2003 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). When NO_2 reacts with chemicals that are common in the atmosphere in the presence of sunlight, it can result in the formation of ozone, particulate matter, haze and acid rain. Nitrogen Oxides (NO_x) is a mixture of gases which is mostly comprised of NO and NO_2. These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during 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. A pie chart summarizing the major sources of NO_x is shown below (Figure 1). As much of the NO_x in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in the graph in Figure 2 (page 2), which also indicates that concentrations tend to be higher in the winter than the summer. This is due in part to poorer local dispersion conditions caused by light winds and other weather conditions that are more prevalent in the colder months of the year.

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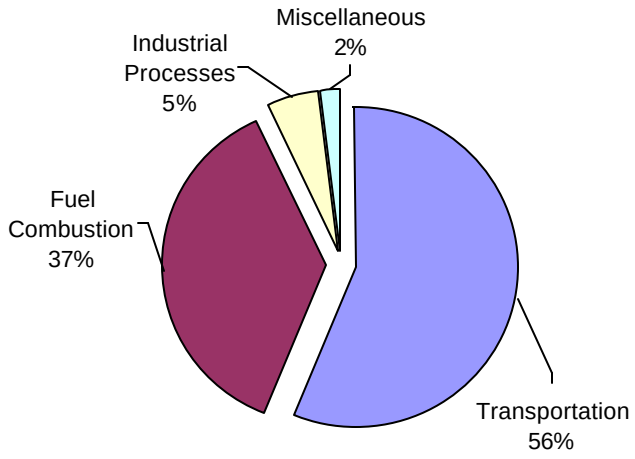
Figure 1
National Summary of 2002
NO_x Emissions by Source Category



Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

Health and Environmental Effects

Short-term exposures (less than 3 hours) to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses, and can cause respiratory illnesses, particularly in children ages 5-12. Symptoms of low level exposure to NO_x include irritation to eyes, nose, throat and lungs, coughing, shortness of breadth, tiredness and nausea. Long-term exposures to NO_2 may increase susceptibility to respiratory infection and may cause permanent damage to the lung. NO and NO_2 are found in tobacco smoke, so people who smoke or breathe in second-hand smoke may be exposed to NO_x. The U.S. Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the U.S. Environmental Protection Agency (EPA) have determined that, with the available information, no conclusion can be made as to the carcinogenicity of NO_x to human beings.

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.

Standards

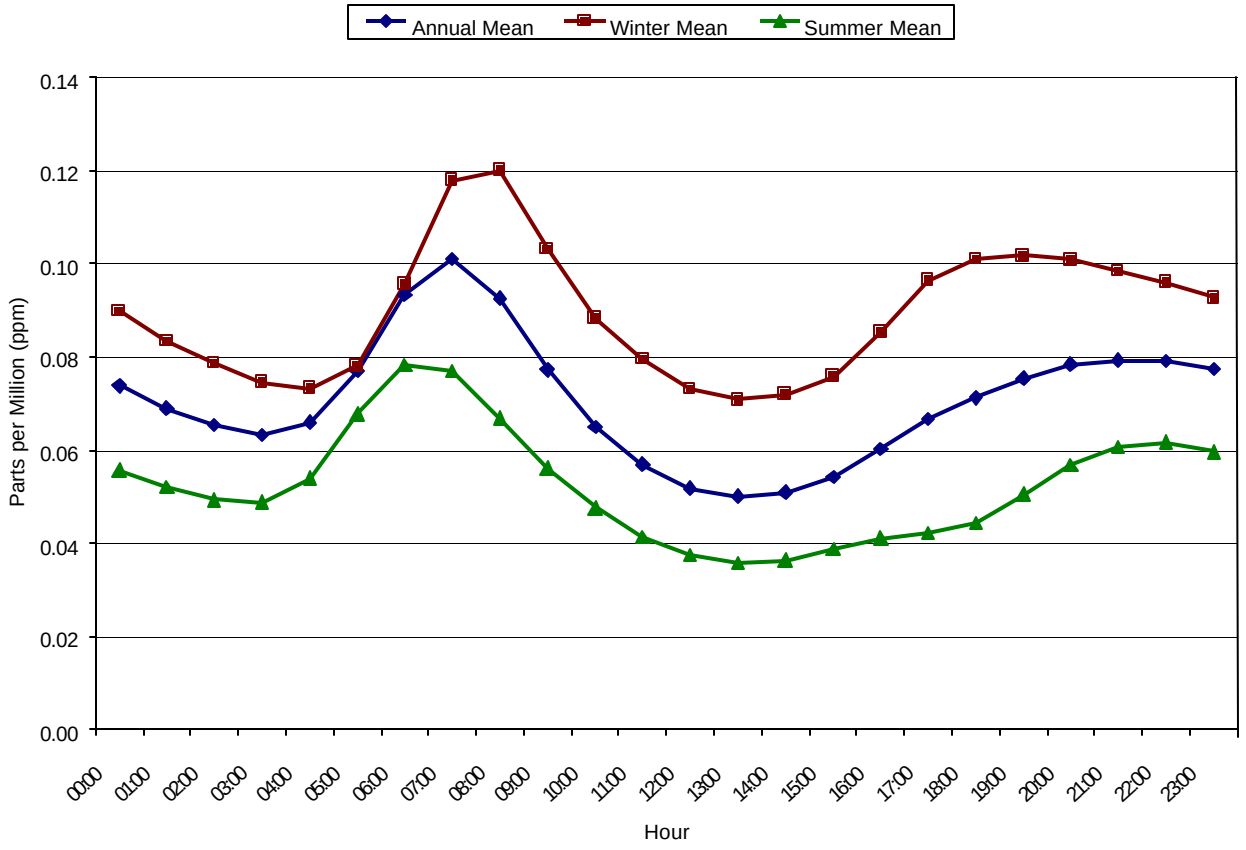
The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) for NO_2 are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except micrograms per cubic meter ($\mu g/m^3$) are the standard units and the state standard applies to any 12-month period, not just the calendar year. The state of California has a one-hour average standard of 470 $\mu g/m^3$ that New Jersey uses as a guideline in assessing short-term impacts from specific sources. Table 1 provides a summary of the NO_2 standards.

Table 1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide

Parts Per Million (ppm)
Micrograms Per Cubic Meter (µg/m^3)

Averaging Period	Type	New Jersey	National	California
12-month average	Primary	100 µg/m^3 (0.05 ppm)		
Annual average	Primary		0.053 ppm (100 µg/m^3)	
12-month average	Secondary	100 µg/m^3 (0.05 ppm)		
Annual average	Secondary		0.053 ppm (100 µg/m^3)	
1-hour average	Primary			470 µg/m^3 (0.25 ppm)

Figure 2
Nitrogen Dioxide & Nitric Oxide Concentrations – New Jersey 1967-1999
Seasonal and Hourly Variation



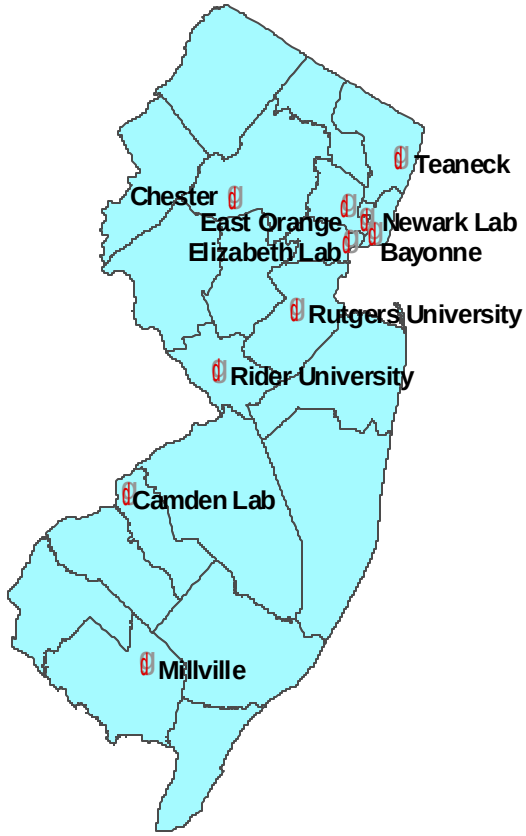
MONITORING LOCATIONS

The state monitored NO_2 levels at 10 locations in 2003. These sites are shown in the map to the right. The Newark Lab monitoring station was discontinued on June 5, 2003 and the Camden Lab monitoring station was temporarily discontinued on September 22. As a result, valid 2003 annual averages could not be calculated for these sites. The Camden Lab monitoring station resumed operation on January 8, 2004, and the DEP is continuing efforts to establish a station to replace the Newark Lab station.

NO_2 LEVELS IN 2003

None of the monitoring sites recorded exceedances of either the National or New Jersey Air Quality Standards for NO_2 during 2003. The maximum annual average concentration recorded was 0.032 ppm at Exit 13 of the New Jersey Turnpike in Elizabeth. While national health and welfare standards have not been established for Nitric Oxide (NO), it is considered to be an important pollutant that contributes to the formation of ozone, fine particles and acid rain. The maximum annual average concentration of NO recorded in 2003 was 0.050 ppm, also at the Exit 13 site (see Table 2 and Figure 4, page 4),

Figure 3
2003 Oxides of Nitrogen Monitoring Network



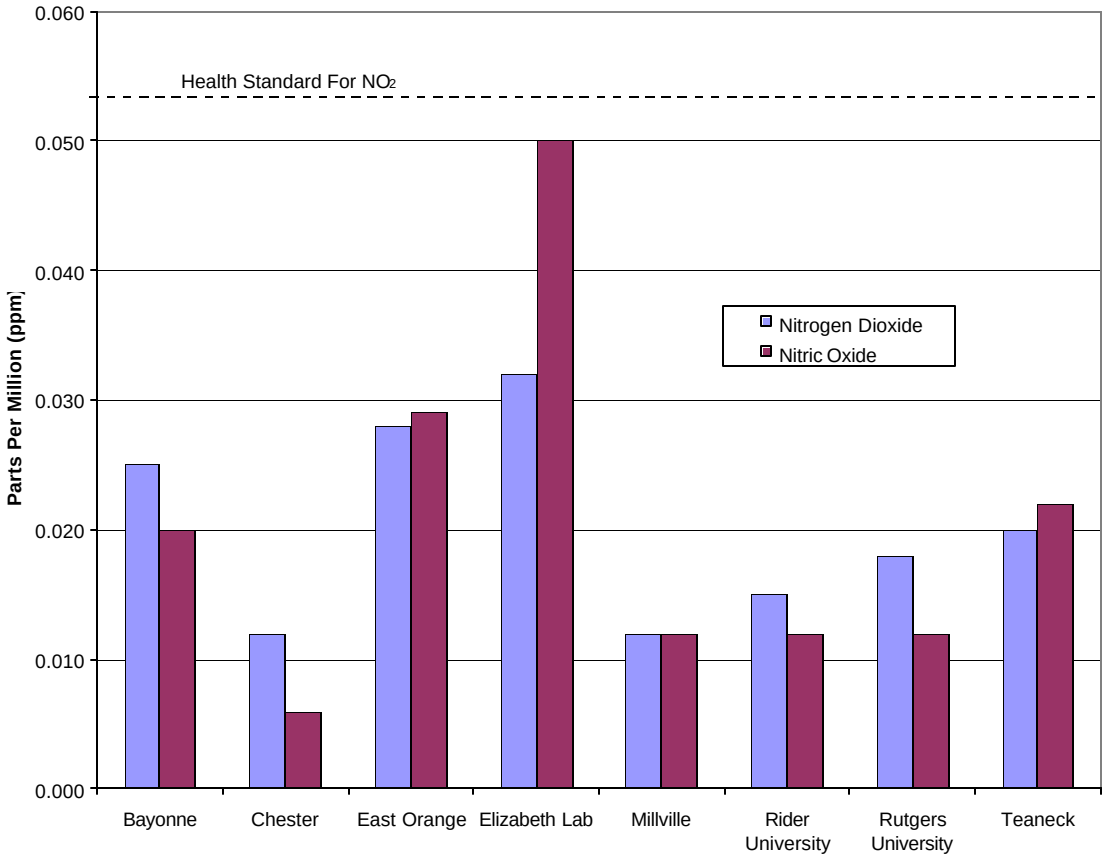
Tabe 2
Nitrogen Dioxide and Nitric Oxide Data-2003
1-Hour and 12-Month Averages

Parts Per Million (ppm)
California 1-Hour Standard = 0.25 ppm
National 12-Month Standard = 0.053 ppm

	Nitrogen Dioxide 1-Hour Average (ppm)		Nitrogen Dioxide 12-Month Average (ppm)		Nitric Oxides Annual
Monitoring Sites	Maximum	2nd Highest	Maximum	Calendar year	Average(ppm)
Bayonne	0.138	0.101	0.026	0.025	0.020
Camden Lab[a]	0.078	0.076	0.022	----	----
Chester	0.058	0.057	0.013	0.012	0.006
East Orange	0.093	0.091	0.028	0.028	0.029
Elizabeth Lab	0.092	0.088	0.039	0.032	0.050
Millville	0.054	0.050	0.014	0.012	0.012
Newark Lab[b]	0.084	0.080	0.029	----	----
Rider University	0.064	0.060	0.017	0.015	0.012
Rutgers University	0.091	0.090	0.018	0.018	0.012
Teaneck	0.124	0.119	0.021	0.020	0.022

[a]Data not available after September
[b]Data not available after June

Figure 4
Annual Average NO and NO_2 Concentrations in New Jersey - 2003



TRENDS

NO_2 concentrations have not posed a significant direct health problem in New Jersey. A graph of NO_2 levels provided in Figure 5 shows the statewide average annual mean concentrations recorded from 1975 to 2003 in the form of a trendline. The graph also includes the levels of the sites that measured the highest annual mean and lowest annual mean in each year as points above and below this trendline. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of interest in oxides of nitrogen because of their role in the formation of other pollutants – most notably ozone and fine particles. Both these pollutants are of concern over much of the northeastern United States and efforts to reduce levels of ozone and fine particles are likely to require reductions in NO emissions.

TOTAL REACTIVE OXIDES OF NITROGEN (NO_Y)

Although not specifically defined, there is a broad group of nitroxyl compounds in the ambient air that react in the troposphere and contribute to the formation of ozone. These compounds, called Total Reactive Oxides of Nitrogen (NO_y), include nitrogen oxides (NO_x), peroxyacyl nitrates ($RC(O)OONO_2$ or PAN), peroxynitric acid (HO_2NO_2), nitrous acid (HONO), nitric acid (HNO_3), dinitrogen pentoxide (N_2O_5) and nitrate radicals (NO_3). NO_y can also be described as the sum of the nitrogen oxides (NO_x) and the atmospheric NO_x oxidation products. Although measuring NO_y is not required by the federal regulations, it is strongly recommended by the EPA to supplement the data collected by Photochemical Assessment Monitoring Stations (PAMS) Network. NO_y measurements may provide valuable information for evaluating chemical mechanisms in ozone (O_3)

prediction models, indicate NO and NO_2 emission trends, and assist in developing regional control strategies for O_3.

The identification and measurement of individual NO_y compounds is technically difficult and expensive, however, an analyzer that measures total NO_y concentrations is commercially available. The NJDEP began monitoring for NO_y at the Rider University station in March 2002. Nitrogen oxides (NO_x) and speciated volatile organic compounds (VOCs) are also measured at this station.

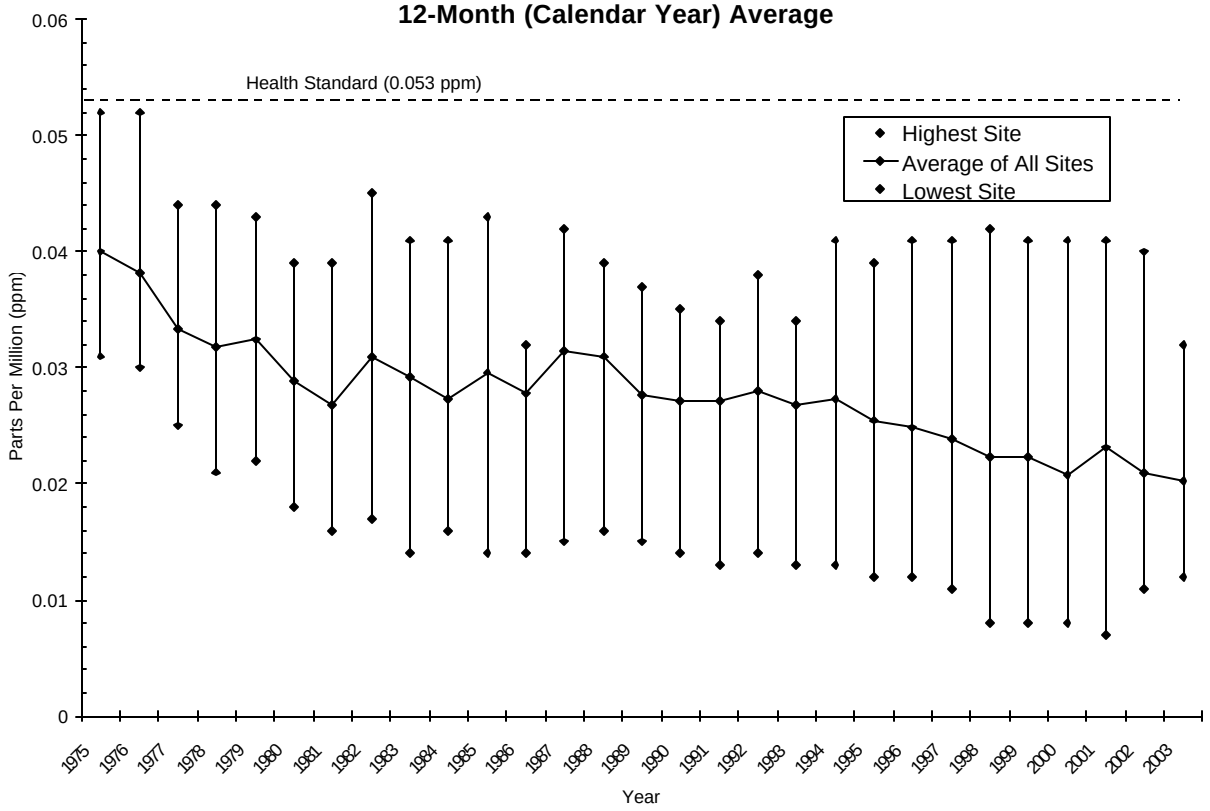
The monthly average NO_y concentrations for 2003 are presented in Table 3 along with the corresponding NO_x concentrations measured by the NO_2 analyzer at Rider University. The concentrations of NO_y closely match the NO_x concentrations, and both follow a trend where the highest concentrations are in the fall and winter months, and the lowest concentrations are in July and August. Poorer air dispersion conditions that are prevalent in the colder months are the cause for the seasonally higher concentrations of NO_x and NO_y.

Table 3
Nitrogen Oxides (NO_x) and
Total Reactive Oxides of Nitrogen (NO_y) Data
Rider University - 2003
Monthly Average

Parts Per Million (ppm)

	NO_x Monthly Average (ppm)	NO_y Monthly Average (ppm)
January	0.032	0.035
February	0.043	0.039
March	0.031	0.032
April	0.022	0.022
May	0.020	0.020
June	0.014	0.014
July	0.014	0.013
August	0.011	0.011
September	0.016	0.015
October	0.031	0.029
November	0.046	0.044
December	0.038	0.036

Figure 5
Nitrogen Dioxide Concentrations in New Jersey
1975-2003
12-Month (Calendar Year) Average



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