Arizona Department of Environmental Quality

2024 Primary Annual Fine Particulate Matter NAAQS Boundary Recommendations Report

Air Quality Division
December 12, 2024 Final Version

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1 Executive Summary and Official Recommendations

In accordance with the Clean Air Act (CAA) section 107(d)(1) and Arizona Revised Statutes (A.R.S.) § 49-405, this report documents and explains Arizona Department of Environmental Quality's (ADEQ) initial boundary recommendations to the governor of Arizona to designate areas of the state in response to the revised 2024 Primary Annual Fine Particulate Matter ($PM_{2.5}$) National Ambient Air Quality Standards (NAAQS) of 9.0 µg/m^3.

After consideration of current available data, in the context of existing Environmental Protection Agency (EPA) guidance, and following consultation with stakeholders, ADEQ recommends to the governor that most of the state be designated attainment/unclassifiable. ADEQ recommends a partial county nonattainment area (NAA) for Maricopa County, Arizona, a contingency based partial county NAA for Pinal County, Arizona, and a partial county NAA for Santa Cruz County, Arizona.

The recommendations are conveyed in terms of township, range, and section below and the remainder of the report provides supporting data for the recommendations. All recommendations exclude Tribal Nations and Communities land, which has the same meaning as the term defined in 18 U.S.C. § 1151.

Chapter 2 provides background regarding the $PM_{2.5}$ NAAQS and EPA's guidance. Chapter 3 details ADEQ's boundary recommendations for Maricopa and Pinal Counties. Chapter 4 discusses ADEQ's boundary recommendations for Santa Cruz County. Chapter 5 describes ADEQ's recommendations for attainment/unclassifiable areas in Arizona.

1.1 Boundary Recommendations for the Phoenix-Mesa-Chandler Metropolitan Statistical Area

1.1.1 Township and Ranges for the Recommended Maricopa County (Partial) NAA

Designated Area[1]	Designation Type
Maricopa County: T1N R1E; T1N R1W;	Nonattainment

[1] All Arizona recommended areas exclude Tribal Nations and Communities land, which has the same meaning as the term defined in 18 U.S.C. § 1151.

T1N R2E; T1N R3E; T1N R4E; T1N R5E; T1N R6E; T1S R1E; T1S R2E; T1S R3E; T1S R4E; T1S R5E; T1S R6E; T2N R1E; T2N R1W; T2N R2E; T2N R3E; T2N R4E; T2N R5E; T3N R1E; T3N R1W; T3N R2E; T3N R3E; T3N R4E; T3N R5E; T4N R1E; T4N R1W; T4N R2E; T4N R3E; T4N R4E; T1N R2W Section 1, 12, 13, 24, 25, 36; T1N R7E Section 4-9, 16-21, 28-33; T1S R7E Section 4-9, 16-21, 28-33; T2N R2W Section 1, 12-13, 24-25, 36; T2N R6E Section 25-36; T2N R7E Section 29-33; T2S R5E Section 1-6; T2S R6E Section 1-6; T2S R7E Section 4-6; T3N R2W Section 1, 12-13, 24-25, 36; T4N R2W Section 1, 12-13, 24-25, 36.	

1.1.2 Township and Ranges for the Recommended Contingency Based Pinal County (Partial) NAA

Designated Area[2]	Designation Type
Pinal County:	Nonattainment
1. Commencing at a point which is the intersection of the eastern line of Range 1 East, Gila and Salt River Baseline and Meridian, and the northern line of Township 4 South, which is the point of beginning:	
2. Thence, proceed easterly along the northern line of Township 4 South to a point where the northern line of Township 4 South intersects the eastern line of Range 4 East;	
3. Thence, southerly along the eastern line of Range 4 East to a point where the eastern line of Range 4 East intersects the northern line of Township 6 South;	
4. Thence, easterly along the northern line of Township 6 South to a point where the northern line of Township 6 South intersects the eastern line of Range 4 East;	
5. Thence, southerly along the eastern line of Range 4 East to a point where the eastern line of Range 4 East intersects the southern line of Township 7 South;	
6. Thence, westerly along the southern line of Township 7 South to a point where the southern line of Township 7 South intersects the quarter section line common to the southwestern southwest quarter section and the southeastern southwest quarter section of section 34, Range 3 East and Township 7 South;	
7. Thence, northerly along the quarter section line common to the southwestern southwest quarter section and the southeastern southwest quarter section of	

[2] *Supra* note 1.

sections 34, 27, 22, and 15, Range 3 East and Township 7 South, to a point where the quarter section line common to the southwestern southwest quarter section and the southeastern southwest quarter section of sections 34, 27, 22, and 15, Range 3 East and Township 7 South, intersects the northern line of section 15, Range 3 East and Township 7 South;	
8. Thence, westerly along the northern line of sections 15, 16, 17, and 18, Range 3 East and Township 7 South, and the northern line of sections 13, 14, 15, 16, 17, and 18, Range 2 East and Township 7 South, to a point where the northern line of sections 15, 16, 17, and 18, Range 3 East and Township 7 South, and the northern line of sections 13, 14, 15, 16, 17, and 18, Range 2 East and Township 7 South, intersect the eastern line of Range 1 East, which is the common boundary between Maricopa and Pinal Counties, as described in Arizona Revised Statutes sections 11-109 and 11-113;	
9. Thence, northerly along the eastern line of Range 1 East to the point of beginning which is the point where the eastern line of Range 1 East intersects the northern line of Township 4 South;	
10. Except that portion of the area defined by paragraphs 1 through 9 above that lies in Indian country.	

1.2 Boundary Recommendation for the Nogales, Arizona Micropolitan Statistical Area

1.2.1 Township and Ranges for the Recommended Santa Cruz County (Partial) NAA

Designated Area[3]	Designation Type
Santa Cruz County: The portions of the following Townships which are within the State of Arizona and lie east of 111 degrees longitude: T23S, R13E, T23S, R14E, T24S, R13E, T24S, R14E.	Nonattainment

[3] *Supra* note 1.

2 Introduction and Background

This chapter provides background regarding $PM_{2.5}$ pollution and the legal framework ADEQ utilized to develop these boundary recommendations. Section 2.1 discusses the human health impacts of $PM_{2.5}$. Section 2.2 analyzes the relevant CAA provisions, the EPA's final rule, and relevant guidance. Section 2.3 describes ADEQ's approach in developing these boundary recommendations.

2.1 Particulate Matter and Health

In ambient air, particulate matter (PM) is a suspended mixture of solid particles and liquid droplets.[4] PM can be composed of multiple chemical species and can include particles such as dust, dirt, soot, smoke, and metallic compounds. PM particles vary in size with some particles being large enough to see with the human eye and others too small to see without an electron microscope.[5] Particles are defined by their aerodynamic diameter for air quality regulatory purposes due to the distinct health and welfare effects linked to exposure with particles of different sizes. Particles with a diameter of 10 microns (µm) or less are inhalable and are the focus of modern air quality regulations. Currently, EPA has established primary (i.e., public health protection) and secondary (i.e., public welfare protection) standards using the indicators PM_{10} (i.e., coarse particles) and $PM_{2.5}$ (i.e., fine particles). PM_{10} and $PM_{2.5}$ refer to particles with a diameter less than or equal to 10 µm and less than or equal to 2.5 µm, respectively.

Long-term and short-term exposure to $PM_{2.5}$ in ambient air have been linked with numerous negative health effects including respiratory and cardiovascular mortality, respiratory effects (e.g., asthma development), cardiovascular effects (e.g., coronary heart disease), and lung cancer.[6] Sources of PM include directly emitted particles and secondary particles formed in the atmosphere through the reaction of gases (e.g., sulfur dioxide, nitrogen oxides, ammonia) and organic compounds.[7] PM can be generated from both natural and anthropogenic sources including dust storms, prescribed fires, wildfires, fuel combustion for electricity production, commercial cooking, agricultural activities, residential wood combustion, fireworks, and more.

2.2 Legal Requirements and Guidance

In accordance with CAA section 108, the EPA Administrator must identify, list, and issue criteria for certain air pollutants that in their "judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare." The EPA has listed six such pollutants, commonly called "criteria pollutants." Because of particulate matter's negative health

[4] 89 FR 16202, 16214 (Mar. 6, 2024).
[5] *Id.*
[6] U.S. Env't. Prot. Agency, Supplement to the 2019 Integrated Science Assessment for Particulate Matter (Final Report, 2022). U.S. Environmental Protection Agency, Washington, DC, EPA/635/R-22/028, 2022.
[7] *Id.*

and welfare (i.e. environment) effects, particulate matter is regulated through the CAA as a criteria pollutant. According to CAA section 109, the EPA must set emission standards for criteria pollutants, also known as National Ambient Air Quality Standards (NAAQS).

Once the EPA establishes or revises the NAAQS, CAA section 107(d)(1) mandates the governor of each state to submit initial area designations to the EPA within the time required by the EPA, but no later than one year after the NAAQS revision. The initial designations must list all areas within the state as either nonattainment, attainment, or unclassifiable. A NAA is any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the primary or secondary NAAQS for the pollutant. An attainment area is any area outside of a NAA that meets the NAAQS. An unclassifiable area is any area that cannot be classified on the basis of available information as meeting or not meeting the NAAQS.

ADEQ is tasked with preparing the boundary designations and supporting documents for the entire state of Arizona.[8] According to Arizona statute, ADEQ's proposed recommendations must first be completed and posted on ADEQ's website between 4 and 5 months before they are due to the governor.[9] ADEQ must then hold a public hearing regarding the recommendations after a comment period.[10] These proposed recommendations are then submitted to the governor at least one month before the governor must submit the initial designations.[11] Finally, the governor submits the initial boundary designations to the EPA before the federally imposed deadline.

The EPA most recently revised and promulgated the primary annual fine PM NAAQS to 9.0 $\mu g/m^3$ on February 7, 2024.[12] In order to comply with CAA section 107(d)(A) and the 2024 Annual Fine PM final rule, all states' initial boundary designations are due before February 7, 2025. ADEQ's recommendation is further time constrained by state statute as noted above.

To comply with statutory time constraints, ADEQ collected and analyzed data as it became available. ADEQ also applied current the EPA guidance as it became available, including the EPA's Initial Area Designations Memorandum (Designations Memo).[13] Attachment 3 of the Designations Memo lays out the main factors to consider in determining NAA boundaries for the 2024 Primary Annual Fine PM NAAQS. The EPA will consider this guidance and associated factors in determining final boundary designations. The five guiding factors and a short summary of each follows:

1. Air Quality Data

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[8] *See* A.R.S. § 49-405.
[9] *Id*.
[10] *Id*.
[11] *Id*.
[12] *See* Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, 89 Fed. Reg. 16202 (Mar. 6, 2024).
[13] *See* Initial Area Designations for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard, Memorandum from Joseph Goffman, Assistant Administrator, to Regional Administrators, Regions 1-10 (February 7, 2024), *available at* https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-designations-memo_2.7.2024-_-jg-signed.pdf.

2. Emissions and Emissions-Related Data
3. Meteorology
4. Geography and Topography
5. Jurisdictional Boundaries

For air quality data, states are instructed by the EPA guidance to identify all monitors in an area, all monitored design value (DV) violations, and DVs for all monitors. States will use 2021-2023 monitored DV data for initial designations, while the EPA will use 2022-2024 DV data. The EPA suggests evaluating historical trend data to provide a greater understanding of the nature of $PM_{2.5}$ issues in an area. The EPA also suggests evaluating the spatial and temporal distribution of DV exceedances. Additionally, the EPA recommends conducting a compositional assessment of $PM_{2.5}$ to determine which chemical species constitute $PM_{2.5}$ in a particular area of interest. Linking the compositional analysis assessment with the urban increment analysis can help identify the likely contributing emissions source types to the nearby concentration increment.

For emissions and emissions-related data, the EPA recommends using the most recent National Emissions Inventory (NEI) Data to evaluate county level emissions magnitudes and the geographic locations of PM sources. As of the date of this analysis, the most current NEI is 2020. The EPA also suggests analyzing population and location of urbanization as these can be indicators of emissions-related activities. In addition, traffic and commuting patterns can directly relate to precursor emissions and can show the interrelatedness to a nearby area. The EPA suggests examining major arteries, traffic volume, and vehicle miles traveled (VMT).

The EPA encourages evaluating meteorological information to assess the "fate and transport of emissions contributing to $PM_{2.5}$ concentrations."[14] The agency also suggests assessing source-receptor analysis relationships using wind speed and wind speed direction, possibly by way of running HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model trajectories.

The EPA states that geography and topography, the location of physical features of land, "may influence the fate and transport of emissions and $PM_{2.5}$ concentrations".[15]

Jurisdictional boundaries may be considered "once the geographic extent of the violating area and the nearby area contributing to violations is determined…for the purposes of providing a clearly defined legal boundary and carrying out the CAA's air quality planning and enforcement functions for nonattainment areas."[16]

The final step is that all of the above five factors are then weighed together as a whole in a weight of evidence. Considering all of the factors and data, one conclusion will appear superior to others according to the EPA.

[14] Initial Area Designations Memo, *supra* note 13, Attachment 3 at 11.
[15] *Id.*
[16] *Id.*

2.3 ADEQ's Approach

This section describes ADEQ's $PM_{2.5}$ five factor data analysis and general approach, and the ADEQ's interpretation of nearby areas and exceptional events.

2.3.1 ADEQ's Five Factor Data and General Approach

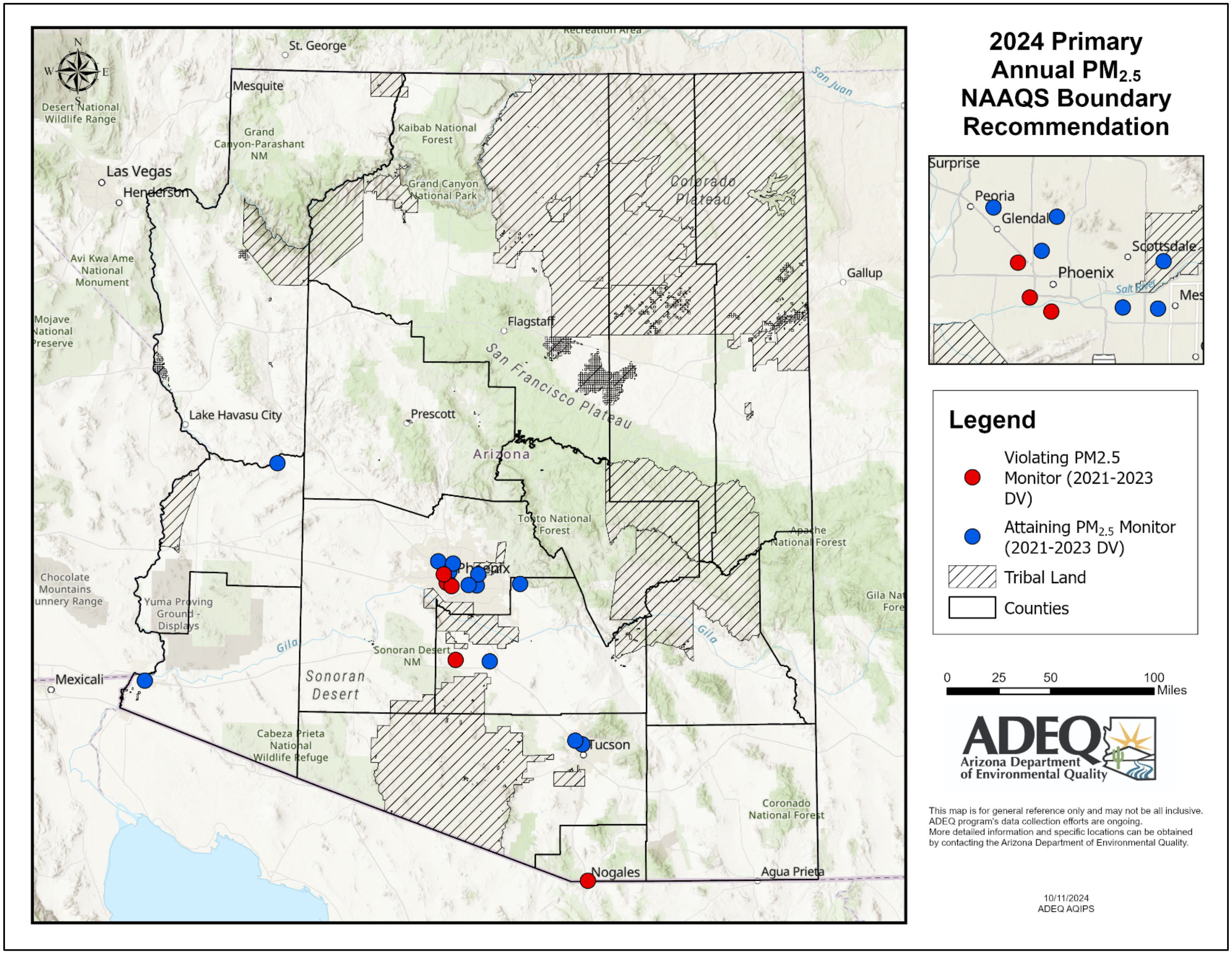
After consideration of currently available data in the context of the Designations Memo's five factors and following consultation with stakeholders, ADEQ recommends most of the state as attainment or unclassifiable areas. These recommendations are based on monitoring data for the years 2021 through 2023. Given future DVs, ADEQ may revise these recommendations, as discussed in Section 5.1.2.

ADEQ analyzed the best available data using the guiding five factors. The general sources of analyzed data is presented in the Technical Support Document found in Appendix A.

For air quality data, ADEQ analyzed 2023 DVs based on the annual arithmetic mean concentrations of $PM_{2.5}$ for 2021-2023.[17] DVs for the entire state are included in the Technical Support Document. See Figure 1 below for a map of the Arizona's $PM_{2.5}$ monitoring network. ADEQ examined historic, temporal, and seasonal trends of $PM_{2.5}$ data using annual DVs from the past 10 years, 24-hour $PM_{2.5}$ concentrations, and daily $PM_{2.5}$ arithmetic means. Additionally, measurements of the ambient $PM_{2.5}$ speciation were used to determine which chemical species constitute $PM_{2.5}$ in the particular area of interest and/or at particular violating monitors.

[17] Calculated in accordance with Appendix N to 40 C.F.R. Part 50 and 40 C.F.R. § 50.20.

Figure 1 Arizona's $PM_{2.5}$ Monitoring Network



For emissions and emissions related data, ADEQ analyzed the following resources: the 2020 National Emissions Inventory (2020 NEI); 2022 permitted minor and major point source reporting data from ADEQ, Maricopa County, and Pinal County; U.S. Department of Agriculture data (USDA data); Arizona State Land Department land ownership data (AZ land ownership data); 2022 Maricopa Association of Governments land use data (MAG land use data); U.S. Census population data for 2010 and 2020 (U.S. Census data); Arizona Office of Economic Opportunity Population Estimates and Projections (AZ OEO Population Estimates); Highway Performance Monitoring System (HPMS) traffic data; U.S. Department of Transportation statistics on border crossing data; and metropolitan planning organizations' (MPO) regional transportation plans (RTPs). Regarding traffic data, ADEQ looked at both average annual daily traffic (AADT),[18] and vehicle miles traveled (VMT).[19] ADEQ found that visually viewing roads in terms of VMT was unrepresentative in that not all traffic-counted road segments are the same length. Hence, all visual representations are shown in terms of AADT. VMT is provided as an area-wide estimate based on HPMS-sourced AADT for a specific area.

For meteorological data, ADEQ extracted real-time data from various sites for the DV period, except in cases where site-specific meteorological data was unavailable. Using the best available meteorological data, ADEQ created annual average wind roses between 2021 and 2023. The meteorological analyses are detailed in the Technical Support Document found in Appendix A.

For geographical and topographical maps, ADEQ used available base and reference maps in ESRI ArcGIS. Meteorological information was analyzed and weighted as appropriate within the context of geography and topography.

Jurisdiction was analyzed by evaluating known entities who have various types of authorities and the physical boundaries of such authorities. ADEQ evaluated what entities have air quality permitting authority, air quality planning authority, transportation planning authority, and where county boundaries, tribal land boundaries, and previously established $PM_{2.5}$ nonattainment areas are located.

The EPA then guides the states to consider the above five factors together in a weight of evidence analysis.

In developing its recommendations, ADEQ involved as many stakeholders as possible. The agency held public stakeholder meetings on May 2, 2024; May 9, 2024; May 16, 2024; July 2, 2024; July 10, 2024; July 11, 2024; July 15, 2024; July 18, 2024, and September 19-20, 2024. ADEQ met individually with several agencies and stakeholders throughout the process, including, but not limited to: Pinal County Air Quality Control District (PCAQCD), Maricopa Association of Governments (MAG), Maricopa County Air Quality Department (MCAQD), Santa Cruz County, MAG Air Quality Technical Advisory Committee, Santa Cruz County Board of Supervisors, Pinal County Board of Supervisors, Arizona Utilities Group (AUG), Arizona Rock Products Association (ARPA), Arizona Mining Association (AMA), MCAQD Clean Air Council, cities within the

[18] AADT is a bidirectional count of the annual vehicle traffic passing through a particular road segment divided by 365 days.
[19] VMT is AADT multiplied by the length of the counted road segment, and annual VMT is that number multiplied by the number of days in the year.

recommended NAA boundaries, and community based organizations including but not limited to the Arizona Center for Law in the Public Interest, American Lung Association, Sierra Club, and Moms Clean Air Force. ADEQ also made the draft boundaries available to the public and impacted stakeholders for a 21-day informal public comment period from June 28, 2024 to July 19, 2024. Response to comments collected from the informal public comment period can be found in Appendix C. In addition, ADEQ held a public hearing regarding the proposed recommendations on October 24, 2024 at the conclusion of a 31-day public comment period that ran from September 23, 2024. – October 24, 2024.

In Section 3 below, ADEQ analyzed the available data for the Phoenix-Mesa-Chandler, Arizona Metropolitan Statistical Area (MSA) to recommend two separate NAAs:

1. a partial county NAA for Maricopa County;[20] and
2. a contingency based partial county NAA for Pinal County.[21]

In Section 4 below, ADEQ analyzed the available data for the Nogales, Arizona Micropolitan Statistical Area (µSA) to recommend a partial county NAA for Santa Cruz County. In Section 5 below, ADEQ recommends attainment/unclassifiable designations for all other counties.

2.3.2 "Nearby" Interpretation

In the Designations Memo, the EPA states that it evaluates emissions data from nearby counties to assess each county's potential contribution to a violating monitor. "Nearby" in the EPA's view means that the EPA will review relevant information associated with the Office of Management and Budget delineated statistical boundaries such as Combined Statistical Areas (CSA) and Core Based Statistical Areas (CBSA), e.g. Metropolitan Statistical Areas (MSA) and Micropolitan Statistical Areas (µSA).[22] While CBSAs and CSAs do not presumptively form a nonattainment boundary,[23] the areas within such CBSAs and CSAs are evaluated to determine whether such areas are likely to be contributing to nearby areas within the same CBSA or CSA.

It is not necessarily appropriate to start with the CBSA or CSA and assume that the entire CBSA or CSA is contributing to a violating monitor. ADEQ believes this is especially true in a state with counties as large as those found in Arizona. Many areas in Arizona are practically, and for all intents and purposes, rural areas. Such areas are still technically a part of a CBSA or CSA because there is an urban area somewhere else in the same county, even if not nearby in the general sense of that word. Some violating monitors may be physically nearby, but outside of, a highly populated or high $PM_{2.5}$ or $PM_{2.5}$ precursor emitting MSA, and impacted mostly by that high emitting area, rather than by other sources within the same CBSA as themselves. Hence, ADEQ agrees that CBSAs are not necessarily a good presumptively nearby starting point for a boundary; and in Arizona, given the large size of the counties, CBSAs may also not be an appropriate limiting

[20] *See infra* Section 3.1.
[21] *See infra* Section 0..
[22] *Initial Area Designations Memo, supra* note 13, Attachment 3 at 8.
[23] *Initial Area Designations Memo, supra* note 13, at 5.

element either. ADEQ grouped the recommendations in this document by the areas applicable CBSA for consistency with the EPA's reviews.

2.3.3 Exceptional Events

The EPA's Designations Memo identifies that some states may wish to address impacts from exceptional events on $PM_{2.5}$ DVs and associated boundary recommendations. During the five factor analyses prepared for this report, ADEQ evaluated the potential impacts of pursuing exceptional event demonstrations for fireworks, dust storms, and wildfires in accordance with the EPA's Exceptional Events Rule (EER).[24] After consideration, the 2023 $PM_{2.5}$ DVs in this document do not reflect the exclusion of impacts from exceptional events, as these events would not affect attainment status based on data for 2020 through 2023. However, should this change with the availability of 2024 monitoring data, ADEQ will work to submit required exceptional event documentation to the EPA in accordance with the EER prior to final designations.

[24] *See* 81 FR 68216 (Oct. 3, 2016).

3 Phoenix-Mesa-Chandler MSA Recommendations

This chapter provides ADEQ's recommendations regarding the Phoenix-Mesa-Chandler MSA. Section 3.1 details ADEQ's nonattainment boundary recommendation for part of Maricopa County. Section 3.2.1 discusses a contingency based nonattainment boundary recommendation for part of Pinal County. While both of these recommended NAAs are within the Phoenix-Mesa-Chandler MSA, ADEQ recommends that they be designated as separate NAAs for the reasons discussed below.

3.1 Boundary Recommendation for Maricopa County (Partial) NAA

ADEQ recommends that the 2024 Primary Annual $PM_{2.5}$ Maricopa County NAA boundary be established for a portion of Maricopa County that focuses on the three violating monitors and the areas that are likely to contribute to those violations. Figure 2 below shows the recommended boundary, and Figure 3 shows the recommended boundary in the context of other relevant data.

Figure 2 Maricopa County Recommended (Partial) NAA

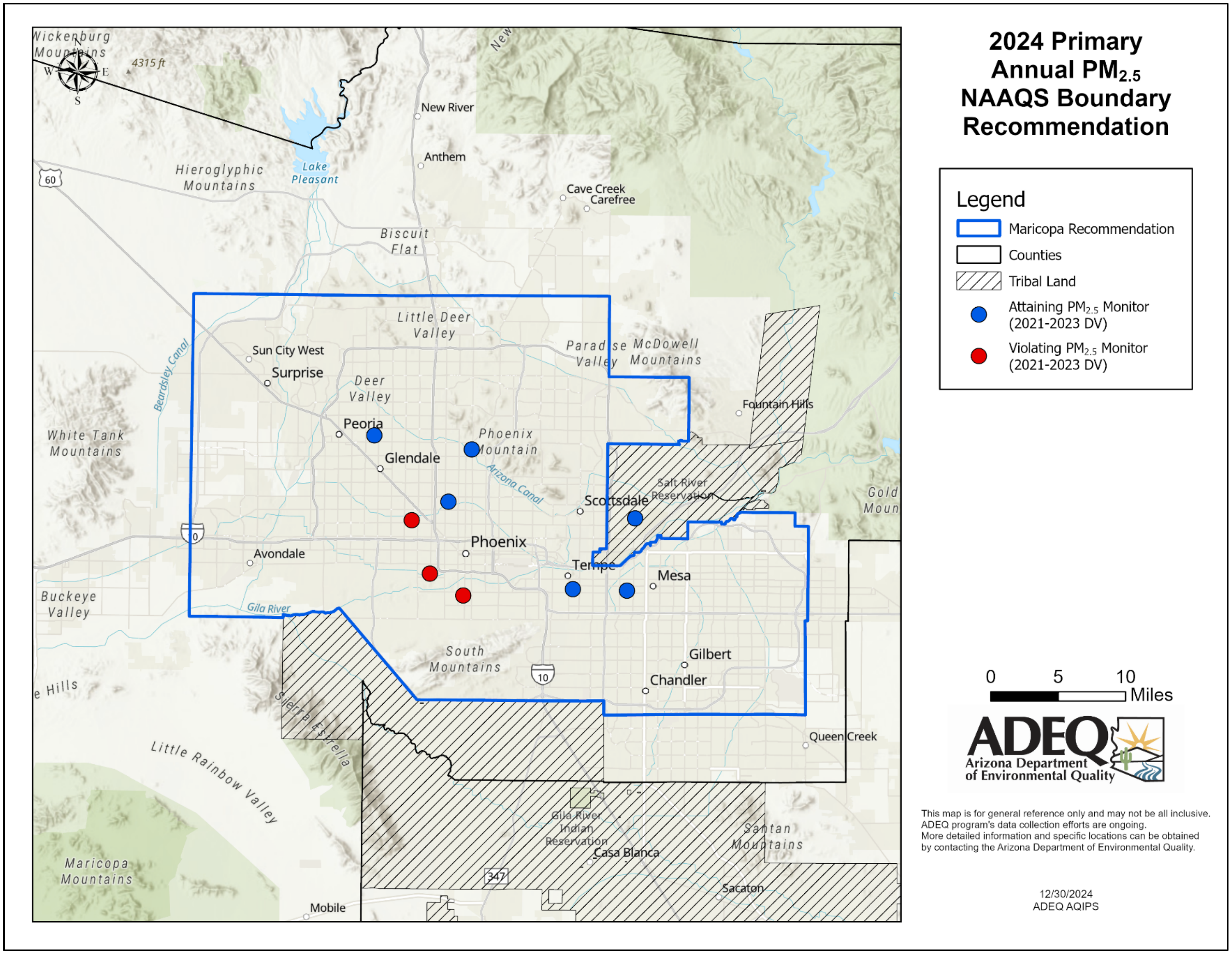
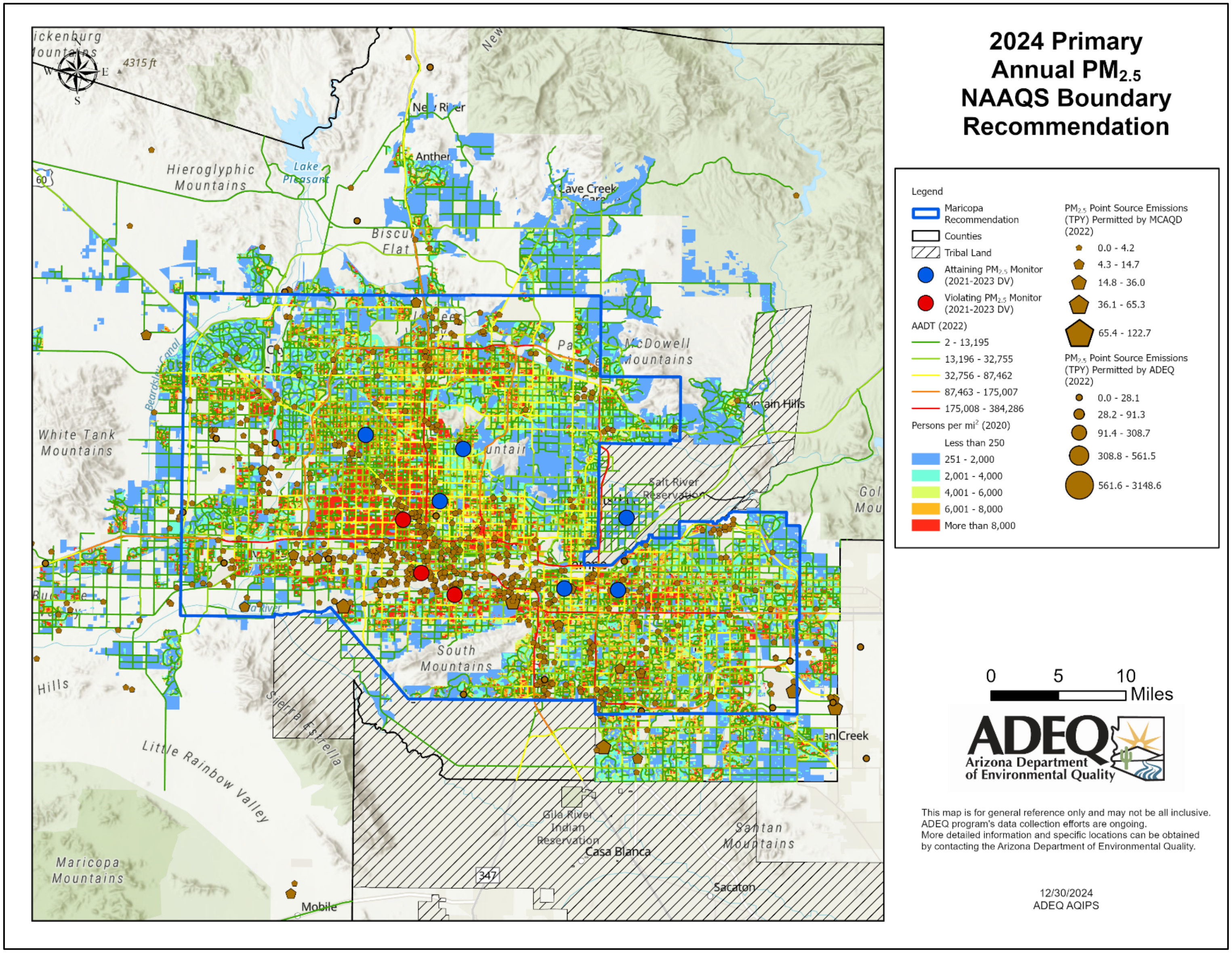


Figure 3 Maricopa County Recommended (Partial) NAA with Relevant Data



The following sections discuss the EPA's five factors: 1) air quality data; 2) emissions and emissions-related data; 3) meteorology; 4) geography/topography; and 5) jurisdictional boundaries. This section concludes with ADEQ's weight of evidence analysis.

3.1.1 Air Quality Data

For this factor, ADEQ considered data from air quality monitors within the Phoenix-Mesa-Chandler MSA (e.g., Maricopa and Pinal Counties). ADEQ considered the annual $PM_{2.5}$ DVs for these monitors, based on the three most recent consecutive years of certified and validated data, 2021-2023. By policy, the DV for a recommended area is determined by the monitor at the site with the highest recorded concentration. In reviewing the violating monitors within the MSA, ADEQ recommends the consideration of the Hidden Valley monitoring site located in Pinal County in a separate contingency based nonattainment boundary addressed in Section 3.2.1 of this document. As a result, the remainder of this section will focus on Maricopa County data. For the 2023 DV, the monitor with the highest recorded concentration within the recommended Maricopa County (partial) NAA is the West Phoenix monitor with a 2023 Annual $PM_{2.5}$ DV of 10.1 $\mu g/m^3$. Figure 4 below shows a color-coded map of the monitor locations within Maricopa County. Table 1 below shows the 2023 Annual $PM_{2.5}$ DV for monitor locations within Maricopa County.

Figure 4 Maricopa County $PM_{2.5}$ Monitor Locations

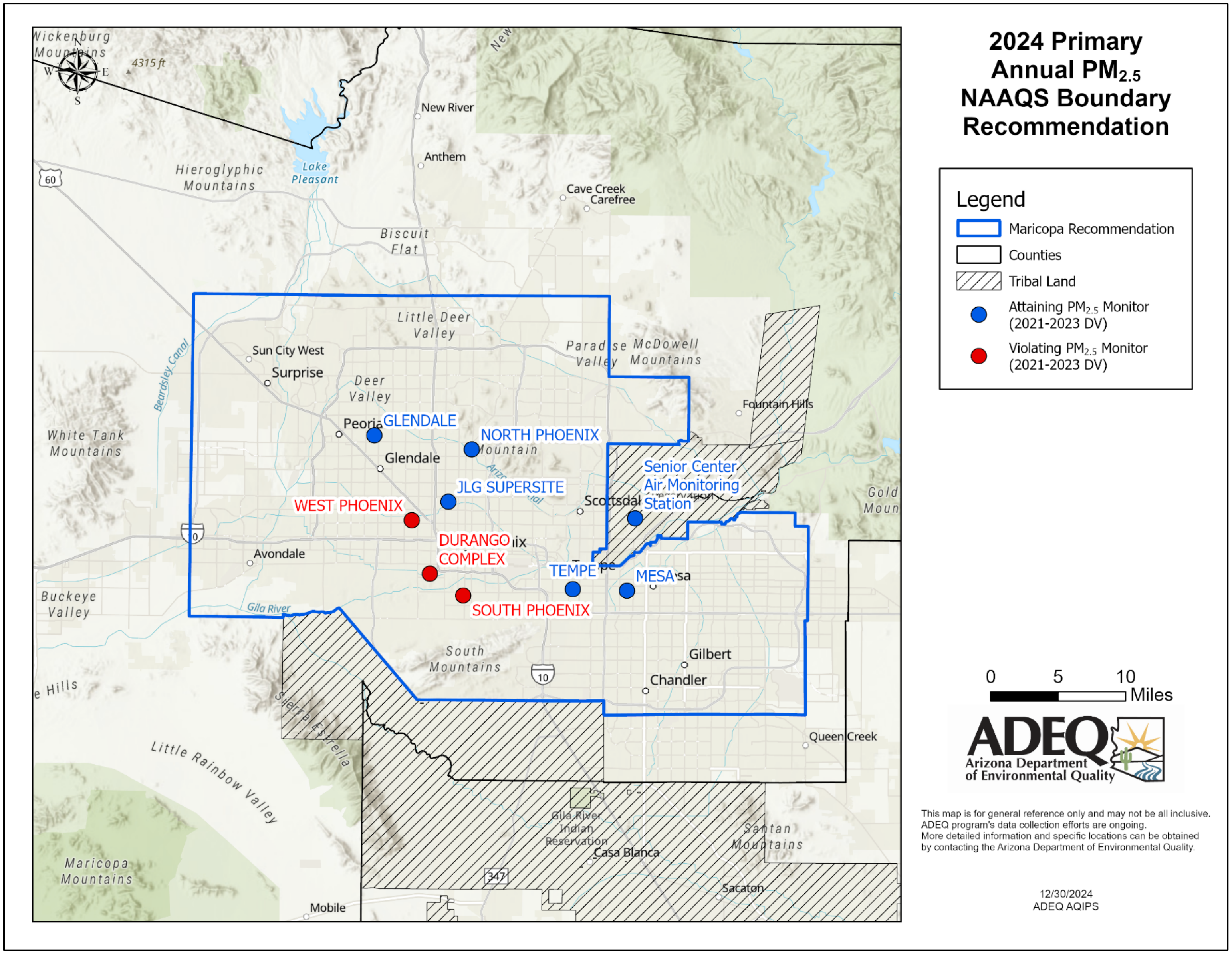


Table 1 Annual $PM_{2.5}$ DV for 2023 Maricopa County Monitors

County	AQS ID	Colloquial Name	2021-2023 DV (µg/m³)
Maricopa	04-013-0019	West Phoenix	10.1
	04-013-4003	South Phoenix	10
	04-013-9812	Durango Complex	9.9
	04-013-9997	JLG Supersite	8.4
	04-013-4005	Tempe	7.5
	04-013-1004	North Phoenix	7.1
	04-013-7020	Senior Center	6.8
	04-013-2001	Glendale	6.7
	04-013-1003	Mesa	6.5

See Figure 5 for the long-term trends in Maricopa County from 2014 to 2023. Overall, most monitors in Maricopa County have been trending downward, with the exception being the 2020-2022 time period which saw an increase in annual DV's across multiple monitors. However, for 2023 all county monitors have seen a decrease from the previous year. Because NAAs are defined by their highest violating monitors, the historical trend for the West Phoenix monitor is shown below in Figure 6.

Figure 5 Maricopa County Historic DV Trends

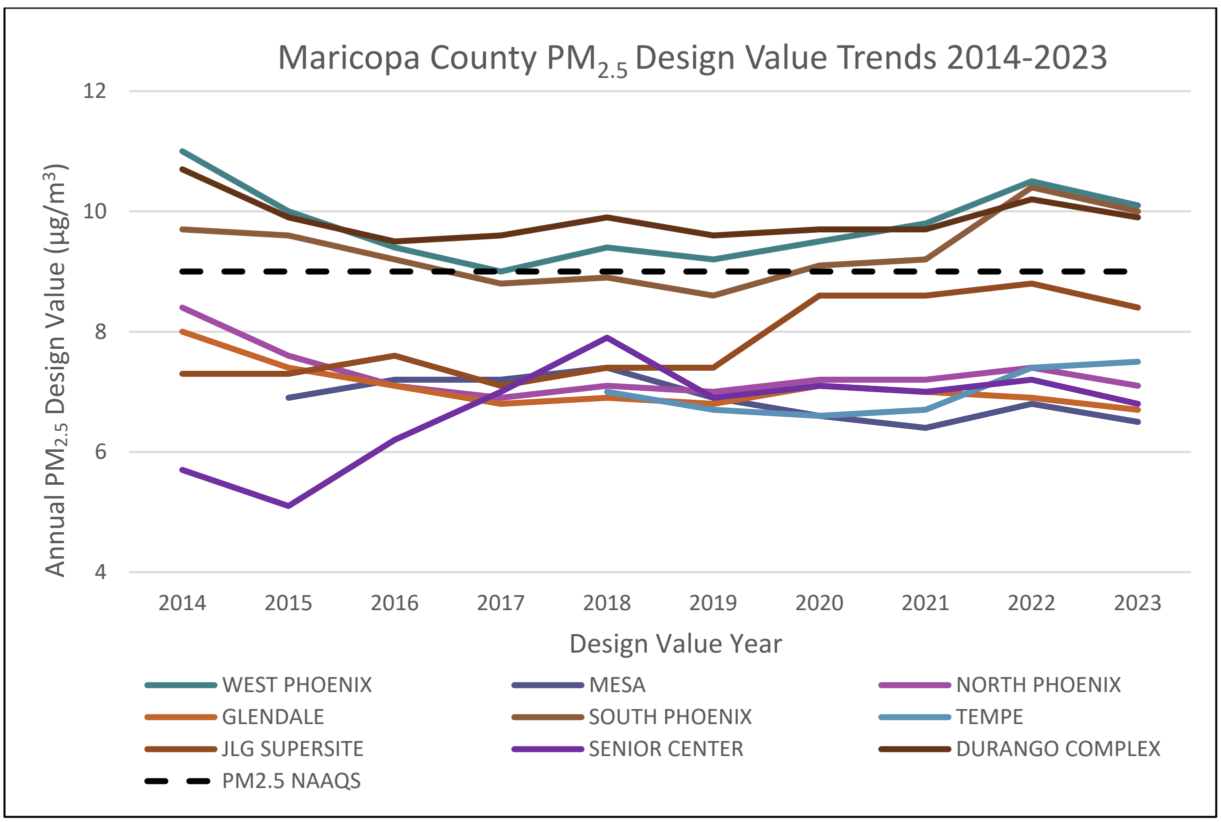


Figure 6 West Phoenix Monitor Historic DV Trends

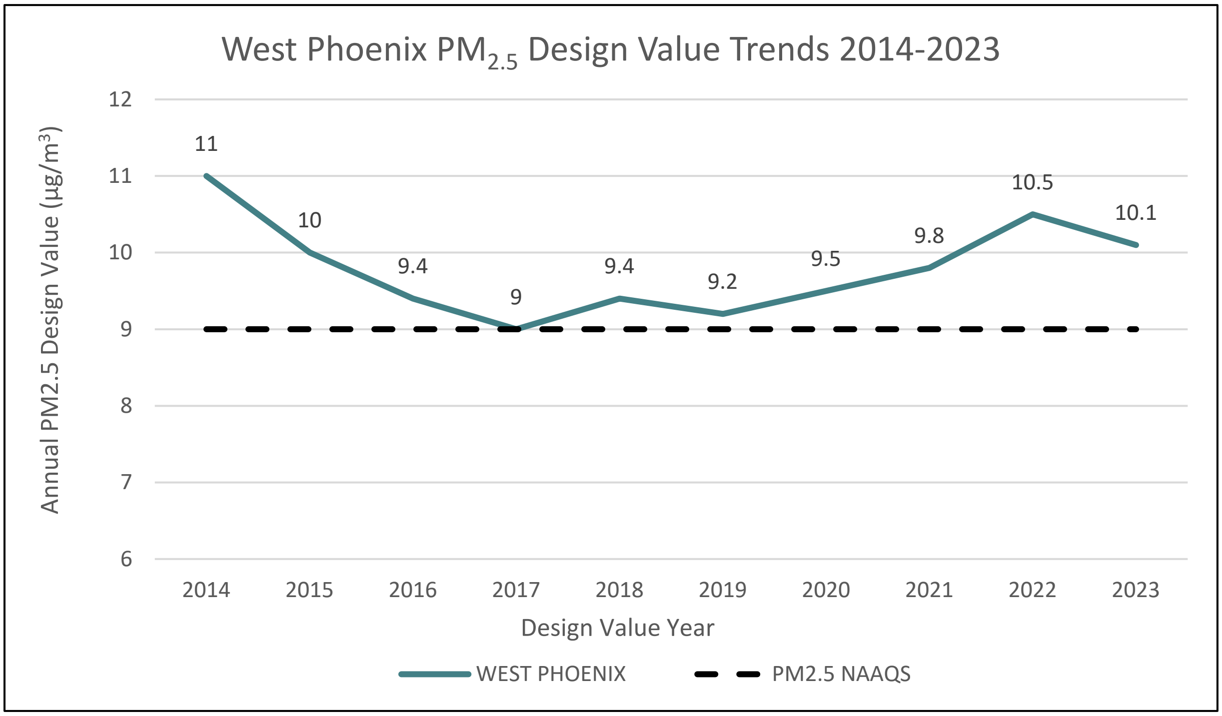
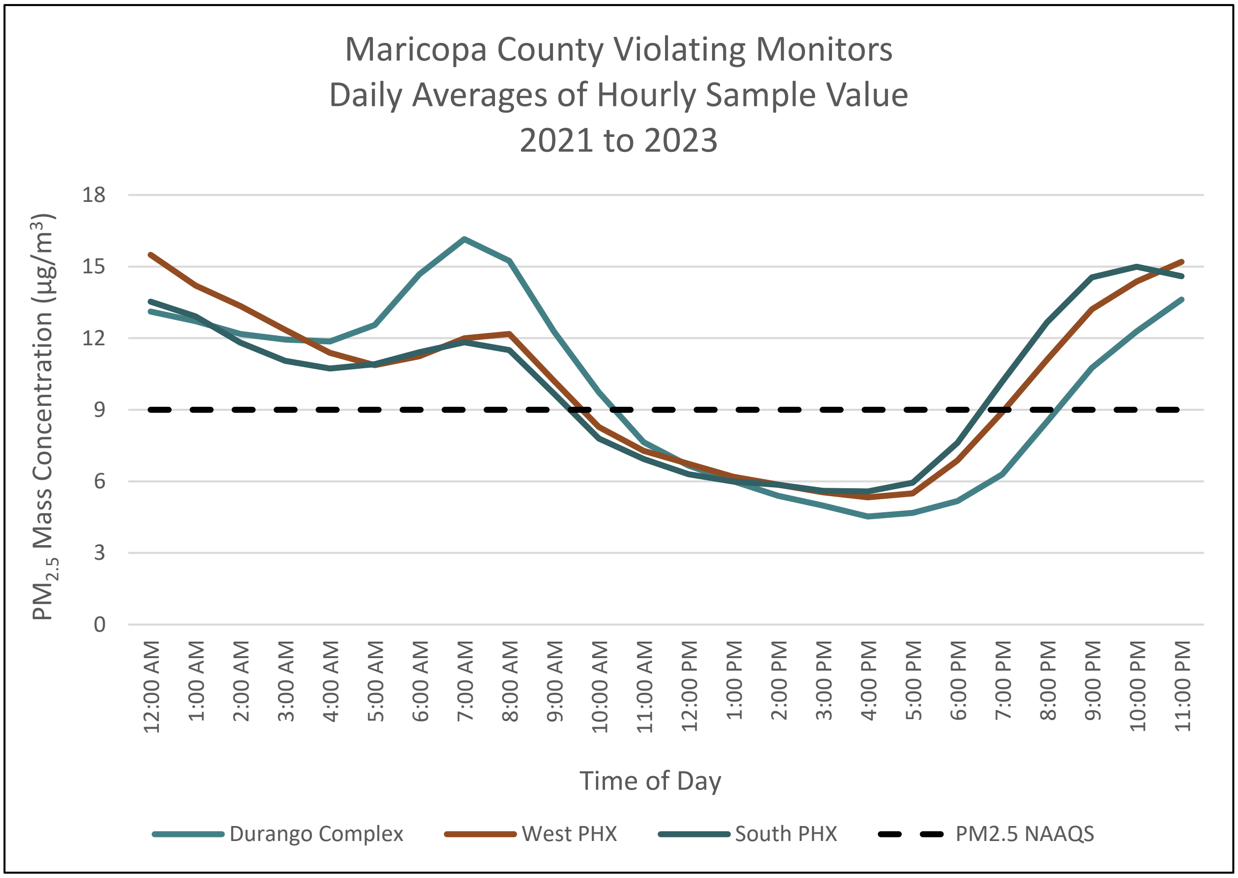


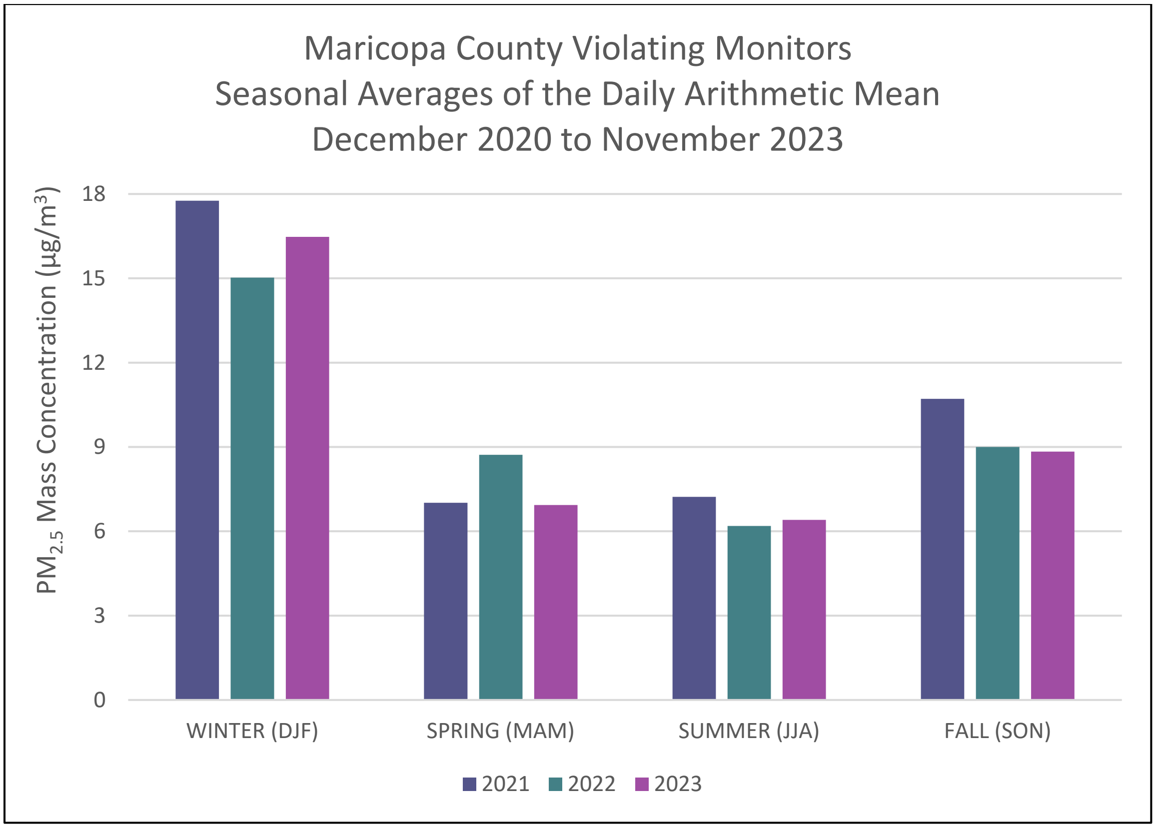
Figure 7 and Figure 8 display temporal trends at the three violating monitors in Maricopa County. Figure 7 displays the 24-hour trends of $PM_{2.5}$ mass concentrations by averaging the 24-hour arithmetic mean for West Phoenix, South Phoenix, and the Durango Complex monitoring sites from 2021 to 2023. This diurnal pattern demonstrates that $PM_{2.5}$ mass concentration is the highest between 6 am and 9 am and from 9 pm to 12 am. These times coincide with cooler temperatures and the potential for an inversion layer to persist. Once the temperature starts warming up during the daytime and the inversion layer breaks down, we see $PM_{2.5}$ mass concentrations drop below the 9.0 µg/m^3 standard.

Figure 7 Maricopa County Violating Monitors Hourly Trends



ADEQ analyzed seasonal trends instead of quarterly trends, as recommended by the EPA, because evidence supported a stronger correlation in seasonal findings. Seasonal influences exist on $PM_{2.5}$ mass concentration at each of the three violating monitors in Maricopa County. The daily $PM_{2.5}$ arithmetic mean from December 2020 to November 2023 was averaged according to season: winter months = December, January, February; spring months = March, April, May; summer months = June, July, August; and fall months = September, October, November. Figure 8 demonstrates that spring and summer months show lower concentrations than fall and winter. The highest concentration of exceedances occurs during the winter months.

Figure 8 Maricopa County Violating Monitors Seasonal Trends



3.1.1.1 $PM_{2.5}$ Compositional Analysis

ADEQ examined speciation measurements of ambient $PM_{2.5}$ such as sulfates, nitrates, organic carbon, elemental carbon, and crustal material to determine which chemical species constitute the largest portions of $PM_{2.5}$ mass found near the violating monitors. The data that was used to represent Maricopa County's metro or urban $PM_{2.5}$ concentration is collected by the Chemical Speciation Network (CSN) monitor located at JLG Supersite. The CSN monitor is co-located at the JLG Supersite $PM_{2.5}$ monitor, nearest to the West Phoenix $PM_{2.5}$ monitor. Chemical speciation at the CSN JLG monitor serves as a representation of the urban concentration in Maricopa County, as none of the three violating $PM_{2.5}$ monitors within the county are currently co-located with a $PM_{2.5}$ speciation monitor. CSN data samples are collected every 3 days at the JLC CSN site. For Maricopa County's urban concentration analysis, ADEQ utilized the sample values collected from December 5, 2020 to November 29, 2023 for: Sulfates (SO4f), Nitrates (NO3f), Organic Carbon (OCf), Elemental Carbon (EC1f+EC2f+EC3f=ECf), and Crustal Material (SOILf). Before processing the dataset, any "Invalid value (-999)" codes were removed. Additionally, each consecutive quarter or season during the study period was verified to contain a minimum of 11 sample values.

ADEQ chose to examine the $PM_{2.5}$ composition by season, rather than by quarter, since evidence indicated a stronger correlation with air quality trends when evaluated on a seasonal basis. Figure 9 shows the average of each chemical species during every season from December 2020 to November 2023: winter = December, January, February; spring = March, April, May; summer =

June, July, August; and fall = September, October, November. The percentages inside the bars reflect the proportion of each chemical species for each of the given seasons.

Figure 9 displays the average percent composition of each chemical species from December 2020 to November 2023 found at the CSN JLG monitor. Table 2 shows 3-year average chemical species of $PM_{2.5}$ at the CSN JLG monitor are comprised of 10% sulfates, 11% nitrates, 37% organic carbon, 18% elemental carbon, and 23% crustal material. Additionally, $PM_{2.5}$ mass concentrations were found to be highest during the winter months and account for 37% of the averaged total concentration from December 2020 to November 2023. Fall months account for 23% of the averaged total concentration. Spring months account for 22% of the averaged total concentration, and lastly summer months account for 19% of the averaged total concentration of the given time period.

However, analyzing $PM_{2.5}$ speciation near the violating monitors alone is generally insufficient to differentiate between contributions from local or nearby sources and those from regional background sources. An assessment of urban concentration is therefore only one step in establishing a link between nearby emissions sources to nearby violating monitors.

Figure 9 Maricopa County's Urban Concentration of $PM_{2.5}$ Speciation

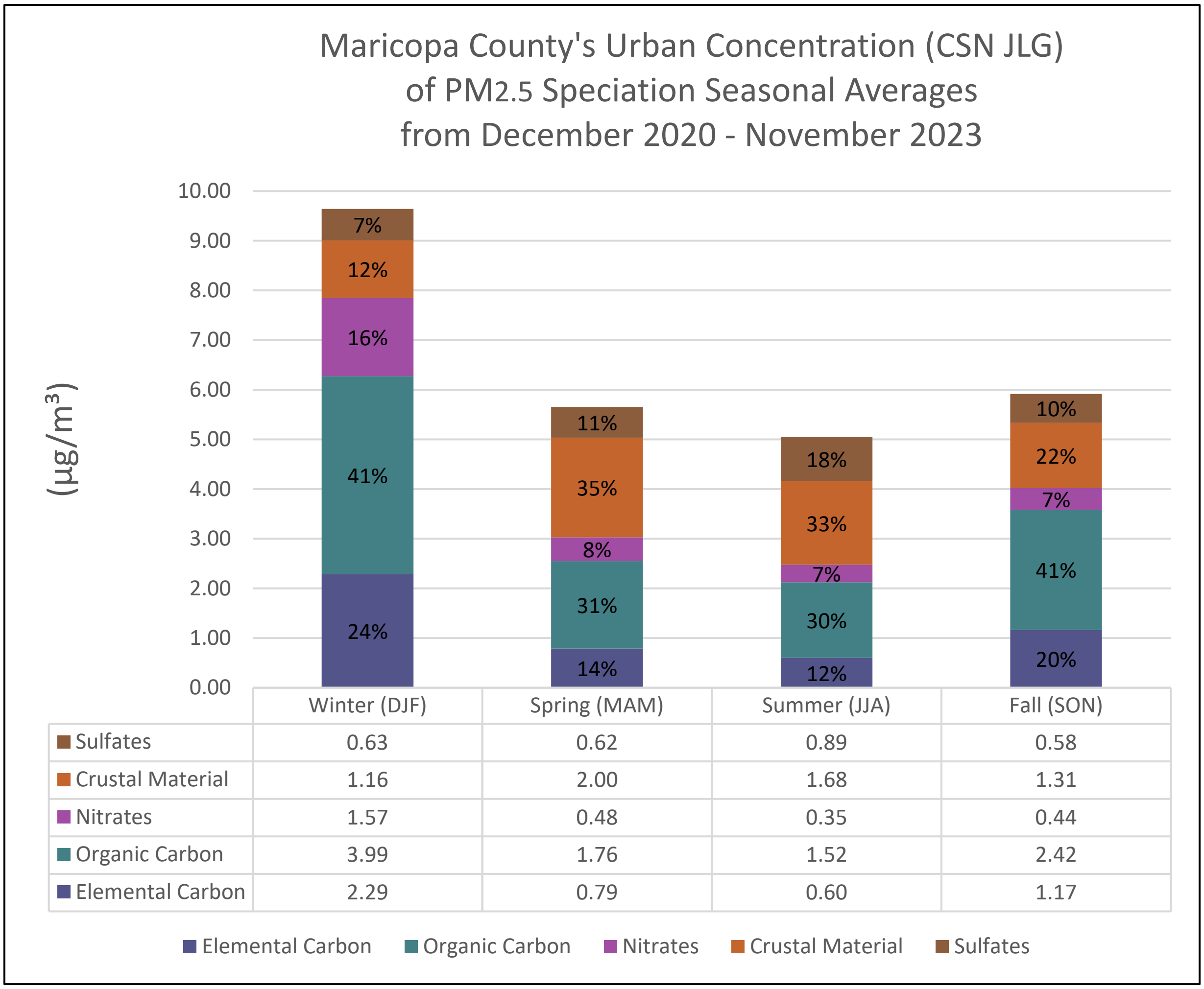


Table 2 Maricopa County's 3-Year Average (December 2020 – November 2023) Percent Composition of the Urban Concentration

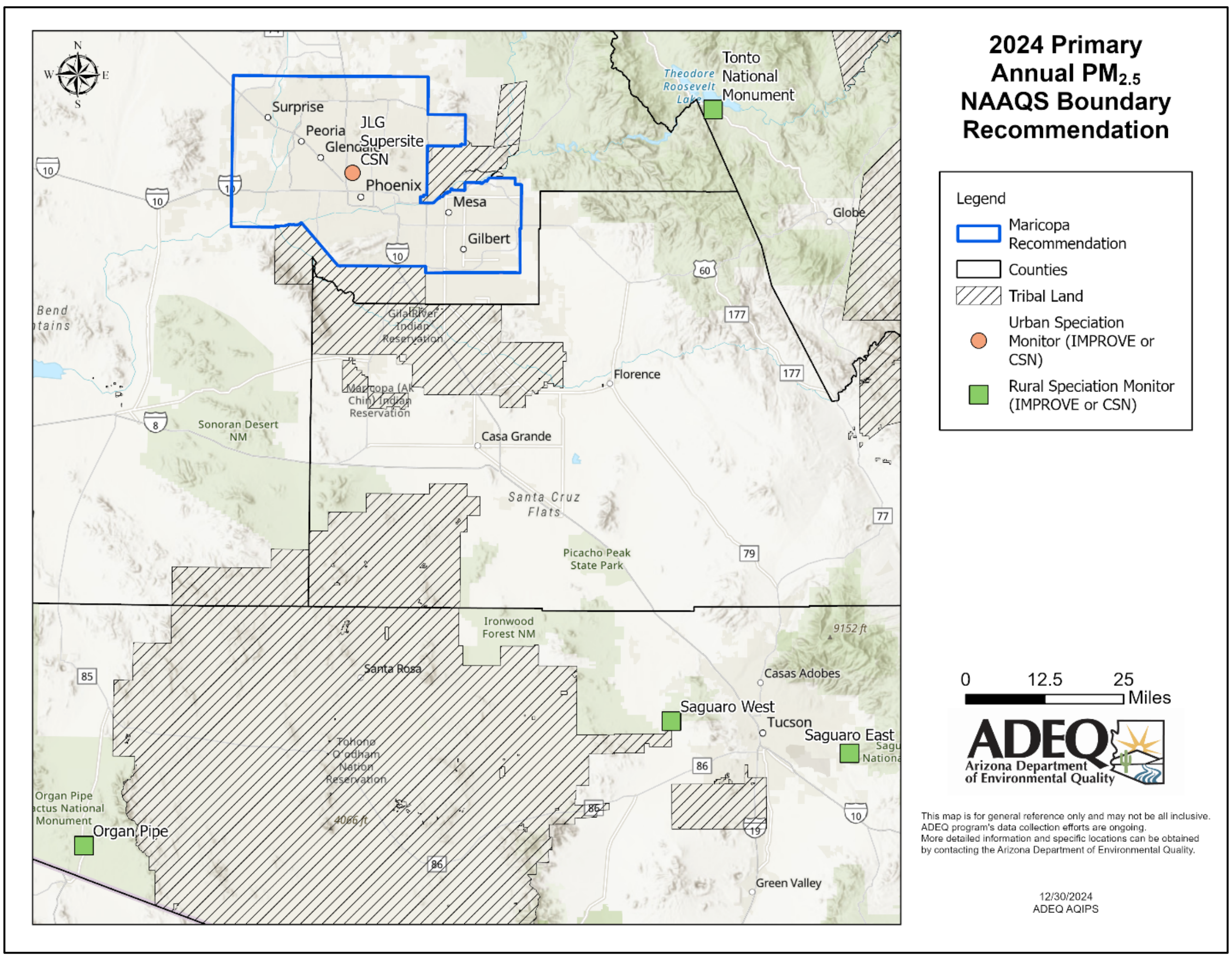
CSN JLG Monitor	
Organic Carbon	37%
Crustal Material	23%
Elemental Carbon	18%
Nitrates	11%
Sulfates	10%

3.1.1.2 $PM_{2.5}$ Urban Increment

The urban increment analysis is a key part of the air quality data evaluation because it can suggest spatial and temporal correlations by identifying the likely contributing emissions source types to the local concentration. To determine the $PM_{2.5}$ urban increment near the violating monitors within Maricopa County, the regional background $PM_{2.5}$ concentration is subtracted from the $PM_{2.5}$ urban concentration.

Figure 10 shows the locations of all speciation monitors whose data were chosen for Maricopa County's urban increment analysis. ADEQ averaged four rural Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring sites located within a 150-mile radius of Maricopa's urban speciation monitor, CSN JLG, to find the regional background concentration. Rural monitor sites for Maricopa County urban increment analysis include: Tonto National Monument (TONT1), Organ Pipe Cactus National Monument (ORPI1), Saguaro National Park East (SAGU1) and Saguaro National Park West (SAWE1). The Maricopa County urban increment analysis and urban concentration analysis found above in section 3.1.1.1 contains certified values at IMPROVE monitoring sites from December 2020 to November 2023. All values for the given time period at the CSN JLG monitor utilized certified CSN data.

Figure 10 Speciation Monitors for Maricopa County's Urban Increment Analysis



If an averaged seasonal value for the urban increment derives a negative number, that value is set to zero, negative values could occur when the estimated average rural concentration is similar to its paired urban value.[25] This was the case for crustal material during the averaged spring months from 2021-2023, shown in the table below the bar graph in Figure 11. This evidence suggests that emissions from crustal material-related sources near the violating monitors in Maricopa County did not likely influence $PM_{2.5}$ violations during March, April, and May from 2021 to 2023 and/or that the regional background concentration of crustal-material for those same time periods was higher than average.

The 3-year average percent composition of species contributing to the local $PM_{2.5}$ concentration, also referred to as urban "excess" is displayed in Table 3 and comprised of 5% sulfates, 13% nitrates, 49% organic carbon, 30% elemental carbon, and 3% crustal material. This "excess" is calculated by the sum of each chemical species seasonal average divided by the total sum. When comparing the urban concentration to the urban increment, ADEQ notes that there is a decrease in sulfates and crustal material when the regional background concentration is removed. Moreover, there is an increase in nitrates, organic carbon and elemental carbon found in the urban increment. A higher percentage of organic carbon can indicate a signature of mobile sources, wood or biomass burning and localized combustion sources.[26] A high organic carbon to elemental carbon ratio can demonstrate a presence of biomass burning, such as residential wood combustion. Additionally, the urban increment near the violating monitors within Maricopa County consistently shows significant seasonal fluctuations, with the highest $PM_{2.5}$ concentrations occurring during the winter months of December, January, and February. The urban excess during the winter months accounts for 51% of the averaged total excess concentration from December 2020 to November 2023. The winter months coincide with the periods when exceedances are most likely to occur at the violating $PM_{2.5}$ monitors. During the winter months, there is also an observed increase of nitrates, which may suggest a greater influence from local mobile sources, local or regional fuel-combustion sources, or a combination of these sources.[27] The sum of each seasonal average was divided by the total sum to showcase the contribution of each season to the total average. Fall months account for 21% of the averaged total excess concentration. Spring months account for 16% of the averaged total excess concentration and finally, summer months account for 12% of the averaged total excess concentration.

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[25] *See* Calculation of Urban Increments to Support the Air Quality Designations for the 2012 PM2.5 Standards National Ambient Air Quality Standards (NAAQS) (SAN5706) from Neil H. Frank, Air Quality Assessment Division OAQPS, to Docket No. EPA-HQ-OAR-2012-0918 Air Quality Designations for the 2012 PM2.5 Standards, *available at* https://www3.epa.gov/pmdesignations/2012standards/docs/UIMemotoSupport2012PM25Desigfinal.pdf.

[26] *See supra* note 13, Attachment 3, 8

[27] *Id.*

Figure 11 Maricopa County's Urban Increment of $PM_{2.5}$ Speciation

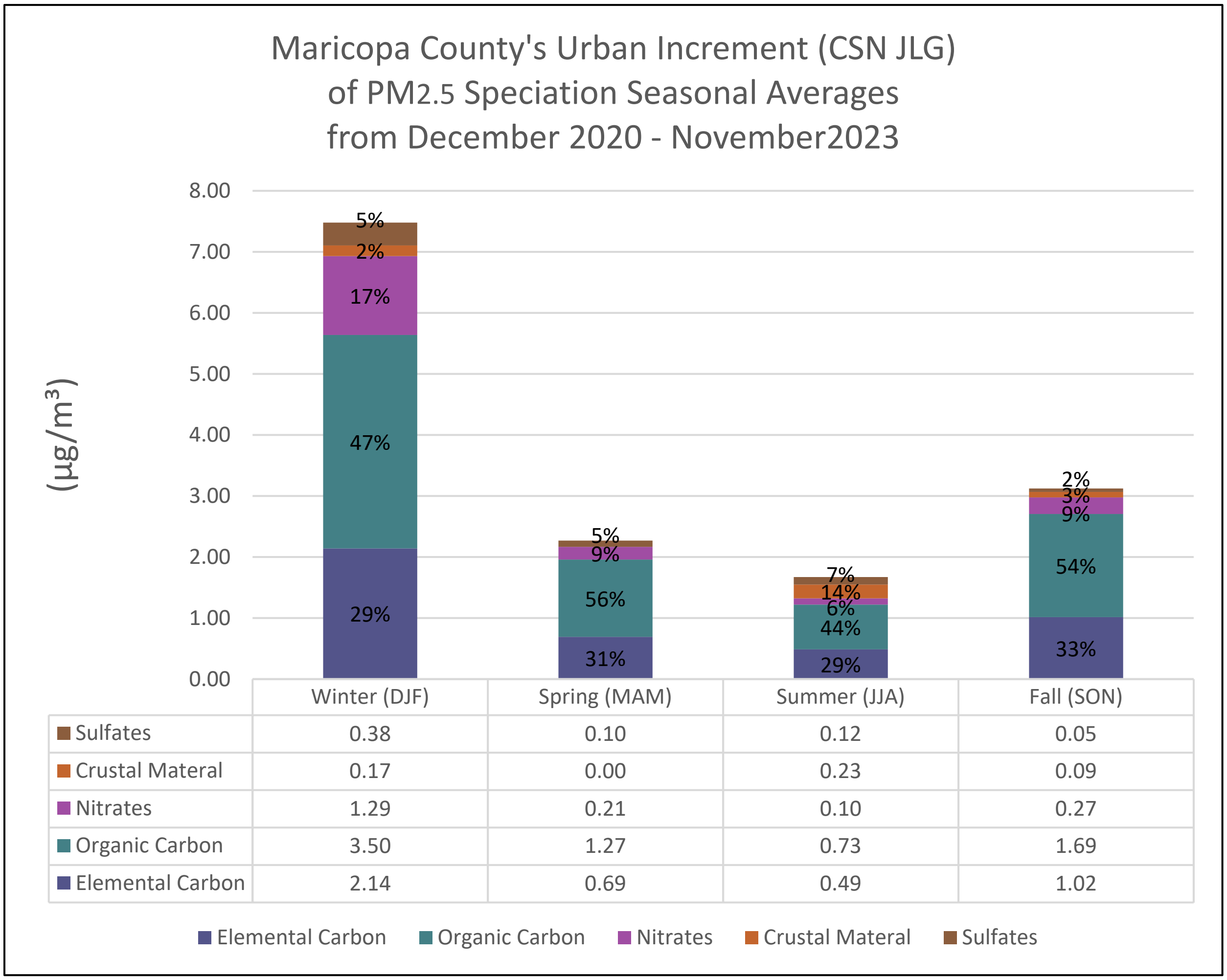


Table 3 Maricopa County's 3-Year Average (December 2020 – November 2023) Percent Composition of the Urban Increment

CSN JLG Urban Increment	
Organic Carbon	49%
Elemental Carbon	30%
Nitrates	13%
Sulfates	5%
Crustal Material	3%

3.1.2 Emissions and Emissions-Related Data

ADEQ evaluated emissions from direct $PM_{2.5}$ emissions and precursor pollutants from the 2020 National Emissions Inventory (NEI), as well as, certified point source emissions data that were reported to local jurisdictions in 2022.

3.1.2.1 Maricopa County Emissions from the 2020 NEI

First, ADEQ evaluated emissions and emissions-related data from Maricopa County that were derived from the 2020 NEI and included supplemented data from Maricopa County Air Quality Department (MCAQD) 2020 Periodic Emissions Inventory (PEI). For this factor, ADEQ examined emissions of identified sources of direct $PM_{2.5}$ (organic carbon, elemental carbon, crustal material), primary nitrate and primary sulfate, and precursor gases associated with fine particulate formation such as, sulfur dioxide (SO_2), oxides of nitrogen (NO_x), volatile organic compounds (VOC), and ammonia (NH_3).

Data were provided by the 2020 NEI and supplemented with MCAQD's 2020 PEI and MCAQD's 2020 PEI Errata[28,29] for five source sector categories: commercial cooking, paved road dust, unpaved road dust, residential wood combustion, and airports. In the NEI Airports are grouped in the point source category and include emissions from aircrafts, ground support equipment (GSE), and auxiliary power units (APU). To match the NEI format, ADEQ combined MCAQD's airport GSE + APU emissions with the aircraft emissions to arrive at a total of 77.8 tons per year. A comparison of $PM_{2.5}$ emissions provided in the 2020 NEI and the MCAQD 2020 PEI are provided in Table 4. ADEQ felt it was necessary to include refined local data to examine a more accurate depiction of Maricopa's $PM_{2.5}$ emissions. Emissions from the paved road dust source sector were not included for Maricopa County in the 2020 NEI.

Table 4 Comparison of $PM_{2.5}$ Emissions in Maricopa County

Comparison of Nonpoint Source Sectors in Maricopa County		
Source Sector	**2020 NEI**	**MCAQD 2020 PEI and PEI Errata**
Commercial Cooking	3,539.5	1,296.8
Unpaved Road Dust	84	595.3
Paved Road Dust	-	2,081.3
Residential Wood Burning	825.6	1,615.3
Airports (Aircrafts + GSE + APU)	136.6	77.8

Table 5, Table 6 and Figure 12 below represent direct $PM_{2.5}$ emissions. Figure 12 shows a breakdown of Maricopa County's $PM_{2.5}$ emissions by source sector, expressed as percentage of the county's total, based on the 2020 NEI with MCAQD 2020 PEI adjustments. The largest contribution to Maricopa County's $PM_{2.5}$ emissions comes from the nonpoint category, which represents 86% of the total. Wildfires, paved road dust, residential wood burning, crops and livestock dust, and commercial cooking being the top five contributing nonpoint source sectors to annual $PM_{2.5}$ emissions. The remaining 14% of $PM_{2.5}$ emissions include: point, onroad, and nonroad sources.

[28] Maricopa County. Air Quality Dept., 2020 Periodic Emissions Inventory for Particulate Matter less than 10 Microns in Diameter (November 2022), available at: https://www.maricopa.gov/2652/Periodic-Emissions-Inventory-Reports

[29] Maricopa County. Air Quality Dept., 2020 Periodic Emissions Inventory: Errata (April 2024), available at: https://www.maricopa.gov/2652/Periodic-Emissions-Inventory-Reports.

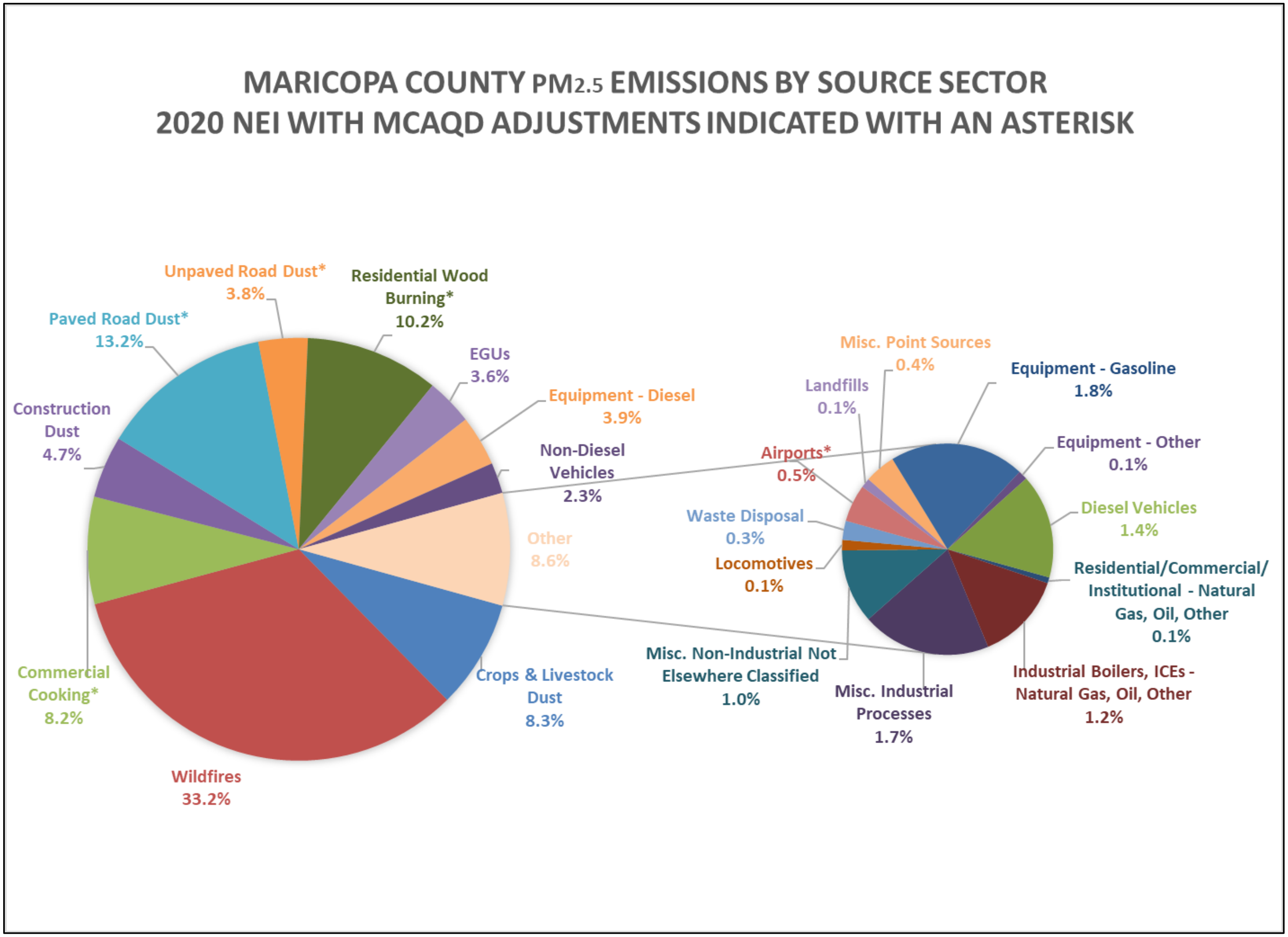
Table 5 Maricopa County $PM_{2.5}$ Emissions by Source and Percentage of Total

$PM_{2.5}$ Emissions from 2020 NEI, *MCAQD 2020 PEI Adjustments					
Source	Point*	Nonpoint*	Onroad	Nonroad	County Total*
TPY	728.2	13,582.4	587.9	911.2	15,809.7
% of Total	4.6%	85.9%	3.7%	5.8%	100.0%

Table 6 Maricopa County $PM_{2.5}$ Emissions by Source Sector and Percentage of Total

$PM_{2.5}$ Emissions from the 2020 NEI with *MCAQD 2020 PEI Adjustments			
Source	**Source Sector Category**	**$PM_{2.5}$ (tpy)**	**Percentage of Total**
Nonpoint			
	Crops & Livestock Dust	1,314.9	8.3%
	Wildfires	5,247.3	33.2%
	Commercial Cooking*	1,296.8	8.2%
	Construction Dust	750.6	4.7%
	Paved Road Dust*	2,081.3	13%
	Unpaved Road Dust*	595.3	3.8%
	Residential/Commercial/Institutional - Natural Gas, Oil, Other	12.4	0.1%
	Industrial Boilers, ICEs - Natural Gas, Oil, Other	184.0	1.2%
	Residential Wood Burning*	1,615.3	10.2%
	Misc. Industrial Processes	268.7	1.7%
	Misc. Non-Industrial Not Elsewhere Classified	154.4	1.0%
	Locomotives	21.8	0.1%
	Waste Disposal	39.7	0.3%
Point			
	Airports*	77.8	0.5%
	Landfills	19.8	0.1%
	EGUs	566.0	3.6%
	Misc. Point Sources	64.7	0.4%
Nonroad			
	Equipment - Diesel	610.8	3.9%
	Equipment - Gasoline	281.1	1.8%
	Equipment - Other	19.3	0.1%
Onroad			
	Diesel Vehicles	217.2	1.4%
	Non-Diesel Vehicles	370.7	2.3%
Grand Total		**15,809.7**	**100.0%**

Figure 12 Maricopa County PM2.5 Emissions by Source Sector and Percentage of Total



Additionally, $PM_{2.5}$ can occur through direct emissions and through secondary formation of precursor pollutants. These particles can have long atmospheric lifetimes, ranging from days to weeks, and can travel hundreds to thousands of kilometers.[30] Table 7 shows emissions from direct $PM_{2.5}$ and precursor pollutants and the portion of chemical species that comprise $PM_{2.5}$ in Maricopa County exclusively from the 2020 NEI.

ADEQ considered the source sectors that contribute the most to precursor pollutants when drafting the $PM_{2.5}$ boundary recommendation. Precursor pollutants for $PM_{2.5}$ are: ammonia (NH_3), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and volatile organic compounds (VOC). ADEQ found that 60% of NO_x emissions from the 2020 NEI in Maricopa County are derived from on-road non-diesel light duty vehicles, non-road diesel equipment, and on-road diesel heavy duty vehicles. Wildfires comprise 46% of the total SO_2 emissions in Maricopa County, and 25% are from point sources. For VOC, 44% of the total is from consumer and commercial solvent use, on-road non-diesel light duty vehicles, and non-industrial solvent surface coating. Lastly, 77% of the total reported ammonia emissions in Maricopa County originates from agricultural activities, primarily livestock waste and fertilizer application. Details of this analysis are located in Section A3.1.1.2

Table 7 Maricopa County $PM_{2.5}$ Emissions and Related Pollutants

Maricopa County $PM_{2.5}$ and Precursor Emissions (tpy) from the 2020 NEI									
Direct	$PM_{2.5}$ Precursor Pollutants				Portion of $PM_{2.5}$				
Total $PM_{2.5}$	Total NH_3	Total NO_x	Total SO_2	Total VOC	Total EC	Total OC	Total NO_3	Total SO_4	Total PM-Fine
14,729	24,059	43,669	1,167	98,879	1,539	6,491	77	227	6,392

3.1.2.2 2022 Point Source Data from Permitting Authorities

ADEQ also evaluated emissions from minor and major sources in Maricopa County that reported directly to ADEQ and MCAQD in 2022. However, it is important to note that not all minor source facilities who report to ADEQ are required to submit their emissions on an annual basis, some class II and portable sources report on a triannual basis and therefore may not be represented in this analysis. Moreover, this data source omits: portable sources that had more than one operating location in 2022, federally permitted sources, sources permitted by sovereign tribal nations, and emissions from burn permits.

Figure 13 provides a visual representation of ADEQ and MCAQD 2022 permitted sources and their reported $PM_{2.5}$ emissions. Similarly, Figure 14 shows permitted sources combined emissions from precursor pollutants: NO_x, SO_2, NH_3, and VOC in tons per year. The size of each symbol is proportional to the sum of emissions. Table 8 displays emissions from direct $PM_{2.5}$ and precursor

[30] U.S. Env't. Prot. Agency, Particulate Matter (PM2.5) Speciation Guidance Final Draft (October 7, 1999), available at https://www.epa.gov/sites/default/files/2017-01/documents/final_draft_pm2.5_speciation_guidance_1999.pdf.

pollutants captured within the recommended Maricopa County (partial) NAA boundary from permitted sources.

Table 8 Emissions from Permitted Sources in 2022 within the Maricopa County NAA

Pollutant	NO_x	SO_2	VOC	NH_3	$PM_{2.5}$
TPY in Maricopa Boundary	908.8	144.6	2214.5	23.0	342.2
% of Total County Emissions	44.2%	50.8%	77.9%	8.1%	43.4%

Figure 13 Permitted Sources $PM_{2.5}$ Emissions from 2022 in Maricopa County

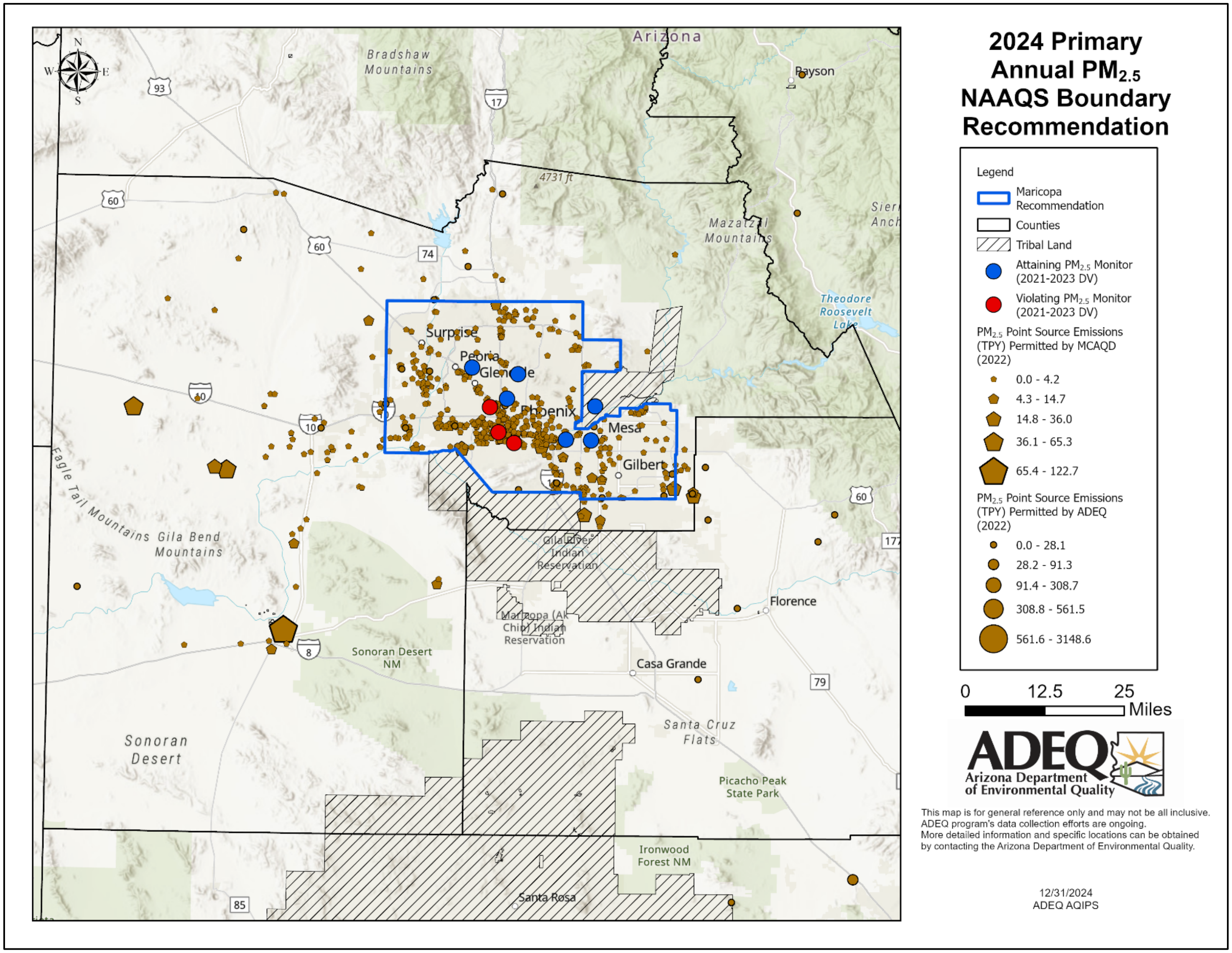
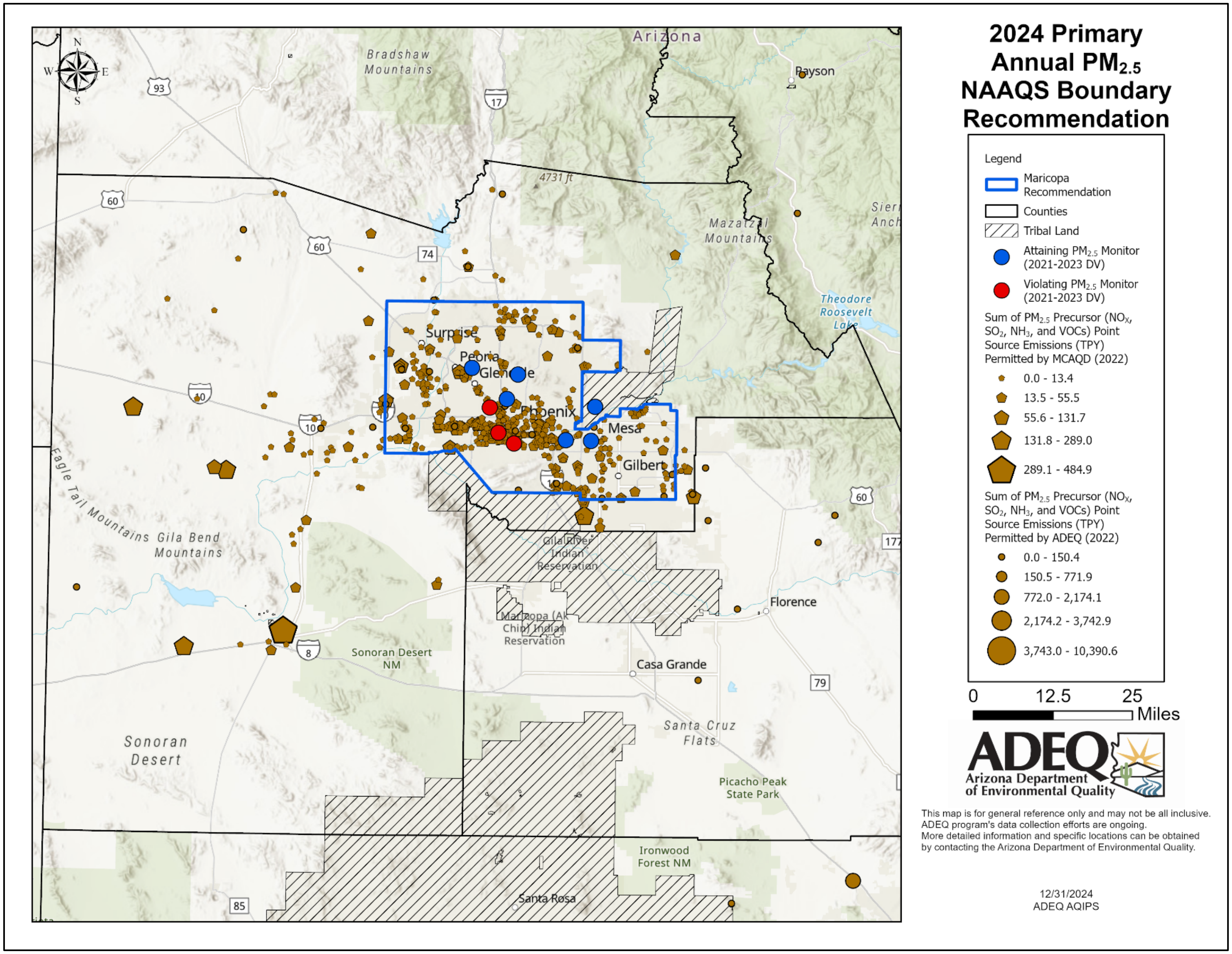


Figure 14 Emissions from Combined Precursor Pollutants in 2022 from Maricopa County



3.1.2.3 Traffic Data

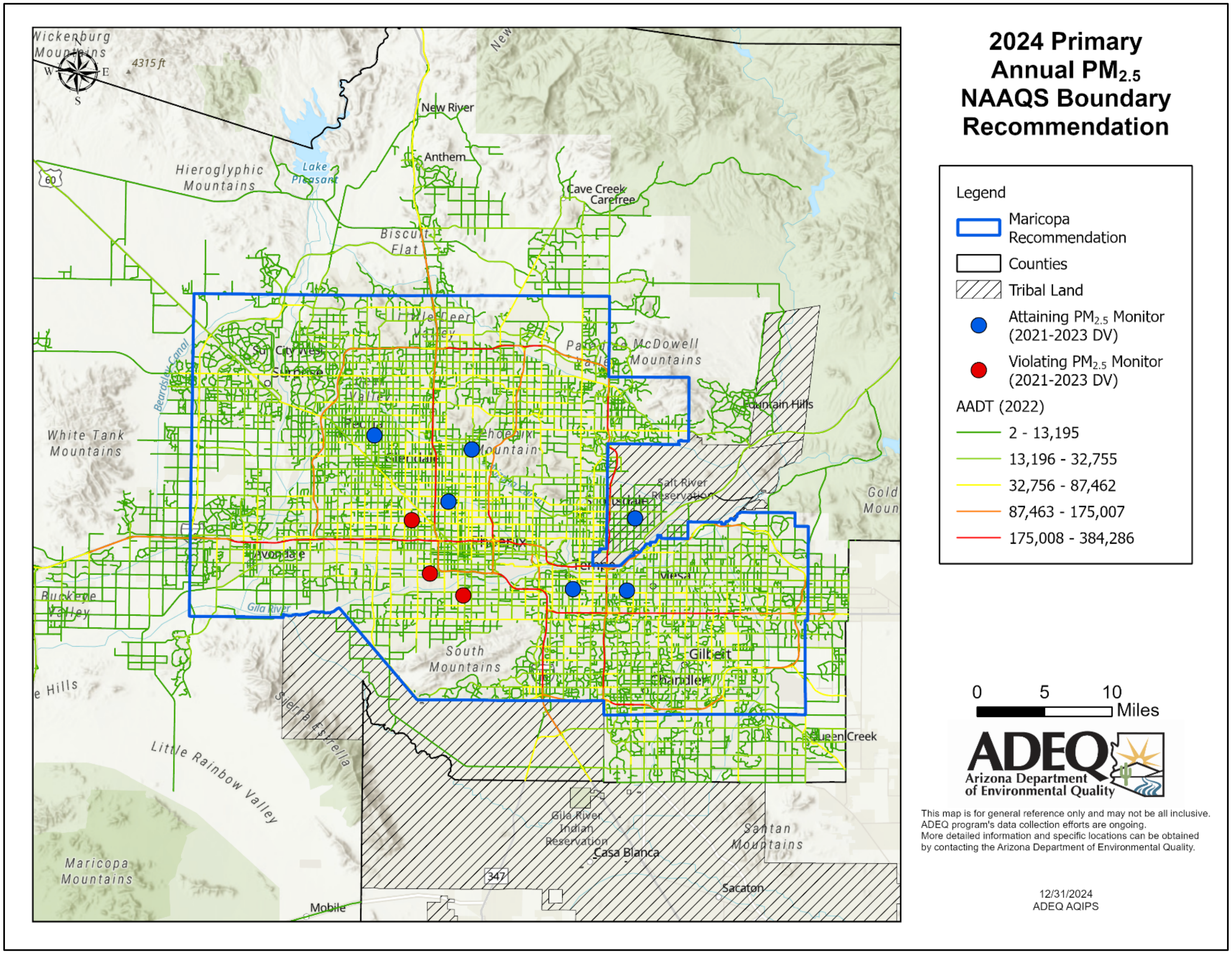
Figure 15 below is a visual representation of average annual daily traffic (AADT) near the recommended Maricopa County (partial) NAA boundary. According to the Arizona Department of Transportation, AADT is "the annualized average 24-hour volume of vehicles at a given point or section of highway is called a traffic count. It is normally calculated by determining the volume[31] of vehicles during a given period and dividing that number by the number of days in that period."[32]

Annual vehicle miles traveled (VMT) for Maricopa County is 42,294,822,605 miles, according to 2022 HPMS data. The VMT for the recommended 2024 $PM_{2.5}$ Maricopa County (partial) NAA is 28,172,378,925 miles. That means that 66.6% of annual VMT in Maricopa County is captured within the recommended area.

[31] I.e. bidirectional count.

[32] Ariz. Dept. of Transp.. *Roadway Configuration: Two Lanes (one lane each direction)*, available at: https://azdot.gov/business/tsmo/operational-and-traffic-safety/az-step/two-lanes-one-lane-each-direction (last visited June 17, 2024).

Figure 15 Maricopa County NAA Average Annual Daily Traffic



3.1.2.4 Population Data

The EPA's Designations Memo asserts that population information can serve as a potential indicator of the probable location and magnitude of $PM_{2.5}$ emissions sources.[33] ADEQ believes that this in combination with the other four factors, especially meteorology, may serve to inform areas that should be included in a nonattainment boundary. Figure 16 and Figure 17 below represents the change in population density in Maricopa County between the years 2010 and 2020, according to the U.S. Census. The total 2020 population for Maricopa County based on the U.S. Census is 4,424,987 people, and the 2020 U.S. Census population for the recommended 2024 $PM_{2.5}$ Maricopa County (partial) NAA is approximately 3,654,046 people. That means that approximately 83% of the county population based on 2020 U.S. Census data is contained within the recommended area.

Table 9 below shows the change in actual population between 2010 and 2020 using AZ Office of Economic Opportunity (OEO) population estimates.[34]

Table 10 below shows the projected change in population between 2020 and 2030 using AZ OEO population projections.[35]

[33] *Supra* note 13,Attachment 3, 9-10.
[34] Arizona is providing AZ OEO specific estimates for 2010 and 2020 to accurately characterize the populations of multi-county municipalities and CDP's given only a percentage of the total population resides within each county. Data were retrieved from Ariz. Off. of Econ. Opportunity, Population Estimates, https://oeo.az.gov/population/estimates (last visited June 17, 2024).
[35] Ariz. Off. of Econ. Opportunity, *2023-2060 Sub-County Population Projections*, available at: https://oeo.az.gov/population/projections (last visited June 11, 2024).

Figure 16 Maricopa County NAA Census Population Density in 2010

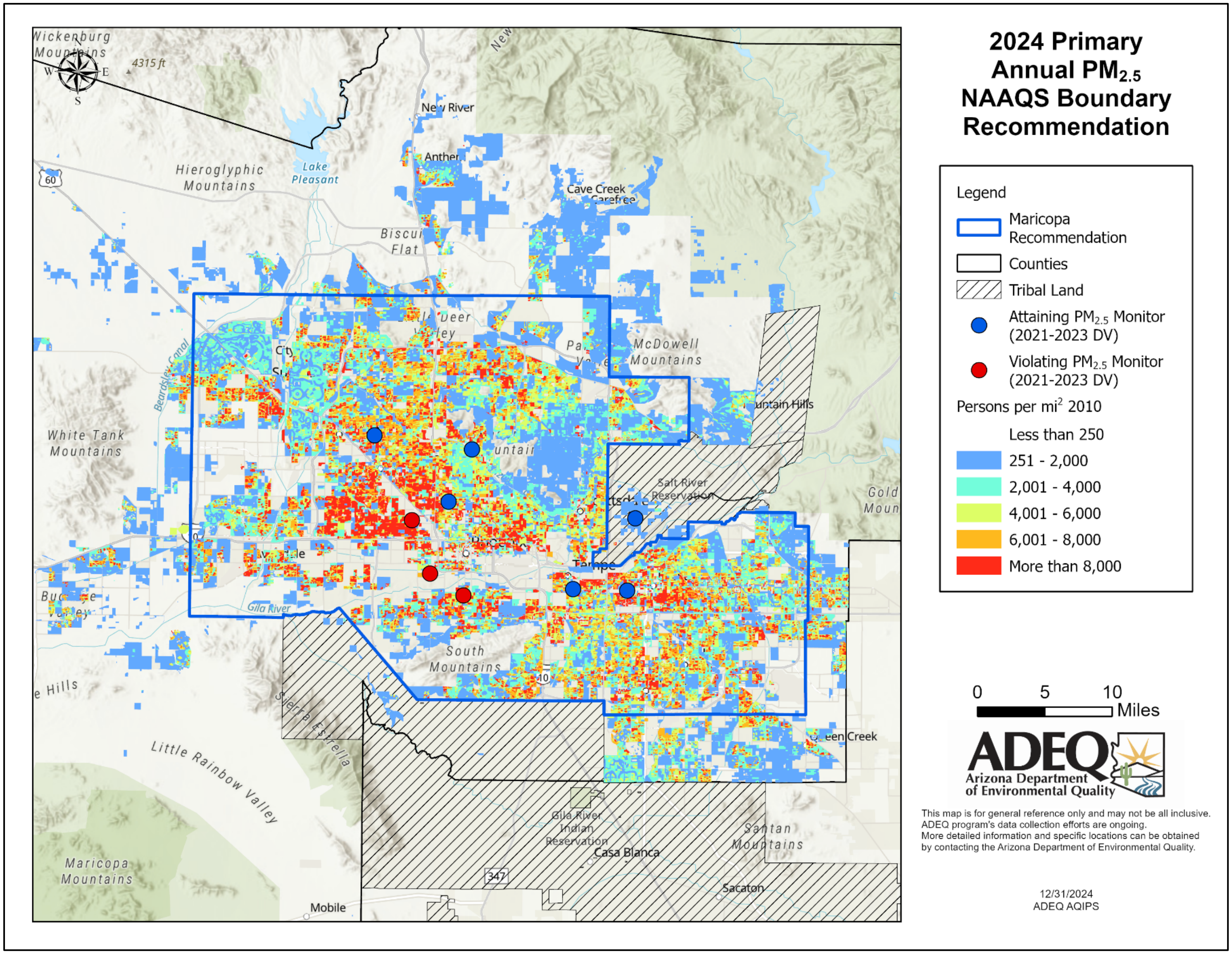


Figure 17 Maricopa County NAA Census Population Density in 2020

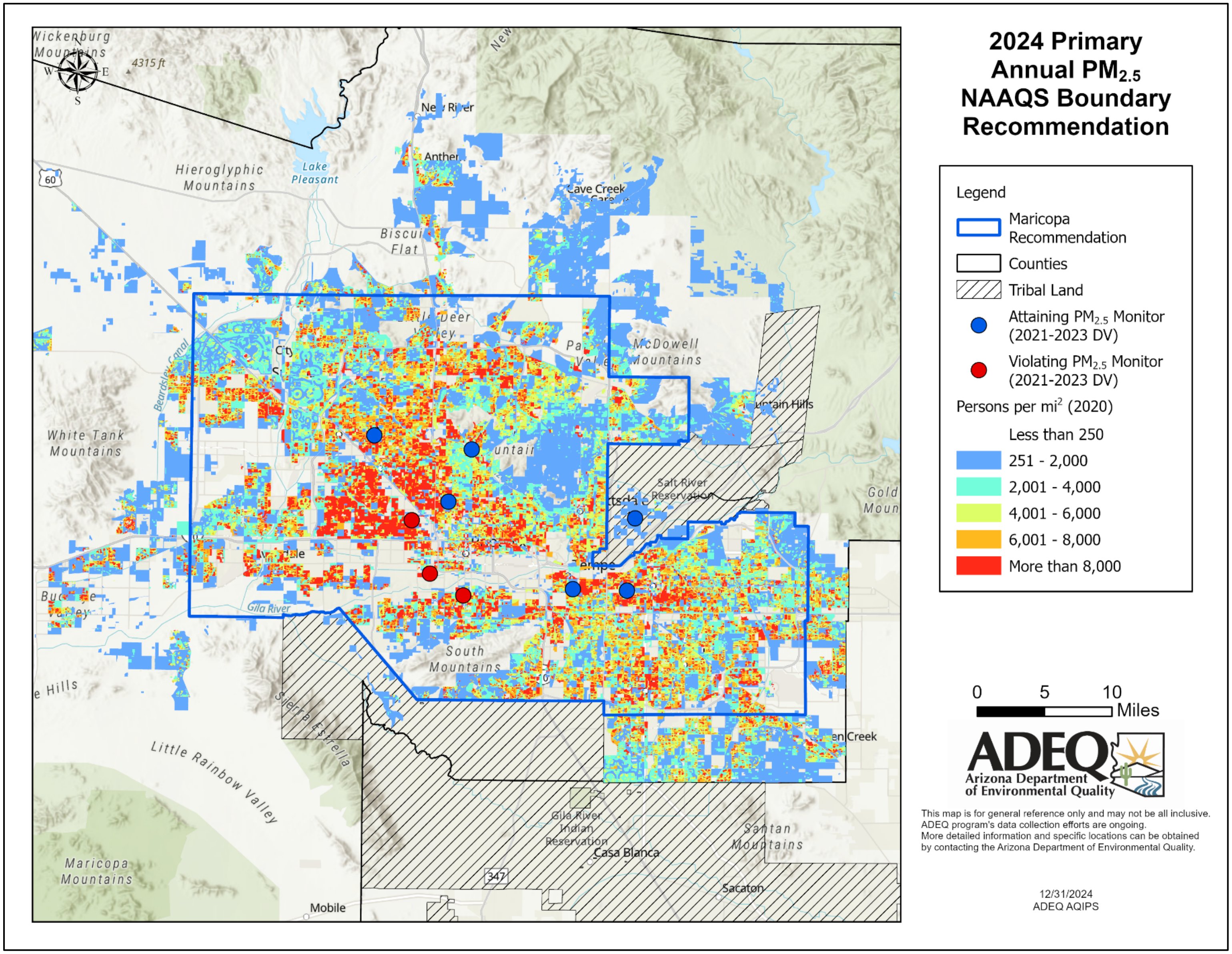


Table 9 Maricopa County Population Changes from 2010 to 2020

County/Municipality/Census Designated Place	AZ OEO 2010 Estimate	AZ OEO 2020 Estimate	Population Change (%)
Maricopa County	3,824,083	4,436,704	16.0%
Apache Junction (part)	295	395	33.9%
Avondale	76,418	89,480	17.1%
Buckeye	51,377	93,629	82.2%
Carefree	3,362	3,692	9.8%
Cave Creek	5,000	4,924	-1.5%
Chandler	236,678	277,116	17.1%
El Mirage	31,825	35,927	12.9%
Fountain Hills	22,486	23,857	6.1%
Gila Bend	1,919	1,892	-1.4%
Gilbert	209,458	268,728	28.3%
Glendale	226,866	248,686	9.6%
Goodyear	65,566	96,789	47.6%
Guadalupe	5,502	5,326	-3.2%
Litchfield Park	5,487	6,881	25.4%
Mesa	439,875	505,447	14.9%
Paradise Valley	12,808	12,671	-1.1%
Peoria (part)	155,053	191,849	23.7%
Phoenix	1,448,683	1,611,162	11.2%
Queen Creek (part)	26,159	51,260	96.0%
Scottsdale	217,285	241,718	11.2%
Surprise	117,720	144,246	22.5%
Tempe	162,010	181,580	12.1%
Tolleson	6,543	7,262	11.0%
Wickenburg	6,354	6,622	4.2%
Youngtown	6,166	7,056	14.4%
Unincorporated Balance of County	283,188	318,509	12.5%

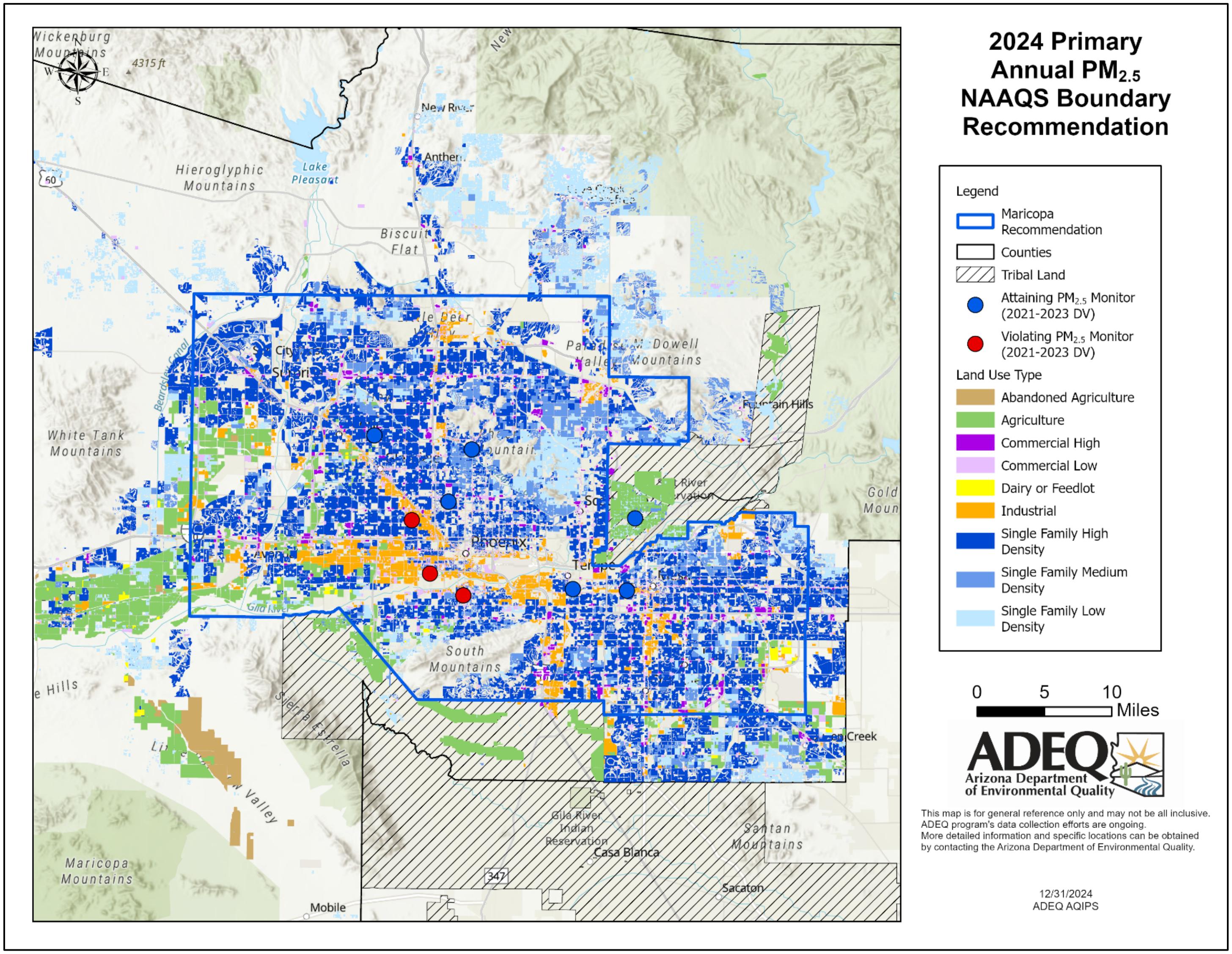
Table 10 Maricopa County Population Projections from 2020 to 2030

County/Municipality/Census Designated Place	AZ OEO 2020 Estimate	AZ OEO 2030 Projection	Population Change (%)
Maricopa County	4,436,704	5,200,400	17.2%
Apache Junction (part)	395	400	1.3%
Avondale	89,480	114,200	27.6%
Buckeye	93,629	164,700	75.9%
Carefree	3,692	4,100	11.1%
Cave Creek	4,924	5,500	11.7%
Chandler	277,116	294,400	6.2%
El Mirage	35,927	37,800	5.2%
Fountain Hills	23,857	25,200	5.6%
Gila Bend	1,892	2,300	21.6%
Gilbert	268,728	297,400	10.7%
Glendale	248,686	275,200	10.7%
Goodyear	96,789	161,000	66.3%
Guadalupe	5,326	5,400	1.4%
Litchfield Park	6,881	7,700	11.9%
Mesa	505,447	543,900	7.6%
Paradise Valley	12,671	13,300	5.0%
Peoria (part)	191,849	224,300	16.9%
Phoenix	1,611,162	1,809,300	12.3%
Queen Creek (part)	51,260	80,000	56.1%
Scottsdale	241,718	275,600	14.0%
Surprise	144,246	234,600	62.6%
Tempe	181,580	219,200	20.7%
Tolleson	7,262	8,100	11.5%
Wickenburg	6,622	7,300	10.2%
Youngtown	7,056	7,500	6.3%
Unincorporated Balance of County	318,509	371,800	16.7%

3.1.2.5 Land Use Data

Figure 18 below is a visual representation of the location of abandoned agriculture, agriculture, high-density commercial, low-density commercial, dairy or feedlot, industrial, and low, medium, and high-density single-family housing based on land use within and near the recommended Maricopa County (partial) NAA boundary. These land use types can contribute to emissions of $PM_{2.5}$. Abandoned agriculture, agriculture, high-density commercial, low-density commercial, dairy or feedlot, industrial, and low, medium, and high-density single-family housing in Maricopa County covers an area of 1,128.1 square miles. The land use for these categories within the NAA for Maricopa county has an area of 414.2 square miles. This means that 36.7% of these land use types within Maricopa County is captured within the recommended NAA boundary.

Figure 18 Land Use in Maricopa County NAA



3.1.2.6 2022 Gridded Emissions

In order to examine emissions at a smaller spatial scale than the county level presented in the National Emissions Inventory (NEI), ADEQ generated maps displaying gridded annual $PM_{2.5}$ and $PM_{2.5}$ precursor emissions for Arizona. ADEQ downloaded final gridded emissions for select source sectors from the 2022v1 Emission Modeling Platform (EMP).[36] The 2022 emission modeling platform is based on the 2020 NEI with updates to reflect 2022 emissions. Gridded emissions are generated through the application of spatial surrogates to allocate county level emission estimates to each 12 km grid cell. Documentation on spatial surrogates used in the 2022 EMP are available in the 2020 EMP Technical Support Document.[37] 2022 EMP gridded emission files were processed in the Visual Environment for Rich Data Interpretation (VERDI) program to generate tile plots for $PM_{2.5}$ and $PM_{2.5}$ precursor emissions. VERDI tile plots were exported to shapefiles and imported into ArcGIS Pro. Gridded emissions were limited to grid cells that intersect with Arizona's boundary and projected to NAD 1983 UTM Zone 12N.[38] Gridded emissions were generated for $PM_{2.5}$ and $PM_{2.5}$ + $PM_{2.5}$ Precursors (e.g., NO_x, SO_2, VOC, NH_3) for the following source sectors:

- Residential wood burning
- Area fugitive dust (adjusted with meteorological and transport fractions by EPA)
- Nonpoint
- Nonroad

Gridded emissions plots are provided in Appendix A Section A3.4.

[36] https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform
[37] https://www.epa.gov/air-emissions-modeling/2020-emissions-modeling-platform-technical-support-document
[38] Shapefiles exported from VERDI lacked critical information related to the geographic/projected coordinate system. ADEQ obtained a custom coordinate reference system from the Lake Michigan Air Directors Consortium (LADCO) to define the CRS before performing the projection to UTM.

3.1.3 Meteorology

ADEQ's meteorological analysis focuses on assessing relationships between violating monitors and nearby sources through the examination of emissions, wind speed, wind direction, and air parcel trajectory data. An examination of these factors can help determine the fate and transport of emissions which may contribute to violations of the primary annual $PM_{2.5}$ NAAQS. ADEQ did not perform source apportionment modeling for the boundaries contained in this recommendation.

3.1.3.1 Wind, Pollution, and 95th Percentile Roses

Figure **19** shows the location of $PM_{2.5}$ monitoring sites within Maricopa County used for wind rose analysis. Additional rose plots for various locations across the Phoenix-Mesa-Chandler MSA can be found in Section A4.1 and Section A4.2 of Appendix A.

Figure 20, Figure 21, and Figure 22 are wind rose plots showing the seasonal wind patterns at the violating monitors within Maricopa County for 2021-2023. Wind rose plots can be useful in assessing how wind speed and wind direction vary by season and year for each monitor.[39]

Figure 23, Figure 24, and Figure 25 are pollution rose plots showing the wind direction and $PM_{2.5}$ concentrations by season and year for violating monitoring sites in Maricopa County for 2021-2023. Pollution roses categorize the distribution of pollution concentrations into break points and display the wind direction associated with those break points. Pollution roses are useful in assessing the dominant wind direction associated with pollution concentrations.[40]

Figure 26, Figure 27, and Figure 28 are percentile rose plots showing the wind direction of 95th percentile $PM_{2.5}$ concentrations by season and year for violating monitoring sites in Maricopa County for 2021-2023. Percentile rose plots can be useful in assessing the distribution of wind directions associated with high pollution concentrations at a particular monitor. They can also be useful in identifying the direction of upwind emission sources that may be contributing to high pollution concentrations.[41]

[39] David Carslaw, THE OPENAIR MANUAL — OPEN-SOURCE TOOLS FOR ANALYZING AIR POLLUTION DATA: MANUAL FOR VERSION 2.6-6, University of York (2019), available at https://davidcarslaw.com/files/openairmanual.pdf.
[40] *Id.*
[41] *Id.*

Figure 19 Maricopa County Meteorology Analysis Site Locations

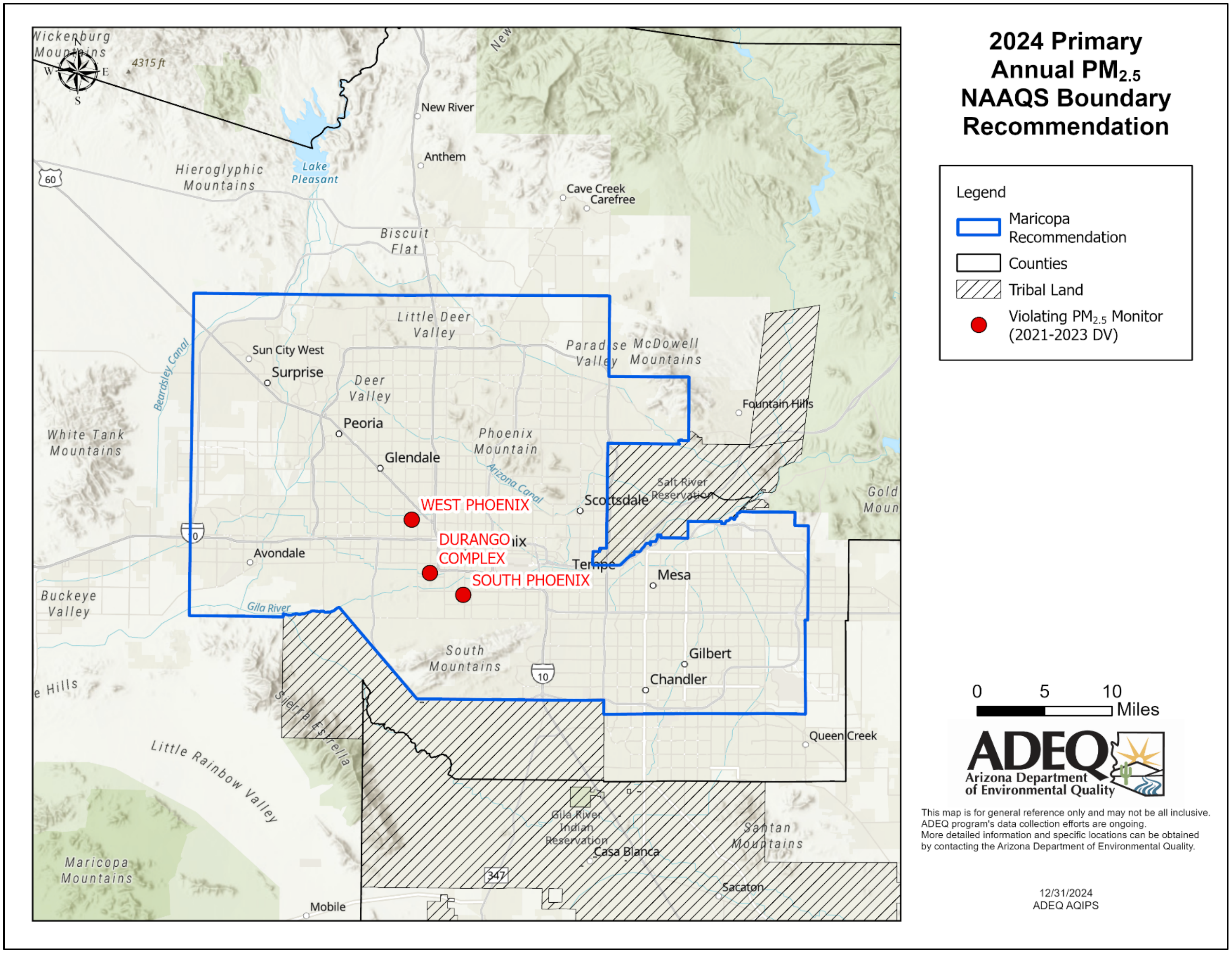


Figure 20 West Phoenix Monitor Wind Rose

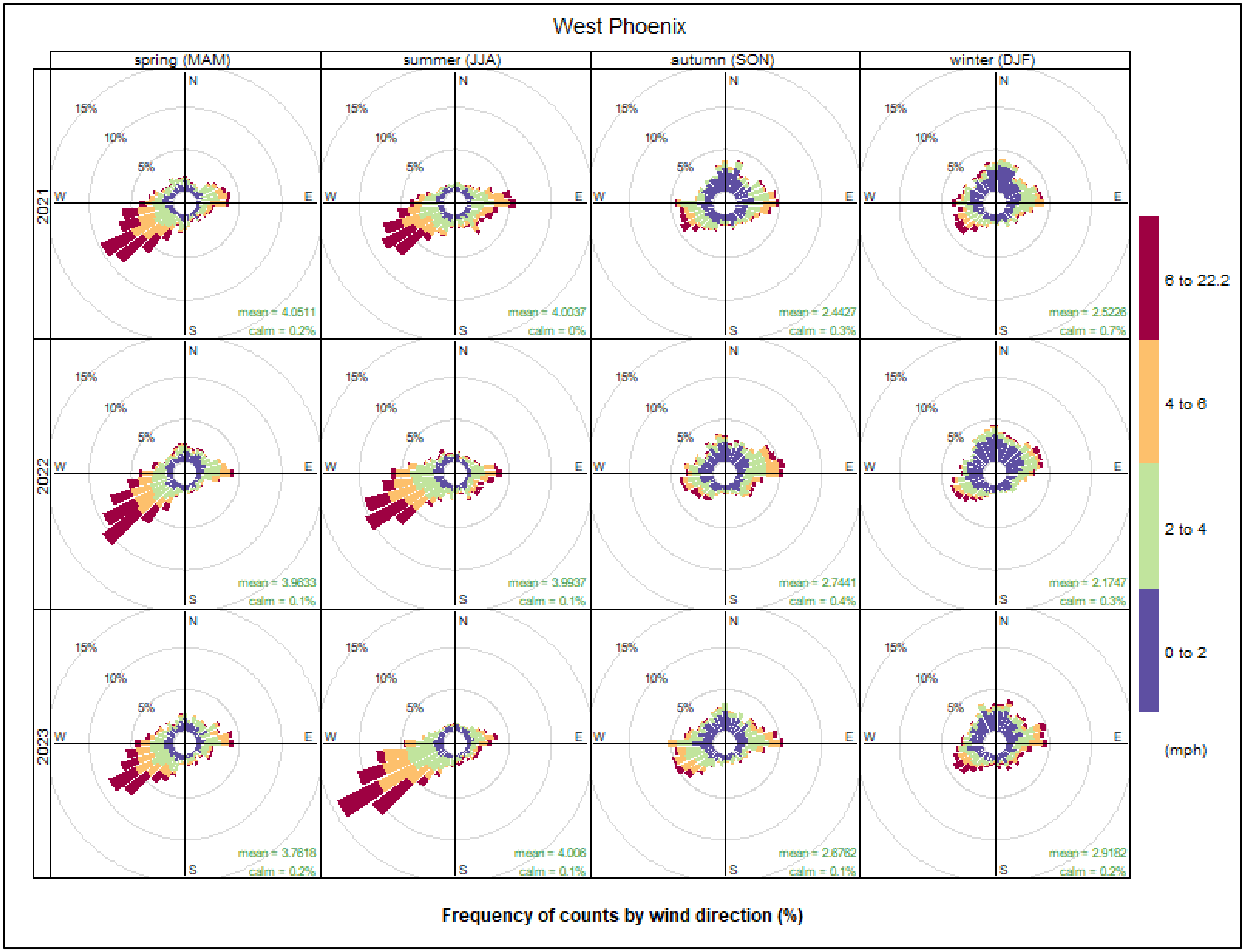


Figure 21 South Phoenix Monitor Wind Rose

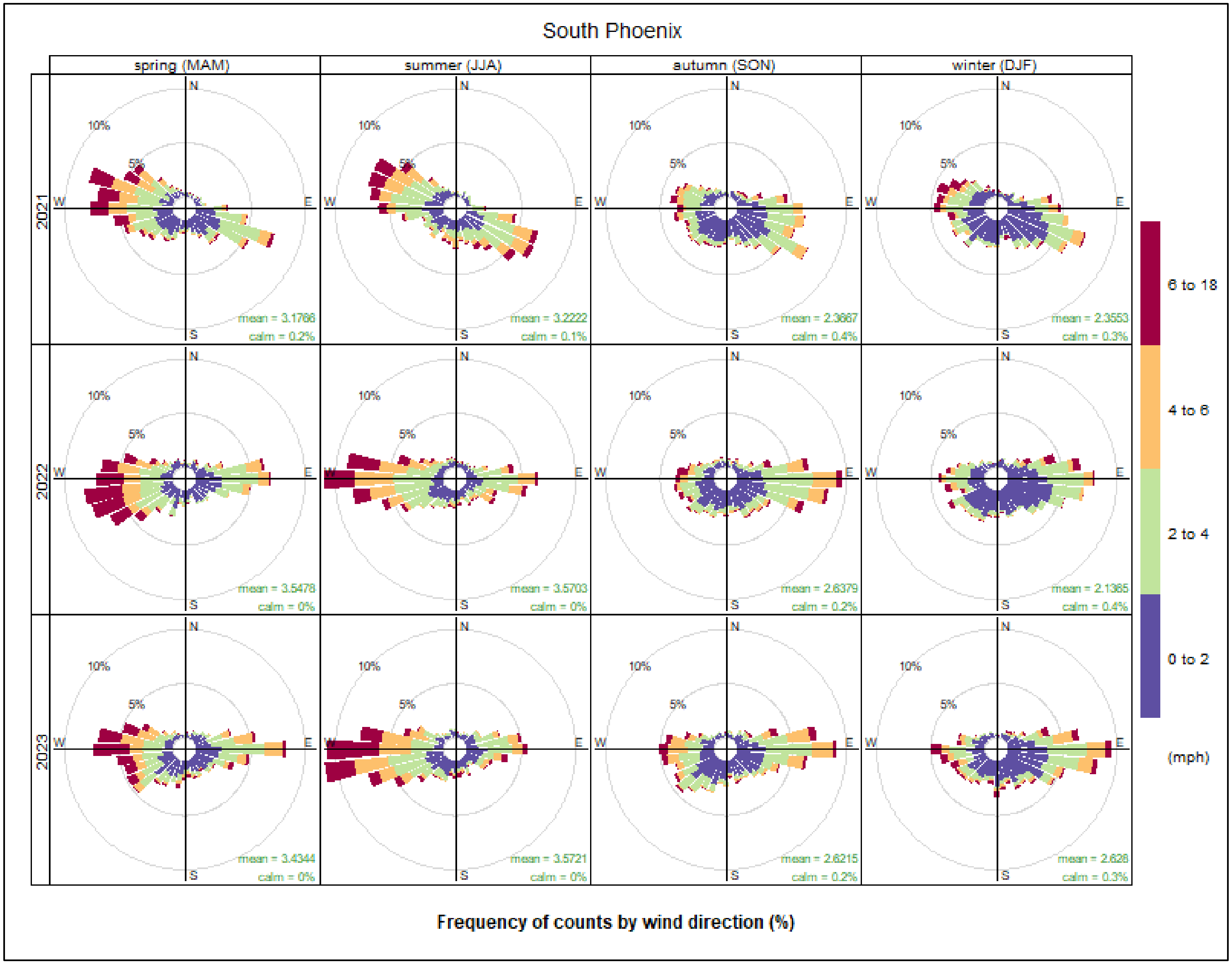


Figure 22 Durango Complex Monitor Wind Rose

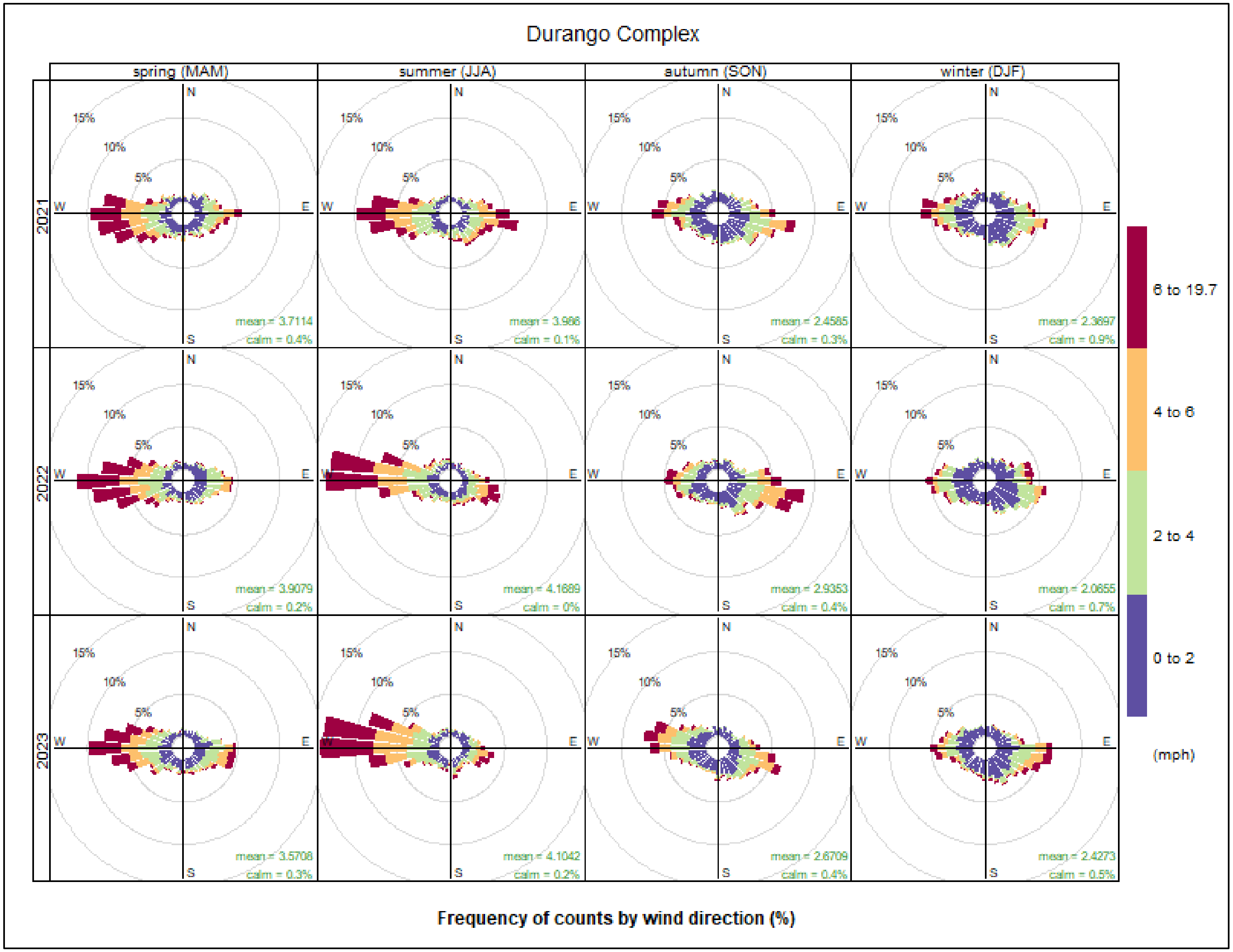


Figure 23 West Phoenix Monitor Pollution Rose

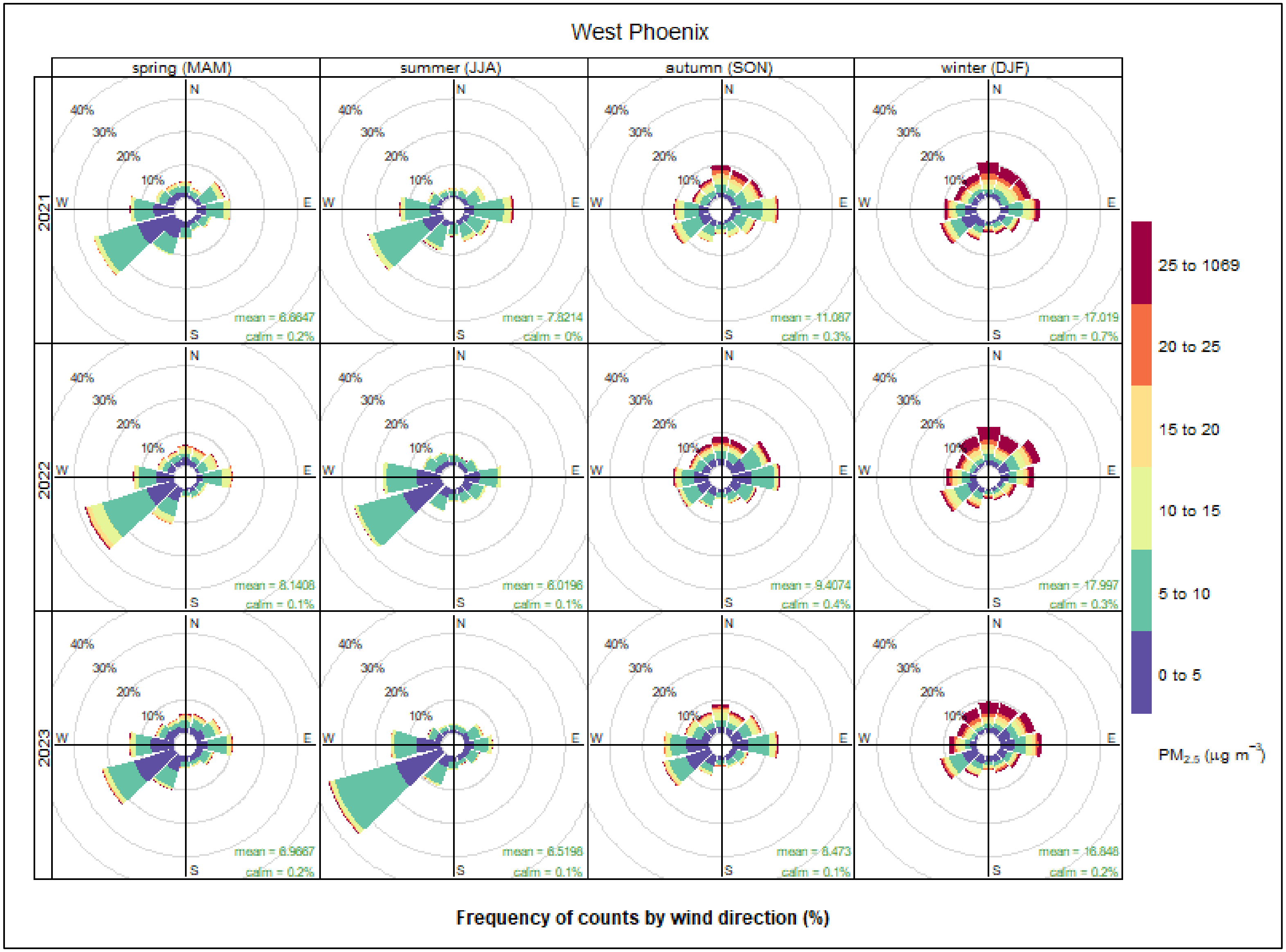


Figure 24 South Phoenix Monitor Pollution Rose

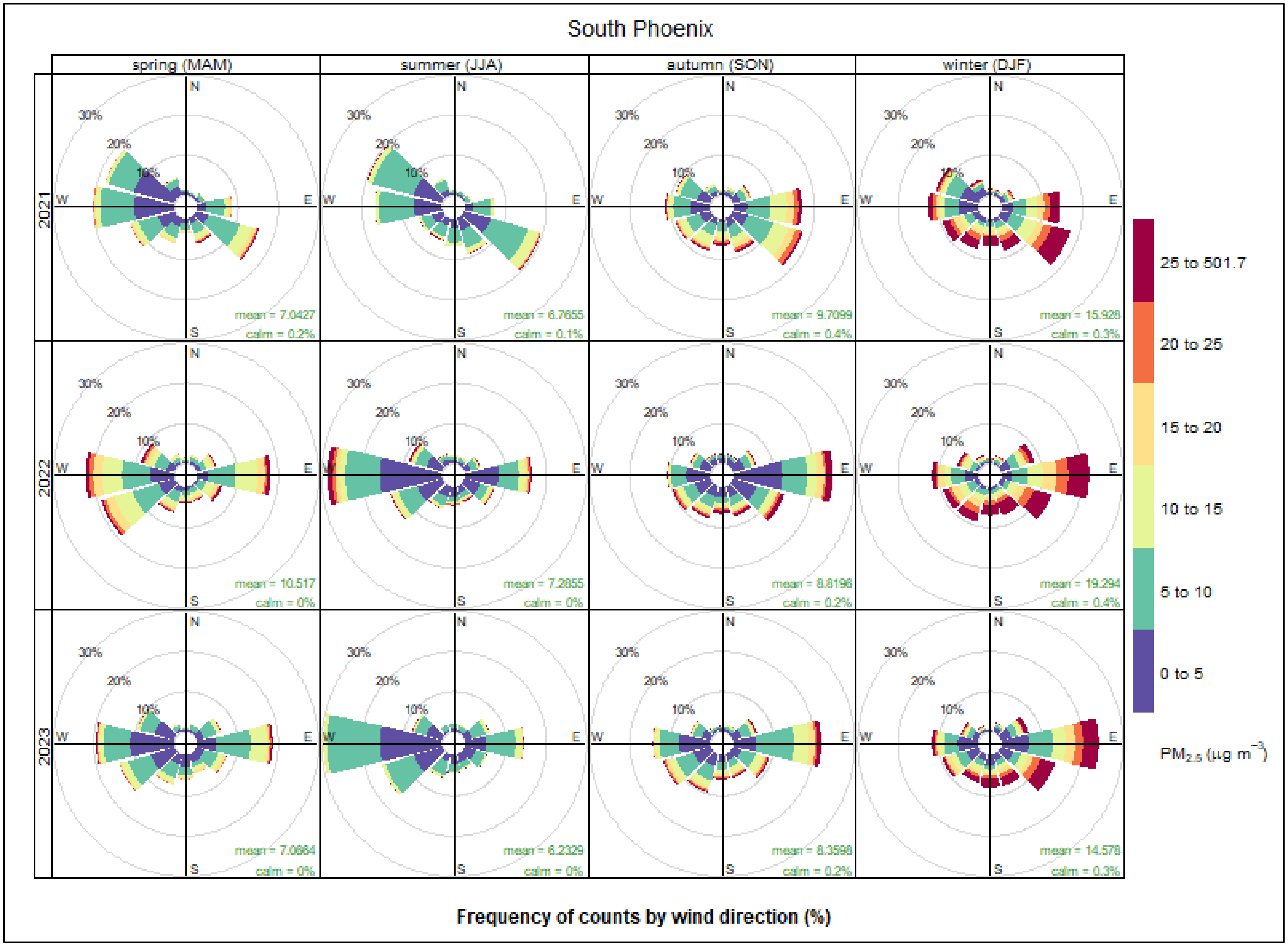


Figure 25 Durango Complex Monitor Pollution Rose

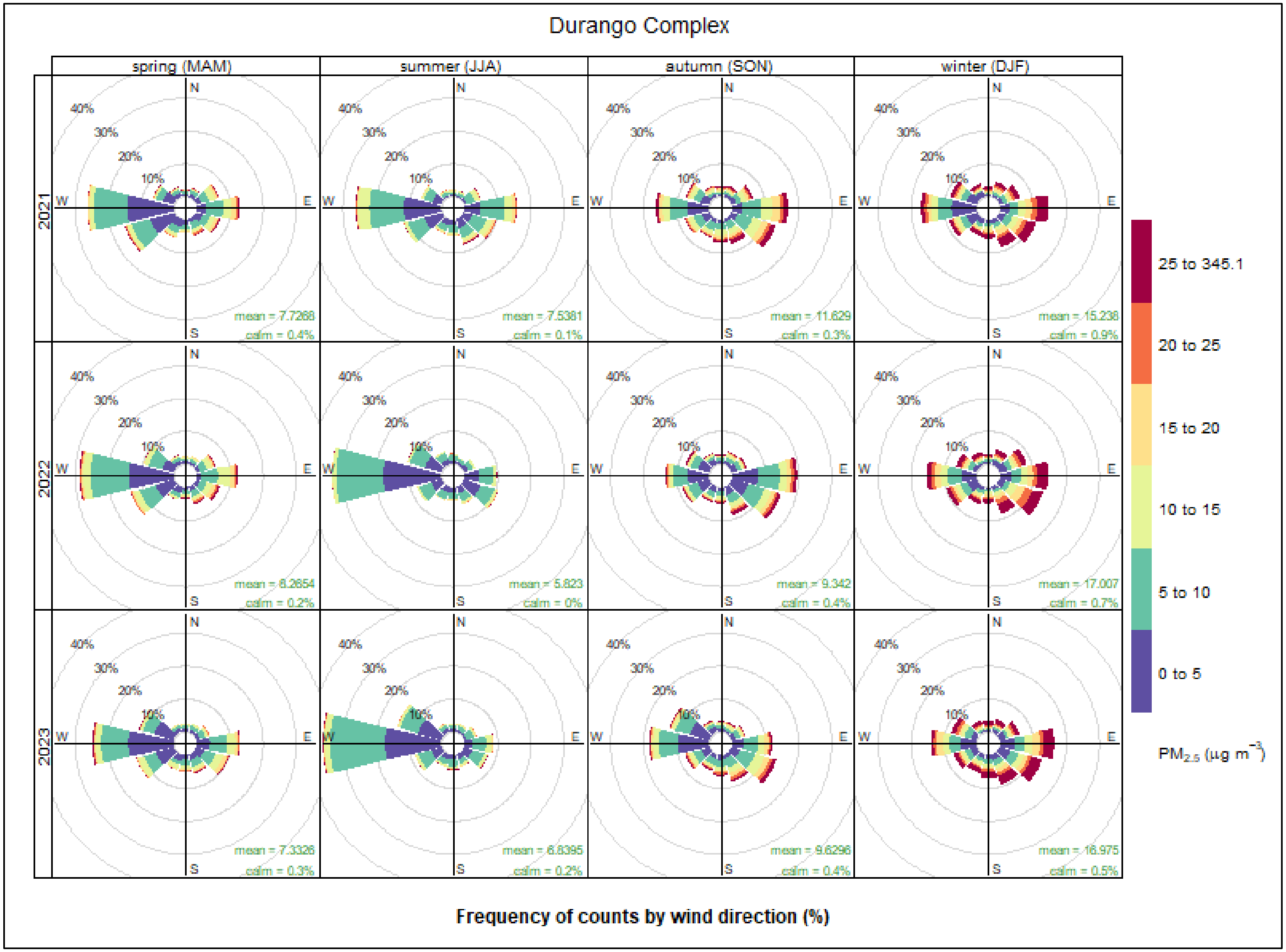


Figure 26 West Phoenix Monitor 95th Percentile Rose

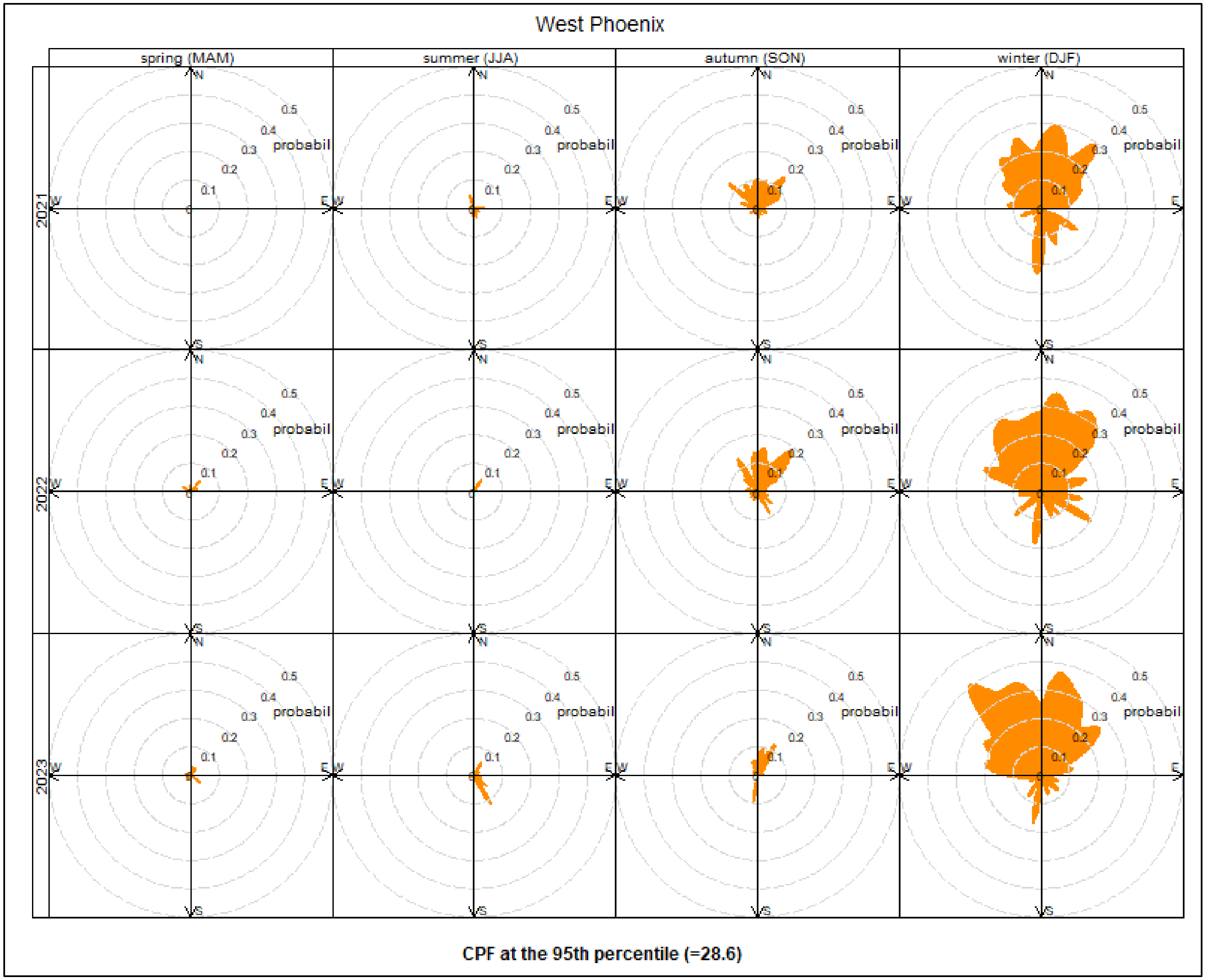


Figure 27 South Phoenix Monitor 95th Percentile Rose

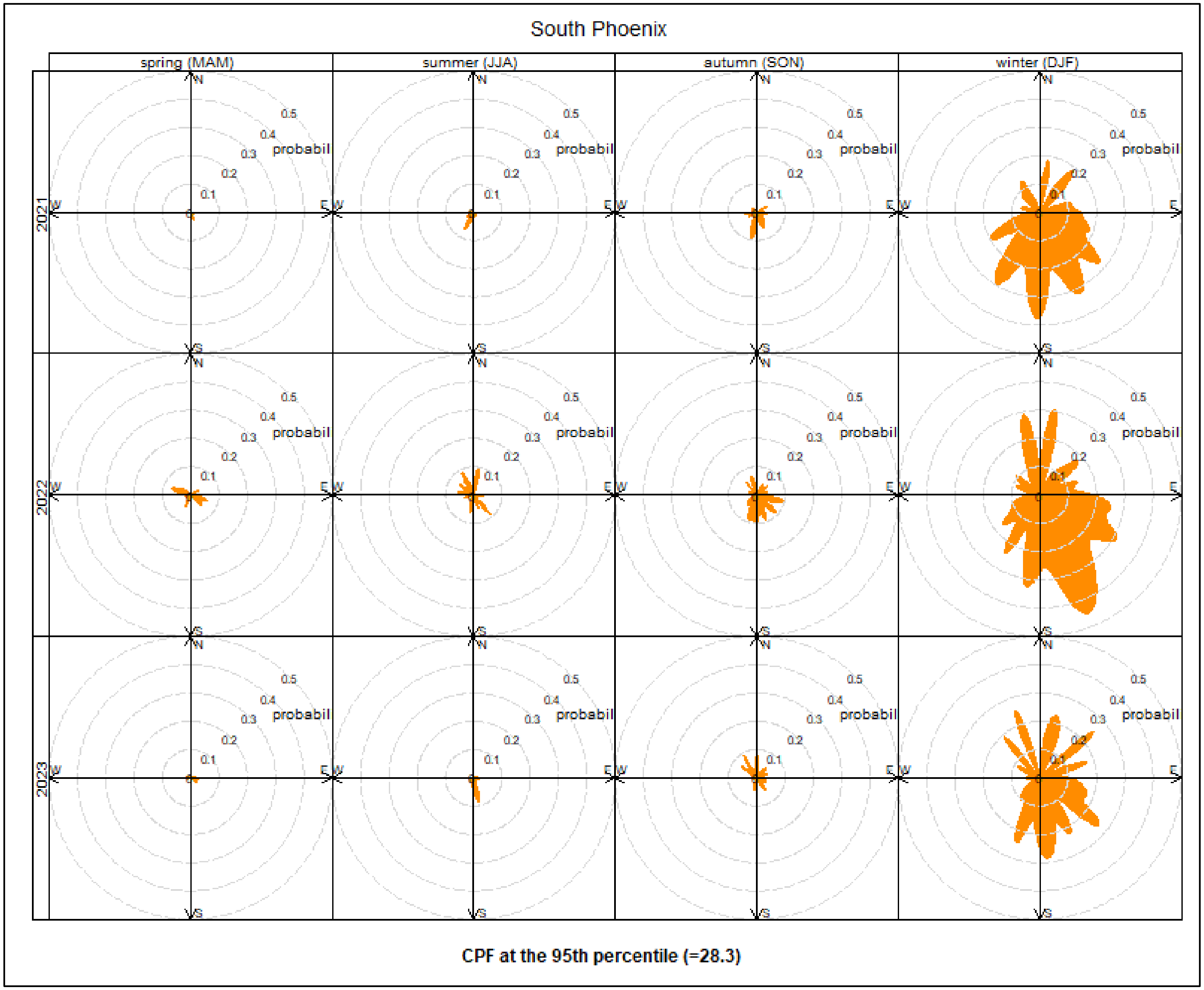
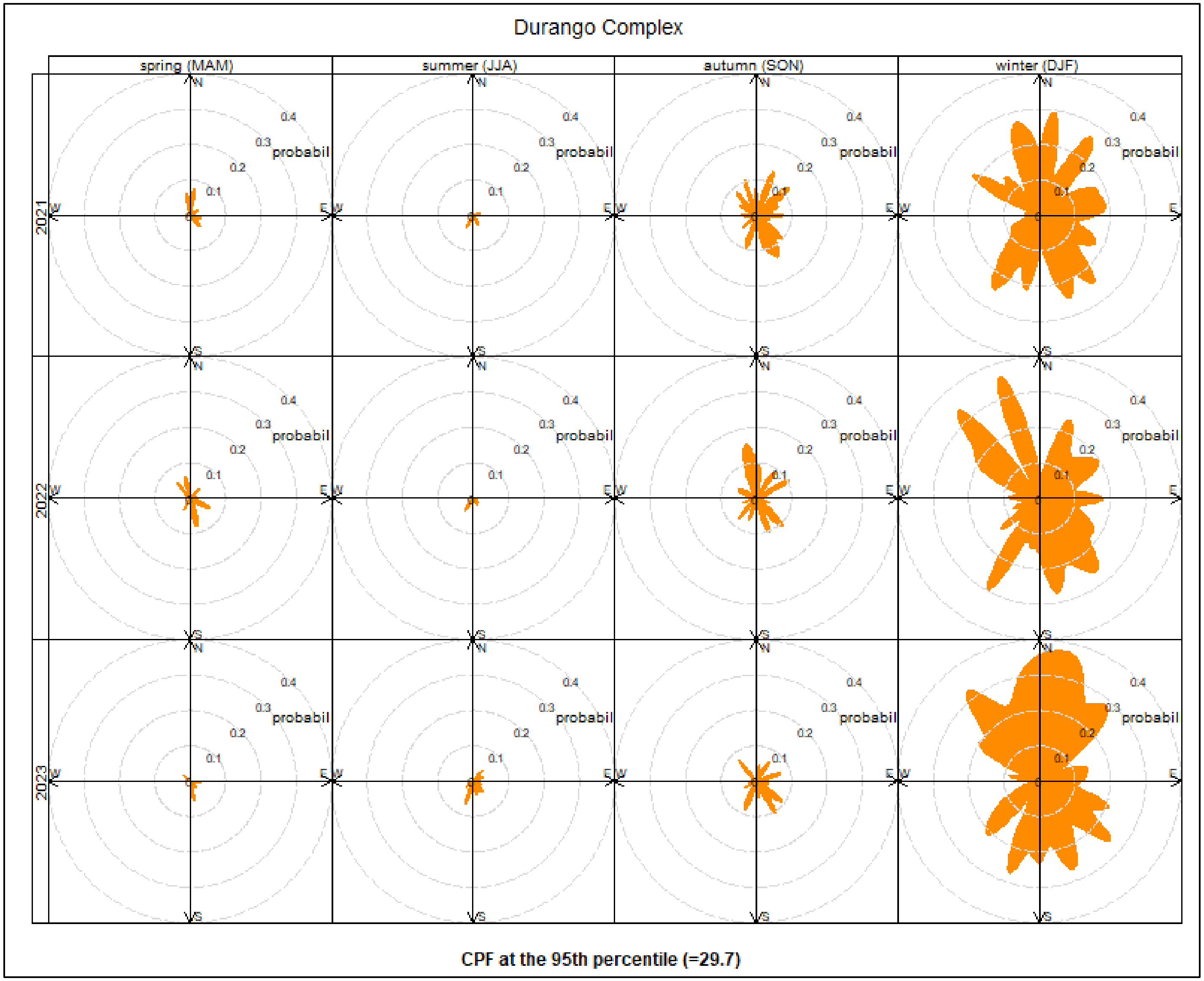


Figure 28 Durango Complex Monitor 95th Percentile Rose



3.1.3.2 HYSPLIT Analyses

HYSPLIT 24-hour back trajectories were used to generate maps showing the origin of air parcels at each violating monitor originated from over a 24-hour period. Back trajectories were run twice daily from 2021-2023 on days when the 24-hour $PM_{2.5}$ concentration was above 9.0 µg/m^3. The air parcels were released at start times during the two peak hourly averages of $PM_{2.5}$ concentrations experienced at each monitor, shown in Table 11.

Table 11 HYSPLIT Back Trajectory Start Times in Maricopa County

Monitor	Morning	Evening
West Phoenix	8:00:00 AM	11:00:00 PM
South Phoenix	7:00:00 AM	10:00:00 PM
Durango Complex	7:00:00 AM	11:00:00 PM

To visualize the HYSPLIT results, ADEQ gathered HYSPLIT back trajectory points of where the air parcel was located at each hour during the 24-hour trajectory period and imported those points into ArcGIS Pro. Vector feature classes were created for each violating monitor in order to visualize the hourly back trajectory points on a map. ADEQ utilized the kernel density geoprocessing tool to generate kernel density estimates for the days between 2021-2023 with a 24-hour $PM_{2.5}$ concentration above 9.0 µg/m^3 for each violating monitor. Kernel density estimation (KDE) calculates the density of point features around each output raster cell (a cell in a matrix of equally sized cells that are organized by columns and rows in a grid) and was used by the EPA to visualize HYSPLIT back trajectory results for the 2012 $PM_{2.5}$ NAAQS revision. The KDE was run using a cell size of 0.1 decimal degrees which is approximately 11.1 km and roughly equivalent to the 12 km grid resolution at which HYSPLIT was run (e.g., NAM 12 km). The purpose of these KDE plots is to provide insight as to where $PM_{2.5}$ at the monitors is being transported from. This information is displayed in Figure 29, Figure 30, and Figure 31. For additional HYSPLIT model results please see Appendix A Section A4.3.

Figure 29 HYSPLIT Back Trajectories from the West Phoenix Monitor

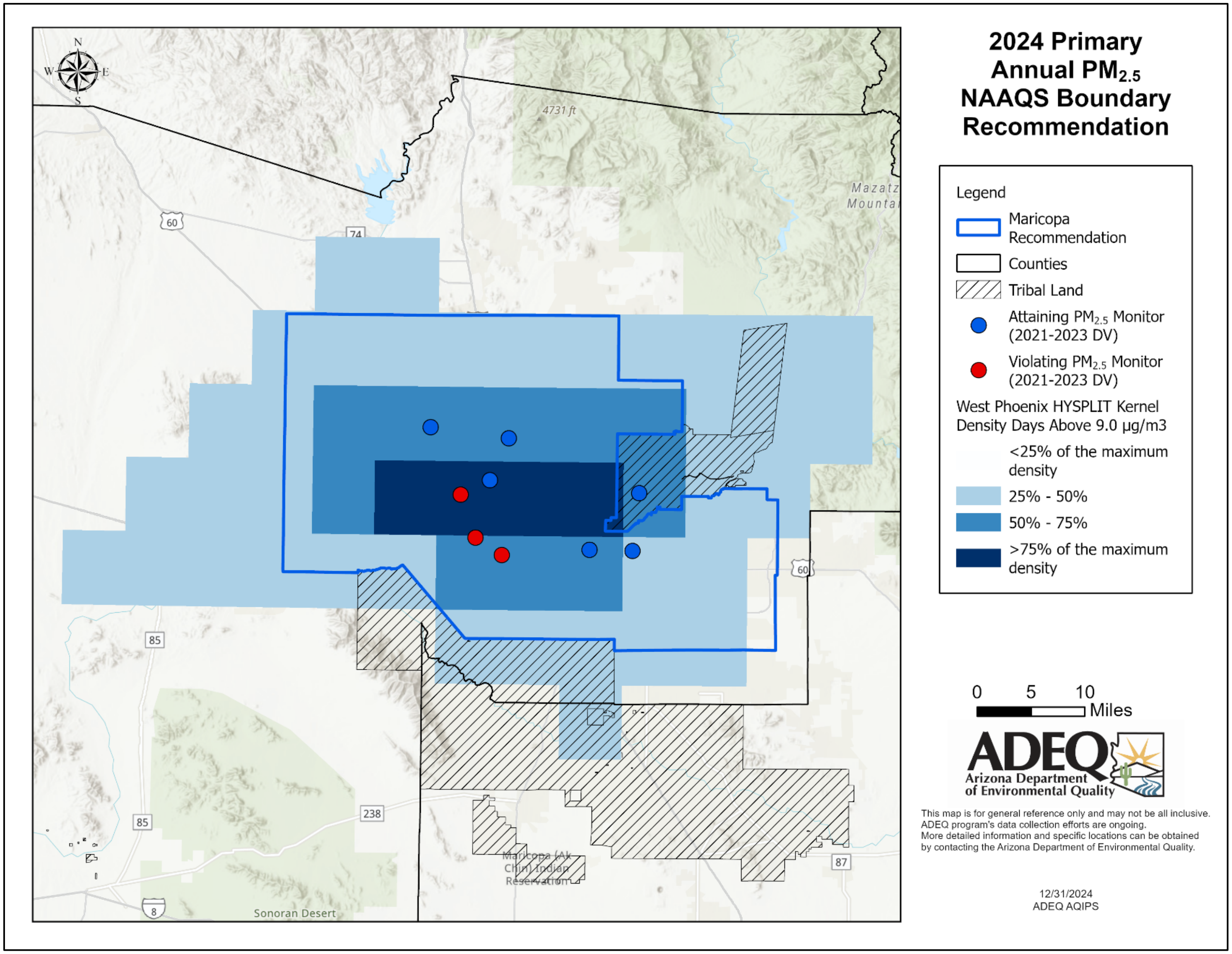


Figure 30 HYSPLIT Back Trajectories from the South Phoenix Monitor

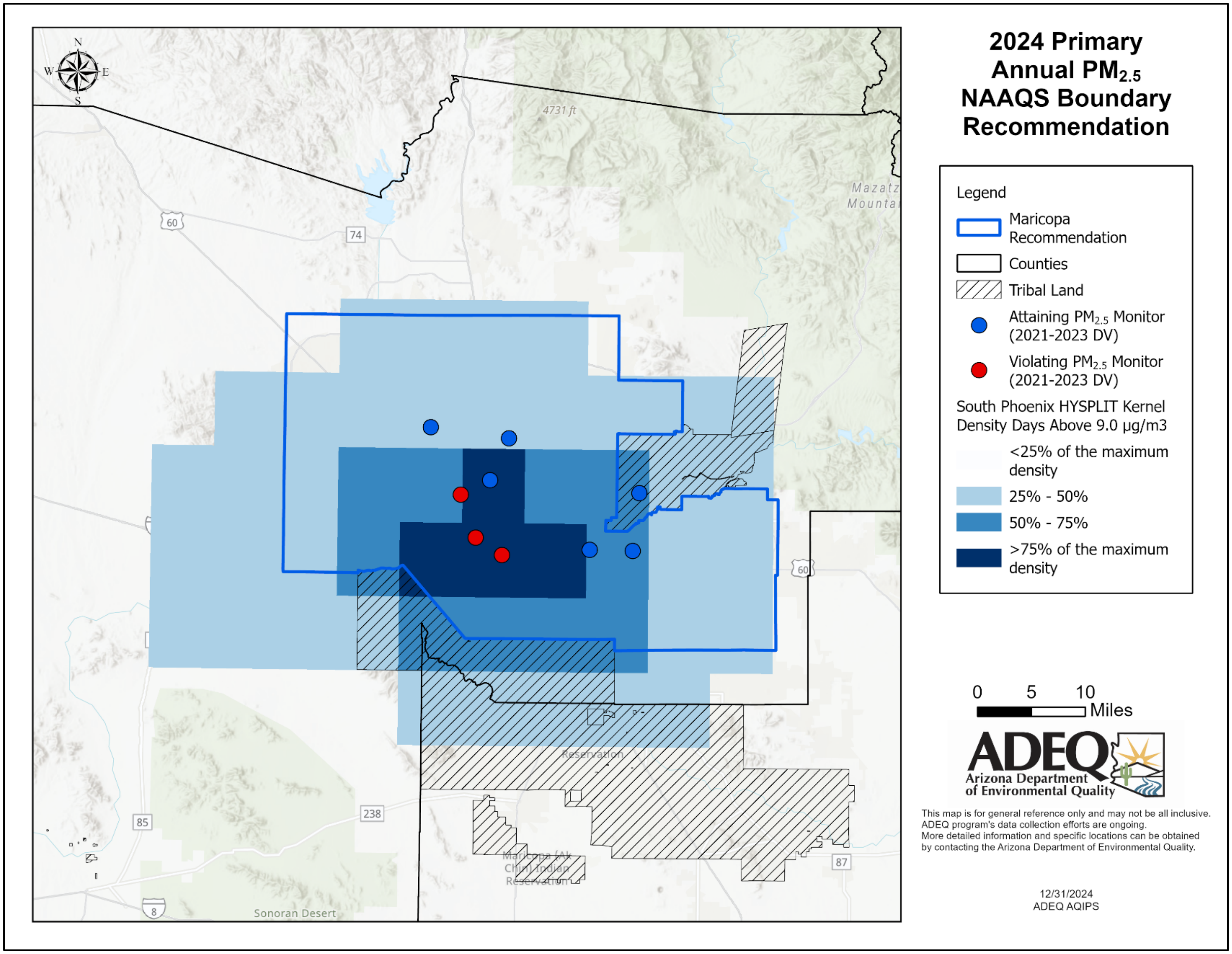
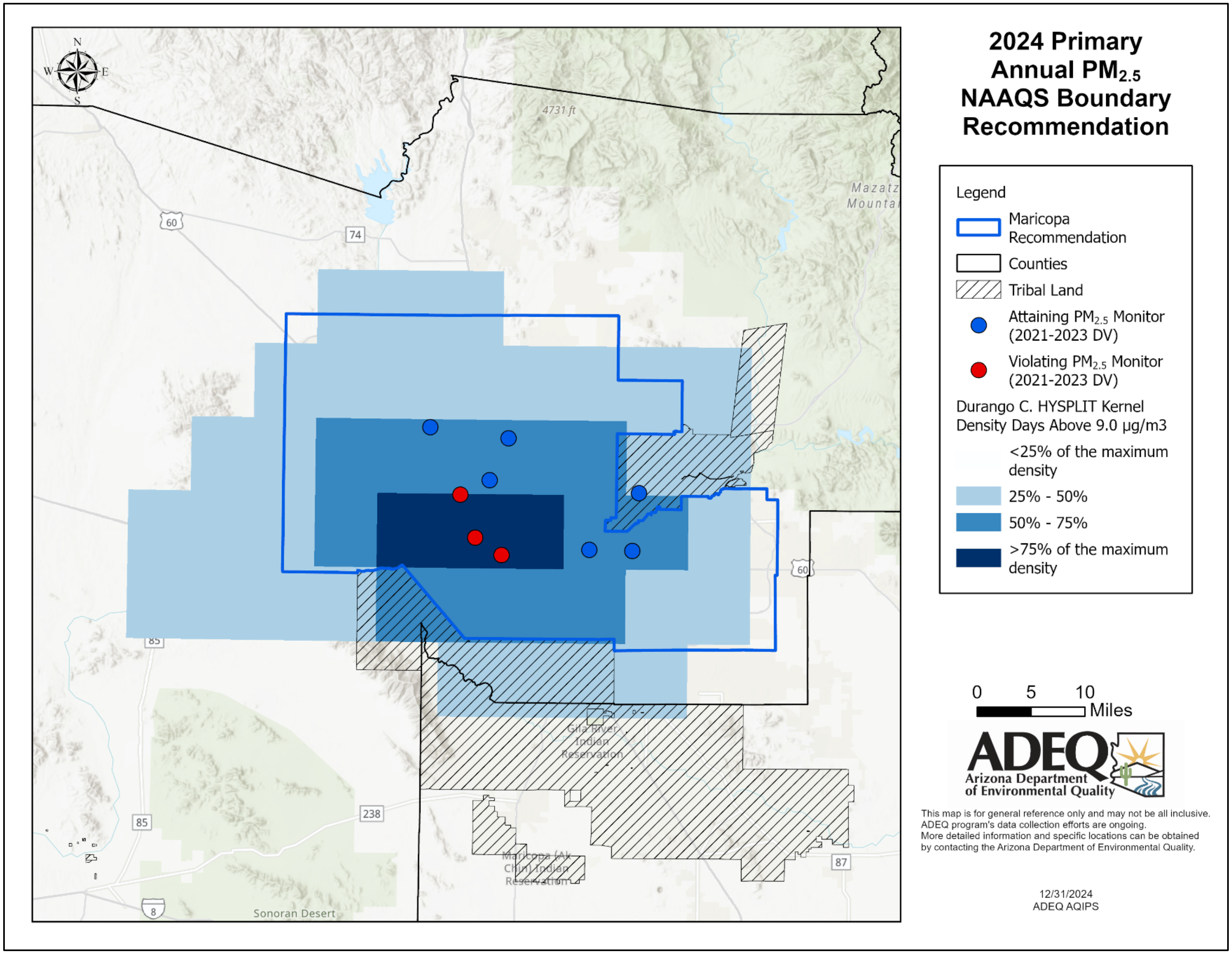


Figure 31 HYSPLIT Back Trajectories from the Durango Complex Monitor



3.1.4 Geography and Topography

Maricopa County is located in the central portion of the state and is bordered by Gila, La Paz, Pinal, Pima, Yavapai, and Yuma counties. Maricopa County has 9,202.0 square miles of land area and is the fifth largest county in Arizona by land area.[42] Maricopa County also has a land area greater than the smallest four U.S. States (e.g., Rhode Island, Delaware, Connecticut, and New Jersey).

Although located in the broad and mostly flat Salt River Valley, metropolitan Phoenix lies close to mountainous, complex terrain. The valley is bordered by several mountain chains including: the Mazatzal and Superstition Mountains to the east, the New River Mountains to the north and northeast, the Hieroglyphic Mountains to the northwest near Lake Pleasant, the White Tank Mountains in the west, the Estrella Mountains to the southwest, and the South Mountains to the south. Elevations range from about 1000 feet above sea level near downtown Phoenix to nearly 8000 feet along the Maricopa County border with Gila County and Yavapai County. This higher terrain, located to the north and east, generally forms a natural boundary between the Salt River Valley and complex terrain beyond the Maricopa County border.

A typical mountain-valley diurnal wind pattern takes place within the Salt River Valley. Hence, in the absence of major storm fronts, topography dictates the strength and direction of surface winds and drives the diurnal wind shift and flow. According to the EPA, "while the mountains to the east and west can prevent transport of pollutants in certain directions, they do not form a closed basin."[43] Absent any overriding weather pattern, winds typically start out from the east in the morning, become near calm around noon, and shift out of the southwest and west during the afternoon.

In order to spatially analyze the influence of topology, ADEQ has reviewed airsheds within Arizona. According to the EPA:

> "Airsheds refer to areas with common weather or meteorological conditions and sources of air pollution. Generally speaking, an airshed contains source and receptor areas."[44]

In Arizona, airsheds have the same meaning as smoke management units as defined by A.A.C. R18-2-1501(27):

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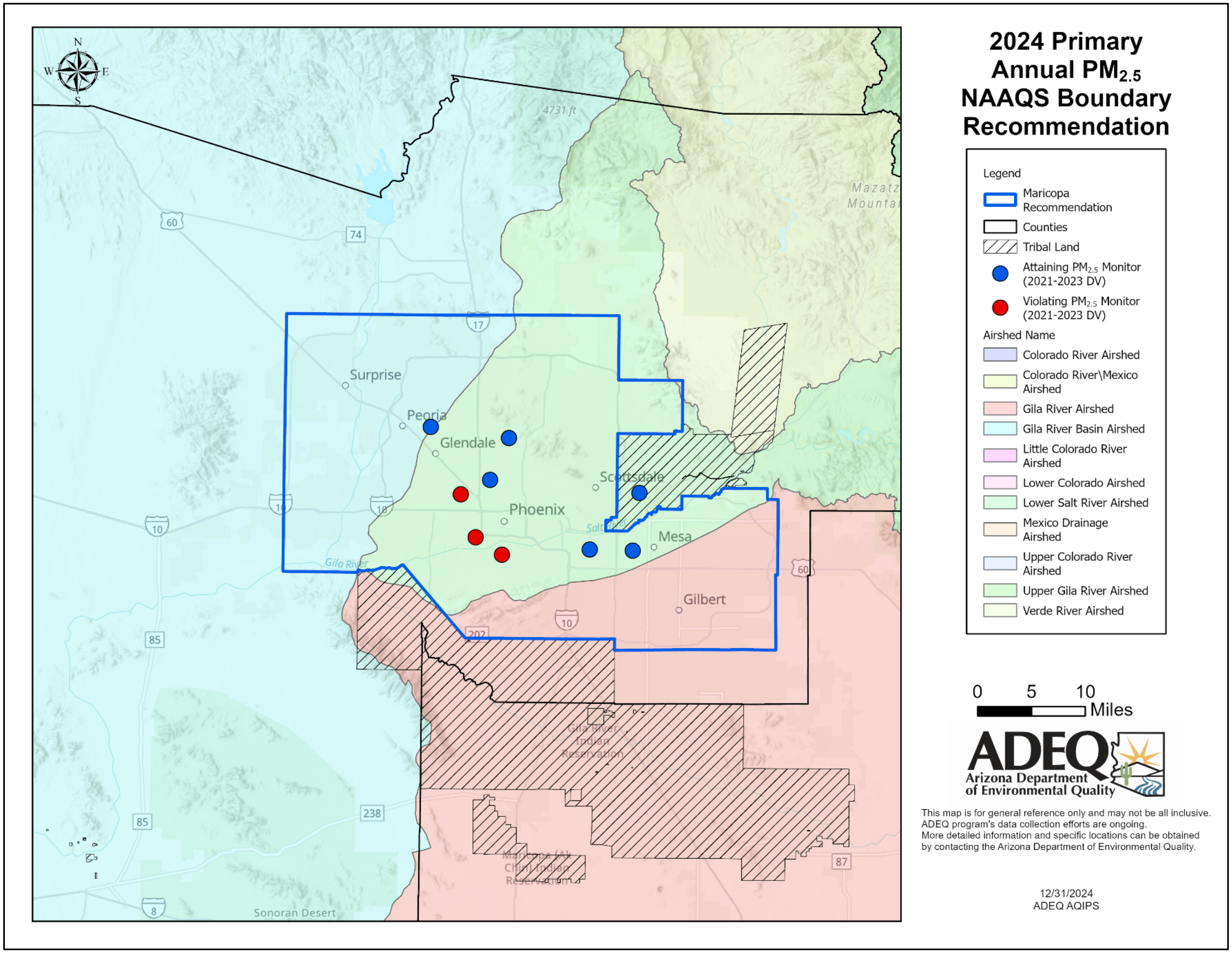
[42] U.S. Census Bureau, *Maricopa County, Arizona*, available at: https://data.census.gov/profile/Maricopa_County,_Arizona?g=050XX00US04013 (last visited June 17, 2024).
[43] U.S. Env't. Prot. Agency, *Phoenix-Mesa and Yuma Nonattainment Areas Intended Area Designations for the 2015 Ozone National Ambient Air Quality Standards Technical Support Document (TSD)*, available at: https://www.epa.gov/sites/default/files/2017-12/documents/az_120d_tsd_combined_final_0.pdf (last visited June 17, 2024).
[44] 72 FR 14422, 14425 (Mar. 28, 2007).

> ""Smoke management unit" means any of the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns."

In combination with an analysis of meteorological conditions and emission sources, consideration of topography and airsheds can support a weight of evidence analysis by identifying geographic areas where there is likely to be no significant transport of emissions between areas. Figure 32 below shows the topography and airsheds near the recommended 2024 $PM_{2.5}$ Maricopa County (partial) NAA boundary.

Figure 32 Maricopa County NAA Airsheds



3.1.5 Jurisdictional Boundaries

ADEQ considered existing jurisdictional boundaries to establish a clearly defined legal boundary for implementing the revised primary annual $PM_{2.5}$ NAAQS. ADEQ considered counties, local air quality departments and districts, Tribal Nations and Communities land, metropolitan planning organizations, and existing NAAs. The local air quality department for Maricopa County is the MCAQD who operates pursuant to an agreement with ADEQ and is governed by the Maricopa County Board of Supervisors. Recommendations for the Maricopa County $PM_{2.5}$ NAA excludes Tribal Nations and Communities land, which has the same meaning as the term defined in 18 U.S.C. § 1151. MAG, the metropolitan planning organization (MPO) and council of government (COG) for the region, has authority for certain air quality and transportation planning for Maricopa County, including authority for state implementation plan development for $PM_{2.5}$. Maricopa County does not have an existing $PM_{2.5}$ NAA for the 1997, 2006, or 2012 NAAQS. Figure 33 below shows jurisdictional boundaries near the recommended Maricopa County (partial) NAA boundary.

In Figure 34, ADEQ displays city boundaries in relation to the Maricopa County (partial) NAA boundary recommendation. However, municipality boundaries were not considered within the jurisdicational boundaries factor of the five factor analysis. The legal boundaries that are relevant for the boundary recommendation process are those that are relevant for carrying out the CAA planning and enforcement functions. For the areas around the violating monitors, relevant jurisdictions carrying out CAA responsibilities are MAG, MCAQD, and ADEQ. While cities may be responsible for adopting measures as part of a nonattainment or maintenance plan, local municipalities do not have an individual role in air quality planning or enforcement under state law. Therefore, ADEQ did not consider city boundaries as a method for analyzing the jurisdictional boundary factor.

Figure 33 Maricopa County NAA Jurisdictional Boundaries

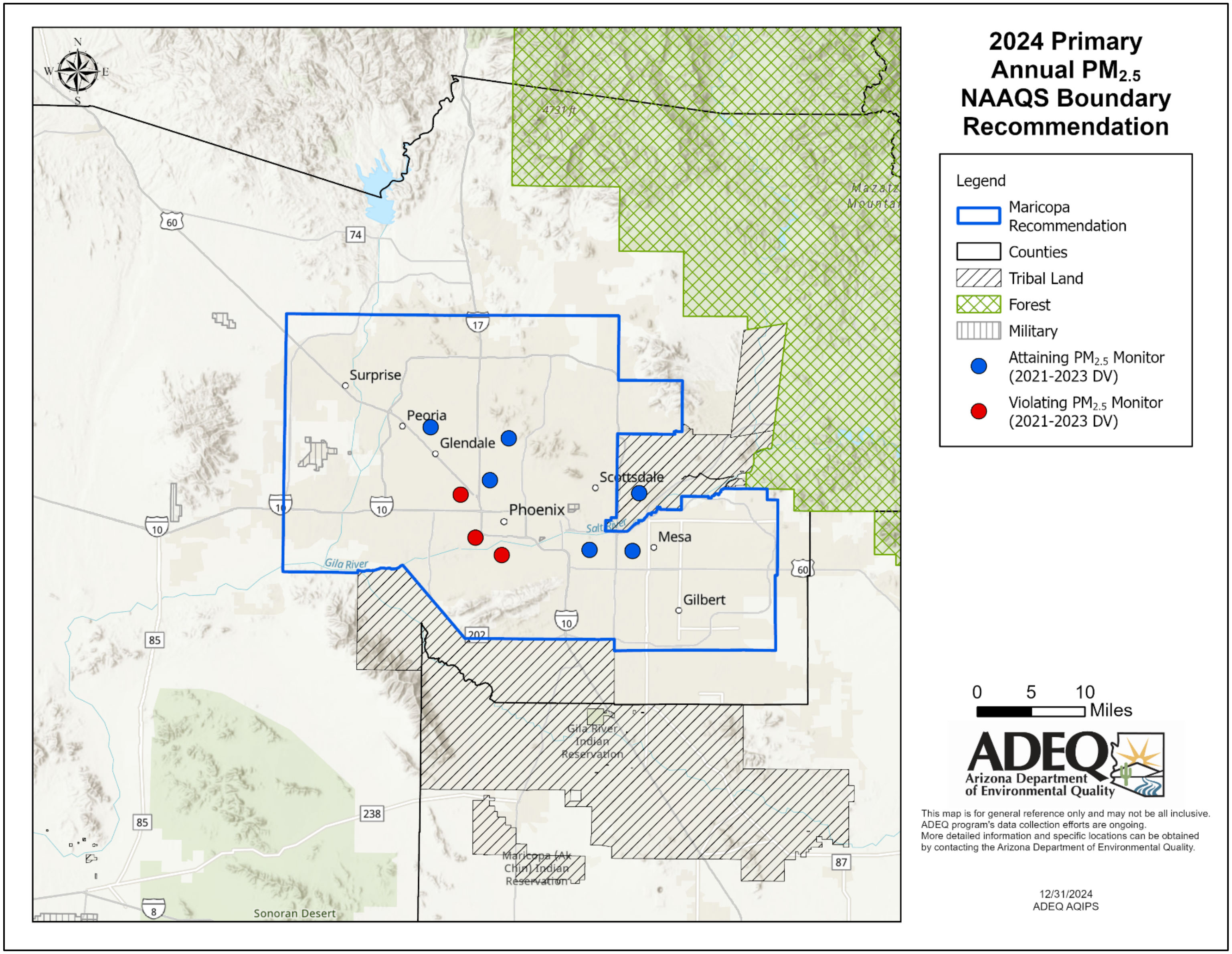
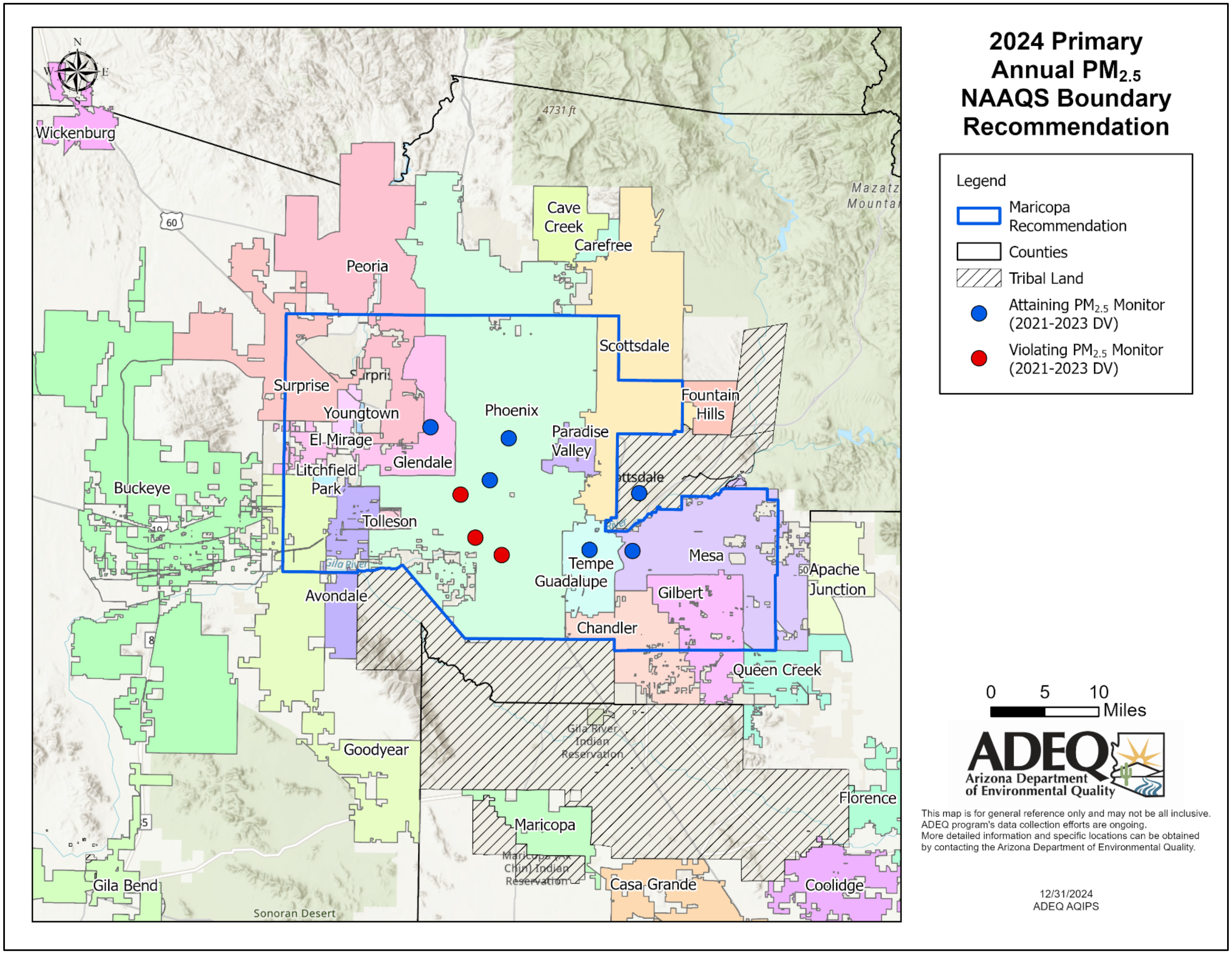


Figure 34 City Boundaries in Relation to the Maricopa County (Partial) NAA



3.1.6 Weight of Evidence Analysis and Recommendation Summary

This section presents ADEQ's weight of evidence analysis for its based recommendation for Maricopa County (partial). As described in the EPA's guidance, the weight of evidence is to aggregate or synthesize the previously described assessments into a cogent narrative that describes the relationship between the emissions sources in the analysis area and measured violations.[45] This section synthesizes the five factors considered above.

ADEQ's starting point for the weight of evidence analysis was to examine the location of monitors within Maricopa County which are currently not meeting the 2024 primary annual $PM_{2.5}$ NAAQS. Based on 2021-2023 DVs, the West Phoenix, Durango Complex, and South Phoenix monitors are not attaining the 2024 primary annual $PM_{2.5}$ NAAQS. These three monitors are located in close proximity to each other and are located in the City of Phoenix. All of these monitors are operated by Maricopa County Air Quality Department and are listed in the most recent annual monitoring network plan as neighborhood spatial scale monitors (0.5 to 4.0 km) with a site type of highest concentration and a monitoring objective of NAAQS comparison.[46] Given the close proximity of these violating monitors to each other and given that they are located in close proximity to other attaining $PM_{2.5}$ monitors (e.g., JLG Supersite and Eastwood) it is reasonable to conclude that the air quality violations are confined to a small geographic area. All areas within 4.0 km of the violating monitors are contained within the recommended 2024 primary annual $PM_{2.5}$ boundary for Maricopa County.

ADEQ also examined relevant $PM_{2.5}$ speciation data. Currently, none of the three violating monitors collect $PM_{2.5}$ speciation data. However, the JLG Supersite, operated by ADEQ, is located approximately 3 miles away from the West Phoenix site and does collect $PM_{2.5}$ speciation data. Based on ADEQ's review of $PM_{2.5}$ speciation data from December 2020 to November 2023, crustal material, organic carbon, and elemental carbon make up 79% of the major chemical species of the $PM_{2.5}$ mass near the JLG Supersite monitor with nitrates and sulfates contributing 21% on an annual average basis.

Results of the urban increment analysis for Maricopa County were considered next. With the regional background concentration removed, ADEQ noted that organic carbon and elemental carbon make up an even greater percentage of the $PM_{2.5}$ mass in the area at 79%, with nitrates, sulfates, and crustal-material comprising the remaining 21%. In addition, ADEQ noted the high organic carbon to elemental carbon ratio (7.19 $\mu g/m^3$/4.34 $\mu g/m^3$) of the total 14.54 $\mu g/m^3$ which can be indicative of biomass burning having a larger impact on ambient $PM_{2.5}$ concentrations

[45] *Supra* note 13, Attachment 3 at 4.
[46] Maricopa County Air Quality Dept., 2024 Air Monitoring Network Plan (May 2024) available at: https://www.maricopa.gov/DocumentCenter/View/93515/2024-Annual-Monitoring-Network-Plan-Public-Comment-Draft.

when compared to emissions from fossil fuel combustion sources. Moreover, the lower contributions from sulfates and nitrates could indicate lower contributions from sources such as fossil fuel combustion for electric utilities, industrial, motor sources (e.g., spark ignition and compression ignition engines), and smelting and metal processing.[47]

Next, ADEQ examined emissions and emissions related data, meteorology, and geography/topography data to assess which nearby emissions sources, source sector categories, or neighboring areas may have contributed to violations at the three Phoenix area monitors. Generally, ADEQ's found that nonpoint sources contribute the most to $PM_{2.5}$ emission totals as reported in the 2020 NEI with some adjustments from the 2020 MCAQD PEI and are distributed around the Phoenix metro area with a higher density of sources located near the violating monitors. The highest $PM_{2.5}$ emitting point sources in the region are electrical generating units. For population density and land use, the Phoenix metro area is a highly urbanized area that has a mix of single-family high-density housing, industrial land use, and agricultural land use in close proximity to the violating monitors. Lastly, examination of the $PM_{2.5}$ and $PM_{2.5}$ precursor emissions showcases that the Maricopa County NAA boundary covers most of the 12 km grid cells with high allocated annual $PM_{2.5}$ and $PM_{2.5}$ precursor emissions for nonpoint, nonroad, area fugitive dust, and residential wood combustion near the violating monitors. While examination of gridded emissions can highlight where emissions from more dispersed activites are being generated, an examination of whether emissions from these areas are being transported to violating monitors is necessary. An examination of gridded emissions on their own should not be seen as decisive on where to draw boundaries.

Looking at the meteorological trends for the violating $PM_{2.5}$ monitors within the county, they display both seasonal and diurnal trends that are indicative of stagnant wind and inversion conditions contributing to elevated $PM_{2.5}$ concentrations at the violating monitors during quarter 1 and quarter 4. These factors point to influence from local sources as being likely contributors to elevated $PM_{2.5}$ concentrations at the violating monitors. Evidence of these meteorological patterns are showcased in the wind roses, pollution roses, percentile roses, HYSPLIT analysis, and kernel density plots for the Durango Complex, South Phoenix, and West Phoenix monitors. In examination of the HYSPLIT analysis and kernel density plots, it can be seen that air impacting violating monitor on days with 24-hour concentrations above 9.0 $\mu g/m^3$ comes from all directions when running back trajectories for 24-hours. However, a higher density of back trajectory endpoints are clustered around the violating monitors and showcase patterns of declining point density across the Phoenix metro area. These patterns of air transport on high concentration days were incorporated into the weight of evidence model by ADEQ in assessing source-receptor relationships in the area.

In reviewing the geography and topography for the region, ADEQ noted the trifurcated nature of the Phoenix metro area belonging to three distinct airsheds and having multiple mountain ranges

[47] *See supra* note 30.

including the Goldfield, South Mountain, Superstition, Sierra Estrella, White Tank, and McDowell Mountains all contributing to the formation of the Lower Salt River airshed.

Lastly, ADEQ considered existing jurisdictional boundaries and air quality planning authority in making its determination. The Maricopa Association of Governments has $PM_{2.5}$ state implementation planning authority for Maricopa County. ADEQ also evaluated and excluded Tribal Nations and Communities lands during the boundary designation evaluation process.

For all the reasons above, ADEQ recommends that a NAA covering a portion of Maricopa County, as described in Section 1.1.1, be recommended to the EPA administrator.

3.2 Boundary Recommendation for Contingency Based Pinal County (Partial) NAA

This section will begin with a discussion of ADEQ's contingency based Pinal County (partial) NAA recommendation. Following, this section is an evaluation of the EPA's five factors: 1) air quality data; 2) emissions and emissions-related data; 3) meteorology; 4) geography/topography; and 5) jurisdictional boundaries. This section concludes with ADEQ's weight of evidence analysis.

3.2.1 Contingency Based Recommendation Justification

ADEQ makes its recommendation for the Pinal County NAA contingent upon the EPA's determination of Pinal County Air Quality Control District's (PCAQCD) request, pursuant to 40 C.F.R. § 58.30, to find that the Hidden Valley $PM_{2.5}$ monitor is ineligible for comparison to the NAAQS. Specifically, 40 C.F.R. § 58.30(a) states, in relevant part:

> Consistent with appendix D to this part, section 4.7.1, when micro- or middle-scale $PM_{2.5}$ monitoring sites collectively identify a larger region of localized high ambient $PM_{2.5}$ concentrations, such sites would be considered representative of an area-wide location and, therefore, eligible for comparison to the annual $PM_{2.5}$ NAAQS. $PM_{2.5}$ measurement data from monitors that are not representative of area-wide air quality but rather of relatively unique micro-scale, or localized hot spot, or unique middle-scale impact sites are not eligible for comparison to the annual $PM_{2.5}$ NAAQS. $PM_{2.5}$ measurement data from these monitors are eligible for comparison to the 24-hour $PM_{2.5}$ NAAQS. For example, if a micro- or middle-scale $PM_{2.5}$ monitoring site is adjacent to a unique dominating local $PM_{2.5}$ source, then the $PM_{2.5}$ measurement data from such a site would only be eligible for comparison to the 24-hour $PM_{2.5}$ NAAQS. Approval of sites that are suitable and sites that are not suitable for comparison with the annual $PM_{2.5}$ NAAQS is provided for as part of the annual monitoring network plan described in § 58.10.

In 2010, the Cowtown Road site was determined by the EPA to be a unique middle-scale site that met the requirements to be excluded from comparison to the annual $PM_{2.5}$ NAAQS.[48] In its technical support document, the EPA concluded:

> Based on the analysis above, the Cowtown site should be considered a relatively unique, population-oriented, microscale site. Furthermore, the monitoring site is located in close proximity to a “unique dominating local $PM_{2.5}$ source” and is likely to have “concentrations representative of a smaller than neighborhood spatial scale.” Therefore, the $PM_{2.5}$ data from the Cowtown site in Pinal County should not be compared to the annual $PM_{2.5}$ NAAQS.[49]

In 2013, PCAQCD was notified by the landowners of the Cowtown Road site that they would no longer allow Pinal County to use the property. PCAQCD and the landowners reached an agreement to allow PCAQCD until January 20, 2016 to remove all equipment from the site.[50]

In 2015, PCAQCD proposed the Hidden Valley site as the replacement for Cowtown Road, which the EPA approved.[51] In its letter approving the Hidden Valley site, the EPA stated:

> In 2010 and as part of the ANP approval process, the EPA has approved PCAPCD's request that the Cowtown Road $PM_{2.5}$ site be considered ineligible for comparison to the annual $PM_{2.5}$ NAAQS. At this time, the EPA will not be making a determination on whether the Hidden Valley replacement site will be eligible for comparison to the annual $PM_{2.5}$ NAAQS. Please work with the EPA to determine next steps.[52]

In 2016, the Hidden Valley $PM_{2.5}$ monitor began operation as the relocation site for the Cowtown Road site.[53]

As part of its 2023 Annual Network Plan (ANP), PCAQCD submitted an analysis demonstrating that the Hidden Valley site is ineligible for comparison to the annual NAAQS.[54]

In 2024, PCAQCD developed an updated analysis and request to find the Hidden Valley site as ineligible for comparison to the annual NAAQS.[55] PCAQCD’s analysis reviewed “spatial scale of the site and then move into land use around the site, the proximity of the sources to the site, the

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[48] *See* U.S. Env’t Prot. Agency, *Technical Support Document for Determination that the Cowtown Monitor is Ineligible for Comparison with the Annual PM2.5 NAAQS* (Apr. 26, 2010), available at https://www3.epa.gov/pmdesignations/1997standards/rec/letters/9/s/Arizona_R4.pdf.
[49] *Id.* at 6.
[50] Pinal Cnty. Air Quality Control Dist., *Draft 2024 Ambient Monitoring Network Plan and 2023 Data Summary*, 92, available at https://www.pinal.gov/DocumentCenter/View/12306/Pinal-County-2024-Network-Plan-PDF?bidId=.
[51] Letter from Meredith Kurpius, Manager, EPA Region 9 Air Quality Analysis Office, to Michael Sundblom, Director of PCAQCD (Oct. 22, 20215), available at https://www.regulations.gov/document/EPA-R09-OAR-2019-0068-0011.
[52] *Id.* at. 3-4.
[53] *Supra* note 50.
[54] Pinal Cnty. Air Quality Control Dist., *2023 Ambient Monitoring Network Plan and 2022 Data Summary*, 92, available at https://www.pinal.gov/DocumentCenter/View/15595/Pinal-County-2023-Network-Plan?bidId=.
[55] *See supra* note 50.

impacts of the sources on the site, and the uniqueness of the site."[56] A copy of PCAQCD's Appendix F to the ANP is attached to this recommendation as Appendix B. ADEQ agrees with PCAQCD's request, and urges the EPA to find the Hidden Valley site to be ineligible for comparison to the annual NAAQS. ADEQ asks that the EPA issue a final decision on PCAQCD's 40 C.F.R. § 58.30 request prior to acting on the boundary designations.

If the EPA determines that the Hidden Valley $PM_{2.5}$ monitor is ineligible for comparison to the NAAQS, then ADEQ recommends that the area be designated as unclassifiable due to a lack of available information to accurately classify the area. However, if the EPA determines that the Hidden Valley $PM_{2.5}$ monitor is eligible for comparison to the NAAQS, then ADEQ makes its recommendation for Pinal County as follows.

3.2.2 Air Quality Data

For this factor, ADEQ considered data from air quality monitors within the Phoenix-Mesa-Chandler MSA (e.g. Maricopa and Pinal Counties). ADEQ considered the annual $PM_{2.5}$ design values DVs for these monitors, based on the three most recent consecutive years of certified data, 2021-2023, shown in Figure 35 and listed in Table 12. By policy, the DV for a recommended area is determined by the monitor with the highest recorded concentration. As discussed in Section 3.1.1, ADEQ's contingency based nonattainment boundary for the Hidden Valley monitoring site, located in Pinal County, is separate from the recommended Maricopa County (partial) NAA boundary recommendation. The highest $PM_{2.5}$ concentration recorded in Pinal County is the Hidden Valley monitor, with a 2023 Annual $PM_{2.5}$ DV of 10.4 $\mu g/m^3$.

[56] *Id.*

Figure 35 Pinal County $PM_{2.5}$ Monitor Locations

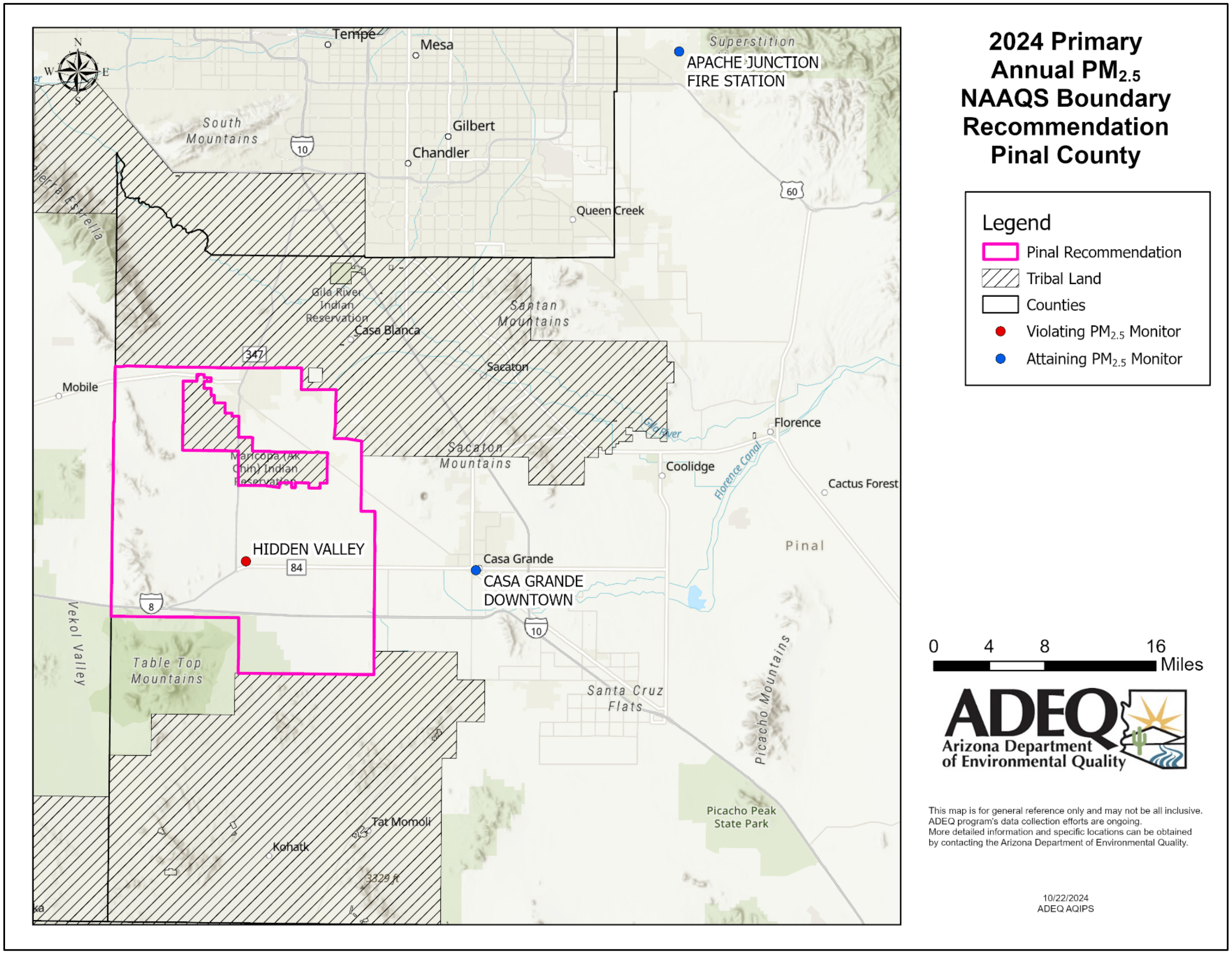


Table 12 Annual $PM_{2.5}$ DVs for 2023 Pinal County Monitors

County	AQS ID	Colloquial Name	2021-2023 DV (µg/m^3)
Pinal	04-021-3015	Hidden Valley	10.4
	04-021-0001	Casa Grande Downtown	7
	04-021-3002	Apache Junction Fire station	4.9

Figure 36 shows historical $PM_{2.5}$ DV trends from 2014-2023 for all three monitors in Pinal County. The Hidden Valley monitor has been significantly exceeding the NAAQS for several years, although it experienced a decrease in 2023, once 2020 monitoring data was no longer considered in the 3-year annual average DV. The Casa Grande Downtown and Apache Junction monitors have both have a history of attaining the 9.0 µg/m^3 $PM_{2.5}$ NAAQS.

Figure 36 Pinal County Monitors Historic DV Trends

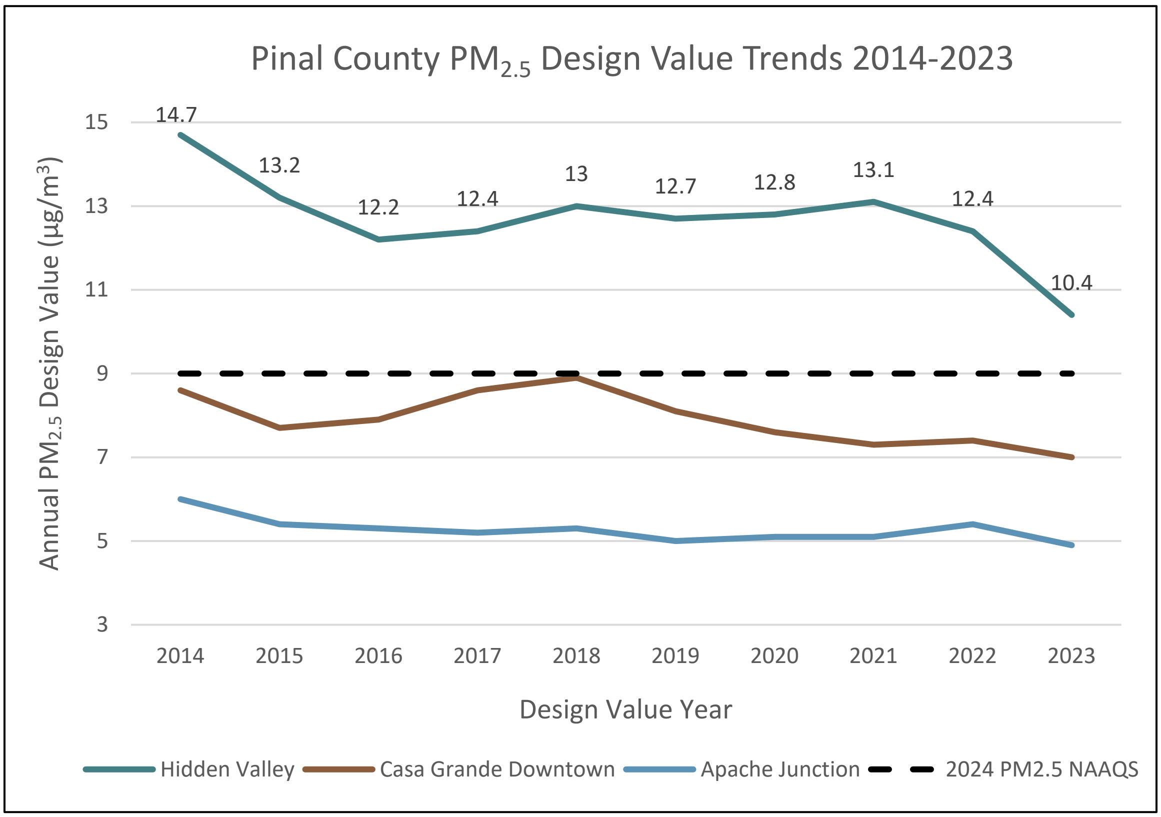
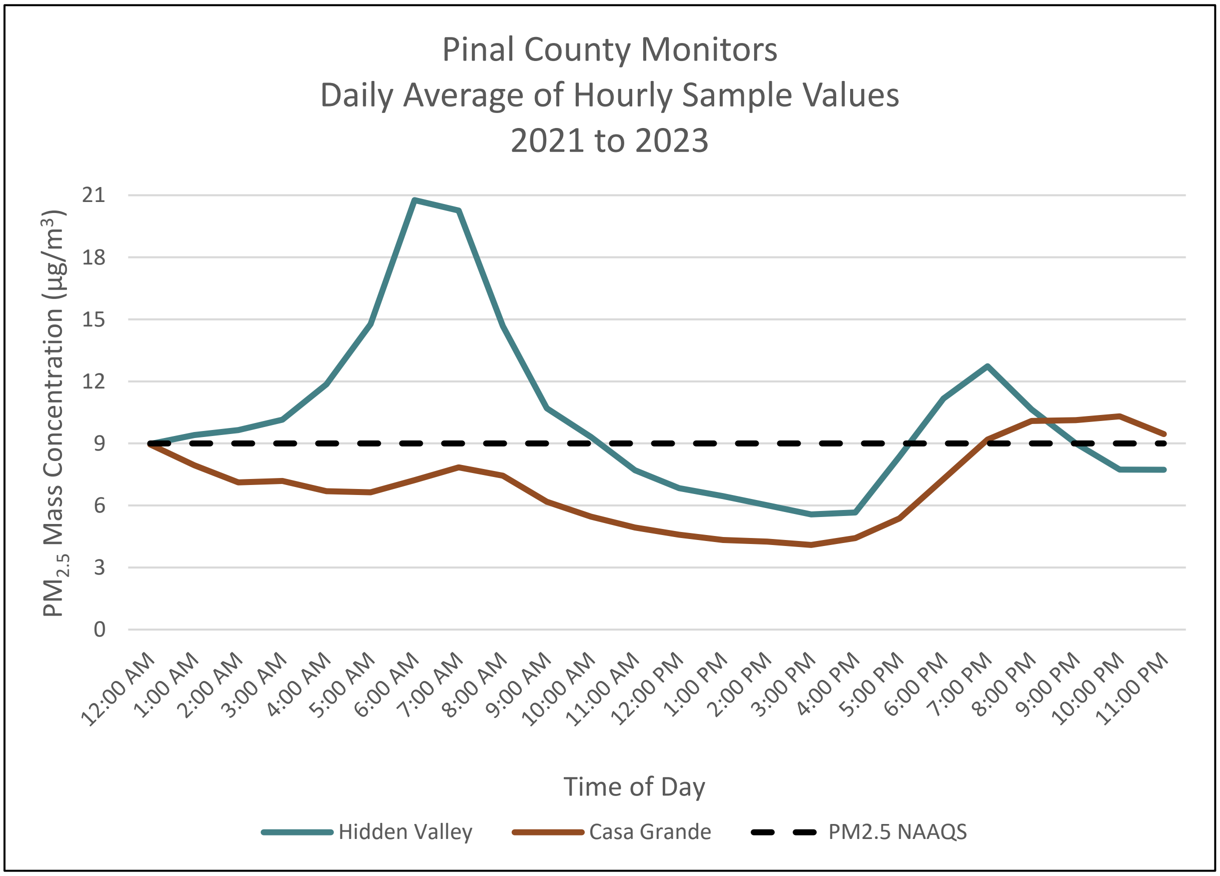


Figure 37 displays the 24-hour trends of $PM_{2.5}$ mass concentrations by averaging the hourly sample values at the Hidden Valley and Casa Grande Downtown monitoring sites from 2021 to 2023. Both monitors show similar patterns of increased $PM_{2.5}$ concentrations during nighttime hours, although the Hidden Valley monitor remains higher in concentration than the Downtown monitor. Increased $PM_{2.5}$ concentrations at night could likely be due to colder temperatures that are not warm enough to break through the inversion layer, trapping pollutants closer to the surface. In the morning time, peak spikes at the Hidden Valley monitor occur between 6 am and

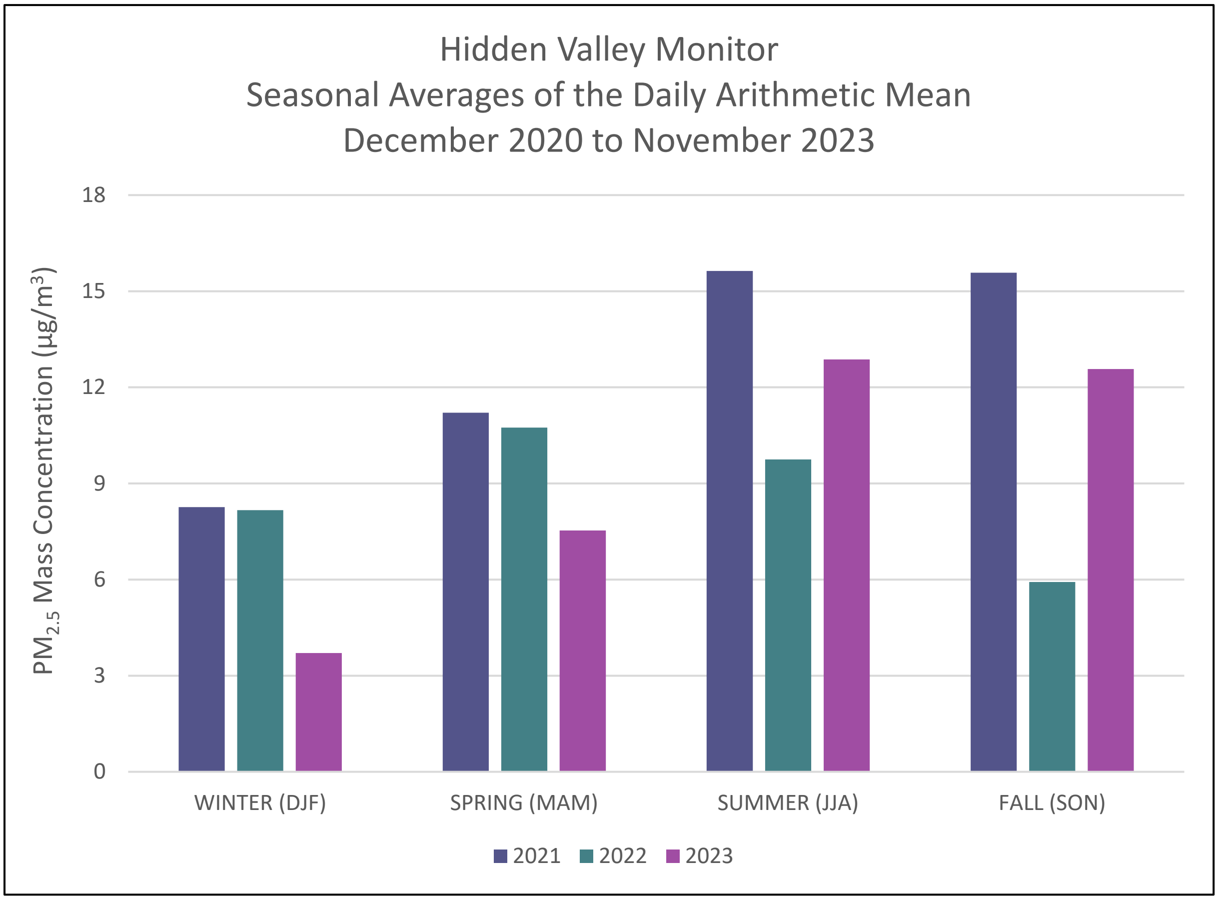
7 am, whereas the Casa Grande Downtown monitor does not display this same trend and stays below the 2024 annual $PM_{2.5}$ NAAQS.

Figure 37 Hidden Valley and Casa Grande Downtown Monitors Hourly Trends



ADEQ evaluated potential seasonal trends from December 2020 to November 2023 at the Hidden Valley monitor to best represent data from the 2023 DV period. Figure 38 shows seasonal averages of the $PM_{2.5}$ daily arithmetic mean at the Hidden Valley monitoring site. ADEQ found that the Hidden Valley monitor experienced higher $PM_{2.5}$ concentrations across all seasons in 2021. However, this graphic also shows that elevated $PM_{2.5}$ concentrations predominately occur in spring, summer and fall and do not have a strong association with any one season. Given that the Hidden Valley monitor is located in a relatively unpopulated area, we would expect the wintertime concentrations to not be heavily influenced by certain wintertime activities such as residential wood burning.

Figure 38 Hidden Valley Monitor Seasonal Trends



3.2.2.1 $PM_{2.5}$ Compositional Analysis

Pinal County does not have an IMPROVE and/or a CSN monitor to analyze the urban $PM_{2.5}$ concentration's chemical speciation and therefore a $PM_{2.5}$ compositional analysis could not be performed.

3.2.2.2 $PM_{2.5}$ Urban Increment

For the same reason listed above, ADEQ did not perform a $PM_{2.5}$ urban increment analysis.

3.2.3 Emissions and Emissions-Related Data

ADEQ evaluated emissions and emissions-related data from Pinal County. Emissions data were derived from the 2020 National Emissions Inventory (NEI), as well as, certified emissions data that were reported to ADEQ and PCAQCD in 2022. For this factor, ADEQ also examined emissions of identified sources of direct $PM_{2.5}$ (organic carbon, elemental carbon, crustal material), primary nitrate and primary sulfate, and precursor gases associated with fine particulate formation such as SO_2, NO_x, VOC, and NH_3.

3.2.3.1 Pinal County Emissions from the 2020 NEI

Table 13, Table 14, and Figure 39 below represent data for Pinal County from the 2020 NEI. Table 13 shows a breakdown of Pinal County's $PM_{2.5}$ emissions by source sector as percentage of the county total. The largest contribution to Pinal County's $PM_{2.5}$ emissions comes from the nonpoint category, which represents 94.3% of the total. Wildfires, crops and livestock dust, construction dust, waste disposal, and residential wood burning comprise the top five nonpoint source sectors. $PM_{2.5}$ emissions from point, onroad, and nonroad sources combined create the remaining 5.7%.

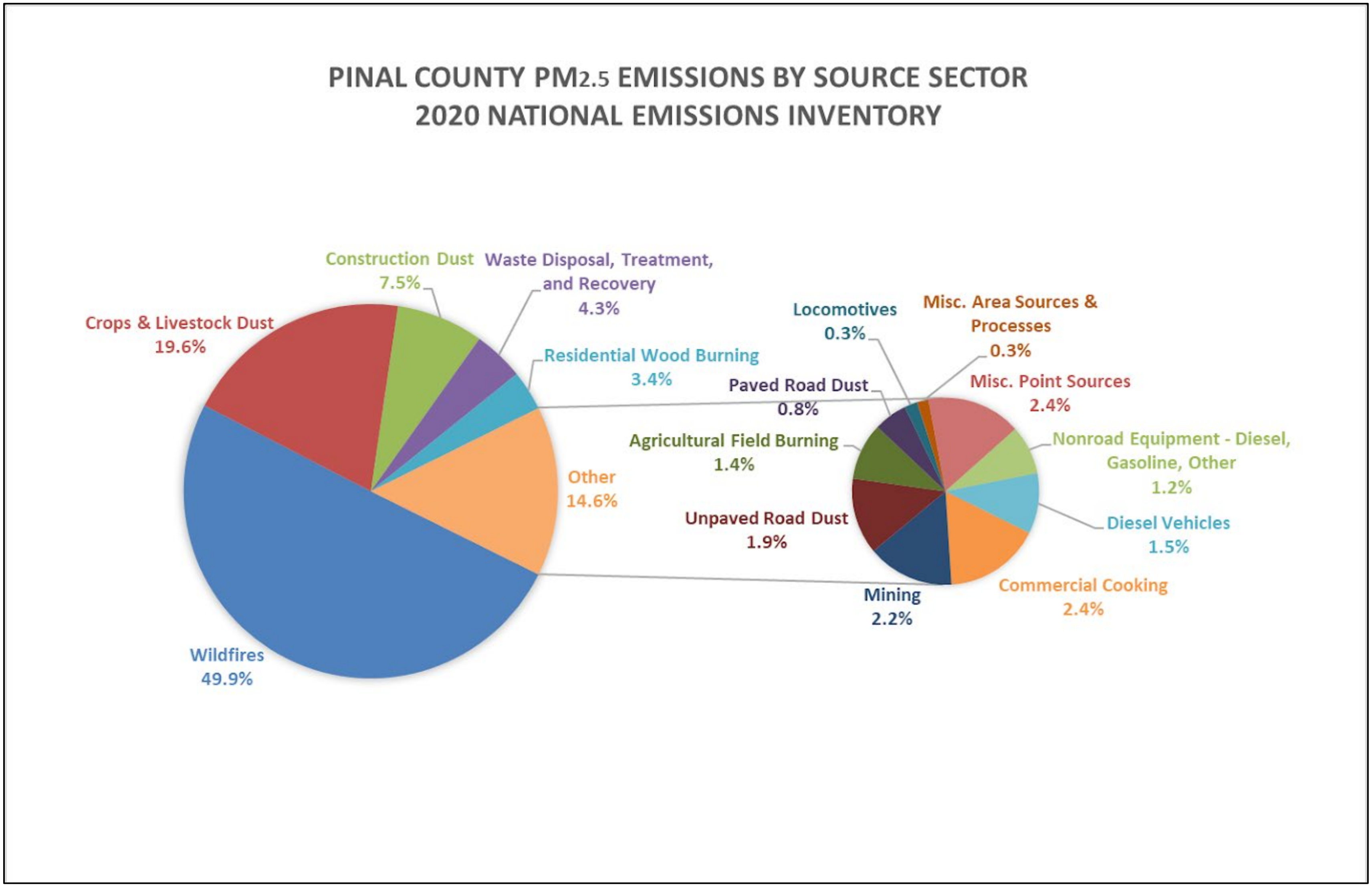
Table 13 Pinal County $PM_{2.5}$ Emissions by Source and Percentage of Total

$PM_{2.5}$ Emissions from the 2020 NEI					
Source	**Point**	**Nonpoint**	**Onroad**	**Nonroad**	**County Total**
TPY	148.0	5,857.9	132.3	76.8	6,214.9
% of Total	2.4%	94.3%	2.1%	1.2%	100.0%

Table 14 Pinal County $PM_{2.5}$ Emissions by Source Sector as Percentage of Total

$PM_{2.5}$ Emissions from the 2020 NEI			
Source	**Source Sector Category**	**$PM_{2.5}$ (tpy)**	**Percentage of Total**
Nonpoint			
	Wildfires	3,104.0	49.9%
	Crops & Livestock Dust	1,220.2	19.6%
	Construction Dust	464.6	7.5%
	Waste Disposal	270.3	4.3%
	Residential Wood Burning	212.7	3.4%
	Commercial Cooking	151.0	2.4%
	Mining	135.5	2.2%
	Unpaved Road Dust	119.5	1.9%
	Agricultural Field Burning	89.2	1.4%
	Paved Road Dust	52.3	0.8%
	Locomotives	20.5	0.3%
	Misc. Area Sources	14.2	0.2%
	Miscellaneous Industrial, Commercial, & Institutional Processes	3.8	0.1%
Point			
	Misc. Point Sources	148.0	2.4%
Nonroad			
	Equipment - Diesel	51.9	0.8%
	Equipment - Gasoline	24.4	0.4%
	Equipment - Other	0.5	0.0%
Onroad			
	Diesel Vehicles	94.3	1.5%
	Non-Diesel Vehicles	37.9	0.6%
Grand Total		**6,214.9**	**100.0%**

Figure 39 Pinal County $PM_{2.5}$ Emissions by Source Sector as Percentage of Total



ADEQ considered emissions from direct $PM_{2.5}$ and precursor pollutants when drafting the $PM_{2.5}$ boundary recommendation. Table 15 shows direct $PM_{2.5}$ emissions and precursor pollutant emissions from the 2020 NEI. In Pinal County 50% of NO_X emissions are derived from diesel and non-diesel mobile sources. Wildfires comprise 75% of the total SO_2 emissions, while miscellaneous point sources make up 14% of the total SO_2. For VOC, 68% of Pinal County's total VOC emissions are from biogenic sources and wildfires. Lastly, 94% of the total reported NH_3 emissions in Pinal County are from livestock waste and fertilizer application from the agricultural source sectors. Appendix A, Section A3.1.2.2 shows the full breakdown of source sectors and their associated contributions to precursor emissions in Pinal County.

Table 15 Pinal County $PM_{2.5}$ and Related Emissions

Pinal County $PM_{2.5}$ and Precursor Emissions from the 2020 NEI									
Direct	$PM_{2.5}$ Precursor Pollutants				Portion of $PM_{2.5}$				
Total $PM_{2.5}$	Total NH_3	Total NO_x	Total SO_2	Total VOC	Total EC	Total OC	Total NO_3	Total SO_4	Total PM-Fine
6,215	15,461	9,002	435	33,377	542	2,225	55	74	3,319

3.2.3.2 2022 Point Source Data from Permitting Authorities

ADEQ also evaluated emissions from class I, class II, and portable sources in Pinal County that reported directly to ADEQ and PCAQCD in 2022. However, it is important to note that not all minor source facilities who report to ADEQ are required to submit their emissions on an annual basis, some class II and portable sources are on a triannual reporting basis and therefore may not be represented in this analysis. Moreover, this data source omits: portable sources that had more than one operating location in 2022, federally permitted sources, sources permitted through sovereign tribal nations, and emissions from burn permits.

Figure 40 provides a visual representation of all permitted point sources from 2022 and their reported $PM_{2.5}$ emissions. The contingency based Pinal County (partial) nonattainment boundary recommendation captures 4.2% of point source $PM_{2.5}$ emissions. Figure 41 displays the locations and magnitude of point sources weighted NO_x, SO_2, NH_3, and VOC emissions in Pinal County. The size of each symbol is proportional to their combined tons per year of precursor emissions. Shown in Table 16, the recommended contingency-based Pinal County (partial) NAA boundary contains 2.7% of NO_x, 3.2% of SO_2, 0% of NH_3, and 8.6% of VOC emissions from point sources that reported to ADEQ and PCAQCD in 2022.

Table 16 Emissions from Permitted Sources in 2022 within the Pinal County NAA

Pollutant	NO_x	SO_2	VOC	NH_3	$PM_{2.5}$
TPY in Pinal Boundary	34.4	4.00	128.3	0	6.1
% of Total County Emissions	2.7%	3.2%	8.6%	0%	4.2%

Figure 40 Permitted Sources $PM_{2.5}$ Emissions in 2022 from Pinal County

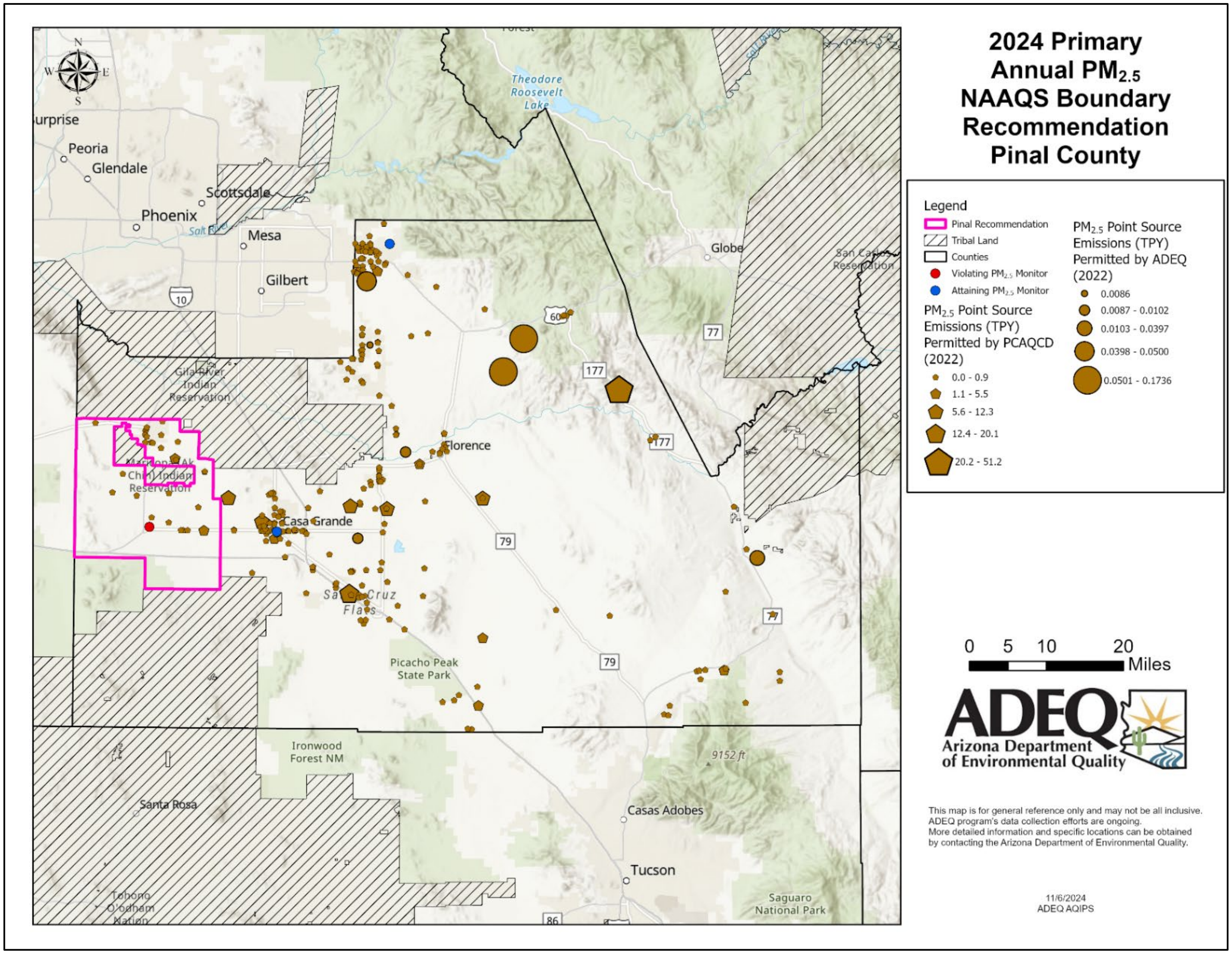
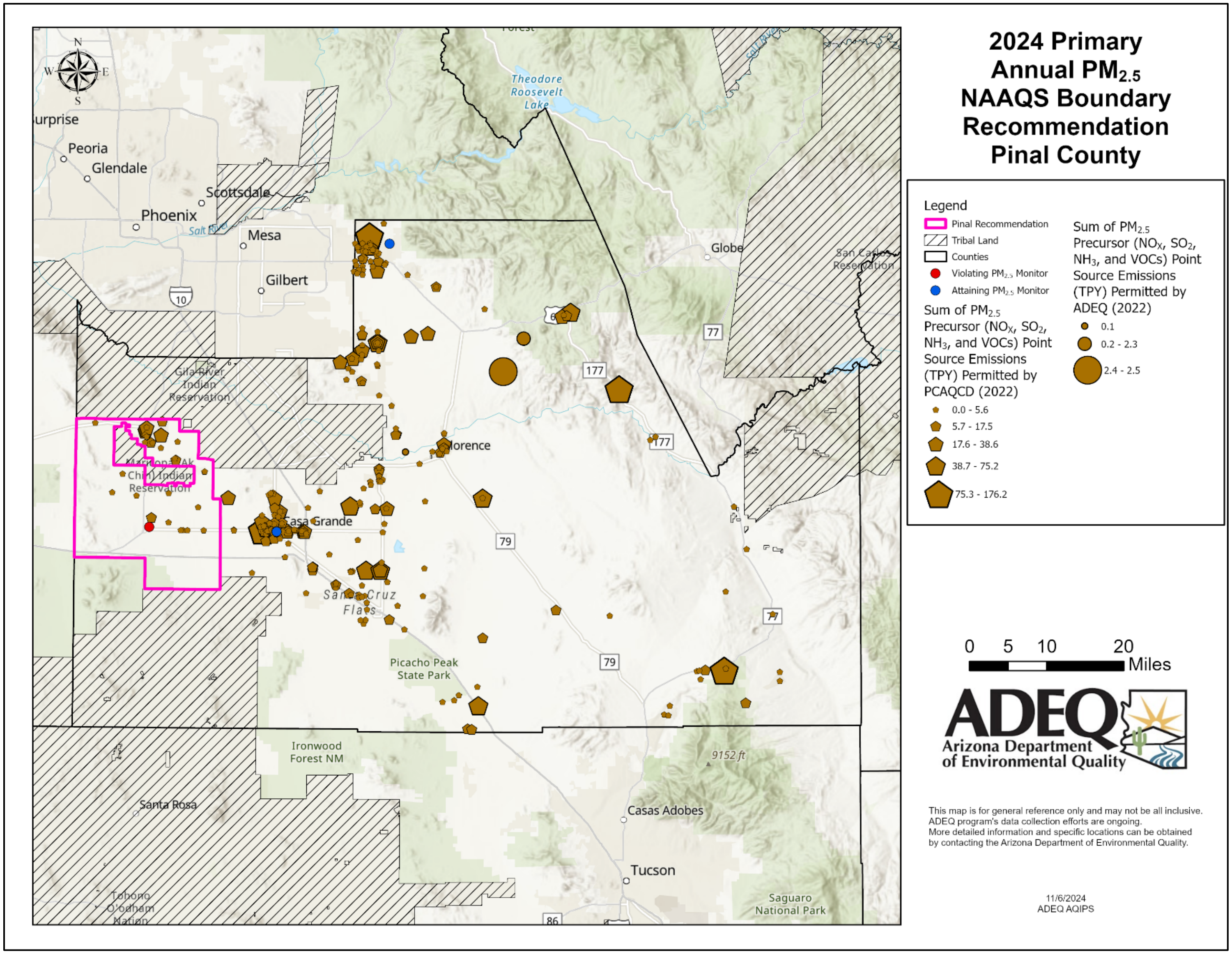


Figure 41 Emissions from Combined Precursor Pollutants in 2022 from Pinal County



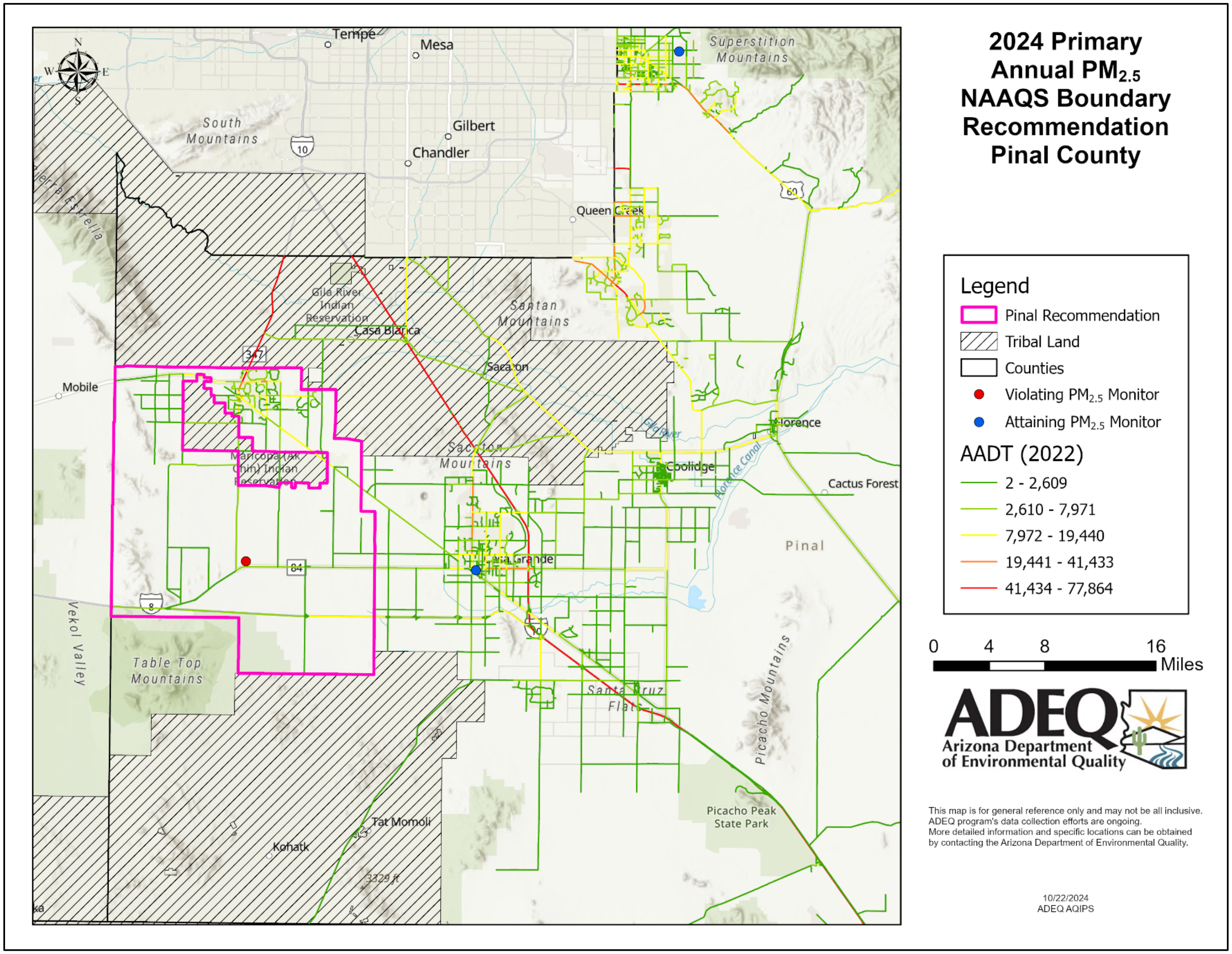
3.2.3.3 Traffic Data

Figure 42 below represents average annual daily traffic (AADT) within and near the recommended contingency-based Pinal County (partial) NAA boundary. According to the Arizona Department of Transportation, AADT is "the annualized average 24-hour volume of vehicles at a given point or section of highway is called a traffic count. It is normally calculated by determining the volume[57] of vehicles during a given period and dividing that number by the number of days in that period."[58]

Annual vehicle miles traveled (VMT) for Pinal County is 4,148,000,142 miles, according to 2022 HPMS data. The VMT for the recommended 2024 $PM_{2.5}$ Pinal County (partial) NAA is 302,727,661 miles. That means that 7.3% of annual VMT in Pinal County is captured within the recommended area.

[57] I.e. bidirectional count
[58] *Supra* note 32.

Figure 42 Pinal County NAA Average Annual Daily Traffic



3.2.3.4 Population Data

Figure 43 and Figure 44 below represent the change in population density in Pinal County between 2010 and 2020, according to the U.S. Census. The total 2020 population for Pinal County using census estimates is 425,264 people, and the 2020 population for the recommended contingency based 2024 $PM_{2.5}$ Pinal County (partial) NAA is 65,418 people. That means that approximately 15.4% of the county population based on 2020 U.S. Census data is contained within the recommended NAA.

Table 17 below shows the change in actual population between 2010 and 2020 using AZ OEO population estimates.[59] Table 18 below shows the projected change in population between 2020 and 2030 using AZ OEO population projections.[60]

[59] Arizona is providing AZ OEO specific estimates for 2010 and 2020 to accurately characterize the populations of multi-county municipalities and CDP's given only a percentage of the total population resides within each county. Retrieved from https://oeo.az.gov/population/estimates.

[60] *Supra* note 35.

Figure 43 Pinal County NAA Census Population Density in 2010

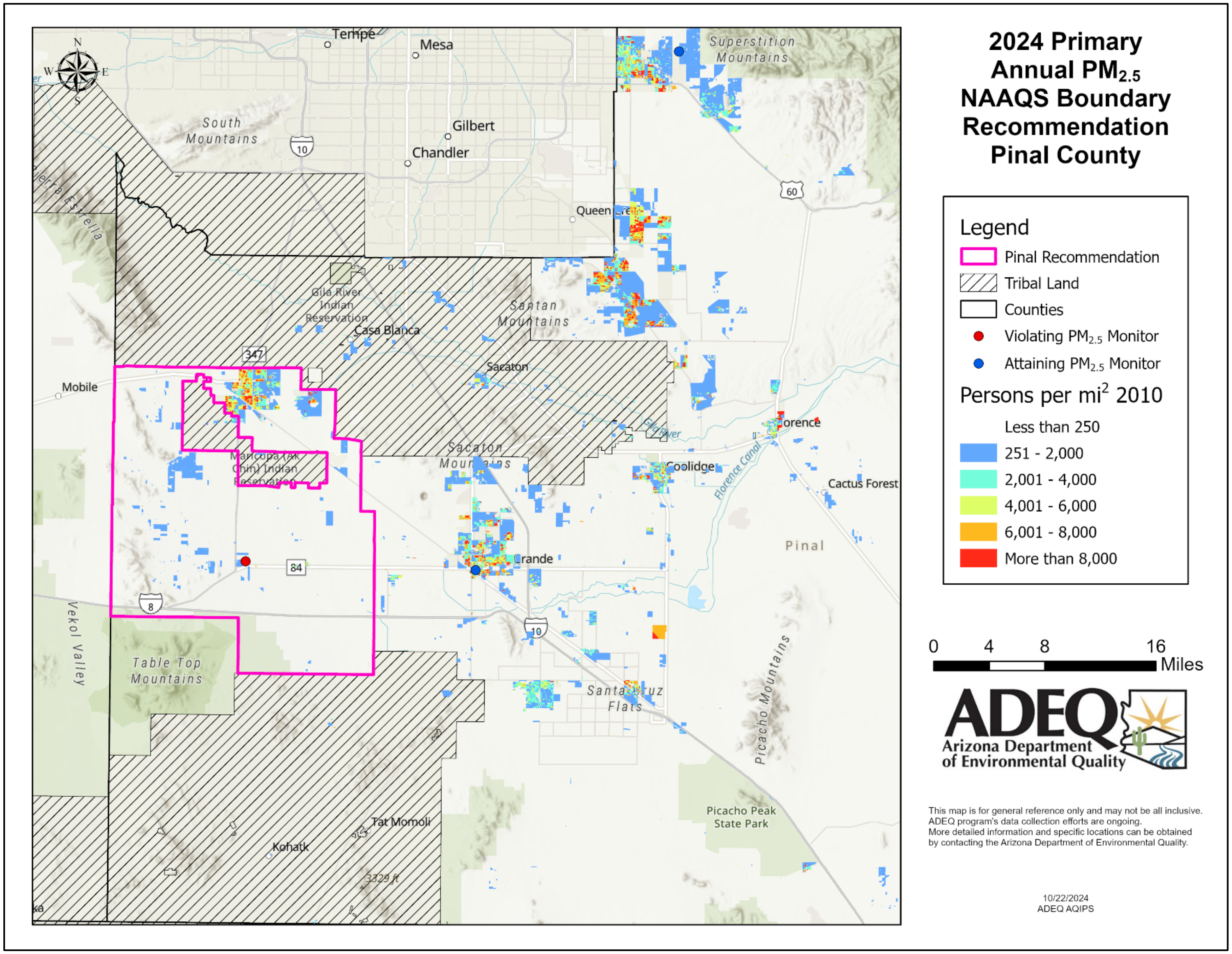


Figure 44 Pinal County NAA Census Population Density in 2020

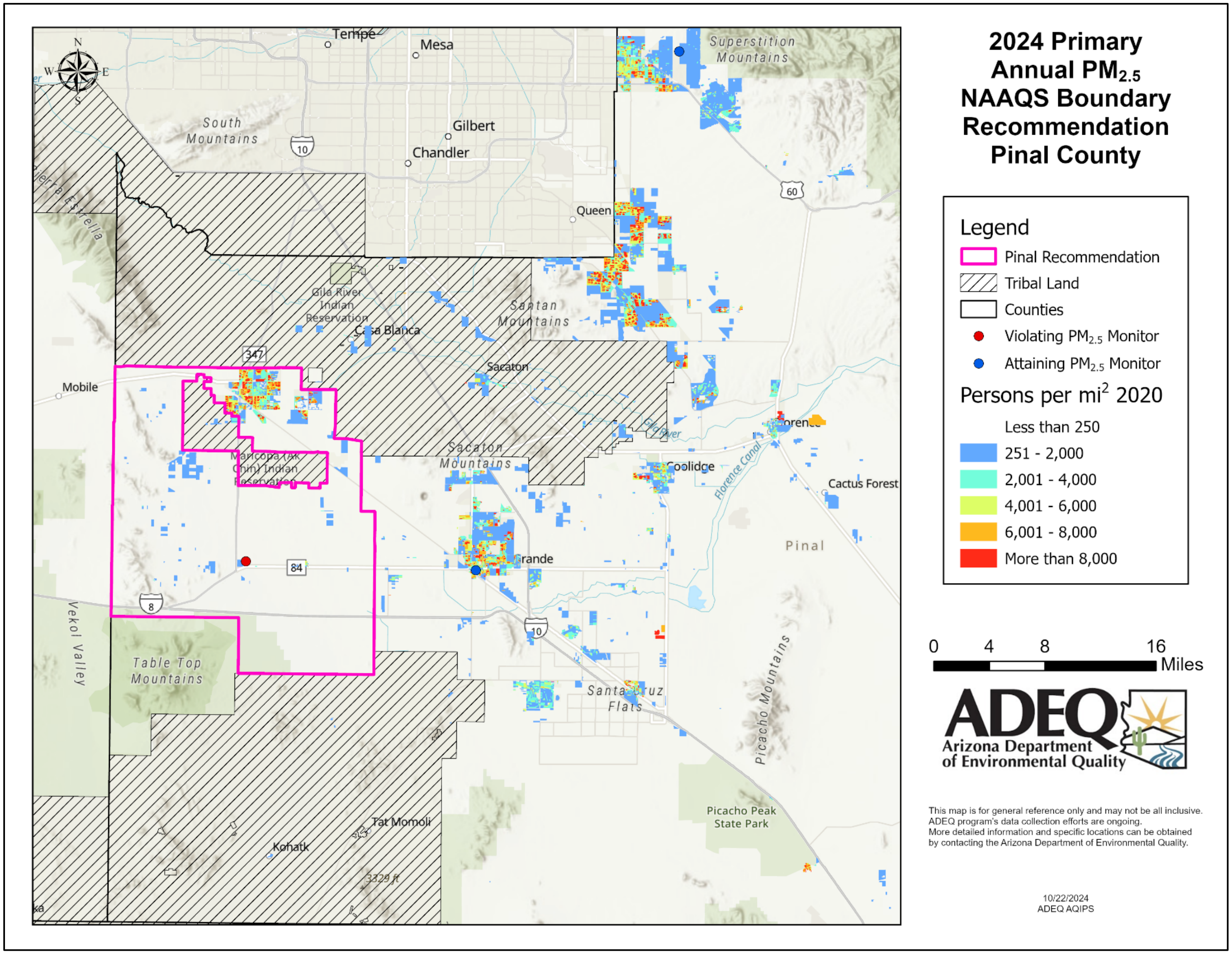


Table 17 Pinal County Population Changes from 2010 to 2020

County/Municipality/Census Designated Place	AZ OEO 2010 Estimate	AZ OEO 2020 Estimate	Population Change (%)
Pinal	375,541	428,220	14.0%
Apache Junction (part)	35,343	38,198	8.1%
Casa Grande	48,373	53,930	11.5%
Coolidge	11,749	13,347	13.6%
Eloy	16,679	15,657	-6.1%
Florence	26,752	26,931	0.7%
Hayden (part)	0	0	N/A
Kearny	1,927	1,741	-9.7%
Mammoth	1,408	1,076	-23.6%
Marana (part)	0	0	N/A
Maricopa	43,396	58,622	35.1%
Queen Creek (part)	444	9,559	2052.9%
Superior	2,801	2,409	-14.0%
Winkelman (part)	0	0	N/A
Balance of Pinal County	186,670	206,750	10.8%

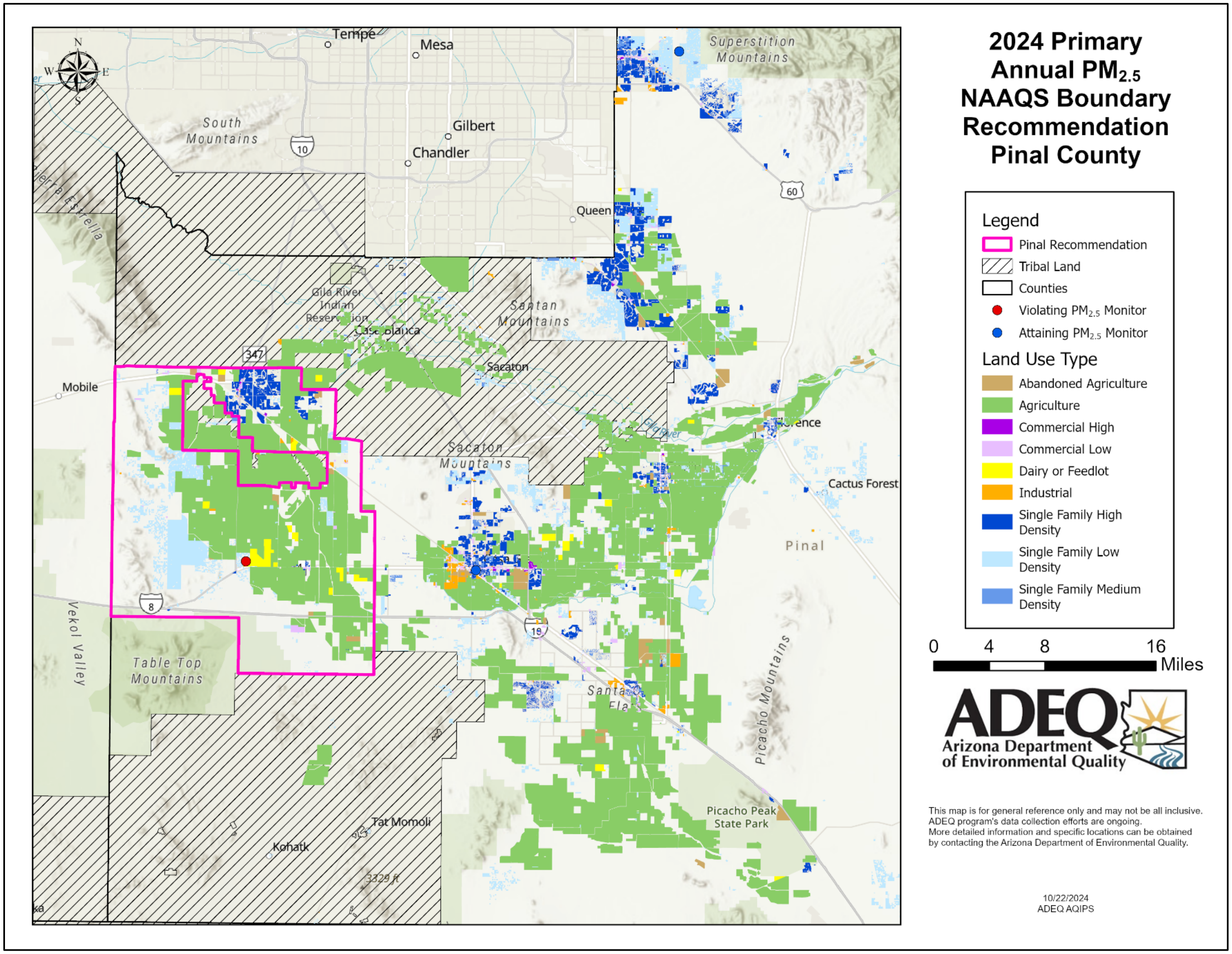
Table 18 Pinal County Population Projections from 2020 to 2030

County/Municipality/Census Designated Place	AZ OEO 2020 Estimate	AZ OEO 2030 Projections	Population Change (%)
Pinal County	425,264	587,800	38.2%
Apache Junction (part)	38,198	52,400	37.2%
Casa Grande	53,930	74,300	37.8%
Coolidge	13,347	31,200	134.6%
Eloy	15,657	20,700	31.8%
Florence	26,931	38,300	42.4%
Hayden (part)	0	N/A	N/A
Kearny	1,741	1,700	0.0%
Mammoth	1,076	1,100	0.0%
Marana (part)	0	N/A	N/A
Maricopa	58,622	91,500	56.1%
Queen Creek (part)	9,559	16,900	76.0%
Superior	2,409	2,400	0.0%
Winkelman (part)	0	N/A	N/A
Balance of Pinal County	206,750	246,700	25.7%

3.2.3.5 Land Use Data

Figure 45 below is a visual representation of the location of abandoned agriculture, agriculture, high-density commercial, low-density commercial, dairy or feedlot, industrial, and low, medium, and high-density single-family housing based on land use within and near the recommended contingency based Pinal County (partial) NAA boundary. These land use types can contribute to emissions of $PM_{2.5}$. The land use for these categories in Pinal County covers an area of 560.5 square miles. The land use for these categories within the NAA for Pinal County has an area of 152.9 square miles. This means that 27.3% of the land use for these categories within Pinal County is captured within the recommended area.

Figure 45 Pinal County NAA Land Use



3.2.3.6 2022 Gridded Emissions

In order to examine emissions at a smaller spatial scale than the county level presented in the NEI, ADEQ generated maps displaying gridded annual $PM_{2.5}$ and $PM_{2.5}$ precursor emissions for Arizona. ADEQ downloaded final gridded emissions for select source sectors from the 2022v1 EMP.[61] The 2022 emission modeling platform is based on the 2020 NEI with updates to reflect 2022 emissions. Gridded emissions are generated through the application of spatial surrogates to allocate county level emission estimates to each 12 km grid cell. Documentation on spatial surrogates used in the 2022 EMP are available in the 2020 EMP Technical Support Document.[62] 2022 EMP gridded emission files were processed in the Visual Environment for Rich Data Interpretation (VERDI) program to generate tile plots for $PM_{2.5}$ and $PM_{2.5}$ precursor emissions. VERDI tile plots were exported to shapefiles and imported into ArcGIS Pro. Gridded emissions were limited to grid cells that intersect with Arizona's boundary and projected to NAD 1983 UTM Zone 12N.[63] Gridded emissions were generated for $PM_{2.5}$ and $PM_{2.5}$ + $PM_{2.5}$ Precursors (e.g., NO_x, SO_2, VOC, NH_3) for the following source sectors:

- Residential wood burning
- Area fugitive dust (adjusted with meteorological and transport fractions by EPA)
- Nonpoint
- Nonroad

Gridded emissions plots are provided in Appendix A Section A3.4.

[61] https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform
[62] https://www.epa.gov/air-emissions-modeling/2020-emissions-modeling-platform-technical-support-document
[63] Shapefiles exported from VERDI lacked critical information related to the geographic/projected coordinate system. ADEQ obtained a custom coordinate reference system from the Lake Michigan Air Directors Consortium (LADCO) to define the CRS before performing the projection to UTM.

3.2.4 Meteorology

Pinal County often faces strong winds due to a variety of meteorological events, including frontal passages, troughs of low pressure, summer monsoon storms, and occasional intense pressure gradients. Wind patterns are influenced by a range of systems, from large-scaled synoptic events like frontal passages, strong pressure gradients, to Mesoscale Convective Systems and regional monsoon activity. Additionally, localized micro-scale storm cells also contribute to these wind events.

The frontal passages are typically associated with strong Pacific Northwest low-pressure systems that develop over the northern Pacific Ocean and move southeast into the western United States. Strong winds in advance of cold fronts can reach speeds over 30 miles per hour (mph), which cause significant quantities of blowing dust in central Arizona. The duration of the strong, gusty winds can last up to 8 hours and results in elevated hourly $PM_{2.5}$ concentrations.

Pressure gradient exceptional/natural events result from strong high-pressure building over the western United States and low pressure to the east. As the high pressure builds, a pressure differential is created that causes strong winds over Arizona. The result is locally developed blowing dust and dust transported from areas surrounding Pinal County. As with frontal passages, duration of strong, gusty winds can last several hours. The combination of the long duration of transported dust and locally derived dust overwhelm the air quality monitors.

The monsoon is a seasonal wind that takes place in the southwestern United States and northern Mexico during the summer months. The typical diurnal winds in central Arizona are 'drainage' in nature; in the morning, easterly winds that originate in the mountains switch direction to westerly winds in the afternoon due to the heating of the desert floor. During a monsoon, however, winds will shift to an easterly to southeasterly direction. This is due to a ridge of high pressure that sets up over the Four Corners region in northeastern Arizona. The result is an influx of atmospheric moisture from the south and east, and storm development which can be synoptic in nature as large lines of storms form either over the northern Arizona or northern Mexico/southern Arizona and move into the central area of Pinal County. Monsoon thunderstorms can also be local in nature, with the formation of localized monsoon-supported storm cells. Both monsoon setups can pack significant winds (reaching gusts over 60 mph) that cause dust storms to develop, transporting a wall of dust (haboob) up to hundreds of miles. These storms have dust causing effects similar to frontal passages and strong pressure gradients. The monsoon, as defined by the National Weather Service, starts on June 15th and lasts through September 30th.

Haboobs are frequent at the beginning of the monsoon and subside as the storm progresses, when measurable rainfall normally occurs. Monsoon storm cell(s), however, can create strong enough wind gusts to cause blowing dust even after recent precipitation. These events, however, tend to increase coarse particle loading in the atmosphere and disperse $PM_{2.5}$.

3.2.4.1 Wind, Pollution, and 95th Percentile Roses

Figure 46 shows the location of the Hidden Valley $PM_{2.5}$ monitoring site in Pinal County that was used for meteorological analysis.

Figure 47 is a wind rose plot showing the seasonal wind patterns at the Hidden Valley site for 2021-2023. Wind rose plots can be useful in assessing how wind speed and wind direction vary by season and year for a given monitoring site.[64]

Figure 48 is a pollution rose plot showing the wind direction and $PM_{2.5}$ concentrations by season and year for the Hidden Valley site for 2021-2023. Pollution roses categorize the distribution of pollution concentrations into break points and display the wind direction associated with those break points. Pollution roses are useful in assessing the dominant wind direction associated with pollution concentrations.[65]

Figure 49 is a percentile rose plot showing the wind direction of 95th percentile $PM_{2.5}$ concentrations by season and year for the Hidden Valley site for 2021-2023. Percentile rose plots can be useful in assessing the distribution of wind directions associated with high pollution concentrations at a particular monitor. They can also be useful in identifying the direction of upwind emission sources that may be contributing to high pollution concentrations.[66]

[64] *Supra* note 39.
[65] *Supra* note 39.
[66] *Supra* note 39.

Figure 46 Hidden Valley Meteorology Analysis Site Location

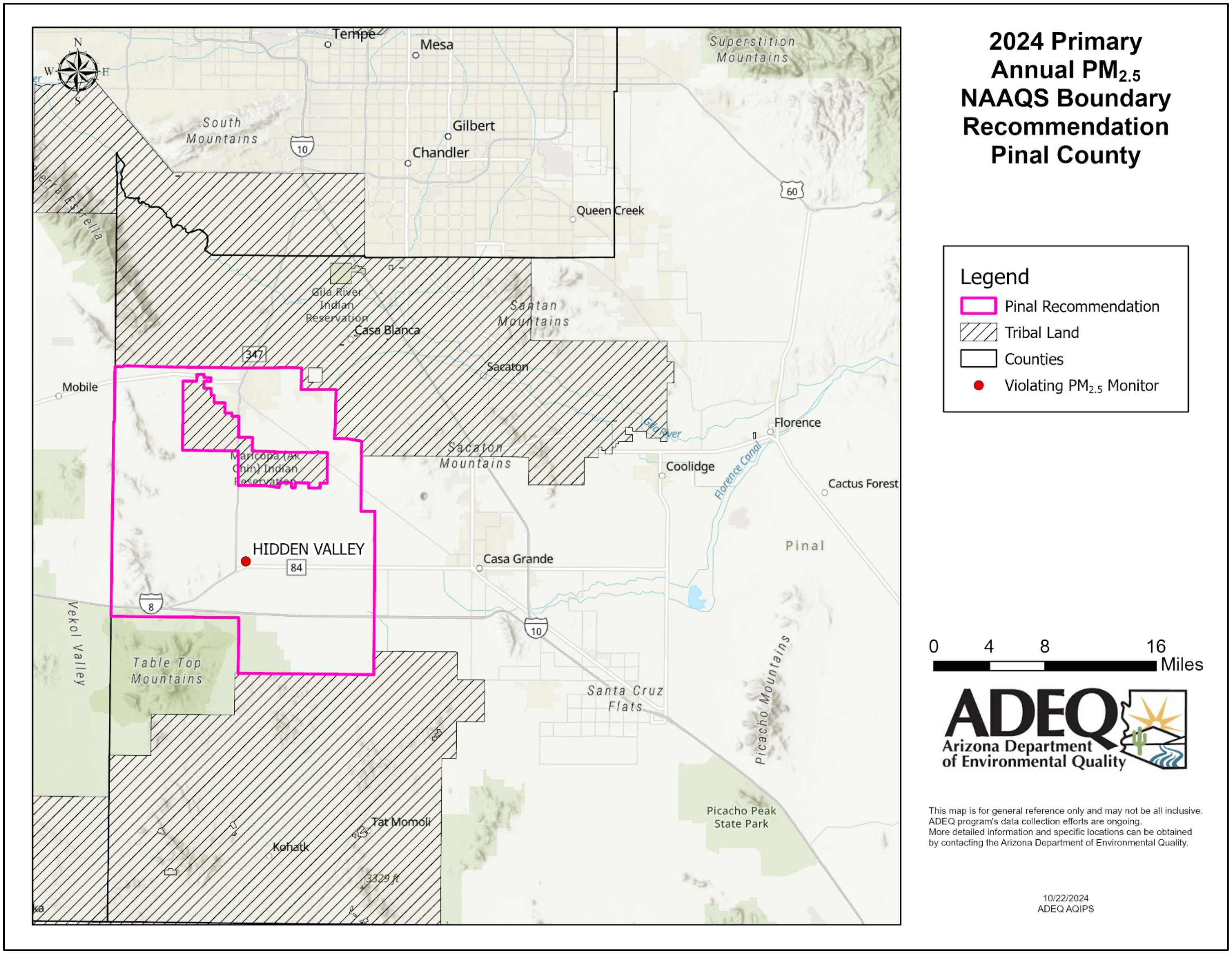


Figure 47 Hidden Valley Monitor Wind Rose

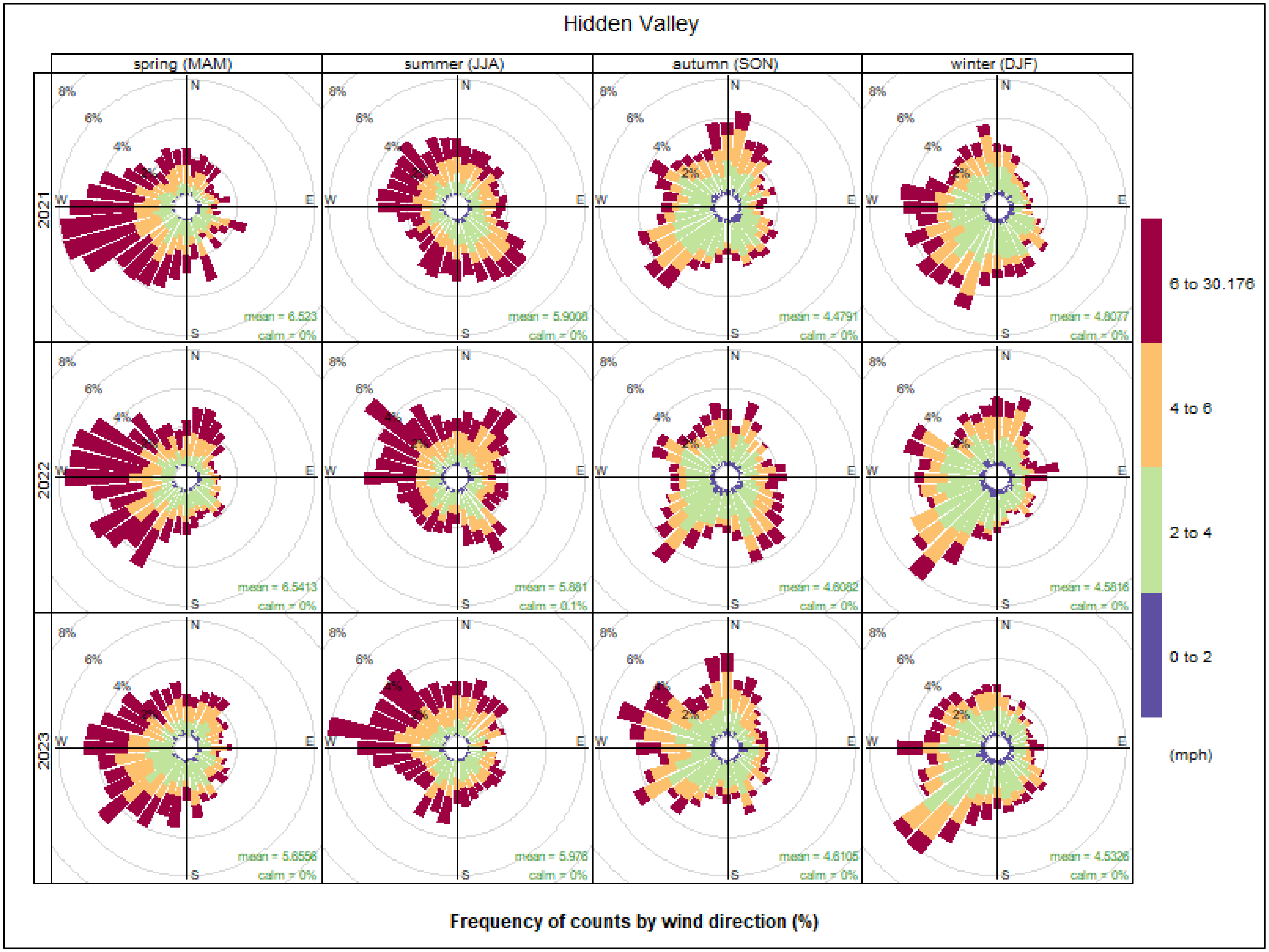


Figure 48 Hidden Valley Monitor Pollution Rose

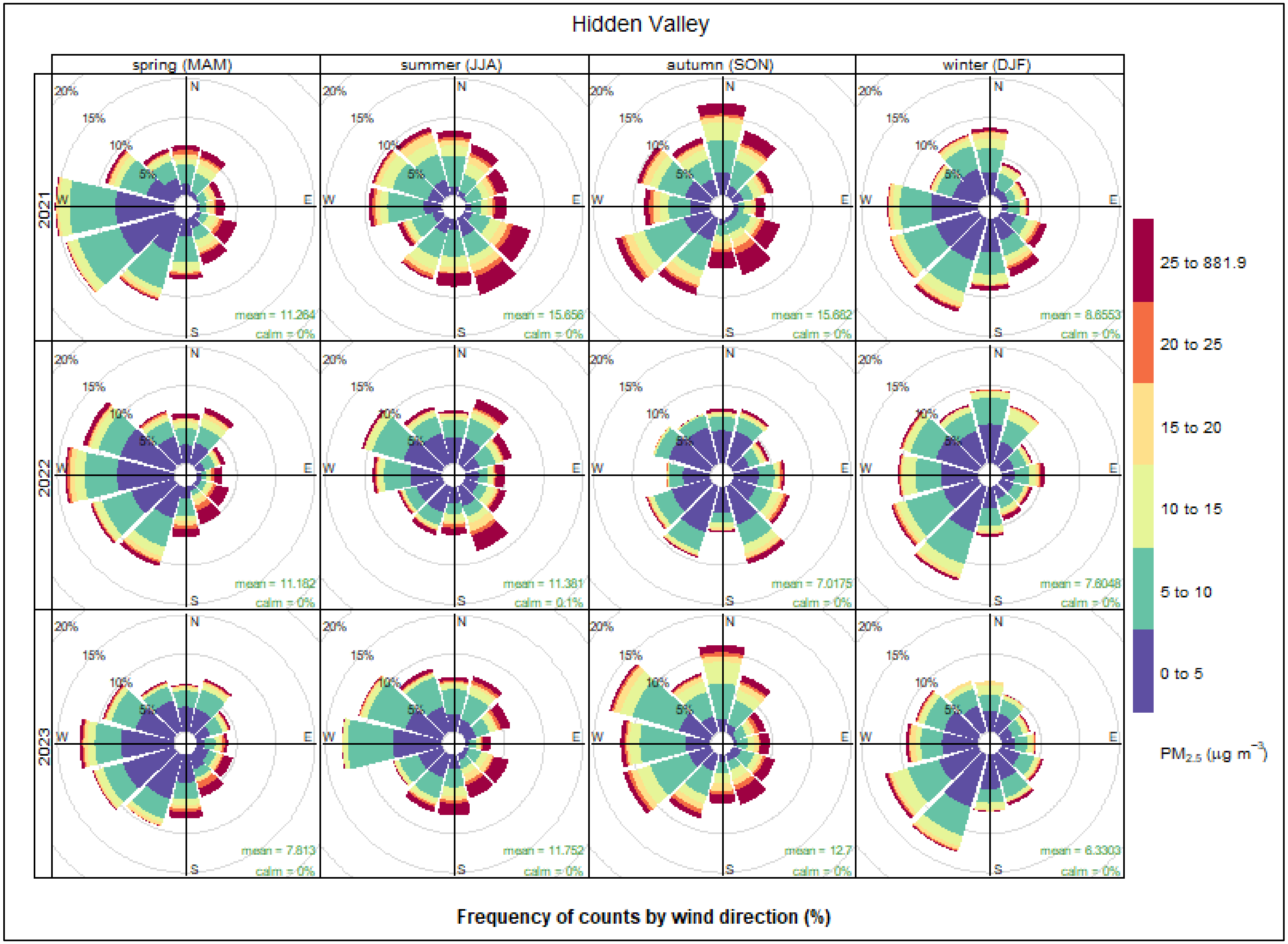
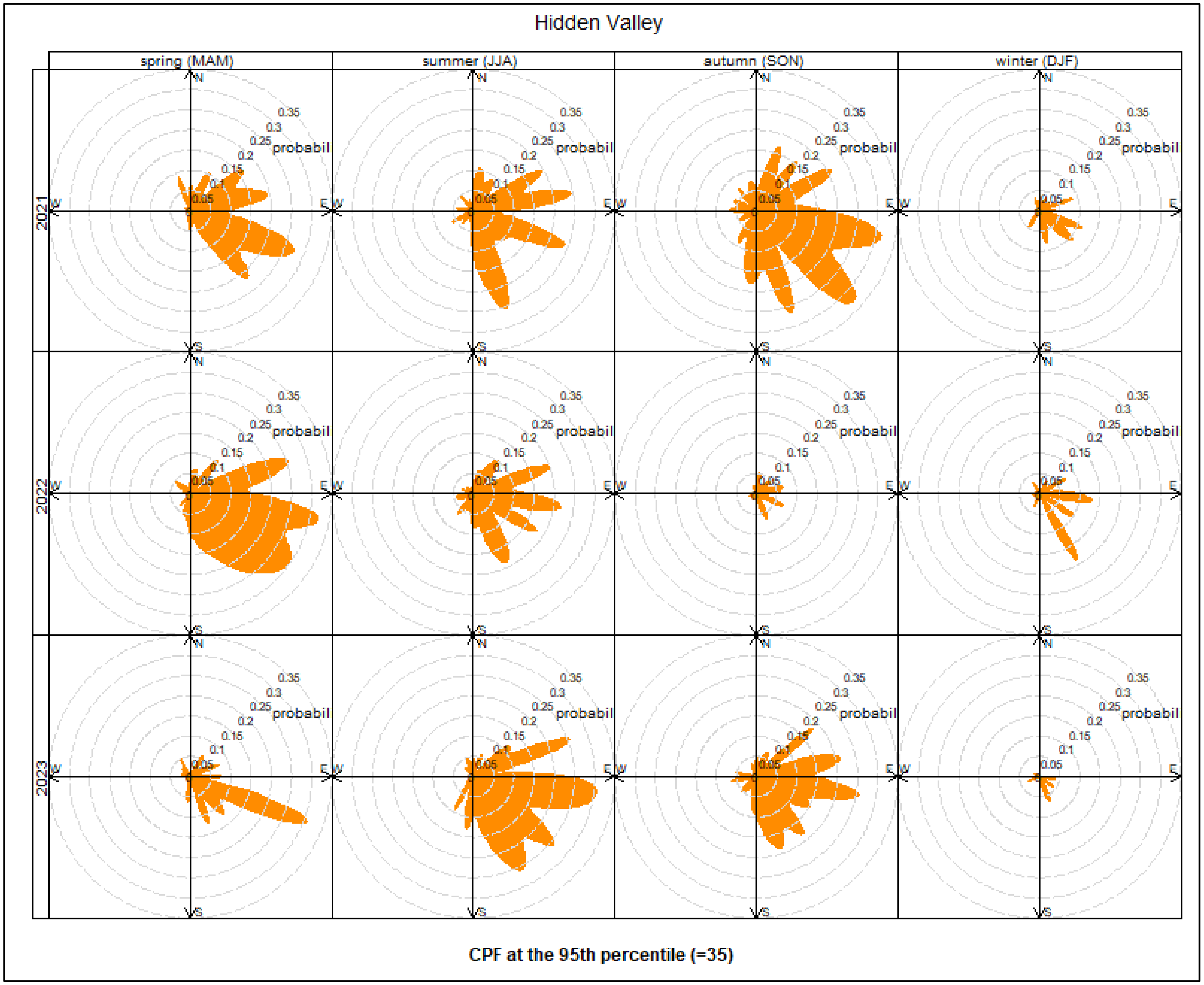


Figure 49 Hidden Valley Monitor 95th Percentile Rose



3.2.4.2 HYSPLIT Analyses

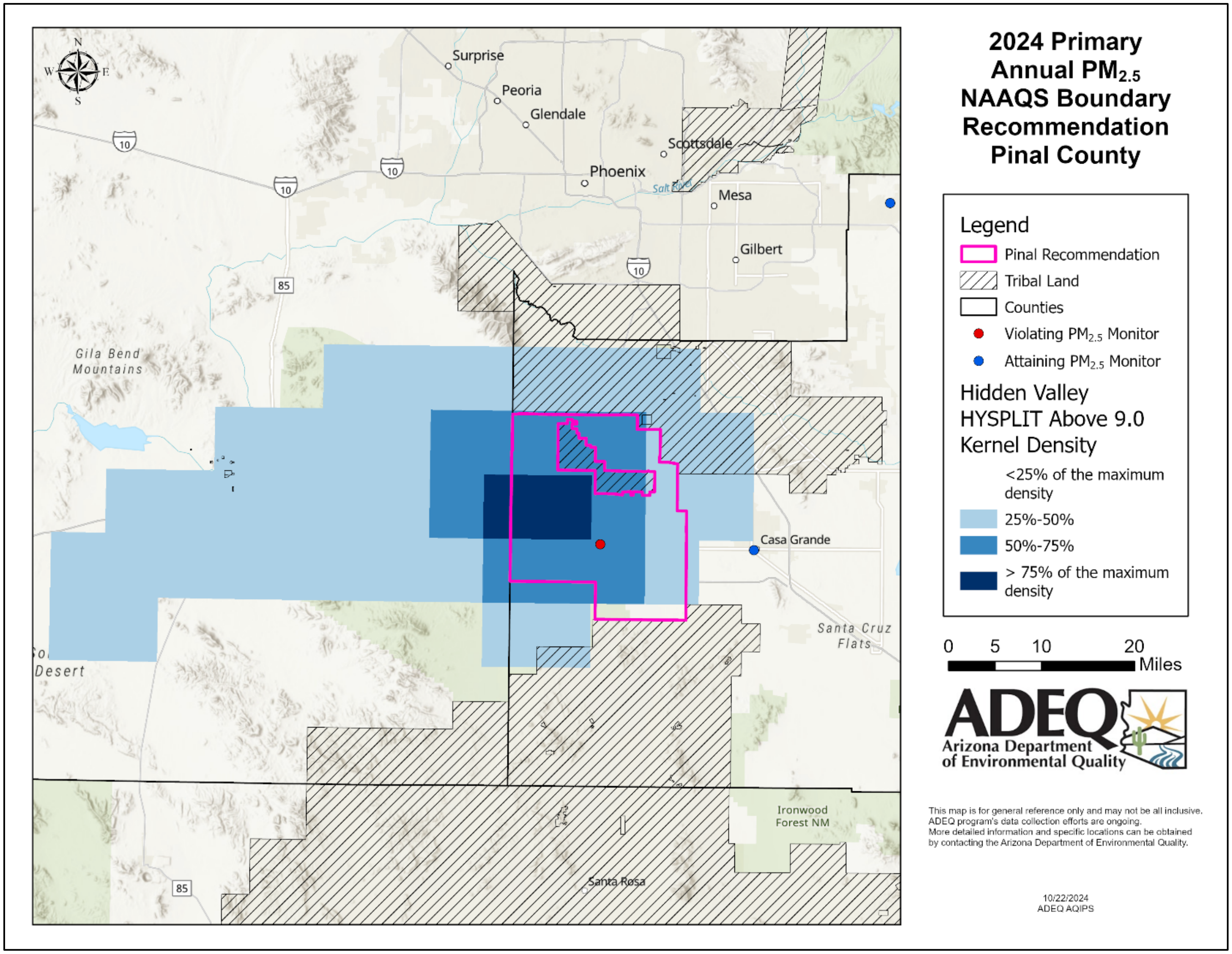
HYSPLIT 24-hour back trajectories were used to generate maps showing the origin of air parcels at each violating monitor originated from over a 24-hour period. Back trajectories were run twice daily from 2021-2023 on days when the 24-hour $PM_{2.5}$ concentration was above 9.0 µg/m^3. The air parcels were released at start times during the two peak hourly averages of $PM_{2.5}$ concentrations experienced at each monitor, shown in Table 19.

Table 19 HYSPLIT Back Trajectory Start Times

Monitor	Morning	Evening
Hidden Valley	6:00:00 AM	7:00:00 PM

To visualize the HYSPLIT results, ADEQ gathered HYSPLIT back trajectory points of where the air parcel was located at each hour during the 24-hour trajectory period and imported those points into ArcGIS Pro. Vector feature classes were created for each violating monitor in order to visualize the hourly back trajectory points on a map. ADEQ utilized the kernel density geoprocessing tool to generate kernel density estimates for the days between 2021-2023 with a 24-hour $PM_{2.5}$ concentration above 9.0 µg/m^3 for each violating monitor. Kernel density estimation (KDE) calculates the density of point features around each output raster cell (a cell in a matrix of equally sized cells that are organized by columns and rows in a grid) and was used by the EPA to visualize HYSPLIT back trajectory results for the 2012 $PM_{2.5}$ NAAQS revision. The KDE was run using a cell size of 0.1 decimal degrees which is approximately 11.1 km and roughly equivalent to the 12 km grid resolution at which HYSPLIT was run (e.g., NAM 12 km). The purpose of these KDE plots is to provide insight as to where $PM_{2.5}$ at the monitors is being transported from. This information is displayed in Figure 50. For additional HYSPLIT model results please see Appendix A Section A4.3.

Figure 50 HYSPLIT Back Trajectories from the Hidden Valley Monitor



3.2.5 Geography and Topography

Pinal County is located in the central portion of the state and is bordered by Maricopa, Gila, Graham, and Pima Counties. Pinal County is comprised of 5,374 square miles and is the 10th largest county in Arizona by total area. Pinal County has a land area greater than the two smallest U.S. States (e.g., Delaware and Rhode Island).

The topography of Pinal County can best be described as a broad basin surrounded in each direction by mountain ranges. The Estrella Mountains in the northwest portion of the County reach 4,125 feet in elevation and provide a buffer between Pinal and Maricopa Counties. In the northern portion of Pinal County, the Superstition and San Tan Mountains rise to a height of 5,036 and 3,054 feet, respectively. Near the western border of the County, the Table Top Mountains reach 3,392 feet in elevation. To the south, the Black Mountains reach 5,577 feet. The Pinal Mountains in western Gila County, near Pinal County's eastern border, reach 7,848 feet in elevation. The elevation of the basin area of Pinal County is approximately 1,200 feet above sea level. Open-ended valleys characterize the western portion of the County.

In order to spatially analyze the influence of topology, ADEQ has reviewed airsheds within Arizona. According to the EPA:

> "Airsheds refer to areas with common weather or meteorological conditions and sources of air pollution. Generally speaking, an airshed contains source and receptor areas."[67]

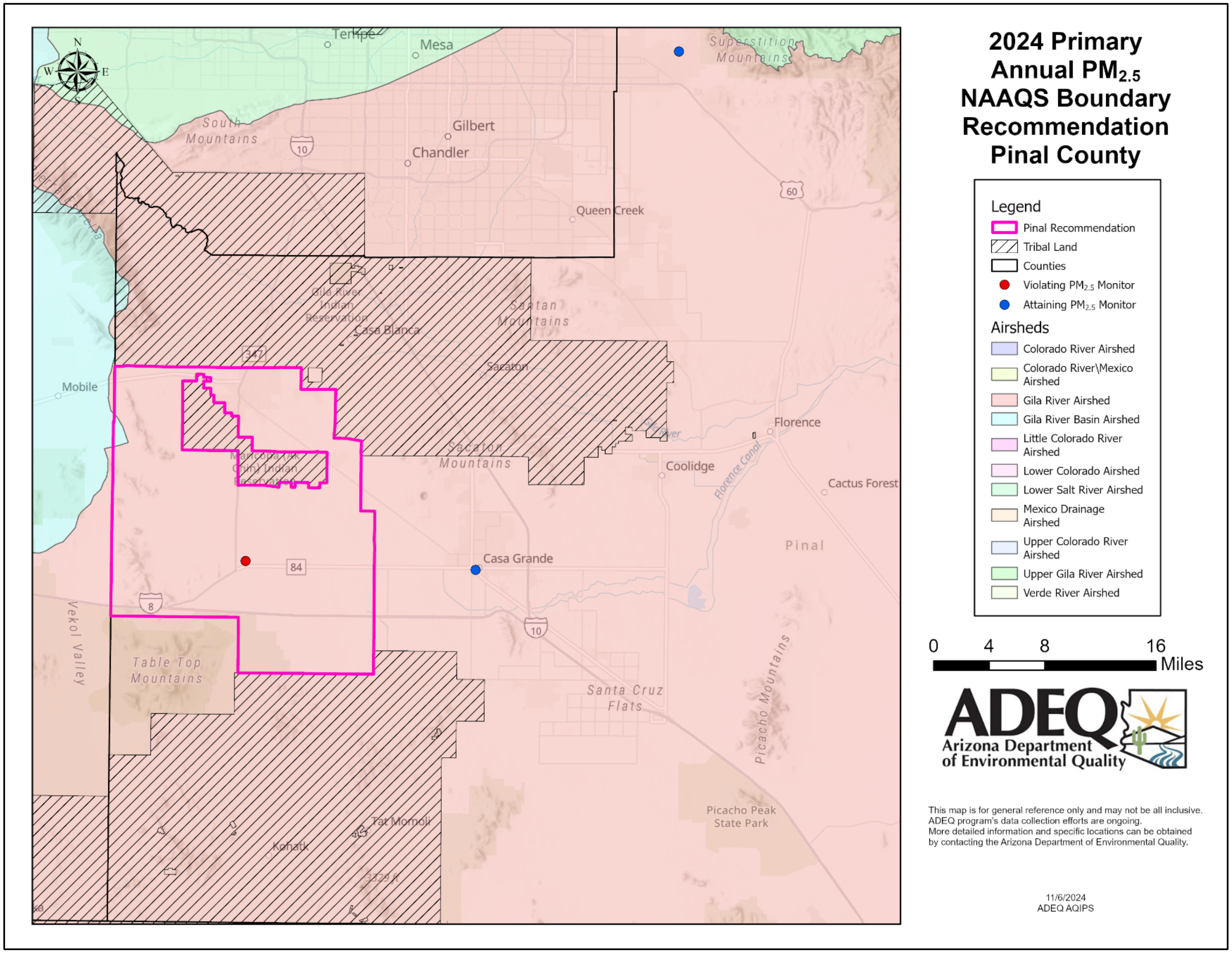
In Arizona, airsheds have the same meaning as smoke management units as defined by A.A.C. R18-2-1501(27):

> ""Smoke management unit" means any of the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns."

When combined with an analysis of meteorological conditions and permitted emissions sources, considering topography and airsheds can enhance a weight of evidence approach by identifying geographic regions where significant emissions transport between areas is unlikely. The region near the recommend NAA does not have geographical or topographical barriers limiting air pollution transport within its airshed. Figure 51 below shows the topography and airsheds near the recommended 2024 $PM_{2.5}$ Pinal County (partial) NAA boundary. While the significantly lower $PM_{2.5}$ concentrations recorded at the Casa Grande Downtown monitor indicate that distance plays a key role in protecting the majority of Pinal County's population from exposure to $PM_{2.5}$ concentrations exceeding the 2024 annual $PM_{2.5}$ NAAQS.

[67] *Supra* note 44.

Figure 51 Pinal County NAA Airsheds



3.2.6 Jurisdictional Boundaries

ADEQ considered existing jurisdictional boundaries to establish a clearly defined legal boundary for purposes of implementing the revised primary annual $PM_{2.5}$ NAAQS. ADEQ considered counties, local air quality departments and districts, Tribal Nations and Communities land, metropolitan planning organizations, and existing NAAs. The local air quality department for Pinal County is PCAQCD, which operates pursuant to an agreement with ADEQ and is governed by the Pinal County Board of Supervisors. Recommendations for the Pinal County $PM_{2.5}$ NAA exclude Tribal National and Communities land, which has the same meaning as the term defined in 18 U.S.C. § 1151. MAG, as the certified lead planning organization for PM_{10} and $PM_{2.5,}$ has authority for certain air quality planning in Pinal County, in cooperation with the Sun Corridor MPO.[68]

Pinal County has an existing $PM_{2.5}$ NAA for the 2006 $PM_{2.5}$ NAAQS.[69] Figure 52 below shows the jurisdictional boundaries near the recommended Pinal County (partial) NAA boundary.

In Figure 53, ADEQ displays city boundaries in relation to the Pinal County (partial) NAA boundary recommendation. However, municipality boundaries were not considered within the jurisdicational boundaries factor of the five factor analysis. The legal boundaries that are relevant for the boundary recommendation process are those that are relevant for carrying out the CAA planning and enforcement functions. For the areas around the violating monitors, relevant jurisdictions carrying out CAA responsibilities are MAG, PCAQCD, and ADEQ. While cities may be responsible for adopting measures as part of a nonattainment or maintenance plan, local municipalities do not have an individual role in air quality planning or enforcement under state law. Therefore, ADEQ did not consider city boundaries as a method for analyzing the jurisdictional boundary factor.

[68] Douglas Ducey, Governor, to Alexis Strauss, Acting Regional Administrator (June 22, 2016), available at https://static.azdeq.gov/pn/sip_agbmp_appf.pdf.
[69] *See* 40 C.F.R. § 81.303.

Figure 52 Pinal County NAA Jurisdictional Boundaries

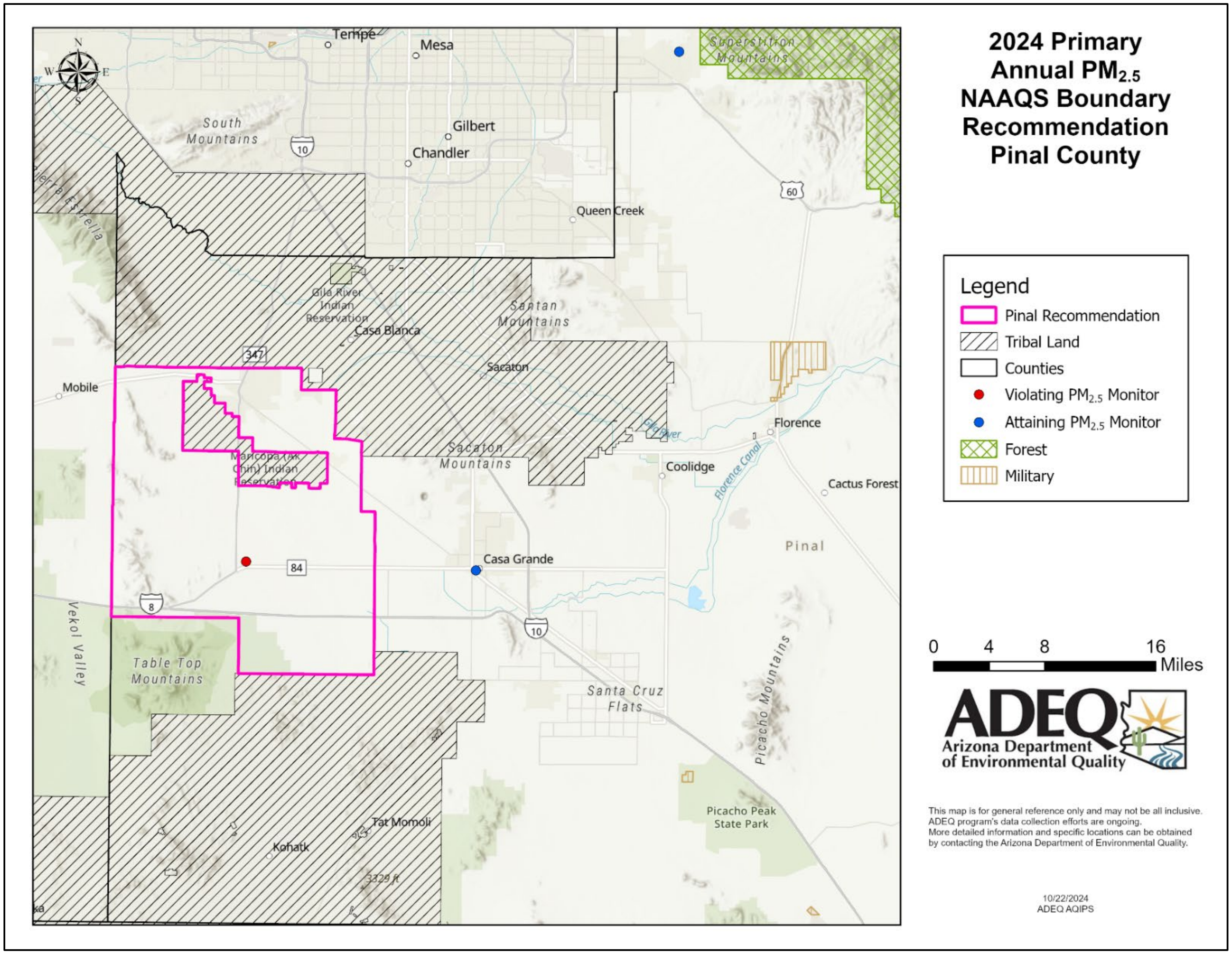
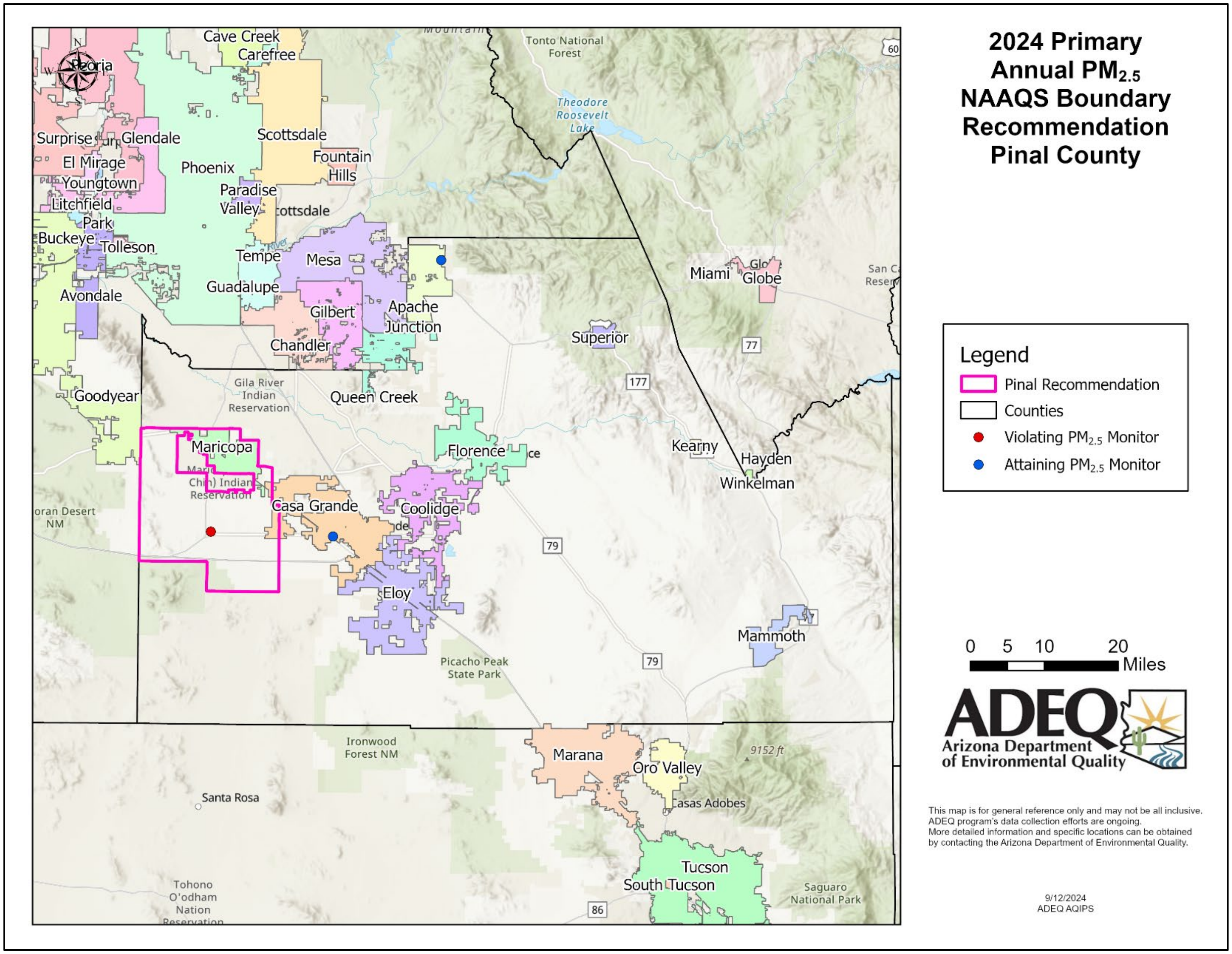


Figure 53 City Boundaries in Relation to the Pinal County (Partial) NAA



3.2.7 Weight of Evidence Analysis and Recommendation Summary

This section presents ADEQ's weight of evidence analysis for its contingency based recommendation for Pinal County (partial). As described in the EPA's guidance, the weight of evidence is to aggregate or synthesize the previously described assessments into a cogent narrative that describes the relationship between the emissions sources in the analysis area and measured violations.[70] This section synthesizes the five factors considered above.

For air quality data, ADEQ's starting point for the weight of evidence analysis was to examine the location of monitors within Pinal County which are not currently meeting the 2024 primary annual $PM_{2.5}$ NAAQS, utilizing 2021-2023 DVs. Based on these DVs, the Hidden Valley monitoring site is the only monitor in Pinal County that is not meeting the 2024 primary annual $PM_{2.5}$ NAAQS. As described above in Section 3.2.1, ADEQ and PCAQCD believes that the Hidden Valley site is a middle scale (100 meters to 0.5 kilometers) site with a unique sole source contributing the vast majority of the $PM_{2.5}$.

Given the spatial scale and the unique sole source contributing the vast majority of $PM_{2.5}$, and that there are no other violating monitors within Pinal County, it is reasonable to conclude that the air quality violations are confined to a small geographic area. All areas within 0.5 kilometers of the violating monitor are contained within the recommended 2024 primary annual $PM_{2.5}$ boundary for Pinal County.

Next, ADEQ was unable to examine speciation data for Pinal County because no IMPROVE or CSN monitors are in place to represent the urban concentration. Additionally, an urban increment analysis was not performed for Pinal County because urban concentration data for this area does not exist.

For emissions and emissions related data, ADEQ examined data for: 1) nonpoint and point sources; 2) traffic; 3) population data; and 4) land use. The majority (94.3%) of $PM_{2.5}$ emissions within Pinal County are from nonpoint sources such as (but not limited to): wildfires, crops and livestock dust, construction dust, waste disposal, and residential wood burning. The remaining 5.7% for $PM_{2.5}$ emissions come from point, onroad, and nonroad sources. Traffic data show the recommended area would capture 7.3% of annual VMT in Pinal County. Population data shows the recommended area would capture approximately 15.4% of the county population. Land use data shows 27.3% of the land use that contributes $PM_{2.5}$ emissions from abandoned agriculture, agriculture, high-density commercial, low-density commercial, dairy or feedlot, industrial, and single-family homes, are captured within the recommended area. Lastly, analysis of the $PM_{2.5}$ and its precursor emissions shows that the existing NAA boundary encompasses most of the 12 km grid cells with high annual $PM_{2.5}$ and precursor emissions for nonpoint, nonroad, area fugitive dust, and residential wood burning, all located near the violating monitor. While analyzing gridded emissions can identify where emissions from dispersed activites are being generated, it is equally important to assess whether these emissions are being transported to

[70] *Supra* note 13, Attachment 3 at 4.

the violating monitor is necessary. An examination of gridded emissions alone should not be considered the determining fcator for establishing on where to draw boundaries.

The meteorological trends observed at the Hidden Valley monitor reveal distinct seasonal and diurnal patterns characteristic of Arizona's dry season, which loosens the soil, and contributes to elevated $PM_{2.5}$ concentrations at the violating monitor during spring, summer and fall months. Additionally, the Hidden Valley monitor is in a relatively unpopulated area, meaning that the anthropogenic influence that would normally be expected for wintertime concentrations, is greatly dampened. Evidence of these meteorological patterns are showcased in the wind roses, pollution roses, percentile roses, HYSPLIT analysis, and kernel density plots for the Hidden Valley monitor. An examination of the HYSPLIT analysis and kernel density plots reveals, that on days when 24-hour concentrations exceed 9.0 $\mu g/m^3$, air impacting the violating monitor originates from all directions, as shown by the 24-hour back trajectory analysis. However, a higher density of back trajectory endpoints are clustered around the violating monitor and showcase patterns of declining point density across western Pinal County, meaning that air parcels disperse the further distance they travel from the monitor. These patterns of air transport on high concentration days were incorporated into the weight of evidence model by ADEQ in assessing source-receptor relationships in the area.

In examining the geography and topography of the region, the area does not have geographical or topographical barriers limiting air pollution transport within its airshed. With no topographical barriers that separate the recommended NAA from the rest of Pinal County, the significantly lower $PM_{2.5}$ concentrations recorded at the Casa Grande Downtown monitor (which is attaining the 2024 primary annual $PM_{2.5}$ NAAQS) demonstrate that distance prevents most of the County's population from exposure to high $PM_{2.5}$ concentrations.

Lastly, ADEQ considered existing jurisdictional boundaries and air quality planning authority in making its recommendation. Currently, MAG has $PM_{2.5}$ planning authority to develop nonattainment or maintenance area plans for the West Central Pinal NAA for the 2006 24-hour $PM_{2.5}$ NAAQS and the West Pinal NAA for the PM_{10} NAAQS.[71] ADEQ also evaluated and excluded Tribal Nations and Communities lands during the evaluation process. As part of its jurisdictional analysis, ADEQ reviewed its and the EPA's analysis for the 2006 $PM_{2.5}$ West Pinal NAA boundary as part of the basis for this recommendation.

For all the reasons discussed above, if the EPA does not concur with PCAQCD's request to exclude the Hidden Valley monitoring site for comparison to the primary annual $PM_{2.5}$ NAAQS, ADEQ recommends that a NAA covering a portion of Pinal County, as described in Section 1.1.2, be recommended to the EPA Administrator.

[71] Ducey, *supra* note 68.

4 Nogales, Arizona Micropolitan Statistical Area Recommendation

This chapter discusses ADEQ's recommendations for the Nogales, Arizona micropolitan statistical area (μSA), based on the EPA's five factors. The following sections will discuss the EPA's five factors: 1) air quality data; 2) emissions and emissions-related data; 3) meteorology; 4) geography/topography; and 5) jurisdictional boundaries. This section concludes with ADEQ's weight of evidence analysis.

4.1 Boundary Recommendation for Santa Cruz County (Partial) NAA

ADEQ recommends that the 2024 Primary Annual $PM_{2.5}$ Santa Cruz County NAA boundary retain the existing 2006 24-hour $PM_{2.5}$ NAAQS Nogales, AZ maintenance area boundary. Figure 54 below shows the recommended boundary, and Figure 55 shows the recommended boundary in the context of other relevant data in the five-factor analysis. As will be discussed in Section 5.1.2, if the DV based on 2022-2024 is at or below the standard of 9.0 μg/m^3, ADEQ recommends that the area be designated as attainment.

Figure 54 Santa Cruz County Recommended (Partial) NAA

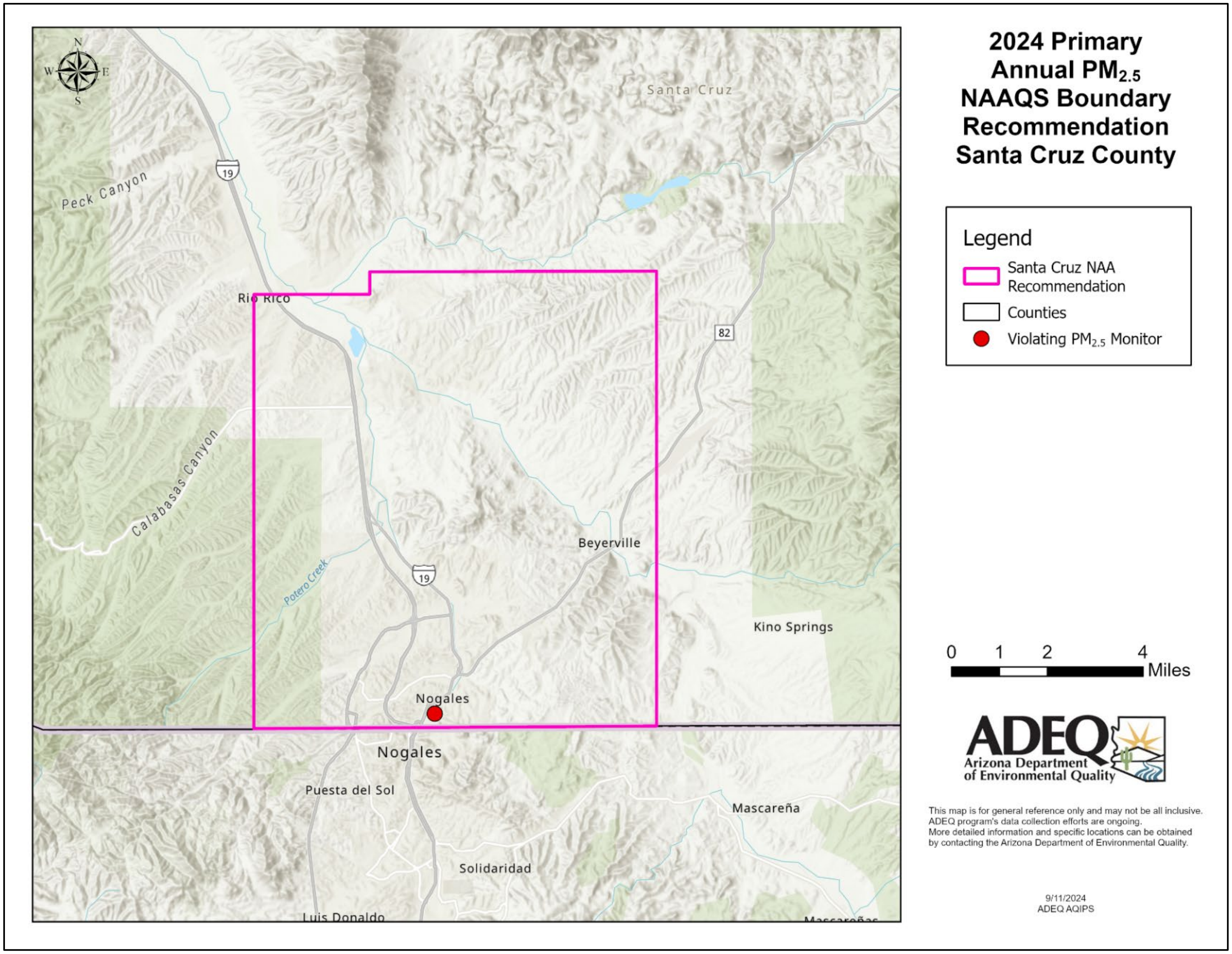
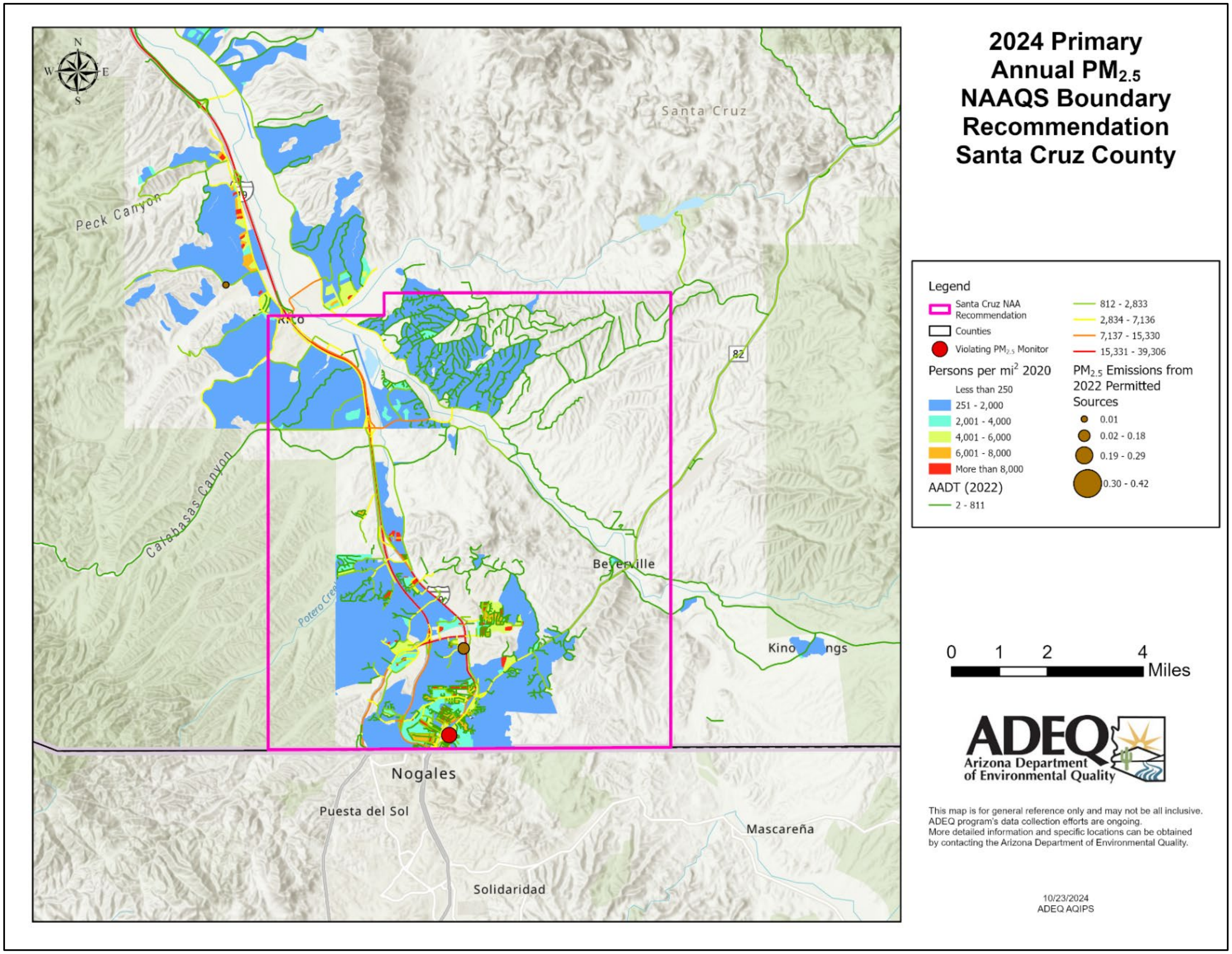


Figure 55 Santa Cruz County NAA with Relevant Data



4.1.1 Air Quality Data

For this factor, ADEQ considered data from air quality monitor within the Nogales, Arizona µSA. A µSA, by definition, must have at least one urban cluster with a population of at least 10,000 but less than 50,000. ADEQ considered the annual $PM_{2.5}$ DV for this monitor, based on the three most recent consecutive years of certified data, 2021-2023. For the 2023 DV, the only monitor within the recommended Santa Cruz County (Partial) NAA is the Nogales Post Office monitor with a 2021-2023 DV of 9.4 µg/m^3. Table 20 below shows a table DV information for the violating monitor. Figure 56 below shows a color-coded map of the monitor location within the µSA.

Figure 56 Santa Cruz County $PM_{2.5}$ Monitor Location

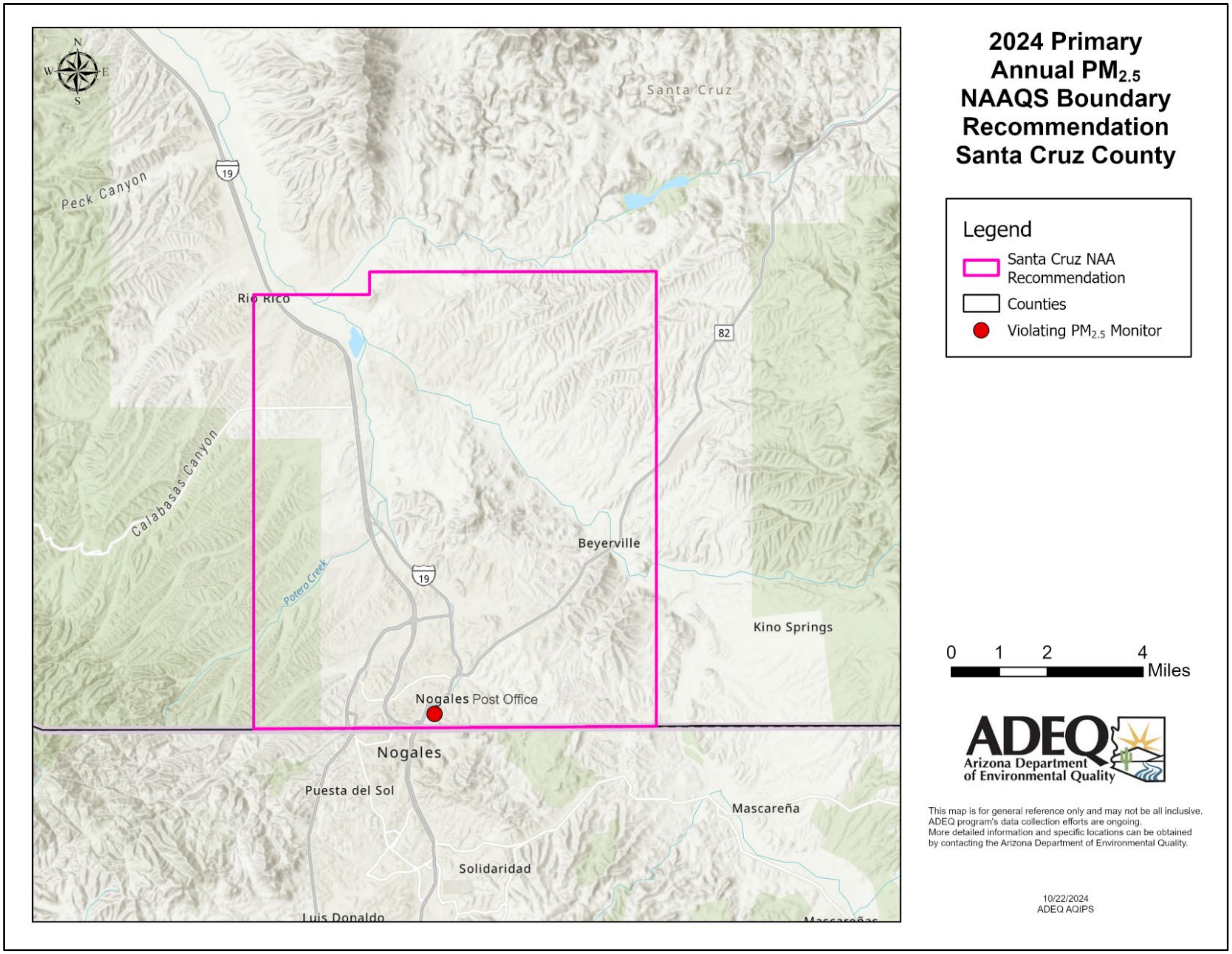


Table 20 Annual $PM_{2.5}$ DV for 2023 Santa Cruz County Monitor

County	AQS ID	Colloquial Name	2021-2023 DV ($\mu g/m^3$)
Santa Cruz	04-023-9000	Nogales Post Office	9.4

See Figure 57 below for the historical $PM_{2.5}$ DV trend for the Nogales Post Office monitor. Nogales Post Office monitor has been hovering just above the new NAAQS standard of 9 $\mu g/m^3$ for the past several years. The 3-year annual average DV has been trending downward recently due to years with particularly high annual average DVs being dropped off from newer 3-year averages.

Figure 57 Nogales Post Office Historic DV Trends

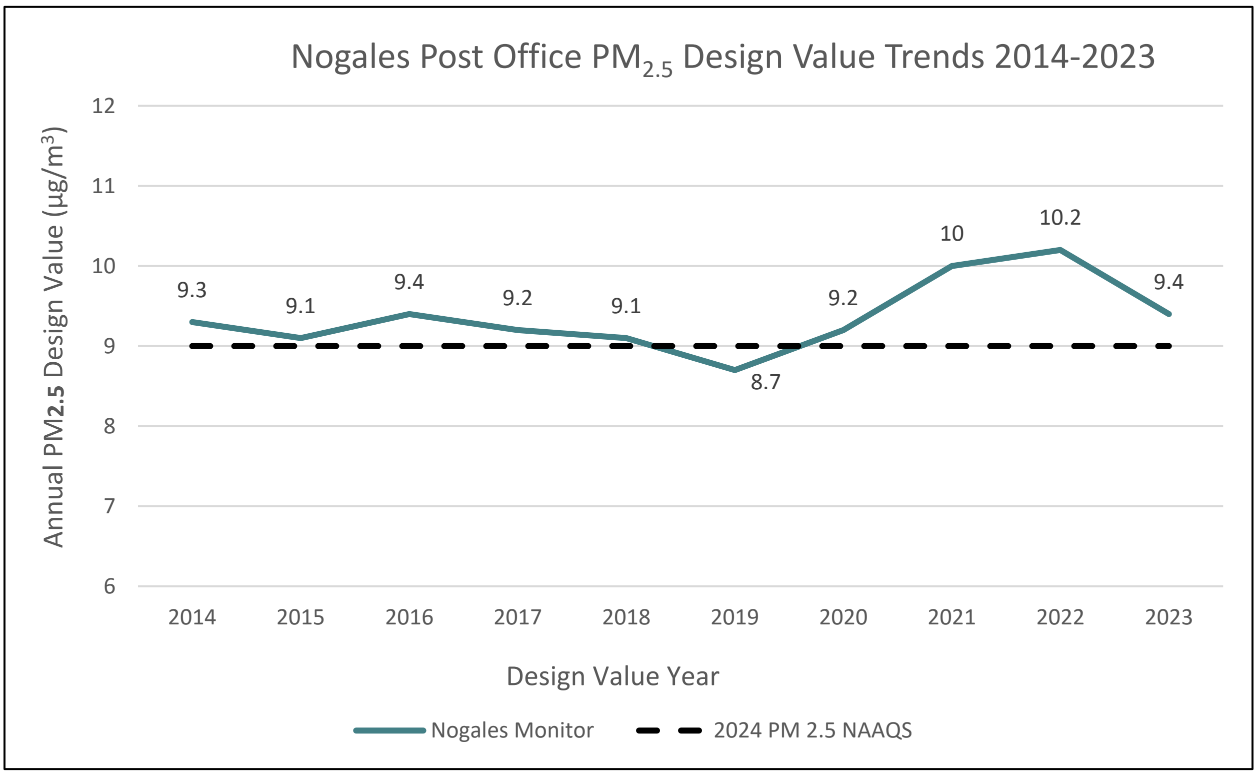
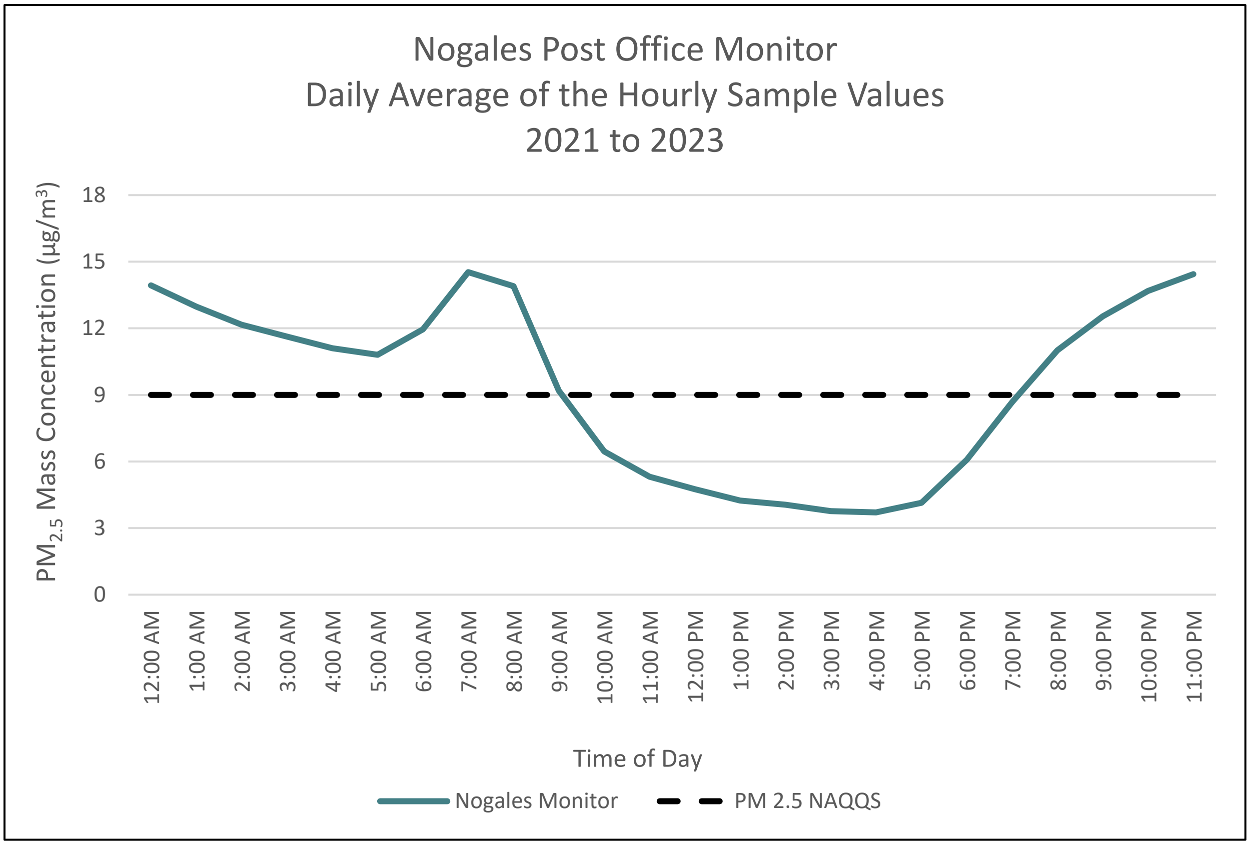


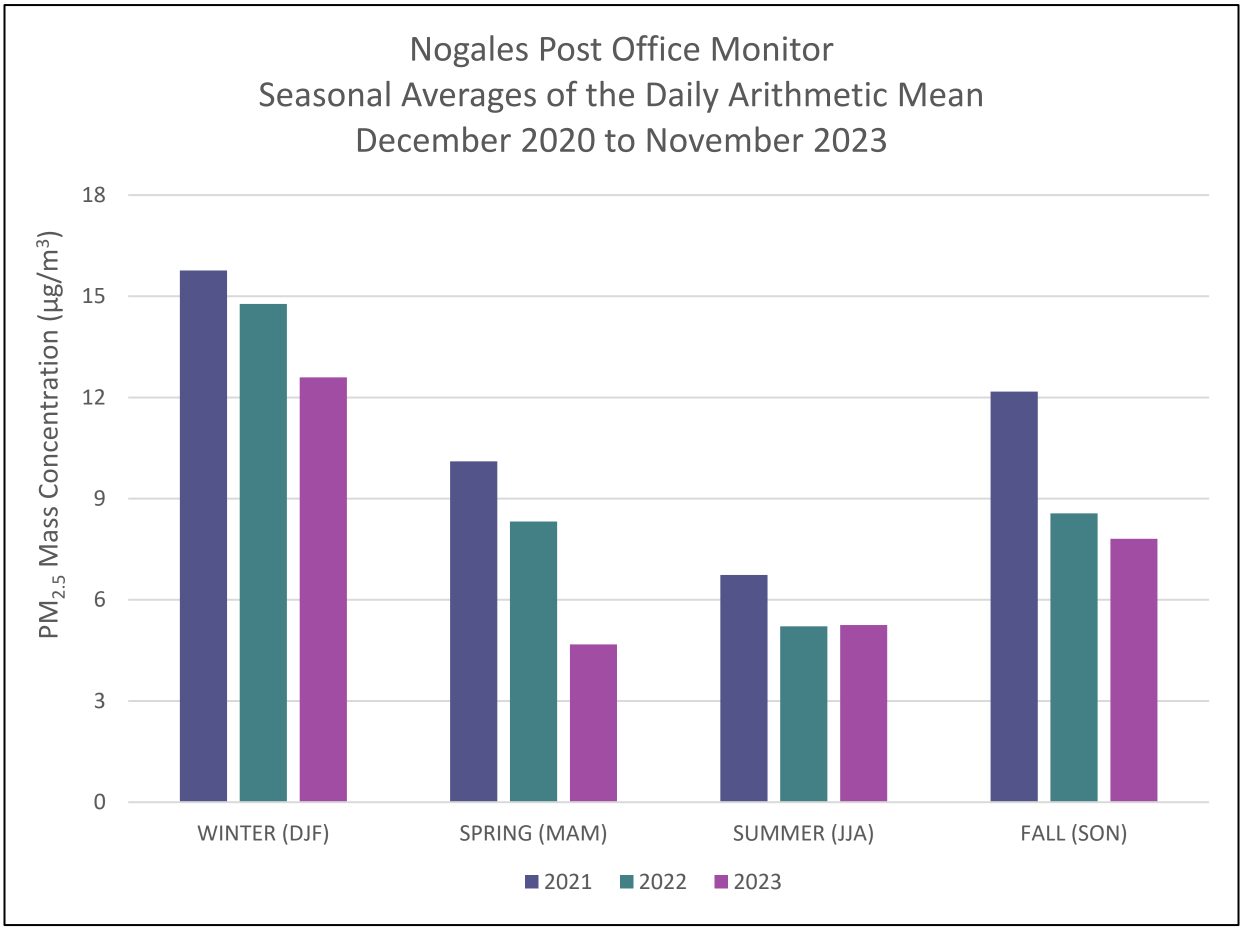
Figure 58 illustrates the 24-hour average $PM_{2.5}$ trends at the Nogales Post Office Monitor from 2021 to 2023, at the Nogales Post Office showing peak concentrations occurring at 7 am and 11 pm. This can be partially attributed to increased anthropogenic influence during colder nighttime temperatures such as from residential wood burning, but also the inversion layer keeping pollutants trapped near the surface. As temperatures heat during the daytime the inversion layer can break down and allow pollutants to be dispersed more freely.

Figure 58 Nogales Post Office Violating Monitor Hourly Trends



ADEQ found a strong correlation in seasonal trends in Santa Cruz. Figure 59 shows the seasonal average of $PM_{2.5}$ concentrations at the Nogales Post Office monitor. $PM_{2.5}$ concentrations are highest during the winter months, December to February. The year of 2021 shows higher concentrations of $PM_{2.5}$ within every season. It should be noted that during cooler seasons such as fall and winter is when an inversion layer is strongest, which can keep pollutants trapped closer to the surface. This also often correlates to when there is a greater anthropogenic influence from residential wood burning contributing to $PM_{2.5}$ concentrations.

Figure 59 Nogales Post Office Monitor Seasonal Trends



4.1.1.1 $PM_{2.5}$ Compositional Analysis

ADEQ examined speciation measurements of the ambient $PM_{2.5}$ such as, sulfates, nitrates, organic carbon, elemental carbon, and crustal material to determine which chemical species constitute the largest portions of $PM_{2.5}$ mass found near the violating monitor in Santa Cruz County. Data that was used to represent Santa Cruz County's metro or urban $PM_{2.5}$ concentration is collected by an IMPROVE speciation monitor (NOGA1) which is co-located at the Nogales Post Office $PM_{2.5}$ monitor.

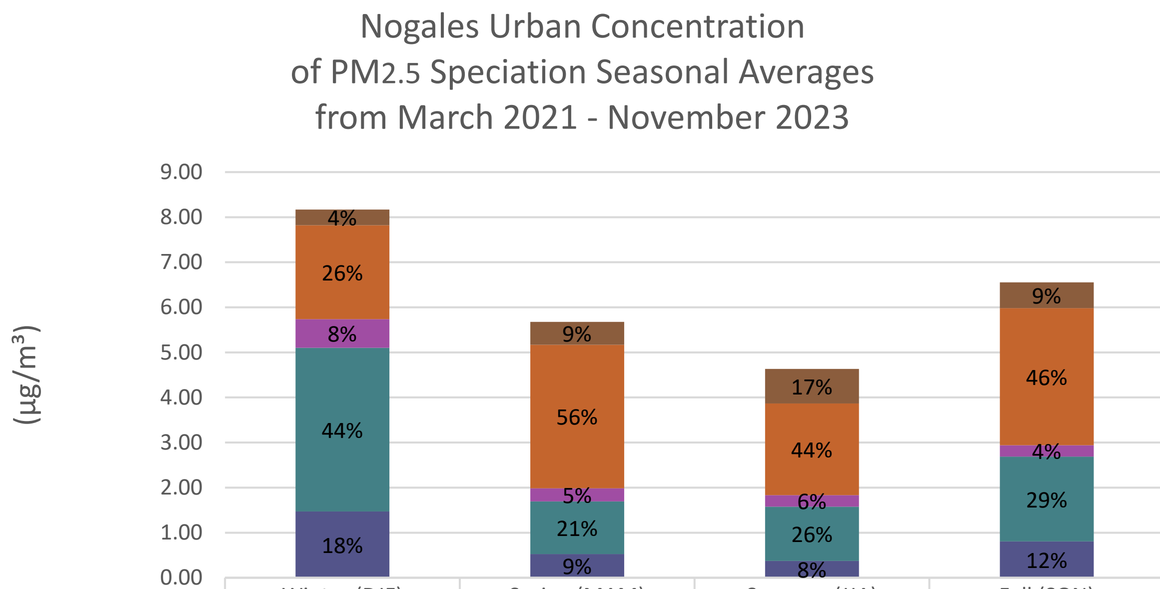
The Nogales Post Office urban concentration analysis and urban increment analysis found below in Section 4.1.1.2, utilize certified values at four IMPROVE monitoring sites (Nogales Post Office (NOGA 1), Organ Pipe Cactus National Monument (ORPI1), Saguaro National Park East (SAGU1), and Saguaro National Park West (SAWE1) for March 2021 to November 2023. For Santa Cruz County's urban concentration analysis, ADEQ utilized the sample values collected from March 17, 2023 to November 29, 2023 for: Sulfates (SO4f), Nitrates (NO3f), Organic Carbon (OCf), Elemental Carbon (ECf), and Crustal Material (SOILf). The reason the Nogales urban increment analysis begins in March 2021 is because the NOGA1 site did not meet the required minimum of 11 observations per quarter or season for the winter season of 2020/2021[72]. Therefore, data from the winter season consisting of December 2020, January 2021, and February 2021 were not factored into the Nogales Post Office winter average for urban concentration analysis or the Nogales Post Office winter average for urban increment analysis found in Section 4.1.1.2 of this document.

For the Nogales Post Office $PM_{2.5}$ compositional analysis, ADEQ chose to examine data by season again rather than by quarter since evidence supported a stronger correlation in findings when reviewing air quality trends. Figure 60 shows the average of each chemical species during every season from March 2021 to November 2023: winter = December, January, February; spring = March, April, May; summer = June, July, August; and fall = September, October, November. The percentages inside the bars in Figure 60 reflect the proportion of each chemical species within each of the given seasons. Similarly, the table in Figure 60 below the bar graph displays the seasonal average of each chemical species from March 2021 to November 2023.

The Nogales Post Office urban concentration averaged percent composition of each chemical species for the total given time period of March 2021 to November 2023, shown in Table 22, is comprised of is 9% sulfates, 6% nitrates, 31% organic carbon, 13% elemental carbon, and 41% crustal material. This compositional assessment indicates a strong presence of crustal material-related particles that could be associated with road dust, construction, dust from crops and/or livestock, etc. However, analysis of $PM_{2.5}$ speciation at the violating monitor alone will generally not be able to distinguish between local or nearby source contributions from regional background contributions. This assessment is therefore only one step in establishing a link between nearby emissions sources to the violating monitor.

[72] *See* Calculation of Urban Increments to Support the Air Quality Designations for the 2012 PM2.5 Standards National Ambient Air Quality Standards (NAAQS) (SAN5706) from Neil H. Frank, Air Quality Assessment Division OAQPS, to Docket No. EPA-HQ-OAR-2012-0918 Air Quality Designations for the 2012 PM2.5 Standards, *available at* https://www3.epa.gov/pmdesignations/2012standards/docs/UIMemotoSupport2012PM25Desigfinal.pdf.

Figure 60 Nogales Post Office Urban Concentration of $PM_{2.5}$ Speciation



	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)
Sulfates	0.35	0.51	0.77	0.57
Crustal Material	2.09	3.18	2.04	3.04
Nitrates	0.64	0.29	0.25	0.26
Organic Carbon	3.63	1.17	1.20	1.88
Elemental Carbon	1.47	0.53	0.38	0.81

Elemental Carbon, Organic Carbon, Nitrates, Crustal Material, Sulfates

Table 21 Santa Cruz County 3-Year Average (March 2021 – November 2023) Percent Composition of the Urban Concentration

Nogales Post Office Urban Concentration	
Crustal Material	41%
Organic Carbon	31%
Elemental Carbon	13%
Sulfates	9%
Nitrates	6%

4.1.1.2 Nogales Post Office $PM_{2.5}$ Urban Increment

Linking the previously described $PM_{2.5}$ compositional analysis with the urban increment assessment can help identify the likely emissions source types contributing to Nogales Post Office's urban excess. $PM_{2.5}$ mass concentrations are generally higher in urban areas compared to surrounding regions. This "urban increment", also known as the "urban excess", is due to locally generated and largely directly-emitted $PM_{2.5}$ in addition to regional contributions.[73,74] To determine the urban increment found at the Nogales Post Office Monitor, the regional background concentration is subtracted from the urban concentration.

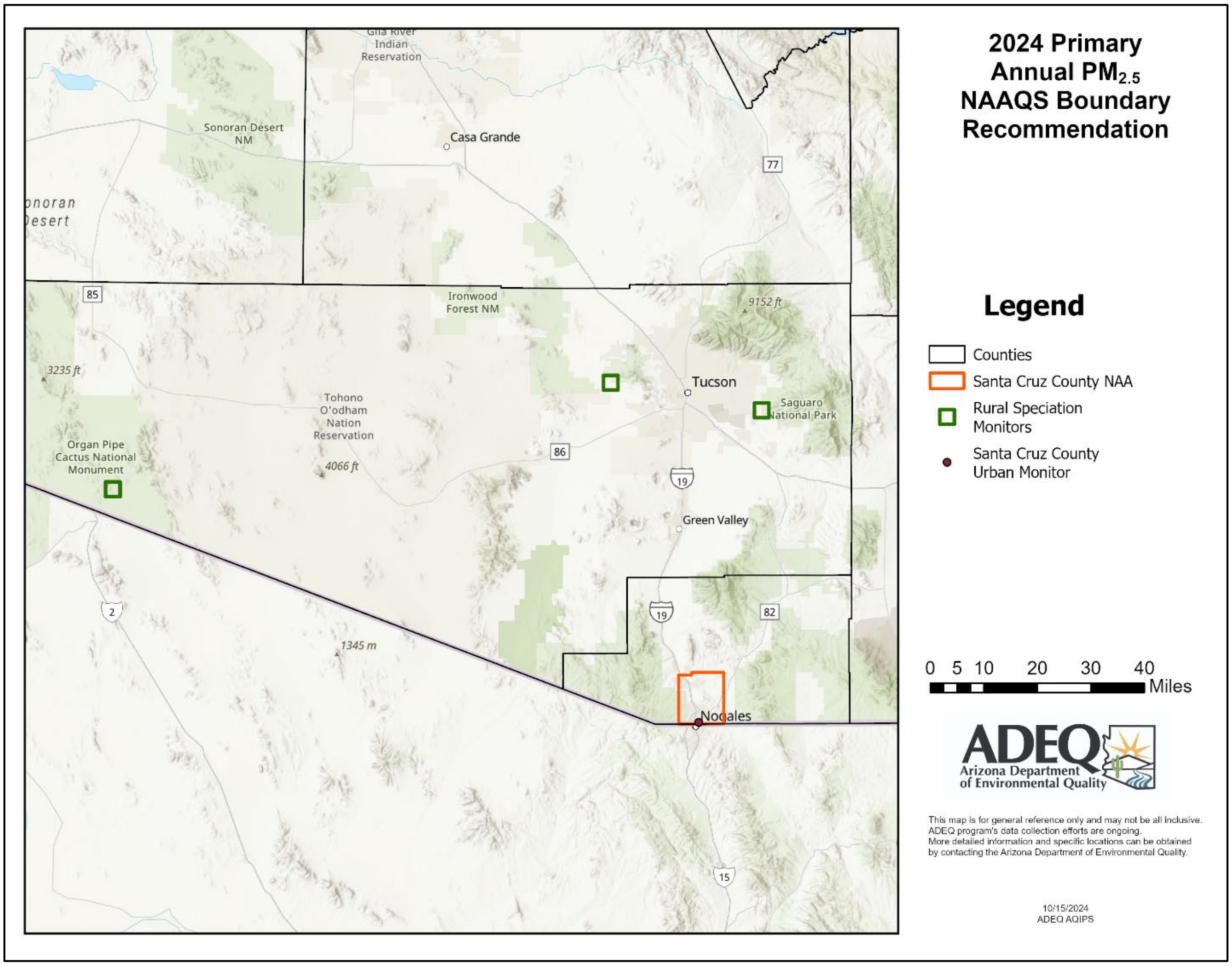
Figure 61 shows the locations of the speciation monitors that were used for Santa Cruz County's urban increment analysis. The three rural IMPROVE monitors whose data were chosen to represent the regional background concentration for the Nogales Post Office monitor area include: Organ Pipe Cactus National Monument (ORPI1), Saguaro National Park East (SAGU1), and Saguaro National Park West (SAWE1). All three of these rural monitors are located within a 150-mile radius of the Nogales Post Office monitor. However, since daily values from both urban and rural monitors must be available for the urban increment calculation and they were not available for the urban monitor, during the winter 2020/2021 season, data from the three rural monitors for the time period were excluded in the urban increment calculation[75].

[73] Rao, V. and N. Frank, A. Rush, F. Dimmick. Chemical Speciation of PM2.5 in Urban and Rural Areas. Special Studies, National Air Quality and Emissions Trends Report, 2003. Available at http://www.epa.gov/airtrends/studies.html

[74] Frank, N. H., The Chemical Composition of PM2.5 to support PM Implementation, EPA State / Local / Tribal Training Workshop: PM2.5 Final Rule Implementation and 2006 PM2.5 Designation Process, Chicago IL, June 20-21, 2007, http://www.epa.gov/ttn/naaqs/pm/presents/pm2.5_chemical_composition.pdf.

[75] *See* Initial Area Designations for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard, Memorandum from Joseph Goffman, Assistant Administrator, to Regional Administrators, Regions 1-10 (February 7, 2024), *available at* https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-designations-memo_2.7.2024-_-jg-signed.pdf

Figure 61 Speciation Monitors for Santa Cruz County's Urban Increment Analysis



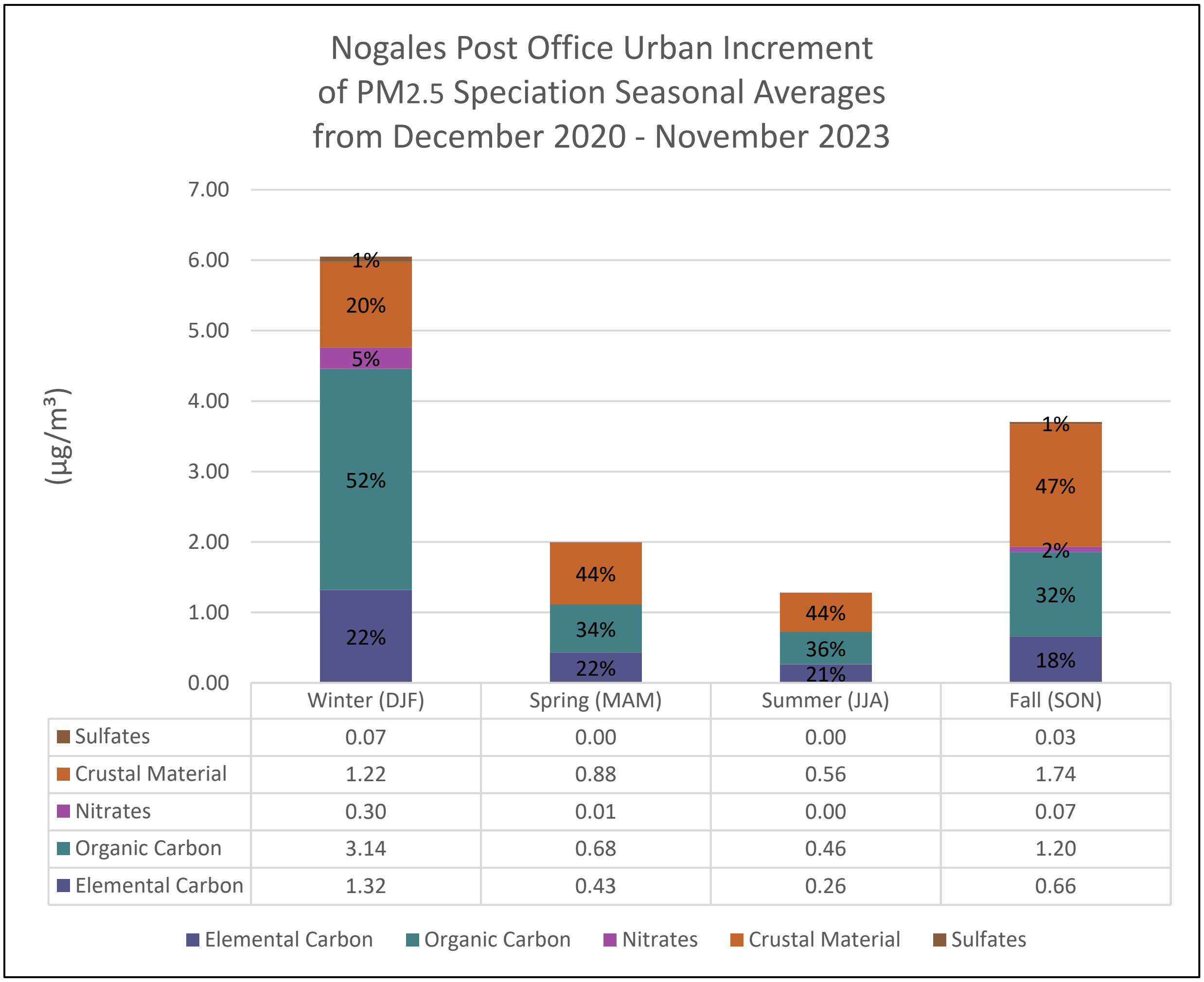
ADEQ also applied guidance from the 2012 $PM_{2.5}$ NAAQS Calculation of Urban Increments to Support the Air Quality Designations. 3-year averaged seasonal values that derived a negative number for the urban increment were set to zero, negative values could occur when the estimated average rural concentration is similar to its paired urban value.[76] For the Nogales Post Office urban increment analysis, negative values were found for nitrates during the averaged summer months and sulfates during the averaged spring and summer months for the given study period. This evidence suggests that emissions from nitrates and sulfates near the violating Nogales Post Office monitor did not likely influence $PM_{2.5}$ violations during the summer months of June, July, and August from 2021 to 2023.

[76] *See* Calculation of Urban Increments to Support the Air Quality Designations for the 2012 PM2.5 Standards National Ambient Air Quality Standards (NAAQS) (SAN5706) from Neil H. Frank, Air Quality Assessment Division OAQPS, to Docket No. EPA-HQ-OAR-2012-0918 Air Quality Designations for the 2012 PM2.5 Standards, *available at* https://www3.epa.gov/pmdesignations/2012standards/docs/UIMemotoSupport2012PM25Desigfinal.pdf.

Analysis of the urban increment found in Figure 62 indicates that the periods with the highest fine particle concentrations generally occur during the winter and fall months. Table 22 shows the urban concentration average percent composition that is calculated from the sum of each chemical species seasonal average which is divided by the total sum. The chemical composition that has the largest presence during spring, summer, and fall is crustal material. Although during the winter months organic carbon has a larger presence than crustal material.

Additionally, the urban excess found at the Nogales Post Office Monitor shows that high $PM_{2.5}$ values generally occur under stagnant, light wind conditions during winter, and are associated with winds from the southwest (i.e. from the direction of Mexico). The urban increment shows no presence of sulfates during spring and summer months which can be indicative of electric generating units (EGUs) that burn fossil fuels. Carbonaceous emissions (carbon-containing emissions such as organic carbon and elemental carbon) are consistent with wood burning, commercial cooking, and mobile emissions although they are not consistent with diesel-specific emissions. The Nogales urban increment does not display a high elemental carbon to organic carbon mass ratio, which would be a signature of diesel combustion source contributions, such as diesel trucks, construction engines, vehicles, and trains. Identifying the influence of specific sources within the mobile source category on Nogales's $PM_{2.5}$ concentration is important when considering Nogales is a port of entry city with the majority of the population living on the Nogales, Sonora, Mexico side of the border-crossing.

Figure 62 Nogales Post Office Urban Increment of $PM_{2.5}$ Speciation



	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)
Sulfates	0.07	0.00	0.00	0.03
Crustal Material	1.22	0.88	0.56	1.74
Nitrates	0.30	0.01	0.00	0.07
Organic Carbon	3.14	0.68	0.46	1.20
Elemental Carbon	1.32	0.43	0.26	0.66

Table 22 Santa Cruz County's 3-Year Average (March 2021 – November 2023) Percent Composition of the Urban Concentration

Nogales Post Office Urban Increment	
Organic Carbon	42%
Crustal Material	34%
Elemental Carbon	21%
Nitrates	3%
Sulfates	1%

4.1.2 Emissions and Emissions-Related Data

For this factor, ADEQ evaluated Santa Cruz County emission data from the 2020 NEI, as well as, certified emissions data that were reported to ADEQ in 2022 for the following direct $PM_{2.5}$ components - organic carbon, elemental carbon, crustal material, primary nitrate and primary sulfate, and precursor gases such as SO_2, NO_x, VOC, and NH_3.

4.1.2.1 Santa Cruz County Emissions from the 2020 NEI

Table 23, Table 24, and Figure 63, below represent $PM_{2.5}$ emissions from Santa Cruz County. Emissions from the nonpoint category represents 85.1% of the total while emissions from point, onroad, and nonroad sources comprise the remaining 14.9%.

Table 24 shows a breakdown of Santa Cruz County's $PM_{2.5}$ emissions by source sector, which the top five are: crops and livestock dust, commercial cooking, waste disposal, residential wood combustion, and construction dust. It should also be noted that Santa Cruz County has much lower direct $PM_{2.5}$ emissions than other counties in Arizona.

Table 23 Santa Cruz County $PM_{2.5}$ Emissions by Source and Percentage of Total

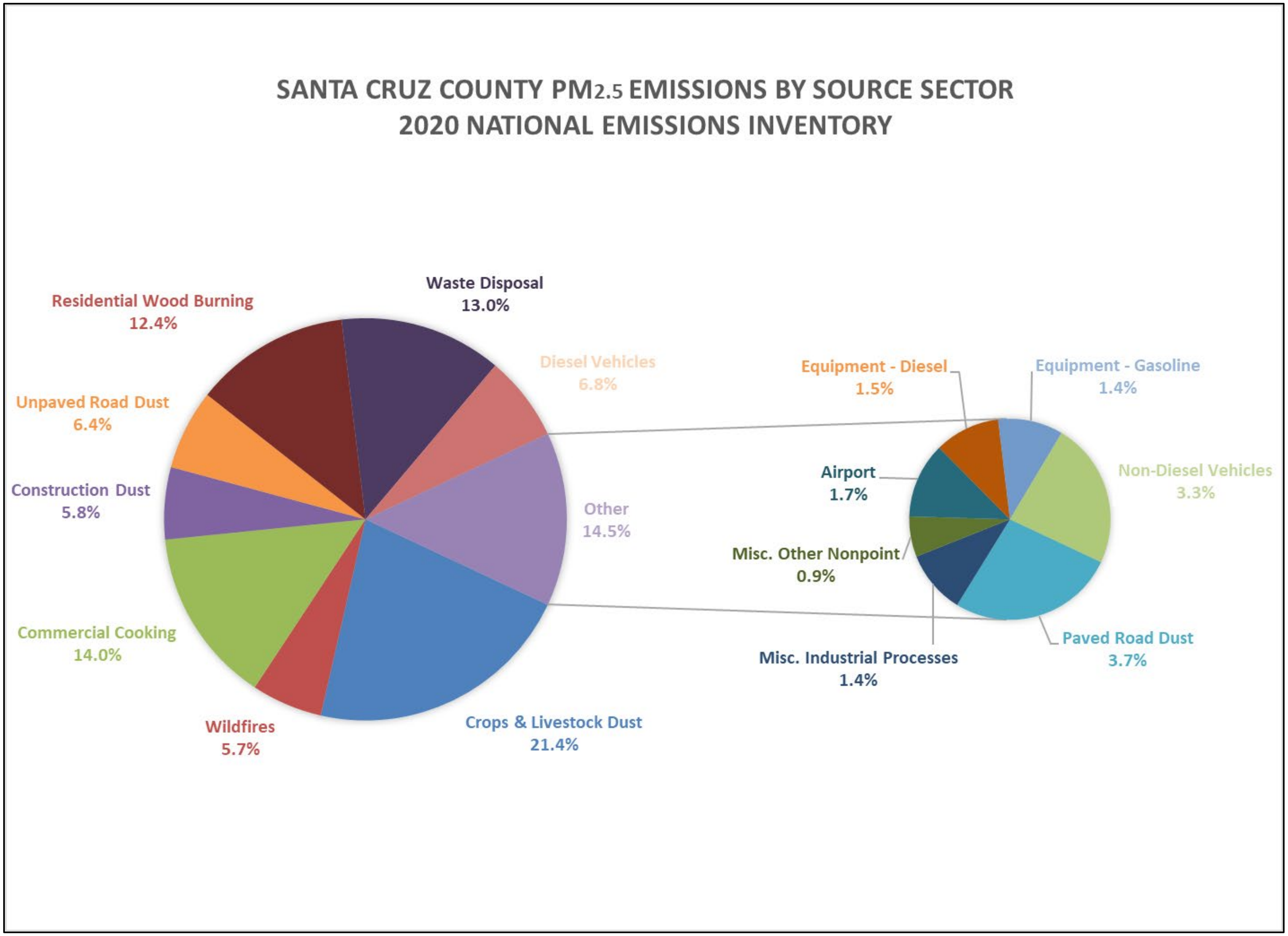
Santa Cruz County $PM_{2.5}$ Emissions (tpy) from the 2020 NEI					
County	Point	Nonpoint	Onroad	Nonroad	County Total
TPY	4.0	181.5	21.5	6.4	213.3
% of Total	1.9%	85.1%	10.1%	3.0%	100.0%

Table 24 Santa Cruz County $PM_{2.5}$ Emissions by Source Sector as Percentage of Total

$PM_{2.5}$ Emissions from the 2020 NEI			
Source	Source Sector Category	$PM_{2.5}$ (tpy)	Percentage of Total
Nonpoint			
	Crops & Livestock Dust	45.7	21.4%
	Wildfires	12.1	5.7%
	Commercial Cooking	29.9	14.0%
	Construction Dust	12.3	5.8%
	Paved Road Dust	7.9	3.7%
	Unpaved Road Dust	13.6	6.4%
	Misc. Industrial Processes	3.0	1.4%
	Residential - Natural Gas or Other	0.1	0.0%
	Residential Wood Combustion	26.4	12.4%
	Misc. Other Nonpoint	1.9	0.9%
	Locomotives	0.8	0.4%
	Waste Disposal	27.6	13.0%
Point			

	Airport	3.6	1.7%
	EGU	0.4	0.2%
Nonroad			
	Equipment - Diesel	3.1	1.5%
	Equipment - Gasoline	3.1	1.4%
	Equipment - Other	0.1	0.1%
Onroad			
	Diesel Vehicles	14.5	6.8%
	Non-Diesel Vehicles	6.9	3.3%
Grand Total		**6,214.9**	**100.0%**

Figure 63 Santa Cruz County $PM_{2.5}$ Emissions by Source Sector as Percentage of Total



ADEQ also considered contributions of precursor pollutants when drafting the $PM_{2.5}$ boundary recommendation for Santa Cruz County, shown in Table 25. County-level emissions data from the 2020 NEI shows that diesel and non-diesel vehicles make up 65% of NO_x emissions. Fertilizer application and livestock waste account for 97% of Santa Cruz County's ammonia emissions. 91% of VOC emissions in Santa Cruz are from biogenic sources. Lastly, the total emissions from SO_2 in Santa Cruz County is 8.1 tons per year which is relatively insignificant. Appendix A, Section A3.1.3.2 shows the full breakdown of source sectors and their associated contributions to precursor emissions in Santa Cruz County.

Table 25 Santa Cruz County $PM_{2.5}$ Emissions and Related Pollutants

Santa Cruz County Direct $PM_{2.5}$ and Precursor Emissions (tpy) from the 2020 NEI									
Direct	$PM_{2.5}$ Precursor Pollutants				Portion of $PM_{2.5}$				
Total $PM_{2.5}$	Total NH_3	Total NO_x	Total SO_2	Total VOC	Total EC	Total OC	Total NO_3	Total SO_4	Total PM-Fine
213	1,027	1,164	8	13,857	25	77	4	4	103

4.1.2.2 2022 Point Source Data from ADEQ

ADEQ evaluated emissions from class I, class II, and portable sources in Santa Cruz County that reported directly to ADEQ in 2022. However, it is important to note that not all minor source facilities who report to ADEQ are required to submit their emissions on an annual basis, some class II and portable sources are on a triannual reporting basis and therefore may not be represented in this analysis. Moreover, this data source omits: portable sources that had more than one operating location in 2022, federally permitted sources such as the Nogales International Airport and emissions from burn permits.

Figure 64 provides a visual representation of ADEQ permitted point sources in 2022 and their reported $PM_{2.5}$ emissions. Figure 65 provides a visual representation of combined point source precursor emissions, which combines NO_x, SO_2, VOC and NH_3. However, there was no reported ammonia emissions in 2022 from permitted point sources in Santa Cruz County. Table 26 shows that Santa Cruz County (partial) boundary recommendation contains 19.7% of direct $PM_{2.5}$ emissions, 37.6% of NO_x, 57.3% of SO_2, and 9.7% of VOC from permitted point sources that reported for 2022.

Table 26 Emissions from Permitted Sources in 2022 within the Santa Cruz County NAA

Pollutant	NO_x	SO_2	VOC	NH_3	$PM_{2.5}$
TPY in Santa Cruz County Boundary	6.01	0.06	0.07	0	0.18
% of Total County Emissions	37.6%	57.3%	11.8%	0%	19.7%

Figure 64 Permitted Sources $PM_{2.5}$ Emissions in 2022 from Santa Cruz County

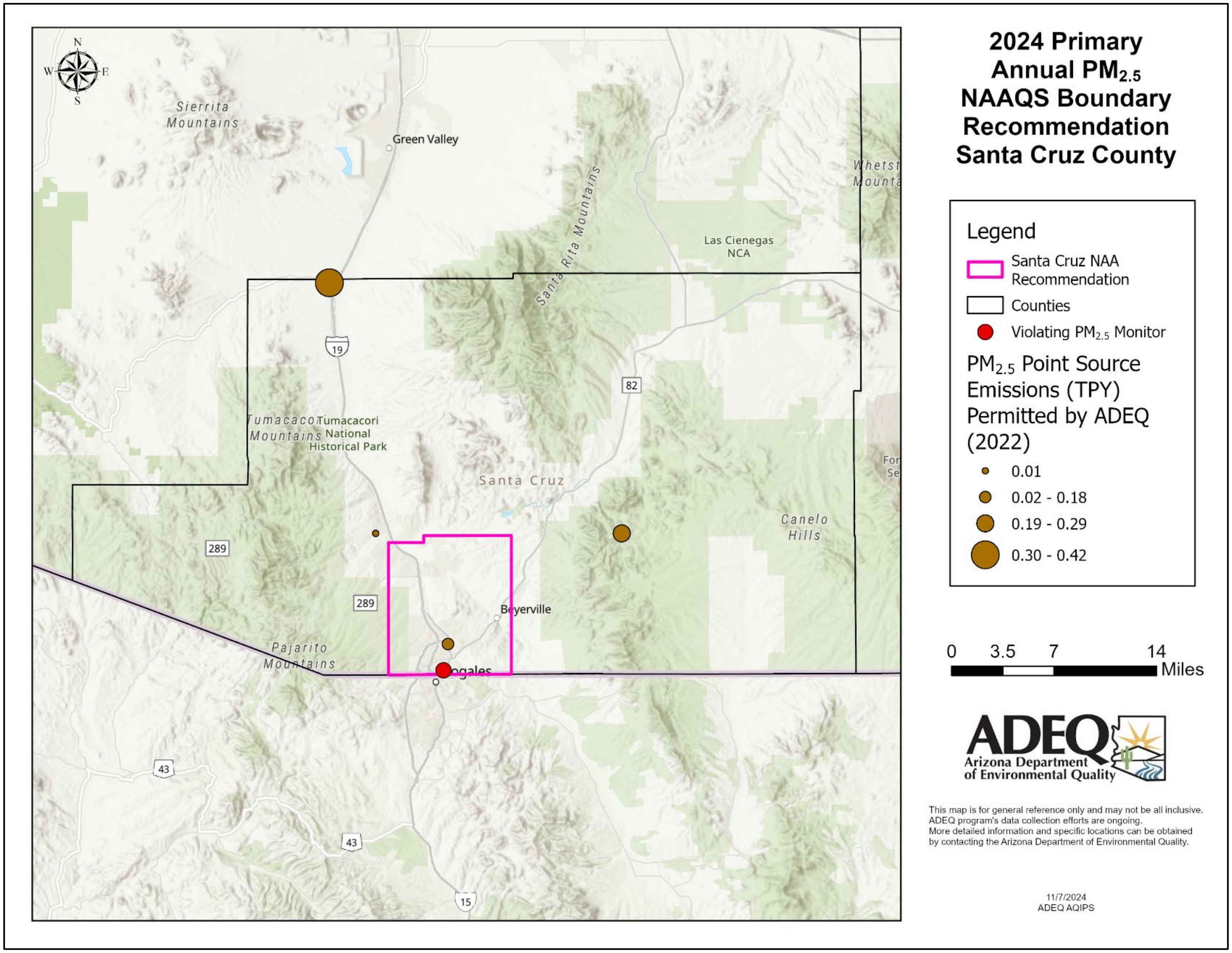
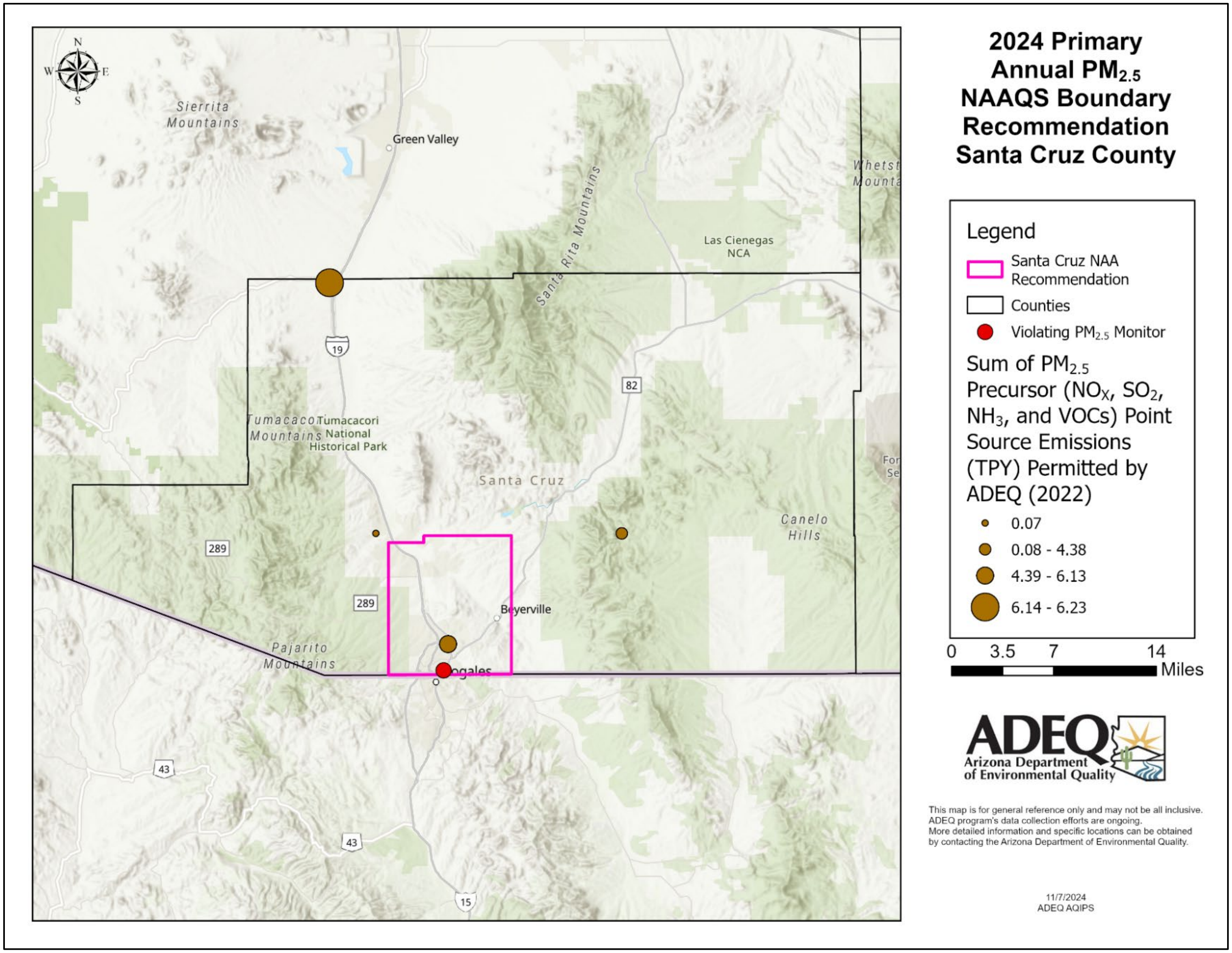


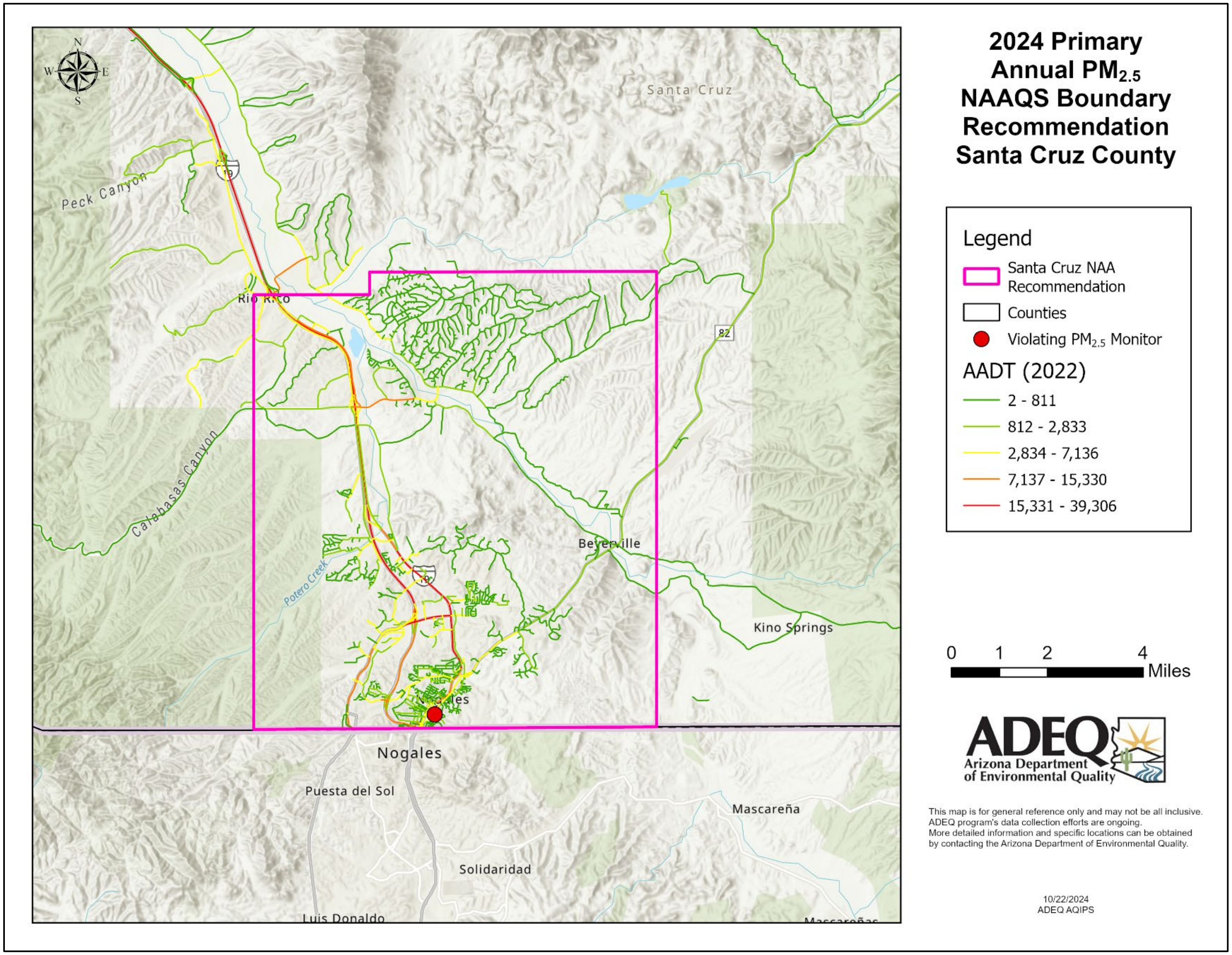
Figure 65 Emissions from Combined Precursor Pollutants in 2022 from Santa Cruz County



4.1.2.3 Traffic Data

Figure 66 below represents average annual daily traffic (AADT) near the recommended Santa Cruz County (partial) NAA boundary. Annual vehicle miles traveled (VMT) for Santa Cruz County is 492,134,659 miles, according to 2022 HPMS data. The VMT for the recommended 2024 $PM_{2.5}$ Santa Cruz County (partial) NAA is 248,731,767 miles; capturing 50.5% of the annual VMT in Santa Cruz County within the recommended boundary area.

Figure 66 Santa Cruz County (Partial) NAA Average Annual Daily Traffic



4.1.2.4 Population Data

Figure 67 and Figure 68 below represent the change in population density in Santa Cruz County between the years 2010 and 2020, according to the U.S. Census. The total 2020 population for Santa Cruz County is 47,669 people, and the 2020 population for the recommended 2024 $PM_{2.5}$ Santa Cruz County NAA is 29,791 people. That means that approximately 62.5% of the county population based on 2020 U.S. Census data is contained within the recommended area.

ADEQ also examined census data in Nogales, Sonora, Mexico abutted on its north by the city of Nogales, Arizona. In 2020, the municipality of Nogales in the state of Sonora, Mexico reported a population of by 264,782 inhabitants[77]. When the 2020 population of Nogales, Arizona is added to Nogales, Sonora's 2020 population there is a total of 284,557 people in the greater bi-national Nogales area. That means approximately 10.5% of the greater Nogales population is captured within the recommended nonattainment area, while the remaining 89.5% of the population reside in Mexico. This statistic illustrates how small the Nogales, Arizona population is in comparison to Nogales, Sonora.

Table 27 below shows the change in actual population between 2010 and 2020 using AZ Office of Economic Opportunity (OEO) population estimates.[78] Table 28 below shows the projected change in population between 2020 and 2030 using AZ OEO population projections.[79]

[77] Gobierno de Mexico.Nogales: Economy, employment, equity, quality of life, education, Health and Public Safety. Data México. https://www.economia.gob.mx/datamexico/en/profile/geo/nogales?redirect=true#economy (last visited September 12, 2024).

[78] Arizona is providing AZ OEO specific estimates for 2010 and 2020 to accurately characterize the populations of multi-county municipalities and CDP's given only a percentage of the total population resides within each county. Data were retrieved from Ariz. Off. of Econ. Opportunity, Population Estimates, https://oeo.az.gov/population/estimates (last visited June 17, 2024).

[79] Ariz. Off. of Econ. Opportunity, *2023-2060 Sub-County Population Projections*, available at: https://oeo.az.gov/population/projections (last visited June 11, 2024).

Figure 67 Santa Cruz County Census Population Density in 2010

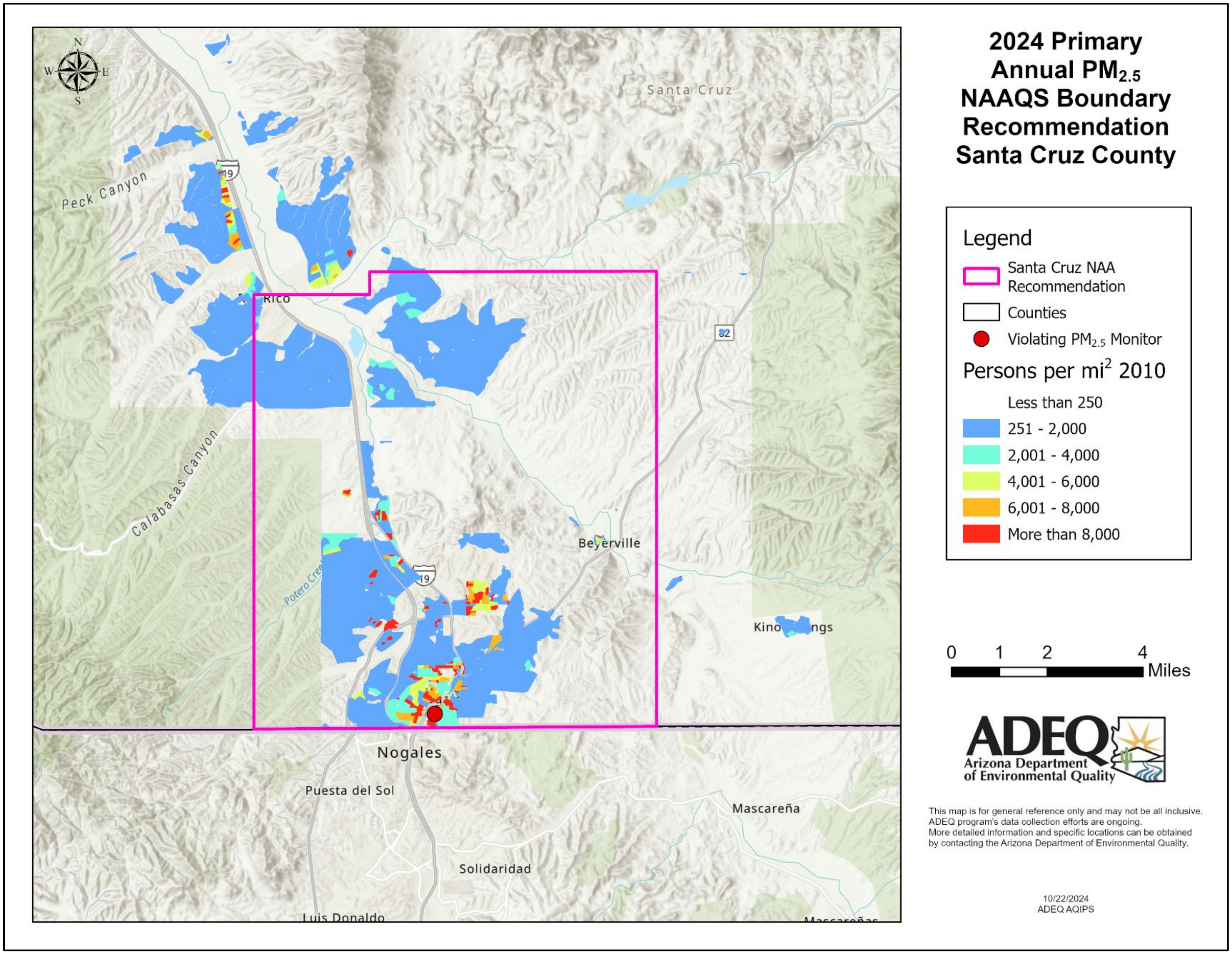


Figure 68 Santa Cruz County Census Population Density in 2020

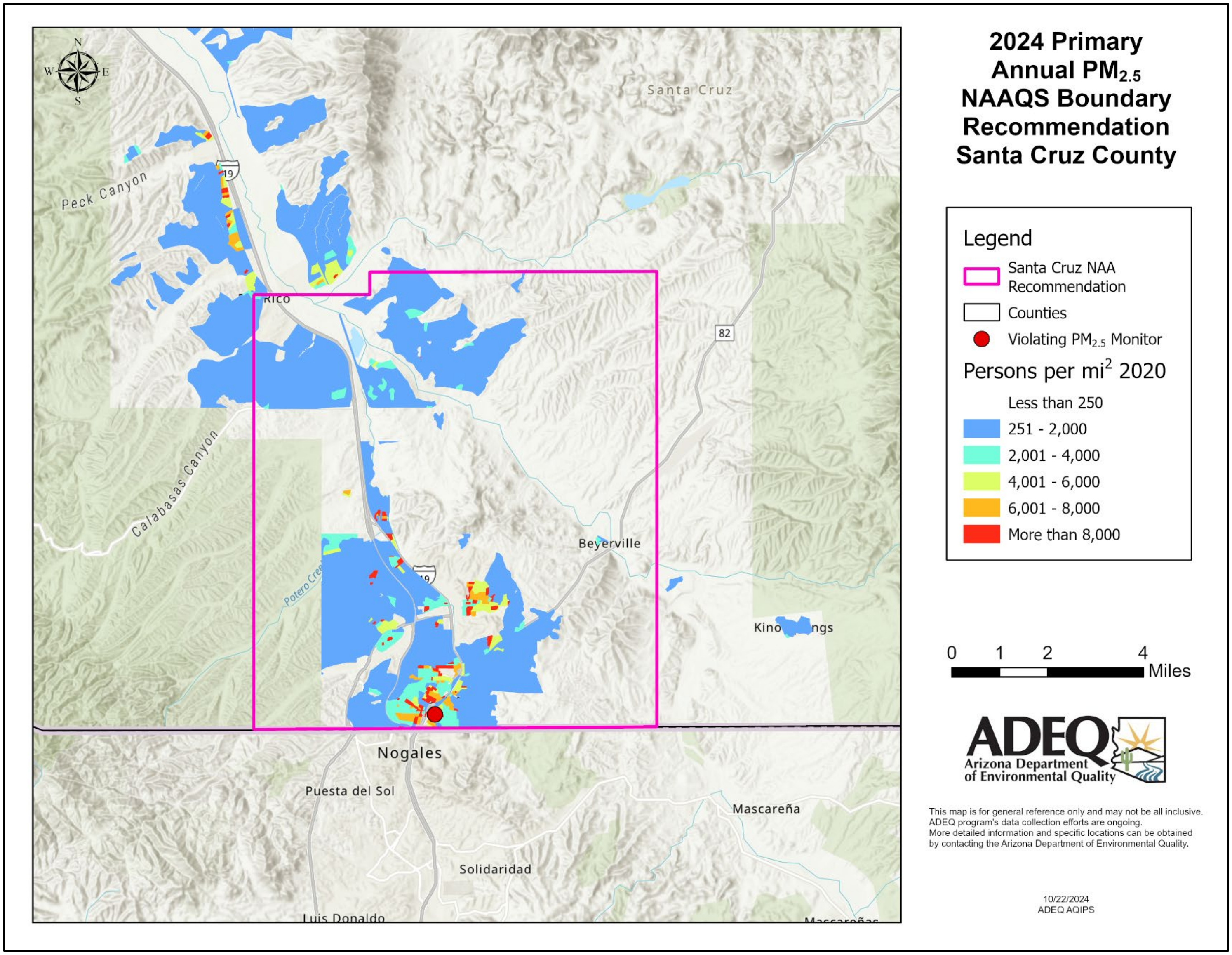


Table 27 Santa Cruz County Population Changes from 2010 to 2020

County/Municipality/Census Designated Place	AZ OEO 2010 Estimate	AZ OEO 2020 Projection	Population Change (%)
Santa Cruz County	47,401	47,787	0.8%
Nogales	20,802	19,775	-4.9%
Patagonia	904	804	-11.1%
Unincorporated Balance of County	25,695	27,208	5.9%

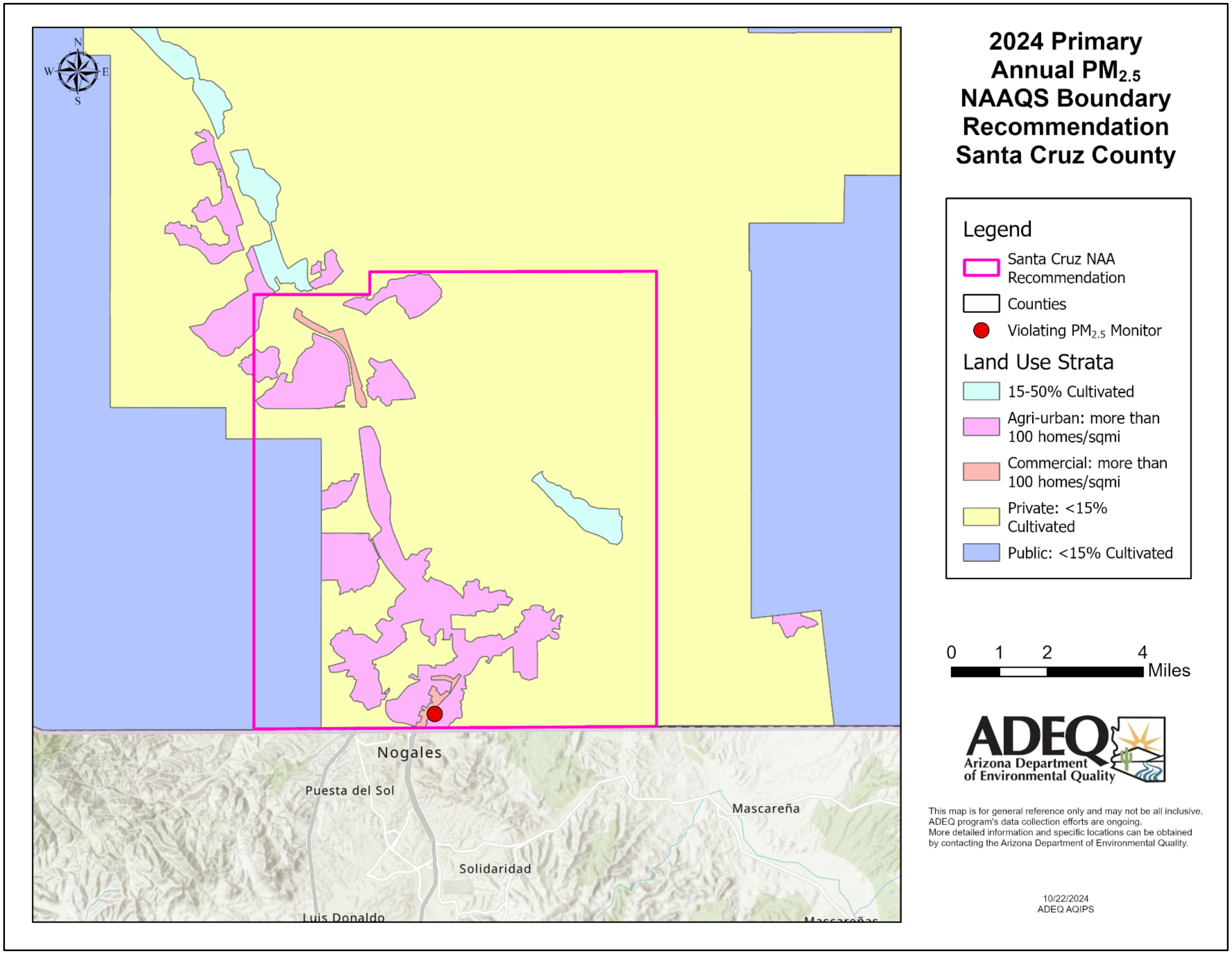
Table 28 Santa Cruz County Population Projections from 2020 to 2030

County/Municipality/Census Designated Place	AZ OEO 2020 Estimate	AZ OEO 2030 Projection	Population Change (%)
Santa Cruz County	47,787	50,794	6.3%
Nogales	19,775	19,769	0.0%
Patagonia	804	784	-2.5%
Unincorporated Balance of County	27,208	30,241	11.1%
Census Designated Places (2020 population >=500)			
Rio Rico	20,635	22,935	11.1%
Sonoita	806	896	11.2%
Tubac	1,588	1,765	11.1%

4.1.2.5 Land Use Data

Figure 69 below is a visual representation of available land use strata data that is near the Santa Cruz County (partial) NAA boundary. These land use strata are 15-50% cultivated, Agri-urban: more than 100 homes per square mile, commercial: more than 100 homes per square mile, private land: less than 15% cultivated, and public land: less than 15% cultivated. Land use strata nearest to the violating monitor is mostly composed of commercial, agri-urban, and private land: less than 15% cultivated.

Figure 69 Santa Cruz County (Partial) NAA Land Use



4.1.2.6 2022 Gridded Emissions

In order to examine emissions at a smaller spatial scale than the county level presented in the NEI, ADEQ generated maps displaying gridded annual $PM_{2.5}$ and $PM_{2.5}$ precursor emissions for Arizona. ADEQ downloaded final gridded emissions for select source sectors from the 2022v1 EMP.[80] The 2022 emission modeling platform is based on the 2020 NEI with updates to reflect 2022 emissions. Gridded emissions are generated through the application of spatial surrogates to allocate county level emission estimates to each 12 km grid cell. Documentation on spatial surrogates used in the 2022 EMP are available in the 2020 EMP Technical Support Document.[81] 2022 EMP gridded emission files were processed in the Visual Environment for Rich Data Interpretation (VERDI) program to generate tile plots for $PM_{2.5}$ and $PM_{2.5}$ precursor emissions. VERDI tile plots were exported to shapefiles and imported into ArcGIS Pro. Gridded emissions were limited to grid cells that intersect with Arizona's boundary and projected to NAD 1983 UTM Zone 12N.[82] Gridded emissions were generated for $PM_{2.5}$ and $PM_{2.5}$ + $PM_{2.5}$ Precursors (e.g., NO_x, SO_2, VOC, NH_3) for the following source sectors:

- Residential wood burning
- Area fugitive dust (adjusted with meteorological and transport fractions by EPA)
- Nonpoint
- Nonroad

Gridded emissions plots are provided in Appendix A Section A3.4.

[80] https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform
[81] https://www.epa.gov/air-emissions-modeling/2020-emissions-modeling-platform-technical-support-document
[82] Shapefiles exported from VERDI lacked critical information related to the geographic/projected coordinate system. ADEQ obtained a custom coordinate reference system from the Lake Michigan Air Directors Consortium (LADCO) to define the CRS before performing the projection to UTM.

4.1.3 Meteorology

4.1.3.1 Wind, Pollution, and 95th Percentile Roses

Figure 70 shows the location of the Nogales Post Office $PM_{2.5}$ monitoring site within Santa Cruz County used for the meteorological analysis.

Figure 71 is a wind rose plot showing the seasonal wind patterns at the Nogales Post Office site for 2021-2023. Wind rose plots can be useful in assessing how wind speed and wind direction vary by season and year for a given monitoring site.[83]

Figure 72 is a pollution rose plot showing the wind direction and $PM_{2.5}$ concentrations by season and year for the Nogales Post Office site for 2021-2023. Pollution roses categorize the distribution of pollution concentrations into break points and display the wind direction associated with those break points. Pollution roses are useful in assessing the dominant wind direction associated with pollution concentrations.[84]

Figure 73 is a percentile rose plot showing the wind direction of 95th percentile $PM_{2.5}$ concentrations by season and year for the Nogales Post Office site for 2021-2023. Percentile rose plots can be useful in assessing the distribution of wind directions associated with high pollution concentrations at a particular monitor. They can also be useful in identifying the direction of upwind emission sources that may be contributing to high pollution concentrations.[85]

[83] *Supra* note 39.
[84] *Supra* note 39.
[85] *Supra* note 39.

Figure 70 Nogales Meteorology Analysis Site Location

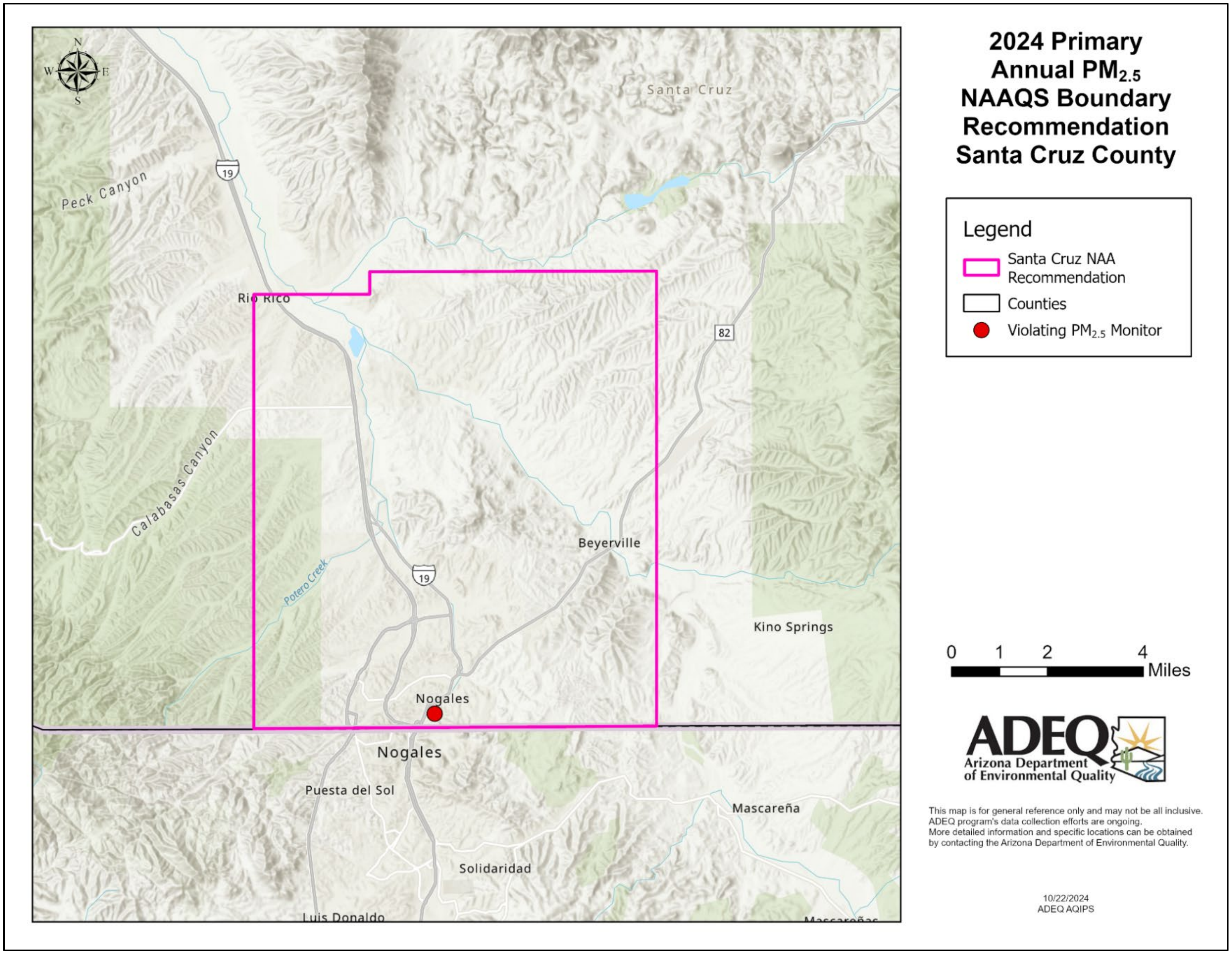


Figure 71 Nogales Post Office Monitor Wind Rose

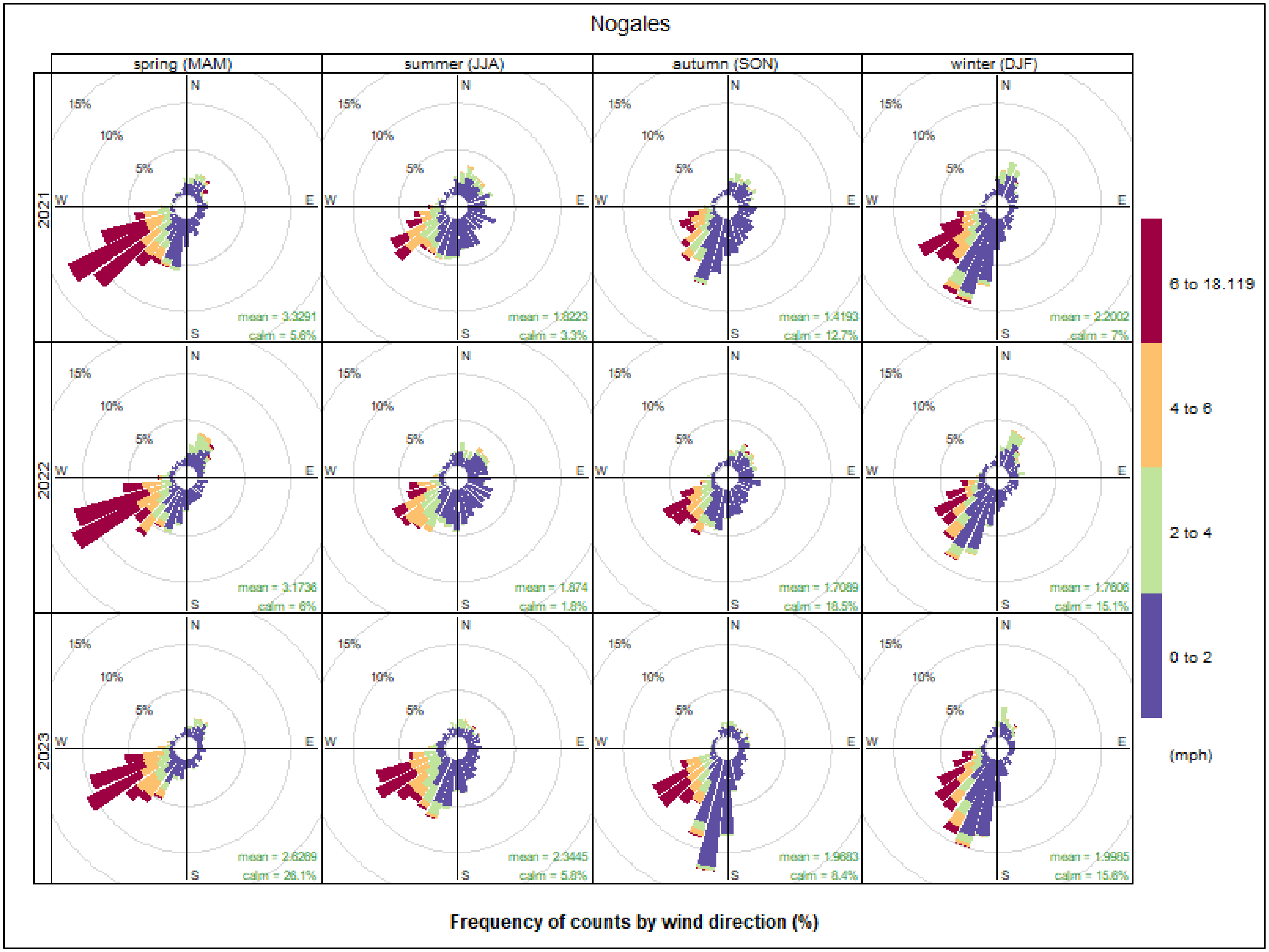


Figure 72 Nogales Post Office Monitor Pollution Rose

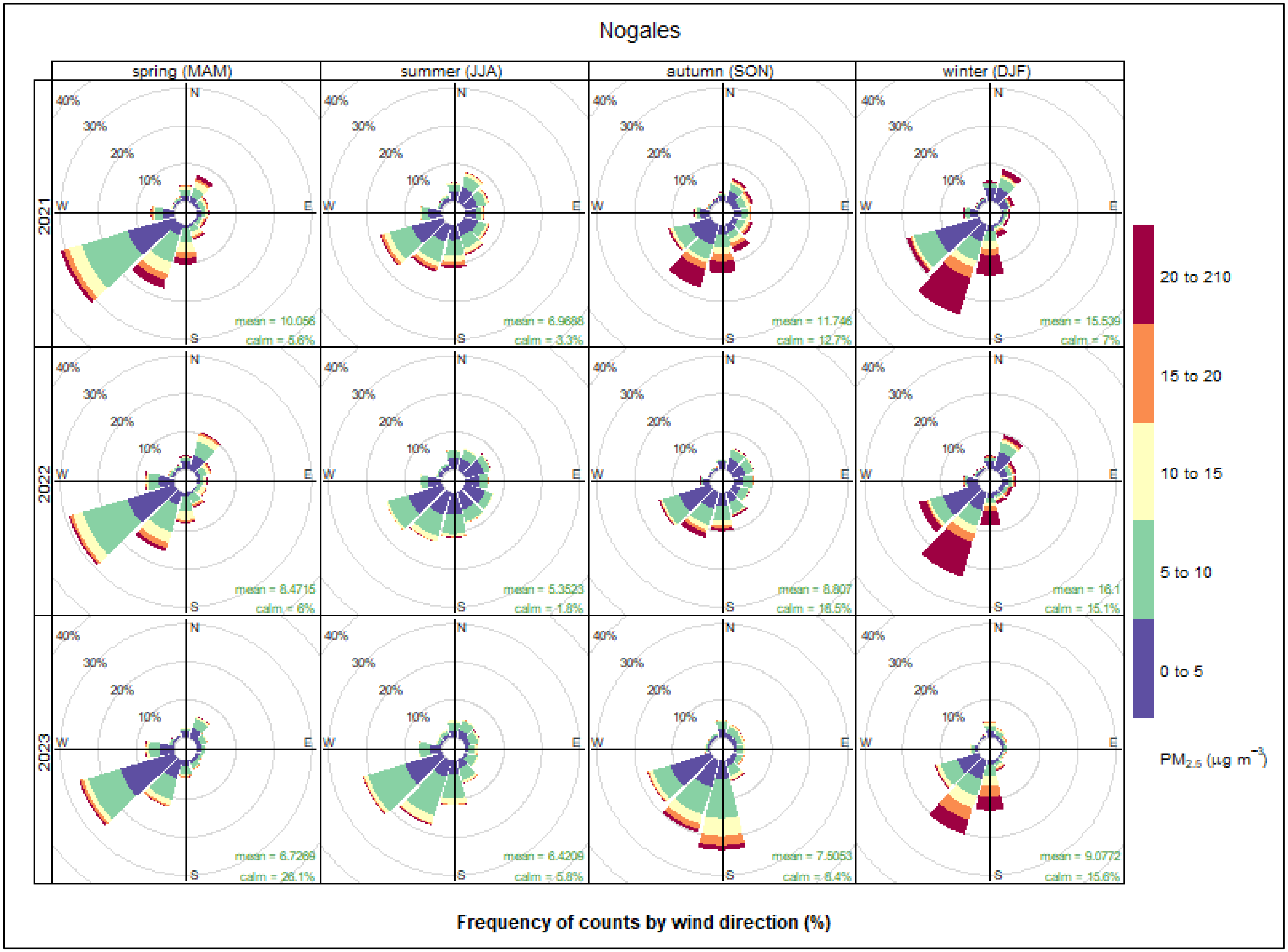
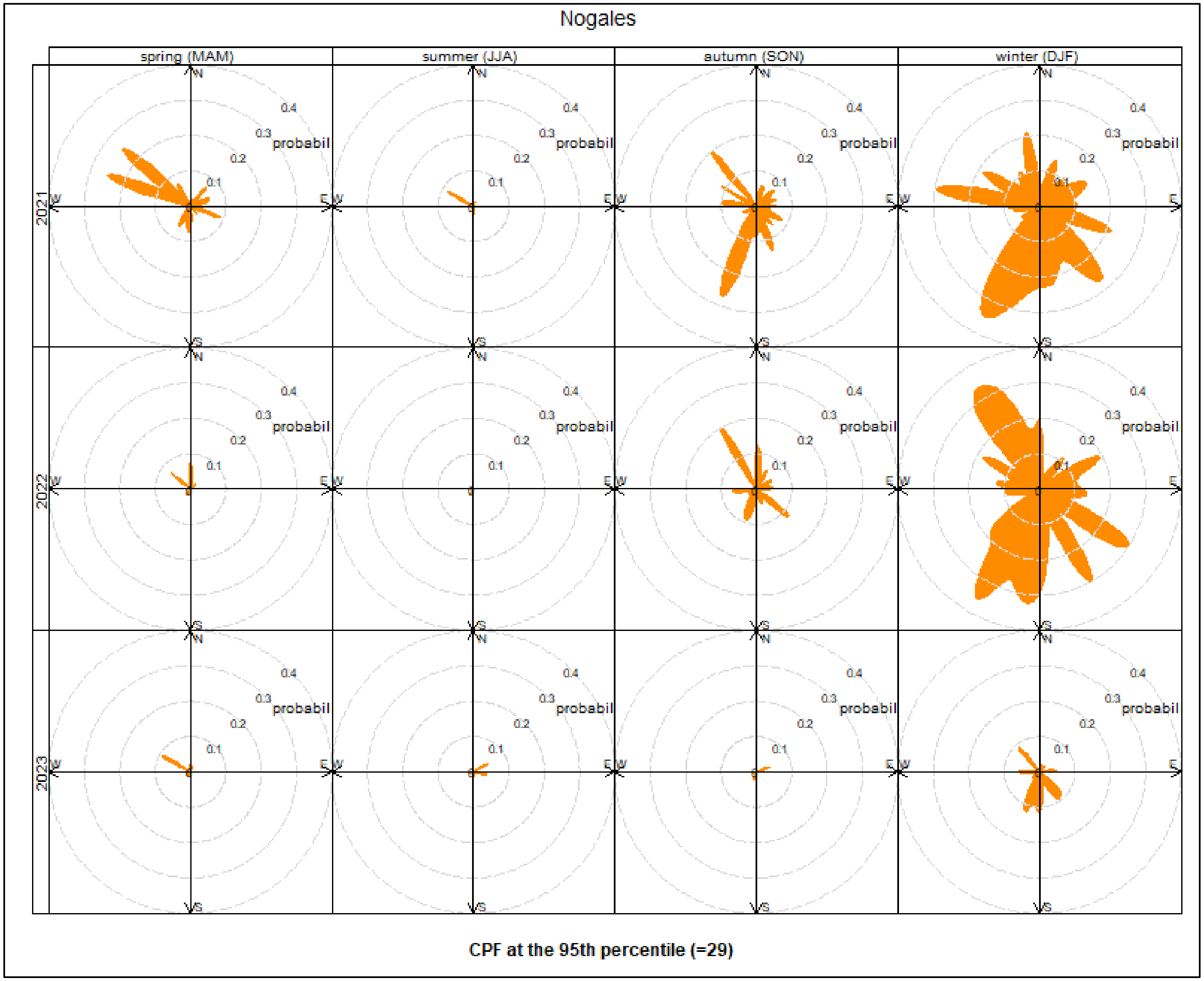


Figure 73 Nogales Post Office Monitor 95th Percentile Rose



4.1.3.2 HYSPLIT Analyses

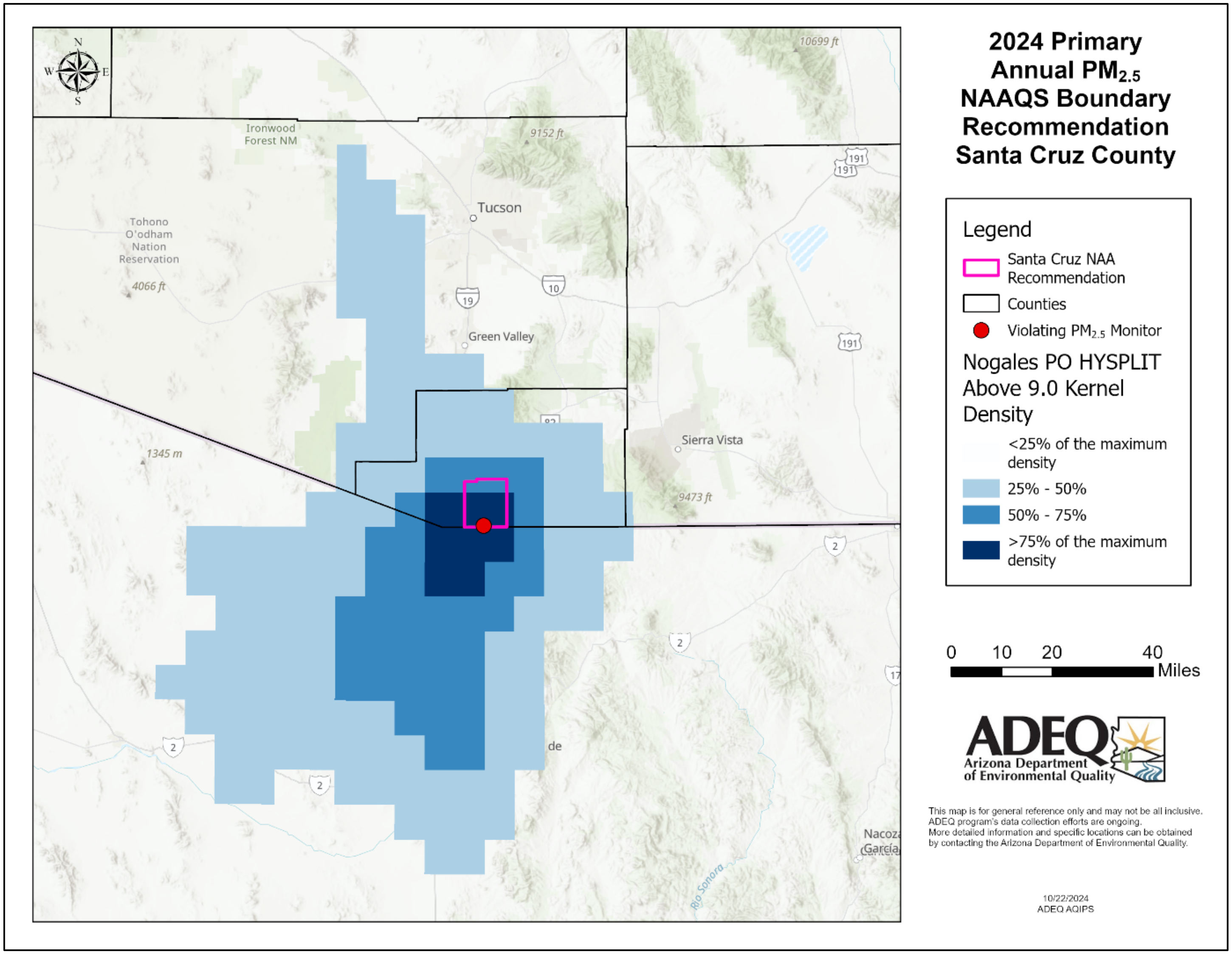
HYSPLIT 24-hour back trajectories were used to generate maps showing the origin of air parcels at each violating monitor originated from over a 24-hour period. Back trajectories were run twice daily from 2021-2023 on days when the 24-hour $PM_{2.5}$ concentration was above 9.0 µg/m^3. The air parcels were released at start times during the two peak hourly averages of $PM_{2.5}$ concentrations experienced at each monitor, shown in Table 29.

Table 29 HYSPLIT Back Trajectory Start Times

Monitor	Morning	Evening
Nogales Post Office	7:00:00 AM	11:00:00 PM

To visualize the HYSPLIT results, ADEQ gathered HYSPLIT back trajectory points of where the air parcel was located at each hour during the 24-hour trajectory period and imported those points into ArcGIS Pro. Vector feature classes were created for each violating monitor in order to visualize the hourly back trajectory points on a map. ADEQ utilized the kernel density geoprocessing tool to generate kernel density estimates for the days between 2021-2023 with a 24-hour $PM_{2.5}$ concentration above 9.0 µg/m^3 for each violating monitor. Kernel density estimation (KDE) calculates the density of point features around each output raster cell (a cell in a matrix of equally sized cells that are organized by columns and rows in a grid) and was used by the EPA to visualize HYSPLIT back trajectory results for the 2012 $PM_{2.5}$ NAAQS revision. The KDE was run using a cell size of 0.1 decimal degrees which is approximately 11.1 km and roughly equivalent to the 12 km grid resolution at which HYSPLIT was run (e.g., NAM 12 km). The purpose of these KDE plots is to provide insight as to where $PM_{2.5}$ at the monitors is being transported from. This information is displayed in Figure 74. For additional HYSPLIT model results please see Appendix A Section A4.3.

Figure 74 HYSPLIT Back Trajectories from the Nogales Post Office Monitor



4.1.4 Geography and Topography

The geography/topography analysis looks at physical features of the land that might have an effect on the airshed and, therefore, on the distribution of $PM_{2.5}$ over Santa Cruz County.

The Nogales, Arizona µSA is located within Santa Cruz County, Arizona which is bordered by Pima County, Cochise County, and the international border with Mexico. Santa Cruz County has 1,236.3 square miles of land area and is the smallest county is Arizona.[86] The City of Nogales, Arizona, encompasses 21 square miles (54 square kilometers) and lies 3,865 feet above sea level. With the Pajarito, Atascosa, and Tumacacori Mountains about 7 miles west and the Patagonia Mountains roughly 13 miles east, Nogales, Arizona rests between the two mountain ranges in the Nogales Wash. The elevation decreases from south of the U.S./Mexico border heading north towards Tucson and ultimately Phoenix, Arizona. Thus, under calm wind conditions, the nighttime drainage in this valley is typically from south to north along the Nogales Wash and Interstate 19.

To the north and northeast are the Santa Rita mountains, including Mount Wrightson at 9,432 feet which forms a barrier to northward flow. The elevation decreases from the City of Nogales, Sonora heading north toward the Nogales Post Office monitor and Tucson, Arizona. Thus, nighttime drainage flow is typically from south to north along the Nogales Wash. The topography of the narrow valley can trap emissions of $PM_{2.5}$ especially during the evening hours when the diurnal flow is from Nogales, Sonora.[87] Figure 75 below shows the topography near the recommended Santa Cruz County (partial) NAA boundary

In order to spatially analyze the influence of topology, ADEQ has reviewed airsheds within Arizona. According to the EPA:

> "Airsheds refer to areas with common weather or meteorological conditions and sources of air pollution. Generally speaking, an airshed contains source and receptor areas."[88]

In Arizona, airsheds have the same meaning as smoke management units as defined by A.A.C. R18-2-1501(27):

> ""Smoke management unit" means any of the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns."

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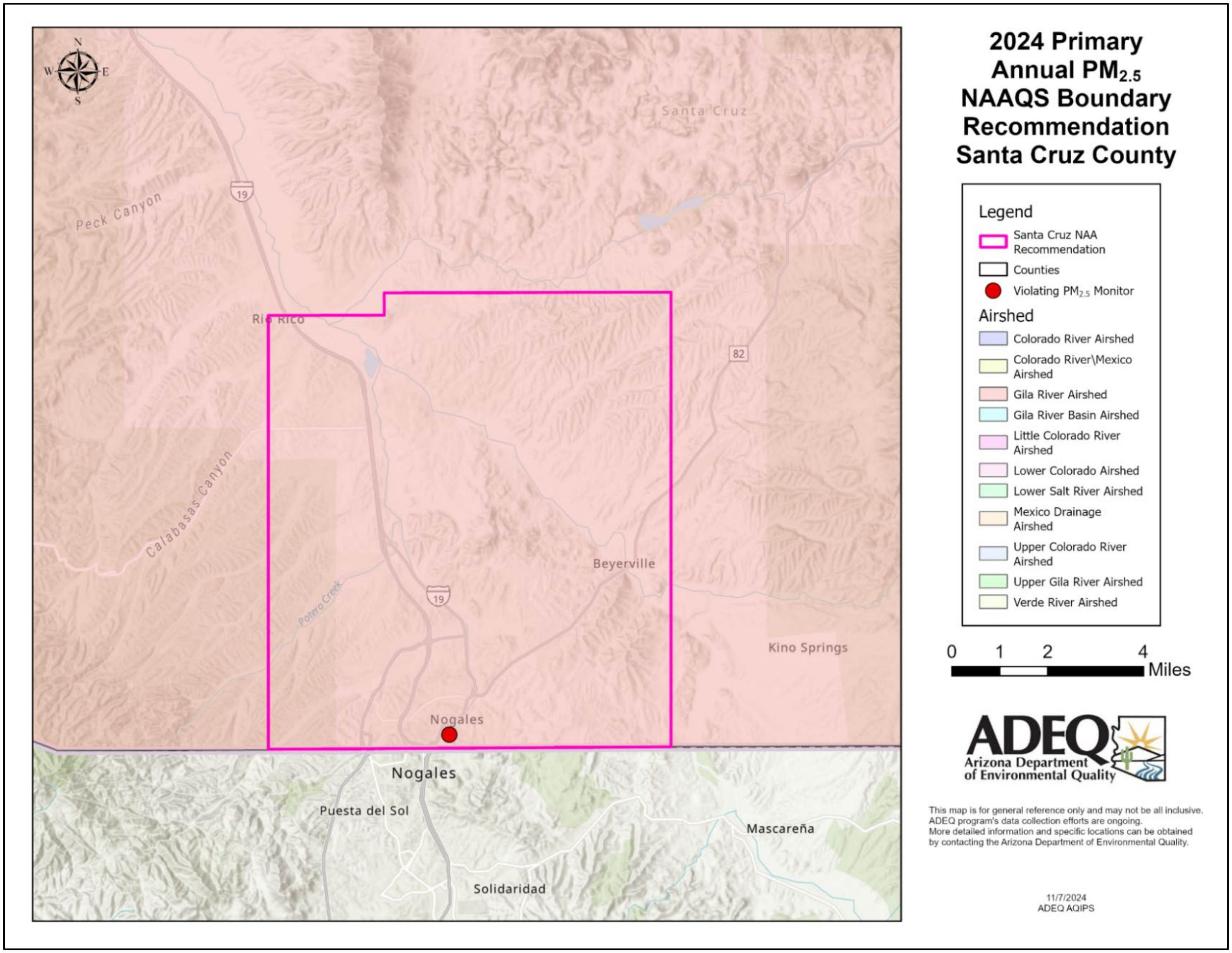
[86] U.S. Census Bureau, Santa Cruz County, Arizona Profile, available at: https://data.census.gov/profile?g=050XX00US04023 (last visited June 17, 2024).
[87] *See* Letter from Wayne Nastri, EPA Regional Administrator, to Governor Janet Napolitano (Aug. 18, 2008), Attachment 1, available at: https://www3.epa.gov/pmdesignations/2006standards/rec/letters/09_AZ_EPAMOD.pdf.
[88] *Supra* note 44.

In combination with an analysis of meteorological conditions and local emission sources, consideration of topography and airsheds can support a weight of evidence analysis by identifying geographic areas where there is likely to be no significant transport of emissions between areas. All of Santa Cruz County is contained within the Gila River airshed and consideration of airsheds is not a significant factor for the weight of evidence analysis. Figure 75 below shows the topography and airsheds near the recommended 2024 $PM_{2.5}$ Santa Cruz County (partial) NAA boundary.

Figure 75 Santa Cruz County (Partial) NAA Airshed



4.1.5 Jurisdictional Boundaries

ADEQ considered existing jurisdictional boundaries to establish a clearly defined legal boundary for purposes of implementing the revised 2024 primary annual $PM_{2.5}$ NAAQS. ADEQ considered counties, Tribal Nations and Communities land, international borders, state and federal lands, and existing NAAs. Recommendations for the Santa Cruz $PM_{2.5}$ NAA excludes Tribal Nations and Communities land, which has the same meaning as the term defined in 18 U.S.C. § 1151. ADEQ has authority for air quality planning for Santa Cruz County, including authority for state implementation plan development for $PM_{2.5}$. Santa Cruz County has an existing $PM_{2.5}$ maintenance area for the 2006 24-hour $PM_{2.5}$ NAAQS which is equivalent to the area ADEQ is recommending for the 2024 $PM_{2.5}$ primary annual NAAQS. The City of Nogales, Sonora, Mexico is located directly south of Nogales, Arizona across the international border. The City of Nogales, Sonora emissions have a large impact on the air quality of the Nogales PM_{10} NAA. A map showing some of these jurisdictional boundaries can be seen in Figure 76.

In Figure 77, ADEQ displays city boundaries in relation to the Santa Cruz County (partial) NAA boundary recommendation. However, municipality boundaries were not considered within the jurisdicational boundaries factor of the five factor analysis. The legal boundaries that are relevant for the boundary recommendation process are those that are relevant for carrying out the CAA planning and enforcement functions. For the area around the violating monitor, the relevant jurisdiction carrying out CAA responsibilities is ADEQ. While cities may be responsible for adopting measures as part of a nonattainment or maintenance plan, local municipalities do not have an individual role in air quality planning or enforcement under state law. Therefore, ADEQ did not consider city boundaries as a method for analyzing the jurisdictional boundary factor.

Figure 76 Santa Cruz County (Partial) NAA Jurisdictional Boundaries

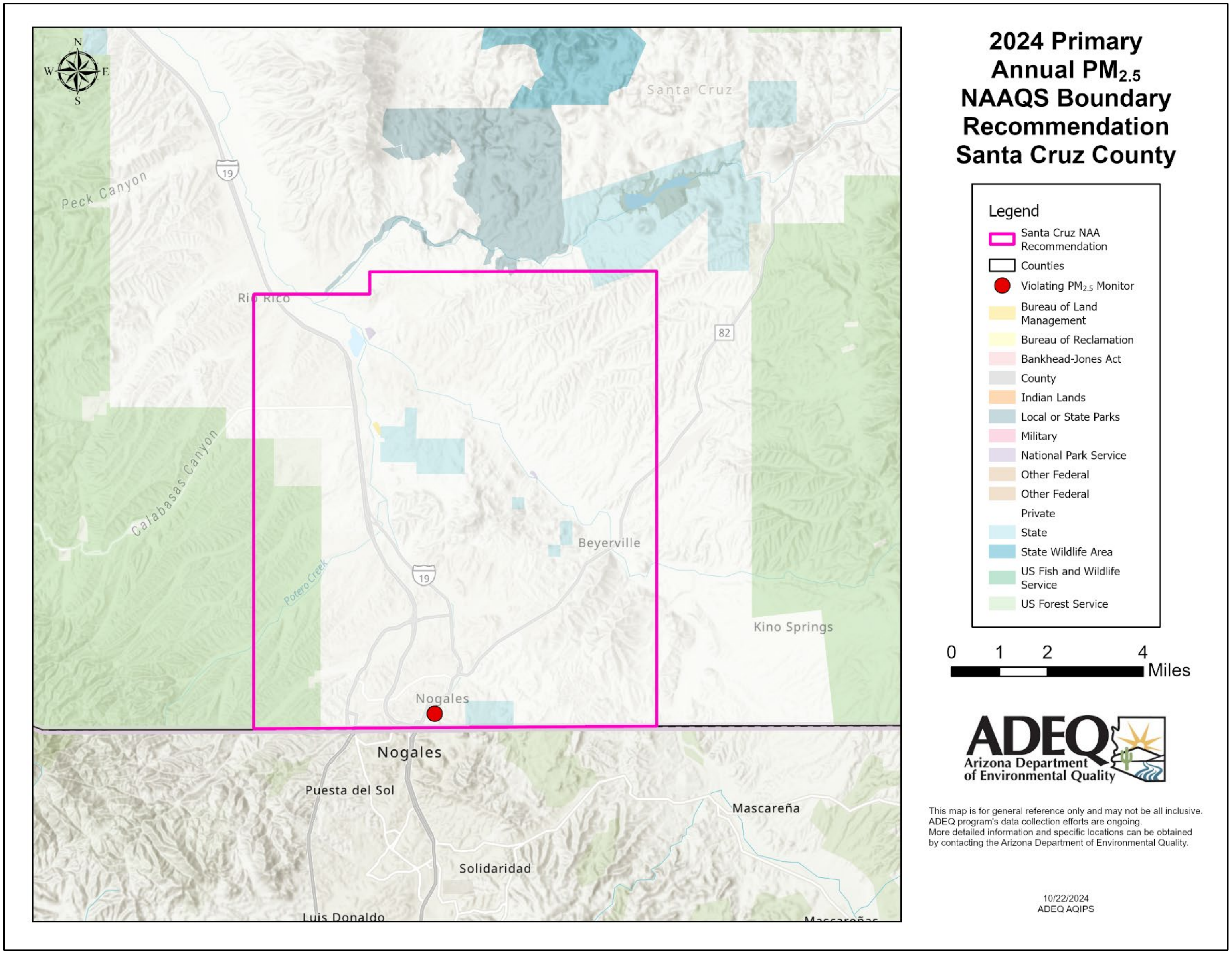
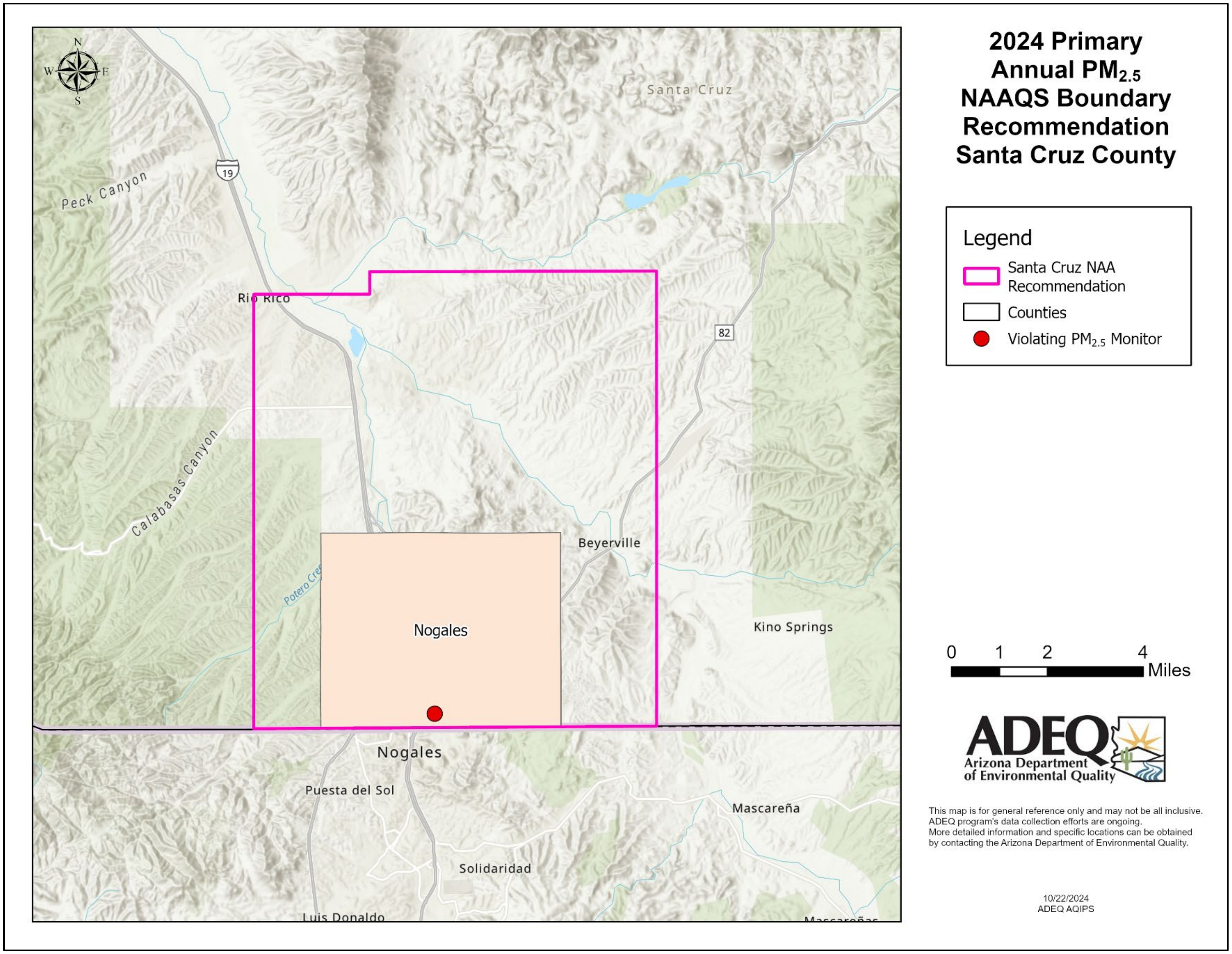


Figure 77 City Boundaries in Relation to the Santa Cruz (Partial) NAA



4.1.6 Weight of Evidence Analysis and Recommendation Summary

This section presents ADEQ's weight of evidence analysis for its recommendation for Santa Cruz County (Partial). As previously discussed, the weight of evidence synthesizes the previously described assessments into a cogent narrative that describes the relationship between the emissions sources in the analysis area and measured violations. To that end, this section synthesizes the five factors considered above for Santa Cruz County.

For air quality data, ADEQ's starting point was to examine the Nogales Post Office monitor within Santa Cruz County which is not currently meeting the 2024 primary annual $PM_{2.5}$ NAAQS, utilizing the 2021-2023 DV. Based on that DV, the Nogales Post Office monitoring site is not meeting the 2024 primary annual $PM_{2.5}$ NAAQS. However, as described below in Section 5.1.2, 2022-2024 DVs may be at or below the 2024 primary annual $PM_{2.5}$ NAAQS. The Nogales Post Office site is a neighborhood scale (0.5 – 4 km) located near the U.S.-Mexico Border.[89] All areas within 4 km of the violating monitor are contained within the recommended area for the 2024 primary annual NAAQS, except for areas across the international border.

As part of the air quality data analysis, ADEQ examined relevant $PM_{2.5}$ speciation data from the IMPROVE monitor located at the Nogales Post Office. ADEQ found the $PM_{2.5}$ composition shows the main emission sources are residential wood burning, commercial cooking, open burning, dust emissions, and tailpipe emissions from on-road and off-road vehicles. Carbonaceous emissions with about 14% elemental carbon are consistent with residential wood burning or commercial cooking, and not consistent with diesel emissions.

The analysis noted that crustal, organic carbon, and elemental carbon make up approximately 86% of the major chemical species of the $PM_{2.5}$ mass in the area. ADEQ noted the high level of organic carbon to element carbon ratio (5.47 $\mu g/m^3$/ 2.67 $\mu g/m^3$) of the total urban increment 13.03 $\mu g/m^3$ could be indicative of biomass burning having a larger impact on ambient $PM_{2.5}$ concentrations compared to fossil fuel combustion sources. Additionally, the lower concentrations of sulfates and nitrates could indicate lower contributions from fossil fuel combustion sources. Similarly, the urban increment analysis showed crustal, organic carbon, and elemental carbon make up approximately 97% of the major chemical species of the $PM_{2.5}$ mass in the area.

For emissions and emissions related data, ADEQ examined: 1) non-point and point sources; 2) traffic; 3) population data; 4) land use; and 5) 2022 gridded emissions. For all the reasons above, ADEQ recommends that a NAA covering a portion of Santa Cruz County, as described in Section 1.2.1, be recommended to the EPA Administrator. The majority (85.1%) of $PM_{2.5}$ emissions within Santa Cruz County are from non-point sources. The remaining 14.9% of $PM_{2.5}$ emissions come from point, onroad, and nonroad sources. Traffic data show the recommended boundary for Santa Cruz County would capture approximately 50.5% of VMT for the county.

[89] Ariz. Dept. Env't. Quality, State of Arizona Air Monitoring Network Plan for the Year 2023 (May 2023), Appendix C, 17, available at https://static.azdeq.gov/aqd/air_monitoring_network_plan2023.pdf

The recommended boundary would include 62.5% of Santa Cruz County's population. Land use data show that the NAA would include a mixture commercial, agri-urban, and private land: less than 15% cultivated. Lastly, an analysis of the $PM_{2.5}$ and its precursor emissions shows that the existing NAA boundary encompasses most of the 12 km grid cells with high annual $PM_{2.5}$ and precursor emissions for nonpoint, nonroad, area fugitive dust, and residential wood burning, all located near the violating monitor. For this analysis, gridded emissions for Mexico were not generated. While analyzing gridded emissions can identify where emissions from dispersed activites are being generated, it is equally important to assess whether these emissions from these areas are being transported to the violating monitor is necessary. An examination of gridded emissions alone should not be considered the determining factor for establishing NAA boundaries.

For meteorology, ADEQ's analysis shows the prevailing trends are the winds and pollution are coming from the South and Southwest, likely from across the international border with Mexico. Evidence of these meteorological patterns are showcased in the wind roses, pollution roses, percentile roses, HYSPLIT analysis, and kernel density plots for the Nogales Post Office monitor. In examination of the HYSPLIT analysis and kernel density plots, it can be seen that air impacting the violating monitor on days with 24-hour concentrations above 9.0 $\mu g/m^3$ comes from all directions when running back trajectories for 24-hours. However, a higher density of back trajectory points are clustered around the violating monitors and showcase patterns of declining point density across southern Santa Cruz county. These patterns of air transport on high concentration days were incorporated into the weight of evidence model by ADEQ in assessing source-receptor relationships in the area.

The geography of the area, Nogales is between the two mountain ranges in the Nogales Wash. The elevation decreases from south of the U.S./Mexico border heading north towards Tucson and ultimately Phoenix, Arizona. Thus, under calm wind conditions, the nighttime drainage in this valley is typically from south to north along the Nogales Wash and Interstate 19. To the north and northeast are the Santa Rita mountains. The elevation decreases from Nogales, Sonora heading north towards the recommended NAA boundary and Tucson, Arizona. Thus, nighttime drainage flow is typically from south to north along the Nogales Wash. The topography of the narrow valley can trap emissions of $PM_{2.5}$ especially during the evening hours when the diurnal flow is from Nogales, Sonora

Finally, ADEQ considered the jurisdictional boundaries and air quality planning authority. ADEQ considered counties, Tribal Nations and Communities land, international borders and existing NAAs. ADEQ has air quality planning authority for Santa Cruz County, which has the existing Nogales $PM_{2.5}$ maintenance area in Santa Cruz County for the 2006 24-hour $PM_{2.5}$ NAAQS. As part of its jurisdictional analysis, ADEQ considered the analysis from the 2006 $PM_{2.5}$ NAAQS boundary for the Santa Cruz County (Partial) NAA.

For the reasons discussed above, ADEQ recommends that a NAA covering an option of Santa Cruz County, as described in Section 1.2, be recommended to the EPA Administrator.

5 Recommended 2024 Primary Annual $PM_{2.5}$ Attainment/Unclassifiable Areas in Arizona

5.1.1 Attainment/Unclassifiable Recommendation

All other areas within the state that are not otherwise discussed in Sections 3 and 4 above and which are under Arizona's jurisdiction (e.g. excluding tribal land areas) are recommended as attainment/unclassifiable areas.

Recommended attainment areas meet the revised NAAQS for $PM_{2.5}$. Unclassifiable areas are those areas for which ADEQ does not have enough information to designate as either attainment or nonattainment. The rest of the state of Arizona not recommended for nonattainment is recommended as attainment/unclassifiable, including the following:

- Remainder of Maricopa and Santa Cruz counties
    - If the 2022-2024 DV for the Nogales Post Office monitoring site is at or below 9.0 $\mu g/m^3$, ADEQ recommends that that all of Santa Cruz County be designated as attainment/unclassifiable.
- Apache County
- Cochise County
- Coconino County
- Gila County
- Greenlee County
- Graham County
- La Paz County
- Mohave County
- Navajo County
- Pima County
- Pinal County Contingency
    - If the EPA approves PCAQD's 2024 40 C.F.R. § 58.30 request for the Hidden Valley monitoring site:
        - Pinal County is recommended for attainment/unclassifiable.
    - If the EPA does not approve PCAQD's 2024 40 C.F.R. § 58.30 request for the Hidden Valley monitoring site:
        - Remainder of Pinal County not included in the recommended Pinal County (partial) NAA boundary as described in Section 1.1.2 of this document is recommended as attainment/unclassifiable.
- Yavapai County
- Yuma County

5.1.2 Consideration of 2022-2024 DVs

As discussed above, the EPA's $PM_{2.5}$ designations guidance states that "[the] EPA expects that in making final designations decisions, the EPA will rely on air quality data from 2022 to 2024."[90] However, ADEQ's recommendations are based on 2021-2023 (as 2024 data is not available at the time of this recommendation). Therefore, ADEQ requests that the EPA consider the impacts of the 2022 to 2024 data on the recommendations above. For example, if the 2022-2024 DVs for all monitors in a given county whose 2021-2023 DV is above 9 µg/m^3 shows a new DV at or below the revised NAAQS, ADEQ would recommend those areas as attainment/unclassifiable, regardless of the analysis presented in prior sections. If this occurs, Arizona requests the ability to submit additional information to the EPA in support of designated these areas of the State as attainment/unclassifiable.

[90] *Supra* note 13, at 3.