pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECRETARY

December 10, 2013

Mr. Shawn M. Garvin
Regional Administrator
U.S. Environmental Protection Agency, Region III
1650 Arch Street (Mail Code: 3RA00)
Philadelphia, PA 19103-2029

Dear Mr. Garvin:

Pursuant to Section 107 of the Clean Air Act (CAA), enclosed are the Commonwealth of Pennsylvania's designation recommendations pertinent to the revised annual National Ambient Air Quality Standard (NAAQS) for particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$). The U.S. Environmental Protection Agency (EPA) promulgated the annual $PM_{2.5}$ NAAQS of 12 micrograms per cubic meter on December 14, 2012 (78 FR 3086; January 15, 2013). The Commonwealth determined the recommended geographical boundaries for annual $PM_{2.5}$ "attainment," "nonattainment" and "unclassifiable/attainment" areas in accordance with EPA's April 16, 2013, guidance entitled, "Initial Area Designations for the 2012 Revised Primary Annual Fine Particle National Ambient Air Quality Standard."

Prior to finalizing the designation recommendations, the Department of Environmental Protection (DEP) provided public notice and a public comment period on the proposed recommendations. A Comment/Response document addressing the public comments received is also enclosed.

We understand that EPA will provide notice of any modifications to Pennsylvania's recommendations at least 120 days prior to issuing final designations. The DEP will comment on any proposed modifications to our recommendations, as appropriate and as authorized under Section 107 of the CAA. We look forward to collaborating with your staff during the development of the final annual $PM_{2.5}$ designations for this Commonwealth.

Thank you in advance for your favorable consideration of our annual $PM_{2.5}$ designation recommendations. Should you have any questions or need additional information during the annual $PM_{2.5}$ designation process, please contact Joyce E. Epps, Director, Bureau of Air Quality, by e-mail at jeepps@state.pa.us or by telephone at 717.787.9702.

Sincerely,

E. Christopher Abruzzo
Acting Secretary

Enclosures

Commonwealth of Pennsylvania
Department of Environmental Protection

DESIGNATION RECOMMENDATIONS FOR THE 2012 ANNUAL FINE PARTICULATE MATTER ($PM_{2.5}$) NATIONAL AMBIENT AIR QUALITY STANDARD

DECEMBER 2013

Bureau of Air Quality
Pennsylvania Department of Environmental Protection
P.O. Box 8468
Harrisburg, PA 17105-8468
717-787-9495

www.dep.state.pa.us

E. Christopher Abruzzo
Acting Secretary

Tom Corbett
Governor

[This page intentionally left blank.]

Designation Recommendations for the 2012 Annual PM2.5 NAAQS

Table of Contents

PAGE

What is this document? ... 1
What is fine particulate matter? ... 1
What is the NAAQS for $PM_{2.5}$? ... 1
Health Effects ... 2
Environmental Effects ... 2
What is the process for designating areas? ... 3
Designation Methodology ... 4
EPA Guidance for $PM_{2.5}$ Designation Boundaries ... 4
The Department's Approach ... 4
Designation Recommendations for the 2012 Annual $PM_{2.5}$ NAAQS ... 5
Attainment Areas ... 5
Nonattainment Areas ... 5
Unclassifiable/Attainment Areas ... 5
Discussion of Related Factors ... 5
Air Quality Data ... 5
Table 1: Design Values by Monitor (2010-2012) ... *6*
Emissions and Emissions Related Data ... 7
Meteorology, Geography and Topography ... 8
Figure 1: Wind Roses for Western Pennsylvania ... *9*
Figure 2: Wind Roses for Eastern Pennsylvania ... *9*
Jurisdictional Boundaries ... 10
Discussion of Designation Recommendations ... 10
Recommended Nonattainment Areas ... 10
Recommended Attainment Areas ... 12
Recommended Unclassifiable/Attainment Areas ... 12
Available Data ... 12
Conclusions / Summary ... 12
Acronyms and Terms ... 14

List of Appendices

APPENDIX A.

Table A-1: Recommended Designations for the 2012 Annual $PM_{2.5}$ NAAQS for Pennsylvania

Figure A-1: Map of Recommended 2012 $PM_{2.5}$ Nonattainment Areas in Pennsylvania

APPENDIX B. Supplementary Information

Figure B-1: 2012 Annual $PM_{2.5}$ Design Values

Figure B-2 - B-14: Emissions Information for $PM_{2.5}$ and Precursors

- B-2: $PM_{2.5}$ Point Source Density
- B-3: SO_2 Point Source Density
- B-4: NO_X Point Source Density
- B-5: VOC Point Source Density
- B-6: Direct $PM_{2.5}$ Area Source Density
- B-7: SO_2 Area Source Density
- B-8: NO_X Area Source Density
- B-9: VOC Area Source Density
- B-10: NH_3 Area Source Density
- B-11: $PM_{2.5}$ Point Source Emissions by Facility
- B-12: SO_2 Point Source Emissions by Facility
- B-13: NO_X Point Source Emissions by Facility
- B-14: VOC Point Source Emissions by Facility

Figure B-15: Population Density by County

Figure B-16: Population Growth by County

Figure B-17: Pennsylvania Air Basins Map

APPENDIX C. Meteorological, Geographical and Topographical Analysis for Recommended Nonattainment Areas

Appendix C-1: Greater Philadelphia Area

Appendix C-2: Northampton County Area

Appendix C-3: Lancaster County Area

Appendix C-4: Cambria County Area

Appendix C-5: Greater Pittsburgh Area

Appendix C-6: Liberty-Clairton Area

What is this document?

The federal Clean Air Act (CAA) provides a mechanism for states to make recommendations to the United States Environmental Protection Agency (EPA) on the designation of areas not meeting the health-based National Ambient Air Quality Standards (NAAQS).

In this document, the Commonwealth of Pennsylvania (Commonwealth) is making recommendations to EPA concerning the designation of attainment and nonattainment areas in Pennsylvania for the revised annual fine particulate matter NAAQS (78 FR 3086; Jan. 15, 2013). The Commonwealth's designation recommendations are based on air quality monitoring data for 2010-2012 and other available information, including particulate-forming emissions, meteorology, geography, topography, jurisdictional boundaries and demographics. Since EPA anticipates making final designations in December 2014 using air quality monitoring data for 2011-2013, the Department of Environmental Protection (DEP) will continue to work with EPA during the process leading to EPA's promulgation of the final designations.

What is fine particulate matter?

Particulate matter (PM) includes both solid and liquid particles suspended in the air. PM is chemically and physically diverse and originates from a variety of human and natural activities. PM is composed of particles in a wide range of sizes. Smaller particles pose a health concern because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers in diameter are referred to as fine particulate matter ($PM_{2.5}$) and generally pose the largest health risks, because their small size allows for penetration deep into the lungs. $PM_{2.5}$ is primarily composed of sulfates, nitrates, organic carbon, elemental carbon and crustal material.

$PM_{2.5}$ may either be directly emitted from a source ("primary" particulate, also called "direct" emissions of particulate) or formed in the atmosphere by chemical reaction of gaseous precursors ("secondary" particulate). Precursors of $PM_{2.5}$ can include sulfur dioxide, nitrogen oxides (NO_X), volatile organic compounds (VOC), and ammonia (NH_3). $PM_{2.5}$ and its precursors result mainly from fuel combustion (motor vehicles, power plants and nonroad engines) and industrial processes.

$PM_{2.5}$ is a significant air pollution problem in parts of Pennsylvania. Reducing concentrations of $PM_{2.5}$ is important because levels above the health-based standard are a serious human health threat and also can cause or contribute to other negative environmental impacts.

What is the NAAQS for $PM_{2.5}$? The EPA sets NAAQS based on its review of existing scientific knowledge about the adverse health and welfare effects. The CAA requires EPA to review and update periodically, if necessary, every NAAQS to "protect public health with an adequate margin of safety" based on the latest, best-available science (CAA § 109(d), 42 U.S.C. § 7409(d)).

Prior to 1997, particulate standards had been based on total suspended particulates and then particles less than 10 micrometers in diameter (PM_{10}). In 1997, EPA revised the NAAQS to reflect the growing body of scientific knowledge that links serious health effects to fine particles. On July 18, 1997, EPA promulgated two new $PM_{2.5}$ standards – an annual average of 15 micrograms per cubic meter ($\mu g/m^3$), and a 24-hour daily average of 65 $\mu g/m^3$ (The PM_{10} standards were retained as an indicator for coarse PM; all areas of Pennsylvania meet this standard.). EPA designated attainment and nonattainment areas for the 1997 standards in December 2004 and published the designations in the *Federal Register* on January 5, 2005, effective on April 5, 2005 (70 FR 944).

On October 17, 2006, EPA published a revised 24-hour standard for $PM_{2.5}$, lowering the standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. EPA retained the annual standard for $PM_{2.5}$ of 15 $\mu g/m^3$. EPA also retained the daily standard for PM_{10} of 150 $\mu g/m^3$ but revoked the annual standard of 50 $\mu g/m^3$ (No area in Pennsylvania violates the PM_{10} standard.). On November 13, 2009, EPA published the $PM_{2.5}$ nonattainment areas designations for the 2006 $PM_{2.5}$ standards, with an effective date of December 14, 2009 (74 FR 58688).

On December 14, 2012, EPA revised the $PM_{2.5}$ NAAQS annual health-based standard (the "primary" standard), lowering the existing standard from 15 $\mu g/m^3$ to 12 $\mu g/m^3$, with an effective date of March 18, 2013 (78 FR 3086). EPA retained the $PM_{2.5}$ 24-hour standard of 35 $\mu g/m^3$, as well as the existing PM_{10} 24-hour standard of 150 $\mu g/m^3$. EPA retained the secondary annual standard of 15 $\mu g/m^3$ and the secondary 24-hour standard of 35 $\mu g/m^3$, though EPA revised the form of the secondary annual standard to remove the option for spatial averaging to be consistent with the primary annual standard. EPA had proposed to set a separate secondary 24-hour standard for PM-related visibility effects, but after further review, determined that the existing 24-hour secondary standard of 35 $\mu g/m^3$ provides adequate protection of public welfare with regard to visual air quality. EPA's new annual $PM_{2.5}$ standard is expected to provide significantly increased health and environmental protection.

Health Effects. Millions of Pennsylvanians live in areas where the $PM_{2.5}$ health-based standards are exceeded. Fine particles generally pose greater health risks than larger particles. Because of their small size (less than one-seventh the average width of a human hair), fine particles can lodge deeply into the lungs. Health studies have shown a significant association between exposure to $PM_{2.5}$ and premature mortality. Studies have also linked exposure to $PM_{2.5}$ with other significant health problems, including aggravation of respiratory and cardiovascular disease, lung disease, decreased lung function, asthma attacks, increases in respiratory symptoms like coughing and difficult or painful breathing, chronic bronchitis, and certain cardiovascular problems such as heart attacks and cardiac arrhythmia. Individuals particularly sensitive to $PM_{2.5}$ exposure include older adults, people with heart and lung disease, and children.

Environmental Effects. Fine particles are the major cause of reduced visibility (haze) in certain parts of the United States, including many national parks. Fine particles cause visibility impairment by scattering and absorbing light before it reaches an observer. In the Eastern United States, haze has reduced the average visual range from approximately 90 miles in the absence of manmade pollution to 15 to 25 miles. In addition, components of $PM_{2.5}$, such as nitrates and sulfates, contribute to acid rain formation. Acid rain makes lakes, rivers, and streams unsuitable for many fish, and erodes buildings, historical monuments, and paint on cars. $PM_{2.5}$ and its precursor pollutants can be carried over long distances by wind and then settle on ground or water. This changes the nutrient balance in coastal waters and large river basins, contributing to fish kills and algae blooms in sensitive waterways, such as the Chesapeake Bay. The settling of $PM_{2.5}$ also depletes the nutrients in soil, damages sensitive forests and farm crops, and affects the diversity of ecosystems. Soot, a type of $PM_{2.5}$, stains and damages stone and other materials.

What is the process for designating areas?

Section 107 (d)(1)(B) of the CAA requires EPA to designate areas after promulgating a new NAAQS (CAA § 107(d)(1)(B), 42 U.S.C. § 7407(d)(1)(B)). Following promulgation of new or revised air standards, Governors are given the opportunity to submit recommendations for attainment and nonattainment areas, supported by the most recent quality-assured monitoring data. EPA provides criteria for states' recommendations for designating areas.

Governors' designation recommendations for the revised $PM_{2.5}$ NAAQS must be submitted to EPA by December 13, 2013, within one year after the promulgation of the revised NAAQS. EPA may make modifications and promulgate all or part of a Governor's recommendations. If EPA determines that a modification to the recommendation is necessary, EPA will notify the state no later than 120 days prior to promulgating the designations. This provides an opportunity for the state to work with EPA, if the state believes EPA's decisions are not appropriate.

This document contains Pennsylvania's designation recommendations for the revised annual $PM_{2.5}$ health-based standard. The recommendations are based on 2010-2012 air quality monitoring data, because 2012 is the most recent full-year of quality-assured and quality-controlled data available. EPA is required to make final $PM_{2.5}$ designations by December 2014. EPA's final designations will most likely be based on 2011-2013 air quality monitoring data.

Section 189(a)(2)(B) of the CAA requires that the $PM_{2.5}$ attainment demonstration State Implementation Plan (SIP) revisions will be due to EPA in June 2016, 18 months after final designations are expected to be effective (CAA § 189(a)(2)(B), 42 U.S.C. § 7513a(a)(2)(B)). As provided in CAA § 188(c)(1), the attainment date for each nonattainment area classified moderate for the 2012 annual $PM_{2.5}$ NAAQS shall be as met as expeditiously as practicable, but no later than the end of the sixth calendar year after the area was designated nonattainment, or by December 2020 (42 U.S.C. § 7513(c)(1)). EPA has indicated that it will initially classify all nonattainment areas as 'moderate' nonattainment areas, consistent with CAA § 188(a), 42 U.S.C. § 7513(a).

The Department provided notice of a public comment period on the proposed designation recommendations in the *Pennsylvania Bulletin* on November 2, 2013 (43 *Pa. B.* 6598). The public comment period closed November 18, 2013. Comments were received from two commentators during the public comment period. A brief summary of the comments and the Department's responses can be found in the Comment and Response Document.

Designation Methodology

EPA Guidance for $PM_{2.5}$ Designation Boundaries. On April 16, 2013, EPA issued a guidance memorandum, *Initial Area Designations for the 2012 Revised Primary Annual Fine Particle National Ambient Air Quality Standard* (Designations Guidance). EPA explains in the Designations Guidance that nonattainment area boundaries will encompass the area(s) that violate(s) the standard and the nearby areas that contribute to the violations. EPA explains in the Designations Guidance that it intends to begin its analysis of what areas contribute to a violating area by considering those counties in the entire metropolitan area (for instance, the Core Based Statistical Area (CBSA) or Combined Statistical Areas (CSA)) in which the violating monitor(s) is (are) located; and to evaluate any adjacent counties to the CBSA or CSA that have the potential to contribute to the violations. EPA explains that it does not presume that the CBSA or CSA constitutes the nonattainment area boundary, however. EPA describes criteria that states should examine when recommending nonattainment area boundaries. The factors include air quality data, emissions and emissions related data, meteorology, geography, topography, and jurisdictional boundaries. Pennsylvania used this Designations Guidance, as described below, when developing designation recommendations for the 2012 annual $PM_{2.5}$ NAAQS.

The Department's Approach. The Department has strived to provide continuity of existing air quality planning efforts in its recommendations for the 2012 annual $PM_{2.5}$ NAAQS, wherever appropriate. In central and eastern Pennsylvania, previous designations generally followed county boundaries and, in part, the U.S. Office of Management and Budget's (OMB) boundaries for Metropolitan Statistical Areas (MSA) and CSAs. The OMB-defined areas are defined primarily by having a high degree of social and economic integration measured by commuting ties with outlying counties. Where EPA's designations did not follow these boundaries in the past, EPA tended to make the nonattainment area smaller than the MSA, CBSA or CSA. Pennsylvania's recommendations for the 2012 annual $PM_{2.5}$ NAAQS use existing nonattainment area boundaries, where appropriate.

The Department has also considered the five factors recommended by EPA in its Designations Guidance, and other sources of information relevant to $PM_{2.5}$ designations. In some cases, an analysis of these factors suggested that one or more counties in the MSA, CBSA or CSA should be recommended as attainment or unclassifiable/nonattainment.

Designation Recommendations for the 2012 Annual PM2.5 NAAQS

Attainment Areas
Of the 37 network monitors in Pennsylvania, 28 monitors in 19 counties did not show violations of the 2012 annual $PM_{2.5}$ NAAQS. The design values for each monitor in Pennsylvania are listed in Table 1. A design value for the 2012 annual $PM_{2.5}$ NAAQS is the 3-year average (in this case, 2010 to 2012) of the annual average concentration for each monitor.

Nonattainment Areas
There are 10 monitors in eight counties that are violating the 2012 annual $PM_{2.5}$ NAAQS: the counties are Allegheny, Cambria, Chester, Delaware, Lancaster, Northampton, Philadelphia and Westmoreland Counties. The design values for each monitor in Pennsylvania are listed in Table 1 below, with Appendix B, Figure B-1 showing a map of the 2012 $PM_{2.5}$ design values for all of the $PM_{2.5}$ monitors in Pennsylvania.

Unclassifiable/Attainment Areas
At this time, the Department is recommending that all other counties in Pennsylvania that do not have ambient air monitoring data be designated as unclassifiable/attainment.

Discussion of Related Factors
EPA recommends that states look at a number of factors in making their recommendations for the 2012 annual $PM_{2.5}$ NAAQS designations. In attachment 3 of EPA's Designations Guidance, EPA suggests using a five-factor approach, which includes the consideration of the following factors: (1) air quality data; (2) emission and emissions-related data; (3) meteorology; (4) geography and topography; and (5) jurisdictional boundaries. The Department has considered these factors and sources of information relevant to $PM_{2.5}$ designations, and provides a general discussion of this information as follows:

Air Quality Data. The Commonwealth's recommendations are based on the 2012 $PM_{2.5}$ design values (using the 2010, 2011 and 2012 monitored data). Table 1 (relating to design values by monitor) lists these design values by monitor site, in descending order of design value, including only the monitors with three full years of monitoring data. Information pertaining to monitors with design values exceeding the 2012 annual $PM_{2.5}$ NAAQS is identified in bold.

Table 1: Design Values by Monitor (2010 – 2012)

County	Site Name	AIRS Code	Design Value (in µg/m^3)
Allegheny	**Liberty**	**42-003-0064**	***14.8***
Philadelphia	**AMS Laboratory**	**42-101-0004**	***13.4***
Allegheny	**Avalon**	**42-003-0002**	***13.4***
Northampton	**Freemansburg**	**42-095-0025**	***13.2***
Delaware	**Chester**	**42-045-0002**	***13.1***
Westmoreland	**Greensburg**	**42-129-0008**	***12.6***
Allegheny	**North Braddock**	**42-003-1301**	***12.5***
Chester	**New Garden**	**42-029-0100**	***12.3***
Cambria	**Johnstown**	**42-021-0011**	***12.3***
Lancaster	**Lancaster**	**42-071-0007**	***12.1***
Beaver	Beaver Falls	42-007-0014	*12.0*
Dauphin	Harrisburg	42-043-0401	*11.9*
Washington	Charleroi	42-125-0005	*11.9*
York	York	42-133-0008	*11.7*
Allegheny	Harrison 2	42-003-1008	*11.7*
Armstrong	Kittanning	42-005-0001	*11.7*
Adams	Arendtsville	42-001-0001	*11.6*
Erie	Erie	42-049-0003	*11.3*
Allegheny	Lawrenceville	42-003-0008	*11.1*
Washington	Washington	42-125-0200	*11.1*
Philadelphia	Ritner	42-101-0055	*11.0*
Cumberland	Carlisle	42-041-0101	*11.0*
Bucks	Bristol	42-017-0012	*10.9*
Philadelphia	CHS (Broad St)	42-101-0047	*10.9*
Berks	Reading Airport	42-011-0011	*10.9*
Allegheny	Clairton	42-003-3007	*10.9*
Philadelphia	FAB (Spring Garden St)	42-101-0057	*10.8*
Northampton	Lehigh Valley	42-095-0027	*10.6*
Mercer	Farrell	42-085-0100	*10.6*
Allegheny	South Fayette	42-003-0067	*10.5*
Montgomery	Norristown	42-091-0013	*9.8*
Blair	Altoona	42-013-0801	*9.8*
Centre	State College	42-027-0100	*9.5*
Allegheny	North Park	42-003-0093	*9.4*
Lackawanna	Scranton	42-069-2006	*9.1*
Monroe	Swiftwater	42-089-0002	*8.0*
Washington	Florence	42-125-5001	*7.2*

Most of the monitors exceeding the annual $PM_{2.5}$ standard are in the southwest and southeast areas of the Commonwealth. Specifically, they are in Allegheny, Cambria, Chester, Delaware, Lancaster, Northampton, Philadelphia and Westmoreland counties.

A map showing the 2012 annual $PM_{2.5}$ design values across Pennsylvania is attached in Appendix B, Figure B-1. The monitors exceeding the 12 $\mu g/m^3$ standard are displayed in red (with rounding, design values of 12.05 are considered to be exceeding the standard). The Commonwealth is recommending that all of these areas be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS.

Emissions and Emissions Related Data.

Stationary Point Sources. The Department prepares an emission inventory for all criteria pollutants from all sectors every three years. Only stationary source data is available every year; the most recent full inventory was for the year 2011, and was submitted to EPA for review and input for the 2011 National Emissions Inventory (NEI). Figures B-2 through B-5 in Appendix B show the $PM_{2.5}$ precursor emissions per square mile for stationary point sources, which are sources for which the Department collects individual emissions-related information. Stationary point sources include major manufacturing operations and power plants. Figures B-11 through B-14 show similar information for specific point sources.

Area Sources. Figures B-6 through B-10 (Emission Density for Area Sources) in Appendix B show $PM_{2.5}$ precursor emissions per square mile, including emissions resulting from:

- Stationary area sources, which are the industrial, commercial, and residential sources too small or too numerous to be handled individually, such as commercial and residential open burning, architectural and industrial maintenance coatings application and clean-up, consumer product use, and vehicle refueling at service stations.

- Highway vehicles, which include passenger cars and light-duty trucks, other trucks, buses and motorcycles; and

- Nonroad sources, which consist of a diverse collection of engines, including engines in outdoor power equipment, recreational vehicles, farm and construction machinery, lawn and garden equipment, industrial equipment, recreational marine vessels, commercial marine vessels, locomotives, ships, aircraft and many other such sources.

Stationary area source emissions of NH_3 are primarily concentrated in the areas with high concentrations of agriculture, including areas of animal and crop operations. Stationary area source emissions of the other $PM_{2.5}$ precursors tend to be more concentrated in populated areas as a result of vehicle traffic or combustion sources.

Highway and nonroad emissions of NO_X, direct $PM_{2.5}$ and VOC have been declining and will continue to do so, as national and state controls on new highway vehicles, nonroad equipment and motor vehicle fuels come into effect, and older vehicles are replaced.

Population, urbanization, traffic, commuting, and growth factors are the primary determinates of the OMB's designation of metropolitan and micropolitan statistical areas and were used extensively by Pennsylvania in its recommendations, and to a lesser extent, by EPA in its final designations, for the 1997 $PM_{2.5}$ standard. For the 2006 24-hour standard, EPA explicitly stated that these area boundaries would no longer be presumed to define nonattainment areas. The Commonwealth, however, has emphasized continuity of planning for attainment of the 2012 annual $PM_{2.5}$ NAAQS. Consequently, the Commonwealth's recommended boundaries take these factors into account. Figure B15 shows population density by county and Figure B16 shows population growth between 2000 and 2010.

Meteorology, Geography and Topography. Many regions across the Commonwealth have weather that is influenced by topography. There are many areas of river valleys and higher terrain across western Pennsylvania that influence the way wind flows across the region. Topography also enhances the strength of morning inversions when they form. Morning inversions are a key meteorological feature that contributes to higher daily levels of $PM_{2.5}$ across a region. Various areas contend with the influences of the Appalachian Mountains, as well. The changes in local elevation become less drastic in southcentral and southeastern portions of the Commonwealth. The Philadelphia area, by contrast, has relatively few topographic features that restrict airflow.

Wind direction and speed are important meteorological factors to consider. Wind can weaken or improve air quality conditions. Strong winds can transport PM emissions or their precursors regionally, while weak winds can lead to the accumulation of emissions on a local basis. Figures 1 and 2, below, show wind roses for the western and eastern portions of Pennsylvania, respectively. These images are taken from the EPA PM online tool (http://geoplatform2.epa.gov/PM_Map/), which shows wind data averaged over the 2009-2012 time period in the form of wind roses, from National Weather Service sites. Figure 1 shows a map of wind roses in western Pennsylvania. The wind roses in this area indicate that the wind primarily comes from the west or southwest. Figure 2 shows a map of wind roses in eastern Pennsylvania. The wind roses in this area indicate that the wind primarily comes from the west and northwest.

Figure 1: Wind Roses for Western Pennsylvania

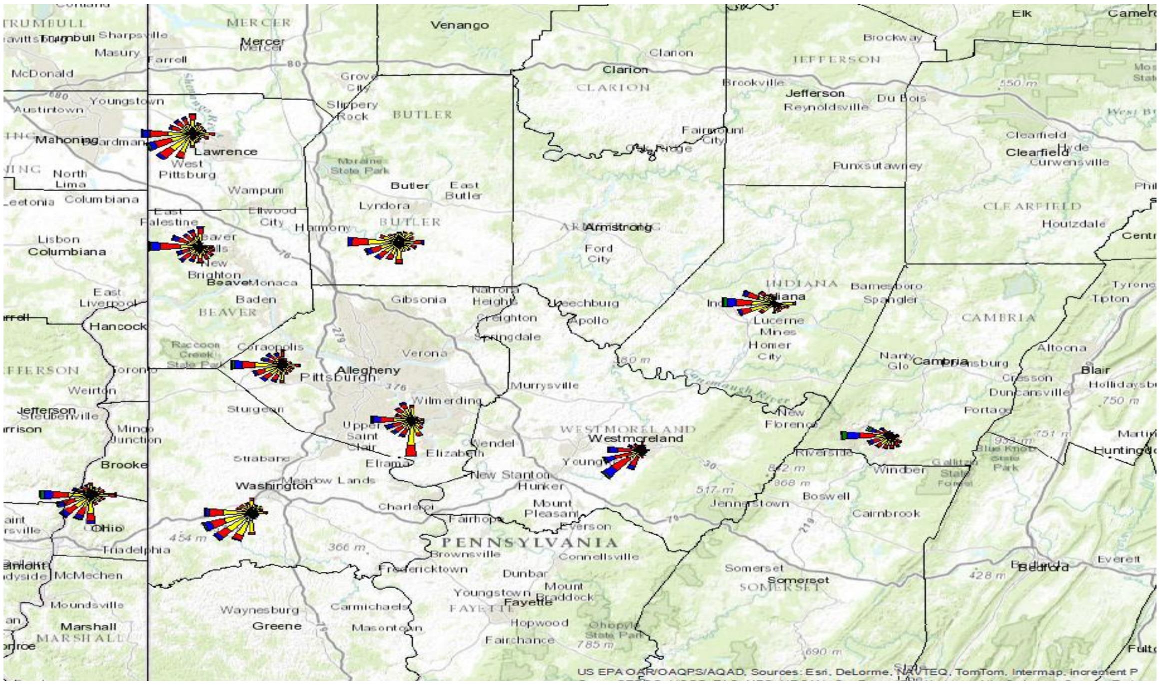
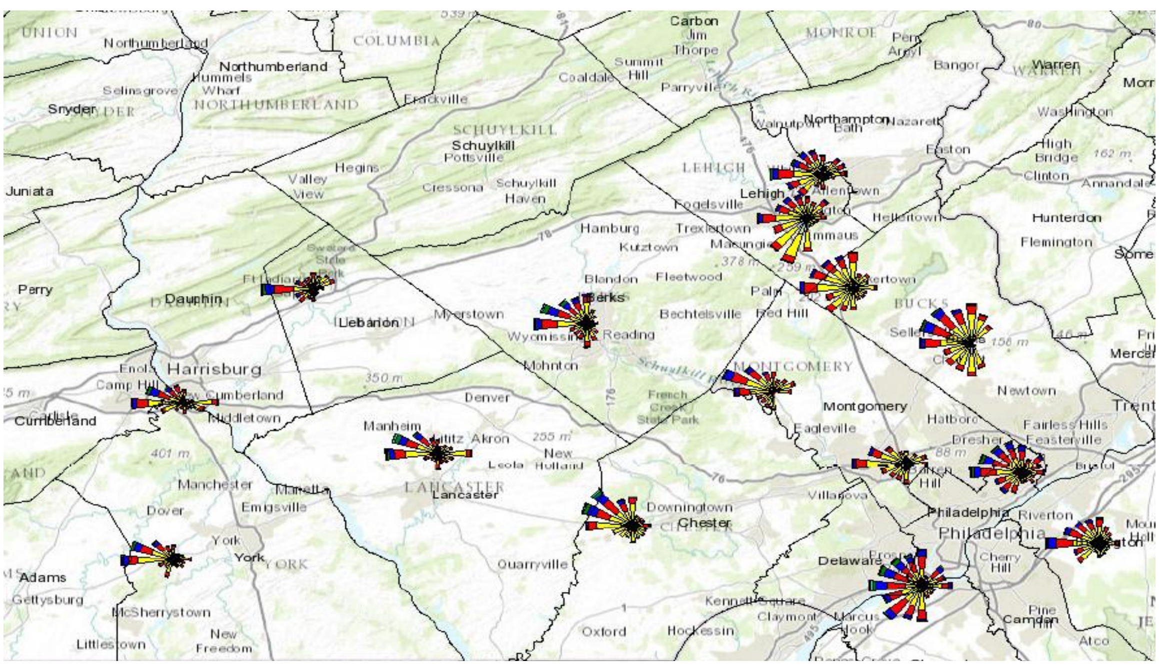


Figure 2: Wind Roses for Eastern Pennsylvania



The Department has conducted meteorological, geographical and topographical analysis for the monitors in the recommended nonattainment areas. These analyses are contained in Appendix C (relating to Meteorological, Geographical and Topographical Analysis for Recommended Nonattainment Areas).

Jurisdictional Boundaries. The Department recommends the use of county boundaries because these are the same boundaries used by the Commonwealth's regional transportation planning organizations (which are also often economic planning organizations as well). Inventory data for nonpoint sources is also more accurate and available on the county level, which is useful in meeting the requirements in nonattainment areas for emission inventory information and for reasonable further progress (incremental emission reductions). While EPA does not presume that the CBSA or CSA should be the nonattainment boundary for the areas, EPA considers the CBSA or CSA as a reasonable starting point for analysis of what nearby areas may be contributing to the violation of the NAAQS at a given monitor. Having considered the relevant data, the Department is recommending that the boundaries of nonattainment areas associated with monitors violating the annual $PM_{2.5}$ standard primarily follow the county boundaries. In some cases, the nonattainment area is being recommended to be limited to one partial county or one whole county, while in other cases the nonattainment areas are recommended as a small multi-county area combining two or three counties within a regional transportation planning organization.

Discussion of Designation Recommendations

Recommended Nonattainment Areas

The Commonwealth is recommending the following 2012 annual $PM_{2.5}$ NAAQS nonattainment area designations based upon air quality monitoring data for 2010-2012, the other information described above regarding the factors in EPA's Designations Guidance, and any additional information described below and in the applicable Appendix C. Each of the following descriptions for a recommended area references a corresponding Appendix C that contains a more detailed analysis of the recommended nonattainment area.

Eastern Pennsylvania:

Greater Philadelphia Nonattainment Area: The Commonwealth is recommending that Chester, Delaware and Philadelphia counties be designated as a 2012 annual $PM_{2.5}$ NAAQS nonattainment area. Bucks and Montgomery counties make insignificant contributions to the nonattaining monitors in the traditional five-county Philadelphia area and are excluded from the recommended nonattainment area. Details can be found in Appendix C-1.

Northampton County Nonattainment Area: The Commonwealth is recommending that Northampton County be designated as a 2012 annual $PM_{2.5}$ NAAQS nonattainment area. The Freemansburg monitor in Northampton County is violating the annual standard, while the Lehigh Valley monitor, situated to the northwest of the Freemansburg monitor, shows attainment of the standard. The Freemansburg monitor had a 2012 design value of 13.2 μg/m^3, while the Lehigh Valley monitor had a 2012 design value of 10.6 μg/m^3. Other Pennsylvania counties in this region make insignificant contributions to the nonattainment problem at the Freemansburg monitor. The problem at the Freemansburg monitor appears to be a localized, rather than regional, issue. Details can be found in Appendix C-2.

Southcentral Pennsylvania:

Lancaster County Nonattainment Area: The Commonwealth recommends that Lancaster County be designated as a nonattainment area for the 2012 annual $PM_{2.5}$ NAAQS. Lancaster County is served by a single-county transportation planning agency based on economic, political and commuting patterns. The nonattainment area contains the Lancaster air basin, which defines a common set of sulfur compound controls (25 *Pa Code* § 121.1 and 123.22). Sulfur compounds are an important $PM_{2.5}$ precursor. Lancaster County was designated as a single-county nonattainment area for the 2006 24-hour $PM_{2.5}$ standard and the 1997 and 2008 8-hour ozone standards. Details can be found in Appendix C-3.

Southwest Pennsylvania:

Cambria County Nonattainment Area: The Commonwealth recommends that Cambria County, which includes the City of Johnstown, be designated as a nonattainment area for the 2012 annual $PM_{2.5}$ NAAQS. The nonattainment area contains the Johnstown air basin, which defines a common set of sulfur compound controls (25 *Pa Code* § 121.1 and 123.22). Sulfur compounds are an important $PM_{2.5}$ precursor. Other Pennsylvania counties in this region make insignificant contributions to the nonattainment problem at the Johnstown monitor. The problem at the Johnstown monitor appears to be a localized, rather than regional, issue. Details can be found in Appendix C-4.

Greater Pittsburgh Nonattainment Area: The Commonwealth recommends that Westmoreland and Allegheny counties (with the exception of the Liberty-Clairton area in Allegheny County) be designated as a 2012 annual $PM_{2.5}$ NAAQS nonattainment area. The Liberty-Clairton area of Allegheny County is being recommended as a separate partial-county nonattainment area, as described below. Other Pennsylvania counties in this region make insignificant contributions to the nonattainment problem. Details of the Greater Pittsburgh nonattainment area recommendation can be found in Appendix C-5.

Liberty-Clairton Nonattainment Area: The Commonwealth recommends that the City of Clairton, and boroughs of Glassport, Liberty, Lincoln and Port View be designated as the Liberty-Clairton nonattainment area for the 2012 annual $PM_{2.5}$ NAAQS. The Liberty-Clairton area of Allegheny County has significant differences from the surrounding areas in the county due to local sources and topography. Details can be found in Appendix C-6.

Recommended Attainment Areas

The Commonwealth recommends that EPA designate the following counties as attainment areas, because they have monitors showing attainment of the 2012 annual $PM_{2.5}$ standard and they are not contributing to nonattainment of the standard in another area: Adams, Armstrong, Beaver, Berks, Blair, Bucks, Centre, Cumberland, Dauphin, Erie, Lackawanna, Mercer, Monroe, Montgomery, Washington and York counties.

Recommended Unclassifiable/Attainment Areas

The Commonwealth recommends that EPA designate the counties set forth below as unclassifiable/attainment areas, because they have do not have monitors showing attainment or nonattainment of the 2012 annual $PM_{2.5}$ standard. Additionally, they have not been determined to be contributing to nonattainment of the standard in another area.

The recommended "unclassifiable/attainment areas" counties are provided as follows: Bedford, Bradford, Butler, Cameron, Carbon, Clarion, Clearfield, Clinton, Columbia, Crawford, Elk, Fayette, Forest, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lawrence, Lebanon, Lehigh, Luzerne, Lycoming, McKean, Mifflin, Montour, Northumberland, Perry, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Venango, Warren, Wayne and Wyoming.

Available Data

Appendix A includes a table that lists the recommendations for annual $PM_{2.5}$ areas, as well as a map showing the Commonwealth's recommendations for the 2012 annual $PM_{2.5}$ nonattainment areas. Appendix B includes documenting material that addresses EPA's designation criteria pertaining to air quality, emissions, and jurisdictional boundaries. Appendix C includes additional designation criteria relating to meteorology, geography and topography.

Conclusions / Summary

In this document, the DEP is making recommendations to EPA, on behalf of the Commonwealth, concerning the designation of attainment, unclassifiable/attainment and nonattainment areas in Pennsylvania for the 2012 annual $PM_{2.5}$ NAAQS. The designation recommendations are based primarily on air quality monitoring data for 2010-2012.

Monitors in the following eight counties are violating the annual NAAQS using 2010-2012 monitoring data: Allegheny, Cambria, Chester, Delaware, Lancaster, Northampton, Philadelphia and Westmoreland counties. The Department is recommending that these counties be designated as nonattainment, and grouped in nonattainment areas as previously discussed and described in Appendix C. In addition, the Department recommends that the Liberty-Clairton area of

Allegheny County be designated as a separate nonattainment area from the Greater Pittsburgh Area for the reasons described in Appendix C-6.

The Department is recommending that counties monitoring attainment of the 2012 annual $PM_{2.5}$ NAAQS be designated as attainment. The Department is recommending that all other counties in Pennsylvania be designated as unclassifiable/attainment. A complete breakdown of designation recommendations for the Commonwealth of Pennsylvania can be found in Appendix A, Table A-1.

ACRONYMS AND TERMS

CAA	Clean Air Act
CBSA	Core Based Statistical Area
CSA	Combined Statistical Area
DEP	Department of Environmental Protection (Pennsylvania)
EPA	Environmental Protection Agency (United States)
FR	Federal Register
$\mu g/m^3$	micrograms per cubic meter (of air)
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NEI	National Emissions Inventory
NH_3	chemical formula for ammonia
NO_X	oxides of nitrogen
OMB	Office of Management and Budget (United States)
PM	particulate matter
$PM_{2.5}$	particulate matter under 2.5 microns in size
PM_{10}	particulate matter under 10 microns in size
SIP	State Implementation Plan
SO_2	sulfur dioxide
USDOT	United States Department of Transportation
U.S.C.	United States Code
VOC	volatile organic compounds

APPENDIX A

Table A-1: Recommended Designations for the 2012 Annual $PM_{2.5}$ NAAQS for Pennsylvania

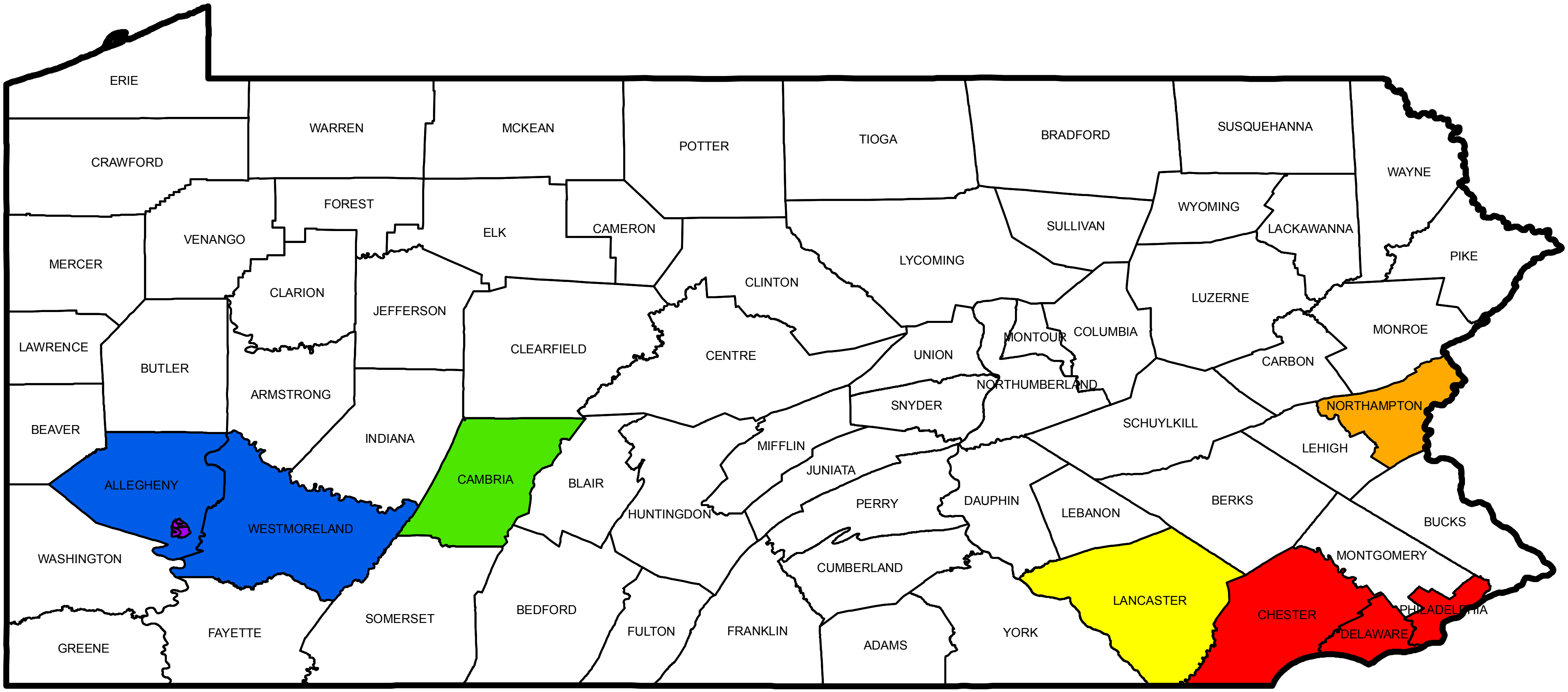
Figure A-1: Map of Recommended 2012 $PM_{2.5}$ Nonattainment Areas in Pennsylvania

Table A-1. RECOMMENDED DESIGNATIONS FOR THE 2012 ANNUAL $PM_{2.5}$ NAAQS FOR PENNSYLVANIA

Based on Five Factor Analysis, including 2010-2012 Air Quality Data

NONATTAINMENT	ATTAINMENT	UNCLASSIFIABLE/ATTAINMENT
Greater Philadelphia Area	Adams County	Bedford County
Chester County	Armstrong County	Bradford County
Delaware County	Beaver County	Butler County
Philadelphia County	Berks County	Cameron County
	Blair County	Carbon County
Northampton County Area	Bucks County	Clarion County
Northampton County	Centre County	Clearfield County
	Cumberland County	Clinton County
Lancaster County Area	Dauphin County	Columbia County
Lancaster County	Erie County	Crawford County
	Lackawanna County	Elk County
Cambria County Area	Mercer County	Fayette County
Cambria County	Monroe County	Forest County
	Montgomery County	Franklin County
Greater Pittsburgh Area	Washington County	Fulton County
(excludes Liberty-Clairton Area)	York County	Greene County
Allegheny County (partial)		Huntingdon County
Westmoreland County		Indiana County
		Jefferson County
Liberty-Clairton Area		Juniata County
City of Clairton		Lawrence County
Borough of Glassport		Lebanon County
Borough of Liberty		Lehigh County
Borough of Lincoln		Luzerne County
Borough of Port View		Lycoming County
		McKean County
		Mifflin County
		Montour County
		Northumberland County
		Perry County
		Pike County
		Potter County
		Schuylkill County
		Snyder County
		Somerset County
		Sullivan County
		Susquehanna County
		Tioga County
		Union County
		Venango County
		Warren County
		Wayne County
		Wyoming County

Figure A-1
Recommended Annual $PM_{2.5}$ Nonattainment Areas



Recommended $PM_{2.5}$ Nonattainment Areas

- Greater Philadelphia Area
- Lancaster County
- Greater Pittsburgh Area
- Northampton County
- Cambria County
- Liberty-Clairton

APPENDIX B:
Supplementary Information

Figure B-1: 2012 Annual $PM_{2.5}$ Design Values

Figures B-2 to B-14: Emissions Information for $PM_{2.5}$ and Precursors

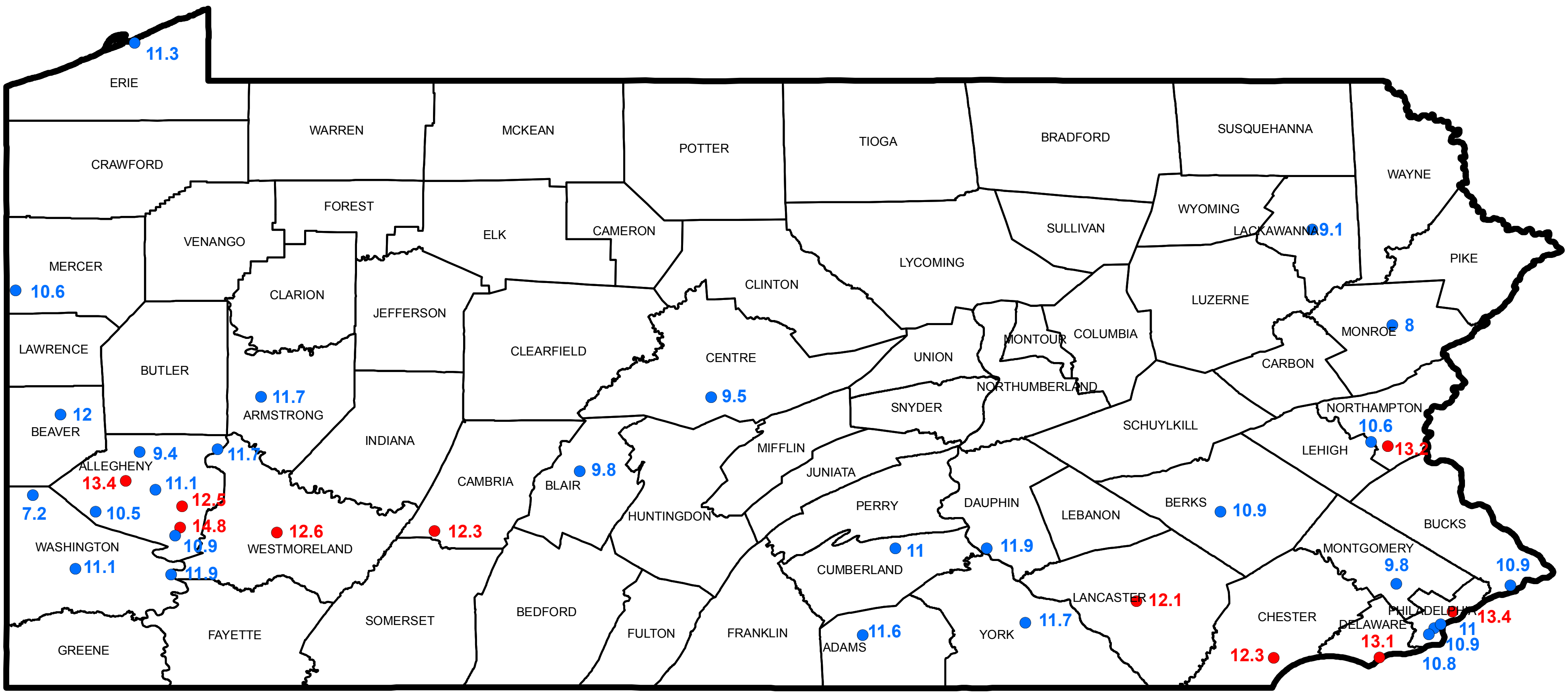
- B-2: $PM_{2.5}$ Point Source Density
- B-3: SO_2 Point Source Density
- B-4: NO_X Point Source Density
- B-5: VOC Point Source Density
- B-6: Direct $PM_{2.5}$ Area Source Density
- B-7: SO_2 Area Source Density
- B-8: NO_X Area Source Density
- B-9: VOC Area Source Density
- B-10: NH_3 Area Source Density
- B-11: $PM_{2.5}$ Point Source Emissions by Facility
- B-12: SO_2 Point Source Emissions by Facility
- B-13: NO_X Point Source Emissions by Facility
- B-14: VOC Point Source Emissions by Facility

Figure B-15: Population Density by County

Figure B-16: Population Growth by County

Figure B-17: Pennsylvania Air Basins

Figure B-1
2012 Annual $PM_{2.5}$ Design Values

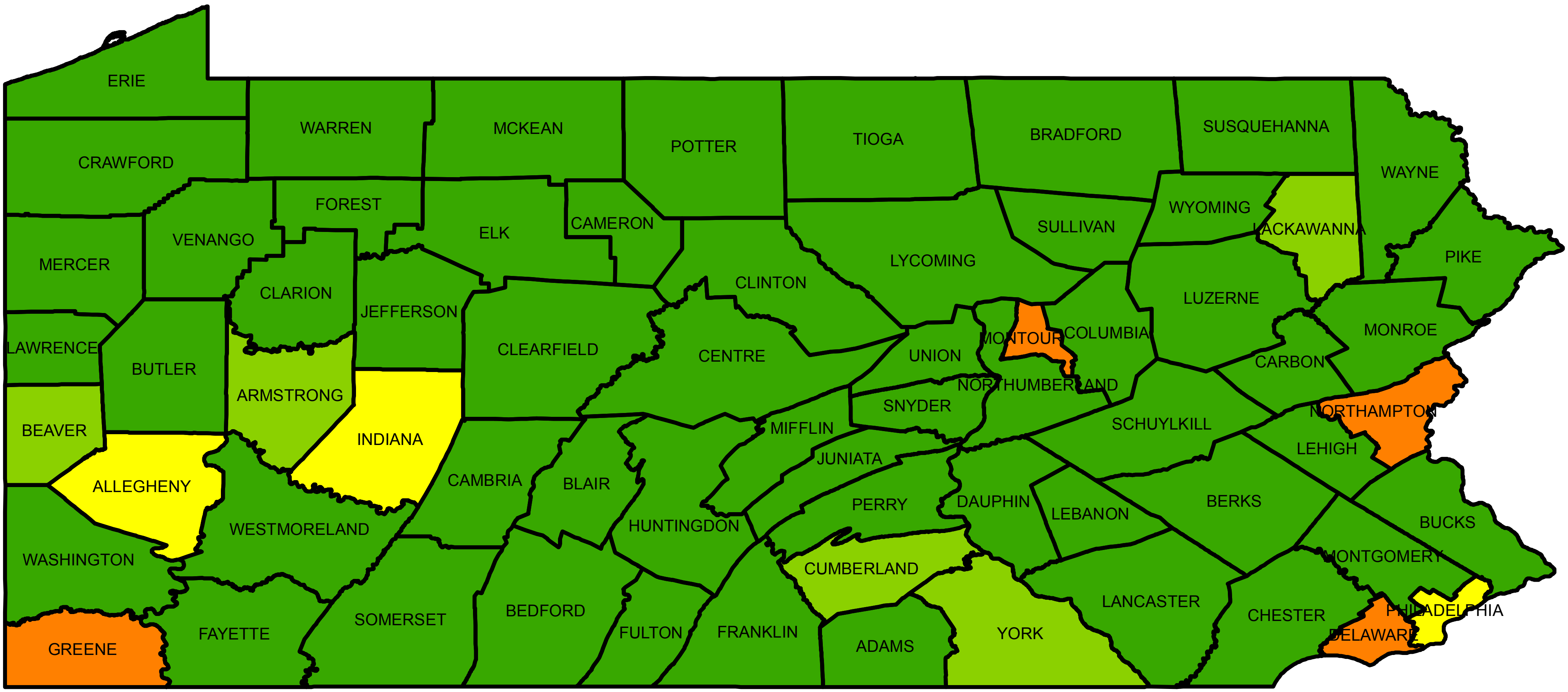


Appearing in Red - 2012 Annual $PM_{2.5}$ Design Values Above the Standard of 12 ug/m^3

Appearing in Blue - 2012 Annual $PM_{2.5}$ Design Values Below the Standard of 12 ug/m^3

Figure B-2
Emission Density Map by County

$PM_{2.5}$ Point Source Emissions



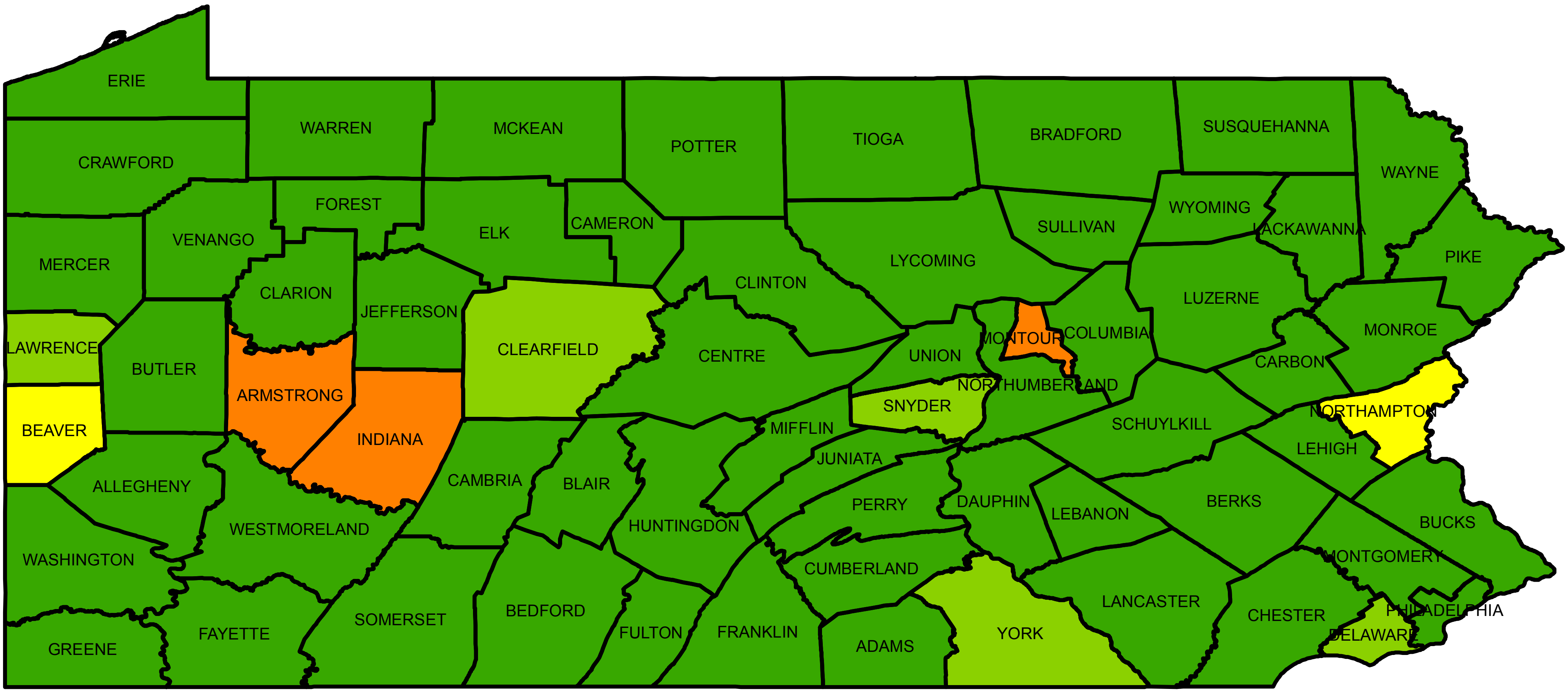
$PM_{2.5}$ Point Source Emissions are from the 2011 National Emissions Inventory

$PM_{2.5}$ Emission Density (tons per year per square mile)

0 - 0.5	0.5 - 1.0	1.0 - 2.0	2.0 - 4.0	Above 4.0

Figure B-3
Emission Density Map by County

SO_2 Point Source Emissions



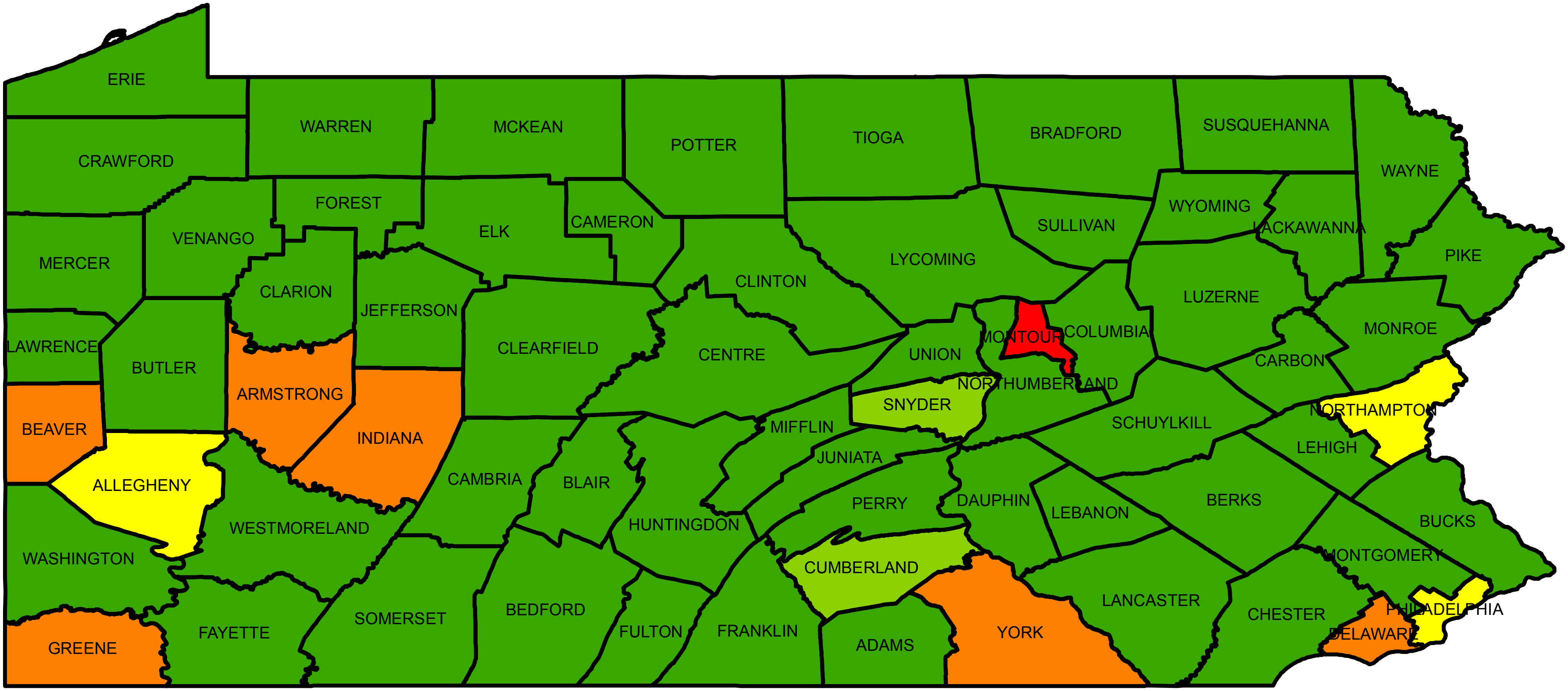
SO_2 Point Source Emissions are from the 2011 National Emissions Inventory

SO_2 Emission Density (tons per year per square mile)

0 - 20 | **20 - 50** | **50 - 100** | **100 - 200** | **Above 200**

Figure B-4
Emission Density Map by County

NO_x Point Source Emissions



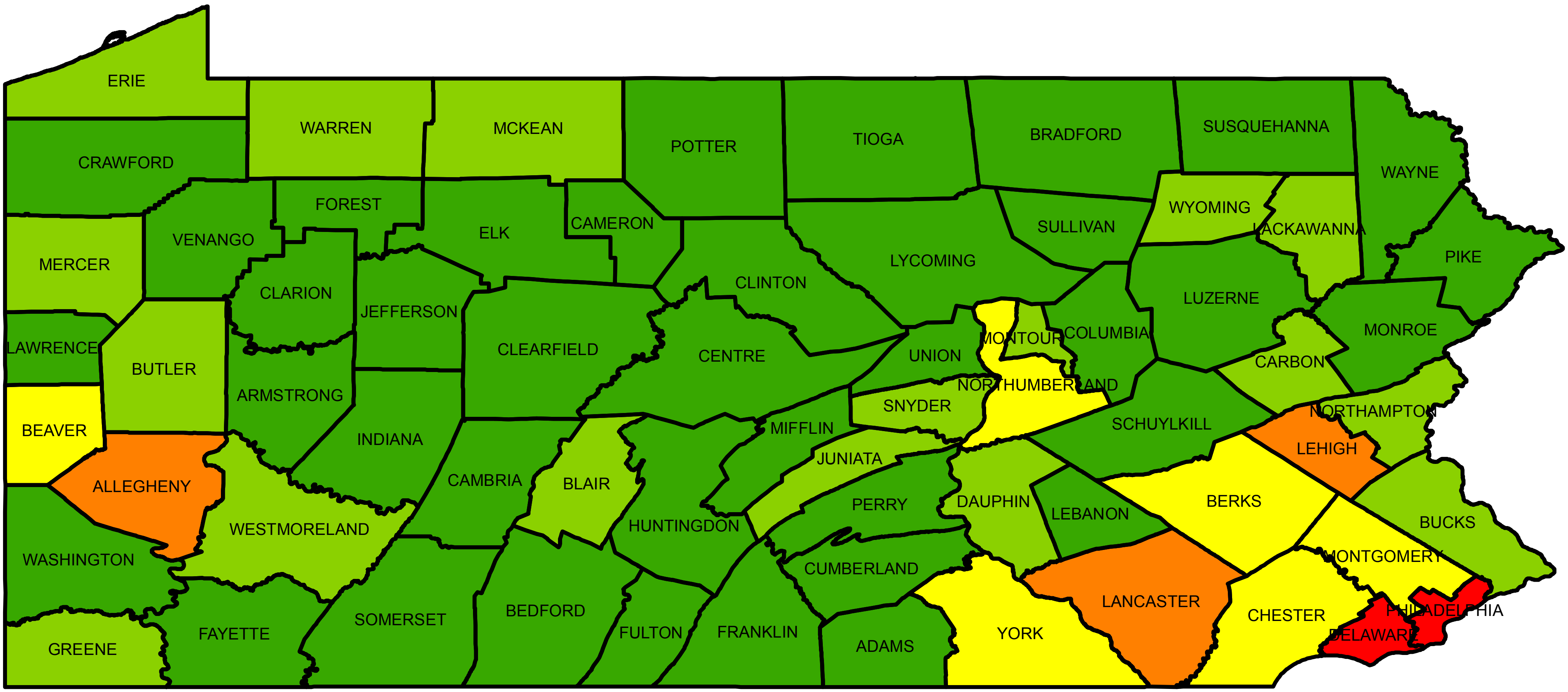
NO_x Point Source Emissions are from the 2011 National Emissions Inventory

NO_x Emission Density (tons per year per square mile)

0 - 5 **5 - 10** **10 - 25** **25 - 50** **Above 50**

Figure B-5
Emission Density Map by County

VOC Point Source Emissions



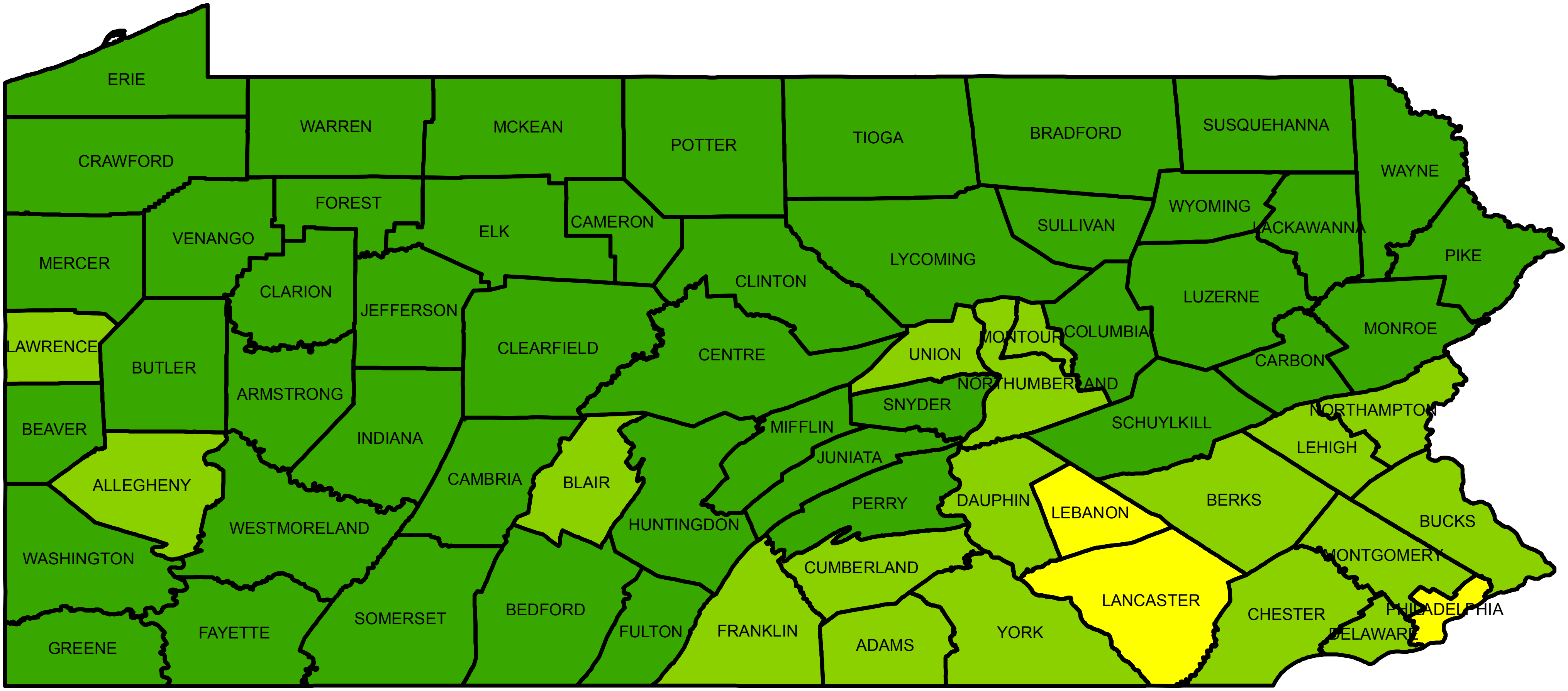
VOC Point Source Emissions are from the 2011 National Emissions Inventory

VOC Emission Density (tons per year per square mile)

0 - 0.5 **0.5 - 1.0** **1.0 - 2.0** **2.0 - 4.0** **Above 4.0**

Figure B-6
Emission Density Map by County

$PM_{2.5}$ Area Source Emissions



$PM_{2.5}$ Area Source Emissions are from the 2011 National Emissions Inventory

$PM_{2.5}$ Emission Density (tons per year per square mile)

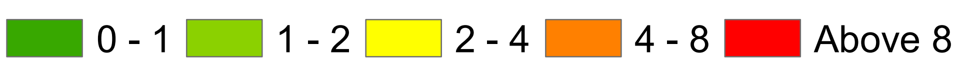
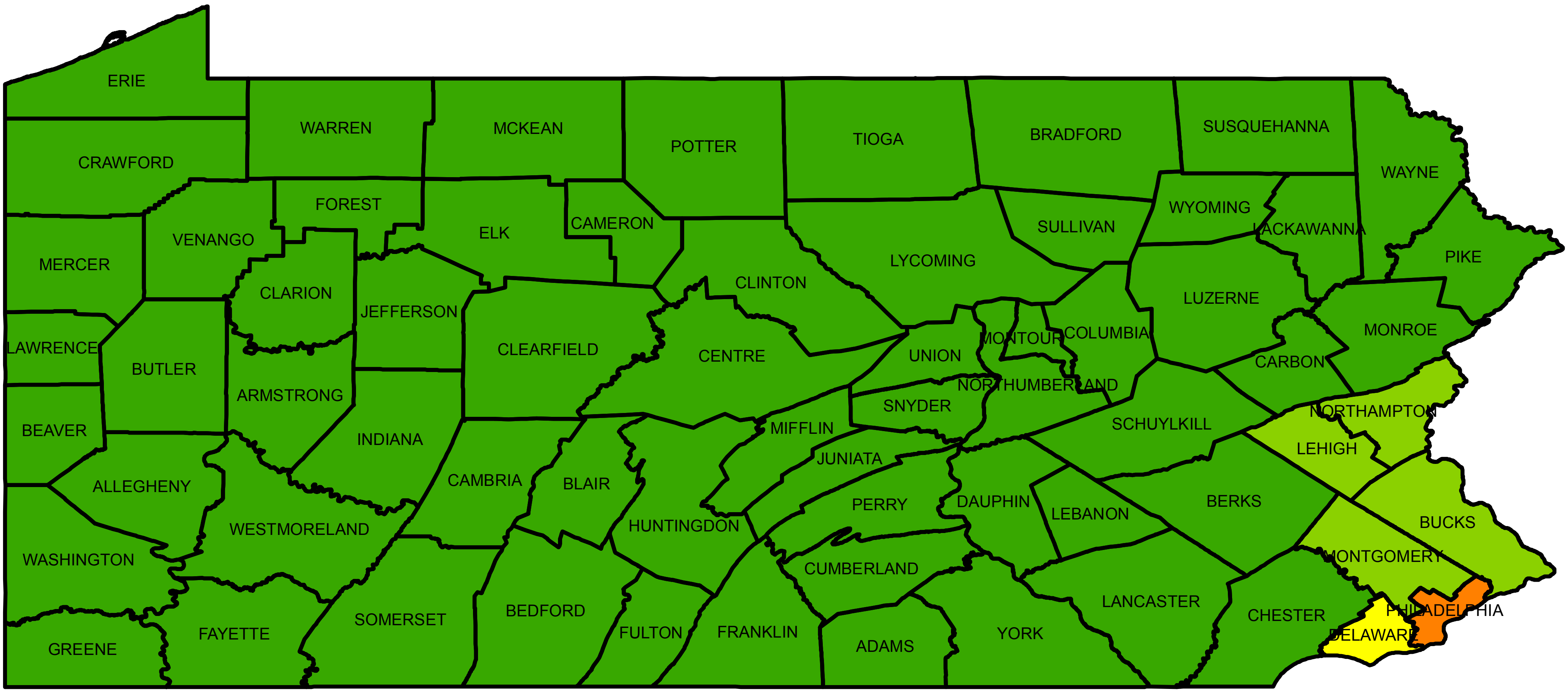


Figure B-7
Emission Density Map by County

SO_2 Area Source Emissions



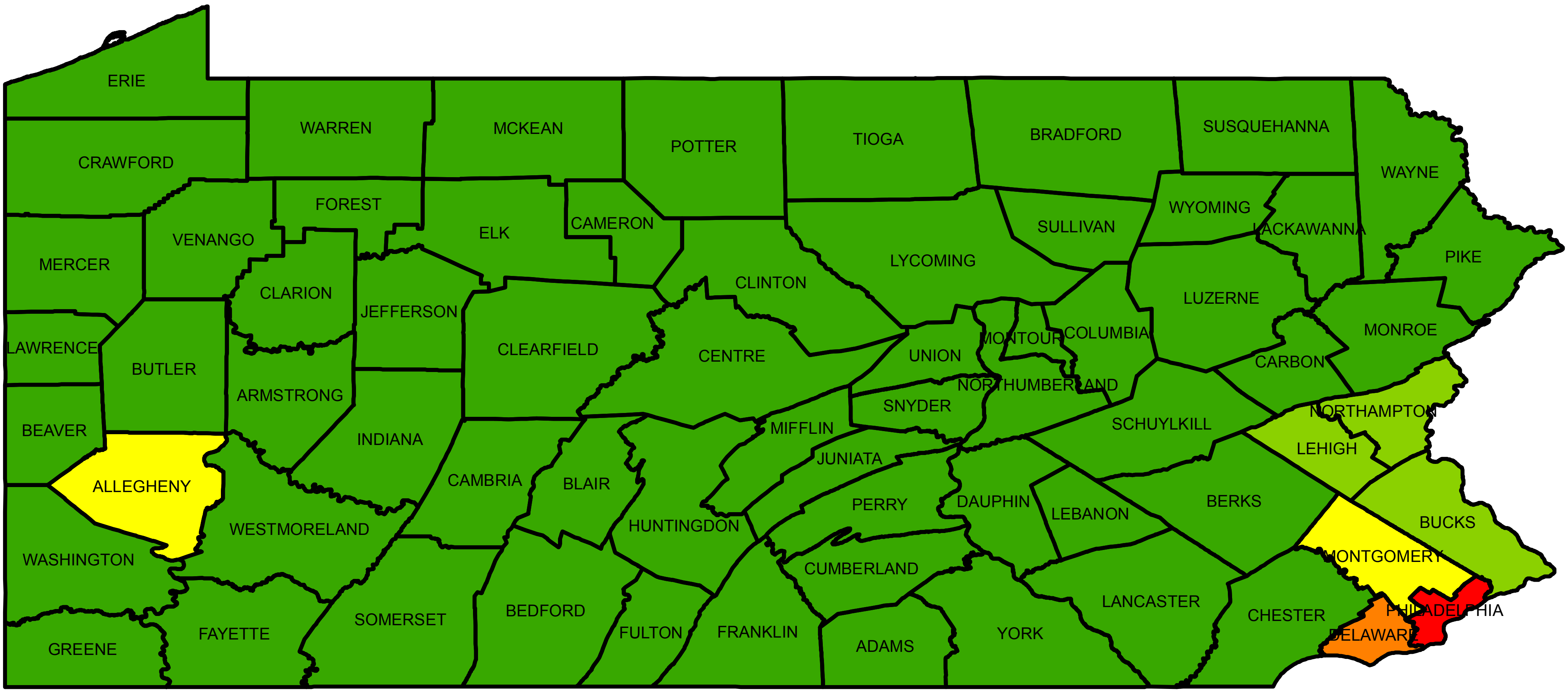
SO_2 Area Source Emissions are from the 2011 National Emissions Inventory

SO_2 Emission Density (tons per year per square mile)

0 - 1 | 1 - 2 | 2 - 4 | 4 - 8 | Above 8

Figure B-8
Emission Density Map by County

NO_x Area Source Emissions



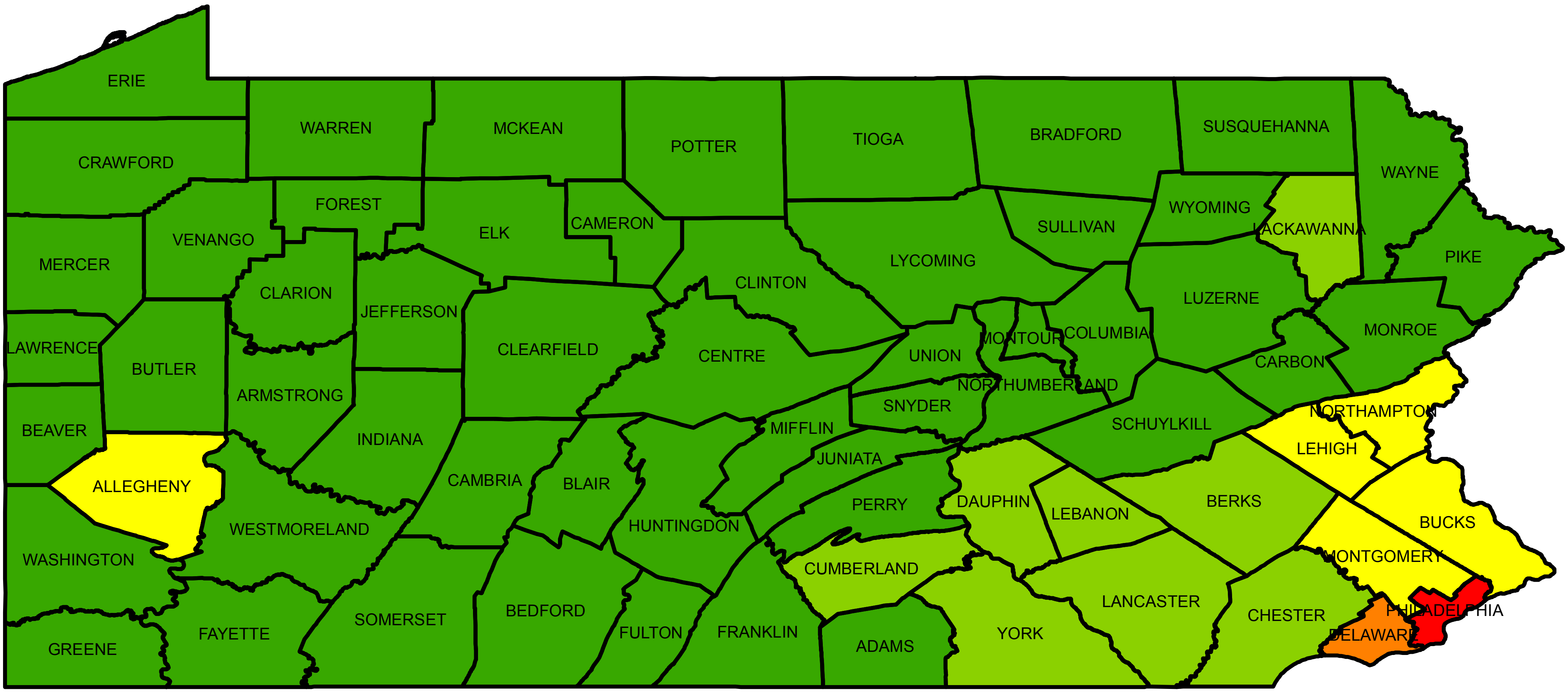
NO_x Area Source Emissions are from the 2011 National Emissions Inventory

NO_x Emission Density (tons per year per square mile)

0 - 1 | 1 - 2 | 2 - 4 | 4 - 8 | Above 8

Figure B-9
Emission Density Map by County

VOC Area Source Emissions



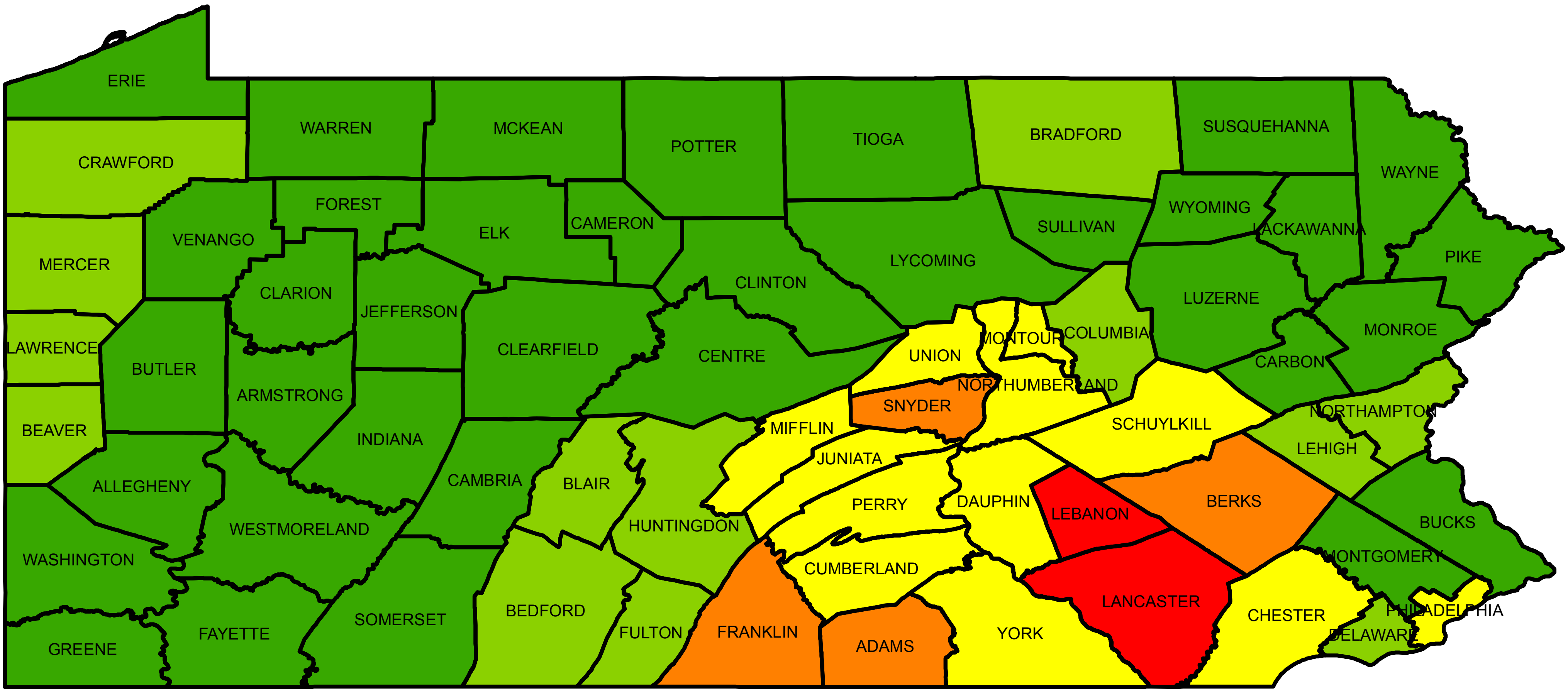
VOC Area Source Emissions are from the 2011 National Emissions Inventory

VOC Emission Density (tons per year per square mile)

0 - 4 | 4 - 8 | 8 - 16 | 16 - 32 | Above 32

Figure B-10
Emission Density Map by County

NH_3 Area Source Emissions

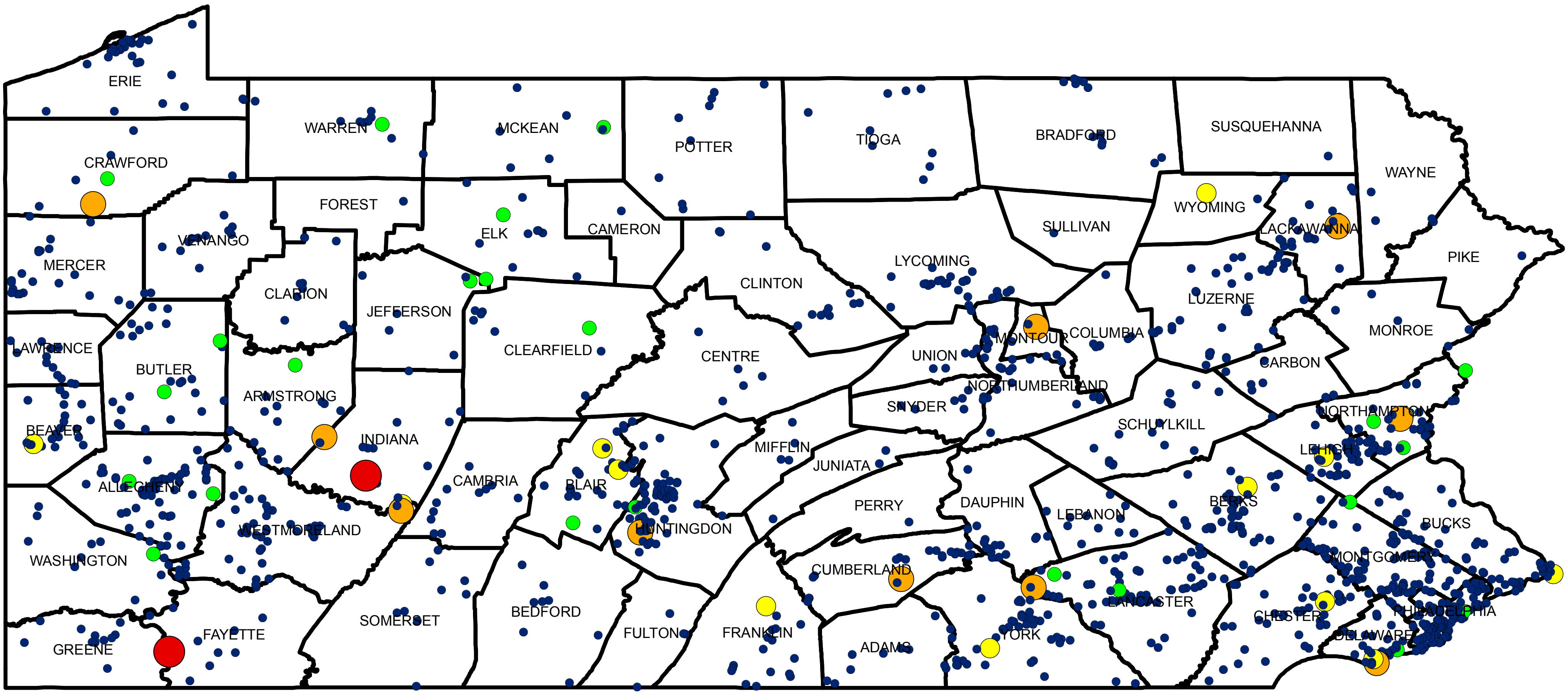


NH_3 Area Source Emissions are from the 2011 National Emissions Inventory

NH_3 Emission Density (tons per year per square mile)

Figure B-11
Point Source Emissions by Facility

PM$_{2.5}$ Point Source Emissions



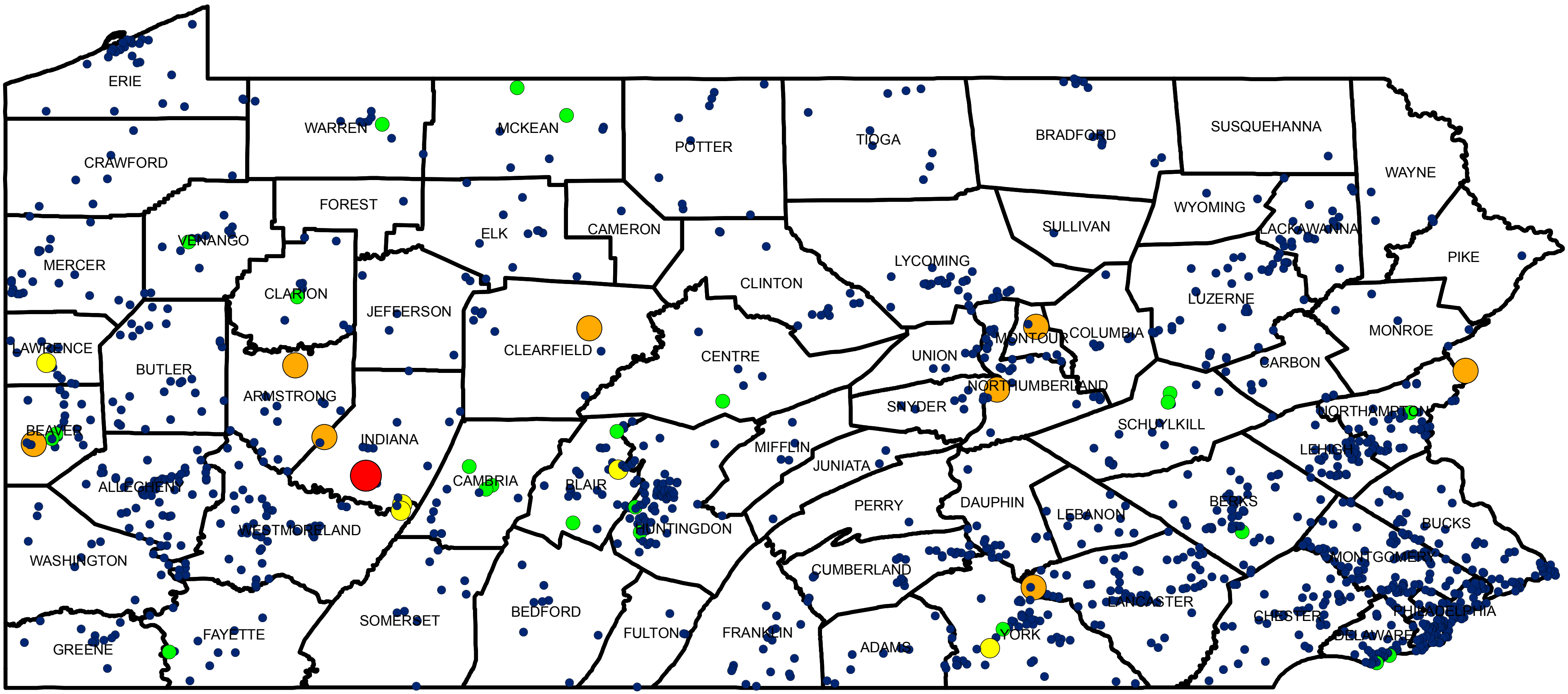
PM$_{2.5}$ Point Source Emissions are from the 2011 National Emissions Inventory

PM$_{2.5}$ Point Source Emissions (tons per year)

0 - 50 | 50 - 100 | 100 - 250 | 250 - 750 | Above 750

Figure B-12
Point Source Emissions by Facility

SO_2 Point Source Emissions



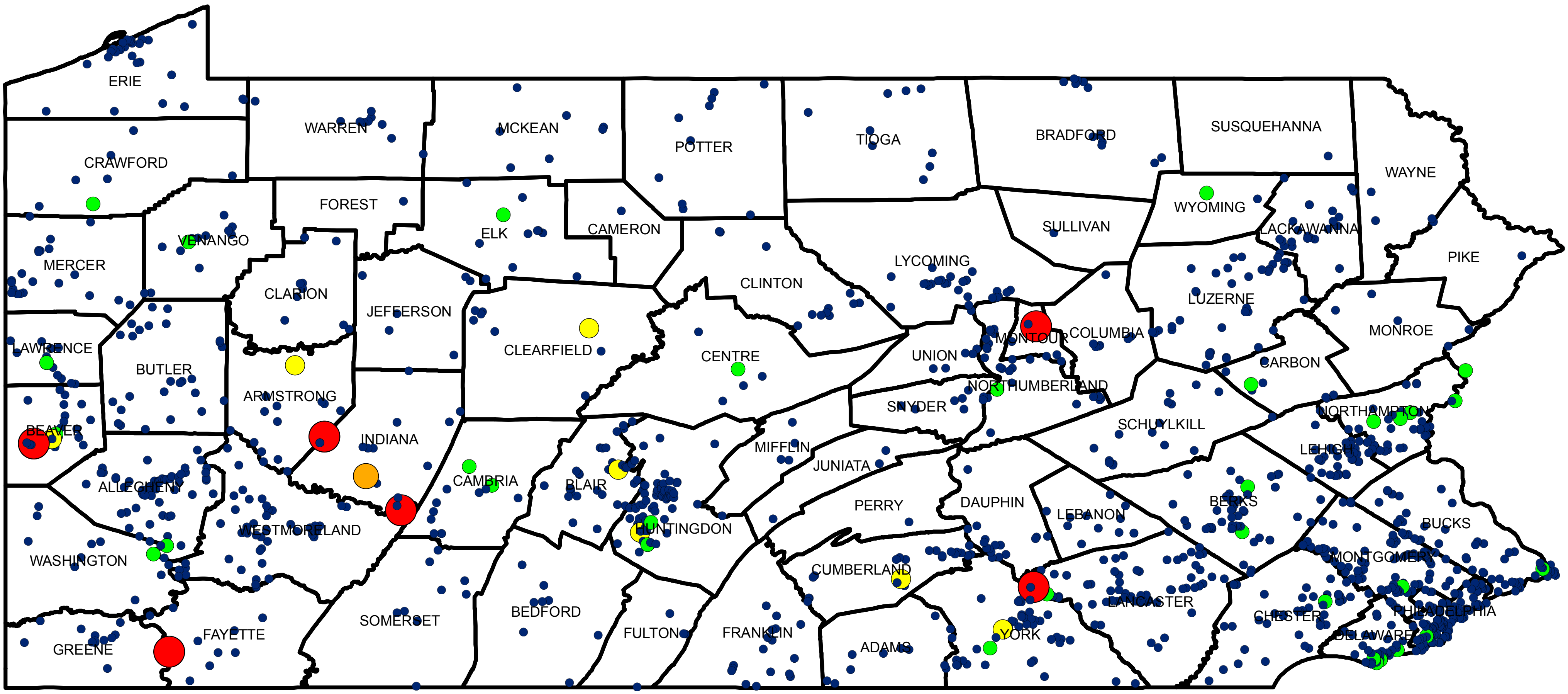
SO_2 Point Source Emissions are from the 2011 National Emissions Inventory

SO_2 Point Source Emissions (tons per year)

0 - 1000 | 1000 - 5000 | 5000 - 10000 | 10000 - 50000 | Above 50000

Figure B-13
Point Source Emissions by Facility

NO_x Point Source Emissions



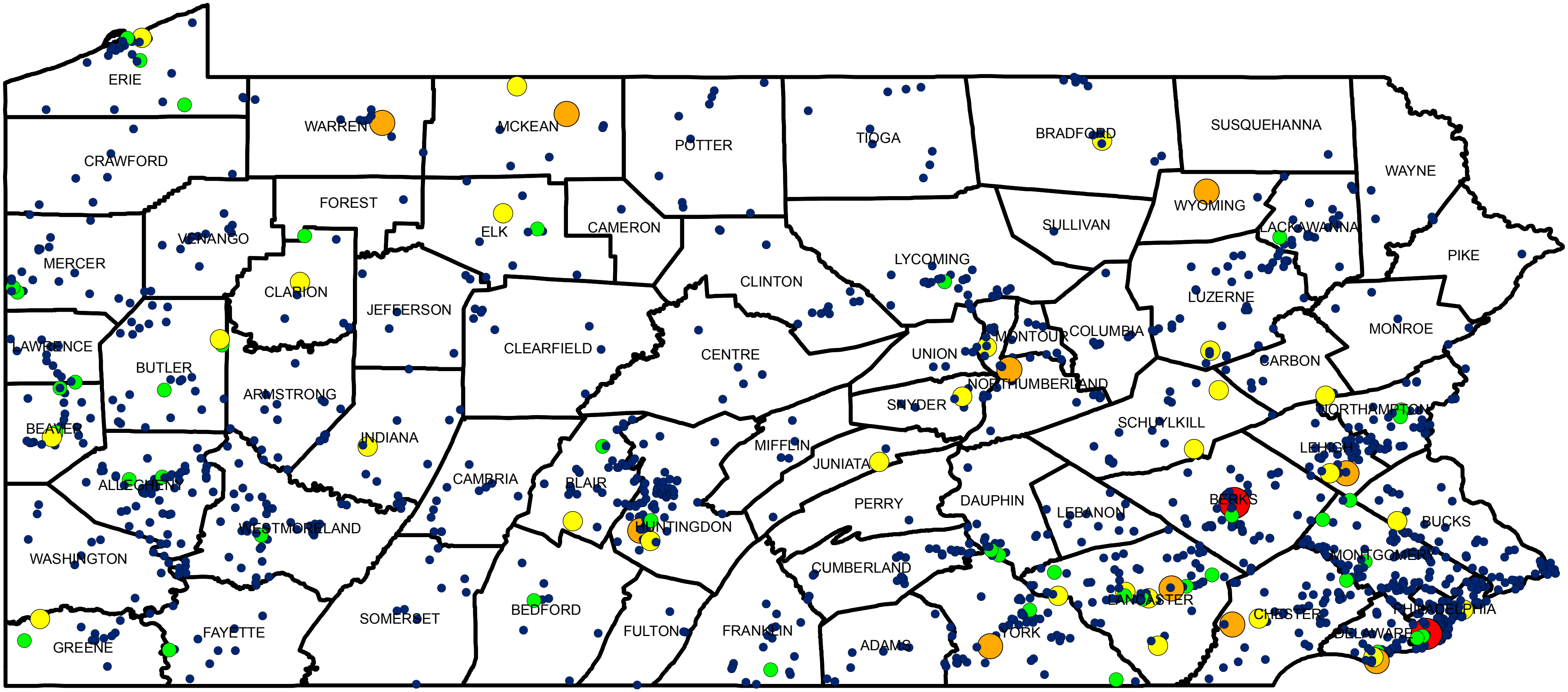
NO_x Point Source Emissions are from the 2011 National Emissions Inventory

NO_x Point Source Emissions (tons per year)

0 - 500 | 500 - 2000 | 2000 - 5000 | 5000 - 10000 | Above 10000

Figure B-14
Point Source Emissions by Facility

VOC Point Source Emissions



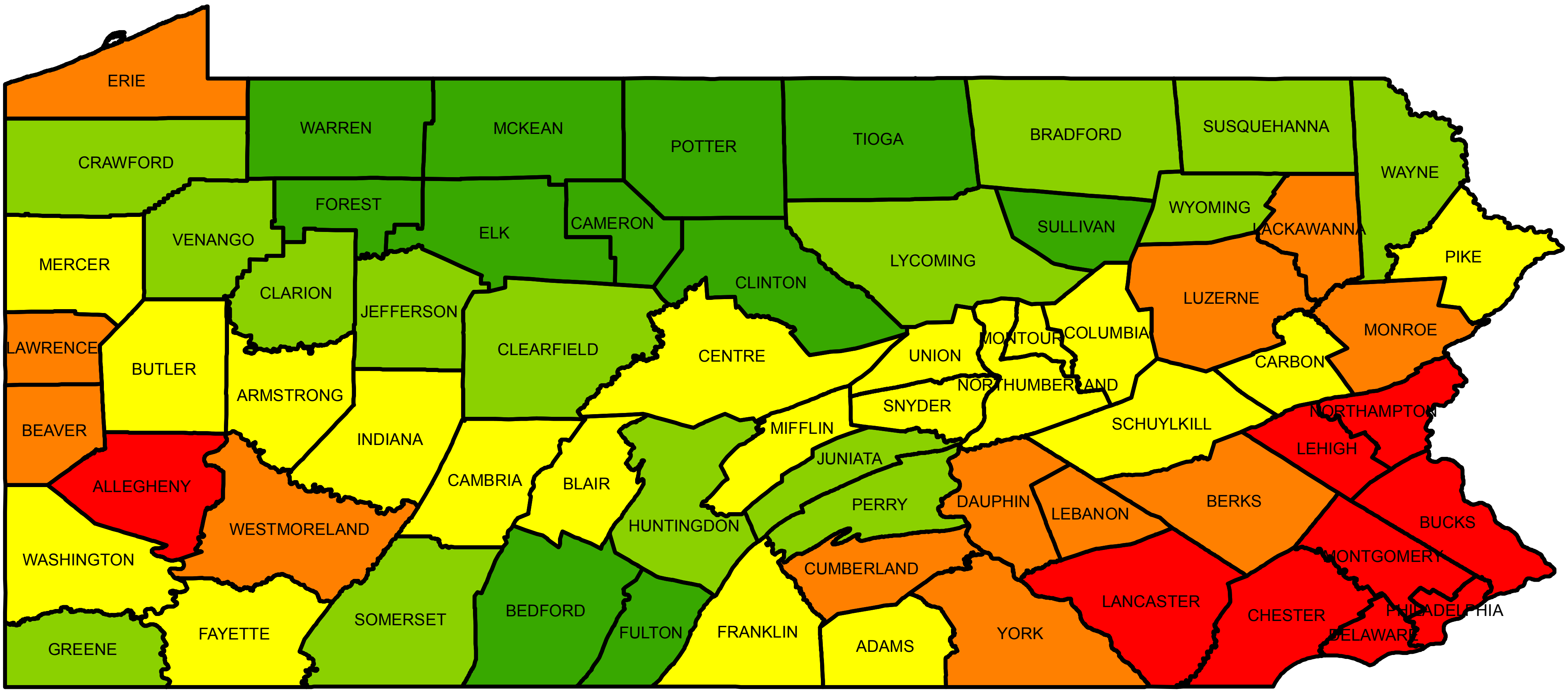
VOC Point Source Emissions are from the 2011 National Emissions Inventory

VOC Point Source Emissions (tons per year)

0 - 50 | 50 - 100 | 100 - 250 | 250 - 500 | Above 500

Figure B-15
Population Density Map by County

Population based on 2010 US Census Results

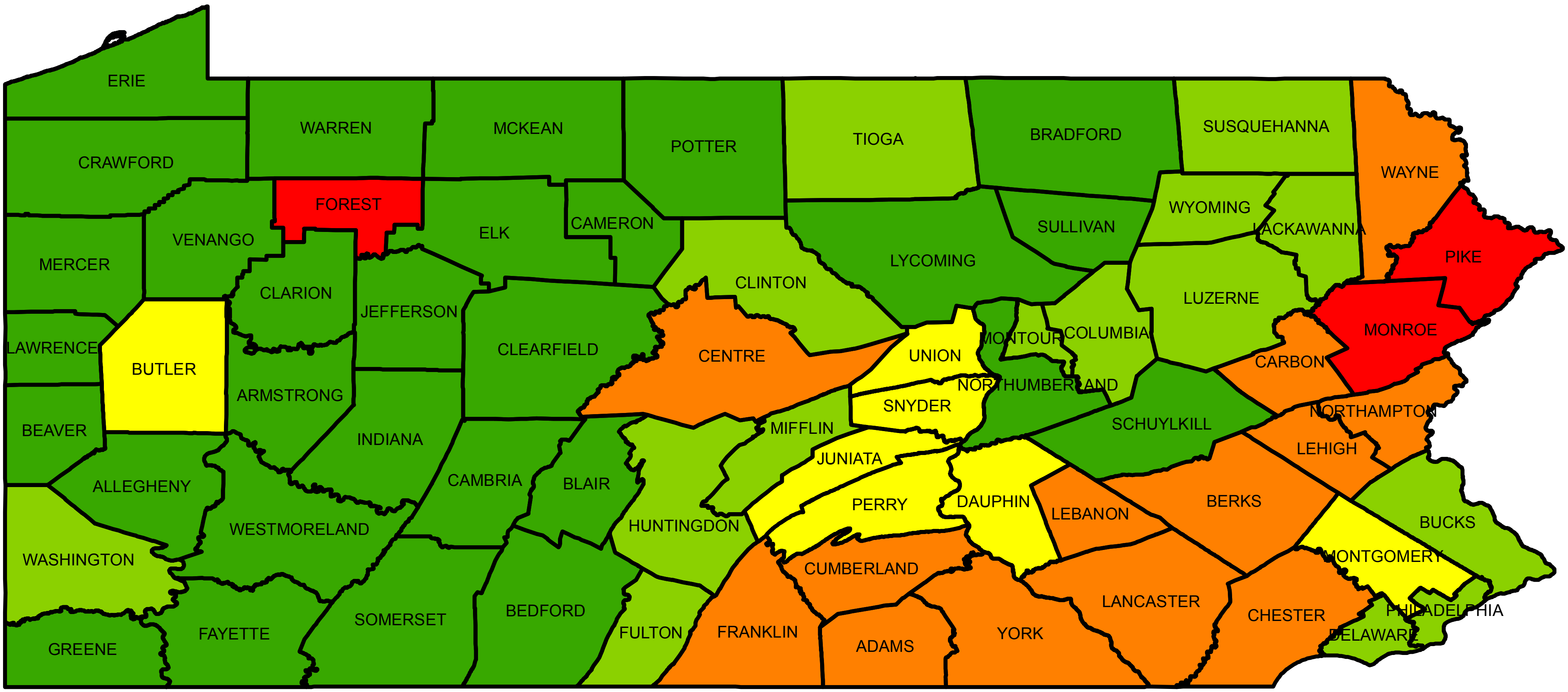


Population Density (Person per square mile)

0 - 50 | 50 - 100 | 100 - 250 | 250 - 500 | Above 500

Figure B-16
Population Growth Map by County

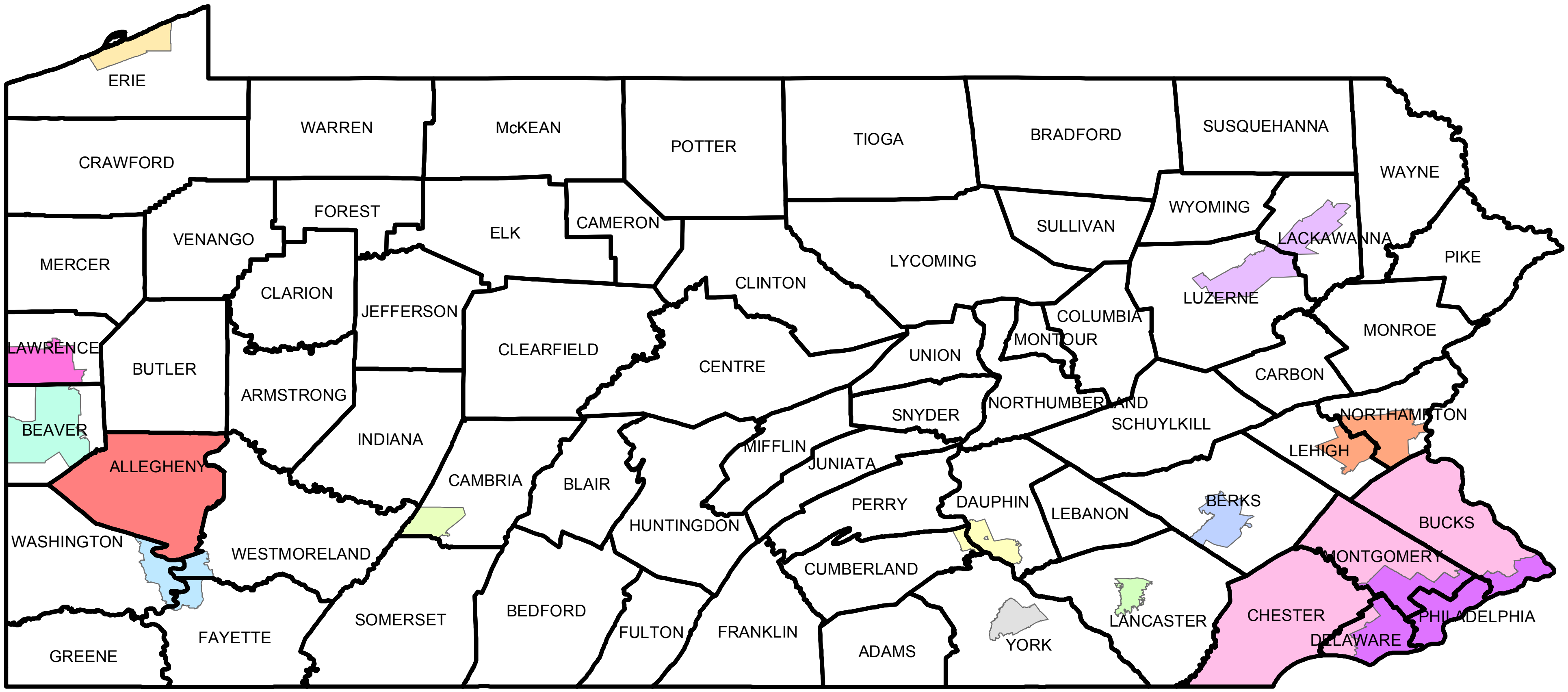
Population Trends based on 2000 and 2010 US Census Results



Population Growth (% Change: Year 2010 - Year 2000)

-15% to 0% | 0% to 5% | 5% to 10% | 10% to 20% | Above 20%

Figure B-17
Pennsylvania Air Basins Map



Air Basins

Allegheny County	Johnstown	Reading	Upper Beaver Valley
Allentown Bethlehem Easton	Lancaster	Scranton Wilkes-Barre	York
Erie	Lower Beaver Valley	Southeast Pennsylvania Inner	Liberty-Clairton
Harrisburg	Monongahela Valley	Southeast Pennsylvania Outer	

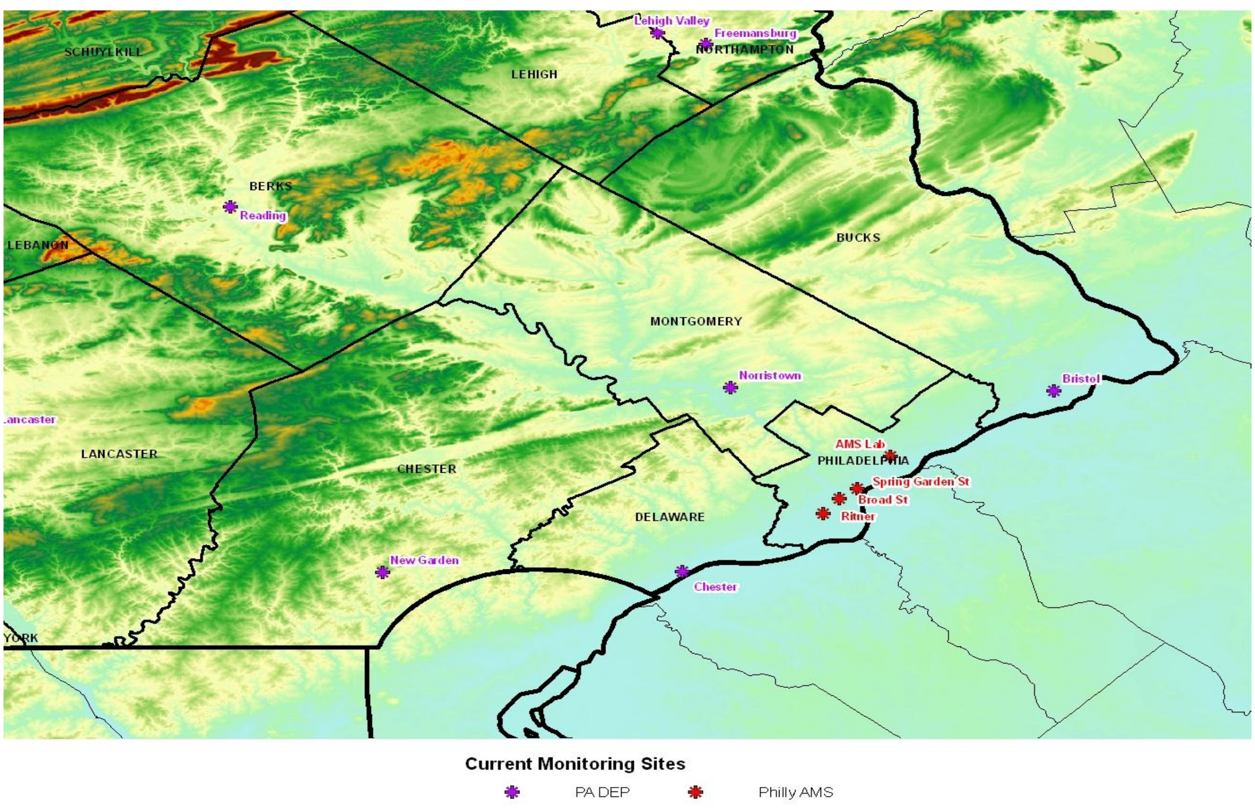
Appendix C-1
GREATER PHILADELPHIA AREA

The Department is recommending a Greater Philadelphia annual $PM_{2.5}$ NAAQS nonattainment area consisting of Chester, Delaware and Philadelphia counties. The Department completed an analysis of the $PM_{2.5}$ ambient air quality data, which outlines the reason for recommending a smaller nonattainment area than the five-county nonattainment area EPA designated for the 1997 and 2006 $PM_{2.5}$ standards. This analysis is provided below.

Analysis of the Ambient $PM_{2.5}$ Data – A Design Value Contribution Analysis

Based on EPA-certified 2012 $PM_{2.5}$ design values, three monitors in the Philadelphia metropolitan statistical area (MSA) are violating the 2012 $PM_{2.5}$ annual standard of 12 µg/m^3. The monitors and their design values are: AMS Lab (AIRS # 42-101-0004) at 13.4 µg/m^3 (in Philadelphia County); Chester (AIRS # 42-045-0002) at 13.1 µg/m^3 (in Delaware County) and New Garden (AIRS # 42-029-0100) at 12.3 µg/m^3 (in Chester County). Figure C-1.1 is a map showing the location of these monitors, along with monitors in attainment, in the five-county Philadelphia region.

Figure C-1.1: Greater Philadelphia Area $PM_{2.5}$ Monitoring Map



The Department has completed a design value contribution analysis for all of the $PM_{2.5}$ monitors in the five-county Philadelphia region. The analysis attempts to determine the daily contribution of $PM_{2.5}$ concentrations to the annual $PM_{2.5}$ design value. Daily $PM_{2.5}$ measurements were grouped into different $PM_{2.5}$ concentration ranges. An analysis of each range's contribution was then conducted to determine which measurements are contributing to the monitor's design value. Dates of these measurements were then further analyzed to determine if there are specific meteorological conditions or sources that are adversely impacting the monitor's design value.

Results from the design value contribution analysis for the five-county Philadelphia area are summarized in Table C-1.1. Ultimately, the type of contribution a given monitor's daily value had on the 3-year design value (by comparing this value to 12 $\mu g/m^3$) was determined. The daily value for each day a monitor measured $PM_{2.5}$ levels was placed in one of the ten categories. For example, on January 1, 2010, the Chester monitor's 24-hour $PM_{2.5}$ average was 19.1 $\mu g/m^3$. Since this value falls in the 18-24 $\mu g/m^3$ category in Table C-1.1, the calculated daily contribution to the design value was placed in this category. In the first quarter of 2010 (January 1 to March 31), the Chester monitor recorded 82 measurements. The Department determined that the January 1, 2010, contribution assessment to the 2012 design value was 0.007215 $\mu g/m^3$. The 0.007215 $\mu g/m^3$ was calculated by dividing the average daily value of 19.1 $\mu g/m^3$ by a factor of the number of measurements for the quarter (82) by 12 (there are a total of 12 quarters in a 3-year design value period). This type of analysis was completed for every day of measurements from January 1, 2010, through December 31, 2012. In Table C-1.1, the sum of the categorical breakdowns for the Chester monitor equals 1.09 $\mu g/m^3$, which demonstrates that the design value is 1.09 $\mu g/m^3$ above the annual standard of 12 $\mu g/m^3$.

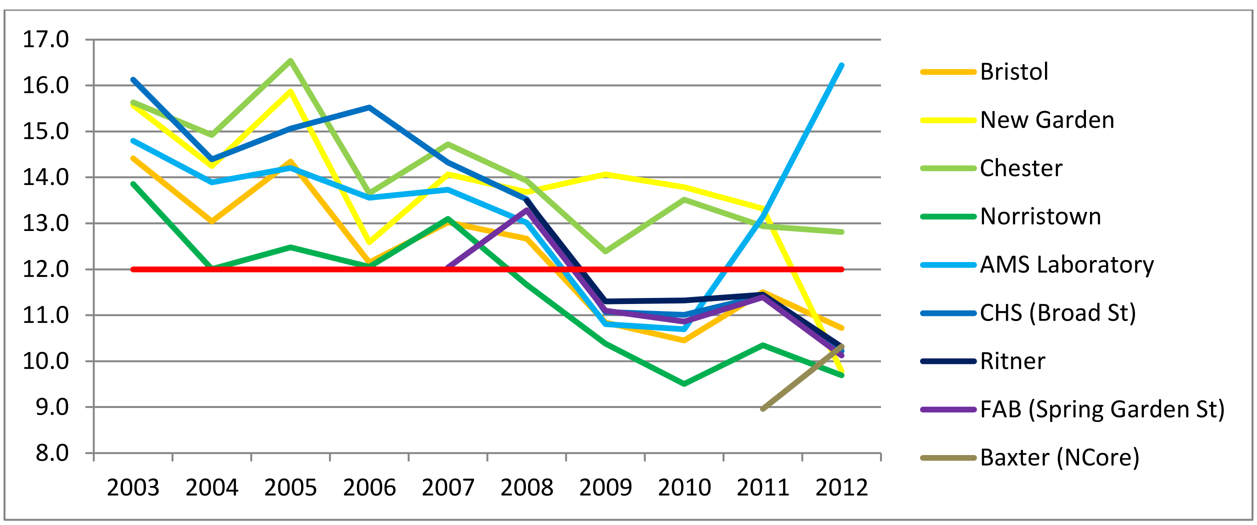
Table C-1.1: Five-County Philadelphia Area
2012 $PM_{2.5}$ Annual Design Value Contribution Analysis

Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	SUM
Monitors Attaining 2012 PM 2.5 Standard													
Bristol	420170012	PA DEP	-2.0077	-1.2251	0.5704	0.6417	0.5463	0.2973	0.0000	0.0288	0.0348	0.0000	-1.1136
Norristown	420910013	PA DEP	-2.3198	-1.3695	0.5001	0.6010	0.3150	0.0910	0.0246	0.0000	0.0000	0.0000	-2.1577
Broad St	421010047	Philly AMS	-1.5940	-1.4150	0.5896	0.6951	0.4013	0.1521	0.0229	0.0278	0.0000	0.0000	-1.1202
Ritner	421010055	Philly AMS	-1.7293	-1.2970	0.6520	0.6949	0.4003	0.2666	0.0000	0.0379	0.0000	0.0000	-0.9747
Spring Garden St	421010057	Philly AMS	-1.7675	-1.3664	0.5719	0.6756	0.4337	0.1647	0.0470	0.0340	0.0000	0.0000	-1.2070
Monitors Not Attaining 2012 PM 2.5 Standard													
New Garden	420290100	PA DEP	-1.4113	-1.2355	0.7396	0.9641	0.6423	0.3972	0.1618	0.0321	0.0000	0.0000	0.2904
Chester	420450002	PA DEP	-0.9361	-1.1286	0.7357	1.2684	0.7250	0.4323	0.0536	0.0293	0.0000	0.0000	1.0896
AMS Lab	421010004	Philly AMS	-1.0822	-0.9314	0.8128	1.2817	0.9323	0.3058	0.0771	0.0389	0.0000	0.0000	1.4351
Five-County Philadelphia Area Average			-1.6060	-1.2573	0.6465	0.8528	0.5495	0.2634	0.0484	0.0286	0.0044	0.0000	

Table C-1.1 illustrates the differences between the monitors that are attaining the 2012 $PM_{2.5}$ annual standard and the monitors that are not attaining the 2012 $PM_{2.5}$ annual standard. The monitors that are not attaining the standard have relatively fewer "clean" days (0-12 $\mu g/m^3$) than the monitors that are attaining the standard. For example, the Chester monitor's $PM_{2.5}$ contribution to the design value in the 0-12 $\mu g/m^3$ range was 0.7 $\mu g/m^3$ lower than the five-county average.

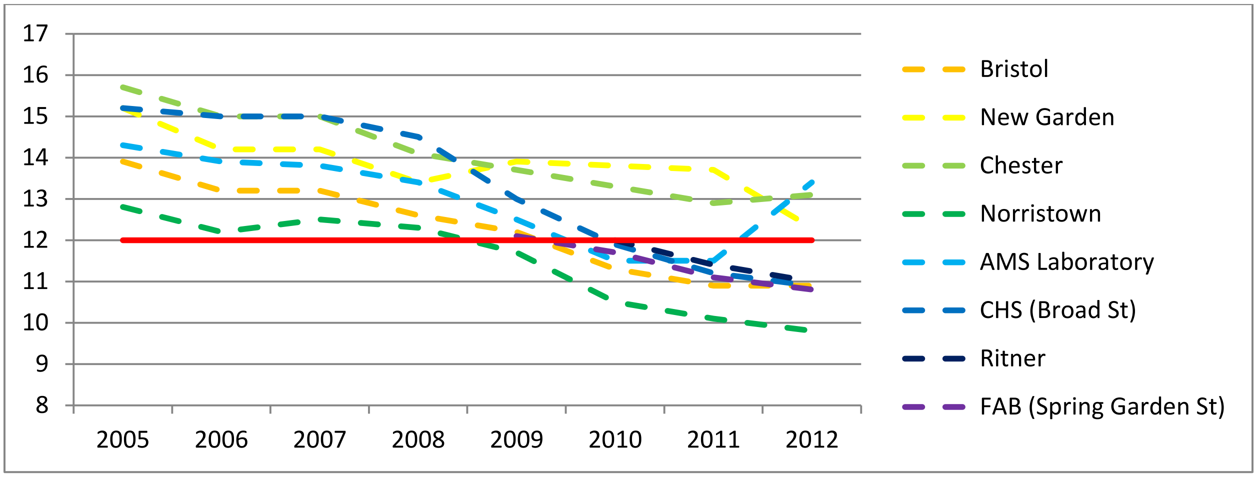
The analysis described in the remainder of this Appendix focuses on the Chester monitor because it is the monitor of most concern. Figure C-1.2a illustrates the trend of annual averages while Figure C-1.2b illustrates the trend of annual design values for monitors in the five-county region. The Chester monitor is the only monitor in this region with an annual average and annual design value constantly above the 2012 standard. Since 2003, annual $PM_{2.5}$ levels have been in a general decline in the Greater Philadelphia area. The Bristol monitor in Bucks County has been below the 2012 standard on an annual average since 2009 and under the annual design value since 2010. In addition, the Norristown monitor in Montgomery County has been under the 2012 standard on an annual average since 2008 and the annual design value since 2009. Over the last three years, levels at the New Garden monitor have fallen at a significant rate. If the trend continues, the New Garden monitor's 2013 design value is expected to reach attainment of the 12 $\mu g/m^3$ standard. As quickly as levels at the New Garden monitor have fallen, levels at the AMS Lab monitor have increased. In fact, the AMS Lab monitor's $PM_{2.5}$ annual average has increased an average of 3 $\mu g/m^3$ since 2010. The Department does not believe this trend will continue, however, because the annual average trend at this monitor does not coincide with what is occurring regionally. The Department is investigating the reason for the spike in $PM_{2.5}$ values at the AMS Lab monitor, especially since three other monitors in Philadelphia County have 2012 annual design values at or below 11.0 $\mu g/m^3$.[1]

Figure C-1.2a: Greater Philadelphia Area $PM_{2.5}$ Annual Averages



[1] It should be noted that Philadelphia Air Management Services (AMS), the local air pollution control agency for the City of Philadelphia, submitted a request to EPA for the AMS Lab monitor asking that EPA exclude data from the AMS Lab monitor for 2011 through the second quarter of 2013. The request is pending with EPA at the time of submittal of this designation recommendation.

Figure C-1.2b: Greater Philadelphia Area $PM_{2.5}$ Annual Design Values



Additional analyses were completed to determine what was contributing to the fewer number of "clean" days at the Chester monitor. The Department identified days when the Chester monitor's $PM_{2.5}$ concentrations were relatively high but regional monitoring concentrations in the five-county Philadelphia area were "clean." Between 2010 and 2012, the Department identified 212 days in which the Chester monitor was at least one standard deviation above the five-county regional average while the regional average was at or below 12 $\mu g/m^3$. The most extreme events (top 25%) were further analyzed to determine why the Chester monitor's concentrations were high when regional concentrations were low.

Meteorological Conditions Impacting High $PM_{2.5}$ Days at the Chester Monitor

The top 25% days were examined to determine the reason the Chester monitor's concentrations were high. The Chester monitor has a collocated meteorological tower that monitors wind direction and wind speed. Figure C-1.3 illustrates the number of hours the wind is coming from a particular direction, while Figure C-1.4 illustrates the total $PM_{2.5}$ concentration coming from a particular direction.

Figure C-1.3: Chester Wind Direction Frequency
Top 25% of Regionally "Clean" Days

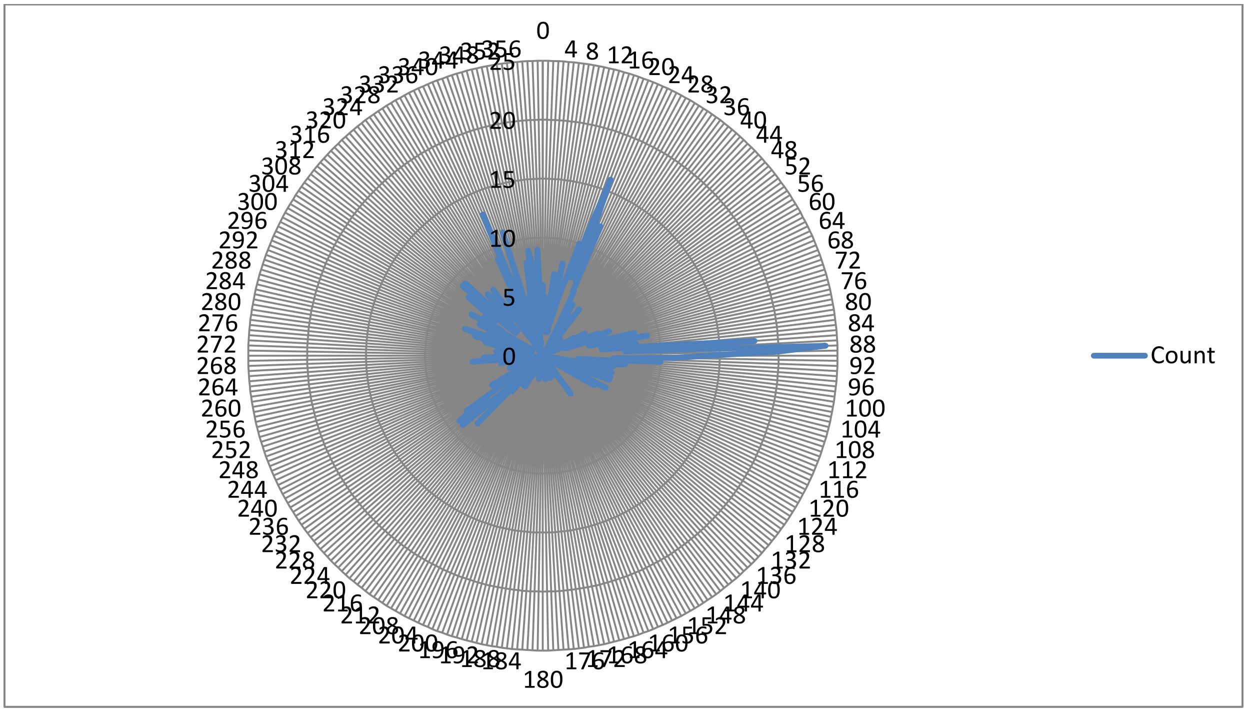


Figure C-1.4: Chester $PM_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

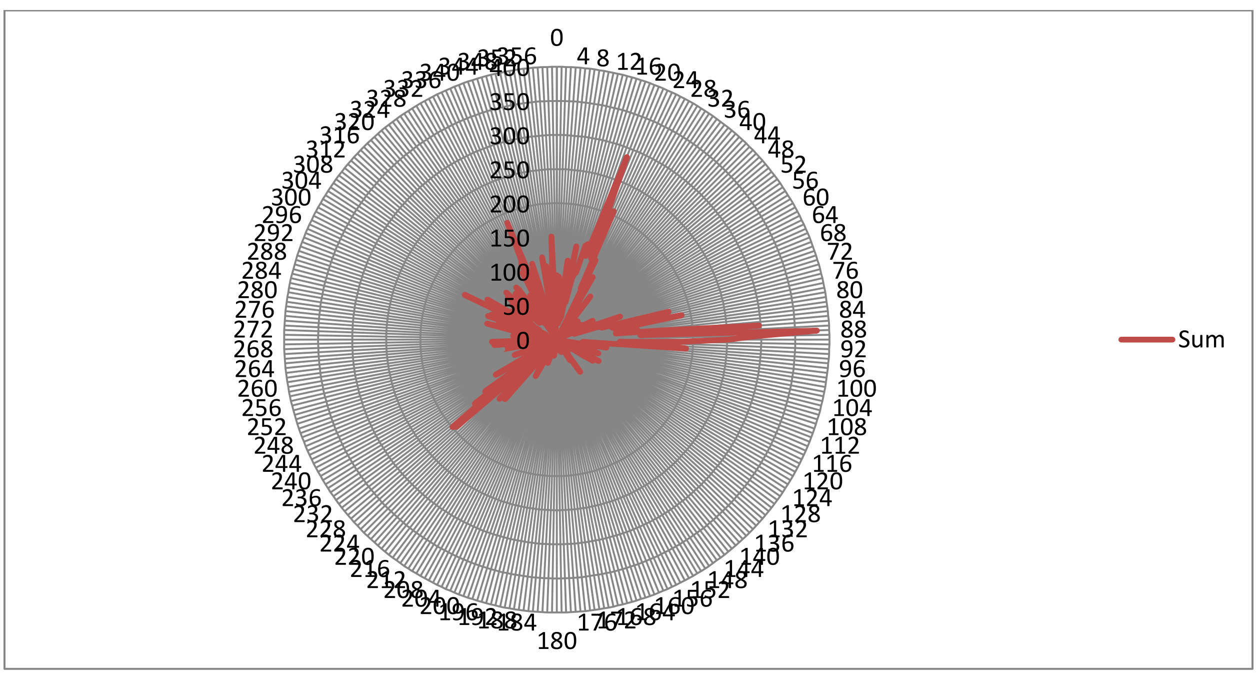
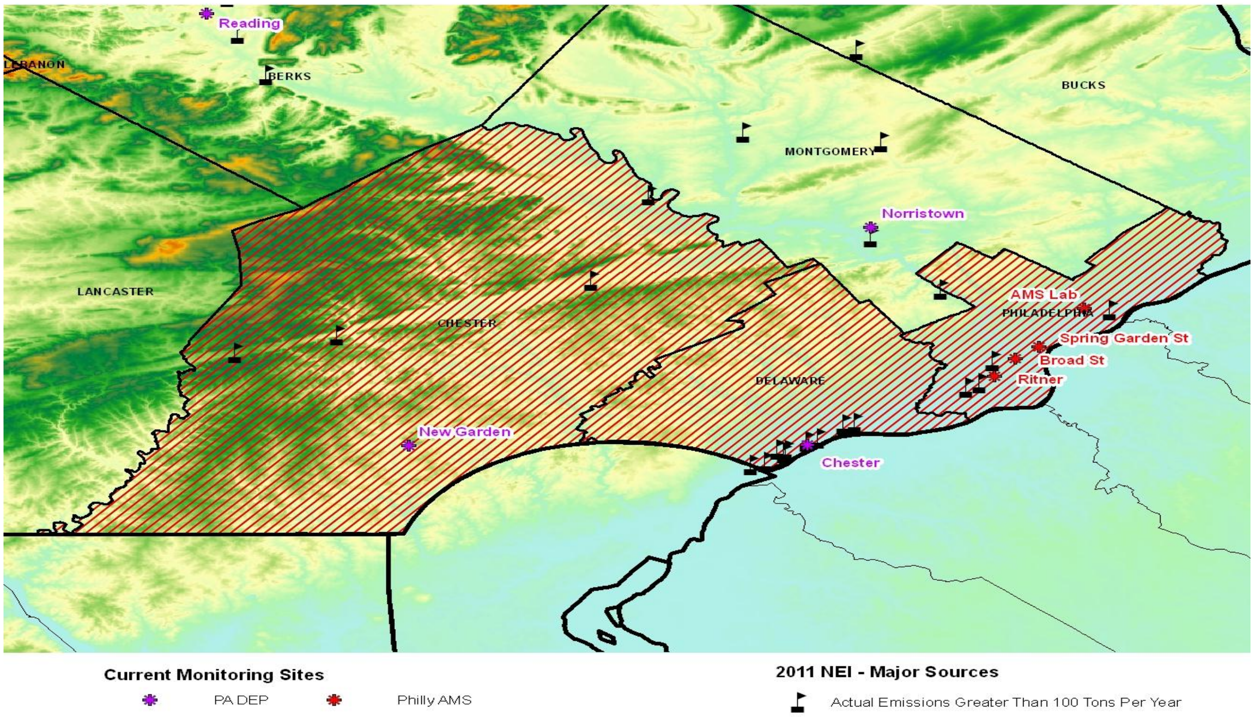


Figure C-1.3 illustrates that the highest frequency of wind distribution on the top 25% days is coming from due east. Figure C-1.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from the same direction. These graphs also illustrate the local nature of the problem. Developed from the EPA PM online tool (http://geoplatform2.epa.gov/PM_Map/), Figure C-1.5 illustrates the sources within the immediate proximity of the Chester monitor.

Figure C-1.5: Greater Philadelphia Area
Major Sources (Over 100 Tons Per Year) Based on 2011 NEI



There are multiple major sources of $PM_{2.5}$, SO_2, and NO_X that are in close proximity of the Chester monitor. The wind direction analysis above shows that the predominant winds on the top 25% days travel directly over these sources. This analysis indicates the local nature of the problem near the Chester monitor.

The Change in the Composition of the $PM_{2.5}$

Up until 2009, the Chester monitor was recording speciated data. In 2009, the Chester speciation monitor was moved to Johnstown, in order to provide speciation data for the Johnstown region. However, it should be noted that the Department continues to operate a speciation monitor in New Garden. The composition of $PM_{2.5}$ has changed at the New Garden monitor since the height of $PM_{2.5}$ concentrations in the 2005 to 2007 time period. Table C-1.2 outlines the main speciated components of $PM_{2.5}$ during the cold season (1^{st} quarter). Table C-1.3 outlines the main speciated components of $PM_{2.5}$ during the warm season (3rd quarter). Overall, Table C-1.2 and Table C-1.3 illustrate the decline in the main speciated components of $PM_{2.5}$ from the 2005 to 2007 period to the 2010 to 2012 period.

Table C-1.2: New Garden Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.65328904	4.52661674	3.47913757	3.53138555	0.57891952	0.37101403
2010 – 12	1.73366732	3.44228334	2.34297412	2.39326413	0.26977607	0.22850717
Difference (2005 – 07 minus 2010 – 12)	0.91962172	1.08433340	1.13616344	1.13812142	0.30914344	0.14250686

*All concentrations are averages and have units of $\mu g/m^3$

Table C-1.3: New Garden Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	3.27416025	2.01363812	6.99463900	4.57287913	0.62645942	0.56450840
2010 – 12	1.29830701	1.24423445	3.14620296	2.39450910	0.24473608	0.39749725
Difference (2005 – 07 minus 2010 – 12)	1.97585325	0.76940368	3.84843604	2.17837002	0.38172334	0.16701115

*All concentrations are averages and have units of $\mu g/m^3$

During the cold season, there has been an equal amount of reduction in ammonium, nitrate, sulfate, and organic carbon concentrations. During the warm season, the largest reductions have occurred in ammonium, sulfate and organic carbon concentrations.

To analyze this further, we chose to compare these seasonal values with what has occurred in Arendtsville (AIRS # 42-001-0001), located in Adams County. Arendtsville is in a rural location of Pennsylvania and does not have a major nitrogen oxide or sulfur dioxide source within 50 kilometers of the monitor. For that reason, the Arendtsville monitor reflects the transport that is coming into eastern Pennsylvania from areas to the west (prevailing wind flow is from west to east across Pennsylvania).

Table C-1.4: Arendtsville Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.22066410	3.57386769	3.39904757	3.17044419	0.45550711	0.22843761
2010 – 12	1.23919565	2.07028981	2.18818154	1.68097944	0.16095925	0.18801487
Difference (2005 – 07 minus 2010 – 12)	0.98146846	1.50654787	1.21086602	1.48946475	0.29454786	0.04042275

*All concentrations are averages and have units of $\mu g/m^3$

Table C-1.5: Arendtsville Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.43772827	0.68269750	7.29288441	3.85331667	0.37004536	0.34223237
2010 – 12	0.98470271	0.50442874	3.13218233	2.13687247	0.15489114	0.32755852
Difference (2005 – 07 minus 2010 – 12)	1.45302555	0.17816876	4.16070208	1.71644420	0.21515422	0.01467385

*All concentrations are averages and have units of $\mu g/m^3$

The reductions at Arendtsville reflected in the “difference” row of Table C-1.5 are more representative of the reductions observed in eastern Pennsylvania due to emission control strategies of various sources (for example, the installation of flue gas desulfurization units on electric generation units across western Pennsylvania into the Ohio Valley). The data indicates that the greatest level of reduction at the New Garden and Arendtsville monitors occurs during the summer months (when sulfate is the primary constituent of $PM_{2.5}$). During the 2005 – 07 time frame, Arendtsville had a 3rd quarter total mass average of 19.08 $\mu g/m^3$, and during the 2010 – 12 time frame it had a 3rd quarter total mass average of 12.06 $\mu g/m^3$, a 7 $\mu g/m^3$ reduction.

An analysis of the 2010 – 12 differences between the New Garden and Arendtsville monitors indicates the nature of the problem at New Garden.

Figure C-1.6: Urban Excess
New Garden vs. Arendtsville
2010-12 - 1st Quarter

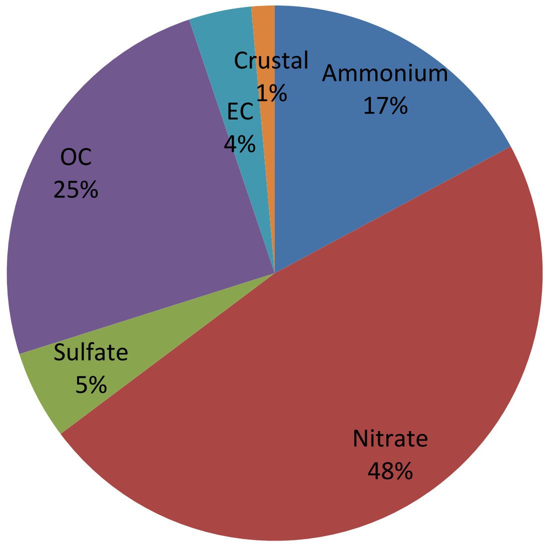


Figure C-1.7: Urban Excess
New Garden vs. Arendtsville
2010-12 - 3rd Quarter

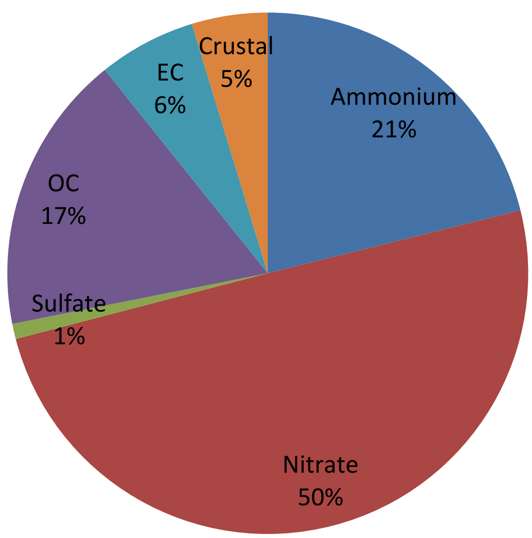
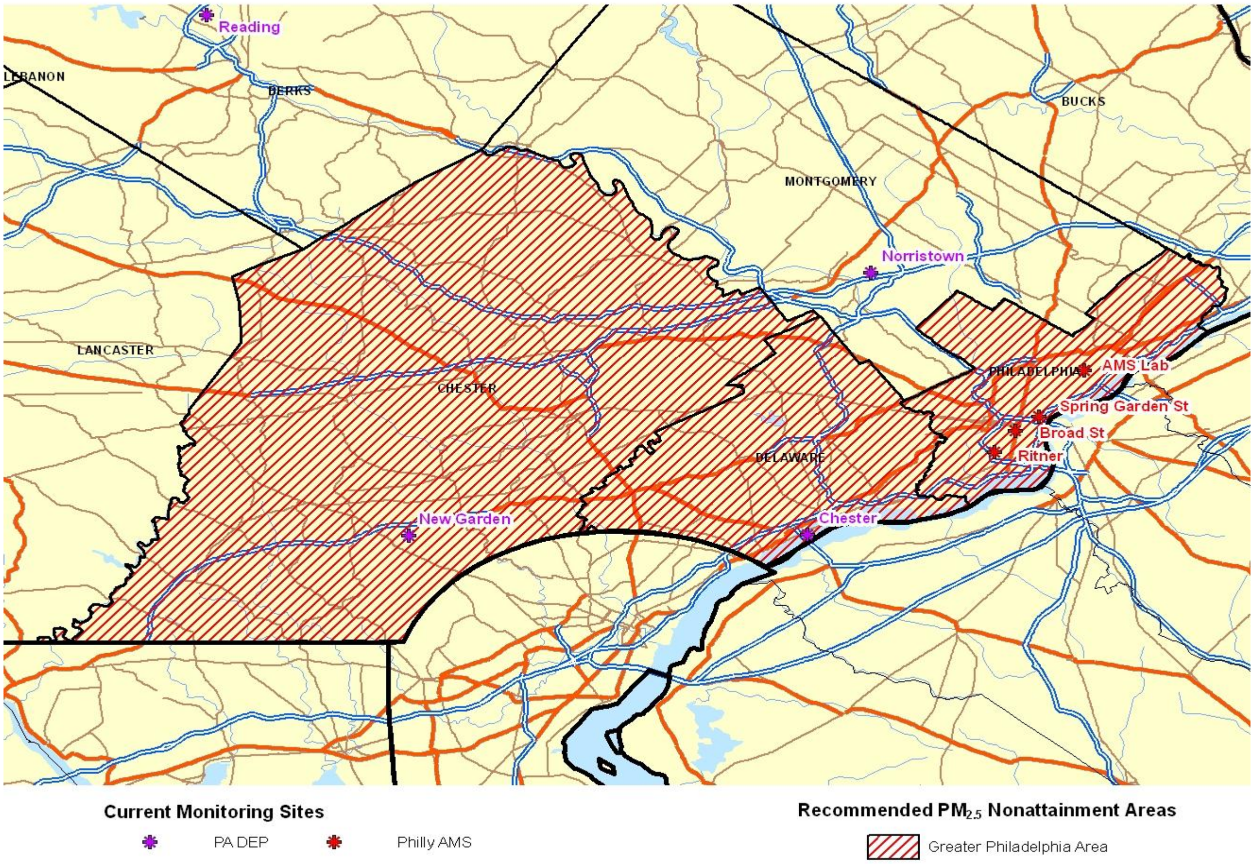


Figure C-1.6 and Figure C-1.7 display the same problem; New Garden has excess nitrate, ammonium, and organic carbon emissions compared to Arendtsville. Sulfate levels, which are indicative of regional emissions from sources such as coal fired electric generation units, were fairly uniform at the New Garden and Arendtsville monitors. This indicates a miniscule change in concentration. The excess nitrate, ammonium, and organic carbon at the New Garden monitor links closely with sources of secondary nitrate formation, such as traffic, suggest that New Garden's emissions are local in nature.

Summary

The Department's analysis illustrates the need for one small multi-county nonattainment area in southeastern Pennsylvania. An analysis of the $PM_{2.5}$ data monitored at the Chester monitor in Delaware County illustrates that Chester sees concentrations in the 12-30 $\mu g/m^3$ range while the regional concentrations are in the 0-12 $\mu g/m^3$ range. A further examination into the monitoring data demonstrates that the high concentrations are coming out of three primary directions: southwesterly, easterly, and northeasterly. These wind profiles travel over local point source emissions, further illustrating the local issue at the Chester monitor. An analysis of the speciated data at the New Garden and Arendtsville monitors illustrates the excess nitrate, ammonium, and organic carbon at the New Garden monitor, in Chester County. This concentration profile is indicative of secondary nitrate formation, another local source of emissions near the New Garden monitor. The AMS Lab monitor in Philadelphia County has a 2012 annual design value that exceeds the 2012 annual $PM_{2.5}$ NAAQS. Finally, the Bristol and Norristown monitors, in Bucks and Montgomery counties, respectively, are and have been monitoring attainment of the 2012 standard for several years and are not contributing to excess emissions elsewhere. Therefore, the Department is recommending the Greater Philadelphia nonattainment area encompassing Chester, Delaware and Philadelphia counties in Pennsylvania be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. A map of the proposed nonattainment area is provided below as Figure C-1.8.

Figure C-1.8: Recommended Greater Philadelphia $PM_{2.5}$ Nonattainment Area



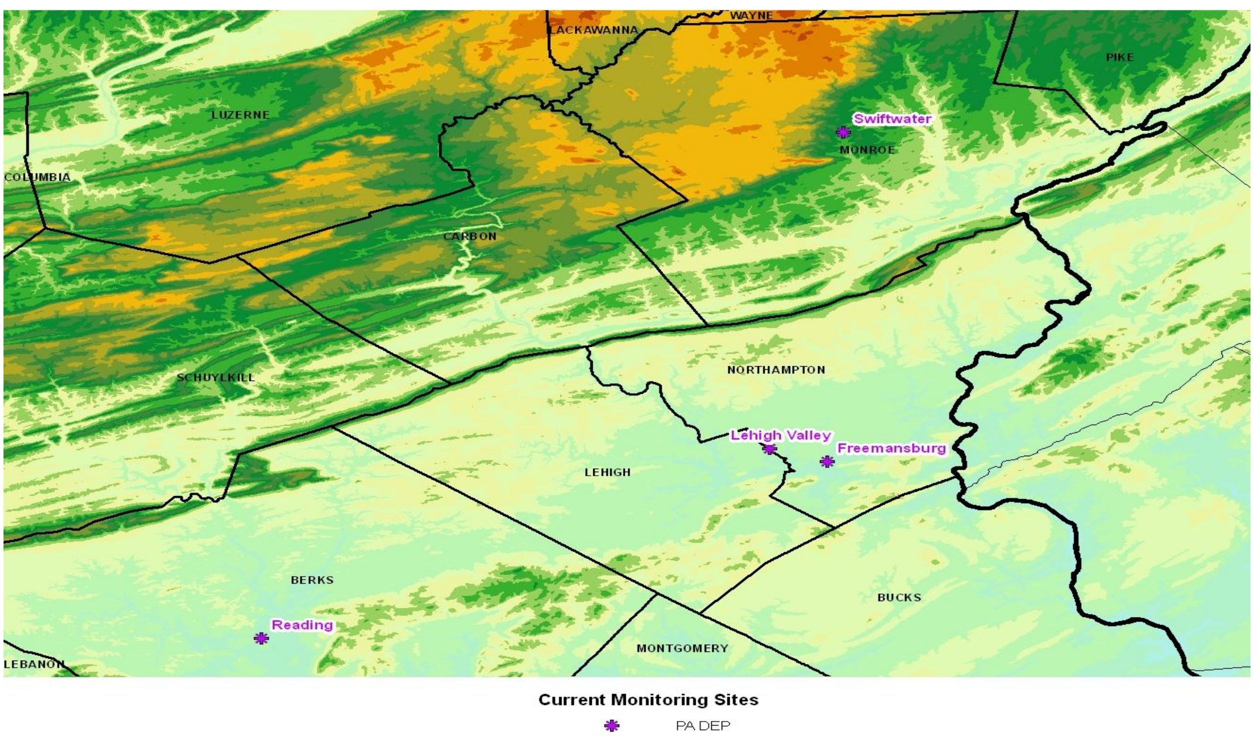
Appendix C-2
NORTHAMPTON COUNTY AREA

The Department is recommending a Northampton County annual $PM_{2.5}$ NAAQS nonattainment area consisting of Northampton County. The Department completed an analysis of the $PM_{2.5}$ ambient air quality data, which outlines the reason for recommending a smaller nonattainment area than the two-county nonattainment area EPA designated for the 1997 and 2006 $PM_{2.5}$ standards. This analysis is provided below.

Analysis of the Ambient $PM_{2.5}$ Data – A Design Value Contribution Analysis

Based on EPA-certified 2012 $PM_{2.5}$ design values, one monitor in the Allentown-Bethlehem-Easton (ABE) metropolitan statistical area (MSA) is violating the 2012 $PM_{2.5}$ annual standard of 12 $\mu g/m^3$. The monitor and its design value are Freemansburg (AIRS # 42-095-0025) (which is located near Bethlehem, in Northampton County) at 13.2 $\mu g/m^3$. The Lehigh Valley monitor (AIRS # 42-095-0027), by contrast, is monitoring attainment of the standard at 10.6 $\mu g/m^3$. The Lehigh Valley monitor is also in Northampton County, located to the northwest of the Freemansburg monitor. Figure C-2.1 is a map showing the location of these monitors, along with other monitors in attainment, in the ABE region.

Figure C-2.1: ABE Regional $PM_{2.5}$ Monitoring Map



The Department has completed a design value contribution analysis for all of the $PM_{2.5}$ monitors in the ABE region. The analysis attempts to determine the daily contribution of $PM_{2.5}$ concentrations to the annual $PM_{2.5}$ design value. Daily $PM_{2.5}$ measurements were grouped into different $PM_{2.5}$ concentration ranges. An analysis of each range's contribution was then conducted to determine which measurements are contributing to the monitor's design value. Dates of these measurements were then further analyzed to determine if there are specific meteorological conditions or sources that are adversely impacting the monitor's design value.

Results from the design value contribution analysis for the ABE region are summarized in Table C-2.1. Ultimately, the type of contribution a given monitor's daily value had on the 3-year design value (by comparing this value to 12 $\mu g/m^3$) was determined. The daily value for each day a monitor measured $PM_{2.5}$ levels was placed in one of the ten categories. For example, on January 1, 2010, the Freemansburg monitor's 24-hour $PM_{2.5}$ average was 30.2 $\mu g/m^3$. Since this value falls in the 30-36 $\mu g/m^3$ category in Table C-2.1, the calculated contribution to the design value for the monitor was placed in this category. In the first quarter of 2010 (January 1 to March 31), the Freemansburg monitor recorded 90 measurements. The Department determined that the January 1, 2010, contribution assessment to the 2012 design value was 0.016852 $\mu g/m^3$. The 0.016852 $\mu g/m^3$ was calculated by dividing the average daily value of 30.2 $\mu g/m^3$ by a factor of the number of measurements for the quarter (90) by 12 (there are a total of 12 quarters in a 3-year design value period). This type of analysis was completed for every day of measurements from January 1, 2010, through December 31, 2012. In Table C-2.1, the sum of the categorical breakdowns for the Freemansburg monitor equals 1.21 $\mu g/m^3$, which demonstrates that the design value for this monitor is 1.21 $\mu g/m^3$ above the annual standard of 12 $\mu g/m^3$.

Table C-2.1: ABE Region
2012 $PM_{2.5}$ Annual Design Value Contribution Analysis

Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	Sum
Monitors Attaining 2012 PM 2.5 Standard													
Lehigh Valley	420950027	PA DEP	-2.2126	-1.1699	0.5775	0.6846	0.4958	0.1112	0.0242	0.0297	0.0723	0.0000	-1.3873
Reading Airport	420110011	PA DEP	-2.0603	-1.1748	0.6055	0.7689	0.4963	0.1172	0.0988	0.0000	0.0000	0.0000	-1.1485
Swiftwater	420890002	PA DEP	-3.4836	-1.0432	0.3348	0.3602	0.1083	0.0000	0.0000	0.0000	0.0000	0.0000	-3.7235
Monitors Not Attaining 2012 PM 2.5 Standard													
Freemansburg	420950025	PA DEP	-1.0979	-1.1677	0.7814	1.0820	0.7884	0.4709	0.1288	0.0555	0.0392	0.1303	1.2108
Allentown-Bethlehem-Easton Regional Average			-2.2136	-1.1389	0.5748	0.7239	0.4722	0.1748	0.0629	0.0213	0.0279	0.0326	

Table C-2.1 illustrates the differences between the monitors that are attaining the 2012 $PM_{2.5}$ annual standard and the monitor that is not attaining the standard. The Freemansburg monitor has fewer "clean" days (0-12 µg/m^3) than the monitors that are attaining the standard. For example, the Freemansburg monitor's $PM_{2.5}$ contribution to the design value in the 0-12 µg/m^3 range was 1.1 µg/m^3 lower than the regional average.

The analysis described in the remainder of this Appendix focuses on the Freemansburg monitor because it is the one monitor of concern in the ABE region. Figure C-2.2a illustrates the trend of annual averages, while Figure C-2.2b illustrates the trend of annual design values during the period in the ABE region. The Reading monitor's $PM_{2.5}$ levels have continued to decline over the last ten years while the Freemansburg monitor has seen levels remain steady. As a result, the Freemansburg monitor's 2012 design value is 2.3 µg/m^3 above the Reading monitor's 2012 design value.

Figure C-2.2a: ABE Region $PM_{2.5}$ Annual Averages

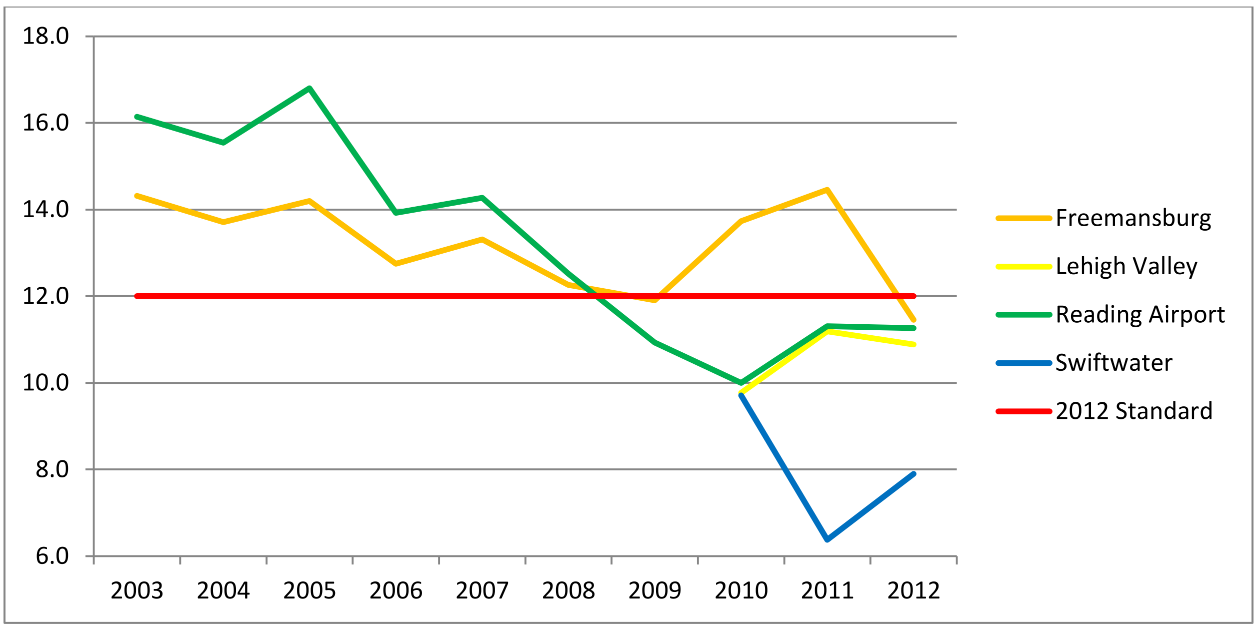


*Figure C-2.2b: ABE Region $PM_{2.5}$ Annual Design Values***

** Swiftwater does not have a full three year data set to calculate a design value.

Additional analyses were completed to determine what was contributing to the fewer number of "clean" days at the Freemansburg monitor. The Department identified days when the Freemansburg monitor's $PM_{2.5}$ concentrations were relatively high but regional monitoring concentrations in the ABE region were "clean." Between 2010 and 2012, the Department identified 344 days in which the Freemansburg monitor was at least one standard deviation above the ABE regional average while the regional average was at or below 12 µg/m^3. The most extreme events (top 25%) were further analyzed to determine why the Freemansburg monitor's concentrations were high when regional concentrations were low.

Meteorological Conditions Impacting High $PM_{2.5}$ Days at Freemansburg

The top 25% days were examined to determine the reason why the Freemansburg monitor's concentrations were high. The Freemansburg monitor has a collocated meteorological tower which monitors wind direction and wind speed. Figure C-2.3 illustrates the number of hours the wind is coming from a particular direction, while Figure C-2.4 illustrates the total $PM_{2.5}$ concentration coming from a particular direction.

Figure C-2.3: Freemansburg Wind Direction Frequency
Top 25% of Regionally "Clean" Days

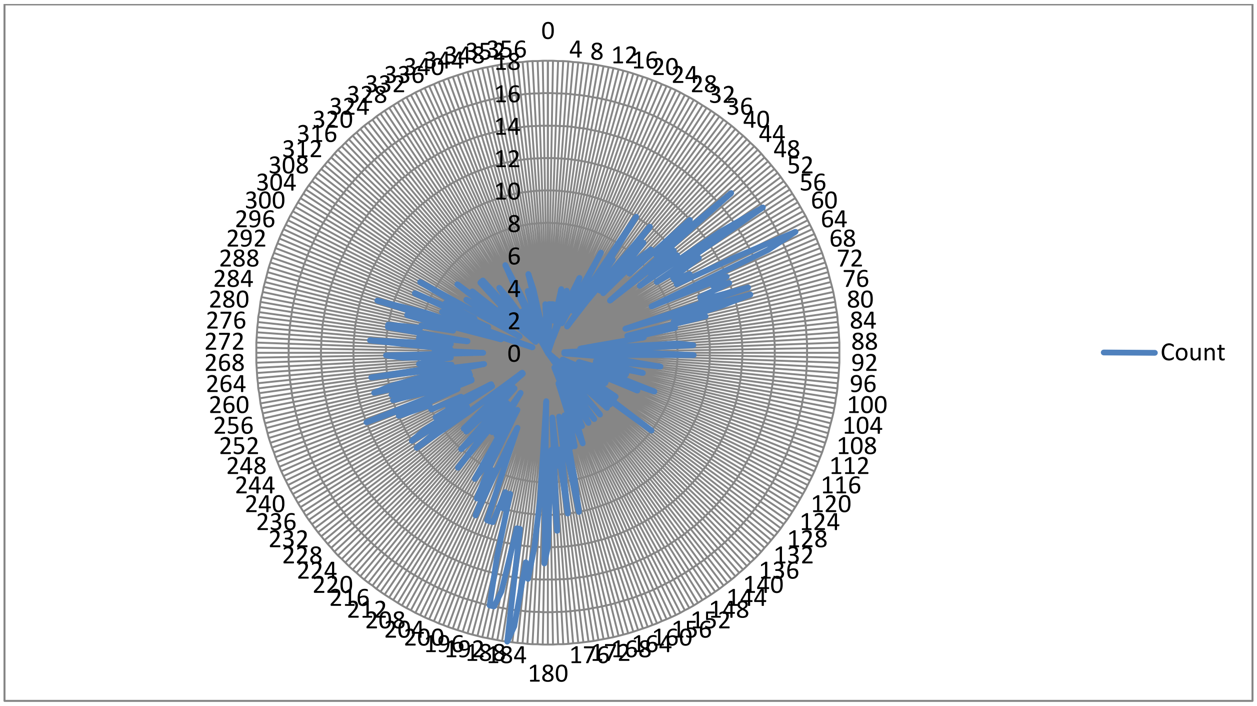


Figure C-2.4: Freemansburg $PM_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

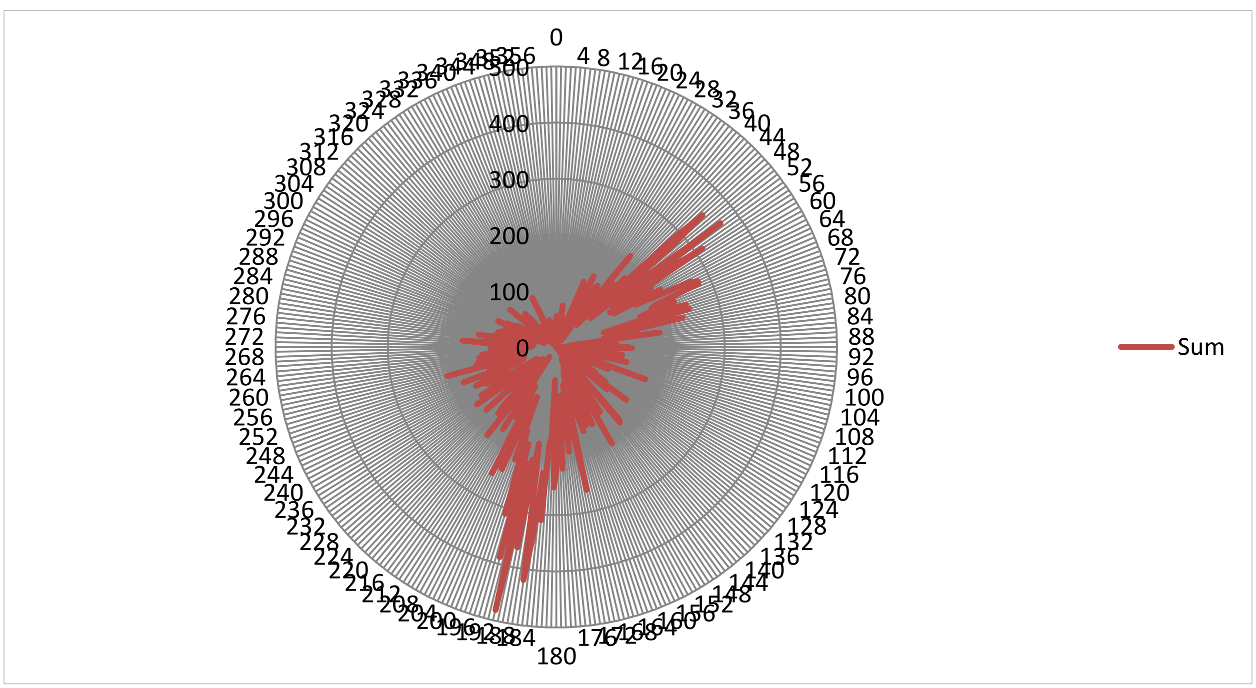


Figure C-2.3 illustrates that the highest frequency of wind distribution on the top 25% days is coming from due south. Figure C-2.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from the same direction.

Analysis of Speciated $PM_{2.5}$ During Top 25% Days

The Department analyzed the days in which the Freemansburg monitor collected speciation data during the top 25% days. Of the 86 days which were in the top 25%, speciated data was collected on nine days. Figure C-2.5 displays the distribution of the speciated components of $PM_{2.5}$ during the entire 2010-12 season. Figure C-2.6 displays the distribution of the speciated components of $PM_{2.5}$ during the nine days in the top 25% of the "clean" days in the ABE region.

Figure C-2.5: Freemansburg $PM_{2.5}$ Speciation Data 2010-12

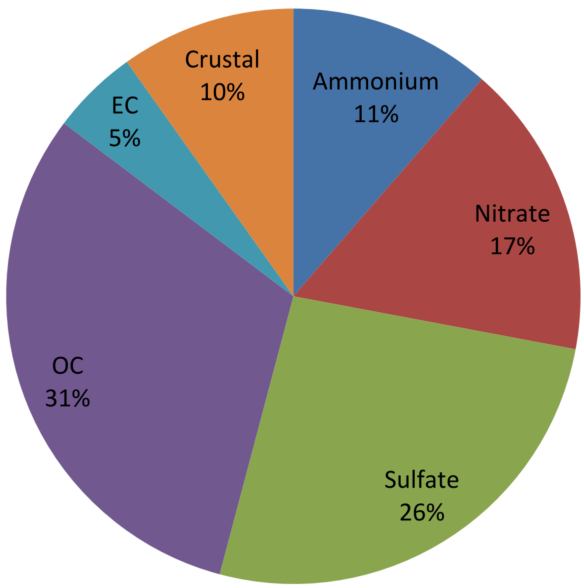
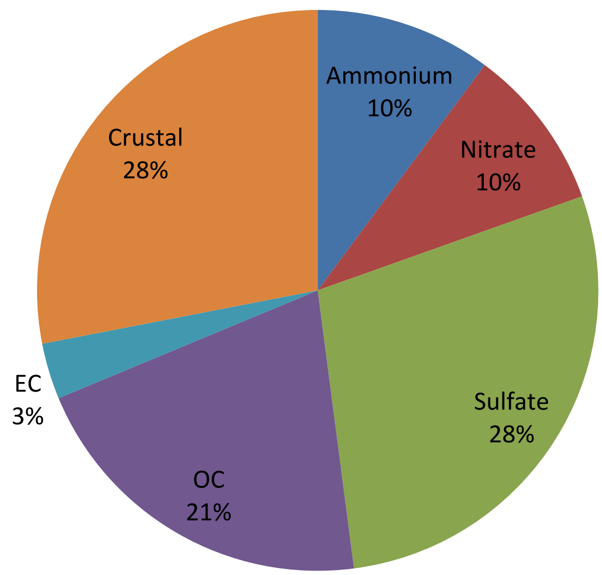
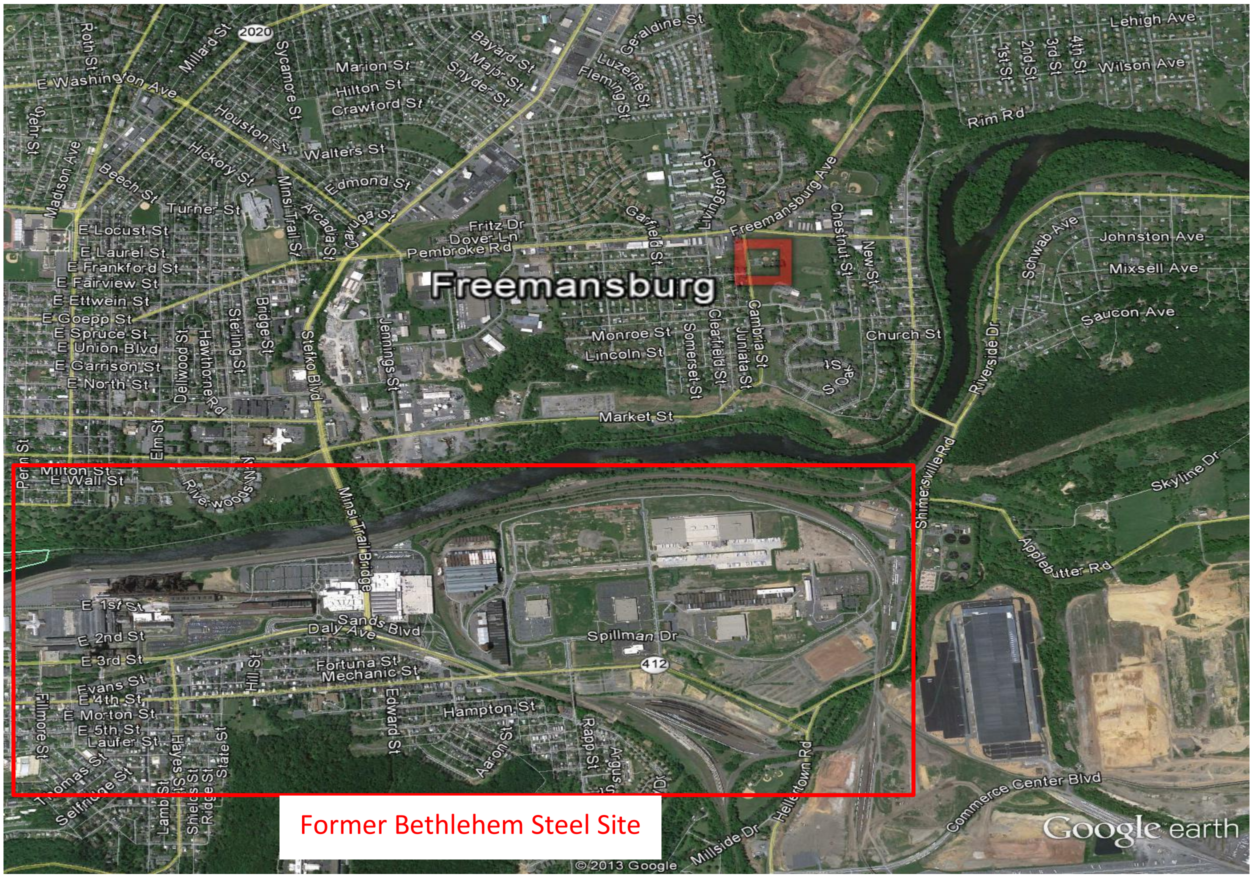


Figure C-2.6: Freemansburg $PM_{2.5}$ Speciation Data
Top 25% of Regionally "Clean" Days



The change in the $PM_{2.5}$ during the top 25% days of regionally clean days is evident. The crustal portion of the speciated $PM_{2.5}$, which was at 10% in the 2010-12 period, rises to 28% during the top 25% days. The additional crustal material illustrates the local nature of the problem at the Freemansburg monitor. Iron, which is a factor of the crustal calculation along with aluminum, calcium, silicon, and titanium, is abnormally high on several of the nine days. The iron, which can be found in dust associated with construction activities, often reached levels 10 to 20% of the total mass measured from the daily speciated sample. The high iron contribution to the $PM_{2.5}$, coupled with the strong southerly signal outlined in Figure C-2.3 and Figure C-2.4, could be attributed to the recent disturbing of soil at the former Bethlehem Steel Corporation industrial site (which lies just to the south of Freemansburg). The Bethlehem Steel site produced 2,500 to 3,000 tons of iron a day to manufacture steel. The Bethlehem Steel plant at the site closed down in 2003. The western portion of the Bethlehem Steel site, which is south-southwest of the Freemansburg monitor, has transformed into the Sands Casino, with a casino, hotel, and outlet shopping center. Also, the area just east of the Sands Casino, an area downwind of the Freemansburg monitor, appears to have been developed over the last three to four years, according to time lapse photos on Google Maps. Construction, disturbance of ground, and truck traffic on unpaved roads in this area are likely to cause dust particles to leave the premises. With a southerly wind, this explains some of the crustal portion of the speciated data recorded at the Freemansburg monitor. Figure C-2.7 illustrates the proximity of the Freemansburg monitor to the old Bethlehem Steel site.

Figure C-2.7: Freemansburg and Bethlehem Steel Site Map



The Change in the Composition of the $PM_{2.5}$

The composition of $PM_{2.5}$ has changed at the Freemansburg monitor since the height of $PM_{2.5}$ concentrations in the 2005 to 2007 time period. Table C-2.2 outlines the main speciated components of $PM_{2.5}$ during the cold season (1st quarter). Table C-2.3 outlines the main speciated components of $PM_{2.5}$ during the warm season (3rd quarter). Overall, Table C-2.2 and Table C-2.3 illustrate the decline in the main speciated components of $PM_{2.5}$ from the 2005 to 2007 period to the 2010 to 2012 period.

Table C-2.2: Freemansburg Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.14463696	3.30050517	3.45715107	4.47227941	0.97620399	0.43071642
2010 – 12	1.16832362	2.08211529	2.01404067	2.14272275	0.32455965	0.47814912
Difference (2005 – 07 minus 2010 – 12)	0.97631334	1.21838988	1.44311040	2.32955666	0.65164433	-0.04743270

*All concentrations are averages and have units of µg/m^3

Table C-2.3: Freemansburg Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.29951810	0.78502649	6.41198050	4.41530676	0.88078346	0.51979868
2010 – 12	0.80943392	0.57709580	2.59564740	2.60585732	0.41256613	0.79557909
Difference (2005 – 07 minus 2010 – 12)	1.49008418	0.20793069	3.81633310	1.80944943	0.46821734	-0.27578041

*All concentrations are averages and have units of µg/m^3

During the cold season, there has been an equal amount of reduction in ammonium, nitrate, sulfate, and organic carbon concentrations. During the warm season, the largest reductions have occurred in ammonium, sulfate and organic carbon concentrations. However, in each quarter, there has been an increase in the amount of crustal material.

To analyze this further, we chose to compare these seasonal values with what has occurred in Arendtsville (AIRS # 42-001-0001), located in Adams County. Arendtsville is in a rural location of Pennsylvania and does not have a major nitrogen oxide or sulfur dioxide source within 50 kilometers of the monitor. For that reason, the Arendtsville monitor reflects the transport that is coming into eastern Pennsylvania from areas to the west (prevailing wind flow is from west to east across Pennsylvania).

Table C-2.4: Arendtsville Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.22066410	3.57683769	3.39904757	3.17044419	0.45550711	0.22843761
2010 – 12	1.23919565	2.07028981	2.18818154	1.68097944	0.16095925	0.18801487
Difference (2005 – 07 minus 2010 – 12)	0.98146846	1.50654787	1.21086602	1.48946475	0.29454786	0.04042275

*All concentrations are averages and have units of µg/m^3

Table C-2.5: Arendtsville Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.43772827	0.68269750	7.29288441	3.85331667	0.37004536	0.34223237
2010 – 12	0.98470271	0.50452874	3.13218233	2.13687247	0.15489114	0.32755852
Difference (2005 – 07 minus 2010 – 12)	1.45302555	0.17816876	4.16070208	1.71644420	0.21515422	0.01467385

*All concentrations are averages and have units of $\mu g/m^3$

The reductions at Arendtsville reflected in the “difference” row of Table C-2.4 and Table C-2.5 are more representative of the reductions observed in eastern Pennsylvania due to emission control strategies of various sources (for example, the installation of flue gas desulfurization units on electric generation units across western Pennsylvania into the Ohio Valley). The data indicates that the greatest level of reduction in Freemansburg and Arendtsville occurs during the summer months (when sulfate is the primary constituent of $PM_{2.5}$). During the 2005-07 time frame, Arendtsville had a 3rd quarter total mass average of 19.08 $\mu g/m^3$, and during the 2010 – 12 time frame it had a 3rd quarter total mass average of 12.06 $\mu g/m^3$, a 7 $\mu g/m^3$ reduction.

An analysis of the 2010 – 12 differences between the Freemansburg and Arendtsville monitors indicates the nature of the problem at Freemansburg.

Figure C-2.8: Urban Excess
Freemansburg vs. Arendtsville
2010-12 – 1st Quarter

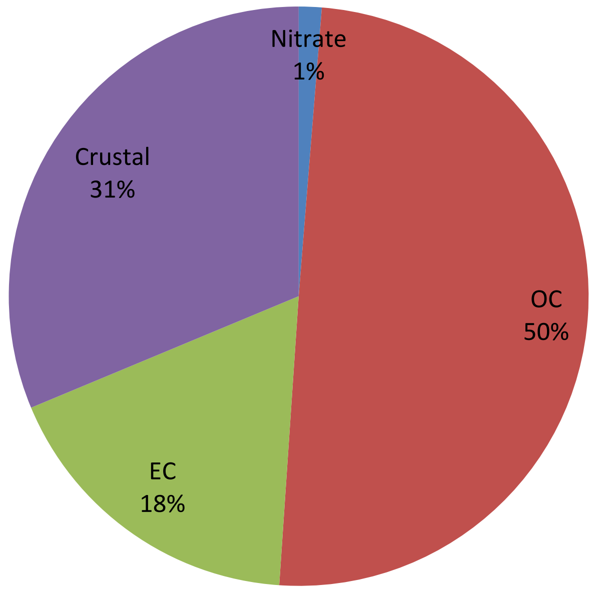
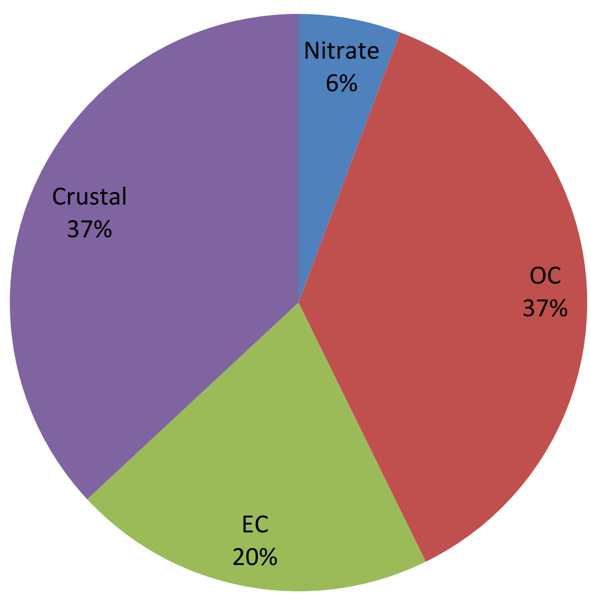


Figure C-2.9: Urban Excess
Freemansburg vs. Arendtsville
2010-12 – 3rd Quarter

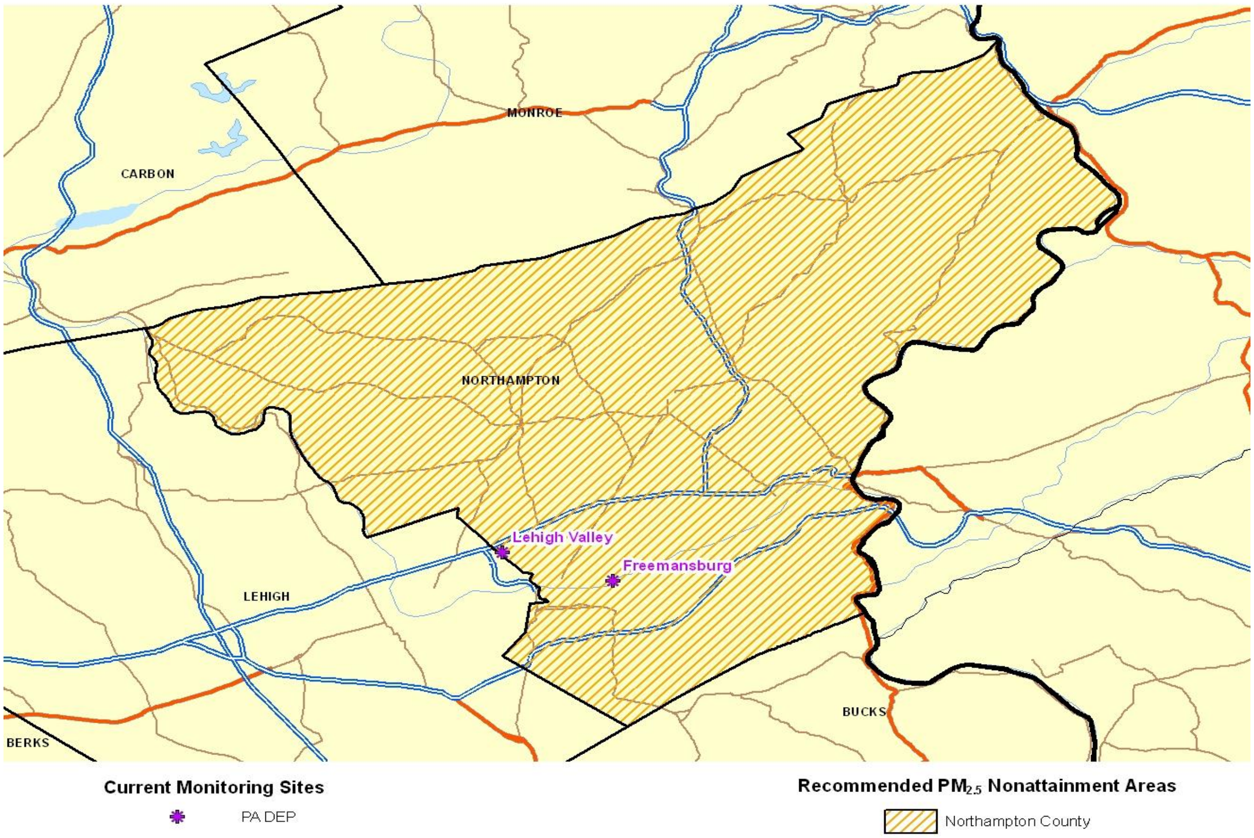


In the case of Freemansburg and Arendtsville, the sulfates and ammonium portion of the speciated $PM_{2.5}$ were higher in Arendtsville than Freemansburg. This strengthens the argument that the $PM_{2.5}$ problem at Freemansburg is a local issue. The excess organic carbon, elemental carbon and crustal material (and to some extent nitrate) at the Freemansburg monitor links closely with sources of dust and secondary nitrate formation, such as traffic, suggesting that Freemansburg's emissions are local in nature.

Summary

The Department's analysis illustrates the need for a one-county nonattainment area of Northampton County in the ABE region of Pennsylvania. An analysis of the $PM_{2.5}$ data monitored at the Freemansburg monitor in Northampton County illustrates that the monitor sees concentrations in the 12-30 $\mu g/m^3$ range while the regional concentrations are in the 0-12 $\mu g/m^3$ range. A further examination into the monitoring data demonstrates that the high concentrations are coming out of two primary directions: southerly and northeasterly. The southerly wind profile is coming from an area once inhabited by the Bethlehem Steel Corporation plant and an area of apparent recent construction activity on the land of the former industrial site. An analysis of the speciated data at the Freemansburg monitor on the top 25% days illustrates the excess of crustal material on the high days. Of those species used in the calculation of the $PM_{2.5}$ crustal material, iron is the driving factor. The differences between the Freemansburg and Arendtsville monitors illustrate the excess crustal material, elemental carbon, and organic carbon (and nitrate during the summer) at the Freemansburg monitor in Northampton County. This concentration profile is indicative of dust and secondary nitrate formation, both local sources of emissions near the Freemansburg monitor. Finally, the Lehigh Valley monitor, also in Northampton County and just to the northwest of the Freemansburg monitor, is and has been monitoring attainment of the 2012 standard for several years and is not contributing to excess emissions elsewhere. Therefore, the Department is recommending the Northampton County nonattainment area encompassing Northampton County in Pennsylvania be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. A map of the proposed nonattainment area is provided below as Figure C-2.10.

Figure C-2.10: Recommended Northampton County $PM_{2.5}$ Nonattainment Area



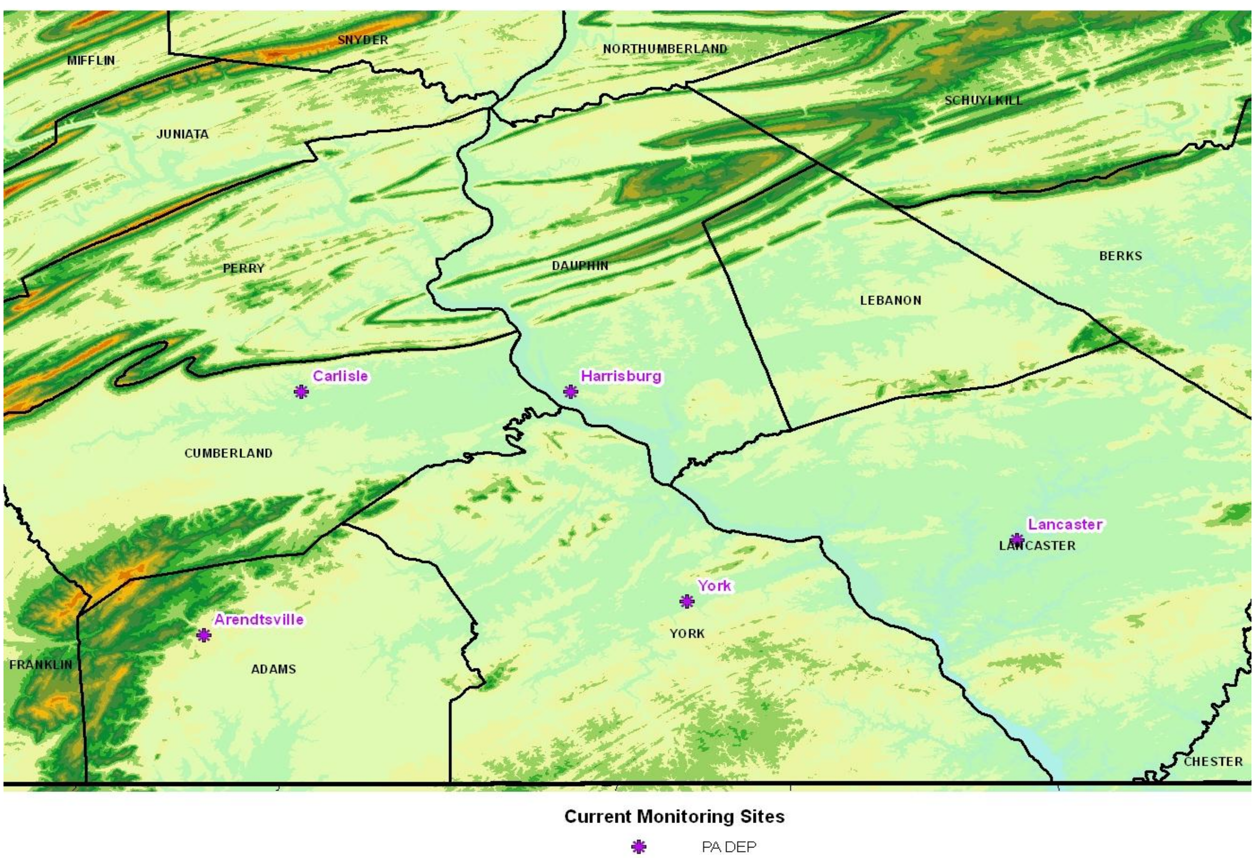
Appendix C-3
LANCASTER COUNTY AREA

The Department is recommending a Lancaster County annual $PM_{2.5}$ NAAQS nonattainment area consisting of Lancaster County. The Department completed an analysis of the $PM_{2.5}$ ambient air quality data, which outlines the reason for recommending an area consisting of only Lancaster County. This analysis is provided below.

Analysis of the Ambient $PM_{2.5}$ Data – A Design Value Contribution Analysis

Based on EPA-certified 2012 $PM_{2.5}$ design values, one monitor in the Lancaster metropolitan statistical area (MSA) is violating the 2012 $PM_{2.5}$ annual standard of 12 $\mu g/m^3$. The monitor and its design value are: Lancaster (AIRS # 42-071-0007) at 12.1 $\mu g/m^3$ (in Lancaster County). Figure C-3.1 is a map outlining the location of this monitor, along with monitors in attainment in the vicinity of the Lancaster County area.

Figure C-3.1: Lancaster Area $PM_{2.5}$ Monitoring Map



The Department has completed a design value contribution analysis for all of the $PM_{2.5}$ monitors in the proximity of the Lancaster monitor. The analysis attempts to determine the daily contribution of $PM_{2.5}$ concentrations to the annual $PM_{2.5}$ design value. Daily $PM_{2.5}$ measurements were grouped into different $PM_{2.5}$ concentration ranges. An analysis of each range's contribution was then conducted to determine which measurements are contributing to the monitor's design value. Dates of these measurements were then further analyzed to determine if there are specific meteorological conditions or sources that are adversely impacting the monitor's design value.

Results from the design value contribution analysis for the Lancaster County area are summarized in Table C-3.1. Ultimately, the type of contribution a given monitor's daily value had on the 3-year design value (by comparing this value to 12 $\mu g/m^3$) was determined. The daily value for each day a monitor measured $PM_{2.5}$ levels was placed in one of the ten categories. For example, on January 8, 2010, the Lancaster monitor's 24-hour $PM_{2.5}$ average was 24 $\mu g/m^3$. Since this value falls in the 18-24 $\mu g/m^3$ category in Table C-3.1, the calculated daily contribution to the design value was placed in this category. In the first quarter of 2010 (January 1 to March 31), the Lancaster monitor recorded 80 measurements. The Department determined that the January 8, 2010, contribution assessment to the 2012 design value was 0.0125 $\mu g/m^3$. The 0.0125 $\mu g/m^3$ was calculated by dividing the average daily value of 24 $\mu g/m^3$ by a factor of the number of measurements for the quarter (80) by 12 (there are a total of 12 quarters in a 3-year design value period). This type of analysis was completed for every day of measurements from January 1, 2010, through December 31, 2012. In Table C-3.1, the sum of the categorical breakdowns for the Lancaster monitor equals 0.11 $\mu g/m^3$, which demonstrates that the design value is 0.11 $\mu g/m^3$ above the annual standard of 12 $\mu g/m^3$.

Table C-3.1: Lancaster Area
2012 $PM_{2.5}$ Annual Design Value Contribution Analysis

Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	Sum
Monitors Attaining 2012 PM 2.5 Standard													
Carlisle	420410101	PA DEP	-2.2671	-1.0983	0.5772	0.8099	0.4437	0.3272	0.1197	0.0620	0.0000	0.0000	-1.0257
Arendtsville	420010001	PA DEP	-1.5064	-1.2343	0.5945	0.9867	0.4176	0.3170	0.0540	0.0000	0.0000	0.0000	-0.3710
York	421330008	PA DEP	-1.4100	-1.3579	0.6939	0.9591	0.4741	0.2743	0.0234	0.0000	0.0000	0.0000	-0.3431
Harrisburg	420430401	PA DEP	-1.9733	-1.0485	0.6803	0.9606	0.6412	0.4097	0.1289	0.0301	0.0746	0.0000	-0.0963
Monitors Not Attaining 2012 PM 2.5 Standard													
Lancaster	420710007	PA DEP	-1.6300	-1.1159	0.6843	1.0150	0.5705	0.3273	0.2257	0.0284	0.0000	0.0000	0.1052
Lancaster Regional Average			-1.7574	-1.1710	0.6460	0.9463	0.5094	0.3311	0.1103	0.0241	0.0149	0.0000	

Table C-3.1 illustrates the differences between the monitors that are attaining the 2012 $PM_{2.5}$ annual standard and the monitor that is not attaining the 2012 $PM_{2.5}$ annual standard. The Lancaster monitor has slightly fewer "clean" days (0-12 µg/m^3) than the monitors that are attaining the standard. For example, the Lancaster monitor's $PM_{2.5}$ contribution to the design value in the 0-12 µg/m^3 range was 0.18 µg/m^3 lower than the regional average.

The analysis described in the remainder of this Appendix focuses on the Lancaster monitor because it is the only monitor of concern. Figure C-3.2a illustrates the trend of annual averages while Figure C-3.2b illustrates the trend of annual design values during the period in the Lancaster County area. The Lancaster monitor's $PM_{2.5}$ levels have continued to decline over the last ten years along with the regional monitors' $PM_{2.5}$ levels. The Lancaster monitor's 2012 design value is very close to the 2012 $PM_{2.5}$ annual standard.

Figure C-3.2a: Lancaster Area $PM_{2.5}$ Annual Averages

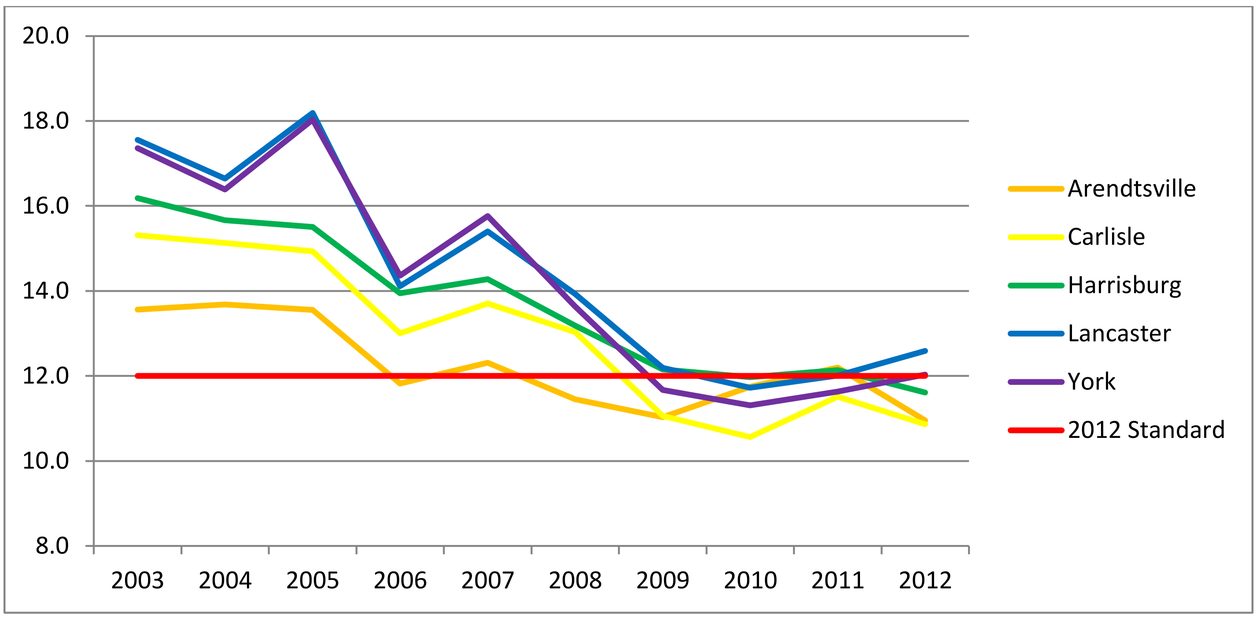
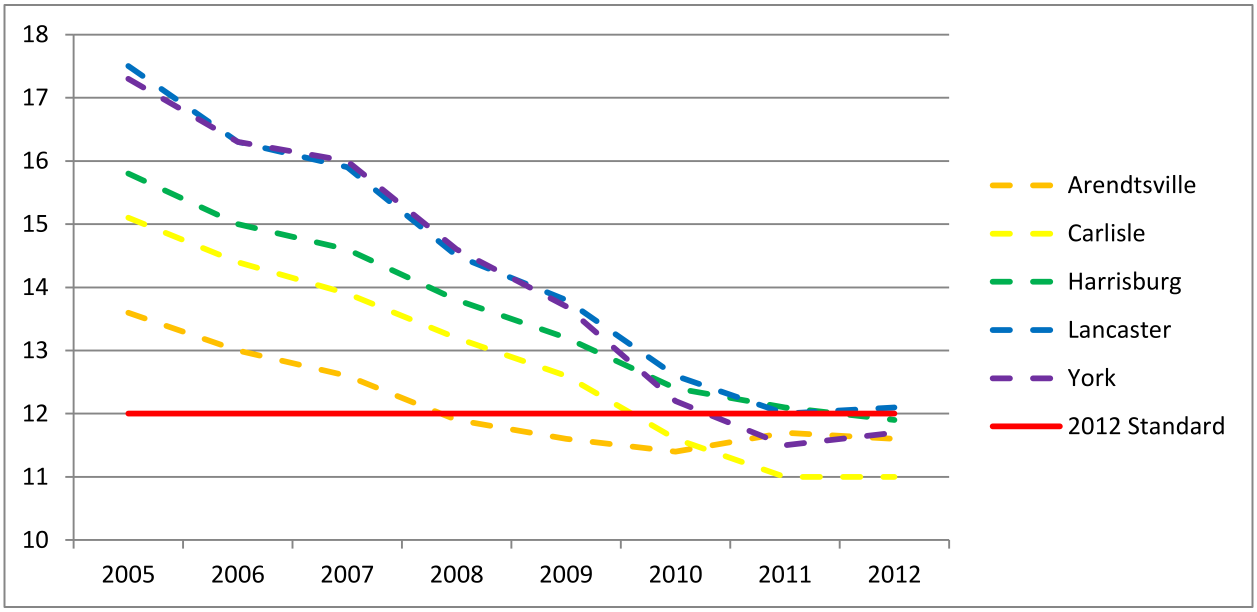


Figure C-3.2b: Lancaster Area $PM_{2.5}$ Annual Design Values



Additional analyses were completed to determine what was contributing to the fewer number of "clean" days at the Lancaster monitor. The Department identified days when the Lancaster monitor's $PM_{2.5}$ concentrations were relatively high but regional monitoring concentrations in the Lancaster area were "clean." Between 2010 and 2012, the Department identified 119 days in which the Lancaster monitor was at least one standard deviation above the regional average while the regional average was at or below 12 µg/m^3. The most extreme events (top 25%) were further analyzed to determine why the Lancaster monitor's concentrations were high when regional concentrations were low.

Meteorological Conditions Impacting High $PM_{2.5}$ Days at the Lancaster Monitor

The top 25% days were examined to determine the reason the Lancaster monitor's concentrations were high. The Lancaster monitor has a collocated meteorological tower that monitors wind direction and wind speed. Figure C-3.3 illustrates the number of hours the wind is coming from a particular direction, while Figure C-3.4 illustrates the total $PM_{2.5}$ concentration coming from a particular direction.

Figure C-3.3: Lancaster Wind Direction Frequency
Top 25% of Regionally "Clean" Days

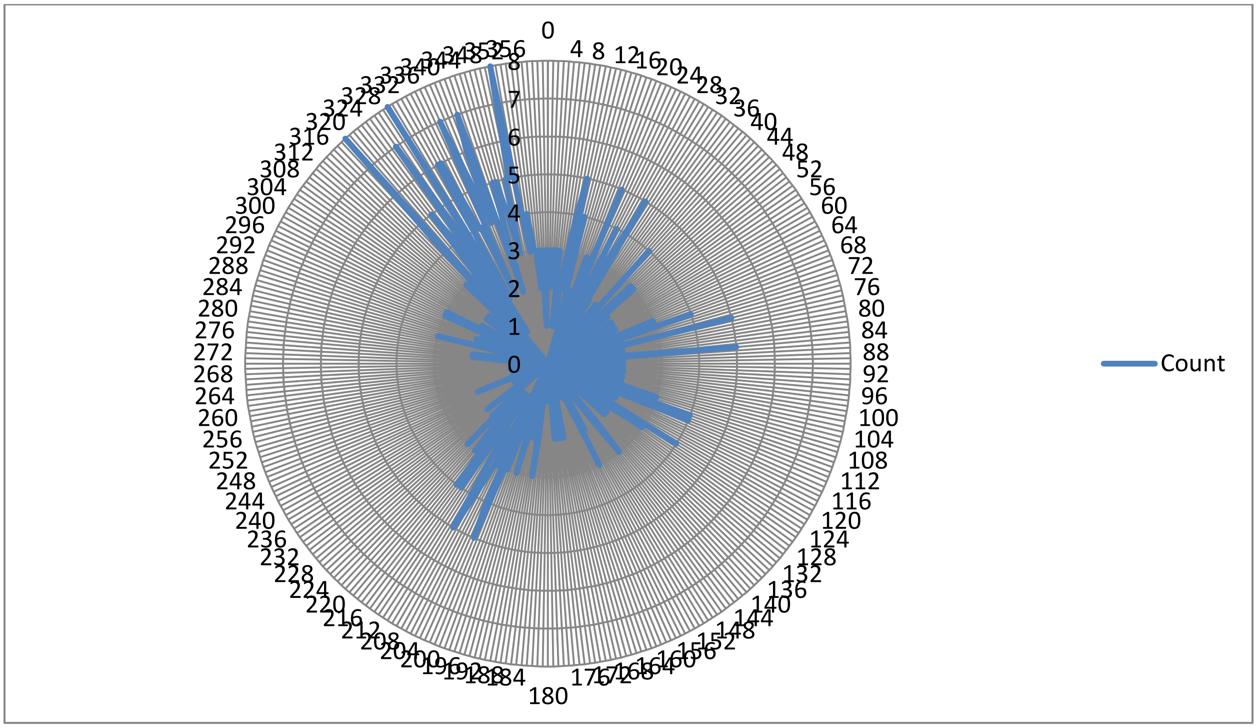


Figure C-3.4: Lancaster $PM_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

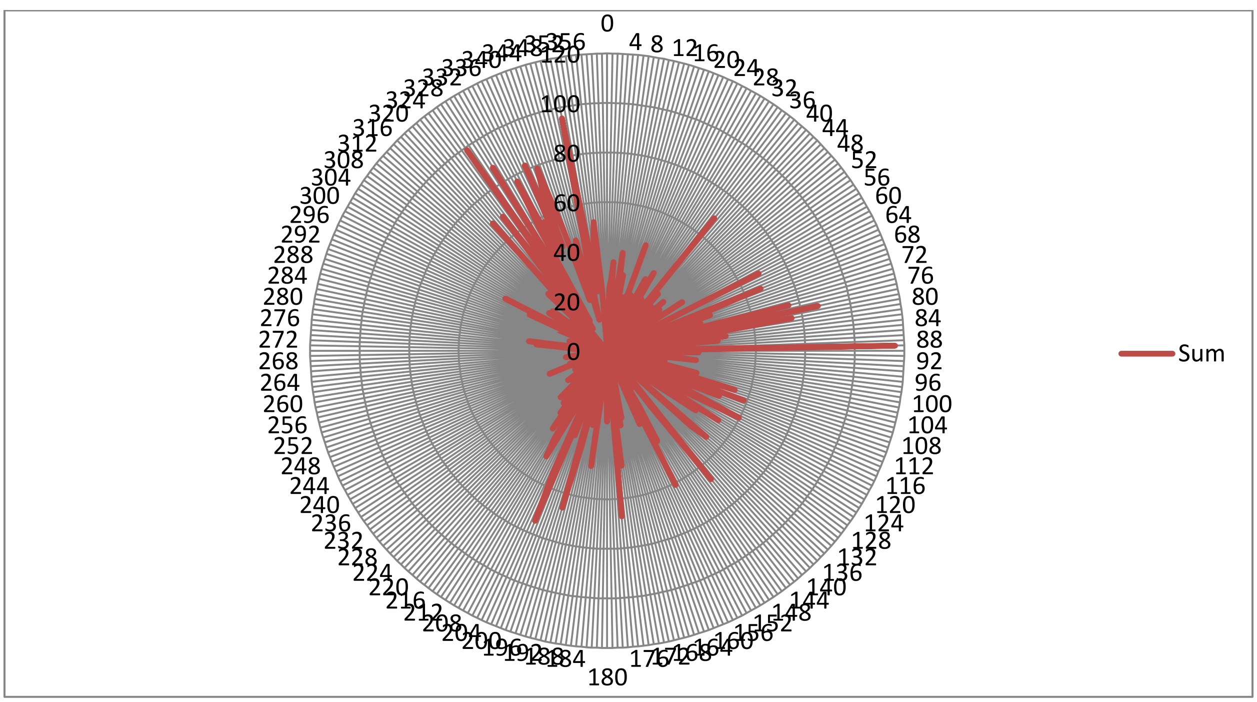
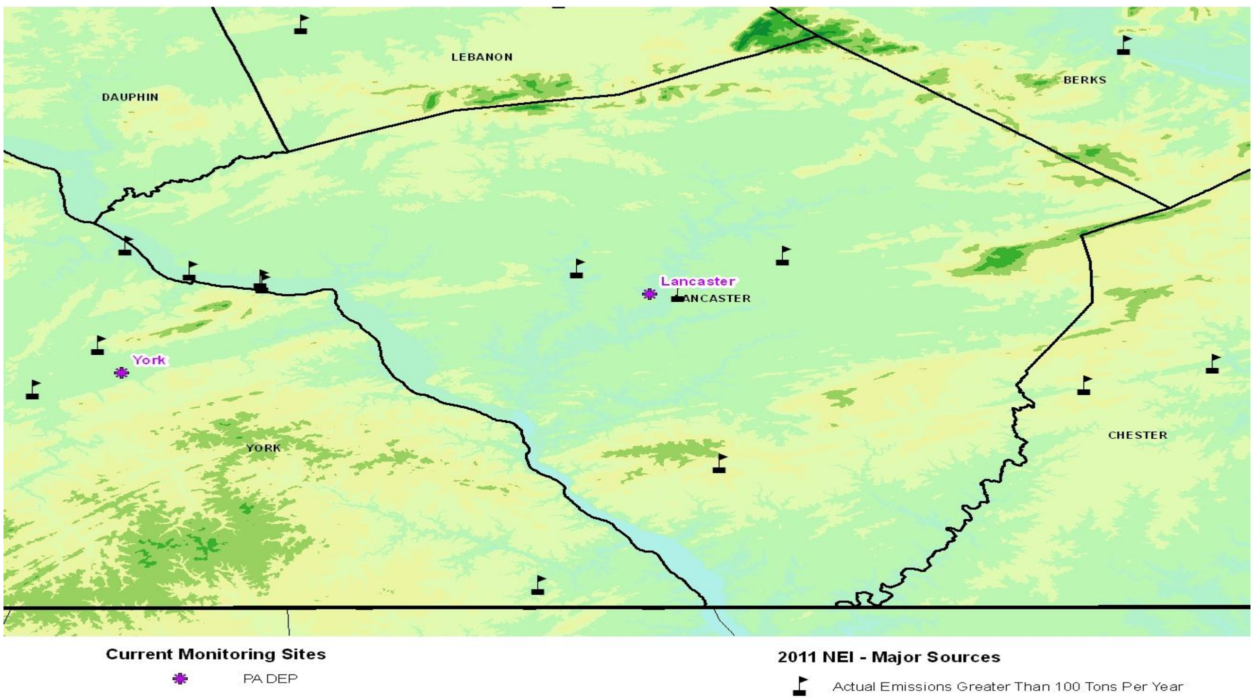


Figure C-3.3 illustrates that the highest frequency of wind distribution on the top 25% days is coming from the east, southwest and northwest. Figure C-3.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from east and northwest as well. Figure C-3.5 displays the major sources of sulfur dioxide in the Lancaster area.

Figure C-3.5: Lancaster Area
Major Sources (Over 100 Tons Per Year) Based on 2011 NEI



The closest major source of sulfur dioxide (which would create sulfates, a major constituent of $PM_{2.5}$ in the eastern US) is located approximately 20 kilometers to the west-northwest of the Lancaster monitor. Figure C-3.3 and Figure C-3.4 illustrate that the wind does not come from that direction on the top 25% days. This analysis also illustrates that there is a potential local influence to the high $PM_{2.5}$ concentrations at the Lancaster monitor.

The Change in the Composition of the $PM_{2.5}$

The composition of $PM_{2.5}$ has changed at the Lancaster monitor since the height of $PM_{2.5}$ concentrations in the 2005 to 2007 time period. Table C-3.2 outlines the main speciated components of $PM_{2.5}$ during the cold season (1st quarter). Table C-3.3 outlines the main speciated components of $PM_{2.5}$ during the warm season (3rd quarter). Overall, Table C-3.2 and Table C-3.3 illustrate the decline in the main speciated components of $PM_{2.5}$ from the 2005 to 2007 period to the 2010 to 2012 period.

Table C-3.2: Lancaster Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	4.03363248	6.80728034	4.68105853	5.01901610	0.85225712	0.45108978
2010 – 12	1.78220900	3.40209955	2.44059214	2.50229362	0.33200174	0.25016904
Difference (2005 – 07 minus 2010 – 12)	2.25142349	3.40518079	2.24046639	2.51672248	0.52025538	0.20092075

*All concentrations are averages and have units of $\mu g/m^3$

Table C-3.3: Lancaster Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	3.16090351	1.95417791	7.10641873	4.62527334	0.65753995	0.48242955
2010 – 12	1.26162865	1.31270310	2.99130570	2.77750490	0.30896226	0.32314873
Difference (2005 – 07 minus 2010 – 12)	1.89927487	0.64147481	4.11511303	1.84776844	0.34857770	0.15928082

*All concentrations are averages and have units of $\mu g/m^3$

During the cold season, there has been an equal amount of reduction in ammonium, nitrate, sulfate, and organic carbon concentrations. During the warm season, the largest reductions have occurred in ammonium, sulfate and organic carbon concentrations.

To analyze this further, we chose to compare these seasonal values with what has occurred in Arendtsville (AIRS # 42-001-0001), located in Adams County. Arendtsville is in a rural location of Pennsylvania and does not have a major nitrogen oxide or sulfur dioxide source within 50 kilometers of the monitor. For that reason, the Arendtsville monitor reflects the transport that is coming into eastern Pennsylvania from areas to the west (prevailing wind flow is from west to east across Pennsylvania).

Table C-3.4: Arendtsville Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.22066410	3.57683769	3.39904757	3.17044419	0.45550711	0.22843761
2010 – 12	1.23919565	2.07028981	2.18818154	1.68097944	0.16095925	0.18801487
Difference (2005 – 07 minus 2010 – 12)	0.98146846	1.50654787	1.21086602	1.48946475	0.29454786	0.04042275

*All concentrations are averages and have units of $\mu g/m^3$

Table C-3.5: Arendtsville Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.43772827	0.68269750	7.29288441	3.85331667	0.37004536	0.34223237
2010 – 12	0.98470271	0.50452874	3.13218233	2.13687247	0.15489114	0.32755852
Difference (2005 – 07 minus 2010 – 12)	1.45302555	0.17816876	4.16070208	1.71644420	0.21515422	0.01467385

*All concentrations are averages and have units of $\mu g/m^3$

The reductions at Arendtsville reflected in the “difference” row of Table C-3.5 are more representative of the reductions observed in eastern Pennsylvania due to emission control strategies of various sources (for example, the installation of flue gas desulfurization units on electric generation units across western Pennsylvania into the Ohio Valley). The data indicates that the greatest level of reduction at the Lancaster and Arendtsville monitors occurs during the summer months (when sulfate is the primary constituent of $PM_{2.5}$). During the 2005 – 07 time frame, Arendtsville had a 3rd quarter total mass average of 19.08 $\mu g/m^3$, and during the 2010 – 12 time frame it had a 3rd quarter total mass average of 12.06 $\mu g/m^3$; a 7 $\mu g/m^3$ reduction.

An analysis of the 2010-12 differences between the Lancaster and Arendtsville monitors indicates the nature of the problem at the Lancaster monitor.

Figure C-3.6: Urban Excess
Lancaster vs. Arendtsville
2010-12 – 1st Quarter

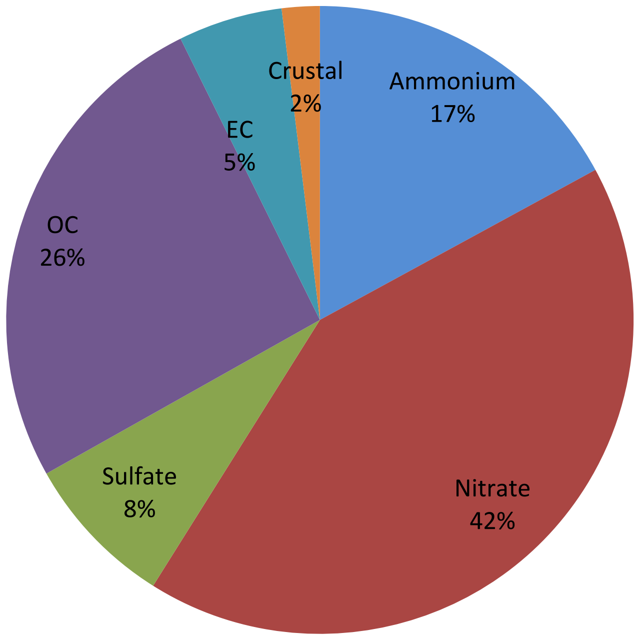


Figure C-3.7: Urban Excess
Lancaster vs. Arendtsville
2010-12 – 3rd Quarter

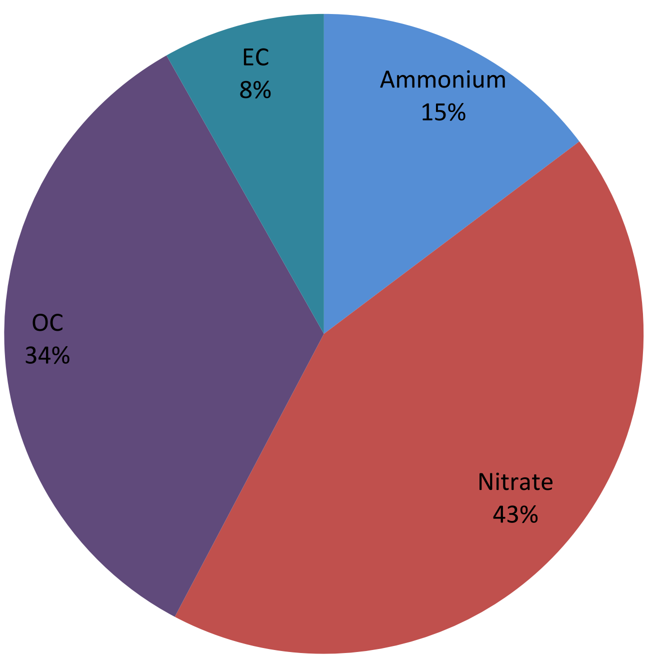
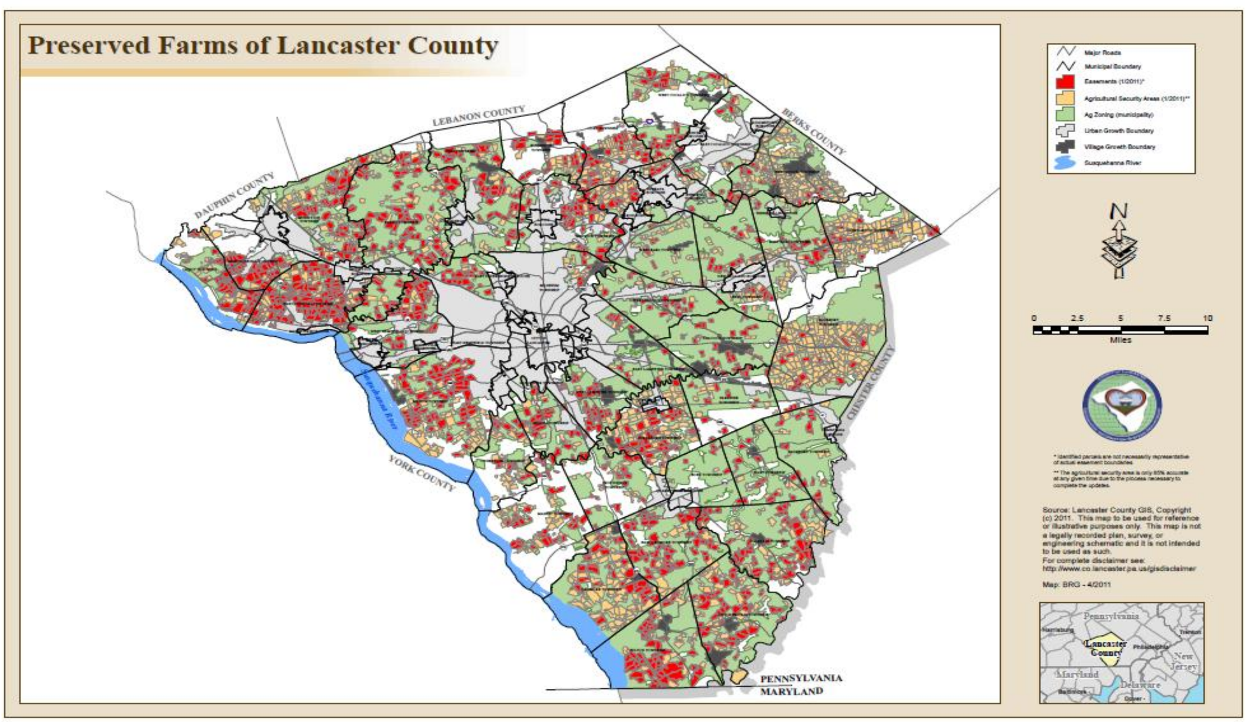


Figure C-3.6 and Figure C-3.7 display the same problem; Lancaster has excess nitrate, ammonium, and organic carbon emissions compared to Arendtsville. Sulfate levels, which are indicative of regional emissions from sources such as coal fired electric generation units, were fairly uniform at the Lancaster and Arendtsville monitors. The largest difference in overall emission concentrations is in the 1st quarter (cold season). The total mass emissions concentration at the Lancaster monitor is 4.40 $\mu g/m^3$ higher than that at the Arendtsville monitor. During the 3rd quarter (warm season), the Lancaster monitor is only 0.23 $\mu g/m^3$ higher than the Arendtsville monitor. Lancaster County has a strong tie to the agricultural sector. Lancaster County has the most farms and acres of farmland in the Commonwealth. Lancaster County consists of mostly farmlands surrounding downtown Lancaster and the location of the Lancaster monitor. Figure C-3.8 displays a map of Lancaster County and the proximity of preserved farms, which are farms and acres of land preserved for agricultural production, to the Lancaster monitor. Figure C-3.3 and Figure C-3.4 illustrate the distribution of wind and $PM_{2.5}$ concentrations surrounding the Lancaster monitor. From 2010 to 2012, the highest $PM_{2.5}$ concentrations were coming from the eastern and northwestern wind directions. In addition, Figure C-3.6 displays ammonium as comprising 17% of the $PM_{2.5}$ during the cold season. Ammonia emissions are prevalent in the agricultural sector due to the abundance of manure from livestock and a higher concentration of animals, for instance. The abundance of ammonium during the cold season allows for additional nitrate (from vehicles) to form ammonium nitrate, a constituent of $PM_{2.5}$.

Figure C-3.8: Preserved Farms in Lancaster County Map

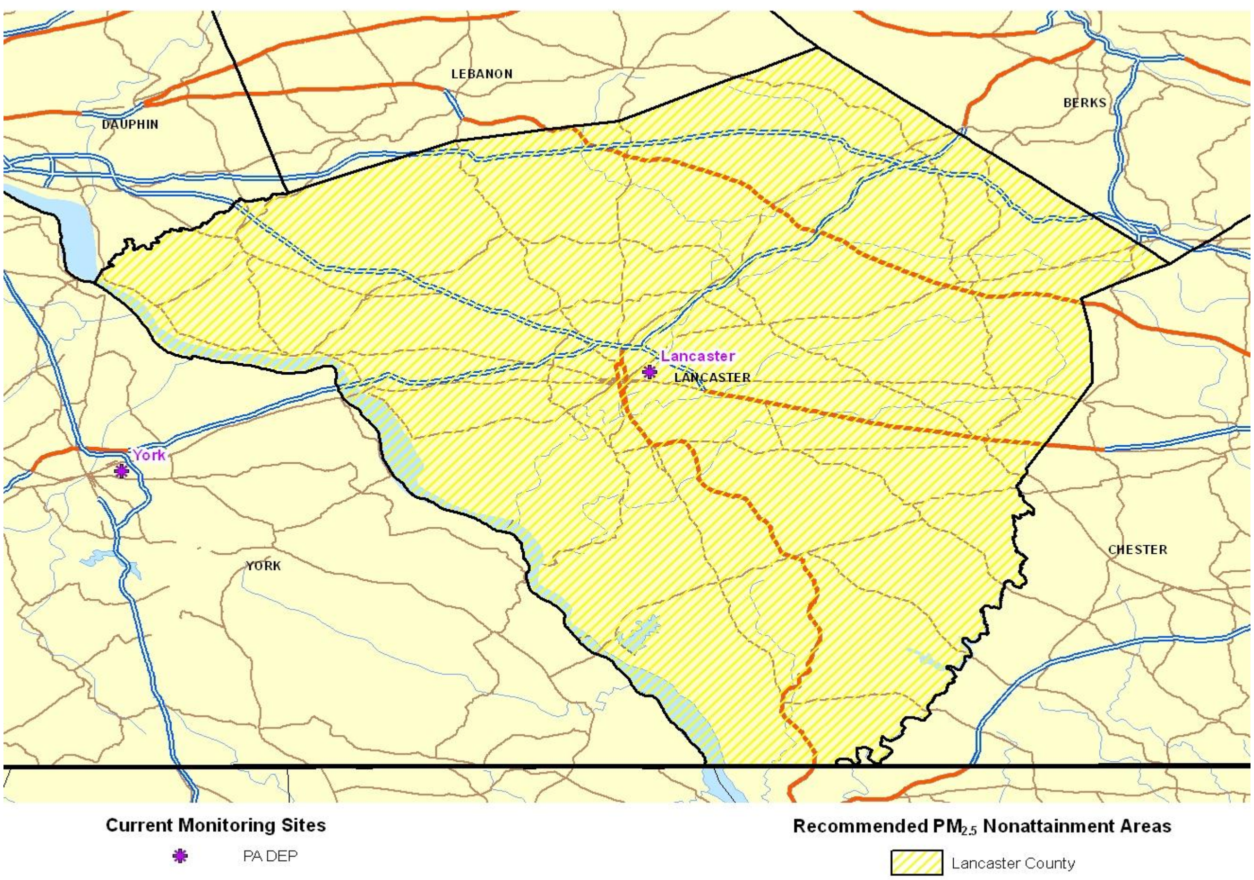


Source:
http://www.co.lancaster.pa.us/lanco/lib/lanco/agpreserve/lancastercountyeasements2011.pdf

Summary

The Department's analysis illustrates the need for a small nonattainment area constituting Lancaster County. An analysis of the $PM_{2.5}$ data monitored at the Lancaster monitor in Lancaster County illustrates that the Lancaster monitor sees concentrations in the 12-30 $\mu g/m^3$ range while the regional concentrations are in the 0-12 $\mu g/m^3$ range. A further examination into the monitoring data demonstrates that the high concentrations are coming out of two primary directions: easterly and northwesterly. These wind profiles travel over local farms, further illustrating the local issue at the Lancaster monitor. An analysis of the speciated data at the Lancaster and Arendtsville monitors illustrates the excess nitrate, ammonium, and organic and elemental carbon at the Lancaster monitor, primarily during the 1st quarter (cold season). The excess ammonium is likely a function of the high number of farms in the immediate vicinity of the Lancaster monitor. The excess ammonium, when in contact with excess nitrate, forms ammonium nitrate, a large constituent of $PM_{2.5}$ during the cold season. Therefore, the Department is recommending the Lancaster County nonattainment area encompassing Lancaster County in Pennsylvania be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. A map of the proposed nonattainment area is provided below as Figure C-3.9.

Figure C-3.9: Recommended Lancaster County $PM_{2.5}$ Nonattainment Area



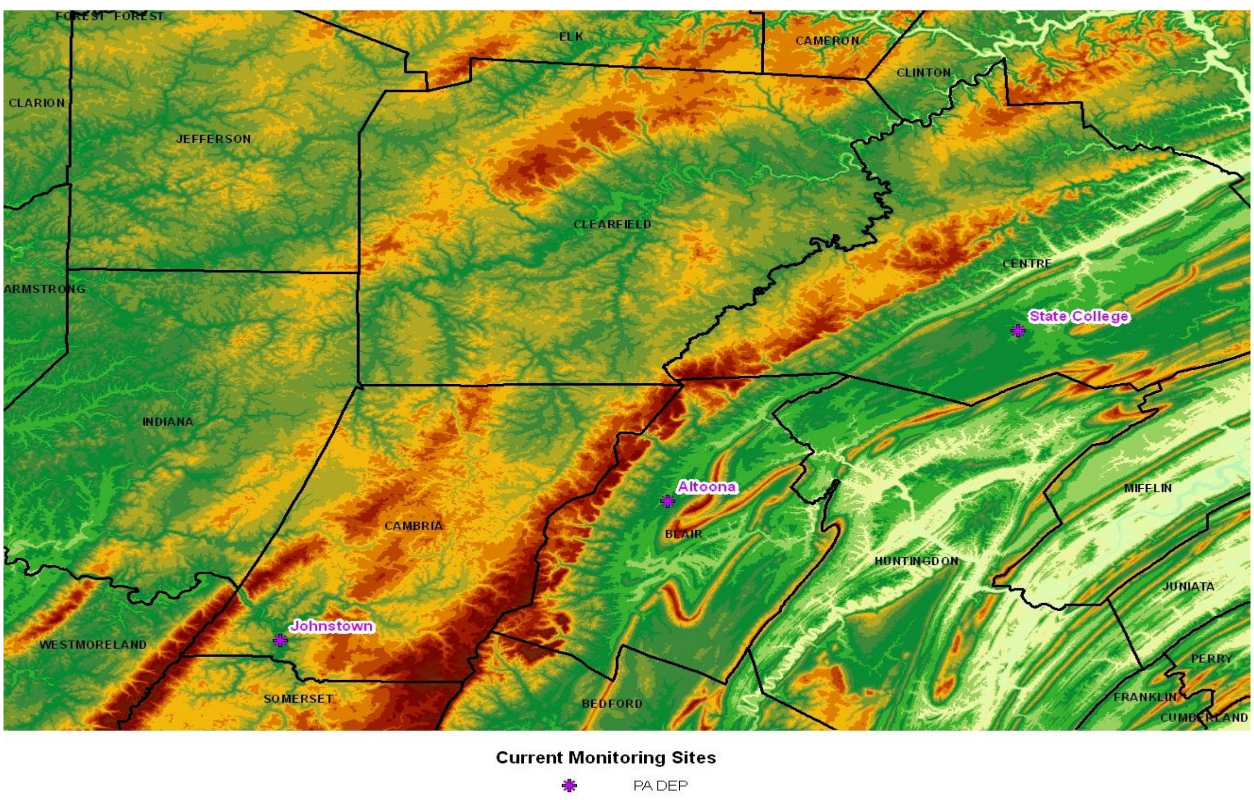
Appendix C-4
CAMBRIA COUNTY AREA

The Department is recommending a Cambria County annual $PM_{2.5}$ NAAQS nonattainment area consisting of Cambria County. The Department completed an analysis of the $PM_{2.5}$ ambient air quality data, which outlines the reason for recommending an area consisting of only Cambria County. This analysis is provided below.

Analysis of the Ambient $PM_{2.5}$ Data – A Design Value Contribution Analysis

Based on EPA-certified 2012 $PM_{2.5}$ design values, one monitor in the Johnstown metropolitan statistical area (MSA) is violating the 2012 $PM_{2.5}$ annual standard of 12 µg/m^3. The monitor and its design value are: Johnstown (AIRS # 42-021-0011) at 12.3 µg/m^3 (in Cambria County). Figure C-4.1 is a map outlining the location of this monitor, along with monitors in attainment in the vicinity of the Johnstown area.

Figure C-4.1: Johnstown Area $PM_{2.5}$ Monitoring Map



The Department has completed a design value contribution analysis for all of the $PM_{2.5}$ monitors in the Johnstown area. The analysis attempts to determine the daily contribution of $PM_{2.5}$ concentrations to the annual $PM_{2.5}$ design value. Daily $PM_{2.5}$ measurements were grouped into different $PM_{2.5}$ concentration ranges. An analysis of each range's contribution was then conducted to determine which measurements are contributing to the monitor's design value. Dates of these measurements were then further analyzed to determine if there are specific meteorological conditions or sources that are adversely impacting the monitor's design value.

Results from the design value contribution analysis for the Johnstown area are summarized in Table C-4.1. Ultimately, the type of contribution a given monitor's daily value had on the 3-year design value (by comparing this value to 12 $\mu g/m^3$) was determined. The daily value for each day a monitor measured $PM_{2.5}$ levels was placed in one of the ten categories. For example, on January 1, 2010, the Johnstown monitor's 24-hour $PM_{2.5}$ average was 12.2 $\mu g/m^3$. Since this value falls in the 12-18 $\mu g/m^3$ category in Table C-4.1, the calculated daily contribution to the design value was placed in this category. In the first quarter of 2010 (January 1 to March 31), the Johnstown monitor recorded 90 measurements. The Department determined that the January 1, 2010, contribution assessment to the 2012 design value was 0.000185 $\mu g/m^3$. The 0.000185 $\mu g/m^3$ was calculated by dividing the average daily value of 12.2 $\mu g/m^3$ by a factor of the number of measurements for the quarter (90) by 12 (there are a total of 12 quarters in a 3-year design value period). This type of analysis was completed for every day of measurements from January 1, 2010, through December 31, 2012. In Table C-4.1, the sum of the categorical breakdowns for the Johnstown monitor equals 0.31 $\mu g/m^3$, which demonstrates that the design value is 0.31 $\mu g/m^3$ above the annual standard of 12 $\mu g/m^3$.

Table C-4.1: Johnstown Area
2012 $PM_{2.5}$ Annual Design Value Contribution Analysis

Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	Sum
Monitors Attaining 2012 PM 2.5 Standard													
Altoona ***	420130801	PA DEP	-2.2398	-1.0951	0.4699	0.5702	0.3526	0.1729	0.0768	0.0000	0.0000	0.0000	-1.6925
State College	420270100	PA DEP	-2.7741	-1.2511	0.4456	0.5427	0.2605	0.1324	0.0715	0.0000	0.0353	0.0000	-2.5371
Monitors Not Attaining 2012 PM 2.5 Standard													
Johnstown	420210011	PA DEP	-1.3884	-1.1097	0.7757	0.9442	0.5555	0.3495	0.1853	0.0000	0.0000	0.0000	0.3120
Johnstown Regional Average			-2.1341	-1.1520	0.5637	0.6857	0.3895	0.2183	0.1112	0.0000	0.0118	0.0000	

***The Altoona monitor did not have three complete years of data. The monitor began operating in June 2010.

Table C-4.1 illustrates the differences between the monitors that are attaining the 2012 $PM_{2.5}$ annual standard and the monitor that is not attaining the 2012 $PM_{2.5}$ annual standard. The Johnstown monitor has slightly fewer "clean" days (0-12 $\mu g/m^3$) than the monitors that are attaining the standard. For example, the Johnstown monitor's $PM_{2.5}$ contribution to the design value in the 0-12 $\mu g/m^3$ range was 1.18 $\mu g/m^3$ lower than the regional average.

The analysis described in the remainder of this Appendix focuses on the Johnstown monitor because it is the only monitor of concern. Figure C-4.2a illustrates the trend of annual averages, while Figure C-4.2b illustrates the trend of annual design values during the period in the Johnstown area. The Johnstown monitor's $PM_{2.5}$ levels have continued to decline over the last ten years along with the regional monitors' $PM_{2.5}$ levels. The Johnstown monitor's 2012 design value is very close to the 2012 $PM_{2.5}$ annual standard.

Figure C-4.2a: Johnstown Area $PM_{2.5}$ Annual Averages

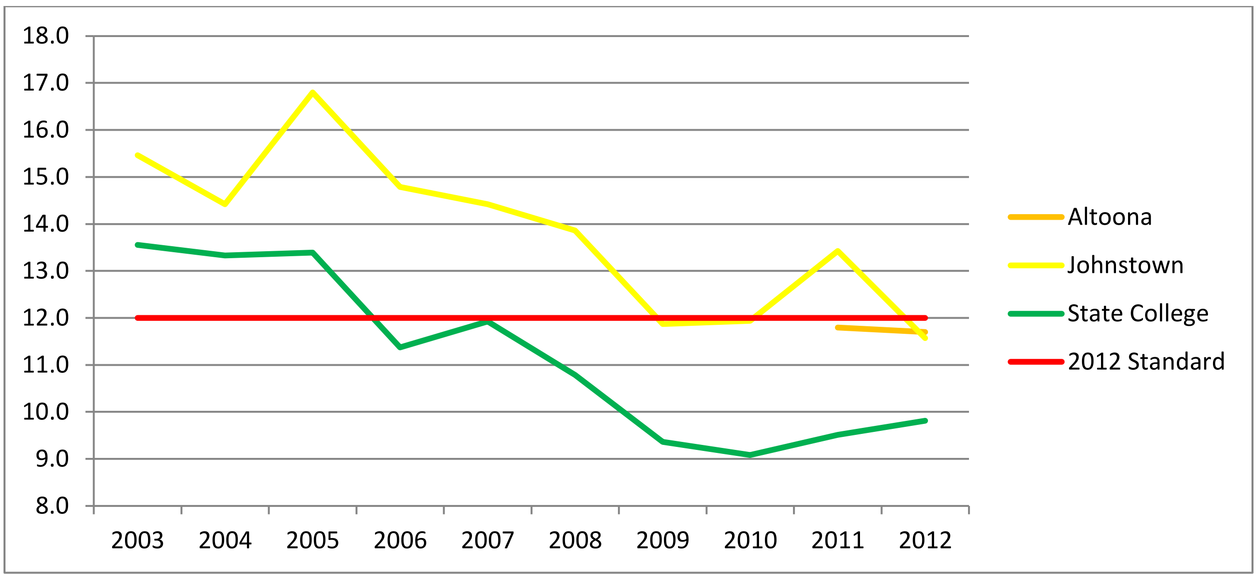
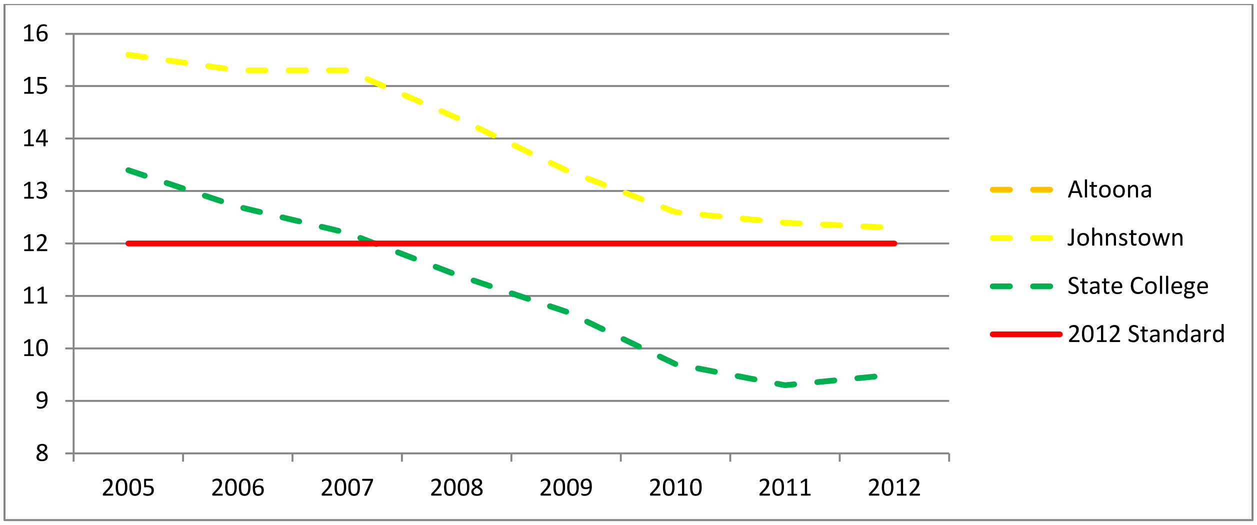


Figure C-4.2b: Johnstown Area $PM_{2.5}$ Annual Design Values



*** Altoona does not have a full three year data set to calculate a design value.

Additional analyses were completed to determine what was contributing to the fewer number of "clean" days at the Johnstown monitor. The Department identified days when the Johnstown monitor's $PM_{2.5}$ concentrations were relatively high but regional monitoring concentrations in the Johnstown area were "clean." Between 2010 and 2012, the Department identified 173 days in which the Johnstown monitor was at least one standard deviation above the regional average while the regional average was at or below 12 $\mu g/m^3$. The most extreme events (top 25%) were further analyzed to determine why the Johnstown monitor's concentrations were high when regional concentrations were low.

Meteorological Conditions Impacting High $PM_{2.5}$ Days at the Johnstown Monitor

The top 25% days were examined to determine the reason the Johnstown monitor's concentrations were high. The Johnstown monitor has a collocated meteorological tower that monitors wind direction and wind speed. Figure C-4.3 illustrates the number of hours the wind is coming from a particular direction, while Figure C-4.4 illustrates the total $PM_{2.5}$ concentration coming from a particular direction.

Figure C-4.3: Johnstown Wind Direction Frequency
Top 25% of Regionally "Clean" Days

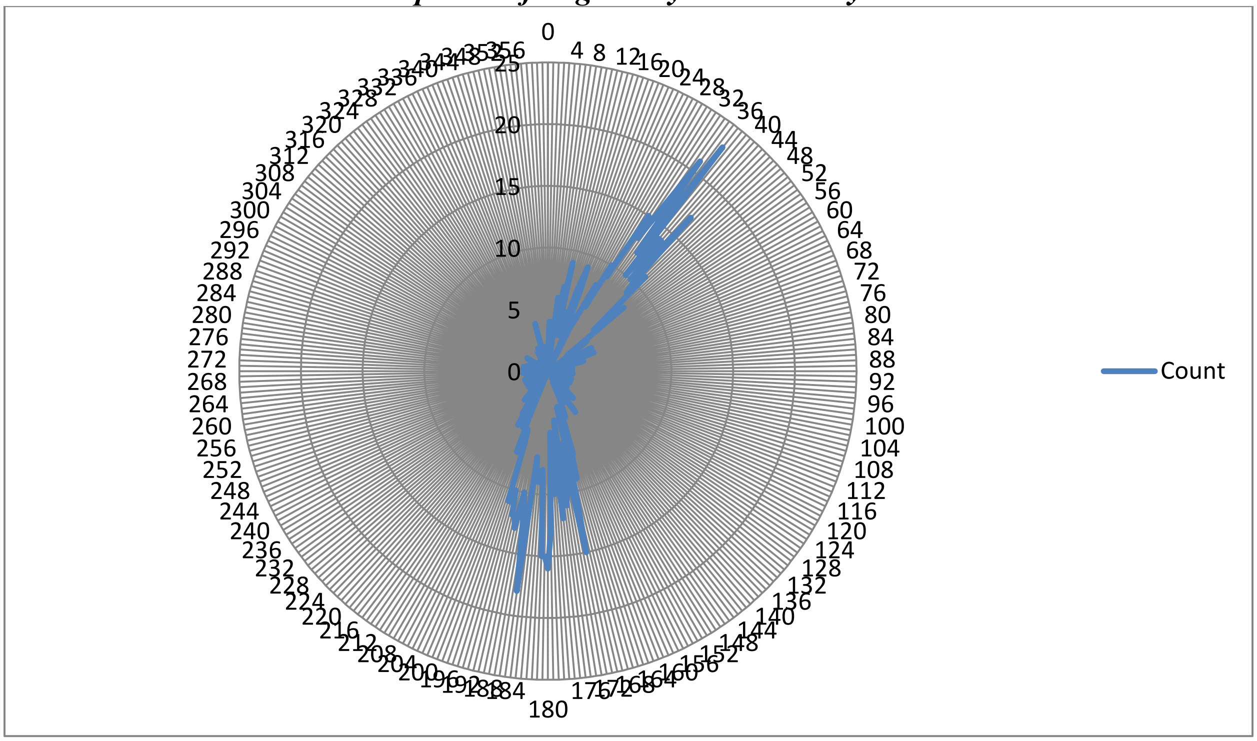


Figure C-4.4: Johnstown PM$_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

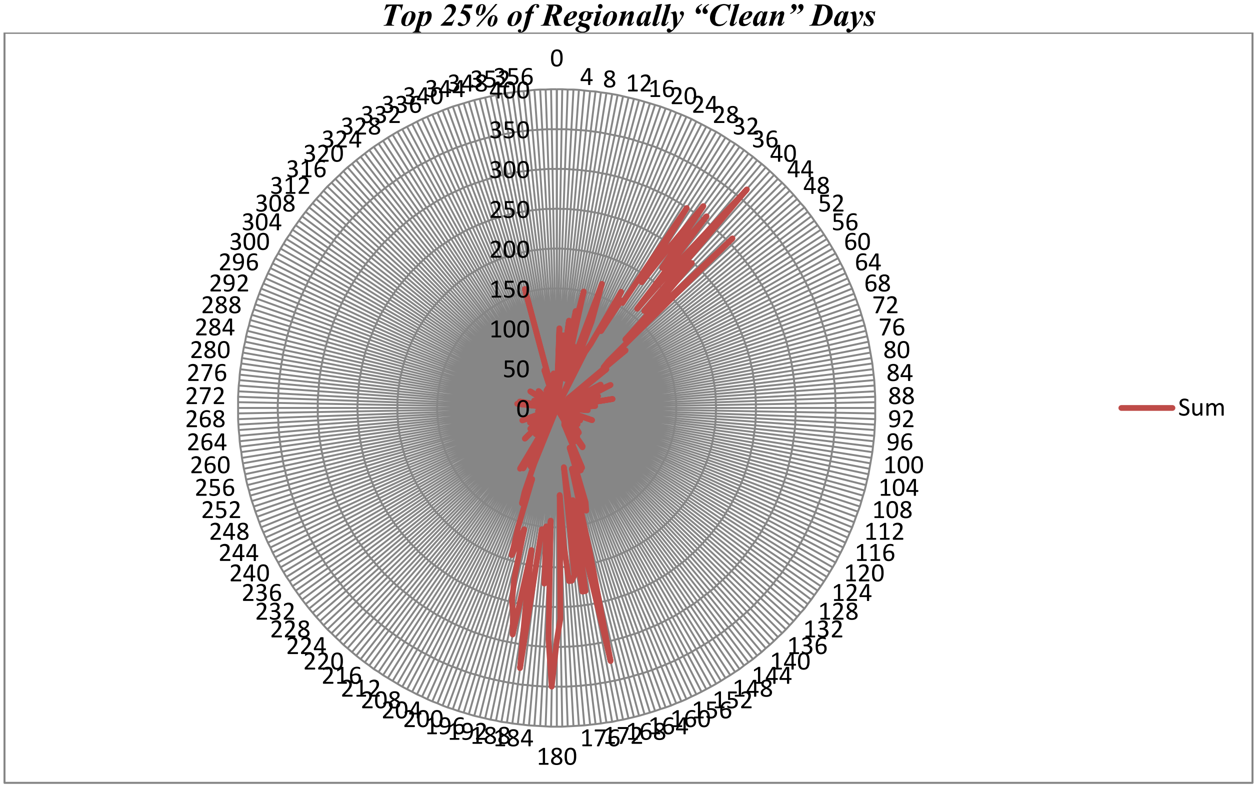
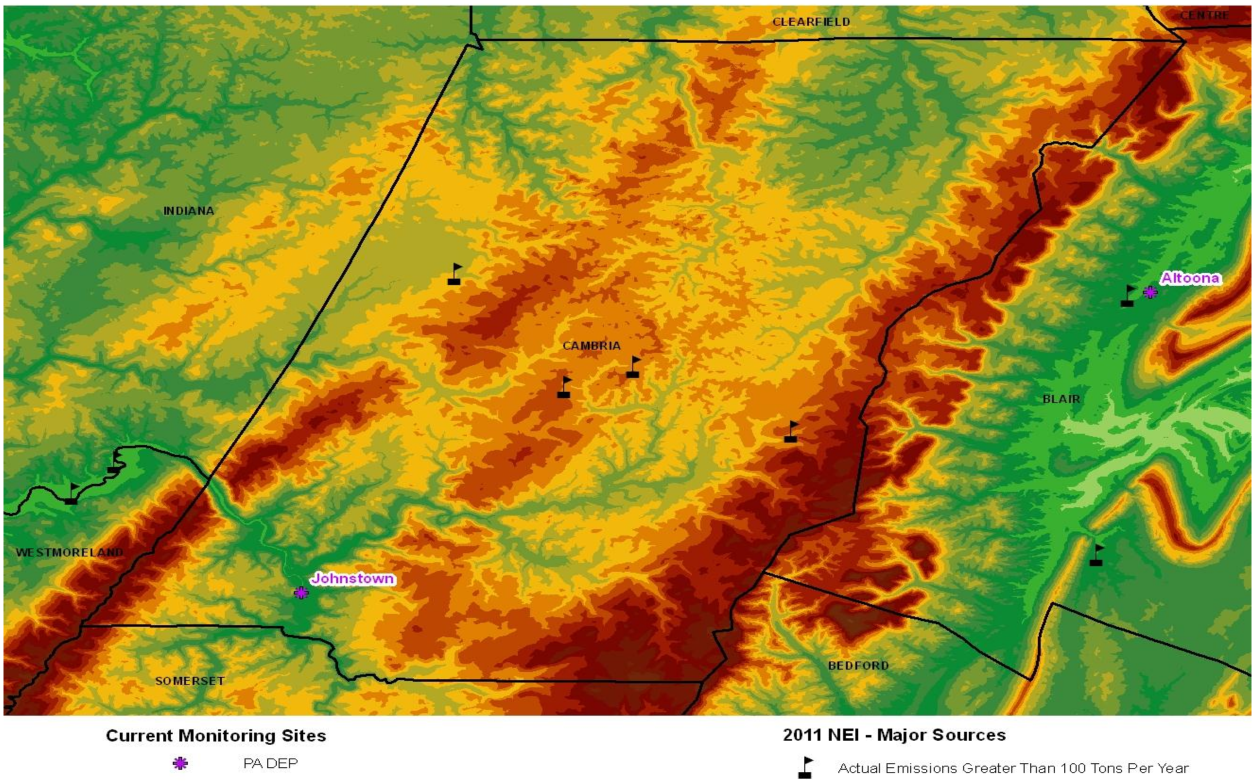


Figure C-4.3 illustrates that the highest frequency of wind distribution on the top 25% days is coming from the south and northeast. Figure C-4.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from south and northeast as well.

Figure C-4.5 displays the major sources of sulfur dioxide near the Johnstown monitor.

Figure C-4.5: Johnstown Area
Major Sources (Over 100 Tons Per Year) Based on 2011 NEI



The closest major source of SO_2 (which would create sulfates, a major constituent of $PM_{2.5}$ in the eastern U.S.) is located approximately 20 kilometers to the west, northwest of the Johnstown monitor. Figure C-4.3 and Figure C-4.4 illustrate that the wind does not come from that direction on the top 25% days. This analysis also illustrates that there is a potential local influence to the high $PM_{2.5}$ concentrations at the Johnstown monitor.

The Composition of the $PM_{2.5}$

The Johnstown speciation monitor began operating in 2009. There are slight differences in the composition of $PM_{2.5}$ emissions when comparing the cold season speciated components with the warm season speciated components. Table C-4.2 outlines the main speciated components of

$PM_{2.5}$ during the cold season (1st quarter). Table C-4.3 outlines the main speciated components of $PM_{2.5}$ during the warm season (3rd quarter).

Table C-4.2: Johnstown Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Breakdown – 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2010 – 12	1.31844944	1.74140128	2.86875084	2.78728364	0.40773458	0.81128770

*All concentrations are averages and have units of $\mu g/m^3$

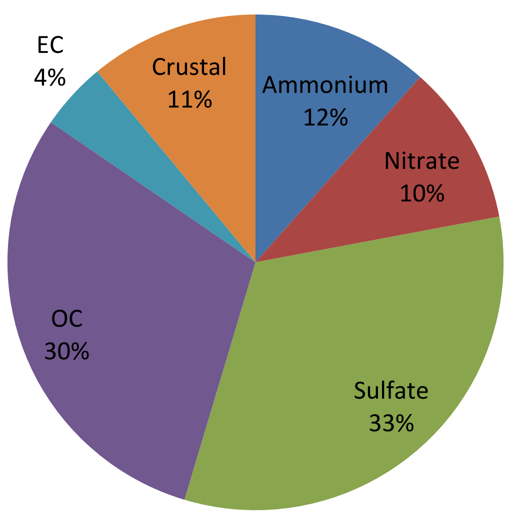
Table C-4.3: Johnstown Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Breakdown – 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2010 – 12	1.09971756	0.33369140	3.91246610	2.61778990	0.24602563	0.99635324

*All concentrations are averages and have units of $\mu g/m^3$

During the cold season, nitrate has a larger contribution to the total $PM_{2.5}$ mass than in the warm season. During the warm season, sulfate has a larger contribution to the total $PM_{2.5}$ mass than in the cold season. For the entire three year period, the crustal material encompasses a substantial portion of the $PM_{2.5}$. Figure C-4.6 illustrates the breakdown of the main speciated components of $PM_{2.5}$ at the Johnstown monitor for the entire three year period.

Figure C-4.6: Johnstown Speciated $PM_{2.5}$ Data - 2010-12



To analyze this further, we chose to compare these seasonal values with what has occurred at the Florence monitor (AIRS # 42-125-5001), located in Washington County, Pennsylvania. The Florence monitor is situated in Hillman State Park in northern Washington County. The monitor's location is less than ten miles east of the West Virginia / Pennsylvania border. For that reason, the Florence monitor reflects the transport that is coming into western Pennsylvania from areas to the west (prevailing wind flow is from west to east across Pennsylvania).

Table C-4.4: Florence Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	1.31827402	1.45532736	3.20309281	2.88969583	0.59347306	0.32894438
2010 – 12	1.15058471	1.85637720	2.43243089	1.73627967	0.17623659	0.25624708
Difference (2005 – 07 minus 2010 – 12)	0.16768931	-0.40104984	0.77066192	1.15341616	0.41723647	0.07269730

*All concentrations are averages and have units of $\mu g/m^3$

Table C-4.5: Florence Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.15507812	0.34361657	8.17978175	3.32471443	0.35976005	0.83256858
2010 – 12	0.90089860	0.21878832	3.84856214	2.40295511	0.19830720	0.51222953
Difference (2005 – 07 minus 2010 – 12)	1.25417952	0.12482826	4.33121961	0.92175932	0.16145285	0.32033904

*All concentrations are averages and have units of $\mu g/m^3$

The reductions at the Florence monitor reflected in the "difference" row of Table C-4.5 are more representative of the reductions observed in western Pennsylvania due to emission control strategies of various sources (for example, the installation of flue gas desulfurization units on electric generation units across the Ohio Valley). The data indicates that the greatest level of reduction in Johnstown and Florence occurs during the summer months (when sulfate is the primary constituent of $PM_{2.5}$). During the 2005 – 07 time frame, Florence had a 3rd quarter total mass average of 19.98 $\mu g/m^3$, and during the 2010 – 12 time frame it had a 3rd quarter total mass average of 12.94 $\mu g/m^3$: this is a 7 $\mu g/m^3$ reduction.

An analysis of the 2010 – 12 differences between the Johnstown and Florence monitors indicates the nature of the problem at Johnstown.

Figure C-4.7: Urban Excess
Johnstown vs. Florence
2010-12 – 1st Quarter

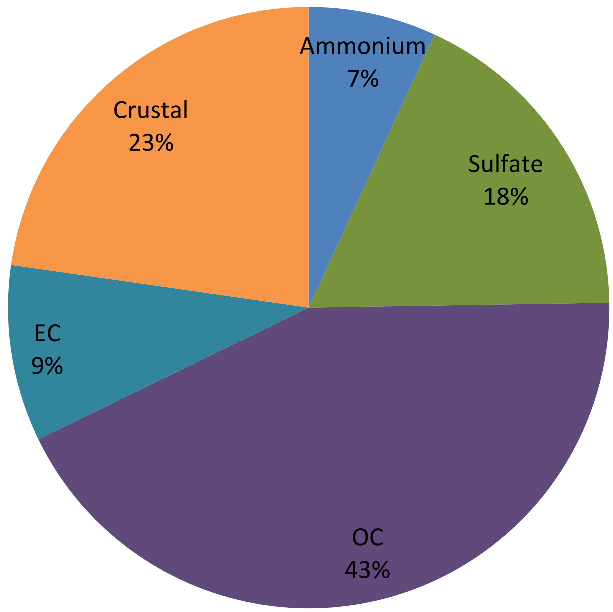


Figure C-4.8: Urban Excess
Johnstown vs. Florence
2010-12 – 3rd Quarter

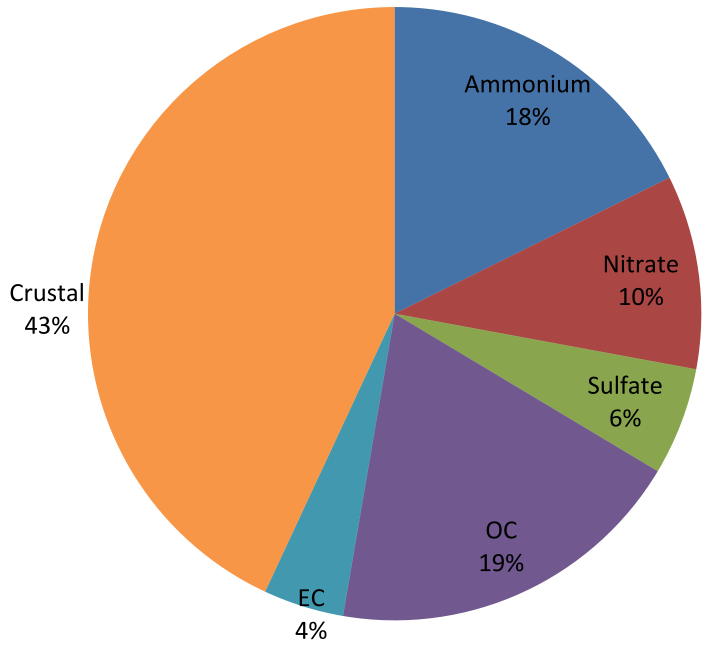


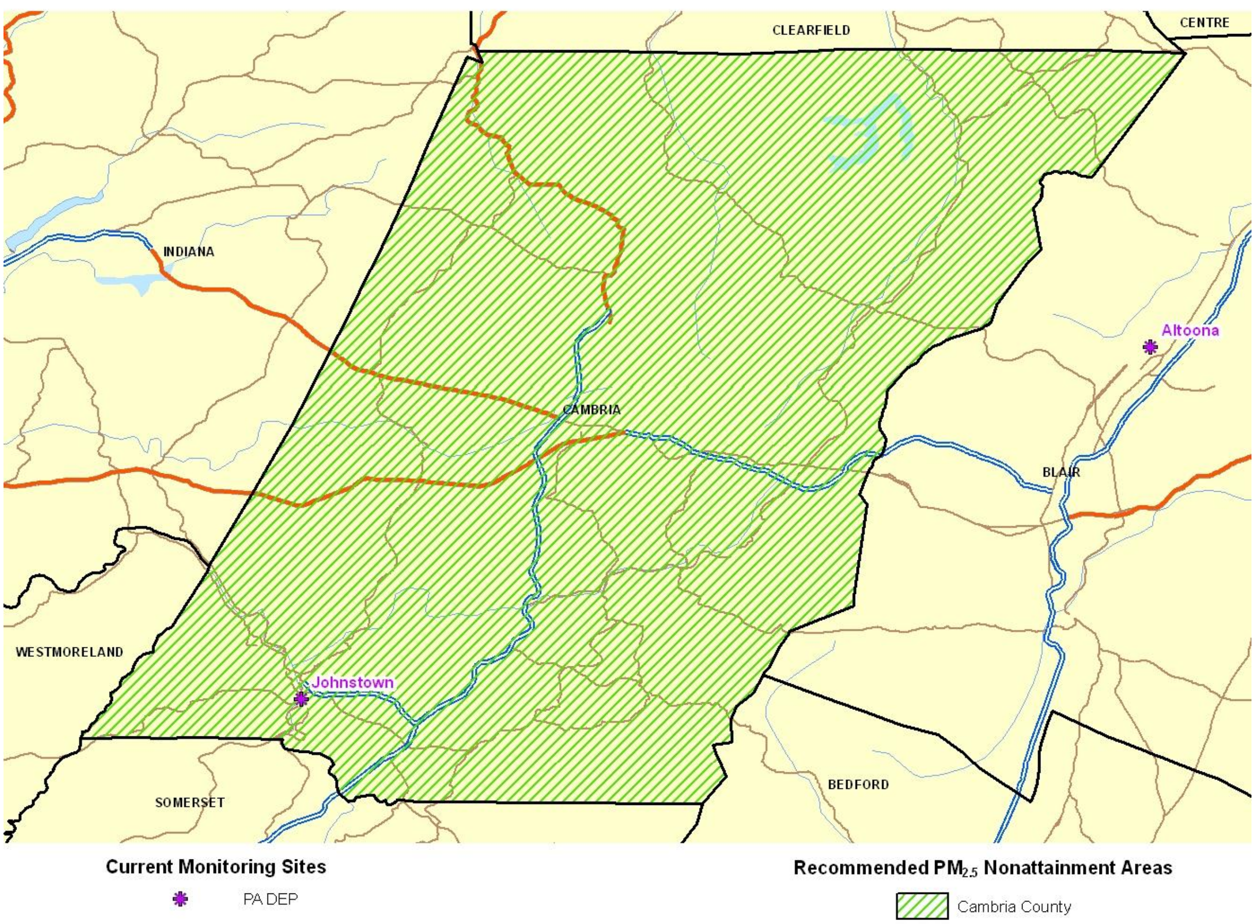
Figure C-4.7 and Figure C-4.8 display the same problem; Johnstown has excess ammonium, organic carbon and crustal mass compared to Florence. Sulfate levels, which are indicative of regional emissions from sources such as coal fired electric generation units, were fairly uniform at the Johnstown and Florence monitors. The largest difference in overall emission concentrations is in the 1^{st} quarter (cold season). The total mass emissions concentration at the Johnstown monitor is 3.08 $\mu g/m^3$ higher than that at the Florence monitor. During the 3^{rd} quarter (warm season), the total mass emissions concentration at the Johnstown monitor is 1.50 $\mu g/m^3$ higher than that at the Florence monitor. The excess crustal mass is indicative of dust impacting the monitor and also the local nature of the problem at the monitor. The proximity of a rail yard and a warehouse with unpaved roads near the Johnstown monitor has the possibility of contributing to the local crustal mass being collected at the monitor. Figure C-4.9 illustrates the location of the Johnstown monitor to local sources.

Figure C-4.9: Proximity of Johnstown Monitor to Local Sources

Summary

The Department's analysis illustrates the need for a one-county (Cambria County) nonattainment area in the Johnstown area. An analysis of the $PM_{2.5}$ data monitored at the Johnstown monitor in Cambria County illustrates that the monitor sees concentrations in the 12-30 $\mu g/m^3$ range while the regional concentrations are in the 0-12 $\mu g/m^3$ range. A further examination into the monitoring data demonstrates that the high concentrations are coming out of two primary directions: northeasterly and southerly. These wind profiles travel over unpaved sections of roads very close to the Johnstown monitor, further illustrating the local issue. An analysis of the speciated data at the Johnstown and Florence monitors illustrates the excess organic carbon and crustal material at the Johnstown monitor. The excess crustal material is likely a function of the number of unpaved roadways in the immediate vicinity of the Johnstown monitor. Therefore, the Department is recommending the Cambria County nonattainment area encompassing Cambria County in Pennsylvania be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. A map of the proposed nonattainment area is provided below as Figure C-4.10.

Figure C-4.10: Recommended Cambria County $PM_{2.5}$ Nonattainment Area



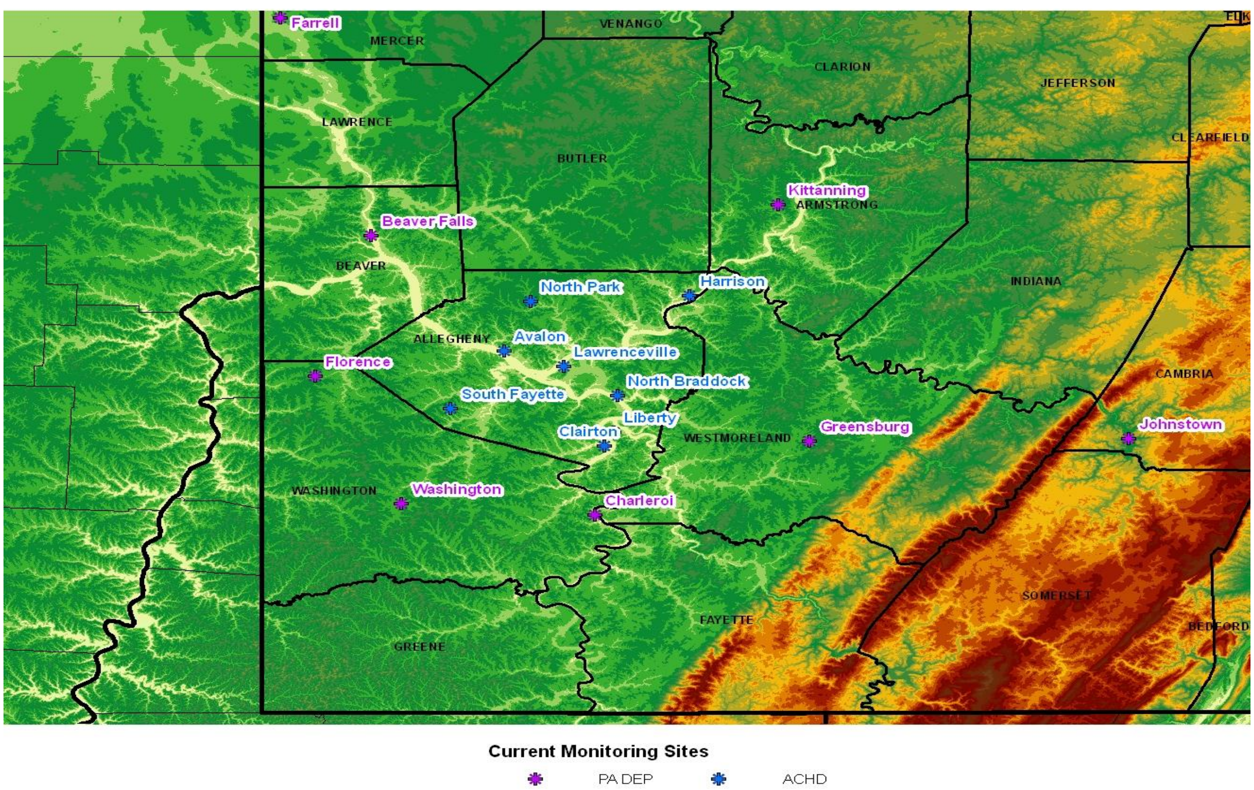
Appendix C-5
GREATER PITTSBURGH AREA

The Department is recommending a Greater Pittsburgh annual $PM_{2.5}$ NAAQS nonattainment area consisting of Westmoreland and Allegheny counties, with the exception of the Liberty-Clairton area of Allegheny County. The Department completed an analysis of the $PM_{2.5}$ ambient air quality data, which outlines the reason for recommending a smaller nonattainment area than the Pittsburgh-Beaver Valley nonattainment area for the 1997 and 2006 $PM_{2.5}$ standards. This analysis is provided below.

Analysis of the Ambient $PM_{2.5}$ Data – A Design Value Contribution Analysis

Based on EPA-certified 2012 $PM_{2.5}$ design values, three monitors in the Pittsburgh metropolitan statistical area (MSA) are violating the 2012 $PM_{2.5}$ annual standard of 12 µg/m^3. The monitors and their design values are: Avalon (AIRS # 42-003-0002) at 13.4 µg/m^3 (in Allegheny County), North Braddock (AIRS # 42-003-1301) at 12.5 µg/m^3 (in Allegheny County) and Greensburg (AIRS # 42-129-0008) at 12.6 µg/m^3 (in Westmoreland County). Figure C-5.1 is a map outlining the location of these monitors, along with monitors in attainment, in the Pittsburgh MSA.

Figure C-5.1: Pittsburgh MSA $PM_{2.5}$ Monitoring Map



The Department has completed a design value contribution analysis for all of the $PM_{2.5}$ monitors in the Pittsburgh MSA. The analysis attempts to determine the daily contribution of $PM_{2.5}$ concentrations to the annual $PM_{2.5}$ design value. Daily $PM_{2.5}$ measurements were grouped into different $PM_{2.5}$ concentration ranges. An analysis of each range's contribution was then conducted to determine which measurements are contributing to the monitor's design value. Dates of these measurements were then further analyzed to determine if there are specific meteorological conditions or sources that are adversely impacting the monitor's design value.

Results from the design value contribution analysis for the Pittsburgh MSA are summarized in Table C-5.1. Ultimately, the type of contribution a given monitor's daily value had on the 3-year design value (by comparing this value to 12 $\mu g/m^3$) was determined. The design value for each day a monitor measured $PM_{2.5}$ levels was placed in one of the ten categories. For example, on January 1, 2010, the Greensburg monitor's 24-hour $PM_{2.5}$ average was 12.8 $\mu g/m^3$. Since this value falls in the 12-18 $\mu g/m^3$ category in Table C-5.1, the calculated daily contribution to the design value was placed in this category. In the first quarter of 2010 (January 1 to March 31), the Greensburg monitor recorded 82 measurements. The Department determined that the January 1, 2010, contribution assessment to the 2012 design value was 0.000813 $\mu g/m^3$. The 0.000813 $\mu g/m^3$ was calculated by dividing the average daily value of 12.8 $\mu g/m^3$ by a factor of the number of measurements for the quarter (82) by 12 (there are a total of 12 quarters in a 3-year design value period). This type of analysis was completed for every day of measurements from January 1, 2010, through December 31, 2012. In Table C-5.1, the sum of the categorical breakdowns for the Greensburg monitor equals 0.57 $\mu g/m^3$, which demonstrates that the design value is 0.57 $\mu g/m^3$ above the annual standard of 12 $\mu g/m^3$.

Table C-5.1: Pittsburgh MSA
2012 $PM_{2.5}$ Annual Design Value Contribution Analysis

Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	Sum
Monitors Attaining 2012 PM 2.5 Standard													
Florence	421255001	PA DEP	-3.7384	-1.4990	0.2361	0.1479	0.0553	0.0180	0.0000	0.0000	0.0000	0.0000	-4.7802
North Park	420030093	ACHD	-2.4093	-1.3915	0.4085	0.3873	0.3814	0.0000	0.0000	0.0000	0.0000	0.0000	-2.6236
South Fayette	420030067	ACHD	-1.5156	-1.6051	0.6252	0.4972	0.1753	0.2974	0.0000	0.0000	0.0000	0.0000	-1.5257
Lawrenceville	420030008	ACHD	-1.5307	-1.3301	0.6605	0.7516	0.3579	0.1419	0.0570	0.0000	0.0000	0.0000	-0.8918
Washington	421250200	PA DEP	-1.4587	-1.2800	0.7331	0.6447	0.3396	0.1206	0.0272	0.0000	0.0000	0.0000	-0.8733
Kittanning	420050001	PA DEP	-1.1986	-1.3255	0.6721	0.8285	0.3825	0.2133	0.0504	0.0301	0.0000	0.0000	-0.3472
Harrison	420031008	ACHD	-1.3211	-1.2859	0.7535	0.9858	0.2371	0.2225	0.0824	0.0000	0.0000	0.0000	-0.3256
Charleroi	421250005	PA DEP	-1.2256	-1.2403	0.7532	0.9015	0.4113	0.1218	0.1404	0.0000	0.0000	0.0000	-0.1376
Beaver Falls	420070014	PA DEP	-1.3739	-1.0749	0.8021	0.9574	0.4968	0.1791	0.0473	0.0000	0.0000	0.0000	0.0339
Monitors Not Attaining 2012 PM 2.5 Standard													
North Braddock	420031301	ACHD	-1.4699	-1.1114	0.7052	1.1313	0.7039	0.3106	0.2247	0.0000	0.0000	0.0000	0.4944
Greensburg	421290008	PA DEP	-1.0231	-1.2125	0.7203	1.0369	0.6247	0.1940	0.2290	0.0000	0.0000	0.0000	0.5693
Avalon	420030002	ACHD	-0.7746	-1.1588	0.7307	1.2707	0.7243	0.3252	0.2649	0.0300	0.0340	0.0000	1.4464
Greater Pittsburgh Regional Average			-1.5866	-1.2929	0.6500	0.7951	0.4075	0.1787	0.0936	0.0050	0.0028	0.0000	

Table C-5.1 illustrates the differences between the monitors that are attaining the 2012 $PM_{2.5}$ annual standard and the monitors that are not attaining the 2012 $PM_{2.5}$ annual standard. The monitors that are not attaining the standard have relatively fewer "clean" days (0-12 µg/m^3) than the monitors that are attaining the standard. For example, the Greensburg monitor's $PM_{2.5}$ contribution to the design value in the 0-12 µg/m^3 range was 0.7 µg/m^3 lower than the average in the Pittsburgh MSA.

The analysis described in the remainder of this Appendix focuses on the Greensburg monitor because it is the only monitor above the standard that also has a speciation monitor.
Figure C-5.2a illustrates the trend of annual averages while Figure C-5.2b illustrates the trend of annual design values for monitors in the Pittsburgh MSA. Of the three monitors measuring nonattainment, the Greensburg monitor is the monitor with the smallest level of decline in its annual design value from 2005 to 2012. Since 2003, annual $PM_{2.5}$ levels have been in a general decline in the Pittsburgh MSA. Over the last three years, annual averages at the Avalon monitor have fallen at a significant rate. If the trend continues, the Avalon monitor's 2013 design value is expected to reach attainment of the 12 µg/m^3 standard. A total of nine monitors in the Pittsburgh MSA are attaining the 2012 standard and continue to show a decline in annual average and annual design values: four monitors in Allegheny County (Lawrenceville, South Fayette, North Park and Harrison monitors), three monitors in Washington County (Charleroi, Washington and Florence monitors), one monitor in Beaver County (Beaver monitor) and one monitor in Armstrong County (Kittanning monitor).

Figure C-5.2a: Pittsburgh MSA $PM_{2.5}$ Annual Averages

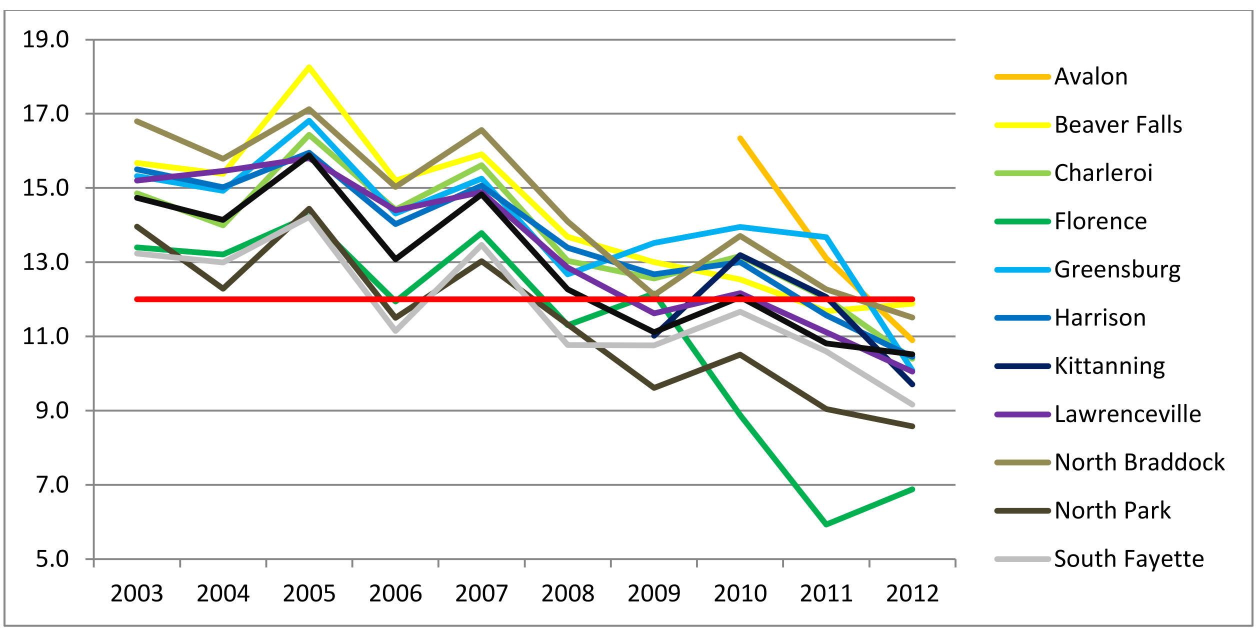
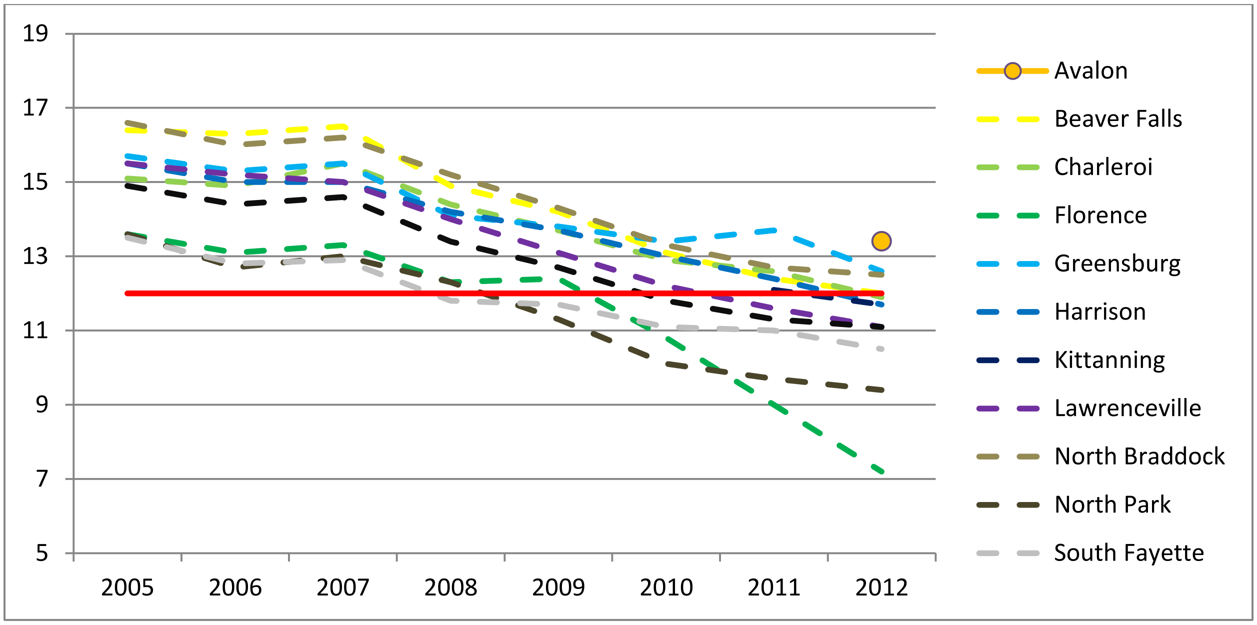


Figure C-5.2b: Pittsburgh MSA $PM_{2.5}$ Annual Design Values



Additional analyses were completed to determine what was contributing to the fewer number of "clean" days at the Greensburg monitor. The Department identified days when the Greensburg monitor's $PM_{2.5}$ concentrations were relatively high but regional monitoring concentrations in the Pittsburgh MSA were "clean." Between 2010 and 2012, the Department identified 189 days in which the Greensburg monitor was at least one standard deviation above the Pittsburgh MSA regional average while the regional average was at or below 12 µg/m^3. The most extreme events (top 25%) were further analyzed to determine why the Greensburg monitor's concentrations were high when regional concentrations were low.

Meteorological Conditions Impacting High $PM_{2.5}$ Days at the Greensburg Monitor

The top 25% days were examined to determine the reason the Greensburg monitor's concentrations were high. The Greensburg monitor has a collocated meteorological tower that monitors wind direction and wind speed. Figure C-5.3 illustrates the number of hours the wind is coming from a particular direction, while Figure C-5.4 illustrates the total $PM_{2.5}$ concentration coming from a particular direction.

Figure C-5.3: Greensburg Wind Direction Frequency
Top 25% of Regionally "Clean" Days

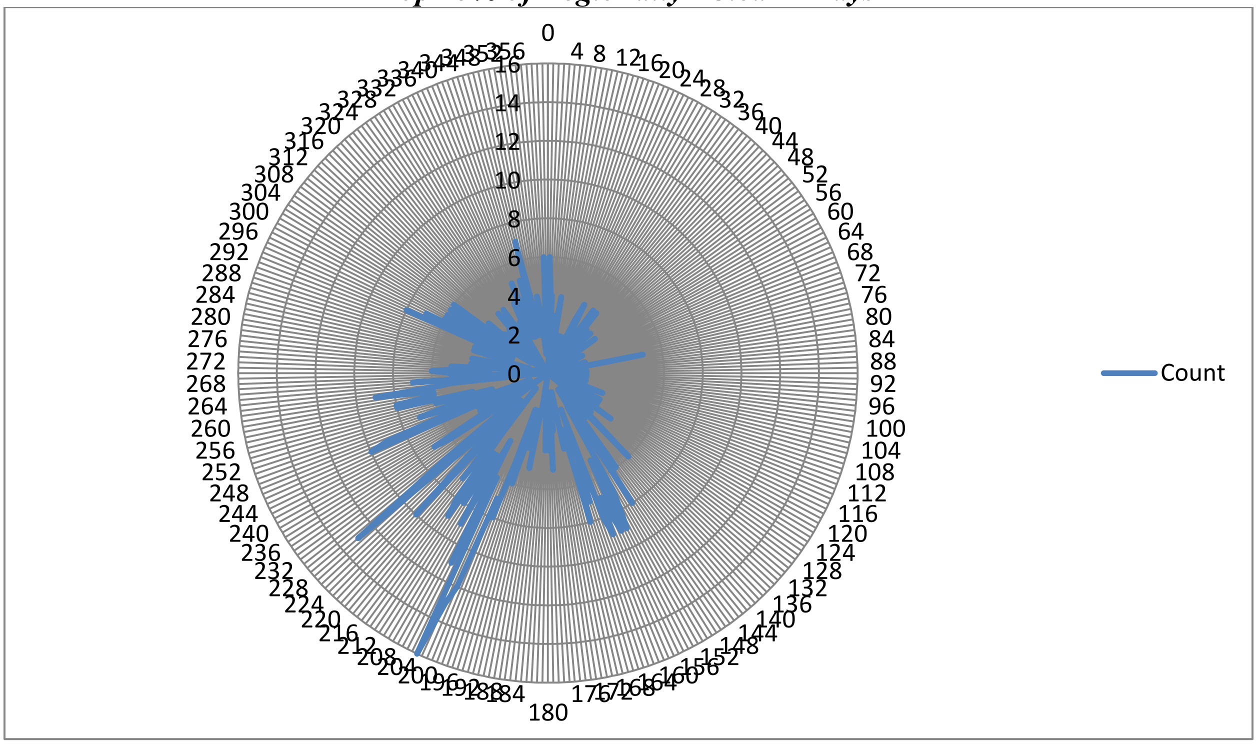


Figure C-5.4: Greensburg $PM_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

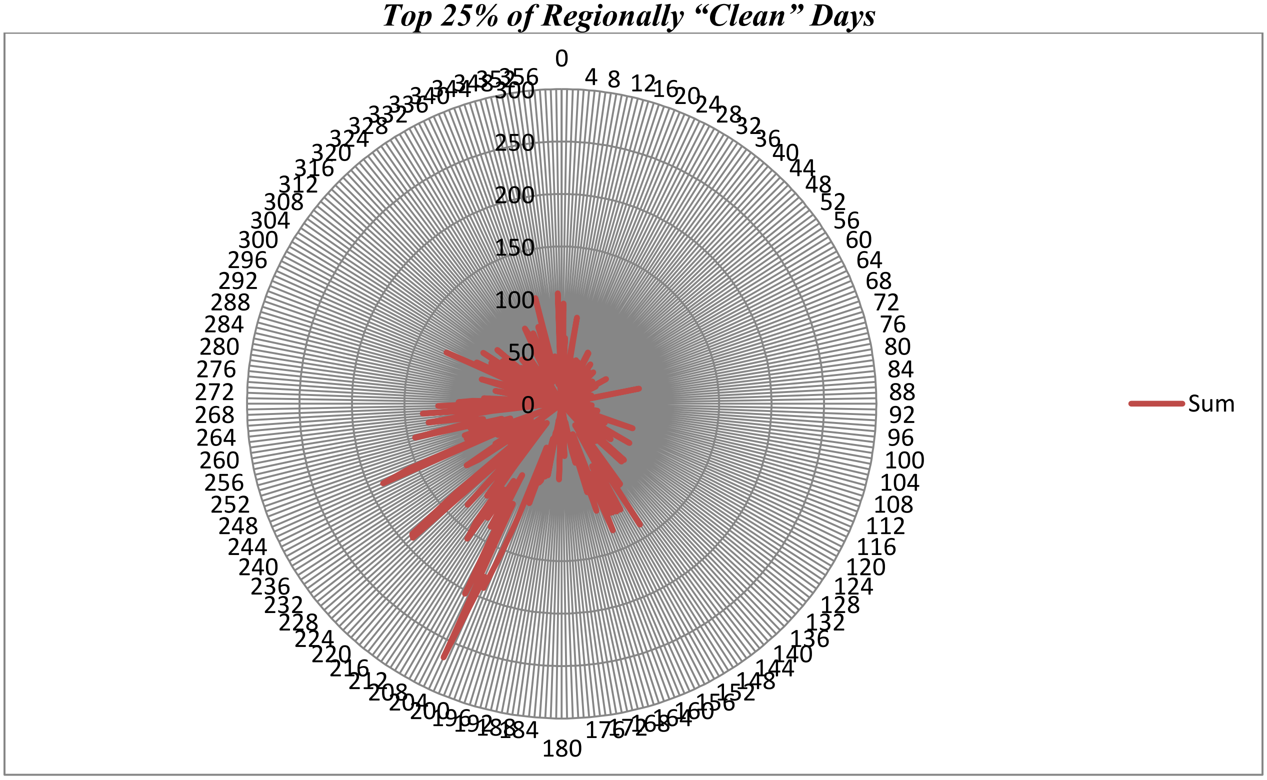
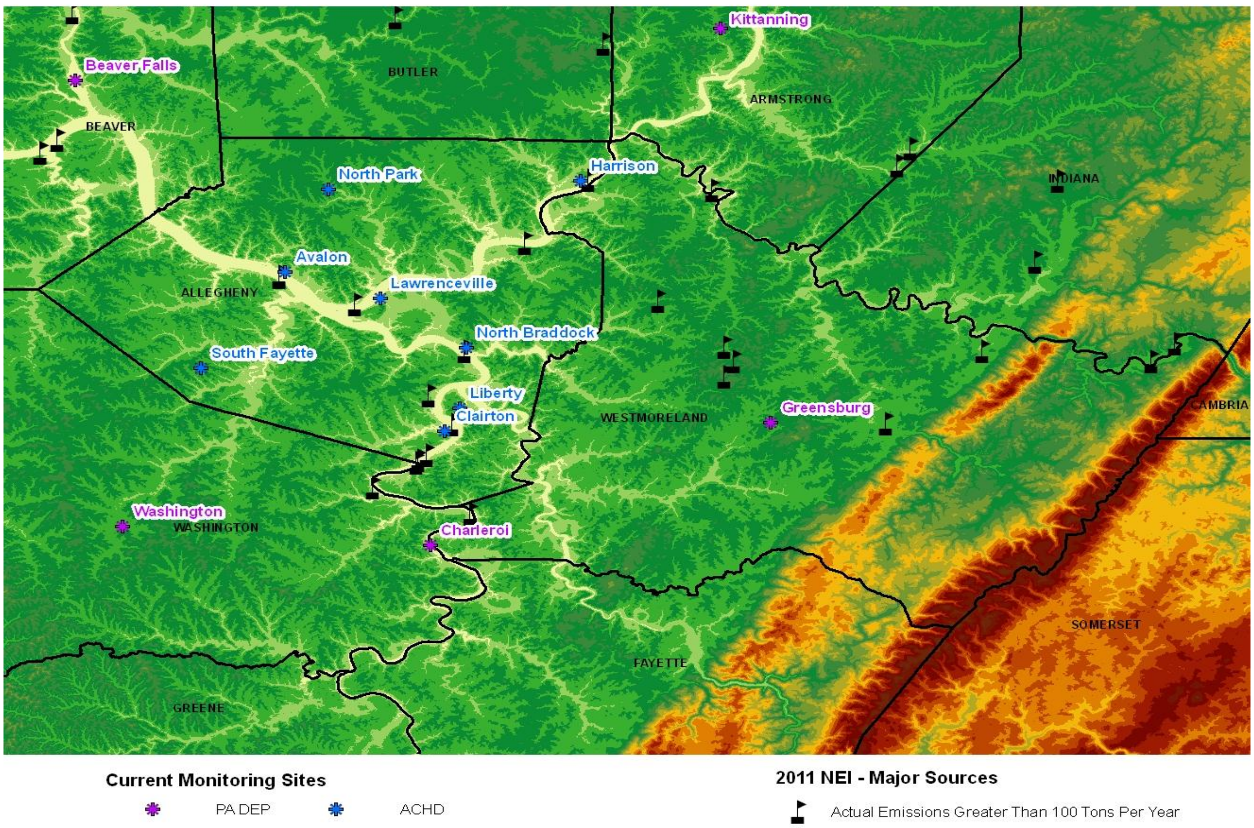


Figure C-5.3 illustrates that the highest frequency of wind distribution on the top 25% days is coming from the southwest. Figure C-5.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from the same direction. These graphs also illustrate the local nature of the problem. Developed from the EPA PM online tool (http://geoplatform2.epa.gov/PM_Map/), Figure C-5.5 illustrates the sources within the immediate proximity of the Greensburg monitor.

Figure C-5.5: Greater Pittsburgh Area
Major Sources (Over 100 Tons Per Year) Based on 2011 NEI



There are multiple major sources of $PM_{2.5}$, SO_2, and NO_X that are in close proximity of the Greensburg monitor. The wind direction analysis above shows that the predominant winds on the top 25% days travel directly over these sources. This analysis indicates the local nature of the problem near the Greensburg monitor.

The Change in the Composition of the $PM_{2.5}$

The Greensburg monitor has been recording speciated data since 2002. The composition of $PM_{2.5}$ has changed at the Greensburg monitor since the height of $PM_{2.5}$ concentrations in the 2005 to 2007 time period. Table C-5.2 outlines the main speciated components of $PM_{2.5}$ during the cold season (1^{st} quarter). Table C-5.3 outlines the main speciated components of $PM_{2.5}$

during the warm season (3rd quarter). Overall, Table C-5.2 and Table C-5.3 illustrate the decline in the main speciated components of $PM_{2.5}$ from the 2005 to 2007 period to the 2010 to 2012 period.

Table C-5.2: Greensburg Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	1.69197627	2.09586219	3.32282328	3.34094542	0.72165949	0.40138048
2010 – 12	1.30488858	1.97861036	2.47803878	2.26913328	0.36529170	0.43543027
Difference (2005 – 07 minus 2010 – 12)	0.38708768	0.11725183	0.84478451	1.07181214	0.35636779	-0.03404979

*All concentrations are averages and have units of $\mu g/m^3$

Table C-5.3: Greensburg Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.91335067	0.61523158	9.05785547	4.16522571	0.63412385	0.81919754
2010 – 12	1.19283974	0.46790007	4.04125965	2.92687463	0.39794990	0.42905305
Difference (2005 – 07 minus 2010 – 12)	1.72051093	0.14733151	5.01659582	1.23835108	0.23617395	0.39014449

*All concentrations are averages and have units of $\mu g/m^3$

During the cold season, there has been an equal amount of reduction in ammonium, nitrate, sulfate, and organic carbon concentrations. During the warm season, the largest reductions have occurred in ammonium, sulfate and organic carbon concentrations.

To analyze this further, we chose to compare these seasonal values with what has occurred in Florence (AIRS # 42-001-0001), located in Washington County. Florence is in a rural location of Pennsylvania and does not have a major nitrogen oxide (NO_X) or sulfur dioxide (SO_2) source within 50 kilometers of the monitor. For that reason, the Florence monitor reflects the transport that is coming into western Pennsylvania from areas to the west (prevailing wind flow is from west to east across Pennsylvania).

Table C-5.4: Florence Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	1.31827402	1.45532736	3.20309281	2.88969583	0.59347306	0.32894438
2010 – 12	1.15058471	1.85637720	2.43243089	1.73627967	0.17623659	0.25624708
Difference (2005 – 07 minus 2010 – 12)	0.16768931	-0.40104984	0.77066192	1.15341616	0.41723647	0.07269730

*All concentrations are averages and have units of $\mu g/m^3$

Table C-5.5: Florence Speciated $PM_{2.5}$ Data*
Warm Season (3^{rd} Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.15507812	0.34361657	8.17978175	3.32471443	0.35976005	0.83256858
2010 - 12	0.90089860	0.21878832	3.84856214	2.40295511	0.19830720	0.51222953
Difference (2005 – 07 minus 2010 – 12)	1.25417952	0.12482826	4.33121961	0.92175932	0.16145285	0.32033904

*All concentrations are averages and have units of $\mu g/m^3$

The reductions at Florence reflected in the "difference" row of Table C-5.5 are more representative of the reductions observed in western Pennsylvania due to emission control strategies of various sources (for example, the installation of flue gas desulfurization units on electric generation units across western Pennsylvania into the Ohio Valley). The data indicates that the greatest level of reduction at the Greensburg and Florence monitors occurs during the summer months (when sulfate is the primary constituent of $PM_{2.5}$). During the 2005 – 07 time frame, the Florence monitor had a 3^{rd} quarter total mass average of 19.97 $\mu g/m^3$, and during the 2010 – 12 time frame it had a 3^{rd} quarter total mass average of 12.94 $\mu g/m^3$, a 7 $\mu g/m^3$ reduction.

An analysis of the 2010 – 12 differences between the Greensburg and Florence monitors indicates the nature of the problem at Greensburg.

Figure C-5.6: Urban Excess
Greensburg vs. Florence
2010 – 12 - 1st Quarter

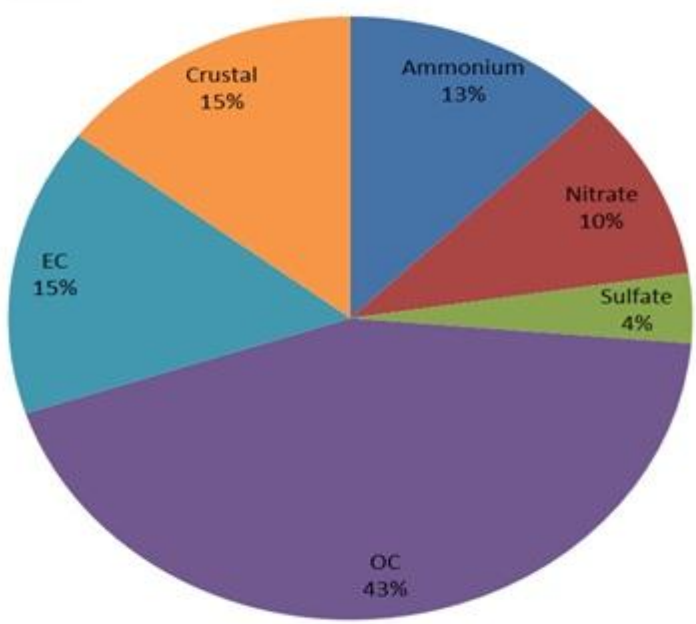


Figure C-5.7: Urban Excess
Greensburg vs. Florence
2010 – 12 – 3rd Quarter

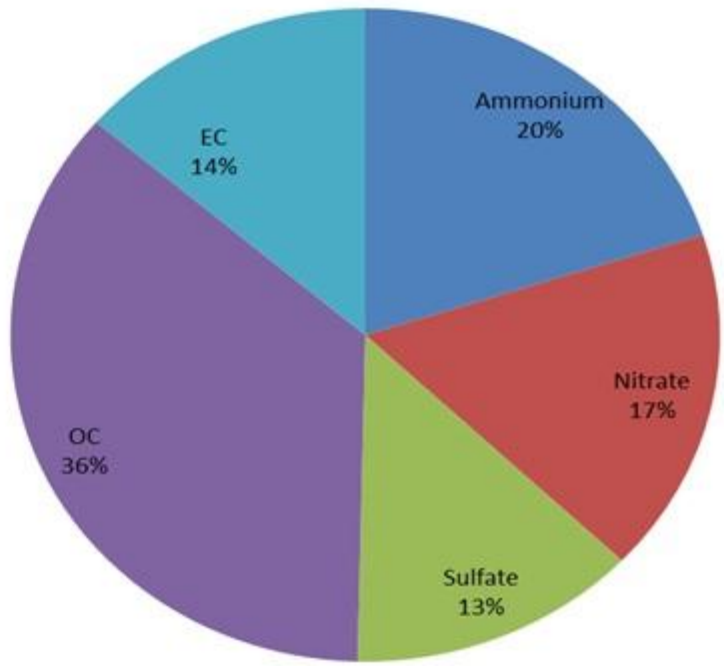


Figure C-5.6 and Figure C-5.7 display the same problem; every major constituent of $PM_{2.5}$ at the Greensburg monitor is in excess when compared to Florence. Overall, the region has seen a drastic reduction in emissions from the 2002 through 2011. Table C-5.6 displays a comparison in the nitrogen oxide (NO_X) emissions from each county in southwestern Pennsylvania (an area including the Pittsburgh MSA plus Greene, Indiana, and Lawrence counties) from the 2002 National Emission Inventory (NEI) to 2011 NEI. The 2002 NEI inventory was used because it was the last national inventory prior to the initiation of a major federal NO_X reduction program (NO_X SIP call) and voluntary SO_2 reduction program (from individual facilities installing scrubbers).

Table C-5.6: NO_X Point Source Emission Comparison 2002 Versus 2011

County	NO_X in 2011 (tons per year)	NO_X in 2002 (tons per year)	% Difference*
Allegheny	10594.2	16225.0	-34.70%
Armstrong	24398.8	23341.7	4.53%
Beaver	15998.7	35426.6	-54.84%
Butler	974.8	1960.3	-50.27%
Fayette	184.3	539.9	-65.87%
Greene	26677.6	23809.1	12.05%
Indiana	28691.7	46948.8	-38.89%
Lawrence	1503.3	7027.4	-78.61%
Washington	2437.5	10938.3	-77.72%
Westmoreland	1506.0	2873.9	-47.60%
TOTAL	112966.9	169091.0	-33.19%

*The percent difference was calculated as 2002 emissions minus 2011 emissions.

In southwestern Pennsylvania, NO_X emissions from 2002 to 2011 have been reduced by one-third (33%). The NO_X SIP call, which was fully implemented in the 2003 – 04 time frame, reduced NO_X emissions from the electric generation unit sector. These reductions can be seen in Table C-5.6. Table C-5.7 displays a comparison in the SO_2 emissions from each county in southwestern Pennsylvania from the 2002 NEI to 2011 NEI.

Table C-5.7: SO_2 Point Source Emission Comparison 2002 Versus 2011

County	SO_2 in 2011 (tons per year)	SO_2 in 2002 (tons per year)	% Difference*
Allegheny	13392.7	47196.8	-71.62%
Armstrong	72216.9	183156.1	-60.57%
Beaver	26703.2	40840.2	-34.62%
Butler	597.6	2265.0	-73.61%
Fayette	10.9	260.6	-95.81%
Greene	2373.2	159506.4	-98.51%
Indiana	97799.1	122465.5	-20.14%
Lawrence	7534.9	28808.6	-73.84%
Washington	1420.3	6611.8	-78.52%
Westmoreland	177.1	541.5	-67.29%
TOTAL	222226.0	591652.7	-62.44%

*The percent difference was calculated as 2002 emissions minus 2011 emissions.

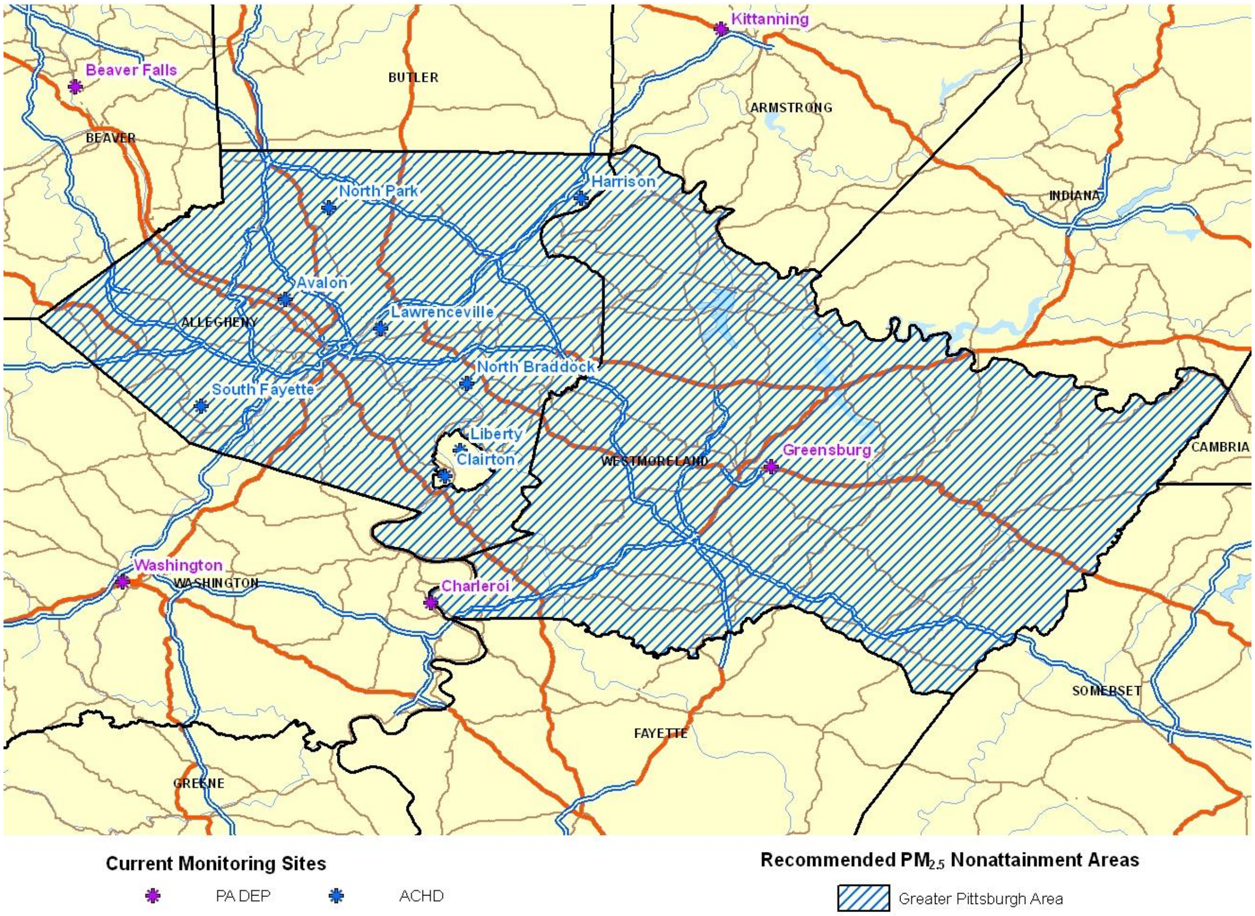
Overall, county wide point source emissions for SO_2 have been reduced by approximately two-thirds (62%) since 2002. As a result of the installation of scrubbers from several of Pennsylvania's coal fired electric generation units, we have seen SO_2 reductions exceeding 95% in some counties.

The emission reductions in NO_X and SO_2 in southwestern Pennsylvania correlate well with the results we are seeing in the speciation data network. The differences in speciation profiles between the Greensburg monitor, at which the 2012 annual $PM_{2.5}$ design value is not attaining the standard, and the Florence monitor, at which the 2012 annual $PM_{2.5}$ design value is attaining the standard, signify the local nature of the problem. The Florence monitor is situated in a location that captures the transport of pollutants from areas to the west (the industrialized Ohio Valley region). The excess amount of sulfate, nitrate, carbon and ammonium at the Greensburg monitor can be contributed to sources within southwestern Pennsylvania.

Summary

The Department's analysis illustrates the need for one small two-county nonattainment area (containing one partial county) in southwestern Pennsylvania. An analysis of the $PM_{2.5}$ data monitored at the Greensburg monitor in Westmoreland County illustrates that the monitor sees concentrations in the 12-30 $\mu g/m^3$ range while the regional concentrations are in the 0-12 $\mu g/m^3$ range. A further examination into the monitoring data demonstrates that the high concentrations are coming out of the southwest. An analysis of the speciated data at the Greensburg and Florence monitors illustrates the excess sulfate, nitrate, ammonium, and carbon at the Greensburg monitor. The Greensburg monitor has a 2012 annual design value that exceeds the 2012 annual $PM_{2.5}$ NAAQS. The Avalon and North Braddock monitors in Allegheny County also have 2012 annual design values that exceed the 2012 annual $PM_{2.5}$ NAAQS. The other monitors in the Pittsburgh MSA (namely the Lawrenceville, South Fayette, North Park and Harrison monitor in Allegheny County, Charleroi, Washington and Florence monitors in Washington County, Beaver monitor in Beaver County and Kittanning monitor in Armstrong County) are monitoring attainment of the 2012 standard, are continuing to have a general decline in the annual average, and are not contributing to excess emissions elsewhere. Therefore, the Department is recommending a Greater Pittsburgh nonattainment area encompassing Westmoreland and Allegheny counties (with the exception of the Liberty-Clairton area in Allegheny County; see Appendix C-6 for details) in Pennsylvania be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. A map of the proposed nonattainment area is provided below as Figure C-5.8.

Figure C-5.8: Recommended Greater Pittsburgh $PM_{2.5}$ Nonattainment Area



Appendix C-6
LIBERTY-CLAIRTON AREA

The Department is recommending a separate annual $PM_{2.5}$ NAAQS nonattainment area for a portion of Allegheny County, referred to as the Liberty-Clairton area, consisting of the City of Clairton and Boroughs of Glassport, Liberty, Lincoln and Port View. The Department completed an analysis of the $PM_{2.5}$ ambient air quality data, which outlines the reasons for recommending the Liberty-Clairton area as a separate nonattainment area. This analysis is provided below.

Analysis of Topography in Proximity of the Liberty Monitor

Based on EPA-certified 2012 $PM_{2.5}$ design values, one monitor in the Liberty-Clairton area of Allegheny County is violating the 2012 $PM_{2.5}$ annual standard of 12 µg/m^3. The monitor and its design value are Liberty (AIRS # 42-003-0064) at 14.8 µg/m^3. Figure C-6.1 is a map outlining the location of this monitor, along with monitors in attainment, in the vicinity of the Liberty and Clairton monitors.

Figure C-6.1: Liberty-Clairton Vicinity $PM_{2.5}$ Monitoring Map

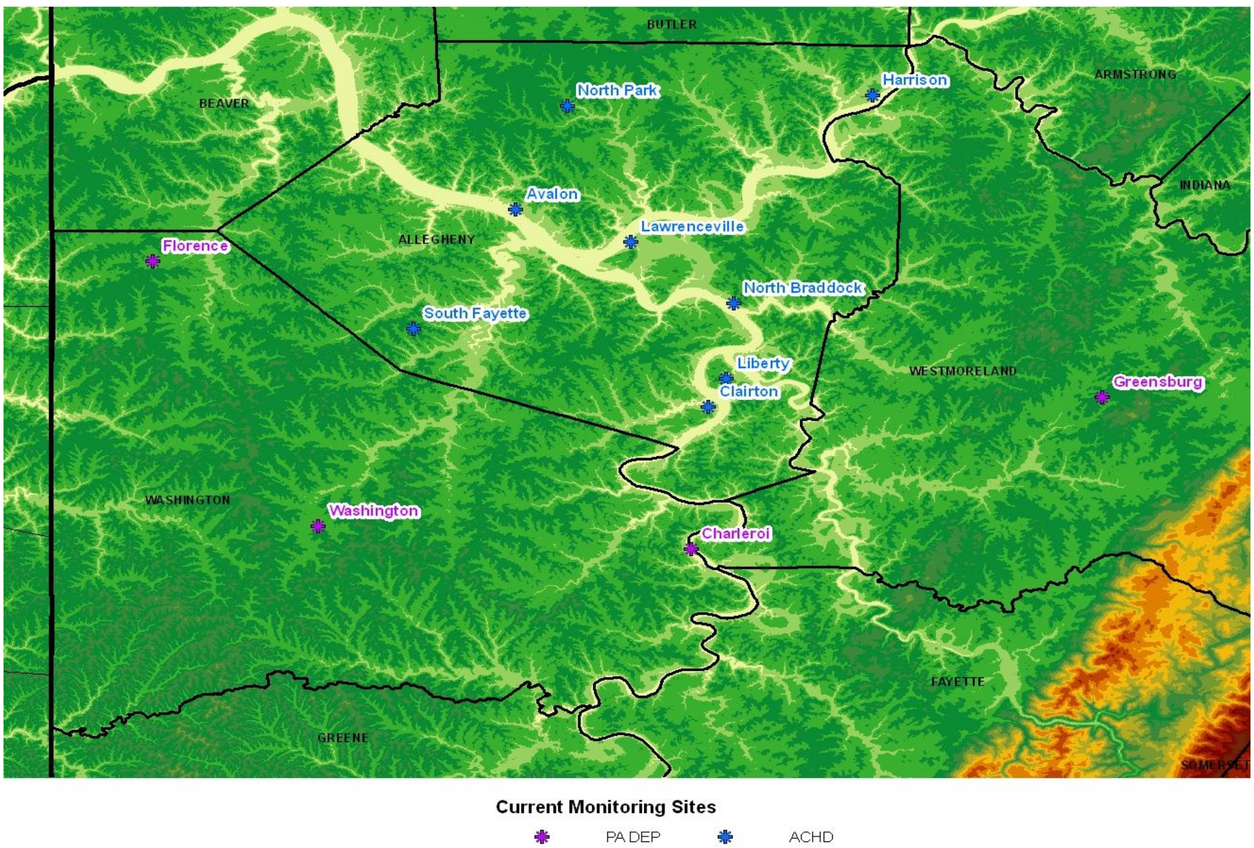


Figure C-6.1 also illustrates the topography near the Liberty monitor. The topographical differences between the location of the local sources of $PM_{2.5}$ and its precursors within the river valley, and the Liberty monitor which is elevated from the river valley, play a role in the violation of the annual standard at the Liberty monitor.

Analysis of the Ambient $PM_{2.5}$ Data – A Design Value Contribution Analysis

The Department has completed a design value contribution analysis for all of the $PM_{2.5}$ monitors in the vicinity of the Liberty-Clairton monitor. The analysis attempts to determine the daily contribution of $PM_{2.5}$ concentrations to the annual $PM_{2.5}$ design value. Daily $PM_{2.5}$ measurements were grouped into different $PM_{2.5}$ concentration ranges. An analysis of each range's contribution was then conducted to determine which measurements are contributing to the monitor's design value. Dates of these measurements were then further analyzed to determine if there are specific meteorological conditions or sources that are adversely impacting the monitor's design value.

Results from the design value contribution analysis for the Liberty-Clairton area are summarized in Table C-6.1. Ultimately, the type of contribution this daily value had on the 3-year design value (by comparing this value to 12 $\mu g/m^3$) was determined. The design value for each day a monitor measured $PM_{2.5}$ levels was placed in one of the ten categories. For example, on January 10, 2010, the Liberty monitor's 24-hour $PM_{2.5}$ average was 59.8 $\mu g/m^3$. Since this value falls in the 54-60 $\mu g/m^3$ category in Table C-6.1, the calculated contribution to the design value was placed in this category. In the first quarter of 2010 (January 1 to March 31), the Liberty monitor recorded 76 measurements. The Department determined that the January 10, 2010, contribution assessment to the 2012 design value was 0.052412 $\mu g/m^3$. The 0.052412 $\mu g/m^3$ was calculated by dividing the average daily value of 59.8 $\mu g/m^3$ by a factor of the number of measurements for the quarter (76) by 12 (there are a total of 12 quarters in a 3-year design value period). This type of analysis was completed for every day of measurements from January 1, 2010, through December 31, 2012. In Table C-6.1, the sum of the categorical breakdowns for the Liberty monitor equals 2.78 $\mu g/m^3$, which demonstrates that the design value is 2.78 $\mu g/m^3$ above the annual standard of 12 $\mu g/m^3$.

Table C-6.1: Liberty-Clairton Area
2012 $PM_{2.5}$ Annual Design Value Contribution Analysis

Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	Sum
Monitors Attaining 2012 PM 2.5 Standard													
Florence	421255001	PA DEP	-3.7384	-1.4990	0.2361	0.1479	0.0553	0.0180	0.0000	0.0000	0.0000	0.0000	-4.7802
South Fayette	420030067	ACHD	-1.5156	-1.6051	0.6252	0.4972	0.1753	0.2974	0.0000	0.0000	0.0000	0.0000	-1.5257
Clairton	420033007	ACHD	-1.3698	-1.4713	0.6930	0.4987	0.2495	0.1271	0.1302	0.0000	0.0000	0.0000	-1.1426
Lawrenceville	420030008	ACHD	-1.5307	-1.3301	0.6605	0.7516	0.3579	0.1419	0.0570	0.0000	0.0000	0.0000	-0.8918
Washington	421250200	PA DEP	-1.4587	-1.2800	0.7331	0.6447	0.3396	0.1206	0.0272	0.0000	0.0000	0.0000	-0.8733
Charleroi	421250005	PA DEP	-1.2256	-1.2403	0.7532	0.9015	0.4113	0.1218	0.1404	0.0000	0.0000	0.0000	-0.1376
Monitors Not Attaining 2012 PM 2.5 Standard													
Liberty	420030064	ACHD	-1.3702	-0.9617	0.6438	1.1443	0.9479	0.9132	0.4753	0.3902	0.2619	0.3374	2.7822
Liberty-Clairton Area Average			-1.3910	-1.2567	0.6967	0.7882	0.4612	0.2849	0.1660	0.0780	0.0524	0.0675	

Table C-6.1 illustrates the differences between the monitors that are attaining the 2012 $PM_{2.5}$ annual standard and the monitor that is not attaining the 2012 $PM_{2.5}$ annual standard. The monitor that is not attaining the standard have relatively few ”clean” days (0-12 µg/m^3) than the monitors that are attaining the standard. For example, the Liberty monitor’s $PM_{2.5}$ contribution to the design value in the 0-12 µg/m^3 range was 0.42 µg/m^3 lower than the regional average. The analysis described in the remainder of this Appendix focuses on the Liberty monitor because it is the only monitor of concern. Figure C-6.2a illustrates the trend of annual averages while Figure C-6.2b illustrates the trend of annual design values during the period. Over the last ten years, the Clairton monitor’s $PM_{2.5}$ levels have declined at a rate higher than the Liberty monitor. As a result, the Liberty monitor’s 2012 design value is 3.9 µg/m^3 above the Clairton monitor’s 2012 design value.

Figure C-6.2a: Liberty-Clairton Area $PM_{2.5}$ Annual Averages

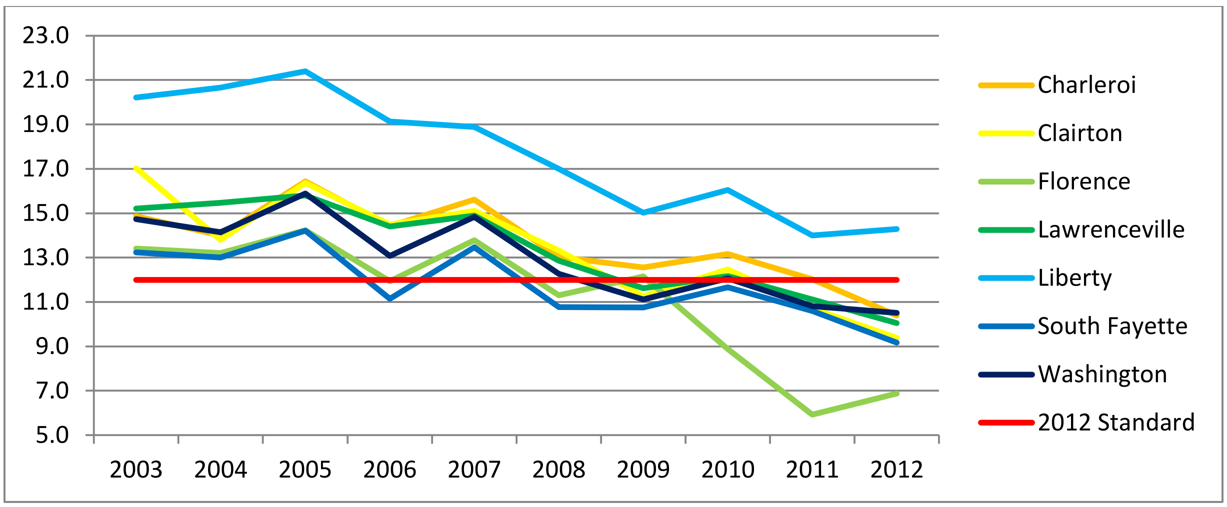
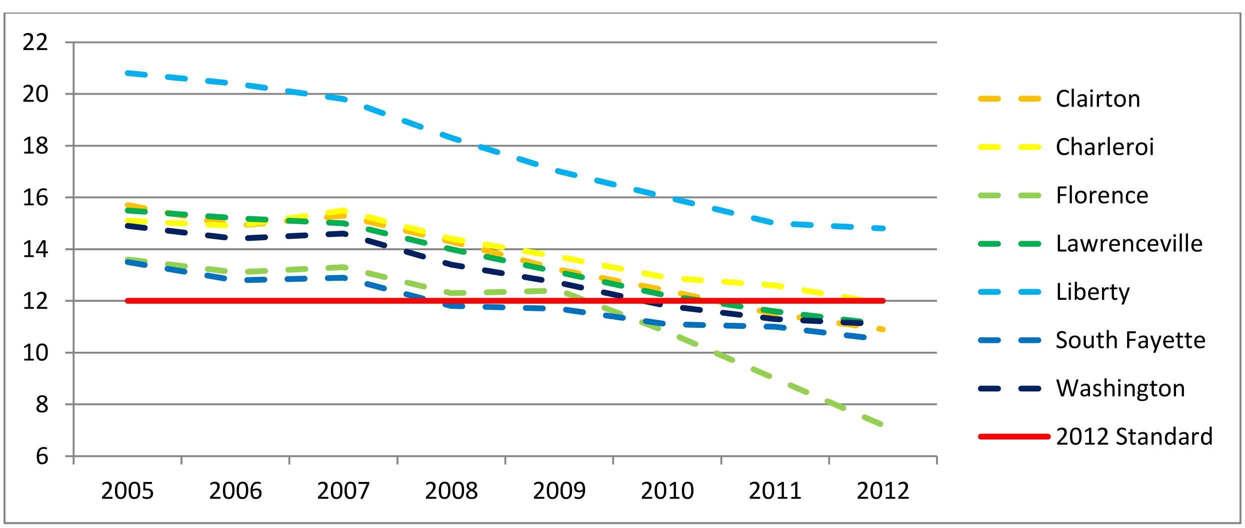


Figure C-6.2b: Liberty-Clairton Area $PM_{2.5}$ Annual Design Values



Additional analyses were completed to determine what was contributing to the fewer number of "clean" days at the Liberty monitor. The Department identified days when the Liberty monitor's $PM_{2.5}$ concentrations were relatively high but regional monitoring concentrations in the Liberty-Clairton area were "clean." Between 2010 and 2012, the Department identified 252 days in which the Liberty monitor was at least one standard deviation above the Pittsburgh metropolitan statistical area (MSA) while the regional average was at or below 12 $\mu g/m^3$. The most extreme events (top 25%) were further analyzed to determine why the Liberty monitor's concentrations were high when regional concentrations were low.

Meteorological Conditions Impacting High $PM_{2.5}$ Days at Liberty

The top 25% days were examined to determine the reason why the Liberty monitor's concentrations were high. The Liberty monitor has a collocated meteorological tower which monitors wind direction and wind speed. Figure C-6.3 illustrates the number of hours the wind is coming from a particular direction, while Figure C-6.4 illustrates the total $PM_{2.5}$ concentration coming from a particular direction.

Figure C-6.3: Liberty Wind Direction Frequency
Top 25% of Regionally "Clean" Days

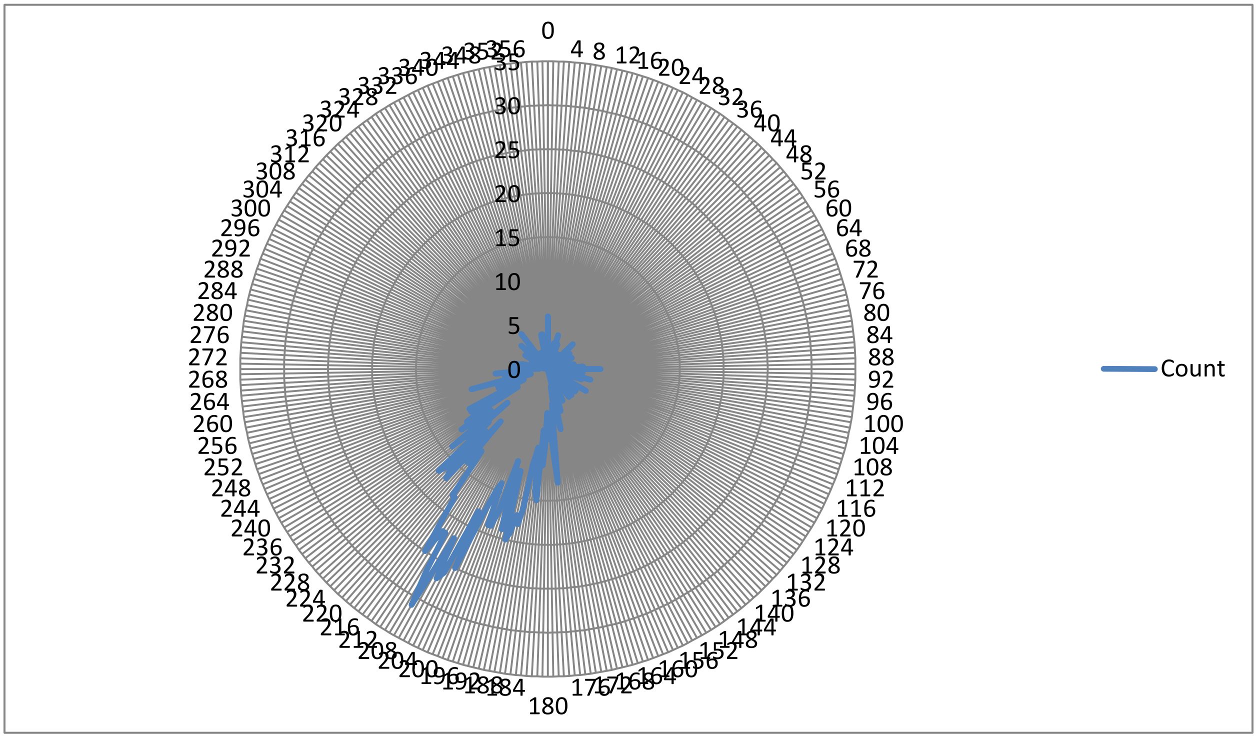


Figure C-6.4: Liberty $PM_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

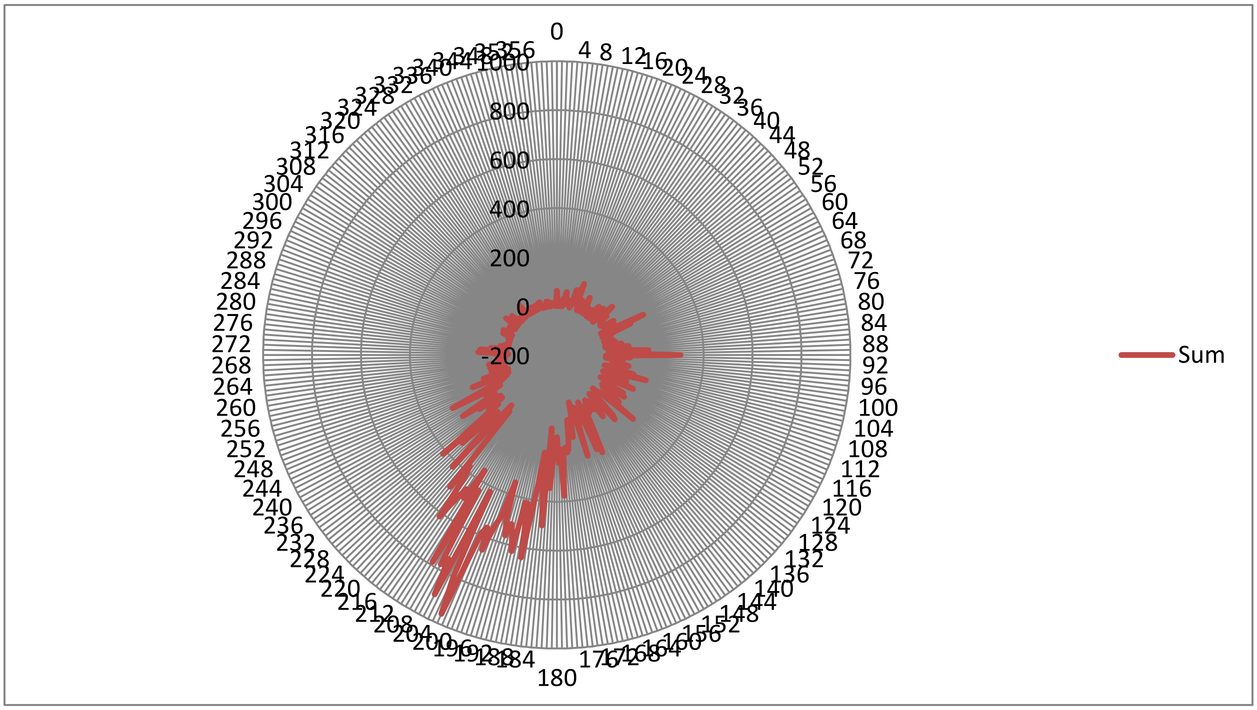


Figure C-6.3 illustrates that the highest frequency of wind distribution on the top 25% high days is coming from the southwest. Figure C-6.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from the same direction.

Of the 252 days in which the Liberty monitor was at least one standard deviation above the Pittsburgh MSA while the regional average was at or below 12 $\mu g/m^3$, 60 days occurred in 2010, 76 days occurred in 2011, and 116 days occurred in 2012. Figure C-6.2a illustrates the trend of regional levels (regional $PM_{2.5}$ levels are become cleaner over the past three years). The contribution analysis illustrates that the Liberty monitor is not declining as fast as regional levels. Therefore, local sources near the Liberty monitor are most likely impacting how high $PM_{2.5}$ concentrations rise on a day-to-day basis.

Analysis of Speciated $PM_{2.5}$ During Top 25% High Days

The Department analyzed the days in which the Liberty monitor collected speciation data during the top 25% days. Of the 63 days which were in the top 25%, speciated data was collected on eight days. Figure C-6.5 displays the distribution of the speciated components of $PM_{2.5}$ during the entire 2010 – 12 season. Figure C-6.6 displays the distribution of the speciated components of $PM_{2.5}$ during the eight days in the top 25% of the regionally "clean" days in the Liberty-Clairton area.

Figure C-6.5: Liberty $PM_{2.5}$ Speciation Data 2010 – 12

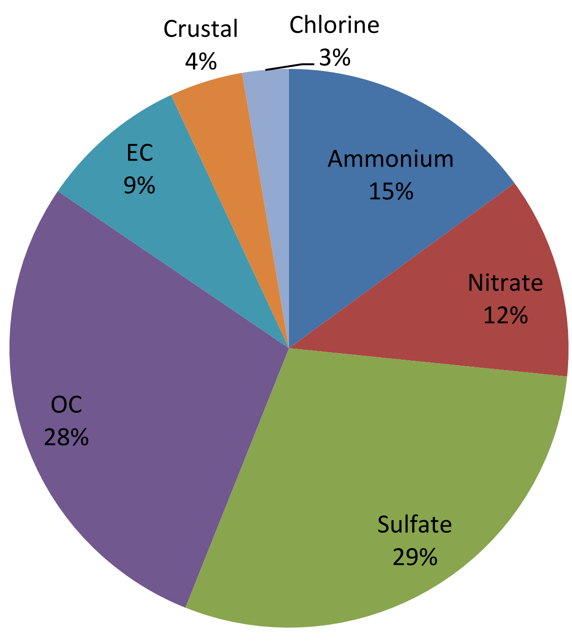
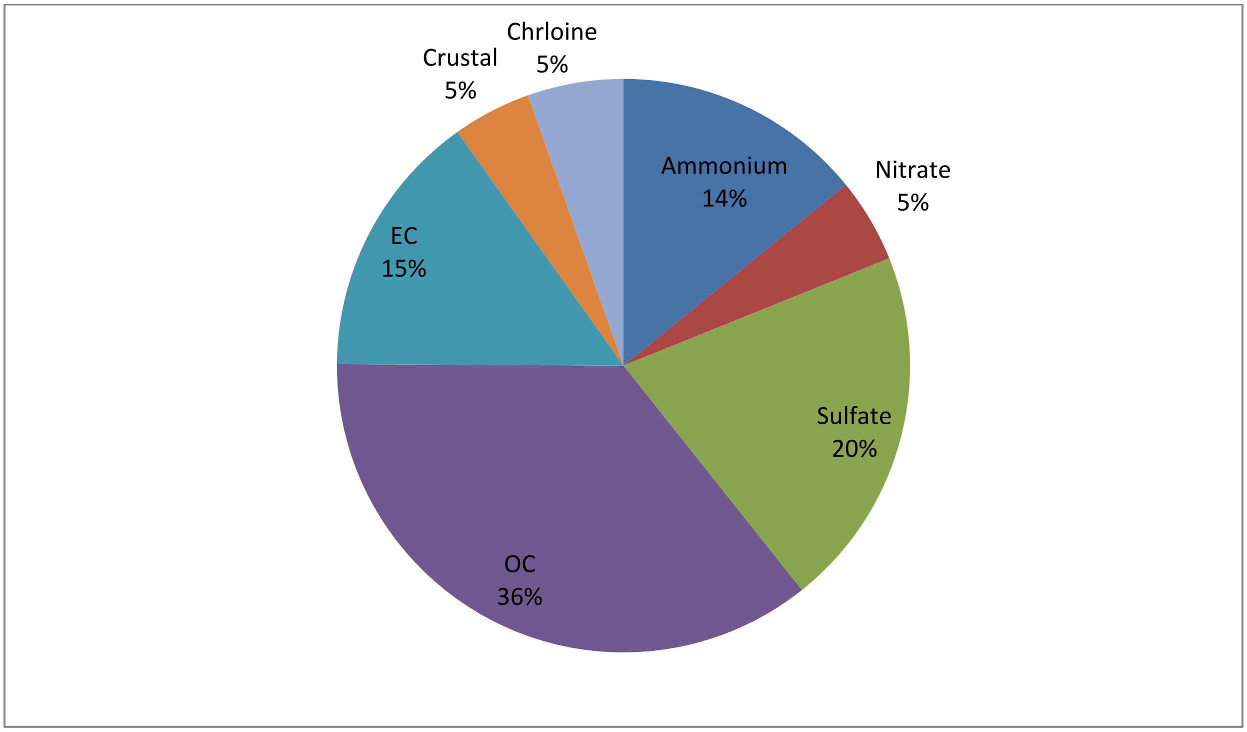
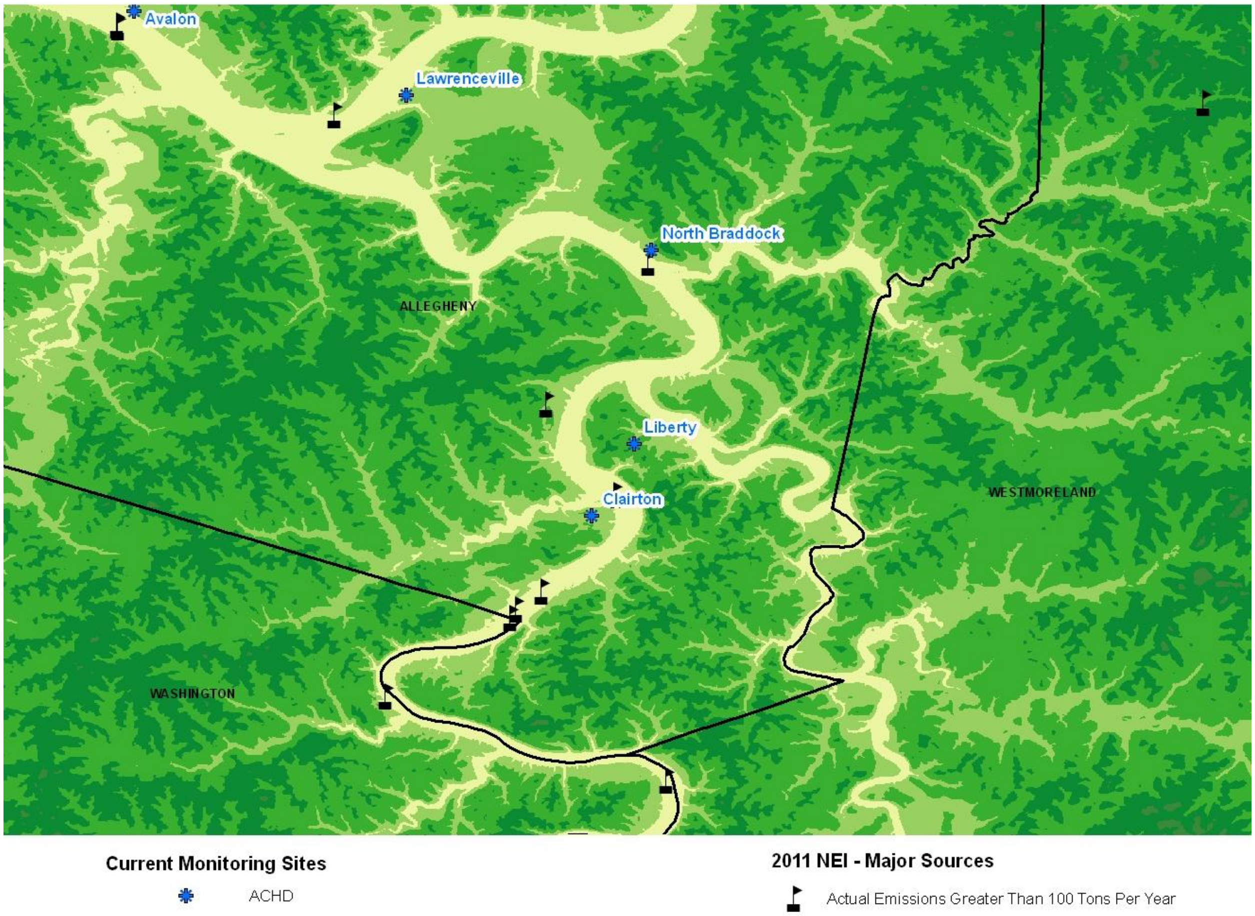


Figure C-6.6: Liberty $PM_{2.5}$ Speciation Data
Top 25% of Regionally "Clean" Days



The change in the $PM_{2.5}$ during the top 25% days is evident. The total carbon (elemental carbon (EC) plus organic carbon(OC)) portion of the speciated $PM_{2.5}$, which was at 37% in the 2010 – 12 period, rises to 51% during the top 25% days. In addition, chlorine levels rise 2%. The reduction in the nitrate and sulfate's contribution to the overall $PM_{2.5}$ mass signifies that there is reduction in the two main constituents that account for regional transport. The increase in carbon and chlorine signify the influence of local sources in the region. Excess elemental carbon and organic carbon can be linked to steel manufacturing. There are two steel facilities within a five mile radius of the Liberty monitor: United States Steel Corporation (US Steel) – Irvin (to the west of the Liberty monitor) and US Steel – Clairton (to the south, southwest of the Liberty monitor). The excess chlorine can be linked to industry that utilizes or emits chlorine. The high levels of chlorine generally occur during the 1st and 4th quarters, signifying the importance of a very stable weather pattern (leading to stronger inversions) to the nonattainment problem.

Figure C-6.7: Liberty-Clairton Area 2011 NEI Site Map



The Change in the Composition of the $PM_{2.5}$

The composition of $PM_{2.5}$ has changed at the Liberty monitor since the height of $PM_{2.5}$ concentrations in the 2005 to 2007 time period. Table C-6.2 outlines the main speciated components of $PM_{2.5}$ during the cold season (1st quarter). Table C-6.3 outlines the main speciated components of $PM_{2.5}$ during the warm season (3rd quarter). Overall, Table C-6.2 and Table C-6.3 illustrate the decline in the main speciated components of $PM_{2.5}$ from the 2005 to 2007 period to the 2010 to 2012 period.

Table C-6.2: Liberty Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal	Chlorine
2005 – 07	2.45914286	2.10728571	4.10433333	4.66666667	1.82175238	0.58034567	0.43629738
2010 – 12	3.26413514	3.36781081	5.10659459	3.60478378	0.86835135	0.52614535	0.71329108
Difference (2005 – 07 minus 2010 – 12)	-0.80499228	-1.26052510	-1.00226126	1.06188288	0.95340103	0.05420031	-0.27699370

*All concentrations are averages and have units of $\mu g/m^3$

Table C-6.3: Liberty Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal	Chlorine
2005 – 07	3.69470732	0.95319512	10.00936585	5.67560976	2.26019512	0.93086823	0.06688780
2010 – 12	1.69650000	0.66026087	4.81934783	4.53978261	1.23897826	0.58566323	0.05235696
Difference (2005 – 07 minus 2010 – 12)	1.99820732	0.29293425	5.19001803	1.13582715	1.02121686	0.34520499	0.01453085

*All concentrations are averages and have units of $\mu g/m^3$

During the cold season, ammonium, nitrate, sulfate, and chlorine levels have increased in the 2010 – 12 period when compared to the 2005 – 07 period, while organic and elemental carbon levels have decreased. During the warm season, the largest reductions have occurred in ammonium, sulfate and organic carbon concentrations.

To analyze this further, we chose to compare these seasonal values with what has occurred in Florence (AIRS # 42-125-), located in Washington County. Florence is in a rural location of Pennsylvania and does not have a major nitrogen oxide or sulfur dioxide source within 20 kilometers of the monitor. For that reason, the Florence monitor reflects the transport that is coming into western Pennsylvania from areas to the west (prevailing wind flow is from west to east in western Pennsylvania).

Table C-6.4: Florence Speciated $PM_{2.5}$ Data*
Cold Season (1st Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	1.31827402	1.45532736	3.20309281	2.88969583	0.59347306	0.32894438
2010 – 12	1.15058471	1.85637720	2.43243089	1.73627967	0.17623659	0.25624708
Difference (2005 – 07 minus 2010 – 12)	0.16768931	-0.40104984	0.77066192	1.15341616	0.41723647	0.07269730

*All concentrations are averages and have units of µg/m^3

Table C-6.5: Florence Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Comparison – 2005-07 Versus 2010-12

Year	Ammonium	Nitrate	Sulfate	OC	EC	Crustal
2005 – 07	2.15507812	0.34361657	8.17978175	3.32471443	0.35976005	0.83256858
2010 – 12	0.90089860	0.21878832	3.84856214	2.40295511	0.19830720	0.51222953
Difference (2005 – 07 minus 2010 – 12)	1.25417952	0.12482826	4.33121961	0.92175932	0.16145285	0.32033904

*All concentrations are averages and have units of µg/m^3

The reductions at the Florence monitor reflected in the "difference" row of Table C-6.4 and Table C-6.5 are more representative of the reductions that have been observed in western Pennsylvania and the Ohio Valley due to emission control strategies of various sources (for example, the installation of flue gas desulfurization units on electric generation units across western Pennsylvania into the Ohio Valley). The data indicates that the greatest level of reduction in Liberty and Florence occurs during the summer months (when sulfate is the primary constituent of $PM_{2.5}$). During the 2005 – 07 time frame, Florence had a 3rd quarter total mass average of 19.97 µg/m^3, and during the 2010 – 12 time frame it had a 3rd quarter total mass average of 12.94 µg/m^3, a 7 µg/m^3 reduction.

An analysis of the 2010 – 12 differences between the Liberty and Florence monitors indicates the nature of the problem at the Liberty monitor.

Figure C-6.8: Urban Excess
Liberty vs. Florence
2010-12 – 1st Quarter

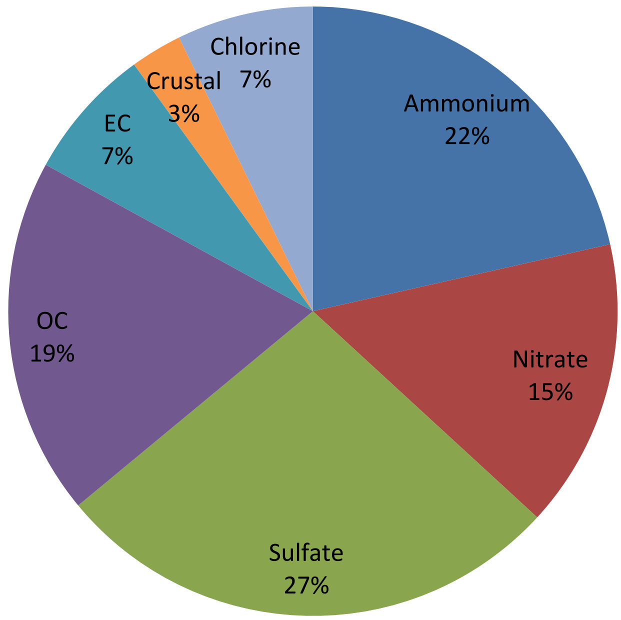
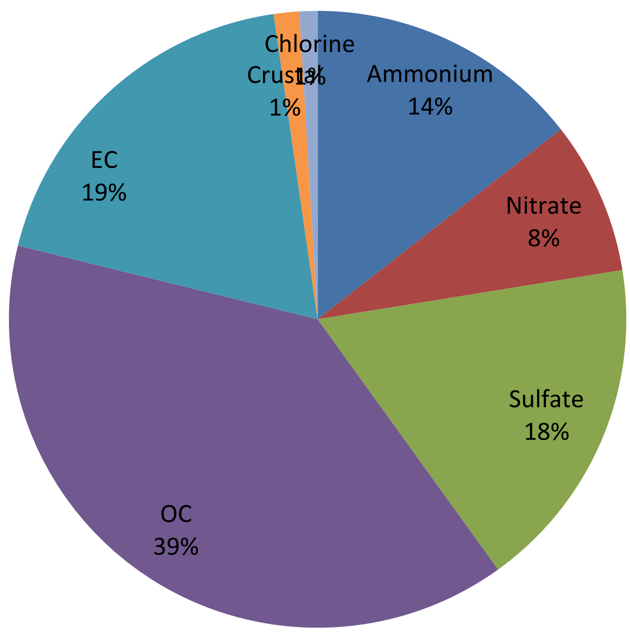


Figure C-6.9: Urban Excess
Liberty vs. Florence
2010-12 – 3rd Quarter



In the case of Liberty and Florence, the excess amounts of the organic and elemental carbon portions of the speciated $PM_{2.5}$ indicate the local nature of the problem at the Liberty monitor. In addition, there is a spike in chlorine levels, primarily during the 1stquarter. Generally during the cold season, very stable weather patterns can set up over the region (cold air near the surface is not easy to erode during the winter). As a result, inversions are likely to form. The topographical differences near the Liberty monitor are more severe than near the Florence monitor. Therefore, this suggests that local emissions, such as those from organic carbon, elemental carbon and chlorine sources, are more likely to be trapped near the surface near the Liberty monitor.

Summary

The Department's analysis illustrates the need for a partial county nonattainment area in the Liberty-Clairton portion of Allegheny County in Pennsylvania. An analysis of the $PM_{2.5}$ data monitored at the Liberty monitor in Allegheny County illustrates that the monitor sees concentrations in the 12-30 $\mu g/m^3$ range while the regional concentrations are in the 0-12 $\mu g/m^3$ range. A further examination into the monitoring data demonstrates that the high concentrations are coming out of the southwest. The southwesterly wind profile is coming from an area occupied by a major steel manufacturer (US Steel). An analysis of the speciated data at the Liberty monitor on the top 25% days illustrates the excess of organic carbon, elemental carbon and chlorine on these days. The differences between the Liberty and Florence monitors illustrate the excess organic carbon, elemental carbon and chlorine at the Liberty monitor in Allegheny County. In addition, sulfate levels collected at the Liberty monitor remain higher than regional levels. This concentration profile is indicative of local sources impacting the Liberty monitor. The elevated organic and elemental carbon levels are indicative of steel manufacturing. Therefore, the Department is recommending a partial county nonattainment area referred to as the Liberty-Clairton area, which includes the City of Clairton and Boroughs of Glassport, Liberty, Lincoln and Port View, in Allegheny County, Pennsylvania be designated nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. A map of the proposed nonattainment area is provided below as Figure C-6.10.

Figure C-6.10: Recommended Liberty-Clairton $PM_{2.5}$ Nonattainment Area