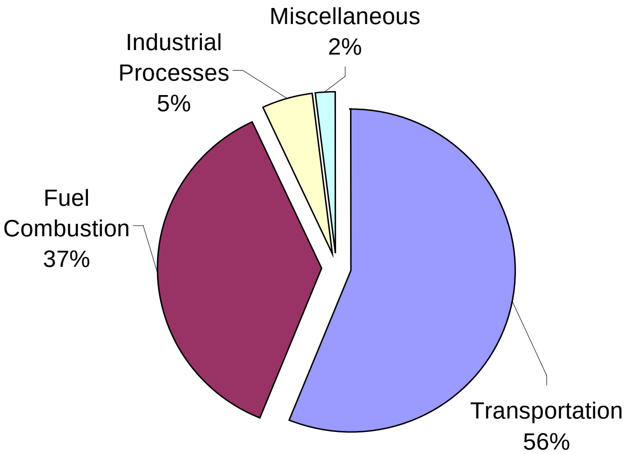
# 2002 Nitrogen Dioxide Summary

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 other chemicals in the atmosphere, it can result in the formation of ozone, particulate matter, haze and acid rain. Nitrogen Oxides ($NO_x$), 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 in 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.

**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 breath, 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 breath in second-hand smoke may be exposed to $NO_x$. The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the 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

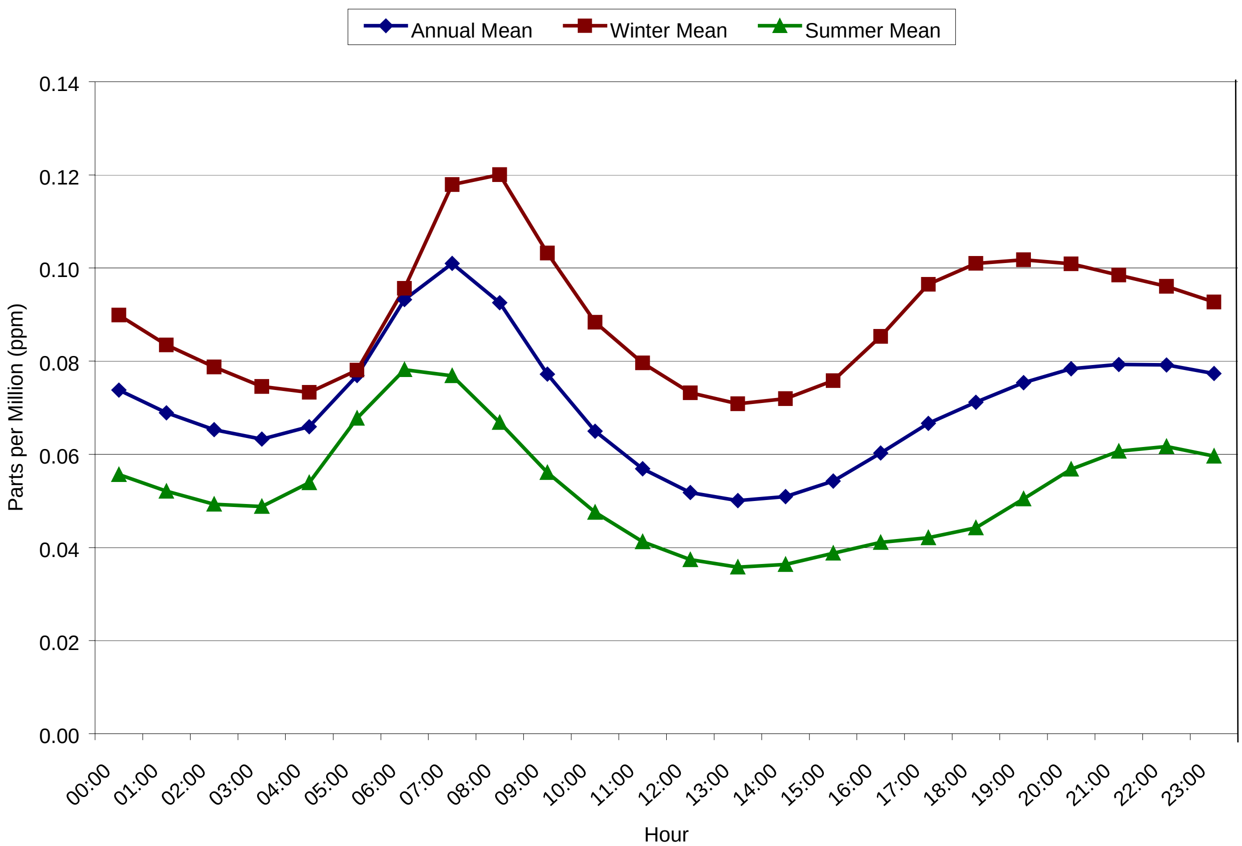
The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) for $NO_2$ are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except 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 (page 2) 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/ $^3$) | |
| 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 Concentration – New Jersey
## 1967-1999
## Seasonal and Hourly Variation



## MONITORING LOCATIONS

The state monitored Oxides of Nitrogen levels at 11 locations in 2002. These sites are shown in the map to the right. The Somers Point monitoring station was discontinued on March 6, 2002. A valid 2002 annual average could not be calculated for this site.

## $NO_2$ LEVELS IN 2002

None of the monitoring sites recorded exceedances of the primary or secondary $NO_2$ NAAQS during 2002. The maximum annual average concentration recorded was 0.040 ppm at Exit 13 of the New Jersey Turnpike in Elizabeth. While national health and welfare standards have not been established for 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 2002 was 0.048 ppm, also at the Exit 13 site (see Table 2 and Figure 4, page 4).

**Figure 3**
**2002 Oxides of Nitrogen Monitoring Network**

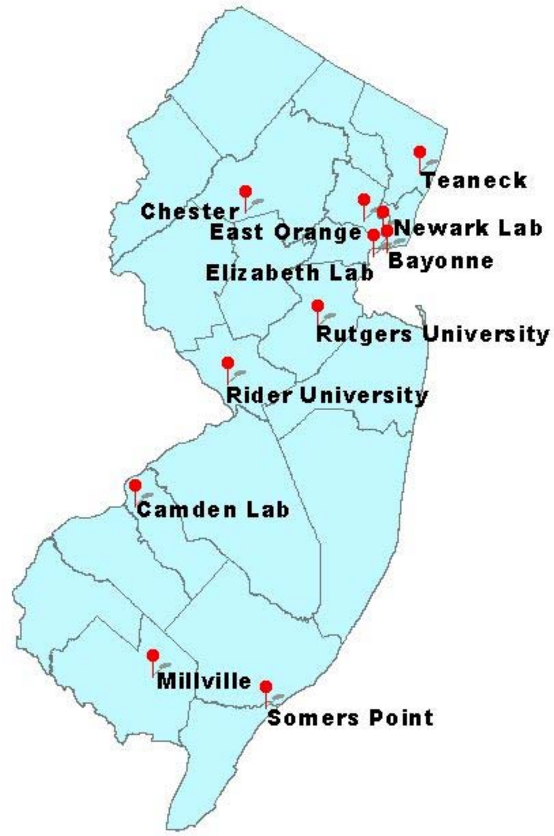


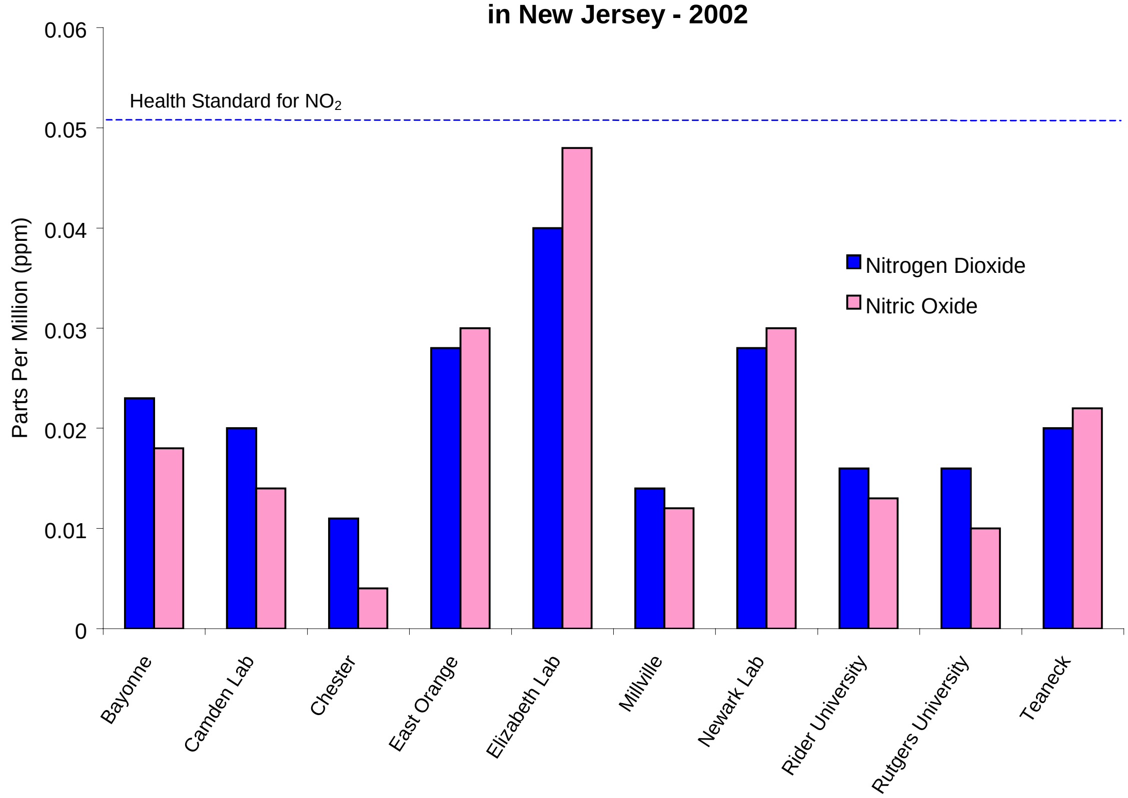

**Table 2**
**Nitrogen Dioxide & Nitric Oxide Data – 2002**

**Parts Per Million (ppm)**

| Monitoring Site | Nitrogen Dioxide 1-Hour Average (ppm) | | Nitrogen Dioxide 12-Month Average (ppm) | | Nitric Oxides Annual Average (ppm) |
|---|---|---|---|---|---|
| | Maximum | 2nd Highest | Maximum | Calendar year | |
| | | | | | |
| Bayonne | .111 | .107 | .026 | .023 | .018 |
| Camden Lab | .096 | .086 | .021 | .020 | .014 |
| Chester | .056 | .056 | .011 | .011 | .004 |
| East Orange | .093 | .091 | .029 | .028 | .030 |
| Elizabeth Lab | .129 | .129 | .041 | .040 | .048 |
| Millville | .065 | .063 | .016 | .014 | .012 |
| Newark Lab | .103 | .093 | .028 | .028 | .030 |
| Rider University | .062 | .060 | .017 | .016 | .013 |
| Rutgers University | .062 | .062 | .018 | .016 | .010 |
| Somers Point[a] | .040 | .038 | .007 | ---- | ---- |
| Teaneck | .086 | .084 | .022 | .020 | .022 |

[a] Data not available after March

**Figure 4**
**Annual Average NO and NO2 Concentrations in New Jersey - 2002**




## TRENDS

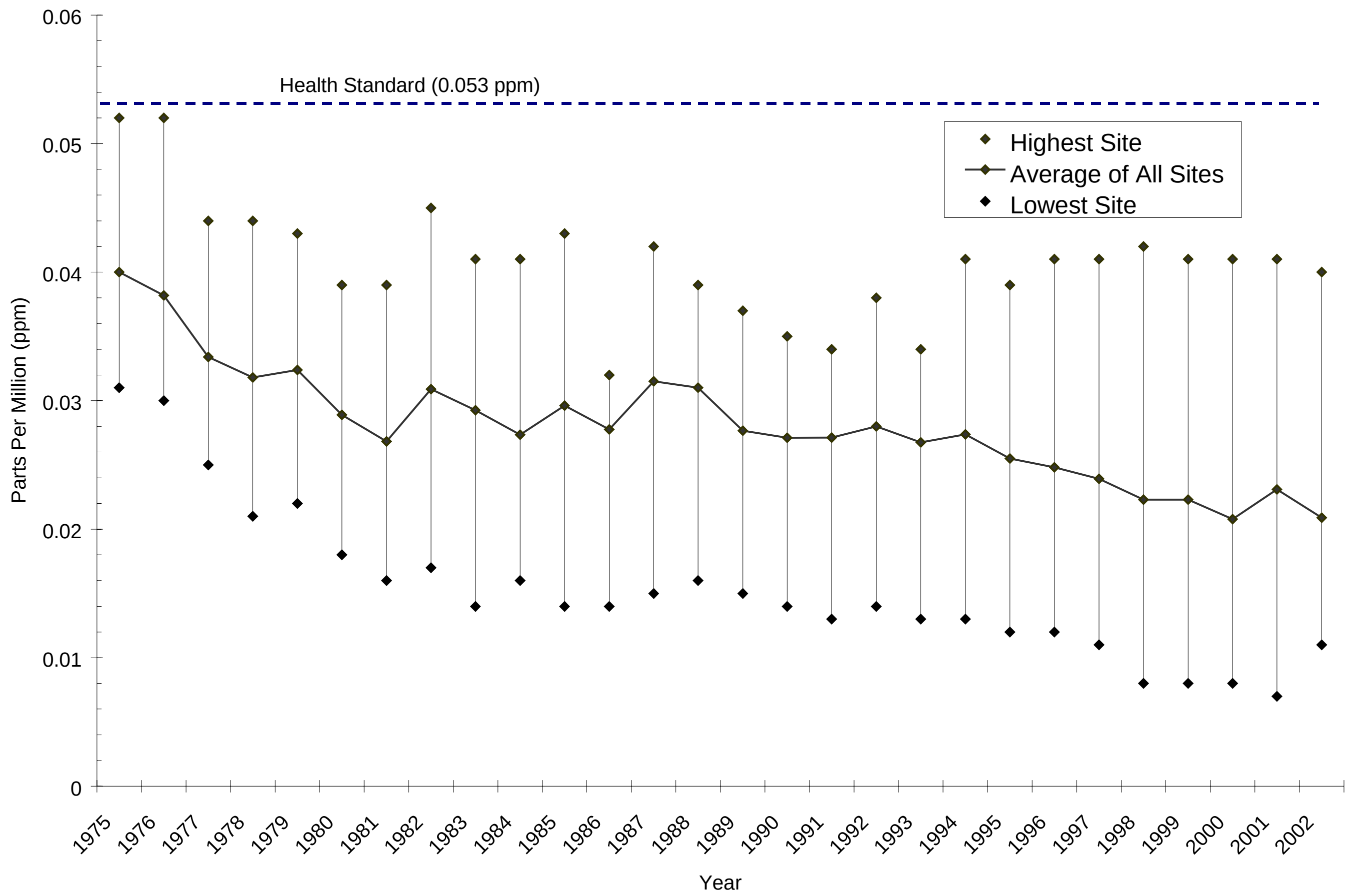
$NO_2$ concentrations have not posed a significant direct health threat in New Jersey. A graph of $NO_2$ levels showing the annual mean concentrations recorded from 1975 to 2002 is provided in Figure 5 (page 5). The graph shows the highest, average of all sites, and lowest annual average recorded at any site. Although NO2 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 group of nitroxyl compounds that react in the troposphere and contribute to the formation of ozone. They are termed Total Reactive Oxides of Nitrogen ($NO_y$). These compounds include $NO_x$, 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 ($XNO_3$). $NO_y$ can also be described as the sum of the $NO_x$ and the atmospheric $NO_x$ oxidation products. Although measuring $NO_y$ is not required, $NO_y$ measurements may provide valuable information for evaluating chemical mechanisms in ozone prediction models, indicate NO and $NO_2$ emission trends, and assist in developing regional control strategies for ozone.

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

## Figure 5
## Nitrogen Dioxide Concentrations in New Jersey
## 1975-2002
## 12-Month (Calendar Year) Average



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