District of Columbia's
Ambient Air Quality TRENDS REPORT

October 2014

DISTRICT DEPARTMENT OF THE ENVIRONMENT
green forward

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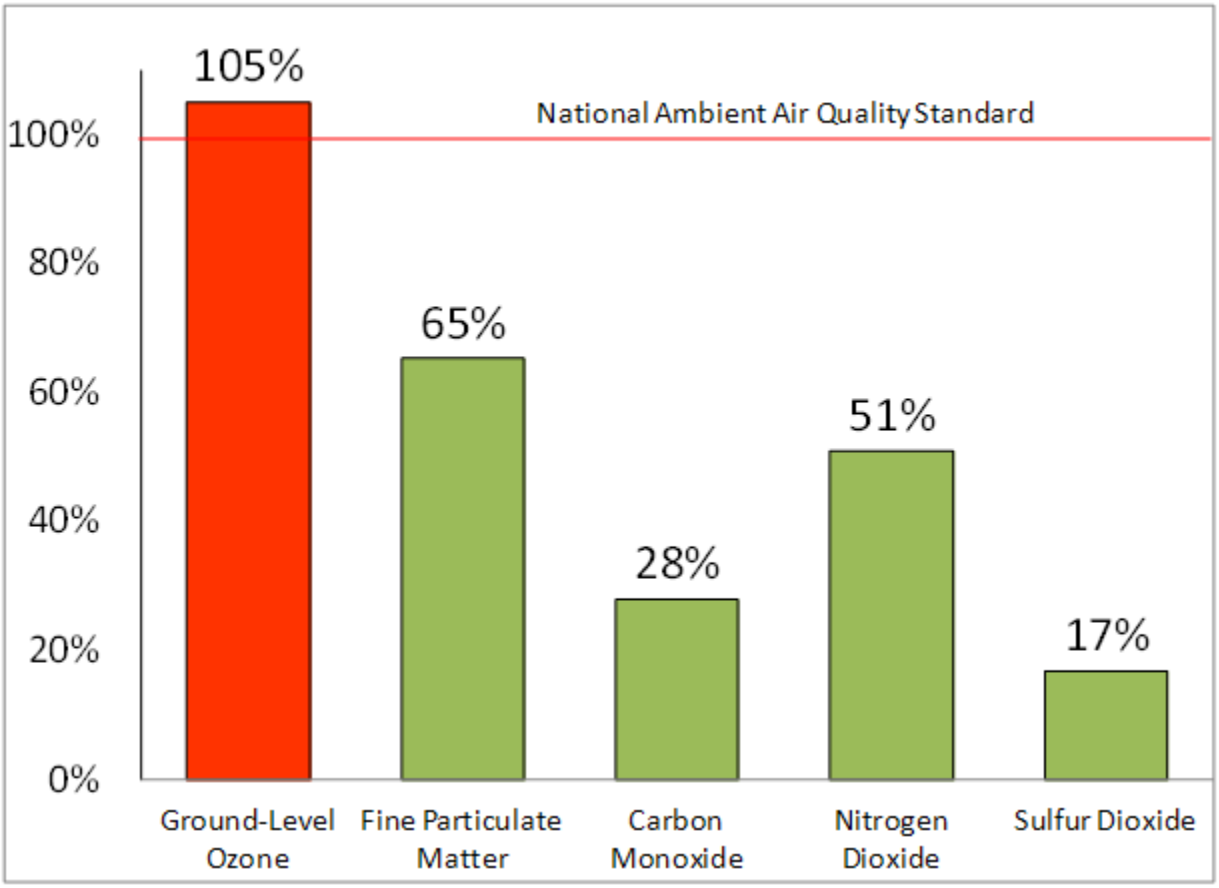
EXECUTIVE SUMMARY

The District of Columbia (District) is an urban environment with little industry. Air quality issues in the District are primarily due to emissions from vehicles and air pollution transported from other states. This Air Quality Trends Report demonstrates that despite population increase and other related activities in the District, ambient concentrations of all criteria pollutants and pollution emissions have dropped during the assessment period. This report will be updated periodically to include new data.



The following conclusions can be made to date:

- O_3 – The District and the metropolitan area are in nonattainment of ground-level ozone (O_3) standards, and the national ambient air quality standards (NAAQS) are expected to become even more stringent in the near future. Ozone continues to be the biggest air pollution challenge the region faces. Controlling emissions from mobile sources and getting cooperation from upwind states and regions to address transported pollution are necessary to improve public health.

- $PM_{2.5}$ – The U.S. Environmental Protection Agency (EPA) is redesignating the region as an attainment area for the 1997 annual standard. The monitored air quality

levels in the recent several years were below the standards. Since the area previously was in nonattainment, demonstrations of continued maintenance with the standard are required for the next 20 years. A new fine particulate standard was finalized in 2012.

- CO – The District is in attainment for the carbon monoxide (CO) standards and the ambient air quality levels have been below the standards since 1996. In February 2010, EPA proposed to retain the existing CO standard.

- SO_2, NO_2 – The District has always attained both the sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) standards, with monitored levels far below the NAAQS. New standards were developed for each pollutant in 2010. The District's monitoring networks are adding monitoring capacity to comply with the new NAAQS.

- Pb – In 2002, the District stopped monitoring for lead (Pb) because levels were consistently very low compared to the NAAQS. The new lead standard established in 2008 is ten times more stringent than the previous standard. Monitoring for lead began in January 2012 to determine compliance with the new standard.

Improvements in air quality can be attributed to the ongoing work of the District's air program. There is still work to be done to protect public health and welfare, particularly as EPA continues to revise the NAAQS and improve its understanding of how policies can impact the environment.

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PART 1: BACKGROUND INFORMATION

1.0 BRIEF HISTORY OF AIR POLLUTION AND CONTROL IN THE UNITED STATES

As population hubs developed, the release of chemicals and matter into the air, commonly known as air pollution, became pervasive in the United States. As early as the 1880s, pollution from the burning of coal and wood became seen as impediments to the enjoyment of property. As a consequence, cities like Chicago and Cincinnati passed the nation's first smoke ordinances.

As industries expanded globally, several alarming incidents heightened concerns about the impact air pollution had on people's health. In Belgium in 1930, an air pollution episode – when persistent meteorological conditions kept emissions trapped near the earth's surface – killed at least 60 people and caused over 600 to become ill. In 1947, summer smog events in Los Angeles, California, significantly affected the health of residents and visibility, resulting in the passage of the nation's first state air pollution law. In 1948, a strong temperature inversion occurred in Donora, Pennsylvania, while a nearby factory continued to contaminate the air. This resulted in nearly 20 deaths and 14,000 of the town's population fell ill. A similar event in London, England, known as the "London Fog" of 1952, resulted in more than 4000 premature deaths.

In the United States, the first nationwide air pollution control law was passed in 1955. The Air Pollution Control Act (APCA) mandated and funded research on air pollution and authorized the federal government to provide states with technical assistance to prevent and control emissions. This prompted the study of air quality criteria as well as the meteorological and topographical aspects of air pollution. A national continuous air quality monitoring program (CAMP) emerged[i] in the late 1950s. The District was one of six cities in the national CAMP network of ambient air quality stations.

The APCA was amended several times to consider motor vehicle exhaust and air pollution issues that extended across state and country borders. Increased awareness and concern about air pollution led to Congress's passage of the first prominent Clean Air Act (CAA) in 1970 and the creation of the U.S. Environmental Protection Agency (EPA). EPA was authorized to establish national ambient air quality standards (NAAQS) for pollutants shown to threaten human health and public welfare. The national approach with statutory deadlines for meeting standards represented a shift in thinking. With it came a belief that economic growth could be accomplished without the sacrifice of environmental protection.

The CAA was amended in 1977, and then again in 1990. The changes in legislation focused on curbing three major threats: acid rain, urban air pollution, and toxic air emissions. The CAA and its amendments establish authority and a framework for the permitting and enforcement of air pollution sources to achieve compliance with NAAQS. As a result, federal, state and local governments have been able to work together to design, implement, and enforce measures that have improved air quality substantially.[ii]

Timeline of Significant Clean Air Act Achievements[iii]

1970 – Creation of EPA and establishment of NAAQS for Criteria Pollutants

1973 – EPA began the phase-out of leaded gasoline

1977 – The CAA Amendments protected air quality and visibility in designated national parks and wilderness areas

1977 – Congress established the New Source Review permitting program

1981 – New motor vehicles met the CAA standards for the first time, due to improved catalytic converters

1983 – The first vehicle Inspection and Maintenance (I/M) programs were established

1990 – The CAA Amendments required states to demonstrate progress in improving air quality and imposed the first acid rain controls

1990 – Title V Operating Permits became a CAA requirement, and CAA enforcement provisions were strengthened

1994 – EPA set many of the first standards to reduce air toxic emissions

1996 – Lead in gasoline fully phased out

1999 – The first tailpipe standards for SUVs and light-duty trucks were set

2003 – EPA began administering a market-based cap and trade program for NO_x emissions from large stationary sources

2009 – EPA ruled that GHGs are subject to CAA requirements

2014 – EPA set new tailpipe and evaporative emissions standards for vehicles and lowered the sulfur content of gasoline, considering the vehicle and its fuel as an integrated system.

2.0 CRITERIA POLLUTANTS AND AIR QUALITY STANDARDS

The federal Clean Air Act authorized EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants that threaten human health and public welfare throughout the country. EPA established NAAQS for six most common pollutants called "criteria" air pollutants: ozone (O_3), particulate matter [particles less than 10 micrometers in aerodynamic diameter (PM_{10}) and particles less than 2.5 micrometers in diameter ($PM_{2.5}$)], carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb). EPA periodically revises the standards based on new science and health impacts information. When ambient air quality in a jurisdiction exceeds the NAAQS for a criteria pollutant, the area is said to be in "nonattainment" for that pollutant.

There are two types of standards: primary and secondary. Primary standards are established according to criteria designed to protect the health of people who breathe the air. They include a margin of safety to protect sensitive populations, including children and the elderly. Secondary standards are set to protect public welfare by preventing decreased visibility, damage to crops or buildings, and other impairment of the natural environment. The CAA requires that the NAAQS be revisited periodically based on up-to-date scientific research findings. Appendix A includes a table of the existing NAAQS.

Understanding the NAAQS

Averaging Time of the Standard – The time period over which air pollutant concentrations are collected and averaged. The averaging times are for one hour, 8 hours, daily, quarterly, and annual, depending on the pollutant.

Level of the Standard – The allowable concentration of air pollutants. The unit of measurement for most pollutants is parts per million (ppm) or parts per billion (ppb) by volume. Due to the nature of pollutants, the unit of measurement for some pollutants, such as lead and particulate matter, is mass of pollutant per unit volume of air and is expressed as micrograms of pollutant per cubic meter of air ($\mu g/m^3$).

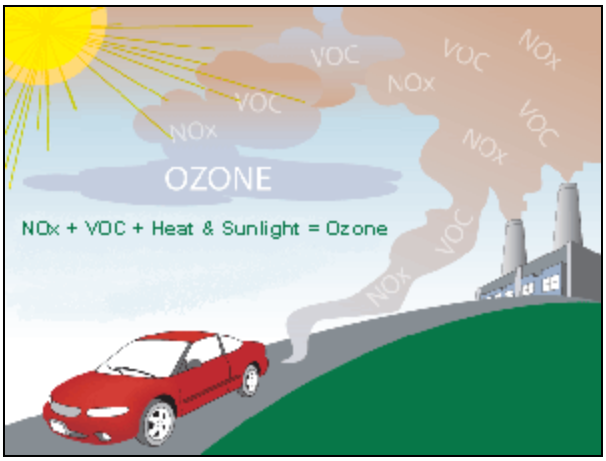
Form – The methodology for summarizing actual concentrations. The form can be directly compared to the NAAQS to determine compliance.

Pollutant levels in the air are measured using a network of air quality monitors. Once the measurements for a pollutant are quality-assured, this data is summarized as a statistically-derived average of a specified number of measurements over a specific period of time. These "design value" (DV) concentrations are calculated to remove variability caused by changing weather patterns or exceptional air pollution events. DVs from a jurisdictional network of monitors are compared to NAAQS to determine the air quality status.

2.1 GROUND-LEVEL OZONE

Ground-level ozone, also known as smog, is the most widespread criteria pollutant. Ozone is a colorless, odorless gas composed of three oxygen atoms. It exists naturally in the stratosphere,

the Earth's upper atmosphere, where it shields the Earth from the Sun's ultraviolet rays. It is also found close to the Earth's surface in the troposphere where we live and breathe. Ground-level ozone is not emitted directly into the air by specific pollution sources, but rather is created by a chemical reaction between precursor pollutants, volatile organic compounds (VOCs) and oxides of nitrogen (NO_x), in the presence of sunlight and high temperatures. NO_x and VOC sources include power plants, industrial processes, vehicle exhaust (onroad and offroad), and commercially available products such as paints, insecticides, and cleaning solvents. VOCs also come from natural sources such as trees and plants.



Depiction of ozone formation. *Photo from EPA*

Because ground-level ozone is the result of photochemical reactions, ozone takes time to form. Concentrations generally become elevated during the hotter, drier days of warmer months of the year when there is little wind. Daily ozone levels generally peak during afternoon and early evening hours, when precursor pollutants are most exposed to sunlight and higher temperatures. "Ozone season" in the Washington, DC, region is between May and September. Ozone is transported through the air into the District from other areas, and then mixes with precursor emissions from local sources of air pollution.

2.1.1 O_3 NAAQS Review

The first ozone standard was set based on a daily maximum 1-hour average concentration. Shortly after passage of the CAAA of 1990, EPA classified the DC-MD-VA region as a "serious" nonattainment area for the 1-hour NAAQS. The region failed to achieve the 1-hour standard by the CAA mandated deadline and was bumped up by EPA to a "severe" nonattainment area in 2003. An attainment deadline was established in 2005, and the District and the metropolitan area met the old 1-hour NAAQS by 2005. To continue meeting CAA requirements, regulatory requirements that reduce emissions must remain in place.

In 1997, EPA revised the air quality standard for ozone to better reflect new scientific health studies that demonstrated cumulative effects from exposure over an entire day. The 1997 standard was the first ozone standard based on an 8-hour averaging period. In 2004, EPA officially designated the region as a "moderate" nonattainment area for the 1997 standard. In June 2005, EPA revoked the 1-hour ozone standard while implementing the 1997 8-hour standards.

The 8-hour ozone standard was revised again in 2008. Based on the monitored air quality data, EPA designated the DC-MD-VA region as a "marginal" nonattainment area for the 2008

standard. The District and the metropolitan area must achieve the 2008 ozone standard by 2015. More stringent revised ozone standards are expected in the near future.

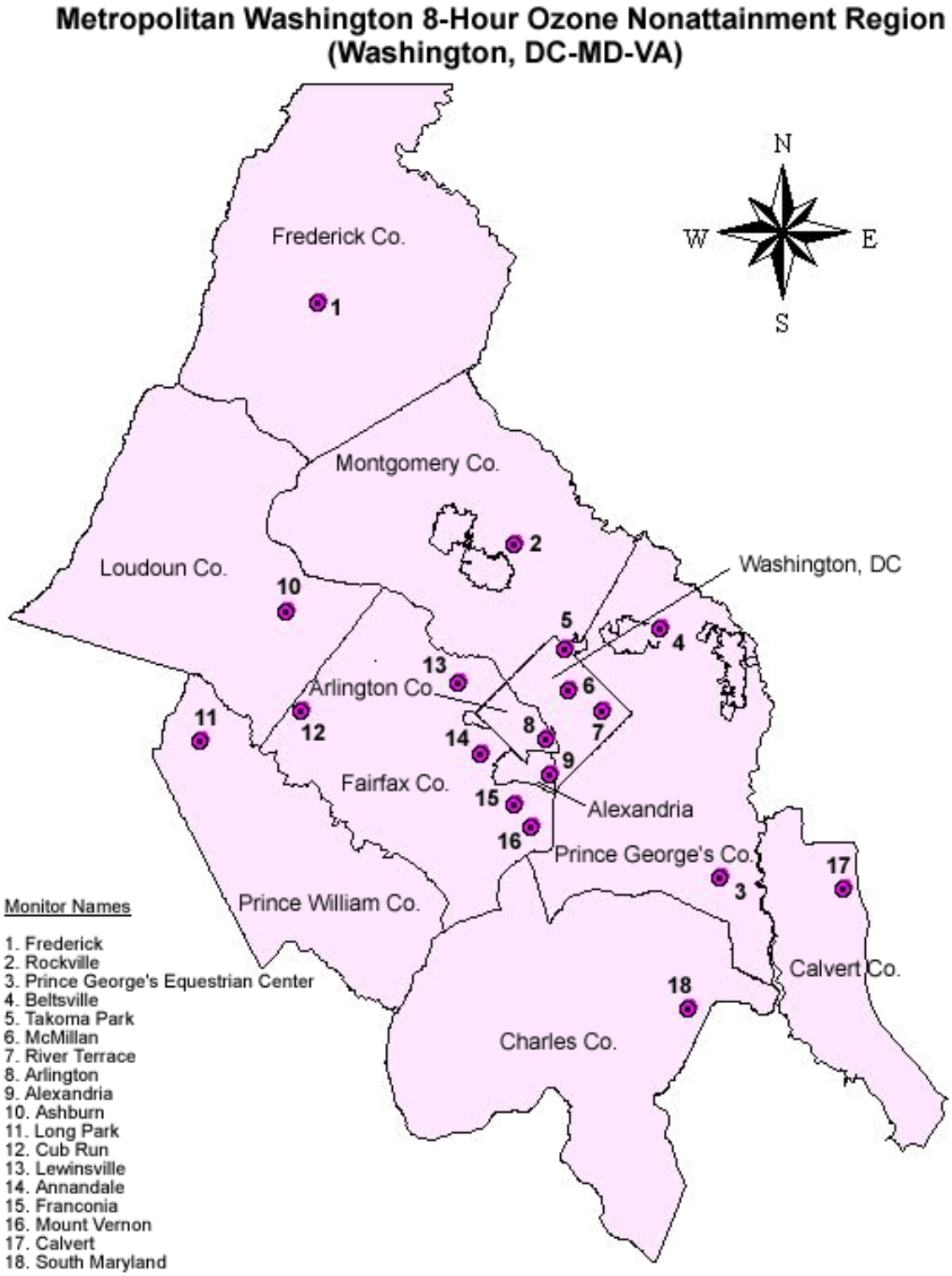


Image courtesy of the Metropolitan Washington Council of Governments

2.2 PARTICULATE MATTER

Particulate matter is comprised of a broad class of extremely small airborne solid particles and liquid droplets, from fine smoke and soot (products of incomplete fuel combustion) to larger-sized dusts and industrially generated particles. Particulate matter also includes particles formed by complex reactions of gaseous pollutants in the atmosphere. $PM_{2.5}$ precursors include ammonia, sulfates, nitrates, organic carbon, and elemental carbon. Particulates can be different sizes and shapes. The size of particles measured over time has decreased with improvements in monitoring technology, as researchers have found that smaller particles have potential for causing more complex health or visibility problems. The current focus is on particles less than 2.5 micrometers (microns) in diameter ($PM_{2.5}$), or about 1/30th the average width of a human hair, which can travel deep into the lungs and move into the bloodstream.

Fireworks contribute to short-term PM pollution.
Photo from DCRA

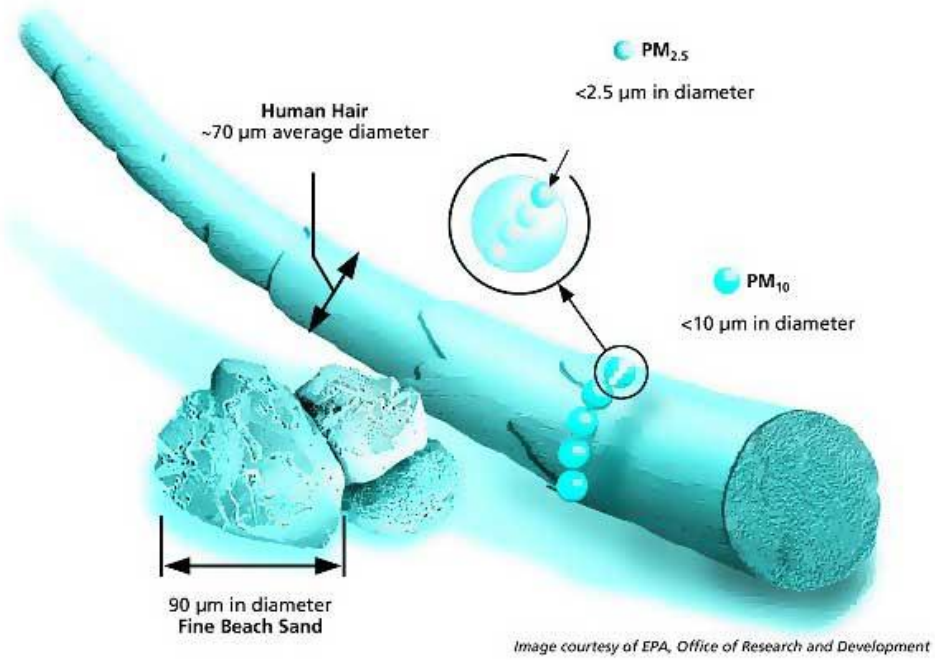


Image courtesy of EPA, Office of Research and Development

$PM_{2.5}$ concentrations vary daily and even within a day. They tend to be higher during peak traffic times. The physical and chemical compositions of $PM_{2.5}$ vary seasonally, since they are mainly influenced by temperature fluctuations.

2.2.1 PM NAAQS Review

Attainment Status of PM_{10} NAAQS		
PM_{10} - coarse	1997 daily	attainment
	1997 annual	attainment
	2006 daily REMANDED	attainment
	2006 annual	STANDARD REVOKED

Attainment Status of $PM_{2.5}$ NAAQS		
$PM_{2.5}$ - fine	1997 daily	attainment
	1997 annual	redesignation to attainment in 2014
	2006 daily	attainment
	2006 annual	attainment
	2012 annual and 24-hour	attainment/unclassifiable

The first PM standards were set in 1971. They addressed total suspended particulates (TSP), which are non-respirable particles. In 1987, annual and daily NAAQS were set for inhalable particles with an aerodynamic diameter of 10 microns, called PM_{10}, or less. In 1997, the PM_{10} standards were slightly revised to regulate inhalable "coarse" particulates that include particles greater than 2.5 microns in diameter. The District is in attainment of all PM_{10} standards.

In 1997, EPA established two more refined health standards for inhalable "fine" particulates, or $PM_{2.5}$. The $PM_{2.5}$ standards account for emissions that are filterable (directly emitted) and condensable (secondarily formed in the atmosphere from gaseous pollutants). $PM_{2.5}$ is generally a part of the PM_{10} concentration. The region was officially designated being in nonattainment of the $PM_{2.5}$ annual standard in April 2005.

In 2006, the annual PM_{10} standard was revoked due to a lack of evidence linking health problems to long-term exposure. The daily PM_{10} standard and the annual $PM_{2.5}$ standard were remanded without vacatur by the courts. A new daily $PM_{2.5}$ standard was established in 2006. EPA determined that the DC-MD-VA area is in attainment of the daily standard.

In 2012, EPA revised the annual standard to make it more stringent. The existing $PM_{2.5}$ ambient air monitors in the District and metropolitan area have been measuring air quality below the 2012 standards. However, the new standards require an expanded monitoring near major roadways, and the District, MD, and VA are in the process of establishing new near-road monitoring stations. Hence, EPA has given an "unclassifiable attainment" designation for the DC-MD-VA region. EPA and the District will revisit the $PM_{2.5}$ air quality status after collecting adequate data from a new near-road monitoring network.

2.3 Carbon Monoxide

Carbon monoxide is a colorless, odorless gas that can be poisonous in high concentrations. When it enters the bloodstream, it reduces the capacity of the body to deliver oxygen to organs and tissues. Concentrations tend to be highest during winter months due to the "cold starting" of automobile engines. In some areas, inefficient or poorly maintained space heating systems, residential wood burning, or industrial processes (metals processing and chemical

manufacturing) are prominent sources. Improvements in motor vehicle emissions controls and the use of oxygenated fuels have reduced CO levels significantly (although oxygenated fuels have not been used in the District since 1996).

2.3.1 CO NAAQS Review

The first CO standards were set in 1971. In 1985, EPA revoked the secondary CO standards due to a lack of evidence that ambient concentrations adversely affect public welfare. Both the 1-hour and 8-hour primary CO standards were retained after EPA's review in 1994. The DC-MD-VA region attained the 8-hour NAAQS in 1996. Attainment areas are required to demonstrate that ambient levels will "maintain" design value concentrations that are under the NAAQS for 20 years after redesignation. The region continues to project that emissions will be consistent with ambient CO levels below the NAAQS through at least 2016. In February 2010, EPA retained the existing CO standards while expanding the ambient air monitoring requirements. All parts of the country currently meet the CO NAAQS.

2.4 Sulfur Dioxide

Sulfur dioxide is a highly reactive gas that forms when fuels containing sulfur (mainly coal and oil) are burned and during industrial processes such as metal smelting and oil refining. It is one of a group of oxides of sulfur.

DID YOU KNOW?

SO_2 is considered to be a main contributor to regional haze in federally designated "Class I" national parks and wilderness areas, such as the nearby Shenandoah National Park. These photos show views from the park on a clear day compared to a hazy day.

Views from Dickey Ridge (split image).
Photo from NPS

2.4.1 SO_2 NAAQS Review

EPA first set both primary and secondary standards in 1971. During the next NAAQS review in 1996, the standards were not revised.

In June 2010, EPA issued a revised the primary NAAQS to establish a new 1-hour standard to protect against short-term exposures. The existing annual and daily standards were revoked. EPA also proposed to revise the SO_2 monitoring rule to require both monitoring and refined dispersion modeling to determine compliance. The secondary standards will be reconsidered under a separate review.

2.5 NITROGEN DIOXIDE

Nitrogen dioxide is a brownish and highly chemically reactive gaseous pollutant. It is the indicator of a class of compounds called nitrogen oxides (NO_x), which contribute to ground-level ozone and fine particulate pollution. NO_2 is formed during high-temperature combustion of fuels and by vehicle engines and industrial processes, such as electricity generation. All areas in the country meet the annual NO_2 standards. Mobile source regulations are expected to continue reducing NO_2 concentrations into the future.

2.5.1 NO_2 NAAQS Review

The first primary and secondary NO_2 NAAQS were set by EPA in 1971. They were reviewed twice but never revised. In its January 2010 revision, EPA retained the current annual NO_2 standards, while setting a new 1-hour NO_2 standard to protect against short-term exposures. The existing NO_2 ambient air monitors in the District and metropolitan area have been measuring air quality below the 2010 standards. However, the new standards require an expanded monitoring within 50 meters of major roadways and additional monitors in large urban areas. The District, MD and VA are in the process of establishing new near-road monitoring stations. Hence, EPA has given an "unclassifiable attainment" designation for the DC-MD-VA region. EPA and the District will revisit the NO_2 air quality status after collecting adequate data from the new near-road monitoring network. EPA plans to consider changes to the secondary standard under a separate review.

2.6 LEAD

Lead is a metal found naturally in the environment and in manufactured products. Soils and dusts can be contaminated with lead from older paints, construction materials, and industrial processes such as smelters or battery plants. Lead levels throughout the country dropped dramatically after 1973 when EPA began phasing out the use of leaded gasoline. Today, lead levels in ambient air are very low. They result mainly from disturbed soils and dusts contaminated with lead, older paints and other lead-containing construction materials, and aviation gasoline. The highest levels are usually found near lead smelters, where lead is extracted from ores.

2.6.1 Pb NAAQS and Monitoring Review

Ambient lead monitoring in the District has a long history. Through the 1960s and 1970s, the District's air monitors reported high concentrations of Pb. In 1976, the phase-out of leaded gasoline caused monitors to report a significant drop in ambient Pb concentrations. The first Pb NAAQS were established in 1978. By the 1990s, Pb concentrations consistently measured below five percent of the standard.

In 2008, EPA revised and replaced the Pb NAAQS with a standard that is ten times more stringent than the old standard. The District's air program revived the population-based ambient lead measurements in January of 2012, as required by the new standard.

3.0 AIR POLLUTION IMPACTS

Air pollution is a result of the combustion of fuels (gasoline, natural gas, oil, diesel, coal, wood, etc.), release of vapors, suspension of aerosols, disturbance of matter, and other commercial or industrial processes. Some pollutants are directly harmful to the public or the environment, while others undergo chemical reactions in the air that make them more harmful. Impacts of criteria pollutants on each individual or ecosystem can vary and be pollutant-specific, but short-term and long-term exposure to air pollution is known to cause a range of problems.

3.1 HEALTH IMPACTS

Health impacts of air pollution include the following:

- Inflammation and irritation of the respiratory tract;
- Coughing, throat irritation, difficulty breathing;
- Aggravated asthma and other lung (respiratory) diseases leading to increased medication use, hospital admissions, emergency department visits, and premature mortality;
- Aggravated heart (cardiovascular) diseases leading to increased medication use, hospital admissions, emergency department visits, and premature mortality; alterations in pulmonary defenses;
- The development of lung or heart disease;
- (Carbon monoxide) – Visual impairment, reduced work capacity, poor learning ability, difficulty in performance of complex tasks; headaches and nausea; and
- (Lead) – Damage to the developing nervous system, resulting in IQ loss and impacts on learning, memory, behavior, and even growth in children; kidney (renal) effects in adults; anemia; reproductive disorders; neurological impairments.

In 2003, the American Lung Association estimated that 11.8% of District children had asthma, as compared to 8.8% nationally.[iv] The current childhood asthma rate is 18% compared to a national average of 8%; adult asthma rates are higher than the national average as well[v]. In 2011, out of a population of approximately 618,000, there were an estimated 19,330 cases of asthma in children under age 18 and 51,553 cases of adult asthma.[vi] Asthma is the leading cause of school absences from a chronic illness in children aged five to seventeen. It accounts for roughly 25 percent of all emergency room visits in the United States each year.[vii]

3.2 ENVIRONMENTAL IMPACTS

Air pollution impacts on the natural and built environment include:

- Damage to vegetation such as visible injury to leaves, reduced photosynthesis, impaired reproduction and growth, and decreased crop yields;
- Damage to physical structures and property, especially marble and limestone;
- Acid rain and acidification of lakes and streams; and eutrophication (a reduced amount of oxygen) in coastal waters, which is destructive to fish and other animal life;
- Reduced visibility;

- Formation of greenhouse gases such as CO_2 and ozone; and
- Decreased plant uptake of carbon dioxide (CO_2) and soil, which can harm plants and wildlife.

The Chesapeake Bay, the largest estuary in the United States and one of the most polluted, is affected by air pollutants, particularly nitrogen that enters its waters when it rains. Roughly one third of all nitrogen compounds in the Bay are deposited from the air.[viii]

According to the U.S. National Park Service, green streaks are evidence of acid rain's effects. ***Photo from NPS***

Climate change is another serious impact of emissions. Emissions of criteria and other types of pollutants called greenhouse gases (GHGs) gather in the atmosphere and slow the loss of heat from the earth to space, creating what is known as the greenhouse effect.[ix] Climate change is expected to alter the timing and location of traditional rainfall and other weather patterns, ecosystem structure, biodiversity, and numerous other systems that drive current ways of life.

3.3 Factors that Impact Air Quality in the District

Pollutants are emitted by sources referred to as "stationary sources," which are in fixed locations, and "mobile sources," which do not have a fixed location and are generally propelled by or operated using an internal combustion engine.

Larger stationary "point" sources are individual facilities with smoke stacks (factories, power plants), generally classified as electric generating units (EGUs) or non-EGUs. Smaller stationary "area" or nonpoint sources are not identified individually because they have more impact collectively (such as small industrial or commercial facilities, gas stations, printing operations, auto maintenance facilities, painting operations, use of consumer products, and fires). Mobile "nonroad" or offroad vehicles or equipment include locomotives, boats, aircraft, construction equipment, and lawn and garden equipment. Mobile "onroad" highway vehicles include cars, trucks, buses, and motorcycles.

Natural "biogenic" sources such as trees, crops, soils, and vegetation, also emit volatile organic compounds that can influence the formation of ground-level ozone.

Air pollution emissions can be minimized using technology at a source or by adapting how or when a source is used. The costs and effectiveness of an air pollution control measure is often inherent in decisions to use them. Additional factors are integral to the quality of the District's ambient air, as discussed below.

3.3.1 Meteorology and Topography

Chemical and physical interactions can occur between elements naturally in the air and emissions produced by human activity.

The District is predominantly a built urban environment scattered with forested parks and open spaces. It is situated close to sea level at the confluence of the Anacostia and Potomac Rivers. There are four seasonal temperature fluctuations per year. Average temperatures (in degrees Fahrenheit) range from the low 20s in January to the high 80s in July. Precipitation distribution is uniform at roughly 40 inches annually in the form of rain or snow throughout the year.

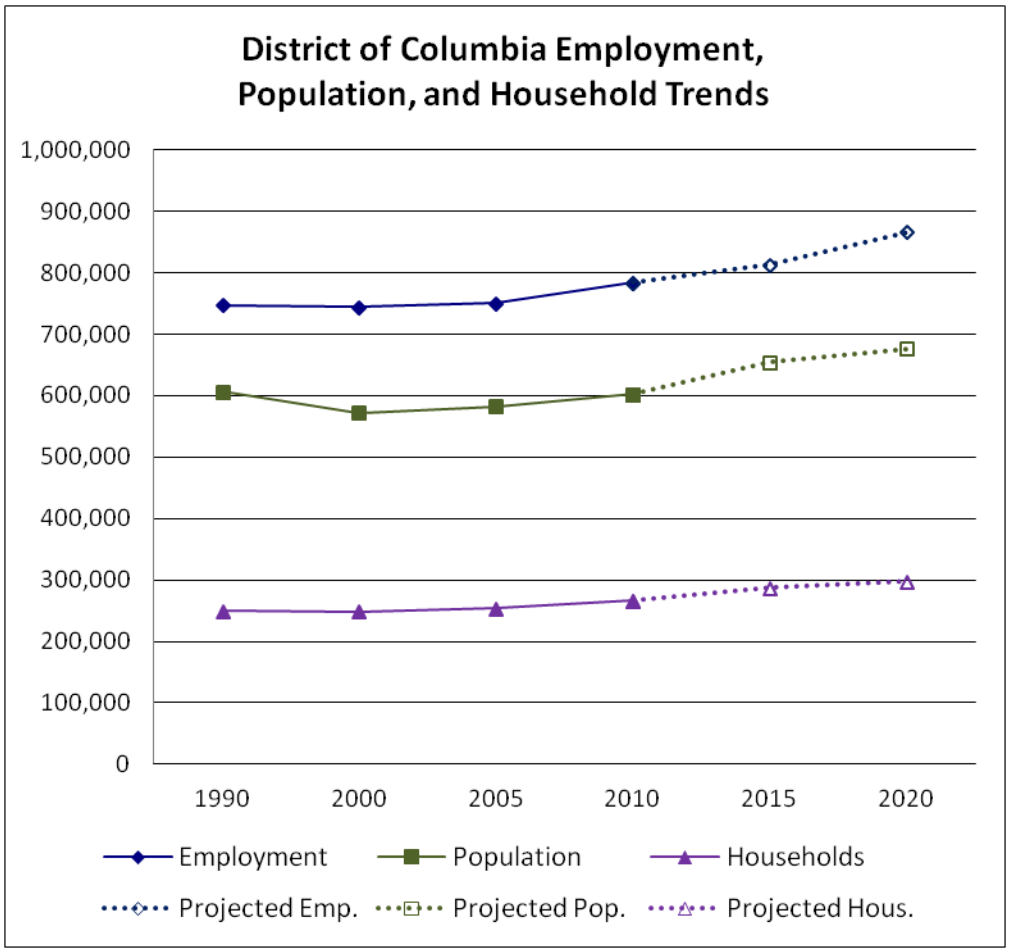
The District is located in the Mid-Atlantic region, between more rigorous climates in the north and warm temperate climates in the south. Weather patterns are influenced by the Chesapeake Bay and Atlantic Ocean to the east and the Appalachian Mountains to the west and north. Since the District is near the average path of the low pressure systems that move across the country, changes in wind direction are frequent. During the summer, the area is influenced by large semi-permanent high pressure system commonly known as the Bermuda High, which is typically centered over the Atlantic Ocean near the coast of Florida that brings warm humid air to the Washington area. Downtown areas often experience a heat island effect. The proximity of large bodies of water and the inflow of winds from the south contribute to high relative humidity during much of the year.

3.3.2 Employment, Population and Households

Employment, population, and household estimates are often used as indicators of emissions activity. More activity in an area means more people are driving, more energy is used, and more goods are produced. The Metropolitan Washington Council of Governments (MWCOG) projects how much change will occur in the region and periodically publishes a "cooperative forecast."

DID YOU KNOW?
Paints, solvents, adhesives, cleaners, and other household products often contain volatile organic compounds (VOCs), which contribute to formation of ground-level ozone (smog), particularly on hot days.

The number of jobs, people, and households in the District dropped in the 1990s. The drop in population was accompanied by a rise in population in surrounding areas. As indicated in the following graph, there has been growth in employment, population, and the number of households in the District in the past decade. The District currently has over 600,000 residents. Its workforce quadruples in size each day due to commuters, and millions of national and international tourists visit the Nation's Capital on an annual basis.

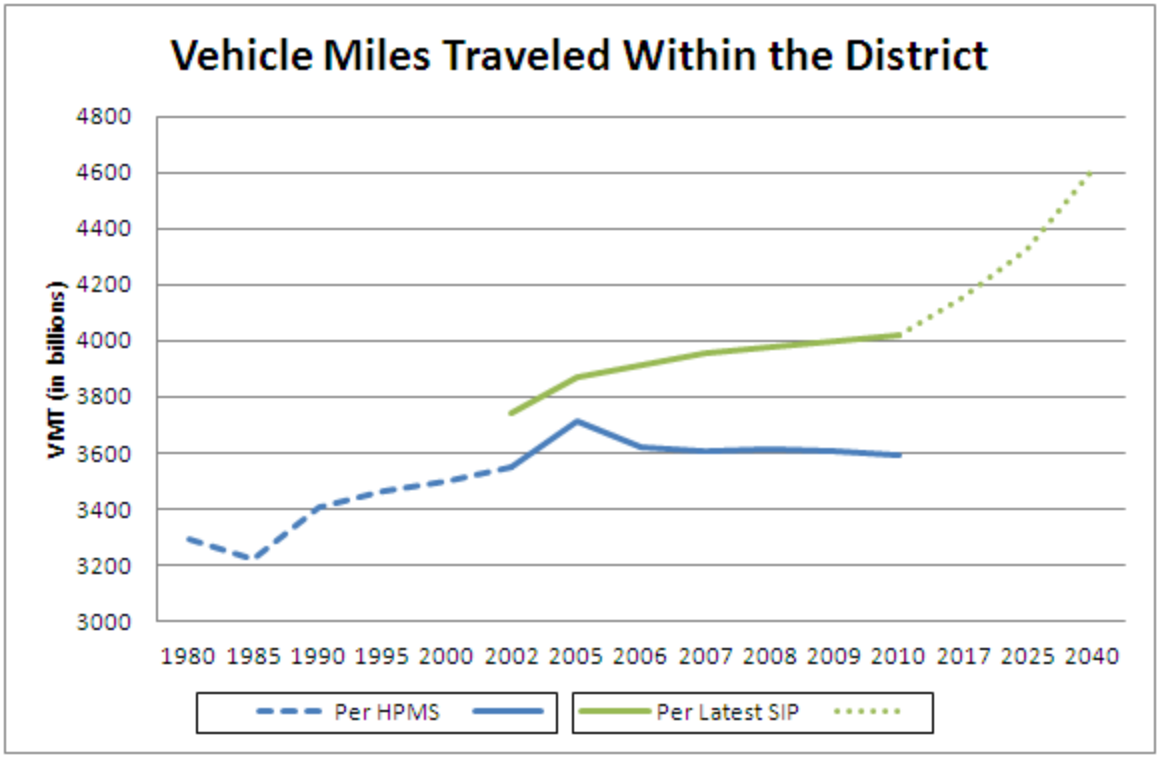


Based on MWCOG Cooperative Forecast Round 8.2

Between 2008 and 2018, employment is projected to increase by one percent per year, or 10 percent for the 10-year period, which is slightly higher than anticipated during the 2006 to 2016 and 2004 to 2014 time periods. Job growth is expected in service-based industries, with at least two-thirds of future job openings intended to replace aging workers. Most job losses are anticipated in the manufacturing sector (5.2%), which is already the smallest industry sector in the District. The highest gains are expected in professional and business services (including computer, legal, and employment services), educational services, and health care and social assistance sectors (2.1%, 1.3%, and 1.5% respectively).[x]

3.3.3 Vehicle Miles Traveled

Onroad emissions are typically derived from activity represented by traffic counts. "Vehicle miles traveled" (VMT) is the average annual daily traffic for a section of road multiplied by the length of the road.



"Latest SIP" is the $PM_{2.5}$ Maintenance Plan submitted to EPA in 2013

Federal VMT estimates are from the Federal Highway Administration's (FHWA) Highway Statistics Series. VMT estimates used in the DC-MD-VA region's State Implementation Plans (SIPs) to improve are quality are prepared by the Metropolitan Washington Council of Government's Department of Transportation Planning using a Travel Demand Model (TDM). The TDM model is a trip-based model that is occasionally calibrated based on FHWA Highway Performance Monitoring System (HPMS) data.

According to MWCOG transportation planners, VMT has steadily increased since the end of World War II. Since 2007, there has been an unprecedented leveling off in the region. Despite a rise in population and employment, reasons for changes in driving behavior are possibly related to a global economic recession in 2008, fuel price volatility in 2008, changes in commuting and communication technologies, changes in travel preferences, and improvements in alternative transportation services.[xi]

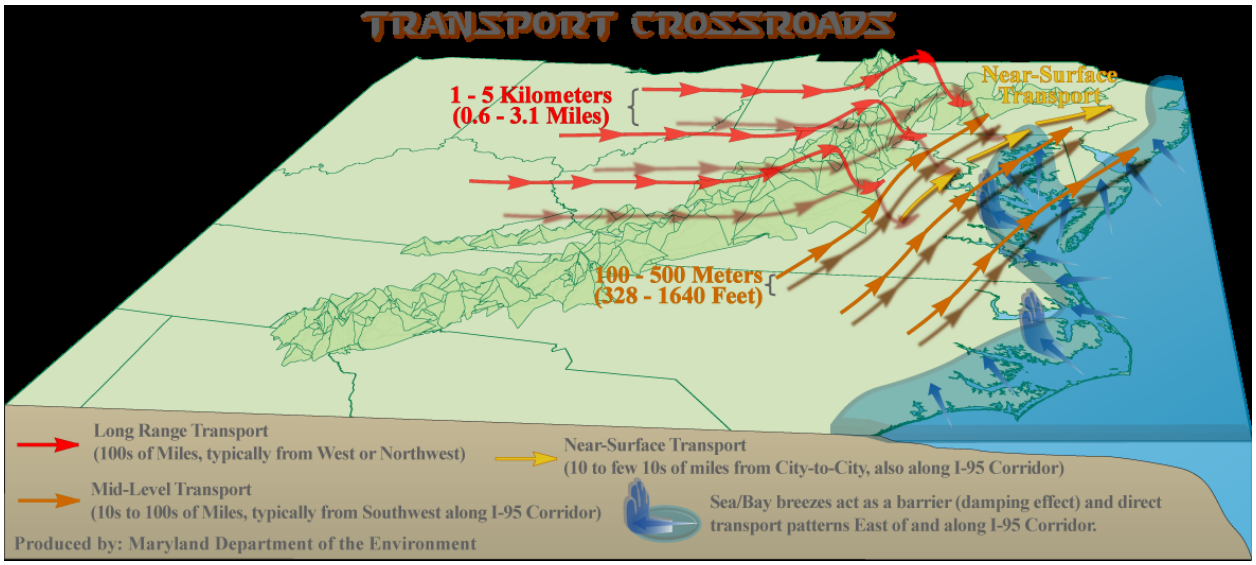
3.3.4 Interstate Transport of Ozone Pollution

Air quality in the District is primarily driven by incoming pollution from other jurisdictions. According to modeling performed in support of EPA's proposed rulemakings, nearly 75 percent of ozone pollution in the DC-MD-VA region is transported in the wind from other states.[xii]

University of Maryland (UMD) and Maryland Department of the Environment (MDE) have conducted extensive research over the past 20 years using airplanes, balloons, mountaintop monitors, and other devices to measure pollution that enters the State of Maryland, a close

neighbor of the District. They have identified at least three predominant types of air pollution transport:

- Long-range transport travels hundreds of miles, typically from the west or northwest. An "elevated ozone reservoir" of air is trapped at about 2,000 feet above the earth's surface at night by a nocturnal inversion until temperatures cause it to drop during morning hours. Ozone in the reservoir reacts with local pollutants by the afternoon.
- Medium-range transport travels within the Mid-Atlantic, typically from the southwest and up along the I-95 corridor (east of the Appalachian Mountains). It is typically found at about 2,000 feet above the earth's surface and is transported by a "nocturnal low level jet" that moves an average of 30 miles per hour.
- Local transport travels ten to a few dozen miles from city to city, also along the I-95 corridor.[xiii]

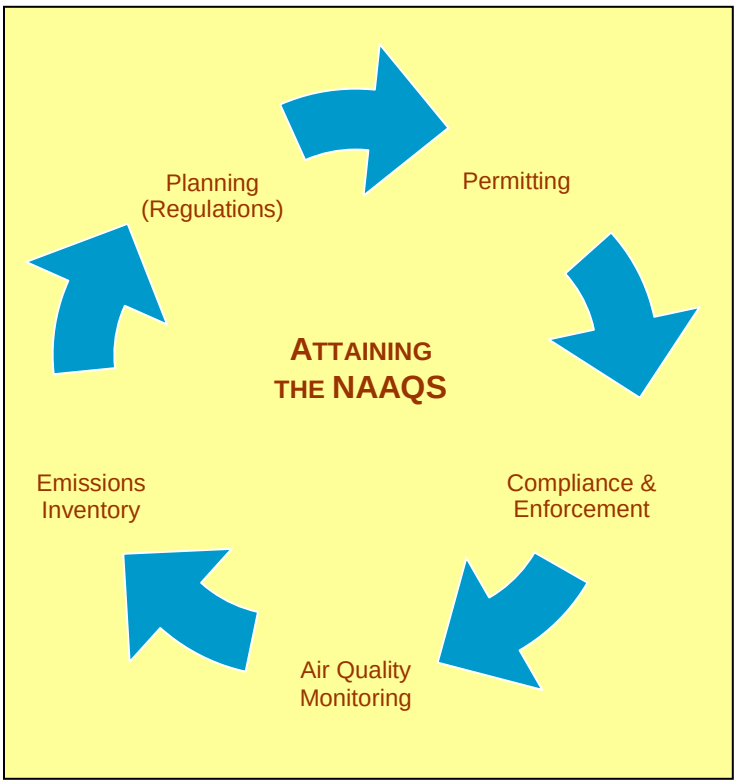


Picture courtesy of the Maryland Department of the Environment

In Maryland, and likely in the District, pollution that is transported from other states alone can exceed the NAAQS. Likewise, emissions generated in the District can harm public health and welfare in downwind states. Local as well as regional and national efforts are required to fully address the ozone problem.

4.0 OVERVIEW OF THE DISTRICT'S AIR QUALITY IMPROVEMENT PROGRAM

The CAA requires establishment and operation of air monitoring networks to measure the ambient air quality. EPA compares air quality data from these networks to the NAAQS. Once EPA formally concludes that criteria pollutant levels in a defined area exceed the standards, state and local agencies such as DDOE engage in an air quality improvement process.



Planning and Regulatory Development – Under the CAA, areas in nonattainment of a particular pollutant are required to develop long-term plans (called "state implementation plans," or SIPs) to meet the NAAQS. SIP strategies to control emissions from specific types of sources must be quantifiable, surplus, permanent, and enforceable. The District develops both mandatory regulations and voluntary policies, often in collaboration with neighboring states, to maintain existing air quality and further reduce emissions.

Permitting – The largest sources of pollution are required by law to acquire permits that give them permission to pollute based on a mutual agreement that specified conditions will be met. Emissions limits in permits can initiate the installation of control technologies or necessitate operational or work practices changes. Noncompliance with final permits is enforceable.

Inspection and Maintenance of Vehicle Emission Control Systems

One local control measure that has reduced CO and ozone emission levels is the District's Vehicle Emissions Inspection and Maintenance Program ("I&M Program"). DDOE ensures that the program operates efficiently and effectively by reviewing data collection procedures, testing instrument, and conducting station performance reviews. (District's vehicle inspection facilities are operated and maintained by the Department of Motor Vehicles and DDOE provides regulatory air agency oversight.)

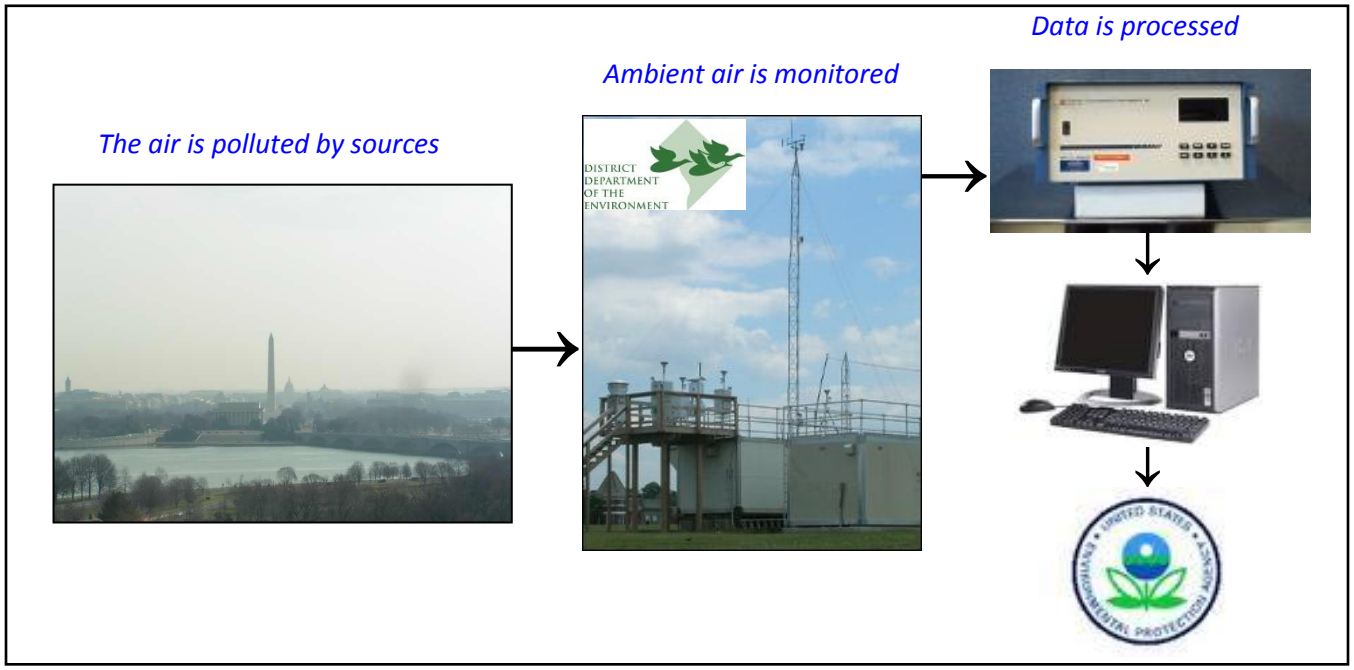
Enforcement and Compliance – DDOE ensures that the regulated community complies with applicable permits and other legal and regulatory requirements by inspecting facilities, reviewing reports, and issuing fines for noncompliance.

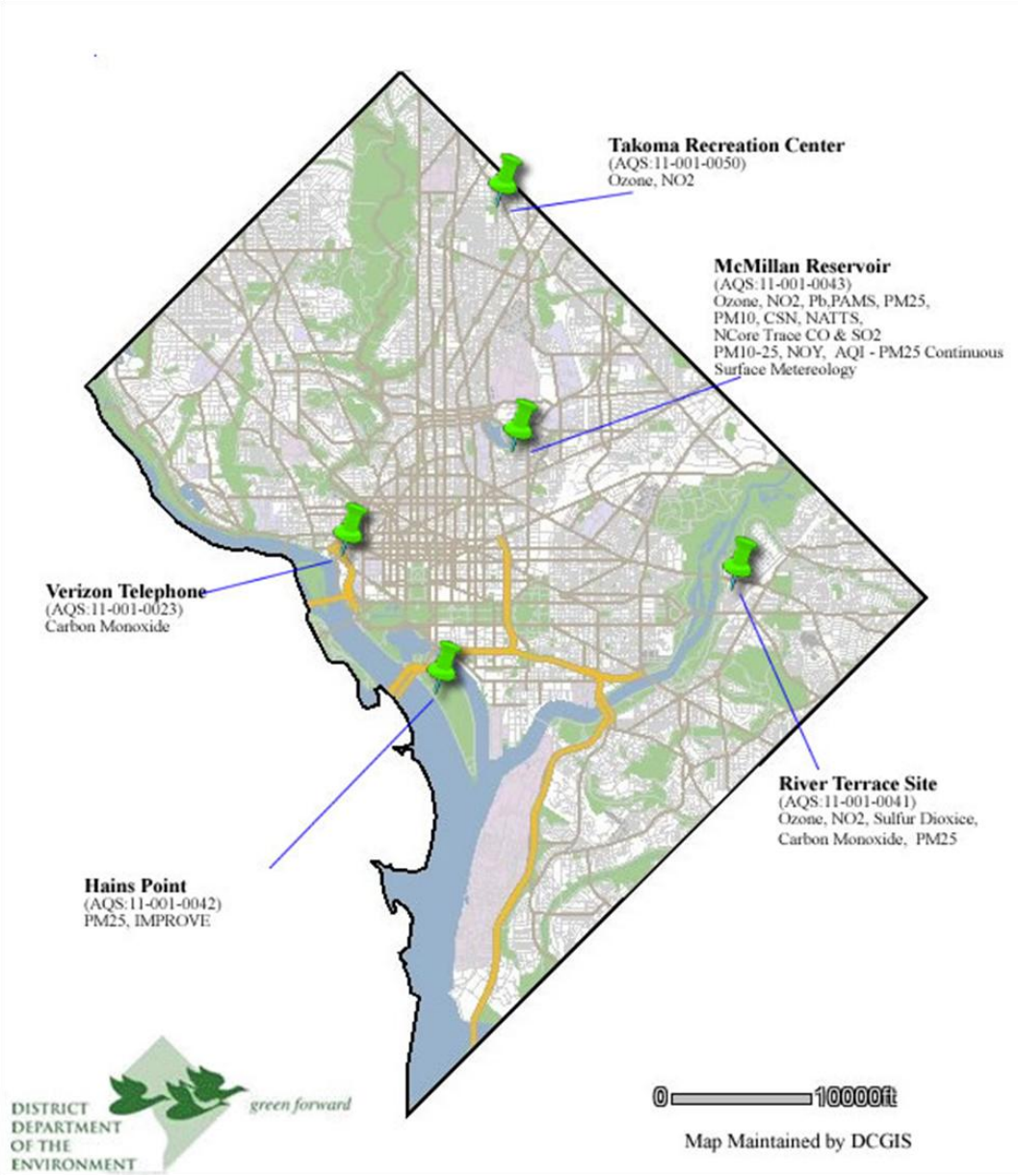
Monitoring & Assessment – Ambient air quality monitoring is the "litmus test" that reveals the effectiveness of the air quality program. Monitoring results are compared with air quality projections to influence decision-making.

IN FOCUS: THE DISTRICT'S MONITORING NETWORK

Air quality monitoring has evolved since its beginnings in the late 1950s. The earliest monitors were simple mechanisms or passive collectors such as dust-fall buckets and tape samplers. These were followed by wet-chemistry instruments in the 1960s, which were soon replaced by more advanced electronic automated instruments. Advancements in computer technology in the late 1970s and early 1980s led to the development of the modern network.

The District was home to one of the first ambient air monitoring stations in the nation in the 1960s. Today, the District operates and maintains a network of monitors to measure outdoor air quality. Raw data is collected using an air sampling device and stored in a data logger. Some analyzers collect air samples on a filter medium, which must then be analyzed in a lab. The measurement equipment requires regular calibrations and scheduled maintenance. The collected data is moved to the District's database computers, where it is further processed and checked to ensure that accurate measurements are taken (through quality assurance audits and quality control investigations) before reporting to the EPA's Air Quality System (AQS) database on a schedule set forth in the federal regulations of CAA.





Federal regulations require that air monitors be located in areas of general background concentrations, expected high concentrations, high population density, significant pollution sources, transported air from other areas, and potential impact. Land use, traffic patterns, and pollution source locations can impact the placement of monitoring sites. On a regular basis, particularly upon the adoption of a new NAAQS, changes or modifications to the monitoring sites, sampling schedules, sampling equipment, and technologies are identified to ensure that evolving regulatory requirements (siting criteria, boundary definitions) are met. There are often tradeoffs between the data needs and available resources.

The District's ambient air monitoring network consists of five stations: Hains Point, McMillan Reservoir, River Terrace, Takoma Recreation Center, and Verizon Building.

Each monitor in the District's network is also part of a nationwide network of monitors. Each nationwide network is designed to measure particular pollutants or types of pollutants based on detailed data collection methods and goals. Some networks are intended to collect data on a long-term basis, while others are more pertinent in the short term. Some networks include several monitors to capture information on pollution affecting a population at an urban scale, and others, such as the District's River Terrace monitor, gather neighborhood-scale data.

DDOE's most recent Ambient Air Monitoring Network Plan gives information about the current monitoring network in the District.

5.0 PUBLIC OUTREACH

Air quality predictions and conditions are communicated to the public using a color-coded Air Quality Index (AQI) that rates pollutant levels on a given day based on the measured concentration of pollutants in the air and the corresponding potential health impacts. AQI levels correspond with the NAAQS. The most common AQIs are for ground-level ozone and particulate matter, since pollutant levels for these two pollutants tend to hover near the NAAQS. AQI forecasts alert the public when local weather conditions may contribute to unhealthy air.

Information about air quality can promote changes in daily activities. For example, some organizations implement telework policies on Code Red Days. Code Orange and Code Red days can be a regular occurrence in the District during summer months.

"State of the Air"

The American Lung Association (ALA) grades cities throughout the country based on the number of Code Orange and Code Red days per summer. Their *State of the Air* report for 2012 ranked the Washington-Baltimore-Northern Virginia, DC-MD-VA-WV, metropolitan statistical area (MSA) as number 13 of the top 25 most ozone-polluted cities in the U.S. In 2013, the MSA that includes the District was ranked worse at number 9.[xiv]

ALA's annual report demonstrates that opportunities for pollution control remain before the air is considered healthy for everyone.

CLEAN AIR PARTNERS

AIR QUALITY ACTION GUIDE

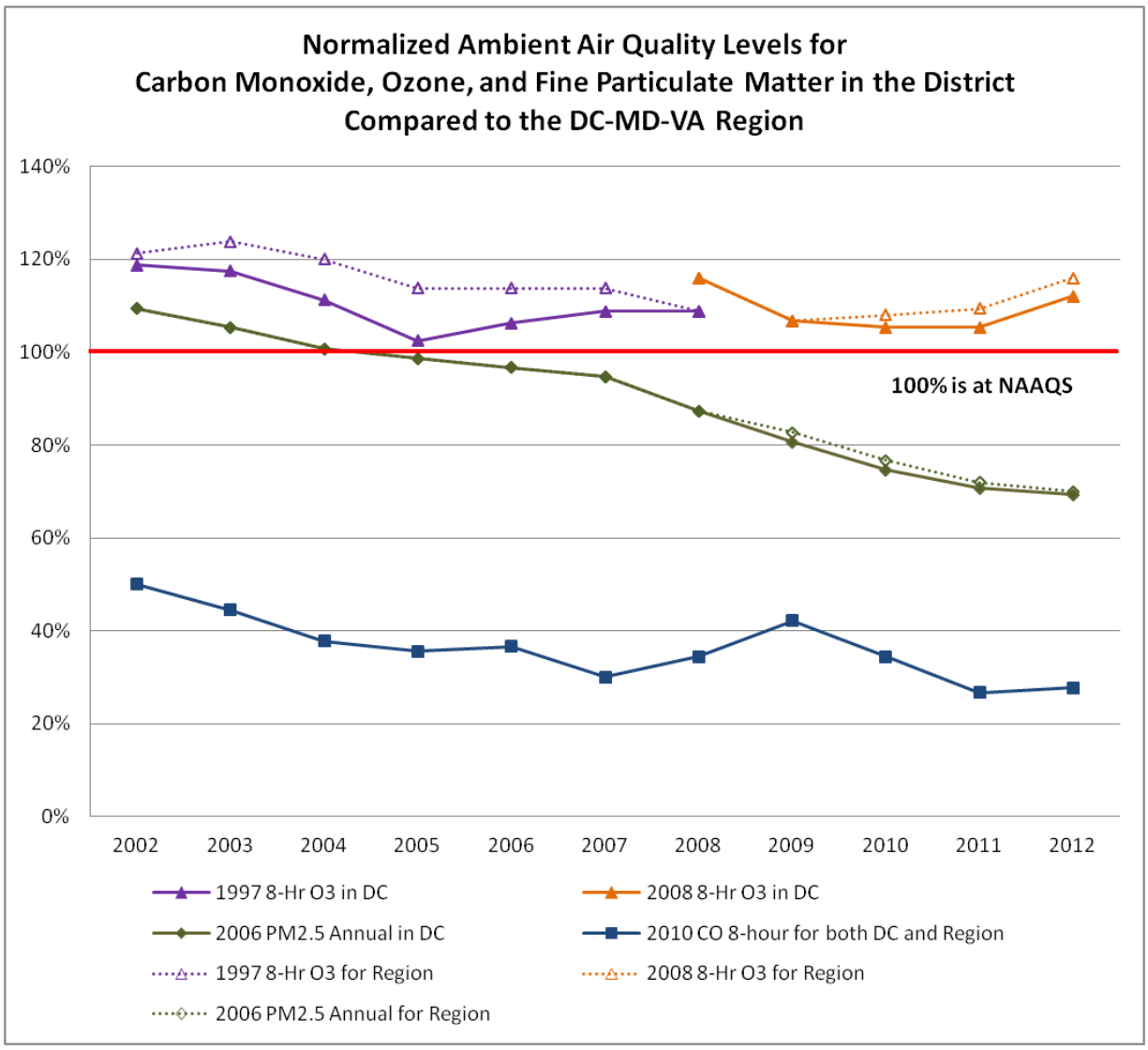
Your "how to" guide for cleaner air

Air Quality Rating	Steps to Protect Your Health and Our Environment
GOOD 0-50	Enjoy the great outdoors. · Rather than drive - bike or walk when possible. · Conserve energy. Replace incandescent bulbs with CFLs. · Plant a tree to improve health and air quality.
MODERATE 51-100	Some pollution. Even moderate levels pose risks to highly sensitive groups. · Bundle errands. Eliminate unnecessary trips. · Check AirAlerts to see if tomorrow's forecast is unhealthy. · Perform regular maintenance on your car.
UNHEALTHY For Sensitive Groups 101-150	Pollution levels are harmful to children, older adults and anyone with a respiratory or heart condition. Limit physical outdoor activity. · Don't drive alone. Carpool, take public transit. · Refuel your car in the evening. · Put off lawn care until air quality improves. · Use a gas or electric grill instead of charcoal.
UNHEALTHY 151-200	Everyone should limit strenuous outdoor activity when the air is unhealthy to breathe. · Telework and take public transit. · Turn off lights and electronics when not in use. · Avoid lawn mowing or use an electric mower. · Sign up for health alerts at cleanairpartners.net. · Don't use chemicals on your lawn and garden.
VERY UNHEALTHY 201-300	Pollution levels are very unhealthy for everyone. Avoid any physical outdoor activity. · Follow all of the action steps above.

PART 2: TRENDS ANALYSIS

1.0 AIR QUALITY TRENDS

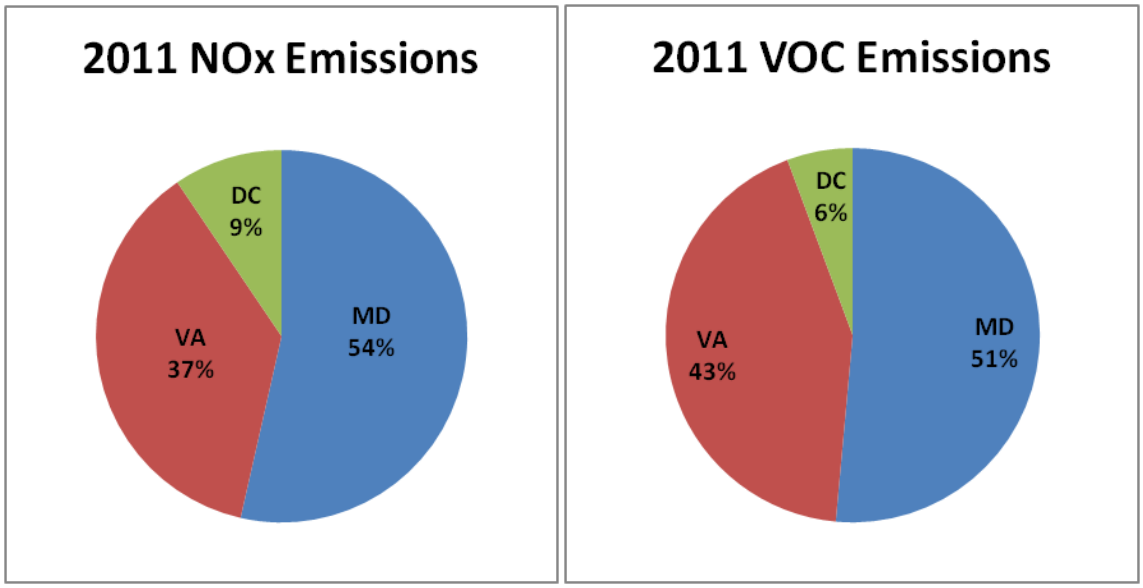
To date, the District has always been in compliance with the federal standards for three of the six criteria air pollutants: nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). As demonstrated in the following chart, ambient air concentrations remain in nonattainment of the NAAQS for one pollutant: ground-level ozone (O_3). In recent years, the District has consistently attained the NAAQS for particulate matter ($PM_{2.5}$). The District came into attainment of the carbon monoxide (CO) standard in 1996 and is required to continue demonstrating attainment until 2016, at which time no further reporting is required.



There are small differences in air quality between the District itself and the DC-MD-VA nonattainment region as a whole. Since 2002, ozone levels have been very similar but have

usually been lower in the District compared to the region. Since 2008, fine PM ($PM_{2.5}$) levels have generally been slightly lower in the District compared to the region. CO levels in the District compared to the region have remained similar. The District's River Terrace monitor has been the monitor with the highest CO readings overall, making it the "design value" monitor.

Monitored air quality values can at least partially be understood by considering emissions. Emissions in the District are low compared to emissions from other parts of the ozone nonattainment region as a whole.

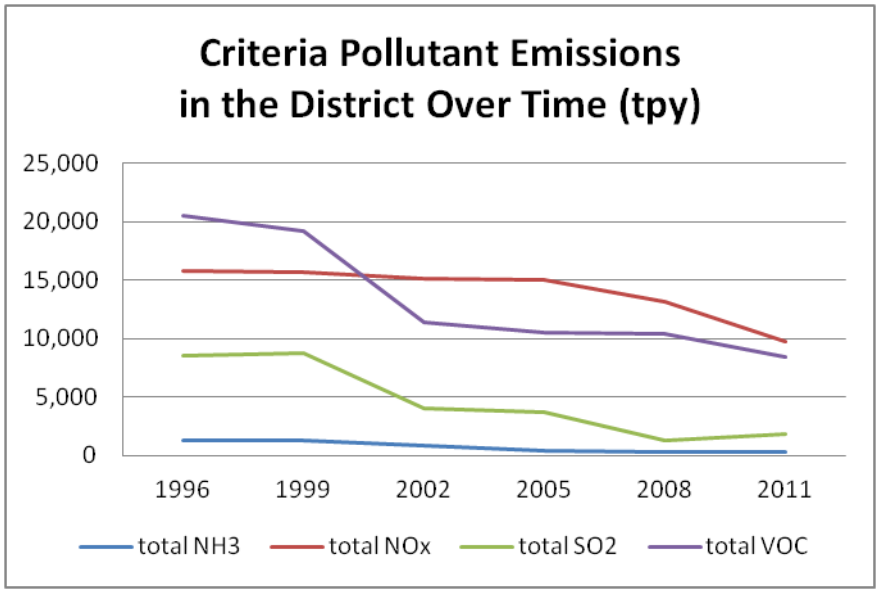


The District is one jurisdiction, while the nonattainment portion of Maryland includes five separate jurisdictions (Calvert, Charles, Frederick, Montgomery, and Prince George's counties) and the nonattainment portion of Virginia includes nine jurisdictions (Arlington, Fairfax, Loudoun, and Prince William counties plus Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park cities).

2.0 EMISSIONS TRENDS

Air pollution can result from human (anthropogenic) activities such as fuel combustion in industries and vehicles. Volcanic eruptions and forest fires are some of the natural sources of air pollution. Anthropogenic emissions are the ones that need to be controlled or mitigated when developing air quality improvement strategies. Emissions are generally calculated using data about how much activity occurs in a sector, along with additional technical information about the emissions source (such as a typical emissions rate). Emissions measurements from a particular source or activity are not always possible; hence, air pollution emission estimates based on proven methods are typically used. Estimation methodologies can change over time as new information becomes available.

EPA gathers and develops emissions data for the following criteria pollutants and their precursors: NO_x and VOC (ozone precursors), CO, PM (primary, condensable, and filterable emissions data for both PM_{10} and $PM_{2.5}$), NH_3 (a primary $PM_{2.5}$ precursor), SO_2, and Pb. Based on official EPA National Emissions Inventory (NEI) estimates (not including biogenics)[xv], emissions of criteria pollutants and their precursors in the District have dropped gradually since 1996 despite increases in population, employment, households, and VMT over time.



Such evidence suggests that measures to control pollution have been successful to date. There are similar overall trends for CO and $PM_{2.5}$-primary, but on different scales.

Air quality and emissions trends per pollutant and per sector are discussed in the following chapters.

3.0 POLLUTANT-SPECIFIC TRENDS

Air quality and emissions trends per pollutant and per sector are analyzed in the following sections. Even though averaging methodologies of the NAAQS may change, monitored results (design values) do not.

3.1 O_3 MONITORING RESULTS AND EMISSIONS

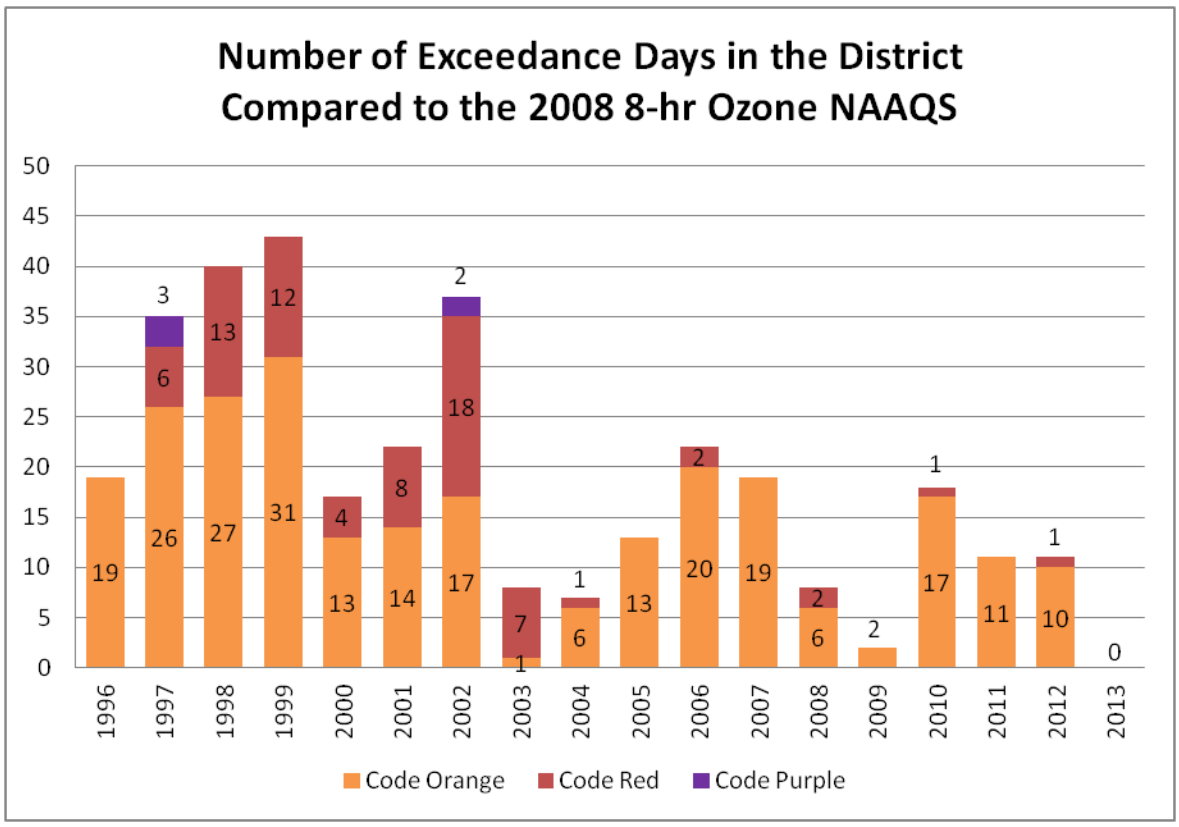
Ground-level ozone levels are measured at three monitoring sites in the District: McMillan, River Terrace, and Takoma. A fire at the Takoma monitoring station in 2011 ceased measurements at that location. A replacement station was established in 2013. The 2008 8-hour ozone NAAQS is based on the fourth highest maximum reading in one year. Data is collected hourly, with 8-hour forward-rolling averages established for every hour in a day.

(There are 24 8-hour averages per day). An arithmetic mean over three consecutive years is used to determine the DV.

The following chart demonstrates how, over time, 8-hour ozone concentrations have generally dropped at all three monitoring stations that measure ozone in the District. The McMillan station consistently measures the highest levels of ozone.

NO_x emissions began dropping after 2004 throughout the region in step with implementation of EPA's NO_x SIP Call (2004) and Clean Air Interstate Rule (CAIR, 2009), which controlled emissions of NO_x from large facilities such as power plants. The downward trends in both NO_x and VOC emissions also were also influenced by the "Tier 2" light-duty vehicle rule (2004 to 2007), heavy-duty highway diesel rules (2007), and federal standards for nonroad engines beginning in 2008.

The next figure shows the number of days that ozone levels exceeded the 2008 8-hour ozone NAAQS of 0.075 ppm. (Since the standard did not go into effect until 2008, it does not portray actual exceedances experienced per year.)



Regional analysis by the Metropolitan Washington Council of Governments (MWCOG) suggests that before 2006, a 90 degree day was an indicator of an exceedance day.

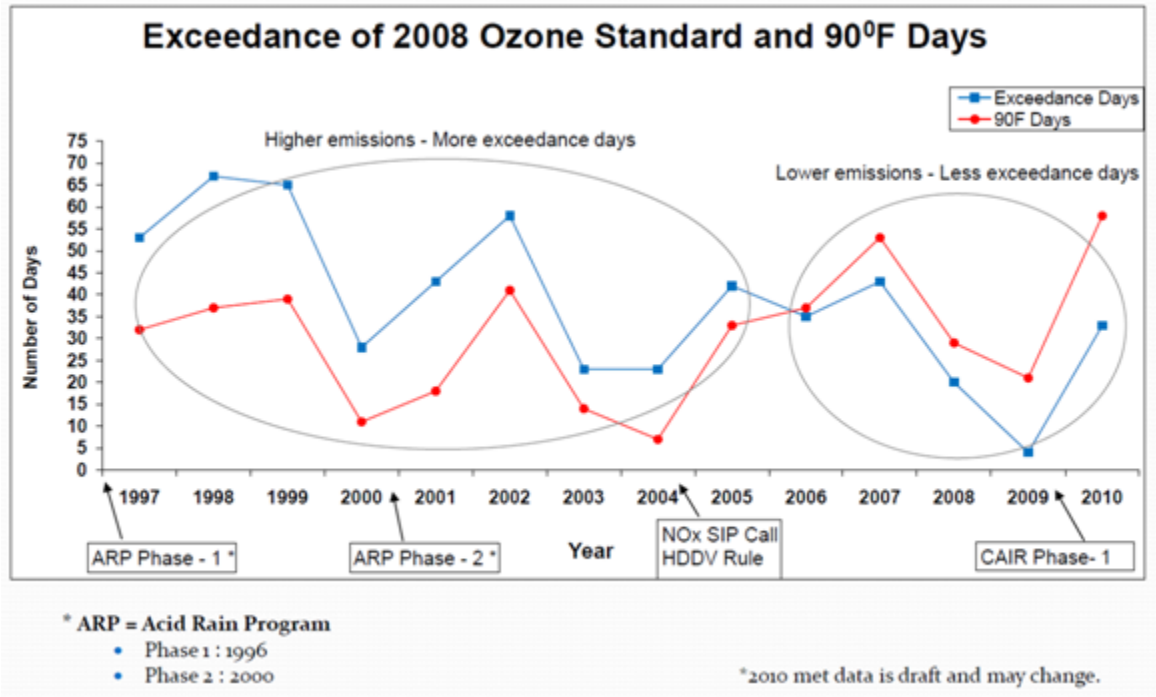


Figure courtesy of MWCOG

Since 2006, a 90 degree day is not indicative of an exceedance day because fewer pollutants are available to react in the air to develop ozone.

Despite this success, the DC-MD-VA region remains in nonattainment of the 2008 8-hour NAAQS. The District emits less than ten percent of all NO_x and VOCs emitted by all 15 separate jurisdictions in the region.

Even with emissions reductions in all 15 jurisdictions, the area may remain in nonattainment into the foreseeable future. EPA's modeling analysis for the draft Cross-State Air Pollution Rule (CSAPR)[xvi] suggested that nearly 75% of all ozone pollution in the region is from out-of-state[xvii], and actual monitored values for 2012 were higher than the EPA model predictions.

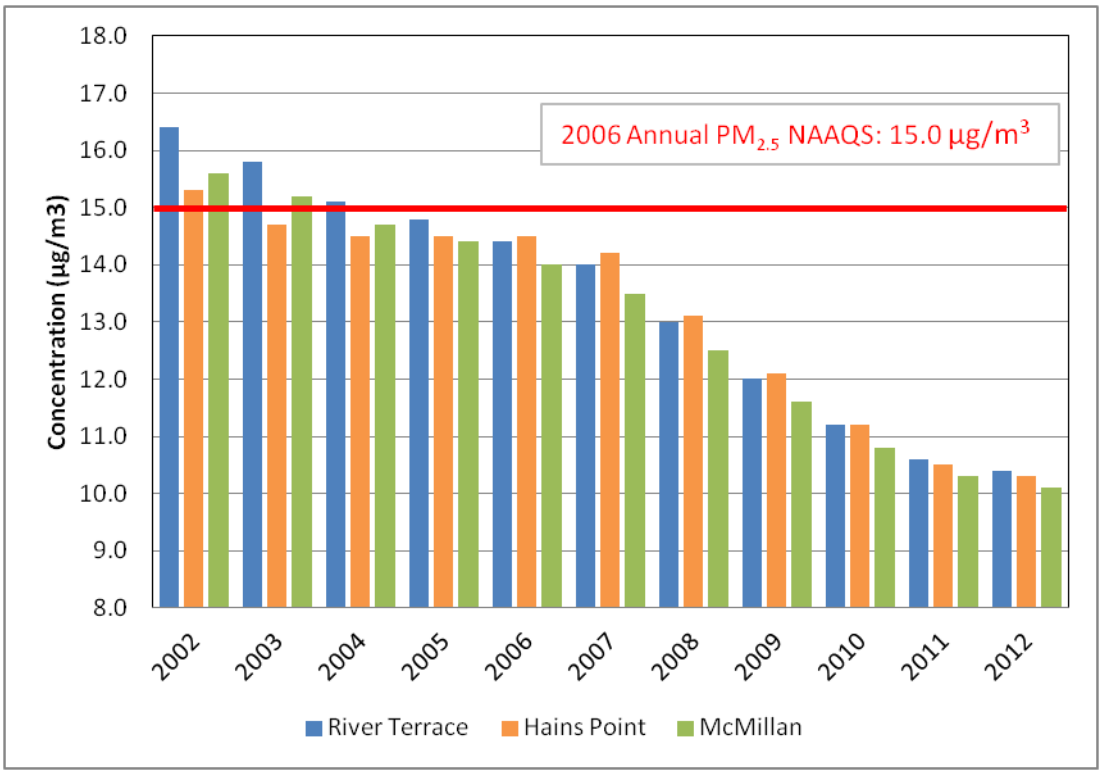
District of Columbia Monitor Site	2012 Base Case Average Values (ppb)	2012 Base Case Maximum Values (ppb)	Actual DVs, 2010 (ppb)	Actual DVs, 2011 (ppb)	Actual DVs, 2012 (ppb)
110010043 (McMillan)	76.9	79.0	**79**	**79**	**84**
110010041 (River Terrace)	72.9	77.2	77	76	80
110010025 (Takoma)	72.7	73.9	75	75*	N/A*

** There was a fire at the Takoma monitoring station in 2011, so measurements ceased at that location.*

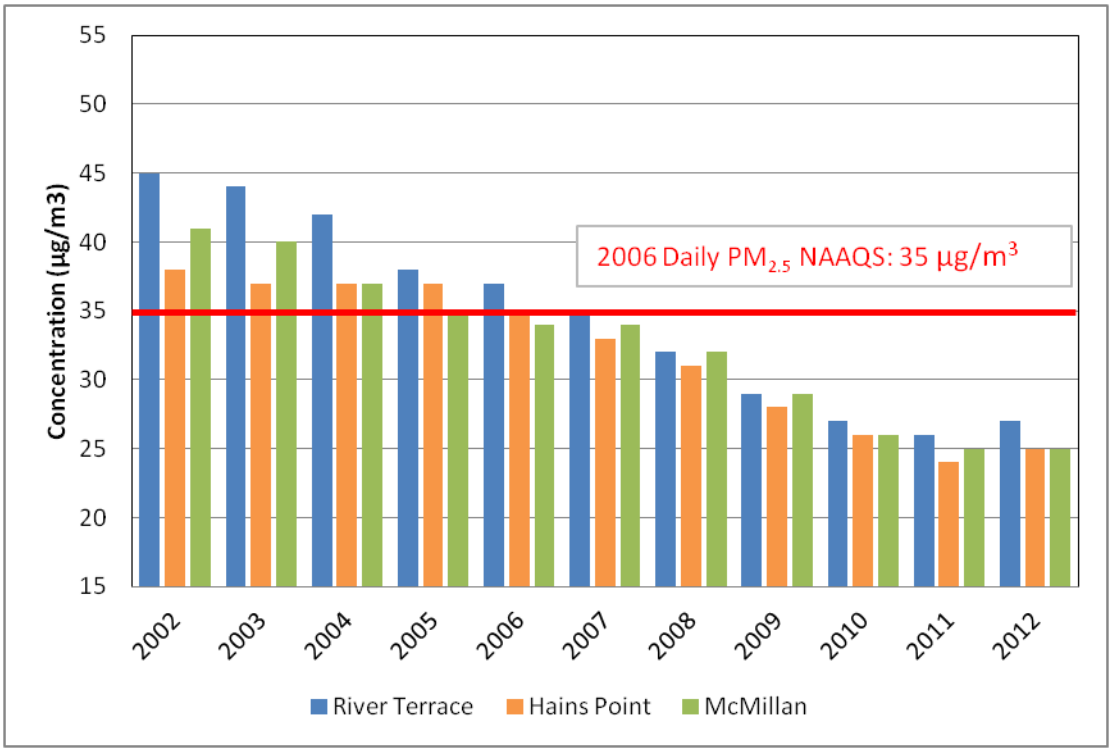
3.2 $PM_{2.5}$ Monitoring Results and Emissions

Particulate matter is measured at three monitoring sites in the District: River Terrace, Hains Point, and McMillan. The annual $PM_{2.5}$ NAAQS is measured using the arithmetic mean of four quarterly averages per year. The 24-hour standard is based on the 98th percentile reading per year, where data is ranked from highest to lowest. Each station collects data using one 24-hour filter per day.

Annual $PM_{2.5}$ levels have gradually declined each year since 2004. Data shows that the region has been in attainment of the standards long enough to submit a formal request to change its designation status to attainment.



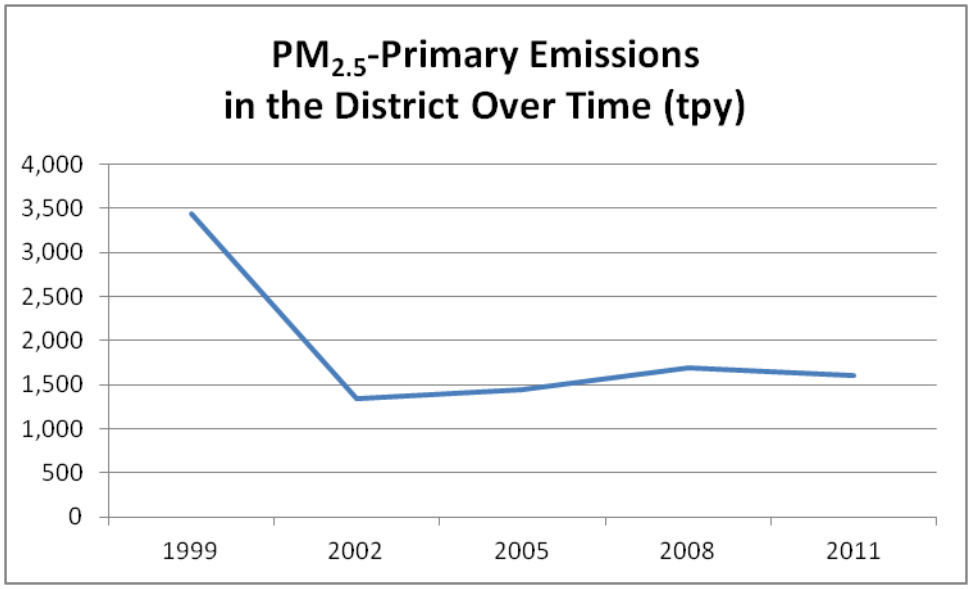
Also since 2004, 24-hour $PM_{2.5}$ levels have declined. Shorter-term daily exposures are meeting the standards.



These downward trends are likely because of Federal control programs that limit emissions from nonroad gasoline and diesel engines, locomotives, and heavy-duty diesel trucks.

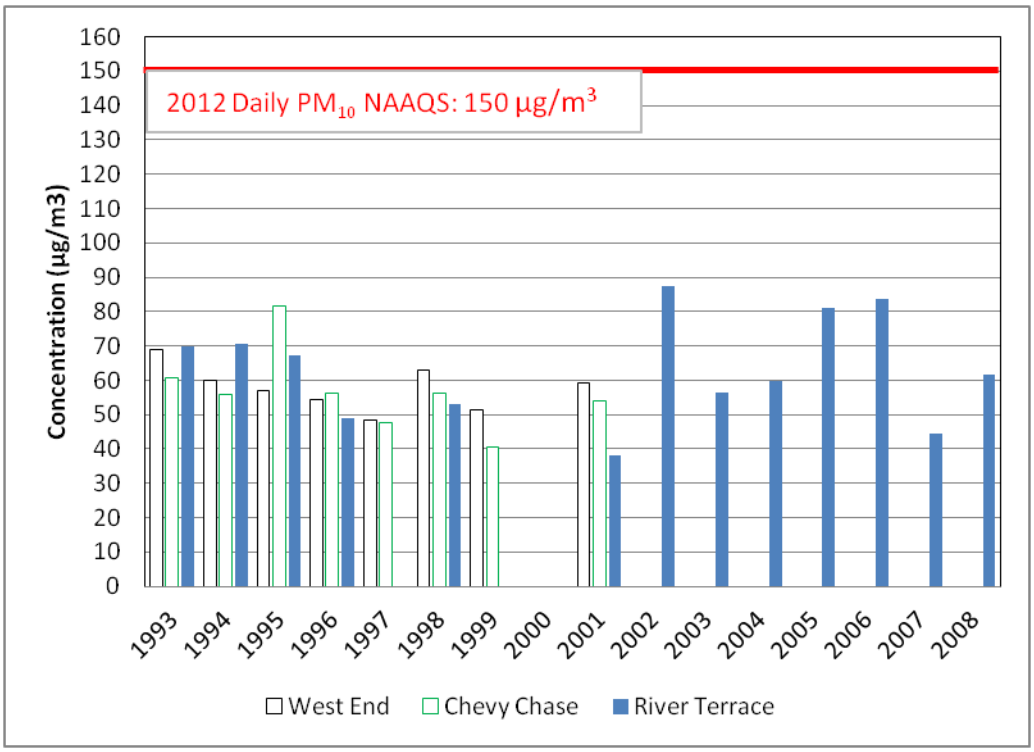
PM emissions are estimated as PM-primary, which are particulates that are directly emitted by a source; PM-filterable, which are emissions that are collectable using a filter; and PM-condensable, which are formed after they are emitted. Filterable plus condensable emissions equate to PM-primary emissions.

$PM_{2.5}$ precursors include ammonia, sulfates, nitrates, organic carbon, and elemental carbon. Ammonia emissions in the District have remained relatively constant. The drop in primary $PM_{2.5}$ emissions in 2002 occurred primarily in the area source sector. There have been slight increases since then, not because of actual emissions increases but because of changes in the calculation methodologies for residential wood combustion and paved roads that began with EPA's 2008 National Emissions Inventory. Reductions since 2008 appear to be an accumulation of small changes to emission calculation methodologies in the onroad sector.



3.2.1 PM_{10} Monitoring Results

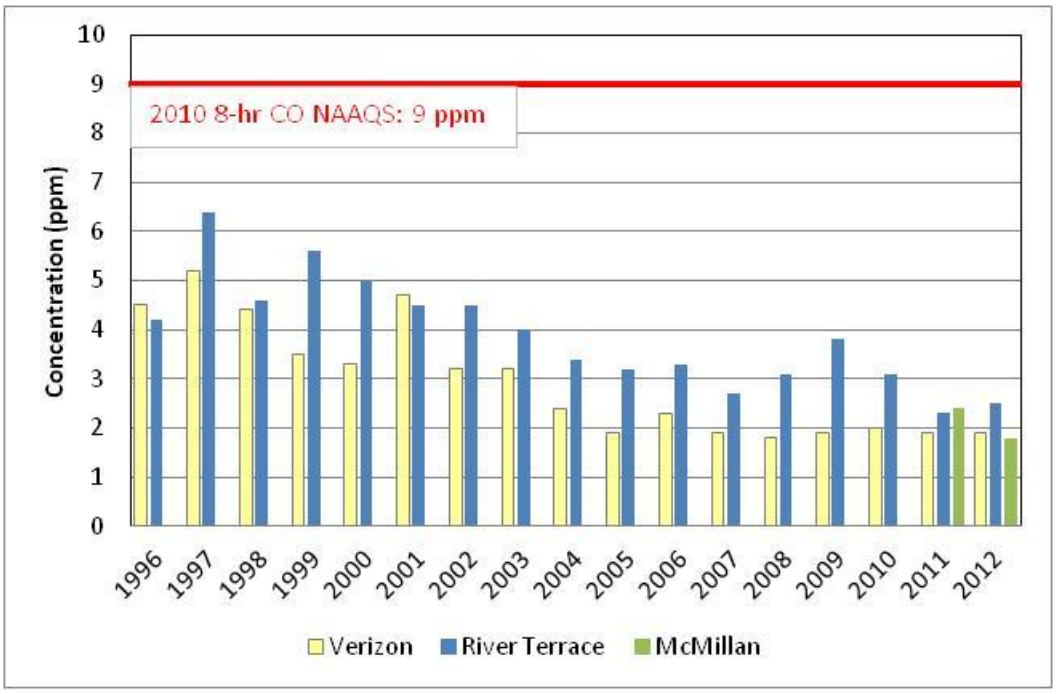
PM_{10} is currently measured at one location in the District because levels are generally very low. Concentrations are collected using 24-hour filters. A DV is calculated by taking the 99th percentile reading of data ranked from high to low for a year. The monitoring network for PM_{10} changed substantially after 2002, upon the full implementation of monitors at a new monitoring location. Western states tend to have more PM_{10} concerns.



3.3 CO Monitoring Results and Emissions

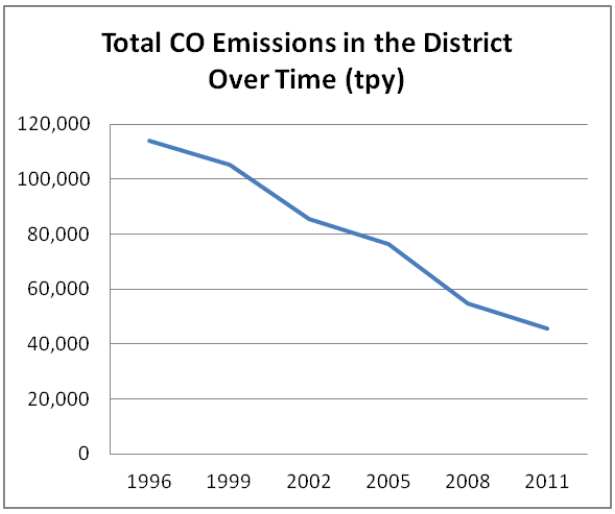
Historically, there have been two monitors for CO in the District. A third monitor was added to meet requirements of the 2010 CO NAAQS. For the 8-hour standards, hourly measurements are averaged over eight hours on a backward-rolling basis to establish the daily 8-hour averages. The second highest maximum reading is taken per year to determine an annual estimate, and the DV is the highest annual estimate over two consecutive years.

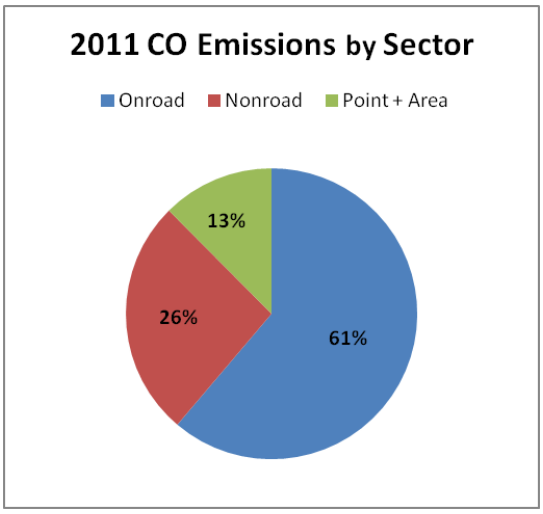
The District's CO concentration levels have remained well below the NAAQS since 1996.



The River Terrace "urban" scale monitor generally shows more CO pollution than the Verizon Center "neighborhood" scale monitor, presumably because of the differences in traffic, the movement of air in each location, and the scale of measurement.

CO emissions have decreased steadily during this time with improvements in motor vehicle emissions controls and fleet turnover. They primarily come from the mobile source sector.

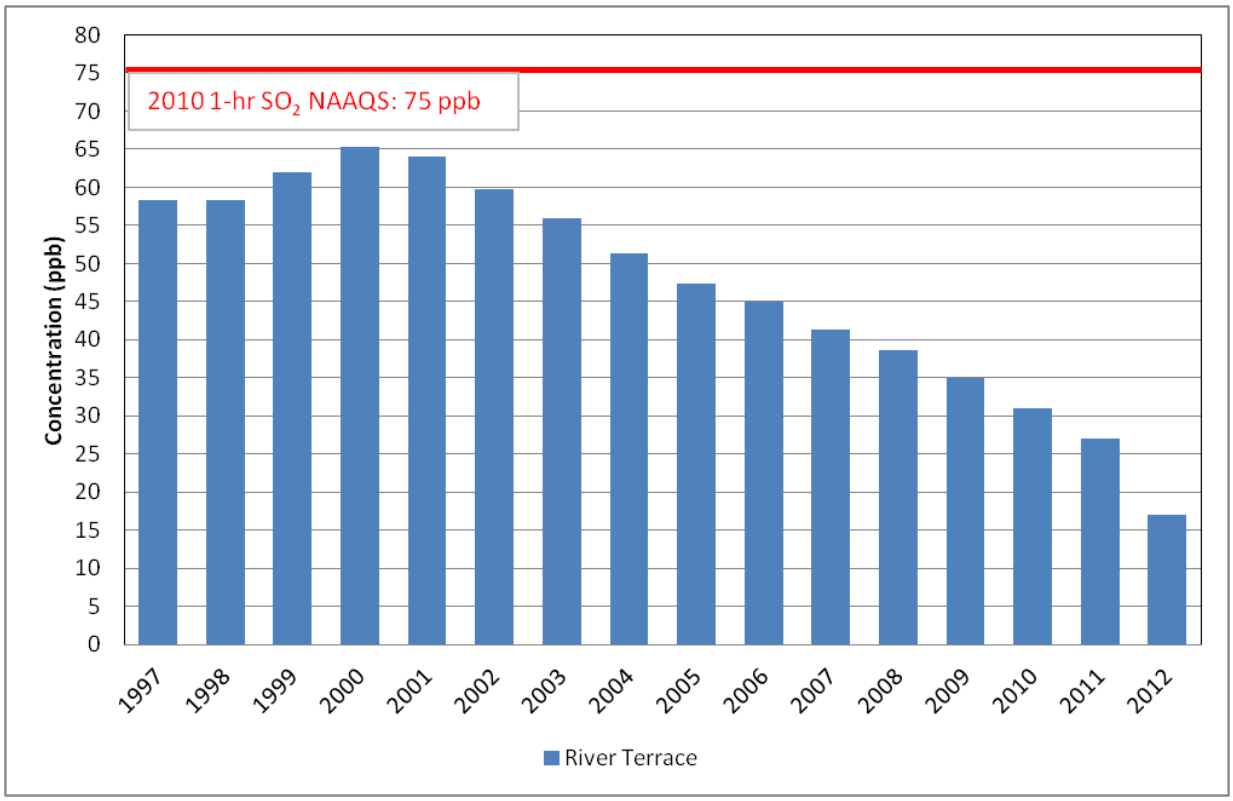




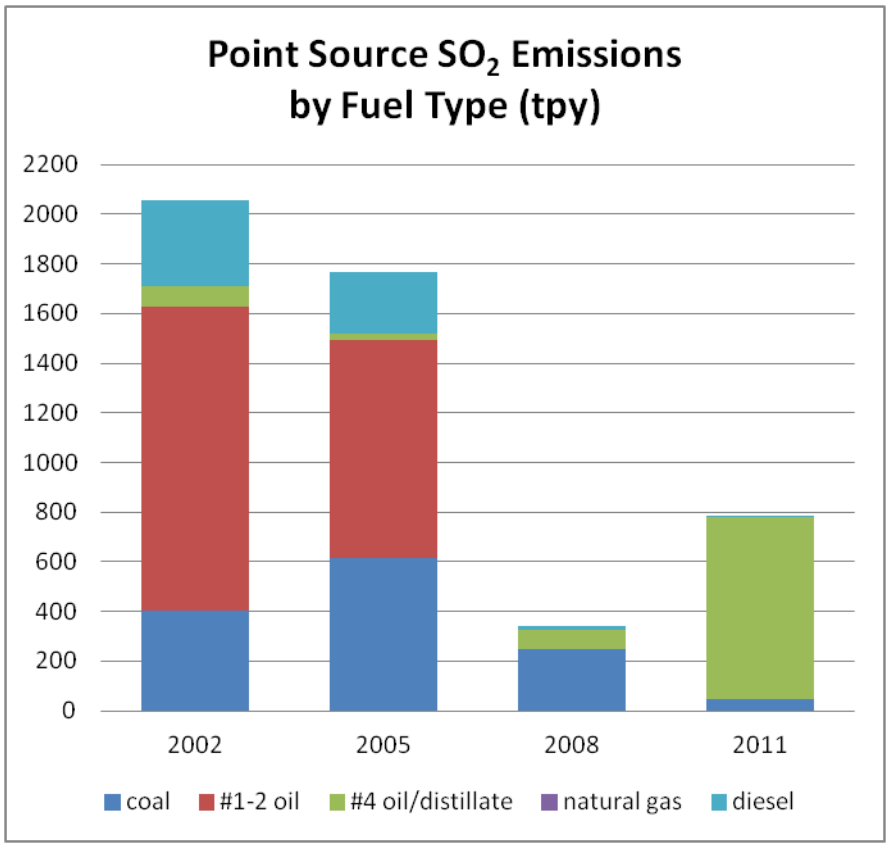
3.4 SO_2 Monitoring Results and Emissions

SO_2 has been measured historically only at the River Terrace monitor. Hourly measurements are taken to comply with the 2010 standard. A trace-level SO_2 analyzer was deployed at the McMillan national core (NCore) station in 2011. The 99th percentile reading averaged over three consecutive years determines the SO_2 DV concentration. For the 1996 24-hour NAAQS, an average of hourly measurements per day is averaged per year, and the DV is the highest of the three annual values over three consecutive years.

The District's SO_2 levels have consistently remained below the NAAQS and have dropped since the highest readings in 2000. The following chart shows that existing SO_2 monitoring results are still below the federal standards, even compared to the new 2010 NAAQS.



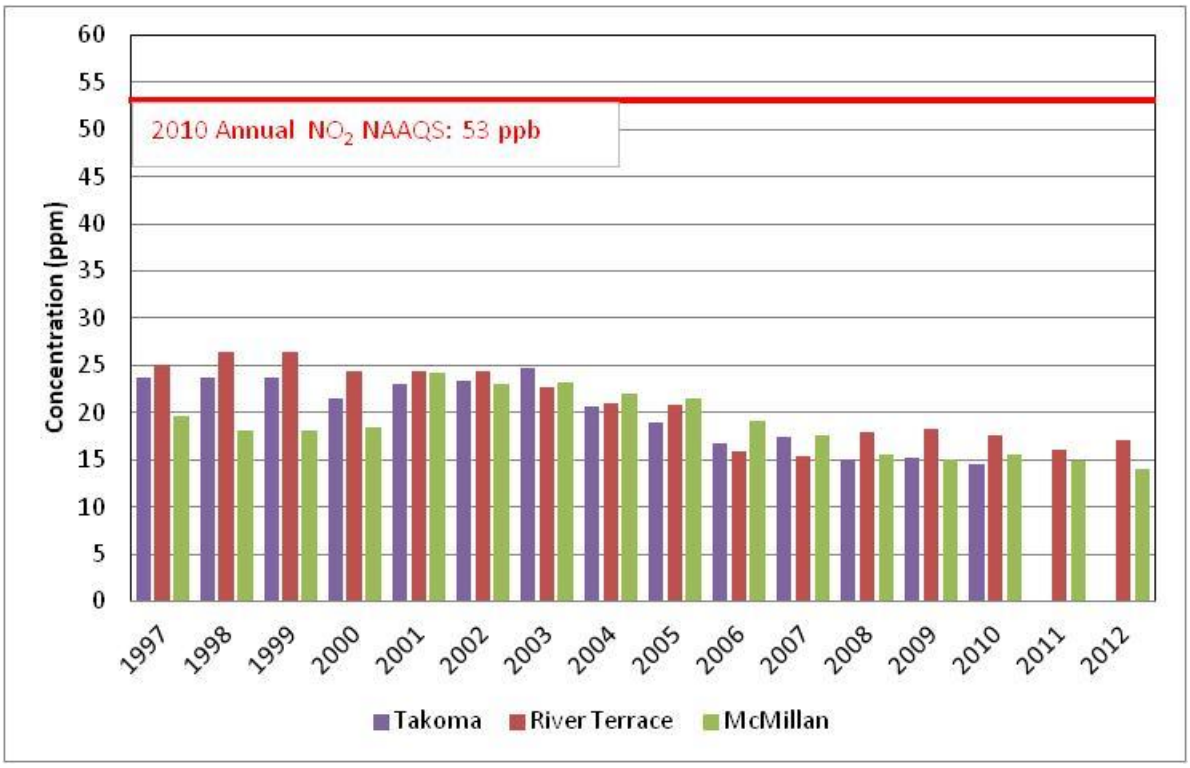
SO_2 emissions have been linked to the use of coal at the District's one coal-burning facility, which has generally waned since the 1990s, and the combustion of oil at the District's remaining two electric generating units (EGUs), which shut down in 2012. In 2011, SO_2 emissions from the use of distillate oil (#4) was more prevalent than SO_2 emissions from the use of any other fuel source used by large facilities in the District.



3.5 NO_2 Monitoring Results

For the 2010 1-hour NO_2 standard, an annual estimate is the 99th percentile reading of hourly measurements ranked from high to low. The annual NAAQS is the average of hourly measurements per year. For both, the DV is the highest estimate over two consecutive years. Since the fire at Takoma in 2011, NO_2 is measured at two locations: River Terrace and McMillan.

Over the past fifteen years, the maximum annual average NO_2 levels have remained at approximately half of the federal standard at all monitoring stations. They continue to remain well below the NAAQS.



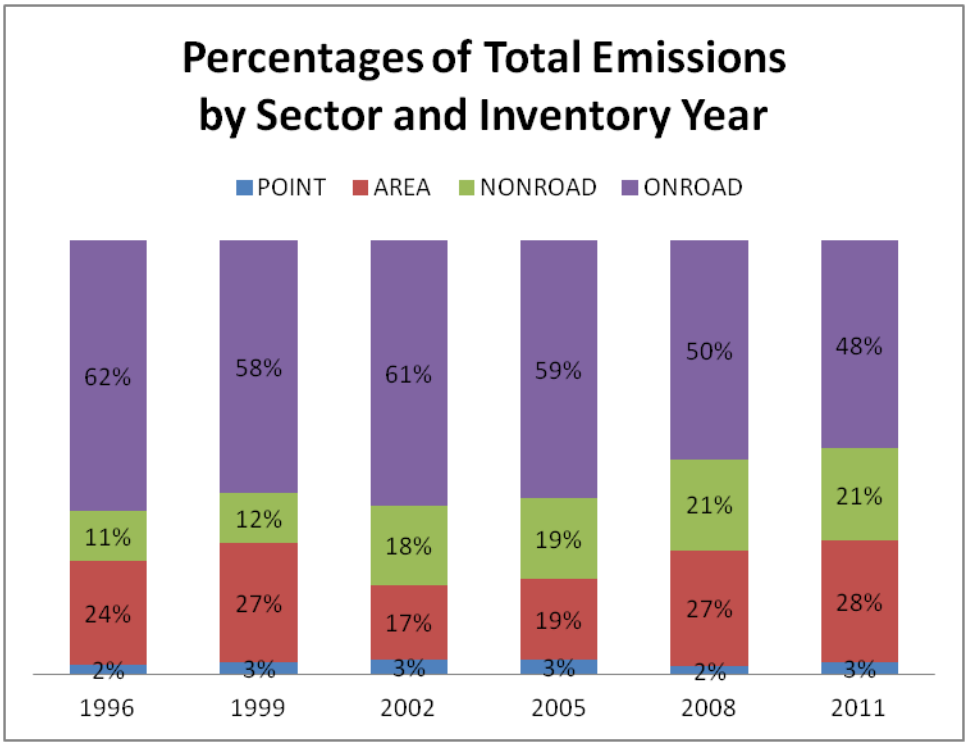
New monitors are being established to meet the monitoring requirements of the new 1-hour standard. NO_x emission data is collected for inventory purposes as a surrogate for NO_2.

3.6 Pb Monitoring Results

The District's air program began operating population-based ambient lead monitors in January of 2012, as required by the 2008 Pb NAAQS revision.

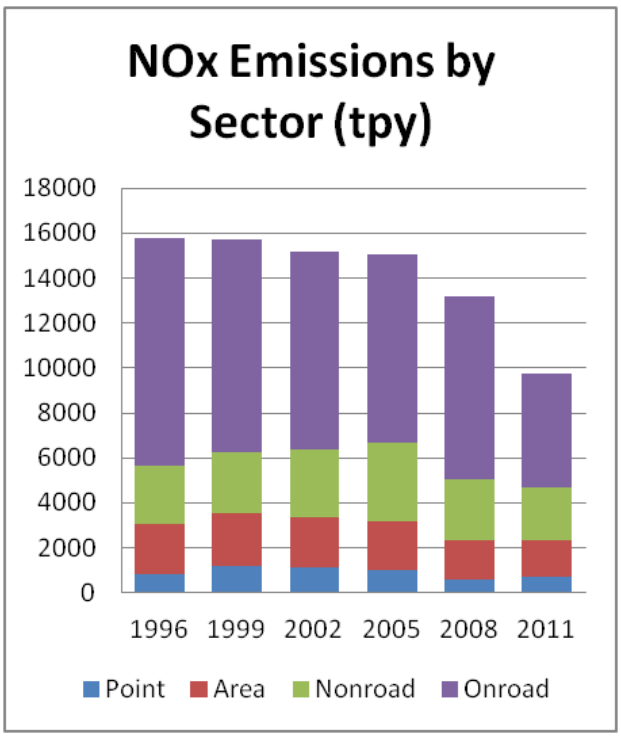
4.0 SECTOR-BY-SECTOR ANALYSIS

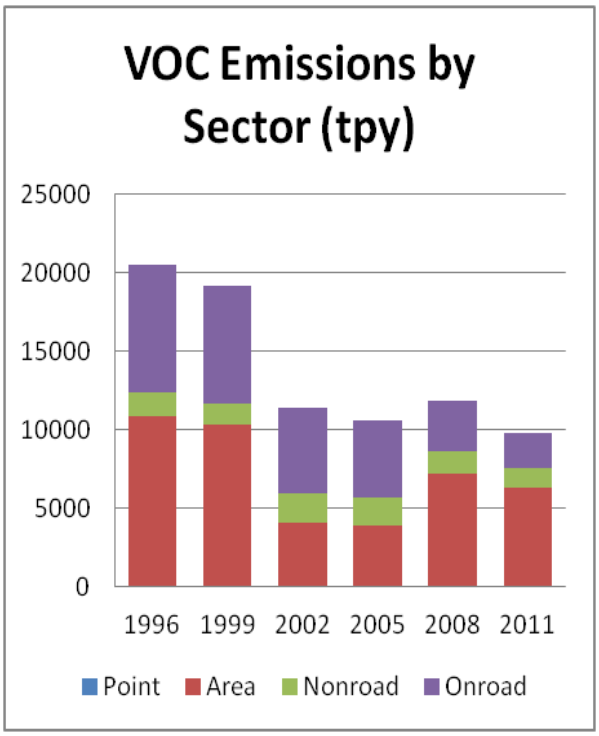
Roughly half of the air pollution in the District comes from vehicles.



The onroad mobile sector contributed less to overall emissions in 2011 than in previous years. The District's area (nonpoint) and nonroad sectors are contributing a larger portion of emissions. The point source sector remains a small percentage of the District's inventory. There may be slight differences in how specific source categories are characterized from year to year, but changes generally do not significantly affect the total estimates.

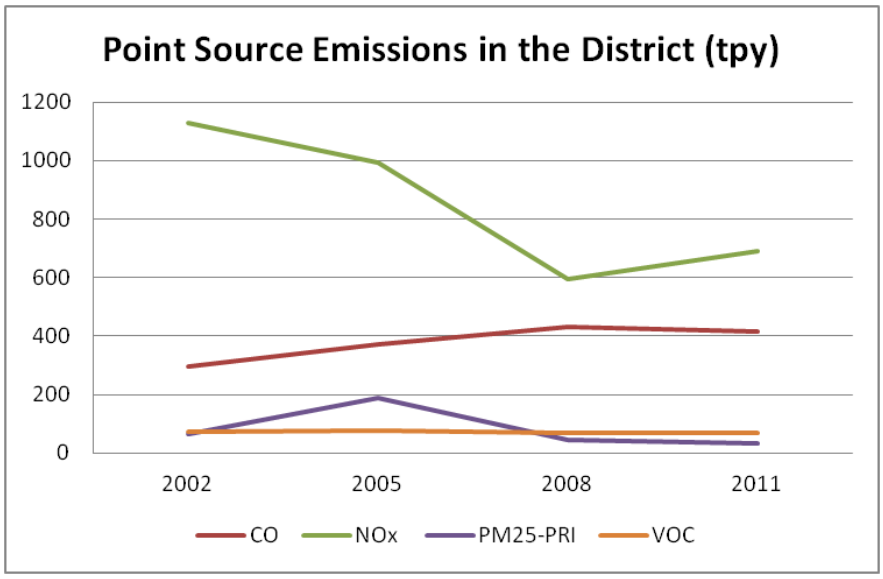
Onroad mobile emissions are the primary source of the ozone precursor NO_x, followed by the nonroad sector. The area source sector is the main emissions source of the ozone precursor VOCs, followed by the onroad sector.





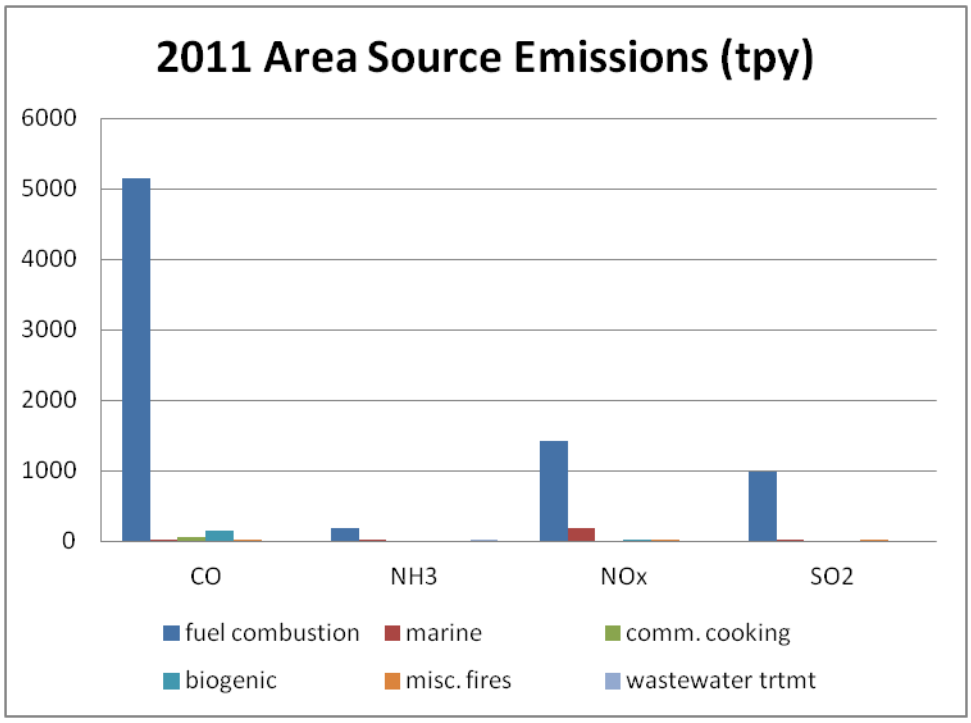
4.1 STATIONARY POINT SOURCES

Major point sources with the potential to emit high levels of pollutants [for example, over 25 tons per year (tpy) of NO_x or CO, or over 10 tpy of VOC] are required to report emissions to DDOE annually. In the District, they include universities, hotels, and government establishments that have large fuel-burning boilers. NO_x is the most dominant criteria pollutant from the point source sector. VOC emissions from point sources are somewhat constant.

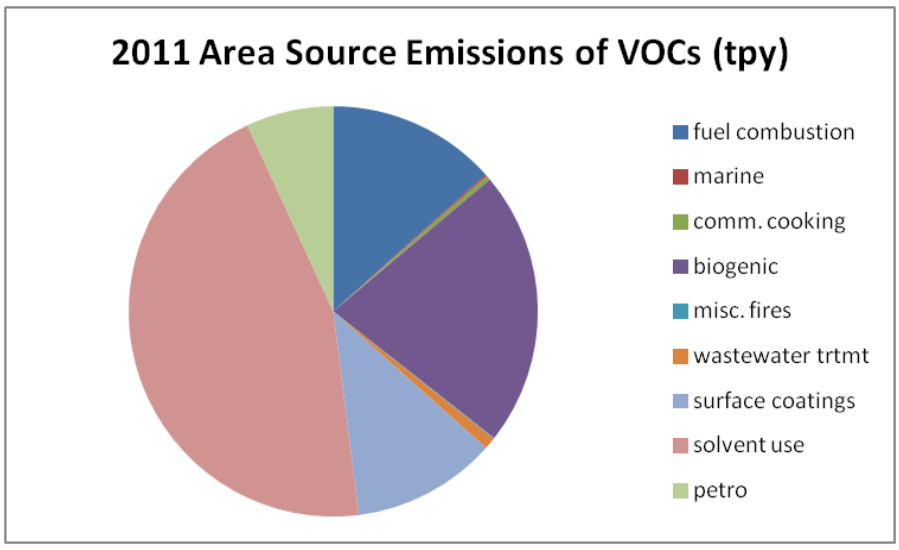


4.2 STATIONARY AREA SOURCES

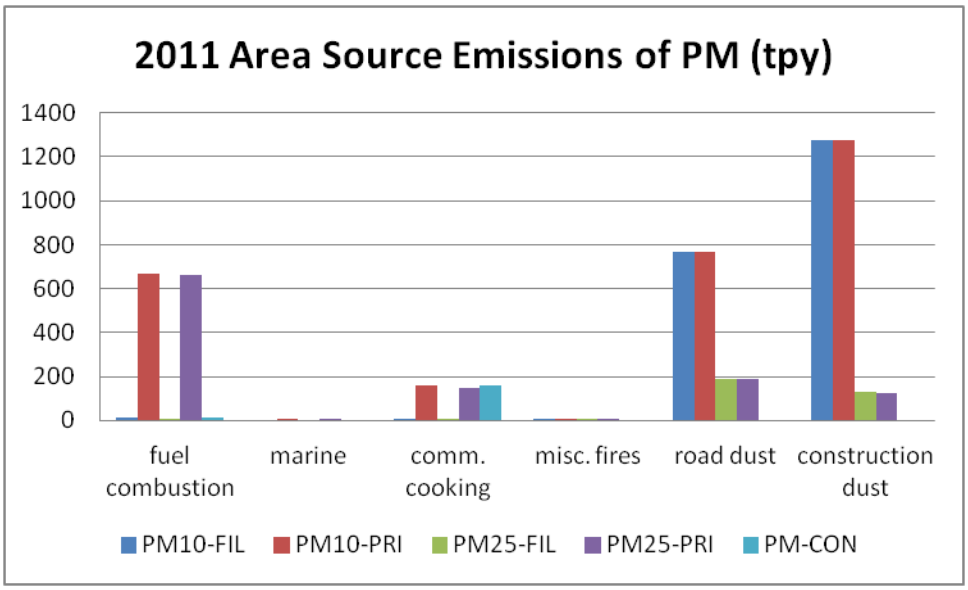
All other stationary sources such as dry cleaners, autobody shops, and consumer products are inventoried as area (nonpoint) sources. The following chart demonstrates that fuel combustion is the primary cause of area source emissions for most pollutants (not including PM or VOCs).



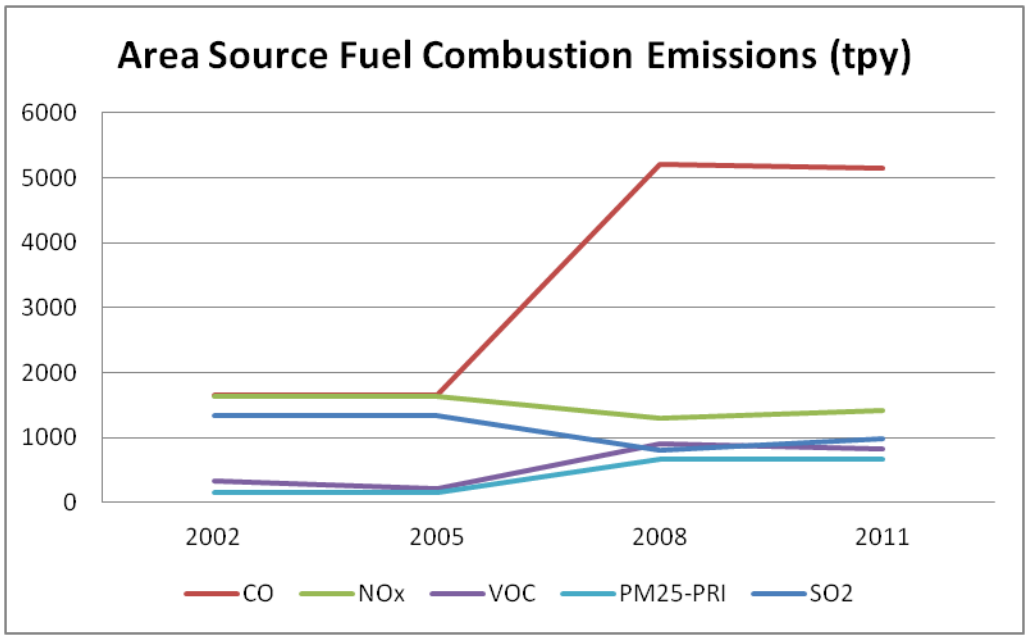
The largest source of VOC emissions from area sources is solvent use, followed by biogenics.



The largest sources of course PM (PM_{10}) emissions are construction and road dust. The largest source of fine PM ($PM_{2.5}$) is fuel combustion.



There was a steep increase in CO emissions from area source fuel combustion activities in 2008, as well as in VOC and $PM_{2.5}$ emissions. Increases are mainly due to improvements in emissions estimation methodologies made during the Eastern Regional Technical Advisory Committee (ERTAC) effort to coordinate and update data sources and assumptions used throughout the eastern part of the country. Changes were particularly noticeable in the solvent use and residential wood combustion categories.

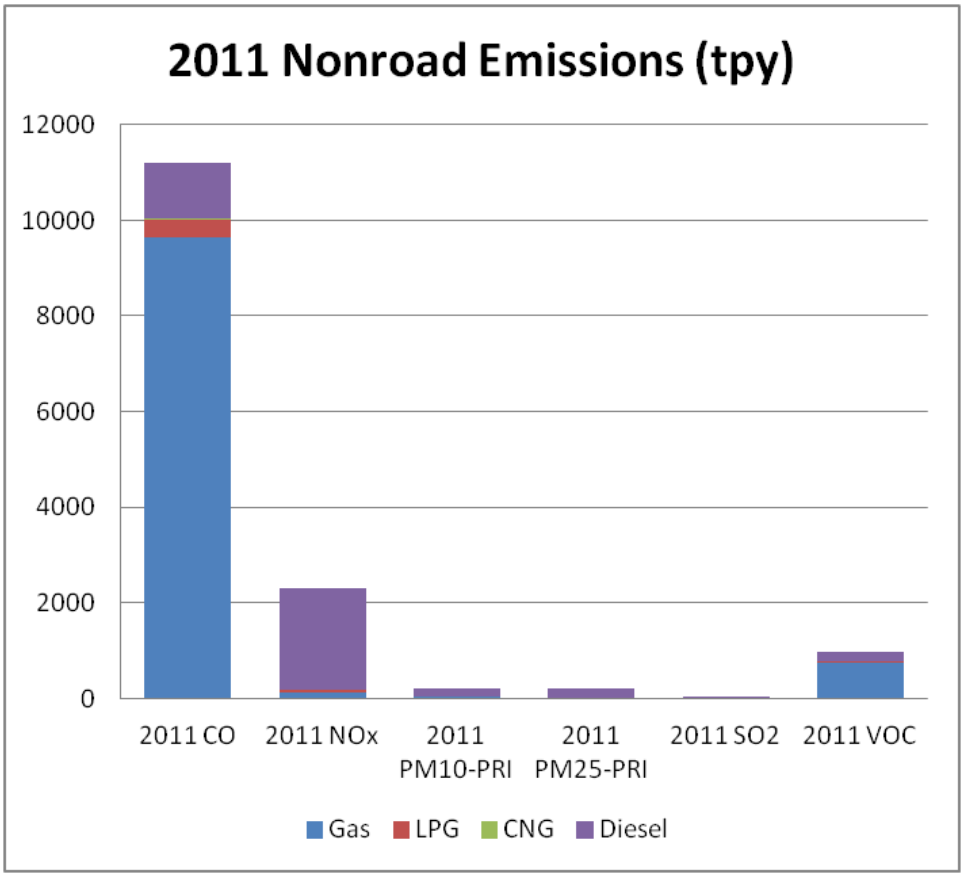


This is compared to NO_x emissions, where area source estimations have not substantially changed.

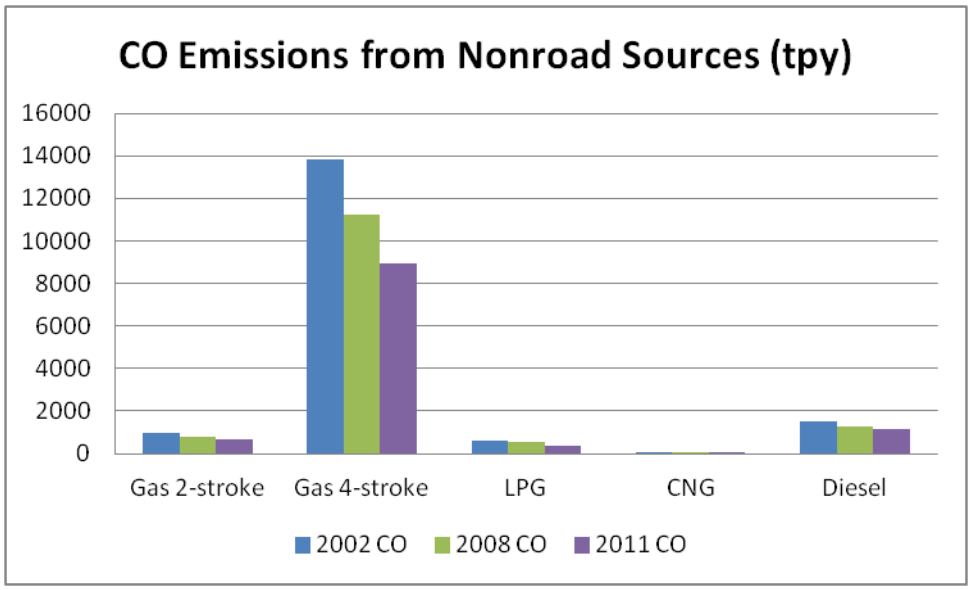
4.3 NONROAD MOBILE SOURCES

Nonroad source emissions were estimated by EPA using the National Mobile Inventory Model (NMIM, which combined capabilities of two other EPA models: MOBILE6, the predecessor to MOVES for the onroad sector, and NONROAD)[xviii]. The NONROAD database includes information on nonroad equipment populations and about each type of equipment such as age, fuel type, available horsepower, hours of activity, and pollution controls or standards. Emissions based on national defaults are then allocated temporally (to specific times of the day, week, or year) and geographically.

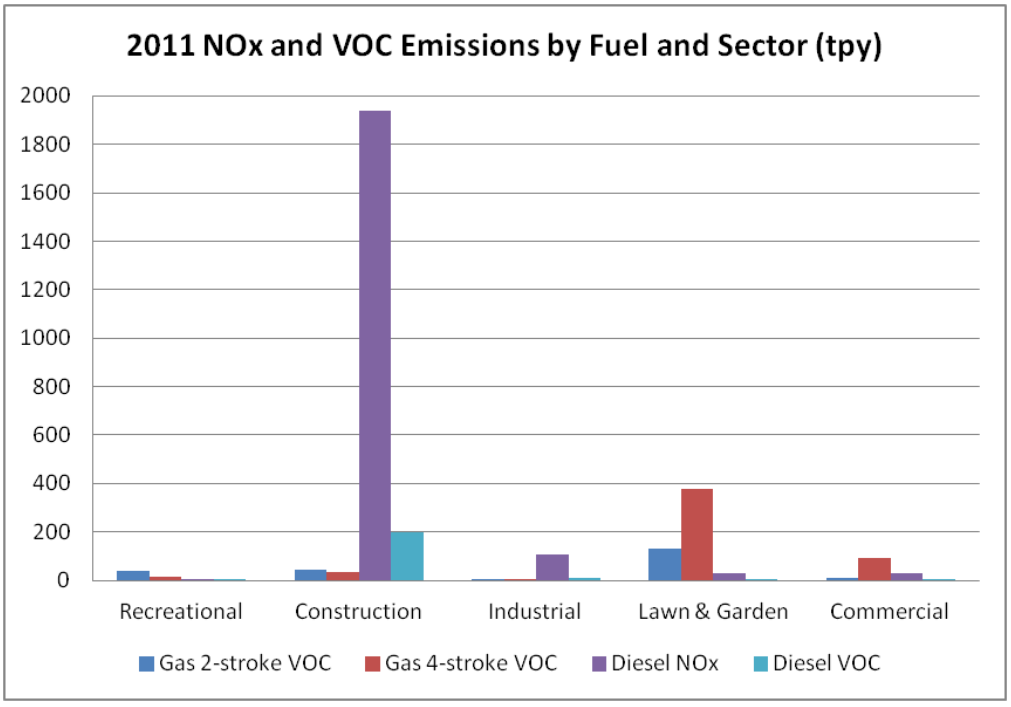
The following chart indicates that CO, NO_x, and VOCs were the most prevalent pollutants emitted by the District's nonroad sector in 2011. Gas and diesel were the main fuel sources used to power nonroad engines. NO_x emissions in the nonroad sector primarily come from equipment that runs on diesel fuel. Roughly 75 percent of VOC emissions come from gas-powered equipment.



CO emissions are primarily emitted from 4-stroke gasoline engines and are on a downward trend. In general, liquefied petroleum gas (LPG) is used more than compressed natural gas (CNG) in nonroad equipment, although both fuels are much less common than gas and diesel.



In 2011, most diesel NO_x emissions were from the construction sector. VOCs from diesel equipment were also primarily from the construction sector. VOC emissions from gas-powered equipment were prominent in the lawn and garden sector, where 4-stroke gas engines such as residential and commercial lawn mowers and leaf blowers emitted the most.



NO_x and VOC emissions from nonroad sources are also dropping. Reductions since 2002 are likely due to a myriad of exhaust and evaporative emissions standards on nonroad engines such as compression-ignition engines and spark-ignition engines.

4.4 MAR – Marine, Aircraft, and Railroads

Starting with the 2008 NEI, EPA no longer includes emissions data for commercial marine vessels (CMV), aircraft, and rail locomotives (collectively referred to as "MAR") in the nonroad category. According to EPA's website:

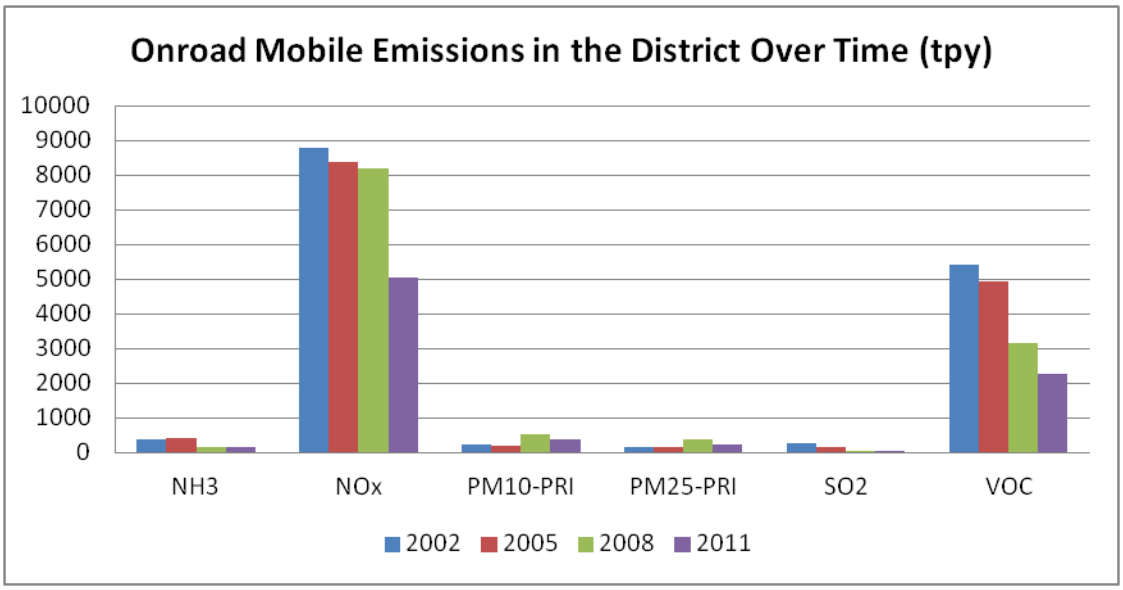
- Aircraft engine emissions occurring during Landing and Takeoff operations (LTO) and the Ground Support Equipment and Auxiliary Power Units associated with the aircraft are included in the point data category at individual airports.
- Emissions from locomotives that occur at rail yards are also included in the point data category.
- In-flight aircraft emissions, locomotive emissions outside of the rail yards, and commercial marine vessel emissions (both underway and port emissions) are included in the nonpoint (area source) data category.

Emissions from these categories are small and insignificant for the purposes of this document. There are heliports and rail yards in the District, but there are no major airports or marine ports like in other states.

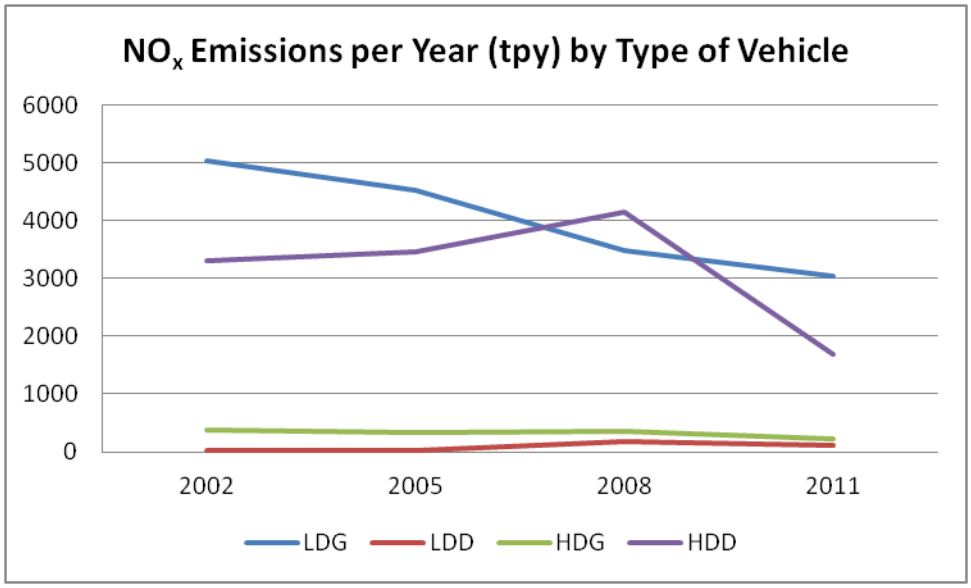
4.5 Onroad Mobile Source

Onroad emissions from cars, trucks, and motorcycles are estimated using models. With the 2011 NEI, EPA upgraded from using the MOBILE6.2 model to using a state-of-the-art model called Motor Vehicle Emission Simulator (MOVES). The MOVES model incorporates a large body of additional research on emission factors and new source groupings. Model inputs include vehicle population, vehicle age, vehicle miles traveled, vehicle speeds, road types, formulation and supply of fuels, and meteorological data.

Based on EPA estimates, onroad mobile emissions of all pollutants have dropped over time. Reductions can be attributed to lower emissions standards, cleaner fuels, and vehicle fleet turnover. CO emissions are the highest and are not included in the following chart of emissions because tons per year (tpy) quantities are on a different scale than other criteria pollutants. The primary pollutant of concern from the mobile sector is NO_x.



Emissions from gasoline vehicles are generally higher than emissions from diesel vehicles, except in 2008 when there was an unusual spike in emissions from heavy-duty diesel vehicles along with a drop in emissions from light-duty gasoline vehicles.



The drop in heavy-duty emissions after 2008 is a result of EPA's Heavy Duty Diesel Rule, which required emissions reductions of more than 90 percent beginning with the 2007 model year. It may also partially be attributed to EPA's transition to the MOVES model.

5.0 OTHER AIR POLLUTANTS

Other gaseous emissions such as greenhouse gases (GHGs) and pollutants such as air toxics are regulated under the Clean Air Act (CAA), and are briefly summarized below in this Report.

5.1 AIR TOXICS

Section 112 of the CAA addresses hazardous air pollutants (HAPs), or air toxics. There are 187 identified HAPs. HAPs come from the same types of sources as criteria pollutants such as vehicle exhaust, gasoline vapors, and commercial and industrial sources that use chemical solvents, paint thinners, or other chemical compounds.

HAPs are known to cause or possibly cause serious health effects even in very small amounts. Potential human impacts include cancer; damage to the immune system; neurological, reproductive, developmental, and respiratory problems; and disturbances to the hormonal or endocrine system. In the environment, HAPs deposit onto soils and into water and eventually accumulate in the food chain and cause birth defects, reproductive failure, and disease in animals. HAPs also contribute to the formation of criteria pollutants.

EPA began controlling HAPs based on pollutant-specific risks to human health. A technology-based strategy was developed with passage of the Clean Air Act Amendments in 1990. EPA now addresses HAPs by adopting emissions limit standards for specific source categories of polluters.

EPA's Air Toxics monitoring program began with one ambient air toxics 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 of National Air Toxics Trends Stations (NATTS). In addition, EPA Region 3 developed a regional air toxics monitoring network to look at ambient air toxic concentration gradients within a more densely populated urban area. The District currently collects air toxics samples at one monitoring station.

EPA also periodically conducts a National Air Toxics Assessment (NATA) to identify which geographic areas, pollutants and types of emission sources of HAPs might need closer investigation. The NATA characterizes potential risks based on cancer and noncancer toxicity, determines if actions may need to be taken to protect public health, and identifies priorities for expanding the air toxics monitoring network.

EPA's Toxics Release Inventory (TRI) is a database of information about actual releases of toxic chemicals from manufacturing facilities, accessible by zip code.

Once risks are fully characterized, state air agencies decide if steps should be taken locally to reduce air toxics emissions.

5.1.1 HAPs Monitoring Results

All toxic pollutants are harmful. The degree of harm associated with a toxic pollutant is a question of dose. Cancer toxicity weight approximates how many people will get cancer as a result of long-term exposure. Noncancer toxicity weight estimates pollutant concentrations that can influence the onset of other health impacts.

EPA's 2007 NATA found the following pollutants to be most prevalent in the District.

Long-Term Exposure (may cause cancer)		**Short-Term Exposure (may cause acute illness)**	
Pollutant	Cancer Toxicity Weight (risk based on toxicity-weighted emissions)	Pollutant	Noncancer Toxicity Weight (risk based on toxicity-weighted emissions)
Benzene	1.71 in 1,000	Arsenic	335,237.81
1,3-Butadiene	7.96 in 10,000	1,3-Butadiene	13,271.78
Tetrachloroethylene	2.07 in 10,000	Formaldehyde	12,690.12
Napthalene	1.94 in 10,000	Chlorine	8,575.00
Hexavalent Chromium	1.58 in 10,000	Benzene	7,327.25
p-Dichlorobenzene	1.34 in 10,000	Cyanide Compounds, gas	7,313.33
Arsenic, PM	1.12 in 10,000	Acetaldehyde	4,851.97
Acetaldehyde	9.61 in 100,000	Xylenes	3,447.74
POM, Group 2	7.87 in 100,000	Naphthalene	1,900.71
Ethylene oxide	7.87 in 100,000	Toluene	1,237.45

The District plans to analyze air toxics data more extensively in the future.

5.2 Regional Haze

A Federal Regional Haze Rule was published in 1999 to improve visibility in 156 designated "Class I" national parks and wilderness areas. States and the District are required to coordinate with Federal agencies to reduce pollution that causes visibility impairment, also known as regional haze. The closest Class I areas to the District are Shenandoah National Park and James River Face Wilderness Area in Virginia, Dolly Sods and Otter Creek Wilderness Areas in West Virginia, and Brigantine Wilderness Area in New Jersey. Haze-causing pollutants are typically a combination of criteria pollutants and their precursors.

A Regional Haze Plan for the District was completed in 2010, resulting in a permit condition to close the District's remaining electric generating units (EGUs) to minimize the District's contribution to haze in Class I areas. With partner agencies, the District will continue evaluating regional haze progress and goals and potential control measures with the aim of eliminating visibility problems by 2064.

5.3 Greenhouse Gases

Greenhouse gases (GHGs) are pollutants that trap heat in the upper atmosphere and influence the global climate. In 2010, the District committed to reducing GHG emissions by 20 percent below 2006 levels by 2012, 30 percent below 2006 levels by 2020, and 80 percent below 2006 levels by 2050. A Climate Action Plan called "Climate of Opportunity" lays out measures and actions for agencies throughout the District government to help meet the city's GHG goals and protect it from climate risks.

EPA is taking action at the Federal level to begin regulating GHG emissions from power plants under the Clean Air Act. DDOE's Air Program remains interested in energy sector opportunities to reduce GHG emissions because of air quality co-benefits.

5.4 Acid Rain Precursors and Stratospheric Ozone Depleting Substances

Stratospheric ozone, which is the "good" upper ozone layer that protects life on Earth from the sun's ultraviolet rays, is depleted when man-made chemicals, such as chlorofluorocarbons (CFCs), mix high in the atmosphere and react. The chemicals degrade the ozone layer and are then deposited with higher than normal levels of nitric and sulfuric acids as "acid rain." Title IV of the CAA implements the country's commitment under the Montreal Protocol, an international treaty, to phase out the production of ozone-depleting substances.

6.0 DISTRICT'S AIR QUALITY STATUS – SUMMARY

DDOE's Air Program works relentlessly to realize air quality improvements in the District. Progress has been made since the program began, yet more can be done:

- O_3 – The District and the metropolitan area are in **nonattainment** of ground-level ozone (O_3) standards, and the national ambient air quality standards (NAAQS) are expected to become even more stringent. Ozone continues to be the biggest air pollution challenge the region faces. Controlling emissions from mobile sources and getting cooperation from upwind states and regions to address transported pollution are necessary to improve public health.

- $PM_{2.5}$ – The U.S. Environmental Protection Agency (EPA) is redesignating the region as an **attainment** area for the 1997 annual standard. The monitored air quality levels in the recent several years were below the standards. Since the area previously was in nonattainment, demonstrations of continued maintenance with the standard are required for the next 20 years. A new fine particulate standard was finalized in 2012.

- CO – The District is in **attainment** for the carbon monoxide (CO) standards and the ambient air quality levels have been below the standards since 1996. In February 2010, EPA proposed to retain the existing CO standard.

- SO_2, NO_2 – The District continues to attain both the sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) standards, with monitored levels far below the NAAQS. New standards were developed for each pollutant in 2010. The District's monitoring networks are adding monitoring capacity to comply with the new NAAQS.

- Pb – In 2002, the District stopped monitoring for lead (Pb) because levels were consistently very low compared to the NAAQS. The new lead standard established in 2008 is ten times more stringent than the previous standard. Monitoring for lead began in January 2012 to determine compliance with the new standard.

Efforts will persist to protect public health and welfare, particularly as EPA continues to revise the NAAQS and improve its understanding of how policies can impact the environment.

APPENDIX A

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 µg/m^3	annual mean, averaged over 3 years
		secondary	Annual	15 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

as of October 2011

Figure courtesy of EPA at: **http://www.epa.gov/air/criteria.html**

ENDNOTES AND REFERENCES

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[xii] U.S. Environmental Protection Agency. "Cross-State Air Pollution Rule" (last updated 9/10/2014), found at: http://www.epa.gov/airtransport/CSAPR/.
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[xiv] American Lung Association. "State of the Air 2013," found at: http://www.stateoftheair.org/2013/city-rankings/most-polluted-cities.html (accessed in 2014).

[xv] U.S. Environmental Protection Agency. "The 2011 National Emissions Inventory: Version 1" (9/30/2013), found at: http://www.epa.gov/ttnchie1/net/2011inventory.html.

[xvi] On August 12, 2012, the U.S. Court of Appeals for the District of Columbia Circuit vacated CSAPR. The U.S. Supreme Court reversed the opinion vacating CSAPR in August 2014, and in October 2014 the D.C. Circuit Court granted EPA's motion to lift a stay on the rule and established a schedule for briefings on remaining issues.

[xvii] CSAPR modeling projected two kinds of design values for a 2012 base case: "average values" are the projected mean of the modeled 8-hour average daily max predictions across all days with predictions greater than or equal to 85 ppb, with a relative reduction factor applied; and "maximum values" that are the highest of the values predicted from three base years (2003-2005, 2004-2006, and 2005-2007). You can see that the actual 2012 DVs are far above the predicted maximum DVs from CSAPR.

[xviii] On July 31, 2014, EPA released MOVES2014, which incorporates NONROAD2008.