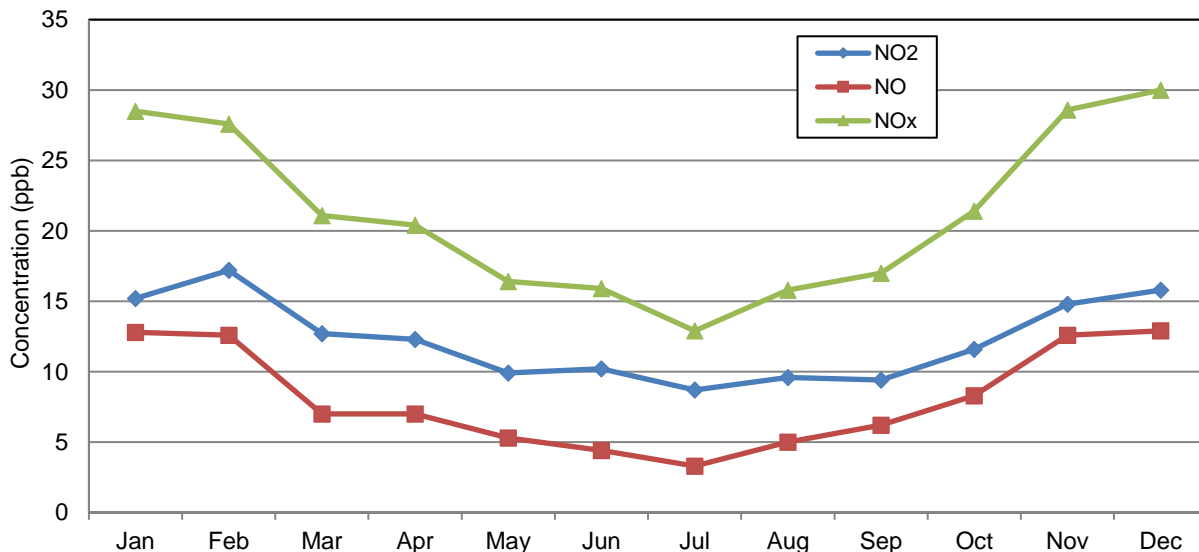
**Figure 6-1**  
**2017 New Jersey NO<sub>x</sub> Projected Emissions**



Inventory Source: MARAMA 2017 BETA2

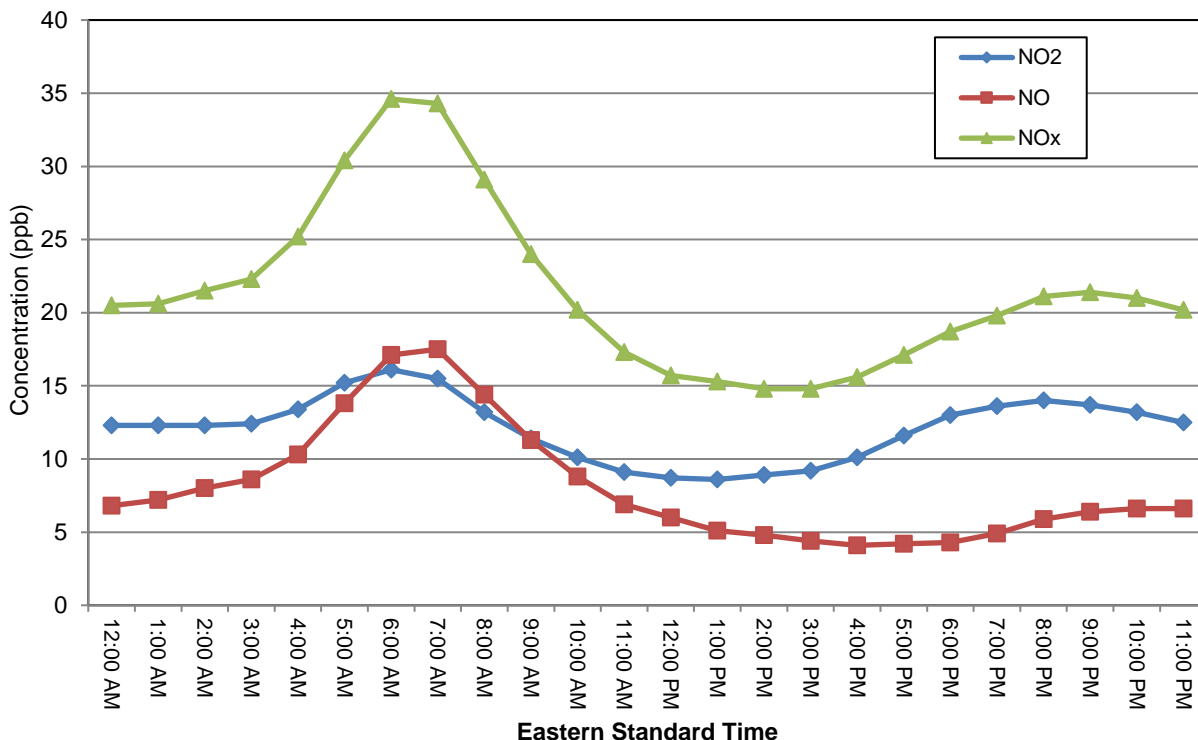
Figure 6-2 shows that NO<sub>x</sub> concentrations tend to be higher in the winter than in the summer. This is due in part to building heating, and to weather conditions that are more prevalent in the colder months of the year, such as lighter winds that result in poorer local dispersion conditions.

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



Because much of the NO<sub>x</sub> in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in Figure 6-3.

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



## HEALTH AND ENVIRONMENTAL EFFECTS

Short-term exposures to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses and cause respiratory illnesses in children, people with asthma, and the elderly. Symptoms of low-level exposure to NO and NO<sub>2</sub> include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO<sub>2</sub> may increase susceptibility to respiratory infection and may cause permanent damage to the lung. Studies show a connection between breathing elevated short-term NO<sub>2</sub> concentrations and increases in hospital emergency department visits and hospital admissions for respiratory issues, especially asthma. Individuals who spend time on or near major roadways can experience high short-term NO<sub>2</sub> 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<sub>2</sub> also reacts with water and oxygen to form nitric acid, a component of acid rain, which causes acidification of freshwater bodies and harms sensitive ecosystems such as lakes and forests.

## AMBIENT AIR QUALITY STANDARDS

There are two types of National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (USEPA). Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. A 1-hour primary standard for NO<sub>2</sub> of 100 parts per billion (ppb) was promulgated in 2010. The primary and secondary annual NAAQS for NO<sub>2</sub> are the same, a calendar year average concentration of 53 ppb. The annual New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS, except that micrograms per cubic meter (µg/m<sup>3</sup>) 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<sub>2</sub> standards.

**Table 6-1**  
**National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO<sub>2</sub>)**  
**Parts per Billion (ppb)**  
**Parts per Million (ppm)**  
**Micrograms per Cubic Meter (µg/m<sup>3</sup>)**

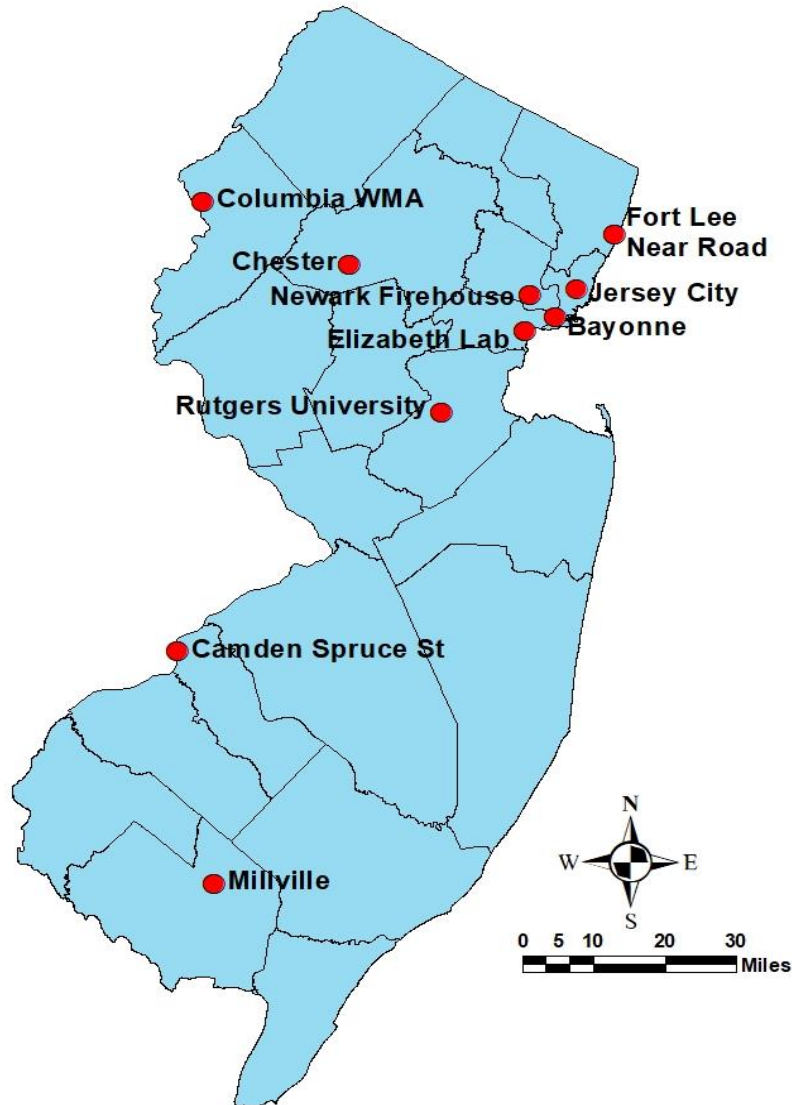
| Averaging Period | Type                | National            | New Jersey                        |
|------------------|---------------------|---------------------|-----------------------------------|
| 1-Hour           | Primary             | 100 ppb (0.100 ppm) | ---                              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

A state or other designated area is in compliance with a NAAQS when it meets the design value. For the annual standard, the annual average is the design value. However, for the 1-hour NO<sub>2</sub> standard, the NAAQS is met when the 3-year average of the 98th percentile of the daily maximum 1-hour NO<sub>2</sub> concentrations is less than 100 ppb. This statistic is calculated by first obtaining the maximum 1-hour average NO<sub>2</sub> concentrations for each day at each monitor. Then the 98th percentile value of the daily maximum NO<sub>2</sub> concentrations must be determined for the current year, and for each of the previous two years. Finally, the average of these three annual 98<sup>th</sup>-percentile values is the design value.

## NO<sub>2</sub> MONITORING NETWORK

NJDEP monitored NO<sub>2</sub> levels at ten locations in 2017. The monitoring stations are Bayonne, Camden Spruce Street, Chester, Columbia, Elizabeth Lab, Fort Lee Near Road, Jersey City, Millville, Newark Firehouse, and Rutgers University. These sites are shown in Figure 6-4.

**Figure 6-4**  
**2017 Nitrogen Dioxide Monitoring Network**



## **NO<sub>2</sub> LEVELS IN 2017**

None of New Jersey's monitoring sites exceeded the 1-hour or annual NO<sub>2</sub> ambient air standards in 2017. Fort Lee Near Road had the highest daily maximum 1-hour concentration at 92 ppb (see Table 6-2 and Figure 6-5). The 2017 98<sup>th</sup>-percentile values for each monitoring station are also shown in Table 6-2 and Figure 6-5. The design value for NO<sub>2</sub>, which determines whether or not there is a violation of the NAAQS, is actually the 3-year average of the 98<sup>th</sup>-percentile of the 1-hour daily maximum concentrations. The 2015-2017 design value for each site is given in Table 6-2 and Figure 6-7. The site with the highest design value for 2015-2017 was Fort Lee Near Road, with 63 ppb, although the 2015 data does not meet USEPA completeness criteria. The design values for Jersey City, Millville, and Rutgers University stations also have incomplete data for the three-year period (see Table 6-2 footnotes).

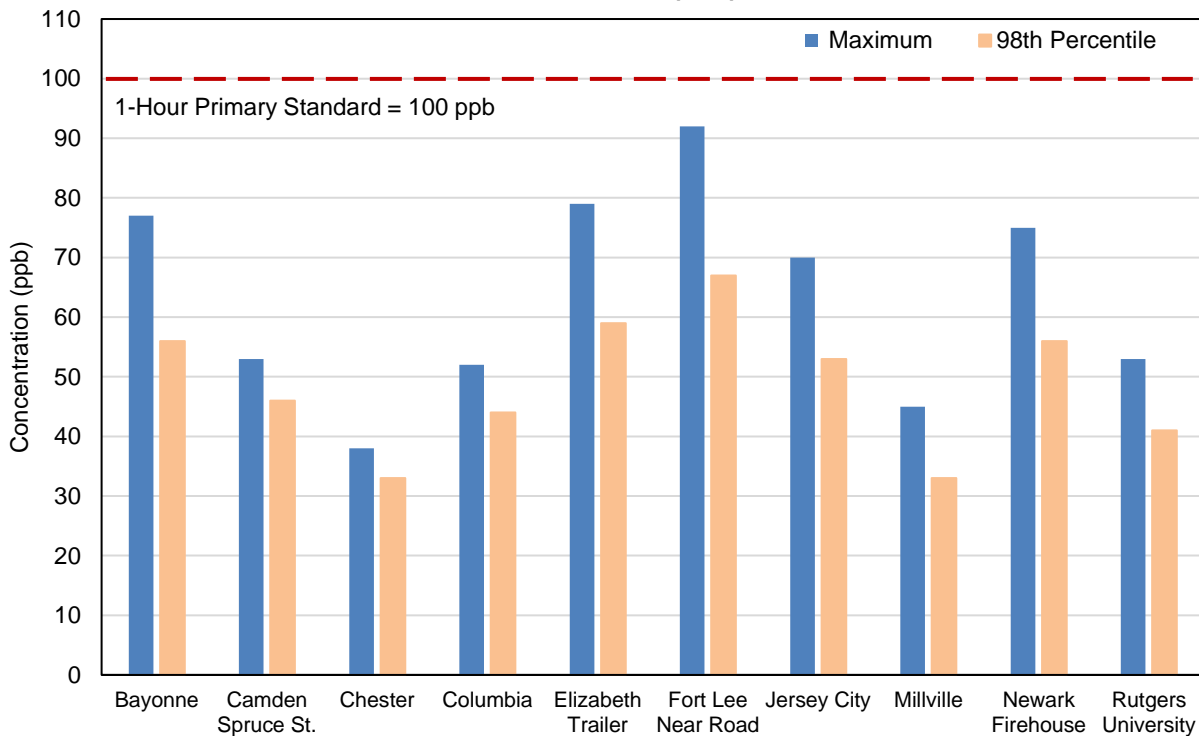
**Table 6-2**  
**2017 Nitrogen Dioxide Concentrations in New Jersey**  
**1-Hour Averages**  
**Parts per Billion (ppb)**

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

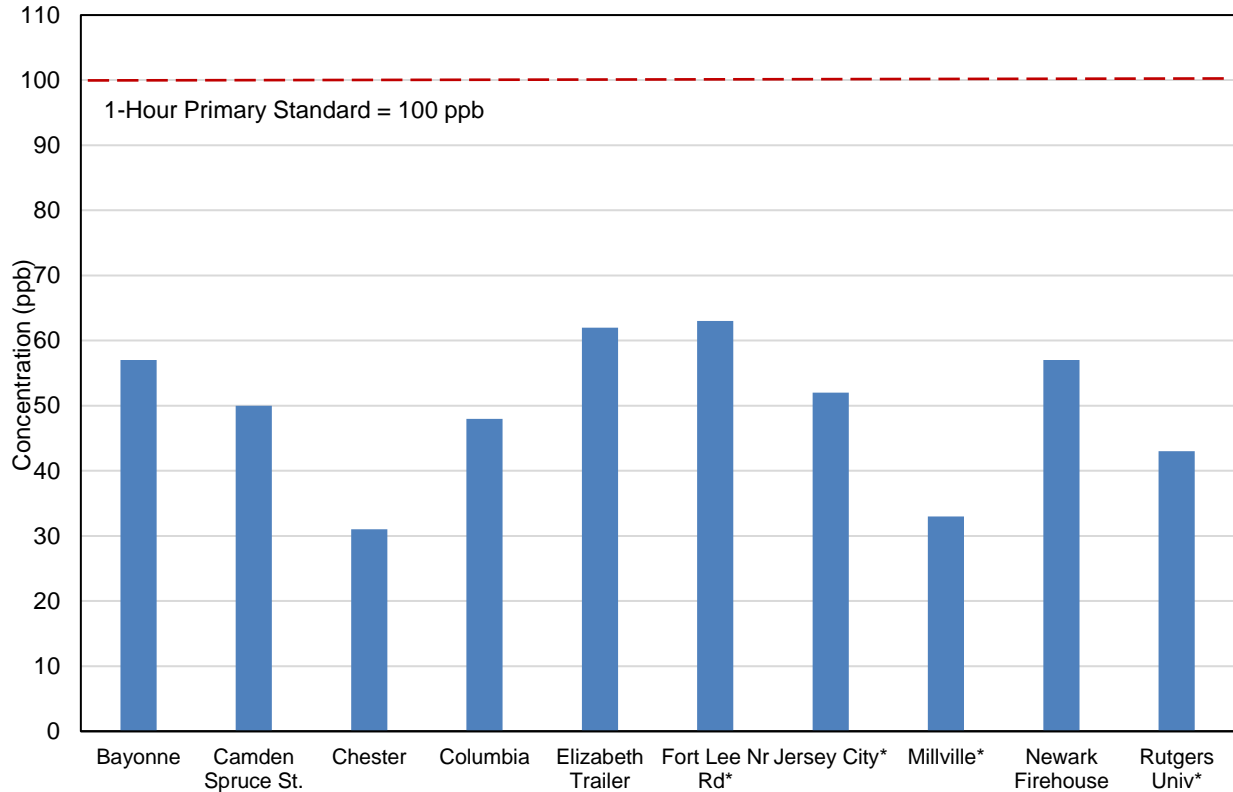
\*The following sites do not have three complete years of data for 2015 to 2017, and do not meet the design value criteria for NO<sub>2</sub>:

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

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



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



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

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

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

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

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

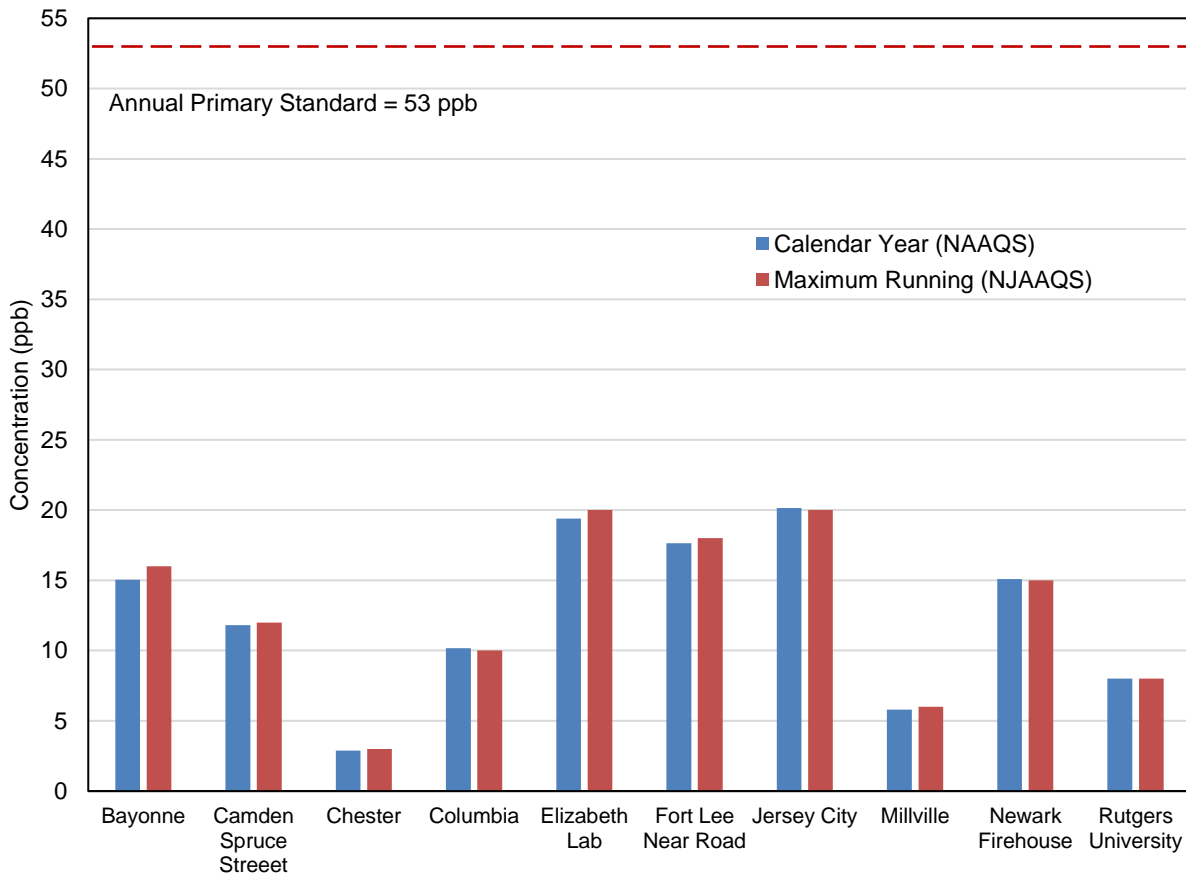
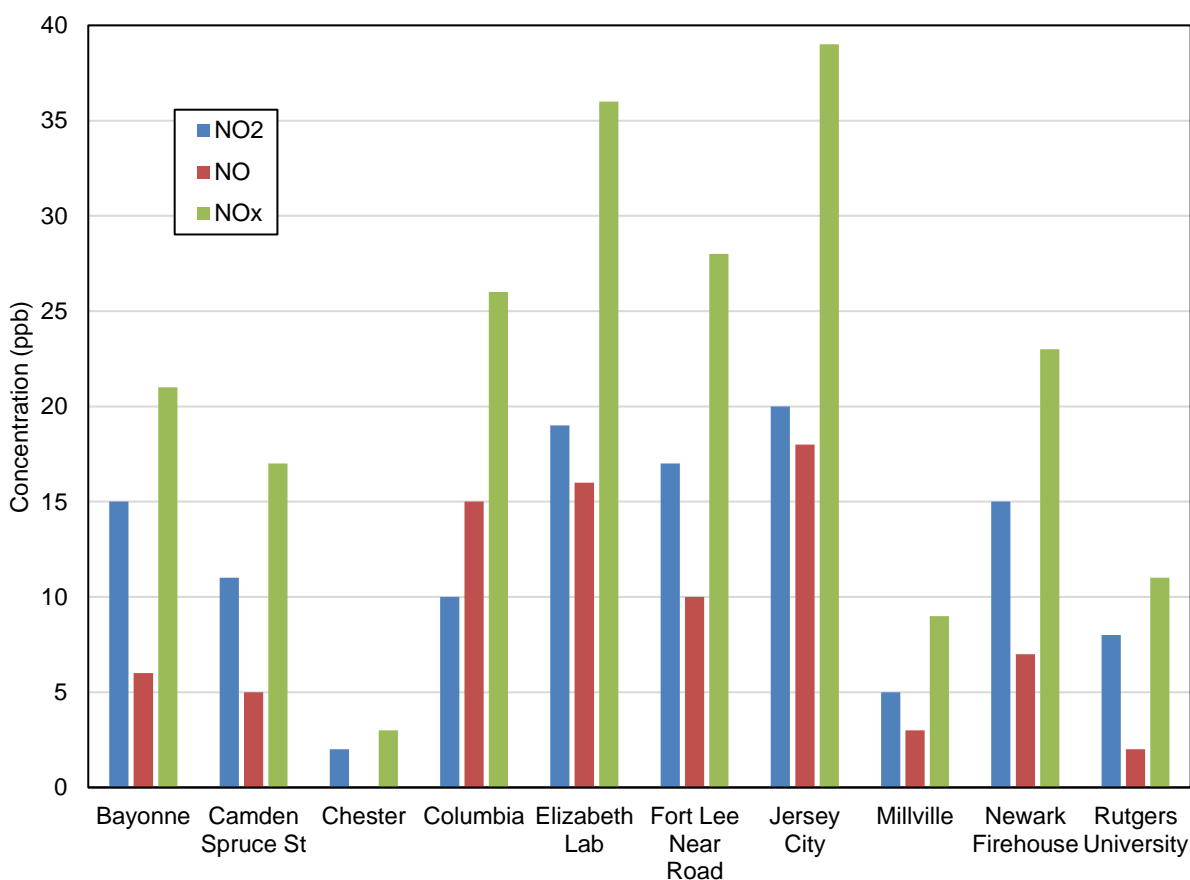


Figure 6-9 shows the calendar-year annual average concentrations of NO<sub>2</sub>, NO and NO<sub>x</sub> at each New Jersey monitoring site. The stations that measure NO<sub>2</sub> concentrations also measure NO and NO<sub>x</sub>, even though there are no ambient air standards for them. NO<sub>x</sub> levels are approximately (not exactly) the sum of the NO<sub>2</sub> and NO concentrations. The concentration of NO tends to be lower than NO<sub>2</sub>, because it quickly reacts with other air pollutants (particularly ozone) after it is emitted from a source, and converts to NO<sub>2</sub>. The higher NO concentration at the Columbia monitor is believed to result from its proximity to Interstate Highway 80. The road is a significant source of NO emissions from vehicles, but the expected conversion of NO to NO<sub>2</sub> is probably hindered by the area's relatively low levels of other pollutants.

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



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



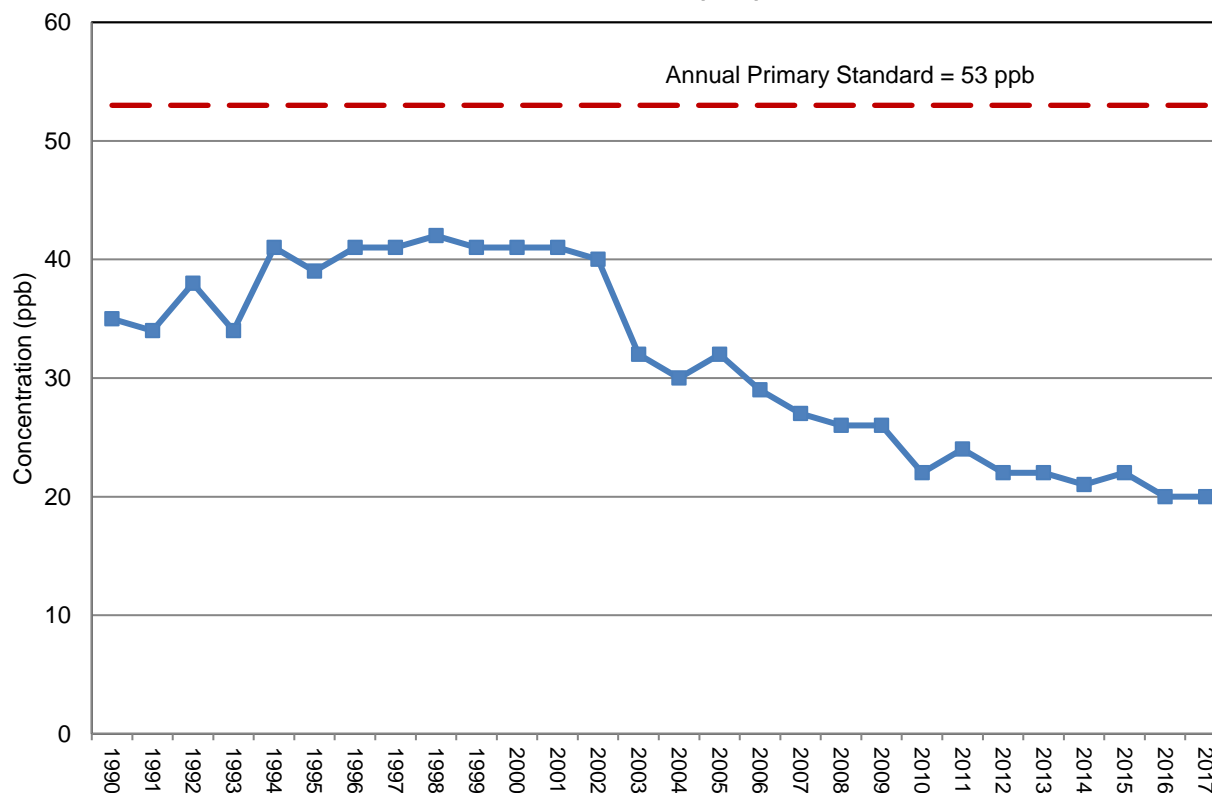
## NO<sub>2</sub> TRENDS

Routine monitoring for NO<sub>2</sub> in New Jersey began in 1966. The last year in which the annual average NO<sub>2</sub> concentration exceeded the NAAQS was 1974. The graph of NO<sub>2</sub> levels in Figure 6-10 shows the highest statewide annual average concentrations recorded from 1990 to 2017. Although NO<sub>2</sub> 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<sub>x</sub> emissions.

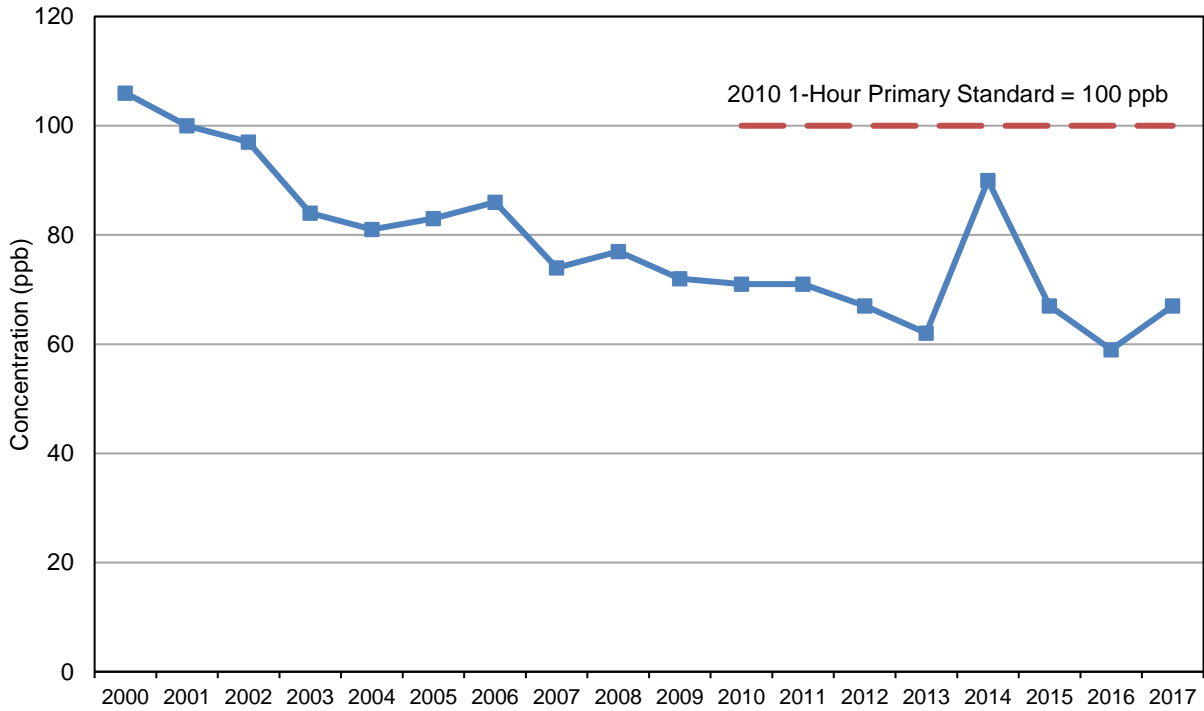
Figure 6-11 shows the highest 98<sup>th</sup> percentile values of the daily maximum one-hour concentrations of NO<sub>2</sub> for the years 2000 to 2017 in New Jersey. The 1-hour NAAQS of 100 ppb has not been exceeded since it was promulgated in 2010.

Figure 6-12 shows the New Jersey design values for the 1-hour NAAQS for the years 2000-2017. The design value, which determines compliance with the 1-hour NO<sub>2</sub> NAAQS, is the highest 3-year average of the 98<sup>th</sup> percentile values of the daily maximum one-hour concentrations at each New Jersey monitoring site. New Jersey has not violated the 1-hour NAAQS since it was implemented.

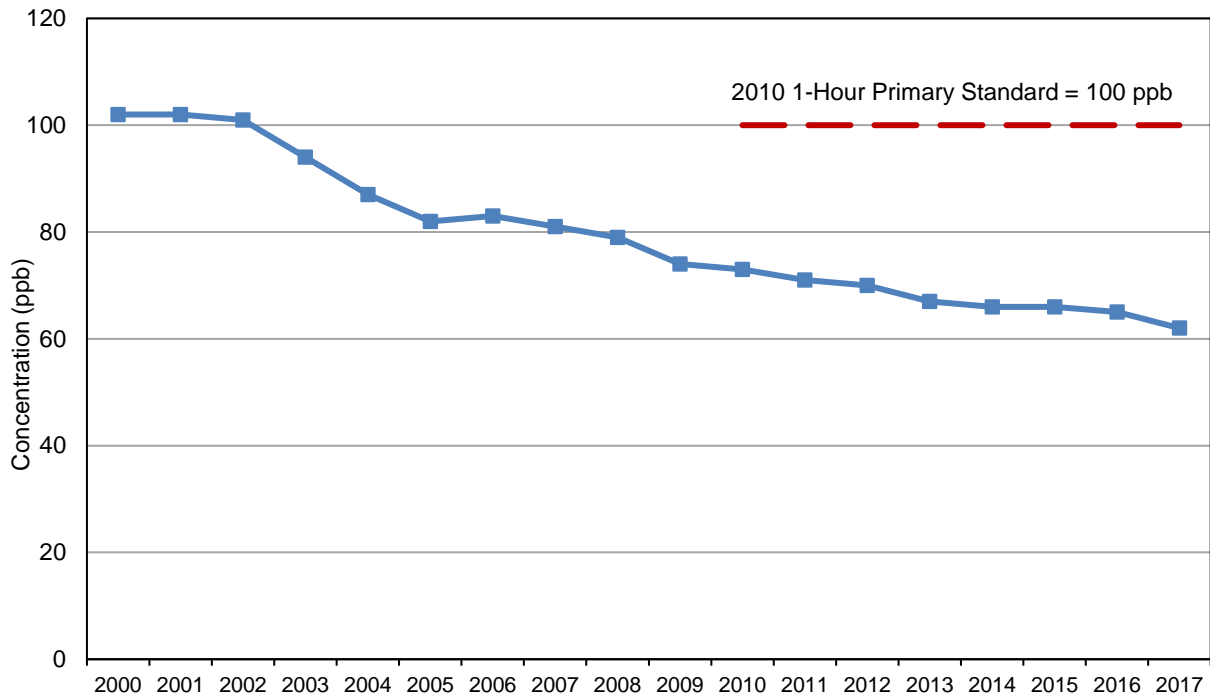
**Figure 6-10**  
**Nitrogen Dioxide Concentrations in New Jersey, 1990-2017**  
**Highest Annual (Calendar Year) Averages**  
**Parts per billion (ppb)**



**Figure 6-11**  
**Nitrogen Dioxide Concentrations in New Jersey, 2000-2017**  
**98<sup>th</sup>-Percentile of the Daily Maximum 1-Hour Concentrations**  
**Parts per Billion (ppb)**



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



## REFERENCES

New Jersey Department of Environmental Protection, Bureau of Evaluation and Planning. *New Jersey Air Emission Inventories*. [www.state.nj.us/dep/bagp/inventory.html](http://www.state.nj.us/dep/bagp/inventory.html) . Accessed 7/30/18.

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