

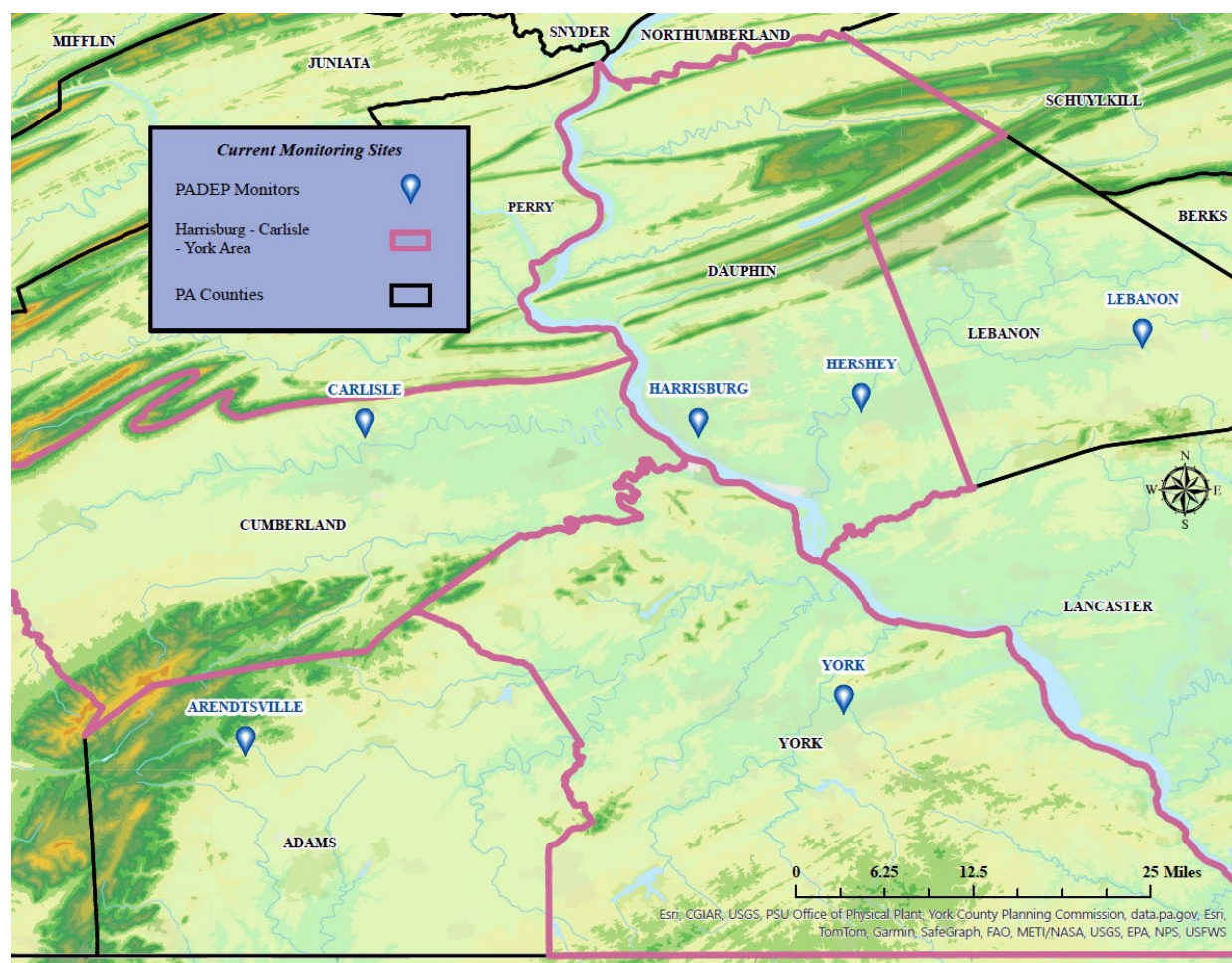
Appendix C-3 HARRISBURG-CARLISLE-YORK AREA

PADEP is recommending a Harrisburg-Carlisle-York area annual PM_{2.5} NAAQS nonattainment area consisting of Cumberland, Dauphin, and York counties. PADEP completed an analysis of the PM_{2.5} ambient air quality data, which outlines the reason for recommending an area consisting of Cumberland, Dauphin, and York counties. This analysis is provided below.

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

Based on EPA-certified 2023 PM_{2.5} valid design values, two monitors in the Harrisburg-Carlisle-York area are violating the 2024 PM_{2.5} annual standard of 9 µg/m³. The monitors and their design values are: Harrisburg (AIRS # 42-043-0401) at 9.8 µg/m³ (in Dauphin County) and York (AIRS #42-133-0008) at 9.3 µg/m³ (in York County). Figure C-3.1 is a map outlining the location of these monitors, along with monitors in attainment in the vicinity of the Harrisburg-Carlisle-York area.

Figure C-3.1: Harrisburg-Carlisle-York Area PM_{2.5} Monitoring Map



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PADEP has completed a design value contribution analysis for all of the PM_{2.5} monitors in the proximity of the Harrisburg-Carlisle-York region. The analysis attempts to determine the daily contribution of PM_{2.5} concentrations to the annual PM_{2.5} design value. EPA-certified daily PM_{2.5} measurements (EPA AQS AMP355 Report) 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 Harrisburg-Carlisle-York area are summarized in Table C-3.1. Ultimately, the type of contribution a given monitor's daily value had on the 3-year design value (by comparing this value to 9 µg/m³) 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, 2021, the Harrisburg monitor's 24-hour PM_{2.5} average was 13.8 µg/m³. Since this value falls in the 13.5-18.0 µg/m³ category in Table C-3.1, the calculated daily contribution to the design value was placed in this category.

In the first quarter of 2021 (January 1 to March 31), the Harrisburg monitor recorded 83 measurements. PADEP determined that the January 1, 2021, contribution assessment to the 2023 design value was 0.0048 µg/m³. The 0.0048 µg/m³ was calculated by subtracting the standard of 9.0 µg/m³ from the average daily value of 13.8 µg/m³ and then dividing this by the number of measurements for the quarter (83) times 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, 2021, through December 31, 2023. In Table C-3.1, the sum of the categorical breakdowns for the Harrisburg monitor equals 0.81 µg/m³, which demonstrates that the design value is 0.81 µg/m³ above the annual standard of 9 µg/m³.

Figures C-3.2.1 through C-3.2.11 show the design value contribution and category breakdown for the monitors in the Harrisburg-Carlisle-York area.

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**Table C-3.1: Harrisburg-Carlisle-York Area
2023 PM_{2.5} Annual Design Value Contribution Analysis**

Site Name	Site ID	Owner	0 - 4.5	4.5 - 9.0	9.0 - 13.5	13.5 - 18.0	18.0 - 22.5	22.5 - 27.0	27.0 - 31.5	31.5 - 36.0	36.0 - 40.5	40.5 - 300.0	Sum
Monitors Attaining 2024 PM 2.5 Standard													
Arendtsville	420010001	PA DEP	-1.2559	-1.1795	0.4409	0.4522	0.3403	0.1526	0.1208	0.0549	0.0253	0.5278	-0.3206
Lebanon	420750101	PA DEP	-1.4119	-1.0792	0.4014	0.4472	0.2835	0.2189	0.0510	0.0898	0.0268	0.3375	-0.6351
Carlisle	420410101	PA DEP	-1.7784	-1.0681	0.3199	0.4276	0.3550	0.1622	0.0589	0.0691	0.0000	0.3089	-1.1449
Monitors Not Attaining 2024 PM 2.5 Standard													
York	421330008	PA DEP	-0.9040	-1.1509	0.4474	0.5392	0.3779	0.2101	0.0834	0.1065	0.0329	0.5335	0.2760
Harrisburg	420430401	PA DEP	-0.9630	-0.9896	0.4592	0.6620	0.4259	0.3172	0.1714	0.1155	0.0281	0.5841	0.8108
Harrisburg-Carlisle-York Area Average			-1.2626	-1.0935	0.4138	0.5056	0.3565	0.2122	0.0971	0.0872	0.0226	0.4584	-0.2028

Figure C-3.2.1: Harrisburg PM_{2.5} Design Value Contribution (µg/m³)

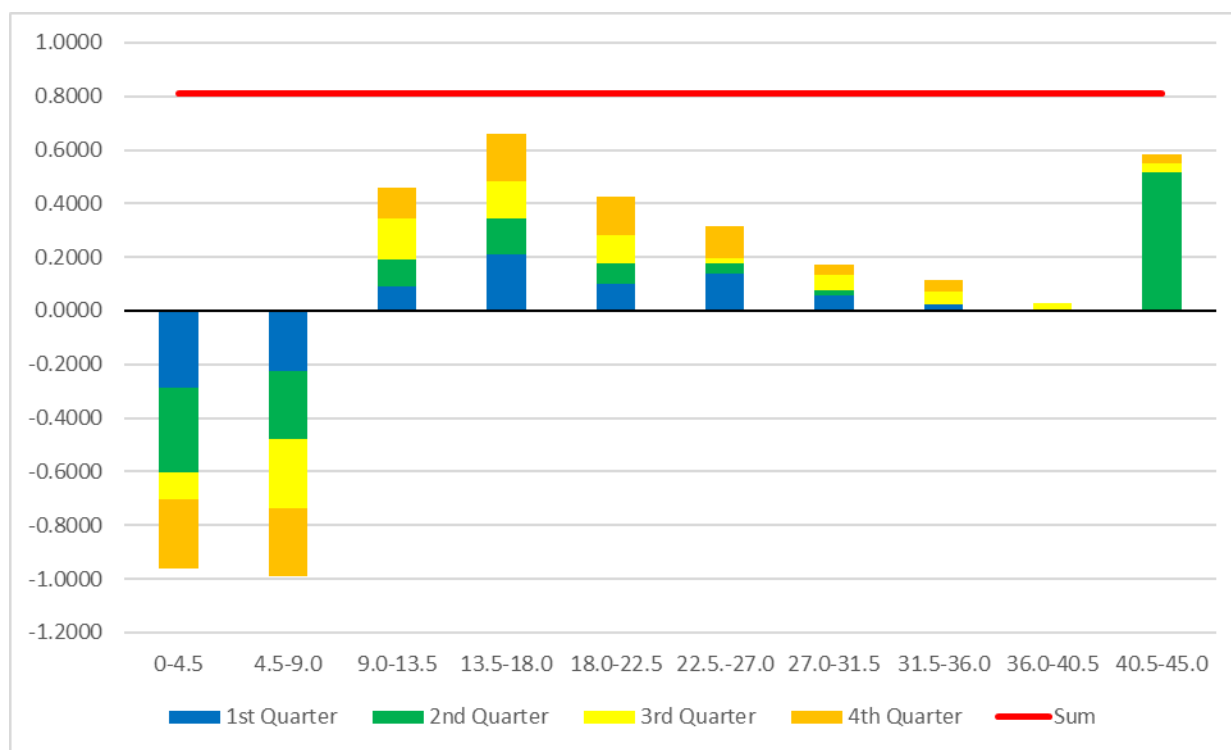


Figure C-3.2.2: Harrisburg PM_{2.5} Design Value Category Breakdown

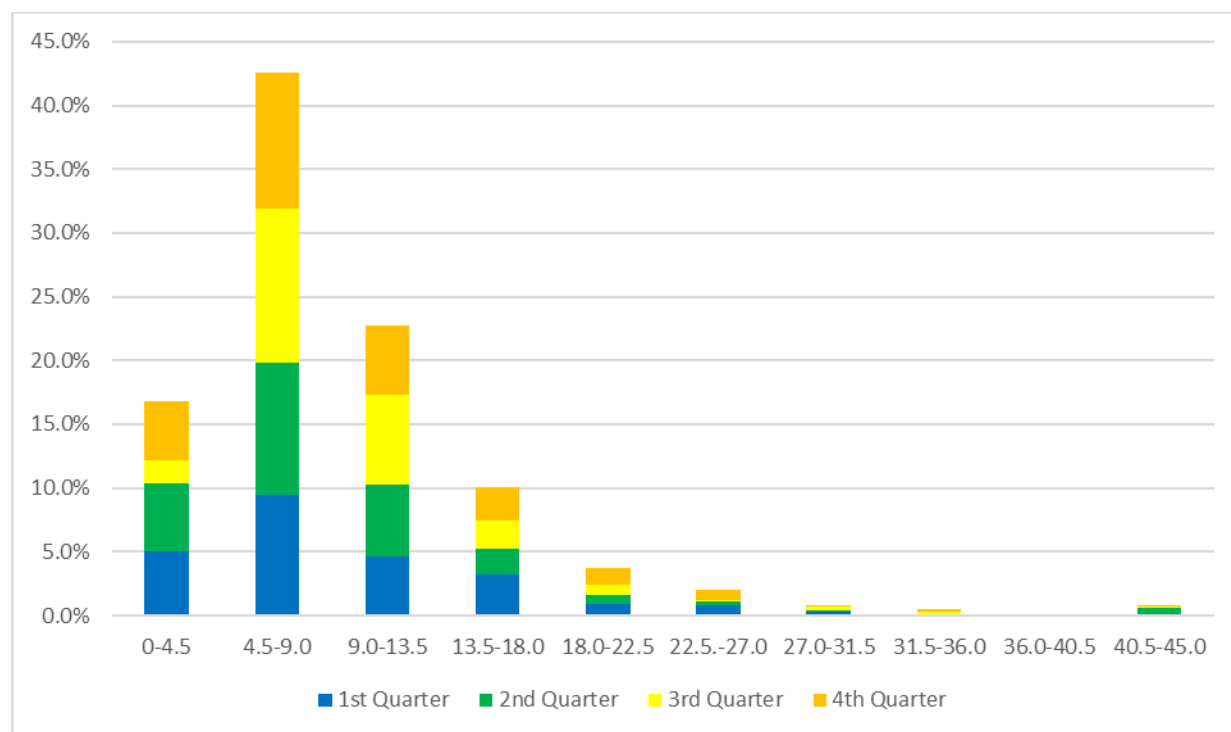


Figure C-3.2.3: York PM_{2.5} Design Value Contribution (µg/m³)

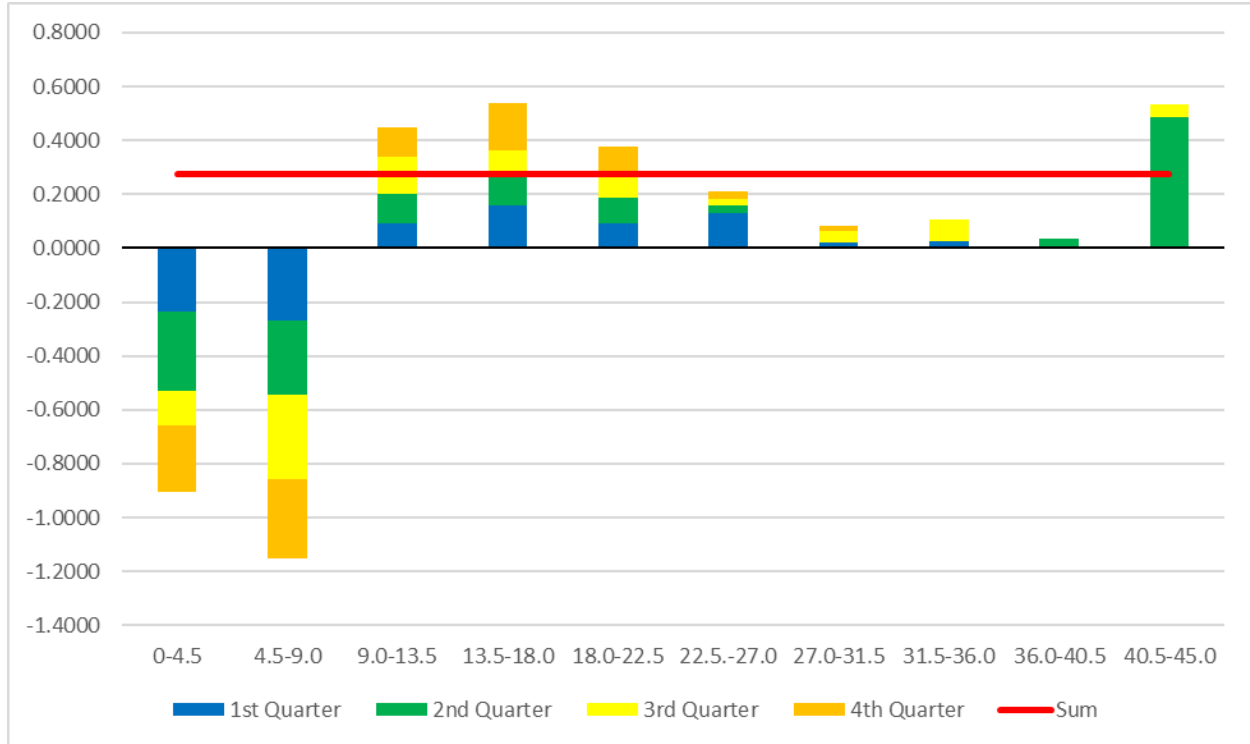


Figure C-3.2.4: York PM_{2.5} Design Value Category Breakdown

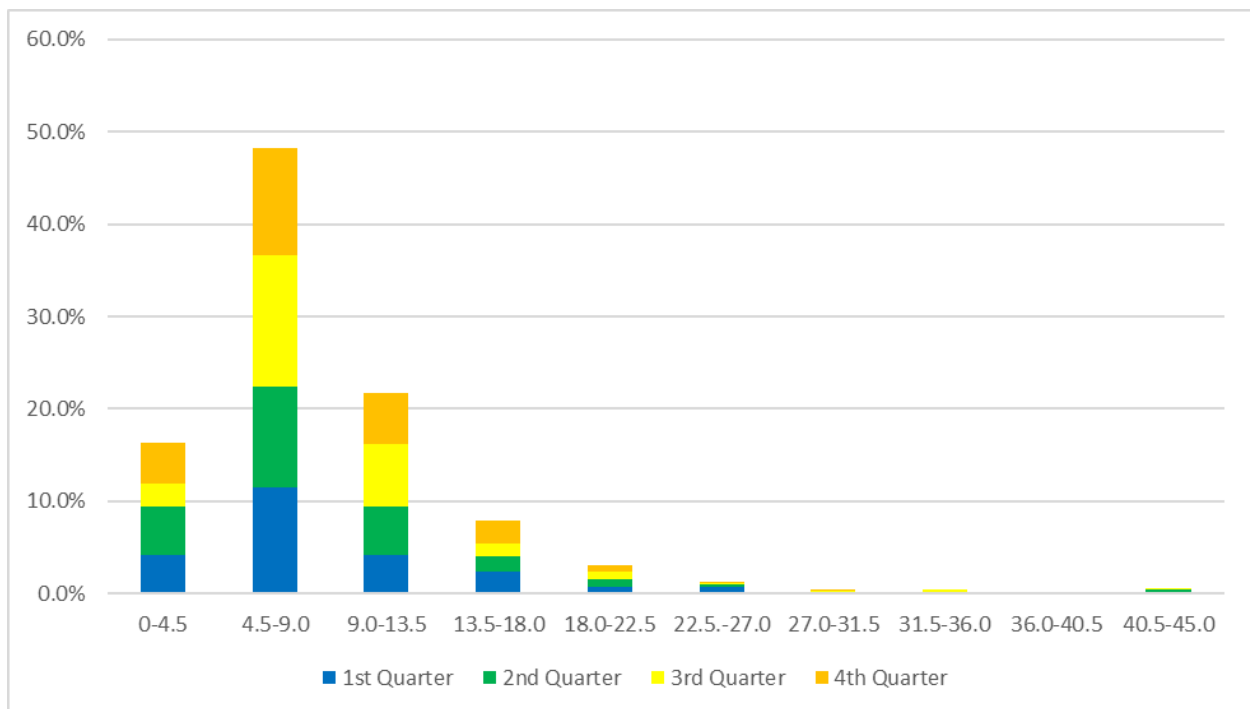


Figure C-3.2.5: Arendtsville PM_{2.5} Design Value Contribution (µg/m³)

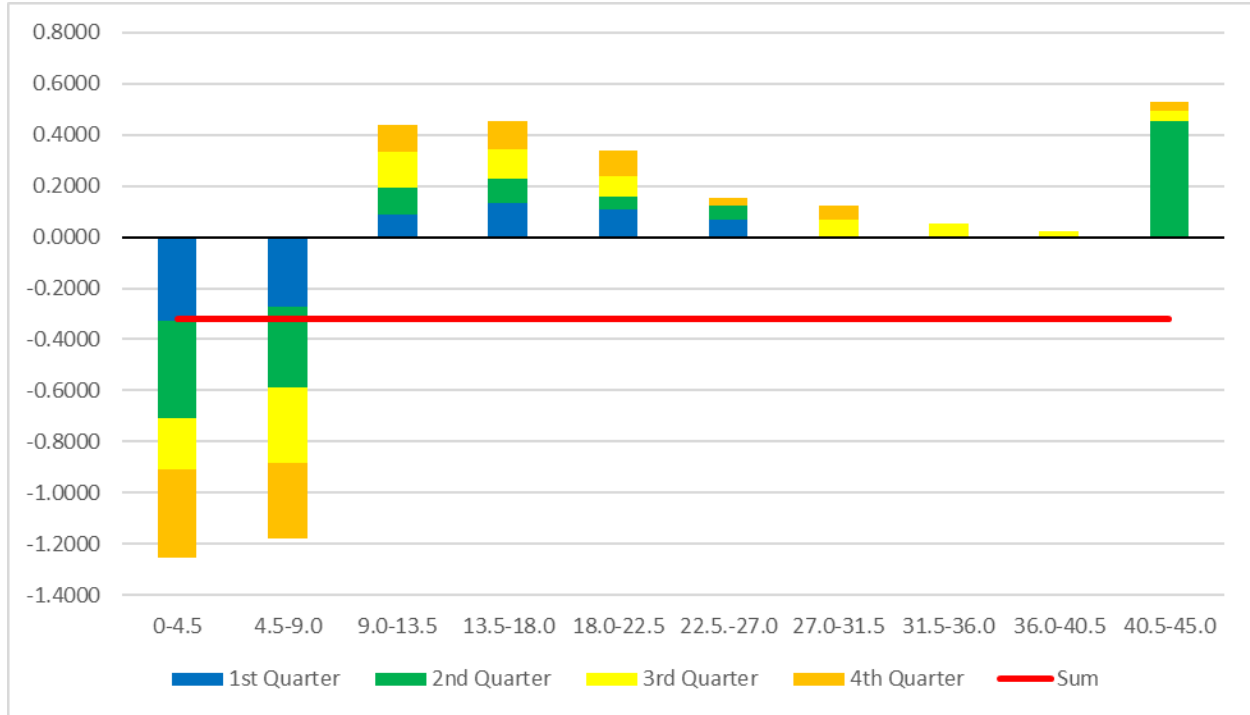


Figure C-3.2.6: Arendtsville PM_{2.5} Design Value Category Breakdown

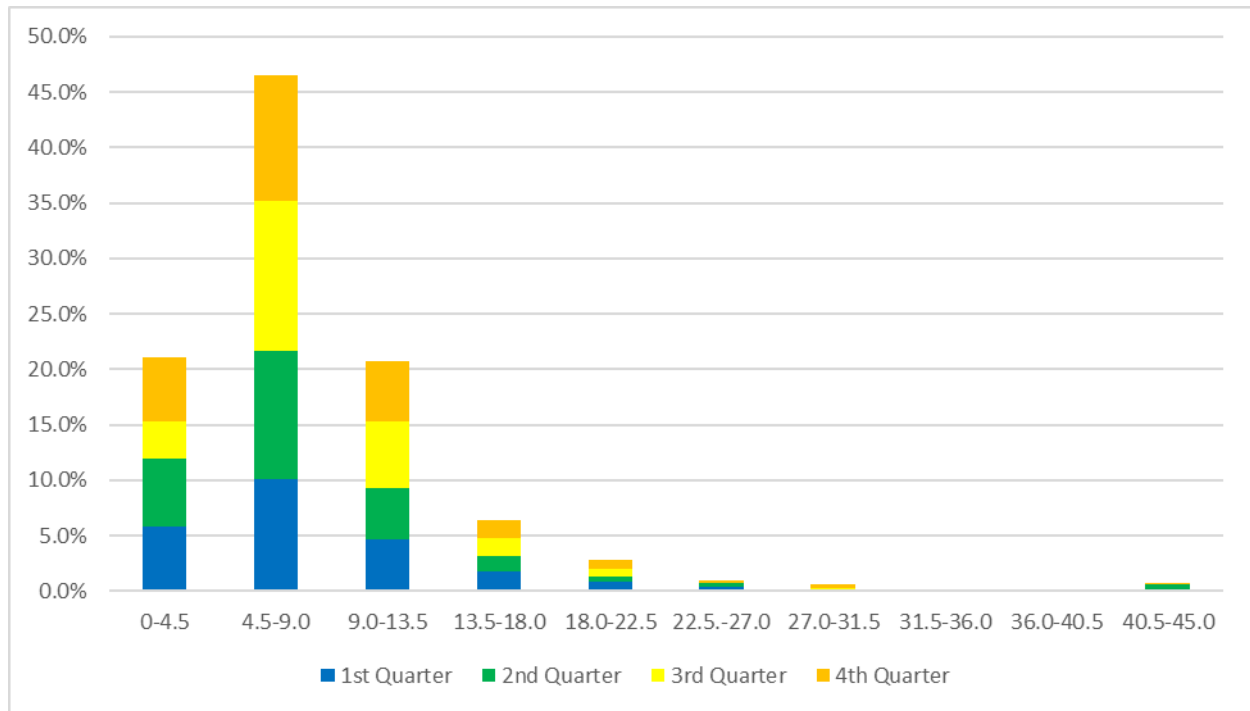


Figure C-3.2.7: Carlisle PM_{2.5} Design Value Contribution (µg/m³)

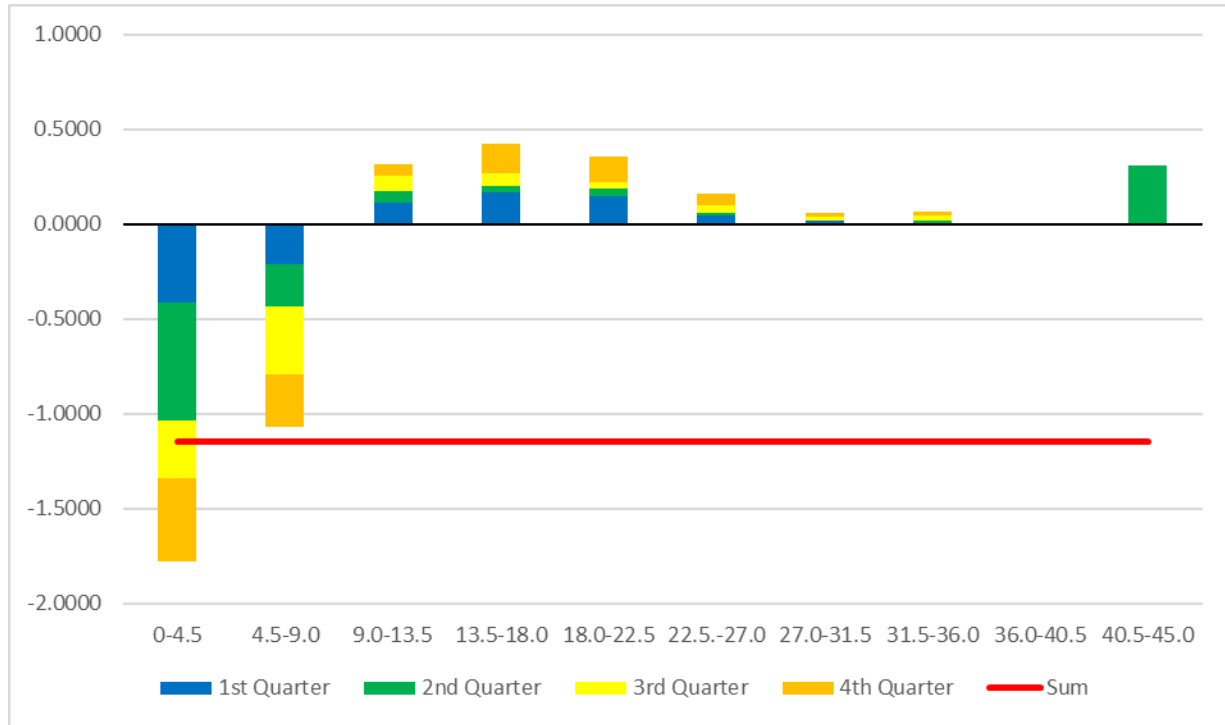


Figure C-3.2.8: Carlisle PM_{2.5} Design Value Category Breakdown

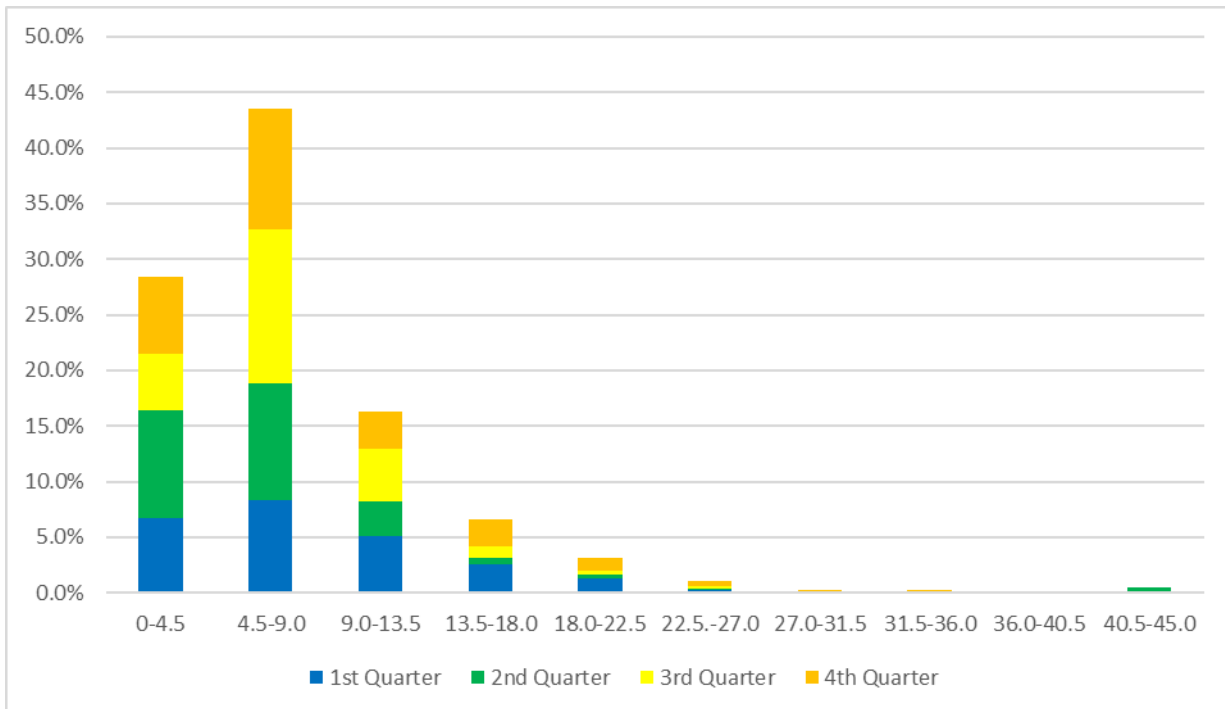


Figure C-3.2.9: Lebanon PM_{2.5} Design Value Contribution (µg/m³)

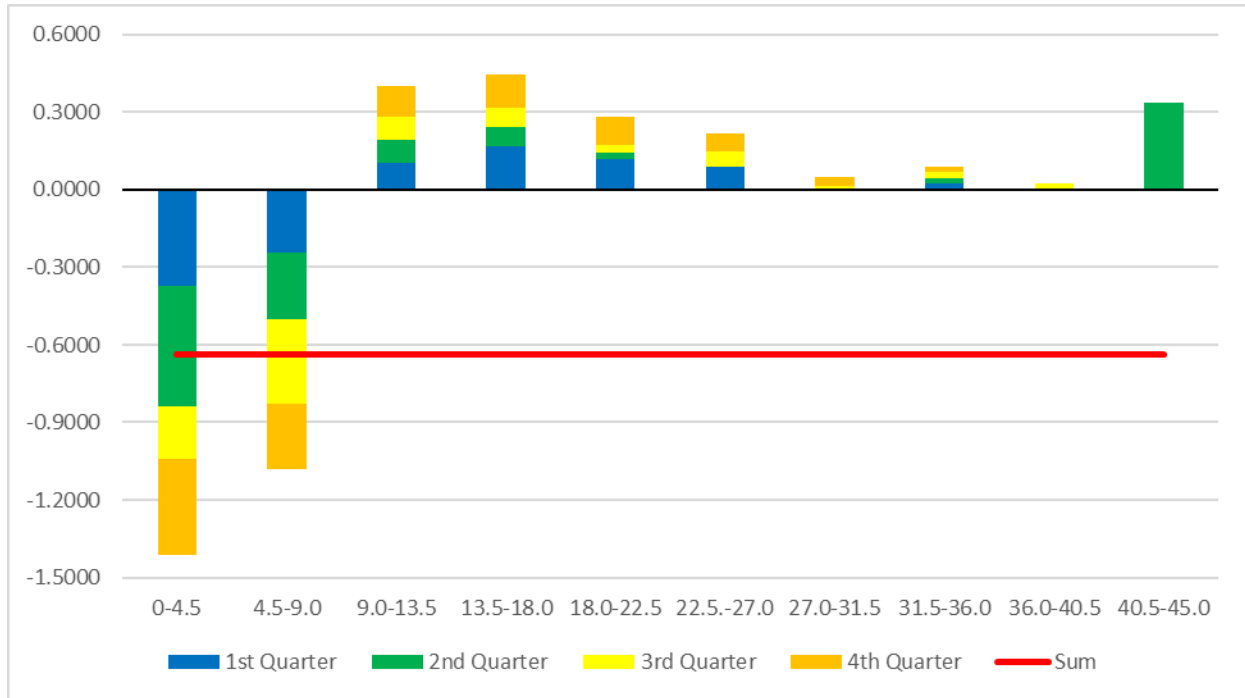


Figure C-3.2.10: Lebanon PM_{2.5} Design Value Category Breakdown

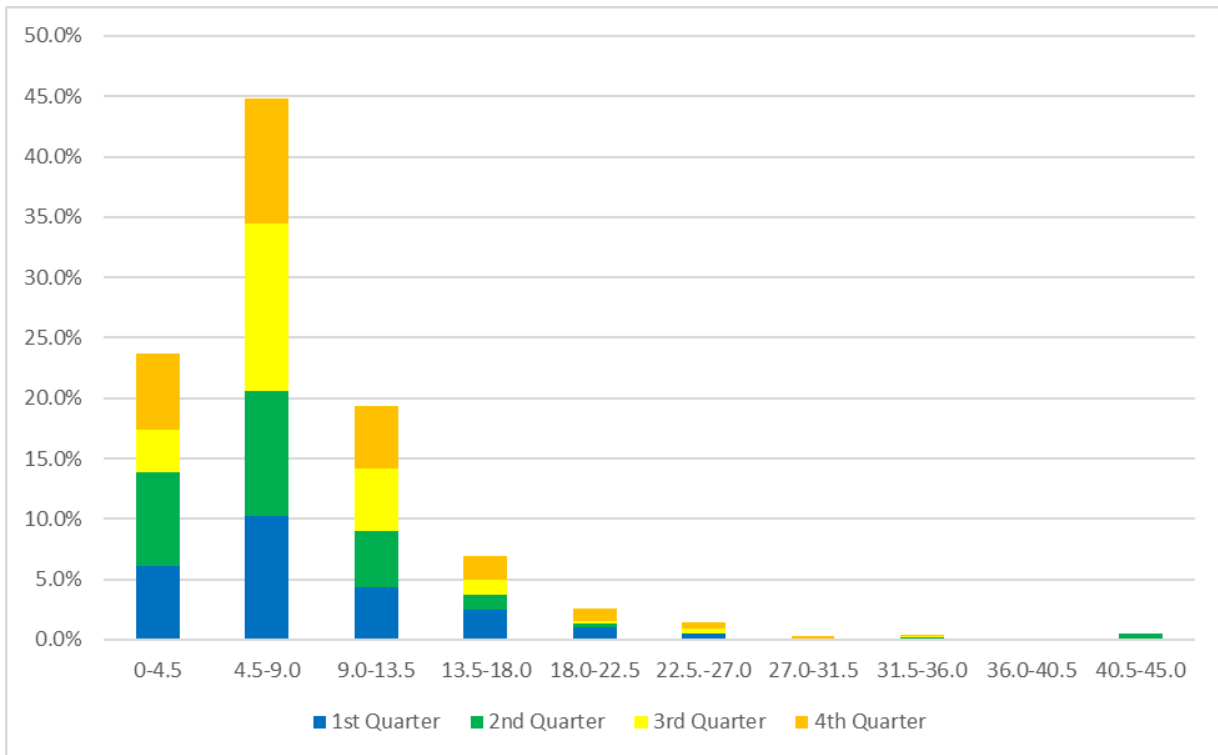


Figure C-3.2.11: Harrisburg-Carlisle-York Area PM_{2.5} Annual Design Value Contribution ($\mu\text{g}/\text{m}^3$)

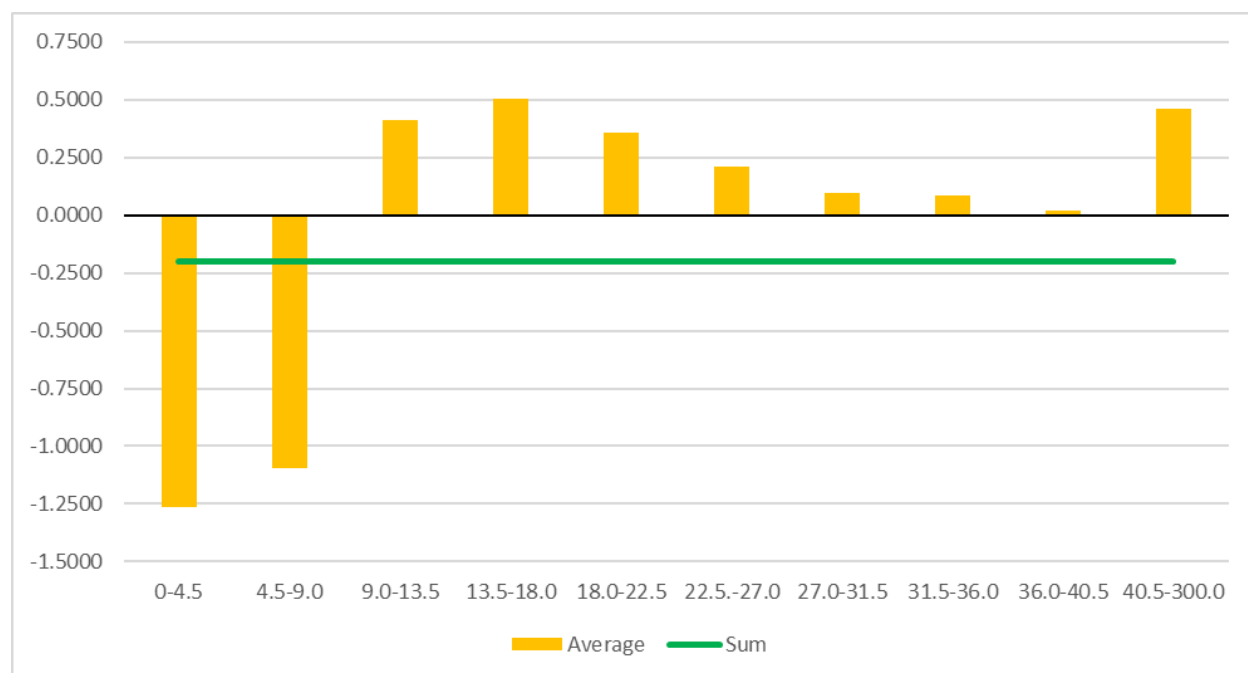


Table C-3.1 illustrates the differences between the monitors that are attaining the 2024 PM_{2.5} annual standard and the monitors that are not attaining the 2024 PM_{2.5} annual standard. The Harrisburg monitor has slightly fewer “clean” days (0-9 $\mu\text{g}/\text{m}^3$) than the monitors that are attaining the standard. For example, the Harrisburg monitor’s PM_{2.5} contribution to the design value in the 0-9 $\mu\text{g}/\text{m}^3$ range was 0.4 $\mu\text{g}/\text{m}^3$ lower than the regional average.

The analysis described in the remainder of this Appendix focuses on the violating monitors in the Harrisburg-Carlisle-York area (Harrisburg and York). Figure C-3.3.1 illustrates the trend of annual averages while Figure C-3.3.2 illustrates the trend of annual design values for monitors in the Harrisburg-Carlisle-York area with valid 2023 PM_{2.5} design values. The Harrisburg and York monitors have both a 2023 annual average and design value above the 2024 standard. Since 2014, annual PM_{2.5} levels have been in a general decline in the Harrisburg-Carlisle-York area. It is important to note that 2023 was an extremely active year for Canadian wildfires, leading to an excessive amount of smoke transported into southcentral PA.

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Figure C-3.3.1: Harrisburg-Carlisle-York Area PM_{2.5} Valid Annual Averages (µg/m³)

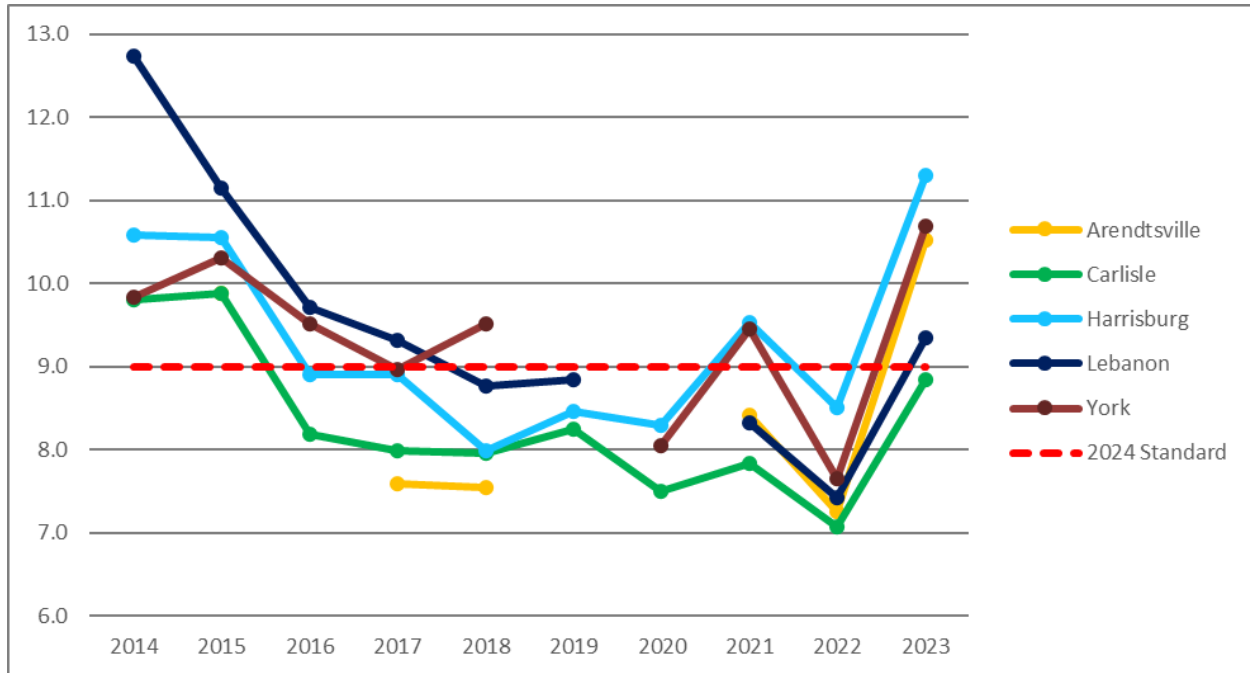
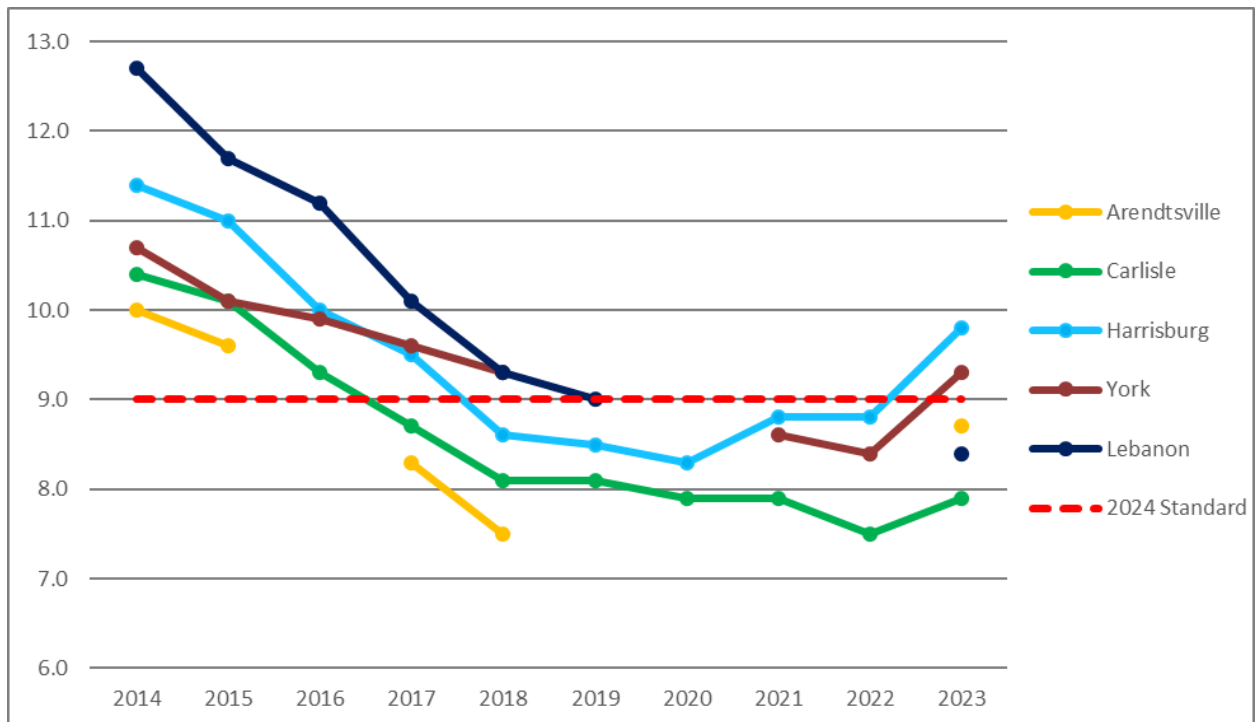


Figure C-3.3.2: Harrisburg-Carlisle-York Area PM_{2.5} Valid Annual Design Values (µg/m³)



Additional analyses were completed to determine what was contributing to the fewer number of “clean” days at the Harrisburg and York monitors. PADEP identified days when these monitors’

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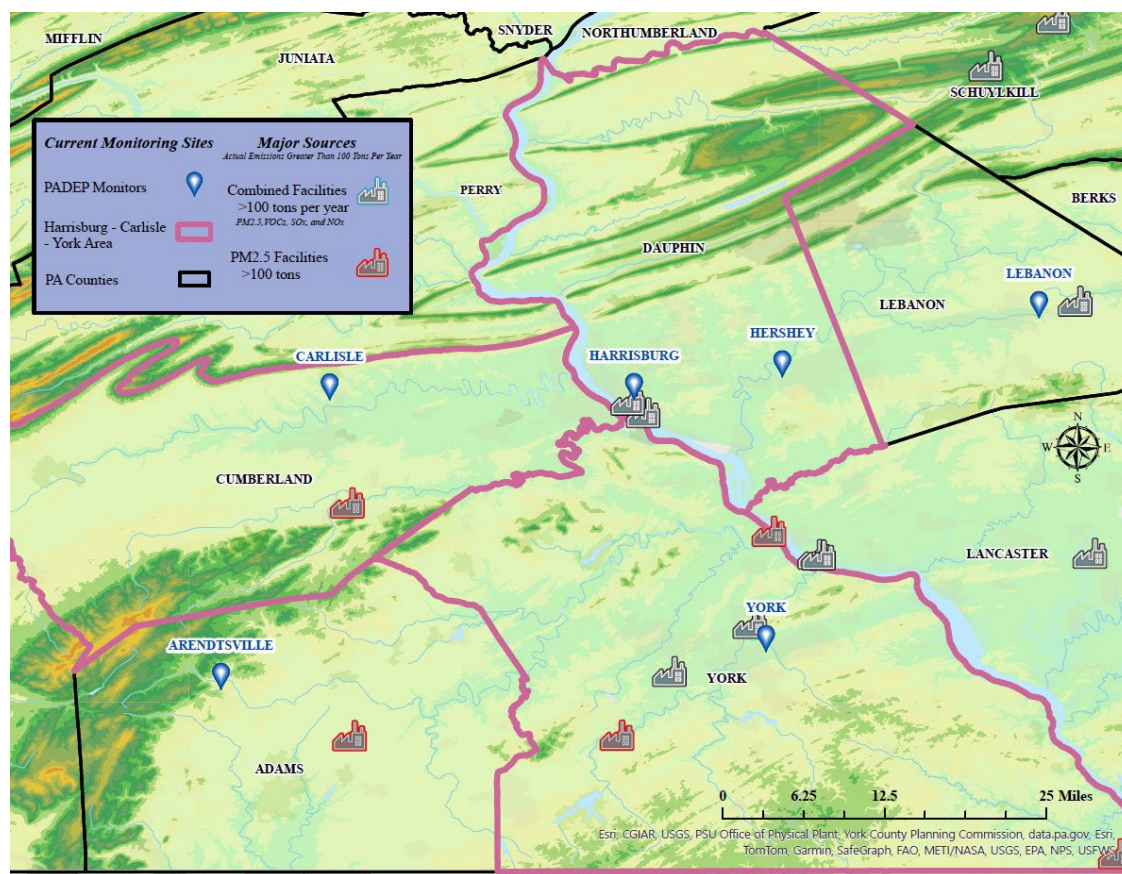
PM_{2.5} concentrations were relatively high but regional monitoring concentrations in the Harrisburg-Carlisle-York area were “clean.” Between 2021 and 2023, PADEP identified 75 days in which the Harrisburg monitor was at least one standard deviation above the regional average while the regional average was at or below 9 µg/m³ and 78 days in which the York monitor was at least one standard deviation above the regional average while the regional area average was at or below 9.0 µg/m³.

Meteorological Conditions Impacting High PM_{2.5} Days at the Harrisburg and York Monitors

The Harrisburg-Carlisle-York area made up of Cumberland, Dauphin, and York counties includes the following air basins per Appendix B, Figure 17: Harrisburg and York. The Susquehanna River borders the Harrisburg monitor to the west. Elevations vary from 102 to over 2,200 feet. Wind patterns are generally influenced by weather systems moving from the west.

Figure C-3.4.1 illustrates the sources within the immediate proximity of the Harrisburg and York monitors. Using the meteorological station at the Capital City Airport (CXY), Figure C-3.4.2 illustrates the frequency of wind distribution coming from a particular direction.

Figure C-3.4.1: Harrisburg-Carlisle-York Area
Major Sources (Over 100 Tons Per Year) Based on PADEP 2022 Emission Inventory



There are multiple major sources of SO₂ and NO_x in close proximity of the Harrisburg and York monitors. The closest major source of NO_x is located within 0.5 kilometer to the southwest of the Harrisburg monitor and within five kilometers to the north of the York monitor. Per Appendix B, Figure B-2, the greatest PM_{2.5} point source emission density is in York and Cumberland Counties, followed by Dauphin County. PM_{2.5}, SO₂ precursor, NO_x precursor, and VOC precursor point source emissions are similarly spread throughout Cumberland, Dauphin, and York Counties as seen in Appendix B, Figures B-21 – B-24. Per Appendix B, Figure B-5, the greatest VOC precursor point source emission density is in York County. Per Appendix B, Figures B-6 – B-9, PM_{2.5}, SO₂ precursor, NO_x precursor, and VOC precursor area source emission density all fall within the same range in Cumberland, Dauphin, and York Counties. Figures B-11 – B-20 in Appendix B show similar on-road and non-road source emissions in Cumberland, Dauphin, and York Counties.

*Figure C-3.4.2: Harrisburg-Carlisle-York Area
Capital City Airport (CXY) Wind Rose*

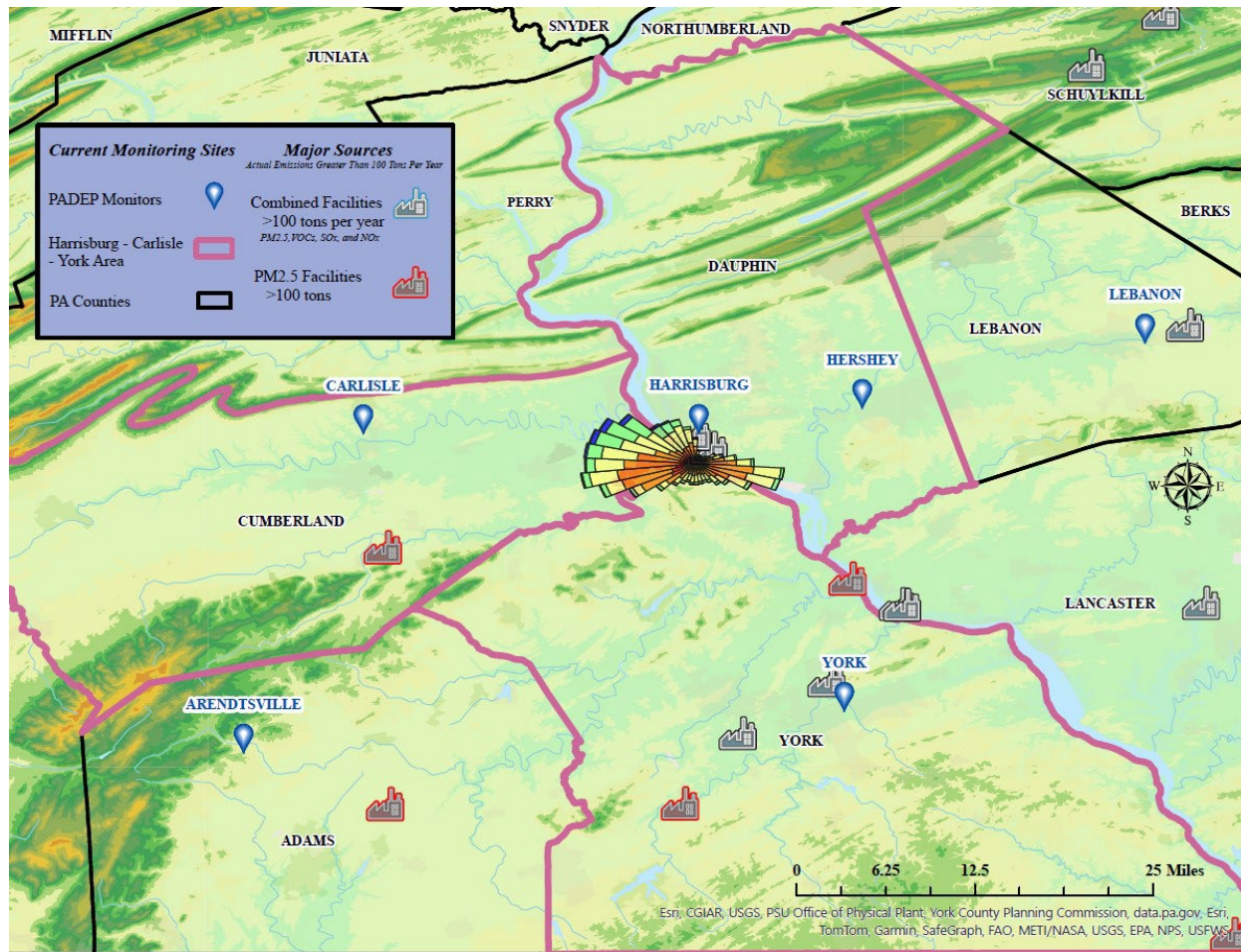


Figure C-3.4.2 shows that, based on the Capital City Airport wind data, the predominant wind flow is from the west/northwest/southwest in the Harrisburg region. The wind direction above shows that the predominant winds travel directly over these sources. This analysis indicates the local nature of the problem near the Harrisburg and York monitors.

The Change in the Composition of the PM_{2.5}

PADEP does not currently operate a speciation monitor in the Harrisburg-Carlisle-York area. PADEP is considering adding a speciation monitor to the Harrisburg site in 2025.

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Summary

PADEP's analysis illustrates the need for a nonattainment area consisting of Cumberland, Dauphin, and York counties. An analysis of the PM_{2.5} data monitored at the Harrisburg monitor in Dauphin County and the York monitor in York County illustrates that the Harrisburg and York monitors see greater concentrations in the 9-27 $\mu\text{g}/\text{m}^3$ range than the regional concentrations in the same range. A further examination into the monitoring data demonstrates that the predominant winds travel directly over local point sources, further illustrating the local issue at the Harrisburg and York monitors. There are multiple point sources clustered along the Cumberland/Dauphin County border. The Harrisburg monitor in Dauphin County and York monitor in York County have a 2023 annual design value that exceeds the 2024 annual PM_{2.5} NAAQS. The Lebanon monitor in Lebanon County has been monitoring in attainment of the 2024 standard for several years and is not contributing to excess emissions elsewhere. Therefore, PADEP is recommending the Harrisburg-Carlisle-York nonattainment area encompassing Cumberland, Dauphin, and York counties in Pennsylvania be designated nonattainment for the 2024 annual PM_{2.5} NAAQS. A map of the proposed nonattainment area is provided below as Figure C-3.5.

Figure C-3.5: Recommended Harrisburg-Carlisle-York Area PM_{2.5} Nonattainment Area

