draft
AIR QUALITY TRENDS
METROPOLITAN WASHINGTON, D.C. REGION
1993-2009

Department of Environmental Programs
Metropolitan Washington Council of Governments
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Introduction

The U.S. Environmental Protection Agency (EPA) has established health standards (National Ambient Air Quality Standards, NAAQS) for six air pollutants. These six pollutants, which are also called the criteria air pollutants, are regulated under the federal Clean Air Act (CAA). Table 1 lists the criteria pollutants and their possible precursors.

Table 1: Criteria Pollutants and Precursors[a]

Carbon Monoxide (CO)
Sulfur Dioxide (SO_2)
Nitrogen Dioxide (NO_2)
Particulate Matter (PM)
Lead (Pb)
Ground-Level Ozone (O_3) *Precursors*: Volatile Organic Compounds (VOCs) Nitrogen Oxides (NO_x)

[a]*precursors of a criteria pollutant are chemical compounds that react in the air with other chemical compound(s) to form that criteria pollutant.*

In general, there are two types of ambient air quality standards - primary and secondary. The primary NAAQS are designed to protect human health and, by law, are established with an adequate margin of safety to protect all individuals. The secondary NAAQS are established to protect welfare-related values such as agricultural production, forests, building materials, and ecosystems. Sometimes the primary and secondary NAAQS have the same numerical value. For certain pollutants, no secondary standard has been established. Table 2 summarizes the NAAQS for all six criteria pollutants.

Table 2: National Ambient Air Quality Standards for Criteria Pollutants

Pollutant	Averaging Time	Primary Standard	Secondary Standard	Current NAAQS Implementation Year	Expected New NAAQS Implementation Year
Carbon monoxide (CO)	1-hour [a] 8-hour [a]	35 ppm 9 ppm	None None	1971	May 2011
Lead (Pb)	Rolling 3-month avg [b]	0.15 µg/m³	0.15 µg/m³	2008	?
Sulfur dioxide (SO_2)	1-hour [c] 3-hour [a]	0.075 ppm None	None 0.50 ppm	2010 (Primary) 1971 (Secondary)	March 2012 (Secondary)
Nitrogen dioxide (NO_2)	Annual (Arithmetic avg) 1-hour [d]	0.053 ppm 0.100 ppm	0.053 ppm None	2010 (1-Hour Primary Std) 1971 (Annual Primary & Secondary Stds)	March 2012 (Secondary)
Ground-Level Ozone (O_3)	8-hour [e]	0.075 ppm	0.075 ppm	2008	November 2010
Particulate Matter: **PM_{10}** **$PM_{2.5}$**	24-hour [f] 24-hour [g] Annual [h]	150 µg/m³ 35 µg/m³ 15.0 µg/m³	150 µg/m³ 35 µg/m³ 15.0 µg/m³	PM10 (1987) PM2.5 (24-Hour - 2006) PM2.5 (Annual – 1997)	PM2.5 (October 2011)

[a] Not to be exceeded more than once per year at any monitor.
[b] Not to be exceeded even once at any monitor during any 3 consecutive years.
[c] The 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor must not exceed the standard.
[d] The 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor must not exceed the standard.
[e] The 3-year average of the 4th highest daily maximum 8-hour average concentration must not exceed the standard.
[f] Not to be exceeded more than once per year on average over 3 years.
[g] The 3-year average of the 98th percentile of the 24-hour average at each population-oriented monitor must not exceed the standard.
[h] The 3-year average of the weighted annual mean concentration at each community-oriented monitor must not exceed the standard.

The Metropolitan Washington Council of Governments (MWCOG) analyzes monitored air quality data in the Metropolitan Washington, D.C. region and prepares a synthesis report on the status of the air quality in the region. This information is useful for policy makers, local and state governmental planning agencies, the media, and the public with an interest in air quality trends in the national capital region. Figure 1 shows a map of the air quality monitors in the Metropolitan Washington, D.C. region. Table 3 contains the location names and monitored air pollutants at each location.

This report presents an air quality data analysis for all criteria pollutants during the period, 1993-2009. During this period, only monitors located within the Metropolitan Washington, D.C. region were used in preparing the data summaries. The measured concentrations for the period 1993-2009 are presented in tables complimented by graphs in a manner that permits direct comparison to the NAAQS.

In general, pollution levels have decreased over the past decade. Most pollutants have never exceeded their standards during this eleven year period and one, lead is not currently monitored.

Figure 1: Washington, DC Region Air Quality Monitors

Monitor Names

1. Takoma Park
2. River Terrace
3. McMillian
4. Prince George's County Equestrain Center
5. Beltsville
6. Rockville
7. Southern Maryland
8. Frederick
9. Calvert
10. Bladensburg
11. Alexandria
12. Aurora Hills
13. Long Park
14. Ashburn
15. Franconia
16. Ferdinand Drive

Table 3: Washington, D.C. Region Air Quality Monitors (Key to Figure 1)

Monitor Number	Monitor Name	Years in Operation	Jurisdiction	Pollutants Monitored						
				O3	$PM_{2.5}$	PM_{10}	CO	NO_2	SO_2	Pb
1	Takoma Park	1985-Till Date	Washington, D.C.	●				●		
2	River Terrace	1993- Till Date	Washington, D.C.	●	●	●	●	●	●	
3	McMillan Reservoir	1994- Till Date	Washington, D.C.	●	●			●		
	Haines Point/Park Services	1999- Till Date	Washington, D.C.		●					
4	PG Equestrian Center	2002- Till Date	Prince George's Co, MD	●	●					
5	Hu-Beltsville	2005- Till Date	Prince George's Co, MD	●	●		●	●	●	
6	Rockville	1985- Till Date	Montgomery Co, MD	●	●					
7	Southern Maryland	1985- Till Date	Charles Co, MD	●						
8	Frederick	1999- Till Date	Frederick Co, MD	●						
9	Calvert	2005- Till Date	Calvert Co, MD	●						
10	Bladensburg		Prince George's Co, MD		●					
11	Alexandria	1985- Till Date	Alexandria, VA	●			●	●	●	
12	Aurora Hills/Arlington	1985- Till Date	Arlington Co, VA	●	●		●	●		
13	James Long Park	1991- Till Date	Prince William Co, VA	●				●		
14	Ashburn	1998- Till Date	Loudoun Co, VA	●	●			●		
15	Franconia	1999- Till Date	Fairfax Co, VA	●	●		●			
16	Ferdinand Drive	2009- Till Date	Alexandria, VA			●				
	N Saint Asaph St	2009- Till Date	Alexandria, VA			●				

O_3: Ozone $PM_{2.5}$: Particulate Matter 2.5 µm in diameter or less CO: Carbon Monoxide Pb: Lead
NO_2: Nitrogen Dioxide PM_{10}: Particulate Matter 10 µm in diameter or less SO_2: Sulfur Dioxide

1.0 Ground-Level Ozone (O_3)

Health Effects and Sources

Ozone is a colorless odorless gas that is found in the atmosphere. Each molecule of ozone has three atoms of oxygen. The additional oxygen atom makes ozone extremely reactive and irritating to tissues in the respiratory system.

Ozone exists naturally in the stratosphere, the Earth's upper atmosphere, where it shields the Earth from the sun's ultraviolet rays. However, ozone is also found close to the Earth's surface, where we live and breathe. There, ground-level ozone is an air pollutant.

High concentrations of ground-level ozone may cause inflammation and irritation of the respiratory tract, even during short exposures and particularly during heavy physical exercise. The resulting symptoms may include coughing, throat irritation, and difficulty breathing. Inhaling moderate amounts of ozone, for seven or eight hours, can reduce the ability of our lungs to function properly even in healthy individuals and may worsen asthma attacks in vulnerable people. Ozone may increase the susceptibility of the lungs to infections, allergens, and other air pollutants.

Ground-level ozone is not emitted directly into the air by specific sources. It is created by the chemical reaction between volatile organic compounds (VOCs) and oxides of nitrogen (NO_x), in the presence of sunlight and elevated temperatures. For this reason, ground-level ozone concentrations only become elevated during the warmer months of the year. In the Metropolitan Washington, D.C. region, almost all elevated ground-level ozone concentrations are recorded between May through September, during afternoon or early evening hours. Man-made sources of VOCs and NO_x are industrial and automobile emissions, commercial products such as paints, insecticides, and cleaners, and the evaporation of gasoline from large and small gasoline and diesel-powered engines. Plants and trees also emit VOCs, which combine especially quickly with NO_x to create ozone.

Nitrogen oxides and VOCs are also released from sources hundreds of miles away. Such transported emissions contribute to ground-level ozone in this region and elsewhere in the Eastern United States. Further progress in the control of transported ozone, as well as the implementation of our regional plan, will be needed to meet the ground-level ozone health standard.

National Ambient Air Quality Standards for Ground-Level Ozone

In 1997, the EPA revised the air quality standards for ozone to better reflect new scientific health studies that demonstrated cumulative effects from exposure over an entire day. This new standard is based on an 8-hour averaging period. In June 2004, the EPA officially designated the Metropolitan Washington, D.C. region as moderate nonattainment for the 8-hour ozone standard. On June 15, 2005, the EPA revoked the 1-hour ozone standard. In 2008 the standard was strengthened further from 85 ppb to 75 ppb. A new standard set between 60 and 70 ppb will be released by the EPA in the near future.

Table 4: Ground-Level Ozone National Ambient Air Quality Standards

Averaging Period	Primary Standard	Secondary Standard
8-hour	0.075 ppm	Same

Transport of Ground-Level Ozone

The Metropolitan Washington, D.C. region's air quality is significantly affected by ozone and its precursors from other regions outside the Metropolitan Washington, D.C. area. Regional transport occurs when ozone is trapped within the lower layer of the atmosphere over a wide area (e.g., several hundred square miles). These regional-scale ozone plumes become embedded within the large-scale atmospheric flows affecting areas well away from their source regions. These regional plumes are often observed at ozone monitors located in elevated terrain and can drift across regions and then mix down to the surface affecting monitors over a large area.

A recent study by Marufu *et al*. provides further evidence of regional ozone transport into the Metropolitan Washington, D.C. region.[1] This paper discusses the August 2003 North American electrical blackout, which provided a unique opportunity to quantify the contribution of Northeastern US and Southeastern Canada power plants' emissions to ozone levels in the Pennsylvania and Metropolitan Washington, D.C. regions. Ozone levels decreased by approximately 38 ppb in response to a 34 percent and 20 percent reductions in SO_2 and NO_X emissions from power plants during that period. The improvement in air quality provides evidence that transported pollutant emissions from power plants hundreds of kilometers upwind play an important role in ozone production in the Metropolitan Washington, D.C. region.

Ground-Level Ozone Trends

Trends analysis of ground-level ozone is complicated by the influence of weather systems on the formation of ozone. Ozone concentrations are quite dependent on meteorological conditions. In particular, temperatures above 90 degrees Fahrenheit (ºF), light winds, and stationary high pressure systems contribute to the formation of unhealthy ozone levels. Some years may have warmer and sunnier summers than other years and in those years, ozone levels can reach high values more often despite very little change in the emission rates of ozone-forming precursors. Correlations can be made between ozone concentrations and meteorological variables such as the number of 90ºF days, average temperature, and average winds, during the peak hours of ozone formation. Hot dry summers can produce long periods of elevated ozone concentrations while ozone production can be limited during cool and wet summers. For this report, the influence of weather is partially removed by averaging the highest levels of ozone concentrations over a three-year period. This method is consistent with EPA's method of using three consecutive year periods as a basis for determining compliance.

[1] *The 2003 North American electrical blackout: An accidental experiment in atmospheric chemistry*, Marufu, *et al.*; Geophysical Research Letters, Vol. 31, 2004.

Figure 2: 90 Degree Days (IAD) and Ozone Exceedance Days (2008 Standard)

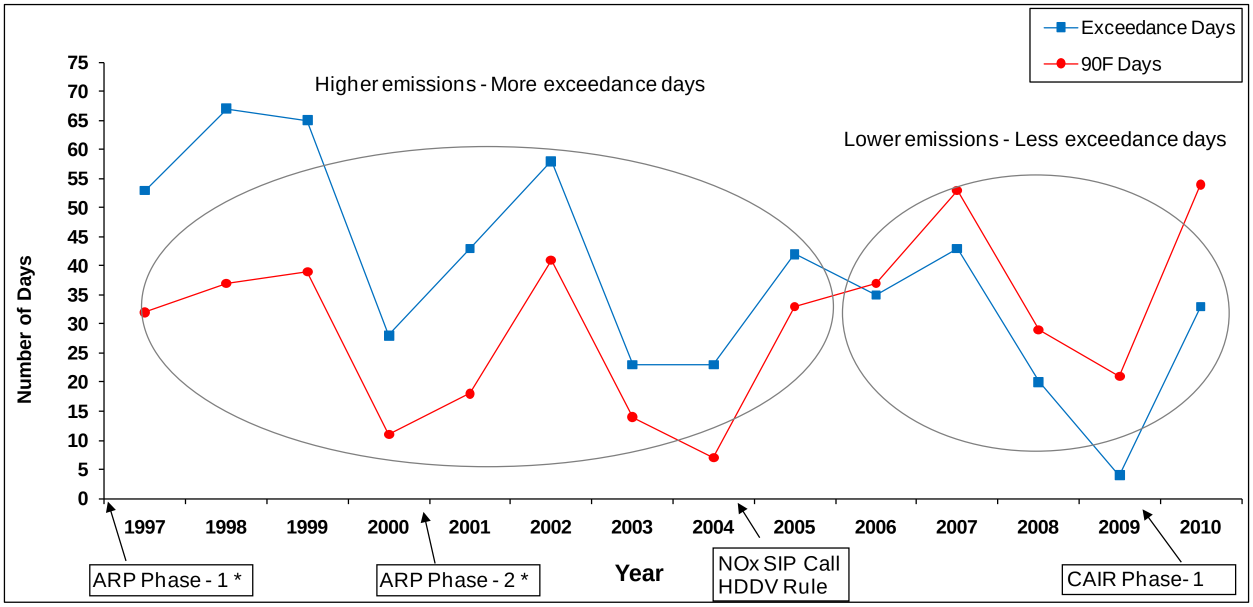


Figure 2 shows that while in the past there were more exceedances of ozone standard than 90 degree days, beginning 2006 the trend reversed. This happened as a number of emissions control programs such as, Acid Rain Program (ARP), NOx SIP Call, Heavy-Duty Diesel Vehicle (HDDV) Rule, Clean Air Interstate Rule (CAIR), etc. were implemented over the years at federal, state, and local levels. As a result of these controls the ozone levels in the region has reduced so much that exceedances mostly occur when the temperature is above 90 degree.

<u>Trend in Exeedances (2008 Ozone Standard):</u>

Figure 3 shows how often the 2008 ozone standard (0.075 ppm) would have been exceeded, had it been in effect during the reporting period and the number of actual exceeded days after the standard was implemented. Data shows that there is a gradual improvement in the number of exceedances of the 8-hour standard from year to year. Figure 4 shows the break-down of code orange and above days along with the total number of exceedance days for the 2008 ozone standard. Based on the Figure 3 and Figure 4, overall there seems to be a declining trend in the number of code orange and above days and the total number of exceedance days for the 2008 ozone standard. The maximum 8-hour ozone concentrations at each monitor in the region are given in Table A-1 (Appendix A).

Figure 3: Exceedances of 2008 Ozone Standard
(Washington, D.C. Region : 1997-2009)

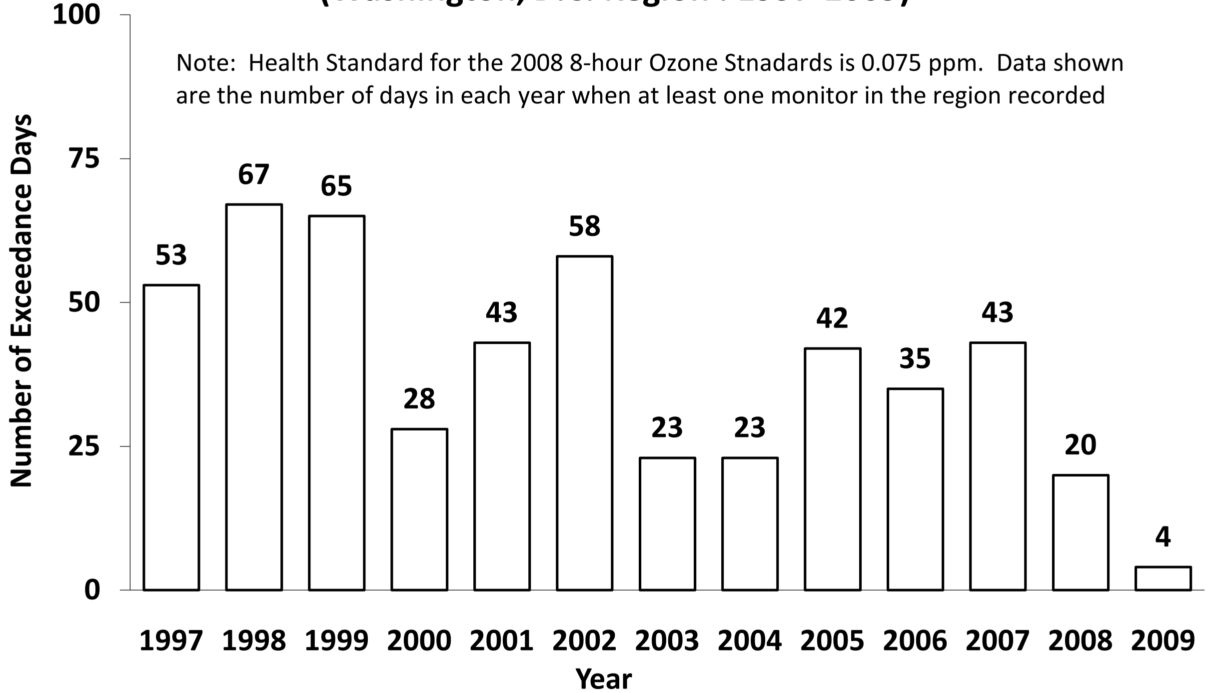
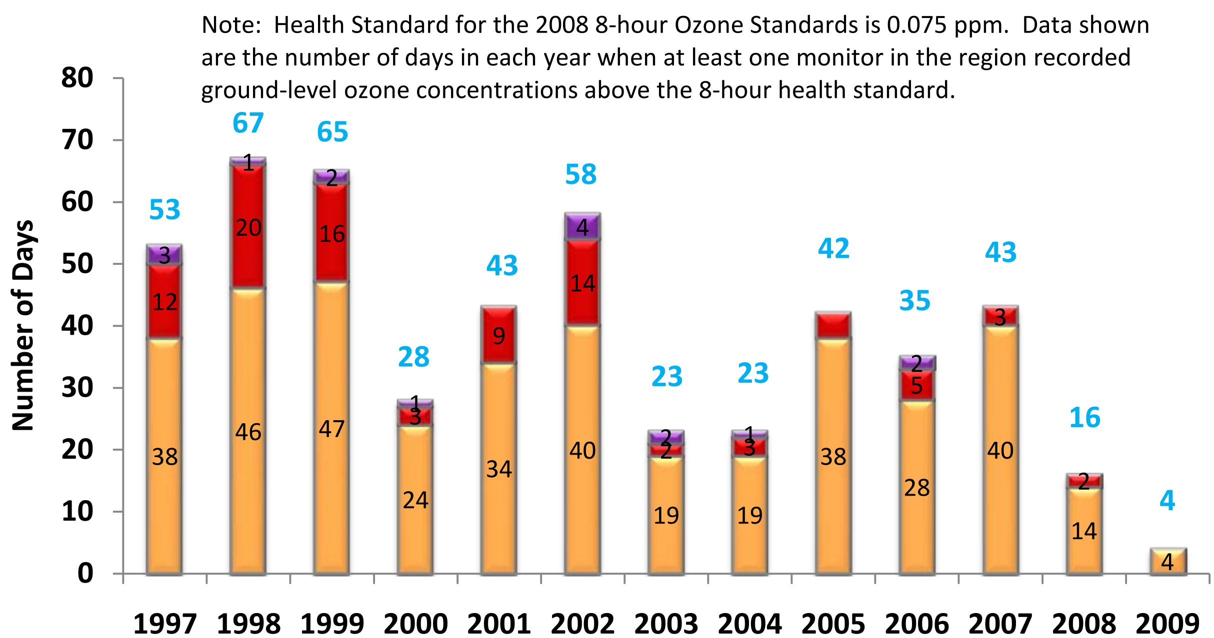
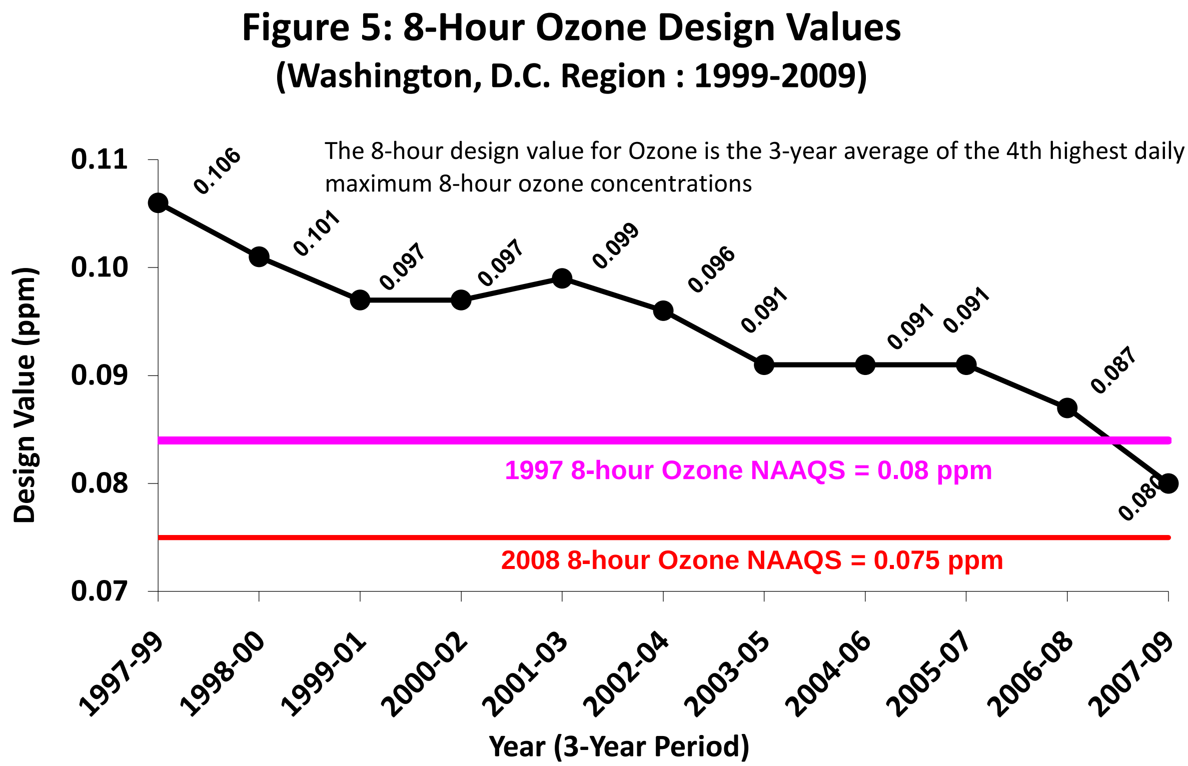


Figure 4: Exceedances of 2008 Ozone Standard
Breakdown of Code Orange, Red, and Purple Days
(Washington, DC Region : 1997 - 2009)





<u>Trend in Ozone Design Values:</u>

Figure 5 shows the trend in ozone design values. It is clear from the figure that there is a declining trend in the design values. While the region achieved in the 1997 ozone standard, it is moving closer to achieving the 2008 standard.

Summary of Ozone Trends

The data shows that the Metropolitan Washington, D.C. region is above the 2008 8-hour ozone standard. However trends in both the number of exceedance days and design values are downwards.

2. Carbon Monoxide (CO)

Health Effects and Sources

Carbon monoxide (CO) is a colorless, odorless, and in high concentrations, poisonous gas that forms when the carbon in fuels is not completely burned. When CO enters the bloodstream, it reduces the capacity of the body to deliver oxygen to its organs and tissues, thus depriving the body of an essential for life. The health threat from ambient CO is most serious for those who suffer from particular cardiovascular diseases. Elevated CO levels can lead to visual impairment, reduced work capacity, poor learning ability, and difficulty in the performance of complex tasks. At still higher levels, levels that can occur in the indoor environment, CO can lead to headaches and nausea, even in healthy persons. Fortunately, the health threat from current levels of ambient CO in the Metropolitan Washington, D.C. region is minimal for healthy individuals.

Carbon monoxide in ambient air mainly results from the incomplete combustion of fuels in motor vehicles. Concentrations tend to be highest in winter months as a result of the presence of thermal inversions in combination with the "cold starting" of automobile engines and the use of inefficient or poorly maintained space heating systems in certain local areas.

Other sources of CO emissions include industrial processes (including metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires. Woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters are sources of indoor CO.

National Ambient Air Quality Standards for CO

Table 5: CO National Ambient Air Quality Standards

Averaging Period*	Primary Standard	Secondary Standard
1-hour	35 ppm	None
8-hour	9 ppm	None

*Not to be exceeded more than once in a given year at any monitor.

Carbon Monoxide Trends

Both the 1-hour and 8-hour NAAQS for carbon monoxide require that the second maximum value in either category does not exceed the standard (one exceedance is allowed each year which is why the second maximum is used). These are compared on a two year basis, the highest second maximum value of the two years is used as the design value for that period.

Table A-2 and Table A-3 (Appendix A) show that both 1-hour and 8-hour averaged CO levels in the Metropolitan Washington, D.C. region have been steadily declining and the region is in attainment of the health standards. Presented in Figure 6 and Figure 7 are the 2nd highest CO concentrations based on (a) 1-hour averages, and (b) 8-hour averages. Currently, the 2^{nd} highest 8-hour average CO levels at the highest regional monitor are approximately half of the NAAQS for CO.

Figure 6: Carbon Monoxide Design Values (1-Hour)
(Washington, D.C. Region : 1999-2009)

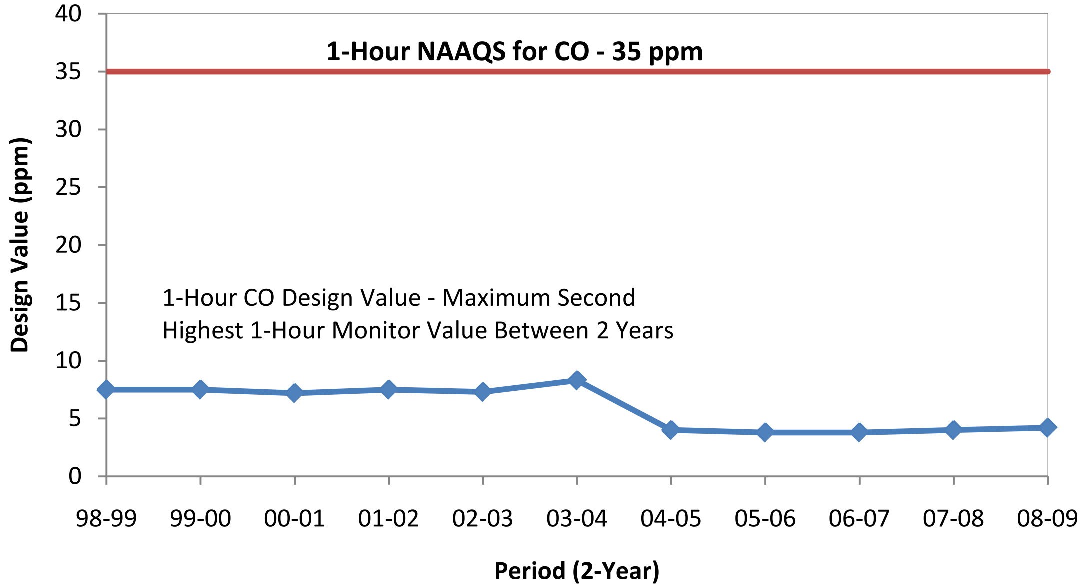
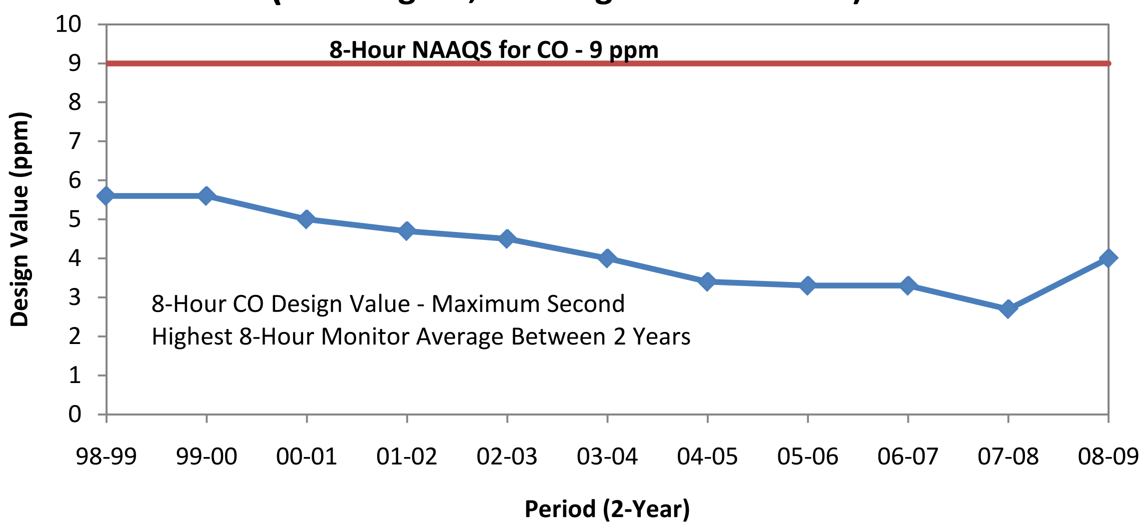


Figure 7: Carbon Monoxide Design Values (8-Hour)
(Washington, D.C. Region : 1999-2009)



Summary

Both the 8-hour and 1-hour data illustrate that carbon monoxide levels in the Metropolitan Washington, D.C. region have improved in the past decade. Since 1990, both 1-hour and 8-hour averaged CO concentrations are below the health standards at all monitors in the region.

3. Sulfur Dioxide (SO_2)

Health Effects and Sources

Sulfur dioxide is a gas that forms when sulfur-bearing fuels (mainly coal and oil) are burned. SO_2 can also be released into the air during certain industrial processes. High concentrations of SO_2 can result in difficulties in breathing, respiratory illness, the aggravation of existing cardiovascular disease, and can cause alterations in the lung's defenses. The primary ambient air quality standard is intended to protect against these adverse health effects.

SO_2 can produce damage to the foliage of trees and agricultural crops. The presence of both sulfur dioxide and nitrogen dioxide in the atmosphere can also lead to acidic deposition (acid rain). Thus, the EPA also established a secondary ambient air quality standard for SO_2 based on 3-hour averaged concentrations.

National Ambient Air Quality Standards for SO_2

For the region as a whole, all monitors must attain both primary standards for the region to be considered in attainment with the primary NAAQS.

Table 6: SO_2 National Ambient Air Quality Standards

Averaging Period	Primary Standard	Secondary Standard
1-hour	.075 ppm	None
3-hour	None	0.50 ppm

SO_2 Trends

A general characterization of SO_2 concentrations in the Metropolitan Washington, D.C. region is that levels are low and declining. Figure 8 shows the maximum 1-hour SO_2 design values for each year for the analysis period, 1999-2009. The data show that in recent years the highest SO_2 levels in the region have been less than the 1-hour health standard of 0.075 ppm. Additionally, Figure 9 shows that observed values have been less than 20% of the 3-hour federal secondary health standard of 0.5 ppm since 1999. Figure 10 shows the highest, lowest and the median 1-hour maximum SO2 concentrations. Table A-4 (Appendix A) shows the 99^{th} percentile of the 1-hour maximum SO2 concentrations in the region.

Figure 8: Sulfur Dioxide Design Values (1-Hour)
(Washington, D.C. Region : 1999-2009)

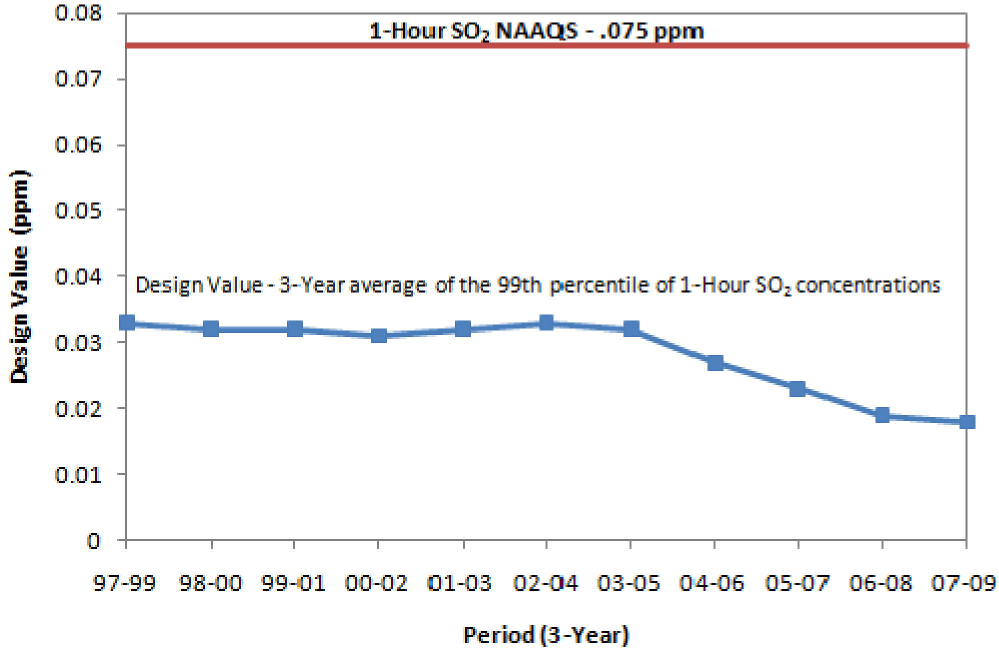


Figure 9: Sulfur Dioxide Design Values (3-Hour/Secondary)
(Washington, D.C. Region : 1999-2009)

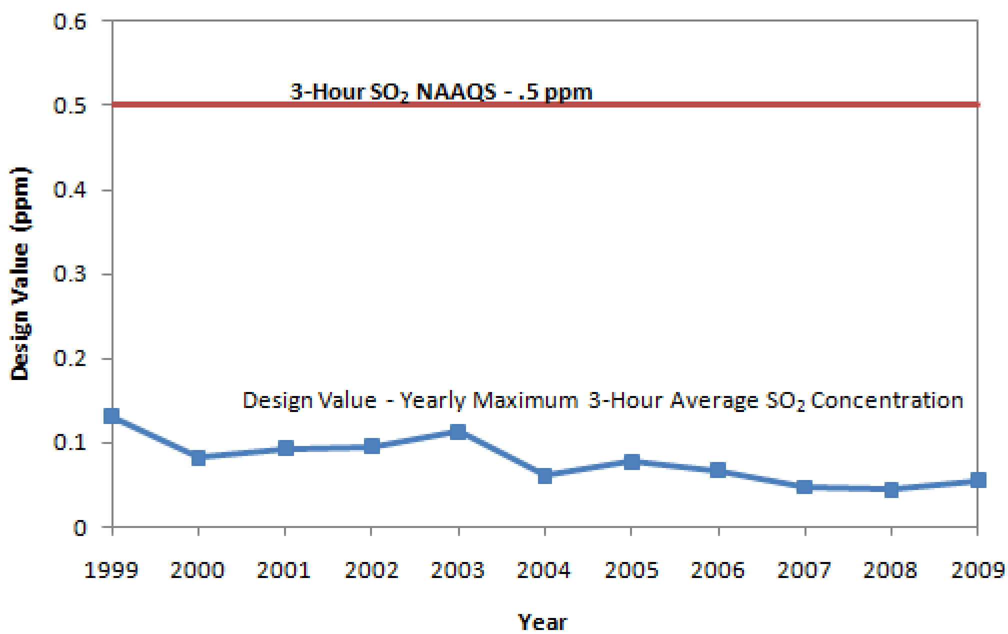
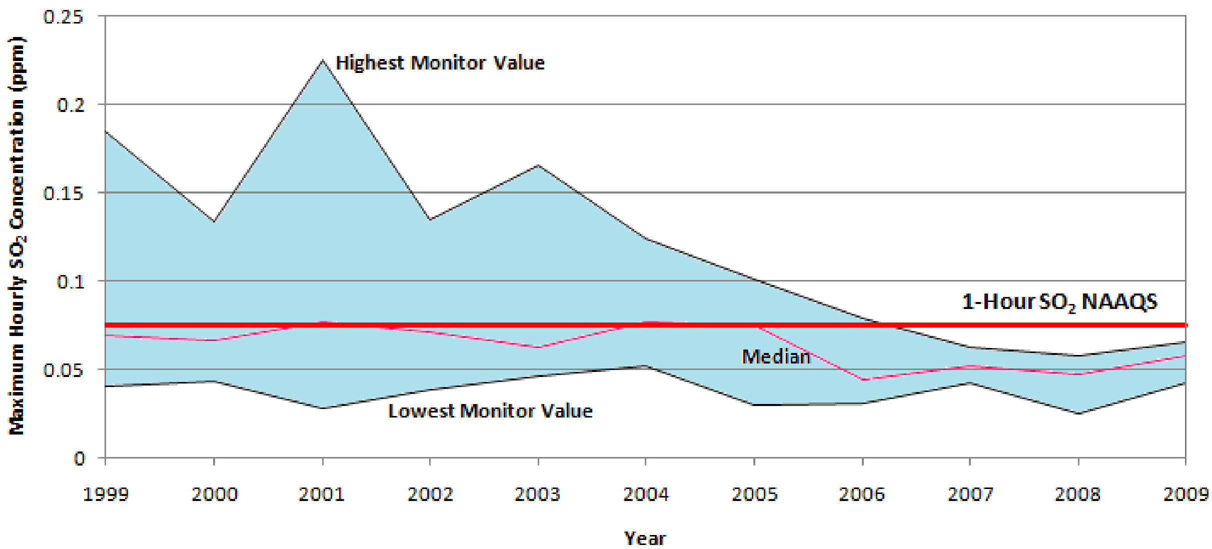


Figure 10: Highest, Lowest and Median Maximum 1-Hour Sulfur Dioxide Concentrations
(Washington, D.C. Region : 1999-2009)



Summary

All monitors in the Metropolitan Washington, D.C. region are well within each of the sulfur dioxide NAAQS.

4. Nitrogen Dioxide (NO_2)

Health Effects and Sources

Nitrogen dioxide is a gaseous pollutant, one of a class of compounds called nitrogen oxides (NO_x). NO_2 can irritate the lungs and lower resistance to respiratory infections. NO_2 is a brownish and highly chemically reactive gas. It is formed during the high-temperature combustion of fuels, in vehicle engines and industrial facilities (primarily electric generating power plants). NO_2 plays a major role in the atmospheric reactions that produce ground-level ozone in the warmer months.

National Ambient Air Quality Standards for NO_2

EPA has established a long-term (annual average) ambient air quality standard and a short term (1-hour) air quality standard for NO_2 as seen in Table 7.

Table 7: NO_2 National Ambient Air Quality Standards

Averaging Period	Primary Standard	Secondary Standard
Annual	0.053 ppm	Same
1-Hour	0.1 ppm	None

NO_2 Trends

Figure 11 shows the 1-hour NO_2 design value. It shows that currently NO_2 concentrations are less than half of the NAAQS standard and is in a downward trend. Figure 12 also shows our compliance with the annual NO_2 standard of 0.053 ppm, our annual averages are also less than half of the standard. Figure 13 shows that the median and lowest maximum 1-hour NO_2 concentrations are generally becoming lower and lower, the highest monitor concentrations appear to be more random and focused on extreme events. Table A-5 (Appendix A) shows the annual average NO2 concentrations for the region.

Figure 11: Nitrogen Dioxide Design Values (1-Hour)
(Washington, D.C. Region : 1999-2009)

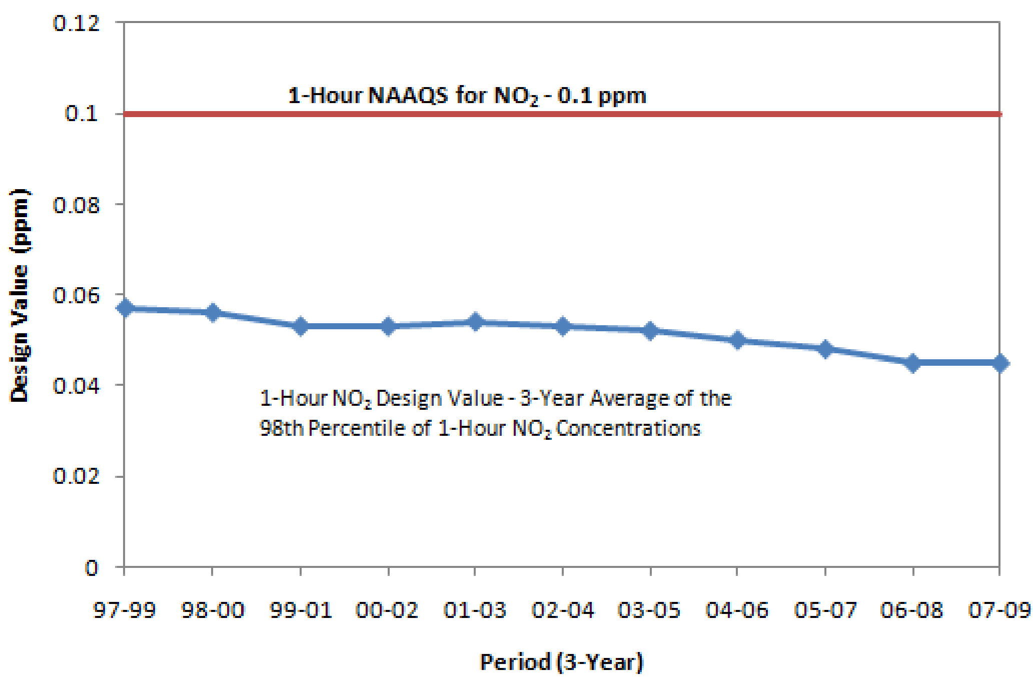


Figure 12: Nitrogen Dioxide Design Values (Annual)
(Washington, D.C. Region : 1999-2009)

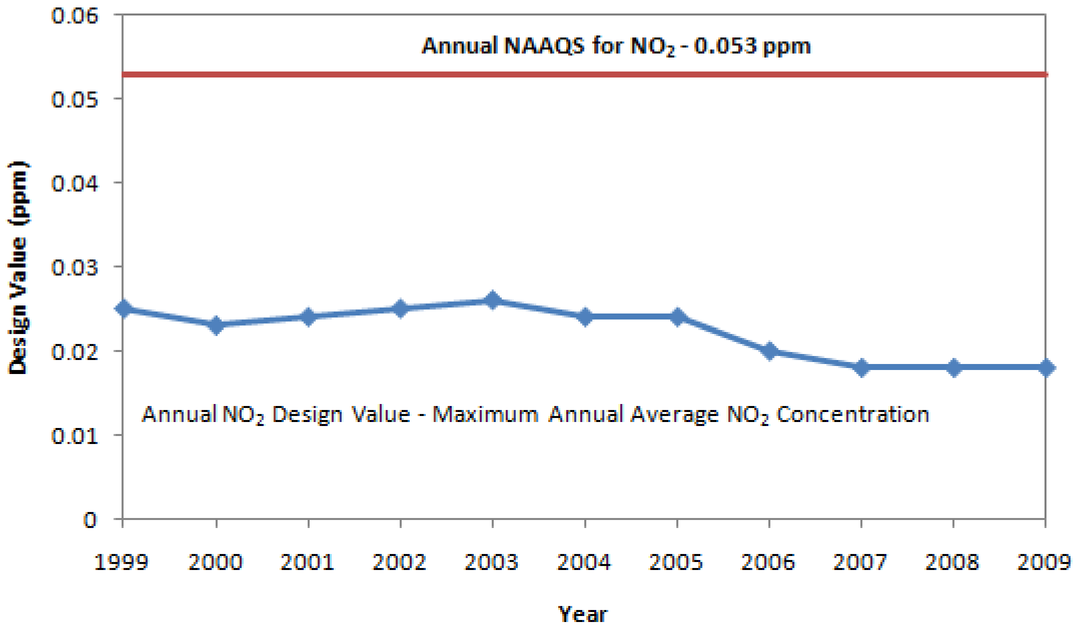
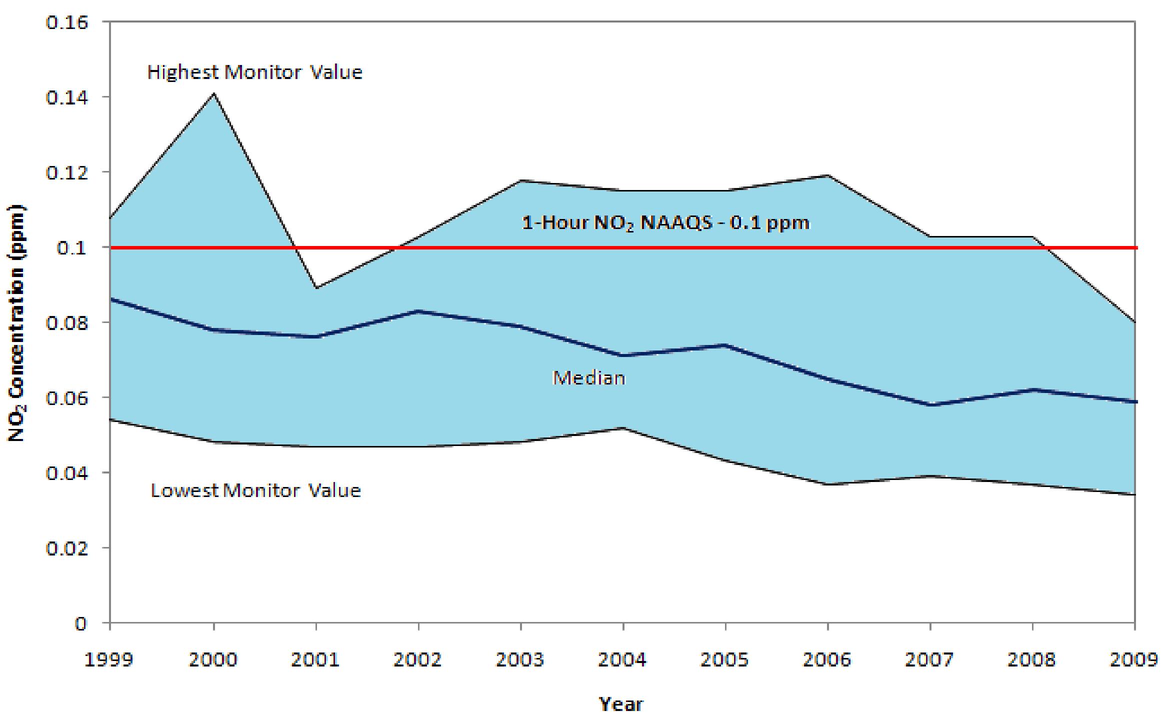


Figure 13: Nitrogen Dioxide Maximum 1-Hour Monitor Concentrations
(Washington, D.C. Region : 1999-2009)



Summary

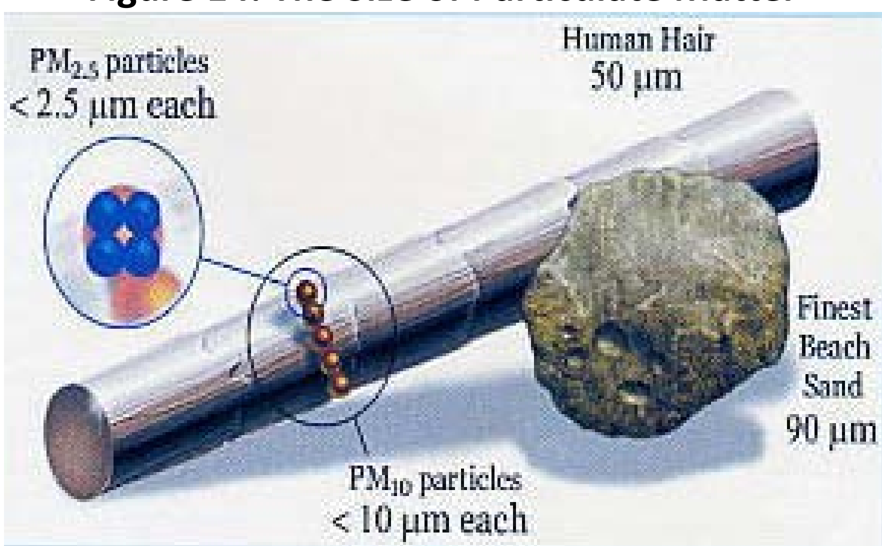
All monitors in the Metropolitan Washington, D.C. region are well within each of the nitrogen dioxide NAAQS.

5. Particulate Matter (PM)

Particulate Matter is a mixture of microscopic solid and liquid droplets suspended in air. This pollution is comprised of a number of components including acids (nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens (such as pollen or mold spores).

The two types of particles the region is required to monitor are PM_{10} and $PM_{2.5}$. PM_{10} refers to those particles less than 10 microns in diameter. $PM_{2.5}$ refers to those particles less than 2.5 microns in diameter. Figure 12 graphically depicts the relative size of both PM_{10} and $PM_{2.5}$.

Figure 14: The Size of Particulate Matter



Particulate matter in the region is measured by two types of methods; the federal reference method and the continuous monitor method. Federal reference method instruments acquire deposits over 24-hour periods on filters from ambient air drawn into the monitor through an inlet. This method requires the samples to be sent to a laboratory for analysis.

To make particulate matter data available to the public in a timely manner, continuous monitors are also used in the Metropolitan Washington, D.C. region. These monitors collect particle data on an hourly basis. Since these monitors collect particle samples more frequently, this data is used to calculate the Air Quality Index posted on the Metropolitan Washington Council of Governments (MWCOG) website.

Health Effects and Sources

Particulate matter comprises a broad class of aerosol particles from fine smoke and soot (products of incomplete combustion) to larger sized dusts and industrially generated particles. Particulate matter also includes particles formed by reactions in the atmosphere from gaseous pollutants. The largest components of particulates in urban areas along the east coast are sulfates formed from SO_2 emissions.

The size of the particles directly relates to their potential for causing health problems. Small particles less than 10 micrometers (microns) in diameter pose the greatest problems, because they can travel deep into the lungs and some may even move into the bloodstream. Exposure to such particles can affect both the respiratory and cardiovascular systems. Larger particles are of less concern, although they can irritate the eyes, nose, and throat.

Concerns about the health effects of breathing particles include potential damage to the respiratory and cardiovascular systems, lung tissue damage, cancer, and premature death. Particulate matter is a major cause of reduced visibility in many regions and national parks, and it can also cause damage to building materials.

National Ambient Air Quality Standards for Particulate Matter

The national ambient air quality standards for PM_{10} were established in 1987. These should not be confused with the newer standards for very fine particles, known as $PM_{2.5}$. In 1997, the EPA established a new health standard for fine particulate (particles with aerodynamic diameters of less than 2.5 microns, $PM_{2.5}$). In November 2004, the EPA designated the following counties in the Metropolitan Washington, D.C. region as nonattainment for the annual $PM_{2.5}$ standard: Charles County, MD, Frederick County, MD, Montgomery County, MD, Prince George's County, MD, District of Columbia, Alexandria, VA, Arlington County, VA, Fairfax County, VA, Loudoun County, VA, and Prince William County, VA. Table 10 provides the NAAQS for PM_{10} and $PM_{2.5}$.

Table 8: Particulate Matter National Ambient Air Quality Standard

Pollutant	Averaging Time	Primary Standard	Secondary Standard
PM_{10}	24-hour [a]	150 $\mu g/m^3$	Same
$PM_{2.5}$	24-hour [c]	35 $\mu g/m^3$	Same
	Annual [b]	15 $\mu g/m^3$	Same

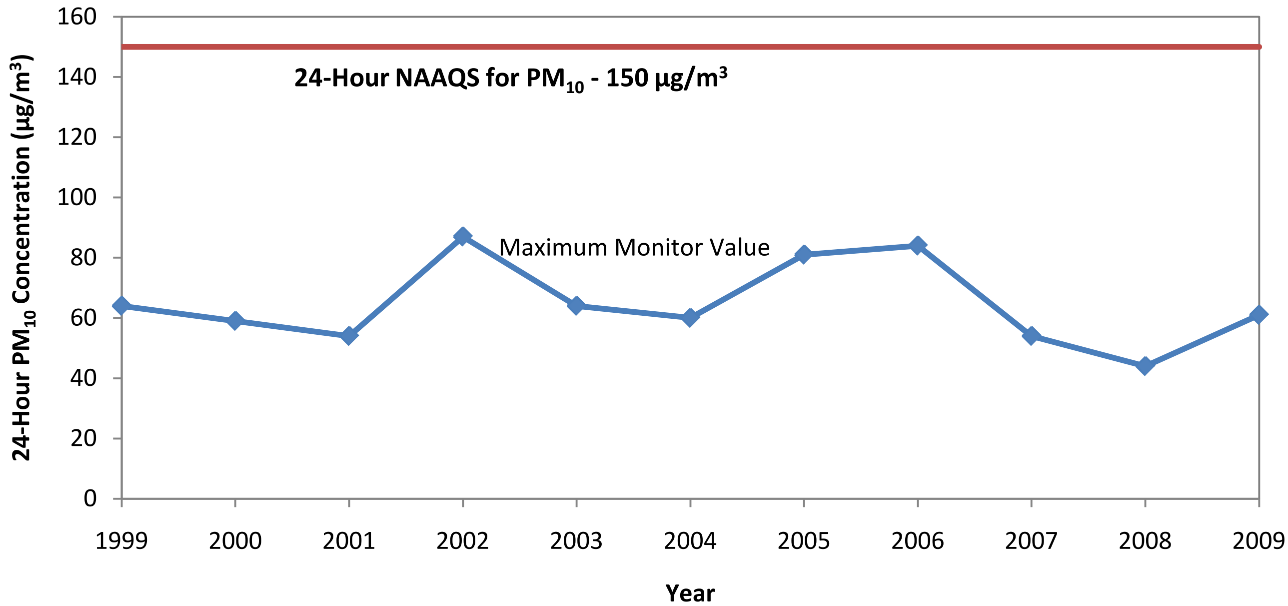
[a] Not to be exceeded more than once a year averaged over 3 years
[b] The 3-year average of the weighted annual mean concentration at each monitor must not exceed the standard.
[c] The 3-year average of the 98th percentile at each monitor must not exceed the standard.

PM_{10} Trends

The federal health standard for particulate matter was changed in 1987 from Total Suspended Particulate (TSP) to PM_{10} in order to reflect the fact that non-respirable particles greater than 10 microns in diameter were being measured by the TSP samplers then in place. Therefore, the trend data for PM_{10} begin with the year 1989 data when broad scale PM_{10} sampling began in this area.

Figure 14 shows the maximum 24-hour PM_{10} concentrations in different years during the period 1999-2009. The 24-hour NAAQS is determined by averaging the number of exceedances over a three year period. If the average number of exceedances is over 1 per each three year period, the area is considered to be in exceedance of the standard. Table A-6 (Appendix A) shows the annual maximum 24-hour PM10 concentrations in the region.

Figure 14: Annual Maximum 24-Hour PM_{10} Concentrations
(Washington, D.C. Region : 1999-2009)



$PM_{2.5}$ Trends

A new federal health standard for particulate matter was created in 1997 for $PM_{2.5}$. The standard was updated again in 2006, lowering the 24-hour standard from 65 to 35 $\mu g/m^3$.

Figure 15 shows the annual average $PM_{2.5}$ design values for the Metropolitan Washington, D.C. region. Data show a general downward trend. Figure 16 shows the 24-hour average $PM_{2.5}$ design values for the Metropolitan Washington, D.C. region for the same period. Data show that the Metropolitan Washington, D.C. region is below the 24-hour and annual $PM_{2.5}$ NAAQS.

Figure 17 and Figure 18 show that the number of daily exceedances of the 2006 PM2.5 standard and the code orange and above days for that standard respectively. Based on these two figures, a declining trend in both the number of PM2.5 exceedance days and code orange and above days is clear.

Table A-7 and A-8 show the annual average and the 98th percentile of the 24-hour average PM2.5 concentration for the region respectively.

Figure 15: Annual $PM_{2.5}$ Design Values
(Washington, D.C. Region : 1999-2009)

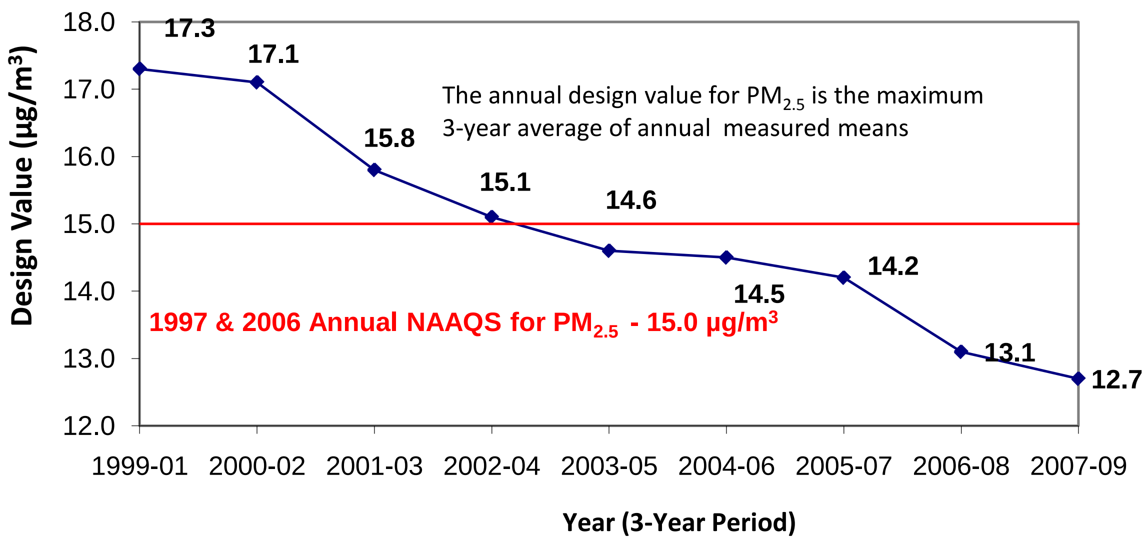


Figure 16: 24-Hour $PM_{2.5}$ Design Values
(Washington, D.C. Region : 1999-2009)

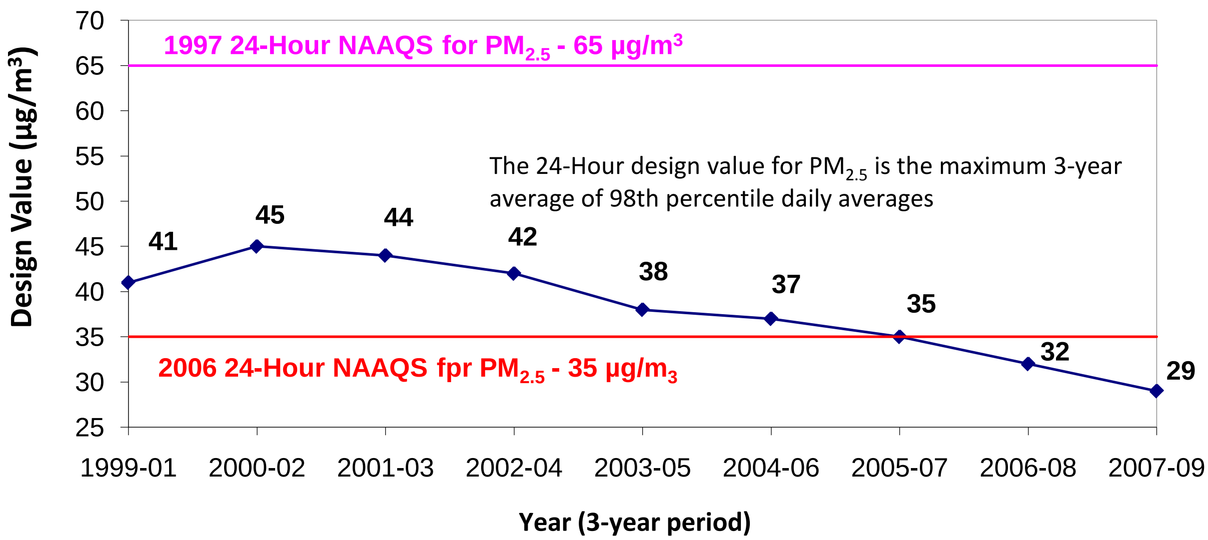


Figure 17: Exceedances of 2006 24-Hour PM2.5 Standard
(Washington, D.C. Region : 1999-2009)

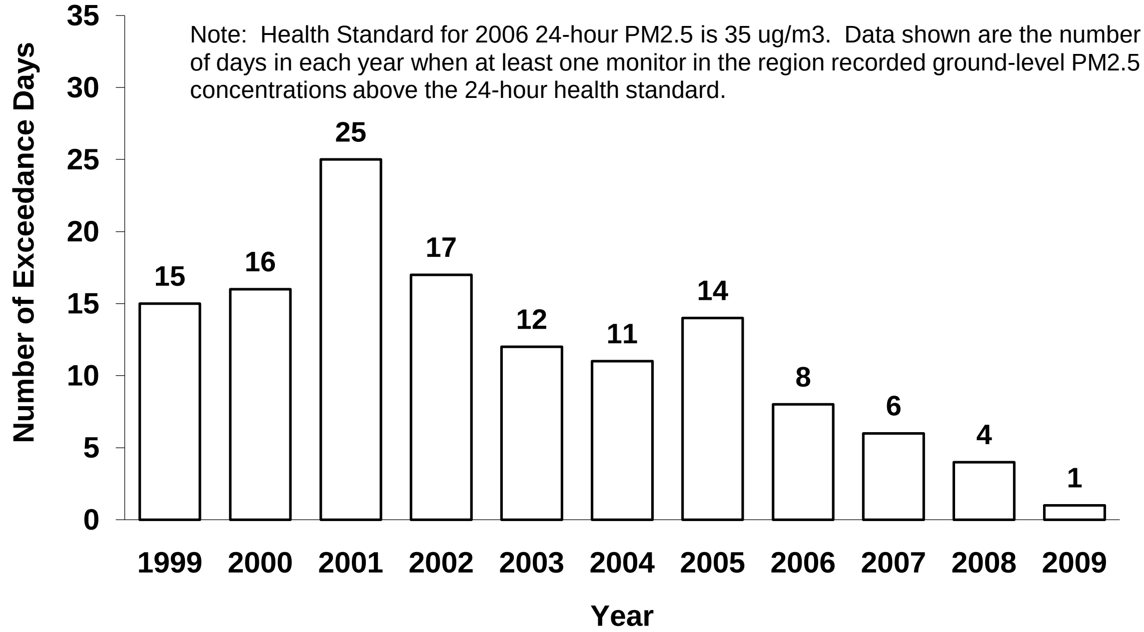
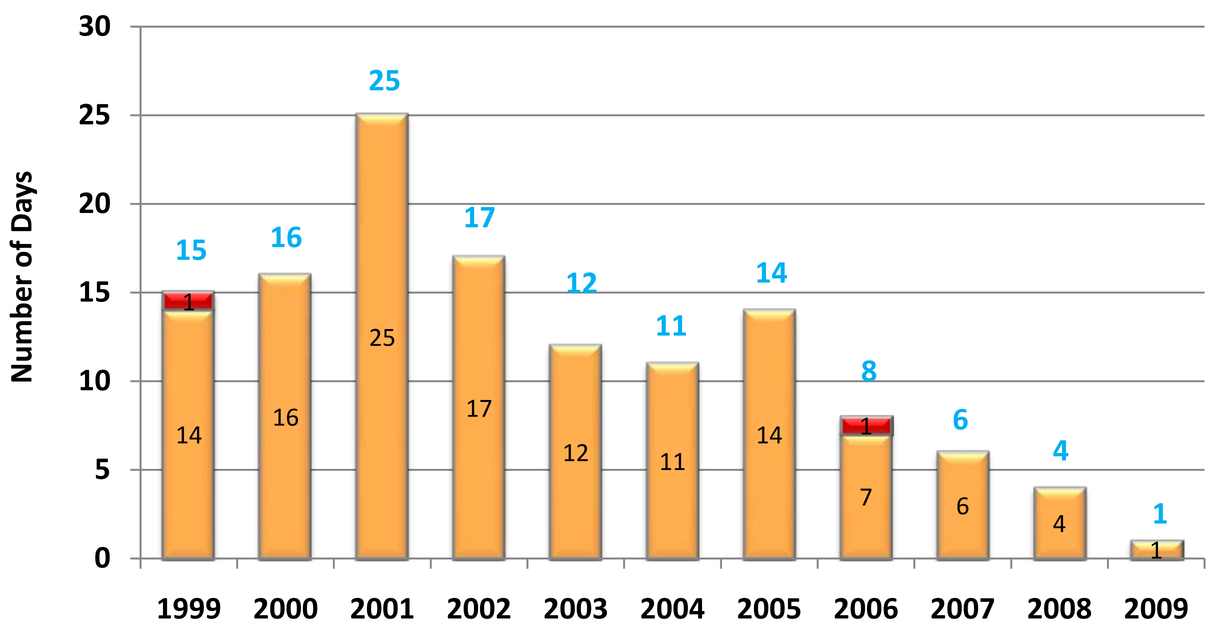


Figure 18: Exceedance of 2006 24-Hour PM2.5 Standard
Breakdown of Code Orange, Red, and Purple Days
(Washington, DC Region : 1999 - 2009)



Summary

All monitors in the Metropolitan Washington, D.C. region are well within the PM_{10} NAAQS. The Metropolitan Washington, D.C. region began monitoring for $PM_{2.5}$ in 1999, since 2005 the Metropolitan Washington, D.C. region has been within both of the $PM_{2.5}$ standards as PM concentrations have been trending downward over the last decade.

6. Lead (Pb)

Health Effects and Sources

Lead in ambient air mainly result from soils and dusts that have become contaminated with lead from older paints and other lead-containing construction material. The elimination of lead as an additive to motor fuels two decades ago has substantially reduced lead in ambient atmospheres.

Exposure to lead is a serious health concern because lead can accumulate in the body in blood, bone, and soft tissue. Excessive exposure may cause anemia, kidney disease, reproductive disorders and neurological impairments. Even at low doses, lead exposure is associated with fundamental processes in the body. For children, susceptibility to low doses may lead to central nervous system damage or slowed growth.

National Ambient Air Quality Standards for Pb

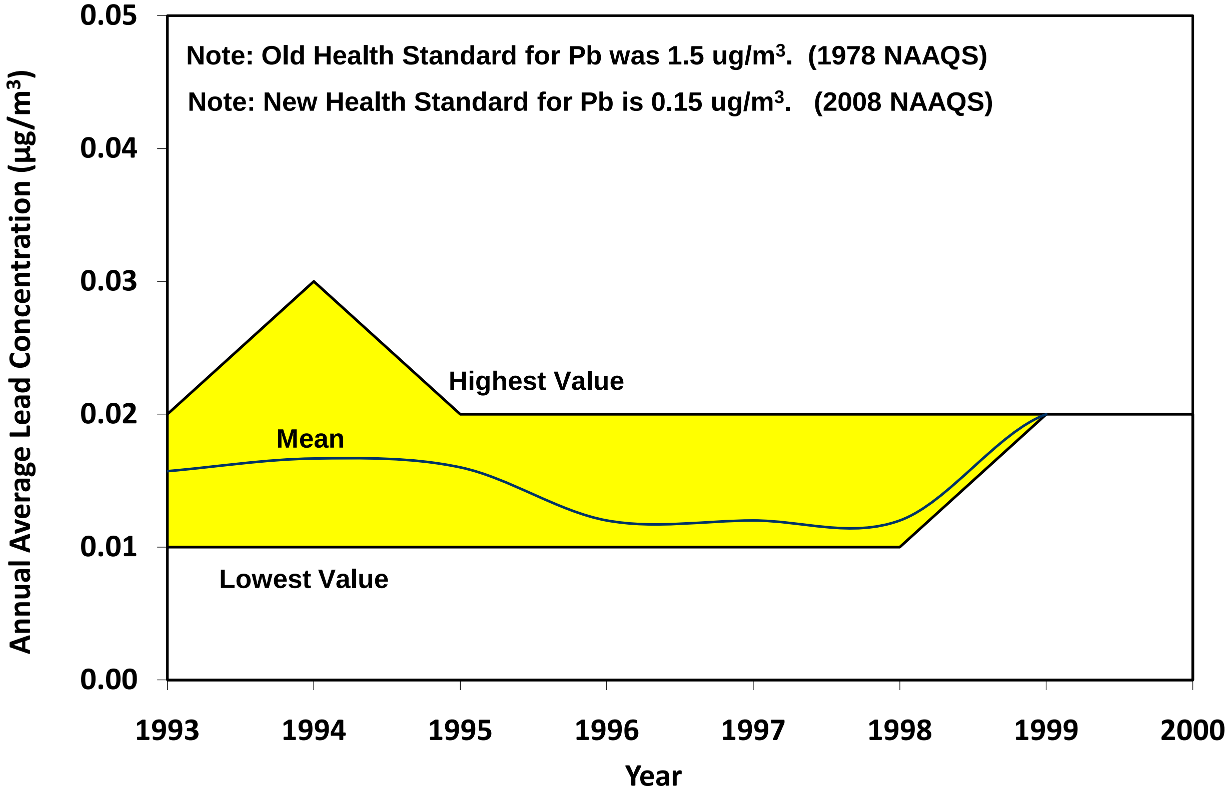
Table 9: Pb National Ambient Air Quality Standards

Averaging Period	Primary Standard	Secondary Standard
Rolling 3-Month Average	0.15 $\mu g/m^3$	Same

Pb Trends

In 2008 the NAAQS for lead was changed from 1.5 $\mu g/m^3$ on a quarterly average, to 0.15 $\mu g/m^3$ on a rolling three month average. Lead in the Metropolitan Washington, D.C. region had been far enough under the standard that monitoring ended in Maryland in 1994, Virginia in 1998 and D.C. in 2001 with the EPA's approval. Along with the new standard are new monitoring requirements, the new monitors will be placed depending on population and on lead industrial sources and will employ a new method of monitoring than the monitors used up until 2001 and must be in place by January 1, 2011. Figure 19 shows the region's annual average lead concentrations compared to the 1978 standard of 1.5 $\mu g/m^3$ and 2008 standard of 0.15 $\mu g/m^3$. In order to determine attainment with the new standard, Virginia calculated design values for the new standard for the years 2006-2008 and found that the values were less than 0.00 $\mu g/m^3$, these values however were calculated from a monitor that is not consistent with the new EPA monitoring method.

Figure 19: Lead Annual Average Concentrations
(Washington, D.C. Region : 1993-2000)



Note: This graph represents data collected with a different monitoring technique than the one laid out in the new 2008 NAAQS for lead, lead monitoring was discontinued in the region in 2001.

Summary

The monitors showed the Metropolitan Washington, D.C. Region was in compliance with the 1978 NAAQS and it is anticipated that the region will also be in compliance with the new 2008 NAAQS.

Appendix A

Table A-1: Maximum 8-hour Average Ozone Concentrations by Monitor (1999-2009) (ppm)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Takoma	0.100	0.104	0.108	0.113	0.110	0.093	0.087	0.086	0.087	0.089	0.082
River Terrace	0.102	0.101	0.101	0.128	0.107	0.083	0.089	0.093	0.091	0.092	0.080
McMillan Reservoir	0.115	0.102	0.107	0.129	0.112	0.101	0.093	0.102	0.093	0.100	0.085
Calvert	0.102	0.098	0.091					0.090	0.089	0.087	0.076
Southern Maryland	0.113	0.112	0.097	0.113	0.121	0.097	0.097	0.099	0.100	0.089	0.072
Frederick	0.116	0.100	0.104	0.098	0.110	0.095	0.086	0.088	0.089	0.085	0.073
Rockville	0.113	0.088	0.107	0.099	0.115	0.094	0.100	0.101	0.103	0.094	0.074
Greenbelt	0.124	0.117	0.111	0.120	0.112						
Suitland	0.105	0.109	0.105								
PG Equestrian Center				0.114	0.125	0.100	0.097	0.102	0.110	0.081	0.071
Beltsville								0.098	0.089	0.097	0.076
Arlington	0.105	0.098	0.103	0.133	0.115	0.101	0.094	0.101	0.095	0.104	0.078
Cub Run	0.106	0.094	0.099	0.099	0.103	0.105	0.084	0.088	0.081	0.098	0.068
Mt. Vernon	0.111	0.108	0.101	0.127	0.120	0.123	0.094	0.125	0.095	0.095	0.075
Franconia	0.106	0.082	0.106	0.128	0.123	0.121	0.095	0.109	0.094	0.095	0.080
Annandale				0.122	0.119	0.098	0.097	0.092	0.095	0.102	0.077
Seven Corners	0.115	0.100									
Lewinsville	0.105	0.101	0.103	0.104	0.112	0.109	0.093	0.100	0.092	0.102	0.074
Ashburn	0.106	0.092	0.104	0.119	0.116	0.107	0.082	0.102	0.091	0.100	0.069
Long Park	0.096	0.093	0.100	0.108	0.109	0.097	0.074	0.098	0.082	0.082	0.068
Widewater Elementary	0.112	0.086	0.090	0.126	0.109	0.098	0.084	0.116	0.089	0.085	0.069
Alexandria	0.102	0.095	0.097	0.123	0.107	0.109	0.089	0.118	0.090	0.090	0.069
Highest	*0.124*	0.117	*0.111*	*0.133*	*0.125*	*0.123*	*0.100*	*0.125*	*0.110*	*0.104*	*0.085*
Lowest	*0.096*	*0.082*	*0.090*	*0.098*	*0.103*	*0.083*	*0.074*	*0.086*	*0.081*	*0.081*	*0.068*
Median	*0.106*	*0.100*	*0.103*	*0.120*	*0.112*	*0.100*	*0.093*	*0.100*	*0.091*	*0.094*	*0.075*

Blank data indicates the monitor has not been installed or has been removed.

Table A-2: Second Highest 8-hour Average Carbon Monoxide Concentrations (1999-2009) (ppm)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
C&P Telephone	3.5	3.3	4.7	3.2	3.2	2.4	1.9	2.3	2.0	1.8	2.0
River Terrace	5.6	5.0	4.5	4.5	4.0	3.4	3.2	3.3	2.7	2.1	4.0
Beltsville									0.9	0.8	0.9
Bladensburg	4.3										
Arlington	3.8	2.7	2.7	2.6	2.5	2.2	1.6	2.3	1.5	1.1	1.6
Cub Run	1.2	1.5	1.3	1.2	1.4	1.2	1.5	1.2	1.3	1.0	
Seven Corners	2.1	2.3	1.7								
Annandale				1.5	1.6	1.4	1.3	1.2	1.1	0.8	
Lewinsville	3.1	3.5	3.0	2.3	2.7	2.3	1.9	2.0	1.6	1.5	
Alexandria	3.6	2.9	2.4	2.4	2.8	2	1.6	1.8	1.4	1.2	1.4
Franconia	1.8	1.9	1.9	1.5	1.5	1.2	1.3	1.8	1.2	1.8	
Highest	*5.6*	*5.0*	*4.7*	*4.5*	*4.0*	*3.4*	*3.2*	*3.3*	*2.7*	*2.1*	*4.0*
Lowest	*1.2*	*1.5*	*1.3*	*1.2*	*1.4*	*1.2*	*1.3*	*1.2*	*0.9*	*0.8*	*0.9*
Median	*3.5*	*2.8*	*2.6*	*2.4*	*2.6*	*2.1*	*1.6*	*1.9*	*1.4*	*1.2*	*1.6*

Blank data indicates the monitor has not been installed or has been removed.

Table A-3: Second Highest 1-hour Average Carbon Monoxide Concentrations (1999-2009) (ppm)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
C&P Telephone	5.4	5.9	5.2	7.5	8.3	3.4	2.9	3.2	2.7	4.0	2.5
River Terrace	7.3	6.6	6.3	5.6	7.6	4.0	3.8	4.0	3.8	2.7	4.2
Beltsville									1.1	1.0	1.1
Bladensburg	7.5										
Arlington	4.9	3.5	2.8	3.4	4.1	3.2	2.3	2.9	1.8	1.6	1.7
Cub Run	1.7	2.4	1.7	1.4	1.9	1.6	1.7	1.4	1.4	1.4	
Seven Corners	3.2	4.2	2.8								
Annandale				2.1	2.2	1.8	1.6	2.1	1.4	1.0	
Lewinsville	7.0	5.6	4.6	3.3	3.3	3.6	2.5	2.7	2.1	2.0	
Alexandria	4.7	4.0	4.3	4.0	3.5	2.9	2.3	2.4	2.1	1.9	1.8
Franconia	3.4	2.8	2.6	2.7	2.4	1.6	1.9	2.2	1.5	1.9	
Highest	*7.5*	*6.6*	*6.3*	*7.5*	*8.3*	*3.6*	*3.8*	*4.0*	*3.8*	*4.0*	*4.2*
Lowest	*1.7*	*2.4*	*1.7*	*1.4*	*1.9*	*1.6*	*1.6*	*1.4*	*1.1*	*1.0*	*1.1*
Median	*4.9*	*4.1*	*3.6*	*3.4*	*3.4*	*3.1*	*2.3*	*2.6*	*1.8*	*1.9*	*1.7*

Blank data indicates the monitor has not been installed or has been removed.

Table A-4: 99th Percentile 1-Hour Sulfur Dioxide Concentrations (1999-2009) (ppm)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
River Terrace	0.030	0.030	0.029	0.031	0.033	0.025	0.022	0.020	0.018	0.017	0.018
Cub Run	0.020	0.022	0.015	0.014	0.016	0.018	0.016	0.012	0.013	0.012	
Seven Corners	0.026	0.032						0.014	0.015	0.013	0.011
Beltsville											
Lewinsville	0.027	0.033	0.027	0.023	0.025	0.026	0.023	0.019	0.019	0.019	
Alexandria	0.036	0.031	0.030	0.033	0.034	0.031	0.030	0.019	0.019	0.017	0.015
Annandale					0.025	0.025	0.023	0.017	0.017	0.018	
Highest	*0.036*	*0.033*	*0.030*	*0.033*	*0.034*	*0.031*	*0.030*	*0.020*	*0.019*	*0.019*	*0.018*
Lowest	*0.020*	*0.022*	*0.015*	*0.014*	*0.016*	*0.018*	*0.016*	*0.012*	*0.013*	*0.012*	*0.011*
Median	*0.027*	*0.031*	*0.028*	*0.027*	*0.025*	*0.025*	*0.023*	*0.018*	*0.018*	*0.017*	*0.015*

Blank data indicates the monitor has not been installed or has been removed.

Table A-5: Annual Average Nitrogen Dioxide Concentrations (1999-2009) (ppm)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Takoma	0.022	0.020	0.023	0.023	0.025	0.021	0.019	0.017	0.017	0.014	0.015
River Terrace	0.024	0.023	0.024	0.024	0.023	0.021	0.021	0.016	0.015	0.018	0.018
McMillan Reservoir	0.018	0.018	0.024	0.023	0.023	0.022	0.022	0.019	0.018	0.014	0.015
Beltsville							0.011	0.011	0.011	0.009	
Arlington	0.025	0.023	0.022	0.022	0.026	0.022	0.021	0.018	0.016	0.013	0.013
Cub Run	0.011	0.010	0.009	0.009	0.010	0.010	0.010	0.008	0.008	0.006	
Seven Corners	0.023	0.020	0.023	0.018	0.018						
Annandale				0.018	0.018	0.017	0.018	0.015	0.013	0.011	
Lewinsville	0.020	0.021	0.020	0.019	0.023	0.018	0.017	0.015	0.014	0.013	
Long Park	0.012	0.009	0.014	0.014	0.012	0.010	0.009	0.007	0.007	0.006	0.006
Alexandria	0.025	0.023	0.023	0.025	0.023	0.024	0.024	0.020	0.018	0.016	0.015
Ashburn	0.014	0.013	0.014	0.014	0.016	0.015	0.014	0.013	0.011	0.008	0.007
Highest	*0.025*	*0.023*	*0.024*	*0.025*	*0.026*	*0.024*	*0.024*	*0.020*	*0.018*	*0.018*	*0.018*
Lowest	*0.011*	*0.009*	*0.009*	*0.009*	*0.010*	*0.010*	*0.009*	*0.007*	*0.007*	*0.006*	*0.006*
Median	*0.022*	*0.020*	*0.023*	*0.022*	*0.023*	*0.021*	*0.018*	*0.015*	*0.014*	*0.013*	*0.015*

Blank data indicates the monitor has not been installed or has been removed.

Table A-6: Annual Maximum 24-Hour PM_{10} Concentrations (1999-2009) ($\mu g/m^3$)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
West End Library	50		54								
Connecticut Avenue	40		54								
McMillan											60
River Terrace				87	56	60	81	84	44	30	61
Suitland	64	59	54								
Cub Run	56	53	49	57	52	48	48	41	54	42	
Mt. Vernon	47	52	46	46	64	50	39	42	33	44	
Brandon Avenue	42	52	42	60	61	52					
Manassas	47	54	39	51	56	53					
Alexandria											50
Ferdinand Drive											40
Highest	*64*	*59*	*54*	*87*	*64*	*60*	*81*	*84*	*54*	*44*	*61*
Lowest	*40*	*52*	*39*	*46*	*52*	*48*	*39*	*41*	*33*	*30*	*40*
Median	*47*	*53*	*49*	*57*	*56*	*52*	*48*	*42*	*44*	*42*	*55*

Blank data indicates the monitor has not been installed or has been removed.

Table A-7: Annual Average $PM_{2.5}$ Concentrations (1999-2009) ($\mu g/m^3$)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
River Terrace	15.9	18.9	16.9	16.3	14.9	14.9	14.9	13.4	13.6	12.0	10.5
Park Services	15.3	15.3	15.0	15.6	13.4	14.5	15.6	13.3	13.7	12.2	10.2
McMillan Reservoir	18.1	15.7	16.1	15.6	14.3	14.4	14.6	13.0	13.0	11.7	10.2
Rockville	13.5	14.3	12.8	13.0	11.9	12.6	13.5	11.3	11.8	12.4	9.4
Bladensburg	19.3	18.3	17.1	18.4					14.1	13.4	10.7
Greenbelt				12.1	11.5	9.8					
Beltsville						12.6	13.4	11.5	11.8	12.0	8.7
Suitland	15.2	14.4	13.5								
PG Equestrian Center				15.4	12.6	13.3	13.8	12.2	12.1	12.1	8.9
Arlington	13.8	14.9	14.7	14.9	14.1	14.5	15.3	12.9	13.9	12.3	10.1
Franconia	13.4	14.1	14.3	13.1	13.2	13.9	13.7	12.7	12.5	11.1	9.8
Seven Corners	14.5	15.3	13.9								
Annandale				13.7	13.2	13.7	14.4	12.7	13.3	11.2	9.5
Lewinsville	14.3	15.1	14.5	14.1	13.6	14.0	14.8	12.7	13.5	11.9	9.7
Ashburn	12.8	13.8	14.1	13.5	13.1	14.1	14.6	12.2	12.8	11.2	9.2
Highest	*19.3*	*18.9*	*17.1*	*18.4*	*14.9*	*14.9*	*15.6*	*13.4*	*14.1*	*13.4*	*10.7*
Lowest	*12.8*	*13.8*	*12.8*	*12.1*	*11.5*	*9.8*	*13.4*	*11.3*	*11.8*	*11.1*	*8.7*
Median	*14.5*	*15.1*	*14.5*	*14.5*	*13.2*	*14.0*	*14.6*	*12.7*	*13.2*	*12*	*9.8*

Blank data indicates the monitor has not been installed or has been removed.

Table A-8: 98th Percentile of 24-Hour $PM_{2.5}$ Concentrations (1999-2009) ($\mu g/m^3$)

MONITOR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
River Terrace	37.4	41.2	44.8	47.8	39.0	38.4	36.2	35.0	32.8	31.1	24.3
Park Services	34.7	37.2	35.1	35.9	38.7	36.0	36.4	33.0	28.7	31.6	22.7
McMillan Reservoir	35.4	38.6	43.7	40.0	35.2	34.8	34.4	33.2	33.1	30.8	24.0
Rockville	30.1	36.2	37.5	36.3	32.1	31.7	31.7	29.3	29.2	34.3	21.5
Bladensburg	36.7	42.9	38.9	35.2					31.5	33.4	21.2
Greenbelt				27.0	32.3	16.9					
Beltsville						38.1	32.4	33.8	29.0	30.6	17.7
Suitland	36.5	36.5	35.2								
PG Equestrian Center				47.2	31.5	37.7	30.9	32.5	28.8	32.7	18.6
Arlington	34.1	37.7	37.2	35.6	39.2	35.7	34.2	32.5	29.5	31.4	23.2
Franconia	33.4	35.3	34.3	36.1	32.6	35.3	35.8	33.9	31.9	28.4	24.2
Seven Corners	35.7	38.7	37.2								
Annandale				35.0	36.7	34.0	35.1	32.0	29.5	22.7	20.8
Lewinsville	38.3	37.2	37.8	33.7	32.9	33.7	34.6	32.4	30.9	25.6	21.2
Ashburn	35.6	36.6	35.6	32.3	35.3	34.2	37.7	32.8	27.7	23.9	20.0
Highest	*38.3*	*42.9*	*44.8*	*47.8*	*39.2*	*38.4*	*37.7*	*35.0*	*33.1*	*34.3*	*24.3*
Lowest	*30.1*	*35.3*	*34.3*	*27.0*	*31.5*	*16.9*	*30.9*	*29.3*	*27.7*	*22.7*	*17.7*
Median	*35.6*	*37.2*	*37.2*	*35.8*	*35.2*	*35.1*	*34.6*	*32.8*	*29.5*	*31.0*	*21.4*

Blank data indicates the monitor has not been installed or has been removed.

Appendix B

How to Find Additional Information

States	Organization	Address	Telephone/Internet
	District Department of the Environment	1200 First Street, NE Washington, D.C. 20002	(202) 535-2600 www.ddoe.dc.gov
	Maryland Department of the Environment	Air & Radiation Management Administration 1800 Washington Blvd. Baltimore, MD 21230	(410) 631-3245 www.mde.state.md.us/arma
	Virginia Department of Environmental Quality Office of Air Monitoring	5324 Distribution Drive Richmond, VA 23225	(804) 230-7734 www.deq.state.va.us
Forecasts & Data	**Organization**	**Address**	**Telephone/Internet**
	Baltimore-Washington Real Time AQ Data Map	1800 Washington Blvd. Baltimore, MD 21230	www.cleanairpartners.net
	EPA Air Quality Data Maps & Forecasts	Environmental Protection Agency 109 TW Alexander Drive (E 143-03) Research Park Triangle, NC 27711	www.airnow.gov
	Metropolitan Washington Council of Governments	Suite 300 777 N. Capitol Street, NE Washington, D.C. 20002	(202) 962-3200 www.mwcog.org
Organizations	**Organization**	**Address**	**Telephone/Internet**
	Clean Air Partners	777 N. Capitol Street, NE Washington, D.C. 20002	(877) 515-4593 www.cleanairpartners.net
	EPA Homepage	Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, D.C. 20460	www.epa.gov
	EPA Region 3	US EPA Region III Air Protection Division 1650 Arch Street (3AP00) Philadelphia, PA 19103-2029	(215) 814-2100 www.epa.gov/reg3artd
	EPA Air Quality Data Policy and Standards	Research Triangle Park North Carolina, 27711 Mail Drop C404-04	(919) 541-5618 www.epa.gov/oar/oaqps
	EPA Office of Transportation and Air Quality	1200 Pennsylvania Avenue, N.W. Washington, D.C. 20460	(734) 214-4269 www.epa.gov/otaq
	Mid-Atlantic Regional Air Management Association	711 West 40th Street Suite 312 Baltimore, MD 21211-2109	(410) 467-0170 www.marama.org
	Ozone Transport Commission	Hall of the States 444 N. Capitol Street, NE Suite 638 Washington, D.C. 20001	(202) 508-3840 www.otcair.org