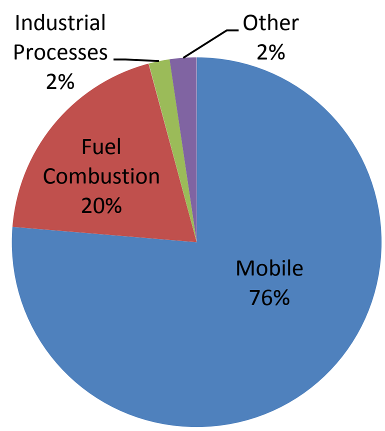
2014 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Nitrogen dioxide (NO_2) is a reddish-brown highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). NO_2 is used by regulatory agencies as the indicator for the group of gases known as nitrogen oxides (NOx). These gases are emitted from motor vehicle exhaust, combustion of coal, oil or natural gas, and industrial processes such as welding, electroplating, and dynamite blasting. Although most NOx is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. When NO_2 reacts with other chemicals it can form ozone, particulate matter, and other compounds which can contribute to regional haze and acid rain. A pie chart summarizing the major sources of NOx In New Jersey is shown in Figure 1. Because much of the NOx in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in Figure 2.

Figure 1
2011 New Jersey NOx Emissions
by Source Category



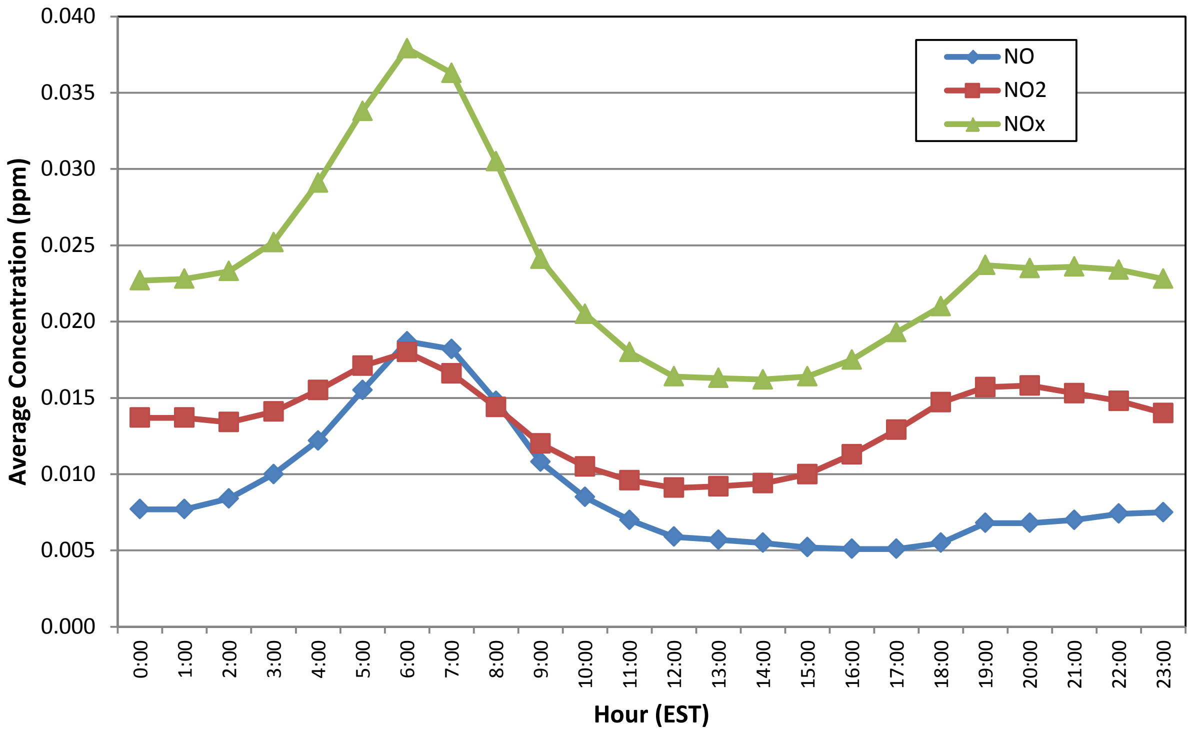
www3.epa.gov/air/emissions/index.htm

HEALTH AND ENVIRONMENTAL EFFECTS

Short-term exposures to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses, and can actually cause respiratory illnesses, particularly in children ages 5-12. 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 increased visits to emergency departments and hospital admissions for respiratory issues, especially asthma. Individuals who spend time on or near major roadways can experience high short-term NO_2 exposures.

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

Figure 2
2014 Concentrations of Nitrogen Oxides in New Jersey
Hourly Variation



Ambient Air Quality Standards

The primary (health-based) and secondary (welfare-based) annual average National Ambient Air Quality Standards (NAAQS) for NO_2 are the same: a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except that micrograms per cubic meter ($\mu g/m^3$) are the standard units and the averaging time is any 12-month period, not just the calendar year. In 2010, the U.S. Environmental Protection Agency (USEPA) strengthened the primary NAAQS by adding a 1-hour NO_2 standard of 0.100 ppm, based on the 98^{th} percentile of the daily maximum 1-hour concentration. Table 1 provides a summary of the NO_2 standards.

Table 1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)
Parts Per Million (ppm) and Micrograms Per Cubic Meter ($\mu g/m^3$)

Averaging Period	Type	New Jersey	National
12-month average	Primary	100 $\mu g/m^3$ (0.053 ppm)	
Annual average	Primary		0.053 ppm (100 $\mu g/m^3$)
12-month average	Secondary	100 $\mu g/m^3$ (0.053 ppm)	
Annual average	Secondary		0.053 ppm (100 $\mu g/m^3$)
1-hour average	Primary		0.100 ppm (190 $\mu g/m^3$)

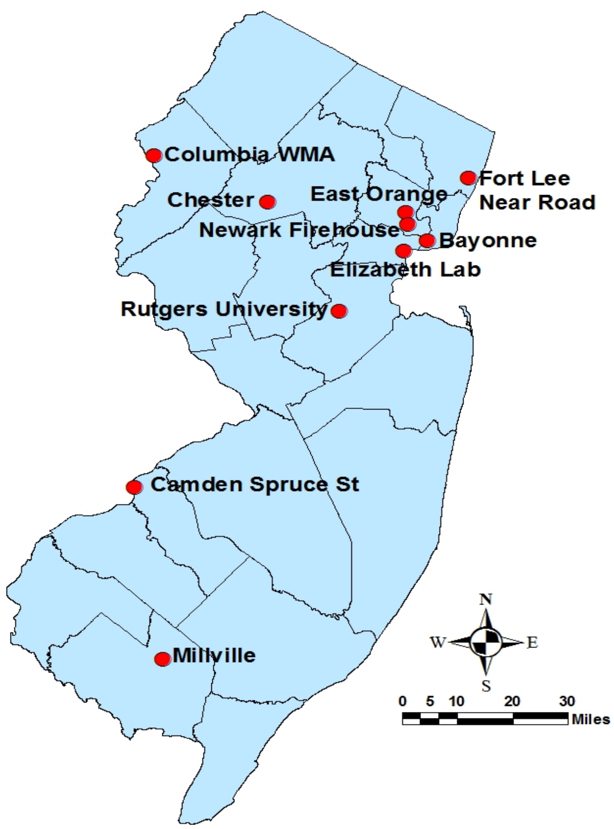
An area meets the new 1-hour NO_2 standard when the 3-year average of the 98th percentile of the daily maximum 1-hour NO_2 concentration is less than 0.100 ppm. This statistic, also known as the design value, is calculated by first obtaining the maximum 1-hour average NO_2 concentrations for each day at each monitor. Then the 98th percentile value of the daily maximum NO_2 concentrations must be determined for the current year, and for each of the previous two years. Finally, the average of these three 98th percentile values is the design value.

As part of the 2010 revision to the NAAQS, in addition to adopting a 1-hour NO_2 standard, USEPA required that in urban areas with populations of 1 million or more, an NO_2 near-road monitoring station be established and operational by January 1, 2014. A near-road station must be located no more than 50 meters (164 feet) from the nearest traffic lane of a major roadway. The New Jersey Department of Environmental Protection (NJDEP) established one near-road station for the New York-Northern New Jersey-Long Island Metropolitan area in Fort Lee along Interstate 95 and adjacent to the tollbooths for the George Washington Bridge.

MONITORING LOCATIONS

NJDEP monitored NO_2 levels at 10 locations in 2014. The Fort Lee Near Road monitoring station began operating in March 2014. These sites are shown in Figure 3.

Figure 3
2014 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2014

Fort Lee Near Road was the only monitoring site in New Jersey that recorded any exceedances of either the National or New Jersey Air Quality Standards for NO_2 during 2014. The maximum 1-hour concentration at Fort Lee was 0.258 ppm, and the 2nd highest maximum 1-hour concentration was 0.130 ppm (see Table 2). While these values exceeded the NAAQS, it will not be known if this is a violation of the NAAQS until three years of data are collected at the Fort Lee site. The 98th percentile of the 1-hour daily maximum concentration for 2014 for each site is given in Table 2 and Figure 4. The 3-year average of the 98th percentile of the 1-hour daily maximum concentration (for 2012-2014) for each site is given in Table 2 and Figure 5. This is the design value that determines compliance with the 1-hour NO_2 NAAQS. The site with the highest design value for 2012-2014 was Elizabeth Trailer, with 0.066 ppm. In addition to Fort Lee Near Road, the three-year averages for the Bayonne and Millville stations could not be calculated because of incomplete data for certain years (see Table 2 notes).

The highest running-12-month and calendar-year average concentrations of NO_2 measured were 0.023 and 0.21 ppm respectively, at the Elizabeth Trailer site, located at Exit 13 of the New Jersey Turnpike (Table 2 and Figure 6).

Table 2
Nitrogen Dioxide (NO_2) and Nitric Oxide (NO) Data – 2014
1-Hour and 12-Month Averages
1-Hour NAAQS = 0.100 ppm
12-Month NAAQS = 0.053 ppm

	Nitrogen Dioxide 1-Hour Average (ppm)				Nitrogen Dioxide 12-Month Average (ppm)	
Monitoring Site	**Daily Maximum**	**2nd Highest Daily Max.**	**2014 98th%-ile**	**2012-2014 98th%-ile 3-year Avg.**	**Maximum (Running 12-Month)**	**Calendar Year**
Bayonne	0.075	0.071	0.061	a	0.018	0.017
Camden Spruce Street	0.064	0.060	0.050	0.046	0.013	0.013
Chester	0.051	0.049	0.040	0.036	0.005	0.004
Columbia WMA	0.058	0.056	0.049	0.045	0.013	0.012
East Orange	0.090	0.074	0.064	0.057	0.017	0.016
Elizabeth Trailer	0.085	0.083	0.070	0.066	0.023	0.021
Fort Lee Near Road	0.258	0.130	0.074	b	0.018	0.018
Millville	0.042	0.040	0.036	c	0.006	0.006
Newark Firehouse	0.083	0.083	0.070	0.063	0.019	0.018
Rutgers University	0.083	0.060	0.047	0.044	0.009	0.009

a. Bayonne site temporarily shut down October 2012 through July 2013 due to damage from Superstorm Sandy.
b. Fort Lee Near Road site began operating March 2014.
c. Millville temporarily shut down for site renovations December 2012 to March 2013.

Figure 4
2014 98th Percentile Daily Maximum 1-Hour
Nitrogen Dioxide Concentrations in New Jersey

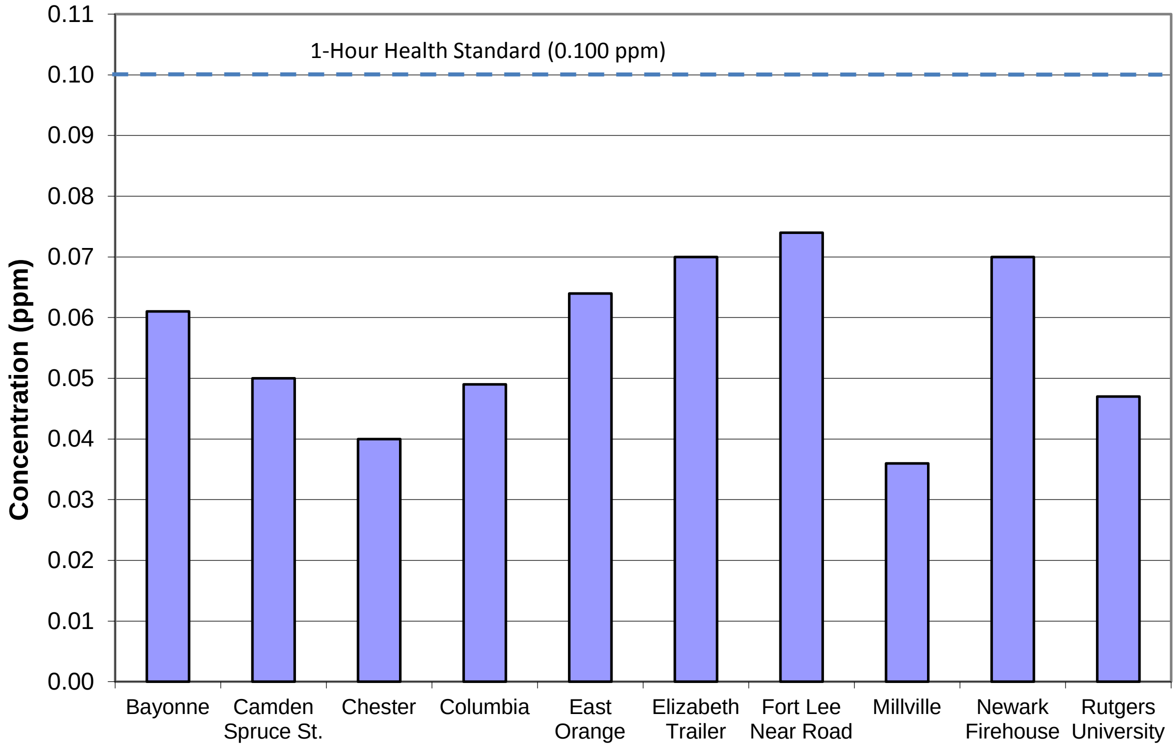


Figure 5
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average
Nitrogen Dioxide Concentrations in New Jersey (2012-2014)

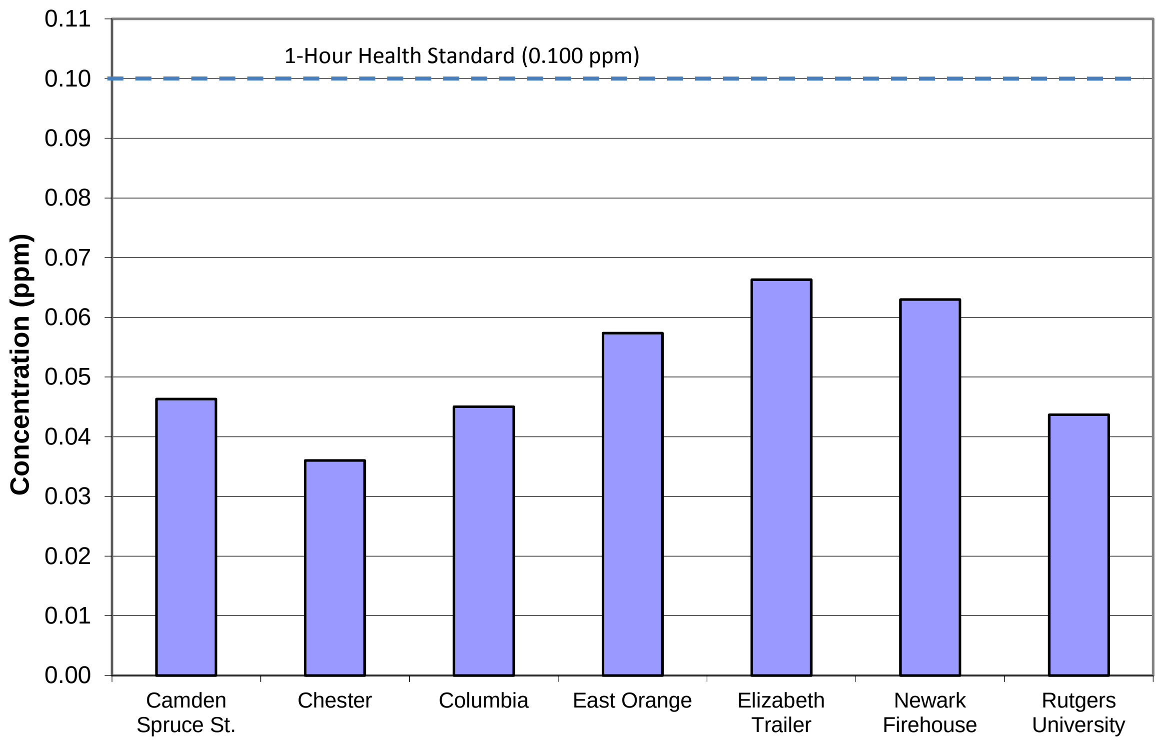
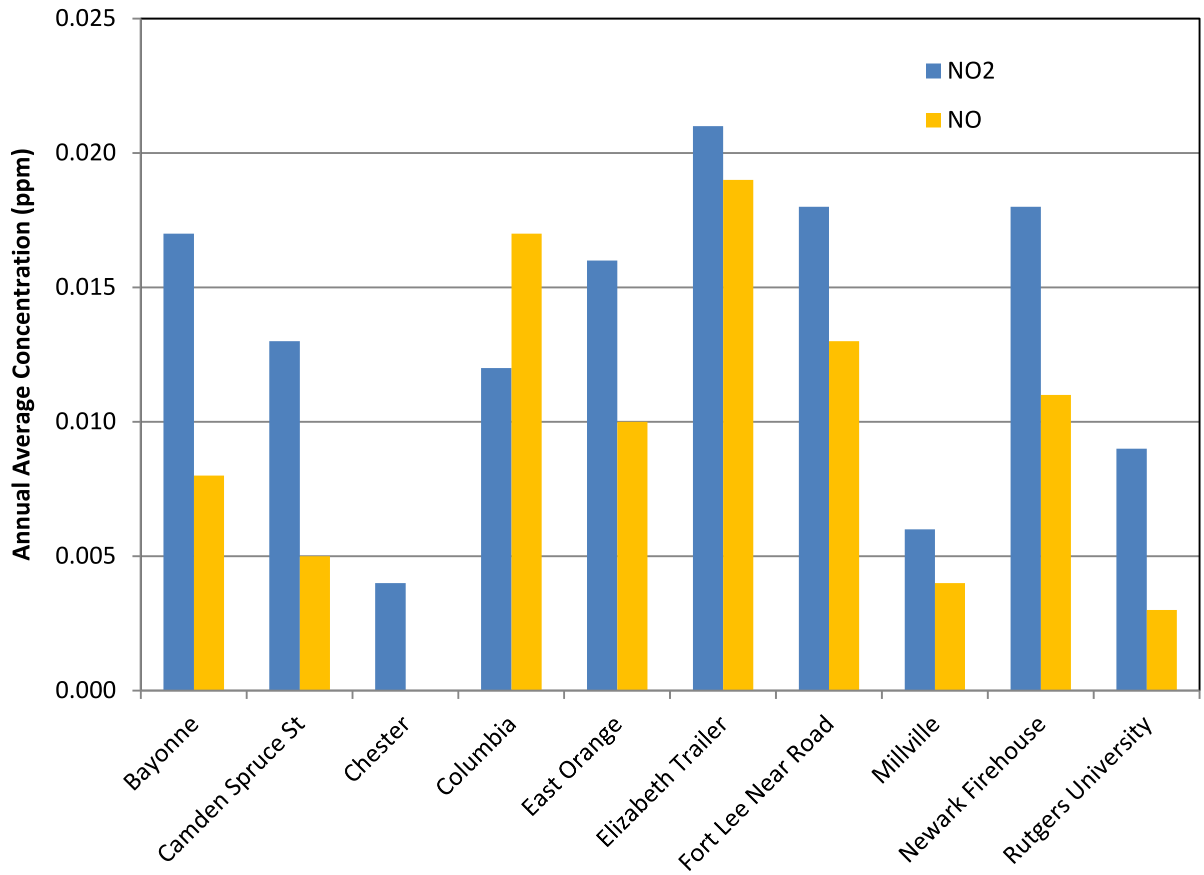


Figure 6
Calendar Year Annual Average
Nitrogen Dioxide & Nitric Oxide Concentrations
in New Jersey – 2014



In addition to showing the calendar year annual average concentrations for nitrogen dioxide at each site, Figure 6 also includes values for nitric oxide. The New Jersey monitoring stations that measure NO_2 levels also measure NO and NOx levels. NOx levels are approximately the sum of the NO_2 and NO concentrations.

TRENDS

Figure 7 shows that NOx concentrations tend to be higher in the winter than in the summer. This is due in part to building heating, and to poorer local dispersion conditions caused by light winds and other weather conditions that are more prevalent in the colder months of the year.

Routine monitoring for NO_2 in New Jersey began in 1966, and 1974 was the last year in which the annual mean NO_2 concentrations exceeded the NAAQS. The graph of NO_2 levels in Figure 8 shows the statewide average annual mean concentrations recorded from 1975 to 2014 in the form of a trend line. The graph also includes the levels at of the sites that measured the highest annual mean and lowest annual mean in each year, as points above and below this trend line. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of concern about oxides of nitrogen because of their role in the formation of other pollutants, most notably ozone and fine particles. Both of these pollutants are of interest over much of the northeastern United States, and efforts to reduce levels of ozone and fine particles are likely to require continued reductions in NOx emissions.

Figure 9 shows the highest, lowest, and average 98th percentile values of the daily maximum one-hour concentrations for the years 2000 to 2014 at each New Jersey monitoring site. The average values are well below the 1-hour NAAQS of 0.100 ppm.

Figure 7
2014 Concentrations of Nitrogen Oxides in New Jersey
Monthly Variation

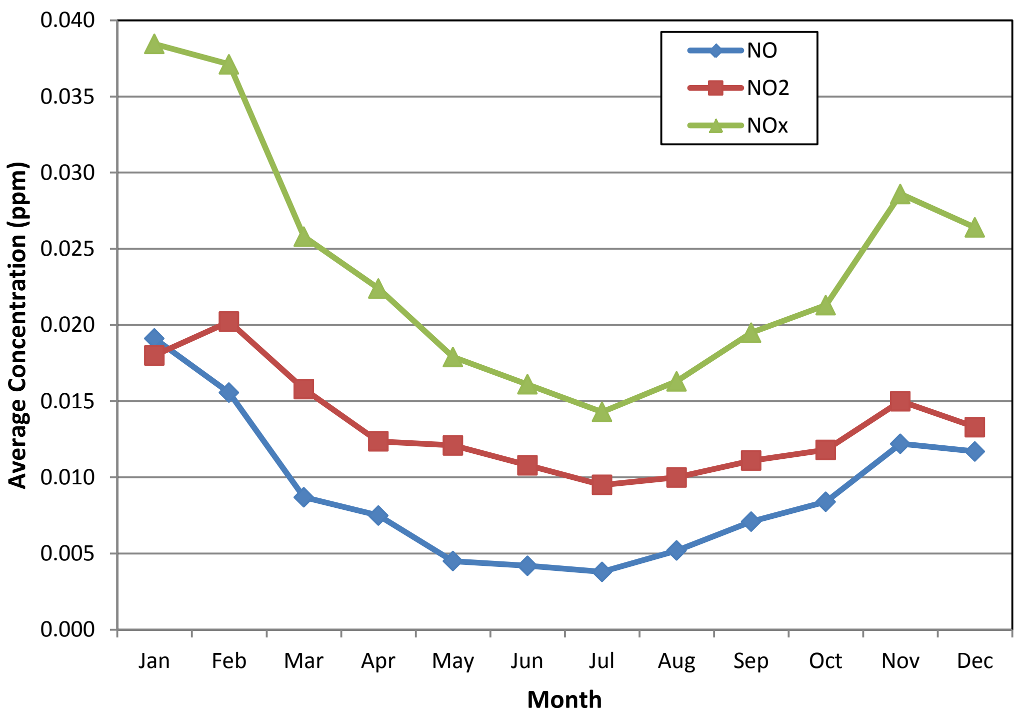


Figure 8
Nitrogen Dioxide Concentrations in New Jersey, 1975-2014
12-Month (Calendar Year) Average

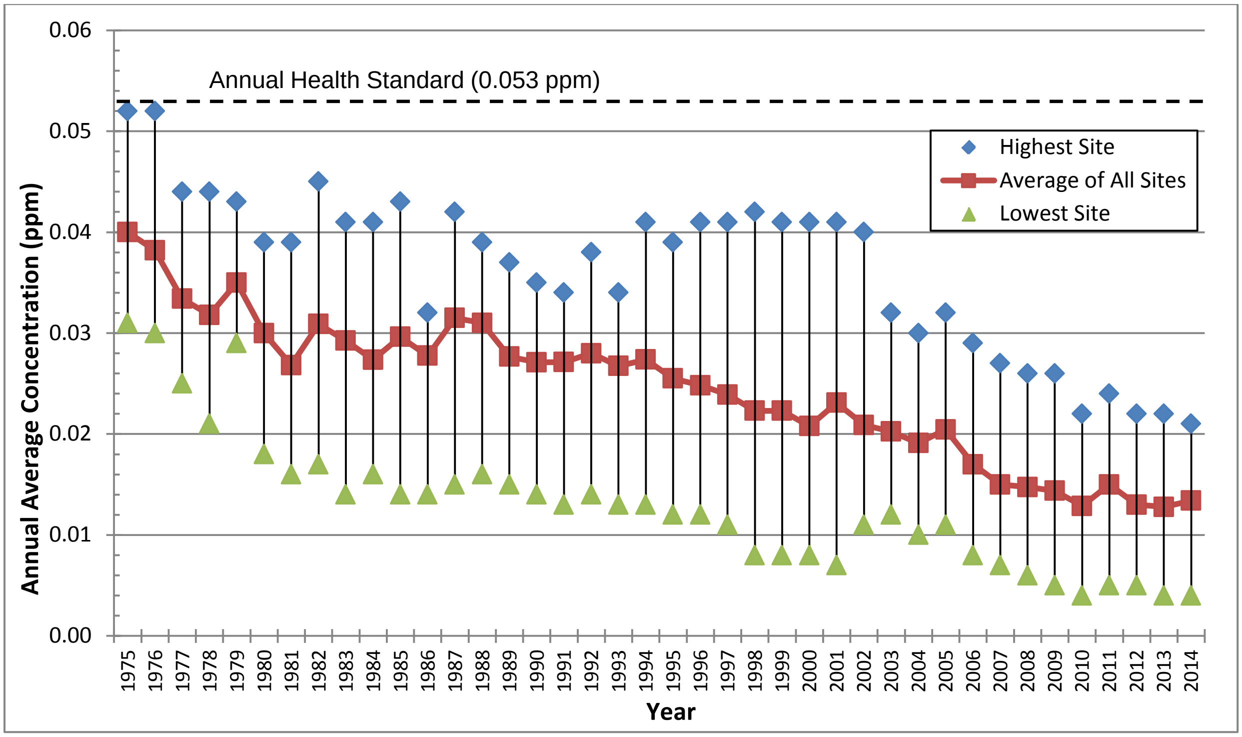
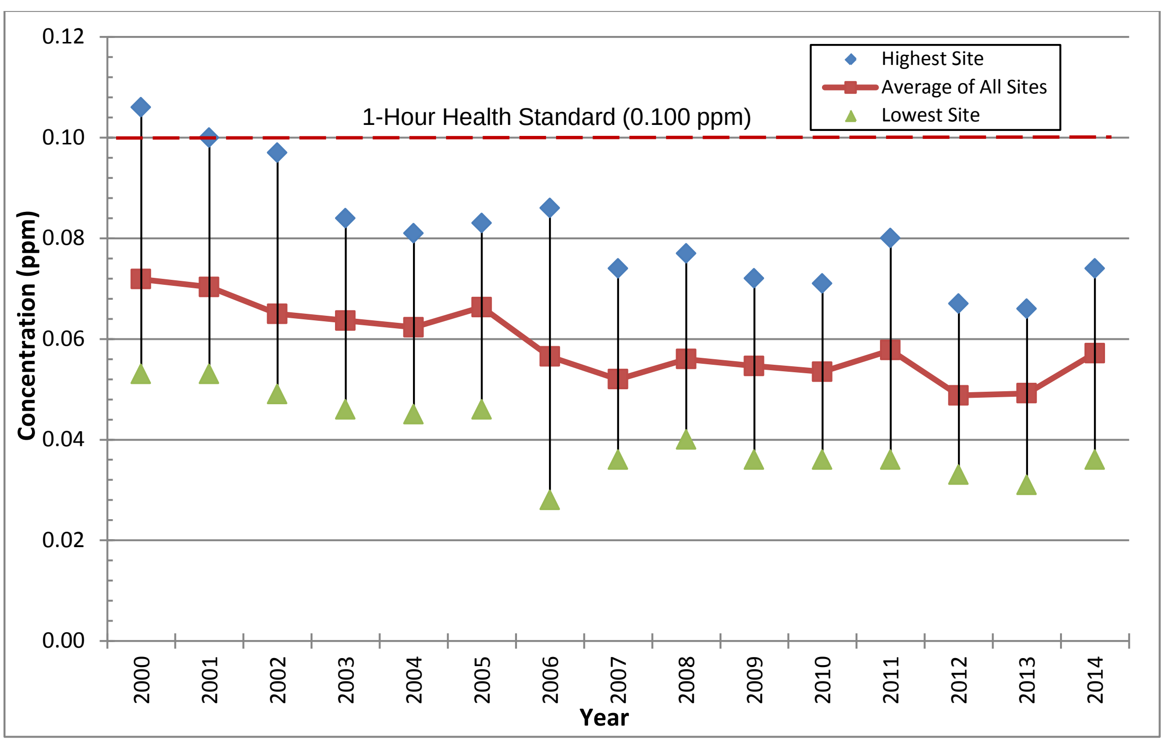


Figure 9
Nitrogen Dioxide Concentrations in New Jersey, 2000-2014
98th Percentile of Daily Maximum 1-Hour Concentrations



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