

## Appendix C-6 LIBERTY-CLAIRTON AREA

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

### Analysis of Topography in Proximity of the Liberty Monitor

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

*Figure C-6.1: Liberty-Clairton Vicinity PM<sub>2.5</sub> Monitoring Map*

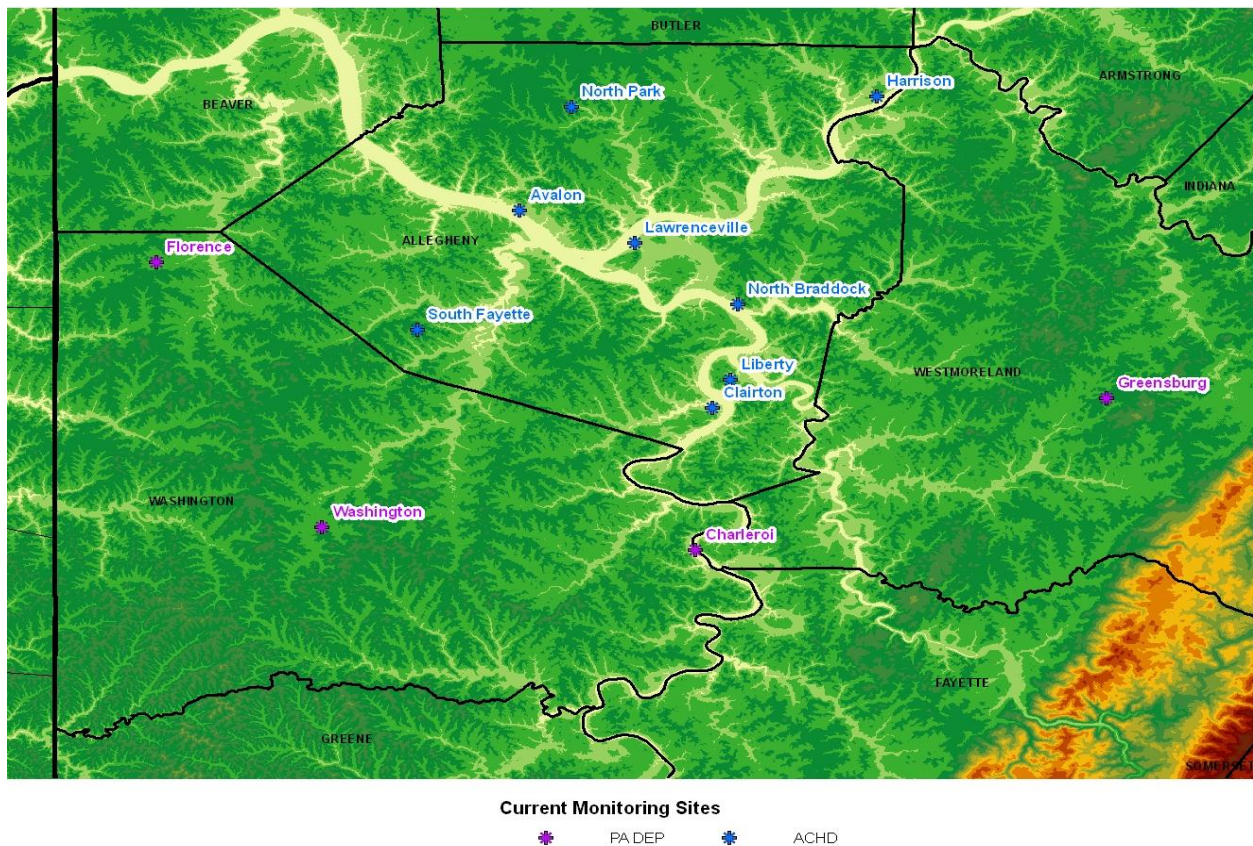


Figure C-6.1 also illustrates the topography near the Liberty monitor. The topographical differences between the location of the local sources of PM<sub>2.5</sub> and its precursors within the river valley, and the Liberty monitor which is elevated from the river valley, play a role in the violation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

### **Analysis of the Ambient PM<sub>2.5</sub> Data – A Design Value Contribution Analysis**

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

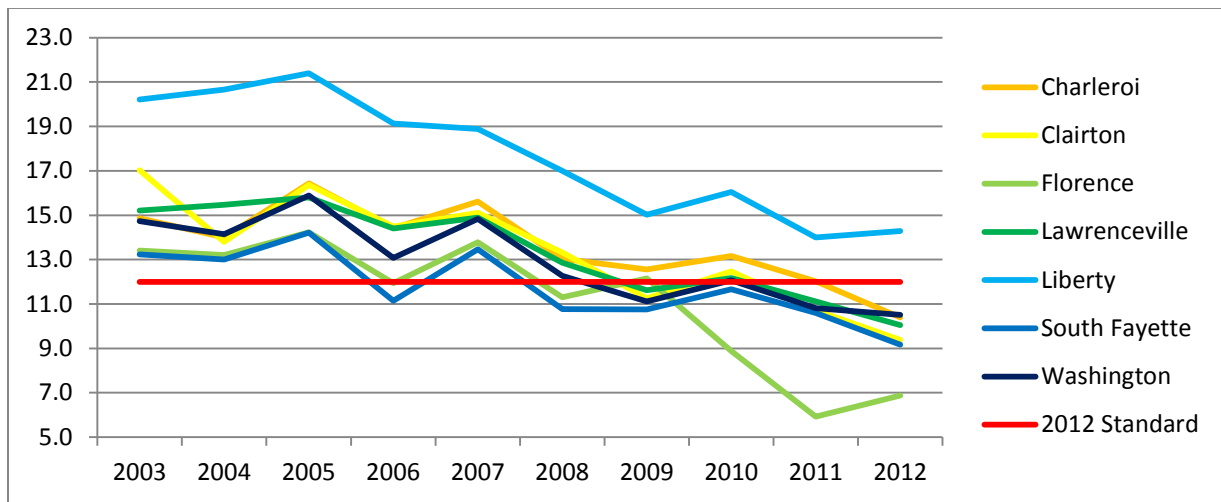
Results from the design value contribution analysis for the Liberty-Clairton area are summarized in Table C-6.1. Ultimately, the type of contribution this daily value had on the 3-year design value (by comparing this value to 12 µg/m<sup>3</sup>) was determined. The design value for each day a monitor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

**Table C-6.1: Liberty-Clairton Area  
2012 PM<sub>2.5</sub> Annual Design Value Contribution Analysis**

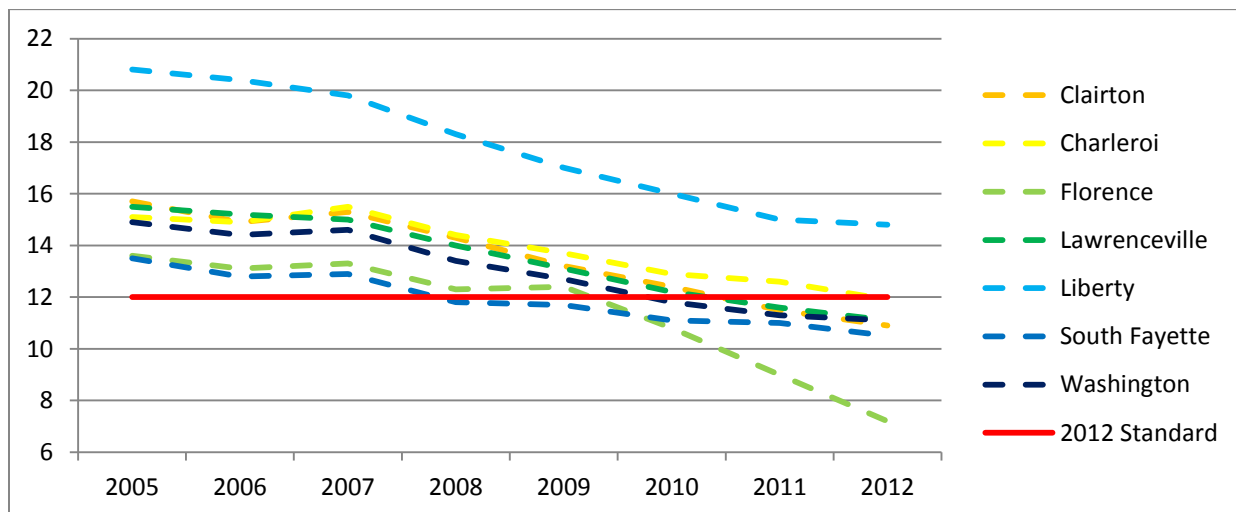
Site Name	Site ID	Owner	0 - 6.0	6.0 - 12.0	12.0 - 18.0	18.0 - 24.0	24.0 - 30.0	30.0 - 36.0	36.0 - 42.0	42.0 - 48.0	48.0 - 54.0	54.0 - 60.0	Sum
<b>Monitors Attaining 2012 PM 2.5 Standard</b>													
Florence	421255001	PA DEP	-3.7384	-1.4990	0.2361	0.1479	0.0553	0.0180	0.0000	0.0000	0.0000	0.0000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

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

**Figure C-6.2a: Liberty-Clairton Area PM<sub>2.5</sub> Annual Averages**



**Figure C-6.2b: Liberty-Clairton Area PM<sub>2.5</sub> Annual Design Values**

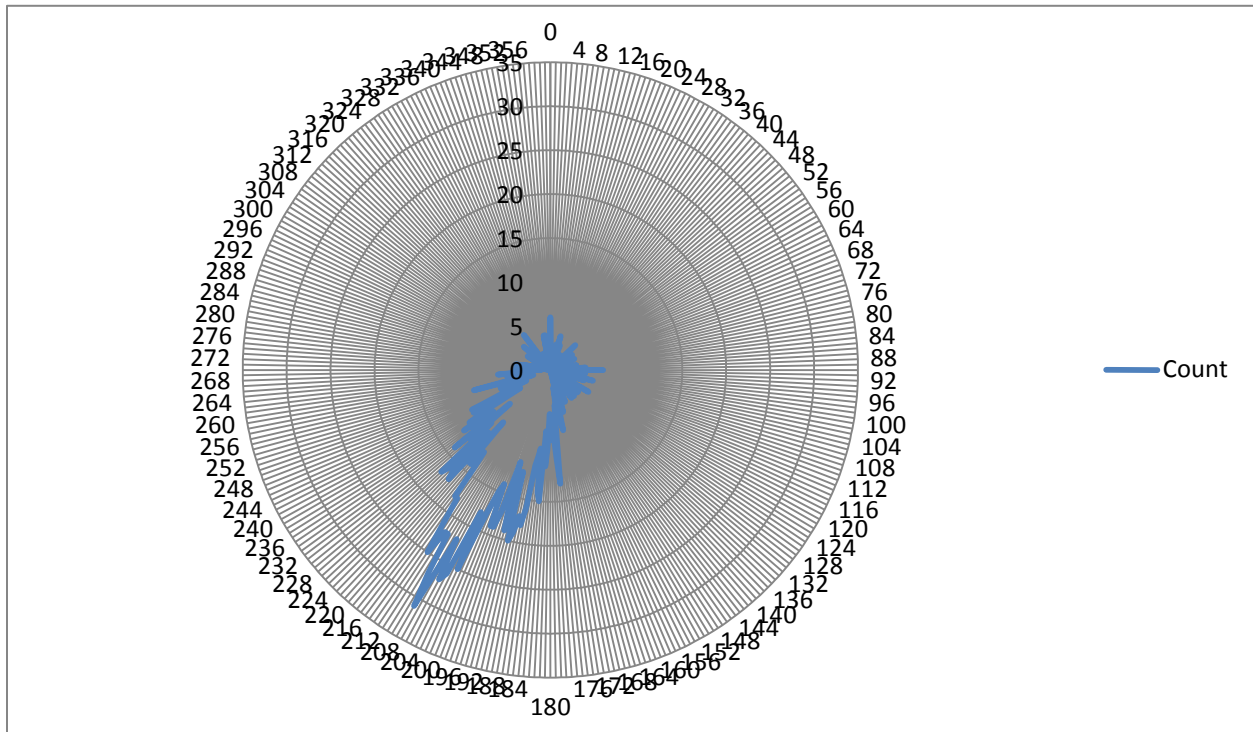


Additional analyses were completed to determine what was contributing to the fewer number of “clean” days at the Liberty monitor. The Department identified days when the Liberty monitor’s PM<sub>2.5</sub> concentrations were relatively high but regional monitoring concentrations in the Liberty-Clairton area were “clean.” Between 2010 and 2012, the Department identified 252 days in which the Liberty monitor was at least one standard deviation above the Pittsburgh metropolitan statistical area (MSA) while the regional average was at or below 12 µg/m<sup>3</sup>. The most extreme events (top 25%) were further analyzed to determine why the Liberty monitor’s concentrations were high when regional concentrations were low.

### **Meteorological Conditions Impacting High PM<sub>2.5</sub> Days at Liberty**

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

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



**Figure C-6.4: Liberty PM<sub>2.5</sub> Concentration Distribution by Wind Direction  
Top 25% of Regionally “Clean” Days**

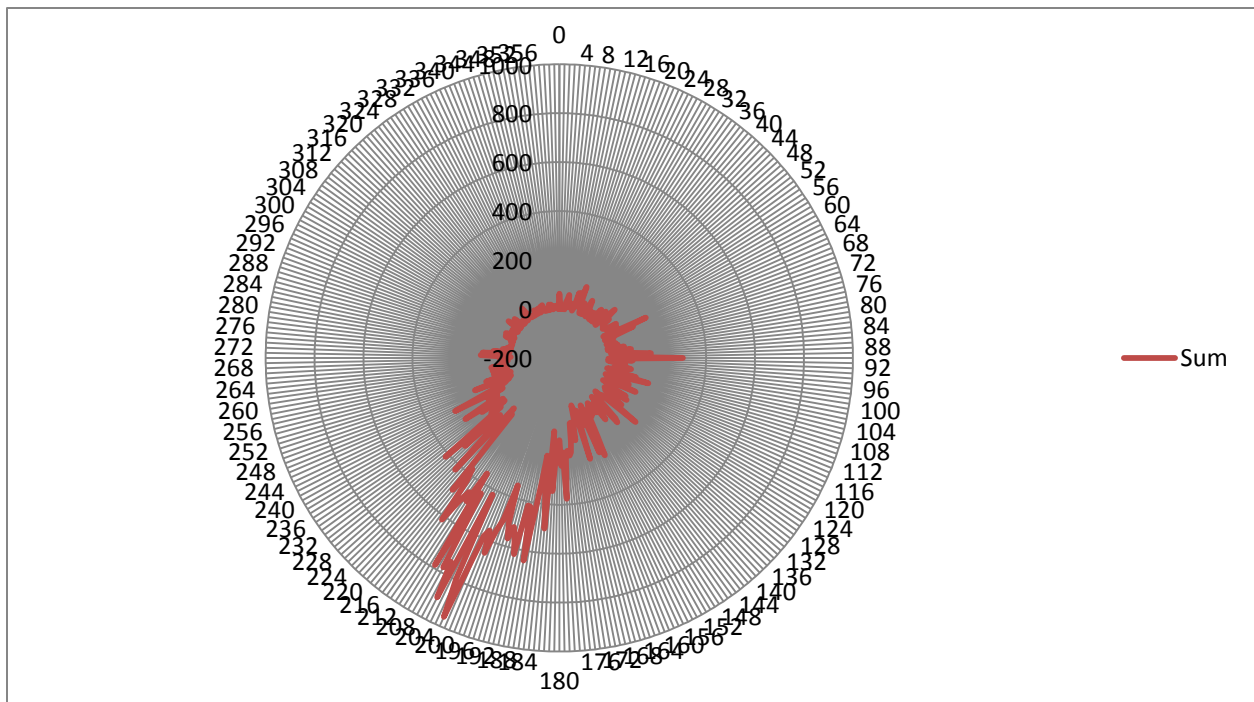


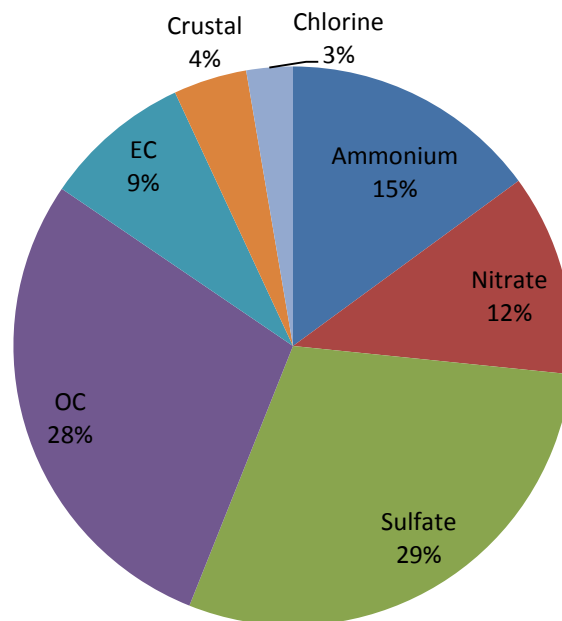
Figure C-6.3 illustrates that the highest frequency of wind distribution on the top 25% high days is coming from the southwest. Figure C-6.4 illustrates that the highest PM<sub>2.5</sub> concentrations are coming from the same direction.

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

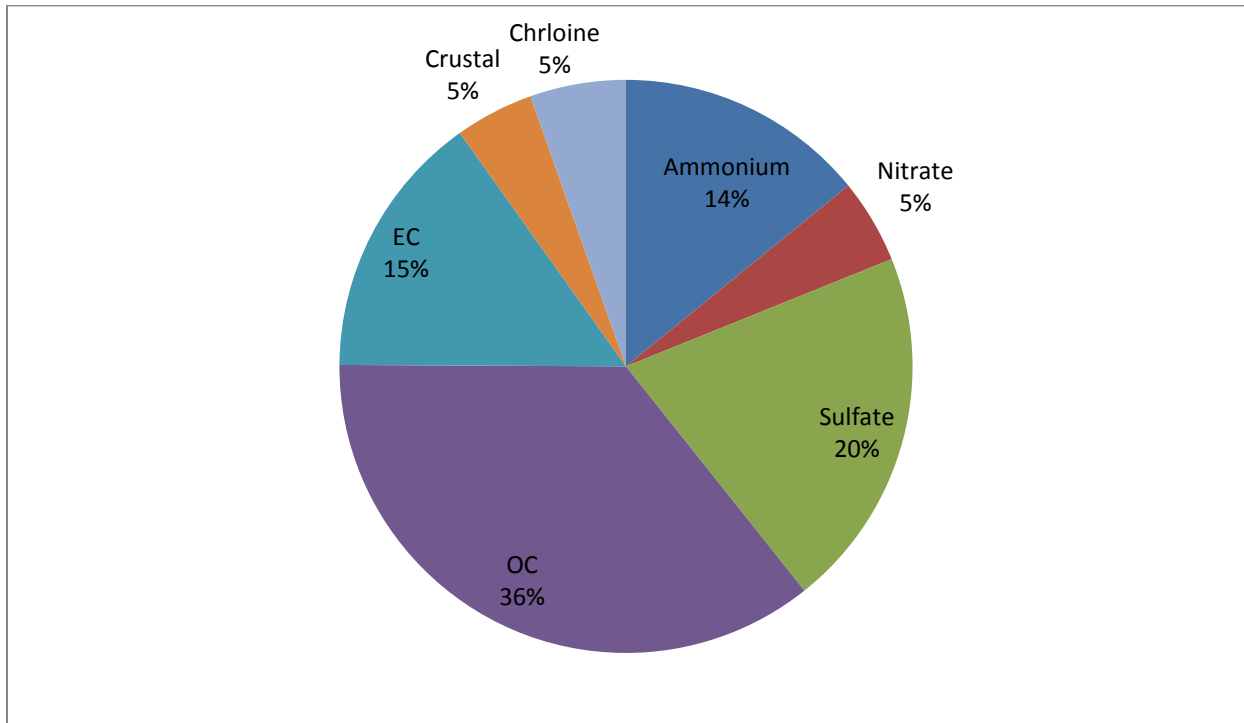
### Analysis of Speciated PM<sub>2.5</sub> During Top 25% High Days

The Department analyzed the days in which the Liberty monitor collected speciation data during the top 25% days. Of the 63 days which were in the top 25%, speciated data was collected on eight days. Figure C-6.5 displays the distribution of the speciated components of PM<sub>2.5</sub> during the entire 2010 – 12 season. Figure C-6.6 displays the distribution of the speciated components of PM<sub>2.5</sub> during the eight days in the top 25% of the regionally “clean” days in the Liberty-Clairton area.

**Figure C-6.5: Liberty PM<sub>2.5</sub> Speciation Data 2010 – 12**



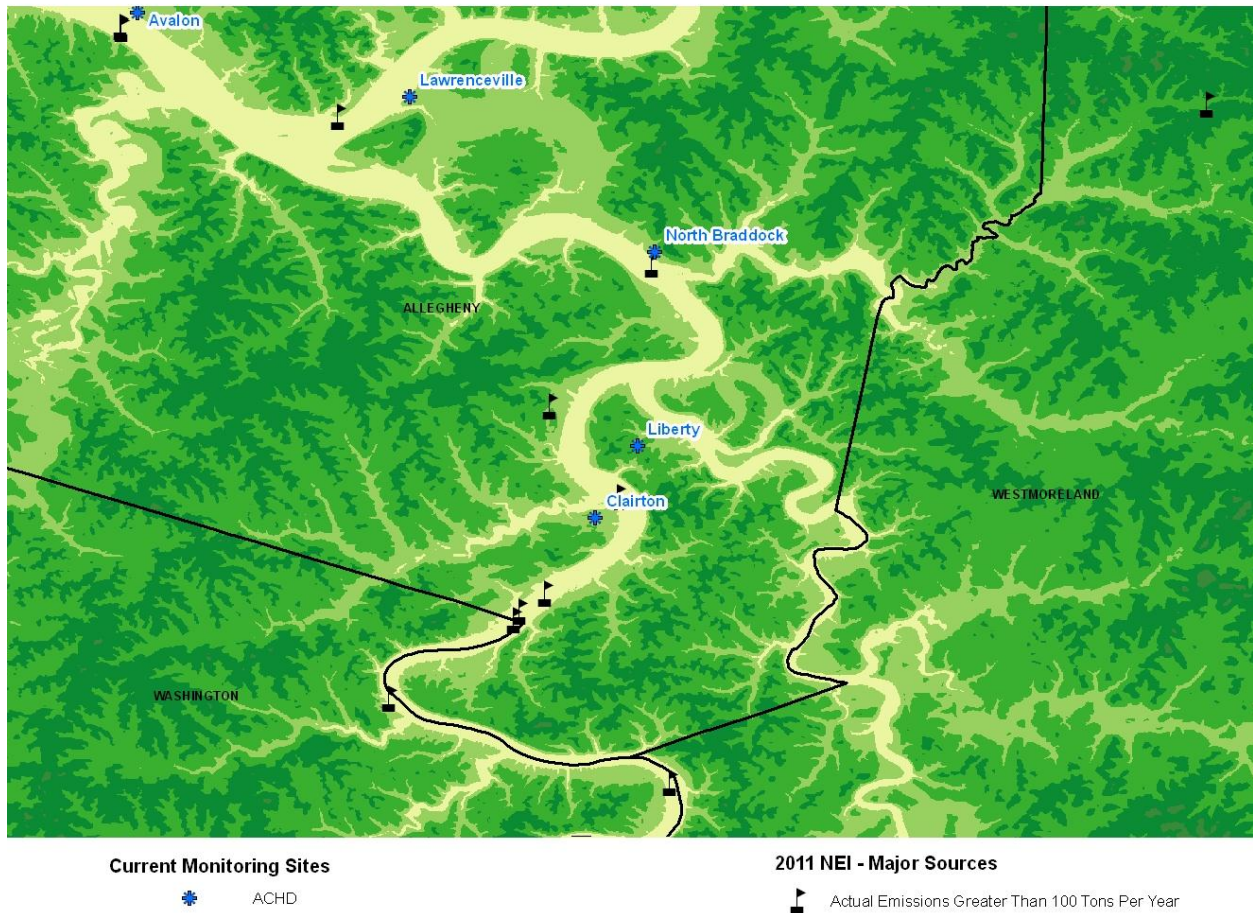
**Figure C-6.6: Liberty PM<sub>2.5</sub> Speciation Data  
Top 25% of Regionally “Clean” Days**



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



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



### **The Change in the Composition of the PM<sub>2.5</sub>**

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

**Table C-6.2: Liberty Speciated PM<sub>2.5</sub> Data\***  
**Cold Season (1<sup>st</sup> Quarter) Comparison – 2005-07 Versus 2010-12**

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

\*All concentrations are averages and have units of µg/m<sup>3</sup>

**Table C-6.3: Liberty Speciated PM<sub>2.5</sub> Data\***  
**Warm Season (3<sup>rd</sup> Quarter) Comparison – 2005-07 Versus 2010-12**

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

\*All concentrations are averages and have units of µg/m<sup>3</sup>

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

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

**Table C-6.4: Florence Speciated PM<sub>2.5</sub> Data\***  
**Cold Season (1<sup>st</sup> Quarter) Comparison – 2005-07 Versus 2010-12**

<b>Year</b>	<b>Ammonium</b>	<b>Nitrate</b>	<b>Sulfate</b>	<b>OC</b>	<b>EC</b>	<b>Crustal</b>
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  $\mu\text{g}/\text{m}^3$

**Table C-6.5: Florence Speciated PM<sub>2.5</sub> Data\***  
**Warm Season (3<sup>rd</sup> Quarter) Comparison – 2005-07 Versus 2010-12**

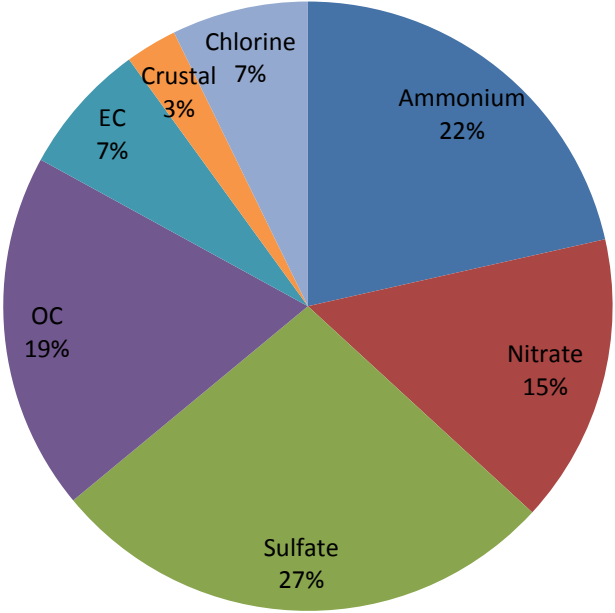
<b>Year</b>	<b>Ammonium</b>	<b>Nitrate</b>	<b>Sulfate</b>	<b>OC</b>	<b>EC</b>	<b>Crustal</b>
2005 – 07	2.15507812	0.34361657	8.17978175	3.32471443	0.35976005	0.83256858
2010 – 12	0.90089860	0.21878832	3.84856214	2.40295511	0.19830720	0.51222953
Difference (2005 – 07 minus 2010 – 12)	1.25417952	0.12482826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

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

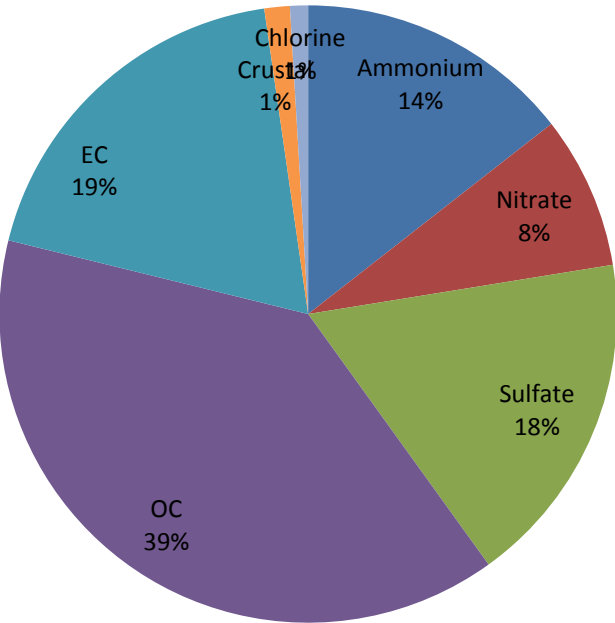
The reductions at the Florence monitor reflected in the “difference” row of Table C-6.4 and Table C-6.5 are more representative of the reductions that have been observed in western Pennsylvania and the Ohio Valley due to emission control strategies of various sources (for example, the installation of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

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

**Figure C-6.8: Urban Excess  
Liberty vs. Florence  
2010-12 – 1<sup>st</sup> Quarter**



**Figure C-6.9: Urban Excess  
Liberty vs. Florence  
2010-12 – 3<sup>rd</sup> Quarter**



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

## Summary

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

**Figure C-6.10: Recommended Liberty-Clairton PM<sub>2.5</sub> Nonattainment Area**

