

# Delaware Ambient Air Monitoring 2010 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 first submittal under this requirement.

For this 5-Year Monitoring Network Assessment (Assessment), Air Quality Management (AQM) performed a technical review of the data collected in the ambient monitoring network. To conduct this review, AQM 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 ozone, PM<sub>2.5</sub>, and PM<sub>10</sub>. 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.

AQM 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.



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Based upon the evaluation of these performance measures, AQM 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. Because of revisions to the SO<sub>2</sub> National Ambient Air Quality Standard (NAAQS) an additional monitor will be required in the Seaford micro statistical area (microSA). Further, AQM is faced with a large capital expense to upgrade equipment to current standards.

## 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<sub>3</sub>), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), particulate matter less than 10 microns (PM<sub>10</sub>), particulate matter less than 2.5 microns (PM<sub>2.5</sub>) 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<sub>2.5</sub>, 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
Killens Pond 10-001-0002	Ozone - seasonal	4/1/1995
	PM <sub>2.5</sub>	1/1/1999
	WS/WD	4/1/1995
Dover 10-001-0003	PM <sub>2.5</sub>	1/1/1999
	PM <sub>2.5</sub> speciation	6/1/2001
Brandywine 10-003-1010	Ozone - seasonal	7/1/1994
Bellefonte2 10-003-1013	Ozone	4/1/2001
	SO <sub>2</sub>	3/1/2003
Bellefonte 10-003-1003	PM <sub>2.5</sub>	1/1/1999
MLK 10-003-2004	SO <sub>2</sub>	1/1/1999
	CO	1/1/1999
	NO <sub>2</sub>	1/1/2001
	PM <sub>10</sub>	1/1/2000
	PM <sub>2.5</sub>	1/1/1999

Site Name & AQS ID	Parameter	Start Date
	PM <sub>2.5</sub> speciation	6/1/2001
	BC	1/1/2001
	VOCs	1/1/1999
	Carbonyls	1/1/2003
	Metals	1/1/2003
	WS/WD	6/1/2000
Newark 10-003-1012	PM <sub>2.5</sub>	12/15/1999
Lums Pond 10-003-1007	Ozone	1/1/1992
	PM <sub>2.5</sub>	1/1/1999
Delaware City 10-003-1008	SO <sub>2</sub>	2/1/1992
	CO	1/1/1994
	VOCs	1/1/2001
	WS/WD	
Seaford 10-005-1002	Ozone - seasonal	3/1/1990
	PM <sub>2.5</sub>	1/1/1999
	WS/WD	
Lewes 10-005-1003	Ozone - seasonal	5/1/1997
	WS/WD	6/1/1997

Air Quality Summary table, 2007 – 2009

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?
Ozone	Non-attainment statewide	All three counties	47	New Castle County - Philadelphia CBSA
CO	Attainment	NA	0	NA
SO <sub>2</sub>	Attainment current annual NAAQS Potential non-attainment proposed 1-hour NAAQS	NA	0	NA
NO <sub>2</sub>	Attainment current annual NAAQS	NA	0	NA
PM <sub>2.5</sub>	Attainment current annual and daily NAAQS	NA	4 <i>Old AQI calc.</i>	New Castle County - Philadelphia CBSA

<b>Pollutant</b>	<b>Status of NAAQS and major Risk Issues in Agencies Network</b>	<b>Extent of NAAQS Violations (list cities violating NAAQS)</b>	<b>Days above 100 on the AQI</b>	<b>Contribution to downwind Violations?</b>
PM <sub>10</sub>	Attainment current daily NAAQS	NA	0	NA
Pb	Attainment current and proposed NAAQS	NA	NA	NA

***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, 2007 – 2009, only ozone is above the NAAQS. PM<sub>2.5</sub> meets the current 24-hour and annual average NAAQS, but is very close to both. New Castle County, however, is part of the Philadelphia CSA which is still violating the NAAQS.
- The new proposed SO<sub>2</sub> NAAQS will require changes in the existing monitoring network to focus on source-impacted areas; it is possible that some areas will exceed the new SO<sub>2</sub> NAAQS (see Appendix I.

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## ***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 state air quality standards, as well as establishing background levels and measuring pollution transported from areas outside of Delaware.

With the passage of the Clean Air Act in 1970, and the Clean Air Act Amendments in 1990, various control measures implemented by the federal and state governments resulted in major improvements in air quality, particularly regarding major industrial sources. 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	2010
Kent	10-001-0001	Dover		X	X	X		
	10-001-0002	Killens Pond St. Pk.				X	X	X
	10-001-0003	Dover PM <sub>2.5</sub> , 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 <sub>2.5</sub>					X	
	10-003-1012	Newark PM <sub>2.5</sub>					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<sub>10</sub>, SO<sub>2</sub>, and CO towards the pollutants that remained above the NAAQS, particularly ozone, 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<sub>2.5</sub> monitors in response to the new PM<sub>2.5</sub> NAAQS. Through careful rebalancing of resources, including elimination of non-essential monitors, Delaware was able to establish and maintain a statewide PM<sub>2.5</sub> 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 II.



**Delaware 2010 Air Monitoring Network*****Population Summary***

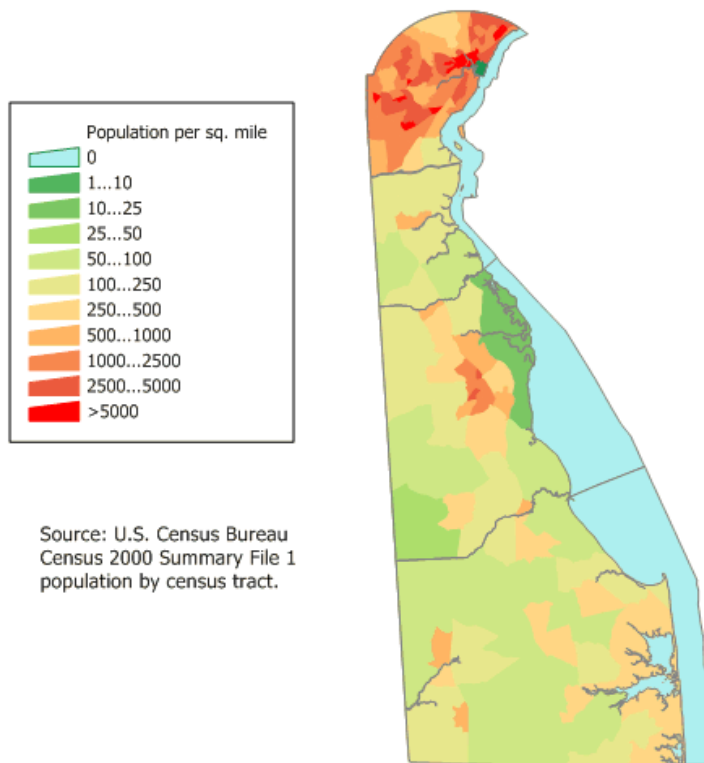
Although New Castle County is the most densely populated county, the population is growing much more slowly than in the other areas of the state. The greatest growth is occurring in the southern and western portions of New Castle County which continues to have the greatest total population in Delaware. 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. There is one micropolitan statistical area in Sussex County – Seaford, which is located in the western 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 from April 1, 2000 (Estimates Base) to July 1, 2008	Total Population: July 1, 2008	Total Population: April 1, 2000 (Estimates Base)
New Castle	5.9%	529641	500265
Kent County	22.7%	155415	126702
Sussex	20.1%	188036	156628

**Population density (2000 census)****CSAs and MSAs for Delaware.**

CBSA Code	Metro Division Code	CSA 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	428	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
42580			Seaford, DE	Micropolitan Statistical Area	2			Sussex County

***Meteorological summary***

Following are climate data summaries for NOAA weather stations in each county. The data is taken from the Southeast Regional Climate Center, [sercc@climate.ncsu.edu](mailto:sercc@climate.ncsu.edu)

## WILMINGTON WSO ARPT, DELAWARE

## NCDC 1971-2000 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	39.3	42.5	51.9	62.6	72.5	81.1	86.0	84.1	77.2	65.9	55.0	44.4	63.5
Mean Temperature (F)	31.5	34.2	42.7	52.4	62.5	71.5	76.6	75.0	67.7	55.8	45.9	36.4	54.4
Mean Min. Temperature (F)	23.7	25.8	33.4	42.1	52.4	61.8	67.3	65.8	58.1	45.6	36.9	28.4	45.1
Mean Precipitation (in.)	3.43	2.81	3.97	3.39	4.15	3.59	4.28	3.51	4.01	3.08	3.19	3.40	42.81
Heating Degree Days (F)	1029	864	687	376	132	15	1	2	49	297	564	872	4888
Cooling Degree Days (F)	0	0	2	9	62	215	368	317	135	16	1	0	1125

## DOVER, DELAWARE

## NCDC 1971-2000 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	43.7	46.8	55.2	65.4	74.8	82.9	87.4	85.5	79.5	69.1	58.7	48.4	66.5
Mean Temperature (F)	35.3	37.7	45.4	54.6	64.3	72.9	77.8	76.2	69.9	58.8	49.2	39.9	56.8
Mean Min. Temperature (F)	26.9	28.5	35.6	43.8	53.8	62.8	68.2	66.9	60.3	48.5	39.7	31.4	47.2
Mean Precipitation (in.)	3.94	3.04	4.40	3.47	4.29	3.77	4.16	4.73	4.56	3.26	3.16	3.50	46.28
Heating Degree Days (F)	920	767	608	316	100	7	0	0	16	223	476	779	4212
Cooling Degree Days (F)	0	0	0	4	77	243	396	348	162	31	1	0	1262

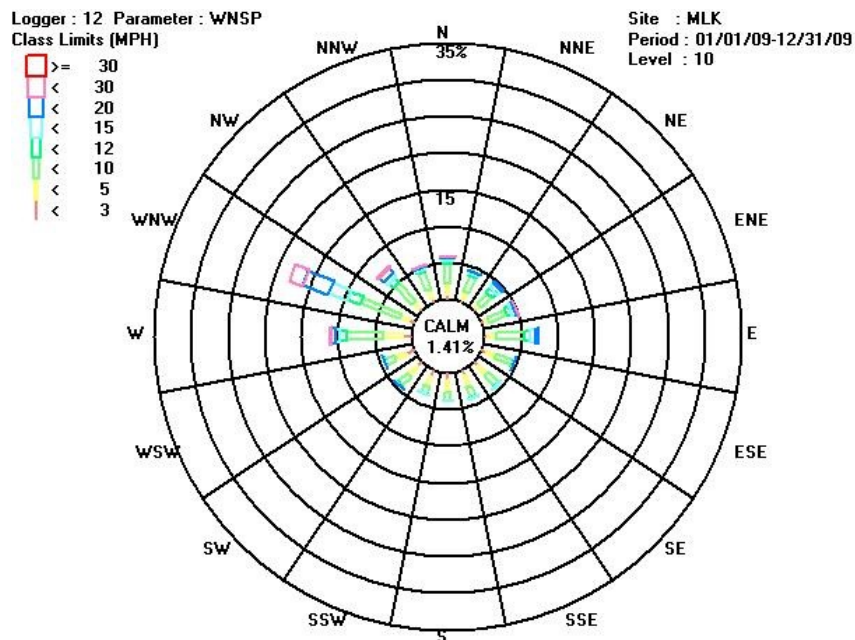
## GEORGETOWN 5 SW, DELAWARE

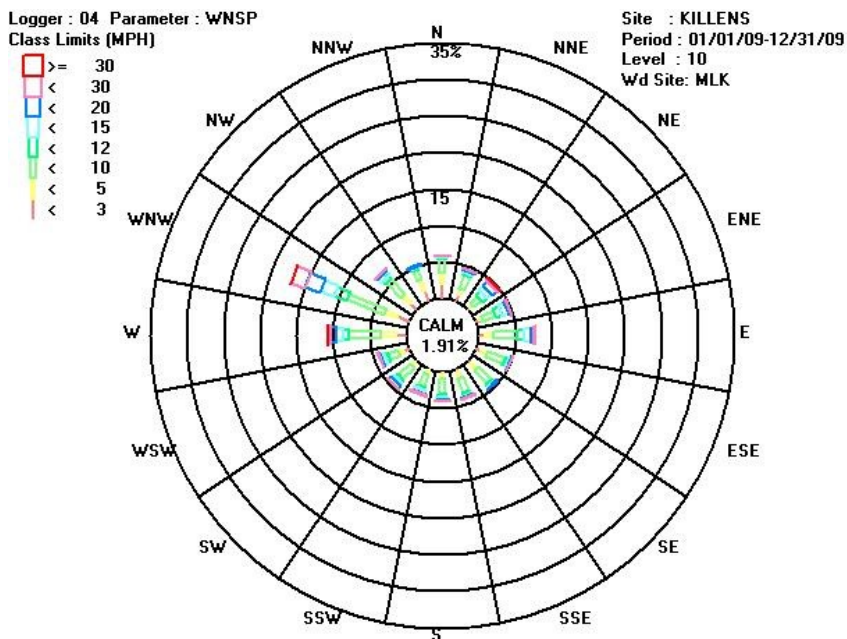
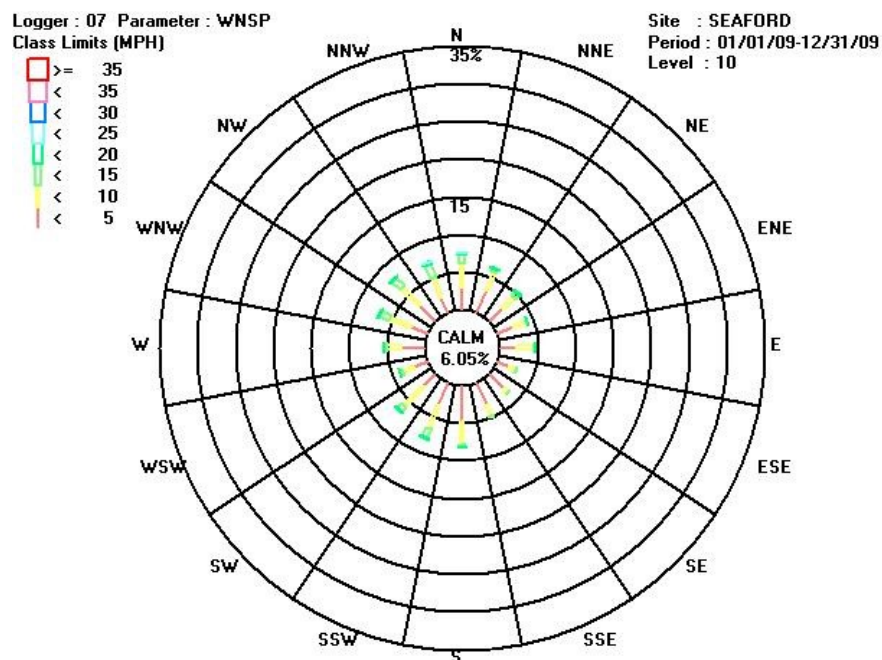
## NCDC 1971-2000 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	43.6	45.8	54.3	64.2	73.2	81.9	86.9	84.9	78.9	68.2	58.2	48.3	65.7
Mean Temperature (F)	34.3	36.2	43.9	52.7	62.2	70.9	75.8	74.3	68.0	56.7	47.7	38.7	55.1
Mean Min. Temperature (F)	24.9	26.6	33.5	41.1	51.1	59.9	64.7	63.6	57.0	45.2	37.1	29.1	44.5
Mean Precipitation (in.)	3.94	3.17	4.57	3.44	3.91	3.32	3.47	5.59	3.99	3.36	3.26	3.32	45.34
Heating Degree Days (F)	953	806	654	370	129	14	0	0	28	275	521	817	4567
Cooling Degree Days (F)	0	0	0	1	4	192	335	287	116	18	0	0	989

Following are wind roses for monitoring sites in each county, using 2009 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.

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***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 III.

*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 or from the Air Quality Monitoring web site.

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/m³)	8-hour <sup>(1)</sup>	None	
	35 ppm (40 mg/m³)	1-hour <sup>(1)</sup>		
Lead	1.5 µg/m³	Quarterly Average	None	
Nitrogen Dioxide	0.053 ppm (100 µg/m³)	Annual (Arithmetic Mean)	None	
Particulate Matter (TSP)	75 µg/m³	Annual (Geometric Mean)	60 µg/m³	Annual Geometric Mean
	260 µg/m³	24-hour <sup>(1)</sup>	150 µg/m³	24-hour
Particulate Matter (PM <sub>10</sub> )	150 µg/m³	24-hour <sup>(2)</sup>	Same as Primary	
	50 µg/m³	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM <sub>2.5</sub> )	15.0 µg/m³	Annual <sup>(3)</sup> (Arithmetic Mean)	Same as Primary	
	65 µg/m³	24-hour <sup>(4)</sup>	Same as Primary	
Ozone	0.08 ppm (1997 std)	8-hour <sup>(6)</sup>	Same as Primary	
	0.12 ppm	1-hour <sup>(7)</sup> (Applies only in New Castle and Kent counties)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 µg/m³)	3-hour <sup>(1)</sup>
	0.14 ppm	24-hour <sup>(1)</sup>		
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<sub>2.5</sub> concentrations must not exceed 15.0 µg/m<sup>3</sup>.

(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/m<sup>3</sup> (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 0.08 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.

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](http://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 (or another term) – 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 (1)** – 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 (2)** – 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., ozone transport or PM<sub>2.5</sub> 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

#### 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 ozone throughout the state.

#### Monitoring Requirements

Within an O<sub>3</sub> network, at least one O<sub>3</sub> 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<sub>3</sub> sites are neighborhood, urban, and regional. Since O<sub>3</sub> 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<sub>3</sub> concentrations, more specifically, downwind during periods of photochemical activity. Since O<sub>3</sub> levels decrease significantly in the colder parts of the year in many areas, O<sub>3</sub> is required to be monitored only during the “ozone season” as designated in the 40 CFR Part 58 Appendix D, which in Delaware is April 1 through October 31.

Delaware operates six ozone monitoring sites, including sites for maximum downwind concentrations, background concentrations, and transport conditions. The monitors at Bellefonte and Lums Pond operate year-round, while the remaining sites operate during the ozone season (currently April through October). Hourly data is sent to the AirNow website to generate the daily Air Quality Index and to be used in mapping ozone 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 micropolitan statistical area and one in the coastal resort area (Lewes). In January 2011, the NCore site in Wilmington will begin official ozone monitoring; however, since that is a required parameter of the NCore program, it is not included in the following ozone network assessment.



Following are the ozone 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 ozone sites.**

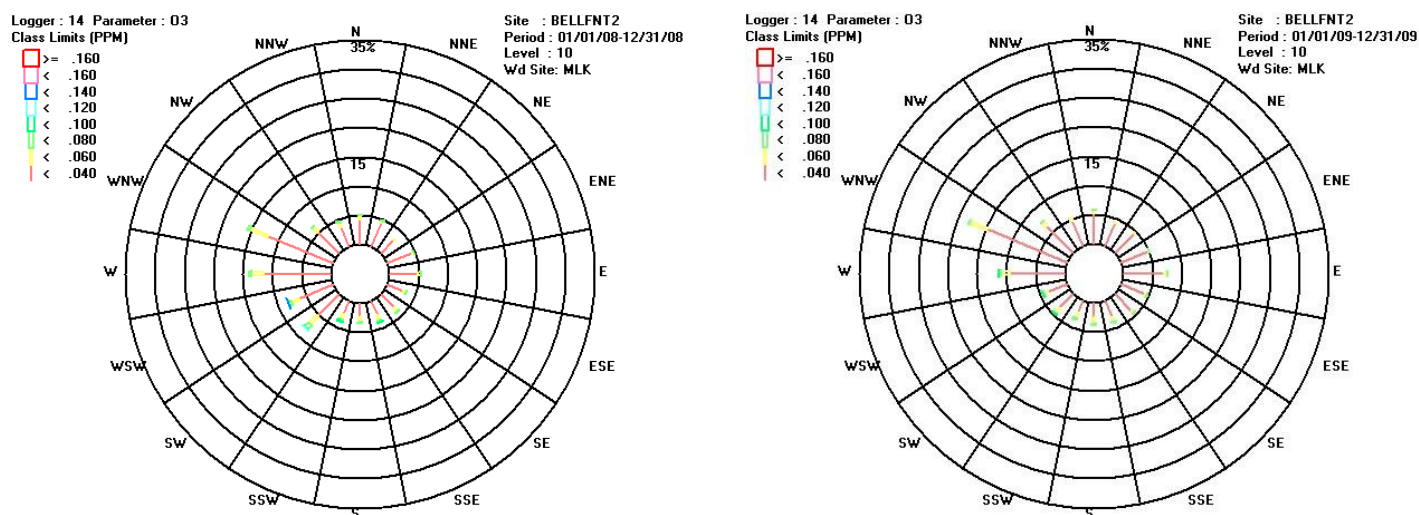
Site	County/MSA	Objectives and Monitor Type
Brandywine (BCSP)	New Castle Phil. CSA	NAAQS compliance Population exposure Secondary downwind from Wilmington (max. conc.) Trends
Bellefonte2	New Castle Phil. CSA	NAAQS compliance Population exposure Primary downwind from Wilmington (max. conc.) Trends
Lums 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

**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<sub>3</sub> and SO<sub>2</sub>. 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 ozone, 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.

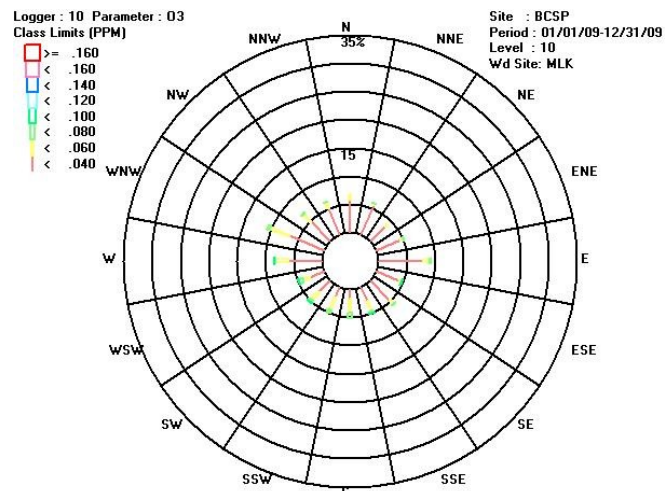
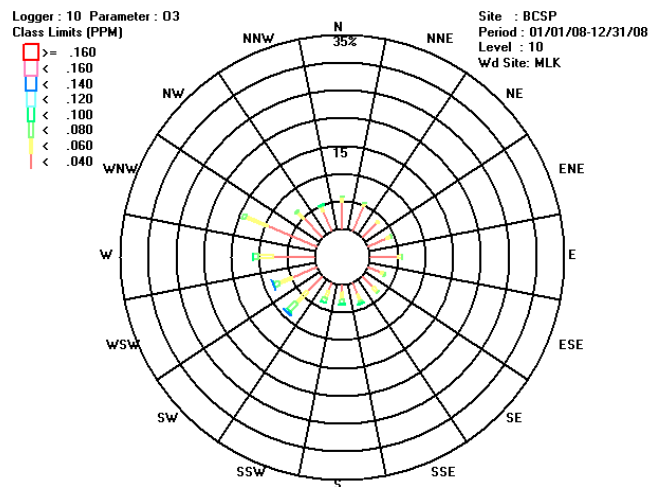
### Pollution roses – 2008 and 2009



2009 was not a typical year from the meteorological perspective. The summer was characterized by a weak El Nino. A strong upper atmospheric trough maintained a persistent advection of cold air from the north. The 2008 and 2009 annual pollution roses show some similarity. While there is significant frequency of west/north west winds (regional transport), high ozone concentrations are also seen with west/south west winds (local from Wilmington).

**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<sub>3</sub> 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<sub>3</sub> NAAQS, population exposure, and trends.

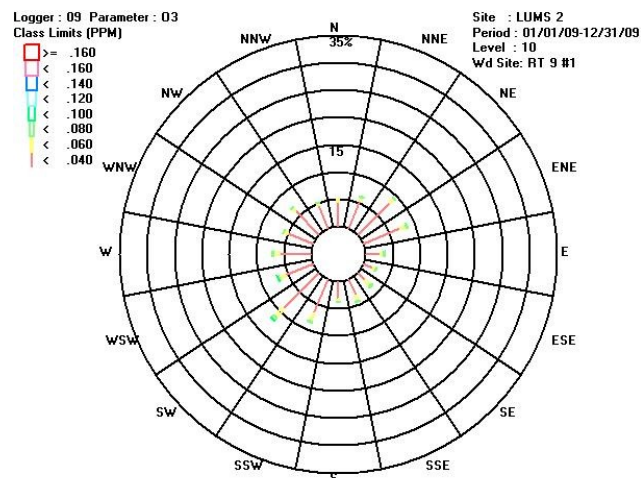
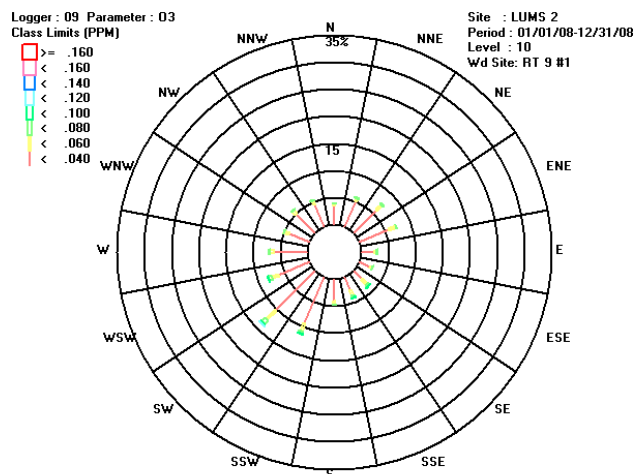
This site was established after the Claymont (10-003-1003) site was discontinued. Unlike Claymont, which was in the same downwind direction as Bellefonte from Wilmington, Brandywine was sited to represent ozone concentrations in a different direction from the urban area of Wilmington. The availability 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 NO<sub>x</sub> scrubbing of ozone. 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 ozone condition for New Castle County.

**Pollution roses – 2008 and 2009**

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

**Lums Pond (Summit) (10-003-1007).** The original Lums Pond ozone 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.

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, and was a Photochemical Assessment Monitoring (PAMS) designated site from 1993 to 2003. The PAMS site was considered to be distant downwind from the Baltimore/Washington area, and upwind for the Philadelphia area.

**Pollution roses – 2008 and 2009**

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

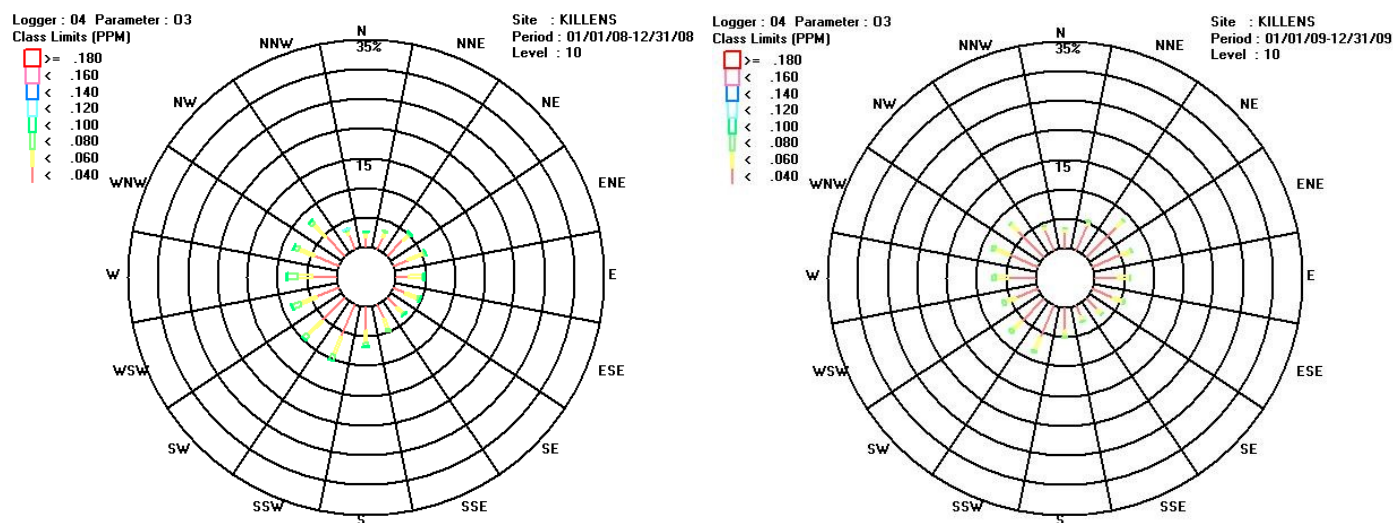
Years	Brandywine	Bellefonte	Lums Pond
95-97	0.093	0.094	0.099
96-98	0.094	0.084	0.094
97-99	0.099	0.089	0.099
98-00	0.096	0.091	0.097
99-01	0.095	0.091	0.097
00-02	0.096	0.092	0.096
01-03	0.093	0.090	0.093
02-04	0.089	0.085	0.084
03-05	0.082	0.082	0.080
04-06	0.082	0.081	0.078
05-07	0.083	0.081	0.082
06-08	0.083	0.078	0.080
07-09	0.078*	0.074	0.075

\* low data capture

**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 ozone 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 ozone monitoring site in Kent County.

**Pollution roses 2008 - 2009**

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



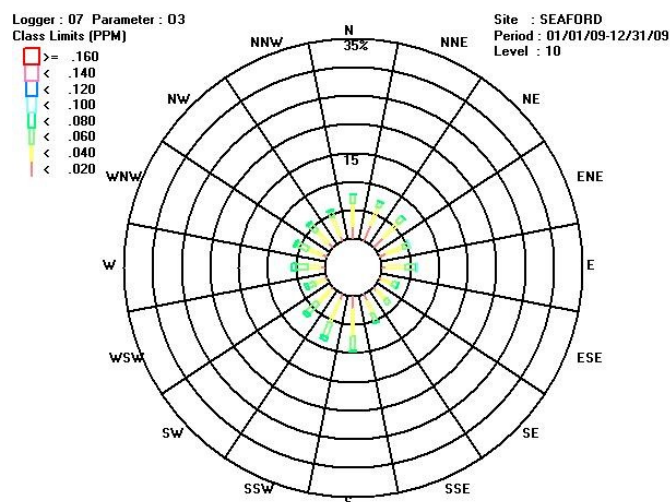
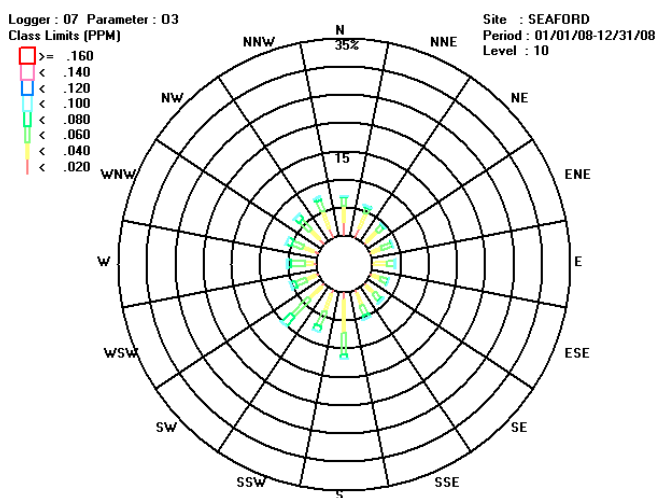
**Trends - Kent county 8-hour ozone design values (ppm)**

Years	Killens Pond
95-97	0.094
96-98	0.096
97-99	0.099
98-00	0.097
99-01	0.093
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

**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. Ozone monitoring began in 1983. Over time, site maintenance problems developed at the water tower that interfered with ozone 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 roses 2008 – 2009**

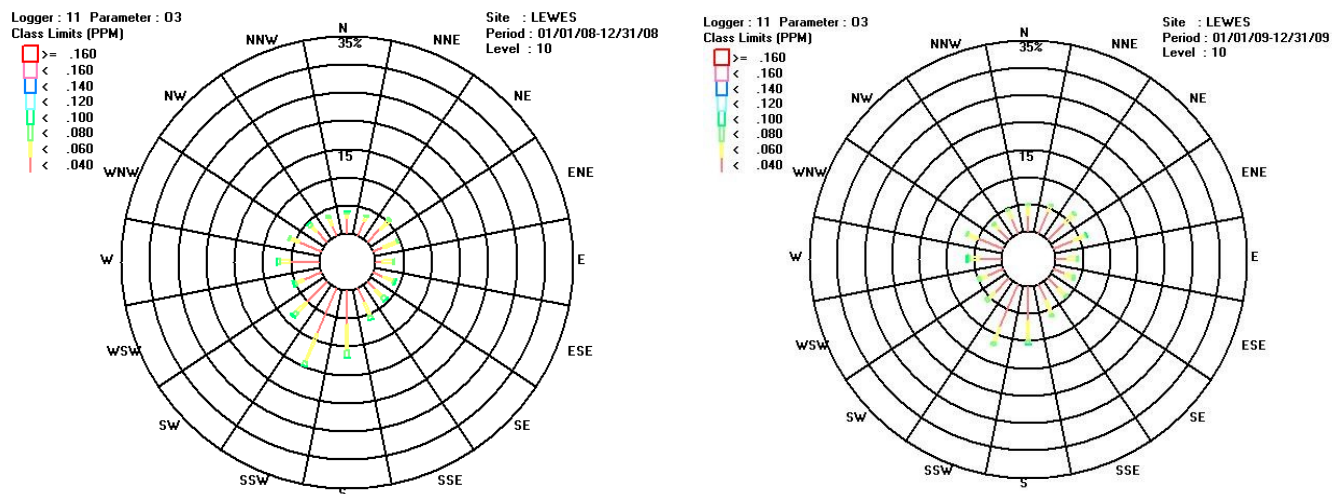


While elevated ozone concentrations occur with winds from all directions, highest concentrations are associated with winds with a westerly component.

**Lewes (10-005-1003)** It had been recognized for some time that the ozone 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.

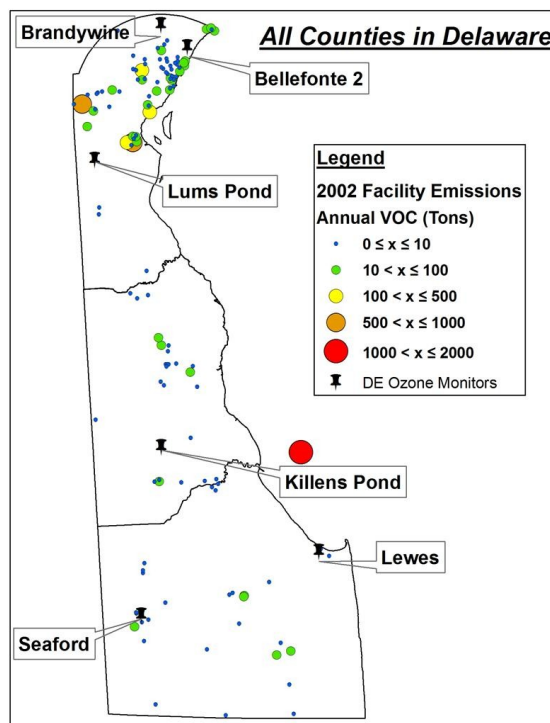
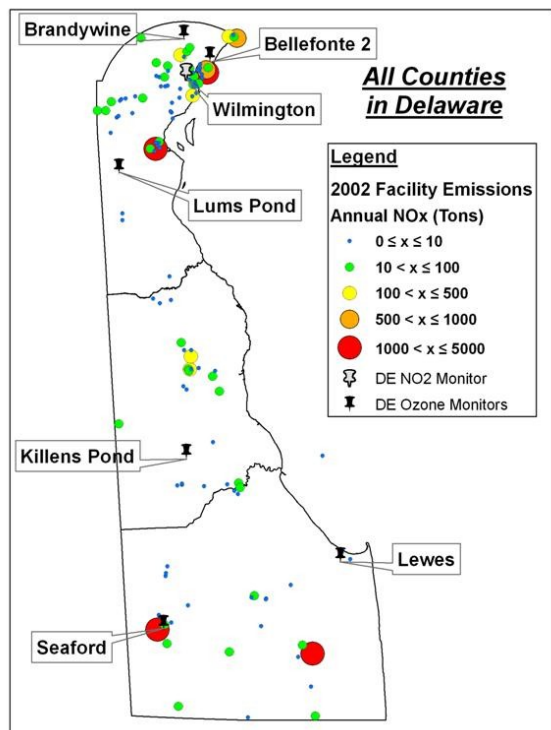
The site meets all EPA siting criteria. The monitoring objectives include NAAQS compliance, population exposure, and trends.

### Pollution roses 2008 – 2009



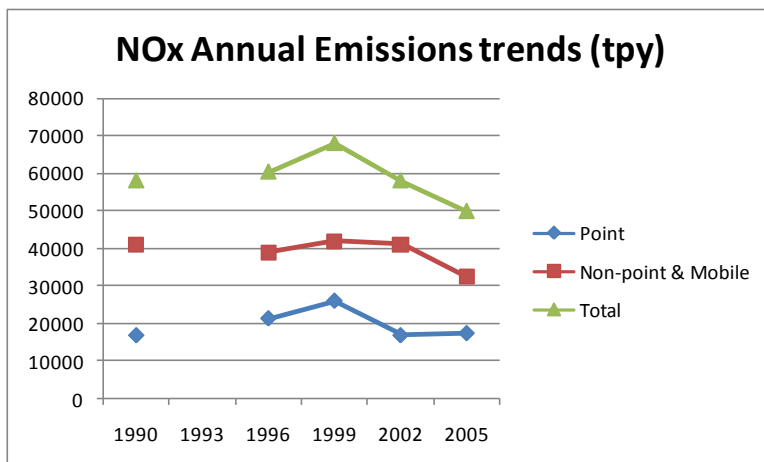
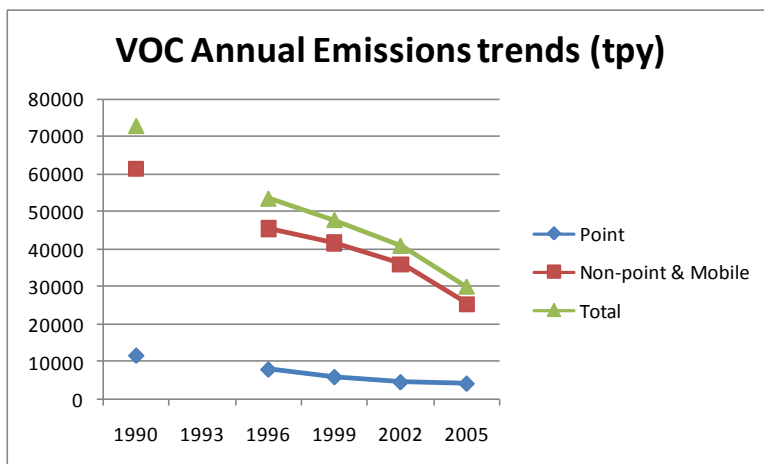
### Trends - Sussex County 8-hour Ozone Design Values (ppm)

	Seaford	Lewes
95-97	0.093	
96-98	0.097	
97-99	0.099	0.099
98-00	0.098	0.095
99-01	0.095	0.090
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

**Emissions info/maps**

2005 Statewide Peak Ozone Season Daily Emissions			
	Pollutant Emissions (TPD)		
Source Category	VOC	NO <sub>x</sub>	CO
Point	14.39	78.02	25.21
Non-point	25.09	3.09	6.26
On-road Mobile	24.95	46.95	334.72
Off-road Mobile	29.94	50.00	286.16
Natural	173.94	3.86	16.08

*Note on emissions inventory information* – Data for 1993 was not available at the time this document was prepared; 2005 data was only available for NO<sub>x</sub> and VOC emissions.

**Emissions Trends - statewide**

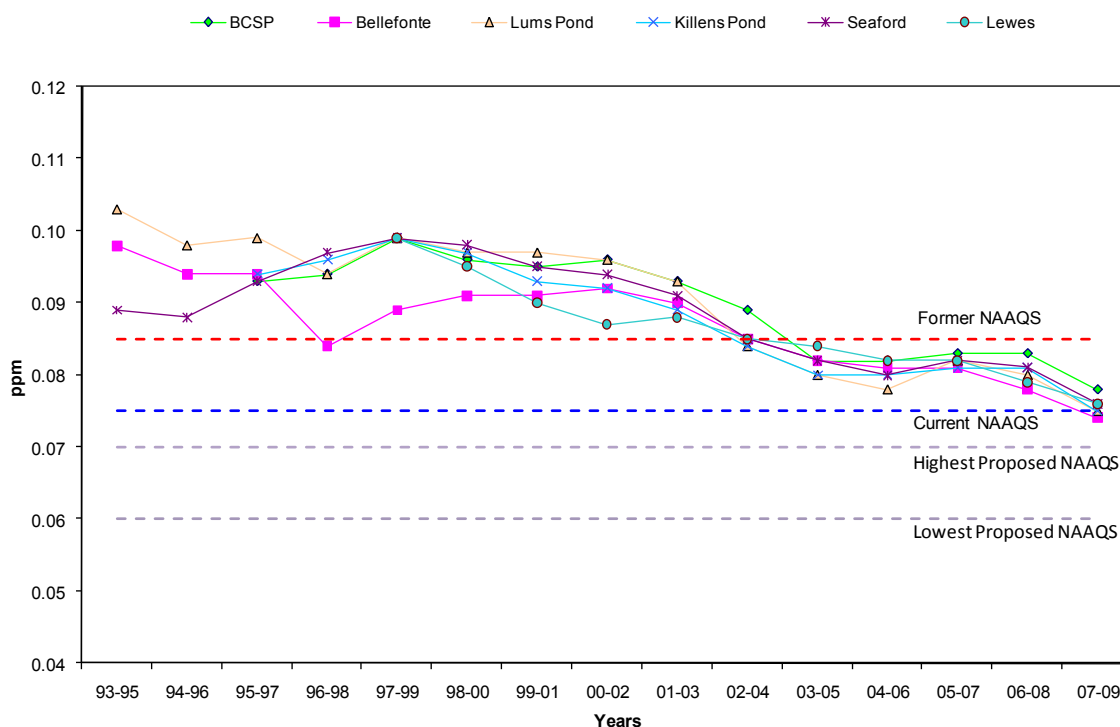
Emissions in all categories have trended downward, which correlates with the improvement in ambient ozone levels as seen in the following section.

## Statistical analyses

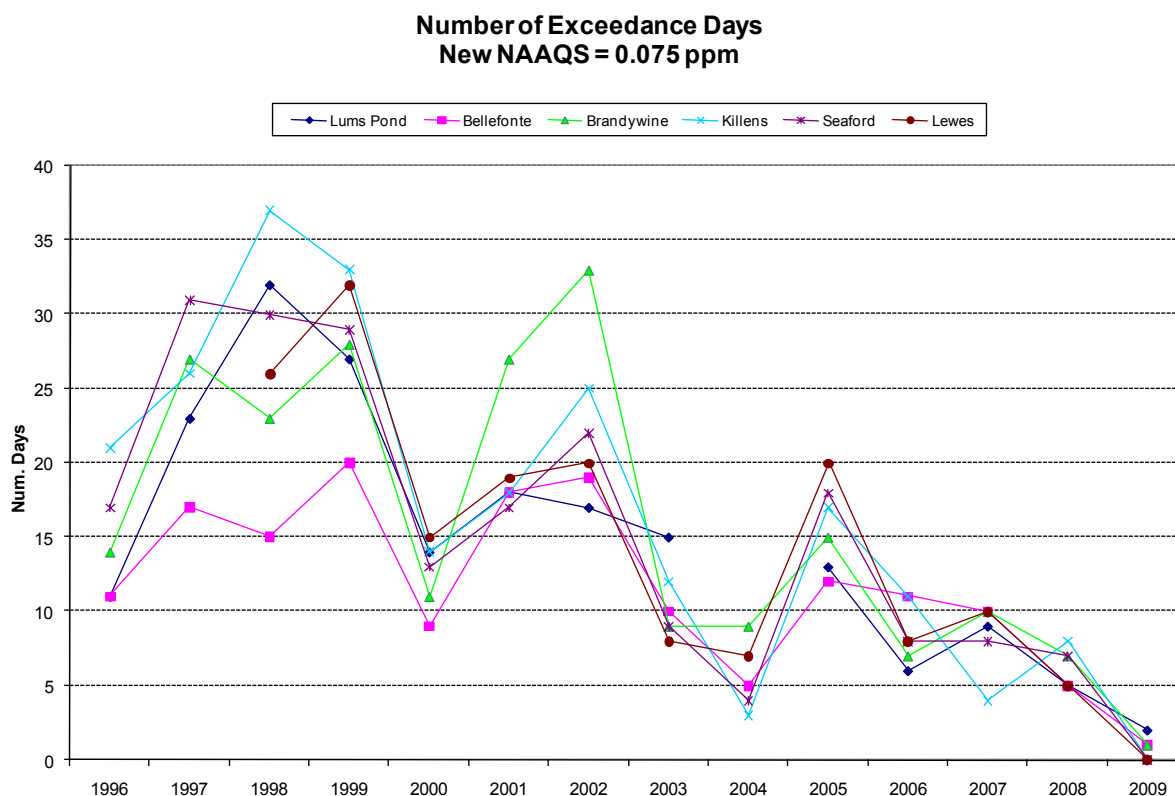
Ozone sites in Delaware have shown steadily improving air quality since the 1980s. The ozone design value chart shows the 8-hour design value trends for each site in comparison with the changing NAAQS and proposed new NAAQS. Data for individual sites is included in previous discussions on each monitoring 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 new proposed NAAQS, however, will be below the concentrations measured throughout the state.

**Ozone 8-hr Design Value by Site: 3-yr avg 4th max**



The number of days with 8-hour concentrations exceeding the level of the NAAQS is shown in the chart below. As with the design values, the trend has been downward with increasingly similar numbers of exceedance days across all sites.



While the increasing similarity (or decreasing variance) among the sites is a strong trend, the fact that all sites are above or close to the NAAQS requires closer examination to determine any significant difference or bias between the sites.

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

County	Site	2007-2009 DV ppb	% D current NAAQS 75 ppb	% D proposed NAAQS 60 ppb	% D proposed NAAQS 70 ppb
Kent	KILLENS POND	75.0	0%	25%	7%
New Castle	BCSP* <i>incomplete</i>	83.5 – two years	11%	39%	19%
New Castle	BELLFONTE2	74.3	-1%	24%	6%
New Castle	LUMS POND	75.7	1%	26%	8%
Sussex	LEWES	76.0	1%	27%	9%
Sussex	SEAFORD	76.3	2%	27%	9%

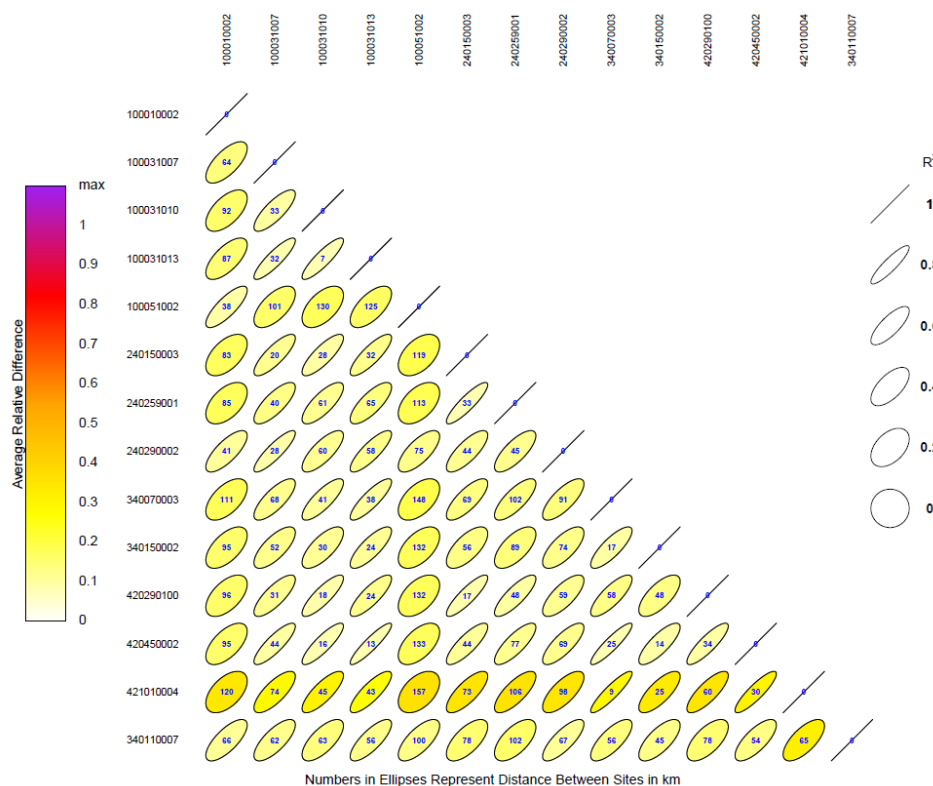
In addition, while the design values for all three counties are at or very close to the existing 8-hour NAAQS, they are all above the range of the proposed 8-hour NAAQS. Although low data capture at Brandywine in 2009 prevented the use of three full years of data in calculating that site's design value, the concentrations at Brandywine site follow similar trends as the other sites in New Castle County (see discussion below).

### Correlation Matrix

EPA has provided a data analysis tool to examine correlation coefficients between sites (OAQPS/AQAD/AQAG, March 1, 2010). According to EPA, the purpose of this particular analysis/tool is 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 ozone, 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.

Using the tool to examine the ozone 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. Only sites that met the data completeness requirements for 2005 – 2008 were used, therefore the Lewes site was not included in this analysis.

### Correlation Matrix – DE and nearby state ozone sites 2005 - 2008



**Correlation data ( $R^2$ ) for ozone sites 2005 – 2008; Delaware sites shaded**

Site Code	10-001-0002	10-003-1007	10-003-1010	10-003-1013	10-005-1002	24-015-0003	24-025-9001	24-029-0002	34-007-0003	34-011-0007	34-015-0002	42-029-0100	42-045-0002
10-001-0002													
10-003-1007	0.68												
10-003-1010	0.59	0.80											
10-003-1013	0.67	0.88	0.88										
10-005-1002	0.80	0.63	0.56	0.64									
24-015-0003	0.54	0.81	0.82	0.83	0.49								
24-025-9001	0.52	0.77	0.77	0.77	0.50	0.89							
24-029-0002	0.75	0.87	0.77	0.83	0.72	0.78	0.76						
34-007-0003	0.57	0.77	0.81	0.85	0.53	0.77	0.76	0.75					
34-011-0007	0.73	0.74	0.70	0.78	0.70	0.66	0.62	0.78	0.74				
34-015-0002	0.59	0.72	0.72	0.80	0.54	0.67	0.65	0.71	0.81	0.71			
42-029-0100	0.56	0.79	0.84	0.82	0.51	0.87	0.82	0.74	0.80	0.65	0.69		
42-045-0002	0.61	0.85	0.86	0.91	0.57	0.82	0.80	0.79	0.91	0.74	0.80	0.86	
42-101-0004	0.53	0.76	0.80	0.82	0.47	0.77	0.76	0.72	0.91	0.69	0.75	0.80	0.88

**Correlation data - average relative differences for ozone sites 2005 – 2008; Delaware sites shaded**

Site Code	10-001-0002	10-003-1007	10-003-1010	10-003-1013	10-005-1002	24-015-0003	24-025-9001	24-029-0002	34-007-0003	34-011-0007	34-015-0002	42-029-0100	42-045-0002
10-001-0002													
10-003-1007	0.13												
10-003-1010	0.14	0.09											
10-003-1013	0.14	0.08	0.07										
10-005-1002	0.09	0.15	0.16	0.15									
24-015-0003	0.16	0.11	0.09	0.11	0.17								
24-025-9001	0.16	0.12	0.11	0.13	0.17	0.07							
24-029-0002	0.10	0.08	0.11	0.11	0.12	0.11	0.11						
34-007-0003	0.16	0.11	0.10	0.10	0.18	0.12	0.13	0.13					
34-011-0007	0.10	0.11	0.13	0.11	0.12	0.14	0.15	0.10	0.13				
34-015-0002	0.14	0.11	0.10	0.10	0.16	0.12	0.13	0.11	0.09	0.11			
42-029-0100	0.15	0.11	0.08	0.11	0.16	0.08	0.09	0.11	0.12	0.14	0.12		
42-045-0002	0.15	0.09	0.08	0.08	0.16	0.10	0.11	0.11	0.07	0.12	0.09	0.09	
42-101-0004	0.31	0.26	0.28	0.24	0.33	0.32	0.33	0.32	0.27	0.29	0.30	0.32	0.28

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.

The Delaware sites are somewhat correlated with each other ( $R^2$  from 0.56 – 0.88) 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 wider range of correlation ( $R^2$  from 0.47 – 0.91) and somewhat higher average relative difference, again largely increasing with greater distance between the sites.

The conclusion is that while there is some correlation among the closest sites, they are not strongly correlated across all sites or distances. The decreasing variation in overall ozone concentrations noted in



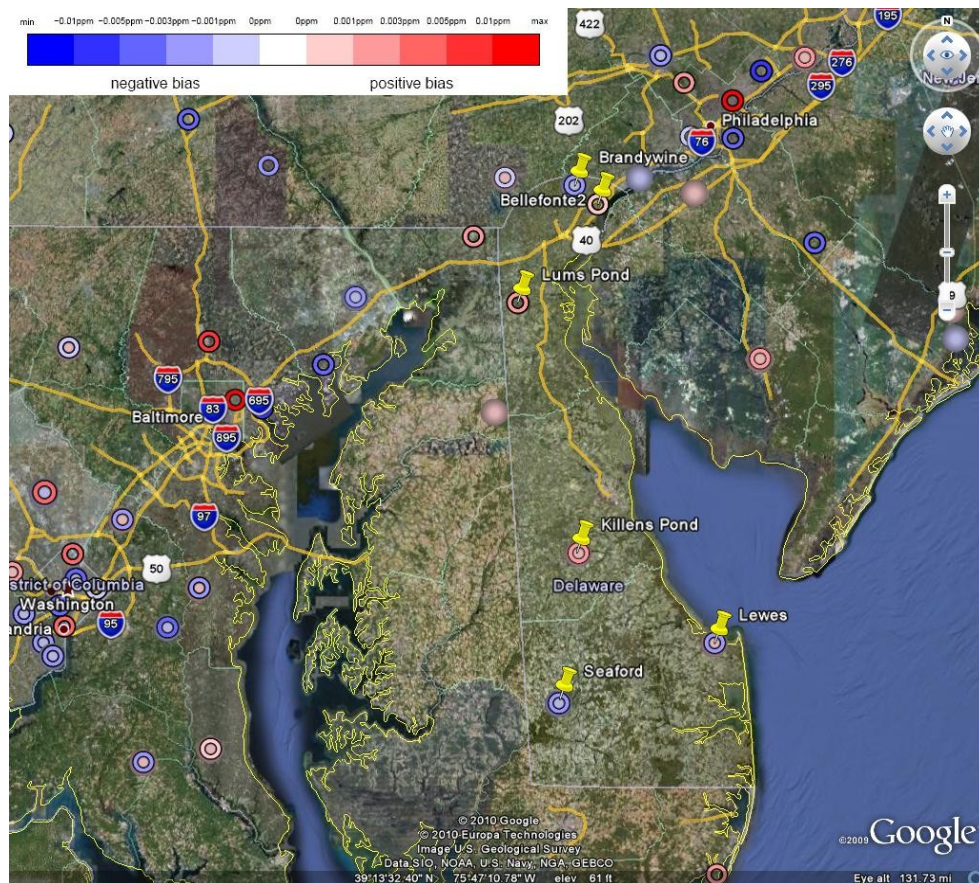
the design value statistics is reflected in the moderate level of correlation and relative difference among ozone sites in Delaware and nearby states.

### Removal Bias

Another EPA tool to examine differences and potential redundancy between sites is the removal bias tool (QAQPS/AQAD/AQAG, March 1, 2010). The analyses use an interpolation method for the nearest neighbors to each site to estimate the concentration at the location of the site if the site had never existed. The bias is calculated for each day at each site by taking the difference between the predicted value from the interpolation and the measured concentration, and the average bias is compared to determine whether or not it was statistically different from zero at a 95% probability. 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.

The Google Earth map below was generated by this tool using the 2006 – 2008 data for the same ozone sites in Delaware and surrounding states as used in the correlation matrix tool. In Google Earth, statistically insignificant sites are shown as solid dots while other sites are color coded according to the magnitude of their average bias and displayed as rings. The removal bias results table shows the output including the average bias and average relative bias (which is the average of the daily bias divided by the measured concentration at the site), and the determination of significance.

### Ozone site removal bias output as Google Earth image



**Removal bias data results.**

Site ID	Site Name	Design Value 2006-2008	Mean bias	Std Dev bias	Significance?
100010002	KILLENS POND STATE PARK	0.081	0	0.005171	insig
100031007	LUMS POND STATE PARK	0.080	0.003	0.004412	sig
100031010	BRANDYWINE CREEK STATE PARK	0.083	0.001	0.006063	sig
100031013	BELLEFONTE2 BELLEVUE STATE PARK	0.078	0.002	0.003565	sig
100051002	SEAFORD 350 VIRGINIA AVE SEAFORD	0.081	-0.002	0.004764	sig
100051003	LEWES UNIV. OF DE COLLEGE OF MARINE STUDIES	0.079	-0.001	0.004614	sig

From this analysis, it is seen that removing any site in Delaware results in a statistically significant level of bias (either negative or positive depending on the site) in the design value calculation, with the exception of Killens Pond. Although there is a positive bias in the design values if Killens is removed, the bias is below the 95% level of significance.

**Other Considerations**

Most of the existing monitoring equipment, including calibrators, is over 10 years old, and replacements will be needed in the near future.

**Future needs**

On January 6, 2010, EPA proposed to strengthen the national ambient air quality standards (NAAQS). The proposed revisions are:

- Strengthen the 8-hour “primary” ozone standard, designed to protect public health, to a level within the range of 0.060-0.070 parts per million (ppm). Both of these levels are shown in the design value trends chart.
- Establish a distinct cumulative, seasonal “secondary” standard, designed to protect sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. EPA is proposing to set the level of the secondary standard within the range of 7-15 ppm-hours.

In a separate rule, EPA proposed in July 2009 to modify the ozone air quality monitoring network design requirements. The proposed modifications are:

- Change minimum monitoring requirements in urban areas, add new minimum monitoring requirements in non-urban areas, and extend the length of the required ozone monitoring season in many states.

- o Urban areas with populations between 50,000 and 350,000 people operate at least one ozone monitor.
- o States be required to operate at least three ozone monitors in non-urban areas.
- Extend the ozone monitoring season; for Delaware the monitoring season would start March 1 and run through October 31.

EPA plans to issue a final rule in coordination with the final ozone standards in August 2010.

It is not anticipated that the proposed new monitoring requirements will require any additional monitors in Delaware since the existing network provides adequate representation for all urban MSAs and non-urban areas in the state. It is particularly noted that despite the various types and locations of ozone monitoring sites in Delaware, the 8-hour design value trends show decreasing variance over time. 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 O<sub>3</sub> – critical criteria shown in bold**

<u>Site</u>	<u>Data Criteria:</u> % NAAQS, Max Concentration, Longevity, AQI	<u>Statistical Criteria:</u> Measurement Criticality, Uniqueness, Trends	<u>Situational Criteria:</u> Meteorological Pattern, Area(1), Area(2), Federal Requirements, Multi-pollutant	<u>Future Needs,</u> <u>Special Considerations:</u> Impact from NAAQS Revisions, Concentration Gradient, Source- impact, Cost, Community	<u>Rating</u>
<b>Brandywine</b>	% <b>NAAQS: Above Current NAAQS</b> Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Calculated	<b>Measurement Criticality:</b> <b>Significant Removal Bias</b> Uniqueness: Moderate Correlation	<b>Meteorological Pattern: Secondary Downwind Direction Wilmington</b>	<b>Impact from NAAQS Revisions:</b> <b>Above Proposed NAAQS</b> Cost: Age of Equipment is greater than 7 years	<b>Critical</b>
<b>Bellefonte 2</b>	% <b>NAAQS: Above Current NAAQS</b> Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Calculated	<b>Measurement Criticality:</b> <b>Significant Removal Bias</b> Uniqueness: Moderate Correlation	<b>Meteorological Pattern: Primary Downwind Direction Wilmington</b>	<b>Impact from NAAQS Revisions:</b> <b>Above Proposed NAAQS</b> Concentration Gradient: between Wilmington and nearby PA/Philadelphia Cost: Age of Equipment is greater than 7 years	<b>Critical</b>
<b>Lums Pond</b>	% <b>NAAQS: Above Current NAAQS</b> Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Calculated	<b>Measurement Criticality:</b> <b>Significant Removal Bias</b> Uniqueness: Moderate Correlation	Meteorological Pattern: Upwind Wilmington <b>Federal Requirement: Transport from Baltimore/Washington Area</b>	<b>Impact from NAAQS Revisions:</b> <b>Above Proposed NAAQS</b> Cost: Age of Equipment is greater than 7 years	<b>Critical</b>
<b>Killens Pond</b>	% <b>NAAQS: Above Current NAAQS</b> Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Forecasted	Measurement Criticality: Insignificant Removal Bias Uniqueness: Moderate Correlation	Area(1): Only site in Kent Co., closest to Dover MSA <b>Federal Requirement: Rural Background</b>	<b>Impact from NAAQS Revisions:</b> <b>Above Proposed NAAQS</b> Cost: Age of Equipment is greater than 7 years Non-urban, rural location for future secondary NAAQS compliance	<b>Critical</b>
<b>Seaford</b>	% <b>NAAQS: Above Current NAAQS</b> Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Forecasted	<b>Measurement Criticality:</b> <b>Significant Removal Bias</b> Uniqueness: Moderate Correlation	Area(2): Micropolitan SA	<b>Impact from NAAQS Revisions:</b> <b>Above Proposed NAAQS</b> Cost: Age of Equipment is 5 years	<b>Critical</b>
<b>Lewes</b>	% <b>NAAQS: Above Current NAAQS</b> Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Forecasted	<b>Measurement Criticality:</b> <b>Significant Removal Bias</b> Uniqueness: Moderate Correlation	<b>Area(2): Only Coastal Site, significant seasonal population exposure</b>	<b>Impact from NAAQS Revisions:</b> <b>Above Proposed NAAQS</b> Population growth expected to continue	<b>Critical</b>

## ***Particulate Matter - Fine (PM<sub>2.5</sub>)***

### **Current PM<sub>2.5</sub> sites**

PM<sub>2.5</sub> is a priority pollutant in Delaware because concentrations remain close to the NAAQS, particularly in the urban Wilmington area. New Castle County continues to be non-attainment for the NAAQS as part of the Philadelphia CSA. Despite improving ambient concentrations, there continue to be days with unhealthy levels of PM<sub>2.5</sub> in the state.

Delaware operates PM<sub>2.5</sub> 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<sub>2.5</sub> 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.
- (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<sub>2.5</sub> site to monitor for regional background and at least one PM<sub>2.5</sub> site to monitor regional transport.



### **PM<sub>2.5</sub> 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 are MLK in Wilmington and Dover in Kent County. The PM<sub>2.5</sub> chemical speciation sites include analysis for elements, selected anions and cations, and carbon.

### **Continuous PM<sub>2.5</sub>**

Delaware operates a continuous PM<sub>2.5</sub> monitor that generates FRM-like hourly and 24-hour data at the MLK site. This monitor operates year-round, and is collocated with an FRM PM<sub>2.5</sub> monitor.

Note: Continuous PM<sub>2.5</sub> data had also been collected at Newark, Killens Pond, and Seaford using different monitoring methodology. The data collected with that instrumentation did not consistently compare well with the FRM data. Operation of these monitors at Killens Pond and Seaford is continuing during work with the manufacturer on improving performance, with the goal of supporting AQI forecasting and providing supplemental information on hourly PM<sub>2.5</sub> concentrations in the relevant counties.

**PM<sub>2.5</sub> 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<sub>2.5</sub> data represents 24-hour averages, traditional pollution roses are not available; if hourly continuous PM<sub>2.5</sub> 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 ozone and SO<sub>2</sub>; PM<sub>2.5</sub> monitoring began in 1999. Bellefonte PM<sub>2.5</sub> 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 will begin during 2010 with all monitors fully operational by January 1, 2011.

Continuous PM<sub>2.5</sub> monitoring using an 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 hourly data are submitted to the AirNOW website and the AQS database. This is currently the only continuous PM<sub>2.5</sub> monitoring in New Castle County.

**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<sub>2.5</sub> 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<sub>2.5</sub> monitoring began in 1999. Monitoring objectives are regional transport, general population exposure, trends, and NAAQS compliance.

#### **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.

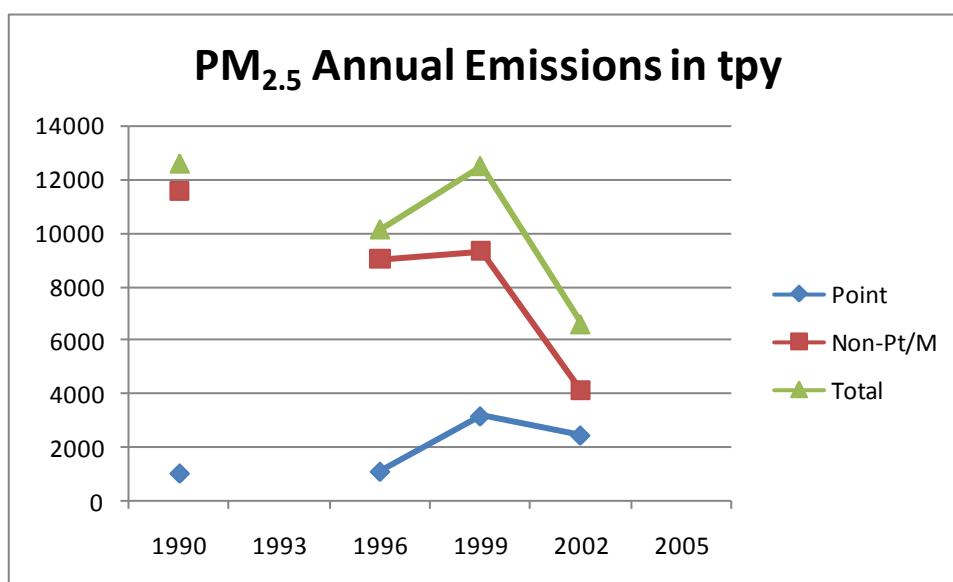
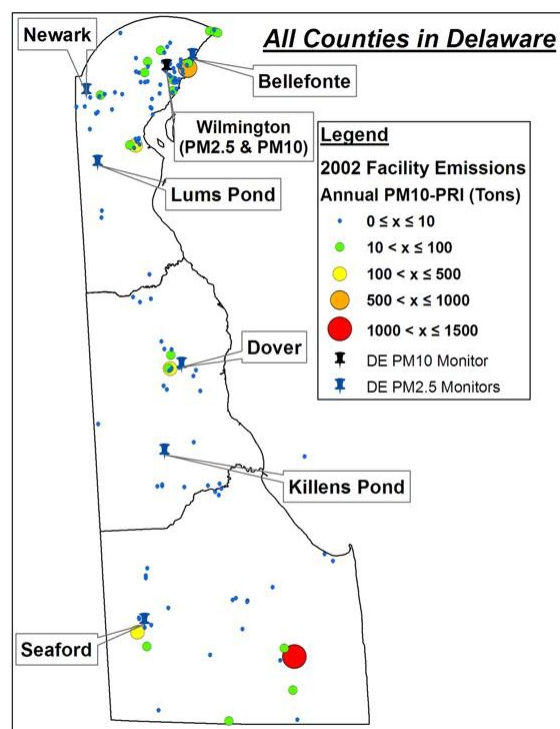
**Killens Pond** (10-001-0002) The Killens Pond site was established in 1997 and is located in a rural area that is part of Killens Pond State Park. PM<sub>2.5</sub> monitoring began at this site in 1999. The site meets all EPA siting criteria. The objectives for this site are regional background concentrations, NAAQS compliance, and trends.

Continuous PM<sub>2.5</sub> monitoring using a non-FRM-like method began at this site in 2003 and is continuing in support of data analysis, diurnal pattern assessment, and potential AQI generation. This is the only continuous PM<sub>2.5</sub> monitoring in Kent County.

#### **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<sub>2.5</sub> 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.

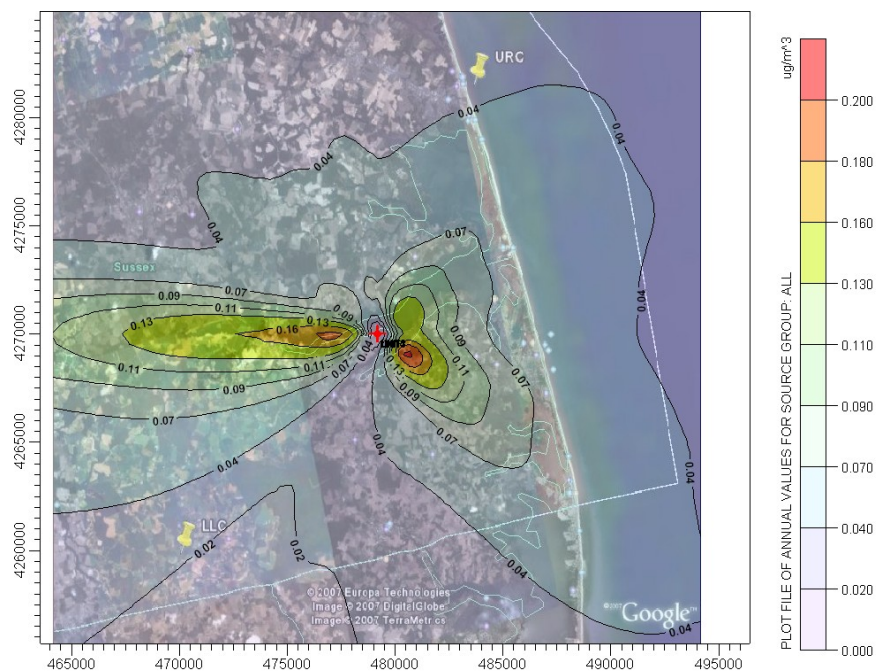
Continuous PM<sub>2.5</sub> monitoring using a non-FRM-like method began at this site in 2003 and is continuing in support of data analysis, diurnal pattern assessment, and potential AQI generation. This is the only continuous PM<sub>2.5</sub> monitoring in Sussex County.

**Emissions info/maps**

The largest PM<sub>2.5</sub> point sources in Delaware are power plants, refineries, and industrial boilers. The largest source is the coal fired power plant in Millsboro, Sussex County; however, new pollution controls and unit shut-downs will result in major emissions reductions over the next three to five years.

In 2007, a special three month study was conducted to determine if the Seaford site was representative of the Millsboro area for PM<sub>2.5</sub>. American Meteorological Society/EPA Regulatory Model (AERMOD) analysis indicated that the source contribution of PM<sub>2.5</sub> to the local area annual average was less than 2 µg/m<sup>3</sup>.

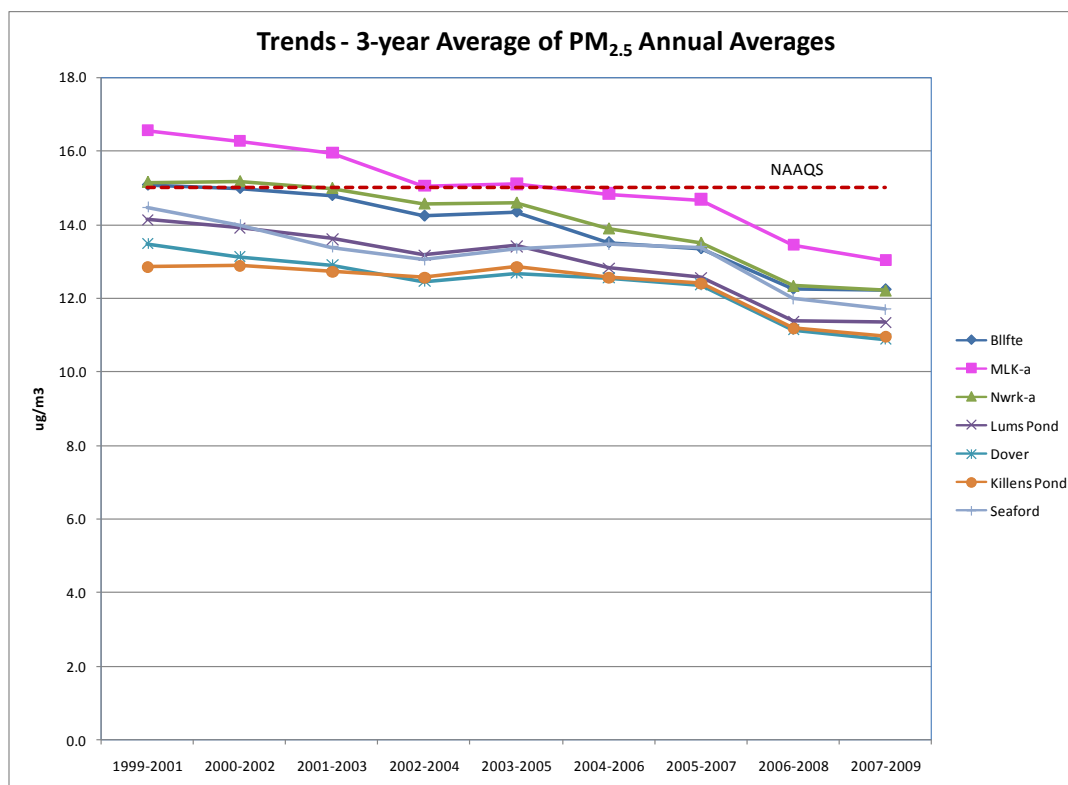


**Modeled PM<sub>2.5</sub> annual average concentration contribution from Millsboro power plant**

Results of the 3-month monitoring study using portable PM<sub>2.5</sub> samplers indicated that the Seaford site was representative of ambient concentrations in the Millsboro area. Analysis included evaluation of meteorology associated with the highest concentrations days, and supported the conclusion that regional PM<sub>2.5</sub> levels were the dominant factor for ambient concentrations in Sussex County.

## Statistical Analysis

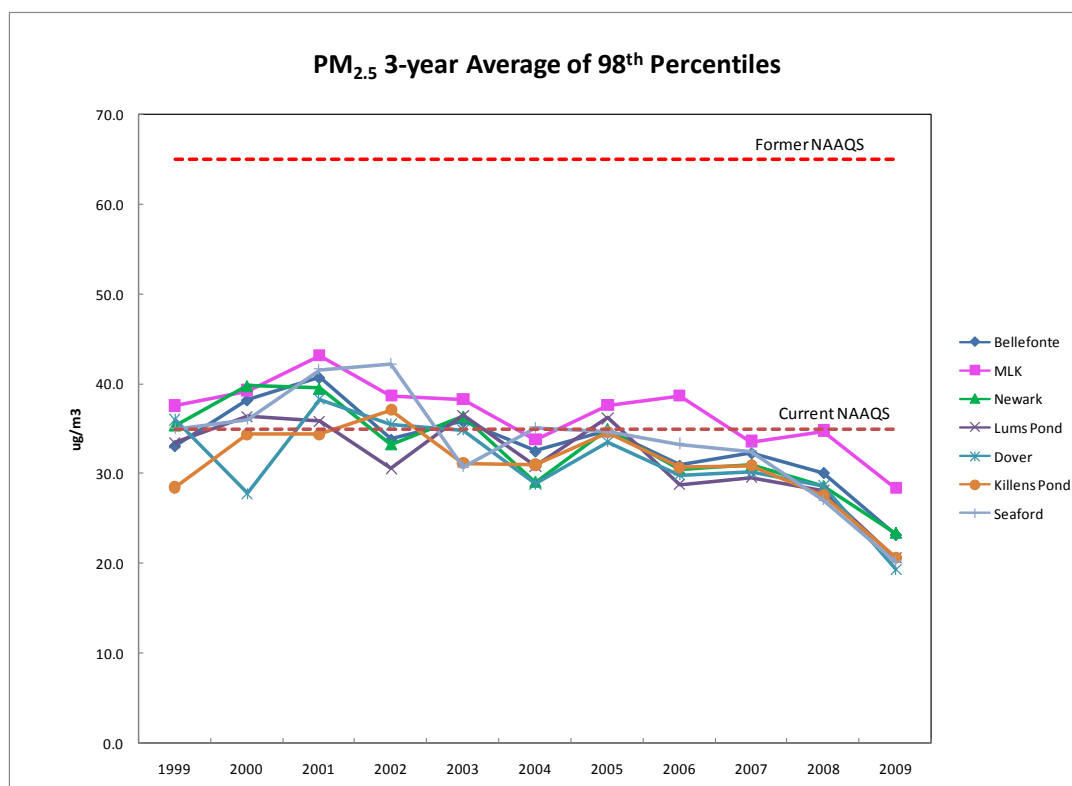
### Design value trends – annual average



### 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

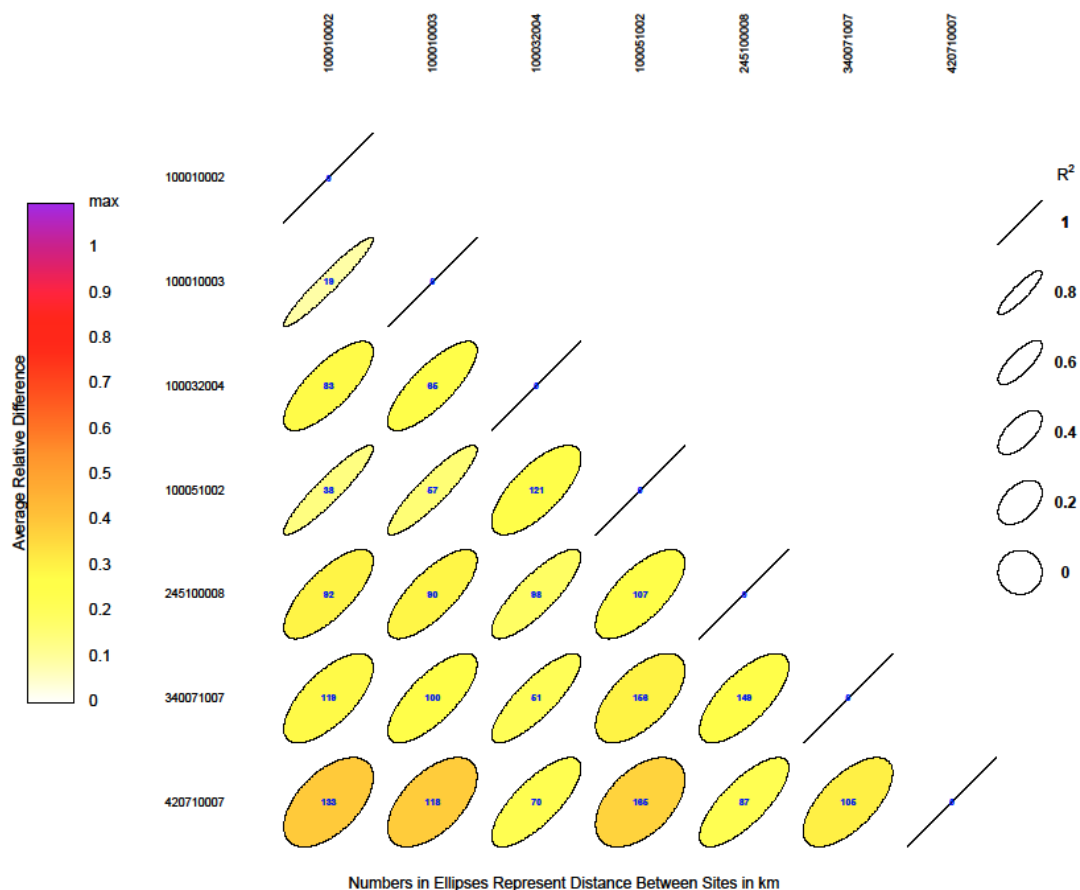
The trends in annual average concentrations at all sites in Delaware have been downward since monitoring began in 1999.

**Design value trends – 98<sup>th</sup> percentiles****98<sup>th</sup> 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

Trends for the 98<sup>th</sup> 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  $\mu\text{g}/\text{m}^3$  NAAQS.

Correlation matrix - Only four sites in Delaware (MLK, Killens Pond, Dover, and Seaford) were used for the correlation test due to low data capture at the remaining sites (Bellefonte, Newark, and Lums Pond). Please refer to the ozone section for more information on the correlation matrix tool and output.

**Correlation matrix – Delaware and nearby state PM<sub>2.5</sub> FRM monitors****Correlation data – R<sup>2</sup> values for 2005 – 2008 annual averages**

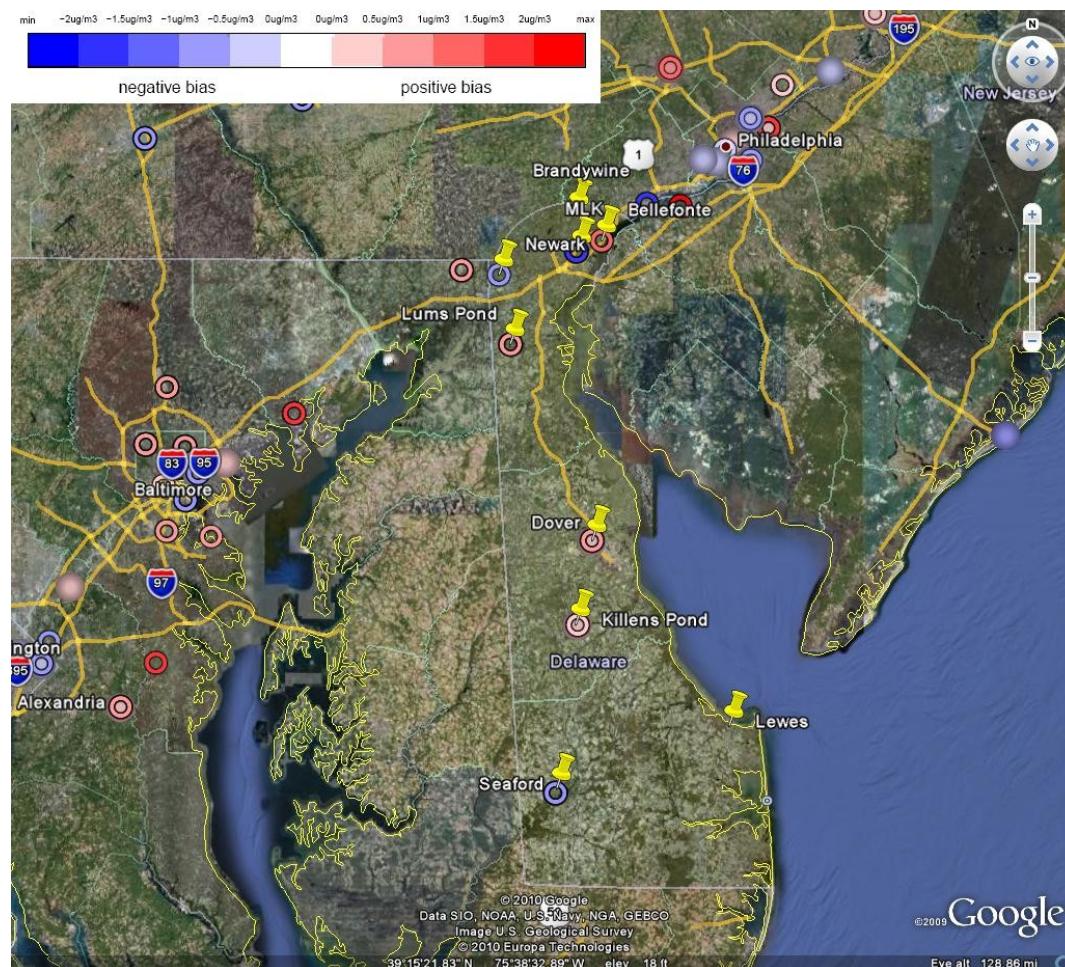
Site ID	10-001-0002	10-001-0003	10-003-2004	10-005-1002	24-510-0008	34-007-1007
10-001-0002						
10-001-0003	0.96					
10-003-2004	0.77	0.80				
10-005-1002	0.93	0.91	0.72			
24-510-0008	0.75	0.76	0.83	0.70		
34-007-1007	0.68	0.74	0.83	0.62	0.71	
42-071-0007	0.55	0.57	0.77	0.50	0.77	0.65

**Correlation data – average relative difference for 2005 – 2008 for annual averages**

Site ID	10-001-0002	10-001-0003	10-003-2004	10-005-1002	24-510-0008	34-007-1007
10-001-0002						
10-001-0003	0.08					
10-003-2004	0.25	0.25				
10-005-1002	0.13	0.14	0.23			
24-510-0008	0.27	0.27	0.17	0.25		
34-007-1007	0.26	0.23	0.19	0.27	0.25	
42-071-0007	0.36	0.35	0.21	0.34	0.20	0.28

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 was less correlated ( $R^2$  from 0.7 – 0.8). Looking at sites outside Delaware, there was slightly less correlation ( $R^2$  from 0.5 – 0.7) and somewhat higher average relative difference, again generally increasing with greater distance between the sites.

**Removal bias** – Please refer to the discussion in the Ozone section for more information on this EPA statistical tool.



**Removal bias data output – only years with complete data used in calculations**

AQS ID	Site Name	Mean bias	Significant/ Insignificant	Years used in calc.	DV annual avg 06-08	DV 24-hr avg 06-08
100010002	Killens Pond	0.275	sig	2005-2008	11.8	30
100010003	Dover	0.375	sig	2005-2008	11.7	30
100031003	Bellefonte	1.15	sig	2005-2007	12.9	32
100031007	Lums Pond	1.23	sig	2005-2007	11.8	29
100031012	Newark	-1	sig	2007	12.9	30
100032004	MLK	-1.625	sig	2005-2008	14.2	36
100051002	Seaford	-0.925	sig	2005-2008	12.7	31

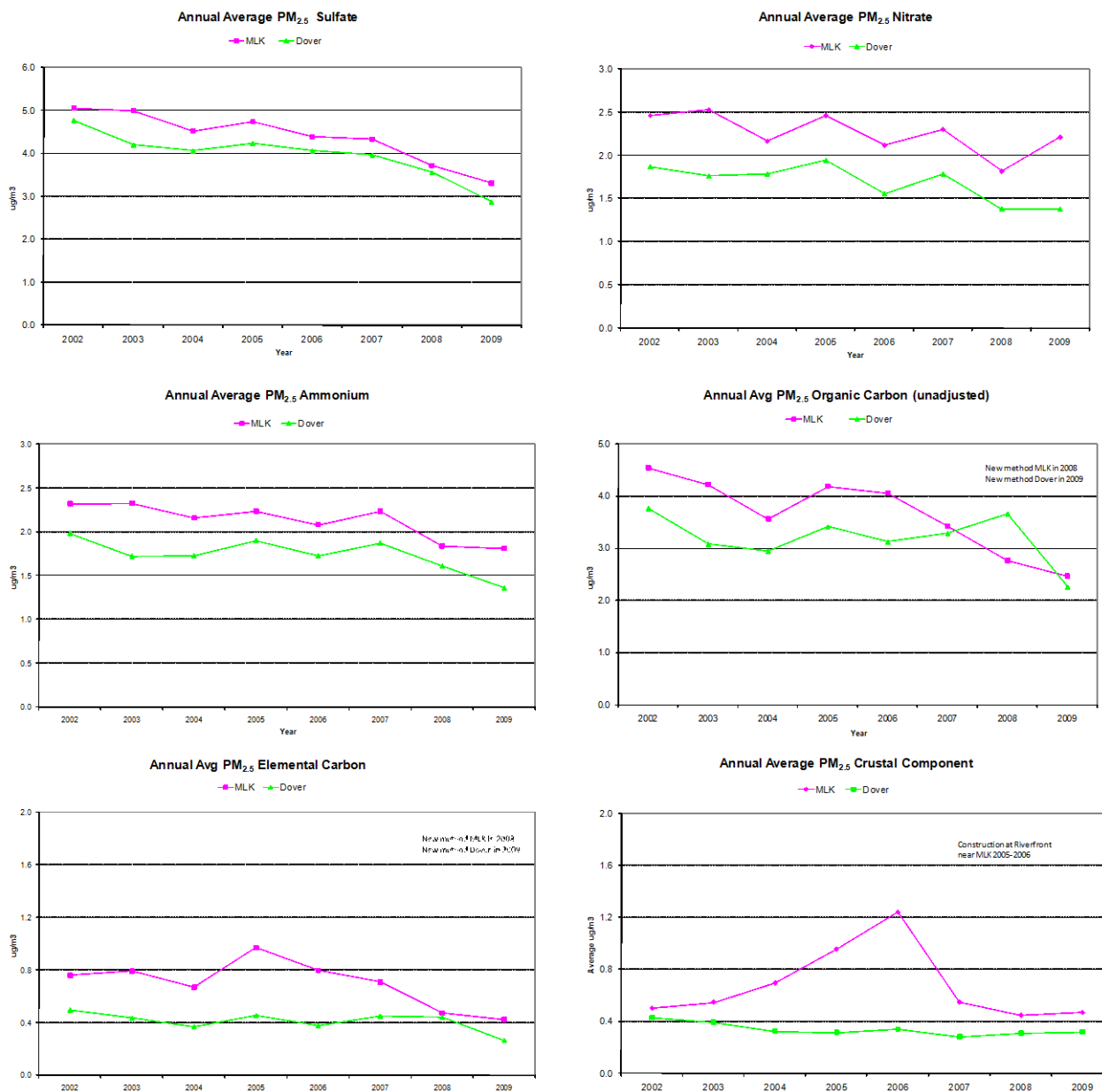
The removal bias analysis indicates that for all PM<sub>2.5</sub> monitoring sites in Delaware, a significant bias would be introduced to the design values if any site were removed.

## PM<sub>2.5</sub> speciation

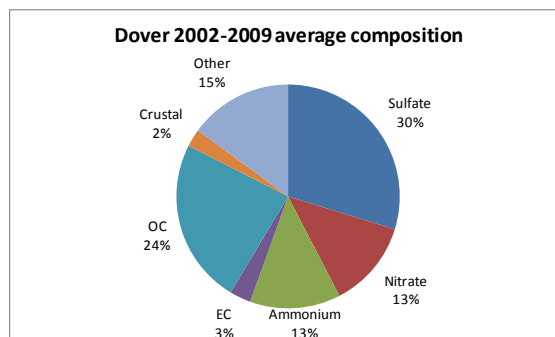
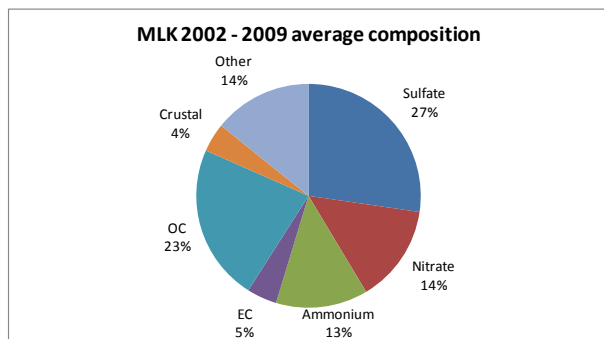
Delaware began operating PM<sub>2.5</sub> chemical speciation monitors in 2001 at two sites; one at the annual and 98<sup>th</sup> percentile design value site in Wilmington (MLK) and the other at Dover. The first full year of data was collected in 2002. In 2008 the carbon method was changed to the Improve method at MLK; the change occurred at Dover in 2009.

Data from these monitors is used to evaluate PM<sub>2.5</sub> composition, possible sources impacting concentrations, and evaluation of control measures and trends. Analysis of the data is ongoing.

### PM<sub>2.5</sub> speciation trends of major components.





**Speciation data – major components as percentage of total mass, averaged over 2002 – 2009**

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 reflects nearby construction activity

**Other issues**

Local community concerns have become more prominent in recent years, particularly with regard to ambient particulate matter concentrations. One local community that has expressed concerns is in the Millsboro area of Sussex County (power plant); others include the Claymont community in northern Delaware (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 either underway or 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) as well as encouraging local large point sources to conduct their own monitoring projects.

 **$PM_{10}$** 

Delaware currently operates one continuous  $PM_{10}$  FEM monitor for AQI generation and supplemental information purposes. When the NCore program is fully implemented, a  $PM_{10}$  FRM will be operating as part of the  $PM_{coarse}$  monitor and provide FRM data on a 1 in 6 day basis.

**Continuous  $PM_{2.5}$  monitoring**

Delaware currently operates two different models of continuous  $PM_{2.5}$  monitors – the SHARP and the BAM C-14, both from Thermo Fischer.



The SHARP is a hybrid nephelometer/beta attenuation monitor. At this time only the SHARP monitor is close to meeting the Federal Equivalency Method (FEM) requirements for PM<sub>2.5</sub>; this monitor is located at the design value site (MLK) and is used to support AQI forecasting and reporting as well as other types of data analyses, including diurnal and meteorological patterns.

The BAM monitors were purchased in 2003 and represent older beta attenuation technology. The BAM monitors are sited at Killens Pond and Seaford so that each county has a continuous monitor; however, the BAMs do not have the hardware and firmware upgrades necessary to meet FEM status. These upgrades cannot be achieved without additional funding support. Meanwhile, the data are used for general data analyses and non-FRM-like AQI estimates for internal use only.

Delaware does not anticipate being able to transition from FRM to continuous FEM without significant additional funding support.

## **Future needs**

Monitoring data indicate that all areas in Delaware are in compliance with the current annual and 24-hour NAAQS; however, since New Castle County is considered part of the larger Philadelphia CBSA it is still considered to be non-attainment for PM<sub>2.5</sub>. Any future changes or modifications to the NAAQS may impact Delaware's status and monitoring network requirements.

Future areas of effort include updating the 2005 speciation data source apportionment study using more recent data, incorporating multi-pollutant factors and trends, on-going evaluation of continuous monitoring methods and data, and updating the PM emissions inventory.

**Summary information and monitor rating for PM<sub>2.5</sub> - critical criteria shown in bold**

<u>Site</u>	<u>Data Criteria:</u> % NAAQS, Max Concentration, Longevity, AQL	<u>Statistical Criteria:</u> Measurement Criticality, Uniqueness, Trends	<u>Situational Criteria:</u> Meteorological Pattern, Area(1), Area(2), Federal Requirements, Multi-pollutant	<u>Future Needs, Special Considerations:</u> Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	<u>Rating</u>
Bellefonte	% NAAQS: Below current NAAQS Longevity: Long trend history	Measurement Criticality: Significant removal bias	Meteorological Pattern: Generally downwind of Wilmington	Concentration Gradient: Between Wilmington and Chester, PA Closest Site to Claymont community and local power plant	Credible
<b>MLK</b>	% NAAQS: Below current NAAQS Longevity: Long trend history <b>Max Concentration: Design Value</b>	<b>Measurement Criticality:</b> <b>Significant removal bias</b> Uniqueness: Moderate Correlation <b>Trends: Tracking control strategies</b>	<b>Federal Requirement: NCore Site</b> <b>Federal Requirement: Speciation Data</b> Area(1): Urban site Multi-pollutant: Collocated with multiple parameters	Source impact: Local source impacts  Local community concerns	<b>Critical</b>
Newark	% NAAQS: Below current NAAQS Longevity: Long trend history	Measurement Criticality: Significant removal bias	Area(2): Only monitor in Newark area	Single pollutant site Concentration Gradient: Gradient between Wilmington, DE and Fair Hill, MD	Credible
<b>Lums Pond</b>	% NAAQS: Below current NAAQS Longevity: Long trend history	<b>Measurement Criticality:</b> <b>Significant removal bias</b>	<b>Federal Requirement:</b> Background/Transport Site	Not applicable	<b>Critical</b>
<b>Dover</b>	% NAAQS: Below current NAAQS Longevity: Long trend history	<b>Measurement Criticality:</b> <b>Significant removal bias</b> Uniqueness: Moderate Correlation	<b>Federal Requirement: Speciation Data</b> Area(1): Represents Dover MSA	Not applicable	<b>Critical</b>
<b>Killens Pond</b>	% NAAQS: Below current NAAQS Longevity: Long trend history	<b>Measurement Criticality:</b> <b>Significant removal bias</b> Uniqueness: Moderate Correlation	<b>Federal Requirement: Rural Background Site</b>	Not applicable	<b>Critical</b>
<b>Seaford</b>	% NAAQS: Below current NAAQS Longevity: Long trend history <b>Max Concentration: Design Value for Seaford microSA</b>	<b>Measurement Criticality:</b> <b>Significant removal bias</b> Uniqueness: Moderate Correlation	<b>Area(1): Only Site in Sussex County</b>	Future emissions decrease for Millsboro source Local community concerns Largest Delaware PM <sub>2.5</sub> source located in Sussex County	<b>Critical</b>

## **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 operates two CO monitoring sites, both in New Castle County; monitors operate 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
Route 9/Delaware City	New Castle Not in MSA	NAAQS compliance Point source impact Trends

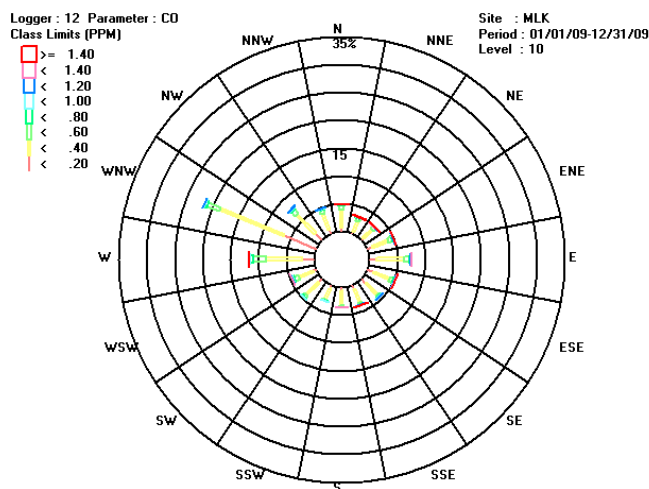
## Situational analyses

### New Castle County sites and characteristics

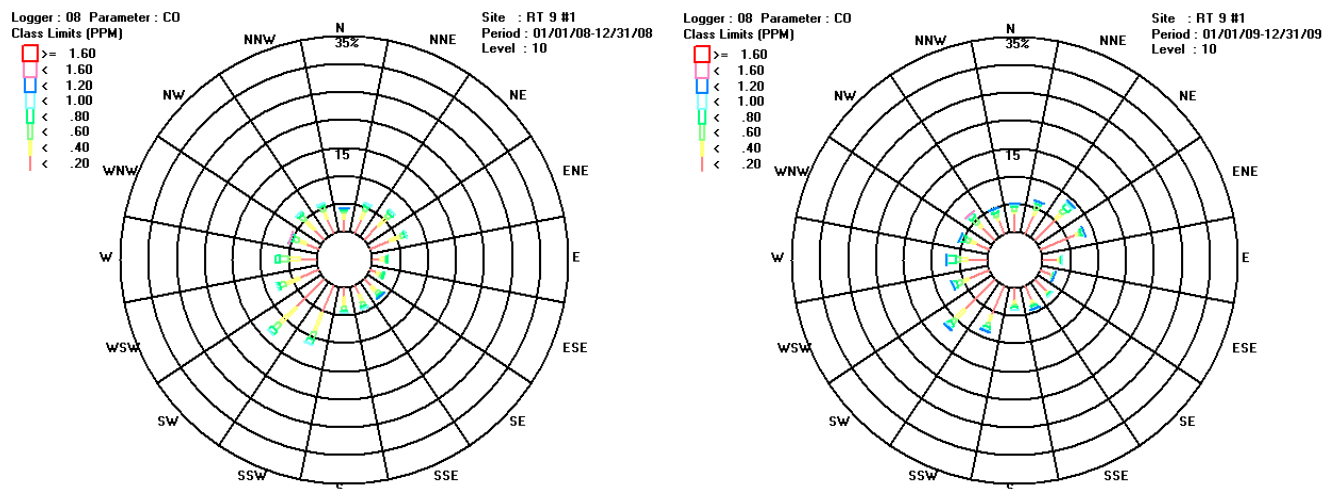
**MLK (10-003-2004)** The MLK site was established in 1999 at the intersection of Justison St. and MLK Blvd in Wilmington. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is middle scale for CO and represents an urban mobile-source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

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 2009 data

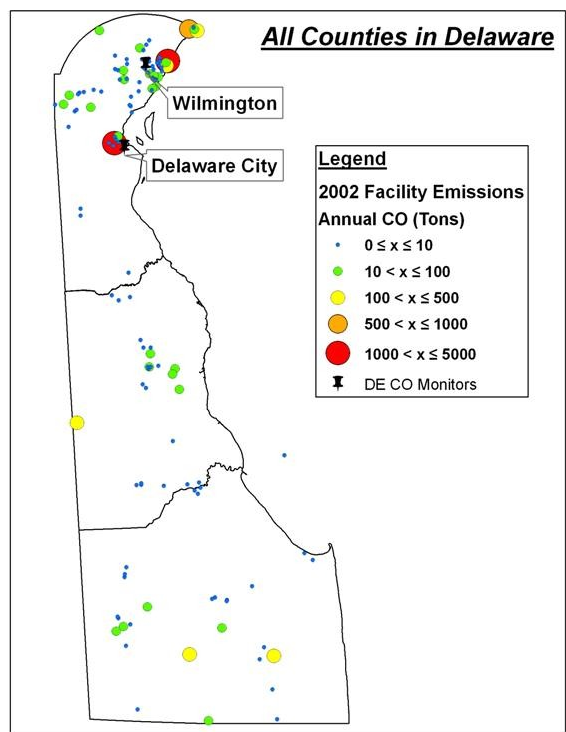


**Delaware City (10-003-1008)** The Delaware City site was established as an SO<sub>2</sub> site in 1992 at a location along Route 9 between the Delaware City industrial complex (including an oil refinery) and the nearest populated area (Delaware City) in the predominant downwind direction. CO monitoring was added in 1994. This site is middle scale and the primary objective is point-source impact assessment. The site meets all EPA siting criteria.

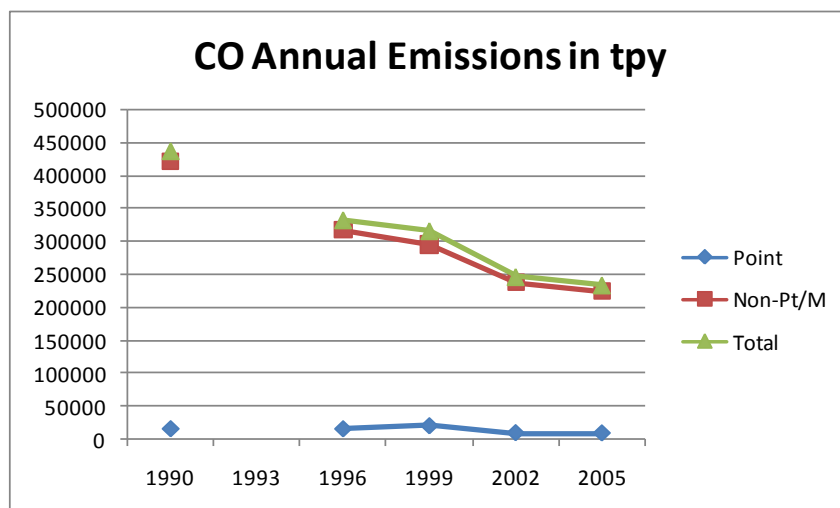
**CO Pollution roses - Delaware City 2008 and 2009 data**

Two different years of pollution roses are shown for Delaware City because the major point source that impacts the site (Delaware City oil refinery) underwent a temporary shutdown in 2009 (continuing into 2010); thus 2008 maybe more representative of pollution patterns.

Overall concentrations of CO at Delaware City are quite low, despite the large oil refinery to the northwest.

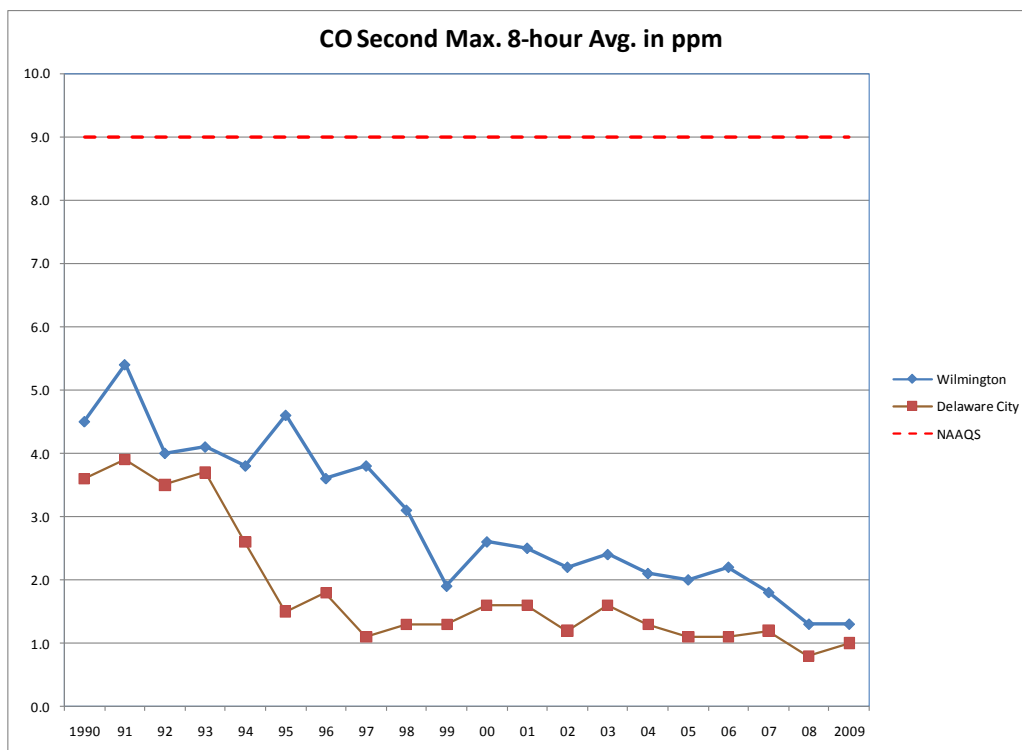
**Emissions info: maps & trends**

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 maximum daily 8-hour average. Wilmington data from 1990 – 1998 is from the 12<sup>th</sup> & King Sts. location; after that the data are from the MLK location.

**Annual 2<sup>nd</sup> max. 8-hour average in ppm**

Year	Wilmington	Del. City	Year	Wilmington	Del. City
1990	4.5	3.6	2000	2.6	1.6
1991	5.4	3.9	2001	2.5	1.6
1992	4.0	3.5	2002	2.2	1.2
1993	4.1	3.7	2003	2.4	1.6
1994	3.8	2.6	2004	2.1	1.3
1995	4.6	1.5	2005	2.0	1.1
1996	3.6	1.8	2006	2.2	1.1
1997	3.8	1.1	2007	1.8	1.2
1998	3.1	1.3	2008	1.3	0.8
1999	1.9	1.3	2009	1.3	1.0

The trend in annual average concentrations at all sites in Delaware 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; although air quality continues to improve, the rate is slower in recent years.

### **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.

The CO NAAQS is scheduled for review in the near future, and the possibility exists of a change in emphasis from community-wide or middle-scale sites to near-roadway sites. This is similar to currently under consideration in the most recent NO<sub>2</sub> NAAQS proposal. Delaware will evaluate CO monitoring requirements to maintain compliance with future EPA specifications.

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

<u>Site</u>	<u>Data Criteria:</u> % NAAQS, Max Concentration, Longevity, AQI	<u>Statistical Criteria:</u> Measurement Criticality, Uniqueness, Trends	<u>Situational Criteria:</u> Meteorological Pattern, Area(1), Area(2), Federal Requirements, Multi-pollutant	<u>Future Needs,</u> <u>Special Considerations:</u> Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	<u>Rating</u>
<b>MLK</b>	% NAAQS: Below current NAAQS Longevity: Long trend history <b>Max Concentration: Design Value</b> AQI Calculated	<b>Trend: Used for tracking control strategies,</b> downward trend in concentrations	<b>Federal Requirement: NCore Site</b> Multi-pollutant: Collocated with multiple parameters	Local community concerns May qualify as near-road site for CO only Source-impact: local & mobile source impacts	<b>Critical</b>
Route 9 DE City	% NAAQS: Below 50% of current NAAQS Longevity: Moderate trend history Max Concentration: Lowest concentration	Trend: Downward trend in concentrations	Meteorological Pattern: Downwind major point source Multi-pollutant: Collocated with SO <sub>2</sub> and air toxics monitors	Cost: Age of Equipment is greater than 7 years Urban street canyons most appropriate sites	Marginal



## SO<sub>2</sub>

### Current SO<sub>2</sub> sites

While SO<sub>2</sub> is not currently a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS, the proposed new NAAQS may result in areas in Delaware becoming non-attainment. Monitoring objectives for SO<sub>2</sub> include NAAQS compliance, trends tracking, AQI generation, and emission control strategy tracking.

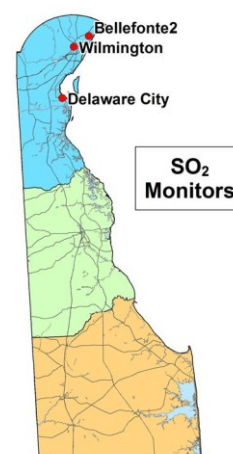
From the 1970s through the 1990s, SO<sub>2</sub> monitoring was conducted in all three counties in Delaware. Since the mid 1990s, however, due to continuing low ambient concentrations (well below the primary and secondary NAAQS) and declining resources, monitoring has been restricted to sites in New Castle County where the highest concentrations were being recorded.

### Monitoring Requirements

There are currently no minimum requirements for the number of SO<sub>2</sub> monitoring sites in Delaware; however, proposed new NAAQS monitoring regulations will require some SO<sub>2</sub> monitors, with the exact number to be determined (at least two based on existing proposals). The new regulations will require source-oriented sites in populated areas with maximum short-term concentrations.

The NCore program also requires trace SO<sub>2</sub> monitoring at the single NCore site in Delaware (MLK in Wilmington).

Delaware currently operates four SO<sub>2</sub> monitoring sites, all in New Castle County; monitors operate year-round. The appropriate spatial scales for SO<sub>2</sub> monitoring are the micro, middle, and possibly neighborhood scales.



### SO<sub>2</sub> 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

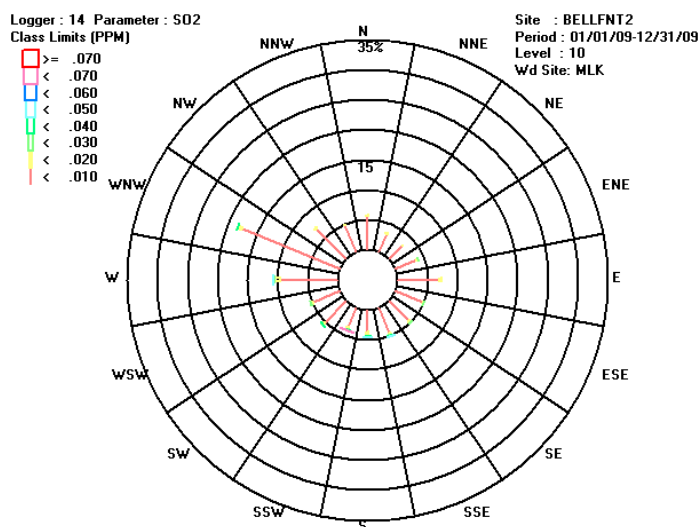
## Situational analyses

### New Castle County sites and characteristics

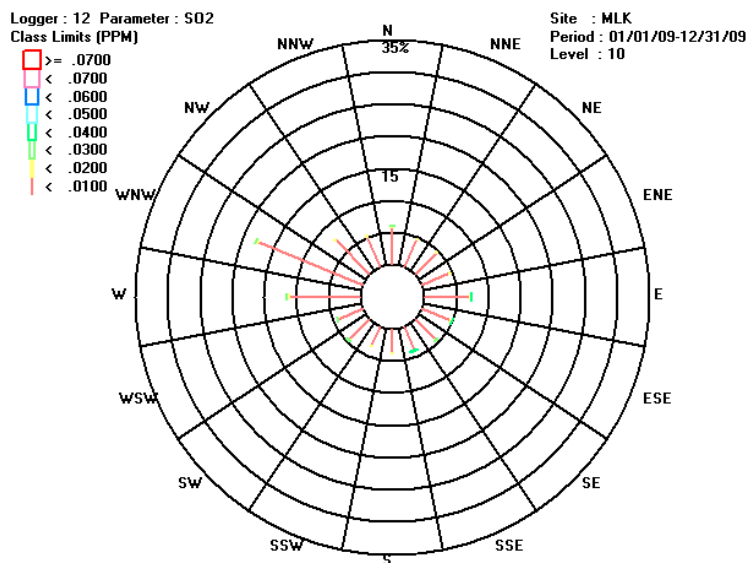
**Bellefonte2** (10-003-1013) is the successor site to Bellefonte (10-003-1003). Bellefonte was originally established in 1969 to monitor O<sub>3</sub> and SO<sub>2</sub>. When changing site characteristics began to interfere with ozone monitoring, a new site (Bellefonte2) was established in 2001 in Bellevue State Park, less than a mile to the north. The Bellefonte2 site meets all EPA siting criteria.

Bellefonte2 is neighborhood scale for SO<sub>2</sub>, 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 – 2009



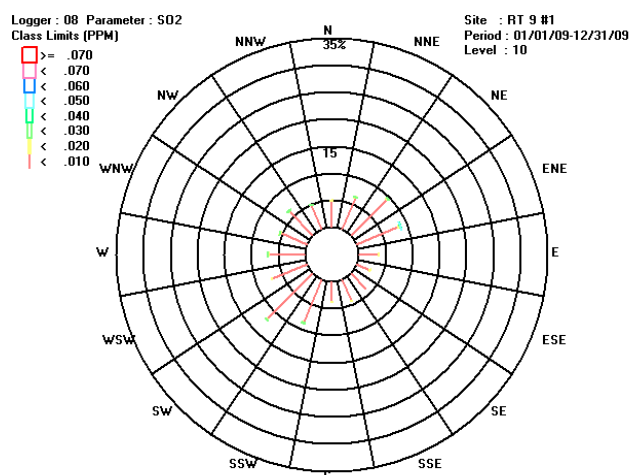
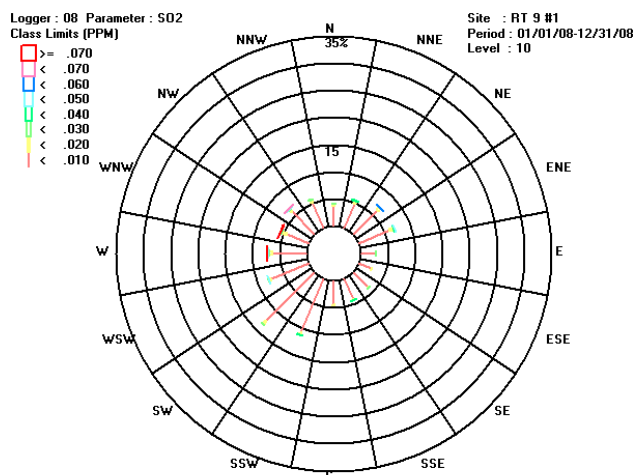
**MLK** (10-003-2004) The MLK site was established in 1999 at the intersection of Justison St. and MLK Blvd in Wilmington. It replaced another urban site at 12th and King Streets that had operated at that location for over 20 years. The MLK site is neighborhood scale for SO<sub>2</sub> and represents an urban core site impacted by point, area, and mobile sources. The site meets all EPA siting criteria. Trace SO<sub>2</sub> monitoring began in 2009 and will continue as the MLK site transitions to NCore.

**SO<sub>2</sub> Pollution rose – MLK 2009 data**

**Delaware City (10-003-1008)** The Delaware City site was established as an SO<sub>2</sub> 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 Gov. Bacon operated from 1969 to 1991) in Delaware City. The current site is neighborhood scale for SO<sub>2</sub> and the primary objective is point-source impact assessment. The site meets all EPA siting criteria.

**SO<sub>2</sub> Pollution roses - Delaware City 2008 and 2009 data**

Two different years of pollution roses are shown for Delaware City because the major point source that impacts the site (Delaware City oil refinery) underwent a temporary shutdown in 2009 (continuing into 2010); thus 2008 maybe more representative of pollution patterns.

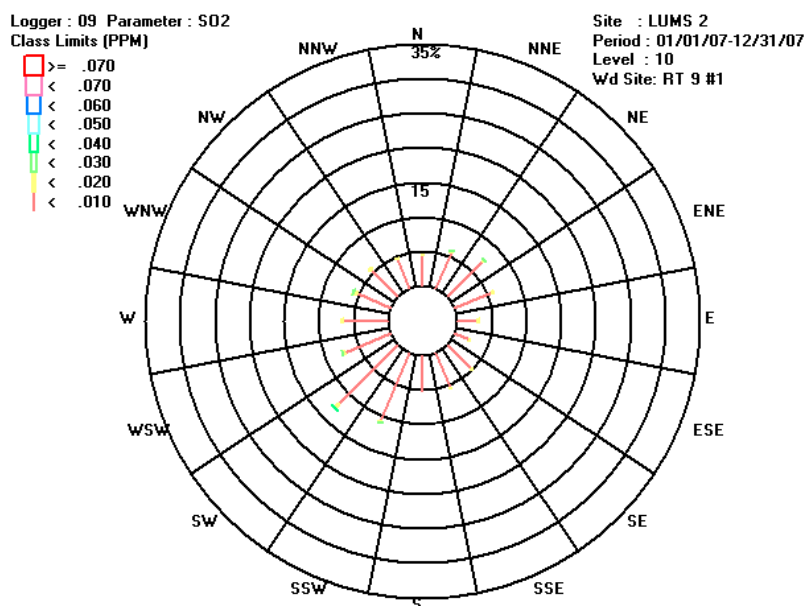


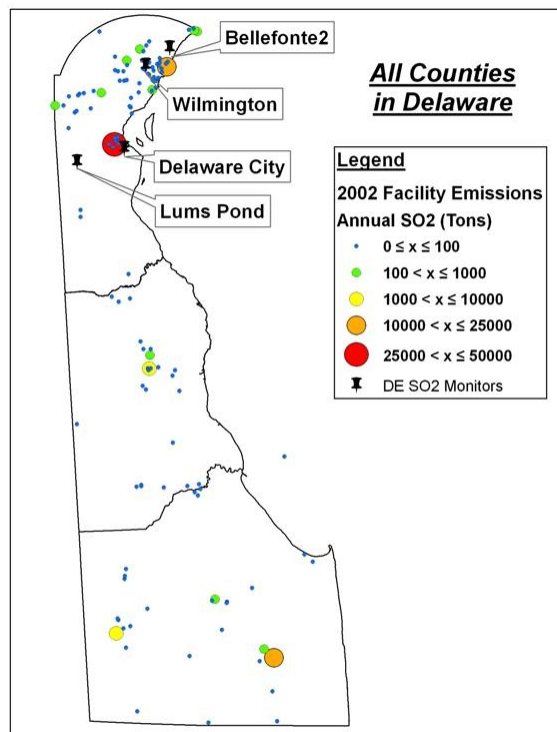
**Lums Pond) (10-003-1007).** The original Lums Pond site (10-003-0018) was established primarily as an ozone monitoring site in 1981 at Lums Pond State Park. Changes in a nearby park maintenance area caused the site to be moved to a more open area of the park in late 1991, and the new Lums Pond site began reporting data in January 1992. SO<sub>2</sub> 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.

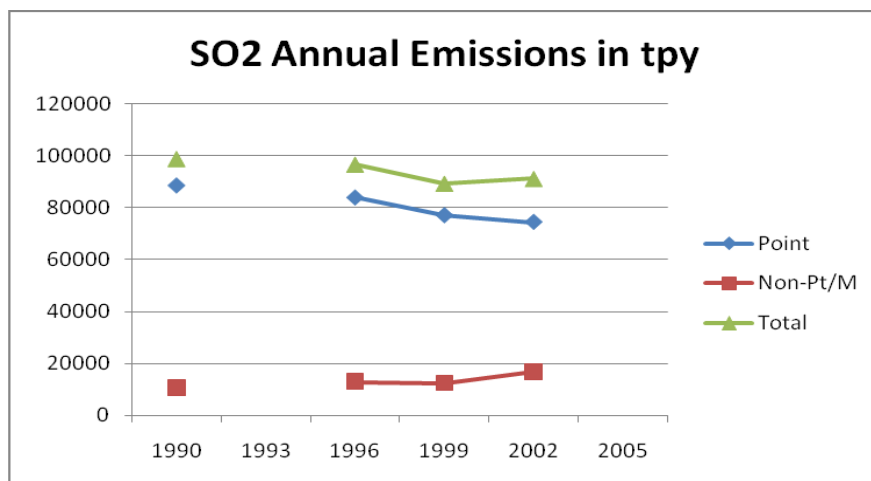
The objectives and site types are NAAQS compliance, secondary downwind source impact, regional transport, population exposure, and trends.

#### Pollution rose – 2007 (most recent year of data)



**Emissions info: maps & trends**

The largest SO<sub>2</sub> point source in Delaware is the oil refinery in Delaware City, followed by power plants in Edgemoor (northeast of Wilmington) and Millsboro. The vast majority of SO<sub>2</sub> emissions are from industrial point sources.

**SO<sub>2</sub> Emissions Trends**

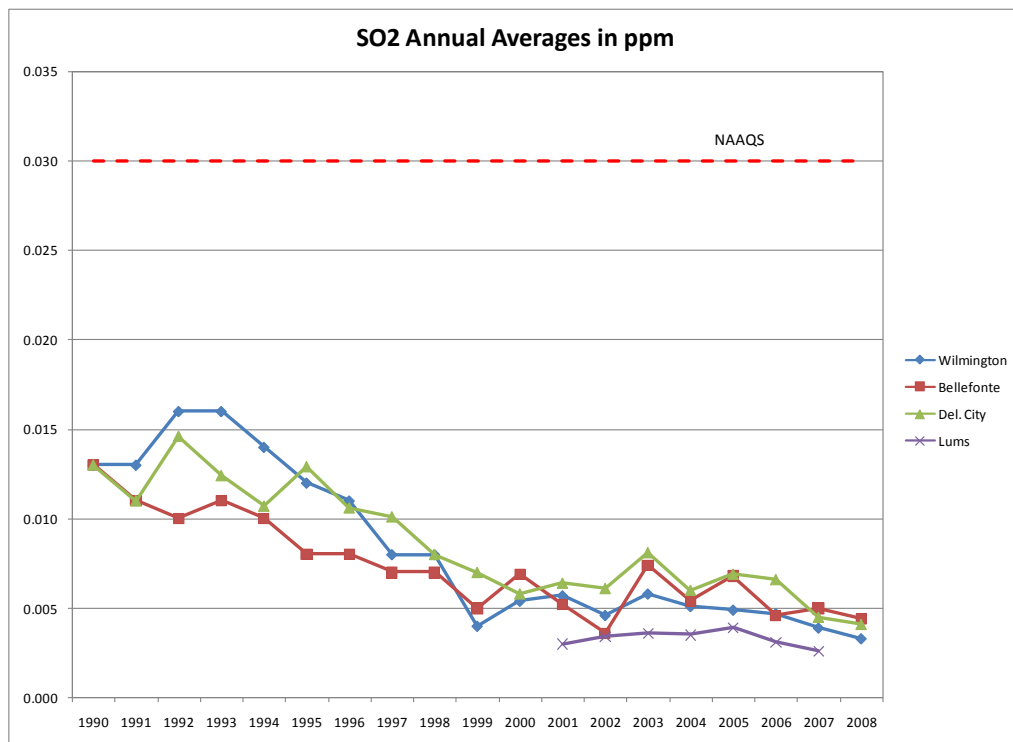
Downward trends in point source emissions are largely due to regulatory programs such as the Acid Rain Program, Clean Air Interstate Rule (CAIR), and sulfur in fuel requirements.

## Statistical Analysis

The current primary NAAQS for SO<sub>2</sub> are an annual arithmetic mean of 0.03 ppm and a 24-hour average of 0.14 ppm; the secondary NAAQS is a 3-hour average of 0.5 ppm. The 24-hour and 3-hour standards are not to be exceeded more than once per year.

### Design value trends – Annual averages in ppm

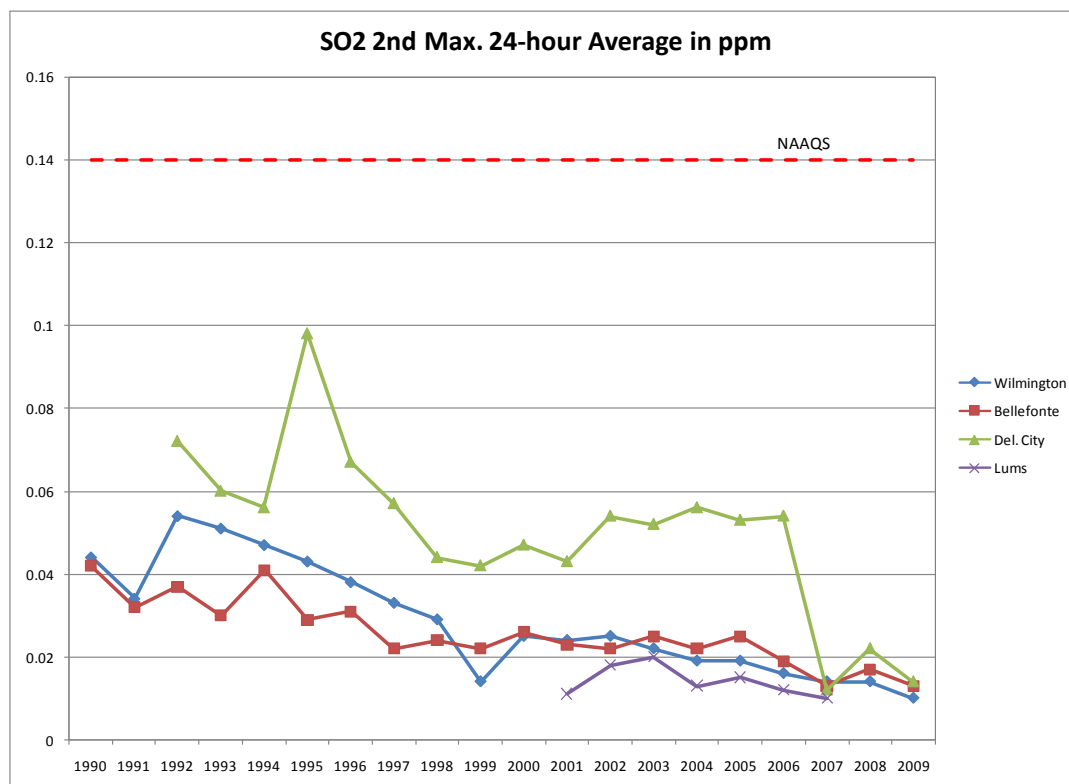
Year	Bellefonte/2	Wilmington/MLK	Del. City	Lums Pond
1990	0.013	0.013	0.011	
1991	0.011	0.013	0.012	
1992	0.010	0.016	0.016	
1993	0.011	0.016	0.012	
1994	0.010	0.014	0.011	
1995	0.008	0.012	0.013	
1996	0.008	0.011	0.011	
1997	0.007	0.008	0.011	
1998	0.007	0.008	0.008	
1999	0.005	0.004	0.007	
2000	0.007	0.005	0.006	
2001	0.005	0.006	0.006	0.003
2002	0.004	0.005	0.006	0.003
2003	0.007	0.006	0.008	0.004
2004	0.005	0.005	0.006	0.004
2005	0.007	0.005	0.007	0.004
2006	0.005	0.005	0.007	0.003
2007	0.005	0.004	0.005	0.003
2008	0.004	0.003	0.004	Not avail.
2009	0.004	0.003	0.004	Not avail.

**SO<sub>2</sub> Trends – Annual Averages****SO<sub>2</sub> Second Maximum 24-hour Average Data**

Year	Wilmington/ MLK	Bellefonte/2	Del. City	Lums Pond
1990	0.044	0.042		
1991	0.034	0.032		
1992	0.054	0.037	0.072	
1993	0.051	0.03	0.06	
1994	0.047	0.041	0.056	
1995	0.043	0.029	0.098	
1996	0.038	0.031	0.067	
1997	0.033	0.022	0.057	
1998	0.029	0.024	0.044	
1999	0.014	0.022	0.042	
2000	0.025	0.026	0.047	
2001	0.024	0.023	0.043	0.011
2002	0.025	0.022	0.054	0.018
2003	0.022	0.025	0.052	0.020
2004	0.019	0.022	0.056	0.013
2005	0.019	0.025	0.053	0.015

Year	Wilmington/ MLK	Bellefonte/2	Del. City	Lums Pond
2006	0.016	0.019	0.054	0.012
2007	0.014	0.013	0.012	0.010
2008	0.014	0.017	0.022	Not available
2009	0.010	0.013	0.014	Not available

### SO<sub>2</sub> Trends – Second Highest 24-hour Average



The trend in annual average and 24-hour concentrations at all sites in Delaware has been downward since monitoring began in the 1960s. Significant improvements in ambient concentrations of SO<sub>2</sub> 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.

There have been no exceedances of the existing SO<sub>2</sub> NAAQS in Delaware since the 1970s.



## Future needs

On November 16, 2009, EPA proposed to strengthen the NAAQS for SO<sub>2</sub>. EPA is proposing to revise the primary SO<sub>2</sub> standard, designed to protect public health, to a level of between 50 and 100 parts per billion (ppb) measured over 1-hour. The existing primary standards were 140 ppb measured over 24-hours, and 30 ppb measured over an entire year. For the new 1-hour SO<sub>2</sub> standard, EPA is proposing that the form be a 3-year average of the 4th highest daily maximum 1-hour average concentration in a year, or its equivalent (a 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations).

### SO<sub>2</sub> 4<sup>th</sup> Highest Daily 1-hour Average in ppm

Year	Wilmington	Bellefonte	Del. City
2006	0.047	0.077	0.139
2007	0.050	0.063	0.041
2008	0.044	0.060	0.051
2009	0.029	0.041	0.028

EPA is proposing specific minimum requirements to guide where SO<sub>2</sub> monitors should be placed. The current SO<sub>2</sub> network is not primarily configured to monitor locations of expected maximum short-term concentrations. The proposal would therefore establish two categories of required monitors in the revised SO<sub>2</sub> network: monitors that are required to be placed in CBSAs based on population size and SO<sub>2</sub> emissions, and monitors to be located within a state based on that state's contribution to national SO<sub>2</sub> emissions. States will determine the specific location of these monitors within state boundaries (which can be inside or outside of CBSAs), with EPA approval. For Delaware, this proposal would require two SO<sub>2</sub> monitoring sites. EPA is proposing to require that all new SO<sub>2</sub> monitors be operational by January 1, 2013.

The change in emphasis in the form of the standard (from longer term averages to short term peaks) and monitoring network design (based on emission impacts) has significant implications for existing monitoring networks. It represents a shift from community-wide population exposure to maximum short-term population exposure sites. Delaware performed a preliminary modeling analysis to evaluate the location of expected short-term maximum SO<sub>2</sub> concentrations, with results shown in Appendix I. This exercise indicates the possibility of multiple areas in Delaware with potential exceedances of the new short-term NAAQS, and these areas are not necessarily the same as current monitor locations. The exercise also indicated that there may be more than two monitors needed to adequately determine whether there are areas in the state that are non-attainment for the new NAAQS.

Because any changes in the monitoring network are not required to be complete until January 2013, Delaware notes that there is adequate time to work with EPA Region 3 to determine the most appropriate monitor number and locations to determine compliance with the new NAAQS when it becomes final.

**Summary information and monitor rating for SO<sub>2</sub> - critical criteria shown in bold**

<u>Site</u>	<u>Data Criteria:</u> % NAAQS, Max Concentration, Longevity, AQI	<u>Statistical Criteria:</u> Measurement Criticality, Uniqueness, Trends	<u>Situational Criteria:</u> Meteorological Pattern, Area(1), Area(2), Federal Requirements, Multi-pollutant	<u>Future Needs, Special Considerations:</u> Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	<u>Rating</u>
Bellefonte 2	% NAAQS: Below former NAAQS Max Concentration: Highest annual average (former NAAQS) Longevity: Moderate trend history AQI: Calculated	Trend: Downward trend	Meteorological Pattern: Secondary downwind for Edgemoor power plant, Marcus Hook PA refinery/industrial complex	Cost: Age of Equipment is greater than 7 years Community concerns (Edgemoor, Claymont)	Credible
MLK	% NAAQS: Below former NAAQS Longevity: Long trend history Max Concentration: Concentrations between levels at Bellefonte and DE City AQI: Calculated	<b>Trend: Used for tracking control strategies, downward trend</b>	<b>Federal Requirement: NCore Site</b> Area(1): Urban site Multi-pollutant: Collocated with multiple parameters	Source-impact: Local & mobile source impacts Local community concerns	<b>Critical</b>
Route 9 DE City	% NAAQS: Below former NAAQS <b>Max Concentration: Highest short-term average</b> Longevity: Long trend history	Trend: Downward trend	<b>Meteorological Pattern: Downwind major point source</b> Multi-pollutant: Collocated with CO and air toxics monitors	<b>Impact from NAAQS Revision: Most likely to exceed future proposed NAAQS</b> <b>Source-impact: Downwind of major SO<sub>2</sub> source</b> Cost: Age of Equipment is greater than 7 years	<b>Critical</b>
Lums Pond	% NAAQS: Below former NAAQS Max Concentration: Lowest concentrations Longevity: Moderate trend history	Trend: No significant trend	Meteorological Pattern: Secondary downwind direction for DE City oil refinery/industrial complex	Cost: Age of Equipment is greater than 7 years Community concerns: West (secondary downwind) of DE City refinery/industrial complex	Credible
<b>Possible Future Sites:</b> - Seaford-Invista - Millsboro; Eastern Sussex - DuPont Exp. Station - Hercules	<i>Not applicable</i>	<i>Not applicable</i>	<b>Federal Requirement: Monitor required in Seaford microSA</b>	<i>Modeling indicates potential exceedances of proposed short-term NAAQS at sites listed;</i> <i>Community concerns in Millsboro: Eastern Sussex County</i>	<b>At least one New Site in Seaford</b>

## **NO<sub>2</sub>**

### **Current NO<sub>2</sub> sites**

NO<sub>2</sub> is not currently a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS. There is one NO<sub>2</sub> 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<sub>2</sub> monitoring at the urban Wilmington site at 12<sup>th</sup> and King Streets, then at two non-urban sites in New Castle County in the 1990s. The Bellefonte site was a supplemental NO<sub>2</sub> site collocated with an ozone monitor; when the site was relocated to Bellefonte2 the NO<sub>2</sub> monitoring was discontinued. The Lums Pond monitor was part of the PAMS program; when the PAMS program ended in 1999, the NO<sub>2</sub> monitor was moved back to the urban Wilmington site.

Monitoring objectives for NO<sub>2</sub> include NAAQS compliance, maximum concentration, population exposure, trends tracking, AQI generation, and emission control strategy tracking.

### **Monitoring Requirements**

There are currently no minimum requirements for the number of NO<sub>2</sub> monitoring sites in Delaware; The NCore program requires NO<sub>y</sub> monitoring at the single NCore site in Delaware (MLK in Wilmington). This monitoring will begin in 2010 and will be completely operational by January 1, 2011.

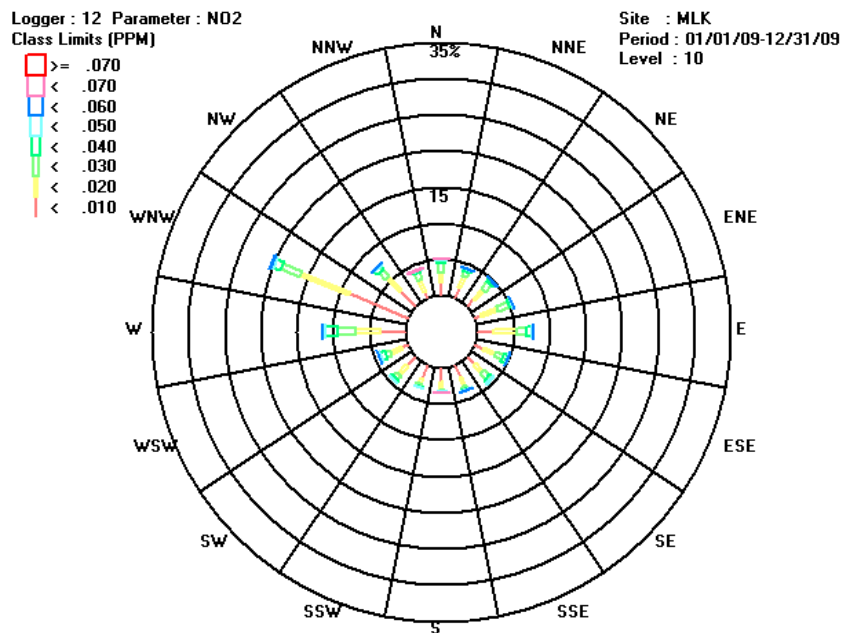
### **NO<sub>2</sub> monitoring sites in Delaware**

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

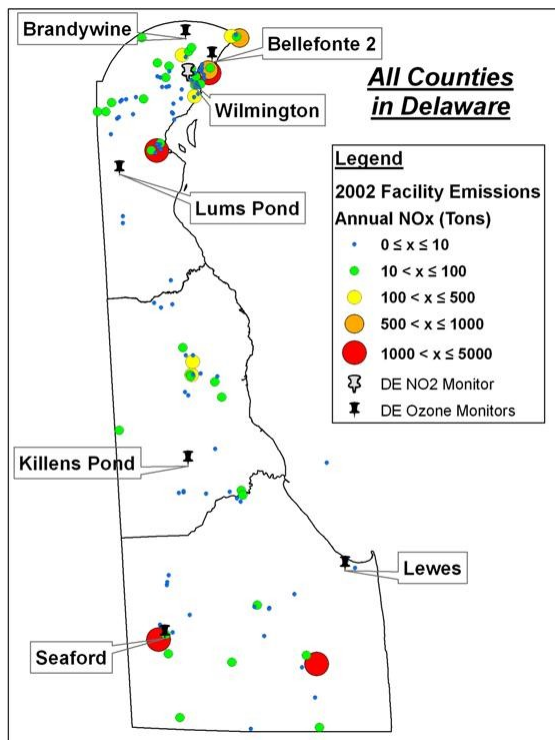
## **Situational analyses**

### **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 12<sup>th</sup> and King Streets that had operated at that location for over 20 years. The MLK site is neighborhood scale for NO<sub>2</sub> and represents an urban core site impacted by point, area, and mobile sources. The site meets all EPA siting criteria. NO<sub>y</sub> monitoring will begin in 2010 and will continue as the MLK site transitions to the full complement of NCore monitors by January 1, 2011.

**NO<sub>2</sub> Pollution rose – MLK 2009 data**

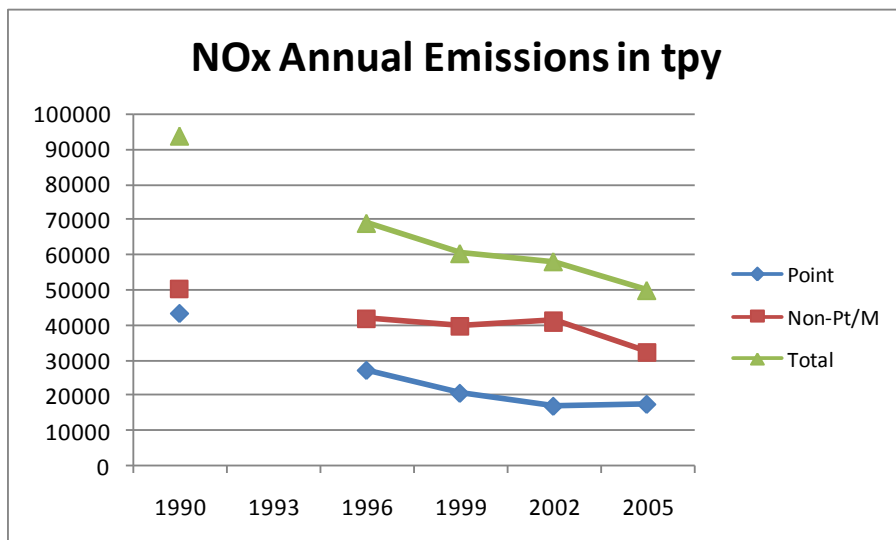
Elevated concentrations of NO<sub>2</sub> can occur with any wind direction; concentrations tend to be highest during calm periods and inversions.

**Emissions info: maps & trends**

The largest NO<sub>2</sub> point sources in Delaware power plants in Edgemoor (northeast of Wilmington) and Millsboro in Sussex County, followed by the oil refinery in Delaware City and a manufacturing facility in Seaford.

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.

### NO<sub>x</sub> Emissions Trends



### Statistical Analysis

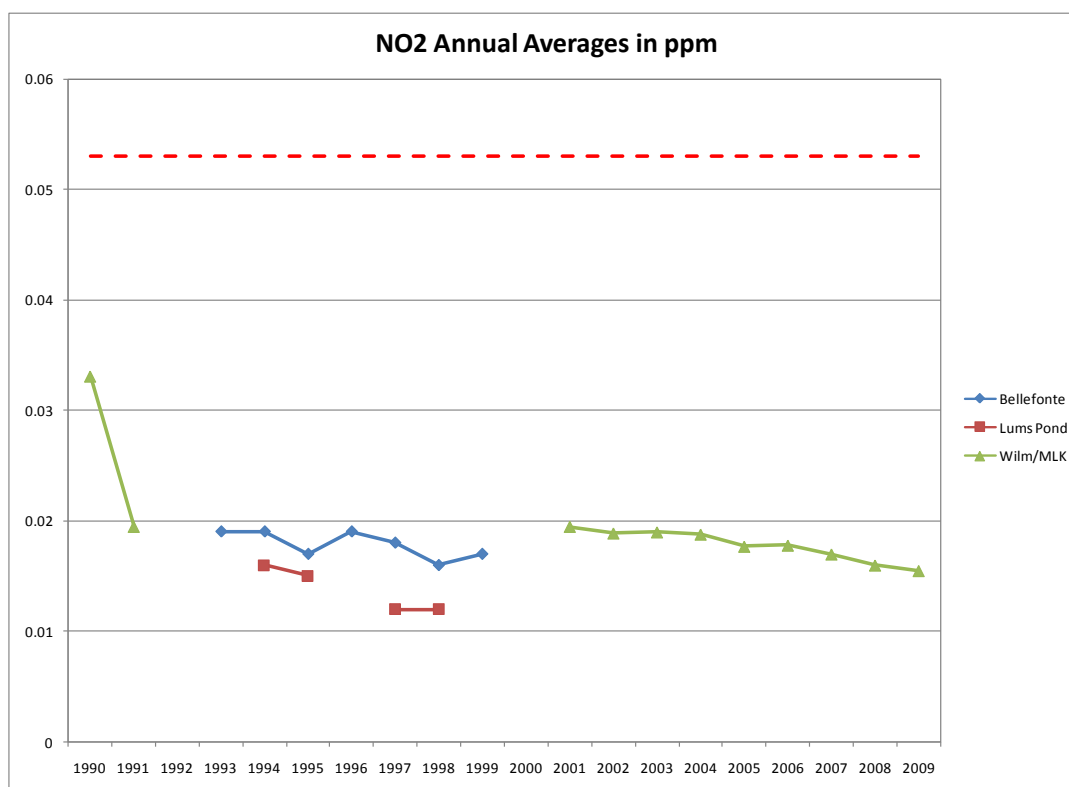
The current primary NAAQS for NO<sub>2</sub> is an annual arithmetic mean of 0.053 ppm.

#### Design value trends – annual averages in ppm

Year	Bellefonte	Lums Pond	Wilmington/MLK
1990			0.033
1991			0.027
1992			0.020
1993	0.019		
1994	0.019	0.016	
1995	0.017	0.015	
1996	0.019	0.012	
1997	0.018	0.012	
1998	0.016		
1999	0.018		
2000			
2001			0.020
2002			0.019

Year	Bellefonte	Lums Pond	Wilmington/MLK
2003			0.019
2004			0.019
2005			0.018
2006			0.018
2007			0.017
2008			0.016
2009			0.016

### NO<sub>2</sub> Trend – Annual Average



The trend in annual averages has been downward since monitoring began in the 1980s. Improvements in ambient concentrations of NO<sub>2</sub> 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 NO<sub>x</sub> standards for heavy-duty engines are phasing in between 2007 and 2010 model years.

### Future needs

*From EPA Fact Sheet on new NO<sub>2</sub> NAAQS:* On January 22, 2010, EPA strengthened the health-based (NAAQS for NO<sub>2</sub>) by setting a new 1-hour NO<sub>2</sub> standard at the level of 100 parts per billion (ppb). This

level defines the maximum allowable concentration anywhere in an area. It will protect against adverse health effects associated with short-term exposure to NO<sub>2</sub>, including respiratory effects that can result in admission to a hospital. In addition to establishing an averaging time and level, EPA also is setting a new “form” for the standard. The form is the air quality statistic used to determine if an area meets the standard. The form for the 1-hour NO<sub>2</sub> standard is the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations.

EPA also is retaining, with no change, the current annual average NO<sub>2</sub> standard of 53 ppb.

#### **Recent Delaware NO<sub>2</sub> Annual 4<sup>th</sup> Highest Daily 1-hour Average in ppb**

Year	Wilmington/MLK
2006	83
2007	67
2008	74
2009	58

Using the 4<sup>th</sup> highest daily 1-hour average as a surrogate for the 98<sup>th</sup> percentile, data from the Wilmington MLK monitor are below the proposed new NAAQS of 100 ppb.

NO<sub>2</sub> concentrations near major roads are appreciably higher than those measured at monitors in the current network. Concentrations in heavy traffic or on freeways can be twice as high as levels measured in residential areas or near smaller roads. Monitoring studies indicate that near-road (within about 50 meters) concentrations of NO<sub>2</sub> can be 30 to 100 percent higher than concentrations away from major roads.

EPA is setting new requirements for the placement of new NO<sub>2</sub> monitors in urban areas. These include:

- Near Road Monitoring
  - At least one monitor must be located near a major road in any urban area with a population greater than or equal to 500,000 people. A second monitor is required near another major road in areas with either:
    - population greater than or equal to 2.5 million people, or
    - one or more road segment with an annual average daily traffic (AADT) count greater than or equal to 250,000 vehicles.
  - These NO<sub>2</sub> monitors must be placed near those road segments ranked with the highest traffic levels by AADT, with consideration given to fleet mix, congestion patterns, terrain, geographic location, and meteorology in identifying locations where the peak concentrations of NO<sub>2</sub> are expected to occur. Monitors must be placed no more than 50 meters (about 164 feet) away from the edge of the nearest traffic lane.
- Community Wide Monitoring
  - A minimum of one monitor must be placed in any urban area with a population greater than or equal to 1 million people to assess community-wide concentrations..
- Monitoring to Protect Susceptible and Vulnerable Populations

- Working with the states, EPA Regional Administrators will site at least 40 additional NO<sub>2</sub> monitors to help protect communities that are susceptible and vulnerable to NO<sub>2</sub> - related health effects.

Based on these criteria, the Philadelphia CSA will need two near-roadway monitors and one community-wide monitor. Based on current population and traffic density statistics, these monitors will be located in the Philadelphia metropolitan area, and Delaware will not require any new monitors.



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**Summary information and monitor rating for NO<sub>2</sub> - critical criteria shown in bold**

<u>Site</u>	<u>Data Criteria:</u> % NAAQS, Max Concentration, Longevity, AQI	<u>Statistical Criteria:</u> Measurement Criticality, Uniqueness, Trends	<u>Situational Criteria:</u> Meteorological Pattern, Area(1), Area(2), Federal Requirements, Multi-pollutant	<u>Future Needs,</u> <u>Special Considerations:</u> Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	<u>Rating</u>
<b>MLK</b>	% NAAQS: Below current NAAQS Longevity: Long trend history <b>Max Concentration: Design Value Site</b>	<b>Trends: Tracking control strategies</b>	<b>Federal Requirement: NCore Site</b> Area(1): Urban neighborhood scale site Multi-pollutant: Collocated with multiple parameters	Cost: Age of Equipment is greater than 7 years Source-impact: Point, local & mobile source impacts Urban area population exposure	<b>Critical</b>

## **Lead**

### **Current Lead sites**

Lead is not currently a high priority pollutant monitored in Delaware because ambient concentrations are well below the NAAQS. There is one current lead site in Delaware – the urban Wilmington MLK NCore site. The proposed new NAAQS requires one lead site at the NCore site in each state. While the current monitor is operating as part of the EPA Region 3 air toxics monitoring program, it will transition to NCore monitor status by January 1, 2011.

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 NAAQS compliance, 63% of the samples were below the analytical detection limits.

### **Monitoring Requirements**

There are currently no minimum requirements for the number of lead monitoring sites in Delaware. The NCore program and new lead NAAQS monitoring regulations require monitoring in at least one NCore site per state, which will be MLK in Wilmington for Delaware.

### **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 12<sup>th</sup> 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. More complete point source information will be included in future emissions inventories.

## Statistical Analysis

The proposed primary NAAQS for lead is  $0.15 \mu\text{g}/\text{m}^3$ . EPA will use a maximum (not-to-be-exceeded) rolling three-month average evaluated over a three-year period. Any three-month average exceeding  $0.15 \mu\text{g}/\text{m}^3$  within a three-year period will be considered a violation of the NAAQS.

Delaware has not implemented reference method lead monitoring appropriate for comparison to the new NAAQS, but 3-month averages of the data from the air toxics program can be used to estimate NAAQS compliance status as follows.

### Maximum 3-month Average Total Suspended Particles (TSP) Lead Concentrations in $\mu\text{g}/\text{m}^3$

Year	Max 3-month Avg
2003	0.01
2004	0.01
2005	0.03
2006	0.02
2007	0.02

## Future needs

*From EPA Fact Sheet on new 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 ( $\mu\text{g}/\text{m}^3$ ), to  $0.15 \mu\text{g}/\text{m}^3$ , 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.

EPA proposed that these source-oriented monitors would begin operating one year after this rule is finalized. Monitors around the largest sources (those that emit 1.0 tpy or greater) are already required to be operational no later than January 1, 2010. EPA also proposed to require lead monitoring at sites comprising the “NCore Network” instead of the current requirement to place lead monitors in each Core Based Statistical Area (CBSA) with a population of 500,000 or more people. Under this proposal, lead monitoring at NCore sites, including MLK in Wilmington, would begin January 1, 2011.

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

<u>Site</u>	<u>Data Criteria:</u> % NAAQS, Max Concentration, Longevity, AQI	<u>Statistical Criteria:</u> Measurement Criticality, Uniqueness, Trends	<u>Situational Criteria:</u> Meteorological Pattern, Area(1), Area(2), Federal Requirements, Multi-pollutant	<u>Future Needs,</u> <u>Special Considerations:</u> Impact from NAAQS Revisions, Concentration Gradient, Source-impact, Cost, Community	<u>Rating</u>
<b>MLK</b>	% NAAQS: Below new NAAQS (based on air toxics sampling)	<b>Trends: Used for tracking control strategies</b>	<b>Federal Requirement: NCore Site</b> Area(1): Urban neighborhood scale site Multi-pollutant: Collocated with multiple parameters	Not applicable	<b>Critical</b>

## Technology

*Monitors* - The majority of monitors currently in use in the Delaware air monitoring network are over 5 years old; many are over 10 years old. Since the recommended life expectancy for most monitoring equipment is 7 years, it is becoming very difficult to keep the instrumentation operational, despite regular maintenance activities and routine repairs. Increasing staff resources are being devoted to these in order to maximize network operations, leaving little resources for implementation of new projects or programs.

Site	Monitor Age in Years					
	O <sub>3</sub>	SO <sub>2</sub>	CO	NO <sub>x</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> Continuous
MLK/Wilmington		2	4	12	2	7
Bellfonte I					2	
Bellfonte II	11	15				
Brandywine	11					
Newark					1	
Delaware City		14	12			
Lums Pond	15	14			2	
Dover					2	
Seaford	5				2	7
Killens Pond	15				2	7
Lewes	14					

All monitors used for NAAQS compliance meet EPA requirements as FRM or FEM monitors. Continuous PM<sub>2.5</sub> monitors are not FRM/FEM but are used for AQI and supplemental information only, not for NAAQS compliance determination.

*Calibrators* - Many of the same issues affecting the ambient monitors exist for the support equipment such as calibrators.

All field and laboratory calibrators meet all EPA specifications and requirements.

*Data acquisition system* – Delaware is in the process of transitioning to a digital data acquisition system as part of implementation of the NCore program. Once the digital system is fully operational, it will provide increased capabilities in remote communications with the monitoring stations, including the ability to perform remote diagnostic functions and operational checks.

*Other support equipment* – All gas cylinders used for monitor calibrations, checks and audits are EPA Protocol cylinders. Sampling manifolds meet all 40 CFR Part 58 Appendix E requirements for residence time, materials, and probe/inlet heights.

*Audit equipment* – The same problem with lack of resources for regular replacement of aging equipment affects the auditing equipment. All audit equipment is independent of field operations, including separate calibrators, zero air sources, and gas standards.

Audit Equipment	Approximate Age
Sabio 2010 calibrator	8 years
TE 49 PS ozone calibrator	5 years
Sabio 2020 zero air source	8 years
DeltaCal flow meter, temp. & press.	9 years
Bios DC-Lite flow meter	12 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 will have the most complete meteorological suite of measurements that will be in full compliance with EPA NCore requirements and standards.

## **Cost**

The network requires capital investment for procurement and support of analytical equipment. Historically, the Branch has used equipment well beyond manufacturer estimated life expectancy of seven years. In fact, over 50% of the equipment operating within the network exceeds this life expectancy.

Consequently, the Branch is faced with a large capital expense to upgrade equipment to current standards. The Branch proposes to perform these upgrades over a 5-year period. Once these technology upgrades are complete, the Branch suggests that equipment be replaced after seven years of service.

The Branch estimates that the cost for this upgrade to be about \$260,000. Additionally, the Branch estimates that approximately \$53,000 will be needed to establish the new SO<sub>2</sub> site required as a result of the revised 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
<b>Killens Pond</b> 10-001-0002	Not in a city Kent County	4/1/95	Rural	O <sub>3</sub>	SLAMS	Neighborhood	<b>Critical</b> - % NAAQS: Above current NAAQS, Max Concentration: Design Value for Kent County, Federal Requirement: Rural Background, Impact from NAAQS Revisions: Above Proposed NAAQS	<b>Critical</b>
				PM <sub>2.5</sub> FRM	SLAMS	Neighborhood	<b>Critical</b> - Measurement Criticality: Significant removal bias, Federal Requirement: Rural Background Site	
				PM <sub>2.5</sub> continuous	SPM	N/A	Marginal - Supports AQI (not FRM-like), supplemental information	
<b>Dover</b> 10-001-0003	Dover Kent County	1/1/99	Urban	PM <sub>2.5</sub> FRM	SLAMS	Neighborhood	<b>Critical</b> - Measurement Criticality: Significant removal bias, Federal Requirement: Speciation Data	<b>Critical</b>
				PM <sub>2.5</sub> speciation	N/A	N/A	<b>Critical</b> - Federal Requirement: Speciation Data	
<b>Brandywine</b> 10-003-1010	Not in a city New Castle	7/1/94	Rural/Suburban	O <sub>3</sub>	SLAMS	Neighborhood	<b>Critical</b> - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Significant Removal Bias, Meteorological Pattern: Secondary Downwind Direction Wilmington, Impact from NAAQS Revisions: Above Proposed NAAQS	<b>Critical</b>
<b>Bellefonte 2</b> 10-003-1013	Not in a city New Castle	4/1/01	Suburban	O <sub>3</sub>	SLAMS	Neighborhood	<b>Critical</b> - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Significant Removal Bias, Meteorological Pattern: Primary Downwind Direction Wilmington, Impact from NAAQS Revisions: Above Proposed NAAQS	<b>Critical</b>
				SO <sub>2</sub>	SLAMS	Neighborhood	<b>Credible</b> - % NAAQS: Below current NAAQS, Max Concentration: highest annual avg (former NAAQS), Meteorological Pattern: Secondary downwind for power plant	
Bellefonte 10-003-1003	Not in a city New Castle	1/1/99 (PM <sub>2.5</sub> only)	Suburban	PM <sub>2.5</sub> FRM	SLAMS	Neighborhood	<b>Credible</b> - % NAAQS: Below current NAAQS, Measurement Criticality: Significant 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
<b>MLK</b> 10-003-2004	Wilmington New Castle	1/1/99	Urban	SO <sub>2</sub>	SLAMS/N Core	Neighborhood	<b>Critical</b> - Trend: Used for tracking control strategies, downward trend, Federal Requirement: NCore Site	<b>Critical</b>
				CO	SLAMS/N Core	Middle	<b>Critical</b> - Max Concentration: Design Value, Trend: Used for tracking control strategies, Federal Requirement: NCore Site	
				NO <sub>2</sub>	SLAMS/N Core	Neighborhood	<b>Critical</b> - Max Concentration: Design Value Site, Trends: Tracking control strategies, Federal Requirement: NCore Site	
				PM <sub>2.5</sub> FRM	SLAMS/N Core	Neighborhood	<b>Critical</b> - Max Concentration: Design Value, significant Measurement Criticality: Significant removal bias, Trends: Tracking control strategies, Federal Requirement: NCore Site and speciation data	
				PM <sub>2.5</sub> speciation	SLAMS	N/A	<b>Critical</b> - Federal Requirement: Speciation Data	
				WS/WD	SPM/ NCore	N/A	<b>Critical</b> - Federal Requirement: NCore Site	
				PM <sub>10</sub> continuous	SPM	Neighborhood	Credible - AQI, supplemental information	
				PM <sub>2.5</sub> continuous	SPM	Neighborhood	<b>Credible</b> – AQI (FRM-like), supplemental information	
Newark 10-003-1012	Newark New Castle	12/15/99	Suburban	PM <sub>2.5</sub> FRM	SLAMS	Neighborhood	Credible - % NAAQS: Below current NAAQS, Measurement Criticality: Significant removal bias	Credible
<b>Lums Pond</b> 10-003-1007	Not in a city New Castle	1/1/92	Suburban/Rural	O <sub>3</sub>	SLAMS	Neighborhood	<b>Critical</b> - above NAAQS, max. concentration,/design value, significant removal bias, Federal requirement: transport site, Impact from NAAQS Revisions: Above Proposed NAAQS	<b>Critical</b>
				SO <sub>2</sub>	SLAMS	Neighborhood	Credible - Max Concentration: Lowest concentrations, Meteorological Pattern: Secondary downwind direction for DE City	
				PM <sub>2.5</sub>	SLAMS	Neighborhood	<b>Critical</b> - Measurement Criticality: Significant removal bias, Federal Requirement: Transport Site	



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
<b>Route 9 DE City</b> 10-003-1008	Not in a city New Castle	2/1/92	Suburban	SO <sub>2</sub>	SLAMS	Neighborhood	<b>Critical</b> - 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 <sub>2</sub> source	<b>Critical</b>
				CO	SLAMS	Middle	Marginal - % NAAQS: Below 50% of current NAAQS, Trend: Downward trend in concentrations	
<b>Seaford</b> 10-005-1002	Seaford Sussex	3/1/90	Suburban/Small Urban	O <sub>3</sub>	SLAMS	Neighborhood	<b>Critical</b> - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Significant Removal Bias, Impact from NAAQS Revisions: Above Proposed NAAQS	<b>Critical</b>
				PM <sub>2.5</sub> FRM	SLAMS	Neighborhood	<b>Critical</b> - Max Concentration: Design Value for Seaford microSA, Measurement Criticality: Significant removal bias, Area(1): Only Site in Sussex County	
				PM <sub>2.5</sub> continuous	SPM	N/A	Marginal – AQI (not FRM-like), supplemental information	
<b>Lewes</b> 10-005-1003	Not in a city Sussex	5/1/97	Rural/Suburban	O <sub>3</sub>	SLAMS	Neighborhood	<b>Critical</b> - % NAAQS: Above Current NAAQS, Max Concentration: Design Value, Measurement Criticality: Significant Removal Bias, Area(2): Only Coastal Site, significant seasonal population exposure, Impact from NAAQS Revisions: Above Proposed NAAQS	<b>Critical</b>
<b>New Site</b>	Seaford, Eastern Sussex	Unknown	Unknown	SO <sub>2</sub>	New SLAMS	Middle	<b>Critical</b> - Federal Requirement: Monitor required in Seaford microSA	<b>Required by New NAAQS</b>

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## 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.

Code of Federal Regulations Title 40 Parts 50 and 58 and Appendices, Protection of the Environment, July 1, 2009.

Delaware Ambient Air Monitoring Network Description for Criteria Pollutants, Air Quality Management Section, Division of Air and Waste Management, Department of Natural Resources and Environmental Control, New Castle, DE, April 30, 2010.

Designing a Network Assessment for an Ambient Air Monitoring Program, OAQPS/AQAD/AQAG, <http://www.epa.gov/ttnamti1/network-assessment.html>.

Network Assessment Analyses and Tools Documentation, Michael Rizzo, OAQPS/AQAD/AQAG, March 1, 2010.

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

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

## **Appendix I**

### **SO<sub>2</sub> Source Impact Modeling for the Proposed 1-Hr Max NAAQS**

1/20/2010

## Modeling Methodology

Modeling inventory - 2005 SO<sub>2</sub> emissions inventory for point sources

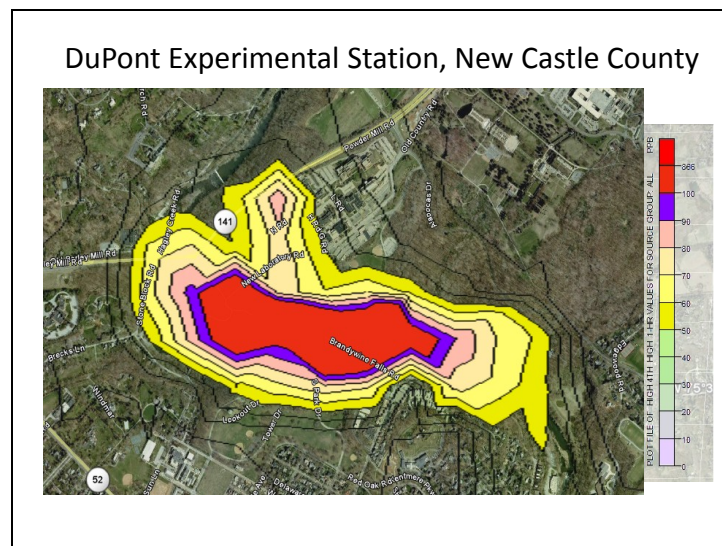
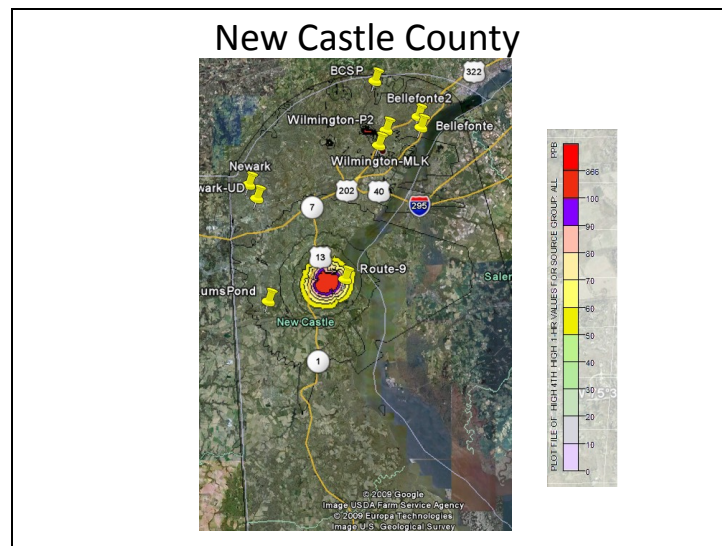
Modeling - AERMOD w/2003 meteorology

4th highest hourly max modeled concentrations converted to PPB's.

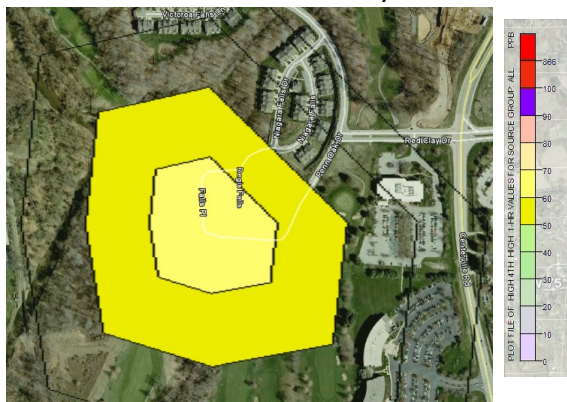
Hot spots due to inaccurate stack parameters ignored for this analysis

Background concentrations ignored for this analysis

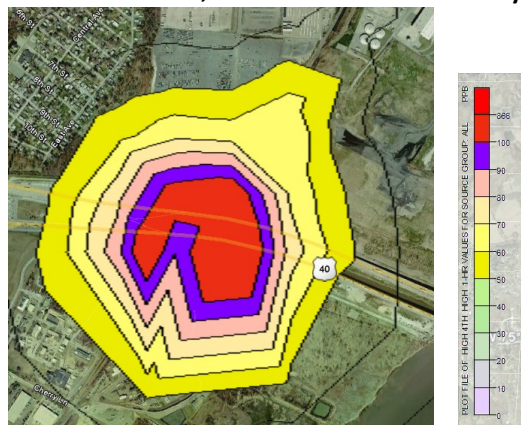
Results plotted on GoogleEarth maps along with existing Delaware Air Monitoring Network sites



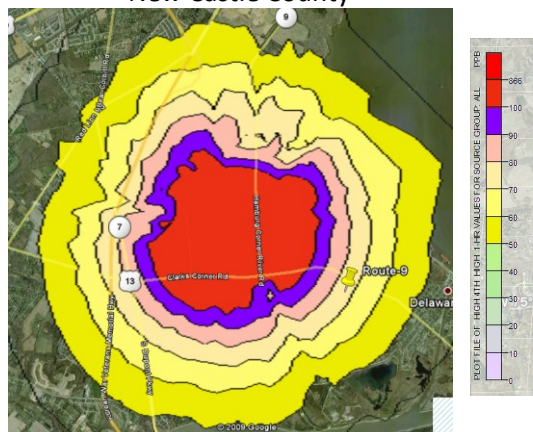
### HERCULES INCORPORATED RESEARCH CENTER, New Castle County



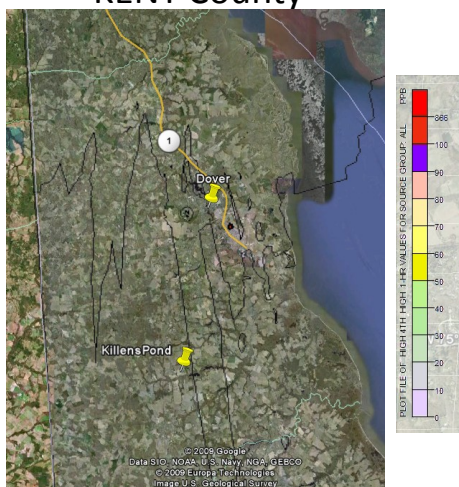
### SPI POLYOLS INC, New Castle County



### THE PREMCOR REFINING GROUP INC, New Castle County

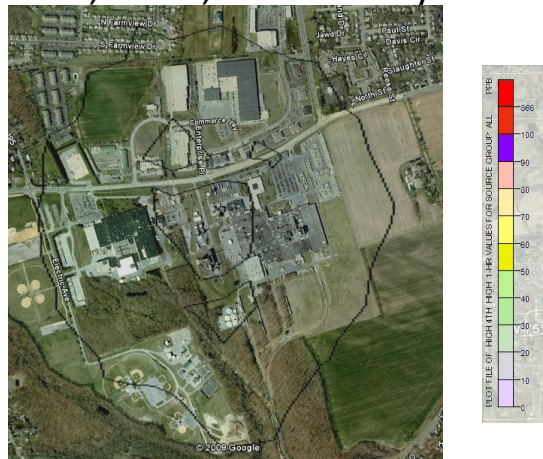


### KENT County

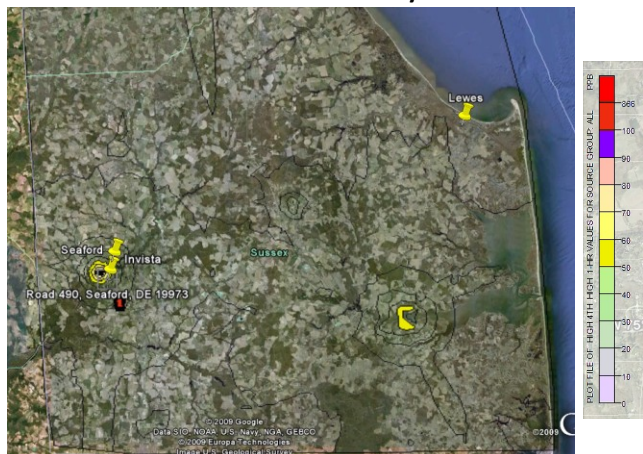




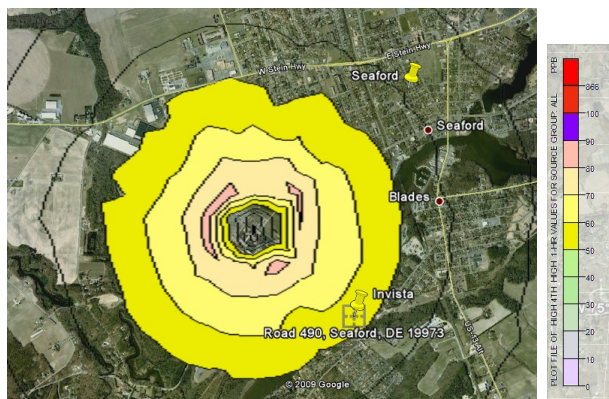
### NRG, Dover, KENT County



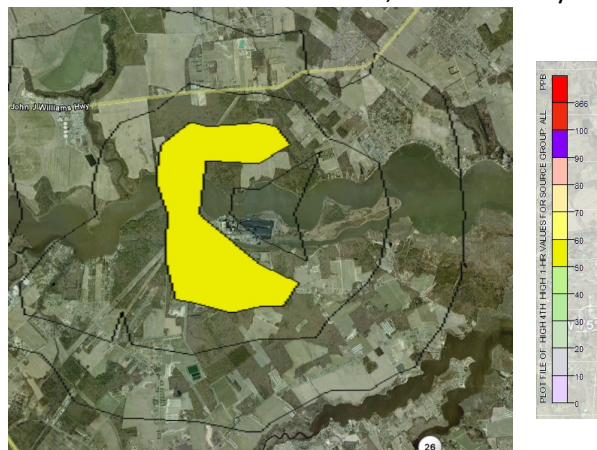
### Sussex County



### Invista, Sussex County



### INDIAN RIVER GENERATING STATION , Sussex County





## **Appendix II**

### **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 Castle	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 III**

### **Delaware Monitoring Network Site Descriptions**

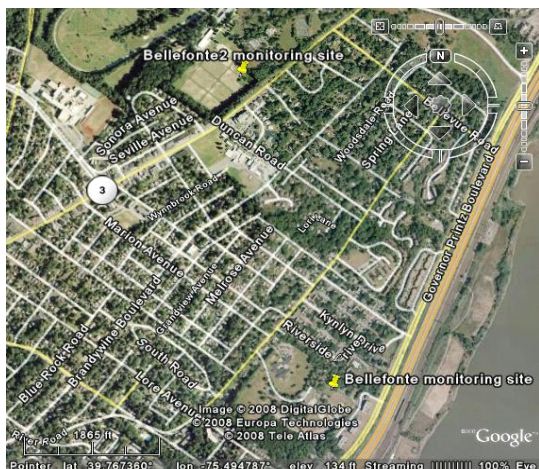


**Site: Bellefonte and Bellefonte2**

County:	New Castle	Latitude:	Bellefonte 39.7611 Bellefonte2 39.7739
Address:	Bellefonte: River Road Park Bellefonte2: Bellevue State Park	Longitude:	Bellefonte -75.4919 Bellefonte2 -75.4964
AQS site ID:	Bellefonte: 10-003-1003 Bellefonte2: 10-003-1013	Year Established:	Bellefonte 1969 Bellefonte2 2001
Spatial Scale:	Neighborhood	Area Represented:	Wilmington area



Bellefonte and Bellefonte2 locations



Bellefonte2

**Monitored Parameters**

	Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
Bellefonte					X					
Bellefonte2	X	X								

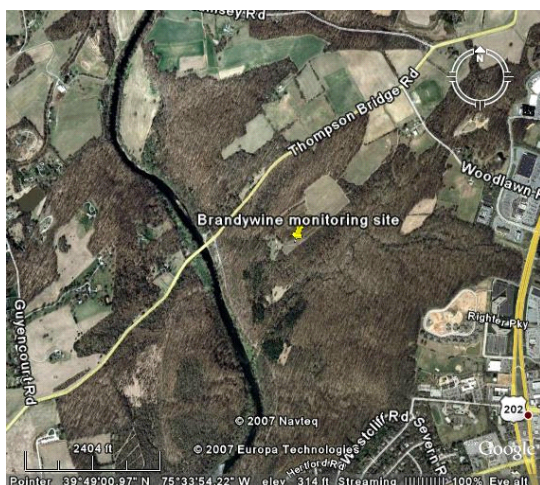
**Site Description:** Bellefonte was originally established in 1969 to monitor O<sub>3</sub> and SO<sub>2</sub>. PM<sub>2.5</sub> was added in 1999. When changing site characteristics began to interfere with ozone monitoring, a new site (Bellefonte2) was established in 2001, less than a mile to the north. The O<sub>3</sub> and SO<sub>2</sub> monitors were relocated to the new site, while the PM<sub>2.5</sub> 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<sub>3</sub> maximum downwind concentration site for Wilmington. The SO<sub>2</sub> 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 2010:** 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: Wilmington area

**Station Photo Not Available****Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
X									

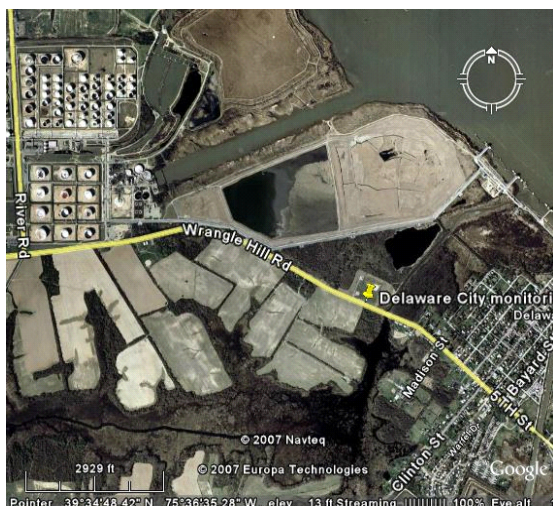
**Site Description:** The Brandywine site is located in Brandywine Creek State Park. This is a neighborhood scale site for O<sub>3</sub> monitoring. The site meets all EPA siting requirements.

**Monitoring Objectives:** The Brandywine site is in the secondary downwind direction from Wilmington. The objectives are compliance with the O<sub>3</sub> NAAQS, population exposure, and trends.

**Planned Changes through 2010:** No changes are planned.

**Site: Delaware City**

County: New Castle Latitude: 39.5778  
 Address: Route 9, Delaware City Longitude: -75.6111  
 AQS site ID: 10-003-1008 Year Established: 1992  
 Spatial Scale: Neighborhood Area Represented: Delaware City

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
	X	X						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 siting criteria.

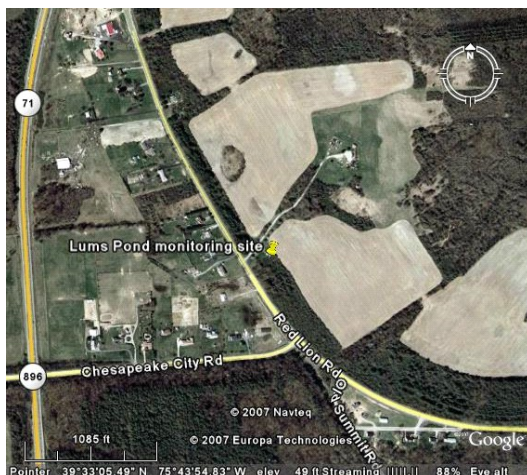
**Monitoring Objectives:** This monitoring site is a stationary source-impacted site for SO<sub>2</sub>. The monitoring objectives are compliance with the NAAQS, population exposure, and trends.

**Planned Changes through 2010:** No changes planned.



**Site: Lums Pond**

County: New Castle Latitude: 39.5511  
 Address: Lums Pond State Park Longitude: -75.7308  
 AQS site ID: 10-003-1007 Year Established: 1991  
 Spatial Scale: Neighborhood Area Represented: Wilmington area

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
X	TBD			X					

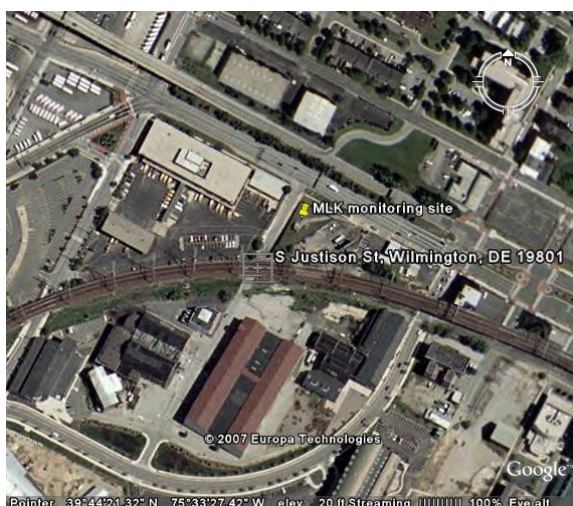
**Site Description:** The Lums Pond site is a neighborhood scale site located in a general upwind direction from Wilmington. The immediate area is rural. The site meets all EPA siting criteria.

**Monitoring Objectives:** The site objectives for O<sub>3</sub> are NAAQS compliance, regional transport, population exposure, and trends. This site was originally planned to monitor O<sub>3</sub> transported into Delaware from the Baltimore/Washington area, and continues to serve this purpose. The SO<sub>2</sub> monitor was added 2000 to detect impacts from major point sources directly to the east. PM<sub>2.5</sub> monitoring began in 1999 as both a transport and general population exposure site, as well as for NAAQS compliance. All parameters are neighborhood scale.

**Planned Changes through 2010:** SO<sub>2</sub> monitoring will be reinstated by the end of 2010.

**Site: MLK**

County: New Castle Latitude: 39.7394  
 Address: Justison St. and MLK Blvd Longitude: -75.5581  
 AQS site ID: 10-003-2004 Year Established: 1999  
 Spatial Scale: Neighborhood Area Represented: Wilmington

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction	NO/NO <sub>y</sub>	Lead	PM <sub>10-2.5</sub>
	X	X	X	X	X	X	X	X	X			

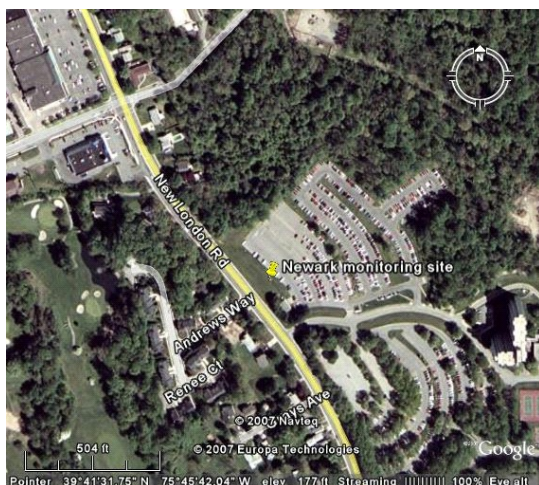
**Site Description:** The MLK site is located in Wilmington at the intersection of Justison St. and MLK Blvd. It replaced another urban site at 12<sup>th</sup> and King Streets that had operated at that location for over 20 years. The MLK site represents urban population exposure to multiple pollution sources. The site meets all EPA siting criteria.

**Monitoring Objectives:** Monitoring objectives are compliance with the NAAQS, maximum population exposure, and trends.

**Planned Changes through 2010:** NCore monitoring will begin during 2010 with all monitors fully operational by January 1, 2011.

**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: Newark

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
				X					

**Site Description:** The Newark site is a platform only. It is a PM<sub>2.5</sub> neighborhood scale site. The location is suburban and generally impacted by mobile sources and regional transport. The site meets all EPA siting criteria.

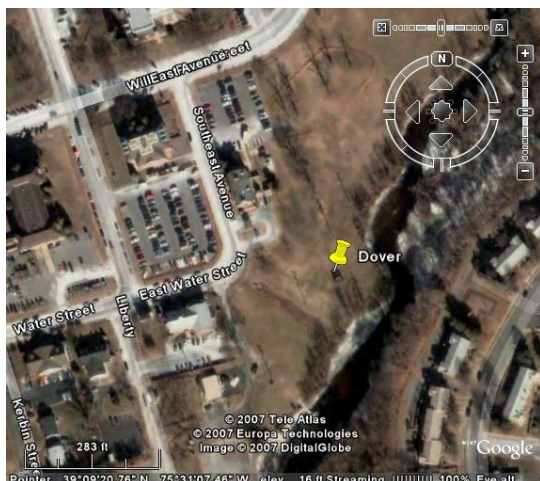
**Monitoring Objectives:** The objectives are NAAQS compliance, regional transport, population exposure, and trends.

**Planned Changes through 2010:** No changes planned.



**Site: Dover**

County:	Kent	Latitude:	39.155
Address:	Water St.	Longitude:	-75.5181
AQS site ID:	10-001-0003	Year Established:	1999
Spatial Scale:	Neighborhood	Area Represented:	Dover

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
				X	X				

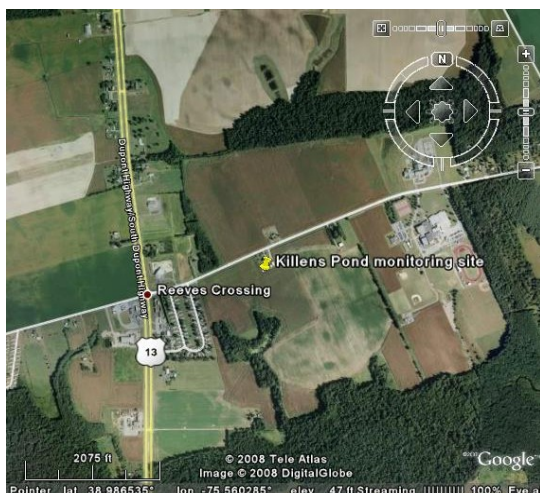
**Site Description:** The Dover site is a platform only. It is a neighborhood scale site representative of the Dover area, and is impacted by a combination of source types including mobile, large and small point sources. The site meets all EPA siting criteria.

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

**Planned Changes through 2010:** No changes planned.

**Site: Killens Pond**

County:	Kent	Latitude:	38.9847
Address:	Killens Pond Rd.	Longitude:	-75.5555
AQS site ID:	10-001-0002	Year Established:	1995
Spatial Scale:	Neighborhood	Area Represented:	Not in an urban area

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
X				X				X	X

**Site Description:** The Killens Pond site is located in a rural area that is part of Killens Pond State Park. The site meets all EPA siting criteria.

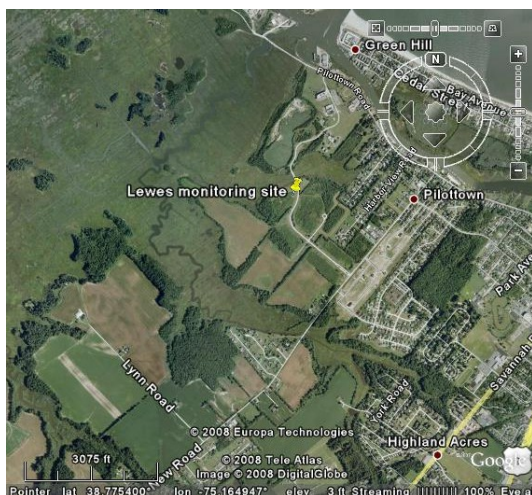
**Monitoring Objectives:** The objectives for this site are background concentrations, NAAQS compliance, and trends.

**Planned Changes through 2010:** No changes planned.



**Site: Lewes**

County:	Sussex	Latitude:	38.7792
Address:	University of Delaware College of Marine Studies	Longitude:	-75.1631
AQS site ID:	10-005-1003	Year Established:	1997
Spatial Scale:	Neighborhood	Area Represented:	Lewes

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
X								X	X

**Site Description:** The Lewes site is neighborhood scale. It is near the University of Delaware College of Marine Studies campus in Lewes, and is representative of the coastal Sussex County area. The site meets all EPA siting criteria.

**Monitoring Objectives:** The objectives include NAAQS compliance, population exposure, and trends.

**Planned Changes through 2010:** No changes planned.

**Site: Seaford**

County:	Sussex	Latitude:	38.6444
Address:	350 Virginia Ave.	Longitude:	-75.6131
AQS site ID:	10-005-1002	Year Established:	1990
Spatial Scale:	Neighborhood	Area Represented:	Seaford

**Monitored Parameters**

Ozone	SO <sub>2</sub>	CO	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>2.5</sub> speciation	PM <sub>2.5</sub> continuous	PM <sub>10</sub>	Wind Speed	Wind Direction
X				X				X	X

**Site Description:** The Seaford site was originally 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. The site meets all EPA siting criteria.

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

**Planned Changes through 2010:** No changes planned.