2024

Evening Glide by RM

Delaware Annual Air Quality Report

Published April 2026

This page is intentionally blank.

Executive Summary

Delaware's 2024 annual air quality report continues to document the changes and overall improvement in ambient air quality in the state. In Delaware in 2024 all pollutants except ozone remained below the National Ambient Air Quality Standards (NAAQS) throughout the year. Air toxics and carbon monoxide (CO) were unable to be monitored for 2024 due to equipment malfunctions.

Throughout the summer of 2023 significant amounts of smoke pollution entered the United States from Canadian wildfires. This had a detrimental impact on air quality throughout the United States, resulting in high ozone and particulates in affected areas, including Delaware. In 2024 the effects of wildfires are still present and affecting the air quality.

As measured by the statewide Air Quality Index (AQI), Delaware experienced improved air quality in 2024 compared with 2023. The majority of days were within "Good" and "Moderate" categories, consistent with typical seasonal variability. No "Unhealthy" or "Very Unhealthy" days were observed in 2024. While some daily AQI exceedances did occur during periods of high temperature or through smoke influence, these AQI exceedances do not necessarily indicate non-attainment of the NAAQS.

This report demonstrates that while Delaware still faces air quality challenges, air quality continues to improve overall. In addition, through the use of continuous particulate matter (PM) monitoring and tools like AirNow.gov, our ability to communicate air quality concerns continues to improve. It is fundamental to the mission of the Division of Air Quality (AQ) to help the public make informed decisions about their life and their health, so we will continue to improve and expand access to this critically important information.

Table of Contents

List of Figures

List of Tables

List of Acronyms

AQ	Division of Air Quality
AQI	Air Quality Index
CAA	Clean Air Act
CO	Carbon Monoxide
DCR	Delaware City Refinery
DV	Design Value
DNREC	Department of Natural Resources and Environment Control
EPA	Environmental Protection Agency
FRM	Federal Reference Method
FEM	Federal Equivalent Method
GC/MS	Gas Chromatograph/Mass Spectrometer
HAP	Hazardous Air Pollutant
MDL	Method Detection Limit
$\mu g/m^3$	Micrograms per cubic meter
mg/m^3	Milligrams per cubic meter
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NCore	National Core Monitoring Station
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
O_3	Ozone
Pb	Lead
PM	Particulate matter
$PM_{2.5}$	Particulate matter less than 2.5 microns
PM_{10}	Particulate matter less than 10 microns
PM_{coarse}	Difference between PM_{10} and $PM_{2.5}$ particulate concentrations
ppb	Parts per billion by volume
ppm	Parts per million by volume
SIP	State Implementation Plan
SO_x	Sulfur Oxides
SO_2	Sulfur Dioxide
TSP	Total Suspended Particulate Matter
VOC	Volatile Organic compound

Introduction

In 1970, Congress passed the Clean Air Act (CAA) that authorized the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for pollutants shown to threaten human health and welfare. Primary standards were set according to criteria designed to protect public health, including an adequate margin of safety to protect sensitive populations such as children and asthmatics. Secondary standards were set according to criteria designed to protect public welfare (decreased visibility, damage to crops, vegetation, buildings, etc.).

Six pollutants currently have NAAQS:

- carbon monoxide (CO),
- lead (Pb),
- nitrogen dioxide (NO_2),
- ozone (O_3),
- particulate matter (PM), and
- sulfur dioxide (SO_2).

These are commonly called the “criteria” pollutants. When air quality does not meet the NAAQS, the area is said to be in “nonattainment” with the NAAQS.

This report covers Delaware’s air quality status and trends for the criteria pollutants and some non-criteria pollutants. Non-criteria pollutants are substances that do not have standard criteria for ambient concentrations, such as air toxics. Technical details regarding monitoring activities along with references and sources of more information are included in the appendices.

General Information

DNREC Division of Air Quality

The Department of Natural Resources and Environmental Control's (DNREC) Division of Air Quality (AQ) is led by an Air Quality Division Director and is organized by two main sections that are defined as:

- Planning
- Engineering and Compliance

Planning Section

Ambient Air Quality Monitoring Program

The Ambient Air Quality Monitoring Program monitors pollutants in ambient air. This is primarily accomplished by conducting long-term, fixed-site air monitoring of specific air pollutants. Most monitoring is focused on the pollutants that have standards set by the EPA to protect public health and are commonly called "criteria" pollutants.

This program also conducts or assists in special short-term air monitoring studies as resources allow. The data is used to provide the public with information on current air quality conditions, assess compliance with or progress made towards meeting NAAQS, measure long term air quality trends for urban and non-urban areas, verify the effectiveness of air pollution control strategies, support State Implementation Plan (SIP) development, evaluate air emission inventories, and verify computer models.

Airshed Planning and Inventory Program

As mandated by the CAA, all states must achieve and maintain attainment of the NAAQS. Delaware and the surrounding states are in "non-attainment" for some of those standards. The air quality problem that requires immediate attention is ground-level ozone. Other pollutants to be addressed include fine particulate matter ($PM_{2.5}$), regional haze, and hazardous air pollutants (HAPs) as defined by the EPA.

The Airshed Planning Program seeks to find ways to reverse the non-attainment of an air quality standard by evaluating the combination of air pollution problems that are either generated locally or result from emissions transported through the atmosphere from distant areas. SIPs are prepared and adopted to reduce air pollution burden and to provide a plan to meet “attainment” of air quality standards.

The Inventory Program works to develop comprehensive emission inventories of regulated pollutants from all emission source sectors, including point sources, stationary non-point sources, mobile sources, and natural sources, as well as to compile periodic inventory data, procedures and documentation.

Area Source Compliance Program

The Area Source Compliance Program inspects, and issues air pollution control permits for smaller sources, such as dry cleaners, auto body shops, gasoline tank trucks, open burning activity, and asbestos abatement projects. Program personnel make periodic facility inspections and review data to ensure that permit and regulatory requirements are being met. Enforcement actions are initiated for violation of regulations or permit conditions when warranted.

Greenhouse Gas, Mobile Sources, Air Toxics Program

The Greenhouse Gas, Mobile Source and Air Toxics Program identifies and develops strategies on a multi-pollutant basis (i.e., considering impacts of climate change, ozone, particulate matter less than 2.5 microns ($PM_{2.5}$) and toxics). The Greenhouse Gas Program covers all greenhouse gas-related planning and regulatory development activities. The Mobile Source Program oversees land use and general/transportation conformity related planning and regulatory development activities. The Air Toxics Program administers and implements related planning and regulatory development activities associated with the mitigation of air toxics.

Engineering and Compliance Section

Permitting and Compliance Programs

The Engineering and Compliance Section issues air pollution control permits for minor and major stationary air pollution sources. Section personnel conduct periodic facility inspections, review reports, and review emission test results to ensure that permit conditions and regulatory requirements are being met. Enforcement actions are initiated for violations of regulations or permit conditions when warranted.

Source Testing Program

The Source Testing Program verifies actual air pollution emission levels from industrial sources. Actual emission levels are needed to establish emission factors and to determine compliance with permit conditions after a permit has been issued. The program is responsible for observing emission tests to ensure that test methods are followed and reviewing emission test reports for accuracy. A variety of source testing methods are used to verify actual emissions.

Refinery Support Program

The Refinery Support Program issues air pollution control permits, reviews reports, and conducts inspections for the Delaware City Refinery (DCR), Delaware’s largest source of air pollutant emissions. Personnel dedicated to DCR ensure that permit conditions and regulatory requirements are being met. Enforcement actions are initiated for violations of regulations or permit conditions when warranted.

Frequently Asked Questions

1. What is a “criteria” air pollutant?

A criteria air pollutant is an air pollutant that has a NAAQS established for it by the EPA. There are six criteria pollutants: CO, lead, NO_2, ozone, PM, and SO_2. PM NAAQS are set for both PM less than 10 microns (PM_{10}) and $PM_{2.5}$ (see Table 1).

When discussing ozone in this report, we are concerned with ground-level ozone, or tropospheric ozone. This is different from stratospheric ozone, which makes up the protective ozone layer. Concentrations are in either parts per million (ppm), parts per billion (ppb), milligrams per cubic meter (mg/m^3) or micrograms per cubic meter ($\mu g/m^3$).

Table 1. National Ambient Air Quality Standards

Pollutant (Scientific Notation)	Primary / Secondary Standard	Averaging Time	Concentration	Form
Carbon Monoxide (CO)	Primary	8 hours	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Lead (Pb)	Primary & Secondary	Rolling 3-month average	0.15 µg/m^3	Maximum arithmetic mean of 3 consecutive monthly means in a 3-year period
Nitrogen Dioxide (NO_2)	Primary	1 hour	100 ppb	Annual 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary & Secondary	1 year	53 ppb	Annual Mean
Ozone (O_3)	Primary & Secondary	8 hours	0.070 ppm	Annual 4th highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter (PM) $PM_{2.5}$	Primary	1 year	9.0 µg/m^3	Annual mean, averaged over 3 years
	Secondary	1 year	15.0 µg/m^3	Annual mean, averaged over 3 years
	Primary & Secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
PM_{10}	Primary & Secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)	Primary	1 hour	75 ppb	Annual 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary[1]	1 year	10 ppb	Annual mean, averaged over 3 years

[1] EPA changed SO_2 secondary NAAQS to 10 ppb annual mean, averaged over 3 years, effective January 27, 2025.

2. What is the difference between primary and secondary NAAQS?

Primary standards are set to protect human health. Secondary standards are set to protect public welfare and take into consideration such factors as crop damage, architectural damage, damage to ecosystems, and visibility in scenic areas.

3. How is the location of an air monitoring station decided?

Multiple factors are considered when determining the location of air monitoring stations. Sites are selected based on the purpose of the monitoring (representative ambient concentrations, maximum source impact, etc.), the pollutant or pollutants to be monitored, the population density, location of other monitoring stations (including those in other states) and operational efficiency.

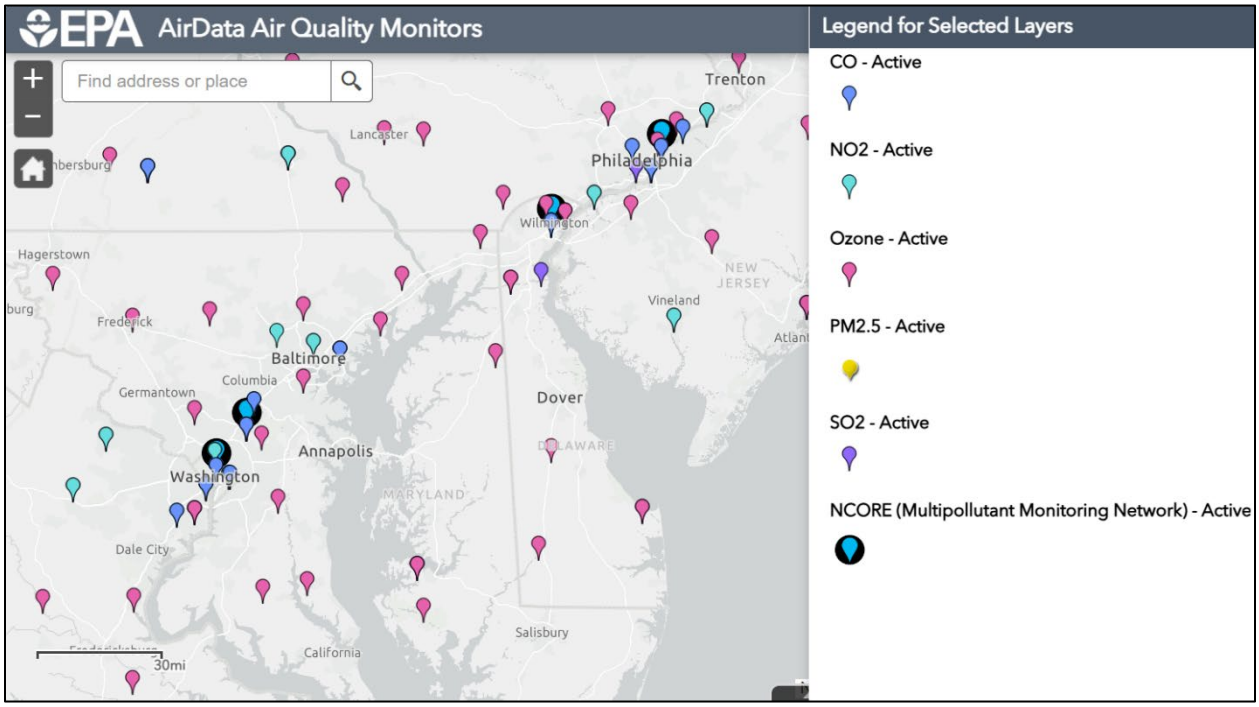
The EPA has developed siting requirements for each of the “criteria” air pollutants. These requirements include distance from trees, buildings and roadways, distance from major point sources, and height of the sampler probe or inlet. Other factors include site security and access, availability of electricity, aesthetics, local zoning issues, and long-term (10+ years) site availability. Unfortunately, ideal monitoring sites are difficult to acquire, especially in urban areas.

Air monitoring stations are primarily used to house continuous instruments that measure “criteria” air pollutants (those that have established NAAQS). Sampling (filter-type) particulate monitors are typically set up on a stand-alone platform or roof. Continuous particulate monitors are typically placed inside of a monitoring station with a roof intake, or on a platform in a specialized protective cabinet with intake on top.

Delaware has had air monitoring sites located around the state since the late 1960s. The original focus of the monitoring network was on monitoring close to “point” sources (large facilities with high emissions). As air pollution control strategies were successfully implemented and emissions from large facilities were brought into compliance with air quality regulations, the focus has shifted to monitoring ambient air to understand and report the levels on a regional scale.

Delaware’s Air Monitoring Network is shown at de.gov/airdata. This GIS map shows the locations of monitoring stations, current data and plots of past data.

To see locations of monitoring sites in Delaware and the rest of the country, visit EPA’s Interactive Air Quality Monitoring Tool.



4. How large an area does an air monitoring station represent?

Depending on the location of a station and the pollutant being monitored, the data from a given site can represent a large geographical area or a smaller local area impacted by specific sources.

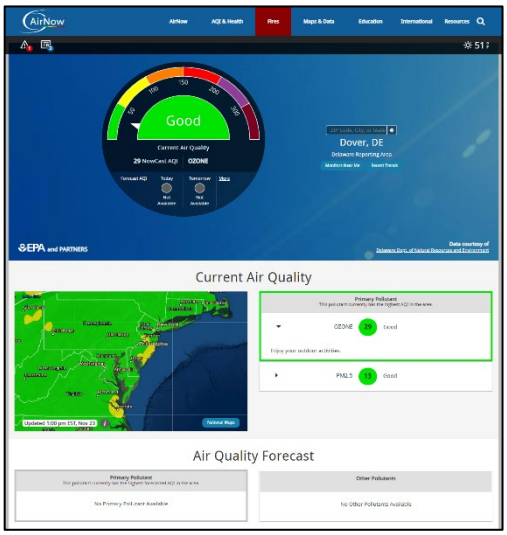
5. What do I do if I have a complaint about an odor or other air quality issues?

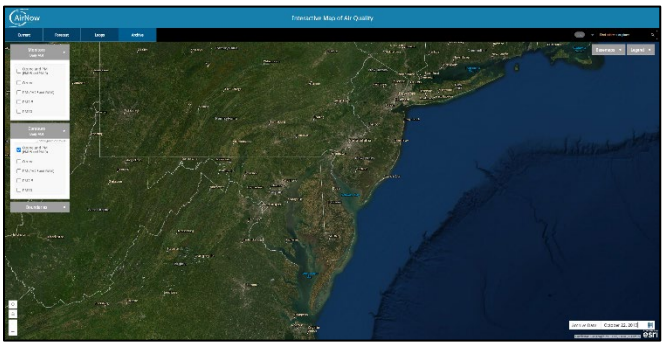
Odors and other environmental complaints can be reported to the Natural Resources Police environmental crimes unit 24-hour Hotline at **1-800-662-8802**. The Delaware Natural Resources Police also provide a smartphone app called Tip411 so the public can report environmental crimes and concerns and receive information about closures of parks or other public lands and public safety alerts. More information can be found at Delaware Natural Resources Police 411 - DNREC.

6. How do I find current air quality data?

Near real time air quality data and other information is available at de.gov/airdata. This tool shows all continuous air monitoring in Delaware.

Alternatively, you can visit the EPA's AirNow site, which has been updated with the latest Air Quality Index (AQI) ranges (May 2024) and an updated Fire & Smoke Map (September 2024). AirNow has ozone and PM data from monitoring stations across the U.S. and also displays air sensor data on the fire and smoke map.



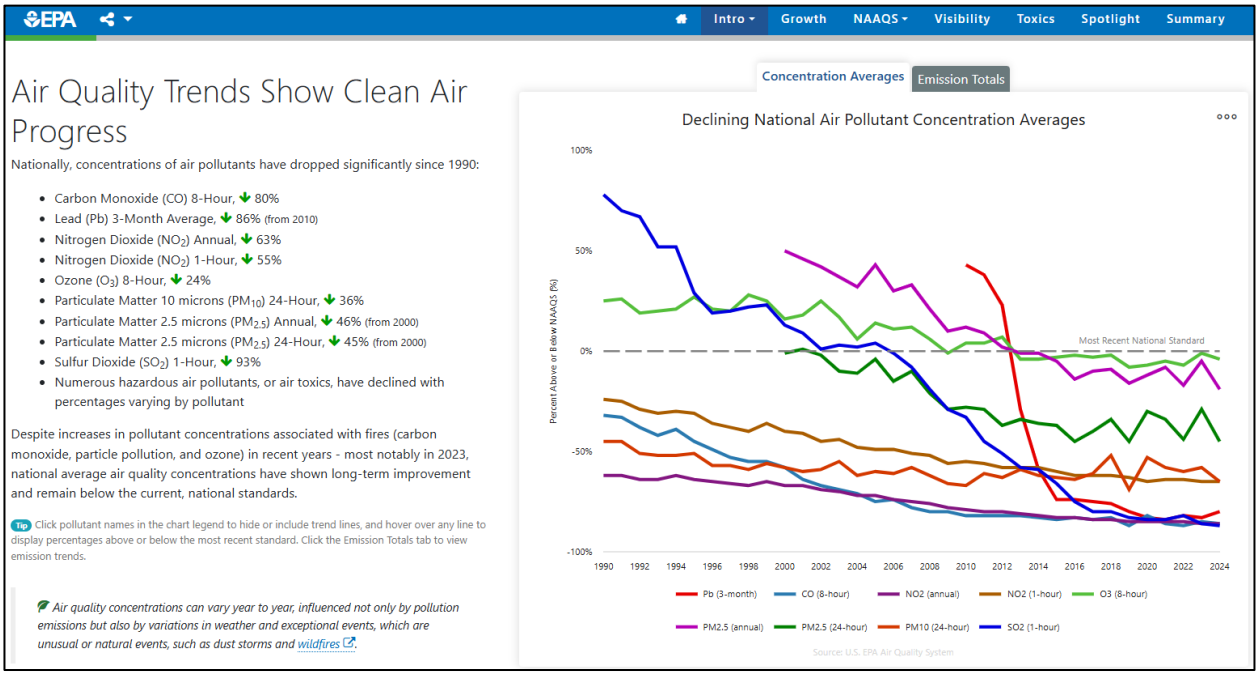


7. How can I find historical air quality data?

Historic air quality data for Delaware and other states is available on the internet from the EPA's Air Data site. Delaware's historic annual air quality reports are also available at https://dnrec.delaware.gov/air/quality/monitoring/.

8. How can I find out how air quality compares across the country?

EPA has released a National Air Quality: Status and Trends of Key Air Pollutants report in an online interactive format since 2015. They have historical reports available as well. Visit the EPA's interactive National Trends Report.



9. What is open burning and why can't I burn leaves or trash?

Open burning is conducted outside where smoke and other emissions are released directly into the air. **Open burning is prohibited in Delaware from May 1 through September 30** due to its contribution to harmful summertime ozone levels. Exemptions include small camping, cooking, and ceremonial fires.

Delaware's Open Burning Regulations prohibit certain types of burning at all times, to include the burning of leaves and trash which emits large amounts of harmful fine particulates and toxic air pollutants some of which may be cancer causing. Since 1968, Delaware has prohibited the burning of trash, while the burning of leaves has been prohibited statewide since 1995. Guidance for allowable burning under specific conditions can be found in a Citizen's Guide to Residential Open Burning on AQ's website.

10. Who can I call about an indoor air quality problem?

Indoor air quality problems are handled by the Environmental Health Toxicology section of the Division of Public Health. **(302) 744-4546.**

11. Where do I find the AQ regulations?

The State of Delaware regulations are posted on the air quality regulations web page.

Delaware's Air Quality Attainment Status

For 2024, Delaware met all NAAQS based on the three-year design values (DV) (2022-2024) calculated by the EPA.

Eight-hour ozone averages at the monitors in New Castle County exceeded the ozone NAAQS on four separate days (May 24-25, June 26, and July 8). These exceedances occurred primarily under warm, stagnant conditions conducive to ozone formation; though thin smoke also likely contributed to increased ozone levels.

Because the annual ozone DV is determined by the fourth-highest daily maximum eight-hour average, these events influenced but did not alter Delaware's overall attainment status. The three-year DV for New Castle County remained below the 0.070 ppm standard (see Figure 1).

Over the last decade, ambient concentrations of all criteria pollutants have generally declined or stabilized, while 2023 showed temporary increases in ozone and fine particulate matter due to transported smoke, 2024 reflected a return to more typical levels.

Ozone and particulate matter DV either stabilized or declined slightly across monitoring sites, and NO_2 and SO_2 concentrations continued their long-term downward trends. Overall, 2024 air quality conditions in Delaware were consistent with continued progress toward sustaining attainment of federal standards.

Lead is a Criteria Pollutant, and Delaware is in attainment for the NAAQS. In 2016 EPA ruled that official monitoring for lead is no longer required at National Core (NCore) sites. (Federal Register Vol. 81, No. 59, 3/28/2016). Monitoring continues as part of the Chemical Speciation Network but is not reported here.

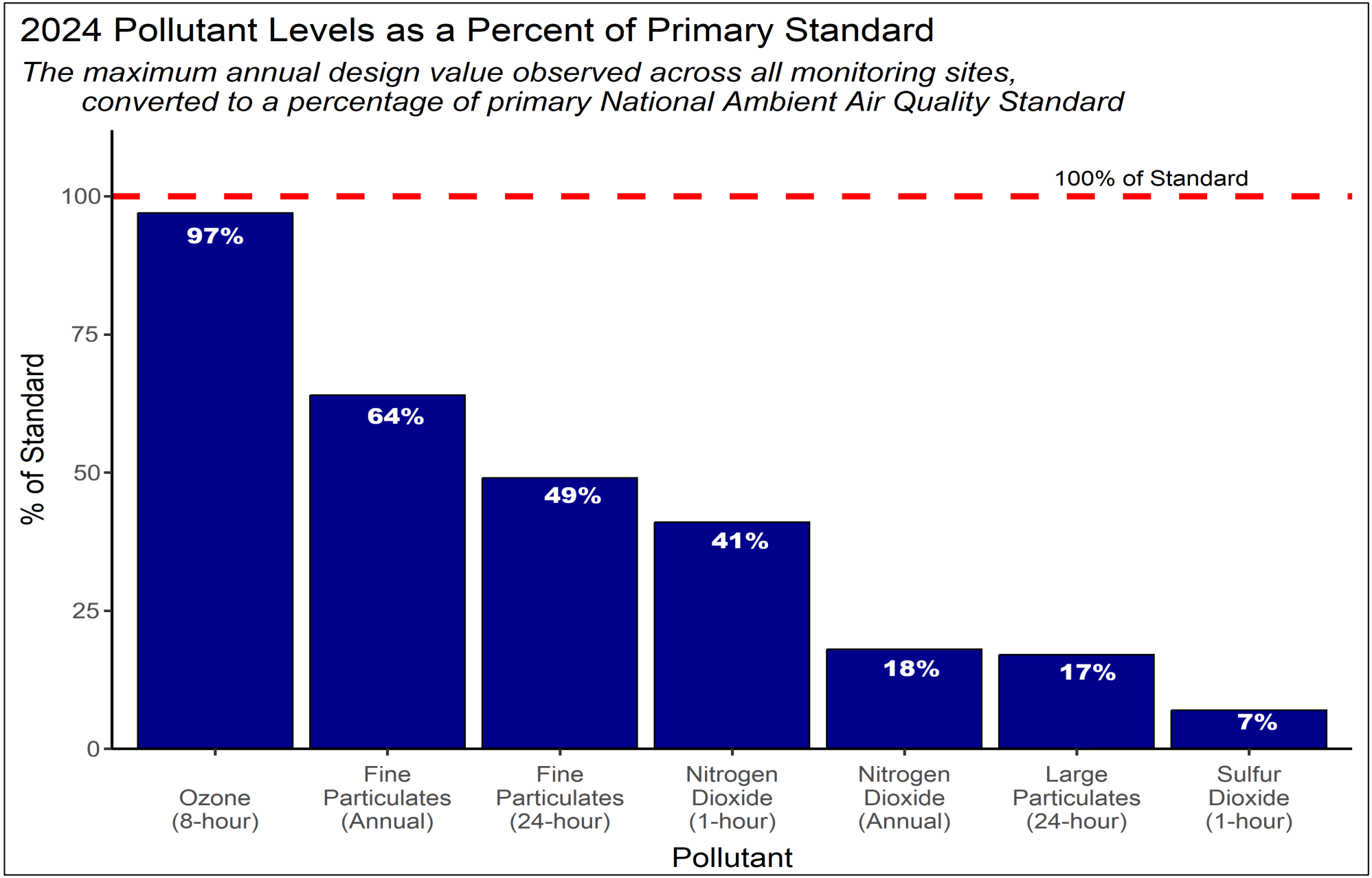


Figure 1. Maximum Pollutant Levels as Percent of Individual Standard

EPA Air Quality Index

The AQI was created by the EPA to ensure national uniformity of daily air quality reports. Ambient concentrations of five pollutants (CO, NO_2, ozone, PM_{10}/$PM_{2.5}$, and SO_2) are used to calculate a health-related value or index. The procedures and calculations used to generate the AQI are defined by the EPA.

For each pollutant, the AQI is calculated using mathematical functions to transform ambient pollutant concentrations onto a scale from zero to 301+, with 101 corresponding to the low end of the NAAQS orange “Unhealthy for Sensitive Groups” category. Index ranges and descriptions are listed in Table 2. The AQI is used most frequently for ozone and PM, because these pollutants are the most likely to be present at or above the NAAQS.

Table 2. Air Quality Indexes and Descriptions

Color	Levels of Concern	Value	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Delaware Annual AQI

Delaware reports criteria pollutant concentrations from the statewide monitoring network on an hourly basis to the EPA AirNow website. AirNow uses Delaware's data to calculate an AQI for ozone and PM. The pollutant with the highest AQI determines the AQI category for the day. AQI information is also available at de.gov/airdata.

The EPA made changes to the AQI when the $PM_{2.5}$ NAAQS was updated in 2024. The $PM_{2.5}$ range for the Good (green) AQI category was lowered from 0 to 12.0 µg/m^3 to 0 to 9.0 µg/m^3 and the range for the Moderate (yellow) AQI category was lowered from 12.1 to 35.4 µg/m^3 to 9.1 µg/m^3 to 35.4 µg/m^3.

Figures 2, 3 and 4 show the calculated AQI for each day in each county for 2024. New Castle County had four days in the Unhealthy for Sensitive Groups (orange) category; Kent County had zero; Sussex County had zero. Some pollutants such as ozone and PM are influenced by seasons. Warmer months tend to have higher ozone. Cooler months tend to have more particulates. More information on seasonal variations can be found in this report under pollutant sub-sections.

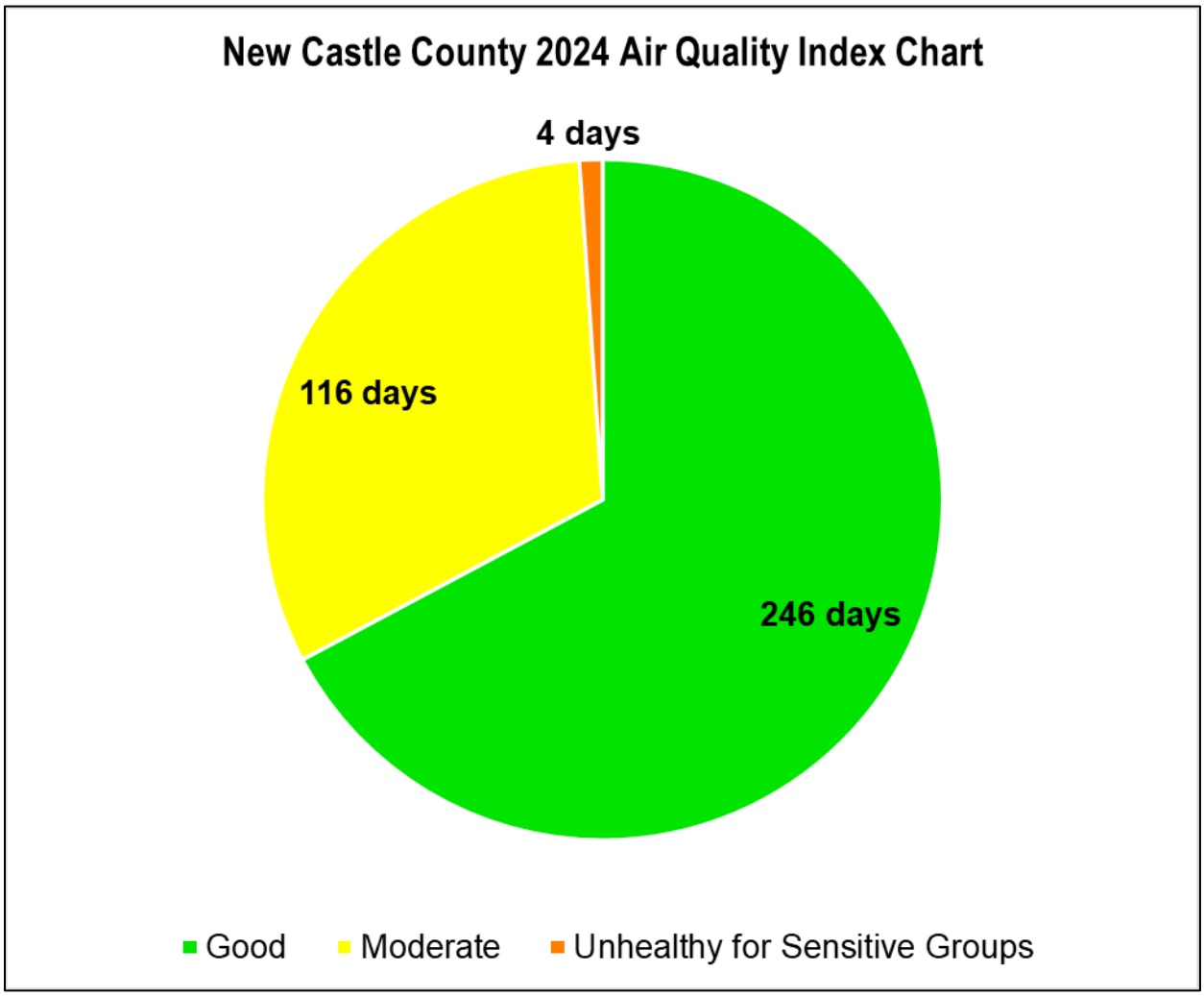


Figure 2. Air Quality Index Chart for New Castle County

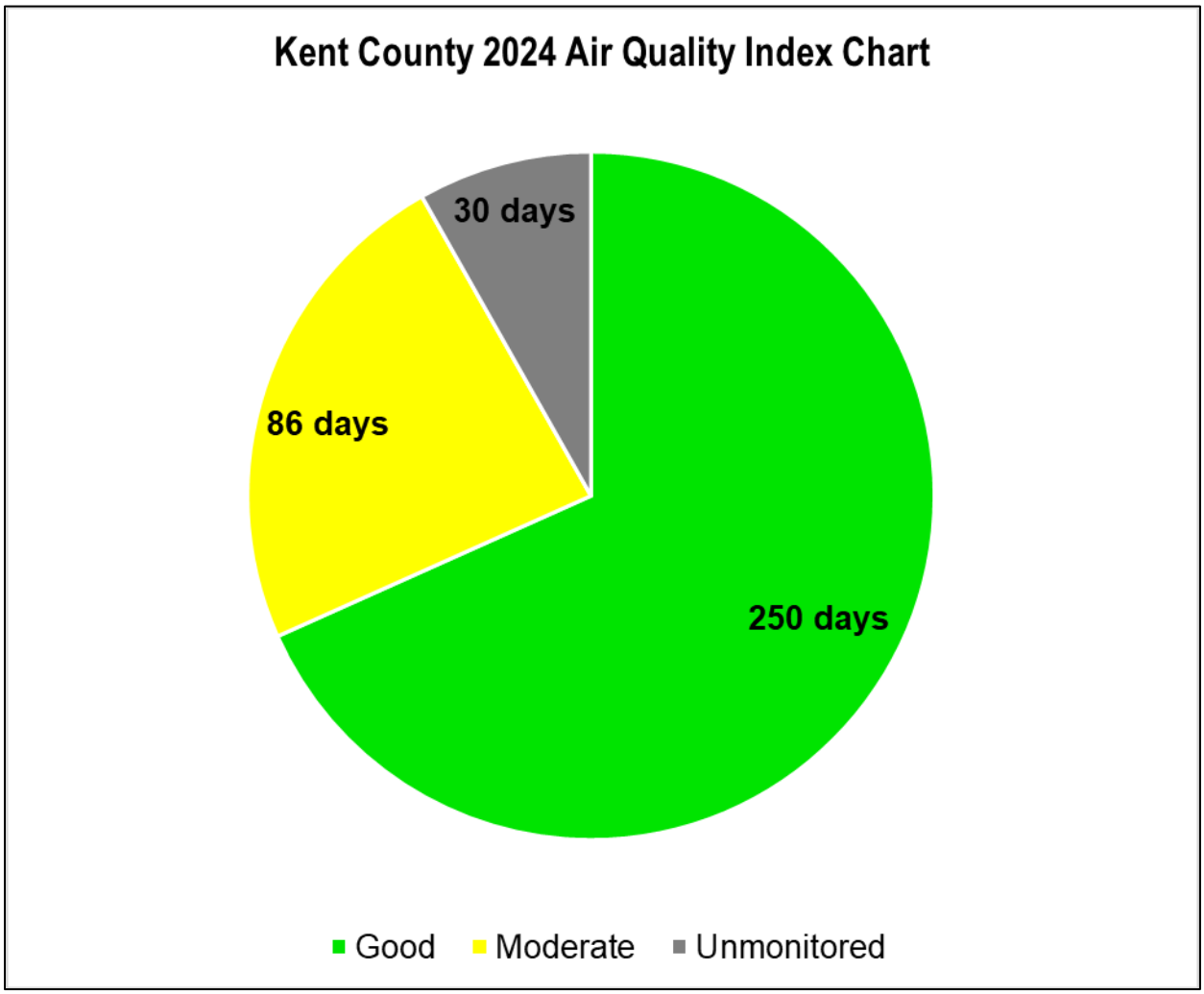


Figure 3. Air Quality Index Chart for Kent County

Note: None of the PM and ozone monitors in Kent County were operating from January 1 to January 30.

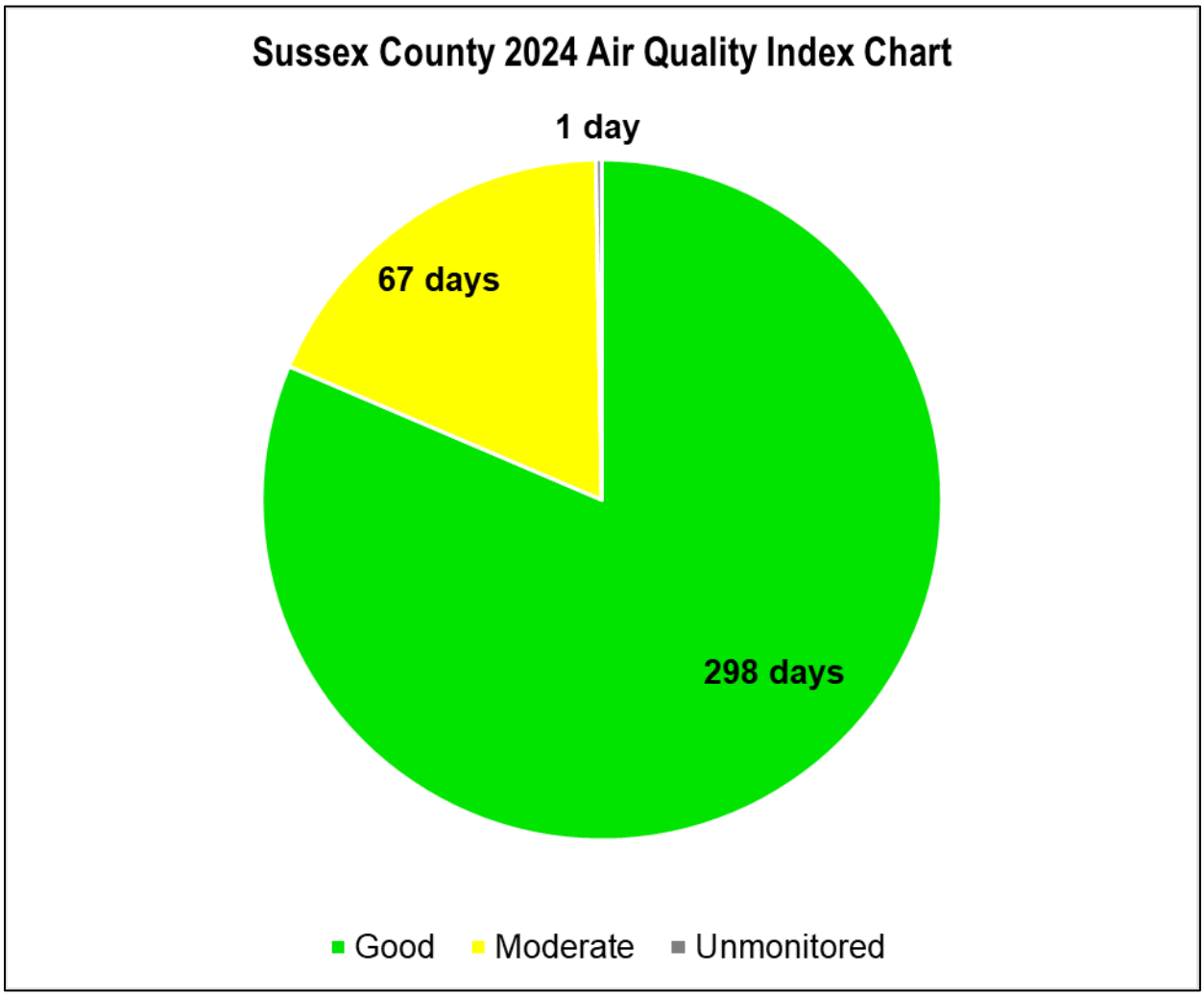


Figure 4. Air Quality Index Chart for Sussex County

The definition of AQI levels has been updated through the years. For example, in 1999 an ozone level of 80 ppb would have been considered “Moderate”, while in 2024, 80 ppb is considered “Unhealthy for Sensitive Groups”. For current AQI definitions, see Federal Regulation 40 CFR 58 appendix G “Uniform AQI and Daily Reporting”.

Figure 5 shows the daily AQI trends for New Castle County from 2000 through 2024, according to 2024 AQI definitions, so that data from different years is comparable.

The number of days with Good-Moderate air quality has been generally increasing. 2023 was an exception due to wildfire smoke from outside the State. New Castle County in 2024 has shown a higher ratio of days in Good standing opposed to Moderate or higher compared to the previous years.

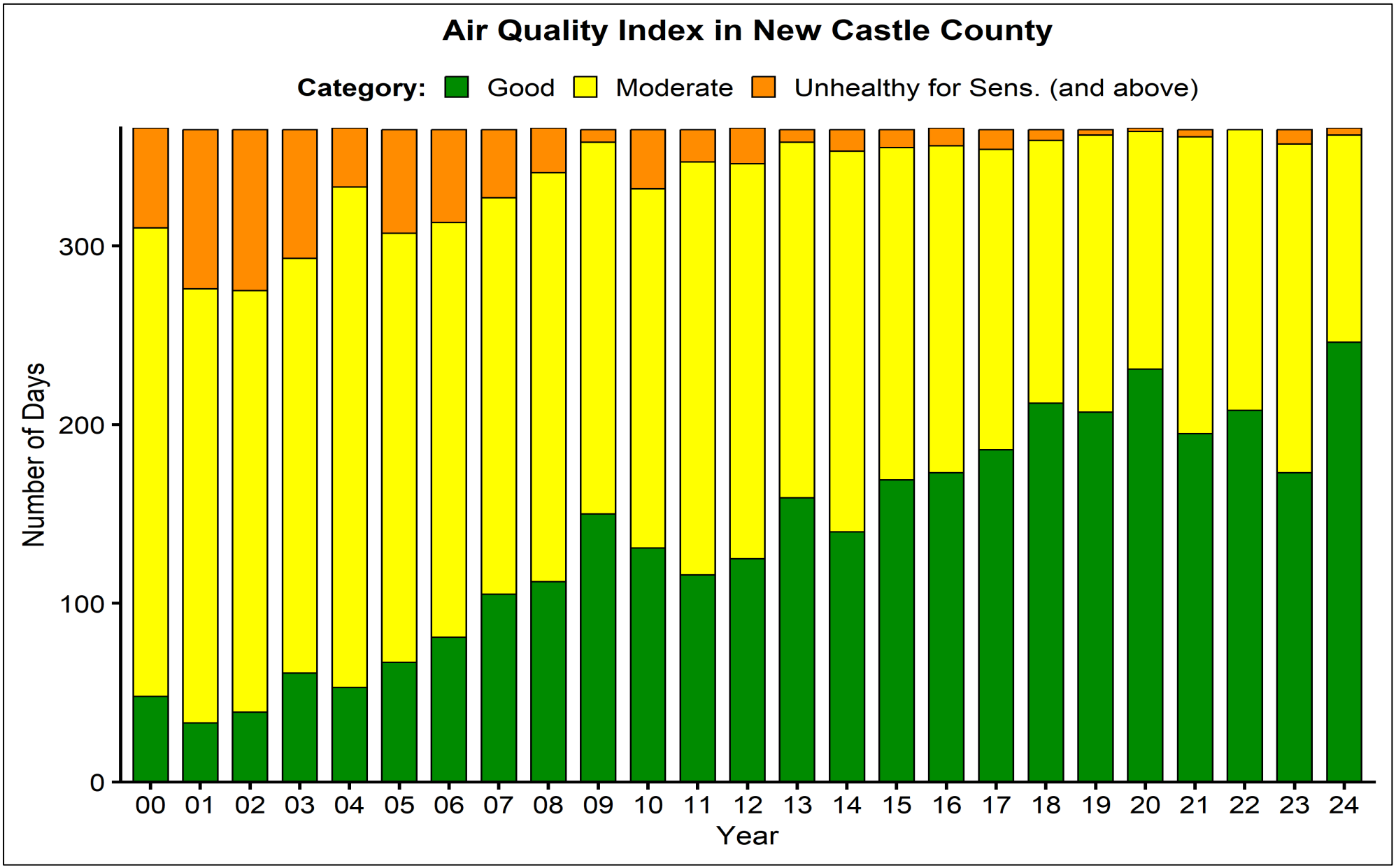


Figure 5. Air Quality Index Trend for New Castle County

Delaware's Air Monitoring Network

The State of Delaware has established an air monitoring network to determine the ambient levels of pollutants for which NAAQS have been established. The earliest monitors were placed near pollution sources to measure direct impact of pollution emissions. As ambient air pollution standards became established and monitoring methods standardized, the monitoring network expanded to include monitors in both urban and suburban areas. Monitoring goals shifted to include measuring high pollution concentrations in population centers, detecting trends, and determining compliance with the national ambient air quality standards, as well as establishing background levels and measuring pollution transported from areas outside of Delaware.

In 2006 the EPA introduced a requirement to establish NCore monitoring stations. National Core Monitoring Station is a national multi-pollutant network that integrates several advanced measurement systems for particulates, gaseous pollutants, and meteorology. The purpose of this requirement was to enhance ambient air quality monitoring to better serve current and future air quality needs. Delaware's Wilmington site was configured to meet NCore requirements and began monitoring in 2010.

Although monitoring takes place statewide, most of the stations are concentrated in the northern urban/industrial areas, which have the highest population and number of pollutant sources. Different stations also monitor different pollutants, depending on sources, population, and monitoring goals for the station. As air quality has improved and ambient levels continue to be well below standards, monitoring for pollutants such as CO are only monitored at the NCore monitoring site in Wilmington. More detailed information on the network is available in the Delaware Air Monitoring Network Plan which can be found under the Delaware Air Quality Monitoring Network heading of the monitoring website. See also question 3 in the FAQ section for more information on how and why monitors are sited.

The network is maintained and operated by the Air Monitoring Program within the Planning Section of the AQ. The gaseous criteria pollutants, along with wind speed and wind direction, are measured continuously with hourly averages computed and reported via a telemetry system to a central data storage computer. Particulate samples are collected as 24-hour samples that run every day, every third day, every sixth day; or, collected continuously with hourly averages. The Delaware Air Monitoring Network consists of sites and monitors listed in Table 3 and Figure 6.

Air Quality Monitoring Scenes in Delaware

Table 3. Delaware Air Monitoring Network and Criteria Pollutants Monitored

Sites (listed from North to South)[2]	CO	NO_2	Ozone	PM_{10}	$PM_{2.5}$	SO_2
Brandywine Creek State Park			X			
Bellefonte I & II — ***River Road Park (I)***					X	
Bellefonte I & II — ***Bellevue State Park (II)***			X			X
MLK National Core (NCore) *Wilmington*	X	X	X	X	X	X
Newark					X	
Delaware City (Rt.9)					X	X
Lums Pond State Park			X		X	X
Dover					X	
Killens Pond State Park			X		X	
Lewes			X			X
Seaford			X		X	

Dover Monitoring Platform

Seaford Site Shelter

Bellefonte II Site

Examples of monitoring sites in Delaware

[2] "X" indicates pollutant monitored

Air Quality Monitoring Sites in Delaware

Figure 6. Map of Delaware Air Quality Monitoring Sites

Factors Influencing Air Quality and Air Quality Measurements

Wildfire Smoke

Wildfire smoke has remained a major factor affecting Delaware's air quality over the last two years. The 2023 Canadian wildfire season was among the most severe on record, generating a persistent long range smoke transport that degraded air quality across much of the eastern United States. In Delaware in 2023, transported smoke led to exceedances of the 24-hour $PM_{2.5}$ NAAQS on 10 days (June 1, 6, 7, 8, 9, 28, 29, and 30; July 1 and 18) and contributed to multiple ozone exceedances through the presence of ozone precursor compounds on affected days (June 2, 7, 29, and 30).

These impacts resulted in the highest annual ozone DV in the state at 0.072 ppm, exceeding the 0.070 ppm NAAQS threshold. Together, these events demonstrated that large scale wildfire activity can significantly influence measured pollutant concentrations and regulatory air quality outcomes in Delaware.

In 2024, wildfire smoke continued to influence air quality, though impacts were less severe than those observed in 2023. While the frequency and intensity of exceedances declined compared to 2023, wildfire smoke continued to affect air quality measurements and background concentrations in Delaware throughout the 2024 ozone season. From May through September, daily $PM_{2.5}$ AQI levels were Good on 69% of days and Moderate on 31% of days. There were no Unhealthy (red) days or higher for 2024.

These numbers are an improvement from the 2023 AQI levels but not as good as the 2022 AQI levels. Smoke played a large role in the summer season when it was detected on 104 out of the 153 days statewide. Compared to previous summers, 2024 had more smoke detected than 2022 and 2021 but less than 2023. This means that even though pollution did not reach harmful levels, wildfire smoke still raised background $PM_{2.5}$ and pushed many days from Good into Moderate.

EPA's 2024 $PM_{2.5}$ NAAQS rule change lowered the minimum threshold of Moderate AQI to 9.0 $\mu g/m^3$. This change has caused more Good category days to be switched over to Moderate.

When comparing the 2012 NAAQS to the 2024 NAAQS for the years 2019-2023 the average number of Good days during the summer season has decreased from 88% to 69%.

For the 2024 summer season the 2012 NAAQS would have counted 145 days or 87% in the Good category while the new 2024 NAAQS would have counted 114 days or 68%.

Across Delaware's monitoring network, for the summer forecast season, most sites showed 70-80% Good air quality days for $PM_{2.5}$. In comparison, previous years have shown a 70%-80% average of Good days with 2023 having a 63% average.

Compared with the 2019-2023 average, $PM_{2.5}$ AQI levels in summer 2024 were only slightly higher; 31% of days were Moderate or higher compared with the five-year average of 30%. This small increase is likely due to the frequent presence of wildfire smoke, even though smoke was not as intense as the year before. Overall, Delaware did not experience any $PM_{2.5}$ or ozone standard violations from wildfire smoke in 2024, but smoke still had a noticeable effect on daily air quality and background pollution levels.

Pollutant Attainment Status and Trends

Ozone

Description

Ozone is a highly reactive gas that is the main component of smog. Ozone in the lower atmosphere (troposphere) is considered a pollutant and is distinct from the ozone layer in the upper atmosphere (stratosphere) where it acts as a shield from ultraviolet radiation. Tropospheric ozone is also called ground-level ozone. Ozone is a strong respiratory irritant that affects healthy individuals as well as those with impaired respiratory systems. It can cause respiratory inflammation and reduce lung function.

Ozone also adversely affects trees, crops (soybeans are a particularly sensitive species), and other vegetation. The national agricultural loss from ozone pollution is estimated by the EPA to be several billion dollars annually. It is also implicated in white pine damage and reduced growth rates for red spruce; studies have shown forest and ecosystem damage can result from high ozone concentrations.

Standards

Primary & Secondary NAAQS:

- Maximum eight-hour average = 0.070 ppm
    - The eight-hour standard is achieved when the annual fourth highest daily eight-hour concentration, averaged over three years, is less than or equal to the standard.

State Standard:

- Maximum one-hour[3] = 0.120 ppm, former NAAQS, current Delaware AAQS.
    - The one-hour standard is achieved when the number of days per calendar year, with a maximum hourly average of greater than 0.120 ppm (235 $\mu g/m^3$) is less than or equal to one.

[3] EPA revoked the one-hour standard for ozone in June 2005. Delaware has maintained the one-hour standard in its regulations (Regulation 1103) due to historical non-attainment designations and continues to track and record these values.

Sources

Ozone is not generally emitted directly from a pollution source but is formed in the lower atmosphere by the reaction of nitrogen oxides (NO_X) and volatile organic compounds (VOC) in the presence of sunlight and warm temperatures. When temperature and sunlight are not sufficient to form ozone, these same compounds destroy ozone, which may be referred to as “scavenging”.

Sources of NO_x include automobiles, power plants and other combustion activities. VOCs can come from automobiles, gasoline vapors, and a variety of large and small commercial and industrial sources that use chemical solvents, paint thinners, and other chemical compounds. These compounds or “precursors of ozone” can travel for miles before chemical reactions in the atmosphere form ozone.

Controlling ozone is a complex task due to the wide variety of sources for nitrogen oxides and VOCs as well as the long-distance transport of ozone and its precursors. Control methods include regulation to control gasoline vapor emissions, inspection and maintenance programs for motor vehicle exhaust, and regulation of VOC and NO_X emissions from industrial sources

Locations

Ozone is monitored throughout the state (see Figure 7). Monitors are located away from or at some distance downwind of urban areas and major traffic corridors to avoid “scavenging” of ozone by NOx emissions. While short-term 1-hour average peak ozone levels are usually highest in New Castle County, longer-term 8-hour averages are normally below the standard throughout Delaware.

.

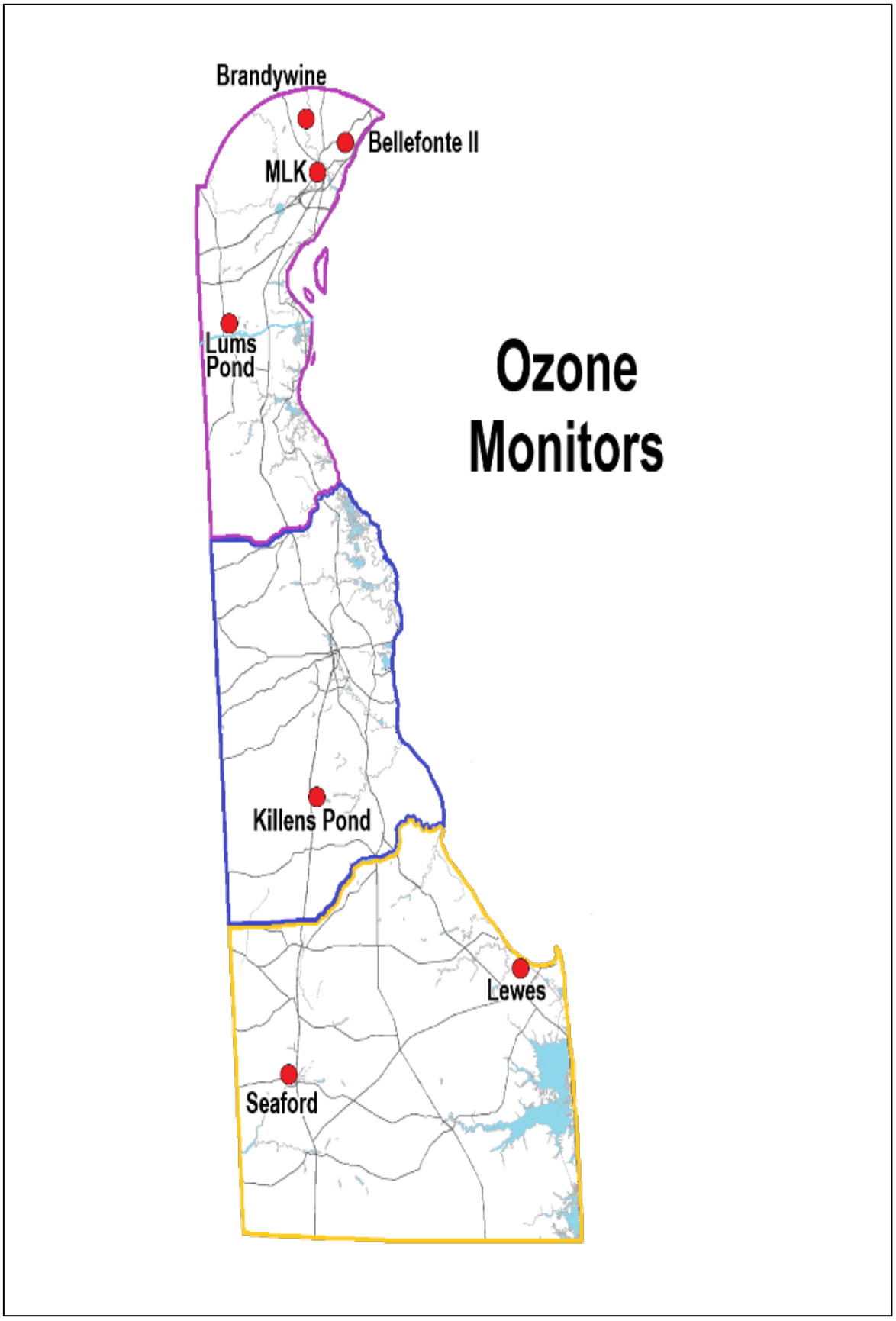


Figure 7. Map of Delaware Ozone Monitors

Delaware Air Quality and Trends

Hot, dry weather and stagnant air conditions favor the formation of ozone, and the greatest number of exceedance days typically occur during the summer.

Overall, Delaware ozone levels have shown a downward trend, with fewer exceedance days despite the standard being lowered twice in the past two decades.

Eight-hour Ozone Data and Trends

2008 NAAQS: Prior to 2008, a measured 8-hour average concentration would have exceeded the 0.08 ppm standard if the concentration was equal to or greater than 0.085 ppm. This is due to numerical rounding to two decimal places. In 2008 the 8-hour standard was revised to 0.075 ppm with numerical rounding to three decimal places.

2015 NAAQS: In October 2015 the 8-hour NAAQS was strengthened to 0.070 ppm (continuing with numerical rounding to three decimal places). Currently a measured 8-hour average concentration above 0.070 ppm is an exceedance of the standard. Exceedances in 2015 are counted based on the 2008 standard since the 2015 NAAQS was not enacted until after the 2015 Ozone Season.

In 2024 ozone exceedances occurred on four days in New Castle County and zero days in Kent and Sussex County. Since the 4th highest day at each site is used for comparison, the NAAQS was met at every site.

In Figure 8, the total number of statewide exceedance days is shown as a bar chart in gray based on the applicable standard. The lines for each county do not necessarily correspond with the statewide count because an exceedance in a particular county may have occurred on the same day as another county.

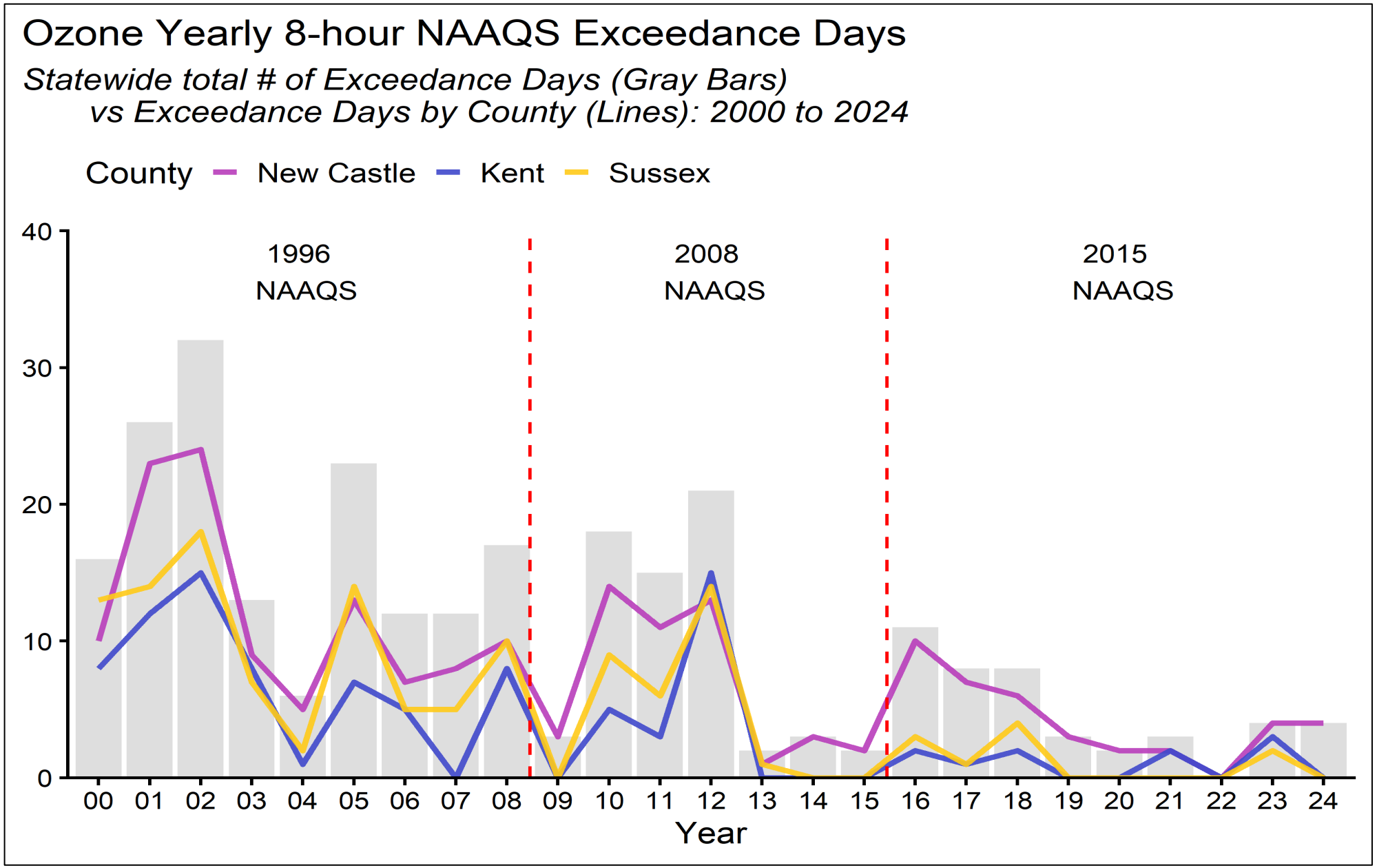


Figure 8. Number of Days Exceeding 8-hour Ozone NAAQS

The “Ozone Design Value by County” numbers in Figure 9 are the annual fourth highest (4th Maximum) daily 8-hour concentration, averaged over three years, referred to as the DV. If the DV is less than or equal to the standard, the 8-hour standard is attained. Based on 2022–2024 data, all three Counties in Delaware attained the ozone 8-hour NAAQS (see Table 5).

However, New Castle County is part of the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area (MSA), which may also be listed as Philadelphia-Wilmington-Atlantic City, Pennsylvania, New Jersey, Maryland and Delaware. If any monitor’s DV in the MSA exceeds the standard, the highest DV determines the classification for the entire MSA. For 2022–2024 the MSA DV was 0.073 ppm which exceeded the 0.070 ppm standard. This only impacts New Castle County’s attainment status; the other two counties are unaffected.

Table 4 shows the 2024 1-year DV determination for each ozone monitoring site. For each day, the maximum 8-hour average is determined. The 4th highest daily 8-hour maximum is taken as the 1-year DV for that site. More information is available at Air Quality Design Values on the EPA website.

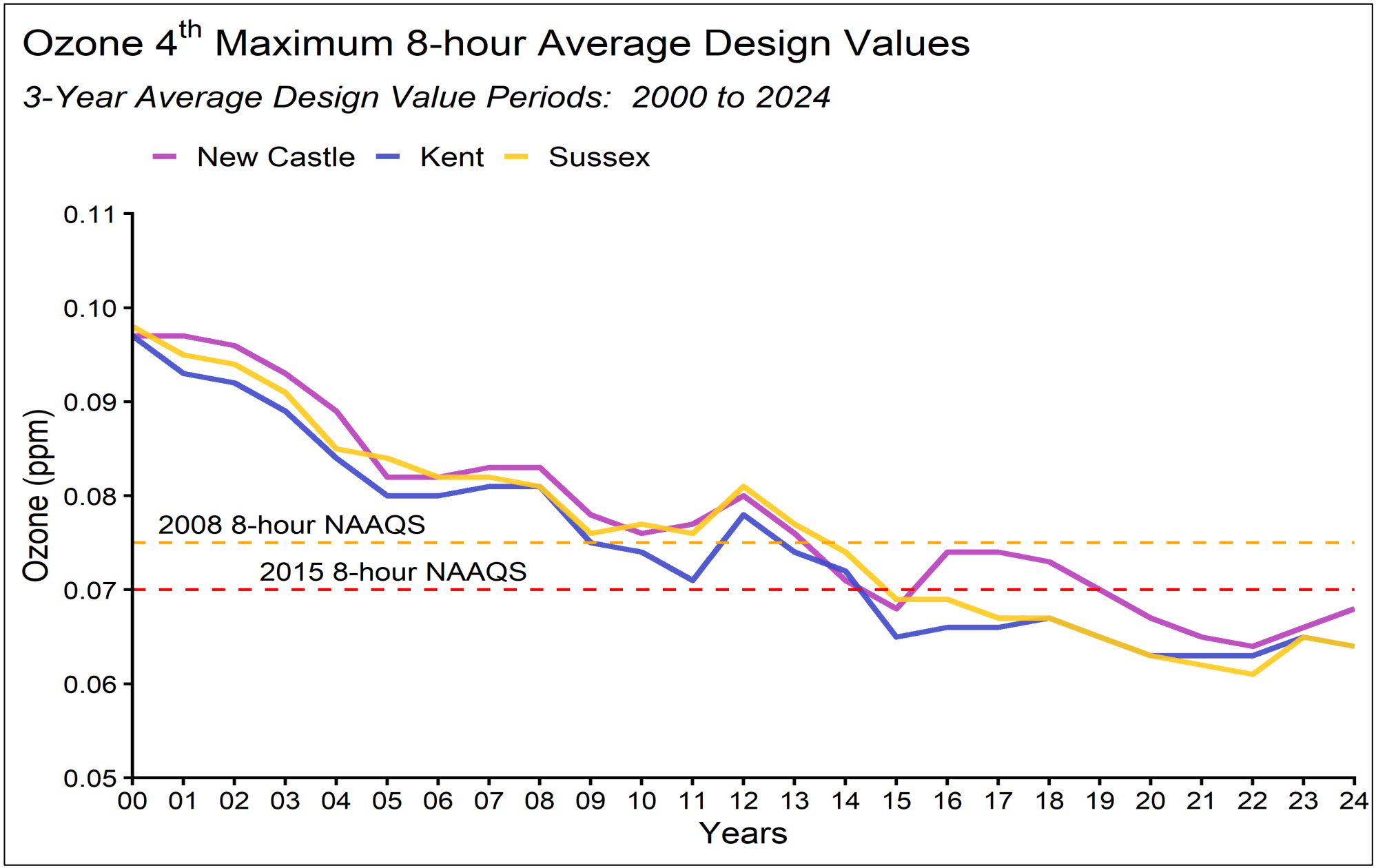


Figure 9. Ozone Design Value by County

Table 4. Ozone 1-year Site Design Values (ppm)

2024	Number of Ozone Exceedance Days & Maximum per Site (ppm)				
Sites (listed North to South)	# Exceedances[4]	1st Max.	2nd Max.	3rd Max.	(Design Value) 4th Max.
Brandywine Creek	1	0.073	0.068	0.067	0.063
Bellefonte II	2	0.073	0.071	0.069	0.068
MLK NCore	3	0.076	0.075	0.073	0.070
Lums Pond	0	0.070	0.069	0.068	0.066
Killens Pond	0	0.070	0.068	0.067	0.063
Lewes	0	0.063	0.062	0.061	0.061
Seaford	0	0.067	0.066	0.065	0.063

Table 5 shows trends over the last decade for 3-year Average DV at each Delaware ozone monitoring site.

[4] #Exceedances = Number of days with at least one 8-hour average greater than 0.070 ppm.

Table 5. Ozone Trends: 3-year Average Design Values (ppm)

Sites (listed North to South)[5]	2012 to 2014	2013 to 2015	2014 to 2016	2015 to 2017	2016 to 2018	2017 to 2019	2018 to 2020	2019 to 2021	2020 to 2022	2021 to 2023	2022 to 2024
Brandywine	0.071	0.069	0.074	0.074	0.073	0.069	0.063	0.063	0.062	0.066	0.065
Bellefonte II	0.071	0.068	0.070	0.071	0.072	0.070	0.066	0.064	0.063	0.066	0.067
MLK NCore	0.071	0.069	0.071	0.072	0.071	0.069	0.067	0.065	0.064	0.066	0.068
Lums Pond	0.071	0.066	0.068	0.067	0.069	0.068	0.065	0.062	0.062	0.066	0.067
Killens Pond	0.072	0.065	0.066	0.066	0.067	0.065	0.063	0.063	0.063	0.065	0.064
Lewes	0.074	0.069	0.069	0.067	0.067	0.063	0.062	0.059	0.060	0.062	0.062
Seaford	0.070	0.064	0.065	0.065	0.066	0.065	0.063	0.062	0.061	0.065	0.064

[5] Official EPA DV may vary due to data completeness rules for calculations. For historical consistency those complexities are not detailed or indicated in this document unless a value is unavailable.

State Regulation

The State of Delaware primary and secondary ozone ambient air quality standards (separate from the NAAQS), per State Regulation 1103, are met when the number of days per calendar year with maximum hourly average concentrations above 235 $\mu g/m^3$ (0.12 ppm) is equal to or less than 1. In 2024, the maximum 1-hour average ozone concentration was 0.086 ppm on August 1, which met the State standards.

Regional Ozone Levels

Figure 10 shows the Ozone annual 4^{th} maximum 8-hour concentrations for New Castle County, Delaware compared to nearby monitored sites in neighboring states. These are not DV, which are computed as a 3-year average. Only data from 2024 is included here. Only Baltimore County exceeds the 2015 NAAQS while New Castle County meets the criteria.

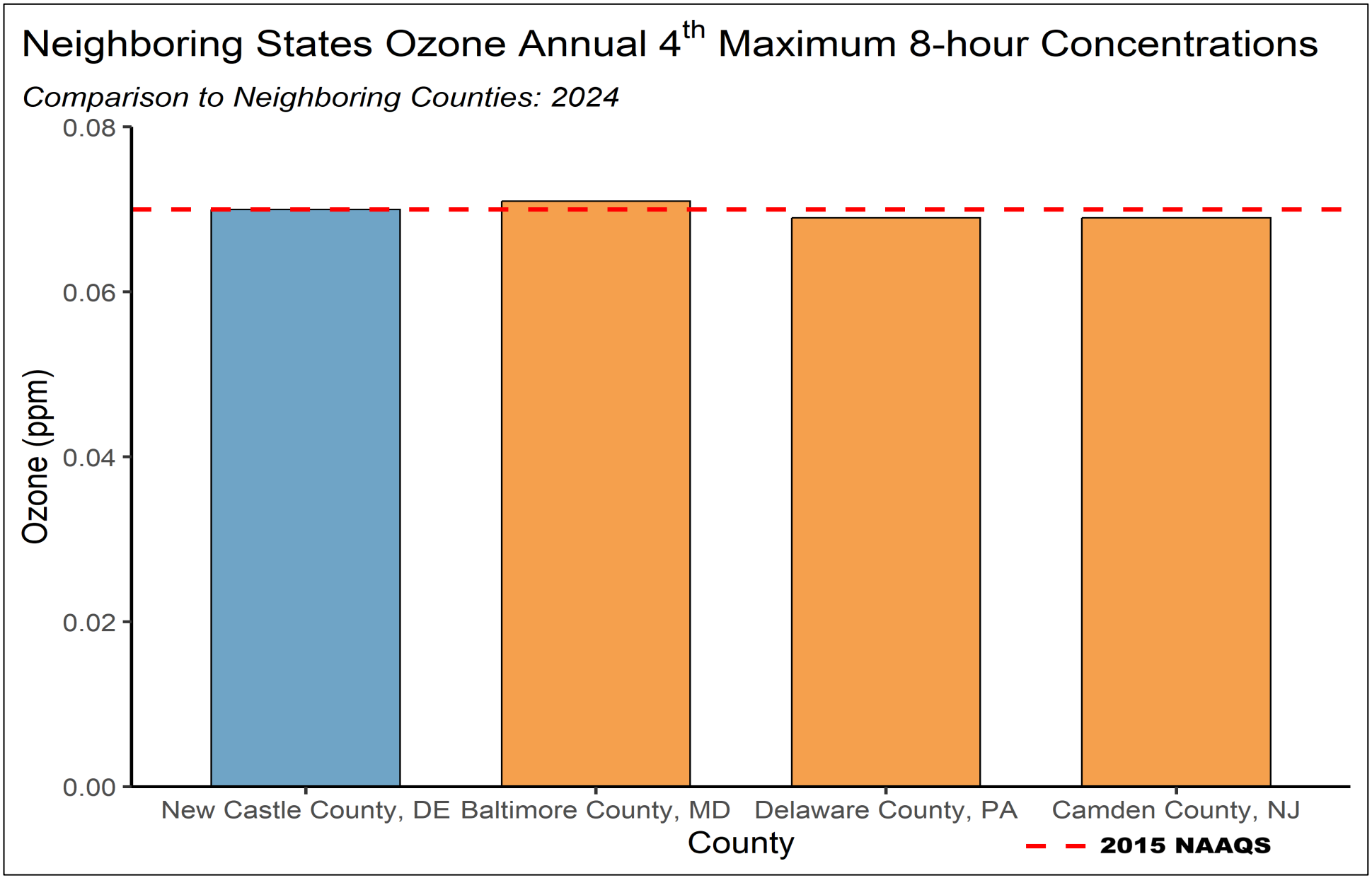


Figure 10. Ozone Compared to Nearby Monitored Sites

Ozone Mapping Project (AirNow)

The Ozone Mapping Project has been integrated into EPA's AirNow website and includes PM and ozone data. Participating states and local agencies submit real-time pollutant data to the AirNow database where the data is converted into color-coded maps based on the AQI (see Table 2). These maps are then distributed by AirNow to local television stations for inclusion in the weather segment of the news program. Stations are most likely to broadcast the map during periods of poor air quality.

The purpose of AirNow is to increase awareness of elevated ozone and PM concentrations so people can take protective measures and to educate the public about the regional nature of ozone formation and transport. For more information, current and historical maps, please visit the EPA AirNow web site.

Figure 11 is an example of an ozone map from the updated AirNow system showing the regional nature of increased ozone levels.

Air Quality Index Ozone Peak Values – July 8, 2024

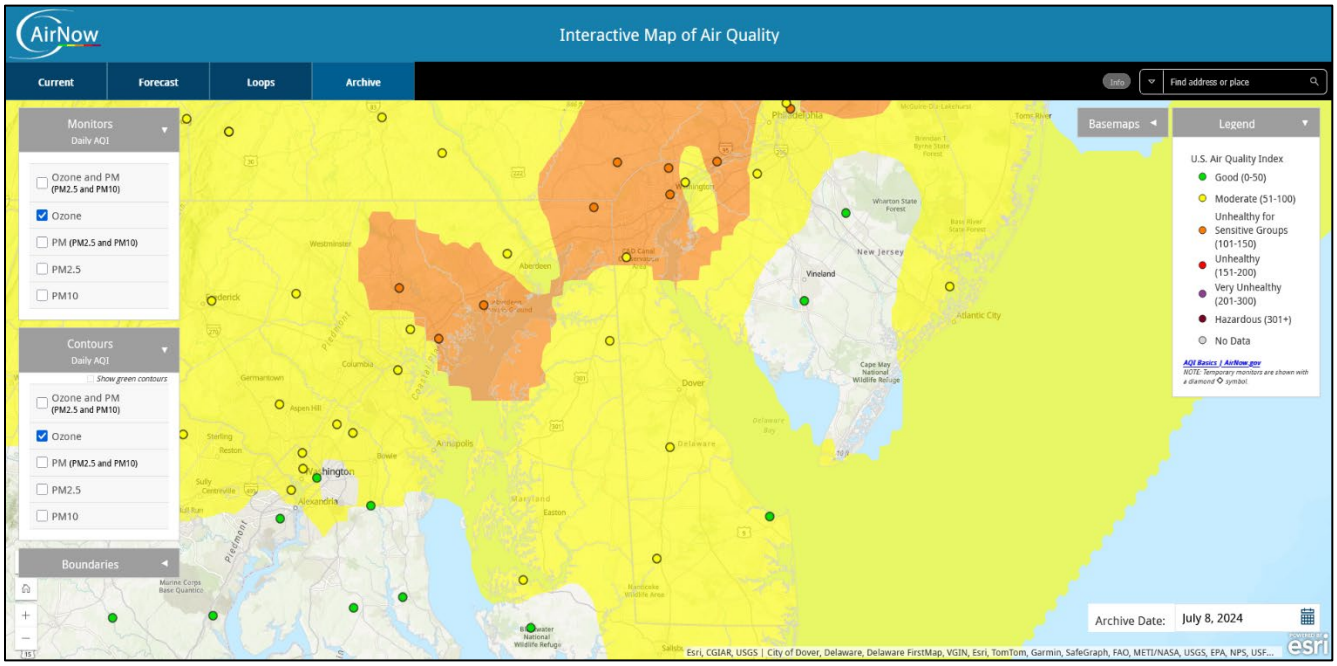


Figure 11. Air Quality Index Ozone Peak Values Example

Source: EPA AirNow website Maps. Archived maps are available in the menu at the bottom right as seen in the screen capture above.

Carbon Monoxide (CO)

Description

CO is a colorless, odorless, poisonous gas produced by incomplete combustion of fossil fuels. It reduces the blood's ability to carry oxygen. Exposure can cause fatigue, headache, and impaired judgment and reflexes at moderate concentrations; at high levels unconsciousness and death can result. People with heart disease, angina, emphysema and other lung or cardiovascular diseases are most susceptible.

Standards

Primary NAAQS:

- 8-hour average = 9 ppm (10 mg/m^3) (Not to be exceeded more than once per year)
- 1-hour average = 35 ppm (40 mg/m^3) (Not to be exceeded more than once per year)

The State standard is the same as the NAAQS.

Sources

Carbon monoxide is formed when carbon in fuel is not completely burned. The EPA estimates that approximately 60% of all CO emissions are from motor vehicle exhaust. Other sources include incinerators, wood stoves, furnaces, and some industrial processes. Concentrations are highest along heavily traveled highways and decrease significantly with increasing distance from traffic. Therefore, CO monitors are usually located close to roadways or in urban areas.

Locations

The monitor for CO is located at the Wilmington MLK NCore site, in New Castle County (see Figure 12).

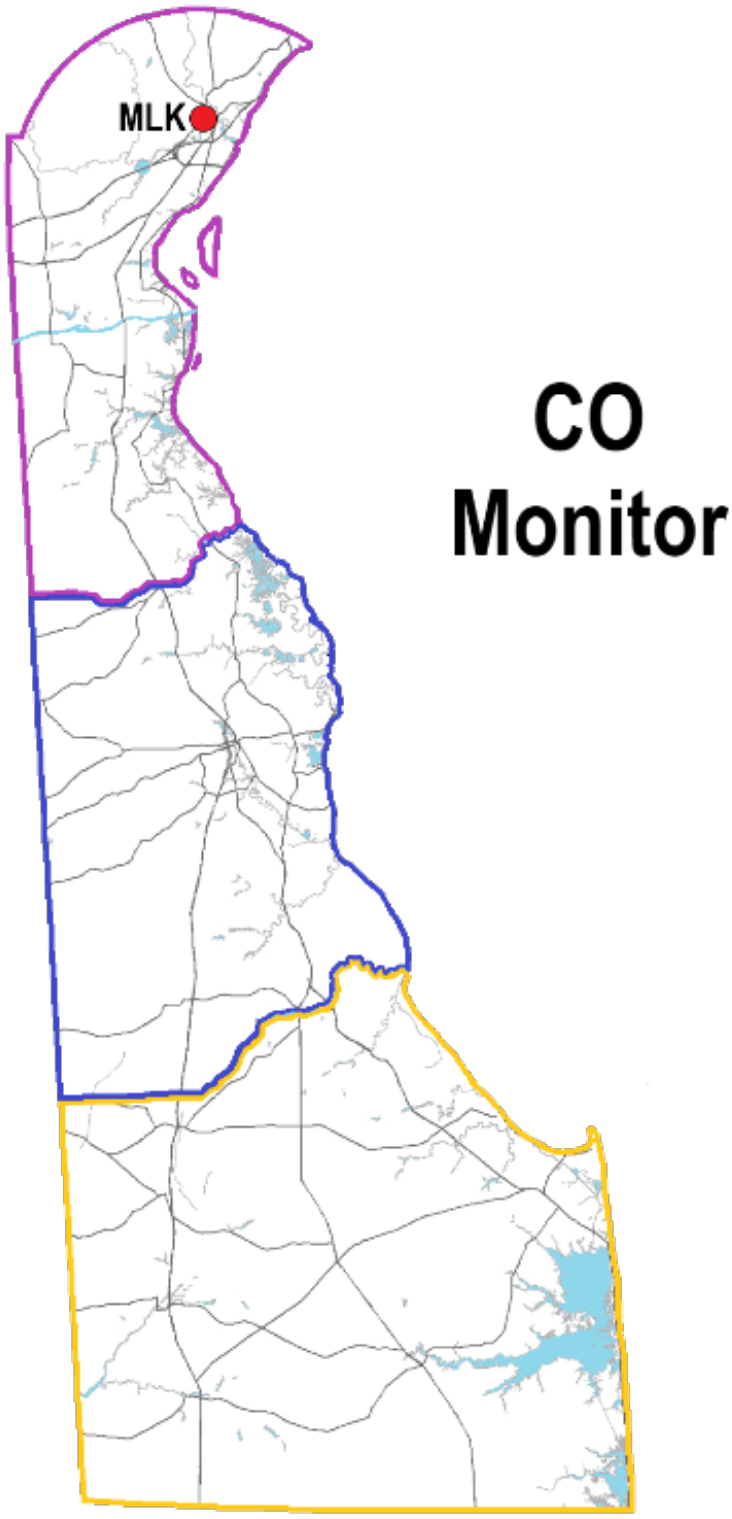


Figure 12. Map of Delaware CO Monitors

Delaware Air Quality and Trends

Mobile sources cause most of the ambient CO detected at the Wilmington MLK NCore site.

MLK NCore Station

There has been a slight downward trend in CO concentrations since monitoring began in the 1970's, and no violations of the ambient standards have occurred since 1977. Improvements are largely due to cleaner burning engines in cars and tighter automobile emission standards.

Due to equipment malfunctions and supply chain issues, Delaware was unable to monitor CO in 2023 and 2024.

EPA calculates the 8-hour average DV for CO as the higher of two consecutive years' 2nd highest values. Because of the lack of 2023 and 2024 data, the Delaware CO DV for 2024 will be the 2nd highest value from 2022 (0.8 ppm). This is less than a tenth of the NAAQS value of 9 ppm.

Nearby sites show 2024 DV between 1.2 and 1.4 ppm. Historically, Delaware DV has been lower than these three nearest CO monitoring sites.

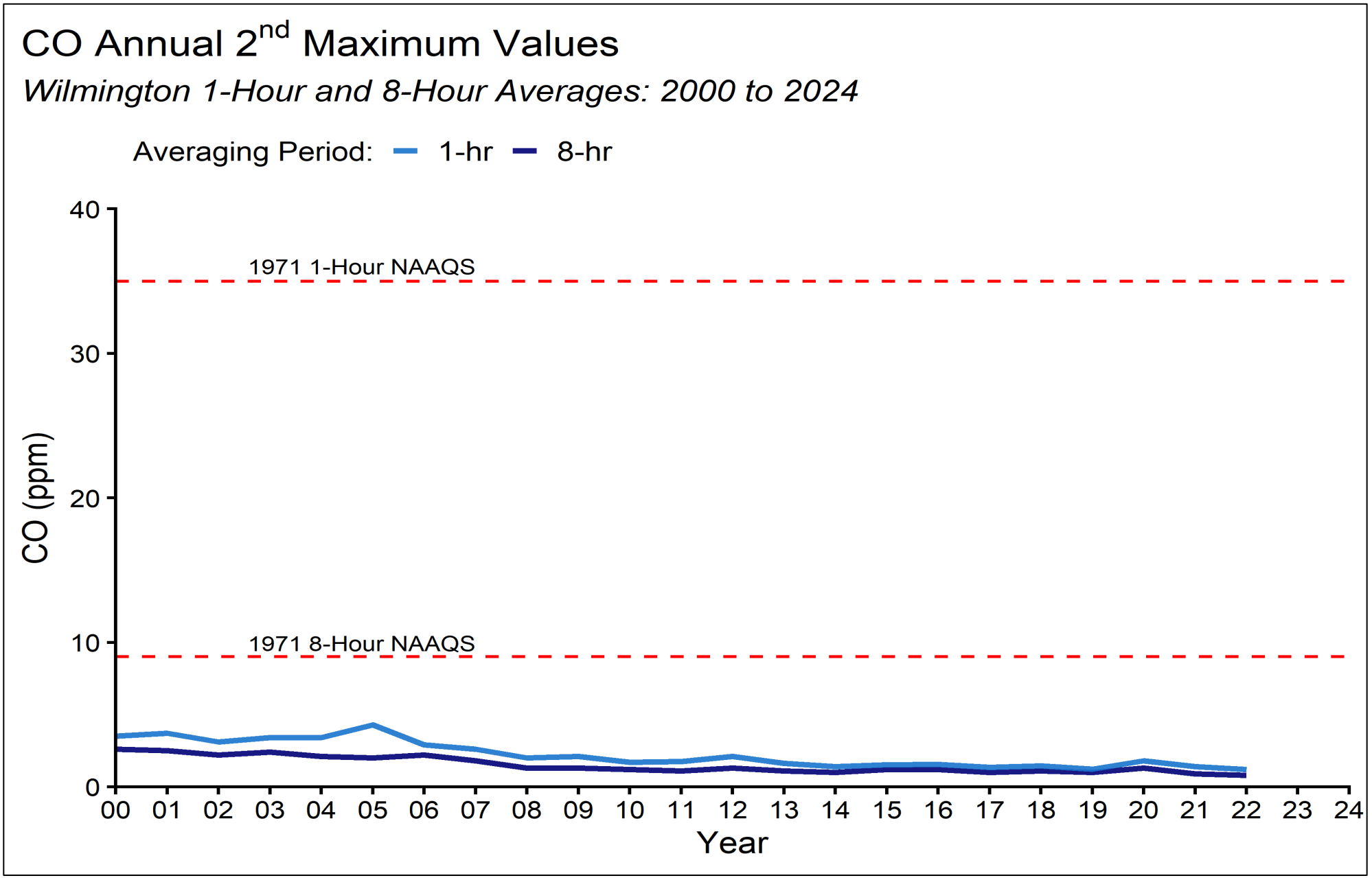


Figure 13. CO Design Value Trends - Primary 1-hour & 8-hour Averages

Table 6. CO Annual Maximum Values (ppm)

2022 Site[6]	8-Hour Avg. (primary) NAAQS = 9 ppm		1-Hour Avg. (secondary) NAAQS = 35 ppm	
	1st Max.	2nd Max.	1st Max.	2nd Max.
MLK NCore	0.9	0.8	1.2	1.1

Regional CO Levels

Figure 14[7] shows the CO annual 1st maximum 8-hour concentrations for New Castle County, Delaware compared to nearby monitored sites in neighboring states. Most CO monitors are located in urban areas. CO concentrations monitored in New Castle County are similar to those concentrations reported in nearby cities.

[6] These values are taken from 2022 data, due to lack of collected 2023 and 2024 data.

[7] The values for New Castle County are taken from 2022 data, due to lack of collected 2023 and 2024 data. The other values are taken from 2024 data.

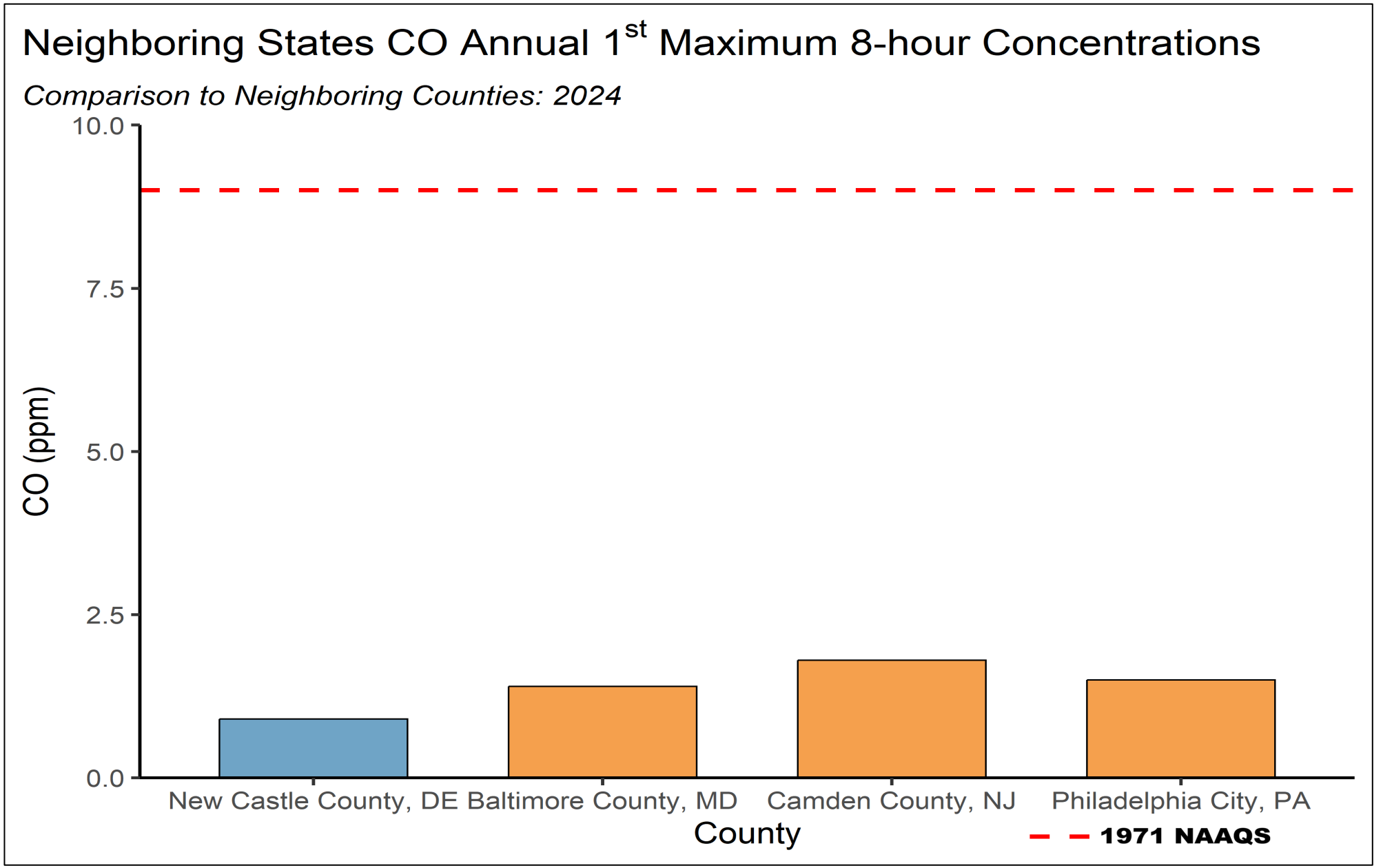


Figure 14. CO Compared to Nearby Monitored Sites

Nitrogen Dioxide (NO_2)

Description

Nitrogen dioxide a reddish-brown toxic gas that is part of a group of gases containing nitrogen and oxygen called NO_X. Nitrogen dioxide irritates the lungs and upper respiratory system and lowers resistance to respiratory infections. It can be fatal in high concentrations.

Nitrogen dioxide is also known to damage vegetation by stunting growth and reducing seed production. It acts to reduce visibility. Reactions between NO_2 and other compounds in the atmosphere can form nitric acid, which contributes to acid rain. Oxides of nitrogen can also have a significant impact on fine particulate matter concentrations, most notably in the western areas of the United States.

One of the most important features of NO_X is their ability to react with VOCs to form ozone. Air quality computer models have shown that control of NO_X is necessary in many areas of the United States to reach attainment of the ozone standard.

Atmospheric deposition of NO_X has recently been estimated to be a significant source of nitrogen to bodies of water such as the Chesapeake Bay and Delaware's Inland Bays. Nitrogen acts as a nutrient and contributes to excess nutrient loading and algal blooms in estuary systems.

Standards

Primary NAAQS:

- 1-hour average = 100 ppb (98^{th} percentile of 1-hour daily max. concentrations, averaged over 3 years)

Primary & Secondary NAAQS:

- Annual arithmetic mean = 53 ppb

The State standard is the same as the NAAQS.

Sources

Oxides of nitrogen are produced during high temperature burning of fuels. Sources of NO_X include motor vehicles and stationary sources that burn fossil fuels including power plants and industrial boilers.

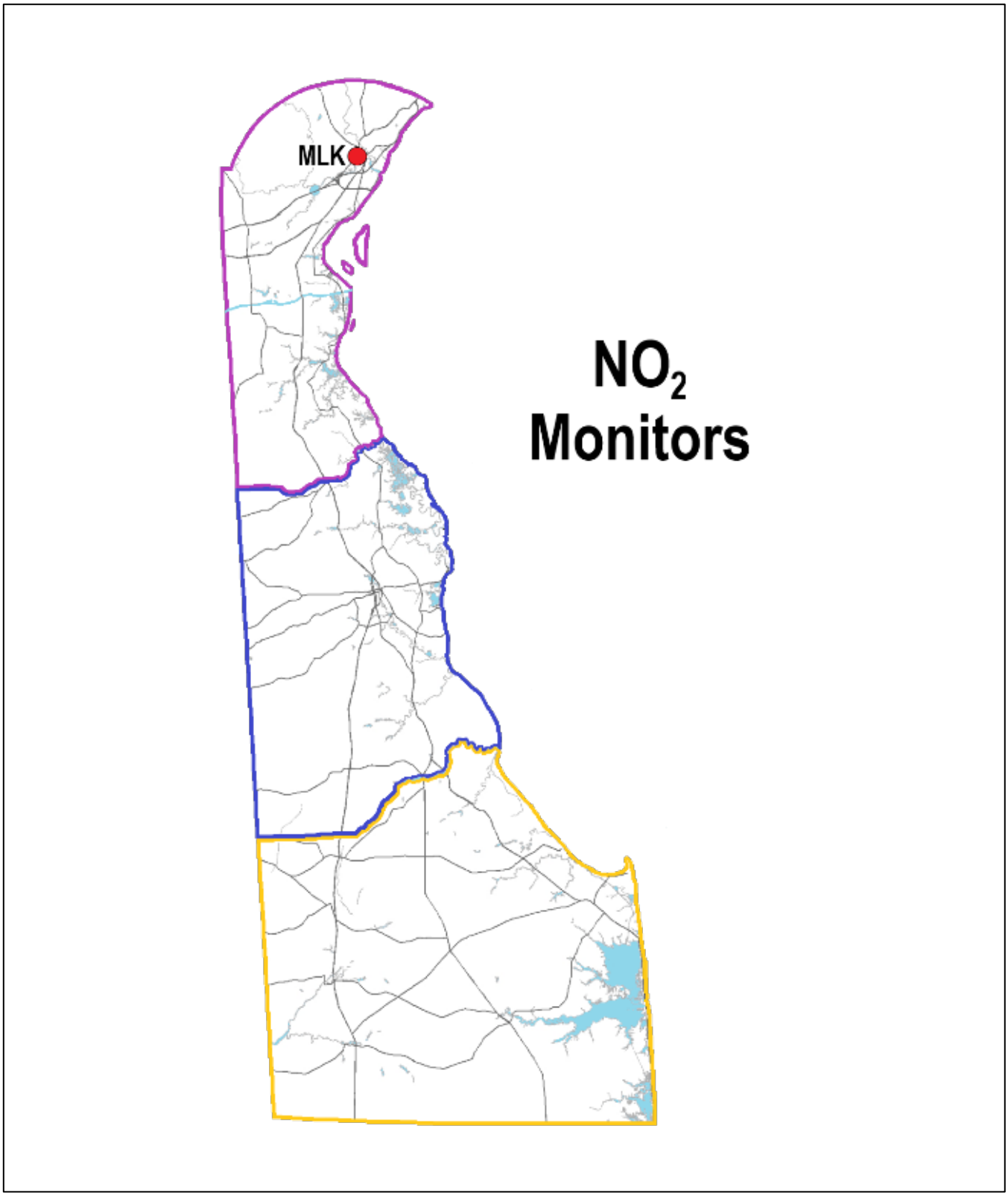


Figure 15. Map of Delaware NO_2 Monitors

Locations

Delaware monitors NO_2 at the Wilmington MLK NCore site (see Figure 15).

Delaware Air Quality and Trends

Nitrogen dioxide levels in Delaware have remained well below the NAAQS since monitoring began. In 2024, levels continued to remain well below the standard with a slight downward trend in the DV (see Table 7).

Table 7. NO_2 Design Value Trends (ppb)

Site	NO_2 Trends, Annual Mean & 98th Percentile of Daily Max 1-hour Avgs (ppb)										
MLK NCore	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual Average	13	12	12	11	10	10	9	9	9	9	9
98th Percentile	45	46	47	46	44	42	42	42	42	41	41

MLK NCore Criteria Gas Analyzers

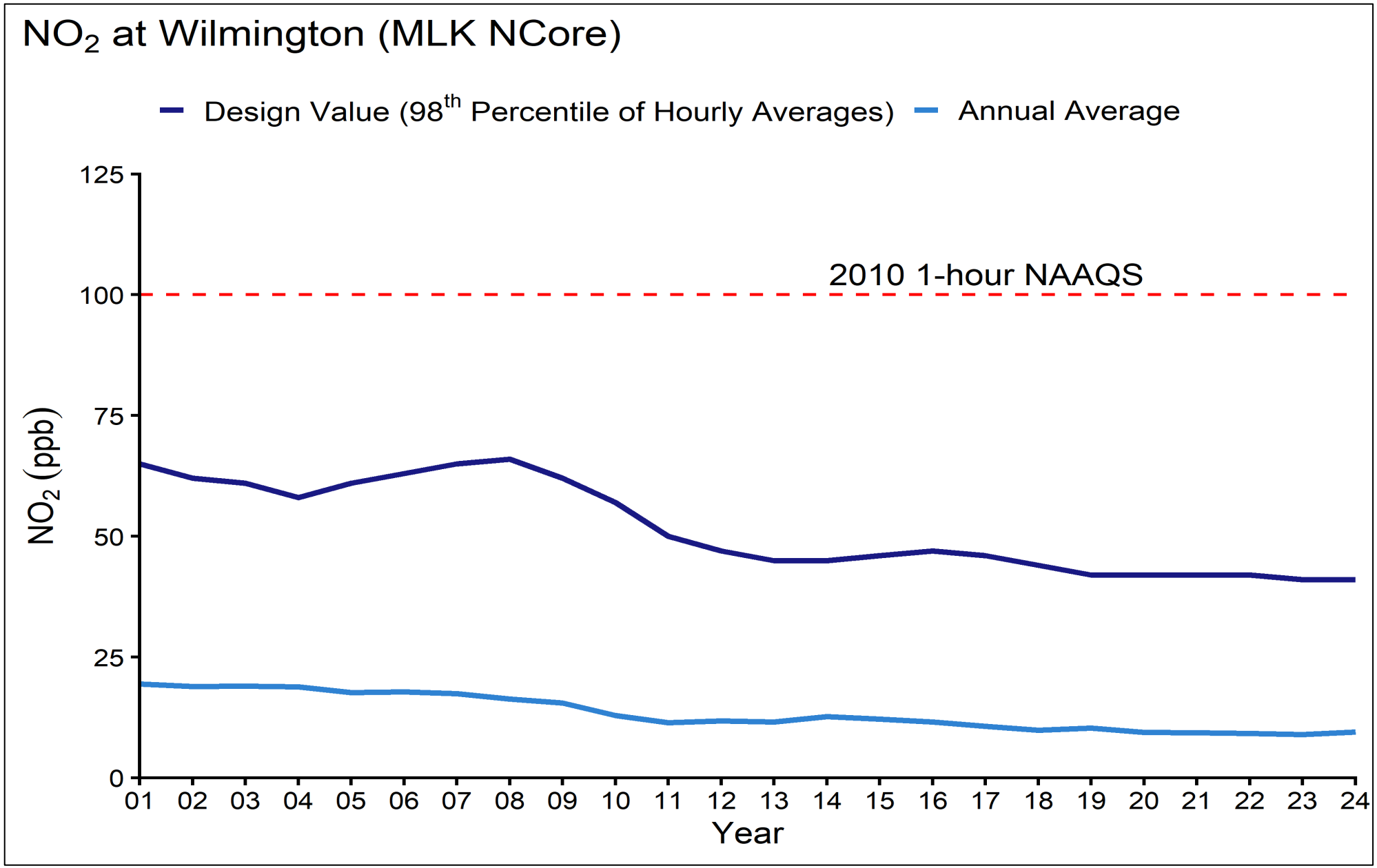


Figure 16. NO_2 Design Value Trends – Primary 1-hour & Annual Averages

Regional NO_2 Levels

Figure 17 shows the NO_2 annual 98th percentile 1-hour concentrations for New Castle County, Delaware compared to nearby monitored sites in neighboring states. Most NO_2 monitors are located in urban areas. NO_2 concentrations monitored in Delaware are similar to or lower than those in nearby monitored areas.

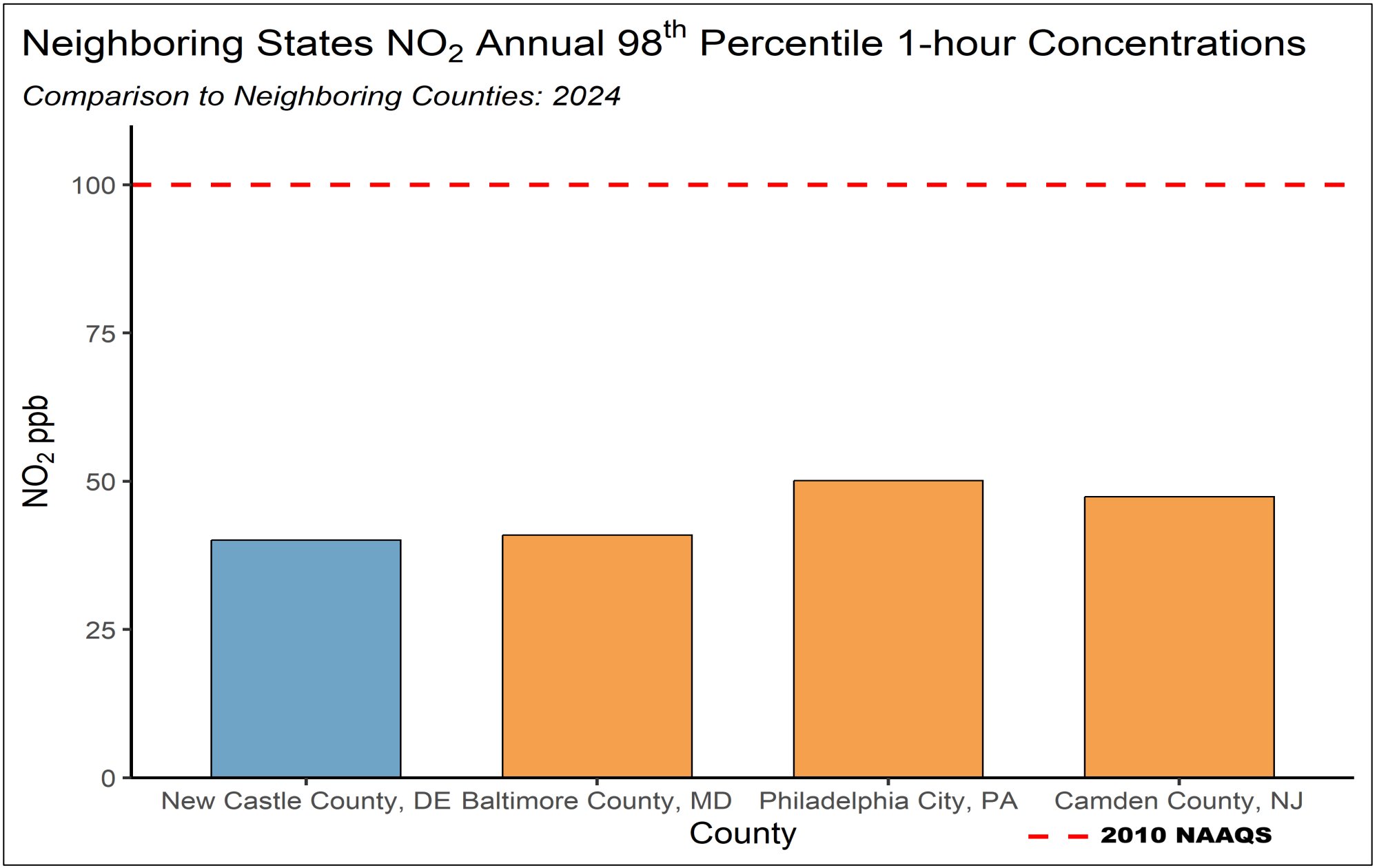


Figure 17. NO_2 Compared to Nearby Monitored Sites

Particulate Matter (PM_{10})

Description

PM_{10} is the fraction of total suspended particulate matter (TSP) that is less than 10 microns in diameter, which is about 1/7 the diameter of a human hair (see Figure 21). Particles of this size are small enough to be inhaled into the lungs. Particulate matter can include solid or liquid droplets that remain suspended in the air for various lengths of time.

Particulates small enough to be inhaled can carry other pollutants and toxic chemicals into the lungs while larger particulates can cause coughing and throat irritation. Major effects of PM_{10} listed by EPA include aggravation of existing respiratory and cardiovascular disease, alterations in immune responses in the lung, damage to lung tissue, carcinogenesis, and premature mortality.

The most sensitive populations are those with chronic obstructive pulmonary or cardiovascular disease, asthmatics, the elderly, and children. Particulates are also a major cause of reduced visibility and can be involved in corrosion of metals (acidic dry deposition).

Standards

Primary NAAQS:

- 24-Hour maximum = 150 $\mu g/m^3$ (Not to be exceeded more than once per year averaged over three years)

The State standard is the same as the NAAQS for PM_{10}.

Delaware also retains TSP standards.

Primary State Standard:

- Annual Average = 75 $\mu g/m^3$
- 24-Hour maximum = 260 $\mu g/m^3$

Secondary State Standard:

- Annual Average = 60 $\mu g/m^3$
- 24-Hour maximum = 150 $\mu g/m^3$

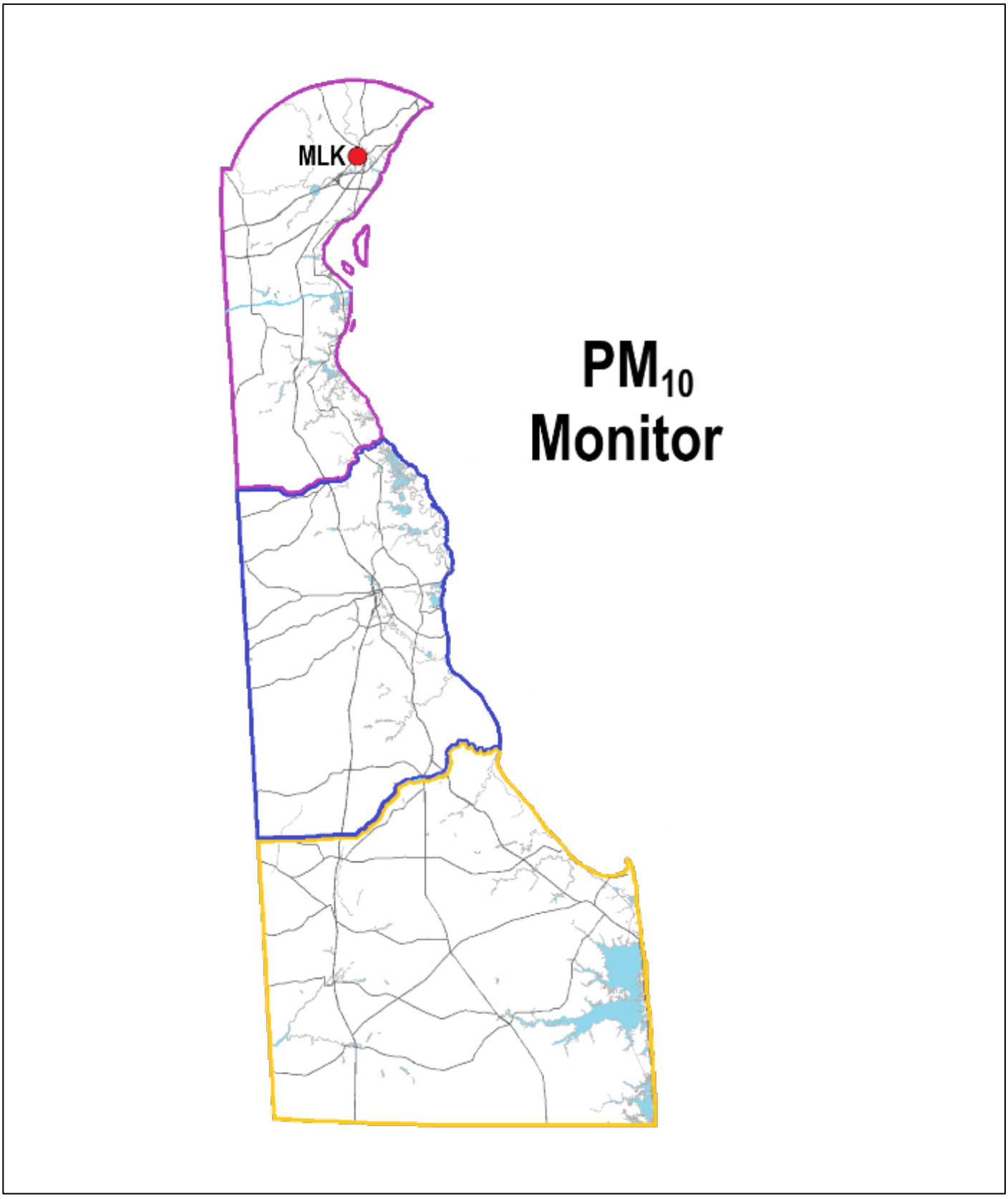


Figure 18. Map of Delaware PM_{10} Monitors

EPA rules do not currently require PM_{10} to be monitored in Delaware, except at the MLK NCore site in Wilmington, where it is only used to determine PM_{coarse}, the concentration of particulate matter between 2.5 and 10 microns (the difference between PM_{10} and $PM_{2.5}$). Delaware measurements of PM_{10} are not compared to the NAAQS for regulatory purposes.

Sources

Major sources of PM_{10} include power plants, motor vehicles, industrial plants, unpaved roads, and agricultural activities. The wide variety of PM_{10} sources means that the chemical and physical composition of the particles is highly variable.

Locations

PM_{10} is currently monitored at the urban Wilmington MLK NCore site (see Figure 18).

Delaware Air Quality and Trends

Delaware would be in attainment with the PM_{10} NAAQS if EPA required the comparison to be made. The data shown in Figure 19 and Table 8 are only from approved federal reference method (FRM) filter-based discrete sampling methods and are presented here for informational purposes only.

Particulate Monitoring at MLK NCore

The significant increase for 2023 was due to wildfire smoke from Canada.
The PM_{10} instrument was not operating in 2010.

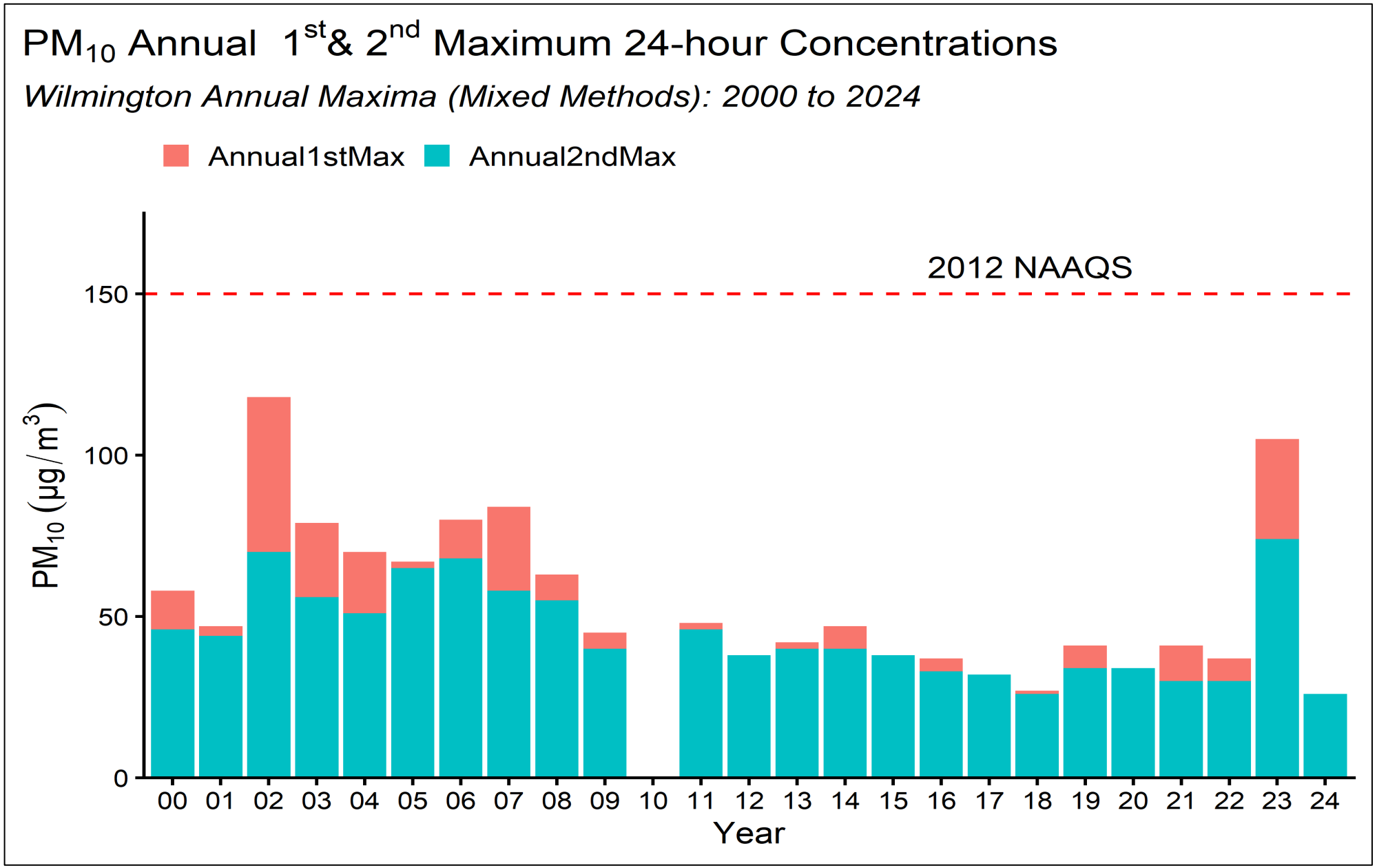


Figure 19. PM_{10} Trends – Annual 1st & 2nd Highest 24-hour Concentrations

Table 8. PM_{10} Trends: Annual Average ($\mu g/m^3$)

Site[8]	Annual Arithmetic Mean ($\mu g/m^3$)										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
MLK NCore	17.0	17.1	14.2	14.0	12.7	14.3	13.1	14.0	12.8	16.0	12.4

Regional PM_{10} Levels

Figure 20 shows the PM_{10} annual 1st maximum daily concentrations for New Castle County, Delaware compared to nearby monitored sites in neighboring states. PM_{10} peak daily concentrations in Delaware have been similar to those in nearby areas, yet it remains the lowest for 2024.

[8] EPA has back-calculated PM DV based on a correction algorithm for T640 and T640x analyzers that has resulted in different values compared to prior publications.

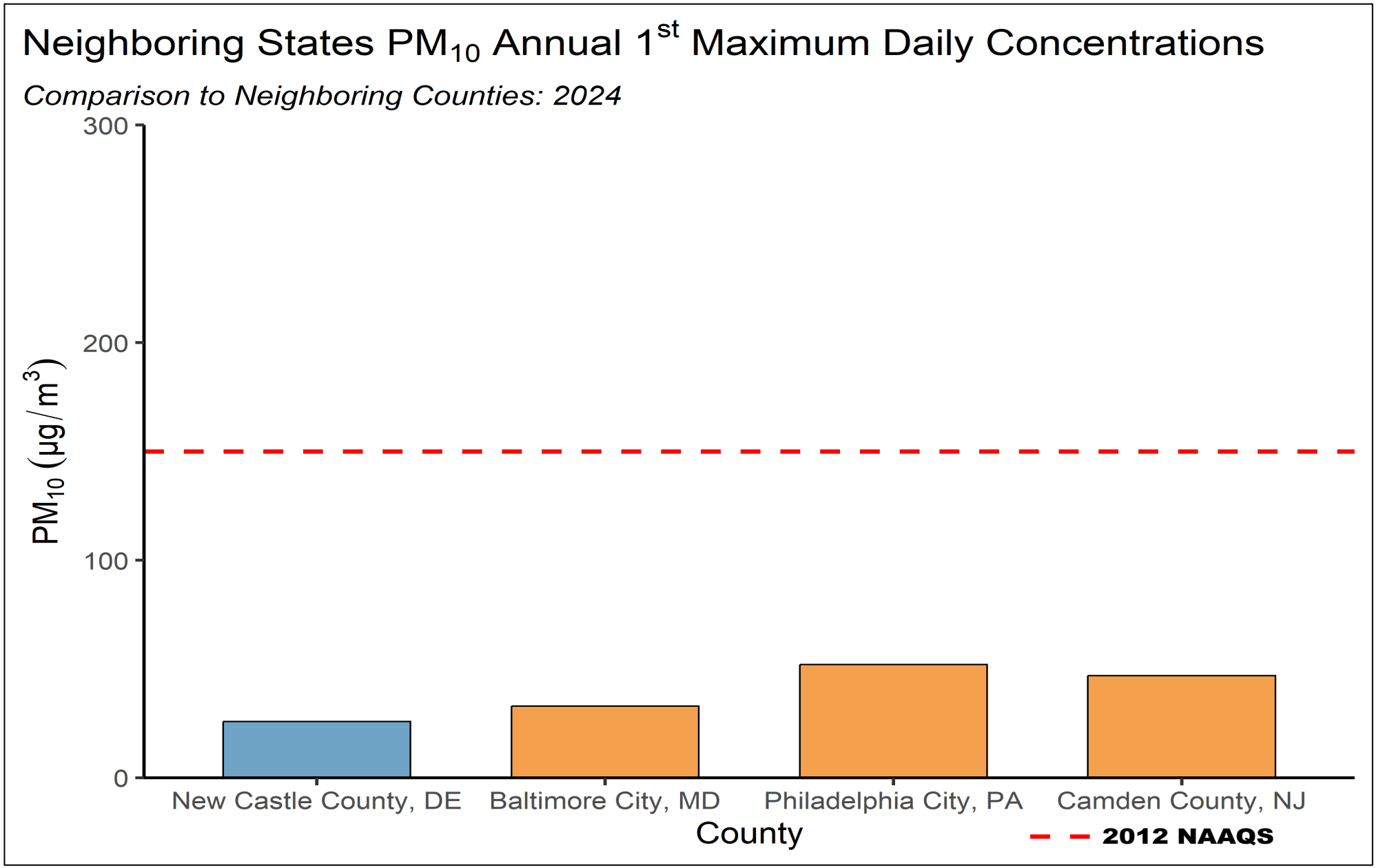


Figure 20. PM_{10} Compared to Nearby Monitored Sites

Particulate Matter – Fine ($PM_{2.5}$)

Description

Fine particulate matter is made up of particles smaller than 2.5 microns in diameter. These fine particles, also called $PM_{2.5}$, penetrate more deeply into the lungs than coarse particles (2.5-10.0 microns) and are more likely to contribute to health effects.

Health effects of concern associated with $PM_{2.5}$ pollution demonstrated in recent community studies include premature death and increased hospital admissions and emergency room visits, primarily by the elderly and individuals with cardiopulmonary disease, increased respiratory symptoms and disease in children and individuals with cardiopulmonary disease, and decreased lung function and alterations in lung tissue and structure, particularly in children and people with asthma. Figure 21 illustrates a comparison of the different size classes of particulate matter compared to a human hair and beach sand.

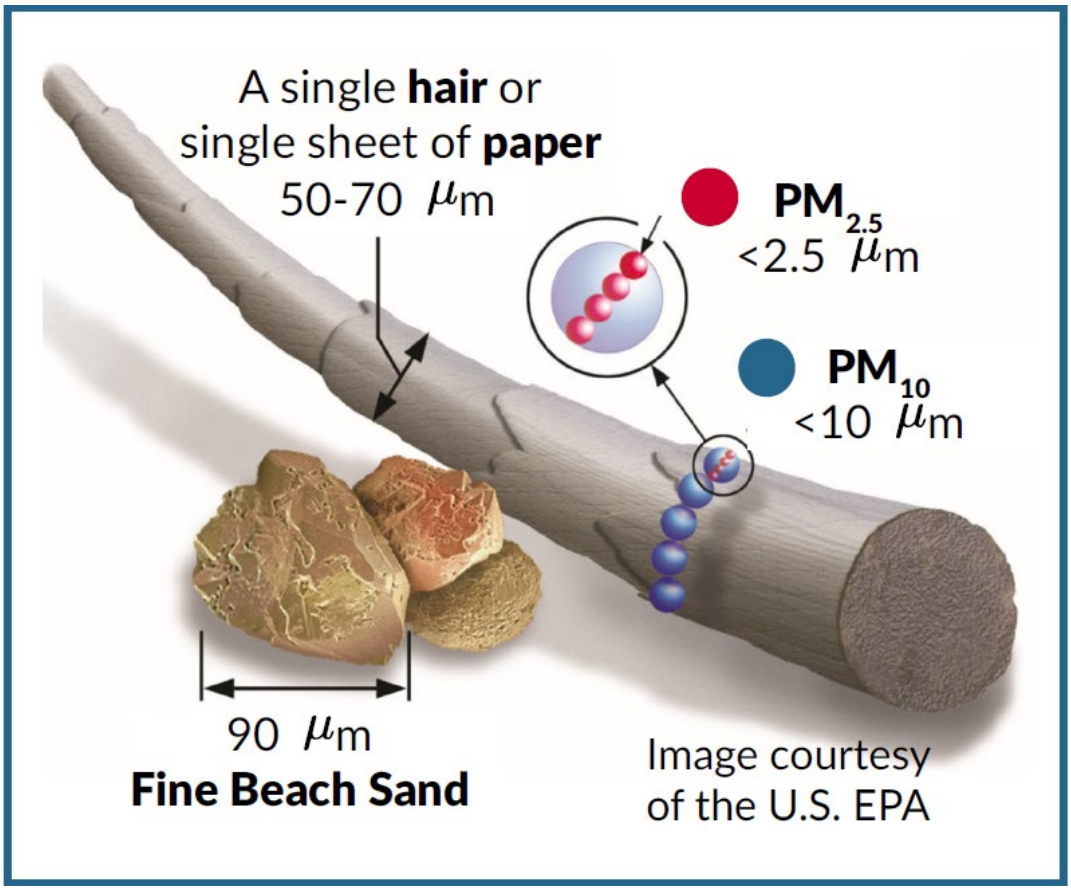


Figure 21. Particulate Matter Size Comparison

Standards

Primary NAAQS:

- Annual arithmetic mean[9] = 9.0 µg/m^3 (Averaged over three years)
- 24-Hour maximum = 35 µg/m^3 (98^{th} percentile of daily maximum 1-hour average concentrations, averaged over three years)

Secondary NAAQS:

- Annual arithmetic mean = 15.0 µg/m^3 (Averaged over three years)
- 24-Hour maximum = 35 µg/m^3 (98^{th} percentile of daily maximum 1-hour average concentrations, averaged over three years)

State Standard:
Primary NAAQS:

- Annual arithmetic mean = 12.0 µg/m^3 (Averaged over three years)
- 24-Hour maximum = 35 µg/m^3 (98^{th} percentile of daily maximum 1-hour average concentrations, averaged over three years)

Secondary NAAQS:

- Annual arithmetic mean = 15.0 µg/m^3 (Averaged over three years)
- 24-Hour maximum = 35 µg/m^3 (98^{th} percentile of daily maximum 1-hour average concentrations, averaged over three years)

Sources

Fine particles are generally emitted from combustion activities (such as industrial and residential fuel burning and motor vehicles) while coarse particles come from dust emitted during activities such as construction and agricultural tilling. Fine particles can also form in the atmosphere from precursor compounds (substances that are the source of another substance), such as SO_2 and NO_X, through various physical and chemical processes.

Locations

Monitors are located throughout Delaware, with most monitors in New Castle County where the highest concentrations occur (see Figure 22).

[9] On February 7, 2024, the EPA strengthened the primary NAAQS for $PM_{2.5}$ from the 2013 NAAQS of 12.0 µg/m^3 averaged over three years to 9.0 µg/m^3 averaged over three years.

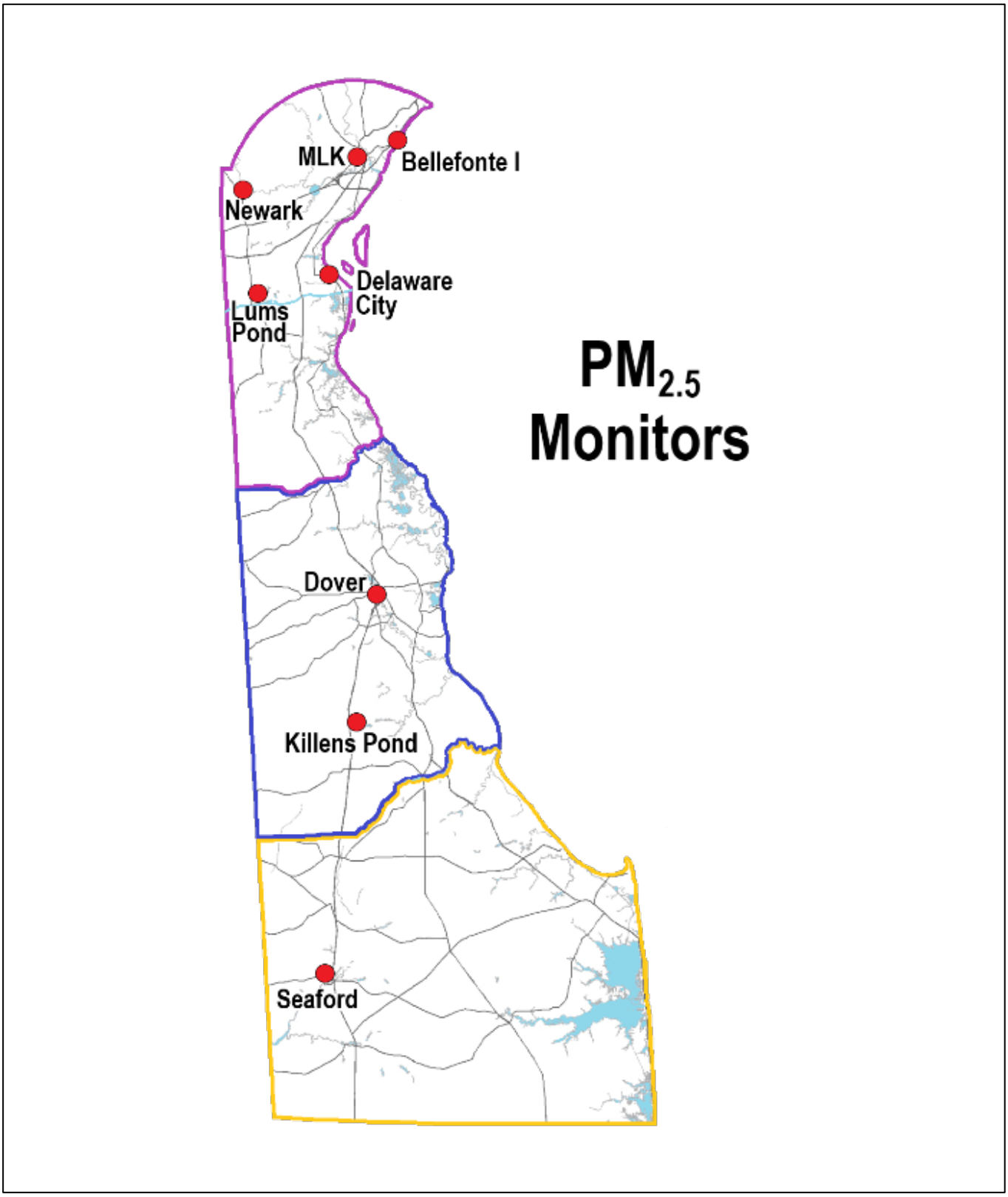


Figure 22. Map of Delaware $PM_{2.5}$ Monitors

Delaware Air Quality and Trends

Delaware's monitoring network began collecting $PM_{2.5}$ data in January 1999. Three years of complete data are required for comparison to the national standard. Both local and regional sources of fine particulate matter and its precursors contribute to concentrations seen in Delaware.

Bellefonte I Monitoring Platform

In recent years, the state has improved its ability to track $PM_{2.5}$ by shifting from filter-based FRM samples to continuous federal equivalent method (FEM) monitors. This transition, supported by the EPA and funded in part through the American Rescue Plan Grant, enhances how Delaware identifies and evaluates changes in fine particulate matter throughout the day.

Delaware selected the Teledyne T640 and T640X light-scattering continuous monitors as its primary $PM_{2.5}$ instruments because they provide real time measurements rather than once every three days filter results. Continuous monitors capture hourly changes caused by local emissions, meteorological conditions, and regional transport. This process allows a more detailed understanding of short-term air quality fluctuations. Since 2019, all monitoring sites except MLK have transitioned to the T640 as their primary monitor with FRM instruments now serving as secondary monitors.

The expanded use of continuous monitoring strengthens Delaware's ability to interpret $PM_{2.5}$ trends and supports more accurate public communication. Real time data help confirm when observed concentrations reflect typical seasonal patterns versus transient events, and they improve the reliability of daily forecasts and long-term assessments. This broader monitoring capability ensures that $PM_{2.5}$ trends reported for Delaware reflect both multi-year averages and day-to-day variation that can influence public exposure and regulatory analysis.

Annual Average

In 2000, New Castle County was originally designated for non-attainment for $PM_{2.5}$ based on the 1997 annual NAAQS. $PM_{2.5}$ has since followed a downward trend for all Delaware counties and has maintained attainment with each year's standard since 2006.

Figure 23 shows $PM_{2.5}$ 3-year average of annual average DV for each site from 2000-2024. The highest site for the most recent 3-year average period (2022-2024) was Newark (7.7 µg/m^3) in New Castle County. Aside from 2023, which was influenced by wildfire smoke from outside the state, there is a downward trend showing continued air quality improvement across all sites.

Significant correlation persists among all monitoring sites in Delaware. In other words, if high concentrations of $PM_{2.5}$ are recorded at one site, all other sites in Delaware usually record high concentrations on that same day, except for local events such as some farming activities.

Killens Pond Monitoring Site

24-hour Average

The current 98th percentile 24-hour average $PM_{2.5}$ standard of 35 µg/m^3 was met at all monitoring sites in Delaware for the 2022-2024 DV period. Figure 23 shows the 98th percentile 24-hour average $PM_{2.5}$ DV for each site from 2000-2024. The highest for the most recent 3-year average period (2022-2024) was 22 µg/m^3, at Killens Pond (Kent County) site. Aside from 2023, due to the wildfire smoke, there is a downward trend showing continued air quality improvement across all sites. Since the 2023 event the DV have either dropped or remained the same.

Like the annual average data, there is significant correlation between 24 hour concentrations measured at all sites throughout Delaware. 98th percentile of 24-hour averages DV for all sites in Delaware have remained below the applicable $PM_{2.5}$ annual average standard every year since 2009.

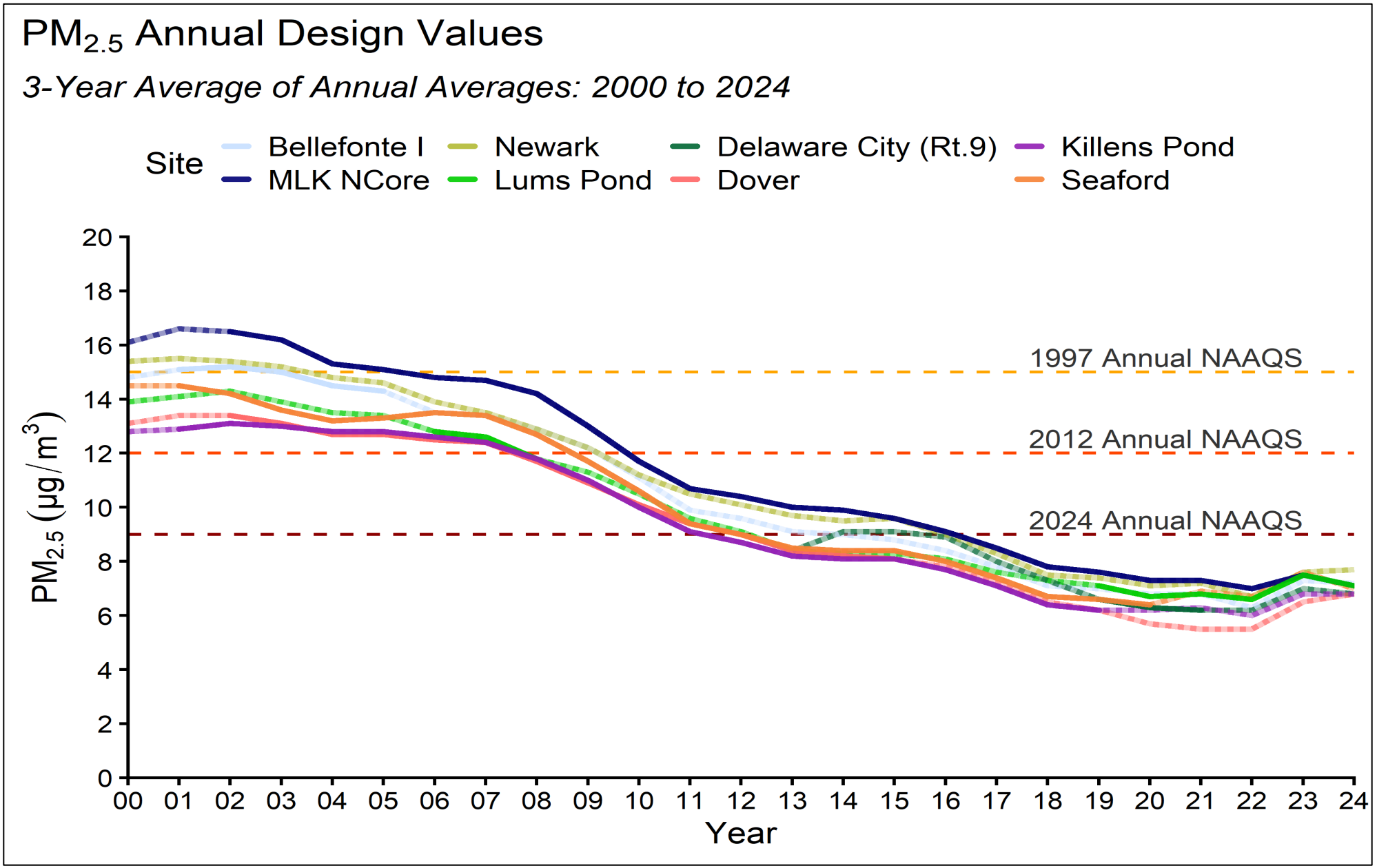


Figure 23. $PM_{2.5}$ Design Value Trends – Primary Annual Averages

Table 9. $PM_{2.5}$ 3-year Design Value Trends per Site: Annual Mean ($\mu g/m^3$)

Sites (listed North to South)	3-year Design Values: Annual Arithmetic Mean (NAAQS = 9.0 $\mu g/m^3$)										
	2012 to 2014	2013 to 2015	2014 to 2016	2015 to 2017	2016 to 2018	2017 to 2019	2018 to 2020	2019 to 2021	2020 to 2022	2021 to 2023	2022 to 2024
Bellefonte I	9.0	8.8	8.4	7.8	7.1	7.0	6.8	6.8	6.3	7.3	7.2
MLK NCore	9.9	9.6	9.1	8.5	7.8	7.6	7.3	7.3	7.0	7.5	7.1
Newark	9.5	9.6	9.0	8.3	7.5	7.4	7.1	7.2	6.7	7.6	7.7
Delaware City	9.1	9.1	8.9	8.0	7.3	6.6	6.3	6.2	6.2	7.0	6.8
Lums Pond	8.3	8.3	8.1	7.6	7.3	7.1	6.7	6.8	6.6	7.5	7.1
Dover	8.2	8.1	7.8	7.2	6.5	6.2	5.7	5.5	5.5	6.5	6.8
Killens Pond	8.1	8.1	7.7	7.1	6.4	6.2	6.2	6.3	6.0	6.8	6.8
Seaford	8.4	8.4	8.0	7.4	6.7	6.6	6.4	6.9	6.7	7.6	7.0

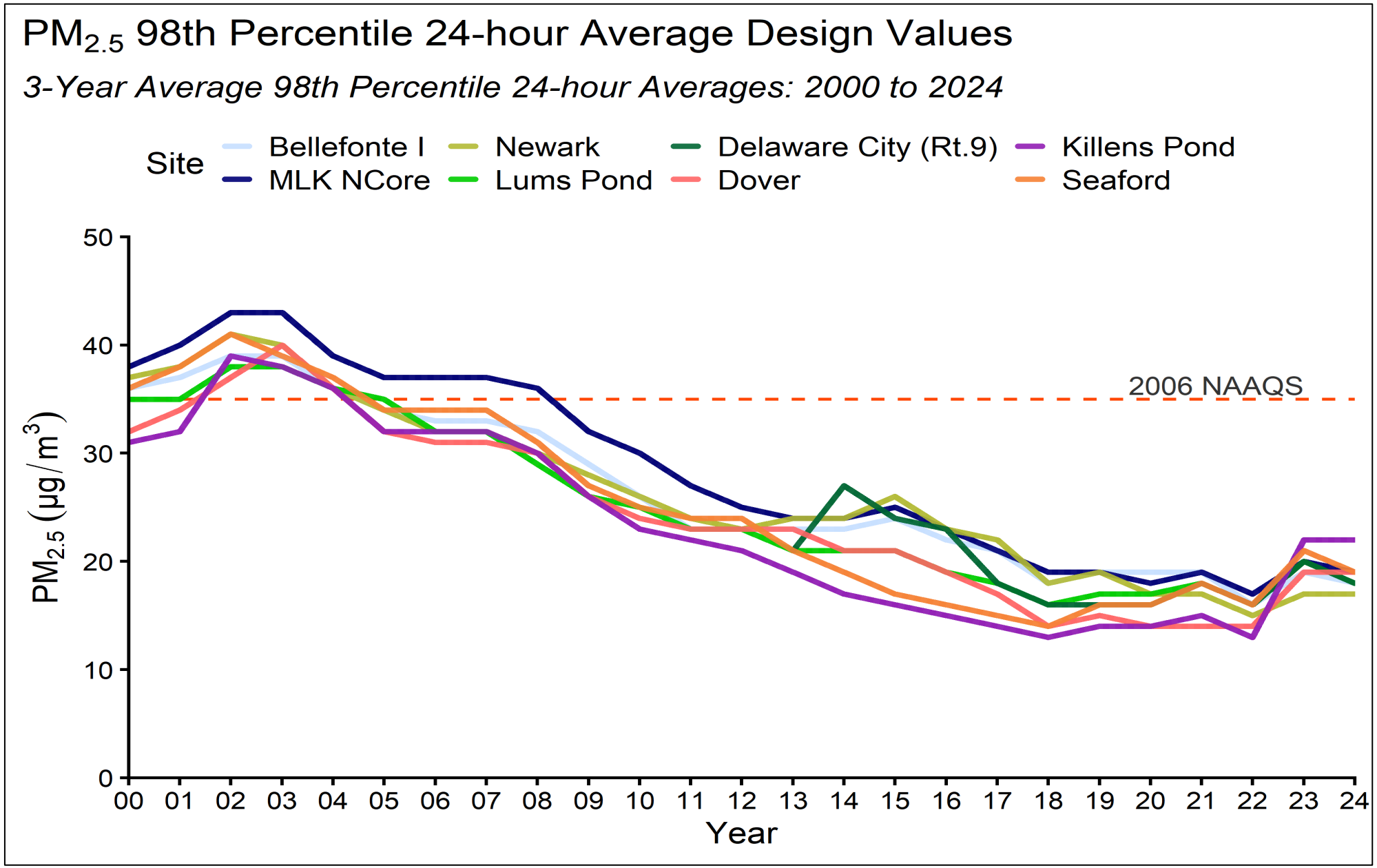


Figure 24. $PM_{2.5}$ Design Value Trends – Primary 24-hour Averages

Table 10. $PM_{2.5}$ 3-year Design Value Trends per Site: 98th Percentile of Daily (µg/m^3)

Sites (listed North to South)[10]	3-year Design Values: 98th Percentile of Daily Averages (NAAQS = 35 µg/m^3)										
	2012 to 2014	2013 to 2015	2014 to 2016	2015 to 2017	2016 to 2018	2017 to 2019	2018 to 2020	2019 to 2021	2020 to 2022	2021 to 2023	2022 to 2024
Bellefonte I	23	24	22	21	18	19	19	19	16	19	18
MLK NCore	24	25	23	21	19	19	18	19	17	20	19
Newark	27	24	23	18	16	16	16	18	16	20	18
Delaware City	24	26	23	22	18	19	17	17	15	17	17
Lums Pond	21	21	19	18	16	17	17	18	16	20	18
Dover	21	21	19	17	14	15	14	14	14	19	19
Killens Pond	17	16	15	14	13	14	14	15	13	22	22
Seaford	19	17	16	15	14	16	16	18	16	21	19

[10] EPA has back-calculated PM DV based on a correction algorithm for T640 and T640x analyzers that has resulted in different values compared to prior publications.

Regional $PM_{2.5}$ Levels

Figure 25 shows the $PM_{2.5}$ annual arithmetic mean concentrations for New Castle County, Delaware compared to nearby monitored sites in neighboring states. These are not DV, which are computed as a 3-year average. Only data from 2024 is included here.

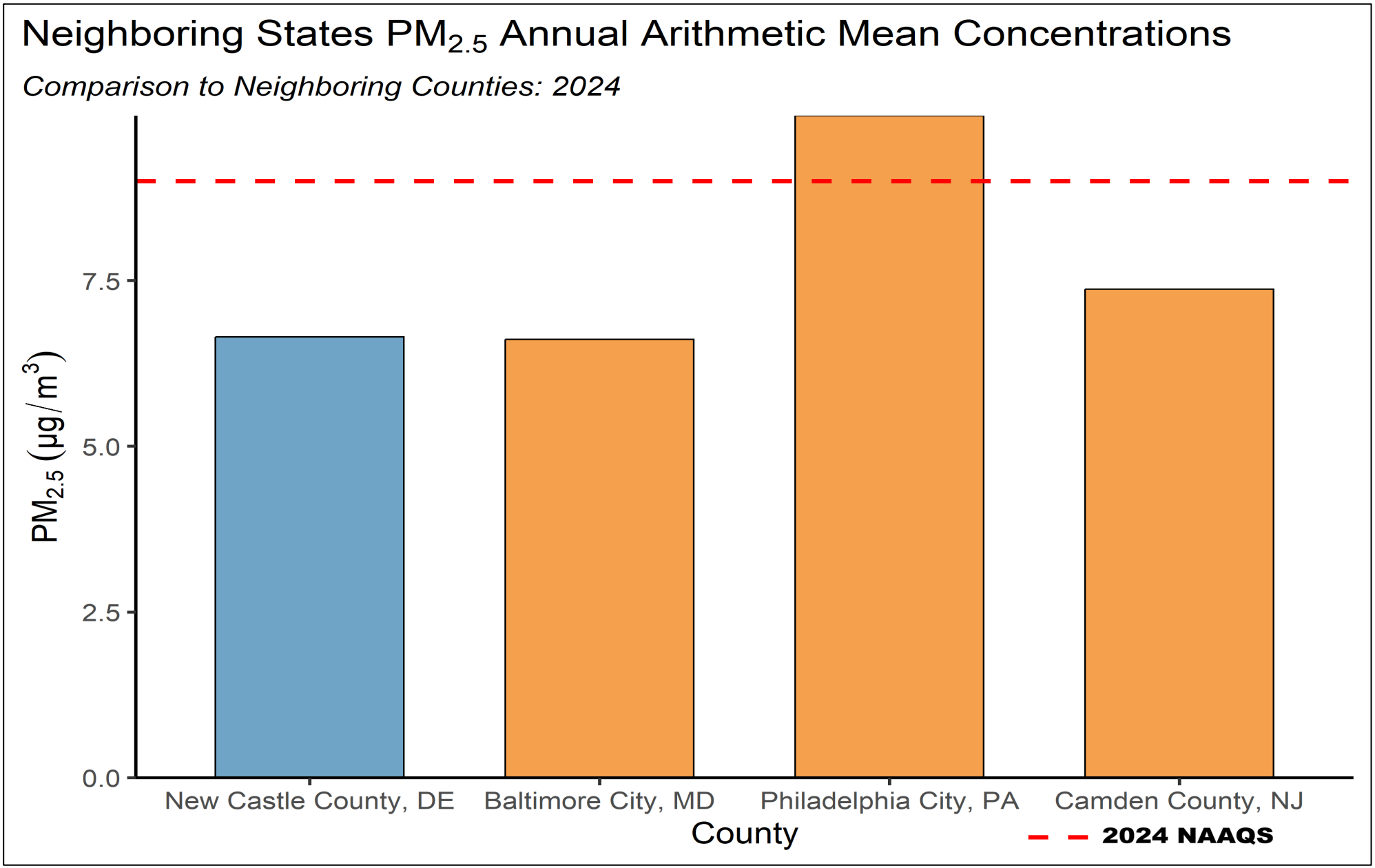


Figure 25. $PM_{2.5}$ Annual Arithmetic Mean Concentrations Compared to Nearby Monitored Sites

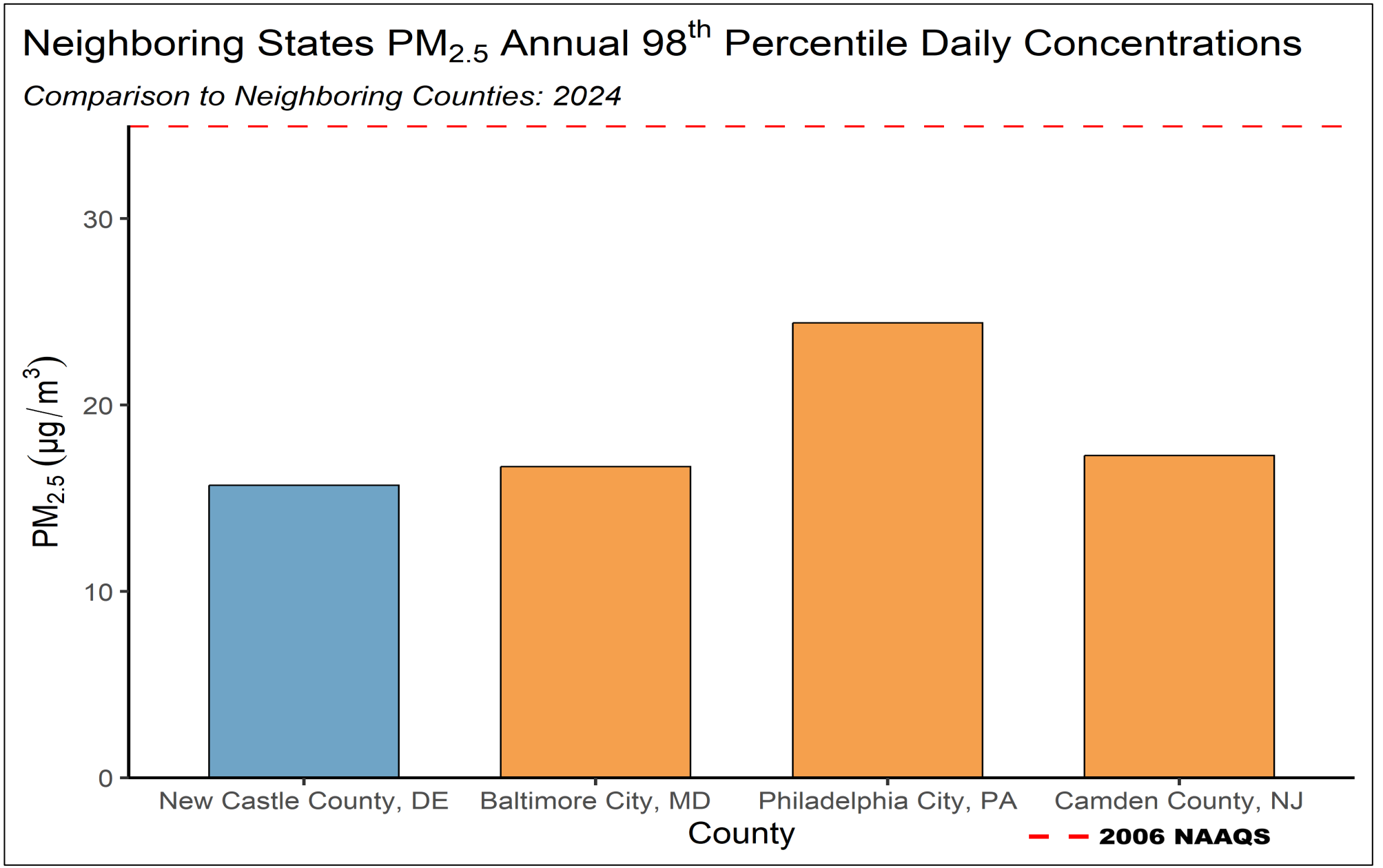


Figure 26. $PM_{2.5}$ Annual 98th Percentile Compared to Nearby Monitored Sites

$PM_{2.5}$ Speciation

To understand the nature of fine particle pollution and possible sources, EPA initiated a program to monitor the major components, or “species”, that make up $PM_{2.5}$. The main objectives of the $PM_{2.5}$ speciation monitoring program are to provide additional information to characterize the annual and spatial aspects of $PM_{2.5}$, detect and track trends in aerosol component concentrations, and provide information to develop and evaluate emission control programs.

The $PM_{2.5}$ speciation program in Delaware consists of monitors at one site: MLK NCore (Wilmington, Delaware). Samples are collected on filters for 24 hours every third day. The filters are sent to a contract laboratory for chemical analyses. The target species are ions (sulfate, nitrate, ammonium, sodium, and potassium), trace elements/metals, and carbon (elemental and organic). There are no ambient air quality standards for the chemical components of $PM_{2.5}$, but understanding the components of this pollutant is important. This analysis is essential to the reduction of regional haze, which tracks visibility at national parks and wilderness areas, and to understanding regional differences in PM exposure and PM measurements using continuous instruments.

Trends for most major components of $PM_{2.5}$ are declining. Organic and elemental carbon show significant decrease from 2023. Soil dust remains stable for 2024 (see Figure 27).

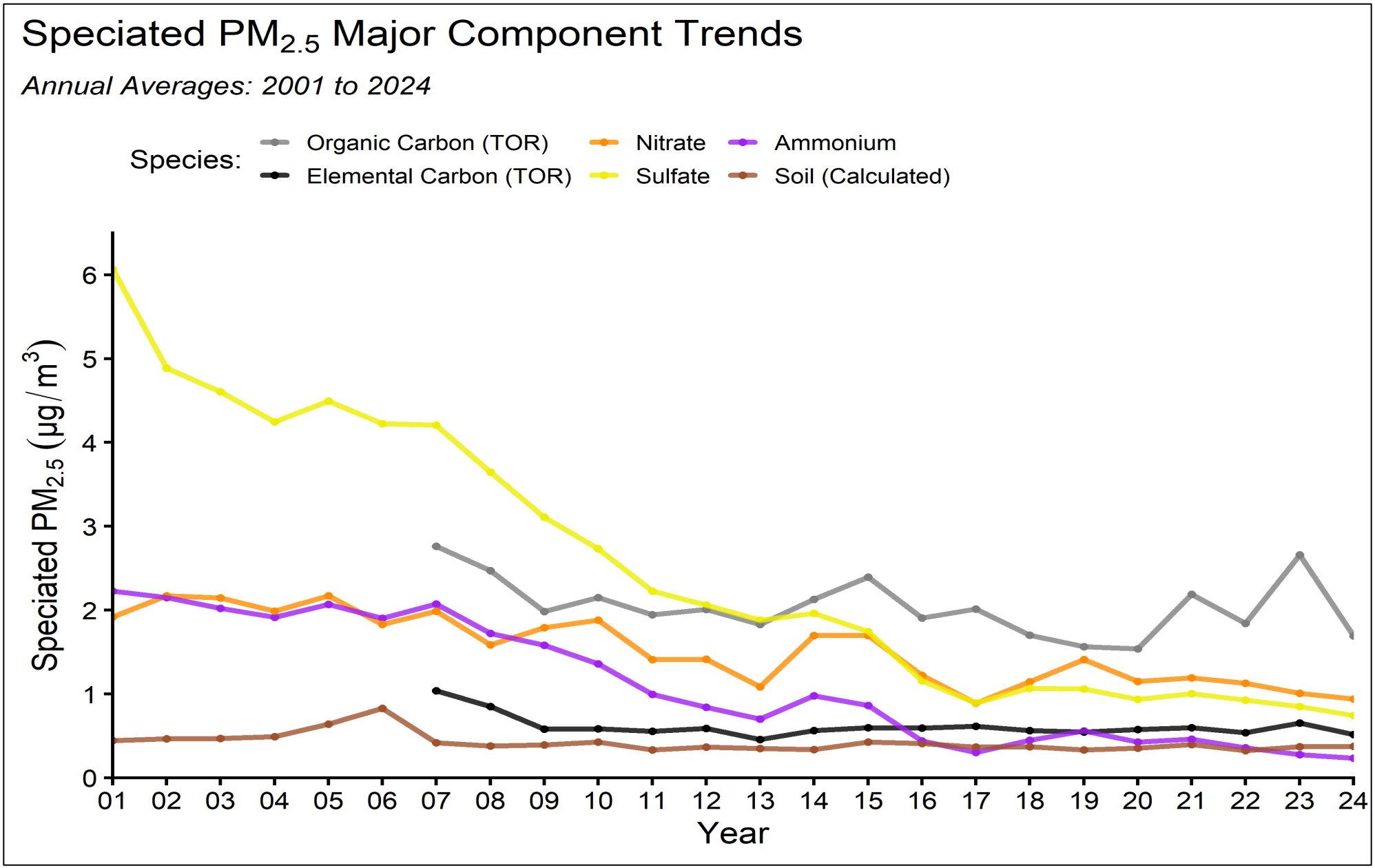


Figure 27. Annual Average Trends for Some of the Target $PM_{2.5}$ Species

Sulfur Dioxide (SO_2)

Description

Sulfur dioxide is a pungent, poisonous gas. It is an irritant that can interfere with normal breathing functions even at low levels. It aggravates respiratory diseases such as asthma, emphysema, and bronchitis. These effects can be magnified by high particulate levels. High SO_2 levels can obstruct breathing passages and cause increased death rates among people with existing heart and lung disease.

SO_2 can bind to dust particles and aerosols in the atmosphere, traveling long distances on the prevailing winds. It can also be combined with water vapor to form sulfuric acid and fall as acid rain, damaging materials and harming aquatic life. Sulfur compounds contribute to visibility degradation in many areas including national parks. Sulfur dioxide in the atmosphere can also cause plant chlorosis (loss of green color) and stunted growth.

Standards

Primary NAAQS:

- 1-hour average = 75 ppb (99th percentile of 1-hour daily max. concentrations, averaged over 3 years)

New Secondary NAAQS:

- Annual average[11] = 10 ppb (Averaged over 3 years)

State Standard:
Primary Standard:

- 1-hour average = 75 ppb (99th percentile of 1-hour daily max. concentrations, averaged over 3 years)

Secondary Standard:

- 3-hour average = 0.5 ppm (Not to be exceeded more than once per year)

[11] On December 11th, 2024, the EPA strengthened the secondary NAAQS for SO_2 from the 2010 NAAQS of the 3-hour average of 0.5 ppm to an annual mean, averaged over 3 years of 10 ppb.

Sources

The largest source of SO_2 in the atmosphere is the burning of fossil fuels by power plants and other industrial facilities. Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore; natural sources such as volcanoes; and locomotives, ships, other vehicles & heavy equipment that burn fuel with a high sulfur content.

From 1995-2023, annual emissions of SO_2 from power plants fell by 95 percent and annual emissions of NO_x from power plants fell by 89 percent. Since 2016, Delaware has required the use of ultra-low sulfur diesel fuel, which is distillate fuel containing less than 15 ppm sulfur by weight.

The NAAQS for SO_2 are designed to protect against exposure to the entire group of sulfur oxides (SO_x). SO_2 is the component of greatest concern and is used as the indicator for the larger group of gaseous SO_x. Other gaseous SO_x (such as SO_3) are found in the atmosphere at concentrations much lower than SO_2.

Control measures that reduce SO_2 can generally be expected to reduce people's exposures to all gaseous SO_x. This may have the important co-benefit of reducing the formation of particulate sulfur pollutants, such as fine sulfate particles.

Locations

Delaware's SO_2 monitors are located at the MLK NCore, Bellefonte II, Lums Pond, and Delaware City sites in New Castle County (see Figure 28). Due to resource restrictions, there was no monitoring at the Lums Pond site in 2009. Monitoring in Sussex County began at the Lewes site in 2012.

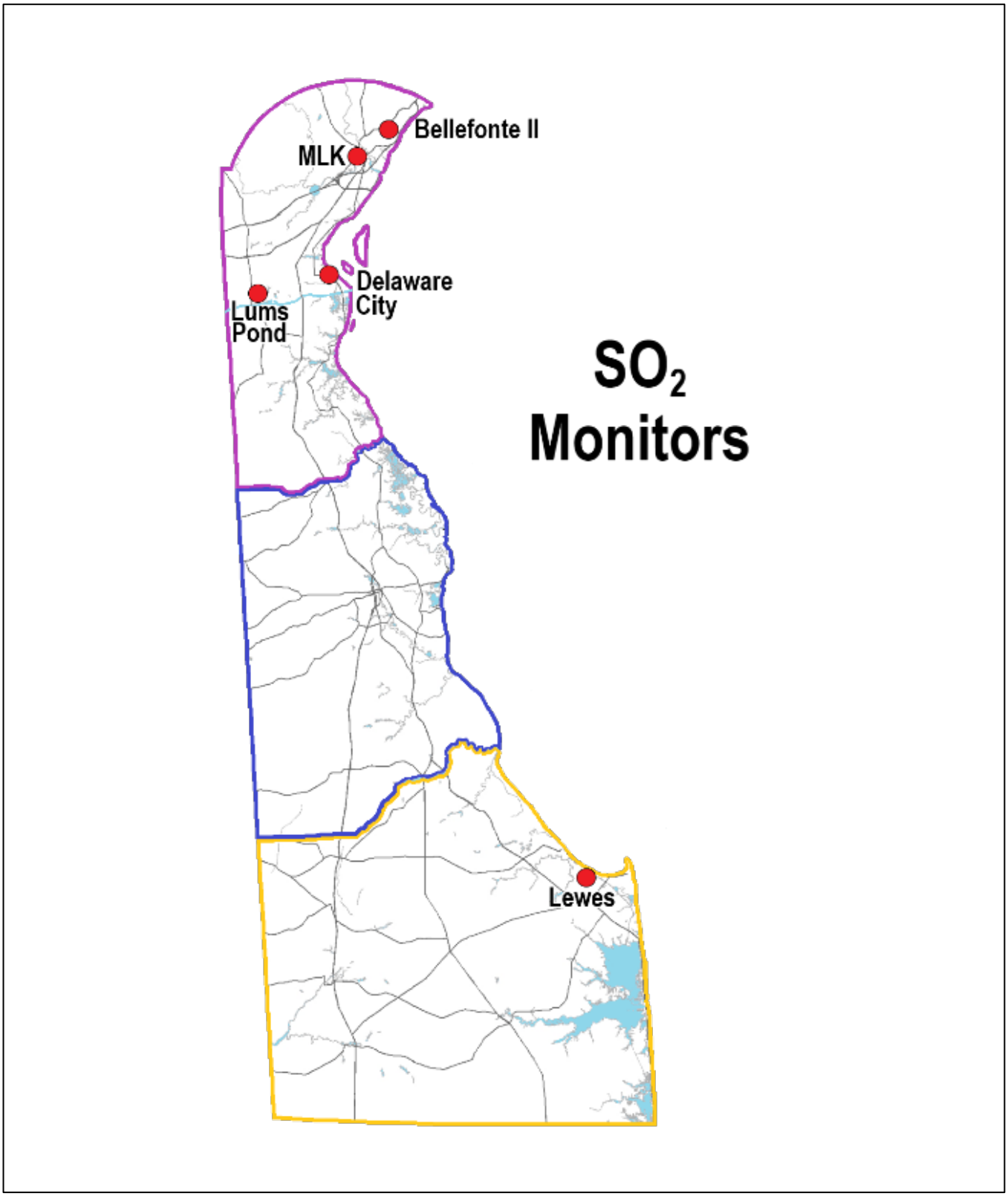


Figure 28. Map of Delaware SO_2 Monitors

Delaware Air Quality and Trends

Over the last decade, measured ambient SO_2 concentrations in Delaware have remained well below all applicable NAAQS, continuing a slight long-term downward trend. Concentrations consistently remain far below the 2010 primary 10-hour average standard of 75 ppb, and since 2010 have also remained beneath the former secondary 3-hour average standard of 0.5 ppm (see Tables 11 and 12).

Lums Pond Monitoring Station

In December 2024, the US EPA finalized a revised secondary SO_2 NAAQS, establishing a new annual standard of 10 ppb. Delaware's monitored SO_2 levels continue to remain well below this updated standard, with no recorded exceedances.

In comparing hourly averages to the 2010 standard, a significant improvement can be noted at the Delaware City monitoring site when additional emission controls were added to the nearby oil refinery (see Figure 29). In 2024, SO_2 levels throughout Delaware remained well below the current NAAQS.

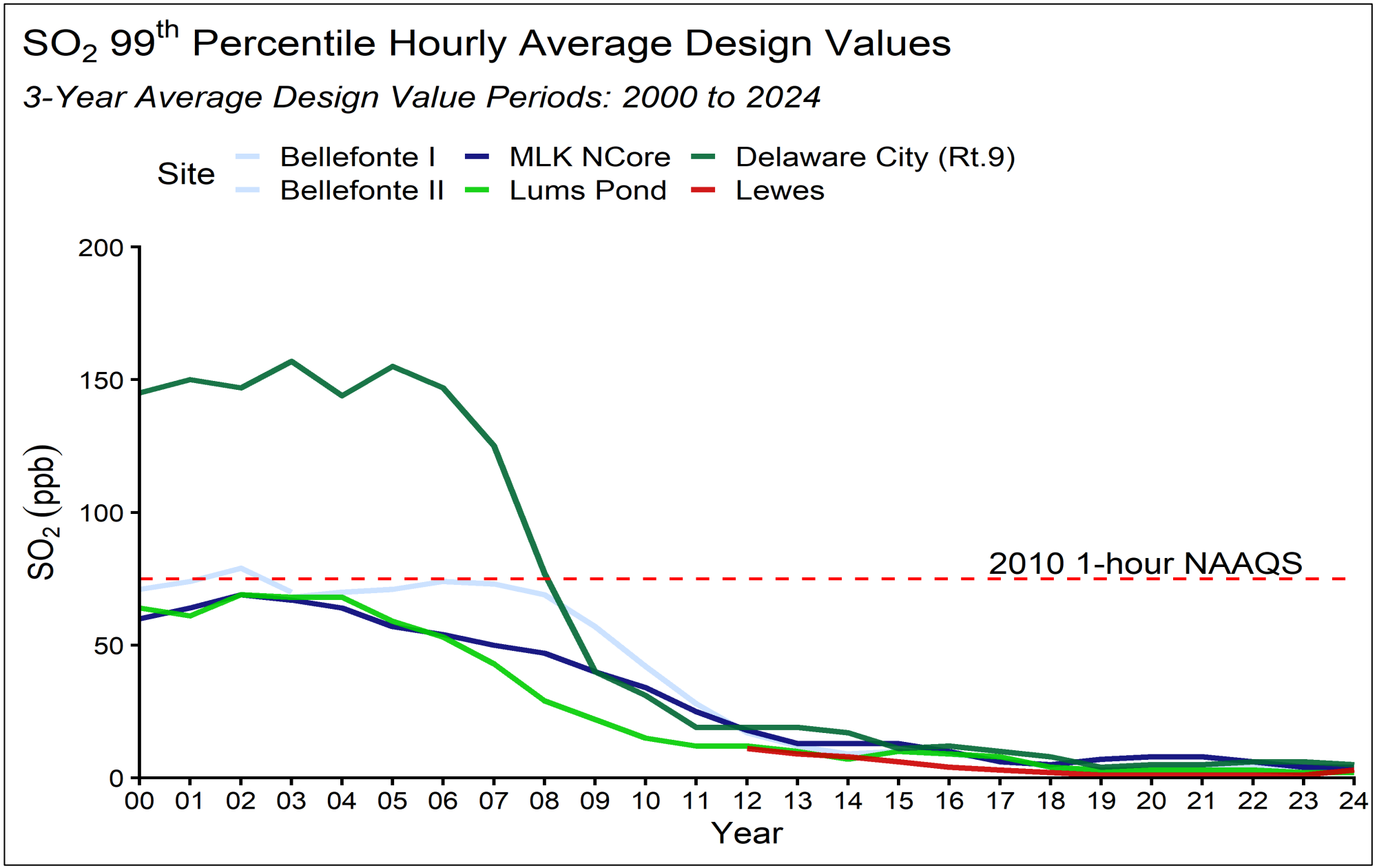


Figure 29. SO_2 Design Value Trends – Primary 1-hour Averages

Table 11. SO_2 Primary 3-year Design Value Trends (ppb)

Site	SO_2 Primary Design Values: 3-yr Avg of 99th Percentile of Daily Max 1-hour Avgs (NAAQS = 75 ppb)										
	2012 to 2014	2013 to 2015	2014 to 2016	2015 to 2017	2016 to 2018	2017 to 2019	2018 to 2020	2019 to 2021	2020 to 2022	2021 to 2023	2022 to 2024
Bellefonte II	9	10	9	7	4	3	4	5	5	4	2
MLK NCore	13	13	10	6	5	7	8	8	6	4	4
Lums Pond	7	10	9	8	4	3	3	3	3	2	2
Delaware City	17	11	12	10	8	4	5	5	6	6	5
Lewes	8	6	4	3	2	1	1	1	1	1	3

Table 12. SO_2 Secondary 3-year Design Value Trends (ppb)

Site[12]	SO_2 Secondary Design Values: 3-yr Avg of Annual Avgs (NAAQS = 10 ppb)										
	2012 to 2014	2013 to 2015	2014 to 2016	2015 to 2017	2016 to 2018	2017 to 2019	2018 to 2020	2019 to 2021	2020 to 2022	2021 to 2023	2022 to 2024
Bellefonte II	1	1	1	0	0	0	0	0	0	0	0
MLK NCore	1	1	1	1	1	1	1	0	0	0	0
Lums Pond	1	1	0	0	0	0	0	0	0	0	0
Delaware City	1	1	1	0	0	0	0	0	0	0	0
Lewes	0	0	0	0	0	0	0	0	0	0	0

[12] Official EPA DV may vary due to data completeness rules for calculations. For historical consistency those complexities are not detailed or indicated in this document, unless a value is unavailable.

Regional SO_2 Levels

Figure 30 shows the SO_2 annual 99th percentile 1-hour concentrations for New Castle County, Delaware compared to nearby monitored sites in neighboring states. SO_2 concentrations in Delaware are similar to those in nearby monitored areas.

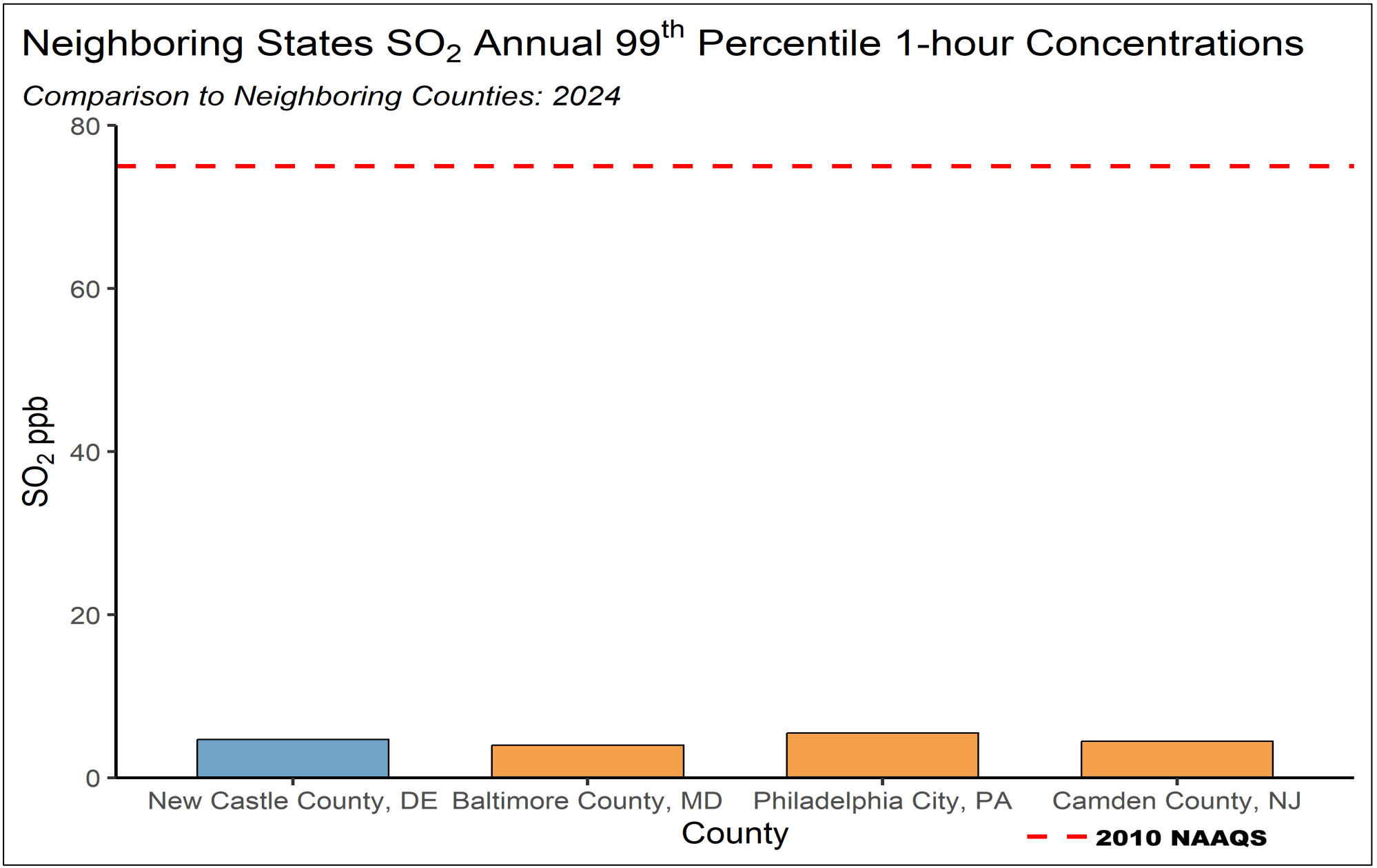


Figure 30. SO_2 Compared to Nearby Monitored Sites

Air Quality – Pollutants without Ambient Standards

Air Toxics

Description

Toxic air pollutants, also called air toxics or HAPs, are pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. In 1990, Delaware began developing a routine ambient air sampling program for selected VOCs. In 2000, this program was updated by changing the sampling and analytical method to detect a greater number of VOCs. In 2003, the program was expanded to include other types of chemical compounds such as carbonyls and heavy metals.

Sources

Sources of ambient air toxics include both stationary and mobile sources. Stationary industrial sources include power plants, chemical manufacturing plants, and refineries. There are many small stationary sources of air toxics (sometimes referred to as "area" sources) such as dry cleaners, printers, and automobile paint shops. Mobile sources include both on-road and off-road motor vehicles as well as marine craft and aircraft.

Locations

The history of air toxics collection in Delaware has changed as requirements and methods varied as well as with restrictions on resources. Since 1990 VOC samples continue to be collected at the MLK NCore (Wilmington) site. Since 2003 heavy metals continue to be monitored at the MLK NCore site (see Figure 31). Monitoring for carbonyls beginning in 2003 was discontinued in 2015 due to resource restrictions but resumed in 2022. Historical data is available for certain pollutants at other sites in Delaware.

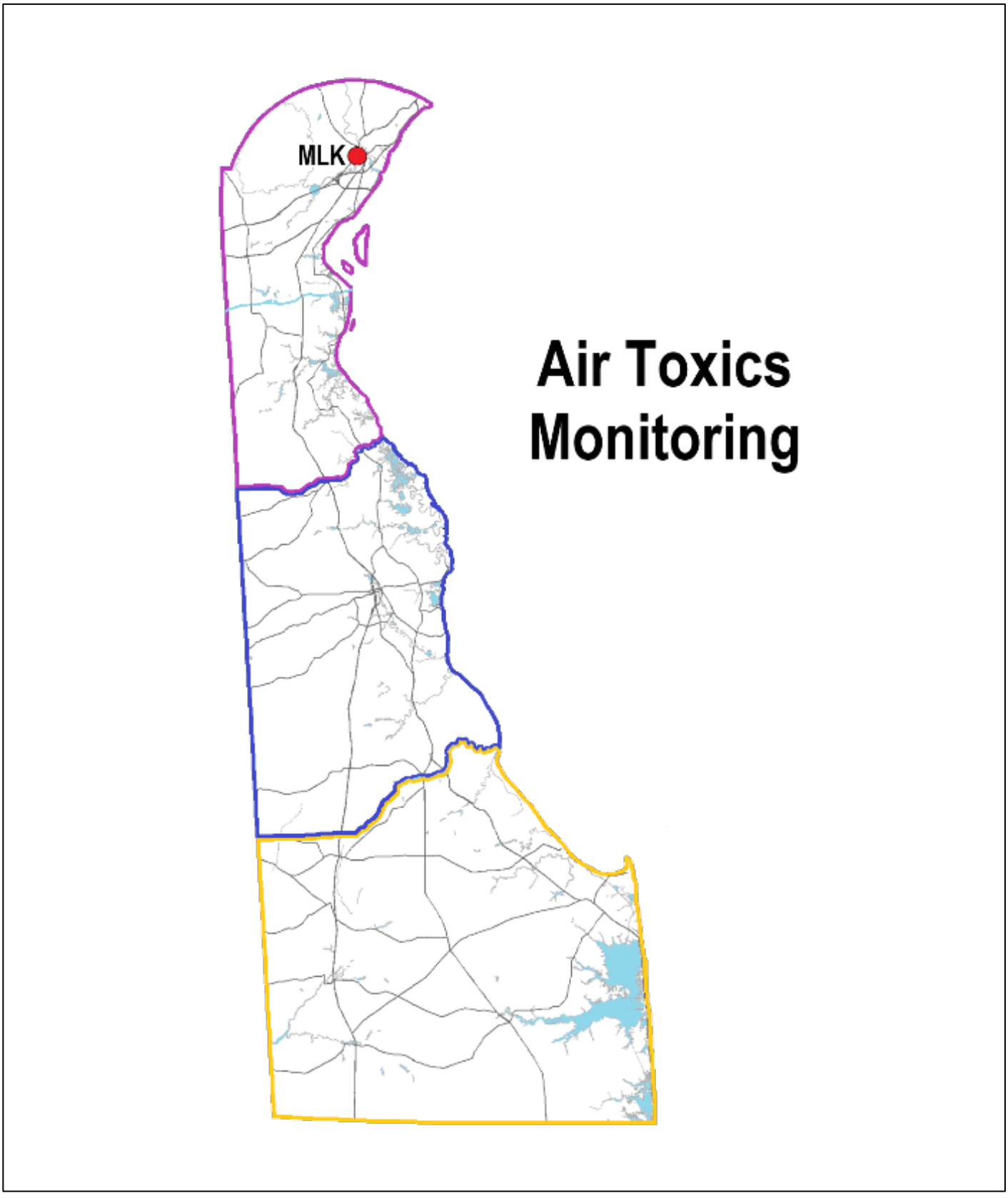


Figure 31. Map of Delaware Air Toxics Monitoring Site

Delaware Air Quality and Trends

The monitoring framework is based on a combination of VOCs and particulate metals, with each pollutant class collected using different sampling methods and analytical techniques. These measurements support state and federal programs, including EPA's Chemical Speciation Network and Region 3 Cooperative Toxics Monitoring Program, and provide detailed information on both the sources and composition of air toxics in Delaware.

Control programs that focus on improving ambient ozone levels by reducing emissions of VOCs, as well as programs specifically aimed at controlling emissions of HAPs, have continued to reduce ambient concentrations of many air toxics. VOC samples are collected for 24 hours in canisters on a schedule of once every six days. A duplicate sample is collected the same way once every 12 days. The canisters are analyzed using a gas chromatograph mass spectrometer system (GC/MS).

Due to equipment malfunctions, Delaware was unable to monitor VOCs in 2024. In 2023 ambient concentrations of most VOCs continued their downward trend at the MLK NCore site. A slight increase in the average of some compounds was observed in 2023, generally close to 2019 (pre-Covid) levels, while most continued flat or declined.

Particulate Metals

Metals monitoring provides information on emissions from industrial, mobile, and area sources, and supports evaluation of long-term trends in hazardous air pollutants. These data are submitted to the EPA Air Quality System and are used to assess compliance with air toxic control programs and to characterize background urban metal levels.

Photochemical Assessment Monitoring Stations

The photochemical assessment monitoring site (PAMS) is located at the MLK NCore site. The PAMS sites are required to measure the hourly speciated VOC measurements with auto-gas chromatographs, carbonyl sampling by measuring three 8-hour samples on a one-in-three-day sampling frequency, NO, NO_2, and total reactive oxides of nitrogen measurements, and surface meteorology such as wind, temperature, humidity, atmospheric pressure, precipitation, solar radiation, ultraviolet radiation, and mixing height. At the time of this publication, complete data for PAMS is not available for inclusion in this report. This information will be provided in future updates.

Appendix A – Monitoring Methods

Ozone (O_3)

Ozone is measured by ultraviolet absorption photometry. Air is drawn through a sample cell where ultraviolet light (254 nm wavelength) passes through it. Light not absorbed by the ozone is converted into an electrical signal proportional to the ozone concentration.

In Delaware, the ozone monitoring season runs from March 1 to October 31 during which monitors are required to be in operation (see section Delaware Air Monitoring Network). Delaware currently maintains monitoring year-round at all sites to provide additional information for trends analyses.

Carbon Monoxide (CO)

Carbon monoxide is measured by infrared absorption photometry. Air is drawn continuously through a sample cell where infrared light passes through it. Carbon monoxide molecules in the air absorb part of the infrared light, reducing the intensity of the light reaching a light sensor. The light is converted into an electrical signal related to the concentration of CO.

Nitrogen Dioxide (NO_2)

Nitrogen oxides are measured using the chemiluminescence reaction of nitric oxide (NO) with ozone. Air is drawn into a reaction chamber where it is mixed with a high concentration of ozone from an internal ozone generator. Any NO in the air reacts with the ozone to produce NO_2. Light emitted from this reaction is detected with a photo multiplier tube and converted to an electrical signal proportional to the NO concentration.

Nitrogen dioxide must be measured indirectly. Total oxides of nitrogen (NO_X) are measured by passing the air through a converter where any NO_2 in the air is reduced to NO before the air is passed to the reaction chamber. By alternately passing the air directly to the reaction chamber, and through the converter before the reaction chamber, the analyzer alternately measures NO and NO_X. The NO_2 concentration is equal to the difference between NO and NO_X.

Sulfur Dioxide (SO_2)

Sulfur dioxide is measured with a fluorescence analyzer. Air is drawn through a sample cell where it is subjected to high intensity ultraviolet light. This causes the sulfur dioxide molecules in the air to fluoresce and release light. The fluorescence is detected with a photo multiplier tube and converted to an electrical signal proportional to the SO_2 concentration.

Particulate Matter – Fine ($PM_{2.5}$)

Discrete sampling

Fine particulate matter is sampled by drawing air through a specially designed inlet that excludes particles larger than 2.5 microns in diameter. The particles are collected on a Teflon® microfiber filter that is weighed to determine the particulate mass. The normal sampling schedule is 24 hours every third day; however, at one site (MLK NCore) samples are collected for 24 hours every day, and a collocated sampler collects every sixth day. Delaware uses the Thermo model 2025i sampler, which is a Federal Reference Method.

Continuous Monitors

Fine particulate matter is also monitored continuously, recording 1-minute, hourly and daily averages. Delaware uses the Teledyne model T640 continuous particulate monitor for this type of sampling, which uses an optical method to count particles and measure their sizes, with a constant 5 liter per minute air flow through the optical detection chamber. This is a FEM.

Particulate Matter (PM_{10})

Discrete sampling

Particulate matter is sampled every third day at the Martin Luther King National Core (MLK NCore) site, in the same manner as $PM_{2.5}$, but with a different inlet that excludes particles larger than 10 microns in diameter. Delaware uses the Thermo model 2025i sampler, which is a FRM.

Continuous Monitors

Particulate matter can also be monitored continuously, recording 1-minute, hourly and daily averages, using the Teledyne model T640X. This is a FEM. Delaware is currently evaluating a T640X at the MLK NCore site, to possibly complement discrete sampling in the future.

Air Toxics

There are no EPA "reference" methods for monitoring ambient air for volatile organic compounds. In Delaware's program from 1991 through 1999, samples were taken on sorbent tubes once per week, rotating Monday through Thursday, for 24-hour intervals. The tubes were analyzed by the Department of Natural Resources and Environmental Control (DNREC) Environmental Services Laboratory using a GC/MS.

VOCs and heavy metals are the two main classes of air toxics being monitored. VOC samples are collected for 24 hours in evacuated canisters with a canister sampler. Speciated VOCs are collected hourly with an automated gas chromatograph. Heavy metals are collected for 24 hours on a TSP quartz filter.

Quality control measurements included collocated samplers, travel and laboratory blanks, spiked tubes, internal and various calibration standards. This method was replaced in 2000 by EPA Method TO-15a, which collects 24-hour samples once every six days using stainless-steel canisters followed by GC/MS analysis.

References

References and Reports

Air Quality Index (AQI) - A Guide to Air Quality and Your Health, EPA
https://www.airnow.gov/aqi/aqi-basics/

National air quality and emissions trends, EPA
https://www.epa.gov/air-trends

Delaware Toxics Release Inventory Report, Delaware DNREC
https://dnrec.delaware.gov/waste-hazardous/emergency-response/community-right-to-know/tri/

Delaware Annual Air Quality Reports, Delaware DNREC
https://dnrec.delaware.gov/air/quality/monitoring/

State of Delaware Final Report: Ozone and PM2.5 Observations and Forecasts in 2024
https://dnrec.delaware.gov/air/quality/forecast/

Air Quality Related World Wide Web Sites

AIRData - Access to national and state air pollution concentrations and emissions data
http://www.epa.gov/airdata/

American Lung Association
http://lung.org

Delaware State Climatologist
http://climate.udel.edu/

Delaware Valley Regional Planning Commission
http://www.dvrpc.org/

Delaware Air Quality Forecast (Seasonally May – September)
https://dnrec.delaware.gov/air/quality/forecast/

Air Quality Partnership
http://www.airqualitypartnership.org/

State of Delaware Division of Air Quality current hourly monitoring data
Delaware - Current Air Quality Data

US National Oceanic and Atmospheric Administration, Environmental Research Laboratories
www.arl.noaa.gov

USEPA Office of Air Quality Planning and Standards “AirNow” - ozone maps, real-time data
https://www.AirNow.gov

USEPA Office of Transportation and Air Quality
http://www.epa.gov/air-pollution-transportation

USEPA Region III
https://www.epa.gov/aboutepa/epa-region-3-mid-atlantic

USEPA Ambient Monitoring Technology Information Center (AMTIC Web formerly TTN)
https://www.epa.gov/amtic

List of Websites Linked to in this Report

Department of Natural Resources and Environmental Control (DNREC)
https://dnrec.delaware.gov/

Interactive Air Quality Monitoring Tool
https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors

Division of Air Quality web page
https://dnrec.delaware.gov/air/

EPA’s AirNow
http://www.airnow.gov/

EPA’s Air Data
https://www.epa.gov/outdoor-air-quality-data

Citizens’ Guide to Residential Open Burning
https://dnrec.delaware.gov/air/open-burning/residential/

Delaware Air Quality Regulations
http://regulations.delaware.gov/AdminCode/title7/1000/1100/index.shtml

Air Quality Design Values
https://www.epa.gov/air-trends/air-quality-design-values

Delaware Ambient Air Monitoring Network Plan
https://documents.dnrec.delaware.gov/Air/monitoring/delaware-air-monitoring-network-plan.pdf

Air Quality Monitoring website
https://dnrec.delaware.gov/air/quality/monitoring/

Archived AirNow Maps (No longer separate page, but a tab in the map view)
https://gispub.epa.gov/airnow/?tab=0&clayer=ozonepm&mlayer=none

EPA Particulate Matter Basics (graphic source)
https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM

Division of Air Quality Contacts

Department of Natural Resources and Environmental Control

Main - Dover Office
302-739-9402
100 West Water Street, Suite 6A
Dover, DE 19904

New Castle Office
302-323-4542
715 Grantham Lane
New Castle, DE 19720

Division of Air Quality

Director - Angela Marconi, Dover/New Castle
Monitoring Data and Quality Assurance – James Roberts, New Castle
Monitoring Data and Quality Assurance – Arthur Newell, New Castle

Engineering and Compliance Section
Section Administrator – Amy Mann, New Castle

Planning Section
Section Administrator – Valerie Gray, Dover

Airshed Planning and Inventory Program
Program Manager – Renae Held, Dover

Ambient Monitoring Program
Program Manager – Tristan Bostock, New Castle

Area Source Compliance Program
Program Manager – Deanna Cuccinello, Dover

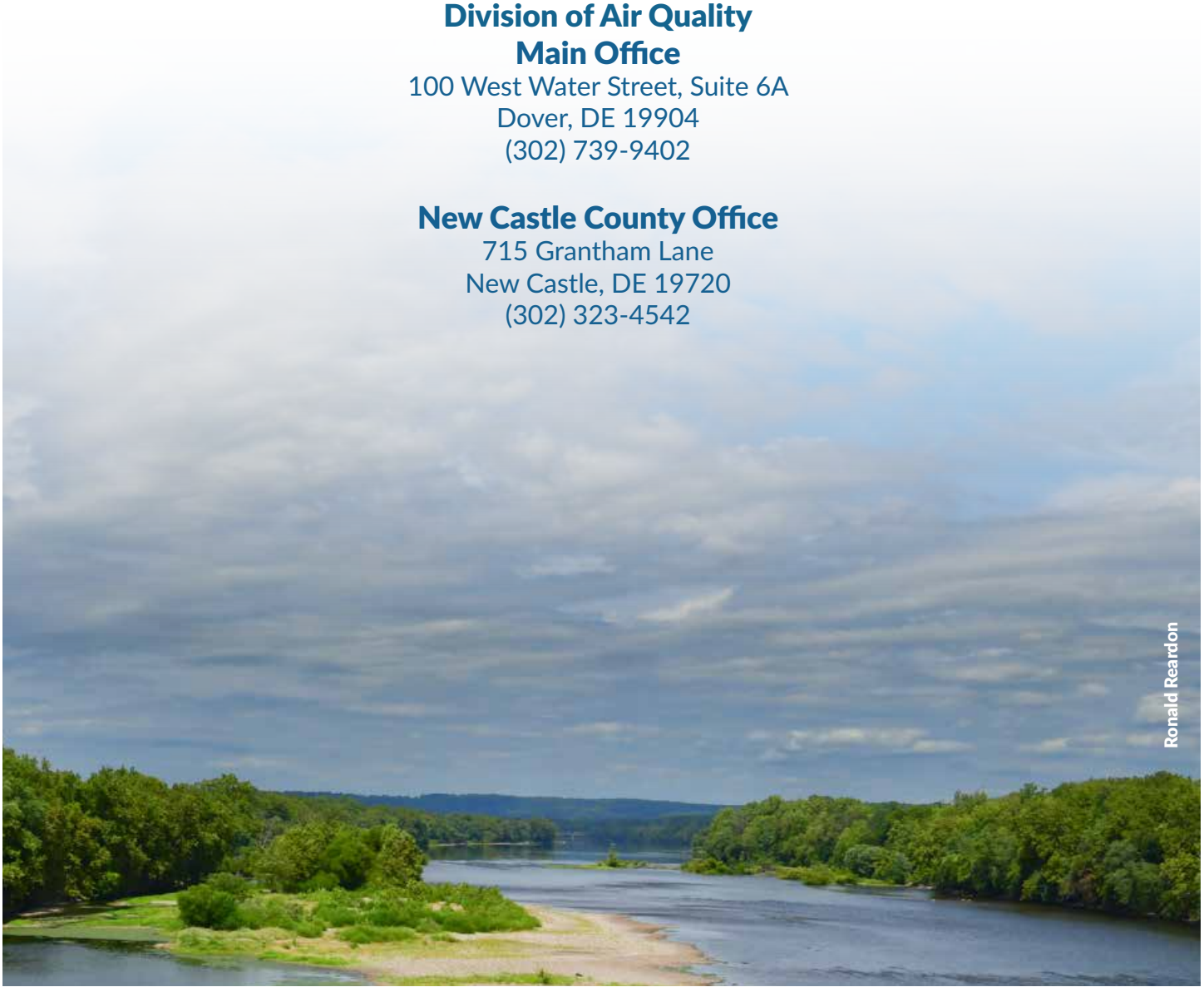
Greenhouse Gas, Mobile, and Air Toxics Program
Program Manager – Pamela Keeney, Dover

DNREC DIVISION OF AIR QUALITY

Delaware Department of Natural Resources and Environmental Control

Division of Air Quality
Main Office
100 West Water Street, Suite 6A
Dover, DE 19904
(302) 739-9402

New Castle County Office
715 Grantham Lane
New Castle, DE 19720
(302) 323-4542



Ronald Reardon