7. AIR QUALITY

Board of Supervisors Environmental Vision:
"*The county will continue to support attainment of air quality through regional planning and action.*"

INTRODUCTION

Fairfax County is part of a federal-state-regional-local partnership, which has worked for the last several decades to improve air quality. While air quality is a regional issue that is beyond the control of any one state or local government, governments at all levels play important roles in identifying measures that are needed to improve air quality and in implementing related strategies.

In the metropolitan Washington, D.C. region, air quality planning efforts have been focused on regional strategies to bring the area into attainment with federal air quality standards (i.e., the National Ambient Air Quality Standards, or NAAQS). The Metropolitan Washington Council of Governments (MWCOG), through the Metropolitan Washington Air Quality Committee (MWAQC), has coordinated, and continues to coordinate, these efforts for the Washington DC region, which include northern Virginia, DC and nearby Maryland counties.

The county's major responsibilities in the partnership involve participation and coordination with regional and state organizations on plans intended to reduce air pollution and improve air quality as well as the implementation of local programs that help to minimize or eliminate air pollution.

Over the past three decades, the region has made significant progress in improving air quality. Given the April 4, 2025 decision by EPA redesignating the Washington DC area as being in attainment of the ozone standard, all six pollutants (Ground-level Ozone, Particulate Matter, Nitrogen Dioxide, Sulfur Dioxide, Carbon Monoxide, and Lead) regulated by the federal Clean Air Act have shown a downward trend in the region, and are all in compliance with federal air quality standards. While overall the number of unhealthy air days has significantly decreased over the past 25 years, the number of unhealthy air days increased in 2023 and 2024.

The region has made tremendous progress in its air quality thanks to actions at the federal, state, and local government levels, including new regulations 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.

Fairfax County does not have an air quality monitoring program; it works with MWCOG and the Virginia Department of Environmental Quality (DEQ) to assess air quality in the region. DEQ is responsible for air quality monitoring in Fairfax County in addition to air

quality facility inspections. It provides current air quality and forecast data for Northern Virginia and other regions at VA DEQ Current Air Quality and Forecast.

CURRENT STATUS AND CONCERNS

Air quality, as measured by unhealthy air days, has fluctuated significantly in the past several years. The COVID-19 pandemic had a positive impact on air quality in 2020, with a number of the actions taken to limit virus transmission contributing to lower emissions. This resulted in fewer unhealthy air days, with just two such days being recorded in 2020. However, that decrease was temporary. As the region reopened, data from MWCOG registered eight unhealthy air days in 2021. While data from 2022 showed a decrease in unhealthy air days compared to 2021, that reduction was again short-lived. The region recorded 15 unhealthy air days in 2023 and 7 unhealthy days in 2024.

Last amended in 1990, the Clean Air Act requires EPA to set NAAQS for six principal "criteria" pollutants (particulate matter, carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, and lead). It is worth understanding the concern for and impact of each pollutant within the county.

Criteria Pollutants

Particulate Matter

On February 7, 2024, the U.S. Environmental Protection Agency (EPA) strengthened the federal air quality standard for fine particulate matter by setting the level of the primary (health-based) annual $PM_{2.5}$ standard at 9 micrograms per cubic meter. The previous standard was 12 micrograms per cubic meter. The Washington, D.C. metropolitan region already meets this new standard, having recorded $PM_{2.5}$ levels below 9 micrograms per cubic meter since 2019.

Particular matter poses a multifaceted risk to human health through its interaction with vital organs and biological processes in the body. For example, alveoli within the lungs are very sensitive to fine particulate matter. Larger, coarse particulate matter can end up in the digestive tract. Both fine and coarse particles can be toxic. Fine particles are also the main cause of reduced visibility (haze) in parts of the United States. This haze from the wildfire smoke was readily apparent in the Washington, D.C. metropolitan region on the unhealthy air days in 2023.

The Washington Metropolitan region has made significant progress in reducing particulate pollution so that the region is in compliance with both $PM_{2.5}$ (that is particulate matter with an aerodynamic diameter of 2.5 μm) and PM_{10} (particulate matter with an aerodynamic diameter of 10 μm). Air quality trends data for $PM_{2.5}$ (which is known as the fine particle standard) had elevated levels in 2023, which were largely attributed to Canadian wildfires. This wildfire smoke brought the worst air quality seen in the region in more than a decade. Wildfire smoke will remain an ever-increasing wild card in Fairfax County. Air quality agencies and research groups agree that understanding the composition of wildfire smoke

remains a major scientific challenge due to its complex chemistry. This in turn makes it challenging to determine the magnitude and breadth of the immediate and long-term health effects on county residents. Wildfire smoke contains primary pollutants—particulate matter, carbon monoxide, nitrogen oxides, and sulfur oxides—that are released directly by the fire. Once in the atmosphere, these chemicals react and transform, producing secondary pollutants like ground-level ozone and secondary organic aerosols (or haze). These secondary pollutants form through complex chemical processes that are still not fully understood. Additionally, they can travel hundreds, even thousands, of miles, impacting people far from the fire's source.

Further exacerbating the negative impacts of wildfire smoke is unavoidable urban growth. As populations trend towards moving into and developing wildland areas, wildfires in wildland-urban areas are fueled by dry brush and towering trees. Burning homes, vehicles, and everyday household materials – including plastics, resins, and treated wood – release an additional unpredictable hazardous mix of pollutants into the air (NOAA Chemical Sciences Laboratory). Moreover, the smoke can also impact the weather itself. Aerosols made up of tiny particles can affect cloud formation and precipitation (NSF NCAR).

Carbon Monoxide

Carbon monoxide is another pollutant for which the EPA has established a National Ambient Air Quality Standard. Carbon monoxide is a product of incomplete combustion. Thus, carbon monoxide is emitted from vehicle and bus emissions, combustion of fossil fuels for power generation, wildfires and other sources. Because CO tends to disperse quickly from the point of combustion, the biggest risk falls to at-risk populations and firefighters close to the combustion source, such as a fire . When CO enters the bloodstream via the lungs, it readily binds with hemoglobin where oxygen should normally bind and it reduces oxygen delivery to organs, tissues, and the rest of the body. At high levels, CO exposure can cause headaches, weakness, dizziness, confusion, nausea, disorientation, visual impairment, coma, and even death in otherwise healthy individuals (AirNow.gov).

Ozone

Ground-level ozone, colloquially called “smog”, can cause breathing problems for sensitive persons, especially those with asthma and other respiratory conditions. It is formed by chemical reactions between oxides of nitrogen (NOx) - note EPA has set a NAAQS for nitrogen dioxide - and volatile organic compounds (VOCs) as they combine in sunlight and heat. Ground-level ozone is considered a summertime pollutant.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a gaseous pollutant formed during the high-temperature combustion of fuels in vehicle engines, industrial facilities (primarily electric generating power plants), and many other sources (e.g., aircraft, marine vessels, lawn equipment, etc.). NO_2 is also a factor in the production of ground-level ozone as previously noted. It can irritate the lungs and lead to respiratory problems.

Sulfur Dioxide

Diesel vehicle exhaust can also contain sulfur dioxide (SO_2). SO_2 is a gas that forms when sulfur-bearing fuels, mainly oil and coal, are burned. High concentrations of SO_2 can result in difficulty breathing and respiratory illness.

Ozone, NO_2, and SO_2 can also have damaging effects on the foliage of trees and agricultural crops. Acid rain is primarily formed from the emissions of SO_2 and nitrogen oxides (NO_X) and it has harsh effects on ecosystems (U.S. EPA). For example, the eggs of some species of fish can't hatch in acidic waters. Acid rain can cause aluminum from soils to leach which is harmful to plant life. Like many things in nature, we often see many related synergies and feedback loops. It's important to take advantage of positive feedback loops (e.g., improving air quality/reducing heat islanding reduces acid rain which, in turn, preserves plant life which leads to further reduced heat islanding effects and so forth), while avoiding and mitigating negative feedback loops with urgency.

Lead

Lead is an especially concerning contaminant for young children under the age of 6. Swallowing and/or inhalation of lead or lead dust can cause well-documented health effects such as brain and nervous system damage along with slowed growth and development. Hearing, speech, and learning and behavioral problems can persist (CDC).

Lead is a naturally occurring metal that can be found in gasoline; paints; drinking water via plumbing pipes; ceramics; batteries; certain foods and cosmetics; and soils near airports, busy roads, and buildings. County residents may not know their lead exposure unless their homes are tested (CDC, CDPH).

Alternatively, one of the best ways to assess lead exposure within a given population and/or a group of concern – e.g., young children, is through blood testing. The county follows Virginia Department of Health guidelines and recommendations to investigate cases of childhood lead and investigate new treads and potential exposures. While county staff suspect children with elevated blood lead levels received their lead exposure in a foreign country before moving to Fairfax County, there is not sufficient information nor comprehensive data within the county to eliminate lead paint or other sources of lead as the source(s) responsible for these elevated lead levels. Given this uncertainly, EQAC supports the continued monitoring that the Fairfax Couty Health Department undertakes to follow up on high lead levels in children.

Recommendations

Sources of criteria pollutant emissions can come from onsite centralized and distributed power generation, industrial processes, all modes of transportation, lawn equipment, agricultural activities, among others.

There is extensive use of motor vehicles in Fairfax County and vehicle emissions are the largest single source of toxic and smog forming air pollution in the county and Northern Virginia (Virginia Dept. of Environmental Quality). Vehicle emissions are a major contributor to ground-level ozone formation and greenhouse gas emissions in Fairfax County and those impacts, combined with climate change, present a threat to the county's future air quality because rising temperatures speed up the formation of ground-level ozone. As noted in the Climate and Energy Chapter, the Community-wide Energy and Climate Action Plan (CECAP) contains several climate action goals involving vehicle use in the county. These include increasing the use of electric vehicles in the county; reducing vehicle miles traveled; and increasing fuel economy and access to low-carbon fuels.

The environmental benefits and advantages of electric vehicles (e.g., battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV), fuel cell electric vehicles (FCEV) over traditional gasoline vehicles are most notably: 1) having zero tailpipe greenhouse gas (GHG) and criteria pollutant emissions and 2) being more energy efficient from a fuel lifecycle standpoint. Something that has recently gained more widespread recognition revolves around the topic of brake dust emissions. Regenerative braking found in hybrid gasoline-electric and BEVs significantly reduces brake dust emissions. This is because electric motor(s) help slow the vehicle down by capturing braking energy leading to less reliance on the brake pads (Virginia Tech). Brake dust emissions are also impacted by other numerous factors such as traffic conditions, vehicle weight, individual driving styles, among others. More future research is emerging and needed to better quantify these factors and to understand the course and fine composition of brake dust.

In addition, as an alternative to the use of motor vehicles, the Fairfax County Board of Supervisors has directed the Fairfax County Department of Transportation to lead the effort to improve bicycle and pedestrian safety and mobility, including constructing bicycle and pedestrian improvements in high-priority areas of Fairfax County.

Recommendations:

- **BOS continue to support growing the adoption of electric vehicles in the county; reducing vehicle miles traveled through continued bicycle and pedestrian improvements; and supporting increasing fuel economy and access to low-carbon fuels.**
- **Fairfax County should continue hosting "Green Your Lawn Events" to promote air quality awareness and sustainability. Besides opting for electric lawn tools, county residents should be incentivized and encouraged to:**
    - **Mow lawns only on good air quality days**
    - **Use organic fertilizers and pesticides**
    - **Leave grass clippings to make their own mulch**

- **Fairfax County BOS continue to blood lead screening in children part of routine healthcare.**

Indoor Air Quality

When addressing the topic of air quality, it is critical for the community not to forget the importance of indoor air quality on health. While the county and regional governments are inherently best positioned for improving outdoor air quality, county residents can proactively improve the indoor air quality of the buildings they reside in. In fact, according to the EPA, Americans are indoors 90% of the time – in built environments such as homes, schools, workplaces, places of worship, and gyms. And ironically as average global temperatures increase annually, time spent indoors will continue to trend upwards as well. This is compounded by studies suggesting that indoor concentrations of air pollutants are increasing – driven by inadequate ventilation, the myriad and types of chemicals in home products, hotter temperatures, and increasing humidity. The health effects of indoor air pollution can be just as destructive as that of outdoor air pollution – including respiratory diseases, heart disease, cognitive deficits, and forms of cancer. And similar to other environmental issues, sensitive populations such as children and older adults with preexisting conditions, Native Americans, and households of low socioeconomic status often have exposure to higher levels of indoor pollutants (National Institute of Environmental Health Sciences).

Indoor air quality is impacted by pollutants that penetrate from the outdoors as well as sources that are unique to indoor environments. While this synergy can be good news in situations where local outdoor air quality improvement partially contributes to improved indoor air quality, days of unhealthy outdoor air stress the importance of reducing indoor air pollution sources. These sources include, but are not limited to:

- Human activities near and within buildings such as smoking, burning solid fuels, cooking, and cleaning;
- Vapors from building and construction materials, equipment, and furniture;
- and biological contaminants such as mold, viruses, and/or allergens.

Common contaminants to be on the lookout for include:

- Allergens
- Asbestos
- Carbon Monoxide
- Formaldehyde
- Lead
- Mold
- Pesticides
- Radon

- Smoke

Recommendations

According to the EPA, county residents can employ three basic strategies to improve indoor air quality: 1) source control, 2) improved ventilation, and 3) air cleaners/filtration.

- **Source Control**: Reducing individual sources of pollution or reducing their emissions is usually the most effective strategy. Some sources (e.g., those containing asbestos) can be sealed or contained. Other sources (e.g., gas stoves) can be adjusted or replaced to decrease the amount of emissions. Source control also tends to be more cost-efficient than the other strategies since increasing ventilation can result in increased energy costs.
- **Improved Ventilation**: In days where outdoor air quality is good and weather permits, increasing the amount of outdoor air entering the building is another strategy to reduce the concentration of indoor air pollutants. With the exception of newer, more advanced heating, ventilation, and air conditioning (HVAC) systems, most HVAC systems do not generally bring fresh air into the house. Opening windows and doors, operating window or ceiling fans, or running an HVAC system with vent controls open can increase the intake of outdoor ventilation. Local bathroom and kitchen fans exhaust contaminants to the outdoors while simultaneously drawing air in.
- **Air cleaners/filtration**: Air cleaners and filters on the market range vastly in cost, sophistication, and required operation and maintenance. Some are designed to cover individual rooms while others are designed for an entire house. Some models are more effective than others at removing certain particles. Most air cleaners/filters are not designed to remove gaseous pollutants. It is important to keep in mind that the effectiveness of an air cleaner/filter depends both on: 1) how well it removes pollutants from indoor air (i.e., efficiency) and 2) how much air it draws through the cleaning/filtering element (i.e., circulation rate).

In recent years, there has been some publicity suggesting that houseplants can reduce levels of some chemicals. There is currently no evidence that a reasonable number of houseplants can remove significant quantities of pollutants in indoor spaces. Moreover, overwatering of indoor plants could result in overly damp soils that lead to the growth of microorganisms affecting allergic individuals.

Recommendation: BOS and OEEC include indoor air quality concerns and mitigation methods on its websites, resources, and outreach materials (e.g., Sustain Fairfax)