North Jersey Transportation Planning Authority Document

Status of Air Quality within the NJTPA Region

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Overview

For generations, residents of northern New Jersey have experienced poor air quality, stemming from the air pollution that has accompanied industrialization in and around the region. Based on the federal Clean Air Act, first passed in 1963, but overhauled in 1970 and substantially amended in 1990, the U.S. Environmental Protection Agency (USEPA) now sets health standards to protect the public from the negative consequences of breathing polluted air. This report documents how the air within the NJTPA region has measured up in comparison to these national health standards.

In New Jersey, the Department of Environmental Protection (NJDEP) is responsible for administering the state's environmental protection and conservation efforts. In the transportation arena, NJTPA (as northern New Jersey's federally authorized Metropolitan Planning Organization) is responsible for generating transportation plans and programs that serve to reduce the pollution emitted by motor vehicle travel. With action by public agencies and thanks to great improvements in vehicle technology and maintenance, the region has seen improved air quality in recent years. More progress is still needed, though, and NJTPA will continue to fulfill its role in this critical undertaking.

Figure 1 shows the relative levels of air pollution as a percentage of USEPA standards (values above 100% indicate air failing the standard) for the three pollutants that have been measured at unhealthy levels within the region in recent years. As shown, northern New Jersey has met the standard for carbon monoxide (the green line is within the health standard). However, for fine particulate matter and ozone, the NJTPA region has not met the standard set by USEPA, although improvements have been seen over the years[1]. Each of these pollutants is discussed in more detail in this report.

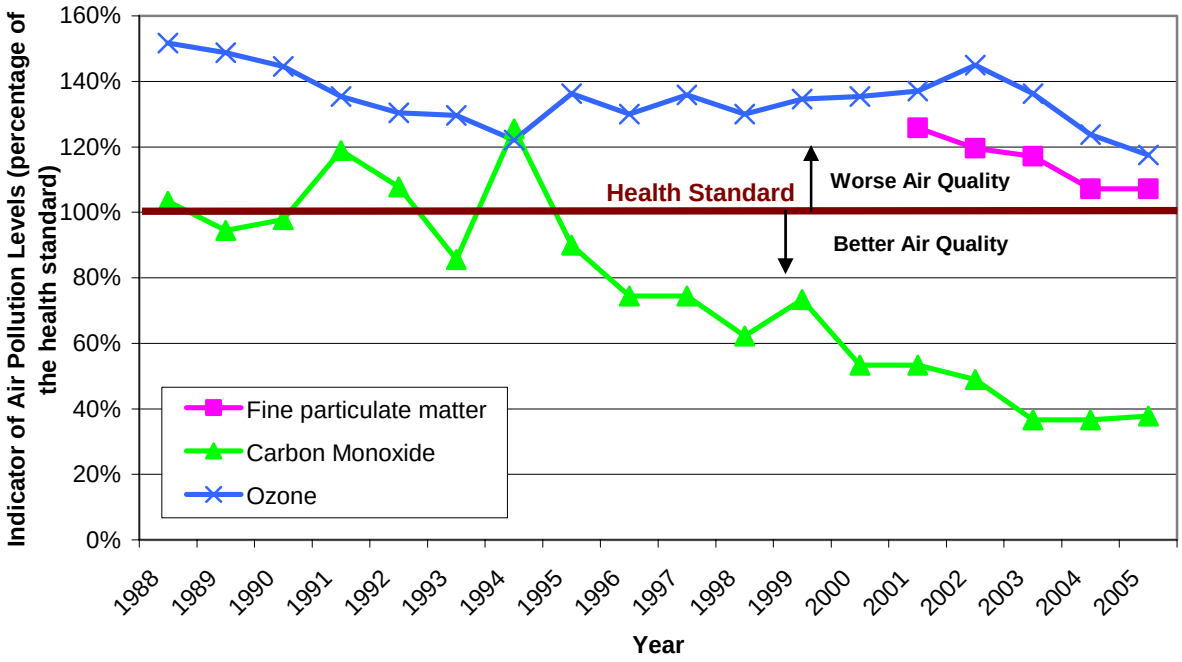
Note on Air Quality Monitoring

There are three pollutants in the NJTPA region that have been measured at unhealthy levels in the past and/or in the present. They are: **carbon monoxide (CO)**, **ozone** and **fine particulate matter ($PM_{2.5}$)**. (These and other important terms are presented in **bold** in this report.)

It should be pointed out that USEPA and NJDEP can not monitor the air quality of the NJTPA region as a whole. There are several air quality monitoring stations throughout the region that are used to gauge pollutant levels. For the three pollutants discussed in this document, in the NJTPA region there are 7 monitoring stations for carbon monoxide (CO), 8 monitoring stations for ozone, and 14 monitoring stations for fine particulates ($PM_{2.5}$). Many of these monitoring sites were only recently established and therefore data trends are not available for all sites.

[1] Note: 2001 is the first year that sufficient data on fine particulate matter was available. NJ began monitoring fine particles in 1999, but the standards for fine particles are based on an average over 3 years.

Figure 1. Indicator of northern New Jersey air pollution levels relative to USEPA health standards for fine particulate matter, ozone and carbon monoxide over time[2]



[2] The method for creating the air pollutant indicator involves detailed data and calculations described later in this report.

Status of Air Quality within the NJTPA Region

Background

There are several factors that contribute to poor air quality. The two most important factors are the amount of pollutants emitted into the atmosphere and the meteorology or weather. Note that pollutants are emitted from a variety of sources. Although NJTPA is most concerned with controlling emissions from cars, trucks, and other vehicles (known as **on-road mobile** sources), it is important to be aware that there are other sources of pollutants, including power plants, manufacturing facilities, and consumer products.

USEPA has set national air quality standards for six common pollutants (also referred to as "**criteria**" pollutants). These pollutants are particulate matter, ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead. Standards are set based on the best scientific research at the time; however, USEPA periodically reviews and revises the standards as needed.

For each of these pollutants, USEPA and NJDEP track two kinds of air pollution trends: **air concentrations**, based on actual measurements of pollutant concentrations in the ambient (outside) air at selected monitoring sites throughout the country; and **emissions**, based on engineering estimates of the total tons of pollutants released into the air each year. Despite the progress made in the last 30 years, millions of people live in counties with monitored air concentrations that show unhealthy air for one or more of the six criteria pollutants.

The NJTPA region is a **maintenance area** for carbon monoxide which means that while past monitoring has shown levels that fail the USEPA standard, current levels meet the standard. USEPA requires New Jersey to continue to monitor carbon monoxide to show that concentrations do not increase again to unhealthy levels.

However, all 13 counties within the NJTPA region are in **nonattainment** for ozone, and 9 counties are in **nonattainment** for fine particulates. Nonattainment means that the air fails to meet the standards at *one or more* monitoring stations within the area. Counties can also be designated as nonattainment if their pollution sources contribute to unhealthy levels of air quality measured in downwind areas outside their boundaries[3]. However, improvements have occurred in the amount of **exceedances** (monitored results above the standard) that occur and the amount of emissions that contribute to poor air quality. Below is a summary detailing how far New Jersey and the NJTPA region have come in improving our air quality.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a by-product of motor vehicle combustion and a

[3] Note that USEPA has shown that emissions from sources in the NJTPA region contribute to poor air quality in downwind areas both inside the NJTPA region, and within the wider tri-state nonattainment area.

component of tailpipe exhaust, which contributes over 50 percent of all CO emissions nationwide.

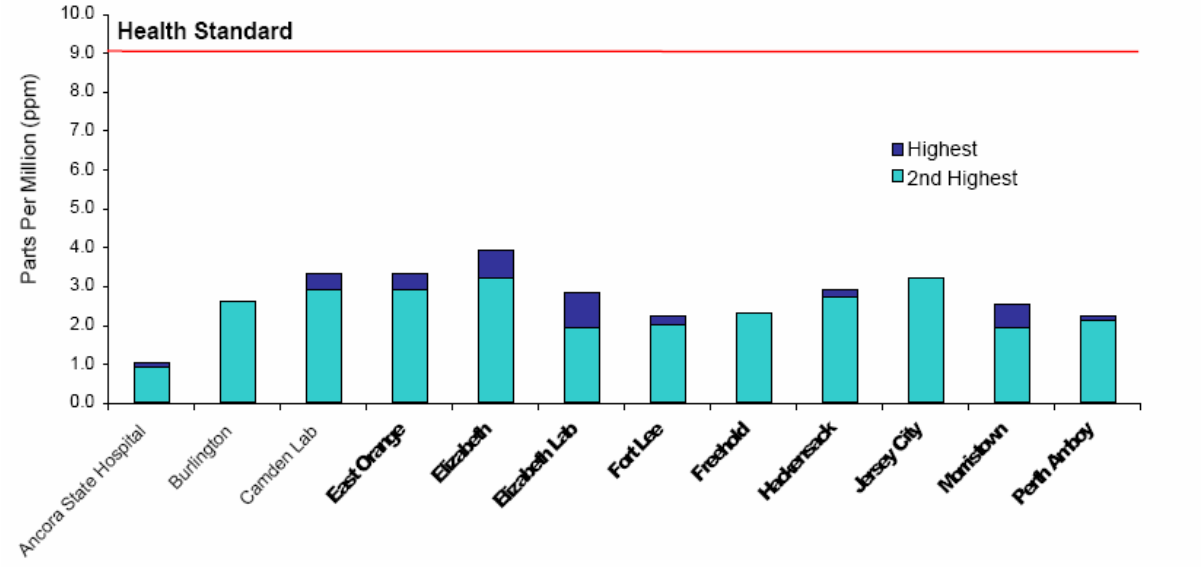
USEPA has set two health-based, standards for CO. The one-hour average concentration standard—the maximum acceptable level over any given hour—is set at 35 parts per million (ppm). The maximum over any longer 8-hour period, the 8-hour average concentration standard, is set lower at 9 ppm. These levels are not to be exceeded more than once in any calendar year[4].

In New Jersey, CO levels have been improving over the years. The last exceedance of either health-based standard occurred in January 1995. The entire state was declared as having attained the CO standard on August 23, 2002. The reduction in CO levels is primarily due to the use of cleaner burning cars.

Figure 2 shows the highest and second highest 8-hour averages of CO for monitoring stations throughout New Jersey in 2004. Monitoring stations within the NJTPA region are highlighted in bold in the chart labels. The figure depicts the second highest 8-hour average as this is the value that determines if the health-based standard is being met. As shown, the second highest 8-hour average at all locations is well within the health standard of 9 ppm.

[4] The CO standard is not met at a monitoring site if there are two or more exceedances of the level of the CO standards in either of the two most recent calendar years of monitoring data.

Figure 2. Highest and second highest 8-hour averages of carbon monoxide in New Jersey – 2004



Note: Fort Lee data is not available after October 3, 2004
Source: NJDEP 2004 Air Quality Report, http://www.state.nj.us/dep/airmon/co04.pdf

Ground-level Ozone

Ozone is not usually emitted into the air; rather, it is formed in the atmosphere by chemical reactions. Ozone forms when emissions of **volatile organic compounds (VOC)** and **nitrogen oxides (NO_x)** react in the presence of sunlight.

$$\mathbf{VOC + NO_x + Sunlight \rightarrow Ozone}$$

Nitrogen oxides are 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. Ozone and these pollutants that form ozone (**precursor pollutants**) can also be transported into an area from sources hundreds of miles upwind.

Repeated exposure to ozone can cause health problems including permanent lung damage, chest pains, coughing, nausea, throat irritation, and congestion. Exposure to ozone can also aggravate other health problems such as bronchitis, heart disease, emphysema, and asthma, and can reduce lung capacity.

USEPA established a 1-hour ozone standard in 1971, and subsequently revised it in 1979 to 0.12 parts per million, measured as 1-hour average concentrations. This 1-hour standard was used for 18 years before being replaced in 1998 by an 8-hour standard.

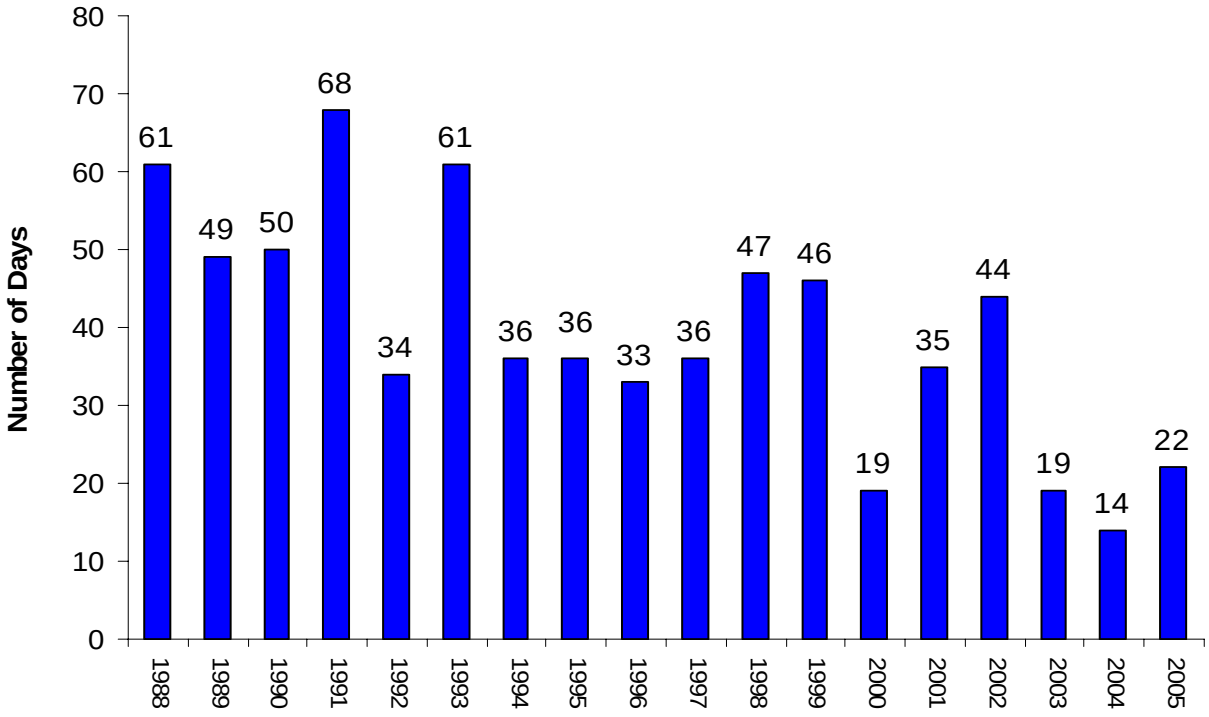
The 8-hour ozone standard was established to better reflect new scientific health studies. These studies showed that longer-term exposures to moderate levels of ozone may cause irreversible changes in the lungs. The 8-hour standard is set at 0.08 ppm; however,

USEPA does allow for brief intermittent exceedances of this number. The ozone standard is set in such a way that determining whether it is being attained is not based on a single year. Under the new standard, attainment is determined by calculating what is called a **design value**[5] which is based on 3 years of data.

Figure 3 shows the number of exceedances in New Jersey of the 8-hour ozone standard from 1988 to 2005. The data used to develop Figure 3 was obtained from many different monitoring stations throughout the state. As stated in the purpose section of this report, USEPA and NJDEP do not monitor air quality in the NJTPA region overall, however many monitoring sites are located throughout the state to estimate a representation of pollutant concentrations for the state.

As shown by the figure, the number of days that at least one monitor in the state exceeded the standard has generally decreased over time. However, New Jersey is still experiencing many days with unhealthy ozone levels.

Figure 3. Number of days on which the 8-hour ozone standard was exceeded in New Jersey (1988 – 2005)



Source: New Jersey Department of Environmental Protection correspondence (January 5, 2006)

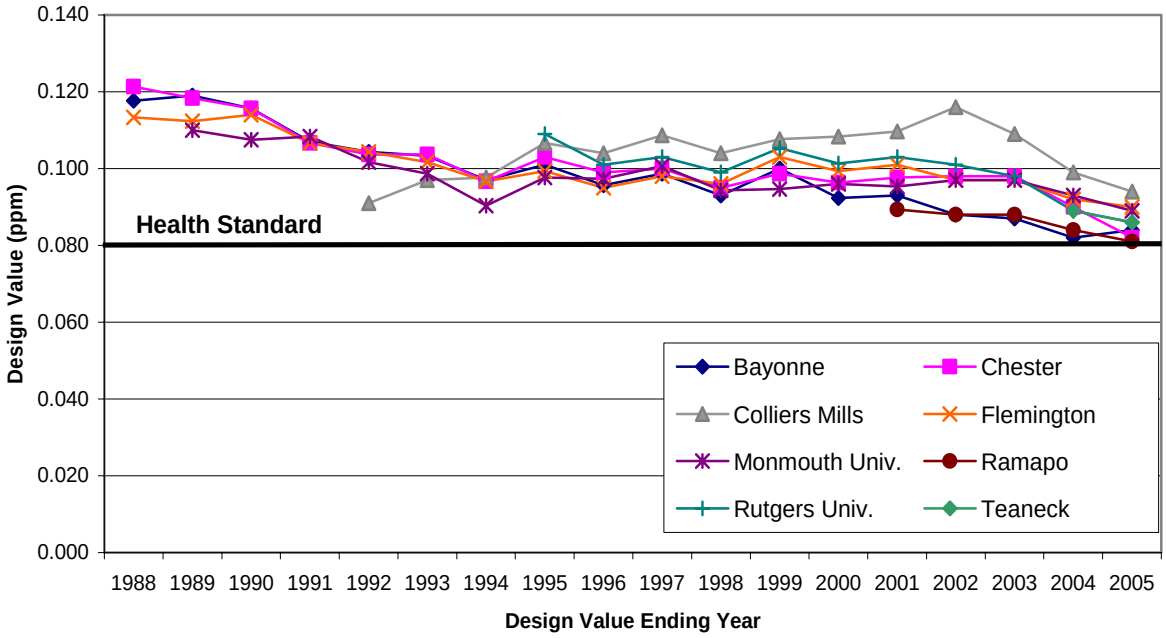
Figure 4 shows the 8-hour ozone design values from 1988 to 2005 at current monitoring sites in the NJTPA region. A design value is calculated from monitored data, and is an

[5] The ozone standard is met when the **design value** calculated from monitoring station data is below 0.08 ppm. The design value is an indicator of air pollution levels and is calculated by taking the average of the 4th highest maximum 8-hour average concentration over a 3 year period.

indicator of the ozone in the atmosphere (as described above). Generally, the monitors in the NJTPA region show improvements in design values over the time period shown; however, all monitors are still above the 0.08 ppm standard. NJDEP is expected to submit a plan to USEPA in 2007 that demonstrates how and when the state will attain the 8-hour ozone standard.

Figures 5 and 6 show the decline of VOC and NO_x emissions statewide, respectively[6]. On-road emissions have reduced considerably from 1990. This decrease may be attributed to federal and state emission control measures including federal emission standards for vehicles, as well as inspection and maintenance programs.

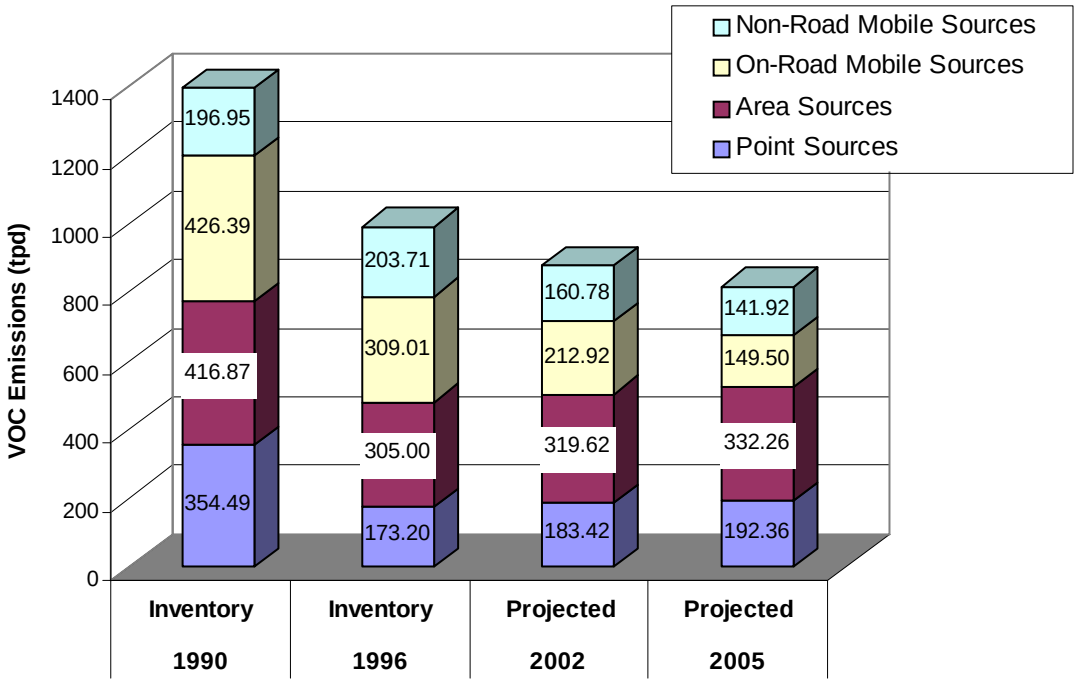
Figure 4: Monitored 8-hour ozone design values in the NJTPA region



Source: New Jersey Department of Environmental Protection correspondence (January 5, 2006)

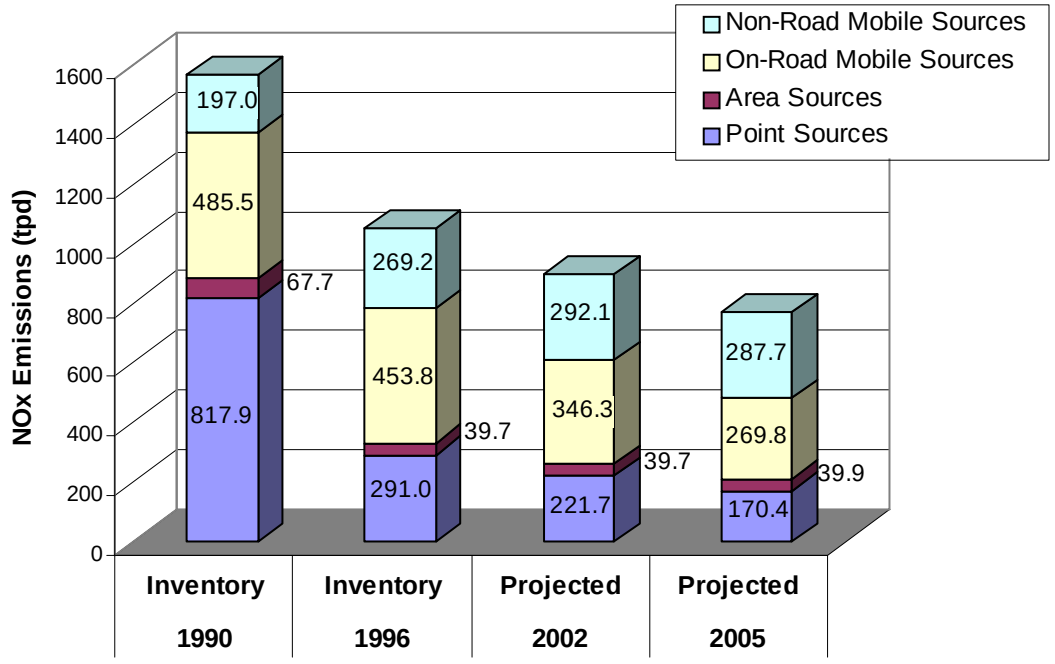
[6] The emissions shown for 2002 and 2005 are projected emissions based on assumptions used by NJDEP.

Figure 5. VOC emissions in New Jersey (tons per day)



Source: New Jersey Department of Environmental Protection correspondence (January 5, 2006)

Figure 6. NO_x emissions in New Jersey (tons per day)



Source: New Jersey Department of Environmental Protection correspondence (January 5, 2006)

Fine Particulate Matter ($PM_{2.5}$)

Particle pollution is very complex. Particles found in the atmosphere can range in size and in origin. They can be directly emitted into the air, or can be formed by complicated chemical reactions in the atmosphere. Particle formation is affected by temperature, humidity, and wind. Fine particles or $PM_{2.5}$ are particles with diameters equal to or smaller than 2.5 micrometers (approximately one-thirtieth the diameter of a human hair).

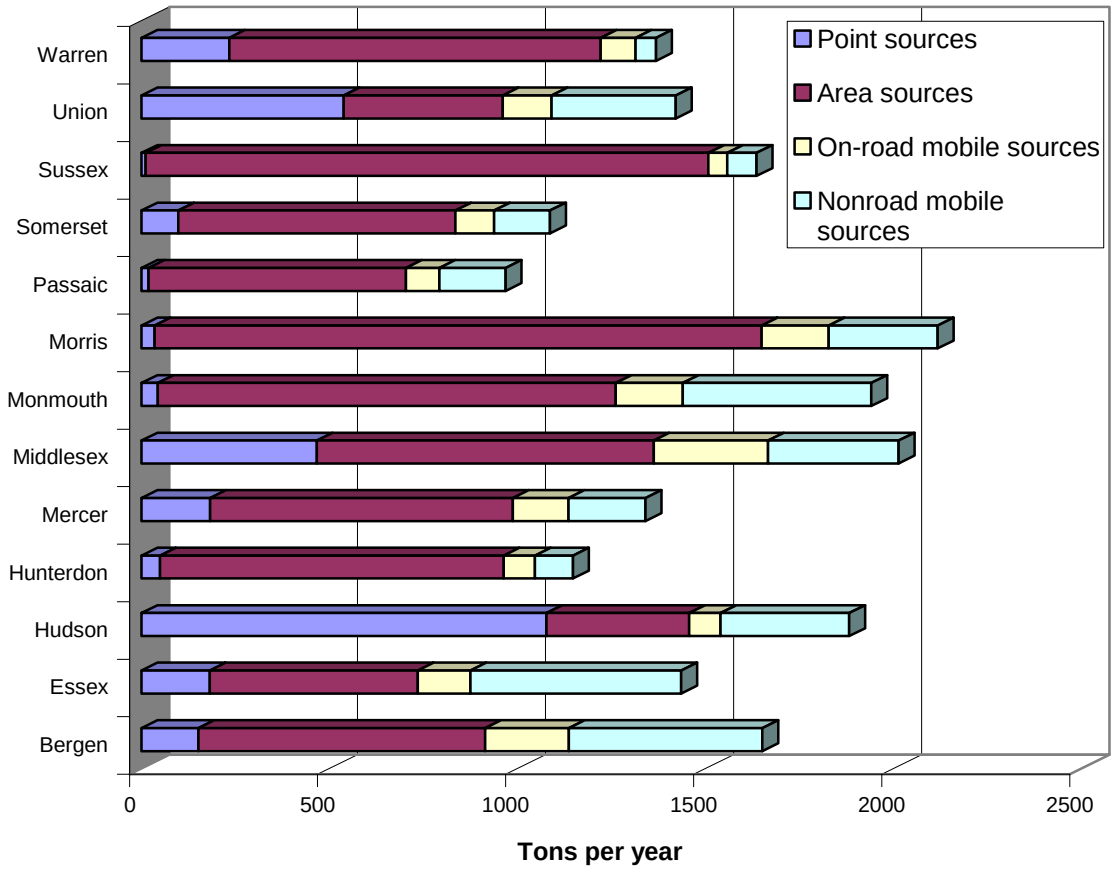
When inhaled, fine particles can accumulate in the respiratory system and are associated with increased hospital admissions and emergency room visits for heart and lung conditions, such as asthma, bronchitis, cardiac arrhythmias, heart attacks, and even premature death (USEPA 2001*).*

Both natural and manmade sources contribute to fine particulate matter. Manmade sources include soot from fuel combustion, and secondary particle formation from organic compounds, biomass burning, and emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Natural sources of fine particles include biogenic gases, which result in the formation of secondary particles.

Particles are made up of different chemical components including carbon, sulfate and nitrate compounds, and crustal materials such as soil and ash. The chemical makeup of particles varies across the United States. For example, in the eastern half of the United States fine particles mainly consist of sulfates and carbon, whereas, the fine particles in the western U.S. consist mostly of nitrates and carbon.

Figure 7 shows the 2002 **direct $PM_{2.5}$ emissions** (the emissions of fine particles) by county for the NJTPA region. The emissions are broken down to show the amount coming from each major source category. On-road sources generally make up a small portion of the overall direct $PM_{2.5}$ emissions.

Figure 7. 2002 Direct $PM_{2.5}$ emissions by county in the NJTPA region



Source: 2002 MANE-VU Inventory version 2 (extracted January 9, 2006)

USEPA has set two standards for $PM_{2.5}$: a daily and an annual standard. As with the ozone and CO standard, the $PM_{2.5}$ standards allow some exceedances and involve various averaging methods. The daily standard is set at 65 micrograms per cubic meter[7] and the annual standard is set at a level of 15 micrograms per cubic meter[8]. While the NJTPA region meets the daily standard for $PM_{2.5}$, nine counties within the region do not meet the annual mean $PM_{2.5}$ standard.

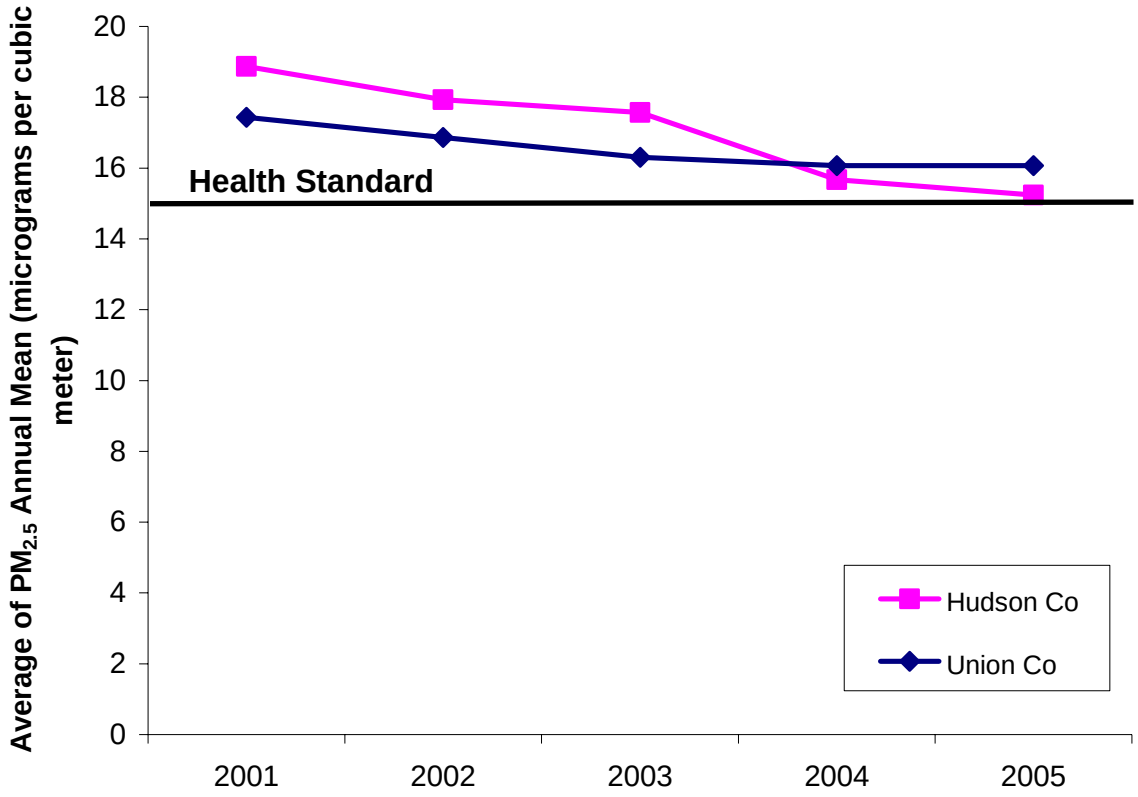
Figure 8 shows the monitored $PM_{2.5}$ values from 2001 through 2005 for Hudson and Union counties. Data for other monitoring sites in the NJTPA region exist, but these counties show the highest measured $PM_{2.5}$ values in the NJTPA region. Importantly, even though some counties in the NJTPA region may report annual concentrations that meet the $PM_{2.5}$ standard, USEPA has shown that all nine of the NJTPA counties within the USEPA defined NY-NJ-CT $PM_{2.5}$ nonattainment area (Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union Counties) contribute to nonattainment in downwind monitors. Therefore this portion of the NJTPA region will

[7] The daily $PM_{2.5}$ standard is based on a 3-year average of the 98th percentile of 24-hour concentrations.
[8] The annual mean $PM_{2.5}$ standard is based on a 3-year average of annual mean $PM_{2.5}$ concentrations.

remain in nonattainment until all monitors in the nonattainment area report no exceedances of the $PM_{2.5}$ standard.

NJDEP is tasked with submitting a plan to meet the $PM_{2.5}$ annual standard by April 2008. Attainment must be reached by 2010 unless an extension is granted by USEPA.

Figure 8. Average of three-year $PM_{2.5}$ annual mean concentration for in the NJTPA region showing poorest air quality



NOTE: Years shown represent the average of the annual mean for the 3 previous years. For example, 2001 represents the average annual mean $PM_{2.5}$ value for 1999 through 2001.

Source: USEPA Air Now data, http://www.epa.gov/air/data/geosel.html

Future Regulations

USEPA is required to periodically review established National Ambient Air Quality Standards and revise them if needed based on new scientific research. With this charge, USEPA has recently proposed a revision to the daily average $PM_{2.5}$ standard. The new proposed daily standard is set at 35 micrograms per cubic meter (compared to the current standard of 65 micrograms per cubic meter). USEPA is currently taking comments on this proposal. It is not known whether the NJTPA region will meet the new daily average $PM_{2.5}$ standard. In fact, even if all of the monitors within the NJTPA region meet this standard, several counties may still be designated as nonattainment due to their contribution of pollution to a downwind area that does not meet the standard. However,

current information from USEPA indicates that designations under this revised standard would not take place for at least five to six years.

Of note, in addition to efforts to meet federal air quality standards, New Jersey has taken several steps to curb emissions of carbon dioxide, a major greenhouse gas[9]. In October 2005, New Jersey was one of the first states in the country to classify carbon dioxide as an air contaminant. More recently, New Jersey's Governor Richard J. Codey signed the Regional Greenhouse Gas Initiative Agreement which has been approved by six other northeastern states and calls for a mandatory cap on carbon dioxide emissions at power plants, coupled with a market-based trading program to achieve the lowest possible compliance costs. Although this agreement does not involve transportation, New Jersey is taking steps to go beyond federal air quality standards to ensure healthy air quality for the area.

Conclusion

The NJTPA joins other public agencies to focus on improving the quality of the air in our region. The reduction of emissions by federal, state, and local programs, which generally have led to improved combustion technology and lowered vehicular emissions, has contributed significantly to cleaner air. New Jersey has met the standard set by USEPA for carbon monoxide. However, the NJTPA region continues to fail to meet the standards for ozone and fine particulate matter.

NJDEP is required to submit a plan to USEPA demonstrating how and when the state will meet both standards. NJTPA can continue to assist in improving air quality by ensuring that all projects, plans, and programs conform to the national standards and to the NJDEP plans for attaining those standards.

There are many challenges in attaining and maintaining healthy air quality. The atmosphere is very complex and scientific research is continually improving our understanding of healthy air levels and harmful air pollutants. However, diligent efforts by federal, state, and local authorities to reduce emissions and educate the public on these issues should help the region's air continue to progress to healthy levels.

[9] No federal standard has been established for carbon dioxide.

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