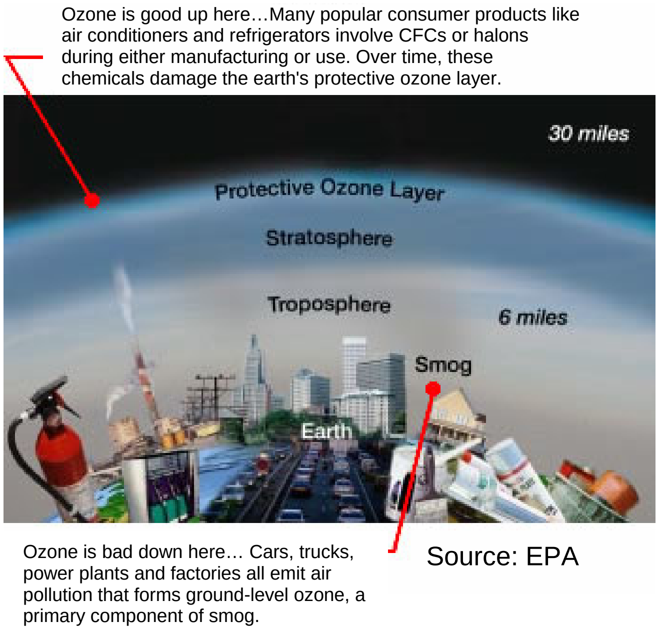
2005 Ozone Summary

New Jersey Department of Environmental Protection

Nature and Sources

Figure 1: Good and Bad Ozone



Source: EPA

Ozone (O_3) is a gas consisting of three oxygen atoms. It occurs naturally in the upper atmosphere (stratospheric ozone) where it protects us from harmful ultraviolet rays (see Figure 1). However, at ground-level (tropospheric ozone) it is considered an air pollutant and can have serious adverse health effects. Ground-level ozone is created when nitrogen oxides (NOx) and volatile organic compounds (VOC's) react in the presence of sunlight and heat. NOx is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOC's are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. Ozone and the pollutants that form ozone (precursor pollutants) can also be transported into an area from sources hundreds of miles upwind.

Since ground-level ozone needs sunlight to form, it is mainly a daytime problem during the summer months. Weather patterns have a significant effect on ozone formation and hot, dry summers will result in more ozone than cool, wet ones. In New Jersey, the ozone monitoring season runs from April 1st to October 31st, although unhealthy conditions are rare before mid-May or after the first few weeks of September. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the U.S. Environmental Protection Agency (EPA) publication "Ozone: Good Up High, Bad Nearby".

Environmental Effects

Ground-level ozone damages plant life and is responsible for 500 million dollars in reduced crop production in the United States each year. It interferes with the ability of plants to produce and store food, making them more susceptible to disease, insects, other pollutants, and harsh weather. "Bad" ozone damages the foliage of trees and other plants, sometimes marring the landscape of cities, national parks and forests, and recreation areas. The black areas on the leaves of the blackberry bush and sassafras tree shown in Figure 2 and Figure 3 are damage caused by exposure to ground-level ozone. (Figure 2 and 3 Photos by: Teague Prichard, Wisconsin Department of Natural Resources)

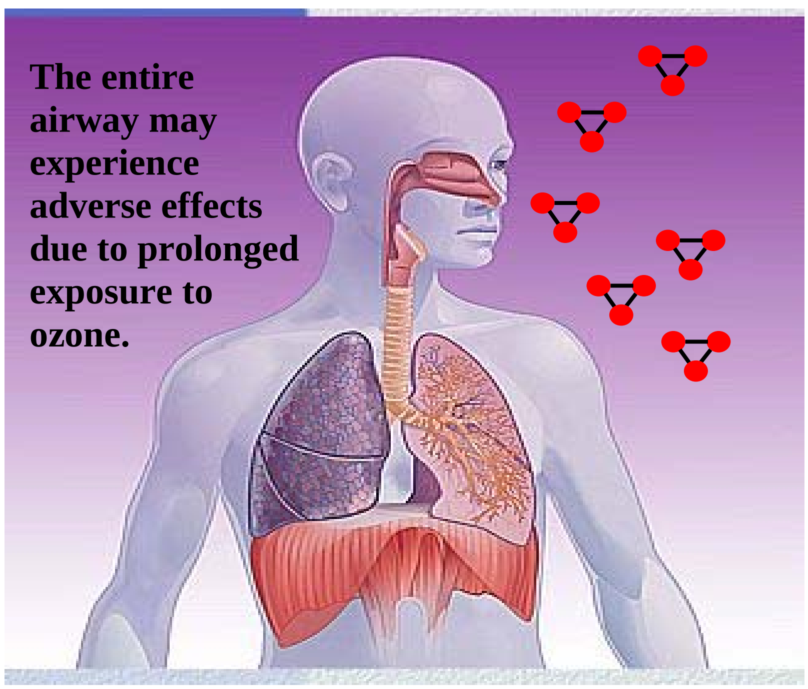
Figure 2: Ozone Damage to Blackberry Bush

Figure 3: Ozone Damage to Sassafras Tree

HEALTH EFFECTS

Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present in low levels, inhaling it can trigger a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. Ozone also can aggravate other health problems such as bronchitis, heart disease, emphysema, and asthma, and can reduce lung capacity. People with pre-existing respiratory ailments are especially prone to the effects of ozone. For example, asthmatics affected by ozone may have more frequent or severe attacks during periods when ozone levels are high. As shown in Figure 4 ozone can irritate the entire respiratory tract. Children are also at risk for ozone related problems. Their respiratory systems are still developing and they breathe more air per pound of body weight than adults. They are also generally active outdoors during the summer when ozone levels are at their highest. Anyone who spends time outdoors in the summer can be affected and studies have shown that even healthy adults can experience difficulty in breathing when exposed to ozone. Anyone engaged in strenuous outdoor activities, such as jogging, should limit activity to the early morning or late evening hours on days when ozone levels are expected to be high.

Figure 4



Area of the Respiratory Tract that may be Affected by Ozone

Ambient Air Quality Standards for Ozone

National and state air quality standards have been established for ground-level ozone. There are both primary standards, which are based on health effects, and secondary standards, which are based on welfare effects (e.g. damage to trees, crops and materials). For ground-level ozone, the primary and secondary National Ambient Air Quality Standards (NAAQS) are the same (see Table 1). The ozone NAAQS were revised in 1997 because EPA had determined that the old standard of 0.12 parts per million (ppm) maximum daily one-hour average was not sufficiently protective of public health. They set a revised standard of 0.08 ppm maximum daily 8-hour average. The standard changes were challenged in court but eventually upheld. As many people are accustomed to the old standards, summary information relative to that standard will be provided in this report along with summaries based on the new standard.

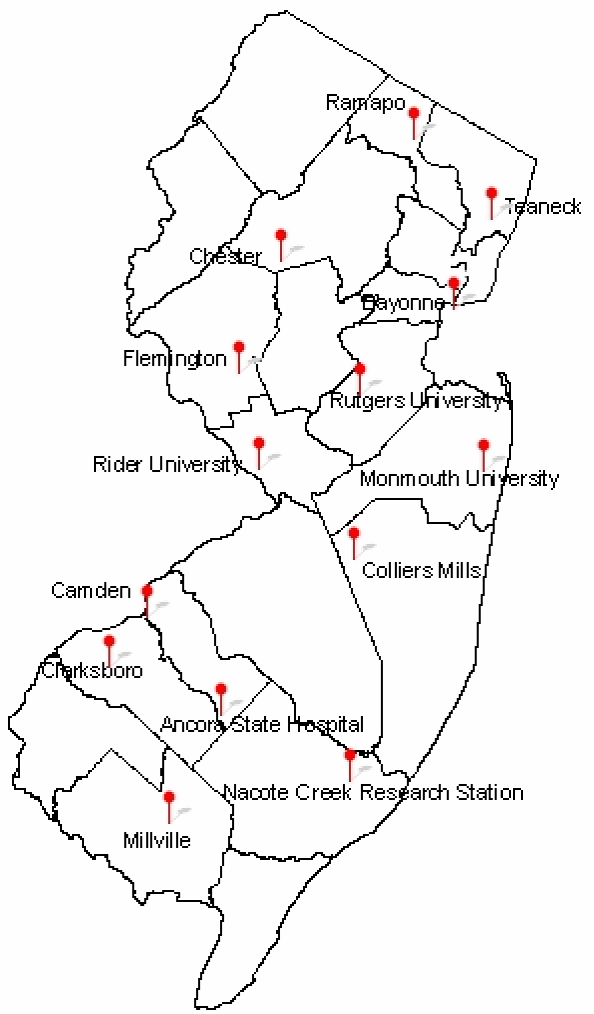
Table 1
National and New Jersey Ambient Air Quality Standards for Ozone
ppm = Parts per Million

Averaging Period	Type	New Jersey	National
1-Hour	Primary	0.12 ppm	0.12 ppm
1-Hour	Secondary	0.08 ppm	0.12 ppm
8-Hour	Primary	-----	0.08 ppm
8-Hour	Secondary	-----	0.08 ppm

Ozone Network

Ozone was monitored at 14 locations in New Jersey during 2005. Of those 14 sites, 11 operated year round and 3 operated only during the ozone season (April 1st through October 31st). Site locations are shown in Figure 5.

Figure 5
2005 Ozone Monitoring Network



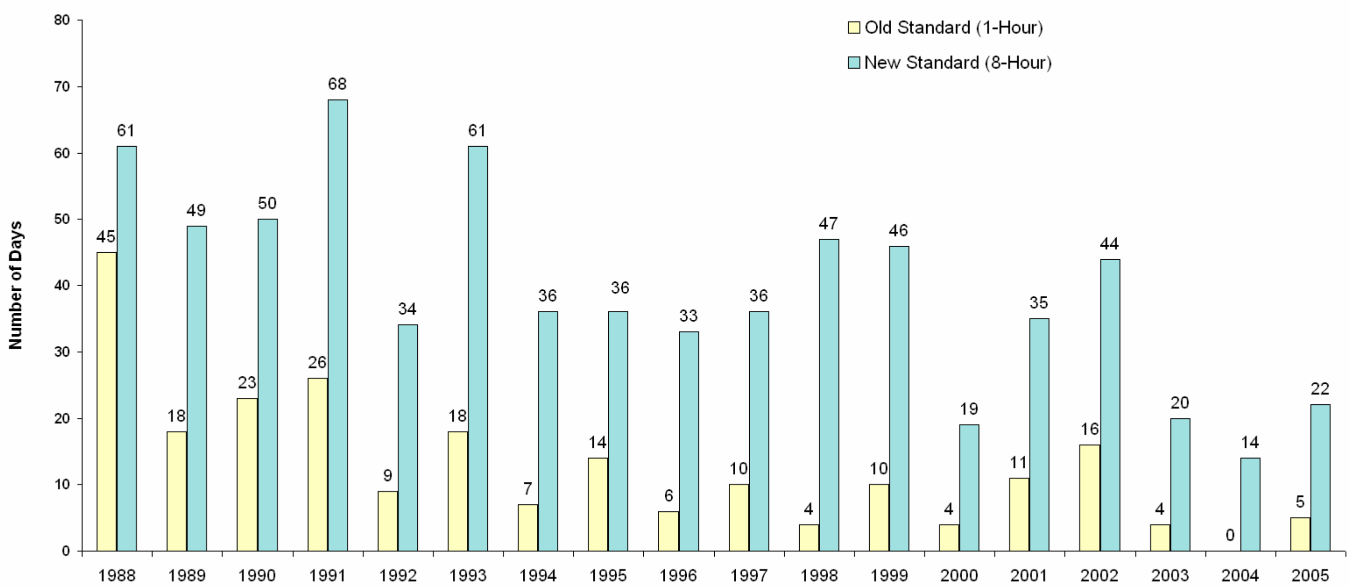
How the Changes to the Ozone Standards Affect Air Quality Ratings

In 2005 there were five days on which the old standard was exceeded in New Jersey and 22 days on which the new standard was exceeded. Significant progress is being made towards meeting the old standard (see Figure 6 below). There are fewer days on which that standard is exceeded, and when it is, fewer sites tend to be involved. Also, the maximum levels reached are not as high as they were in the past. The maximum 1-hour average concentration recorded in 1988 was 0.218 ppm, compared to a maximum of 0.141 ppm in 2005.

It is apparent, however, that the current standard is significantly more stringent than the old one (see Figure 6 below). As a result, additional control measures to reduce ozone levels will be needed. These measures will have to be implemented over a wide area and will require the cooperative effort of many states and the federal government if they are to be successful.

Figure 6

Days on Which the Old and New Ozone Standards Have Been Exceeded in New Jersey 1988 - 2005



DESIGN VALUES

The NAAQS for ozone are set in such a way that determining whether they are being attained is not based on a single year. For example, an area was considered to be attaining the old 1-hour average standard if the average number of times the standard was exceeded over a three-year period was 1 or less (after correcting for missing data). Thus it was the fourth highest daily maximum 1-hour concentration that occurred over a three-year period that determined if an area would be in attainment. If the fourth highest value was above 0.12 ppm then the average number of exceedances would be greater than 1. The fourth highest value is also known as the design value.

Under the new standard, attainment is determined by taking the average of the fourth highest daily maximum 8-hour average concentration that is recorded each year for three years. This becomes the design value for an area under the new standard. When plans are developed for reducing ozone concentrations, an area must demonstrate that the ozone reduction achieved will be sufficient to ensure the design value will be below the NAAQS, as opposed to ensuring that the standards are never exceeded. This avoids having to develop plans based on extremely rare events.

Figures 7 and 8 show the design value for the 1 and 8-hour standards starting with the 1986-1988 period. Design values are calculated for all ozone sites in the network and the median, maximum and minimum for each year were used in the graphics.

Figure 7

1 Hour Ozone Air Quality, 1986 - 2005

(Based on 4th Highest 1-hour average - Design Values)

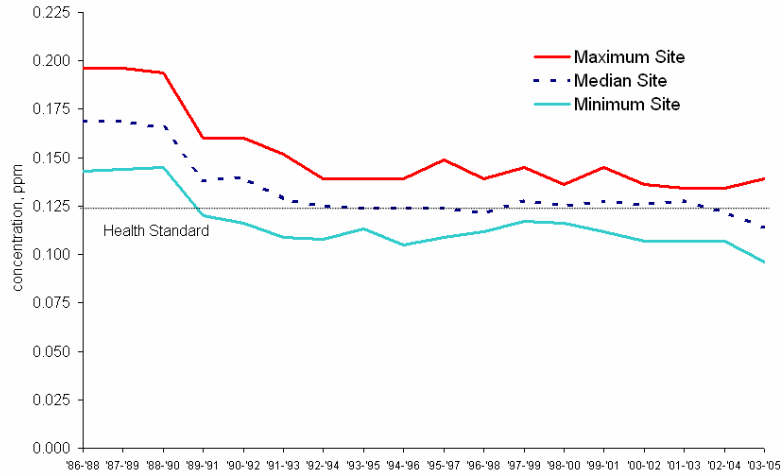
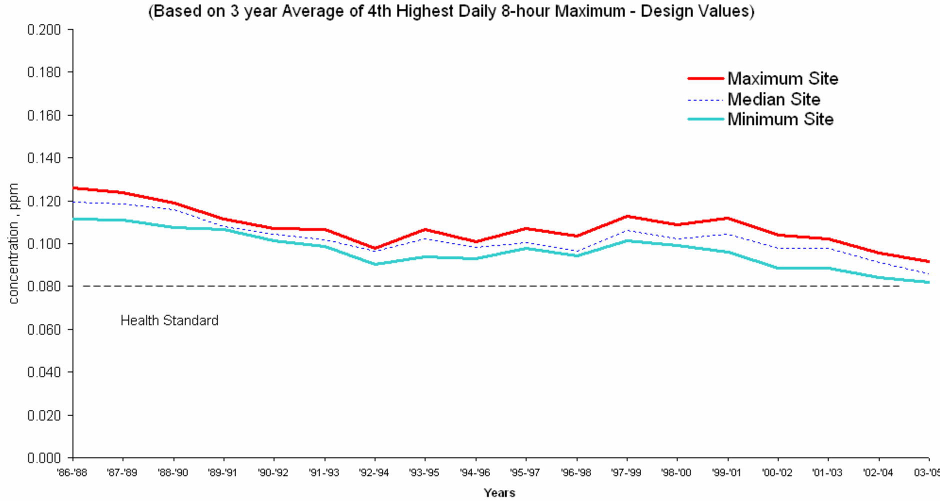


Figure 8

8-Hour Ozone Air Quality, 1986 - 2005

(Based on 3 year Average of 4th Highest Daily 8-hour Maximum - Design Values)

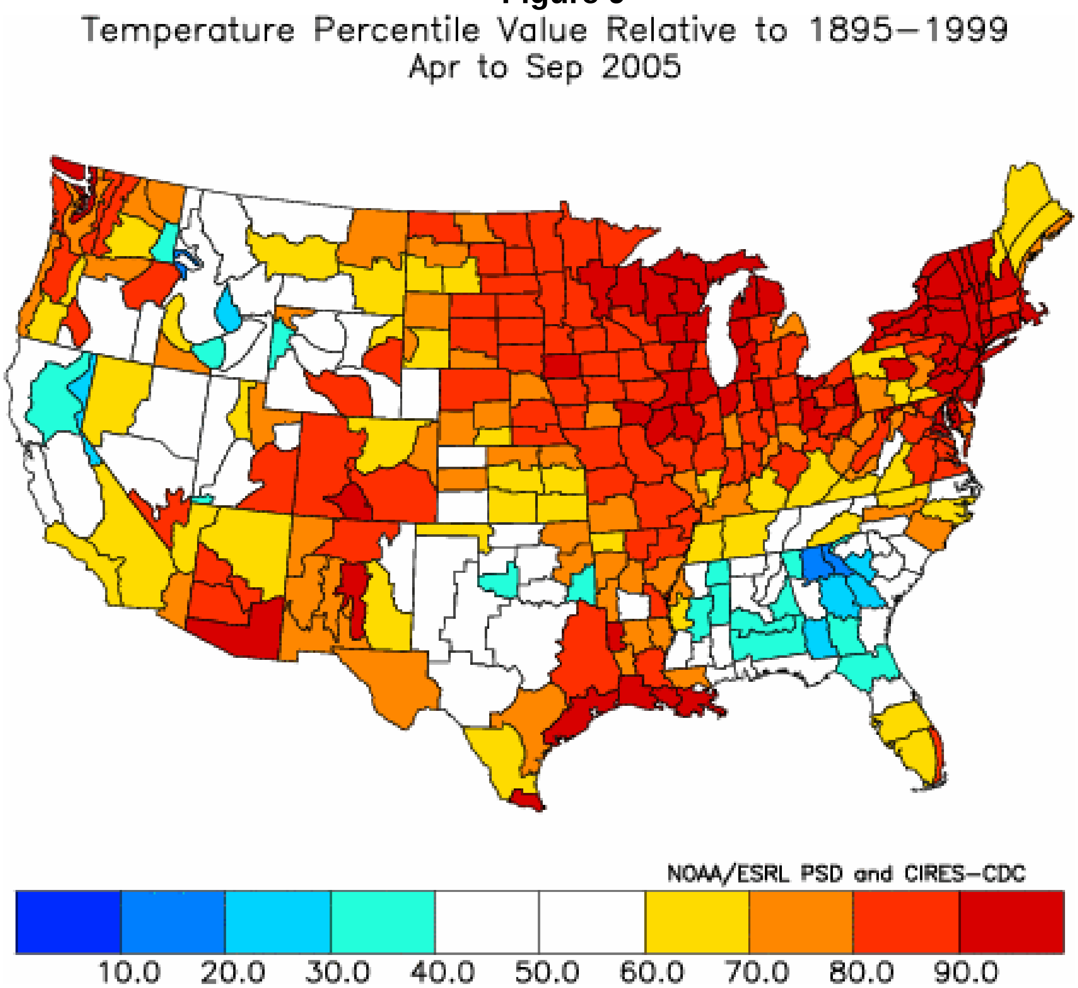


MAJOR OZONE EPISODES

Historically, several ozone episodes occur throughout the New Jersey summer. The 2005 ozone season, unlike a typical New Jersey ozone season, produced no major ozone episodes. An ozone episode is loosely defined as two or more consecutive days of widespread ozone concentrations above the health standard. There were 5 exceedances days above the 0.12 ppm level and 22 exceedances days of the 0.08 ppm standard. Both July 21st and September 13th produced the most single day exceedances as 10 sites went above the 0.08 ppm standard with Colliers Mills and Camden being the highest, respectively with 0.104 ppm and 0.098 ppm 8-hour averages. As recently as 1998, there were 47 days when ozone concentrations where above the 8-hour standard. Unlike 2005, the 1998 exceedance days were more widespread with typically more than half of the monitors exceeding the standard on each exceedance day. There were instances in 2005 when several consecutive days recorded exceedances of the 8-hour standard, but they were not widespread occurrences. August 11th -14th were all exceedance days but at no more than 5 monitors per day and at only 1 monitor exceeded the standard on August 14th.

The summer of 2005 showed typical weather characteristics of an ordinary New Jersey ozone season. Figure 9 below illustrates the average temperature throughout the summer and how it deviated from typical averages. Besides the Southeast, most of the nation experienced near standard summer temperatures. Ozone exceedances remained relatively low, despite normal hot and humid conditions.

Figure 9



SUMMARY OF 2005 Ozone Data Relative to the 1-HOUR STANDARD

Of the 14 monitoring sites that operated during the 2005 ozone season, 5 recorded levels above the old 1-hour standard of 0.12 ppm during the year. The highest 1-hour concentration was 0.141 ppm at the Bayonne monitor on July 22nd. In the 2004 ozone season no sites recorded levels above the 1-hour standard.

Figure 10
Highest and Second Highest Daily 1-Hour Averages

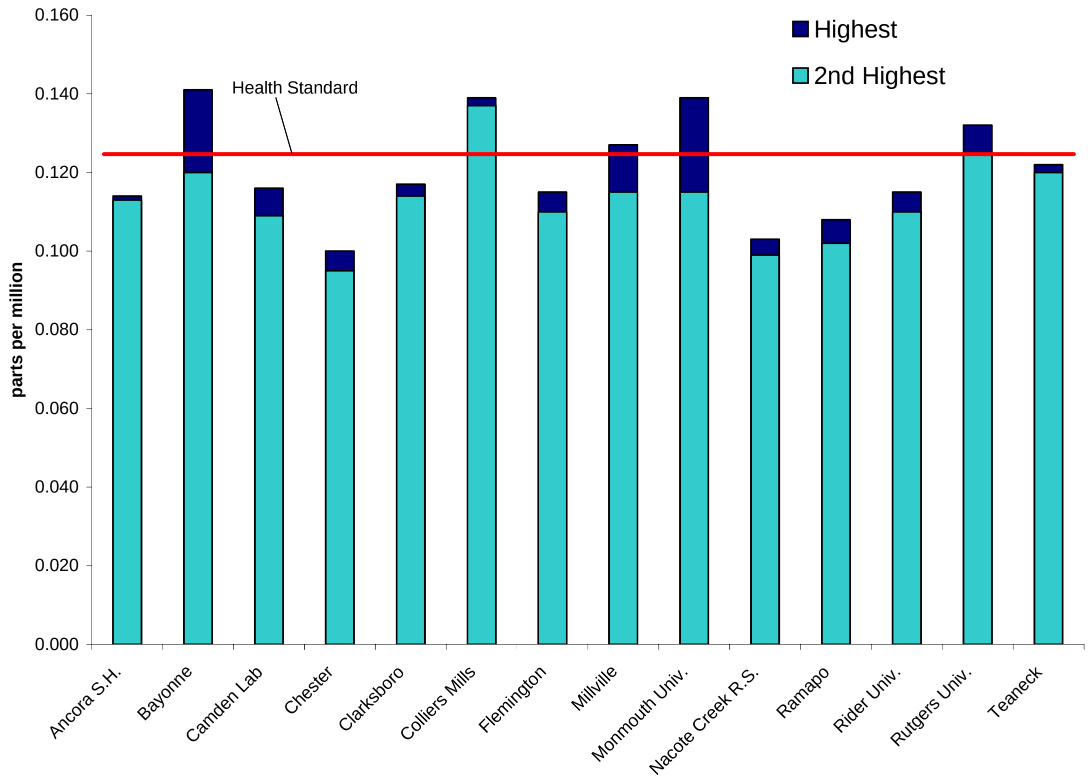


Table 3
Ozone Data – 2005
1-Hour Averages

Parts Per Million (ppm) — 1-hour standard is 0.12 ppm

Monitoring Site	1-hr Max	2nd Highest 1-hr Max	4th Highest[1] 1-hour Average 2003-2005	# of days with 1-hour Averages above 0.12ppm
Ancora S.H.	0.114	0.113	0.114	0
Bayonne	0.141	0.120	0.115	1
Camden Lab	0.116	0.109	0.114	0
Chester	0.100	0.095	0.096	0
Clarksboro	0.117	0.114	0.117	0
Colliers Mills	0.139	0.137	0.122	2
Flemington	0.115	0.110	0.114	0
Millville	0.127	0.115	0.113	1
Monmouth Univ.	0.139	0.115	0.139	1
Nacote Creek R.S.	0.103	0.099	0.101	0
Ramapo	0.108	0.102	0.102	0
Rider University	0.115	0.110	0.110	0
Rutgers University	0.132	0.125	0.120	2
Teaneck	0.122	0.120	0.110	0
Statewide	0.141	0.139	0.139	5

Summary of 2005 Ozone Data Relative to the 8-Hour Standard

All 14 monitoring sites that operated during the 2005 ozone season recorded levels above the 8-hour standard of 0.08 ppm. Colliers Mills recorded the most exceedances with 14. The highest 8-hour concentration recorded was 0.110 ppm at the MIllville site on July 22nd. 12 of 14 sites recorded levels above the 8-hour standard in 2004, with a maximum concentration of 0.103 ppm, recorded at the Ancora S.H. site on July 21st. Design values for the 8-hour standard were also above the standard at 10 of 14, indicating that the ozone standard is being violated throughout most of New Jersey.

Figure 11

Ozone Design Values for 2003-2005

3 Year Average of the 4th Highest 8-Hour Value

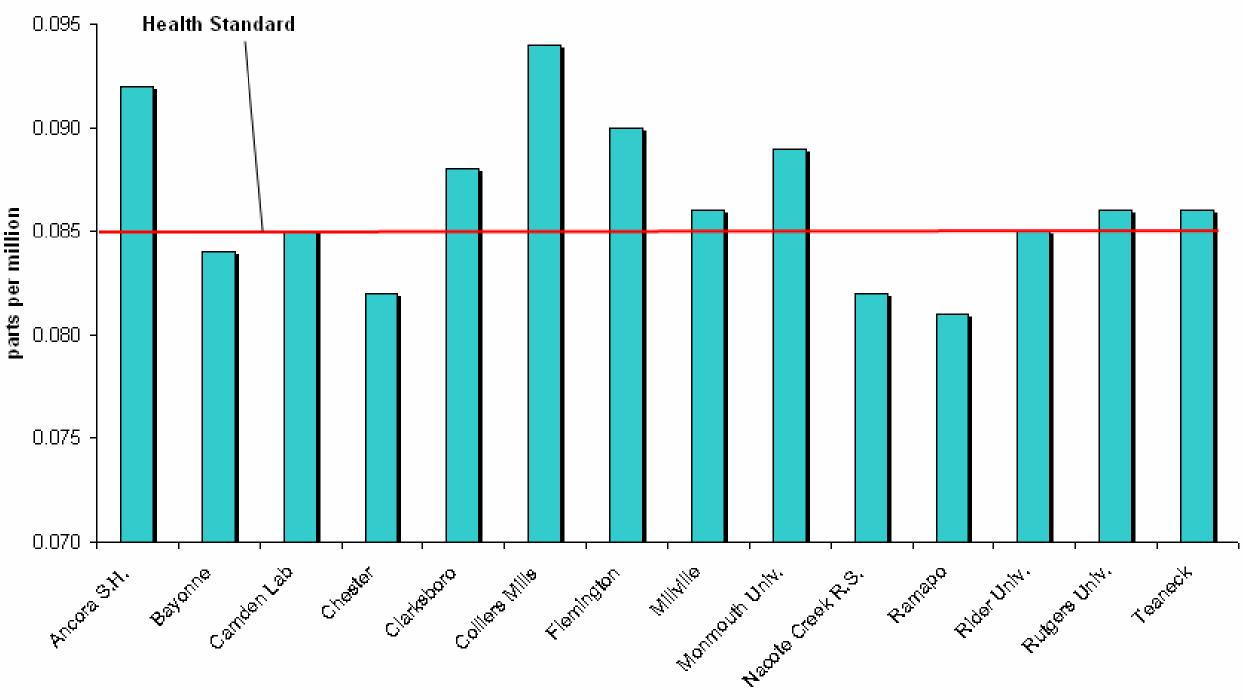
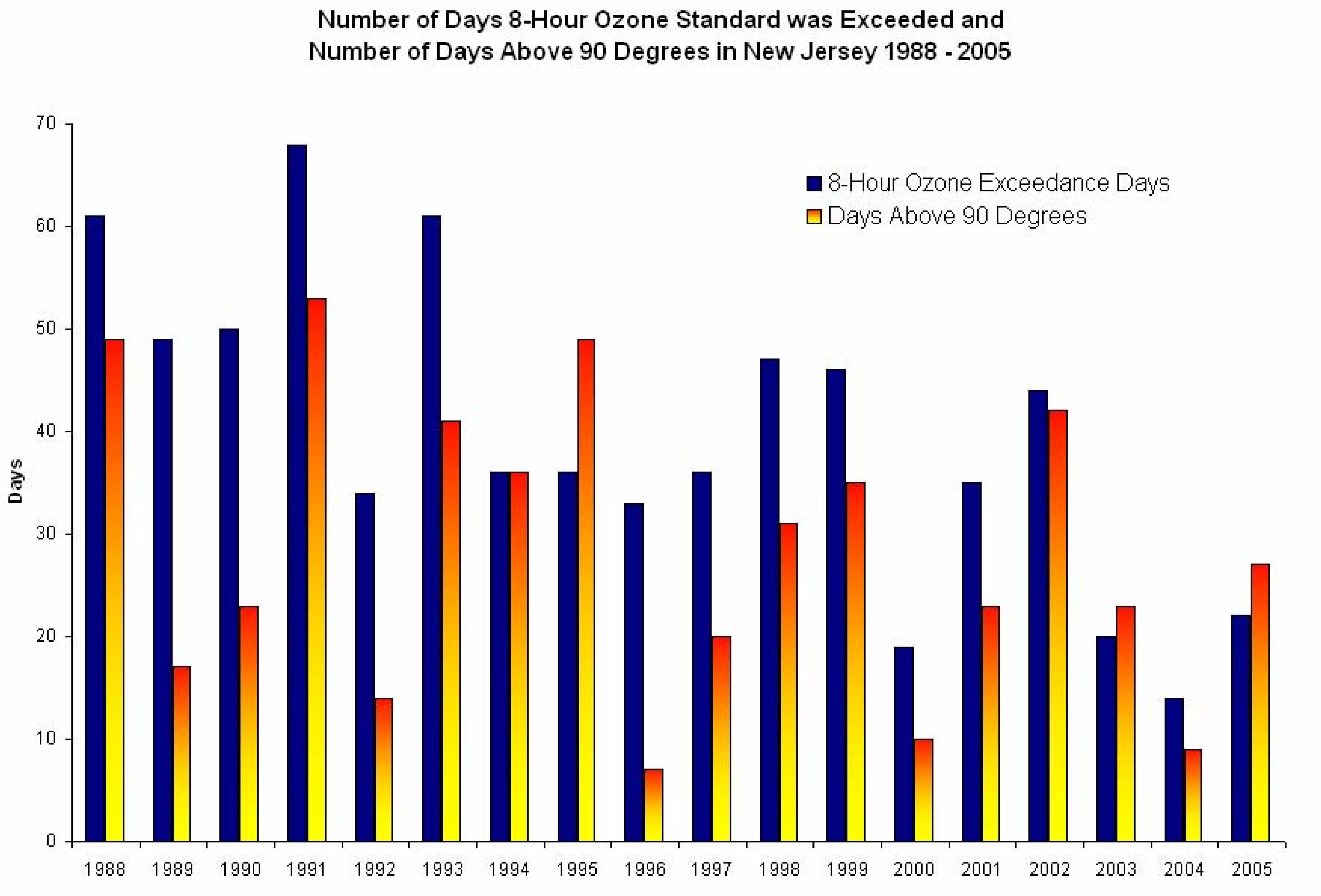


Table 4
Ozone Data – 2005
8-Hour Averages
Parts Per Million (ppm)

8-hour standard is 0.08 ppm

Monitoring Site	1st Highest	2nd Highest	3rd Highest	4th Highest	Avg. of 4th Highest 8-hour Averages 2003-2005	# of days with 8-hour above 0.08ppm
Ancora S.H.	0.097	0.096	0.093	0.092	0.092	12
Bayonne	0.096	0.093	0.092	0.091	0.084	6
Camden Lab	0.100	0.098	0.092	0.087	0.085	5
Chester	0.091	0.088	0.085	0.081	0.082	3
Clarksboro	0.097	0.094	0.091	0.091	0.088	6
Colliers Mills	0.109	0.104	0.104	0.100	0.094	14
Flemington	0.100	0.093	0.093	0.093	0.090	13
Millville	0.110	0.092	0.088	0.085	0.086	4
Monmouth Univ.	0.100	0.096	0.089	0.088	0.089	8
Nacote Creek R.S.	0.091	0.087	0.086	0.084	0.082	3
Ramapo	0.095	0.091	0.091	0.088	0.081	8
Rider University	0.099	0.094	0.093	0.089	0.085	7
Rutgers University	0.097	0.095	0.095	0.093	0.086	10
Teaneck	0.100	0.094	0.093	0.091	0.086	8
Statewide	0.110	0.109	0.104	0.104	0.100	22

Figure 12



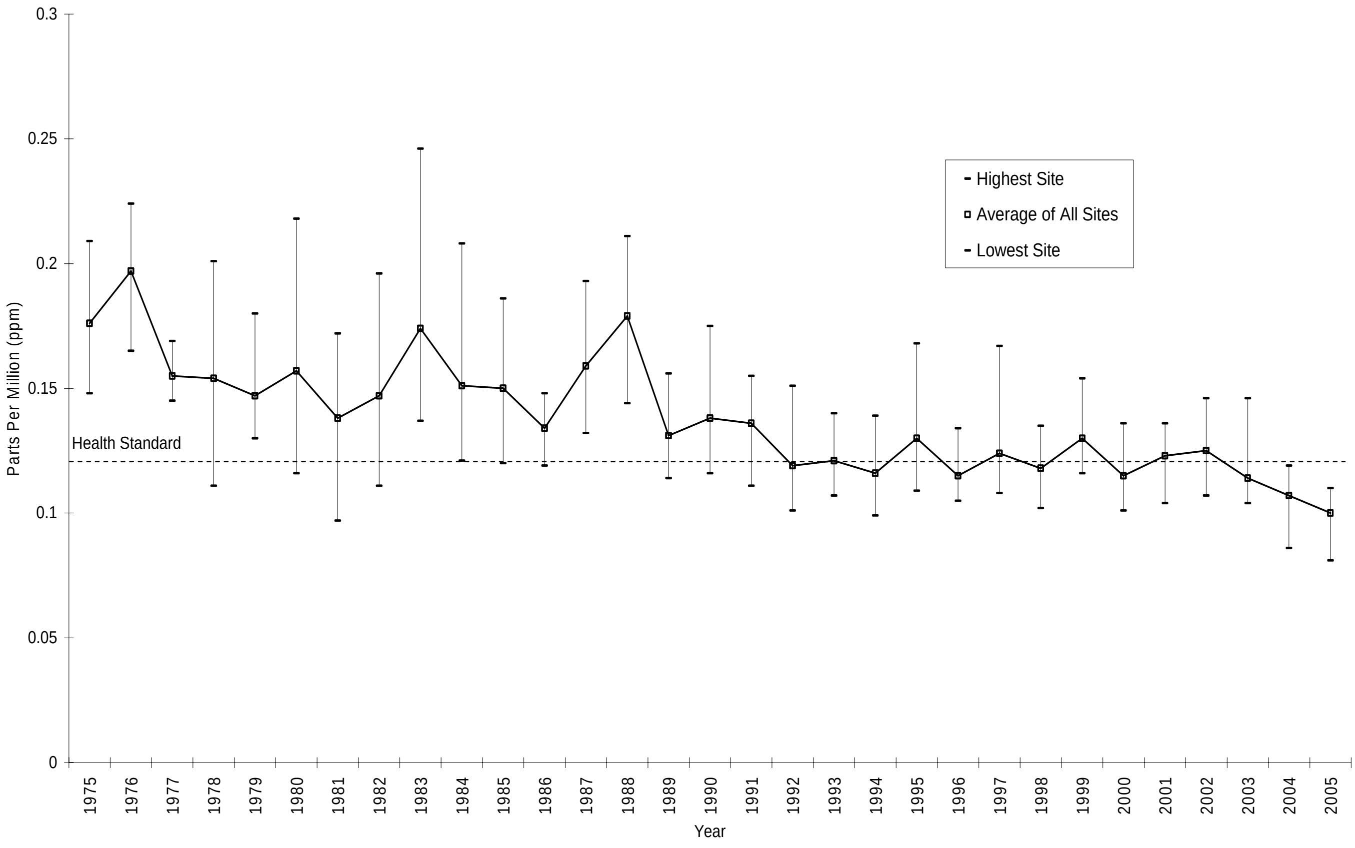
ACCOUNTING FOR THE INFLUENCE OF WEATHER

Trends in ground level ozone are influenced by many factors including weather conditions, transport, growth, and the state of the economy, in addition to changes brought about by regulatory control measures. Of these factors, weather probably has the most profound effect on year to year variations in ozone levels. Several methods have been developed to try to account for the effect of weather on ozone levels so that the change due to emissions could be isolated. While none of these methods are completely successful they do show that over the long term, real reductions in ozone levels have been achieved. A simple way of showing the changing effect of weather on ozone is shown above in Figure 12. The number of days each year on which the ambient temperature was 90 degrees or greater is shown next to the number of days the ozone standard was exceeded. In the earliest years shown (1981-1985) there are significantly more days with high ozone than days above 90 degrees. But this pattern gradually changes and for the most recent years there are more "hot" days than "ozone" days. This is an indication that on the days when conditions are suitable for ozone formation, unhealthy levels are being reached less frequently.

Ozone Trends

The primary focus of efforts to reduce concentrations of ground-level ozone in New Jersey has been on reducing emissions of volatile organic compounds (VOCs). Studies have shown that such an approach should lower peak ozone concentrations, and it does appear to have been effective in achieving that goal. Maximum 1-hour concentrations have not exceeded 0.200 ppm since 1988 and the last time levels above 0.180 ppm were recorded was in 1990 (Figure 13). Improvements have leveled off in recent years, especially with respect to maximum 8-hour average concentrations. Significant further improvements will require reductions in both VOCs and NOx. The NOx reductions will have to be achieved over a very large region of the country because levels in New Jersey are dependent on emissions from upwind sources.

Figure 13
Ozone Concentrations in New Jersey
1975 – 2005
Second Highest 1-Hour Averages

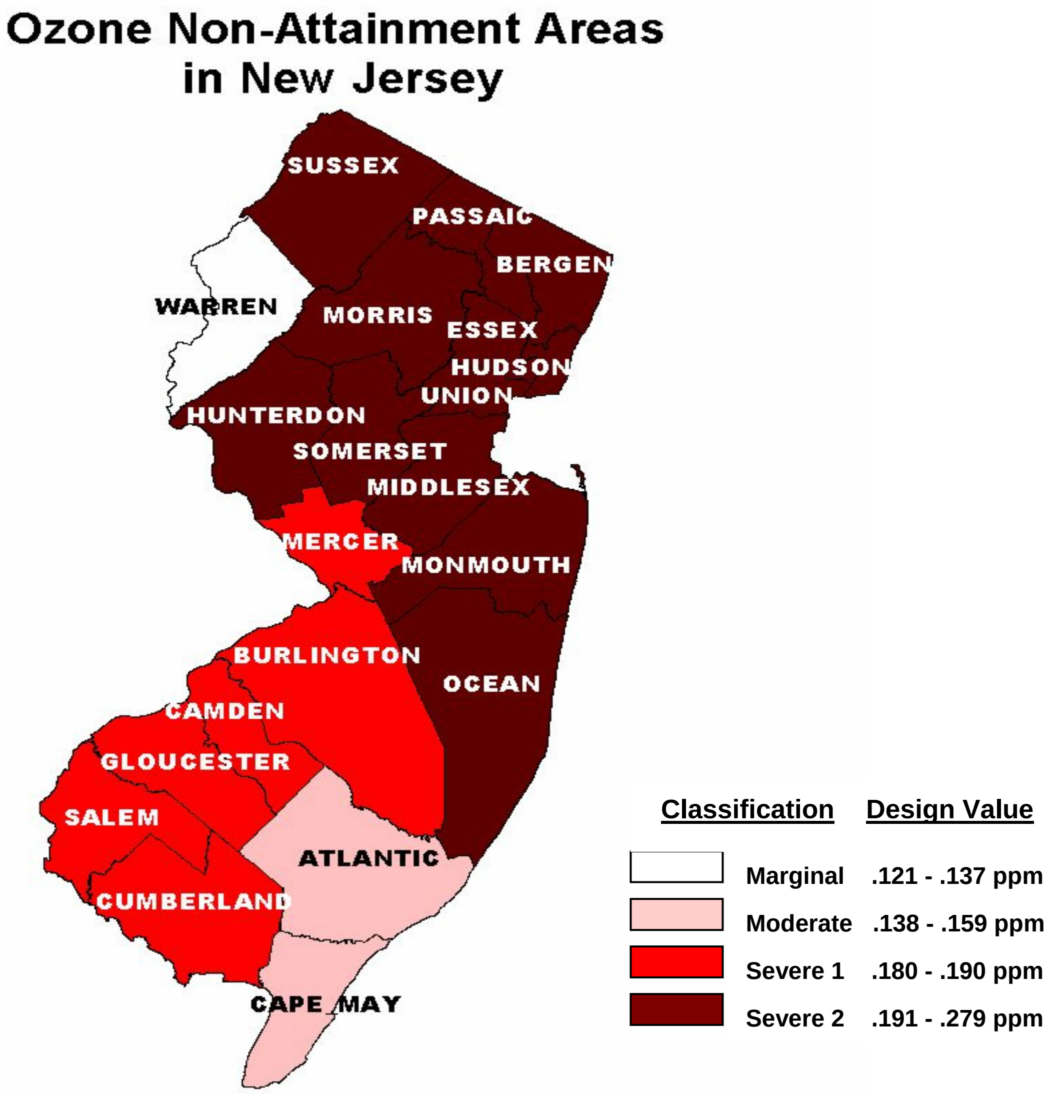


Ozone Non-Attainment Areas in New Jersey

The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Areas can also be found to be “unclassifiable” under certain circumstances. The 1990 amendments to the act required that areas be further classified based on the severity of non-attainment. The classifications range from “marginal” to “extreme” and are based on “design values”. The design value is the value that actually determines whether an area meets the standard. For the 1-hour ozone standard for example, the design value is the fourth highest daily maximum 1-hour average concentration recorded over a three year period. Note that these classifications did not take into account the transport of ozone and its precursors and missed the concept of multi-state controls.

New Jersey is part of four planning areas, the New York, Philadelphia, Atlantic City and Allentown/Bethlehem areas. Their classification with respect to the old 1-hour standard is shown on the map below. Now that the new 8-hour average standard for ozone has been upheld by the courts, new designations will have to be made.

Figure 14



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