Delaware Ambient Air Monitoring
2025 Network Assessment

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Air Quality

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Executive Summary

In accordance with 40 CFR Part 58.10(d) Delaware is required to submit an assessment of the ambient air monitoring network (AAMN), to the Environmental Protection Agency (EPA) Regional Administrator, every 5 years. This assessment is to determine, at a minimum, if the network meets the monitoring objectives defined in Appendix D of this part, whether new sites are needed, whether existing sites are no longer needed, and where new technologies are appropriate for use in the ambient air monitoring network (AAMN). This report serves as Delaware's 2025 assessment.

To complete the 2025 5-Year Monitoring Network Assessment (Assessment), the Division of Air Quality (AQ) performed a technical review of data collected by the AAMN. This review included:

a. Summarizing population data for all counties in Delaware (Kent, New Castle and Sussex). This was used to determine the appropriateness of monitoring for population exposure.
b. Reviewing meteorological parameters to establish upwind/downwind relationships between a monitor site and surrounding emission sources.
c. Reviewing emission inventory summary data. This was used to determine if a monitor is sited appropriately to represent maximum pollution concentrations or specific ambient source impacts.
d. Reviewing historical data from each site for trends and comparison to current National Ambient Air Quality Standards (NAAQS). This showed Delaware's progress in improving air quality and meeting air quality standards.
e. Performing a site by site correlation analysis for appropriate monitors, using tools supplied by EPA. This was used to determine whether any sites have been collecting redundant information and may be considered for elimination.
f. Performing bias calculations to predict possible impacts of removing specific monitors from the network.

The Division of Air Quality (AQ) evaluated the data from this technical review according to defined performance measures listed in the EPA's guidance document.[1] AQ also expanded performance measures beyond application of this technical information by considering item d below. Performance measures were organized into the following categories:

[1] Ambient air Monitoring Network Assessment Guidance, Analytical Techniques for Technical Assessments of Ambient Air Monitoring Networks Contract No. EP-D-05-004, Work Assignment No. 2-12, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, North Carolina.

a. Data Criteria
b. Statistical Criteria
c. Situational Criteria
d. Future Needs and Special Considerations

Specific performance measures used in this Assessment are detailed in the Delaware Air Monitoring Network – Current Network Description section. Not all performance measures were applicable to every monitor/site. Based on evaluation of these performance measures, AQ determined the importance (critical, credible, marginal, new site required) of each monitor in the network:

- **Critical sites** are of high value and will be continued.
- **Credible sites** are expected to continue but may not be the design value location.
- **Marginal sites** or **monitors** are subject for removal or movement.
- **New site required** represent potential areas of investment.

Results

The results of this Assessment indicate that the network contains critical, credible and marginal monitors. In addition, the network meets the requirements in the Federal regulations and provides more than sufficient monitoring throughout Delaware to accurately determine compliance with the NAAQS. The investment to operate the AAMN is significant, and Delaware is concerned about future funding needs. Additional factors that may impact future network design include new monitoring requirements associated with new or revised NAAQS, aging equipment, and required maintenance. The marginal monitors could be considered for removal, however, at this time, Delaware is not recommending any monitors for removal. If funding is in jeopardy, Delaware will use this assessment to determine which monitors could be removed from service and will work closely with EPA Region 3 to ensure that if changes are made, all monitoring requirements are met and changes are implemented with the smallest impact to achieving our DQOs.

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List of Acronyms

µg/m^3	micrograms per cubic meter
AAMN	Ambient Air Monitoring Network
AQ	Delaware Division of Air Quality
AQI	Air Quality Index
AQS	Air Quality System
Assessment	5-year Monitoring Network Assessment
BC	Black Carbon
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CAMPD	Clean Air Markets Program Data
CBSA	Core Based Statistical Areas
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSA	Combined Statistical Area
CSAPR	Cross-State Air Pollution Rule
DAS	Data Acquisition System
DNREC	Delaware Department of Natural Resources and Environmental Control
DQA	Data Quality Assessment
DQI	Data Quality Indicators
DQO	Data Quality Objectives
EMP	Enhanced Monitoring Plan
EPA	Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GC	Gas Chromatograph
LCD	Local Climate Data
MARAMA	Mid-Atlantic Regional Air Management Association
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Station
NOAA	National Oceanic and Atmospheric Administration
Ncore	National Core Network
NEI	National Emissions Inventory
NIST	National Institute of Standards and Technology
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NO	Nitric Oxide
NO_y	Total Reactive Oxides of Nitrogen
O_2	Oxygen
O_3	Ozone
OAQPS	Office of Air Quality Planning and Standards

OTR	Ozone Transport Region
PAMS	Photochemical Assessment Monitoring Station
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate Matter less than 10 microns
$PM_{2.5}$	Fine Particulate Matter less than 2.5 microns
PMcoarse	Difference between PM_{10} and $PM_{2.5}$ particulate concentrations
ppb	Parts per billion
ppm	Parts per million
PWEI	Population Weighted Emissions Index
QA	Quality Assurance
SIP	State Implementation Plan
SLAMS	State and Local Air Monitoring Station
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
SPM	Special Purpose Monitor
TAPI	Teledyne Advanced Pollution Instrumentation
TSP	Total Suspended Particulates
VOC	Volatile Organic Compound
WS/WD	Wind Speed/Wind Direction

Introduction

In 1970, Congress passed the Clean Air Act (CAA) that authorized the 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 with 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 with criteria designed to protect public welfare (decreased visibility, damage to crops, vegetation, buildings, etc.).

Seven pollutants have NAAQS: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 2.5 microns ($PM_{2.5}$), particulate matter less than 10 microns (PM_{10}), and sulfur dioxide (SO_2). These are called the "criteria" pollutants. When air quality in a county does not meet the NAAQS, the area is in “nonattainment” with the NAAQS.

In October 2006, the EPA issued final regulations concerning state and local agency ambient air monitoring networks. These regulations require periodic assessments of the monitoring networks including the information as described in 40 CFR Part 58.10 (d) annual monitoring network plan and periodic network assessment, which states:

> The State, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and where new technologies are appropriate for incorporation in the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan to the Regional Administrator. The first assessment is due July 1, 2010.

This 2025 Monitoring Network Assessment (Assessment) is written in compliance with this regulation.

Delaware Air Monitoring Network - Current Description of Monitoring Network

The current air monitoring network in Delaware consists of 11 sites throughout the state. In 40 CFR Part 58, Appendix D, the objectives of a monitoring network and types of monitoring sites are:

1) Three main monitoring objectives:
   a) Provide air pollution data to the public in a timely manner;
   b) Support compliance with ambient air quality standards and emissions reduction strategies; and
   c) Support air pollution research studies.

2) Six general site types needed to achieve the three main objectives:
   a) Maximum concentration;
   b) Population exposure;
   c) Source impact;
   d) Background;
   e) Transport; and
   f) Welfare-based impact (visibility, vegetation, etc.).

Appendix D also discusses the six scales of representativeness and specific network design criteria, including the National Core Network (NCore) and pollutant-specific requirements. Delaware's monitoring network complies with all requirements in 40 CFR Part 58 and all appendices.

Table 1: Delaware's Current Monitoring Network

Site Name (Abbreviation) AQS ID	Parameter	Monitor Start Date	Monitoring Objectives
Bellefonte I (BF1) 10-003-1003	PM2.5	1/1/1999	Population Exposure
Bellefonte II (BF2) 10-003-1013	O3	4/1/2001	Population Exposure
	SO_2	3/1/2003	Population Exposure
Brandywine Creek State Park (BSP) 10-003-1010	O_3	7/1/1994	Population Exposure
	Wind Speed/Wind Direction (WS/WD)	11/1/2013	Currently offline, was not reinstalled after shelter replaced

Site Name (Abbreviation) AQS ID	Parameter	Monitor Start Date	Monitoring Objectives
Delaware City (RT9) 10-003-1008	$PM_{2.5}$	6/1/2013	Population Exposure Source Oriented
	SO_2	2/1/1992	Population Exposure Source Oriented
	WS/WD	5/1/2011	Point Source directions, equipment not operational
Dover (DVR) 10-001-0003	$PM_{2.5}$	1/1/1999	Population Exposure
Killens Pond State Park (KIL) 10-001-0002	O_3	4/1/1995	General/ Background
	$PM_{2.5}$	1/1/1999	General/ Background
Lewes (LEW) 10-005-1003	O_3	5/1/1997	Population Exposure
	SO_2	1/1/2013	Population Exposure
	$NO/NO_2/NOx$	Planned	Enhanced Monitoring Plan
	WS/WD	6/1/1997	Microscale Analysis Coastal wind data
Lums Pond State Park (LUM) 10-003-1007	O_3	1/1/1992	Upwind Background Population Exposure
	$PM_{2.5}$	1/1/1999	Regional Transport Population Exposure
	SO_2	1/1/2000	General Background Population Exposure
	WS/WD	6/1/2013	Microscale Analysis
Newark (NWK) 10-003-1012	$PM_{2.5}$	12/15/1999	Population Exposure
Seaford (SEA) 10-005-1002	O_3	3/1/1990	Population Exposure
	$PM_{2.5}$	1/1/1999	Population Exposure

Site Name (Abbreviation) AQS ID	Parameter	Monitor Start Date	Monitoring Objectives
Wilmington NCore (MLK) 10-003-2004	SO_2	1/1/1999	Population Exposure
	CO	1/1/1999	Population Exposure
	NO_2	1/1/2001	Population Exposure/ Maximum Concentration/ PAMS
	NOy	1/1/2011	Population Exposure/ PAMS
	O_3	1/1/2011	Population Exposure/ NCore
	$PM_{2.5}$	1/1/1999	Population Exposure/ Maximum Concentration
	$PM_{2.5}$ Speciation	6/1/2001	Population Exposure/ NCore
	PM_{10} and PM_{coarse}	1/1/2011	Population Exposure/ NCore
	Black Carbon (BC)	1/1/2001	$PM_{2.5}$ Speciation
	Volatile Organic Compounds (VOCs)	1/1/1999	Year-round Air Toxics
	Metals	1/1/2003	Year-round Air Toxics
	PAMS VOCs	6/1/2023	PAMS VOCs by AutoGC
	Carbonyls	6/1/2022	PAMS
	Precipitation	6/1/2023	PAMS
	Mixing Layer Height	6/1/2022	PAMS
	Solar Radiation	6/1/2023	PAMS
	UV Radiation	6/1/2023	PAMS
	WS/WD	6/1/2000	PAMS/ NCore
	Temp/RH	1/1/2011	PAMS/ NCore

The highest priority of Delaware's Ambient Air Monitoring Network (AAMN) is to measure and report O_3 and $PM_{2.5}$. This is because O_3 and $PM_{2.5}$ are the pollutants with recorded measurements that have recently or historically been close to or exceeded the NAAQS in Delaware. For the most current 3 years of validated data, 2022 – 2024, all Delaware design values met the NAAQS. The ozone monitor at LUM did exceed the NAAQS for the 1-year site design value in 2023, due to the exceptional wildfire events of 2023. This exceedance is ameliorated by the 3-year regulatory averaging done before comparing to the NAAQS. However, because New Castle County is part of the greater Philadelphia area CBSA, which continues to have ozone design values above the NAAQS, New Castle County continues to be classified as "non-attainment" for ozone. This is shown in Table 2. All other pollutants and counties remain in attainment.

Table 2: Most Recent 3-Year Air Quality Summary (2022 to 2024)

Pollutant	Status of NAAQS and major Risk Issues in Agencies Network	Counties violating NAAQS	Days above 100 on the AQI	Contribution to Downwind Violations?[a]
CO	Attainment	not applicable (NA)	0	NA
NO_2	Attainment	NA	0	NA
O_3	Non-attainment (New Castle County only)	New Castle County	8	New Castle County to Philadelphia CBSA
$PM_{2.5}$	Attainment	NA	8	NA
PM_{10}	Attainment	NA	2	NA
Pb	Attainment	NA	NA	NA
SO_2	Attainment	NA	0	NA

[a] Identifies the Delaware county adjacent to a CBSA in the next downwind State violating the NAAQS

History of Air Monitoring in Delaware

Delaware is located within the northeastern portion of the Delmarva Peninsula and is the second smallest state in the nation with a total area of 1,982 square miles. Delaware is 96 miles long and varies from nine to 35 miles in width. It is bordered by Pennsylvania to the north, Maryland to the west and south, and New Jersey to the east. Delaware is composed of three counties, from north to south these are New Castle, Kent, and Sussex.

Most of the land area in Delaware is part of the coastal plain. The exception is the northern part of New Castle County, which includes the rolling hills of the Piedmont area. The highest elevation in the state is approximately 450 feet.

Air pollution monitoring in Delaware began in the 1950s, prior to the establishment of the EPA. The first monitors were simple mechanisms or passive collectors such as dust-fall buckets and tape samplers and often operated for limited time periods. These were followed in the 1960s by wet-chemistry instruments, which were soon replaced by more advanced electronic

instruments and the establishment of permanent monitoring stations. The addition of computer technology in monitoring systems and air pollution data collection in the late 1970s and early 1980s was critical to the development of the core monitoring network that exists today. These technology advances required more technical skills for monitoring operations.

The earliest monitors were placed near pollution sources to measure direct impact of pollution emissions. As ambient air pollution standards were 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 new national and state air quality standards, as well as establishing background levels and measuring pollution transported from areas outside of Delaware.

With the passage of the Clean Air Act in 1970, and the Clean Air Act Amendments in 1990, various control measures implemented by the federal and state governments resulted in major improvements in air quality, particularly regarding major industrial sources. Today, pollutants of concern come from a variety of sources, including mobile (both on and off-road vehicles), large industrial facilities, and smaller industries and businesses. Delaware continues to use its AAMN to track changes in air quality across the state and evaluate compliance with the NAAQS.

Table 3 shows the history of Delaware's AAMN by decade (X indicates monitor was operating for at least 1 year during that decade); shaded sites are stations not currently operating.

Table 3: Monitoring Network History

County	AQS Site ID	Name/Location	1960s	1970s	1980s	1990s	2000s	2010s	2020s
Kent	10-001-0001	Dover		X	X	X			
	10-001-0002	Killens Pond State Park. (KIL)				X	X	X	X
	10-001-0003	Dover $PM_{2.5}$, Water St. (DVR)					X	X	X
	10-001-1001	Bombay Hook	X	X					
New Castle	10-003-0001	Claymont Fire Station	X						
	10-003-0002	UD Farm		X	X				
	10-003-0003	501 Ogletown Rd (Hudson Bldg)			X				
	10-003-0004	Ferris School		X					
	10-003-0005	Old SPCA		X					
	10-003-0006	Gov. Bacon, Delaware City		X	X	X			
	10-003-0007	Mt. Pleasant Farm		X					
	10-003-0010	NCC Engineering Bldg		X	X				
	10-003-0011	Lombardy School		X					
	10-003-0012	St. Georges		X					
	10-003-0018	Lums Pond			X				
	10-003-0069	McKean High School		X					
	10-003-0070	Summit		X	X				
	10-003-1001	UD Farm		X					
	10-003-1002	Naamans Rd	X						
	10-003-1003	River Rd. Park, Bellefonte (BF1)		X	X	X	X	X	X
	10-003-1004	Marine Terminal		X	X				
	10-003-1005	Pennsylvania Ave			X				
	10-003-1006	3rd and Union St. Fire Station			X	X			
	10-003-1007	Lums Pond Park (LUM)				X	X	X	X
	10-003-1008	Delaware City (RT9)				X	X	X	X
	10-003-1009	Elsmere				X			

County	AQS Site ID	Name/Location	1960s	1970s	1980s	1990s	2000s	2010s	2020s
	10-003-1010	Brandywine Creek State Park (BSP)				X	X	X	X
	10-003-1011	UD - Newark $PM_{2.5}$					X		
	10-003-1012	Newark $PM_{2.5}$ (NWK)					X	X	X
	10-003-1013	Bellevue State Park (BF2)					X	X	X
	10-003-1069	Millcreek Rd		X					
	10-003-2001	Ommelanden		X	X				
	10-003-2002	Wilmington, 12th and King	X	X	X	X			
	10-003-2003	Walnut and Taylor St.		X					
	10-003-2004	MLK Blvd and Justison St. (MLK)					X	X	X
	10-003-3001	Claymont, Women's Correctional Ctr		X	X	X			
	10-003-4001	1000 King St	X	X					
	10-005-0001	Milford		X					
	10-005-1001	Seaford Water Tower		X	X				
Sussex	10-005-1002	Seaford, Virginia Ave. (SEA)				X	X	X	X
	10-005-1003	Lewes (LEW)				X	X	X	X
	10-005-2001	Millsboro Delmarva Power			X				
		Totals:	5	23	16	13	12	11	11

The largest number of monitoring sites existed during the 1970s. PM and SOx were the most commonly monitored pollutants. The majority of sites have always been in New Castle County, which has the largest population and largest pollution sources. As the network shifted towards more automated methods and systems, the monitoring network began to shrink in favor of long-term and permanent monitoring stations.

Locations of monitors continued to evolve to match population growth and pollution source changes. Other issues affecting monitoring locations included changes in land use/ownership and changes in available funding for station upkeep and improvements.

As air quality continued to improve, monitoring focus shifted away from pollutants such as total suspended particulates (TSP), PM_{10}, SO_2, and CO towards pollutants that remained near or above the NAAQS, primarily $PM_{2.5}$, O_3 and pollutant precursors. More advanced monitoring methods, emissions inventories, control strategy development, and sophisticated computer modeling tools were important in the redirection of monitoring sites throughout this period. Population changes also played a role in the development of the monitoring network. While New Castle County continued to have the highest population density, significant growth was occurring in Sussex and Kent counties.

Throughout the 1990s and into the new century, restrictions on available resources (both staffing and technological) required consolidation of the network to focus on pollutants of concern in the most populated areas. A significant new addition to the monitoring network in the late 1990s was the introduction of $PM_{2.5}$ monitors in response to the new $PM_{2.5}$ NAAQS.

Specific information on the status of the AAMN and current challenges are covered in the rest of this document. More tables on historical monitoring parameters and locations are included in Appendix I.

Figure 1 shows a map of the 2025 AAMN in Delaware.

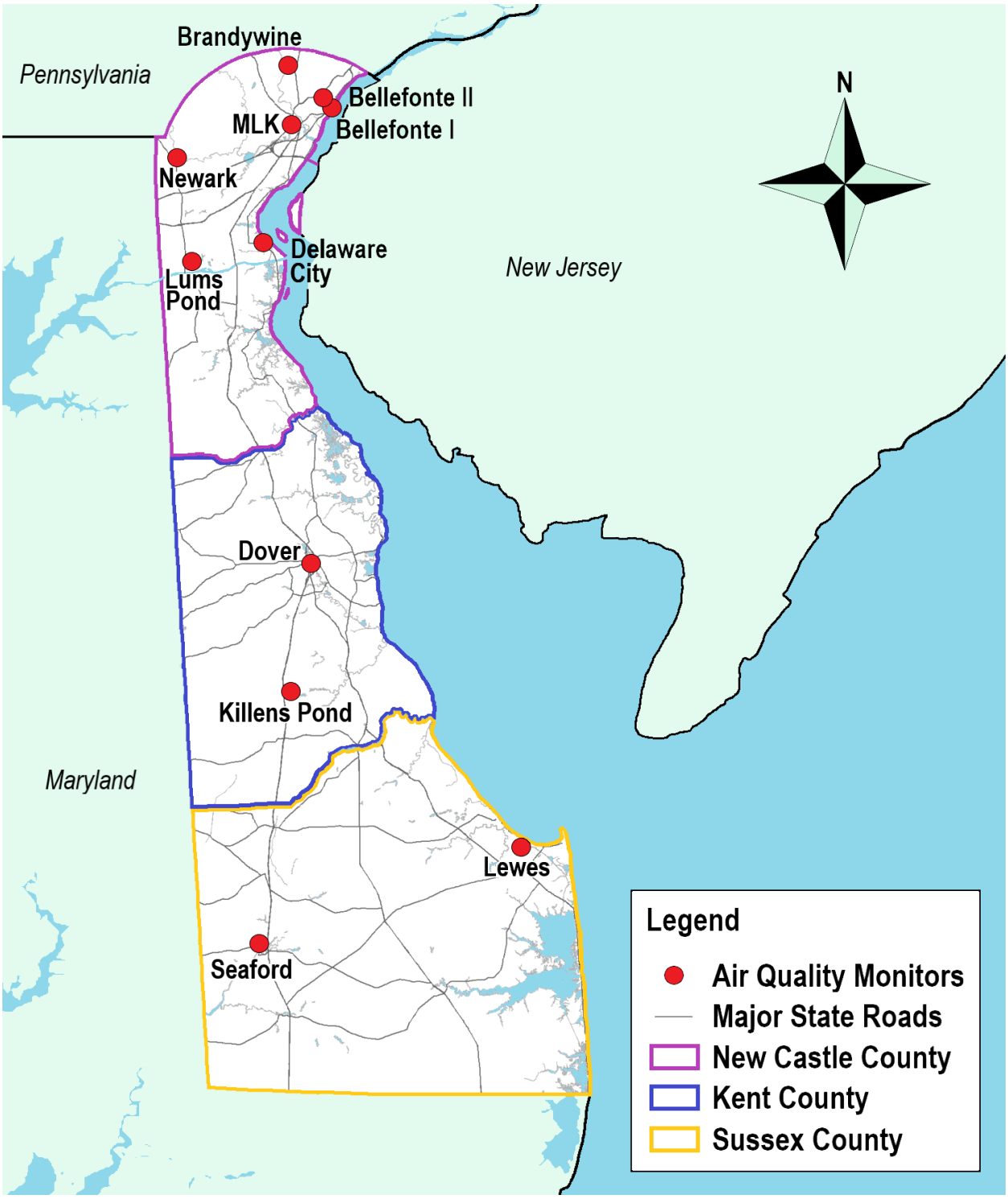


Figure 1: Delaware Air Monitoring Network Map

Population Summary

Although New Castle County is the most densely populated county, this population is growing more slowly than in the other areas of the state. The greatest growth is occurring in the southern and western portions of New Castle County which continues to have the greatest total population in Delaware. New Castle is also the most industrialized county with the highest number of air pollution sources as well as traffic density.

Kent County is the middle county in Delaware. While Kent has the lowest population density, it also has demonstrated significant population growth since 2010. There is one metropolitan statistical area (MSA) in Kent County, Dover, which is the centrally located capital city.

Sussex County is the southernmost county in Delaware. Largely because of the resort area along the coast, it typically has a higher population density in the summer months than Kent County.

The state experienced population growth of 10.5% between the 2010 and 2020 censuses, as shown in Table 4. Estimated population numbers as of July 1, 2024 can be found in U.S. Census data at https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html.

Table 4: Population Summary

County	Population: 2010 Census	Population: 2020 Census	Percent Change in Population 2010 - 2020	Population Estimate July 1, 2024	Percent Change in Estimated Population 2010 - 2024
New Castle	538,479	570,957	+6.0%	588,093	+9.2%
Kent	162,310	182,317	+12.3%	192,690	+18.7%
Sussex	197,145	238,654	+21.1%	271,134	+37.5%
Totals	897,934	991,928	+10.5%	1,051,917	+17.1%

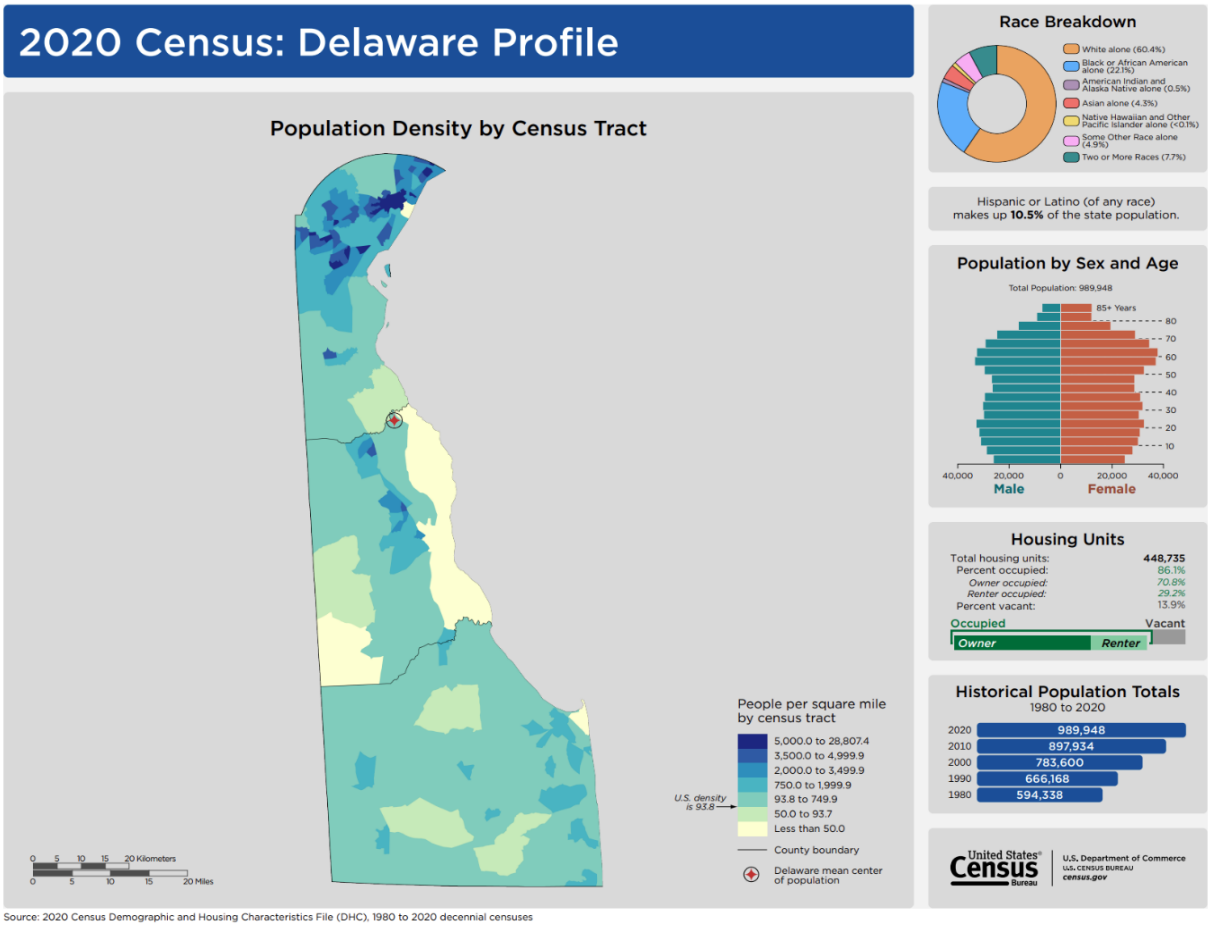


Figure 2: US Census, Delaware Population Profile

Table 5: CBSAs and CSAs for Delaware

CBSA Code	Metro Division Code	CBSA Title	Level of CBSA	Metropolitan Division Title	CSA Title	Component Name
20100		Dover, DE	Metropolitan Statistical Area (MSA)			Kent County
37980	48864	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Metropolitan Statistical Area	Wilmington, DE-NJ-MD	Philadelphia-Reading-Camden, PA-NJ-DE-MD	New Castle County
41540		Salisbury, MD-DE	Metropolitan Statistical Area		Salisbury	Sussex County

Meteorological Summary

Monthly Climate Normals

Table 6 contains temperature and precipitation data summaries for National Oceanic and Atmospheric Administration (NOAA) weather stations in each county in Delaware. The data are retrieved from the NOAA website http://www.ncdc.noaa.gov/cdo-web/datatools.

Table 6: Monthly Climate Normals by County

NEW CASTLE AIRPORT, DELAWARE: NCDC 1991-2020 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	41.4	44.1	52.5	64.2	73.5	82.2	86.8	84.9	78.5	67.0	55.9	46.0	64.75
Mean Temperature (F)	33.5	35.5	43.2	53.9	63.5	72.6	77.6	75.8	68.9	57.2	46.6	38.2	55.54
Mean Min. Temperature (F)	25.6	27.0	33.9	43.5	53.4	63.0	68.3	66.6	59.3	47.3	37.4	30.3	46.30
Mean Precipitation (in.)	3.2	2.8	4.2	3.5	3.6	4.7	4.4	4.0	4.4	3.7	3.1	3.9	45.33

DOVER, DELAWARE: NCDC 1991-2020 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	41.4	44.1	52.5	64.2	73.5	82.2	86.8	84.9	78.5	67.0	55.9	46.0	64.75
Mean Temperature (F)	33.5	35.5	43.2	53.9	63.5	72.6	77.6	75.8	68.9	57.2	46.6	38.2	55.54
Mean Min. Temperature (F)	25.6	27.0	33.9	43.5	53.4	63.0	68.3	66.6	59.3	47.3	37.4	30.3	46.30
Mean Precipitation (in.)	3.2	2.8	4.2	3.5	3.6	4.7	4.4	4.0	4.4	3.7	3.1	3.9	45.33

GEORGETOWN COASTAL AIRPORT, DELAWARE: NCDC 1991-2020 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	45.2	47.8	55.2	66.3	74.5	83.1	87.7	85.7	79.5	69.3	58.7	49.9	66.91
Mean Temperature (F)	36.9	38.9	45.8	55.8	64.5	73.6	78.6	76.7	70.3	59.3	49.2	41.3	57.58
Mean Min. Temperature (F)	28.6	30.0	36.3	45.3	54.5	64.0	69.5	67.7	61.2	49.4	39.6	32.7	48.23
Mean Precipitation (in.)	3.0	2.6	3.9	3.3	3.6	4.1	4.1	4.0	4.5	4.1	3.2	3.5	43.88

Monitoring Network General Issues

Delaware's Annual Network Plan includes summaries for each monitoring site that include current information on specific parameters, latitude/longitude coordinates, and photographs. These summaries are included as Appendix II of this document.

Data Users: Primary data users of ambient air quality data are professional staff within the Division of Air Quality (AQ). Other users include EPA and university researchers; the University of Delaware and Delaware State University are frequent users of data and have occasionally collocated projects with monitoring sites. The public most frequently uses the data as part of the Air Quality Index (AQI), either through local news media, from the Delaware Air Quality Monitoring websites, or through the EPA AirNow website (airnow.gov).

Other data users can include independent researchers, including public health researchers, federal agencies other than EPA, and local government agencies. AQ is not aware of all data users since the data are publicly available from the EPA Air Quality System (AQS) database and users do not need to request the data directly from AQ.

Objectives: The most important monitoring objectives for the networks include NAAQS compliance, population exposure, and long-term trends tracking. These objectives have been part of the network design throughout the history of the monitoring program. Additional objectives include evaluation of emission control strategies and contribution to state implementation plans (SIPs) or maintenance plans. Near real-time AQI reporting is also a required objective that continues to be met.

Special studies, such as atmospheric pollutant research and/or model validation, are not generally required but are considered on a case-by-case basis. Local community concerns are considered whenever monitoring network changes are needed and play a role in special study design and reporting.

Domain of Responsibility: AQ is responsible for monitoring air quality throughout Delaware. Adjoining upwind and downwind areas maintain their own ambient monitoring networks and data is shared through the AQS system. The Baltimore/Washington area is generally upwind of Delaware while Philadelphia/southern and central New Jersey are generally downwind.

State Requirements: Delaware maintains its own State Air Quality Standards pursuant to 7 DE Admin. Code 1103 and as shown in Table 7.

Table 7: State of Delaware Air Quality Standards

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide (CO)	9 parts per million (ppm) (10 mg/m^3)	8-hour[(1)]	None	
	35 ppm (40 mg/m^3)	1-hour[(1)]		
Lead (Pb)	0.15 µg/m^3	3-months	Same as Primary	
Nitrogen Dioxide (NO_2)	100 parts per billion (ppb)	1-hour[(7)]	None	
	53 ppb	Annual Arithmetic Mean	Same as Primary	
Total Suspended Particulates (TSP)	75 µg/m^3	Annual Geometric Mean	60 µg/m^3	Annual
	260 µg/m^3	24-hour[(1)]	150 µg/m^3	24-hour
Particulate Matter (PM_{10})	150 µg/m^3	24-hour[(1)]	Same as Primary	
Fine Particulate Matter ($PM_{2.5}$)	12.0 µg/m^3	Annual[(2)]	15.0 µg/m^3	Annual[(3)]
	35 µg/m^3	24-hour[(4)]	Same as Primary	
Ozone (O_3)	0.070 ppm	8-hour[(5)]	Same as Primary	
	0.12 ppm	1-hour[(6)]	Same as Primary	
Sulfur Dioxide (SO_2)	75 ppb	1-hour[(8)]	0.5 ppm	3-hour[(1)]
Hydrogen Sulfide (H_2S)	0.06 ppm	3-minute	None	
	0.03 ppm	1-hour		

(1) Not to be exceeded more than once per year.
(2) The annual arithmetic mean $PM_{2.5}$ concentrations must not exceed 12.0 µg/m^3.
(3) The annual arithmetic mean $PM_{2.5}$ concentrations must not exceed 15.0 µg/m^3.
(4) The 98th percentile of 24-hour concentrations must not exceed 35 µg/m^3.
(5) The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations must not exceed 0.070 ppm.
(6) The standard is met when the number of days per calendar year with maximum hourly average ozone concentration above 0.12 ppm is ≤ 1.
(7) The 3-year average of the 98th percentile of 1-hour daily maximum concentrations must not exceed 100 ppb.
(8) The 3-year average of the 99th percentile of 1-hour daily maximum concentrations must not exceed 75 ppb.

Delaware also maintains an Ozone Action Day program that includes statewide open burning restrictions in effect throughout Delaware from May 1 through September 30. Ozone Action Day notices are issued via the state website and provided to local news media in conjunction with the AQI forecast and federal Enviroflash program. This program involves partners in other agencies and encourages the use of public transit and other actions to limit air pollution releases. More specific information on these programs is available at de.gov/aqi.

Performance Measures Defined in the Network Assessment

To determine relative value of individual monitors and monitoring sites, a set of criteria or performance measures was developed that could be used to evaluate whether the monitors and sites are meeting all relevant monitoring objectives. These performance measures were grouped into four categories: data criteria, statistical criteria, situational criteria, and future needs and special considerations.

The following list shows the performance measures used in the Assessment. Not all measures were relevant for all monitors or sites.

Data Criteria:

- **Max concentration** – Ambient data that represents the highest concentration in an area and/or is used as the "design value" to determine attainment with the NAAQS is of higher value.
- **% of NAAQS** – Ambient data showing air quality at, near, or above the NAAQS are of higher value than data showing air quality significantly below (less than 50% of) the NAAQS.
- **Longevity** – Sufficient ambient data has been collected at that location to apply trends analysis; longer periods of time are of higher value. Characterized as: long (> 10 years), moderate (5 – 10 years), short (3 – 5 years), or insufficient (less than 3 years).
- **AQI** – Ambient data used to generate an AQI or AQI forecast for an area are of value.

Statistical Criteria:

- **Uniqueness** – Air quality data that is dissimilar to air quality measurements from different areas as shown by statistical analyses (correlation, standard deviation, and average difference) is of high value.
- **Measurement Criticality** – A significant difference in the design value for an area if monitoring is terminated at a specified location (as shown by statistical analysis for removal bias) supports a high value for that monitor. Data that is not significantly different is of less value.
- **Trends** – Upward, downward, or stable trend that can be used to evaluate progress towards attainment or evaluate control strategies is of high value.

Situational Criteria:

- **Federal Requirement** – Ambient monitoring specifically required by EPA is of highest value.
- **Meteorological pattern** – Monitor located in primary downwind location of a source or urban area is of high value.
- **Area Scale** – A monitor located with the appropriate scale of representation according to federal and local requirements (micro, middle, neighborhood, urban, or regional scale) is of higher value. Locations judged not to represent the appropriate scale are of low value.

- **Area Represented** – A monitor representing air quality in an area not otherwise represented is of high value. Redundant monitors in an area (with statistically similar data) are of low value.
- **Concentration gradient** – Ambient data at the specified location that are used to determine changes in concentrations between different areas are of high value.
- **Multi-pollutant** – Ambient measurement that complement measurements of one or more other pollutants at the same location is of additional value.

Future Needs and Special Considerations:

- **Cost** – For monitors classified as Marginal and below, the funding needed to support continued measurements may be considered.
- **Impact from NAAQS Revisions** – New or revised NAAQS may require modifications to the design of the existing monitoring network.
- **Source-impact** – Ambient measurements can be dominated by impacts from local sources; if a site is designated for source-oriented impacts, this would be of high value.
- **Community Representation** – Ambient data being collected to address local concerns is of additional value.

Each monitor in the existing network was evaluated and ranked as listed below. The monitors were then grouped by parameter measured, and listed according to relative rank (most critical to least critical).

- **Critical Sites and Monitors** – These are of high value and will be continued. Critical sites and/or monitors meet one or more of the following criteria:
    - The site is the design value site for an area that is at or above the NAAQS;
    - Design values would be significantly changed if the monitor at this site were discontinued (removal bias);
    - Ambient data are close to or above the NAAQS;
    - Long-term multi-pollutant site(s) used by multiple data users for trends and model evaluation (e.g. SIP development and tracking); or
    - Federally mandated monitor or site (e.g., O_3 transport or $PM_{2.5}$ background).

- **Credible Sites and Monitors** – These are expected to continue but may not be the design value location at or above the NAAQS. Credible sites and/or monitors meet one or more of the following criteria:
    - Data provides supplemental information to identify exposures and support AQI forecasting and reporting;
    - Data are used for trends, but are below the NAAQS;
    - Data are occasionally the highest across the represented area due to seasonal meteorology or unique winds;
    - Design values are below the NAAQS but would be significantly changed if the monitor at this site were discontinued (removal bias);
    - Site is the design value location but is below the NAAQS; and
    - Data represent a unique area, population, or condition of concern.

- **Marginal Sites and Monitors** – These may be candidates for removal or movement. Marginal sites and/or monitors meet one or more of the following criteria:
    - Data are used for trends, but are far below (< 50% of) the NAAQS;
    - Not a federally mandated monitor or site; and
    - Sites where data correlates well with nearby site, but which measure lower levels than the nearby site (i.e., redundant for the area – keep the one with higher measurements).

- **New Sites and Monitors** – These represent potential areas of investment pending movement of monitoring resources from other locations or new resources introduced to the program.
    - Newly required locations from recent NAAQS reviews; or
    - Additional measurements at critical and credible locations that could provide additional insight to data users.

Analysis of Current Network by Pollutant

Ozone (O_3)

Current O_3 Sites

O_3 is a priority pollutant in Delaware due to the continuing non-attainment status of New Castle County, which is currently part of the "Philadelphia-Camden-Wilmington, PA-NJ-DE-MD" Core Based Statistical Area (CBSA). Kent County is the entire "Dover, DE" CBSA. Sussex County is part of the "Salisbury, MD-DE" CBSA.

During the past 5 years (2020-2024), the only O_3 monitor in Delaware to exceed the NAAQS was at LUM in 2023, with a one-year site design value of 72 ppb; this was a direct consequence of the exceptional wildfire smoke events of that year. There have been no other O_3 one-year site design value exceedances in New Castle County since 2018, and none in either Kent or Sussex Counties for the last 10 years.

The statewide average O_3 design value for the previous 5-year Assessment (2015-2019) was 68 ppb. This has declined approximately 6% for 2020-2024, to 64 ppb.

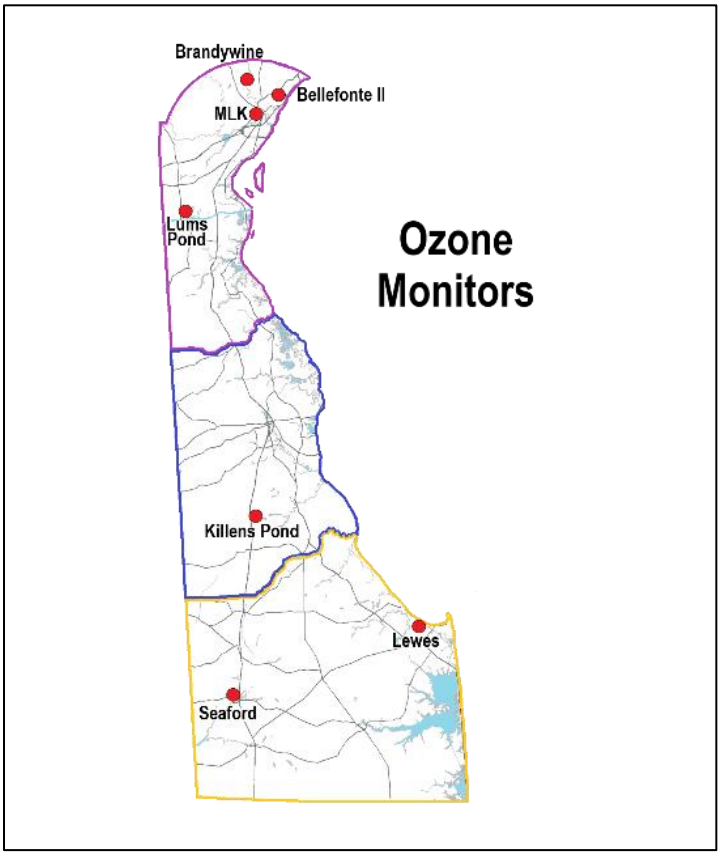


Figure 3: DE O_3 Monitor Site Map

Monitoring Requirements

Within an O_3 network, at least one O_3 site for each MSA must be designed to record the maximum concentration for that area. More than one maximum concentration site may be necessary in some areas. Other types of monitoring sites are needed to determine maximum population exposure, background concentrations, and concentrations being transported into an area (boundary conditions). The appropriate spatial scales for O_3 sites are neighborhood, urban, and regional. Since O_3 requires appreciable formation time, the mixing of reactants and products occurs over large volumes of air, which reduces the importance of monitoring small scale spatial variability.

A prospective maximum concentration monitor site is selected in a direction from the city that is most likely to observe the highest O_3 concentrations; more specifically, downwind during periods of high photochemical activity. Since O_3 levels decrease significantly in the colder parts of the year in many areas, O_3 is required to be monitored only during the ozone season as designated in the 40 CFR Part 58 Appendix D. In Delaware this is March 1 through October 31, except for MLK (NCore site) for which the ozone season is year-round.

Site Details

Delaware operates seven O_3 monitoring sites, including sites for maximum downwind concentrations, background concentrations, and transport conditions. As of 2014, all monitors operate year-round, except during maintenance, quality assurance (QA) activities, or shelter replacement. Hourly data is sent to AirNow.gov, where it is used to generate near-real time AQI and a map of O_3 concentrations throughout the region. Four monitors are in the northern part of the state, New Castle County, which has the highest population density and most recent history of NAAQS exceedances. There is one monitor in Kent County, which serves as a rural/background site, at Killens Pond State Park (KIL). There are two monitors in Sussex County: one in the Seaford area (SEA), and one in Lewes representing the coastal resort area (LEW).

Table 8 shows the Delaware O_3 monitoring sites, along with the county and associated CBSA, and monitoring objectives. Every site serves multiple objectives. It should be noted that the coastal resort areas in Sussex County have a high seasonal population density that is not reflected in annual census bureau population statistics.

Table 8: Delaware O_3 Monitoring Sites

Site Name (Abbreviation) AQS ID	County / CBSA	Spatial Measurement Scale	Monitoring Objectives
Bellefonte II (BF2) 10-003-1013	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Neighborhood	NAAQS compliance Population exposure Primary downwind from Wilmington Trends AQI
Brandywine Creek State Park (BSP) 10-003-1010	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Urban	NAAQS compliance Population exposure Regional Transport (boundary conditions) Secondary downwind from Wilmington Background Trends AQI
Killens Pond State Park (KIL) 10-001-0002	Kent / Dover, DE	Urban	NAAQS compliance Background Trends AQI
Lewes (LEW) 10-005-1003	Sussex / Salisbury, MD-DE	Urban	NAAQS compliance Population exposure Coastal area Trends AQI
Lums Pond State Park (LUM) 10-003-1007	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Urban	NAAQS compliance Regional Transport (boundary conditions) Upwind for Wilmington Background Trends AQI
Seaford (SEA) 10-005-1002	Sussex / Salisbury, MD-DE	Regional	NAAQS compliance Population exposure Regional Transport (boundary conditions) Background Trends AQI
Wilmington NCore (MLK) 10-003-2004	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Urban	NCore requirement NAAQS compliance Maximum concentration Population exposure Trends AQI

On October 1, 2015, the EPA strengthened the primary and secondary NAAQS for ground-level O_3 from the 2008 NAAQS of 0.075 parts per million (ppm) over an 8-hour period to 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.

Situational Analysis

Meteorological data for pollution roses was obtained from the NOAA Local Climatological Database (LCD), unless otherwise noted. https://www.ncdc.noaa.gov/cdo-web/datatools/lcd

Hourly wind data were retrieved from airports located in each county:

- New Castle County: Wilmington New Castle County Airport
  - Station ID: WBAN13781
- Kent County: Dover Airforce Base
  - Station ID: WBAN13707
- Sussex County: Georgetown Delaware Coastal Airport
  - Station ID: WBAN13764

EPA AQI colors and breakpoints used for each pollutant.

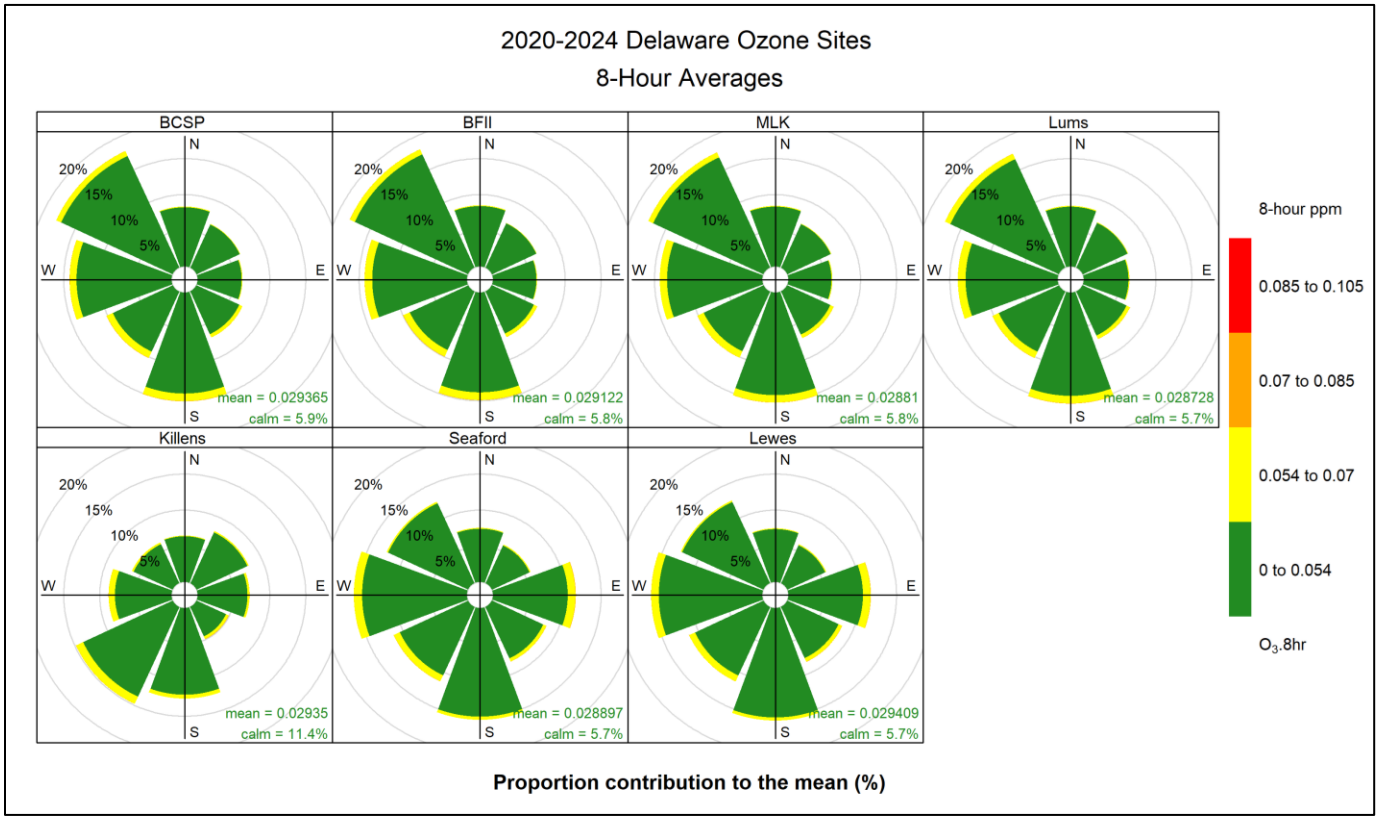


Figure 4: Pollution Roses for All O_3 Monitoring Sites
2020-2024 Rolling 8-Hour Averages

Figure 4 shows pollution roses for all O_3 monitoring sites in Delaware. The length of each rose petal indicates the proportional amount of pollutant that was detected with winds from that direction. The colors indicate what portion of each petal represents pollution concentrations in the range associated with that color.

New Castle County Sites and Characteristics

BF2 (10-003-1013) is the successor site to BF1 (10-003-1003) at the New Castle County River Road Park. BF1 was originally established in 1969 to monitor O_3 and SO_2. When changing site characteristics began to interfere with O_3 monitoring, a new site (BF2) was established in 2001 in Bellevue State Park, less than a mile to the north. The BF2 site meets all EPA siting criteria.

BF2 is a neighborhood scale monitor for O_3, and monitoring objectives are NAAQS compliance, population exposure, AQI, and trends. It is in the primary downwind direction from MLK, and historically was the maximum downwind concentration site. Over the last 10 years, the O_3 design values for MLK and BF2 have not differed by more than 1 ppb. Over the last 5 years, BF2 design values have been consistently 1 ppb below MLK, making it essentially redundant. It is therefore now ranked as marginal for O_3; however, it is not recommended for removal, unless future budgetary constraints force reconsideration.

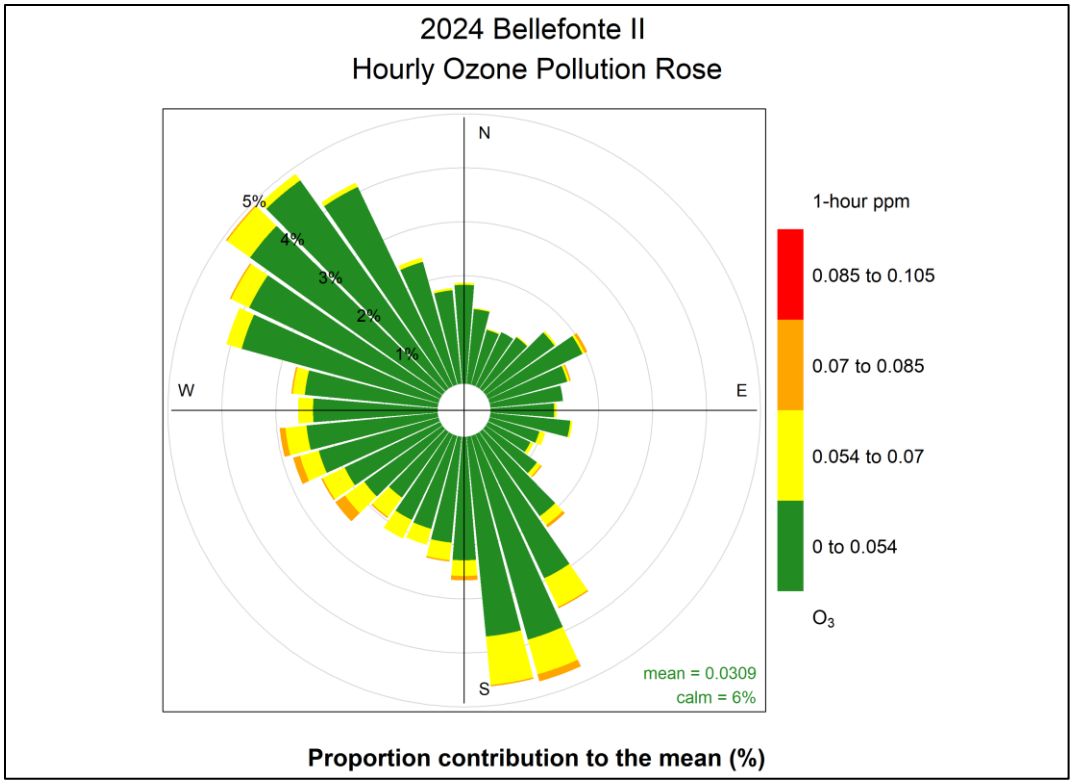


Figure 5: O_3 Pollution Rose – BF2
Wind data source: Wilmington, New Castle County Airport, NOAA LCD

Figure 5 shows that at BF2, highest hourly O_3 concentrations are mostly from the west-southwest and south-southeast directions, although occasional elevated O_3 levels can be seen from most directions except north. Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. The orange areas on this figure do not represent NAAQS exceedances

BSP (10-003-1010). This site is in Brandywine Creek State Park. It is an urban scale site for O_3 monitoring established in 1994. It is in the secondary downwind direction from MLK. Objectives are compliance with NAAQS, population exposure, regional transport, background, AQI, and trends. The site was moved to the park's south end in January 2025, to resolve ongoing power outage and physical access issues, while retaining the significant characteristics of the original site. The site continues to meet all EPA siting requirements.

A site within this state park's boundaries allows monitoring close to populated areas but in a rural setting, far enough from nearby major roadways to avoid NO_X scrubbing of O_3. The location also allows representation of regional transport on days with winds from the northwest quadrant.

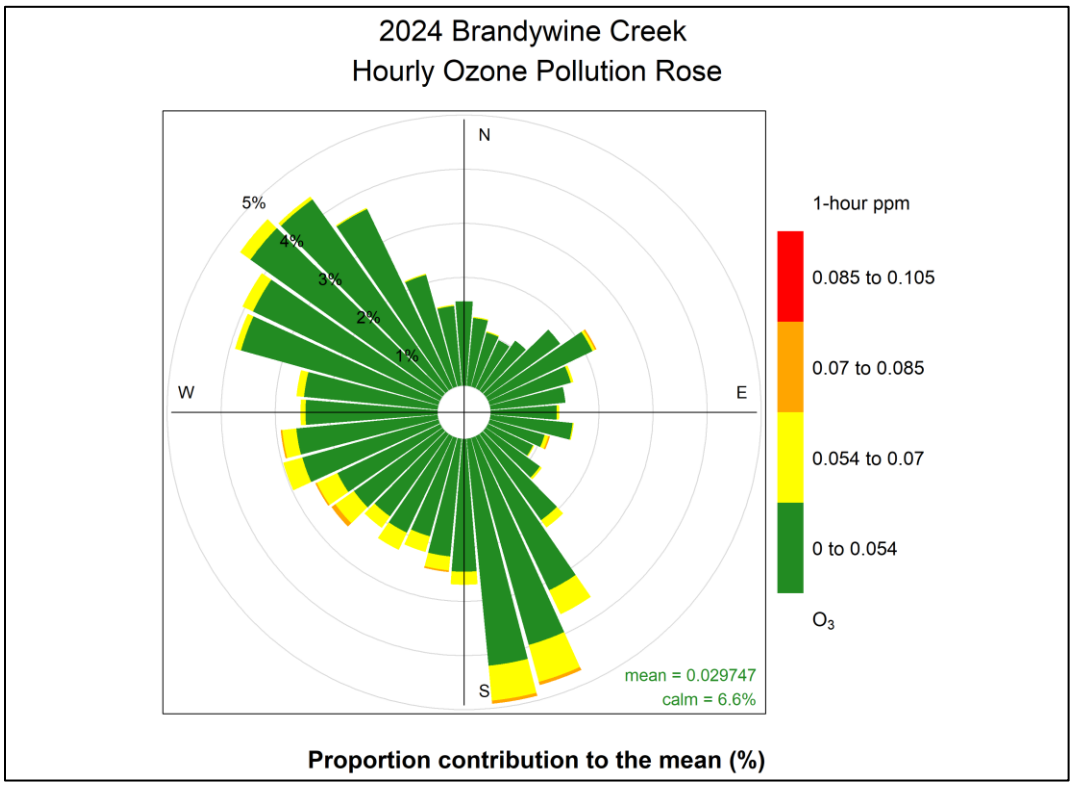


Figure 6: O_3 Pollution Rose - BSP
Wind data source: Wilmington New Castle County Airport, NOAA LCD

Figure 6 shows that at BSP, highest hourly O_3 concentrations are with winds from the southwest and south-southeast. Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. The orange areas on this figure do not represent NAAQS exceedances.

LUM (10-003-1007). The original LUM site (10-003-0018) was established in 1981 at Lums Pond State Park. Changes in a nearby park maintenance area caused the site to be moved to a more open area of the park in late 1991, and the relocated LUM site began reporting data in January 1992. LUM is an urban scale O_3 monitoring site located in a general upwind direction from MLK. The site meets all EPA siting criteria. The site objectives are NAAQS compliance, regional transport, population exposure, AQI, and trends. This location is representative of transport into New Castle County from the Interstate-95 corridor in Maryland to the West, and from the Chesapeake and Delaware (C&D) Canal to the South.

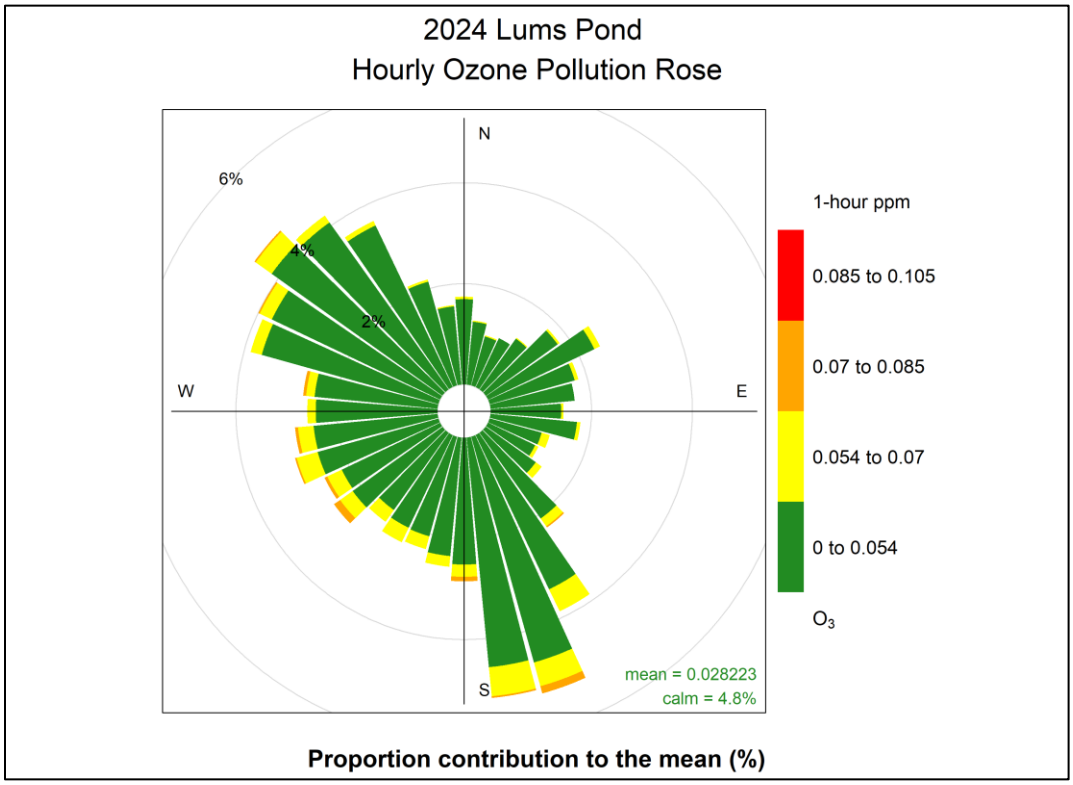


Figure 7: O_3 Pollution Rose - Lums Pond
Wind data source: Wilmington New Castle County Airport, NOAA LCD

Figure 7 shows that at LUM, highest hourly O_3 concentrations are primarily from westerly and southerly directions. Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. The orange areas on this figure do not represent NAAQS exceedances.

MLK (10-003-2004)

National Core (NCore) Monitoring Strategy

In October 2006 the EPA issued amendments to the ambient air monitoring regulations for criteria pollutants. These amendments are codified in 40 CFR parts 53 and 58. The purpose of the amendments was to enhance ambient air quality monitoring to better serve current and future air quality needs. One of the most significant changes was the requirement to establish at least one NCore multi-pollutant monitoring station in each state. These stations provide data on several pollutants at lower detection limits and replace the National Air Monitoring Station (NAMS) network that existed since the 1970s. NCore sites must measure, at a minimum, CO, NO/NOy, O_3, Pb, $PM_{2.5}$ particle mass using filter-based samplers and/or continuous monitors, PM_{coarse} particle mass, speciated $PM_{2.5}$, SO_2, WS/WD, relative humidity, and ambient temperature.

The objective of NCore is to locate and help characterize urban- and regional-scale patterns of air pollution. In 2009, EPA provided funding to begin the process of establishing an NCore station in Delaware. After evaluating the existing network, historical data, census data, meteorology, and topography, Delaware's proposal for the existing MLK monitoring site as Delaware's NCore site was accepted by EPA.

Delaware's NCore monitoring, including PM_{coarse}, O_3, and NOy, became operational on January 1, 2011. The shelter is planned to be replaced in late 2025.

Photochemical Assessment Monitoring System (PAMS) Strategy

In the CAA Amendments of 1990, Section 182 (c)(1), required the EPA to publish rules for enhanced monitoring of O_3, NO_x, and volatile organic compounds (VOCs) for O_3 non-attainment areas, based on their classification, with the goal of obtaining more comprehensive and representative data on O_3 air pollution and its precursors. PAMS measurements are required minimally during the PAMS (summer) sampling season, which is June 1 through August 31, at all NCore sites in CBSAs with a population of 1,000,000 people or more.

As part of the "Philadelphia-Camden-Wilmington, PA-NJ-DE-MD" CBSA and the Ozone Transport Region (OTR), Delaware is required to operate a PAMS at the MLK NCore site. The following measurements are required:

1. Hourly speciated VOC measurements with auto-GCs;
2. Carbonyl sampling (three 8-hour samples on a one-in-three-day sampling frequency);
3. NO, true NO_2, and NO_y measurements; and
4. Surface meteorology measurements including mixing height.

Based on 40 CFR part 58, Appendix D, as amended, state air monitoring agencies were required to begin making PAMS measurements at their NCore location(s) by June 1, 2021, due to an extension granted on 12/20/2019. Most Delaware PAMS monitors collected data for the 2022 PAMS season, but the data are not fully validated. PAMS was in full operation for the 2023 PAMS season.

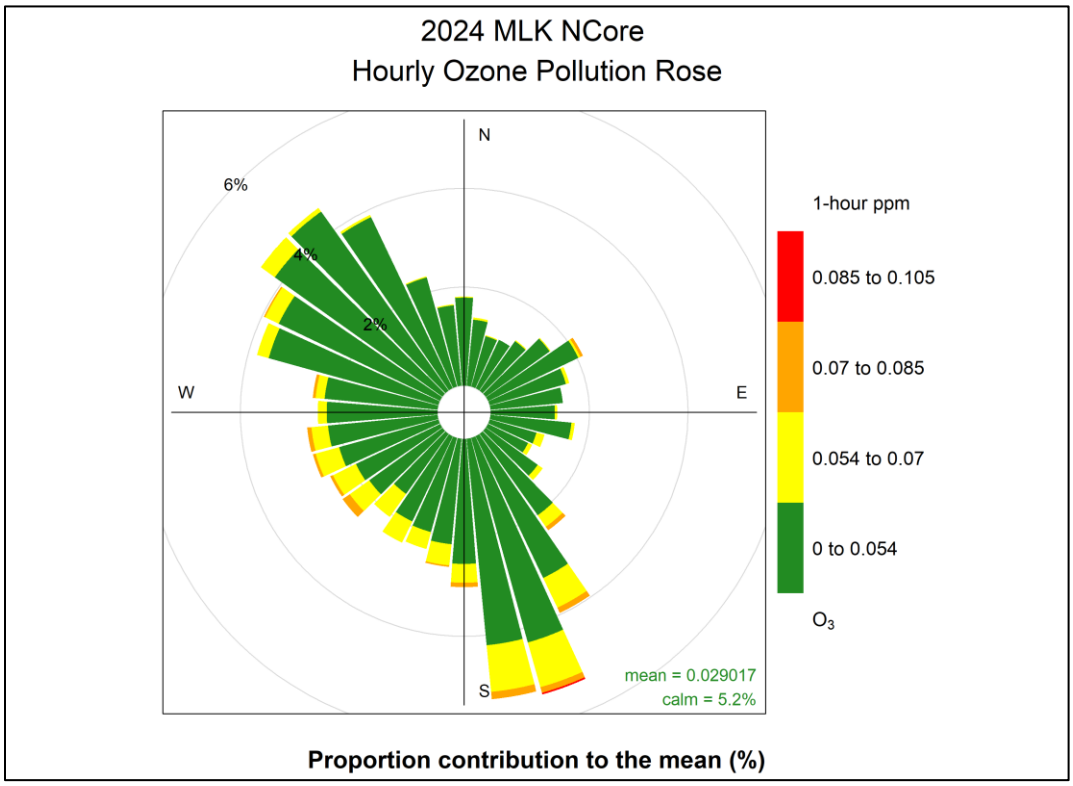


Figure 8: O_3 Pollution Rose – MLK NCore
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

Figure 8 shows that at MLK, highest hourly O_3 concentrations are with winds from the south-southeast and west-southwest. Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. The orange areas on this figure do not represent NAAQS exceedances.

Kent County Sites and Characteristics

KIL (10-001-0002). This site was established in 1995 in Killens Pond State Park, a rural area south of Dover, as a background O_3 site. It is urban scale for O_3 and meets all EPA siting criteria. KIL is the only required O_3 monitoring site in Kent County. Objectives include NAAQS compliance, regional transport, background, AQI, and trends.

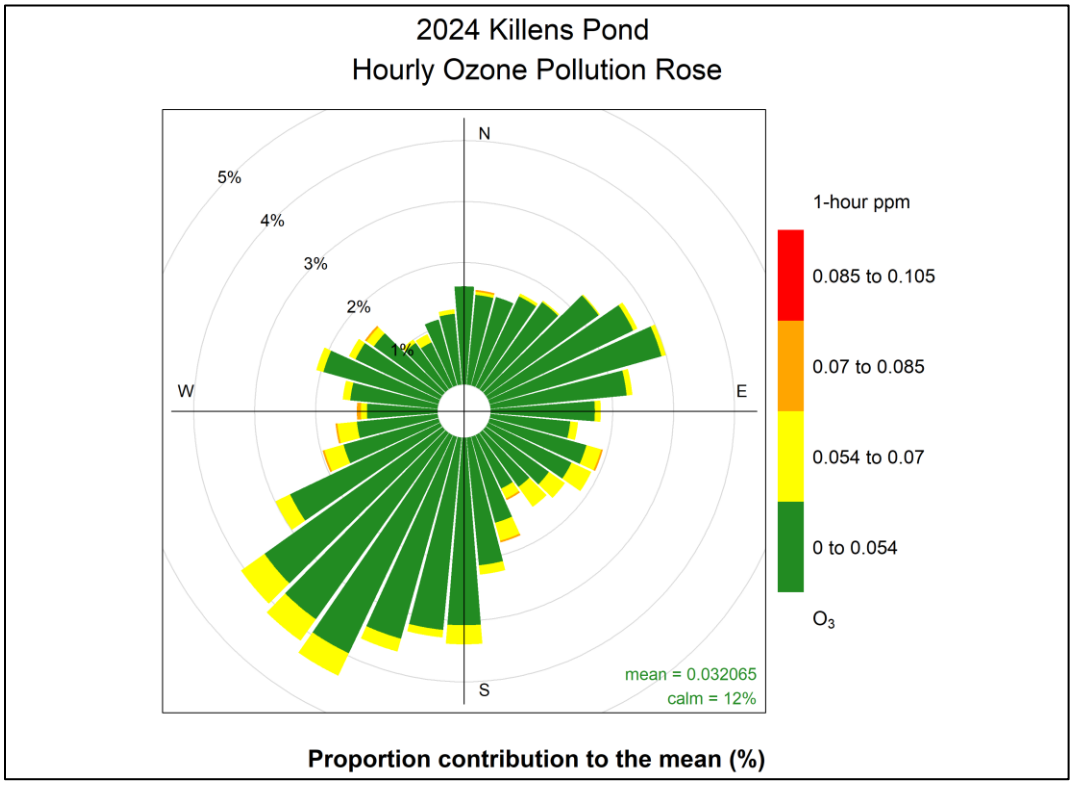


Figure 9: O_3 Pollution Rose - KIL
Wind data source: Dover Airforce Base, NOAA LCD

Figure 9 shows that at KIL, the highest hourly O_3 concentrations are with westerly winds, although that is the least common wind direction at the site. Winds come mostly from southwesterly directions, but typically carrying O_3 lower concentrations. Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. The orange areas on this figure do not represent NAAQS exceedances.

Sussex County Sites and Characteristics

SEA (10-005-1002) The original Seaford monitoring site (10-005-1001) was established in 1971 at a location near the Seaford water tower. O_3 monitoring was added in 1983. Over time, site maintenance problems developed at the water tower that interfered with O_3 monitoring, and in 1990 it was relocated further north to the current site on Virginia Ave.

This O_3 site is urban scale and is in a suburban setting. The site is impacted by local point sources, mobile sources, and regional transport. The site meets all EPA siting criteria. The monitoring objectives are NAAQS compliance, population exposure, regional transport, background, AQI, and trends.

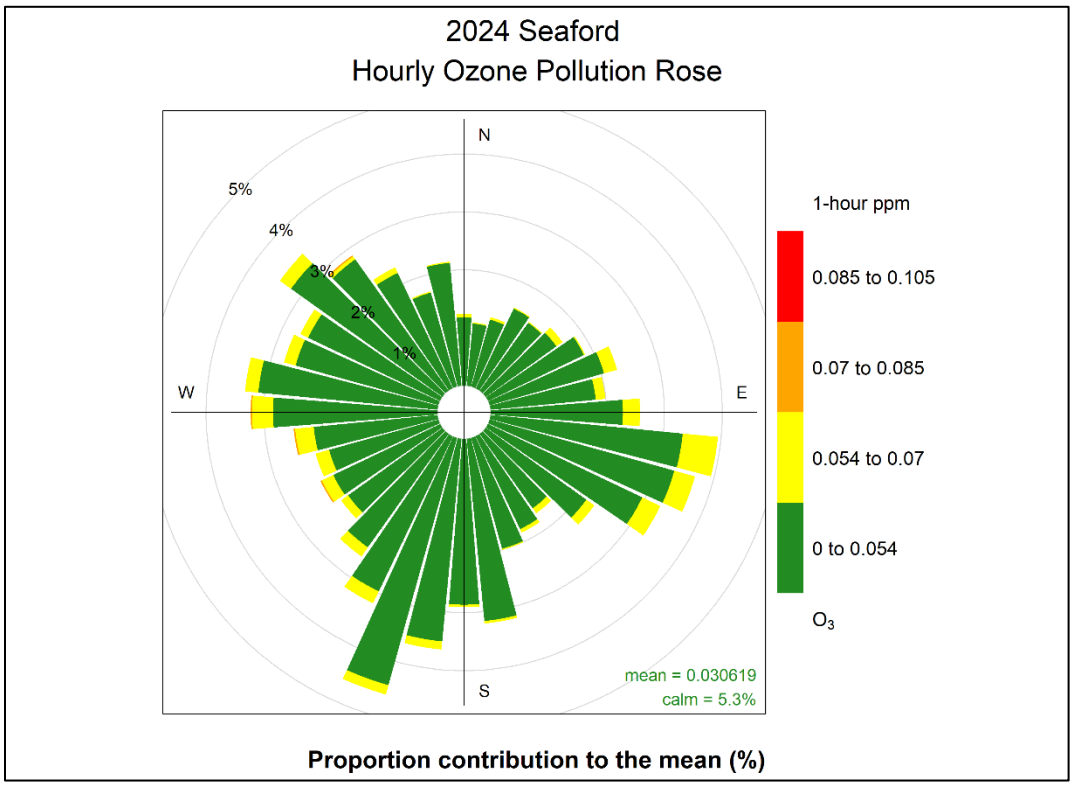


Figure 10: O_3 Pollution Rose - SEA
Wind data source: Georgetown Delaware Coastal Airport, NOAA LCD

Figure 10 shows that at SEA moderately elevated hourly O_3 concentrations occur with winds from all directions, but the occasional highest concentrations occur mainly with winds from the west. Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. The orange areas on this figure do not represent NAAQS exceedances.

LEW (10-005-1003) It was recognized for some time that the SEA O_3 site was not completely representative of the maximum population exposure in the county because of the seasonal population shift to resort areas along the coast. In addition, coastal meteorology was not adequately represented by the meteorological monitoring at SEA. In 1997, LEW was established on the property of the University of Delaware College of Marine Studies campus. The site meets all EPA siting criteria. Monitoring objectives include NAAQS compliance, population exposure, coastal conditions, AQI, and trends.

The Indian River Generating Station, a coal-fired power plant located in Dagsboro, DE, approximately 13 miles to the south-southwest of LEW, ceased operation in February 2025. The site had been equipped with effective pollution control equipment that helped bring Sussex County into attainment with the NAAQS. The shutdown is not expected to have a large impact on ambient O_3 levels, but may further lower SO_2 readings in Sussex County.

Because LEW has the most unique pollutant levels in Delaware, covers an area with seasonally large population density, and characterizes coastal conditions, LEW remains ranked as critical. Due to differences between coastal and inland meteorological conditions, it is strongly recommended to collect weather data on site, with certified and audited equipment meeting acceptable EPA data quality objectives (DQO).

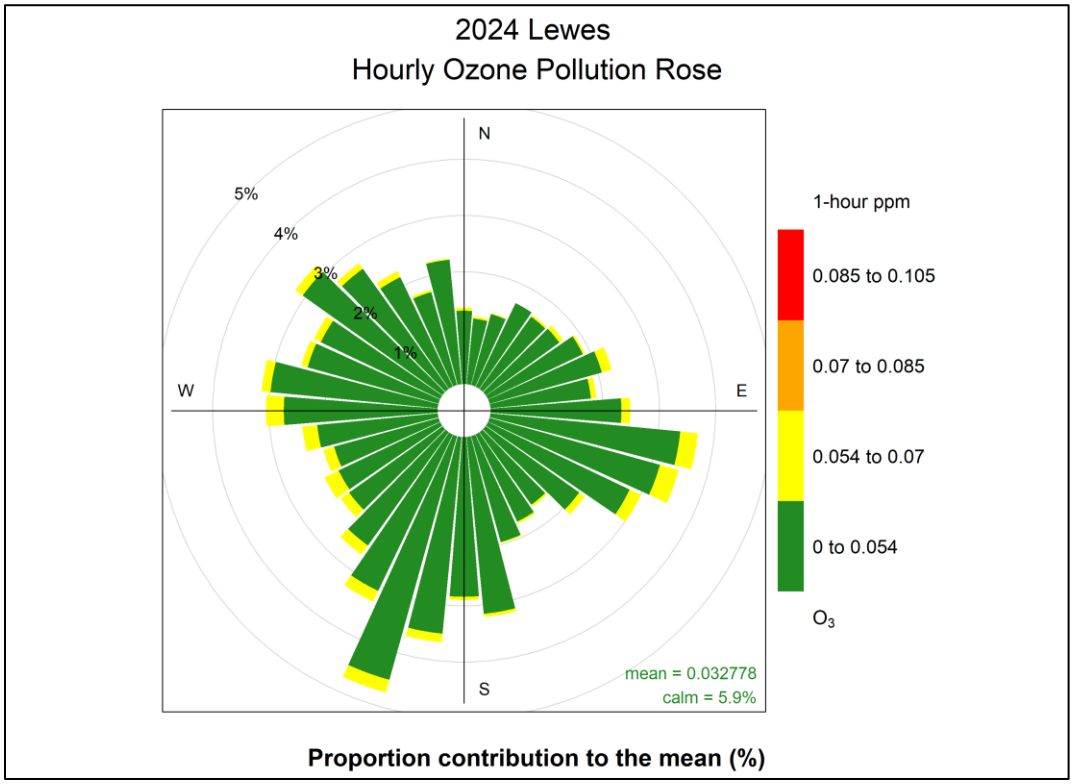


Figure 11: O_3 Pollution Rose - Lewes
Wind data source: Georgetown Delaware Coastal Airport, NOAA LCD
**Note this is an inland airport vs a coastal site*

Figure 11 shows that at LEW, high O_3 concentrations do not appear strongly correlated with wind direction. This may be due to the limitations of using inland wind data for a coastal site, and/or because LEW has had the lowest O_3 levels in Delaware since 2019.

Note that hourly O_3 concentrations are not compared to the NAAQS, only 8-hour averages. Hourly averages at LEW never exceeded 0.070 ppm in 2024, so there are no orange areas on this figure.

Emissions Information

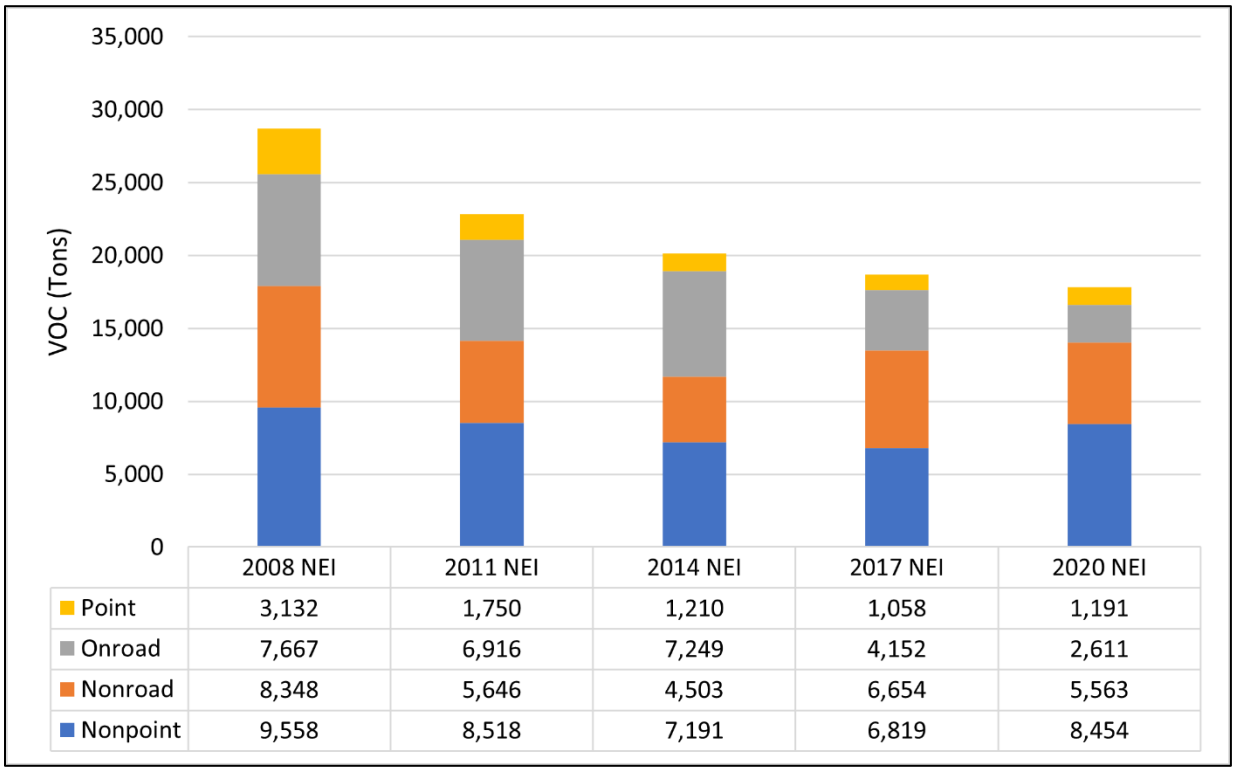
Trends – Statewide from 2020 National Emissions Inventory (NEI)

O_3 is rarely a directly emitted pollutant, but rather a byproduct from atmospheric reactions of ozone precursors, which include VOCs, NO_X, and CO. VOC trends are shown in Figure 12, while CO and NO_X are discussed in their respective sections of this report (Figures 31 and 44, respectively).

Figure 12 show VOC emissions for Delaware as reported in the DNREC 2025 Regional Haze Report, based on data from the most recently available completed NEI (2020). VOC emissions in Delaware are generally dominated by the nonpoint, nonroad, and onroad categories.

Overall, point sources are generally not a major contributor to VOC emissions. Figure 12 shows there has been a modest decline in total Delaware VOC emissions between 2008 and 2020. This correlates with improving ambient O_3 levels.

More information on the NEI, including data, is available from the EPA's NEI page.



	2008 NEI	2011 NEI	2014 NEI	2017 NEI	2020 NEI
Point	3,132	1,750	1,210	1,058	1,191
Onroad	7,667	6,916	7,249	4,152	2,611
Nonroad	8,348	5,646	4,503	6,654	5,563
Nonpoint	9,558	8,518	7,191	6,819	8,454

Figure 12: VOC Emissions Trends

The highest emitting point sources for VOCs in Delaware according to the 2020 NEI are:

- Delaware City Refinery
- Dover AFB Airport
- Port of Wilmington

Statistical Analysis

O_3 monitors in Delaware have shown steadily improving air quality since the 1980s. The O_3 design value chart shows the 8-hour design value trends for each site compared to the applicable NAAQS for each year. Data for individual sites is included in Table 9.

In the 1990s there was greater variation in design values between sites in New Castle County compared to sites in the other two counties. After 2000, design values became more similar throughout the state. Since 2019, O_3 design values (3-yr average of highest 1-yr site design values in each county) in all three counties have met the standard. "Philadelphia-Camden-Wilmington, PA-NJ-DE-MD" CBSA design values remain above the standard. New Castle County remains designated by EPA as "non-attainment for O_3" because it is part of that CBSA.

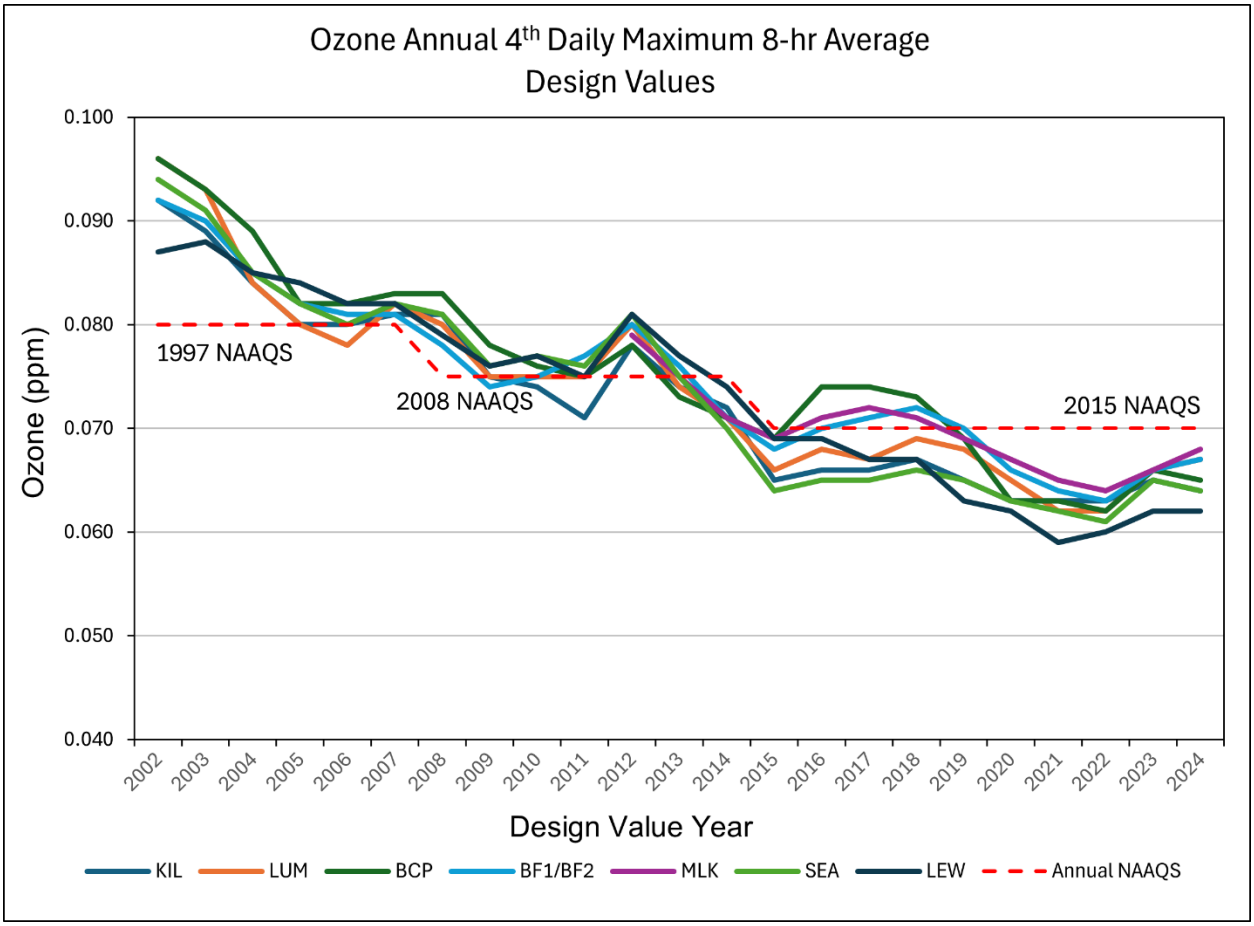


Figure 13: O_3 Design Value Trends

3 Year Average 4th Daily Maximum 8-hour Average (ppm)

Table 9: O_3 8-hour Design Values by Site

3 Year Average 4th Daily Maximum 8-hour Average O_3 measurement in ppm

Notes: Design Value year is the last indicated year (e.g., 2000-2002 is design value year 2002 which includes 2000, 2001, and 2002). 5-Year Assessments began in 2010. Periods are shaded to help distinguish between assessments.

5-Year Assessment	DV Years	KIL	LUM	BSP	BF2	MLK	SEA	LEW
2010	2000-2002	0.092	0.096	0.096	0.092		0.094	0.087
	2001-2003	0.089	0.093	0.093	0.090		0.091	0.088
	2002-2004	0.084	0.084	0.089	0.085		0.085	0.085
	2003-2005	0.080	0.080	0.082	0.082		0.082	0.084
	2004-2006	0.080	0.078	0.082	0.081		0.080	0.082
	2005-2007	0.081	0.082	0.083	0.081		0.082	0.082
	2006-2008	0.081	0.080	0.083	0.078		0.081	0.079
	2007-2009	0.075	0.075	0.078 *	0.074		0.076	0.076
2015	2008-2010	0.074	0.075	0.076 *	0.075		0.077	0.077
	2009-2011	0.071	0.075	0.075 *	0.077		0.076	0.075
	2010-2012	0.078	0.080	0.078 *	0.080	0.079 *	0.081	0.081
	2011-2013	0.074	0.074	0.073 *	0.076	0.075 *	0.075	0.077
	2012-2014	0.072	0.071	0.071 *	0.071	0.071	0.070	0.074
2020	2013-2015	0.065	0.066	0.069 *	0.068	0.069 *	0.064	0.069
	2014-2016	0.066	0.068	0.074	0.070	0.071	0.065	0.069
	2015-2017	0.066	0.067	0.074	0.071	0.072	0.065	0.067
	2016-2018	0.067	0.069	0.073	0.072	0.071	0.066	0.067
	2017-2019	0.065	0.068	0.069	0.070	0.069	0.065	0.063
2025	2018-2020	0.063	0.065	0.063	0.066	0.067	0.063	0.062
	2019-2021	0.063	0.062 *	0.063	0.064	0.065	0.062	0.059*
	2020-2022	0.063	0.062 *	0.062	0.063	0.064	0.061	0.060
	2021-2023	0.065	0.066	0.066	0.066	0.066	0.065	0.062*
	2022-2024	*0.064*	*0.067*	*0.065*	*0.067*	*0.068*	*0.064*	*0.062*

*One or more years with less than 75% data completeness

2024 design values are preliminary; data certified by AQ but awaits concurrence from EPA.

Table 10 shows the comparison of the two most recent Delaware O_3 design values and percent differences from the 2015 NAAQS.

Table 10: Two Most Recent Design Value Years Compared to NAAQS

County	Site	2021-2023 DV ppm	% Δ from 2015 NAAQS 0.070 ppm	2022-2024 DV ppm	% Δ from 2015 NAAQS 0.070 ppm
New Castle	BF2	0.066	-6	0.067	-4
New Castle	BSP	0.066	-6	0.065	-7
New Castle	LUM	0.066	-6	0.067	-4
New Castle	MLK	0.066	-6	0.068	-3
Kent	KIL	0.065	-7	0.064	-9
Sussex	LEW	0.062	-11	0.062	-11
Sussex	SEA	0.065	-7	0.064	-9

Current design values for all three counties are below the primary O_3 NAAQS.

Correlation Matrix

In 2010 EPA provided a data analysis tool to examine correlation coefficients between sites. According to EPA, the purpose of this tool was to provide a means of determining possible redundant sites that could be removed. Redundant sites exhibit consistently high correlations (shown in the red scale on figure 14) across all their pairings and have low average difference, (shown in the blue scale on figure 14) regardless of distance between them. It is expected that correlation between sites will decrease as distance increases. However, for a regional air pollutant such as O_3, sites in the same air shed can have similar concentrations and be highly correlated. More unique sites would exhibit the opposite characteristics; they would not be well correlated with other sites and their relative differences would be higher than other site to site pairs.

In 2025 the NetAssess application was updated by the EPA's Office of Air Quality Planning and Standards (OAQPS). The tool was based on the 2015 NetAssess[2] by a LADCO (Lake Michigan Air Directors Consortium) workgroup consisting of people from Indiana, Minnesota, and Michigan focusing on the 2015 network assessment. NetAssess2025[3] is the most recent update to the Network Assessment tools. It uses AQS data from 2021 through 2023.

AQ used the tool to examine the O_3 monitoring sites in Delaware along with the nearest sites in adjoining states (Maryland, Pennsylvania, and New Jersey) in the same air shed. The results are shown in Figure 14.

[2] LADCO (Lake Michigan Air Directors Consortium) NetAssess tool, http://ladco.github.io/NetAssessApp/index.html
[3] EPA OAQPS NetAssess2025, https://rconnect-public.epa.gov/NetAssess2025/

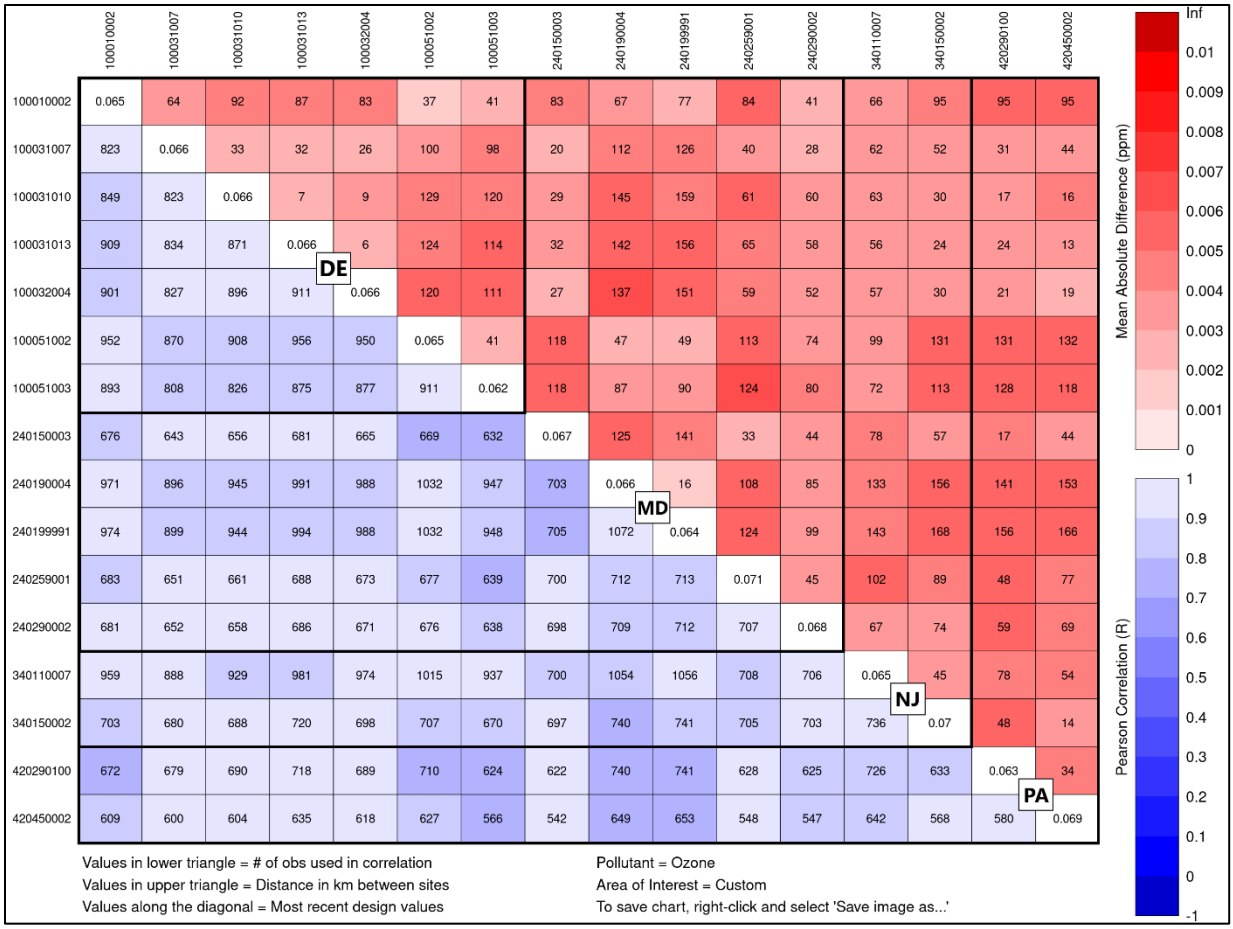


Figure 14: NetAssess Correlation Matrix - Delaware and Nearby State O_3 Sites
Design Value Year 2023
Note: Sites listed in AQS ID order

The sites used in this analysis are shown on the map in Figure 15.

As described in the NetAssess application documentation, the correlation between two sites quantitatively describes the degree of relatedness between measurements made at two sites. That relatedness could be caused by various influences including a common source affecting both sites to pollutant transport caused meteorology. The correlation, however, may indicate whether a pair of sites is related, but it does not indicate if one site consistently measures pollutant concentrations at levels substantially higher or lower than the other. For this purpose, the daily relative difference is defined as:

$$\frac{abs(s1-s2)}{avg(s1,s2)}$$

where "s1" and "s2" represent the O_3 concentrations at sites one and two in the pairing, "abs" is the absolute difference between the two sites and "avg" is the average of the two site concentrations.

The average relative difference between two sites is an indicator of overall measurement similarity between them. Site pairs with a lower average relative difference are more like each other than pairs with a larger difference. Both the correlation and the relative difference between sites are influenced by the distance separating them. Usually, sites farther from each other will be less correlated and have larger differences in measured pollutant concentrations.

Table 11: Correlation Data (R^2) for Delaware O_3 Sites

Including with nearby out of state sites, DV Year 2023

Site ID	10-001-0002 **KIL**	10-003-1007 **LUM**	10-003-1010 **BSP**	10-003-1013 **BF2**	10-003-2004 **MLK**	10-005-1002 **SEA**	10-005-1003 **LEW**
10-003-1007 **LUM**	0.91						
10-003-1010 **BSP**	0.87	0.95					
10-003-1013 **BF2**	0.87	0.96	0.96				
10-003-2004 **MLK**	0.87	0.96	0.95	0.97			
10-005-1002 **SEA**	0.97	0.89	0.85	0.85	0.85		
10-005-1003 **LEW**	0.93	0.85	0.81	0.81	0.82	0.94	
24-015-0003 **Fair Hill**	0.84	0.96	0.94	0.95	0.95	0.8	0.77
24-019-0004 **Horn Point**	0.93	0.87	0.83	0.83	0.83	0.95	0.90
24-019-9991 **Blackwater**	0.93	0.87	0.84	0.84	0.84	0.95	0.89
24-025-9001 **Aldino**	0.95	0.96	0.91	0.91	0.91	0.91	0.86
24-029-0002 **Millington**	0.85	0.94	0.92	0.94	0.94	0.83	0.81
34-011-0007 **Millville**	0.79	0.92	0.91	0.92	0.92	0.78	0.71
34-015-0002 **Clarksboro**	0.82	0.94	0.92	0.95	0.97	0.81	0.78
42-029-0100 **New Garden**	0.85	0.94	0.92	0.93	0.93	0.81	0.78
42-045-0002 **Chester**	0.95	0.93	0.89	0.9	0.91	0.92	0.91

DE
MD
NJ
PA

Note: Sites listed in AQS ID order

Table 12: Correlation Data - Average Relative Differences for O_3 Sites (ppm)

DV Year 2023

Site ID	10-001-0002 **KIL**	10-003-1007 **LUM**	10-003-1010 **BSP**	10-003-1013 **BF2**	10-003-2004 **MLK**	10-005-1002 **SEA**	10-005-1003 **LEW**
10-003-1007 **LUM**	0.003						
10-003-1010 **BSP**	0.004	0.003					
10-003-1013 **BF2**	0.004	0.003	0.002				
10-003-2004 **MLK**	0.005	0.003	0.003	0.002			
10-005-1002 **SEA**	0.002	0.004	0.005	0.005	0.005		
10-005-1003 **LEW**	0.003	0.004	0.005	0.005	0.006	0.003	
24-015-0003 **Fair Hill**	0.004	0.002	0.003	0.003	0.003	0.005	0.005
24-019-0004 **Horn Point**	0.003	0.004	0.005	0.005	0.006	0.003	0.004
24-019-9991 **Blackwater**	0.003	0.004	0.005	0.005	0.006	0.002	0.004
24-025-9001 **Aldino**	0.005	0.004	0.005	0.005	0.004	0.005	0.006
24-029-0002 **Millington**	0.003	0.003	0.004	0.004	0.004	0.003	0.004
34-011-0007 **Millville**	0.003	0.003	0.004	0.004	0.004	0.004	0.004
34-015-0002 **Clarksboro**	0.005	0.003	0.004	0.003	0.003	0.005	0.006
42-029-0100 **New Garden**	0.005	0.004	0.004	0.004	0.004	0.005	0.006
42-045-0002 **Chester**	0.005	0.003	0.004	0.003	0.003	0.006	0.006

DE
MD
NJ
PA

Note: Sites listed in AQS ID order

Tables 11 and 12 show New Castle County sites are well correlated (R^2 0.81-0.97), with low average differences (2-4 ppb). KIL and SEA are very well correlated (R^2 0.97, diffs 2 ppb). LEW is least like other sites in the state (R^2 0.81-0.94, diffs 3-6 ppb). Nearby sites outside Delaware have wider range of correlations with Delaware sites (R^2 0.71-0.97, diffs 2-6 ppb), typically worse with increasing distance between pairs.

The decreasing variation in O_3 design values suggests less influence from local sources and more influence due to regional sources and transport.

Removal Bias

The removal bias tool is meant to aid in determining redundant sites. The bias estimation uses the nearest neighbors to each site to estimate the concentration at the location of the site if the site had never existed. This is done using the Voronoi Neighborhood Averaging algorithm with inverse distance squared weighting. The squared distance allows for higher weighting on concentrations at sites located closer to the site being examined. The bias was calculated for each day at each site by taking the difference between the predicted value from interpolation and the measured concentration. A positive average bias (red) means that if the site being examined was removed, the neighboring sites would estimate the concentration to be larger than the measured concentration. Likewise, a negative average bias (blue) means the estimated concentration at the site would be smaller than the measured concentration.

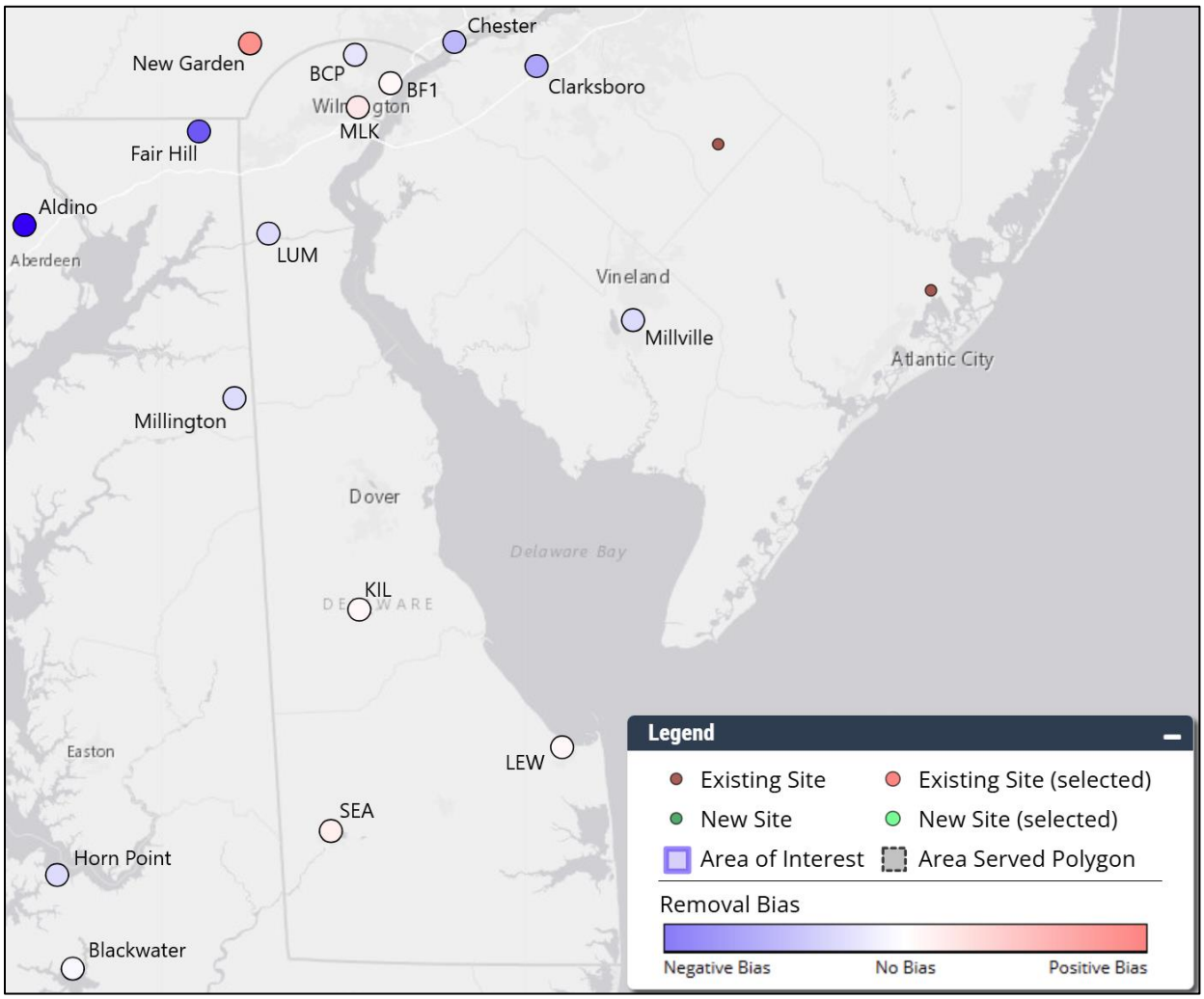


Figure 15: NetAssess O_3 Site Removal Bias Map Output

Table 13: NetAssess O_3 Removal Bias results

AQS ID	Site	Removal Bias Mean	Removal Bias Standard Deviation	Mean Relative Removal Bias (%)
10-001-0002	KIL	0.0001	0.0021	0.5
10-003-1007	LUM	-0.0004	0.0025	-1.2
10-003-1010	BSP	-0.0003	0.0034	-1.1
10-003-1013	BF2	0.0001	0.0026	0.7
10-003-2004	MLK	0.0003	0.0030	2.4
10-005-1002	SEA	0.0002	0.0021	0.9
10-005-1003	LEW	0.0001	0.0032	0.4

Note: Sites listed in AQS ID order

Figure 15 and Table 13 show that some small amount of bias could be introduced to O_3 design value calculations by removing any site in Delaware. However, all these biases are small (≤ 0.4 ppb). This is consistent with decreasing variation in O_3 design values. Thus, O_3 removal bias is not a distinguishing factor in this assessment.

Other Considerations

Since the 2020 assessment, some monitoring equipment has been updated; however, all but one of the O_3 monitors in service are older than the recommended maximum age of seven years (ranging from eight to 14 years old). All the older instruments are Thermo Model 49i, which is no longer manufactured. These should be considered for replacement as soon as resources become available. The newest instrument is a Thermo Model 49iQ, which is the currently preferred replacement, because it uses the same EPA measurement method as the Model 49i it replaces, is very similar to operate, and takes many of the same parts.

Similarly, most O_3 calibrators in service are Thermo Model 49i-PS, and all but one of those have been in service for more than seven years. AQ operates one newer (less than three years old) Thermo Model 49iQ-PS, which is currently functioning well in the field.

AQ also operates two Teledyne T703U O_3 calibrators that have proven difficult to verify against Level 2 Ozone Transfer Standards and have high sensitivity to installation variations in the field.

It is recommended that only one type of ozone calibrator be used throughout the network. This would provide greater consistency, ease of training, and fewer kinds of spare parts needed.

Future Needs

While 2020 through 2024 ambient air data showed O_3 design values below the NAAQS, continued monitoring is necessary. As funds become available, instruments and shelters will continue to need replacement.

Assessment Recommendations

See Table 29 in the "Results" section, page 101, for a summary of the 5 Year Network Assessment Rankings for O_3 monitors at each O_3 monitoring site. All existing O3 monitors are ranked "Critical" with the exceptions of LEW ("Credible") and BF2 ("Marginal").

LEW O_3 is ranked credible, even though it consistently has the lowest DV in the State and a small removal bias. It is the only coastal site, covers seasonal population exposure, and generally has the most unique readings in the State. The February 2025 shutdown of nearby Indian River Generating Station may affect DVs. No changes are recommended at this time.

BF2 O_3 is ranked marginal, because it is statistically redundant with MLK, and consistently about 1 ppb lower. It is also statistically similar to the O_3 monitor in nearby Chester, PA. It meets all CFR requirements for removal, requiring only EPA concurrence. However, it is not currently recommended to remove it, unless lack of funding or other operational constraints require it.

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

Current $PM_{2.5}$ Sites

$PM_{2.5}$ is a priority pollutant in Delaware because concentrations remain close to the NAAQS, particularly in the urban Wilmington area. In 2012, New Castle County reached attainment for the 2008 $PM_{2.5}$ NAAQS, as part of the "Wilmington DE-MD-NJ Metro Division" consisting of New Castle County, DE, Cecil County, MD, and Salem County, NJ. This metro division is a subset of the "Philadelphia-Camden-Wilmington, PA-NJ-DE-MD" CBSA. In 2012 a maintenance plan for $PM_{2.5}$ was put in place for New Castle County. At this time the entire state of Delaware remains in attainment for $PM_{2.5}$, even when taking into consideration the 2024 reduction in the $PM_{2.5}$ annual average NAAQS standard from 12 to 9 $\mu g/m^3$. See Figures 24 and 25 for more detail. Delaware submitted designations to EPA in 2025, recommending attainment.

Delaware operates either sampler-based Federal Reference Method (FRM) or continuous Federal Equivalent Method (FEM) $PM_{2.5}$ monitors at eight sites throughout the state. All monitors operate year-round. Collocated FRM samples are taken at the MLK site. Delaware has replaced FRM samplers with continuous FEM monitors at most sites. The MLK and LUM sites are exceptions, where FRM and FEM monitors are collocated. The FRM sampler at LUM is counted towards meeting collocation requirements but would count the same at any site except MLK, which already has collocated FRM. It is recommended that consideration be given to moving the LUM FRM sampler to different sites that might benefit from FRM collocation, for example NWK.

The normal EPA National Sampling Schedule for manual samplers is 24 hours every three days as specified. At MLK samples are collected every day and collocated samples are collected every sixth day. Continuous FEM monitors generate data at hourly and 24-hour intervals. Continuous monitors help support the goal of near real-time AQI reporting.

Monitoring Requirements

State agencies must operate at least the minimum number of required $PM_{2.5}$ sites listed in 40 CFR Part 58 Appendix D Table D-5. As of the 2020 census population figures, as well as the estimated 2023 populations, the CFR requires a minimum of two PM2.5 monitors in New Castle County, and one each in Kent and Sussex Counties. These required monitors must be sited to represent community-wide air quality. In addition, the following siting criteria apply:

1) At least one monitoring station is to be sited in a population-oriented area of expected maximum concentration (MLK).
2) For areas with more than one required station, a monitoring station is to be sited in an area of poor air quality (RT9).
3) Each State shall install and operate at least one $PM_{2.5}$ site to monitor for regional background (KIL) and at least one $PM_{2.5}$ site to monitor regional transport (LUM).

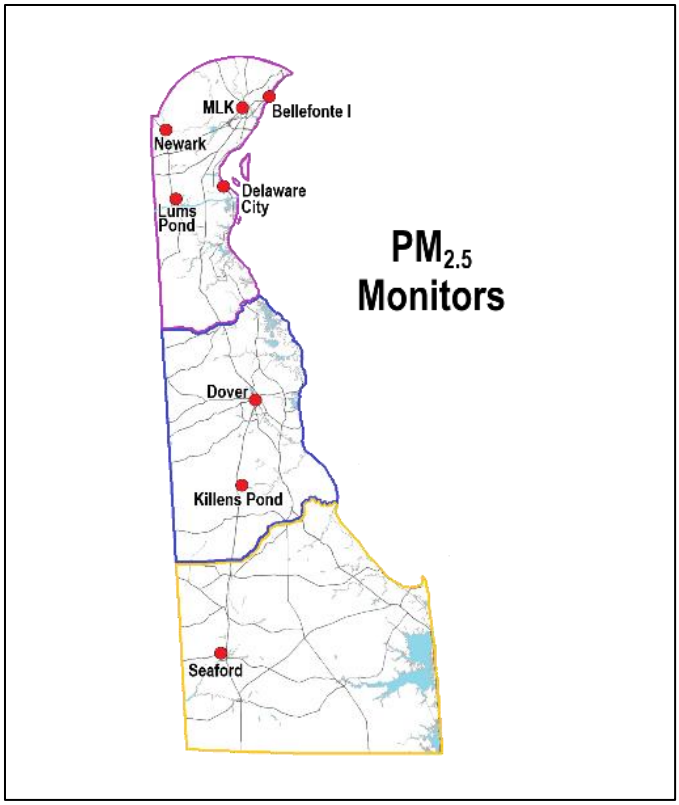


Figure 16: Delaware $PM_{2.5}$ Monitor Map

Table 14: Delaware $PM_{2.5}$ Monitoring Sites

Site Name (Abbreviation) AQS ID	County / CBSA	Spatial Measurement Scale	Monitoring Objectives
Bellefonte I (BF1) 10-003-1003	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Middle	NAAQS compliance Population exposure Trends Continuous monitor for AQI
Delaware City (RT9) 10-003-1008	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Neighborhood	NAAQS compliance Population exposure Trends Continuous monitor for AQI
Lums Pond State Park (LUM) 10-003-1007	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Urban	NAAQS compliance Population exposure Regional transport Upwind for MLK Trends Continuous monitor for AQI

Site Name (Abbreviation) AQS ID	County / CBSA	Spatial Measurement Scale	Monitoring Objectives
Newark (NWK) 10-003-1012	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Micro	Population exposure Maximum concentration Continuous monitor for AQI
Wilmington NCore (MLK) 10-003-2004	New Castle / Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Neighborhood	NAAQS compliance Population exposure/Max. concentration NCore PAMS Trends Continuous monitor for AQI
Dover (DVR) 10-001-0003	Kent / Dover, DE	Neighborhood	NAAQS compliance Population exposure Trends Continuous monitor for AQI
Killens Pond State Park (KIL) 10-001-0002	Kent / Dover, DE	Urban	NAAQS compliance Regional background Trends Continuous monitor for AQI
Seaford (SEA) 10-005-1002	Sussex / Salisbury, MD-DE	Urban	NAAQS compliance Regional transport from south and southwest Population exposure Trends Continuous monitor for AQI

Situational Analysis

Pollution roses utilize hourly data, because the $PM_{2.5}$ data from FRM methods represent 24-hour averages, traditional pollution roses are not available; where hourly continuous $PM_{2.5}$ data was available, pollution roses were generated. Meteorological data for pollution roses was obtained from the NOAA Local LCD, unless otherwise noted. Refer to the Meteorological Summary section for more details on wind data sources.

The NAAQS is still based on a 24-hour average, but FEM instruments have allowed for hourly observations. The highest hourly average concentrations over the past 5 years vary by site, but were dominated by wildfire smoke events of 2023. The Newark monitor was malfunctioning during several months of 2023, including during the wildfire smoke events, so its pollution rose does not show any red or purple for PM AQI.

EPA AQI colors and breakpoints used for each pollutant.

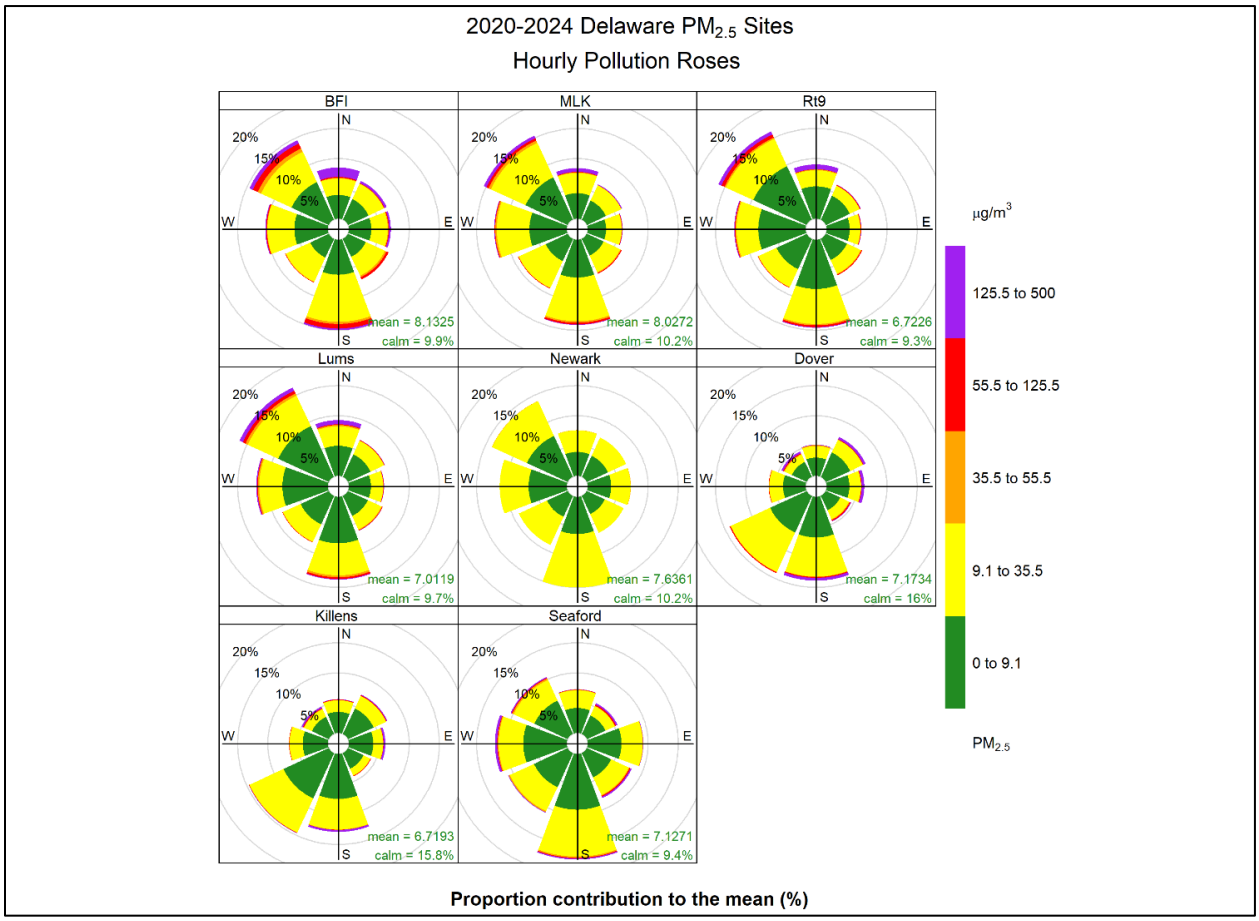


Figure 17: Pollution Roses for All Continuous $PM_{2.5}$ Monitoring Sites

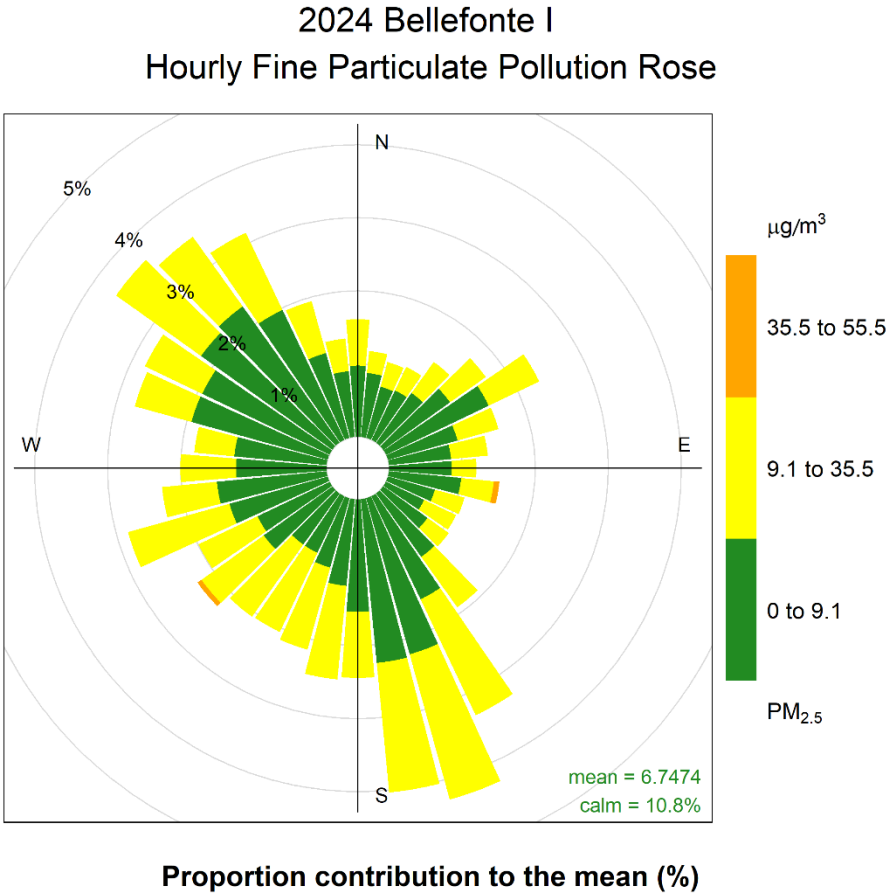
In Figure 17, the length of each rose petal indicates the proportional amount of pollutant that was detected with winds from that direction. The colors indicate what portion of each petal represents pollution concentrations in the range associated with each color. This figure shows five years of wind and $PM_{2.5}$ data. The red and purple areas are almost exclusively associated with out of state wildfire smoke events in 2023. Despite this, $PM_{2.5}$ design values did not exceed the NAAQS. This is due to regulatory 3-year averaging.

Individual site analyses using pollution roses with hourly data from 2024 are presented below.

Platform Sites

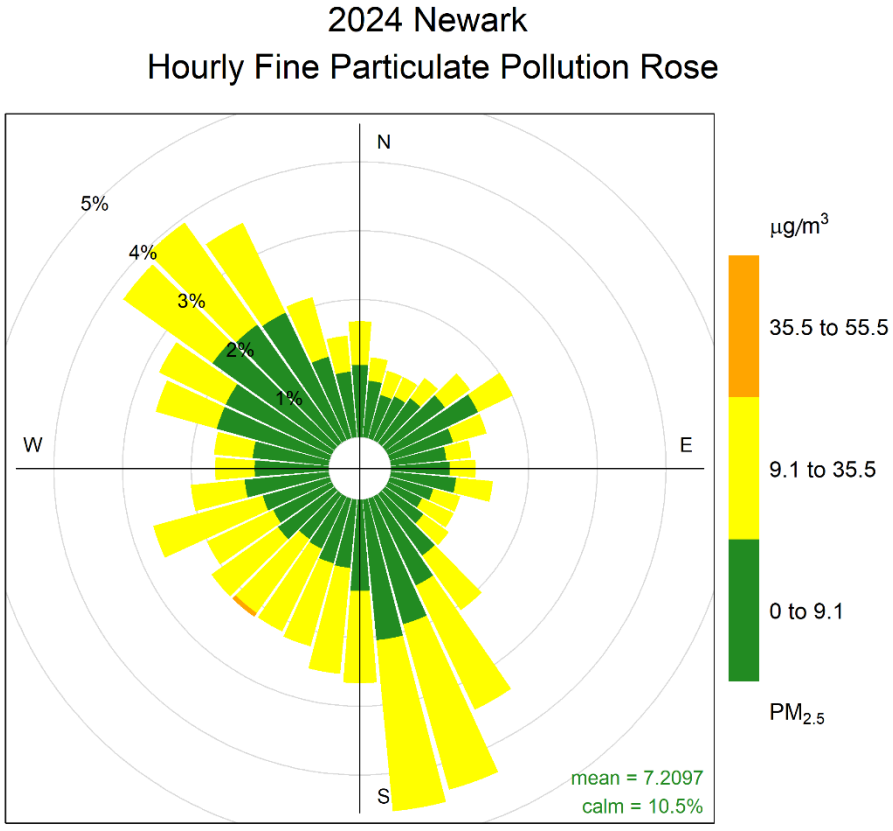
New Castle County Platforms

BF1 (10-003-1003) The original Bellefonte site was established in 1969 to monitor O_3 and SO_2. $PM_{2.5}$ monitoring was added in 1999. It began as a shelter at the New Castle County River Road Park, but when the O_3 and SO_2 monitors were moved to a new location (BF2) in 2001, the original Bellefonte shelter was replaced by a platform for ongoing $PM_{2.5}$ sampling and renamed "Bellefonte I" (BF1). It is a $PM_{2.5}$ neighborhood scale site. The objectives are NAAQS compliance, population exposure, primary downwind from Wilmington, AQI, and trends. BF1 has also been used to determine concentration gradients between Wilmington and Chester, PA. BF1 meets all EPA siting criteria, except for distance from obstacles (trees), which have grown significantly taller. Due to this, BF1 spatial scale must be redesignated as micro or middle, as per 40 CFR 58, Appendix E, section 2.3(c). This should not significantly affect the site's value in meeting its objectives.



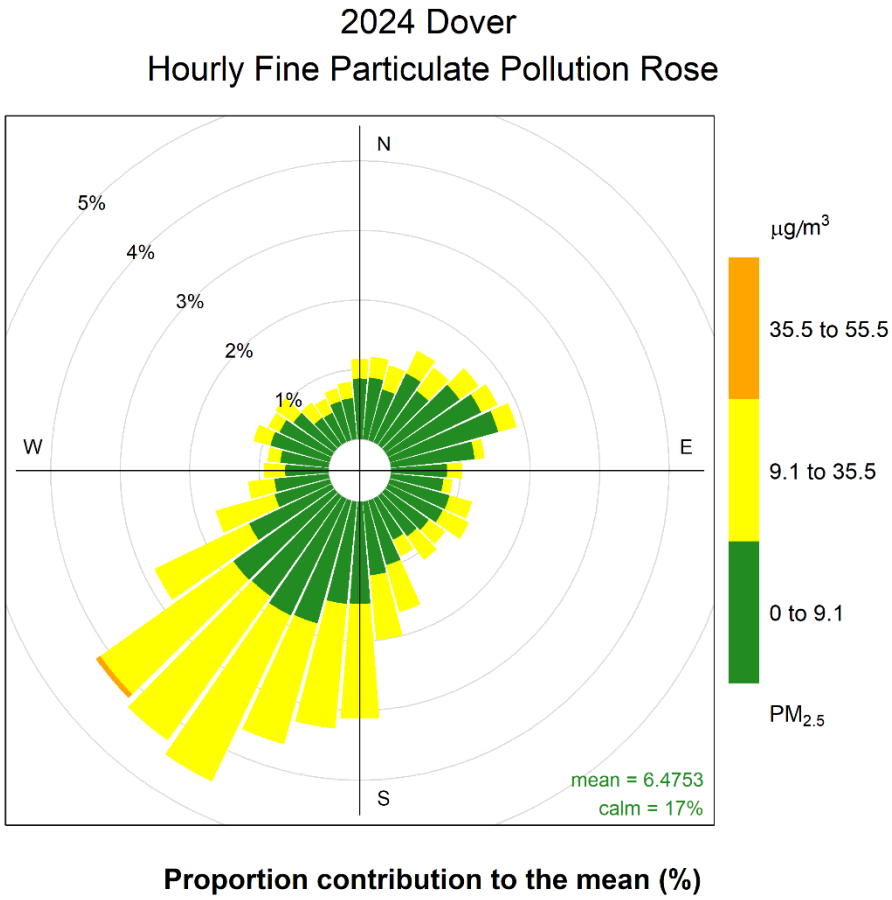
NWK (10-003-1012) The original Newark site (10-003-1011) was established in 1999 in central Newark on University of Delaware (UD) property and operated for almost a year before land use changes required it to be relocated. The current site was established in 2000 as a platform only and is located on the north campus of UD. The location is suburban and impacted by local sources and regional transport. It has been a $PM_{2.5}$ neighborhood scale site. The objectives are NAAQS compliance, regional transport, population exposure, and trends.

NWK meets all EPA siting criteria, except for distance from obstacles (trees), which have grown significantly taller. Due to this, NWK spatial scale must be redesignated as micro or middle, as per 40 CFR 58, Appendix E, section 2.3(c). This site is no longer suitable for the regional transport objective.



Kent County Platform

DVR (10-001-0003) This platform site was established in 1999. Speciation monitoring was discontinued at this location in 2014. Continuous FEM monitoring of PM2.5 was added in 2021, and the collocated FRM sampler was removed in 2022. It is a neighborhood scale site representative of the Dover area and is impacted by a combination of source types, including mobile and point sources. The monitoring objectives are NAAQS compliance, population exposure, AQI, and trends. The site meets all EPA siting criteria.



Shelter Sites

New Castle County Sites and Characteristics

MLK (10-003-2004) The MLK site is in the City of Wilmington at the intersection of Justison St. and Martin Luther King Boulevard. It replaced another urban site at 12th and King Streets that had operated for over 20 years. MLK represents urban population exposure to multiple pollution sources. Monitoring objectives are NAAQS compliance, population exposure, AQI, and trends. The site meets all EPA siting criteria.

NCore monitoring began during 2010 with all monitors fully operational by January 1, 2011. Continuous FEM $PM_{2.5}$ monitoring since 2018 has used a Teledyne Advanced Pollution Instrumentation (TAPI) T640 and continues to support $PM_{2.5}$ collocation requirements and AQI calculations. Hourly data are submitted to AirNow.gov and the AQS database.

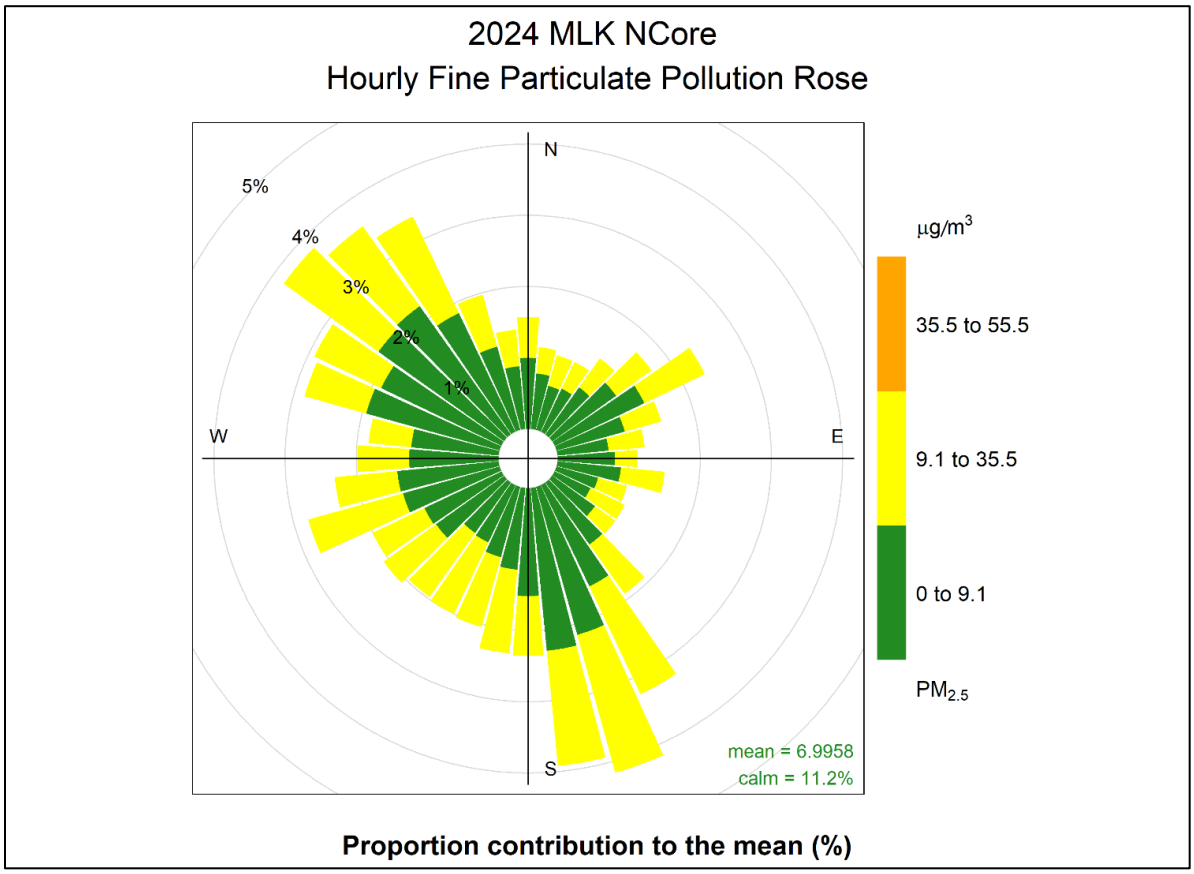


Figure 18: $PM_{2.5}$ Pollution Rose - MLK (Wilmington NCore)
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

Figure 18 shows that at MLK, elevated hourly $PM_{2.5}$ concentrations show limited directionality, with similar ratios of green and yellow from all wind directions. Prevailing winds were from the northwest and south-southeast.

LUM (10-003-1007) This is a neighborhood scale site located in Lums Pond State Park and is in the general upwind direction from MLK. The immediate area is rural. The site meets all EPA siting criteria. $PM_{2.5}$ monitoring began in 1999. Monitoring objectives are regional transport, background, population exposure, NAAQS compliance, AQI, and trends. In 2018 an EPA designated FEM TAPI T640 was installed as the primary $PM_{2.5}$ monitor. To satisfy requirements in 40 CFR Part 58, Appendix A, Section 3.2.5, an FRM is collocated with the FEM.

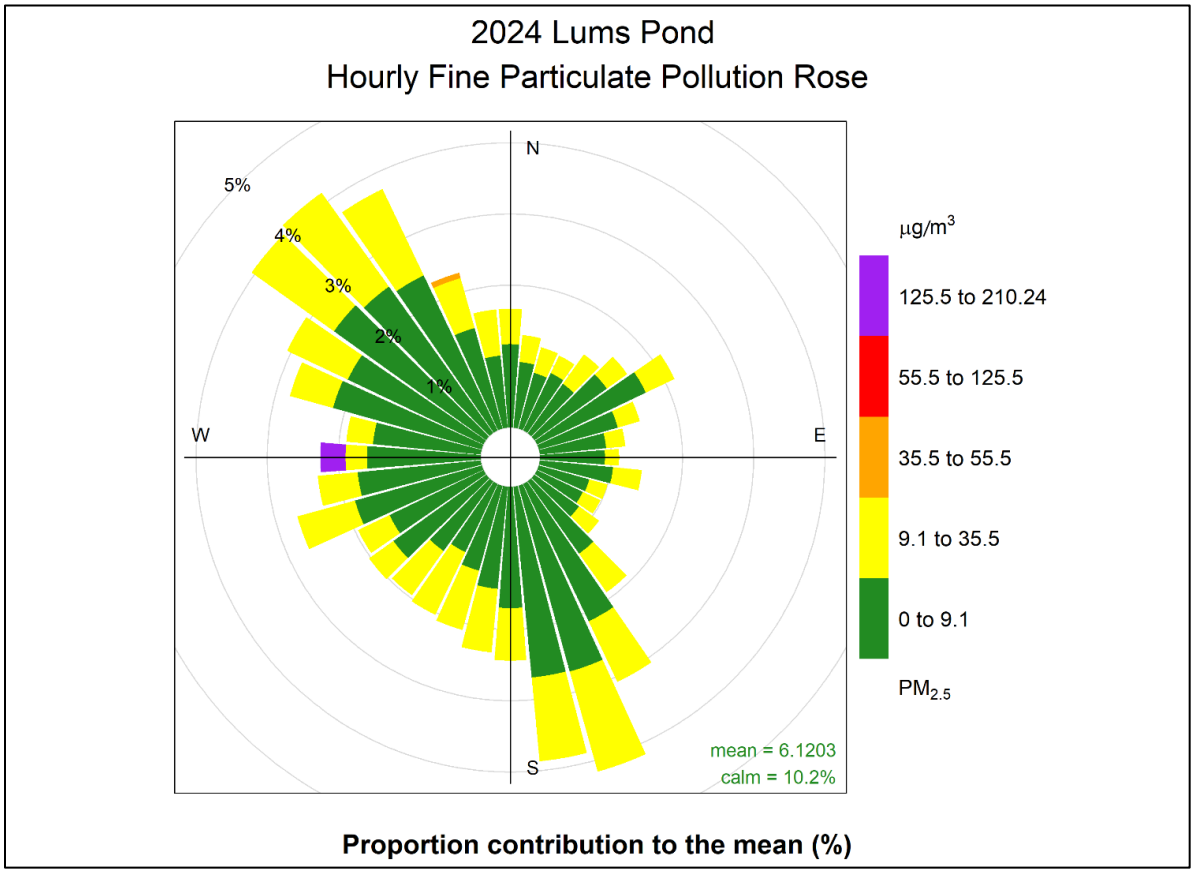


Figure 19: $PM_{2.5}$ Pollution Rose - LUM
Wind data source: Wilmington New Castle County Airport, NOAA LCD

Figure 19 shows that for LUM, the prevailing winds were from the northwest and south-southeast. A single exceptionally high hourly reading of 210 µg/m^3, with winds from the West, was from farming activity immediately adjacent to the monitoring site on the evening of Saturday April 13, 2024. The 24-hr average for that day was 33 µg/m^3, which did not exceed the 35 µg/m^3 NAAQS.

RT9 (10-003-1008) This site is between the Delaware City Refinery and Delaware City. It originally monitored SO_2 and CO. In the 2000's VOC monitoring was added. In the 2010's CO and VOCs were discontinued. In 2013 Delaware added an FEM Thermo SHARP continuous $PM_{2.5}$ monitor as a Special Purpose Monitor (SPM). In 2016 the designation changed from SPM to State and Local Air Monitoring Station (SLAMS). In 2018 an EPA designated FEM TAPI T640 replaced the SHARP monitor as the primary $PM_{2.5}$ monitor.

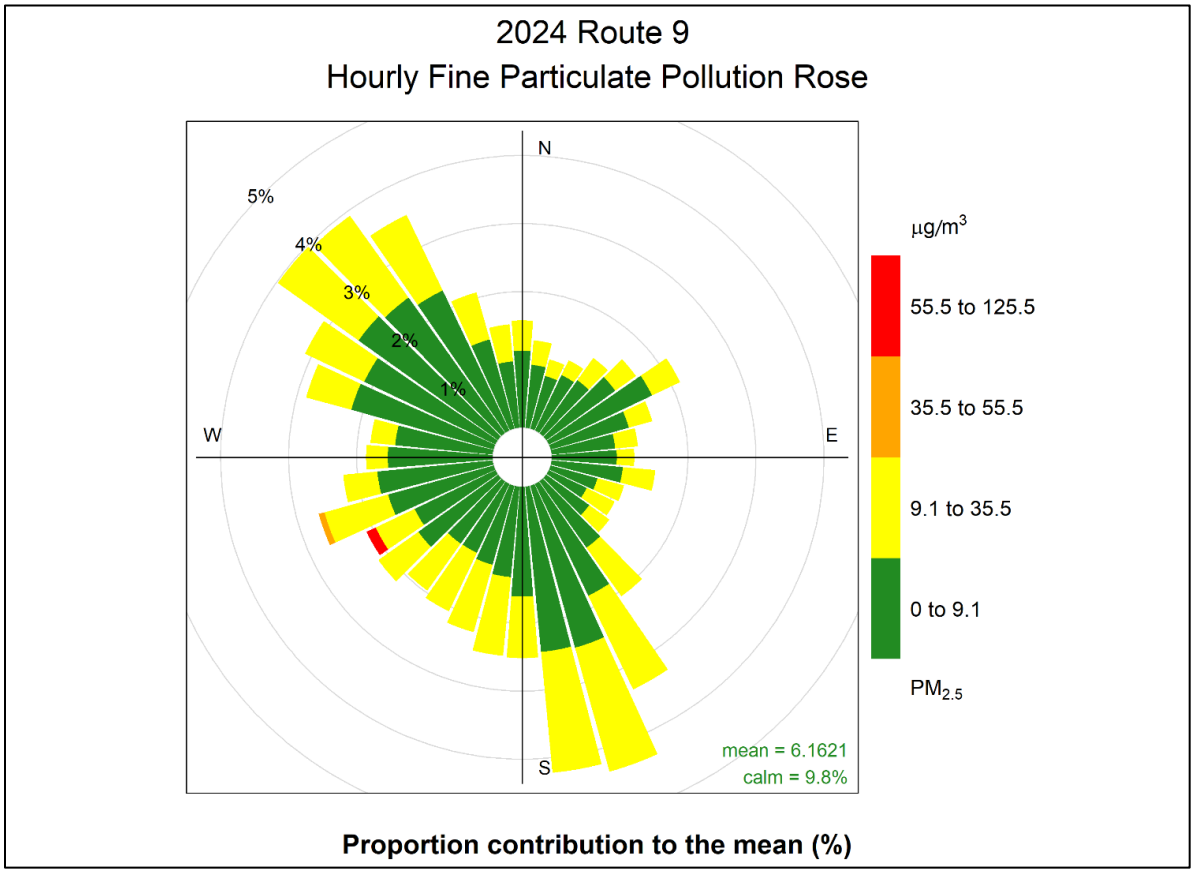


Figure 20: $PM_{2.5}$ Pollution Rose – RT9
Wind data source: Wilmington New Castle County Airport, NOAA LCD

Figure 20 shows that at RT9, elevated hourly $PM_{2.5}$ concentrations had limited directionality, with similar ratios of green and yellow from all wind directions. Prevailing winds were from the northwest and south-southeast. Two hours of unusually high hourly average readings were likely from local activity near the monitoring site on the evening of Monday, October 21, 2024, with winds from the west-southwest. High readings were not present at other PM monitoring sites. The 24-hr average at RT9 for that day was 23 µg/m^3, which did not exceed the 35 µg/m^3 NAAQS.

Kent County Sites and Characteristics

KIL (10-001-0002) This site was established in 1997 in a rural area, in part of Killens Pond State Park. $PM_{2.5}$ monitoring began at this site in 1999. The site meets all EPA siting criteria. The objectives are background, NAAQS compliance, AQI, and trends.

Continuous FEM $PM_{2.5}$ monitoring since 2018 has used a Teledyne Advanced Pollution Instrumentation (TAPI) T640 and continues monitoring objectives. Hourly data are submitted to AirNow.gov and the AQS database. At the end of 2018 monitoring with the collocated FRM ceased and the FEM T640 became primary.

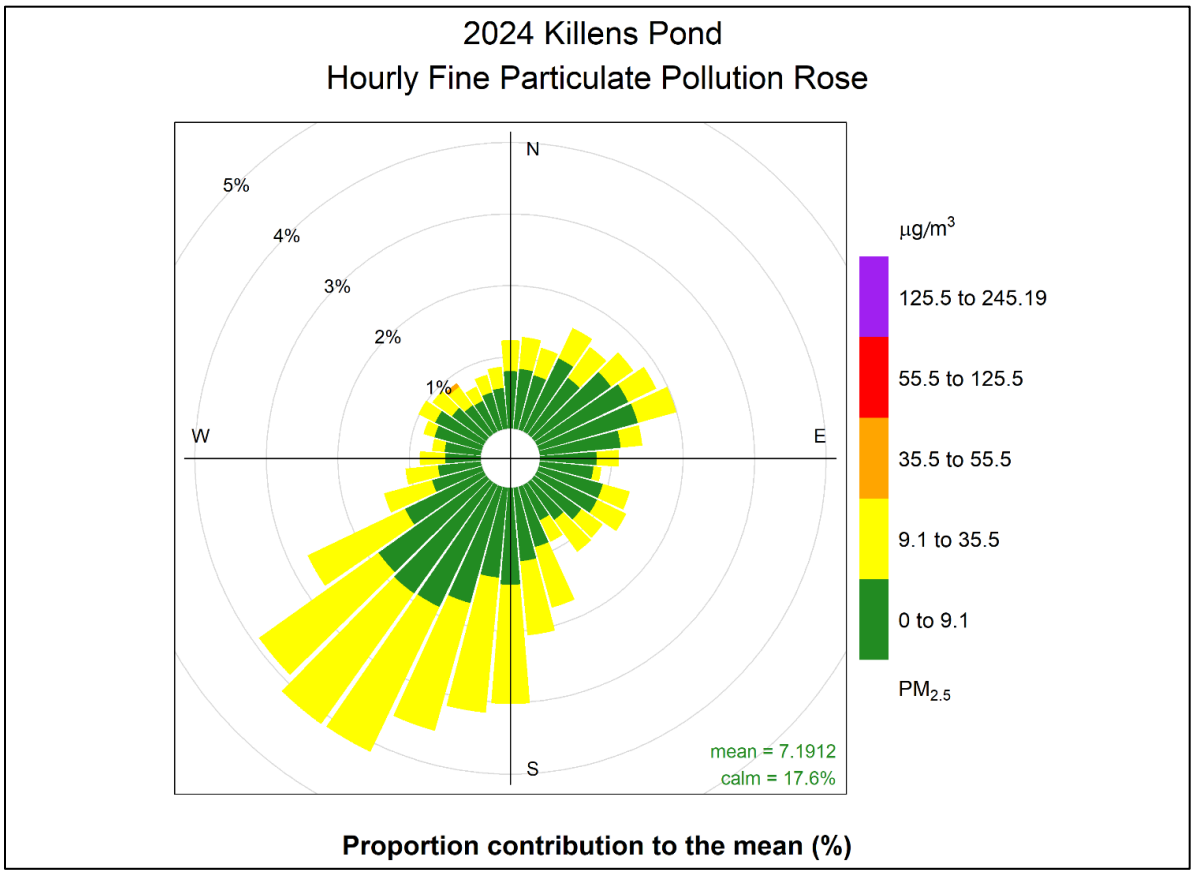


Figure 21: $PM_{2.5}$ Pollution Rose - KIL
Wind data source: Dover Airforce Base, NOAA LCD

Figure 21 shows that at KIL, elevated hourly $PM_{2.5}$ concentrations come primarily with winds from the southwest. However, the highest recorded hourly concentration for the year (55 µg/m^3) was from the northwest, reportedly due to nearby farming activity on the evening of Thursday, October 10, 2024. The 24-hr average for that day was 5 µg/m^3, well below the 35 µg/m^3 NAAQS.

Sussex County Sites and Characteristics

SEA (10-005-1002) This site was established in 1990 on Virginia Avenue in Seaford, and $PM_{2.5}$ monitoring began in 1999. The site is neighborhood scale, in a suburban location. Objectives are NAAQS compliance, population exposure, background, regional transport, AQI, and trends. Spatial scale should be redesignated urban, consistent with the regional transport objective. Based on the relatively flat geography of the Salisbury CBSA, and comparison with other nearby PM2.5 sites, regional transport is a reasonable objective. The site meets all EPA siting criteria.

Continuous FEM $PM_{2.5}$ monitoring since 2018 has used a Teledyne Advanced Pollution Instrumentation (TAPI) T640 and continues monitoring objectives. Hourly data are submitted to AirNow.gov and the AQS database. This is the only $PM_{2.5}$ monitor in Sussex County.

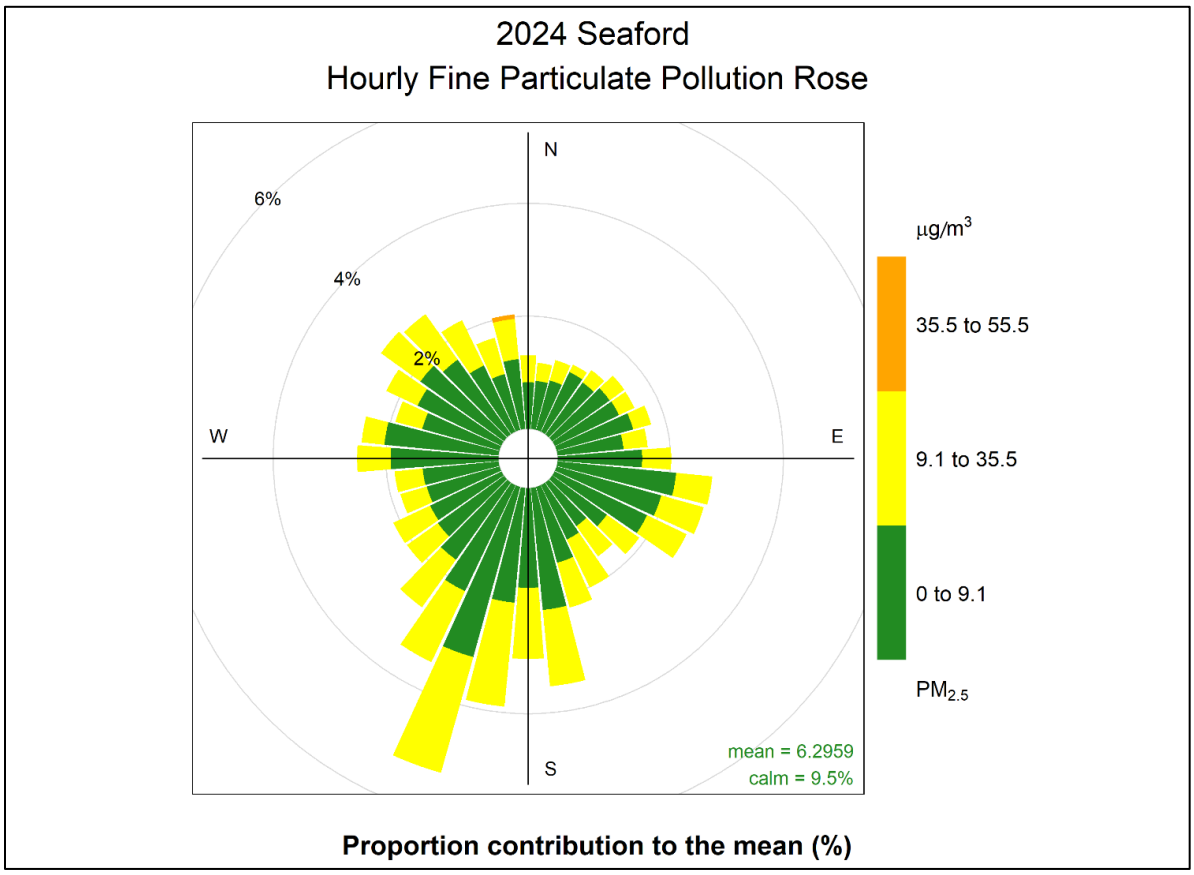


Figure 22: $PM_{2.5}$ Pollution Rose – SEA
Wind data source: Georgetown Delaware Coastal Airport, NOAA LCD

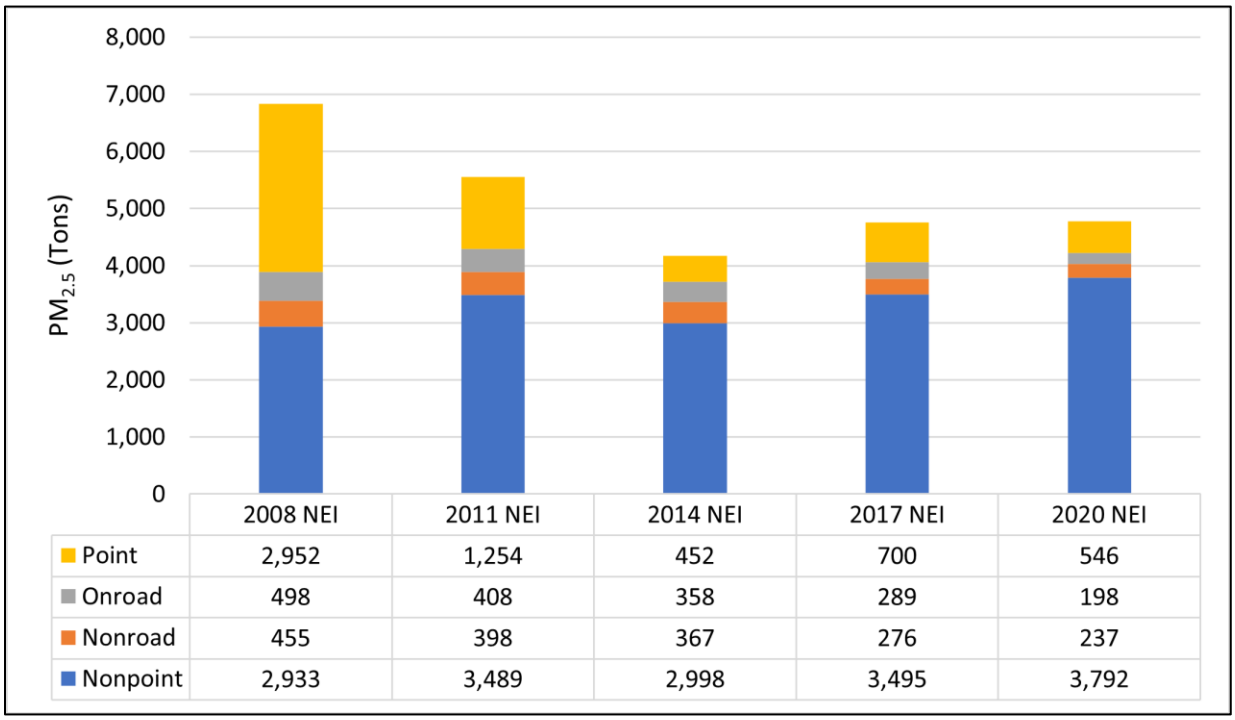
Figure 22 shows that at SEA, elevated hourly $PM_{2.5}$ concentrations come mostly from the south-southwest. The highest recorded hourly concentration for the year (47 µg/m^3) was from the north-northwest on the evening of February 5, 2024. There is no firm explanation for this anomalous reading; a local source, such as an idling vehicle in the adjacent parking lot, is suspected. The 24-hr average for that day was 9 µg/m^3, well below the 35 µg/m^3 NAAQS.

Emissions Information

Trends – Statewide from 2020 NEI

Figure 23 shows that $PM_{2.5}$ emissions in most categories have trended downward, which correlates with the improvements in ambient $PM_{2.5}$ levels as seen in Figure 24.

More information on the National Emissions Inventory including data is available from the EPA's NEI page.



	2008 NEI	2011 NEI	2014 NEI	2017 NEI	2020 NEI
Point	2,952	1,254	452	700	546
Onroad	498	408	358	289	198
Nonroad	455	398	367	276	237
Nonpoint	2,933	3,489	2,998	3,495	3,792

Figure 23: $PM_{2.5}$ Emissions Trends

Since 2008 the majority of $PM_{2.5}$ emission reductions have been achieved in the point source category. The highest emitting point sources in Delaware according to the 2020 NEI were:

- Delaware City Refinery
- Hay Road Energy Center
- Perdue Farms - Bridgeville
- Garrison Energy Center

The dominant category since 2011 has been nonpoint sources. This is also the only category trending upwards. The highest nonpoint sources in Delaware according to the 2020 NEI were:

- Construction Dust
- Paved Road Dust
- Residential Wood Burning
- Commercial Cooking

Statistical Analysis

Figure 24 shows that the trends in annual average $PM_{2.5}$ concentrations at all sites in Delaware have been downward since 2001, except in 2023, due to the impact of Canadian wildfires on Delaware, $PM_{2.5}$ concentrations did show an increase. Annual design values have remained below the applicable NAAQS at all sites since 2006. They have also all been below the new 2024 standard of 9.0 µg/m^3 since 2017.

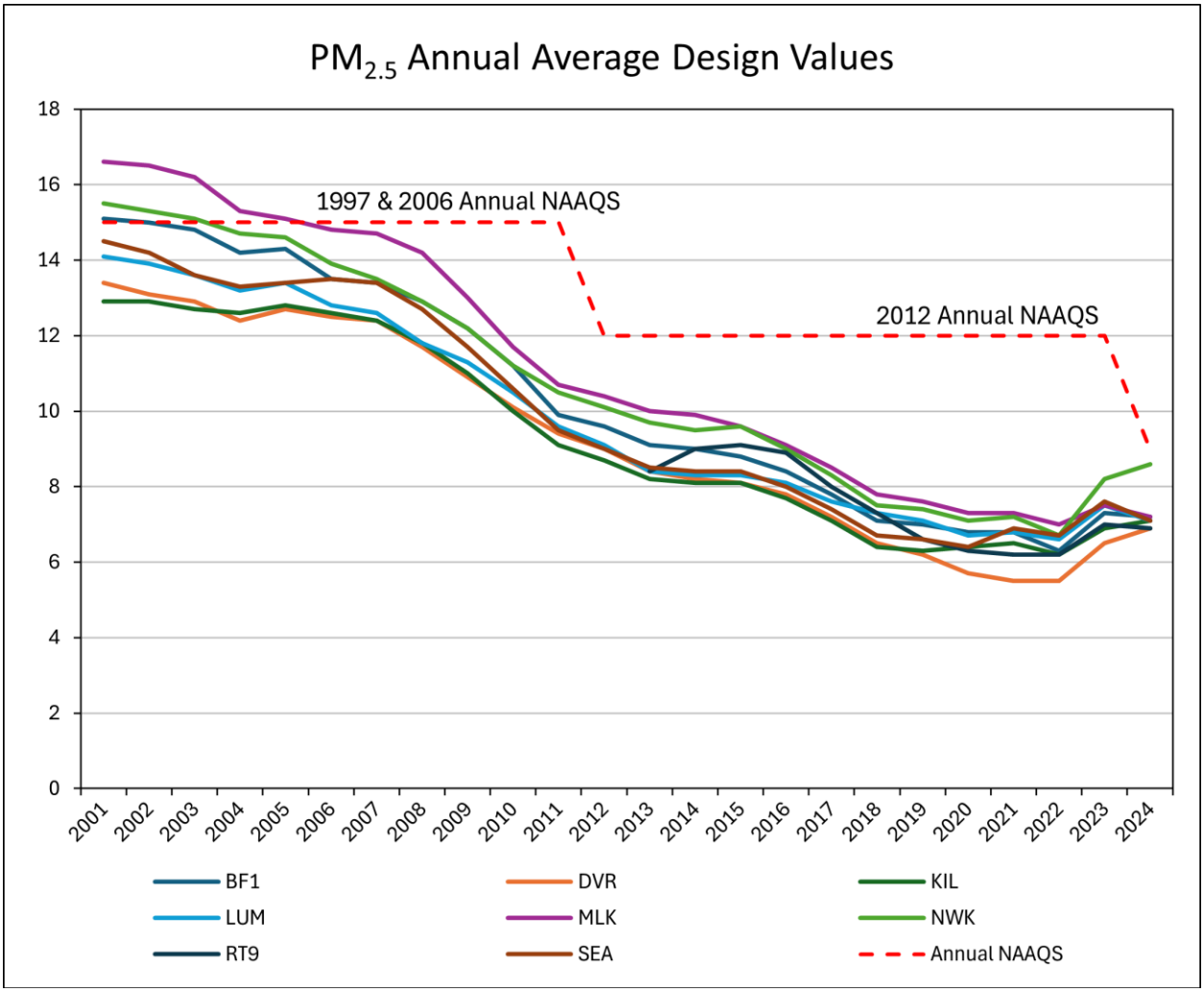


Figure 24: $PM_{2.5}$ Annual Average, Design Value Trends
3 Year Annual Average (µg/m^3)

Table 15: $PM_{2.5}$ Annual Average Design Values by Site

3-year Annual Average (µg/m^3) Design Values

Notes: Design Value year is the second indicated year (e.g., 2000-2002 is design value year 2002 which includes 2000, 2001, and 2002). 5-Year Assessments began in 2010, periods shaded to help distinguish between assessments.

5-Year Assessment	DV Years	BF1	DVR	KIL	LUM	MLK	NWK	RT9	SEA
	1999-2001	15.1	13.4	12.9	14.1	16.6	15.5		14.5
	2000-2002	15.0	13.1	12.9	13.9	16.5	15.3		14.2
	2001-2003	14.8	12.9	12.7	13.6	16.2	15.1		13.6
	2002-2004	14.2	12.4	12.6	13.2	15.3	14.7		13.3
2010	2003-2005	14.3	12.7	12.8	13.4	15.1	14.6		13.4
	2004-2006	13.5	12.5	12.6	12.8	14.8	13.9		13.5
	2005-2007	13.4	12.4	12.4	12.6	14.7	13.5		13.4
	2006-2008	12.9	11.7	11.8	11.8	14.2	12.9		12.7
	2007-2009	12.2	10.9	11.0	11.3	13.0	12.2		11.7
	2008-2010	11.2	10.1	10.0	10.5	11.7	11.2		10.6
	2009-2011	9.9	9.4	9.1	9.6	10.7	10.5		9.5
2015	2010-2012	9.6	9.0	8.7	9.1	10.4	10.1		9.0
	2011-2013	9.1	8.4	8.2	8.4	10.0	9.7	8.4	8.5
	2012-2014	9.0	8.2	8.1	8.3	9.9	9.5	9.0	8.4
	2013-2015	8.8	8.1	8.1	8.3	9.6	9.6	9.1	8.4
	2014-2016	8.4	7.8	7.7	8.1	9.1	9.0	8.9	8.0
2020	2015-2017	7.8	7.2	7.1	7.6	8.5	8.3	8.0	7.4
	2016-2018	7.1	6.5	6.4	7.3	7.8	7.5	7.3	6.7
	2017-2019	7.0	6.2	6.3	7.1	7.6	7.4	6.6	6.6
	2018-2020	6.8	5.7	6.4	6.7	7.3	7.1	6.3	6.4
	2019-2021	6.8	5.5	6.5	6.8	7.3	7.2	6.2	6.9
2025	2020-2022	6.2 *	5.5 *	6.3 *	6.6	6.2	6.7 *	7.0	6.7 *
	2021-2023	6.9 *	6.5 *	7.3 *	7.5	7.0	8.2 *	7.5	7.6 *
	2022-2024	*7.1 **	*6.9 **	*7.2 **	*7.1 **	*6.9 **	*8.6 **	*7.2 **	*7.1 **

*One or more years with less than 75% data completeness

2024 design values are preliminary; data certified by AQ but awaits concurrence from EPA.

Trends for the 98th percentile 24-hour average design values show declining concentrations similar in character to the annual average concentrations. All 24-hour design values were below the current 35 µg/m^3 NAAQS since 2009, except for MLK for 2006-2008. The 24-hour average NAAQS was not changed in 2024.

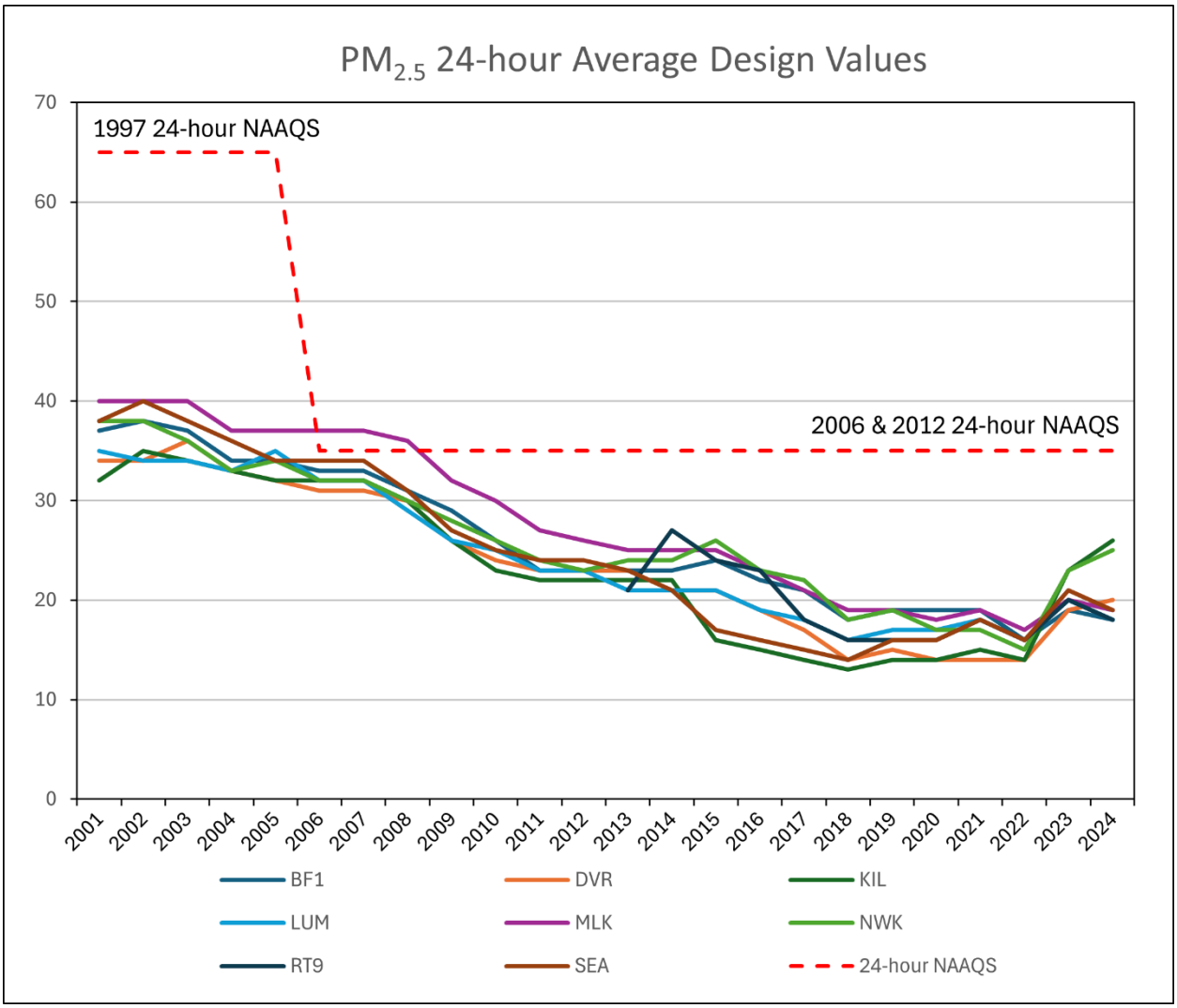


Figure 25: $PM_{2.5}$ 24-hour Average Design Value Trends
3-year averages of 98th percentiles of 24-hour averages (µg/m^3)

Table 16: $PM_{2.5}$ 24-hour Design Values by Site

3 Year 98th Percentile 24-hour Averages ($\mu g/m^3$) Design Values

Notes: Design Value Year is the second indicated year (e.g., 2000-2002 is design value year 2002 which includes 2000, 2001, and 2002). 5-Year Assessments began in 2010, periods shaded to help distinguish between assessments.

5-Year Assessment	DV Years	BF1	DVR	KIL	LUM	MLK	NWK	RT9	SEA
	1999-2001	15.1	13.4	12.9	14.1	16.6	15.5		14.5
	2000-2002	15.0	13.1	12.9	13.9	16.5	15.3		14.2
	2001-2003	14.8	12.9	12.7	13.6	16.2	15.1		13.6
	2002-2004	14.2	12.4	12.6	13.2	15.3	14.7		13.3
2010	2003-2005	14.3	12.7	12.8	13.4	15.1	14.6		13.4
	2004-2006	13.5	12.5	12.6	12.8	14.8	13.9		13.5
	2005-2007	13.4	12.4	12.4	12.6	14.7	13.5		13.4
	2006-2008	12.9	11.7	11.8	11.8	14.2	12.9		12.7
	2007-2009	12.2	10.9	11.0	11.3	13.0	12.2		11.7
	2008-2010	11.2	10.1	10.0	10.5	11.7	11.2		10.6
	2009-2011	9.9	9.4	9.1	9.6	10.7	10.5		9.5
2015	2010-2012	9.6	9.0	8.7	9.1	10.4	10.1		9.0
	2011-2013	9.1	8.4	8.2	8.4	10.0	9.7	8.4	8.5
	2012-2014	9.0	8.2	8.1	8.3	9.9	9.5	9.0	8.4
	2013-2015	8.8	8.1	8.1	8.3	9.6	9.6	9.1	8.4
	2014-2016	8.4	7.8	7.7	8.1	9.1	9.0	8.9	8.0
2020	2015-2017	7.8	7.2	7.1	7.6	8.5	8.3	8.0	7.4
	2016-2018	7.1	6.5	6.4	7.3	7.8	7.5	7.3	6.7
	2017-2019	7.0	6.2	6.3	7.1	7.6	7.4	6.6	6.6
	2018-2020	6.8	5.7	6.4	6.7	7.3	7.1	6.3	6.4
	2019-2021	6.8	5.5	6.5	6.8	7.3	7.2	6.2	6.9
2025	2020-2022	6.2 *	5.5 *	6.3 *	6.6	6.2	6.7 *	7.0	6.7 *
	2021-2023	6.9 *	6.5 *	7.3 *	7.5	7.0	8.2 *	7.5	7.6 *
	2022-2024	7.1 *	6.9 *	7.2 *	7.1 *	6.9 *	8.6 *	7.2 *	7.1 *

*One or more years with less than 75% data completeness

2024 design values are preliminary; data certified by AQ but awaits concurrence from EPA.

Correlation Matrix

The Correlation Matrix tool, included in the NetAssess 2025 tool, calculates and displays the correlation, relative difference, and distance between pairs of sites within a user selected set of air monitoring sites. Please see discussion in the Ozone Correlation Matrix section for more detail. Usually, it is expected that correlation between sites will decrease as distance increases. However, for a regional air pollutant, sites in the same air shed can have very similar concentrations and be highly correlated. More unique sites would exhibit the opposite characteristics. They would not be very well correlated with other sites and their relative difference would be higher than other site pairs.

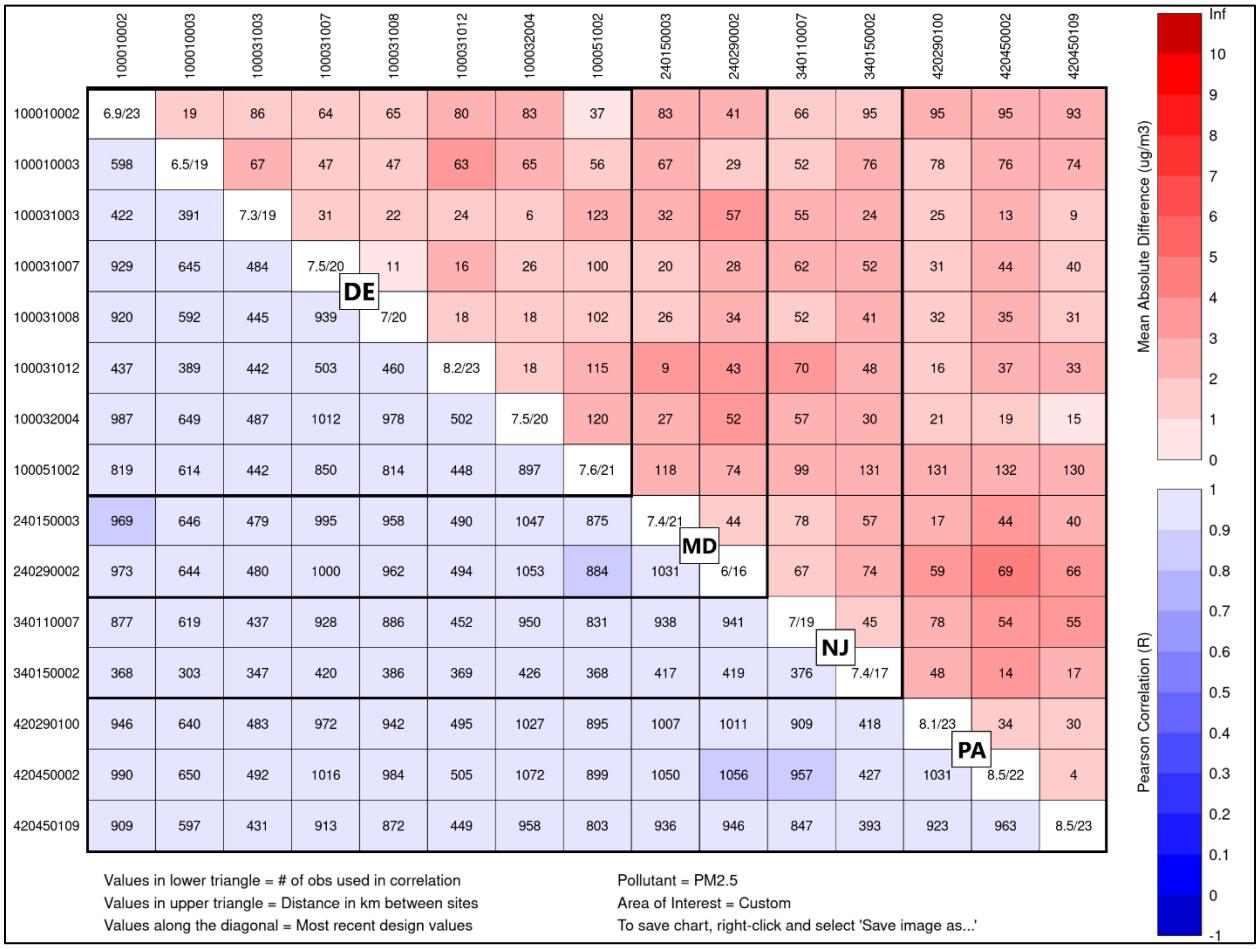


Figure 26: NetAssess Correlation Matrix: DE and Nearby State $PM_{2.5}$ Sites
Design Value Year 2023

The sites used in this analysis are shown on the map in Figure 27.

Table 17: Correlation Data (R^2) for $PM_{2.5}$ Sites

DV Year 2023, State sites shaded

Site ID	10-001-0002 **KIL**	10-001-0003 **DVR**	10-003-1003 **BF1**	10-003-1007 **LUM**	10-003-1008 **RT9**	10-003-1012 **NWK**	10-003-2004 **MLK**	10-005-1002 **SEA**
10-010-0003 **DVR**	0.97							
10-031-1003 **BF1**	0.95	0.94						
10-031-1007 **LUM**	0.95	0.97	0.96					
10-031-1008 **RT9**	0.96	0.97	0.98	0.98				
10-031-1012 **NWK**	0.95	0.96	0.97	0.97	0.98			
10-032-2004 **MLK**	0.94	0.94	0.99	0.96	0.98	0.97		
10-051-1002 **SEA**	0.98	0.96	0.94	0.93	0.95	0.95	0.94	
24-150-0003 **Fair Hill**	0.90	0.93	0.93	0.94	0.94	0.96	0.94	0.90
24-290-0002 **Millington**	0.92	0.96	0.90	0.95	0.94	0.94	0.91	0.90
34-110-0007 **Millville**	0.96	0.97	0.93	0.93	0.94	0.94	0.92	0.95
34-150-0002 **Clarksboro**	0.94	0.94	0.94	0.93	0.94	0.93	0.94	0.91
42-290-0100 **New Garden**	0.94	0.95	0.98	0.96	0.97	0.98	0.99	0.94
42-450-0002 **Chester**	0.92	0.92	0.98	0.94	0.96	0.95	0.97	0.91
42-450-0109 **Marcus Hook**	0.93	0.94	0.99	0.96	0.98	0.97	0.99	0.93

DE
MD
NJ
PA

Table 18: Correlation Data - Average Relative Differences for $PM_{2.5}$ Sites

DV Year 2021 – 2023, State sites shaded

Site ID	10-001-0002 **KIL**	10-001-0003 **DVR**	10-003-1003 **BF1**	10-003-1007 **LUM**	10-003-1008 **RT9**	10-003-1012 **NWK**	10-003-2004 **MLK**	10-005-1002 **SEA**
10-010-0003 **DVR**	1.25							
10-031-1003 **BF1**	1.97	2.06						
10-031-1007 **LUM**	1.59	1.47	1.57					
10-031-1008 **RT9**	1.21	1.45	1.29	0.92				
10-031-1012 **NWK**	2.46	3.01	1.55	2.03	1.84			
10-032-2004 **MLK**	2.20	2.08	1.45	1.41	1.53	1.90		
10-051-1002 **SEA**	0.97	1.39	2.35	1.70	1.46	2.52	2.14	
24-150-0003 **Fair Hill**	2.08	2.11	2.92	1.99	1.93	3.38	2.47	2.43
24-290-0002 **Millington**	2.03	1.96	3.26	2.76	2.37	3.99	3.47	2.73
34-110-0007 **Millville**	1.66	1.56	2.50	2.32	1.97	3.20	2.94	2.11
34-150-0002 **Clarksboro**	1.96	2.07	2.25	2.32	2.10	2.72	2.79	2.51
42-290-0100 **New Garden**	2.09	1.86	1.60	1.30	1.44	1.98	1.01	2.11
42-450-0002 **Chester**	2.88	2.85	2.03	2.12	2.27	2.67	1.51	2.75
42-450-0109 **Marcus Hook**	2.29	2.15	1.54	1.45	1.67	2.25	0.90	2.34

DE
MD
NJ
PA

Tables 17 and 18 show that all Delaware $PM_{2.5}$ sites are highly correlated ($R^2 \geq 0.90$) with each other, as well as with nearby out of state sites. Correlation between sites has increased significantly since the 2020 assessment. Average R^2 of all Delaware site pairs increased from 0.86 to 0.96. When nearby out of state site pairings with Delaware sites are included, average R^2 increased from 0.78 to 0.95. This suggests less influence from local sources and more influence due to regional sources and transport.

Removal bias

A positive average bias (red) means that if the site being examined was removed, the neighboring sites would estimate the concentration to be larger than the measured concentration. Likewise, a negative average bias (blue) means the estimated concentration at the site would be smaller than the measured concentration. Please refer to the discussion in the O_3 section for more detailed information on this EPA statistical method.

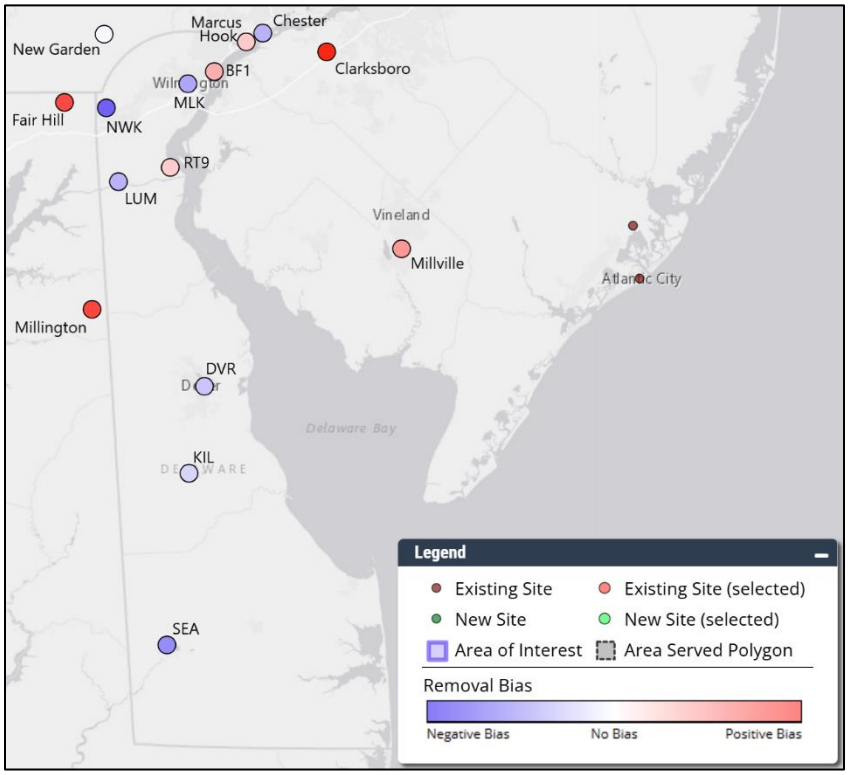


Figure 27: NetAssess $PM_{2.5}$ site Removal Bias Map Output

Table 19: NetAssess $PM_{2.5}$ Removal Bias Results

AQS ID	Site	Removal Bias Average	Removal Bias Standard Deviation	Mean Relative Removal Bias (%)
10-001-0002	KIL	-0.40	1.57	-4.1
10-001-0003	DVR	-0.54	1.38	-6.3
10-003-1003	BF1	0.79	2.13	15.8
10-003-1007	LUM	-0.70	1.64	-7.8
10-003-1008	RT9	0.50	1.23	7.6
10-003-1012	NWK	-1.46	3.23	-8.1
10-003-2004	MLK	-0.82	1.61	-8.3
10-005-1002	SEA	-1.07	1.56	-10.5

Note: Sites listed in AQS ID order

Figure 27 and Table 19 show that most sites would introduce only a small bias to design value calculations if removed. This is consistent with the increasing correlation among $PM_{2.5}$ sites.

$PM_{2.5}$ Speciation

As part of the $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) review completed in 1997, EPA established a $PM_{2.5}$ Chemical Speciation Network (CSN)[4] consisting of Speciation Trends Network (STN) sites and supplemental speciation sites. The CSN is a component of the National $PM_{2.5}$ Monitoring Network, whose goal is to establish if the NAAQS are being attained. However, CSN data are not used for attainment or nonattainment decisions, but are intended to complement the activities of the larger gravimetric PM2.5 measurement network.

Chemical speciation monitoring was encouraged by EPA at sites where the chemically resolved data would be useful in developing SIPs and supporting atmospheric or health effects related studies. These sites in Delaware were originally at MLK in New Castle County and DVR in Kent County. The $PM_{2.5}$ chemical speciation sites include analysis for specific elements, selected anions/cations, and carbon, collected on a 1-in-3-day schedule.

Delaware began operating $PM_{2.5}$ chemical speciation monitors in 2001 at two sites, MLK and DVR. The first full year of data was collected in 2002. In 2008 the carbon collection method was changed to the Improve method at MLK; the change occurred at Dover in 2009. The Dover site was discontinued in 2014.

In 2014 EPA completed an assessment[5] of the national speciation network. The purpose was to create a network that was sustainable with the current situation of reduced federal funding by redistributing resources to new or high priorities from those of low-priority or low-benefit. As part of this process, EPA developed a scoring metric to identify existing speciation sites of lower value for defunding. The DVR site was identified as low-value due to redundancy with MLK. Speciation monitoring at the Dover site ended in 2014 in response to termination of EPA support. Speciation monitoring continues at the MLK site in Wilmington on a 1-in-3-day schedule.

Data from these monitors is used to evaluate $PM_{2.5}$ composition, possible sources impacting concentrations, and evaluation of control measures and trends. Analysis of the data is ongoing; the most recent validated data available is for 2023.

Figure 28 shows that trends for major components of speciation data at MLK are generally downward or stable. Relative composition (major components as percent of total mass) remains similar across all years, except Sulfate has been declining relatively more rapidly.

The relative concentrations of the major components are also consistent with data reported for other speciation monitors in the mid-Atlantic region, i.e., sulfate, nitrate, and organic carbon are the largest percentages of total mass.

[4] https://www.epa.gov/amtic/chemical-speciation-network-csn
[5] https://www.epa.gov/sites/default/files/2016-09/documents/chemical_speciation_network_and_improve.pdf

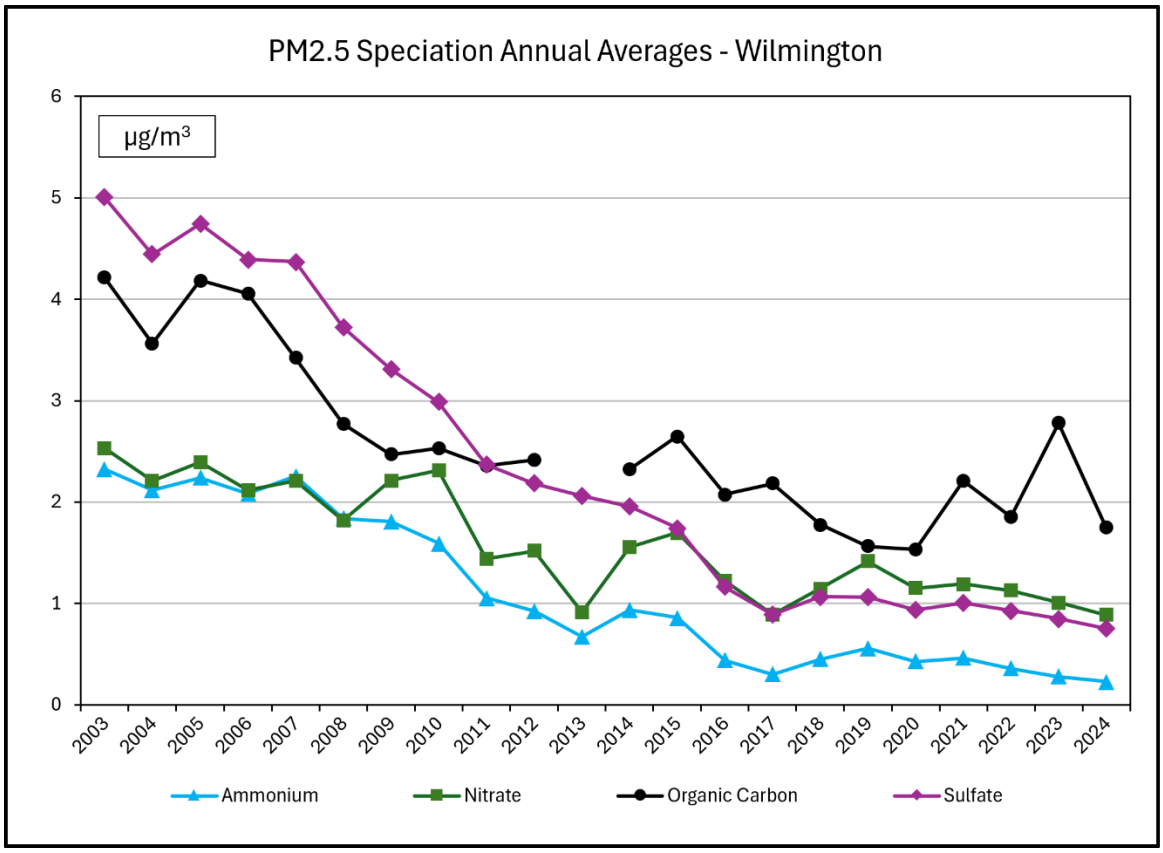


Figure 28: $PM_{2.5}$ Speciation Trends of Some Major Components through 2024

Other Issues

Delaware is supporting community monitoring projects (e.g., installing low-cost particulate sensors at State public libraries), temporary portable monitoring methods (e.g., ongoing development of a Moveable Ambient Monitoring Platform), and incorporating air quality sensor installation into enforcement settlements.

Between 2018 and 2023, Delaware replaced most FRM $PM_{2.5}$ monitors with new continuous FEM TAPI T640s in support of near-real-time AQI reporting, at all PM monitoring sites except MLK and LUM, which have retained their FRM samplers to satisfy collocation requirements.

PM_{10}

Delaware currently operates two PM_{10} monitors at the Wilmington MLK NCore site. One is an FRM sampler, measuring PM_{10} at local condition, used for calculating NCore required PM_{coarse} concentrations on a 1-in-3-day basis. The other is a TAPI T640X FEM continuous monitor, which simultaneously records $PM_{2.5}$ and PM_{10} concentrations at local conditions; this monitor is currently undergoing collocation testing to validate its performance. Data will be uploaded to AirNow.gov for use in calculating near-real-time AQI values.

Future Needs

Community assessments and special projects are anticipated to be important in future PM monitoring efforts. Future activities will depend on resource availability.

Assessment Recommendations

See Tables 30 to 33 in the "Results" section, pages 102 and 103, for a summary of the 5 Year Network Assessment Rankings for PM monitors at each PM monitoring site. All existing PM monitors are ranked "Critical" with the exceptions of $PM_{2.5}$ continuous monitors at BF1 and NWK ("Marginal"), and the $PM_{2.5}$ sampler at LUM ("Critical" monitor, "Credible" location).

BF1 $PM_{2.5}$ is ranked marginal because it is redundant with MLK and Chester, PA, $PM_{2.5}$ monitors, and is no longer meeting the neighborhood scale of representativeness (due to vegetative growth). This site is also experiencing frequent electrical power interruptions, and the platform needs replacement. But removal is not recommended unless resources are unavailable to continue operation. BF1 $PM_{2.5}$ is recommended to be redesignated as middle scale, which still allows meeting its objectives as a downwind site for MLK.

NWK $PM_{2.5}$ is ranked marginal because it no longer meets its original urban scale siting requirements needed for its intended regional transport role. It is also experiencing electrical power interruptions, and influences from nearby sources. It is recommended that NWK $PM_{2.5}$ be redesignated as a micro scale SPM, until it can be relocated or removed.

The $PM_{2.5}$ sampler at LUM is critical for meeting FRM collocation requirements with FEM $PM_{2.5}$ continuous monitors. However, LUM itself is ranked credible for FRM $PM_{2.5}$ sampling at the site, because the collocation requirements would still be met as long as the sampler is located at any other site with an FEM $PM_{2.5}$ monitor (other than MLK, which already has FRM samplers collocated with FEM).

Carbon Monoxide (CO)

Current CO Sites

CO is not a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS, as shown in Figure 32. Monitoring objectives for CO include maximum concentration, NAAQS compliance, NCore trace level monitoring, and emission control strategy tracking. Although CO technically can be included in AQI calculations, the levels in Delaware and surrounding states are so low that it is never the dominant pollutant, and therefore never affects actual AQI, which is defined by the individual pollutant with the highest calculated AQI.

Monitoring Requirements

There are no minimum requirements for the number of CO monitoring sites in Delaware. Continued operation of existing CO sites is required until discontinuation is approved by the EPA Regional Administrator. Where CO monitoring is ongoing, at least one site must be a maximum concentration site for that area under investigation.

Delaware formerly operated two CO monitoring sites year-round, with a trace level monitor at MLK and a legacy (non-trace) monitor at RT9. Monitoring at RT9 was discontinued at the end of 2014. Ambient concentrations at MLK have remained well below the NAAQS and close to the minimum detectable limit of the trace-level monitor since 2018.

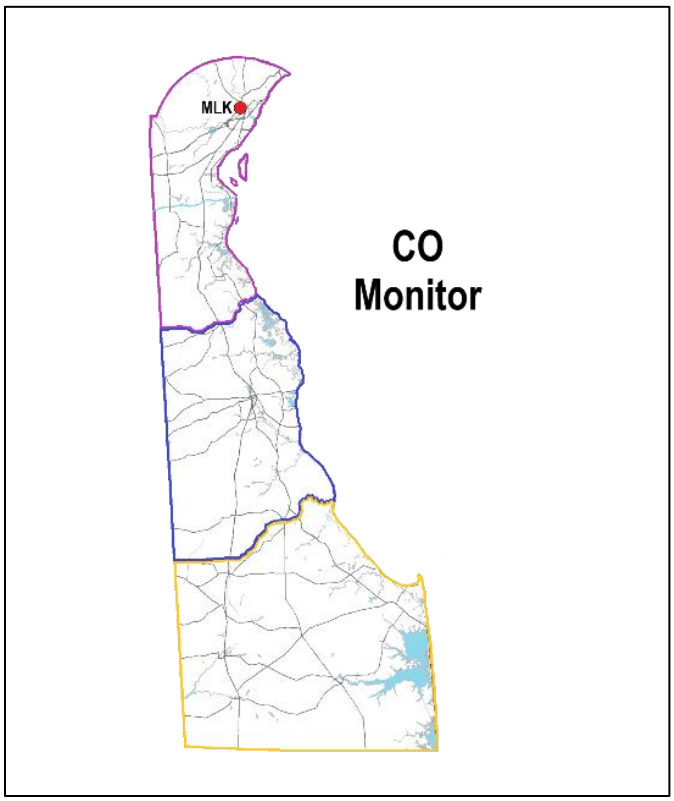


Figure 29: Delaware CO Monitor Map

Unfortunately, CO monitoring in Delaware has been offline during the past few years. This is due to equipment malfunctions, supply chain delays, and difficulty with quality control testing. Delaware did not collect any valid CO data between November 2022 and May 2025, until new equipment met DQO.

Table 20: Delaware CO Monitoring Site

Site	County/CBSA	Objectives
MLK	New Castle / Wilmington DE-MD-NJ Metro Division	Maximum concentration NAAQS compliance NCore trace monitoring Emission control strategy tracking

Situational Analysis

New Castle County Site and Characteristics

MLK (10-003-2004) This site was established in 1999 at the intersection of Justison St. and MLK Blvd in Wilmington. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is middle scale for CO and represents an urban mobile-source dominated site representative of the urban Wilmington core; the primary monitoring objective is maximum concentrations. The site meets all EPA siting criteria. Trace CO monitoring began in 2009 and continues as an NCore requirement.

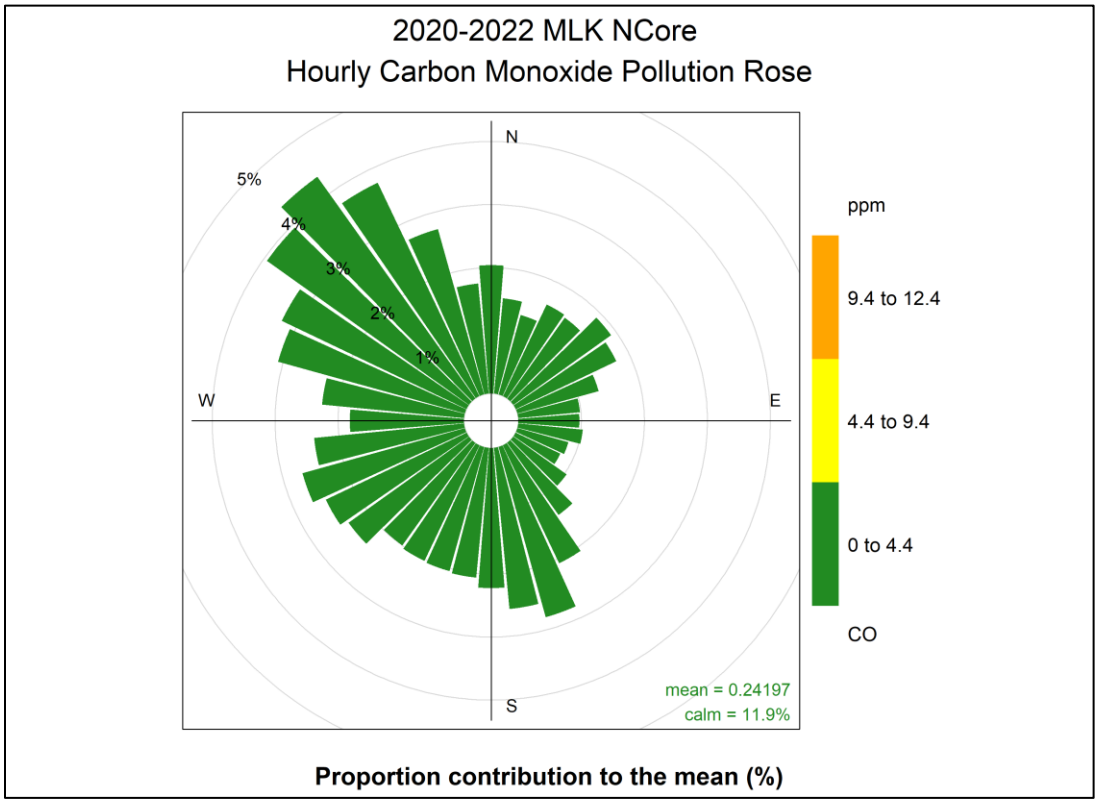


Figure 30: CO Pollution Rose - MLK NCore

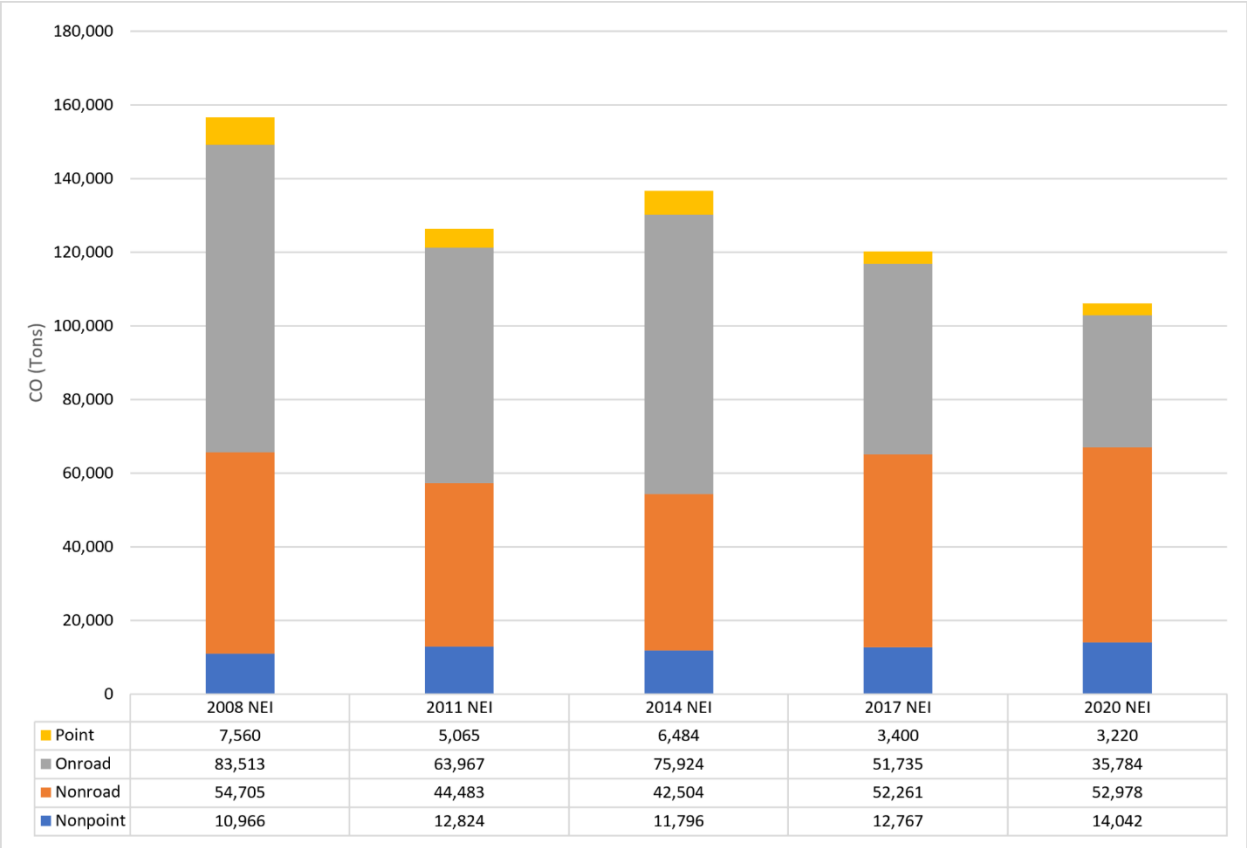
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

Figure 30 shows that at MLK, higher amounts of CO accrue mostly with winds from the northwest and south-southeast, but CO can accrue from any wind direction due to the generalized urban area surrounding the monitoring site. In general, higher CO concentrations occur during calm periods and periods with low wind speeds. "Higher CO concentrations" are still very low compared to the NAAQS. Since 2020, the highest hourly average recorded was 1.92 ppm, just 5.5% of the NAAQS CO hourly standard of 35 ppm.

Emissions Information

Trends – Statewide from 2020 National Emissions Inventory

Figure 31 shows CO emissions from several source categories from the 2008 through 2020 NEI.



	2008 NEI	2011 NEI	2014 NEI	2017 NEI	2020 NEI
Point	7,560	5,065	6,484	3,400	3,220
Onroad	83,513	63,967	75,924	51,735	35,784
Nonroad	54,705	44,483	42,504	52,261	52,978
Nonpoint	10,966	12,824	11,796	12,767	14,042

Figure 31: CO Emissions Trends

Since 2008 most CO emission reductions have been achieved in the onroad category. Onroad and nonroad categories continue to be the dominant sources. Point sources contribute the least amount of CO emissions. Although nonroad and nonpoint categories increased since 2014, total annual CO emissions continue to trend downward.

Statistical Analysis

The primary NAAQS for CO are an 8-hour average concentration of 9 ppm and 1-hour average concentration of 35 ppm, which are not to be exceeded more than once per year. These criteria have not changed since 1971. The most frequently used design value for CO is the annual second highest maximum daily 8-hour average. Figure 32 shows both.

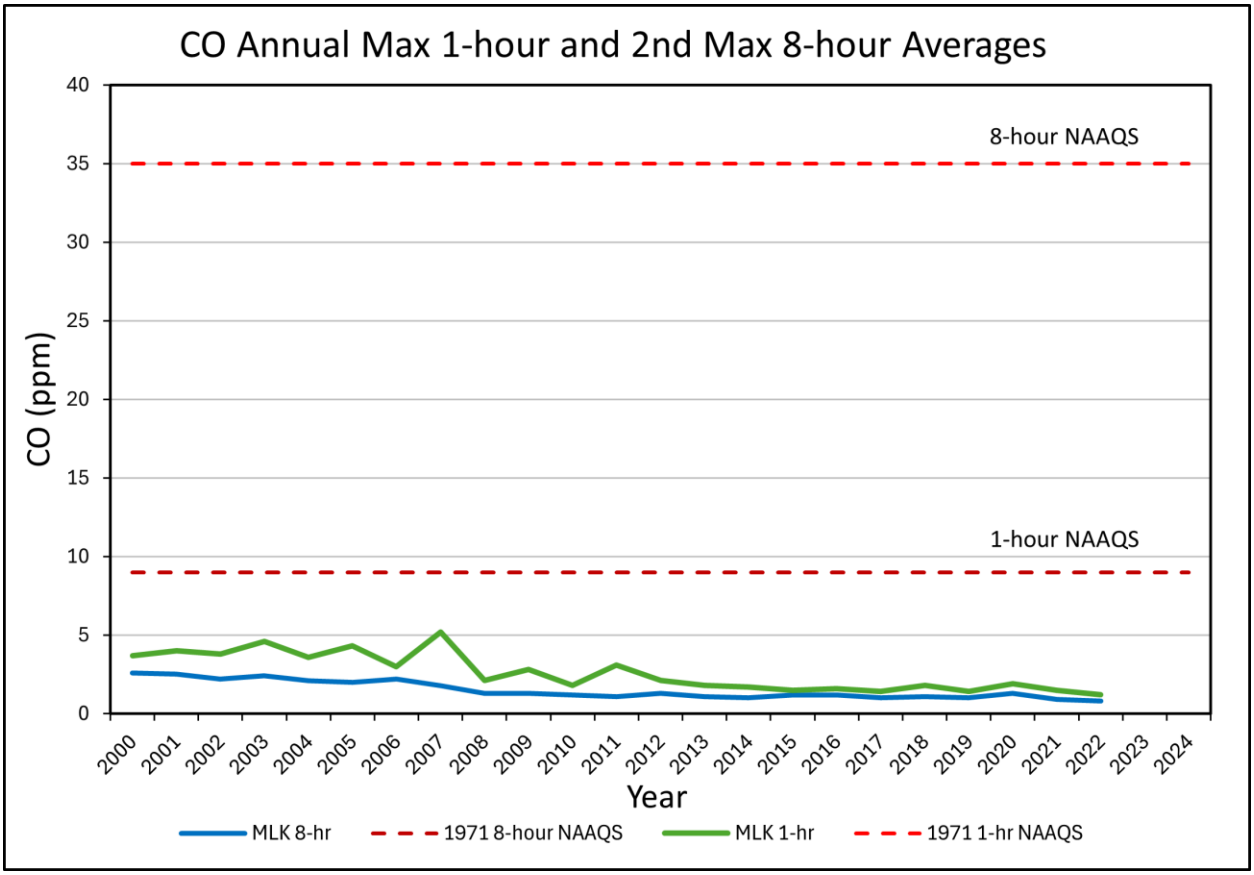


Figure 32: CO Design Value Trends

Table 21: CO Annual Design Values

Annual 2nd max. 8-hour and 1-hour averages (ppm)

DV Year	MLK 8-hr	MLK 1-hr	DV Year	MLK 8-hr	MLK 1-hr	DV Year	MLK 8-hr	MLK 1-hr
2000	2.6	3.7	2010	1.2	1.8	2020	1.3	1.92
2001	2.5	4	2011	1.1	3.1	2021	0.9	1.53
2002	2.2	3.8	2012	1.3	2.1	2022	0.8	1.22
2003	2.4	4.6	2013	1.1	1.8	2023	No data	No data
2004	2.1	3.6	2014	1.0	1.7	2024	No data	No data
2005	2.0	4.3	2015	1.2	1.5			
2006	2.2	3	2016	1.2	1.6			
2007	1.8	5.2	2017	1.0	1.4			
2008	1.3	2.1	2018	1.1	1.8			
2009	1.3	2.8	2019	1.0	1.4			

5-Year Assessments began in 2010; periods are shaded to help distinguish between assessments.

The trends in CO concentrations have been downward since monitoring began in 1979. Much improvement through the 1990's was related to new motor vehicle emissions standards and technologies. Despite traffic volume increases, in recent years annual maximum 8-hour CO levels have remained near 1 ppm. Maximum 1-hour levels have approached closer to the 8-hour levels, indicating a reduction in variability. This suggests ambient CO may be getting closer to background levels.

Future Needs

The existing MLK site is located near major traffic routes in the urban Wilmington area. Since CO maxima occur in areas near major roadways and intersections, this location is considered appropriate for monitoring typical concentrations in urban areas of Wilmington near major roadways.

It is recommended that an additional CO monitor be obtained as a backup for the one operational monitor currently in the network.

Assessment Recommendations

MLK CO monitor is ranked critical, as it is the only CO monitor in the network. The only recommendation is to obtain a spare CO monitor and adequate reserves of spare parts, in case there are problems with the instrument.

Sulfur Dioxide (SO_2)

Current SO_2 Sites

Monitoring objectives for SO_2 include NAAQS compliance, trends tracking, AQI generation, and emission control strategy tracking. From the 1970s through the 1990s, SO_2 monitoring was conducted in all three counties in Delaware. Since the mid-1990s until 2013, due to continuing ambient concentrations well below the primary and secondary NAAQS, and declining resources, monitoring was restricted to sites in New Castle County where the highest concentrations were being recorded. In July 2012, SO_2 trace-level monitoring was added at LEW in preparation for new EPA requirements effective January 1, 2013.

Delaware currently operates five SO_2 monitoring sites, four in New Castle County. The fifth site, at LEW in Sussex County, started operations as a SPM in late summer 2012 and as a SLAMS on January 1, 2013.

Monitoring Requirements

On June 2, 2010, EPA strengthened the primary NAAQS for SO_2. The primary SO_2 standard was revised by establishing a new 1-hour standard of 75 parts per billion (ppb). The new form of the primary standard is the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations. The previous annual and 24-hour average SO_2 standards were revoked. On December 27, 2024, EPA established a new secondary NAAQS for SO_2, an annual average of 10 ppb averaged over 3 years.

EPA also revised the ambient air monitoring requirements for SO_2. For Delaware, the new 2010 standard required one SO_2 monitoring site be established in Sussex County. New monitors needed to meet the network design regulations for the new 1-hour SO_2 standard must have been sited and operational by January 1, 2013, in accordance with 40 CFR Part 58 Appendix D. Delaware complied with this requirement by adding a monitor at LEW, to fulfill the requirement for monitoring in the Sussex County portion of the Salisbury MSA.

EPA also made changes to data reporting requirements for SO_2. State and local agencies are now required to report two data values for every hour of monitoring conducted:

- the 1-hour average SO_2 concentration; and
- the maximum 5-minute block average SO_2 concentration of each hour.

Over the last five years of validated data (2020-2024), Delaware SO_2 measurements have remained in attainment with the 2010 primary NAAQS, as well as the new secondary 2024 NAAQS.

More detailed information on the current SO_2 standards and monitoring requirements can be found on the EPA Historical Table of SO2 NAAQS website.

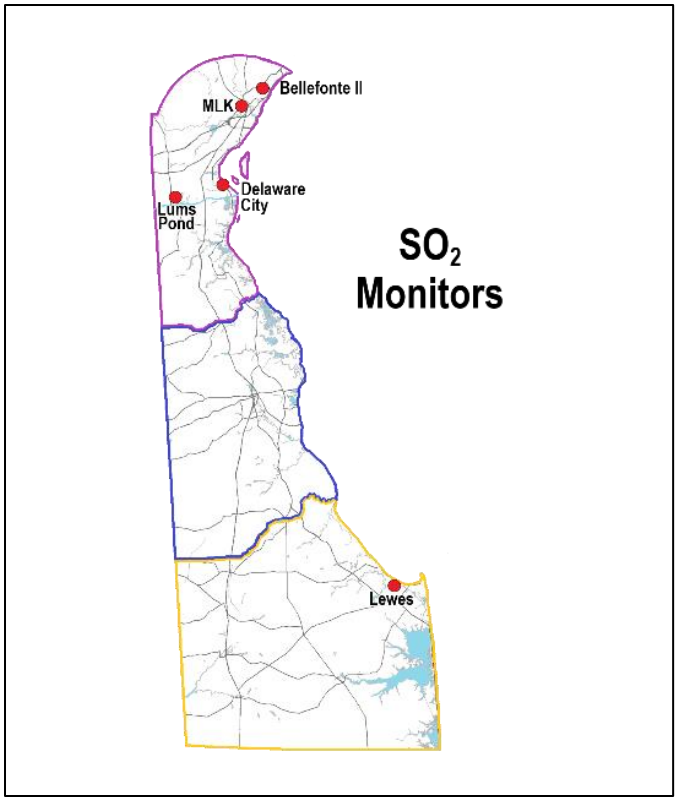


Figure 33: Delaware SO_2 Monitor Map

Table 22: Delaware SO_2 Monitoring Sites

Site	County / MSA	Objectives
Bellefonte II (BF2) 10-003-1013	New Castle / Wilmington DE-MD-NJ Metro Division	NAAQS compliance Trends
Delaware City (RT9) 10-003-1008	New Castle / Wilmington DE-MD-NJ Metro Division	NAAQS compliance Point source impact Trends
Lewes (LEW) 10-005-1003	Sussex County / Salisbury MSA	NAAQS compliance Trends
Lums Pond State Park (LUM) 10-003-1007	New Castle / Wilmington DE-MD-NJ Metro Division	NAAQS compliance Trends Background/transport
Wilmington (MLK) 10-003-2004	New Castle / Wilmington DE-MD-NJ Metro Division	NAAQS compliance NCore trace monitoring Max. concentration Trends AQI

Situational Analysis

Meteorological data for pollution roses was obtained from the NOAA Local Climatological Database (LCD), unless otherwise noted. https://www.ncdc.noaa.gov/cdo-web/datatools/lcd

SO_2 hourly concentrations have not exceeded the 75 ppb primary NAAQS threshold at any Delaware monitoring sites since a single 1-hour spike at RT9 on May 3, 2017. Annual average values have remained ≤ 0.8 ppb at all sites from at least 2015 thru 2024 (≤ 0.08% of the new 2024 10 ppb secondary NAAQS).

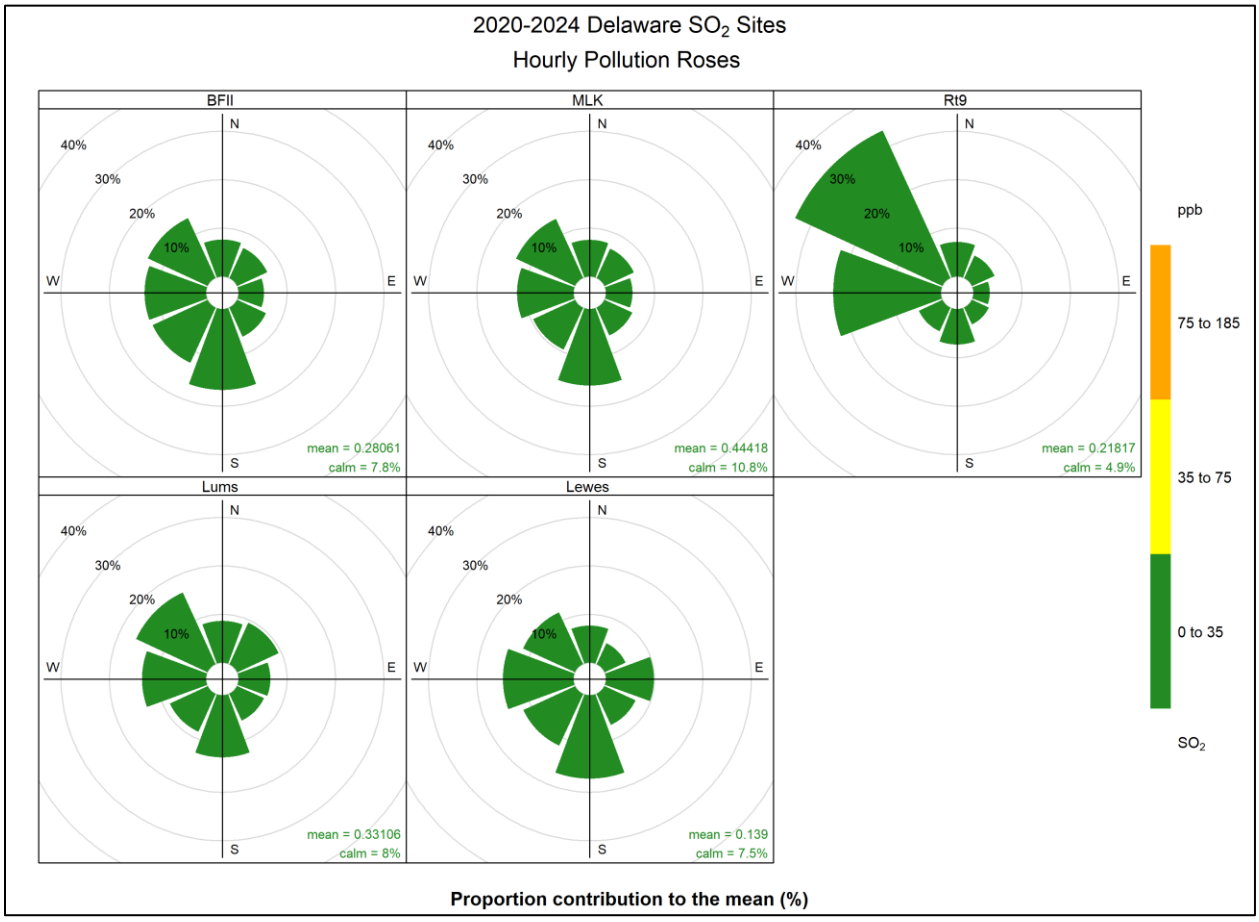


Figure 34: Pollution Roses for All SO_2 Monitoring Sites
2020-2024 Hourly Averages
Wind data source: County Airports, NOAA LCD

Figure 34 shows total hourly SO_2 amounts come mostly from southern and westerly directions. The exception is RT9, which is source oriented near the Delaware City Refinery. All sites continue to be well below the SO_2 NAAQS. None of the hourly data exceeded the green AQI level of "Good".

New Castle County Sites and Characteristics

BF2 (10-003-1013) is the successor site to BF1 (10-003-1003). BF1 was originally established in 1969 to monitor O_3 and SO_2. When changing site characteristics began to interfere with ozone monitoring, a new site (BF2) was established in 2001 in Bellevue State Park, less than a mile to the north. BF2 meets all EPA siting criteria for SO_2.

BF2 is neighborhood scale for SO_2, and monitoring objectives are compliance with the NAAQS, population exposures, and trends. BF2 is in the primary downwind direction from MLK and is also in a secondary downwind direction from a large power plant in the Edgemoor area northeast of Wilmington, DE and an industrial complex (formerly a refinery) in Marcus Hook, PA further to the northeast.

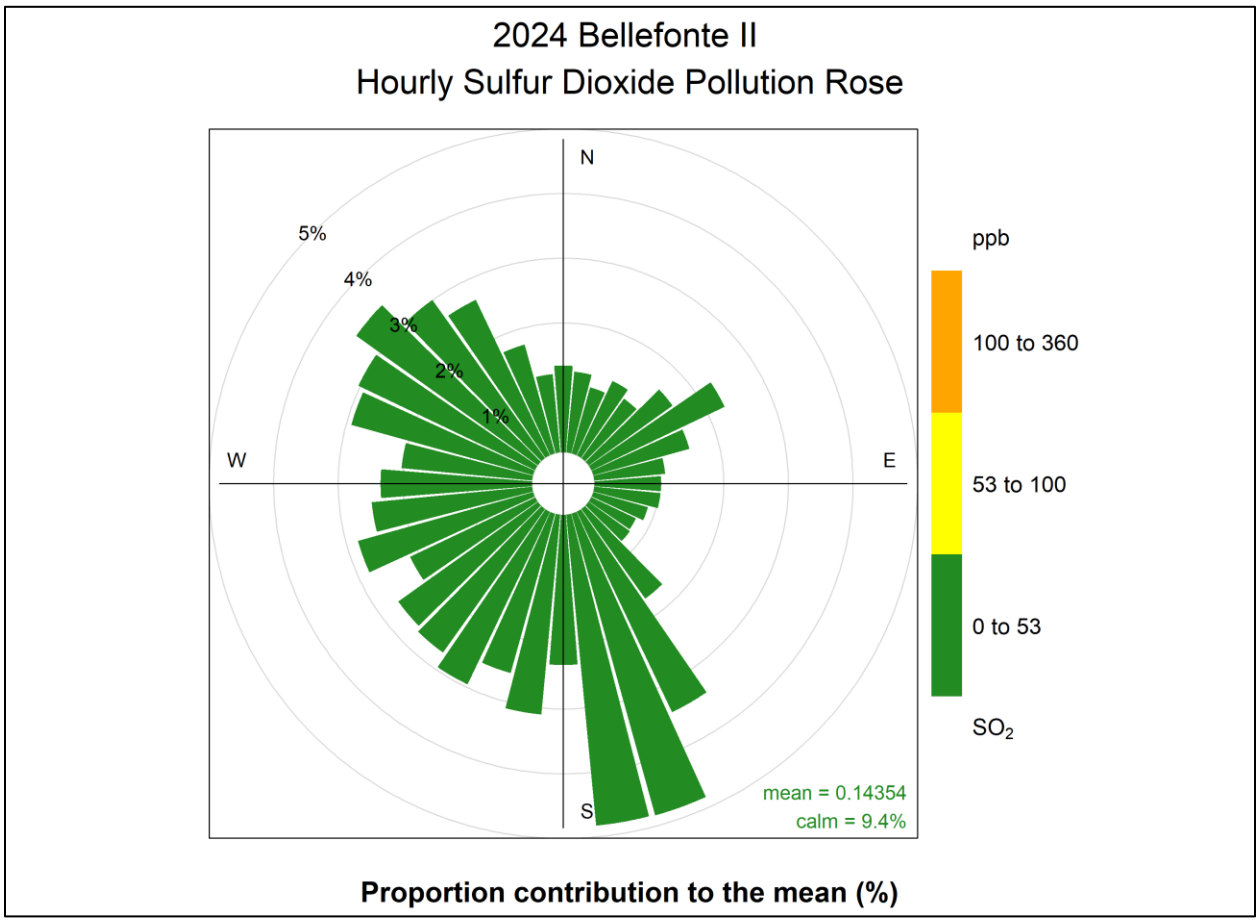


Figure 35: SO_2 Pollution Rose – BF2
Wind data source: Wilmington New Castle County Airport, NOAA LCD

Figure 35 shows that at BF2, the largest amounts of SO2 accrue with winds from the south-southeast (i.e., from the general direction of the Delaware City Refinery).

MLK (10-003-2004) This site was established in 1999 at the intersection of Justison St. and MLK Boulevard in Wilmington. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is neighborhood scale for SO_2 and represents an urban core site impacted by point, area, and mobile sources. The site meets all applicable EPA siting criteria. Trace SO_2 monitoring began in 2009 and continues as an NCore requirement.

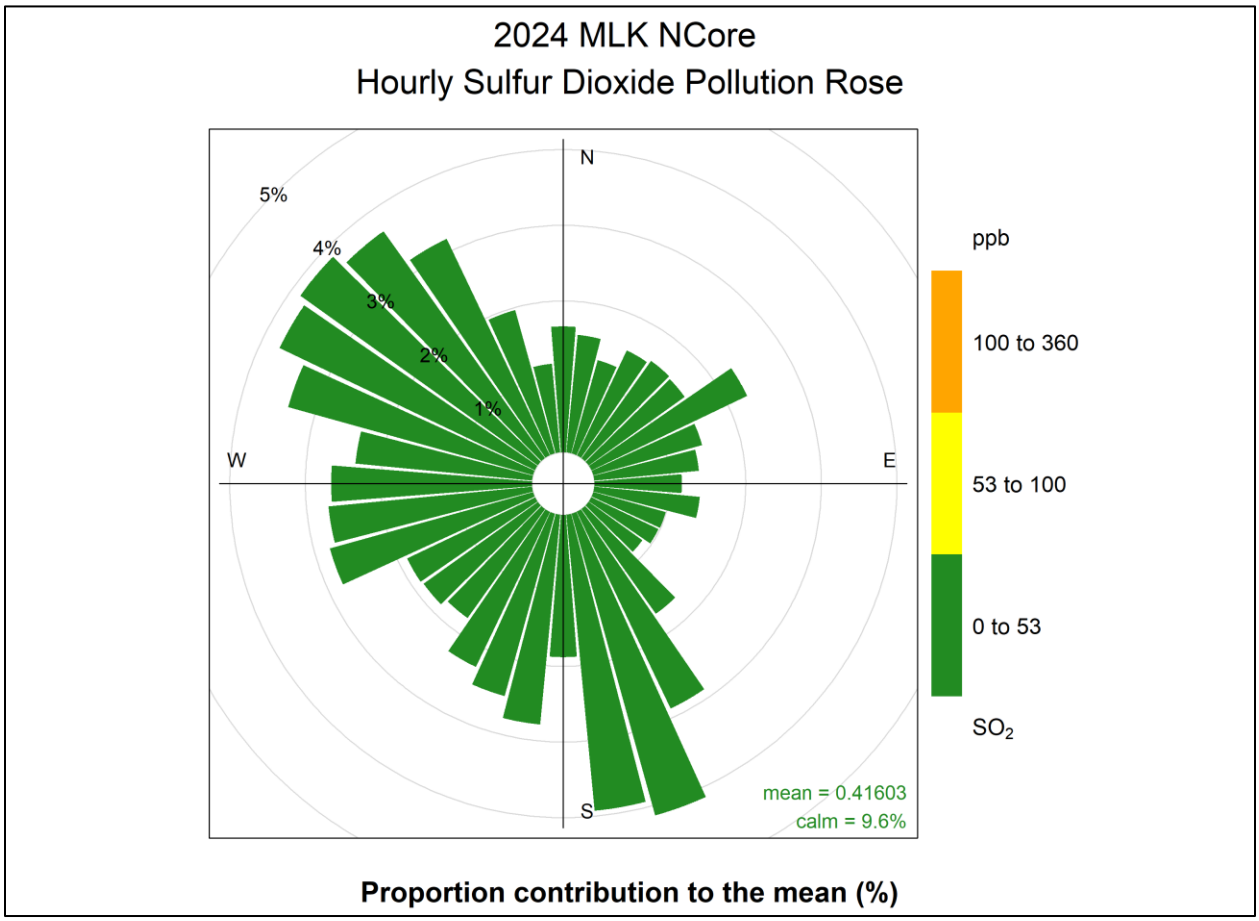


Figure 36: SO_2 Pollution Rose - MLK NCore (Wilmington)
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

Figure 36 shows that at MLK, the largest amounts of SO2 accrue with winds from the south-southeast (i.e., from the general direction of the Delaware City Refinery).

RT9 (10-003-1008) This site was established as an SO_2 monitoring site in 1992 at a location along Route 9 between the Delaware City Refinery and the nearest populated area (Delaware City) in the predominant downwind direction. This site replaced an older site a few miles to the southeast (10-003-0006 at the Governor Bacon Center from 1969 to 1991) in Delaware City.

The current site is neighborhood scale for SO_2, and the primary objectives are source-oriented and population exposure. The site meets all EPA siting criteria.

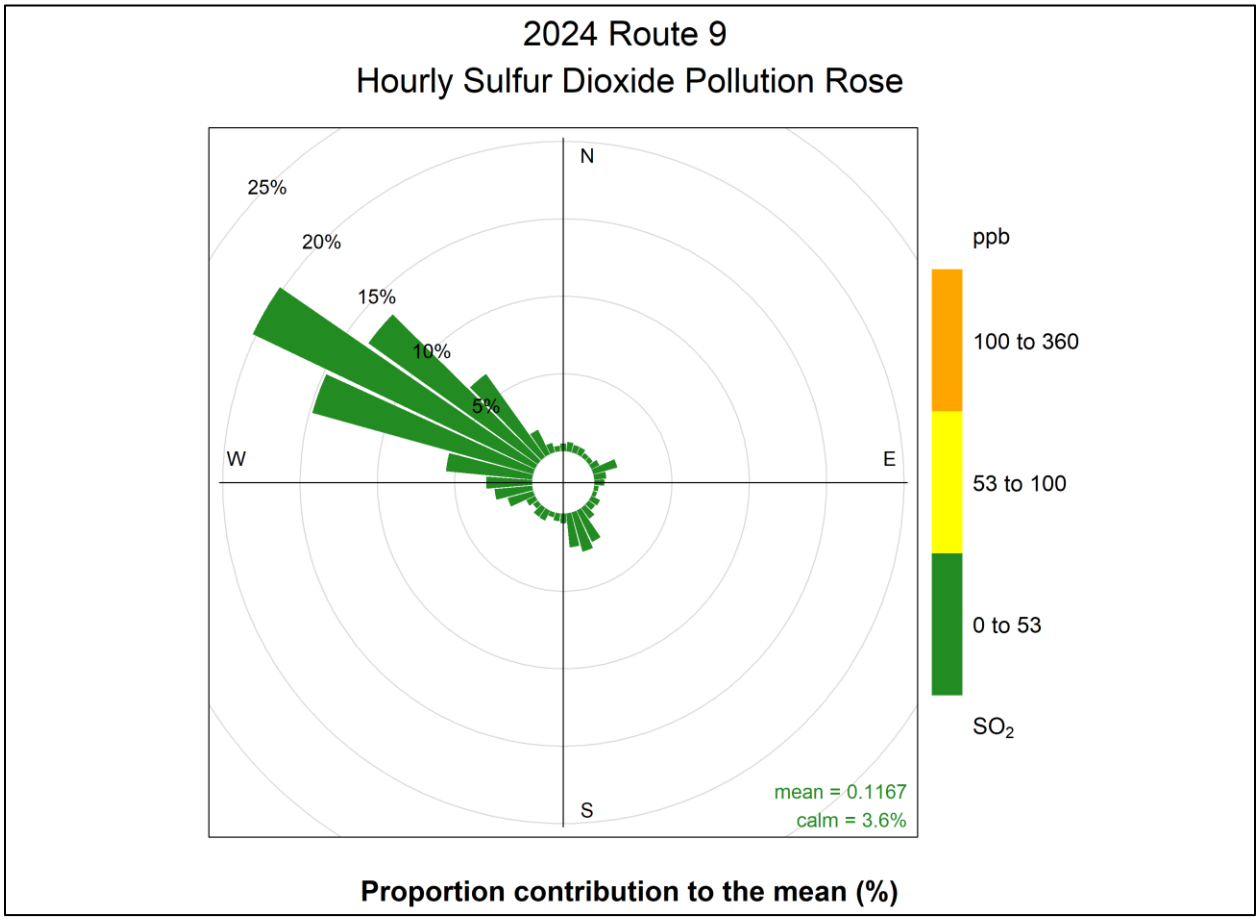


Figure 37: SO_2 Pollution Rose – RT9
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

Being a source-orientated site, the largest amounts of SO_2 come mostly with winds from the west-northwest, where the Delaware City Refinery (point source) is located.

LUM (10-003-1007) The original Lums Pond site (10-003-0018) was established primarily as an ozone monitoring site in 1981 at Lums Pond State Park. Changes in a nearby park maintenance area caused the site to be moved to a more open area of the park in late 1991, and the new LUM site began reporting data in January 1992. SO_2 monitoring was added in 2001 in response to community concerns about impacts from the oil refinery in Delaware City.

LUM is a neighborhood scale site located in a general upwind direction from MLK and secondary downwind from the Delaware City Refinery. The site meets all EPA siting criteria.

The objectives and site types are NAAQS compliance, secondary downwind source impact, regional transport, population exposure, and trends.

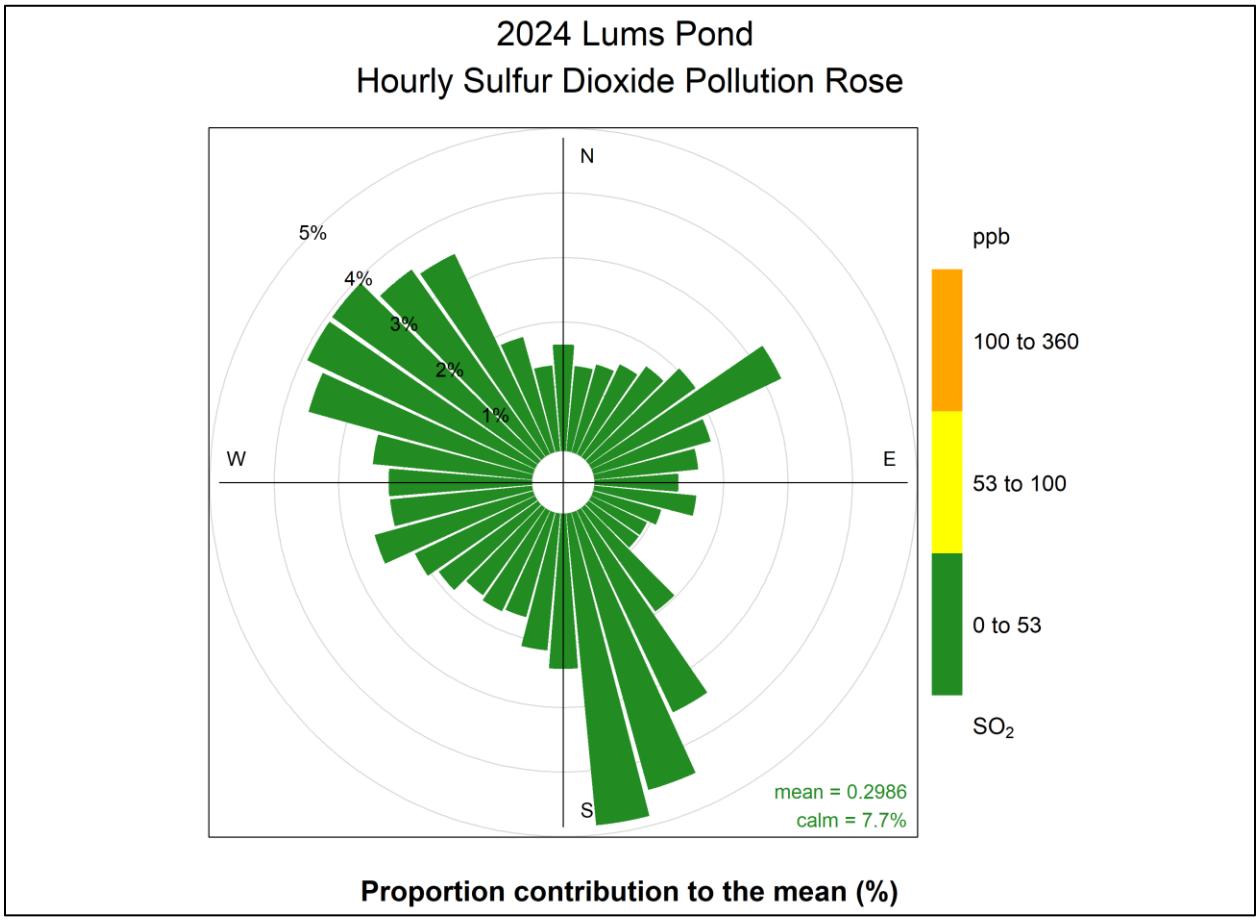


Figure 38: SO_2 Pollution Rose - LUM
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

Figure 38 shows that at LUM, the largest amounts of SO_2 accrue with winds from the south-southeast (from the C&D Canal area), the northwest (from the I-95 and Route 896 traffic corridors), and a narrow direction east-northeast (from the Delaware City Refinery area).

LEW (10-005-1003) This site was established on the property of the UD College of Marine Studies campus in 1997. The SO_2 monitor became operational as a SPM in late summer 2012 and was designated as a SLAMS on January 1, 2013.

The site meets all EPA siting criteria. The monitoring objectives include NAAQS compliance, population exposure, regional transport, and trends.

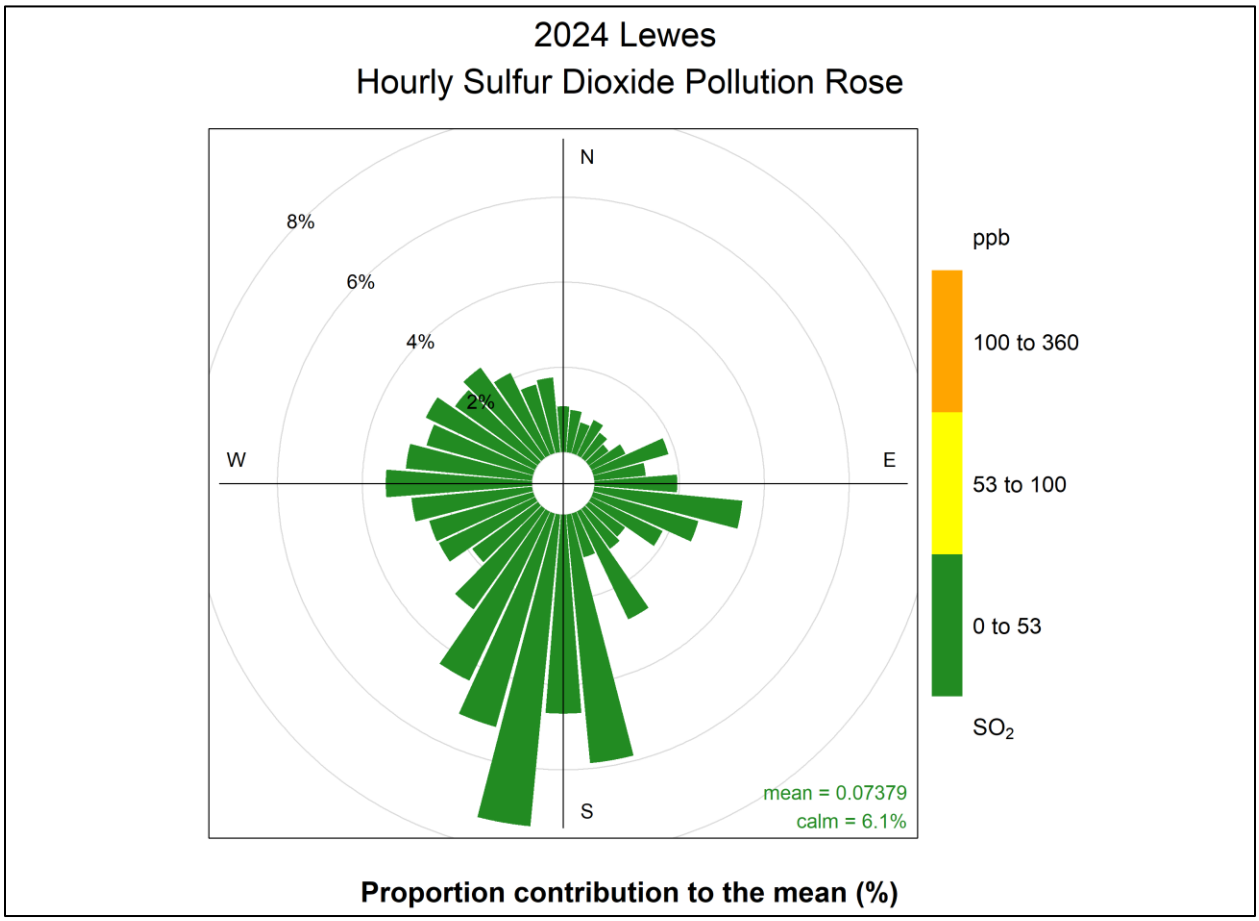


Figure 39: SO_2 Pollution Rose - LEW
Wind data source: Georgetown Delaware Coastal Airport, NOAA LCD*
**Note: this is an inland Airport vs a coastal site, so some wind direction errors may be expected*

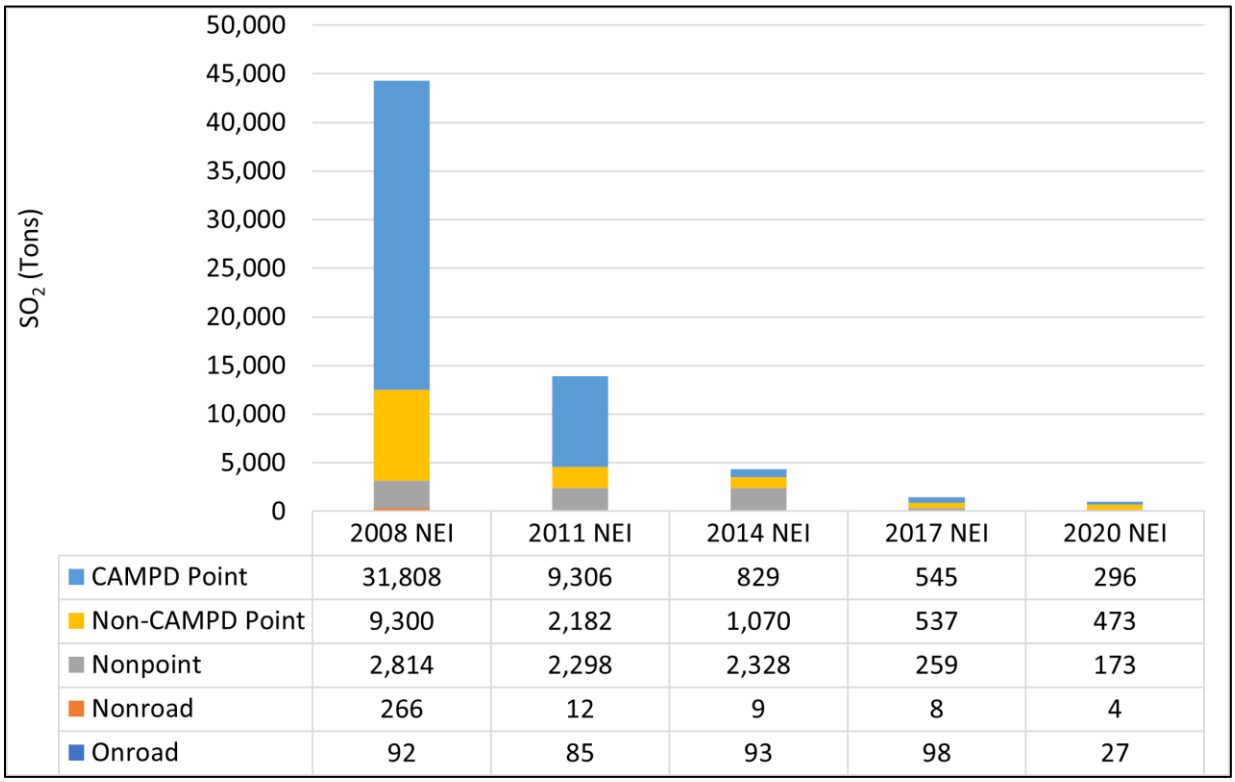
Figure 39 shows that at LEW, the largest amounts of SO_2 accrue with winds from the south-southwest, although this may change going forward because the Indian River Generating Station shut down operation of its last unit (coal burning unit 4) in February 2025.

Emissions Information

Trends – Statewide from 2020 National Emissions Inventory

Downward trends in point source emissions are largely due to regulatory programs such as the Acid Rain Program, Clean Air Interstate Rule (CAIR), Clean Air Markets Program Data (CAMPD) and sulfur in fuel requirements. Changes at power plants since 2000 (emission controls, changes in fuels, and shutdown of older generating units) have resulted in lower emissions and improvements in ambient concentrations. Construction of pollution control equipment at the Delaware City Refinery has also achieved major reductions in SO_2 emissions.

More information on the National Emissions Inventory including data is available from the EPA's NEI page.



	2008 NEI	2011 NEI	2014 NEI	2017 NEI	2020 NEI
CAMPD Point	31,808	9,306	829	545	296
Non-CAMPD Point	9,300	2,182	1,070	537	473
Nonpoint	2,814	2,298	2,328	259	173
Nonroad	266	12	9	8	4
Onroad	92	85	93	98	27

Figure 40: SO_2 Annual Emission Trends, by Category

Figure 40 shows the large reductions in SO_2 emissions achieved in Delaware since 2008, in every NEI category, especially point sources. The highest emitting SO_2 point sources in Delaware according to the 2020 NEI were:

- Indian River Generating Station[6]
- Delaware City Refinery
- Nexpera (formerly Veolia Red Lion)

[6] *Note that since it was permanently shut down in February 2025, Indian River Generating Station will not be on this list for the next assessment.*

Statistical Analysis

The current primary NAAQS for SO_2 is a 1-hour average of 75 ppb calculated as a 3-year average of the 99th percentile 1-hour average. In 2024 EPA restored a secondary annual average standard of 10 ppb effective in 2024.

The trend in SO_2 concentrations at all sites in Delaware has been downward since monitoring began in the 1960s. Significant improvements in ambient concentrations of SO_2 are due to regulatory programs such as the Acid Rain Program, Tier 3 tailpipe and fuel standards, Clean Air Interstate Rule (CAIR), diesel fuel sulfur standards, and standards for marine diesel engines. The dramatic improvement in the 24-hour averages at RT9 between 2006 and 2009 is attributed to the installation of scrubbers at the oil refinery.

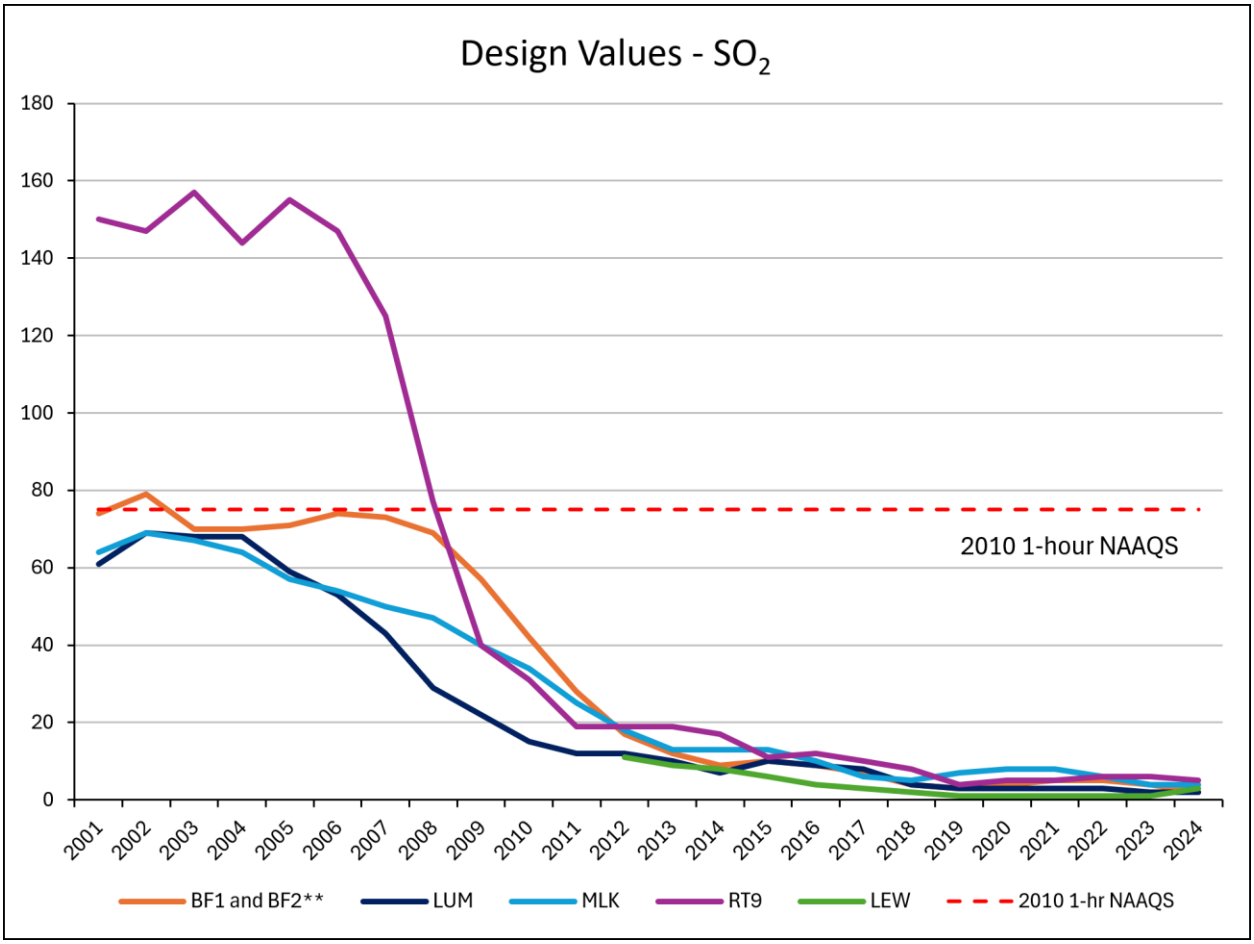


Figure 41: SO_2 Design Value Trends

3-year Averages of 99th Percentiles of Maximum Daily 1-Hour Averages (ppb)

Table 23: SO_2 Design Values by Site

3-year Averages of 99th Percentiles of Maximum Daily 1-Hour Averages (ppb)

Notes: Design Value Year is the second indicated year, 2000-2002 is design value year 2002 which includes 2000, 2001, and 2002. 5-Year Assessments began in 2010, periods shaded to help distinguish changes between assessments.

5-Year Assessment	DV Years	BF1 and BF2**	LUM	MLK	RT9	LEW
2010	1998-2000	71	64 *	60 *	145	
	1999-2001	74	61 *	64 *	150	
	2000-2002	79	69 *	69	147	
	2001-2003	70 *	68 *	67 *	157	
	2002-2004	70 *	68 *	64 *	144	
	2003-2005	71 *	59 *	57	155	
	2004-2006	74	53 *	54	147	
	2005-2007	73 *	43 *	50	125	
	2006-2008	69 *	29 *	47	77	
	2007-2009	57 *	22 *	40	40	
2015	2008-2010	42 *	15 *	34	31 *	
	2009-2011	28 *	12 *	25	19 *	
	2010-2012	17 *	12 *	18	19 *	11 *
	2011-2013	12 *	10 *	13 *	19 *	9 *
	2012-2014	9 *	7 *	13 *	17	8 *
2020	2013-2015	10	10 *	13 *	11	6
	2014-2016	9	9 *	10	12	4
	2015-2017	7 *	8 *	6	10	3
	2016-2018	4 *	4 *	5	8	2 *
	2017-2019	3 *	3 *	7	4	1 *
2025	2018-2020	4 *	3	8	5	1 *
	2019-2021	5 *	3	8	5	1 *
	2020-2022	5 *	3 *	6	6	1 *
	2021-2023	4 *	2 *	4	6	1 *
	2022-2024	2 *	*2 **	*4*	*5*	*3 **

*One or more years with less than 75% data completeness

**Design Value years 2000-2004 from BF1, remainder from BF2

2024 design values are preliminary; data certified by AQ but awaits concurrence from EPA.

Future Needs

SO_2 Design Values continue to be well below 50% of the primary NAAQS of 75 ppb, and in 2024 the EPA added a secondary annual average NAAQS of 10 ppb. Source-oriented monitors continue to see occasional short-term peaks, but annual averages have remained below 1 ppb since 2015.

All of Delaware's SO_2 monitors exceed the recommended 7-year replacement schedule. As funds become available some of these monitors should be replaced, starting with monitors deemed critical.

The SO_2 monitor at LEW is a potential candidate for removal, should adequate funds for continuing operation become unavailable. This is based on historically very low readings (lowest in the state), and the recent (February 2025) shutdown of a major upwind point source approximately 13 miles to the SSW (the coal-fired power plant at Indian River Generating Station).

Assessment Recommendations

Three of the five SO_2 monitors in the network are ranked "Critical". LEW and BF2 are ranked "Marginal".

LEW SO_2 monitor is technically eligible for removal based on 40 CFR 58.14(c), due to very low measurements for long time, and on 40 CFR 58 Appendix D, section 4.4.2, due to a Population Weighted Emissions Index (PWEI) consistently under 100, much less than the 5000 threshold that mandates at least one SO_2 monitor in an MSA.

LEW SO_2 monitor is not recommended for removal at this time, due to being the only SO_2 monitor in the Salisbury MSA. Removing it would require the use of modeling instead, which could potentially be more expensive than continuing to operate the monitor.

BF2 SO_2 monitor is technically eligible for removal based on 40 CFR 58.14(c), due to very low measurements for long time. It has not been the New Castle County design value site in at least the last 10 years.

BF2 SO_2 monitor is not recommended for removal at this time due to a long trend history and possible community concerns.

Nitrogen Dioxide (NO_2)

Current NO_2 Sites

NO_2 is not a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS. There is one NO_2 site in Delaware at MLK (NCore site). EPA final near road monitoring requirements were established in March 2013. This created requirements for near road NO_2 monitors in the "Philadelphia-Camden-Wilmington, PA-NJ-DE-MD" CBSA by January 1, 2014, and collocated CO and $PM_{2.5}$ monitors at NO_2 near road sites by January 1, 2015. This did not require any additional monitors in Delaware.

Delaware began NO_2 monitoring at the urban Wilmington site at 12th and King Streets, then at two non-urban sites in New Castle County, in the 1990s. BF1 was a supplemental NO_2 site collocated with an ozone monitor. When the site was relocated to BF2 the NO_2 monitoring was discontinued. LUM was part of the PAMS program until the PAMS program ended in 1999, at which time the LUM NO_2 monitor was moved back to the urban Wilmington site.

Monitoring objectives for NO_2 include NAAQS compliance, maximum concentration, population exposure, trends tracking, and emission control strategy tracking.

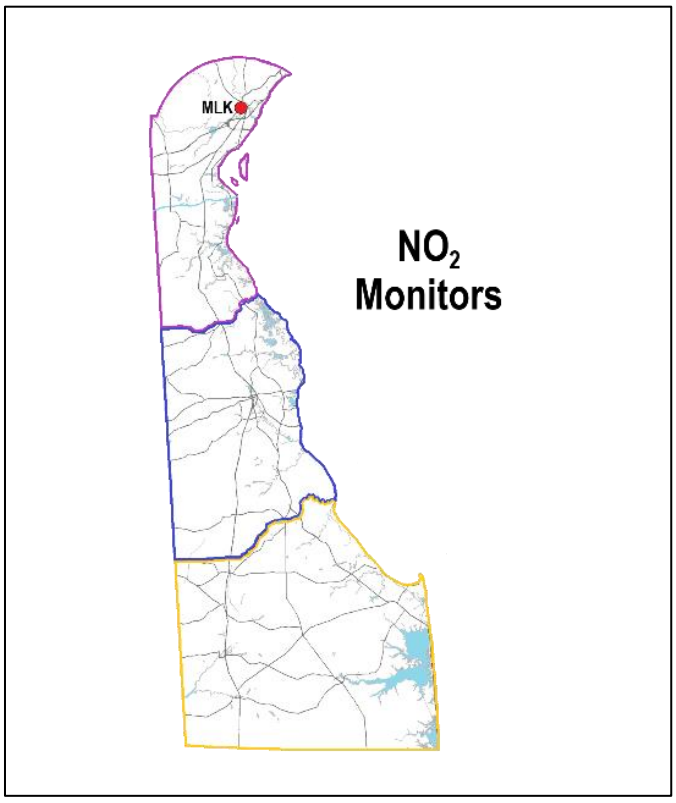


Figure 42: Delaware NO_2 Monitor Map

Monitoring Requirements

On January 22, 2010, EPA strengthened NAAQS for NO_2. EPA set a new primary 1-hour NO_2 standard of 100 parts per billion (ppb). The form for the 1-hour NO_2 standard is the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations. EPA also retained, with no change, the current annual average NO_2 standard of 53 ppb.

More detailed information on NO_2 standards and monitoring requirements can be found on the EPA Historical Table for NO_2 NAAQS website.

The NCore program requires NOy monitoring at the single NCore site in Delaware (MLK). This monitoring began in 2010.

Table 24: Delaware NO_2 Monitoring Site

Site	County/MSA	Objectives
MLK	New Castle / Wilmington DE-MD-NJ Metro Division	NAAQS compliance Maximum concentration Population exposure Trends Emissions control strategy tracking

Situational Analyses

New Castle County Sites and Characteristics

MLK (10-003-2004) The MLK site was established in 1999 at the intersection of Justison St. and MLK Blvd in Wilmington. It replaced the prior urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is neighborhood scale for NO_2 and represents an urban core site impacted by point, area, and mobile sources. The site meets all EPA siting criteria. NOy monitoring began in 2010 and continues as an NCore requirement.

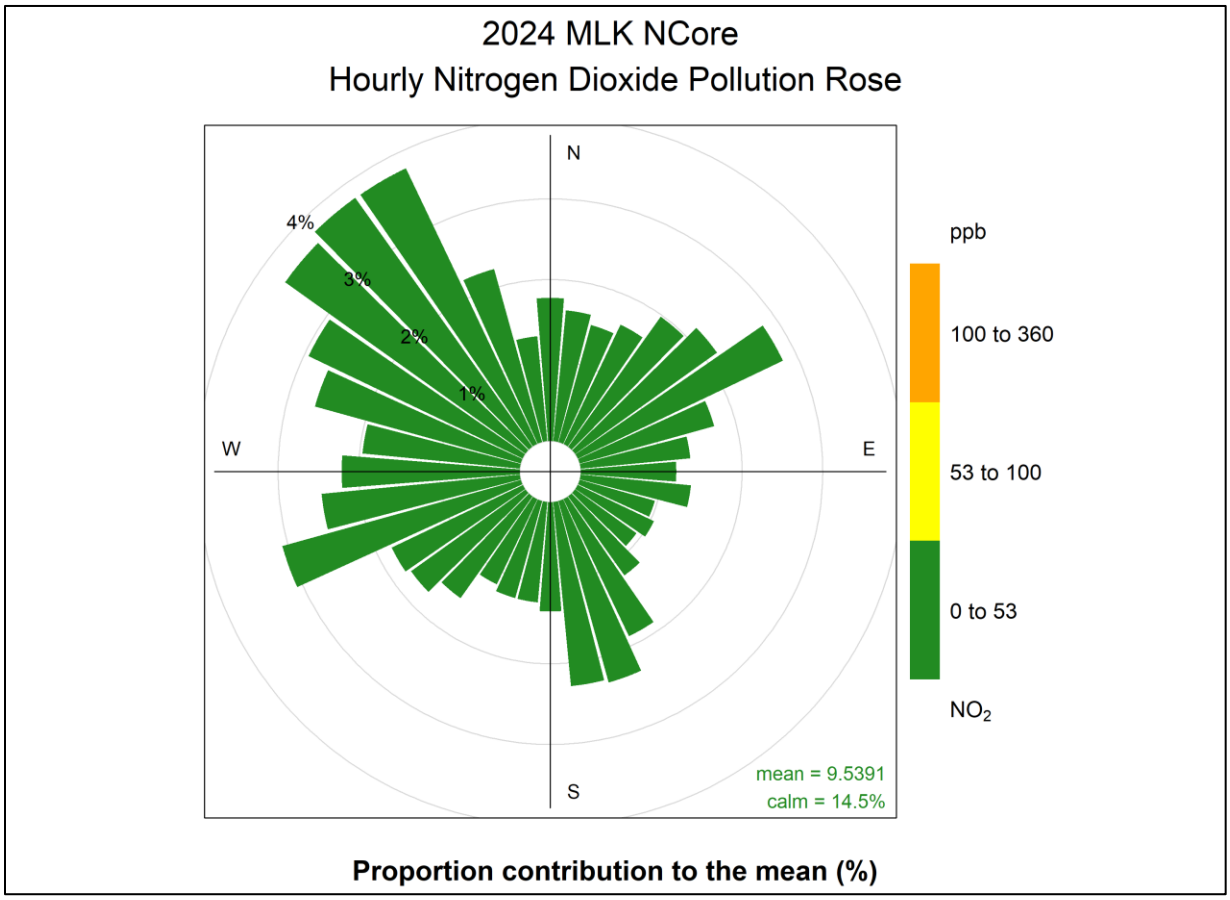


Figure 43: NO_2 Pollution Rose - MLK
Met Data Source: Wilmington New Castle County Airport, NOAA LCD

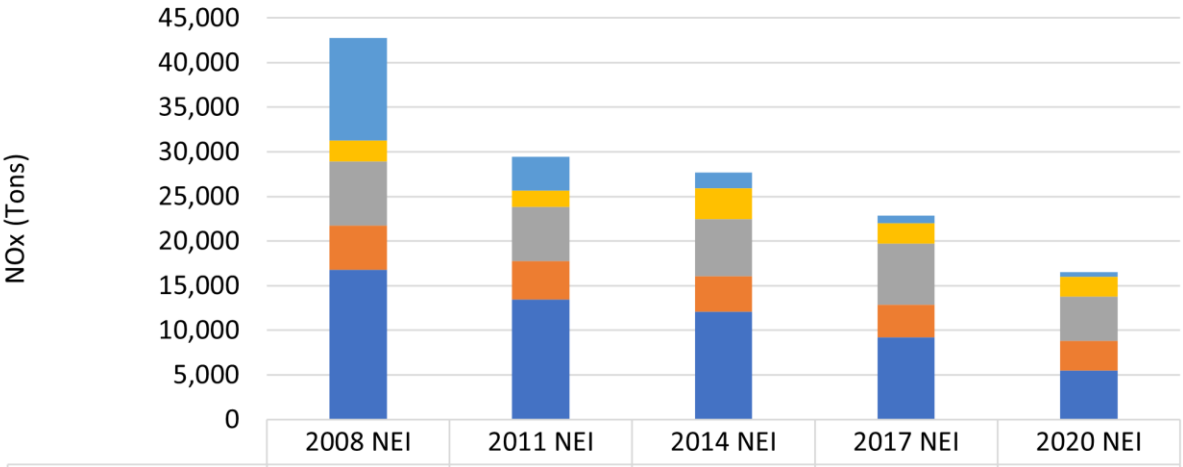
Elevated concentrations of NO_2 can occur with any wind direction; concentrations tend to be highest during calm periods and inversions. Figure 43 shows that at MLK, the largest amounts of NO_2 accrue with winds from numerous directions, including the northwest, west-southwest, the northeast, and the south-southeast. This may be due to the prevalence of winds from those directions, and possibly stronger sources of NO_2 in those directions, such traffic on I-95 and I-495, idling traffic in the city of Wilmington, and perhaps the nearby train station and/or more distant Delaware City Refinery to the south-southwest.

Emissions Information

Trends – Statewide from 2020 National Emissions Inventory

Emissions are measured as NOx and not NO_2; NO_2 is formed in the atmosphere but is primarily emitted as NOx. The largest change has been the decrease in point source emissions due to controls on the largest sources. Significant non-point sources include both on and off-road diesel engines. Non-point and mobile sources are a greater percentage of total emissions than point sources.

More information on the National Emissions Inventory including data is available from the EPA's NEI page.



	2008 NEI	2011 NEI	2014 NEI	2017 NEI	2020 NEI
CAMPD Point	11,545	3,748	1,791	889	524
Non-CAMPD Point	2,304	1,876	3,424	2,246	2,242
Nonpoint	7,204	6,024	6,383	6,881	4,968
Nonroad	4,972	4,347	4,020	3,623	3,293
Onroad	16,765	13,441	12,066	9,243	5,505

Figure 44: NO_x Emissions Trends

The highest emitting NOx point sources in Delaware according to the 2020 NEI were:

- Delaware City Refinery
- Dover AFB Airport
- Hay Road Energy Center
- Port of Wilmington

Statistical Analysis

The current primary NAAQS for NO_2, set in 2010, are an annual arithmetic mean of 53 ppb, and annual 98th percentiles of maximum daily 1-hour averages, averaged over 3 years, not to exceed 100 ppb.

The trend in annual averages has been downward since monitoring began in the 1980s. Improvements in ambient concentrations of NO_2 are due to regulatory programs such as Tier 3 tailpipe and fuel standards, and Delaware's adoption of low emission vehicle standards. The Federal Tier 3 standards were phased in between the 2017 through 2026 model years.

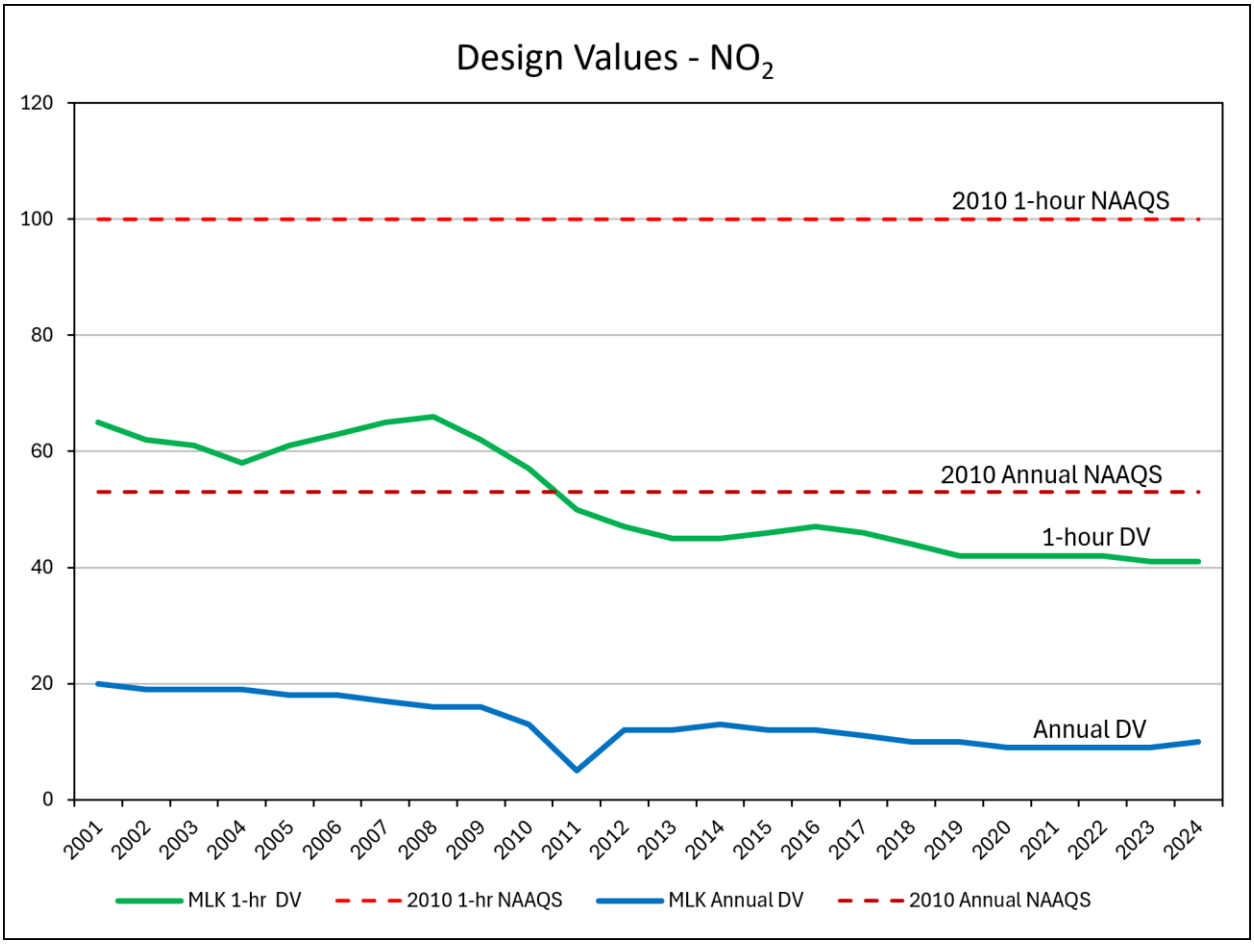


Figure 45: NO_2 Design Value Trends

3-year Average 98th Percentiles of Maximum Daily 1-Hour Averages (ppb)

Table 25: NO_2 Design Values Trends

3-year Average 98th Percentile Daily Max 1-Hour Average (ppb) and Annual mean averaged over 3 years

5-Year Assessment	DV Years	MLK 1-hour Average	MLK Annual Average
2010	1999-2001	65 *	19.5
	2000-2002	62 *	19.5
	2001-2003	61 *	18.9
	2002-2004	58	19.0
	2003-2005	61	18.8
	2004-2006	63	17.7
	2005-2007	65 *	17.8
	2006-2008	66 *	17.4
	2007-2009	62 *	16.3
2015	2008-2010	57 *	15.5
	2009-2011	50 *	12.9
	2010-2012	47 *	4.9
	2011-2013	45 *	11.8
	2012-2014	45 *	12.2
2020	2013-2015	46 *	12.6
	2014-2016	47 *	12.2
	2015-2017	46 *	11.6
	2016-2018	44	10.7
	2017-2019	42	9.9
2025	2018-2020	42	10.3
	2019-2021	42	9.4
	2020-2022	42	9.3
	2021-2023	41	9.2
	2022-2024	41	9.0

*One or more years with less than 75% data completeness

Design Value Year is the second indicated year, 2000-2002 is design value year 2002 which includes 2000, 2001, and 2002. 5-Year Assessments began in 2010, periods shaded to help distinguish changes between assessments.

Future Needs

With the new PAMS Program direct NO_2 monitoring at NCore sites in O_3 nonattainment areas is required. Delaware is currently testing a continuous FEM monitor (TAPI N500) for direct measurement of NO_2, to satisfy NCore requirements at MLK. Additionally, with implementation of the Enhanced Monitoring Plan (EMP), supplemental monitoring for NO_X in the OTR requires a NO_X monitor be installed at LEW.

Assessment Recommendations

MLK NO_2 monitor is ranked “Critical”, as it is the only currently operating NO/NO_2/NOx monitor in the network. The only recommendation is to obtain a spare monitor and adequate reserves of spare parts, in case the existing one malfunctions.

Lead (Pb)

Current Lead Monitoring

As of 2016 Delaware discontinued FRM PM_{10} lead monitoring at MLK. However, lead monitoring continues as part of both the $PM_{2.5}$ Speciation and TSP Heavy Metals monitoring programs.

Historically, Delaware operated lead TSP monitors at multiple locations in New Castle County. Measured ambient concentrations decreased by approximately 94% between 1978 and 1988 due to the change to unleaded gasoline in cars. In 1989, the last year in which samples were collected for compliance with the former NAAQS, 63% of the samples were below the analytical detection limits.

Monitoring Requirements

As of 2016 EPA ruled that lead no longer is required to be monitored at NCore Sites (Federal Register Vol. 81, No. 59, 3/28/2016). Monitors were eligible to be discontinued after collecting 3 years of data per approval by the Regional Office and upon showing compliance with 40 CFR Part 58.14(c).

Assessment Recommendations

There are no assessment recommendations for Pb. No changes are anticipated through 2029.

Monitoring Network Technology

Monitors

Since the 2020 Network Assessment Delaware has updated $PM_{2.5}$ instruments, prioritizing continuous FEM monitoring, and replaced some aging instruments, as shown in Table 26.

The table below lists the monitors that are critical to meet Delaware's monitoring objectives and monitor recommended replacement ages. Manufacturer recommended life expectancy for most monitors is 7 years. This requires our agency to maintain a replacement schedule to maintain data capture. Many deployed monitors currently exceed their recommendation replacement age. These are highlighted in Table 26. Most $PM_{2.5}$ FRM samplers have been replaced with continuous FEM monitors. The collocated FRM monitor at LUM was replaced in 2022. Funding is the most critical component of Delaware's ability to replace monitors.

Table 26: Delaware Monitor Ages

	Monitor Age in Years					
Site	**O_3**	**SO_2**	**CO**	**NOx**	**PM FRM**	**$PM_{2.5}$ FEM Continuous**
BF1					retired	3
BF2	14	15				
BSP	7					
DVR					retired	7
KIL	13				retired	3
LEW	1	13				
LUM	5	13			3	7
MLK	14	11	1	14	10-15	7
NWK					retired	7
RT9		15				3
SEA	9					3

All monitors used for NAAQS compliance meet EPA requirements as FRM or FEM monitors.

Calibrators

One of the largest concerns for collecting valid data is the accurate calibration of all continuous gas analyzers in the monitoring network. With Delaware's efforts to control source emissions, many ambient air pollutant concentrations are recording well below the NAAQS. This causes precision point checks to be in very low concentration ranges where (for example) a tenth of a ppb incurs percent differences outside established DQO. Producing reliable very low concentrations from standard calibrators is difficult. Some newer zero air supplies and calibrators with multiple mass flow controllers have been acquired. All field and laboratory calibrators currently in use meet all EPA specifications and requirements. There remain some calibrators and zero air supplies that have exceeded their recommended life spans.

Shelters

Monitoring shelter and platform replacements are extremely expensive. However, over time shelters and platforms deteriorate and no longer safely support equipment and personnel. Funding is the most critical component of this replacement schedule. Since December 2022, one platform and five shelters have been replaced. State funding to support this has been necessary due to lack of Federal funds.

Table 27: Delaware Monitoring Shelter Ages

Shelter Sites	Estimated Age in Years
BF2	3
BSP	1
KIL	2
LEW	2
LUM	3
MLK NCore	10
MLK PAMS	30
RT9	26
SEA	35
Platform Sites	**Estimated Age in Years**
BF1	25
DVR	2
NWK	26

$PM_{2.5}$ FRM Samplers

The $PM_{2.5}$ FRM samplers are beginning to show their age, resulting in many malfunctions and missed sample collections. Delaware has migrated to continuous $PM_{2.5}$ FEMs at all monitoring stations to reduce logistical concerns with manual sample collection. All $PM_{2.5}$ FRM samplers, except for those at LUM and MLK, have been discontinued to reduce expenditures on sample analysis. An added benefit of continuous monitors is that data is available to generate near real-time AQI reporting, allowing communities access to the data and supporting coordinated government efforts when high levels are present. The discontinued samplers have been used for spare parts. As of this 2025 assessment, four FRM samplers have been retained in operation, with three at MLK to fulfill NCore requirements, and one at LUM fulfilling collocation requirements. Collocation requirements could be met b an FRM sampler with any continuous FEM monitor in the network, except MLK which already has collocated monitors.

Data Acquisition System

Delaware is using a digital Data Acquisition System (DAS) supplied by DRDAS/Envitech. This system provides increased capabilities in remote communications with monitoring stations, including the ability to perform remote diagnostic functions and automate some operational checks. The monitoring station DAS computers are standardized across the network, to support the requirements of Delaware's Department of Information and Technology and upgraded DAS software.

Other Support Equipment

All gas cylinders used for monitor calibrations, checks and audits are EPA Protocol I cylinders. Delaware also participates in the AA-PGVP when cylinders are available. Sampling manifolds meet all 40 CFR Part 58 Appendix E requirements for residence time, materials, and probe/inlet heights.

Performance Evaluation/Audit Equipment

Delaware has upgraded some of the instrumentation used in the Performance Evaluation/Audit Program. All audit equipment is independent of field operations, including separate calibrators, zero air sources, and gas standards. Audit equipment is independently certified against National Institute of Standards and Technology (NIST) standard reference materials annually (or per manufacturer recommendation) by outside laboratories.

Table 28: Delaware Performance Evaluation/Audit Equipment Ages

Audit Equipment	Approximate Age
Teledyne T750U gas dilution calibrator	3
TEI 49i-PS ozone level 2 Bench calibrator	9
TEI 49i-PS ozone level 2 Field calibrator	12
Sabio 1001P zero air source	13
Five (5) Alicat FP-25 flow, temp and press meters	7+
Vaisala WXT536 weather transmitter	1
Met Station One weather station	3
Kipp & Zonen SMP-10V Solar Pyranometer	4
Kipp & Zonen SUV5-V Ultraviolet Radiometer	3
Tisch TSP Audit Kit and Dwyer Digital Manometer	7+
Precipitation Tipping Bucket audit kit	1

Meteorological Equipment

Delaware currently operates ultrasonic wind speed/wind direction sensors at LEW, LUM, and MLK. The sensor at BSP was not reinstalled after the shelter was replaced. Delaware does intend to reinstall this equipment. The sensor at RT9 is currently not operational. Delaware would like to repair and reinstall this equipment. Wind sensors are factory calibrated; checks with portable equipment are performed as needed. The sensor at MLK satisfies NCore requirements. The other sites use the data for supplemental information only; any advanced modeling/dispersion analyses use certified wind data from the nearest NOAA sites.

The MLK NCore site has the most complete suite of meteorological sensors in compliance with EPA NCore requirements and standards. These measurements include wind direction, wind speed, ambient pressure, ambient temperature, and percent relative humidity. PAMS

requirements add precipitation, solar pyranometer, UV radiometer, and ceilometer (mixing height) to the meteorological equipment at MLK.

Future Program Funding

Historically, the Program has used equipment well beyond manufacturer estimated life expectancy of seven years. The network requires capital investment for procurement and support of analytical equipment to maintain a replacement schedule.

Since the last 5-Year Network Assessment was completed in 2020, Delaware has replaced one platform (DVR) and five shelters (LUM, BF2, KIL, LEW, and BSP), and replaced wooden stairs with metal at a few other sites. This represents an investment of $450,000, using State of Delaware general funds from the Minor Capital program. The AAMN has four shelters and two platforms in need of replacement over the next 5-year period. These structures are planned to be replaced at approximately two sites per year.

Delaware has relied on our federal 103 and 105 STAG grants along with new grant opportunities (103-IRA Supplemental and 103-IRA Direct awards) to fund the replacement of essential monitoring instruments and equipment totaling over $1.3 million since the last 5-year Network Assessment. Delaware remains concerned about sustainable funding to maintain the integrity of the program going forward as there is still much left to replace and maintain.

The Asset Management list of instruments, equipment and monitoring shelters provides detailed information that is used to prioritize future replacements. However, the funding available to maintain the monitoring program is expected to be a challenge once the IRA spending is exhausted.

Results - Summary of Delaware Monitoring Sites and Monitors

Tables 29 through 37 list the Assessment Rankings of each monitor in the network, grouped by measured parameter, and listed in approximate order of most to least critical. The assessed ranks were developed using the tools provided by EPA. The methods to reach these conclusions are explained throughout the document, except for table 37, which addresses meteorological equipment.

The results of this Assessment indicate that the network contains critical, credible and marginal monitors. In addition, the network meets the requirements in the Federal regulations and provides more than sufficient monitoring throughout Delaware to accurately determine compliance with the NAAQS. The investment to operate the AAMN is significant, and Delaware is concerned about future funding needs. Additional factors that may impact future network design include new monitoring requirements associated with new or revised NAAQS, aging equipment, and required maintenance. The marginal monitors could be considered for removal, however, at this time, Delaware is not recommending any monitors for removal. If funding is in jeopardy, Delaware will use this assessment to determine which monitors could be removed from service and will work closely with EPA Region 3 to ensure that if changes are made, all monitoring requirements are met and changes are implemented with the smallest impact to achieving our DQOs.

Table 29: Delaware Site/Monitor Rating Summaries - O_3

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Neighborhood	NCore requirement Maximum concentration Population exposure Tracking control strategies Trends	**Critical**
Lums Pond State Park (LUM) 10-003-1007	Not in a city New Castle	1/1/1992	SLAMS	Urban	Background requirement Maximum concentration Upwind for MLK Enhanced monitoring in non-attainment area	**Critical**
Killens Pond State Park (KIL) 10-001-0002	Not in a city Kent	4/1/1995	SLAMS	Urban	Req'd min monitor for Kent MSA DV for Kent County Rural background Trends	**Critical**
Seaford (SEA) 10-005-1002	Seaford Sussex	3/1/1990	SLAMS	Urban	Maximum concentration Represents Salisbury MSA Background Trends	**Critical**
Brandywine Creek State Park (BSP) 10-003-1010	Not in a city New Castle	7/1/1994	SLAMS	Urban	Maximum concentration Regional transport from northwest Secondary downwind from MLK Background Trends	**Critical**
Lewes (LEW) 10-005-1003	Not in a city Sussex	5/1/1997	SLAMS	Urban	Seasonal population exposure Only coastal site Most unique readings in State 2025 shutdown of nearby power plant may affect DVs.	**Credible**
Bellefonte II (BF2) 10-003-1013	Not in a city New Castle	4/1/2001	SLAMS	Neighborhood	Primary downwind from MLK; but Chester, PA, monitor is in same direction, satisfies same criteria, and is statistically similar.	**Marginal**

Table 30: Delaware Site/Monitor Rating Summaries - $PM_{2.5}$ FEM

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Neighborhood	Maximum concentration NCore requirements Speciation requirements Tracking control strategies Continuous monitor for AQI Trends	**Critical**
Delaware City (RT9) 10-003-1008	Not in a city New Castle	2/1/1992	SLAMS	Neighborhood	Point source oriented Maximum concentration Tracking control strategies Continuous monitor for AQI Trends	**Critical**
Lums Pond State Park (LUM) 10-003-1007	Not in a city New Castle	1/1/1992	SLAMS	Urban	Maximum concentration Rural background requirement Regional transport from west Continuous monitor for AQI Trends	**Critical**
Seaford (SEA) 10-005-1002	Seaford Sussex	3/1/1990	SLAMS	Urban	Maximum concentration DV for Sussex County Only PM site in Salisbury MSA; Regional background Continuous monitor for AQI Trends	**Critical**
Killens Pond State Park (KIL) 10-001-0002	Not in a city Kent	4/1/1995	SLAMS	Urban	Maximum concentration DV for Kent County Rural background requirement Continuous monitor for AQI Trends	**Critical**
Dover (DVR) 10-001-0003	Dover Kent	1/1/1999	SLAMS	Neighborhood	Population exposure Continuous monitor for AQI Trends Technically eligible for removal; redundant with KIL; but not recommended to remove due to long trend history and possible community concerns.	**Credible**
Bellefonte I (BF1) 10-003-1003	Wilmington New Castle	1/1/1969	SLAMS	Middle	NAAQS compliance Population exposure; Trends Continuous monitor for AQI Technically eligible for removal; redundant with MLK and Chester, PA; but not recommended unless resources are not available.	**Marginal**
Newark (NWK) 10-003-1012	Newark New Castle	12/16/ 1999	SLAMS	Micro	Population exposure Trends (broken due to siting issue) Technically eligible for removal or relocation; site no longer suitable for larger measurement scales and associated objectives.	**Marginal**

Table 31: Delaware Site/Monitor Rating Summaries - $PM_{2.5}$ FRM

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Criteria from Monitor Assessment	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Neighborhood	FRM collocation req't with continuous FEM.	**Critical**
Lums Pond State Park (LUM) 10-003-1007	Not in a city New Castle	1/1/1992	SLAMS	Urban	FRM collocation req't with continuous FEM (critical monitor); potential for relocation to other FEM sites (credible location).	**Critical/ Credible**

Table 32: Delaware Site/Monitor Rating Summaries - $PM_{2.5}$ SPECIATION

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS	N/A	Federal requirement to collect speciation data for the CSN portion of $PM_{2.5}$ monitoring.	**Critical**

Table 33: Delaware Site/Monitor Rating Summaries - PM_{10}

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Neighborhood	Federal NCore requirement for PM_{coarse} calculation Supplemental information.	**Critical**

Table 34: Delaware Site/Monitor Rating Summaries - CO

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Middle	Federal NCore requirement Maximum concentration Design Value site Trends	**Critical**

Table 35: Delaware Site/Monitor Rating Summaries - SO_2

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Neighborhood	Federal NCore requirement Maximum concentration Tracking control strategies	**Critical**
Delaware City (RT9) 10-003-1008	Not in a city New Castle	2/1/1992	SLAMS	Neighborhood	Maximum concentrations DV site for NCC Primary downwind of major SO_2 point source (Delaware City Refinery).	**Critical**
Lums Pond State Park (LUM) 10-003-1007	Not in a city New Castle	1/1/1992	SLAMS	Neighborhood	Secondary downwind direction for Delaware City Refinery	**Credible**
Lewes (LEW) 10-005-1003	Not in a city Sussex	5/1/1997	SLAMS	Neighborhood	Technically eligible for removal based on 40 CFR 58.14(c), very low measurements for long time. Not recommended for removal at this time due to being the only SO_2 monitor in Salisbury MSA.	**Marginal**
Bellefonte II (BF2) 10-003-1013	Not in a city New Castle	4/1/2001	SLAMS	Neighborhood	Technically eligible for removal based on 40 CFR 58.14(c), very low measurements for long time. Not recommended for removal at this time due to long trend history and possible community concerns.	**Marginal**

Table 36: Delaware Site/Monitor Rating Summaries - NO_2

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Neighborhood	Federal NCore req't Maximum concentration Design Value site Tracking control strategies Trends	**Critical**

Table 37: Delaware Site/Monitor Rating Summaries - WS/WD

Site Name (Abbreviation) AQS ID	City County	Site Start Date	Monitor Class	Measurement Scale	Major Assessment Criteria	Assessed Rank
Wilmington (MLK) 10-003-2004	Wilmington New Castle	1/1/1999	SLAMS/ NCore	Micro	Federal NCore & PAMS requirements	**Critical**
Delaware City (RT9) 10-003-1008	Not in a city New Castle	2/1/1992	SLAMS	Micro	Not technically required, but important for analysis of pollutant release episodes from adjacent oil refinery. Equipment currently nonfunctional	**Credible**
Lewes (LEW) 10-005-1003	Not in a city Sussex	5/1/1997	SLAMS	Micro	Not technically required, but useful for understanding differences in wind patterns between the coastal area and inland airport NOAA station.	**Credible**
Lums Pond State Park (LUM) 10-003-1007	Not in a city New Castle	1/1/1992	SLAMS	Micro	Not technically required, but useful for determining directions of nearby point sources and/or regionally transported pollutants.	**Credible**
Brandywine Creek State Park (BSP) 10-003-1010	Not in a city New Castle	7/1/1994	SLAMS	Micro	Not technically required, but useful for determining directions of nearby point sources and/or regionally transported pollutants. Currently offline, not yet reinstalled after shelter replaced.	**Credible**

Appendix I

Monitoring Network

History Tables

Appendix I – Monitoring Network History Tables

The following pages contain tables of historical monitoring sites by county and pollutant for various periods.

Pre-1969

Site ID	County	Name	TSP	TSP metals, lead	SO_2	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ CSN	Other
10-001-1001	Kent	Bombay Hook	x	x	x							Benzene sol. organics, beta radiation
10-003-0001	New Castle	Claymont Fire Station	x									Sulfation rate, fabric fading, rubber deterioration
10-003-1001	New Castle	UD Farm	x	x	x							TSP ammonium, sulfate, nitrate, beta radiation
10-003-4001	New Castle	1000 King St. – Public Bldg	x	x								TSP ammonium, sulfate, nitrate

1969 – 1979

Site ID	County	Name	TSP	TSP metals, lead	SO_2	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ CSN	Other
10-001-0001	Kent	Dover – police station	x		x							WS/WD
10-001-1001	Kent	Bombay Hook	x	x	x							TSP ammonium, sulfate, nitrate
10-003-0002	New Castle	Newark – UD Ag farm	x		x							soil index (COH)
10-003-0004	New Castle	Ferris School	x		x							soil index (COH)
10-003-0005	New Castle	Old SPCA property	x		x							soil index (COH)
10-003-0006	New Castle	Delaware City – Gov. Bacon Ctr	x		x							soil index (COH)
10-003-0007	New Castle	Mt Pleasant farm	x		x							soil index (COH)
10-003-0010	New Castle	Kirkwood Hwy – NCC Eng. Bldg	X		x							soil index (COH)
10-003-0011	New Castle	Lombardy School	x		x							soil index (COH)
10-003-0012	New Castle	St Georges - Rt 72 and Rt 378	x		x							soil index (COH)
10-003-1001	New Castle	Newark – UD Ag farm	x	x	x		x					TSP ammonium, sulfate, nitrate
10-003-1002	New Castle	Naamans Rd	x		x							soil index (COH)
10-003-1003	New Castle	Bellefonte – River Rd. Park	x		x							soil index (COH)
10-003-1004	New Castle	Wilmington - Marine Terminal Lumber Rd			x							soil index (COH)
10-003-2001	New Castle	New Castle - Ommelanden	x		x							Soil index (COH), (Rud)
10-003-2002	New Castle	Wilmington – 12th and King St.	x	x								soil index (COH), TSP ammonium sulfate, nitrate
10-003-2003	New Castle	Wilmington – Walnut and Taylor	x	x	x							
10-003-3001	New Castle	Claymont – Woods-Haven/Kruse	x		x							soil index (COH)
10-005-0001	Sussex	Milford Elementary	x		x							
10-005-1001	Sussex	Seaford – Water tower	x		x							

1980 – 1989

Site ID	County	Name	TSP	TSP metals, lead	SO_2	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ CSN	Other
10-001-0001	Kent	Dover – police station	x		x			x				WS/WD
10-003-0002	New Castle	Newark - UD Ag farm	x		x							
10-003-0003	New Castle	Newark - Hudson Bldg Ogletown Rd	x									
10-003-0006	New Castle	Delaware City – Gov. Bacon Ctr	x		x							WS/WD
10-003-0010	New Castle	Kirkwood Hwy – NCC Eng. Bldg	x			x						
10-003-0070	New Castle	Summit – Lorewood Rd						x				
10-003-1003	New Castle	Bellefonte – River Road Park	x		x			x				
10-003-1004	New Castle	Wilmington – Marine Terminal			x							
10-003-1005	New Castle	Wilmington – UD Wilcastle Center	x	x								
10-003-1006	New Castle	Wilmington – 3rd and Union fire stn	x						x			
10-003-2001	New Castle	New Castle - Ommelanden	x		x	x						
10-003-2002	New Castle	Wilmington – 12th and King St.	x	x	x	x	x		x			Total NMOC, Methane
10-003-3001	New Castle	Claymont – Woods-Haven/ Kruse	x	x	x	x		x				WS/WD
10-005-1001	Sussex	Seaford – water tower	x		x			x				

1990 – 1999

Site ID	County	Name	TSP	TSP metals, lead	SO_2	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ CSN	Other
10-001-0001	Kent	Dover - police station	x		x			x				WS/WD
10-001-0002	Kent	Killens Pond						x		x		WS/WD
10-003-0006	New Castle	Delaware City – Gov. Bacon Ctr			x				x			WS/WD
10-003-0018	New Castle	Lums Pond						x				
10-003-1003	New Castle	Bellefonte – River Road Park	x		x			x				
10-003-1006	New Castle	Wilmington – 3rd and Union fire stn	x						x			
10-003-1007	New Castle	Lums Pond			x		x	x	x	x		PAMS VOCs, WS/WD
10-003-1008	New Castle	Delaware City - Rt 9			x	x						
10-003-1010	New Castle	Brandywine Creek State Park						x				
10-003-2002	New Castle	Wilmington – 12th and King St.			x	x	x		x			
10-003-3001	New Castle	Claymont – Woods-Haven/Kruse			x	x	x	x	x			WS/WD
10-005-1002	Sussex	Seaford – Virginia Ave			x			x	x			

2000 – 2009

Site ID	County	Name	TSP	TSP metals, lead	SO_2	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ CSN	Other
10-001-0002	Kent	Killens Pond						x		x		WS/WD
10-001-0003	Kent	Dover – Water St.								x	x	
10-003-1003	New Castle	Bellefonte – River Road Park			x		x	x	x	x		
10-003-1007	New Castle	Lums Pond			x			x		x		PAMS VOCs, WS/WD
10-003-1008	New Castle	Delaware City – Rt 9			x	x						VOCs
10-003-1010	New Castle	Brandywine Creek State Park						x				
10-003-1012	New Castle	Newark – UD North Campus								x		
10-003-2004	New Castle	Wilmington – MLK Blvd		x	x	x	x		x	x	x	VOCs, Carbonyls
10-005-1002	Sussex	Seaford – Virginia Ave						x		x		WS/WD
10-005-1003	Sussex	Lewes – UD campus						x				WS/WD

2010 – 2019

Site ID	County	Name	TSP	TSP metals, lead	SO_2	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ CSN	Other
10-001-0002	Kent	Killens Pond						x		x		WS/WD
10-001-0003	Kent	Dover – Water St.								x		
10-003-1003	New Castle	Bellefonte I – River Road Park								x		
10-003-1013	New Castle	Bellefonte II - Bellevue State Park			x			x				
10-003-1007	New Castle	Lums Pond			x			x		x		
10-003-1008	New Castle	Delaware City - Rt 9			x							VOCs, WS/WD
10-003-1010	New Castle	Brandywine Creek State Park						x				
10-003-1012	New Castle	Newark – UD North Campus								x		
10-003-2004	New Castle	Wilmington – MLK Blvd		x	x	x	x	x	x	x		Black Carbon, VOCs, Carbonyls, WS/WD
10-005-1002	Sussex	Seaford – Virginia Ave						x		x		WS/WD
10-005-1003	Sussex	Lewes – UD campus			x			x				WS/WD

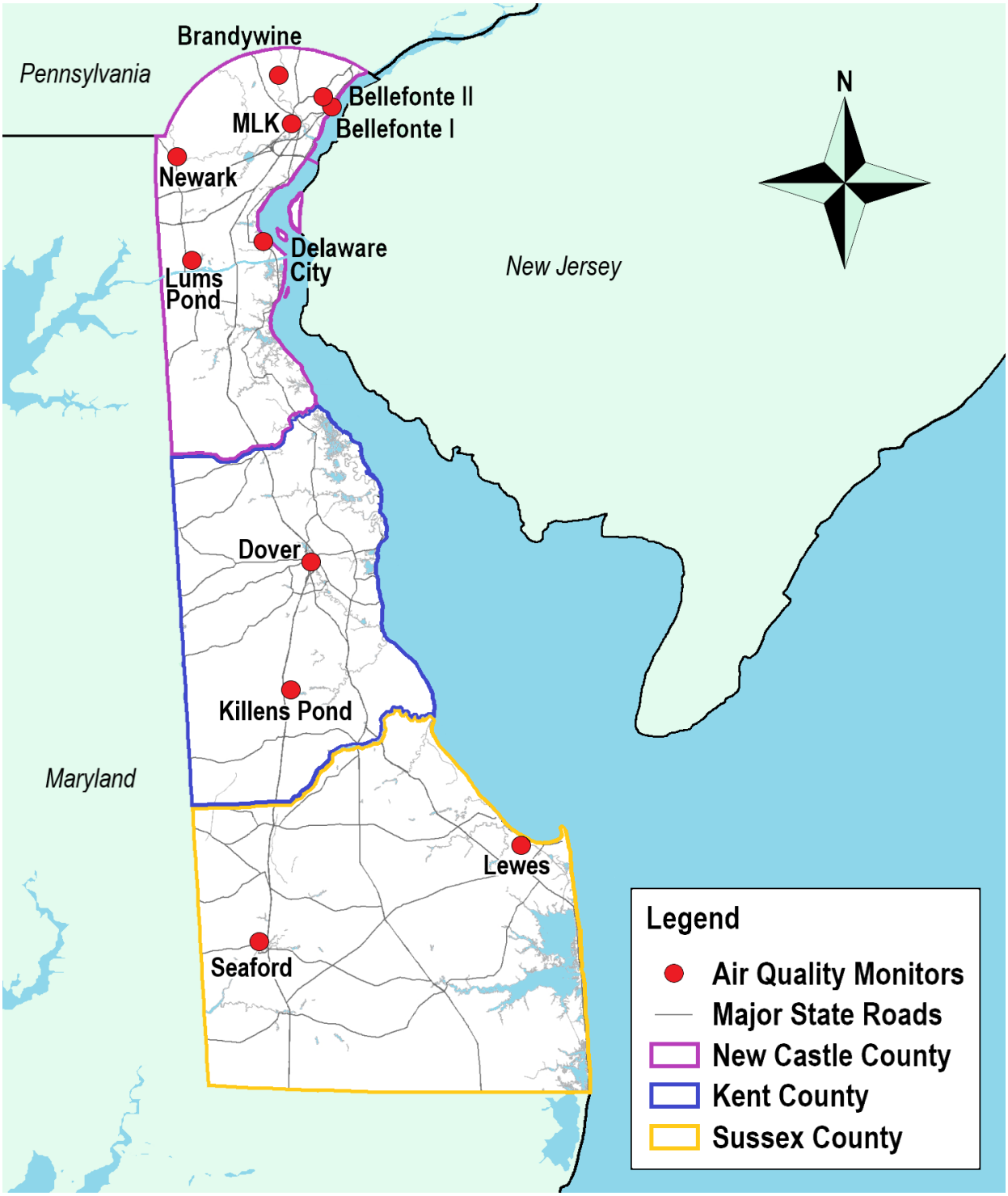
2020 – 2024

Site ID	County	Name	TSP	TSP metals, lead	SO2	CO	NO2	O3	PM10	PM2.5	PM2.5 CSN	Other
10-001-0002	Kent	Killens Pond						x		x		WS/WD
10-001-0003	Kent	Dover – Water St.								x		
10-003-1003	New Castle	Bellefonte I – River Road Park								x		
10-003-1013	New Castle	Bellefonte II - Bellevue State Park			x			x				
10-003-1007	New Castle	Lums Pond			x			x		x		WS/WD
10-003-1008	New Castle	Delaware City - Rt 9			x					x		WS/WD
10-003-1010	New Castle	Brandywine Creek State Park						x				WS/WD
10-003-1012	New Castle	Newark – UD North Campus								x		
10-003-2004	New Castle	Wilmington – MLK Blvd		x	x	x	x	x	x	x	x	PAMS, Black Carbon, VOCs, Carbonyls, Meteorological
10-005-1002	Sussex	Seaford – Virginia Ave						x		x		
10-005-1003	Sussex	Lewes – UD campus			x			x				WS/WD

Appendix II
Delaware Monitoring Network Site Descriptions

Appendix II – Monitoring Site Descriptions

The following pages contain additional site-specific information on all active SLAMS monitoring sites in Delaware.



Appendix Figure 1: Air Quality Monitoring Sites in Delaware

Site: Brandywine Creek State Park (BSP)

Site: Brandywine Creek State Park (BCSP)

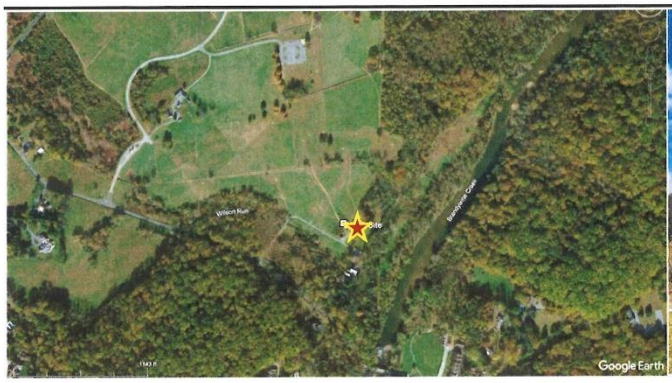
Figure 10 - BCSP monitoring site in DE

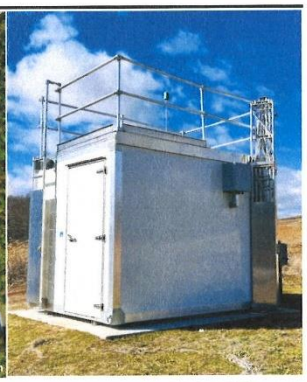
AQS Site ID: 10-003-1010
State: Delaware
County: New Castle
Address: Brandywine Creek State Park, Wilmington

Latitude: 39.8004
Longitude: -75.5764

Spatial Scale: Neighborhood
Area Represented (MSA): Philadelphia-Camden-Wilmington, PA-NJ-DE-MD

Year Established: 1994
Year Relocated: 2024





Monitored Parameters

O_3	Ozone
WS / WD	Wind Speed & Direction
T / Rh	Temperature & Relative Humidity

Site Description

The Brandywine site is located in Brandywine Creek State Park and was established when a secondary downwind site in Claymont was discontinued due to changes in nearby land use and ownership. The site was relocated approximately 1.3 miles to the southwest in 2024 to address issues with infrastructure and site access. This is a neighborhood scale site for O_3 monitoring. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Population exposure, maximum concentration, O_3 NAAQS compliance, and trends.

Planned Changes through 2025

No changes planned.

Site: Bellefonte I (Platform) and II (Shelter)

Site: Bellefonte I (Platform) & II

Figure 11 - Bellefonte I and II monitoring sites in DE

AQS Site ID: BF I – 10-003-1003
BF II – 10-003-1013
State: Delaware
County: New Castle
Address: BF I – River Road Park
BF II – Bellevue State Park

Latitude: BF I – 39.7613
BF II – 39.7739
Longitude: BF I – -75.4920
BF II – -75.4965

Spatial Scale: Neighborhood
Area Represented: Philadelphia-Camden-Wilmington,
(MSA) PA-NJ-DE-MD

Year Established: BF I – 1969
BF II – 2001

Bellefonte I ↑

Bellefonte II →

Monitored Parameters

Bellefonte I	**$PM_{2.5}$**	Particulate Matter: hourly, < 2.5 microns
Bellefonte II	**O_3**	Ozone
	SO_2	Sulfur Dioxide

Site Description

Bellefonte was originally established in 1969 to monitor O_3 (primary downwind direction from Wilmington) and SO_2. $PM_{2.5}$ was added in 1999. When changing site characteristics began to interfere with O_3 monitoring, a new site (Bellefonte II) was established in 2001, less than a mile to the north. The O_3 and SO_2 monitors were relocated to the new site, while the $PM_{2.5}$ monitor remained at the original site to provide data continuity. Both sites meet all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Monitoring objectives are NAAQS compliance, population exposures, and trends. Bellefonte II is the O_3 maximum downwind concentration site for Wilmington. The SO_2 monitor is sited for general population exposure and trends, with major point sources located to the northeast in Marcus Hook, PA and to the south in Edgemoor.

Planned Changes through 2025

No changes planned.

Site: MLK NCore (Wilmington)

Site: MLK NCore (Wilmington)

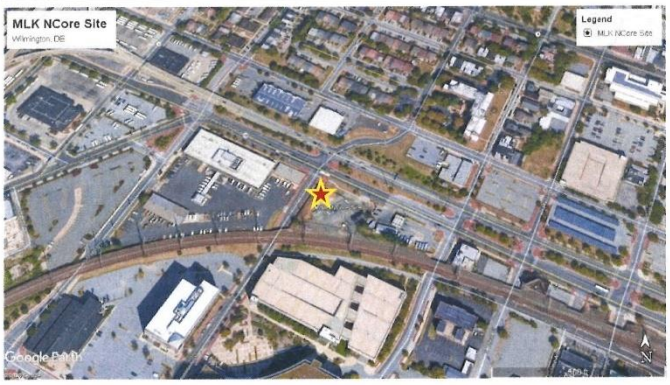
Figure 12 (1) - MLK monitoring site in DE

AQS Site ID: 10-003-2004
State: Delaware
County: New Castle
Address: Justison St. & MLK Blvd., Wilmington

Latitude: 39.7395
Longitude: -75.5575

Spatial Scale: Neighborhood
Area Represented: Philadelphia-Camden-Wilmington,
(MSA) PA-NJ-DE-MD

Year Established: 1999



Monitored Parameters

O_3	Ozone
SO_2	Sulfur Dioxide
CO	Carbon Monoxide
NO_2	Nitrogen Dioxide
NO_y	Total Reactive Oxides of Nitrogen
$PM_{2.5}$, PM_{10}, $PM_{10\text{-}2.5}$	Particulate Matter: Hourly & 24-hour < 2.5 microns, < 10 microns, and 2.5-10 microns ("coarse")
$PM_{2.5}$ Spec.	Chemically speciated particulate matter < 2.5 microns
$PM_{2.5}$ BC	Speciated particulate matter < 2.5 microns – Black Carbon
TSP	Total Suspended Particulate Matter
VOC	Volatile Organic Compounds: 24-hour via TO-15 method
C=O	Carbonyls: 8-hour via TO-11a method
WS / WD	Wind Speed & Direction
T / Rh	Temperature & Relative Humidity
MLH	Mixing Layer Height: hourly via Ceilometer - Unified Ceilometer Network

Site Description

The MLK NCore site is within the city of Wilmington, Delaware at the intersection of Justison St. and MLK Blvd. It replaced the urban site at 12th Street and King Street that was discontinued due to a change in land ownership. It is the one NCore site in Delaware and measures urban population exposure to multiple pollution sources. It is also the site where several Air Toxics are measured: heavy metals via TSP, VOCs via 24-hour canister sampling, and Carbonyls via 8-hour cartridge sampling between June 1 and August 31 annually. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Population exposure, maximum concentration, NAAQS compliance, NCore, Air Toxics, and trends.

Planned Changes through 2025

AQ is planning to replace the existing primary shelter to address structural weakening and water and pest ingress. During replacement, AQ will install a concrete pad and re-install electrical service. AQ is also planning to deploy its replacement CO analyzer and deploy a new replacement direct NO_2 analyzer.

Site: Delaware City (Rt 9)

Site: Delaware City (Rt 9)

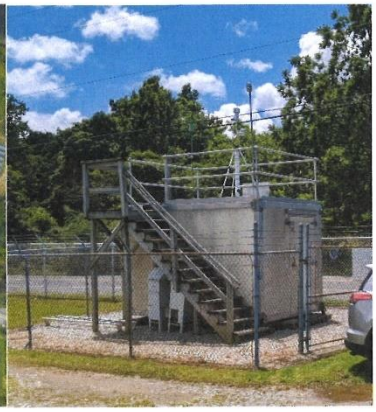
Figure 14 - Delaware City monitoring site in DE

AQS Site ID: 10-003-1008
State: Delaware
County: New Castle
Address: Route 9, Delaware City

Latitude: 39.5777
Longitude: -75.6036

Spatial Scale: Neighborhood
Area Represented: Philadelphia-Camden-Wilmington,
(MSA) PA-NJ-DE-MD

Year Established: 1992



Monitored Parameters

SO_2	Sulfur Dioxide
$PM_{2.5}$	Particulate Matter: hourly, < 2.5 microns
WS / WD	Wind Speed & Direction
T / Rh	Temperature & Relative Humidity

Site Description

The Delaware City site was established at a location along Route 9 that is between the Delaware City industrial complex and the nearest populated area (Delaware City) in the predominant downwind direction. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

This monitoring site is a stationary source-impacted site for SO_2. The monitoring objectives are

population exposure, compliance with the NAAQS, and trends.

Planned Changes through 2025

Install a 10-meter meteorological tower to improve representativeness of wind speed and direction measurements.

Site: Newark (Platform)

Site: Newark (Platform)

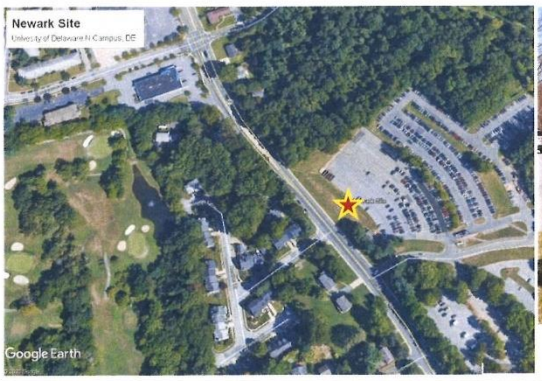
AQS Site ID: 10-003-1012
State: Delaware
County: New Castle
Address: University of Delaware North Campus, Newark

Latitude: 39.6916
Longitude: -75.7617

Spatial Scale: Neighborhood
Area Represented: Philadelphia-Camden-Wilmington, **(MSA)** PA-NJ-DE-MD

Year Established: 1999

Figure 15 - Newark monitoring platform in DE



Monitored Parameters

$PM_{2.5}$ Particulate Matter: Hourly, < 2.5 microns

Site Description

The Newark site is a platform only and was established to understand $PM_{2.5}$ concentrations in the Newark area and potentially transported $PM_{2.5}$ from upwind areas to the west. It is a $PM_{2.5}$ neighborhood scale site. The location is suburban and generally impacted by mobile sources and regional transport. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Population exposure, $PM_{2.5}$ NAAQS compliance, regional transport, and trends.

Planned Changes through 2025

Proposed: redeploy 24-hour $PM_{2.5}$ FRM sampler at site to investigate abnormal hourly readings.

Site: Lums Pond

Site: Lums Pond

AQS Site ID: 10-003-1007
State: Delaware
County: New Castle
Address: Lums Pond State Park, Bear

Latitude: 39.5513
Longitude: -75.7320

Spatial Scale: Urban
Area Represented: Not in an urban area
(MSA)

Year Established: 1991

Figure 16 - Lums Pond monitoring site in DE

Monitored Parameters

O_3	Ozone
SO_2	Sulfur Dioxide
$PM_{2.5}$	Particulate Matter: Hourly and 24-hour, < 2.5 microns
WS / WD	Wind Speed & Direction
T / Rh	Temperature & Relative Humidity

Site Description

The Lums Pond site was originally neighborhood scale located in a general upwind direction from Wilmington. The scale of representation was changed to Urban (4 – 50 km) to reflect the background and transport monitoring objectives. The immediate area is rural. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

The site objectives for O_3 are upwind background for the Wilmington area, population exposure, NAAQS compliance, and trends. This site was originally planned to monitor O_3 transported into Delaware from the Baltimore/Washington area and continues to serve this purpose. The SO_2 monitor was added in 2000 to detect impacts from major point sources directly to the east. $PM_{2.5}$ monitoring began in 1999 as both a

regional transport and general population exposure site, as well as for NAAQS compliance.

Planned Changes through 2025

Proposed: remove collocated 24-hour $PM_{2.5}$ FRM sampler for relocation at Newark monitoring site.

Site: Dover (Platform)

Site: Dover (Platform)

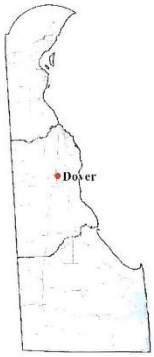


Figure 17 - Dover monitoring platform in DE

AQS Site ID: 10-001-0003
State: Delaware
County: Kent
Address: Water St., Dover

Latitude: 39.1556
Longitude: -75.5182

Spatial Scale: Neighborhood
Area Represented: Dover
(MSA) DE

Year Established: 1999

Monitored Parameters

$PM_{2.5}$ Particulate Matter: Hourly, < 2.5 microns

Site Description

The Dover site is a platform only and was established to understand fine particulate concentrations in the Dover area. It is a neighborhood scale site representative of the Dover MSA impacted by a combination of source types including mobile, large and small point sources. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Population exposure, $PM_{2.5}$ NAAQS compliance, and trends.

Planned Changes through 2025

No changes planned.

Site: Killens Pond

Site: Killens Pond

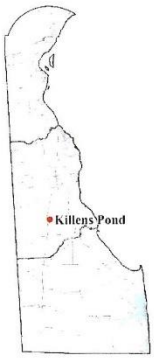


Figure 18 - Killens Pond monitoring site in DE

AQS Site ID: 10-001-0002
State: Delaware
County: Kent
Address: Killens Pond State Park, Felton

Latitude: 38.9867
Longitude: -75.5568

Spatial Scale: Urban
Area Represented: Not in an urban area
(MSA)

Year Established: 1995

Monitored Parameters

O_3	Ozone
$PM_{2.5}$	Particulate Matter: Hourly, < 2.5 microns
WS / WD	Wind Speed & Direction

Site Description

The Killens Pond site is located in a rural area that is part of Killens Pond State Park. It was established to understand background concentrations of O_3 and $PM_{2.5}$. The scale of representation was changed to Urban (4 – 50 km) to reflect the background monitoring objective. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Background concentrations, NAAQS compliance, and trends.

Planned Changes through 2025

No changes planned.

Site: Seaford

Site: Seaford

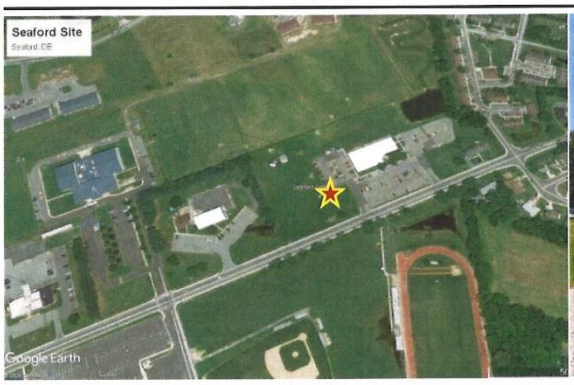
Figure 19 - Seaford monitoring site in DE

AQS Site ID: 10-005-1002
State: Delaware
County: Sussex
Address: 350 Virginia Ave., Seaford

Latitude: 38.6539
Longitude: -75.6106

Spatial Scale: Neighborhood
Area Represented: Salisbury,
(MSA) MD-DE

Year Established: 1990



Monitored Parameters

O_3	Ozone
$PM_{2.5}$	Particulate Matter: Hourly, < 2.5 microns
WS / WD	Wind Speed & Direction

Site Description

The Seaford site was originally located further south to monitor pollutant concentrations in the Seaford area and was relocated in 1990 due to deteriorating conditions. The current site is neighborhood scale and is suburban. The site is impacted by local point sources, mobile sources, and regional transport. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Population exposure, NAAQS compliance, and trends.

Planned Changes through 2025

No changes planned.

Site: Lewes

Site: Lewes

Figure 20 - Lewes monitoring site in DE

AQS Site ID: 10-005-1003
State: Delaware
County: Sussex
Address: University of Delaware: College of Earth, Ocean, & Environment - Hugh R. Sharp Campus, Lewes
Latitude: 38.7791
Longitude: -75.1632

Spatial Scale: Neighborhood
Area Represented: Salisbury, **(MSA)** MD-DE

Year Established: 1991

Monitored Parameters

O_3	Ozone
SO_2	Sulfur Dioxide
WS / WD	Wind Speed & Direction
T / Rh	Temperature & Relative Humidity

Site Description

The Lewes site is neighborhood scale established to understand O_3 concentrations in the coastal area where population increases significantly in the summer months. SO_2 was added in 2012 in response to the new SO_2 NAAQS monitoring requirements. It is representative of the coastal Sussex County area. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives

Population exposure, NAAQS compliance, and trends.

Planned Changes through 2025

A NO_x Chemiluminescence analyzer will be added as part of the Enhanced Monitoring Plan.

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