Delaware Ambient Air Monitoring

2015 Network Assessment

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Executive Summary

40 CFR Part 58.10(d) requires Delaware to 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 of 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.

This report serves as Delaware's 2015 assessment under this requirement.

For this 5-Year Monitoring Network Assessment (Assessment), the Division of Air Quality (DAQ) performed a technical review of the data collected in the ambient monitoring network. To conduct this review, DAQ performed the following:

a. Population data was summarized for all three counties in Delaware. This information was used to determine the appropriateness of monitoring for population exposure.

b. Meteorological parameters were reviewed to establish upwind / downwind relationships between a monitor site and surrounding emission sources.

c. Emission inventory summary data was reviewed. This information was used to determine if a monitor is sited appropriately to represent maximum pollution concentrations or specific ambient source impacts quantification.

d. Historical data collected at each site was reviewed for trends and comparison to the current National Ambient Air Quality Standards. This is helpful to determine if Delaware is achieving air quality improvements and meeting air quality standards.

e. Site by site correlation analysis was performed using tools supplied by EPA. Currently, EPA has provided this tool for O, $PM_{2.5}$, and PM_{10}. This information is used to determine if information collected at sites is redundant and if the site may be considered for elimination.

f. A bias calculation was performed to determine impacts that may occur if a monitor is removed from the network.

DAQ evaluated the data from this technical review according to defined performance measures. We also expanded performance measures beyond application of this technical information. Performance measures were organized into the following categories:

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 upon the evaluation of these performance measures, DAQ 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 at or above the NAAQS. **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 only critical or credible sites. Issues that may impact future network design include new monitoring requirements associated with new or revised NAAQS, aging equipment/maintenance issues, and resource availability.

Introduction

In 1970, Congress passed the Clean Air Act 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 according to criteria designed to protect public health, including an adequate margin of safety to protect sensitive populations such as children and asthmatics. Secondary standards were set according to criteria designed to protect public welfare (decreased visibility, damage to crops, vegetation, and buildings, etc.).

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

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 section 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 monitoring network assessment document is written in compliance with this directive.

Delaware Air Monitoring Network - Current description of monitoring network

The current air monitoring network in Delaware consists of 11 sites throughout the state.

40 CFR Part 58, Appendix D, includes the following objectives and types of sites:

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
   c) Support air pollution research studies
2) Six general site types needed to achieve the 3 main objectives:
   a) Maximum concentration
   b) Population exposure
   c) Source impact
   d) Background
   e) Transport
   f) Welfare-based impact (visibility, vegetation, etc.)

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

Delaware's Current Monitoring Network table

Site Name & AQS ID	Parameter	Start Date	Objective
Killens Pond 10-001-0002	O_3	4/1/1995	General/Background
	$PM_{2.5}$	1/1/1999	General/Background
	WS/WD	4/1/1995	NA
Dover 10-001-0003	$PM_{2.5}$	1/1/1999	Population Exposure
Brandywine 10-003-1010	O_3	7/1/1994	Population Exposure
	WS/WD	11/1/2013	NA
Bellefonte2 10-003-1013	O_3	4/1/2001	Population Exposure
	SO_2	3/1/2003	Population Exposure
Bellefonte 10-003-1003	$PM_{2.5}$	1/1/1999	Population Exposure
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
	NOy	1/1/2011	Population Exposure

Site Name & AQS ID	Parameter	Start Date	Objective
	O_3	1/1/2011	Population Exposure/ NCore
	PM_{10}	1/1/2000	Population Exposure/ Maximum Concentration
	$PM_{2.5}$	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
	Lead	1/1/2012	Population Exposure/ NCore
	BC	1/1/2001	
	VOCs	1/1/1999	
	Carbonyls	1/1/2003	
	Metals	1/1/2003	
	WS/WD	6/1/2000	
	Temp/RH	1/1/2011	
Newark 10-003-1012	PM2.5	12/15/1999	Population Exposure
Lums Pond 10-003-1007	O_3	1/1/1992	Upwind Background/ Population Exposure
	SO_2	1/1/2000	General Background/ Population Exposure
	$PM_{2.5}$	1/1/1999	Regional Transport/ Population Exposure
	WS/WD	6/1/2013	
Delaware City 10-003-1008	SO_2	2/1/1992	Population Exposure/ Source Oriented
	$PM_{2.5}$	6/1/2013	Population Exposure/ Source Oriented
	VOCs	1/1/2001	
	WS/WD	5/1/2011	
Seaford 10-005-1002	O_3	3/1/1990	Population Exposure

Site Name & AQS ID	Parameter	Start Date	Objective
	$PM_{2.5}$	1/1/1999	Population Exposure
	WS/WD	5/1/2011	Population Exposure
Lewes 10-005-1003	O_3	5/1/1997	Population Exposure
	SO_2	1/1/2013	Population Exposure
	WS/WD	6/1/1997	

Air Quality Summary table, 2012 – 2014

Pollutant	Status of NAAQS and major Risk Issues in Agencies Network	Extent of NAAQS Violations (list cities violating NAAQS)	Days above 100 on the AQI	Contribution to Downwind Violations?[a]
O_3	Non-attainment	New Castle and Sussex Counties	18	New Castle County - Philadelphia CBSA
CO	Attainment	NA	0	NA
SO_2	Attainment current annual NAAQS	NA	0	NA
NO_2	Attainment current annual NAAQS	NA	0	NA
$PM_{2.5}$	Attainment current annual and daily NAAQS	NA	8	New Castle County - Philadelphia CBSA
PM_{10}	Attainment current daily NAAQS	NA	0	NA
Pb	Attainment current NAAQS	NA	NA	NA

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

Major factors for network assessment:

- The highest priority monitors are those for pollutants that are close to or exceed the NAAQS levels in Delaware. For the most current years of data, 2012 – 2014, only O_3 is above the NAAQS. $PM_{2.5}$ meets the current 24-hour and annual average NAAQS, but is very close to both.

History of air monitoring in Delaware

Delaware is located in 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 9 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 northernmost portion 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 US 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 operating 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.

The earliest monitors were placed near pollution sources to measure direct impact of pollution emissions. As ambient air pollution standards became established and monitoring methods standardized, the monitoring network expanded to include monitors in both urban and suburban areas. Monitoring goals shifted to include measuring high pollution concentrations in population centers, detecting trends, and determining compliance with the new national and stand 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. Pollutants of concern today come from a variety of sources including mobile (both on road and off road vehicles) sources, large industrial facilities, and smaller industries and business. Delaware continues to use its ambient monitoring network to track changes in air quality across the state and evaluate compliance with ambient air quality standards.

History of monitoring network – by decade (X indicates monitor was operating for at least 1 year during that decade); shaded sites are stations not currently operating.

County	AIRS Site No.	Name/Location	1960s	1970s	1980s	1990s	2000s	2010s
Kent	10-001-0001	Dover		X	X	X		
	10-001-0002	Killens Pond St. Pk.				X	X	X
	10-001-0003	Dover $PM_{2.5}$, behind DE Fed. Credit Union					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		X	X	X	X	X
	10-003-1004	Marine Terminal		X	X			
	10-003-1005	Pennsylvania Ave			X			
	10-003-1006	3rd & Union St. Fire Station			X	X		
	10-003-1007	Lums 2, Lums Pond Park				X	X	X
	10-003-1008	Route 9 #1				X	X	X
	10-003-1009	Elsmere				X		
	10-003-1010	Brandywine Creek St Pk (BCSP)				X	X	X
	10-003-1011	UD - Newark $PM_{2.5}$					X	
	10-003-1012	Newark $PM_{2.5}$					X	X
	10-003-1013	Bellevue State Park (Bellefonte2)					X	X
	10-003-1069	Millcreek Rd		X				
	10-003-2001	Ommelanden		X	X			
	10-003-2002	Wilmington, 12th & King	X	X	X	X		
	10-003-2003	Walnut & Taylor St.		X				
	10-003-2004	MLK, MLK Blvd and Justison St.					X	X
	10-003-3001	Claymont, Women's Correctional Center		X	X	X		
	10-003-4001	1000 King St	X	X				
Sussex	10-005-0001	Milford		X				
	10-005-1001	Seaford Water Tower		X	X			
	10-005-1002	Seaford, Virginia Ave.				X	X	X
	10-005-2001	Millsboro DP&L			X			
	10-005-1003	Lewes				X	X	X
	Totals:		5	23	16	13	12	11

The largest number of monitoring sites existed during the 1970s, with particulate matter and sulfur oxides being the most common pollutants monitored. The largest number of sites has always been located in New Castle County, which has the largest population combined with the largest number of pollution sources. As the network shifted towards more automated monitoring methods and data collection systems in the later 1970s and early 1980s, the size of the monitoring network began to shrink to accommodate long-term or permanent monitoring stations, and greater technical skills required for monitoring operations and management required more focused staff resources.

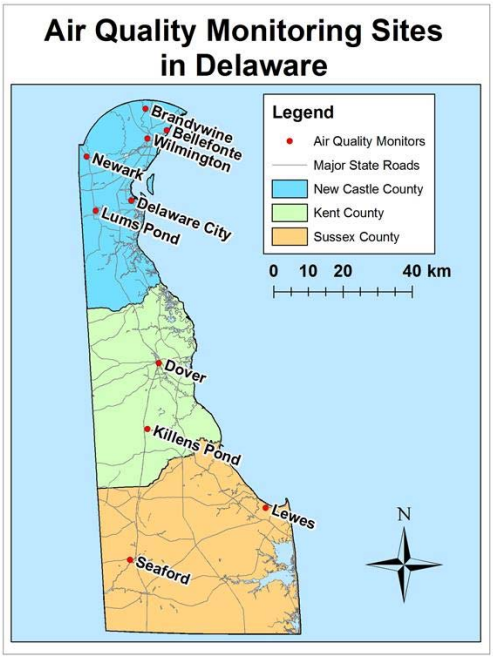
Locations of monitors continued to evolve to match population growth and pollution source changes. Other issues impacting monitoring locations included changes in land use/ownership and changes in available funding for station upkeep and improvements.

As air quality continued to improve, monitoring focus shifted away from TSP/PM_{10}, SO_2, and CO towards the pollutants that remained above the NAAQS, particularly O_3, and pollutant precursors. More advanced monitoring methods, emissions inventories, control strategy development and more sophisticated computer modeling tools were important in the redirection of monitoring sites throughout this time 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 more recently 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 maximum impacted 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. Through careful rebalancing of resources, including elimination of non-essential monitors, Delaware was able to establish and maintain a statewide $PM_{2.5}$ network in full compliance with all EPA requirements without any additional staffing.

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

Delaware 2015 Air Monitoring Network



Population Summary

Although New Castle County is the most densely populated county, the population is growing much 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.

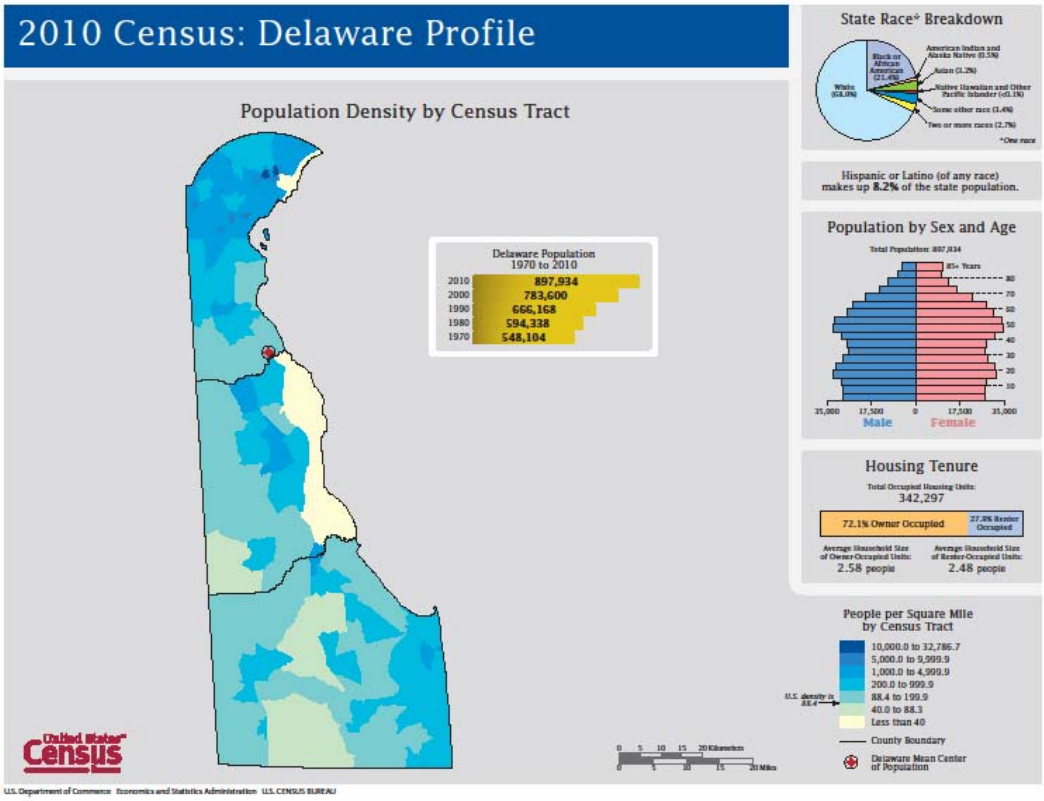
Kent County is the "middle" county in Delaware. While Kent has the lowest population density, it also has demonstrated significant population growth since 2000. There is one metropolitan statistical area in Kent County – Dover, which is the centrally located capital city.

Sussex County is the southernmost county in Delaware. Largely because of the resort area along the coast, it has a higher population density than Kent County which is significantly increased in the summer months. The coastal area is the most rapidly growing portion of the county.

The state has experienced significant population growth in recent years in each county as shown in the following table.

County	Percent Change in Population 2000 - 2010	Total Population: 2000	Total Population: 2010
New Castle	7.6%	500265	538,479
Kent County	28.1%	126702	162,310
Sussex	25.9%	156628	197,145

Population profile (2010 census)



CSAs and MSAs for Delaware.

CBSA Code	Metro Division Code	CBSA Title	Level of CBSA	Status, 1=metro 2=micro	Metropolitan Division Title	CSA Title	Component Name
20100		Dover, DE	Metropolitan Statistical Area	1			Kent County
37980	48864	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	Metropolitan Statistical Area	1	Wilmington, DE-MD-NJ	Philadelphia-Camden-Vineland, PA-NJ-DE-MD	New Castle County
41540		Seaford, DE	Metropolitan Statistical Area	1		Salisbury	Sussex County

Meteorological summary

Following are climate data summaries for NOAA weather stations in each county. The data are taken from the NOAA website http://www.ncdc.noaa.gov/cdo-web/datatools.

NEW CASTLE AIRPORT, DELAWARE

NCDC 1981-2010 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	40.2	43.5	52.4	63.5	73.0	81.8	86.1	84.2	77.4	66.2	55.7	44.6	64.05
Mean Temperature (F)	32.4	35.1	43.0	53.3	62.8	72.2	76.8	75.2	67.8	56.2	46.6	36.7	54.84
Mean Min. Temperature (F)	24.6	26.8	33.6	43.0	52.6	62.6	67.6	66.1	58.2	46.1	37.4	28.7	45.61
Mean Precipitation (in.)	3.01	2.68	3.92	3.50	3.95	3.88	4.57	3.25	4.32	3.42	3.10	3.48	3.59

DOVER, DELAWARE

NCDC 1981-2010 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	43.4	47.0	54.9	65.7	74.7	83.2	87.0	85.2	79.3	68.8	58.5	47.4	66.26
Mean Temperature (F)	35.2	38.0	45.2	55.0	64.2	73.3	77.7	76.1	69.7	68.8	49.2	39.2	57.63
Mean Min. Temperature (F)	27.1	29.0	35.6	44.3	53.8	63.4	68.4	67.0	60.1	48.7	39.8	31.0	47.35
Mean Precipitation (in.)	3.41	3.07	4.31	3.88	4.25	4.00	4.09	4.36	4.13	3.42	3.48	3.65	3.84

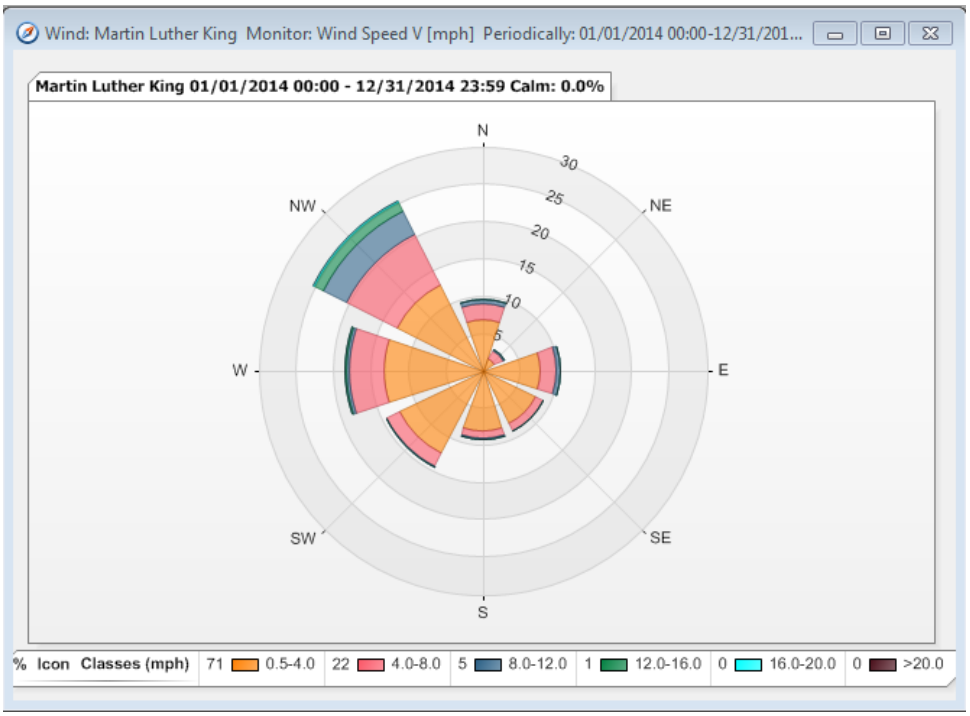
GEORGETOWN 5 SW, DELAWARE

NCDC 1971-2000 Monthly Normals

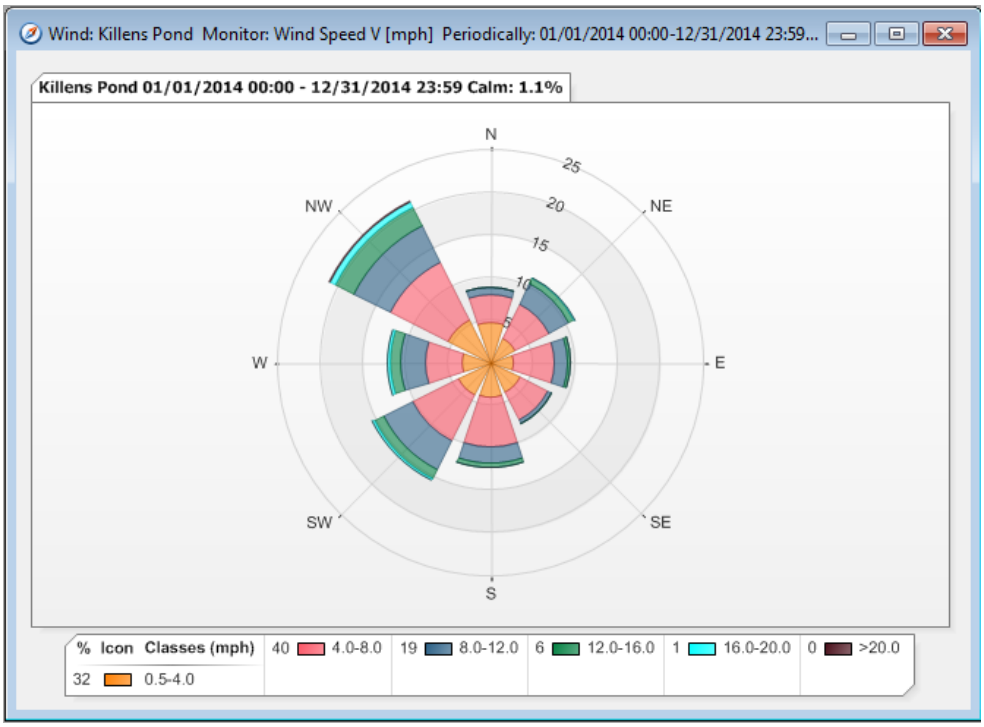
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	43.5	46.7	54.4	64.4	73.5	82.5	86.3	84.8	78.1	68.2	58.4	48.1	65.74
Mean Temperature (F)	35.0	37.5	44.7	54.0	63.1	72.5	76.9	75.6	68.5	57.8	48.5	39.2	56.11
Mean Min. Temperature (F)	26.6	28.3	34.9	43.6	52.7	62.6	67.4	66.4	58.9	47.3	38.5	30.4	46.47
Mean Precipitation (in.)	2.92	2.79	4.05	3.63	3.55	4.61	4.19	3.53	4.13	3.72	3.36	3.29	3.65

Following are wind roses for monitoring sites in each county, using 2014 data.

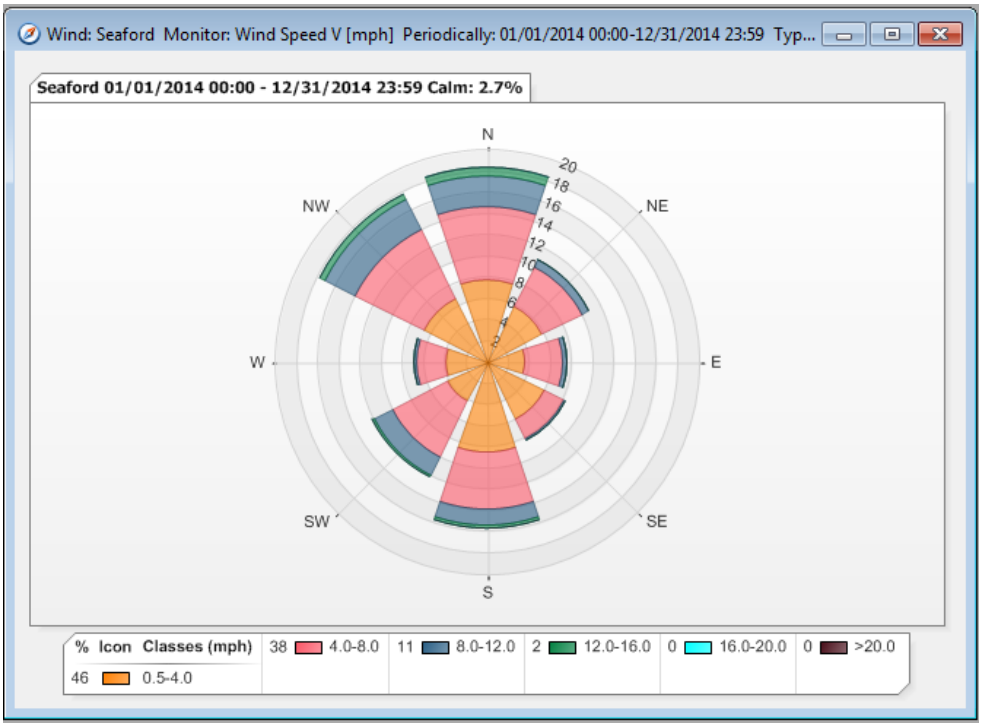
New Castle County wind rose, MLK (Wilmington)



Kent County wind rose, Killens Pond



Sussex County wind rose, Seaford



Wind patterns across the state most frequently include a westerly component; with north/north west more dominant in the winter and south/south west more dominant in the summer; however, easterly wind patterns are not uncommon. This puts the state generally downwind of the Baltimore/Washington area, and upwind of Philadelphia/southern New Jersey.

Monitoring network general issues

Delaware's Annual Monitoring Network Description includes one-page summaries for each monitoring site that contain information on specific parameters (such as lat/long and photographs) that are not discussed in detail in this document. Those summary pages are included in Appendix II.

Data Users: Primary data users are mainly professional staff within the Air Quality Management Section. Other major users include EPA and university researchers; the University of Delaware is a frequent user of data, particularly from the MLK Wilmington site which is collocated with some of the UD research efforts. The general public most frequently uses the data as part of the Air Quality Index, either through local news media, from the Air Quality Monitoring web site, or through the EPA AirNow website.

Other data users can include independent researchers, including public health researchers, other federal agencies besides EPA, and other local government agencies. The Delaware Air Quality Management Section may not be 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 the Section.

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. More recent objectives include evaluation of emission control strategies and contribution to SIPs or maintenance plans. The AQI is also a required

objective that continues to be met and has recently been expanded to include the southern portions of the state.

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

Domain of Responsibility: The Delaware Air Quality Management Section is responsible for monitoring air quality throughout the state. Adjoining upwind and downwind areas maintain their own ambient monitoring networks and data is shared through the AQS system. As mentioned in the meteorological section, the Baltimore/Washington area is generally upwind of Delaware while Philadelphia/southern & central New Jersey are generally downwind.

State Requirements: Delaware maintains its own State Air Quality Standards as follows:

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour(1)	None	
	35 ppm (40 mg/m^3)	1-hour(1)		
Lead	0.15 µg/m^3	3-month Average	Same as Primary	
Nitrogen Dioxide	100 ppb	1-hour(8)	None	
	53 ppb	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (TSP)	75 µg/m^3	Annual (Geometric Mean)	60 µg/m^3	Annual Geometric Mean
	260 µg/m^3	24-hour(1)	150 µg/m^3	24-hour
Particulate Matter (PM_{10})	150 µg/m^3	24-hour(2)	Same as Primary	
Particulate Matter ($PM_{2.5}$)	12.0 µg/m^3	Annual(3) (Arithmetic Mean)	15.0 µg/m^3 annual mean, averaged over 3 years	
	35 µg/m^3	24-hour(4)	Same as Primary	
Ozone	0.075 ppm	8-hour(6)	Same as Primary	
	0.12 ppm	1-hour(7) (Applies only in New Castle and Kent counties)	Same as Primary	
Sulfur Dioxide	75 ppb	1-hour(9)	0.5 ppm (1300 µg/m^3)	3-hour(1)
	0.03 ppm	Annual (Arithmetic Mean)		
	0.14 ppm	24-hour(1)		
Hydrogen Sulfide	0.06 ppm	3-minute	None	
	0.03 ppm	1-hour		

(1) Not to be exceeded more than once per year.

(2) Not to be exceeded more than once per year on average over 3 years.

(3) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations must not exceed 12.0 µg/m3.

(4) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).

(6) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(7) (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is < 1.

(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

(8) To attain this standard, the 3-year average of the 98th percentile of 1-hour daily maximum concentrations must not exceed 100 ppb.

(9) To attain this standard, 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-Sept. 30. Ozone Action Day notices are issued via the state website and local news media in conjunction with the AQI forecast and federal Enviroflash program. This program involves partners in other agencies and encourages the general public to use public transit and take other actions to limit air pollution releases. More specific information on these programs is available from www.wilmapco.org/AQP.

Performance Measures Defined in the Network Assessment

In order to determine relative value of individual monitors and monitor 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.

Following is the list of performance measures used in the assessment. Not all measures were relevant for all monitors or sites.

Data Criteria:

- **% of NAAQS** – ambient data that indicates air quality is at, near, or above the NAAQS level are of greater value than data indicating air quality are significantly (more than 50%) below the NAAQS.
- **Max concentration** – Ambient data that represents the highest concentration in an area and/or is used as the "design value" to determine progress towards attainment with the NAAQS is of higher value.
- **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).
- **Air Quality Index (AQI)** – Ambient data that are used to generate an AQI or AQI forecast for a particular area are of value

Statistical Criteria:

- **Uniqueness** – Air quality data that is not similar to air quality measurements from different areas as shown by statistical analyses (correlation, standard deviation, and average difference) is of high value.
- **Measurement Criticality** – There is a significant difference in the design value for an area as shown by statistical analysis for removal bias if the measurement is terminated at the specified location; this would support 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:

- **Concentration gradient** – Ambient data at the specified location that are used to determine changes in concentrations between different areas are of high value.
- **Meteorological pattern** – Monitor located in primary downwind location of a source or urban area is of high value.
- **Area Scale** – The monitor is located with the appropriate scale of representation according to federal and local requirements (microscale, middle scale, neighborhood scale, etc.); locations judged not to represent the appropriate scale are of low value.
- **Area Represented** – The monitor represents air quality in an area not otherwise represented; may be only monitor in a given area.
- **Multi-pollutant** – Using situational analysis methods, this ambient measurement complements other measurements collected at that location and is of additional value.
- **Federal Requirement** – Ambient monitoring that is specifically required by EPA is of high value.

Future Needs and Special Considerations::

- **Cost** – The funding needed to support continued measurements at the specified location exceeds $500.00 per year.
- **Impact from NAAQS Revisions** – New or revised NAAQS may require modifications to the monitoring design of the existing ambient measurement.
- **Source-impact** – Ambient measurement is dominated by impacts from local sources; if pollutant site is designated for source-oriented impacts, this would be of high value.
- **Community Representation** – Ambient data that are being collected to address local concerns is of additional value.

Each monitor was evaluated and ranked as listed below. Each monitoring site was then evaluated in totality for all monitors at that site.

- Critical Sites and Monitors – These sites are of high value and will be continued. Critical sites 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/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 (i.e., SIP development and tracking)
    - Federally mandated monitor or site (i.e., O_3 transport or $PM_{2.5}$ background)

- Credible Sites and Monitors – These sites are the locations that are expected to continue, but may not be the design value location at or above the NAAQS. Credible sites will have 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/site were discontinued (removal bias)
- Site is the design value location but is below the NAAQS.
- Sites/monitors represent a unique area, population, or condition of concern.

- Marginal Sites and Monitors – These sites and monitors are those locations that may be candidates for removal or movement. Marginal sites are characterized by the following:
  - Data are used for trends, but are far below the NAAQS (< 50% of NAAQS)
  - Not a federally mandated monitor or site
  - Sites that correlate well (i.e., are not unique) with a nearby site(s), but which measure lower levels than the nearby site.

- New Sites and Monitors – These represent potential areas of investment pending movement of monitoring resources from other locations or new resources introduced to our program.
  - Newly required locations from recent NAAQS reviews
  - 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 ozone sites

Ozone is a priority pollutant in Delaware due to the continuing non-attainment status of all three counties in the state. Although concentrations have been declining since monitoring began, the state continues to record unhealthy levels of O_3 throughout the state.

Monitoring Requirements

Within an O_3 network, at least one O_3 site for each MSA, or CSA if multiple MSAs are involved, must be designed to record the maximum concentration for that particular metropolitan 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, and this reduces the importance of monitoring small scale spatial variability.

The 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 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, which currently in Delaware is April 1 through October 31. Starting in 2016 the ozone season will begin on March 1 according to current proposed changes to 40 CFR Part 58.

Delaware operates six O_3 monitoring sites, including sites for maximum downwind concentrations, background concentrations, and transport conditions. As of 2014, all monitors operate year-round. Hourly data is sent to the AirNow website to generate the daily Air Quality Index and to be used in mapping O_3 concentrations throughout the region. The highest number of monitors are located in the northern part of the state, New Castle County, which has the highest population density and longest history of NAAQS violation. There is one monitor in Kent County, which serves as a rural/background site. There are two monitors in Sussex County; one in the Seaford area and one in the coastal resort area (Lewes). In January 2011, the NCore site in Wilmington began official O_3 monitoring; however, although it is included in the list of O_3 sites, because it is a required parameter of the NCore program, it is not included in the full O_3 network assessment.

Following are the O_3 sites along with the county and associated MSA along with the monitoring objectives. Most sites have multiple objectives, with population exposure the most widespread. It should be noted that the coastal resort areas in Sussex County represent a high seasonal population density that is not reflected in the annual census bureau population statistics.

Delaware O_3 sites.

Site	County/MSA	Objectives and Monitor Type
Brandywine (BCSP)	New Castle Phil. CSA	NAAQS compliance Population exposure Secondary downwind from Wilmington (max. conc.) Trends
Bellefonte2	New Castle Phil. CSA	NAAQS compliance Population exposure Primary downwind from Wilmington (max. conc.) Trends
MLK	New Castle Phil CSA	NCore requirement NAAQS compliance Population exposure Trends
Lums Pond	New Castle Phil CSA	NAAQS compliance Transport Upwind for Wilmington Trends
Killens Pond	Kent Not in MSA	NAAQS compliance Background Trends
Seaford	Sussex Seaford mSA	NAAQS compliance Population exposure Trends
Lewes	Sussex Seaford mSA	NAAQS compliance Population exposure Coastal area Trends

The current 8-hr O_3 standard is 0.075 ppm. On Nov. 25, 2014, the U.S. Environmental Protection Agency (EPA) proposed to strengthen the National Ambient Air Quality Standards (NAAQS) for ground-level O_3 as a primary 8-hour standard set within a range of 65 to 70 parts per billion (ppb). More discussion on the proposed new standards is included in the Future Needs section.

Situational analyses

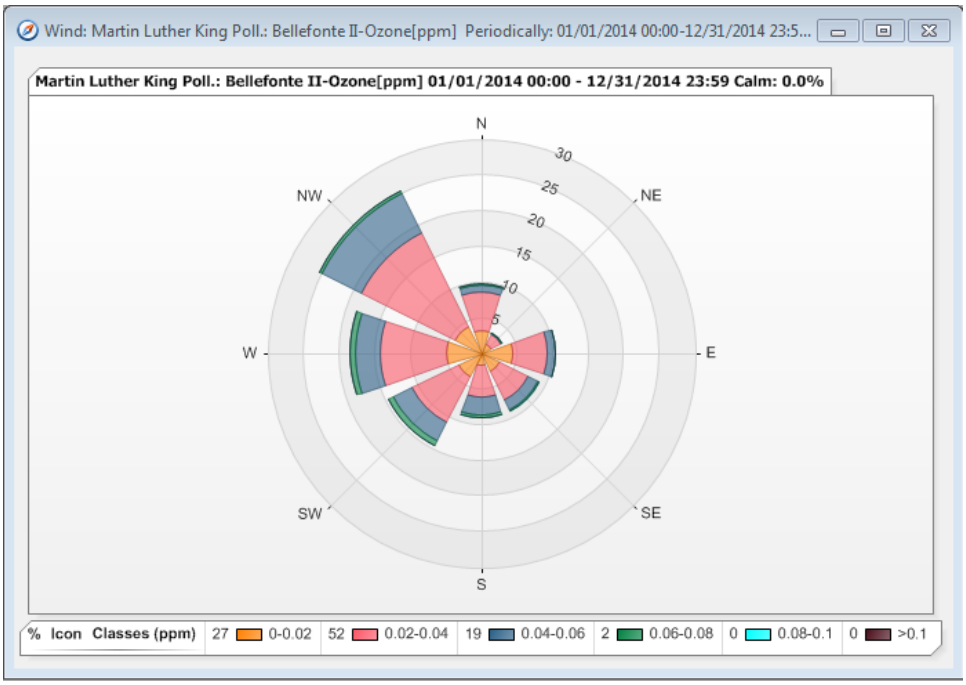
New Castle County sites and characteristics

Bellefonte2 (10-003-1013) is the successor site to Bellefonte (10-003-1003). Bellefonte 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 (Bellefonte2) was established in 2001 in Bellevue State Park, less than a mile to the north. The Bellefonte2 site meets all EPA siting criteria. Because there are no wind speed/wind direction monitors at this site, the MLK site is used to generate wind direction data for the pollution rose.

Bellefonte2 is neighborhood scale for O_3, and monitoring objectives are compliance with the NAAQS, population exposures, and trends. Bellefonte2 is in the primary downwind direction from Wilmington, and historically was the maximum downwind concentration site. Although concentrations in recent years

appear to have declined, the site still provides information on concentration gradients between Wilmington and the nearby Pennsylvania (Delaware County) and Philadelphia CSA.

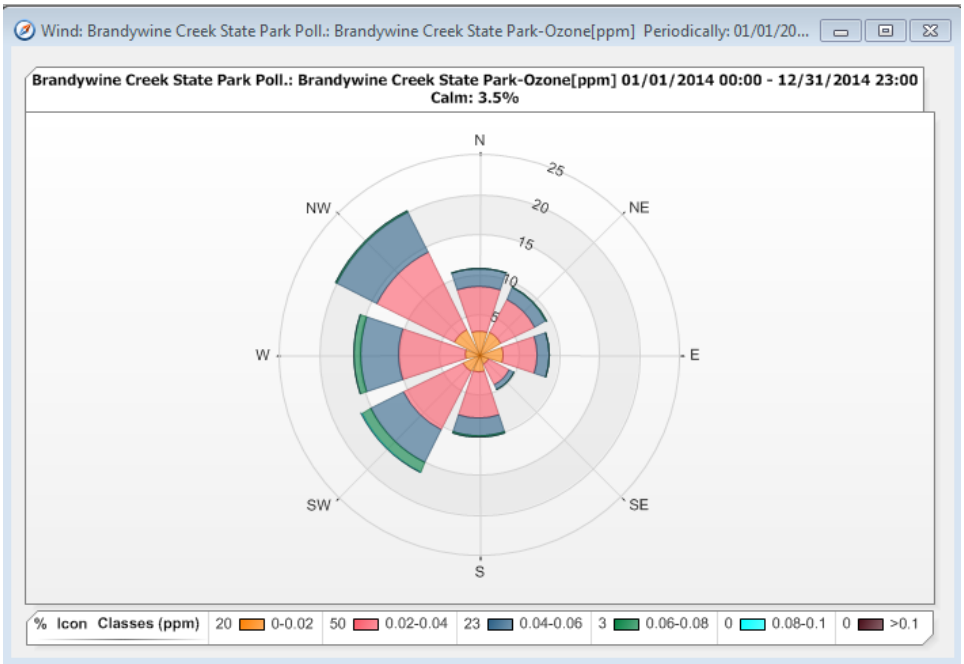
Pollution Rose – Bellefonte2 2014



Brandywine Creek State Park (BCSP) (10-003-1010). The Brandywine site is located in Brandywine Creek State Park. This is a neighborhood scale site for O_3 monitoring, and was established in 1994. The site meets all EPA siting requirements. The Brandywine site is in the secondary downwind direction from Wilmington. The objectives are compliance with the O_3 NAAQS, population exposure, and trends.

This site was established after the Claymont (10-003-1003) site was discontinued. Unlike Claymont, which was in the same downwind direction as Bellefonte from Wilmington, Brandywine was sited to represent O_3 concentrations in a different direction from the urban area of Wilmington. The availability of a site within state park boundaries also allowed a monitoring site close to populated areas but in a rural setting far enough from nearby major roadways to avoid NOx scrubbing of O_3. The location of this site north of Wilmington also allows it to represent regional transport on days with winds from the north/northwest, although this is not the predominant high O_3 condition for New Castle County.

Pollution Rose – Brandywine 2014

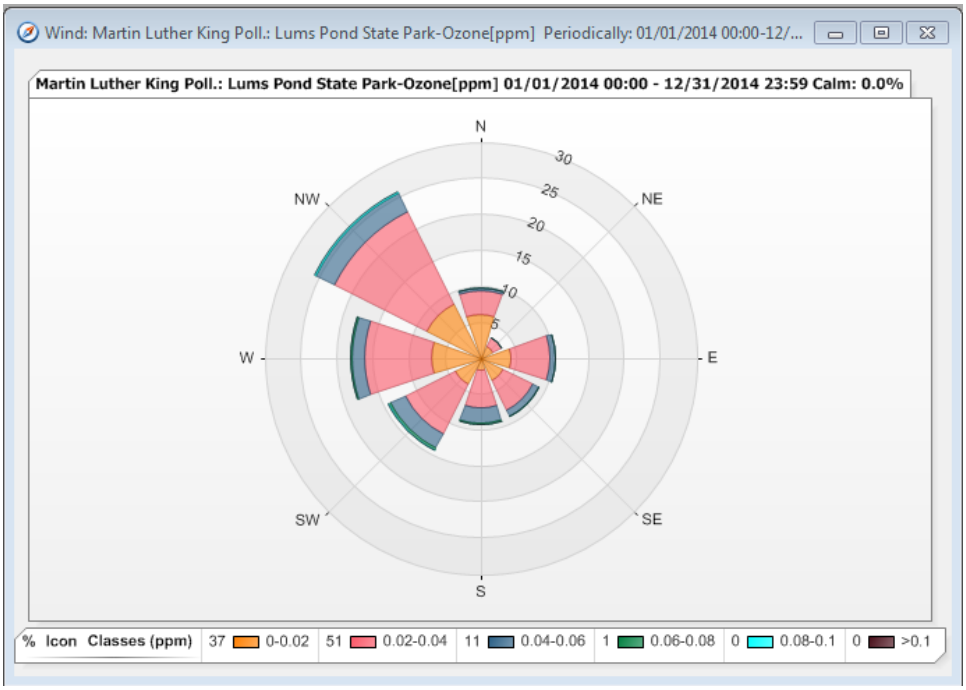


High O_3 concentrations are generally seen with the west/southwest/south wind directions. There are occasional higher concentrations with winds from the north or east but these are not frequent occurrences.

Lums Pond (Summit) (10-003-1007). The original Lums Pond O_3 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 new Lums Pond site began reporting data in January 1992. The Lums Pond site is a neighborhood scale site located in a general upwind direction from Wilmington. The site meets all EPA siting criteria. Because there are insufficient wind speed/wind direction data at this site, the MLK site is used to generate wind direction data for the pollution rose.

The site objectives are NAAQS compliance, regional transport, population exposure, and trends. This location is representative of transport into Delaware along the general I-95 corridor.

Pollution Rose – Lums Pond 2014



MLK Wilmington (10-003-2004)

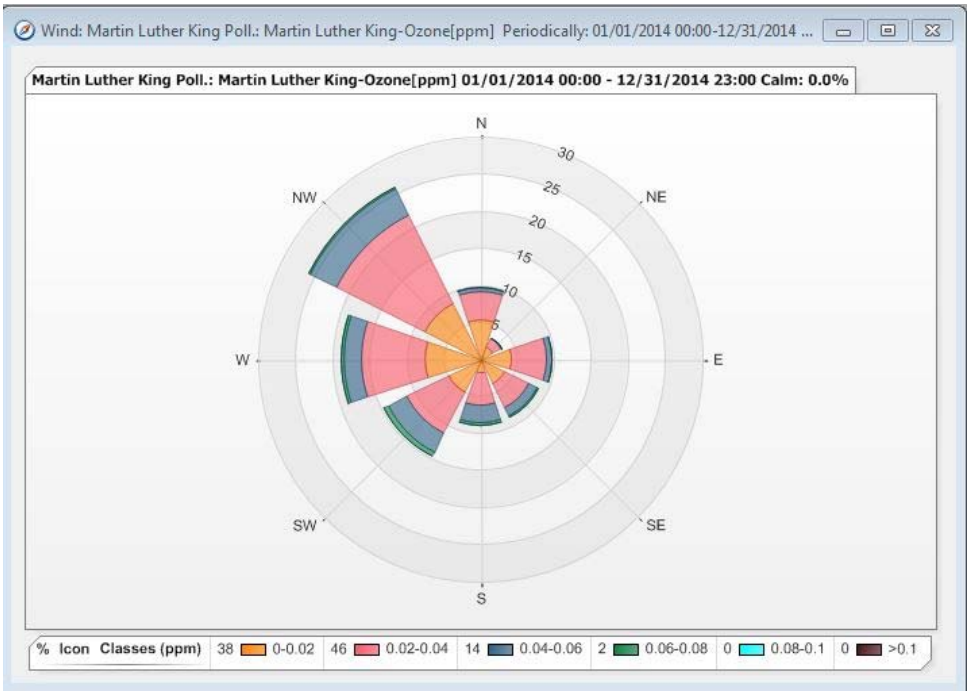
National Core Monitoring Strategy – NCore

In October 2006 the United States Environmental Protection Agency (EPA) issued final 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 in the regulations was the requirement to establish National Core (NCore) multi-pollutant monitoring stations. These stations provide data on several pollutants at lower detection limits and replace the National Air Monitoring Station (NAMS) networks that have existed for several years. The NCore sites must measure, at a minimum, $PM_{2.5}$ particle mass using continuous and integrated/filter-based samplers, speciated $PM_{2.5}$, $PM_{10-2.5}$ particle mass, O_3, SO_2, CO, NO/NOy, lead, wind speed, wind direction, relative humidity, and ambient temperature.

Each State is required to operate at least one NCore site. The objective is to locate to 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 PMcoarse, O_3, and NOy, became operational on January 1, 2011.

Pollution Rose – MLK Wilmington 2014



Trends - New Castle County 8-hour O_3 Design Values (ppm)

Years	Brandywine	Bellefonte	Lums Pond	MLK
00-02	0.096	0.092	0.096	
01-03	0.093	0.090	0.093	
02-04	0.089	0.085	0.084	
03-05	0.082	0.082	0.080	
04-06	0.082	0.081	0.078	
05-07	0.083	0.081	0.082	
06-08	0.083	0.078	0.080	
07-09	0.078*	0.074	0.075	
08-10	0.076*	0.075	0.075	
09-11	0.075*	0.077	0.075	
10-12	0.078*	0.080	0.080	0.079*
11-13	0.073*	0.076	0.074	0.075*
12-14	0.072*	0.071	0.071	0.071

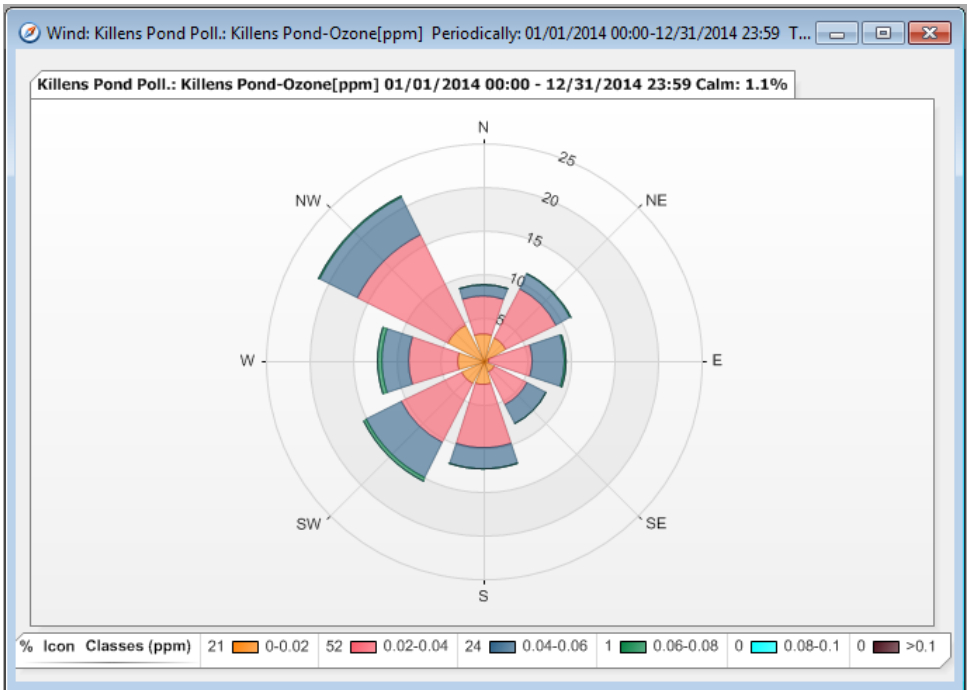
* One or more years with less than 75% data completeness

Kent county sites and characteristics

Killens Pond (10-001-0002). The Killens Pond site was established in 1995 in a rural area south of Dover as a background O_3 site. It is located in Killens Pond State Park. This site is neighborhood scale and meets all EPA siting criteria. The objectives include NAAQS compliance, background concentrations, and trends.

Killens Pond is the only O_3 monitoring site in Kent County.

Pollution Rose – Killens Pond 2014



High O_3 concentrations show less directionality at this site, but there are more frequent instances of elevated O_3 with wind with a westerly component.

Trends - Kent county 8-hour O_3 design values (ppm)

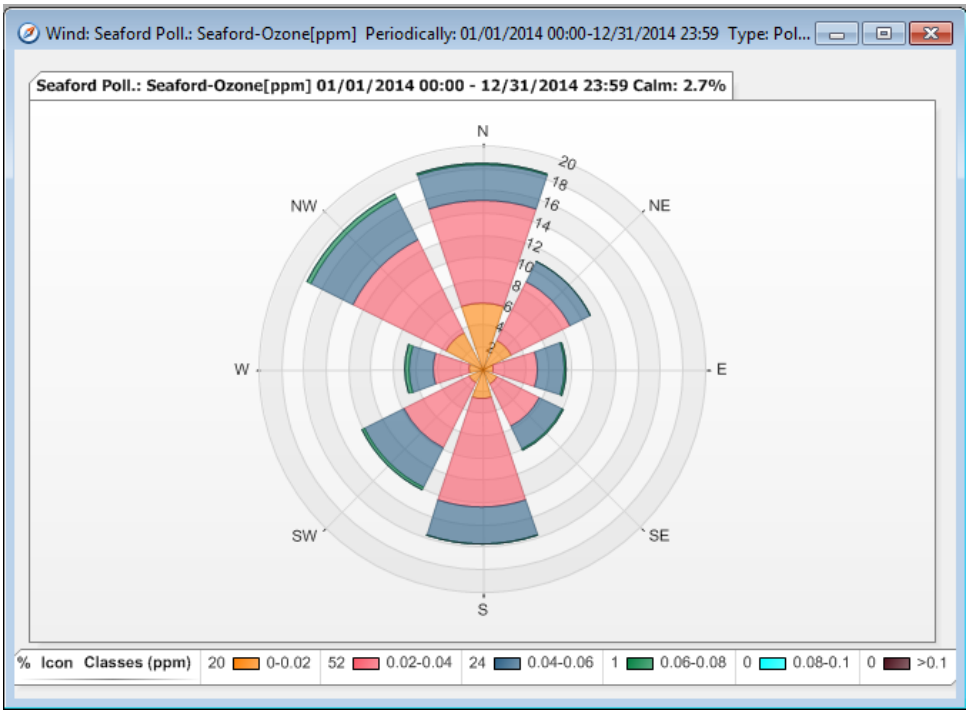
Years	Killens Pond
00-02	0.092
01-03	0.089
02-04	0.084
03-05	0.080
04-06	0.080
05-07	0.081
06-08	0.081
07-09	0.075
08-10	0.074
09-11	0.071
10-12	0.078
11-13	0.074
12-14	0.072

Sussex County sites and characteristics

Seaford (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 began 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.

The site is neighborhood scale and is suburban. 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, and trends.

Pollution Rose - Seaford 2014

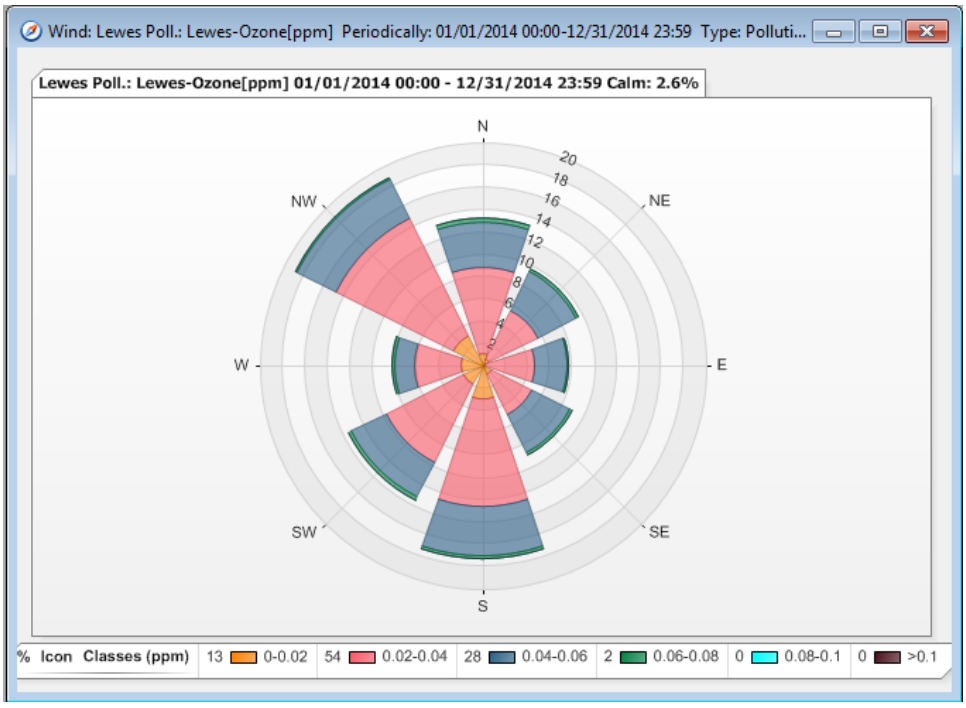


While elevated O_3 concentrations occur with winds from all directions, highest concentrations are associated with winds with a westerly component.

Lewes (10-005-1003) It had been recognized for some time that the O_3 site in Seaford was not completely representative of the maximum population exposure in the county because of the seasonal population shift in the resort areas along the coast. In addition, coastal meteorology was not adequately represented by the monitoring site in Seaford. In 1997 the Lewes site was established on the property of the University of Delaware College of Marine Studies campus.

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

Pollution Rose - Lewes 2014



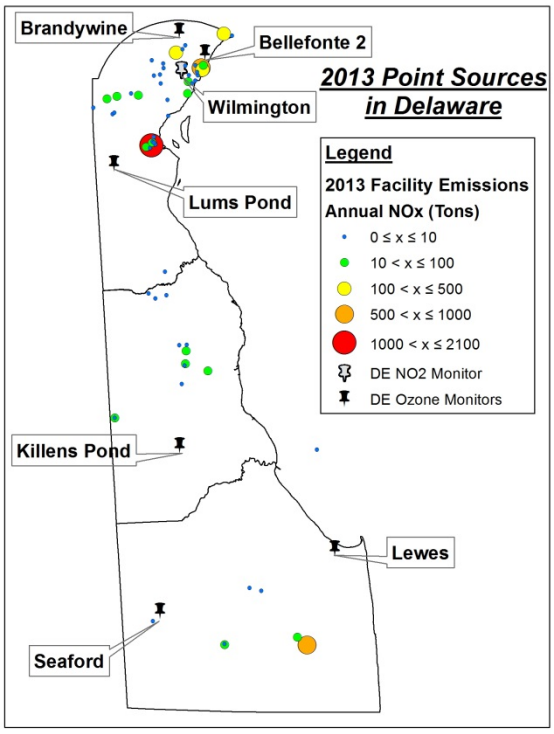
Trends - Sussex County 8-hour O_3 Design Values (ppm)

Years	Seaford	Lewes
00-02	0.094	0.087
01-03	0.091	0.088
02-04	0.085	0.085
03-05	0.082	0.084
04-06	0.080	0.082
05-07	0.082	0.082
06-08	0.081	0.079
07-09	0.076	0.076
08-10	0.077	0.077
09-11	0.076	0.075
10-12	0.081	0.081
11-13	0.075*	0.077*
12-14	0.070	0.074

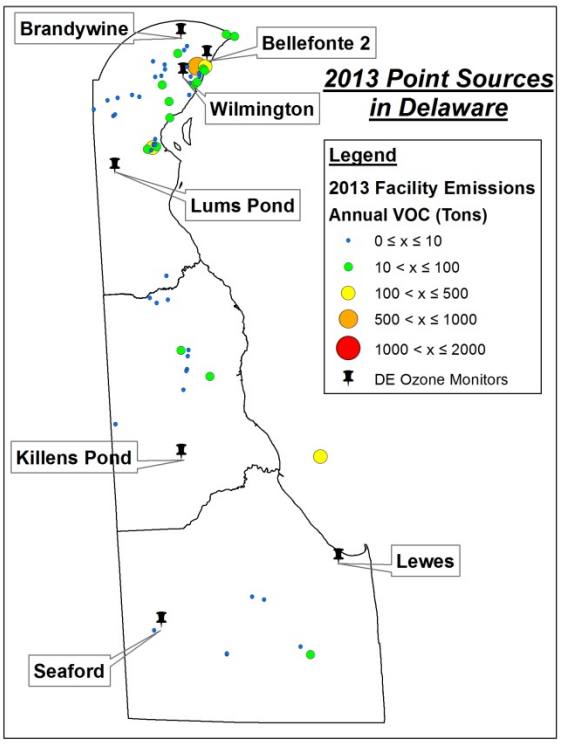
***** low data capture

Emissions info/maps

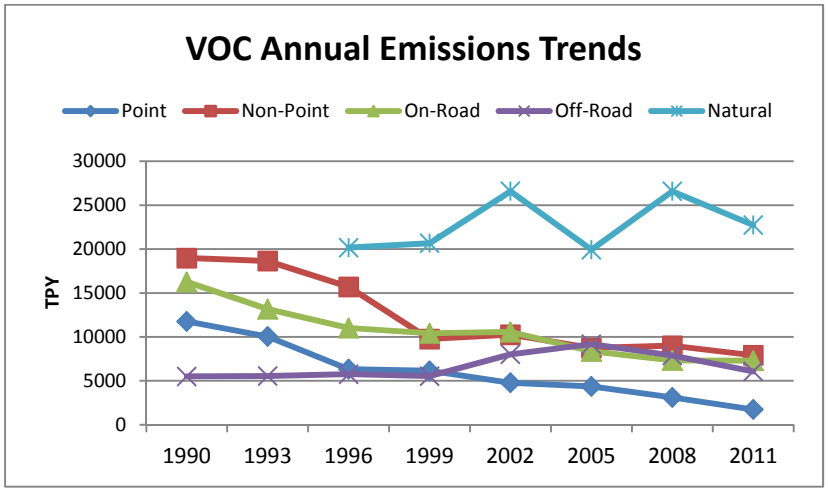
NOx point sources

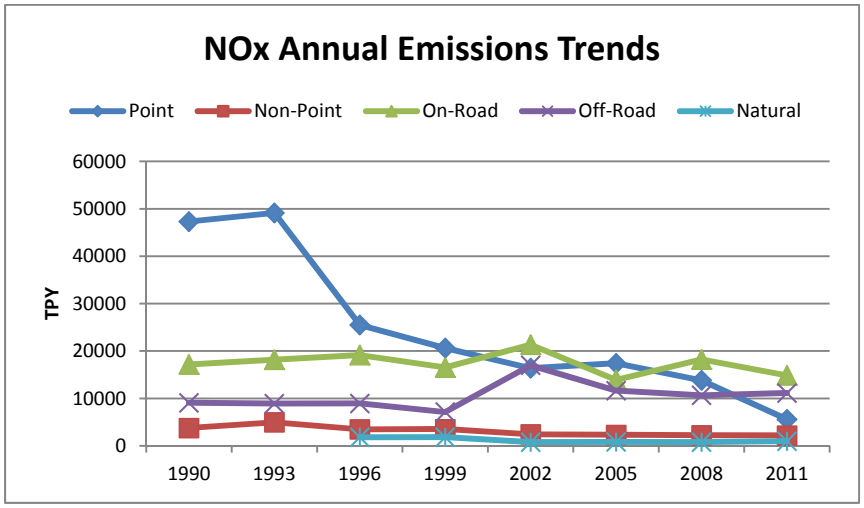


VOC point sources



Emissions Trends - statewide





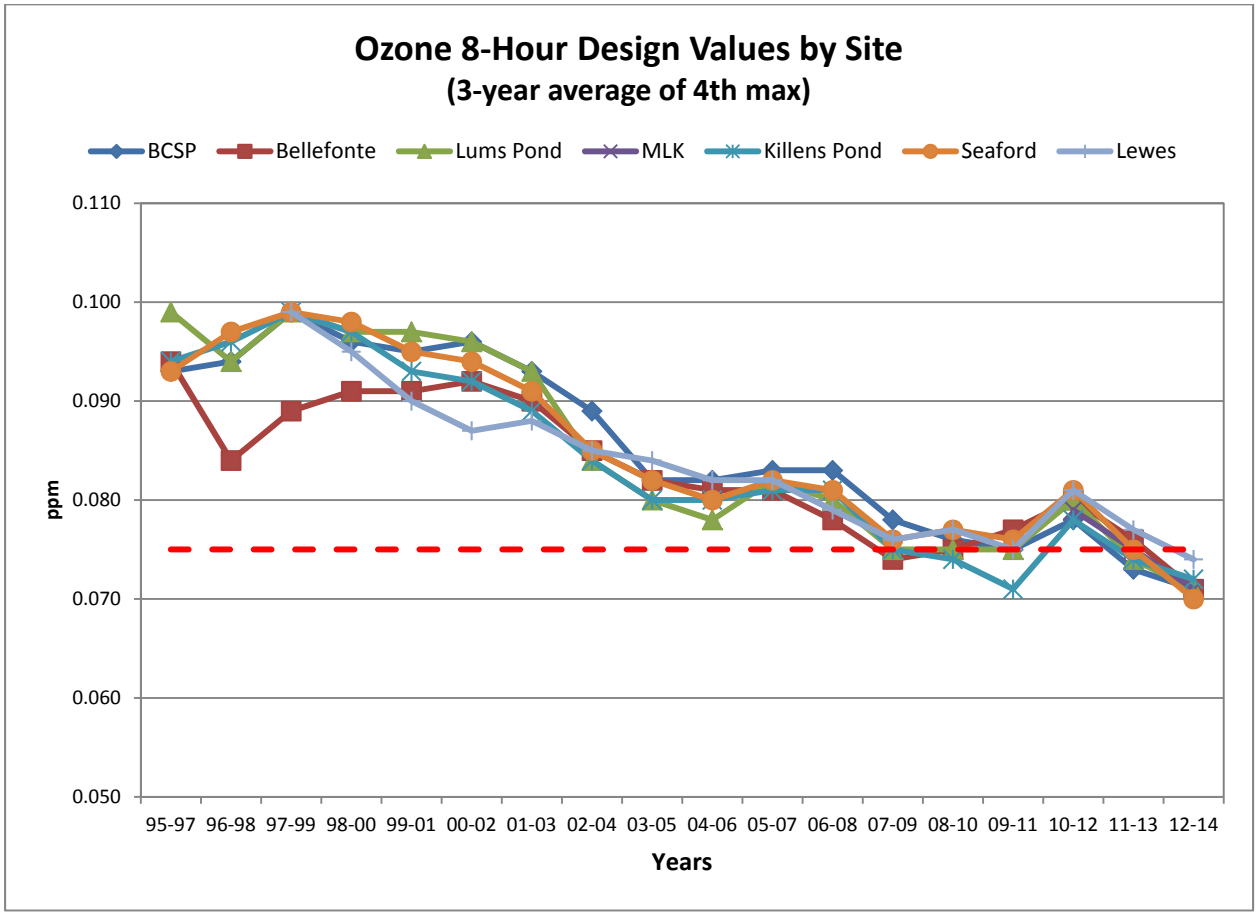
Emissions in most categories have trended downward, which correlates with the improvement in ambient O_3 levels as seen in the following section.

Statistical analyses

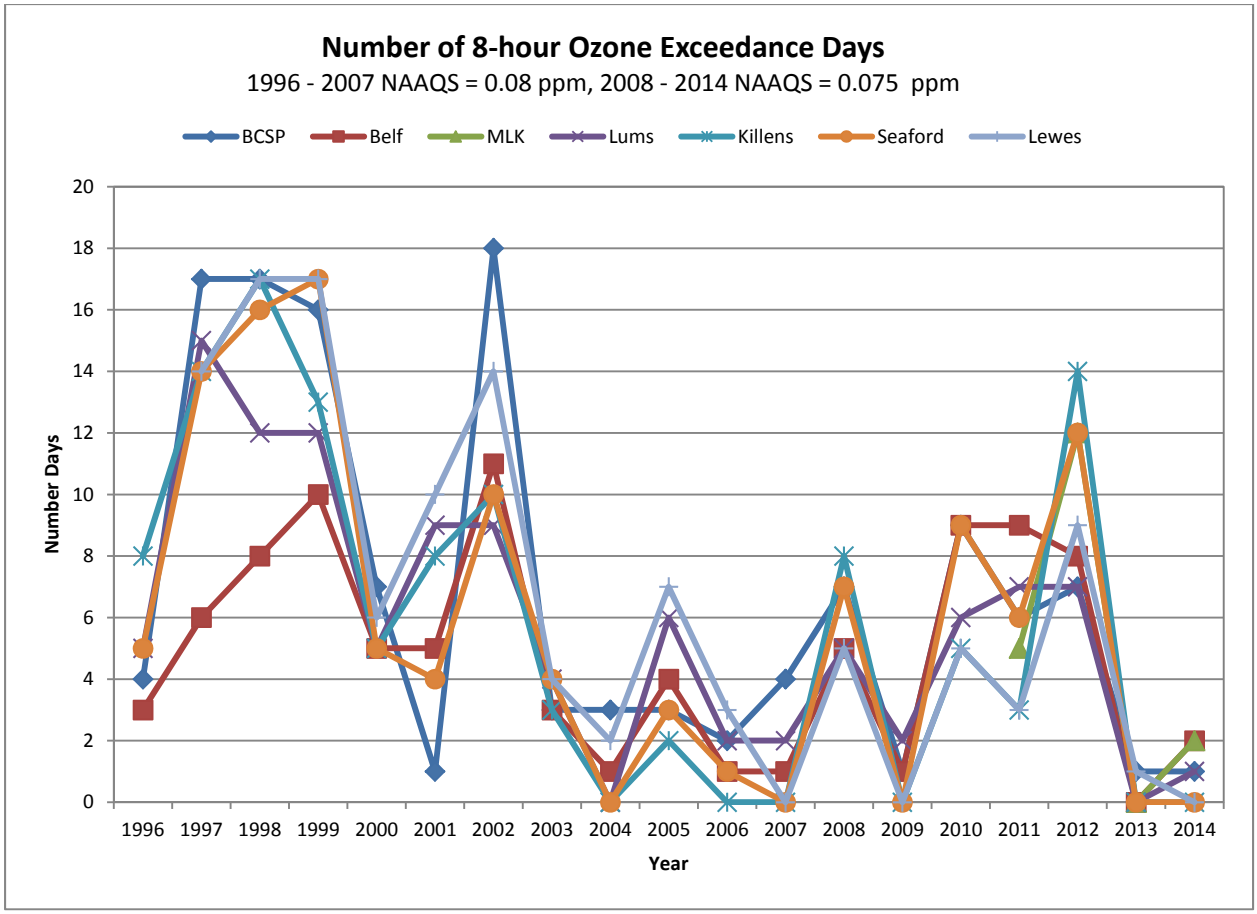
Ozone sites in Delaware have shown steadily improving air quality since the 1980s. The O_3 design value chart shows the 8-hour design value trends for each site in comparison with the changing NAAQS and proposed new NAAQS. Data for individual sites is included in previous discussions on each monitoring site.

In the 1990s there were greater differences in design values between sites in New Castle compared to sites in the other counties. Since 2000, concentrations have shown increasing similarity throughout the state. The recently proposed NAAQS, which will be between 0.065 and 0.070 ppm, will be below the

concentrations measured throughout the state indicating that Delaware will probably be non-attainment for the new NAAQS statewide.



The number of days with 8-hour concentrations exceeding the level of the current NAAQS of 0.075 ppm is shown below. The trend has been downward with increasingly similar numbers of exceedance days across all sites.



Most recent Delaware O_3 design values and percent difference from existing and proposed NAAQS:

County	Site	2012-2014 DV ppb	% D current NAAQS 75 ppb	% D proposed NAAQS 60 ppb	% D proposed NAAQS 70 ppb
Kent	KILLENS POND	72	-4%	+20%	+3%
New Castle	BCSP	71	-4%	+20%	+3%
New Castle	BELLFONTE2	71	-5%	+18%	+1%
New Castle	LUMS POND	71	-5%	+18%	+1%
Sussex	LEWES	74	-1%	+23%	+6%
Sussex	SEAFORD	70	-7%	+17%	0

In addition, while the design values for all three counties are below or very close to the existing 8-hour NAAQS, they are all above or equal to the recently proposed 8-hour NAAQS of 65 – 70 ppb.

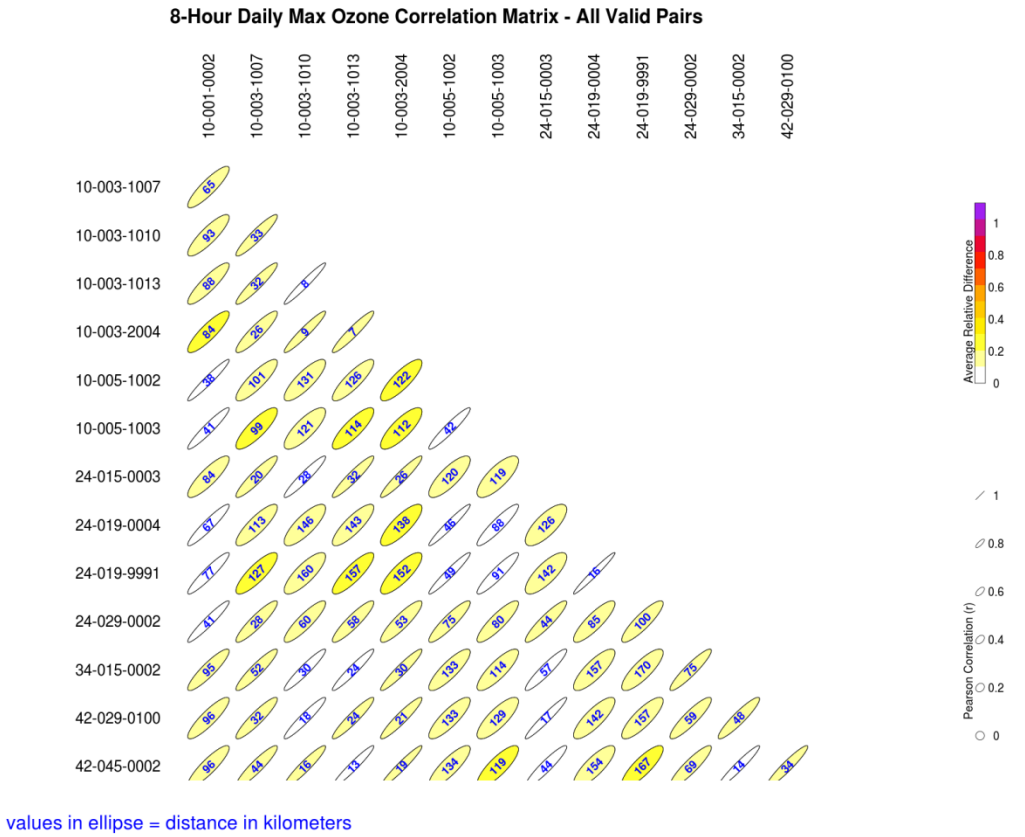
Correlation Matrix

In 2010 EPA provided a data analysis tool to examine correlation coefficients between sites. According to EPA, the purpose of this particular analysis/tool was to provide a means of determining possible redundant sites that could be removed. Possible redundant sites would exhibit fairly high correlations consistently across all of their pairings and would have low average relative difference despite the distance. Usually, 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 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 to site pairs.

In 2015 the NetAssess application was developed by a LADCO (Lake Michigan Air Directors Consortium) workgroup consisting of people from Indiana, Minnesota, and Michigan focusing on the 2015 network assessment. The NetAssiss tool is an update to the original Network Assessment tools developed by Mike Rizzo for the 2010 assessment. The NetAssess tool can be found at http://ladco.github.io/NetAssessApp/index.html. The tool uses data from the national air quality database (AQS) from 2011 through 2013. The Correlation Matrix Tool included in the NetAssess App is a modification of the CorMat tool included in the original Network Assessment package.

Using 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, produced the following results.

Correlation Matrix – DE and nearby state O_3 sites 2011 - 2013



The shape of the ellipse reflects the correlation (R^2); lower correlations are more round and higher correlations are more elongated ellipses. The color represents the average relative difference, with red and purple reflecting higher differences than yellow or white.

As described in the NetAssess App documentation, the correlation between two sites quantitatively describes the degree of relatedness between the 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 color of the ellipses represents the average relative difference between sites where 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 the two sites is an indicator of the overall measurement similarity between the two sites. Site pairs with a lower average relative difference are more similar to each other than pairs with a larger difference. Both the correlation and the relative difference between sites are influenced by the distance by which site pairs are separated. Usually, sites with a larger distance between them will generally be more poorly correlated and have large differences in the corresponding pollutant concentrations.

Correlation data (R^2) for O_3 sites 2011 – 2013; Delaware sites shaded

	10-001-0002	10-003-1007	10-003-1010	10-003-1013	10-003-2004	10-005-1002	10-005-1003	24-015-0003	24-019-0004	24-019-9991	24-029-0002	34-015-0002	42-029-0100
10-003-1007	0.884												
10-003-1010	0.864	0.930											
10-003-1013	0.886	0.936	0.969										
10-003-2004	0.870	0.903	0.951	0.945									
10-005-1002	0.963	0.857	0.830	0.859	0.832								
10-005-1003	0.948	0.836	0.799	0.836	0.804	0.947							
24-015-0003	0.857	0.921	0.948	0.939	0.944	0.805	0.768						
24-019-0004	0.939	0.852	0.801	0.840	0.814	0.966	0.919	0.752					
24-019-9991	0.937	0.839	0.810	0.854	0.820	0.961	0.924	0.780	0.977				
24-029-0002	0.954	0.911	0.884	0.907	0.887	0.908	0.875	0.916	0.858	0.876			
34-015-0002	0.901	0.923	0.947	0.957	0.944	0.853	0.835	0.933	0.816	0.822	0.925		
42-029-0100	0.884	0.917	0.949	0.938	0.937	0.843	0.805	0.961	0.821	0.830	0.895	0.923	
42-045-0002	0.885	0.921	0.939	0.961	0.961	0.845	0.826	0.934	0.816	0.834	0.903	0.960	0.947

Correlation data - average relative differences for O_3 sites 2011 – 2013; Delaware sites shaded

	10-001-0002	10-003-1007	10-003-1010	10-003-1013	10-003-2004	10-005-1002	10-005-1003	24-015-0003	24-019-0004	24-019-9991	24-029-0002	34-015-0002	42-029-0100
10-003-1007	0.18												
10-003-1010	0.15	0.14											
10-003-1013	0.17	0.13	0.10										
10-003-2004	0.23	0.16	0.13	0.13									
10-005-1002	0.06	0.19	0.16	0.18	0.24								
10-005-1003	0.08	0.21	0.18	0.21	0.26	0.08							
24-015-0003	0.12	0.15	0.10	0.12	0.12	0.15	0.16						
24-019-0004	0.08	0.19	0.16	0.20	0.23	0.06	0.10	0.15					
24-019-9991	0.09	0.22	0.18	0.21	0.26	0.07	0.10	0.15	0.06				
24-029-0002	0.08	0.17	0.15	0.15	0.17	0.10	0.11	0.10	0.12	0.11			
34-015-0002	0.11	0.13	0.09	0.09	0.13	0.13	0.15	0.09	0.14	0.16	0.11		
42-029-0100	0.14	0.16	0.10	0.13	0.17	0.16	0.18	0.07	0.15	0.17	0.13	0.10	
42-045-0002	0.18	0.14	0.13	0.10	0.11	0.19	0.21	0.10	0.20	0.21	0.13	0.08	0.13

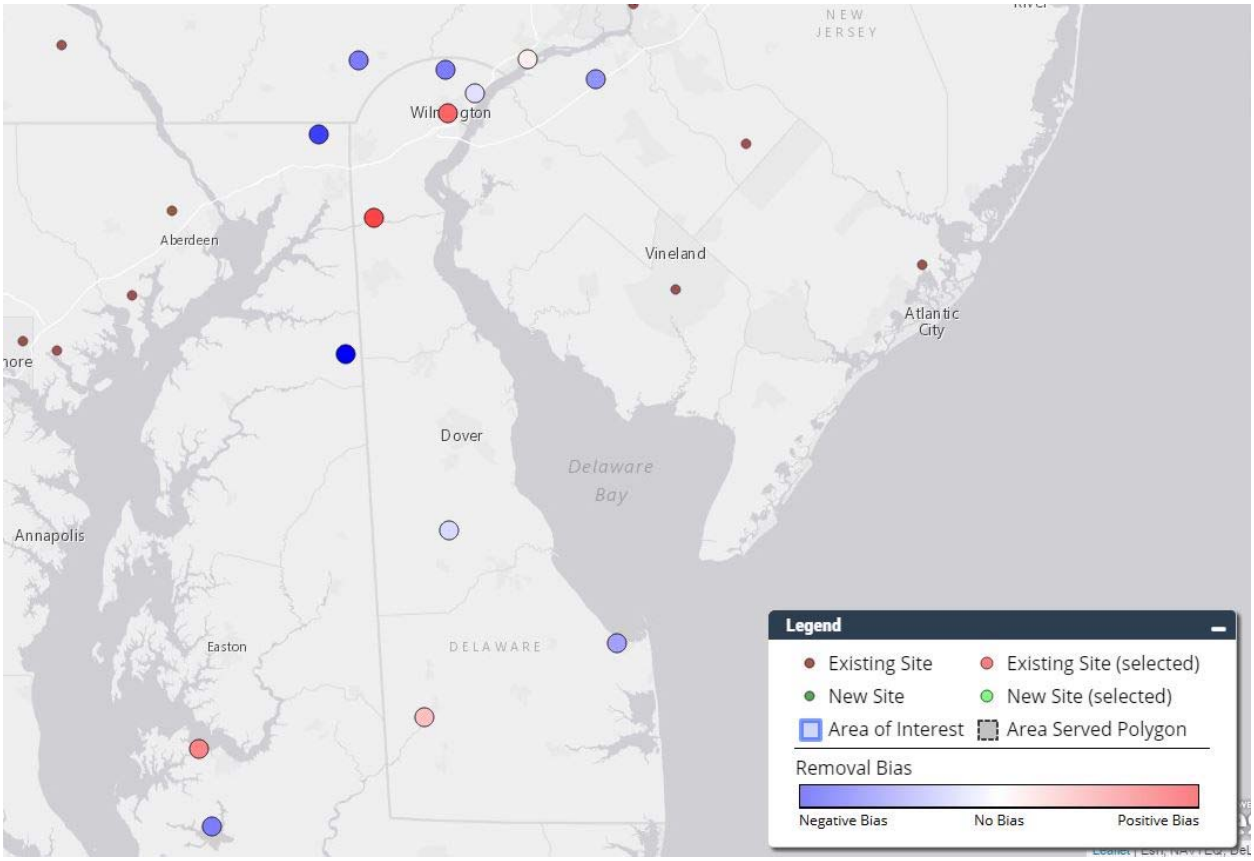
The Delaware sites are correlated with each other (R^2 from 0.799 – 0.963) with fairly low average differences. The sites farthest from each other, as expected, show the lowest correlation and highest difference. Looking at sites outside Delaware, there was a slightly wider range of correlation (R^2 from 0.768 – 0.961), again largely increasing with greater distance between the sites.

The conclusion is that there is some correlation among the all sites, with slightly stronger correlation among the closest sites. The decreasing variation in overall O_3 concentrations noted in the design value statistics over recent years is reflected in the increasing level of correlation and relative difference among O_3 sites in Delaware and nearby states over the past five years.

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 the interpolation and the measured concentration. A positive average bias would mean that if the site being examined was removed, the neighboring sites would indicate that the estimated concentration would be larger than the measured concentration. Likewise, a negative average bias would suggest that the estimated concentration at the location of the site is smaller than the actual measured concentration.

O_3 site removal bias output



Removal bias data results.

Site ID	Site Name	Design Value ppm 2011-2013	Mean bias	Std Dev bias	Mean Relative Removal Bias
10-001-0002	KILLENS POND STATE PARK	0.074	-0.0005	0.00255	-1%
10-003-1007	LUMS POND STATE PARK	0.074	0.0024	0.00578	9%
10-003-1010	BRANDYWINE CREEK STATE PARK	0.073	-0.0017	0.00361	-5%
10-003-1013	BELLEFONTE2 BELLEVUE STATE PARK	0.076	-0.0004	0.00424	0%
10-003-2004	MLK WILMINGTON	0.075	0.0020	0.00478	10%
10-005-1002	SEAFORD SEAFORD	0.075	0.0008	0.00274	3%
10-005-1003	LEWES UNIV. OF DE COLLEGE OF MARINE STUDIES	0.077	-0.0012	0.00355	-3%

From this analysis, it is seen that removing any site in Delaware results in some level of bias (either negative or positive depending on the site) in the design value calculation, with the exception of Bellefonte2.

Other Considerations

Since the 2010 assessment, most monitoring equipment has been updated, however there are still two O_3 analyzers older than the recommended age of 7 years (one is 17 years old and the other is 9 years old). These should be considered for replacement as resources become available.

Future needs

On Nov. 25, 2014, the U.S. Environmental Protection Agency (EPA) proposed to strengthen the National Ambient Air Quality Standards (NAAQS) for ground-level O_3 as a primary 8-hour standard set within a range of 65 to 70 parts per billion (ppb).

EPA is also proposing that the secondary standard in terms of a "W126 index" in a range of 13 to 17 parts per million-hours (ppm-hours), averaged over three years. A "W126 index," named for the formula used to calculate it, is a seasonal index often used to assess the impact of O_3 on ecosystems and vegetation. To achieve a level of protection equivalent to 13 to 17 ppm-hours based on the W126 metric, EPA is proposing to set an 8-hour secondary standard at a level within the range of 65 to 70 ppb. EPA analyzed data from air quality monitors and found that setting a standard in a W126 form would not provide additional protection beyond an 8-hour standard.

The proposed updates also include changes to monitoring requirements, including extending the O_3 monitoring season in Delaware to March 1 through October 31 to match the times of year when data show O_3 can approach unhealthy levels, and to alert the public. The agency also is proposing to:

- Streamline and modernize the Photochemical Assessment Monitoring Stations (PAMS) network to use monitoring resources most efficiently. The PAMS network measures O_3, the pollutants that form it, and meteorology in order to better understand O_3 formation and to evaluate national and local O_3-reduction options; and

- Update the Federal Reference Method for O_3 to include an additional method for measuring O_3 in the outdoor air, which will provide flexibility and choice to state, local and tribal air agencies.

The proposal also would update the Air Quality Index, EPA's color-coded tool for communicating air quality to the public, to reflect changes to the O_3 health standard.

EPA plans to issue a final rule in coordination with the final O_3 standards in October 2015.

It is not anticipated that the proposed new monitoring requirements will require any additional O_3 monitors in Delaware since the existing network provides adequate representation for all MSAs and non-urban areas in the state. However, with new regulations for the PAMS there may be new monitoring requirements for non- O_3 monitors such as auto GC for VOCs, direct NO_2 monitoring or supplemental monitoring for parameters such as NOx. When the final O_3 rule is promulgated, Delaware will work closely with EPA Region 3 to ensure that all new monitoring requirements are met.

Summary information and monitor rating for O_3 – critical criteria shown in **bold**

Site	Data Criteria: % NAAQS, Max Concentration, Longevity, AQI	Statistical Criteria: Measurement Criticality, Uniqueness, Trends	Situational Criteria: Meteorological Pattern, Area Scale, Area Represented, Federal Requirements, Multi-pollutant	Future Needs, Special Considerations: Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	Rating
Brandywine	% NAAQS: Close to Current NAAQS Longevity: Long trend history **Max Concentration: Design Value** AQI Calculated	**Measurement Criticality: Removal Bias** Uniqueness: Moderate Correlation	**Meteorological Pattern: Secondary Downwind Direction Wilmington**	**Impact from NAAQS Revisions: Above Proposed NAAQS**	**Critical**
Bellefonte 2	% NAAQS: Close to Current NAAQS Longevity: Long trend history **Max Concentration: Design Value** AQI Calculated	Measurement Criticality: No Removal Bias Uniqueness: Moderate Correlation	**Meteorological Pattern: Primary Downwind Direction Wilmington**	**Impact from NAAQS Revisions: Above Proposed NAAQS** Concentration Gradient: between Wilmington and nearby PA/Philadelphia	**Critical**
MLK	% NAAQS: Close to Current NAAQS Longevity: Moderate trend history Max Concentration: not Design Value AQI Calculated	**Measurement Criticality: Removal Bias** Uniqueness: Moderate Correlation	**NCore Required monitor**	**Impact from NAAQS Revisions: Above Proposed NAAQS**	**Critical**
Lums Pond	% NAAQS: Close to Current NAAQS Longevity: Long trend history **Max Concentration: Design Value** AQI Calculated	**Measurement Criticality: Removal Bias** Uniqueness: Moderate Correlation	Meteorological Pattern: Upwind Wilmington **Federal Requirement: Transport from Baltimore/Washington Area**	**Impact from NAAQS Revisions: Above Proposed NAAQS**	**Critical**
Killens Pond	% NAAQS: Close to Current NAAQS Longevity: Long trend history **Max Concentration: Design Value** AQI Forecasted	**Measurement Criticality: Removal Bias** Uniqueness: Moderate Correlation	**Area Represented: Only site in Kent Co., closest to Dover MSA** **Federal Requirement: Rural Background**	**Impact from NAAQS Revisions: Above Proposed NAAQS** Non-urban, rural location for future secondary NAAQS compliance	**Critical**
Seaford	% NAAQS: Close to Current NAAQS Longevity: Long trend history Max Concentration: Not Design Value AQI Forecasted	**Measurement Criticality: Removal Bias** Uniqueness: Moderate Correlation	**Area represented: Salisbury MSA**	**Impact from NAAQS Revisions: Equal to a Proposed NAAQS**	**Critical**
Lewes	% NAAQS: Close to Current NAAQS Longevity: Long trend history **Max Concentration: Design Value** AQI Forecasted	**Measurement Criticality: Removal Bias** Uniqueness: Moderate Correlation	**Area Represented: Only Coastal Site, significant seasonal population exposure**	**Impact from NAAQS Revisions: Above Proposed NAAQS** Population growth expected to continue	**Critical**

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. New Castle County recently reached attainment for the NAAQS separate from the Philadelphia CSA, so at this time the entire state is in attainment. Despite improving ambient concentrations, there continue to be some days with unhealthy levels of $PM_{2.5}$ in the state, particularly in New Castle County.

Delaware operates $PM_{2.5}$ monitors at seven sites throughout the state. All monitors operate year-round. There is one collocated site at MLK in Wilmington. The normal sampling schedule is 24 hours every third day, however, at MLK samples are collected every day.

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. These required monitoring stations or sites must be sited to represent community-wide air quality. In addition, the following specific criteria apply:

(1) At least one monitoring station is to be sited in a population-oriented area of expected maximum concentration (MLK Wilmington).

(2) For areas with more than one required station, a monitoring station is to be sited in an area of poor air quality.

(3) Each State shall install and operate at least one $PM_{2.5}$ site to monitor for regional background (Killens Pond) and at least one $PM_{2.5}$ site to monitor regional transport (Lums Pond).

$PM_{2.5}$ Speciation

Chemical speciation is encouraged at sites where the chemically resolved data would be useful in developing State implementation plans and supporting atmospheric or health effects related studies. These sites in Delaware were originally at MLK in Wilmington and Dover in Kent County. The $PM_{2.5}$ chemical speciation sites include analysis for elements, selected anions, cations, and carbon collected on a 1 in 6 day schedule.

In 2014 EPA completed the process of assessing the national speciation network. The purpose of the assessment was to create a network that is sustainable going forward 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, and the Dover site was identified as low-value due to redundancy. Speciation monitoring at the Dover site therefore ended in 2014 in response to termination of support from the EPA. Speciation monitoring continues at the MLK site in Wilmington on a 1 in 3 day schedule.

Continuous $PM_{2.5}$

Delaware operates a continuous $PM_{2.5}$ FEM monitor network that generates hourly and 24-hour data at the several sites, including MLK, Killens Pond, and Seaford. These monitors operate year-round and are collocated with an FRM $PM_{2.5}$ monitor. The goals of continuous monitoring include support for AQI forecasting and providing supplemental information on hourly $PM_{2.5}$ concentrations in the relevant counties.

$PM_{2.5}$ monitoring sites in Delaware

Site	County/MSA	Objectives and Monitor Type
Bellefonte	New Castle Phil. CSA	NAAQS compliance Population exposure Trends
MLK	New Castle Phil. CSA	NAAQS compliance Population exposure/Max. concentration Expected poor air quality Trends Speciation Continuous monitor for AQI
Newark	New Castle Phil. CSA	NAAQS compliance Population exposure Trends
Lums Pond	New Castle Phil CSA	NAAQS compliance Regional transport Upwind for Wilmington Trends
Dover	Kent Dover MSA	NAAQS compliance Population exposure Trends Speciation
Killens Pond	Kent Not in MSA	NAAQS compliance Regional background Trends Continuous monitor for diurnal patterns
Seaford	Sussex Seaford mSA	NAAQS compliance Population exposure Trends Continuous monitor for diurnal patterns

Situational analyses

Note on pollution roses – because the $PM_{2.5}$ data represents 24-hour averages, traditional pollution roses are not available; if hourly continuous $PM_{2.5}$ data is available, pollution roses may be generated. Please refer to representative wind roses in the network summary section for general meteorological patterns.

New Castle County sites and characteristics

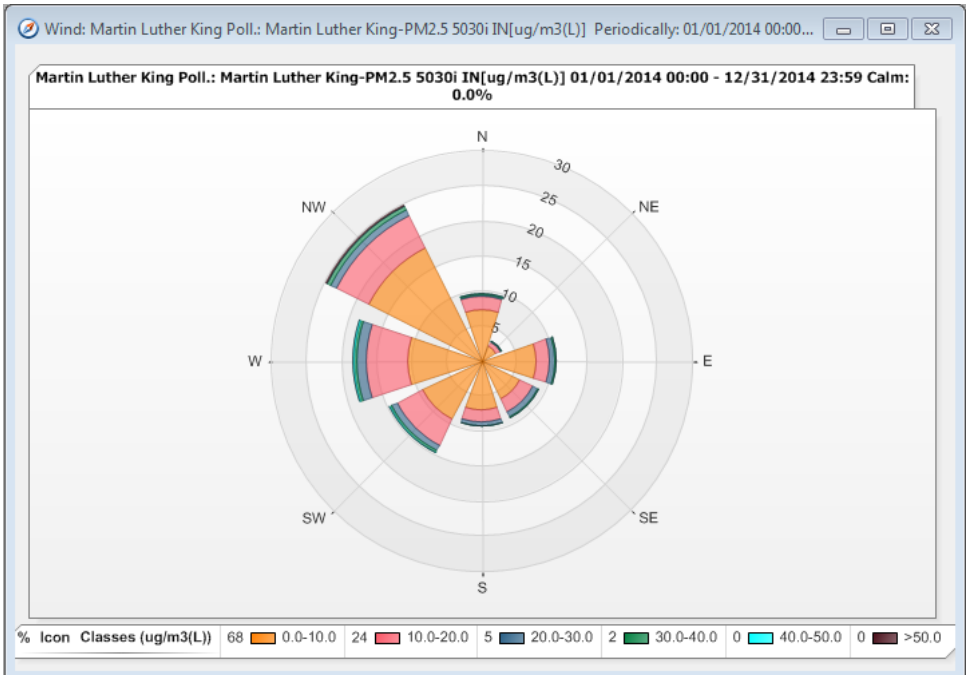
Bellefonte (10-003-1003) The Bellefonte site was established in 1969 to monitor O_3 and SO_2; $PM_{2.5}$ monitoring began in 1999. Bellefonte $PM_{2.5}$ is neighborhood scale and the objectives are compliance with the NAAQS, population exposures, and trends. Bellefonte is also used to determine concentration gradients between Wilmington and monitors in Chester, PA. Bellefonte meets all EPA siting criteria.

MLK (10-003-2004) The MLK site is located in Wilmington at the intersection of Justison St. and MLK Blvd. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years. The

MLK site represents urban population exposure to multiple pollution sources. The site meets all EPA siting criteria. Monitoring objectives are compliance with the NAAQS, maximum population exposure, and trends. NCore monitoring began during 2010 with all monitors fully operational on January 1, 2011.

Continuous $PM_{2.5}$ monitoring using a Federal Reference Method (FRM)-like method (Thermo-Fisher SHARP monitor) began at this site in 2007 and is continuing in support of data analysis, diurnal pattern assessment, and AQI generation. The continuous monitor has been designated by EPA as a Federal Equivalent Method (FEM) and the hourly data are submitted to the AirNow website and the AQS database.

PM2.5 Pollution Rose – MLK 2014



Newark (10-003-1012) The original Newark site (10-003-1011) was established in 1999 in central Newark on University of Delaware property and operated for almost one 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 the UD. It is a $PM_{2.5}$ neighborhood scale site. The location is suburban and generally impacted by mobile sources and regional transport. The site meets all EPA siting criteria. The objectives are NAAQS compliance, regional transport, population exposure, and trends.

Lums Pond (10-003-1007) The Lums Pond site is a neighborhood scale site located in Lums Pond State Park and is the general upwind direction from Wilmington. The immediate area is rural. The site meets all EPA siting criteria. $PM_{2.5}$ monitoring began in 1999. Monitoring objectives are regional transport, general population exposure, trends, and NAAQS compliance.

Delaware City (10-003-1008) The Delaware City site has not had a $PM_{2.5}$ FRM monitor. In 2013 Delaware added another FEM continuous PM2.5 monitor to the Delaware City site as a SPM monitor which will operate for approximately two years, at which time the data will be evaluated to determine if monitoring should continue as a SLAMS. Because of the limited amount of data, this site is not included in the full data analysis that follows.

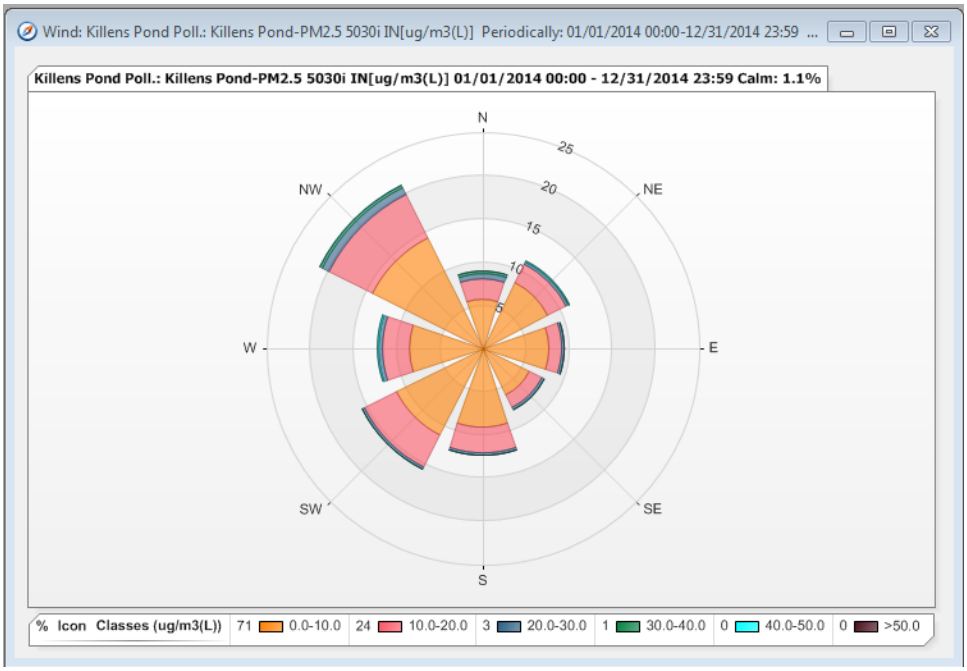
Kent county sites and characteristics

Dover (10-001-0003) The Dover site was established in 1999 and is a platform only. It is a neighborhood scale site representative of the Dover area, and is impacted by a combination of source types including mobile, large and small point sources. The site meets all EPA siting criteria. The monitoring objectives are NAAQS compliance, population exposure, and trends. Speciation monitoring began at this location in 2001.

Killens Pond (10-001-0002) The Killens Pond site was established in 1997 and is located in a rural area that is 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 for this site are regional background concentrations, NAAQS compliance, and trends.

Continuous $PM_{2.5}$ monitoring using a non-FRM-like method began at this site in 2003 and currently uses an FEM monitor in support of data analysis, diurnal pattern assessment, and potential AQI generation. This is the only continuous $PM_{2.5}$ monitoring in Kent County.

$PM_{2.5}$ Pollution Rose – Killens Pond 2014

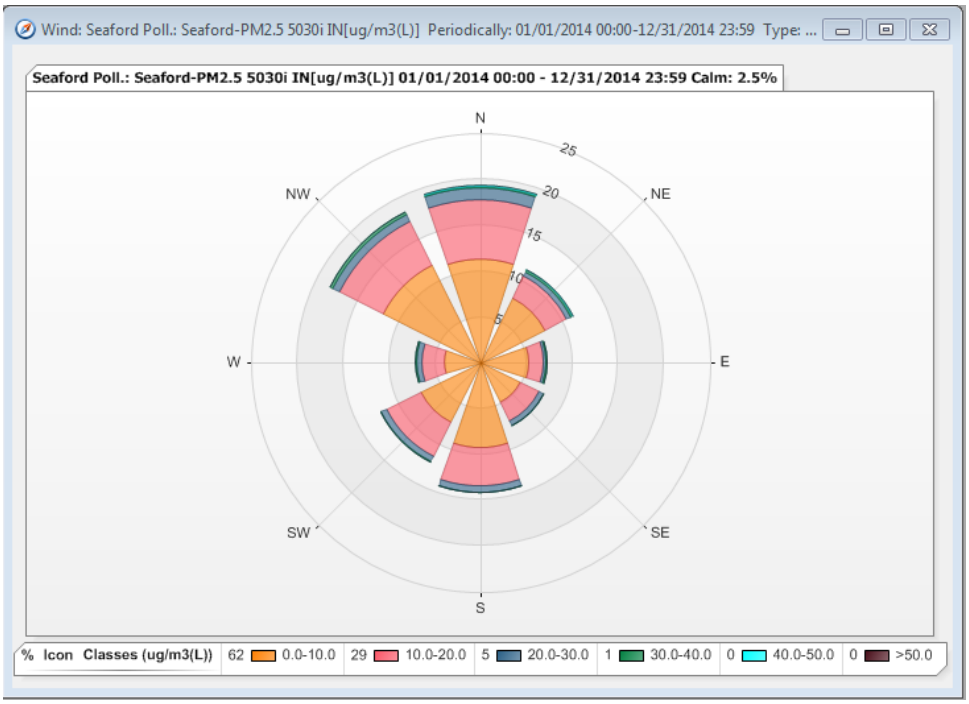


Sussex county sites and characteristics

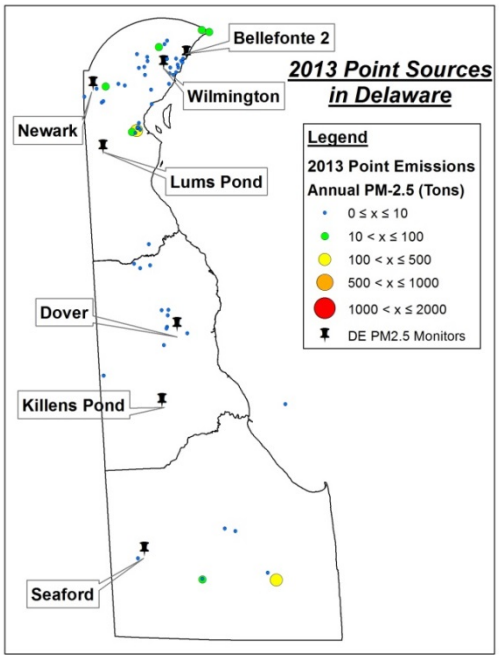
Seaford (10-005-1002) The Seaford site was established in 1990 at the current site on Virginia Ave, and $PM_{2.5}$ monitoring began in 1999. The site is neighborhood scale and is suburban. The site is impacted by local point sources, mobile sources, and regional transport. The site meets all EPA siting criteria. The site objectives are NAAQS compliance, population exposure, and trends.

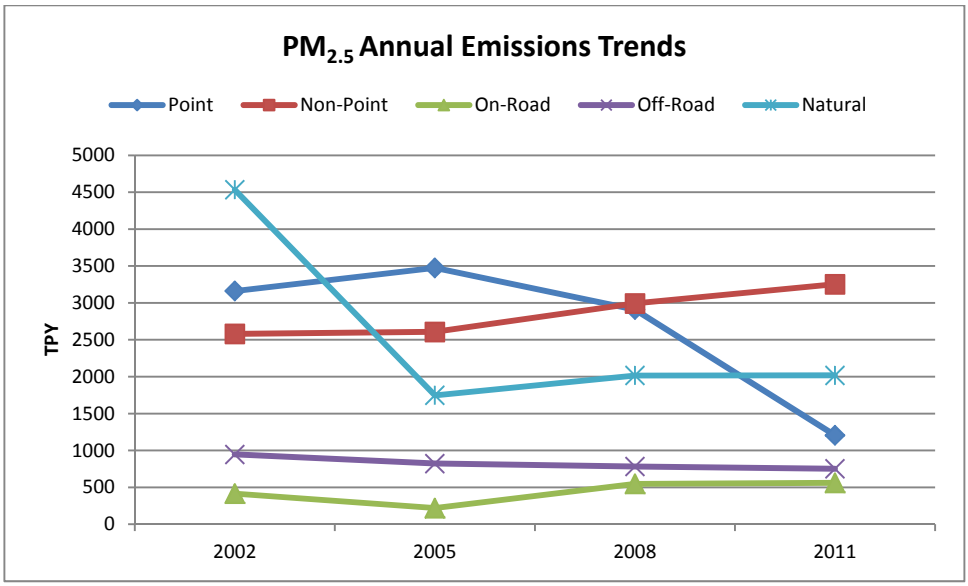
Continuous PM2.5 monitoring using a non-FRM-like method began at this site in 2003 and currently uses an FEM monitor in support of data analysis, diurnal pattern assessment, and potential AQI generation. This is the only continuous PM2.5 monitoring in Sussex County.

$PM_{2.5}$ Pollution Rose – Seaford 2014



Emissions info/maps – Point sources

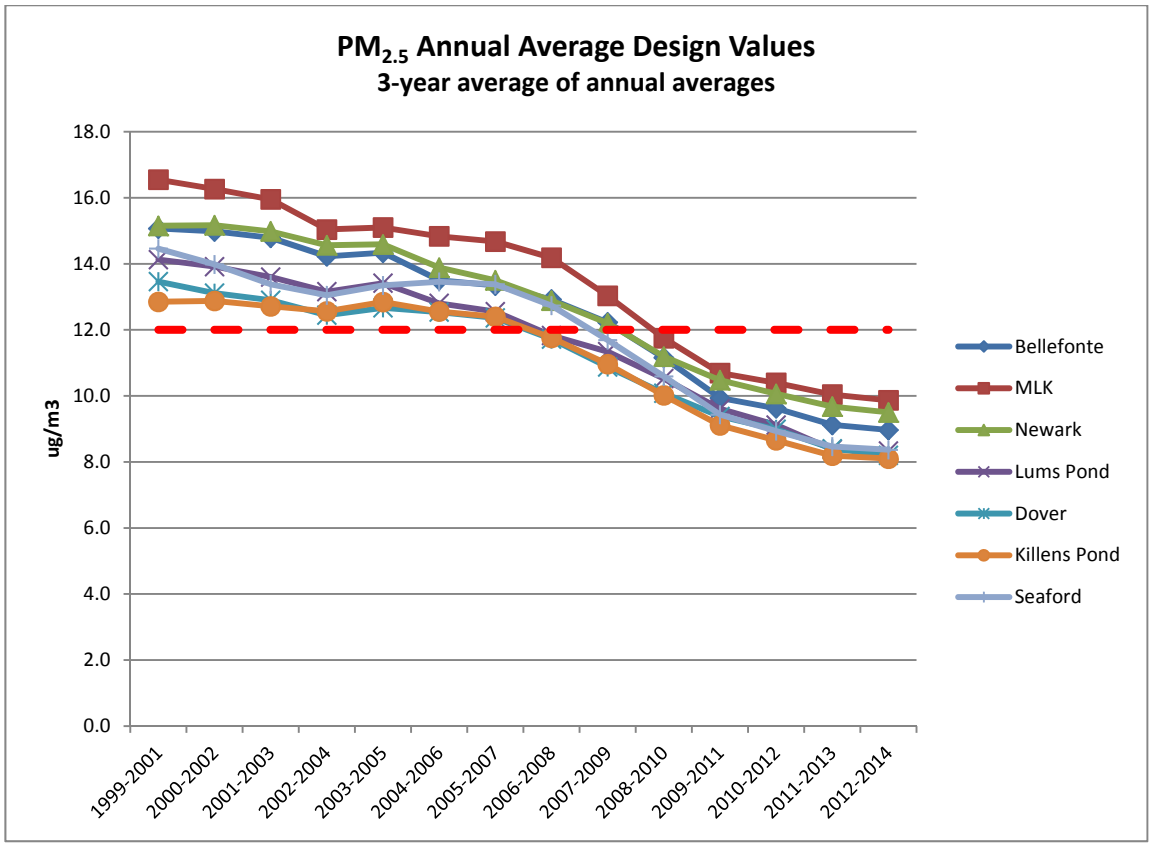




The largest $PM_{2.5}$ point sources in Delaware are power plants, refineries, and industrial boilers. The largest source is the coal fired power plant in Millsboro, Sussex County; new pollution controls and unit shut-downs have resulted in major emissions reductions in recent years.

Statistical Analysis

Design value trends – annual average

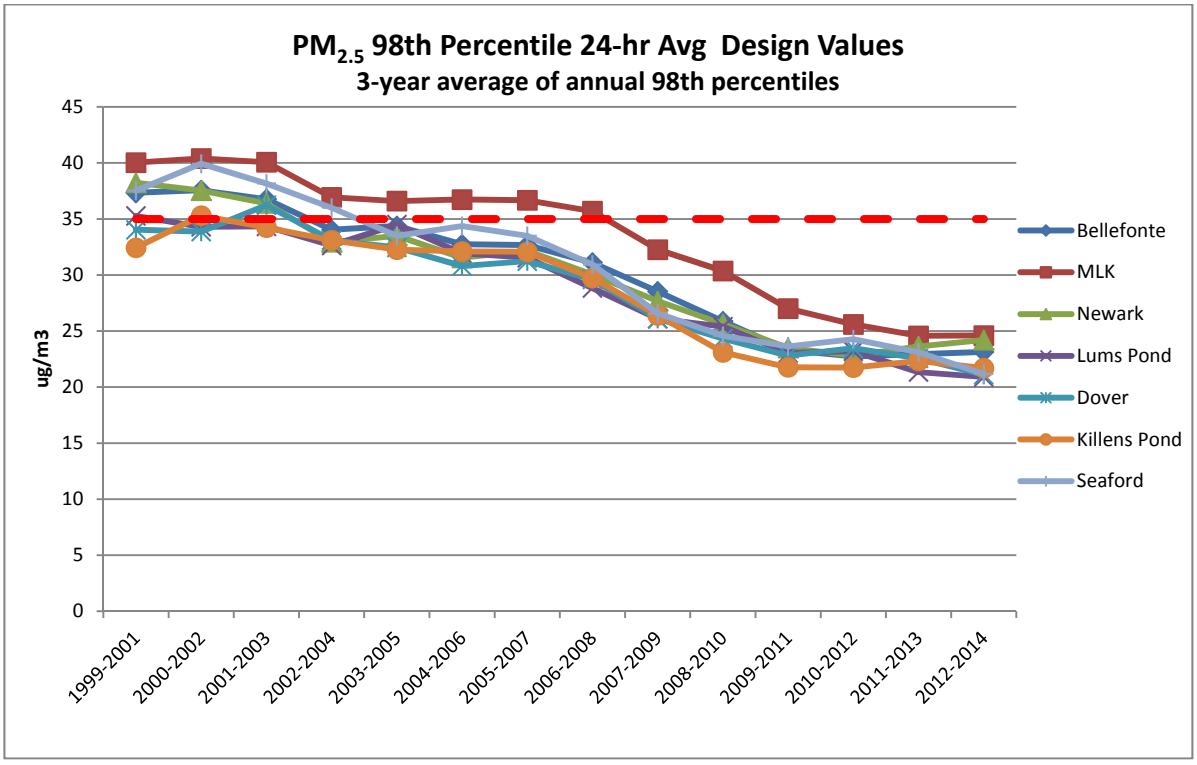


Annual average design values (3-year averages)

Years	Bellefonte	MLK	Newark	Lums Pond	Dover	Killens Pond	Seaford
1999-2001	15.1	16.5	15.1	14.1	13.5	12.8	14.5
2000-2002	15.0	16.3	15.2	13.9	13.1	12.9	14.0
2001-2003	14.8	16.0	15.0	13.6	12.9	12.7	13.4
2002-2004	14.2	15.0	14.6	13.2	12.4	12.6	13.0
2003-2005	14.3	15.1	14.6	13.4	12.7	12.8	13.3
2004-2006	13.5	14.8	13.9	12.8	12.5	12.6	13.5
2005-2007	13.3	14.7	13.5	12.6	12.4	12.4	13.4
2006-2008	12.2	13.4	12.3	11.4	11.1	11.2	12.0
2007-2009	12.2	13.0	12.2	11.3	10.9	11.0	11.7
2008-2010	11.2	11.7	11.2	10.5	10.1	10.0	10.6
2009-2011	9.9	10.7	10.5	9.6	9.4	9.1	9.4
2010-2012	9.6	10.4	10.1	9.1	9.0	8.7	8.9
2011-2013	9.1	10.0	9.7	8.4	8.4	8.2	8.5
2012-2014	9.0	9.9	9.5	8.3	8.2	8.1	8.4

The trends in annual average concentrations at all sites in Delaware have been downward since monitoring began in 1999.

Design value trends – 98th percentiles



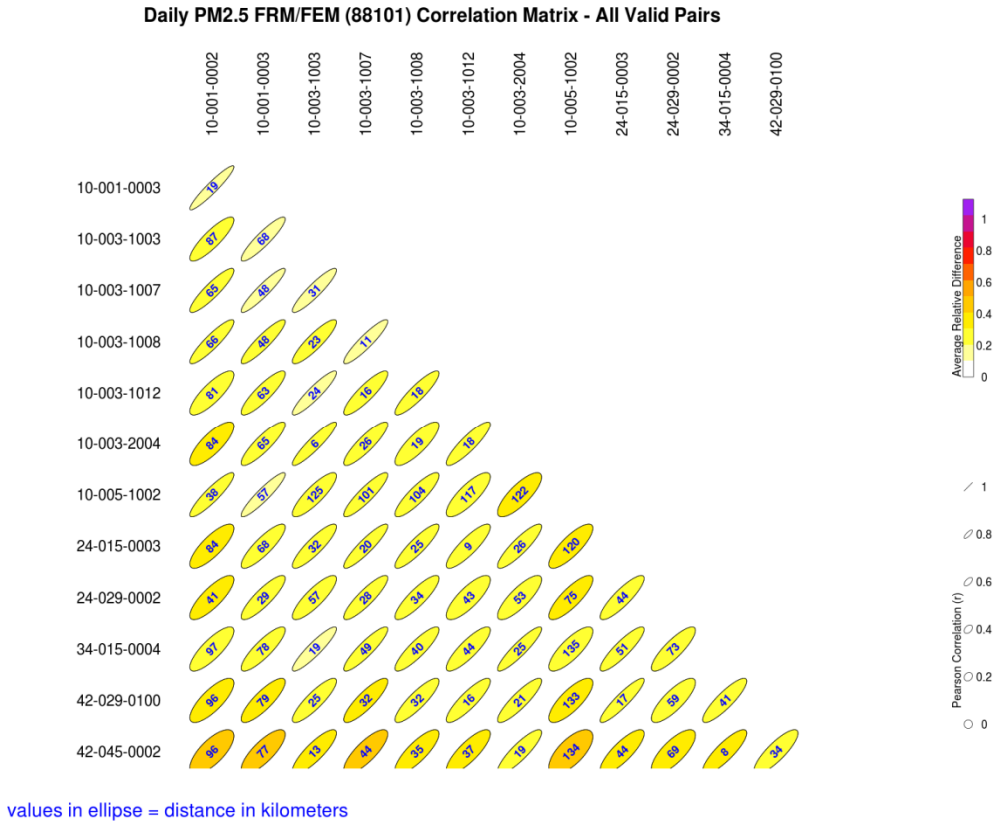
98th percentile design values (3-year averages)

3-year averages	Bellefonte	MLK	Newark	Lums Pond	Dover	Killens Pond	Seaford
1999-2001	37	40	38	35	34	32	38
2000-2002	38	40	38	34	34	35	40
2001-2003	37	40	36	34	36	34	38
2002-2004	34	37	33	33	33	33	36
2003-2005	34	37	34	35	32	32	34
2004-2006	33	37	32	32	31	32	34
2005-2007	33	37	32	32	31	32	34
2006-2008	31	36	30	29	30	30	31
2007-2009	29	32	28	26	26	26	27
2008-2010	26	30	26	25	24	23	25
2009-2011	23	27	24	23	23	22	24
2010-2012	23	26	23	23	23	22	24
2011-2013	23	25	24	21	23	22	23
2012-2014	23	25	24	21	21	22	21

Trends for the 98th percentile 24-hour averages show declining concentrations in recent years, but the trend is not as strong as for the annual average concentrations. All sites show similar improvements in recent years, and current design values are in compliance with the current 35 $\mu g/m^3$ NAAQS.

Correlation matrix - The Correlation Matrix tool calculates and displays the correlation, relative difference, and distance between pairs of sites within a user selected set of air monitoring sites. 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 to site pairs.

Correlation matrix – Delaware and nearby state $PM_{2.5}$ FRM monitors 2011 - 2013



Correlation data (R^2) for PM2.5 sites 2011 – 2013; Delaware sites shaded

Site ID	10-001-0003	10-003-1003	10-003-1007	10-003-1008	10-003-1012	10-003-2004	10-005-1002	24-015-0003	24-029-0002	34-015-0004	42-029-0100	42-045-0002
10-001-0002	0.945	0.863	0.898	0.905	0.824	0.796	0.905	0.803	0.813	0.817	0.781	0.716
10-001-0003		0.908	0.929	0.910	0.876	0.880	0.926	0.858	0.863	0.859	0.838	0.787
10-003-1003			0.916	0.889	0.919	0.923	0.854	0.877	0.847	0.914	0.869	0.846
10-003-1007				0.918	0.880	0.882	0.898	0.908	0.884	0.898	0.860	0.803
10-003-1008					0.892	0.829	0.871	0.888	0.864	0.875	0.869	0.815
10-003-1012						0.889	0.814	0.863	0.803	0.854	0.868	0.815
10-003-2004							0.797	0.885	0.818	0.912	0.882	0.872
10-005-1002								0.813	0.825	0.801	0.784	0.680
24-015-0003									0.868	0.886	0.913	0.820
24-029-0002										0.848	0.809	0.753
34-015-0004											0.873	0.849
42-029-0100												0.842

Correlation data – average relative difference for 2011 – 2013 for annual averages

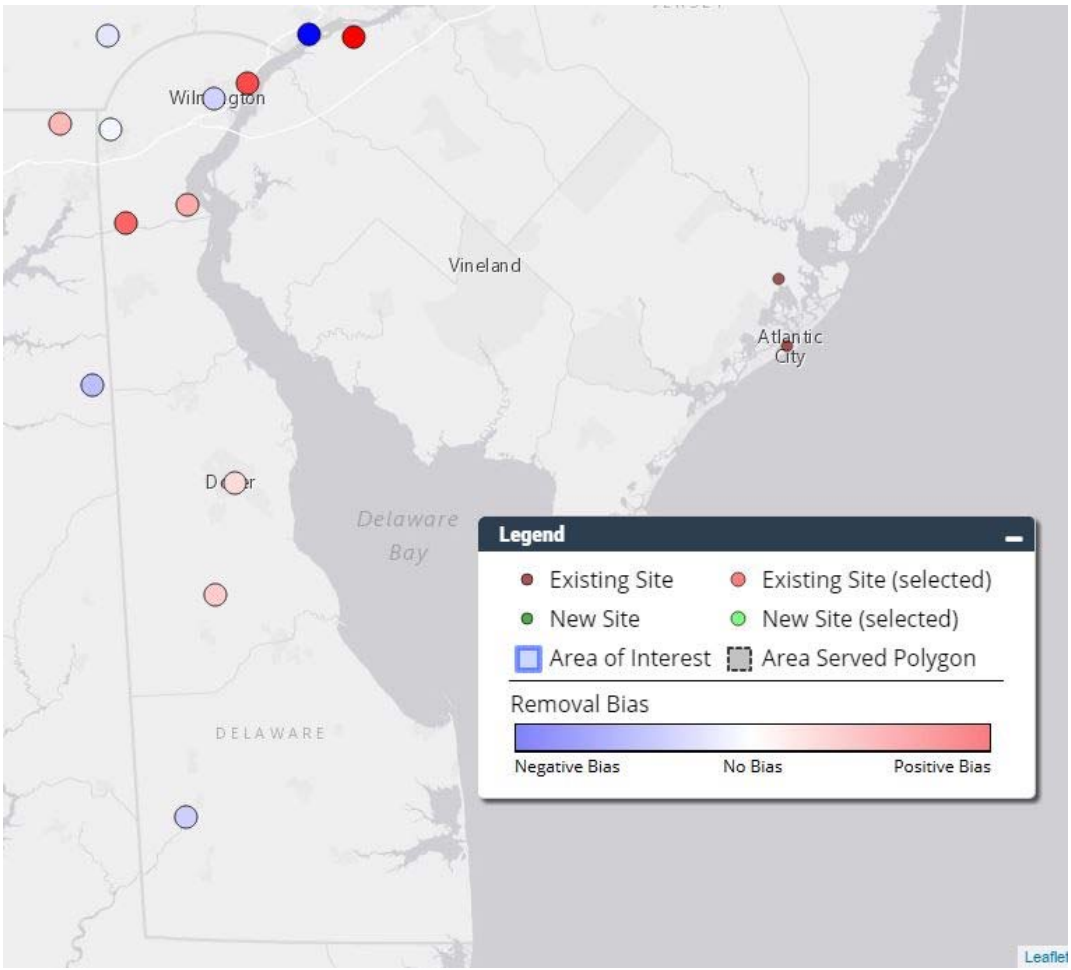
Site ID	10-001-0003	10-003-1003	10-003-1007	10-003-1008	10-003-1012	10-003-2004	10-005-1002	24-015-0003	24-029-0002	34-015-0004	42-029-0100	42-045-0002
10-001-0002	0.160	0.248	0.217	0.225	0.299	0.330	0.211	0.311	0.330	0.282	0.358	0.467
10-001-0003		0.192	0.169	0.217	0.241	0.278	0.190	0.286	0.286	0.244	0.316	0.413
10-003-1003			0.184	0.261	0.167	0.205	0.247	0.244	0.262	0.173	0.263	0.335
10-003-1007				0.199	0.227	0.282	0.222	0.252	0.274	0.216	0.321	0.418
10-003-1008					0.236	0.288	0.249	0.274	0.281	0.248	0.279	0.315
10-003-1012						0.201	0.285	0.233	0.284	0.219	0.236	0.312
10-003-2004							0.337	0.240	0.263	0.210	0.239	0.290
10-005-1002								0.318	0.307	0.279	0.362	0.450
24-015-0003									0.247	0.232	0.225	0.347
24-029-0002										0.249	0.292	0.350
34-015-0004											0.255	0.327
42-029-0100												0.298

The sites farthest from each other, as expected, show the lowest correlation and highest average difference. The MLK site had the least correlation with the other sites in Delaware and nearby states. The two sites in Kent County were well correlated with each other ($R^2 > 0.9$) and also with Seaford ($R^2 > 0.9$); the MLK site had the largest number of lower correlations ($R^2 < 0.9$). Looking at sites outside Delaware, there was slightly less correlation (R^2 from 0.7 – 0.9) and somewhat higher average relative difference, again generally increasing with greater distance between the sites.

All sites showed stronger correlations compared to 2010 data, indicating less influence from local sources and more influence due to regional sources and transport.

Removal bias for 2011-2013 data – A positive average bias would mean that if the site being examined was removed, the neighboring sites would indicate that the estimated concentration would be larger than the measured concentration. Likewise, a negative average bias would suggest that the estimated concentration at the location of the site is smaller than the actual measured concentration.

Please refer to the discussion in the Ozone section for detailed information on this EPA statistical method.



Removal bias data output

AQS ID	Site Name	Mean bias	Removal Bias Standard Deviation	Mean Relative Removal Bias (%)
100010002	Killens Pond	0.4329	2.14	16
100010003	Dover	0.3158	1.52	17
100031003	Bellefonte	1.5342	2.11	22
100031007	Lums Pond	1.3070	1.98	23
100031012	Newark	-0.0883	2.58	4
100032004	MLK	-0.3920	2.31	4
100051002	Seaford	-0.4090	3.22	3

The removal bias analysis indicates that for all $PM_{2.5}$ monitoring sites in Delaware except Newark, a significant bias would be introduced to the design values if any site were removed.

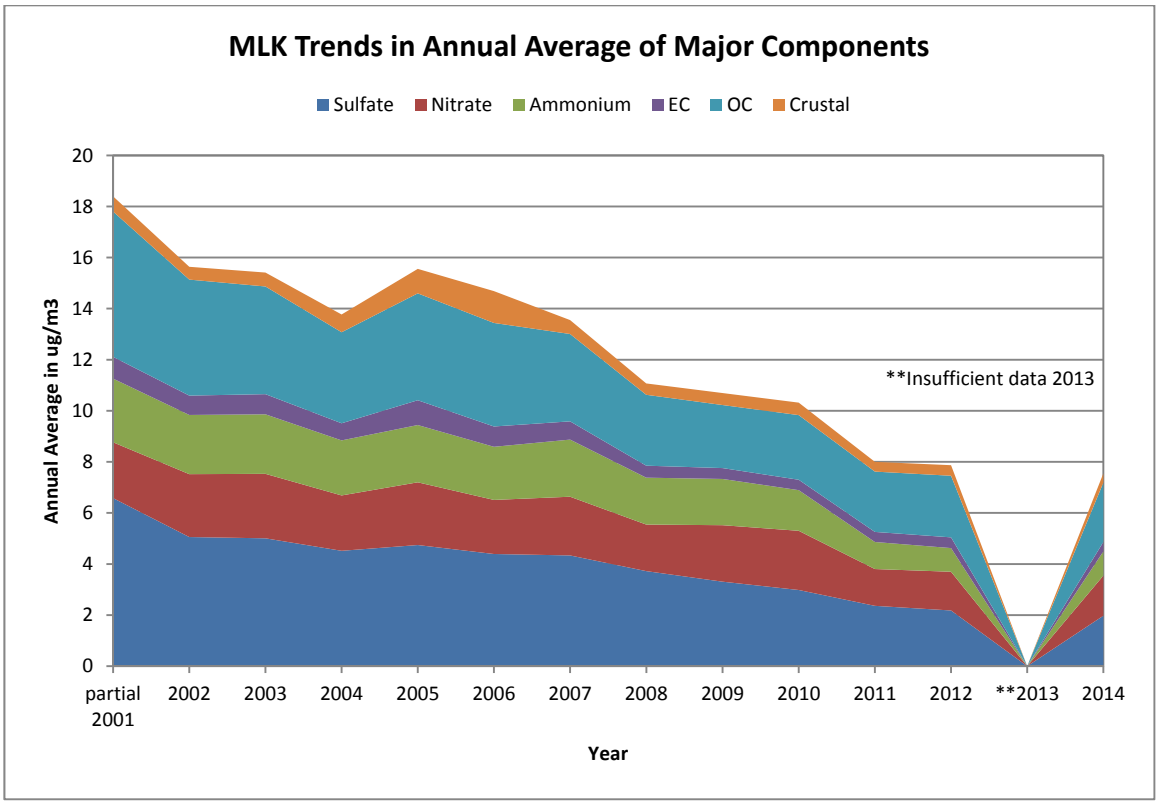
$PM_{2.5}$ speciation

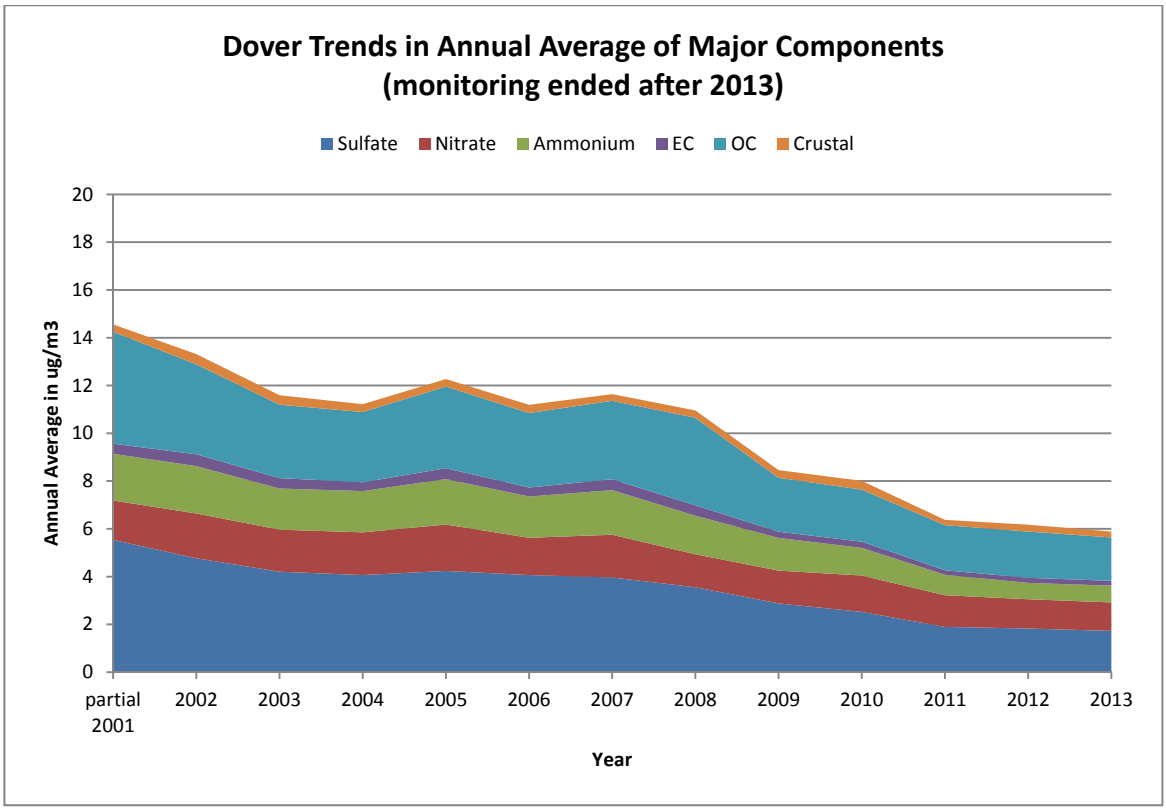
Delaware began operating $PM_{2.5}$ chemical speciation monitors in 2001 at two sites; one at the annual and 98th percentile design value site in Wilmington (MLK) and the other at Dover. The first full year of data was

collected in 2002. In 2008 the carbon collection method was changed to the Improve method at MLK; the change occurred at Dover in 2009.

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.

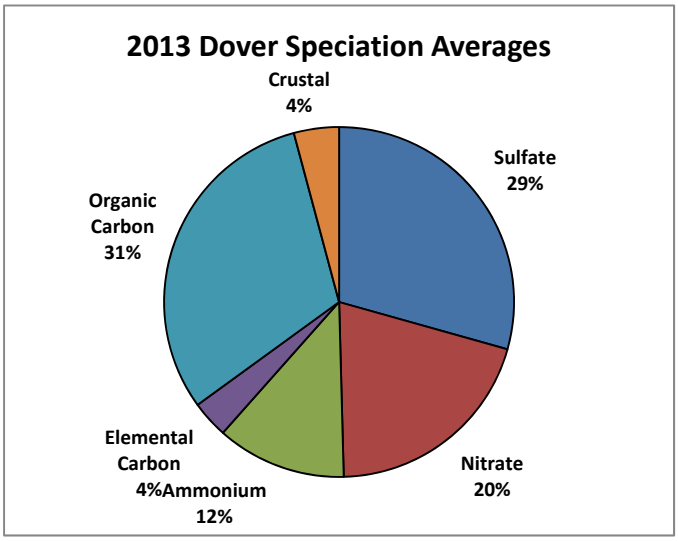
$PM_{2.5}$ speciation trends of major components.

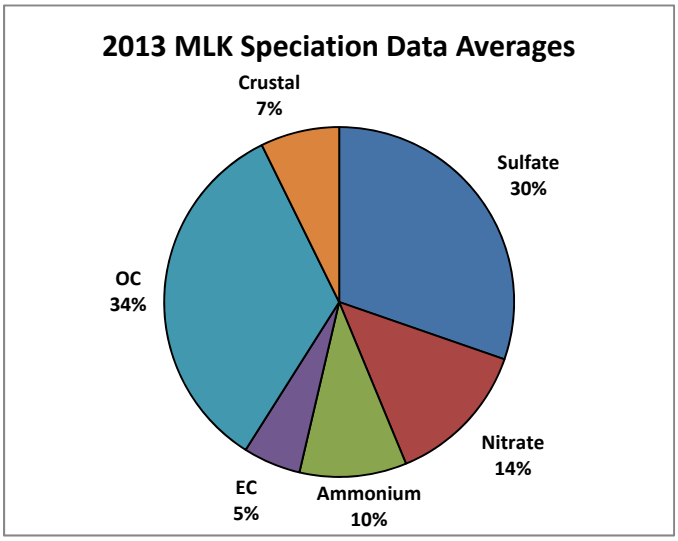




Preliminary analysis of speciation data at MLK and Dover shows trends for major components are generally downward or stable; relative composition (major components as percent of total mass) for each site remains similar across all years. The temporary increase in crustal components 2004 - 2006 at MLK reflected nearby construction activity

Speciation data – major components as percentage of total mass 2013 (last year with data for both sites)





Other issues

Local community concerns have become more prominent in recent years, particularly with regard to ambient particulate matter concentrations. Examples include the Millsboro area of Sussex County (power plant), the Claymont community in northern Delaware (former steel mill) and the Eden Park area of south Wilmington (multiple point and mobile sources, environmental justice issues). Various special studies using portable samplers are have been completed regarding particulate levels in these areas and results show that concentrations of $PM_{2.5}$ are not elevated in these communities compared to the existing network sites.

Many of the local problems appear to be related to larger particulate concentrations (PM_{10} or TSP) or other pollutants, and it is anticipated that local community concerns will continue into the foreseeable future. Without significant expenditure of resources, however, it will not be possible to establish new permanent monitoring sites in these areas. Delaware is exploring alternative methods such as support for community monitoring projects ("bucket brigade" sampling), temporary portable monitoring methods, and encouraging local large point sources to conduct their own monitoring projects.

PM_{10}

Delaware currently operates one PM_{10} monitor for AQI generation and calculating PM_{coarse} concentrations on a 1 in 3 day basis at the Wilmington MLK NCore site.

Continuous $PM_{2.5}$ monitoring

Delaware currently operates one type of continuous $PM_{2.5}$ monitors – the Thermo Fischer SHARP 5030. The SHARP is a hybrid nephelometer/beta attenuation monitor, and has been designated as meeting the Federal Equivalency Method (FEM) requirements for $PM_{2.5.}$

Delaware operates continuous $PM_{2.5}$ FEM monitors at five sites, and anticipates being able to transition from FRM to continuous FEM at most $PM_{2.5}$ monitoring sites over the next several years. FRM monitoring will continue at the MLK Wilmington site alongside the FEM monitoring.

Future needs

Future areas of effort include, evaluating the impact of multi-pollutant factors and trends on PM concentrations, on-going evaluation of continuous monitoring methods and data, and updating the PM emissions inventory. Community assessments and special projects are also anticipated to be important in future PM monitoring efforts. Future activities are dependent on resource availability.

Summary information and monitor rating for $PM_{2.5}$ - critical criteria shown in **bold**

Site	Data Criteria: % NAAQS, Max Concentration, Longevity, AQI	Statistical Criteria: Measurement Criticality, Uniqueness, Trends	Situational Criteria: Meteorological Pattern, Area Scale, Area Represented, Federal Requirements, Multi-pollutant	Future Needs, Special Considerations: Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	Rating
Bellefonte	% NAAQS: Below current NAAQS Longevity: Long trend history	Measurement Criticality: Removal bias	Meteorological Pattern: Generally downwind of Wilmington	Concentration Gradient: Between Wilmington and Chester, PA	Credible
MLK	% NAAQS: Below current NAAQS Longevity: Long trend history **Max Concentration: Design Value**	**Measurement Criticality: Removal bias** Uniqueness: Moderate Correlation **Trends: Tracking control strategies**	**Federal Requirement: NCore Site** **Federal Requirement: Speciation Data** Area Represented: Urban site Multi-pollutant: Collocated with multiple parameters	Source impact: Local source impacts Local community concerns	**Critical**
Newark	% NAAQS: Below current NAAQS Longevity: Long trend history	Measurement Criticality: No removal bias	Area Represented: Only monitor in Newark area	Single pollutant site Concentration Gradient: Gradient between Wilmington, DE and Fair Hill, MD	Credible
Lums Pond	% NAAQS: Below current NAAQS Longevity: Long trend history	**Measurement Criticality: Removal bias**	**Federal Requirement:** Background/**Transport Site**	Not applicable	**Critical**
Delaware City	*Insufficient data – new monitor*	*Insufficient data – new monitor*	*Insufficient data – new monitor*	*Currently SPM using FEM* *Point-source impacted site*	*To be determined*
Dover	% NAAQS: Below current NAAQS Longevity: Long trend history	**Measurement Criticality: Removal bias** Uniqueness: Moderate Correlation	**Area represented: Represents Dover MSA**	Not applicable	**Critical**
Killens Pond	% NAAQS: Below current NAAQS Longevity: Long trend history	**Measurement Criticality: Removal bias** Uniqueness: Moderate Correlation	**Federal Requirement: Rural Background Site**	Not applicable	**Critical**
Seaford	% NAAQS: Below current NAAQS Longevity: Long trend history **Max Concentration: Design Value for Seaford microSA**	**Measurement Criticality: Removal bias** Uniqueness: Moderate Correlation	**Area Represented: Only Site in Sussex County**	Future emissions decrease for Millsboro source Local community concerns Largest Delaware $PM_{2.5}$ source located in Sussex County	**Critical**

CO

Current CO sites

CO is not a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS. Monitoring objectives for CO include trends tracking, AQI generation, and emission control strategy tracking.

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 the MLK site and a legacy (non-trace) monitor at the Delaware City site. Due to continuous maintenance problems with aging equipment at the Delaware City site, monitoring at that location was discontinued at the end of 2014. Ambient concentrations at both sites in 2014 were well below the NAAQS and close to the minimum detectable limit of the monitors.

Delaware currently operates one CO monitoring site in New Castle County; monitor operates year-round.

CO monitoring sites in Delaware

Site	County/MSA	Objectives and Site Type
MLK	New Castle Wilmington division of Philadelphia CSA	NAAQS compliance NCore trace monitoring Max. concentration Trends AQI

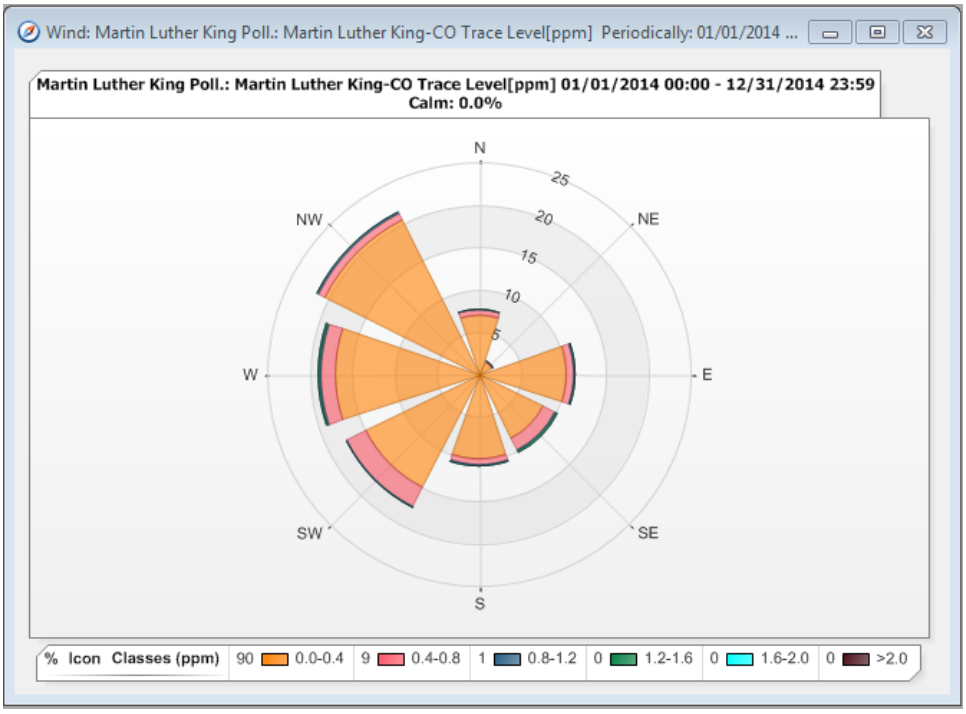
Situational analyses

New Castle County sites and characteristics

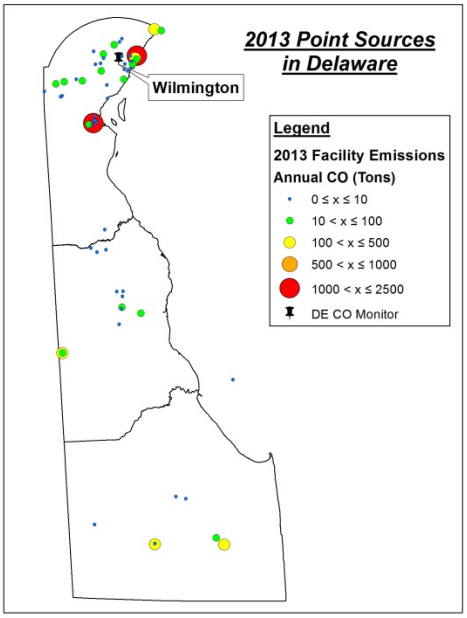
MLK (10-003-2004) The MLK site was established in 1999 at the intersection of Justison St. and MLK Blvd in Wilmington. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is middle scale for CO and represents an urban mobile-source 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 continued as an NCore requirement.

In general, high CO concentrations occur during calm periods and periods with low wind speeds; higher concentrations of CO can be associated with any wind direction due to the generalized urban area surrounding the monitoring site.

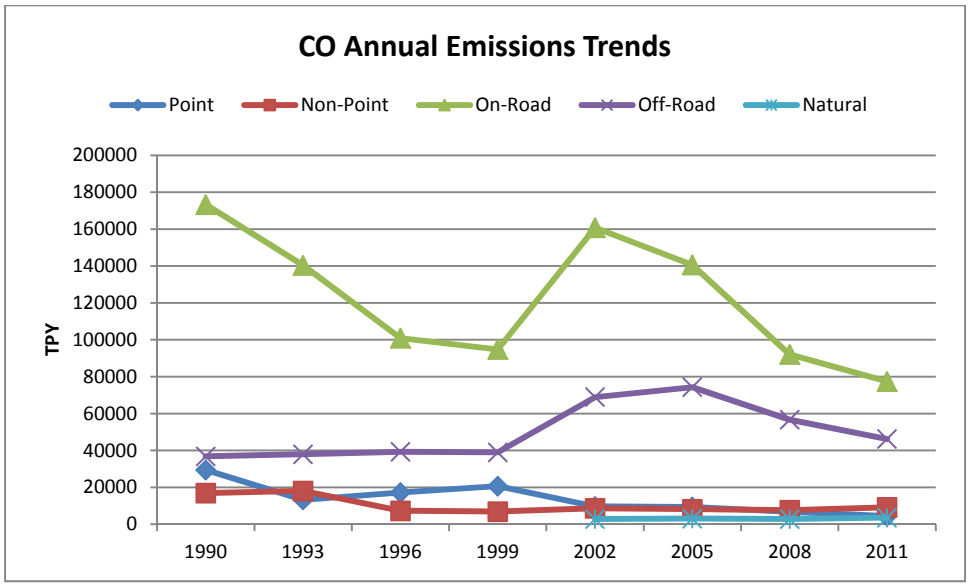
CO Pollution Rose – MLK 2014



Emissions info: maps & trends

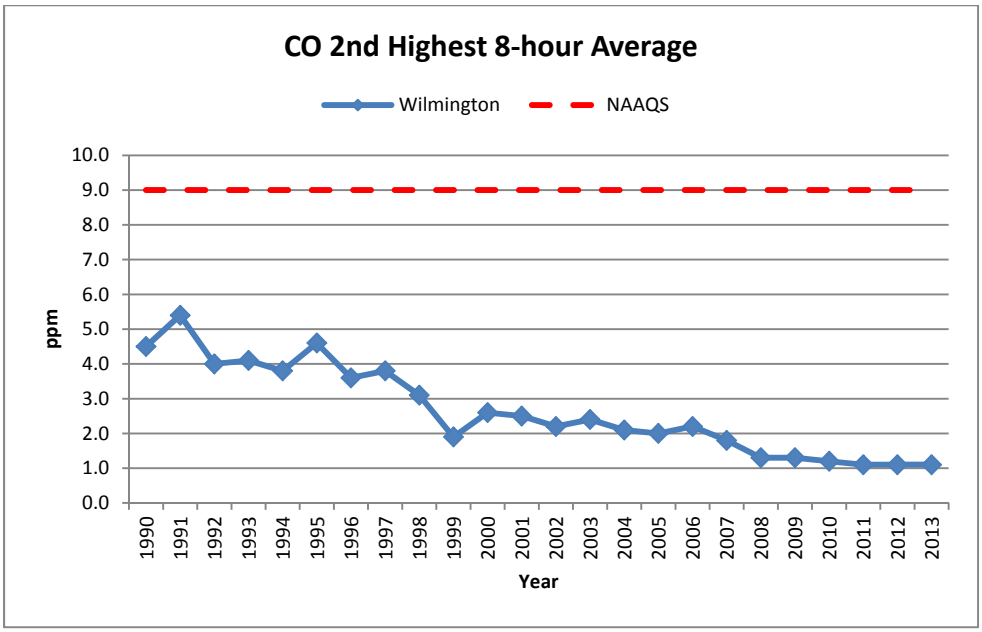


The largest CO point sources in Delaware are power plants, refineries, and industrial boilers; however, the largest source category is mobile sources. The largest point sources are located in New Castle County. Emissions trends have been downward for all source categories, but are flatter in recent years.



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. The most frequently used design value for CO is the annual second maximum daily 8-hour average.



Design value trends – second highest daily 8-hour average. Wilmington data from 1990 – 1998 is from the 12th & King Sts. location; after that the data are from the MLK location.

Annual 2nd max. 8-hour average in ppm

Year	Wilmington	Year	Wilmington
1990	4.5	2002	2.2
1991	5.4	2003	2.4
1992	4.0	2004	2.1
1993	4.1	2005	2.0
1994	3.8	2006	2.2
1995	4.6	2007	1.8
1996	3.6	2008	1.3
1997	3.8	2009	1.3
1998	3.1	2010	1.2
1999	1.9	2011	1.1
2000	2.6	2012	1.1
2001	2.5	2013	1.1
		2014	Insufficient data

The trend in annual average concentrations has been downward since monitoring began in 1979. Much of the improvement through the 1990's was related to new motor vehicle emissions standards and technologies; in recent years the air quality has become stable at low concentrations despite continued increase in traffic volume.

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.

Low data completeness in 2014 was caused by monitor failure. A new monitor will be installed in 2015 and Delaware anticipates improved data completeness.

Summary information and monitor rating for CO - critical criteria shown in **bold**

Site	Data Criteria: % NAAQS, Max Concentration, Longevity, AQI	Statistical Criteria: Measurement Criticality, Uniqueness, Trends	Situational Criteria: Meteorological Pattern, Area Scale, Area Represented, Federal Requirements, Multi-pollutant	Future Needs, Special Considerations: Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	Rating
MLK	% NAAQS: Below current NAAQS Longevity: Long trend history **Max Concentration: Design Value** AQI Calculated	**Trend: Used for tracking control strategies,** downward trend in concentrations	**Federal Requirement: NCore Site** Multi-pollutant: Collocated with multiple parameters	Local community concerns May qualify as near-road site for CO only Source-impact: local & mobile source impacts	**Critical**

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, however, due to continuing low ambient concentrations (well below the primary and secondary NAAQS) and declining resources, monitoring had been restricted to sites in New Castle County where the highest concentrations were being recorded. In 2013 in response to the new SO_2 NAAQS, monitoring began at the Lewes site in Sussex County (see discussion below).

Monitoring Requirements

On June 2, 2010, EPA strengthened the primary National Ambient Air Quality Standard (NAAQS) for sulfur dioxide (SO_2). The primary SO_2 standard was revised by establishing a new 1-hour standard at a level of 75 parts per billion (ppb). The new form of the standard is the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations.

EPA also revised the ambient air monitoring requirements for SO_2. For Delaware, the new standard requires one additional 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 the requirements of 40 CFR Part 58 Appendix D and Delaware complied with this requirement by adding a monitor at the Lewes monitoring site in Sussex County to fulfill the requirement for monitoring in the Sussex County portion of the Salisbury metropolitan statistical area (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.

More detailed information on the new SO_2 standard and monitoring requirements can be found on the EPA website at http://www.epa.gov/air/sulfurdioxide/actions.html#jun10

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

SO_2 monitoring sites in Delaware

Site	County/MSA	Objectives and Monitor Type
MLK	New Castle Wilmington division of Philadelphia CSA	NAAQS compliance NCore trace monitoring Max. concentration Trends AQI
Bellefonte2	New Castle Wilmington division of Philadelphia CSA	NAAQS compliance Trends

Route 9/Delaware City	New Castle Not in MSA	NAAQS compliance Point source impact Trends
Lums Pond	New Castle Not in MSA	NAAQS compliance Trends Background/transport
Lewes	Sussex County Salisbury MD MSA	NAAQS compliance Trends

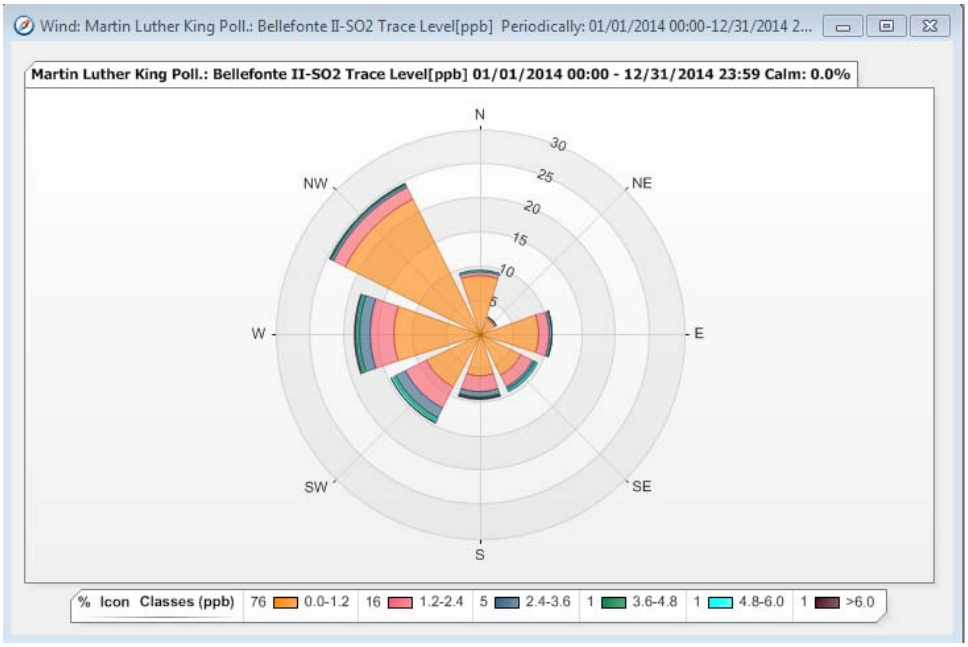
Situational analyses

New Castle County sites and characteristics

Bellefonte2 (10-003-1013) is the successor site to Bellefonte (10-003-1003). Bellefonte 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 (Bellefonte2) was established in 2001 in Bellevue State Park, less than a mile to the north. The Bellefonte2 site meets all EPA siting criteria.

Bellefonte2 is neighborhood scale for SO_2, and monitoring objectives are compliance with the NAAQS, population exposures, and trends. Bellefonte2 is in the primary downwind direction from Wilmington, and is also in a secondary downwind area for a large power plant in the Edgemoor area northeast of Wilmington as well as a steel mill (Claymont) and oil refinery (Marcus Hook, PA).

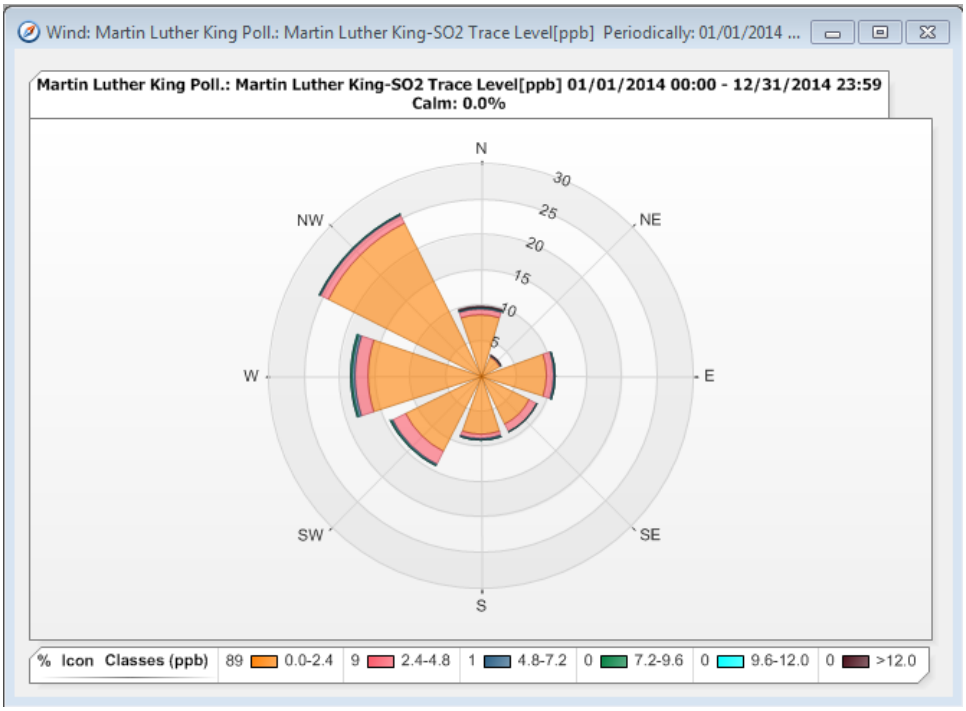
Pollution Rose – Bellefonte2 2014



MLK (10-003-2004) The MLK 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 neighborhood scale for SO_2 and represents an urban core site

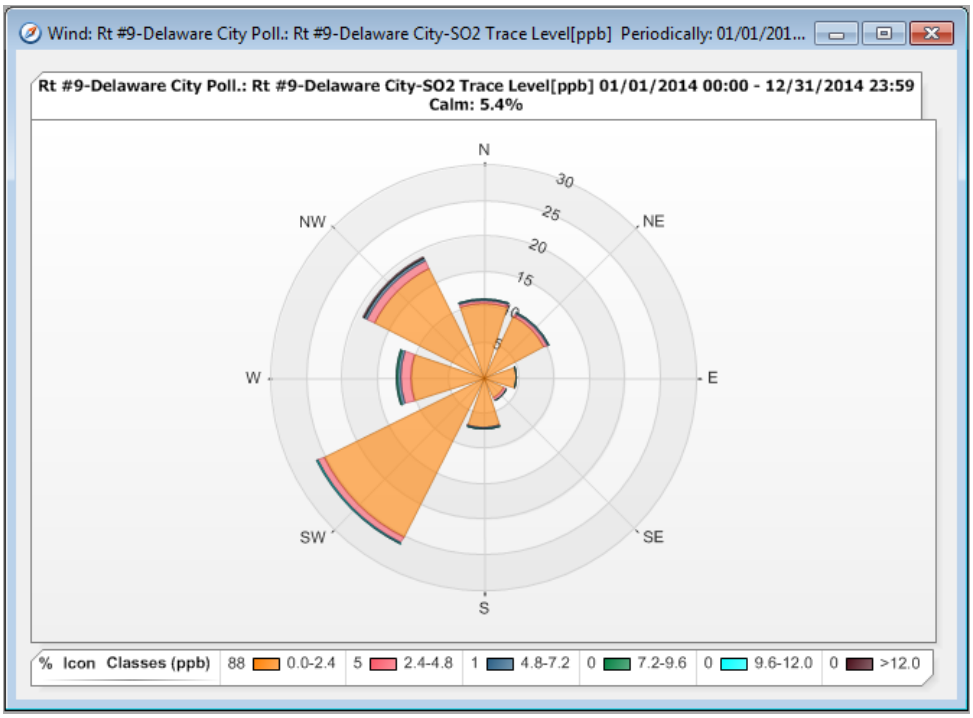
impacted by point, area, and mobile sources. The site meets all EPA siting criteria. Trace SO_2 monitoring began in 2009 and continues as an NCore requirement.

SO_2 Pollution Rose – MLK 2014



Delaware City (10-003-1008) The Delaware City site was established as an SO_2 site in 1992 at a location along Route 9 between the Delaware City industrial complex (including an oil 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 Gov. Bacon Center from 1969 to 1991) in Delaware City. The current site is neighborhood scale for SO_2 and the primary objectives are point-source impact assessment and population exposure. The site meets all EPA siting criteria.

SO_2 Pollution Rose - Delaware City 2014



Lums Pond (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 Lums Pond 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. Monitoring was temporarily suspended from December 2007 to the present time due to monitor breakdowns and lack of resources for replacements resulting in remaining functional monitors being shifted to higher priority sites.

The Lums Pond site is a neighborhood scale site located in a general upwind direction from Wilmington and secondary downwind from the Delaware City area. The site meets all EPA siting criteria.

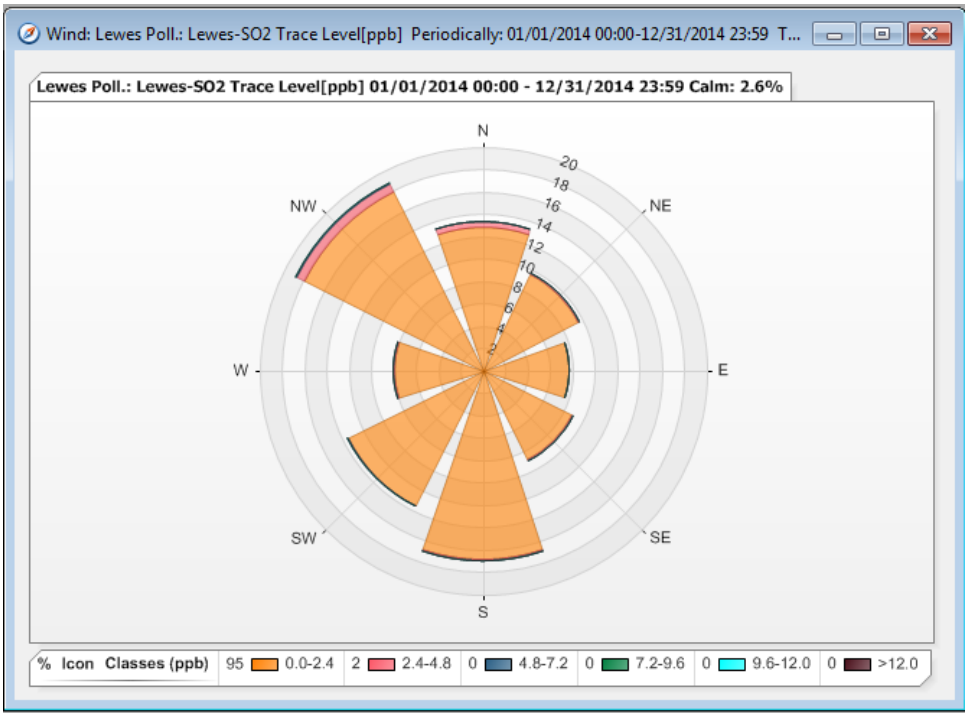
The objectives and site types are NAAQS compliance, secondary downwind source impact, regional transport, population exposure, and trends.

Pollution Rose – Not Available for Lums Pond

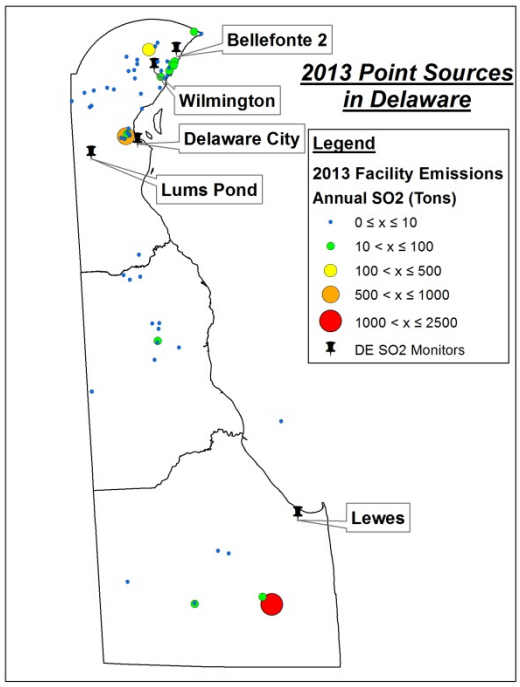
Lewes (10-005-1003) The Lewes site was established on the property of the University of Delaware College of Marine Studies campus in 1997. The SO_2 monitor became operational as a SPM in late summer 2012 and was designated as a SLAMS on January 1, 2013.

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

SO_2 Pollution Rose - Lewes 2014

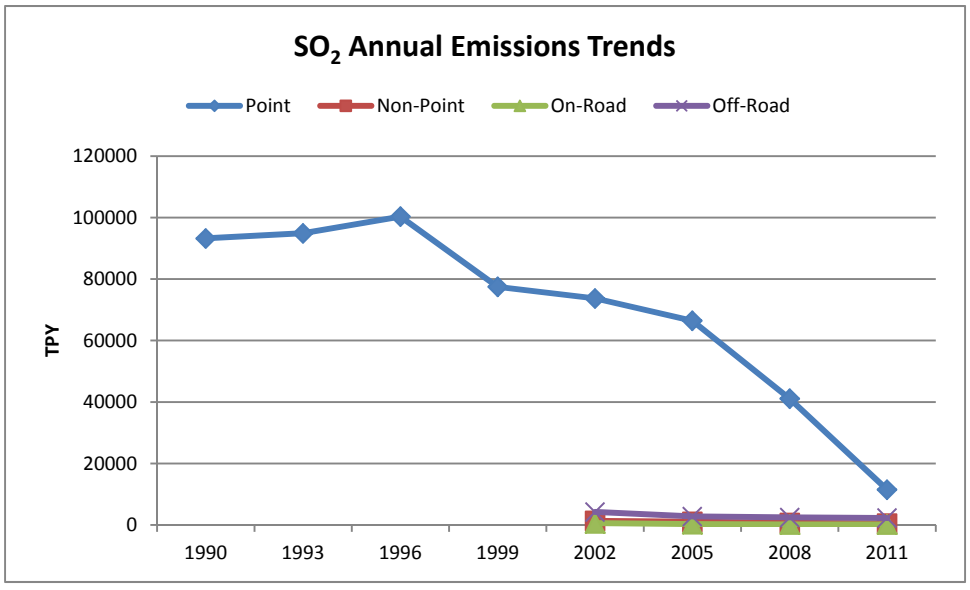


Emissions info: SO_2 maps & trends



The largest SO_2 point sources in Delaware are the oil refinery in Delaware City and the power plants in Edgemoor (northeast of Wilmington) and Millsboro. The vast majority of SO_2 emissions are from industrial point sources.

SO_2 Emissions Trends



Downward trends in point source emissions are largely due to regulatory programs such as the Acid Rain Program, Clean Air Interstate Rule (CAIR), and sulfur in fuel requirements. Recent changes at power

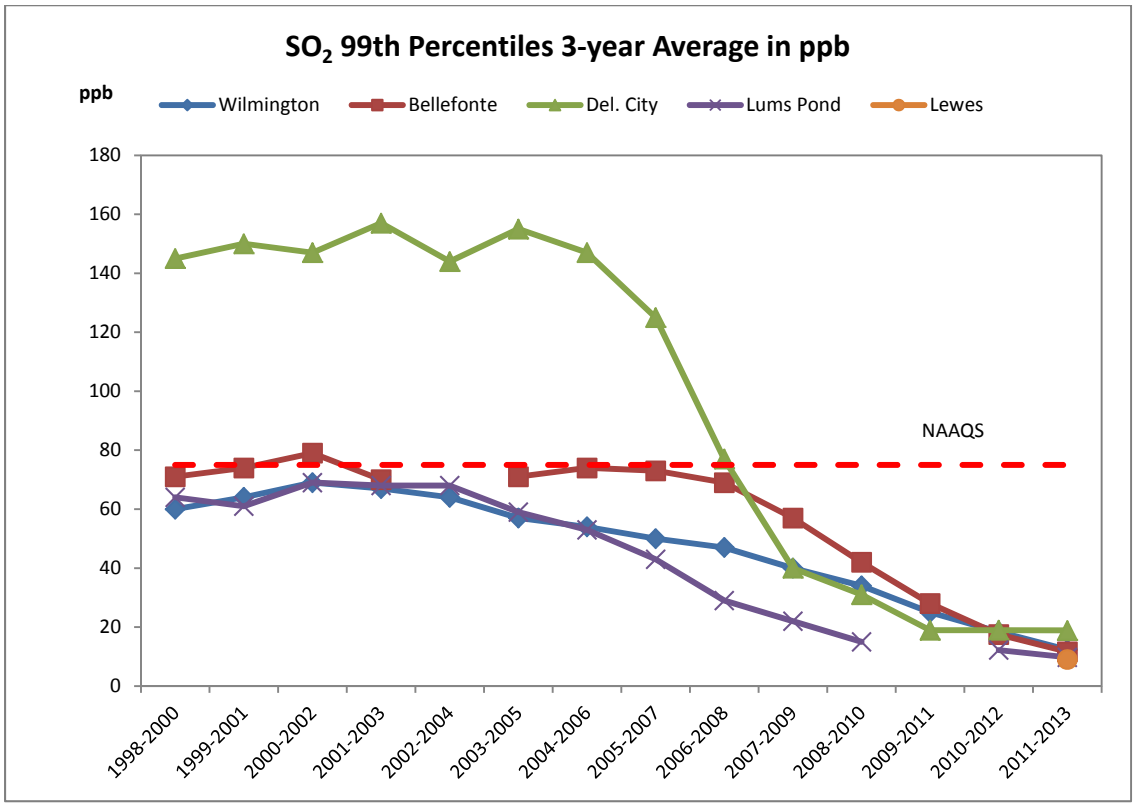
plants (emission controls and changes in fuels) continue to result in lower emissions and improvements in ambient concentrations.

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 2010 EPA revoked the annual average (0.03 ppm) and 24-hour average (0.14 ppm) standards.

Design value trends – 3-year Average 99th Percentile in ppb

Year	Bellefonte/2	Wilmington/MLK	Del. City	Lums Pond	Lewes
1998-2000	71	60	145	64	
1999-2001	74	64	150	61	
2000-2002	79	69	147	69	
2001-2003	70	67	157	68	
2002-2004	Insufficient data	64	144	68	
2003-2005	71	57	155	59	
2004-2006	74	54	147	53	
2005-2007	73	50	125	43	
2006-2008	69	47	77	29	
2007-2009	57	40	40	22	
2008-2010	42	34	31	15	
2009-2011	28	25	19	Insufficient data	
2010-2012	18	18	19	12	
2011-2013	12	12	19	10	
2012-2014	9	12	17	7	8 (2 years)



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 2 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 the Delaware City monitor between 2006 and 2007 is attributed to the installation of scrubbers at the oil refinery.

Summary information and monitor rating for SO_2 - critical criteria shown in **bold**

Site	**Data Criteria: % NAAQS, Max Concentration, Longevity, AQI**	**Statistical Criteria: Measurement Criticality, Uniqueness, Trends**	Situational Criteria: Meteorological Pattern, Area Scale, Area Represented, Federal Requirements, Multi-pollutant	**Future Needs, Special Considerations: Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community**	**Rating**
Bellefonte 2	% NAAQS: Below NAAQS Max Concentration: Highest annual average (former NAAQS) Longevity: Long trend history AQI: Calculated	Trend: Downward trend	Meteorological Pattern: Secondary downwind for Marcus Hook PA refinery/industrial complex	Community concerns	Credible
MLK	% NAAQS: Below NAAQS Longevity: Long trend history Max Concentration: Concentrations between levels at Bellefonte and DE City AQI: Calculated	**Trend: Used for tracking control strategies, downward trend**	**Federal Requirement: NCore Site** Area Represented: Urban site Multi-pollutant: Collocated with multiple parameters	Source-impact: Local & mobile source impacts Local community concerns	**Critical**
Route 9 DE City	% NAAQS: Below NAAQS **Max Concentration: Highest short-term average** Longevity: Long trend history	Trend: Downward trend	**Meteorological Pattern: Downwind major point source** Multi-pollutant: Collocated with CO and air toxics monitors	**Impact from NAAQS Revision: Most likely to exceed future proposed NAAQS** **Source-impact: Downwind of major SO_2 source**	**Critical**
Lums Pond	% NAAQS: Below NAAQS Max Concentration: Lowest concentrations Longevity: Moderate trend history	Trend: Downward trend	Meteorological Pattern: Secondary downwind direction for DE City oil refinery/industrial complex	Community concerns: West (secondary downwind) of DE City refinery/industrial complex	Credible
Lewes	*Insufficient data – new monitor*	*Insufficient data – new monitor*	***Federal Requirement – Salisbury MSA***	*Will be design value site for Salisbury MSA*	**Critical**

NO_2

Current NO_2 sites

NO_2 is not currently a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS. There is one NO_2 site in Delaware – the urban Wilmington MLK site. The proposed new NAAQS requires near-roadway monitoring in the Philadelphia CSA, but no additional monitors would be required in Delaware.

Historically, 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. The Bellefonte site was a supplemental NO_2 site collocated with an ozone monitor; when the site was relocated to Bellefonte2 the NO_2 monitoring was discontinued. The Lums Pond monitor was part of the PAMS program; when the PAMS program ended in 1999, the 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, AQI generation, and emission control strategy tracking.

Monitoring Requirements

On January 22, 2010, EPA strengthened the health-based National Ambient Air Quality Standard (NAAQS) for nitrogen dioxide (NO_2). EPA set a new 1-hour NO_2 standard at the level 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 the new NO_2 standard and monitoring requirements can be found on the EPA website at http://www.epa.gov/air/nitrogenoxides/actions.html#jan10

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

NO_2 monitoring sites in Delaware

Site	County/MSA	Objectives and Monitor Type
MLK	New Castle Wilmington division of Philadelphia CSA	NAAQS compliance Maximum concentration Population exposure Trends AQI Emissions control strategy tracking

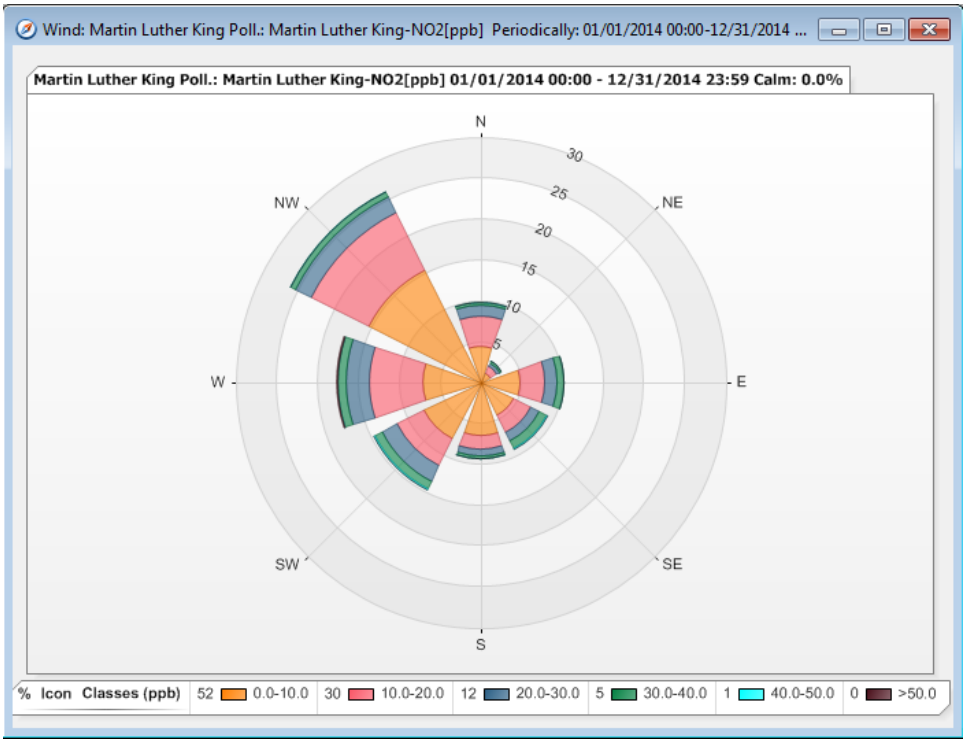
Situational analyses

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 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 NO_2 and represents an urban core site

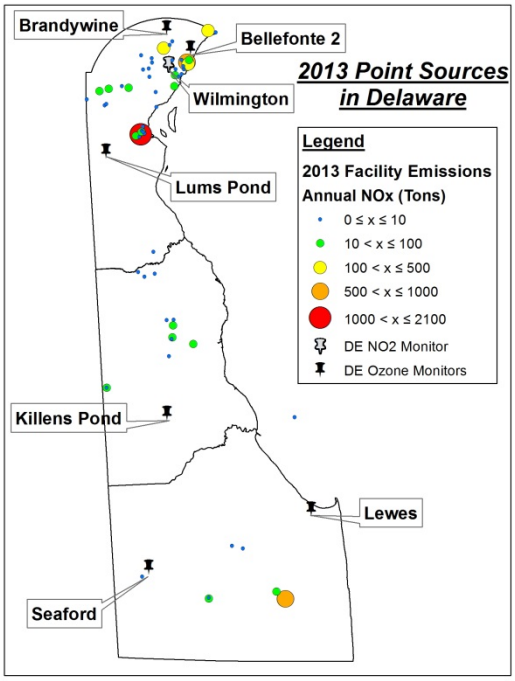
impacted by point, area, and mobile sources. The site meets all EPA siting criteria. NOy monitoring began in 2010 and continues as an NCore requirement.

NO_2 Pollution Rose – MLK 2014



Elevated concentrations of NO_2 can occur with any wind direction; concentrations tend to be highest during calm periods and inversions.

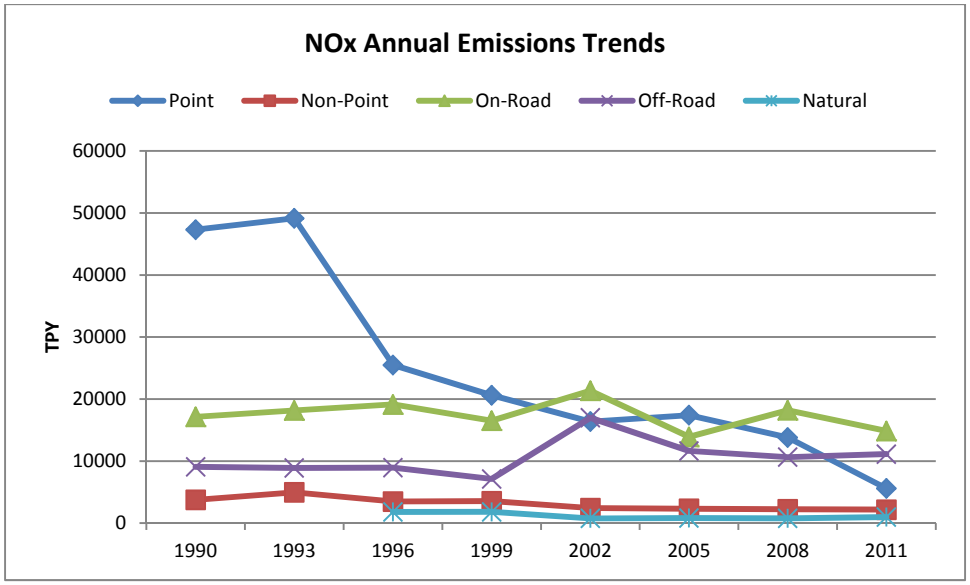
Emissions info: NOx maps & trends



Emissions are measured as NOx and not NO_2; NO_2 is formed in the atmosphere but is primarily emitted as NOx. The largest NOx point sources in Delaware include power plants in Edgemoor (northeast of Wilmington) and Millsboro in Sussex County and the oil refinery in Delaware City.

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.

NOx Emissions Trends



The largest change has been the decrease in point source emissions due to controls on the largest sources.

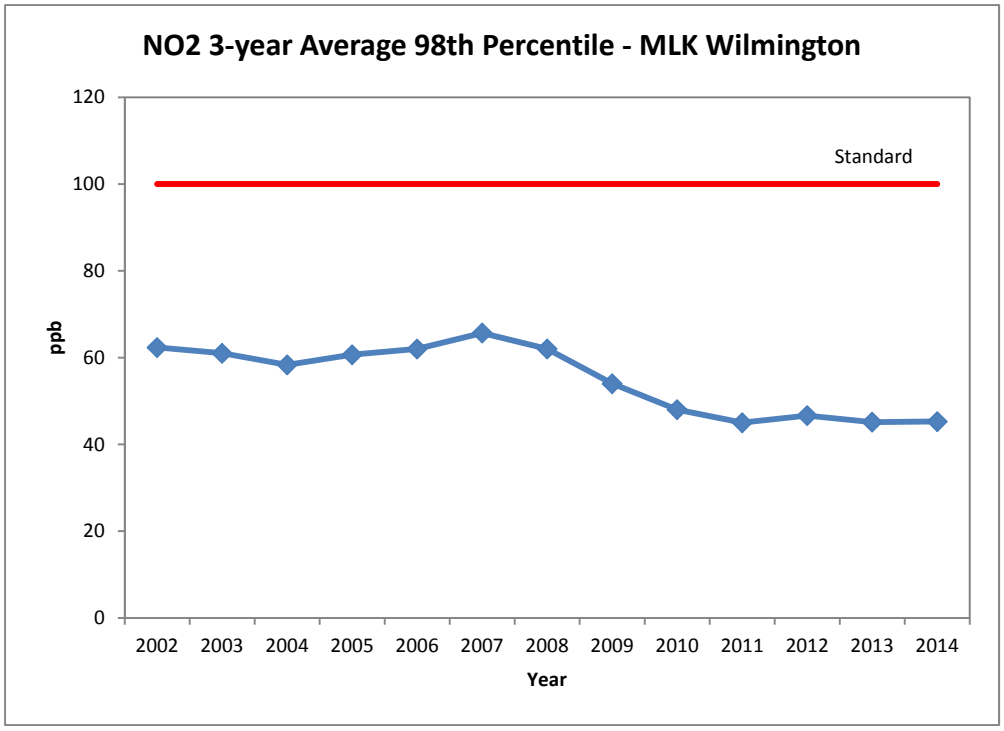
Statistical Analysis

The current primary NAAQS for NO_2 is an annual arithmetic mean of 0.053 ppm (or 53 ppb), and a 1-hour average of 100 ppb as 3-year average of the 98th percentile daily max.

Design value trends – 3-year average of 1-hour 98th percentile

Years	Wilmington/MLK
2000 – 2002	62.3
2001 – 2003	61.0
2002 – 2004	58.3
2003 – 2005	60.7
2004 – 2006	62.0
2005 – 2007	65.7
2006 – 2008	62.0
2007 – 2009	54.0
2008 – 2010	48.0
2009 – 2011	45.0
2010 – 2012	47.7
2011 – 2013	46.2
2012 - 2014	45.3

NO_2 Trend – Annual Average



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 2 tailpipe and fuel standards. The Tier 2 standards for light-duty vehicles began phasing in in 2004, and new NOx standards for heavy-duty engines were phased in between the 2007 and 2010 model years.

Future needs

With the new ozone NAAQS and associated monitoring requirements, there are proposals for direct NO_2 monitoring at NCore sites in O_3 nonattainment areas, and supplemental monitoring for parameters such as NOx in non-NCore ozone nonattainment sites. When the final ozone rule is promulgated, Delaware will work closely with EPA Region 3 to ensure that all new monitoring requirements are met.

Summary information and monitor rating for NO_2 - critical criteria shown in **bold**

Site	Data Criteria: % NAAQS, Max Concentration, Longevity, AQI	Statistical Criteria: Measurement Criticality, Uniqueness, Trends	Situational Criteria: Meteorological Pattern, Area Scale, Area Represented, Federal Requirements, Multi-pollutant	Future Needs, Special Considerations: Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	Rating
MLK	% NAAQS: Below current NAAQS Longevity: Long trend history **Max Concentration: Design Value Site**	**Trends: Tracking control strategies**	**Federal Requirement: NCore Site** Area(1): Urban neighborhood scale site Multi-pollutant: Collocated with multiple parameters	Source-impact: Point, local & mobile source impacts Urban area population exposure Cost: Future need for direct NO2 monitor	**Critical**
Possible future expansion of NOx monitoring to non-NCore O_3 non-attainment areas					

Lead

Current Lead sites

Lead is not currently a high priority pollutant monitored in Delaware because ambient concentrations are well below the 2008 NAAQS of 0.15 ug/m3. There is one current lead site in Delaware – the urban Wilmington MLK NCore site. The 2010 lead monitoring requirements rule requires one lead site at the NCore site in each state.

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

Lead monitoring in Delaware is required as part of the NCore network, and takes place at the NCore site at MLK in Wilmington. The samples are collected on a 1 in 6 day schedule that began on January 4, 2012. Lead is sampled as PM_{10} with the Teflon filters sent to a laboratory for analysis by XRF after they have been weighed for mass. The method is considered a federal equivalent method (FEM) and complies with the EPA requirements of 40 CFR Part 50 Appendix Q.

Lead monitoring sites in Delaware

Site	County/MSA	Objectives and Monitor Type
MLK	New Castle Wilmington division of Philadelphia CSA	NAAQS compliance Maximum concentration Population exposure Trends

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 another urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is an urban core site impacted by point, area, and mobile sources. The site meets all EPA siting criteria.

Lead Pollution rose – because the lead data represents 24-hour averages, traditional pollution roses are not available. Please refer to representative wind roses in the network summary section for general meteorological patterns.

Emissions info: maps & trends

There are no point sources in Delaware that exceed the 0.5 tpy emissions threshold.

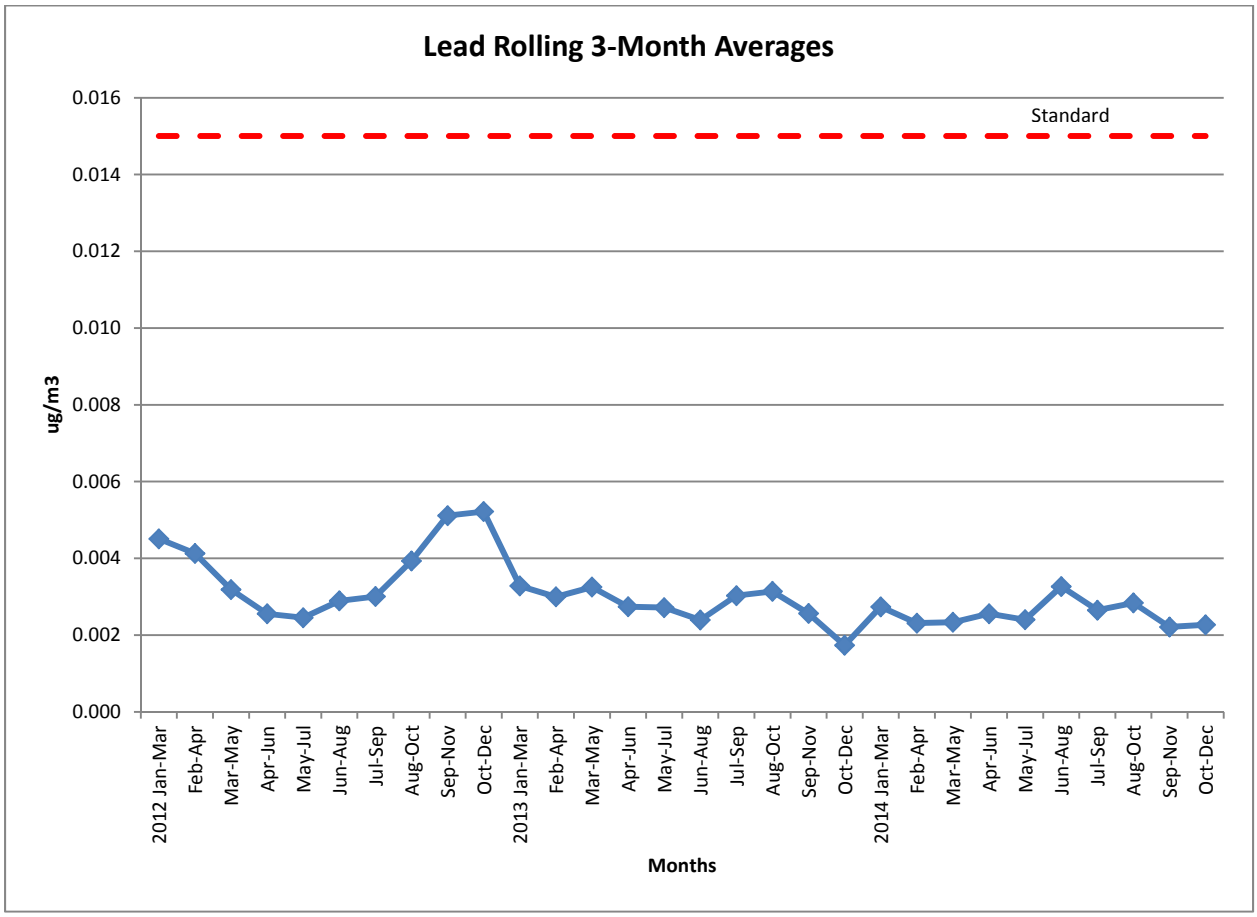
Statistical Analysis

The primary NAAQS for lead is 0.15 µg/m^3 calculated as a maximum (not-to-be-exceeded) rolling three-month average evaluated over a three-year period. Any three-month average exceeding 0.15 µg/m^3 within a three-year period is considered a violation of the NAAQS.

Maximum Rolling 3-month Average PM_{10} Lead Concentrations in µg/m^3

Year	Max 3-month Avg
2012	0.0052
2013	0.0033
2014	0.0033

Trends for new NAAQS



Future needs

From EPA Fact Sheet on Lead NAAQS: On October 15, 2008, EPA substantially strengthened the national ambient air quality standards (NAAQS) for lead. The revised standards are 10 times tighter than

the previous standards and will improve health protection for at-risk groups, especially children. EPA has revised the level of the primary (health-based) standard from 1.5 micrograms per cubic meter ($\mu g/m^3$), to 0.15 $\mu g/m^3$, measured as total suspended particles (TSP). EPA has revised the secondary (welfare-based) standard to be identical in all respects to the primary standard.

On December 23, 2009 the EPA proposed to revise the ambient monitoring requirements for measuring airborne lead. EPA proposed to change the lead emissions monitoring threshold to 0.50 tpy. Air quality monitoring agencies would use this threshold to determine if an air quality monitor is required to be placed near a facility emitting lead.

Note: Delaware does not have any point sources above the 0.50 tpy threshold.

On December 19, 2014, EPA announced its proposed decision to retain, without revision, the national ambient air quality standards (NAAQS) for lead of 0.15 ug/m3 , in terms of a 3- month average concentration The existing primary (health based) standard provides health protection for at-risk groups, especially children, and the existing secondary (welfare based) standard provides protection against adverse effects to public welfare, including harm to aquatic and terrestrial ecosystems.

Additionally, in the 2014 proposed monitoring regulations, EPA removed the requirement for urban NCore sites to measure Lead (Pb). Monitors are 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). If these rules are approved, Delaware plans to discontinue FRM lead monitoring at MLK, but will continue lead monitoring as part of the $PM_{2.5}$ speciation program.

Summary information and monitor ranking for Lead – critical criteria shown in **bold**

Site	Data Criteria: % NAAQS, Max Concentration, Longevity, AQI	Statistical Criteria: Measurement Criticality, Uniqueness, Trends	Situational Criteria: Meteorological Pattern, Area Scale, Area Represented, Federal Requirements, Multi-pollutant	Future Needs, Special Considerations: Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	Rating
MLK	% NAAQS: Below new NAAQS (based on air toxics sampling)	**Trends: Used for tracking control strategies**	**Federal Requirement: NCore Site** Area Scale: Urban neighborhood scale site Multi-pollutant: Collocated with multiple parameters	Future changes to monitoring regulations may end requirement for Lead monitoring at NCore sites.	**Critical**

Technology

Monitors – Since the 2010 Network Assessment the State of Delaware has updated several of the older analyzers in the monitoring network. The table below lists the analyzers critical to meet our monitoring objectives and their age. The manufacturers recommended life expectancy for most monitoring equipment is 7 years. This requires our agency to maintain a replacement schedule to maintain data capture. Funding is the most critical component of this replacement schedule and as with every agency has been shrinking over the past several years.

Site	Monitor Age in Years					
	O_3	**SO_2**	**CO**	**NOx**	**$PM_{2.5}$**	**$PM_{2.5}$ Continuous**
MLK/Wilmington	4	6	< 1	4	8	3
Bellefonte I					8	
Bellefonte II	17	5				
Brandywine	3					
Newark					8	
Delaware City		5				3
Lums Pond	3	3			8	
Dover					8	
Seaford	9				8	3
Killens Pond	4				8	3
Lewes	3	3				

All monitors used for NAAQS compliance meet EPA requirements as FRM or FEM monitors. Continuous $PM_{2.5}$ monitors are FEM and are used for AQI and supplemental information only, not for NAAQS compliance determination.

Calibrators - One of the largest concerns is in regards to calibration of all the continuous gas analyzers in the monitoring network. With Delaware's efforts to control source emissions the ambient air concentrations are recording well below the NAAQS. This causes precision point checks to be in the sub-ppb concentration range where a tenth of a ppb incurs % differences outside the established Minimum Quality Objectives. Producing reliable sub-ppb concentrations from standard calibrators is difficult and newer multi-mass flow control calibrators need to be acquired. All field and laboratory calibrators meet all EPA specifications and requirements.

$PM_{2.5}$ FRM's – The $PM_{2.5}$ FRM samplers are beginning to show their age and we have experienced several malfunctions and missed sample collection. Delaware is in the process of migrating to continuous $PM_{2.5}$ FEM's at select monitoring stations to reduce logistical concerns with manual sample collection. Some of the $PM_{2.5}$ FRM samplers will be discontinued in the future to reduce the expenditures of sample analysis. The added benefit with continuous monitors is that data is constantly collected and decisions on air quality can be made quickly. The discontinued samplers may be used for parts and any special study that may arise. It is anticipated that a maximum of 4 FRM samplers that may be maintained at the following locations; MLK, Newark, Bellefonte I and Dover.

Data acquisition system – Delaware has transitioned to a digital data acquisition system supplied by DRDAS/Envitech as part of implementation of the NCore program. This system provides increased capabilities in remote communications with the monitoring stations, including the ability to perform remote diagnostic functions and operational checks. The monitoring station data logger software is in the process being upgraded to the newest version of Envidas Ultimate due to the suspension of support on old software version EnvidasFW.

Other support equipment – All gas cylinders used for monitor calibrations, checks and audits are EPA Protocol 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 been also upgrading 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 NIST standard reference materials by outside laboratories.

Audit Equipment	Approximate Age
Sabio 2010 calibrator	2 years
TE 49 PS ozone calibrator	1 years
Sabio 2020 zero air source	8 years
DeltaCal flow meter, temp. & press.	9 years
Bios DC-Lite flow meter	2 years
Chinook Flow Transfer Standard	11 years

Meteorological equipment – Delaware maintains ultrasonic wind speed/wind direction monitors at multiple sites. Monitors are factory calibrated; checks with portable equipment are performed as needed. The data are used for supplemental information only; any advanced modeling/dispersion analysis uses NWS wind data from the nearest NWS site.

The NCore site in Wilmington has the most complete meteorological suite of measurements in compliance with EPA NCore requirements and standards. These measurements include Wind Direction, Wind Speed, Ambient Pressure, Ambient Temperature and Percent Relative Humidity.

Cost

Historically, the Branch 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. The next major replacement is going to be with equipment shelters. Delaware has submitted purchase request to replace the MLK/NCore station in Wilmington, DE. This shelter was specified to provide twice the space as the current station. This was done in anticipation of the addition of a PAMS GC and NO_2 direct measurement monitor to comply with the proposed new O_3 NAAQS. Addition of co-located continuous $PM_{2.5}$ monitors will also need to be added to support the migration to continuous $PM_{2.5}$ FEM monitors.

Consequently, the Branch is faced with a large capital expense to upgrade equipment and shelters to current standards. The Branch proposes to maintain a replacement program and suggests that equipment be replaced after seven years of service to avoid future data completeness issues. The estimated cost over the next 5 years to maintain the replacement program is approximately $375,000. This cost also includes the addition of equipment due to the new O_3 NAAQS.

Results - Summary of Delaware monitoring sites and monitors

Site Name/ID	City, County	Site Start Date	Location Setting	Pollutant/ Method	Monitor Class	Measurement Scale	Rating and Major Criteria from Individual Pollutant Assessment	Site Rating
Killens Pond 10-001-0002	Not in a city Kent County	4/1/95	Rural	O_3	SLAMS	Neighborhood	**Critical** - % NAAQS: Above current NAAQS, Max Concentration: Design Value for Kent County, Federal Requirement: Rural Background, Impact from NAAQS Revisions: Above Proposed NAAQS	**Critical**
				$PM_{2.5}$ FRM	SLAMS	Neighborhood	**Critical -** Measurement Criticality: Removal bias, Federal Requirement: Rural Background Site	
				$PM_{2.5}$ continuous	SPM	N/A	Marginal - Supports AQI (not FRM-like), supplemental information	
				WS/WD	SLAMS	N/A	Marginal – Not required	
Dover 10-001-0003	Dover Kent County	1/1/99	Urban	$PM_{2.5}$ FRM	SLAMS	Neighborhood	**Critical** - Measurement Criticality: Removal bias, Federal Requirement: Speciation Data	**Critical**
Brandywine 10-003-1010	Not in a city New Castle	7/1/94	Rural/Suburban	O_3	SLAMS	Neighborhood	**Critical** - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Removal Bias, Meteorological Pattern: Secondary Downwind Direction Wilmington, Impact from NAAQS Revisions: Above Proposed NAAQS	**Critical**
				WS/WD	SLAMS	N/A	Marginal – Not required	
Bellefonte 2 10-003-1013	Not in a city New Castle	4/1/01	Suburban	O_3	SLAMS	Neighborhood	**Critical** - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Removal Bias, Meteorological Pattern: Primary Downwind Direction Wilmington, Impact from NAAQS Revisions: Above Proposed NAAQS	**Critical**
				SO_2	SLAMS	Neighborhood	**Credible** – % NAAQS: Below current NAAQS, Max Concentration: highest annual avg (former NAAQS), Meteorological Pattern:	
Bellefonte 10-003-1003	Not in a city New Castle	1/1/99 (PM2.5 only)	Suburban	$PM_{2.5}$ FRM	SLAMS	Neighborhood	**Credible** - % NAAQS: Below current NAAQS, Measurement Criticality: Removal bias, Concentration Gradient: Between Wilmington and Chester, PA	Credible

Site Name/ID	City, County	Site Start Date	Location Setting	Pollutant/ Method	Monitor Class	Measurement Scale	Rating and Major Criteria from Individual Pollutant Assessment	Site Rating
MLK 10-003-2004	Wilmington New Castle	1/1/99	Urban	SO_2	SLAMS/ NCore	Neighborhood	**Critical** - Trend: Used for tracking control strategies, downward trend, Federal Requirement: NCore Site	**Critical**
				CO	SLAMS/ NCore	Middle	**Critical** - Max Concentration: Design Value, Trend: Used for tracking control strategies, Federal Requirement: NCore Site	
				NO_2	SLAMS/ NCore	Neighborhood	**Critical** - Max Concentration: Design Value Site, Trends: Tracking control strategies, Federal Requirement: NCore Site	
				O_3	SLAMS/ NCore	Neighborhood	**Critical** - Federal requirement: NCore site, above NAAQS, Removal bias, Impact from NAAQS Revisions: Above Proposed NAAQS	
				$PM_{2.5}$ FRM	SLAMS/ NCore	Neighborhood	**Critical** - Max Concentration: Design Value, significant Measurement Criticality: Removal bias, Trends: Tracking control strategies, Federal Requirement: NCore Site and speciation data	
				$PM_{2.5}$ speciation	SLAMS	N/A	**Critical** - Federal Requirement: Speciation Data	
				WS/WD	SPM/ NCore	N/A	**Critical** - Federal Requirement: NCore Site	
				PM_{10} FRM	SLAMS/ NCore	Neighborhood	**Critical** - Federal Requirement: NCore Site , for PMcoarse calculation, AQI, supplemental information	
				$PM_{2.5}$ continuous	SPM	Neighborhood	**Credible** – AQI (FRM-like), supplemental information	
				Lead	SLAMS/ NCore	Neighborhood	**Critical** - Federal Requirement: NCore Site	
Newark 10-003-1012	Newark New Castle	12/15/99	Suburban	$PM_{2.5}$ FRM	SLAMS	Neighborhood	Credible - % NAAQS: Below current NAAQS, Measurement Criticality: Removal bias	Credible

Site Name/ID	City, County	Site Start Date	Location Setting	Pollutant/ Method	Monitor Class	Measurement Scale	Rating and Major Criteria from Individual Pollutant Assessment	Site Rating
Lums Pond 10-003-1007	Not in a city New Castle	1/1/92	Suburban/Rural	O_3	SLAMS	Neighborhood	**Critical** - above NAAQS, max. concentration,/design value, Removal bias, Federal requirement: transport site, Impact from NAAQS Revisions: Above Proposed NAAQS	**Critical**
				SO_2	SLAMS	Neighborhood	Credible - Max Concentration: Lowest concentrations, Meteorological Pattern: Secondary downwind direction for DE City	
				$PM_{2.5}$	SLAMS	Neighborhood	**Critical** - Measurement Criticality: Significant removal bias, Federal Requirement: Transport Site	
Route 9 DE City 10-003-1008	Not in a city New Castle	2/1/92	Suburban	SO_2	SLAMS	Neighborhood	**Critical** - Max Concentration: Highest short-term average, Meteorological Pattern: Downwind major point source, Impact from NAAQS Revision: Most likely to exceed future proposed NAAQS, Source-impact: Downwind of major SO_2 source	**Critical**
				CO	SLAMS	Middle	Marginal - % NAAQS: Below 50% of current NAAQS, Trend: Downward trend in concentrations	
				WS/WD	SPM	N/A	Credible – Not required but useful for episode analysis	
				$PM_{2.5}$ continuous	SPM	Neighborhood	To be determined	
Seaford 10-005-1002	Seaford Sussex	3/1/90	Suburban/Small Urban	O_3	SLAMS	Neighborhood	**Critical** - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Significant Removal Bias, Impact from NAAQS Revisions: Above Proposed NAAQS	**Critical**
				$PM_{2.5}$ FRM	SLAMS	Neighborhood	**Critical** - Max Concentration: Design Value for Sussex County/Salisbury MSA, Measurement Criticality: Significant removal bias, Area Represented: Only Site in Sussex County	
				$PM_{2.5}$ continuous	SPM	N/A	Marginal – AQI (not FRM-like), supplemental information	
Lewes 10-005-1003	Not in a city Sussex	5/1/97	Rural/Suburban	O_3	SLAMS	Neighborhood	**Critical** - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Removal Bias, Area Represented: Only Coastal Site, seasonal population exposure, Impact from NAAQS Revisions: Above Proposed NAAQS	**Critical**
				SO_2	SLAMS	Neighborhood	**Critical:** only monitor for Salisbury MSA	

References

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.

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Network Assessment Goals, Presented at MARAMA 2010 Monitoring Committee Training Workshop, Kevin Cavender, Ambient Air Monitoring Group, EPA/OAQPS, February 23, 2010.

NOAA climatological data, http://www.ncdc.noaa.gov/cdo-web/datatools.

U. S. Census Bureau, http://factfinder.census.gov

Appendix I

Monitoring Network History

Pre-1969

Site ID	County	Name	TSP	TSP/metals/ lead	SO2	CO	NO2	Ozone	PM10	PM2.5	PM2.5 speciation	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	SO2	CO	NO2	Ozone	PM10	PM2.5	PM2.5 speciation	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 Center	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 - Rte 72 and Rte 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 & Taylor sts	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	SO2	CO	NO2	Ozone	PM10	PM2.5	PM2.5 speciation	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 Center	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 Rd. 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 Caslte	Wilmington - 3rd & 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	SO2	CO	NO2	Ozone	PM10	PM2.5	PM2.5 speciation	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 Caslte	Delaware City - Gov. Bacon Center			x				x			WS/WD
10-003-0018	New Caslte	Lums Pond						x				
10-003-1003	New Caslte	Bellefonte - River Rd. Park	x		x			x				
10-003-1006	New Caslte	Wilmington - 3rd & 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 - Rte 9			x	x						
10-003-1010	New Castle	Brandywine Creek State Park						x				
10-003-2002	New Caslte	Wilmington - 12th and King St.			x	x	x		x			
10-003-3001	New Caslte	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	SO2	CO	NO2	Ozone	PM10	PM2.5	PM2.5 speciation	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 Rd. 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 - Rte 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

Site ID	County	Name	TSP	TSP/metals/ lead	SO2	CO	NO2	Ozone	PM10	PM2.5	PM2.5 speciation	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 - River Rd. Park								x		
10-003-1013	New Castle	Bellefonte2 - Bellevue St. Park			x			x				
10-003-1007	New Castle	Lums Pond						x		x		
10-003-1008	New Castle	Delaware City - Rte 9			x	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		trace SO2, trace CO, 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				WS/WD

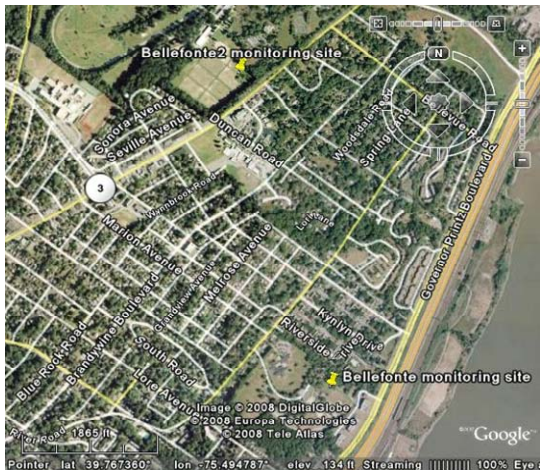
Appendix II

Delaware Monitoring Network Site Descriptions

Site: **Bellefonte and Bellefonte2**

County:	New Castle	Latitude:	Bellefonte 39.7613 Bellefonte2 39.7739
Address:	Bellefonte: River Road Park Bellefonte2: Bellevue State Park	Longitude:	Bellefonte -75.4920 Bellefonte2 -75.4965
AQS site ID:	Bellefonte: 10-003-1003 Bellefonte2: 10-003-1013	Year Established:	Bellefonte 1969 Bellefonte2 2001
Spatial Scale:	Neighborhood	Area Represented (MSA):	Philadelphia-Camden-Wilmington PA-NJ-DE-MD

Bellefonte and Bellefonte2 locations



Bellefonte2

Monitored Parameters

	Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
Bellefonte					X					
Bellefone2	X	X								

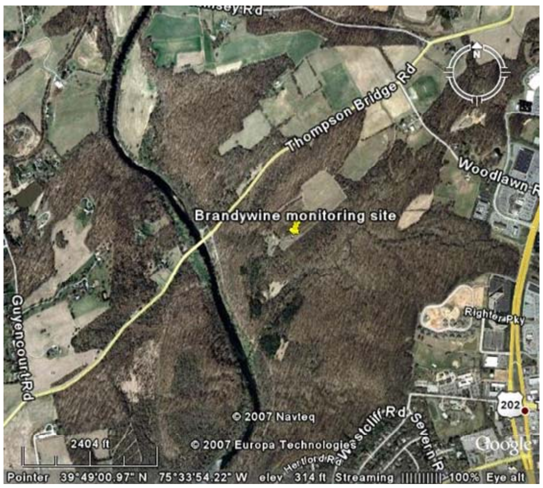
Site Description: Bellefonte was originally established in 1969 to monitor O_3 (primary downwind direction from Wilmington) and SO_2. $PM_{2.5}$ was added in 1999. When changing site characteristics began to interfere with ozone monitoring, a new site (Bellefonte2) was established in 2001, less than 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 siting criteria.

Monitoring Objectives: Both monitoring sites are neighborhood scale, and collect data to determine compliance with the NAAQS, to determine population exposures, and to track trends. Bellefonte2 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 2015: No changes planned.

Site: Brandywine

County:	New Castle	Latitude:	39.8172
Address:	Brandywine Creek State Park	Longitude:	-75.5639
AQS site ID:	10-003-1010	Year Established:	1994
Spatial Scale:	Neighborhood	Area Represented (MSA):	Philadelphia-Camden-Wilmington PA-NJ-DE-MD



Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
X								X	X

Site Description: The Brandywine site is located in Brandywine Creek State Park, and was established when a secondary downwind site in Claymont was discontinued to changes in nearby land use and ownership. This is a neighborhood scale site for O_3 monitoring. The site meets all EPA siting requirements. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives: The Brandywine site is in the secondary downwind direction from Wilmington. The objectives are population exposure, compliance with the O_3 NAAQS, and trends.

Planned Changes through 2015: No changes planned.

Site: Delaware City

County:	New Castle	Latitude:	39.5777
Address:	Route 9, Delaware City	Longitude:	-75.6036
AQS site ID:	10-003-1008	Year Established:	1992
Spatial Scale:	Neighborhood	Area Represented (MSA):	Philadelphia-Camden-Wilmington PA-NJ-DE-MD

Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
	X					SPM		X	X

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 2015: CO monitoring was discontinued at the end of 2014 due to problems with aging equipment. No other changes are planned for 2015.

Site: Lums Pond

County:	New Castle	Latitude:	39.5513
Address:	Lums Pond State Park	Longitude:	-75.7320
AQS site ID:	10-003-1007	Year Established:	1991
Spatial Scale:	Urban	Area Represented (MSA):	Not in an urban area

Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
X	X			X				X	X

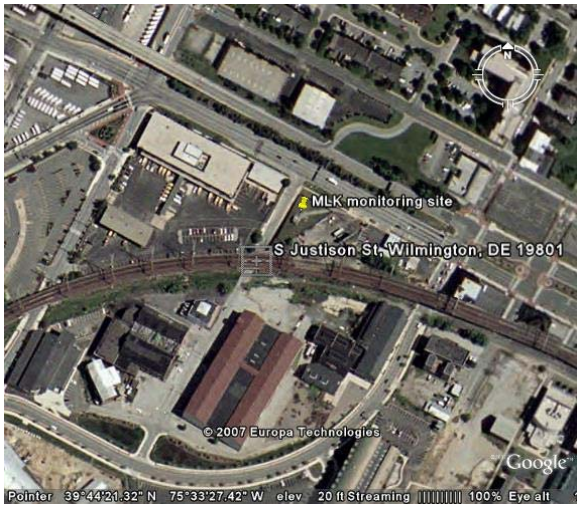
Site Description: The Lums Pond site is a neighborhood scale site located in a general upwind direction from Wilmington. The immediate area is rural. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

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 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. The scale of representation was changed to Urban (4 – 50 km) to reflect the background and transport monitoring objectives.

Planned Changes through 2015: No changes planned.

Site: MLK

County:	New Castle	Latitude:	39.7395
Address:	Justison St. and MLK Blvd	Longitude:	-75.5575
AQS site ID:	10-003-2004	Year Established:	1999
Spatial Scale:	Neighborhood	Area Represented (MSA):	Philadelphia-Camden-Wilmington PA-NJ-DE-MD



Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction	NO/NO_y	Lead	$PM_{10-2.5}$	Temp & Rel. Hum.
X	X	X	X	X	X	X	X	X	X	X	X	X	X

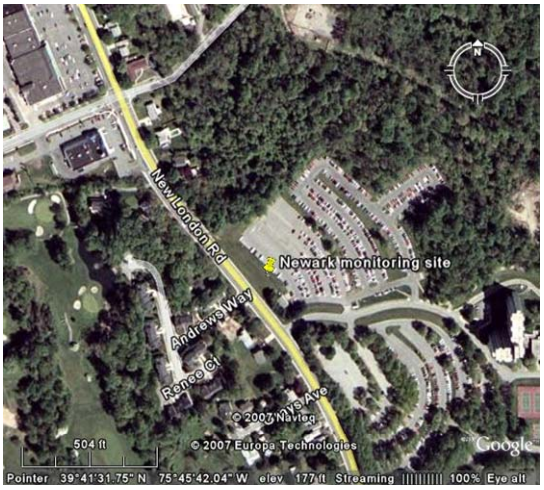
Site Description: The MLK site is located in Wilmington at the intersection of Justison St. and MLK Blvd. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years and was discontinued to to a change in land ownership. The MLK site is the state NCore site and represents urban population exposure to multiple pollution sources. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.

Monitoring Objectives: Monitoring objectives are population exposure, maximum concentration, NAAQS compliance, NCore, and trends.

Planned Changes through 2015: Monitoring shelter replacement is planned for late in 2015 or early 2016.

Site: Newark

County:	New Castle	Latitude:	39.6919
Address:	University of Delaware North Campus	Longitude:	-75.7617
AQS site ID:	10-003-1012	Year Established:	1999
Spatial Scale:	Neighborhood	Area Represented (MSA):	Philadelphia-Camden-Wilmington PA-NJ-DE-MD



Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
				X					

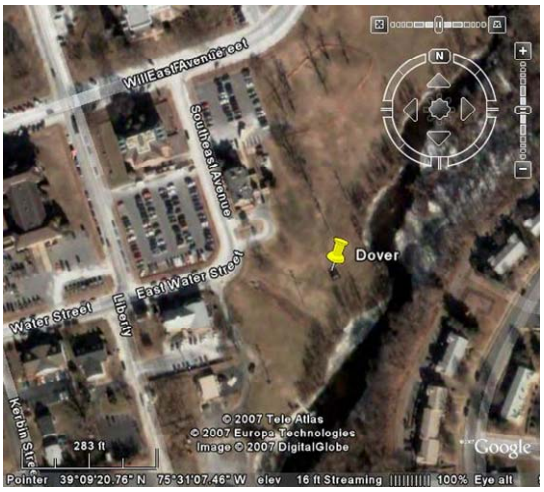
Site Description: The Newark site is a platform only and was established to understand $PM_{2.5}$ concentrations in the Newark area and potentially transported $PM_{2.5}$ from upwind areas to the west. It is a $PM_{2.5}$ neighborhood scale site. The location is suburban and generally impacted by mobile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

Monitoring Objectives: The objectives are population exposure, NAAQS compliance, regional transport, and trends.

Planned Changes through 2015: No changes planned.

Site: Dover

County:	Kent	Latitude:	39.1556
Address:	Water St.	Longitude:	-75.5182
AQS site ID:	10-001-0003	Year Established:	1999
Spatial Scale:	Neighborhood	Area Represented (MSA):	Dover



Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
				X					

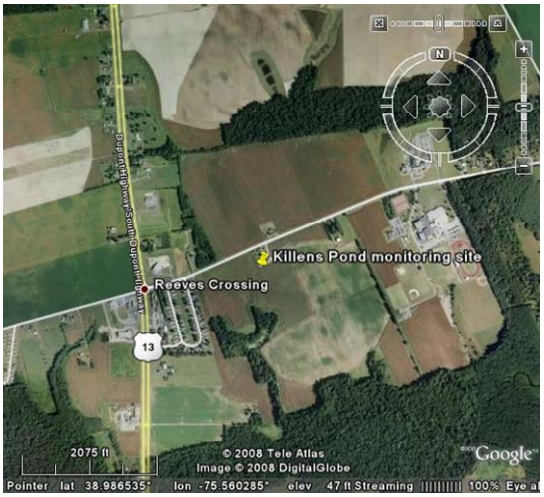
Site Description: The Dover site is a platform only and was established to understand fine particulate concentrations in the Dover area as well as speciated components of fine particulate. It is a neighborhood scale site representative of the Dover MSA, and is impacted by a combination of source types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

Monitoring Objectives: The monitoring objectives are population exposure, NAAQS compliance, and trends.

Planned Changes through 2015: Speciation monitoring ended in 2014 due to lack of funding. No changes planned for 2015.

Site: Killens Pond

County:	Kent	Latitude:	38.9867
Address:	Killens Pond Rd.	Longitude:	-75.5568
AQS site ID:	10-001-0002	Year Established:	1995
Spatial Scale:	Urban	Area Represented (MSA):	Not in an urban area



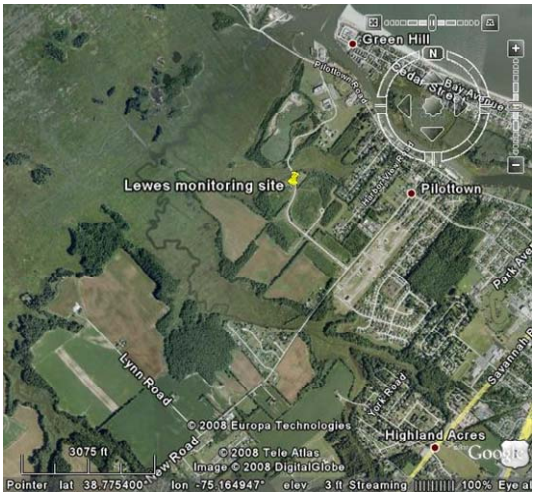
Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
X				X		X		X	X

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 ozone and PM2.5. This site meets all EPA 40 CFR Part 58 App D and E siting criteria.
Monitoring Objectives: The objectives for this site are background concentrations, NAAQS compliance, and trends. The scale of representation was changed to Urban (4 – 50 km) to reflect the background monitoring objective.
Planned Changes through 2015: No changes planned.

Site: Lewes

County:	Sussex	Latitude:	38.7791
Address:	University of Delaware College of Marine Studies	Longitude:	-75.1632
AQS site ID:	10-005-1003	Year Established:	1997
Spatial Scale:	Neighborhood	Area Represented (MSA):	Salisbury MD-DE



Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
X	X							X	X

Site Description: The Lewes site is neighborhood scale, and was established to understand ozone concentrations in the coastal area where population increases significantly in the summer months. SO2 was added in 2012 in response to the new SO2 NAAQS monitoring requirements. It is near the University of Delaware College of Marine Studies campus in Lewes, and 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: The objectives include population exposure, NAAQS compliance, and trends.

Planned Changes through 2015: SPM NO2 ended in 2014. No changes planned for 2015.

Site: Seaford

County:	Sussex	Latitude:	38.6539
Address:	350 Virginia Ave.	Longitude:	-75.6106
AQS site ID:	10-005-1002	Year Established:	1990
Spatial Scale:	Neighborhood	Area Represented (MSA):	Salisbury MD-DE

Monitored Parameters

Ozone	SO_2	CO	NO_2	$PM_{2.5}$	$PM_{2.5}$ speciation	$PM_{2.5}$ continuous	PM_{10}	Wind Speed	Wind Direction
X				X		X		X	X

Site Description: The Seaford site was originally located to monitor pollutant concentrations in the Seaford area. The original site was located further south, near the Seaford water tower. It was relocated to the present location in 1990 due to deteriorating conditions at the original site. 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: The site objectives are population exposure, NAAQS compliance, and trends.

Planned Changes through 2015: No changes planned.