IMPROVING THE REGION'S AIR

Air Quality Trends for Metropolitan Washington from 2007-2022

January 2024

Metropolitan Washington
Council of Governments

IMPROVING THE REGION'S AIR
Prepared by the Metropolitan Washington Council of Governments on behalf of the Metropolitan Washington Air Quality Committee.
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MESSAGE FROM THE CHAIR

2024 MWAQC Chair Kenny Boddye

The Metropolitan Washington Air Quality Committee (MWAQC) at the Metropolitan Washington Council of Governments (COG) is the regional policy committee responsible for air quality planning, reviewing policies, and adopting air quality plans. Through regional coordination and the expertise of its members, metropolitan Washington has seen a dramatic improvement in air quality.

In the late-1990's, the region experienced an average of 80 unhealthy air days, compared to just 7 on average over the past five years. All six pollutants regulated by the Clean Air Act have shown a downward trend and are below the federal health-based air quality standards.

This great progress is thanks to more than a decade of action at the federal, state, and local government levels to reduce emissions from power plants, passenger vehicles, and heavy-duty diesel engines as well as programs to improve energy efficiency and renewable energy use.

Despite this good news, air quality monitors show that people in the region continue to breathe unhealthy air on many days. There is still more work to be done to reduce pollutant levels to make sure pollutants stay below their standards and to protect the public's health. Our most vulnerable populations also continue to find themselves at higher risks of asthma, shortness of breath, heart-related issues, and other health challenges due to poor air quality. As a growing region, we must confront the air quality challenges posed by population growth, more vehicles on our roadways, and increased energy demands of emergent industries.

Each of us can do our part to help. Minimizing driving alone, using transit, teleworking, walking, biking, or carpooling can help reduce vehicle-based emissions. Turning off lights and electronics when not in use, purchasing power from renewable energy sources and following tips from electric utilities about how to use less electricity, postponing lawn mowing or using an electric mower, and filling vehicles' gas tanks after dark on poor air quality days are other ways to help.

It should be noted that the combination of abnormally low pollution levels in 2020 (due to COVID-related changes in energy use, travel) and 2022 (due to weather unfavorable to ozone formation) helped the region meet the 2015 federal ozone standard, the last remaining criteria pollutant. Having met all criteria pollutant standards, we must keep taking steps to increase clean energy use and encourage people to telework, use alternative forms of transport (e.g., biking, scooting, and walking), and take public transit to make sure that the region does not fall back into nonattainment for any pollutant. In addition, while not included in this trends report, we know that air pollution levels rose in 2023 (due in large part to Canadian wildfire smoke). Despite the vast improvements to air quality in the region, it's a reminder that there is still much more that can be done – and should be done - to increase our resilience to extreme weather and ensure a safe and healthy environment in our communities.

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has established federal health standards for six criteria air pollutants, also referred to as the National Ambient Air Quality Standards (NAAQS), which are regulated under the Clean Air Act (CAA). The CAA also classifies areas that do not meet the federal standards as nonattainment areas and establishes processes to reduce pollution.

Criteria Air Pollutants

- **Ground-Level Ozone (O_3)**
- **Particulate Matter (PM)**
- **Carbon Monoxide (CO)**
- **Sulfur Dioxide (SO_2)**
- **Nitrogen Dioxide (NO_2)**
- **Lead (Pb)**

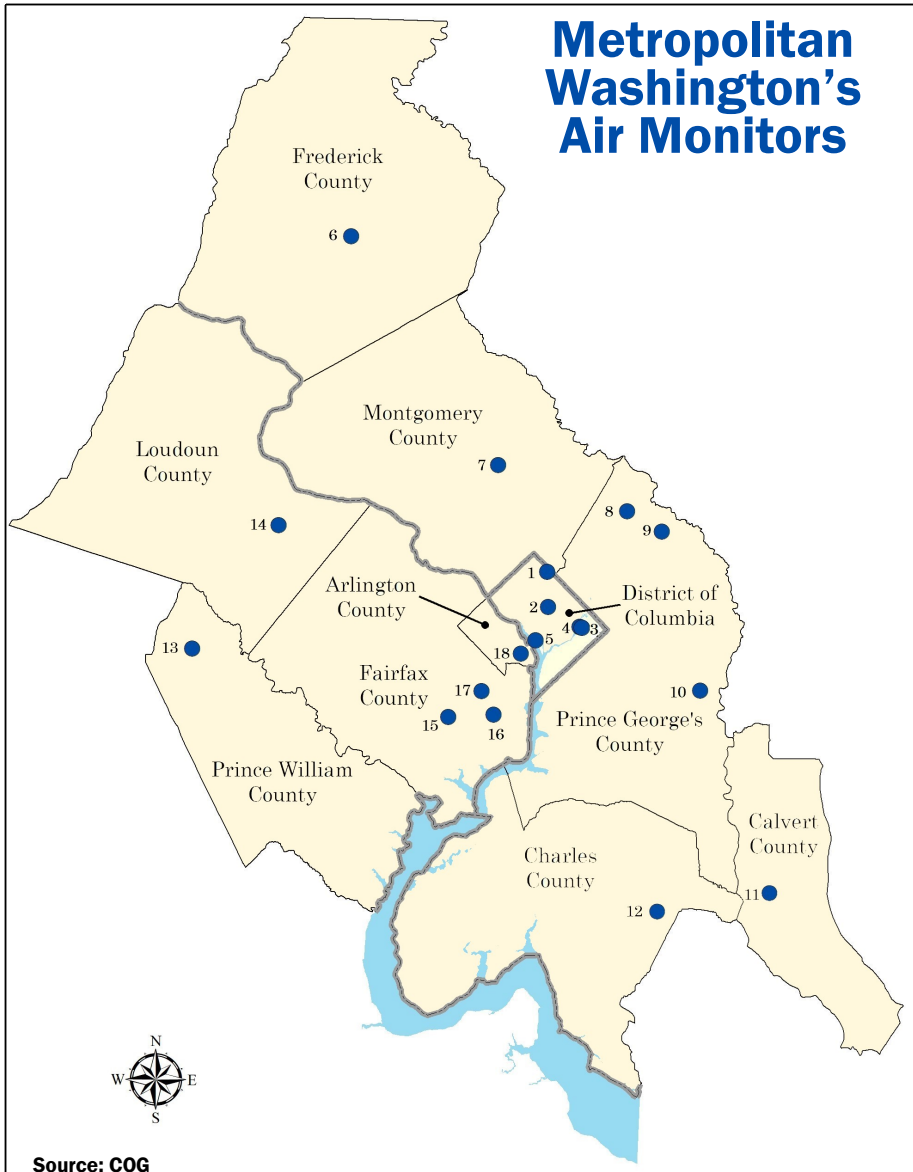
There are two types of federal air quality standards - primary and secondary. The primary standard is designed to protect human health while the secondary standard protects public welfare, such as agricultural production, forests, building materials, and ecosystems.

In order to determine if metropolitan Washington meets a federal standard, pollutant data is collected from air monitors, analyzed, and compared to its corresponding standard.

There are 18 monitors throughout the region. The District Department of Energy and Environment (DOEE), Maryland Department of the Environment (MDE), and Virginia Department of Environmental Quality (VDEQ) operate and maintain the monitors and provide the data for air quality analyses. Monitoring data is also used to produce daily forecasts for ozone and fine particles ($PM_{2.5}$). These forecasts can be found on local agency websites including DOEE, MDE, VDEQ, COG, and Clean Air Partners.

This trends report provides information on each pollutant and shows their trends during a 16-year period, 2007–2022. The report was prepared on behalf of the Metropolitan Washington Air Quality Committee (MWAQC), the regional planning committee responsible for developing air quality plans to improve the region's air.

Metropolitan Washington's Air Monitors



Source: COG

Monitor Name		Pollutants Currently Monitored					
		O_3	$PM_{2.5}$	PM_{10}	CO	NO_2	SO_2
1.	Takoma Rec Center	•				•	
2.	McMillan NCore	•	•	•	•	•	•
3.	DC Near Road		•		•	•	
4.	River Terrace	•	•			•	
5.	King Greenleaf		•				
6.	Frederick Airport	•					
7.	Rockville	•	•				
8.	Beltsville (Howard University site)	•	•	•	•	•	•
9.	Beltsville	•					•
10.	Prince George's Equestrian Center	•					
11.	Calvert	•					
12.	Southern Maryland	•					
13.	James S. Long Park	•				•	
14.	Ashburn	•	•			•	
15.	Springfield Near Road		•		•	•	
16.	Lee District Park	•	•	•			•
17.	Tucker Elementary School			•			
18.	Aurora Hills	•	•		•	•	

GROUND-LEVEL OZONE

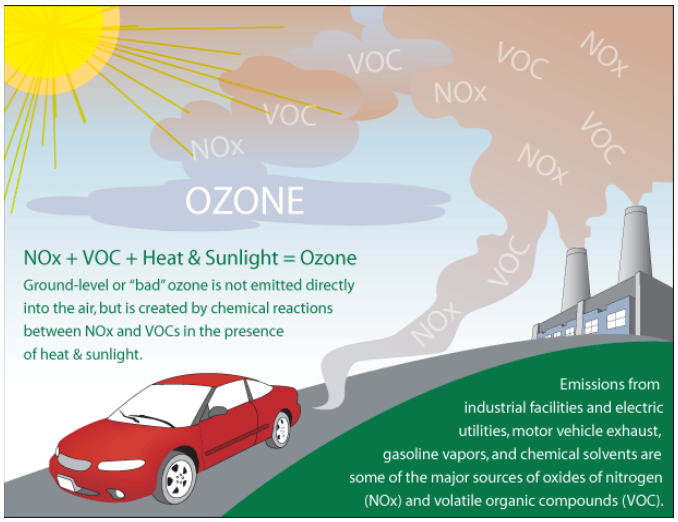
Ozone (O_3) is a colorless, odorless gas found in the atmosphere. Ozone exists naturally in the stratosphere, the Earth's upper atmosphere, where it shields the Earth from the sun's ultraviolet rays. Ozone is also found close to the Earth's surface, where we live and breathe. At ground-level, ozone is an air pollutant affecting the health and well-being of area residents.

High concentrations of ground-level ozone can reduce lung function and cause respiratory symptoms, such as coughing, throat irritation, and shortness of breath. Ozone exposure also aggravates asthma and lung diseases. Ozone may increase the susceptibility of the lungs to infections, allergens, and other air pollutants.

The most vulnerable groups affected by ground-level ozone include:

- Children
- People with respiratory problems
- Athletes and individuals who exercise outdoors
- Older adults

Ground-level ozone is not emitted directly into the air—it is created by the chemical reaction between volatile organic compounds (VOCs) and oxides of nitrogen (NO_x), in the presence of heat and sunlight. Ground-level ozone is a summertime pollutant, only becoming elevated during the warmer months of the year. In the metropolitan Washington region, high levels of ground-level ozone occur between April and October, in the afternoon or early evening hours. Man-made sources of VOCs and NO_x are industrial and automobile emissions, commercial products such as paints, insecticides, and cleaners, and the evaporation of gasoline from engines. Plants and trees also emit natural VOCs, which can combine with NO_x to create ozone.



Source: U.S. EPA AirNow Ozone

Nitrogen oxides and VOCs are also released from sources hundreds of miles away and get transported into the region and other states along the east coast of the United States. Studies have shown that the metropolitan Washington region's air quality is significantly affected by the transport of ozone and its precursors from other regions' air pollution.

Ground-Level Ozone Standards

Ground-level ozone standards have been revised to protect public health and welfare.

1997 Standard - 84 ppb
The region met the standard in 2009.

2008 Standard - 75 ppb
The region met the standard in 2015 and was subsequently redesignated to Attainment/Maintenance Area in 2019.

2015 Standard - 70 ppb
Revised to reflect new scientific health studies to protect public health.

EPA initially designated the region as Marginal nonattainment area.

Though the region met the standard in 2021, EPA still reclassified it to Moderate nonattainment area in 2023 as it failed to attain by 2020 (Deadline).

Ground-Level Ozone Federal Standards and Trends

EPA first established the National Ambient Air Quality Standards (NAAQS) for ground-level ozone in the 1970s. EPA has continued to lower the standards to protect human health and the environment as understanding of the health effects of ozone has improved.

Starting in 1997, EPA established both primary and secondary standards for ground-level ozone based on an eight (8) hour period and subsequently revised the standards in 2008 and 2015.

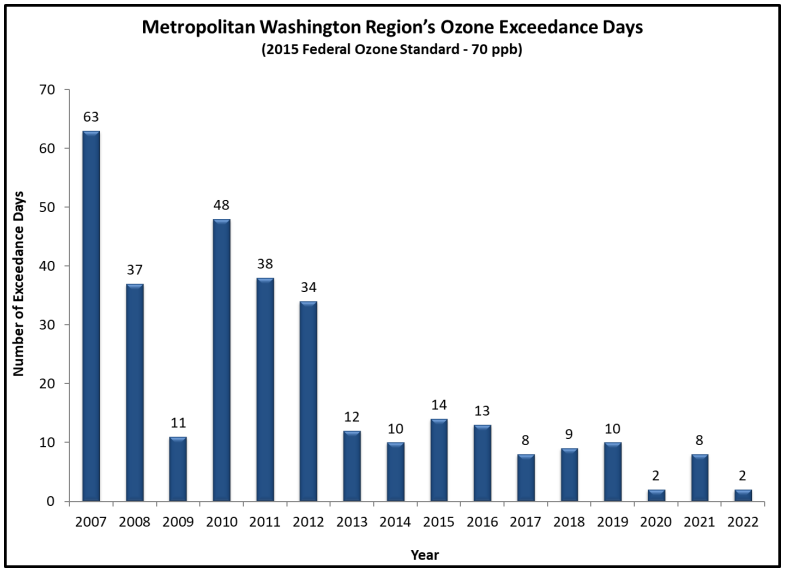
Over the past decade, the region has made dramatic improvements in regional ozone levels and has met, or attained, both 1997 and 2008 standards. In 2015, EPA revised the federal standards to reflect scientific studies that show levels below 70 parts per billion (ppb) are more protective of public health.

EPA initially designated the region as a Marginal nonattainment area for the 2015 ozone standard and required it to attain by 2020. The region missed that deadline and instead met the standard in 2021. Following this, EPA reclassified it to Moderate nonattainment area in 2023 even though data shows that the region has been meeting the current standard since 2021.

Meeting federal ozone standards can be difficult because ozone concentrations are also dependent on weather conditions. Temperatures above 90 degrees Fahrenheit (°F), light winds, and stationary high-pressure systems contribute to the formation of unhealthy ozone levels. Hot, dry summers can produce long periods of elevated ozone concentrations, while cool and wet summers can limit ozone production. In warmer, drier years, ozone levels can reach high values more often despite very little change in the emission rates of ozone-forming precursors (VOCs and NO_x).

Just 16 years ago in 2007, the combination of high emissions and temperatures resulted in more than 40 unhealthy ozone days each summer. As pollution decreased, high temperatures had less of an impact, resulting in a dramatic decrease in ozone levels even as the region experienced warmer summer-time temperatures.

This can be seen by examining the number of exceedance days over the past 16 years. An exceedance day is when ozone concentrations, averaged over eight hours, has reached above the ozone threshold. Since there were different federal standards in place over the years, the ozone threshold changed. Based on the 2015 ozone NAAQS, the number of exceedance days has decreased by more than 97 percent between 2007 and 2022.

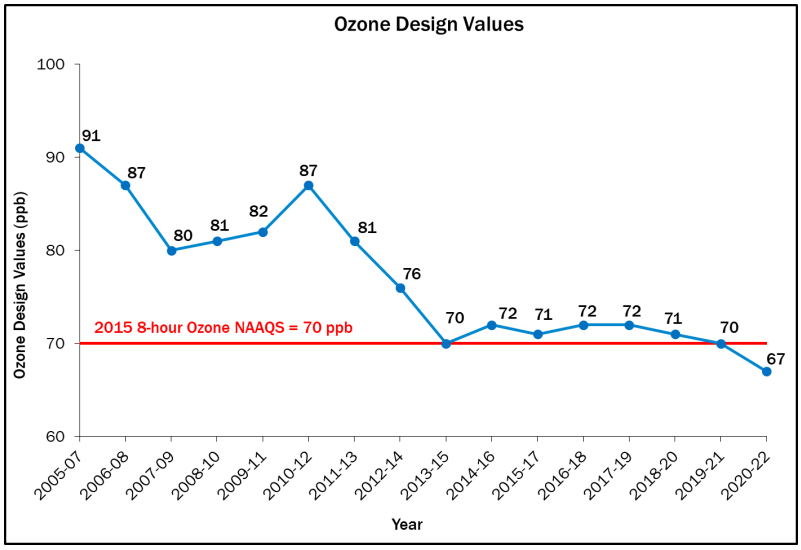


Source: COG

Trends can also be illustrated using EPA's design value for ozone. Design values for ozone are the three-year average of the fourth highest ozone concentration. The graph below shows the design values over the 16-year period. Before 2015, ozone concentrations were well above the federal standards. Over time, ozone levels have decreased to where the region now meets the current 2015 ozone standard, at 67 ppb.

As shown in the graphs, there have been many exceedance days in the past years, and ozone concentrations have been above the federal standards. However, actions by federal, state, and local governments to lower emissions from power plants, passenger vehicles, and heavy-duty diesel engines have helped the region meet the current ozone standard.

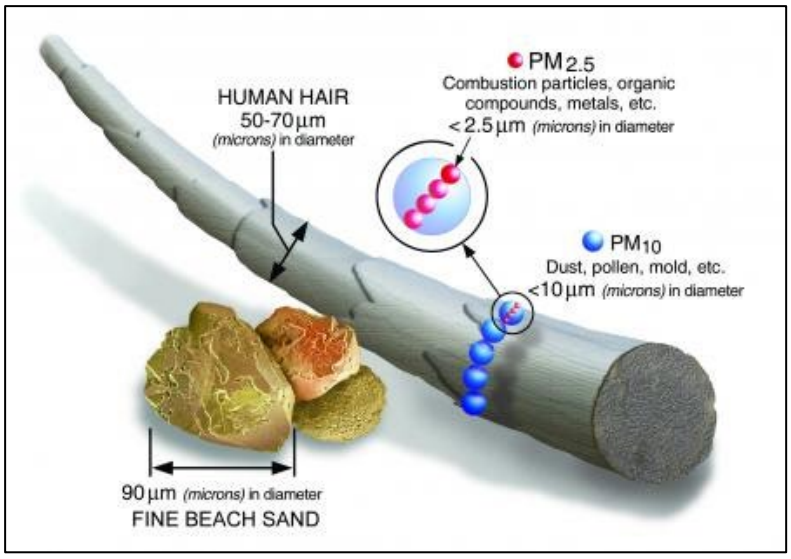
However, the region, and the nation, must continue to take actions to reduce emissions further to allow the region to keep meeting the current standard and to help attain any future tougher standards.



Design value = 3-year average of 4th highest daily maximum 8-hour average ozone concentrations

PARTICULATE MATTER

Particulate Matter (PM) is a mixture of microscopic solid particles and liquid droplets suspended in air. This pollution is comprised of several components including acids (like nitrates and sulfates), organic chemicals, metals, soil or dust particles (fine smoke and soot), and allergens. Particulate matter is released directly into the air and is formed by reactions in the atmosphere from gaseous pollutants. The largest components of particulates in urban areas along the east coast are sulfates formed from SO_2 emissions.



Source: U.S. EPA

The two classes of particles that the region monitors are PM_{10} and $PM_{2.5}$. PM_{10} refers to particles that are less than 10 µm (micrometers or microns) in diameter. $PM_{2.5}$, also known as fine particles, refers to particles that are less than 2.5 microns in diameter.

The size of the particles directly relates to their potential for causing health problems. Fine particles, like $PM_{2.5}$, pose the greatest problems, because they can travel deep into the lungs and move into the bloodstream. Exposure to such particles can cause health effects like damage to the respiratory and cardiovascular systems, lung tissue damage, cancer, and premature death. Larger particles (>10 microns) are of less concern, although they can irritate the eyes, nose, and throat. Particulate matter is also a major cause of reduced visibility in many regions, and it can cause damage to building materials.

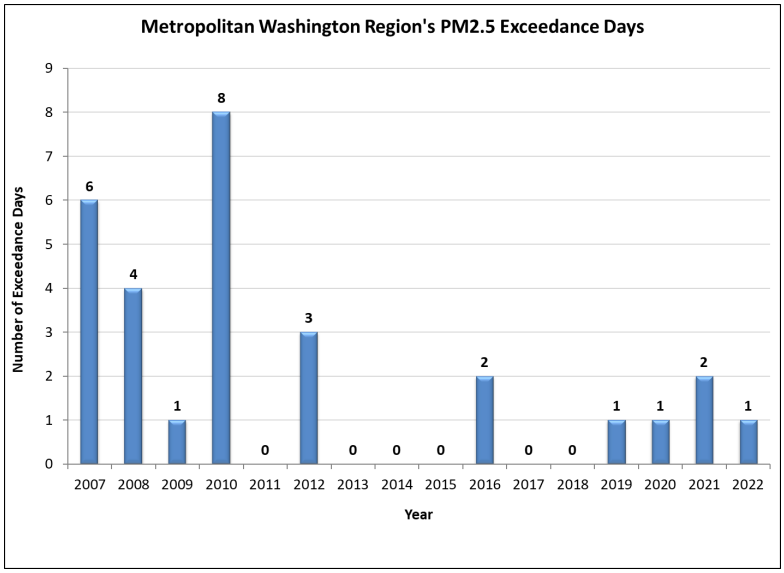
Particulate Matter Federal Standards and Trends

The EPA established a primary and secondary standard for PM_{10} in 1987. At that time, EPA required concentrations to be averaged over both a twenty-four (24) hour period and an annual period to determine if levels met the federal standards. EPA subsequently revised the standard in 1997, 2006, and 2012. The metropolitan region met the PM_{10} standards in the mid-1990s and levels have continued to be in a downward trend, with concentrations decreasing from 54 µg/m³ (micrograms per meter cubed) in 2007 to 46 µg/m³ in 2022.

Particulate Matter Standards

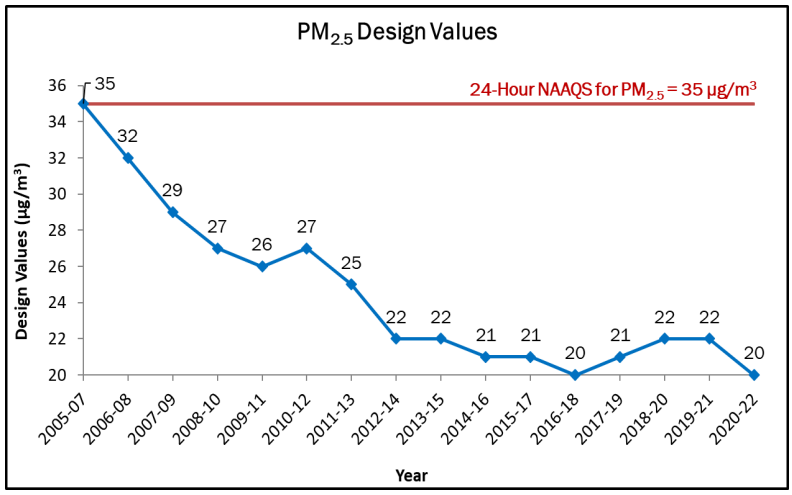
The metropolitan Washington region has met all federal standards for particulate matter.

In 1997, EPA classified $PM_{2.5}$ as a separate pollutant. Both primary and secondary standards were set for a twenty-four (24) hour period and an annual period. In 2006 and 2012, EPA set stricter federal standards to ensure public health and a clean environment. Metropolitan Washington now meets both the 2006 and 2012 federal standards, and concentrations continue to decline.



Source: COG

The number of exceedance days for $PM_{2.5}$ is one way to illustrate this downward trend. For $PM_{2.5}$, an exceedance day is when $PM_{2.5}$ concentrations averaged over a day are above a certain $PM_{2.5}$ threshold. In the last few years, exceedance days for $PM_{2.5}$ have reduced to an average of near zero.



Source: COG

$PM_{2.5}$ design values for the twenty-four (24) hour averaging period also show a significant decline over the past 16 years. $PM_{2.5}$ concentrations were above the federal standard, but most recently, $PM_{2.5}$ concentrations are well below the standard, at 20 µg/m³. $PM_{2.5}$ design values for the annual averaging period show a downward trend as well. Those concentrations are just under 10 µg/m³ over the last few years, which is also below the federal standards.

Actions taken by federal, state, and local governments to lower emissions from power plants, passenger vehicles, heavy-duty diesel engines, and other sources have helped the region meet all fine particle standards.

The region must continue to control emissions of particulate matter and its precursors such as, sulfur dioxide and nitrogen dioxide to keep the air in compliance with current and potentially tougher future federal standards.

OTHER CRITERIA POLLUTANTS

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas that forms when the carbon in fuel is not completely burned. Ambient CO is different from indoor CO in that ambient CO is produced from outside sources, and not inside buildings or homes. Ambient concentrations tend to be highest in winter months due to the presence of thermal inversions, "cold starting" of automobile engines, and the use of inefficient or poorly maintained space heating systems. Other sources of CO emissions include industrial processes, residential wood burning, and natural sources such as forest fires.

Washington DC Traffic (Ted, Flickr)

When CO enters the bloodstream, it reduces the capacity of the body to deliver oxygen to its organs and tissues. 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 performing complex tasks. Fortunately, the health threat from current levels of ambient CO in the metropolitan Washington region is minimal for healthy individuals.

The primary and secondary federal standards for ambient CO were established in 1971 and by 1985, the EPA revoked the secondary standard. The primary federal standard for CO requires two different averaging periods. One standard averages CO over one hour and the other averages CO over eight hours. By 1995, metropolitan Washington met these federal standards, and has been below the standards since then.

From 2010 to 2022, CO concentrations have been below 1-hour and 8-hour standards. Both one-hour average and eight-hour average CO concentrations vary between 1.8 ppm and 5.1 ppm during 2010-2022. Even though CO levels are very low, it is important that the region continues to produce low emissions in order to keep the air healthy moving into the future.

Carbon Monoxide Standards

The metropolitan Washington region has met all federal standards for carbon monoxide.

Sulfur Dioxide

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

Chalk Point Power Plant in southern Maryland (Allie, Flickr)

Ambient sulfur dioxide can be detrimental to the environment as well. SO_2 can have damaging effects on the foliage of trees and agricultural crops. The presence of both sulfur dioxide and nitrogen dioxide in the atmosphere can lead to acidic deposition (acid rain). Thus, the EPA has established a secondary federal standard for SO_2.

Sulfur Dioxide Standards

The metropolitan Washington region has met all federal standards for sulfur dioxide.

EPA established these standards in 1971, and then revised them in later years due to updated research. The EPA revoked the secondary federal standard in 1973 that averaged SO_2 concentrations annually but retained the 3-hour average standard. EPA then revoked primary annual and 24-hour average standards in 2010 and introduced a new 1-hour average primary standard. By that time, SO_2 concentrations were well below both primary and secondary federal standards. In fact, SO_2 concentrations dropped significantly over the 15-year period. In 2007, SO_2 concentrations for 1-hour and 3-hour averaging periods were at 55 ppb and 46 ppb respectively. Both of them are at 4 ppb and 3 ppb respectively in 2022.

This dramatic decline does not mean that the region can produce more SO_2. The region needs to continue to keep these concentrations low, so the region will maintain a healthy environment for future generations.

Nitrogen Dioxide

Capitol Power Plant in DC (Apasciuto, Flickr)

Nitrogen dioxide (NO_2) is a gaseous pollutant that belongs to a class of compounds called nitrogen oxides (NO_x). NO_2 is a brownish and highly reactive gas. It is formed during the high-temperature combustion of fuels in vehicle engines and industrial facilities (primarily electric generating power plants). NO_2 plays a major role in the atmospheric reactions that produce ground-level ozone in the warmer months. It is also a main pollutant in the production of acid rain and contributes to lower visibility and haze in national parks.

NO_2 can irritate the lungs and lead to respiratory symptoms (coughing and difficulty breathing). Long exposures can cause lower resistance to respiratory infections and the development of asthma.

To reduce NO_2 concentrations, EPA established primary and secondary federal standards in 1971, where concentrations were averaged over a year. By 2010, EPA updated the primary federal standard to a 1-hour average period, and the secondary federal standard was not changed. When these current federal standards were established, NO_2 concentrations in the metropolitan Washington region were already below these standards.

NO_2 concentrations continue to show a steady decline. Concentrations averaged over an hour reduced from 63 ppb in 2007 to 47 ppb in 2022. Additionally, annual concentrations decreased from 18 ppb to 15 ppb during the same period. The rise in industry and population has not had much impact on the air because of the strict laws and regulations that are in put in place to protect the public and the environment in this region.

Nitrogen Dioxide Standards

The metropolitan Washington region has met all federal standards for nitrogen dioxide.

Lead

Airplane Contrails (Transport Pixels, Flickr)

Lead (Pb) in ambient air mainly results from ore and metals processing and aircraft running on leaded aviation fuel. Other sources of lead come from waste incinerators, lead smelters, and lead-acid battery manufacturers. Lead was also in motor fuels two decades ago, but has since been removed. Unleaded fuels have substantially reduced lead in the atmosphere.

Exposure to lead is a serious health concern - lead can accumulate in the blood, bone, and soft tissue of the body. Excessive exposure can affect the nervous system, kidney function, reproductive system, and the cardiovascular system. Neurological impairments mostly occur in children, but adults can experience cardiovascular problems. In the environment, lead can reduce growth and reproductive rates in plants and animals.

Lead federal standards, primary and secondary, were first established in 1978 with a quarterly averaging period. With EPA's approval, monitoring ended in Maryland in 1994, Virginia in 1998, and the District of Columbia in 2001 because lead in the metropolitan Washington region had been far enough under the federal standards. In 2008, the federal standards for lead were changed from 1.5 $\mu g/m^3$ on a quarterly average to 0.15 $\mu g/m^3$ on a rolling three-month average.

To determine if the metropolitan Washington region was below the updated federal standards, new monitors were placed based on population and on lead industrial sources. The District of Columbia Department of Energy and Environment (DOEE) installed a Total Suspended Particle (TSP) based lead monitor at the McMillan Reservoir location on January 1, 2012. This monitor has a rolling three-month average concentration of 0.00 $\mu g/m^3$ from 2012 to 2015. In 2017, this was reported at .005 $\mu g/m^3$ at the Howard University-Beltsville site. There was one other monitor site at Lee Park in Virginia that recorded the maximum level at 0.0037 $\mu g/m^3$. Both these sites stopped monitoring Lead since 2018.

With such low concentrations, lead in ambient air is not a problem in the region. Lead should continue to stay low as long as there are no drastic changes in sources of lead emissions.

Lead Standards

The metropolitan Washington region has met all federal standards for lead.

LOOKING TO THE FUTURE

Air pollution has been a problem in the region and across the U.S. However, air pollutants have significantly declined due to the federal, state, and local measures coupled with actions taken by individuals and businesses. Data collected from the region's monitors show that this downward trend has continued over the last decade.


Potomac River near Mount Vernon, MD (Intiaz Rahim, Flickr)

Metropolitan Washington is now in attainment of the federal standards for all criteria pollutants except ozone. EPA reclassified the region from Marginal to Moderate nonattainment area as it failed to attain the standard by 2020 (deadline). However, ozone data in 2022 dropped below the standard and continues to show a downward trend. The region plans to request EPA to redesignate it to an attainment/maintenance area.

While ozone levels can be high during hot, dry summers, emissions of ozone precursors (VOCs and NO_x) are decreasing, so days with high concentrations of ozone are less frequent. However, more action needs to be taken in order to continue to reduce ozone and its precursors. It is important that businesses follow the laws and regulations and individuals take actions to reduce emissions, so the region's air can continue to improve.

Except for ozone, all other criteria pollutants are substantially below the federal standards and do not pose much of a threat to the region. However, it is important to continue to maintain control of these pollutants in order to meet potentially tougher standards in future and to sustain a healthy environment for the region and neighboring regions.

Metrobus (Paul Sullivan/Flickr)

The public can help as well. When there are unhealthy air days, days when there are high ozone concentrations, individuals should take actions such as postponing mowing, filling up gas tanks during the evening hours, using transit or carpools, and using less electricity.

COVID-19 related restrictions reduced emissions of pollutants to some extent in 2020. This contributed to cleaner air in the region. However, those restrictions are no longer in place and as a result emissions could increase worsening regional air quality. Residents of the region should continue to be encouraged to telecommute, use alternative forms of transport (e.g., biking, scooting, and

walking), and take public transit after the situation improves rather than relying on single occupancy vehicles.

Together, governments, businesses, and individuals can work to ensure a healthier region for many years to come.

RESOURCES

	Organization	Website
States	District of Columbia Department of Energy & Environment	https://doee.dc.gov/
	Maryland Department of the Environment	http://mde.maryland.gov/Pages/index.aspx
	Virginia Department of Environmental Quality	http://www.deq.virginia.gov/
Forecasts & Data	**Organization**	**Website**
	Metropolitan Washington Council of Governments (COG)	https://www.mwcog.org/
	EPA AirNow	https://www.airnow.gov/
	EPA Air Quality Trends	https://www.epa.gov/air-trends
	COG (1993, 2005 & 2007 Trends Reports)	https://www.mwcog.org/documents/2017/09/27/air-quality-trends-air-quality-air-quality-data
Other Organizations	**Organization**	**Website**
	Clean Air Partners	http://www.cleanairpartners.net/
	Environmental Protection Agency	www.epa.gov
	Mid-Atlantic Regional Air Management Association	http://www.marama.org/
	Ozone Transport Commission	http://www.otcair.org/