3.0 AIR QUALITY TRENDS SUMMARY

The New Jersey Department of Environmental Protection (NJDEP) analyzed various data for trends in ozone values. The trends analyzed include 8-hour ozone design values, monitor exceedances, ozone precursor concentrations, and meteorology. Eight-hour average ozone concentrations have been calculated since 1986, prior to the 8-hour ozone standard implementation in 1997 in New Jersey and before designations were made in 2004. Data for 8-hour ozone before 1997 are used for analysis purposes only and do not represent official reporting for the 8-hour ozone National Ambient Air Quality Standard (NAAQS).

In addition to trends in 8-hour ozone data, 1-hour ozone data were also analyzed. Trends for 1-hour ozone data include design values and monitor exceedances for New Jersey and both the New York and Philadelphia nonattainment areas. The following discussion is a summary of the key conclusions from these analyses. For more detailed information on the air quality trends in New Jersey, please refer to Appendix B.

3.1 1-Hour Ozone

3.1.1 1-Hour Ozone Design Values and Exceedances

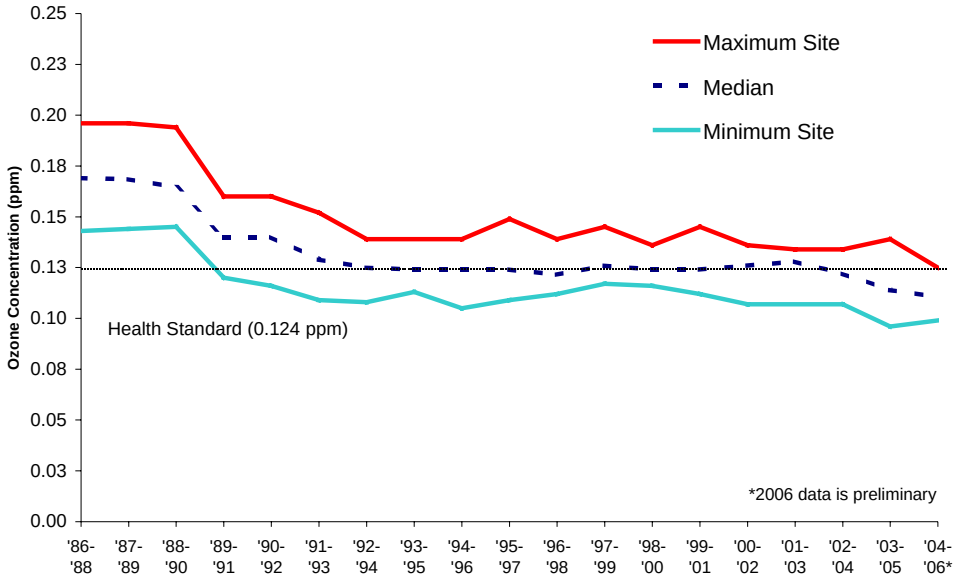
In order to determine compliance for an area under the NAAQS for ozone, a design value is calculated based upon ambient air monitoring data and compared to the federal standard. An area is considered to be attaining the 1-hour average ozone standard if the average number of times the standard is exceeded at any one monitoring station over a three-year period is 1 or less (after correcting for missing data) (40 C.F.R. 50, Appendix H). Thus, it is the fourth highest daily maximum 1-hour concentration that occurs over a three-year period that determines if an area is in attainment. If the fourth highest value is above 0.12 parts per million (ppm) then the average number of exceedances is greater than 1. The fourth highest value is also known as the design value. One-hour ozone design values in nonattainment areas associated with New Jersey have declined substantially over time, as displayed in Figure 3.1. As discussed in Chapter 1, the maximum 1-hour ozone average concentration (not shown) recorded in New Jersey in 1988 was 0.218 ppm compared to a maximum of 0.119 ppm in 2004.[1] In fact, of the 14 ozone monitoring sites that were operating during the 2004 ozone season in New Jersey, none recorded levels above the 1-hour ozone standard of 0.12 ppm during the year. Most recently, all but one New Jersey monitor (at 0.125 ppm) met the 1-hour ozone standard in 2006.

One-hour ozone design values in the 1-hour ozone New York and Philadelphia nonattainment areas from 1991-2006 have declined approximately 29 percent and 20 percent, respectively, when compared to average design values from 1982-1990 (pre-

[1] NJDEP. 2004 Ozone Summary, 2004 Air Quality Report. New Jersey Department of Environmental Protection, Bureau of Air Monitoring, 2005.

1990 Clean Air Act Amendments).[2,3] Figures 3.2 and 3.3 display the improving trend of 1-hour ozone design values for the 24 county 1-hour ozone New York nonattainment area and the 14 county 1-hour ozone Philadelphia nonattainment area, respectively.

Figure 3.1: New Jersey 1-Hour Ozone Design Values, 1988-2006 (Based on 4th Highest 1-Hour Average Concentration)



[2] NJDEP. Mid-Course Review for the New Jersey Portion of the Philadelphia-Southern New Jersey and New York-Northern New Jersey 1-Hour Ozone Nonattainment Areas. New Jersey Department of Environmental Protection, Bureau of Air Quality Planning, January 2005.
[3] USEPA. AirData: Access to Air Pollution Data, 2006. United States Environmental Protection Agency, http://www.epa.gov/air/data/, accessed December 7, 2006.

Figure 3.2: Design Values for the 1-Hour Ozone New York Nonattainment Area, 1982-2006

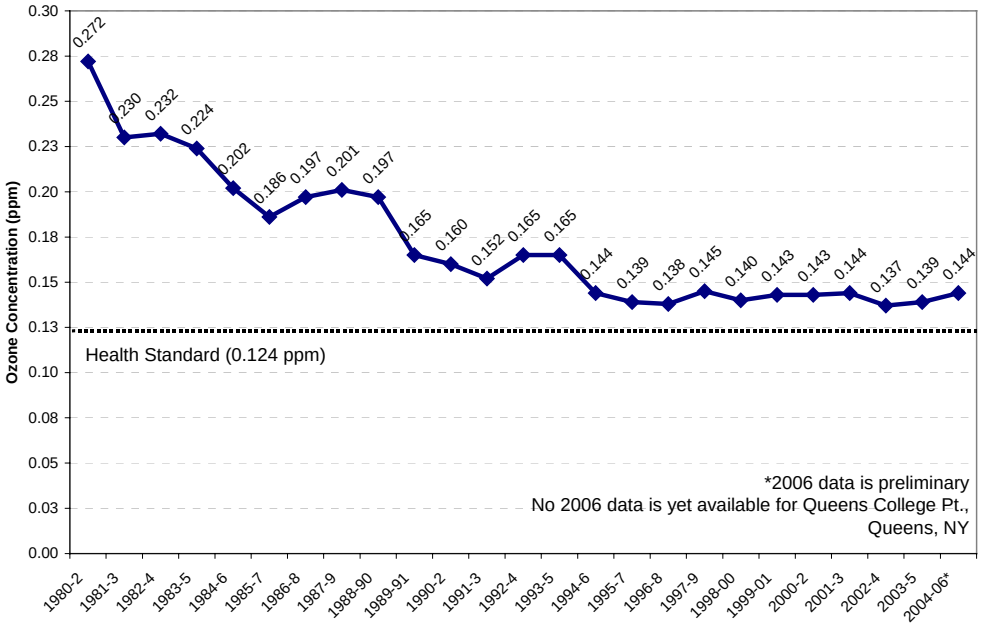
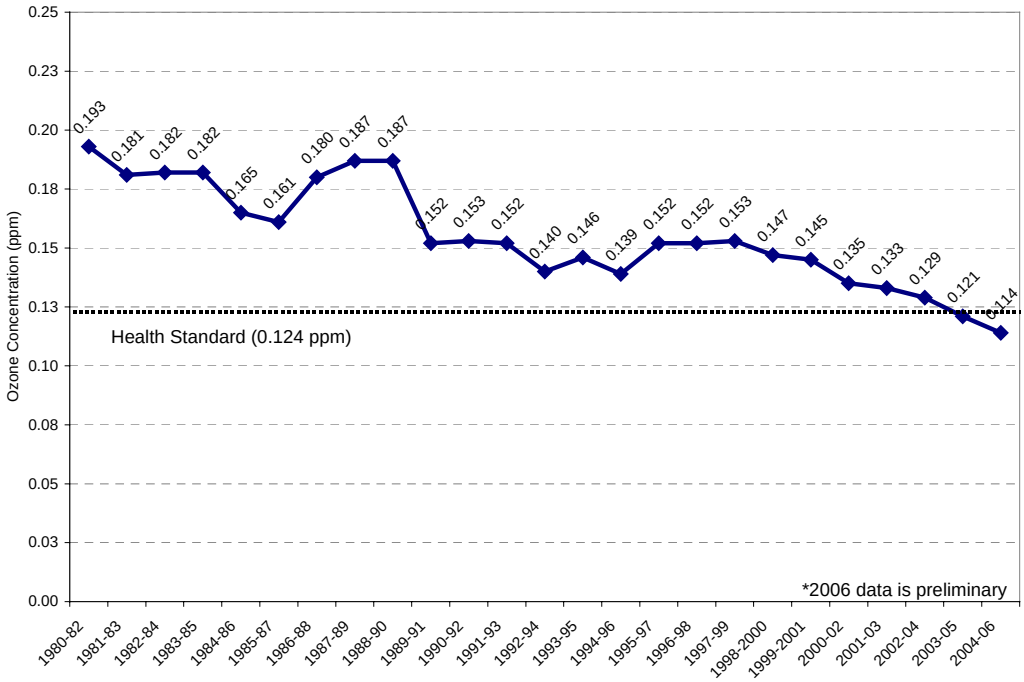
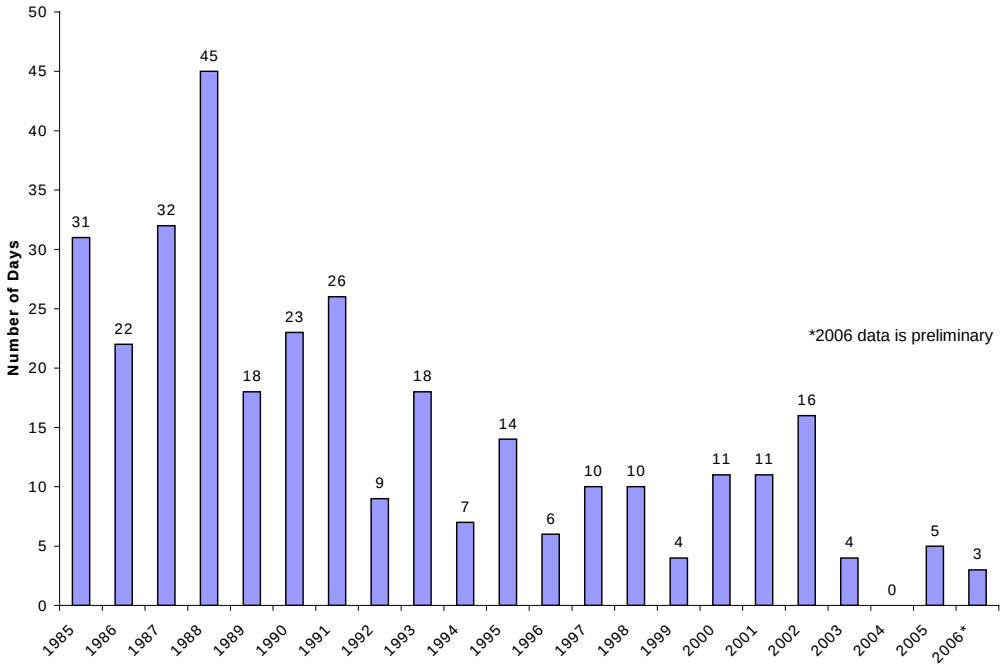


Figure 3.3: Design Values for the 1-Hour Ozone Philadelphia Nonattainment Area, 1982-2006



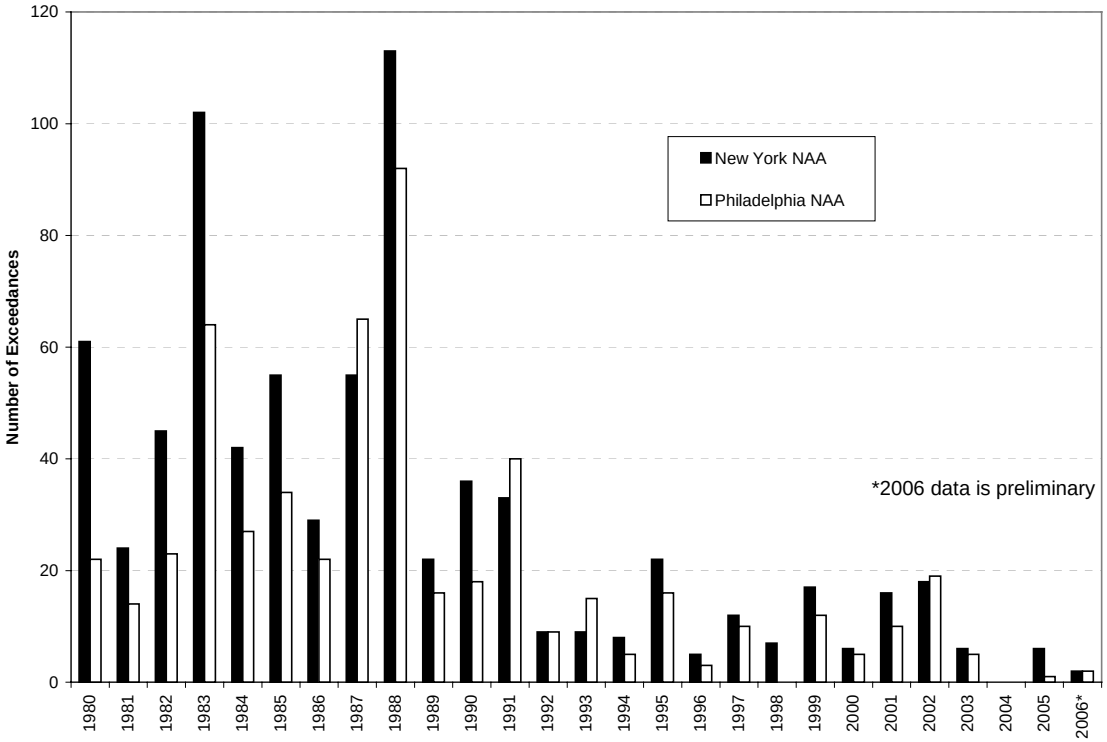
Monitored exceedances of the 1-hour ozone standard occur whenever a 1-hour ozone concentration is greater than or equal to 0.125 ppm. The declining total number of days on which monitors exceeded the 1-hour ozone standard for New Jersey's monitors between 1985 and 2006 is shown in Figure 3.4. In the New Jersey portions of both the New York and Philadelphia 1-hour ozone nonattainment areas, there have also been dramatic decreases in the total number of monitor exceedances, as shown in Figure 3.5.

Figure 3.4: Number of Days on which the 1-Hour Ozone Standard was Exceeded in New Jersey,[4] 1985-2006



[4] As used here, monitor exceedances refer to the total number of days the ozone health standard was exceeded.

Figure 3.5: Monitored Exceedances in the New Jersey Portion of 1-Hour Ozone New York and Philadelphia Nonattainment Areas,[5] 1980-2006



The data presented for the 1-hour ozone Philadelphia and New York nonattainment areas demonstrate that the states within those nonattainment areas have made great progress in reducing ozone precursor levels through the implementation of control strategies, thereby reducing ozone concentrations and exceedances in the region under the 1-hour ozone NAAQS. However, further reductions in ozone precursors, not only from local sources but also from sources upwind of New Jersey, are needed in order to attain the 8-hour ozone NAAQS.

3.1.2 Other New Jersey-Associated 1-Hour Ozone Nonattainment Areas

As discussed in Chapter 11, in addition to the Philadelphia and New York nonattainment areas, the Atlantic City and Allentown-Bethlehem-Easton, PA-NJ nonattainment areas were originally designated as moderate. Both of these areas have ambient air quality levels that meet the 1-hour ozone NAAQS. For additional details on these nonattainment areas, refer to Chapter 11.

[5] As used here, monitor exceedances refer to the sum across the network of each monitor's individual number of exceedance days in a given year.

3.2 8-Hour Ozone

In the entire 8-hour ozone Northern New Jersey/New York/Connecticut nonattainment area, there are currently 21 monitors for ozone. Seven of these monitors operate in the 12 county New Jersey portion of Northern New Jersey/New York/Connecticut nonattainment area. In the entire 8-hour ozone Southern New Jersey/Philadelphia nonattainment area, there are currently 22 ozone monitors. Seven of these monitors operate in the nine county New Jersey portion of the 8-hour ozone Southern New Jersey/Philadelphia nonattainment area. Figure 3.6 is a map of ozone monitoring site locations in New Jersey.

Figure 3.6: 2006 New Jersey Ozone Monitoring Network

3.2.1 8-Hour Ozone Design Values

A design value under the 8-hour ozone NAAQS is defined as the average of the fourth highest daily maximum 8-hour ozone concentration that is recorded each year for three years for a given monitoring site (40 C.F.R. 50, Appendix I). Median 8-hour ozone design values in New Jersey have declined approximately 28 percent, as shown in Figure 3.7. Figures 3.8 and 3.9 show that the average 8-hour ozone design values in the 8-hour ozone Northern New Jersey/New York/Connecticut nonattainment area and Southern New Jersey/Philadelphia nonattainment area from 1999-2006 have declined approximately 14 percent and 16 percent, respectively.[6] The design value for a nonattainment area is the maximum monitor design value for all monitors for each 3-year

[6] Data for other states in the nonattainment areas were obtained from USEPA's Air Quality System (AQS) and might not reflect states' corrected data, T. Downs, personal communication, November 3, 2006.

period. The 8-hour ozone Northern New Jersey/New York/Connecticut nonattainment area's current monitor with the highest design value is Danbury, Fairfield County, Connecticut. The 8-hour Southern New Jersey/Philadelphia nonattainment area's current monitor with the highest design value is Colliers Mills, Ocean County, New Jersey.

Figure 3.7: New Jersey 8-Hour Ozone Design Values, 1988-2006
(Based on 3-Year Average of 4th Highest Daily 8-Hour Concentration)

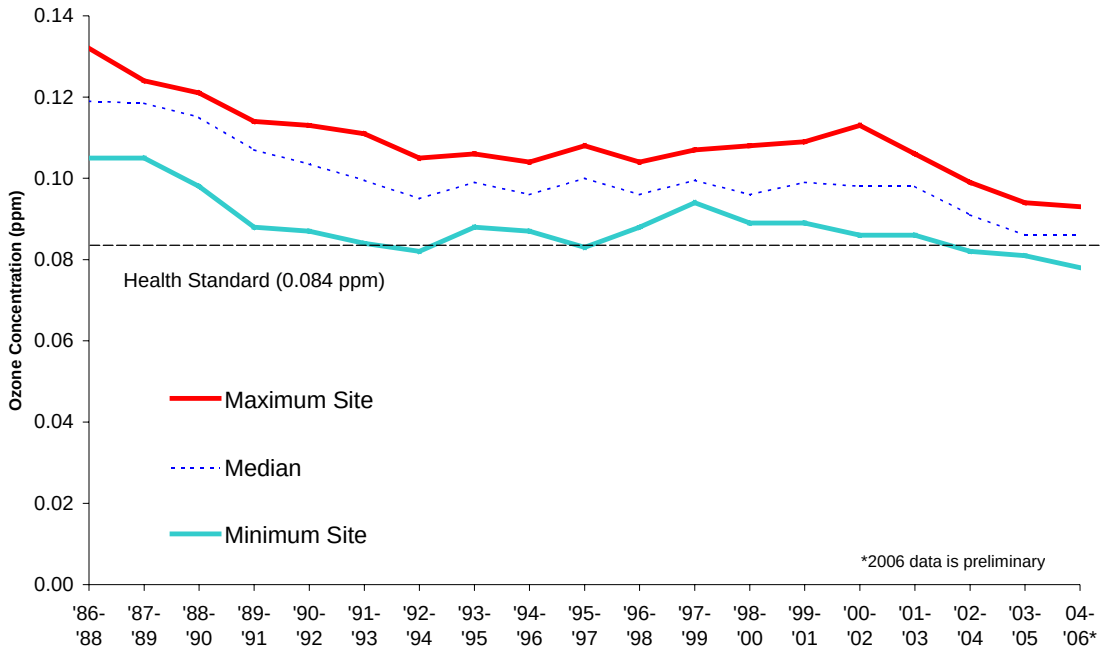


Figure 3.8: NNJ/NY/CT Nonattainment Area 8-Hour Ozone Design Values 1999-2006

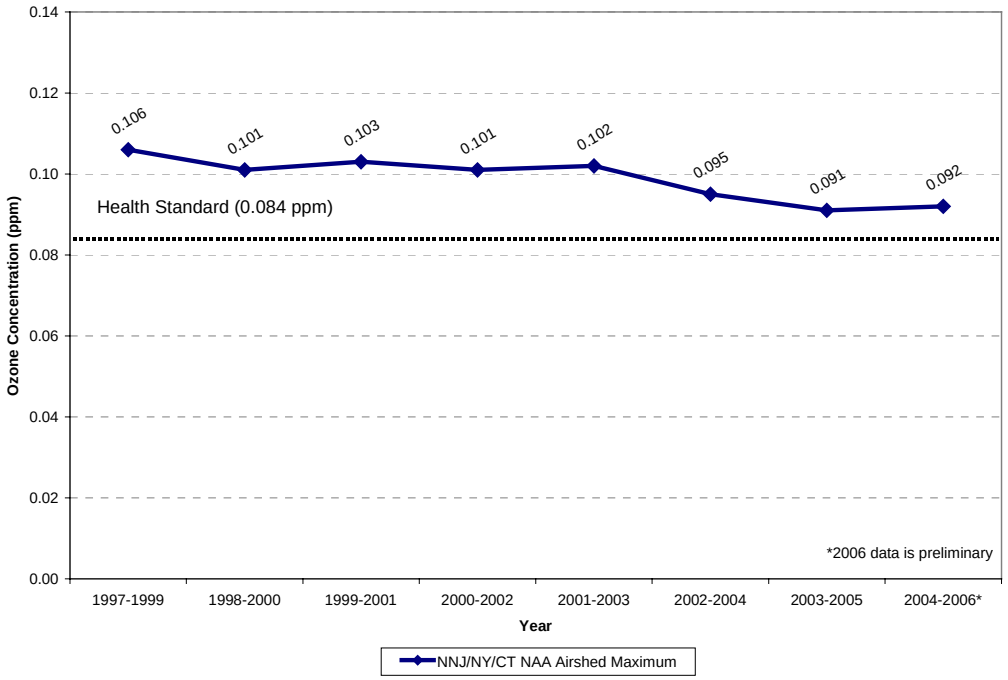
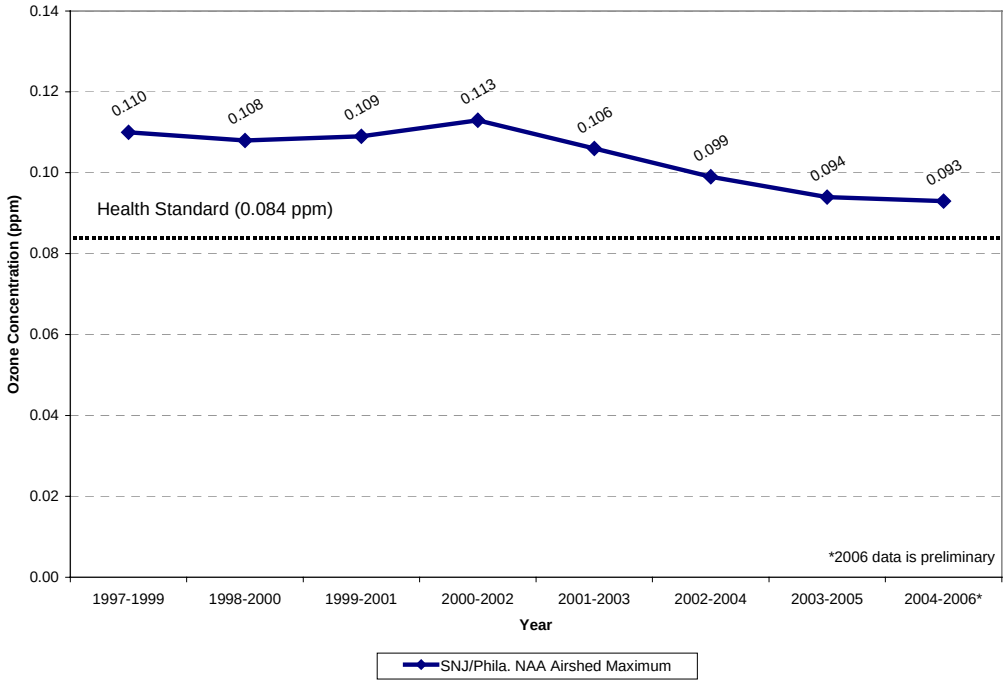


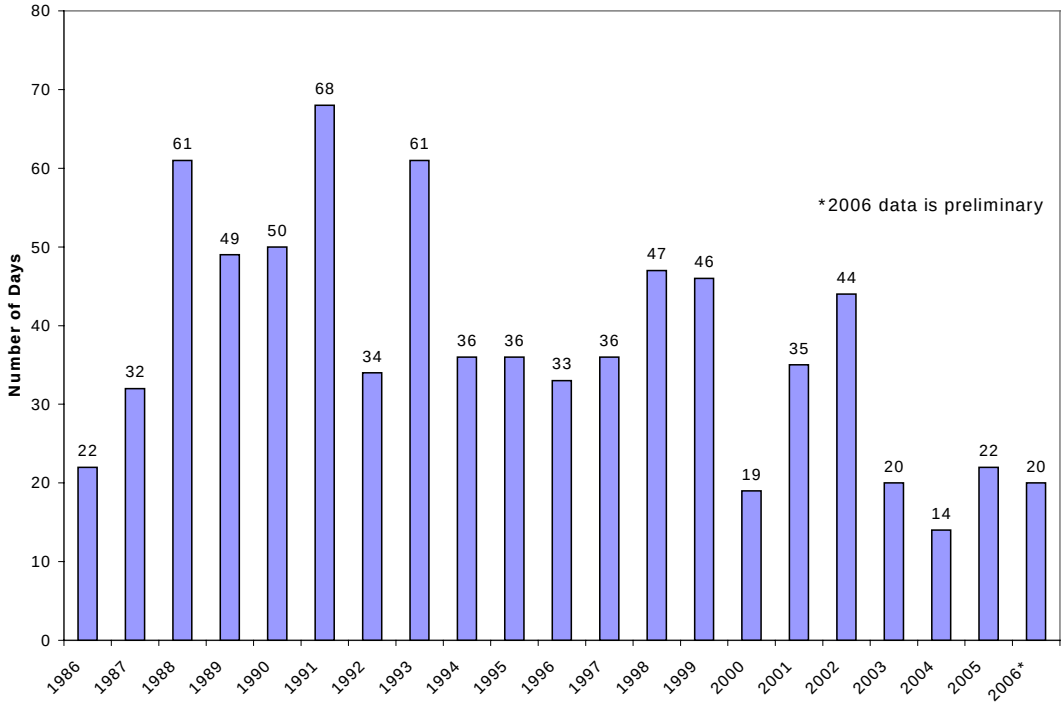
Figure 3.9: SNJ/Phila. Nonattainment Area 8-Hour Ozone Design Values 1999-2006



3.2.2 8-Hour Ozone Monitor Exceedances

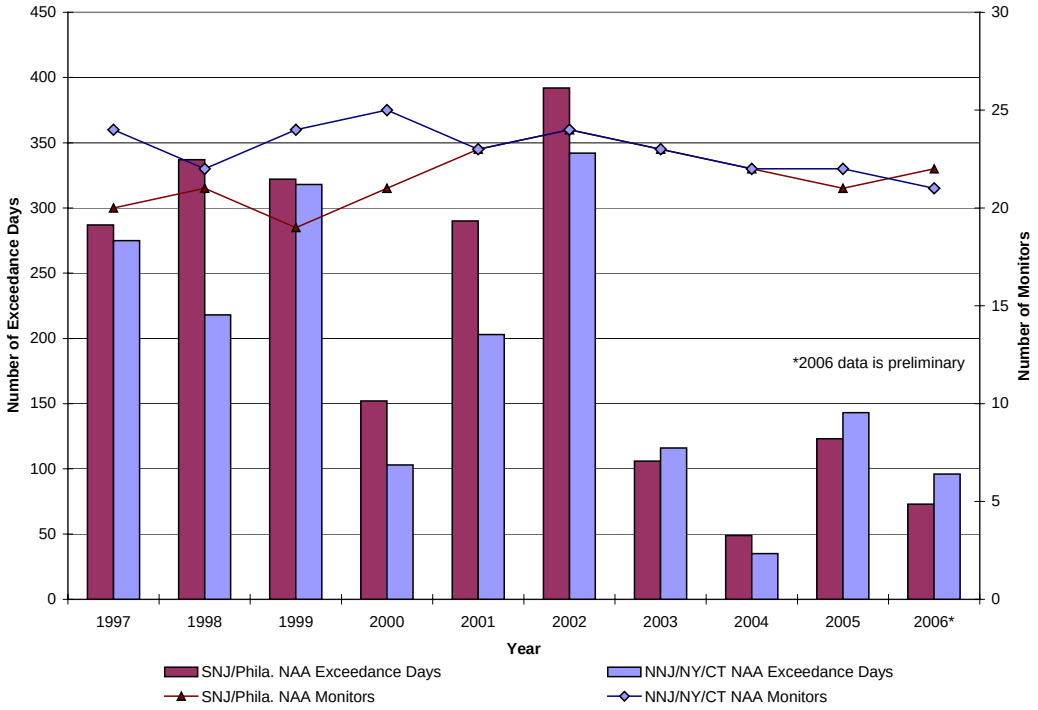
Monitored exceedances (i.e., number of days that exceeded the health-based standard) occur whenever an 8-hour ozone concentration is greater than or equal to 0.085 ppm. Figures 3.10 and 3.11 demonstrate that the total number of monitored exceedances of the 8-hour ozone standard has decreased slightly for New Jersey and significantly for both nonattainment areas.

Figure 3.10: Number of Days on which the 8-Hour Ozone Standard was Exceeded in New Jersey,[7] 1985-2006



[7] As used here, monitor exceedances refer to the total number of days the ozone health standard was exceeded.

Figure 3.11: Monitored Exceedances in the 8-Hour Ozone NNJ/NY/CT Nonattainment Area and SNJ/Phila. Nonattainment Area,[8,9] 1997-2006



3.2.3 New Jersey Monitor Trends

In addition to the design value and exceedance trends discussed for 8-hour ozone, the NJDEP analyzed 8-hour ozone monitor trends for the New Jersey portions of the Northern New Jersey/New York/Connecticut nonattainment area and Southern New Jersey/Philadelphia nonattainment area.[10]

The following are key points of the monitor trends in the New Jersey portion of the Northern New Jersey/New York/Connecticut nonattainment area for data collected from 1986-2006:

- Design values have fallen 7-32 percent.
- There have been significant reductions in the number of total 8-hour ozone exceedance days.
- Eight-hour ozone exceedance days at individual monitors decreased up to 75 percent.
- Peak 8-hour ozone concentrations have generally decreased by 11-33 percent.

[8] As used here, monitor exceedances refer to the sum across the network of each monitor's individual number of exceedance days in a given year.
[9] As used here, monitor exceedances refer to the total number of days the ozone health standard was exceeded.
[10] ibid.

The following are key points of the monitor trends in the New Jersey portion of the Southern New Jersey/Philadelphia nonattainment area for data collected from 1986-2006:

- Design values have fallen 19-36 percent.
- There have been significant reductions in the number of total 8-hour ozone exceedance days.
- Eight-hour ozone exceedance days at individual monitors decreased up to 89 percent.
- Peak 8-hour ozone concentrations have decreased by 12-30 percent.

Based upon the data available for New Jersey and both nonattainment areas, the general trend for 8-hour ozone is improving. However, attainment of the 8-hour ozone NAAQS has not yet been reached.

3.3 Ozone Precursor Concentrations

As discussed in Chapter 1, ozone is formed when oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. This section outlines the monitoring trends for these specific ozone precursors, lending additional support to the State's claim that ozone levels have been, and continue to be, reduced throughout New Jersey.

3.3.1 Volatile Organic Compounds (VOCs)

In 1993, federal revisions to air monitoring regulations required states to enhance monitoring for ozone and its precursors.[11] Because of those new regulations, New Jersey now gathers data at three locations for ambient concentrations of VOCs, including several carbonyls, through the Photochemical Assessment Monitoring Station (PAMS) program as part of New Jersey's Manual Monitoring Network.[12,13] The VOC and carbonyl measurements are only taken during the peak part of the ozone season, from June 1 to August 31 each year (the official ozone season in New Jersey runs from April 1 to October 31).[14] Figure 3.12 shows that VOC trends for the PAMS sites in the New York City metropolitan area are similar to those for the Philadelphia area in Figure 3.13. Overall, the levels of total non-methane organic carbon (TNMOC) at the PAMS monitors have decreased, with some monitors showing a more significant decrease than others.

[11] 58 Fed. Reg. 8452 (February 12, 1993).
[12] NJDEP. State Implementation Plan (SIP) Revision for the Attainment and Maintenance of the Ozone National Ambient Air Quality Standards, Meeting the Federal Clean Air Act Requirements for November 15, 1993. New Jersey Department of Environmental Protection, September 14, 1993, p. 83.
[13] NJDEP. 2003 Photochemical Assessment Monitoring Stations (PAMS), 2003 Air Quality Report. New Jersey Department of Environmental Protection, Bureau of Air Monitoring, 2004.
[14] op. cit., note 1

Figure 3.12: Total Non-methane Organic Carbon (TNMOC), Seasonal Average 1995-2005, New York Metropolitan Area

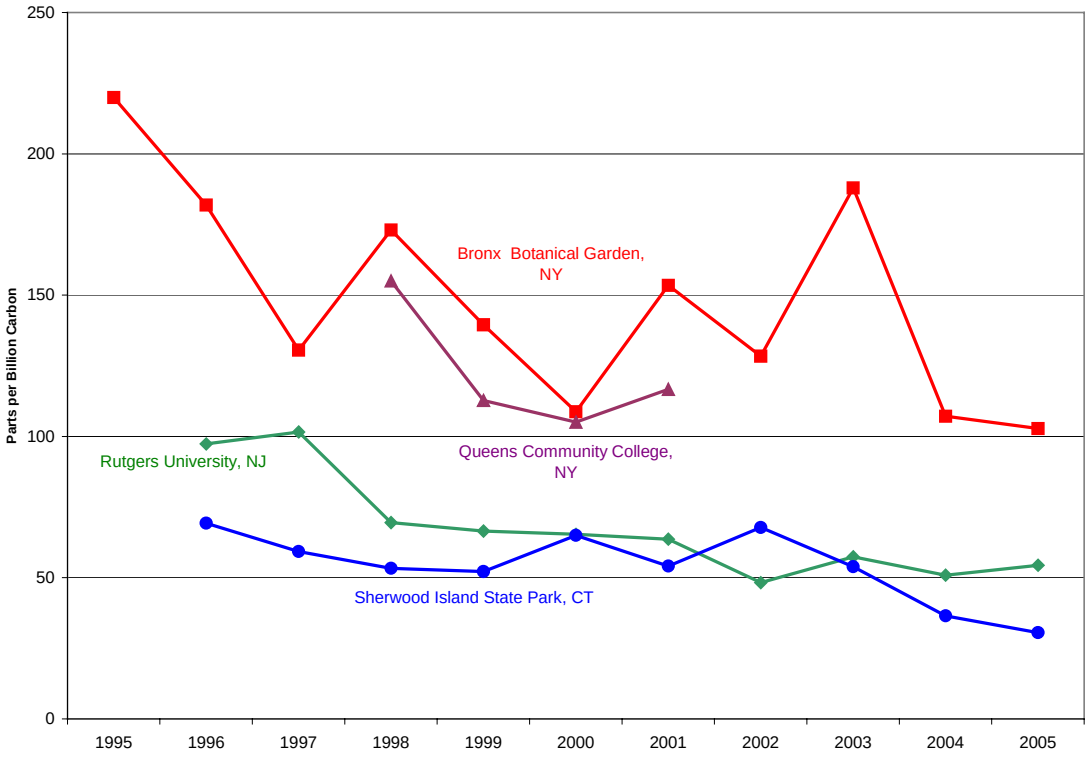
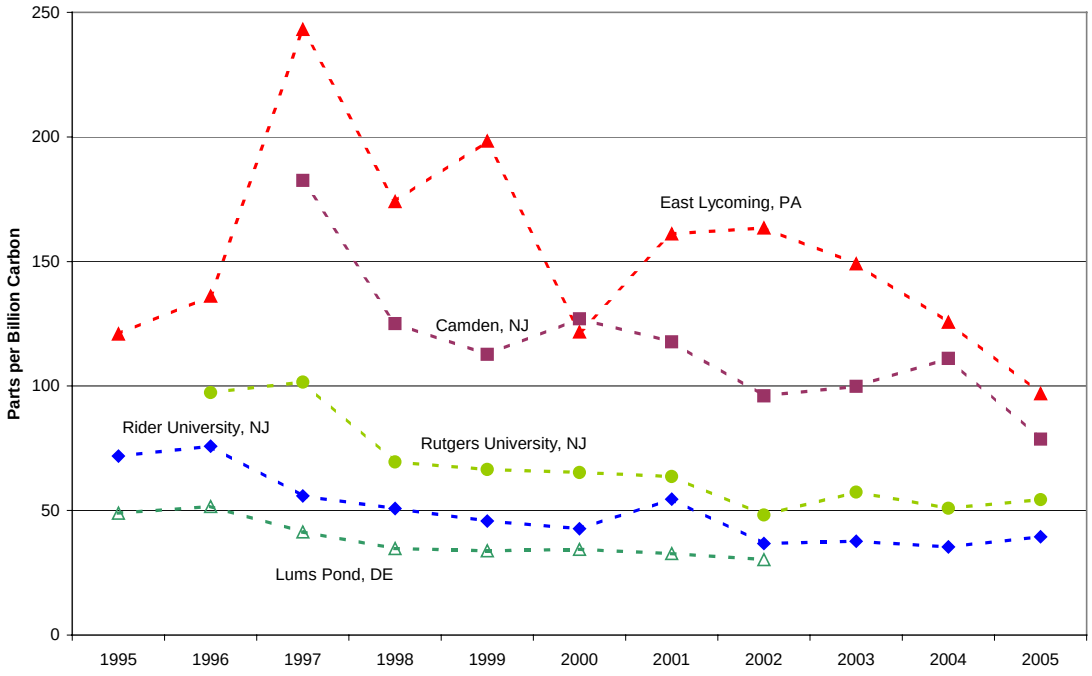


Figure 3.13: Total Non-methane Organic Carbon (TNMOC), Seasonal Average 1995-2005, Philadelphia Metropolitan Area[15]

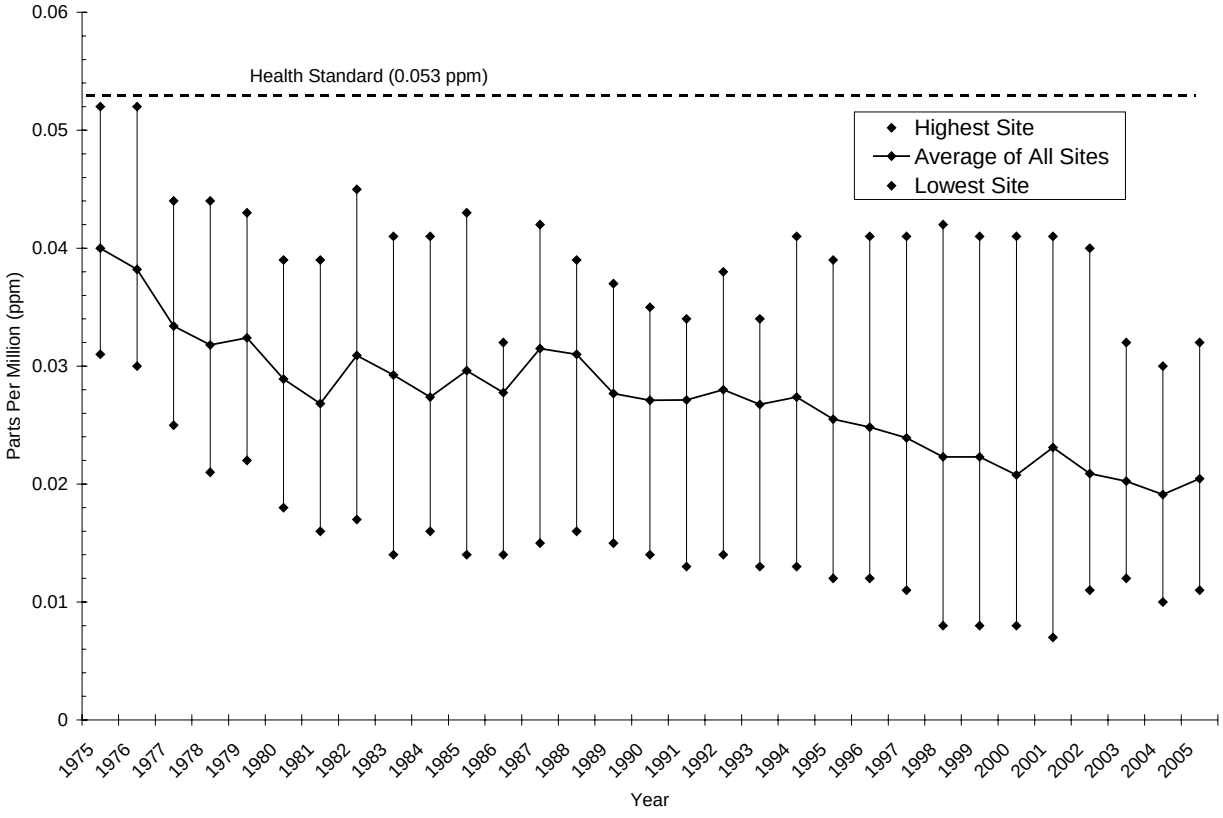


[15] The Rutgers University monitor is both a Type 1 and Type 4 PAMS monitor for New York City and Philadelphia, respectively. For more information on the structure of the PAMS network, please see Appendix B.

3.3.2 Nitrogen Dioxide[16]

Currently, New Jersey monitors NO_2 and NO levels at nine locations in the Continuous Air Monitoring Network, separate from the PAMS measurements of NO_x, NO_2, and NO.[17,18,19] As Figure 3.14 shows, NO_2 levels have decreased in New Jersey from 1975-2005. The NO_2 NAAQS is 0.053 ppm and the last exceedance occurred in 1974.

Figure 3.14: New Jersey Nitrogen Dioxide Air Quality, 1975-2005, 12-Month (Calendar Year) Average

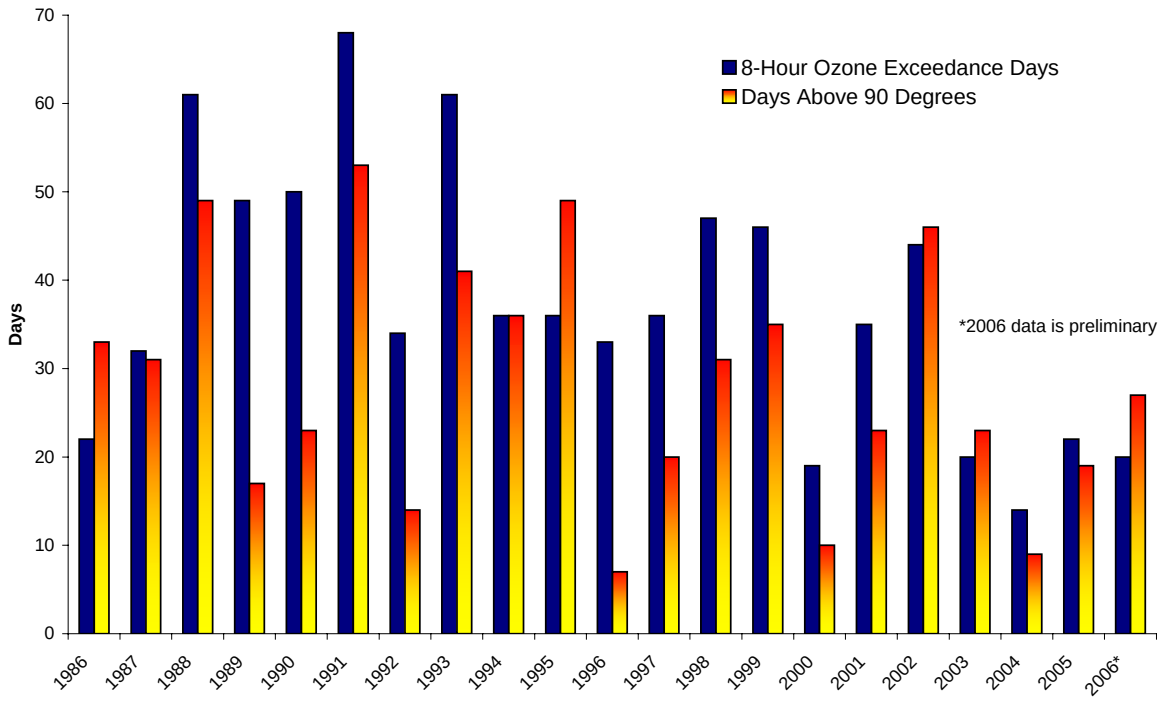


[16] Please see Appendix B, Section 1.4.2 for information on the relationship between NO, NO_2, and NO_x.
[17] NJDEP. 2005 Nitrogen Dioxide Summary, 2005 Air Quality Monitoring Report. New Jersey Department of Environmental Protection, Bureau of Air Monitoring, 2006.
[18] NJDEP. 2004 Network Summary, 2004 Air Quality Report. New Jersey Department of Environmental Protection, Bureau of Air Monitoring, 2005.
[19] op. cit., note 13

3.4 Meteorological Trends

Ozone formation is influenced by many factors including weather conditions, transport, and growth in emissions, in addition to changes brought about by air quality control strategies. Of these factors, weather has a significant effect on year to year variations in ozone levels. As previously stated, ozone is not emitted directly to the atmosphere, but is formed by photochemical reactions between VOCs and NO_x in the presence of sunlight. The hot days of summer are particularly conducive to ozone formation, and as such ozone levels are of general concern during the months of May through September. Hot summers usually produce long periods of elevated ozone concentrations, while ozone production is usually limited during cool and wet summers, which may be in part responsible for the low levels of ozone during 2004.[20,21] In Figure 3.15, most of the years shown have more days when the 8-hour ozone NAAQS was exceeded than "hot" days. This indicates that there are other factors besides meteorology that contribute to decreasing ozone levels in New Jersey.

Figure 3.15: New Jersey 8-Hour Ozone "Unhealthy" Days vs. "Hot Days"



[20] op. cit., note 1

[21] USEPA. Evaluating Ozone Control Programs in the Eastern United States: Focus on the NO_x Budget Trading Program, 2004. United States Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Office of Atmospheric Programs, Washington, D.C., EPA454-K-05-001, August 2005.