Five-Year Assessment of District of Columbia's Ambient Air Monitoring Network

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Acronyms and Definitions

AQI	Air Quality Index
AQS	Air Quality Subsystem
AQD	Air Quality Division
BAM/BAMM	Beta Attenuation (Mass) Monitor - typically used for measuring continuous particulate matter
CAA	Clean Air Act
CFR	Code of Federal Regulations
CSN	Chemical Speciation Network
CO	Carbon Monoxide
DISTRICT	District of Columbia
DDOE	District Department of the Environment
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FID	Flame Ionization Detector
FRM	Federal Reference Method
GC	Gas Chromatograph
HAPS	Hazardous Air Pollutants
IMPROVE	Interagency Monitoring of Protected Visual Environments
IR	Infrared (radiation)
MAB	Monitoring and Assessment Branch, Air Quality Division
MSA	Metropolitan Statistical Area
NAA	Nonattainment Area
NAAQS	National Ambient Air Quality Standard
NATTS	National Air Toxic Trends Stations
NAMS	National Air Monitoring Station
NCore	National Core Monitoring Network
NO	Nitrogen Oxide
NO2	Nitrogen Dioxide
NOx	Oxides of Nitrogen (ozone precursor)
NOy	Total Reactive Nitrogen Species (ozone precursor)
O3	Ozone
OC/EC	Organic Carbon/Elemental Carbon
PAHs	Polycyclic Aromatic Hydrocarbons
PAMS	Photochemical Assessment Monitoring network Stations
Pb	Lead
$PM_{2.5}$	Particulate matter with an equivalent diameter less than or equal to 2.5 µm
PM_{10}	Particulate matter with an equivalent diameter less than or equal to 10 µm
QA	Quality Assurance
SIP	State Implementation Plan
SLAMS	State and Local Air Monitoring Stations
SO_2	Sulfur Dioxide
STN	PM2.5 Speciation Trends Network
TEOM	Tapered Element Oscillating Microbalance
UV	Ultraviolet
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) amended the ambient air monitoring regulations at 40 CFR Part 58, and finalized them on October 17, 2006. These amendments require state and, where applicable, local monitoring agencies to conduct an assessment of ambient air monitoring network once every five years. The first of such 5-year network assessments is due to the Regional Administrator by July 1, 2010. To this end, the District Department of the Environment's Air Monitoring and Assessment Branch conducted a 5-year assessment of the District of Columbia's air monitoring network and presented the findings and recommendations in this report. Being the first of such 5-year assessments, District will continue to evaluate the regulatory changes as they pertain to monitoring requirements and considers this to be a living document.

The primary goal of the 5-year assessment is to comprehensively review the agency's monitoring network to optimize networks and equipment to meet the most important data uses.

After reviewing the assessment that was completed to satisfy the requirements set forth in 40 CFR § 58.10, District's monitoring program came to the following conclusions and recommendations:

- The minimum number of sites for all species is either met or exceeded.
- No SO_2, CO, PM_{10}, or PAMS sites were found to be redundant.
- Once sufficient monitoring data is made available from a newly established station in Alexandria, VA, the need for a PM2.5 monitor at Hains Point will be re-evaluated. It is possible that the monitor will be relocated or removed.
- The NO_2 and ozone monitors at the Takoma station may be redundant. The District will consider relocating the monitors to an alternate location with better probe siting provisions.
- New NO_2 sites will be required based on new regulations. The program is currently investigating near-roadway locations for a possible new site in the District.
- Continuous monitoring technology utilizing $PM_{2.5}$ FEM monitors will be evaluated for gradual phase-out of the $PM_{2.5}$ FRM monitors.

1.0 INTRODUCTION

As part of the Clean Air Act, state and local air agencies are required to operate and maintain ambient air monitoring networks. Ambient air monitoring objectives have shifted over time, causing air quality agencies to re-evaluate and reconfigure monitoring networks. A variety of factors contribute to these shifting monitoring objectives:

- Air quality has changed – for the better in most geographic areas – since the adoption of the federal Clean Air Act and National Ambient Air Quality Standards (NAAQS). For example, the problems of high ambient concentrations of lead and carbon monoxide have largely been solved.

- Populations and behaviors have changed. For example, the U.S. population has (on average) grown, aged, and shifted toward urban and suburban areas over the past four decades. In addition, rates of vehicle ownership and annual miles driven have grown.

- New air quality objectives have been established, including rules to reduce air toxics, fine particulate matter ($PM_{2.5}$), and regional haze.

- The understanding of air quality issues and the capability to monitor air quality have both improved. Together, the enhanced understanding and capabilities can be used to design more effective air monitoring networks.

As a result of these changes, air monitoring networks may have unnecessary or redundant monitors or ineffective and inefficient monitoring locations for some pollutants, while other regions or pollutants suffer from a lack of monitors. Air monitoring agencies should, according to the U.S. Environmental Protection Agency (EPA), refocus monitoring resources on pollutants that are new or persistent challenges, such as $PM_{2.5}$, air toxics, and ground-level ozone and precursors, and should deemphasize pollutants that are steadily becoming less problematic and better understood, such as lead and carbon monoxide.

In addition, monitoring agencies need to adjust networks to protect today's population and environment, while maintaining the ability to understand long-term historical air quality trends. Moreover, monitoring networks can take advantage of the benefits of new air monitoring technologies and improved scientific understanding of air quality issues. Existing monitoring networks should be designed to address multiple, interrelated air quality issues and to better operate in conjunction with other types of air quality assessments (e.g., photochemical modeling, emission inventory assessments). Reconfiguring air monitoring networks can enhance their value to stakeholders, scientists, and the general public. [EPA, 2008][1]

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[1] [EPA, 2008] EPA, Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, EPA-454/B-08-003.

1.1 Purpose of the Network Assessment

In October 2006, the EPA issued final regulations (Title 40 of the Code of Regulations, or CFR, Part 58) concerning state and local agency ambient air monitoring networks. The five-year Network Assessment requirements, as stated in 40 CFR §58.10(d), read as follows:

> *"(d) The State, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in [Appendix D of 40 CFR 58], whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For PM2.5, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator."*

In short, the purpose of this Network Assessment is, at a minimum, to:

- Determine if the network meets the monitoring objectives of 40 CFR Part 58, Appendix D;
- Determine whether new sites are needed;
- Determine whether existing sites are no longer needed and can be terminated;
- Determine whether new technologies are appropriate for incorporation into the ambient air monitoring network;
- Consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma);
- Determine for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies; and
- Identify needed changes to $PM_{2.5}$ population-oriented sites.

This document is the first such five-year assessment and contains a description of the District of Columbia's air monitoring network, various parameters within the network, monitoring stations, and data information. These materials have been used to investigate whether the current network contains redundant, inefficient or otherwise ineffective monitoring sites and includes recommendations for their future use.

2.0 BACKGROUND

In 1970, Congress passed the Clean Air Act (CAA) and authorized the EPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants shown to threaten human health and welfare. Primary standards were set according to criteria designed to protect public health, including an adequate margin of safety to protect sensitive populations such as children and elderly. Secondary standards were set to protect public welfare and the environment (e.g. decreased visibility, damage to crops, vegetation, and buildings, etc). There are NAAQS for six pollutants: ozone (O3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter (less than 10 microns, PM_{10}, and less than 2.5 microns aerodynamic diameter, $PM_{2.5}$) and lead (Pb). These are commonly known as the "*criteria*" air pollutants. When air quality does not meet the NAAQS for one of the criteria pollutants, the area is said to be in "nonattainment" for that pollutant.

Table 1. National Ambient Air Quality Standards

Pollutant	**Primary Standards**		**Secondary Standards**	
	Level	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour	None	
	35 ppm (40 mg/m^3)	1-hour		
Lead	0.15 µg/m^3	Rolling 3-Month Average	Same as Primary	
	1.5 µg/m^3	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary	
	100 ppb	1-hour	None	
Particulate Matter (PM_{10})	150 µg/m^3	24-hour	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual (Arithmetic Mean)	Same as Primary	
	35 µg/m^3	24-hour	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour	Same as Primary	
	0.08 ppm (1997 std)	8-hour	Same as Primary	
	0.12 ppm	1-hour (Applies only in limited areas)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 µg/m^3)	3-hour
	0.14 ppm	24-hour		
	75 ppb	1-hour	None	

Source and for more details: U.S. EPA (http://www.epa.gov/air/criteria.html)

The District Department of the Environment (DDOE) regulates air pollution sources in the District of Columbia (District) to protect public health and the environment. The District's ambient air monitoring network is used to track changes in air quality in the District and to evaluate compliance with the NAAQS.

2.1 Air Quality Summary

The District is currently in attainment of the NAAQS for all pollutants except ozone. The following chart indicates the number of ozone NAAQS violations in the District per year since 2006, where a violation is considered to be a day above 100 on the Air Quality Index (AQI) scale (i.e. Code Orange or above):

Table 2. Ozone NAAQS Violation in the District

Year	NAAQS Violations (District only)	NAAQS Violations (DC-MD-VA-WV MSA)
2006	22	35
2007	21	43
2008	8	19
2009	2	4

Source: Reports generated using EPA's Air Quality System (AQS) database

For comparison purposes, the number of ozone violations is also included for the Washington, DC-MD-VA-WV Metropolitan Statistical Area. Note that EPA's release of a new, more stringent ozone standard in 2008 impacted the AQI scale. A reading of 100 on the scale changed from 0.084 parts per million (ppm) to 0.075 ppm to reflect the change in the standard.

For PM2.5, there were three violations of the daily NAAQS in the District in both 2006 and 2007, and one each in 2008 and 2009.

There are no major risk issues in the agency's ambient air monitoring network. One District monitor is located in a community that has historically been concerned about exposure to pollution from a nearby power plant, but emissions from the facility have dropped significantly in recent years.

Being an urban area with no industry, transported pollution and precursors generated upwind of the District may have a significant role, and mitigating the transported pollution is critical for achieving air quality improvements in the District.

2.2 Population Summary

The District of Columbia is part of the larger Washington-Baltimore Combined Statistical Area (CSA) designated by the U.S. Office of Management and Budget, which includes parts of Maryland, Virginia, and West Virginia. It is also part of a smaller Metropolitan Statistical Area (MSA), referred to as the Washington Metropolitan Area or the National Capital Region, which also includes parts of Maryland, Virginia, and West Virginia.

Table 3. Population of the DC Area

Year	CSA	MSA	District
1990	6,726,395	4,222,830*	606,900
2000	7,603,090	4,821,031	571,744
2009	8,440,617	5,476,241	599,657

Source: U.S. Census (http://www.census.gov/popest/metro/CBSA-est2009-annual.html, http://www.census.gov/popest/archives/1990s/, and http://www.census.gov/popest/states/NST-ann-est.html)
** In 1990, the MSA was considered a PMSA*

The population represented by the District's monitoring network dropped during the 1990s, accompanied by a rise in population in surrounding areas. The past decade has shown growth in population in all areas. The District has not evaluated shifts in population within District or the metropolitan area to date.

2.3 Meteorological Summary

The District of Columbia lies in the Mid-Atlantic region between the rigorous climates of the North and the warm temperate climates of the South. The District is located adjacent to the modifying influences of the Chesapeake Bay and Atlantic Ocean to the east and the Appalachian Mountains to the west and north. Since this region is near the average path of the low pressure systems which move across the country, changes in wind direction are frequent. Table 4 gives a monthly climate summary for Sterling, VA, a weather station located in the Washington D.C. metropolitan area.

Table 4. Monthly Climate Summary – Sterling R & D Center, Virginia (448084)
Period of Record: 1977 to 2009

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	41.9	44.8	53.9	65.6	74.2	82.6	86.8	85.8	78.9	67.6	57.1	45.8	65.4
Average Min. Temperature (F)	21.6	22.8	30.2	39.8	49.3	58.3	62.9	61.6	54.0	41.3	33.1	24.7	41.6
Average Total Precipitation (in.)	3.15	2.65	3.64	3.57	4.61	4.04	3.68	3.56	3.89	3.67	3.64	3.04	43.13
Average Total Snowfall (in.)	7.2	7.1	3.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.4	2.5	20.6

Rainfall distribution is uniform throughout the year. In summer, the area is under the influence of the large semi-permanent high pressure system commonly known as the Bermuda High and centered over the Atlantic Ocean near 300 N Latitude. This pressure system brings warm humid air to the area. The proximity of large water areas and the inflow of southerly winds contribute to high relative humidity during much of the year.

2.4 Emissions Inventory Summary

Over the last 20 years, monitored levels of the criteria pollutants have decreased significantly in the District due to the implementation of various air pollution reduction measures. The decade of the 1980's was a transition for air quality with the introduction of automobiles equipped with catalytic converters and the accompanying air pollution reductions for NO2, CO, and VOCs. The phasing out of leaded gasoline in the 1980s led to a significant drop in ambient Pb levels. New air pollution control technologies have been introduced over the years for stationary sources, including lower sulfur fuels, to reduce SO2, NO2 and VOCs. Ozone and PM10 levels have been greatly reduced, although the District remains in nonattainment for ozone.

As indicated in Figure 1, a majority of the District’s emissions come from mobile sources. This is because there are few larger, industrial sources within city limits compared to other states in the Washington region, as demonstrated in Figure 2. Figure 3 shows that only 6 percent of the region’s emissions were from the District in 2002.

Figure 1. District Emissions in 2002

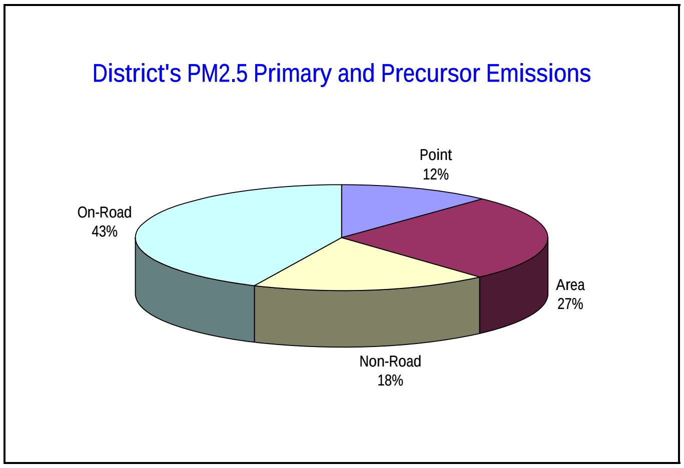


Figure 2. Regional Emissions in 2002

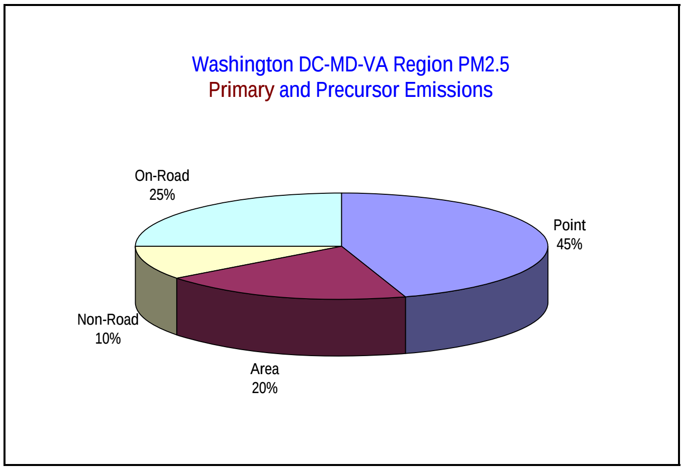
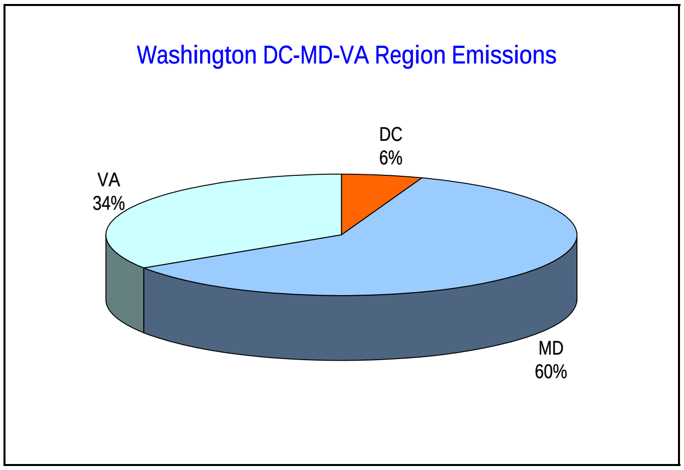


Figure 3. Percentage of Emissions from the District Compared to the Region



There are plans for emissions sources to change over time, but these plans were not considered when assessing the monitoring network.

3.0 THE DISTRICT OF COLUMBIA'S AMBIENT AIR MONITORING NETWORK

The District has operated an ambient air monitoring network as part of the regulatory requirements of the Clean Air Act since the early 1970s. The District is required to collect and report all air monitoring data to the public and to the National Air Quality Database, known as the Air Quality System (AQS), pursuant to reporting requirements in 40 CFR Part 58.

Ambient air monitoring systems are a critical part of the DC's air quality management program. Air quality management involves a cycle of air quality monitoring, setting standards and objectives, designing and implementing control strategies, assessing the results of those control strategies, and measuring progress. Ambient air monitoring data provide accountability for emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors. The data also form the basis for air quality forecasting and other public outreach air quality reports. Ambient monitoring data have many uses throughout this process, such as:

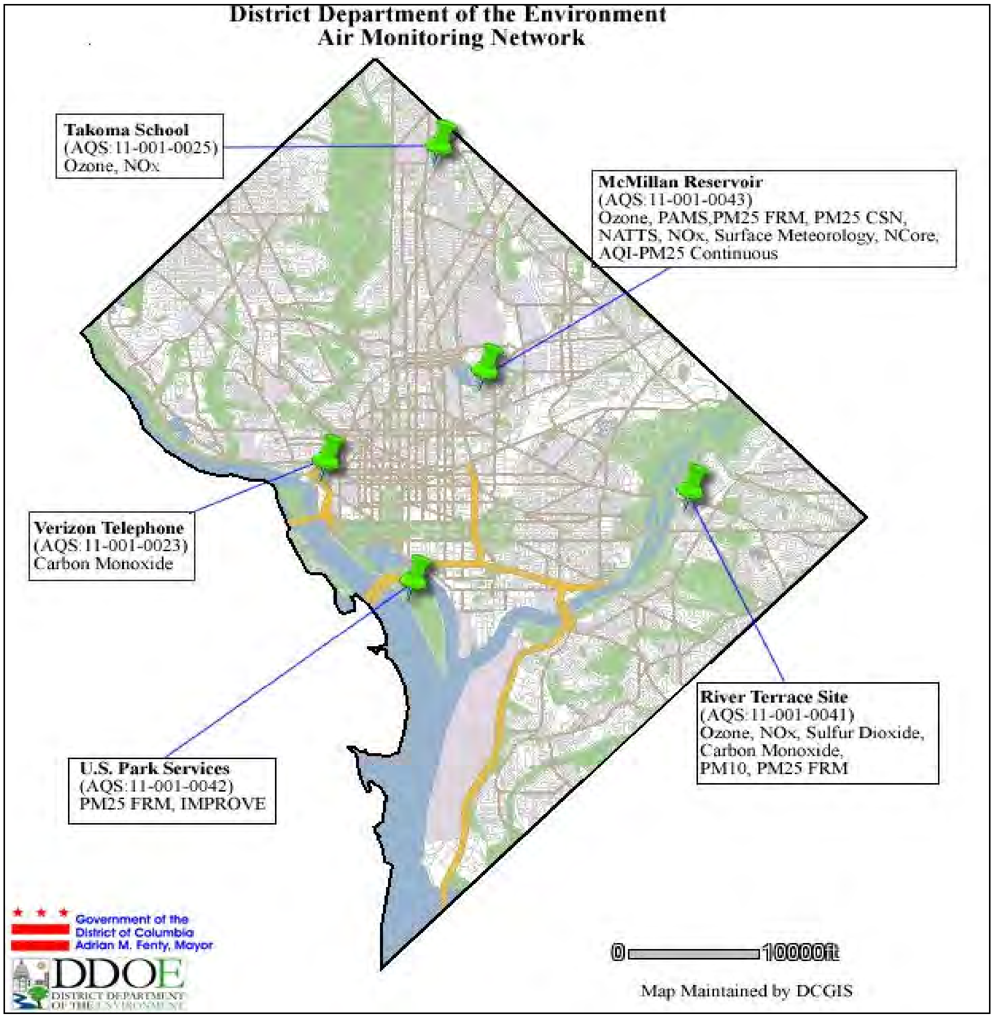
- Determining compliance with the NAAQS;
- Characterizing air quality and trends;
- Estimating health risks and ecosystem impacts;
- Developing and evaluating emission control strategies;
- Evaluating source-receptor relationships;
- Providing data for input to run and to evaluate models; and
- To measure overall progress of air pollution control programs.

A complete description of the District of Columbia air monitoring network can be found in the *District of Columbia 2010 Annual Ambient Air Monitoring Network Plan*.

3.1 Monitoring Sites

The District's network, shown in Figure 4, currently consists of **five** air monitoring sites: McMillan, River Terrace, Takoma, Verizon, and Hains Point.

Figure 4. The District's Ambient Air Monitoring Network



3.1.1 McMillan

The McMillan Reservoir air monitoring site was established in 1993 as a PAMS Type 2 station. Surface meteorological measurements (10 meter tower) are carried out as part of the PAMS monitoring. The station expanded during 2000 and 2001 with the addition of $PM_{2.5}$ FRM, PM2.5 Chemical Speciation Network (CSN) monitoring, PM2.5 continuous, NATTS and BC/EC sensors. The McMillan station was the first NATTS site in EPA Region 3.

Being the most comprehensive air monitoring site in the Nation's Capital, the McMillan station houses a host of measurement equipment that are vital to the District's entire monitoring network. Continuous measurements for ground-level ozone, nitrogen oxides, fine particulate matter ($PM_{2.5}$), and surface meteorological parameters are made at this station. Also, measurements for fifty-six target hydrocarbons are conducted with a PAMS GC air sampling system.

3.1.2 River Terrace

The River Terrace monitoring station has been operational since May of 1993. This location has measurement sensors for ground-level ozone, sulfur dioxide, carbon monoxide, nitrogen oxides, and particulate matter ($PM_{2.5}$ and PM_{10}).

3.1.3 Takoma

The Takoma School station has been operational since January 1980. This monitoring station is located on the roof top of a school building in the District's Takoma Park neighborhood. Ground-level ozone and nitrogen oxides are measured with automated continuous analyzers at this location.

3.1.4 Verizon

The Verizon station was initiated in October 1980 and houses a carbon monoxide measurement sensor. This measuring component is important for the District because it is located in the heart of downtown among heavy pedestrian and automobile traffic congestion. Classified as a "Micro-scale" site, the Verizon station is in a city canyon type of environment.

3.1.5 Hains Point

The Hains Point monitoring station has been operational since January 1988 and houses measurement sensors on the rooftop of U.S. National Park Service building. DDOE operates a $PM_{2.5}$ FRM monitor at this location. This is also one of the very few urban IMPROVE sites in the nation to measure regional haze. The U.S. National Park Service operates IMPROVE, $PM_{2.5}$ mass and speciation, and PM_{10} monitors at this site.

3.2 Monitoring Network Objectives

According to 40 CFR Part 58, Appendix D, the ambient air monitoring network must be designed to meet three basic monitoring objectives (in no specific order):

1. *Provide air pollution to the general public in a timely manner. Data can be presented to the public in a number of attractive ways including through air quality maps, newspapers, Internet sites, and as part of weather forecasts and public advisories.*

2. *Support compliance with ambient air quality standards and emissions strategy development. Data from [Federal Reference Method (FRM), Federal Equivalency Method (FEM), and Automated Reference Method (ARM) monitors] for NAAQS pollutants will be used for comparing an area's air pollution levels against the NAAQS. Data from monitors of various types can be used in the development of attainment and maintenance plans. SLAMS, and especially NCore station data, will be used to evaluate the regional air quality models used in developing emission strategies, and to track trends in air pollution abatement control measures' impact on improving air quality. In monitoring locations near major air pollution sources,*

source-oriented monitoring data can provide insight into how all industrial sources are controlling their pollutant emissions.

3. *Support for air pollution research studies. Air pollution data from the NCore network can be used to supplement data collected by researchers working on health effects assessments and atmospheric processes, or for monitoring methods development work.*

In order to meet these objectives, a network must be designed with a variety of types of monitoring sites. Sites are generally located to:

- Determine highest concentrations expected to occur in the area;
- Measure typical concentrations in areas of high population density;
- Determine the impact of significant sources or source categories on air quality;
- Determine general background concentration levels;
- Determine the extent of regional pollutant transport among populated areas; or
- Measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

The total number of sites and optimum size of an ambient air quality network often involves trade-offs among data needs and available resources.

One goal in locating monitors is to correctly match the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for the monitoring site type, air pollutant to be measured, and the monitoring objective. In 40 CFR Part 58, Appendix D, EPA defines and illustrates which of six spatial scales can most appropriately be used at various site types to support the basic monitoring objectives:

Site Type	**Appropriate Siting Scales**
Highest Concentration	Micro, middle, neighborhood (sometimes urban or regional for secondarily formed pollutants)
Population Oriented	Neighborhood, urban
Source Impact	Micro, middle, neighborhood
General / Background & Regional Transport	Urban, regional
Welfare-Related Impacts	Urban, regional

Source: 40 CFR Part 58, Table D-1 of Appendix D

EPA specifies design criteria for each pollutant-specific network of monitors at SLAMS (State and Local Air Monitoring Station) sites. They also define design criteria for required NCore sites. The District is in the process of establishing one NCore site at the McMillan monitoring station, which should be operational by January of 2011.

4.0 SPECIFIC POLLUTANT NETWORKS

The District's ambient air monitoring network measures a range of pollutants. The group of monitors that measure concentrations of a specific pollutant, which are sometimes located in more than one monitoring site location, are called a pollutant network. Methods employed when monitoring criteria pollutants are explicitly laid out in 40 CFR Part 50. These measurements are then compared to the NAAQS to determine whether an area is in attainment of the NAAQS.

DDOE's Air Monitoring and Assessment Branch staff operate and maintain the District's air monitoring network. Staff perform routine data checks, performance audits, scheduled maintenance, filter replacements, and, depending on the type of sampler, retrieve raw data or perform other quality assurance or quality control duties. They review all air quality data on a regular schedule and perform quality assurance audits and quality control investigations that are reported to the EPA's AQS database.

The following sections describe each pollutant network represented in the District.

4.1 Air Toxics

Toxic air pollutants, also known as "hazardous air pollutants" (HAPs), are pollutants that are known or suspected to cause cancer or other serious health effects or adverse environmental effects, even in small quantities. Section 112 of the Clean Air Act addresses 188 HAPs. Air toxics can come from automobiles, gasoline vapors, and large variety of large and small commercial and industrial sources that use chemical solvents, paint thinner and other chemical compounds.

EPA's Air Toxics monitoring program began with one ambient air toxic station in each EPA region. The District's McMillan station was a part of this pilot program. The goal was to determine the feasibility of operating a multi-station network across regions as part of a national program. As a result, EPA expanded the program. The current National Air Toxic Trends Station (NATTS) network has grown to 28 stations throughout the country. The primary goal for NATTS is to determine a trend (if any) over two consecutive 3-year averaging periods at a particular station. Since NATTS sites are for trend purposes, they are located away from any major sources that could impact a trends analysis. The goal was to have NATTS monitor at neighborhood-scale type sites. However, whatever the scale of measurement, the monitors should represent a broad area and have little chance of being shut down or relocated. In addition, Region 3 developed a regional air toxics monitoring network to look at ambient air toxic concentration gradients within a more densely populated urban area.

4.1.1 Existing Network and Compliance with Network Requirements

The District currently operates <u>one</u> NATTS monitoring station at McMillan site. Air toxics samples are collected for 24 hours on a 1-in-6 day schedule.

Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	Air Toxics	1/1/2001	150	4	Urban	Population Exposure/Trends	NATTS	Every 6 Days

4.1.2 Monitoring Results

Figure 5 below gives data charts for a select group of air toxics measured at the District's NATTS monitoring station. These graphs show the monthly average concentrations for six toxic pollutants for three or more years. Ambient data for the select six air toxics of concern are discussed below:

- **Hexavalent chromium –** Concentrations represented in the graph were sampled between 2004 and 2008. The lowest concentration observed was in 2005. Notable spikes were repeated in two or more years within the range of months (January to December), compared in the graph. No seasonal variation is seen in the concentration pattern.

- **Acrolein –** The graph compares observed concentrations between 2005 and 2008. Results show an inconsistent concentration amongst the years, over the comparison months. A consistent concentration below 0.5 ppb was observed in 2006, representing the lowest concentration for the entire four years that were compared. The highest readings were noticed in 2007 and 2008, with 2007 having the higher peaks in the first and last quarter of the year.

- **Arsenic –** The graph represents sampled concentrations between 2005 and 2009. Concentrations at detection level or below are fewer for the entire years that are represented, for this pollutant. Three noticeable peaks were in January, March and December. There was no noticeable seasonality in air samples for the entire five years of compared data.

- **Benzene –** Data between 2004 and 2009 were plotted against months (January through December). The lowest concentrations of ambient air benzene were observed in 2004 and 2006. The concentration pattern is similar for 2007, 2008 and 2009. The highest readings were in the first and last quarter of 2007.

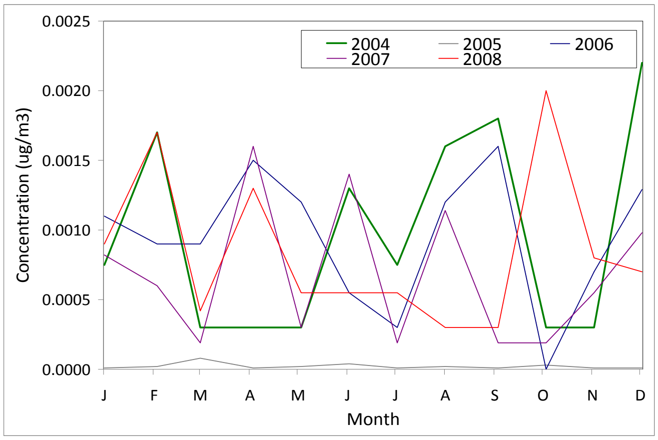
- **Formaldehyde –** The formaldehyde graph compares sampling data for five consecutive years (2005 to 2009). The second and third quarters has higher reading than the other two (first and last quarter). Observed peaks were in the first, third and forth quarter of 2006. A notable rise in concentration is seen between the beginning of second quarter and the third quarter, for all the years represented.

- **1,3-butadiene –** The samples plotted here are taken from 2005 to 2009. Higher readings are seen in the first and forth quarter. Notable peaks were in the first and last quarter of 2007, as well as the 2005 of the same period.

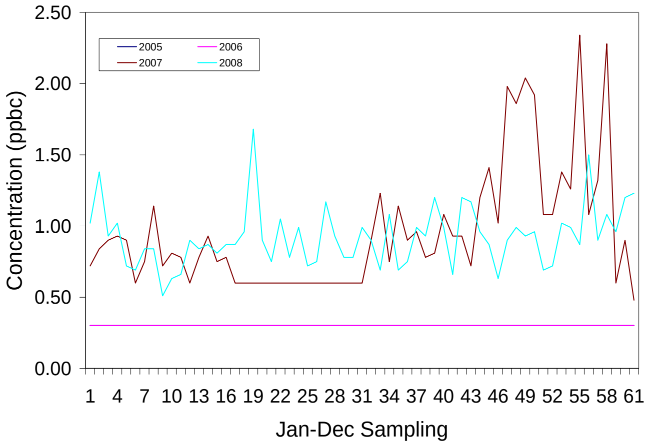
- **Carbon tetrachloride –** The monitored values for this pollutant were consistent. No plotting was considered for this reason.

Figure 5. Concentrations of Toxic Pollutants in the District

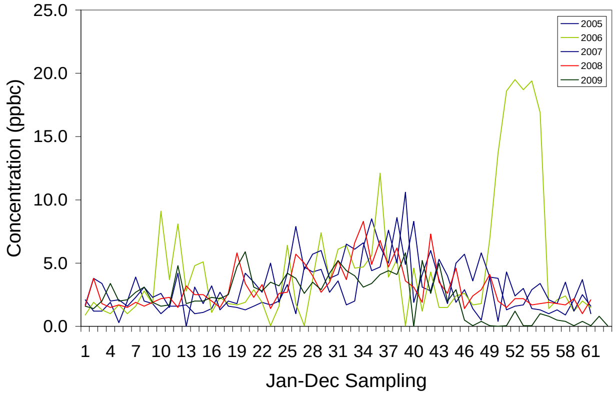
Hexavalent Chromium (2004 to 2008)



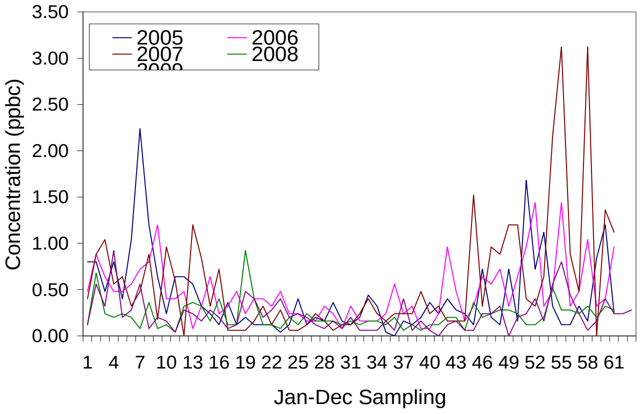
Acrolein (2005 to 2008)



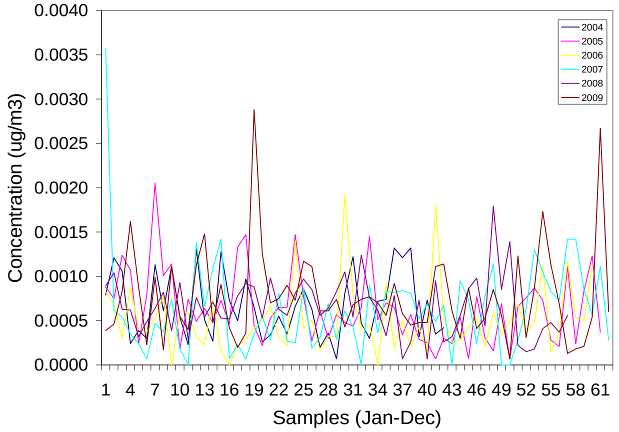
Formaldehyde (2005 to 2008)



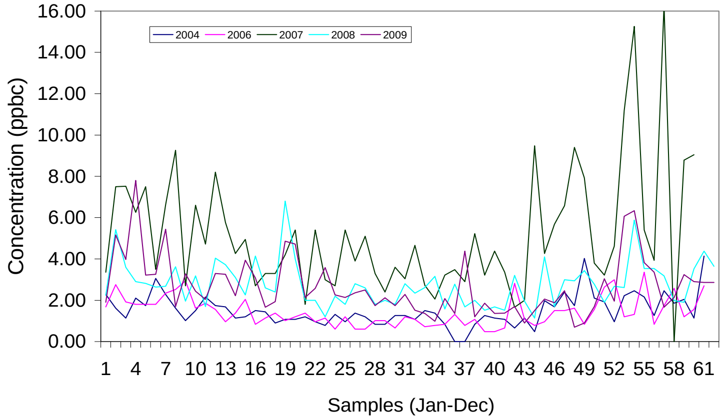
1,3-Butadiene (2005 to 2009)



Arsenic (2005 to 2009)



Benzene (2005 to 2009)



4.1.3 Identification of Redundant Sites or New Sites Needed

There is only one monitor, so there is no redundancy. No new toxics sites are being considered at this time.

4.1.4 Proposed Regulations

No new regulations or modeling rules have been proposed for air toxics.

4.1.5 Network Recommendations

No new sites are recommended. The District will continue to operate the NATTS station as long as funding is made available through federal grants.

4.2 CO Monitoring Network

Carbon monoxide (CO) is a colorless, odorless gas. In high concentrations, it can be poisonous. 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. This occurs because hemoglobin's affinity for oxygen is decreased when a high concentration of carbon monoxide is present in the blood, thus reducing the amount of oxygen present in circulation. The health threat from ambient CO is most serious for those who suffer from 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.

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 poorly vented gas and kerosene space heaters are sources of indoor CO.

The Washington DC-MD-VA area is currently a maintenance area for CO.

4.2.1 Existing Network and Compliance with Network Requirements

The basic design criteria for CO are specified in 40 CFR Part 58, Appendix D (section 4.2):

> *"Where SLAMS CO Monitoring is ongoing, at least one site must be a maximum concentration site for that area under investigation."*

The District currently operates two carbon monoxide (CO) monitoring stations in the District. CO samplers collect data hourly and are operated year-round at the River Terrace and Verizon sites.

Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	CO (trace)	1/1/2011	554	3	Urban	General/Background	NCore	Hourly
River Terrace	CO	5/1/1993	054	10	Neighborhood	Population Exposure	SLAMS	Hourly
Verizon	CO	10/1/1980	054	3	Urban	Population Exposure	SLAMS/NAMS	Hourly

The CO monitoring rule states that micro-scale and middle-scale measurements are useful site classifications for SLAMS sites because most people have the potential for exposure at these scales. The River Terrace station has a community-based monitor, so meets the middle-scale requirement. The Verizon site, where only CO is monitored, is considered part of a smaller "core business district" where CO gradients are expected, so meets the micro-scale requirement.

Beginning in January of 2011, trace levels of CO will also be measured at McMillan as part of the NCore network requirement.

4.2.2 Monitoring Results

As Figures 6 and 7 demonstrate, the CO concentrations in the District have continued to remain well below the NAAQS since 1996. Looking at the graphs of River Terrace, CO concentrations in 1-hour averages and 8-hour averages consistently stayed below their NAAQS standards of 35 ppm and 9 ppm from 1996 through 2008. These concentration levels are represented by the highest value (1st Max) compared to the second highest value (2nd Max) per year.

Figure 6. River Terrace Monitor Readings, Compared to the 1-Hour CO Standard and the 8-Hour Ozone Standard

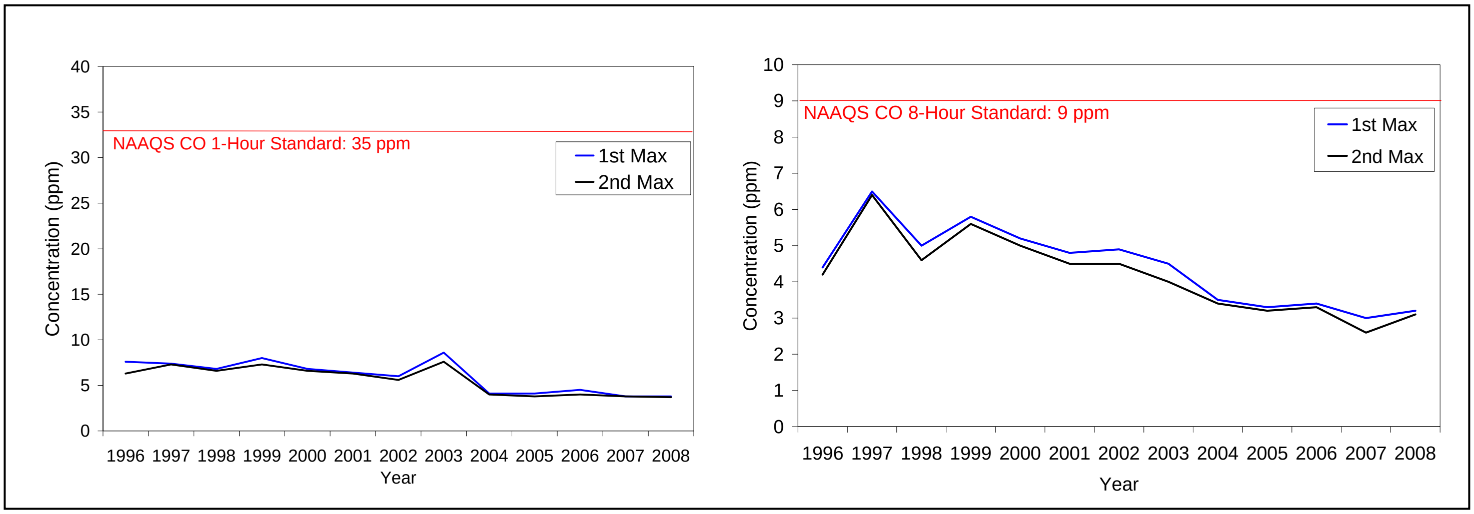
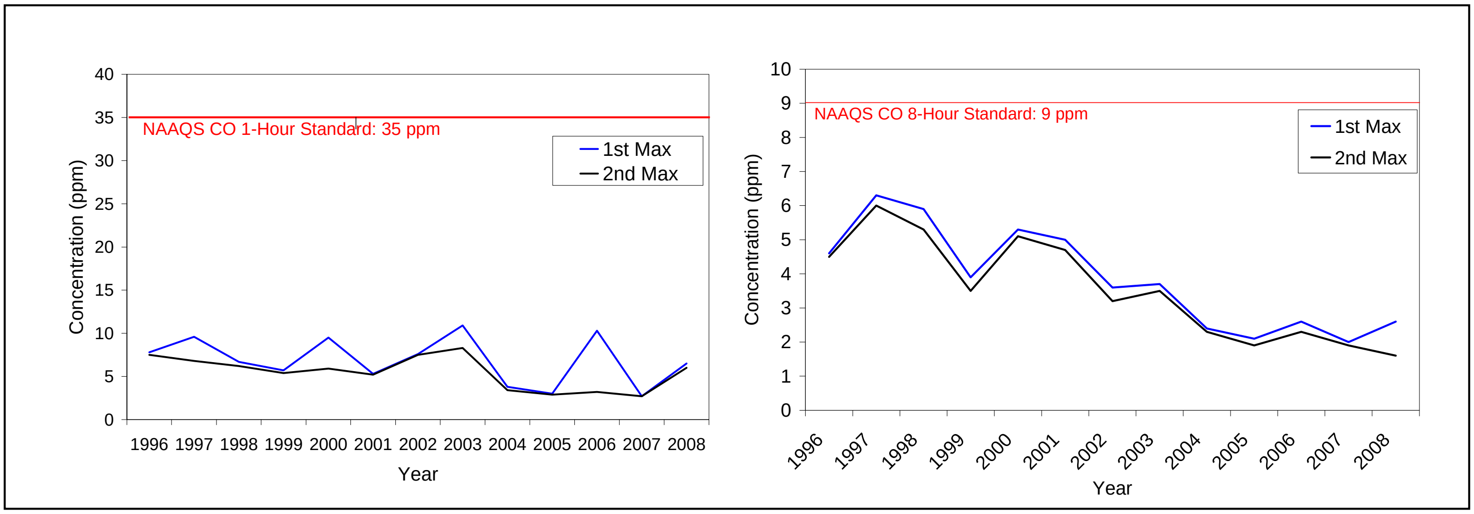


Figure 7 illustrates CO concentrations at the District's Verizon urban area location, where the result of the 1-hour and 8-hour averages are represented by the highest max value compared to the second highest value. The results are similar to those at the neighborhood-area River Terrace location, where concentrations are also far below the NAAQS.

Figure 7. Verizon Monitor Readings, Compared to the 1-Hour CO Standard and the 8-Hour Ozone Standard



Looking at both Figures 6 and 7, there is a steady decrease in CO 8-hour average concentrations at both locations over the 12-year span of the graph.

Figures in the Appendix also demonstrate that design values for CO are well below the NAAQS.

4.2.3 Identification of Redundant Sites or New Sites Needed

The two CO sites represent different scales (neighborhood and urban), and thus are not considered to be redundant.

Given that CO concentrations at all sites are well below the NAAQS and the network requirements are being met, there is no pressing need to identify potential new sites.

4.2.4 Proposed Regulations

The CO NAAQS and monitoring rule are currently under review. EPA is expected to propose revisions to the CO NAAQS and monitoring rule by October 2010. Changes required by any revisions will be addressed in future Annual Network Plans and/or Periodic Network Assessments dependent on the implementation schedule in the final rule.

4.2.5 Network Recommendations

In the year 2011, CO trace level monitoring will be added to NCore station at the McMillan site. The District will continue to monitor at the River Terrace and Verizon sites to compare 1-hour and 8-hour average results to the new NAAQS, once they are revised and implemented.

4.3 Lead Monitoring Network

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. 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.

Ambient Lead (Pb) monitoring in the District's air has had a long history. Through the 1960s and 1970s, the District's air monitors reported concentrations in the range of 5-10 µg/m3 and violated the Pb air quality standards. However, with the phase-out of leaded gasoline that began in 1976, District's monitors reported a significant drop in ambient Pb concentrations. Ambient Pb levels dropped to the 0.05 µg/m3 range by the 1990s, with concentrations measured below 5% of the then existing standard (1.5 µg/m3). Due to these improvements in air quality, Pb monitoring using the established Total Suspended Particles (TSP) sampling reference method effectively ceased by 2002. The District, however, continued to monitor Pb through other monitoring programs such as the air toxic network and fine particulate matter speciation monitoring programs. These new networks that began in the 2002 timeframe were based on either coarse particulate matter (PM10) or fine particulate matter (PM2.5) filter sampling instead of the TSP sampling, and these methods are not deemed equivalent to Federal reference methods.

The Pb standards established in 1978 were revised in 2008 and replaced with more stringent standards. The new air quality standard for Pb, set at 0.15 µg/m3 (3-month average), is ten times stronger than the old 1.5 µg/m3 (quarterly average) standard. The District's air program and the EPA plan to reinstate reference method monitoring efforts beginning Jan 2011, as required by the new standards. EPA is also proposing to require lead monitoring comprising the "NCore Network" instead of the current requirement to place lead monitors in each Core Based Statistical Area (CBSA) with a population of 500,000 or more people. Under this proposal, lead monitoring at NCore sites would also begin January 1, 2011. The District is currently investigation monitors to be placed at the McMillan Reservoir site.

4.4 NO_2 Monitoring Network

Nitrogen dioxide (NO_2) is a gaseous pollutant, one of a class of compounds called nitrogen oxides (NO_x). It is brownish and highly chemically reactive. NO_2 can irritate the lungs and lower resistance to respiratory infections. It is formed during the high-temperature combustion of fuels, in vehicle engines and in 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.

There does not appear to be a discernable trend in the annual NO_2 values in the region. However, during the past ten years, the maximum annual average NO_2 levels have remained at approximately half of the federal standard. Nitrogen dioxide levels in the District of Columbia continue to remain well below the NAAQS.

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4.4.1 Existing Network and Compliance with Network Requirements

The basic design criteria for NO_2 are specified in 40 CFR Part 58, Appendix D (section 4.3):

> *"Within the NO_2 network, there must be one microscale near-road NO_2 monitoring station in each CBSA with a population of 500,000 or more persons to monitor a location of expected maximum hourly concentrations sited near a major road with high AADT (annual average daily traffic) count…"*

The District currently operates <u>three</u> NO_2 monitors co-located with ozone measurement sensors and operated year-round. The monitoring objective at all three sites is population exposure. The McMillan site also measures maximum concentration, and is co-located with PAMS. The River Terrace site has a neighborhood-scaled monitor due to its close proximity to a large NO2 source.

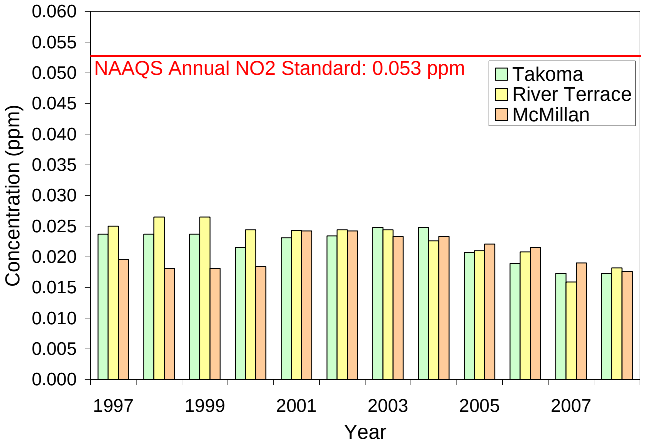
Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	Nitrogen Dioxide, Nitric Oxide	06/01/1994	074	3	Urban	Population Exposure/Max Precursor	PAMS/SLAMS	Hourly
	Nitrogen Dioxide, Nitric Oxide	1/1/2011	075	3	Urban	General/Background	NCore	Hourly
River Terrace	Nitric Oxide, Nitrogen Dioxide, Oxides of Nitrogen	5/1/1993	074	10	Neighborhood	Population Exposure	SLAMS	Hourly
Takoma	Nitric Oxide, Nitrogen Dioxide, Oxides of Nitrogen	1/1/1980	074	10	Urban	Population Exposure	SLAMS/NAMS	Hourly

In January 2011, NOx will be measured at McMillan as part of the NCore monitoring requirement. DDOE is working with the regional partners, Maryland Department of the Environment and Virginia Department of Environmental Quality, on the new NO_2 NAAQS monitoring requirements, specifically near-roadway NO_2 monitoring requirements in the MSA.

4.4.2 Monitoring Results

As demonstrated in Figure 8, design values for NO_2 in the District are well below both the annual and 1-hour NAAQS. The values have remained consistently below the standards for all three NO2 sites throughout the time period examined (1996 through 2008).

Figure 8. NO_2 Design Values in the District



Figures in the Appendix shows annual averages since 1996.

4.4.3 Identification of Redundant Sites or New Sites Needed

Sites that measure nearly similar concentrations of ozone are considered to be highly correlated, and show R^2 values above 0.6 (1.0 being a perfect correlation). Table 5 shows the correlation values between sites in the District.

Table 5. NO_2 Daily Maximum Hourly Data Correlation Statistics

Site 1	Site 2	Correlation (R^2)	Slope	Intercept
Takoma	River Terrace	0.717	0.683	0.011
Takoma	McMillan	0.758	0.697	0.009
McMillan	River Terrace	0.688	0.823	0.011

The high correlations (above 0.6) indicate that these sites may be redundant and several could be considered candidates for removal.

The District plans to work with regional partners to evaluate the network plan and new monitoring requirements referenced in section 4.4.4.

4.4.4 Proposed Regulations

On February 9, 2010, EPA promulgated a new 1-hour NO_2 standard at the level of 100 parts per billion (ppb). This level defines the maximum allowable 1-hour NO_2 concentration anywhere in an area. In addition to establishing an averaging time and level, EPA also set a new "form" for the standard. The form is the air quality statistic used to determine if an area meets the standard.

The form for the 1-hour NO_2 standard is the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations. In addition, EPA is also retaining, with no change, the current annual average NO_2 standard of 53 ppb (40 CFR Parts 50, 53 and 58). The EPA is considering the need for changes to the secondary standard under a separate review.

EPA has set new requirements for the placement of new NO_2 monitors in urban areas. The River Terrace monitor meets the requirement for community-wide monitoring. Also, monitored NO_2 levels at River Terrace in the recent years could have exceeded the federal standards if the new 1-hour NAAQS were in place. The District will continue to work with EPA to consider siting of additional NO_2 monitors.

As part of the NCore program requirements, an NO_y analyzer will be deployed at the McMillan Reservoir site by January 1, 2011.

4.4.5 Network Recommendations

Based on NO_2 monitoring data and correlation results, it is possible to recommend a site for removal consideration. Of the three NO_2 monitoring sites, River Terraces would not be considered as it is the design value monitor. The Takoma site, which has the highest correlation with the other sites, would be the most likely considered for removal or relocation.

4.5 Ozone Monitoring Network

Ozone is a colorless, odorless gas. It exists naturally in the stratosphere, the Earth's upper atmosphere, where it shields the Earth from the Sun's ultraviolet rays, and is found close to the Earth's surface where we live and breathe. 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.

Ground-level ozone is not emitted directly into the air by specific air pollution 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 Washington D.C., 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 power plants, industries, on-road and off-road automobile exhaust, diesel engine exhaust, commercial products such as paints, insecticides, and cleaning solvents. Certain plants and trees also emit VOCs, which combine especially quickly with NO_x to form ozone.

Data in the recent years show that there is a downward trend in the number of days with monitored exceedances of the 8-hour ozone health standard. The 8-hour ozone design concentrations, a measure of attainment of the health standard, in the District currently remain above the standard. However, the ozone air quality shows measurable improvements in the recent years due to air pollution reductions attributable to various control programs.

4.5.1 Existing Network and Compliance with Network Requirements

The basic design criteria for ozone can be found at 40 CFR Part 58, Appendix D (section 4.1):

> *"…at least one O3 site for each MSA, or CSA if multiple MSAs are involved, must be designed to record the maximum concentration for that particular area. More than one maximum concentration site may be necessary for some areas."*

The District operates three ozone monitors in the District's ambient network. The continuous ozone monitors are located at the Takoma, River Terrace, and McMillan monitoring stations. Year-round ozone measurements are made on an hourly basis, including during the prescribed ozone monitoring season (defined as April through October for the District), and the data are sent to EPA's databases.

Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	Ozone	06/01/1994	047	3	Urban	Population Exposure/Max Precursor	PAMS/SLAMS	Hourly
River Terrace	Ozone	5/1/1993	047	10	Neighborhood	Population Exposure	SLAMS	Hourly
Takoma	Ozone	1/1/1980	047	10	Urban	Population Exposure	SLAMS/NAMS	Hourly

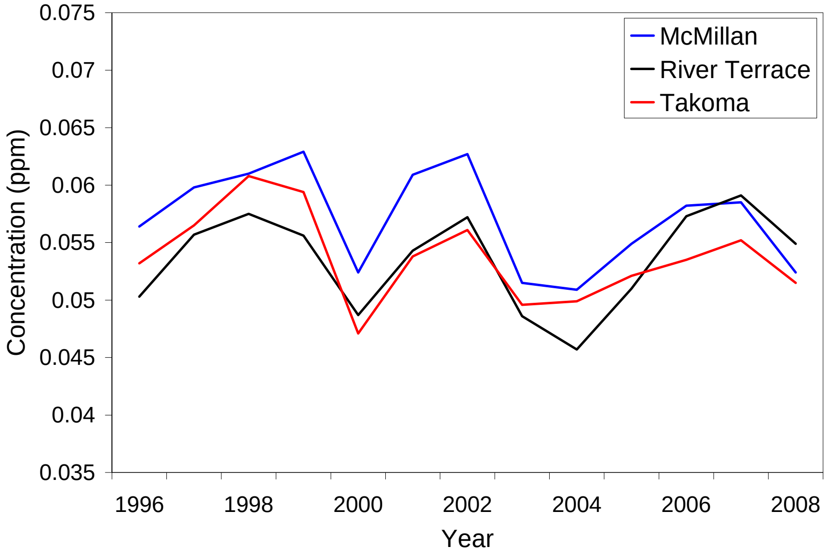
All three sites have population exposure designations as a primary objective. The ozone monitoring rule requires at least one maximum concentration site in each MSA, as met by the McMillan monitor.

Neighborhood-scaled sites should be located to measure typical city concentrations and should be near the influence of major NO_2 sources. River Terrace site meets this requirement, although the nearby NO_2 source (Pepco Benning EGU) is expected to shut down by December 2012.

4.5.2 Monitoring Results

Ozone concentrations follow similar patterns at all monitoring sites throughout the District. As demonstrated in Figure 9, the highest concentrations are persistently seen at the McMillan station, which is considered the design value site for ozone. It is interesting to note that ozone levels at River Terrace rise above levels at McMillan in 2007 and 2008.

Figure 9. Ozone Annual Averages in the District



The following three figures show first and fourth maximum concentrations at each ozone monitor since 1996 compared to the 8-hour ozone standard. All three figures show persistent exceedances of the ozone NAAQS, except for concentrations at the River Terrace monitor in 2004.

Figure 10. Ozone 8-Hour 1st and 4th Max. at McMillan

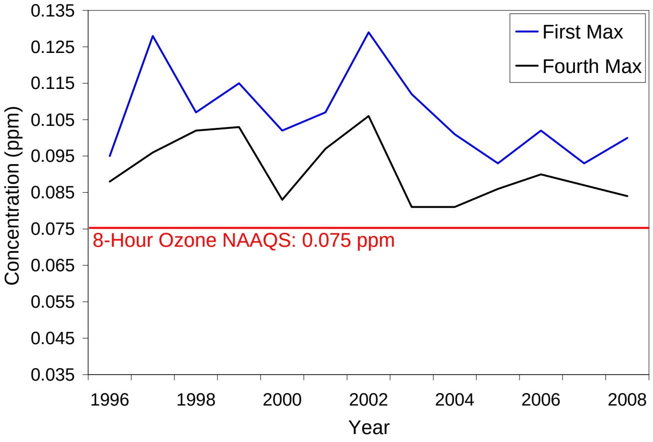


Figure 11. Ozone 8-Hour 1st and 4th Max. at River Terrace

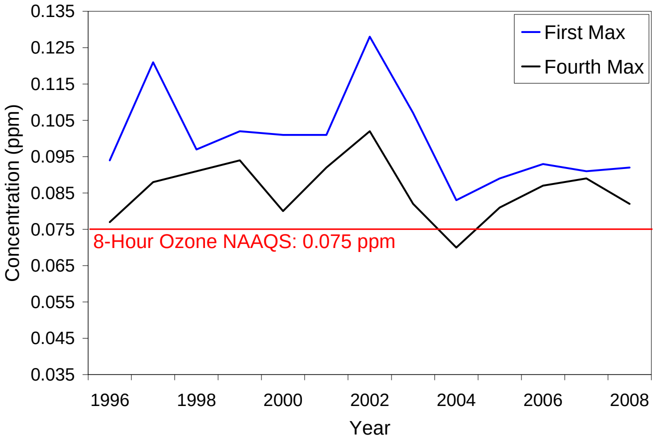
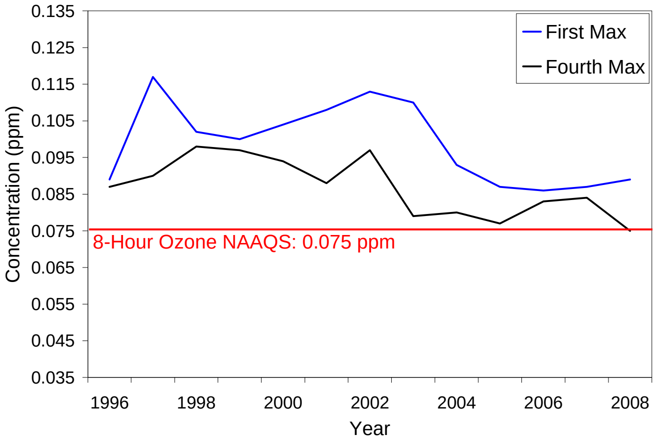
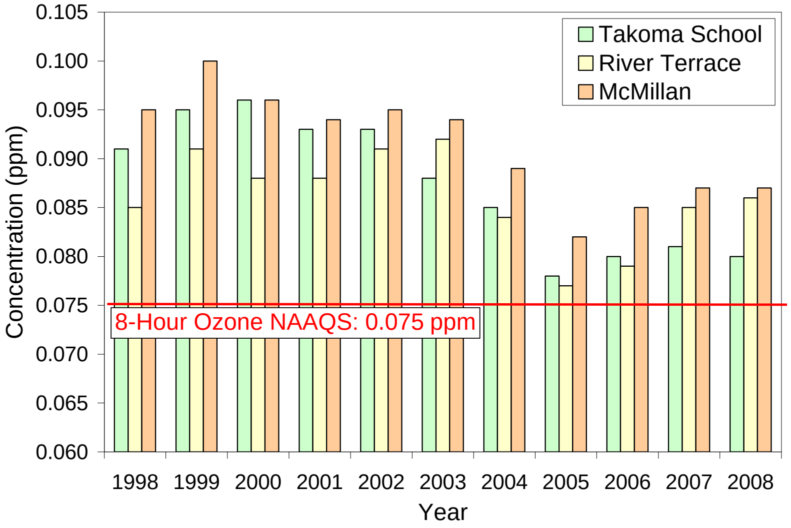


Figure 12. Ozone 8-Hour 1st and 4th Max. at Takoma



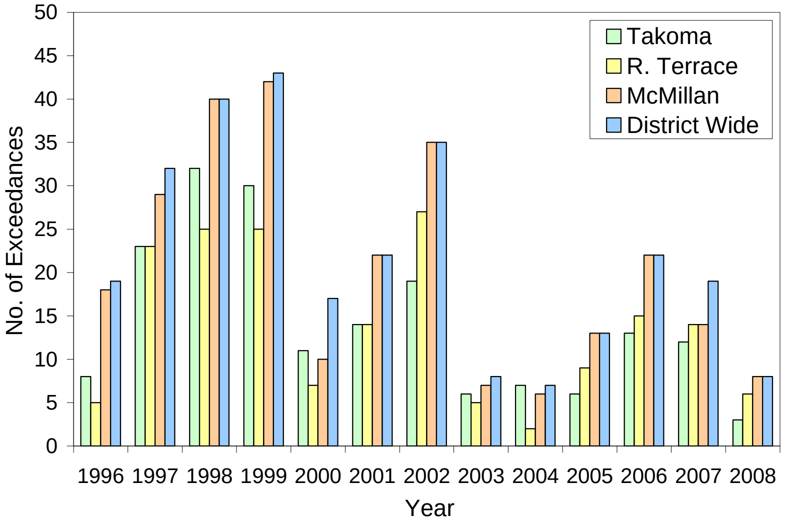
The following figure shows the design value concentrations since 1996 are also above the ozone NAAQS for ozone at all three monitoring stations. Of the three sites, McMillan has consistently maintained the highest design values during the time period examined.

Figure 13. District Ozone 8-Hour Design Values



The McMillan site has measured more exceedances than any of the ozone monitors. It has consistently measured most of the District-wide exceedances monitored each year, while the Takoma and River Terrace monitors have been more variable in their exceedance recording.

Figure 14. District Exceedances



4.5.3 Identification of Redundant Sites or New Sites Needed

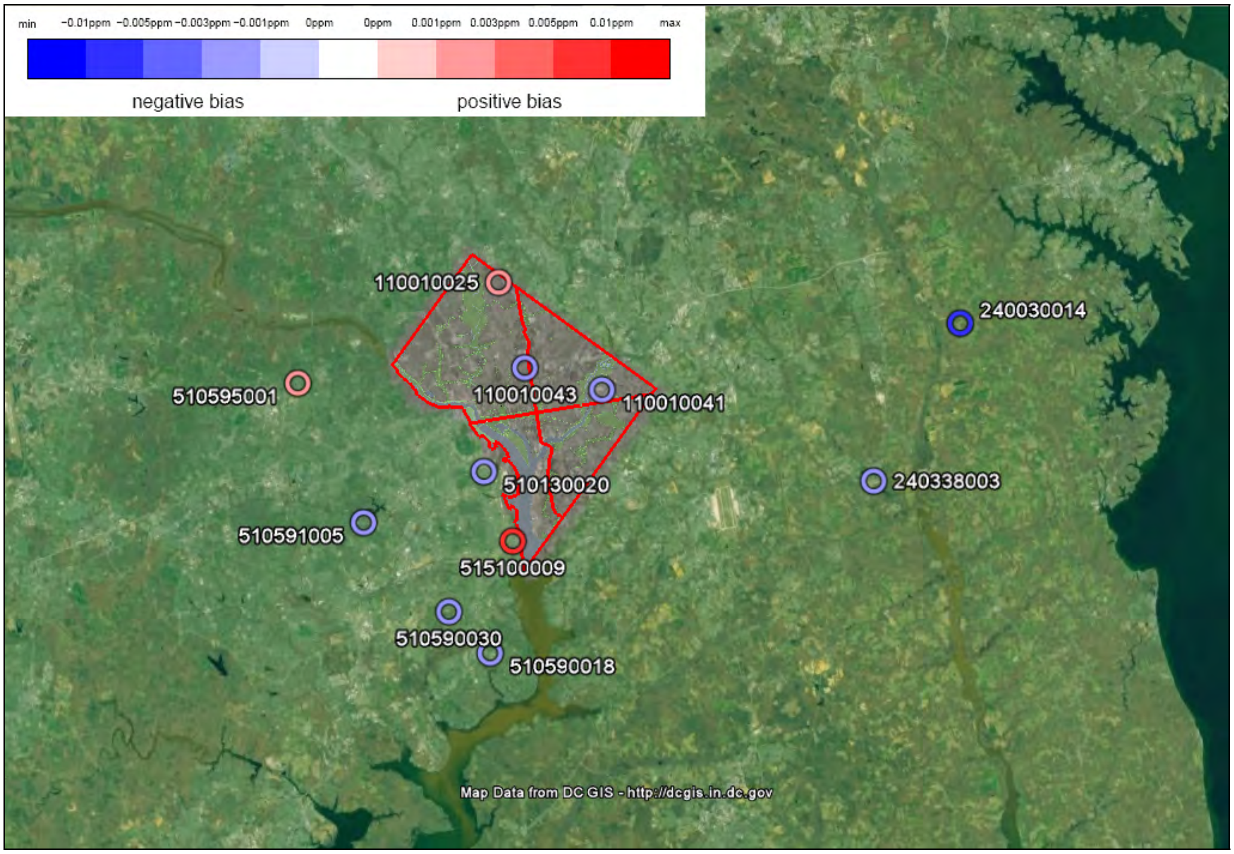
Sites that measure nearly the same concentrations of ozone are considered to be highly correlated, and show R^2 values above 0.6 (1.0 being a perfect correlation). Table 6 shows the correlation values between various sites in the District and throughout northern Virginia, which supports the nearest ozone monitoring sites. All site pairs have correlations of at least 0.917, which means the monitoring results are very similar.

Table 6: Ozone Site Correlation Comparison

Site 1	Site 2	Correlation (R^2)	Distance (km)
Takoma	Takoma	1.000	0
McMillan	Takoma	0.952	6
River Terrace	Takoma	0.944	11
510130020	Takoma	0.943	13
510591005	Takoma	0.922	19
510590018	Takoma	0.921	26
510595001	Takoma	0.943	16
510590030	Takoma	0.917	23
515100009	Takoma	0.920	18
Site 1	**Site 2**	**Correlation (R^2)**	**Distance (km)**
Takoma	McMillan	0.952	6
McMillan	McMillan	1.000	0
River Terrace	McMillan	0.962	6
510130020	McMillan	0.955	8
510591005	McMillan	0.924	16
510590018	McMillan	0.944	20
510595001	McMillan	0.950	16
510590030	McMillan	0.942	18
515100009	McMillan	0.938	12
Site 1	**Site 2**	**Correlation (R^2)**	**Distance (km)**
Takoma	River Terrace	0.944	11
McMillan	River Terrace	0.962	6
River Terrace	River Terrace	1.000	0
510130020	River Terrace	0.966	10
510591005	River Terrace	0.929	19
510590018	River Terrace	0.958	20
510595001	River Terrace	0.933	22
510590030	River Terrace	0.942	19
515100009	River Terrace	0.950	12

The high correlations indicate that these sites may be redundant and several could be considered candidates for removal. To help examine redundancies, EPA developed a removal bias tool. In this tool, a site's nearest neighbors are used to estimate how that location's concentrations would have measured if the site had never existed. The tool calculates a bias based on the difference between the measured concentration values and the estimated concentration values. The site may be considered redundant if the calculated ozone is not significantly different from the measured ozone at that site. Removal bias results from 2006 to 2008 based on AQS data, presented on EPA’s Network Assessment website (http://www.epa.gov/ttn/amtic/netassess/ozone/), are also shown in Figure 15 below.

Figure 15. Ozone Site Removal Bias Comparison



Red and blue circles indicate a positive and negative bias, respectively. They show how a location’s concentration would be measured in the event of its removal. A positive bias would measure higher than actual concentrations, a negative bias lower than actual.

The Washington region shows sites tend towards negative bias. Of the three District sites, two show negative biases (McMillan and River Terrace sites) while one shows a positive bias (Takoma site). All three sites show a fairly weak bias. It is interesting to note that the 515100009 site in Virginia reads a much higher positive bias than any of the other local monitoring sites.

4.5.4 Proposed Regulations

On January 6, 2010, EPA proposed to strengthen the NAAQS for ground-level ozone. EPA proposed strengthening the 8-hour “primary” ozone standard, designed to protect public health, to a level within the range of 0.060 to 0.070 parts per million (ppm). EPA also proposed establishing a distinct cumulative, seasonal “secondary” standard, designed to protect sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. EPA proposed setting the level of the secondary standard within the range of 7 to 15 ppm-hours.

On July 8, 2009, EPA had previously proposed modifying the minimum ozone monitoring requirements to require one monitor to be placed in MSAs of populations ranging from 50,000 to less than 350,000 in situations where there is no current monitor and no history of ozone monitoring within the previous 5 years indicating a design value of less than 85 percent of the revised NAAQS. These urban areas would be required to operate at least one ozone monitor if monitoring is not already being conducted. EPA also proposed additional monitoring requirements in non-urban areas. States will be required to operate a minimum of three ozone monitors in non-urban areas which will be located in:

1. Areas such as some Federal, State or Tribal lands, including wilderness areas that have ozone-sensitive natural vegetation and /or ecosystems; lands with ownership may also be appropriate.

2. Micropolitan statistical area (10,000-50,000 people) expected to have ozone design value concentrations of at least 85 percent of the NAAQS.

3. The area of expected maximum ozone concentration outside of any MSA, potentially including the far-downwind transport zones of currently well-monitored urban areas.

In addition, EPA proposed lengthening the required ozone monitoring season to account for the tightened level of the revised NAAQS. The proposed ozone season for the District would start on March 1st and end on October 31st. It was also proposed that ozone monitors operated as part of NCore be required to operate on a year-round schedule when the network is fully operational in 2011. EPA proposed that the revised ozone monitoring season for existing monitors be effective for the 2011 monitoring season. New ozone monitors are proposed to be operational no later than January 1, 2012.

Any changes to the network necessary to meet these proposed new requirements will be addressed in the District's Annual Network Plan due by July 1, 2011, pending final approval of the proposed rule (expected in August 2010).

4.5.5 Network Recommendations

Based on the ozone data, removal bias, and correlation graphs and tables, there is evidence that sites could be removed from the District without significantly impacting the monitoring network. The McMillan site would not be considered for discontinuation. While its correlation and removal bias indicate its removal would not cause significant impact, it is the District's ozone design value monitor and has consistently measured high number of NAAQS exceedances. Based on ozone data alone, Takoma and River Terrace may be considered for removal.

Due to the high correlation and low removal bias values among the sites already in place, there is no reason to consider any new sites for ozone monitoring. Population shifts in the District are nominal over time, being an urban area, so site locations are still considered appropriate.

An update in ozone technology would not be required for the District as all current monitors have been upgraded from Thermo C- Series, to the newer I-Series.

4.6 Photochemical Monitoring for Ozone Precursors

In accordance with the 1990 Clean Air Act Amendments, EPA has required more extensive monitoring of ozone and its precursors in areas with persistently high ozone levels. In these areas, the States have established ambient air monitoring sites called Photochemical Assessment Monitoring Stations (PAMS) which collect and report detailed data for volatile organic compounds, nitrogen oxides, ozone and meteorological parameters. PAMS VOCs can come from automobiles, gasoline vapors, and vast variety of large and small commercial and industrial sources that use chemical solvents, paint thinner and other chemical compounds. Analyses of these data helps to better understand the underlying causes of ozone pollution, to devise effective remedies, and to measure environmental improvement.

4.6.1 Existing Network and Compliance with Network Requirements

Design criteria for the PAMS network, described in 40 CFR Part 58, Appendix D (section 5.1), are based on locations relative to ozone precursor source areas and predominant wind directions associated with high ozone events. There are specific monitoring objectives associated with each location. The overall design should enable characterization of precursor emissions sources within the nonattainment area, transport of ozone and its precursors, and the photochemical processes related to ozone nonattainment. Specific monitoring objectives associated with each of these sites may result in four distinct site types:

> Type 1 Sites – Intended to characterize upwind background and transported ozone and its precursor concentrations entering the area and will identify those areas which are subjected to transport.
>
> Type 2 Sites – Intended to monitor the magnitude and type of precursor emissions in the area where maximum precursor emissions are expected to impact and are suited for the monitoring of urban air toxic pollutants.
>
> Type 3 Sites – Intended to monitor maximum ozone concentrations occurring downwind from the area of maximum precursor emissions.
>
> Type 4 Sites – Intended to characterize the downwind transported ozone and its precursor concentrations exiting the area and will identify those areas which are potentially contributing to overwhelming transport in other areas.

The District operates <u>one</u> PAMS Type 2 station at McMillan monitoring site, as required. The parameters measured are O_3, NO, NOx, NO_2, and speciated VOCs. During the core ozone season (June-August), 3-hour air samples are collected for carbonyls on a 1-in-3 day schedule. In addition, measurements for the 56 target hydrocarbons are analyzed on-site every hour. The District also measures ozone and oxides of nitrogen with surface meteorological measurements at this site.

Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	Type 2 PAMS	06/01/1994	128	3	Urban	General/Background	NCore	Hourly

The objective of the McMillan PAMS site is to measure background and transported ozone and precursor emissions.

4.6.2 Monitoring Results

Various pollutant trends over the last five years (more or less depending on pollutant) are graphically represented in this document. The observed trends are discussed and recommendations made. Selected CSN pollutants monitored are equally discussed.

4.6.3 Identification of Redundant Sites or New Sites Needed

There is only one PAMS site in the District, and it is an NCore site, so there is no redundancy.

The program currently meets the monitoring requirements for the minimum number of PAMS sites per PAMS area. No additional sites are under consideration.

4.6.4 Proposed Regulations

No revisions to the PAMS monitoring rule have been proposed or scheduled to be proposed in the near future.

4.6.5 Network Recommendations

There is only one PAMS site in the District, and it is an NCore site, so there is no redundancy.

4.7 $PM_{2.5}$ Monitoring Network

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 of gaseous pollutants in the atmosphere. The size of the particles directly relates to their potential for causing health problems. Small particles less than 2.5 micrometers (microns) in diameter pose the greatest problems, because they can travel deep into the lungs to the alveoli, and therefore, some may move into the bloodstream. Exposure to such particles can affect both the respiratory and cardiovascular systems. Particulate matter is also a major cause of reduced visibility in many regions and national parks and can cause damage to building materials.

Washington, D.C. trend analysis for $PM_{2.5}$ begins with the data from 1999, when broad-scale $PM_{2.5}$ sampling began in the District.

4.7.1 Existing Network and Compliance with Network Requirements

The District has met the basic design criteria for PM2.5, as described in 40 CFR Part 58, Appendix D (section 4.7). Three monitors are required for MSA populations greater than 1,000,000, when the most recent design value is over or equal to 85 percent of any PM2.5 NAAQS. Two are required when the most recent design value is less than 85 percent of any PM2.5 NAAQS.

The District has at least the minimum number of PM2.5 SLAMs, continuous, and chemical speciation monitor sites required based on MSA population.

- **$PM_{2.5}$ Continuous Monitoring –** The District currently operates one continuous $PM_{2.5}$ station at the McMillan site. This continuous $PM_{2.5}$ station operates year-round and hourly data are sent to EPA’s AirNow real-time air quality information web portal and to the AQS national database. The data is primarily used to support AQI forecasting and reporting.

- **$PM_{2.5}$ FRM Network –** The District operates four $PM_{2.5}$ FRM monitors. One monitor is located at McMillan, one at Hains Point, and two $PM_{2.5}$ FRMs are co-located at the River Terrace station. It is a requirement that the McMillan and River Terrace primary monitors are daily sampling sites while the Hains Point site is on a 1-in-3 day sample schedule. The co-located monitor at River Terrace is operated on a 1-in-6 day sampling schedule.

- **PM2.5 Chemical Speciation Network –** The District currently operates one $PM_{2.5}$ chemical speciation network (CSN) monitor at its McMillan Reservoir station. The CSN station at McMillan site operates on a 1-in-3 day sampling schedule to measure $PM_{2.5}$ chemical species.

The following table summarizes the objectives and other details of each monitor.

Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	PM2.5 Continuous	01/01/2003	701	4	Urban	Population Exposure/Max Precursor	SLAMS	Hourly
	PM2.5	01/01/1999	120	4	Urban	Population Exposure/Max Precursor	SLAMS	Daily
	PM2.5 Chemical Speciation	01/01/2002	810	4	Urban	Population Exposure/Trends	CSN	Every 3 days
River Terrace	PM2.5	01/01/1999	120	10	Neighborhood	Population Exposure	SLAMS	Daily
Hains Point	PM2.5	03/01/1999	120	10	Urban	Population Exposure	SLAMS	Every 3 Days

With regards to $PM_{2.5}$ FRM, the design value site is McMillan. All sites are population oriented. This means they are not influenced by single sources, and they are located where large numbers of people live, work, or play.

The McMillan station is among the few $PM_{2.5}$ CSN core sites collocated with PAMS that measure ozone and its precursors. $PM_{2.5}$ filter samples that require chemical speciation are collected with aerosol samplers. Chemical speciation quantifies significant $PM_{2.5}$ components of geological material, such as sulfate, nitrate, ammonium, organic carbon, and elemental carbon, in addition to mass concentration. While sampling continues on this station, collocating the samplers may help in data comparison and improved pollutant concentration determination for regulators, researchers and other interest groups.

The District does not have a formally designated transport site, although the Hains Point $PM_{2.5}$ FRM monitor is collocated with National Park Service's IMPROVE $PM_{2.5}$ mass and speciation monitors at this location.

4.7.2 Monitoring Results

Currently, all District monitors are in attainment of both the daily and annual NAAQS. The following figures show concentrations based on the District's PM2.5 FRM monitors.

Figure 16. $PM_{2.5}$ Annual Design Value All Sites

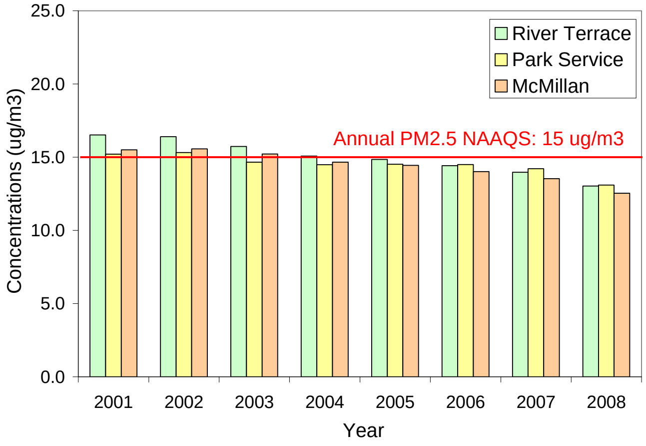
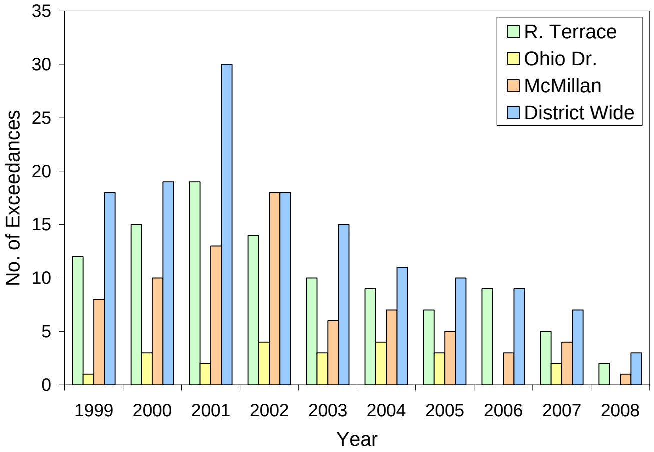


Figure 17. $PM_{2.5}$ Number of Daily Exceedances



4.7.3 Identification of Redundant Sites or New Sites Needed

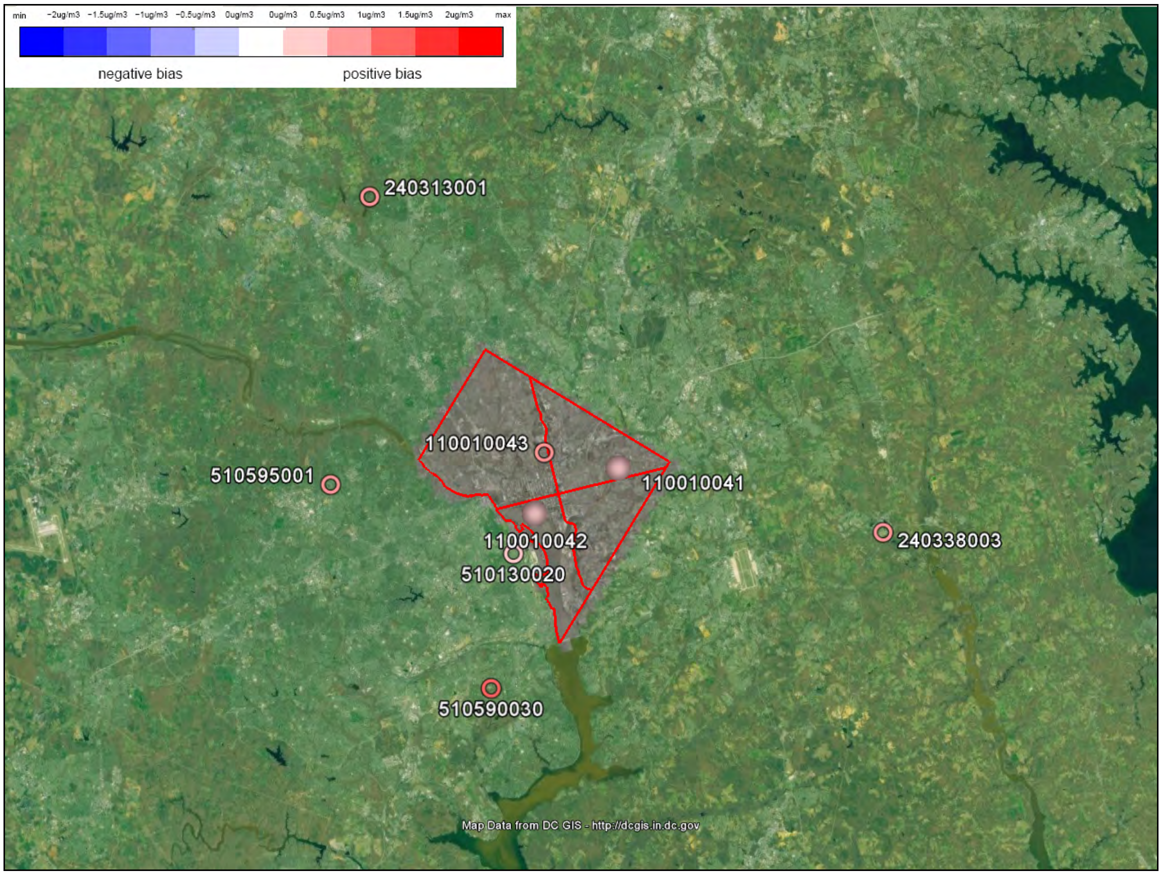
Recommendations for moving or removal of sites were made only after the candidate sites were ranked according to their value relative to all other sites in the network, as noted in Table 7. All correlations are high.

Table 7. $PM_{2.5}$ 1-in-3 Day Correlation Comparison

Site 1	Site 2	Correlation (R^2)	Distance (km)
McMillan	McMillan	1	0
Haines Point	McMillan	0.900	5
River Terrace	McMillan	0.927	6
240313001	McMillan	0.892	23
240338003	McMillan	0.888	26
245100008	McMillan	0.889	57
245100040	McMillan	0.867	55
245100007	McMillan	0.887	55
245100006	McMillan	0.890	59
510130020	McMillan	0.943	8
510595001	McMillan	0.930	16
511071005	McMillan	0.877	43
Site 1	**Site 2**	**Correlation (R^2)**	**Distance (km)**
McMillan	Haines Point	0.900	5
Haines Point	Haines Point	1.000	0
River Terrace	Haines Point	0.894	7
240313001	Haines Point	0.900	27
240338003	Haines Point	0.946	26
245100008	Haines Point	0.851	61
245100040	Haines Point	0.867	59
245100007	Haines Point	0.861	59
245100006	Haines Point	0.867	64
510130020	Haines Point	0.937	3
510595001	Haines Point	0.923	15
511071005	Haines Point	0.877	43
Site 1	**Site 2**	**Correlation (R^2)**	**Distance (km)**
McMillan	River Terrace	0.927	6
Haines Point	River Terrace	0.894	7
River Terrace	River Terrace	1.000	0
240313001	River Terrace	0.874	27
240338003	River Terrace	0.889	20
245100008	River Terrace	0.869	55
245100040	River Terrace	0.837	53
245100007	River Terrace	0.867	54
245100006	River Terrace	0.883	58
510130020	River Terrace	0.934	10
510595001	River Terrace	0.932	22
511071005	River Terrace	0.865	48

The 1-in-3 day removal bias picture in Figure 18 shows that all sites in the District have a positive bias.

Figure 18. $PM_{2.5}$ – 1-in-3 Day Removal Bias



4.7.4 Proposed Regulations

No new regulations or monitoring rules have been proposed for $PM_{2.5}$ as of this writing, although a final NAAQS revision is anticipated in October of 2011.

4.7.5 Network Recommendations

DDOE is in the process of adding a continuous $PM_{2.5}$ Beta Attenuation Mass Monitor (BAMM) 1020 FEM at McMillan.

All three sites are monitoring $PM_{2.5}$ concentrations greater than 85 percent of the NAAQS. For this reason, it is suggested that all three sites be retained until we can re-evaluate our design values, relative to a new $PM_{2.5}$ NAAQS.

A change in technology currently employed in monitoring $PM_{2.5}$ is also recommended. All of the three sites currently employ the 24-hour FRM monitors. Changing from this technology to the Federal Equivalent method (FEM) with continuous monitoring is hereby recommended.

The River Terrace (11-001-0041) and Hains Point sites (11-001-0042), both have the probes located well above the human breathing height. Relocating the monitors to locations that permit siting at breathing level is worth considering.

River Terrace is the design value site and has a collocated monitor. This makes it imperative to retain the PM2.5 monitoring at this site. Hains Point monitor needs re-evaluation, considering the high correlation coefficient between all the sites in the area and the fact that a new monitor deployed approximately 3 kilometer in Alexandria, VA. It is worth noting that the National Park Service is also operates IMPROVE $PM_{2.5}$ mass and chemical speciation monitors at Hains Point station. District's Hains Point $PM_{2.5}$ monitor will be re-evaluated against Alexandria monitor when sufficient data becomes available.

4.8 PM_{10} Monitoring Network

PM_{10} refers to those particles less than 10 microns in diameter.

4.8.1 Existing Network and Compliance with Network Requirements

Basic design criteria for PM_{10} networks are based on population and ambient air concentrations, as described in 40 CFR Part 58, Appendix D (section 4.8). In contrast with design requirements for other pollutant networks, there are no required objectives for PM_{10} monitoring.

The District operates two PM_{10} Hi-Vol manual gravimetric method monitors in its air monitoring network. Both primary and co-located monitors are operated at the River Terrace site and the measurements are made on a 1-in-6 day sampling schedule.

Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	PMcoarse	1/1/2011		3	Urban	General/Background	NCore	Hourly
River Terrace	PM10	5/1/1993	063	10	Neighborhood	Population Exposure	SLAMS	Every 6 Days

4.8.2 Monitoring Results

As demonstrated in Figures 19 and 20, PM_{10} concentration and design value have been well below the NAAQS since 1996.

PM_{10} monitoring was gradually phased-out towards the years of 1999 and 2000 when $PM_{2.5}$ monitoring became much more important.. The District's $_{PM10}$ network downsized from three sites up until 1990s to one monitoring station. Figure 19 shows yearly highest values (1st Max) compared to the second highest values (2nd Max) at the River Terrace (neighborhood area) location. The graph shows that District's monitors continue to monitor well below the 150 ug/m^3 daily NAAQS.

Figure 19. River Terrace 1st and 2nd Maxima PM_{10} Concentrations

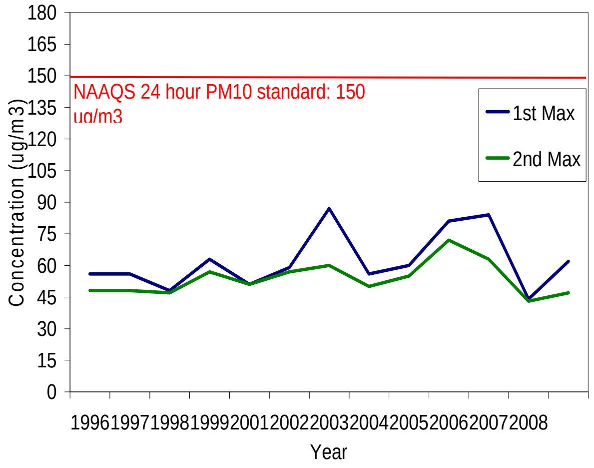
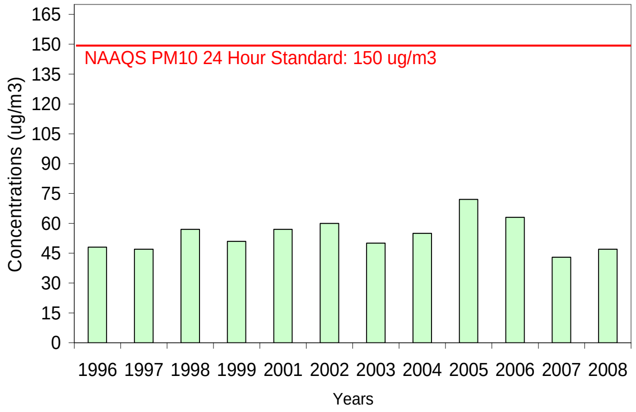


Figure 20. River Terrace PM_{10} Design Values



4.8.3 Identification of Redundant Sites or New Sites Needed

Since there is only one PM_{10} site, there is no redundancy. No new sites are being considered.

4.8.4 Proposed Regulations

No changes to either the NAAQS or the monitoring rule have been proposed.

4.8.5 Network Recommendations

Currently, DDOE operates very old (aging) PM10 Hi-Vol monitoring technology for PM10 network. It is recommended to evaluate continuous measurement FEM technology.

4.9 SO_2 Monitoring Network

Sulfur dioxide is a gas that forms when sulfur-bearing fuels (mainly coal and oil) are burned. High concentrations can result in difficulties in breathing, respiratory illness, the aggravation of existing cardiovascular disease, and can cause alterations in the lung's defenses. 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.

4.9.1 Existing Network and Compliance with Network Requirements

Basic SO2 design criteria are specified in 40 CFR Part 58, Appendix D (section 4.4). There are no minimum requirements for SLAMS monitors. Continued operation of existing SLAMS sites using FRM or FEM is required until discontinuation is approved by the EPA Administrator. Where SLAMS SO_2 monitoring is ongoing, at least one site must be a maximum concentration site for the area.

The District operates one SO_2 monitor in its air monitoring network. An automated continuous SO_2 monitor is located at the River Terrace station and collects data year-round on an hourly basis.

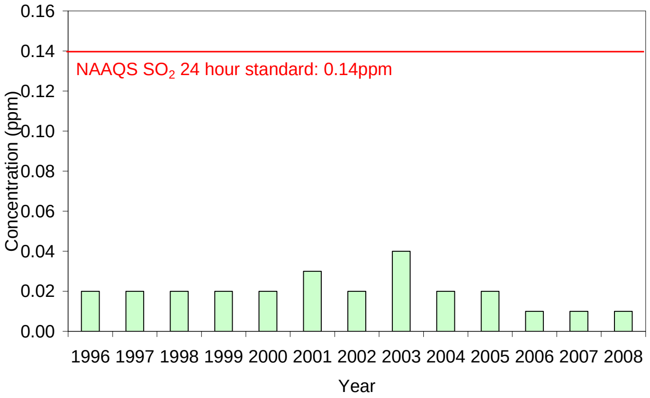
Site Name, AQS ID	Parameter	Start Date	Method Code	Probe Height (m)	Scale of Representative	Monitoring Objective	Type	Sample Schedule
McMillan	SO2 (trace)	1/1/2011	560	3	Urban	General/Background	NCore	Hourly
River Terrace	Sulfur Dioxide	5/1/1993	060	10	Neighborhood	Population Exposure	SLAMS	Hourly

In addition, an NCore site will be added to the McMillan station to monitor trace levels of SO2 by January of 2011.

4.9.2 Monitoring Results

The District's only monitoring location in Washington, D.C., shows levels well below each of the SO_2 NAAQS, as demonstrated in the Appendix. The design value for SO_2 (Figure 21) has also been well below the NAAQS.

Figure 21. SO_2 Design Value at River Terrace



4.9.3 Identification of Redundant Sites or New Sites Needed

Since there is only one SO_2 monitor, there are no redundant sites. Additional sites may be considered based on the monitoring requirements for the new NAAQS.

4.9.4 Proposed Regulations

On November 16, 2009, EPA proposed to revise the primary SO2 NAAQS to establish a new 1-hour SO2 standard within the range of 50-100 ppb, based on the 3-year average of the annual 99th percentile (or 4th highest) of 1-hour daily maximum concentrations (40 CFR Parts 50, 53 and 58). At the same time, EPA also proposed to revise the SO2 monitoring rule. These revision address specific minimum requirements to guide where SO2 monitors should be placed. The proposal establishes two categories of required monitors for the revised SO2 network. These two categories include the following: monitors are required to be placed in Core Based Statistical Areas (CBSAs) based on population size and SO2 emissions, and monitors are required to be located within a state based on that state's contribution to national SO2 emissions. States will determine the specific location of these monitors within state boundaries (which can be inside or outside of CBSAs), with EPA approval.

EPA proposed that the first prong of the ambient SO2 monitoring network account for SO2 exposure by requiring monitors in locations where population and emissions may lead to higher potential for population exposure to peak hourly SO2 concentrations. In order to do this, EPA has developed a Population Weighted Emissions Index (PWEI) that uses population and emissions inventory data at the CBSA level to assign required monitors for a given CBSA (population and emissions being obvious relevant factors in prioritizing numbers of required monitors). Based on EPA's proposed SO2 monitoring regulation…

EPA proposed that monitors triggered in this first prong of the network design must be sited in locations of expected maximum 1-hour concentrations, at the appropriate spatial scale (micro, middle, and neighborhood scales), within the boundaries of a given CBSA. EPA also proposed that when state or local agencies make selections for monitoring sites from a pool of similar candidate site locations, they shall prioritize monitoring where the maximum expected hourly concentrations occur in relative greater proximity to populations. EPA believes that states will likely need to use some form of quantitative analysis, such as modeling, data analysis or saturation studies to aid in determining where the ground-level SO2 maxima may occur in a given CBSA. The program will begin work on these analyses when the rules are finalized and guidance has been provided by EPA. Monitors are proposed to be in place and operational by January 1, 2013. Final monitor locations will be chosen in consultation with neighboring states and EPA Region III.

In the second prong of the SO2 network, approximately 117 sites nationwide will be distributed among the states based on the corresponding percent contribution of each individual state to the national anthropogenic SO2 emission inventory. This is intended to allow a portion of the overall required monitors to be placed where needed, independent of the PWEI, inside or outside of CBSAs.

4.9.5 Network Recommendations

In the year 2011, SO_2 trace level monitoring will be added to the District's NCore station at McMillan. The District will continue to monitor at the River Terrace neighborhood area site because there are not many SO_2 monitoring stations in the region.

5.0 AIR MONITORING PROGRAM AND DATA CONTACTS

The Monitoring and Assessment Branch in DDOE's Air Quality Division monitors the ambient air quality and performs quality assurance and quality control on all air pollution data recorded at the various monitoring stations in the District of Columbia. DDOE is modifying the data acquisition system so that all communication between the continuous analyzers, the remote data logger, and central office are transmitted via digital format over internet protocol TCP/IP. Data are stored locally for use by staff and for preparation of special reports and data charts or special Freedom of Information Act requests.

Data are delivered to the EPA Air Quality Subsystem (AQS) and reported on a schedule set forth in 40 CFR Part 58 of the Clean Air Act. EPA controls the access to the raw ambient air quality data DDOE submits to the national database. Annual SLAMS Reports are generated from AQS and data certifications are prepared by DDOE according to Data Reporting Requirement of 40 CFR, Part 58. Data requests can be directed via email to: robert.day@District.gov

District of Columbia's air monitoring program main contact:

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Acknowledgements

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APPENDIX

Tables and Figures in this appendix are supplemental data for the network assessment main document.

Table A1. District of Columbia 2010 Ambient Air Monitoring Network and Monitor Details

Site Name, AQS ID	Street Address	City, County	Zip Code	Latitude, Longitude	Location Setting	Nearest Road	Traffic Count	Traffic Count Year	Distance (m)	Metro Statistical Area (MSA)
McMillan 110010043	2500 1st St., N.W.	Washington DC	20001	38°55'18.81"N 77° 0'47.58"W	Urban	First Street NW	7600	2008	50	DC-Arlington-Alexandria
River Terrace 110010041	420 34th Street N.E.,	Washington, DC	20019	38°53'44.06"N 76°57'29.06"W	Urban	Benning Rd.	45700	2008	100	DC-Arlington-Alexandria
Takoma 110010025	7010 Piney Branch Rd. N.W.,	Washington, DC	20012	8°58'32.09"N 77° 1'21.45"W	Urban	Piney Branch Rd.	15800	2008	50	DC-Arlington-Alexandria
Verizon 110010023	2055 L St., N.W.,	Washington, DC	20036	38°54'13.94"N 77° 2'45.03"W	City Center	L St.	11200	2008	5	DC-Arlington-Alexandria
Hains Point 110010042	1100 Ohio Drive S.W.,	Washington, DC	20242	8°52'34.40"N 77° 2'3.78"W	Urban	I-395	209200	2008	250	DC-Arlington-Alexandria

Table A2. Constituent Compounds and Species Measured in DC

Constituent Group	Compounds in the Constituent Group
Air Toxics	Dichlorodifluoromethane, Chloromethane, 1,2-Dichloro-1,1,2,2,tetrafluoroleth, Chloroethene, 1,3-Butadiene, Bromomethane, Chloroethane, Trichlorofluoromethane, Acrolein, Acetone, 1,1-Dichloroethene, Methylene Chloride, Carbon disulfide, Isopropyl Alcohol, 1,1,2-Trichloro-1,2,2-trifluoroethane, Trans-1,2-Dichloroethene, 1,1-Dichloroethane, 2-methoxy-2-methyl-Propane, Methyl ethyl Ketone (2-butanone), Cis-1,2-Dichloroethene, Hexane, Chloroform, Ethyl Acetate, Tetrahydrofuran, 1,2-Dichloroethane, 1,1,1-Trichloroethane, Benzene, Carbon tetrachloride, Cyclohexane, 1,2-Dichloropropane, Bromodichloromethane, Trichloroethylene, Heptane, Cis-1,3-Dichloro-1-Propene, Methyl Isobutyl Ketone , Trans-1,3-Dichloro-1-Propene, 1,1,2-Trichloroethane, Toluene, Dibrochloromethane, Methyl butyl Ketone, (2-Hexanone), 1,2-Dibromoethane, Tetrachloroethylene, Chlorobenzene, Ethyl benzene, m & p- Xylene, Bromoform (Tribromomethane), Styrene, 1,1,2,2-Tetrachloroethane, o-Xylene, 1-Ethyl-4-Methylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, Benzyl Chloride, 1,3-dichlorobenzene,1,4-Dichlorobenzene, 1,2-Dichlorobenzene, 1,2,4-Trichlorobenzene, and Hexachloro-1,3-Butadiene
PAMS VOCs	Acetone, Ethane, Acetylene, Propane, 2,2-dimethylbutane, Benzene, i-Butane, n-Butane, i-Pentane, n-Pentane, 2,2,4-trimethylpentane, i-Propylbenzene, n-hexane, 2-methylpentane, 2,3-dimethylbutane, Cyclopentane, Ethylbenzene, n-Propylbenzene, 3-methylpentane, Toluene, Styrene, n-Heptane, 2-methylhexane, 2,4-dimethylpentane, 2,3,4-trimethylpentane, o-Xylene, 3-methylhexane, 2,3-dimethylpentane, Formaldehyde, n-Octane, 2-methylheptane, Cyclohexane, 3-methylheptane, n-Nonane, m&p-Xylenes, Methylcyclohexane, Methylcyclopentane, n-Decane, n-Undecane, Acetaldehyde, 1,2,3-Trimethylbenzene, 1,2,4-Trimethylbenzene, 3-methyl-1-butene, 1-Butene, Propene, 1-Pentene, 1,3,5-Trimethylbenzene, 2-methyl-1-pentene, 2-methyl-2-butene, c-2-hexene, c-2-pentene, c-2-Butene, Cyclopentene, 4-methyl-1-pentene, t-2-hexene, t-2-Butene, t-2-pentene, Isoprene
Speciated PM2.5 Mass	Aluminum, Ammonium, Antimony, Arsenic, Barium, Bromine, Cadmium, Calcium, Carbonate carbon, Cerium, Cesium, Chlorine, Chromium, Cobalt, Copper, Elemental carbon, Europium, Gallium, Gold, Hafnium, Indium, Iridium, Iron, Lanthanum, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Niobium, Nitrate, OCX, OCX2, Organic carbon, Phosphorus, Pk1_OC, Pk2_OC, Pk3_OC, Pk4_OC, Potassium, PyrolC, Rubidium, Samarium, Scandium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfate, Sulfur, Tantalum, Terbium, Tin, Titanium, Total carbon, Vanadium, Wolfram, Yttrium, Zinc, and Zirconium

Figure A1. CO 1-Hour Design Values since 1996

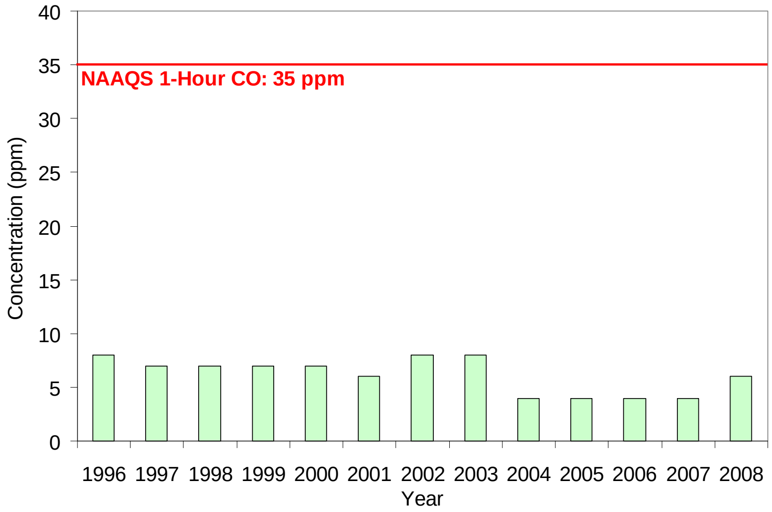


Figure A2. CO 8-Hour Design Values since 1996

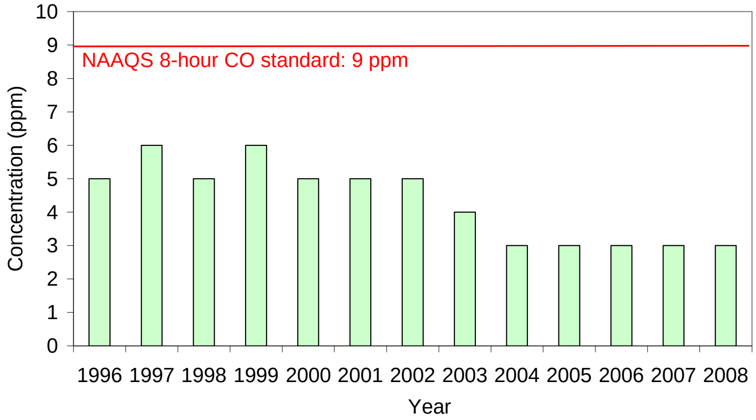


Figure A3. NO2 Annual Averages – District of Columbia

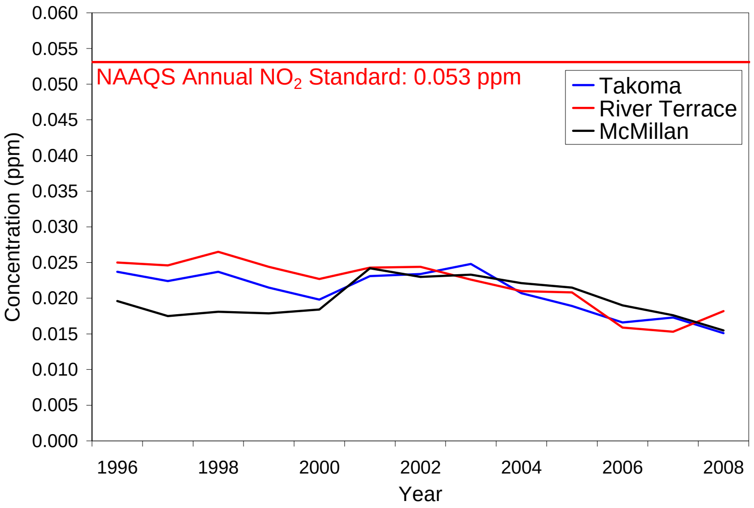


Figure A4. NO2 1-Hour 98th Percentile – District of Columbia

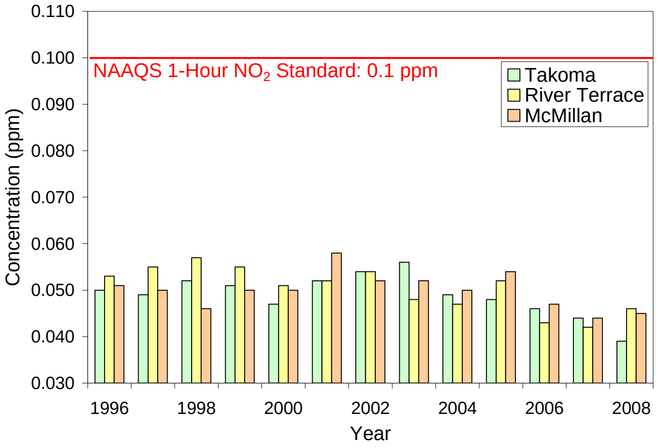


Figure A5. SO_2 1-Hour 1st and 2nd Max Values at River Terrace

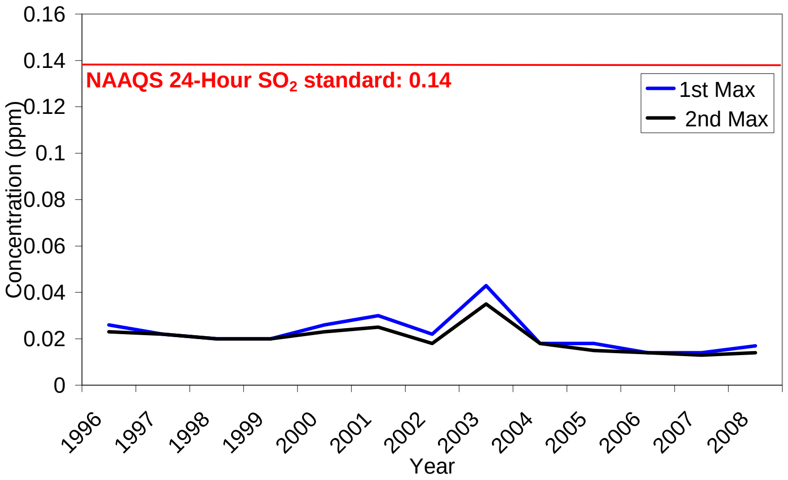


Figure A6. SO_2 Annual Means at River Terrace

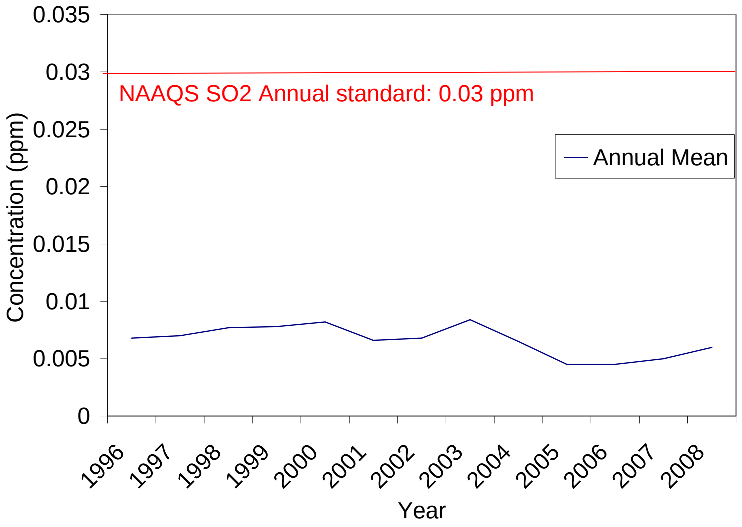


Figure A7. PM2.5 Annual Averages – District of Columbia

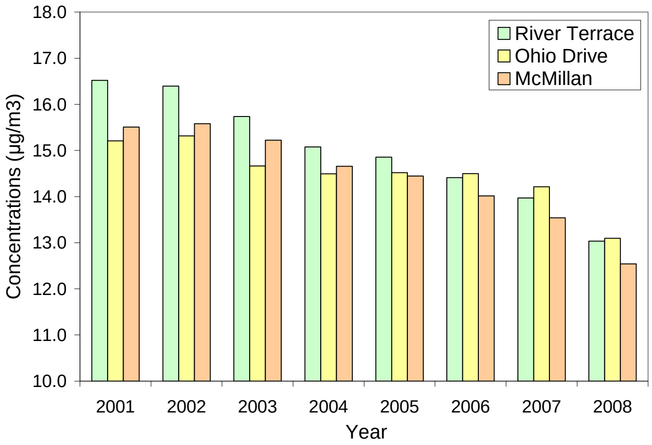


Figure A8. PM2.5 98th Percentile Data – District of Columbia

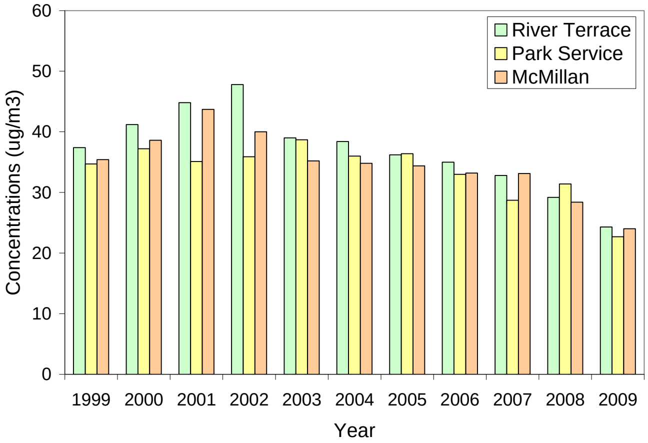


Table A3. PM$_{2.5}$ Continuous Monitoring

Site 1	**Site 2**	**Correlation**	**Distance (km)**
110010043	110010043	1.000	0
110010043	510591005	0.934	16

Figure A9. PM2.5 Removal Bias – PM2.5 Continuous Monitors Network

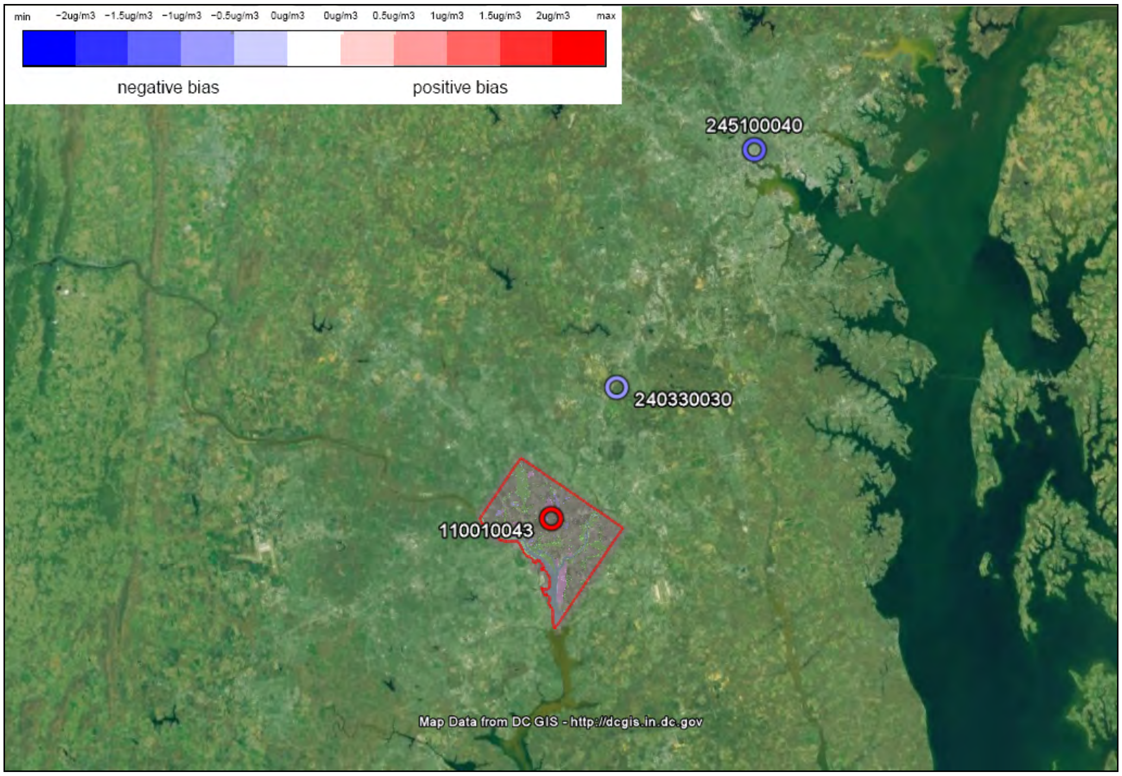


Figure A10. PM2.5 1-in-6 Day Removal Bias

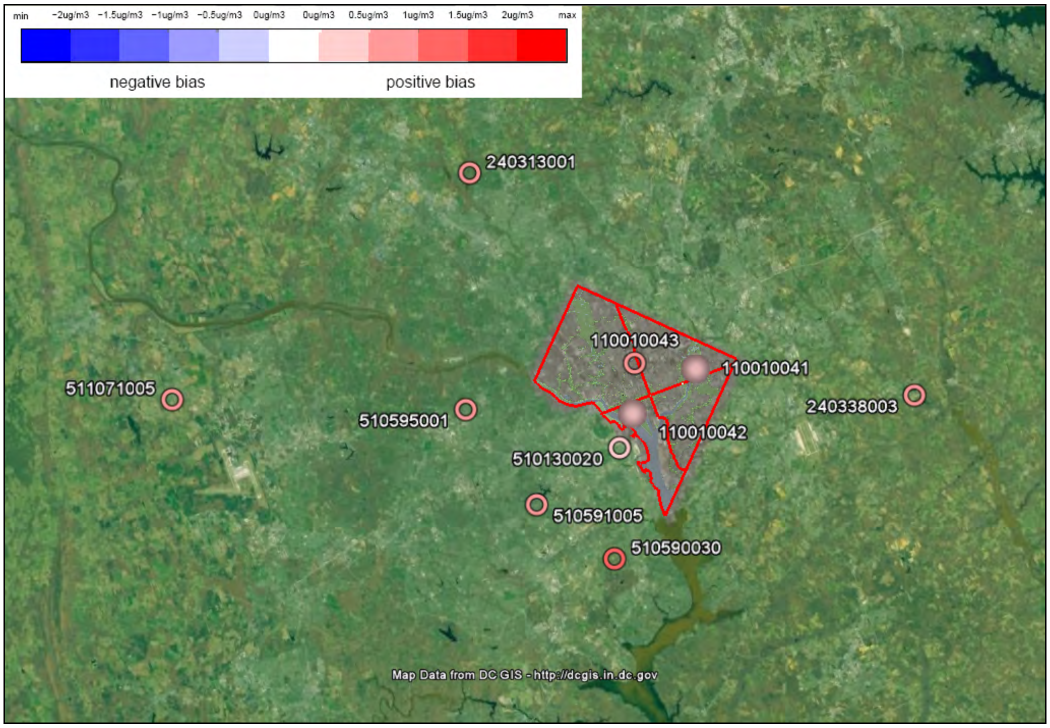
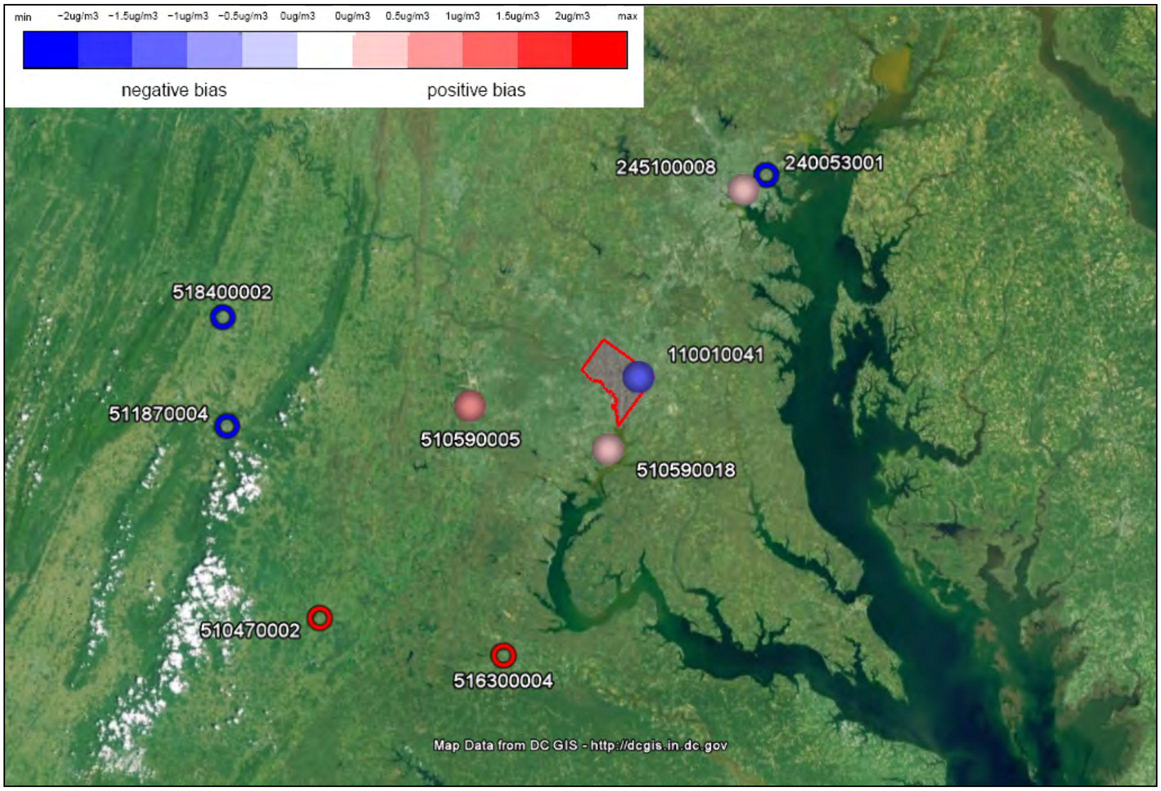


Figure A4. PM$_{2.5}$ FRM Network1-in-6 Day Data. Correlation Comparison

Site 1	**Site 2**	**Correlation**	**Distance (km)**
Haines Point	Haines Point	1	0
McMillan	Haines Point	0.917466917	5
River Terrace	Haines Point	0.899621193	7
240053001	Haines Point	0.884295003	68
240313001	Haines Point	0.931603321	27
240338003	Haines Point	0.951502423	26
245100006	Haines Point	0.91353743	64
245100007	Haines Point	0.900520389	59
245100008	Haines Point	0.891399079	61
510130020	Haines Point	0.985724128	3
510595001	Haines Point	0.961667832	15
510590030	Haines Point	0.968507944	13
511071005	Haines Point	0.930613173	43
Site 1	**Site 2**	**Correlation**	**Distance (km)**
Haines Point	McMillan	0.917466917	5
McMillan	McMillan	1	0
River Terrace	McMillan	0.900198701	6
240053001	McMillan	0.85690159	63
240313001	McMillan	0.849400351	23
240338003	McMillan	0.86521229	26
245100006	McMillan	0.859398753	59
245100007	McMillan	0.845322207	55
245100008	McMillan	0.863214619	57
510130020	McMillan	0.91720073	8
510595001	McMillan	0.897489501	16
510590030	McMillan	0.897310309	18
511071005	McMillan	0.868044544	43
Site 1	**Site 2**	**Correlation**	**Distance (km)**
Haines Point	River Terrace	0.899621193	7
McMillan	River Terrace	0.900198701	6
River Terrace	River Terrace	1	0
240053001	River Terrace	0.840720107	61
240313001	River Terrace	0.842543107	27
240338003	River Terrace	0.862293648	20
245100006	River Terrace	0.859919197	58
245100007	River Terrace	0.822873609	54
245100008	River Terrace	0.840502305	55
510130020	River Terrace	0.910193305	10
510595001	River Terrace	0.905930306	22
510590030	River Terrace	0.904796501	19
511071005	River Terrace	0.882620083	48

Figure A11. PM_{10} Removal Bias



Map Data from DC GIS - http://dcgis.in.dc.gov

GOVERNMENT OF THE DISTRICT OF COLUMBIA
District Department of the Environment

Air Quality Division

July 1, 2010

Shawn M. Garvin
Regional Administrator
EPA Region 3
Mail Code 3RA00
1650 Arch Street
Philadelphia, PA 19103
Attention: Air Protection Division

Re: 5-Year Assessment - District of Columbia's Ambient Air Monitoring Network

Dear Mr. Garvin,

In accordance with 40 CFR § 58.10(d), the District Department of the Environment's Monitoring and Assessment Branch, Air Quality Division, performed a 5-year technical assessment of the District of Columbia's Ambient Air Monitoring Network. Enclosed please find the 5-year network assessment report.

I can be reached on phone at (202) 535-2989 to answer any questions.

Sincerely,

July 1, 2010

Rama S. Tangirala, Ph.D.
Chief, Monitoring and Assessment Branch

Enclosure (1)

cc: Diana Esher, Director, Air Protection Division, EPA Region 3
Walter Wilkie, Associate Director,Assessment & Analysis Branch,Air Protection Division, EPA Region 3
Cecily Beall, Associate Director, Air Quality Division, DDOE