2014 Ozone Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

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 (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight (see Figure 2). NO_x is 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. The pollutants that form ozone, referred to as "precursor" pollutants, and ozone itself 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. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the U.S. Environmental Protection Agency (USEPA) publication, "Ozone: Good Up High, Bad Nearby."

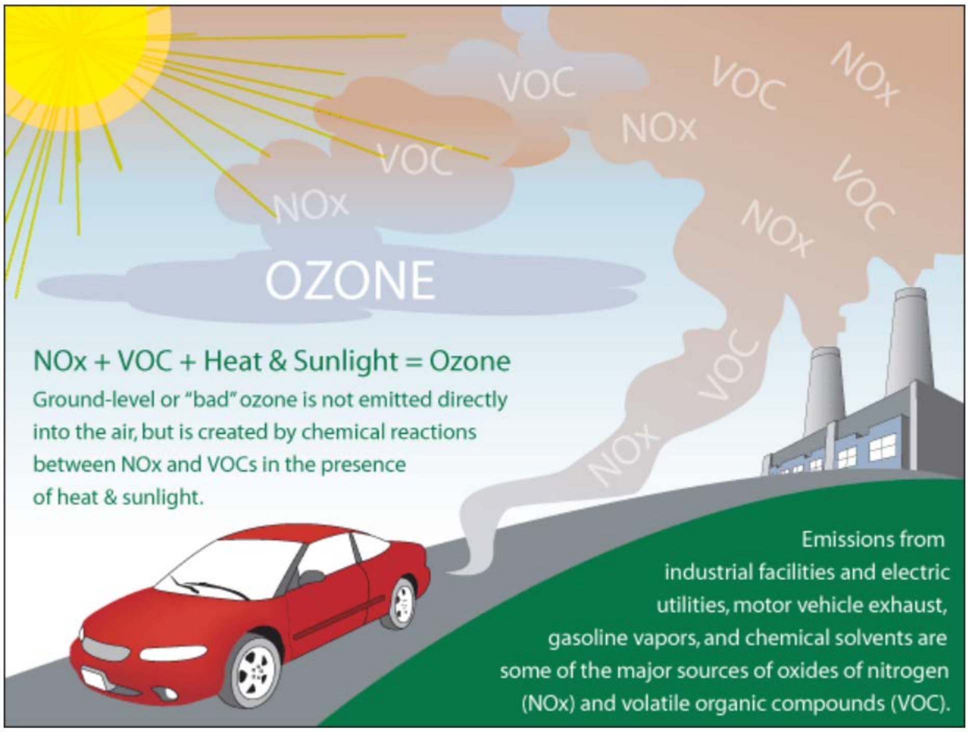
Figure 1: Good and Bad Ozone

OZONE IS GOOD UP HERE…MANY POPULAR CONSUMER PRODUCTS LIKE AIR CONDITIONERS AND REFRIGERATORS INVOLVE CFCS OR HALONS DURING EITHER MANUFACTURING OR USE. OVER TIME, THESE CHEMICALS DAMAGE THE EARTH'S PROTECTIVE OZONE LAYER.

OZONE IS BAD DOWN HERE… CARS, TRUCKS, POWER PLANTS AND FACTORIES ALL EMIT AIR POLLUTION THAT FORMS GROUND-LEVEL OZONE, A PRIMARY COMPONENT OF SMOG.

Source:USEPA

Figure 2
Ozone Formation

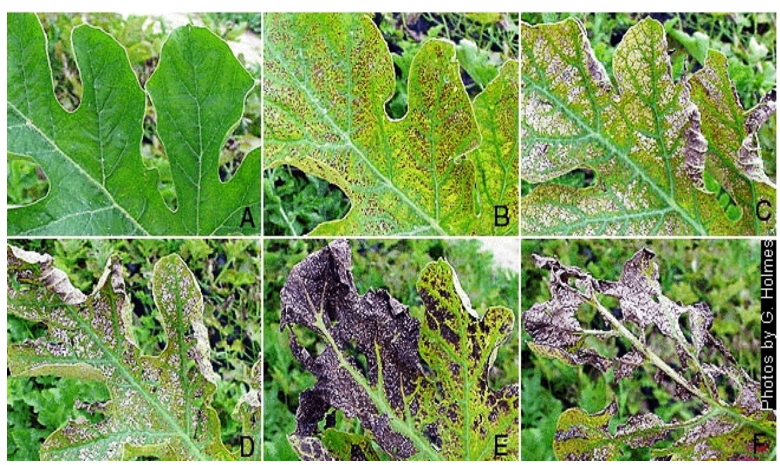


Source: USEPA

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 watermelon plant, shown in Figure 3, are damage caused by exposure to ground-level ozone.

Figure 3
Leaf Damage Caused by Ozone

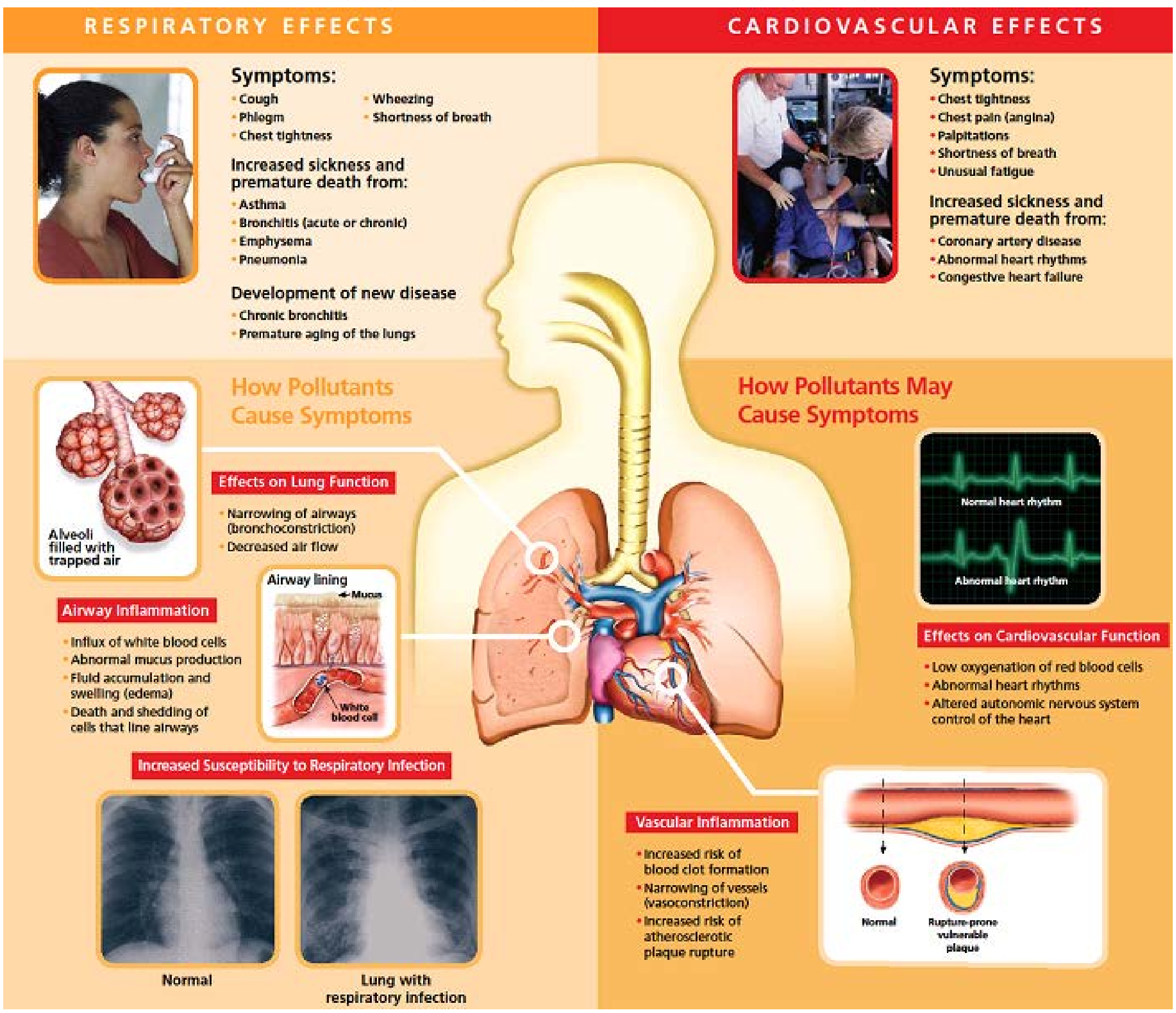


Photos: Gerald Holmes, NCSU Dept. of Horticulture

Health Effects

Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present at 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 special 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 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
Effects of Ozone & Common Air Pollutants



Source: www.airnow.gov

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 (such as 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 most recently revised by USEPA in 2008 because it was determined that the old standard of 0.08 parts per million (ppm) maximum daily eight-hour average was not sufficiently protective of public health. The revised standard of 0.075 ppm maximum daily 8-hour average went into effect on May 27, 2008. The revoked primary 1-hour NAAQS has been retained to compare current data with historical data.

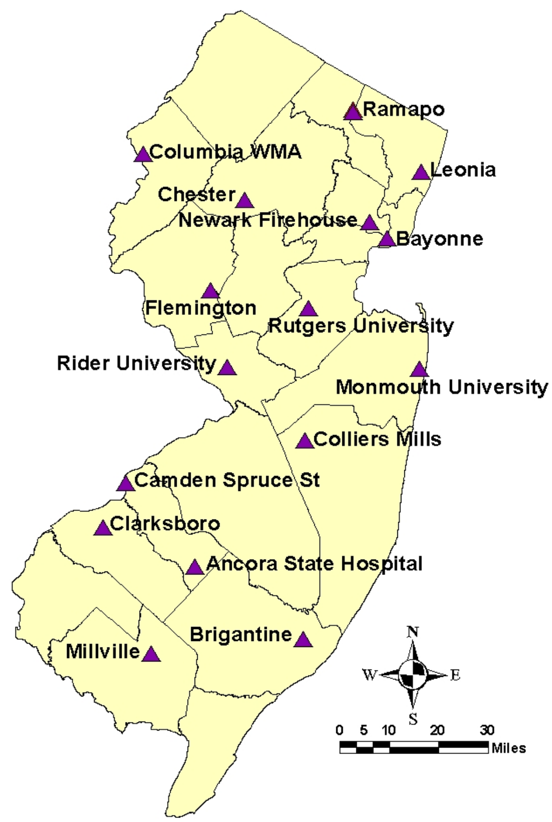
Table 1
National and New Jersey Ambient Air Quality Standards for Ozone
Parts per Million (ppm)

Averaging Period	Type	New Jersey	National
1-Hour	Primary	0.12 ppm	---
8-Hour	Primary	---	0.075 ppm
8-Hour	Secondary	---	0.075 ppm

OZONE MONITORING NETWORK

Ozone was measured at 16 monitoring stations in New Jersey during 2014 (see Figure 5). Of those 16 sites, ten operated year-round and six operated only during the ozone season, which is April 1st through October 31st. Bayonne, Brigantine, Camden Spruce Street, Chester, Columbia WMA, Flemington, Millville, Newark Firehouse, Rider University and Rutgers University operate year-round. Ancora, Clarksboro, Colliers Mills, Leonia, Monmouth University, and Ramapo sites operate only during the ozone season.

Figure 5
2014 Ozone Monitoring Network



DESIGN VALUE

USEPA defines a design value as the mathematically-determined pollutant concentration at a particular site that determines whether that site (and the corresponding state) is in attainment with the NAAQS for that pollutant. In other words, it is a statistic that describes the air quality status of a given location relative to the level of the NAAQS.

The NAAQS for ozone are set in such a way that determining compliance is based a two-step process using data from the most recent three years. The first step involves determining the fourth highest daily maximum 8-hour average concentration for each site for each of the three years. These three values are then averaged, for each site. If this value, at any site in the state, exceeds the NAAQS, the state is determined to be in nonattainment.

OZONE LEVELS IN 2014

Of the 16 monitoring sites that were operating during the 2014 ozone season, none recorded levels above the old 1-hour standard of 0.12 ppm. The highest 1-hour concentration was 0.115 ppm, recorded at Rutgers University on August 27th.

Eight of sixteen monitoring sites operating during the 2014 ozone season recorded levels above the 8-hour NAAQS of 0.075 ppm. The highest daily maximum 8-hour concentration was 0.095 at Rutgers University on August 27th. 2014 design values for the 8-hour standard (based on data from 2012 through 2014) were above the NAAQS at just two of sixteen sites, Ancora and Clarksboro.

Figure 6 on the following page shows the 8-hour design values for the 2012-2014 period. Table 2 summarizes the 1-hour and 8-hour maximum and fourth-highest ozone concentrations at each monitoring station for 2014. It also lists the design values for each site for 2012-2014. .

Figure 6
New Jersey Ozone Design Values for 2012-2014
3-Year Average of the 4th Highest Daily Maximum 8-hour Average

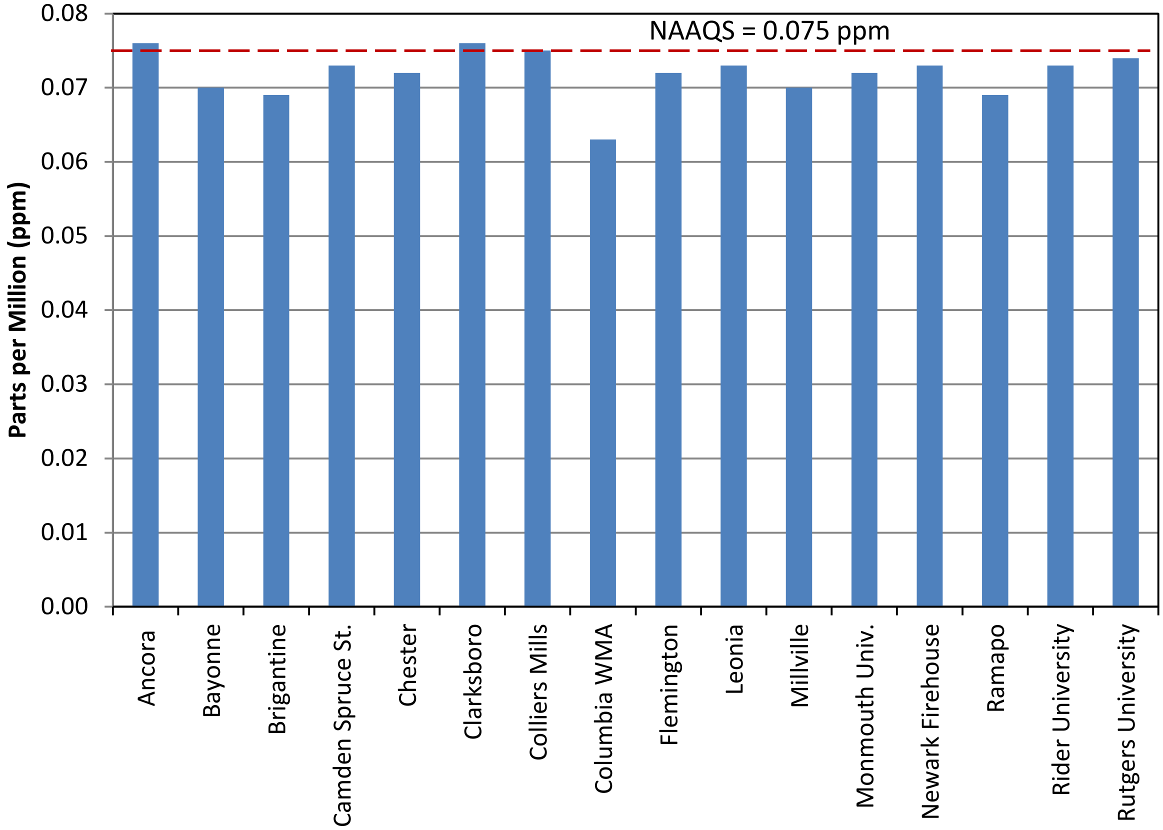


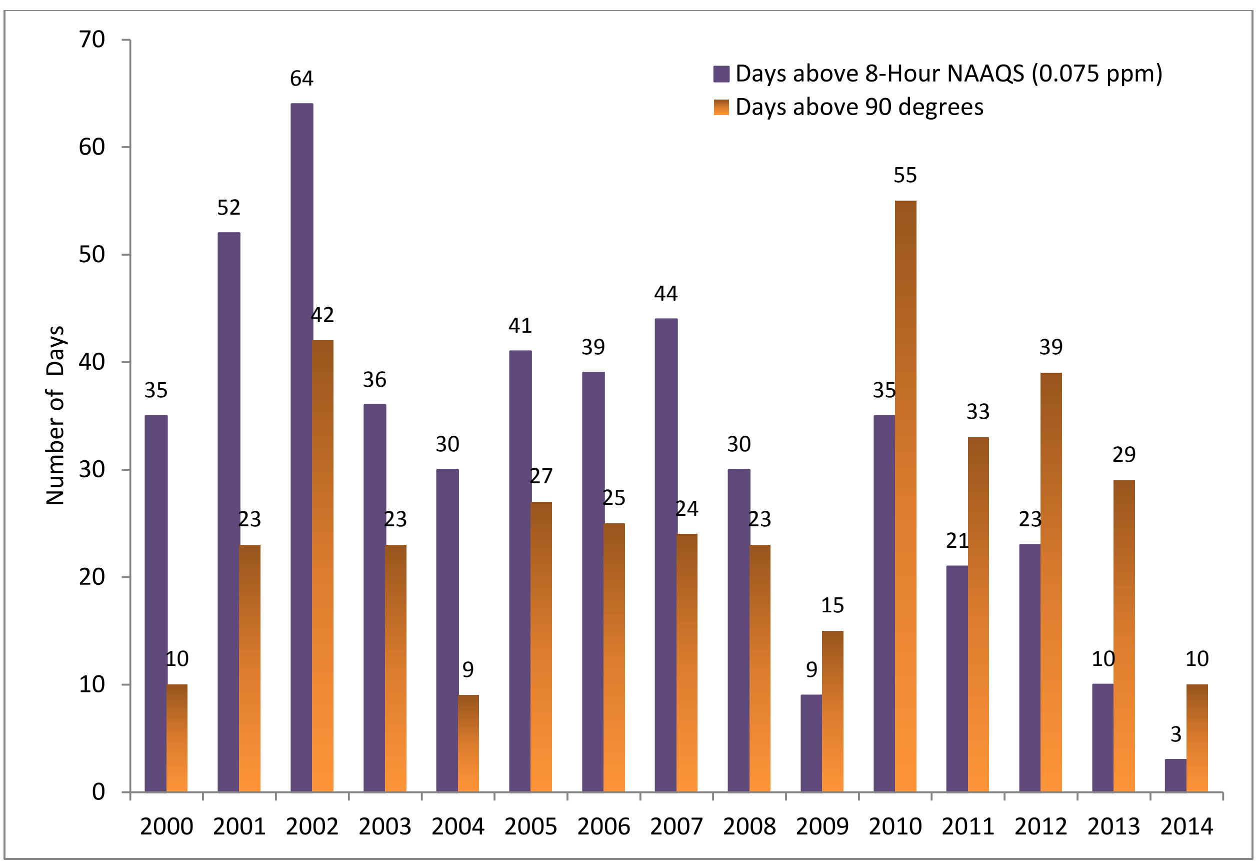
Table 2
2014 New Jersey Ozone Concentrations
Parts per Million (ppm)

Monitoring Site	1-Hour Average Concentrations		8-Hour Average Concentrations		
	Maximum	4th-Highest	Highest Daily Maximum	4th-Highest Daily Maximum	2012-2014 Average of 4th-Highest Daily Max.
Ancora	0.081	0.080	0.076	0.068	0.076
Bayonne	0.102	0.091	0.085	0.072	0.070
Brigantine	0.073	0.071	0.070	0.061	0.069
Camden Spruce St.	0.087	0.084	0.075	0.068	0.073
Chester	0.086	0.078	0.074	0.068	0.072
Clarksboro	0.089	0.083	0.077	0.070	0.076
Colliers Mills	0.087	0.085	0.076	0.072	0.075
Columbia WMA	0.082	0.070	0.063	0.060	0.063
Flemington	0.084	0.079	0.072	0.065	0.072
Leonia	0.093	0.089	0.080	0.073	0.073
Millville	0.076	0.074	0.071	0.067	0.070
Monmouth Univ.	0.086	0.080	0.077	0.064	0.072
Newark Firehouse	0.090	0.084	0.075	0.070	0.073
Ramapo	0.086	0.083	0.069	0.067	0.069
Rider University	0.090	0.087	0.076	0.071	0.073
Rutgers University	0.115	0.089	0.095	0.071	0.074

ACCOUNTING FOR THE INFLUENCE OF WEATHER

Trends in concentrations of 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 simplified way of showing the changing effect of weather on ozone is shown in Figure 7. 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 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.

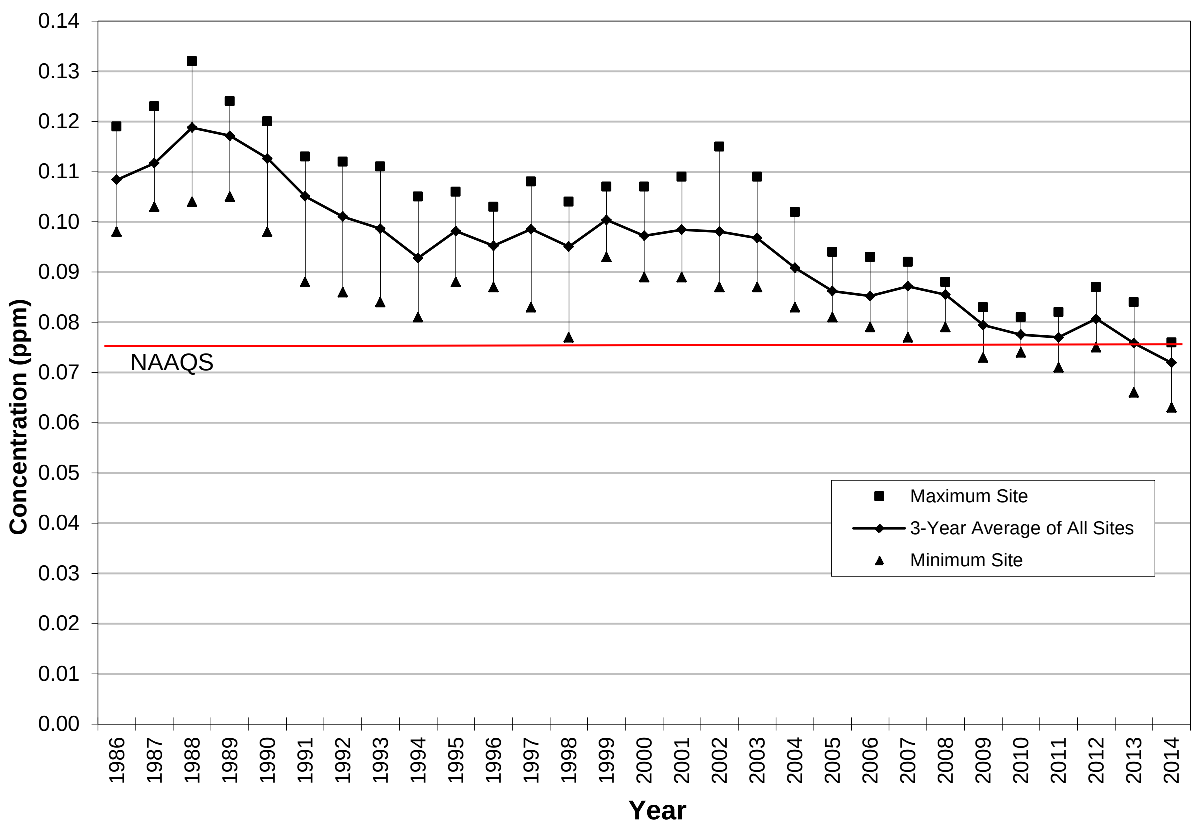
Figure 7
Number of Days above the 8-Hour Ozone Standard of 0.075 ppm and
Number of Days Above 90 Degrees in New Jersey, 2000-2014



OZONE TRENDS

Efforts to reduce concentrations of ground-level ozone in New Jersey have been focused on reducing emissions of VOCs and NOx. Studies have shown that such an approach should lower peak ozone concentrations, and it does appear to have been effective in achieving that goal. The chart in Figure 8 is based on the fourth-highest 8-hour average concentrations recorded each year, which is the basis of the ozone NAAQS. As Figure 8 illustrates, the maximum 8-hour concentrations have decreased fairly steadily since 1988, with the maximum site for 2014 just barely exceeding 0.075 ppm. Further improvements will require more reductions in both VOCs and NO_x. Ozone levels in New Jersey are greatly impacted by emissions from upwind sources in other states, so reductions will have to be achieved over a region beyond state borders.

Figure 8
4th-Highest 8-Hour Ozone Averages
in New Jersey 1986-2014

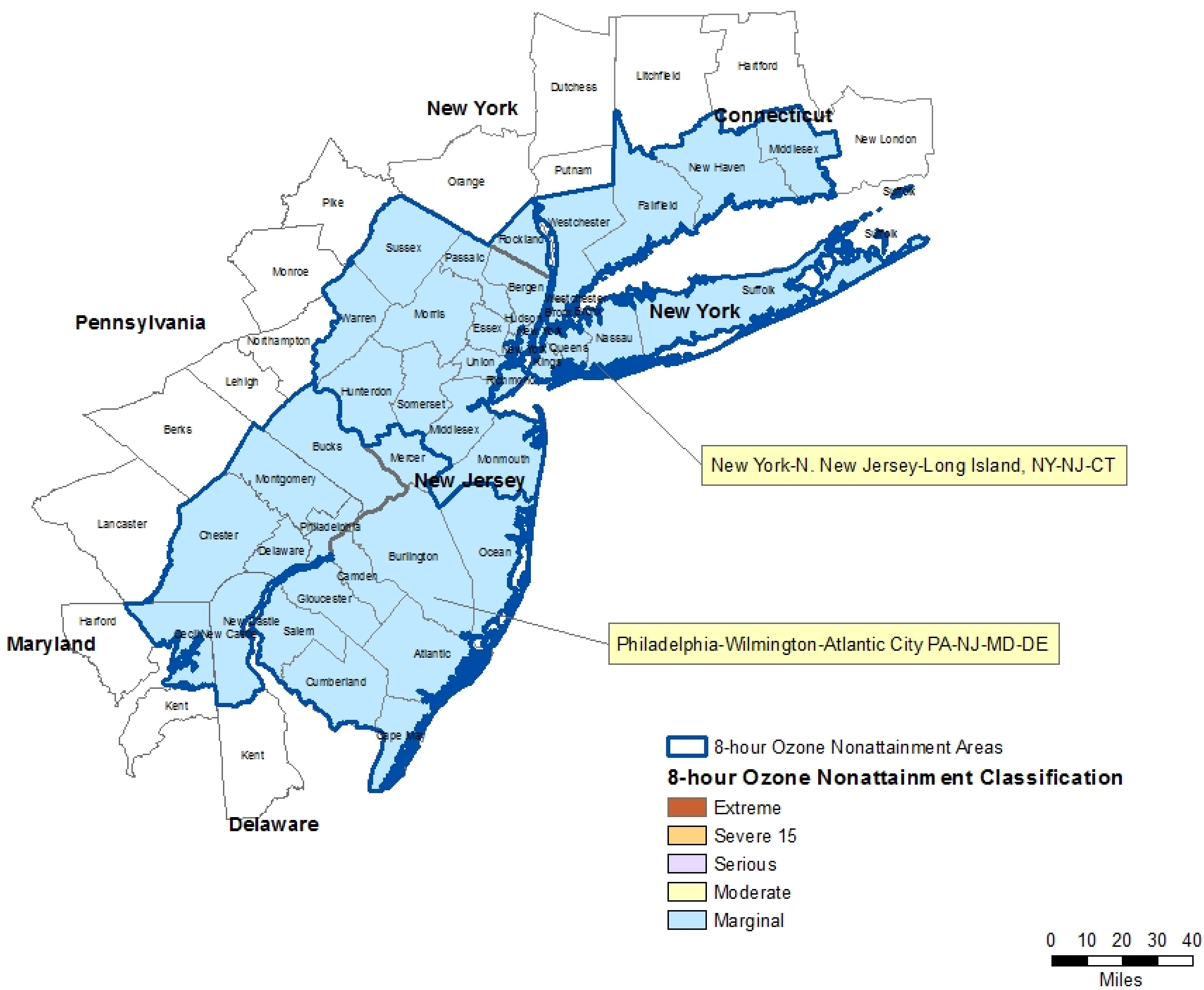


OZONE NONATTAINMENT AREAS IN NEW JERSEY

The Clean Air Act requires that all areas of the country be evaluated for attainment or nonattainment for each of the NAAQS. The 1990 amendments to the Clean Air Act required that areas be further classified based on the severity of nonattainment. The classifications range from “marginal” to “extreme” and are based on the design values that determine whether an area meets the standard.

The entire state of New Jersey is in nonattainment for the ozone NAAQS, and is classified as being “marginal.” A “marginal” area has a design value of 0.076 up to but not including 0.086 ppm. New Jersey’s classification with respect to the 8-hour standard is shown in Figure 9.

Figure 9
New Jersey 8-Hour Ozone Nonattainment Areas



Source: www3.epa.gov/airquality/greenbk/nj8_2008.html

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