PENNSYLVANIA:
Johnstown, Delaware County, Allegheny County, Allentown, and Lebanon County Nonattainment Areas

Area Designations for the 2012 Primary Annual $PM_{2.5}$ National Ambient Air Quality Standard Technical Support Document

1.0 Summary

In accordance with Section 107(d) of the Clean Air Act (CAA), the EPA must promulgate designations for all areas of the country. In particular, EPA must identify those areas that are violating a National Ambient Air Quality Standard (NAAQS) or contributing to a violation of the NAAQS in a nearby area. EPA must complete this process within 2 years of promulgating a new of revised NAAQS, or may do so within 3 years under circumstances not relevant to these designations.[1] This technical support document (TSD) describes the EPA's intent to designate areas in Pennsylvania as nonattainment for the 2012 primary annual fine particle NAAQS (2012 annual $PM_{2.5}$ NAAQS).[2]

Under section 107(d), states are required to submit area designation recommendations to the EPA for the 2012 annual $PM_{2.5}$ NAAQS no later than 1 year following promulgation of the standard, or by December 13, 2013. On December 10, 2013, the Commonwealth of Pennsylvania made designation recommendations for the 2012 annual $PM_{2.5}$ NAAQS based on air quality data from 2010-2012. On July 30, 2014, Pennsylvania updated its recommendations to reflect the latest air quality data. Pennsylvania recommended that the counties and portions of counties identified in Table 1 be designated as nonattainment for the 2012 annual $PM_{2.5}$ NAAQS, based on air quality data from 2011-2013.

After considering these recommendations and based on EPA's technical analysis as described in this TSD, the EPA intends to designate the areas listed in Table 1 as nonattainment for the 2012 annual $PM_{2.5}$ standard. EPA must designate an area nonattainment if it has an air quality monitoring site[3] that is violating the standard or if it has sources of emissions that are contributing to a violation of the NAAQS in a nearby area. Legal descriptions (e.g., county boundaries, townships and ranges) of these

[1] Section 107(d) of the CAA requires the EPA to complete the initial designation process within 2 years of promulgation of a new or revised NAAQS, unless the Administrator has insufficient information to make initial designation decisions in the 2-year time frame. In such circumstances, the EPA may take up to 1 additional year to make initial area designation decisions (i.e., no later than 3 years after promulgation of the standard).

[2] On December 14, 2012, the EPA promulgated a revised primary annual $PM_{2.5}$ NAAQS (78 FR 3086, January 15, 2013). In that action, the EPA revised the primary annual $PM_{2.5}$ standard, strengthening it from 15.0 micrograms per cubic meter ($\mu g/m^3$) to 12.0 $\mu g/m^3$.

[3] In accordance with 40 CFR 50 Appendix N, $PM_{2.5}$ measurements from the primary monitor and suitable collocated $PM_{2.5}$ FRM, FEM or ARMs may be used in a "combined site data record" to establish a $PM_{2.5}$ design value to determine whether the NAAQS is met or not met at a particular $PM_{2.5}$ monitoring site.

areas are found below in the supporting technical analysis for each area. As provided in CAA section 188(a), the EPA will initially classify all nonattainment areas as "Moderate" nonattainment areas.

Table 1. Pennsylvania Recommended Nonattainment Areas and EPA's Intended Designated Nonattainment Areas for the 2012 annual $PM_{2.5}$ NAAQS

Pennsylvania's Recommended		EPA's Intended	
Nonattainment Area	**Nonattainment Counties**	**Nonattainment Area**	**Nonattainment Counties**
Cambria County	Cambria	Johnstown	Cambria and Indiana – partial (townships of West Wheatfield, Center, East Wheatfield and Armagh Borough and Homer City Borough)
Greater Philadelphia	Delaware	Delaware County	Delaware
Liberty-Clairton	Allegheny – partial (City of Clairton, and boroughs of Glassport, Liberty, Lincoln and Port View)	Allegheny County	Allegheny
Northampton County	Northampton	Allentown	Northampton and Lehigh
Lebanon County	Lebanon	Lebanon County	Lebanon

In its recommendation letters, Pennsylvania recommended that EPA designate Adams, Allegheny (except for the Liberty-Clairton area), Armstrong, Beaver, Berks, Blair, Bucks, Centre, Chester, Cumberland, Dauphin, Erie, Lackawanna, Lancaster, Mercer, Monroe, Montgomery, Philadelphia, Washington Westmoreland, and York Counties as "attainment" and all other counties not identified in the Pennsylvania's Recommended Nonattainment Counties column of Table 1 as "unclassifiable/attainment."

EPA agrees with Pennsylvania's nonattainment recommendations for the Delaware County and Lebanon County Areas. As shown in Table 1, EPA's intended nonattainment designations differ from Pennsylvania's recommendations for the Cambria County (Johnstown), Liberty-Clairton (Allegheny County), and Northampton County (Allentown) Areas. EPA intends to designate the remainder of Pennsylvania as unclassifiable/attainment based on Pennsylvania's recommendations, ambient monitoring data collected during the 2011-2013 period showing compliance with the 2012 annual

$PM_{2.5}$ NAAQS, and the EPA's determination that areas within the Commonwealth are not likely contributing to nearby violations.[4,5]

2.0 Nonattainment Area Analyses and Intended Boundary Determination

The EPA evaluated and determined the intended boundaries for each nonattainment area on a case-by-case basis considering the specific facts and circumstances unique to each area. In accordance with the CAA section 107(d), EPA intends to designate as nonattainment not only the area with the monitoring sites that violate the 2012 annual $PM_{2.5}$ NAAQS, but also those nearby areas with emissions sources that contribute to the violation in the violating area. As described in EPA guidance[6], after identifying each monitoring site indicating a violation of the standard in an area, EPA analyzed those areas with emissions contributing to that violating area by considering those counties in the entire metropolitan area (e.g., Core Based Statistical Area (CBSA) or Combined Statistical Area (CSA)) in which the violating monitoring sites are located. The EPA also evaluated counties adjacent to the CBSA or CSA that have emissions sources with the potential to contribute to the violations. EPA uses the CBSA or CSA as a starting point for the contribution analysis because those areas are nearby for purposes of the $PM_{2.5}$ NAAQS. Based upon relevant facts and circumstances in each area, the designated nonattainment area could be larger or smaller that the CBSA or CSA. EPA's analytical approach is described in section 3 of this technical support document.

3.0 Technical Analysis

In this technical analysis, EPA used the latest data and information available to EPA (and to the states and tribes through the $PM_{2.5}$ Designations Mapping Tool[7] and the EPA PM Designations Guidance and Data web page[8]) and/or data provided to EPA by states. This technical analysis identifies the areas with monitoring sites that violate the 2012 annual $PM_{2.5}$ standard. EPA evaluated these areas and other nearby areas with emissions sources or activities that potentially contribute to ambient fine particle

[4] Unless a state or tribe has specifically identified jurisdictional boundaries in their area recommendations, when determining "remainder of the state," EPA will use Federal Information Processing Standard (FIPS) codes maintained by the National Institute of Standards and Technology (NIST), which are used to identify counties and county equivalents (e.g., parishes, boroughs) of the United States and its unincorporated territories (e.g., American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the US Virgin Islands). Available on EPA's Envirofacts website at *http://www.epa.gov/envirofw/html/codes/state.html*.

[5] EPA uses a designation category of "unclassifiable/ attainment" for areas that are monitoring attainment and for areas that do not have monitoring sites but which the EPA believes are likely attainment and does not contain emissions sources that are contributing to nearby violations based on the five factor analysis and other available information.

[6] EPA issued guidance on April 16, 2013, that identified important factors that EPA intended to evaluate, in making a recommendation for area designations and nonattainment boundaries for the 2012 annual $PM_{2.5}$ NAAQS. Available at *http://www.epa.gov/pmdesignations/2012standards/docs/april2013guidance.pdf.*

[7] EPA's $PM_{2.5}$ Designations Mapping Tool can be found at *http://geoplatform2.epa.gov/PM_MAP/index.html*.

[8] EPA's PM Designations Guidance and Data web page can be found at *http://www.epa.gov/pmdesignations/2012standards/techinfo.htm*.

concentrations at the violating monitors in the area based on the weight of evidence of the five factors recommended in EPA guidance and any other relevant information.

These five factors are:

Factor 1: Air Quality Data. The air quality data analysis involves examining available ambient $PM_{2.5}$ air quality monitoring data at, and in the proximity of, the violating monitoring locations. This includes reviewing the design values (DVs) calculated for each monitoring location in the area based on air quality data for the most recent complete 3 consecutive calendar years of quality-assured, certified air quality data in the EPA's Air Quality System (AQS). In general, EPA identifies violations using data from suitable Federal Reference Method (FRM), Federal Equivalent Method (FEM), and/or Approved Regional Method (ARM) monitors sited and operated in accordance with 40 CFR Part 58.[9] Procedures for using the air quality data to determine whether a violation has occurred are given in 40 CFR part 50 Appendix N, as revised by a final action published in the Federal Register on January 15, 2013 (78 FR 3086).[10] In addition to reviewing data from violating monitor sites, EPA also assesses the air quality data from other monitoring locations to help ascertain the potential contribution of sources in areas nearby to the violating monitoring sites. Examples include using chemical speciation data to help characterize contributing emissions sources and the determination of nearby contributions through analyses that differentiate local and regional source contributions.

Factor 2: Emissions and emissions-related data. The emissions analysis examines identified sources of direct $PM_{2.5}$, the major components of direct $PM_{2.5}$ (primary organic carbon/organic mass, elemental carbon, crustal material (and/or individual trace metal compounds)), primary nitrate and primary sulfate, and precursor gaseous pollutants (e.g., sulfur dioxide (SO_2), oxides of nitrogen (NO_X), total volatile organic compounds (VOC), and ammonia (NH_3). Emissions data are generally derived from the most recent National Emissions Inventory (NEI) (i.e., 2011 NEI version 1), and are given in tons per year. The emission estimates are based on the "2011ed" air quality modeling platform.[11] Although many emissions inventory components of the "2011ed" modeling platform derive from the 2011 NEIv1, there are some differences between the platform inventories and the 2011 NEIv1 emissions. There are also some differences in PM emissions between the 2011 NEI v1 and "2011ed" due to the meteorological adjustments made for certain sectors. In some cases, EPA may also evaluate emissions information from states, tribes, or other relevant sources that may not be reflected in the NEI. One example of "other information" could include an inventory or assessment of local/regional area

[9] Suitable monitors include all FEM and/or ARMs except those specific continuous FEMs/ARMs used in the monitoring agency's network where the data are not of sufficient quality such that data are not to be compared to the NAAQS in accordance with 40 CFR part 58.10(b)(13) and approved by the EPA Regional Administrator per 40 CFR part 58.11(e).

[10] As indicated in Appendix N to 40 CFR part 50, Interpretation of the National Ambient Air Quality Standards for $PM_{2.5}$, section 3(a) indicates "Except as otherwise provided in this appendix, all valid FRM/FEM/ARM $PM_{2.5}$ mass concentration data produced by suitable monitors that are required to be submitted to AQS, or otherwise available to EPA, meeting the requirements of part 58 of this chapter including appendices A, C, and E shall be used in the DV (design value) calculations. Generally, EPA will only use such data if they have been certified by the reporting organization (as prescribed by § 58.15 of this chapter); however, data not certified by the reporting organization can nevertheless be used, if the deadline for certification has passed and EPA judges the data to be complete and accurate."

[11] http://www.epa.gov/ttn/chief/emch/2011v6/outreach/2011v6_2018base_EmisMod_TSD_26feb2014.pdf

sources that individually does not meet the current threshold for reporting to the NEI but collectively contributes to area $PM_{2.5}$ concentrations. Emissions data indicate the potential for a source to contribute to observed violations, making it useful in assessing boundaries of nonattainment areas.

Factor 3: Meteorology. Evaluating meteorological data helps to determine the effect on the fate and transport of emissions contributing to $PM_{2.5}$ concentrations and to identify areas potentially contributing to the violations at monitoring sites. The Factor 3 analysis includes assessing potential source-receptor relationships in the area identified for evaluation using summaries of air trajectories, wind speed, wind direction, and other meteorological data, as available.

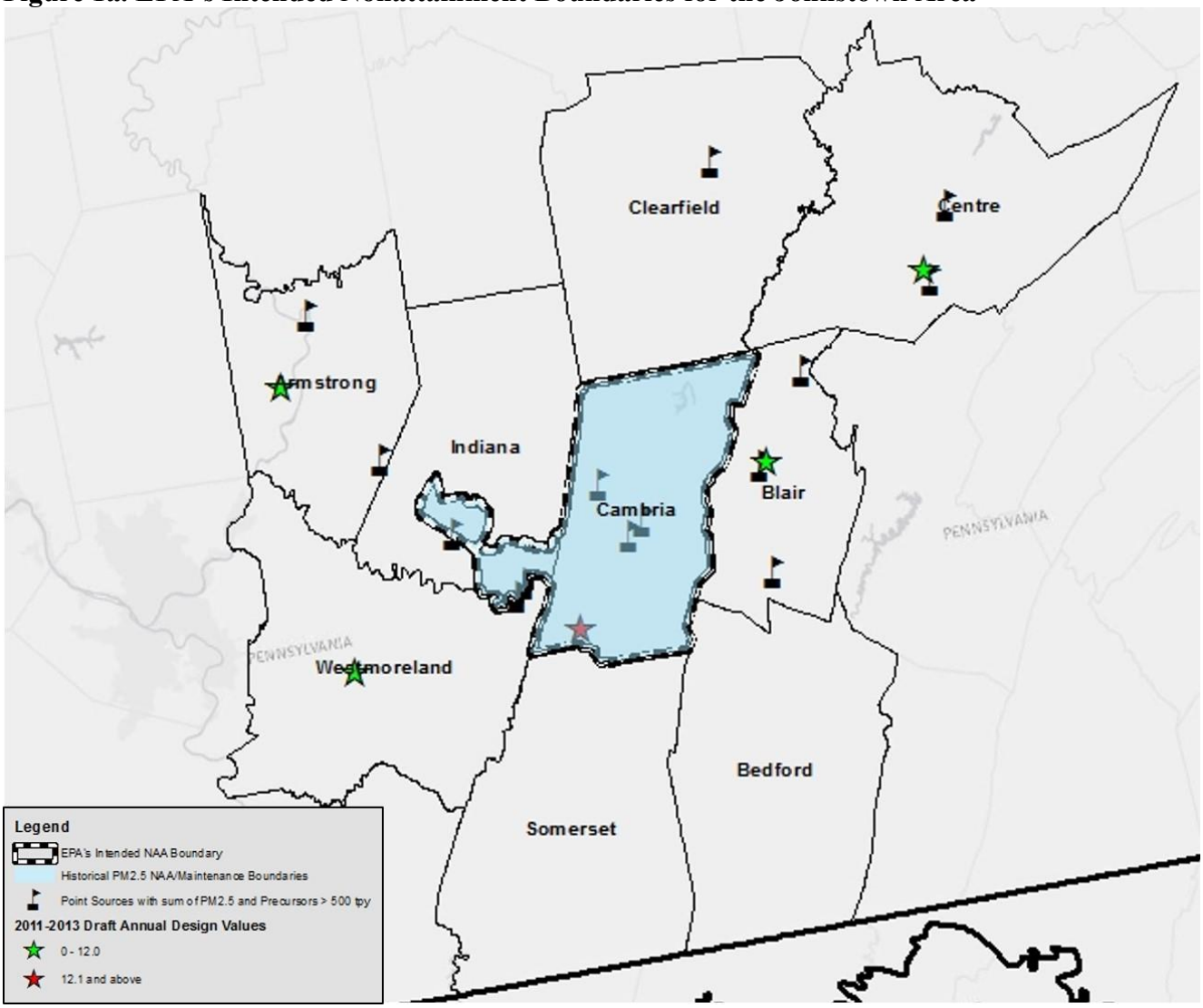
Factor 4: Geography/topography. The geography/topography analysis includes examining the physical features of the land that might define the airshed and, therefore, affect the formation and distribution of $PM_{2.5}$ over an area. Mountains or other physical features may influence the fate and transport of emissions and $PM_{2.5}$ concentrations. Additional analyses may consider topographical features that cause local stagnation episodes via inversions, such as valley-type features that effectively "trap" air pollution, leading to periods of elevated $PM_{2.5}$ concentrations.

Factor 5: Jurisdictional boundaries. The analysis of jurisdictional boundaries identifies the governmental planning and organizational structure of an area that may be relevant for designations purposes. These jurisdictional boundaries provide insight into how the governing air agencies conduct or might conduct air quality planning and enforcement in a potential nonattainment area. Examples of jurisdictional boundaries include counties, air districts, areas of Indian country, CBSA or CSA, metropolitan planning organizations (MPOs), and existing nonattainment areas.

3.1 Area Background and Overview - Johnstown Area

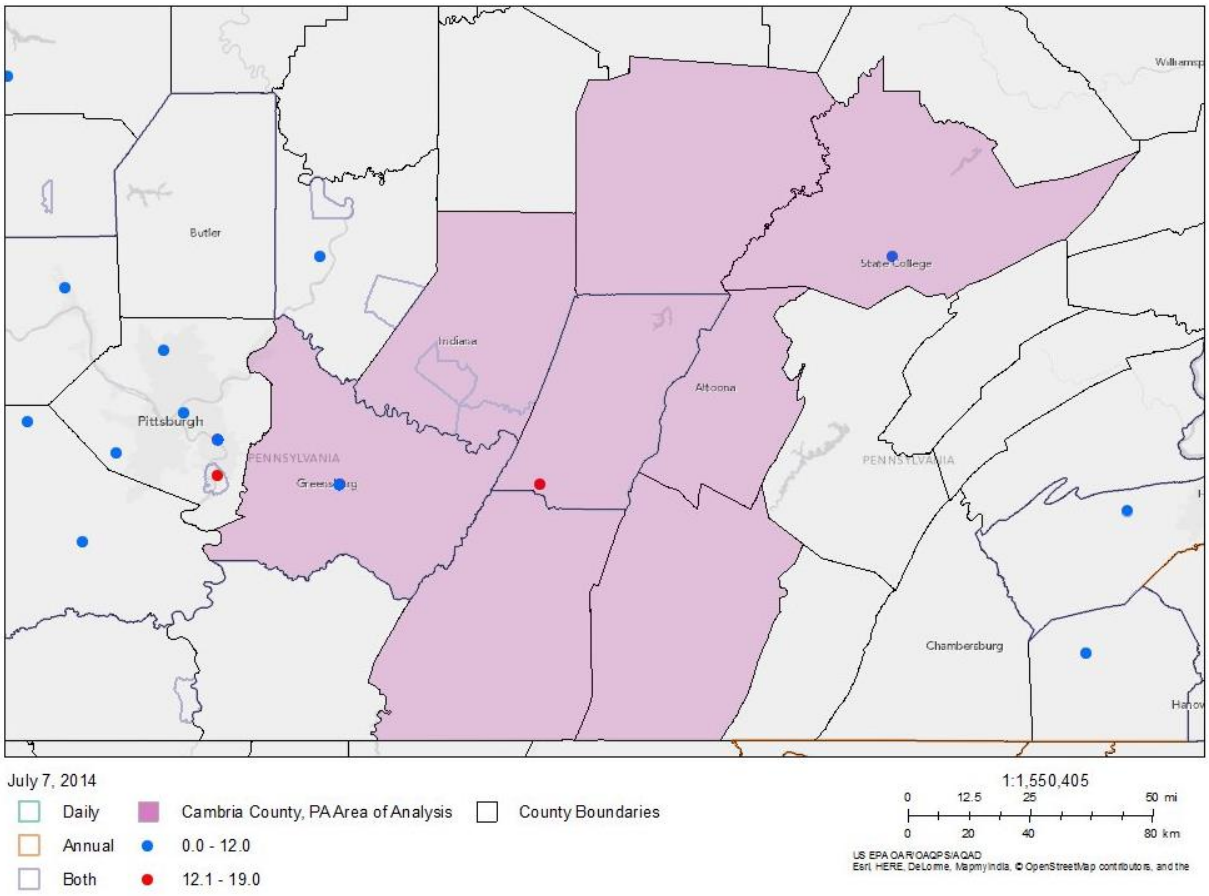
Figure 1a is a map of EPA's intended nonattainment boundary for the Johnstown Area. The map shows the location and DVs of ambient air quality monitoring locations, county and other jurisdictional boundaries including the Johnstown, PA Metropolitan Statistical Area (MSA). For purposes of the 1997 annual $PM_{2.5}$ NAAQS, this area was designated nonattainment. The boundary for the nonattainment area for the 1997 annual $PM_{2.5}$ NAAQS included the entire county of Cambria and part of Indiana County in Pennsylvania. For purposes of the 2006 24-hour $PM_{2.5}$ NAAQS, this area was designated nonattainment. The same boundary represents the nonattainment area for the 2006 24-hour $PM_{2.5}$ NAAQS. The intended nonattainment boundary for the Johnstown Area for the 2012 annual $PM_{2.5}$ NAAQS is the same as the designated nonattainment area boundary for the Johnstown Area for the 1997 annual and the 2006 24-hour $PM_{2.5}$ NAAQS.

Figure 1a. EPA's Intended Nonattainment Boundaries for the Johnstown Area



EPA must designate as nonattainment areas that violate the NAAQS and nearby areas that contribute to the violation in the violating area. Cambria County shows a violation of the 2012 $PM_{2.5}$ NAAQS, therefore this county is included in the nonattainment area. The Johnstown, PA MSA is a single county MSA which consists of Cambria County, PA. As shown in Figure 1b, EPA evaluated the Johnstown, PA MSA and a ring of counties adjacent to the Johnstown, PA MSA which includes Bedford, Blair, Centre, Clearfield, Indiana, Somerset and Westmorland counties in Pennsylvania. EPA's evaluation was based on the five factors and other relevant information and, as discussed below, supports a finding that the townships of West Wheatfield, Center, East Wheatfield and Armagh Borough and Homer City Borough in Indiana County contribute to the nearby violation in Cambria County. The following sections describe this five factor analysis process. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers their interconnections and the dependence of each factor on one or more of the others.

Figure 1b. Area of Analysis for the Johnstown Area



Factor 1: Air Quality Data

All data collected during the year are important when determining contributions to an annual standard such as the 2012 annual $PM_{2.5}$ NAAQS. Compliance with an annual NAAQS is dependent upon monitor readings throughout the year, including days with monitored ambient concentrations below

the level of the NAAQS. For the 2012 annual $PM_{2.5}$ NAAQS, the annual mean is calculated as the mean of quarterly means. A high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV. Although all data are important, seasonal or episodic emissions can provide insight as to relative contributors to measured $PM_{2.5}$ concentrations. For these reasons, for the Factor 1 air quality analysis, EPA assessed and characterized air quality at, and in the proximity of, the violating monitoring site locations first, by evaluating trends and the spatial extent of measured concentrations at monitors in the area of analysis, and then, by identifying the conditions most associated with high average concentration levels of $PM_{2.5}$ mass in the area of analysis.

In most cases, EPA assessed air quality data on a seasonal, or quarterly, basis.[12] EPA also identified the spatial extent of these high $PM_{2.5}$ concentrations. The mass and composition at the DV location represents contributions from various emission sources including local, area-wide (which may comprise nearby urban and rural areas) and regional sources. To determine the source mix (by mass) at the DV monitoring site, EPA examined the chemical composition of the monitored $PM_{2.5}$ concentrations by pairing each violating FRM/FEM/ARM monitoring site with a collocated or nearby Chemical Speciation Network (CSN) monitoring site or sites. Then, EPA contrasted the approximated mass composition at the DV monitoring site with data collected at IMPROVE[13] and other monitoring locations whose data are representative of regional background.[14,15] This comparison of local/area-wide chemical composition data to regional chemical composition data derives an "urban increment," which helps differentiate the influence of more distant emissions sources from the influence of closer

[12] Although compliance with the annual NAAQS depends on contributions from all days of the year, examining data on a quarterly or seasonal basis can inform the relationship between the temporal variability of emissions and meteorology and the resulting $PM_{2.5}$ mass and composition. In some areas of the country where there may be noticeable month-to-month variations in average $PM_{2.5}$, the quarterly averages may not adequately represent seasonal variability. In these areas, air quality data may be aggregated and presented by those months that best correspond to the local "seasons" in these areas.

[13] IMPROVE stands for Interagency Monitoring for Protected Visual Environments and is an aerosol monitoring network in mostly rural and remote areas.

[14] The "urban increment" analysis assesses and characterizes the increase in seasonal and annual average $PM_{2.5}$ mass and chemical components observed at violating monitoring site(s) relative to monitoring sites outside the area of analysis (which represent background concentrations). Developing the urban increment involves pairing a violating FRM/FEM/ARM monitor with a collocated monitor or nearby monitor with speciation data. EPA made every effort to pair these data to represent the same temporal and spatial scales. However, in some cases, the paired violating and CSN "urban" monitoring locations were separated by some distance such that the included urban CSN site(s) reflect(s) a different mixture of emissions sources, which could lead to misinterpretations. To generally account for differences in $PM_{2.5}$ mass between the violating site and the nearby CSN site(s), EPA determined material balance of the $PM_{2.5}$ composition at the violating site by assigning the extra measured $PM_{2.5}$ mass to the carbon components of $PM_{2.5}$. Where the general urban increment approach may be misleading, or in situations where non-carbonaceous emissions are believed to be responsible for a local $PM_{2.5}$ concentration gradient, EPA used alternative analyses to reflect the mix of urban and rural sources contributing to the measured concentrations at violating monitoring sites.

[15] The urban monitors were paired with any rural sites within a 150 mile radius of an urban site to calculate spatial means of the quarterly averages of each species. If there were no rural sites within 150 miles, then the nearest rural site was used alone. That rural mean was then subtracted from the quarterly mean of the urban site to get the increment. Negative values were simply replaced with zeros.

emissions sources, thus representing the portion of the measured violation that is associated with nearby emission contributions.[16,17,18]

$PM_{2.5}$ Design Values and Total Mass Measurements - EPA examined ambient $PM_{2.5}$ air quality monitoring data represented by the DVs at the violating monitoring site and at other monitors in the area of analysis. EPA calculated DVs based on air quality data for the most recent 3 consecutive calendar years of quality-assured, certified air quality data from suitable FEM/FRM/ARM monitoring sites in the EPA's Air Quality System (AQS). For this designations analysis, EPA used data for the 2011-2013 period (i.e., the 2013 DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2012 annual $PM_{2.5}$ NAAQS is met at a monitoring site when the 3-year average annual mean concentration is 12.0 micrograms per cubic meter ($\mu g/m^3$) or less (e.g., 12.1 $\mu g/m^3$ or greater is a violation). A DV is only valid if minimum data completeness criteria are met or when other regulatory data processing provisions are satisfied (See 40 CFR part 50 Appendix N). Table 2 identifies the current DVs (i.e., the 2013 DV) and the most recent two DVs based on all monitoring sites in the area of analysis for the Johnstown Area intended nonattainment area.[19]

Table 2. Air Quality Data collected at Regulatory Monitors (all DV levels in $\mu g/m^3$)[a,b,]

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Bedford, PA	N/A	No	No monitor		
Blair, PA	N/A	No	No monitor		
Cambria, PA	420210011	Yes	**12.4**	**12.3**	**12.3**
Centre, PA	420270100	No	9.3	9.5	9.3
Clearfield, PA	N/A	No	No monitor		
Indiana, PA	N/A	No	No monitor		
Somerset, PA	N/A	No	No monitor		
Westmoreland, PA	421290008	No	13.7	12.6	11.1

[16] In most, but not all, cases, the violating design value monitoring site is located in an urban area. Where the violating monitor is not located in an urban area, the "urban increment" represents the difference between local and other nearby emission sources in the vicinity of the violating monitoring location and more regional sources.

[17] Hand, et. al. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report V, June 2011. Chapter 7 – Urban Excess in $PM_{2.5}$ Speciated Aerosol Concentrations, *http://vista.cira.colostate.edu/improve/Publications/Reports/2011/PDF/Chapter7.pdf*

[18] US EPA, Office of Air Quality Planning and Standards, December 2004. (2004) Area Designations for 1997 Fine Particle ($PM_{2.5}$) Standards, Technical Support Document for State and Tribal Air Quality Fine Particle ($PM_{2.5}$) Designations, Chapter 3, Urban Excess Methodology. Available at *www.epa.gov/pmdesignations/1997standards/documents/final/TSD/Ch3.pdf*

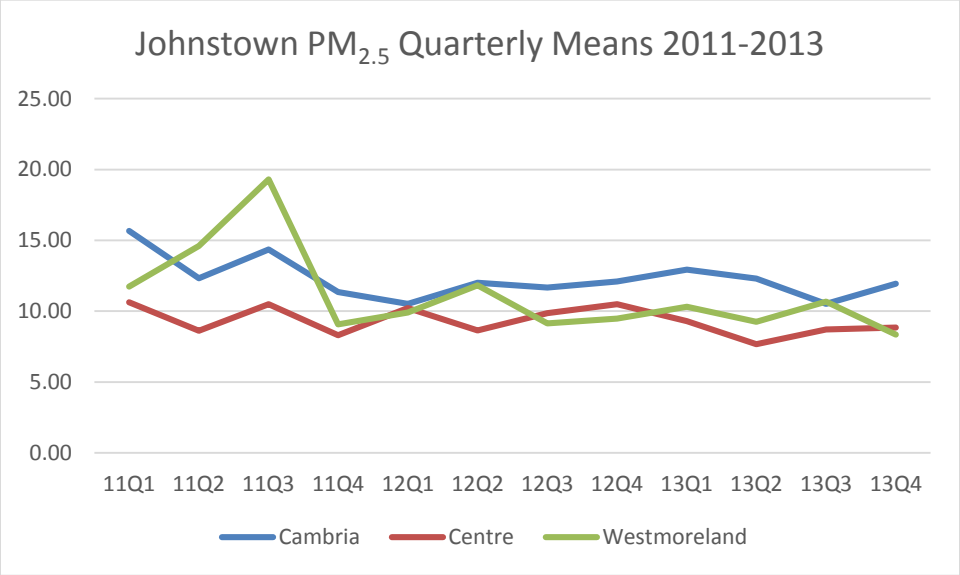
[19] In certain circumstances, one or more monitoring locations within a monitoring network may not meet the network technical requirements set forth in 40 CFR 58.11(e), which states, "State and local governments must assess data from Class III $PM_{2.5}$ FEM and ARM monitors operated within their network using the performance criteria described in table C-4 to subpart C of part 53 of this chapter, for cases where the data are identified as not of sufficient comparability to a collocated FRM, and the monitoring agency requests that the FEM or ARM data should not be used in comparison to the NAAQS. These assessments are required in the monitoring agency's annual monitoring network plan described in §58.10(b) for cases where the FEM or ARM is identified as not of sufficient comparability to a collocated FRM…."

[a]If a county has more than one monitoring location, the county DV is indicated in bold type.
[b]If a monitor is violating, the NAAQS, the violating DV is indicated in red type.

The Figure 1a map, shown previously, identifies the intended boundaries for the Johnstown Area nonattainment area, the Johnstown, PA MSA boundary and monitoring locations with 2011-2013 violating DVs. As indicated on the map, there is one violating monitoring located in Cambria County, PA (Cambria County violating monitor).

Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. Figure 2 shows quarterly mean $PM_{2.5}$ concentrations for the most recent 3-year period for the highest DV monitoring sites in each county within the area of analysis. This graphical representation is particularly relevant when assessing air quality data for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, because, as previously stated, the annual mean is calculated as the mean of quarterly means and a high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV.

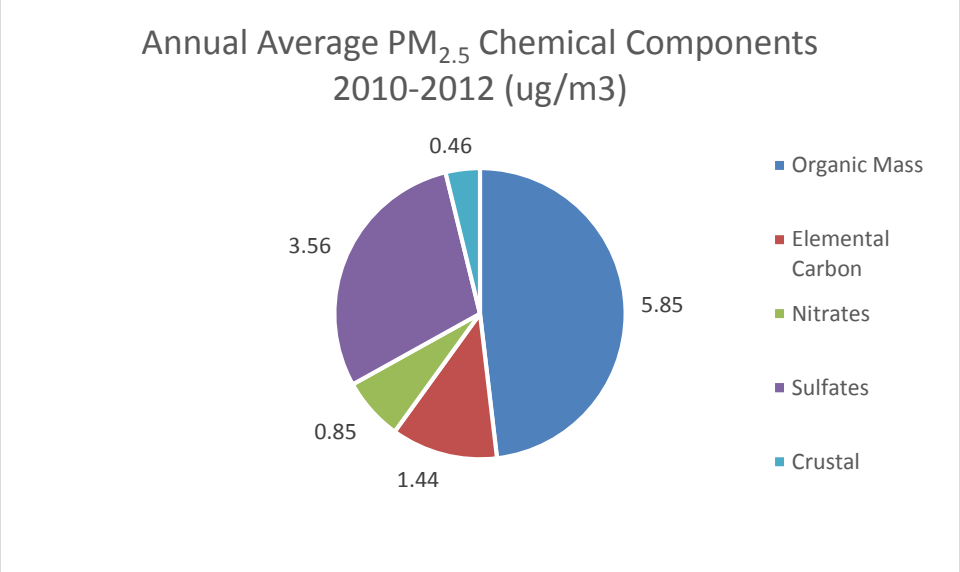
Figure 2. Johnstown Area $PM_{2.5}$ Quarterly Means for 2011-2013



As shown, in Figure 2, the Cambria County monitor does not follow a seasonal pattern with consistent peaks in the first and third quarters. The Centre County monitor does follow a seasonal pattern. The peaks in the first quarter (January – March) may be due to higher electric generating units (EGUs) emissions from increased heating use in winter season and may include emissions from home heating oil and residential wood burning stoves. In addition, there is a greater tendency for NO_x to form in the atmosphere and for FRM monitors to retain particle nitrate during the cooler months. The peaks in the third quarter (July - September) likely correspond to higher emissions from EGUs from higher air conditioning use during summer season. The Westmoreland monitor in the area of analysis somewhat follows this peaking pattern except for the beginning of 2011. Starting in the fourth quarter of 2011 the Westmoreland monitor monitored lower $PM_{2.5}$ and Table 2 shows that it began meeting the 12.0 ug/m3 standard.

$PM_{2.5}$ Composition Measurements - To assess potential emissions contributions for each violating monitoring location, the EPA determined the various chemical species comprising total $PM_{2.5}$ to identify the chemical components over the analysis area, which can provide insight into the types of emission sources impacting the monitored concentration. To best describe the $PM_{2.5}$ at the violating monitoring location, EPA first adjusted the chemical speciation measurement data from a monitoring location at or near the violating FRM monitoring site using the SANDWICH approach to account for the amount of $PM_{2.5}$ mass components retained in the FRM measurement.[20,21,22,23] In particular, this approach accounts for losses in fine particle nitrate and increases in sulfate mass associated with particle bound water. Figure 3a illustrates the fraction of each $PM_{2.5}$ chemical component at the Cambria County, PA monitoring site based on annual averages for the years 2010-2012.

Figure 3a. Johnstown Area Annual Average $PM_{2.5}$ Chemical Components (2010-2012)



[20] SANDWICH stands for measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous mass **H**ybrid Material Balance Approach." The SANDWICH adjustment uses an FRM mass construction methodology that results in reduced nitrates (relative to the amount measured by routine speciation networks), higher mass associated with sulfates (reflecting water included in gravimetric FRM measurements) and a measure of organic carbonaceous mass derived from the difference between measured $PM_{2.5}$ and its non-carbon components. This characterization of $PM_{2.5}$ mass also reflects crustal material and other minor components. The resulting characterization provides a complete mass closure for the measured FRM $PM_{2.5}$ mass, which can be different than the data provided directly by the speciation measurements from the CSN network.

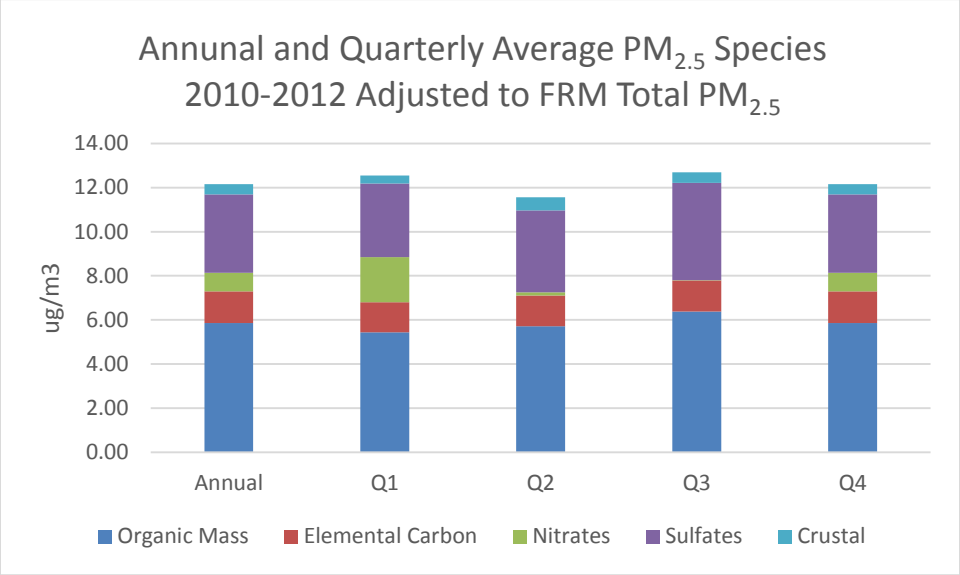
[21] Frank, N. H., SANDWICH Material Balance Approach for $PM_{2.5}$ Data Analysis, National Air Monitoring Conference, Las Vegas, Nevada, November 6-9, 2006. *http://www.epa.gov/ttn/amtic/files/2006conference/frank.pdf*.

[22] Frank, N. H., The Chemical Composition of $PM_{2.5}$ to support PM Implementation, EPA State /Local/Tribal Training Workshop: $PM_{2.5}$ Final Rule Implementation and 2006 $PM_{2.5}$ Designation Process, Chicago IL, June 20-21, 2007, *http://www.epa.gov/ttn/naaqs/pm/presents/pm2.5_chemical_composition.pdf.*

[23] Frank, N. H. *Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities*. J. Air & Waste Manage. Assoc. 2006 56:500–511.

Figure 3b shows annual and quarterly chemical composition profiles and illustrates any seasonal or episodic contributors to $PM_{2.5}$ mass. This "increment analysis," combined with the other factor analyses, can provide additional insight as to which sources or factors may contribute at a greater level. Simply stated, this analysis can help identify nearby sources of emissions that contribute to the violation at the violating monitoring site.

Figure 3b. Johnstown Area Annual and Quarterly Average $PM_{2.5}$ Species (2010-2012)[a]



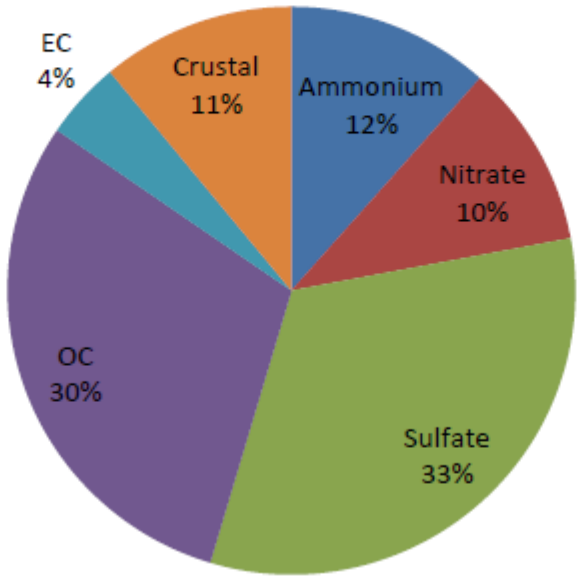
[a]*Adjusted to FRM Total $PM_{2.5}$* indicates that the speciation profile and total mass depicted in this figure are the result of the urban increment calculation for the particular FRM monitor.

The speciation data in Figures 3a and 3b for the Cambria County violating monitoring site indicate that organic mass and sulfates are the predominant species overall. Figure 3b shows that in the first quarter, the nitrate component is higher than in the second through fourth quarters. This may be due to higher EGU emissions during the winter season as well as greater particle nitrate collection during the cooler months. In all four quarters, elemental carbon and crustal are smaller $PM_{2.5}$ components.

In addition, in Pennsylvania's December 2013 recommendation letter, Pennsylvania analyzed the speciation data from the Cambria County monitor for the 2010-2012 monitoring period (note that Pennsylvania's speciation presentation is based on measurement data which was not adjusted by the SANDWICH method.). Figure 3c displays the average distribution of measured speciated components of $PM_{2.5}$ during the entire 2010-2012 monitoring period, and similarly shows that organic carbon and sulfate are large components of $PM_{2.5}$ in the area.[24]

[24] EPA notes that POM is much larger than measured OC and therefore represents a larger percentage of measured $PM_{2.5}$. Similarly, other $PM_{2.5}$ components like crustal material will represent a smaller portion of $PM_{2.5}$ when POM and other adjustments to measured components are made to represent the components of $PM_{2.5}$ using the SANDWICH approach. Crustal is a small $PM_{2.5}$ component whose average quarterly value is 0.4 to 0.6 ug/m3.

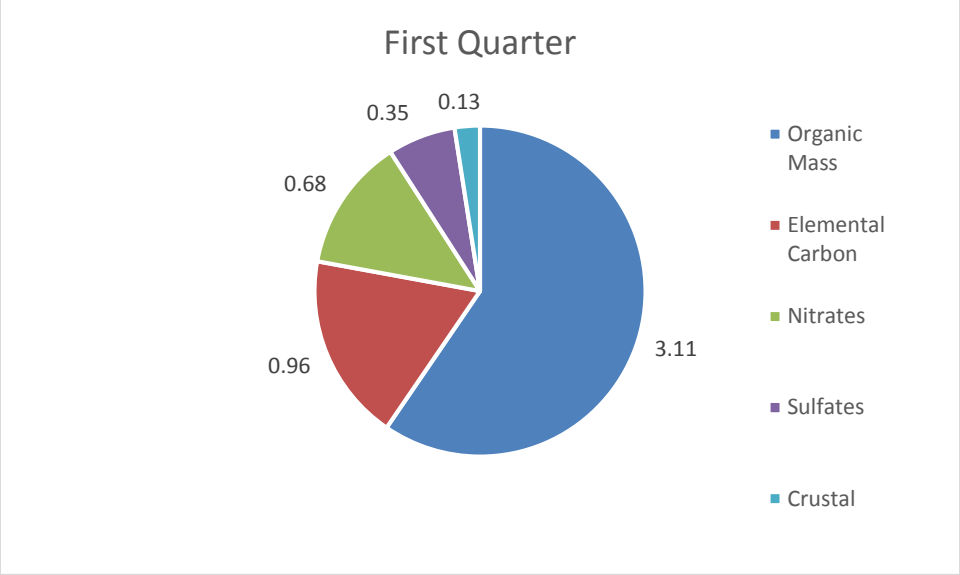
Figure 3c. Johnstown Area Speciated $PM_{2.5}$ Data (2010-2012)

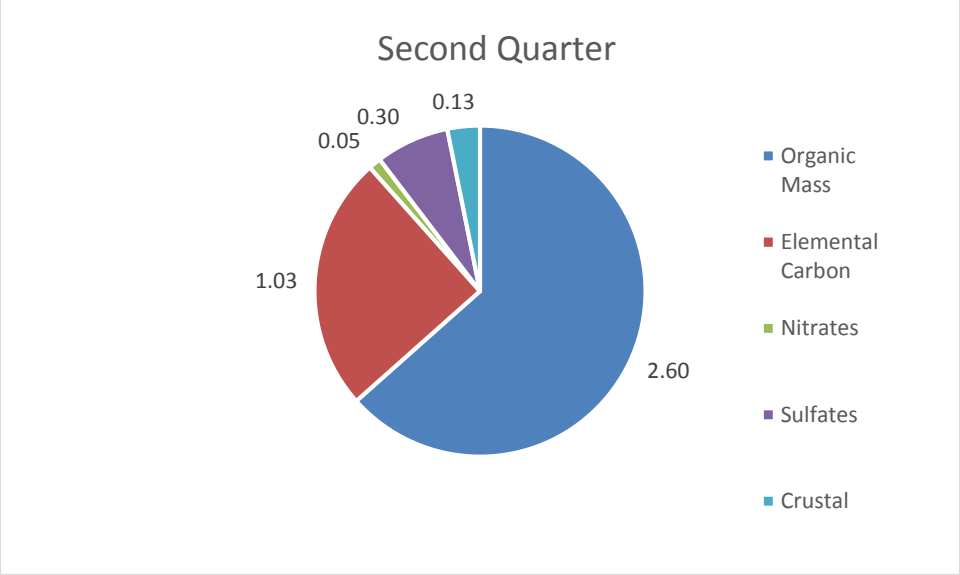


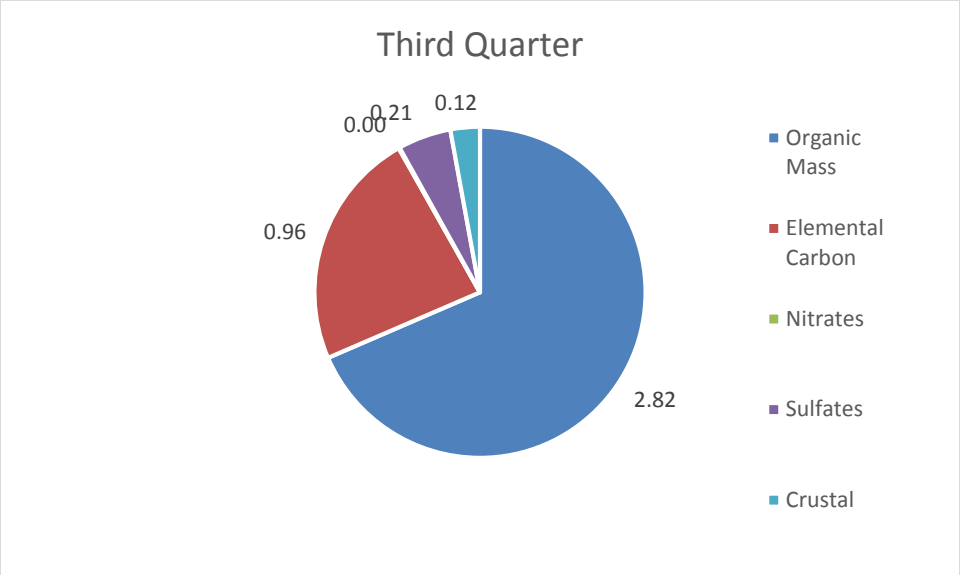
Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-4 - Cambria County Area

EPA assessed seasonal and annual average $PM_{2.5}$ components at monitoring sites within the area relative to monitoring sites outside of the analysis area to account for the difference between regional background concentrations of $PM_{2.5}$, and the concentrations of $PM_{2.5}$ in the area of analysis, also known as the "urban increment." This analysis differentiates between the influences of emissions from sources in nearby areas and in more distant areas on the violating monitor. Estimating the urban increment in the area helps to illuminate the amount and type of particles at the violating monitor that are most likely to be the result of sources of emissions in nearby areas, as opposed to impacts of more distant or regional sources of emissions. Figure 4a includes pie charts showing the annual and quarterly chemical mass components of the urban increment. Note that in these charts, sulfates and nitrates have been adjusted to represent their mass in measured $PM_{2.5}$.

Figure 4a. Johnstown Area Urban Increment Analysis for 2010-2012.






Third Quarter
0.00
0.21
0.12
0.96
2.82
Organic Mass
Elemental Carbon
Nitrates
Sulfates
Crustal

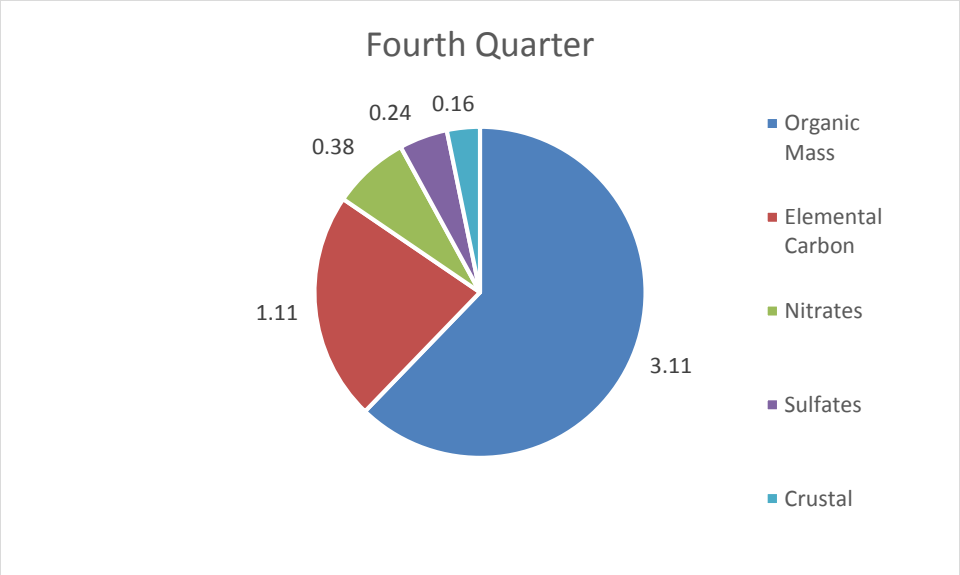
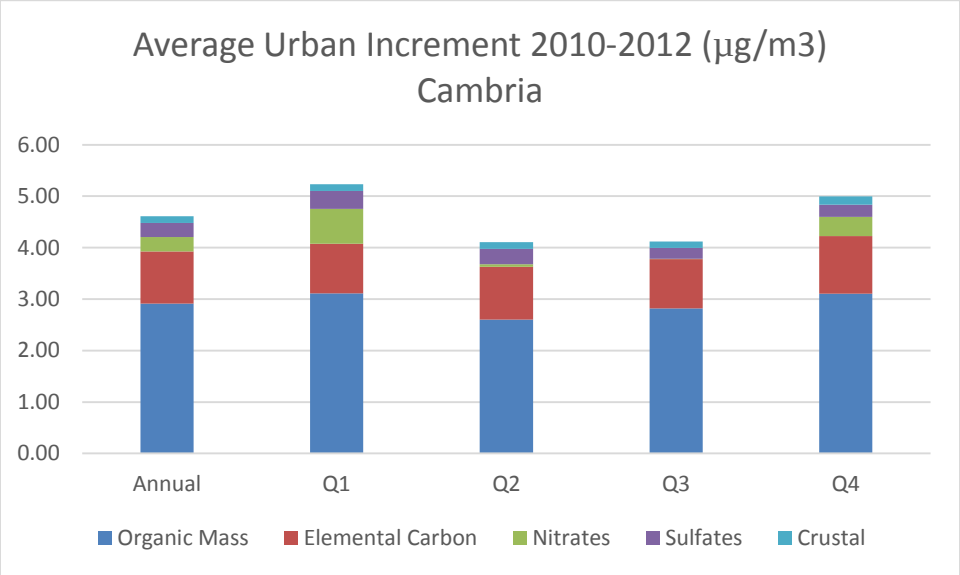

Fourth Quarter
0.24
0.16
0.38
1.11
3.11
Organic Mass
Elemental Carbon
Nitrates
Sulfates
Crustal

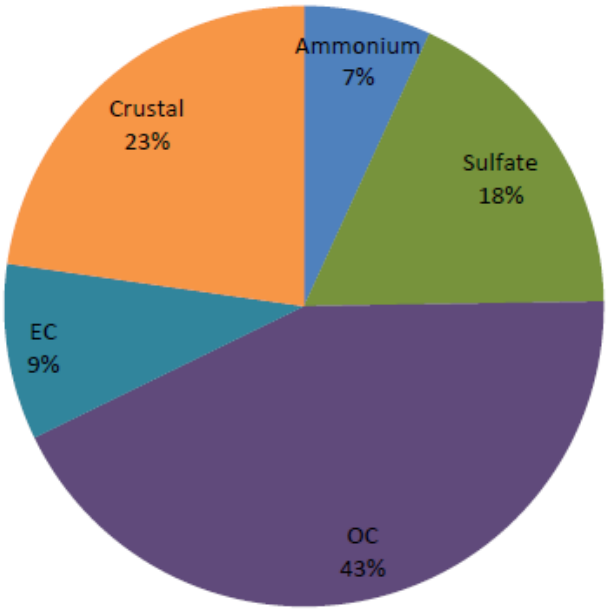
Figure 4b. Johnstown Area Average Urban Increment Analysis for 2010-2012.



The urban increment data provides further insight to the chemical composition of $PM_{2.5}$ at the Cambria County violating monitoring site. As previously stated, Figures 3a-c show that organic mass and sulfates are the predominant species overall. When accounting for the urban increment in Figure 4a and Figure 4b, the sulfate component becomes less dominant, however, there is still some remaining sulfate detected at the monitor. Figure 4a and Figure 4b clearly indicate that organic mass and elemental carbon are the major components of $PM_{2.5}$ contributing to the violation at the Cambria County monitoring site.

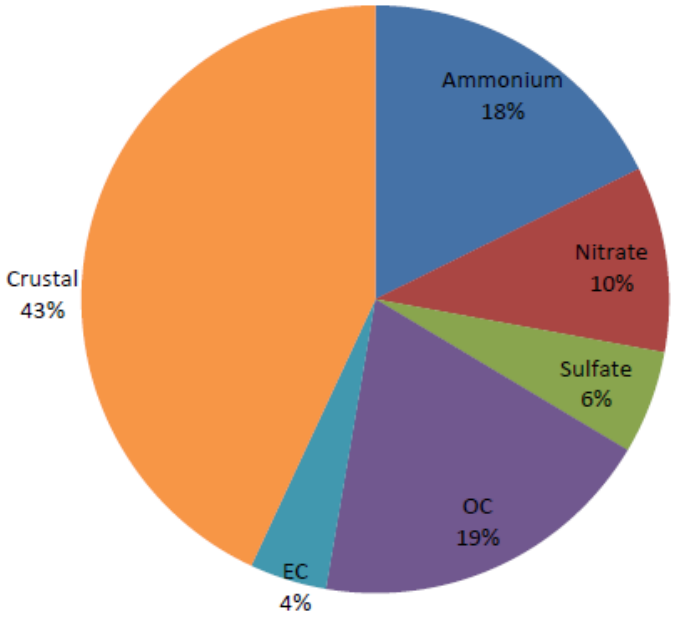
In Pennsylvania's December 2013 recommendation letter, Pennsylvania also included urban increment data (referred to as urban excess by Pennsylvania) for the Cambria County monitor during the 2010-2012 monitoring period. Pennsylvania compared measured $PM_{2.5}$ at the violating monitor (referred to as the Johnstown monitor by Pennsylvania) to the Florence monitor (AIRS #42-125-5001) which is situated in Hillman State Park in northern Washington County and reflects the transport coming into western Pennsylvania from areas to the west. Pennsylvania compared the 1st and 3rd quarters in the 2010-2012 monitoring period for these two monitors. Figures 4c and 4d show the urban excess at the Johnstown monitor (note that Pennsylvania's urban increment presentation is based on measurement data which was not adjusted by the SANDWICH method.).

Figure 4c. Urban Excess for Johnstown (Cambria) vs. Florence for 2010-2012 – 1st Quarter.



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-4 - Cambria County Area

Figure 4d. Urban Excess for Johnstown (Cambria) vs. Florence for 2010-2012 – 3rd Quarter.



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Cambria County Area

Pennsylvania's urban increment analysis shows a large amount of organic carbon in the first quarter with some crustal, sulfate and elemental carbon components. In the third quarter, the crustal component is the largest with some organic carbon and ammonium. As noted, Pennsylvania's data was not adjusted using the SANDWICH method and, as stated above, EPA's urban increment analysis shows that the crustal percent of the increment is only 5-7% and that carbonaceous mass is the predominant component.

Factor 2: Emissions and emissions-related data

In this designations process, for each area with a violating monitoring site, EPA evaluated the emissions data from nearby areas using emissions related data for the relevant counties to assess each county's potential contribution to $PM_{2.5}$ concentrations at the violating monitoring site or monitoring sites in the area under evaluation. Similar to the air quality analysis, these data were examined on a seasonal basis (see Figure 2b and Table 3c). EPA examined emissions of identified sources or source categories of direct $PM_{2.5}$, the major components of direct $PM_{2.5}$ (organic mass, elemental carbon, crustal material (and/or individual trace metal compounds)), primary nitrate and primary sulfate, and precursor gaseous pollutants (i.e., SO_2, NO_X, total VOC, and NH_3). EPA also considered the distance of those sources of emissions from the violating monitoring site. While direct $PM_{2.5}$ emissions and its major carbonaceous components are generally associated with sources near violating $PM_{2.5}$ monitoring sites, the gaseous precursors tend to have a more regional influence (although the EPA is mindful of the potential local NO_X and VOC emissions contributions to $PM_{2.5}$ from mobile and stationary sources) and transport from neighboring areas can contribute to higher $PM_{2.5}$ levels at the violating monitoring sites.

Emissions Data

For this factor, EPA reviewed data from the 2011 National Emissions Inventory (NEI) version 1 (see *http://www.epa.gov/ttn/chief/net/2011inventory.html*). For each county in the area of analysis, EPA examined the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires. EPA also looked at the geographic distribution of major point sources of the relevant pollutants.[25] Significant emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

To further analyze area emissions data, EPA also developed a summary of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants, which is available at *http://www.epa.gov/pmdesignations/2012standards/docs/nei2011v1pointnei2008v3county.xlsx*.

When considered with the urban increment analysis in Factor 1, evaluating the components of direct $PM_{2.5}$ and precursor gases can help identify specific sources or source types contributing to elevated concentrations at violating monitoring sites and thus assist in identifying appropriate area boundaries. In general, directly emitted particulate organic carbon (POC) and VOCs[26] contribute to $PM_{2.5}$ organic mass (POM); directly emitted elemental carbon (EC) contributes to $PM_{2.5}$ EC; NO_X, NH_3 and directly emitted nitrate contribute to $PM_{2.5}$ nitrate mass (PNO3); SO_2, NH_3 and directly emitted sulfate contribute to $PM_{2.5}$ sulfate mass (PSO4); and directly emitted crustal material and metal oxides

[25] For purposes of this designations effort, "major" point sources are those whose sum of PM precursor emissions ($PM_{2.5}$ + NOx + SO_2 + VOC + NH_3) are greater than 500 tons per year based on NEI 2011v1.

[26] As previously mentioned, nearby VOCs are presumed to be a less important contributor to POM than POC.

contribute to $PM_{2.5}$ crustal matter (Pcrustal). [27,28] EPA believes that the quantities of those nearby emissions as potential contributors to the $PM_{2.5}$ violating monitors are somewhat proportional to the $PM_{2.5}$ chemical components in the estimated urban increment. Thus, directly emitted POC is more important per ton than SO_2, partially because POC emissions are already $PM_{2.5}$ whereas SO_2 must convert to $PM_{2.5}$ and not all of the emitted SO_2 undergoes this conversion.

Table 3a provides a county-level emissions summary (i.e., the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires) of directly emitted $PM_{2.5}$ and precursor species in tons per year (tpy) for the county with the violating monitoring site and nearby counties considered for inclusion in the Johnstown Area. Table 3b summarizes the directly emitted components of $PM_{2.5}$ for the same counties in the area of analysis for the Johnstown Area. Table 3c gives total emissions by quarter for the area of analysis. This information will be paired with the urban increment composition previously shown in Figures 4a and 4b.

Table 3a. County-Level Emissions of Directly Emitted $PM_{2.5}$ and Precursors (tpy)

County, State	Total NH_3	Total NOX	Total Direct $PM_{2.5}$	Total SO_2	Total VOC	Total
Indiana, PA	832	35,818	3,172	98,344	5,005	143,171
Clearfield, PA	226	9,471	839	25,644	3,940	40,120
Westmoreland, PA	1,037	12,924	1,957	1,262	9,837	27,017
Cambria, PA	373	6,115	1,334	7,236	4,100	19,158
Blair, PA	1,131	4,849	1,156	4,091	3,961	15,189
Centre, PA	909	6,345	1,222	2,120	4,577	15,173
Somerset, PA	1,173	3,320	1,216	461	4,059	10,230
Bedford, PA	1,222	2,659	539	222	2,537	7,180

Table 3b. County-Level Emissions for Components of Directly Emitted $PM_{2.5}$ (tpy) [29]

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Indiana, PA	547	172	247	4	870	1,333	3,172
Westmoreland, PA	962	277	101	6	206	405	1,957
Cambria, PA	678	148	48	3	158	300	1,334
Centre, PA	743	177	22	3	106	172	1,222
Somerset, PA	751	141	23	5	115	181	1,216
Blair, PA	668	141	48	2	118	180	1,156
Clearfield, PA	433	124	39	2	64	177	839

[27] *See*, Seinfeld J. H. and Pandis S. N. (2006) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 2nd edition, J. Wiley, New York. See also, Seinfeld J. H. and Pandis S. N. (1998) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 1st edition, J. Wiley, New York.

[28] USEPA Report (2004), The Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003, found at: *http://www.epa.gov/airtrends/aqtrnd04/pm.html*.

[29] Data are based on the 2011 and 2018 Emissions Modeling Platform Data Files and Summaries (*ftp://ftp.epa.gov/EmisInventory/2011v6/v1platform*) available at: *http://www.epa.gov/ttn/chief/emch/index.html#2011* (accessed 02/26/14).

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Bedford, PA	330	73	8	1	52	75	539

Table 3b breaks down the direct $PM_{2.5}$ emissions value from Table 3a into its components. These data will also be compared with the previously presented urban increment composition. As can be seen, Indiana County has the highest total emissions of directly emitted $PM_{2.5}$ and its precursors. In Table 3a, Indiana County's total emissions (143,171 tpy) are at least three times more than any other county's total emissions in the area of analysis. Indiana County's total direct $PM_{2.5}$ emissions (3,172 tpy) are also much higher than the other counties in the area of analysis. In the breakdown of direct $PM_{2.5}$ in Table 3b, a large portion of the Indiana County $PM_{2.5}$ is organic mass and crustal material. EPA's urban increment data in Figures 4a and 4b indicate that organic mass is the main component of $PM_{2.5}$ at the Cambria County violating monitor.

Using the previously described relationship between directly emitted and precursor gases and the measured mass to evaluate data presented in Tables 3a and 3b, EPA identified the following emissions warranting additional review: POM, EC, Pcrustal, SO_2 and VOC. EPA then looked at the contribution of these emissions from each of the counties included in the area of analysis as shown in Tables 4a-e.

Table 4a. County-Level POM Emissions

	Emissions in average tpy		
County, State	POM	Pct.	Cumulative %
Westmoreland, PA	962	19%	19%
Somerset, PA	751	15%	34%
Centre, PA	743	15%	48%
Cambria, PA	678	13%	61%
Blair, PA	668	13%	74%
Indiana, PA	547	11%	85%
Clearfield, PA	433	8%	94%
Bedford, PA	330	6%	100%

Table 4b. County-Level EC Emissions

	Emissions in average tpy		
County, State	EC	Pct.	Cumulative %
Westmoreland, PA	277	22%	22%
Centre, PA	177	14%	36%
Indiana, PA	172	14%	50%
Cambria, PA	148	12%	62%
Blair, PA	141	11%	73%
Somerset, PA	141	11%	84%
Clearfield, PA	124	10%	94%
Bedford, PA	73	6%	100%

Table 4c. County-Level Pcrustal Emissions

	Emissions in average tpy		
County, State	**Pcrustal**	**Pct.**	**Cumulative %**
Indiana, PA	870	52%	52%
Westmoreland, PA	206	12%	64%
Cambria, PA	158	9%	73%
Centre, PA	106	6%	79%
Somerset, PA	115	7%	86%
Blair, PA	118	7%	93%
Clearfield, PA	64	4%	97%
Bedford, PA	52	3%	100%

Table 4d. County-Level VOC Emissions

	Emissions in average tpy		
County, State	**Total VOC**	**Pct.**	**Cumulative %**
Westmoreland, PA	9,837	26%	26%
Indiana, PA	5,005	13%	39%
Centre, PA	4,577	12%	51%
Cambria, PA	4,100	11%	62%
Somerset, PA	4,059	11%	73%
Blair, PA	3,961	10%	83%
Clearfield, PA	3,940	10%	93%
Bedford, PA	2,537	7%	100%

Table 4e. County-Level SO2 Emissions

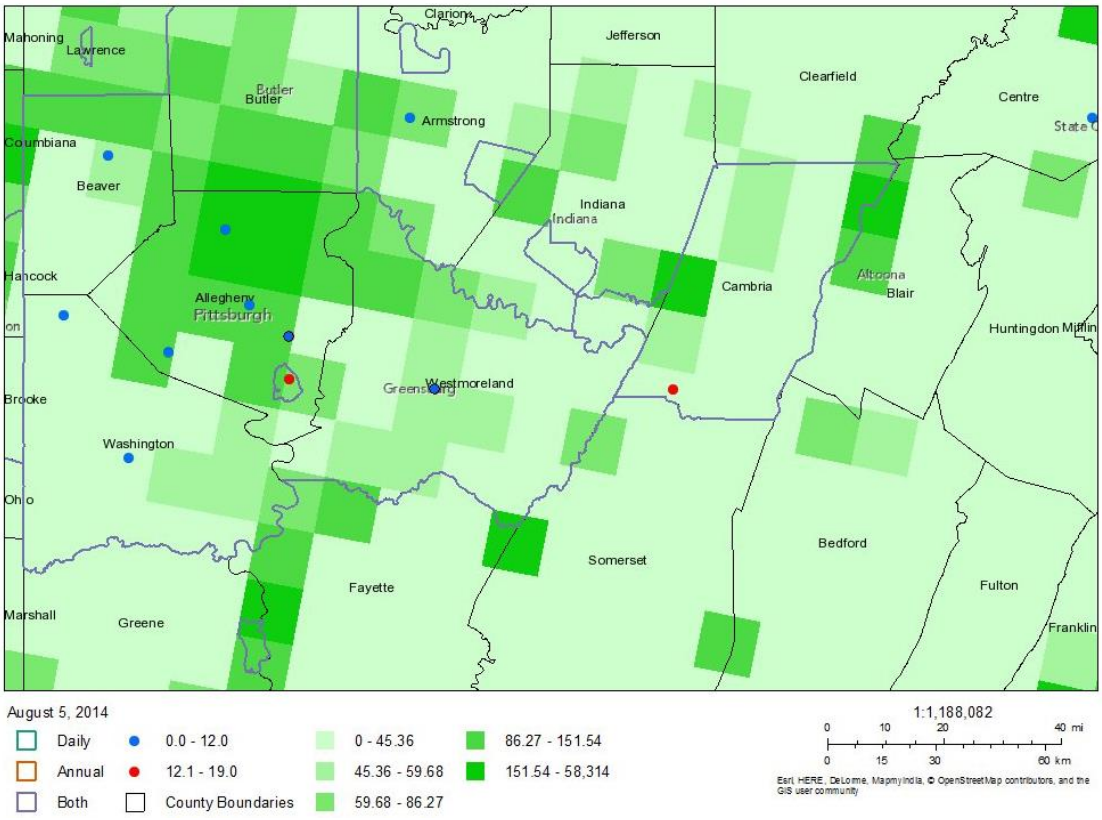
	Emissions in average tons/yr		
County, State	**SO2**	**Pct.**	**Cumulative %**
Indiana, PA	98,344	72%	72%
Clearfield, PA	25,644	19%	90%
Westmoreland, PA	1,262	1%	91%
Cambria, PA	7,236	5%	97%
Blair, PA	4,091	3%	100%
Somerset, PA	461	0%	100%
Bedford, PA	222	0%	100%

Tables 4a and 4b indicate that Westmoreland County produces the highest percentage of direct organic mass and elemental carbon emissions in the counties near the Cambria County violating monitor. In both of these Tables, the emissions of organic mass and elemental carbon appears somewhat evenly distributed between Westmoreland County and the next four highest contributing counties (totaling ~75%). Tables 4c and 4e indicate that Indiana County produces the highest percentage of crustal matter and directly emitted sulfate. In this case, Indiana County's emissions of crustal matter and

sulfate both account for approximately 50% of the total crustal matter and sulfate in counties near the Cambria County violating monitor.

EPA notes that while total emissions of direct $PM_{2.5}$ and its precursors are very important, the distance of and spatial distribution of these emissions are also important. To further analyze the emissions in the area of analysis EPA evaluated the spatial distribution of $PM_{2.5}$ organic mass emissions presented in Figure 4f.

Figure 4f. Spatial Distribution of $PM_{2.5}$ Organic Mass Emissions in the Area of Analysis



As mentioned above, Westmoreland County has the highest amount of $PM_{2.5}$ organic mass. However, the potential for transport to the violating monitor must also be considered. Figure 4f, shows that most emissions in Westmoreland are concentrated in the northwest corner near Allegheny County (darker green). Somerset County to the south of the Cambria monitor has very little $PM_{2.5}$ organic mass. This will be discussed further in the next section on meteorology.. EPA notes, the combination of emission totals together with the other four factors will ultimately identify the areas which contribute to the violating monitor.

In addition to reviewing county-wide emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors in the area of analysis, EPA also reviewed emissions from major point sources located in the area of analysis. The magnitude and location of these sources can help inform nonattainment boundaries. Table 5 provides facility-level emissions of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants (given in tons per

year) from major point sources with total emissions of 500 tpy or more located in the area of analysis for the Johnstown Area. Table 5 also shows the distance from the facility to the Cambria County violating monitor.

Table 5. NEI 2011 v1 Point Source Emissions (tpy)

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NOx	$PM_{2.5}$	SO_2	VOC	Total
Indiana, PA	GenOn Wholesale Gen/Seward Gen Sta (420630002)	9	4	1,774	150	7,010	4	8,942
Indiana, PA	GenOn NE Mgmt Co/Conemaugh Plt (420630001)	9	3	17,562	335	7,190	19	25,109
Cambria, PA	Ebensburg Power Co/Ebensburg Cogeneration Plt (420210033)	13	0	308	50	1,937	4	2,299
Cambria, PA	Cambria Cogen Co/Ebensburg (420210046)	16	2	713	163	1,941	12	2,831
Cambria, PA	Inter Power Ahlcon L/Colver Power Proj (420210034)	18	2	713	20	2,883	4	3,622
Indiana, PA	Homer City Gen LP/ Center Twp (420630003)	20	90	9,026	1,355	83,596	17	94,083
Blair, PA	Appleton Papers/Spring Mill (420130010)	27	35	394	119	1,046	103	1,699
Blair, PA	Norfolk Southern Railway Co/Juniata Locomotive Shops (420130005)	32	0	114	11	484	33	642
Blair, PA	Team Ten/Tyrone Paper Mill (420130004)	44		286	2	2,181	13	2,482
Clearfield, PA	GenOn Rema LLC/Shawville Gen Sta (420330021)	60	2	3,531	77	25,198	6	28,815
Centre, PA	Pa State Univ/Univ Park Campus (420270017)	64		243	7	1,445	6	1,701
Centre, PA	Graymont Pa Inc/Pleasant Gap & Bellefonte Plts (420270003)	72	20	940	36	209	8	1,212

Table 5 shows the major point source emissions (from the 2011 NEI in tons per year) in the area of analysis for the Johnstown Area and the relative distances of these sources from the violating monitoring location, as depicted by red dots. The actual distance from the point sources to the violating monitoring location is presented in Table 5. The distance from the violating monitoring location is particularly important for directly emitted $PM_{2.5}$. The influence of directly emitted $PM_{2.5}$ on ambient $PM_{2.5}$ diminishes more than that of gaseous precursors as a function of distance.[30]

[30] Baker, K. R. and K. M. Foley. *A nonlinear regression model estimating single source concentrations of primary and secondarily formed $PM_{2.5}$.* Atmospheric Environment. 45 (2011) 3758-3767.

Figure 5a. Major Point Source Emissions in the Area of Analysis for the Johnstown Area

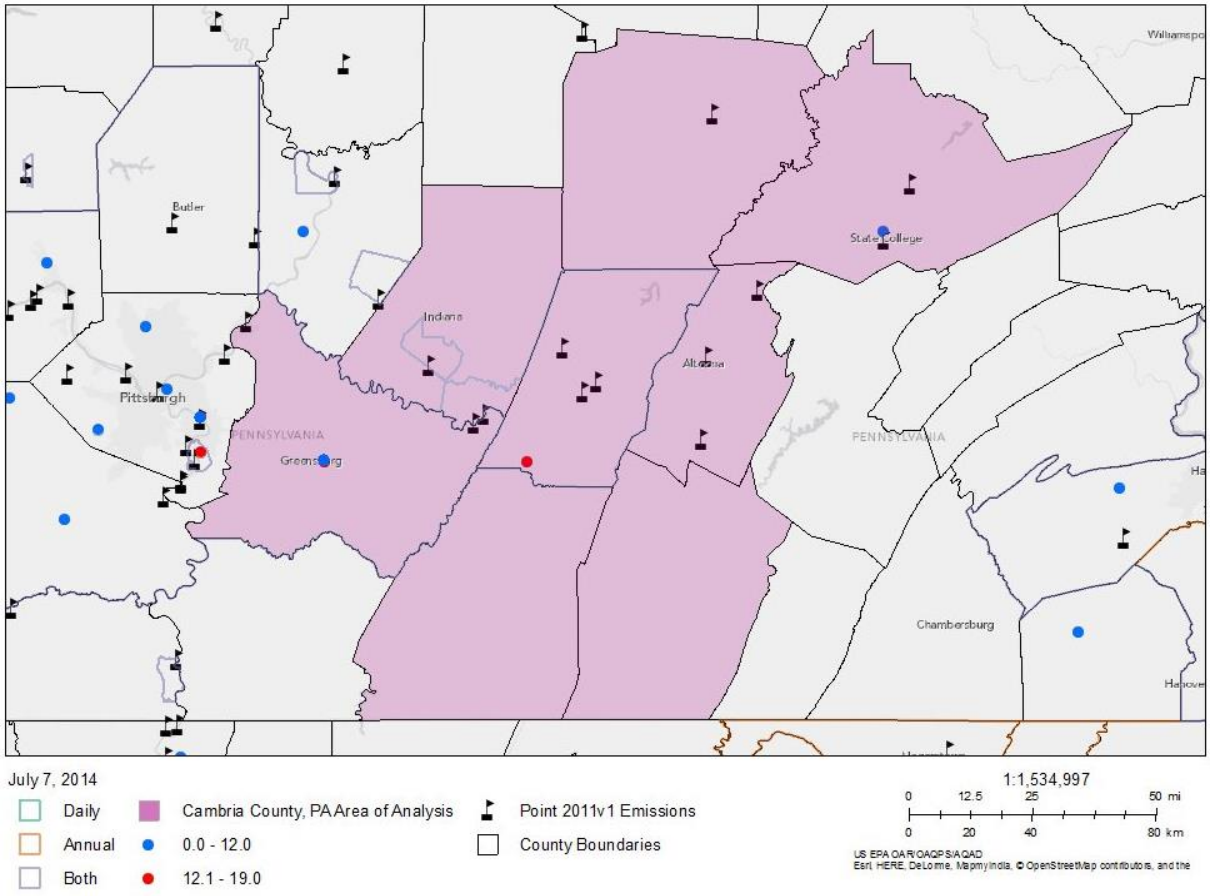
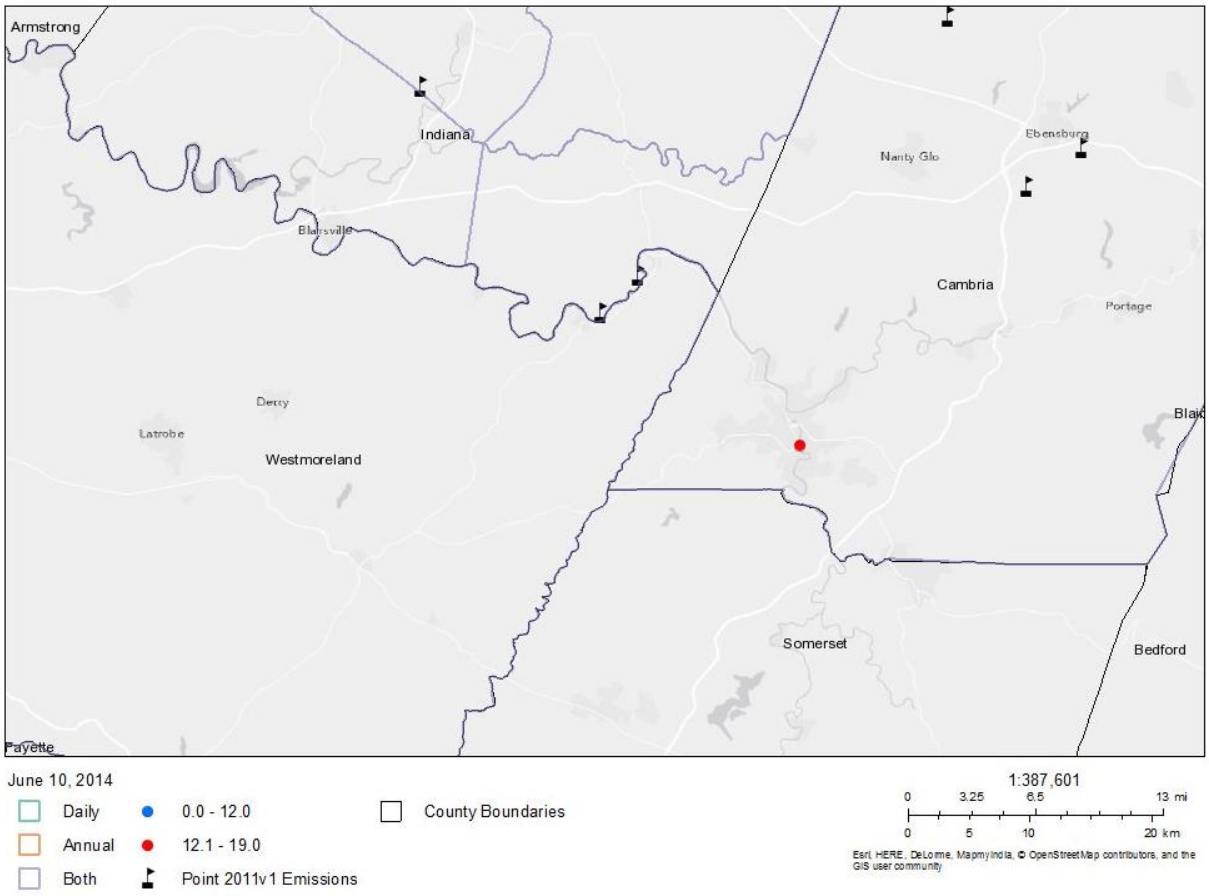


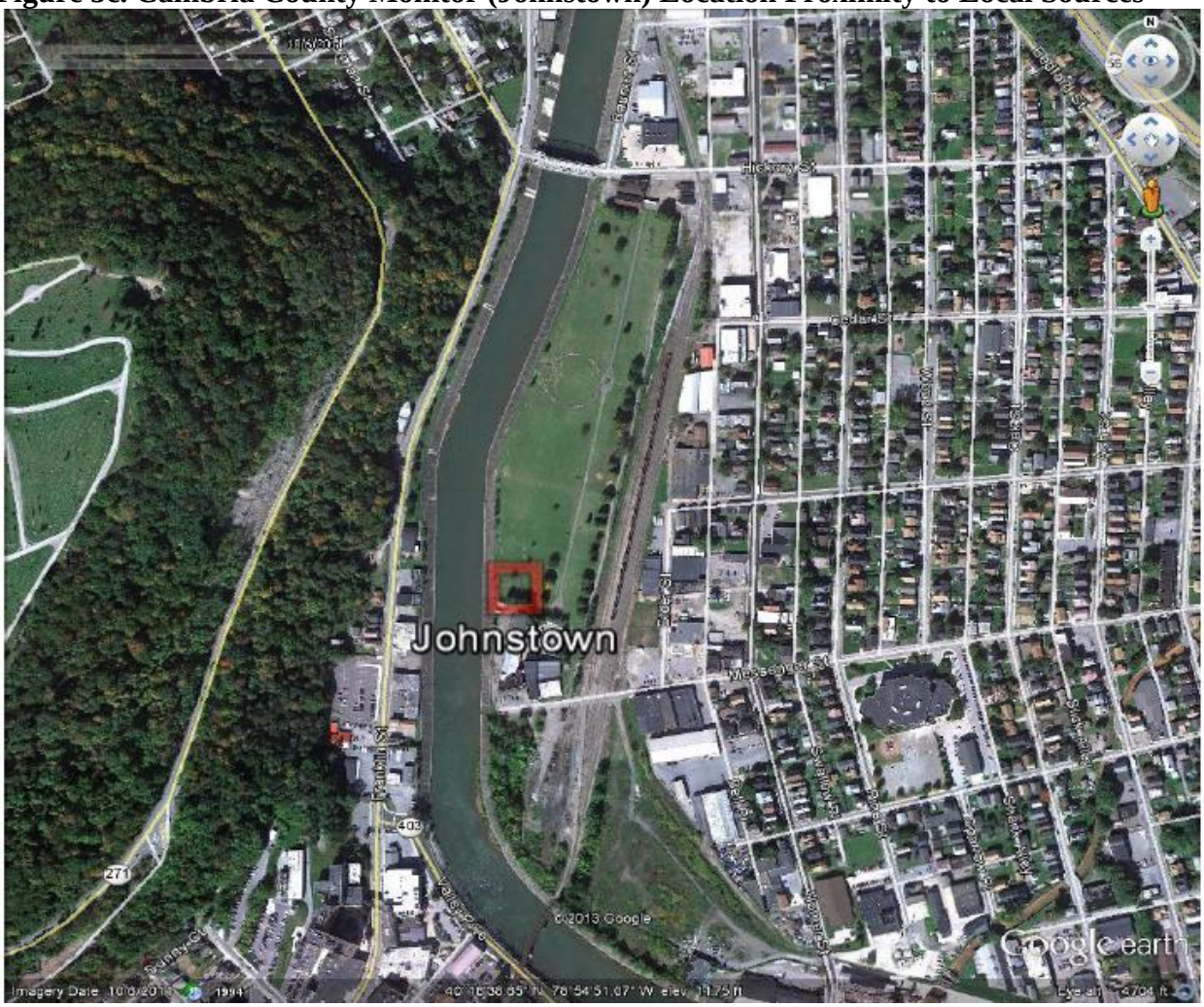
Figure 5b. Close-Up of Major Point Sources Near the Cambria County Monitor



As indicated in Figures 5a and 5b, there are twelve sources with emissions over 500 tpy within the area of analysis. Six of these large point sources are located northeast and northwest of the Cambria County violating monitor. The three point sources to the northwest of this monitor are located in Indiana County and are three large EGUs. These EGUs are Homer City, with emissions of over 94,000 tpy, and two GenOn facilities, Conemaugh and Seward Generating Station, with emissions of over 25,000 tpy and almost 9,000 tpy, respectively. These three EGUs are located in or adjacent to the townships of West Wheatfield, Center, East Wheatfield and Armagh Borough and Homer City Borough in Indiana County. As indicated in Table 5, these three facilities are three of the four largest sources of directly emitted $PM_{2.5}$ and its precursors in the area of analysis. In addition, the majority of the emissions in Indiana County are from these three facilities and, as indicated in Table 3b, the $PM_{2.5}$ emissions in Indiana County are mostly organic mass and crustal material which are components detected at the Cambria County violating monitor. Figure 5a shows that there are no point sources south of the monitor within the area of analysis.

As part of its December 2013 designation recommendation letter Pennsylvania provided additional information regarding local sources of $PM_{2.5}$. Pennsylvania believes that the proximity of a rail yard and a warehouse with unpaved roads near the Cambria County violating monitor may contribute to the local crustal mass collected at the monitor. EPA notes that rail yards can be large emitters of EC and POM and acknowledges that this source may be among the contributing emissions to the violation at the Cambria County monitor. Figure 5c was provided by Pennsylvania in its December 2013 designation recommendation letter and shows the monitor and its proximity to the local sources described above.

Figure 5c. Cambria County Monitor (Johnstown) Location Proximity to Local Sources



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-4 - Cambria County Area

Population density and degree of urbanization

In this part of the factor analysis, EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. Rapid population growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that it may be appropriate to include the county associated with area source and mobile source emissions as part of the nonattainment area. Table 6 shows the 2000 and 2010 population, population growth since 2000, and population density for each county in the area.

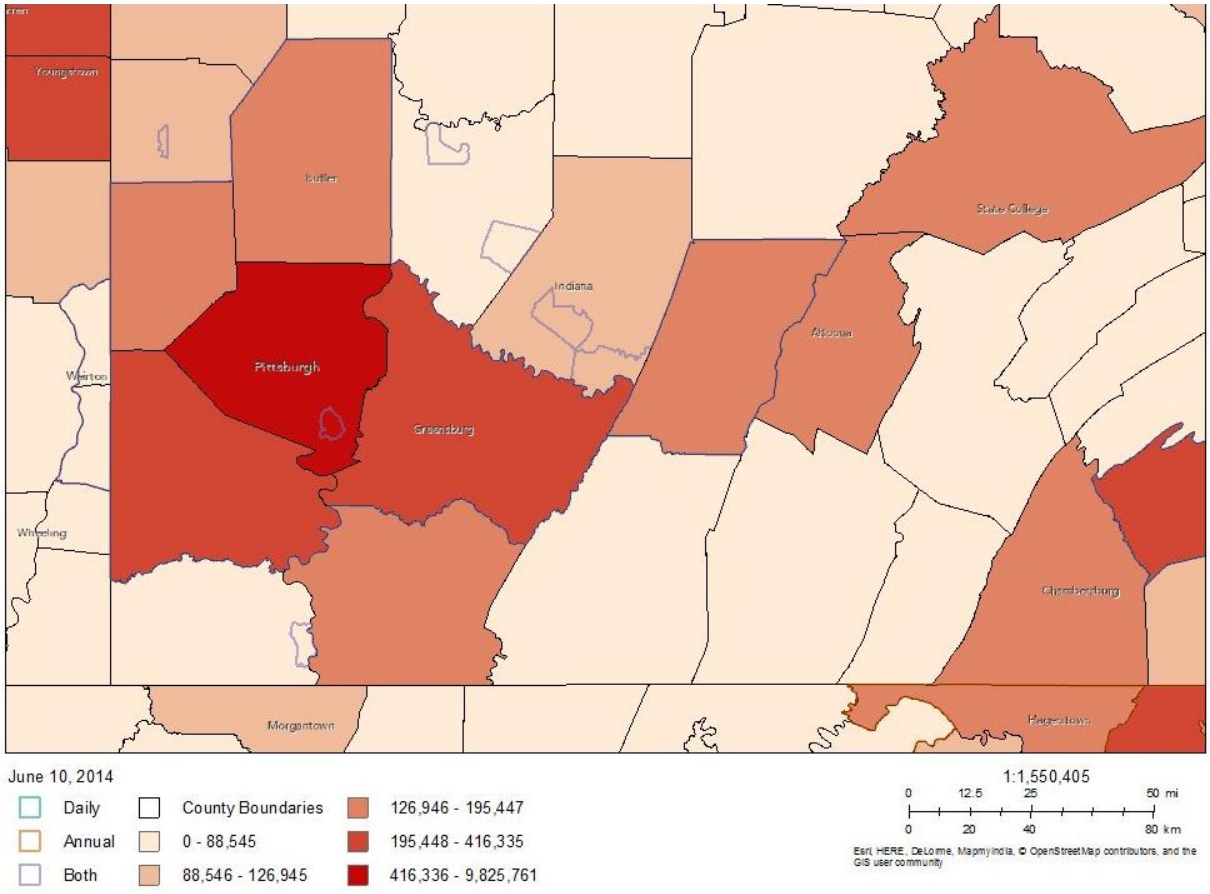
Table 6. Population Growth and Population Density.

County, State	Population 2000	Population 2010	% Change from 2000	Land Area (Sq. Miles)	Population Density (per Sq. Mile)	%	Cumulative %
Westmoreland, PA	369,993	365,086	-1.3%	1,025	356	34%	34%
Centre, PA	135,758	154,193	13.6%	1,108	139	14%	48%
Cambria, PA	152,598	143,484	-6.0%	688	209	13%	61%
Blair, PA	129,144	127,038	-1.6%	526	242	12%	73%
Indiana, PA	89,605	88,818	-0.9%	829	107	8%	81%
Clearfield, PA	83,382	81,579	-2.2%	1,147	71	8%	88%
Somerset, PA	80,023	77,706	-2.9%	1,075	72	7%	95%
Bedford, PA	49,984	49,737	-0.5%	1,015	49	5%	100%

Source: U.S. Census Bureau population estimates for 2000 and 2010

As the above table indicates, although Cambria County has the third highest population in the area of analysis, its population has decreased by 6% from 2000. Westmoreland County has the largest and most dense population in the area of analysis. Overall, all of the counties in the area of analysis are relatively low in population and low in population density and, except for Centre County, each county has seen a decrease in population from 2000 to 2010 with the exception of Centre County. The above data indicates that population and population density are not influential factors in determining nonattainment boundaries for the Johnstown Area.

Figure 6. 2010 County-Level Population in the Area of Analysis for the Johnstown Area.



Traffic and Vehicle Miles Travelled

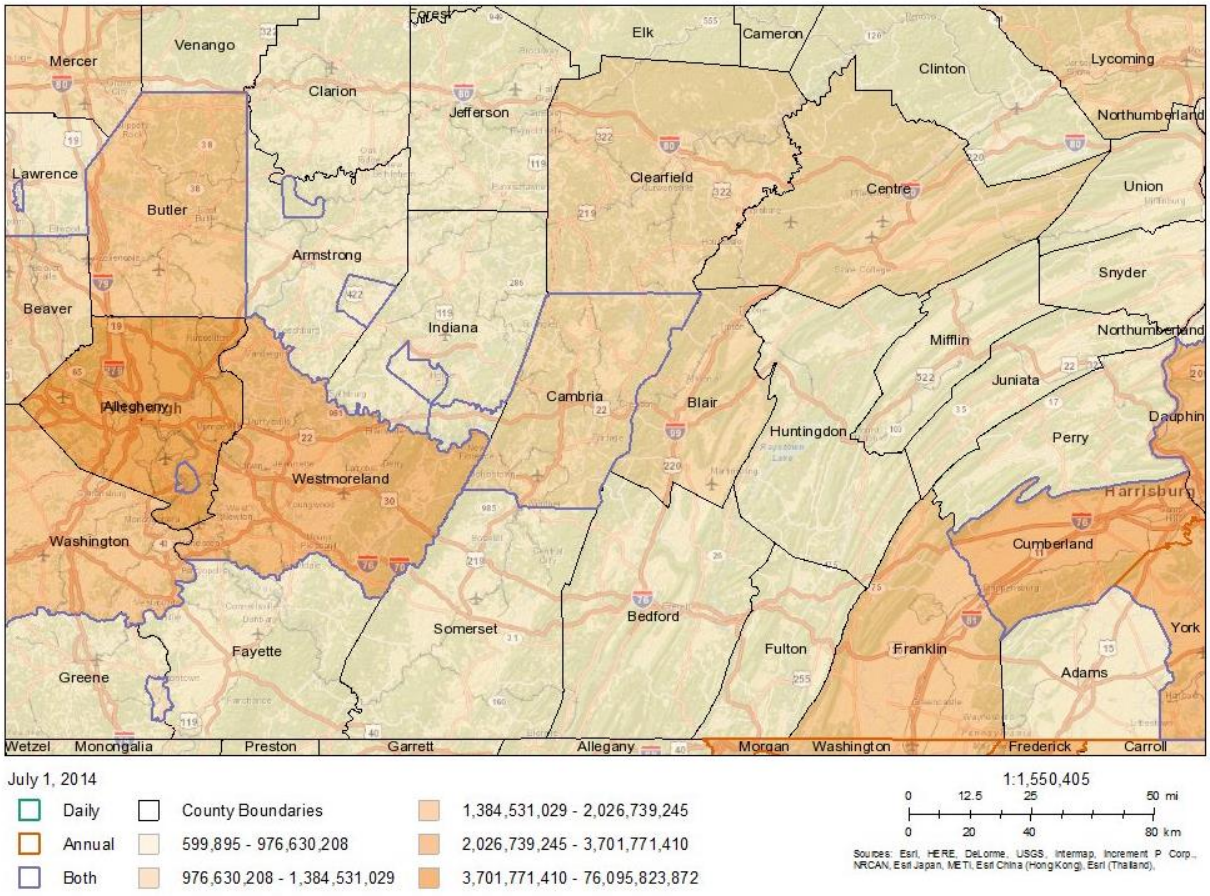
High vehicle miles travelled (VMT) and/or a high number of commuters associated with a county is generally an indicator that the county is an integral part of an urban area. Mobile source emissions of NO_x, VOC, and direct PM may contribute to ambient particulate matter that contributes to monitored violations of the NAAQS in the area. In combination with the population/population density data and the location of main transportation arteries, an assessment of VMT helps identify the probable location of nonpoint source emissions that contribute to violations in the area. Comparatively high VMT in a county outside of the CBSA or CSA signifies integration with the core urban area contained within the CSA or CBSA, and indicates that a county with the high VMT may be appropriate to include in the nonattainment area because emissions from mobile sources in that county contribute to violations in the area. Table 7 shows 2011 VMT while Figure 7 overlays 2011 county-level VMT with a map of the transportation arteries.

Table 7. 2011 VMT for the Johnstown Area

County, State	Total 2011 VMT	Percent	Cumulative %
Westmoreland, PA	3,087,660,497	31%	31%
Centre, PA	1,365,989,654	14%	44%
Cambria, PA	1,007,874,393	10%	54%
Clearfield, PA	1,003,982,533	10%	64%
Blair, PA	993,428,318	10%	74%
Bedford, PA	947,215,986	9%	83%
Somerset, PA	924,890,368	9%	92%
Indiana, PA	778,308,748	8%	100%

http://www.census.gov/hhes/commuting/data/commuting.html

Figure 7. Overlay of 2011 County-level VMT with Transportation Arteries.



As the data in Table 7 illustrates, Westmoreland has the highest VMT which accounts for 31% of the total VMT in the area of analysis. Cambria County is the third highest in VMT, however, this county only accounts for 10% of the total VMT within the area of analysis. An airport to the east of the monitor in Cambria County and a few major roads near the monitor may contribute to the emissions at the Cambria County monitor. Overall, the above data indicates that VMT is not an influential factor in determining nonattainment boundaries for the Johnstown Area.

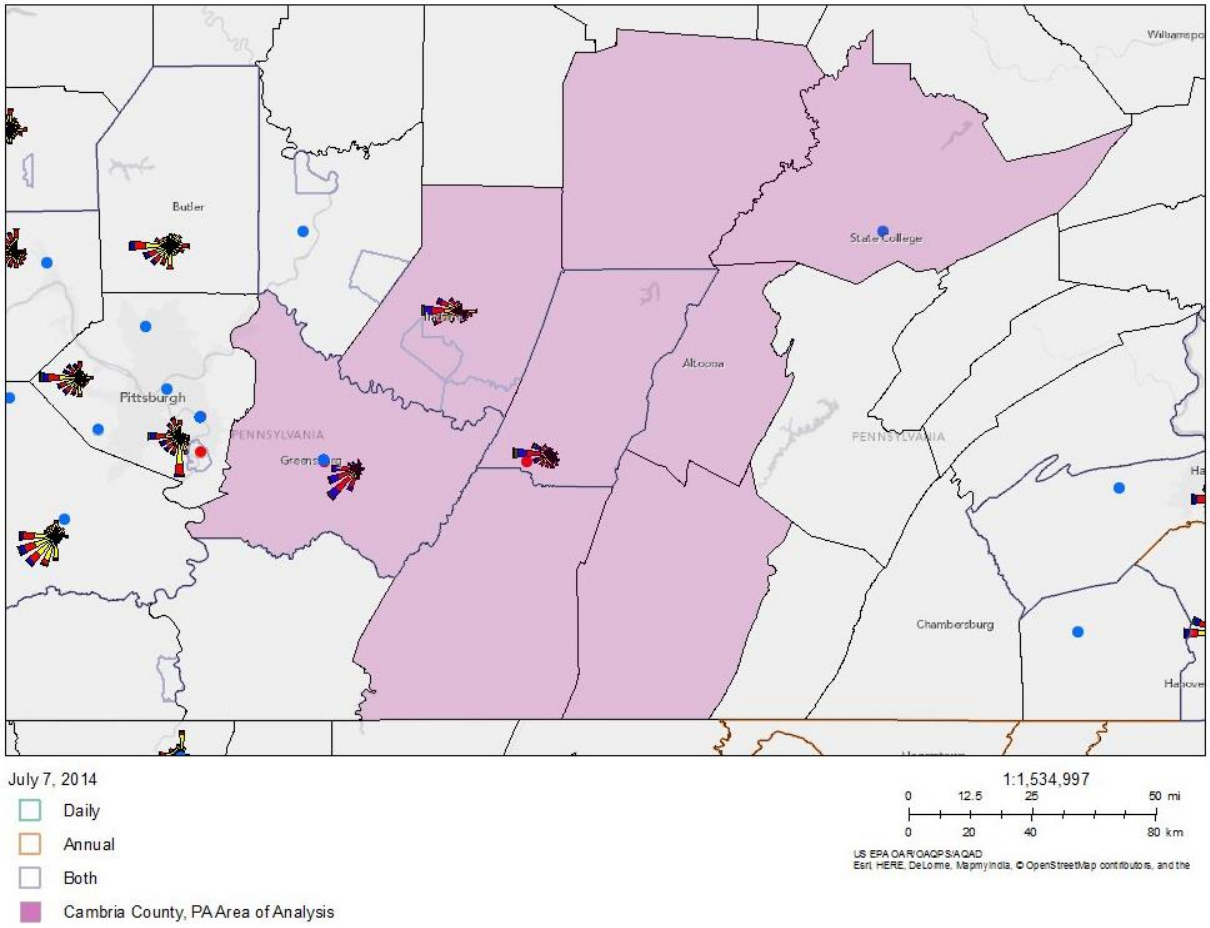
Factor 3: Meteorology

EPA evaluated available meteorological data to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of directly emitted particulate matter and precursor emissions from sources in the area of analysis. EPA used two primary tools for this assessment: wind roses and kernel density estimation (KDE). When considered in combination with area $PM_{2.5}$ composition and county-level and facility emissions source location information, wind roses and KDE can help to identify nearby areas contributing to violations at violating monitoring sites.

Wind roses are graphic illustrations of the frequency of wind direction and wind speed. Wind direction can indicate the direction from which contributing emissions are transported; wind speed can indicate the force of the wind and thus the distance from which those emissions are transported. EPA constructed wind roses from hourly observations of wind direction and wind speed using 2009-2012 data from National Weather Service locations archived at the National Climate Data Center.[31] When developing these wind roses, EPA also used wind observations collected at meteorological sampling stations collocated at air quality monitoring sites, where these data were available. Figure 8a shows wind roses that EPA generated from data relevant in the Johnstown Area.

[31] *ftp.ncdc.noaa.gov/pub/data/noaa* or *http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=cdo&theme=hourly&layers=1&node=gis* Quality assurance of the National Weather Service data is described here: *http://www1.ncdc.noaa.gov/pub/data/inventories/ish-qc.pdf*

Figure 8a. Wind Roses in the Area of Analysis for Johnstown Area.

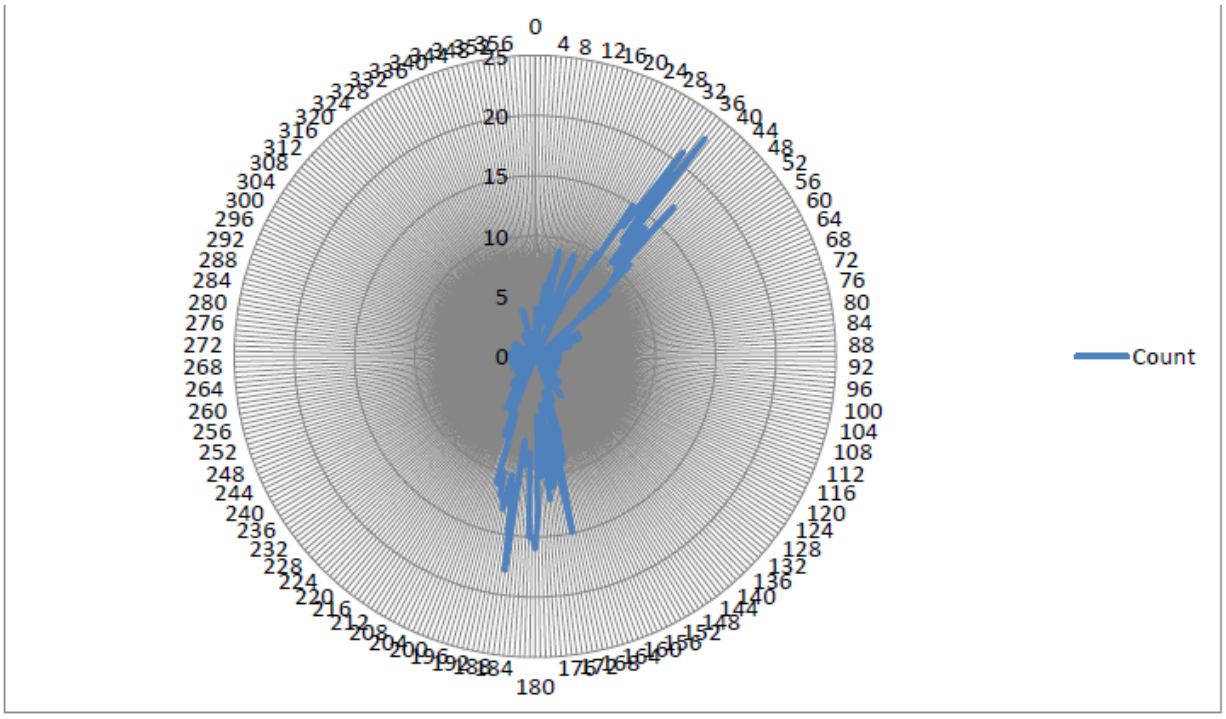


As shown in Figure 8a, the predominant winds near the violating monitor are from the west with some northwesterly and southwesterly components, suggesting that emission sources in the west upwind direction should be considered for analysis. These wind roses represent average wind directions throughout the year. Looking at point sources in the regional wind direction indicated in Figure 8a, there are three large EGUs in Indiana County which are northwest of the Cambria County monitor. These EGUs are Homer City, with emissions of over 94,000 tpy, and two GenOn facilities, Conemaugh and Seward Generating Station, with emissions of over 25,000 tpy and almost 9,000 tpy, respectively. As indicated in Table 5, these three facilities are three of the four largest sources of directly emitted $PM_{2.5}$ and its precursors in the area of analysis. In addition, the majority of the emissions in Indiana County are from these three facilities and, as indicated in Table 3b, the $PM_{2.5}$ emissions in Indiana County are mostly organic mass and crustal material which are components detected at the Cambria County violating monitor.

In its December 2013 recommendation letter, Pennsylvania included wind direction analysis when the Cambria County monitor's $PM_{2.5}$ concentrations were relatively high but the regional monitoring concentrations were "clean," i.e. 0-12 µg/m3. Between 2010 and 2012, Pennsylvania identified 173 days in which the Cambria County monitor was at least one standard deviation above the regional average while the regional average was at or below 12 µg/m3 (high days). The top 25% of these high days (most extreme events) were further analyzed to determine why the Cambria County violating monitor's concentrations were high. The Cambria County monitor is collocated with a meteorological

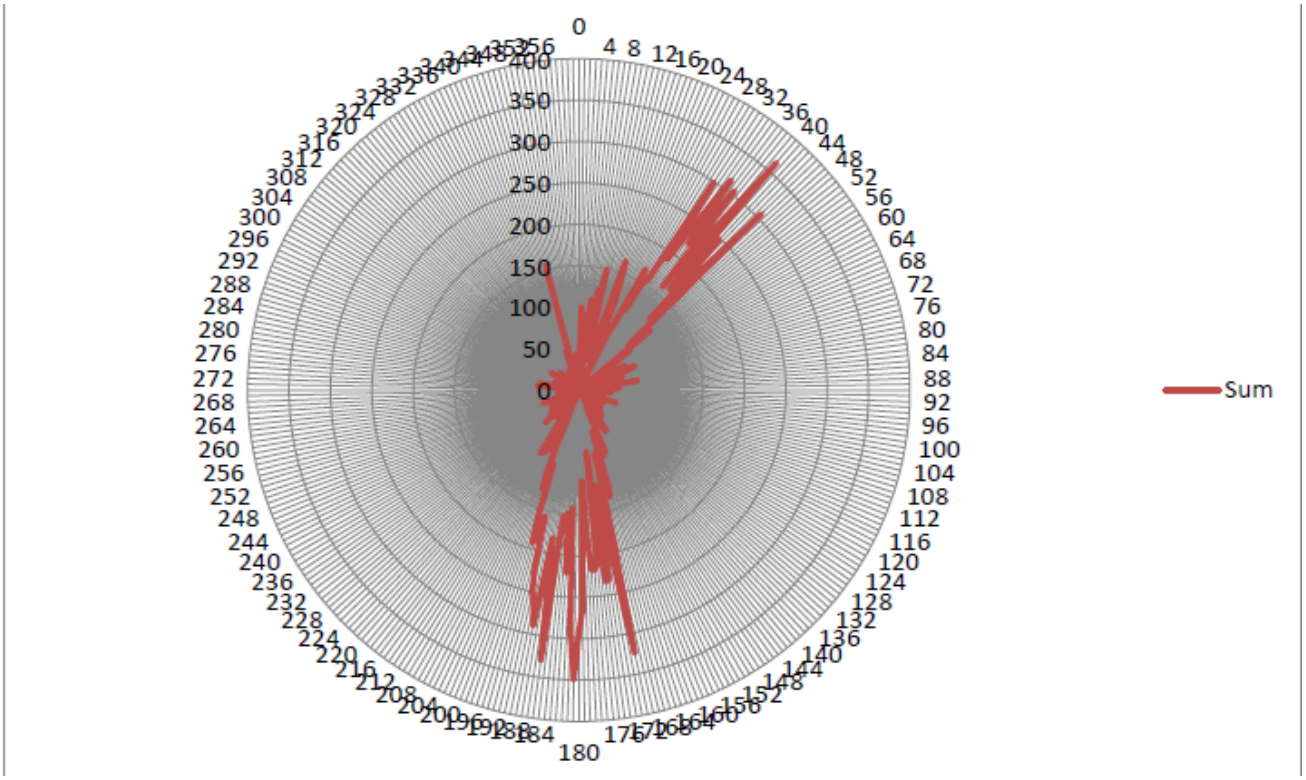
tower which monitors wind direction and wind speed. For the top 25% of these high days (highest $PM_{2.5}$ days), Pennsylvania calculated the number of hours the wind was coming from a particular direction as well as the $PM_{2.5}$ concentrations from a particular direction. Figures 8b and 8c represent the wind direction frequency and $PM_{2.5}$ concentration distribution by wind direction, respectively, at the Cambria County monitor during its highest $PM_{2.5}$ days.

Figure 8b. Cambria County Monitor Wind Direction Frequency – Top 25% of Regionally "Clean" Days



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-4 - Cambria County Area

Figure 8c. Cambria County Monitor $PM_{2.5}$ Concentration Distribution by Wind Direction – Top 25% of Regionally "Clean" Days



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-4 - Cambria County Area

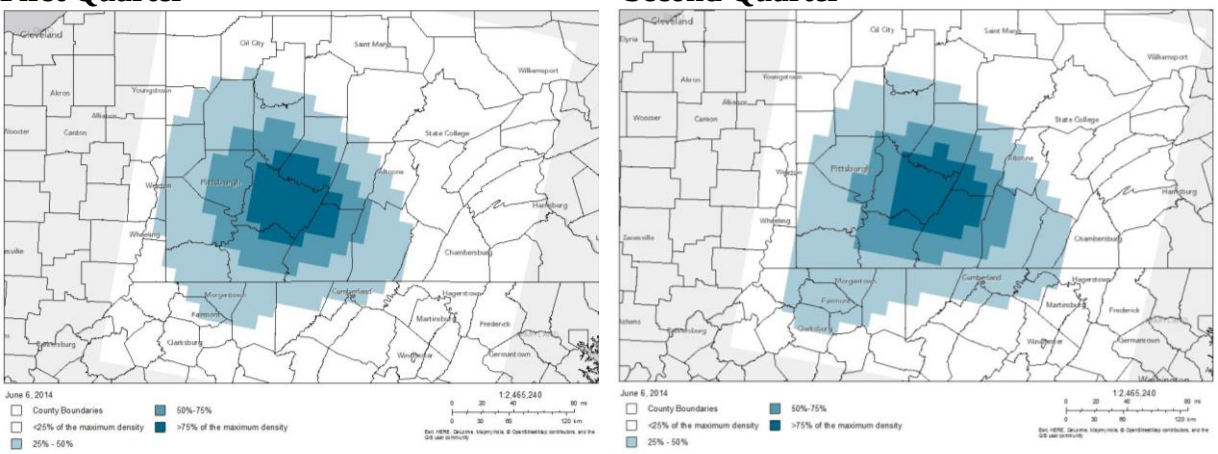
As indicated in Figure 8b, wind directions on high $PM_{2.5}$ days at the Cambria County monitor are coming from due south and from the northeast. As indicated in Figure 8c, the high $PM_{2.5}$ concentrations are also due south and from the northeast. The wind direction on high days identified by Pennsylvania in its December 2013 recommendation letter is slightly different from the regional wind directions identified by EPA shown in Figure 8a which is predominantly from the west and a small component from the northwest and southwest. As previously discussed, there are three large point sources to the west of the violating monitor in the regional wind direction. The wind direction on high $PM_{2.5}$ days in Pennsylvania's analysis is to the northeast and due south. Figure 5a indicates that there are three point sources in Cambria County to the northeast of the monitor however, there are not any point sources to the south of the Cambria monitor within the area of analysis As previously stated from Pennsylvania's December 2013 recommendation letter, proximity to a rail yard and warehouse with unpaved roads near the Cambria County monitor likely contributes to the local $PM_{2.5}$ concentrations and may account for this southerly component.

In addition to wind roses, EPA also generated kernel density estimation (KDE) plots to represent HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) backward trajectory frequency at

violating monitoring sites.[32,33] These KDEs are graphical statistical estimations to determine the density of trajectory endpoints at a particular location represented by a grid cell. The EPA used KDEs to characterize and analyze the collection of individual HYSPLIT backward trajectories for days throughout a 3-year period.[34] Higher density values, indicated by darker blue colors, indicate a greater frequency of observed trajectory endpoints within a particular grid cell. Figure 9 shows a HYSPLIT KDE plot for the Johnstown Area summarized by calendar quarter for the 2010-2012 period. The HYSPLIT KDE is weighted in the westerly direction, indicating a greater frequency of trajectories passing over grid cells to the west.

Figure 9. HYSPLIT Kernel Density Estimation Plots for the Johnstown Area.

First Quarter **Second Quarter**

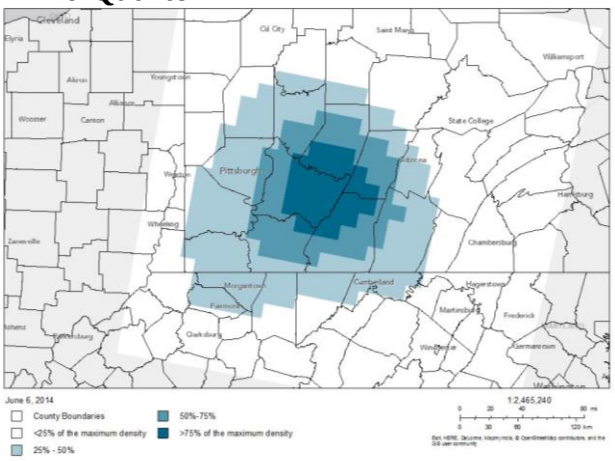


[32] In some past initial area designations efforts, EPA has used HYSPLIT backward trajectories to assist in determining nonattainment area boundaries. A HYSPLIT backward trajectory is usually depicted on a standard map as a single line, representing the centerline of an air parcel's motion, extending in two dimensional (x,y) space from a starting point and regressing backward in time to a point of origin. Backward trajectories may be an appropriate tool to assist in determining an air parcel's point of origin on a day in which a short-term standard, such as an 8-hour standard or a 24-hour standard, was exceeded. However, for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, every trajectory on every day is important. Plotting a mass of individual daily (e.g., 365 individual back trajectories), or more frequent, HYSPLIT trajectories may not be helpful as this process is likely to result in depicting air parcels originating in all directions from the violating monitoring site.

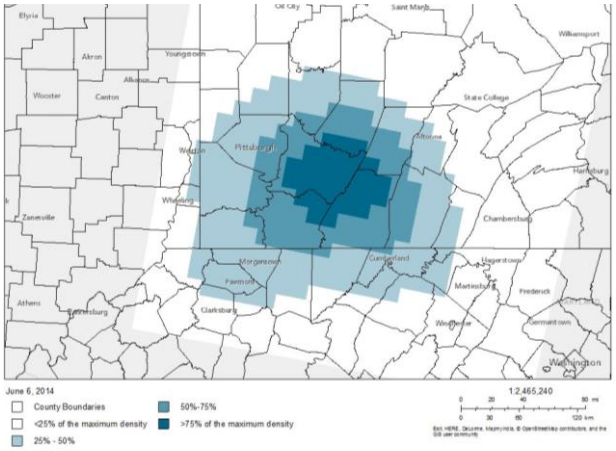
[33] HYSPLIT - Hybrid Single Particle Lagrangian Integrated Trajectory Model, *http://www.arl.noaa.gov/HYSPLIT_info.php*

[34] The KDEs graphically represent the aggregate of HYSPLIT backward trajectories for the years 2010-2012, run every third day (beginning on the first day of monitoring), four times each day, and ending at four endpoint heights.

Third Quarter



Fourth Quarter



The HYSPLIT KDE plots and regional wind roses suggest the greatest potential for contribution of emissions in the area of analysis is from the Westmoreland, Somerset and Indiana counties. As discussed in the emissions section and indicated in Figure 4f, the relatively high county total emissions for Westmoreland County are located in the northwest corner of the county. In Figure 9, the northwest corner of Westmoreland County is not in a grid square with very high potential for transport (darkest blue) to the violating monitor in Cambria County. Figure 4f and Table 3a also indicate that Somerset County has relatively low emissions, therefore, although Somerset County is within the grid cells with the higher potential to transport in Figure 9, there are relatively low emissions to actually transport to the violating monitor. Lastly, the higher density KDE values do include the three EGU's in Indiana County (Homer City and two GenOn facilities, Conemaugh and Seward Generating Stations) located in the south of Indiana County for all four quarters.

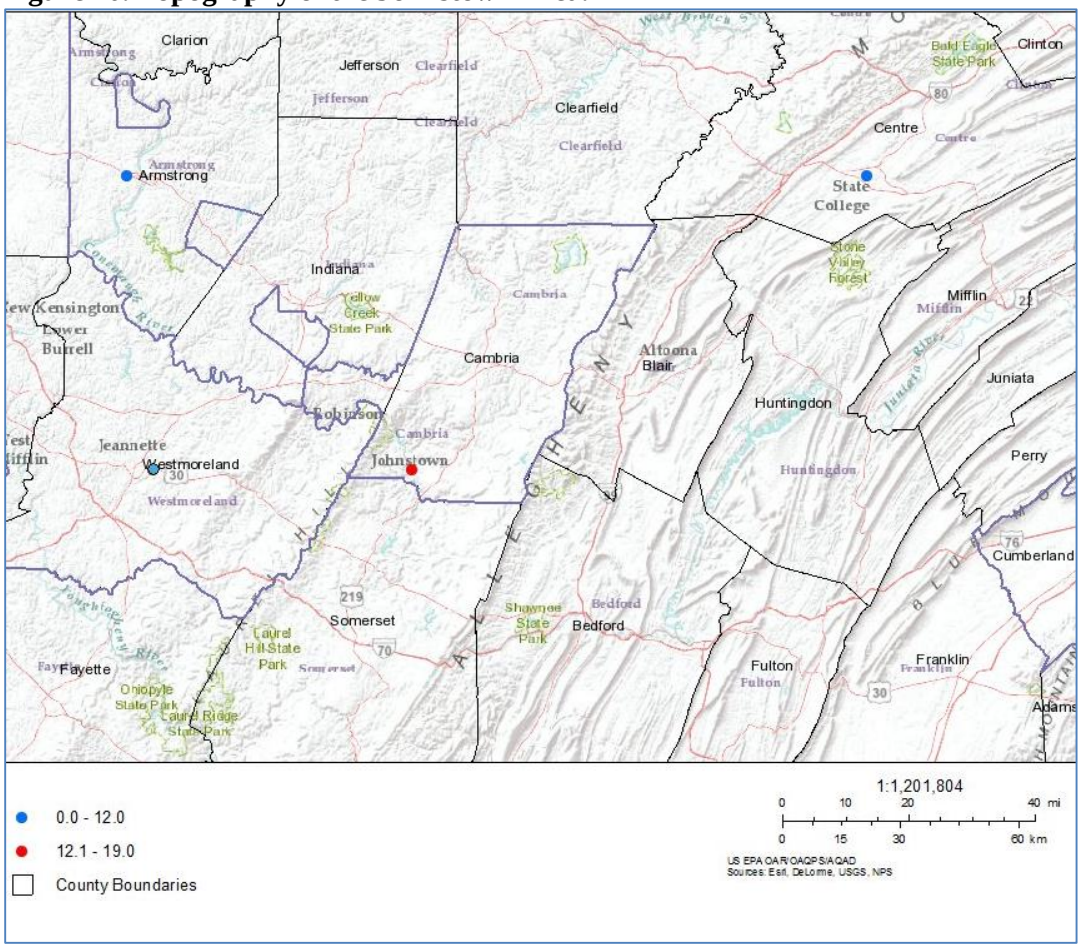
Factor 4: Geography/topography

To evaluate the geography/topography factor, EPA assessed physical features of the area of analysis that might define the airshed and thus affect the formation and distribution of $PM_{2.5}$ concentrations over the area.

For the Johnstown area, topography is an important factor, because the area is part of a river valley almost entirely surrounded by low mountains. These mountains limit transport of low-level emissions but do not limit transport of high-level emissions and $PM_{2.5}$ formation.

Some of the highest terrain in Pennsylvania brackets the Johnstown area with the Allegheny Mountains to the east and Laurel Hills to the west. The city of Johnstown itself lies in the approximately two-mile wide flood plain formed by the junction of the Stonycreek and Little Conemaugh Rivers, and the narrow Conemaugh River Gap where water flows out of the city. The basin within which the city lies is about 300 feet below the surrounding ridgelines. These topographical features diminish the transport of low level emissions such as mobile emissions from surrounding areas but do not diminish transport of high-level emissions from sources such as the EGUs in Indiana County.

Figure 10. Topography of the Johnstown Area.



Factor 5: Jurisdictional boundaries

In defining the boundaries of the intended Johnstown Area nonattainment area, EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Existing jurisdictional boundaries often signify the state and local governmental organization with the necessary legal authority for carrying out air quality planning and enforcement functions for the intended area. Examples of such jurisdictional boundaries include existing/prior nonattainment area boundaries for particulate matter, county lines, air district boundaries, township boundaries, areas covered by a metropolitan planning organization, state lines, and Reservation boundaries, if applicable. Where existing jurisdictional boundaries were not adequate or appropriate to describe the nonattainment area, EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

The violating monitor is located in the Johnstown, PA MSA. This is a single county MSA which consists of Cambria County, PA. Pennsylvania's regional transportation planning organizations fall along county lines. Cambria, Blair and Centre counties are all single-county MPOs named Johnstown

MPO, Altoona MPO and Center MPO, respectively. Bedford, Huntingdon and Somerset Counties are part of the Southern Alleghenies Planning and Development Commission rural planning organization (RPO). Westmoreland and Indiana County are part of the larger Southwestern Pennsylvania Commission MPO.

The Johnstown Area has previously established nonattainment boundaries associated with the 1997 annual and the 2006 24-hour $PM_{2.5}$ NAAQS. The boundary for the nonattainment area for the 1997 annual and the 2006 24-hour $PM_{2.5}$ NAAQS included the entire county of Cambria and part of Indiana County in Pennsylvania.

The state has recommended a different boundary for the 2012 annual $PM_{2.5}$ NAAQS by recommending only the single county of Cambria, PA. EPA's intended boundary for the 2012 annual $PM_{2.5}$ NAAQS differs from the State's recommendation and is the same as the 1997 annual and the 2006 24-hour $PM_{2.5}$ nonattainment boundaries, and includes the entire county of Cambria, PA, and partial county of Indiana, PA. EPA used township boundaries to determine the partial area of Indiana County which includes the townships of West Wheatfield, Center, East Wheatfield and Armagh Borough and Homer City Borough. This portion of Indiana County contains three large sources of direct $PM_{2.5}$ and its precursors: Homer City, GenOn Conemaugh Plant, and GenOn Seward Generating Station. These three EGUs have combined emissions of over 128,000 tpy and are contributing to the violating Cambria County monitor.

Conclusion for the Johnstown Area

Based on the assessment of factors described above, both individually and in combination, EPA has preliminarily concluded that the following counties should be included as part of the Johnstown Area nonattainment area because they are either violating the 2012 annual $PM_{2.5}$ NAAQS or contributing to a violation in a nearby area: Cambria County, PA and a portion of Indiana County, PA which includes the townships of West Wheatfield, Center, East Wheatfield and Armagh Borough and Homer City Borough.

These are the same counties that are included in the Johnstown nonattainment area for the 2006 24-hour and 1997 annual $PM_{2.5}$ NAAQS. The air quality monitoring site in Cambria County indicates violations of the 2012 annual $PM_{2.5}$ NAAQS based on the 2013 DVs; therefore this county is included in the nonattainment area. Indiana County is a nearby county that does not have a violating monitoring site, but EPA has concluded that partial areas of Indiana County contribute to the particulate matter concentrations in violation of the 2012 annual $PM_{2.5}$ NAAQS through emissions from point sources. Indiana County has among the highest emissions of directly emitted $PM_{2.5}$ and/or $PM_{2.5}$ precursors in the area and has three large point sources located in the regional westerly wind direction and near the violating monitor in Cambria County.

The speciation data for the Cambria County violating monitoring site indicate that organic mass and sulfates are the predominant species overall with an exception in the first quarter when nitrates are higher may be due to increased EGU emissions from winter heating needs and greater particle nitrate collection during the cooler months. When accounting for the urban increment, the sulfate component

becomes less dominant, however, there is still some remaining sulfate detected at the monitor. The urban increment analysis indicates that organic mass and elemental carbon are the major components of $PM_{2.5}$ contributing to the violation at the Cambria County monitoring site

The wind roses representing average wind direction throughout the year indicate that the predominant winds near the violating monitor are from the west with some northwest and southwest components. Additional meteorological data provided by Pennsylvania indicate that wind directions on high $PM_{2.5}$ days at the Cambria County violating monitor are coming from due south and from the northeast.

Looking at point sources in the regional wind direction, westerly with components from the northwest and southwest, there are three large EGUs in Indiana County to the northwest of the Cambria County monitor. Considering the wind direction on high $PM_{2.5}$ days, northeast and south, there are point sources to the northeast of the monitor in Cambria County, however, there are not any point sources of $PM_{2.5}$ south of the monitor within the area of analysis. As previously stated in Pennsylvania's December 2013 recommendation letter, proximity to a rail yard and warehouse with unpaved roads near the Cambria County monitor likely contributes to the local $PM_{2.5}$ concentrations and may account for contributions from the south.

In addition, the HYSPLIT KDE is weighted in the westerly direction, indicating a greater frequency of trajectories passing over grid cells to the west. The three EGU's in Indiana County fall within the higher density grid cells indicated by darker blue color in Figure 9 for all four quarters. These high density values indicate a higher potential to transport from a particular grid cell.

The Johnstown area has low population density and low levels of VMT. Thus, population and VMT are generally not influential factors in this case contributing to the exceedances of the Cambria County violating monitor.

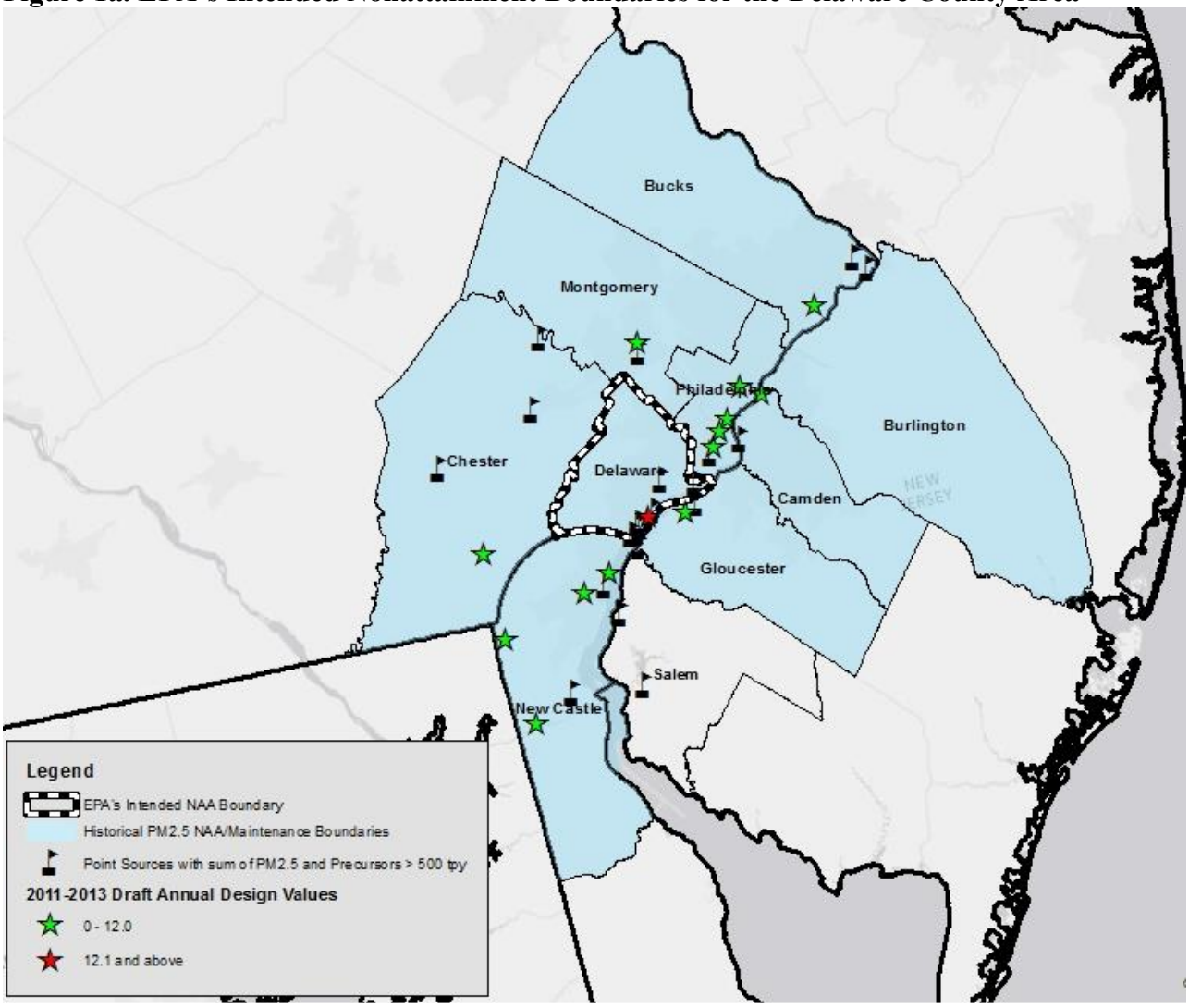
For the Johnstown area, topography is an important factor because the area is part of a river valley almost entirely surrounded by low mountains. These mountains limit transport of low-level emissions such as mobile emissions but do not limit transport of high-level emissions and $PM_{2.5}$ formation from sources such as EGUs.

In conclusion, for the Johnstown area the five factor analysis supports EPA's intention to adopt the same boundaries for the Johnstown 2012 annual $PM_{2.5}$ NAAQS nonattainment area as were designated for the 2006 24-hour and 1997 annual $PM_{2.5}$ NAAQS nonattainment area. The Johnstown Area would therefore consist of Cambria County, PA and the partial county of Indiana, PA containing the townships of West Wheatfield, Center, East Wheatfield, and Armagh Borough and Homer City Borough.

3.2 Area Background and Overview - Delaware County Area

Figure 1a is a map of EPA's intended nonattainment boundary for the Delaware County Area. The map shows the location and DVs of ambient air quality monitoring locations, county and other jurisdictional boundaries, including the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA. For purposes of the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS, Delaware County, PA was designated nonattainment as part of the Philadelphia-Wilmington, PA-NJ-DE nonattainment area. The boundary for the nonattainment area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS included the entire counties of Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; Burlington, Camden, and Gloucester in New Jersey; and New Castle in Delaware.

Figure 1a. EPA's Intended Nonattainment Boundaries for the Delaware County Area

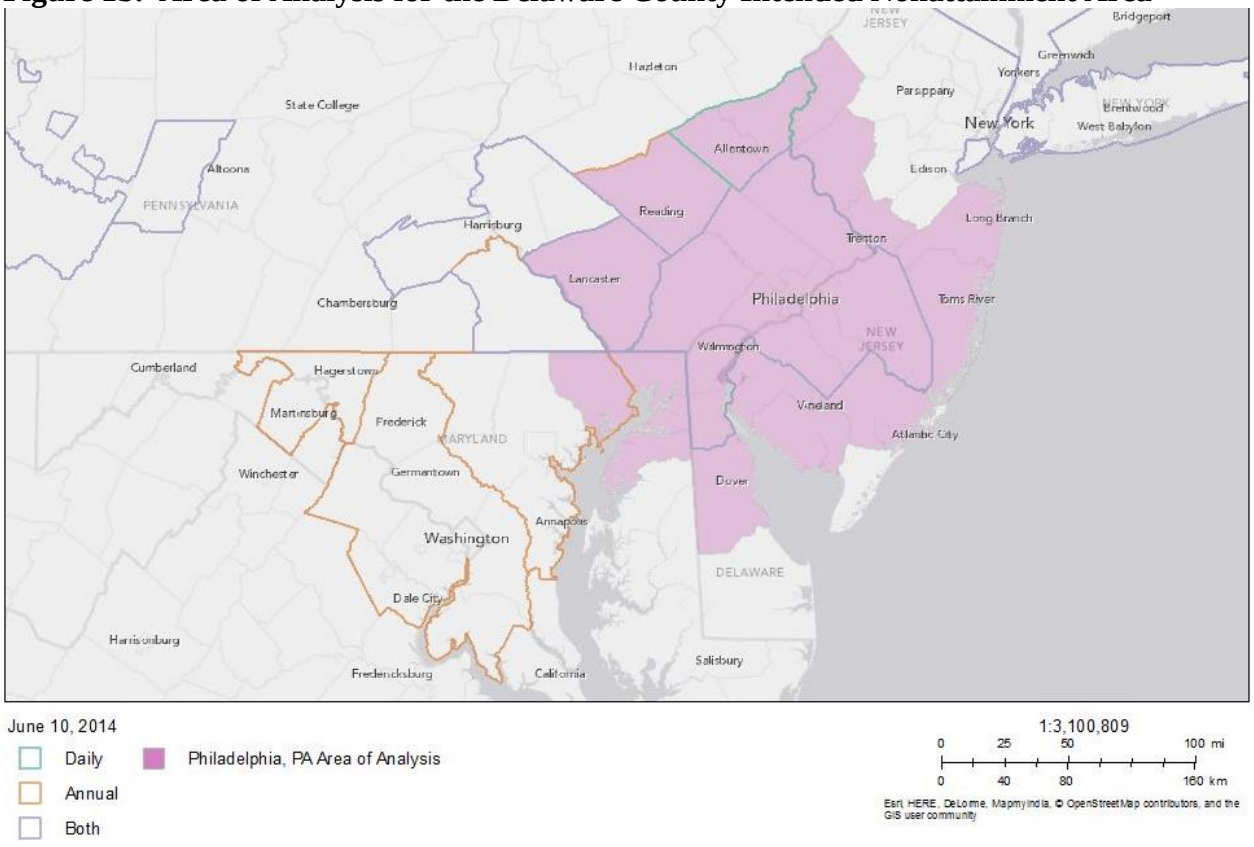


EPA must designate as nonattainment areas that violate the NAAQS and nearby areas that contribute to the violation in the violating area. As discussed below, a monitor in Delaware County, PA shows a violation of the 2012 annual $PM_{2.5}$ NAAQS. Therefore, Delaware County is included in the nonattainment area. As shown in Figure 1b, EPA evaluated each county in the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA, which includes Delaware County, PA as well as New Castle County, Delaware; Cecil County, Maryland; Burlington, Camden, Gloucester, and Salem Counties in

New Jersey; and Bucks, Chester, Montgomery, and Philadelphia Counties in Pennsylvania, and a ring of counties adjacent to the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA. EPA's evaluation was based on the five factors and other relevant information. Based upon the data discussed below, EPA determined that no counties in this area of analysis, other than Delaware County, contribute to the violation at the Delaware County monitor. Note that Northampton County, PA, which shows a violation, is in the area of analysis. As discussed in section 3.4, EPA intends to designate Northampton County, along with Lehigh County, PA, in a separate nonattainment area, the Northampton County Area.

The following sections describe the five factor analysis process. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers their interconnections and the dependence of each factor on one or more of the others.

Figure 1b. Area of Analysis for the Delaware County Intended Nonattainment Area



Factor 1: Air Quality Data

All ambient air quality data collected during the year are important when determining contributions to an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS. Compliance with an annual NAAQS is dependent upon monitor readings throughout the year, including days with monitored ambient concentrations below the level of the NAAQS. For the 2012 annual $PM_{2.5}$ NAAQS, the annual mean is calculated as the mean of quarterly means. A high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV. Although all data are important, seasonal or episodic emissions can provide insight as to relative contributors to measured $PM_{2.5}$ concentrations. For these

reasons, for the Factor 1 air quality analysis, EPA assessed and characterized air quality at, and in the proximity of, the violating monitoring site locations first by evaluating trends and the spatial extent of measured concentrations at monitors in the area of analysis, and then by identifying the conditions most associated with high average concentration levels of $PM_{2.5}$ mass in the area of analysis.

In most cases, EPA assessed air quality data on a seasonal, or quarterly, basis.[35] EPA also identified the spatial extent of these high $PM_{2.5}$ concentrations. The mass and composition at the DV location represents contributions from various emission sources including local, area-wide (which may comprise nearby urban and rural areas) and regional sources. To determine the source mix (by mass) at the DV monitoring site, EPA examined the chemical composition of the monitored $PM_{2.5}$ concentrations by pairing each violating FRM/FEM/ARM monitoring site with a collocated or nearby Chemical Speciation Network (CSN) monitoring site or sites. Then, EPA contrasted the approximated mass composition at the DV monitoring site with data collected at IMPROVE[36] and other monitoring locations whose data are representative of regional background.[37,38] This comparison of local/area-wide chemical composition data to regional chemical composition data derives an "urban increment," which helps differentiate the influence of more distant emissions sources from the influence of closer

[35] Although compliance with the annual NAAQS depends on contributions from all days of the year, examining data on a quarterly or seasonal basis can inform the relationship between the temporal variability of emissions and meteorology and the resulting $PM_{2.5}$ mass and composition. In some areas of the country where there may be noticeable month-to-month variations in average $PM_{2.5}$, the quarterly averages may not adequately represent seasonal variability. In these areas, air quality data may be aggregated and presented by those months that best correspond to the local "seasons" in these areas.

[36] IMPROVE stands for Interagency Monitoring for Protected Visual Environments and is an aerosol monitoring network in mostly rural and remote areas.

[37] The "urban increment" analysis assesses and characterizes the increase in seasonal and annual average $PM_{2.5}$ mass and chemical components observed at violating monitoring site(s) relative to monitoring sites outside the area of analysis (which represent background concentrations). Developing the urban increment involves pairing a violating FRM/FEM/ARM monitor with a collocated monitor or nearby monitor with speciation data. EPA made every effort to pair these data to represent the same temporal and spatial scales. However, in some cases, the paired violating and CSN "urban" monitoring locations were separated by some distance such that the included urban CSN site(s) reflect(s) a different mixture of emissions sources, which could lead to misinterpretations. To generally account for differences in $PM_{2.5}$ mass between the violating site and the nearby CSN site(s), EPA determined material balance of the $PM_{2.5}$ composition at the violating site by assigning the extra measured $PM_{2.5}$ mass to the carbon components of $PM_{2.5}$. Where the general urban increment approach may be misleading, or in situations where non-carbonaceous emissions are believed to be responsible for a local $PM_{2.5}$ concentration gradient, EPA used alternative analyses to reflect the mix of urban and rural sources contributing to the measured concentrations at violating monitoring sites.

[38] The urban monitors were paired with any rural sites within a 150 mile radius of an urban site to calculate spatial means of the quarterly averages of each species. If there were no rural sites within 150 miles, then the nearest rural site was used alone. That rural mean was then subtracted from the quarterly mean of the urban site to get the increment. Negative values were simply replaced with zeros.

emissions sources, thus representing the portion of the measured violation that is associated with nearby emission contributions.[39,40,41]

$PM_{2.5}$ Design Values and Total Mass Measurements - EPA examined ambient $PM_{2.5}$ air quality monitoring data represented by the DVs at each violating monitoring site and at other monitors in the area of analysis. EPA calculated DVs based on air quality data for the most recent 3 consecutive calendar years of quality-assured, certified air quality data from suitable FEM/FRM/ARM monitoring sites in the EPA's Air Quality System (AQS). For this designations analysis, EPA used data for the 2011-2013 period (i.e., the 2013 DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2012 annual $PM_{2.5}$ NAAQS is met at a monitoring site when the 3-year average annual mean concentration is 12.0 micrograms per cubic meter ($\mu g/m^3$) or less (e.g., 12.1 $\mu g/m^3$ or greater is a violation). A DV is only valid if minimum data completeness criteria are met or when other regulatory data processing provisions are satisfied (See 40 CFR part 50 Appendix N). Table 2 identifies the current DVs (i.e., the 2013 DV) and the most recent two DVs based on all monitoring sites in the area of analysis for the Delaware County Area intended nonattainment area.[42]

Table 2. Air Quality Data collected at Regulatory Monitors (all DV levels in $\mu g/m^3$)[a,b]

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Kent, DE	100010002	No	9.1	8.7	8.2
Kent, DE	**100010003**	**No**	**9.4**	**9**	**8.4**
New Castle, DE	100031003	No	9.9	9.6	9.1
New Castle, DE	100031007	No	9.6	9.1	8.4
New Castle, DE	100031012	No	10.5	10.1	9.7
New Castle, DE	100032004	No	**10.7**	**10.4**	**10**

[39] In most, but not all, cases, the violating design value monitoring site is located in an urban area. Where the violating monitor is not located in an urban area, the "urban increment" represents the difference between local and other nearby emission sources in the vicinity of the violating monitoring location and more regional sources.

[40] Hand, et. al. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report V, June 2011. Chapter 7 – Urban Excess in $PM_{2.5}$ Speciated Aerosol Concentrations, *http://vista.cira.colostate.edu/improve/Publications/Reports/2011/PDF/Chapter7.pdf*

[41] US EPA, Office of Air Quality Planning and Standards, December 2004. (2004) Area Designations for 1997 Fine Particle ($PM_{2.5}$) Standards, Technical Support Document for State and Tribal Air Quality Fine Particle ($PM_{2.5}$) Designations, Chapter 3, Urban Excess Methodology. Available at *www.epa.gov/pmdesignations/1997standards/documents/final/TSD/Ch3.pdf*

[42] In certain circumstances, one or more monitoring locations within a monitoring network may not meet the network technical requirements set forth in 40 CFR 58.11(e), which states, "State and local governments must assess data from Class III $PM_{2.5}$ FEM and ARM monitors operated within their network using the performance criteria described in table C-4 to subpart C of part 53 of this chapter, for cases where the data are identified as not of sufficient comparability to a collocated FRM, and the monitoring agency requests that the FEM or ARM data should not be used in comparison to the NAAQS. These assessments are required in the monitoring agency's annual monitoring network plan described in §58.10(b) for cases where the FEM or ARM is identified as not of sufficient comparability to a collocated FRM…."

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Cecil, MD	240150003	No	10.4	10.4	10
Harford, MD	240251001	No	9.8	10.3	10.3
Kent, MD	N/A	No	No monitor		
Atlantic, NJ	340010006	No	8.4	8.2	7.8
Atlantic, NJ	340011006	No	**9.2**	**8.9**	**8.7**
Burlington, NJ	N/A	No	No monitor		
Camden, NJ	340071007	No	9.7	9.5	9.7
Cumberland, NJ	N/A	No	No monitor		
Gloucester, NJ	340150004	No	9.3	9.3	9
Hunterdon, NJ	N/A	No	No monitor		
Mercer, NJ	340210008	No	**9.7**	**9.5**	**9.4**
Mercer, NJ	340218001	No	8.2	8.2	8.2
Monmouth, NJ	N/A	No	No monitor		
Ocean, NJ	340292002	No	8.6	8.5	8.3
Salem, NJ	N/A	No	No monitor		
Warren, NJ	340410006	No	9.2	9.4	9.1
Berks, PA	420110011	No	10.7	10.9	11
Bucks, PA	420170012	No	10.9	10.9	10.8
Chester, PA	420290100	No	13.7	12.3	11.1
Cumberland, PA	N/A	No	No monitor		
Delaware, PA	420450002	Yes	12.9	13.1	12.4
Lancaster, PA	420710007	No	12	12.1	12
Lehigh, PA	N/A	No	No monitor		
Montgomery, PA	420910013	No	10.1	9.8	9.8
Northampton, PA	420950025	Yes (other area)	13.4	13.2	12.2
Northampton, PA	420950027	Yes (other area)		10.6	10.6
Philadelphia, PA	421010004	No	**11.5**	9.8	9.3
Philadelphia, PA	421010047	No	11.2	10.9	10.5

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Philadelphia, PA	421010055	No	11.4	**11**	**11.1**
Philadelphia, PA	421010057	No	11.1	10.8	10.7

[a]If a county has more than one monitoring location, the county DV is indicated in bold type.
[b]If a monitor is violating, the NAAQS, the violating DV is indicated in red type.

The Figure 1 map, shown previously, identifies the Delaware County, PA intended nonattainment area, the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA boundary, and monitoring locations with 2011-2013 violating DVs. As indicated on the map and in Table 2, there are two violating monitoring locations in the area of analysis. One violating monitor is located in Delaware County, PA, monitor 420450002 (the "violating monitor" or the "Delaware County monitor"). The second violating monitor is located in Northampton County, PA. As discussed in Section 3.4, below, EPA conducted a separate five factor analysis for the violating monitor in Northampton County, and has determined that Northampton County, PA should be designated in a separate nonattainment area, the Northampton County Area.

Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. Figure 2a shows quarterly mean $PM_{2.5}$ concentrations for the most recent 3-year period for the highest DV monitoring sites in each county within the area of analysis. This graphical representation is particularly relevant when assessing air quality data for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, because, as previously stated, the annual mean is calculated as the mean of quarterly means and a high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV. Figure 2b shows quarterly mean $PM_{2.5}$ concentrations for the most recent 3-year period for the Delaware County, PA monitoring site and for the highest DV monitor in each county in the area of analysis.

Figure 2a. Delaware County Area of Analysis $PM_{2.5}$ Quarterly Means for 2011-2013 (µg/m^3)

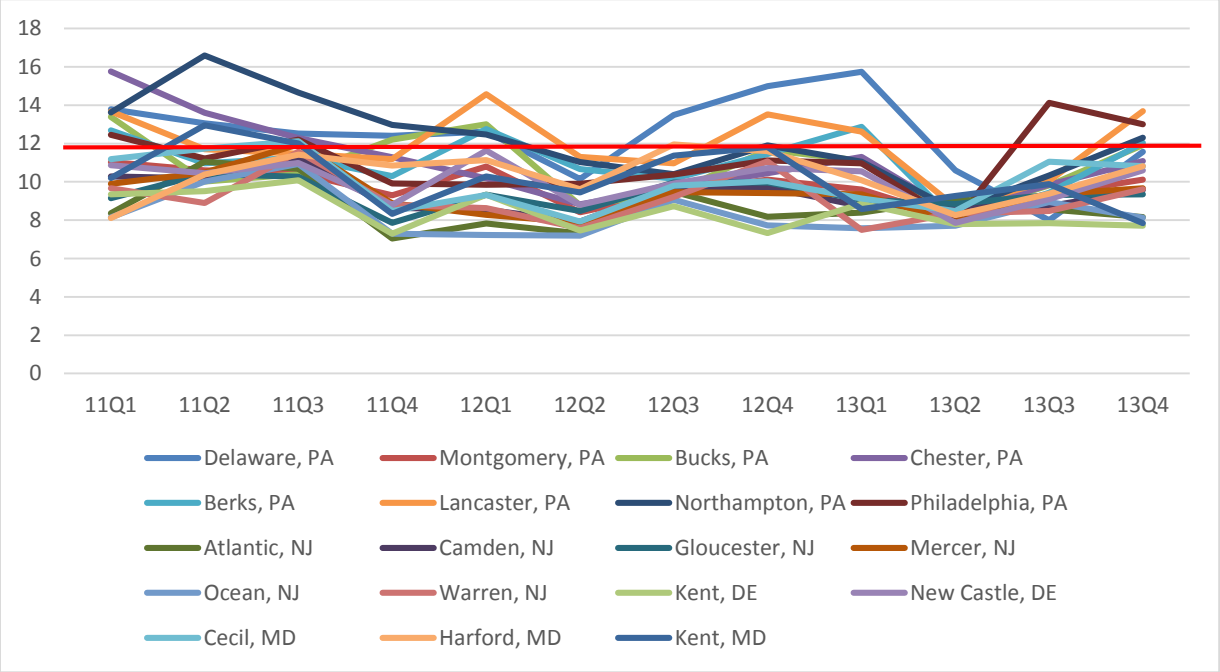
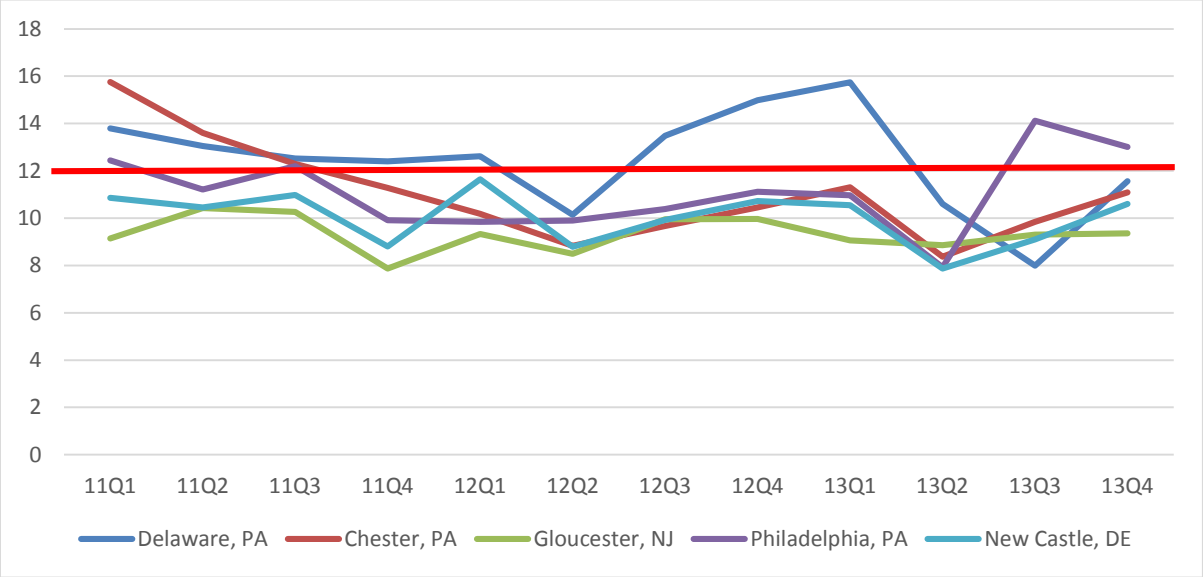


Figure 2b. Delaware County and Adjacent Counties $PM_{2.5}$ Quarterly Means for 2011-2013 ($\mu g/m^3$)



As shown, in Figure 2a, most monitors in the area of analysis show higher quarterly mean values in quarter 3 of each year, which likely corresponds to higher emissions from electric generating units (EGUs) from higher air conditioning use. These monitors also generally show higher quarterly mean values in the first quarter, which may be due to higher EGU emissions from higher heating use and possibly SO_2 emissions from home heating oil. In addition, there is a greater tendency for NO_x to form in the atmosphere and for FRM monitors to retain particle nitrate during the cooler months. However, as shown in Figure 2b, the violating Delaware County monitor does not seem to experience highs and lows in the same quarters as its neighbors. Quarterly means were relatively consistent for the Delaware County monitor starting in the first quarter in 2011 through the first quarter in 2012, with the low point in the second quarter of 2012. From the third quarter in 2012 to the second quarter in 2013, the Delaware County monitor was considerably higher than the other monitors in the area of analysis, while the surrounding monitors either drop off or remain low, suggesting an important local influence at the violating monitor relative to possible influences from elsewhere. In the third and fourth quarters of 2013, the $PM_{2.5}$ values at the Delaware County monitor appear to track with most other monitors in the area. This suggests that the influence of the local sources was less in those quarters. Furthermore, as can be seen in Figure 2b, the Delaware monitor's quarterly means the third and fourth quarters of 2013 are below the 12 $\mu g/m^3$ level of the 2012 annual $PM_{2.5}$ NAAQS.

<u>$PM_{2.5}$ Composition Measurements</u> - To assess potential emissions contributions for each violating monitoring location, the EPA determined the various chemical species comprising total $PM_{2.5}$ to identify the chemical components over the analysis area, which can provide insight into the types of emission sources impacting the monitored concentration. To best describe the $PM_{2.5}$ at the violating monitoring location, EPA first adjusted the chemical speciation measurement data from a monitoring location at or near the violating FRM monitoring site using the SANDWICH approach to account for

the amount of $PM_{2.5}$ mass components retained in the FRM measurement.[43,44,45,46] In particular, this approach accounts for losses in fine particle nitrate and increases in sulfate mass associated with particle bound water. The Delaware County monitoring site does not have the capability to provide speciation data. Therefore, EPA evaluated speciation data at two monitor locations near the Delaware County monitor, the monitoring site 100032004 located in New Castle County, DE and monitoring site 421010055 located in Philadelphia County, PA. Figure 3a illustrates the average fraction of each $PM_{2.5}$ chemical component from these monitoring sites based on annual averages for the years 2010-2012. These monitoring sites were used because of their proximity to the violating monitor in Delaware County, PA, to represent the speciation data in the region.

Figure 3a. Greater Philadelphia Area 2010-2012 Annual Average $PM_{2.5}$ Chemical Components ($\mu g/m^3$)

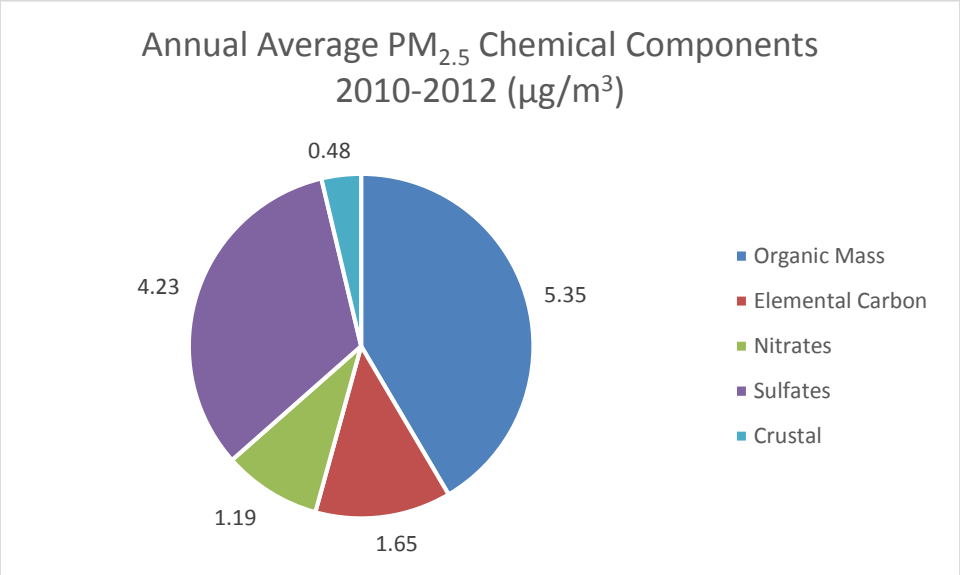


Figure 3b shows annual and quarterly chemical composition profiles and illustrates any seasonal or episodic contributors to $PM_{2.5}$ mass at the New Castle County, DE and Philadelphia County, PA monitors, 100032004 and 421010055. This "increment analysis," combined with the other factor

[43] SANDWICH stands for measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous mass **H**ybrid Material Balance Approach." The SANDWICH adjustment uses an FRM mass construction methodology that results in reduced nitrates (relative to the amount measured by routine speciation networks), higher mass associated with sulfates (reflecting water included in gravimetric FRM measurements) and a measure of organic carbonaceous mass derived from the difference between measured $PM_{2.5}$ and its non-carbon components. This characterization of $PM_{2.5}$ mass also reflects crustal material and other minor components. The resulting characterization provides a complete mass closure for the measured FRM $PM_{2.5}$ mass, which can be different than the data provided directly by the speciation measurements from the CSN network.

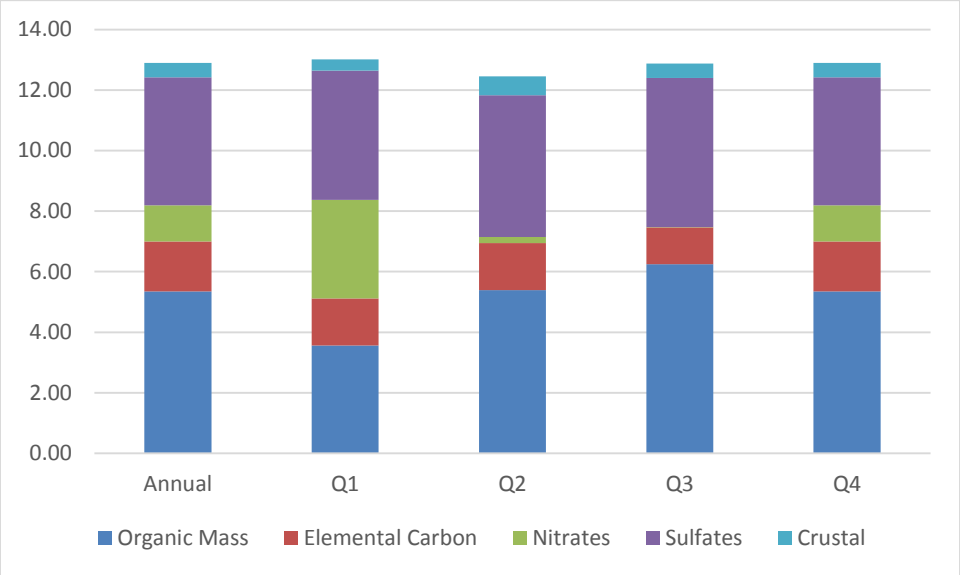
[44] Frank, N. H., SANDWICH Material Balance Approach for $PM_{2.5}$ Data Analysis, National Air Monitoring Conference, Las Vegas, Nevada, November 6-9, 2006. *http://www.epa.gov/ttn/amtic/files/2006conference/frank.pdf*.

[45] Frank, N. H., The Chemical Composition of $PM_{2.5}$ to support PM Implementation, EPA State /Local/Tribal Training Workshop: $PM_{2.5}$ Final Rule Implementation and 2006 $PM_{2.5}$ Designation Process, Chicago IL, June 20-21, 2007, *http://www.epa.gov/ttn/naaqs/pm/presents/pm2.5_chemical_composition.pdf.*

[46] Frank, N. H. *Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities*. J. Air & Waste Manage. Assoc. 2006 56:500–511.

analyses, can provide additional insight as to which sources or factors may contribute at a greater level. Simply stated, this analysis can help identify nearby sources of emissions that contribute to the violation at the violating monitoring site. However, as stated above, because there is no speciation data available at the violating Delaware County monitor, the analysis shown in Figure 3b gives the annual and quarterly chemical composition profiles for monitoring site 100032004 in New Castle County, DE and monitoring site 421010055 in Philadelphia County, PA.

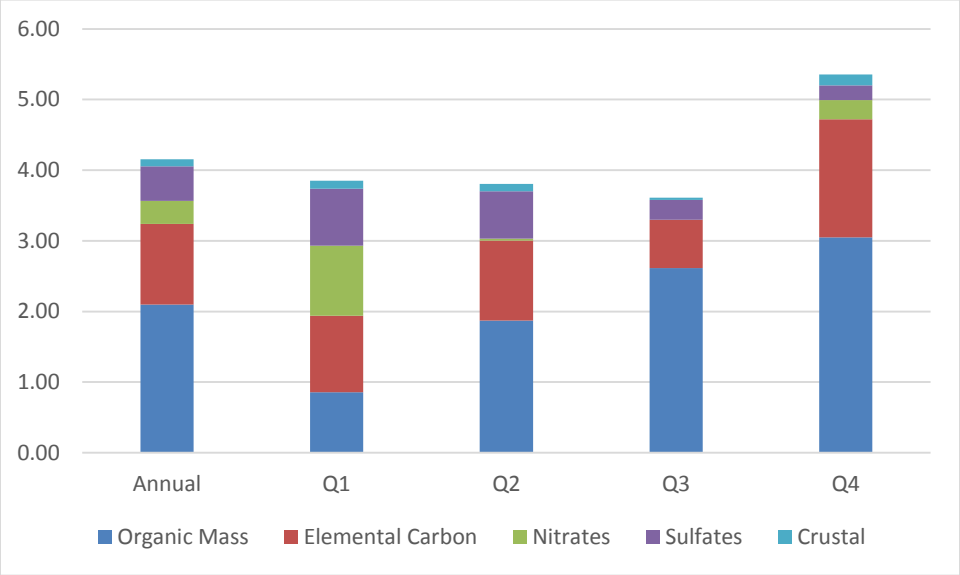
Figure 3b. Greater Philadelphia Area 2010-2012 Annual and Quarterly Average $PM_{2.5}$ Species ($\mu g/m^3$) [a]



[a] *Adjusted to FRM Total $PM_{2.5}$* indicates that the speciation profile and total mass depicted in this figure are the result of the urban increment calculation for the particular FRM monitor.

EPA assessed seasonal and annual average $PM_{2.5}$ components at monitoring sites within the area relative to monitoring sites outside of the analysis area to account for the difference between regional background concentrations of $PM_{2.5}$, and the concentrations of $PM_{2.5}$ in the area of analysis, also known as the "urban increment." This analysis differentiates between the influences of emissions from sources in nearby areas and in more distant areas on the violating monitor. Estimating the urban increment in the area helps to illuminate the amount and type of particles at the violating monitor that are most likely to be the result of sources of emissions in nearby areas, as opposed to impacts of more distant or regional sources of emissions. Figure 4a includes bar charts showing the annual and quarterly chemical mass components of the urban increment at monitoring site 100032004 in New Castle County, DE and monitoring site 421010055 in Philadelphia County, PA. The quarterly bar charts correspond to the high-concentration quarters identified in Figure 2. Evaluating these high concentration quarters can help identify composition of $PM_{2.5}$ during these times. Note that in these charts, sulfates and nitrates have been adjusted to represent their mass in measured $PM_{2.5}$.

Figure 4. Greater Philadelphia Area Average and Quarterly Urban Increment Analysis for 2010-2012 (µg/m^3).



These speciation and urban increment data are illuminating with respect to the chemical composition of $PM_{2.5}$ at monitoring site 100032004 in New Castle County, DE and monitoring site 421010055 in Philadelphia County, PA, and are relevant to the greater Philadelphia region. Figures 3a and 3b show large sulfate and organic mass at these monitors year round, with high nitrates in the first quarter, possibly due to EGU emissions from winter heating needs and greater particle nitrate collection during the cooler months. Figure 4a shows that organic mass and elemental carbon are a large part of the urban increment year round at these monitors, while nitrate appear in the first quarter and sulfates in both the first and second quarters. Since nitrate is limited to quarter one, mobile sources may not be a notable contributor to the urban increment.

However, EPA does not believe that the monitoring data from monitoring site 100032004 in New Castle County, DE and monitoring site 421010055 in Philadelphia County, PA is sufficiently comparable to the Delaware County monitor to draw any conclusions about the sources that contribute to a violation of that monitor. As illustrated in Figures 2a and 2b and discussed above, $PM_{2.5}$ levels at the Delaware County monitor do not track well with the rest of the area of analysis, including monitors 100032004 and 421010055. . The differences in seasonal peaks at the Delaware County monitor is an indication of local influences. There is a local influence at the Delaware County monitor that is not affecting the other monitors in the Philadelphia region, which are all meeting the 2012 annual $PM_{2.5}$ NAAQS.

As stated above, the Delaware County monitor does not appear to be influenced by the same seasonal factors as the other two monitors, or the rest of the greater Philadelphia area. This is supported by the assessment that Pennsylvania provided in its December 10, 2013 designation recommendations, which compared $PM_{2.5}$ levels at the Delaware County to other nearby monitors. Pennsylvania's analysis also supports EPA's finding that $PM_{2.5}$ concentrations at the Delaware County monitor were relatively high and not consistent with other monitors in the region. Here are two excerpts from Pennsylvania's December 10, 2013 recommendation letter, Appendix C-1: Greater Philadelphia Area. Note that because the Delaware County monitor is located in the City of Chester, Pennsylvania refers to it as the "Chester monitor."

"The Chester monitor is the only monitor in this region with an annual average and annual DV 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 μg/m3 standard."

and

"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 μg/m3."

Factor 2: Emissions and emissions-related data

In this designations process, for each area with a violating monitoring site, EPA evaluated the emissions data from nearby areas using emissions related data for the relevant counties to assess each county's potential contribution to $PM_{2.5}$ concentrations at the violating monitoring site or monitoring sites in the area under evaluation. Similar to the air quality analysis, these data were examined on a seasonal basis. However, as discussed above, there are no discernable seasonal trends at the Delaware County monitor. Therefore, EPA is not discussing seasonal emissions in this analysis, and is only discussing annual emissions. EPA examined emissions of identified sources or source categories of direct $PM_{2.5}$, the major components of direct $PM_{2.5}$ (organic mass, elemental carbon, crustal material (and/or individual trace metal compounds)), primary nitrate and primary sulfate, and precursor gaseous pollutants (i.e., SO_2, NO_X, total VOC, and NH_3). EPA also considered the distance of those sources of emissions from the violating monitoring site. While direct $PM_{2.5}$ emissions and its major carbonaceous components are generally associated with sources near violating $PM_{2.5}$ monitoring sites, the gaseous precursors tend to have a more regional influence (although the EPA is mindful of the potential local NO_X and VOC emissions contributions to $PM_{2.5}$ from mobile and stationary sources) and transport from neighboring areas can contribute to higher $PM_{2.5}$ levels at the violating monitoring sites.

Emissions Data

For this factor, EPA reviewed data from the 2011 National Emissions Inventory (NEI) version 1 (see *http://www.epa.gov/ttn/chief/net/2011inventory.html*). For each county in the area of analysis, EPA examined the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires. EPA also looked at the geographic

distribution of major point sources of the relevant pollutants.[47] Significant emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations. To further analyze area emissions data, EPA also developed a summary of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants, which is available at *http://www.epa.gov/pmdesignations/2012standards/docs/nei2011v1pointnei2008v3county.xlsx*.

When considered with the urban increment analysis in Factor 1, evaluating the components of direct $PM_{2.5}$ and precursor gases can help identify specific sources or source types contributing to elevated concentrations at violating monitoring sites and thus assist in identifying appropriate area boundaries. In general, directly emitted POC and VOCs[48] contribute to POM; directly emitted EC contributes to $PM_{2.5}$ EC; NO_X, NH_3 and directly emitted nitrate contribute to PNO3; SO_2, NH_3 and directly emitted sulfate contribute to PSO4; and directly emitted crustal material and metal oxides contribute to Pcrustal.[49,50] EPA believes that the quantities of those nearby emissions as potential contributors to the $PM_{2.5}$ violating monitors are somewhat proportional to the $PM_{2.5}$ chemical components in the estimated urban increment. Thus, directly emitted POC is more important per ton than SO_2, partially because POC emissions are already $PM_{2.5}$ whereas SO_2 must convert to $PM_{2.5}$ and not all of the emitted SO_2 undergoes this conversion.

Table 3a provides a county-level emissions summary (i.e., the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires) of directly emitted $PM_{2.5}$ and precursor species in tons per year (tpy) for the county with the violating monitoring site and nearby counties considered for inclusion in the Delaware County Area. Table 3b summarizes the directly emitted components of $PM_{2.5}$ for the same counties in the area of analysis for the Delaware County Area. This information will be paired with the urban increment composition previously shown in Figures 4a and 4b.

Table 3a. County-Level Emissions of Directly Emitted $PM_{2.5}$ and Precursors (tpy)

County, State	Total NH_3	Total NO_X	Total Direct $PM_{2.5}$	Total SO_2	Total VOC	Total
Lancaster, PA	15,772	13,794	17,361	1,799	4,441	53,166
Philadelphia, PA	801	22,379	21,286	2,956	3,346	50,768
Northampton, PA	613	14,035	7,469	20,033	3,031	45,180
Montgomery, PA	779	17,147	18,975	2,518	3,338	42,757
Berks, PA	4,097	14,317	12,734	6,136	3,606	40,891
Delaware, PA	594	17,929	11,549	6,557	3,112	39,741
New Castle, DE	1,024	16,089	12,815	1,998	2,538	34,463
Bucks, PA	1,024	13,173	15,325	2,035	2,474	34,030

[47] For purposes of this designations effort, "major" point sources are those whose sum of PM precursor emissions ($PM_{2.5}$ + NOx + SO_2 + VOC + NH_3) are greater than 500 tons per year based on NEI 2011v1.

[48] As previously mentioned, nearby VOCs are presumed to be a less important contributor to POM than POC.

[49] *See*, Seinfeld J. H. and Pandis S. N. (2006) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 2nd edition, J. Wiley, New York. See also, Seinfeld J. H. and Pandis S. N. (1998) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 1st edition, J. Wiley, New York.

[50] USEPA Report (2004), The Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003, found at: *http://www.epa.gov/airtrends/aqtrnd04/pm.html*.

County, State	Total NH_3	Total NO_X	Total Direct $PM_{2.5}$	Total SO_2	Total VOC	Total
Chester, PA	1,908	12,094	11,581	2,176	2,220	29,979
Monmouth, NJ	741	9,903	12,111	522	1,408	24,685
Ocean, NJ	345	7,858	13,089	482	1,559	23,333
Lehigh, PA	620	8,861	9,649	1,321	2,081	22,532
Burlington, NJ	576	8,316	9,977	530	1,616	21,014
Camden, NJ	246	8,534	8,958	611	1,872	20,221
Gloucester, NJ	362	7,918	8,762	1,376	1,172	19,590
Mercer, NJ	254	7,397	7,327	946	1,324	17,248
Kent, DE	2,463	5,808	4,254	1,665	932	15,123
Atlantic, NJ	244	4,841	6,962	425	947	13,419
Harford, MD	495	6,050	5,096	490	879	13,010
Cumberland, NJ	463	3,914	4,883	1,349	1,028	11,638
Salem, NJ	708	3,269	2,083	1,757	486	8,303
Cecil, MD	651	3,587	2,776	300	517	7,831
Hunterdon, NJ	450	3,396	3,020	328	423	7,617
Warren, NJ	711	2,585	2,918	328	508	7,049
Kent, MD	744	942	1,218	157	409	3,470

Table 3b. County-Level Emissions for Components of Directly Emitted $PM_{2.5}$ (tpy) [51]

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Lancaster, PA	2,020	465	105.7	9	816	1024.802	4,441
Berks, PA	1,764	436	131.6	15	474	785.2966	3,606
Philadelphia, PA	1,423	568	254.2	19	448	633.553	3,346
Montgomery, PA	1,740	439	98.98	6	415	638.6036	3,338
Delaware, PA	1,131	497	325.8	21	479	658.8593	3,112
Northampton, PA	1,176	354	170	31	581	717.5565	3,031
New Castle, DE	1,374	474	97.31	12	171	408.5423	2,538
Bucks, PA	1,253	403	77.96	8	315	416.3402	2,474
Chester, PA	1,030	433	78.68	10	284	384.1008	2,220
Lehigh, PA	1,208	247	57.17	5	196	367.6977	2,081
Camden, NJ	939	227	55.99	5	88	557.8196	1,872
Burlington, NJ	1,035	266	27.17	6	108	173.9813	1,616
Ocean, NJ	1,028	223	17.68	6	108	175.4669	1,559
Monmouth, NJ	846	226	20.05	3	119	193.3016	1,408
Mercer, NJ	842	223	24.2	3	81	149.5806	1,324
Gloucester, NJ	476	173	86.15	3	172	261.9218	1,172

[51] Data are based on the 2011 and 2018 Emissions Modeling Platform Data Files and Summaries (*ftp://ftp.epa.gov/EmisInventory/2011v6/v1platform*) available at: *http://www.epa.gov/ttn/chief/emch/index.html#2011* (accessed 02/26/14).

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Cumberland, NJ	614	137	62	5	39	170.5686	1,028
Atlantic, NJ	659	147	9.931	3	43	86.27427	947
Kent, DE	392	165	21.88	2	174	177.2305	932
Harford, MD	412	167	17.61	2	118	161.9914	879
Cecil, MD	227	106	12.54	1	78	92.79367	517
Warren, NJ	326	74	8.081	1	30	68.20153	508
Salem, NJ	155	52	47.08	1	56	175.4625	486
Hunterdon, NJ	229	97	7.36	1	33	55.55333	423
Kent, MD	143	42	5.118	1	122	95.91961	409

Table 3b breaks down the direct $PM_{2.5}$ emissions value from Table 3a into its components. These data will also be compared with the previously presented urban increment composition. As stated previously, the urban increment composition was derived from data obtained at monitoring site 100032004 in New Castle County, DE and monitoring site 421010055 in Philadelphia County, PA, because speciation data is not available for the Delaware County monitor.

Using the previously described relationship between directly emitted and precursor gases and the measured mass to evaluate data presented in Tables 3a and 3b, EPA identified the following components warranting additional review: organic mass, VOCs, and elemental carbon. These components were shown to be the most common in the urban increment in the greater Philadelphia area, as shown in Figure 4a. Similar county level POM and VOC emissions are found in Delaware and the adjacent counties. Philadelphia and Delaware Counties had the highest EC. EPA then looked at the contribution of these components of interest from each of the counties included in the area of analysis as shown in Tables 4a-c.

Table 4a. County-Level POM Emission

	Emissions in average tpy		
County	POM	Percent (%)	Cumulative %
Lancaster, PA	2,020	9%	9%
Berks, PA	1,764	8%	17%
Montgomery, PA	1,740	8%	25%
Philadelphia, PA	1,423	6%	31%
New Castle, DE	1,374	6%	37%
Bucks, PA	1,253	6%	43%
Lehigh, PA	1,208	5%	48%
Northampton, PA	1,176	5%	53%
Delaware, PA	1,131	5%	58%
Burlington, NJ	1,035	5%	63%
Chester, PA	1,030	5%	68%
Ocean, NJ	1,028	5%	72%
Camden, NJ	939	4%	76%
Monmouth, NJ	846	4%	80%
Mercer, NJ	842	4%	84%

Atlantic, NJ	659	3%	87%
Cumberland, NJ	614	3%	89%
Gloucester, NJ	476	2%	92%
Harford, MD	412	2%	93%
Kent, DE	392	2%	95%
Warren, NJ	326	1%	97%
Hunterdon, NJ	229	1%	98%
Cecil, MD	227	1%	99%
Salem, NJ	155	1%	99%
Kent, MD	143	1%	100%
Total	22,444		

Table 4b. County-Level EC Emissions

County	Emissions in average tpy		
	EC	Percent (%)	Cumulative %
Philadelphia, PA	568	9%	9%
Delaware, PA	497	7%	16%
New Castle, DE	474	7%	23%
Lancaster, PA	465	7%	30%
Montgomery, PA	439	7%	37%
Berks, PA	436	7%	43%
Chester, PA	433	7%	50%
Bucks, PA	403	6%	56%
Northampton, PA	354	5%	61%
Burlington, NJ	266	4%	65%
Lehigh, PA	247	4%	69%
Camden, NJ	227	3%	72%
Monmouth, NJ	226	3%	76%
Mercer, NJ	223	3%	79%
Ocean, NJ	223	3%	83%
Gloucester, NJ	173	3%	85%
Harford, MD	167	3%	88%
Kent, DE	165	2%	90%
Atlantic, NJ	147	2%	92%
Cumberland, NJ	137	2%	94%
Cecil, MD	106	2%	96%
Hunterdon, NJ	97	1%	97%
Warren, NJ	74	1%	99%
Salem, NJ	52	1%	99%
Kent, MD	42	1%	100%
Total	6,643		

Table 4c. County-Level VOC Emissions

County	Emissions in average tpy		
	VOC	Percent (%)	Cumulative %
Lancaster, PA	4,441	9.81%	9.81%
Berks, PA	3,606	7.97%	18%
Philadelphia, PA	3,346	7.39%	25%
Montgomery, PA	3,338	7.37%	33%
Delaware, PA	3,112	6.88%	39%
Northampton, PA	3,031	6.69%	46%
New Castle, DE	2,538	5.61%	52%
Bucks, PA	2,474	5.46%	57%
Chester, PA	2,220	4.90%	62%
Lehigh, PA	2,081	4.60%	67%
Camden, NJ	1,872	4.14%	71%
Burlington, NJ	1,616	3.57%	74%
Ocean, NJ	1,559	3.44%	78%
Monmouth, NJ	1,408	3.11%	81%
Mercer, NJ	1,324	2.92%	84%
Gloucester, NJ	1,172	2.59%	86%
Cumberland, NJ	1,028	2.27%	89%
Atlantic, NJ	947	2.09%	91%
Kent, DE	932	2.06%	93%
Harford, MD	879	1.94%	95%
Cecil, MD	517	1.14%	96%
Warren, NJ	508	1.12%	97%
Salem, NJ	486	1.07%	98%
Hunterdon, NJ	423	0.94%	99%
Kent, MD	409	0.90%	100%
Total	45,267		

In addition to reviewing county-wide emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors in the area of analysis, EPA also reviewed emissions from major point sources located in the area of analysis. The magnitude and location of these sources can help inform nonattainment boundaries. Table 5a provides facility-level emissions of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants (given in tons per year) from major point sources with total emissions of 500 tpy or more located in the area of analysis for the Delaware County area. Table 5a also shows the distance from the facility to the violating monitor in Delaware County.

Table 5a. NEI 2011 v1 Point Source Emissions (tpy)

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NO_X	$PM_{2.5}$	SO_2	VOC	Total
Delaware, PA	Kimberly Clark Pa LLC/Chester Opr (420450016)	1	2	240	17	1,265	26	1,550
Delaware, PA	Covanta Delaware Valley LP/Delaware Valley Res Rec (420450059)	1		1,260	182	242	6	1,689
Delaware, PA	Monroe Energy LLC/Trainer (420450030)	2	6	656	228	142	241	1,273
Delaware, PA	Sunoco Inc (R&M)/Marcus Hook Refinery (420450025)	3	6	1,490	674	2,044	331	4,545
Gloucester, NJ	Logan Generating Plant, L.P. (55834)	4	2	656	17	600	6	1,280
Delaware, PA	Exelon Generation Co/Eddystone (420450014)	4	6	830	77	940	11	1,863
Gloucester, NJ	Paulsboro Refining Company LLC (55829)	6	5	655	238	77	308	1,283
Delaware, PA	Philadelphia Intl	7		2,246	53	254	318	2,871
New Castle, DE	Hay Road Energy Center (1000300388)	10	53	602	106	11	33	805
Philadelphia, PA	Sunoco Inc/ Phila Refinery R&M (4210101501)	11	4	1,315	722	297	749	3,088
Salem, NJ	Carneys Point Generating Plant (65498)	11	2	752	39	1,157	3	1,953
Camden, NJ	Camden County Municipal Utilities Authority (50163)	14	2	14	521	0	26	562
Montgomery, PA	Covanta Plymouth Renewable Energy/ Plymouth (420910295)	18	1	735	8	25	2	771
Chester, PA	Transcontinental Gas/Frazer Sta 200 (420290047)	18	0	595	248	1	49	893
Salem, NJ	Anchor Glass Container Corporation (65499)	19	1	509	67	90	9	676
New Castle, DE	Delaware City Refinery (1000300016)	22	7	1,072	281	333	139	1,832
Chester, PA	Exelon Gen Co/Cromby Gen Sta (420290023)	23	2	493	38	826	2	1,360
Chester, PA	Arcelormittal Plate LLC/Coatesville (420290024)	26	4	255	72	111	133	575
Bucks, PA	Wheelabrator Falls Inc/Falls Twp (420170469)	39	3	731	9	122	2	867
Bucks, PA	Fairless Energy LLC/Falls Twp (420170131)	40	170	201	196	18	25	609

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NO_X	$PM_{2.5}$	SO_2	VOC	Total
Mercer, NJ	PSEG Fossil LLC Mercer Generating Station (61057)	41	1	430	56	573	18	1,078
Berks, PA	Genon Rema LLC/Titus Gen Sta (420110045)	43	0	683	43	4,087	5	4,818
Kent, DE	Nrg Energy Center Dover LLC (1000100127)	48	0	273	71	1,274	2	1,621
Berks, PA	Cryovac Inc/Cryovac Rigid Packaging (420110093)	50			0		556	556
Berks, PA	Lehigh Cement Co LLC/Evansville Cement Plt & Quarry (420110039)	52	41	1,225	134	200	12	1,611
Lehigh, PA	Lafarge Corp/Whitehall Plt (420770019)	59	14	368	36	331	7	754
Northampton, PA	Northampton Gen Co/Northampton (420950536)	59	2	441	44	546	2	1,034
Northampton, PA	Keystone Portland Cement/East Allen (420950012)	61	2	828	57	984	7	1,878
Northampton, PA	Essroc/Nazareth Lower Cement Plt 1 (420950045)	62	68	1,804	522	722	62	3,177
Northampton, PA	Hercules Cement Co LP/Stockertown (420950006)	63	3	989	29	1,420	20	2,462
Northampton, PA	PPL Martins Creek LLC/Martins Creek (420950010)	68	13	943	37	274	30	1,297
Lancaster, PA	Lancaster Cnty Rrf/ Lancaster (420710145)	69		577	4	12	4	597
Northampton, PA	GenOn Rema LLC/Portland Generating Sta (420950011)	76	0	1,977	67	15,148	14	17,206

Figure 5a shows the major point source emissions (from the 2011 NEI in tons per year) in the area of analysis for the Delaware County Area and the relative distances of these sources from the violating monitoring location, as depicted by red dots. The actual distance from the point sources to the violating monitoring location is presented in Table 5a. The distance from the violating monitoring location is particularly important for directly emitted $PM_{2.5}$. The influence of directly emitted $PM_{2.5}$ on ambient $PM_{2.5}$ diminishes more than that of gaseous precursors as a function of distance.[52]

The Delaware County monitor is located in a heavily industrialized area. As indicated in Table 5a and Figure 5a, there are thirty-three sources with emissions of at least 500 tpy within the area of analysis. Six of these sources are in Delaware County and quite close to the violating monitor, as shown in Figure 5b.

[52] Baker, K. R. and K. M. Foley. *A nonlinear regression model estimating single source concentrations of primary and secondarily formed $PM_{2.5}$.* Atmospheric Environment. 45 (2011) 3758-3767.

Figure 5a. Major Point Sources in the Area of Analysis for the Delaware County Area

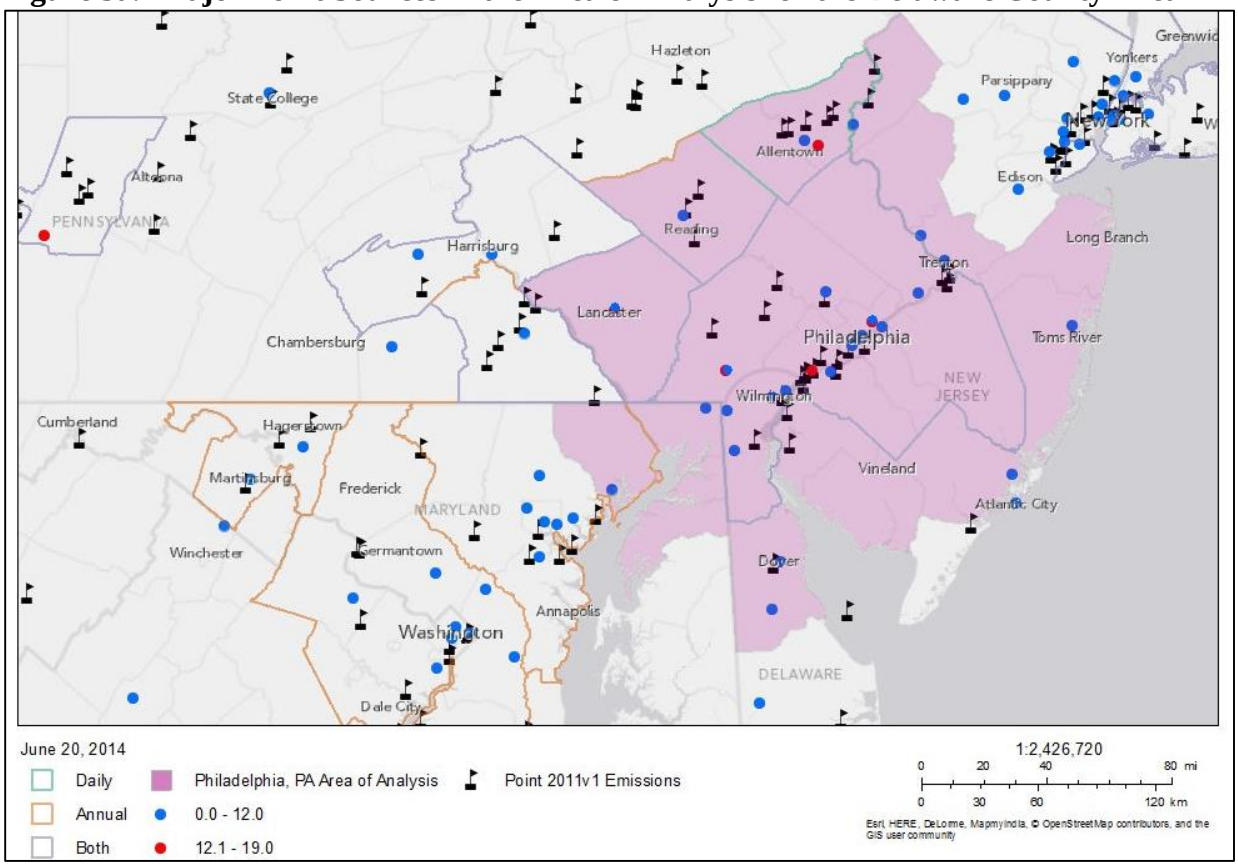
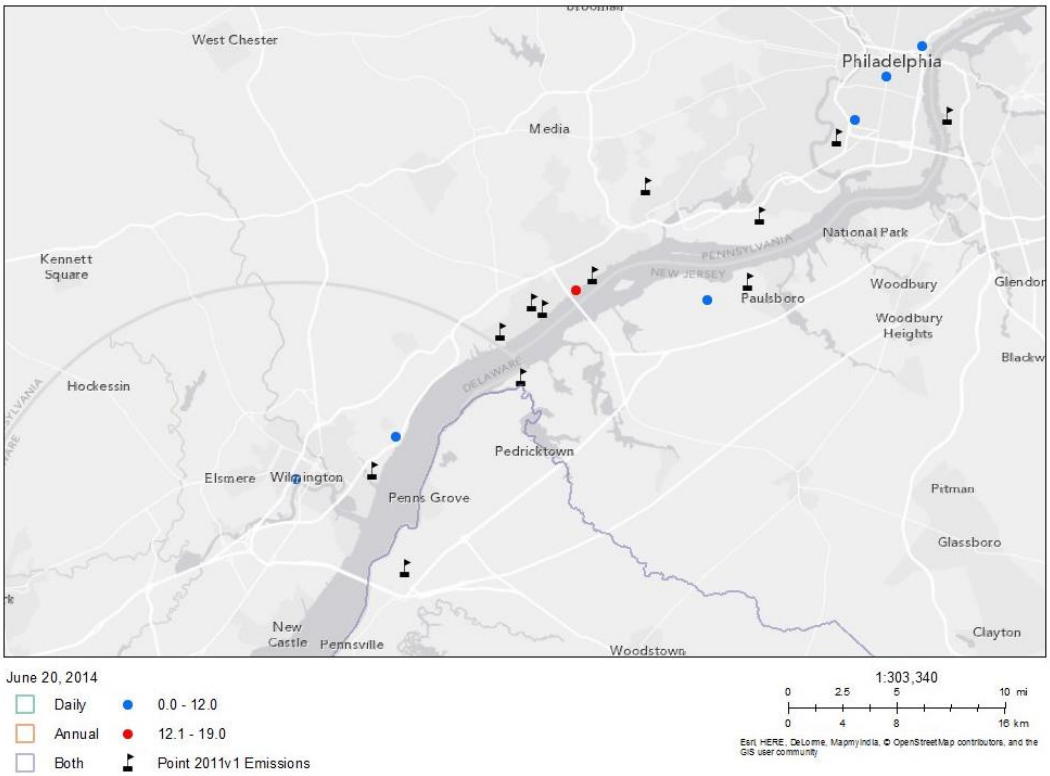


Figure 5b. Close-up of Major Point Sources Near the Delaware County Monitor.



In addition, the Delaware County monitor is located adjacent, and actually within the fenceline of a small (less than 100 tpy) source, called Evonik. However, EPA has approved PA's monitoring plan, which states that the Chester monitor (i.e. Delaware County monitor) is suitable to represent urban scale $PM_{2.5}$ population exposure.[53] Urban scale monitors are designed to represent air quality within an area of 4 to 50 kilometers.

Table 5b shows emissions from the Evonik facility. Figures 5c and 5d show the location of the monitor relative to this source. As discussed below in factor 3, regarding meteorology, the Evonik facility is upwind of the violating Delaware County monitor when its $PM_{2.5}$ levels are highest, indicating that this source is contributing to the violation.

Table 5b. Evonik Facility Emissions (tpy)

County, State	Facility Name (Facility ID)	Distance from monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NO_X	$PM_{2.5}$	SO_2	VOC	Total
Delaware, PA	Evonik Corp/Chester (94723811)	0	0.4168	10.7063	2.9734	1.447	2.7619	18.3054

Figure 5c. Close-up of the Delaware County Monitor.

Source: Google Maps, at http://maps.google.com

[53] Commonwealth of Pennsylvania Department of Environmental Protection 2013 Annual Ambient Air Monitoring Network Plan, dated July 2013.

Figure 5c. Close-up of the Delaware County Monitor and Evonik facility

Source: Google Maps, at http://maps.google.com

Monitors in the nearby vicinity to the east in Gloucester County, NJ, to the north in Philadelphia County, PA, and to the south, New Castle County, DE, are not violating the NAAQS, indicating limited contribution from these areas relative to the contribution from local sources. The monitors to the east and south, are well below the NAAQS, despite their relative proximity to point sources listed in Table 5a. For example, the Gloucester County, NJ monitor is about 1.5 miles west of the Paulsboro Refining Company LLC facility, yet its 2011-2013 DV is 9.0 $\mu g/m^3$, indicating that the refinery may have limited contribution to the violation at the Delaware County monitoring site. The Hay Road Energy Center in New Castle County, DE is about 1.5 miles southwest of the New Castle County monitor, 100031003. The New Castle monitor has a 2011-2013 DV of 9.1 $\mu g/m^3$, again indicating that this major point source may have limited contribution to the violation at the Delaware County monitoring site compared with the contribution from local sources.

The sources in the nearby New Jersey counties are generally well controlled. For example, there are three NJ based coal fired generating stations: Logan Generating in Gloucester, PSEG Mercer in Mercer, and Carney's Point in Salem. PSEG Mercer is northeast of the monitor (not in a predominant wind direction). The other power plants are southwest of the monitor. All three power facilities are well-controlled with scrubbers, selective catalytic reduction (SCR), and baghouses. New Jersey's EGU rule (EGU-Coal, Oil, and Gas Fired Boilers: NJAC 7:27-4.2, 10.2, 19.4), has stringent NOx limits (1.5 pounds per megawatt hour) and SO_2 (0.150 pounds per Million British Thermal Units (MBTU) for a 30 day rolling average , and 0.0250 pounds per MBTU for a 24-hour average)for coal-fired units that required compliance by December 2012. New Jersey's sulfur in fuels regulation (Low Sulfur Distillate and Residual Fuel Strategies: NJAC 7:27-9, 7:27-27.9), covering residential, industrial, commercial, and electric power requires distillate to meet 500 parts per million (ppm) by 2014, and 15 ppm by 2016, as well as requiring residual fuel to meet 5,000 ppm by 2014, likely has further reduced SO_2 emissions from New Jersey counties. New Jersey also has stringent RACT limits (NJAC 7:27-16,19). The Paulsboro Refining Company, which is east of the Delaware monitor, is

under a Consent Decree and Administrative Consent Order with EPA and New Jersey[54], requiring reduction from major refinery processes including fluid catalytic cracking units (FCCU), boiler and process heaters, flare gas recovery, and leak detection and repair, to be completed by December 2011.

Sources in New Castle County, DE are also well controlled through measures in its federally approved State Implementation Plan (SIP). Here is an excerpt from Delaware's November 21, 2013 designation recommendation letter to EPA:

> "…total 2012 emissions of direct $PM_{2.5}$ and its precursors from New Castle County's largest point sources[55] decreased 87% between 2002 and 2012. This included a massive 99% reduction in SO_2, followed by a 65% reduction in direct $PM_{2.5}$, and a 52% decrease of NOx. VOC reductions of 54% have taken place since the early 1990s due to Delaware's ozone nonattainment issues over the years. NH_3 emissions have been reduced 52%, even though New Castle County emissions of ammonia in 2002 from these largest point sources were only 82 tons per year (tpy)."

Delaware's November 21, 2013 designation recommendation letter included a list of top point sources emitters in New Castle County, with their 2002 and 2012 emissions. That information is summarized in Table 5c.

Table 5c New Castle County - Top Point Source Emitters in 2002 and 2012

New Castle Top Emitting Facilities	NH_3		NOx		SO_2		$PM_{2.5}$		VOC		Sum of $PM_{2.5}$ related	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Calpine Edge Moor	30	16	3,138	463	9,854	48	517	4	36	33	13,575	564
Calpine Hay Road	0	1	566	696	11	13	3	142	10	45	590	897
DE City Refinery	43	12	3,555	2,083	34,096	304	905	312	829	208	39,428	2,919
DuPont Edgemoor	1	1	35	29	92	21	27	1	83	98	239	150
DuPont Experimental	3	3	208	176	593	226	37	18	8	11	849	434
Evraz Steel	0	0	125	227	11	40	45	59	67	67	248	393
Formosa	4	6	31	31	0	1	35	15	124	69	194	122
TOTALS	**82**	**39**	**7,658**	**3,705**	**44,658**	**653**	**1,569**	**551**	**1,157**	**531**	**57,126**	**7,491**
2002-2012 % Reduction	**52%**		**52%**		**99%**		**65%**		**54%**		**87%**	

Source: Delaware's November 21, 2013 designation recommendation letter.

[54] United States of America, Plaintiff, and the States of Colorado, Louisiana, New Jersey, Oklahoma and Texas, Plaintiff-Interveners, v. Valero Refining Company, et al, and Tesoro Refining and Marketing Corporation, Defendants, Civil Action No. SA05CA0569, filed June 16, 2005.

[55] 2012 emissions ≥ 50 tpy for any $PM_{2.5}$-related pollutant

In summary, EPA's analysis of relevant county-level emissions and the geographic locations of the relevant pollutants shows that several of the counties within the area of analysis have relatively high emissions. Philadelphia County has the highest NO_X and direct $PM_{2.5}$, while Northampton County has the highest SO_2 emissions, and Lancaster County has the highest NH_3 and VOC emissions. Delaware County ranks second in both NO_X and SO_2 emissions. Furthermore, there are six facilities in Delaware County with emissions of 500 tpy or more that are quite close to the violating monitor, as can be seen in Figure 5b, including the Sunoco Marcus Hook Refinery which has total emissions of 4,545 tpy, and 674 tpy of direct $PM_{2.5}$. Large point sources in Philadelphia, Northampton, and Lancaster Counties are all farther away from the Delaware County monitor, as shown in Table 5a.

Population density and degree of urbanization

In this part of the factor analysis, EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. Rapid population growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that it may be appropriate to include the county associated with area source and mobile source emissions as part of the nonattainment area. Table 6 shows the 2000 and 2010 population, population growth since 2000, and population density for each county in the area.

Table 6. Population Growth and Population Density.

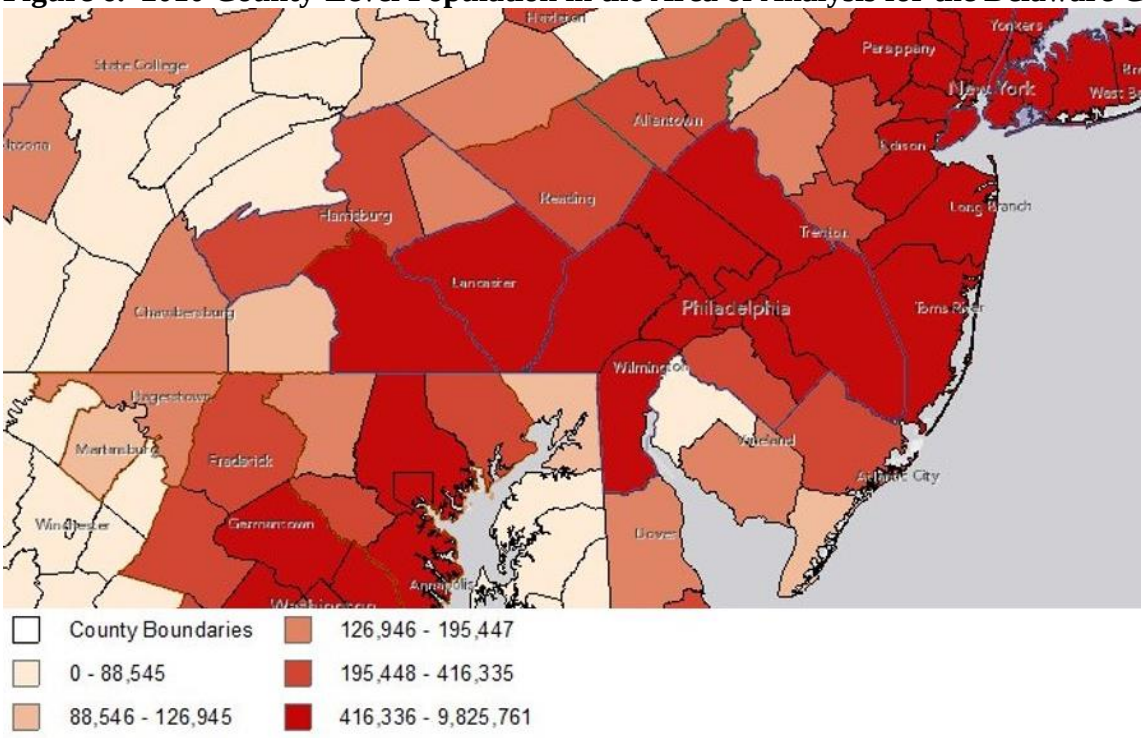
County, State	Population 2000	Population 2010	% Change from 2000	Land Area (square miles)	Population Density (per square mile)	% of Area of Analysis	Cumulative %
Philadelphia, PA	1,517,550	1,528,458	0.7%	135	11,314	15%	15%
Montgomery, PA	750,097	801,134	6.8%	483	1,658	8%	23%
Monmouth, NJ	615,301	630,821	2.5%	472	1,337	6%	29%
Bucks, PA	597,635	625,505	4.7%	607	1,030	6%	35%
Ocean, NJ	510,916	577,697	13.1%	636	908	6%	41%
Delaware, PA	550,864	559,373	1.5%	184	3,037	5%	46%
New Castle, DE	500,265	538,951	7.7%	426	1,264	5%	51%
Lancaster, PA	470,658	520,344	10.6%	949	548	5%	57%
Camden, NJ	508,932	513,744	0.9%	222	2,311	5%	62%
Chester, PA	433,501	499,739	15.3%	756	661	5%	66%
Burlington, NJ	423,394	449,320	6.1%	805	558	4%	71%
Berks, PA	373,638	411,791	10.2%	859	479	4%	75%
Mercer, NJ	350,761	367,093	4.7%	226	1,625	4%	78%
Lehigh, PA	312,090	350,093	12.2%	347	1,010	3%	82%
Northampton, PA	267,066	298,065	11.6%	374	797	3%	85%
Gloucester, NJ	254,673	288,618	13.3%	325	889	3%	88%
Atlantic, NJ	252,552	274,715	8.8%	561	490	3%	90%
Harford, MD	218,590	245,243	12.2%	440	557	2%	93%
Kent, DE	126,697	162,973	28.6%	590	276	2%	94%
Cumberland, NJ	146,438	157,053	7.2%	489	321	2%	96%
Hunterdon, NJ	121,989	128,357	5.2%	430	299	1%	97%
Warren, NJ	102,437	108,693	6.1%	358	304	1%	98%
Cecil, MD	85,951	101,175	17.7%	348	291	1%	99%
Salem, NJ	64,285	66,008	2.7%	338	195	1%	100%

County, State	Population 2000	Population 2010	% Change from 2000	Land Area (square miles)	Population Density (per square mile)	% of Area of Analysis	Cumulative %
Kent, MD	19,197	20,184	5.1%	279	72	0%	100%
Total	9,575,477	10,225,147					

Source: U.S. Census Bureau population estimates for 2000 and 2010

The greater Philadelphia area is densely populated. Philadelphia County has both population and population density much larger than every other county in the area of analysis. Delaware County experienced 1.5 percent population growth between 2000 and 2010. Delaware County has the second highest population density, and ranks sixth in population in the 25 county area of analysis. Because EPA has determined the other factors indicate much less contribution to the Delaware County monitor from emissions in other counties relative to local emissions from Delaware County, population and population density are not influential factors in determining nonattainment boundaries for the Delaware County Area.

Figure 6. 2010 County-Level Population in the Area of Analysis for the Delaware County Area.



Traffic and Vehicle Miles Travelled

High VMT and/or a high number of commuters associated with a county is generally an indicator that the county is an integral part of an urban area. Mobile source emissions of NO_x, VOC, and direct PM may contribute to ambient particulate matter that contributes to monitored violations of the NAAQS in the area. In combination with the population/population density data and the location of main transportation arteries, an assessment of VMT helps identify the probable location of nonpoint source emissions that contribute to violations in the area. Comparatively high VMT in a county outside of the CBSA or CSA signifies integration with the core urban area contained within the CSA or CBSA, and

indicates that a county with the high VMT may be appropriate to include in the nonattainment area because emissions from mobile sources in that county contribute to violations in the area. Table 7 shows 2011 VMT while Figure 7 overlays 2011 county-level VMT with a map of the transportation arteries. This VMT data was obtained from the Federal Highway Administration.

Table 7. 2011 VMT for the Delaware County Area.

County, State	Total 2011 VMT	Percent	Cumulative %
Montgomery, PA	6,505,446,421	8%	8%
Monmouth, NJ	6,240,551,588	8%	16%
Philadelphia, PA	5,344,508,760	7%	22%
New Castle, DE	5,201,246,605	6%	29%
Bucks, PA	4,727,709,143	6%	35%
Ocean, NJ	4,617,759,793	6%	41%
Burlington, NJ	4,477,567,355	6%	46%
Chester, PA	4,277,236,066	5%	51%
Lancaster, PA	4,150,294,150	5%	57%
Camden, NJ	3,848,560,437	5%	61%
Berks, PA	3,381,679,887	4%	66%
Delaware, PA	3,336,446,326	4%	70%
Mercer, NJ	3,325,914,191	4%	74%
Lehigh, PA	2,988,094,564	4%	78%
Gloucester, NJ	2,713,227,986	3%	81%
Atlantic, NJ	2,676,389,714	3%	84%
Harford, MD	2,370,983,706	3%	87%
Northampton, PA	2,046,097,907	3%	90%
Hunterdon, NJ	1,828,353,779	2%	92%
Kent, DE	1,601,985,389	2%	94%
Warren, NJ	1,387,779,166	2%	96%
Cecil, MD	1,356,020,045	2%	97%
Cumberland, NJ	1,122,284,008	1%	99%
Salem, NJ	779,668,486	1%	100%
Kent, MD	205,005,588	0%	100%
Total	80,510,811,059		

http://www.census.gov/hhes/commuting/data/commuting.html

VMT varies greatly within the area of analysis, with Delaware County ranked twelfth out of twenty-six counties. Delaware County's VMT is about half that of the highest county, Montgomery County, PA, and sixteen times higher than the lowest county, Kent County, MD. As seen in Figure 7, numerous large highways run through the area of analysis. Interstate 95 runs near the Delaware County monitor, as well as numerous non-violating monitors in the area.

EPA also considered "journey to work" data submitted by New Jersey and Delaware as part of their analysis in their February 24, 2014 and November 21, 2013 respective designation recommendation letters. New Jersey presented Journey to Work data from the US Census Bureau for the 2000 calendar year, since that was available at the time. The Census Bureau website also has a more recent five year average (2006 -2010 average) that differs slightly from the data presented by New Jersey.

The tables below show that the commuters to Delaware County, PA are mostly from Pennsylvania; relatively few are from New Jersey counties or New Castle County, DE.

Table 8a: Number of Commuters in Pennsylvania and New Jersey to Delaware County, Pennsylvania for the 2000 calendar year

Home County, State	#Commuters to Delaware County, PA
Philadelphia, PA	21,802
Delaware, PA	137,988
Montgomery, PA	11,758
Chester, PA	17,870
Bucks, PA	2,754
Berks, PA	505
Six county PA total commuting to Delaware County, PA	**192,677**
Gloucester, NJ	3,179
Camden, NJ	3,232
Burlington, NJ	1,771
Cumberland, NJ	105
Salem, NJ	486
Five county NJ commuting to Delaware County, PA	**8,773**

Source www.census.gov/population/www/cen2000/commuting/index.html

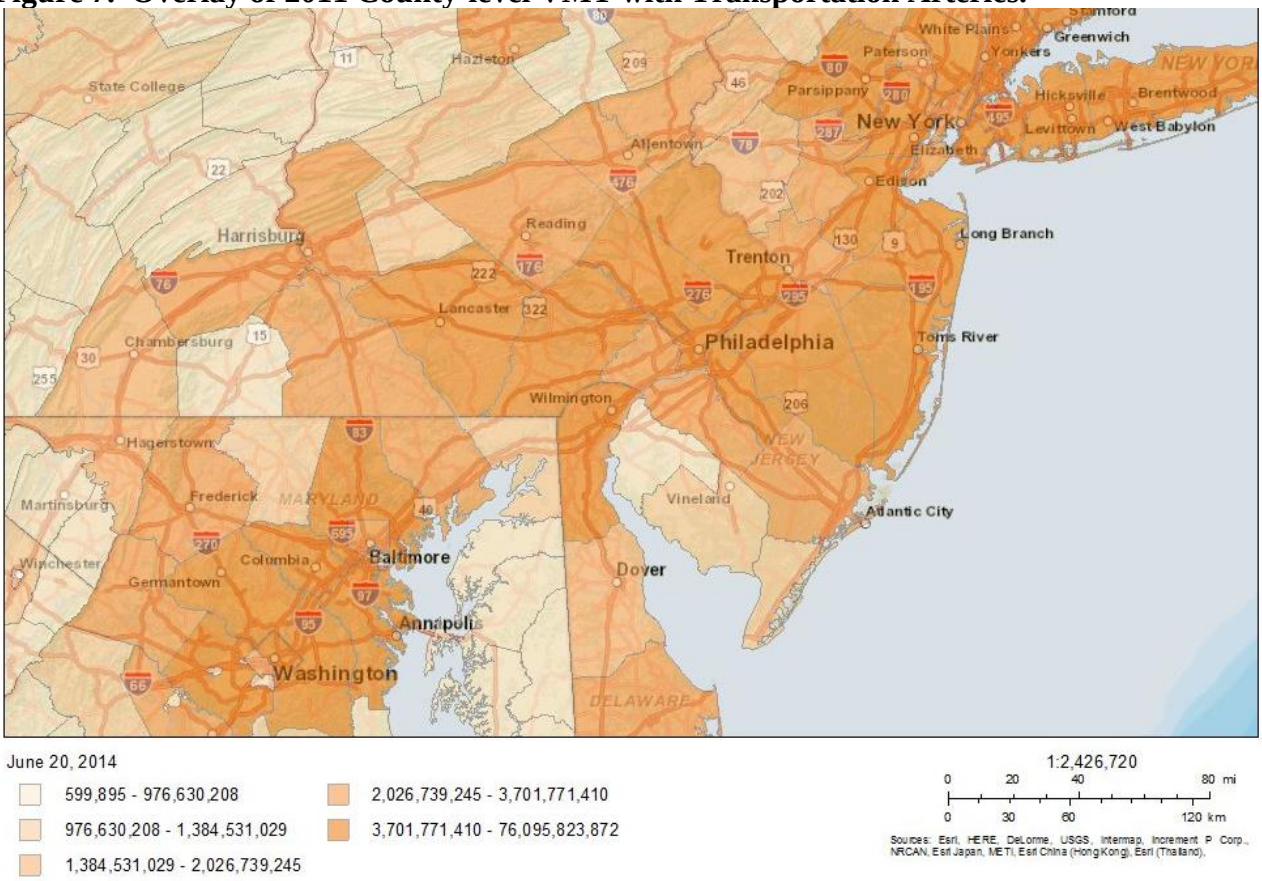
Table 8b. Number of Commuters to Delaware County, Pennsylvania for 2006-2010

Number	Margin of error	Residence State	Residence County, State	Workplace County
137,303	2,156	Pennsylvania	Delaware, PA	Delaware County
18,907	1,009	Pennsylvania	Chester, PA	Delaware County
17,732	1,234	Pennsylvania	Philadelphia, PA	Delaware County
12,113	791	Pennsylvania	Montgomery County, PA	Delaware County
9,097	838	Delaware	New Castle County, DE	Delaware County
3,303	408	New Jersey	Gloucester County	Delaware County
2,274	338	Pennsylvania	Bucks County, PA	Delaware County
2,208	248	New Jersey	Camden County, NJ	Delaware County
1,178	221	New Jersey	Burlington County, NJ	Delaware County
700	200	Pennsylvania	Berks County, PA	Delaware County
625	149	Pennsylvania	Lancaster County, PA	Delaware County
501	129	New Jersey	Salem County, NJ	Delaware County
316	110	Maryland	Cecil County, MD	Delaware County
237	88	Pennsylvania	Lehigh County, PA	Delaware County
181	93	New Jersey	Atlantic County, NJ	Delaware County
178	110	New Jersey	Mercer County, NJ	Delaware County
156	69	Delaware	Kent County, DE	Delaware County
127	56	New Jersey	Cumberland County, NJ	Delaware County

Number	Margin of error	Residence State	Residence County, State	Workplace County
89	81	New Jersey	Middlesex County, NJ	Delaware County
67	44	New Jersey	Ocean County, NJ	Delaware County
64	63	Maryland	Harford County, MD	Delaware County
45	34	Pennsylvania	York County, PA	Delaware County
42	34	Pennsylvania	Northampton County, PA	Delaware County
35	33	New Jersey	Monmouth County, NJ	Delaware County
20	17	Maryland	Kent County, MD	Delaware County
3	5	New Jersey	Hunterdon County, NJ	Delaware County

Source www.census.gov/population/www/cen2000/commuting/index.html

Figure 7. Overlay of 2011 County-level VMT with Transportation Arteries.



Factor 3: Meteorology

EPA evaluated available meteorological data to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of directly emitted particulate matter and precursor emissions from sources in the area of analysis. EPA used two primary tools for this assessment: wind roses and kernel density estimation (KDE). When considered in combination with area $PM_{2.5}$ composition and county-level and facility emissions source location information, wind roses and KDE can help to identify nearby areas contributing to violations at violating monitoring sites.

Wind roses are graphic illustrations of the frequency of wind direction and wind speed. Wind direction can indicate the direction from which contributing emissions are transported; wind speed can indicate the force of the wind and thus the distance from which those emissions are transported. EPA constructed wind roses from hourly observations of wind direction and wind speed using 2009-2012 data from National Weather Service locations archived at the National Climate Data Center.[56] When developing these wind roses, EPA also used wind observations collected at meteorological sampling stations collocated at air quality monitoring sites, where these data were available. Figure 8 shows wind roses that EPA generated from data relevant in the Delaware County Area.

These wind roses represent average wind directions throughout the year. As can be seen in Figure 8a, the predominant wind direction in the area of analysis is westerly, with winds also coming from the southwest and northwest. There are also strong northerly and southerly components. These wind roses suggest potential emission sources in these directions should be considered for analysis. In its December 2013 recommendation letter, Pennsylvania included wind direction analysis at "high $PM_{2.5}$ days" at the Delaware County monitor. Specifically, Pennsylvania identified 212 days during the 2010 to 2012 monitoring period where $PM_{2.5}$ at the Delaware County monitor was at least one standard deviation above the five county Pennsylvania portion of the greater Philadelphia area. Pennsylvania analyzed the wind directions for the highest of those days, the top twenty-five percent. For these highest days, Pennsylvania calculated the number of hours the wind was coming from a particular direction as well as the concentrations coming from a particular direction, using data from a meteorological station collocated with the Delaware County monitor. Figures 8b and 8c represents the wind direction frequency and concentration distribution by wind direction, respectively, at the Delaware County monitor during the high $PM_{2.5}$ days.

As can be seen in Figures 8b and 8c, wind directions on high $PM_{2.5}$ days at the Delaware County monitor are predominantly from the east, with a northeast component and a lesser southwest component. This is contrary to the dominant wind direction in the region, which is westerly. This suggests local, rather than regional, sources are responsible for the high $PM_{2.5}$ days at the Delaware County monitor.

There are numerous sources in Delaware County, upwind of and very close to the violating monitor. The small Evonik facility is located directly east of the violating monitor, which, as illustrated above in Figure 5c, is within the fenceline of the facility. The Kimberly Clark Pa LLC facility is approximately one mile northeast of the monitor. The Covanta Delaware Valley facility is approximately one mile southwest of the monitor. Monroe Energy LLC/Trainer and Sunoco Inc (R&M)/Marcus Hook Refinery are both southwest of the monitor, two and three miles, away respectively. The Exelon Generation Co/Eddystone and the Philadelphia International Airport are northeast of the facility, four and seven miles away, respectively.

[56] *ftp.ncdc.noaa.gov/pub/data/noaa* or *http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=cdo&theme=hourly&layers=1&node=gis* Quality assurance of the National Weather Service data is described here: *http://www1.ncdc.noaa.gov/pub/data/inventories/ish-qc.pdf*

Figure 8a. Wind Roses in the Area of Analysis for the Delaware County Area.

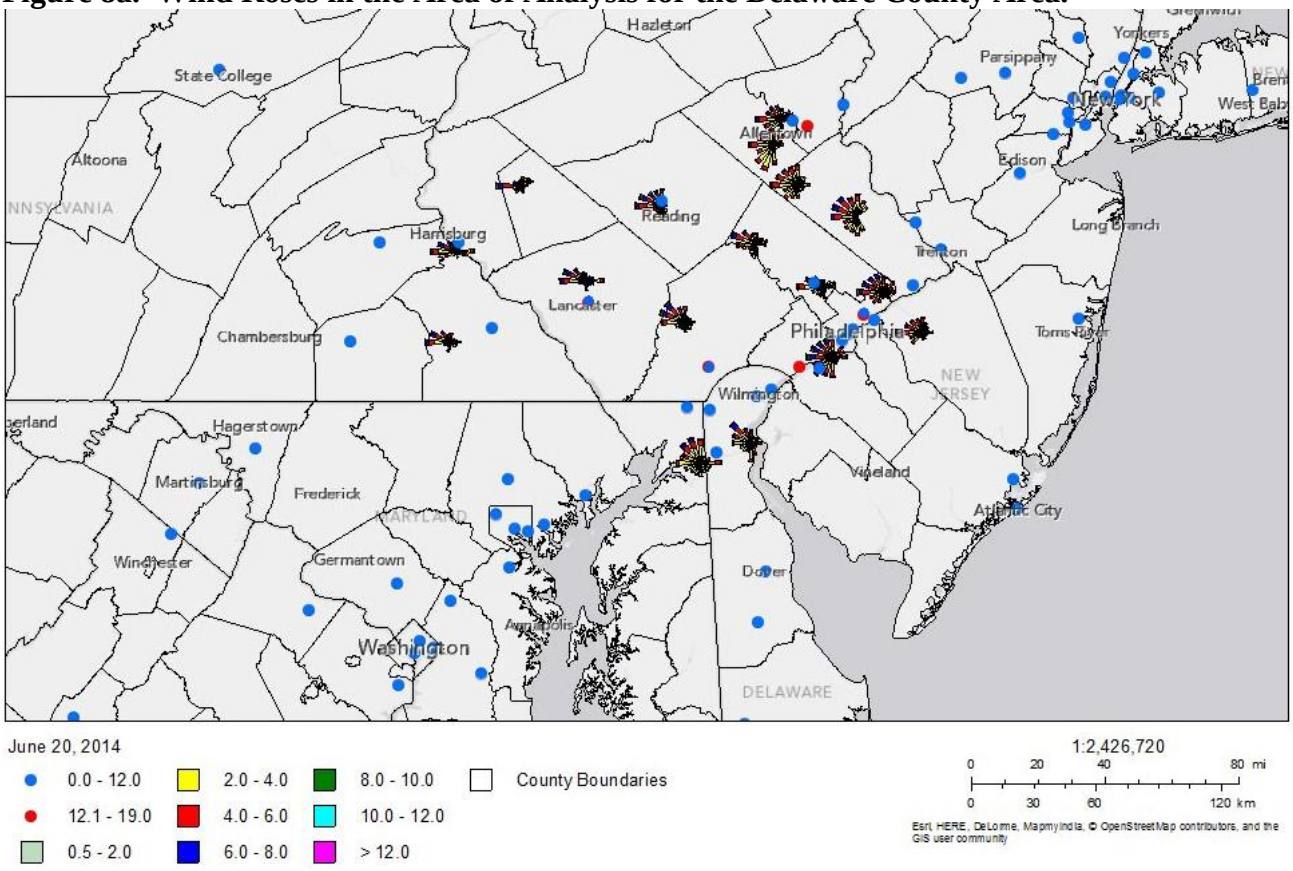
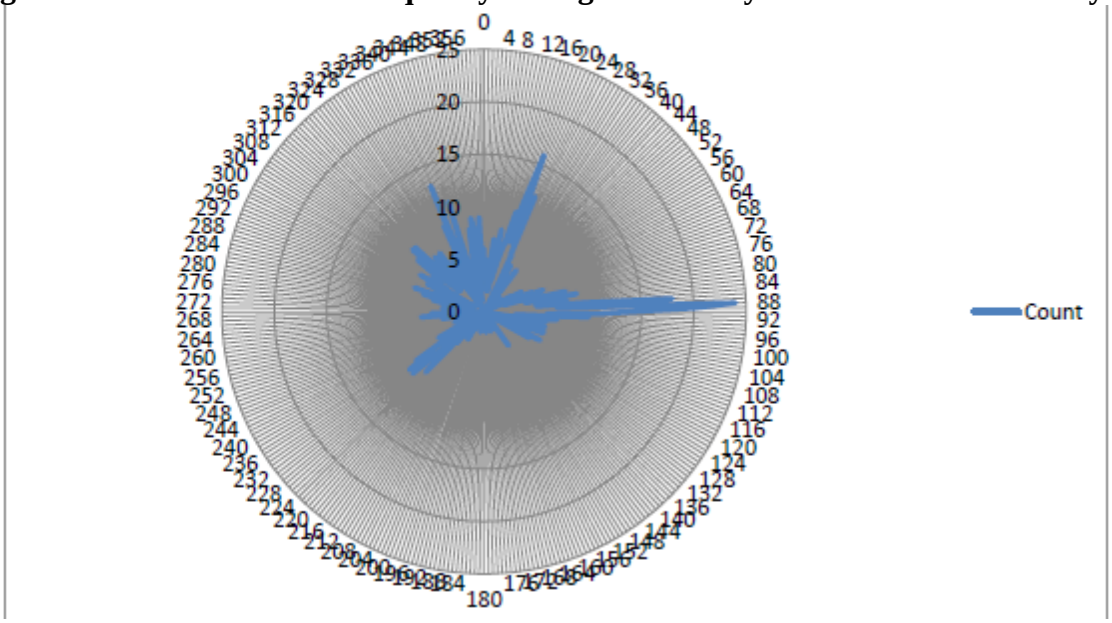
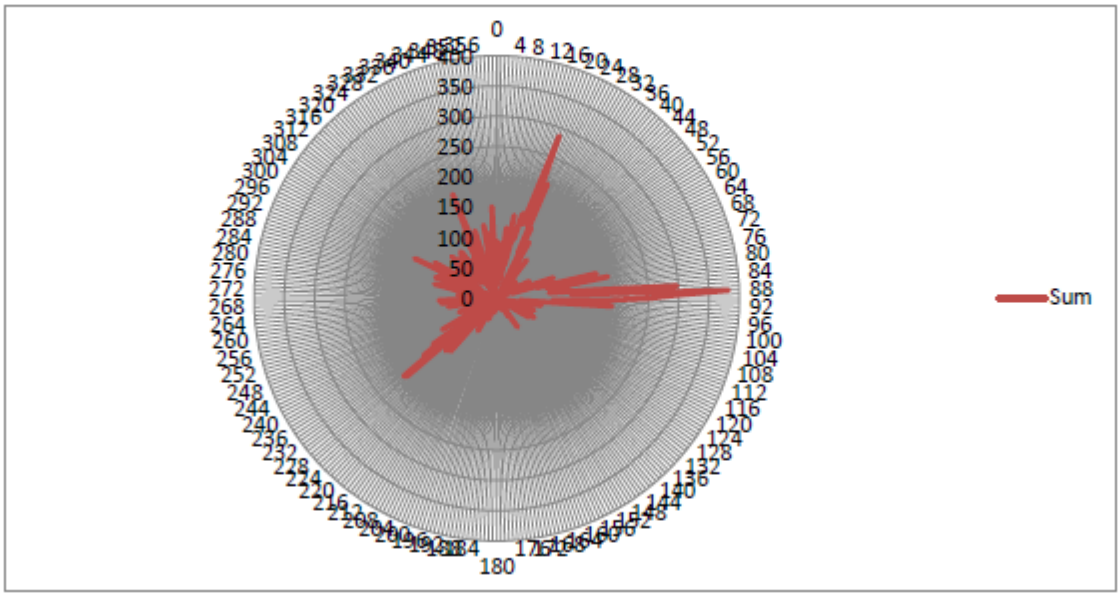


Figure 8b. Wind Direction Frequency on High $PM_{2.5}$ Days at the Delaware County Monitor



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-1- Greater Philadelphia Area

Figure 8c. Concentration Distribution by Wind Direction on High $PM_{2.5}$ Days at the Delaware County Monitor



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-1- Greater Philadelphia Area

In addition to wind roses, EPA also generated kernel density estimation (KDE) plots to represent HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) backward trajectory frequency at violating monitoring sites.[57,58] These KDEs are graphical statistical estimations to determine the density of trajectory endpoints at a particular location represented by a grid cell. The EPA used KDEs to characterize and analyze the collection of individual HYSPLIT backward trajectories.[59] Higher density values, indicated by darker blue colors, indicate a greater frequency of observed trajectory endpoints within a particular grid cell.

Figure 9 shows HYSPLIT KDE plots for the Delaware County Area summarized by calendar quarter for the 2010-2012 period. The HYSPLIT KDE plots are weighted in the westerly direction, indicating a greater frequency of trajectories passing over grid cells to the west of the Delaware County monitor. The first and third quarter plots show a strong northwesterly component, while the fourth quarter plot shows a southwesterly component.
The highest kernel density in the plots is found in Delaware County, indicating that Delaware County has the highest potential to contribute to the violating monitor. As seen in Figure 9, the kernel density

[57] In some past initial area designations efforts, EPA has used HYSPLIT backward trajectories to assist in determining nonattainment area boundaries. A HYSPLIT backward trajectory is usually depicted on a standard map as a single line, representing the centerline of an air parcel's motion, extending in two dimensional (x,y) space from a starting point and regressing backward in time to a point of origin. Backward trajectories may be an appropriate tool to assist in determining an air parcel's point of origin on a day in which a short-term standard, such as an 8-hour standard or a 24-hour standard, was exceeded. However, for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, every trajectory on every day is important. Plotting a mass of individual daily (e.g., 365 individual back trajectories), or more frequent, HYSPLIT trajectories may not be helpful as this process is likely to result in depicting air parcels originating in all directions from the violating monitoring site.

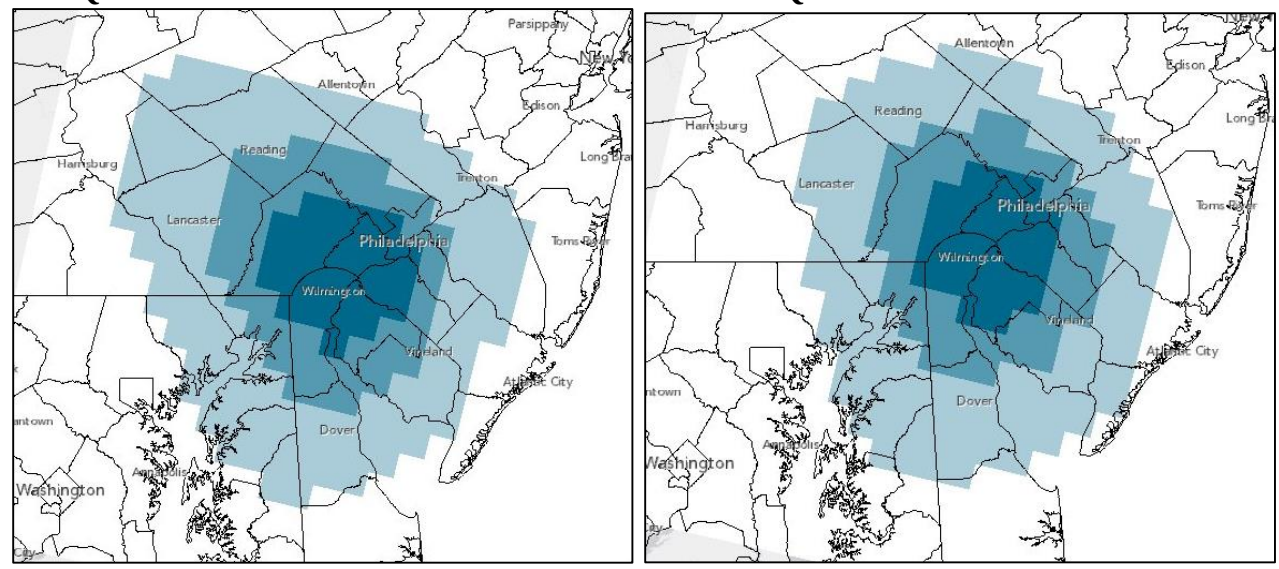
[58] HYSPLIT - Hybrid Single Particle Lagrangian Integrated Trajectory Model, *http://www.arl.noaa.gov/HYSPLIT_info.php*

[59] The KDEs graphically represent the aggregate of HYSPLIT backward trajectories for the years 2010-2012, run every third day (beginning on the first day of monitoring), four times each day, and ending at four endpoint heights.

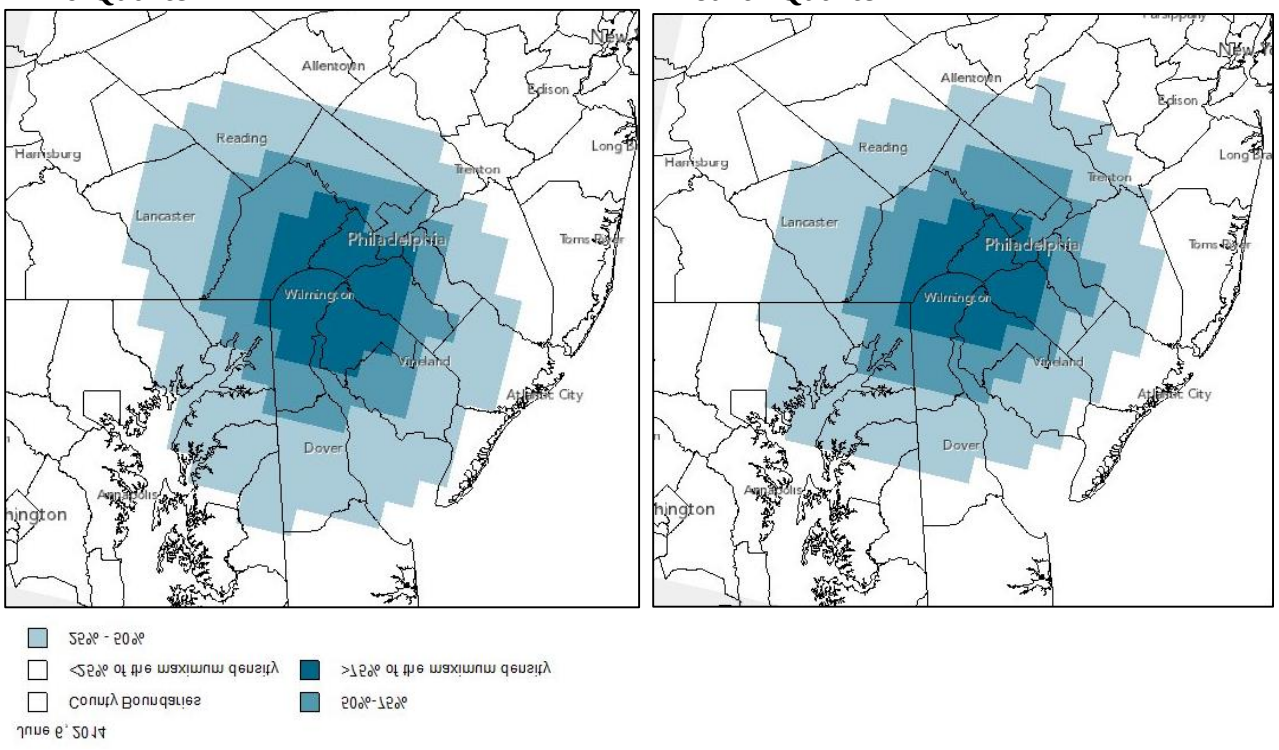
in Lancaster County, which has the highest emissions in the area of analysis, is low, indicating less potential for contribution to the violating monitor in Delaware County. Similarly, the kernel density in most of Philadelphia County, which has the second highest emission in the area of analysis, is also relatively not high. High kernel density is found in portions of Chester, New Castle, Gloucester and Camden Counties. However, these counties have relatively low emissions, and therefore low potential for impacting the violating monitor.

Figure 9. HYSPLIT Kernel Density Estimation Plots for the Delaware County Area.

First Quarter **Second Quarter**



Third Quarter **Fourth Quarter**



Factor 4: Geography/topography

To evaluate the geography/topography factor, EPA assessed physical features of the area of analysis that might define the airshed and thus affect the formation and distribution of $PM_{2.5}$ concentrations over the area. The Delaware County Area does not have any geographical or topographical barriers significantly limiting or directing air pollution transport within its air shed. Therefore, this factor did not play a significant role in this evaluation.

Factor 5: Jurisdictional boundaries

In defining the boundaries of the intended Delaware County nonattainment area, EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Existing jurisdictional boundaries often signify state and local governmental organization with the necessary legal authority for carrying out air quality planning and enforcement functions for the intended area. Examples of such jurisdictional boundaries include existing/prior nonattainment area boundaries for particulate matter, county lines, air district boundaries, township boundaries, areas covered by a metropolitan planning organization, state lines, and Reservation boundaries, if applicable. Where existing jurisdictional boundaries were not adequate or appropriate to describe the nonattainment area, EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

The violating monitor is located in Delaware County, PA, which is part of the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA. The Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA includes as New Castle County, Delaware; Cecil County, Maryland; Burlington, Camden, Gloucester, and Salem Counties in New Jersey; and Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania. The major jurisdictional boundaries in the Philadelphia-Camden-Wilmington area are the state lines between Pennsylvania, Delaware, and New Jersey. Each state is responsible for its own air quality planning. In addition, the Philadelphia Air Management Services is responsible for certain air quality planning tasks in the City of Philadelphia.

The Delaware Valley Regional Planning Commission (DVRPC), the MPO in the Philadelphia area, serves Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania, and Burlington, Camden, Gloucester, and Mercer Counties in New Jersey. New Castle County, DE is in a separate MPO, the Wilmington Area Planning Council (WILMAPCO). WILMAPCO is the Metropolitan Planning Organization for New Castle County, Delaware and Cecil County, Maryland.

Delaware County, PA was designated as part of the Philadelphia-Wilmington, PA-NJ-DE nonattainment area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS. The boundary for the nonattainment area for the 1997 and 2006 $PM_{2.5}$ NAAQS included the entire counties of Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; Burlington, Camden, and Gloucester in New Jersey; and New Castle in Delaware. EPA has redesignated to attainment the New Jersey and Delaware portions of the Philadelphia-Wilmington, PA-NJ-DE nonattainment area for the 1997 and 2006 $PM_{2.5}$ NAAQS (78 FR 54396) and (79 FR 45350), respectively. These redesignations to attainment indicate that air quality has improved in the Philadelphia region.

The states have recommended different boundaries for the 2012 annual $PM_{2.5}$ NAAQS. Both Delaware and New Jersey have recommended that no counties in their respective states should be part of a nonattainment area in the greater Philadelphia area. Pennsylvania recommended that Delaware County be designated as nonattainment, based on 2011-2013 ambient air quality monitoring data. EPA's intended nonattainment area boundary differs from the previously designated Philadelphia-Wilmington, PA-NJ-DE nonattainment area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS, because the data discussed above supports the finding that the violation in Delaware County is due to local, rather than regional emissions.

Conclusion for Delaware County Area

Based on the assessment of factors described above, both individually and in combination, EPA has preliminarily concluded that, within the Philadelphia-Camden-Wilmington MSA, Delaware County, PA should be the only county designated as nonattainment, because it is violating the 2012 annual $PM_{2.5}$ NAAQS and is contributing to the monitored violation. EPA's intended boundary is different from the Philadelphia-Wilmington, PA-NJ-DE nonattainment area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS. All other monitors in Philadelphia-Wilmington, PA-NJ-DE area are meeting the 2012 annual $PM_{2.5}$ NAAQS based on the 2013 DVs. Furthermore, available data does not support a finding that the other counties in the Philadelphia-Wilmington, PA-NJ-DE area are contributing to the monitored violation in Delaware County.

As stated above, starting in 2011, quarterly mean $PM_{2.5}$ levels at the Delaware County monitor are consistently high, while the surrounding monitors either drop off or remain low, suggesting notable local influence at the violating monitor. Most monitors in the area of analysis show higher quarterly mean $PM_{2.5}$ values in the third calendar quarter, which corresponds to higher EGU emissions from higher air conditioning use. These monitors also generally show higher quarterly mean values in the first calendar quarter, which may be due to higher EGU emissions from higher heating use, including home heating oil and from greater collection of particle nitrate during the cooler months. However, the violating Delaware County monitor does not seem to experience highs and lows in the same quarters as its neighbors.

Quarterly means were relatively consistent for the Delaware County monitor starting in the first quarter in 2011 through the first quarter in 2012, with the low point in the second quarter of 2012. From the third quarter in 2012 to the second quarter in 2013, the Delaware County monitor was considerably higher than the other monitors in the area of analysis, while the surrounding monitors either drop off or remain low, suggesting an important local influence at the violating monitor. In the third and fourth quarters of 2013, the $PM_{2.5}$ values at the Delaware County monitor appear to track with most other monitors in the area, and are below the 12 $\mu g/m^3$ level of the 2012 annual $PM_{2.5}$ NAAQS. This suggests that the influence of the local sources was less important in those quarters.

The greater Philadelphia area is densely populated. Delaware County has the second highest population density, and ranks sixth in total population in the 25 county area of analysis. Delaware County's VMT is about half that of the highest county, Montgomery County, PA, and sixteen times higher than the lowest county, Kent County, MD. Numerous large highways run through the area of analysis. Interstate 95 runs near the Delaware County monitor.
The Delaware County monitor is located in a heavily industrialized area, and is sited adjacent to a small industrial source. In the area of analysis, Delaware County ranks second in EC, NO_X and SO_2

emissions. Furthermore, there are six facilities in Delaware County with emissions of 500 tpy or more, located within seven miles of the violating monitor, including the Sunoco Marcus Hook Refinery with total emissions of 4,545 tpy, and 674 tpy of direct $PM_{2.5}$. In addition, the small Evonik site is located adjacent to and directly east of the violating monitor. EPA and the Commonwealth both believe that the high density of emission sources in close proximity to the monitor are the contributor to the $PM_{2.5}$ violation and further emphasize the impacts on the Delaware County monitor is a local contribution rather than a regional one from the surrounding counties.

The predominant wind direction in the area of analysis is westerly, with winds also coming from the southwest and northwest. Wind directions on high $PM_{2.5}$ days at the Delaware County monitor are predominantly from the east, with a northeast component and a lesser southwest component. This is contrary to the dominant wind direction in the region, which is westerly. This suggests local, rather than regional, sources are responsible for the high $PM_{2.5}$ days at the Delaware County monitor.

There are numerous sources in Delaware County, upwind of and very close to the violating monitor. The small Evonik facility is located directly east of, and therefore upwind of, the violating monitor, which, as illustrated above in Figure 5c, is within the fenceline of the facility. The Kimberly Clark Pa LLC facility is approximately one mile northeast of the monitor. The Covanta Delaware Valley facility is approximately one mile southwest of the monitor. Monroe Energy LLC/Trainer and Sunoco Inc (R&M)/Marcus Hook Refinery are both southwest of the monitor, two and three miles, away respectively. The Exelon Generation Co/Eddystone and the Philadelphia International Airport are northeast of the facility, four and seven miles away, respectively.

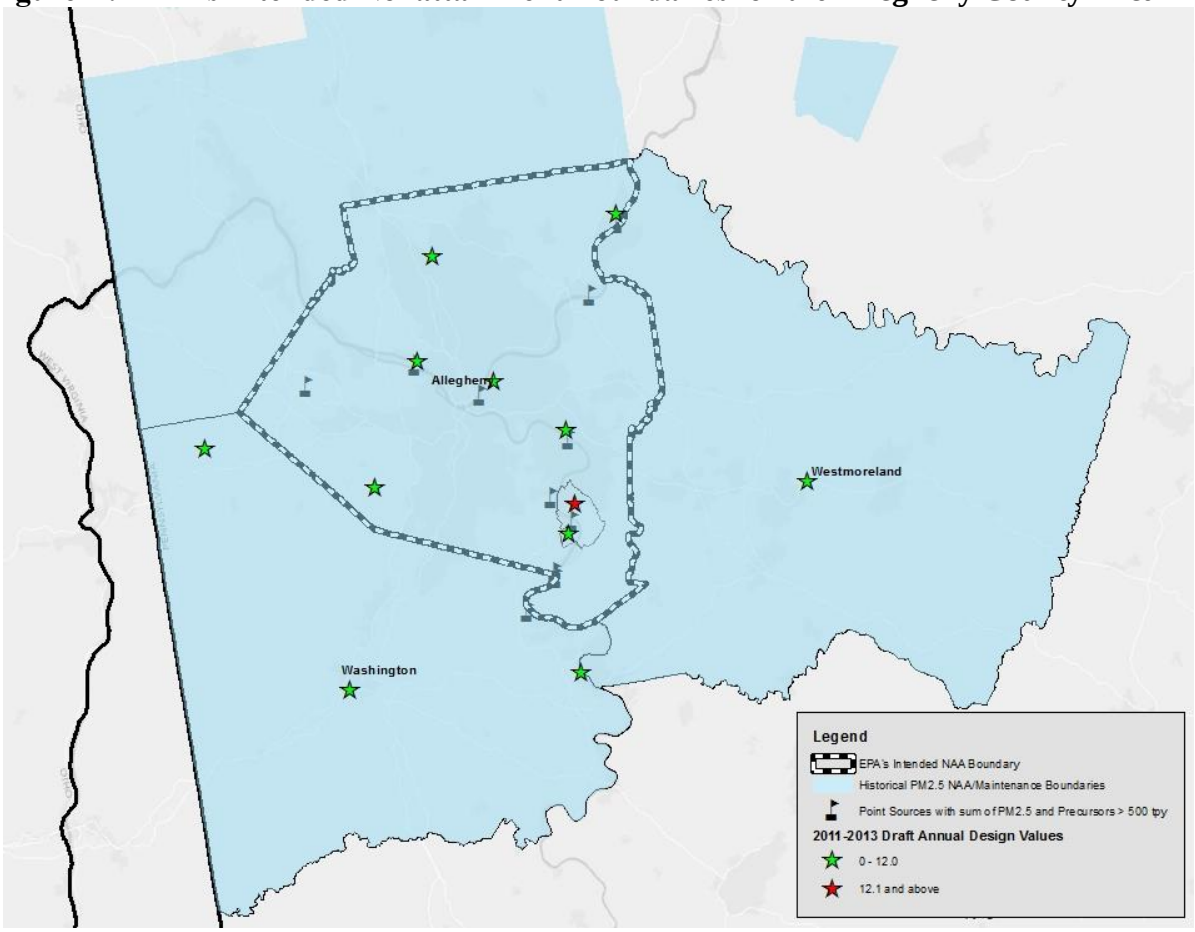
The HYSPLIT KDE plots for the Delaware County violating monitor are weighted in the westerly direction, indicating a greater frequency of trajectories passing over grid cells to the west of the Delaware County monitor. The first and third quarter plots show a strong northwesterly component, while the fourth quarter plot shows a southwesterly component. The highest kernel density in the plots is found in Delaware County, indicating that Delaware County has the highest potential to contribute to the violating monitor. As seen in Figure 9, the kernel density in Lancaster County, which has the highest emissions in the area of analysis, is low, indicating less potential for contribution to the violating monitor in Delaware County. Similarly, the kernel density in most of Philadelphia County, which has the second highest emission in the area of analysis, is also not high. High kernel density is found in portions of Chester, New Castle, Gloucester and Camden Counties. However, these counties have relatively low emissions, and therefore low potential for impacting the violating monitor.

3.3 Area Background and Overview – Allegheny County Area

Figure A is a map of EPA's intended nonattainment boundary for the Allegheny County Area. The map shows the location and DVs of ambient air quality monitoring locations, county and other jurisdictional boundaries, including the Pittsburgh, PA MSA and existing nonattainment area boundaries for the 1997 annual and/or 2006 24-hour $PM_{2.5}$ NAAQS.

For purposes of the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS, this area was designated nonattainment. Part of Allegheny County was designated nonattainment as the Liberty-Clairton Area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS. The Liberty-Clairton Area includes the City of Clairton and the Boroughs of Glassport, Liberty, Lincoln, and Port Vue in Allegheny County, PA. For purposes of the 1997 annual and 2006 24-hour $PM_{2.5}$, the remainder of Allegheny County was designated in the Pittsburg-Beaver Valley nonattainment area, along with the, Beaver, Butler Washington, and Westmoreland Counties and portions of Armstrong Greene, and Lawrence Counties. Pennsylvania recommended that only the five municipalities in the Liberty-Clairton Area be designated as nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. However, EPA intends to designate all of Allegheny County as the Allegheny County nonattainment area for the 2012 annual $PM_{2.5}$ NAAQS.

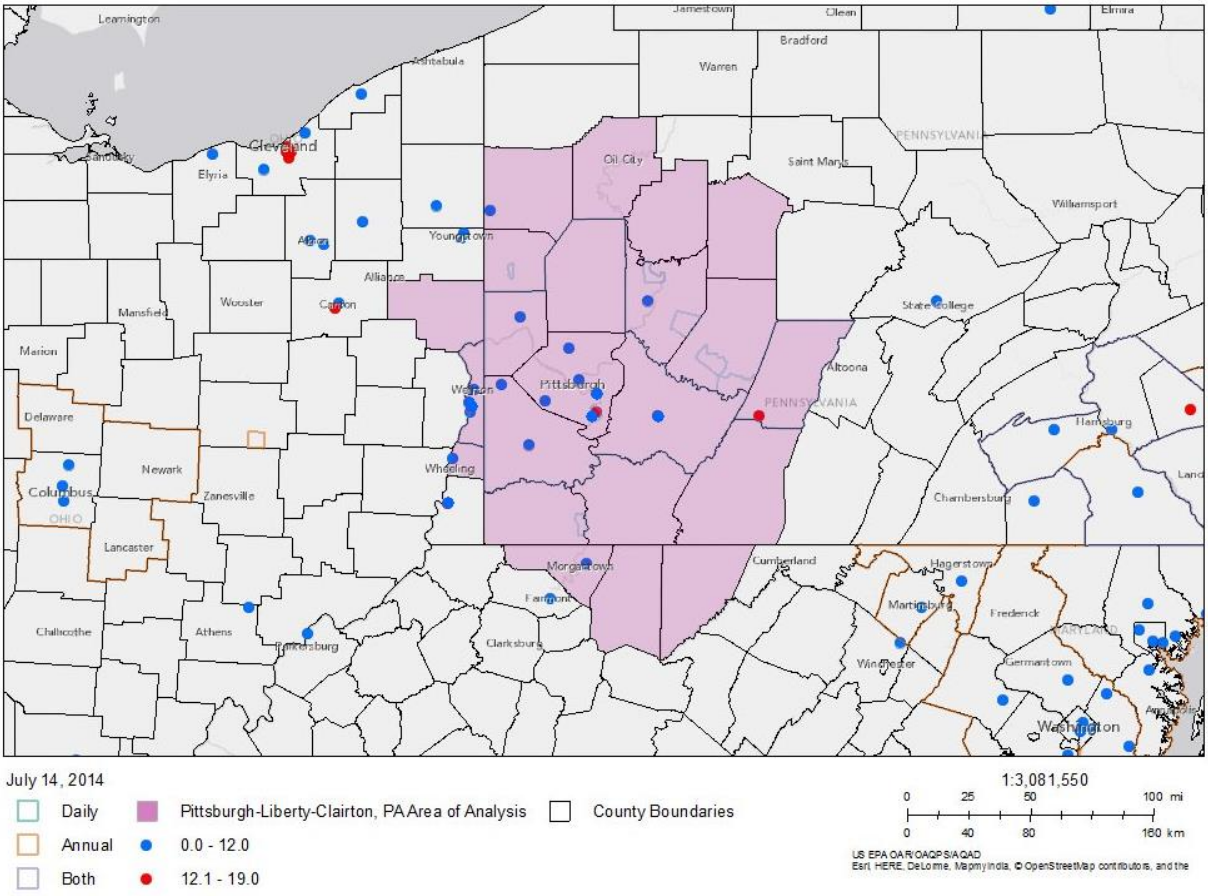
Figure A. EPA's Intended Nonattainment Boundaries for the Allegheny County Area



EPA must designate as nonattainment areas that violate the NAAQS and nearby areas that contribute to the violation in the violating area. A monitor in Liberty Borough in Allegheny County, PA shows a

violation of the 2012 annual $PM_{2.5}$ NAAQS. Therefore, this county is included in the nonattainment area. As shown in Figure B, EPA evaluated each county in the Pittsburgh, MSA, which includes Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, and Westmoreland Counties in Pennsylvania, and a ring of counties adjacent to the Pittsburgh, PA MSA. EPA's evaluation was based on the five factors and other relevant information. EPA has determined that only Allegheny County, PA contributes to the nearby violation. Note that Cambria County, PA, which is in the area of analysis, also shows a violation. As discussed in Section 3.1, EPA intends to designate Cambria County and a portion of Indiana County, PA as nonattainment in a separate nonattainment area, the Johnstown Area. The following sections describe this five factor analysis process. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers their interconnections and the dependence of each factor on one or more of the others.

Figure B. Area of Analysis for the Allegheny County Intended Nonattainment Area



Factor 1: Air Quality Data

All ambient air quality data collected during the year are important when determining contributions to an annual standard such as the 2012 annual $PM_{2.5}$ NAAQS. Compliance with an annual NAAQS is dependent upon monitor readings throughout the year, including days with monitored ambient concentrations below the level of the NAAQS. For the 2012 annual $PM_{2.5}$ NAAQS, the annual mean is calculated as the mean of quarterly means. A high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV. Although all data are important, seasonal or episodic emissions can provide insight as to relative contributors to measured $PM_{2.5}$ concentrations. For these reasons, for the Factor 1 air quality analysis, EPA assessed and characterized air quality at, and in the

proximity of, the violating monitoring site locations first, by evaluating trends and the spatial extent of measured concentrations at monitors in the area of analysis, and then, by identifying the conditions most associated with high average concentration levels of $PM_{2.5}$ mass in the area of analysis.

In most cases, EPA assessed air quality data on a seasonal, or quarterly, basis.[60] EPA also identified the spatial extent of these high $PM_{2.5}$ concentrations. The mass and composition at the DV location represents contributions from various emission sources including local, area-wide (which may comprise nearby urban and rural areas) and regional sources. To determine the source mix (by mass) at the DV monitoring site, EPA examined the chemical composition of the monitored $PM_{2.5}$ concentrations by pairing each violating FRM/FEM/ARM monitoring site with a collocated or nearby Chemical Speciation Network (CSN) monitoring site or sites. Then, EPA contrasted the approximated mass composition at the DV monitoring site with data collected at IMPROVE[61] and other monitoring locations whose data are representative of regional background.[62,63] This comparison of local/area-wide chemical composition data to regional chemical composition data derives an "urban increment," which helps differentiate the influence of more distant emissions sources from the influence of closer

[60] Although compliance with the annual NAAQS depends on contributions from all days of the year, examining data on a quarterly or seasonal basis can inform the relationship between the temporal variability of emissions and meteorology and the resulting $PM_{2.5}$ mass and composition. In some areas of the country where there may be noticeable month-to-month variations in average $PM_{2.5}$, the quarterly averages may not adequately represent seasonal variability. In these areas, air quality data may be aggregated and presented by those months that best correspond to the local "seasons" in these areas.

[61] IMPROVE stands for Interagency Monitoring for Protected Visual Environments and is an aerosol monitoring network in mostly rural and remote areas.

[62] The "urban increment" analysis assesses and characterizes the increase in seasonal and annual average $PM_{2.5}$ mass and chemical components observed at violating monitoring site(s) relative to monitoring sites outside the area of analysis (which represent background concentrations). Developing the urban increment involves pairing a violating FRM/FEM/ARM monitor with a collocated monitor or nearby monitor with speciation data. EPA made every effort to pair these data to represent the same temporal and spatial scales. However, in some cases, the paired violating and CSN "urban" monitoring locations were separated by some distance such that the included urban CSN site(s) reflect(s) a different mixture of emissions sources, which could lead to misinterpretations. To generally account for differences in $PM_{2.5}$ mass between the violating site and the nearby CSN site(s), EPA determined material balance of the $PM_{2.5}$ composition at the violating site by assigning the extra measured $PM_{2.5}$ mass to the carbon components of $PM_{2.5}$. Where the general urban increment approach may be misleading, or in situations where non-carbonaceous emissions are believed to be responsible for a local $PM_{2.5}$ concentration gradient, EPA used alternative analyses to reflect the mix of urban and rural sources contributing to the measured concentrations at violating monitoring sites.

[63] The urban monitors were paired with any rural sites within a 150 mile radius of an urban site to calculate spatial means of the quarterly averages of each species. If there were no rural sites within 150 miles, then the nearest rural site was used alone. That rural mean was then subtracted from the quarterly mean of the urban site to get the increment. Negative values were simply replaced with zeros.

emissions sources, thus representing the portion of the measured violation that is associated with nearby emission contributions.[64,65,66]

$PM_{2.5}$ Design Values and Total Mass Measurements - EPA examined ambient $PM_{2.5}$ air quality monitoring data represented by the DVs at each violating monitoring site and at other monitors in the area of analysis. EPA calculated DVs based on air quality data for the most recent 3 consecutive calendar years of quality-assured, certified air quality data from suitable FEM/FRM/ARM monitoring sites in the EPA's Air Quality System (AQS). For this designations analysis, EPA used data for the 2011-2013 period (i.e., the 2013 DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2012 annual $PM_{2.5}$ NAAQS is met at a monitoring site when the 3-year average annual mean concentration is 12.0 micrograms per cubic meter ($\mu g/m^3$) or less (e.g., 12.1 $\mu g/m^3$ or greater is a violation). A DV is only valid if minimum data completeness criteria are met or when other regulatory data processing provisions are satisfied. See 40 CFR part 50 Appendix N. Table 2 identifies the current DVs (i.e., the 2013 DV) and the most recent two DVs based on all monitoring sites in the area of analysis for the Allegheny County intended nonattainment area.[67]

Table 1. Air Quality Data collected at Regulatory Monitors (all DV levels in $\mu g/m^3$)[a,b]

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Garrett, MD	240230002	No	10.7 [c]	10.0 [c]	10.0 [c]
Columbiana, OH	N/A	No	No monitor		
Allegheny, PA	420030064	Yes (partial)	**15**	**14.8**	**13.4**
Allegheny, PA	420031301	Yes (partial)	12.7	12.5	11.7
Allegheny, PA	420030008	Yes (partial)	11.6	11.1	10.3
Allegheny, PA	420030067	Yes (partial)	11	10.5	9.6
Allegheny, PA	420030093	Yes (partial)	9.7	9.4	8.8
Allegheny, PA	420033007	Yes (partial)	11.5 [c]	10.9 [c]	9.8 [c]
Allegheny, PA	420030002	Yes (partial)	14.7[c]	13.4	11.4

[64] In most, but not all, cases, the violating design value monitoring site is located in an urban area. Where the violating monitor is not located in an urban area, the "urban increment" represents the difference between local and other nearby emission sources in the vicinity of the violating monitoring location and more regional sources.

[65] Hand, et. al. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report V, June 2011. Chapter 7 – Urban Excess in $PM_{2.5}$ Speciated Aerosol Concentrations, *http://vista.cira.colostate.edu/improve/Publications/Reports/2011/PDF/Chapter7.pdf*

[66] US EPA, Office of Air Quality Planning and Standards, December 2004. (2004) Area Designations for 1997 Fine Particle ($PM_{2.5}$) Standards, Technical Support Document for State and Tribal Air Quality Fine Particle ($PM_{2.5}$) Designations, Chapter 3, Urban Excess Methodology. Available at *www.epa.gov/pmdesignations/1997standards/documents/final/TSD/Ch3.pdf*

[67] In certain circumstances, one or more monitoring locations within a monitoring network may not meet the network technical requirements set forth in 40 CFR 58.11(e), which states, "State and local governments must assess data from Class III $PM_{2.5}$ FEM and ARM monitors operated within their network using the performance criteria described in table C-4 to subpart C of part 53 of this chapter, for cases where the data are identified as not of sufficient comparability to a collocated FRM, and the monitoring agency requests that the FEM or ARM data should not be used in comparison to the NAAQS. These assessments are required in the monitoring agency's annual monitoring network plan described in §58.10(b) for cases where the FEM or ARM is identified as not of sufficient comparability to a collocated FRM…."

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Allegheny, PA	420031008	Yes (partial)	12.4[c]	11.7	10.6
Armstrong, PA	420050001	No	12.1[c]	11.7	10.8
Beaver, PA	420070014	No	12.4	12	11.6
Butler, PA	N/A	No	No monitor		
Cambria, PA	420210011	Yes (other area)	12.4	12.3	12.3
Clarion, PA	N/A	No	No monitor		
Fayette, PA	N/A	No	No monitor		
Greene, PA	N/A	No	No monitor		
Indiana, PA	N/A	No	No monitor		
Jefferson, PA	N/A	No	No monitor		
Lawrence, PA	N/A	No	No monitor		
Mercer, PA	420850100	No	10.5	10.6	10.3
Somerset, PA	N/A	No	No monitor		
Venango, PA	N/A	No	No monitor		
Washington, PA	421250200	No	**11.3**	**11.1**	**10.3**
Washington, PA	421255001	No	9	7.2	7.2
Westmoreland, PA	421290008	No	13.7	12.6	11.1
Brooke, WV	540090005	No	13	12.7	11.6
Hancock, WV	540291004	No	11.7	11.3	10.5
Monongalia, WV	540610003	No	10.9	10.3	9.5
Ohio, WV	540690010	No	11.9	11.6	10.6
Preston, WV	N/A	No	No monitor		

[a]If a county has more than one monitoring location, the county DV is indicated in bold type.
[b]If a monitor is violating, the NAAQS, the violating DV is indicated in red type.
[c]Incomplete data.

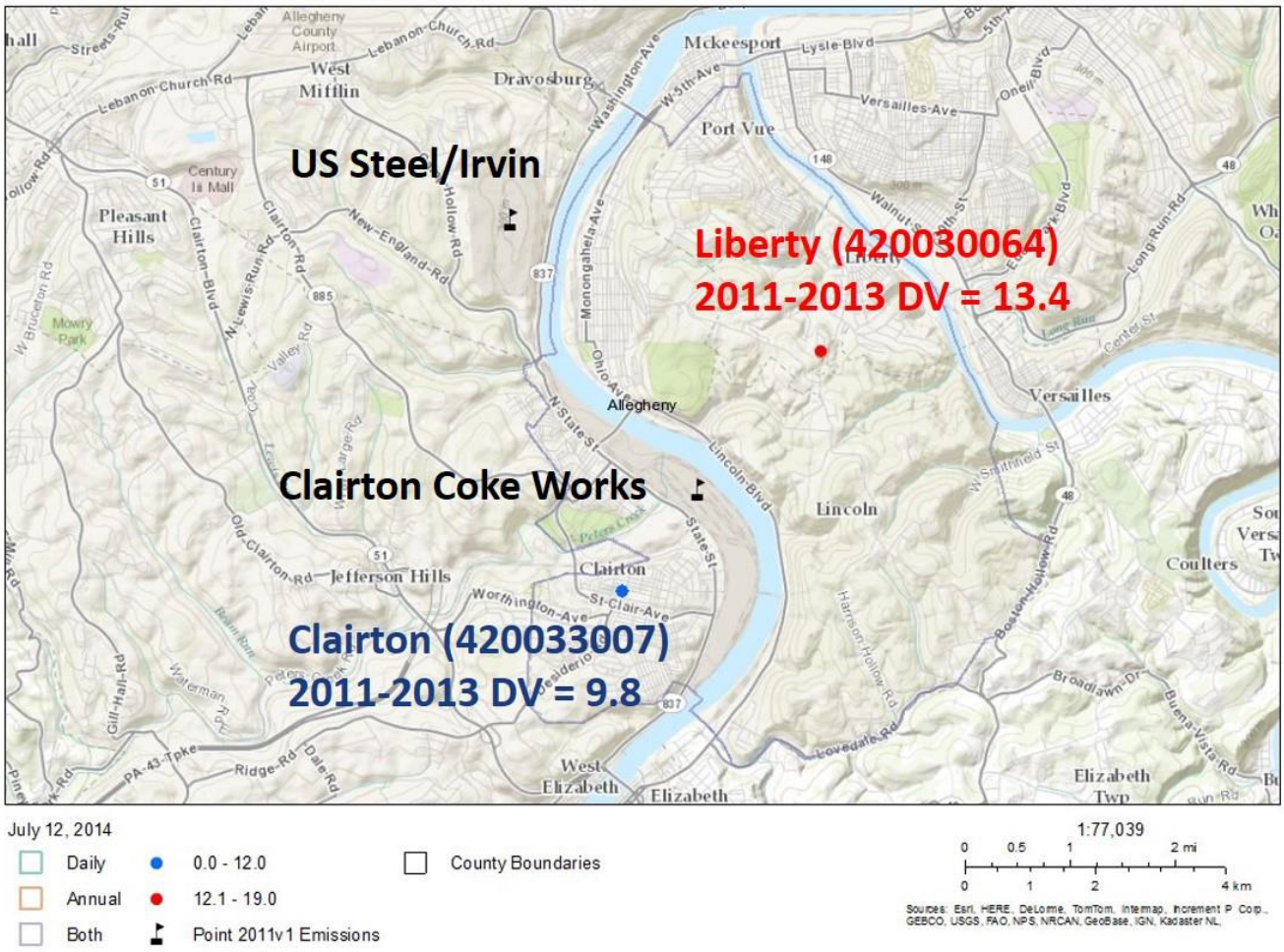
The Figure A map, shown previously, identifies the Allegheny County intended nonattainment area, the Pittsburgh MSA boundary, and monitoring locations with 2011-2013 violating DVs in the area of analysis. Note that Figure A only shows monitors with valid DVs. Therefore, monitors in the area of analysis that did not meet the minimum data capture requirements as defined in 40 CFR 50, Appendix N, are not shown in Figure A. However, EPA has included these "incomplete data" monitors in Table 1.

As indicated on the map in Figures A and B and Table 1, there are 2 violating monitoring locations in the area of analysis. One violating monitor is located in Liberty Borough in Allegheny County, PA ("the Liberty monitor" or "the violating monitor"). The second violating monitor is located in Cambria County, PA. As discussed in Section 3.1, EPA conducted a five factor analysis for the violating monitor in Cambria County, and has determined that Cambria County, PA should be designated in a separate nonattainment area, the Johnstown nonattainment area.

As listed in Table 1, there are eight air quality monitors in Allegheny County. The $PM_{2.5}$ DVs at seven of the eight monitors correlate well. However, the $PM_{2.5}$ DV at the Liberty monitor is considerably higher. The large local sources plus the unique topographical features in this location result in substantially higher $PM_{2.5}$ monitored values at the Liberty monitor than the other monitors in

Allegheny County. This point is demonstrated dramatically in Figure C, where Liberty monitor's 13.4 µg/m^3 DV is contrasted with that of the Clairton monitor (420033007), 9.8 µg/m^3.[68] The Clairton monitor is two miles southwest of the Liberty monitor (420030064), and less than a mile southwest of the U.S. Steel Clairton Cokes Works (Clairton Coke Works).

Figure C. The Liberty and Clairton[69] Air Quality Monitors



Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. Figure 1a shows quarterly mean $PM_{2.5}$ concentrations for the most recent 3-year period for the highest DV monitoring sites in each county within the area of analysis. Figure 1b reflects the same information, for the eight monitors in Allegheny County. This graphical representation is particularly relevant when assessing air quality data for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, because, as previously stated, the annual mean is calculated as the mean of quarterly means and a high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV.

[68] Although this DV is based on incomplete data and is not valid in accordance with Appendix N to 40 CFR 50, its data serves to illustrate the spatial variability of $PM_{2.5}$ in the proximity of the violating monitor. This contrast is further illustrated in Figure 1b.

[69] The Clairton monitor (420033007) has incomplete data for the 2011-2013 monitoring period.

Figure 1a. Allegheny County Area of Analysis $PM_{2.5}$ Quarterly Means for 2011-2013

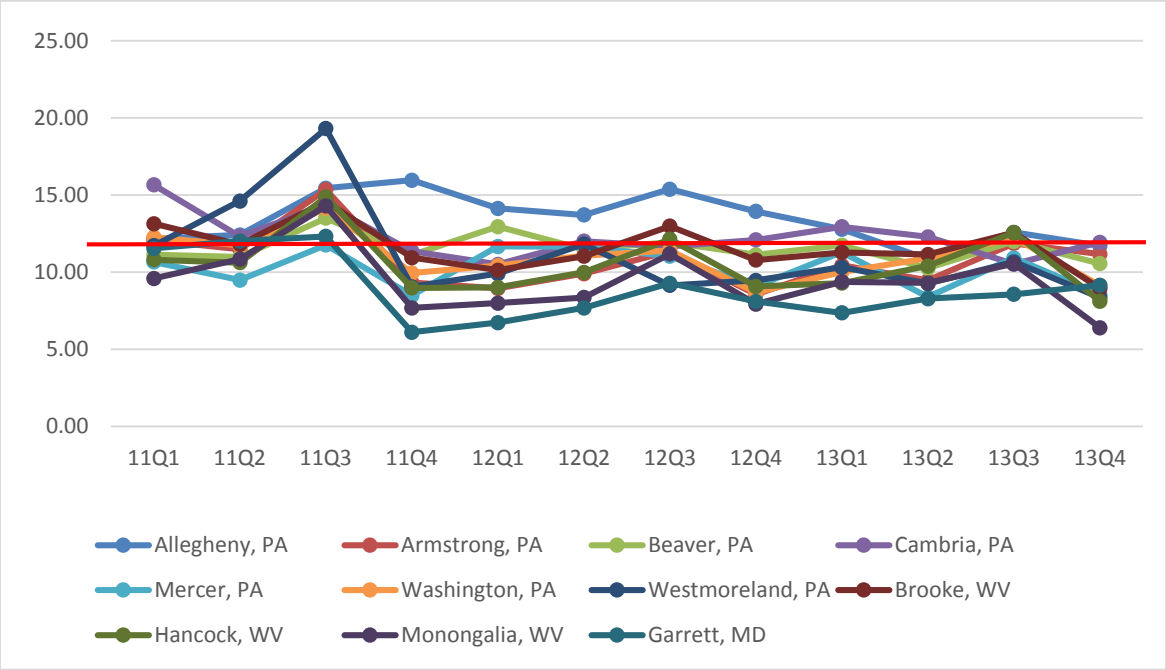
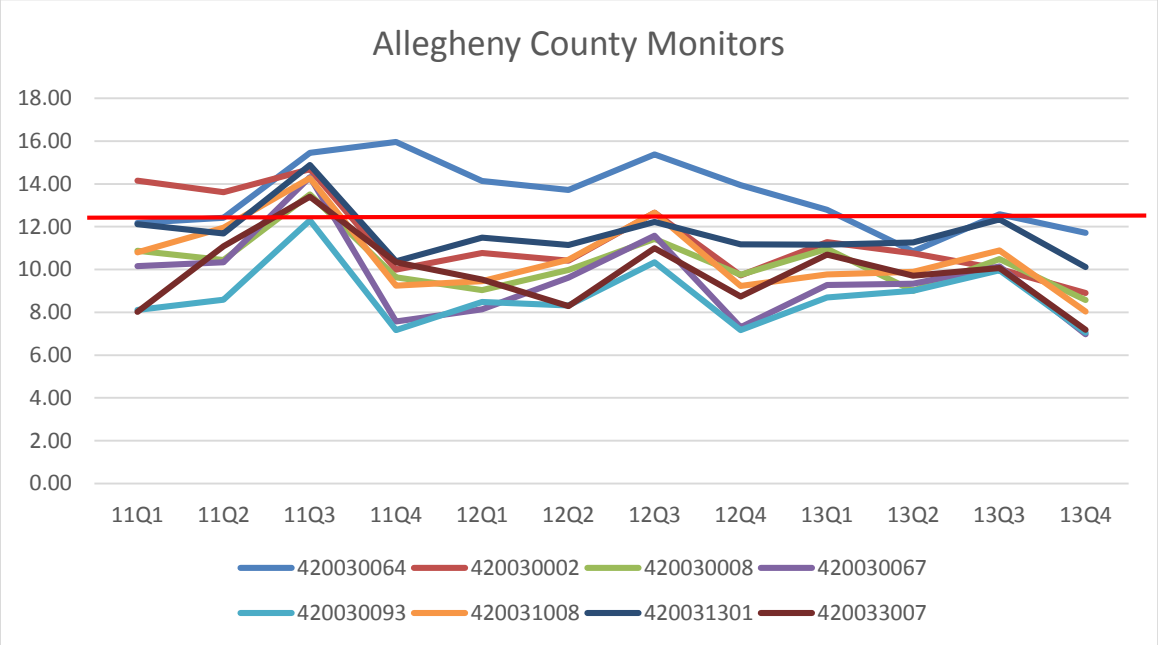


Figure 1b. Allegheny County $PM_{2.5}$ Quarterly Means for 2011-2013

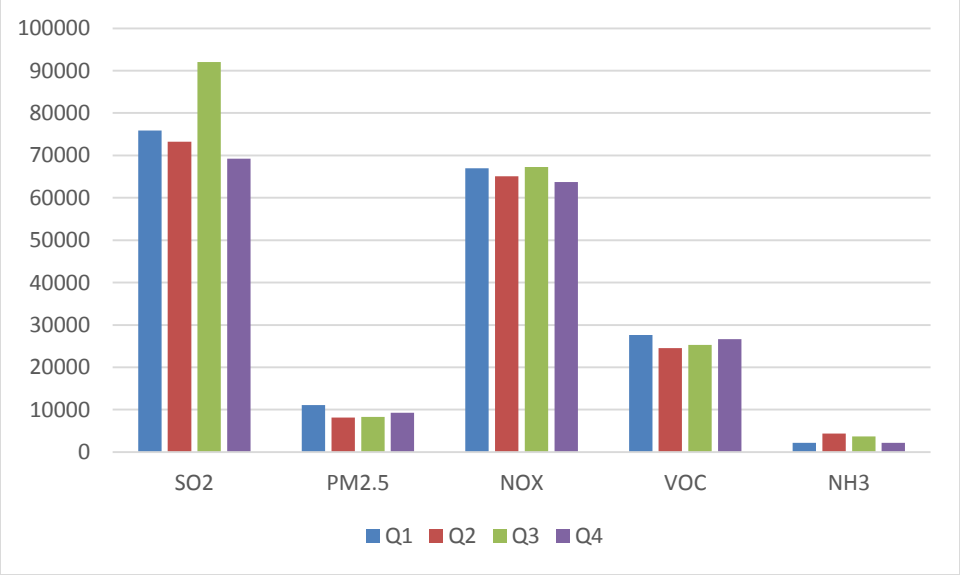


As shown, in Figures 1a and 1b, most monitors in the area of analysis show higher quarterly mean values in third quarter (July-September) of each year. This is typical in the eastern half of the United States, when sulfates are more readily formed from SO_2 emissions from EGUs due to higher air conditioning use. As shown in Figure 1c, below, SO_2 emissions in the area of analysis spike in the third quarter, as expected given this seasonal pattern. The violating Liberty monitor in Allegheny County follows this general pattern, but monitored $PM_{2.5}$ levels that are consistently higher than the rest of the monitors in the area, including the nearby Clairton monitor in the Borough, until the second

quarter of 2013. This indicates that the Liberty monitor is influenced by the same seasonal emissions patterns as the rest of the area, but there is an additional local component causing $PM_{2.5}$ levels to be higher than the rest of the area. Note that the recent improvement in air quality at the Liberty monitor coincide with control measures implemented at the Clairton Coke Works, as explained in factor 5, below. This suggests that air quality at the Liberty monitor benefits from emission controls at the Clairton Coke Works.

Additionally, in the fourth quarter (October-December) of 2011, $PM_{2.5}$ levels at the Liberty monitor peaked, when the other monitors in the area of analysis monitored relatively low $PM_{2.5}$ levels, The high fourth quarter in 2011 was possibly caused by strong temperature inversions in the vicinity of the violating monitor in later months of the year.[70] The effects of temperature inversions are discussed in factor 4 regarding geography and topography, below.

Figure 1c. Quarterly Emissions of Directly Emitted $PM_{2.5}$ and Precursors in the Allegheny County Area of Analysis (tpy)



PM2.5 Composition Measurements - To assess potential emissions contributions for each violating monitoring location, the EPA determined the various chemical species comprising total $PM_{2.5}$ to identify the chemical components over the analysis area, which can provide insight into the types of emission sources impacting the monitored concentration. To best describe the $PM_{2.5}$ at the violating monitoring location, EPA first adjusted the chemical speciation measurement data from a monitoring location at or near the violating FRM monitoring site using the SANDWICH approach to account for

[70] "$PM_{2.5}$ Chemical Speciation Analysis for the Liberty-Clairton Area, 2005-2009," Allegheny County Health Department, December 2012.

the amount of $PM_{2.5}$ mass components retained in the FRM measurement.[71,72,73,74] In particular, this approach accounts for losses in fine particle nitrate and increases in sulfate mass associated with particle bound water. Figure 1d illustrates the fraction of each $PM_{2.5}$ chemical component at the violating Liberty monitoring site in Allegheny County based on annual averages for the years 2011-2013. Figure 1e gives speciation data as provided in Pennsylvania's December 2013 recommendation letter. Note that Pennsylvania's speciation data is the raw data from the speciation monitor at the Liberty monitoring site. Pennsylvania did not adjust this data using the SANDWICH approach. In particular, the organic component is not presented as organic mass and thus significantly understates its contribution to $PM_{2.5}$ mass. Because the Liberty monitor speciation data was not complete for the entire 3-year period, EPA constructed the speciation profile using other speciation monitors and adjusted the final profile to match the $PM_{2.5}$ mass at violating monitor DV. Therefore, the EPA and PA composition profiles are different.

In its December 2013 letter, Pennsylvania identified 252 days in the 2010 to 2012 monitoring period, when the Liberty monitor's $PM_{2.5}$ concentrations were at least one standard deviation above the regional concentrations in the Pittsburgh MSA, and regional average was at or below 12 $\mu g/m^3$, i.e., "clean." Pennsylvania further analyzed the most extreme events during the 252 days, the top 25% high $PM_{2.5}$ days. Figure 1f shows the average chemical component at the violating Liberty monitoring during the top 25% days high $PM_{2.5}$ days.

[71] SANDWICH stands for measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous mass **H**ybrid Material Balance Approach." The SANDWICH adjustment uses an FRM mass construction methodology that results in reduced nitrates (relative to the amount measured by routine speciation networks), higher mass associated with sulfates (reflecting water included in gravimetric FRM measurements) and a measure of organic carbonaceous mass derived from the difference between measured $PM_{2.5}$ and its non-carbon components. This characterization of $PM_{2.5}$ mass also reflects crustal material and other minor components. The resulting characterization provides a complete mass closure for the measured FRM $PM_{2.5}$ mass, which can be different than the data provided directly by the speciation measurements from the CSN network.

[72] Frank, N. H., SANDWICH Material Balance Approach for $PM_{2.5}$ Data Analysis, National Air Monitoring Conference, Las Vegas, Nevada, November 6-9, 2006. *http://www.epa.gov/ttn/amtic/files/2006conference/frank.pdf*.

[73] Frank, N. H., The Chemical Composition of $PM_{2.5}$ to support PM Implementation, EPA State /Local/Tribal Training Workshop: $PM_{2.5}$ Final Rule Implementation and 2006 $PM_{2.5}$ Designation Process, Chicago IL, June 20-21, 2007, *http://www.epa.gov/ttn/naaqs/pm/presents/pm2.5_chemical_composition.pdf.*

[74] Frank, N. H. *Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities*. J. Air & Waste Manage. Assoc. 2006 56:500–511.

Figure 1d. Liberty Monitor Annual Average $PM_{2.5}$ Chemical Components (2010-2012)

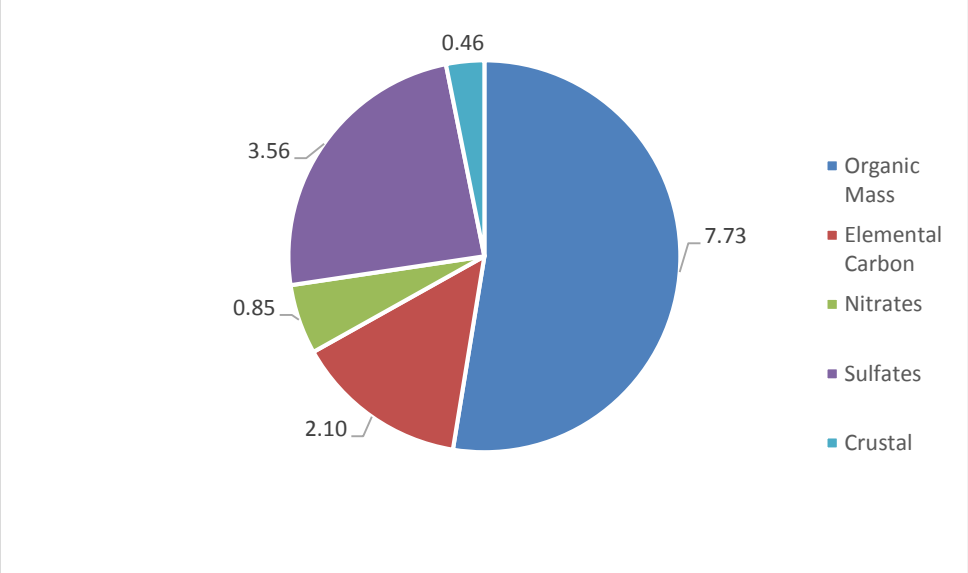
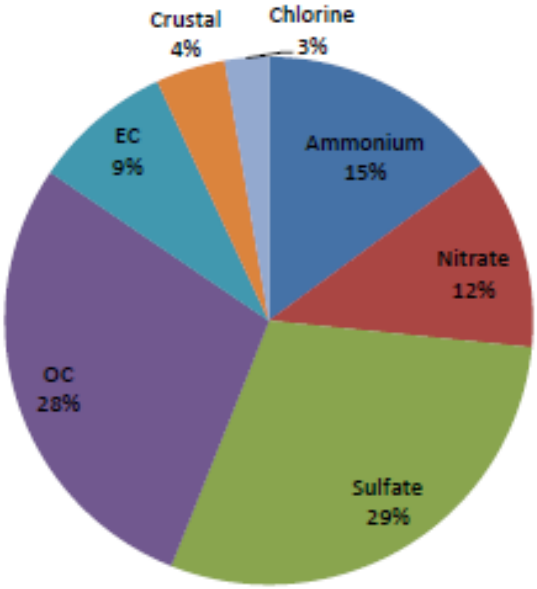
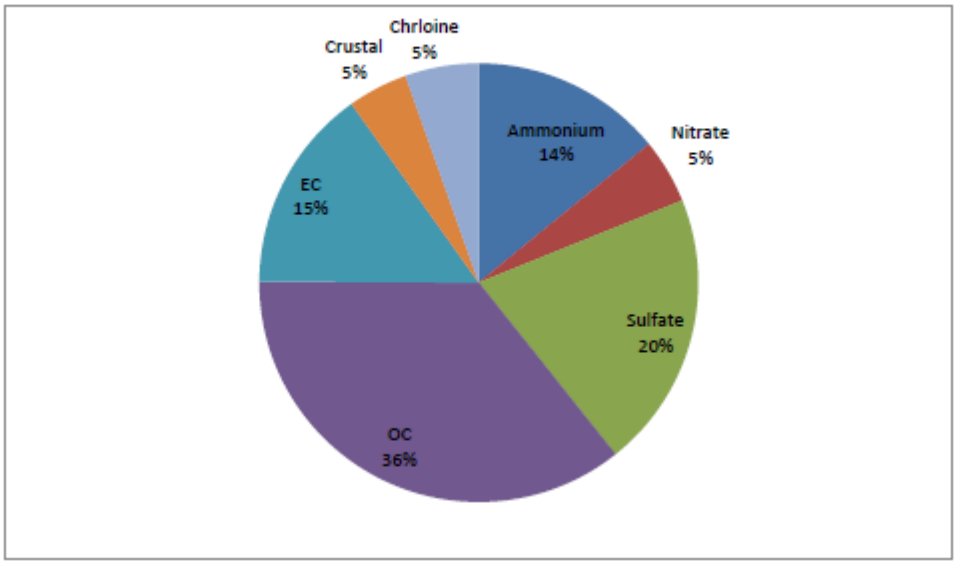


Figure 1e. Liberty Monitor Annual Average $PM_{2.5}$ Chemical Components (2010-2012)



Source: Pennsylvania's December 10, 2013 recommendation lettr, Appendix C-6 - Liberty-Clairton Area

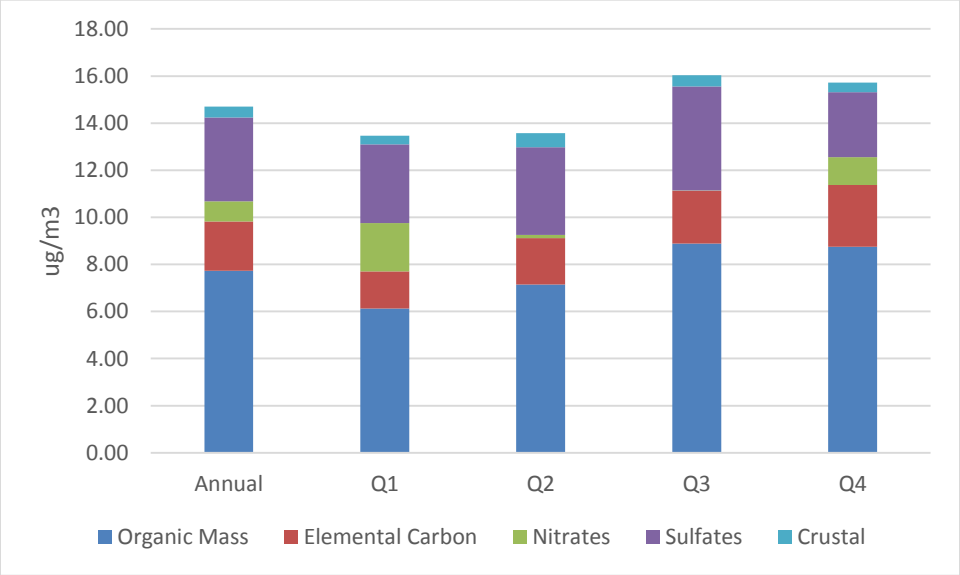
Figure 1f. Liberty Monitor Average $PM_{2.5}$ Chemical Components on the top 25% High $PM_{2,5}$ Days (2010-2012)



Source: Pennsylvania's December 10, 2013 recommendation lettr, Appendix C-6 - Liberty-Clairton Area

Figure 1g shows annual and quarterly chemical composition profiles and illustrates any seasonal or episodic contributors to $PM_{2.5}$ mass. This "increment analysis," combined with the other factor analyses, can provide additional insight as to which sources or factors may contribute at a greater level. Simply stated, this analysis can help identify nearby sources of emissions that contribute to the violation at the violating monitoring site.

Figure 1g. Liberty Monitor Annual and Quarterly Average $PM_{2.5}$ Species (2010-2012)[a]



[a]*Adjusted to FRM Total $PM_{2.5}$* indicates that the speciation profile and total mass depicted in this figure are the result of the urban increment calculation for the particular FRM monitor.

EPA assessed seasonal and annual average $PM_{2.5}$ components at monitoring sites within the area of analysis relative to monitoring sites outside of the analysis area to account for the difference between regional background concentrations of $PM_{2.5}$, and the concentrations of $PM_{2.5}$ in the area of analysis,

also known as the "urban increment." This analysis differentiates between the influences of emissions from sources in nearby areas and in more distant areas on the violating monitor. Estimating the urban increment in the area helps to illuminate the amount and type of particles at the violating monitor that are most likely to be the result of sources of emissions in nearby areas, as opposed to impacts of more distant or regional sources of emissions. Figures 1h and 1j includes pie charts showing the annual and quarterly chemical mass components of the urban increment. The quarterly pie charts correspond to the high-concentration quarters identified in Figures 1a and 1b. Figure 1i presents first and third quarter urban increment data provide by Pennsylvania in its December 2011 designation recommendation letter. Evaluating these high concentration quarters can help identify composition of $PM_{2.5}$ during these times. Note that in these charts, sulfates and nitrates have been adjusted to represent their mass in measured $PM_{2.5}$.

Figure 1h. Liberty Monitor Urban Increment Analysis for 2010-2012.

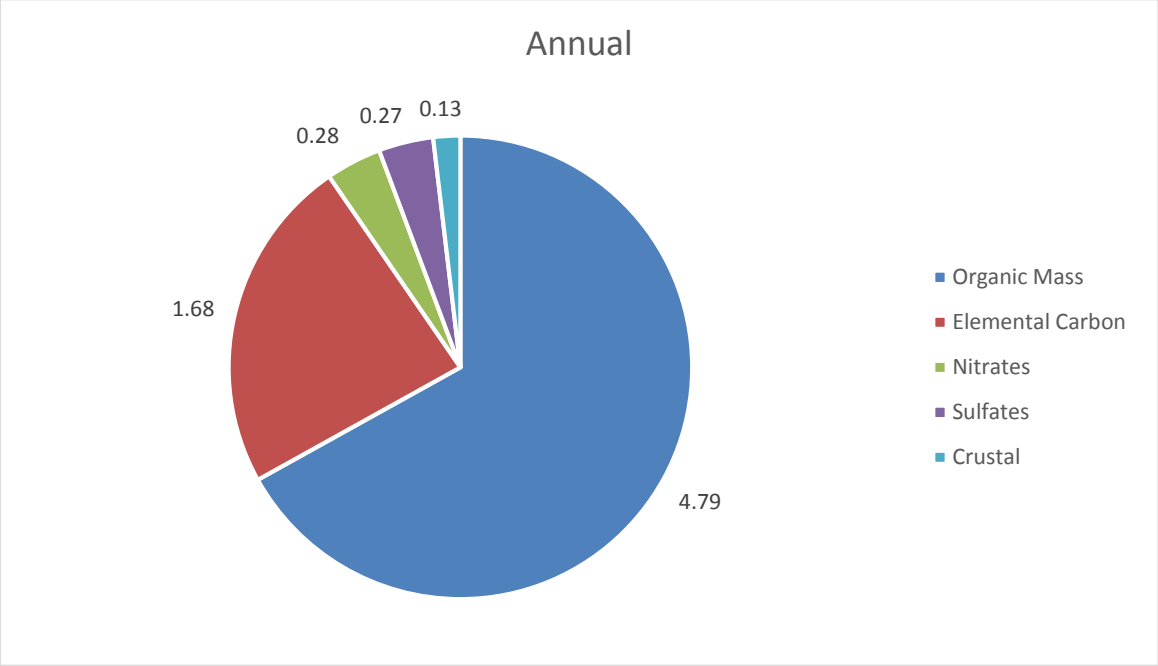
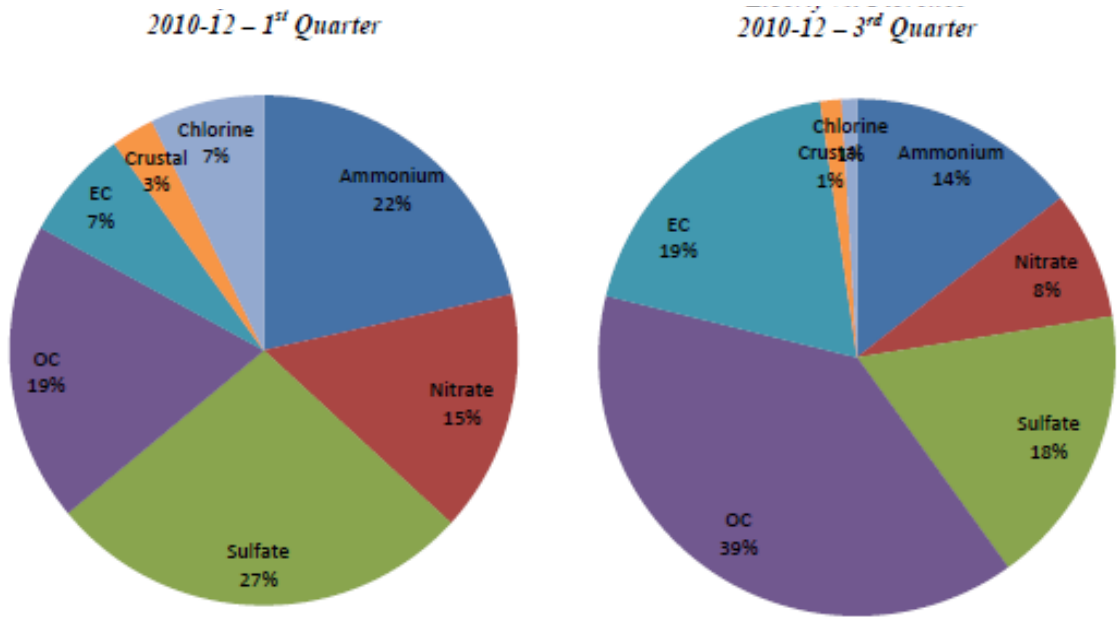
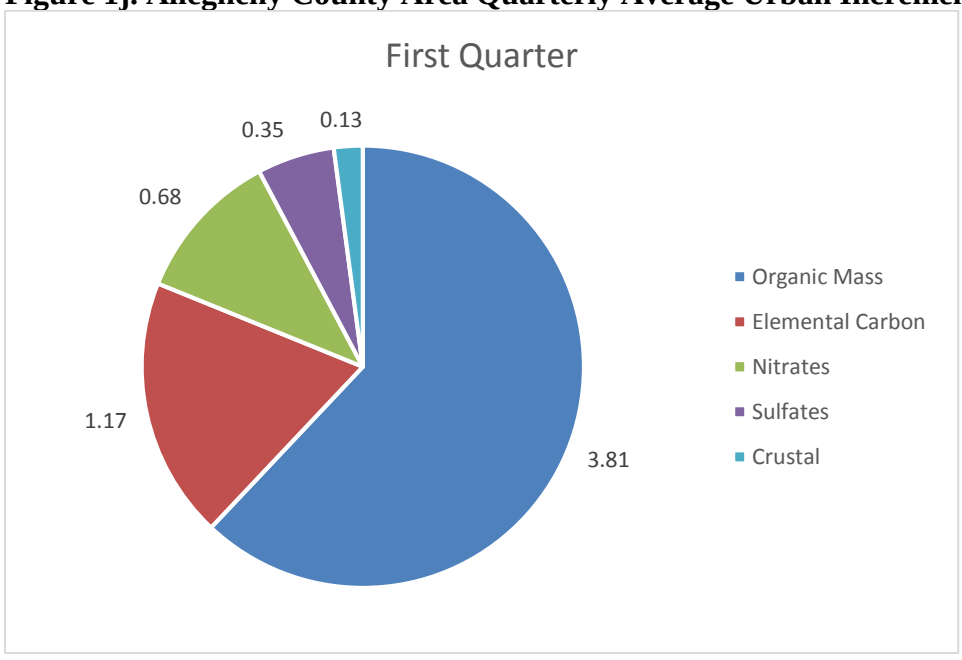


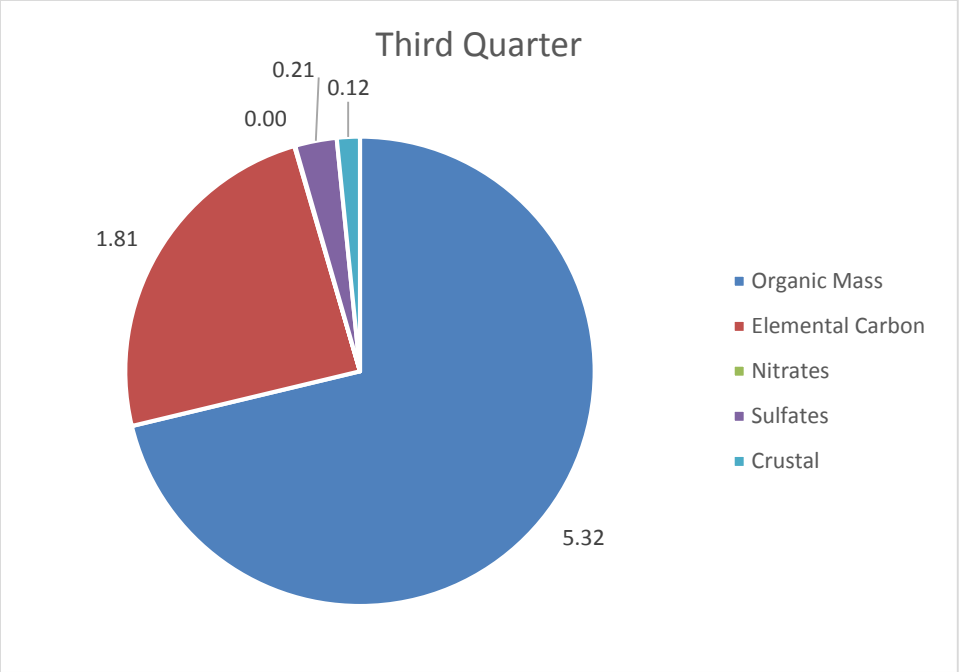
Figure 1i. Allegheny County Area Quarterly Average Urban Increment Analysis for 2010-2012.



Source: Pennsylvania's December 10, 2013 recommendation lettr, Appendix C-6 - Liberty-Clairton Area

Figure 1j. Allegheny County Area Quarterly Average Urban Increment Analysis for 2010-2012.





Both EPA's and PADEP's urban increment data shows high organic mass and elemental carbon. EPA's data shows high first quarter nitrates, while PADEP's shows high first quarter nitrates and sulfates. High first quarter nitrate concentrations are likely due to the greater tendency for NO_x to form in the atmosphere and for FRM monitors to retain particle nitrate during the cooler months. PADEP's data also shows chlorine at 7% in the first quarter. The organic and elemental carbon and chlorine signify contributions from local industrial sources. Note that Pennsylvania's speciation data is the raw data from the speciation monitor at the Liberty monitoring site. Pennsylvania did not adjust this data using the SANDWICH approach. In particular, the organic component is not presented as organic mass and thus significantly understates its contribution to $PM_{2.5}$ mass.

Factor 2: Emissions and emissions-related data

In this designations process, for each area with a violating monitoring site, EPA evaluated the emissions data from nearby areas using emissions related data for the relevant counties to assess each county's potential contribution to $PM_{2.5}$ concentrations at the violating monitoring site or monitoring sites in the area under evaluation. Similar to the air quality analysis, these data were examined on a seasonal basis. EPA examined emissions of identified sources or source categories of direct $PM_{2.5}$, the major components of direct $PM_{2.5}$ (organic mass, elemental carbon, crustal material (and/or individual trace metal compounds)), primary nitrate and primary sulfate, and precursor gaseous pollutants (i.e., SO_2, NO_X, total VOC, and NH_3). EPA also considered the distance of those sources of emissions from the violating monitoring site. While direct $PM_{2.5}$ emissions and its major carbonaceous components are generally associated with sources near violating $PM_{2.5}$ monitoring sites, the gaseous precursors tend to have a more regional influence (although the EPA is mindful of the potential local NO_X and VOC emissions contributions to $PM_{2.5}$ from mobile and stationary sources) and transport from neighboring areas can contribute to higher $PM_{2.5}$ levels at the violating monitoring sites.

Emissions Data

For this factor, EPA reviewed data from the 2011 National Emissions Inventory (NEI) version 1 (see *http://www.epa.gov/ttn/chief/net/2011inventory.html*). For each county in the area of analysis, EPA examined the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires. EPA also looked at the geographic distribution of major point sources of the relevant pollutants.[75] Significant emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

To further analyze area emissions data, EPA also developed a summary of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants, which is available at *http://www.epa.gov/pmdesignations/2012standards/docs/nei2011v1pointnei2008v3county.xlsx*.

When considered with the urban increment analysis discussed in Factor 1, evaluating the components of direct $PM_{2.5}$ and precursor gases can help identify specific sources or source types contributing to elevated concentrations at violating monitoring sites and, thus, assist in identifying appropriate area boundaries. In general, directly emitted POC and VOCs[76] contribute to POM; directly emitted EC contributes to $PM_{2.5}$ EC; NO_X, NH_3 and directly emitted nitrate contribute to PNO3; SO_2, NH_3 and directly emitted sulfate contribute to PSO4; and directly emitted crustal material and metal oxides contribute to Pcrustal.[77,78] EPA believes that the quantities of those nearby emissions as potential contributors to the $PM_{2.5}$ violating monitors are somewhat proportional to the $PM_{2.5}$ chemical components in the estimated urban increment. Thus, directly emitted POC is more important per ton than SO_2, partially because POC emissions are already $PM_{2.5}$ whereas SO_2 must convert to $PM_{2.5}$ and not all of the emitted SO_2 undergoes this conversion.

Table 2a provides a county-level emissions summary (i.e., the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires) of directly emitted $PM_{2.5}$ and precursor species in tpy for each county in the area of analysis for the Allegheny County Area. Table 2b breaks down the direct $PM_{2.5}$ emissions value from Table 2a into its components, This information will be paired with the urban increment composition previously shown in Figures 1g-1i. Table 2c gives total emissions of directly emitted $PM_{2.5}$ and precursor species by quarter for the area of analysis.

[75] For purposes of this designations effort, "major" point sources are those whose sum of PM precursor emissions ($PM_{2.5}$ + NOx + SO_2 + VOC + NH_3) are greater than 500 tpy based on NEI 2011v1.

[76] As previously mentioned, nearby VOCs are presumed to be a less important contributor to POM than POC.

[77] *See*, Seinfeld J. H. and Pandis S. N. (2006) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 2nd edition, J. Wiley, New York. See also, Seinfeld J. H. and Pandis S. N. (1998) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 1st edition, J. Wiley, New York.

[78] USEPA Report (2004), The Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003, found at: *http://www.epa.gov/airtrends/aqtrnd04/pm.html*.

Table 2a. County-Level Emissions of Directly Emitted $PM_{2.5}$ and Precursors (tpy)

County	Total NH_3	Total NOX	Total Direct $PM_{2.5}$	Total SO_2	Total VOC	Total
Indiana, PA	832	35,818	3,172	98,344	5,005	143,171
Armstrong, PA	402	29,321	1,310	72,548	3,602	107,183
Allegheny, PA	1,255	36,427	6,417	15,085	24,456	83,640
Beaver, PA	566	21,266	2,396	26,986	4,110	55,324
Greene, PA	250	30,737	2,638	2,477	2,579	38,680
Monongalia, WV	154	16,941	1,738	8,101	3,716	30,650
Westmoreland, PA	1,037	12,924	1,957	1,262	9,837	27,017
Washington, PA	591	9,748	1,456	1,873	6,252	19,920
Cambria, PA	373	6,115	1,334	7,236	4,100	19,158
Lawrence, PA	575	4,328	736	7,757	2,769	16,165
Butler, PA	651	6,523	1,563	1,096	5,879	15,711
Mercer, PA	934	6,348	1,171	451	5,322	14,226
Fayette, PA	450	5,538	1,008	486	5,256	12,738
Preston, WV	249	2,451	510	6,578	1,321	11,108
Columbiana, OH	2,024	4,160	677	173	3,963	10,996
Somerset, PA	1,173	3,320	1,216	461	4,059	10,230
Jefferson, PA	248	5,273	770	691	2,821	9,804
Venango, PA	223	3,672	615	2,313	2,968	9,791
Clarion, PA	330	3,828	479	1,641	2,669	8,947
Garrett, MD	414	1,923	353	277	1,583	4,550
Brooke, WV	47	1,822	320	880	1,142	4,211
Ohio, WV	91	1,343	274	130	1,521	3,360
Hancock, WV	32	1,290	158	288	993	2,760

Table 2b. County-Level Emissions for Components of Directly Emitted $PM_{2.5}$ (tpy) [79]

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Allegheny, PA	2,501	929	408	23	1,014	1,540	6,417
Indiana, PA	547	172	247	4	870	1,333	3,172
Greene, PA	290	163	200	3	850	1,132	2,638
Beaver, PA	478	178	192	3	493	1,052	2,396
Westmoreland, PA	962	277	101	6	206	405	1,957
Monongalia, WV	359	134	106	2	476	661	1,738
Butler, PA	707	190	74	5	236	351	1,563
Washington, PA	691	183	72	31	154	325	1,456
Cambria, PA	678	148	48	3	158	300	1,334
Armstrong, PA	303	99	113	3	293	499	1,310

[79] Data are based on the 2011 and 2018 Emissions Modeling Platform Data Files and Summaries (*ftp://ftp.epa.gov/EmisInventory/2011v6/v1platform*) available at: *http://www.epa.gov/ttn/chief/emch/index.html#2011* (accessed 02/26/14).

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Somerset, PA	751	141	23	5	115	181	1,216
Mercer, PA	602	156	57	3	107	246	1,171
Fayette, PA	559	185	41	6	46	172	1,008
Jefferson, PA	300	102	120	2	35	211	770
Lawrence, PA	424	93	21	2	81	114	736
Columbiana, OH	328	124	12	2	88	123	677
Venango, PA	327	73	24	1	63	126	615
Preston, WV	169	55	25	1	105	155	510
Clarion, PA	265	73	20	1	26	94	479
Garrett, MD	184	66	11	1	16	75	353
Brooke, WV	90	35	19	1	58	116	320
Ohio, WV	163	47	5	1	18	40	274
Hancock, WV	84	31	6	1	11	26	158

Table 2c. Quarterly Emissions of Directly Emitted $PM_{2.5}$ and Precursors in the Allegheny County Area of Analysis (tpy)

Pollutant	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
SO_2	75854.16	73232.87	92059.14	69266.51
$PM_{2.5}$	11082.82	8112.798	8299.623	9274.499
NO_X	66934.62	65104.02	67248.11	63715.25
VOC	27627.55	24528.25	25252.56	26630.03
NH_3	2218.393	4343.374	3672.554	2151.167

Using the previously described relationship between directly emitted and precursor gases and the measured mass to evaluate data presented in Tables 2a and 2b, EPA identified the following components warranting additional review: organic mass, VOC, SO_2, PSO4, elemental carbon, NH_3, NOx and PNO3. These components were shown to be the most common in the urban increment in the Allegheny County Area, as shown in Figures 1g-1i. EPA then looked at the contribution of these components of interest from each of the counties included in the area of analysis as shown in Tables 2d-g.

Table 2d. County-Level POM and VOC Emissions

County, State	Emissions in average tpy		
	POM	Pct.	Cumulative %
Allegheny, PA	2,501	21%	21%
Westmoreland, PA	962	8%	29%
Somerset, PA	751	6%	36%
Butler, PA	707	6%	42%
Washington, PA	691	6%	48%
Cambria, PA	678	6%	53%
Mercer, PA	602	5%	59%
Fayette, PA	559	5%	63%

County, State	Emissions in average tpy		
	VOC	Pct.	Cumulative %
Allegheny, PA	24,456	23%	23%
Westmoreland, PA	9,837	9%	32%
Washington, PA	6,252	6%	38%
Butler, PA	5,879	6%	44%
Mercer, PA	5,322	5%	49%
Fayette, PA	5,256	5%	54%
Indiana, PA	5,005	5%	59%
Beaver, PA	4,110	4%	62%

Indiana, PA	547	5%	68%		Cambria, PA	4,100	4%	66%
Beaver, PA	478	4%	72%		Somerset, PA	4,059	4%	70%
Lawrence, PA	424	4%	76%		Columbiana, OH	3,963	4%	74%
Monongalia, WV	359	3%	79%		Monongalia, WV	3,716	4%	77%
Columbiana, OH	328	3%	82%		Armstrong, PA	3,602	3%	81%
Venango, PA	327	3%	84%		Venango, PA	2,968	3%	84%
Armstrong, PA	303	3%	87%		Jefferson, PA	2,821	3%	86%
Jefferson, PA	300	3%	89%		Lawrence, PA	2,769	3%	89%
Greene, PA	290	2%	92%		Clarion, PA	2,669	3%	91%
Clarion, PA	265	2%	94%		Greene, PA	2,579	2%	94%
Garrett, MD	184	2%	96%		Garrett, MD	1,583	1.5%	95%
Preston, WV	169	1%	97%		Ohio, WV	1,521	1.4%	97%
Ohio, WV	163	1%	99%		Preston, WV	1,321	1.2%	98%
Brooke, WV	90	1%	99%		Brooke, WV	1,142	1.1%	99%
Hancock, WV	84	1%	100%		Hancock, WV	993	0.9%	100%
Total	11,763					105,925		

Table 2e. County-Level SO_2 and PSO4 Emissions

County, State	Emissions in average tpy				County, State	Emissions in average tpy		
	SO_2	Pct.	Cumulative %			PSO4	Pct.	Cumulative %
Indiana, PA	98,344	38%	38%		Allegheny, PA	408	21%	21%
Armstrong, PA	72,548	28%	66%		Indiana, PA	247	13%	34%
Beaver, PA	26,986	10%	77%		Greene, PA	200	10%	44%
Allegheny, PA	15,085	6%	83%		Beaver, PA	192	10%	54%
Monongalia, WV	8,101	3%	86%		Jefferson, PA	120	6%	60%
Lawrence, PA	7,757	3%	89%		Armstrong, PA	113	6%	66%
Cambria, PA	7,236	3%	92%		Monongalia, WV	106	5%	71%
Preston, WV	6,578	3%	94%		Westmoreland, PA	101	5%	76%
Greene, PA	2,477	1.0%	95%		Butler, PA	74	4%	80%
Venango, PA	2,313	0.9%	96%		Washington, PA	72	4%	84%
Washington, PA	1,873	0.7%	97%		Mercer, PA	57	3%	87%
Clarion, PA	1,641	0.6%	98%		Cambria, PA	48	2%	89%
Westmoreland, PA	1,262	0.5%	98%		Fayette, PA	41	2%	91%
Butler, PA	1,096	0.4%	99%		Preston, WV	25	1.3%	93%
Brooke, WV	880	0.3%	99%		Venango, PA	24	1.2%	94%
Jefferson, PA	691	0.3%	99%		Somerset, PA	23	1.2%	95%
Fayette, PA	486	0.2%	99%		Lawrence, PA	21	1.1%	96%
Somerset, PA	461	0.2%	99%		Clarion, PA	20	1.0%	97%
Mercer, PA	451	0.2%	100%		Brooke, WV	19	1.0%	98%
Hancock, WV	288	0.1%	100%		Columbiana, OH	12	0.6%	99%
Garrett, MD	277	0.1%	100%		Garrett, MD	11	0.5%	99%
Columbiana, OH	173	0.1%	100%		Hancock, WV	6	0.3%	100%

Ohio, WV	130	0.1%	100%		Ohio, WV	5	0.3%	100%
	257,134					1,945		

Table 2f. County-Level EC and NH_3 Emissions

	Emissions in average tpy					Emissions in average tpy		
County, State	EC	Pct.	Cumulative %		County, State	NH_3	Pct.	Cumulative %
Allegheny, PA	929	25%	25%		Columbiana, OH	2,024	16%	16%
Westmoreland, PA	277	8%	33%		Allegheny, PA	1,255	10%	25%
Butler, PA	190	5%	38%		Somerset, PA	1,173	9%	35%
Fayette, PA	185	5%	43%		Westmoreland, PA	1,037	8%	43%
Washington, PA	183	5%	48%		Mercer, PA	934	7%	50%
Beaver, PA	178	5%	53%		Indiana, PA	832	6%	56%
Indiana, PA	172	5%	58%		Butler, PA	651	5%	61%
Greene, PA	163	4%	62%		Washington, PA	591	5%	66%
Mercer, PA	156	4%	67%		Lawrence, PA	575	4%	70%
Cambria, PA	148	4%	71%		Beaver, PA	566	4%	75%
Somerset, PA	141	4%	75%		Fayette, PA	450	3%	78%
Monongalia, WV	134	4%	78%		Garrett, MD	414	3%	81%
Columbiana, OH	124	3%	82%		Armstrong, PA	402	3%	85%
Jefferson, PA	102	3%	84%		Cambria, PA	373	3%	87%
Armstrong, PA	99	3%	87%		Clarion, PA	330	3%	90%
Lawrence, PA	93	3%	90%		Greene, PA	250	2%	92%
Clarion, PA	73	2%	92%		Preston, WV	249	2%	94%
Venango, PA	73	2%	94%		Jefferson, PA	248	2%	96%
Garrett, MD	66	2%	95%		Venango, PA	223	2%	97%
Preston, WV	55	1%	97%		Monongalia, WV	154	1.2%	99%
Ohio, WV	47	1%	98%		Ohio, WV	91	0.7%	99%
Brooke, WV	35	1%	99%		Brooke, WV	47	0.4%	100%
Hancock, WV	31	1%	100%		Hancock, WV	32	0.2%	100%
Total	3,654					12,899		

Table 2g. County-Level NOx and PNO3 Emissions (tpy)

	Emissions in average tpy					Emissions in average tpy		
County, State	Total NOX	Pct.	Cumulative %		County, State	PNO3	Pct.	Cumulative %
Allegheny, PA	36,427	15%	15%		Washington, PA	31	28%	28%
Indiana, PA	35,818	14%	29%		Allegheny, PA	23	21%	50%
Greene, PA	30,737	12%	41%		Westmoreland, PA	6	5%	55%
Armstrong, PA	29,321	12%	53%		Fayette, PA	6	5%	60%
Beaver, PA	21,266	8%	61%		Butler, PA	5	5%	65%
Monongalia, WV	16,941	7%	68%		Somerset, PA	5	5%	69%
Westmoreland, PA	12,924	5%	73%		Indiana, PA	4	3%	73%
Washington, PA	9,748	4%	77%		Mercer, PA	3	3%	76%

Butler, PA	6,523	3%	80%		Beaver, PA	3	3%	78%
Mercer, PA	6,348	3%	82%		Cambria, PA	3	3%	81%
Cambria, PA	6,115	2%	84%		Armstrong, PA	3	2%	83%
Fayette, PA	5,538	2%	87%		Greene, PA	3	2%	86%
Jefferson, PA	5,273	2%	89%		Jefferson, PA	2	2%	88%
Lawrence, PA	4,328	2%	91%		Lawrence, PA	2	2%	90%
Columbiana, OH	4,160	2%	92%		Monongalia, WV	2	2%	92%
Clarion, PA	3,828	2%	94%		Columbiana, OH	2	1%	93%
Venango, PA	3,672	1%	95%		Venango, PA	1	1%	94%
Somerset, PA	3,320	1%	96%		Preston, WV	1	1%	96%
Preston, WV	2,451	1%	97%		Clarion, PA	1	1%	97%
Garrett, MD	1,923	1%	98%		Garrett, MD	1	1%	98%
Brooke, WV	1,822	1%	99%		Brooke, WV	1	1%	99%
Ohio, WV	1,343	1%	99%		Ohio, WV	1	1%	99%
Hancock, WV	1,290	1%	100%		Hancock, WV	1	1%	100%
Total	251,115				Total	110		

As can be seen in Tables 2a-g, Indiana County has the highest emissions in the area of analysis, due to several large sources of SO_2. As further discussed in Section 3.1, EPA has determined that the portions of Indiana County that contain the large SO_2 sources should be designated as part of the Johnstown, PA nonattainment area. Furthermore, as discussed in factor 3 regarding meteorology, because the dominant wind direction in the area of analysis is southwest, Indiana County is not upwind of the violating Liberty monitor, and therefore not likely to be contributing to the violation there.

Allegheny County, which includes the City of Pittsburgh, has the highest NOx, EC, direct $PM_{2.5}$, PSO4, POM, and VOC emissions in the area of analysis. It also has the second highest PNO3 and NH_3 emissions, and the fourth highest SO_2 emissions in the area of analysis.

In addition to reviewing county-wide emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors in the area of analysis, EPA also reviewed emissions from major point sources located in the area of analysis. The magnitude and location of these sources can help inform nonattainment boundaries. Table 2h provides facility-level emissions of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants (given in tpy) from major point sources with total emissions of 500 tpy or more located in the area of analysis for the Allegheny County Area. Table 2h also shows the distance from the facility to the violating Liberty monitor.

Table 2h. NEI 2011 v1 Point Source Emissions (tpy)

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NO_X	$PM_{2.5}$	SO_2	VOC	Total
Allegheny, PA	USS/Clairton Coke Works (4200300032)	1	123	3,075	500	1,468	336	5,502
Allegheny, PA	Us Steel Corp/Irvin Plt (4200300203)	2	4	762	72	419	61	1,318

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NO_X	$PM_{2.5}$	SO_2	VOC	Total
Allegheny, PA	USS Corp/Edgar Thomson Works (4200300202)	5	22	275	633	1,279	41	2,251
Allegheny, PA	Guardian Ind Corp/Jefferson Hills (4200300342)	5	0	978	22	73	19	1,093
Washington, PA	Genon Power Midwest LP/Elrama Power Plt (421250024)	6	0	561	24	428	4	1,017
Washington, PA	Allegheny Energy Supply Co/Mitchell Power Sta (421250014)	9	0	1,305	85	863	11	2,264
Allegheny, PA	Bay Valley Foods LLC/Pgh (4200300024)	11		212	20	313	1	546
Allegheny, PA	Genon Energy Inc/Cheswick Sta (4200300157)	15	3	3,294	498	9,290	10	13,096
Allegheny, PA	Shenango Inc/Shenango Coke Plt (4200300022)	16	3	427	97	372	100	999
Allegheny, PA	Allegheny Ludlum LLC/Brackenridge (4200300093)	21	4	255	223	33	62	576
Allegheny, PA	Pittsburgh International	23		550	17	68	94	729
Beaver, PA	Conway	31	0	545	16	5	41	608
Greene, PA	Allegheny Energy Supply Co/Hatfields Ferry Power Sta (420590006)	32	66	26,032	1,707	1,931	66	29,802
Beaver, PA	AES Beaver Valley LLC/Beaver Valley LLC (420070042)	34	0	2,705	156	3,170	17	6,050
Beaver, PA	Horsehead Corp/Monaca Smelter (420070032)	34	3	908	804	2,015	77	3,808
Butler, PA	Armstrong Cement & Supply/Winfield (420190024)	34		260	13	289	2	564
Butler, PA	AK Steel Corp/Butler Works (420190007)	35	7	310	156	54	63	589
Armstrong, PA	Genon Ne Mgmt Co/Keystone Sta (420050012)	36	2	20,797	438	46,467	29	67,732
Beaver, PA	Firstenergy Gen LLC/Bruce Mansfield Plt (420070005)	36	14	11,550	270	21,196	2	33,032
Beaver, PA	Jewel Acquisition/Midland Fac (420070043)	38	1	300	57	162	41	561
Greene, PA	Consol Pa Coal Co LLC/Bailey Prep Plt (420590008)	38		299	56	434	239	1,028
Indiana, PA	Homer City Gen LP/ Center Twp (420630003)	38	90	9,026	1,355	83,596	17	94,083
Brooke, WV	Mountain State Carbon, LLC (0002)	39	13	965	127	697	222	2,024

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NO_X	$PM_{2.5}$	SO_2	VOC	Total
Monongalia, WV	Monongahela Power Co.- Fort Martin Power (0001)	42	43	11,144	752	3,964	93	15,995
Indiana, PA	Genon Ne Mgmt Co/Conemaugh Plt (420630001)	43	3	17,562	335	7,190	19	25,109
Monongalia, WV	Longview Power (0134)	43		340	55	364	16	775
Indiana, PA	Genon Wholesale Gen/Seward Gen Sta (420630002)	44	4	1,774	150	7,010	4	8,942
Armstrong, PA	Allegheny Energy Supply Co/Armstrong Power Sta (420050001)	47	10	3,109	116	25,739	21	28,994
Monongalia, WV	Morgantown Energy Associates (0027)	48	0	819	106	1,024	4	1,953
Lawrence, PA	Genon Power Midwest LP/New Castle Power Plt (420730025)	50	0	1,310	8	7,510	8	8,837
Cambria, PA	Inter Power Ahlcon L/Colver Power Proj (420210034)	58	2	713	20	2,883	4	3,622
Preston, WV	Monongahela Power Co - Albright P.S. (0001)	59	3	920	206	6,454	7	7,590
Cambria, PA	Ebensburg Power Co/Ebensburg Cogeneration Plt (420210033)	60	0	308	50	1,937	4	2,299
Cambria, PA	Cambria Cogen Co/Ebensburg (420210046)	62	2	713	163	1,941	12	2,831
Clarion, PA	Piney Creek LP/Piney Creek Power Plt (420310406)	63	0	270	8	1,477	0	1,755
Venango, PA	Scrubgrass Generating Co LP/Kennerdell Plt (421210013)	65	2	693	46	1,862	6	2,608
Jefferson, PA	Owens Brockway Glass Container Inc/Crenshaw Plt 19 (420650007)	87	1	410	107	180	23	722

Figure 2a shows the major point sources with emissions of at least 500 tpy (from the 2011 NEI in tpy) in the area of analysis for the Allegheny County Area and the relative distances of these sources from the violating monitoring location, as depicted by red dots. The actual distance from the point sources to the violating Liberty monitoring location is presented in Table 5. The distance from the violating Liberty monitoring location is particularly important for directly emitted $PM_{2.5}$. The influence of directly emitted $PM_{2.5}$ on ambient $PM_{2.5}$ diminishes more than that of gaseous precursors as a function of distance.[80]

As indicated in Table 2h and Figure 2a, there are 37 point sources with emissions of at least 500 tpy located in the area of analysis. Nine of those sources are in Allegheny County. Figure 2b shows the point sources closest to the violating Liberty monitor.

[80] Baker, K. R. and K. M. Foley. *A nonlinear regression model estimating single source concentrations of primary and secondarily formed $PM_{2.5}$.* Atmospheric Environment. 45 (2011) 3758-3767.

Figure 2a. Major Point Source Emissions in the Area of Analysis for the Allegheny County Area.

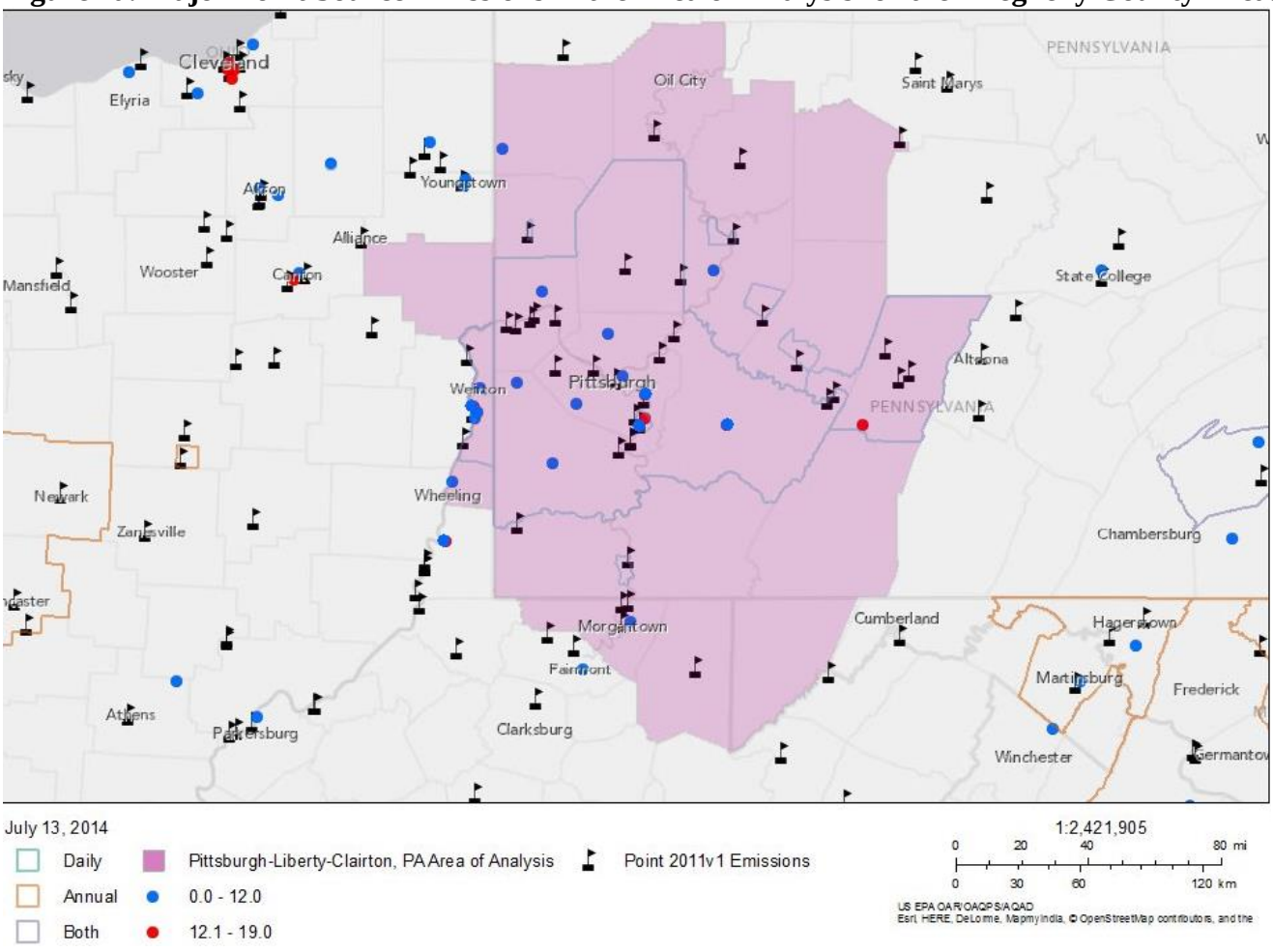
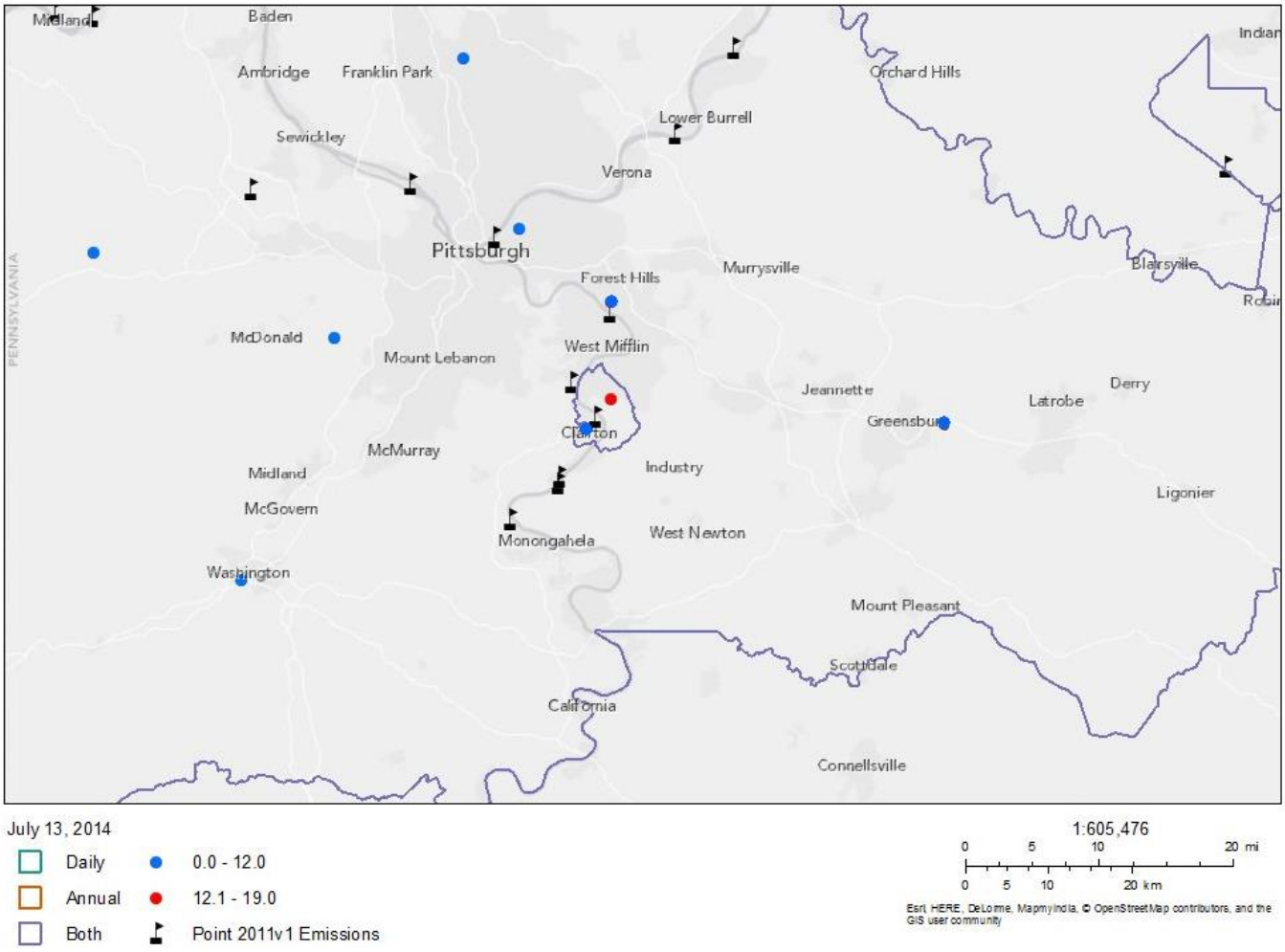


Figure 2b. Close Up of Major Point Source Emissions in the Area of Analysis for the Allegheny County Area.



The spatial distribution of selected emissions throughout the area of analysis also provides useful information. POM and EC are the largest components of the urban increment at the Liberty monitor. Figures 2b2 and 2b3 shows that POM and EC are high throughout Allegheny County, including several 12 km grid squares immediately to the north and west of the Liberty monitor. POM and EC are lower in the surrounding counties. This suggests that POM and EC from the Pittsburgh urban area in Allegheny County, to the north and west of the Liberty monitor, have a relatively high potential to influence $PM_{2.5}$ values at the violating monitor.

Figure 2b2. Spatial distribution of POM in the Allegheny County Area of Analysis

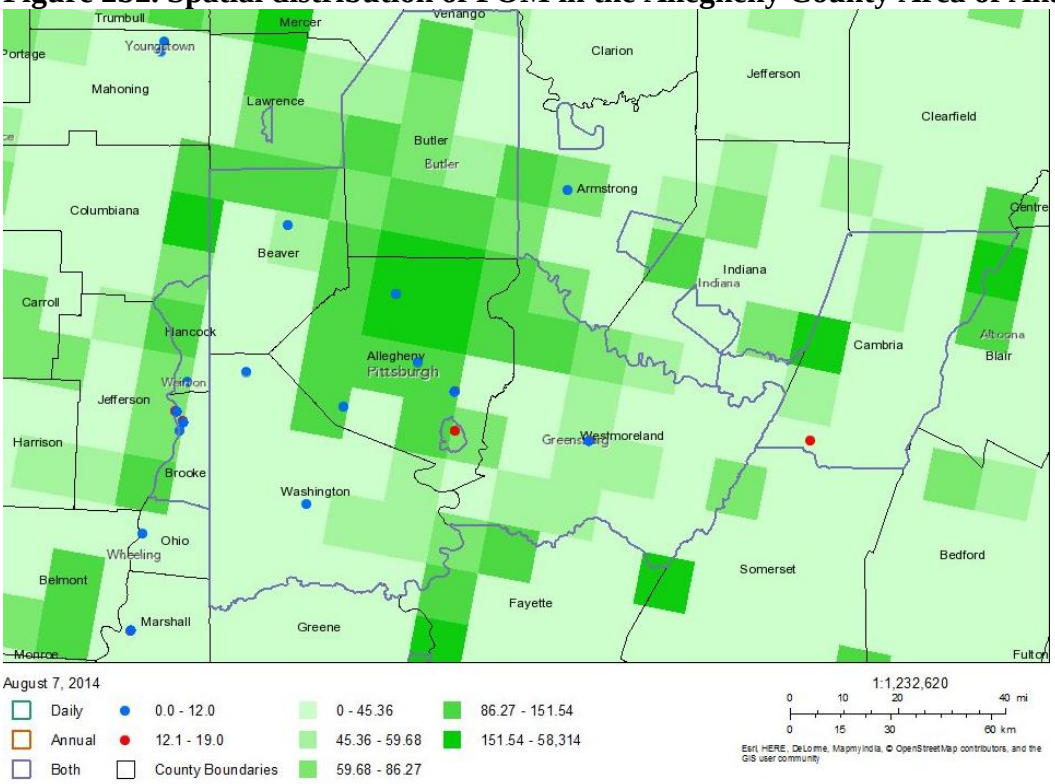
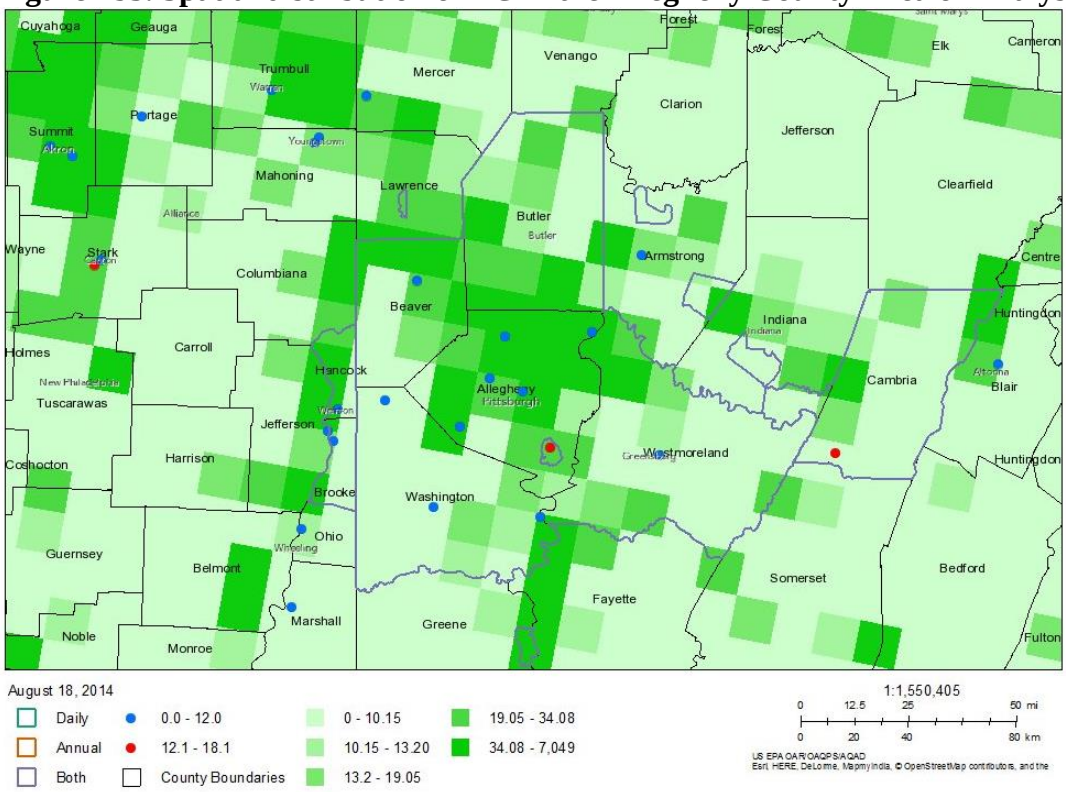


Figure 2b3. Spatial distribution of EC in the Allegheny County Area of Analysis



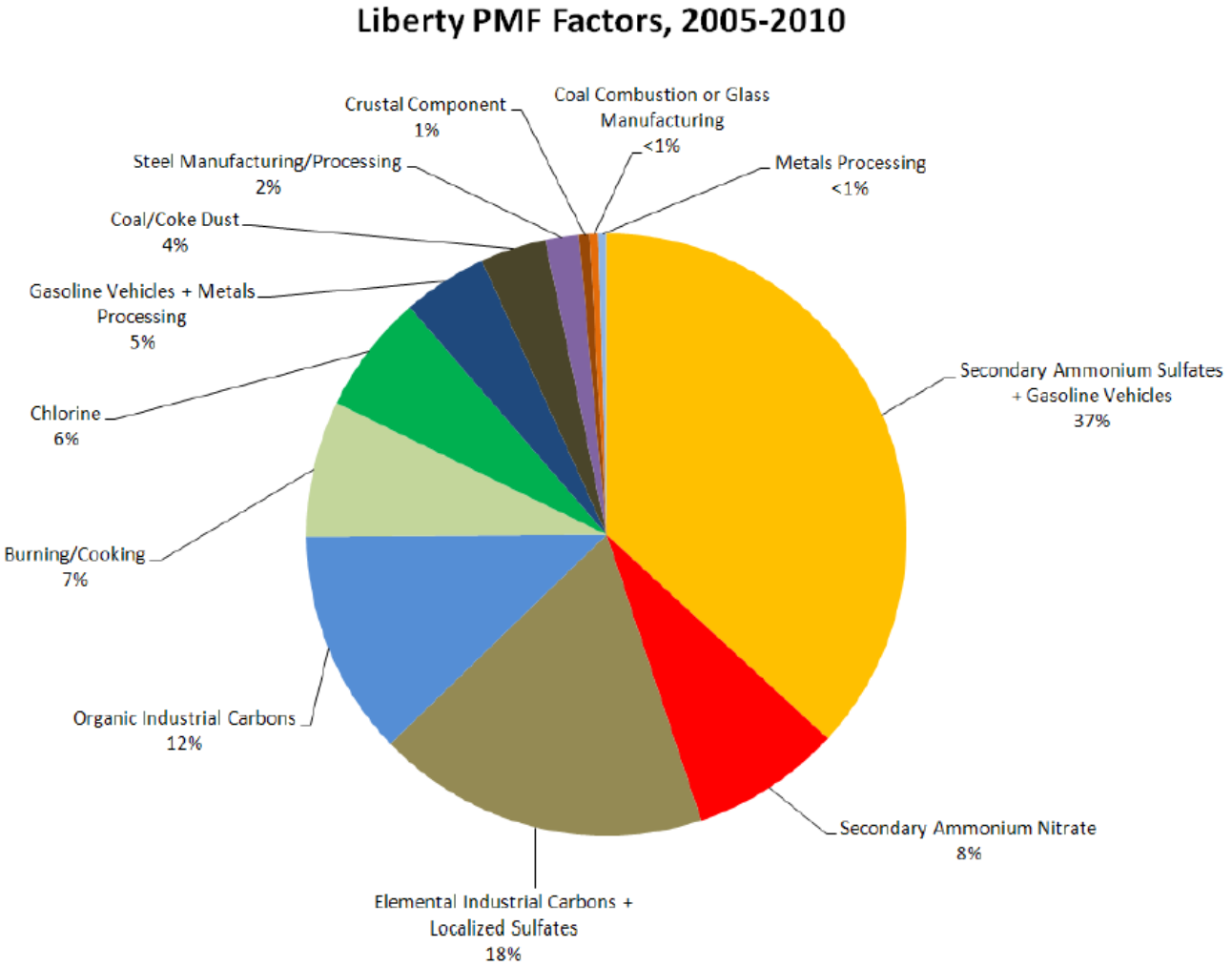
While the area around the Liberty monitor is influenced by the nearby urban area, i.e., the City of Pittsburgh, there is a very strong localized component to the air quality problem in this area. This was depicted by the spatial gradient in $PM_{2.5}$ presented earlier. The Liberty monitor is located in the Monongahela River Valley, known as the Mon Valley. The Mon Valley is historically an industrial area. Emissions in the area near the Liberty monitor are dominated by the Clairton Coke Works. Clairton Coke Works is located approximately 20 miles south of Pittsburgh in Clairton, PA, and sits along the west bank of the Monongahela River. The Clairton Coke Works is the country's largest coking operation, with 816 ovens grouped into 12 batteries, and annual capability of 4.7 million tons. Coke is made by heating coal to extremely high temperatures (1100°C) in an oxygen deficient atmosphere. This concentrates the carbon and removes any impurities. The coke produced is subsequently used as fuel in iron and steel production because it generates very high heat with less smoke than coal. The production of the coke itself, however, produces significant amounts of emissions that affect ambient $PM_{2.5}$ levels in this area.

The Allegheny County Health Department's (ACDH's) December 13, 2011 report, "Allegheny County $PM_{2.5}$ Source Apportionment Results using the Positive Matrix Factorization Model (PMF Version 3.0) and Conditional Probability Function (CPF), Model Timeframe: January 2005 through December 2010," ("ACHD's December 13, 2011 report") explores the local sources contributing to $PM_{2.5}$ levels at the Liberty monitor. ACHD entered data from the Liberty speciation monitor into the Positive Matrix Factorization Model (PFM) to calculate source factors. ACHD then matched the source factors to possible actual emission sources types. ACHD then used wind directions to apply "Conditional Probability Function (CFP)" to each source factor to show the frequency of wind directions for each factor during the factor's highest contributing days.

Figure 2c illustrates the twelve source factors found for the Liberty monitor. Some factors are quite small, such as "coal combustion or glass manufacturing" and "metal processing." Several of these factors are commonly found in Southwestern Pennsylvania ("SW PA"), such as "secondary ammonium sulfates and gasoline vehicles." As stated in ACHD's December 13, 2011 report, contributions of secondary ammonium sulfates and gasoline vehicle are "highest in summer, when sulfates are most prevalent. Sulfates exist as secondary $PM_{2.5}$ throughout SW PA, formed by upwind SO_2 from sources such as coal-fired power plants. This factor also contains carbons that are peaking concurrently with sulfate, possibly from light-duty vehicle exhaust. Factor 7 is the largest factor by percentage of total (37%)."

A discussion of several key factors from ACDH's December 13, 2011 report follows.

Figure 2c. Positive Matrix Factorization Modeled Source Factors for the Liberty Monitor



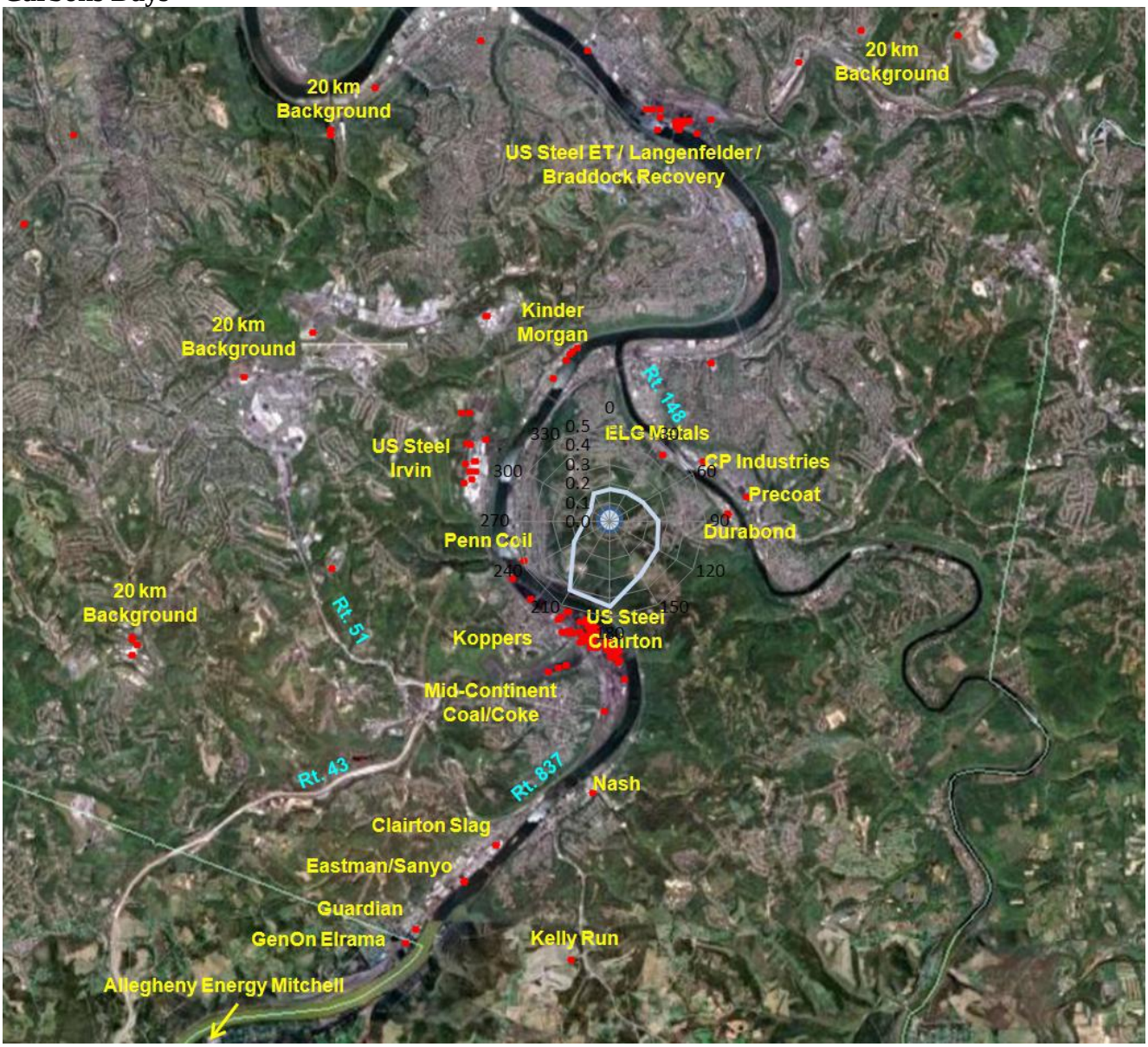
Source: ACDH's December 13, 2011 report.

The organic industrial carbons factor ("Factor 2" in the report) is composed of organic and elemental carbons as well as arsenic. The Clairton Coke Works is a major contributor to this factor. As stated ACHD's December 13, 2011 report:

> "Weekday/weekend contributions are similar, indicating continuous activity. Yearly contributions are the lowest in 2009, with an increase in 2010, which may be attributed to industrial facilities with low production levels in 2009. Factor 2 is a significant factor (12% of total) and is strongly affected by inversions. Organic carbons may be primary or secondary in nature, possibly from coke production, chemical processing, and/or other sources. Arsenic may be attributed to coal combustion, coking, or wood burning. Smaller concentrations of other species are also grouped with this factor."

The ACHD report also explains that high days for organic industrial carbons correspond with days during which the dominant winds from the southwest. This correlation shows that the Clairton Coke Works is directly upwind of the monitor during high contributing days for organic industrial carbons.

Figure 2d. Wind Direction Frequency at the Liberty Monitor on High Organic Industrial Carbons Days



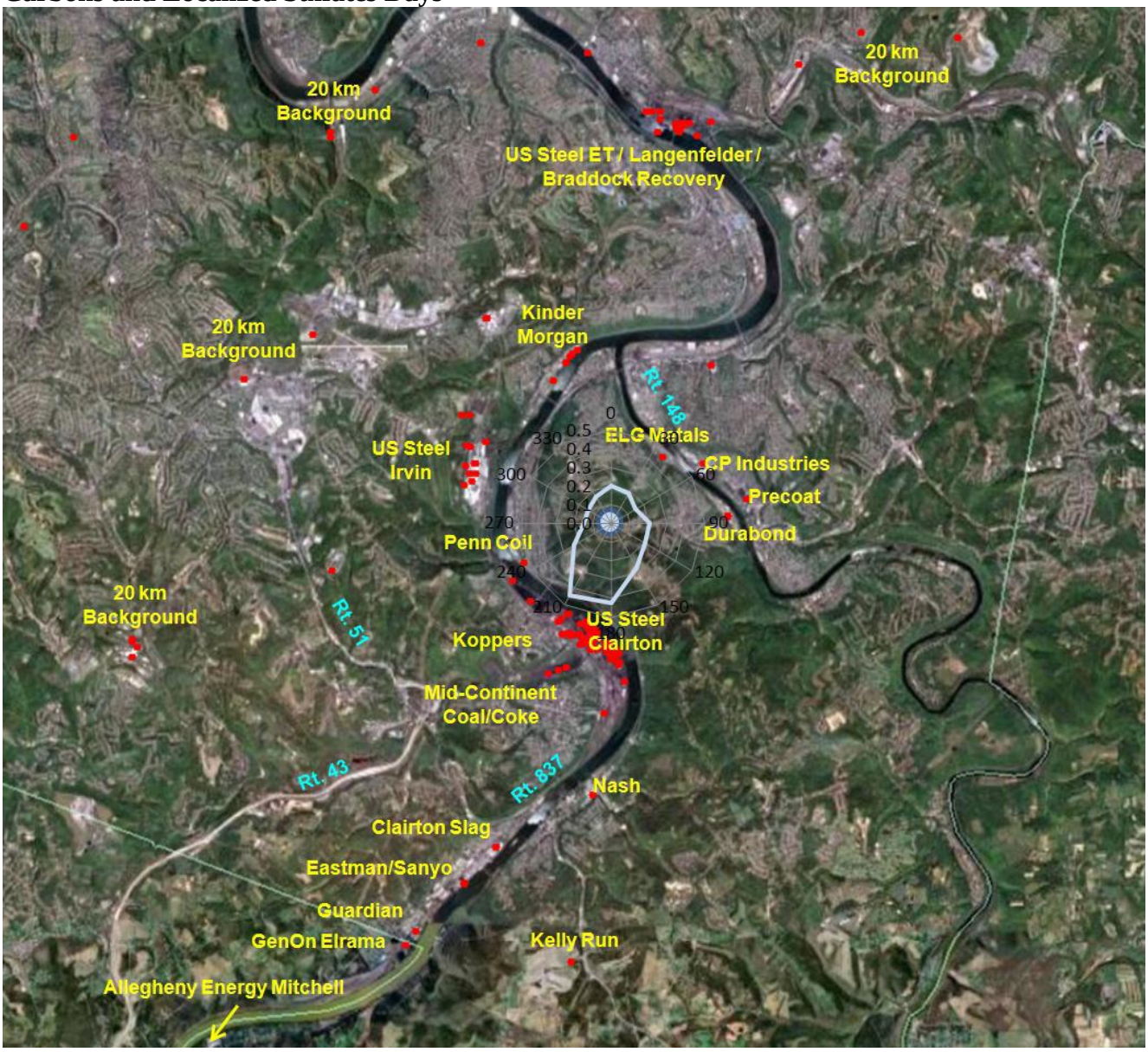
Source: ACDH's December 13, 2011 report.

The Clairton Coke Works is a major contributor to the elemental industrial carbons and localized sulfates factor ("Factor 6" in the report). As stated ACHD's December 13, 2011 report:

> "Factor 6 shows high amounts of elemental carbon, organic carbon, and ammonium sulfates (primary or secondary), along with several trace elements. The factor is continuous with little day of the week differences and is best attributed to a "mix" of continuous industrial activity in the Monongahela River valley. This may include coke production, mobile diesel use (trucks, railroads, tug boats), and/or electric power generation. This factor makes up 18% of the total $PM_{2.5}$ and, along with Factor 2, represents the majority of the excess $PM_{2.5}$ at Liberty in comparison to other SW PA sites. Factor 6 shows the highest levels during inversions, although at lesser extremes in contributions than other factors. High percentages of lead and zinc are also present, which can be due to tire wear or incinerators."

The report also explains that high days for elemental industrial carbons and localized sulfates correspond to days when the dominant winds are from the south and southwest. This correlation shows that the Clairton Coke Works is directly upwind of the monitor during high contributing days for elemental industrial carbons and localized sulfates.

Figure 2e. Wind Direction Frequency at the Liberty Monitor on High Elemental Industrial Carbons and Localized Sulfates Days



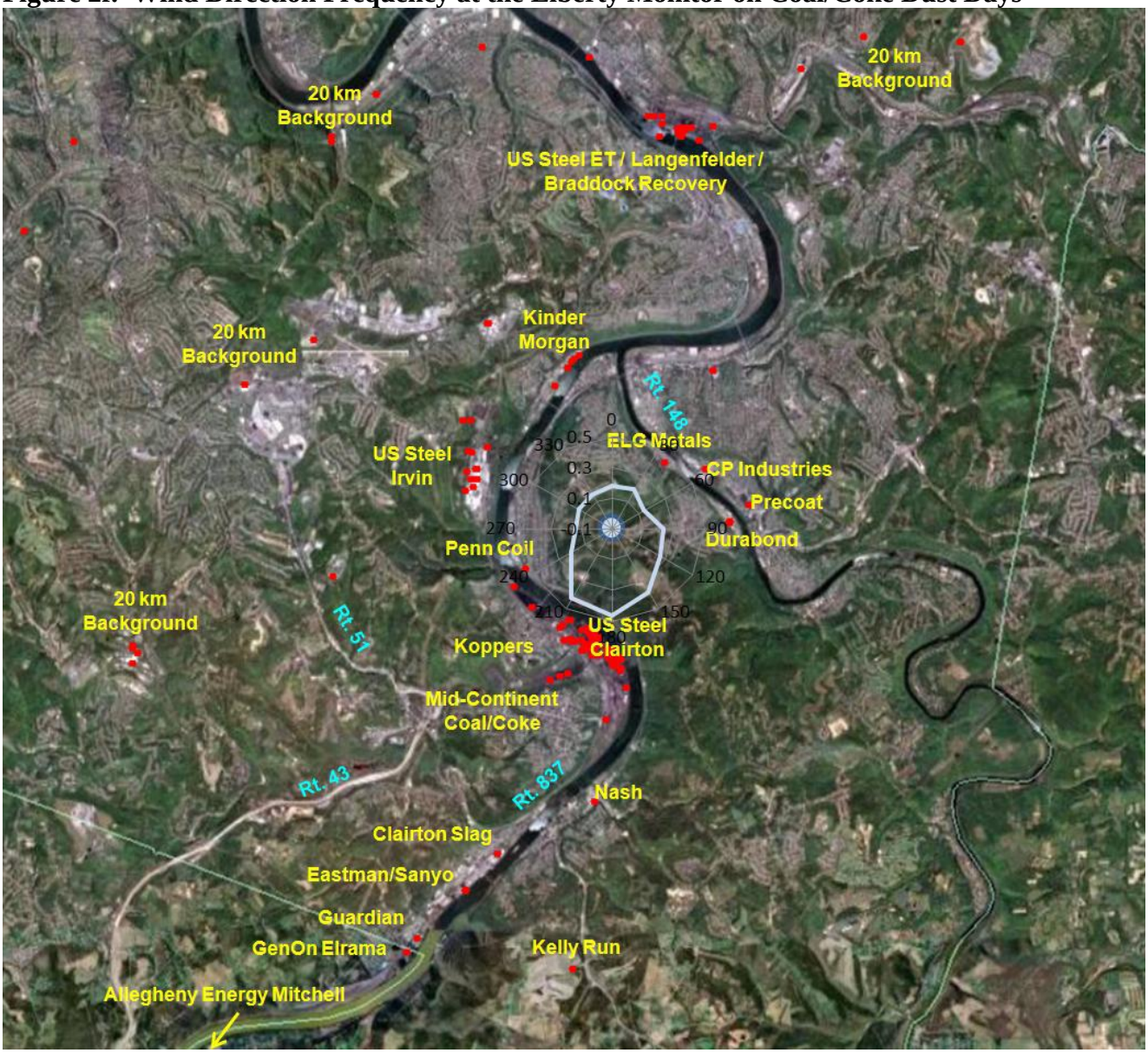
Source: ACDH's December 13, 2011 report.

The coal/coke dust factor ("Factor 8" in the report) consists of silicon and elemental carbon. As stated ACHD's December 13, 2011 report:

> "Factor 8 shows a high amount of silicon and elemental carbon, which can be associated with coal and coke dust. It is a small factor overall (4% of total) and shows the highest contributions during inversions.

As with source factors 2 and 6, discussed above, high days for coal/coke dust again correspond to days when the dominant winds are from the south and southwest. Again, this correlation shows that the Clairton Coke Works is directly upwind of the monitor during high contributing days for coal/coke dust

Figure 2f. Wind Direction Frequency at the Liberty Monitor on Coal/Coke Dust Days



Source: ACDH's December 13, 2011 report.

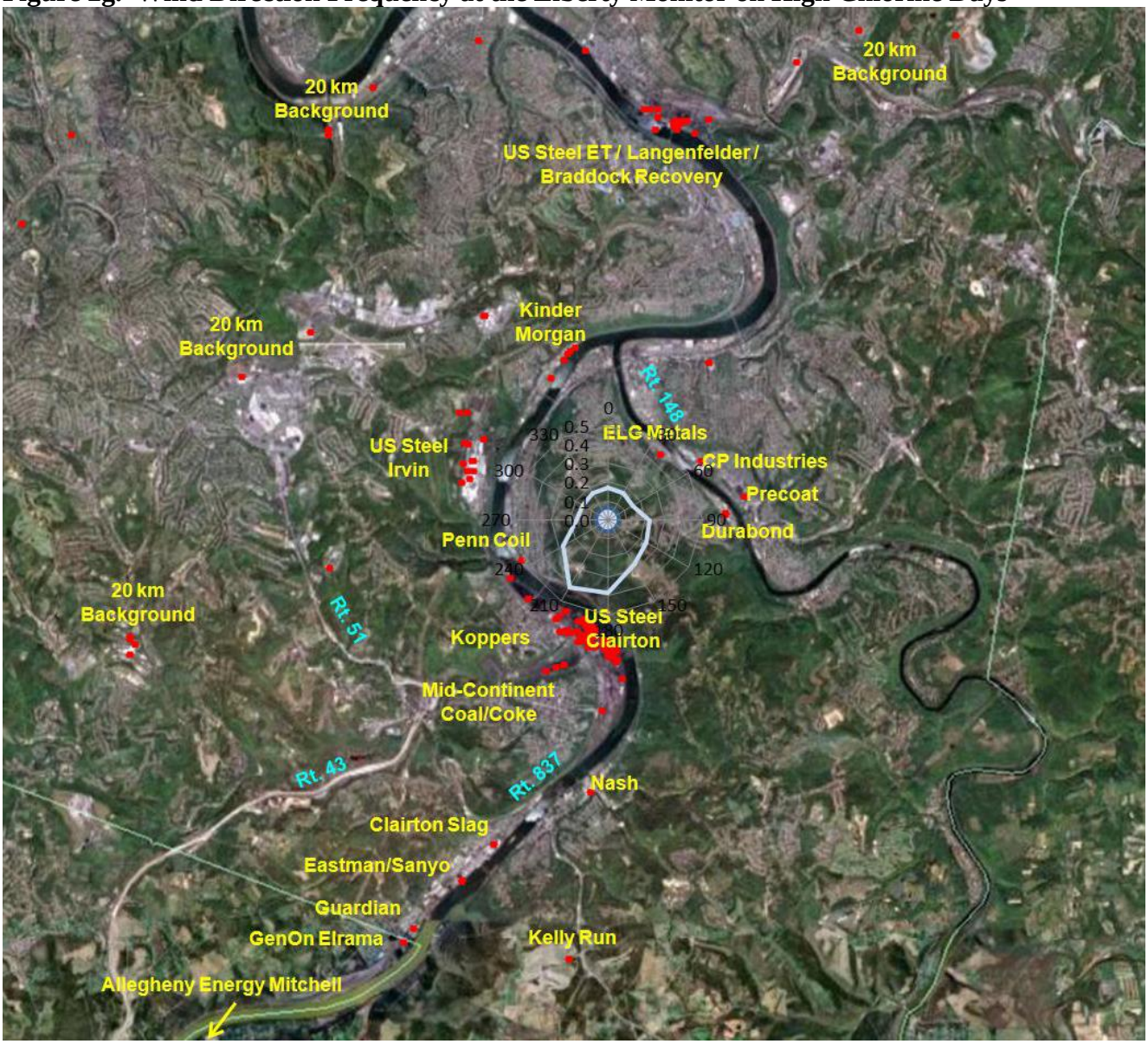
Source factor 10 for the Liberty monitor in ACDH's December 13, 2011 report is chlorine. As stated above, in factor 1 regarding air quality data, the urban increment speciation data at the Liberty monitor presented by PADEP shows seven percent chlorine in the first quarter. As stated in ACDH's December 13, 2011:

> "Contributions from this factor are specific, usually appearing as very large peaks during cool-weather inversions. Unlike the road salt factor for Lawrenceville, this factor is present in fall and spring and at much higher concentrations than road salt. Although road salt may be contributing a portion of the chlorine on winter days, the majority of this factor likely due to

industrial activity that is emitting or utilizing chlorine. Sodium chloride and magnesium chloride are used for de-icing at the Liberty site, but no sodium is present with the factor (magnesium was not modeled due to low signal strength)."

The report also explains that high days for chlorine correspond to days when the dominant winds area from the south and southwest. This correlation shows that the Clairton Coke Works is directly upwind of the monitor during high contributing days for chlorine.

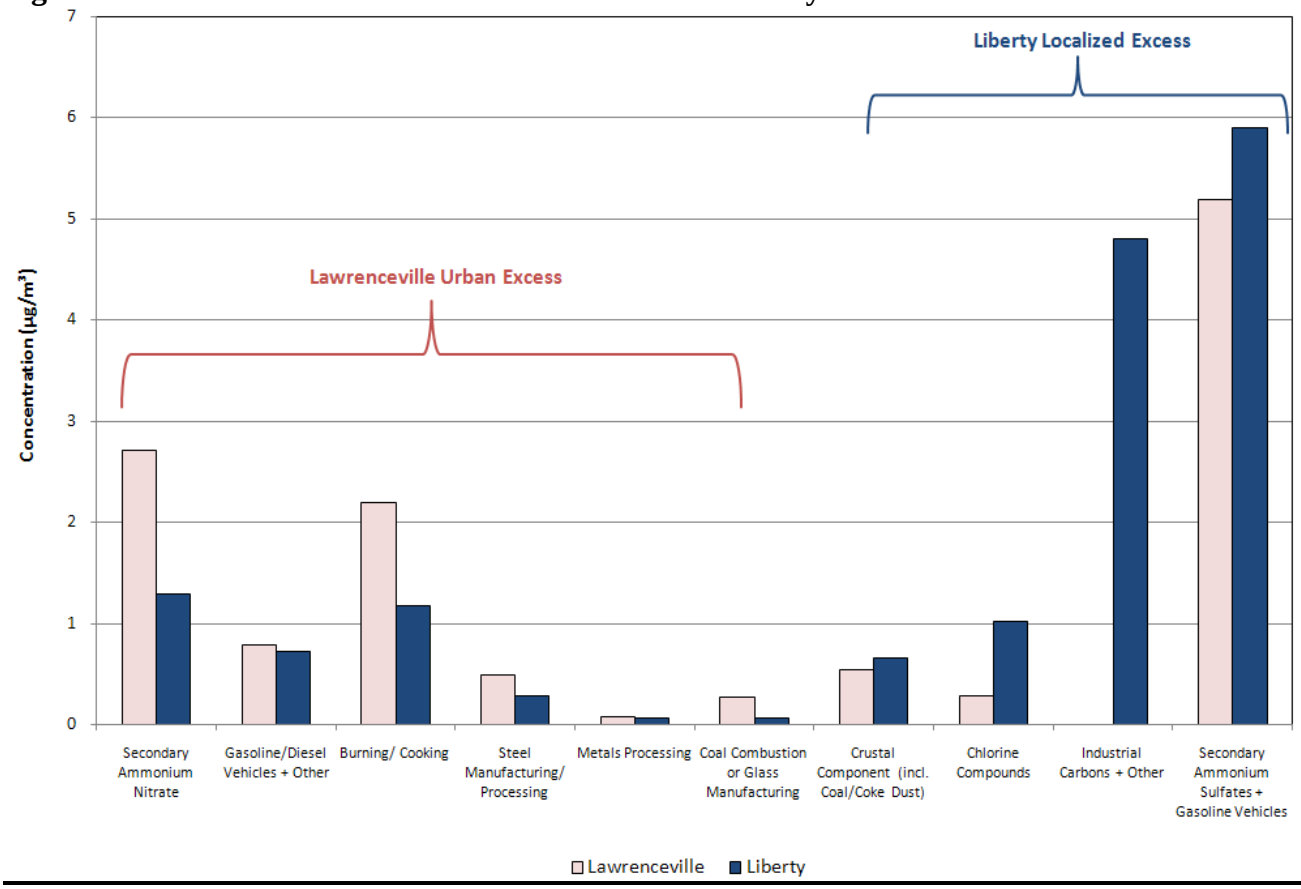
Figure 2g. Wind Direction Frequency at the Liberty Monitor on High Chlorine Days



Source: ACDH's December 13, 2011 report.

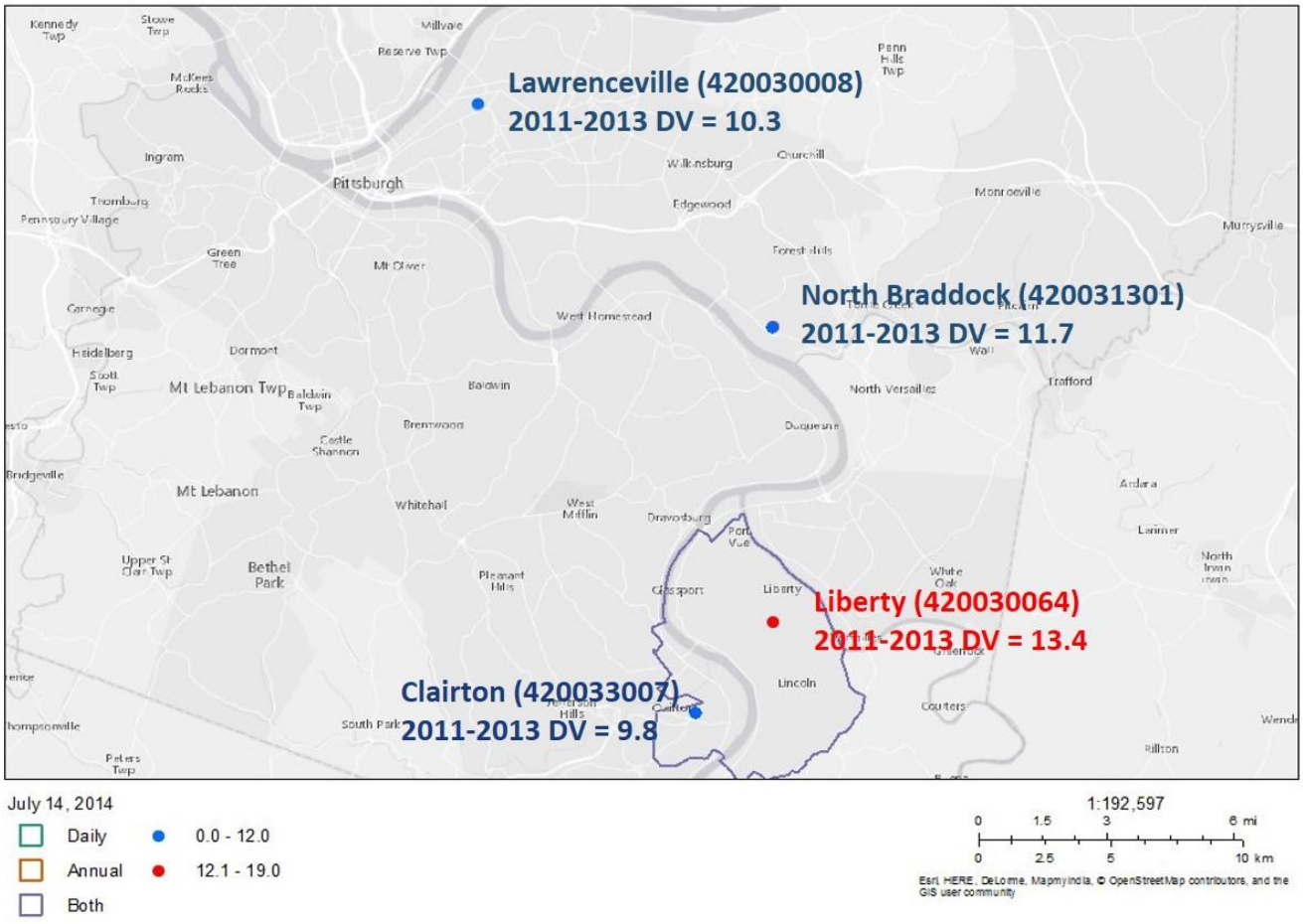
ACDH's December 13, 2011 report included the same type of analysis for the Lawrenceville monitor (420030008), which is an urban monitor in the Pittsburgh area. As illustrated in Table 1, the Lawrenceville monitor is attaining the 2012 annual $PM_{2.5}$ NAAQS. Figure 2h compares the modeled source factors for the two monitors, and shows that the Lawrenceville monitor has large mobile source, light industry, burning and cooking components, typical of urban $PM_{2.5}$. The Liberty monitor shows localized heavy industry. ACDH's December 13, 2011 report also emphasizes that the Liberty monitor is heavily influenced by meteorological conditions, i.e. temperature inversions.

Figure 2h. Modeled Common Source Factors at the Liberty & Lawrenceville Monitors.



Source: ACDH's December 13, 2011 report.

Figure 2i. Location of the Liberty & Lawrenceville Monitors.



The emissions data discussed above illustrates the strong influence of local industrialized sources on $PM_{2.5}$ levels recorded at the Liberty monitor. Source apportionment work by ACHD shows that when organic industrial carbons; elemental industrial carbons and localized sulfates; and coal/coke dust are high at the Liberty monitor, winds are from the southwest and south, indicating that the Clairton Coke Works is the likely upwind source. ACHD's December 13, 2011 report supports a finding that Clairton Coke Works is a major contributor to $PM_{2,5}$ levels at the Liberty monitor on days when $PM_{2.5}$ levels are highest at the site. However, other local industrial sources, shown in Figures 2d-2g, are also southwest of the Liberty monitor, and therefore also likely contribute to the high concentration days. Furthermore, as will be discussed in the next section on meteorology, $PM_{2.5}$-related emissions may be locally transported from other directions and therefore other parts of Allegheny county.

Population density and degree of urbanization

In this part of the factor analysis, EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. Rapid population growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that it may be appropriate to include the county associated with area source and mobile source emissions as part of the nonattainment area. Table 2i shows the 2000 and 2010 population, population growth since 2000, and population density for each county in the area of analysis.

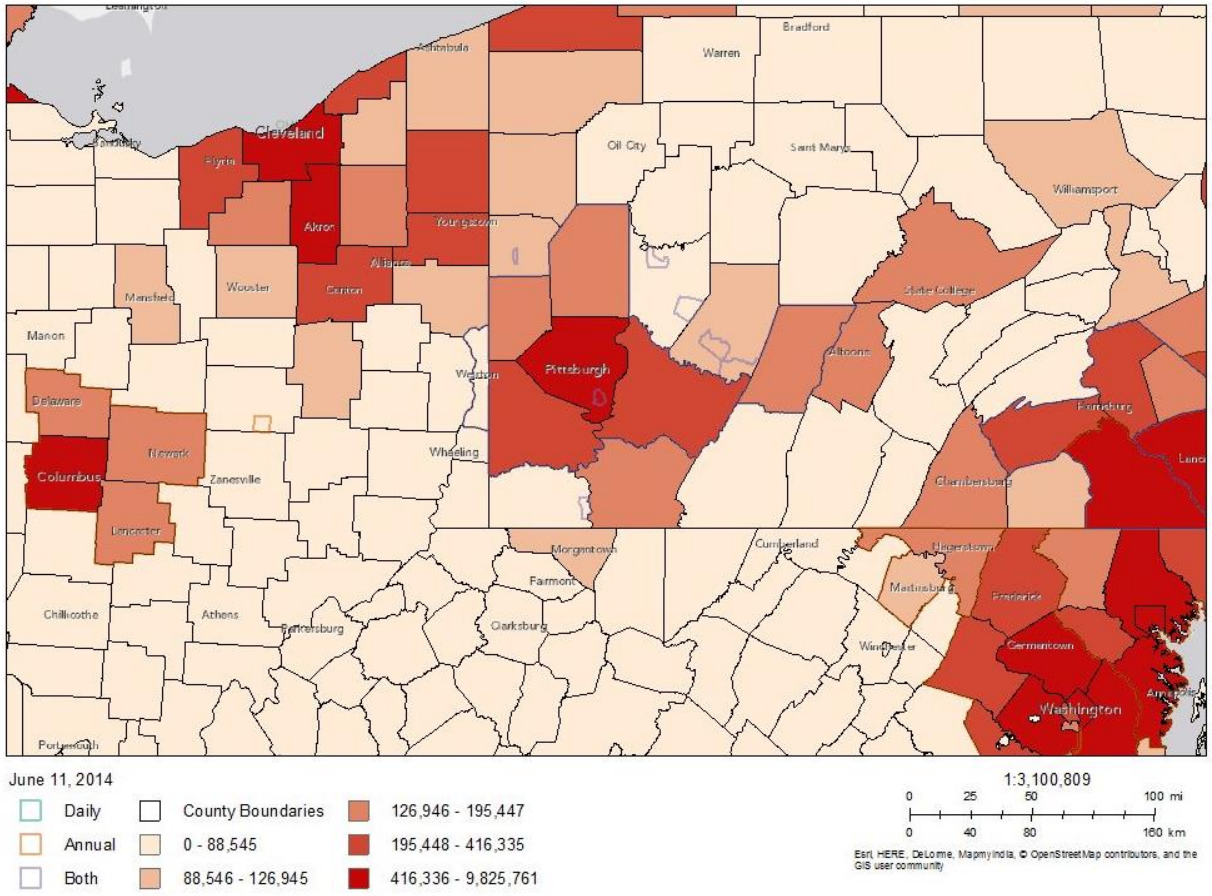
Table 2i. Population Growth and Population Density.

County, State	Population 2000	Population 2010	% Change from 2000	Land Area (square miles)	Population Density (per square mile)	%	Cumulative %
Allegheny, PA	1,281,666	1,223,840	-4.5%	730	1,676	36%	36%
Westmoreland, PA	369,993	365,086	-1.3%	1,025	356	11%	46%
Washington, PA	202,897	207,882	2.5%	857	243	6%	53%
Butler, PA	174,083	184,053	5.7%	789	233	5%	58%
Beaver, PA	181,412	170,595	-6.0%	434	393	5%	63%
Cambria, PA	152,598	143,484	-6.0%	688	209	4%	67%
Fayette, PA	148,644	136,507	-8.2%	790	173	4%	71%
Mercer, PA	120,293	116,541	-3.1%	672	173	3%	74%
Columbiana, OH	112,075	107,820	-3.8%	532	202	3%	78%
Monongalia, WV	81,866	96,774	18.2%	361	268	3%	80%
Lawrence, PA	94,643	90,964	-3.9%	360	252	3%	83%
Indiana, PA	89,605	88,818	-0.9%	829	107	3%	86%
Somerset, PA	80,023	77,706	-2.9%	1,075	72	2%	88%
Armstrong, PA	72,392	68,864	-4.9%	654	105	2%	90%
Venango, PA	57,565	54,940	-4.6%	675	81	2%	92%
Jefferson, PA	45,932	45,224	-1.5%	655	69	1%	93%
Ohio, WV	47,427	44,447	-6.3%	106	419	1%	94%
Clarion, PA	41,765	39,934	-4.4%	602	66	1%	95%
Greene, PA	40,672	38,623	-5.0%	576	67	1%	97%
Preston, WV	29,334	33,534	14.3%	648	52	1%	98%
Hancock, WV	32,667	30,638	-6.2%	83	370	1%	98%
Garrett, MD	29,846	30,075	0.8%	648	46	1%	99%
Brooke, WV	25,447	24,000	-5.7%	89	270	1%	100%
Total	**3,512,845**	**3,420,349**					

Source: U.S. Census Bureau population estimates for 2000 and 2010

This data presented in Table 2i and Figure 2j clearly shows that Allegheny County has the highest population and population density in the area of analysis. Allegheny County accounts for 36 percent of the population in this 23 county area of analysis. Allegheny County's population density is four times higher than Ohio County, WV, which has the second highest population density in the area of analysis.

Figure 2j. 2010 County-Level Population in the Area of Analysis for the Allegheny County Area.



Traffic and Vehicle Miles Travelled

High VMT and/or a high number of commuters associated with a county is generally an indicator that the county is an integral part of an urban area. Mobile source emissions of NO_x, VOC, and direct PM may contribute to ambient particulate matter that contributes to monitored violations of the NAAQS in the area. In combination with the population/population density data and the location of main transportation arteries, an assessment of VMT helps identify the probable location of nonpoint source emissions that contribute to violations in the area. Comparatively high VMT in a county outside of the CBSA or CSA signifies integration with the core urban area contained within the CSA or CBSA, and indicates that a county with high VMT may be appropriate to include in the nonattainment area because emissions from mobile sources in that county contribute to violations in the area of analysis. Table 2j shows 2011 VMT, while Figure 2k overlays 2011 county-level VMT with a map of the transportation arteries.

Table 2j. 2011 VMT for the Allegheny County Area.

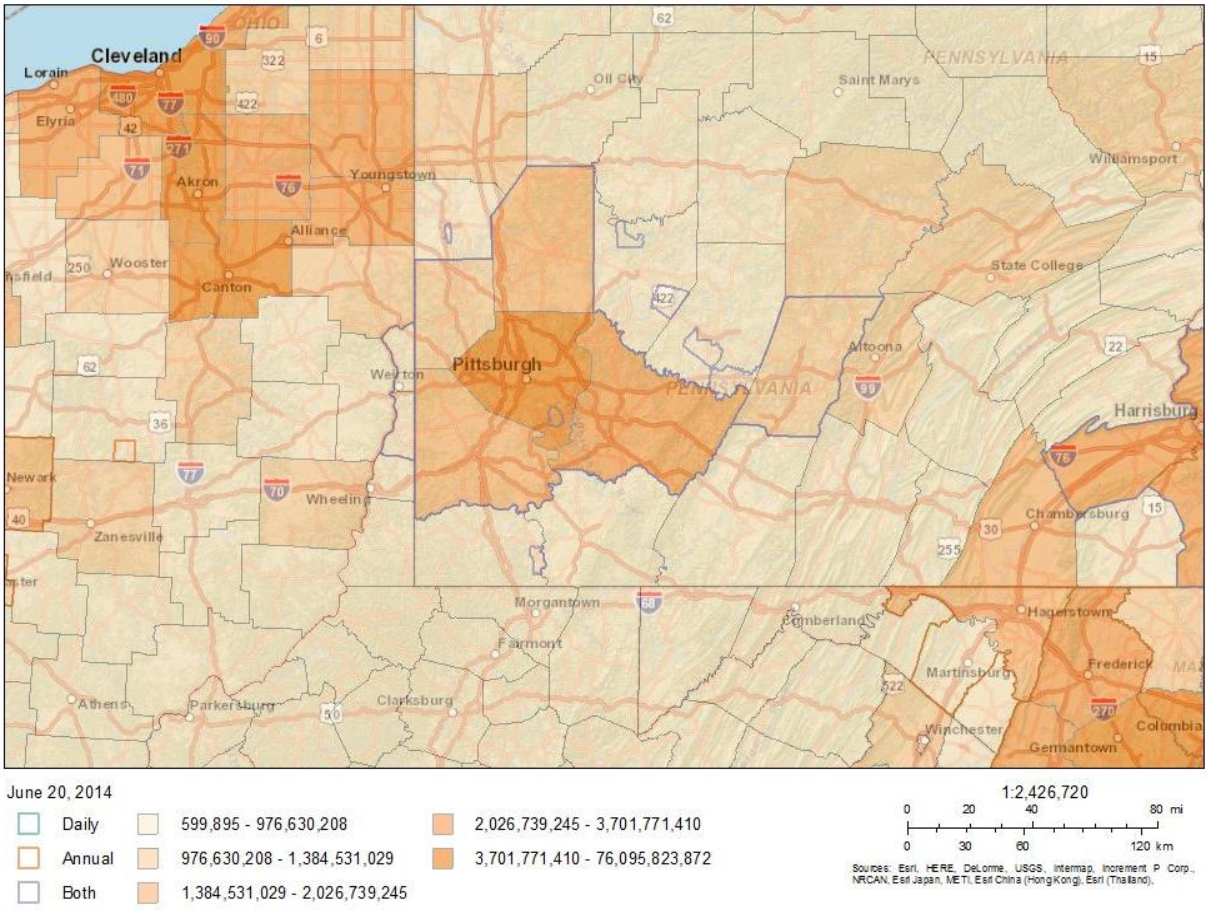
County, State	Total 2011 VMT	Percent	Cumulative %
Allegheny, PA	8,276,513,524	29%	29%
Westmoreland, PA	3,087,660,497	11%	40%
Butler, PA	1,765,361,166	6%	46%

County, State	Total 2011 VMT	Percent	Cumulative %
Washington, PA	1,745,736,088	6%	53%
Mercer, PA	1,346,517,193	5%	57%
Beaver, PA	1,320,804,012	5%	62%
Columbiana, OH	1,092,970,892	4%	66%
Cambria, PA	1,007,874,393	4%	69%
Fayette, PA	948,403,446	3%	73%
Somerset, PA	924,890,368	3%	76%
Monongalia, WV	862,449,234	3%	79%
Indiana, PA	778,308,748	3%	82%
Lawrence, PA	700,366,617	2%	84%
Jefferson, PA	608,222,065	2%	86%
Clarion, PA	583,315,329	2%	89%
Armstrong, PA	582,533,913	2%	91%
Venango, PA	574,609,872	2%	93%
Garrett, MD	536,008,855	2%	95%
Ohio, WV	435,221,104	2%	96%
Greene, PA	421,356,837	1%	98%
Preston, WV	339,402,952	1%	99%
Brooke, WV	203,137,567	1%	99%
Hancock, WV	154,774,599	1%	100%
Total	**28,296,439,271**		

http://www.census.gov/hhes/commuting/data/commuting.html

As shown in Table 2j and Figure 2k, Allegheny County has by far the highest VMT in the area of analysis. Allegheny County accounts for 29 percent of the population in this 23 county area of analysis. Allegheny County's VMT is more than 2.5 times higher than Westmoreland County, which has the second highest VMT in the area of analysis.

Figure 2k. Overlay of 2011 County-level VMT with Transportation Arteries.



Pittsburgh is a densely populated city, with a population of 1.2 million and VMT of over 8 billion. As explained in factor 3, regarding meteorology, the wind rose closest to the Liberty monitor has a northwesterly component, indicating that at least some of the time, Pittsburgh is directly upwind of the violating Liberty monitor. Therefore, emissions from this highly urbanized area in Allegheny County, just northwest of the violating Liberty monitor, have a high potential to contribute to $PM_{2.5}$ levels at the Liberty monitor.

Factor 3: Meteorology

EPA evaluated available meteorological data to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of directly emitted particulate matter and precursor emissions from sources in the area of analysis. EPA used two primary tools for this assessment: wind roses and kernel density estimation (KDE). When considered in combination with area $PM_{2.5}$ composition and county-level and facility emissions source location information, wind roses and KDE can help to identify nearby areas contributing to violations at violating monitoring sites.

Wind roses are graphic illustrations of the frequency of wind direction and wind speed. Wind direction can indicate the direction from which contributing emissions are transported; wind speed can indicate

the force of the wind and, thus, the distance from which those emissions are transported. EPA constructed wind roses from hourly observations of wind direction and wind speed using 2009-2012 data from National Weather Service locations archived at the National Climate Data Center.[81] When developing these wind roses, EPA also used wind observations collected at meteorological sampling stations collocated at air quality monitoring sites, where these data were available. Figure 3a shows wind roses that EPA generated from data relevant in the Allegheny County area. Figure 3b gives a close up of wind roses near the violating Liberty monitor.

As can be seen in Figures 3a and 3b, the dominant wind direction in the area of analysis this southwest, with a large westerly component. The wind rose closest to the Liberty monitor, seen more clearly in Figure 3b, shows strong southerly and westerly components, with southwesterly and northwesterly components. The northwesterly component indicates that the highly urbanized Pittsburgh area is upwind of, and therefore contributing to, the Liberty monitor.

Indiana County, which has the highest emissions in the area of analysis due to several large sources of SO_2, is east of the Allegheny County and therefore east of the violating monitor. Armstrong County, which has the second highest emissions in the area of analysis is northeast of Allegheny County, and therefore northeast of the violating monitor. Because the dominant wind direction in the area of analysis is southwest, Indiana and Armstrong Counties are not upwind of the violating Liberty monitor, and therefore not contributing to the violation there.

Washington County is to the southwest of the violating monitor. However, emissions in Washington County are relatively low, less than a quarter of Allegheny County's emissions. Furthermore, POM and EC, the largest components of the urban increment at the violating monitor, are low in Washington County, as can be seen in Figures 2b2 and 2b3. Washington County also has relatively low population, population density, and VMT. There are two point sources with emissions of greater than 500 tpy in Washington County. However, as seen in Table 2h, these sources have very low direct $PM_{2.5}$ and VOC emissions, which indicates that any potential contribution to the POM and EC in the urban increment at the Liberty monitor is relatively low. Furthermore, as shown in factor 5 regarding topography, the area of analysis is dominated by high terrain. As can be seen in Figure 4a, that terrain limits transport of emissions from Washington County to the Liberty monitor.

[81] *ftp.ncdc.noaa.gov/pub/data/noaa* or *http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=cdo&theme=hourly&layers=1&node=gis* Quality assurance of the National Weather Service data is described here: *http://www1.ncdc.noaa.gov/pub/data/inventories/ish-qc.pdf*

Figure 3a. Wind Roses in the Area of Analysis for Allegheny County Area.

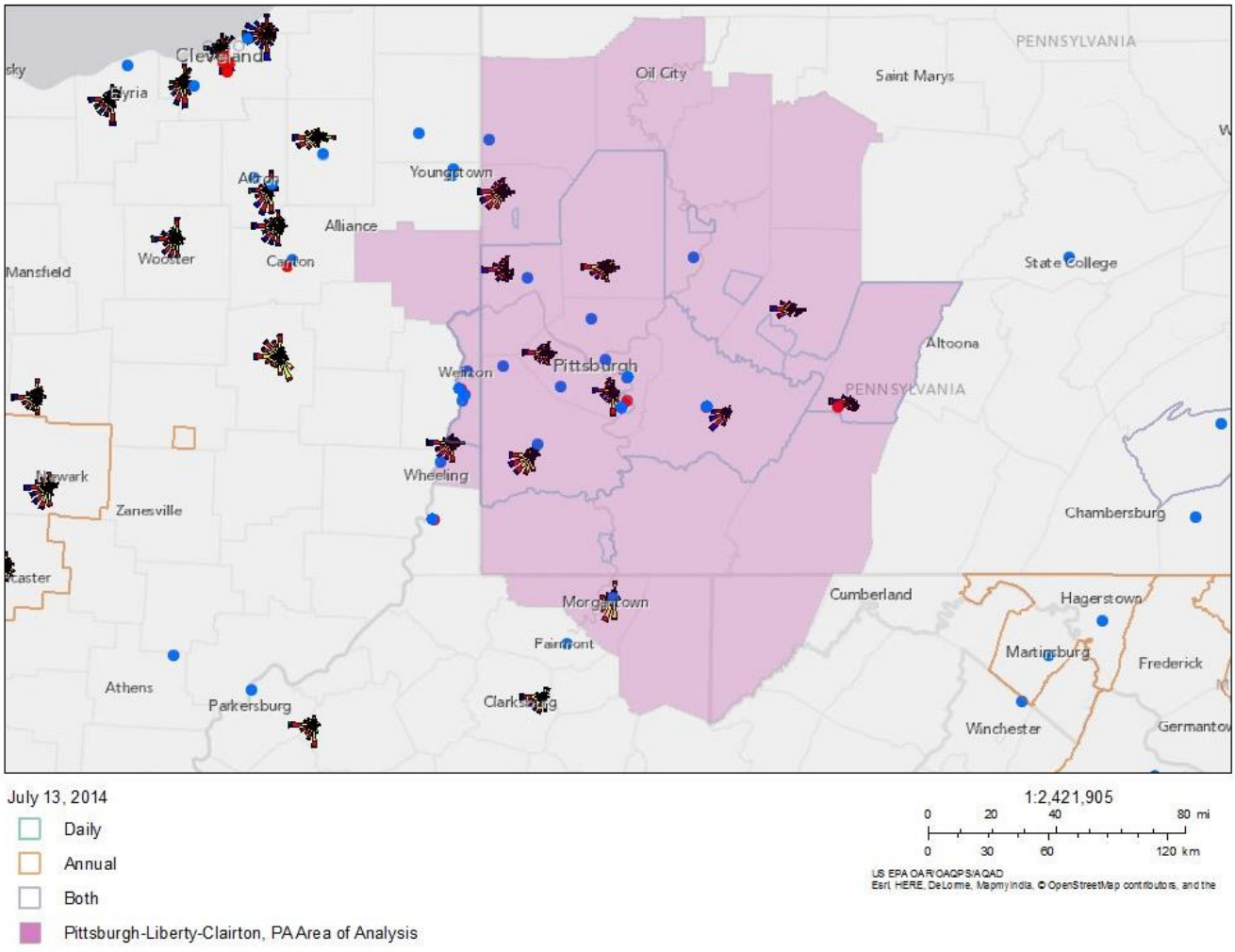
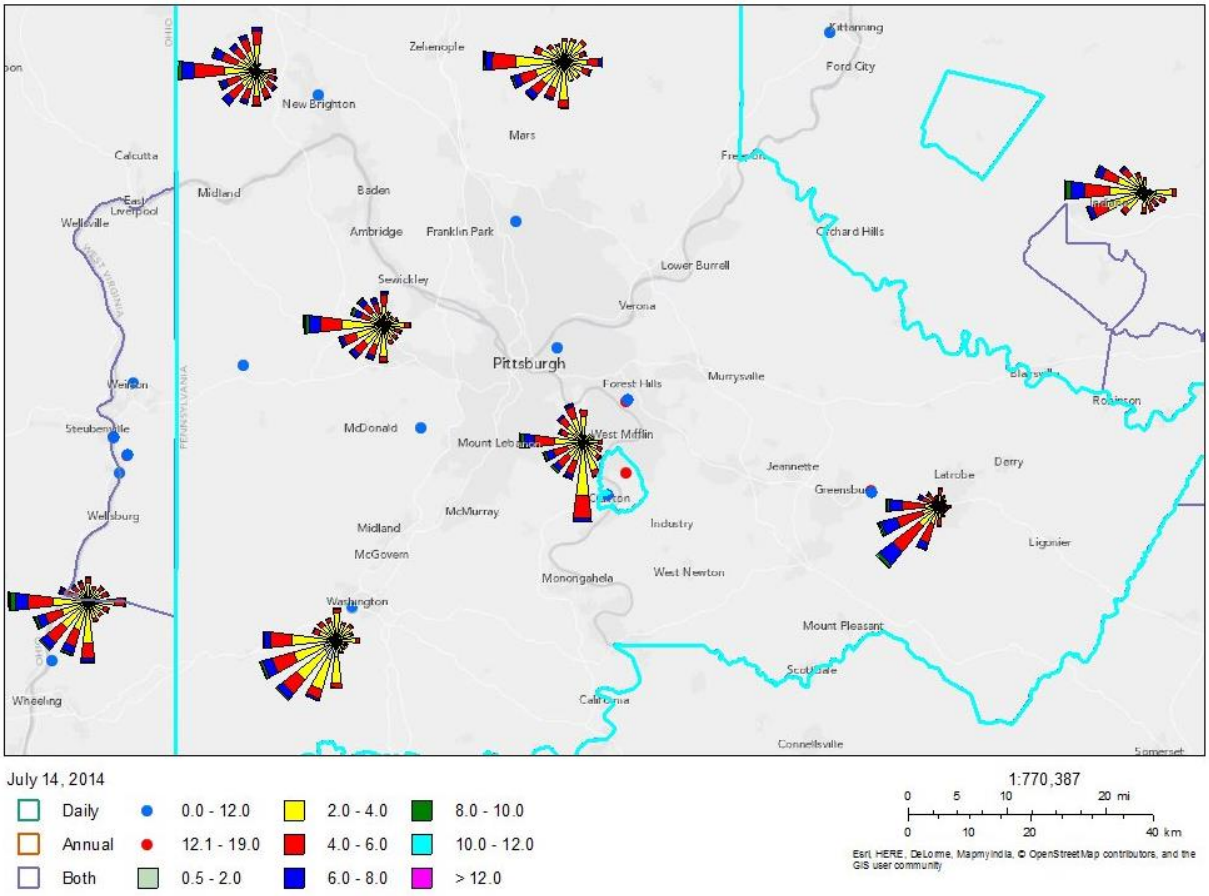


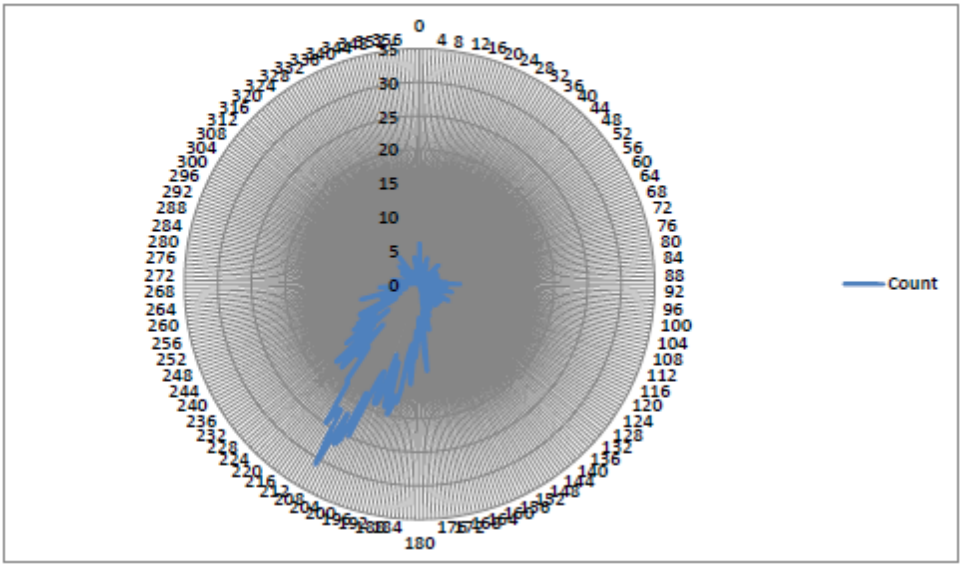
Figure 3b. Wind Roses Close to the Violating Liberty Monitor.



In its December 2013 recommendation letter, Pennsylvania included wind direction analysis at high $PM_{2.5}$ days at the Liberty monitor. As stated above, Pennsylvania identified 252 days in the 2010 to 2012 monitoring period where $PM_{2.5}$ at the Liberty monitor was at least one standard deviation above the Pittsburgh MSA. Pennsylvania analyzed the wind directions for the highest of those days, the top twenty-five percent (the "high $PM_{2.5}$ days"). For these high $PM_{2.5}$ days, Pennsylvania calculated the number of hours the wind was coming from a particular direction as well as the concentrations coming from a particular direction, using data from a meteorological station collocated with the Liberty monitor. Figures 3c and 3d represents the wind direction frequency and concentration distribution by wind direction, respectively, at the Liberty monitor during its high $PM_{2.5}$ days.

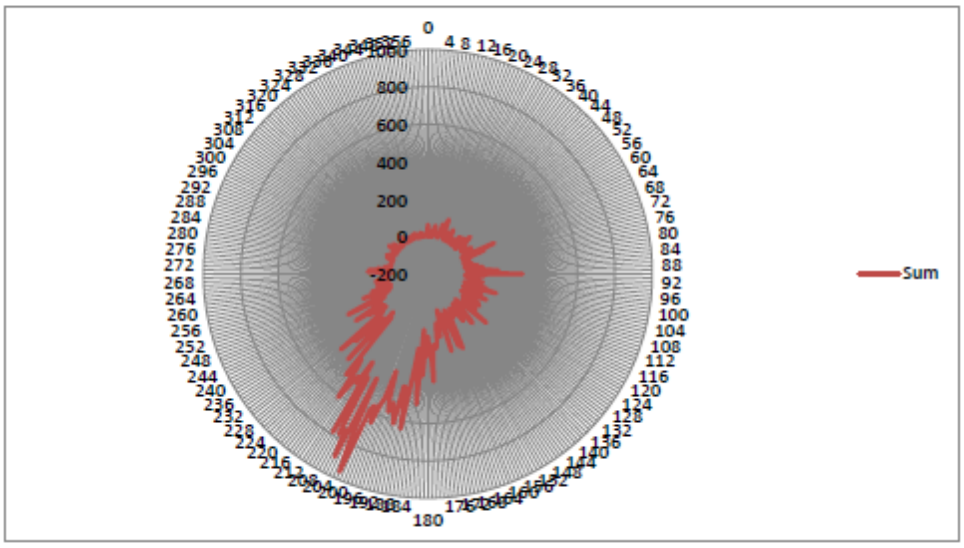
As can be seen in Figures 3c and 3d, wind direction on the high $PM_{2.5}$ days at the Liberty monitor is almost completely from the southwest. This wind direction shows that on high $PM_{2.5}$ days, the Clairton Coke Works is directly upwind of the Liberty monitor. It should be noted that the Clairton monitor, which is attaining the 2012 annual $PM_{2.5}$ NAAQS, is directly southwest, i.e., upwind, of the Clairton Coke Works, as illustrated in Figure C.

Figure 3c. Wind Direction Frequency on High $PM_{2.5}$ Days at the Liberty Monitor



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-6 - Liberty-Clairton Area

Figure 3d. Concentration Distribution by Wind Direction on High $PM_{2.5}$ Days at the Liberty Monitor



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-6 - Liberty-Clairton Area

While the Liberty montor is a population-based monitor, ACHD and the owner and operator of the Clairton Coke Works, US Steel, have acknowlenged that it is uniquely situated to monitor emissions from the Clairton Coke Works. As stated in ACHD's 2013 monitoring plan:

> "This site is population oriented but is also about 3 km downwind of the US Steel Clairton Coke Works, which is a major source of particulate matter and precursor gases as well as sulfur dioxide and air toxics. The area around this monitoring site has a long history of higher than average levels of $PM_{2.5}$, PM_{10} and sulfur dioxide. Significant ambient levels of benzene have also been measured and documented at this site. Liberty is a core $PM_{2.5}$ site that is used to determine compliance with national standards.

> At the request of US Steel, telemetry devices have been installed on the PM_{10}, $PM_{2.5}$, SO_2, H_2S monitors that transmit continuous readings via radio signals to a location within the US Steel facility. Other transmitters are also in use at Lincoln PM_{10} and $PM_{2.5}$ monitors (site # 8.3), Glassport High Street PM_{10} monitor (site # 8.4) and North Braddock SO_2 monitor and sonic anemometer. This real-time data allows US Steel to minimize fugitive emissions and to adjust production levels to keep particulate levels and gaseous emissions within allowable ambient levels in downwind communities."

In addition to wind roses, EPA also generated kernel density estimation (KDE) plots to represent HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) backward trajectory frequency at violating monitoring sites.[82,83] These KDEs are graphical statistical estimations to determine the density of trajectory endpoints at a particular location represented by a grid cell. The EPA used KDEs to characterize and analyze the collection of individual HYSPLIT backward trajectories.[84] Higher density values, indicated by darker blue colors, indicate a greater frequency of observed trajectory endpoints within a particular grid cell. Figure 3e shows a HYSPLIT KDE plot for the Allegheny County Area summarized by calendar quarter for the 2010-2012 period. The HYSPLIT KDE is weighted in the southwesterly direction, indicating a greater frequency of trajectories passing over grid cells to the southwest. However, the darker blue colors also cover most of Allegheny County, including the area to the north and northwest of the county, i.e the highly urbanized Pittsburgh area, that contains high density of POM and EC emissions.

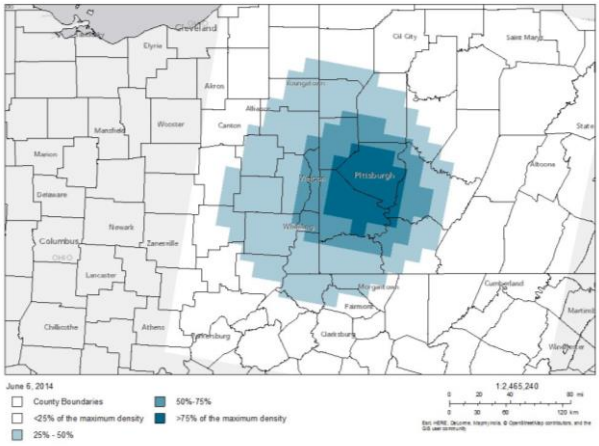
[82] In some past initial area designations efforts, EPA has used HYSPLIT backward trajectories to assist in determining nonattainment area boundaries. A HYSPLIT backward trajectory is usually depicted on a standard map as a single line, representing the centerline of an air parcel's motion, extending in two dimensional (x,y) space from a starting point and regressing backward in time to a point of origin. Backward trajectories may be an appropriate tool to assist in determining an air parcel's point of origin on a day in which a short-term standard, such as an 8-hour standard or a 24-hour standard, was exceeded. However, for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, every trajectory on every day is important. Plotting a mass of individual daily (e.g., 365 individual back trajectories), or more frequent, HYSPLIT trajectories may not be helpful as this process is likely to result in depicting air parcels originating in all directions from the violating monitoring site.

[83] HYSPLIT - Hybrid Single Particle Lagrangian Integrated Trajectory Model, *http://www.arl.noaa.gov/HYSPLIT_info.php*

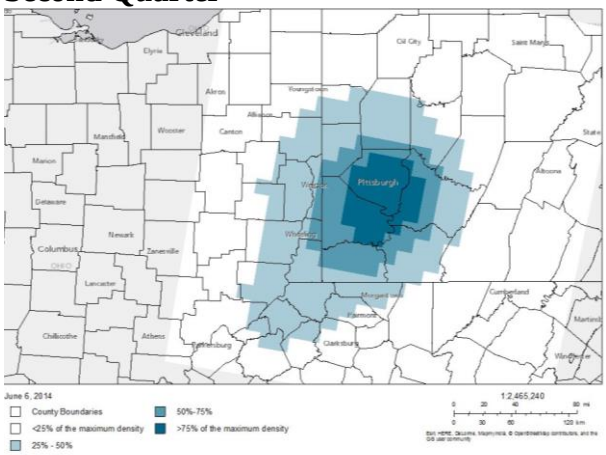
[84] The KDEs graphically represent the aggregate of HYSPLIT backward trajectories for the years 2010-2012, run every third day (beginning on the first day of monitoring), four times each day, and ending at four endpoint heights.

Figure 3e. HYSPLIT Kernel Density Estimation Plots for the Allegheny County Area.

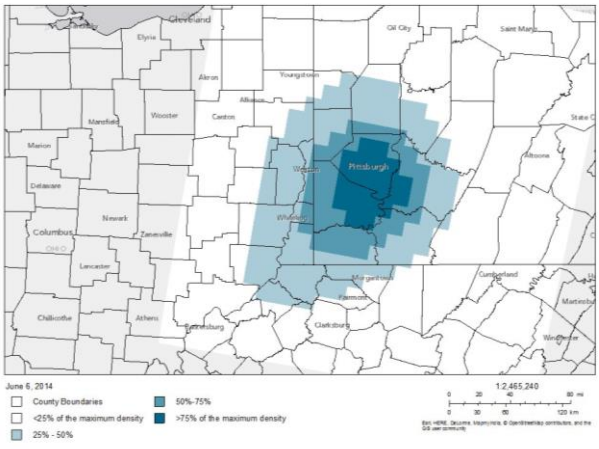
First Quarter



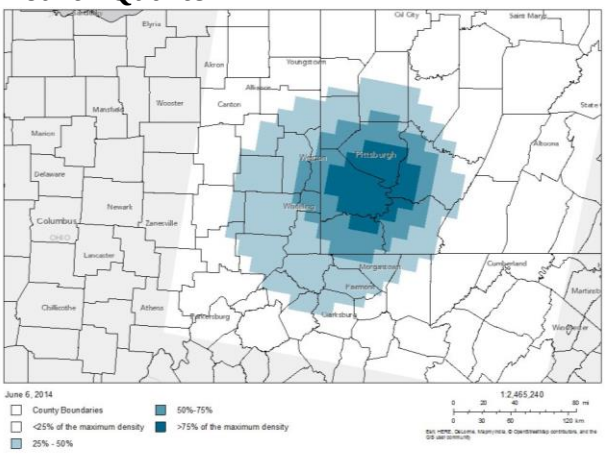
Second Quarter



Third Quarter



Fourth Quarter



Factor 4: Geography/topography

To evaluate the geography/topography factor, EPA assessed physical features of the area of analysis that might define the airshed and thus affect the formation and distribution of $PM_{2.5}$ concentrations over the area.

The Clairton Coke Works is at the base of the Mon Valley, approximately 750 feet above mean sea level (MSL). The facility sits on the west bank of the Monongahela River. On the east bank, the terrain rises sharply reaching elevations more than 300 feet above the coke works within a thousand feet of the plant. The Liberty monitor is about 1100 feet above MSL, to the northeast of the coke works.

Figure 4a. Topography of Liberty Monitor and Surrounding Area.

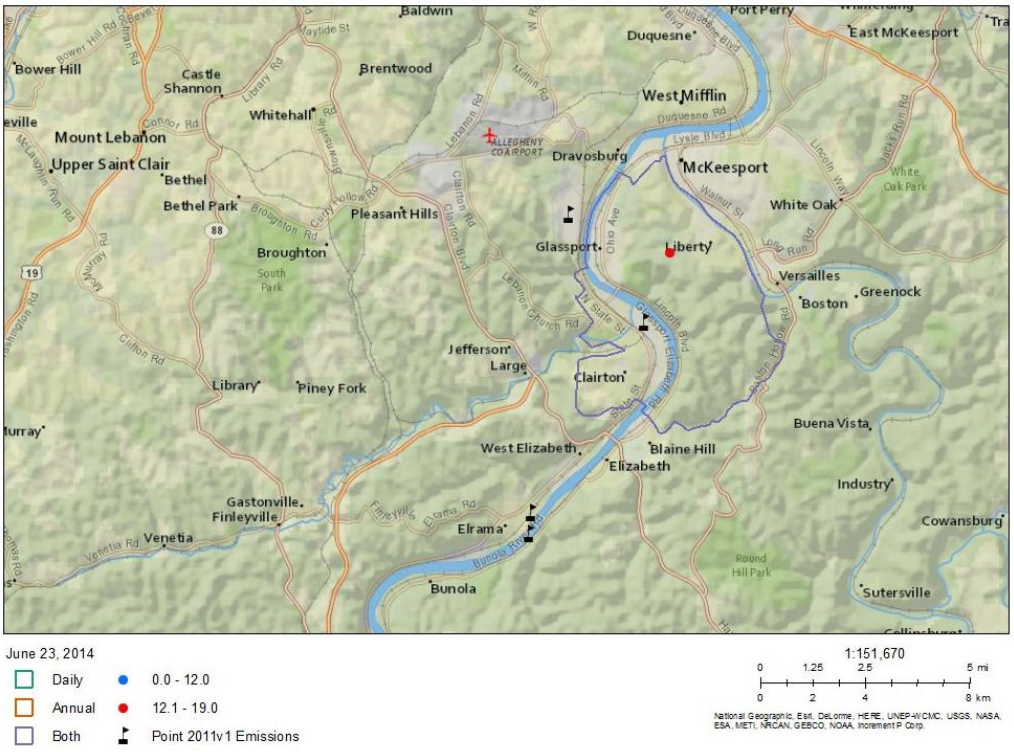
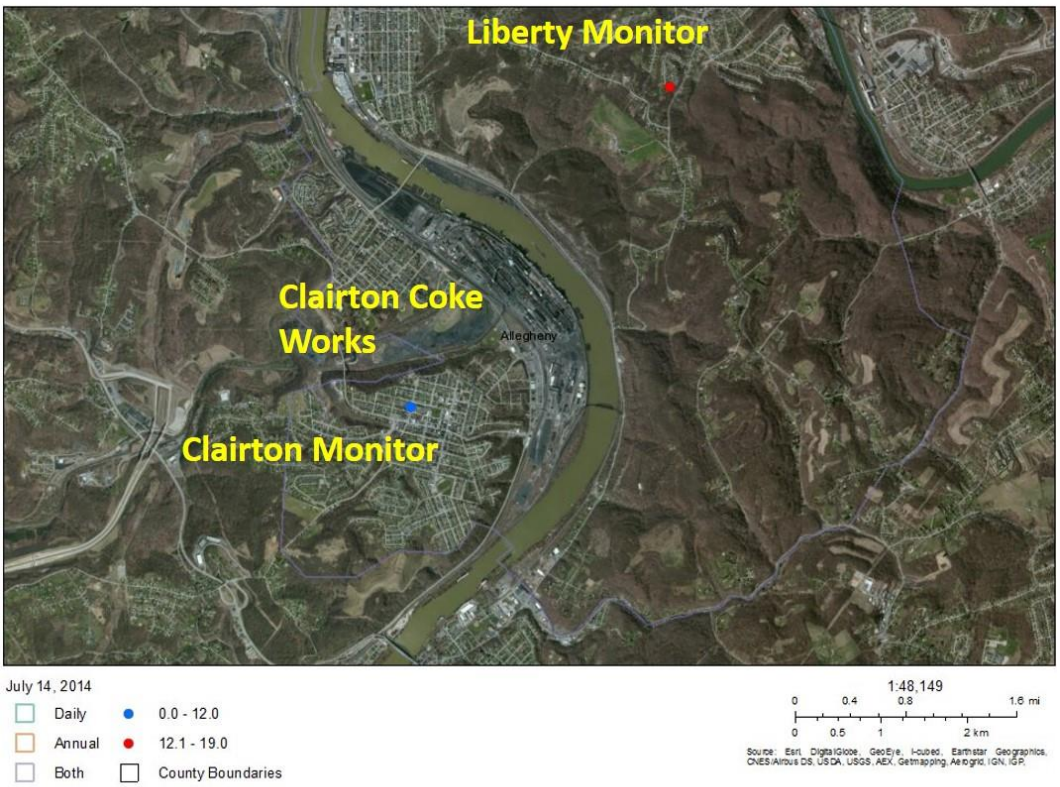


Figure 4b. Satellite Imagery of the Clairton Coke Works and Surroundings



Southwestern Pennsylvania has relatively high terrain cut by numerous river valleys, which tend to trap local emissions. This tendency to trap local emissions, combined with large local emissions, would explain why the monitored values at the Liberty monitor are so much higher than at the other monitors in the Pittsburgh area, which are all attaining the 2012 annual $PM_{2.5}$ NAAQS.

Furthermore, in its October 20, 2008 letter to EPA regarding boundary recommendations for the 2006 $PM_{2.5}$ NAAQS, PADEP stated that the Clairton Coke Works facility has stack heights that are lower than normal power plant stacks. This means that the effects of a source like the coke works would impact the ground at a much closer location locally than a power plant. PADEP's October 20, 2008 letter also explained that the highest $PM_{2.5}$ concentrations occur at the Liberty monitor when there are south-southwesterly winds along with a morning inversion. A morning inversion occurs when air at the ground is cooler than the air above it; normally at night, the area is under the control of high pressure and clear skies. With the warmer air being above the cooler air, vertical mixing is at a minimum. Therefore, with an inversion in place, $PM_{2.5}$ and precursor emissions in the boundary layer will remain trapped in that layer. For example, as the Clairton Coke Works' low level stacks emit emissions, the plume of emissions will only rise to the top of the inversion layer. At that point, the pollution is spread out horizontally. These inversions usually set up only a few hundred feet above the surface. Therefore, fine particulate levels can become very high near the surface. In this case, such a plume impacts the hillside across the river as well; the plume is actually not traveling long distances. This is evident from the speciation data from two monitoring sites, Liberty and Lawrenceville. (For more information on speciation data, see Factor 2, above.)

Factor 5: Jurisdictional boundaries

In defining the boundaries of the intended Allegheny County nonattainment area, EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Existing jurisdictional boundaries often signify the state, local, or tribal governmental organization with the necessary legal authority for carrying out air quality planning and enforcement functions for the intended area. Examples of such jurisdictional boundaries include existing/prior nonattainment area boundaries for particulate matter, county lines, air district boundaries, township boundaries, areas covered by a metropolitan planning organization, state lines, and Reservation boundaries, if applicable. Where existing jurisdictional boundaries were not adequate or appropriate to describe the nonattainment area, EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

There are no jurisdiction issues in the Allegheny County Area. The $PM_{2.5}$ planning for Allegheny County is under the purview of the Allegheny County Health Department. The Pennsylvania Department of Environmental Protection does the planning for the Pittsburgh-Beaver Valley nonattainment areas for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS. However, these two agencies have a long history of cooperation.

ACHD has a long history of air quality planning for the area surrounding the Liberty monitor. The City of Clairton and the Boroughs of Glassport, Liberty, Lincoln, and Port Vue Clairton Area were designated as the Liberty-Clairton nonattainment area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS. The same five municipalities were designated nonattainment for the 1987 PM_{10} NAAQS by operation of law on November 15, 1990. The nonattainment designation and classification as a moderate PM_{10} area was codified in 40 CFR part 81 on November 6, 1991 (56 FR 56694). The area

attained the PM_{10} NAAQS through ACHD's state implementation plan (SIP) approved measures, and was redesignated to attainment in 2003 (68 FR 53515).

As seen in Table 5, air quality in the area has improved markedly over time. This improvement is due to emission reduction measures taken at the Clairton Coke works. Recent measures include[85]:

2009 Batteries 7-9 were permanently shut down
2010 Battery B rebuild completed
2012 25 heating walls on Battery 19 replaced
2013 Construction of new low emission quench towers, Quench Towers 5A and 7A, for Batteries 13-15 and Batteries 19-20. The older Quench Towers 5 and 7 will serve as auxiliary quench towers.

Table 5. Annual $PM_{2.5}$ DVs at the Liberty Monitor (µg/m^3)

2001-2003	2002-2004	2003-2005	2004-2006	2005-2007	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	Preliminary 2011-2013
21.2	20.4	20.8	20.4	19.8	18.3	17.0	16.0	15.0	14.8	13.4

In addition, on October 25, 2013 (78 FR 63881), effective November 25, 2013, EPA determined that the Liberty-Clairton area has air quality data that meets the 1997 annual $PM_{2.5}$ NAAQS, and that the area attained that NAAQS by its attainment date. EPA believes that the same locally focused planning will bring the area into attainment for the 2012 annual $PM_{2.5}$ NAAQS.

Conclusion for the Allegheny County Area

Based on the assessment of factors described above, both individually and in combination, EPA has preliminarily concluded that Allegheny County should be designated as nonattainment for the 2012 annual $PM_{2.5}$ NAAQS. EPA has determined that there are strong local influences throughout Allegheny County that are contributing to its nonattainment. The detailed technical analysis, set forth in Factors 1 - 4 supports a finding that this area presents local air quality problems that differentiate this county from the surrounding counties. Therefore, EPA has determined that it is appropriate to designate Allegheny County, and no other counties in the Pittsburgh MSA, as nonattainment.

The Liberty monitor is located in the industrialized Mon Valley, which is dominated by the U.S. Steel Clairton Cokes Works. The Clairton Coke Works is a large and complex facility that emits a combination of particulates, sulfur dioxide, ammonia, and hundreds of volatile organic chemicals. Although the coke plant has numerous existing emission controls, the combination of a large amount of low-level emissions in a narrow river valley creates a local air quality problem which is uniquely different from the remainder of the area. DVs for 2011-2013 at seven monitors in Allegheny County are below the 12 µg/m^3 standard. However, the 2011-2013 DV at the Liberty monitor is 13.4 µg/m^3. In its December 2013 letter, Pennsylvania identified 252 days in the 2010 to 2012 monitoring period

[85] Page 15 of the "Proposed Revision to the Allegheny County Portion of the Pennsylvania State Implementation Plan, Attainment Demonstration for the Liberty-Clairton $PM_{2.5}$ Nonattainment Area 2006 Standards," by ACHD Air Quality Program, dated May 10, 2013,

when the violating Liberty monitor's $PM_{2.5}$ concentrations were at least one standard deviation above the regional concentrations in the Pittsburgh MSA, and regional average was at or below 12 $\mu g/m^3$.

As discussed in factor 3 regarding meteorology, while Indiana and Armstrong Counties have the first and second highest emissions in the area of analysis the dominant wind directions in the area indicate that Indiana and Armstrong Counties do not contribute to the violation at the Liberty monitor. Furthermore, as discussed in Section 3.1, EPA has determined that the portions of Indiana County that contain the large SO_2 sources should be designated as part of the Johnstown, PA nonattainment area.

Washington County is to the southwest of the violating monitor. However, total emissions, as well as emissions of POM and EC, the largest components of the urban increment at the violating monitor, are relatively low in Washington County. Washington County also has relatively low population, population density, and VMT. There are two point sources with emissions of greater than 500 tpy in Washington County. However, these sources have very low direct $PM_{2.5}$ and VOC emissions, which indicates that any potential contribution to the POM and EC in the urban increment at the Liberty monitor is relatively low. Furthermore, terrain limits transport of emissions from Washington County to the Liberty monitor.

Wind roses provided by PADEP show that wind directions on high $PM_{2.5}$ days at the Liberty monitor are almost completely from the southwest. This wind direction shows that on high $PM_{2.5}$ days, the Clairton Coke Works is directly upwind of the violating Liberty monitor. Furthermore, source apportionment work by ACHD shows that when organic industrial carbons; elemental industrial carbons and localized sulfates; coal/coke dust; and chlorine are high at the Liberty monitor, winds are from the southwest and south, indicating that the Clairton Works is the likely upwind source. ACDH's December 13, 2011 report included the same type of analysis for the Lawrenceville monitor (420030008), which is an urban monitor in the Pittsburgh area that is meeting the 2012 annual $PM_{2.5}$ NAAQS. Figure 2h compares the modeled source factors for the two monitors, and shows that the Lawrenceville monitor has large mobile source, light industry, burning and cooking components typical of urban $PM_{2.5}$. The Liberty monitor shows impacts from localized heavy industry. ACDH's December 13, 2011 report emphasizes that the Liberty monitor is heavily influenced by meteorological conditions, i.e. temperature inversions.

As discussed in factor 4 regarding geography/topography, southwestern Pennsylvania is dominated by high terrain cut by numerous river valleys. The Clairton Coke Works is located in one of these river valleys, the Mon Valley. The fact that this type of terrain tends to trap local emissions, combined with large local emissions, explains why the monitored values at the Liberty Borough monitor are so much higher than at the other seven monitors in the Pittsburgh area. Furthermore, the Clairton Coke Works facility has stack heights that are lower than normal power plant stacks. This would mean that the effects of a source like the coke works would impact the ground at a much closer location locally than a power plant. The highest $PM_{2.5}$ concentrations happen at the Liberty monitor when there are south-southwesterly winds along with a morning inversion. A morning inversion occurs when air at the ground is cooler than the air above it; normally at night, the area is under the control of high pressure and clear skies. With the warmer air being above the cooler air, vertical mixing is at a minimum. Therefore, $PM_{2.5}$ and precursor emissions in the boundary layer with an inversion in place will remain trapped in that layer.

As shown, in Figures 1a and 1b, most monitors in the area of analysis, including the violating Liberty monitor, show higher quarterly mean values in third quarter (July-September) of each year. However,

$PM_{2.5}$ levels at the violating Liberty monitor are consistently higher than the rest of the monitors in the area. This indicates that the Liberty monitor is influenced by the same seasonal emissions patterns as the rest of the area, but there is an additional local component causing $PM_{2.5}$ levels to be higher than the rest of the area.

Pennsylvania has recommended that only the five municipalities in the Liberty-Clairton nonattainment area for the 1997 annual and 2006 24-hour $PM_{2.5}$ NAAQS be designated as nonattainment for the 2012 annual $PM_{2,5}$ NAAQS. While there is a very strong local contribution to the violation at the Liberty monitor from the Clairton Coke Works, EPA has concluded that other sources in the remainder of Allegheny County also contributes to the violation at the Liberty monitor. Allegheny County, which includes the City of Pittsburgh, has the highest NOx, EC, direct $PM_{2.5}$, PSO4, POM, and VOC emissions in the area of analysis. It also has the second highest PNO3 and NH_3 emissions, and the fourth highest SO_2 emissions in the area of analysis. There are nine major sources with emissions of 500 tpy or more in Allegheny County, four of which are within five miles of the violating monitor.

The spatial distribution of selected emissions throughout the area of analysis also provides useful information. POM and EC, the largest components of the urban increment at the Liberty monitor, are high throughout Allegheny County, including several 12 km grid squares immediately to the north and west of the Liberty monitor. POM and EC are lower in the surrounding counties. This suggests that POM and EC from the Pittsburgh urban area in Allegheny County, to the north and west of the Liberty monitor, have a high potential to influence $PM_{2.5}$ values at the violating monitor.

Pittsburgh is a densely populated city, with a population of 1.2 million and VMT of over 8 billion. As explained in factor 3, regarding meteorology, the wind rose closest to the Liberty monitor has a northwesterly component, indicating that at least some of the time, Pittsburgh is directly upwind of the violating Liberty monitor. Therefore, emissions from this highly urbanized area in Allegheny County, just northwest of the violating Liberty monitor, have a high potential to contribute to $PM_{2.5}$ levels at the Liberty monitor. Therefore, EPA has concluded that all of Allegheny County should be designated as nonattainment for the 2012 annual $PM_{2.5}$ area, as the Allegheny County Area.

Attachments

ACDH's December 13, 2011 report, "Allegheny County $PM_{2.5}$ Source Apportionment Results using the Positive Matrix Factorization Model (PMF Version 3.0) and Conditional Probability Function (CPF), Model Timeframe: January 2005 through December 2010"

ACHD Air Quality Program "2013 Air Monitoring Network Review," dated July 1, 2013

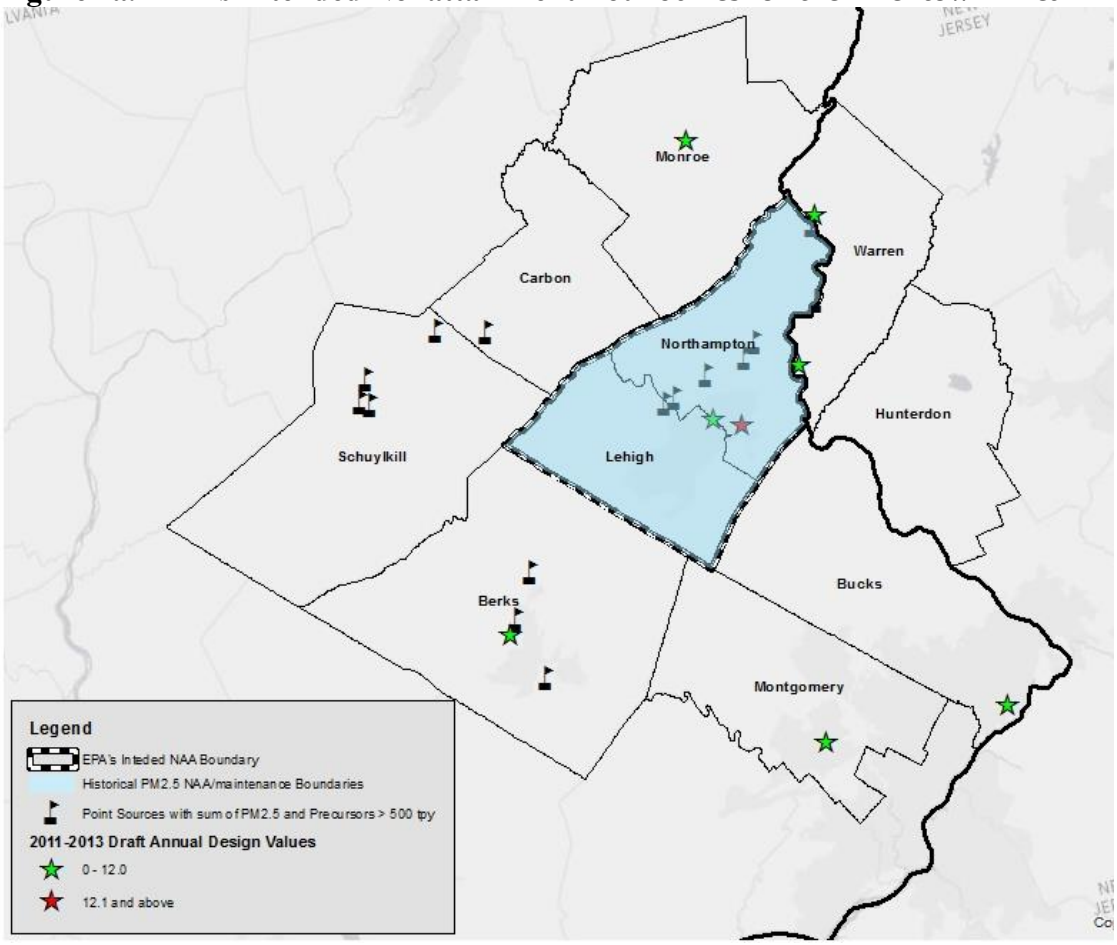
Letter dated October 20, 2008 from the PADEP to EPA regarding boundary recommendations for the 2006 $PM_{2.5}$ NAAQS

"Proposed Revision to the Allegheny County Portion of the Pennsylvania State Implementation Plan, Attainment Demonstration for the Liberty-Clairton $PM_{2.5}$ Nonattainment Area 2006 Standards," by ACHD Air Quality Program, dated May 10, 2013

3.4 Area Background and Overview - Allentown Area

Figure 1a is a map of EPA's intended nonattainment boundary for the Allentown Area. The map shows the location and DVs of ambient air quality monitoring locations, county and other jurisdictional boundaries including the Allentown-Bethlehem-Easton, PA-NJ MSA. For purposes of the 2006 24-hour $PM_{2.5}$ NAAQS, a portion of this area was designated nonattainment. The boundary for the Allentown nonattainment area for the 2006 24-hour $PM_{2.5}$ NAAQS included the entire counties of Lehigh and Northampton counties in Pennsylvania. The boundary for the intended 2012 annual $PM_{2.5}$ NAAQS is the same as the boundary for the 2006 24-hour $PM_{2.5}$ NAAQS.

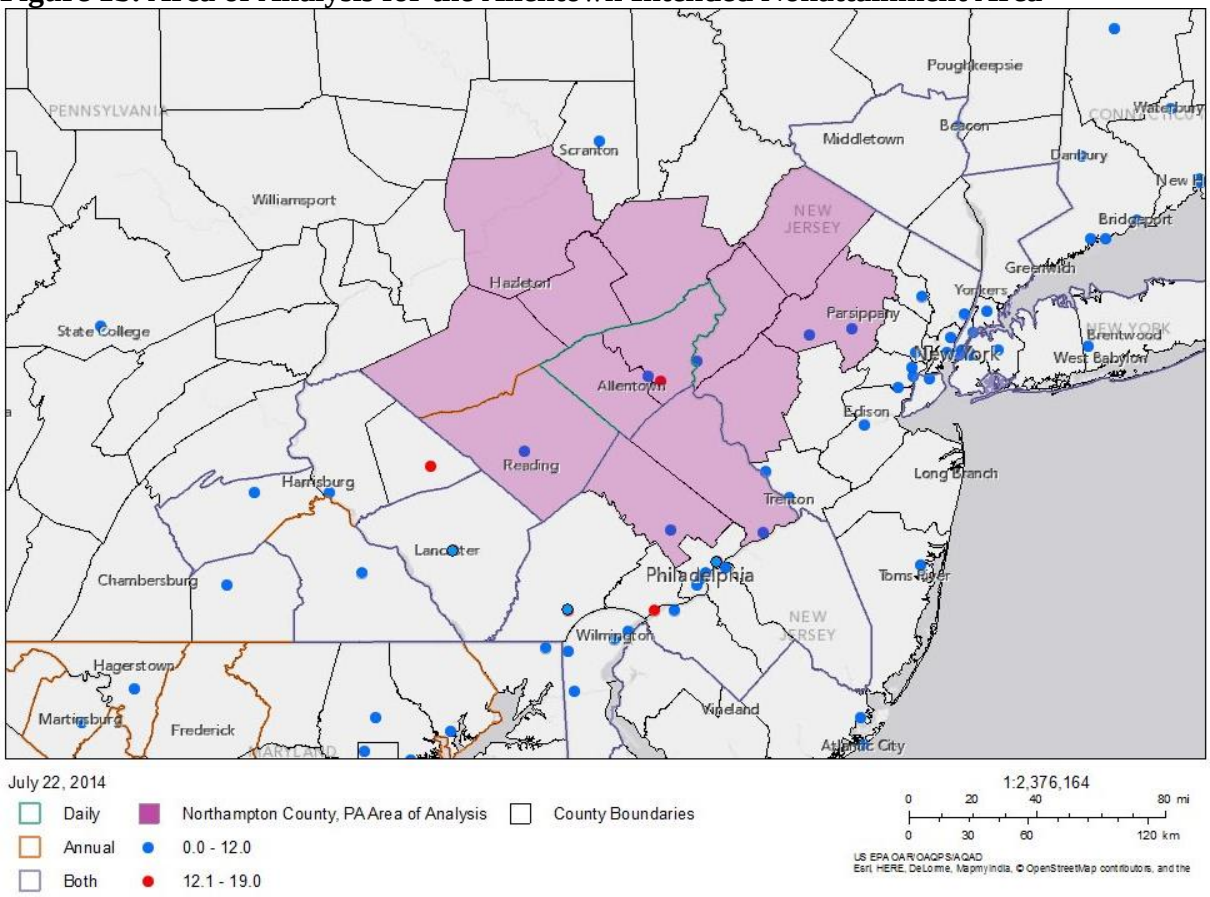
Figure 1a. EPA's Intended Nonattainment Boundaries for the Allentown Area



EPA must designate, as nonattainment, areas that violate the NAAQS and nearby areas that contribute to the violation in the violating area. A monitor in Northampton County, PA shows a violation of the 2012 annual $PM_{2.5}$ NAAQS, therefore this county is included in the nonattainment area. As shown in Figure 1b, EPA evaluated each county in the Allentown-Bethlehem-Easton MSA, which includes Northampton County, PA as well as Carbon County and Lehigh County in Pennsylvania; Warren County, New Jersey, and a ring of counties adjacent to the Allentown-Bethlehem-Easton, PA-NJ MSA. EPA's evaluation was based on the five factors and other relevant information. In addition to Northampton County, EPA has determined that Lehigh County also contributes to the nearby violation at the Northampton County violating monitor. The following sections describe this five factor analysis

process. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers their interconnections and the dependence of each factor on one or more of the others.

Figure 1b. Area of Analysis for the Allentown Intended Nonattainment Area



Factor 1: Air Quality Data

All data collected during the year are important when determining contributions to an annual standard such as the 2012 annual $PM_{2.5}$ NAAQS. Compliance with an annual NAAQS is dependent upon monitor readings throughout the year, including days with monitored ambient concentrations below the level of the NAAQS. For the 2012 annual $PM_{2.5}$ NAAQS, the annual mean is calculated as the mean of quarterly means. A high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV. Although all data are important, seasonal or episodic emissions can provide insight as to relative contributors to measured $PM_{2.5}$ concentrations. For these reasons, for the Factor 1 air quality analysis, EPA assessed and characterized air quality at, and in the proximity of, the violating monitoring site locations first, by evaluating trends and the spatial extent of measured concentrations at monitors in the area of analysis, and then, by identifying the conditions most associated with high average concentration levels of $PM_{2.5}$ mass in the area of analysis.

In most cases, EPA assessed air quality data on a seasonal, or quarterly, basis.[86] EPA also identified the spatial extent of these high $PM_{2.5}$ concentrations. The mass and composition at the DV location represents contributions from various emission sources including local, area-wide (which may comprise nearby urban and rural areas) and regional sources. To determine the source mix (by mass) at the DV monitoring site, EPA examined the chemical composition of the monitored $PM_{2.5}$ concentrations by pairing each violating FRM/FEM/ARM monitoring site with a collocated or nearby Chemical Speciation Network (CSN) monitoring site or sites. Then, EPA contrasted the approximated mass composition at the DV monitoring site with data collected at IMPROVE[87] and other monitoring locations whose data are representative of regional background.[88,89] This comparison of local/area-wide chemical composition data to regional chemical composition data derives an "urban increment," which helps differentiate the influence of more distant emissions sources from the influence of closer emissions sources, thus representing the portion of the measured violation that is associated with nearby emission contributions.[90,91,92]

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[86] Although compliance with the annual NAAQS depends on contributions from all days of the year, examining data on a quarterly or seasonal basis can inform the relationship between the temporal variability of emissions and meteorology and the resulting $PM_{2.5}$ mass and composition. In some areas of the country where there may be noticeable month-to-month variations in average $PM_{2.5}$, the quarterly averages may not adequately represent seasonal variability. In these areas, air quality data may be aggregated and presented by those months that best correspond to the local "seasons" in these areas.

[87] IMPROVE stands for Interagency Monitoring for Protected Visual Environments and is an aerosol monitoring network in mostly rural and remote areas.

[88] The "urban increment" analysis assesses and characterizes the increase in seasonal and annual average $PM_{2.5}$ mass and chemical components observed at violating monitoring site(s) relative to monitoring sites outside the area of analysis (which represent background concentrations). Developing the urban increment involves pairing a violating FRM/FEM/ARM monitor with a collocated monitor or nearby monitor with speciation data. EPA made every effort to pair these data to represent the same temporal and spatial scales. However, in some cases, the paired violating and CSN "urban" monitoring locations were separated by some distance such that the included urban CSN site(s) reflect(s) a different mixture of emissions sources, which could lead to misinterpretations. To generally account for differences in $PM_{2.5}$ mass between the violating site and the nearby CSN site(s), EPA determined material balance of the $PM_{2.5}$ composition at the violating site by assigning the extra measured $PM_{2.5}$ mass to the carbon components of $PM_{2.5}$. Where the general urban increment approach may be misleading, or in situations where non-carbonaceous emissions are believed to be responsible for a local $PM_{2.5}$ concentration gradient, EPA used alternative analyses to reflect the mix of urban and rural sources contributing to the measured concentrations at violating monitoring sites.

[89] The urban monitors were paired with any rural sites within a 150 mile radius of an urban site to calculate spatial means of the quarterly averages of each species. If there were no rural sites within 150 miles, then the nearest rural site was used alone. That rural mean was then subtracted from the quarterly mean of the urban site to get the increment. Negative values were simply replaced with zeros.

[90] In most, but not all, cases, the violating design value monitoring site is located in an urban area. Where the violating monitor is not located in an urban area, the "urban increment" represents the difference between local and other nearby emission sources in the vicinity of the violating monitoring location and more regional sources.

[91] Hand, et. al. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report V, June 2011. Chapter 7 – Urban Excess in $PM_{2.5}$ Speciated Aerosol Concentrations, *http://vista.cira.colostate.edu/improve/Publications/Reports/2011/PDF/Chapter7.pdf*

[92] US EPA, Office of Air Quality Planning and Standards, December 2004. (2004) Area Designations for 1997 Fine Particle ($PM_{2.5}$) Standards, Technical Support Document for State and Tribal Air Quality Fine Particle ($PM_{2.5}$)

$PM_{2.5}$ Design Values and Total Mass Measurements - EPA examined ambient $PM_{2.5}$ air quality monitoring data represented by the DVs at the violating monitoring site and at other monitors in the area of analysis. EPA calculated DVs based on air quality data for the most recent 3 consecutive calendar years of quality-assured, certified air quality data from suitable FEM/FRM/ARM monitoring sites in the EPA's Air Quality System (AQS). For this designations analysis, EPA used data for the 2011-2013 period (i.e., the 2013 DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2012 annual $PM_{2.5}$ NAAQS is met at a monitoring site when the 3-year average annual mean concentration is 12.0 micrograms per cubic meter ($\mu g/m^3$) or less (e.g., 12.1 $\mu g/m^3$ or greater is a violation). A DV is only valid if minimum data completeness criteria are met or when other regulatory data processing provisions are satisfied (See 40 CFR part 50 Appendix N). Table 2 identifies the current DVs (i.e., the 2013 DV) and the most recent two DVs based on all monitoring sites in the area of analysis for the Allentown intended nonattainment area.[93]

Table 2. Air Quality Data collected at Regulatory Monitors (all DV levels in $\mu g/m^3$)[a,b]

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Berks, PA	420110011	No	10.7	10.9	11
Bucks, PA	420170012	No	10.9	10.9	10.8
Lehigh, PA	N/A	No	No monitor		
Luzerne, PA	N/A	No	No monitor		
Monroe, PA	N/A	No	8	8	7.9
Montgomery, PA	420910013	No	10.1	9.8	9.8
Northampton, PA	420950025	Yes	**13.4**	**13.2**	**12.2**
Northampton, PA	420950027	Yes		10.6	10.6
Schuylkill, PA	N/A	No	No monitor		
Hunterdon, NJ	N/A	No	No monitor		
Morris, NJ	340270004	No	**8.5**	**8.4**	**8.4**
Morris, NJ	340273001	No	7.6	7.6	7.5
Sussex, NJ	N/A	No	No monitor		
Warren, NJ	340410006	No	9.2	9.4	9.1

[a]If a county has more than one monitoring location, the county DV is indicated in bold type.
[b]If a monitor is violating, the NAAQS, the violating DV is indicated in red type.

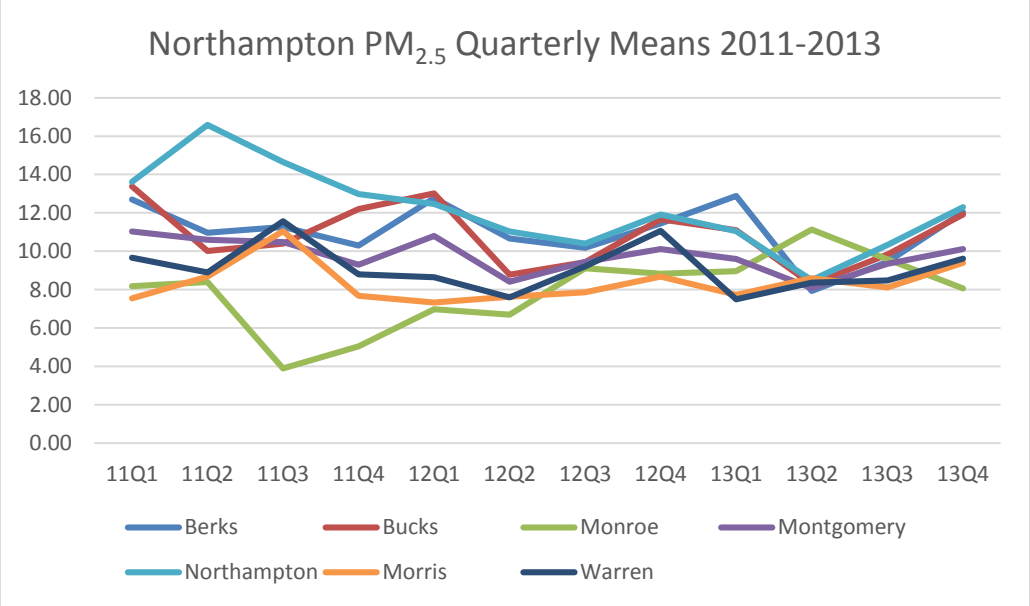
Designations, Chapter 3, Urban Excess Methodology. Available at *www.epa.gov/pmdesignations/1997standards/documents/final/TSD/Ch3.pdf*

[93] In certain circumstances, one or more monitoring locations within a monitoring network may not meet the network technical requirements set forth in 40 CFR 58.11(e), which states, "State and local governments must assess data from Class III $PM_{2.5}$ FEM and ARM monitors operated within their network using the performance criteria described in table C-4 to subpart C of part 53 of this chapter, for cases where the data are identified as not of sufficient comparability to a collocated FRM, and te monitoring agency requests that the FEM or ARM data should not be used in comparison to the NAAQS. These assessments are required in the monitoring agency's annual monitoring network plan described in §58.10(b) for cases where the FEM or ARM is identified as not of sufficient comparability to a collocated FRM…."

The Figure 1a map, shown previously, identifies the Northampton County, PA intended nonattainment area, the Allentown-Bethlehem-Easton, PA-NJ MSA boundary and monitoring locations with 2011-2013 violating DVs. As indicated on the map, there is one violating monitoring located in Northampton County, PA (Northampton County violating monitor). Northwest of the violating monitor there is a non-violating monitor also located in Northampton County (Northampton County non-violating monitor).

Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. Figure 2 shows quarterly mean $PM_{2.5}$ concentrations for the most recent 3-year period for the highest DV monitoring sites in each county within the area of analysis. This graphical representation is particularly relevant when assessing air quality data for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, because, as previously stated, the annual mean is calculated as the mean of quarterly means and a high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV.

Figure 2. Northampton Area $PM_{2.5}$ Quarterly Means for 2011-2013



As shown, in Figure 2, most monitors in the area of analysis show higher quarterly mean values in quarter 1 and quarter 3. Higher quarterly mean values in quarter 3 correspond to higher emissions from electric generating units (EGUs) from higher air conditioning use. Higher quarterly mean values in quarter 1 may be due to higher EGU emissions from increased heating use, and may include emissions from home heating oil and residential wood burning stoves. In addition, there is a greater tendency for NO_x to form in the atmosphere and for FRM monitors to retain particle nitrate during the cooler months. However, the Northampton County violating monitor does not have a clear seasonal pattern similar to other monitors in the area of analysis, indicating local influences at the monitor.

<u>$PM_{2.5}$ Composition Measurements</u> - To assess potential emissions contributions for each violating monitoring location, the EPA determined the various chemical species comprising total $PM_{2.5}$ to

identify the chemical components over the analysis area, which can provide insight into the types of emission sources impacting the monitored concentration. To best describe the $PM_{2.5}$ at the violating monitoring location, EPA first adjusted the chemical speciation measurement data from a monitoring location at or near the violating FRM monitoring site using the SANDWICH approach to account for the amount of $PM_{2.5}$ mass components retained in the FRM measurement.[94,95,96,97] In particular, this approach accounts for losses in fine particle nitrate and increases in sulfate mass associated with particle bound water. Figure 3a illustrates the fraction of each $PM_{2.5}$ chemical component at the violating monitoring site (420950025) located in Northampton County, PA based on annual averages for the years 2010-2012.

Figure 3a. Allentown Area Annual Average $PM_{2.5}$ Chemical Components (2010-2012)

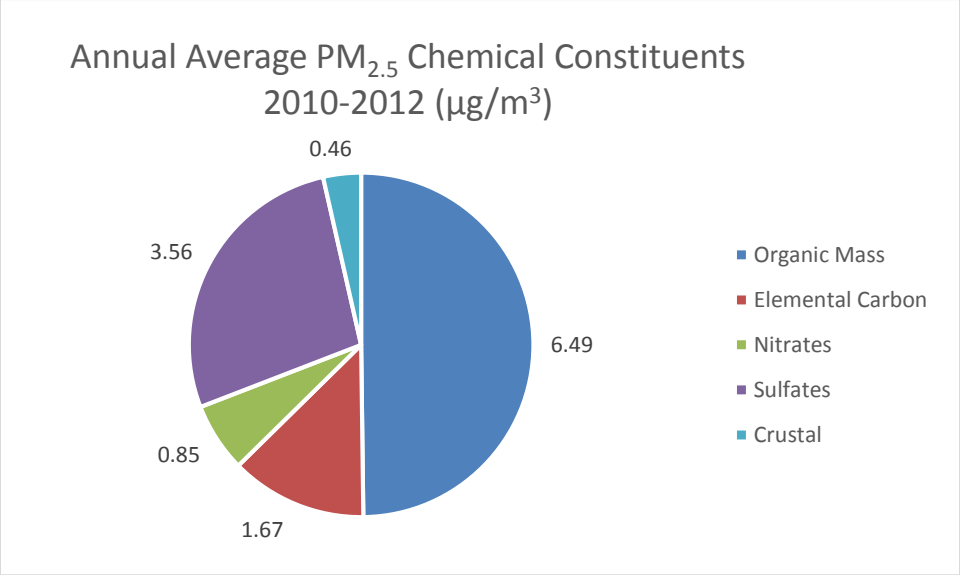


Figure 3b shows annual and quarterly chemical composition profiles and illustrates any seasonal or episodic contributors to $PM_{2.5}$ mass. This "increment analysis," combined with the other factor analyses, can provide additional insight as to which sources or factors may contribute at a greater

[94] SANDWICH stands for measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous mass **H**ybrid Material Balance Approach." The SANDWICH adjustment uses an FRM mass construction methodology that results in reduced nitrates (relative to the amount measured by routine speciation networks), higher mass associated with sulfates (reflecting water included in gravimetric FRM measurements) and a measure of organic carbonaceous mass derived from the difference between measured $PM_{2.5}$ and its non-carbon components. This characterization of $PM_{2.5}$ mass also reflects crustal material and other minor components. The resulting characterization provides a complete mass closure for the measured FRM $PM_{2.5}$ mass, which can be different than the data provided directly by the speciation measurements from the CSN network.

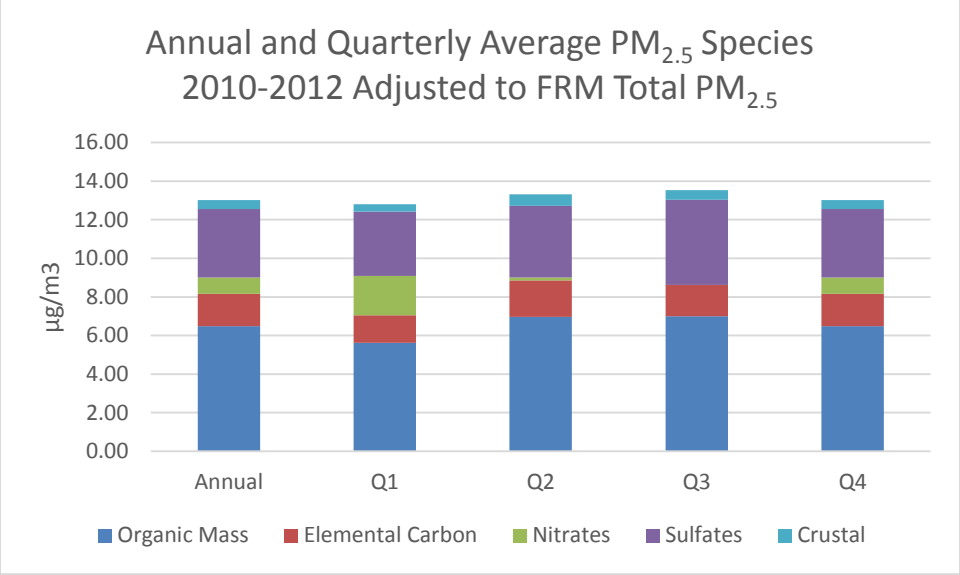
[95] Frank, N. H., SANDWICH Material Balance Approach for $PM_{2.5}$ Data Analysis, National Air Monitoring Conference, Las Vegas, Nevada, November 6-9, 2006. *http://www.epa.gov/ttn/amtic/files/2006conference/frank.pdf*.

[96] Frank, N. H., The Chemical Composition of $PM_{2.5}$ to support PM Implementation, EPA State /Local/Tribal Training Workshop: $PM_{2.5}$ Final Rule Implementation and 2006 $PM_{2.5}$ Designation Process, Chicago IL, June 20-21, 2007, *http://www.epa.gov/ttn/naaqs/pm/presents/pm2.5_chemical_composition.pdf.*

[97] Frank, N. H. *Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities*. J. Air & Waste Manage. Assoc. 2006 56:500–511.

level. Simply stated, this analysis can help identify nearby sources of emissions that contribute to the violation at the violating monitoring site.

Figure 3b. Allentown Area Annual and Quarterly Average $PM_{2.5}$ Species (2010-2012)[a]



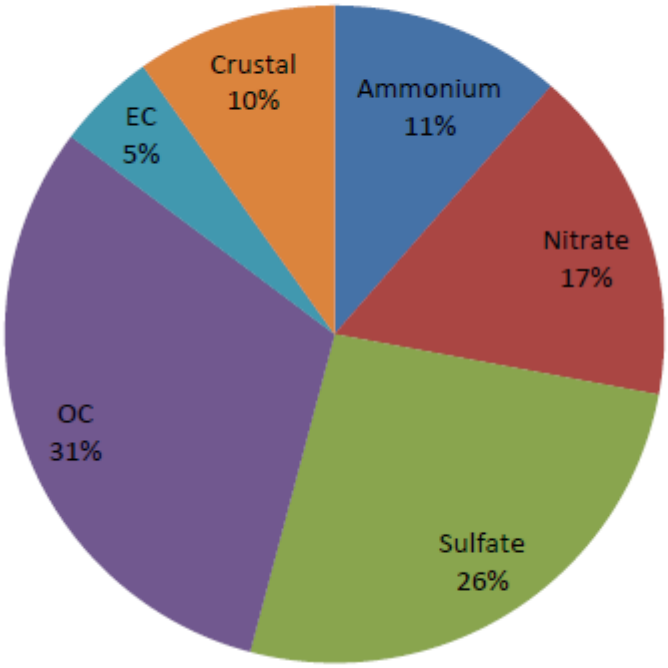
[a]*Adjusted to FRM Total $PM_{2.5}$* indicates that the speciation profile and total mass depicted in this figure are the result of the urban increment calculation for the particular FRM monitor.

The speciation data in Figures 3a and 3b for the Northampton County violating monitoring site indicate that organic mass and sulfates are the predominant species overall. Figure 3b also illustrates that during the first quarter the percentage of nitrates is higher than the other quarters, which may be due to increased EGU emissions from winter heating needs and greater particle nitrate collection during the cooler months. In all four quarters, elemental carbon and crustal are smaller $PM_{2.5}$ components.

In Pennsylvania's December 2013 recommendation letter, Pennsylvania also included speciation data for the 2010-2012 monitoring period (note that Pennsylvania's speciation presentation is based on measurement data which was not adjusted by the SANDWICH method. One consequence is that their POC portion of $PM_{2.5}$ is less than EPA's POM portion). Pennsylvania also included speciation data for days when the Northampton monitor's $PM_{2.5}$ concentrations were relatively high but the regional monitoring concentrations were "clean," i.e. 0-12 µg/m^3. Pennsylvania considered regional monitoring concentrations to be those from the following monitoring sites: Swiftwater (Monroe County), Lehigh Valley (Northampton County) and Reading Airport (Berks County). Specifically, Pennsylvania identified 344 days in the 2010 to 2012 monitoring period where $PM_{2.5}$ at the Northampton County violating monitor was at least one standard deviation above the Allentown-Bethlehem-Easton MSA regional average (high days). The top 25% of these high days (highest $PM_{2.5}$ days) were further analyzed to determine why the Northampton County violating monitor's concentrations were high. During the highest $PM_{2.5}$ days, Pennsylvania analyzed the days when the Northampton County monitor collected speciation data. Of the 86 days which were in the top 25% (highest $PM_{2.5}$ days), speciated data was collected on nine days. Figure 3c displays the distribution of

the speciated components of $PM_{2.5}$ during the entire 2010-2012 monitoring period and, similar to EPA's speciation analysis, shows that organic carbon and sulfate are large components of $PM_{2.5}$. Figure 3d displays the distribution of the speciated components of $PM_{2.5}$ during the nine days in the top 25% of high days. On these highest $PM_{2.5}$ days, organic carbon, sulfate and crustal material are large components of the $PM_{2.5}$. [98]

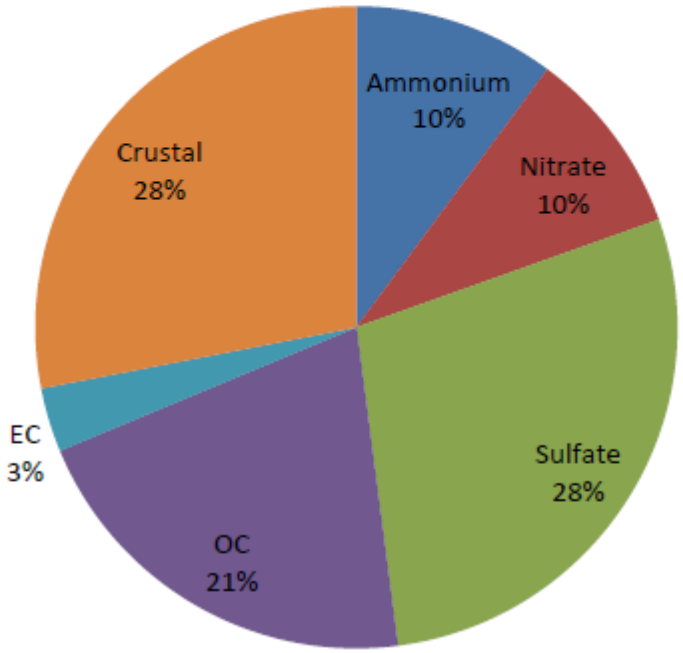
Figure 3c. Northampton County Monitor $PM_{2.5}$ Speciation Data 2010-2012



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

[98] EPA notes that POM is much larger than measured OC and therefore represents a larger percentage of measured $PM_{2.5}$. Similarly, other $PM_{2.5}$ components like crustal material will represent a smaller portion of $PM_{2.5}$ when POM and other adjustments to measured components are made to represent the components of $PM_{2.5}$ using the SANDWICH approach.

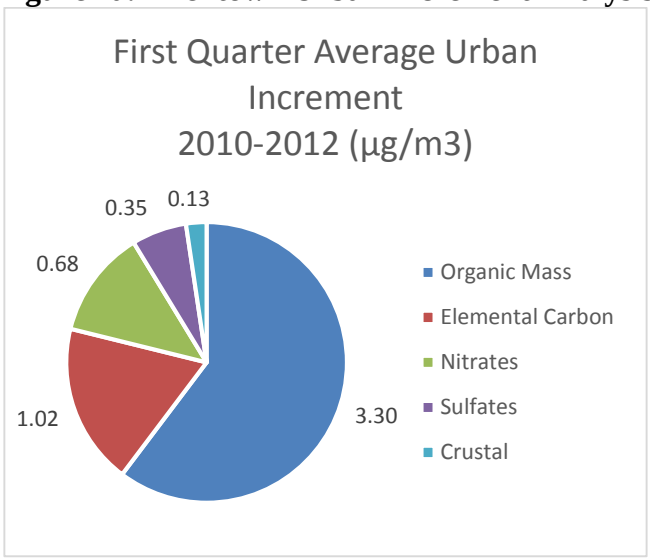
Figure 3d. Northampton County Monitor $PM_{2.5}$ Speciation Data 2010-2012 for Top 25% of Regionally "Clean" Days

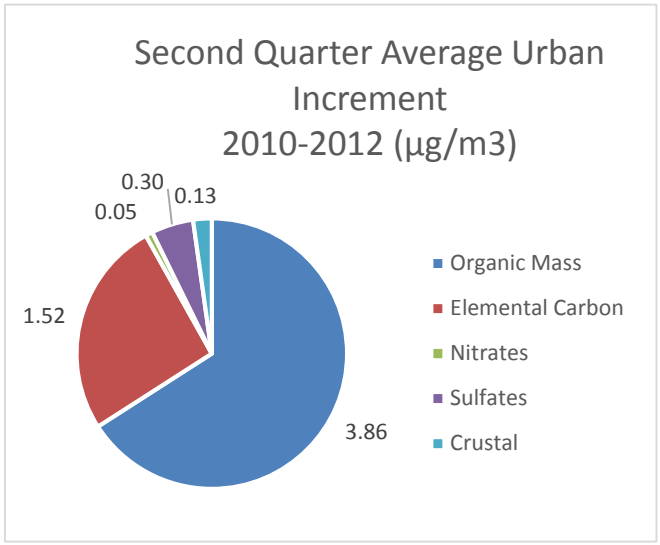


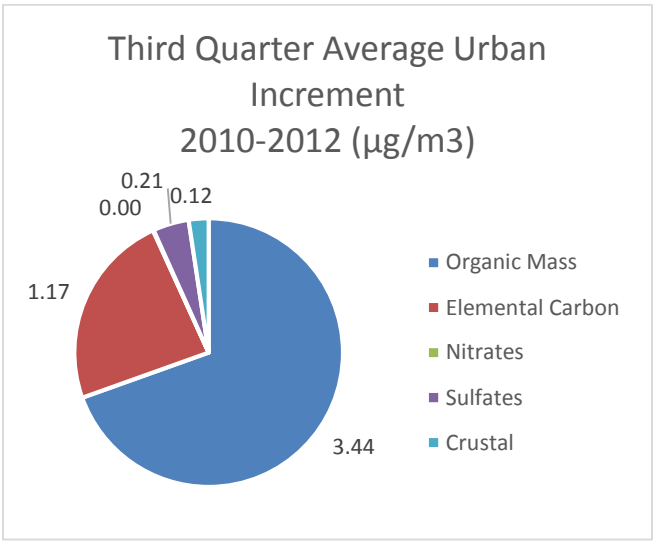
Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

EPA assessed seasonal and annual average $PM_{2.5}$ components at monitoring sites within the area relative to monitoring sites outside of the analysis area to account for the difference between regional background concentrations of $PM_{2.5}$, and the concentrations of $PM_{2.5}$ in the area of analysis, also known as the "urban increment." This analysis differentiates between the influences of emissions from sources in nearby areas and in more distant areas on the violating monitor. Estimating the urban increment in the area helps to illuminate the amount and type of particles at the violating monitor that are most likely to be the result of sources of emissions in nearby areas, as opposed to impacts of more distant or regional sources of emissions. Figure 4a includes pie charts showing the annual and quarterly chemical mass components of the urban increment. Note that in these charts, sulfates and nitrates have been adjusted to represent their mass in measured $PM_{2.5}$.

Figure 4a. Allentown Urban Increment Analysis for 2010-2012.







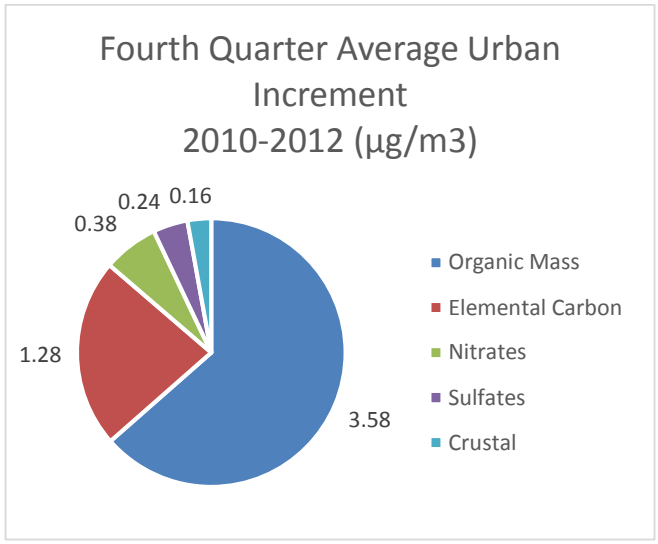
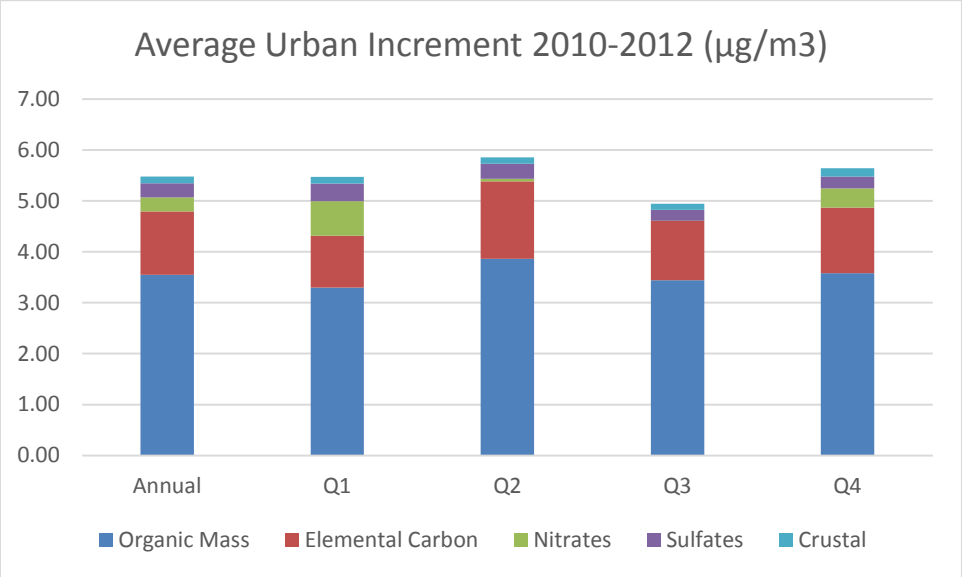


Figure 4b. Allentown Area Average Urban Increment Analysis for 2010-2012.

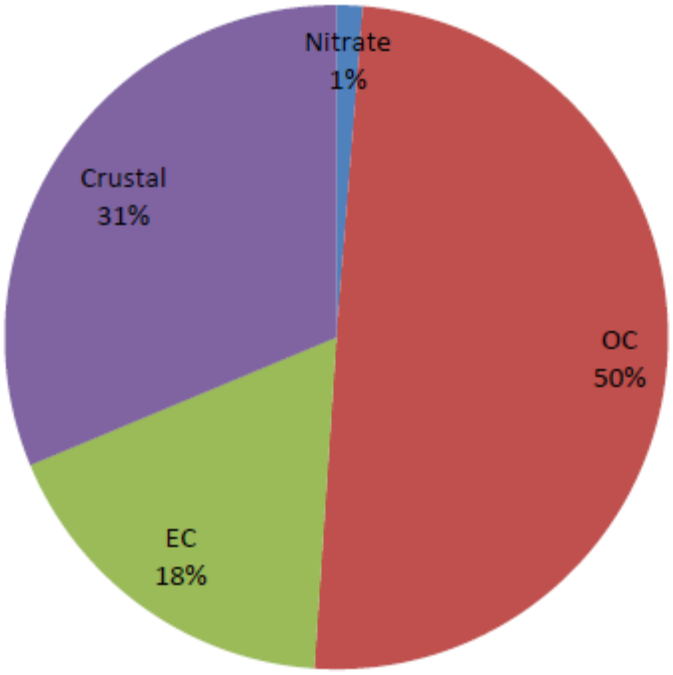


The urban increment data provides further insight to the chemical composition of $PM_{2.5}$ at the Northampton County monitoring site. As previously stated, Figures 3a-d show that organic mass and sulfates are the predominant species overall. When accounting for the urban increment illustrated in Figure 4a and Figure 4b, the sulfate component becomes less dominant, however, there is still some remaining sulfate detected at the monitor. Figure 4a and Figure 4b clearly indicate that organic mass and elemental carbon are the main components of the average urban increment of $PM_{2.5}$ at the Northampton County monitoring site. These components suggests that the sources of $PM_{2.5}$ are local in nature and could result from mobile, area or local industrial sources in the Allentown-Easton-Bethlehem urban area.

In Pennsylvania's December 2013 recommendation letter, Pennsylvania also included urban increment data (referred to as urban excess by Pennsylvania) for the 2010-2012 monitoring period. Pennsylvania compared the violating monitor (referred to as Freemansburg) to the Arendtsville monitor (AIRS # 42-001-0001, Adams County) which is located in a rural area for the 1st and 3rd quarters in the 2010-2012 monitoring period. Figures 4c and 4d show the urban excess at the Freemansburg monitor and, similar to EPA's analysis, indicate that organic carbon, elemental carbon and crustal material are the main components at the violating monitor. (Note that Pennsylvania's urban excess presentation is based on measurement data which was not adjusted by the SANDWICH method.) Below is an excerpt from Pennsylvania's 2013 recommendation letter further explaining the analysis.

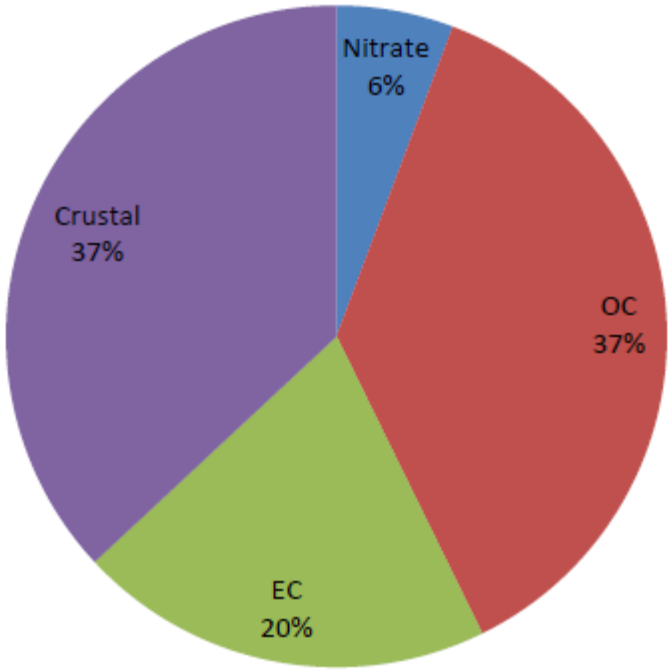
> "In the case of Freemansburg and Arendtsville, the sulfates and ammonium portion of the speciated PM2.5 were higher in Arendtsville than Freemansburg. This strengthens the argument that the PM2.5 problem at Freemansburg is a local issue. The excess organic carbon, elemental carbon and crustal material (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."

Figure 4c. Urban Excess for Freemansburg (Northampton) vs. Arendtsville for 2010-2012 – 1st Quarter



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

Figure 4d. Urban Excess for Freemansburg (Northampton) vs. Arendtsville for 2010-2012 – 3rd Quarter



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

Factor 2: Emissions and emissions-related data

In this designations process, for each area with a violating monitoring site, EPA evaluated the emissions data from nearby areas using emissions related data for the relevant counties to assess each county's potential contribution to $PM_{2.5}$ concentrations at the violating monitoring site or monitoring sites in the area under evaluation. Similar to the air quality analysis, these data were examined on a seasonal basis. However, as discussed in Factor 1, there are no discernable seasonal trends at the Northampton County violating monitor. Therefore, seasonal emissions will not be further discussed in this analysis. EPA examined emissions of identified sources or source categories of direct $PM_{2.5}$, the major components of direct $PM_{2.5}$ (organic mass, elemental carbon, crustal material (and/or individual trace metal compounds)), primary nitrate and primary sulfate, and precursor gaseous pollutants (i.e., SO_2, NO_X, total VOC, and NH_3). EPA also considered the distance of those sources of emissions from the violating monitoring site. While direct $PM_{2.5}$ emissions and its major carbonaceous components are generally associated with sources near violating $PM_{2.5}$ monitoring sites, the gaseous precursors tend to have a more regional influence (although the EPA is mindful of the potential local NO_X and VOC emissions contributions to $PM_{2.5}$ from mobile and stationary sources) and transport from neighboring areas can contribute to higher $PM_{2.5}$ levels at the violating monitoring sites.

Emissions Data

For this factor, EPA reviewed data from the 2011 National Emissions Inventory (NEI) version 1 (see *http://www.epa.gov/ttn/chief/net/2011inventory.html*). For each county in the area of analysis, EPA examined the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires. EPA also looked at the geographic distribution of major point sources of the relevant pollutants.[99] Significant emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

To further analyze area emissions data, EPA also developed a summary of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants, which is available at *http://www.epa.gov/pmdesignations/2012standards/docs/nei2011v1pointnei2008v3county.xlsx*.

When considered with the urban increment analysis discussed in Factor 1, evaluating the components of direct $PM_{2.5}$ and precursor gases can help identify specific sources or source types contributing to elevated concentrations at violating monitoring sites and thus assist in identifying appropriate area boundaries. In general, directly emitted POC and VOCs[100] contribute to POM; directly emitted EC contributes to $PM_{2.5}$ EC; NO_X, NH_3 and directly emitted nitrate contribute to PNO3; SO_2, NH_3 and directly emitted sulfate contribute to PSO4; and directly emitted crustal material and metal oxides

[99] For purposes of this designations effort, "major" point sources are those whose sum of PM precursor emissions ($PM_{2.5}$ + NOx + SO_2 + VOC + NH_3) are greater than 500 tons per year based on NEI 2011v1.

[100] As previously mentioned, nearby VOCs are presumed to be a less important contributor to POM than POC.

contribute to Pcrustal. [101,102] EPA believes that the quantities of those nearby emissions as potential contributors to the $PM_{2.5}$ violating monitors are somewhat proportional to the $PM_{2.5}$ chemical components in the estimated urban increment. Thus, directly emitted POC is more important per ton than SO_2, partially because POC emissions are already $PM_{2.5}$ whereas SO_2 must convert to $PM_{2.5}$ and not all of the emitted SO_2 undergoes this conversion.

Table 3a provides a county-level emissions summary (i.e., the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires) of directly emitted $PM_{2.5}$ and precursor species for the county with the violating monitoring site and nearby counties considered for inclusion in the Allentown Area. Table 3b summarizes the directly emitted components of $PM_{2.5}$ for the same counties in the area of analysis for the Allentown Area. This information will be paired with the urban increment composition previously shown in Figures 4a and 4b.

Table 3a. County-Level Emissions of Directly Emitted $PM_{2.5}$ and Precursors (tpy)

County, State	Total NH_3	Total NOx	Total Direct $PM_{2.5}$	Total SO_2	Total VOC	Total
Northampton, PA	613	14,035	3,031	20,033	7,469	45,180
Montgomery, PA	779	17,147	3,338	2,518	18,975	42,757
Berks, PA	4,097	14,317	3,606	6,136	12,734	40,891
Bucks, PA	1,024	13,173	2,474	2,035	15,325	34,030
Lehigh, PA	620	8,861	2,081	1,321	9,649	22,532
Luzerne, PA	391	9,001	1,804	1,113	9,350	21,659
Morris, NJ	313	8,468	1,164	649	10,466	21,060
Schuylkill, PA	1,655	6,016	1,409	5,481	5,935	20,496
Monroe, PA	212	5,253	1,164	428	6,003	13,060
Hunterdon, NJ	450	3,396	423	328	3,020	7,617
Warren, NJ	711	2,585	508	328	2,918	7,049
Carbon, PA	97	2,819	553	1,042	2,490	7,000
Sussex, NJ	333	2,097	385	499	3,448	6,761

Table 3a indicates that Northampton County has the highest total emissions of directly emitted $PM_{2.5}$ and precursors. The SO_2 emissions in Northampton County are significantly higher than in any other county in the area of analysis. In Table 5 and Figures 5a and 5b, the GenOn Rema Portland Generating Station is the largest source of SO_2 (15,148 tpy) in the area of analysis. This facility is located in Northampton County and to the northeast of the Northampton County violating monitor. Northampton County has high levels of NO_x and VOC emissions as well. As mentioned above, directly emitted VOC contributes to POM. Montgomery, Berks and Bucks counties have the next

[101] *See*, Seinfeld J. H. and Pandis S. N. (2006) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 2nd edition, J. Wiley, New York. See also, Seinfeld J. H. and Pandis S. N. (1998) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 1st edition, J. Wiley, New York.

[102] USEPA Report (2004), The Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003, found at: *http://www.epa.gov/airtrends/aqtrnd04/pm.html*.

highest emissions. As discussed in Factors 3 and 4 below, topography and wind direction indicate that Montgomery, Berks and Bucks counties are less likely to contribute to the Northampton County violating monitor. Among the five counties bordering Northampton, Bucks and Lehigh Co. PA have the highest emissions of most of the listed pollutants. Lehigh County has high levels of NO_x and VOC. It is also worth noting that the violating monitor is near the border with Lehigh County.

Table 3b. County-Level Emissions for Components of Directly Emitted $PM_{2.5}$ (tpy) [103]

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Berks, PA	1,764	436	132	15	474	785	3,606
Montgomery, PA	1,740	439	99	6	415	639	3,338
Northampton, PA	1,176	354	170	31	581	718	3,031
Bucks, PA	1,253	403	78	8	315	416	2,474
Lehigh, PA	1,208	247	57	5	196	368	2,081
Luzerne, PA	1,161	252	39	4	149	200	1,804
Schuylkill, PA	750	170	44	4	159	284	1,409
Monroe, PA	785	176	20	3	49	131	1,164
Morris, NJ	733	208	19	4	66	134	1,164
Carbon, PA	352	64	14	1	30	92	553
Warren, NJ	326	74	8	1	30	68	508
Hunterdon, NJ	229	97	7	1	33	56	423
Sussex, NJ	235	61	8	1	26	54	385

Table 3b breaks down the direct $PM_{2.5}$ emissions value from Table 3a into its components. These data will also be compared with the previously presented Urban Increment composition. Table 3b shows that organic mass is the largest component of direct $PM_{2.5}$ emissions in the area of analysis and organic mass is a significant component of the urban increment. Northampton and Lehigh counties both have high amounts of organic mass. As previously mentioned, and further discussed in Factors 3 and 4, Montgomery, Berks and Bucks counties are less likely to contribute to the Northampton County violating monitor due to wind direction and topography. Luzerne County is also less likely to contribute to the Northampton County violating monitor as a result of the topography.

Using the previously described relationship between directly emitted and precursor gases and the measured mass to evaluate data presented in Tables 3a and 3b, EPA identified the following components warranting additional review: organic mass, elemental carbon, crustal material and VOC. EPA then looked at the contribution of these components of interest from each of the counties included in the area of analysis as shown in Tables 4a-d.

[103] Data are based on the 2011 and 2018 Emissions Modeling Platform Data Files and Summaries (*ftp://ftp.epa.gov/EmisInventory/2011v6/v1platform*) available at: *http://www.epa.gov/ttn/chief/emch/index.html#2011* (accessed 02/26/14).

Table 4a. County-Level POM Emissions

County, State	Emissions in average tons/yr		
	POM	Pct.	Cumulative %
Berks, PA	1,764	15%	15%
Montgomery, PA	1,740	15%	30%
Bucks, PA	1,253	11%	51%
Lehigh, PA	1,208	10%	61%
Northampton, PA	1,176	10%	40%
Luzerne, PA	1,161	10%	71%
Monroe, PA	785	7%	84%
Schuylkill, PA	750	6%	77%
Morris, NJ	733	6%	90%
Carbon, PA	352	3%	93%
Warren, NJ	326	3%	96%
Hunterdon, NJ	229	2%	98%
Sussex, NJ	235	2%	100%

Table 4b. County-Level EC Emissions

County, State	Emissions in average tons/yr		
	EC	Pct.	Cumulative %
Montgomery, PA	439	15%	15%
Berks, PA	436	15%	29%
Bucks, PA	403	14%	43%
Northampton, PA	354	12%	55%
Luzerne, PA	252	8%	63%
Lehigh, PA	247	8%	72%
Morris, NJ	208	7%	84%
Monroe, PA	176	6%	77%
Schuylkill, PA	170	6%	90%
Hunterdon, NJ	97	3%	93%
Warren, NJ	74	2%	96%
Carbon, PA	64	2%	98%
Sussex, NJ	61	2%	100%

Table 4c. County-Level Pcrustal Emissions

County	Emissions in average tons/yr		
	Pcrustal	Pct.	Cumulative %
Northampton, PA	581	23%	23%
Berks, PA	474	19%	42%
Montgomery, PA	415	16%	58%
Bucks, PA	315	12%	71%
Lehigh, PA	196	8%	79%
Schuylkill, PA	159	6%	85%

County	Emissions in average tons/yr		
	Pcrustal	Pct.	Cumulative %
Luzerne, PA	149	6%	91%
Morris, NJ	66	3%	93%
Monroe, PA	49	2%	95%
Hunterdon, NJ	33	1%	97%
Carbon, PA	30	1%	98%
Warren, NJ	30	1%	99%
Sussex, NJ	26	1%	100%

Table 4d. County-Level VOC Emissions

County	Emissions in average tons/yr		
	VOC	Pct.	Cumulative %
Montgomery, PA	18,975	18%	18%
Bucks, PA	15,325	14%	32%
Berks, PA	12,734	12%	44%
Morris, NJ	10,466	10%	53%
Lehigh, PA	9,649	9%	62%
Luzerne, PA	9,350	9%	71%
Northampton, PA	7,469	7%	78%
Monroe, PA	6,003	6%	83%
Schuylkill, PA	5,935	6%	89%
Sussex, NJ	3,448	3%	92%
Hunterdon, NJ	3,020	3%	95%
Warren, NJ	2,918	3%	98%
Carbon, PA	2,490	2%	100%

In Figure 4a, the emissions of organic mass appear somewhat evenly distributed between the top six contributing counties (totaling ~71%). Lehigh County and Northampton County are among the top six counties and contribute similar amounts of the total organic mass component of direct $PM_{2.5}$. As discussed in Factors 3 and 4 below, topography and wind direction indicate that Montgomery, Berks and Bucks counties are less likely to contribute to the Northampton County violating monitor. As seen in Figure 4c, Northampton County contributes the largest amount of the crustal matter component of direct $PM_{2.5}$. In Figure 4d, Lehigh County contributes more VOC than Northampton County. As discussed above, VOCs contribute to $PM_{2.5}$ organic mass and organic mass is a main component of the urban increment at the Northampton County violating monitor. As mentioned, Montgomery, Berks and Bucks, PA are less likely to contribute to the Northampton County monitor due to wind direction and topography. Morris, NJ is also not in the regional wind direction thus less likely to contribute to the Northampton County violating monitor.

In addition to reviewing county-wide emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors in the area of analysis, EPA also reviewed emissions from major point sources located in the area of analysis. The magnitude and location of these sources can help inform nonattainment boundaries. Table 5 provides facility-level

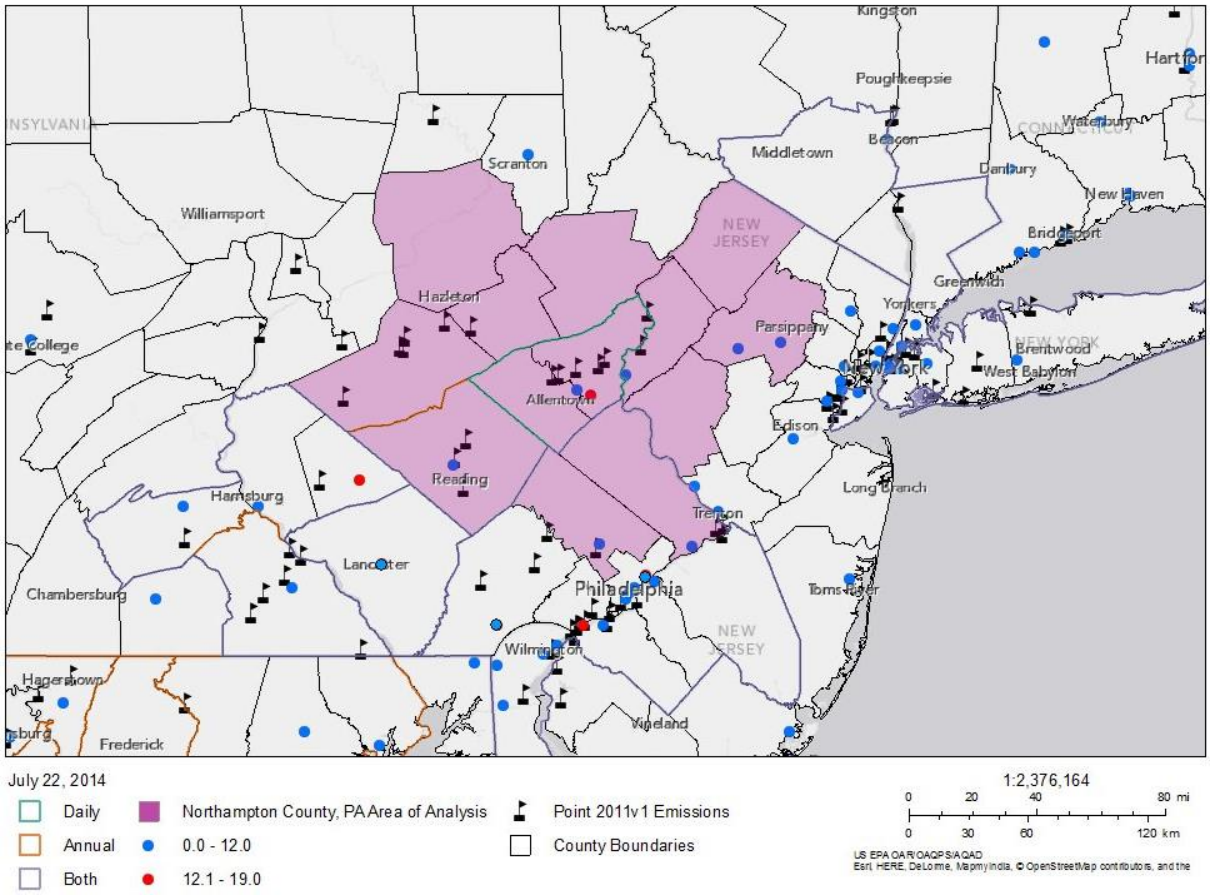
emissions of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants (given in tons per year) from major point sources located in the area of analysis for the Allentown Area. Table 5 also shows the distance from the facility to the Northampton County violating monitor.

Table 5. NEI 2011 v1 Point Source Emissions (tpy)

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NOx	$PM_{2.5}$	SO_2	VOC	Total
Northampton, PA	Keystone Portland Cement/East Allen (420950012)	7	2	828	57	984	7	1,878
Northampton, PA	Essroc/Nazareth Lower Cement Plt 1 (420950045)	7	68	1,804	522	722	62	3,177
Northampton, PA	Northampton Gen Co/Northampton (420950536)	9	2	441	44	546	2	1,034
Northampton, PA	Hercules Cement Co Lp/Stockertown (420950006)	9	3	989	29	1,420	20	2,462
Lehigh, PA	Lafarge Corp/Whitehall Plt (420770019)	10	14	368	36	331	7	754
Northampton, PA	Ppl Martins Creek Llc/Martins Creek (420950010)	17	13	943	37	274	30	1,297
Northampton, PA	Genon Rema Llc/Portland Generating Sta (420950011)	24	0	1,977	67	15,148	14	17,206
Berks, PA	Lehigh Cement Co Llc/Evansville Cement Plt & Quarry (420110039)	31	41	1,225	134	200	12	1,611
Carbon, PA	Panther Creek Partners/Nesquehoning Plt (420250023)	32	1	551	16	571	4	1,143
Berks, PA	Cryovac Inc/Cryovac Rigid Packaging (420110093)	35			0		556	556
Montgomery, PA	Covanta Plymouth Renewable Energy/ Plymouth (420910295)	37	1	735	8	25	2	771
Berks, PA	Genon Rema Llc/Titus Gen Sta (420110045)	37	0	683	43	4,087	5	4,818
Schuylkill, PA	Northeastern Power Co/Mcadoo Cogen (421070054)	38	0	104	16	706	20	846
Bucks, PA	Wheelabrator Falls Inc/Falls Twp (420170469)	44	3	731	9	122	2	867
Schuylkill, PA	Wheelabrator Frackville/Morea Plt (421070022)	45	0	443	19	468	9	938
Schuylkill, PA	Schuylkill Energy Res/St Nicholas Cogen (421070024)	46	1	273	27	1,883	25	2,208
Bucks, PA	Fairless Energy Llc/Falls Twp (420170131)	46	170	201	196	18	25	609
Schuylkill, PA	Gilberton Power Co/John B Rich Mem Power Sta (421070025)	46	0	211	39	1,314	28	1,591
Schuylkill, PA	Wps Westwood Gen Llc/Gen Sta (421070023)	58	0	220	5	268	13	506

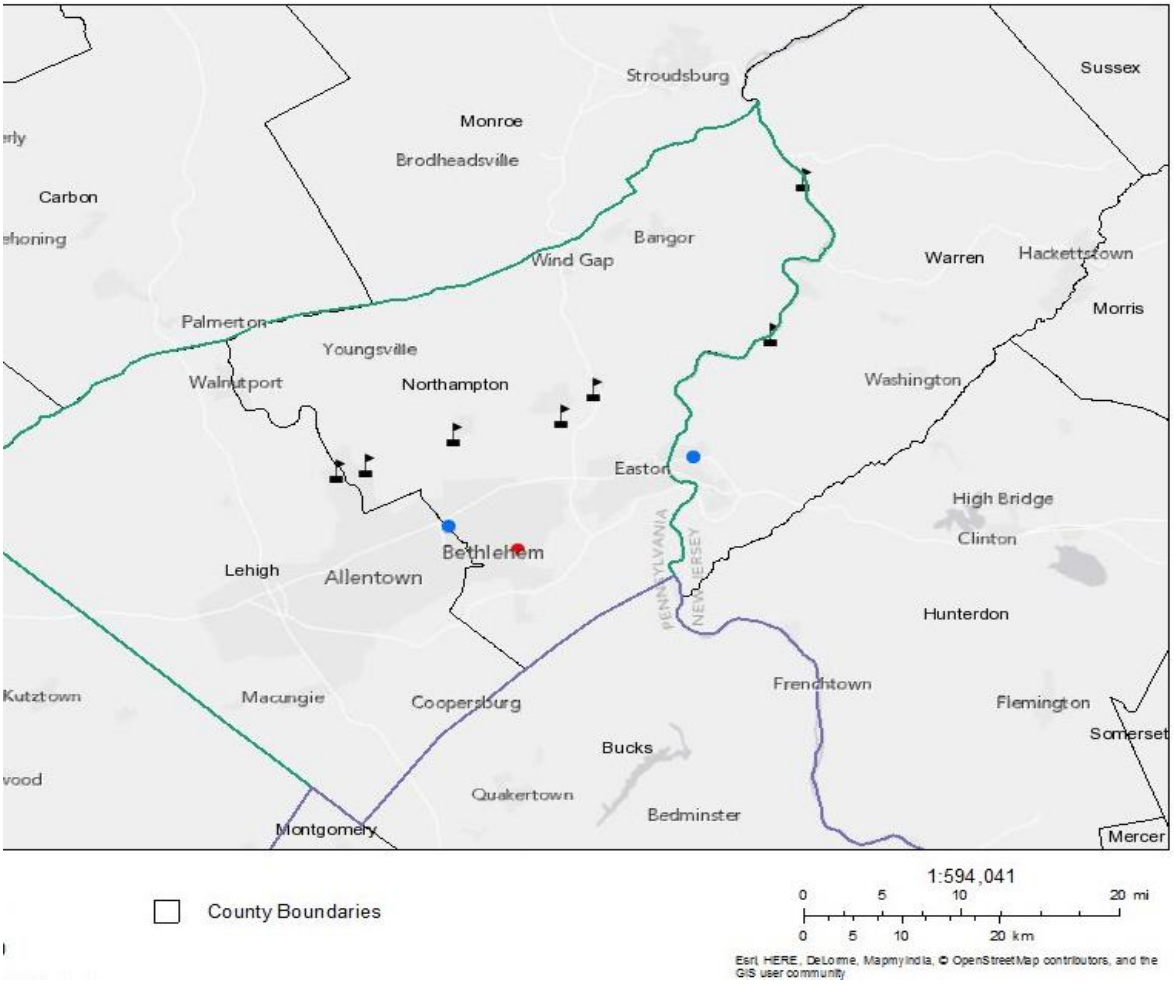
Figure 5a shows the major point source emissions (from the 2011 NEI in tons per year) in the area of analysis for the Allentown Area and the relative distances of these sources from the violating monitoring location, as depicted by a red dot. The actual distance from the point sources to the DV monitoring location is presented in Table 5. The distance from the violating monitoring location is particularly important for directly emitted $PM_{2.5}$. The influence of directly emitted $PM_{2.5}$ on ambient $PM_{2.5}$ diminishes more than that of gaseous precursors as a function of distance.[104] Figure 5b illustrates the location of major point sources listed in Table 5 which are near the Northampton County violating monitor.

Figure 5a. Major Point Source Emissions in the Area of Analysis for the Allentown Area



[104] Baker, K. R. and K. M. Foley. *A nonlinear regression model estimating single source concentrations of primary and secondarily formed $PM_{2.5}$.* Atmospheric Environment. 45 (2011) 3758-3767.

Figure 5b. Close up of Major Point Sources Near the Northampton County violating monitor

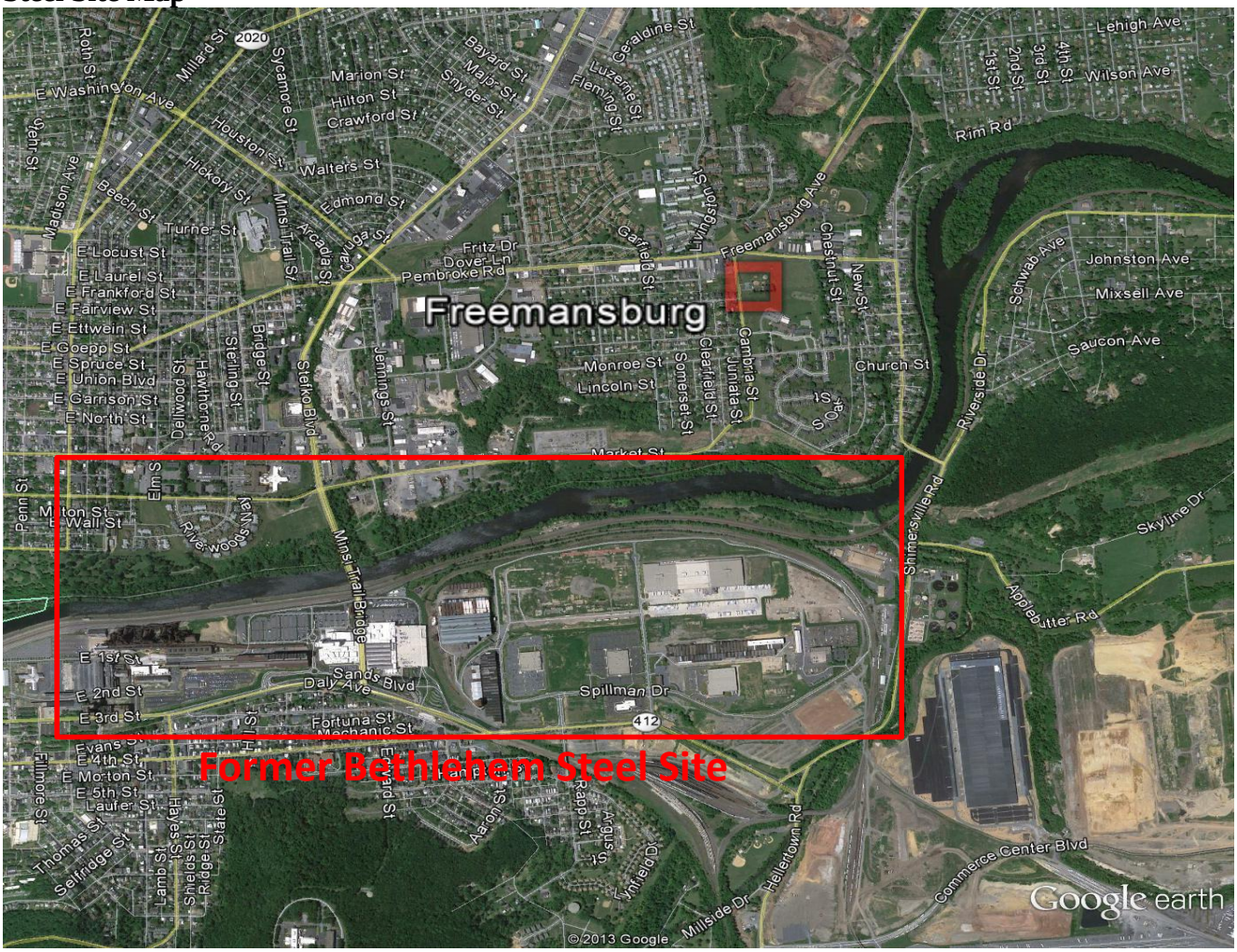


As indicated in Figures 5a and 5b, there are nineteen sources with emissions over 500 tpy within the area of analysis. Seven of these large point sources are located north and northeast of the Northampton County violating monitor. Eight point sources are further west and southwest of the Northampton County violating monitor. Mountains run between the sources which are further west in Schuylkill County and the violating monitor. No major point sources exist south of the monitor in the area of analysis except the Covanta facility in southern Montgomery County. The Covanta facility is relatively low in emissions and, as discussed in Factors 3 and 4, emissions from Montgomery County are not in the regional wind direction and are limited by hills to the south of the monitor. Pennsylvania provided additional information in its December 2013 designation recommendation regarding local influences of $PM_{2.5}$ Below is an excerpt from Pennsylvania's December 2013 recommendation letter, Appendix C-2 Northampton County Area. Figure 5c below was provided in support of the following excerpt. In this excerpt the Northampton County violating monitor is referred to as the Freemansburg monitor.

> "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 5c. Northampton County Monitor (Freemansburg) Location and Former Bethlehem Steel Site Map



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

Population density and degree of urbanization

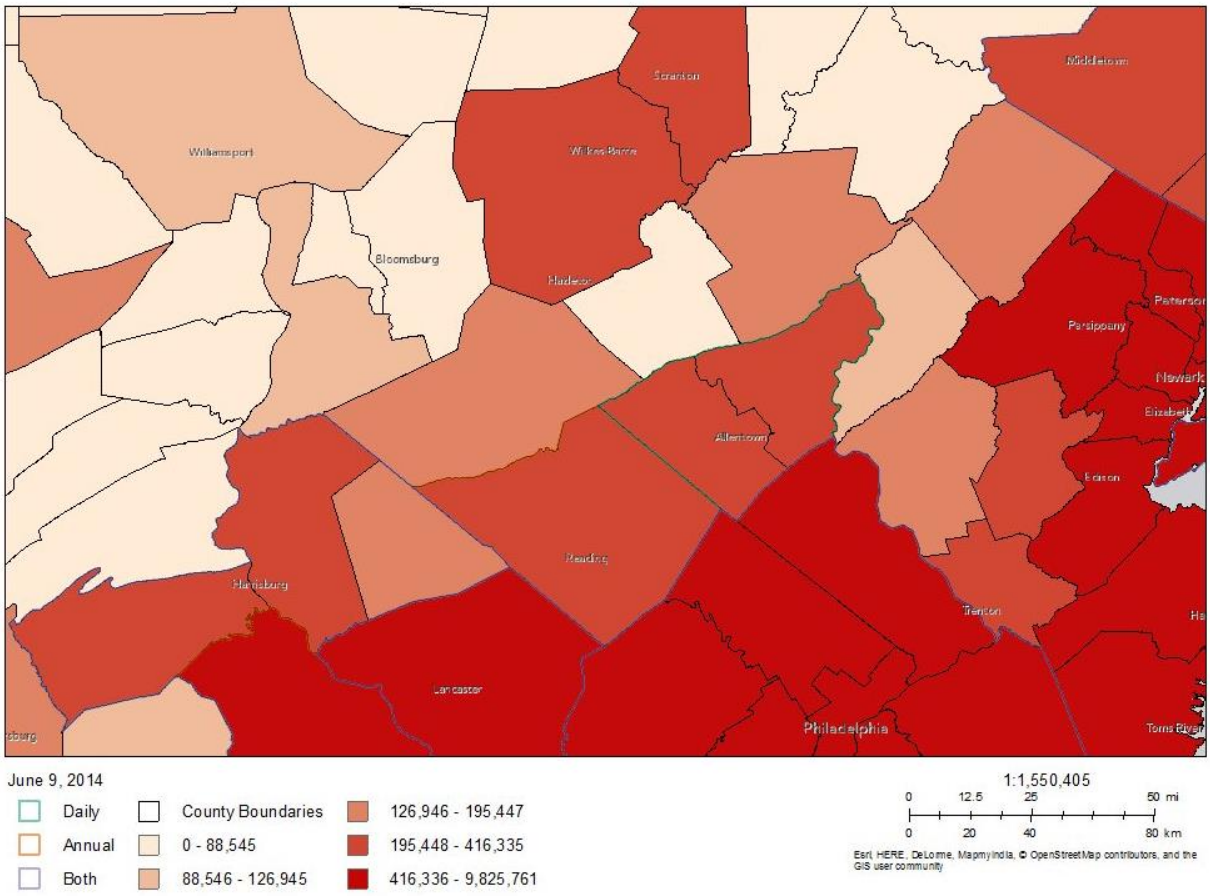
In this part of the five factor analysis, EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. Rapid population growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that it may be appropriate to include the county associated with area source and mobile source emissions as part of the nonattainment area. Table 6 shows the 2000 and 2010 population, population growth since 2000, and population density for each county in the area of analysis.

Table 6. Population Growth and Population Density.

County, State	Population 2000	Population 2010	% Change from 2000	Land Area (square miles)	Population Density (per square mile)	% of Area of Analysis	Cumulative %
Montgomery, PA	750,097	801,134	6.8%	483	1,658	20%	20%
Bucks, PA	597,635	625,505	4.7%	607	1,030	15%	35%
Morris, NJ	470,212	492,899	4.8%	469	1,051	12%	47%
Berks, PA	373,638	411,791	10.2%	859	479	10%	57%
Lehigh, PA	312,090	350,093	12.2%	347	1,010	9%	66%
Luzerne, PA	319,250	320,925	0.5%	891	360	8%	74%
Northampton, PA	267,066	298,065	11.6%	374	797	7%	81%
Monroe, PA	138,687	169,981	22.6%	609	279	4%	85%
Sussex, NJ	144,166	149,221	3.5%	521	286	4%	89%
Schuylkill, PA	150,336	148,199	-1.4%	778	190	4%	93%
Hunterdon, NJ	121,989	128,357	5.2%	430	299	3%	96%
Warren, NJ	102,437	108,693	6.1%	358	304	3%	98%
Carbon, PA	58,802	65,204	10.9%	381	171	2%	100%
Total	**3,806,405**	**4,070,067**					

Source: U.S. Census Bureau population estimates for 2000 and 2010

Figure 6. 2010 County-Level Population in the Area of Analysis for the Allentown Area.



As Table 6 illustrates, Montgomery County has the largest and most dense population than the other counties in the area of analysis. As previously mentioned, Montgomery County emissions are less likely to contribute to the Northampton County violating monitor due to topography and regional wind direction. Northampton County has a moderately sized population, which has increased by 11.6% during 2000 to 2010. Northampton County ranks seventh in population and fifth in population density in the thirteen county area of analysis. Lehigh County has a similar sized population and population density as Northampton County. Lehigh County ranks fifth in population and fourth in population density in the thirteen county area of analysis. A majority of the population in Northampton and Lehigh counties are in the cities of Allentown, Bethlehem and Easton which span the county borders and are located in the Lehigh River Valley.

Traffic and Vehicle Miles Travelled

High VMT and/or a high number of commuters associated with a county is generally an indicator that the county is an integral part of an urban area. Mobile source emissions of NO_x, VOC, and direct PM may contribute to ambient particulate matter that contributes to monitored violations of the NAAQS in the area. In combination with the population/population density data and the location of main transportation arteries, an assessment of VMT helps identify the probable location of nonpoint source

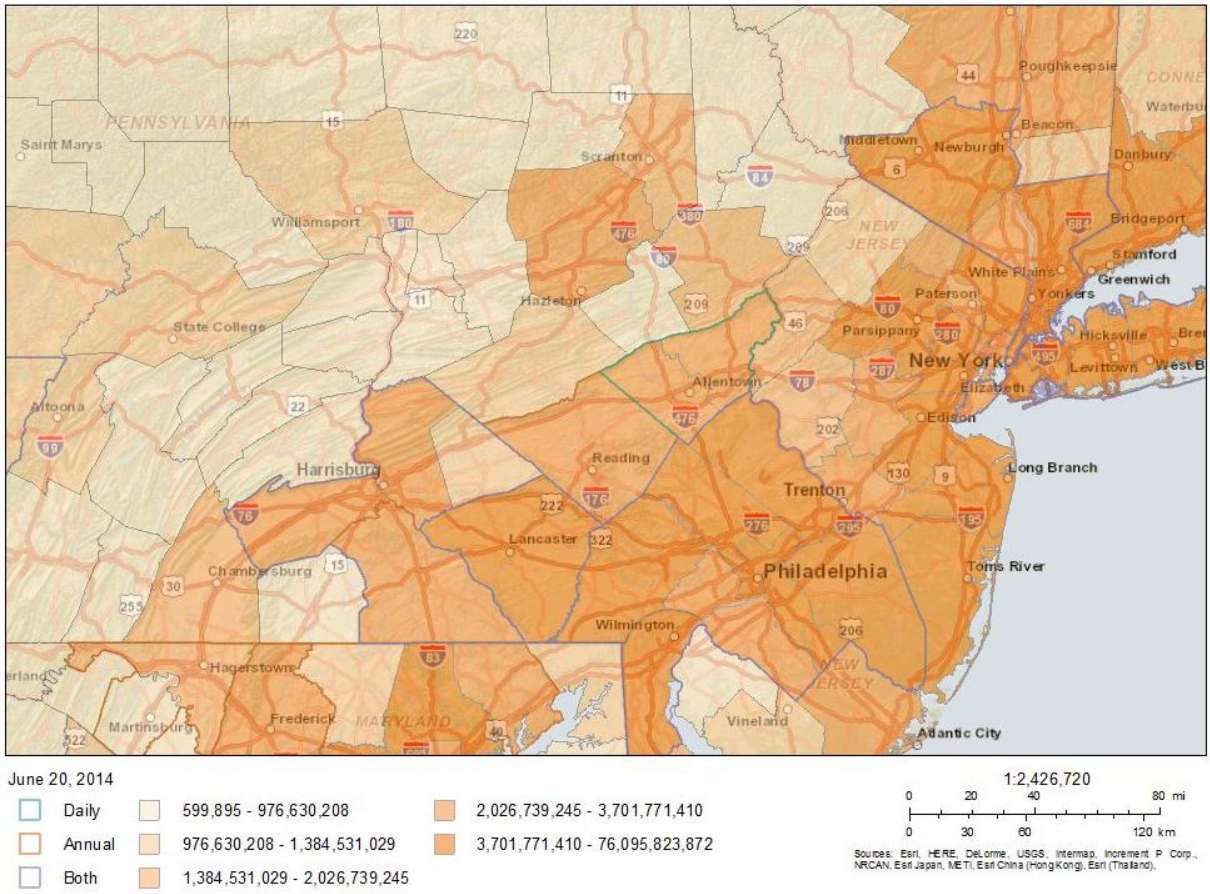
emissions that contribute to violations in the area. Comparatively high VMT in a county outside of the CBSA or CSA signifies integration with the core urban area contained within the CSA or CBSA, and indicates that a county with the high VMT may be appropriate to include in the nonattainment area because emissions from mobile sources in that county contribute to violations in the area. Table 7 shows 2011 VMT while Figure 7 overlays 2011 county-level VMT with a map of the transportation arteries. This VMT data was obtained from the Federal Highway Administration.

Table 7. 2011 VMT for the Allentown Area.

County, State	Total 2011 VMT	Percent	Cumulative %
Montgomery, PA	6,505,446,421	18%	18%
Morris, NJ	5,419,112,025	15%	33%
Bucks, PA	4,727,709,143	13%	46%
Berks, PA	3,381,679,887	9%	56%
Lehigh, PA	2,988,094,564	8%	64%
Luzerne, PA	2,769,808,578	8%	72%
Northampton, PA	2,046,097,907	6%	77%
Hunterdon, NJ	1,828,353,779	5%	82%
Monroe, PA	1,664,133,702	5%	87%
Warren, NJ	1,387,779,166	4%	91%
Schuylkill, PA	1,373,853,518	4%	95%
Sussex, NJ	1,182,572,750	3%	98%
Carbon, PA	772,100,374	2%	100%
Total	36,046,741,815		

http://www.census.gov/hhes/commuting/data/commuting.html

Figure 7. Overlay of 2011 County-level VMT with Transportation Arteries.



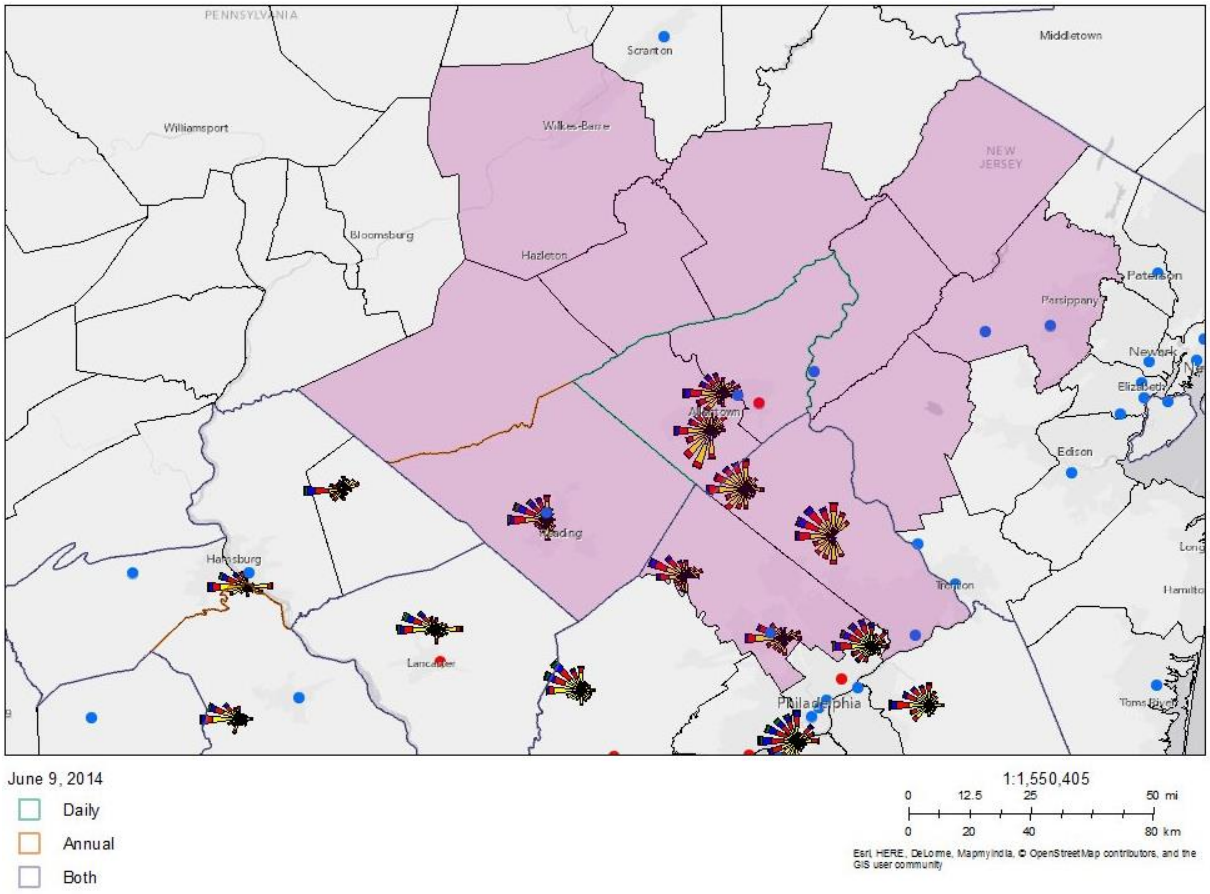
As Table 7 and Figure 7 illustrate, VMT varies within the area of analysis. For vehicle miles traveled, Lehigh County ranks fifth and Northampton County ranks seventh out of the thirteen counties in the area of analysis. The population in Allentown, Bethlehem and Easton and the two interstates that run east to west across these two counties most likely contribute to the emissions impacting the violating monitors. Montgomery County has the most VMT, which is approximately three times higher than the VMT in Northampton County. As previously mentioned, Montgomery County emissions most likely do not contribute to the Northampton County violating monitor due to topography and regional wind direction.

Factor 3: Meteorology

EPA evaluated available meteorological data to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of directly emitted particulate matter and precursor emissions from sources in the area of analysis. EPA used two primary tools for this assessment: wind roses and kernel density estimation (KDE). When considered in combination with area $PM_{2.5}$ composition and county-level and facility emissions source location information, wind roses and KDE can help to identify nearby areas contributing to violations at violating monitoring sites.

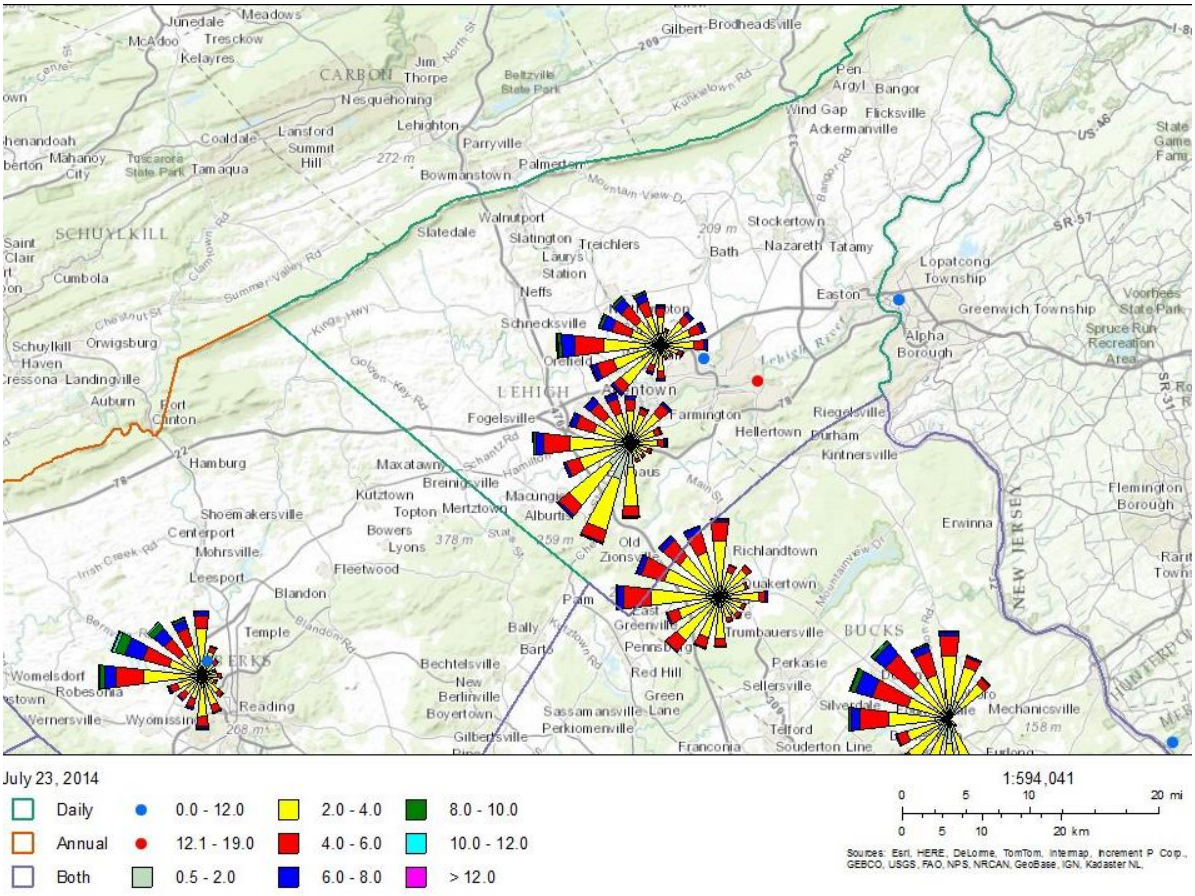
Wind roses are graphic illustrations of the frequency of wind direction and wind speed. Wind direction can indicate the direction from which contributing emissions are transported; wind speed can indicate the force of the wind and thus the distance from which those emissions are transported. EPA constructed wind roses from hourly observations of wind direction and wind speed using 2009-2012 data from National Weather Service locations archived at the National Climate Data Center.[105] When developing these wind roses, EPA also used wind observations collected at meteorological sampling stations collocated at air quality monitoring sites, where these data were available. Figure 8 shows wind roses that EPA generated from data relevant in the Northampton County Area.

Figure 8a. Wind Roses in the Area of Analysis for Allentown Area.



[105] *ftp.ncdc.noaa.gov/pub/data/noaa* or *http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=cdo&theme=hourly&layers=1&node=gis* Quality assurance of the National Weather Service data is described here: *http://www1.ncdc.noaa.gov/pub/data/inventories/ish-qc.pdf*

Figure 8b. Close up of Wind Roses for Allentown Area

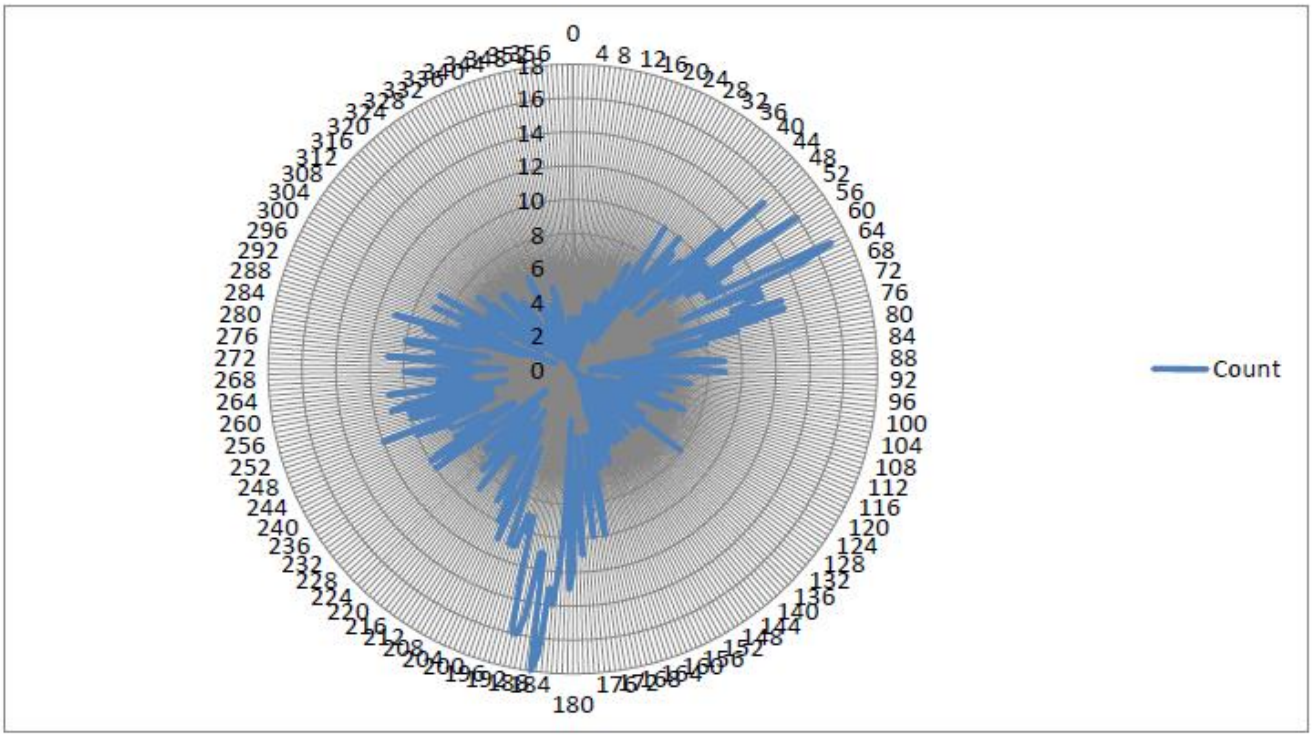


As shown in Figures 8a and 8b, the predominant winds near the Northampton County violating monitor are from the west and the southwest, with some northwesterly, and northeasterly components. These wind roses represent average wind directions throughout the year. Lehigh County is to the west and southwest of the violating monitor and is situated in the Lehigh River Valley with Northampton County. Lehigh County emissions are high in POM which is a main component of the urban increment at the Northampton County violating monitor. As seen in Figures 5a and 5b, there are major point sources in Northampton County to the northwest and northeast of the Northampton County violating monitor. Montgomery and Bucks counties are to the south and southeast of the Northampton County violating monitor which is not in the regional wind direction. Berks County is further southwest of the monitor and emissions are less likely to contribute to the Northampton violating monitor due to hills running between the emission sources and the monitor (see Factor 4).

In its December 2013 recommendation letter, Pennsylvania included wind direction analysis at high $PM_{2.5}$ days at the Northampton County violating monitor. As stated previously, Pennsylvania identified 344 days in the 2010 to 2012 monitoring period where $PM_{2.5}$ at the Northampton County violating monitor was at least one standard deviation above the Allentown-Bethlehem-Easton MSA regional average (high days). The top 25% (highest $PM_{2.5}$ days) were further analyzed to determine why the Northampton County violating monitor's concentrations were high. The Northampton County violating monitor is collocated with a meteorological tower which monitors wind direction and

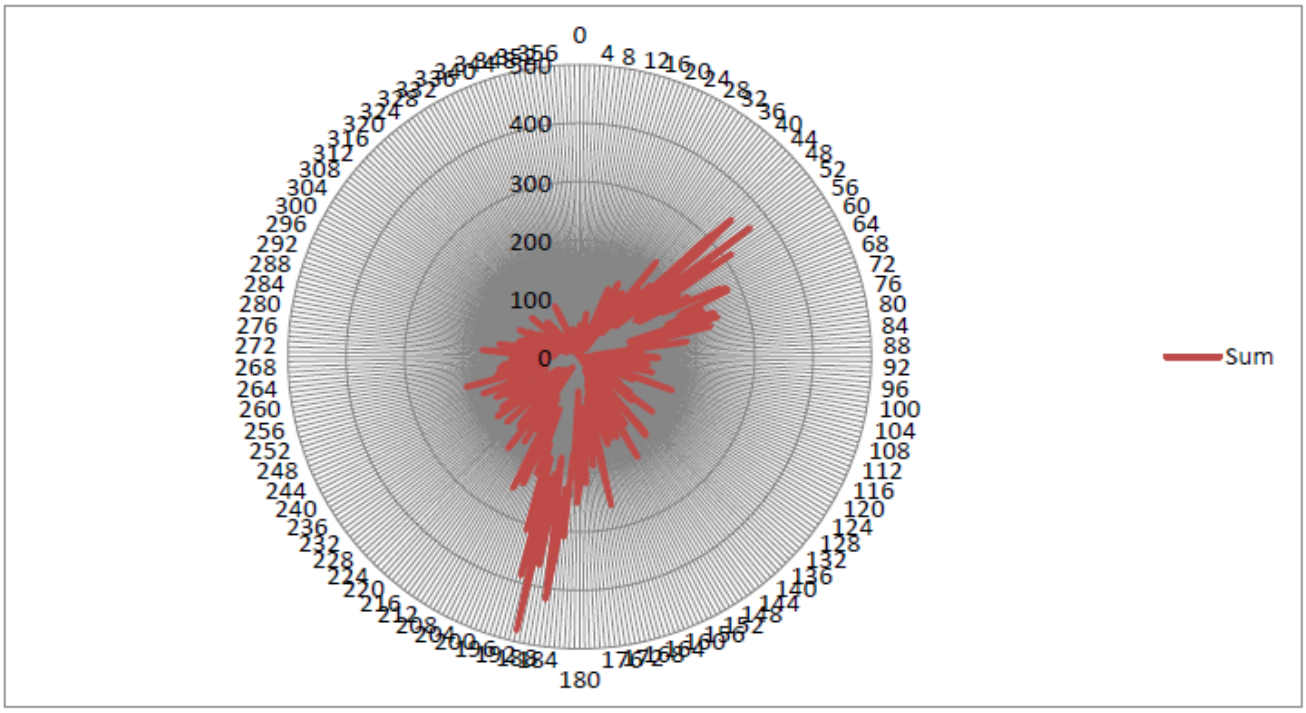
wind speed. For the highest $PM_{2.5}$ days, Pennsylvania calculated the number of hours the wind was coming from a particular direction as well as the concentrations from a particular direction. Figures 8c and 8d represent the wind direction frequency and concentration distribution by wind direction, respectively, at the Northampton County violating monitor during its highest $PM_{2.5}$ days.

Figure 8c. Northampton County Monitor Wind Direction Frequency – Top 25% of Regionally "Clean" Days



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

Figure 8d. Northampton County Monitor $PM_{2.5}$ Concentration Distribution by Wind Direction – Top 25% of Regionally "Clean" Days



Source: Pennsylvania's December 10, 2013 recommendation letter, Appendix C-2 - Northampton County Area

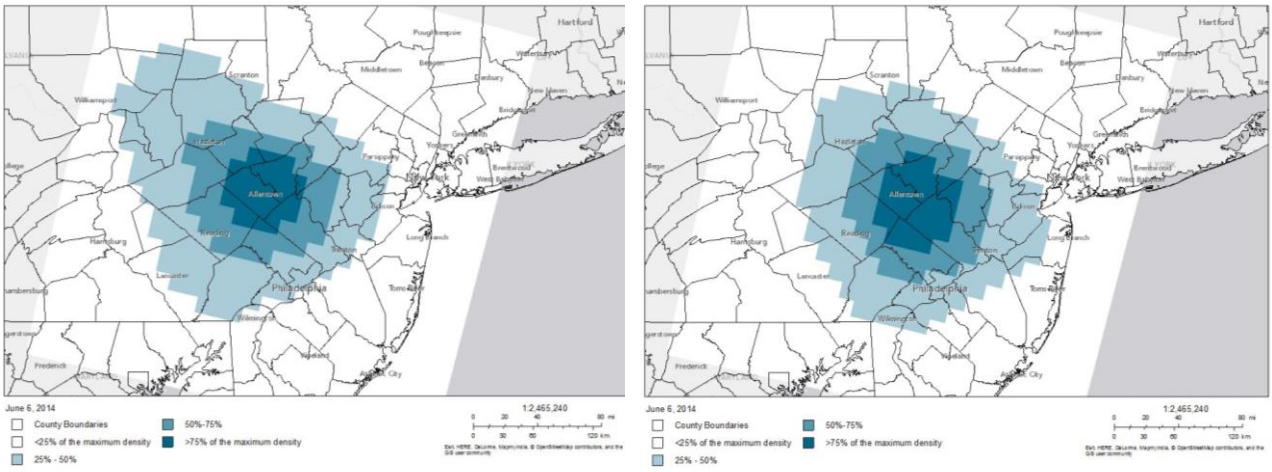
As can be seen in Figure 8c, wind directions on highest $PM_{2.5}$ days at the Northampton County violating monitor are coming predominantly from due south and the northeast. The high $PM_{2.5}$ concentrations in Figure 8d follow the same pattern. This is slightly different from the regional wind directions shown in Figures 8a and 8b which are predominantly from the west and from the southwest with northwesterly and northeasterly components. As discussed above, Table 5 and Figures 5a and 5b list and illustrate the major point sources located in the area of analysis. There are several point sources to the northeast of the violating monitor in Lehigh River Valley corresponding to the wind direction on highest $PM_{2.5}$ days, however, there are not any major point sources of $PM_{2.5}$ to the south likely to contribute to the Northampton County violating monitor. Figure 5c illustrates that the former Bethlehem Steel site is located south and southwest of the Northampton County violating monitor. As Pennsylvania suggested in its December 2013 recommendation letter, heavy construction just south of the monitor at the former Bethlehem Steel Site likely contributed to the high concentration of $PM_{2.5}$ at this monitor.

In addition to wind roses, EPA also generated kernel density estimation (KDE) plots to represent HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) backward trajectory frequency at

violating monitoring sites.[106,107] These KDEs are graphical statistical estimations to determine the density of trajectory endpoints at a particular location represented by a grid cell. The EPA used KDEs to characterize and analyze the collection of individual HYSPLIT backward trajectories.[108] Higher density values, indicated by darker blue colors, indicate a greater frequency of observed trajectory endpoints within a particular grid cell. Figure 9 shows a HYSPLIT KDE plot for the Northampton County Area summarized by calendar quarter for the 2010-2012 period. The HYSPLIT KDE is weighted in the southwesterly direction, indicating a greater frequency of trajectories passing over grid cells to the southwest. Lehigh County is southwest of the violating monitor. Lehigh County and Northampton County fall within the higher density values indicated by darker blue color in all four quarters. The higher density values indicate a greater frequency of observed trajectory endpoints within a particular grid cell. The higher density grid cells do cover the edges of Montgomery, Bucks and Berks counties at times, however as discussed below in Factor 4, hills between the monitor and the emissions in these counties most likely prevent contribution to the Northampton County violating monitor.

Figure 9. HYSPLIT Kernel Density Estimation Plots for the Allentown Area.

First Quarter **Second Quarter**

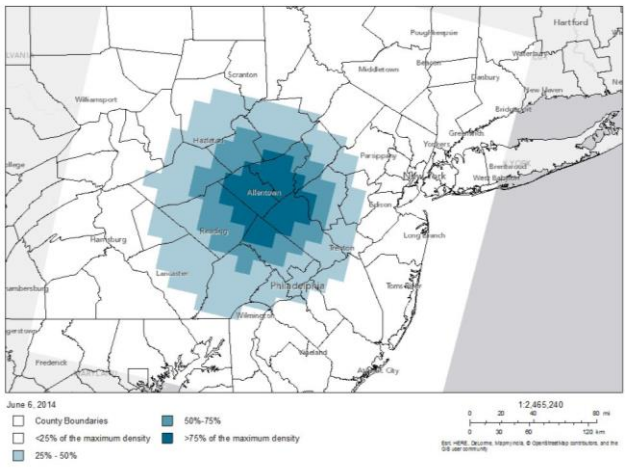


[106] In some past initial area designations efforts, EPA has used HYSPLIT backward trajectories to assist in determining nonattainment area boundaries. A HYSPLIT backward trajectory is usually depicted on a standard map as a single line, representing the centerline of an air parcel's motion, extending in two dimensional (x,y) space from a starting point and regressing backward in time to a point of origin. Backward trajectories may be an appropriate tool to assist in determining an air parcel's point of origin on a day in which a short-term standard, such as an 8-hour standard or a 24-hour standard, was exceeded. However, for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, every trajectory on every day is important. Plotting a mass of individual daily (e.g., 365 individual back trajectories), or more frequent, HYSPLIT trajectories may not be helpful as this process is likely to result in depicting air parcels originating in all directions from the violating monitoring site.

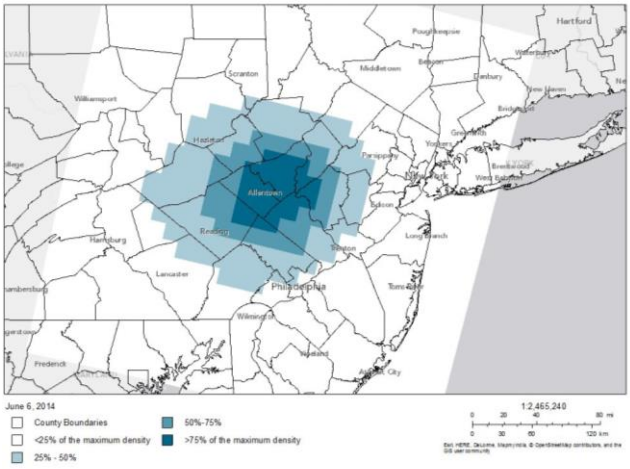
[107] HYSPLIT - Hybrid Single Particle Lagrangian Integrated Trajectory Model, *http://www.arl.noaa.gov/HYSPLIT_info.php*

[108] The KDEs graphically represent the aggregate of HYSPLIT backward trajectories for the years 2010-2012, run every third day (beginning on the first day of monitoring), four times each day, and ending at four endpoint heights.

Third Quarter



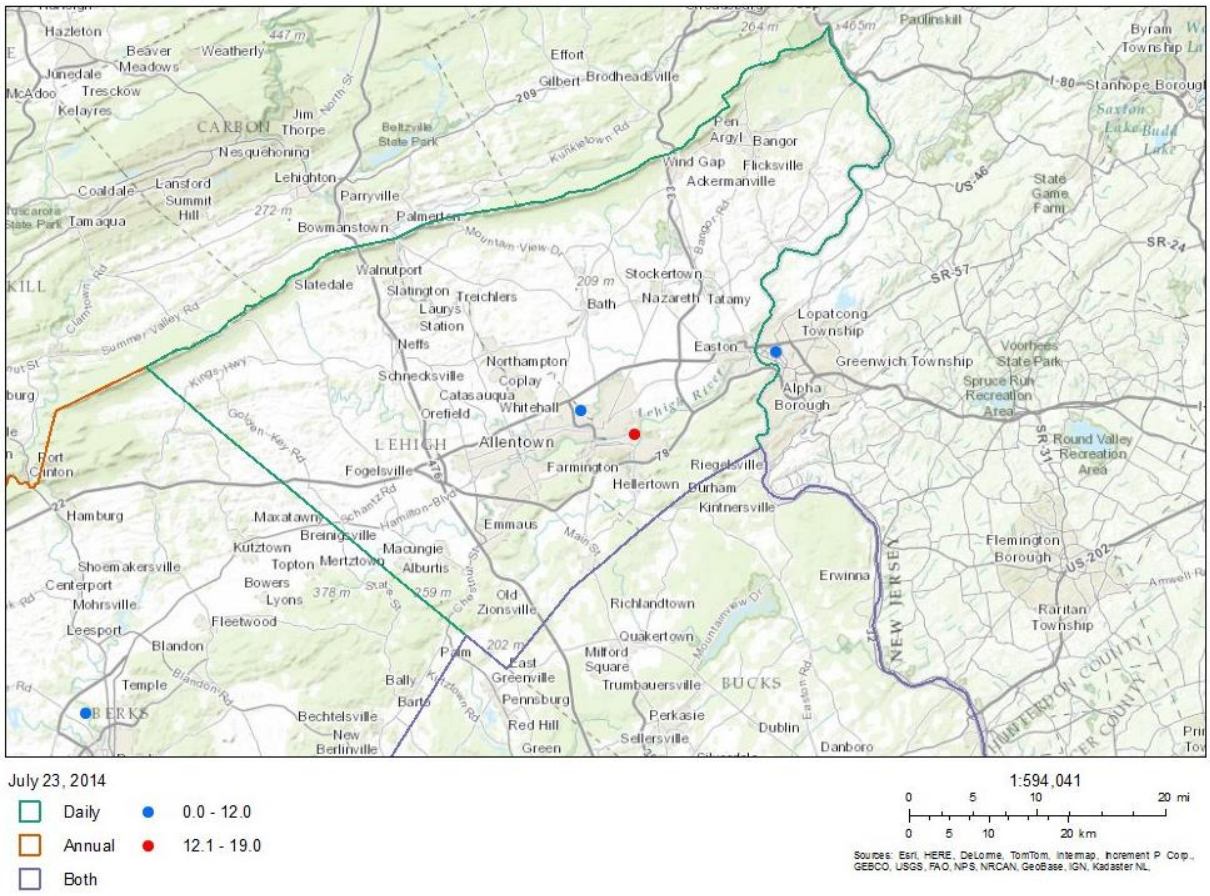
Fourth Quarter



Factor 4: Geography/topography

To evaluate the geography/topography factor, EPA assessed physical features of the area of analysis that might define the airshed and thus affect the formation and distribution of $PM_{2.5}$ concentrations over the area. As seen in Figure 10, the mountain range north of the Northampton County violating monitor runs southwest to northeast and lower hills to the south of the violating monitor also run southwest to northeast. This mountain range provides a physical barrier between Monroe, Carbon and Schuylkill counties and the Northampton County violating monitor. The hills to the south of the violating monitor provide a barrier between this monitor and emissions in Berks, Montgomery, and Bucks counties. The Lehigh River Valley runs between these mountains and hills and connects Lehigh and Northampton counties. A majority of the population and VMT in Northampton and Lehigh counties are in the cities of Allentown, Bethlehem and Easton which are located in the Lehigh River Valley. EPA believes that these topographical barriers significantly affect the formation and distribution of $PM_{2.5}$ concentrations in the area of analysis.

Figure 10. Topography for the Allentown Area



Factor 5: Jurisdictional boundaries

In defining the boundaries of the intended Northampton County nonattainment area, EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Existing jurisdictional boundaries often signify state and local governmental organization with the necessary legal authority for carrying out air quality planning and enforcement functions for the intended area. Examples of such jurisdictional boundaries include existing/prior nonattainment area boundaries for particulate matter, county lines, air district boundaries, township boundaries, areas covered by a metropolitan planning organization, state lines, and Reservation boundaries, if applicable. Where existing jurisdictional boundaries were not adequate or appropriate to describe the nonattainment area, EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

The violating monitor is located in Northampton County, PA, which is located in the Allentown-Bethlehem-Easton MSA. The Allentown-Bethlehem-Easton MSA includes Northampton County, PA as well as Carbon County and Lehigh County in Pennsylvania, and Warren County, New Jersey.

The Lehigh Valley Planning Commission is the MPO for Lehigh and Northampton Counties. Carbon County is part of the Northeastern Pennsylvania Alliance Rural Planning Organization. The MPO for Warren County, NJ is the North Jersey Transportation Planning Authority.

The Allentown, PA area has previously established nonattainment boundaries associated with the 2006 24-hour $PM_{2.5}$ NAAQS. The boundary for the Allentown, PA nonattainment area for the 2006 24-hour $PM_{2.5}$ NAAQS included the entire counties of Lehigh and Northampton in Pennsylvania. The state has recommended a different boundary for the 2012 annual $PM_{2.5}$ NAAQS. Pennsylvania has recommended only the single county of Northampton, PA as the intended nonattainment area for 2012 annual $PM_{2.5}$ NAAQS. EPA's analysis of the five factors supports a finding that Lehigh and Northampton counties contribute to the Northampton County violating monitor. Therefore, EPA's intended nonattainment boundaries for the 2012 annual $PM_{2.5}$ NAAQS are the same as the 2006 24-hour $PM_{2.5}$ NAAQS and include the entire counties of Lehigh County and Northampton County in Pennsylvania.

Conclusion for the Allentown Area

Based on the assessment of factors described above, both individually and in combination, EPA has preliminarily concluded that the following counties should be included as part of the Allentown nonattainment area because they are either violating the 2012 annual $PM_{2.5}$ NAAQS or contributing to a violation in a nearby area: Northampton County, PA and Lehigh County, PA. These are the same counties that are included in the Allentown, PA nonattainment area for the 2006 24-hour $PM_{2.5}$ NAAQS. The air quality monitoring site in Northampton County, PA indicates a violation of the 2012 annual $PM_{2.5}$ NAAQS based on the 2013 DVs; therefore this county is included in the nonattainment area. Lehigh County, PA is a nearby county that does not have a monitoring site, but EPA has concluded that this area contributes to the particulate matter concentrations in violation of the 2012 annual $PM_{2.5}$ NAAQS through emissions from non-point sources (e.g., area sources), and from mobile source emissions.

Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. The Northampton County violating monitor does not follow the seasonal pattern seen at the other monitors in the area of analysis.

The speciation data for the Northampton County violating monitoring site indicate that organic mass and sulfates are the predominant species overall with small amount of nitrates in the first and 4^{th} calendar quarters, which may be due to EGU emissions from winter heating needs and greater particle nitrate collection during the cooler months. When accounting for the urban increment, the sulfate component becomes less dominant, however, there is still some remaining sulfate detected at the monitor. The urban increment data clearly indicates that organic mass and elemental carbon are the main components of $PM_{2.5}$ at the Northampton County violating monitoring site. Additional speciation data provided by Pennsylvania for the top 25% of high $PM_{2.5}$ days also indicate that crustal material is a major component of $PM_{2.5}$ along with organic mass and elemental carbon. These components (organic mass, elemental carbon and crustal material) suggest that the sources of $PM_{2.5}$ at the Northampton County violating monitor are local in nature and could result from mobile, area or local industrial sources.

Montgomery, Bucks, Berks, Northampton and Lehigh counties have the highest emissions of directly emitted $PM_{2.5}$ and precursors in the thirteen county area of analysis. These same five counties also have high amounts of organic mass, crustal matter and elemental carbon components of directly emitted $PM_{2.5.}$

Northampton County and Lehigh County have similar, moderately sized population and population density. A majority of the population in Northampton and Lehigh counties are in the cities of Allentown, Bethlehem and Easton which span the county borders and are located in the Lehigh River Valley. The population in these three cities and the two interstates that run east to west across these counties most likely contribute to the emissions at the Northampton County violating monitor.

Topography is an important factor when evaluating the formation and distribution of $PM_{2.5}$ in the area of analysis. The mountain range north of the Northampton County violating monitor runs southwest to northeast and lower hills to the south of the violating monitor also run southwest to northeast. The mountain range provides a physical barrier between Monroe, Carbon and Schuylkill counties and the Northampton County violating monitor. The hills to the south of the violating monitor provide a barrier between this monitor and Berks, Montgomery and Bucks counties. The Lehigh River Valley runs between these mountains and hills and connects Lehigh and Northampton counties. These topographical barriers suggest that emissions from Lehigh County and Northampton County are most likely impacting the Northampton County violating monitor.

The wind roses representing average wind direction throughout the year indicate that the predominant winds near the violating monitor are from the west and the southwest with northwesterly and northeasterly components. Emissions from Northampton and Lehigh counties are upwind and closest to the violating monitor; therefore they are most likely to impact the violating site. The HYSPLIT KDEs also indicate that Lehigh County and Northampton County fall within the higher density values indicated by darker blue color for all four quarters. The higher density values indicate a greater frequency of observed trajectory endpoints within a particular grid cell.

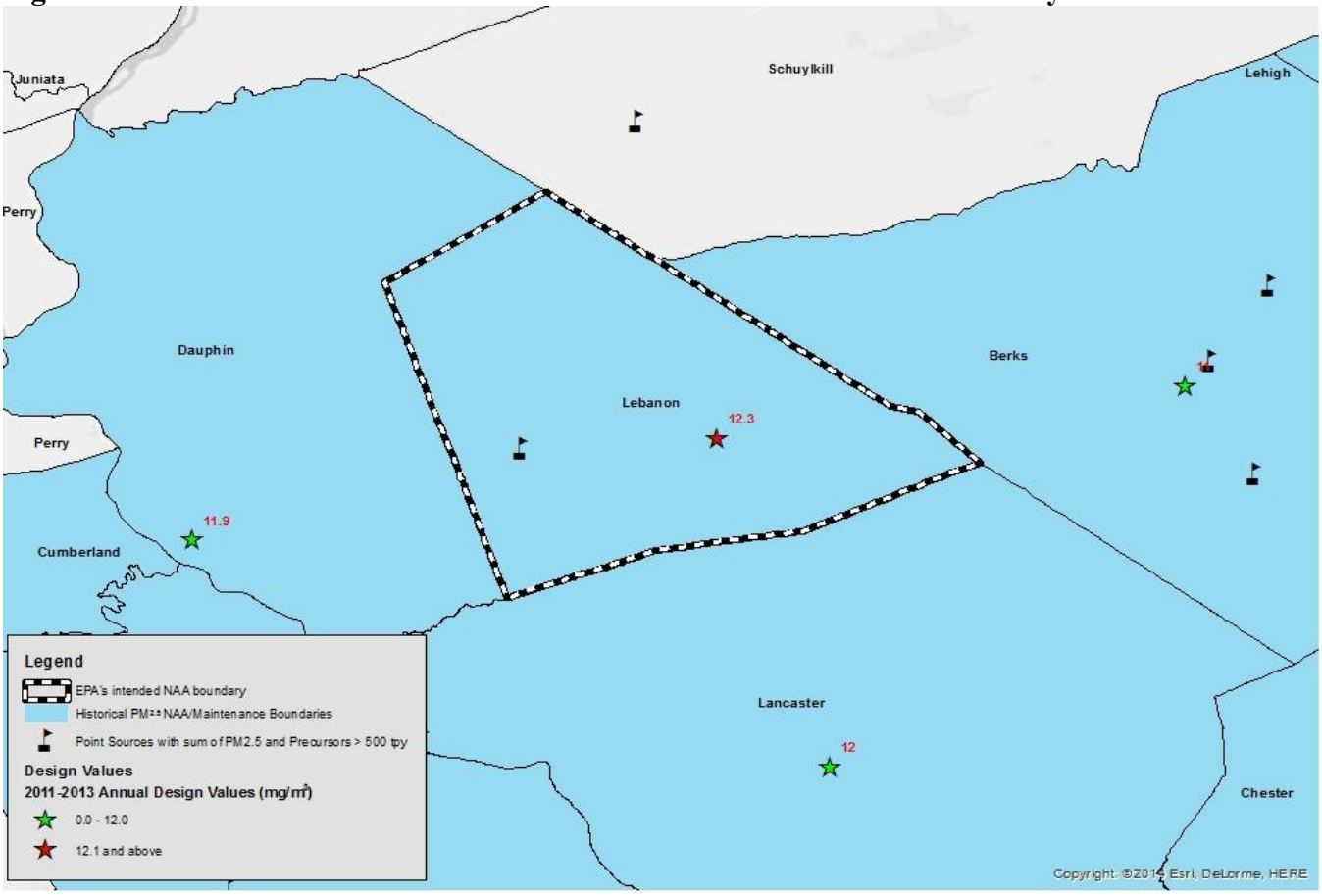
Additional meteorological data provided by Pennsylvania indicate that wind directions on highest $PM_{2.5}$ days at the Northampton County violating monitor are coming from due south and from the northeast. There are point sources in Northampton County to the northeast and upwind of the violating monitor. There are not any point sources of $PM_{2.5}$ south of the Northampton monitor which most likely contribute to the violation. As Pennsylvania suggested in their December 2013 recommendation letter, heavy construction just south of the monitor at the former Bethlehem Steel Site corresponds to the wind direction on the top 25% of high days.

In conclusion, the five factor analysis supports EPA's finding that Lehigh and Northampton counties contribute to the violation at the Northampton County violating monitor. Therefore, EPA's intended nonattainment boundaries for the 2012 annual $PM_{2.5}$ NAAQS include the entire counties of Lehigh County and Northampton County, PA.

3.5 Area Background and Overview - Lebanon County

Figure 1a is a map of EPA's intended nonattainment boundary for the Lebanon County. The map shows the location and DVs of ambient air quality monitoring locations, county and other jurisdictional boundaries including the Lebanon, PA MSA. For purposes of the 1997 annual $PM_{2.5}$ NAAQS, this area was designated nonattainment. The boundary for the nonattainment area for the 1997 annual $PM_{2.5}$ NAAQS included the entire counties of Cumberland, Dauphin and Lebanon in Pennsylvania. For purposes of the 2006 24-hour $PM_{2.5}$ NAAQS, this area was designated nonattainment. The boundary for the nonattainment area for the 2006 24-hour $PM_{2.5}$ NAAQS included the entire counties of Cumberland, Dauphin, Lebanon and York in Pennsylvania. The boundary for the intended 2012 annual $PM_{2.5}$ NAAQS is different than the boundary for the 1997 annual and the 2006 24-hour $PM_{2.5}$ NAAQS. EPA is recommending the single county of Lebanon, PA as the boundary for the nonattainment area for the 2012 annual $PM_{2.5}$ NAAQS.

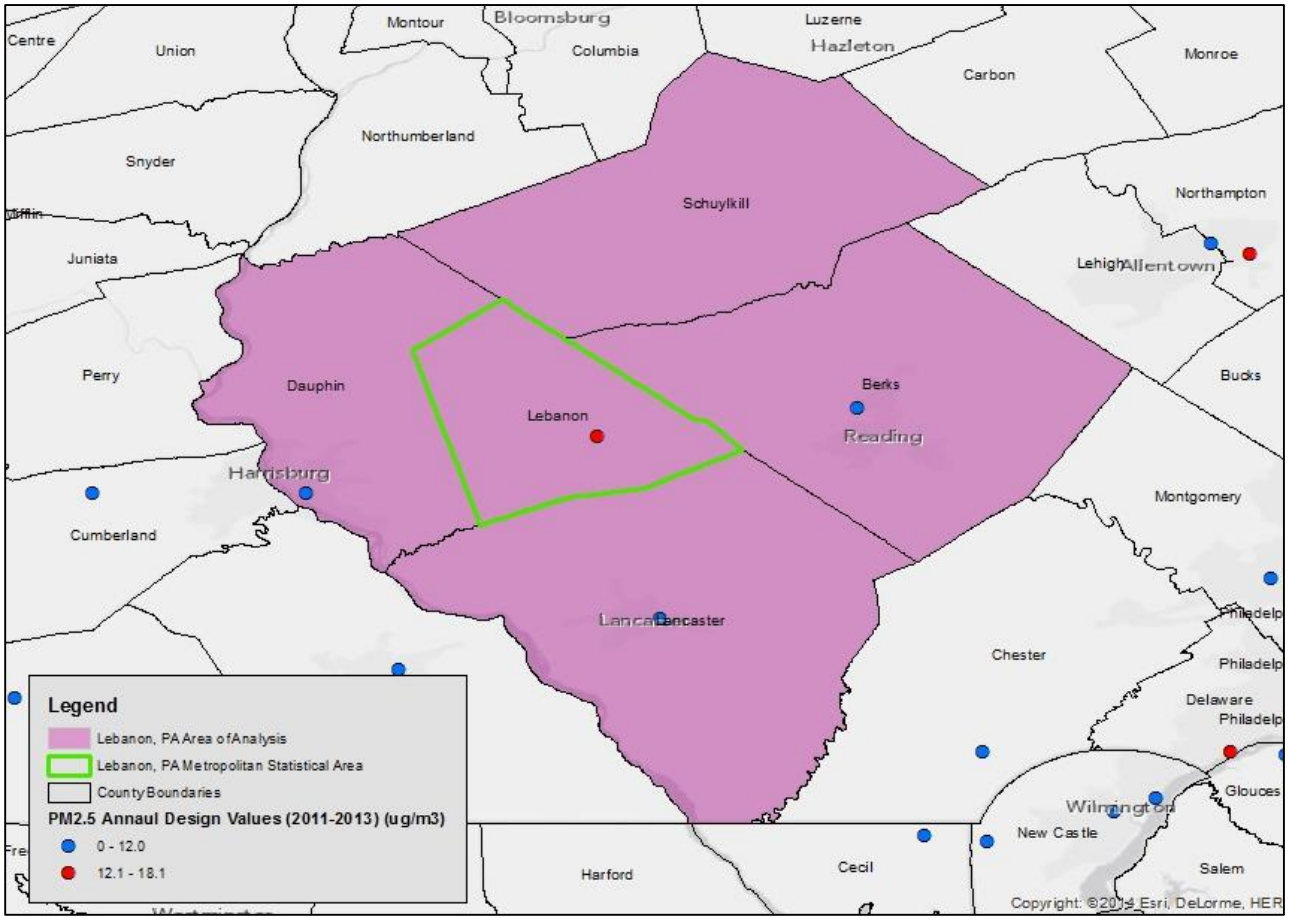
Figure 1a. EPA's Intended Nonattainment Boundaries for the Lebanon County



EPA must designate as nonattainment areas that violate the NAAQS and nearby areas that contribute to the violation in the violating area. Lebanon County shows a violation of the 2012 $PM_{2.5}$ NAAQS, therefore this county is included in the nonattainment area. The Lebanon, PA MSA is a single county MSA which consists of Lebanon County, PA. As shown in Figure 1b, EPA evaluated the Lebanon, PA MSA and a ring of counties adjacent to the Lebanon, PA MSA, including Berks, Dauphin, Lancaster and Schuylkill Counties in Pennsylvania. EPA's evaluation was based on the five factors and other

relevant information. The following sections describe this five factor analysis process. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers their interconnections and the dependence of each factor on one or more of the others.

Figure 1b. Area of Analysis for the Lebanon County



Factor 1: Air Quality Data

All data collected during the year are important when determining contributions to an annual standard such as the 2012 annual $PM_{2.5}$ NAAQS. Compliance with an annual NAAQS is dependent upon monitor readings throughout the year, including days with monitored ambient concentrations below the level of the NAAQS. For the 2012 annual $PM_{2.5}$ NAAQS, the annual mean is calculated as the mean of quarterly means. A high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV. Although all data are important, seasonal or episodic emissions can provide insight as to relative contributors to measured $PM_{2.5}$ concentrations. For these reasons, for the Factor 1 air quality analysis, EPA assessed and characterized air quality at, and in the proximity of, the violating monitoring site locations first, by evaluating trends and the spatial extent of measured concentrations at monitors in the area of analysis, and then, by identifying the conditions most associated with high average concentration levels of $PM_{2.5}$ mass in the area of analysis.

In most cases, EPA assessed air quality data on a seasonal, or quarterly, basis.[109] EPA also identified the spatial extent of these high $PM_{2.5}$ concentrations. The mass and composition at the DV location represents contributions from various emission sources including local, area-wide (which may comprise nearby urban and rural areas) and regional sources. To determine the source mix (by mass) at the DV monitoring site, EPA examined the chemical composition of the monitored $PM_{2.5}$ concentrations by pairing each violating FRM/FEM/ARM monitoring site with a collocated or nearby Chemical Speciation Network (CSN) monitoring site or sites. Then, EPA contrasted the approximated mass composition at the DV monitoring site with data collected at IMPROVE[110] and other monitoring locations whose data are representative of regional background.[111,112] This comparison of local/area-wide chemical composition data to regional chemical composition data derives an "urban increment," which helps differentiate the influence of more distant emissions sources from the influence of closer emissions sources, thus representing the portion of the measured violation that is associated with nearby emission contributions.[113,114,115]

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[109] Although compliance with the annual NAAQS depends on contributions from all days of the year, examining data on a quarterly or seasonal basis can inform the relationship between the temporal variability of emissions and meteorology and the resulting $PM_{2.5}$ mass and composition. In some areas of the country where there may be noticeable month-to-month variations in average $PM_{2.5}$, the quarterly averages may not adequately represent seasonal variability. In these areas, air quality data may be aggregated and presented by those months that best correspond to the local "seasons" in these areas.

[110] IMPROVE stands for Interagency Monitoring for Protected Visual Environments and is an aerosol monitoring network in mostly rural and remote areas.

[111] The "urban increment" analysis assesses and characterizes the increase in seasonal and annual average $PM_{2.5}$ mass and chemical components observed at violating monitoring site(s) relative to monitoring sites outside the area of analysis (which represent background concentrations). Developing the urban increment involves pairing a violating FRM/FEM/ARM monitor with a collocated monitor or nearby monitor with speciation data. EPA made every effort to pair these data to represent the same temporal and spatial scales. However, in some cases, the paired violating and CSN "urban" monitoring locations were separated by some distance such that the included urban CSN site(s) reflect(s) a different mixture of emissions sources, which could lead to misinterpretations. To generally account for differences in $PM_{2.5}$ mass between the violating site and the nearby CSN site(s), EPA determined material balance of the $PM_{2.5}$ composition at the violating site by assigning the extra measured $PM_{2.5}$ mass to the carbon components of $PM_{2.5}$. Where the general urban increment approach may be misleading, or in situations where non-carbonaceous emissions are believed to be responsible for a local $PM_{2.5}$ concentration gradient, EPA used alternative analyses to reflect the mix of urban and rural sources contributing to the measured concentrations at violating monitoring sites.

[112] The urban monitors were paired with any rural sites within a 150 mile radius of an urban site to calculate spatial means of the quarterly averages of each species. If there were no rural sites within 150 miles, then the nearest rural site was used alone. That rural mean was then subtracted from the quarterly mean of the urban site to get the increment. Negative values were simply replaced with zeros.

[113] In most, but not all, cases, the violating design value monitoring site is located in an urban area. Where the violating monitor is not located in an urban area, the "urban increment" represents the difference between local and other nearby emission sources in the vicinity of the violating monitoring location and more regional sources.

[114] Hand, et. al. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report V, June 2011. Chapter 7 – Urban Excess in $PM_{2.5}$ Speciated Aerosol Concentrations, *http://vista.cira.colostate.edu/improve/Publications/Reports/2011/PDF/Chapter7.pdf*

[115] US EPA, Office of Air Quality Planning and Standards, December 2004. (2004) Area Designations for 1997 Fine Particle ($PM_{2.5}$) Standards, Technical Support Document for State and Tribal Air Quality Fine Particle ($PM_{2.5}$)

$PM_{2.5}$ Design Values and Total Mass Measurements - EPA examined ambient $PM_{2.5}$ air quality monitoring data represented by the DVs at the violating monitoring site and at other monitors in the area of analysis. EPA calculated DVs based on air quality data for the most recent 3 consecutive calendar years of quality-assured, certified air quality data from suitable FEM/FRM/ARM monitoring sites in the EPA's Air Quality System (AQS). For this designations analysis, EPA used data for the 2011-2013 period (i.e., the 2013 DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2012 annual $PM_{2.5}$ NAAQS is met at a monitoring site when the 3-year average annual mean concentration is 12.0 micrograms per cubic meter ($\mu g/m^3$) or less (e.g., 12.1 $\mu g/m^3$ or greater is a violation). A DV is only valid if minimum data completeness criteria are met or when other regulatory data processing provisions are satisfied (See 40 CFR part 50 Appendix N). Table 2 identifies the current DVs (i.e., the 2013 DV) and the most recent two DVs based on all monitoring sites in the area of analysis for the Lebanon County intended nonattainment area.[116]

Table 2. Air Quality Data collected at Regulatory Monitors (all DV levels in $\mu g/m^3$)[a,b,]

County, State	Monitor Site ID	State Rec NA?	09-11 DV	10-12 DV	11-13 DV
Berks, PA	420110011	No	10.7	10.9	11
Dauphin, PA	420430401	No	12.1	11.9	11.9
Lancaster, PA	420710007	No	12	12.1	12
Lebanon, PA	420750100	Yes	11.4	12.8	12.3
Schuylkill, PA	N/A	No	No monitor		

[a]If a county has more than one monitoring location, the county DV is indicated in bold type.
[b]If a monitor is violating, the NAAQS, the violating DV is indicated in red type.

The Figure 1a map, shown previously, identifies the Lebanon County intended nonattainment area, the Lebanon, PA MSA boundary and monitoring locations with 2011-2013 violating DVs. As indicated on the map, there is one violating monitoring, monitor 420750100, located in Lebanon County, PA (the "Lebanon County monitor" or the "violating monitor").

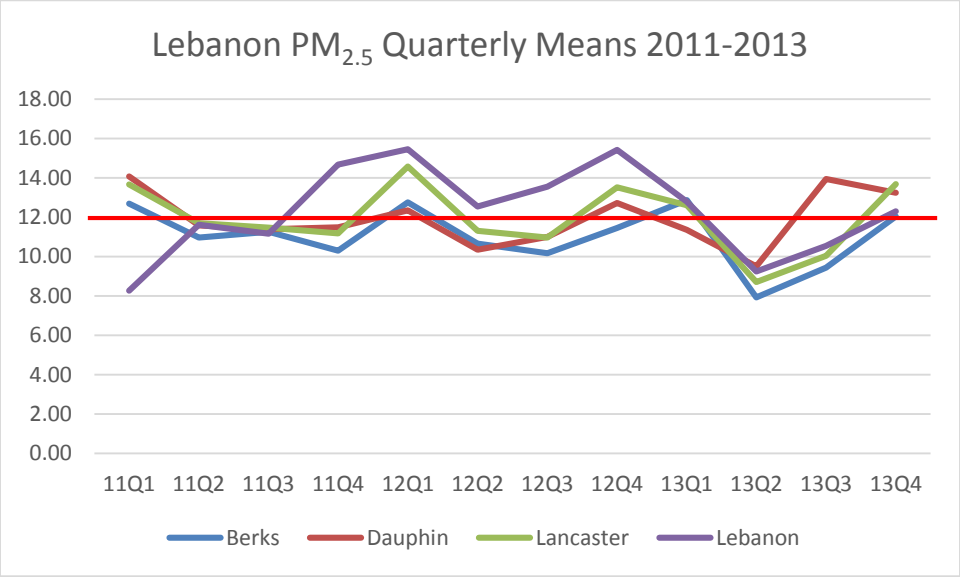
Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. Figure 2 shows quarterly mean $PM_{2.5}$ concentrations for the most recent 3-year period for the highest DV monitoring sites in each county within the area of analysis. This graphical representation is particularly relevant when assessing air quality data for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, because, as previously stated, the annual mean is calculated as the

Designations, Chapter 3, Urban Excess Methodology. Available at *www.epa.gov/pmdesignations/1997standards/documents/final/TSD/Ch3.pdf*

[116] In certain circumstances, one or more monitoring locations within a monitoring network may not meet the network technical requirements set forth in 40 CFR 58.11(e), which states, "State and local governments must assess data from Class III $PM_{2.5}$ FEM and ARM monitors operated within their network using the performance criteria described in table C-4 to subpart C of part 53 of this chapter, for cases where the data are identified as not of sufficient comparability to a collocated FRM, and the monitoring agency requests that the FEM or ARM data should not be used in comparison to the NAAQS. These assessments are required in the monitoring agency's annual monitoring network plan described in §58.10(b) for cases where the FEM or ARM is identified as not of sufficient comparability to a collocated FRM…."

mean of quarterly means and a high quarter can drive the mean for an entire year, which, in turn, can drive an elevated 3-year DV.

Figure 2. Lebanon County $PM_{2.5}$ Quarterly Means for 2011-2013



As shown, in Figure 2, the Lebanon County monitor does not follow a similar pattern to any of the other monitors in the area of analysis. The other three monitors in Berks, Dauphin and Lancaster counties tend to track together, with higher third quarters. All the monitors in the area, including the Lebanon County monitor had a high fourth quarter in 2012. The Lebanon County monitor does not have a clear seasonal pattern, indicating local influences at the violating monitor. However, staring in the second quarter of 2013, the $PM_{2.5}$ values at the Lebanon County monitor appear to track with most other monitors in the area. This suggests that the influence of the local sources was less in those quarters. Furthermore, as can be seen in Figure 2, the Lebanon monitor's quarterly means the second and third quarters of 2013 are below the 12 $\mu g/m^3$ level of the 2012 annual $PM_{2.5}$ NAAQS.

$PM_{2.5}$ Composition Measurements - To assess potential emissions contributions for each violating monitoring location, the EPA determined the various chemical species comprising total $PM_{2.5}$ to identify the chemical components over the analysis area, which can provide insight into the types of emission sources impacting the monitored concentration. To best describe the $PM_{2.5}$ at the violating monitoring location, EPA first adjusted the chemical speciation measurement data from a monitoring location at or near the violating FRM monitoring site using the SANDWICH approach to account for

the amount of $PM_{2.5}$ mass components retained in the FRM measurement.[117,118,119,120] In particular, this approach accounts for losses in fine particle nitrate and increases in sulfate mass associated with particle bound water. Figure 3a illustrates the fraction of each $PM_{2.5}$ chemical component at the Lebanon County, PA monitoring site based on annual averages for the years 2010-2012. Please note that speciation data is not available at the Lebanon County monitor. Therefore, EPA used speciation data representative of the northeastern United States and adjusted it to match the $PM_{2.5}$ mass recorded at the Lebanon monitoring site.

Figure 3a. Lebanon County Annual Average $PM_{2.5}$ Species (2010-2012)[a]

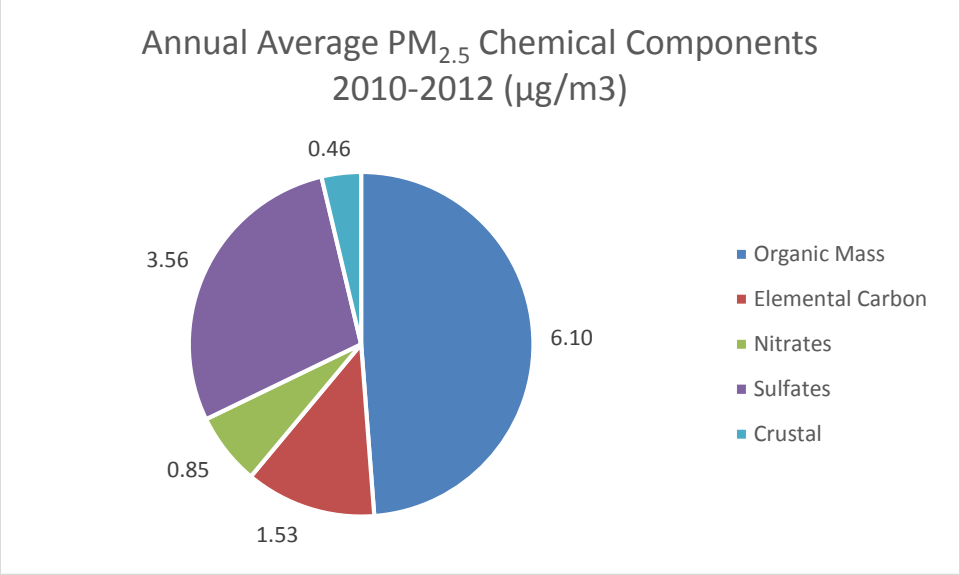


Figure 3b shows annual and quarterly chemical composition profiles and illustrates any seasonal or episodic contributors to $PM_{2.5}$ mass. This "increment analysis," combined with the other factor analyses, can provide additional insight as to which sources or factors may contribute at a greater

[117] SANDWICH stands for measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous mass **H**ybrid Material Balance Approach." The SANDWICH adjustment uses an FRM mass construction methodology that results in reduced nitrates (relative to the amount measured by routine speciation networks), higher mass associated with sulfates (reflecting water included in gravimetric FRM measurements) and a measure of organic carbonaceous mass derived from the difference between measured $PM_{2.5}$ and its non-carbon components. This characterization of $PM_{2.5}$ mass also reflects crustal material and other minor components. The resulting characterization provides a complete mass closure for the measured FRM $PM_{2.5}$ mass, which can be different than the data provided directly by the speciation measurements from the CSN network.

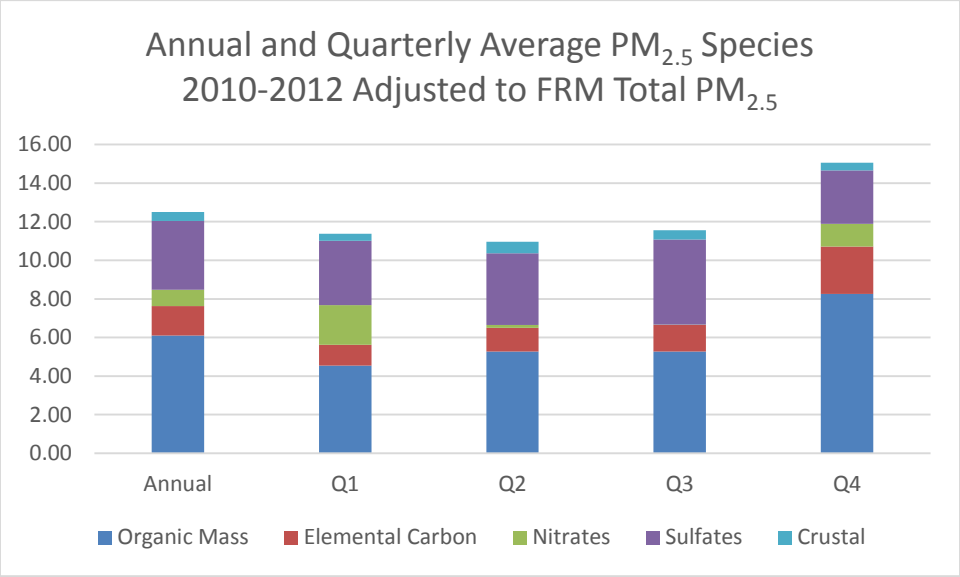
[118] Frank, N. H., SANDWICH Material Balance Approach for $PM_{2.5}$ Data Analysis, National Air Monitoring Conference, Las Vegas, Nevada, November 6-9, 2006. *http://www.epa.gov/ttn/amtic/files/2006conference/frank.pdf*.

[119] Frank, N. H., The Chemical Composition of $PM_{2.5}$ to support PM Implementation, EPA State /Local/Tribal Training Workshop: $PM_{2.5}$ Final Rule Implementation and 2006 $PM_{2.5}$ Designation Process, Chicago IL, June 20-21, 2007, *http://www.epa.gov/ttn/naaqs/pm/presents/pm2.5_chemical_composition.pdf.*

[120] Frank, N. H. *Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities*. J. Air & Waste Manage. Assoc. 2006 56:500–511.

level. Simply stated, this analysis can help identify nearby sources of emissions that contribute to the violation at the violating monitoring site.

Figure 3b. Lebanon County Annual and Quarterly Average $PM_{2.5}$ Species (2010-2012)[a]



[a]*Adjusted to FRM Total $PM_{2.5}$* indicates that the speciation profile and total mass depicted in this figure are the result of the urban increment calculation for the particular FRM monitor.

The speciation data in Figures 3a and 3b for the Lebanon County violating monitoring site indicate that organic mass and sulfates are the predominant species overall with a smaller component of elemental carbon and crustal matter in each quarter. Figure 3b shows that in the first quarter, nitrates are higher, which corresponds to higher EGU emissions from increased heating needs during the winter and greater particle nitrate collection during the cooler months.

EPA assessed seasonal and annual average $PM_{2.5}$ components at monitoring sites within the area relative to monitoring sites outside of the analysis area to account for the difference between regional background concentrations of $PM_{2.5}$, and the concentrations of $PM_{2.5}$ in the area of analysis, also known as the "urban increment." This analysis differentiates between the influences of emissions from sources in nearby areas and in more distant areas on the violating monitor. Estimating the urban increment in the area helps to illuminate the amount and type of particles at the violating monitor that are most likely to be the result of sources of emissions in nearby areas, as opposed to impacts of more distant or regional sources of emissions. Figure 4a includes pie charts showing the annual and quarterly chemical mass components of the urban increment. The quarterly pie charts correspond to the high-concentration quarters identified in Figure 2. Evaluating these high concentration quarters can help identify composition of $PM_{2.5}$ during these times. Note that in these charts, sulfates and nitrates have been adjusted to represent their mass in measured $PM_{2.5}$.

Figure 4a. Lebanon County Urban Increment Analysis for 2010-2012.

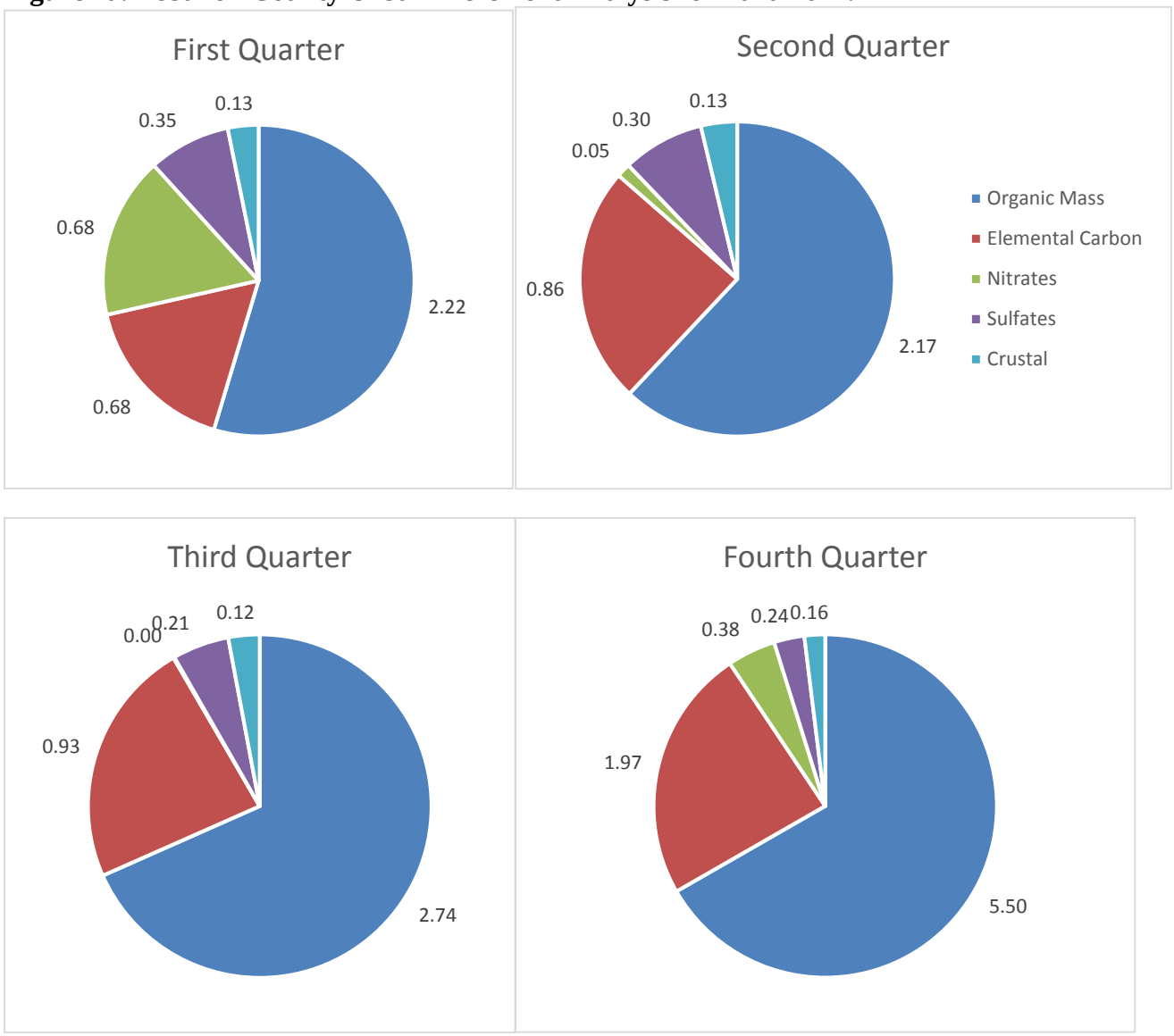
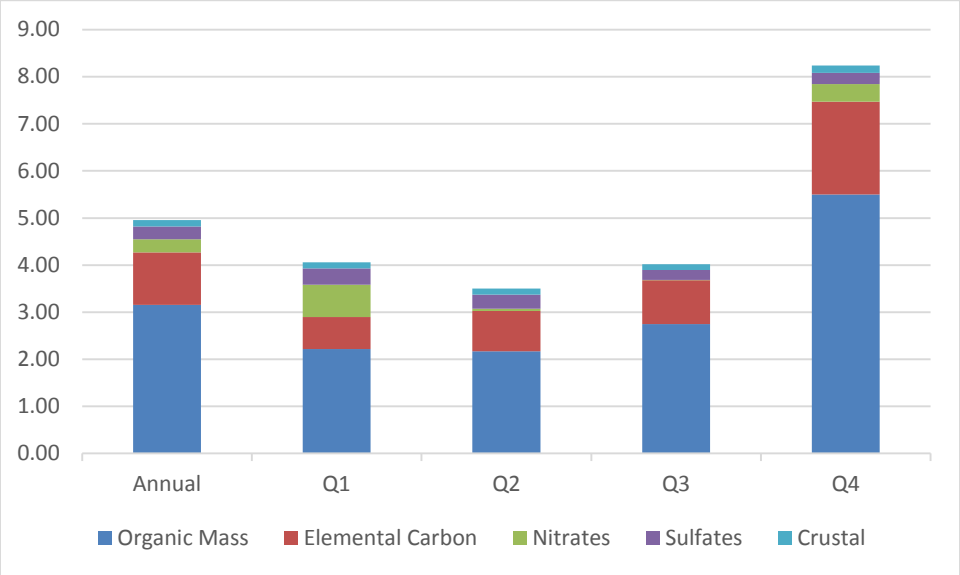


Figure 4b. Lebanon County Average Urban Increment Analysis for 2010-2012.



The urban increment data provides further insight to the chemical composition of $PM_{2.5}$ at the Lebanon County violating monitoring site. As previously stated, Figures 3a and 3b show that organic mass and sulfates are the predominant species overall. When accounting for the urban increment in Figure 4a and Figure 4b, the sulfate component becomes less dominant. However, there is still some remaining sulfate detected at the monitor. Figure 4a and Figure 4b clearly indicate that organic mass and elemental carbon are the major components of $PM_{2.5}$ contributing to the Lebanon County monitor. These components suggests that the sources of $PM_{2.5}$ are local in nature and could result from mobile, area or local industrial sources.

Factor 2: Emissions and emissions-related data

In this designations process, for each area with a violating monitoring site, EPA evaluated the emissions data from nearby areas using emissions related data for the relevant counties to assess each county's potential contribution to $PM_{2.5}$ concentrations at the violating monitoring site or monitoring sites in the area under evaluation. Similar to the air quality analysis, these data were examined on a seasonal basis. Similar to the air quality analysis, these data were examined on a seasonal basis. However, as discussed above, there are no discernable seasonal trends at the Lebanon County monitor. Therefore, EPA is not discussing seasonal emissions in this analysis. EPA examined emissions of identified sources or source categories of direct $PM_{2.5}$, the major components of direct $PM_{2.5}$ (organic mass, elemental carbon, crustal material (and/or individual trace metal compounds)), primary nitrate and primary sulfate, and precursor gaseous pollutants (i.e., SO_2, NO_X, total VOC, and NH_3). EPA also considered the distance of those sources of emissions from the violating monitoring site. While direct $PM_{2.5}$ emissions and its major carbonaceous components are generally associated with sources near violating $PM_{2.5}$ monitoring sites, the gaseous precursors tend to have a more regional influence (although the EPA is mindful of the potential local NO_X and VOC emissions contributions to $PM_{2.5}$ from mobile and stationary sources) and transport from neighboring areas can contribute to higher $PM_{2.5}$ levels at the violating monitoring sites.

Emissions Data

For this factor, EPA reviewed data from the 2011 National Emissions Inventory (NEI) version 1 (see *http://www.epa.gov/ttn/chief/net/2011inventory.html*). For each county in the area of analysis, EPA examined the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires. EPA also looked at the geographic distribution of major point sources of the relevant pollutants.[121] Significant emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

To further analyze area emissions data, EPA also developed a summary of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants, which is available at *http://www.epa.gov/pmdesignations/2012standards/docs/nei2011v1pointnei2008v3county.xlsx*.

When considered with the urban increment analysis in Factor 1, evaluating the components of direct $PM_{2.5}$ and precursor gases can help identify specific sources or source types contributing to elevated concentrations at violating monitoring sites and thus assist in identifying appropriate area boundaries. In general, directly emitted POC and VOCs[122] contribute to POM; directly emitted EC contributes to $PM_{2.5}$ EC; NO_X, NH_3 and directly emitted nitrate contribute to PNO3; SO_2, NH_3 and directly emitted sulfate contribute to PSO4; and directly emitted crustal material and metal oxides contribute to Pcrustal. [123,124] EPA believes that the quantities of those nearby emissions as potential contributors to the $PM_{2.5}$ violating monitors are somewhat proportional to the $PM_{2.5}$ chemical components in the estimated urban increment. Thus, directly emitted POC is more important per ton than SO_2, partially because POC emissions are already $PM_{2.5}$ whereas SO_2 must convert to $PM_{2.5}$ and not all of the emitted SO_2 undergoes this conversion.

Table 3a provides a county-level emissions summary (i.e., the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, nonroad mobile, on-road mobile, and fires) of directly emitted $PM_{2.5}$ and precursor species in tons per year (tpy) for the county with the violating monitoring site and nearby counties considered for inclusion in the Lebanon County. Table 3b summarizes the directly emitted components of $PM_{2.5}$ for the same counties in the area of analysis for the Lebanon County. This information will be paired with the urban increment composition previously shown in Figures 4a and 4b.

[121] For purposes of this designations effort, "major" point sources are those whose sum of PM precursor emissions ($PM_{2.5}$ + NOx + SO_2 + VOC + NH_3) are greater than 500 tons per year based on NEI 2011v1.

[122] As previously mentioned, nearby VOCs are presumed to be a less important contributor to POM than OC.

[123] *See*, Seinfeld J. H. and Pandis S. N. (2006) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 2nd edition, J. Wiley, New York. See also, Seinfeld J. H. and Pandis S. N. (1998) *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, 1st edition, J. Wiley, New York.

[124] USEPA Report (2004), The Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003, found at: *http://www.epa.gov/airtrends/aqtrnd04/pm.html*.

Table 3a. County-Level Emissions of Directly Emitted $PM_{2.5}$ and Precursors (tpy)

County, State	Total NH_3	Total NOX	Total Direct $PM_{2.5}$	Total SO_2	Total VOC	Total
Lancaster, PA	15,772	13,794	4,441	1,799	17,361	53,166
Berks, PA	4,097	14,317	3,606	6,136	12,734	40,891
Dauphin, PA	1,576	9,595	1,923	810	9,378	23,283
Schuylkill, PA	1,655	6,016	1,409	5,481	5,935	20,496
Lebanon, PA	3,917	5,024	1,151	814	4,252	15,158

Table 3b. County-Level Emissions for Components of Directly Emitted $PM_{2.5}$ (tpy) [125]

County, State	POM	EC	PSO4	PNO3	Pcrustal	Residual	Total Direct
Lancaster, PA	2,020	465	106	9	816	1,025	4,441
Berks, PA	1,764	436	132	15	474	785	3,606
Dauphin, PA	1,241	279	32	7	147	216	1,923
Schuylkill, PA	750	170	44	4	159	284	1,409
Lebanon, PA	582	165	27	3	182	193	1,151

As can be seen in Table 3a, Lancaster County has the highest total emissions of directly emitted $PM_{2.5}$ and its precursors, however, as discussed in Factor 3, emissions from Lancaster County are less likely to contribute to the Lebanon County monitor due to the regional wind direction being from the west. Berks and Schuylkill Counties are also not in the regional wind direction. The $PM_{2.5}$ emissions in Lebanon and Dauphin Counties are mainly NO_X and VOC. Lebanon County also has a high level of NH_3 emissions. Table 3b breaks down the direct $PM_{2.5}$ emissions value from Table 3a into its components. These data will also be compared with the previously presented urban increment composition Table 3b shows that throughout the area of analysis organic matter is the largest component of directly emitted $PM_{2.5}$.

Using the previously described relationship between directly emitted and precursor gases and the measured mass to evaluate data presented in Tables 3a and 3b, EPA identified the following components warranting additional review: organic mass, elemental carbon and VOC. EPA then looked at the contribution of these components of interest from each of the counties included in the area of analysis as shown in Tables 4a-e.

Table 4a. County-Level POM Emissions

	Emissions in average tons/yr		
County, State	POM	Pct.	Cumulative %
Lancaster, PA	2,020	32%	32%
Berks, PA	1,764	28%	60%
Dauphin, PA	1,241	20%	79%
Schuylkill, PA	750	12%	91%
Lebanon, PA	582	9%	100%

[125] Data are based on the 2011 and 2018 Emissions Modeling Platform Data Files and Summaries (*ftp://ftp.epa.gov/EmisInventory/2011v6/v1platform*) available at: *http://www.epa.gov/ttn/chief/emch/index.html#2011* (accessed 02/26/14).

Table 4b. County-Level EC Emissions

County, State	Emissions in average tons/yr		
	EC	Pct.	Cumulative %
Lancaster, PA	465	31%	31%
Berks, PA	436	29%	59%
Dauphin, PA	279	18%	78%
Schuylkill, PA	170	11%	89%
Lebanon, PA	165	11%	100%

Table 4c. County-Level VOC Emissions

County, State	Emissions in average tons/yr		
	Total VOC	Pct.	Cumulative %
Lancaster, PA	17,361	35%	35%
Berks, PA	12,734	26%	61%
Dauphin, PA	9,378	19%	79%
Schuylkill, PA	5,935	12%	91%
Lebanon, PA	4,252	9%	100%

In Tables 4a – 4c, Lancaster and Berks counties have high POM, EC and VOC emissions. As previously mentioned, Lancaster and Berks counties are less likely to contribute to the Lebanon County violating monitor due to wind direction. Dauphin, Schuylkill and Lebanon counties have similar levels of POM, EC and VOC emissions.

In addition to reviewing county-wide emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors in the area of analysis, EPA also reviewed emissions from major point sources located in the area of analysis. The magnitude and location of these sources can help inform nonattainment boundaries. Table 5 provides facility-level emissions of direct $PM_{2.5}$, components of direct $PM_{2.5}$, and precursor pollutants (given in tons per year) from major point sources with total emissions of 500 tpy or more located in the area of analysis for the Lebanon County. Table 5 also shows the distance from the facility to the Lebanon County.

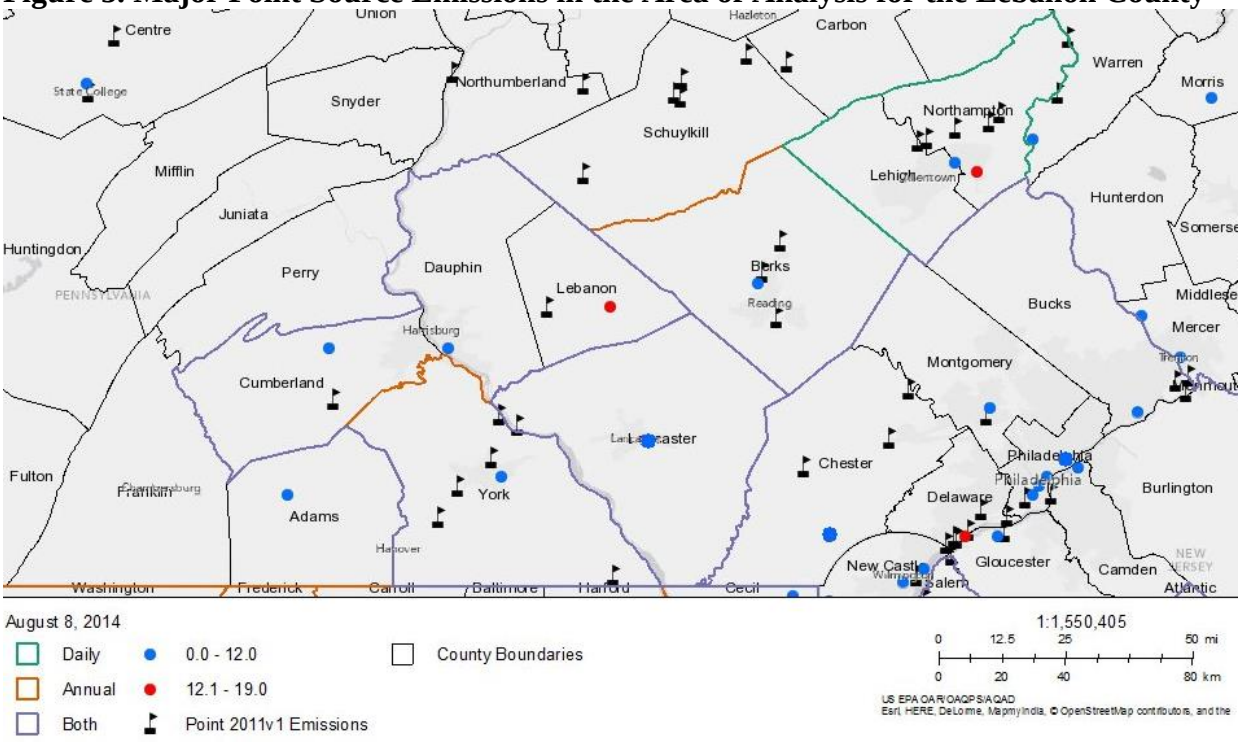
Table 5. NEI 2011 v1 Point Source Emissions (tpy)

County, State	Facility Name (Facility ID)	Distance from violating monitor (miles)	NEI 2011 v1 Emissions (tpy)					
			NH_3	NOx	$PM_{2.5}$	SO_2	VOC	Total
Lebanon, PA	Carmeuse Lime Inc/Millard Lime Plt (420750016)	9	0	444	14	262	4	724
Schuylkill, PA	WPS Westwood Gen LLC/Gen Sta (421070023)	20	0	220	5	268	13	506
Lancaster, PA	Lancaster Cnty RRF/ Lancaster (420710145)	23		577	4	12	4	597
Berks, PA	Cryovac Inc/Cryovac Rigid Packaging (420110093)	23			0		556	556
Berks, PA	Genon Rema LLC/Titus Gen Sta (420110045)	25	0	683	43	4087	5	4818
Berks, PA	Lehigh Cement Co LLC/Evansville Cement Plt & Quarry (420110039)	27	41	1225	134	200	12	1611
Schuylkill, PA	Wheelabrator Frackville/Morea Plt (421070022)	33	0	443	19	468	9	938
Schuylkill, PA	Gilberton Power Co/John B Rich Mem Power Sta (421070025)	33	0	211	39	1314	28	1591
Schuylkill, PA	Schuylkill Energy Res/St Nicholas Cogen (421070024)	35	1	273	27	1883	25	2208
Schuylkill, PA	Northeastern Power Co/Mcadoo Cogen (421070054)	42	0	104	16	706	20	846

Table 5 shows the major point source emissions (from the 2011 NEI in tons per year) in the area of analysis for the Lebanon County and the relative distances of these sources from the violating monitoring location, as depicted by red dots. The actual distance from the point sources to the Lebanon County monitoring location is presented in Table 5. The distance from the violating monitoring location is particularly important for directly emitted $PM_{2.5}$. The influence of directly emitted $PM_{2.5}$ on ambient $PM_{2.5}$ diminishes more than that of gaseous precursors as a function of distance.[126]

[126] Baker, K. R. and K. M. Foley. *A nonlinear regression model estimating single source concentrations of primary and secondarily formed $PM_{2.5}$.* Atmospheric Environment. 45 (2011) 3758-3767.

Figure 5. Major Point Source Emissions in the Area of Analysis for the Lebanon County



As indicated in Table 5 and Figure 5, there are ten sources with emissions over 500 tpy within the area of analysis. One source (Carmeuse Lime) is 9 miles west of the Lebanon County monitor. The largest point sources in the area of analysis are located in Schuylkill and Berks counties. Five point sources are located in Schuylkill County, to the northeast of the Lebanon County monitor. Three point sources are to the east of the Lebanon County monitor in Berks County. As previously mentioned, Schuylkill and Berks counties are not in the regional wind direction (see Factor 3). There are no major point sources with emissions of 500 tpy or more in Dauphin County.

Population density and degree of urbanization

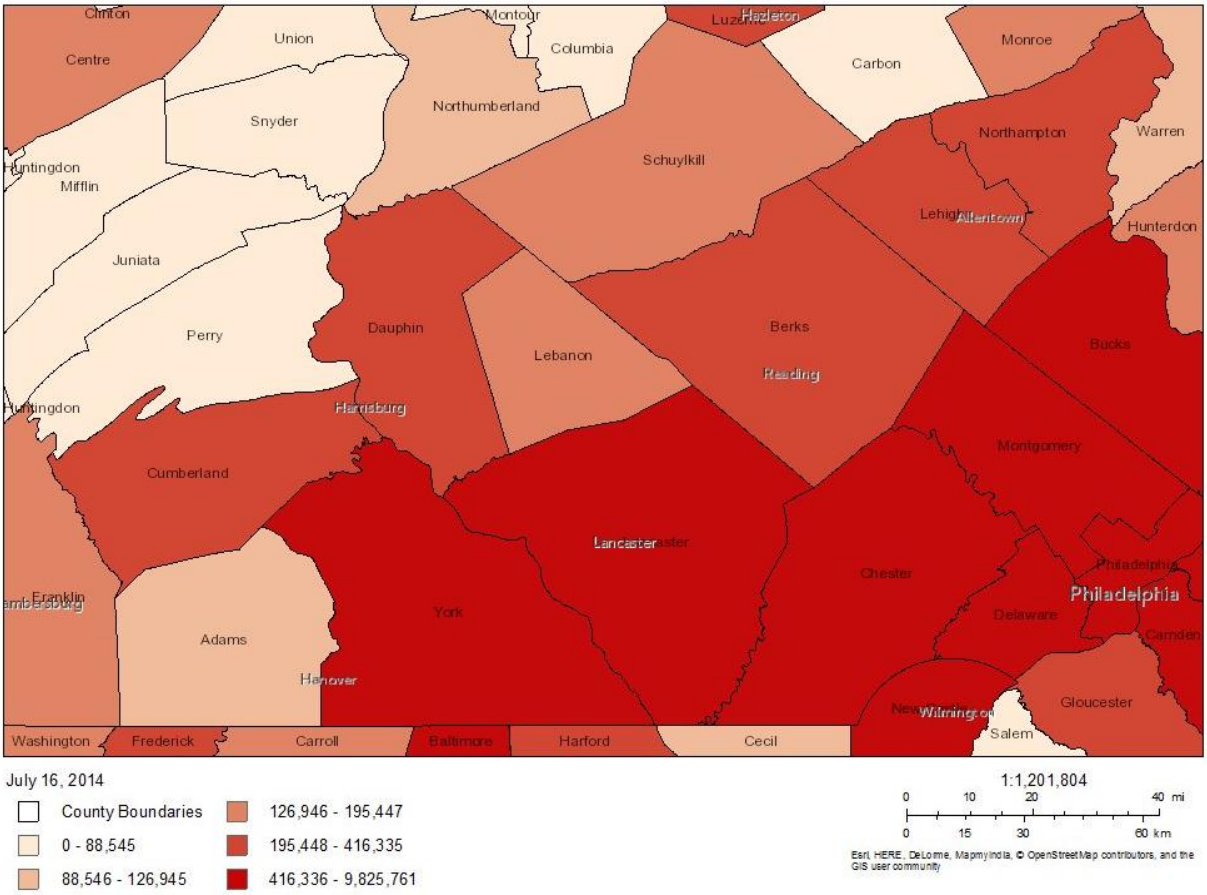
In this part of the factor analysis, EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. Rapid population growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that it may be appropriate to include the county associated with area source and mobile source emissions as part of the nonattainment area. Table 6 shows the 2000 and 2010 population, population growth since 2000, and population density for each county in the area.

Table 6. Population Growth and Population Density.

County, State	Population 2000	Population 2010	% Change from 2000	Land Area (Sq. Miles)	Population Density (per Sq. Mile)	%	Cumulative %
Lancaster, PA	470,658	520,344	10.6%	949	548	35%	35%
Berks, PA	373,638	411,791	10.2%	859	479	28%	63%
Dauphin, PA	251,798	268,281	6.5%	525	511	18%	81%
Schuylkill, PA	150,336	148,199	-1.4%	778	190	10%	91%
Lebanon, PA	120,327	133,717	11.1%	362	370	9%	100%
Total	**1,246,430**	**1,482,332**					

Source: U.S. Census Bureau population estimates for 2000 and 2010

Figure 6. 2010 County-Level Population in the Area of Analysis for the Lebanon County Area.



As indicated in Table 6, Lebanon County has low population but has increased in population by 11.1% from 2000. Lancaster County has the largest and most dense population in the area of analysis. Overall, all of the counties in the area of analysis have seen an increase in population from 2000 to 2010 with the exception of Schuylkill County. The above data indicates that population and population density are not influential factors in determining nonattainment boundaries for the Lebanon County.

Traffic and Vehicle Miles Travelled

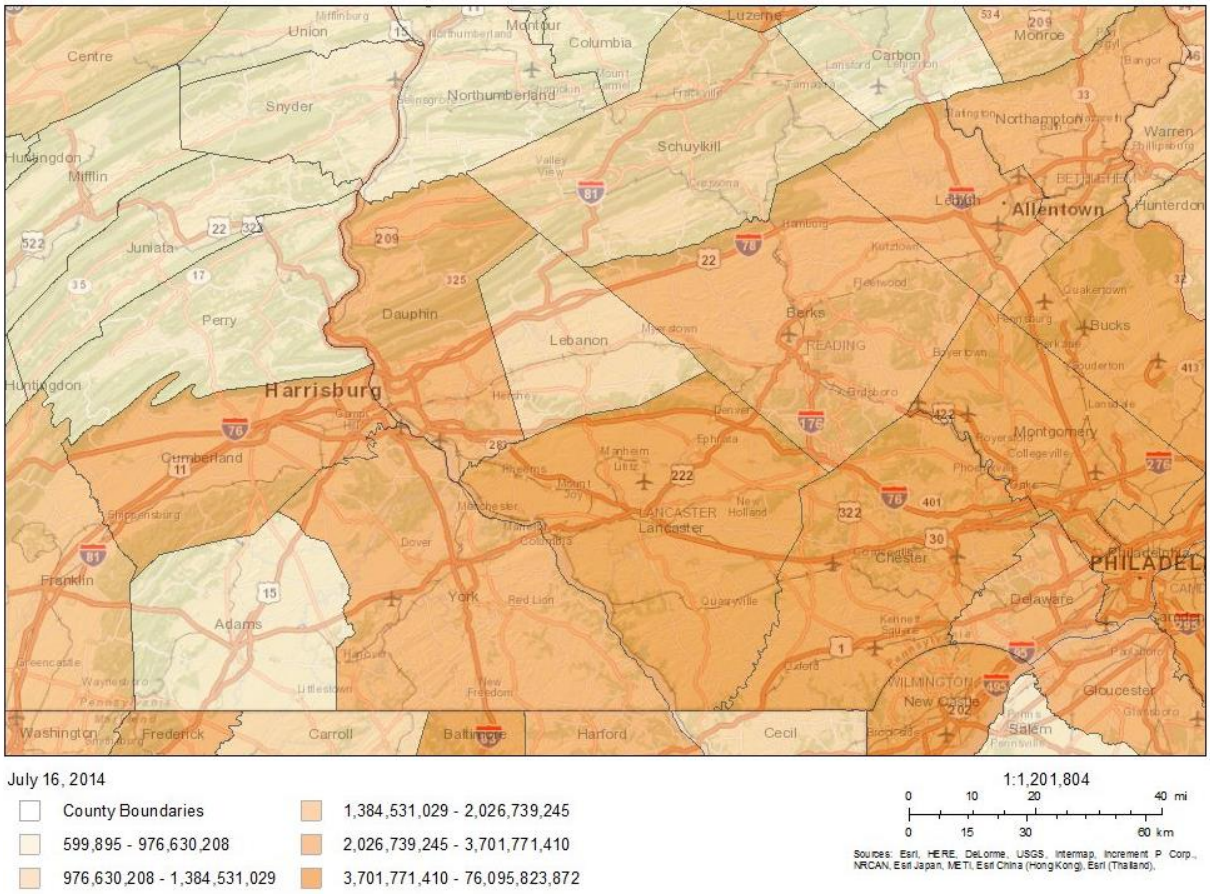
High VMT and/or a high number of commuters associated with a county is generally an indicator that the county is an integral part of an urban area. Mobile source emissions of NO_x, VOC, and direct PM may contribute to ambient particulate matter that contributes to monitored violations of the NAAQS in the area. In combination with the population/population density data and the location of main transportation arteries, an assessment of VMT helps identify the probable location of nonpoint source emissions that contribute to violations in the area. Comparatively high VMT in a county outside of the CBSA or CSA signifies integration with the core urban area contained within the CSA or CBSA, and indicates that a county with the high VMT may be appropriate to include in the nonattainment area because emissions from mobile sources in that county contribute to violations in the area. Table 7 shows 2011 VMT while Figure 7 overlays 2011 county-level VMT with a map of the transportation arteries.

Table 7. 2011 VMT for the Lebanon County

County, State	Total 2011 VMT	Percent	Cumulative %
Lancaster, PA	4,150,294,150	32%	32%
Berks, PA	3,381,679,887	26%	58%
Dauphin, PA	2,800,543,986	22%	80%
Schuylkill, PA	1,373,853,518	11%	91%
Lebanon, PA	1,179,030,237	9%	100%
Total	**12,885,401,778**		

http://www.census.gov/hhes/commuting/data/commuting.html

Figure 7. Overlay of 2011 County-level VMT with Transportation Arteries.



As the data in Table 7 illustrates, Lebanon County has the lowest VMT in the area of analysis. Lancaster and Berks counties together account for 58% of the total VMT in the area of analysis. As previously mentioned, Lancaster and Berks counties are not in the regional wind direction. Dauphin County has the next highest VMT, but as further discussed in Factor 4, transport of emissions from mobile sources is limited by topography.

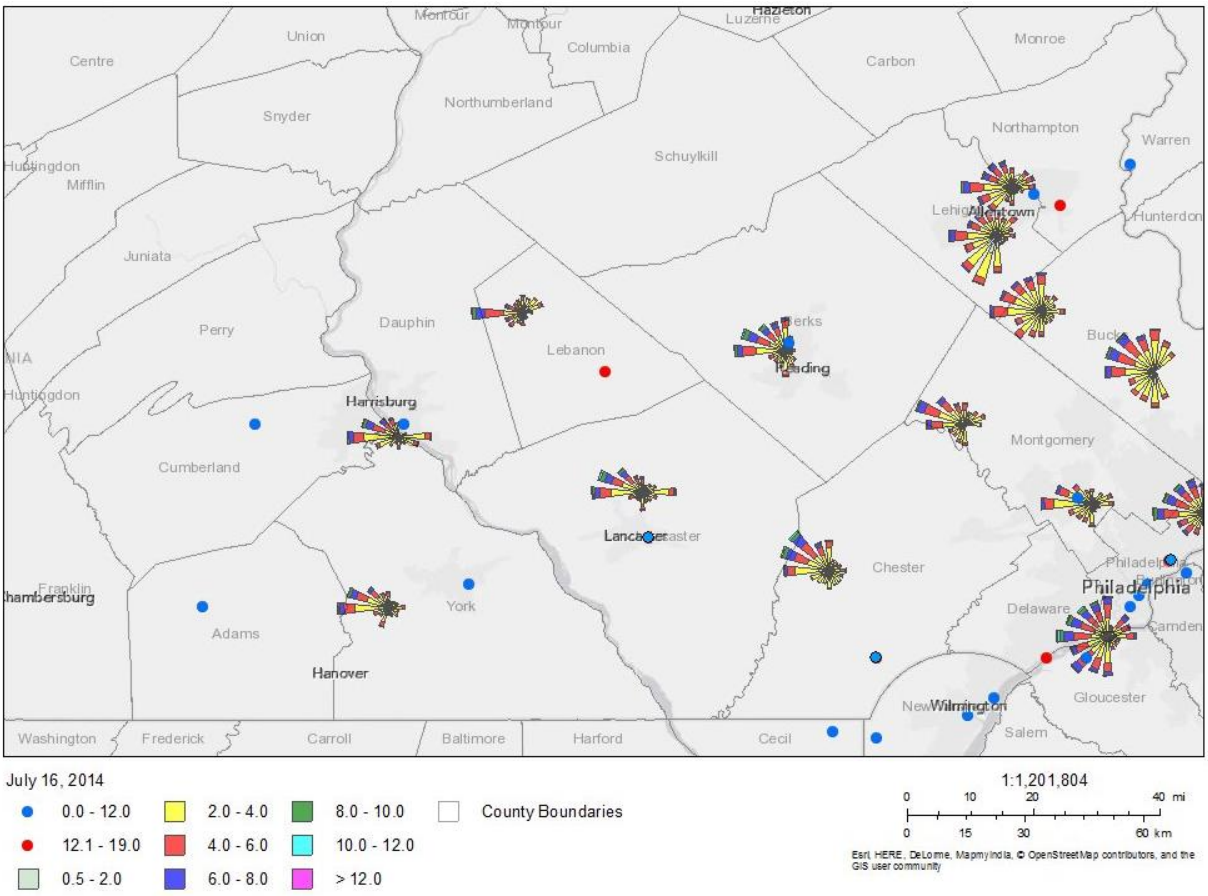
Factor 3: Meteorology

EPA evaluated available meteorological data to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of directly emitted particulate matter and precursor emissions from sources in the area of analysis. EPA used two primary tools for this assessment: wind roses and kernel density estimation (KDE). When considered in combination with area $PM_{2.5}$ composition and county-level and facility emissions source location information, wind roses and KDE can help to identify nearby areas contributing to violations at violating monitoring sites.

Wind roses are graphic illustrations of the frequency of wind direction and wind speed. Wind direction can indicate the direction from which contributing emissions are transported; wind speed can indicate the force of the wind and thus the distance from which those emissions are transported. EPA

constructed wind roses from hourly observations of wind direction and wind speed using 2009-2012 data from National Weather Service locations archived at the National Climate Data Center.[127] When developing these wind roses, EPA also used wind observations collected at meteorological sampling stations collocated at air quality monitoring sites, where these data were available. Figure 8 shows wind roses that EPA generated from data relevant in the Lebanon County.

Figure 8. Wind Roses in the Area of Analysis for Lebanon County.



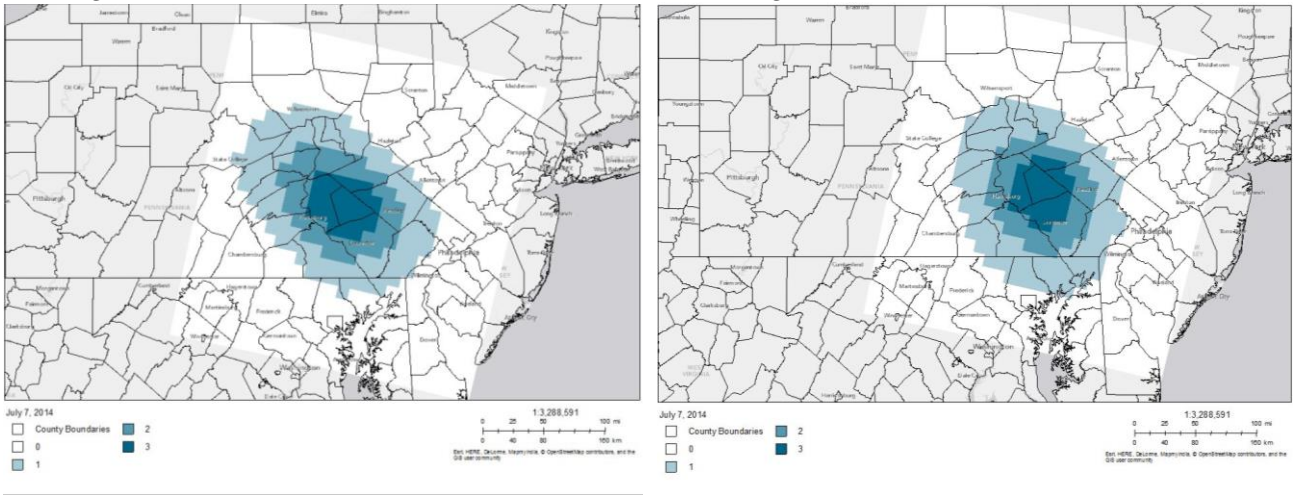
As shown in Figure 8, the predominant winds near the violating monitor are from the west with some northwesterly components. These wind roses represent average wind directions throughout the year. According to Table 3a, Lancaster and Berks counties have high $PM_{2.5}$ emissions, however, they are south and east, respectively, of the Lebanon County monitor. Dauphin County is to the west of the Lebanon monitor. Dauphin County does not have any major point sources with emissions of 500 tpy or more, but does have some population and VMT. However, as discussed in Factor 4 below, topography limits transport of low level emissions, such as mobile emissions, from Dauphin County.

[127] *ftp.ncdc.noaa.gov/pub/data/noaa* or *http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=cdo&theme=hourly&layers=1&node=gis* Quality assurance of the National Weather Service data is described here: *http://www1.ncdc.noaa.gov/pub/data/inventories/ish-qc.pdf*

In addition to wind roses, EPA also generated kernel density estimation (KDE) plots to represent HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) backward trajectory frequency at violating monitoring sites.[128,129] These KDEs are graphical statistical estimations to determine the density of trajectory endpoints at a particular location represented by a grid cell. The EPA used KDEs to characterize and analyze the collection of individual HYSPLIT backward trajectories.[130] Higher density values, indicated by darker blue colors, indicate a greater frequency of observed trajectory endpoints within a particular grid cell. Figure 9 shows HYSPLIT KDE plots for the Lebanon County summarized by calendar quarter for the 2010-2012 period. The HYSPLIT KDE plots are weighted in the northwesterly and westerly directions, indicating a greater frequency of trajectories passing over grid cells to the west and northwest.

Figure 9. HYSPLIT Kernel Density Estimation Plots for the Lebanon County.

First Quarter **Second Quarter**

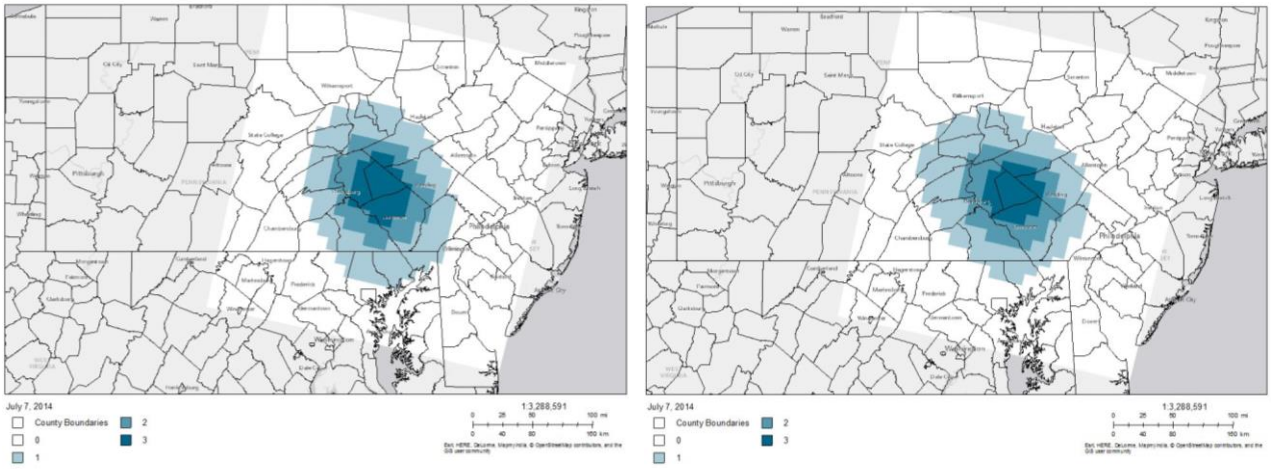


[128] In some past initial area designations efforts, EPA has used HYSPLIT backward trajectories to assist in determining nonattainment area boundaries. A HYSPLIT backward trajectory is usually depicted on a standard map as a single line, representing the centerline of an air parcel's motion, extending in two dimensional (x,y) space from a starting point and regressing backward in time to a point of origin. Backward trajectories may be an appropriate tool to assist in determining an air parcel's point of origin on a day in which a short-term standard, such as an 8-hour standard or a 24-hour standard, was exceeded. However, for an annual standard, such as the 2012 annual $PM_{2.5}$ NAAQS, every trajectory on every day is important. Plotting a mass of individual daily (e.g., 365 individual back trajectories), or more frequent, HYSPLIT trajectories may not be helpful as this process is likely to result in depicting air parcels originating in all directions from the violating monitoring site.

[129] HYSPLIT - Hybrid Single Particle Lagrangian Integrated Trajectory Model, *http://www.arl.noaa.gov/HYSPLIT_info.php*

[130] The KDEs graphically represent the aggregate of HYSPLIT backward trajectories for the years 2010-2012, run every third day (beginning on the first day of monitoring), four times each day, and ending at four endpoint heights.

Third Quarter **Fourth Quarter**



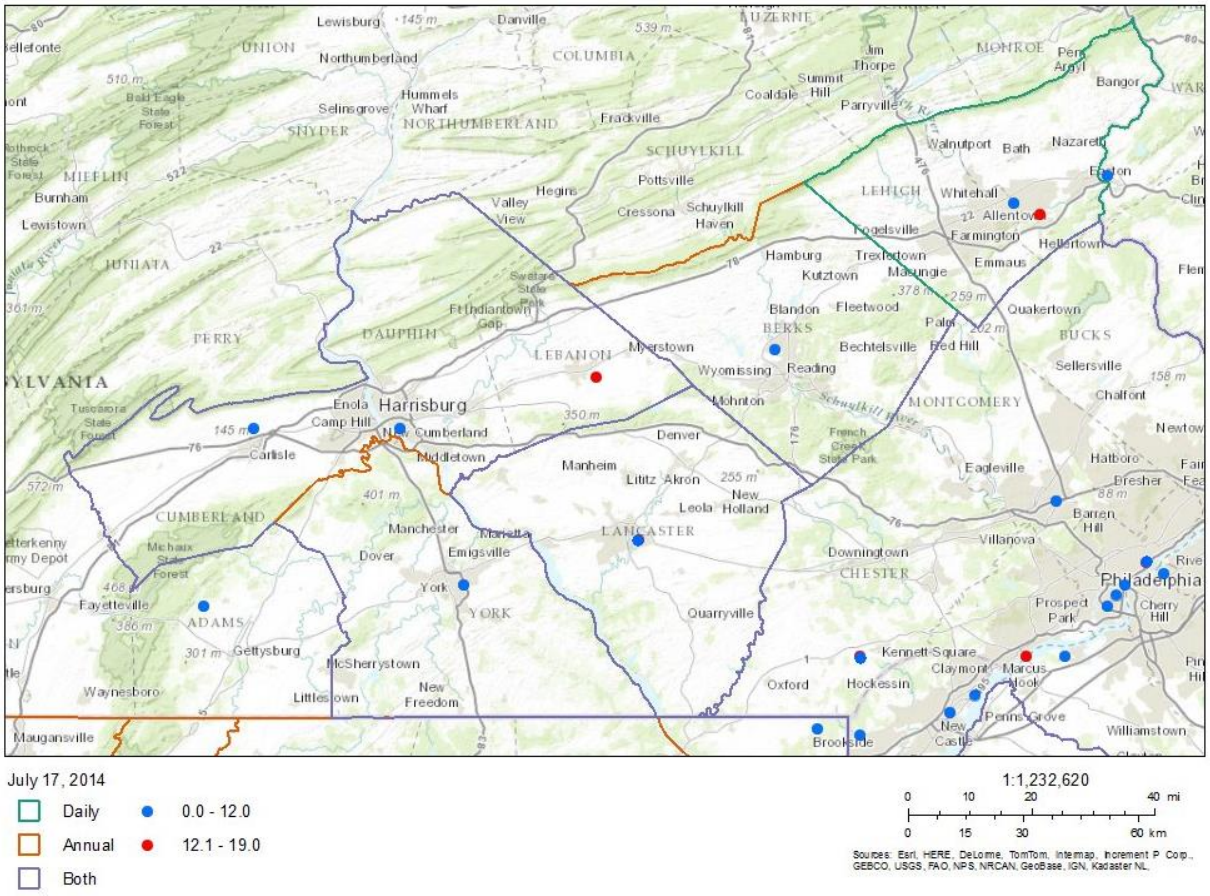
Both the wind roses and HYSPLIT KDE plots indicate that prevailing winds in the Lebanon County area are westerly. The counties with the highest emissions in the area of analysis, Lancaster and Berks, therefore are not upwind of the violating monitor. Lancaster County is south of the violating monitor, and Berks County is to the east. Lebanon County falls in the higher density grid cells which indicate a very high potential for transport (darkest blue) in all four quarters. The Carmeuse Lime facility in Lebanon County is 9 miles west of the Lebanon County monitor. Parts of Dauphin County also fall in the higher density grid cells. There are no major sources in Dauphin County and, as discussed in Factor 4 below, mountains to the north and west of the monitor may limit transport of low level emissions, such as mobile emissions, from Dauphin County.

Factor 4: Geography/topography

To evaluate the geography/topography factor, EPA assessed physical features of the area of analysis that might define the airshed and thus affect the formation and distribution of $PM_{2.5}$ concentrations over the area.

Topography is an important factor, as Lebanon County is in a river valley almost entirely surrounded by low mountains. The mountains to the north of the Lebanon County monitor run from the southwest to the northeast and provide a physical barrier between Schuylkill and Dauphin counties and the violating monitor. These mountains limit transport of low-level emissions, such as mobile emissions, and impact meteorology and $PM_{2.5}$ formation.

Figure 10. Topography of the Lebanon County and Surrounding Area



Factor 5: Jurisdictional boundaries

In defining the boundaries of the intended Lebanon County nonattainment area, EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Existing jurisdictional boundaries often signify the state and local governmental organization with the necessary legal authority for carrying out air quality planning and enforcement functions for the intended area. Examples of such jurisdictional boundaries include existing/prior nonattainment area boundaries for particulate matter, county lines, air district boundaries, township boundaries, areas covered by a metropolitan planning organization, state lines, and Reservation boundaries, if applicable. Where existing jurisdictional boundaries were not adequate or appropriate to describe the nonattainment area, EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

The violating monitor is located in the Lebanon, PA MSA. This is a single county MSA which consists of Lebanon County, PA. The Lebanon, PA MSA is served by the Lebanon County Metropolitan Planning organization.

The Lebanon County has previously established nonattainment boundaries associated with the 1997 annual and the 2006 24-hour $PM_{2.5}$ NAAQS. Lebanon County is part of the Harrisburg-Lebanon-Carlisle nonattainment area for the 1997 annual $PM_{2.5}$ NAAQS. That area consists of Cumberland, Dauphin, Lebanon Counties. For the 2006 24-hour $PM_{2.5}$ NAAQS, Lebanon County is part of the Harrisburg-Lebanon-Carlisle-York nonattainment area, which also includes Cumberland, Dauphin, and York Counties. EPA does not believe that the counties included in those nonattainment areas, Cumberland, Dauphin, and York Counties, contribute to the violation at the Lebanon County monitor.

Conclusion for the Lebanon County

Based on the assessment of factors described above, both individually and in combination, EPA has preliminarily concluded that only Lebanon County should be included in the Lebanon County nonattainment area because it is violating the 2012 annual $PM_{2.5}$ NAAQS. EPA does not believe that the other counties in the area of analysis contribute to the violation in Lebanon County.

Seasonal variation can highlight those conditions most associated with high average concentration levels of $PM_{2.5}$. The Lebanon County monitor does not follow the seasonal pattern seen at the other monitors in the area of analysis. The other three monitors in Berks, Dauphin and Lancaster counties tend to track together, with higher first and third quarters, but the Lebanon County monitor does not have a clear seasonal pattern, indicating local influences at the violating monitor.

Organic mass and elemental carbon are the major components of the urban increment at the Lebanon County monitor. These components suggests that the sources of $PM_{2.5}$ are local in nature and could result from mobile, area or local industrial sources.

Lancaster County has the highest total emissions of directly emitted $PM_{2.5}$ and its precursors in the area of analysis. The $PM_{2.5}$ emissions in Lebanon and Dauphin counties are mainly NO_X and VOC emissions. Lebanon County also has a high level of NH_3 emissions. Looking at the components of $PM_{2.5}$, Lancaster and Berks counties have high POM, EC and VOC emissions, however, Lancaster and Berks counties are less likely to contribute to the Lebanon County violating monitor due to wind direction. Dauphin, Schuylkill and Lebanon counties have similar levels of POM, EC and VOC emissions.

There are large point sources (over 500 tpy) to the northeast and east of the violating Lebanon monitor in Schuylkill County and Berks County, respectively. There is one point source in Lebanon County and there are no point sources in Dauphin County. Dauphin County does have a moderate size population and amount of VMT which likely indicate mobile or area sources of emissions.

Both the wind roses and HYSPLIT KDE plots indicate that prevailing winds in the Lebanon County area are westerly. The counties with the highest emissions in the area of analysis, Lancaster and Berks, therefore are not upwind of the violating monitor. Lancaster County is south of the violating monitor, and Berks County is to the east. Sources to the north in Schuylkill County are also not in the regional wind direction and therefore less likely to contribute to the Lebanon County monitor.

Topography is an important factor, as Lebanon County is in a river valley almost entirely surrounded by low mountains. The mountains to the north of the Lebanon County monitor run from the southwest to the northeast and provide a physical barrier between Schuylkill and Dauphin Counties and the violating monitor. These mountains limit transport of low-level emissions from these counties, such as mobile emissions, and impact meteorology and $PM_{2.5}$ formation.

Lebanon County is in a single county MSA, served by a single county MPO. Lebanon County is in a river valley almost entirely surrounded by low mountains. These mountains limit transport of low-level emissions and impact meteorology and $PM_{2.5}$ formation.

The Lebanon County has previously established nonattainment boundaries associated with the 1997 annual and the 2006 24-hour $PM_{2.5}$ NAAQS. However, EPA does not believe that the counties included in those nonattainment areas, Cumberland, Dauphin, and York Counties, contribute to the violation at the Lebanon County monitor.