Fine Particulate Matter (PM2.5) National Ambient Air Quality Standard

Small Business Compliance Advisory Committee

April 17, 2024

Josh Shapiro, Governor

Jessica Shirley, Interim Acting Secretary

Agenda

- Overview of the National Ambient Air Quality Standards (NAAQS) and Particulate Matter (PM)

- PM2.5 Data Trends

- PM2.5 Designation Process

- PM2.5 Implementation Process

- 2024 PM2.5 Designation Timeline

- PM2.5 Monitoring Update

- PM2.5 Air Quality Index (AQI) Changes

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Overview of the National Ambient Air Quality Standards (NAAQS) and Particulate Matter (PM)

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

National Ambient Air Quality Standards

- The Environmental Protection Agency (EPA) sets primary and secondary NAAQS for six common air pollutants, known as criteria pollutants:

  - Ground-level ozone   - Particulate matter

  - Carbon monoxide   - Lead

  - Nitrogen Dioxide   - Sulfur Dioxide

- Primary standards provide protection to public health.

- Secondary standards provide protection to public welfare, including decreased visibility and damage to animals, crops, vegetation and buildings.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Particulate Matter

- Primary particles are emitted directly from a source.

- Secondary particles are formed in atmospheric reactions that involve chemicals such as nitrogen oxides and sulfur dioxides.

- PM2.5 penetrates deeper into the lungs and poses a greater health risk than larger particles.

https://www.cdc.gov/air/particulate_matter.html

Historical PM NAAQS Revisions

- Revisions to the NAAQS, including the PM NAAQS, are based solely on public health and welfare protection without consideration for implementation costs.

- Previously, in 2012, EPA revised the primary annual PM2.5 NAAQS from 15 micrograms per cubic meter ($\mu g/m^3$) to 12.0 $\mu g/m^3$.

- At that time, EPA retained:
  - the existing primary 24-hour standard;
  - the existing 24-hour PM10 standard; and
  - the secondary PM standards.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

2024 PM NAAQS Rule

- On January 27, 2023, EPA published its proposed rule, retaining the current primary 24-hour PM2.5 standard of 35 $\mu g/m^3$ without revision and revising the primary annual standard from 12.0 $\mu g/m^3$ to within the range of 9.0 to 10.0 $\mu g/m^3$.

- On February 7, 2024, EPA Administrator Regan signed the final rule, revising the primary annual standard to 9.0 $\mu g/m^3$. The primary 24-hour PM2.5 standard of 35 $\mu g/m^3$ was retained.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

# PM2.5 Design Value Calculations

- The ***annual PM2.5 standard design value*** is calculated by averaging the annual value for the latest three years. The annual value is calculated by averaging each quarter.
  - Example: The 2022 design value is the annual average of 2020-2022 data.

- The ***24-hour PM2.5 standard design value*** is the three-year average of the annual 98th percentile.
  - Please note: With 365 valid days, the 98th percentile is the 8th high. With 61 valid days, the 98th percentile is the 2nd high.
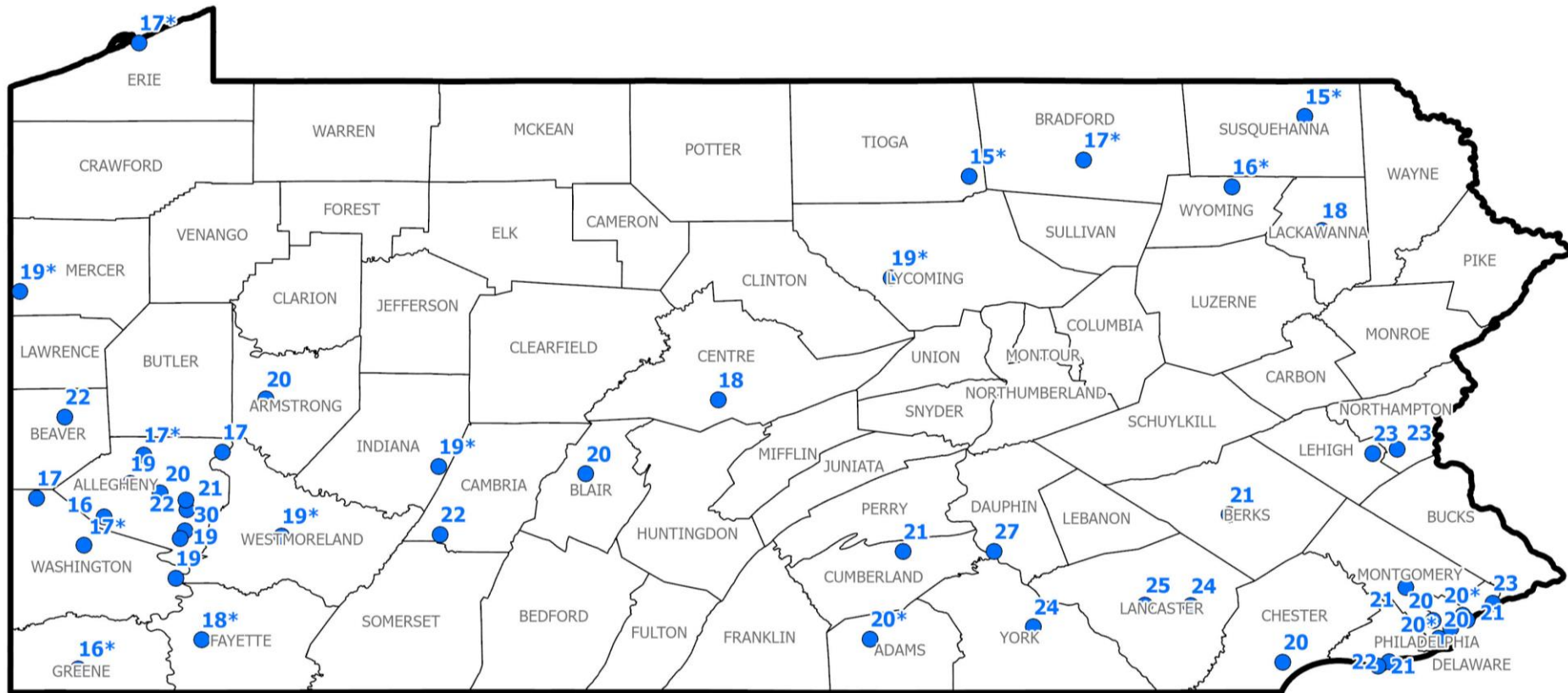
PM2.5 National Trends

PM2.5 Air Quality, 2000 - 2022
(Seasonally-Weighted Annual Average)
National Trend based on 361 Sites
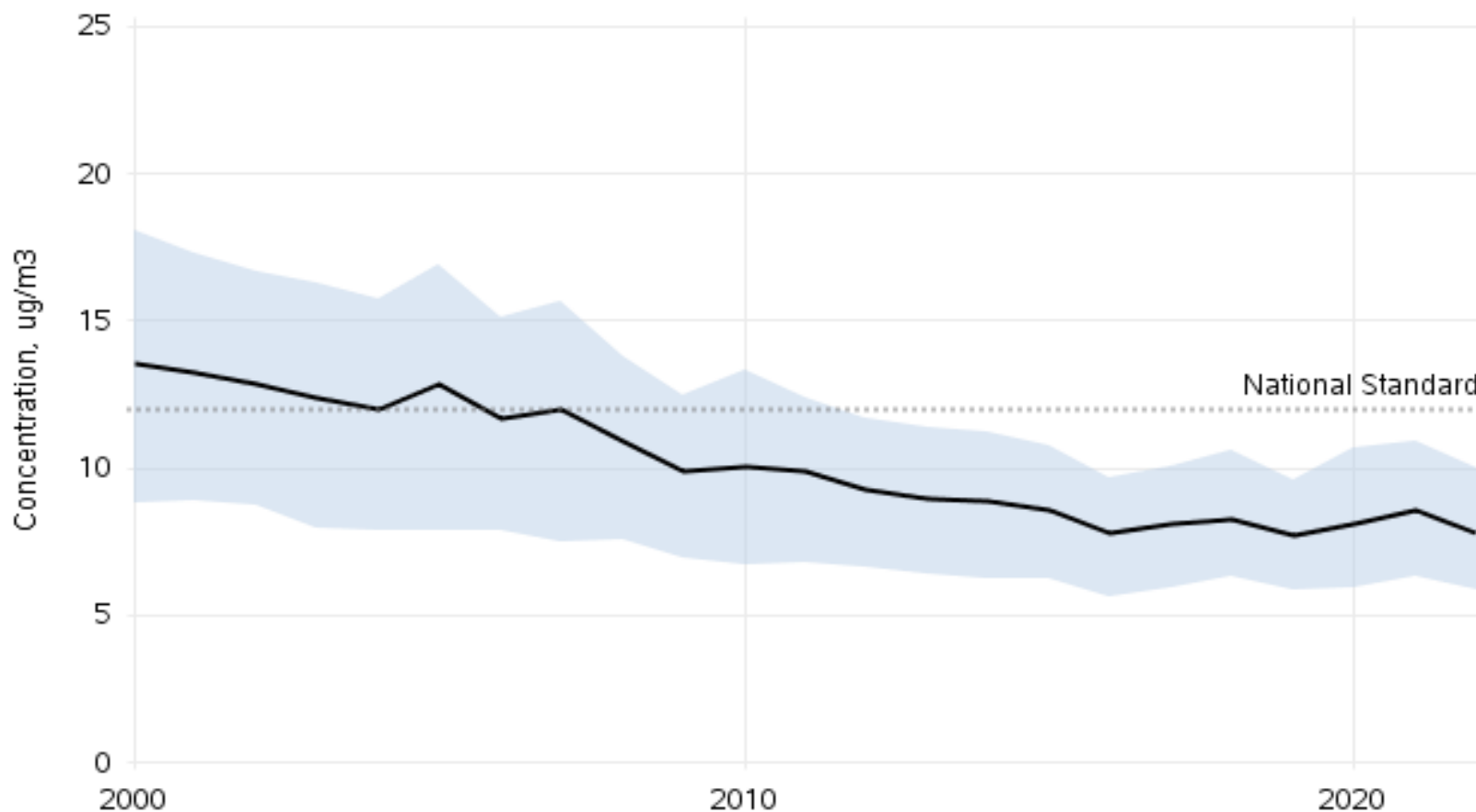
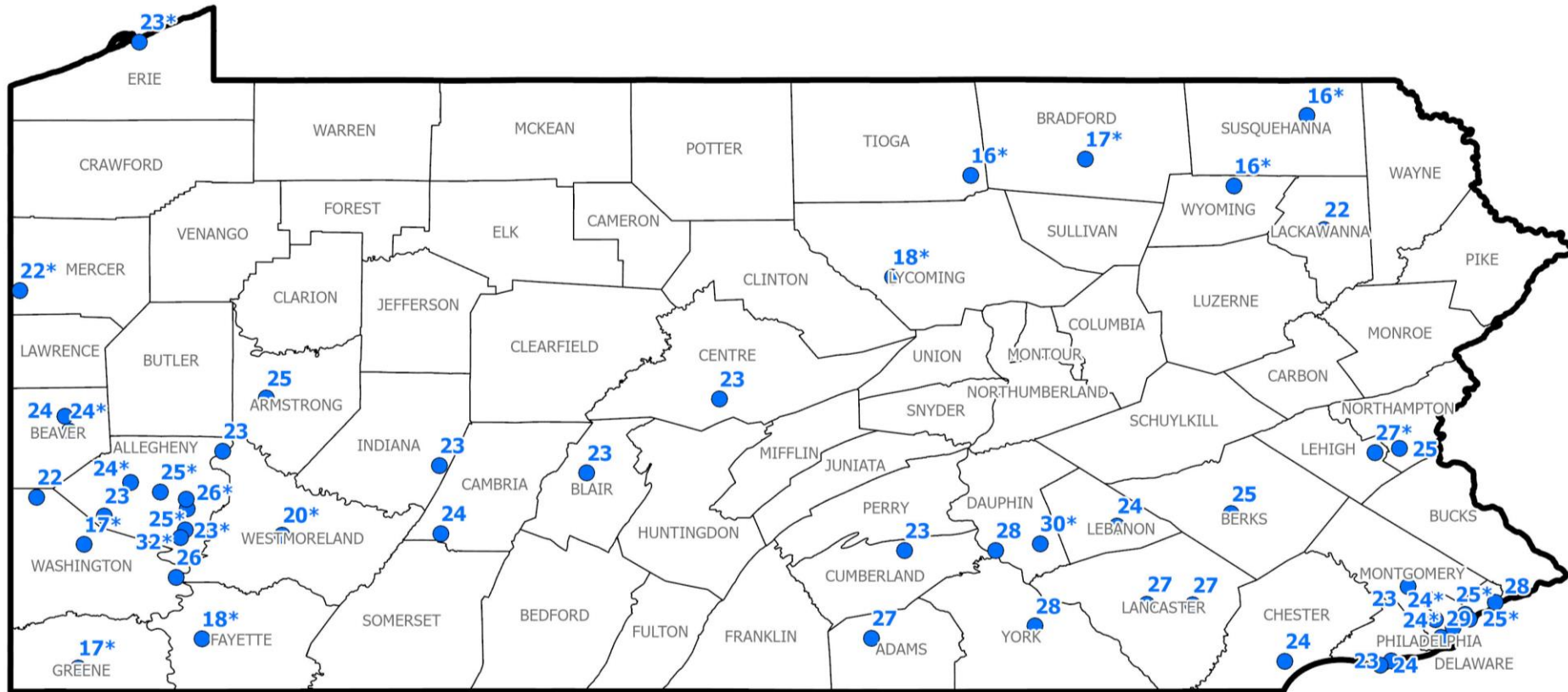**2000 to 2022 : 42% decrease in National Average**

PM2.5 Data Trends

Appearing in Red – 2022 24-hour PM2.5 design value above 35 µg/m³ (2006 PM2.5 Standard)

Appearing in Blue – 2022 24-hour PM2.5 design value at or below 35 µg/m³ (2006 PM2.5 Standard)

Asterisk (*) appearing behind the design value means the data is incomplete during 3-year period.
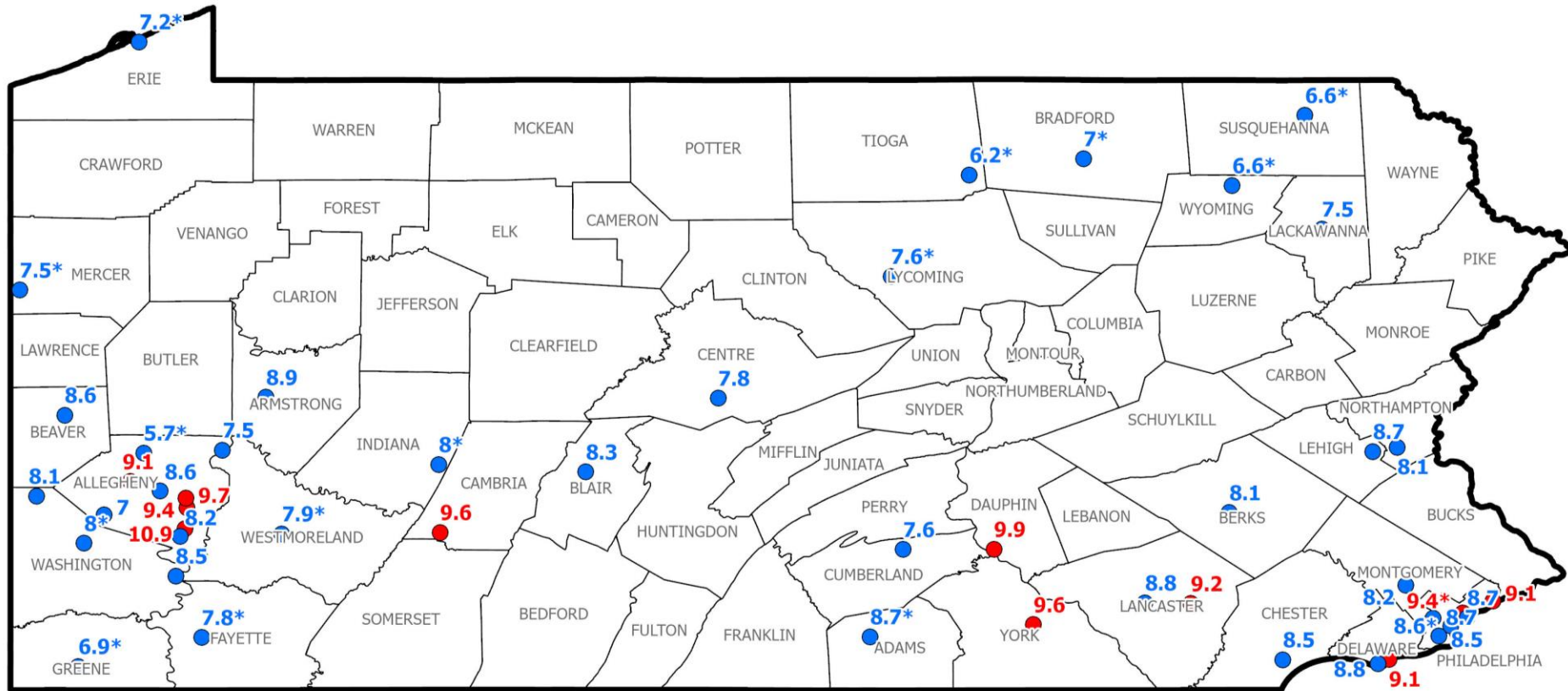
Appearing in Red – 2023 24-hour PM2.5 design value above 35 µg/m³ (2006 PM2.5 Standard)

Appearing in Blue – 2023 24-hour PM2.5 design value at or below 35 µg/m³ (2006 PM2.5 Standard)

Asterisk (*) appearing behind the design value means the data is incomplete during 3-year period.

2022 Annual PM2.5 Design Values – 12.0 μg/m³

Appearing in Red – 2022 annual PM2.5 design value above 12.0 μg/m³ (2012 PM2.5 Standard)
Appearing in Blue – 2022 annual PM2.5 design value at or below 12.0 μg/m³ (2012 PM2.5 Standard)
Asterisk (*) appearing behind the design value means the data is incomplete during 3-year period.

2022 Annual PM2.5 Design Values – 9.0 µg/m³

Appearing in Red – 2022 annual PM2.5 design value above 9.0 µg/m³ (New PM2.5 Standard)

Appearing in Blue – 2022 annual PM2.5 design value at or below 9.0 µg/m³ (New PM2.5 Standard)

Asterisk (*) appearing behind the design value means the data is incomplete during 3-year period.

2023 Annual PM2.5 Design Values – 9.0 µg/m³

Appearing in Red – 2023 annual PM2.5 design value above 9.0 µg/m³ (New PM2.5 Standard)

Appearing in Blue – 2023 annual PM2.5 design value at or below 9.0 µg/m³ (New PM2.5 Standard)

Asterisk (*) appearing behind the design value means the data is incomplete during 3-year period.

Sulfate

Total Nitrate

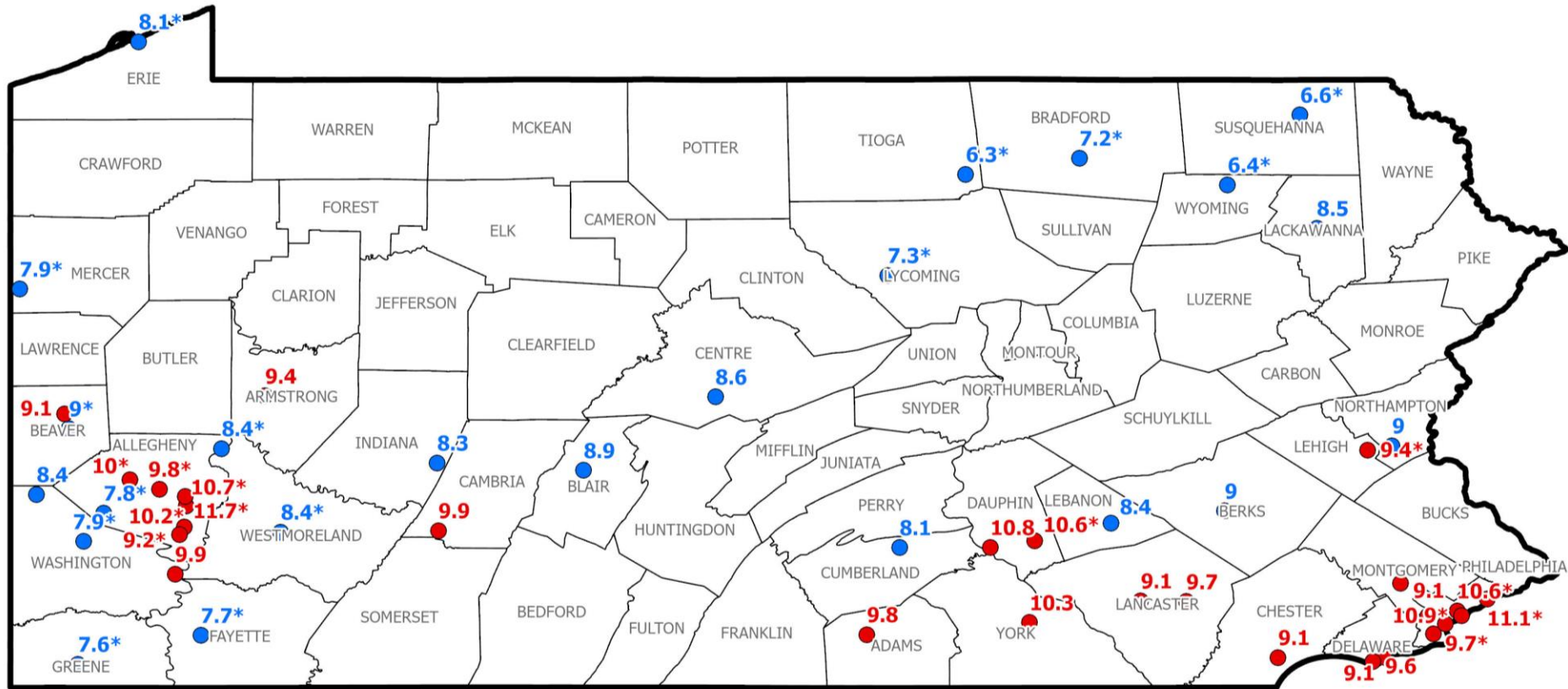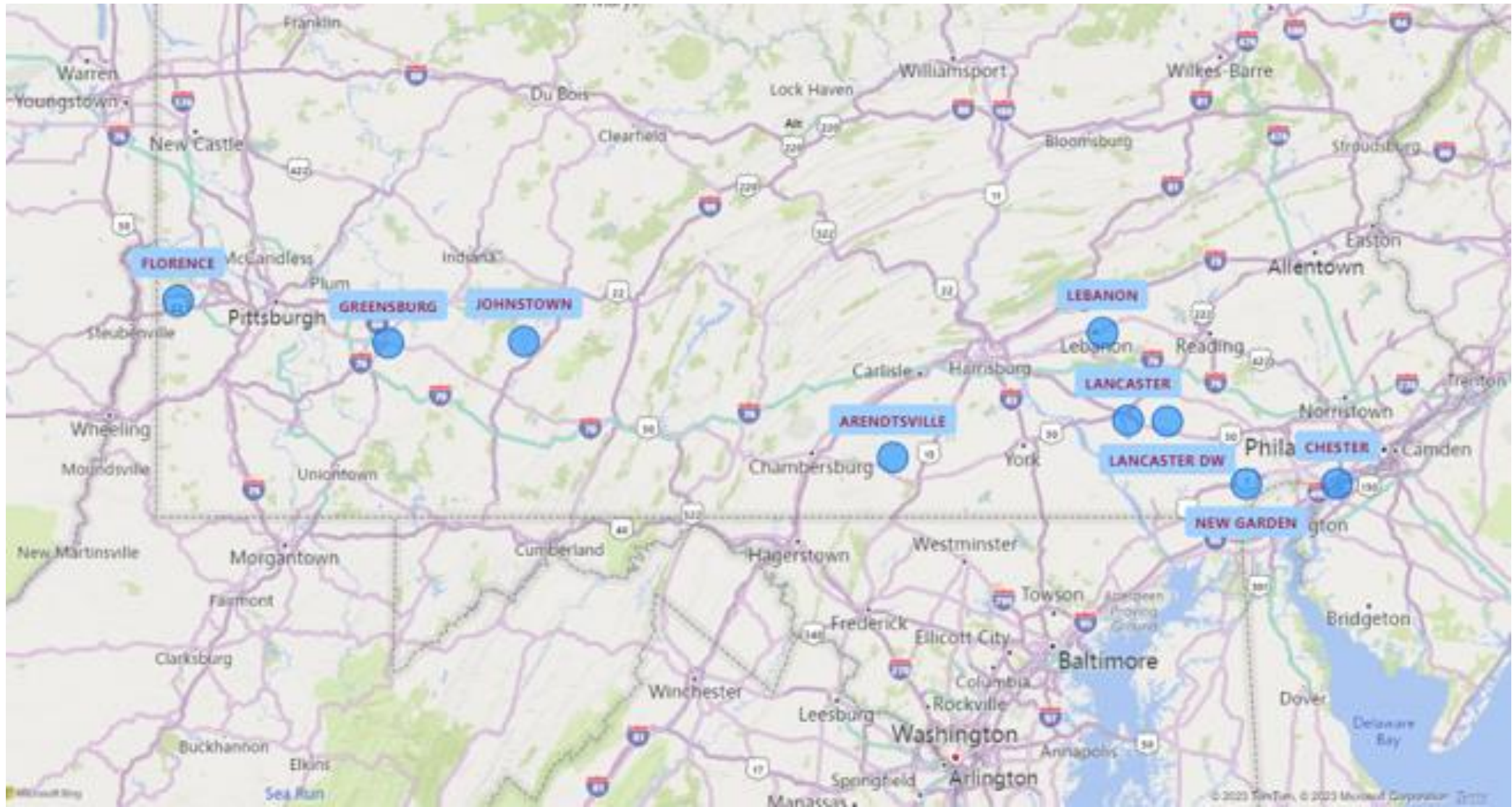Hold for 2023 Data, when it becomes available

Ammonium Ion

Soil

17

Soil = 2.2[Al] + 2.49[Si] + 1.94[Ti] + 1.63[Ca] + 2.42[Fe]

2023 PM2.5 Speciation Quarterly Data Trends

Elemental Carbon

Organic Carbon

Hold for 2023 Data, when it becomes available

So, all that is great.

PM2.5 Designation Process

Understanding the Designation Process

- After EPA issues the final rule, the designation process begins.
  - The <u>Clean Air Act (CAA) Section 107(d)</u> – provides a mechanism for states to make recommendations to EPA on area designations (Does the area meet the new standard?)
  - EPA generally issues designation guidance through memorandum on the process and schedule
- Designations categories:
  - <u>Nonattainment Area</u> – Area that does not meet or contributes to a nearby area that does not meet the NAAQS; (The CAA classifies all initial areas in identified "boundaries" as "moderate" for PM2.5)
  - <u>Attainment/Unclassifiable Area</u> – Area meeting the NAAQS and does not contribute to a nearby area; or
  - <u>Unclassifiable Area</u> – Area that cannot be designated based on available information as meeting or not meeting the NAAQS
- To develop designations, EPA recommends the analysis of five factors, which represents a collective weight-of-evidence approach.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Five Factors for Analysis for Designation Process

Air Quality Data — Examine monitoring data (design values, exceptional events)

Emissions and Emissions-Related Data — Examine source emissions, population, traffic, etc.

Meteorology Data — Examine transport (wind roses, HYSPLIT back trajectory model)
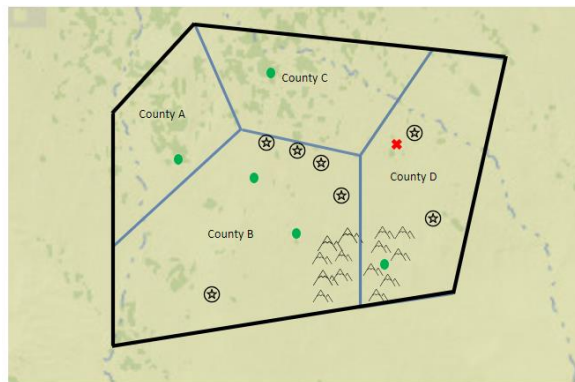
Geography/Topography — Examine physical terrain (GIS)

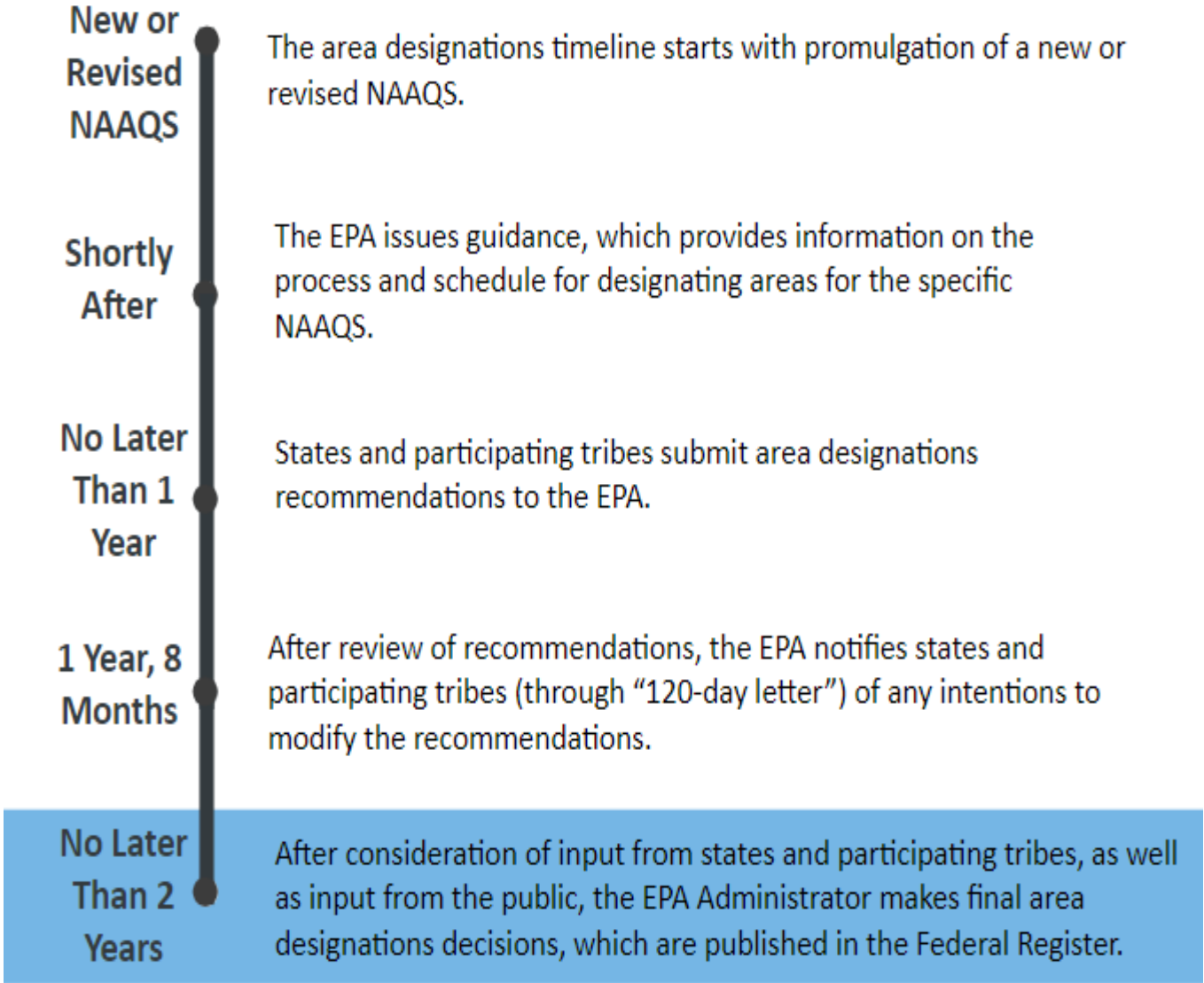**Jurisdictional Boundaries** — Assess a clearly defined legal boundary for air quality planning and enforcement

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Weight-of-Evidence Approach

Pictures Source: EPA Course - PLAN201-SI: Applying Technical Factors for Area Designations

Summarized Key Steps in the Designation Process

New or Revised NAAQS — The area designations timeline starts with promulgation of a new or revised NAAQS.

Shortly After — The EPA issues guidance, which provides information on the process and schedule for designating areas for the specific NAAQS.

No Later Than 1 Year — States and participating tribes submit area designations recommendations to the EPA.

1 Year, 8 Months — After review of recommendations, the EPA notifies states and participating tribes (through "120-day letter") of any intentions to modify the recommendations.

No Later Than 2 Years — After consideration of input from states and participating tribes, as well as input from the public, the EPA Administrator makes final area designations decisions, which are published in the Federal Register.
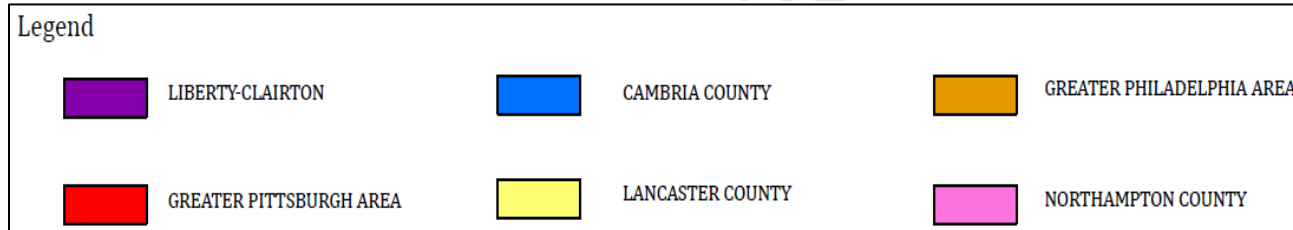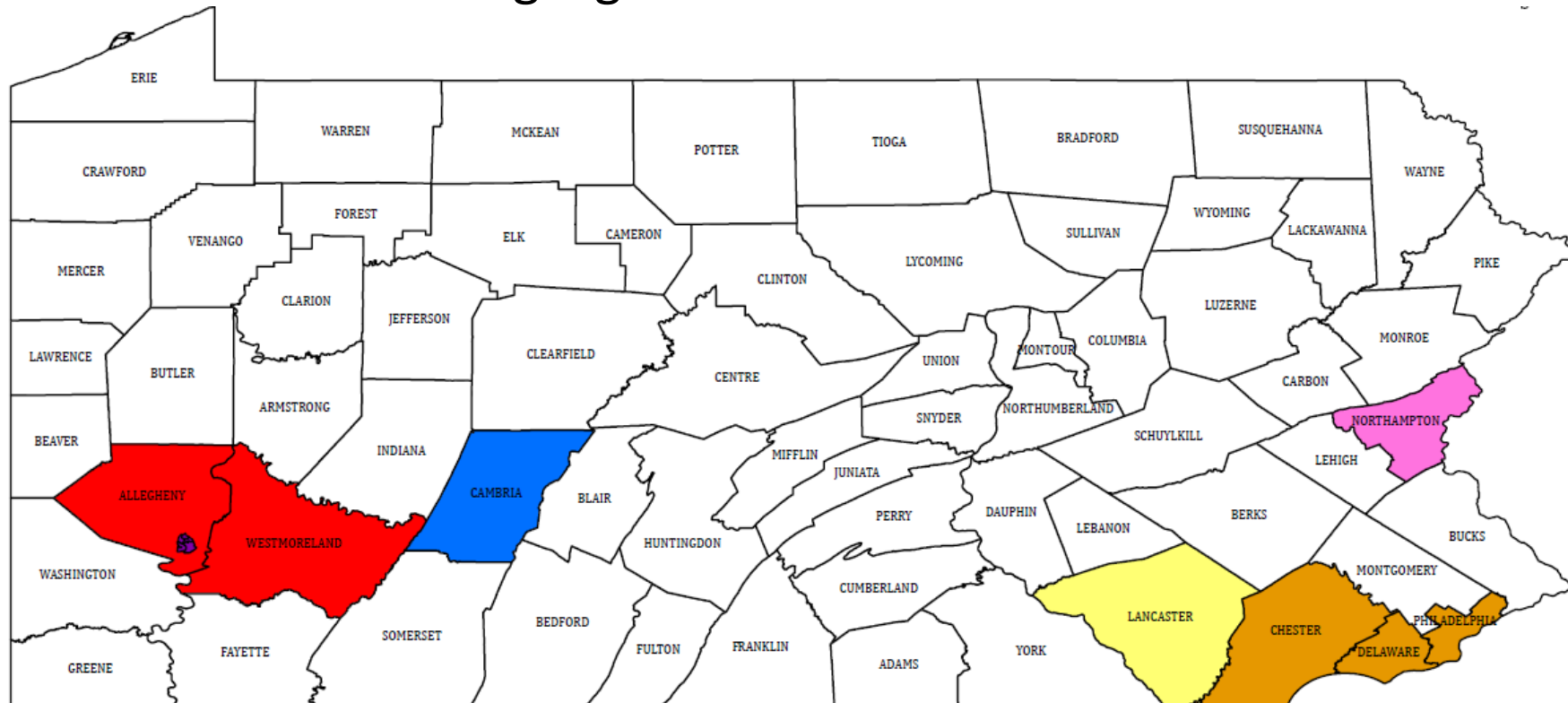
Example - PM2.5 Designation Timeline

As an example, let's look at the 2012 PM NAAQS timeline:

- December 14, 2012 - EPA administrator signed final rule.

- January 15, 2013 - Final Rule was published in the *Federal Register.*

- April 16, 2013 - EPA released designation recommendation guidance.

- December 13, 2013 - PA sent initial designations to EPA.

- July 30, 2014 - PA sent letter to EPA with updated recommendations.

- August 19, 2014 - PA received EPA's 120-day letter.

- December 18, 2014 - PA received EPA's letter proposing designations in PA.

- February 18, 2015 - PA sent letter to EPA with the early certification of 2014 data.

- April 7, 2015 - EPA issues final designations, effective on April 15, 2015.

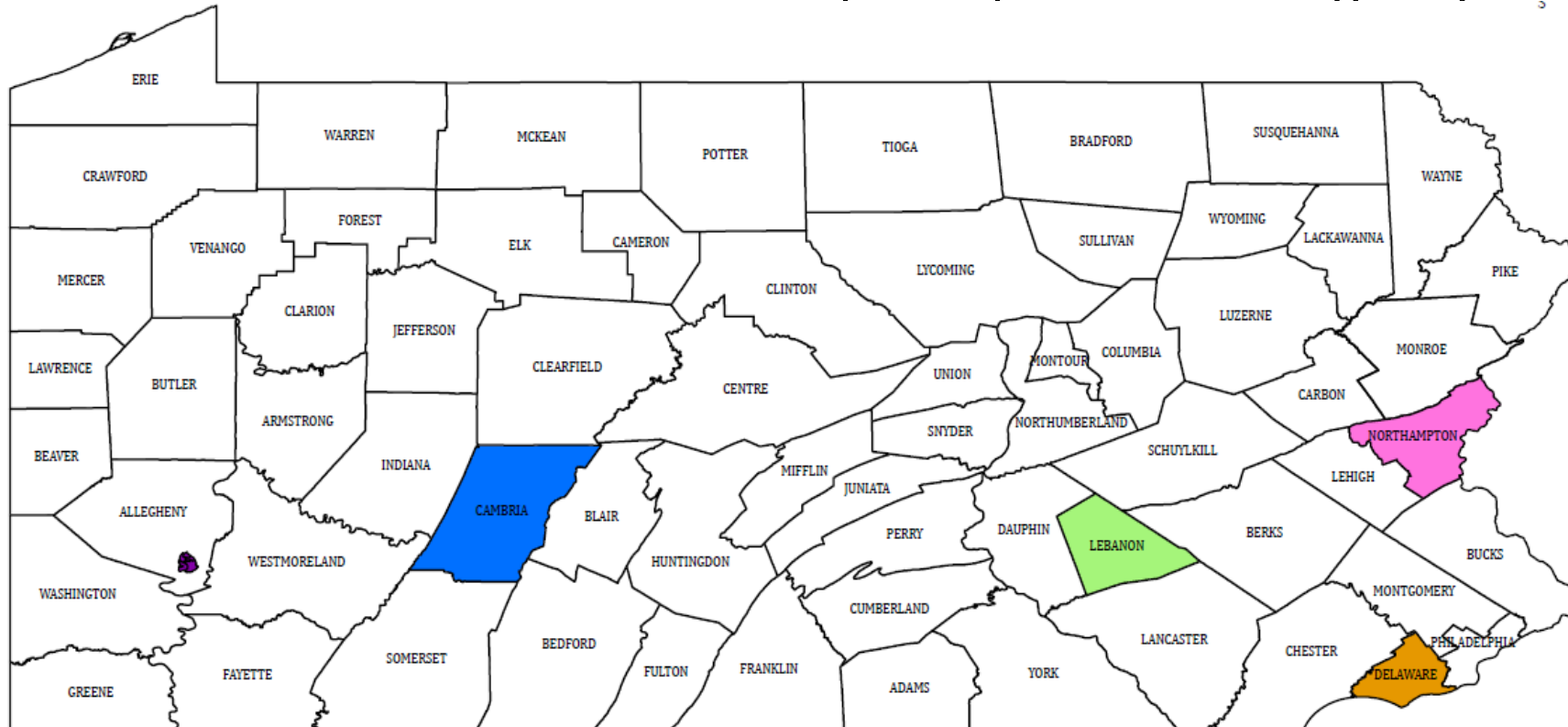# Pennsylvania's Initial Designation Recommendations

- Based on 2012 Design Value: 10 monitors above 12 $\mu g/m^3$. PA recommended six nonattainment areas covering eight counties.

Legend

■ (purple) LIBERTY-CLAIRTON	■ (blue) CAMBRIA COUNTY
■ (orange) GREATER PHILADELPHIA AREA	
■ (red) GREATER PITTSBURGH AREA	■ (yellow) LANCASTER COUNTY
■ (pink) NORTHAMPTON COUNTY	

Pennsylvania's Updated Designation Recommendations

- Based on 2013 Design Values: 5 monitors above 12 μg/m^3. PA updated recommendations included four counties plus a portion of Allegheny County.

Legend

■ LIBERTY - CLAIRTON	■ LEBANON COUNTY	■ NORTHAMPTON COUNTY
■ CAMBRIA COUNTY	■ DELAWARE COUNTY	

EPA's Initial PM2.5 Designations in Pennsylvania

- Five nonattainment areas using 2013 design values, which included all or parts of 7 counties (added Lehigh County and portions of Indiana County, as well as the remainder of Allegheny County.)

Legend

🟥 ALLEGHENY COUNTY	🟩 LEBANON COUNTY	🟪 ALLENTOWN AREA
🟦 JOHNSTOWN AREA	🟧 DELAWARE COUNTY	
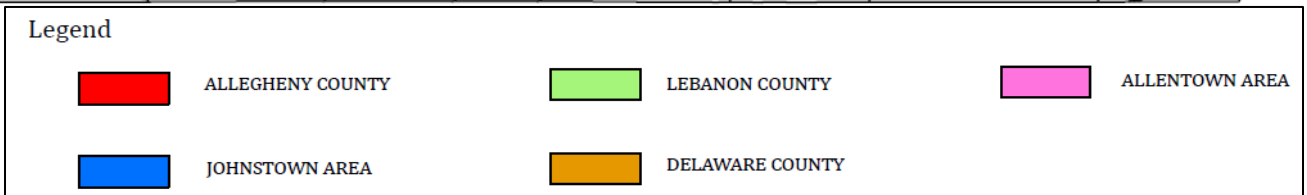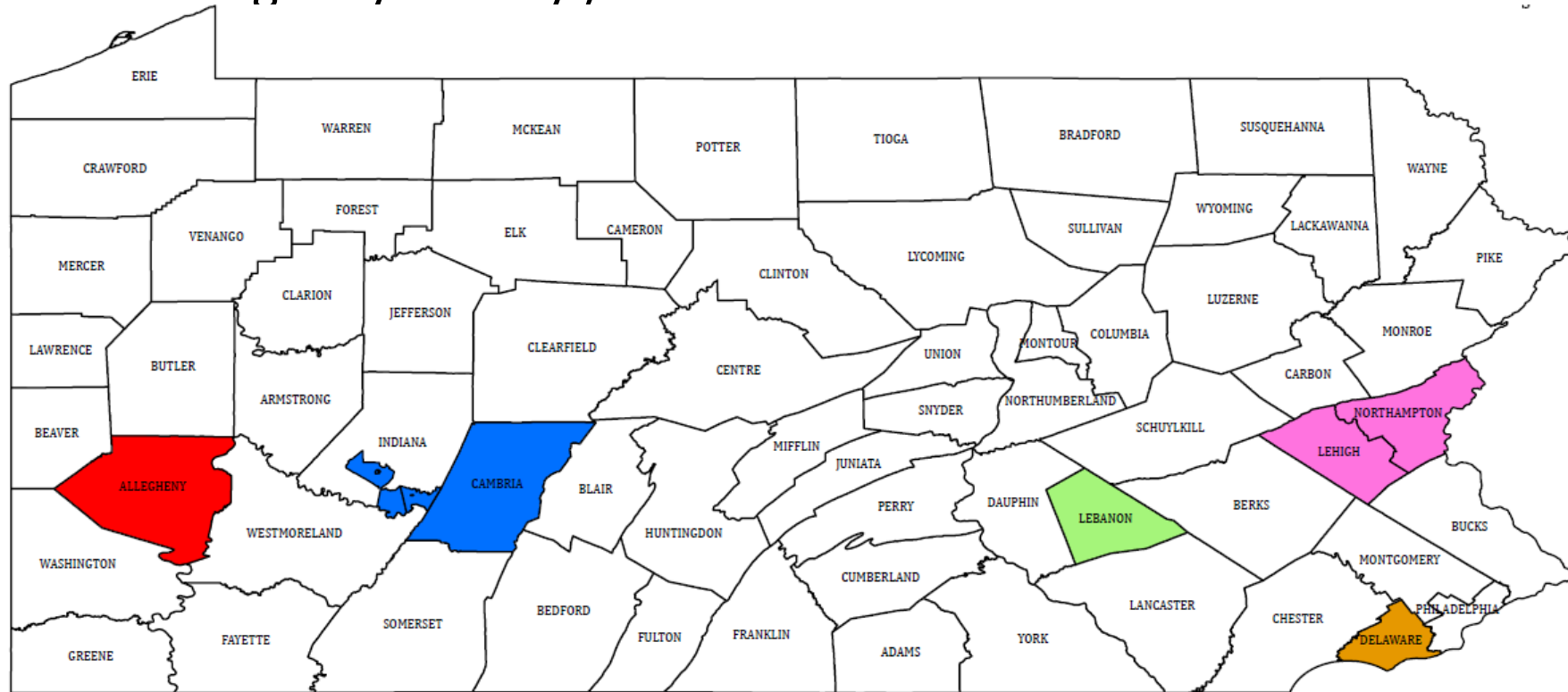
- Based on 2014 Design Values: 3 monitors above 12 µg/m^3. In the end, EPA designated three nonattainment areas, which include three counties.

Legend

🟥	ALLEGHENY COUNTY
🟧	DELAWARE COUNTY
🟩	LEBANON COUNTY
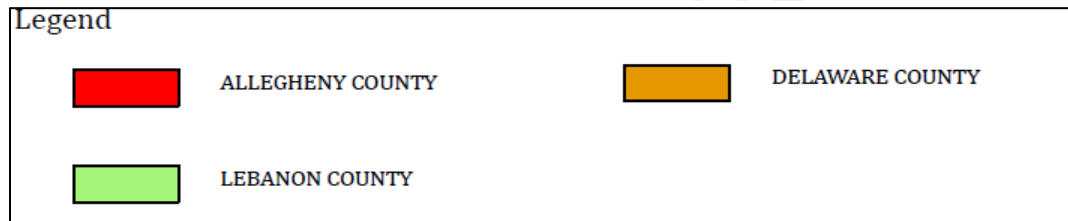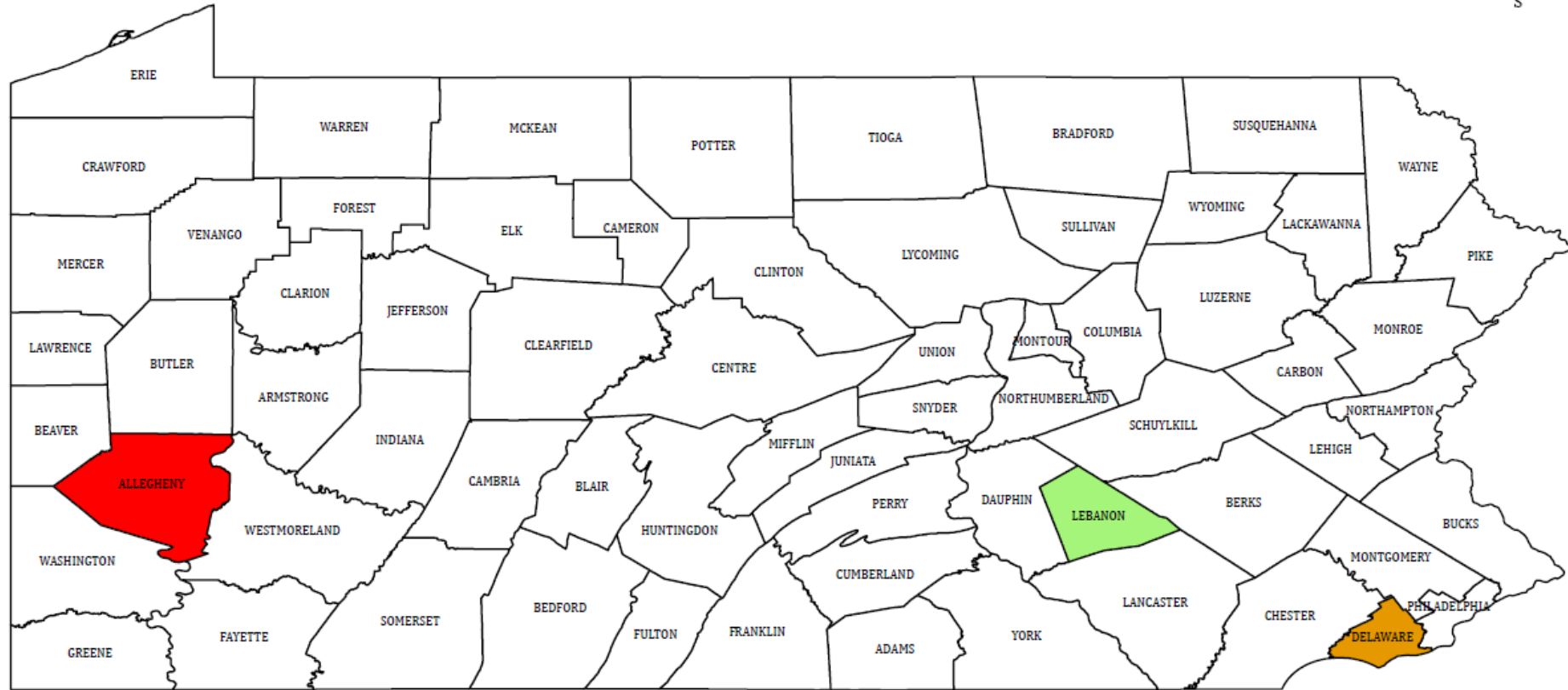
PM2.5 Implementation Process

Pennsylvania's Implementation Process

- July 29, 2016 – EPA issued a PM2.5 SIP Requirements Rule finalizing requirements for states to implement the SIP.

- December 13, 2016 – EPA issued a Clean Data Determination for Delaware County attaining the standard, based on 2013-2015 data.

- March 6, 2018 – EPA issued a Clean Data Determination for Lebanon County for attaining the standard, based on 2014-2016 data.

- January 23 and February 11, 2019 – PA submitted requests to EPA to approve Delaware and Lebanon County Maintenance Plans and Redesignation Requests, respectively.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Pennsylvania's Implementation Process

- July 16 and September 30, 2019 – EPA proposed and finalized, the Delaware and Lebanon County Maintenance Plans and Redesignation Requests, respectively.

- September 12, 2019 – PA submitted Allegheny County's attainment demonstration SIP on behalf of ACHD, which demonstrated attainment by December 31, 2021.

- March 16, 2022 – EPA issued a Clean Data Determination for Allegheny County for attaining the standard, based on 2018-2020 data.

- November 29, 2022 – PA submitted request to EPA to approve Allegheny County Maintenance Plan and Redesignation Request, respectively. (No EPA action yet.)

Identifying Nonattainment Areas and Boundary Determinations

- The analytical starting point for the 2024 PM2.5 designations is the entire metropolitan area where the violating monitor is located (Core Based Statistical Area and Combined Statistical Area).

- States will likely use 2021-2023 data for developing recommendations.

- States are not required to develop complete exceptional events demonstrations for their recommendations but should address any data they believe were affected by exceptional events.

- EPA will likely use 2022-2024 for making final designations.

- Boundaries for each nonattainment area will be evaluated on a case-by-case basis.

- EPA strives for national consistency in decisions.

2024 PM2.5 Designation Timeline

2024 PM2.5 NAAQS - Anticipated Timeline for Designation Process

01 New Revised PM2.5 NAAQS Promulgated
Annual Standard = 9 μg/m³
February 7, 2024

02 2023 PM2.5 Design Values Available
June 2024

03 PA Recommends PM2.5 NAAQS Area Designations
February 7, 2025

04 2024 PM2.5 Design Values Available
June 2025

05 EPA Notifies PA Concerning Any Intended Modifications to Recommendations
120-day letter
October 9, 2025

06 EPA Publishes Public Notice of State Recommendation Availability
Initiates 30-day public comment period
Mid October 2025

07 End of 30-day comment period
Mid November 2025

08 PA Submits Additional Info to Respond to EPA's Recommendation
60 days following publication of notice from Mid October 2025
Mid December 2025

Final 2024 PM2.5 NAAQS Area Designations Promulgated
February 6, 2026

Timeline axis:
JAN 2024 — FEB — MAR — APR — MAY — JUN — JUL — AUG — SEP — OCT — NOV — DEC — JAN 2025 — FEB — MAR — APR — MAY — JUN — JUL — AUG — SEP — OCT — NOV — DEC — JAN 2026 — FEB
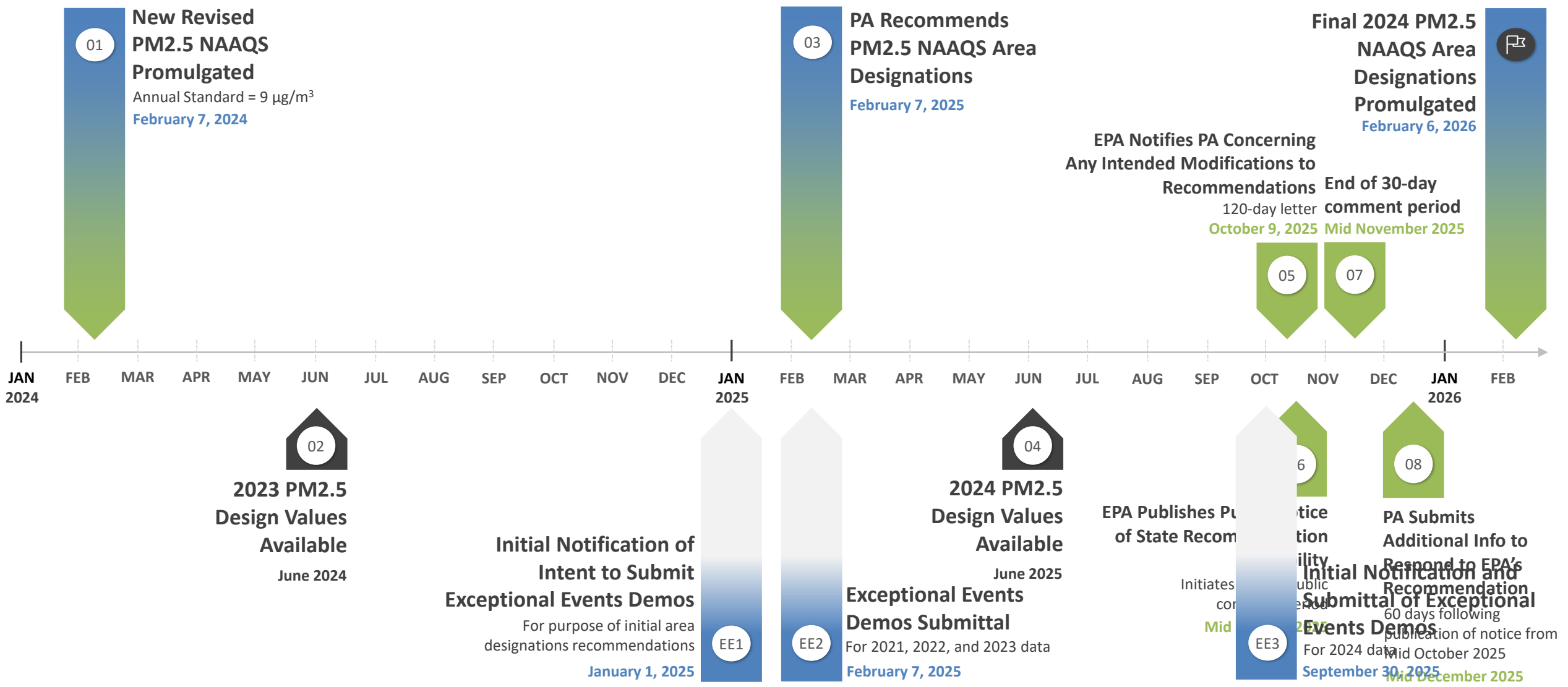
Exceptional Events Related To Initial Area Designations

- Air quality monitoring data affected by exceptional events may be excluded from use in area designations if the data meet the criteria for exclusion, as specified in the Exceptional Events Rule.

- Submittal is discretionary.

- Events should have regulatory significance for the 2024 revised primary annual PM2.5 NAAQS initial area designations.

- DEP is currently reviewing its 2021-23 PM2.5 data. It is possible that DEP completes exceptional event analyses for two distinctive time periods in June-July 2023.

Source: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50#p-50.14(c)(2)(vi)

2024 PM2.5 NAAQS - Anticipated Timeline for Designation Process

01 New Revised PM2.5 NAAQS Promulgated
Annual Standard = 9 µg/m³
February 7, 2024

03 PA Recommends PM2.5 NAAQS Area Designations
February 7, 2025

Final 2024 PM2.5 NAAQS Area Designations Promulgated
February 6, 2026

EPA Notifies PA Concerning Any Intended Modifications to Recommendations
120-day letter
October 9, 2025

End of 30-day comment period
Mid November 2025

05

07

JAN 2024 — FEB — MAR — APR — MAY — JUN — JUL — AUG — SEP — OCT — NOV — DEC — JAN 2025 — FEB — MAR — APR — MAY — JUN — JUL — AUG — SEP — OCT — NOV — DEC — JAN 2026 — FEB

02 2023 PM2.5 Design Values Available
June 2024

EE1 Initial Notification of Intent to Submit Exceptional Events Demos
For purpose of initial area designations recommendations
January 1, 2025

EE2 Exceptional Events Demos Submittal
For 2021, 2022, and 2023 data
February 7, 2025

04 2024 PM2.5 Design Values Available
June 2025

EPA Publishes Public Notice of State Recommendation
Initiates public comment period
Mid

06

EE3 Initial Notification and Submittal of Exceptional Events Demos
For 2024 data
September 30, 2025

08 PA Submits Additional Info to Respond to EPA's Recommendation
60 days following publication of notice from Mid October 2025
Mid December 2025

37

Environmental Justice Factor in Designation Process

- Nonattainment areas may disproportionately impact vulnerable populations. It is important to provide meaningful engagement opportunities for public input into the area designations process.

- Does not add a requirement for new monitors; rather it utilizes existing sites and ensures at risk communities are considered if sites need to move.

- Any new or relocated monitors would not be in effect for the upcoming PM2.5 designations.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

Environmental Justice Factor
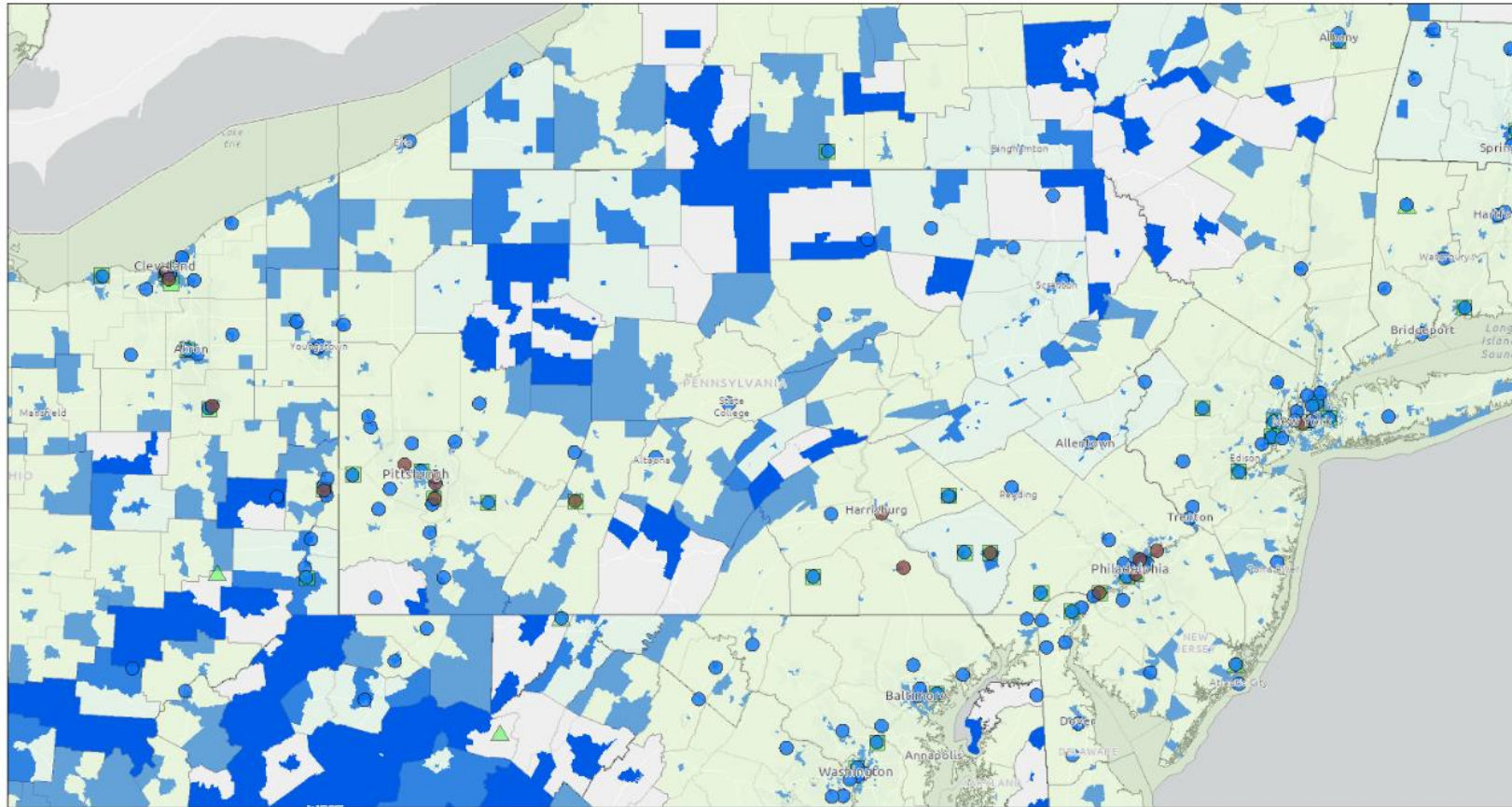
2/23/2024, 9:32:31 AM

PM2.5 Annual DVs 2020-2022 (Violating)

● > 9 ug/m3

PM2.5 Annual DVs 2020-2022 (Non-Violating)

● <= 9 ug/m3

PM2.5 Speciation Network 2020-2022

▢ CSN

△ IMPROVE

▢ Combined Statistical Areas (CSAs)

▢ Core Based Statistical Areas (CBSAs)

Disadvantaged Communities per CEJST v1.0 (as of 11/22/2022)

▢ Disadvantaged

▢ Not Disadvantaged

1:2,861,817

| 0 | 25 | 50 | 100 mi |
| 0 | 40 | 80 | 160 km |

data.pa.gov, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS

Source: https://experience.arcgis.com/experience/a2ca272ce9fc4019a88ce35b863e2cab

PM2.5 Monitoring Update

PM2.5 Monitoring Equipment

Federal Reference Methods (FRM) and Federal Equivalent Methods (FEM) are standardized methods to ensure air quality monitoring is conducted accurately across the United States.

Thermo 2025i (FRM)
Filter Based (24-hour Sampling) PM2.5 Mass Monitor

Teledyne API Model T640/T640x (FEM)
**Real-Time Continuous PM2.5 Mass Monitor**

Source: https://www.thermofisher.com/order/catalog/product/2025I

Source: https://www.teledyne-api.com/prod/Downloads/08354D%20T640%20USER%20MANUAL.pdf

Proposal to Update PM2.5 Data from T640/T640X Monitors

- T640 approved as FEM on July 13, 2016
  - 30 reported in AQS in 2017
  - 400 reported in AQS in 2023
  - Advantages – Less maintenance, fewer consumables, high time resolution data
  - Disadvantages – Positive bias (20% higher than collocated FRMs)
- Clean Air Scientific Advisory Committee (CASAC) 3/18/2022 letter
  - "The FEM bias needs to be addressed to make the FRMs and FEMs more comparable."
- Teledyne API Network Data Alignment Equation Modification
  - EPA approval – April 2023
  - Firmware change available – June 2023
  - Updated method working – January 2024
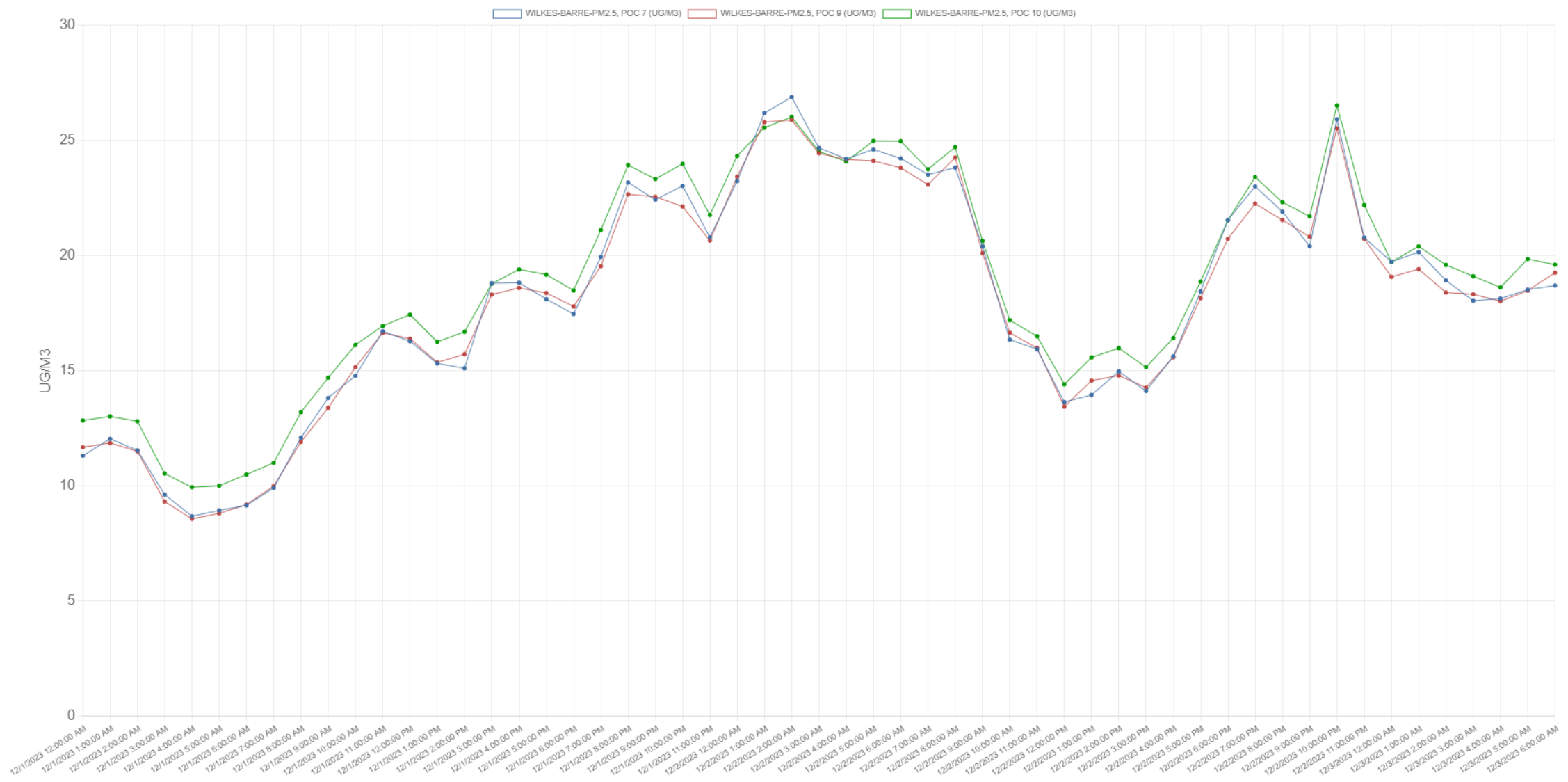
T640 PM Mass Monitors Widespread Use

Legend: PM₂.₅ sites (black dots), T640 monitors (blue dots)
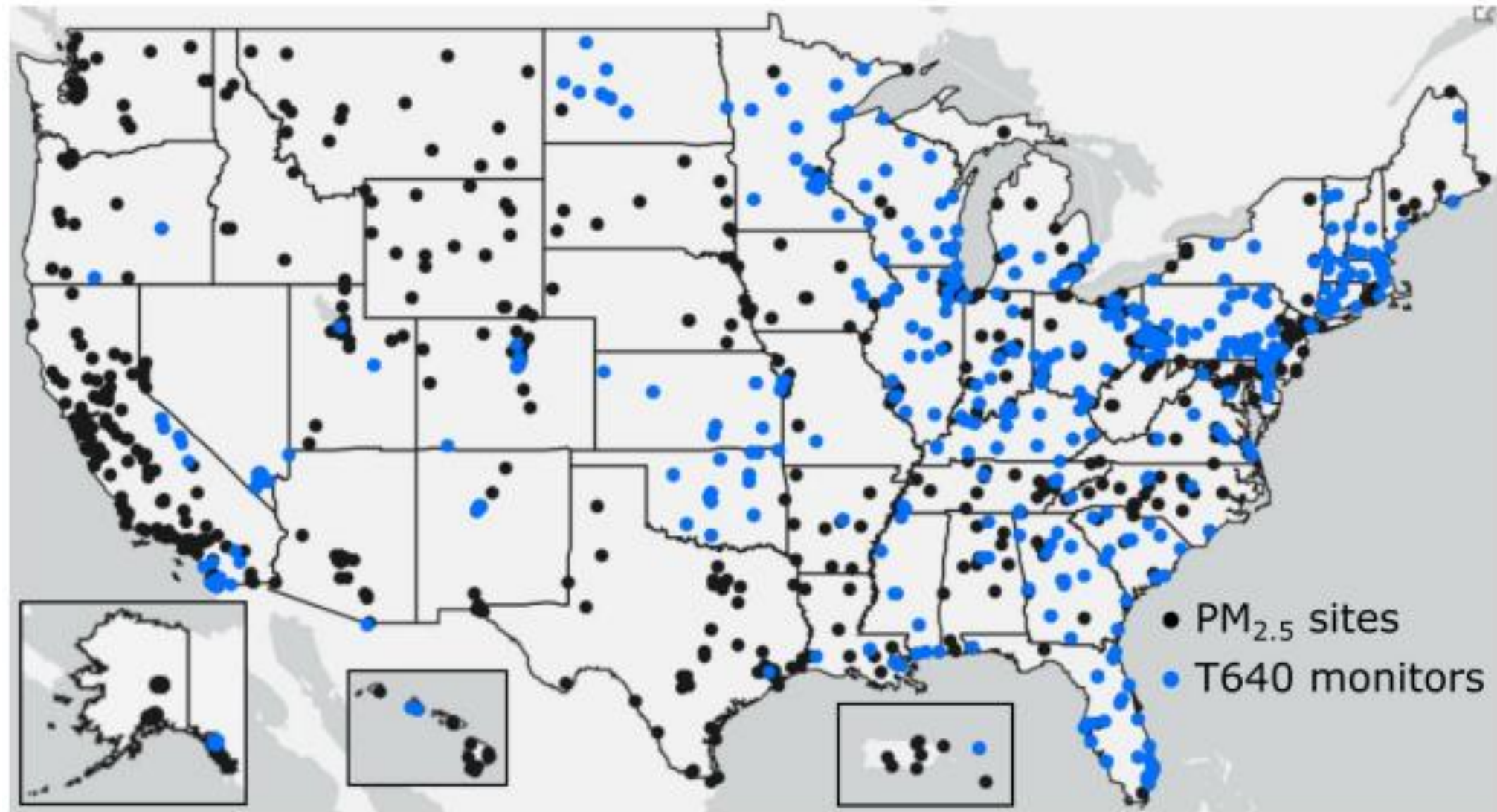
Wilkes-Barre T640 vs. T640x with Algorithm On and Off Example

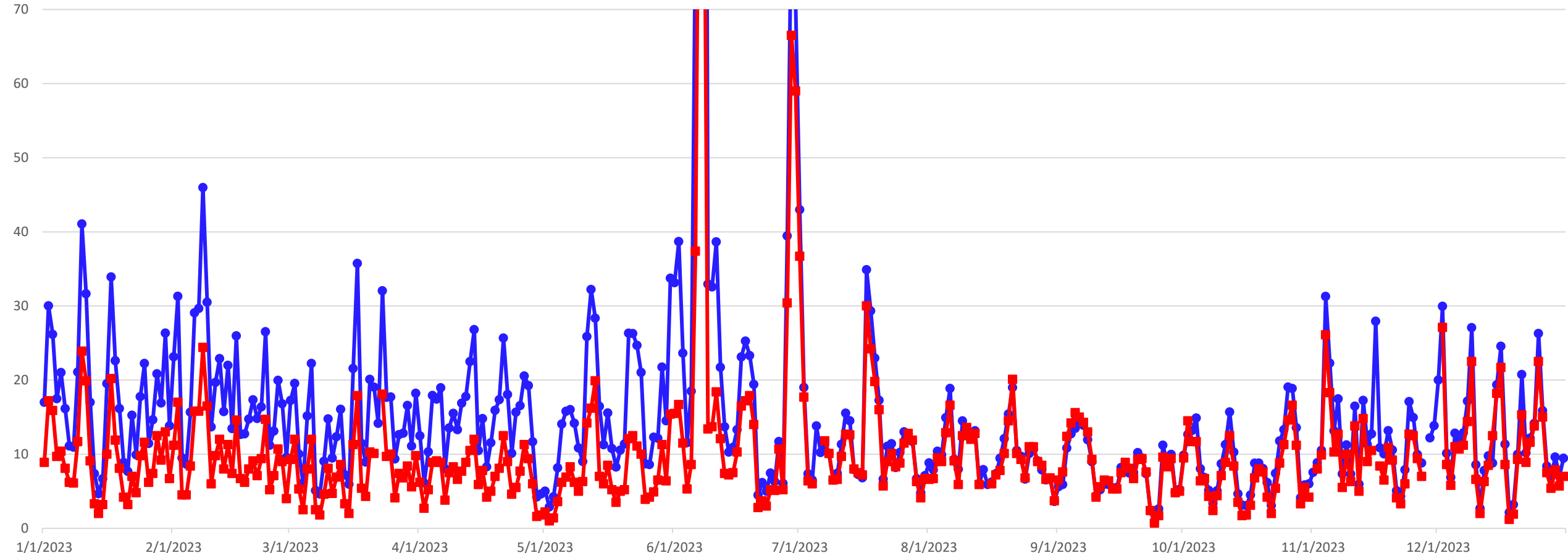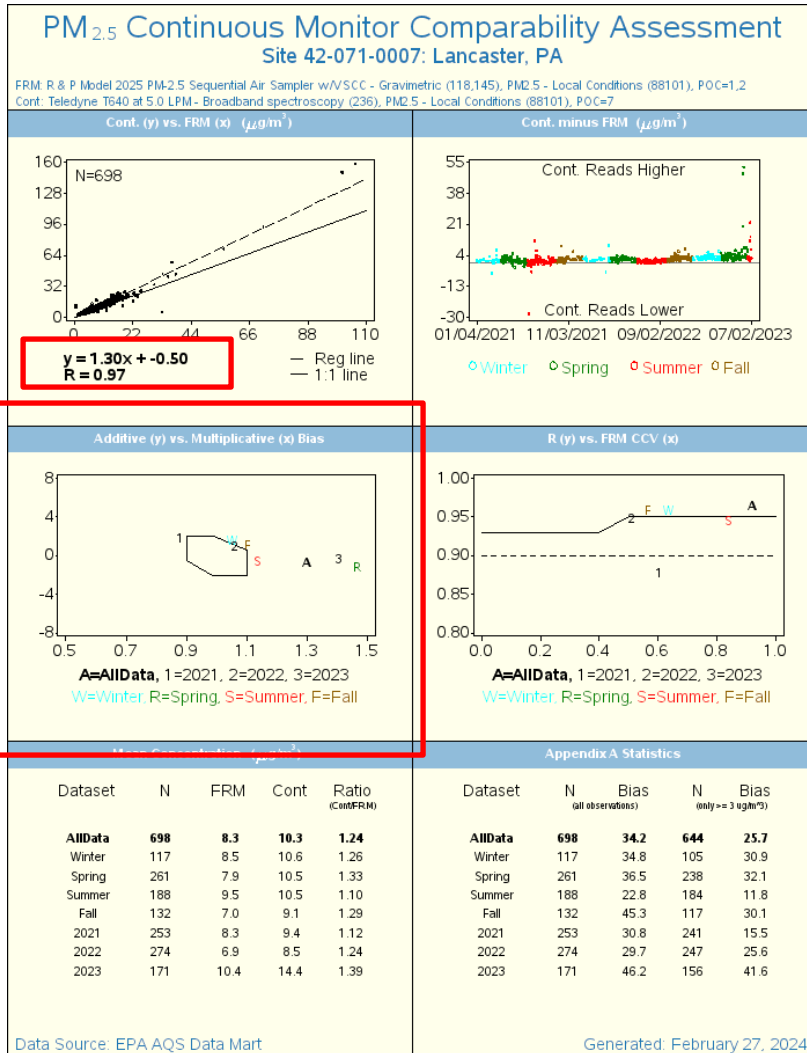# 2023 Lancaster DW T640 vs. FRM Example

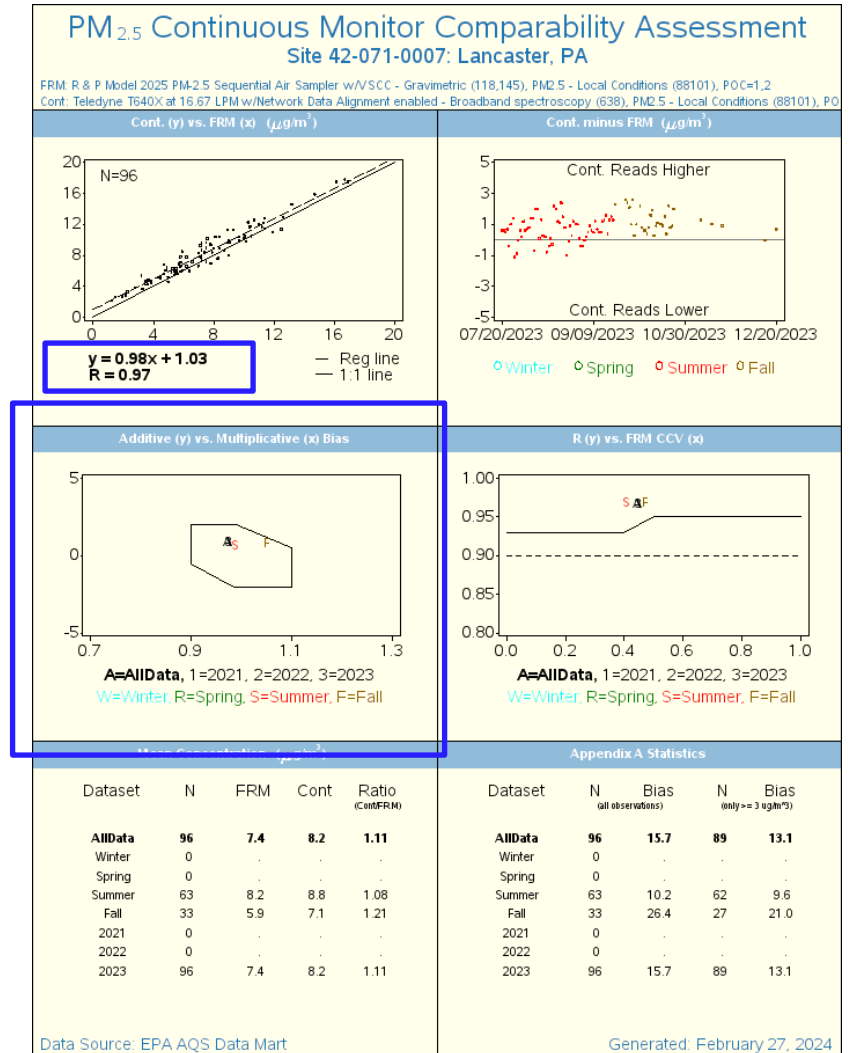FEM (T640)   FRM (Thermo 2025i)

420710012_7   420710012_1

2023 Lancaster DW T640 vs. FRM Example

Before Algorithm

After Algorithm

Proposal to Update PM2.5 Data from T640/T640X Monitors

- 2/15/2024 - EPA published in the *Federal Register* (89 Fed. Reg. 11,831) a "Notice of Opportunity to Comment" on the proposed plan to retroactively update the PM2.5 data in EPA's AQS from Teledyne T640 and T640X mass monitors.
  - Ensure data accurately represents ambient air concentrations
    - Regulatory decisions, PSD permitting, designations, exceptional events, attainment
    - Human health and ecosystem peer-reviewed research that support the NAAQS review process
  - Data update to all hourly T640/T640X PM2.5 in AQS from 2017 – present
  - Both the original and updated data will be publicly available
- 3/15/2024 - Comments received by (Docket ID No. EPA-HQ-OAR-2023-0642).
- April 2024 - Anticipate finalization of data update (if proposal finalized).
- May/June 2024 - Anticipate utilization of updated data in design values (if proposal finalized).

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PM2.5 AQI Changes

AQI Breakpoint Change

- As part of a revision of the NAAQS, EPA adjusts the AQI accordingly.

- With regards to PM2.5...
  - Changes to the annual standard = change to the threshold level between good and moderate.
  - Changes to the 24-hour standard = change to the threshold level between moderate and USG.

Final Revision to AQI for $PM_{2.5}$

AQI Value	Current [µg/m³]	Revisions [µg/m³]
0, Good	0	0
50, Moderate	12	9
100, USG	35	35
150, Unhealthy	55	55
200, Very Unhealthy	150	125
300, Hazardous	250	225
500, Hazardous*	500	325

*The 500 breakpoint is used in conjunction with the 300 breakpoint to calculate AQI values within the hazardous category. The approach does not use the 500 breakpoint to determine other breakpoints values.

Source: https://www.4cleanair.org/wp-content/uploads/EPA-PM-NAAQS-Informational-Presentation-Feb-13-2024.pdf

Bryan Oshinski

Air Quality Program Specialist
Stationary and Area Sources Section
Air Resource Management Division
717-783-8949; boshinski@pa.gov

Hallie Weiss

Air Quality Program Specialist
Quality Assurance and Data Assessment Section
Monitoring Division
484-250-5026; haweiss@pa.gov