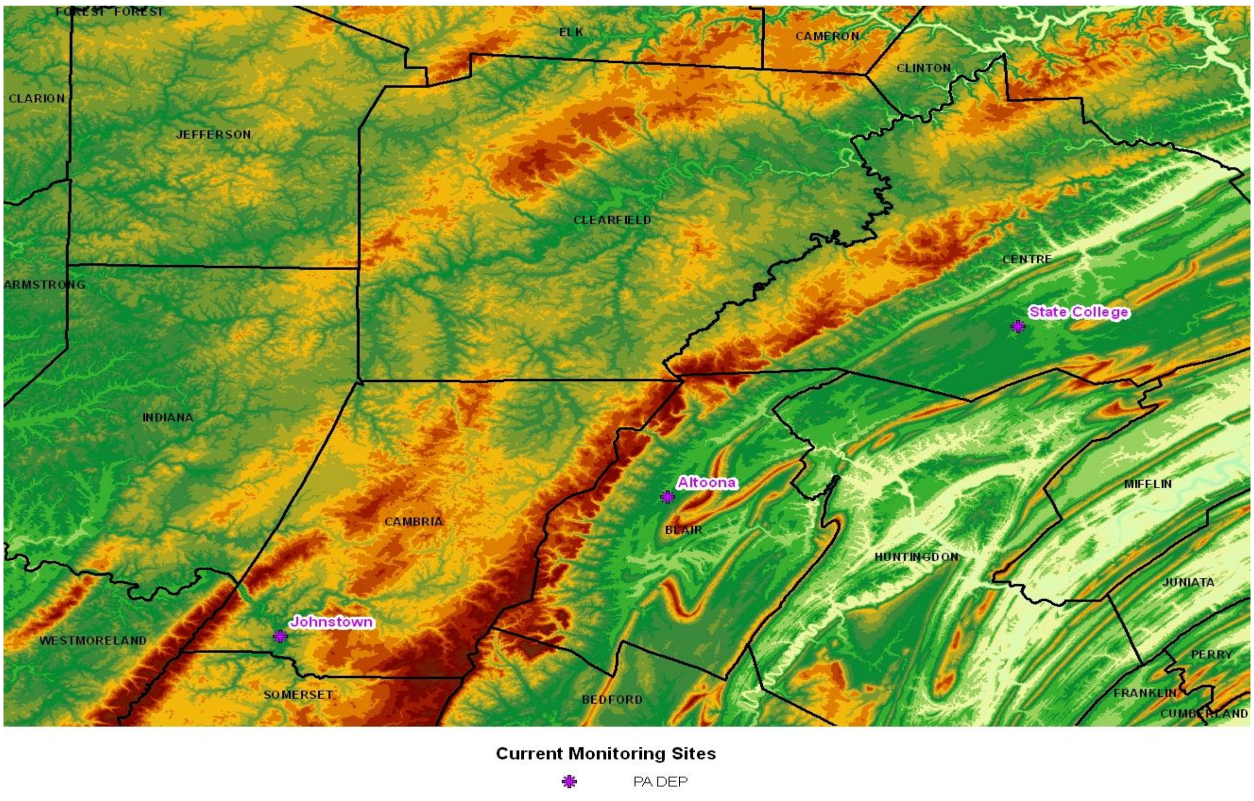
Appendix C-4
CAMBRIA COUNTY AREA

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

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

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

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



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

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

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

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

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

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

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

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

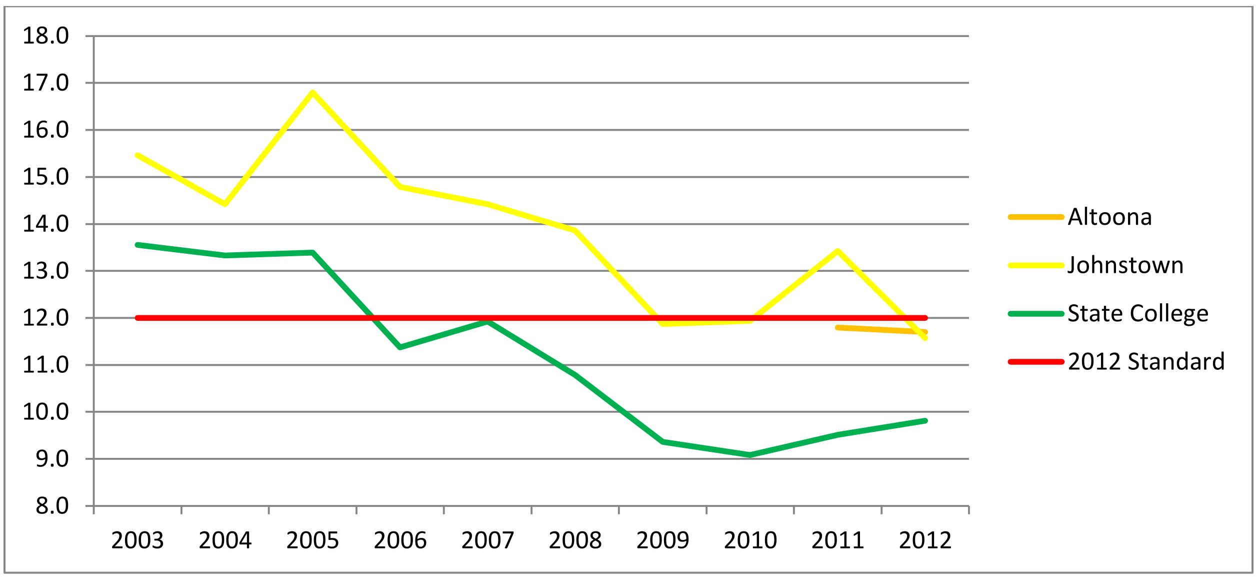
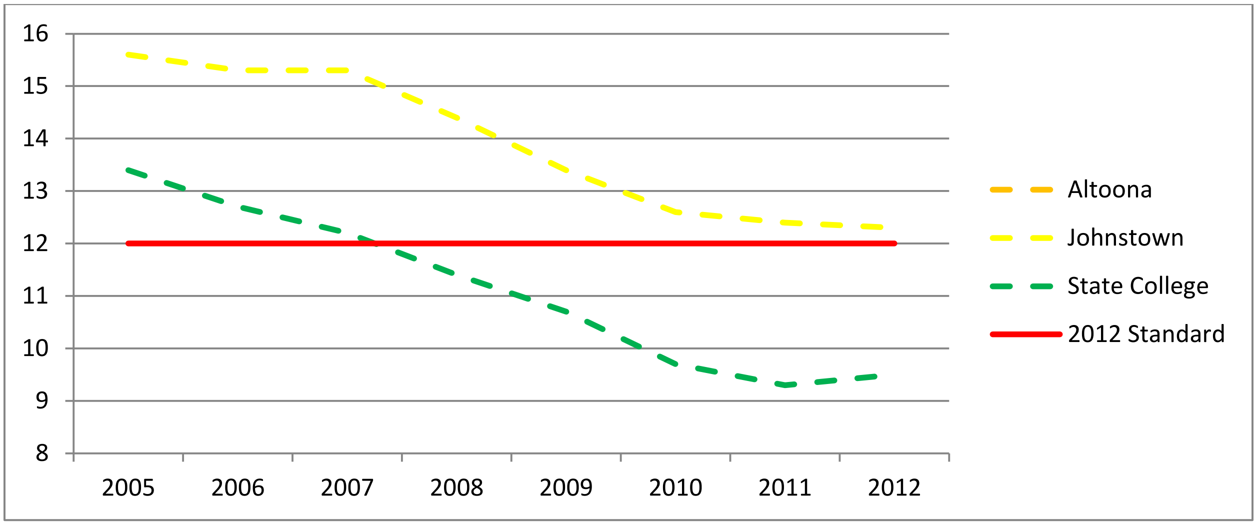


Figure C-4.2b: Johnstown Area $PM_{2.5}$ Annual Design Values



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

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

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

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

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

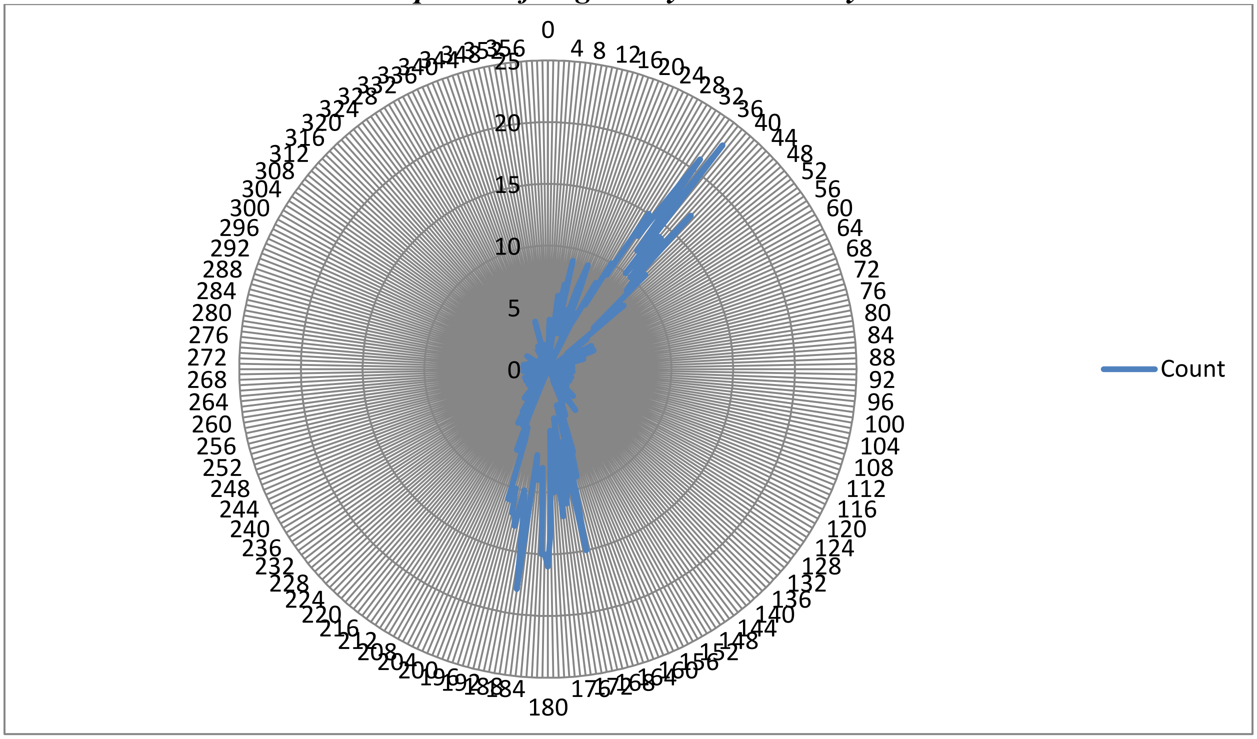


Figure C-4.4: Johnstown $PM_{2.5}$ Concentration Distribution by Wind Direction
Top 25% of Regionally "Clean" Days

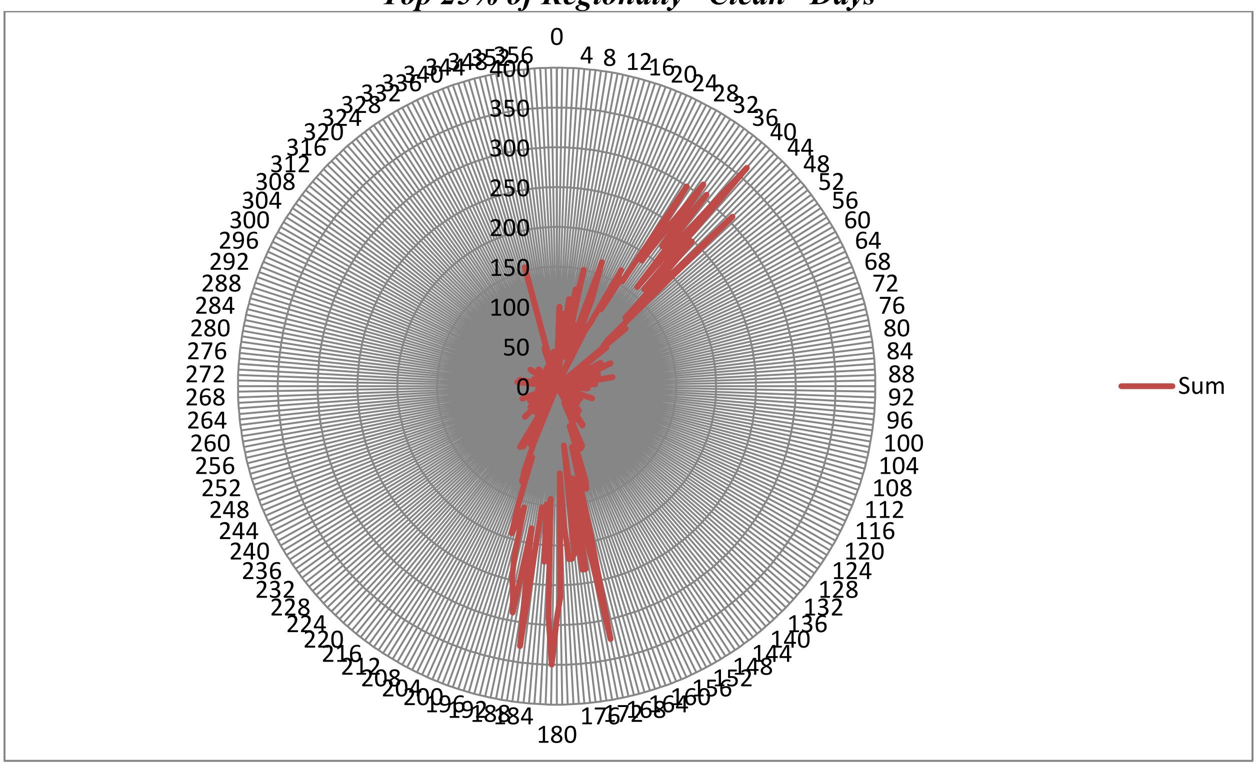
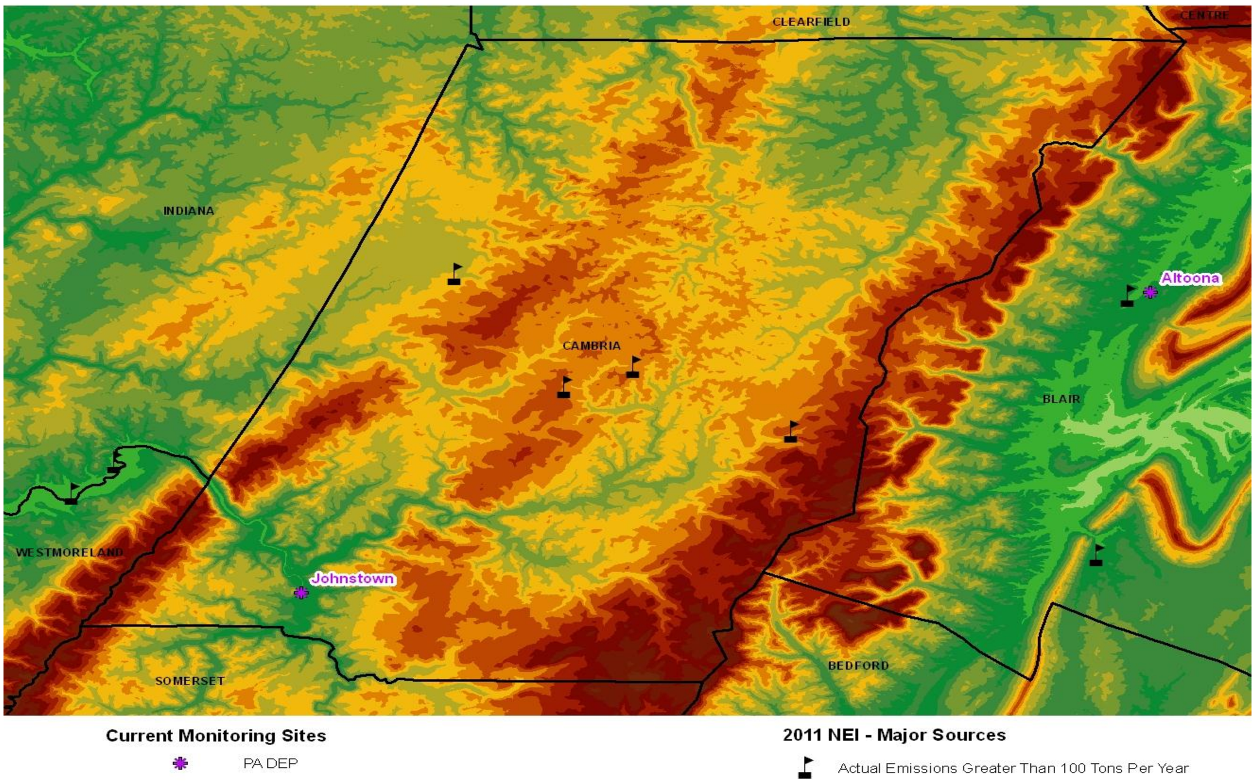


Figure C-4.3 illustrates that the highest frequency of wind distribution on the top 25% days is coming from the south and northeast. Figure C-4.4 illustrates that the highest $PM_{2.5}$ concentrations are coming from south and northeast as well.

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

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



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

The Composition of the $PM_{2.5}$

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

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

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

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

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

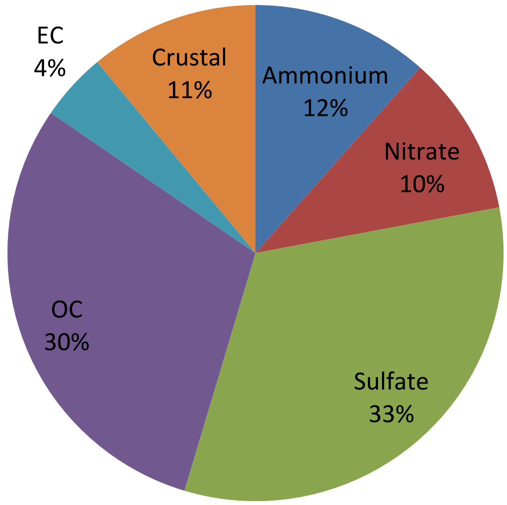
Table C-4.3: Johnstown Speciated $PM_{2.5}$ Data*
Warm Season (3rd Quarter) Breakdown – 2010-12

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

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

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

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



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

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

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

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

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

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

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

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

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

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

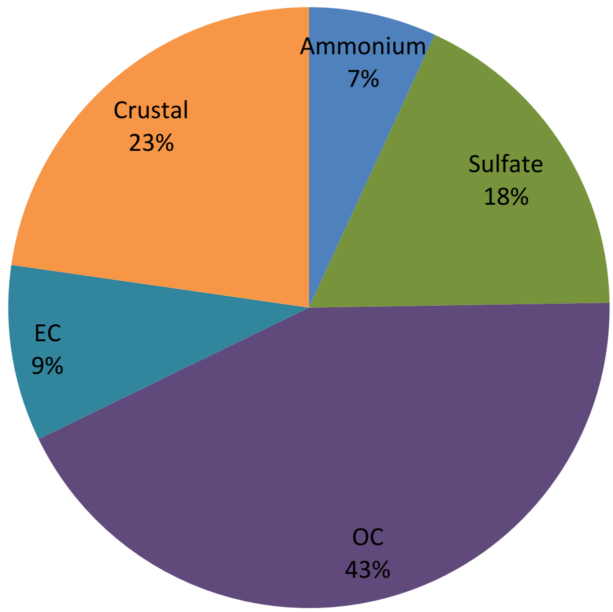


Figure C-4.8: Urban Excess
Johnstown vs. Florence
2010-12 – 3rd Quarter

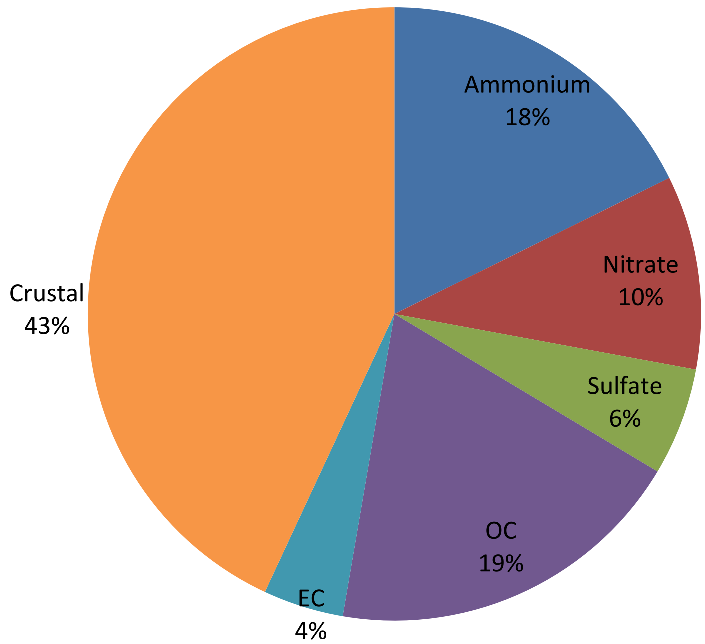


Figure C-4.7 and Figure C-4.8 display the same problem; Johnstown has excess ammonium, organic carbon and crustal mass compared to Florence. Sulfate levels, which are indicative of regional emissions from sources such as coal fired electric generation units, were fairly uniform at the Johnstown and Florence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

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

Summary

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

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