Appendix A

2024 Primary Annual Fine Particulate Matter NAAQS Boundary Recommendation Technical Support Document

Air Quality Division
September 23, 2024 Proposed

This page is intentionally blank.

Table of Contents

Index of Figures

Index of Tables

A1 Data Sources

The tables below (Table A-1, Table A-2, Table A-3, Table A-4, and Table A-5) list the data sets and sources of all data collected and used for the five factor analysis.

Table A-1: Data Sources for Ambient Air Data

Description	Data Year	Data Source	Downloaded
$PM_{2.5}$ Design Values for All Sites in Arizona	2014-2023	EPA Air Quality System (AQS) Design Value Report: https://www.epa.gov/air-trends/air-quality-design-values	08/08/2024
$PM_{2.5}$ 24 Hour Arithmetic Mean for All Sites in Arizona	2021-2023	EPA Air Quality System (AQS) Hourly Data Reports and internal ADEQ data	06/19/2024
$PM_{2.5}$ Hourly Concentrations for All Sites in Arizona	2021-2023	EPA Air Quality System (AQS) Hourly Data Reports and internal ADEQ data	06/19/2024
IMPROVE Speciation Data	2020-2023	Federal Land Manager Environmental Database: https://views.cira.colostate.edu/fed/QueryWizard/Default.aspx	07/08/2024
CSN Speciation Data	2020-2023	Federal Land Manager Environmental Database: https://views.cira.colostate.edu/fed/QueryWizard/Default.aspx	07/08/2024

Table A-2: Data Sources for Emissions and Emissions Related Data

Description	Data Year	Data Source	Downloaded
NEI Data for County Emissions	2020	EPA National Emissions Inventory (NEI) https://www.epa.gov/particle-pollution-designations/particle-pollution-designations-memorandum-and-data-2024-revised	02/18/2024
NEI Data for Facility Point Sources	2020	EPA National Emissions Inventory (NEI) https://www.epa.gov/particle-pollution-designations/particle-pollution-designations-memorandum-and-data-2024-revised	02/18/2024
ADEQ Permitted Facilities	2022	ADEQ permitted class I, class II, and portable source emissions and pollutants.	07/15/2024
MCAQD Permitted Sources	2022	Maricopa County Air Quality Department workbook of all permitted sources in 2022	04/15/2024
MCAQD 2020 Periodic Emissions Inventory Errata	2020	Maricopa County Air Quality Department released a revision to their 2020 Periodic Emissions Inventory	05/07/2024
MCAQD 2020 Periodic Emissions Inventory	2020	Maricopa County Air Quality Department's 2020 Periodic Emissions Inventory	04/23/2024
PCAQCD Permitted Sources	2022	Pinal County Air Quality Control District workbook of permitted sources in 2022	03/21/2024

Census Population by County	2010 and 2020	Arizona Department of Administration (ADOA) – Intercensal Estimates https://population.az.gov/population-estimates	01/16/2024
CDP Level Census Population	2010 and 2020	U.S. Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_00_PL_GCTPL.ST10&prodType=table	01/16/2024
Arizona Population Estimates	2023	Arizona Department of Administration (ADOA) - https://population.az.gov/population-estimates	01/16/2024
County to County Commuting Data	2010 and 2020	U.S. Census Commuting Patterns (American Community Survey) - http://www.census.gov/hhes/commuting/ YMPO Regional Transportation Plan MAG Regional Transportation Plan	01/17/2024
Census Blocks	2010 and 2020	US Census Bureau - https://www.census.gov/cgi-bin/geo/shapefiles/index.php	03/20/2024
Census Block Population	2010	US Census Bureau - Decennial Census H10TOTAL POPULATION IN OCCUPIED HOUSING UNITS 2010: DEC Summary File 1	03/20/2024
Municipality of Nogales, Sonora, Mexico Population	2020	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	09/12/2024
Traffic Data (Annual Average Daily Traffic)	2022	Data provided by Arizona Department of Transportation	04/22/2024
Census Block Level Population and # of Households	2010 and 2020	U.S. Census Bureau - ftp://ftp2.census.gov/geo/tiger/TIGER2010BLKPOPHU/	01/17/2024
ADEQ Minor and Portable Point Source Data	2020-2022	Minor and portable sources from SLEIS, MyDEQ, CAERS datasets.	
Maricopa County Point Source Data	2020-2022	Maricopa County Air Quality Department provided a major and synthetic minor source list	03/14/2024
Pinal County Point Source Data	2022	Pinal County Air Quality Control District provided a major and synthetic minor source list	03/21/2024
Arizona Border Crossing Port Ranking (Nogales)	2023	US Department of Transportation Bureau of Transportation Statistics https://data.bts.gov/stories/s/Maps/4fgg-apek	07/15/2024
Land Use Strata	2022	USDA - https://www.nass.usda.gov/Research_and_Science/stratafront2b.php	02/27/2024
Existing Land Use for Maricopa and Pinal Counties	2022	Maricopa Association of Governments - https://geodata-azmag.opendata.arcgis.com/search?tags=land%2520use%2Cmaricopa%2520association%2520of%2520governments	04/05/2024

Table A-3: Data Sources for Meteorological Data

Description	Data Year	Data Source	Downloaded
Hourly Meteorological Data (Wind speed and wind direction) for $PM_{2.5}$ Monitor Locations in Arizona	2020-2023	Air Quality System (AQS) Hourly Data Reports and internal ADEQ data	1/19/2024
Hourly Meteorological Data (Wind speed and wind direction) for all Arizona	2022-2023	Air Quality System (AQS) Hourly Data Reports and internal ADEQ data	7/17/2024
Air Sheds in Arizona	2021	ADEQ internal shapefiles	2/27/2024
North American Mesoscale Forecast System (NAM) 12km	2021-2023	National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory	6/26/2024

Table A-4: Data Sources for Geographic and Topographic Data

Description	Data Year	Data Source	Downloaded
World Terrain Basemap		Environmental Systems Research Institute (ESRI): http://goto.arcgisonline.com/maps/World_Terrain_Base	--
World Street Basemap		Environmental Systems Research Institute (ESRI): http://goto.arcgisonline.com/maps/World_Street_Map	--

Table A-5: Data Sources for Jurisdictional Boundaries Data

Description	Data Year	Data Source	Downloaded
CBSA/MSA Boundaries		U.S. Census Bureau - http://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2015&layergroup=Core+Based+Statistical+Areas	
Arizona County Boundaries		Arizona Land Resource Information System	
Arizona Tribal Boundaries		Arizona Land Resource Information System	
Arizona Township, Range and Selection		Bureau of Land Management - https://gis.blm.gov/azarcgis/rest/services/cadastral/BLM_AZ_PLSS/MapServer	5/14/2024
Arizona MPO Boundaries	2021	National Transportation Atlas Databases (NTAD) via USDOT - http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/2015/polygon	5/3/2024
2006 Arizona $PM_{2.5}$ NAA Boundaries	2006	ADEQ internal shapefile	
2012 Arizona PM_{10} NAA Boundaries	2012	ADEQ internal shapefile	
Public Land Ownership GIS layer		Arizona Land Resource Information System	
National Forests	2023	AZGeo - https://azgeo-open-data-agic.hub.arcgis.com/datasets/240cfc899f444f00821090ff86ab41ba_0/explore	5/3/2024
Military Bases	2024	USDOT - https://data-usdot.opendata.arcgis.com/datasets/fb5aff99c6e74ed99cd8b36dfae1c469/explore?filters=eyJzdGF0ZW5hbWVjb2RlIjpbIkFaIl19&location=3.231476%2C3.071700%2C1.50	5/3/2024

A2 Ambient Air Data

A2.1 $PM_{2.5}$ Design Values

Ambient $PM_{2.5}$ concentrations are monitored at numerous sites across Arizona. These monitoring sites are operated by the Arizona Department of Environmental Quality (ADEQ)[1], the Maricopa County Air Quality Department (MCAQD)[2], the Pinal County Air Quality Control District (PCAQCD)[3], Salt River Pima-Maricopa Indian Community of the Salt River Reservation and the Clean Air Status and Trends Network (CASTNET)[4]. Figure 1 shows the locations of all regulatory ambient $PM_{2.5}$ monitors in Arizona that achieved design value validity in 2023. Table A-6 gives the site ID number, name, network, latitude, longitude, the 2023 design value, and measurement scale for all of the monitors in Arizona shown in Figure 1.

[1] Arizona Department of Environmental Quality. (2015, July 1). *State of Arizona Air Monitoring Network Plan for the Year 2015*. Retrieved from http://www.azdeq.gov/function/forms/download/air_monitoring_network_plan2015

[2] Maricopa County Air Quality Department. (2015, September). *2014 Air Monitoring Network Plan*. Retrieved from http://www.maricopa.gov/aq/divisions/monitoring/network.aspx

[3] Pinal County Air Quality Control District. (2015). *2015 Ambient Monitoring Network Plan and 2014 Data Summary*. Retrieved from http://pinalcountyaz.gov/AirQuality/Pages/MonitoringNetwork.aspx

[4] Clean Air Status and Trends Network (CASTNET). Retrieved from https://www.epa.gov/castnet

Figure 1: Arizona $PM_{2.5}$ Monitoring Network

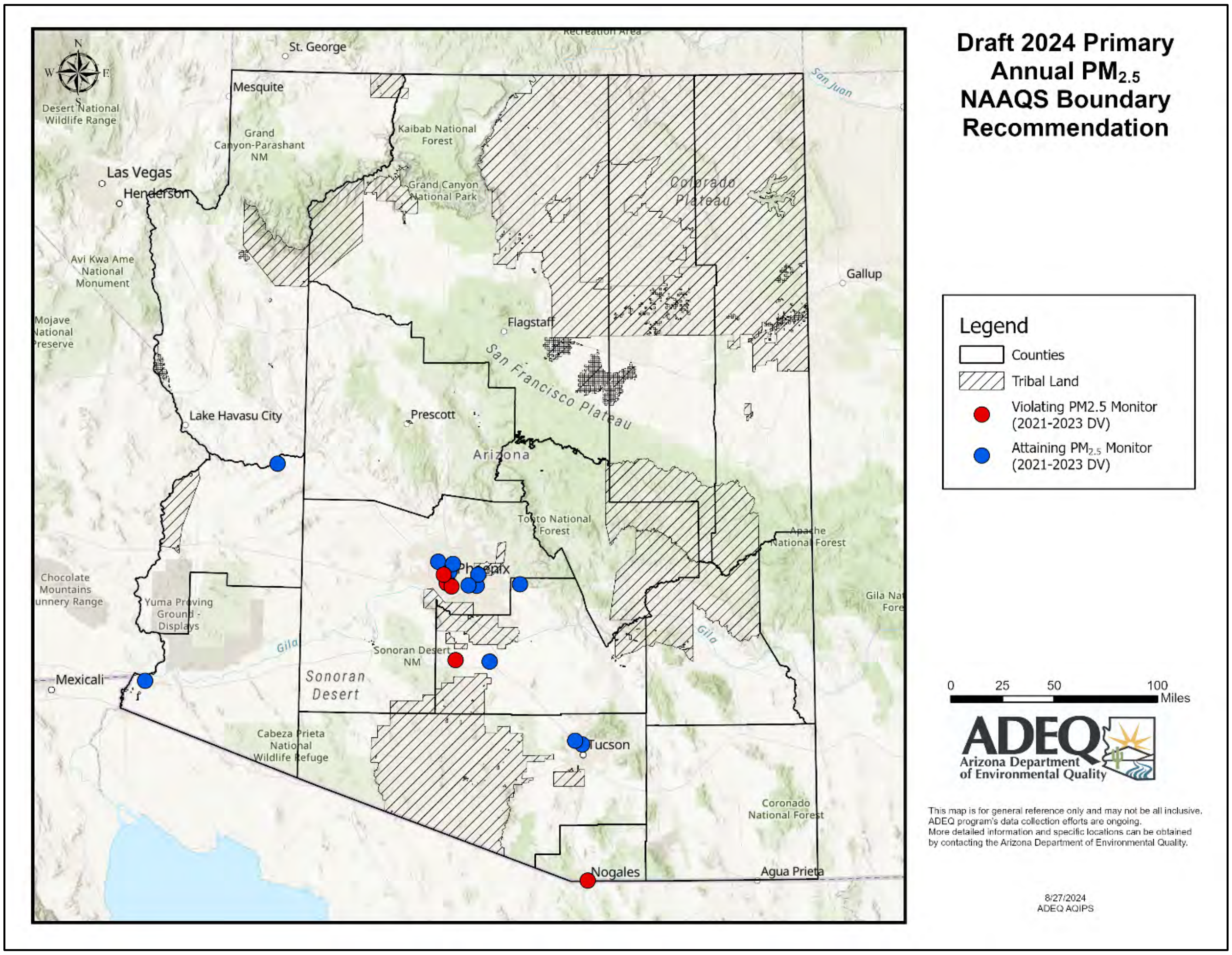


Table A-6: $PM_{2.5}$ Design Values for 2023

Site ID	Monitor Name	County	Latitude	Longitude	2023 Design Value	Measurement Scale
04-021-0001	Casa Grande Downtown	Pinal	32.877583	-111.752222	7.0	Neighborhood
04-023-0004	Nogales Post Office	Santa Cruz	31.337204	-110.936718	9.4	Neighborhood
04-019-0011	Orange Grove	Pima	32.32266142	-111.0383893	5.7	Neighborhood
04-013-0019	West Phoenix	Maricopa	33.48378	-112.14256	10.1	Neighborhood
04-013-1003	Mesa	Maricopa	33.41018	-111.86536	6.5	Neighborhood
04-013-1004	North Phoenix	Maricopa	33.56031	-112.06619	7.1	Neighborhood
04-019-1028	Children’s Park Ncore	Pima	32.29515	-110.9823	6.2	Neighborhood
04-013-2001	Glendale	Maricopa	33.57453	-112.19193	6.7	Neighborhood
04-021-3002	Apache Junction Fire Station	Pinal	33.421194	-111.503222	4.9	Neighborhood
04-021-3015	Hidden Valley	Pinal	32.884761	-112.03705	10.4	Middle Scale
04-013-4003	South Phoenix	Maricopa	33.40314	-112.07526	10.0	Neighborhood
04-013-4005	Tempe	Maricopa	33.41123	-111.93471	7.5	Neighborhood
04-013-7020	Senior Center Air Monitoring Station	Maricopa	33.48813079	-111.8554428	6.8	Neighborhood
04-012-8000	Alamo Lake	La Paz	34.2439	-113.5586	3.4	Regional Scale
04-027-8011	Yuma Supersite	Yuma	32.690278	-114.61444	8.5	Neighborhood
04-013-9812	Durango Complex	Maricopa	33.4265	-112.11821	9.9	Neighborhood
04-013-9997	JLG Supersite	Maricopa	33.503833	-112.095767	8.4	Neighborhood
***ADEQ removed monitors that did not achieve design value validity for 2023 from this table**						

A3 Emissions Analyses

ADEQ considered emissions and emissions-related data during the five-factor analysis process determining nonattainment area boundary recommendations for the 2024 revised primary annual $PM_{2.5}$ National Ambient Air Quality Standards. All sources for emissions data can be found in Section A1 of this document. The TSD will cover additional analyses that are not discussed in the draft boundary recommendation document.

A3.1 2020 National Emissions Inventory

ADEQ performed a multitude of analyses from emissions data that reported in the 2020 National Emissions Inventory (NEI). Pollutants included in analyses are: direct Primary $PM_{2.5}$; gaseous precursors that assist in the formation of $PM_{2.5}$ such as, NO_x, SO_2, VOC, and NH_3; and the five major components of fine particulate matter reported in the 2020 NEI, elemental (black) carbon (EC), organic carbon (OC), nitrate (NO_3), sulfate (SO_4), and the remainder of PM2.5-PRI (PM-FINE).

Figure 2 displays a pie chart of Arizona's statewide direct $PM_{2.5}$ emissions by source sector category and county contribution. Approximately 60% of Arizona's total $PM_{2.5}$ emissions from 2020 were from wildfires within the nonpoint source category. ADEQ also performed analyses for each of the counties of interest: Maricopa, Pinal, and Santa Cruz that display $PM_{2.5}$ emissions by source category and the percent that each source contributes to the county total $PM_{2.5}$ emissions. Details from this work can be found in the draft boundary recommendation.

Table A-7 shows Arizona's Primary $PM_{2.5}$ emissions, precursor emissions, and the species portion of Primary $PM_{2.5}$ emissions by county. Table A-8 shows the five major components of fine particulate matter and their contribution to total $PM_{2.5}$ by county for the state of Arizona. This county-level statewide analysis was also performed for $PM_{2.5}$ emissions and each of the precursor pollutants emissions: NH_3, NO_x, SO_2, and VOC. Table A-9, Table A-10, Table A-11, Table A-12, and Table A-13 display a breakdown of the four main source categories: point, nonpoint, onroad, and nonroad and each of their contributions to the total emissions for the given pollutant.

Figure 2: Arizona $PM_{2.5}$ Emissions by Source Sector

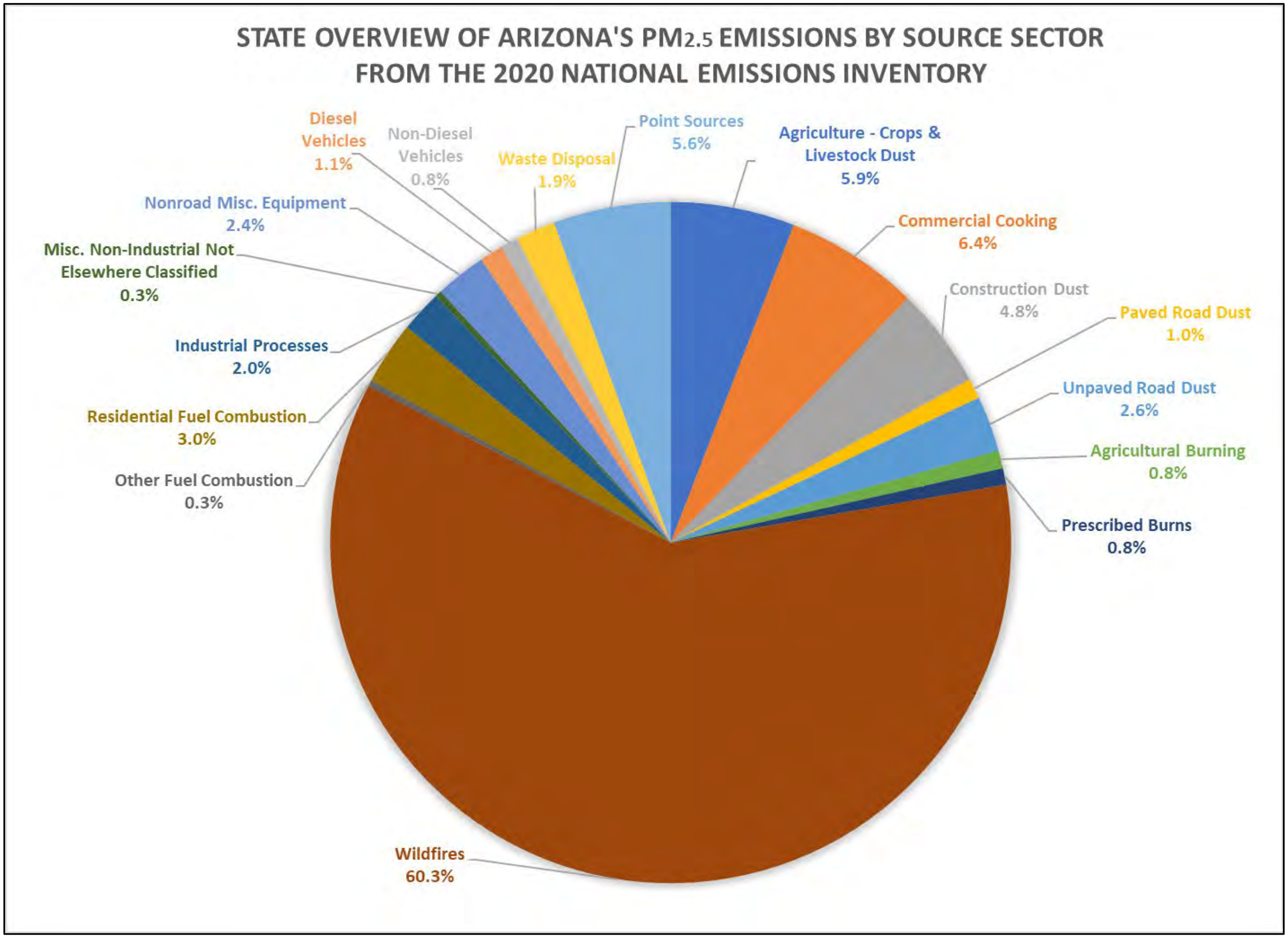


Table A-7: Arizona $PM_{2.5}$ Emissions and Related Emissions by County in TPY from the 2020 NEI

	Primary	Secondary				Portion of $PM_{2.5}$				
Arizona County	**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 PMFine**
Gila	15,110	3,757	5,392	1,763	84,077	1,424	7,291	41	109	6,246
Maricopa	14,729	24,059	43,669	1,167	98,879	1,539	6,491	77	227	6,392
Pima	13,427	6,979	14,961	1,004	64,190	1,093	5,474	32	115	6,714
Coconino	7,465	3,809	12,454	653	105,740	774	3,381	23	61	3,226
Pinal	6,215	15,461	9,002	435	33,377	542	2,225	55	74	3,319
Greenlee	5,550	1,441	1,485	493	28,882	484	2,528	13	42	2,482
Yavapai	4,834	2,640	10,410	2,723	44,087	446	1,875	35	105	2,373
Apache	3,173	3,495	12,522	6,295	49,390	247	876	11	136	1,904
Graham	2,489	2,704	1,461	213	30,191	221	1,124	14	21	1,109
Mohave	2,107	3,401	9,866	146	37,627	247	765	16	29	1,050
Cochise	1,742	4,633	7,878	216	29,769	163	503	70	38	969
Navajo	1,485	2,994	8,799	1,889	34,443	121	342	21	46	955
Yuma	1,410	5,307	5,791	106	15,288	158	373	18	23	838
La Paz	682	3,405	3,142	17	10,728	56	133	5	8	480
Santa Cruz	213	1,027	1,164	8	13,857	25	77	4	4	103
Grand Total	**80,631**	**85,111**	**147,996**	**17,127**	**680,523**	**7,538**	**33,456**	**435**	**1,038**	**38,159**

Table A-8: Portion of PM Components Contribution to Total $PM_{2.5}$

AZ County	Total EC	EC %	Total OC	OC %	Total NO_3	NO_3 %	Total SO_4	SO4 %	Total PM-Fine	PM-Fine %	Total $PM_{2.5}$
Gila	1,424	9%	7,291	48%	41	0%	109	1%	6,246	41%	15,110
Maricopa	1,539	10%	6,491	44%	77	1%	227	2%	6,392	43%	14,729
Pima	1,093	8%	5,474	41%	32	0%	115	1%	6,714	50%	13,427
Coconino	774	10%	3,381	45%	23	0%	61	1%	3,226	43%	7,465
Pinal	542	9%	2,225	36%	55	1%	74	1%	3,319	53%	6,215
Greenlee	484	9%	2,528	46%	13	0%	42	1%	2,482	45%	5,550
Yavapai	446	9%	1,875	39%	35	1%	105	2%	2,373	49%	4,834
Apache	247	8%	876	28%	11	0%	136	4%	1,904	60%	3,173
Graham	221	9%	1,124	45%	14	1%	21	1%	1,109	45%	2,489
Mohave	247	12%	765	36%	16	1%	29	1%	1,050	50%	2,107
Cochise	163	9%	503	29%	70	4%	38	2%	969	56%	1,742
Navajo	121	8%	342	23%	21	1%	46	3%	955	64%	1,485
Yuma	158	11%	373	26%	18	1%	23	2%	838	59%	1,410
La Paz	56	8%	133	19%	5	1%	8	1%	480	70%	682
Santa Cruz	25	12%	77	36%	4	2%	4	2%	103	48%	213
Grand Total	**7,538**	**9%**	**33,456**	**41%**	**435**	**1%**	**1,038**	**1%**	**38,159**	**47%**	**80,631**

Table A-9: Arizona $PM_{2.5}$ Emissions by County and Source in Tons per Year (TPY) from the 2020 NEI

Arizona County	$PM_{2.5}$ Onroad	$PM_{2.5}$ Nonroad	$PM_{2.5}$ Nonpoint	$PM_{2.5}$ Point	Sum of $PM_{2.5}$	Percent of Total	Cumulative $PM_{2.5}$
Gila	25	26	14,638	421	15,110	18.7%	18.7%
Maricopa	588	911	12,443	787	14,729	18.3%	37.0%
Pima	154	288	12,525	459	13,427	16.7%	53.7%
Coconino	110	44	7,286	25	7,465	9.3%	62.9%
Pinal	132	77	5,858	148	6,215	7.7%	70.6%
Greenlee	3	1	5,119	428	5,550	6.9%	77.5%
Yavapai	135	57	4,310	332	4,834	6.0%	83.5%
Apache	41	9	2,046	1,077	3,173	3.9%	87.4%
Graham	9	10	2,468	2	2,489	3.1%	90.5%
Mohave	113	48	1,826	119	2,107	2.6%	93.1%
Cochise	66	27	1,339	311	1,742	2.2%	95.3%
Navajo	60	18	1,109	299	1,485	1.8%	97.1%
Yuma	66	69	1,204	70	1,410	1.7%	98.9%
La Paz	50	10	614	8	682	0.8%	99.7%
Santa Cruz	21	6	181	4	213	0.3%	100.0%
Grand Total	**1,575**	**1,600**	**72,965**	**4,491**	**80,631**	**100.0%**	

Table A-10: Arizona NH_3 Emissions by County and Source in Tons per Year (TPY) from the 2020 NEI

Arizona County	NH_3 Onroad	NH_3 Nonroad	NH_3 Nonpoint	NH_3 Point	Sum of NH_3	Percent of Total NH_3	Cumulative NH_3
Maricopa	12,41.6	23.6	22,560.3	233.1	24,058.7	28.27%	28.27%
Pinal	122.6	1.8	15,299.9	36.3	15,460.6	18.17%	46.43%
Pima	241.4	6.8	6,714.9	15.5	6,978.6	8.20%	54.63%
Yuma	57.1	1.6	5,248.3	0.0	5,307.0	6.24%	60.87%
Cochise	52.0	0.8	3,567.5	1,012.3	4,632.6	5.44%	66.31%
Coconino	85.5	1.1	3,722.3		3,808.9	4.48%	70.79%
Gila	24.4	0.6	3,731.3	0.5	3,756.9	4.41%	75.20%
Apache	31.9	0.2	3,401.7	61.5	3,495.4	4.11%	79.31%
La Paz	36.9	0.3	3,367.9		3,405.0	4.00%	83.31%
Mohave	91.6	1.7	3,308.1	0.1	3,401.4	4.00%	87.30%
Navajo	49.4	0.4	2,944.3	0.0	2,994.1	3.52%	90.82%
Graham	9.5	0.3	2,694.4		2,704.2	3.18%	94.00%
Yavapai	101.7	1.3	2,532.4	4.6	2,640.0	3.10%	97.10%
Greenlee	2.8	0.0	1,435.0	3.3	1,441.1	1.69%	98.79%
Santa Cruz	16.5	0.2	1,010.1		1,026.8	1.21%	100.00%
Grand Total	**21,64.9**	**40.7**	**81,538.5**	**1,367.2**	**85,111.3**	**100.00%**	

Table A-11: Arizona NO_x Emissions by County and Source in Tons per Year (TPY) from the 2020 NEI

Arizona County	NO_x Onroad	NO_x Nonroad	NO_x Nonpoint	NO_x Point	Sum of NO_x	Percent of Total NO_x	Cumulative NO_x
Maricopa	19,845.4	9,429.9	8,896.8	5,496.5	43,668.6	29.51%	29.51%
Pima	4,962.8	2,557.5	3,981.1	3,459.8	14,961.2	10.11%	39.62%
Apache	1,579.2	119.9	2,967.1	7,855.6	12,521.8	8.46%	48.08%
Coconino	4,138.7	463.4	6,896.9	955.3	12,454.2	8.42%	56.49%
Yavapai	4,941.2	491.5	2,829.3	2,148.4	10,410.4	7.03%	63.53%
Mohave	4,586.7	774.7	3,634.1	870.9	9,866.4	6.67%	70.19%
Pinal	4,846.7	754.2	2,453.5	947.9	9,002.4	6.08%	76.28%
Navajo	2,205.0	178.4	2,497.6	3,917.8	8,798.8	5.95%	82.22%
Cochise	2,604.4	361.5	2,155.5	2,756.5	7,877.9	5.32%	87.54%
Yuma	2,533.1	684.9	1,585.0	987.6	5,790.6	3.91%	91.46%
Gila	958.5	203.0	3,995.9	234.4	5,391.9	3.64%	95.10%
La Paz	2,214.2	110.4	540.3	277.1	3,142.0	2.12%	97.22%
Greenlee	96.1	12.0	1,251.4	125.9	1,485.3	1.00%	98.23%
Graham	308.4	135.3	1,002.8	14.0	1,460.5	0.99%	99.21%
Santa Cruz	805.9	64.5	260.5	33.3	1,164.1	0.79%	100.00%
Grand Total	**56,626.3**	**16,341.2**	**44,947.6**	**30,081.0**	**147,996.2**	**100.00%**	

Table A-12: Arizona SO_2 Emissions by County and Source in Tons per Year (TPY) from the 2020 NEI

Arizona County	SO_2 Onroad	SO_2 Nonroad	SO_2 Nonpoint	SO_2 Point	Sum of SO_2	Percent of Total SO_2	Cumulative SO_2
Apache	3.1	0.1	148.2	6143.5	6,295.0	36.75%	36.75%
Yavapai	10.4	0.6	295.2	2416.6	2,722.7	15.90%	52.65%
Navajo	4.9	0.2	21.7	1862.2	1,888.9	11.03%	63.68%
Gila	2.3	0.3	1,430.9	329.8	1,763.2	10.30%	73.98%
Maricopa	53.7	8.4	811.5	293.6	1,167.2	6.82%	80.79%
Pima	25.2	2.9	827.5	148.1	1,003.7	5.86%	86.65%
Coconino	8.6	0.5	634.2	10.2	653.5	3.82%	90.47%
Greenlee	0.3	0.0	491.5	1.0	492.9	2.88%	93.34%
Pinal	12.8	0.7	359.8	61.4	434.7	2.54%	95.88%
Cochise	5.0	0.4	51.7	158.6	215.8	1.26%	97.14%
Graham	1.0	0.1	211.3	0.8	213.2	1.24%	98.39%
Mohave	8.9	0.8	99.2	36.9	145.8	0.85%	99.24%
Yuma	5.7	0.6	28.8	70.6	105.6	0.62%	99.85%
La Paz	3.3	0.1	11.3	2.1	16.8	0.10%	99.95%
Santa Cruz	1.6	0.1	3.7	2.7	8.1	0.05%	100.00%
Grand Total	**146.7**	**15.9**	**5,426.5**	**11,538.0**	**17,127.0**	**100.00%**	

Table A-13: Arizona VOC Emissions by County and Source in Tons per Year (TPY) from the 2020 NEI

Arizona County	VOC Onroad	VOC Nonroad	VOC Nonpoint	VOC Point	Sum of VOC	Percent of Total VOC	Cumulative VOC
Coconino	1,158.9	906.3	103,622.2	52.8	105,740.3	15.54%	15.54%
Maricopa	14,451.7	6,416.2	76,691.1	1,319.7	98,878.7	14.53%	30.07%
Gila	482.4	941.1	82,552.2	101.6	84,077.3	12.35%	42.42%
Pima	3,902.1	2,384.0	57,333.8	569.9	64,189.8	9.43%	51.86%
Apache	477.7	162.3	48,544.2	205.8	49,390.0	7.26%	59.11%
Yavapai	1,893.8	655.0	41,423.1	115.0	44,086.9	6.48%	65.59%
Mohave	2,132.7	1,711.4	33,515.5	267.0	37,626.5	5.53%	71.12%
Navajo	811.4	254.8	33,273.4	103.2	34,442.7	5.06%	76.18%
Pinal	2,299.0	667.8	29,703.3	707.0	33,376.9	4.90%	81.09%
Graham	212.7	152.4	29,820.8	5.2	30,191.1	4.44%	85.52%
Cochise	1,056.2	647.6	27,679.6	385.1	29,768.5	4.37%	89.90%
Greenlee	59.6	18.1	28,736.7	67.6	28,882.0	4.24%	94.14%
Yuma	1,848.9	722.7	12,348.3	367.9	15,287.9	2.25%	96.39%
Santa Cruz	503.0	99.7	13,238.8	15.5	13,857.0	2.04%	98.42%
La Paz	499.1	336.4	9,880.7	11.4	10,727.6	1.58%	100.00%
Grand Total	**31,789.1**	**16,075.9**	**628,363.8**	**4,294.6**	**680,523.4**	**100.00%**	

A3.1.1 Maricopa County

A3.1.1.1 $PM_{2.5}$ Emissions from Point Sources

Figure 3 provides a visual representation of point sources from the 2020 NEI's locations with each circle symbol is proportional to their magnitude of $PM_{2.5}$ emissions. Table A-14 lists the point sources and their associated $PM_{2.5}$ emissions in tons per year that are inside the proposed Maricopa County (partial) $PM_{2.5}$ nonattainment area boundary recommendation. According to the NEI, airports are included in the point source category. The recommended 2024 Maricopa County (partial) $PM_{2.5}$ nonattainment area captures 400.7 tpy of $PM_{2.5}$ emissions from point sources out of the total 786.9 tpy that were reported in the 2020 NEI. That means that 50.9% of Maricopa County's total $PM_{2.5}$ emissions are captured within the recommended nonattainment area.

Figure 3: Point Sources in the Proposed Maricopa County NAA

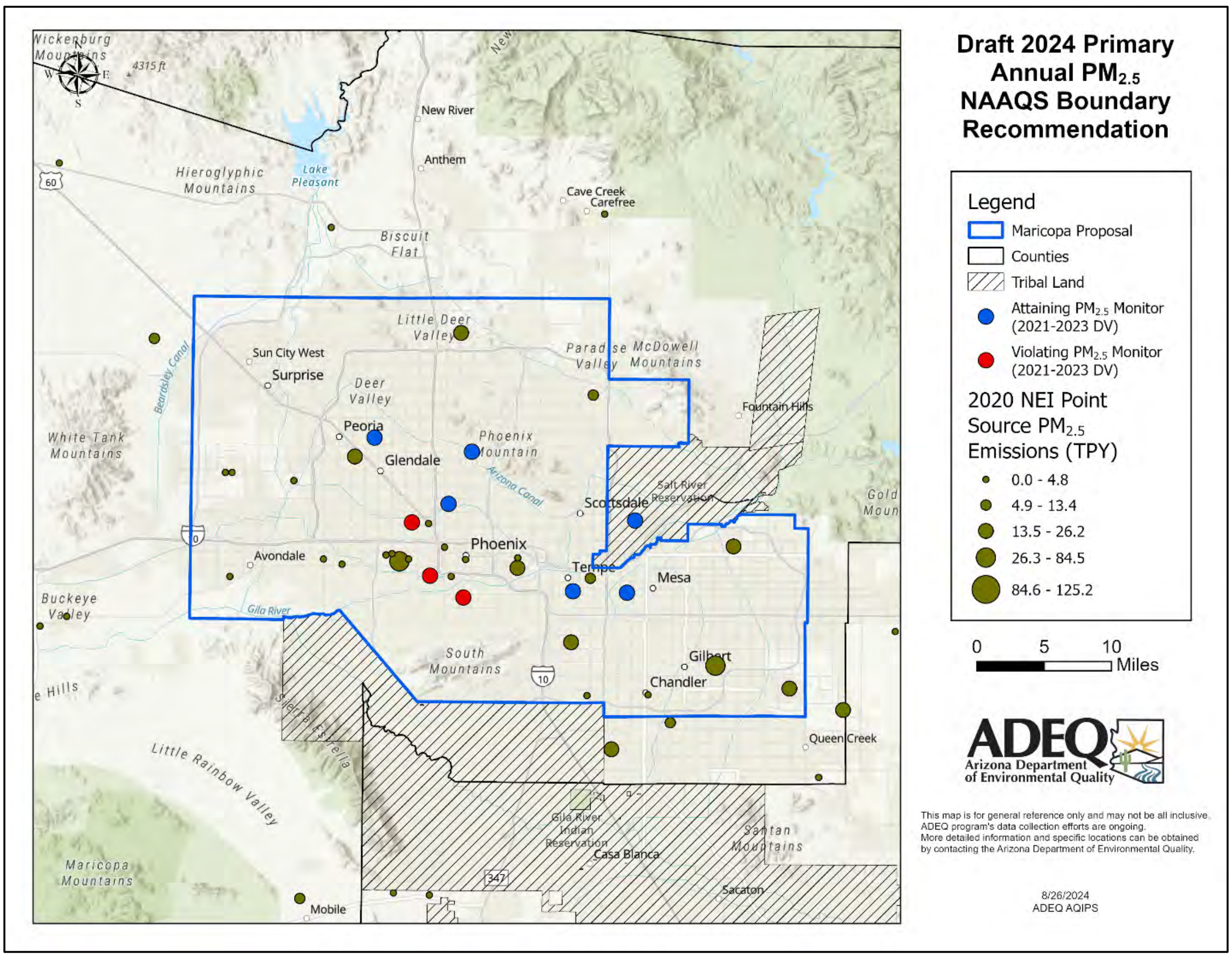


Table A-14: Point Sources in the Proposed Maricopa NAA

Facilities and their $PM_{2.5}$ Emissions from the 2020 NEI	
Site Name	$PM_{2.5}$ Emissions (tpy)
Phoenix Sky Harbor Intl	24.1
Intel Corp – Ocotillo Campus	26.2
CMC Steel Fabrications Inc	20.5
Phoenix-Mesa Gateway	18.3
Northwest Regional Landfill	13.4
Chandler Municipal	11.5
Stellar Airpark	1.9
Chandler	0.3
Pegasus Airpark	0.04
APS West Phx Power Plant	63.6
Salt River Project – Kyrene Generating Station	20.8
Salt River Project – Santan Generating Station	84.5
Salt River Project - Agua Fria Generating Station	17.5
Phoenix - MOBEST	3.3
Rexam Beverage Can Company	0.3
New Wincup Holdings Inc	0.2
APS Ocotillo Power Plant	9.1
Falcon Field	22.5
Oak Canyon Manufacturing Inc	1.4
Phoenix Deer Valley	24.2
Honeywell International Inc	1.9
Phoenix	1.3
Scottsdale Airport	11.6
Trendwood Inc	3.4
Campo	0.7
Tolleson	0.7
Phoenix Goodyear	4.5
Luke Air Force Base	4.8
Luke AFB - 56th Fighter Wing	4.0
Glendale Municipal	4.2
SFPP LP Phoenix Terminal	0.1
Total	400.7

A3.1.1.2 $PM_{2.5}$ Precursor Emissions

ADEQ considered contributions of precursor emissions when drafting the $PM_{2.5}$ boundary recommendation in Maricopa County. County-level emissions data from the 2020 NEI are shown in Table A-15. ADEQ provides an additional breakdown of the top five contributing source sectors for each precursor pollutant in

Table A-16, Table A-17, Table A-18, and Table A-19. ADEQ also considered the source sectors that contribute the most to secondary formation of $PM_{2.5}$ when drafting the $PM_{2.5}$ boundary recommendation and found that 60% of NO_X emissions 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 in Maricopa County comes from agriculture, specifically livestock waste and fertilizer application.

Table A-15: Maricopa County Precursor Emissions in Tons Per Year from the 2020 NEI

Maricopa County	NO_x	NO_x % of total	SO_2	SO_2 % of total	VOCs	VOC % of total	NH_3	NH_3 % of total
Agriculture - Fertilizer Application							4438.3	18%
Agriculture - Livestock Waste					1134.4	1%	14213.6	59%
Biogenics - Vegetation and Soil	1022.6	2%			21018.5	21%		
Bulk Gasoline Terminals					154.7	0%		
Commercial Cooking					520.7	1%		
Fires - Wildfires	1113.2	3%	534.4	46%	13784.5	14%	958.9	4%
Fuel Comb - Natural Gas - Commercial/Institutional	1038.8	2%	6.2	1%	57.1	0%	5.1	0%
Fuel Comb - Oil - Commercial/Institutional	8.9	0%	0.5	0%	0.5	0%	0.1	0%
Fuel Comb - Other - Commercial/Institutional	121.4	0%	59.8	5%	6.3	0%	0.4	0%
Fuel Comb - Natural Gas - Industrial Boilers, ICEs	871.0	2%	5.2	0%	47.9	0%	27.9	0%

Fuel Comb - Oil - Industrial Boilers, ICEs	2645.7	6%	169.9	15%	176.6	0%	8.3	0%
Fuel Comb - Other - Industrial Boilers, ICEs	107.2	0%	0.5	0%	3.9	0%	2.3	0%
Fuel Comb - Natural Gas - Residential	791.2	2%	5.1	0%	46.3	0%	168.3	1%
Fuel Comb - Oil - Residential	0.2	0%	0.1	0%		0%	0.0	0%
Fuel Comb - Other - Residential	53.1	0%	0.2	0%	2.1	0%	0.2	0%
Fuel Comb - Wood - Residential	108.2	0%	14.5	1%	923.9	1%	50.7	0%
Gas Stations					2506.8	3%		
Industrial Processes - Chemical Manufacture					149.4	0%		
Industrial Processes - Non-ferrous Metals	20.5	0%	6.0	1%	46.1	0%	1.2	0%
Industrial Processes - Not Elsewhere Classified	53.0	0%	0.6	0%	1283.4	1%	2566.2	11%
Industrial Processes - Storage and Transfer					113.6	0%		
Miscellaneous Non-Industrial Not Elsewhere Classified	49.0	0%	3.4	0%	2735.8	3%		
Mobile - Locomotives	868.0	2%	0.7	0%	35.8	0%	0.6	0%
Mobile - Non-Road Equipment - Diesel	8234.5	19%	6.6	1%	810.3	1%	18.0	0%
Mobile - Non-Road Equipment - Gasoline	804.3	2%	0.9	0%	5535.3	6%	5.7	0%
Mobile - Non-Road Equipment - Other	391.1	1%	0.9	0%	70.6	0%		
Mobile - On-Road Diesel Heavy Duty Vehicles	6689.1	15%	9.3	1%	316.1	0%	67.1	0%
Mobile - On-Road Diesel Light Duty Vehicles	1100.5	3%	0.9	0%	171.0	0%	9.6	0%
Mobile - On-Road non-Diesel Heavy Duty Vehicles	563.5	1%	4.7	0%	498.7	1%	97.7	0%
Mobile - On-Road non-Diesel Light Duty Vehicles	11492.3	26%	38.8	3%	12236.4	12%	1067.3	4%
Solvent - Consumer & Commercial Solvent Use					21329.2	22%		

Solvent - Degreasing					527.3	1%		
Solvent - Dry Cleaning					12.4	0%		
Solvent - Graphic Arts					234.5	0%		
Solvent - Industrial Surface Coating & Solvent Use					4855.0	5%		
Solvent - Non-Industrial Surface Coating					5369.5	5%		
Waste Disposal	24.7	0%	4.4	0%	844.5	1%	118.2	0%
Point Sources	5496.5	13%	293.6	25%	1319.7	1%	233.1	1%
SUM	**43668.6**	**100%**	**1167.2**	**100%**	**98878.7**	**100%**	**24058.7**	**100%**

Table A-16: Maricopa County Top NO_x Emissions by Source Sector

Maricopa County Top NO_x Source Sectors	TPY	% of total
Mobile - On-Road non-Diesel Light Duty Vehicles	11492.3	26%
Mobile - Non-Road Equipment - Diesel	8234.5	19%
Mobile - On-Road Diesel Heavy Duty Vehicles	6689.1	15%
Point Sources	5496.5	13%
Fuel Comb - Industrial Boilers, ICEs - Oil	2645.7	6%

Table A-17: Maricopa County Top SO_2 Emissions by Source Sector

Maricopa County Top SO_2 Source Sectors	TPY	% of total
Fires - Wildfires	534.4	46%
Point Sources	293.6	25%
Fuel Comb - Industrial Boilers, ICEs - Oil	169.9	15%
Fuel Comb - Comm/Institutional - Other	59.8	5%
Mobile - On-Road non-Diesel Light Duty Vehicles	38.8	3%

Table A-18: Maricopa County Top VOC Emissions by Source Sector

Maricopa County Top VOC Source Sectors	TPY	% of total
Solvent - Consumer & Commercial Solvent Use	21329.2	22%
Biogenics - Vegetation and Soil	21018.5	21%
Fires - Wildfires	13784.5	14%
Mobile - On-Road non-Diesel Light Duty Vehicles	12236.4	12%
Solvent - Non-Industrial Surface Coating	5369.5	5%

Table A-19: Maricopa County Top NH_3 Emissions by Source Sector

Maricopa County Top NH_3 Source Sectors	TPY	% of total
Agriculture - Livestock Waste	14213.6	59%
Agriculture - Fertilizer Application	4438.3	18%
Industrial Processes - Not Elsewhere Classified	2566.2	11%
Mobile - On-Road non-Diesel Light Duty Vehicles	1067.3	4%
Fires - Wildfires	958.9	4%

A3.1.2 Pinal County

A3.1.2.1 $PM_{2.5}$ Emissions from Point Sources

Figure 4 provides a visual representation of point source locations and their $PM_{2.5}$ emissions from the 2020 NEI in Pinal County. Table A-20 lists point source $PM_{2.5}$ emissions from the 2020 NEI that are within the recommended 2024 Pinal County $PM_{2.5}$ nonattainment area. The total $PM_{2.5}$ emissions from point sources in Pinal County is 148.0 tons per year and 2.3 tons of that total are within the proposed contingency based 2024 $PM_{2.5}$ Pinal County (partial) recommended nonattainment area. That equates to approximately 2% of direct $PM_{2.5}$ emissions from point sources would be captured within the recommended area.

Figure 4: Point Sources in the Proposed Pinal County NAA

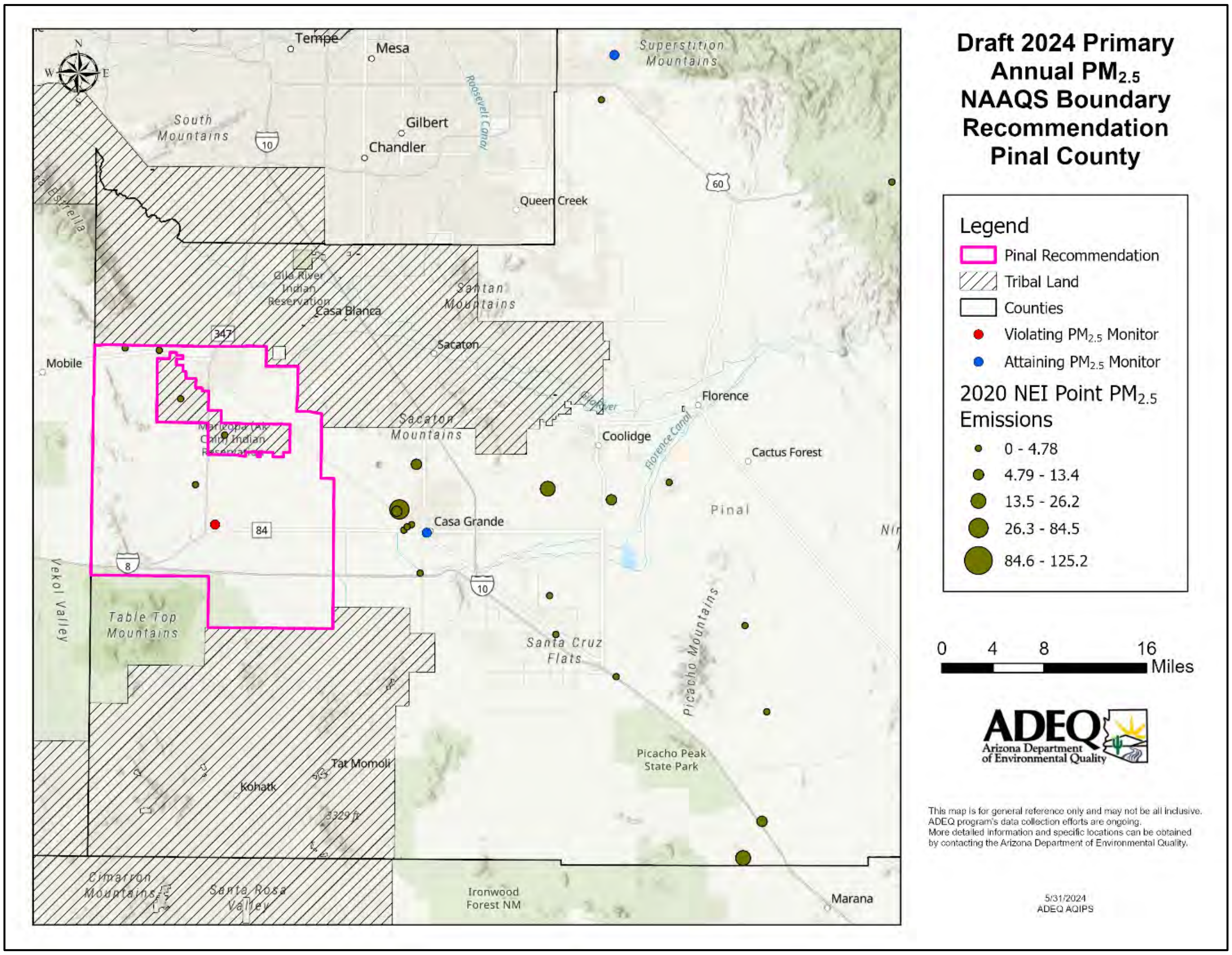


Table A-20: Point Sources in the Proposed Pinal County NAA

Facilities and $PM_{2.5}$ Emissions from the 2020 NEI	
Site Name	$PM_{2.5}$ Emissions (tpy)
Casa Grande Compressor Station	0.7
Arizona Soaring	1.2
Sierra Estrella Landfill	0.4
Total	2.3

A3.1.2.2 $PM_{2.5}$ Precursor Emissions

ADEQ considered contributions of precursor emissions when drafting the $PM_{2.5}$ boundary recommendation in Pinal County. County-level emissions data from the 2020 NEI are shown in Table A-21. ADEQ provides an additional breakdown of the top five contributing source sectors for each precursor pollutant in Table A-22, Table A-23, Table A-24, and Table A-25. 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 ammonia emissions in Pinal County are from livestock waste and fertilizer application from the agricultural source sectors.

Table A-21: Pinal County Precursor Emissions in Tons Per Year from the 2020 NEI

Pinal County	NO_x	NO_x % of total	SO_2	SO_2 % of total	VOC	VOC % of total	NH_3 TPY	NH_3 % of total
Agriculture - Fertilizer Application							4364.3	28%
Agriculture - Livestock Waste					816.3	2%	10203.6	66%
Biogenics - Vegetation and Soil	685.8	8%			14610.7	44%		
Bulk Gasoline Terminals					1.7	0%		
Commercial Cooking					22.4	0%		
Fires - Agricultural Field Burning	24.2	0%	8.3	2%	135.4	0%	28.1	0%
Fires - Wildfires	696.5	8%	326.5	75%	8076.7	24%	561.9	4%
Fuel Comb - Biomass - Commercial/Institutional	0.4	0%	0.05	0%	0.03	0%	0.01	0%
Fuel Comb - Natural Gas - Commercial/Institutional	7.4	0%	0.04	0%	0.41	0%	0.04	0%
Fuel Comb - Other - Commercial/Institutional	1.3	0%	0.01	0%	0.05	0%	0.005	0%
Fuel Comb - Biomass - Industrial Boilers, ICEs	0.5	0%	0.05	0%	0.04	0%	0.01	0%
Fuel Comb - Natural Gas - Industrial Boilers, ICEs	5.0	0%	0.03	0%	0.28	0%	0.16	0%
Fuel Comb - Oil - Industrial Boilers, ICEs	20.2	0%	1.28	0%	1.35	0%	0.06	0%
Fuel Comb - Other - Industrial Boilers, ICEs	0.6	0%	0.00	0%	0.02	0%	0.01	0%
Fuel Comb - Natural Gas - Residential	106.5	1%	0.68	0%	6.23	0%	22.66	0%
Fuel Comb - Oil - Residential	0.1	0%	0.00	0%	0.00	0%	0.01	0%
Fuel Comb - Other - Residential	16.8	0%	0.07	0%	0.65	0%	0.06	0%
Fuel Comb - Wood - Residential	23.5	0%	4.38	1%	231.3	1%	11.6	0%

Gas Stations					492.4	1%		
Industrial Processes - Storage and Transfer					5.8	0%		
Miscellaneous Non-Industrial Not Elsewhere Classified	2.6	0%	0.27	0%	1803.8	5%		
Mobile - Commercial Marine Vessels	1.3	0%	0.01	0%	0.04	0%	0.001	0%
Mobile - Locomotives	803.9	9%	0.59	0%	33.7	0%	0.5	0%
Mobile - Non-Road Equipment - Diesel	680.3	8%	0.53	0%	64.6	0%	1.4	0%
Mobile - Non-Road Equipment - Gasoline	64.1	1%	0.19	0%	601.3	2%	0.4	0%
Mobile - Non-Road Equipment - Other	9.8	0%	0.02	0%	1.8	0%		
Mobile - On-Road Diesel Heavy Duty Vehicles	2908.9	32%	2.81	1%	132.1	0%	17.7	0%
Mobile - On-Road Diesel Light Duty Vehicles	261.5	3%	0.22	0%	40.2	0%	2.4	0%
Mobile - On-Road non-Diesel Heavy Duty Vehicles	70.7	1%	0.39	0%	71.9	0%	3.3	0%
Mobile - On-Road non-Diesel Light Duty Vehicles	1605.6	18%	9.3	2%	1853.9	6%	99.2	1%
Solvent - Consumer & Commercial Solvent Use					3005.4	9%		
Solvent - Degreasing					19.6	0%		
Solvent - Graphic Arts					14.5	0%		
Solvent - Industrial Surface Coating & Solvent Use					163.2	0%		
Solvent - Non-Industrial Surface Coating					252.4	1%		
Waste Disposal	56.8	1%	17.5	4%	210.0	1%	107.1	1%
Point Sources	947.9	11%	61.4	14%	707.0	2%	36.3	0%
Total	**9002.4**	**100%**	**434.7**	**100%**	**33376.9**	**100%**	**15460.6**	**100%**

Table A-22: Pinal County Top NO_x Emissions by Source Sector

Pinal County Top NO_x Source Sectors	TPY	% of total
Mobile - On-Road Diesel Heavy Duty Vehicles	2908.9	32%
Mobile - On-Road non-Diesel Light Duty Vehicles	1605.6	18%
MISC. Point Sources	947.9	11%
Mobile - Locomotives	803.9	9%
Fires - Wildfires	696.5	8%

Table A-23: Pinal County Top SO_2 Emissions by Source Sector

Pinal County Top SO_2 Source Sectors	TPY	% of total
Fires - Wildfires	326.5	75%
MISC. Point Sources	61.4	14%
Waste Disposal	17.5	4%
Mobile - On-Road non-Diesel Light Duty Vehicles	9.3	2%
Fires - Agricultural Field Burning	8.3	2%

Table A-24: Pinal County Top VOC Emissions by Source Sector

Pinal County Top VOC Source Sectors	TPY	% of total
Biogenics - Vegetation and Soil	14610.7	44%
Fires - Wildfires	8076.7	24%
Solvent - Consumer & Commercial Solvent Use	3005.4	9%
Mobile - On-Road non-Diesel Light Duty Vehicles	1853.9	6%
Miscellaneous Non-Industrial Not Elsewhere Classified	1803.8	5%

Table A-25: Pinal County Top NH_3 Emissions by Source Sector

Pinal County Top NH_3 Source Sectors	TPY	% of total
Agriculture - Livestock Waste	10203.6	66%
Agriculture - Fertilizer Application	4364.3	28%
Fires - Wildfires	561.9	4%
Waste Disposal	107.1	1%
Mobile - On-Road non-Diesel Light Duty Vehicles	99.2	1%

A3.1.3 Santa Cruz County

A3.1.3.1 $PM_{2.5}$ Emissions from Point Sources

Figure 5 provides a visual representation of point source $PM_{2.5}$ emissions near the recommended boundary for Santa Cruz County. Table A-26 lists point source $PM_{2.5}$ emissions from the 2020 NEI that are in the recommended 2024 $PM_{2.5}$ Santa Cruz County (partial) $PM_{2.5}$ nonattainment area. According to the EPA NEI, airports are included in the point source category. The only point source in the recommended nonattainment area accounts for 0.4 tons per year of emissions and represents 9.5% of the total $PM_{2.5}$ emissions in Santa Cruz County for 2020.

Figure 5: Point Sources near the Proposed Nogales NAA

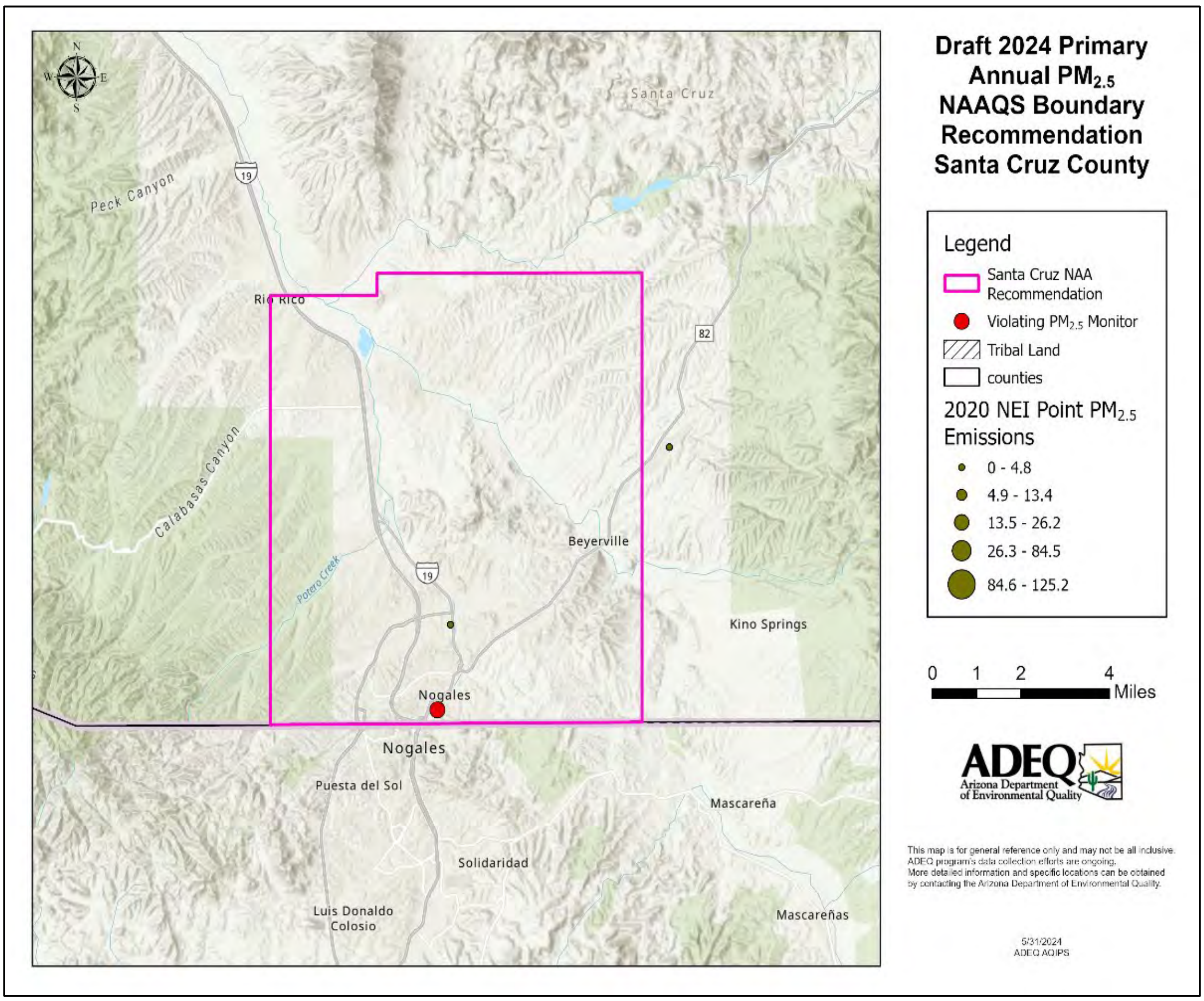


Table A-26: Point Sources in the Proposed Nogales NAA

Facility and $PM_{2.5}$ Emissions from the 2020 NEI	
Site Name	$PM_{2.5}$ Emissions (tpy)
VALENCIA POWER PLANT	0.4
Total	0.4

A3.1.3.2 $PM_{2.5}$ Precursor Emissions

ADEQ considered contributions of emissions from precursor pollutants when drafting the $PM_{2.5}$ boundary recommendation in Santa Cruz County. County-level emissions data from the 2020 NEI are shown in Table A-27. ADEQ provides an additional breakdown of the top five contributing source sectors for each precursor pollutant in Table A-28, Table A-29, Table A-30, and Table A-31. County-level emissions data from the 2020 NEI reveal 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.

Table A-27: Santa Cruz County Precursor Emissions in Tons Per Year from the 2020 NEI

Santa Cruz County	NO_x	NO_x % of total	SO_2	SO_2 % of total	VOC	VOC % of total	NH_3	NH_3 % of total
Agriculture - Crops & Livestock Dust								
Agriculture - Fertilizer Application							506.3	49%
Agriculture - Livestock Waste					39.3	0%	491.5	48%
Biogenics - Vegetation and Soil	191.9	16%			12587.5	91%		
Commercial Cooking					4.3	0%		
Dust - Construction								
Dust - Paved Roads								
Dust - Unpaved Roads								
Fires - Wildfires	3	0%	1.3	17%	30.8	0%	2.1	0%

Fuel Comb - Biomass - Commercial/Institutional	0.1	0%	0.01	0%	0.01	0%	0.002	0%
Fuel Comb – Natural Gas Commercial/Institutional	1.7	0%	0.01	0%	0.1	0%	0.01	0%
Fuel Comb - Other - Commercial/Institutional	0.3	0%	0.001	0%	0.01	0%	0.001	0%
Fuel Comb - Biomass - Industrial Boilers, ICEs	0.04	0%	0.005	0%	0.003	0%	0.001	0%
Fuel Comb - Natural Gas - Industrial Boilers, ICEs	0.4	0%	0.003	0%	0.02	0%	0.01	0%
Fuel Comb - Oil - Industrial Boilers, ICEs	1.8	0%	0.1	1%	0.1	0%	0.01	0%
Fuel Comb - Other - Industrial Boilers, ICEs	0.05	0%			0.002	0%	0.001	0%
Fuel Comb - Natural Gas - Residential	11.3	1%	0.1	1%	0.7	0%	2.4	0%
Fuel Comb - Other - Residential	7.8	1%	0.03	0%	0.3	0%	0.03	0%
Fuel Comb - Wood - Residential	2.8	0%	0.6	7%	28.6	0%	1.4	0%
Gas Stations					117.6	1%		
Industrial Processes - Mining								
Industrial Processes - Storage and Transfer					0.7	0%		
MISC Non-Industrial Not Elsewhere Classified	0.3	0%	0.03	0%	87.5	1%		
Mobile - Locomotives	33.3	3%	0.03	0%	1.3	0%	0.02	0%
Mobile - Non-Road Equipment - Diesel	44.4	4%	0.03	0%	4.2	0%	0.1	0%
Mobile - Non-Road Equipment - Gasoline	15.2	1%	0.05	1%	94.3	1%	0.1	0%
Mobile - Non-Road Equipment - Other	4.8	0%	0.01	0%	1.2	0%		

Mobile - On-Road Diesel Heavy Duty Vehicles	420.0	36%	0.4	5%	20.9	0%	2.3	0%
Mobile - On-Road Diesel Light Duty Vehicles	55.2	5%	0.04	0%	9.7	0%	0.4	0%
Mobile - On-Road non-Diesel Heavy Duty Vehicles	13.5	1%	0.06	1%	14.0	0%	0.5	0%
Mobile - On-Road non-Diesel Light Duty Vehicles	317.1	27%	1.2	14%	428.8	3%	13.2	1%
Solvent - Consumer & Commercial Solvent Use					296.9	2%		
Solvent - Degreasing					6.5	0%		
Solvent - Graphic Arts					6.3	0%		
Solvent - Industrial Surface Coating & Solvent Use					22.9	0%		
Solvent - Non-Industrial Surface Coating					24.6	0%		
Waste Disposal	5.8	0%	1.4	18%	12.2	0%	6.2	1%
Point - Airport	25.0	2%	2.6	32%	15.4	0%		
Point - EGU	8.3	1%	0.1	1%	0.1	0%		
Total	**1164.1**	**100%**	**8.1**	**100%**	**13857.0**	**100%**	**1026.8**	**100%**

Table A-28: Santa Cruz County Top NO_x Emissions by Source Sector

Santa Cruz County Top NO_x Source Sectors	TPY	% of total
Mobile - On-Road Diesel Heavy Duty Vehicles	420.0	37%
Mobile - On-Road non-Diesel Light Duty Vehicles	317.1	28%
Biogenics - Vegetation and Soil	191.9	17%
Mobile - On-Road Diesel Light Duty Vehicles	55.2	5%
Mobile - Non-Road Equipment - Diesel	44.4	4%

Table A-29: Santa Cruz County Top SO_2 Emissions by Source Sector

Santa Cruz County Top SO_2 Source Sectors	TPY	% of total
Point - Airport	2.6	32%
Waste Disposal	1.4	18%
Fires - Wildfires	1.3	17%
Mobile - On-Road non-Diesel Light Duty Vehicles	1.2	14%
Fuel Comb - Residential - Wood	0.6	7%

Table A-30: Santa Cruz County Top VOC Emissions by Source Sector

Santa Cruz County Top VOC Source Sectors	TPY	% of total
Biogenics - Vegetation and Soil	12587.5	91%
Mobile - On-Road non-Diesel Light Duty Vehicles	428.8	3%
Solvent - Consumer & Commercial Solvent Use	296.9	2%
Gas Stations	117.6	1%
Mobile - Non-Road Equipment - Gasoline	94.3	1%

Table A-31: Santa Cruz County Top NH_3 Emissions by Source Sector

Santa Cruz County Top NH_3 Source Sectors	TPY	% of total
Agriculture - Fertilizer Application	506.3	49%
Agriculture - Livestock Waste	491.5	48%
Mobile - On-Road non-Diesel Light Duty Vehicles	13.2	1%
Waste Disposal	6.2	1%
Fuel Comb - Residential - Natural Gas	2.4	0%

A3.2 VMT Analysis

Using 3 years of meteorological data for 2021-2023, ADEQ plotted wind roses to show the wind direction and wind speed for ambient $PM_{2.5}$ monitors, where meteorological data was available. Wind roses, pollution roses, and percentile roses were plotted annually and seasonally for each of the three years, as well as hourly data on days that the 24-hour average concentration exceeds the primary annual standard.

Table A-32: Maricopa County VMT Analysis

Description	Vehicle Miles Traveled	Percent of County Total
Entire County	42,294,822,605	100%
Proposed Boundary	28,172,378,925	66.6%

Table A-33: Pinal County VMT Analysis

Description	Vehicle Miles Traveled	Percent of County Total
Entire County	4,148,000,142	100%
Proposed Boundary	302,727,661	7.3%

Table A-34: Santa Cruz County VMT Analysis

Description	Vehicle Miles Traveled	Percent of County Total
Entire County	492,134,659	100%
Proposed Boundary	248,731,767	50.54%

A3.3 Emissions Analysis from Local Permitting Authorities

ADEQ combined direct $PM_{2.5}$ emissions and precursor emissions data from class I, class II and portable sources that reported directly to ADEQ in 2022, as well as point sources that reported to Maricopa County Air Quality Department and Pinal County Air Quality Control District in 2022. The draft boundary recommendation contains graphics of weighted precursor emissions in Maricopa County, Pinal County, and Santa Cruz County. To find this value NO_x, SO_2, NH_3, and VOC were added together to display a weighted total in tons per year. However, the TSD contains figures of each individual precursor emissions by county as well.

A3.3.1 Maricopa County

A3.3.1.1 Precursor Emissions from Permitted Sources

The TSD provides a visual representation of all locally permitted point sources in 2022 and their reported $PM_{2.5}$, NO_x, SO_2, VOC and NH_3 emissions. Table A-35 displays the amount of direct and precursor emissions captured in the Maricopa County (partial) boundary recommendation from permitted point sources that reported to ADEQ and MCAQD in 2022.

Table A-35: Statistics of $PM_{2.5}$ and Precursor Emissions Captured in the Maricopa NAA

Pollutant	NO_X	SO_2	VOC	NH_3	$PM_{2.5}$
TPY	908.8	144.6	2214.5	23.0	342.2
% of Total	44.2%	50.8%	77.9%	8.1%	43.4%

Figure 6 displays the locations and magnitude of SO_2 emitting MCAQD permitted sources. The size of each symbol is proportional to their SO_2 emissions in tons per year. Figure 7 displays the locations and magnitude of NO_x emitting MCAQD permitted sources. The size of each symbol is proportional to their NO_x emissions in tons per year. Figure 8 displays the locations and magnitude of NH_3 emitting MCAQD permitted sources. The size of each symbol is proportional to their NH_3 emissions in tons per year. Figure 9 displays the locations and magnitude of VOC emitting MCAQD permitted sources. The size of each symbol is proportional to their VOC emissions in tons per year.

Figure 6: SO_2 Emissions from Locally Permitted Sources in 2022

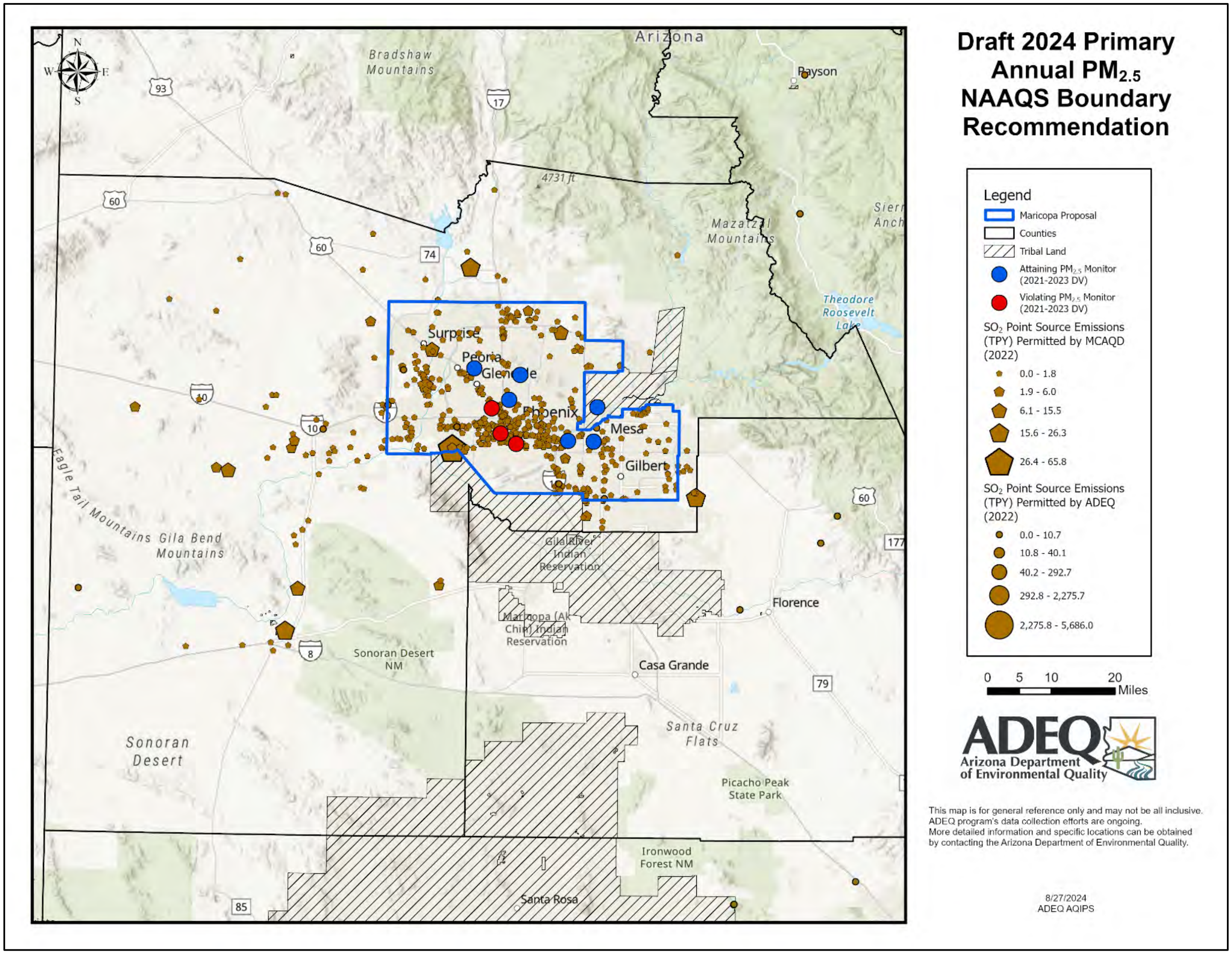


Figure 7: NO_X Emissions from Locally Permitted Sources in 2022

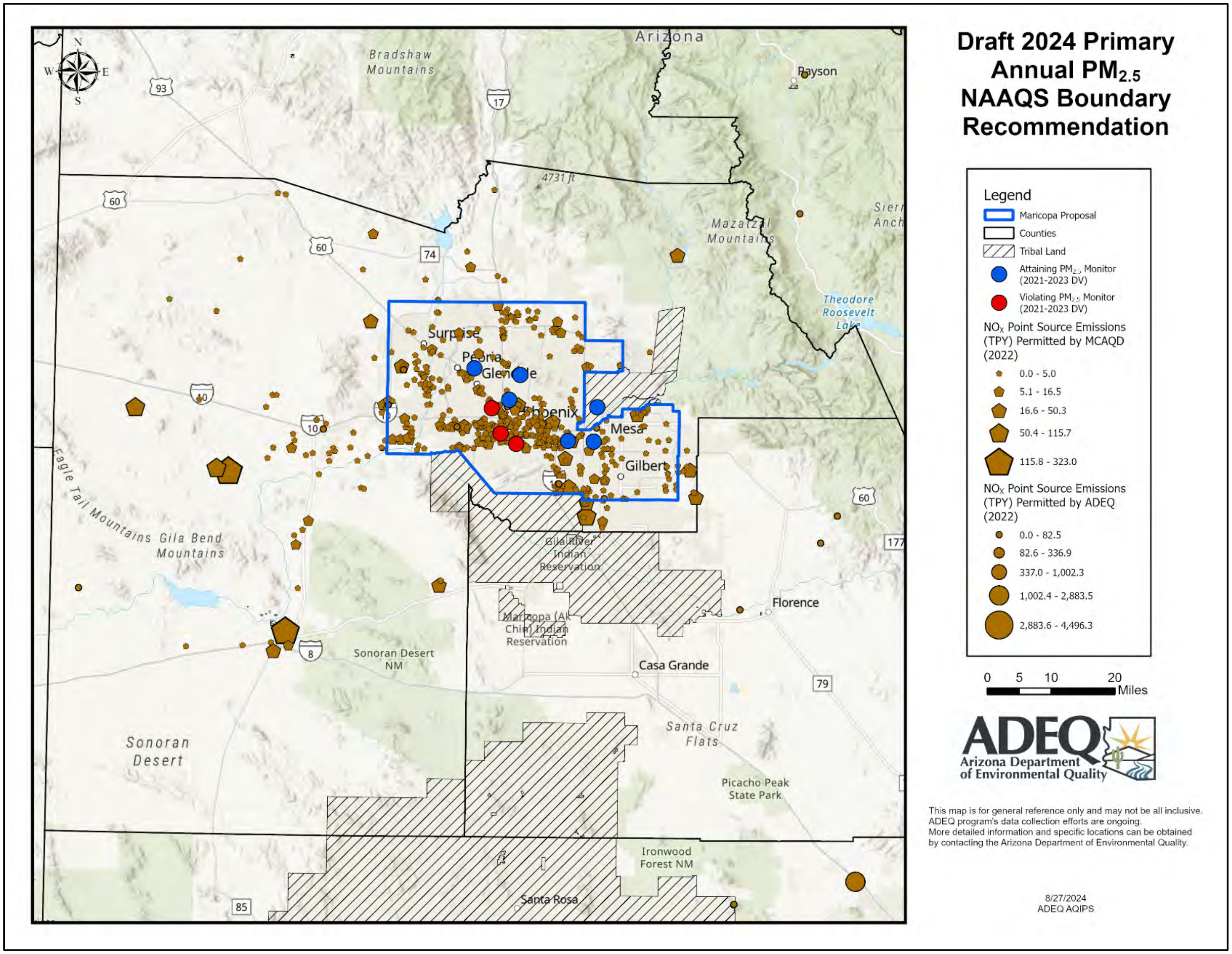


Figure 8: NH_3 Emissions from Locally Permitted Sources in 2022

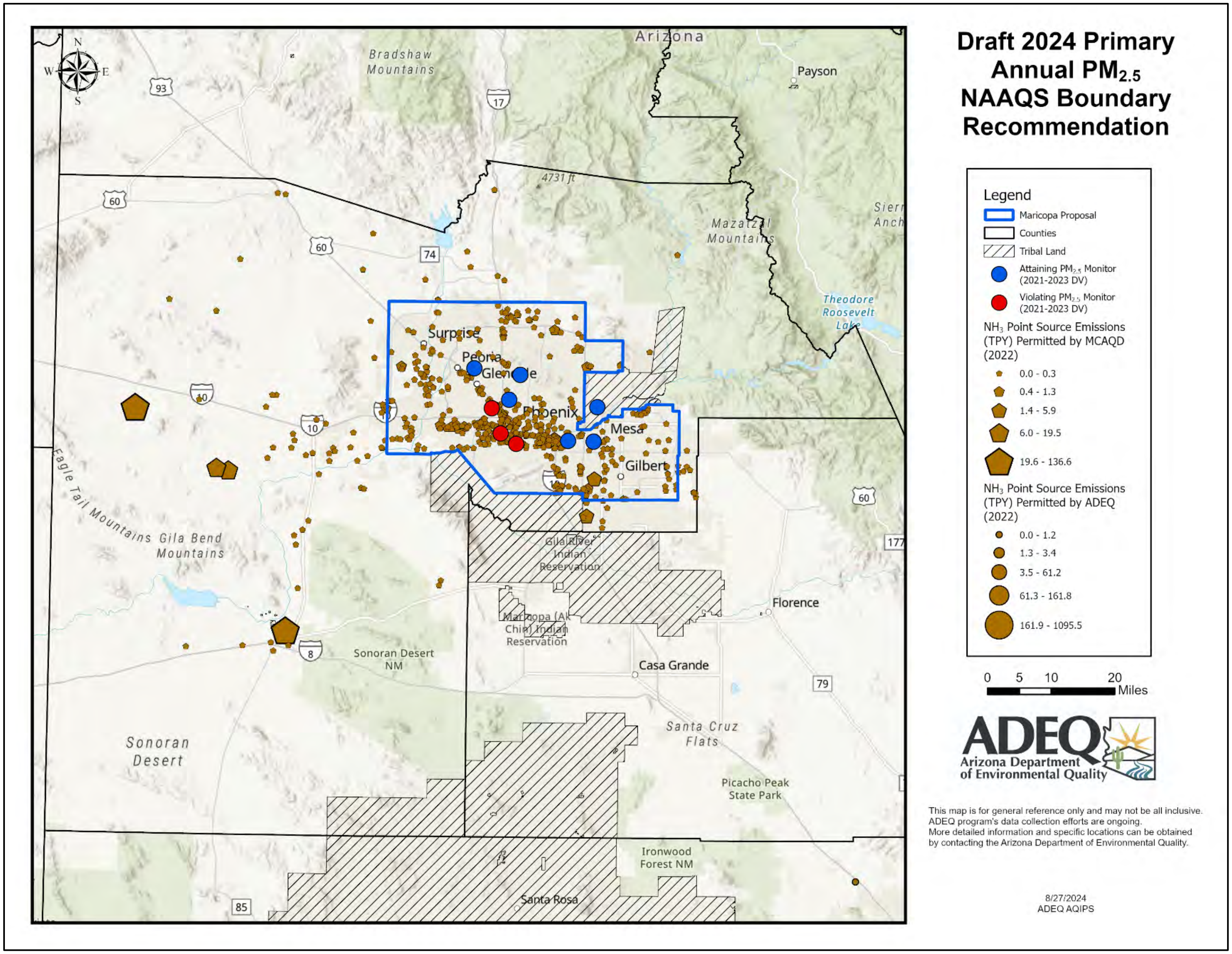
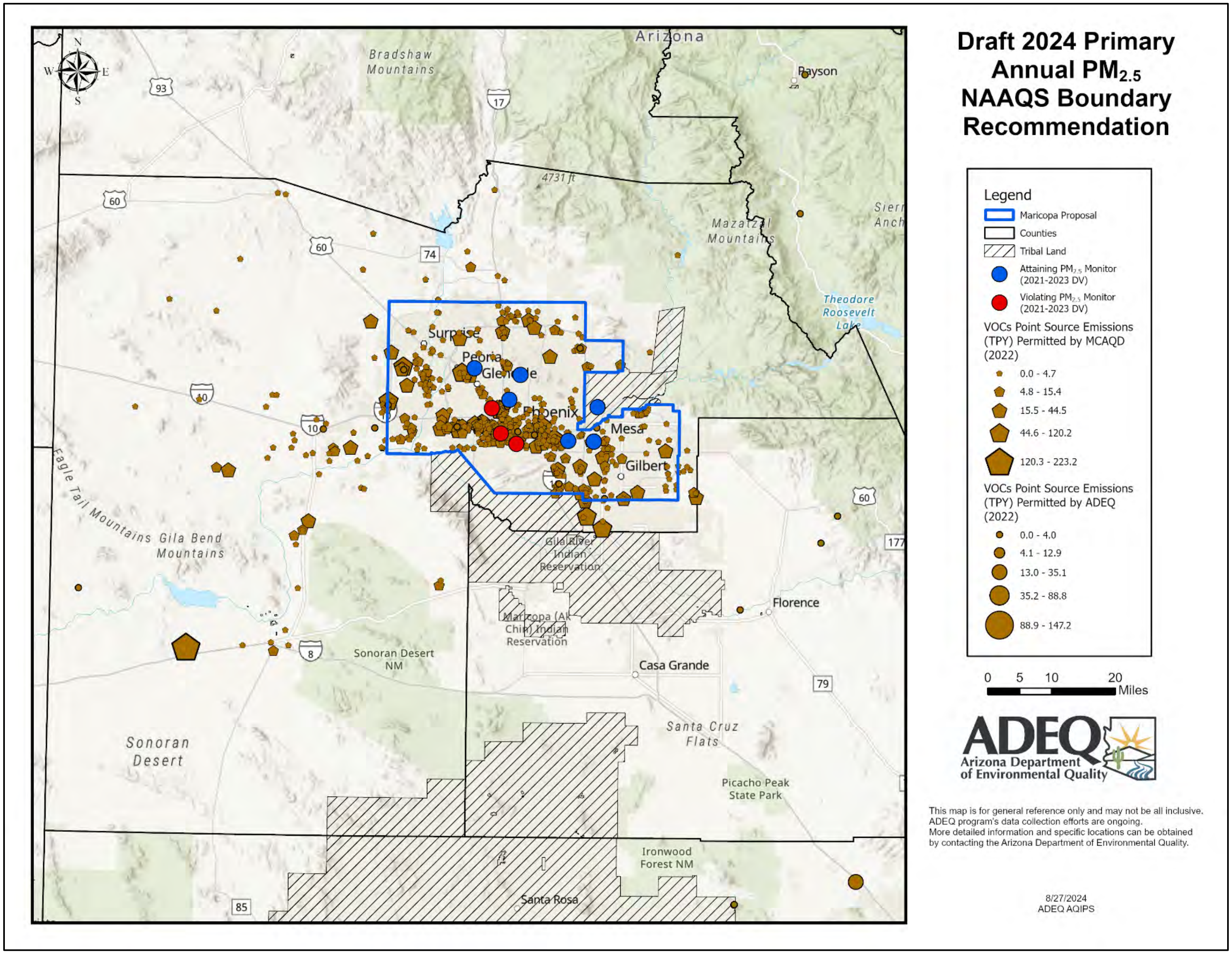


Figure 9: VOC Emissions from Locally Permitted Sources in 2022



A3.3.2 Pinal County

A3.3.2.1 Precursor Emissions from Permitted Sources

The TSD provides a visual representation of all locally permitted point sources in 2022 and their reported NO_x, SO_2, VOC, and NH_3 emissions. Table A-36 shows the contingency based Pinal County (partial) boundary recommendation captures 2.7% of NO_x, 3.2% of SO_2, 8.6% of VOC, and 0% of NH_3 from permitted point sources that reported to ADEQ and PCAQCD.

Table A-36: Statistics of $PM_{2.5}$ and Precursor Emissions Captured within the Pinal 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	2.7%	3.2%	8.6%	0%	4.2%

Figure 10 displays the locations and magnitude of NO_x emitting PCAQCD permitted sources. The size of each symbol is proportional to their NO_x emissions in tons per year. Figure 11 displays the locations and magnitude of SO_2 emitting PCAQCD permitted sources. The size of each symbol is proportional to their SO_2 emissions in tons per year. Figure 12 displays the locations and magnitude of NH_3 emitting PCAQCD permitted sources. The size of each symbol is proportional to their NH_3 emissions in tons per year. Figure 13 displays the locations and magnitude of VOC emitting PCAQCD permitted sources. The size of each symbol is proportional to their VOC emissions in tons per year.

Figure 10: NO_X Emissions from Permitted PCAQCD Sources in 2022

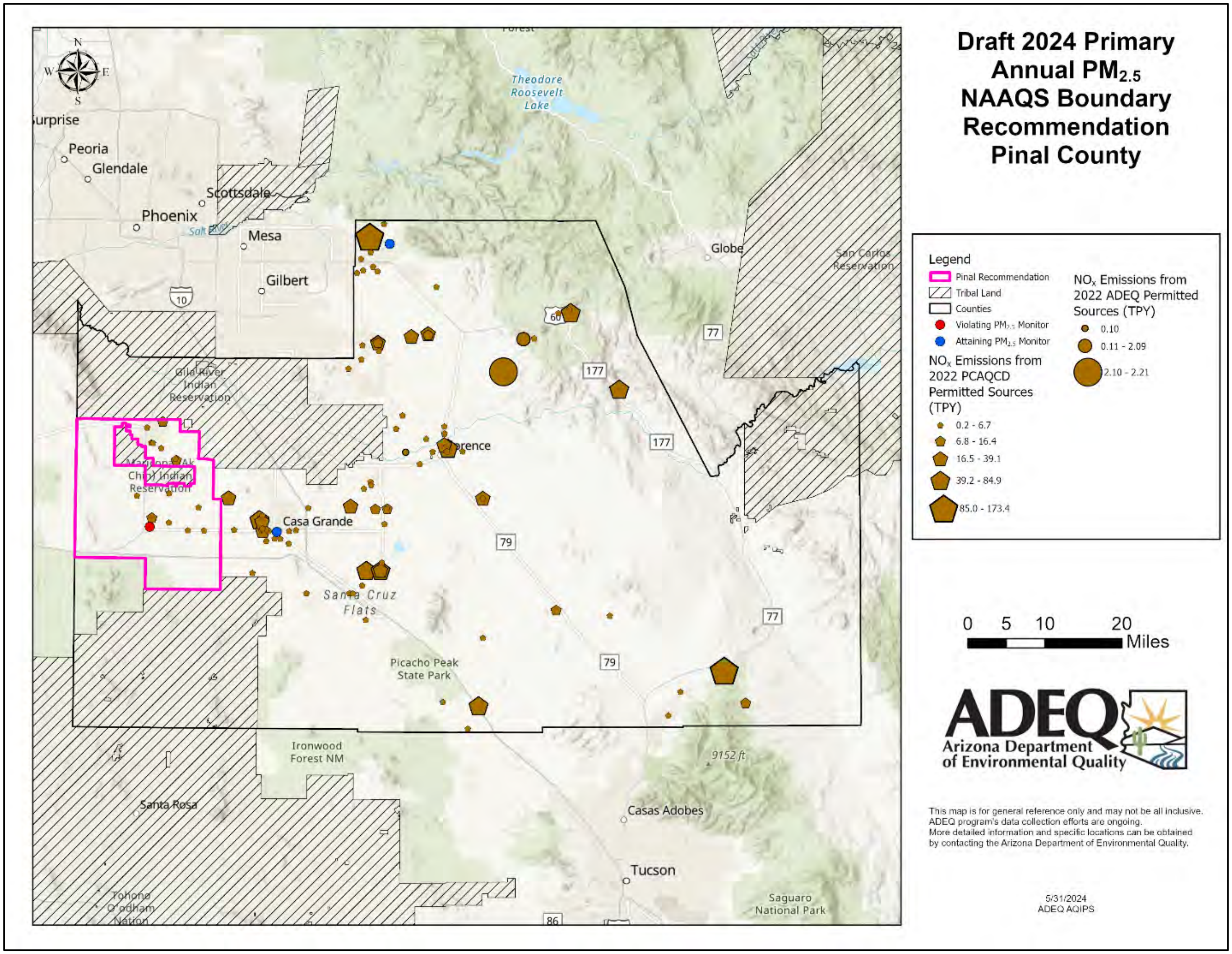


Figure 11: SO_2 Emissions from Permitted PCAQCD Sources in 2022

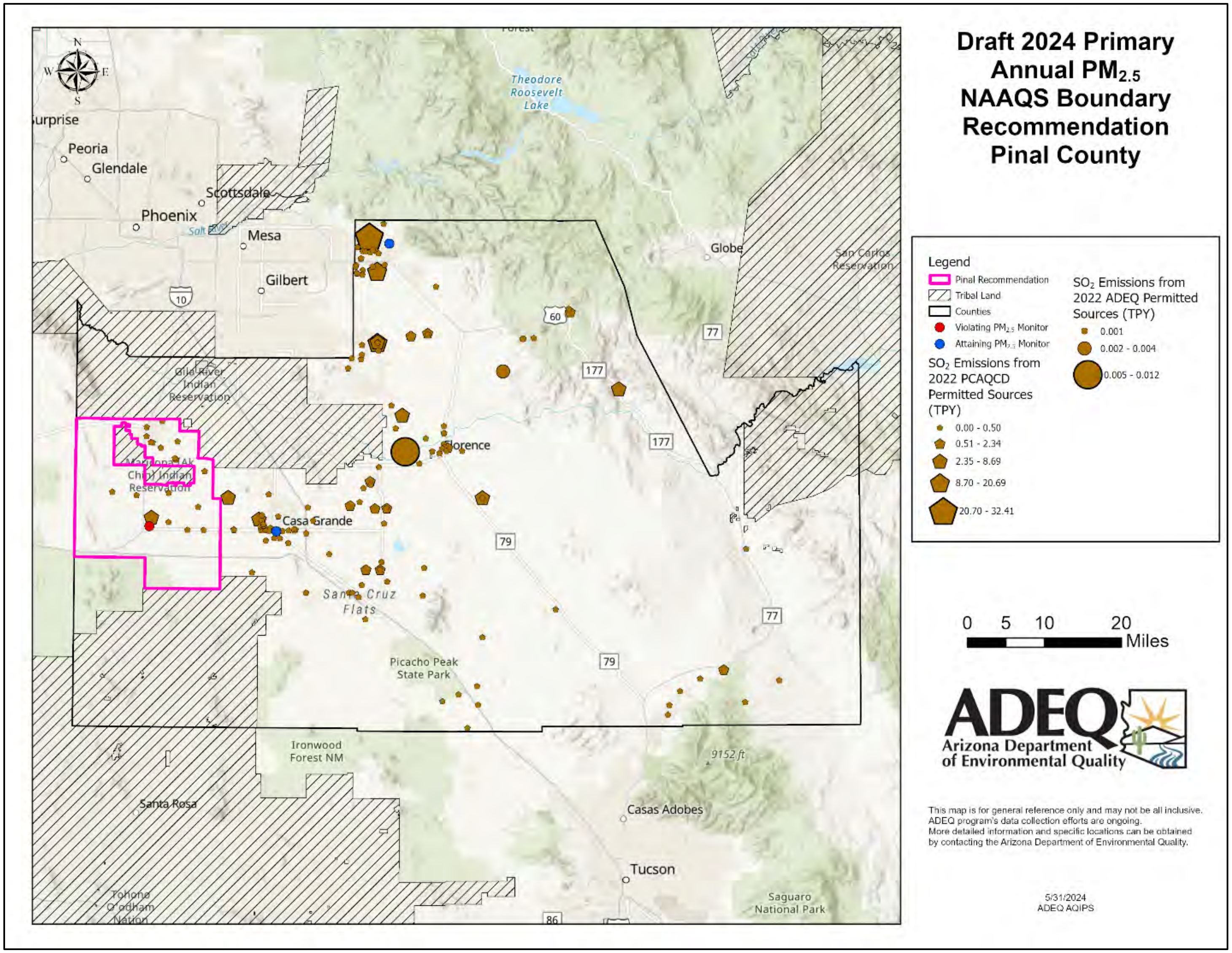


Figure 12: NH_3 Emissions from Permitted PCAQCD Sources in 2022

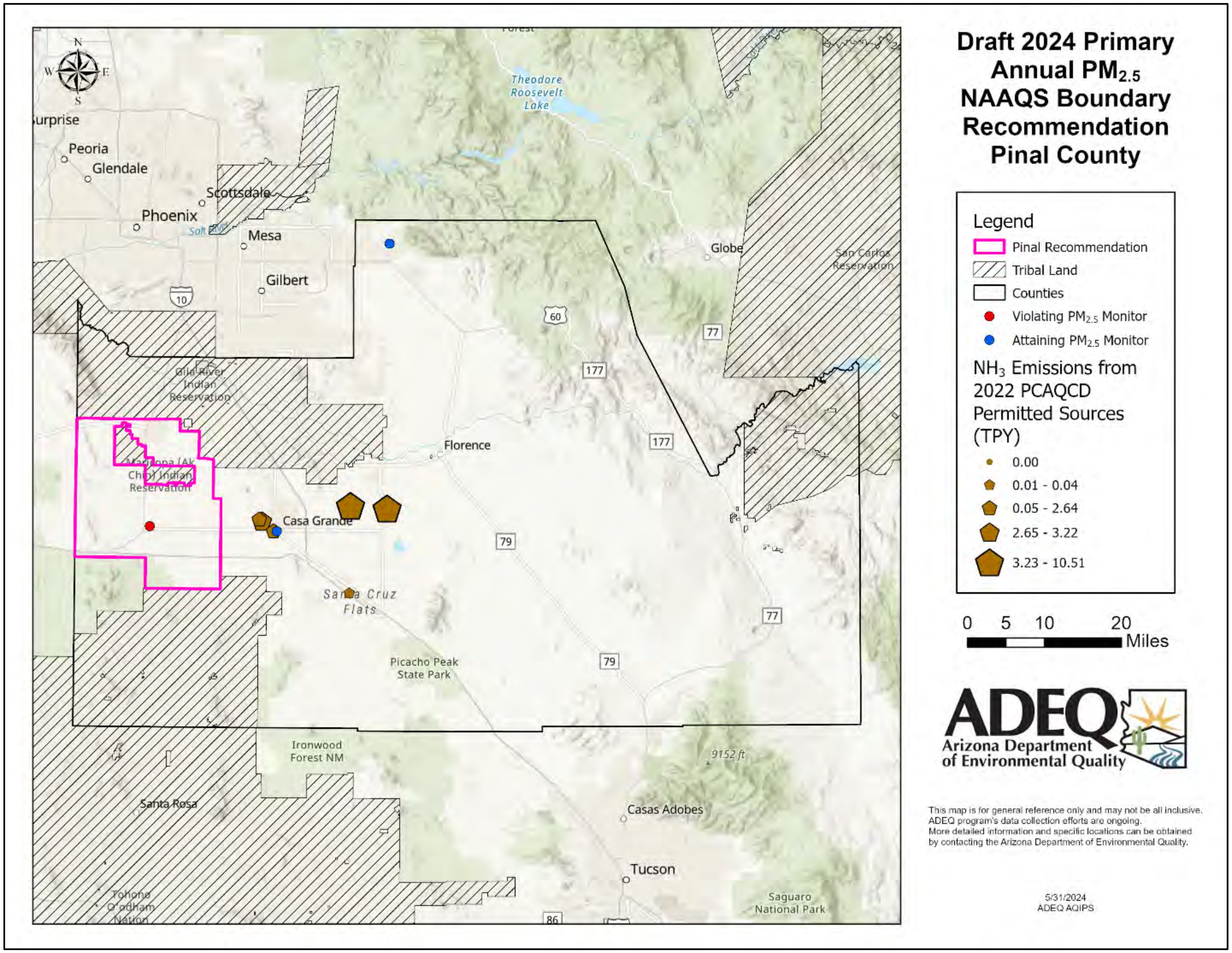
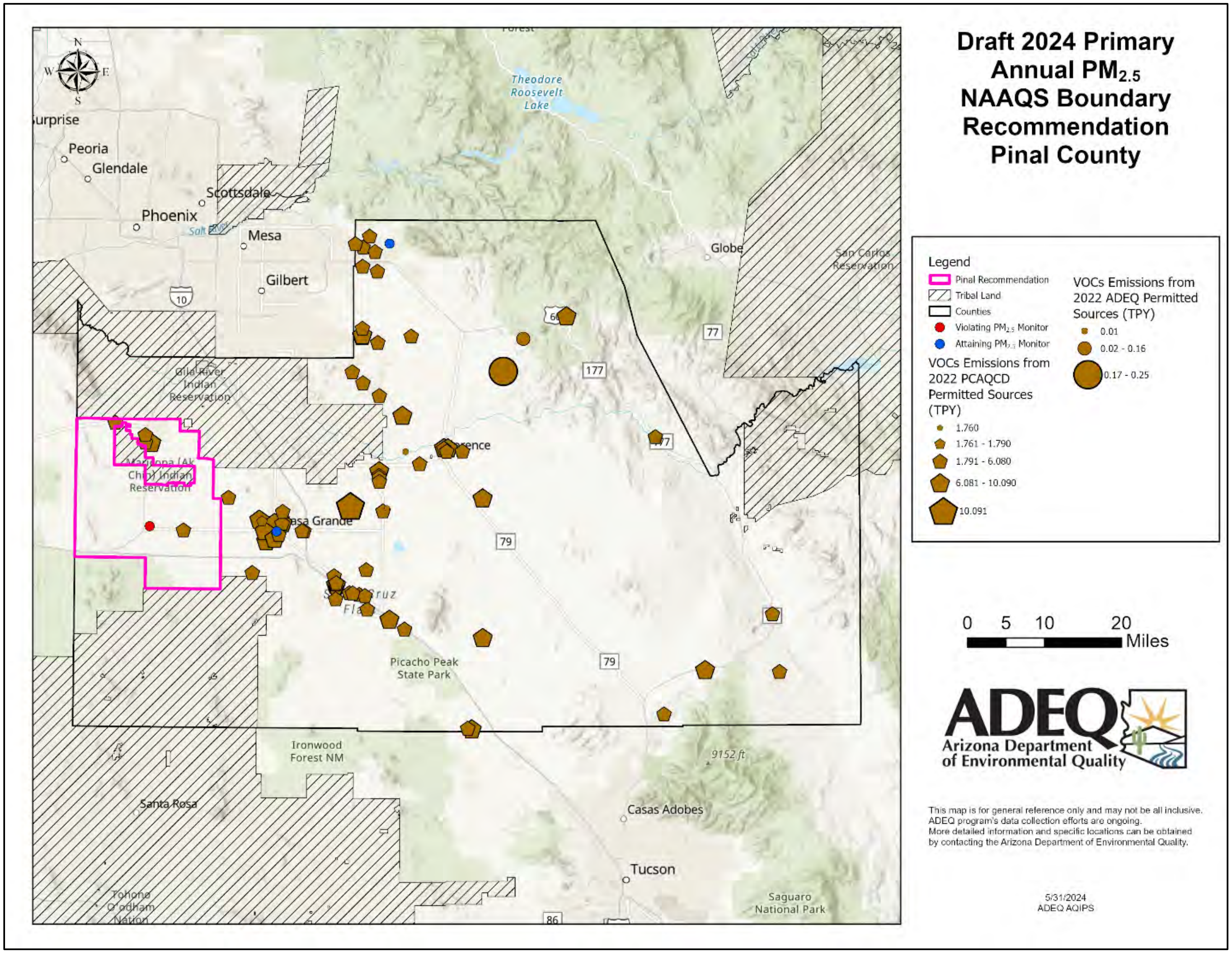


Figure 13: VOC Emissions from Permitted PCAQCD Sources in 2022



A3.3.3 Santa Cruz County

A3.3.3.1 Precursor Emissions from Permitted Sources

The TSD provides a visual representation of all ADEQ permitted sources in 2022 and their reported NO_x, SO_2, VOC, and NH_3 emissions. Shown in Table A-37, the Santa Cruz County (partial) boundary recommendation captures 37.6% of NO_x, 57.3% of SO_2, and 9.7% of VOC. There were no reported ammonia emissions in 2022 from permitted sources in Santa Cruz County.

Table A-37: Statistics of $PM_{2.5}$ and Precursor Emissions Captured in the Nogales NAA

Pollutant	NO_X	SO_2	VOC	NH_3	$PM_{2.5}$
TPY	6.01	0.06	0.07	0	0.18
% of Total	37.6%	57.3%	11.8%	0%	19.7%

Figure 14 displays the locations and magnitude of NO_x emitting permitted sources. The size of each symbol is proportional to their NO_x emissions in tons per year. Figure 15 displays the locations and magnitude of SO_2 emitting permitted sources. The size of each symbol is proportional to their SO_2 emissions in tons per year. Figure 16 displays the locations and magnitude of VOC emitting permitted sources. The size of each symbol is proportional to their VOC emissions in tons per year.

Figure 14: NO_X Emissions from ADEQ Permitted Sources in 2022

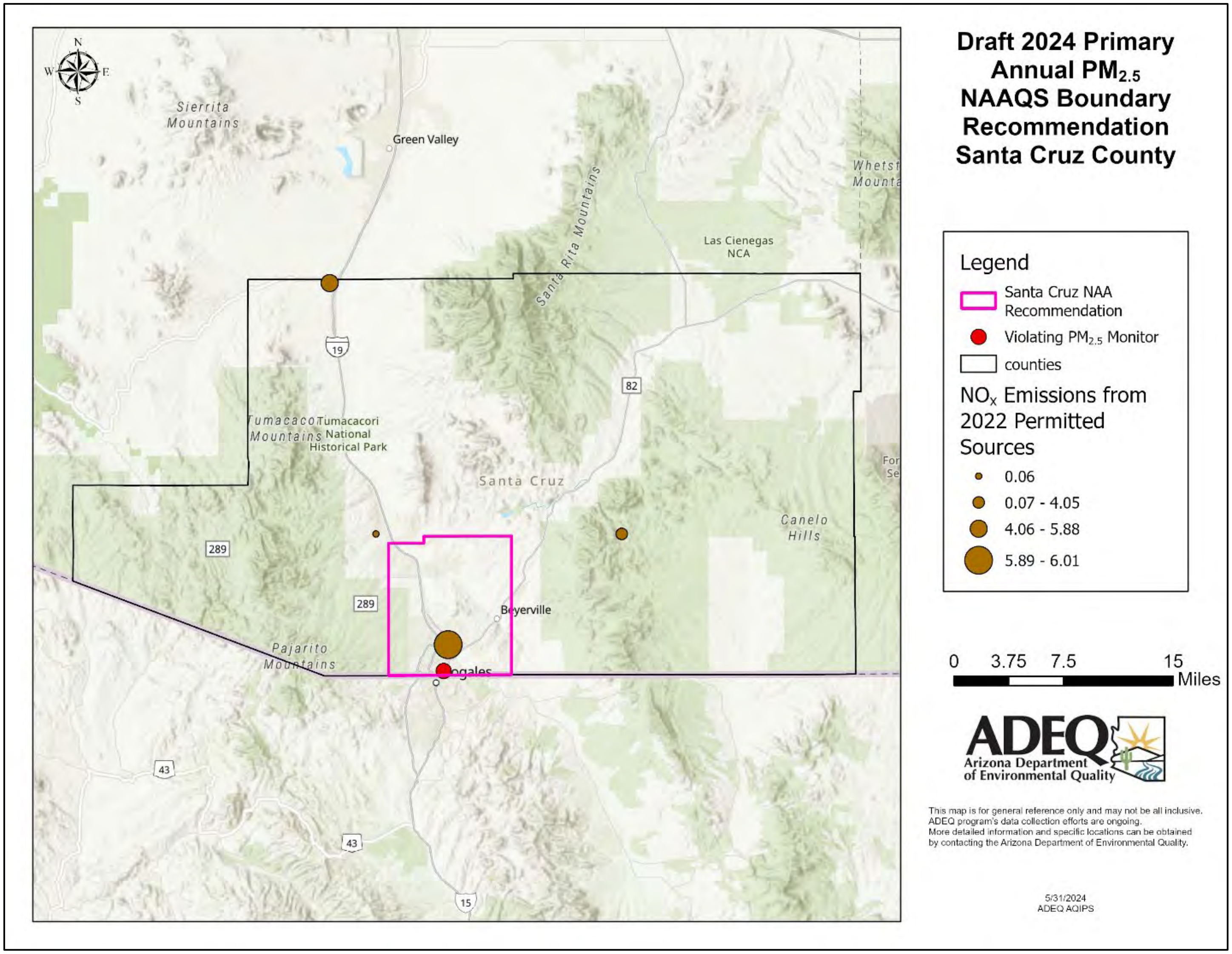


Figure 15: SO_2 Emissions from ADEQ Permitted Sources in 2022

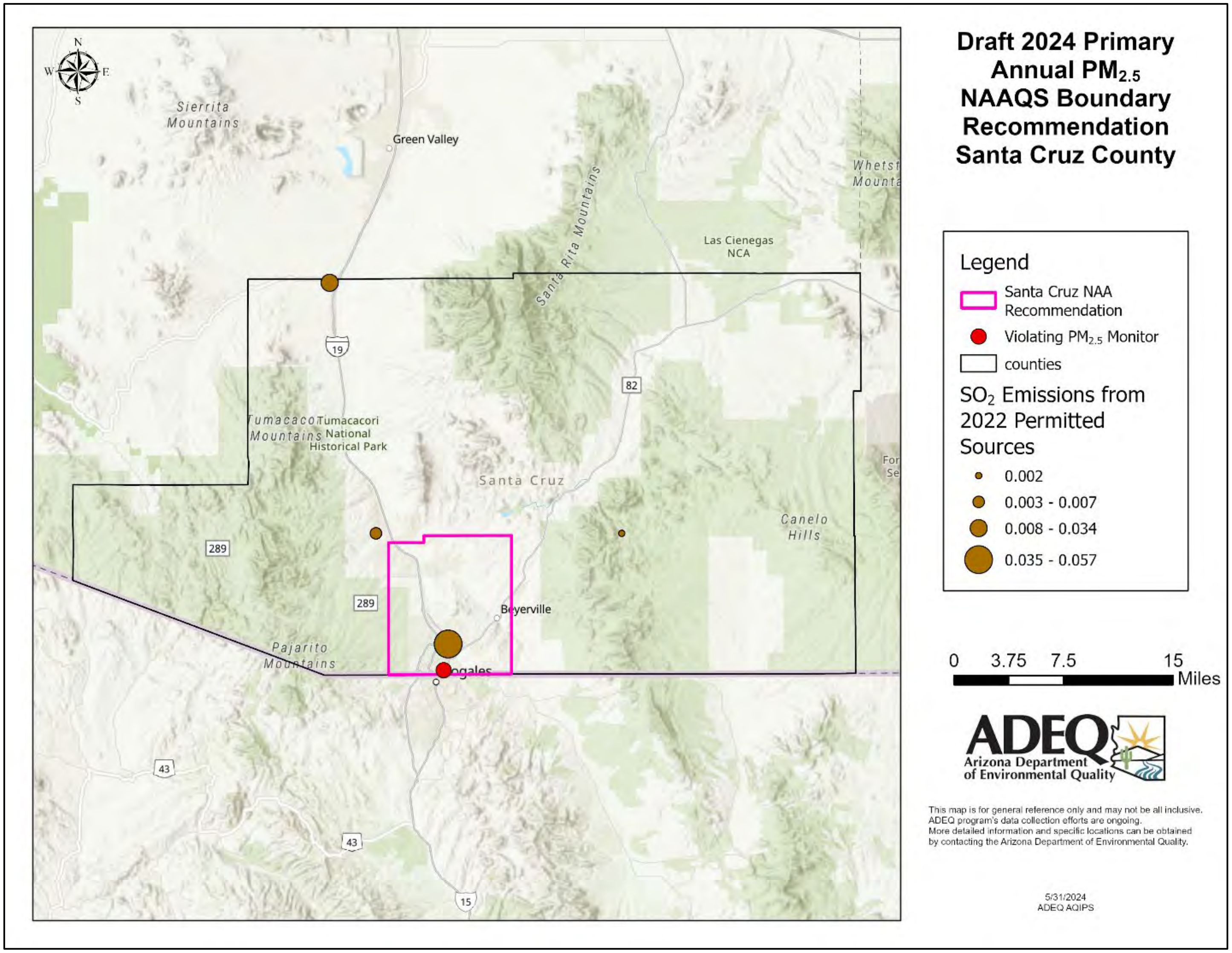
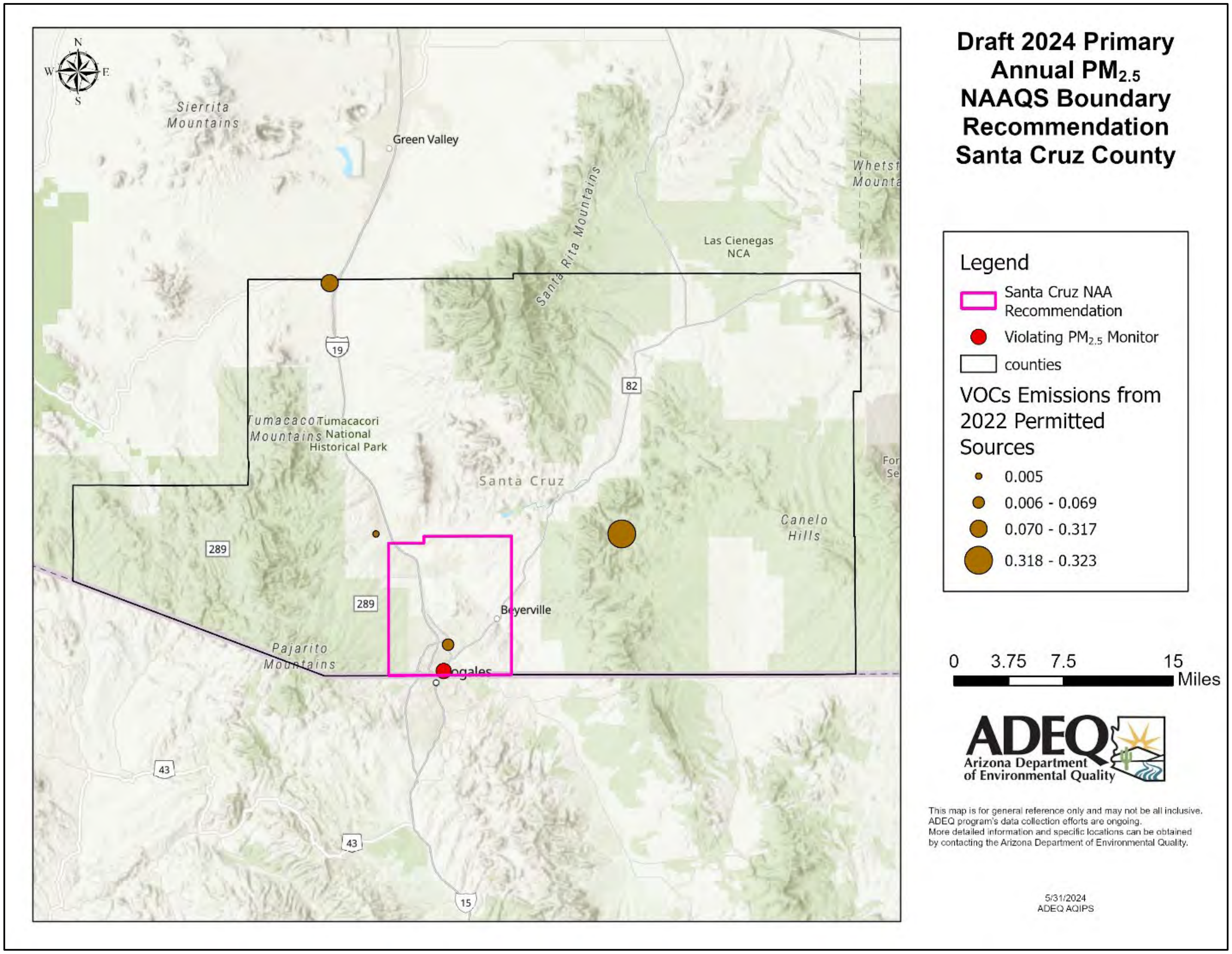


Figure 16: VOC Emissions from ADEQ Permitted Sources in 2022



A3.4 Emissions Analysis from 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 Emission Modeling Platform (EMP). The 2022 emission modeling platform is based on the 2020 National Emission Inventory 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. 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. Gridded emissions were generated for $PM_{2.5}$ and $PM_{2.5}$ + $PM_{2.5}$ Precursors (e.g., NO_X, SO_2, VOCs, NH_3) for the following source sectors:

- Residential wood combustion
- Area fugitive dust (only gridded $PM_{2.5}$ available)
- Nonpoint
- Nonroad

Gridded emissions plots for the violating monitors in Maricopa County are shown in Figure 17 through Figure 23 below. Gridded emissions plots for the violating monitors in Pinal County are shown in Figure 24 through Figure 30 below. Gridded emissions plots for the violating monitors in Santa Cruz County are shown in Figure 31 through Figure 37 below.

Figure 17: 2022 EMP Gridded Area Fugitive Dust $PM_{2.5}$ Emissions for Maricopa Monitors

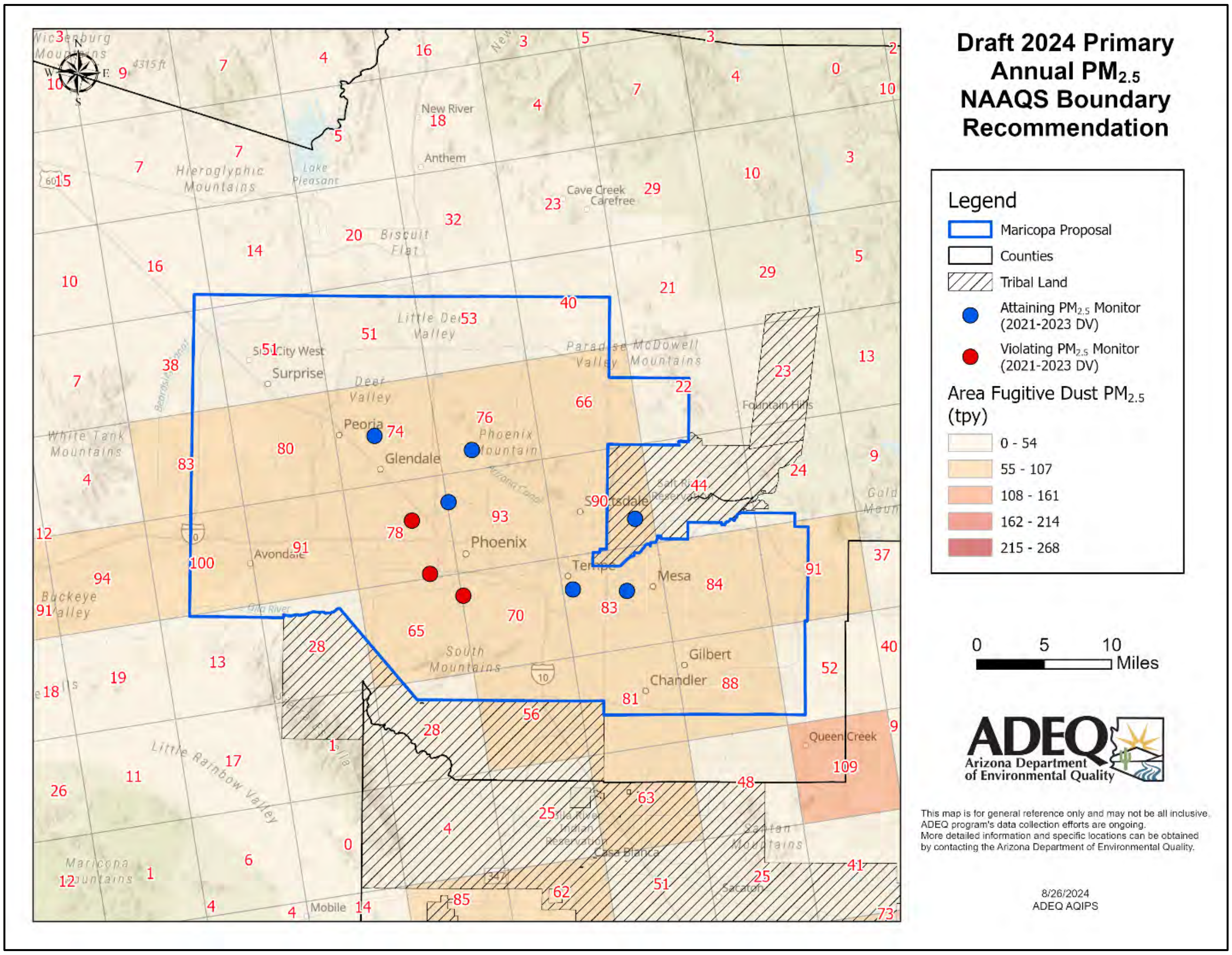


Figure 18: 2022 EMP Gridded Nonpoint $PM_{2.5}$ Emissions for Maricopa Monitors

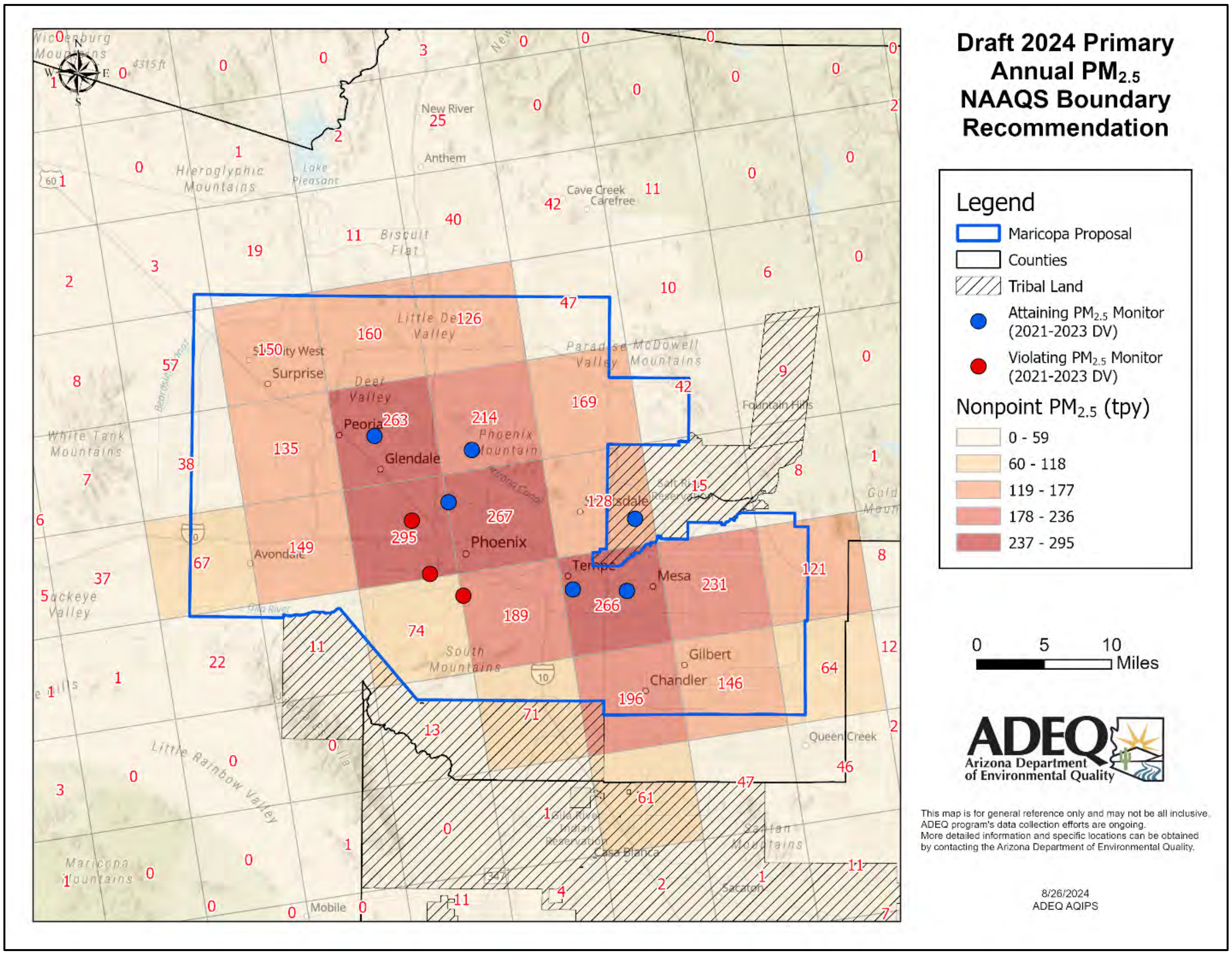


Figure 19: 2022 EMP Gridded Nonpoint $PM_{2.5}$ and Precursor Emissions for Maricopa Monitors

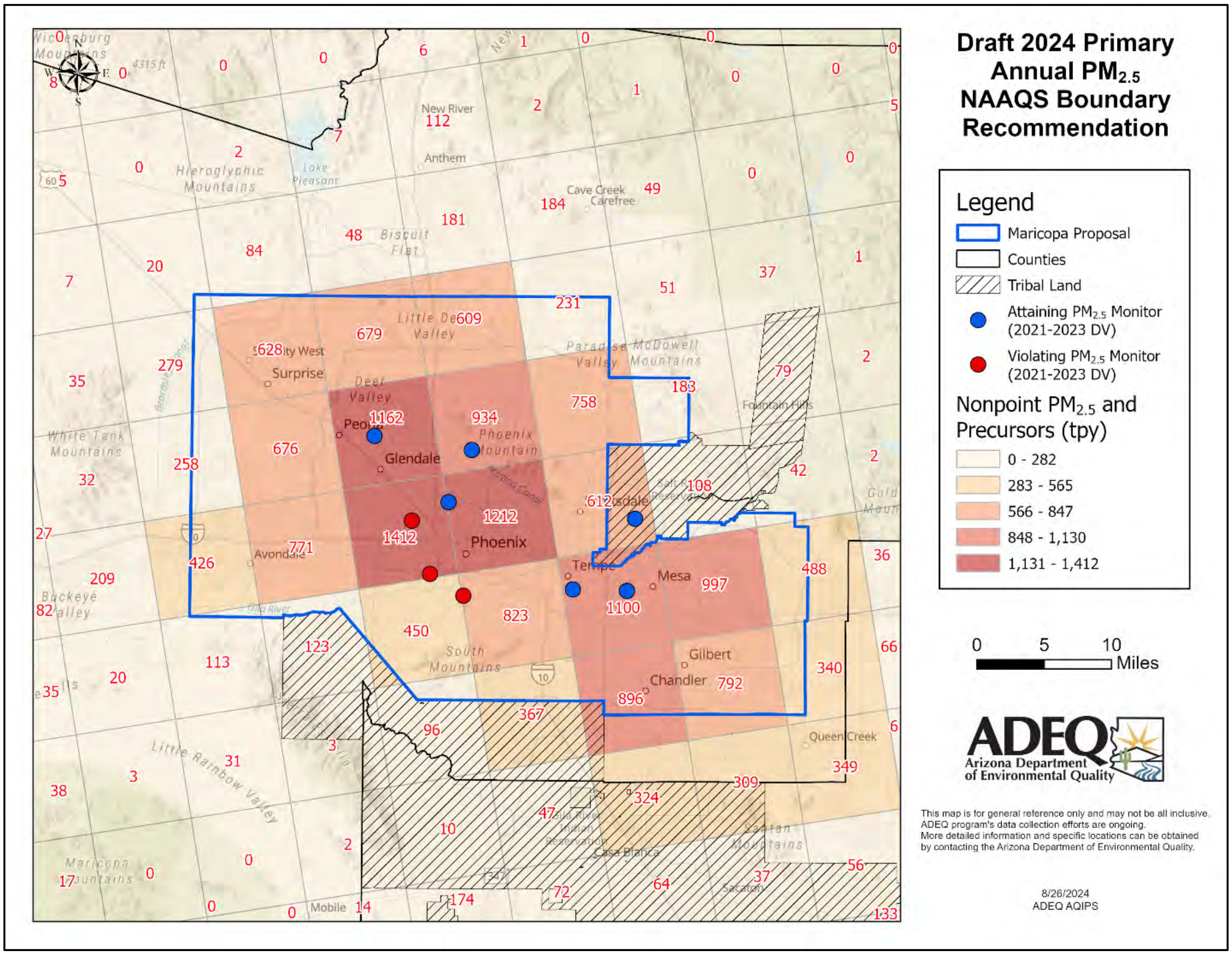


Figure 20: 2022 EMP Gridded Nonroad $PM_{2.5}$ Emissions for Maricopa Monitors

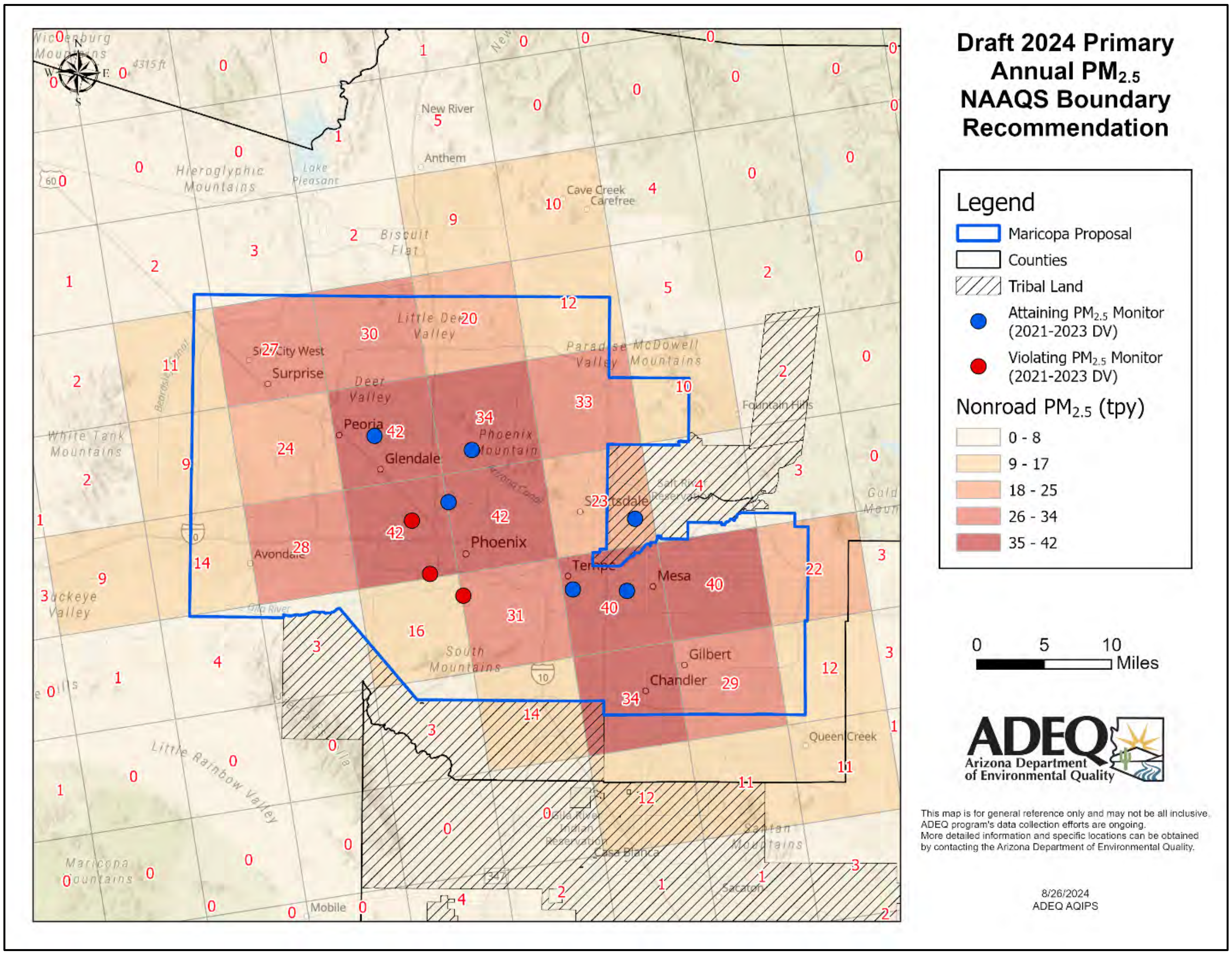


Figure 21: 2022 EMP Gridded Nonroad $PM_{2.5}$ and Precursor Emissions for Maricopa Monitors

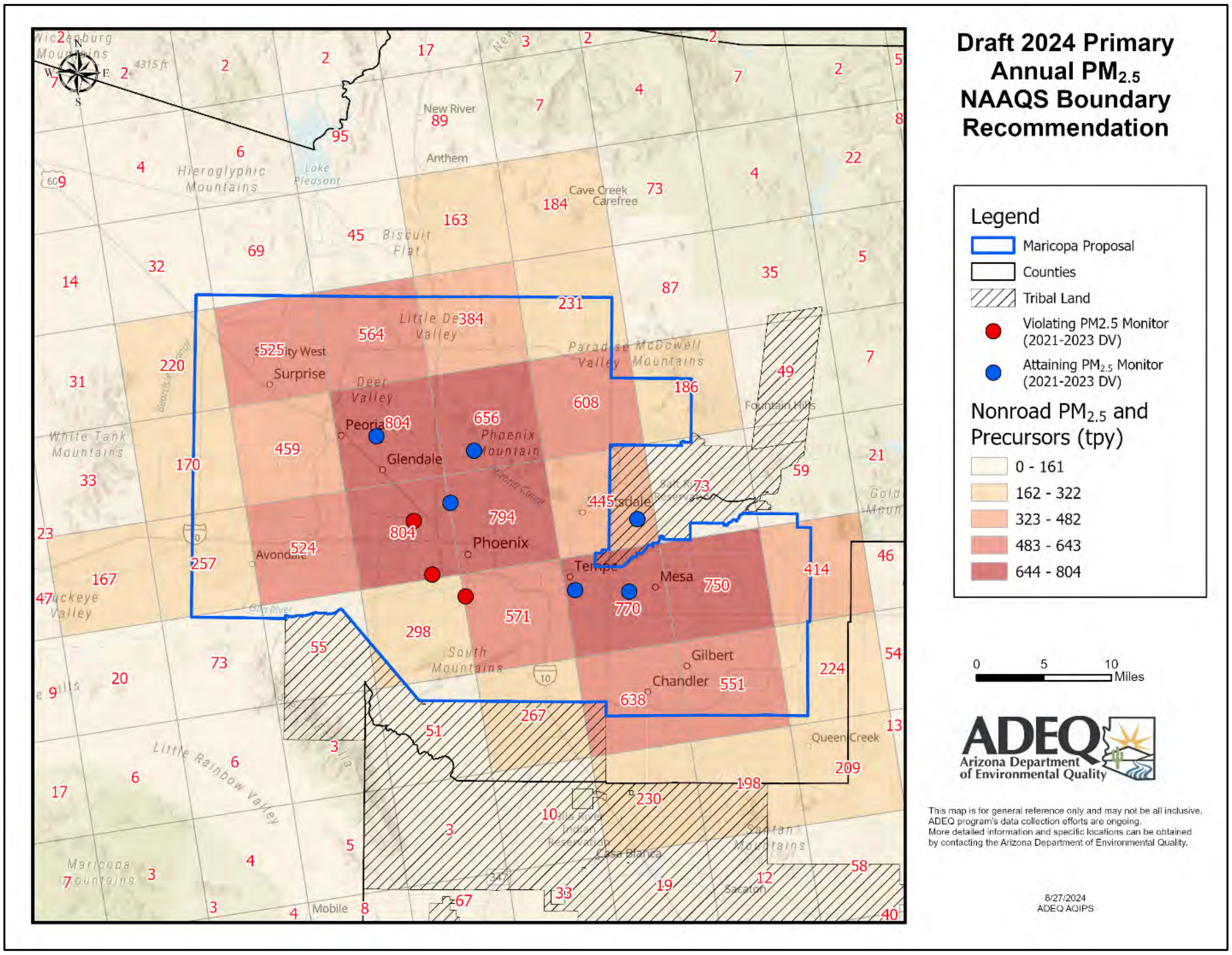


Figure 22: 2022 EMP Gridded Residential Wood Combustion $PM_{2.5}$ Emissions for Maricopa Monitors

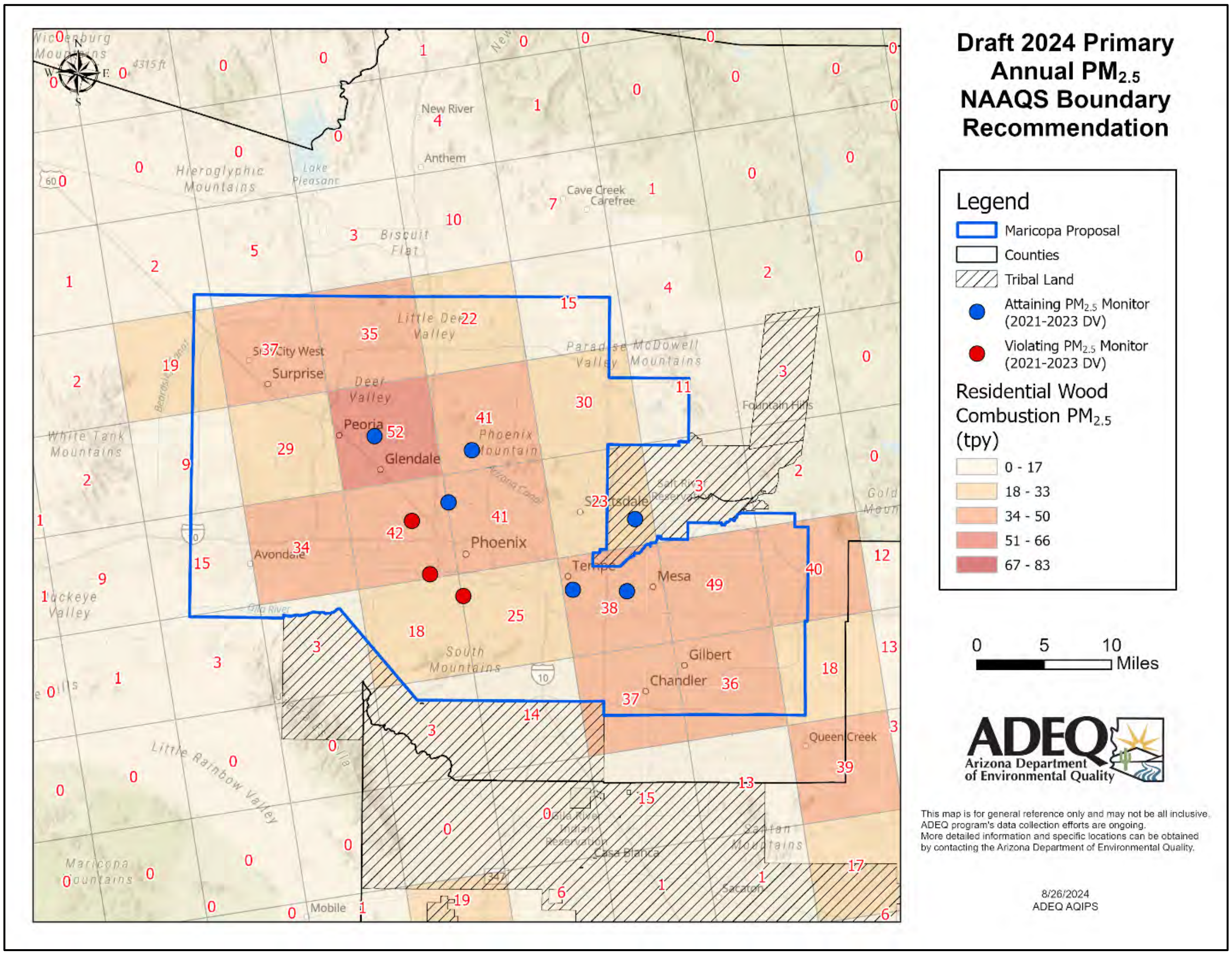


Figure 23: 2022 EMP Gridded Residential Wood Combustion $PM_{2.5}$ and Precursor Emissions for Maricopa Monitors

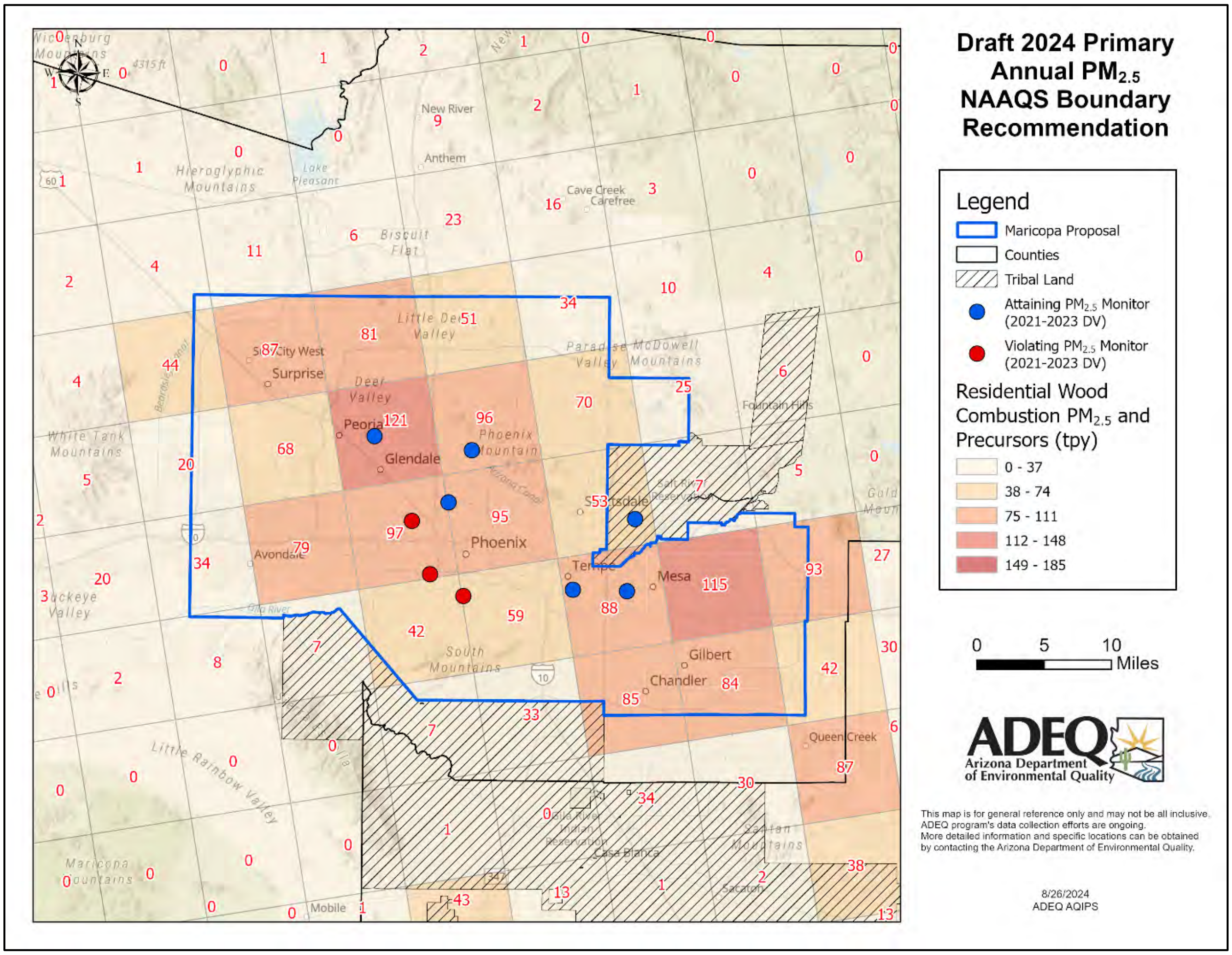


Figure 24: 2022 EMP Gridded Area Fugitive Dust $PM_{2.5}$ Emissions for Pinal Monitors

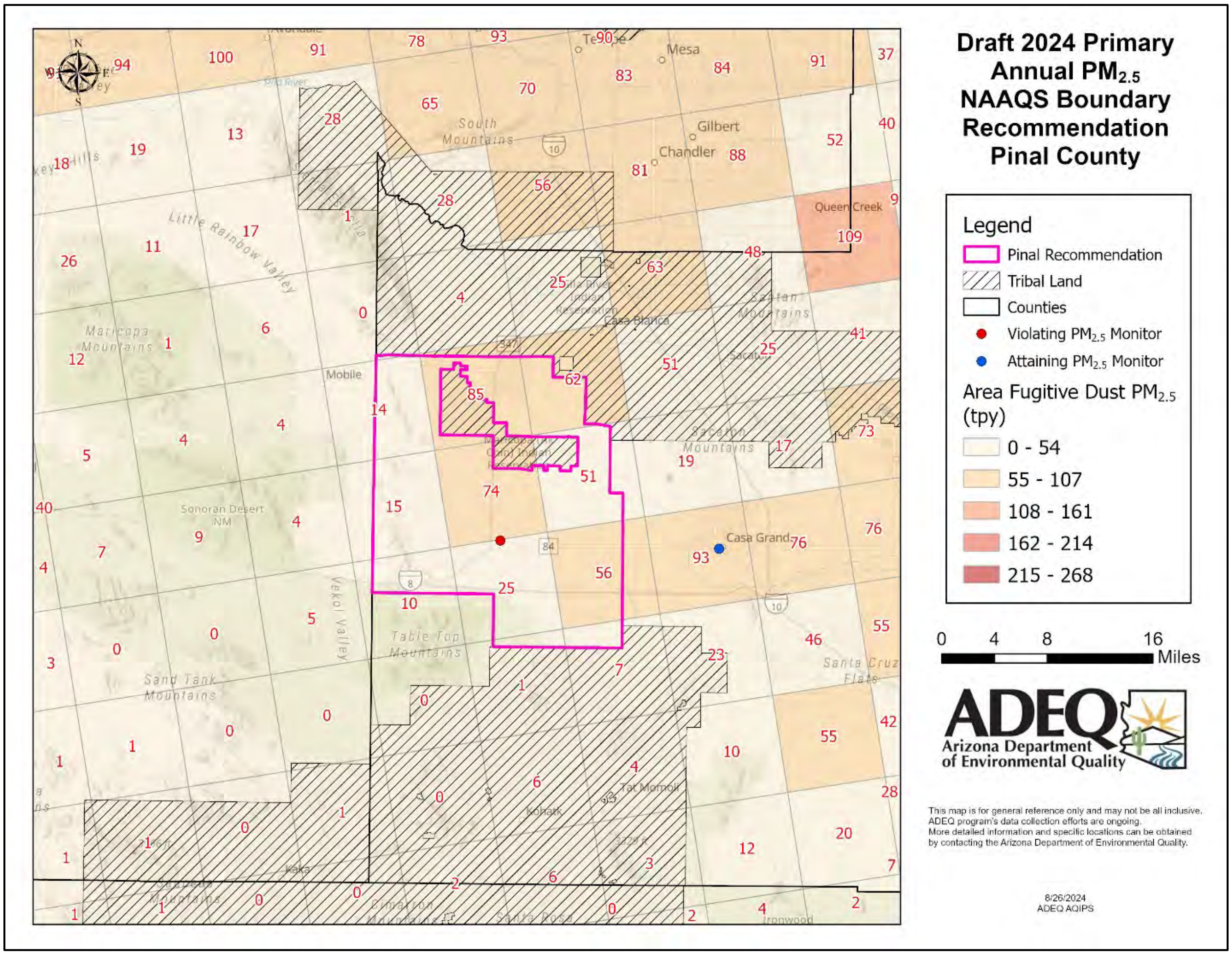


Figure 25: 2022 EMP Gridded Nonpoint $PM_{2.5}$ Emissions for Pinal Monitors

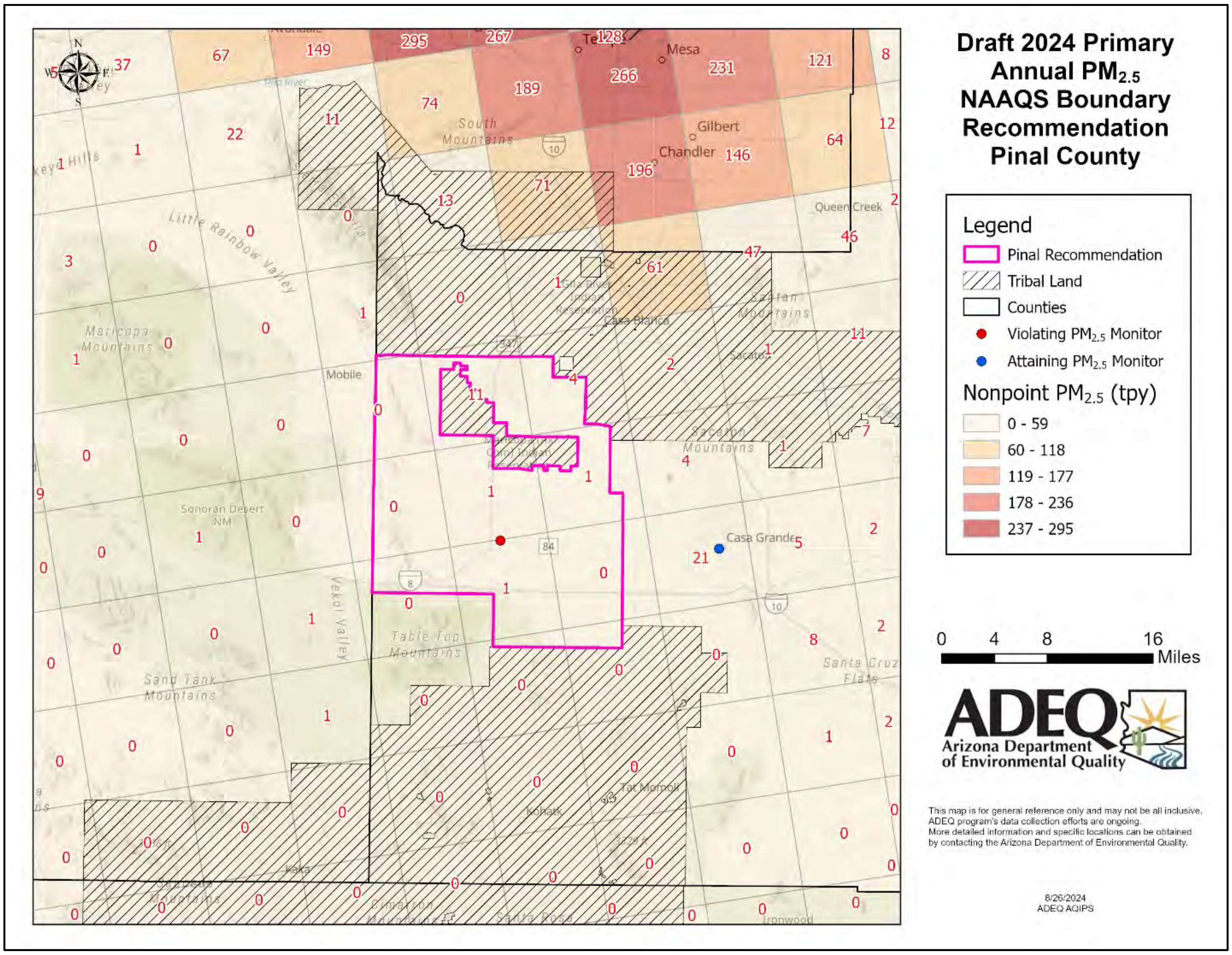


Figure 26: 2022 EMP Gridded Nonpoint $PM_{2.5}$ and Precursor Emissions for Pinal Monitors

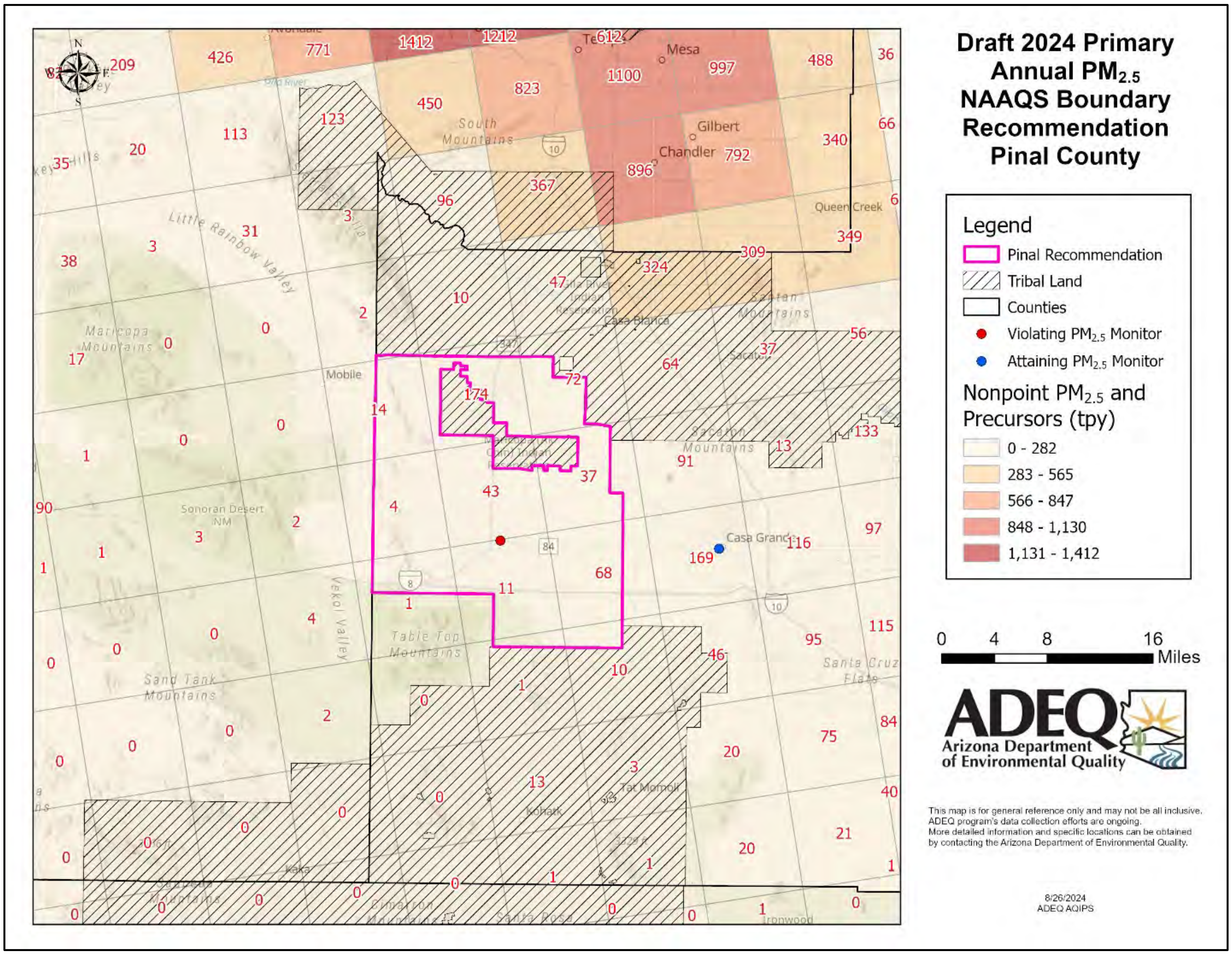


Figure 27: 2022 EMP Gridded Nonroad $PM_{2.5}$ Emissions for Pinal Monitors

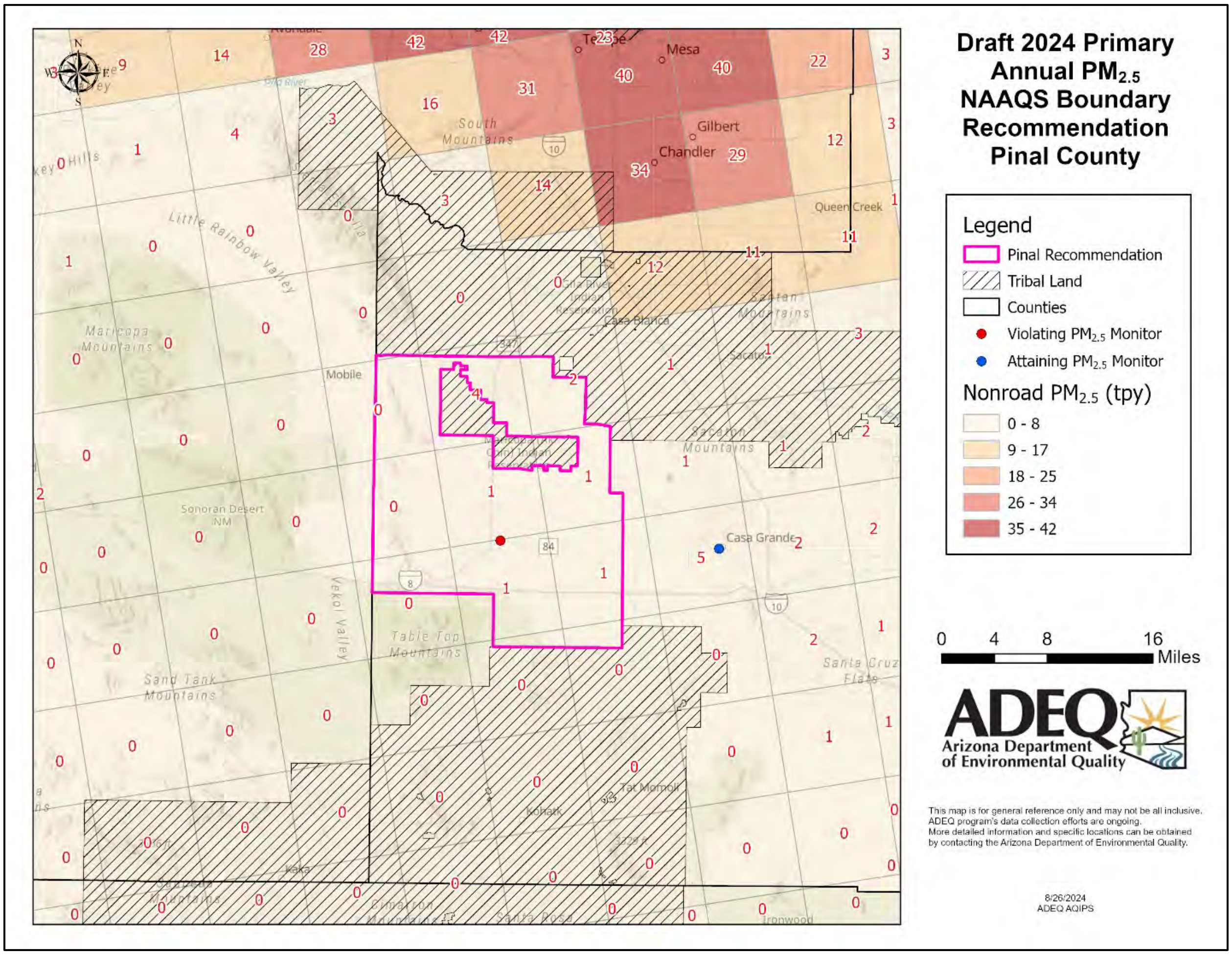


Figure 28: 2022 EMP Gridded Nonroad $PM_{2.5}$ and Precursor Emissions for Pinal Monitors

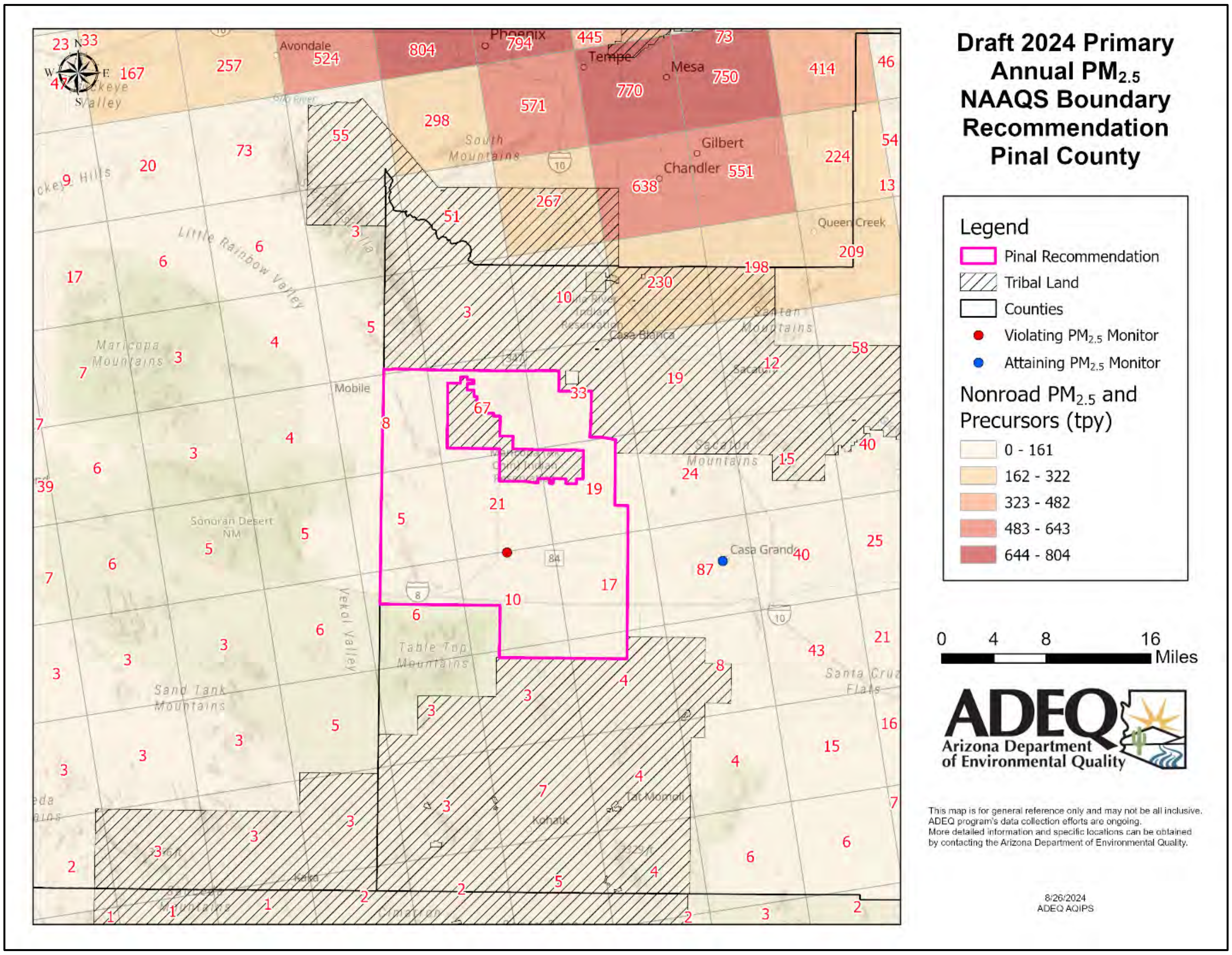


Figure 29: 2022 EMP Gridded Residential Wood Combustion $PM_{2.5}$ Emissions for Pinal Monitors

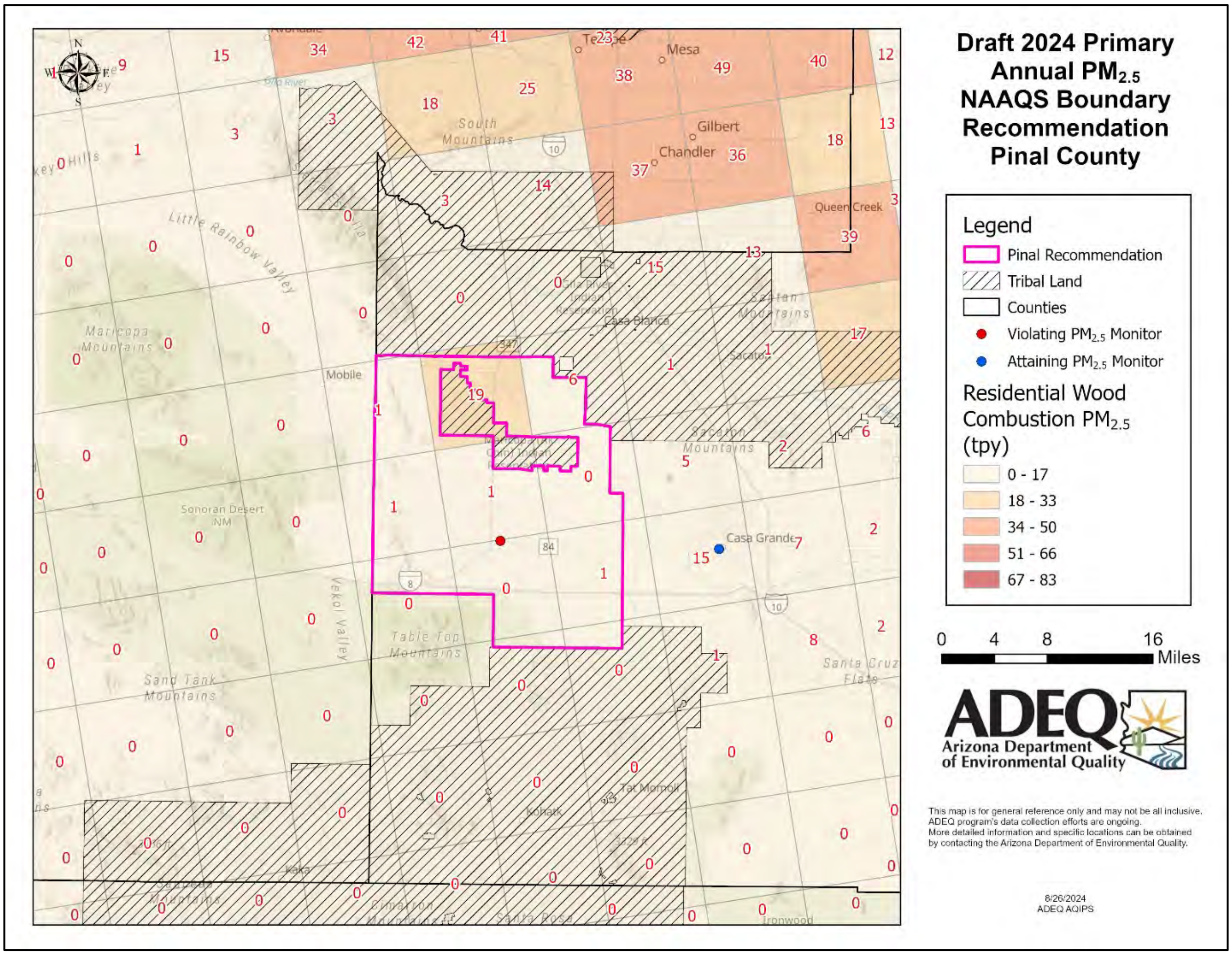


Figure 30: 2022 EMP Gridded Residential Wood Combustion $PM_{2.5}$ and Precursor Emissions for Pinal Monitors

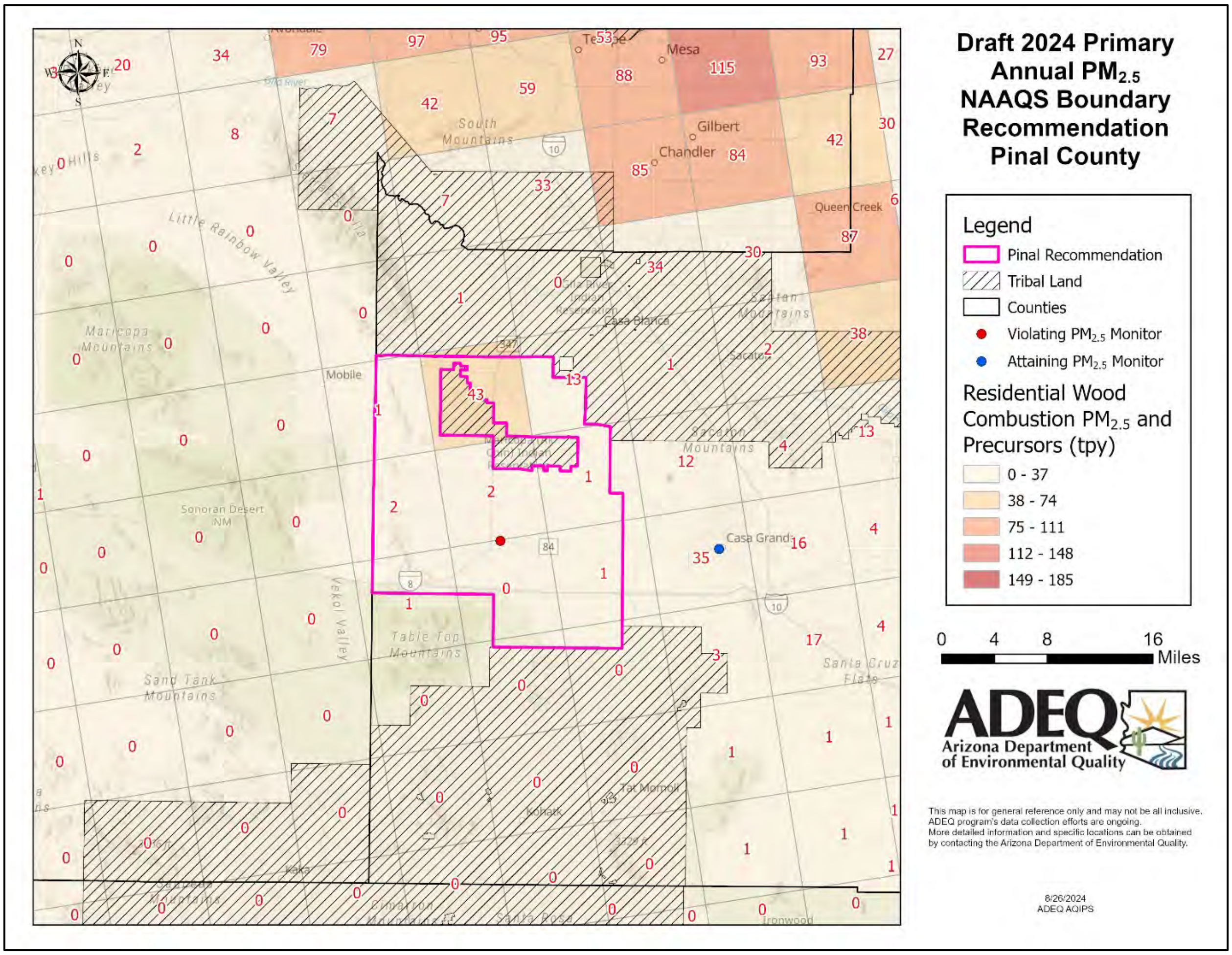


Figure 31: 2022 EMP Gridded Area Fugitive Dust $PM_{2.5}$ Emissions for Santa Cruz Monitors

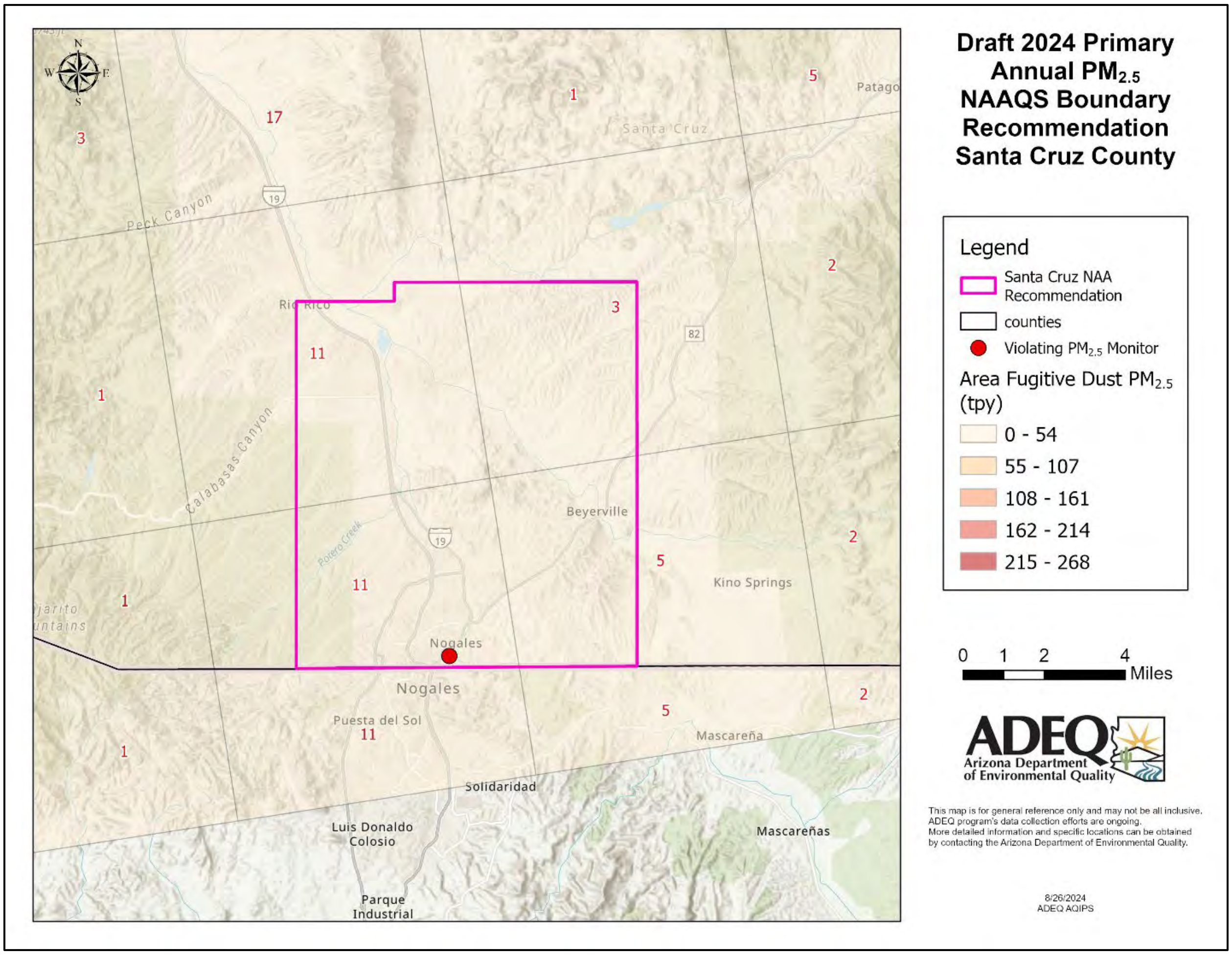


Figure 32: 2022 EMP Gridded Nonpoint $PM_{2.5}$ Emissions for Santa Cruz Monitors

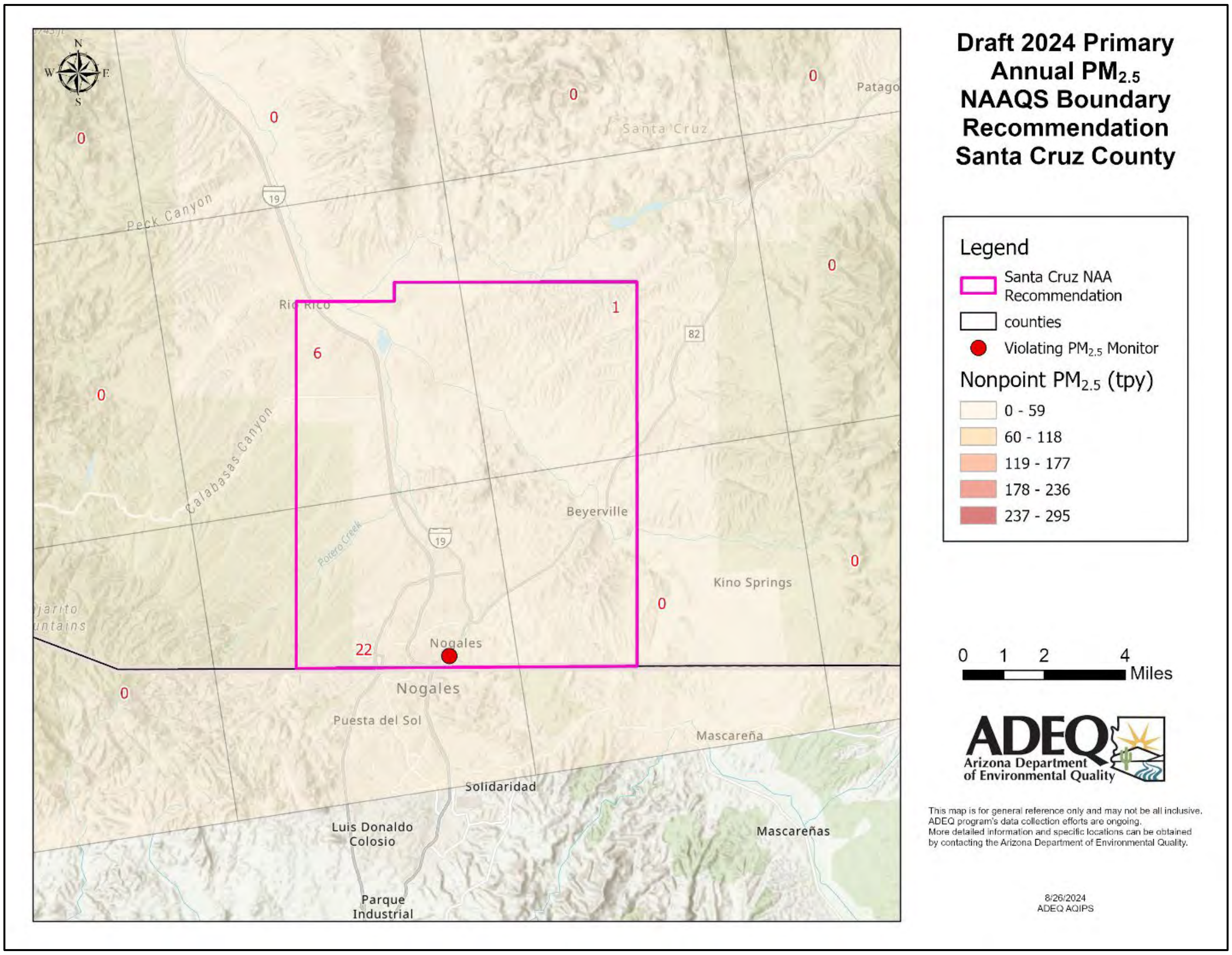


Figure 33: 2022 EMP Gridded Nonpoint $PM_{2.5}$ and Precursor Emissions for Santa Cruz Monitors

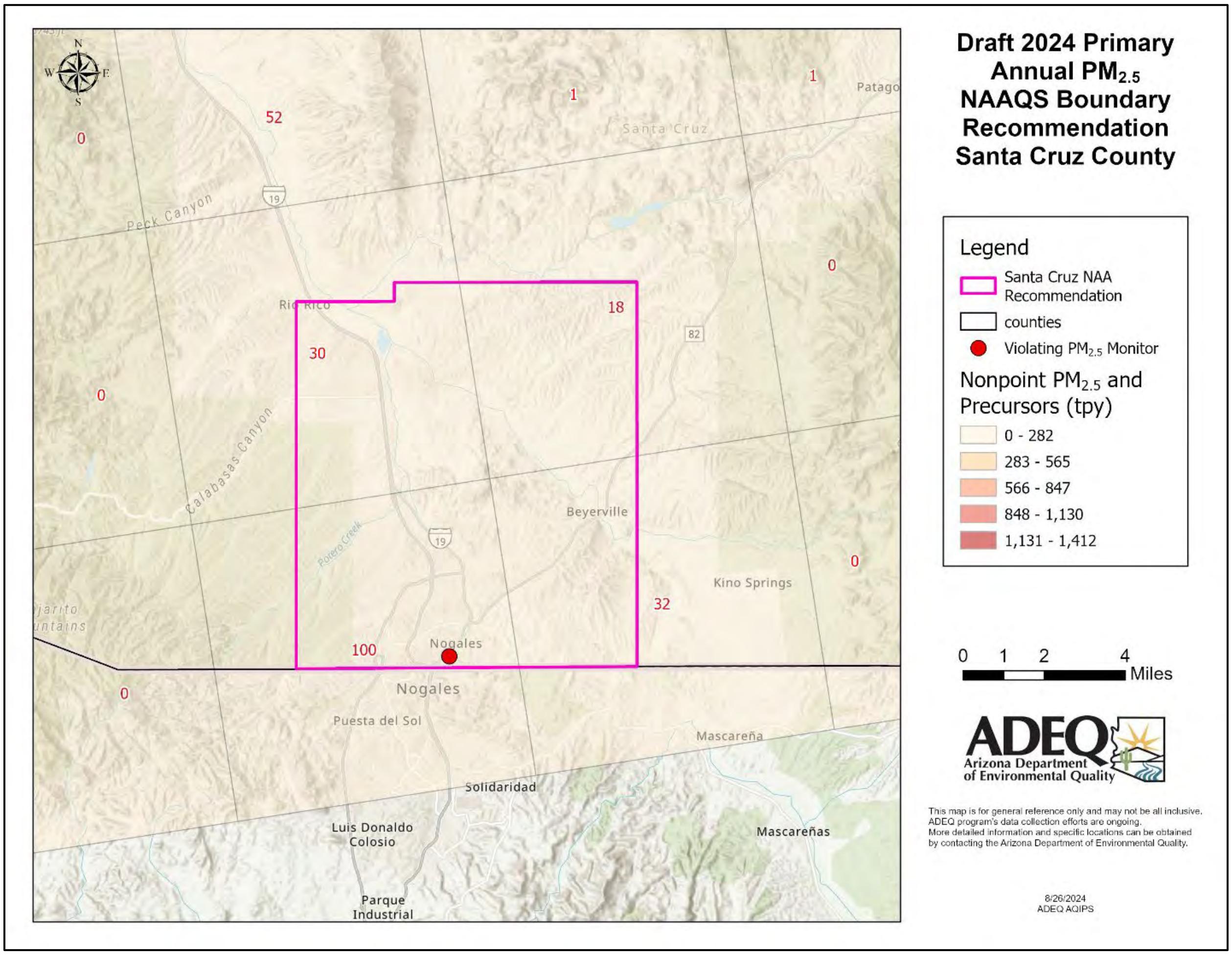


Figure 34: 2022 EMP Gridded Nonroad $PM_{2.5}$ Emissions for Santa Cruz Monitors

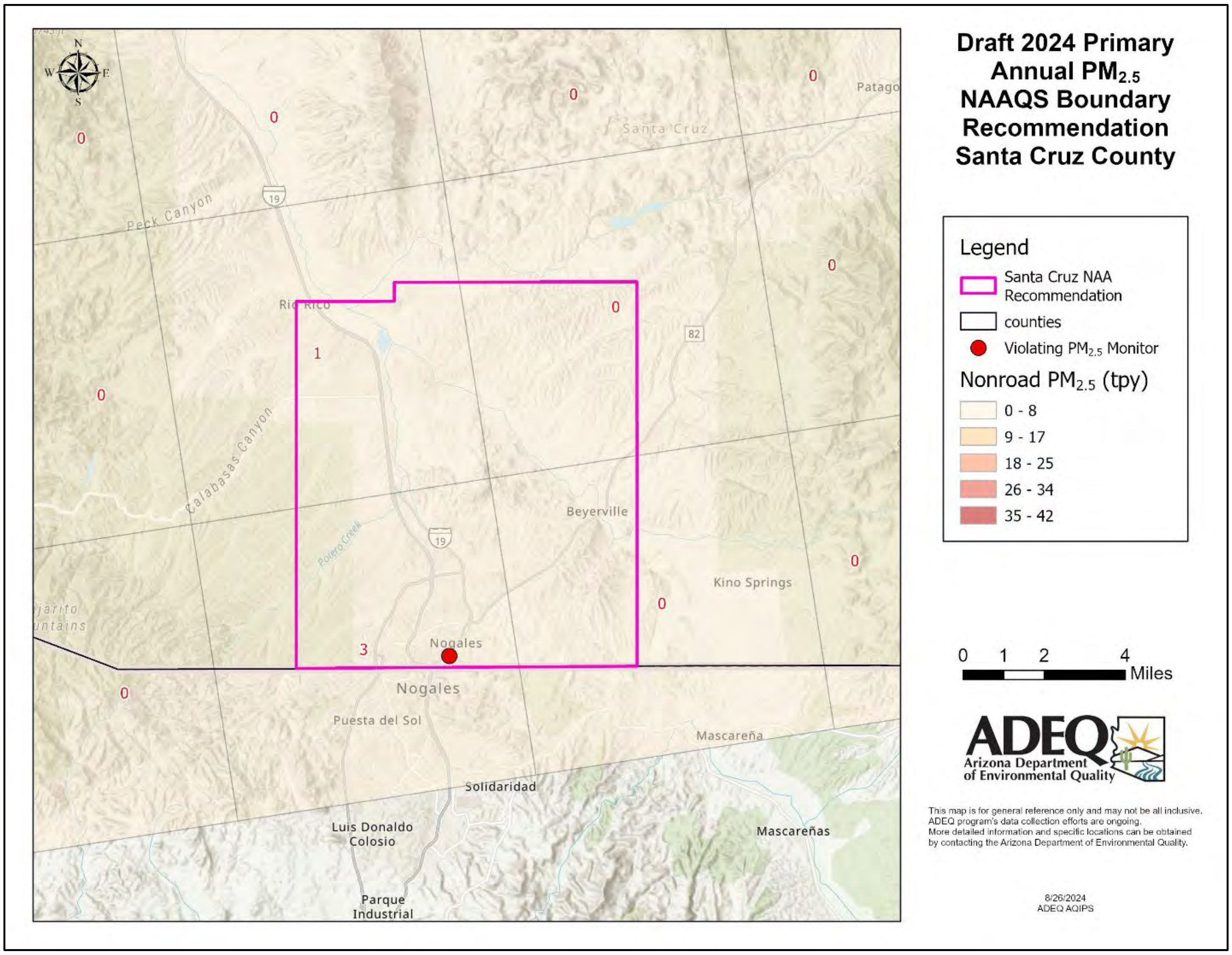


Figure 35: 2022 EMP Gridded Nonroad $PM_{2.5}$ and Precursor Emissions for Santa Cruz Monitors

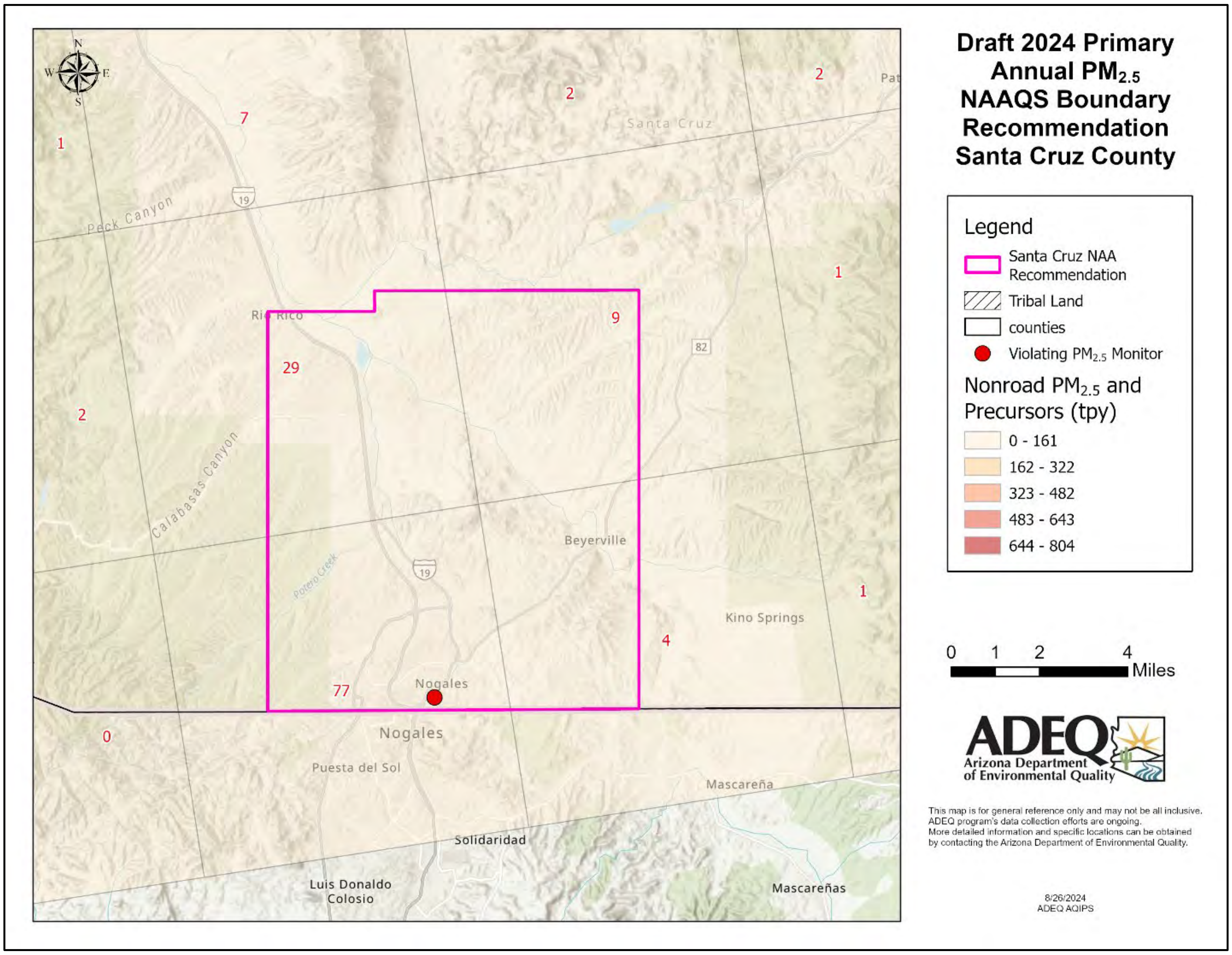


Figure 36: 2022 EMP Gridded Residential Wood Combustion $PM_{2.5}$ Emissions for Santa Cruz Monitors

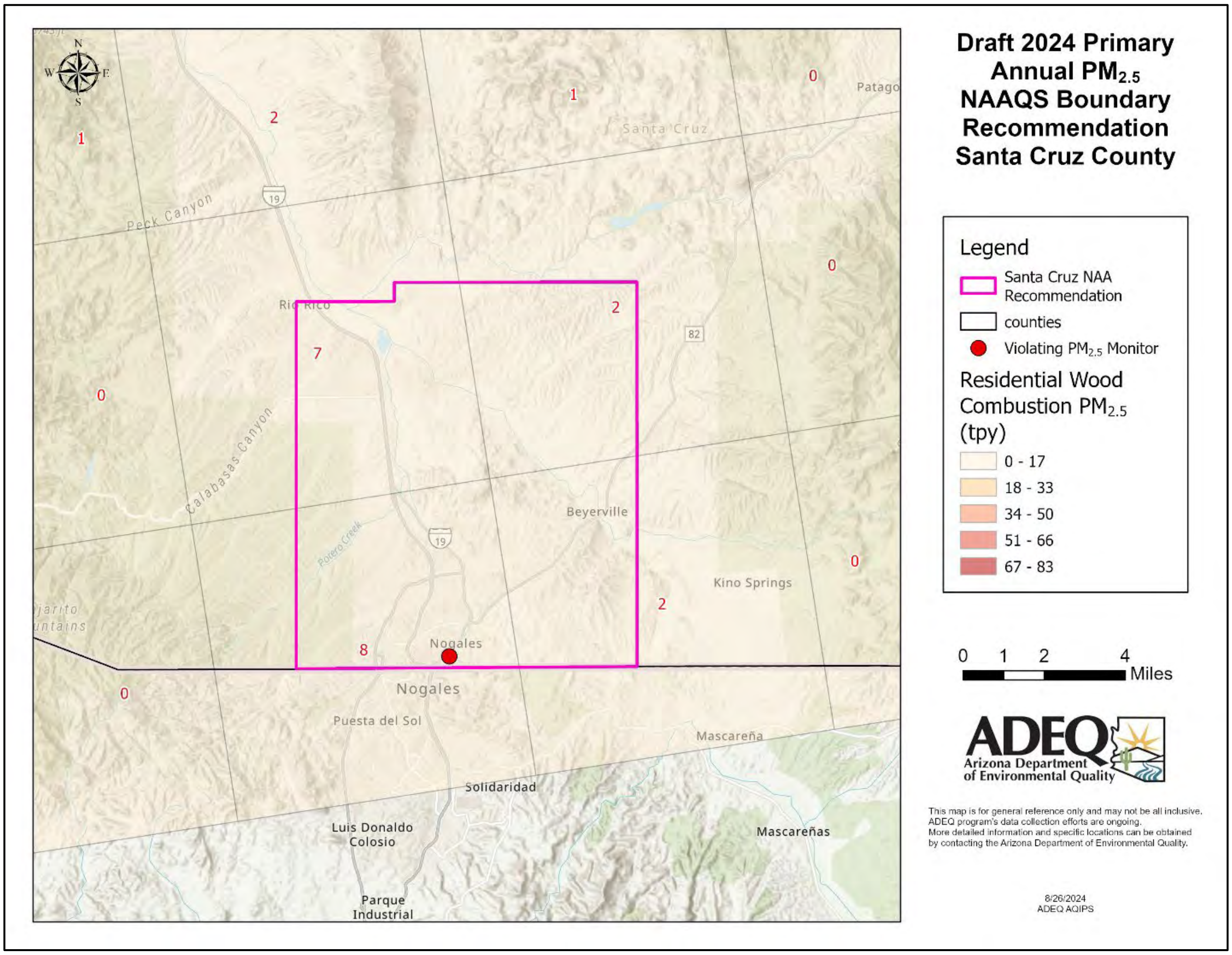
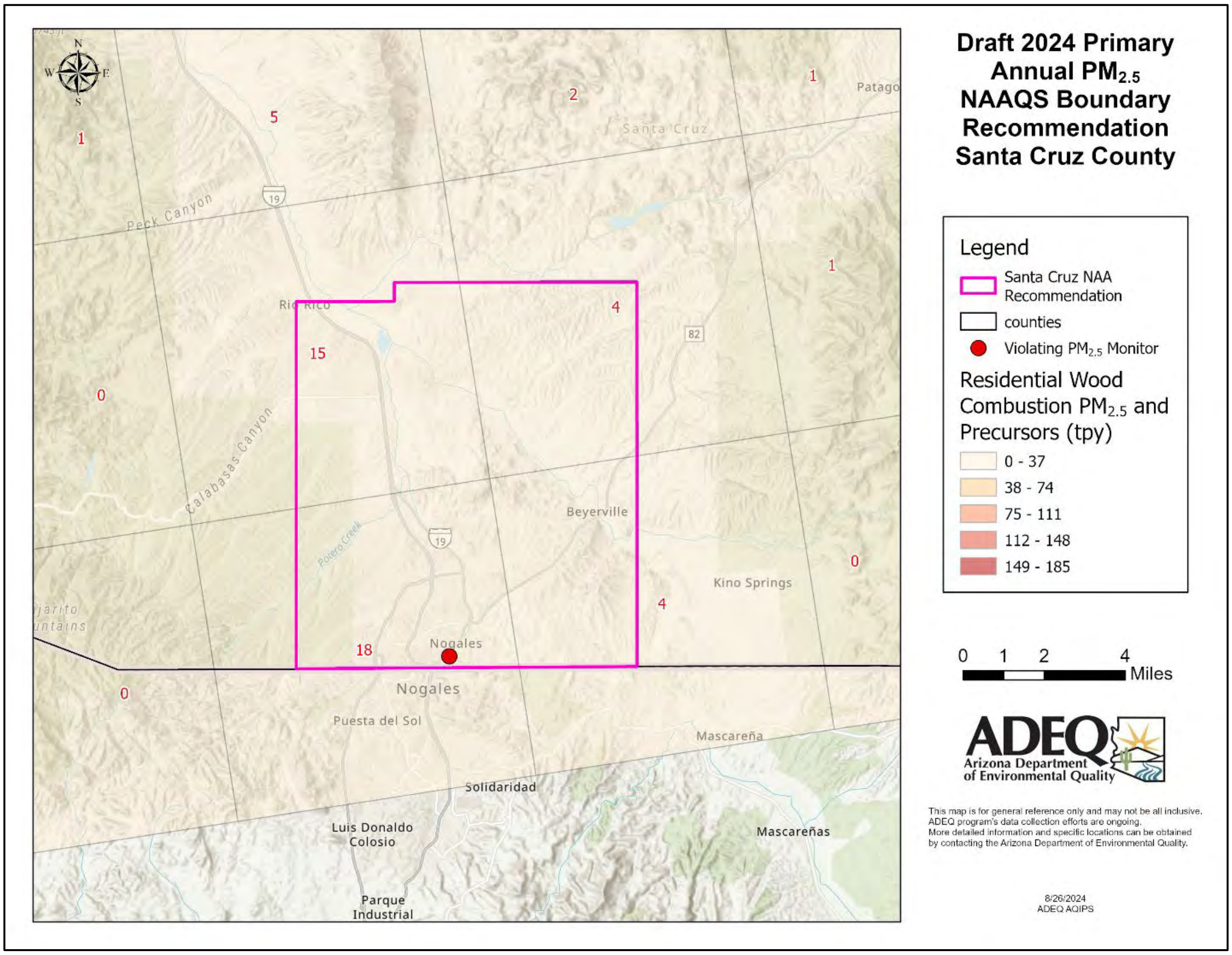


Figure 37: 2022 EMP Gridded Residential Wood Combustion $PM_{2.5}$ and Precursor Emissions for Santa Cruz Monitors



A4 Meteorological Analyses

A4.1 Wind Rose Analysis

Using 3 years of meteorological data for 2021-2023, ADEQ plotted wind roses to show the wind direction and wind speed for ambient $PM_{2.5}$ monitors, where meteorological data was available. Wind roses, pollution roses, and percentile roses were plotted annually and seasonally for each of the three years. The red and blue circle symbols in Figure 38 and Figure 39 indicates the locations of meteorological analysis where $PM_{2.5}$ monitors exist and therefore $PM_{2.5}$ pollution concentration and percentile were examined. The green triangle symbol in Figure 38 and Figure 39 indicates the locations in Maricopa County where an additional comprehensive analysis of wind patterns was performed. Figure 39 provides a zoomed in version of the locations where additional wind analyses were considered in Maricopa County.

Figure 38: Arizona Monitor Locations Used in Meteorological Analysis

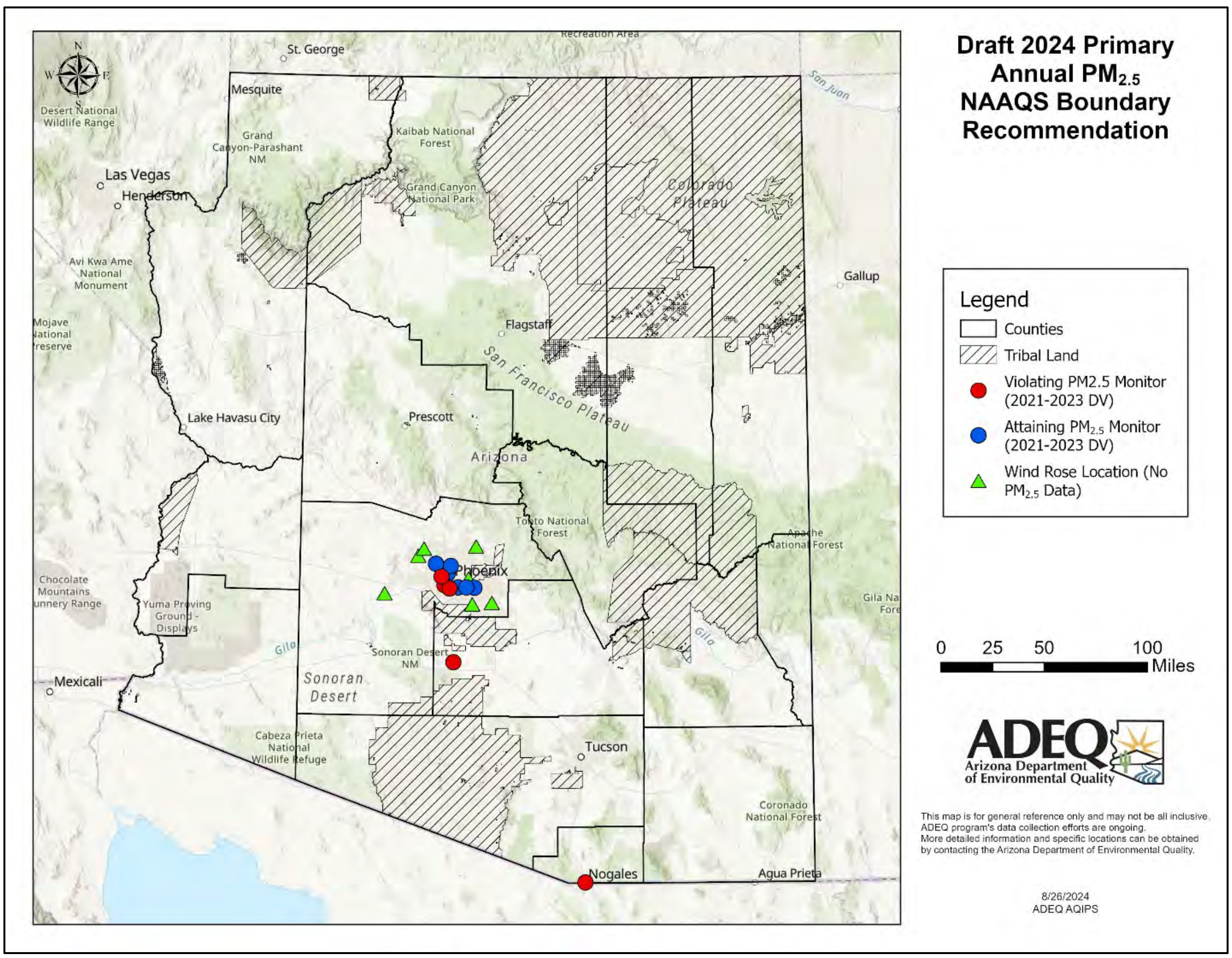
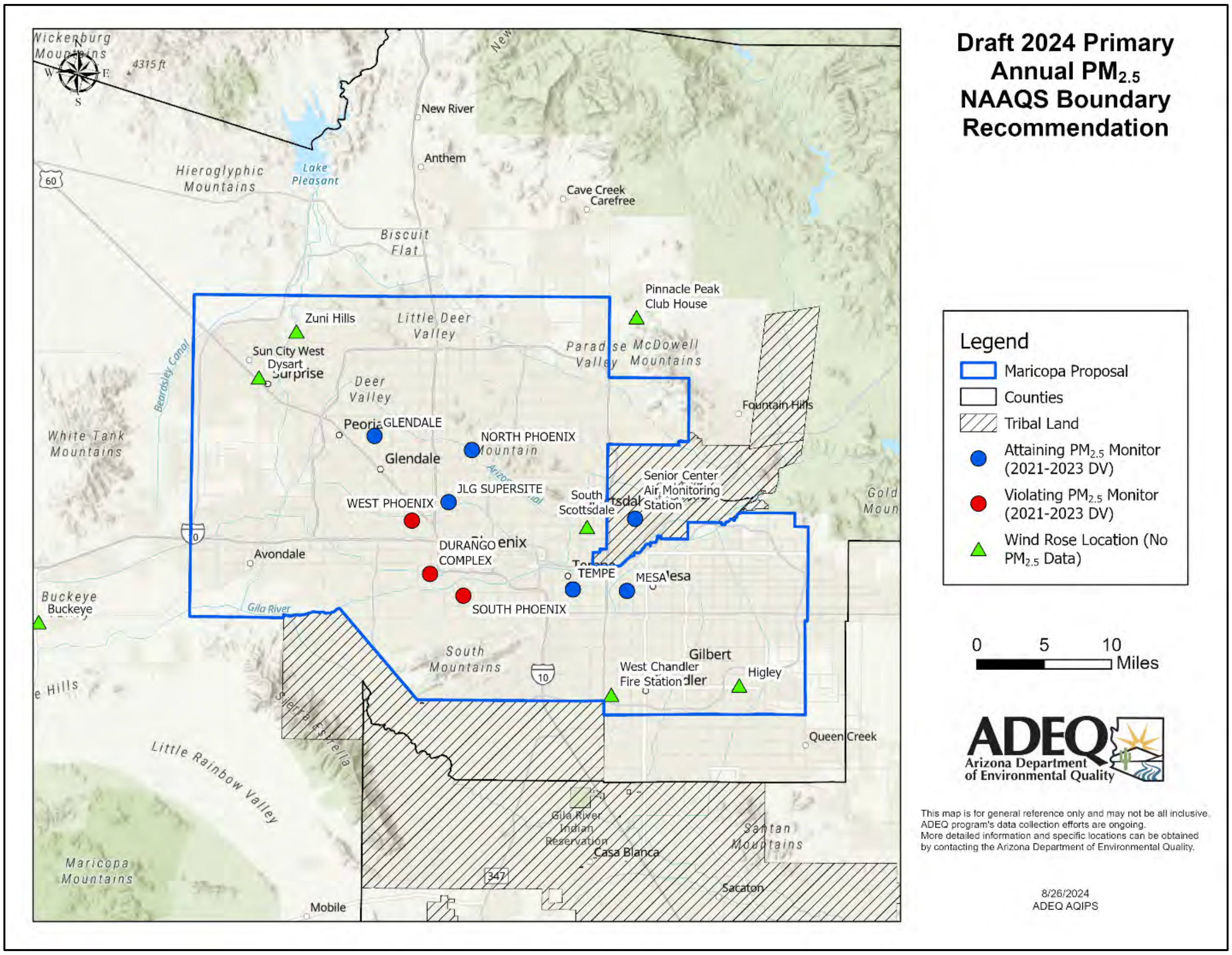


Figure 39: Maricopa County Monitors Used in Meteorological Analysis



The first step in meteorological analysis is to create a wind rose using R studio for each year and season during the study period. Figure 40 is an example of a wind rose analysis at the Durango Complex monitor in Phoenix, AZ for the 2021-2023 time period. This wind rose shows that winds tend to occur from the west and east. The strongest winds tend to come from the west during spring and summer months. For the winds from the west, around 25% of wind speeds are greater than 6 mph. The figure also shows that winds are calm and stagnant during the autumn and winter months from all directions.

Next, Figure 41 provides an example of a pollution rose at the Durango Complex monitor in Phoenix, AZ for each year and season during the 2021-2023 time period. Figure 41: Durango Complex Pollution Rose for All Data (2021-2023) shows that $PM_{2.5}$ pollution greater than 25 μg/m^3 occurs from the east around 12% of the time, with an additional ~20% from the southeast. Additionally, high levels of $PM_{2.5}$ pollution are detected from all directions, but are most prevalent from the east and southeast.

Moreover, percentile roses for each year and season during the study period were examined. An example is provided in Figure 42 at the Durango Complex monitor in Phoenix, AZ for the 2021-2023 time period. A percentile rose is plotted using the cumulative probability function

(CPF) at the 95th percentile. The CPF plots the percent of samples in each wind sector where $PM_{2.5}$ concentrations are greater than 95% of the samples in the data set. The purpose of this analyses is to give ADEQ insight as to where the source of $PM_{2.5}$ could be coming from on the worst exceedance days at a monitor. This percentile rose shows that $PM_{2.5}$ concentrations of the 95th percentile mostly occur in the winter months, and mostly come from the north and south. In 2023, Figure 42: Durango Complex Percentile Rose for All Data (2021-2023) shows that around 35% of 95th percentile $PM_{2.5}$ comes from the north and around 20% comes from the south.

Each of these analyses were also executed for hourly data on days that the 24-hour average concentration exceeds the primary annual standard of 9 μg/m^3. For example, Figure 43 is the wind rose for all days that the 24-hour average concentration exceeds the primary annual standard between 2021-2023 at the Durango Complex monitor. Figure 44 is a pollution rose for all days that the 24-hour average concentration exceeds the primary annual standard between 2021-2023 at the Durango Complex monitor. Figure 45 is a percentile rose for all days that the 24-hour average concentration exceeds the primary annual standard between 2021-2023 at the Durango Complex monitor.

Figure 40: Durango Complex Wind Rose for All Data (2021-2023)

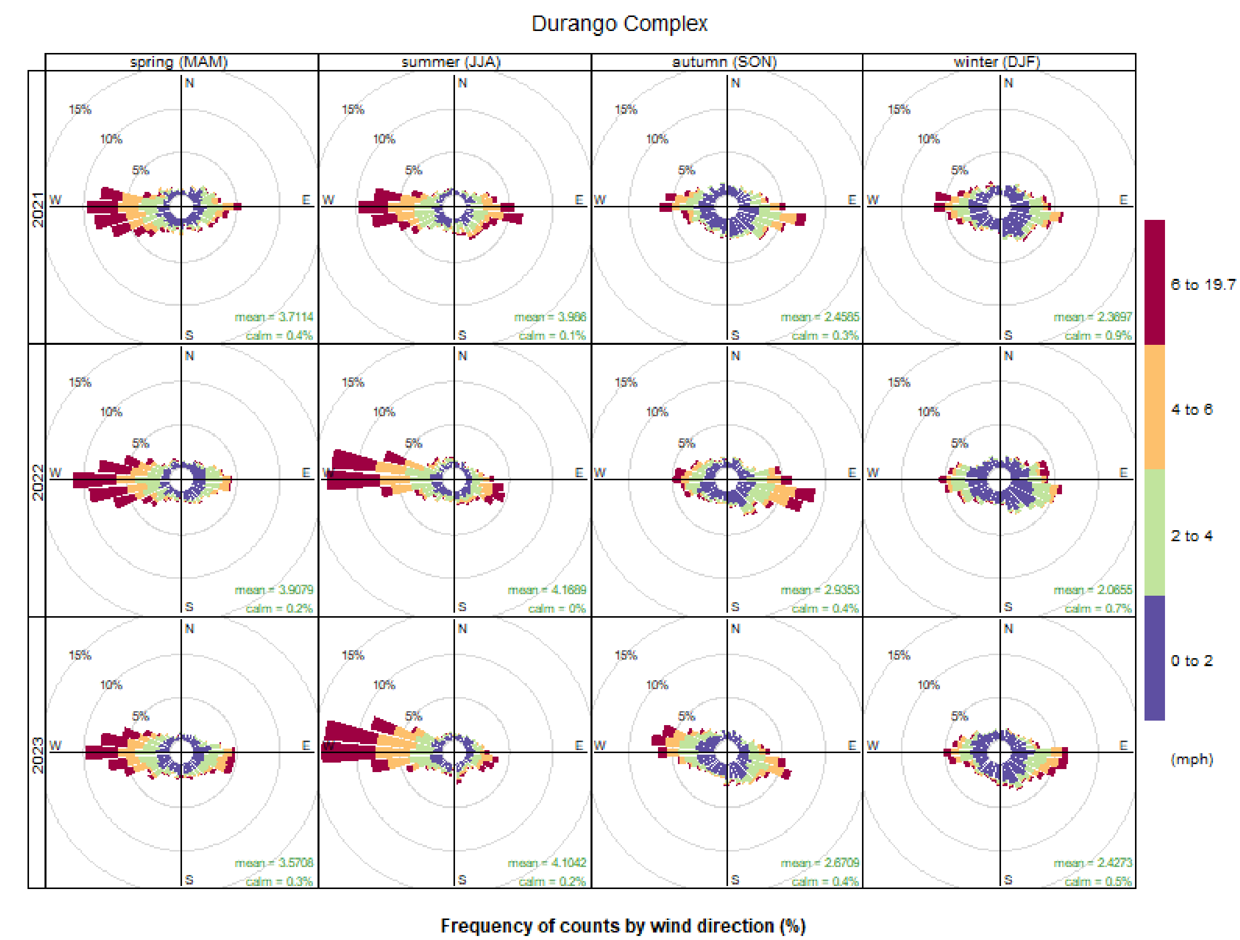


Figure 41: Durango Complex Pollution Rose for All Data (2021-2023)

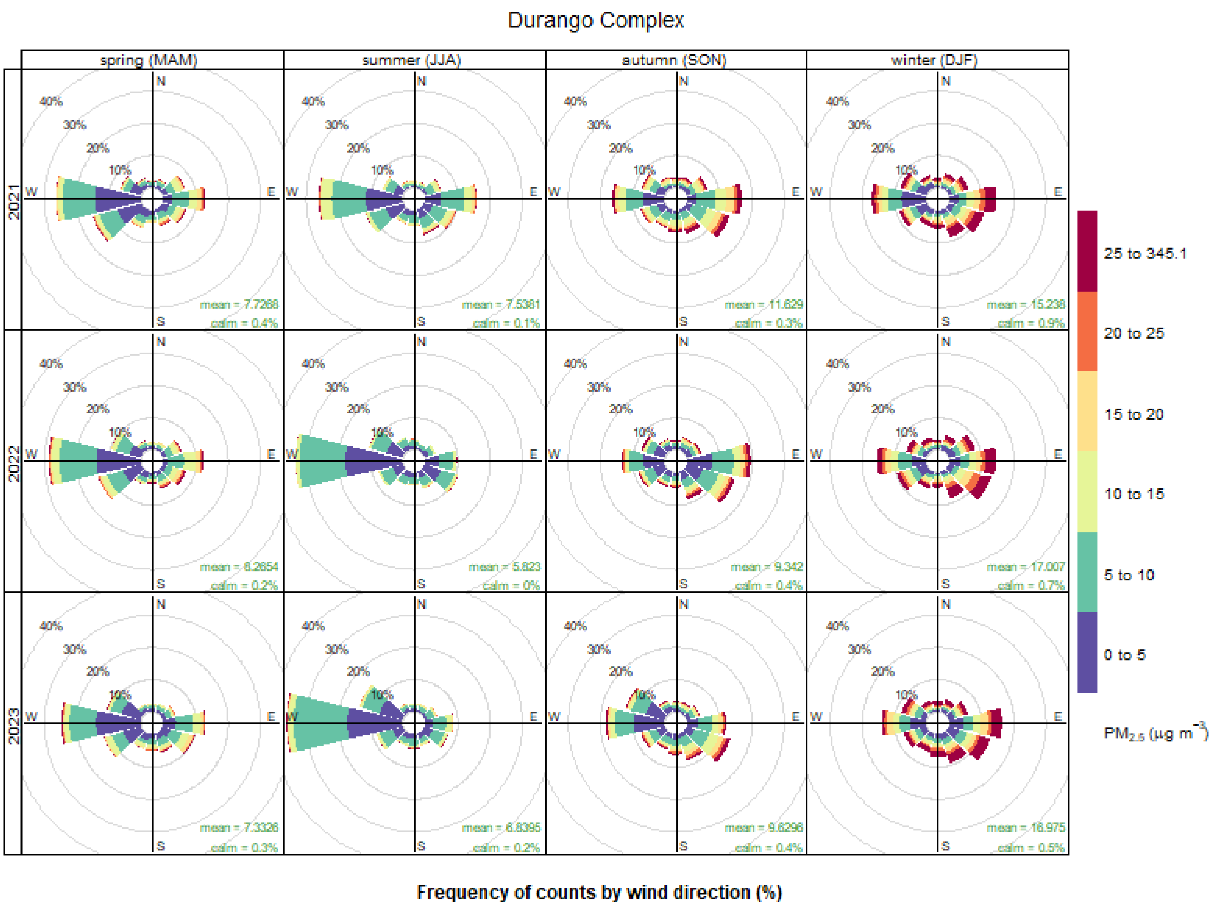


Figure 42: Durango Complex Percentile Rose for All Data (2021-2023)

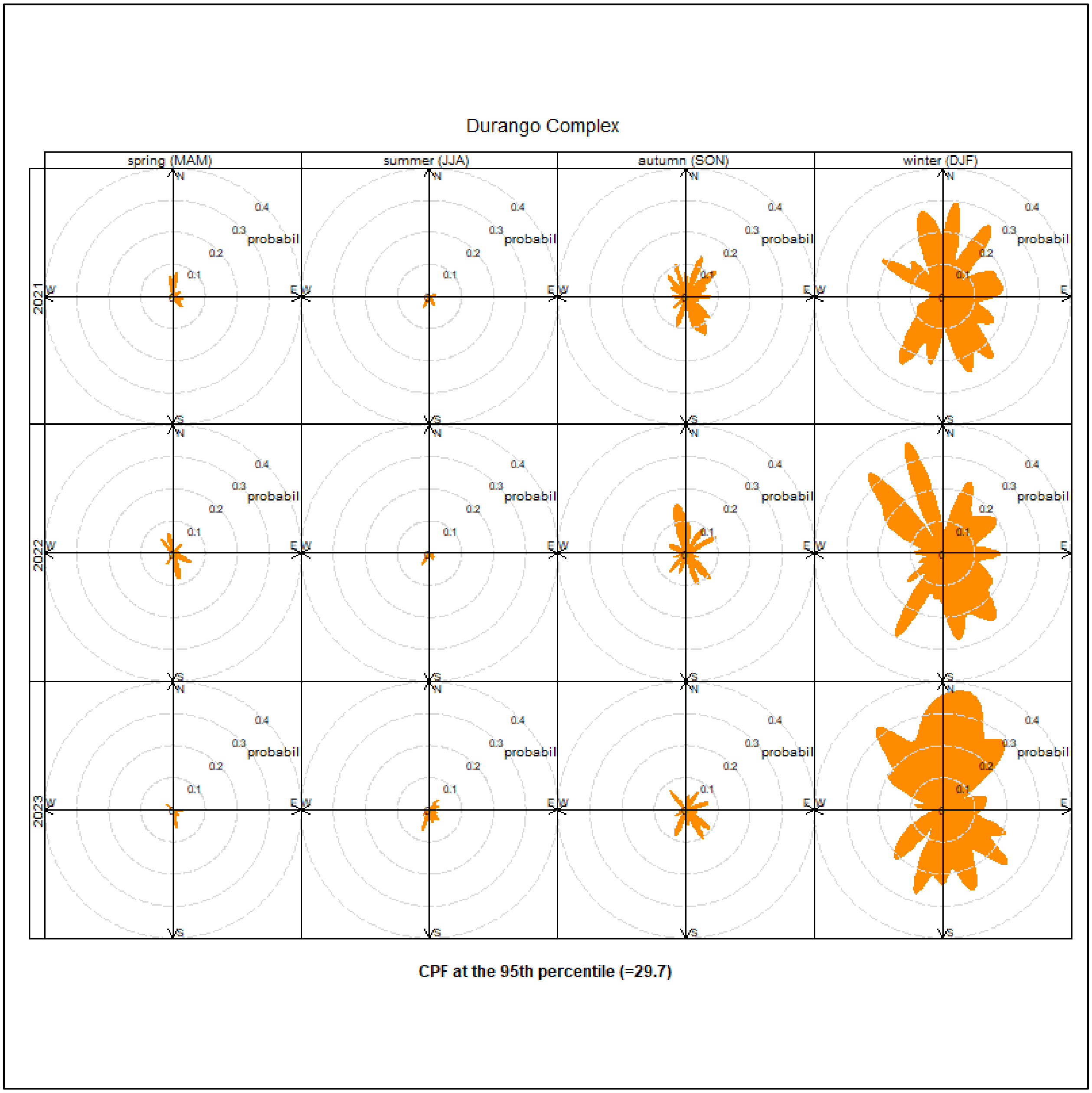


Figure 43: Durango Complex Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

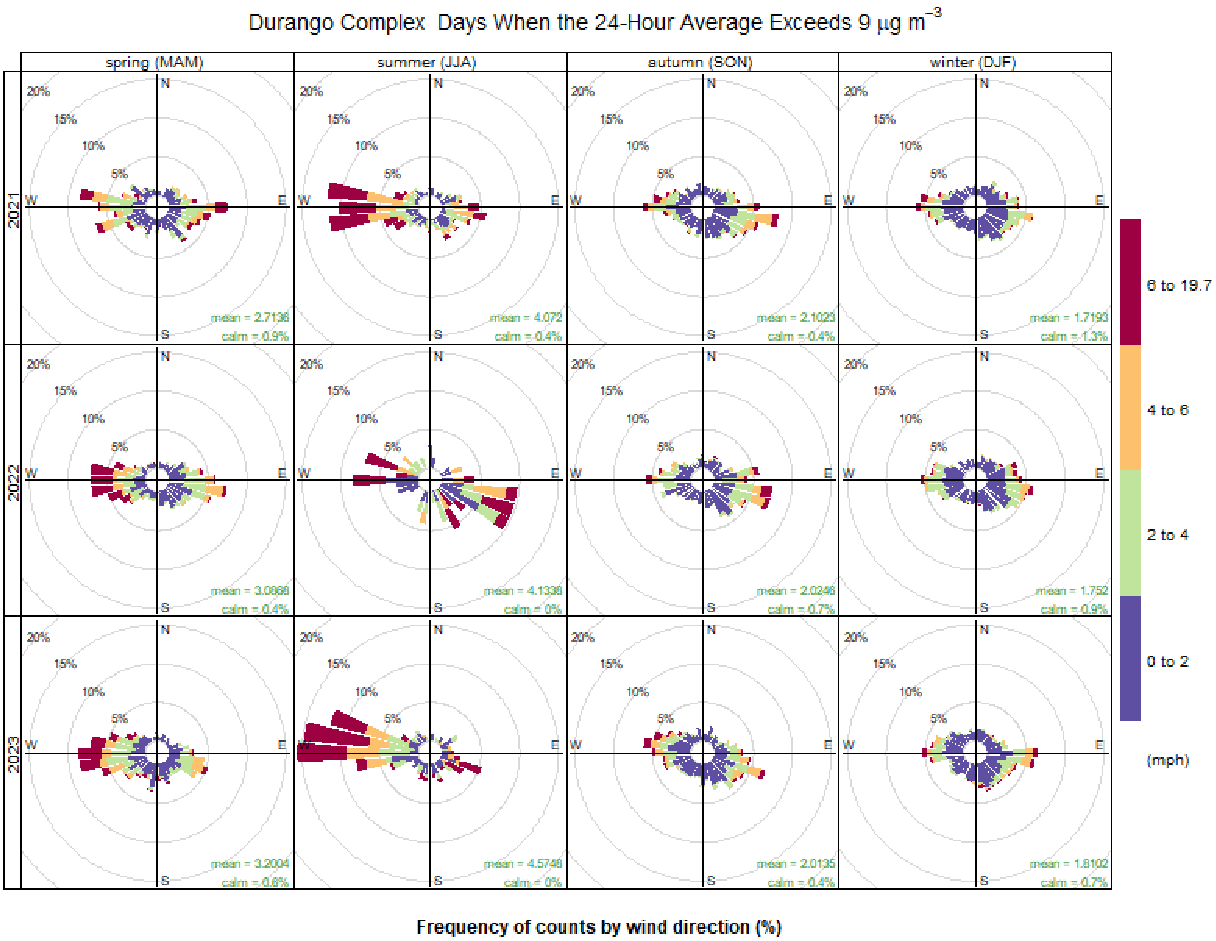


Figure 44: Durango Complex Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

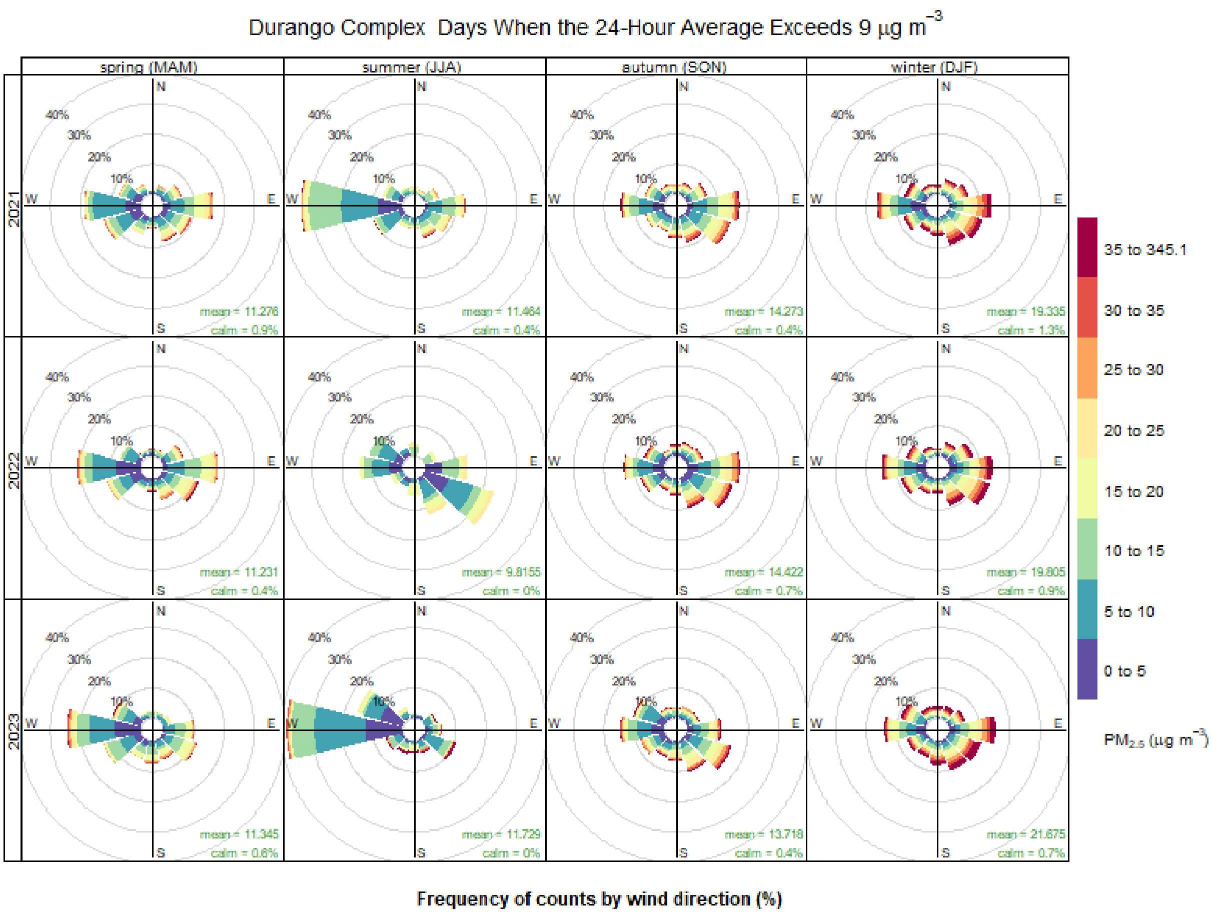


Figure 45: Durango Complex Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

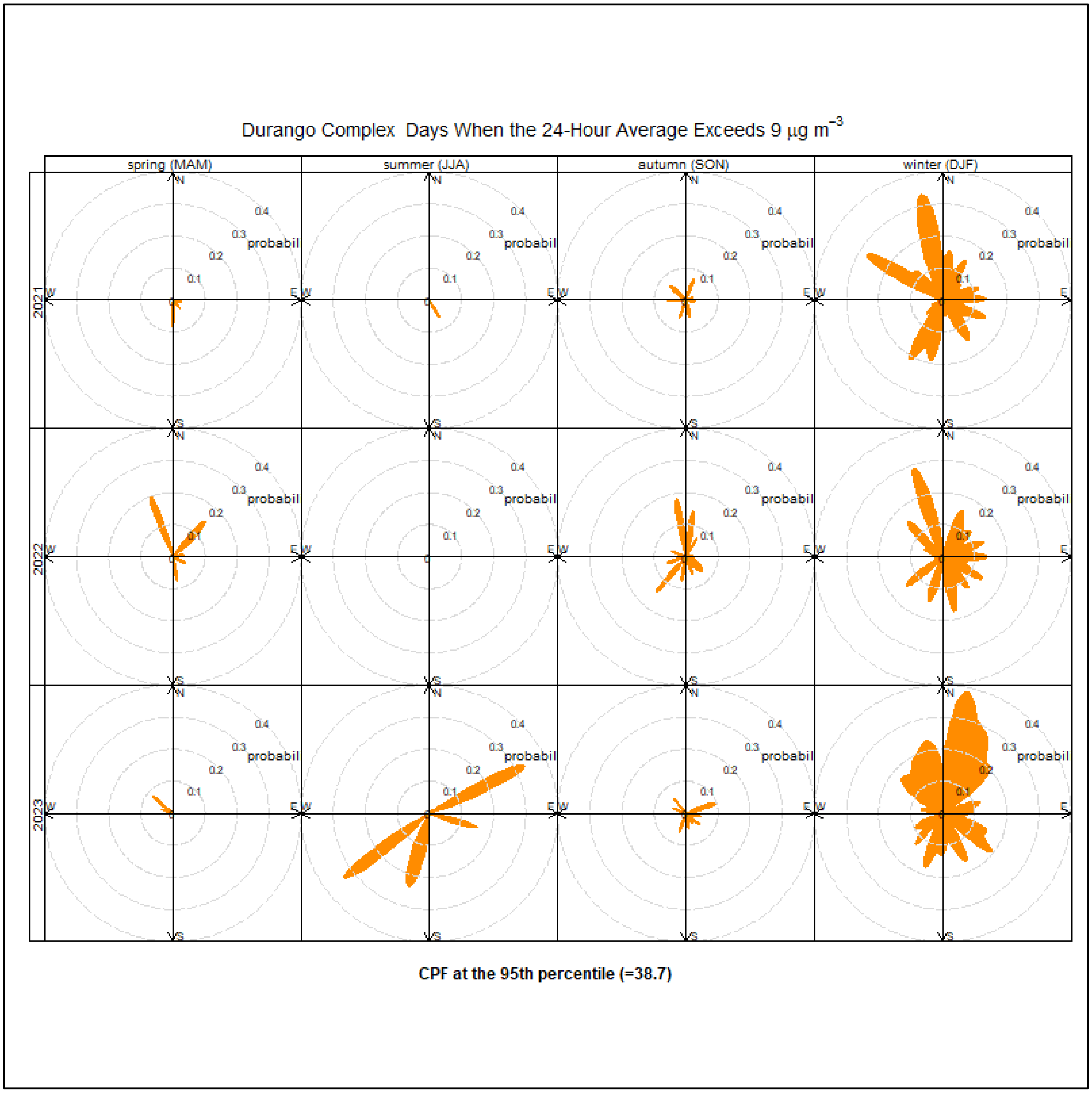


Figure 46: Glendale Wind Rose for All Data (2021-2023)

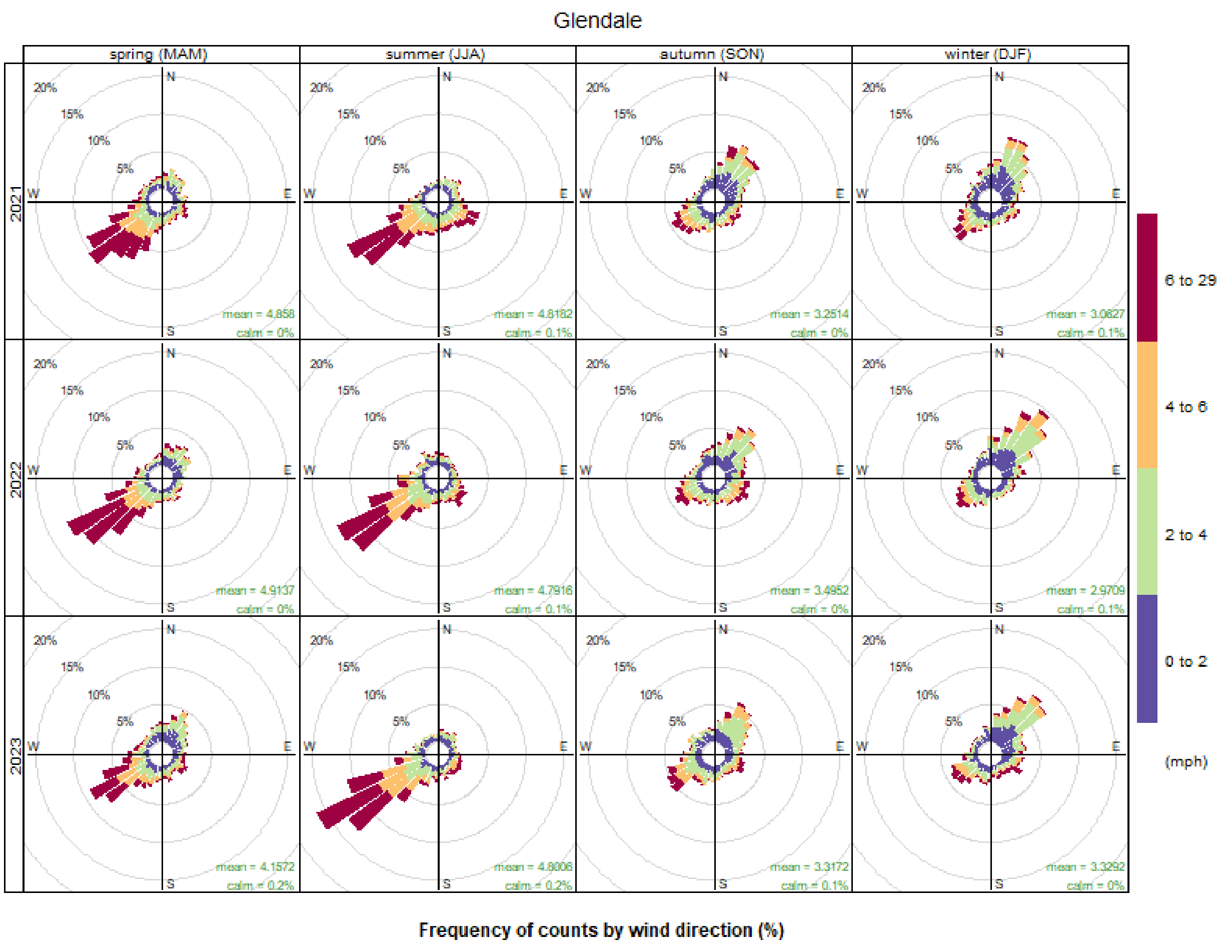


Figure 47: Glendale Pollution Rose for All Data (2021-2023)

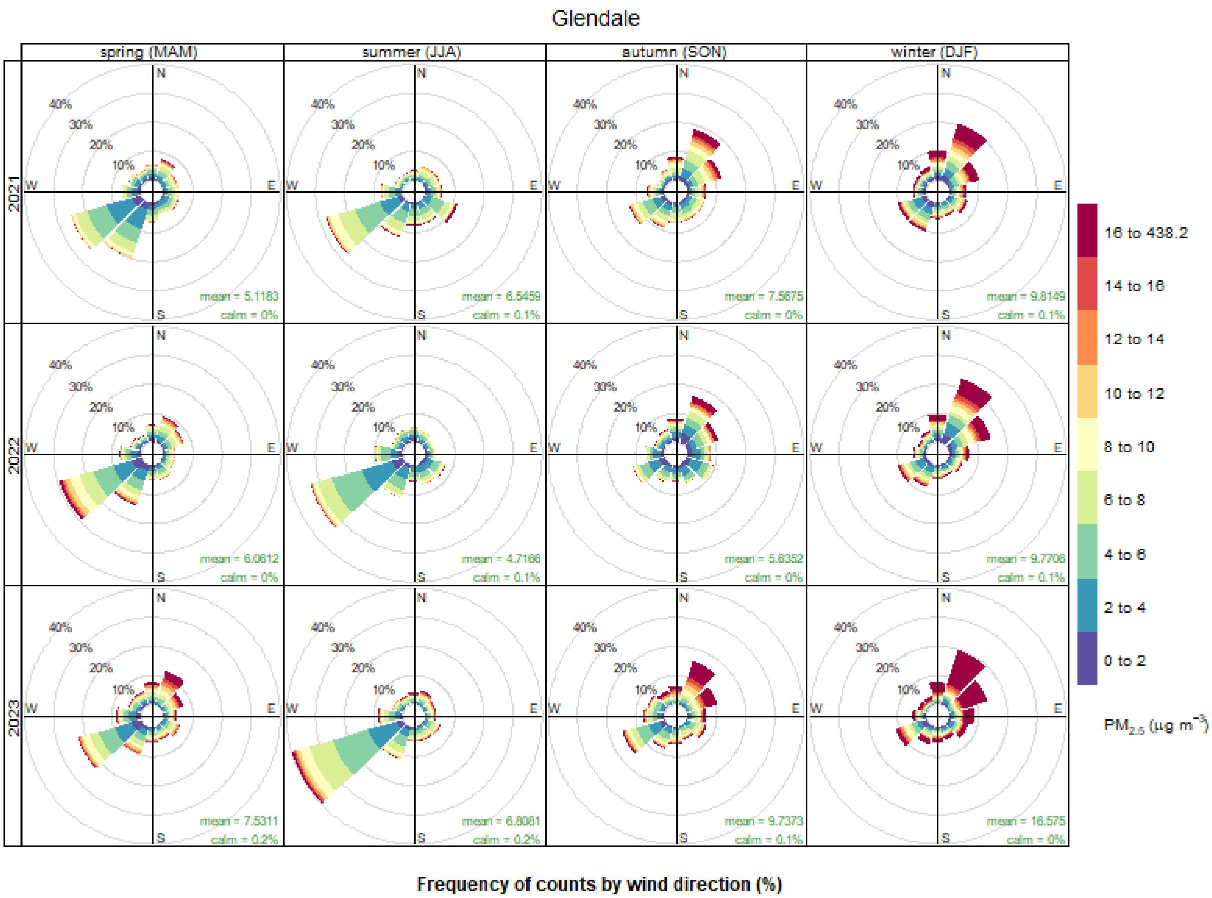


Figure 48: Glendale Percentile Rose for All Data (2021-2023)

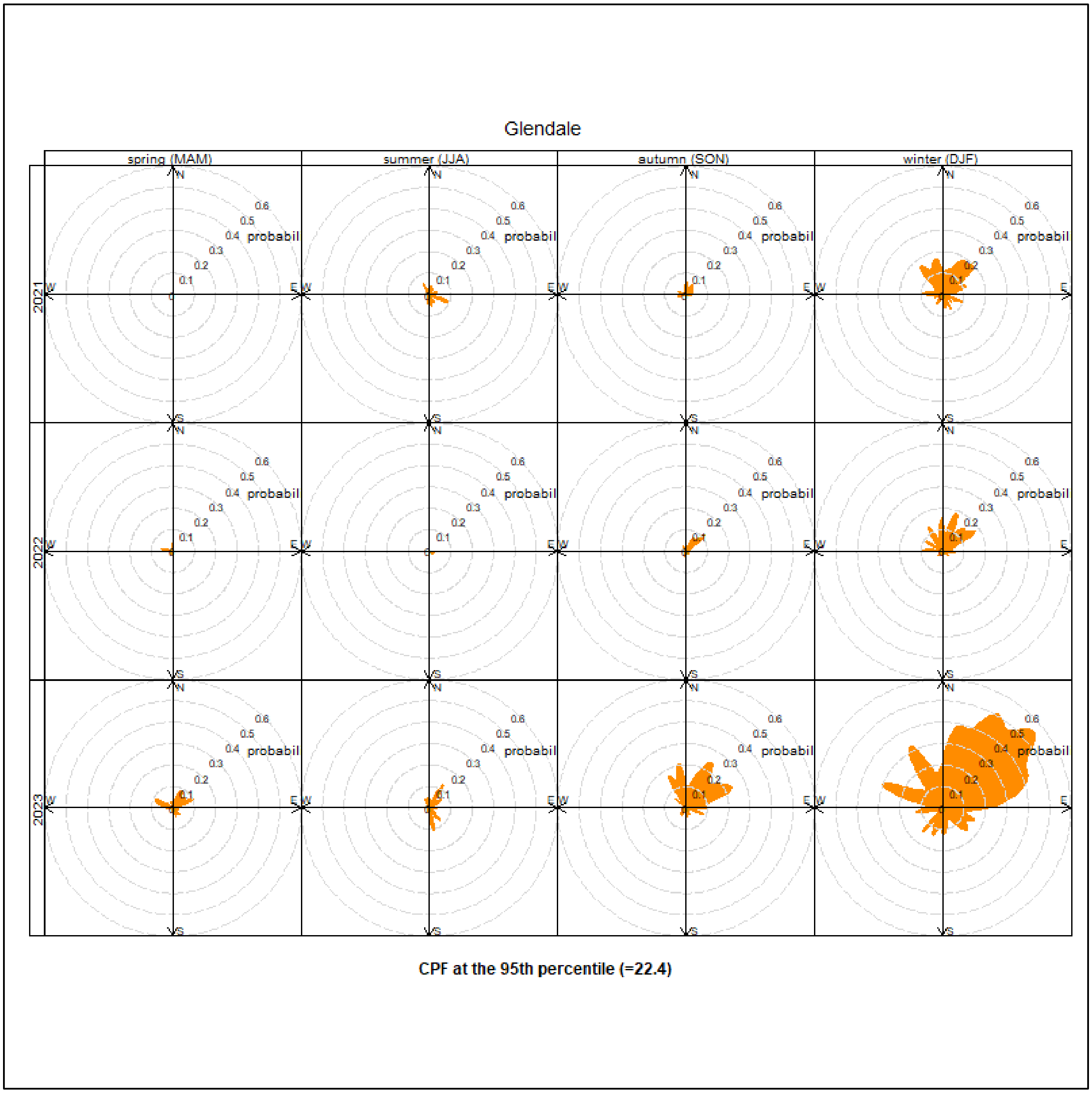


Figure 49: Glendale Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

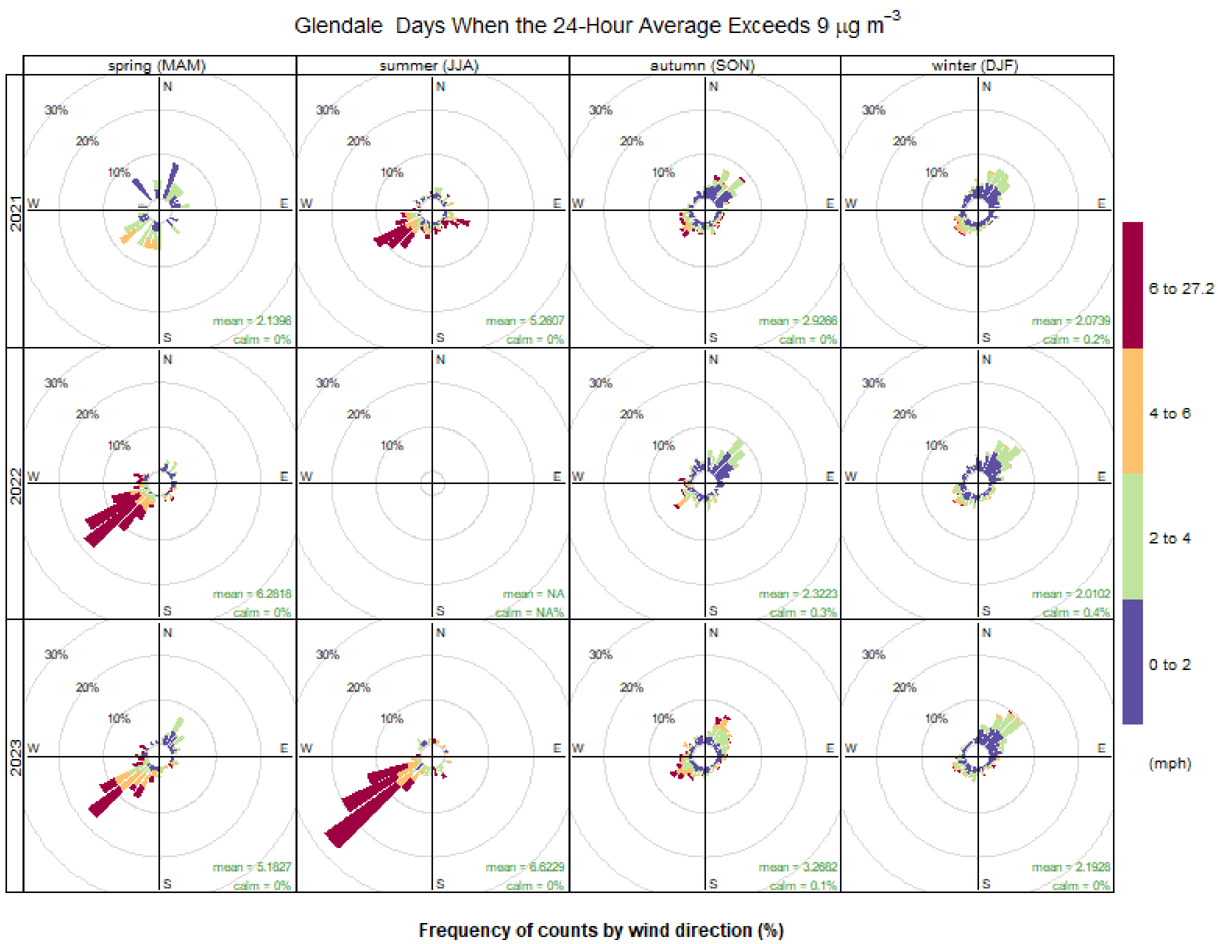


Figure 50: Glendale Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

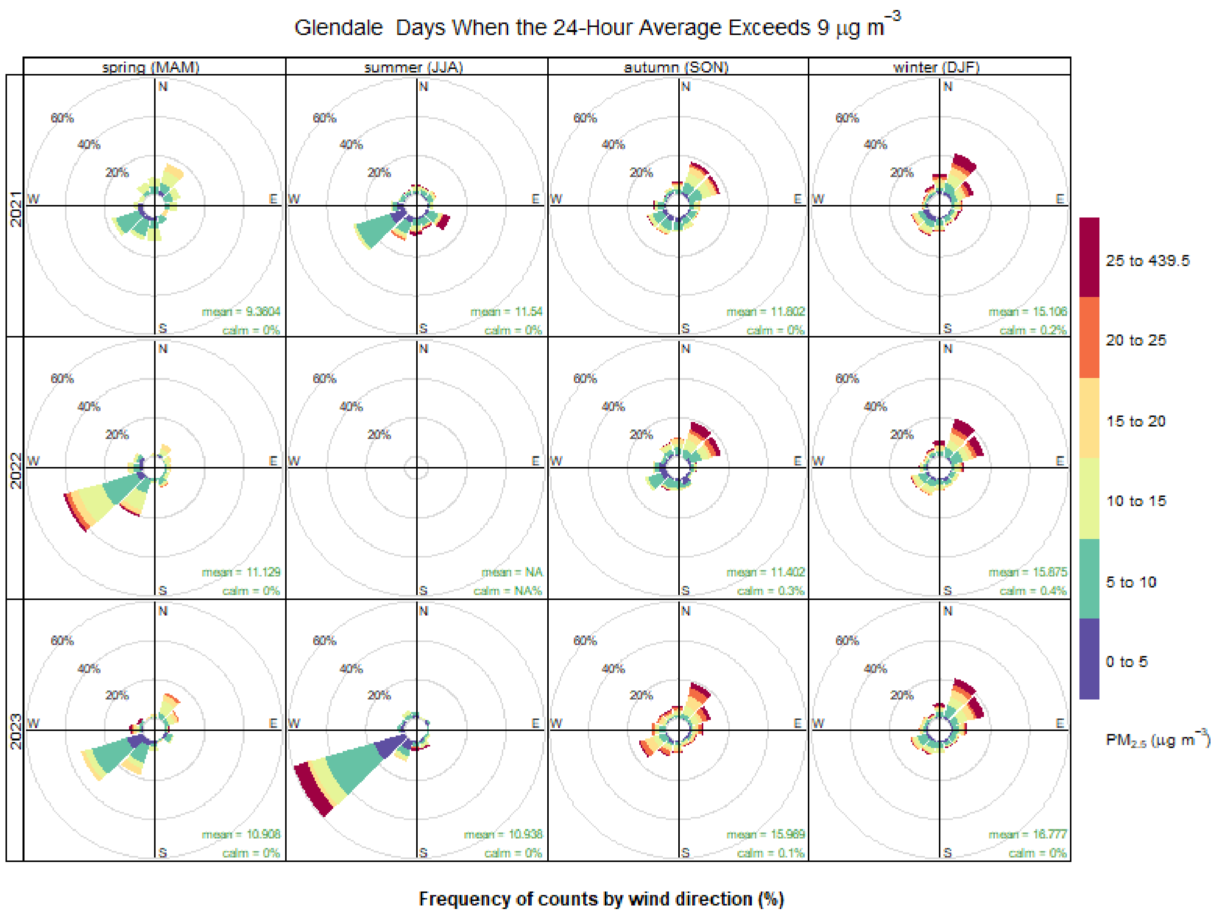


Figure 51: Glendale Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

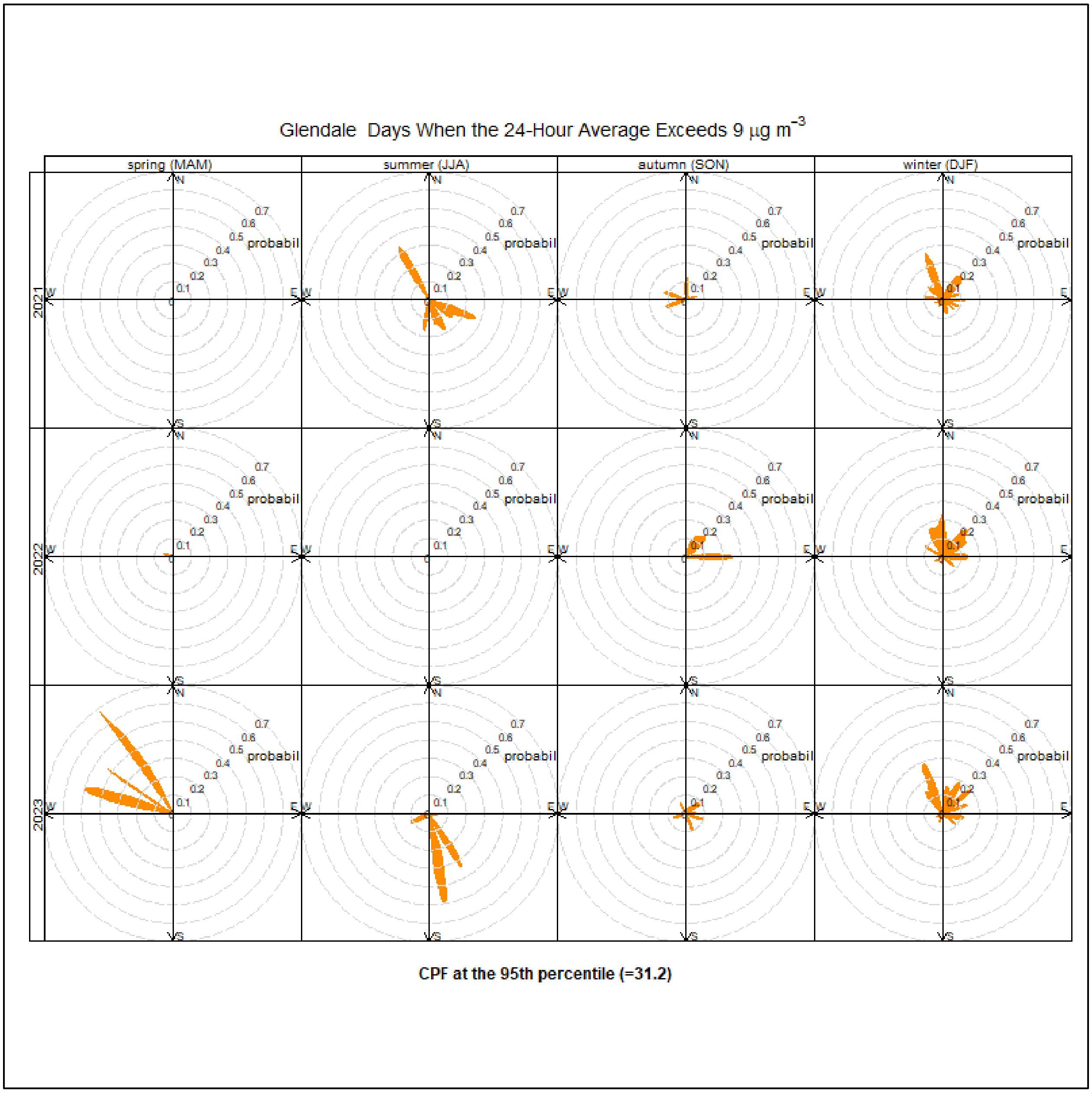


Figure 52: Hidden Valley Wind Rose for All Data (2021-2023)

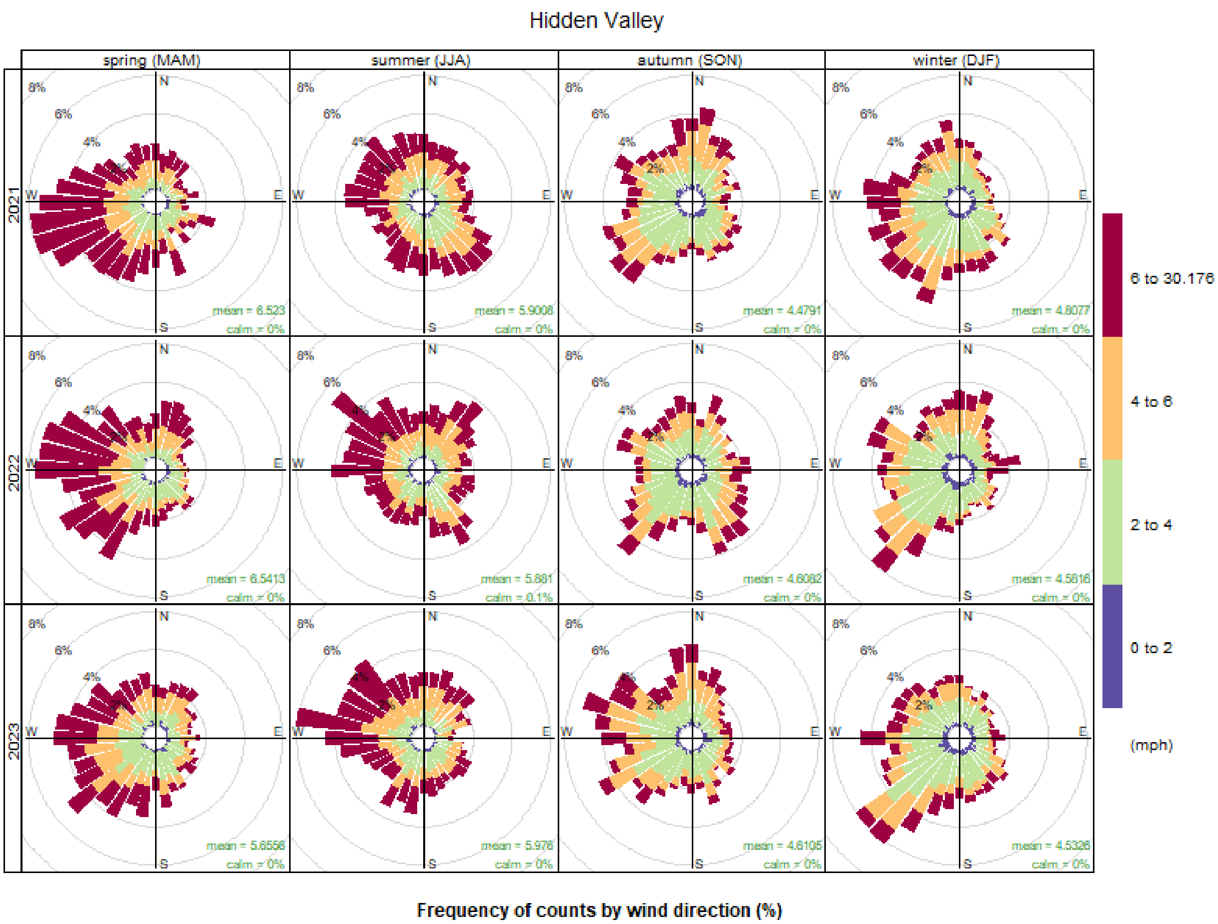


Figure 53: Hidden Valley Pollution Rose for All Data (2021-2023)

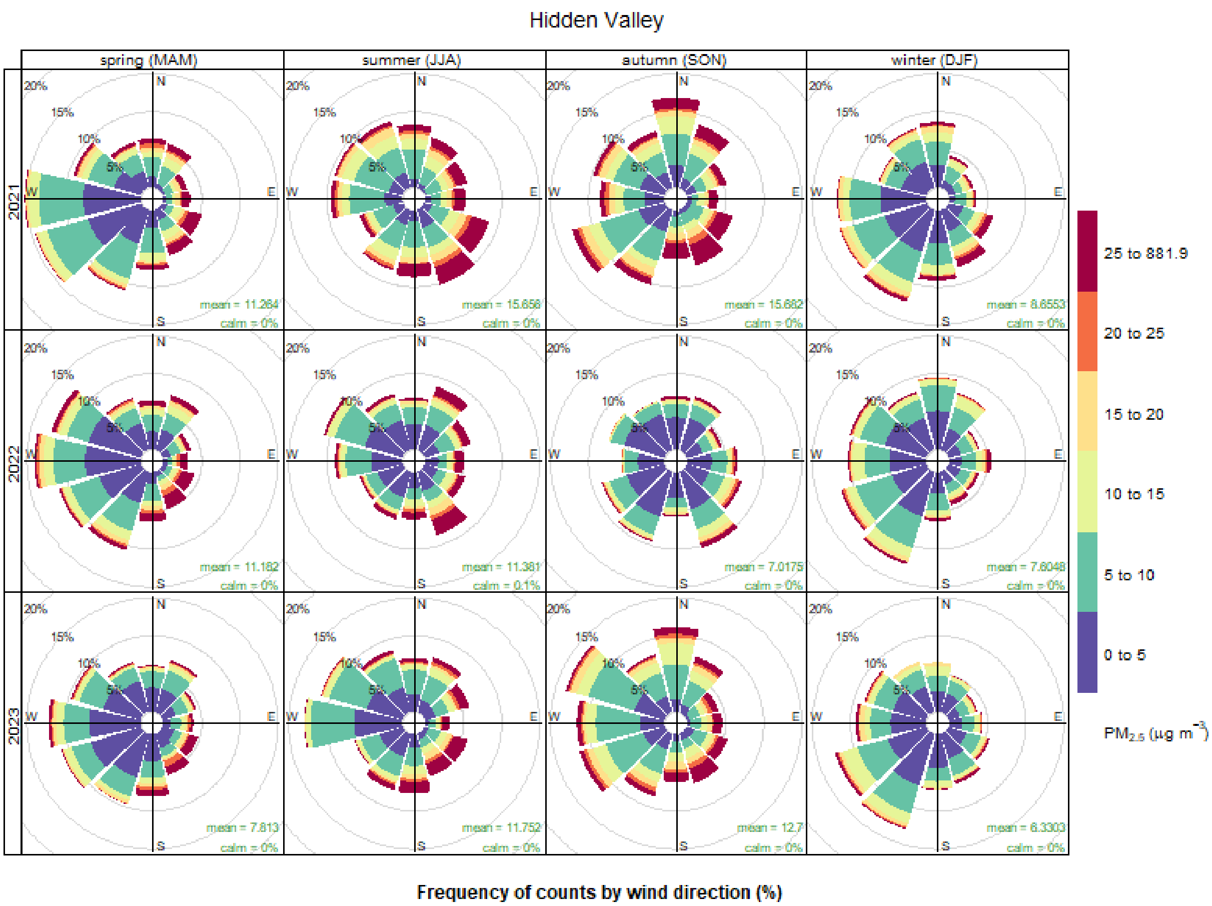


Figure 54: Hidden Valley Percentile Rose for All Data (2021-2023)

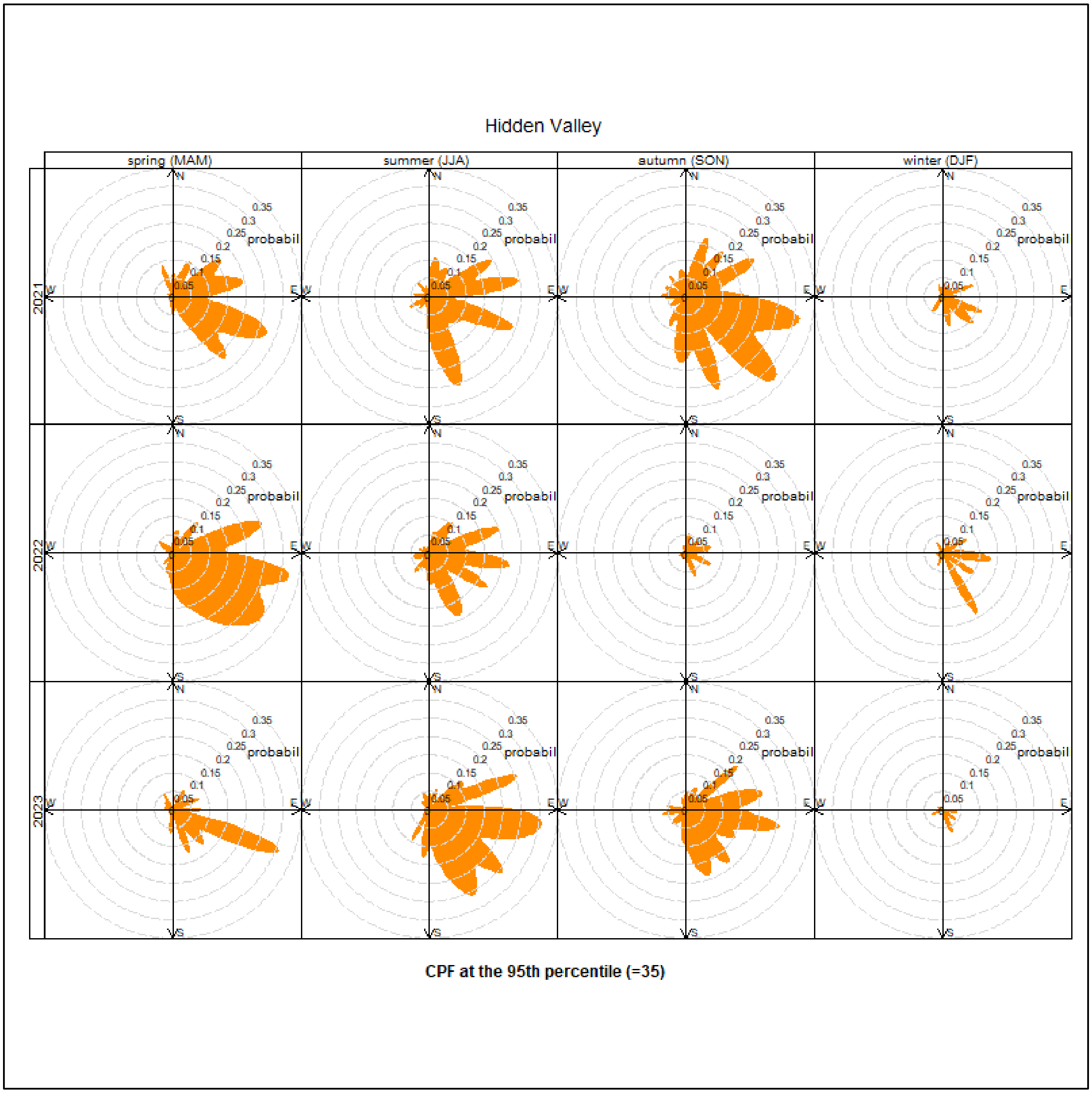


Figure 55: Hidden Valley Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

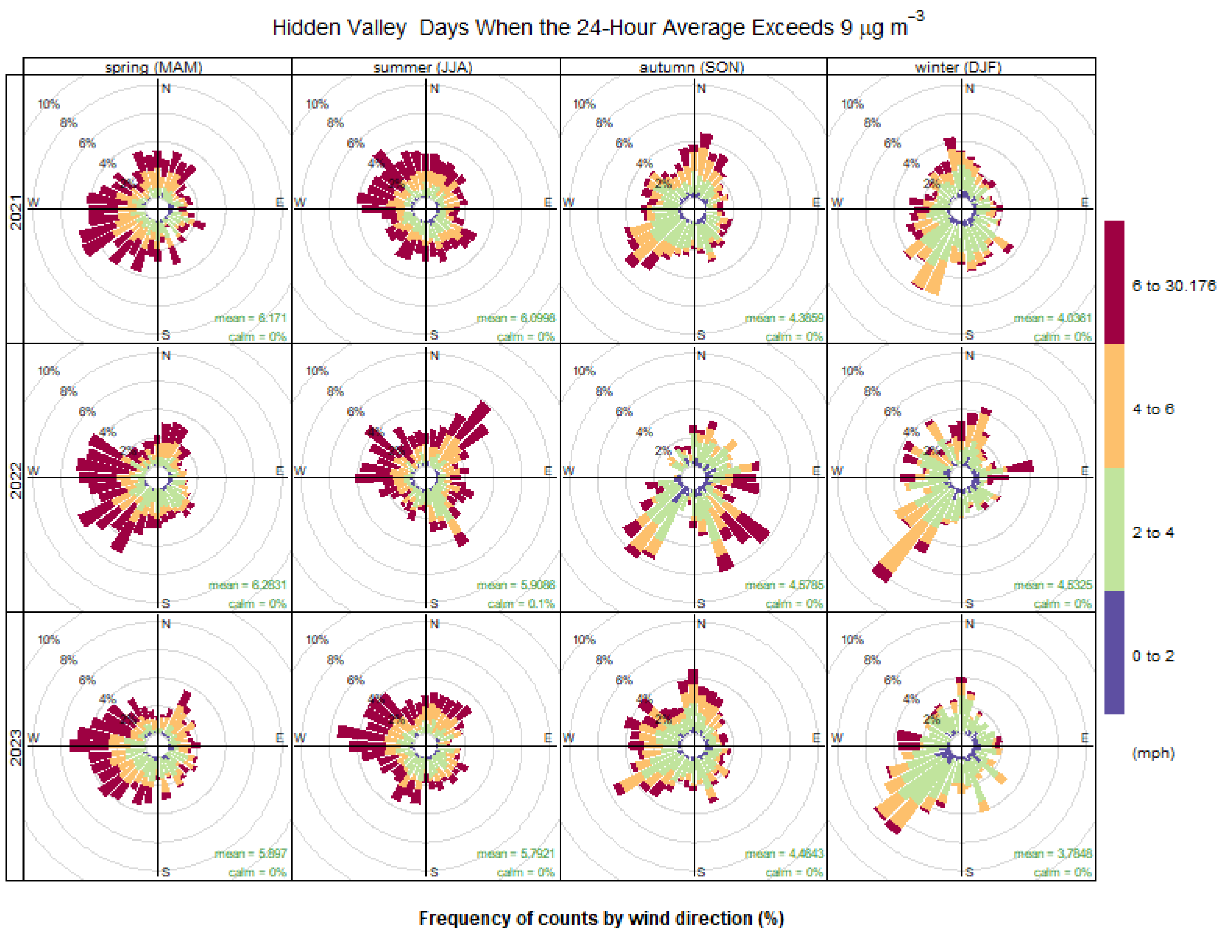


Figure 56: Hidden Valley Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

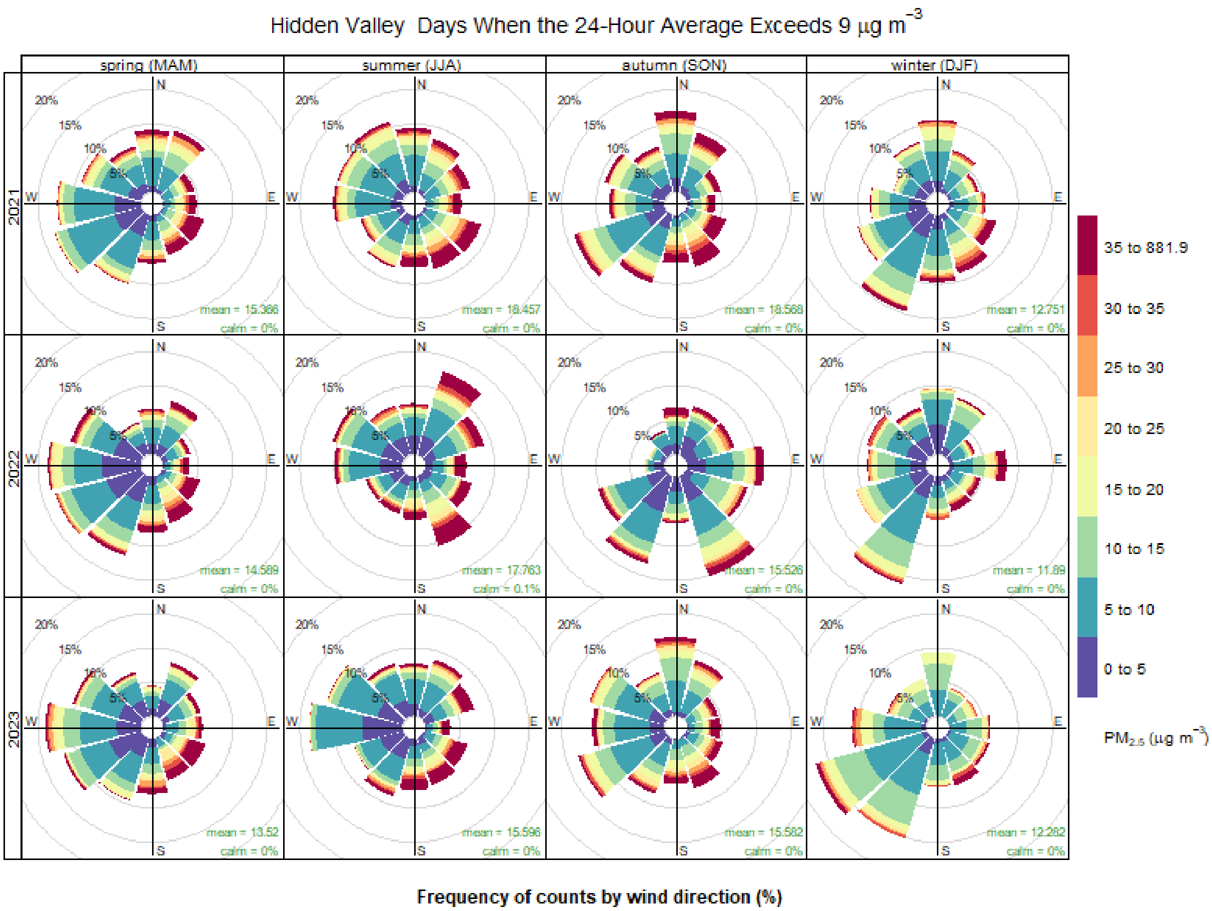


Figure 57: Hidden Valley Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

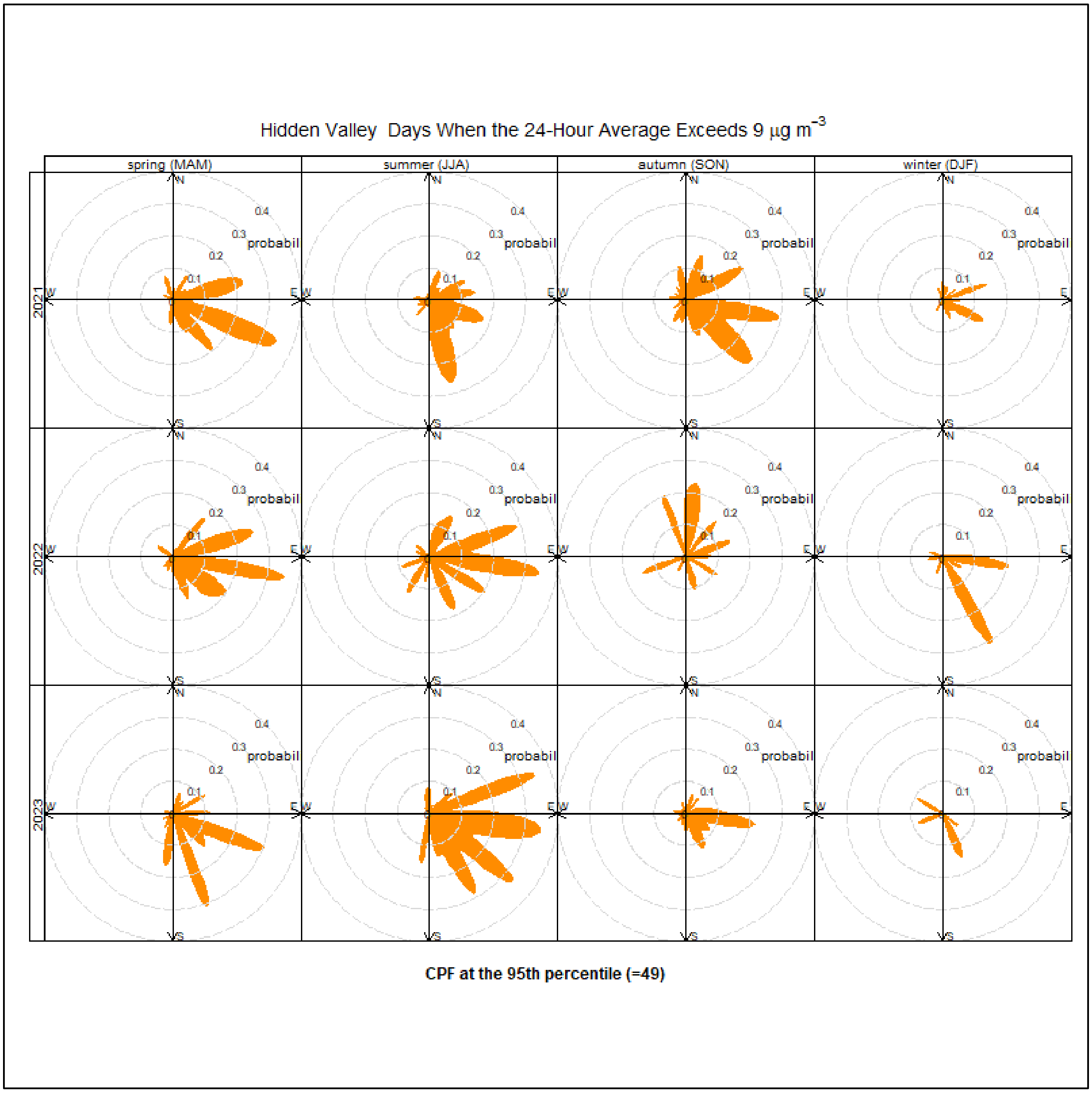


Figure 58: JLG Supersite Wind Rose for All Data (2021-2023)

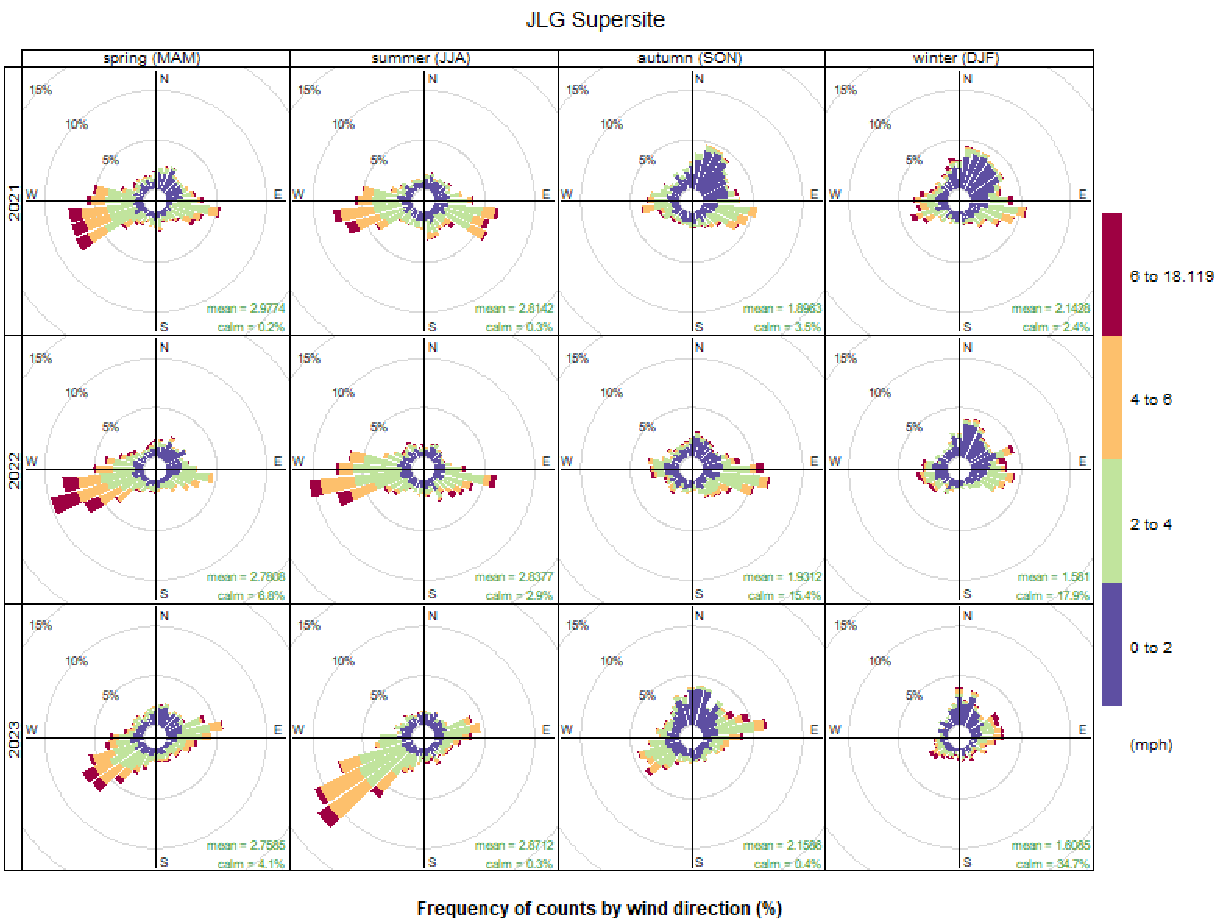


Figure 59: JLG Supersite Pollution Rose for All Data (2021-2023)

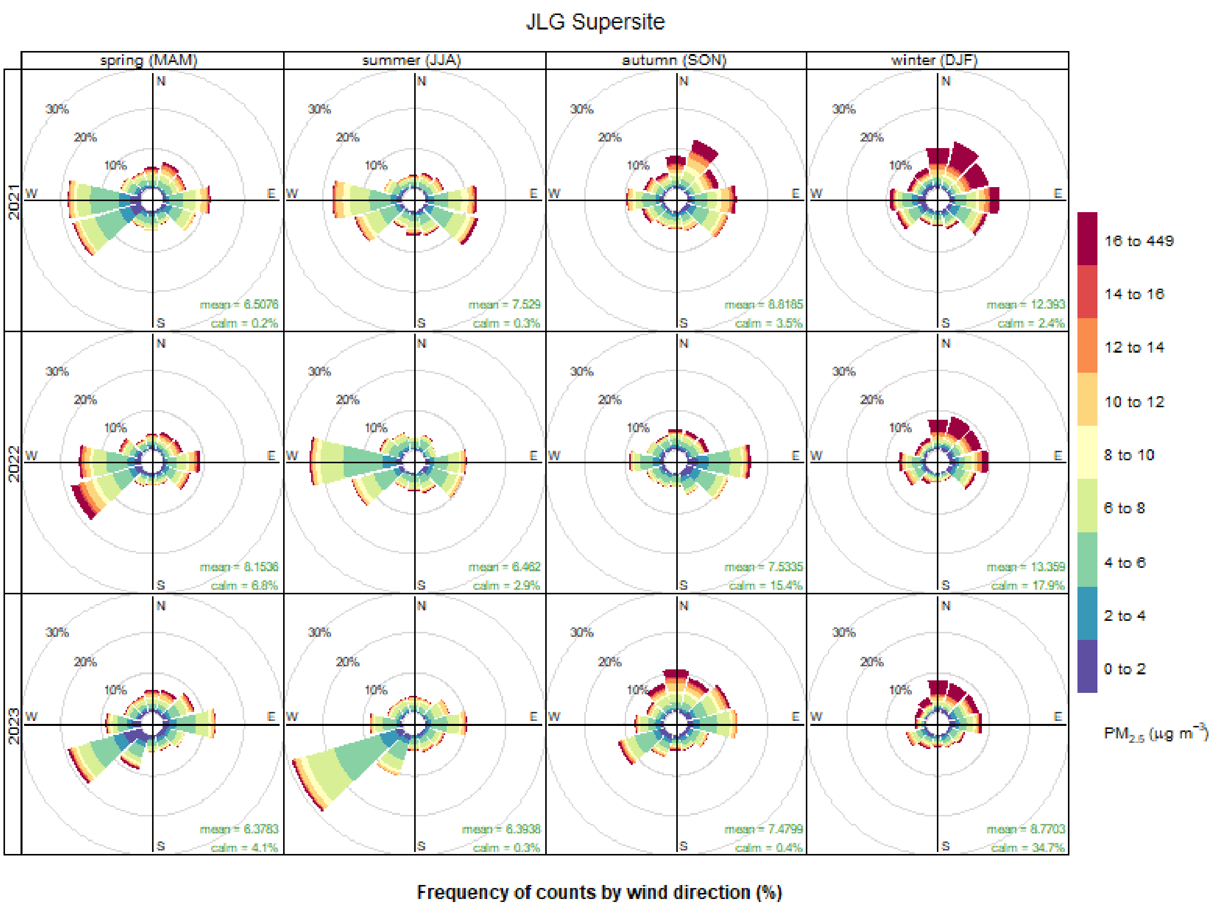


Figure 60: JLG Supersite Percentile Rose for All Data (2021-2023)

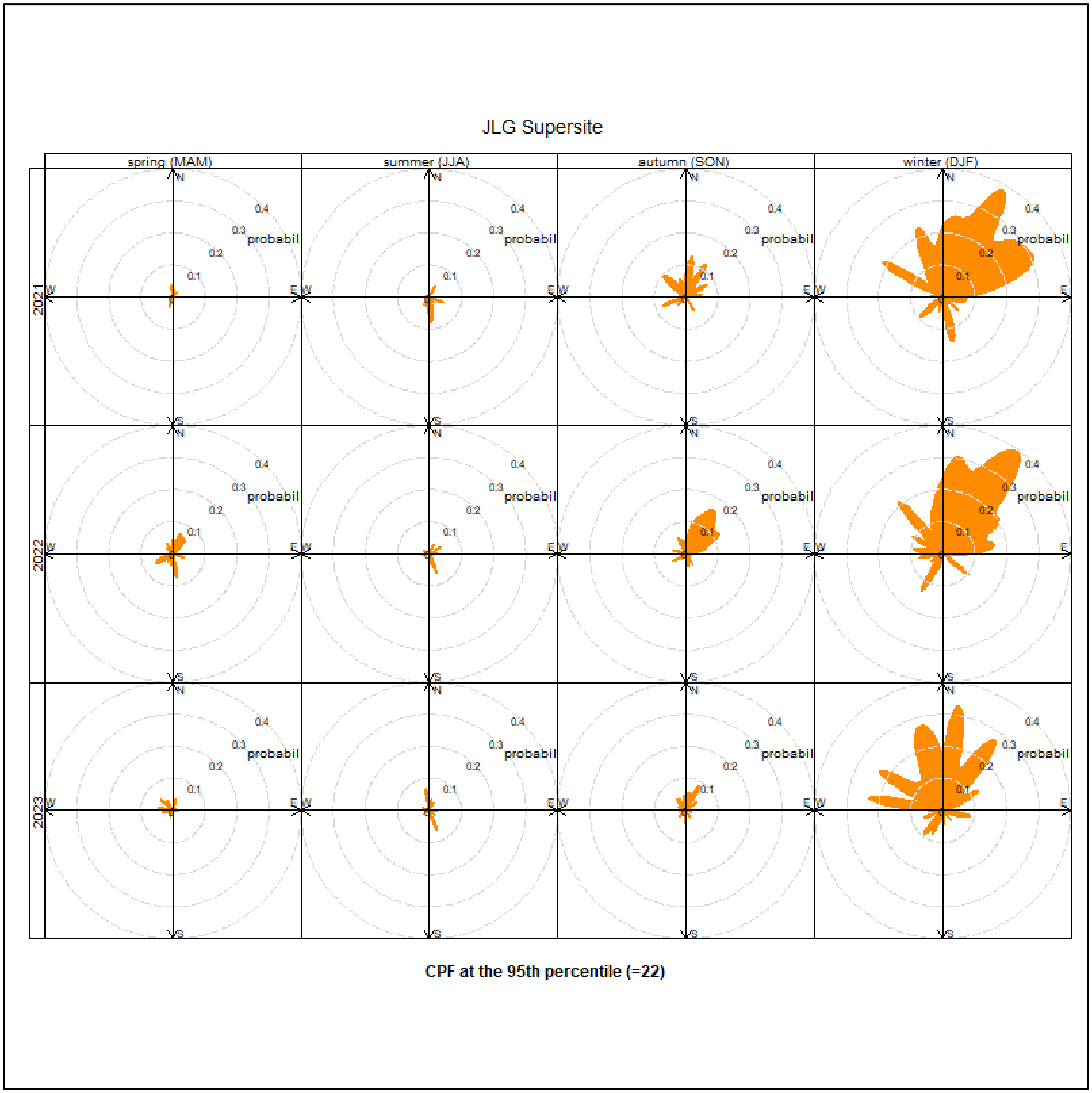


Figure 61: JLG Supersite Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

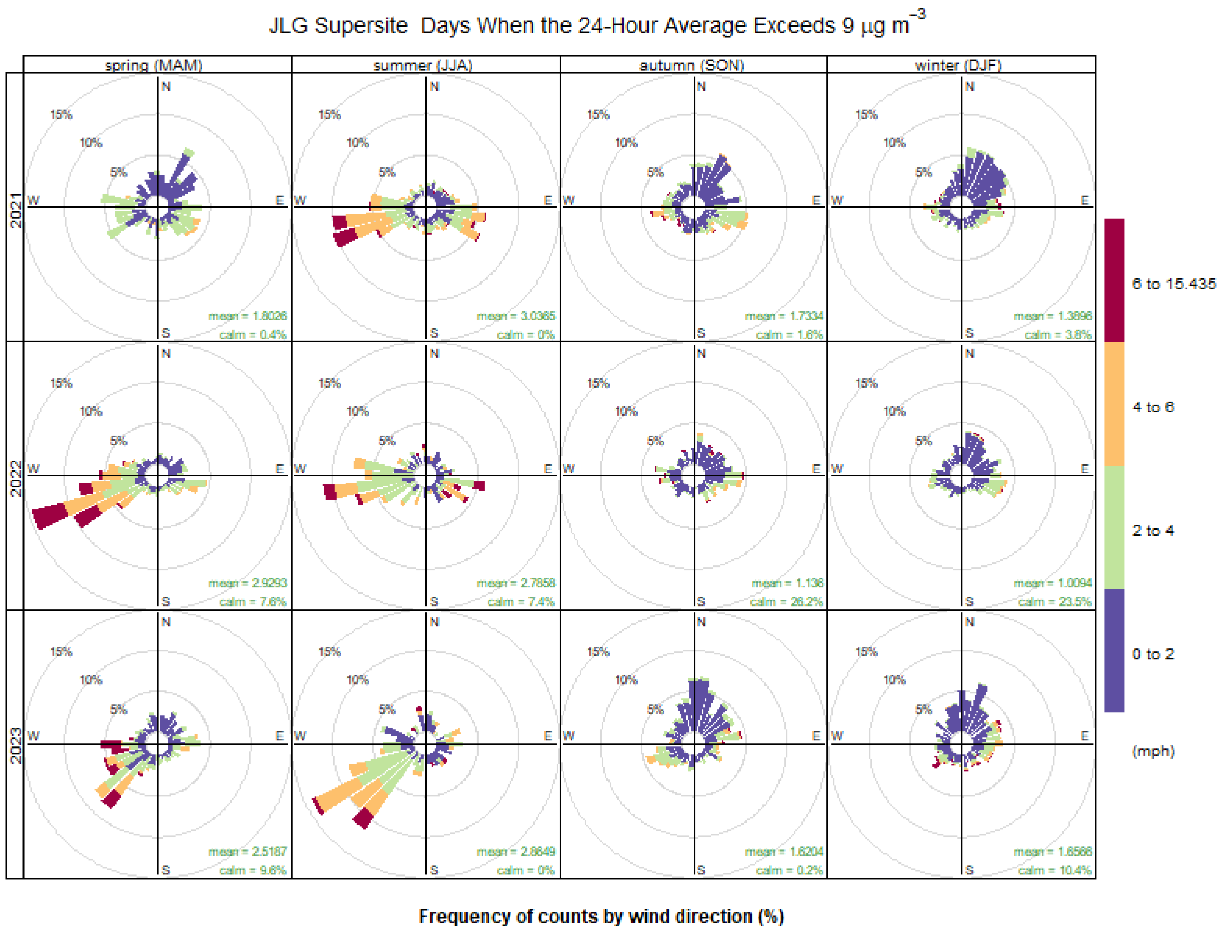


Figure 62: JLG Supersite Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

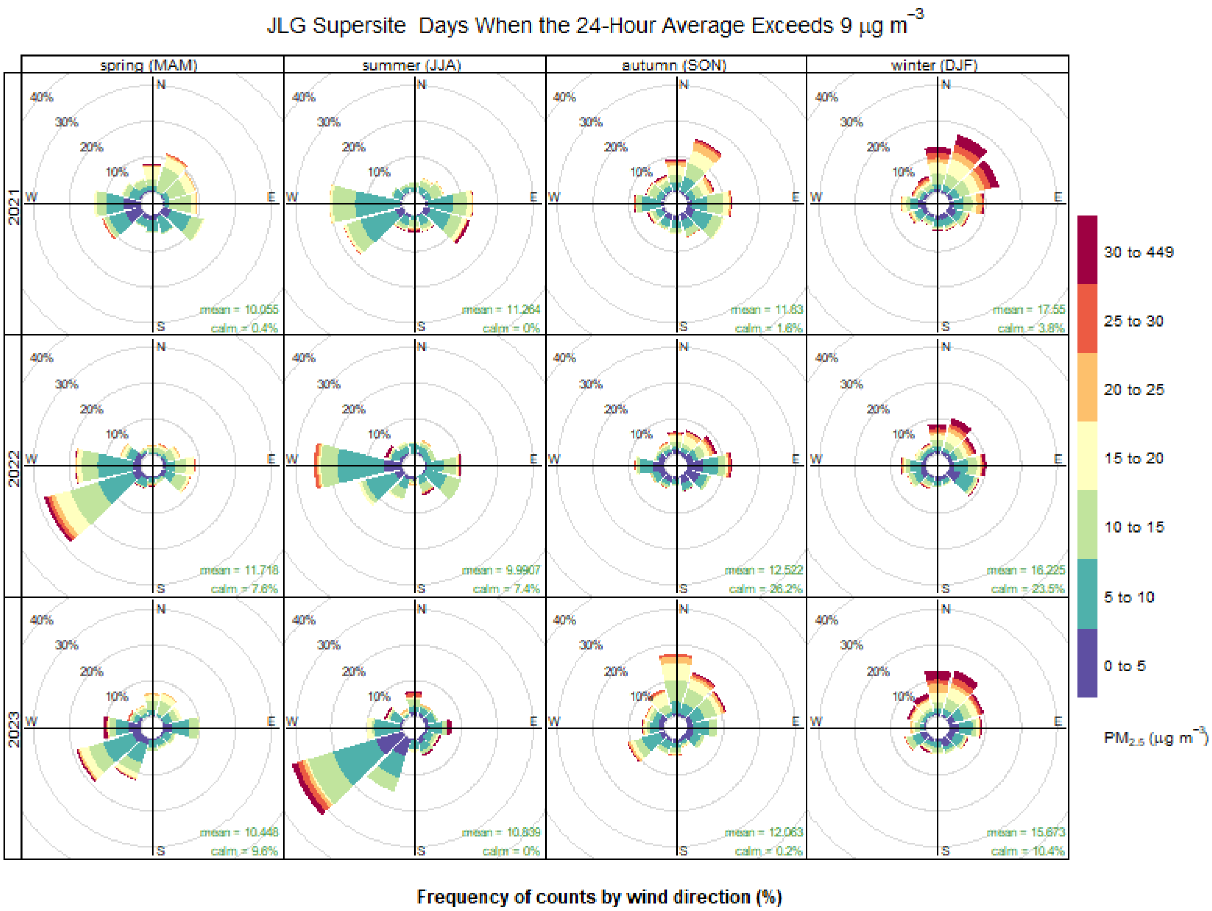


Figure 63: JLG Supersite Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

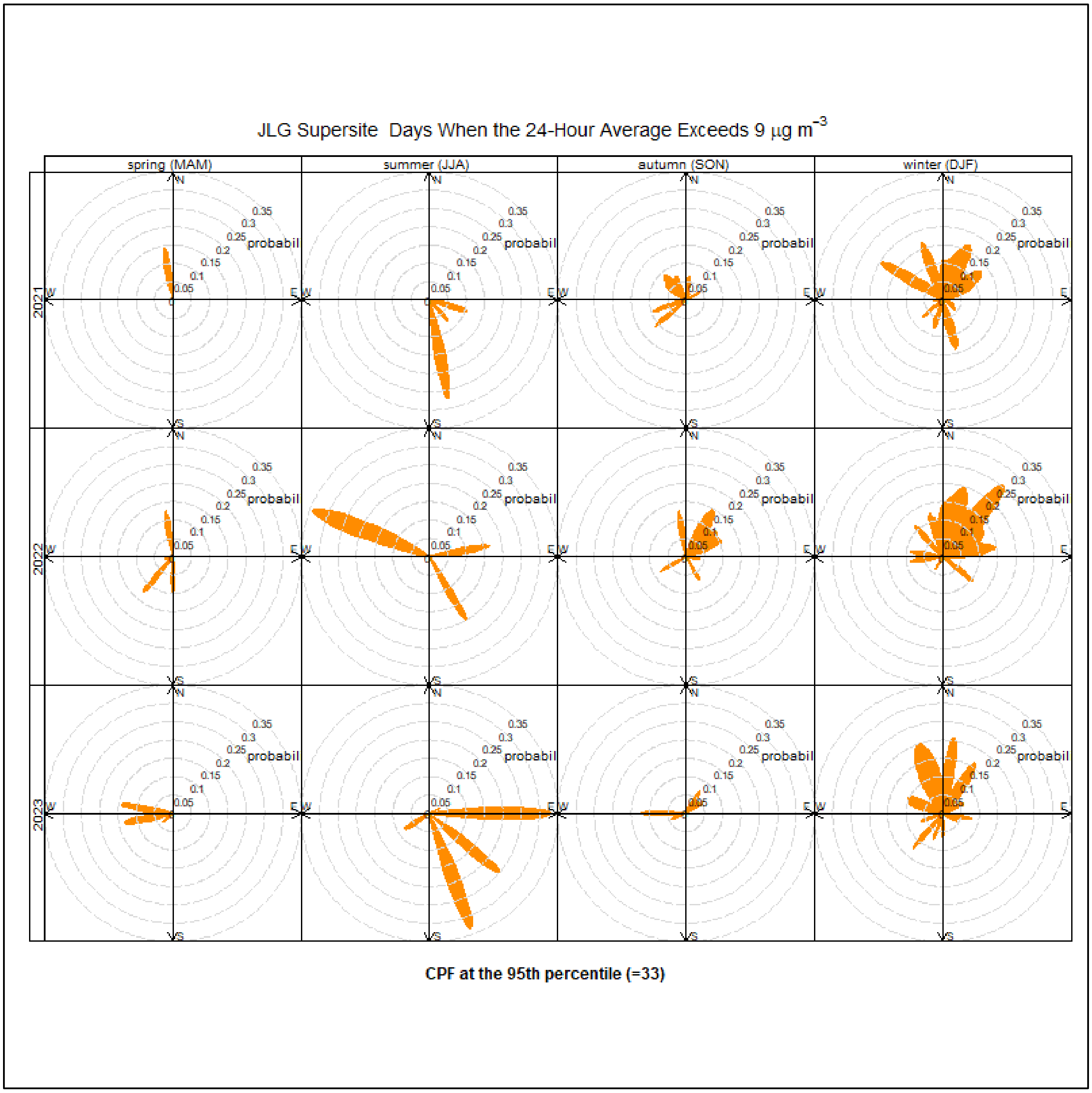


Figure 64: Mesa Wind Rose for All Data (2021-2023)

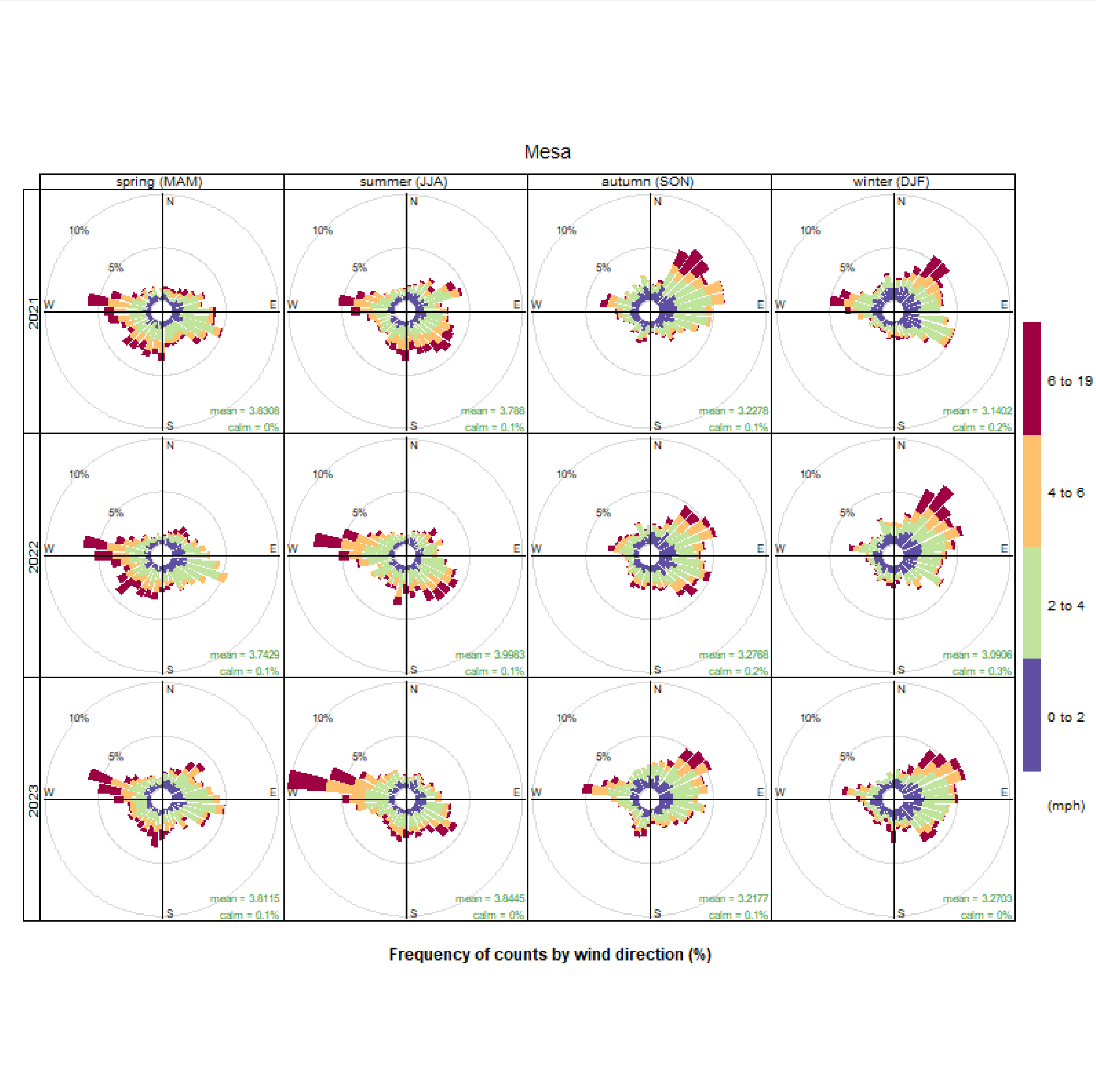


Figure 65: Mesa Pollution Rose for All Data (2021-2023)

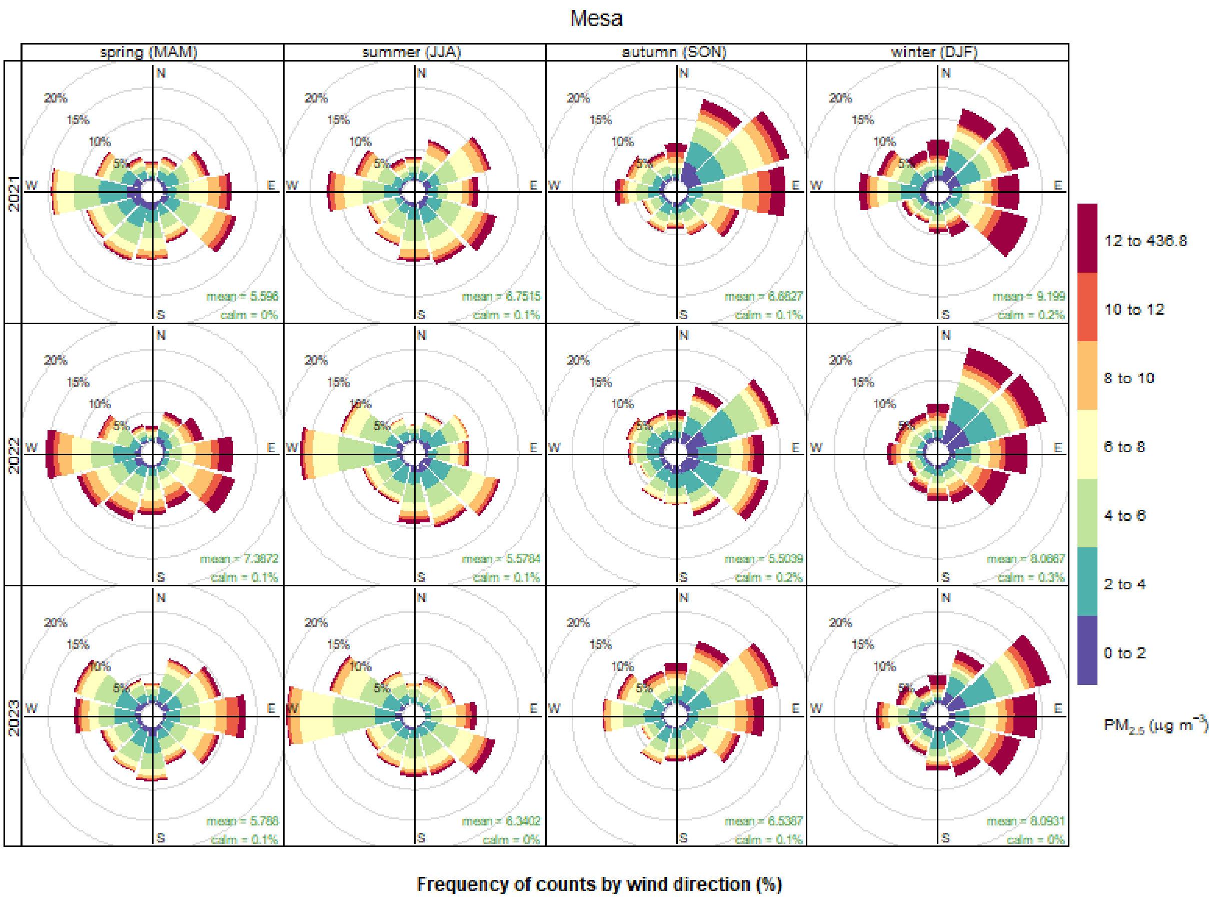


Figure 66: Mesa Percentile Rose for All Data (2021-2023)

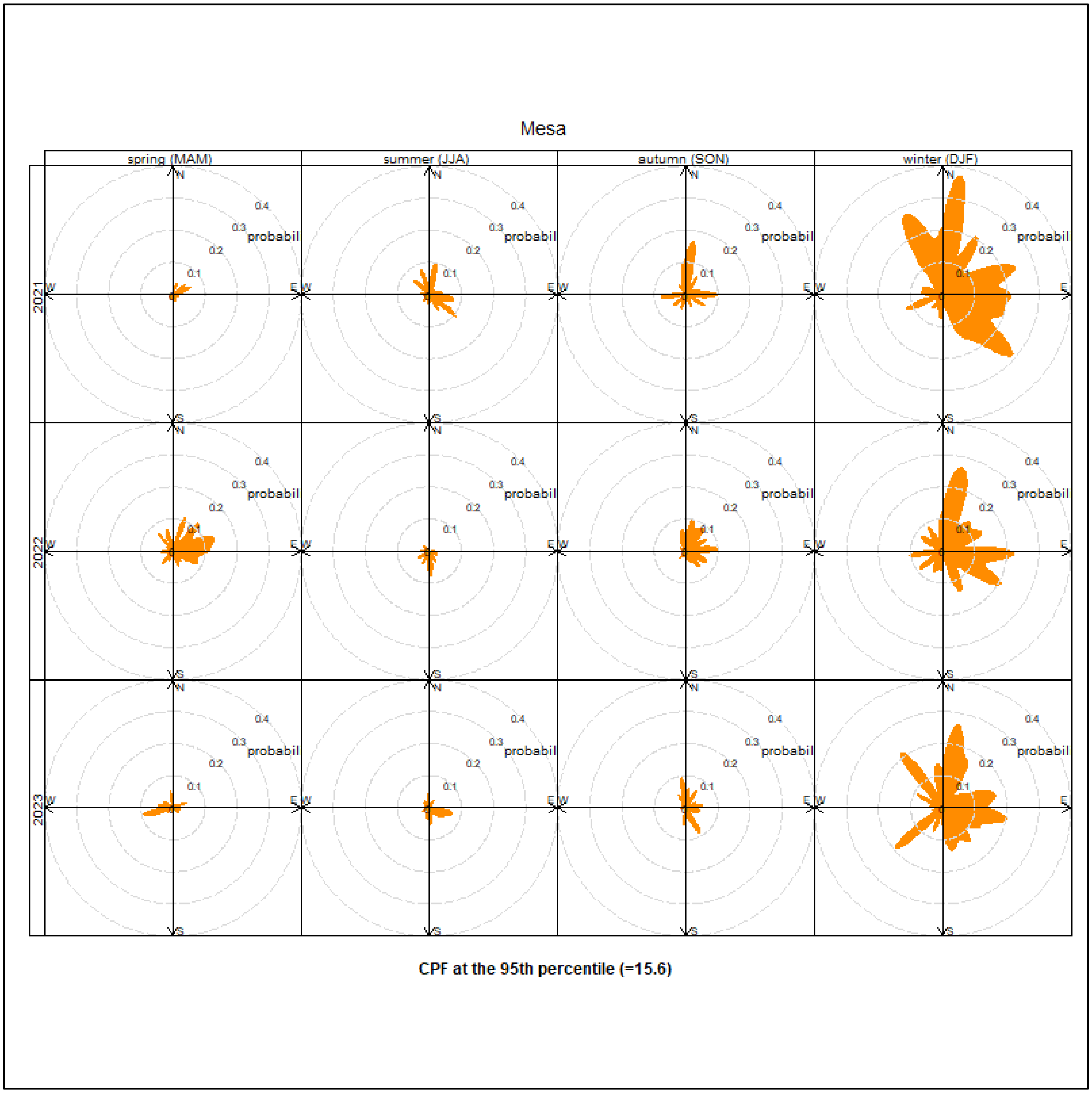


Figure 67: Mesa Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

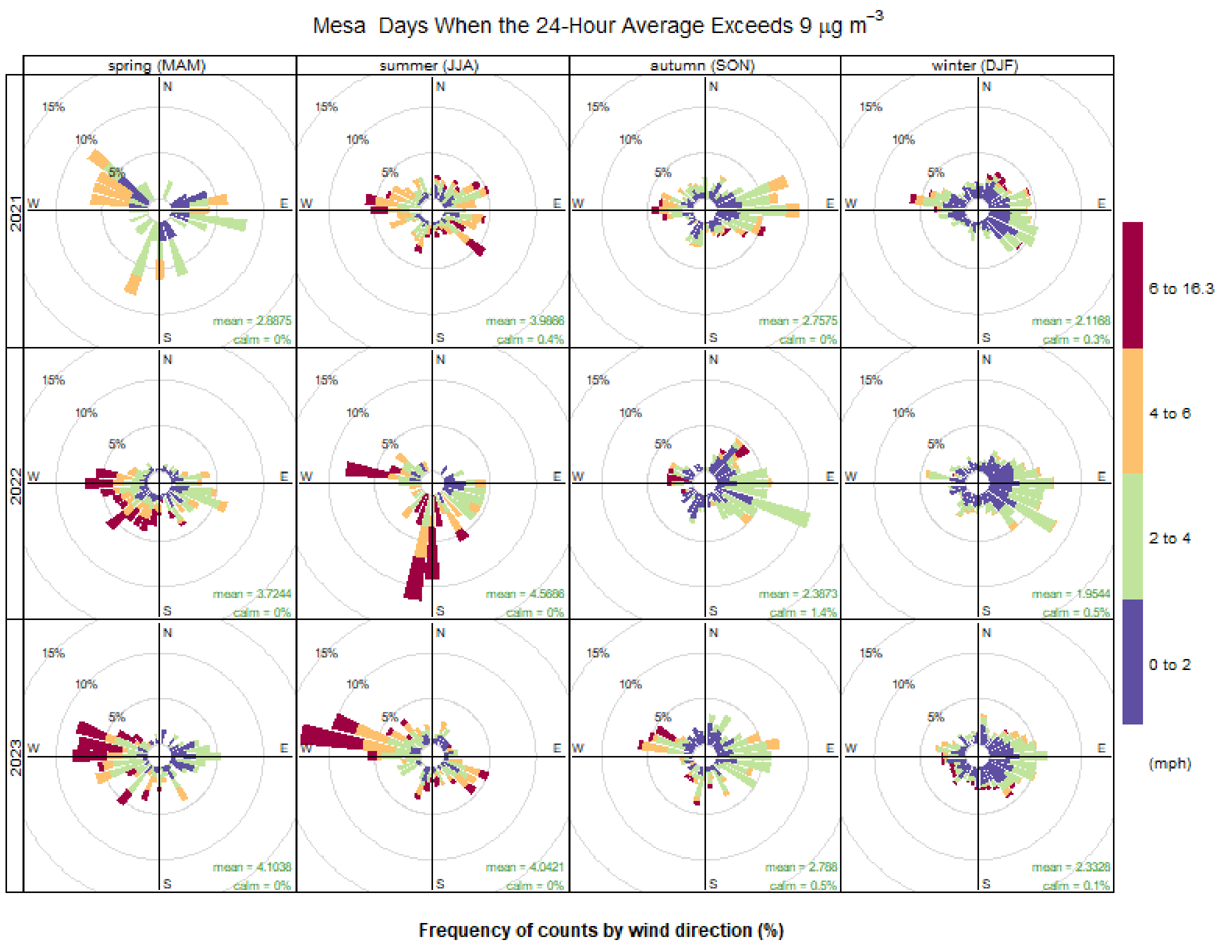


Figure 68: Mesa Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

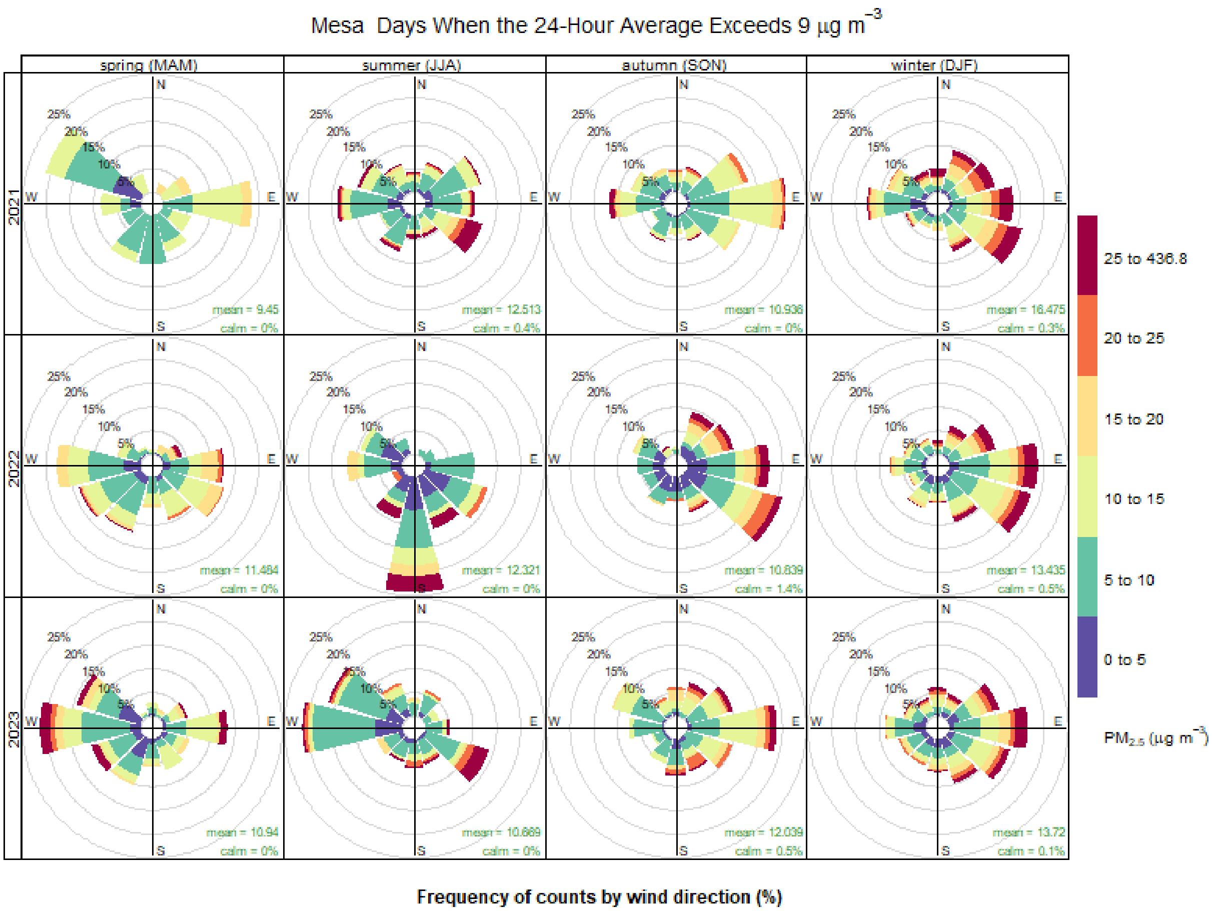


Figure 69: Mesa Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

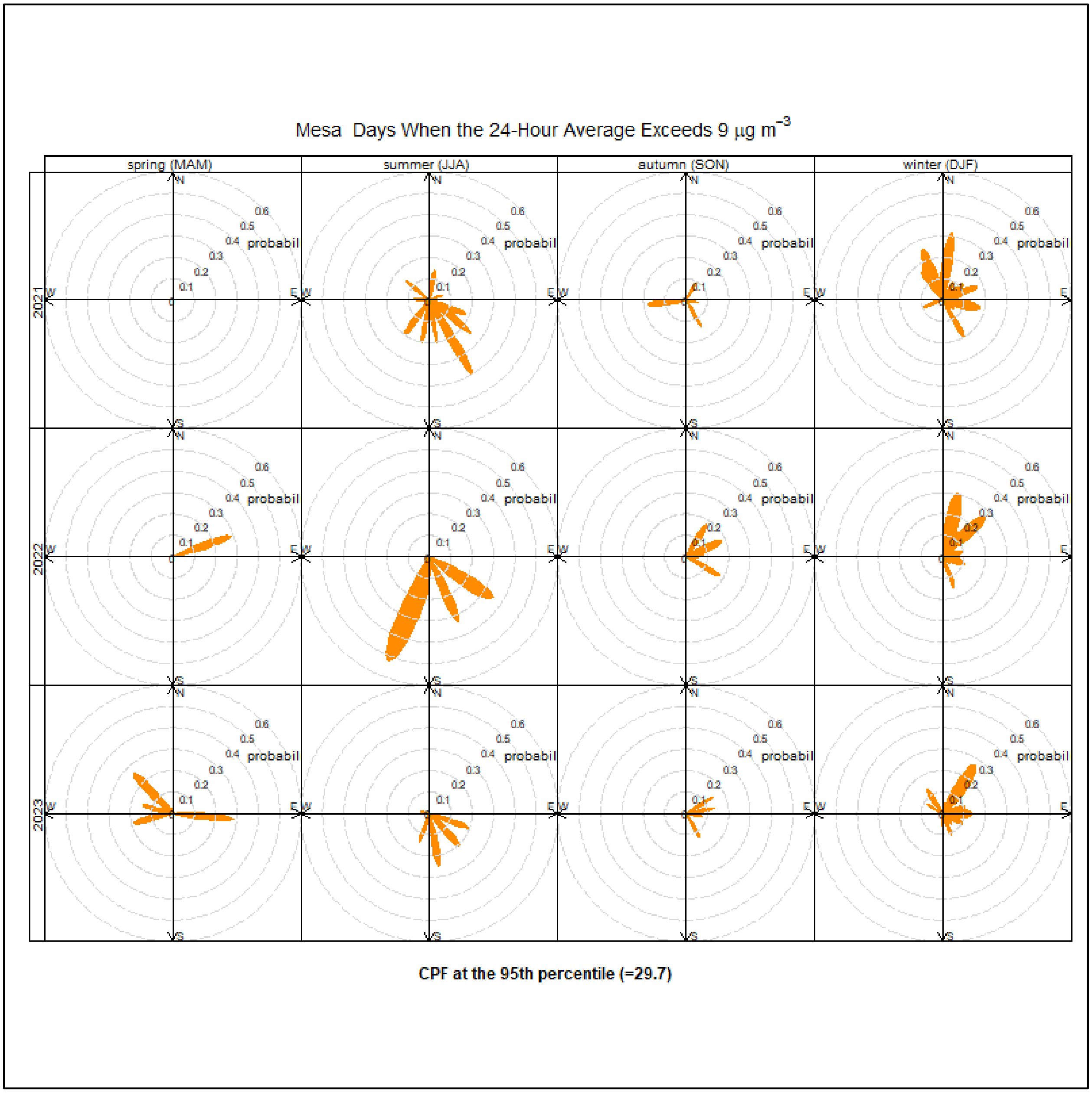


Figure 70: Nogales Wind Rose for All Data (2021-2023)

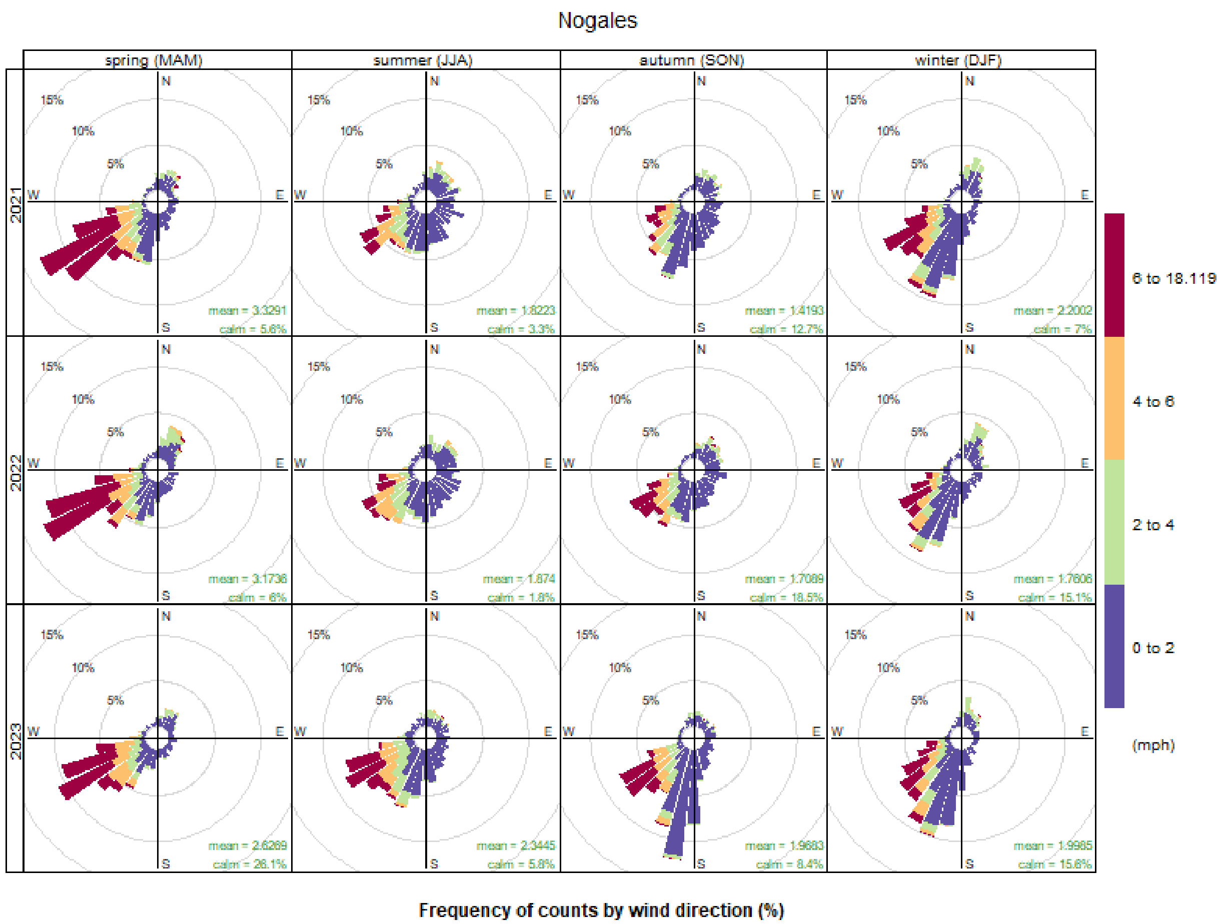


Figure 71: Nogales Pollution Rose for All Data (2021-2023)

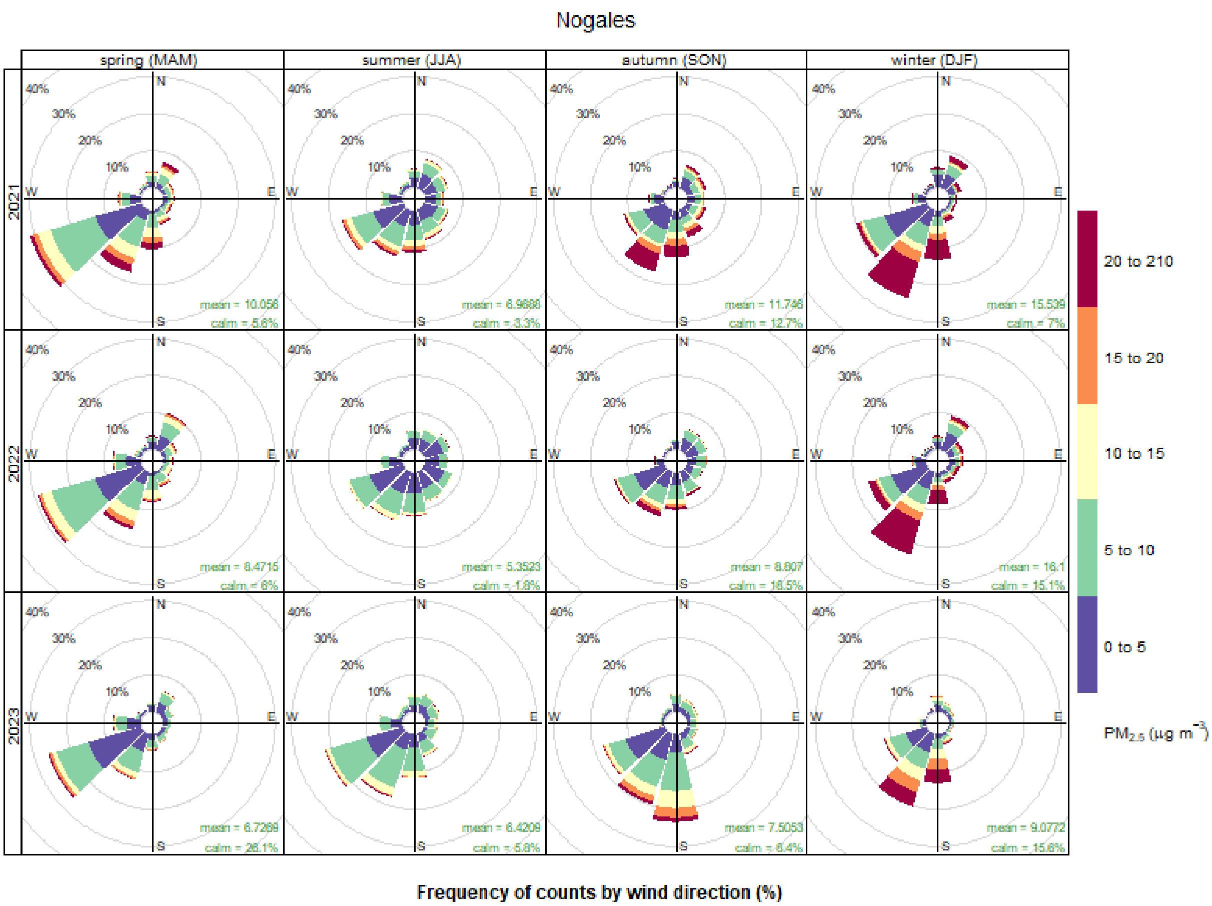


Figure 72: Nogales Percentile Rose for All Data (2021-2023)

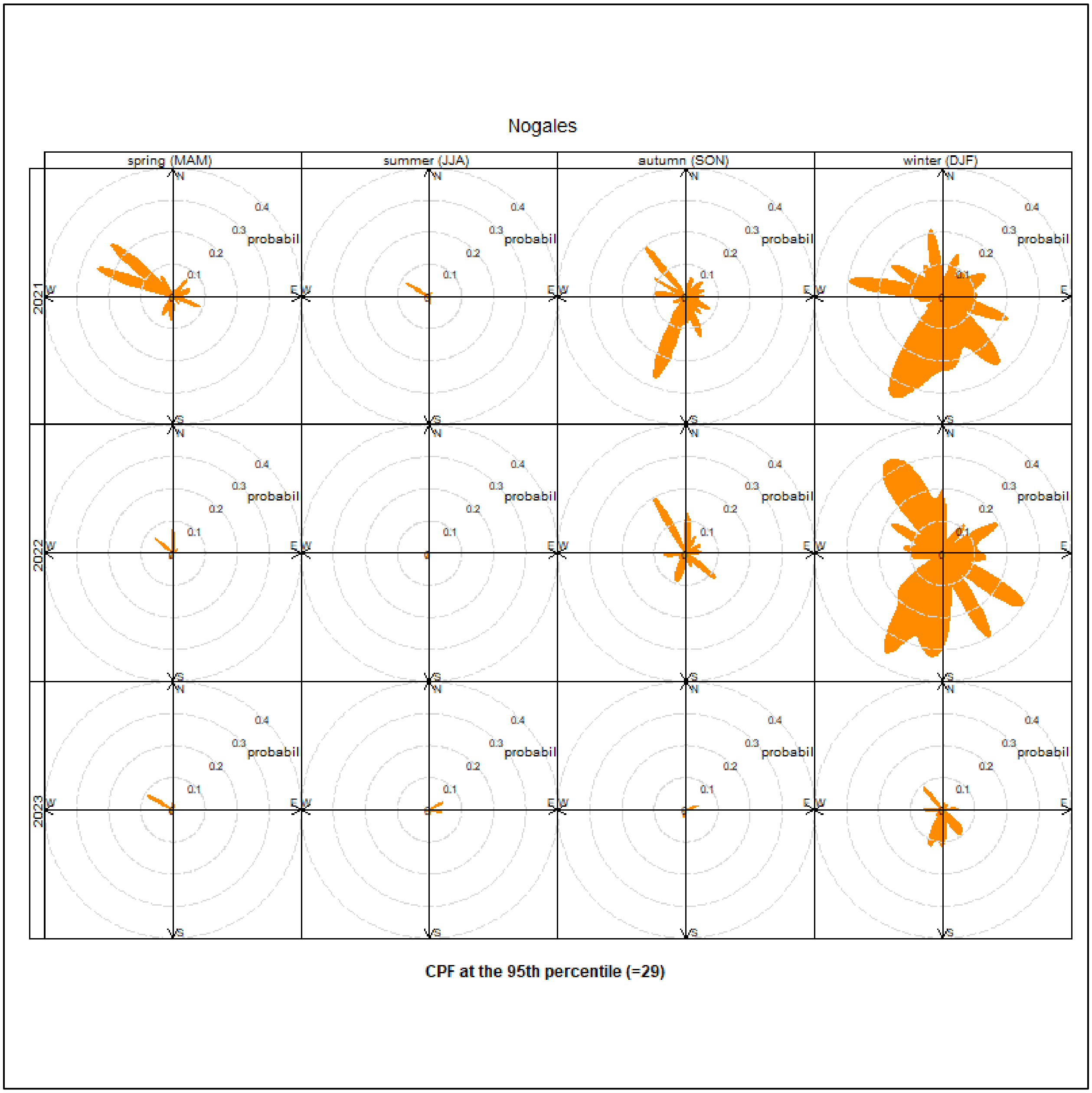


Figure 73: Nogales Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

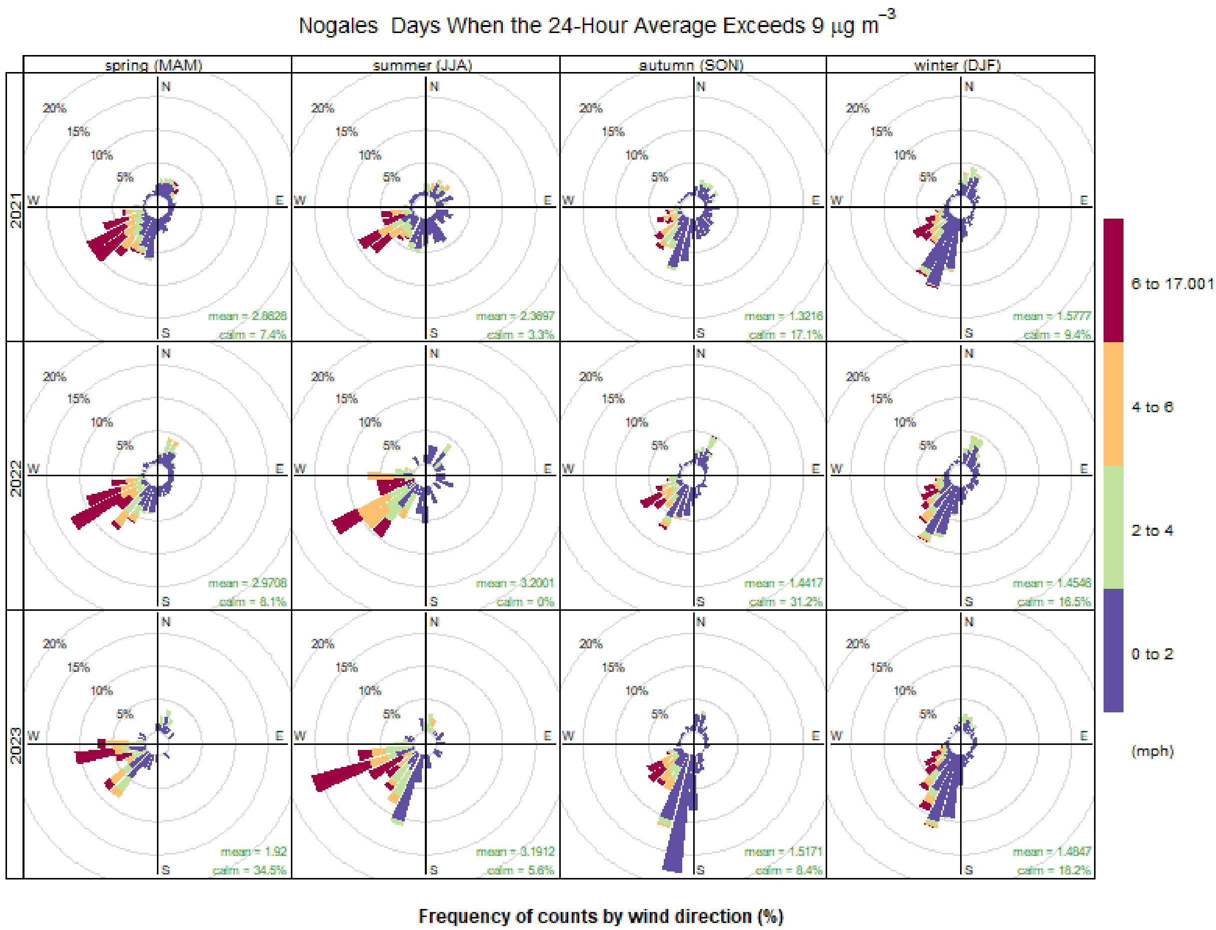


Figure 74: Nogales Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

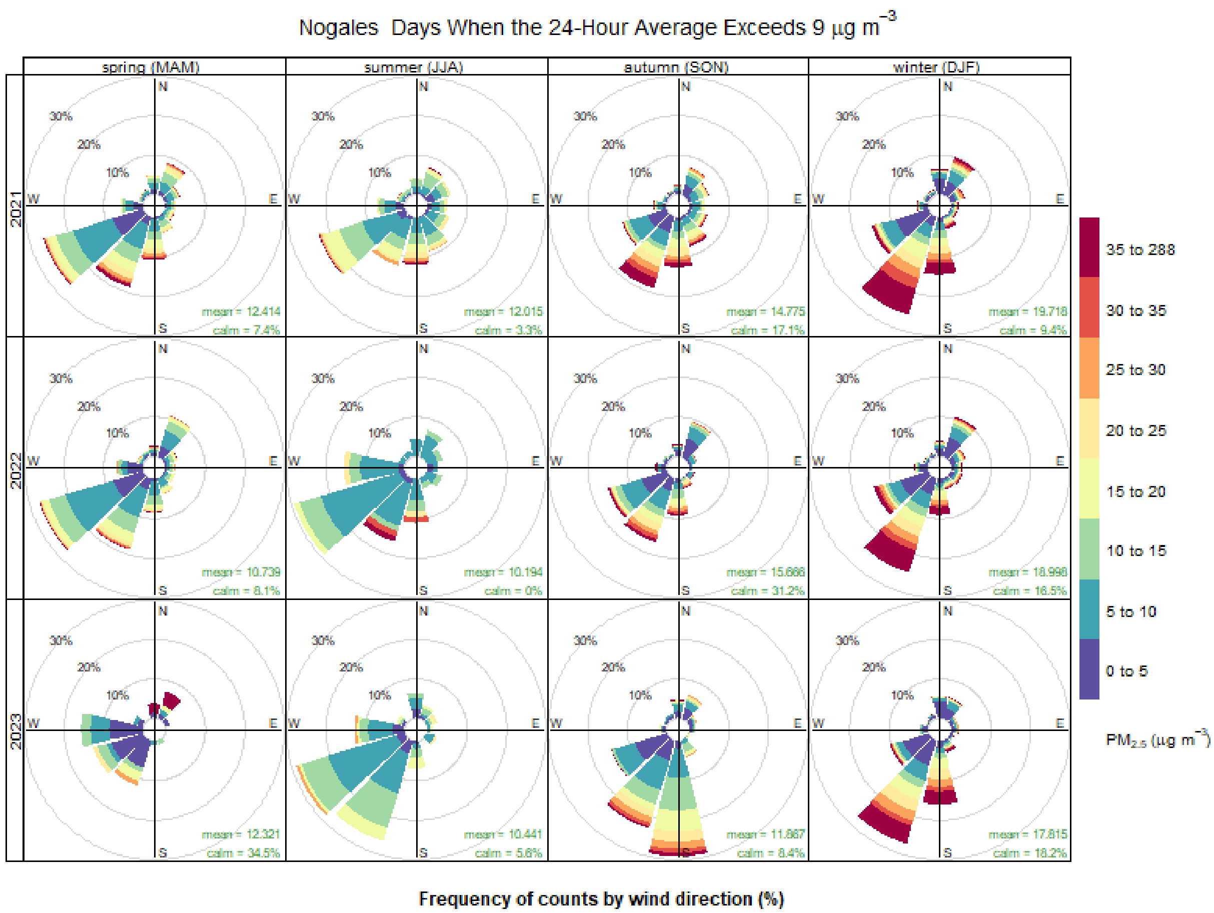


Figure 75: Nogales Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

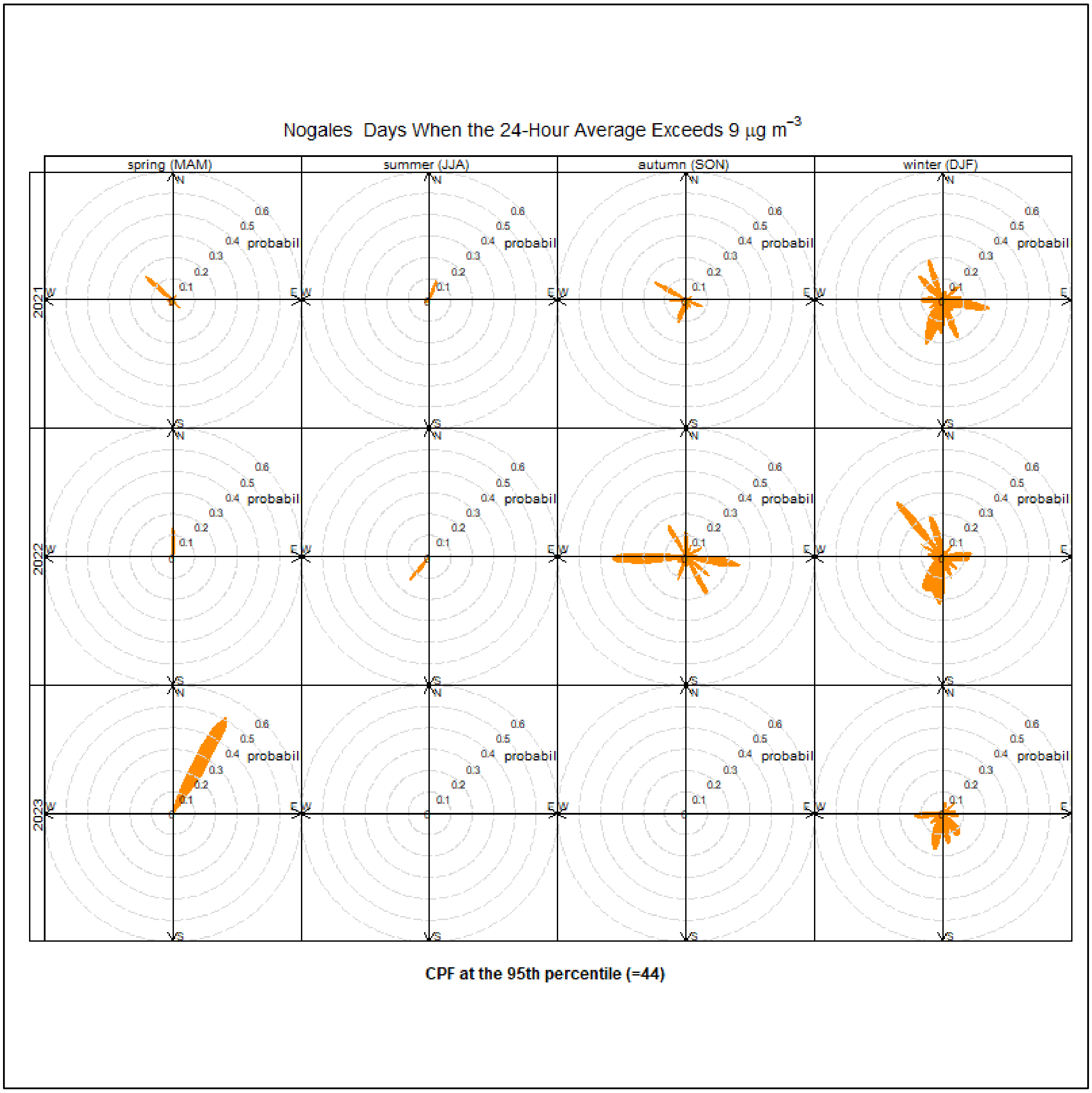


Figure 76: North Phoenix Wind Rose for All Data (2021-2023)

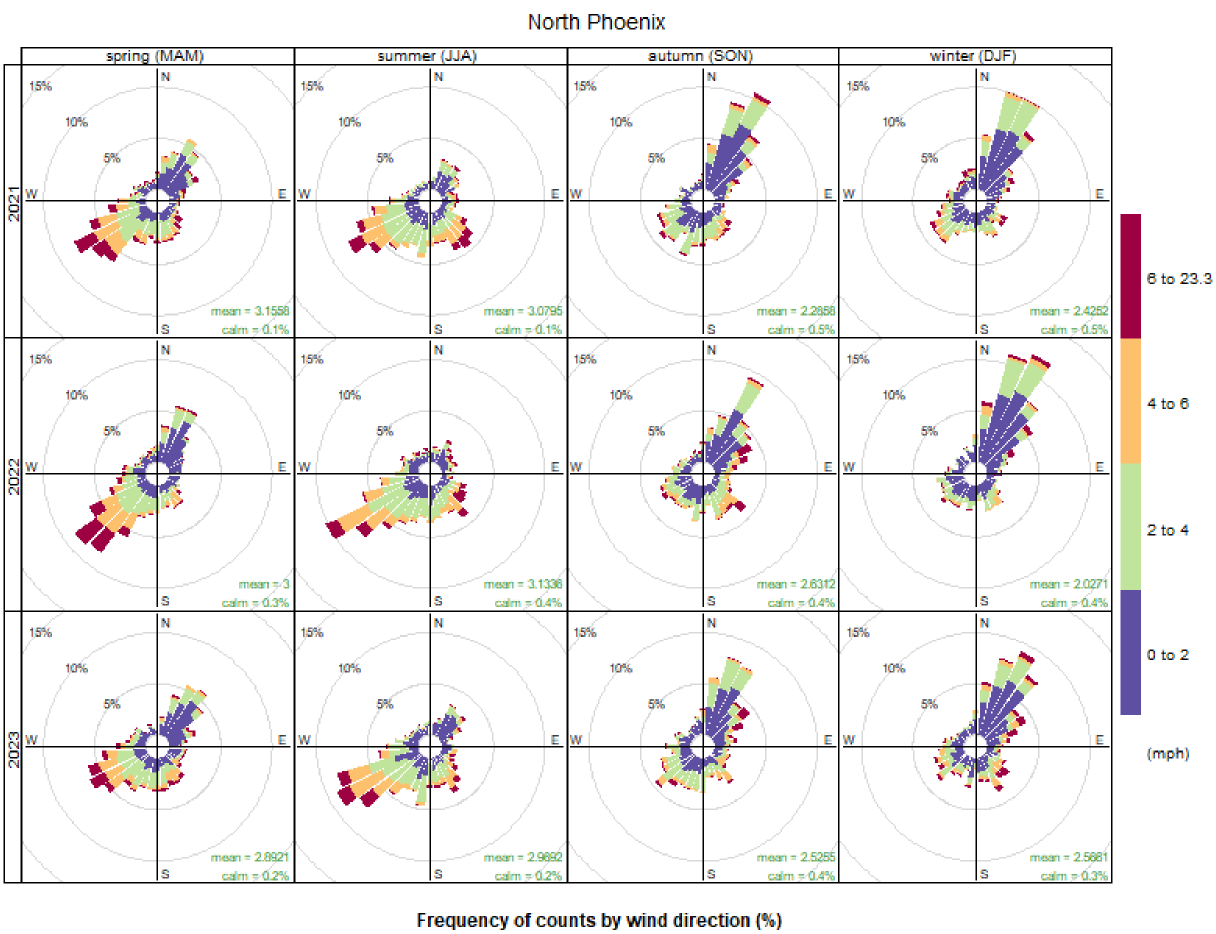


Figure 77: North Phoenix Pollution Rose for All Data (2021-2023)

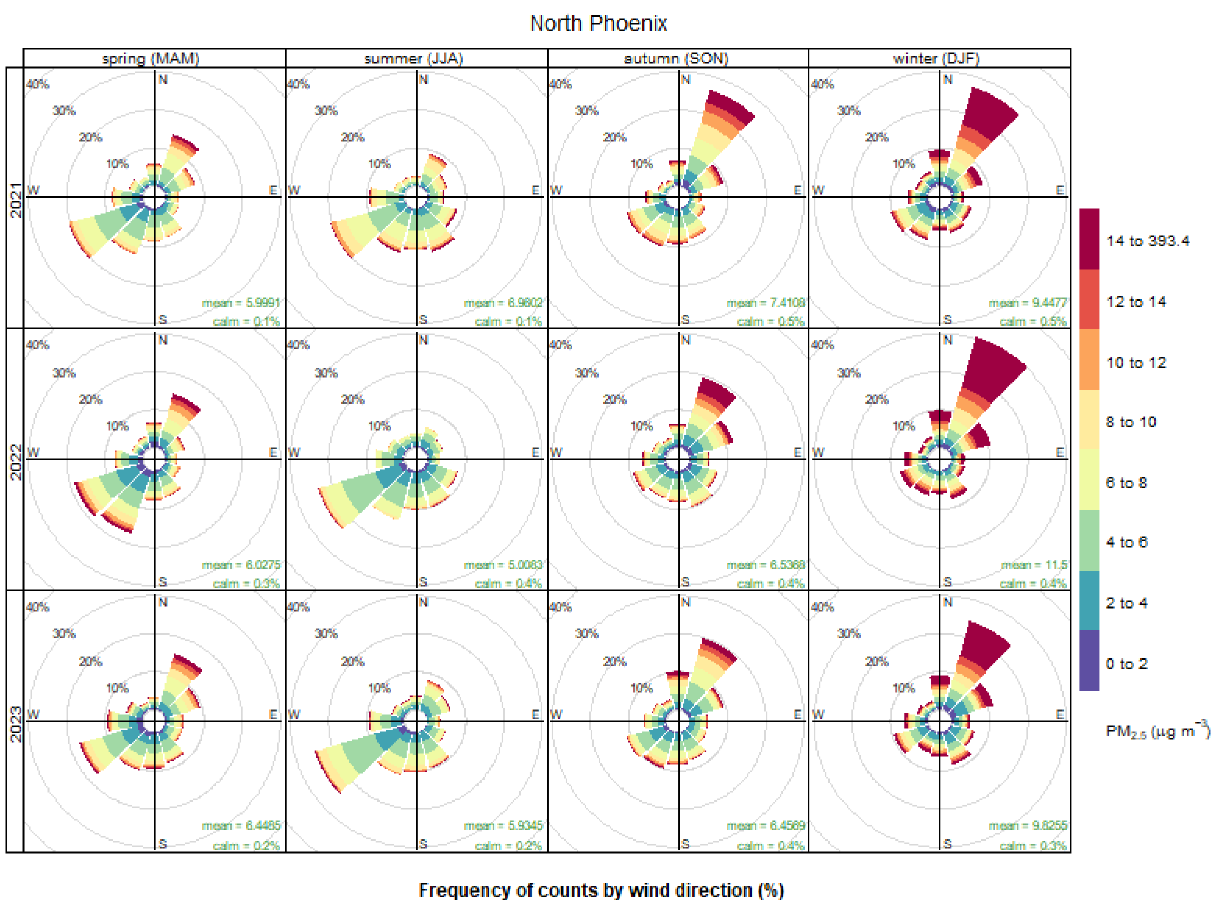


Figure 78: North Phoenix Percentile Rose for All Data (2021-2023)

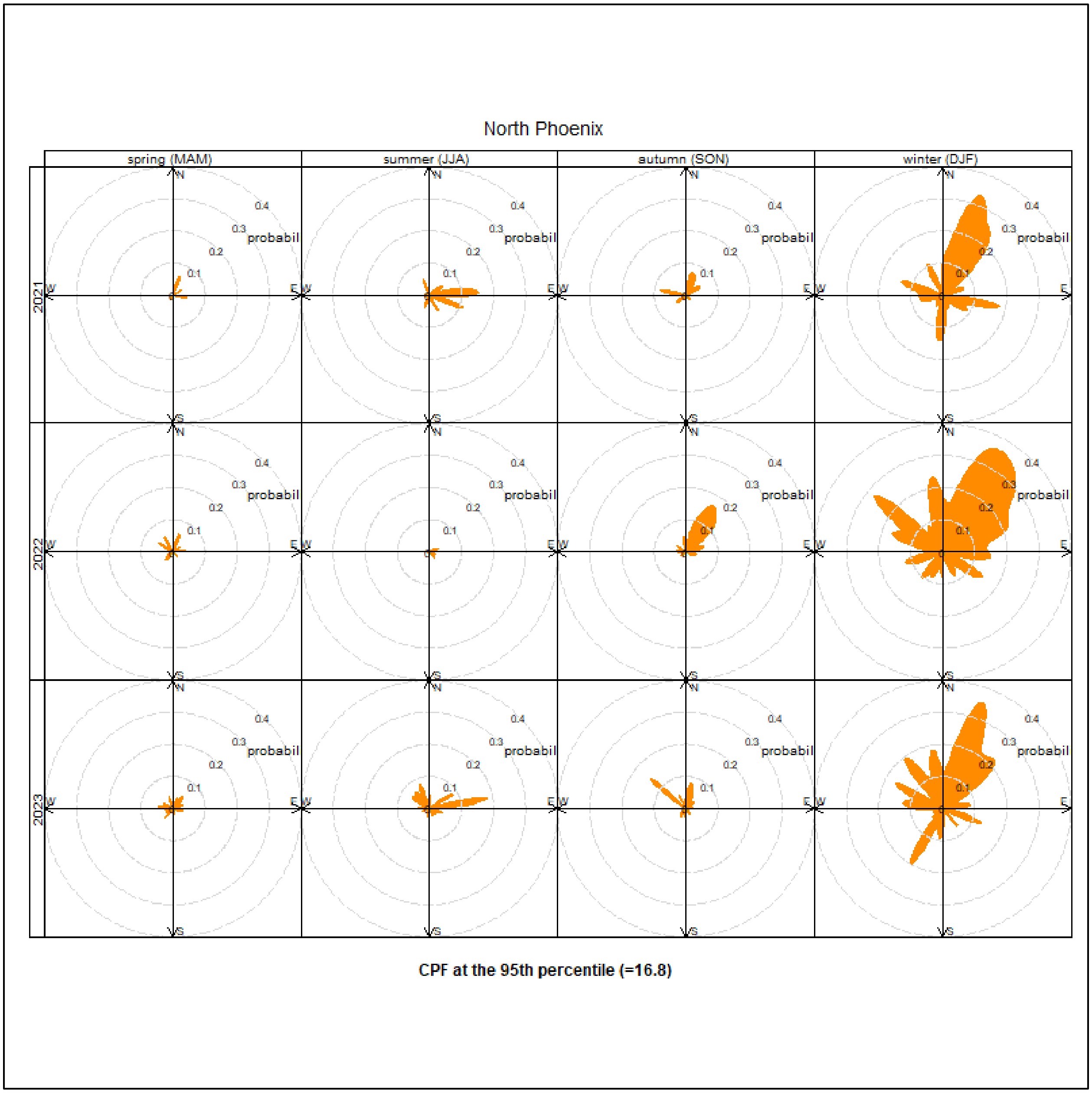


Figure 79: North Phoenix Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

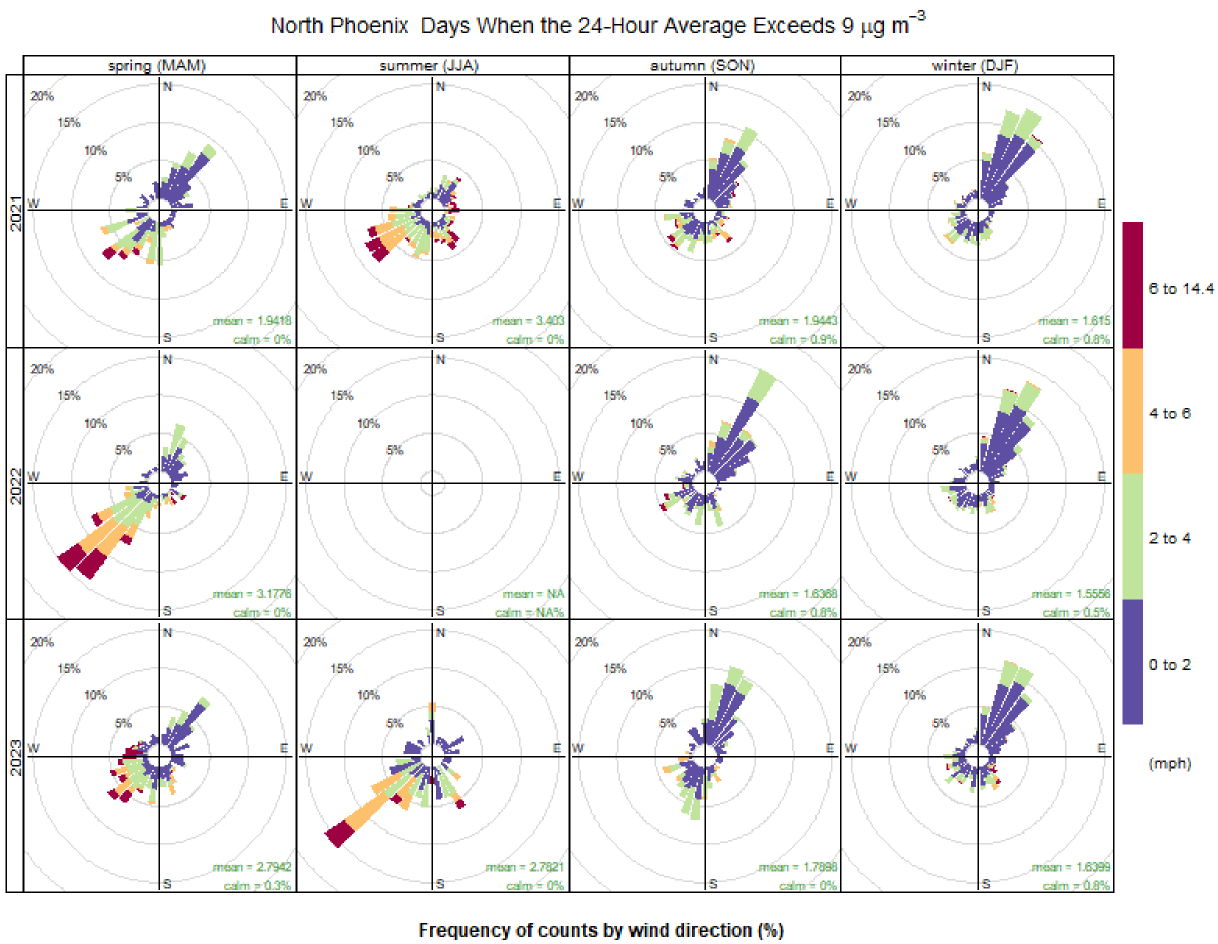


Figure 80: North Phoenix Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

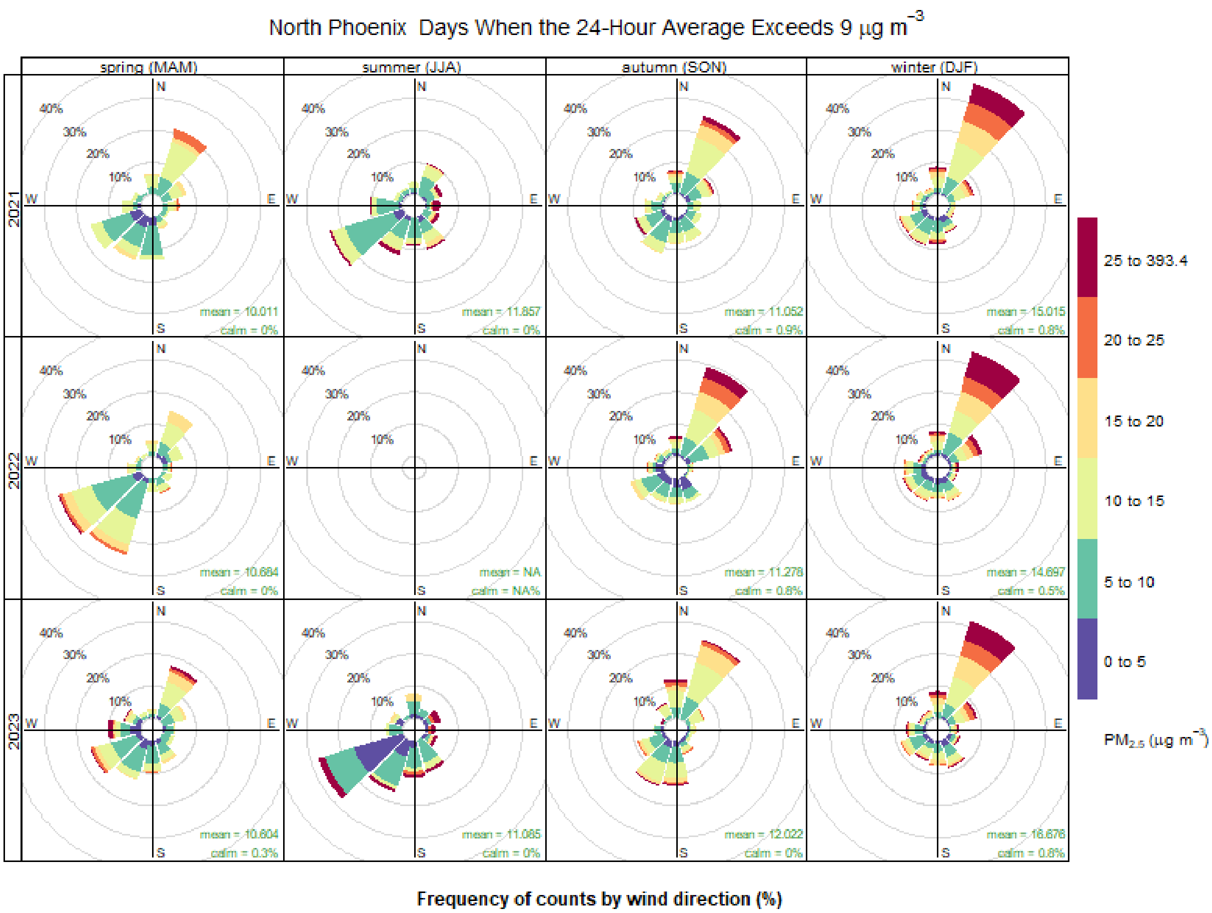


Figure 81: North Phoenix Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

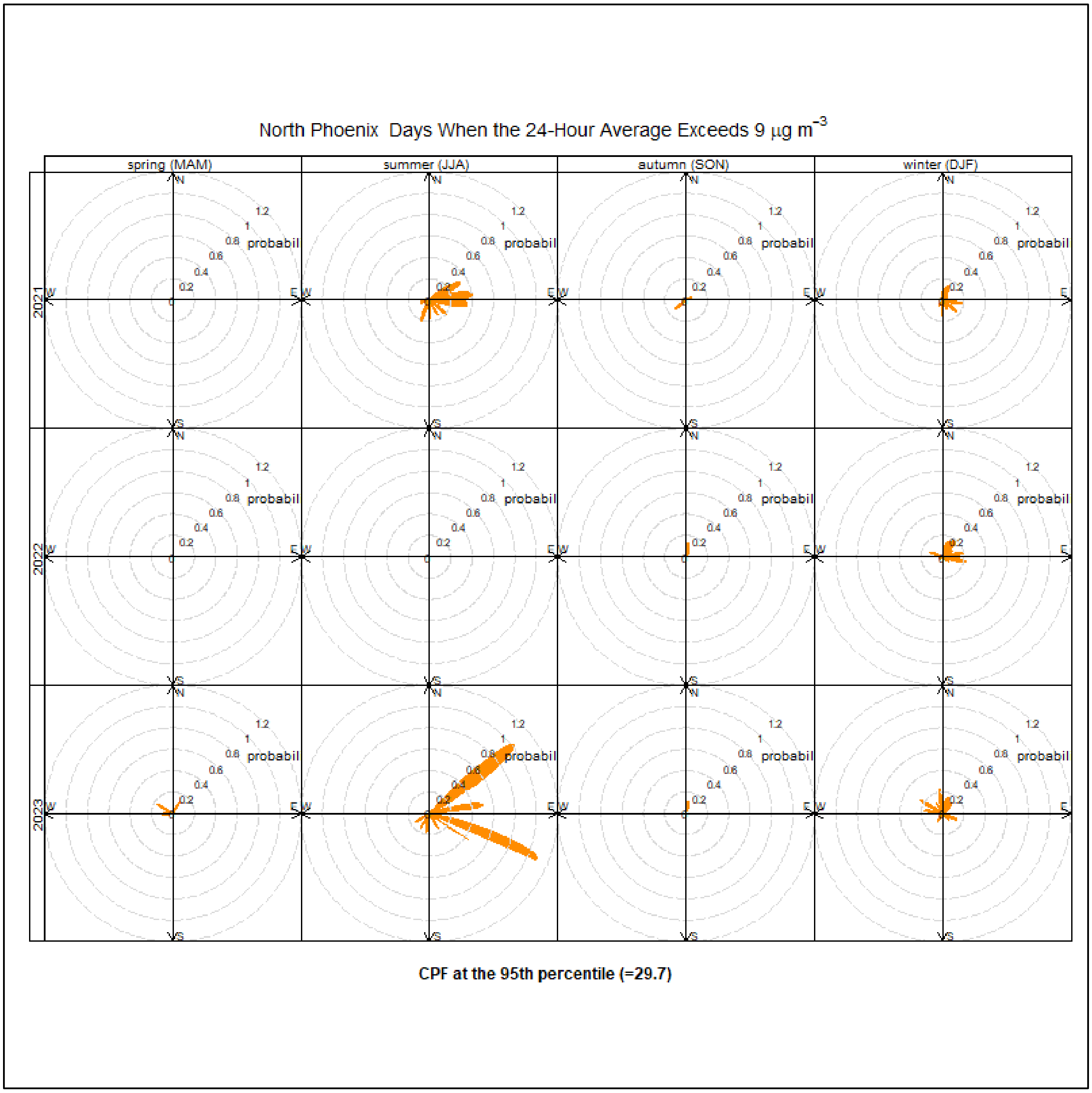


Figure 82: South Phoenix Wind Rose for All Data (2021-2023)

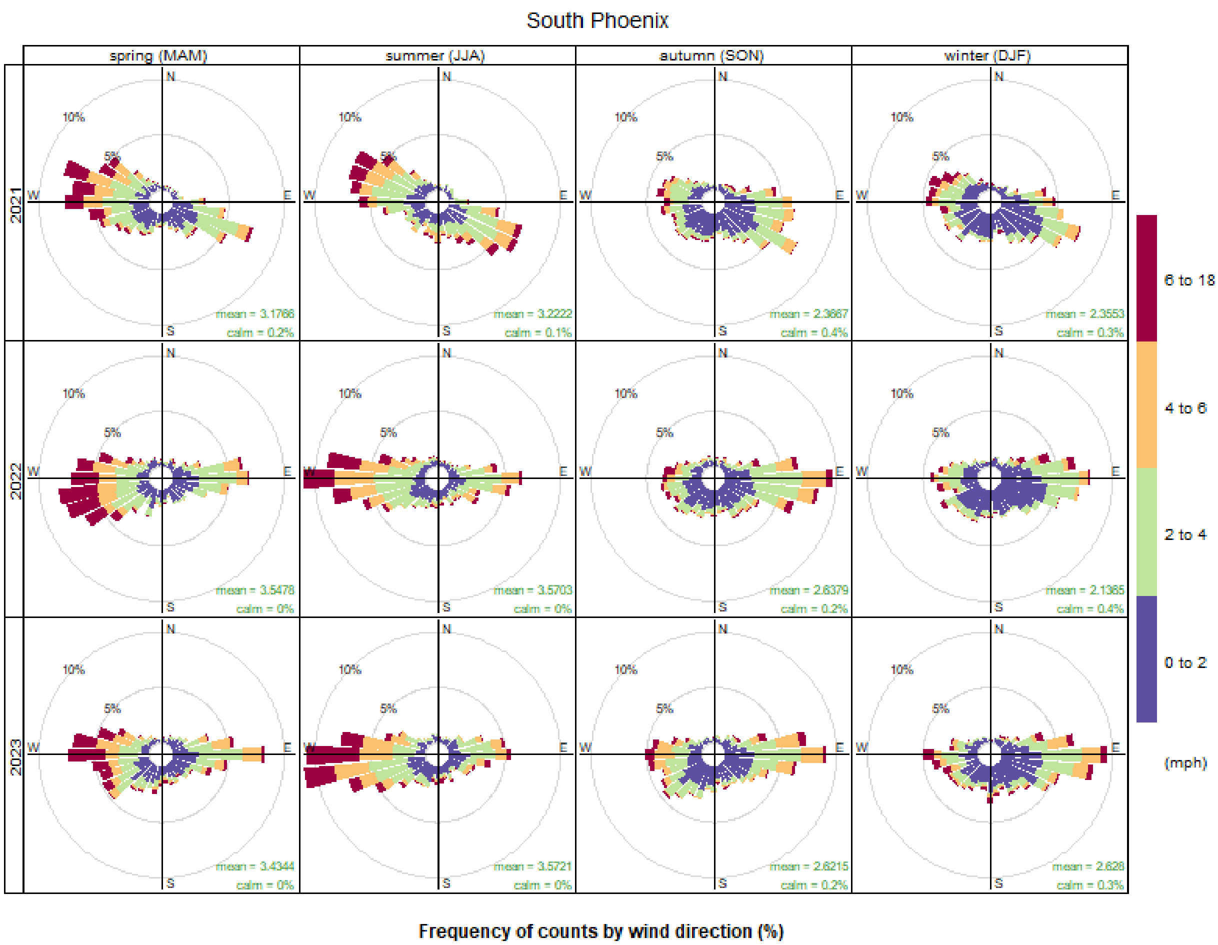


Figure 83: South Phoenix Pollution Rose for All Data (2021-2023)

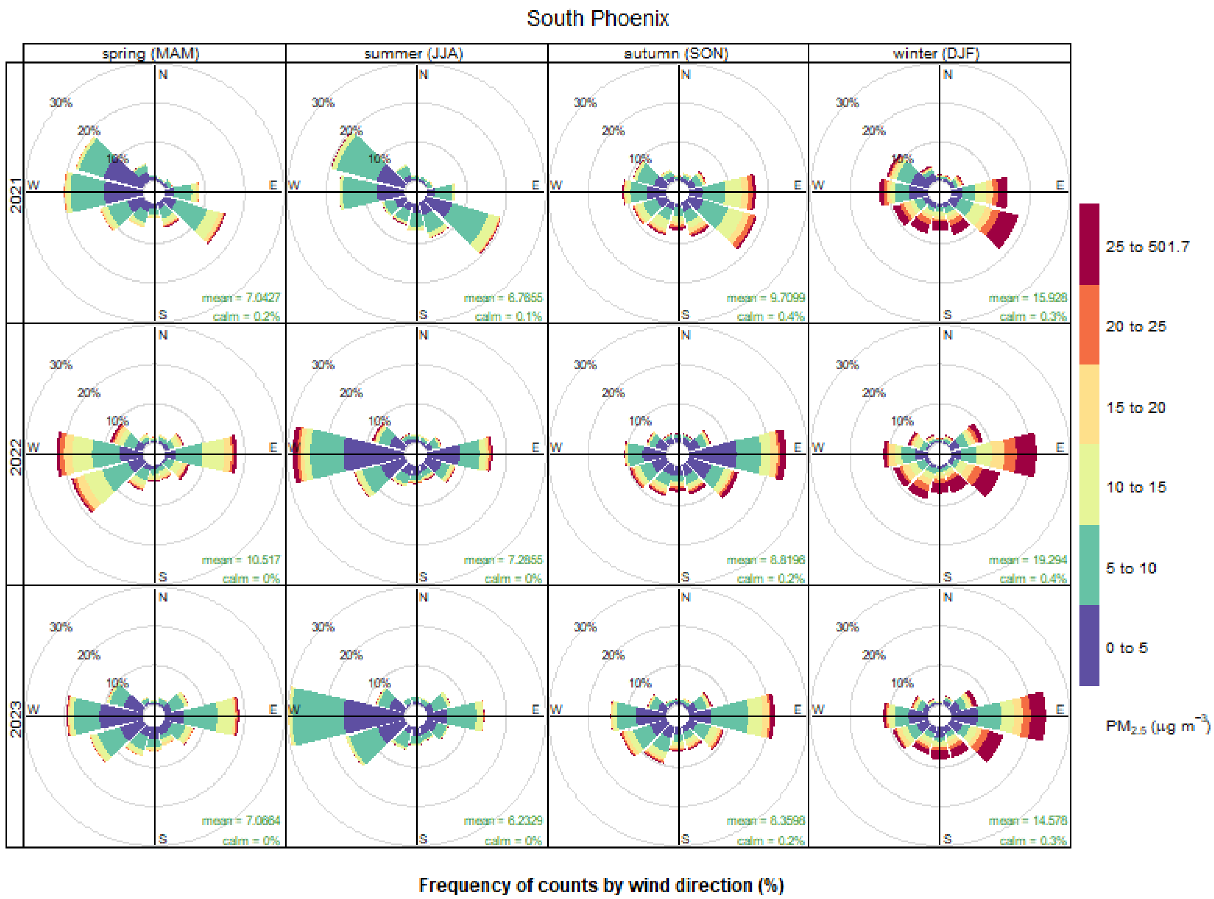


Figure 84: South Phoenix Percentile Rose for All Data (2021-2023)

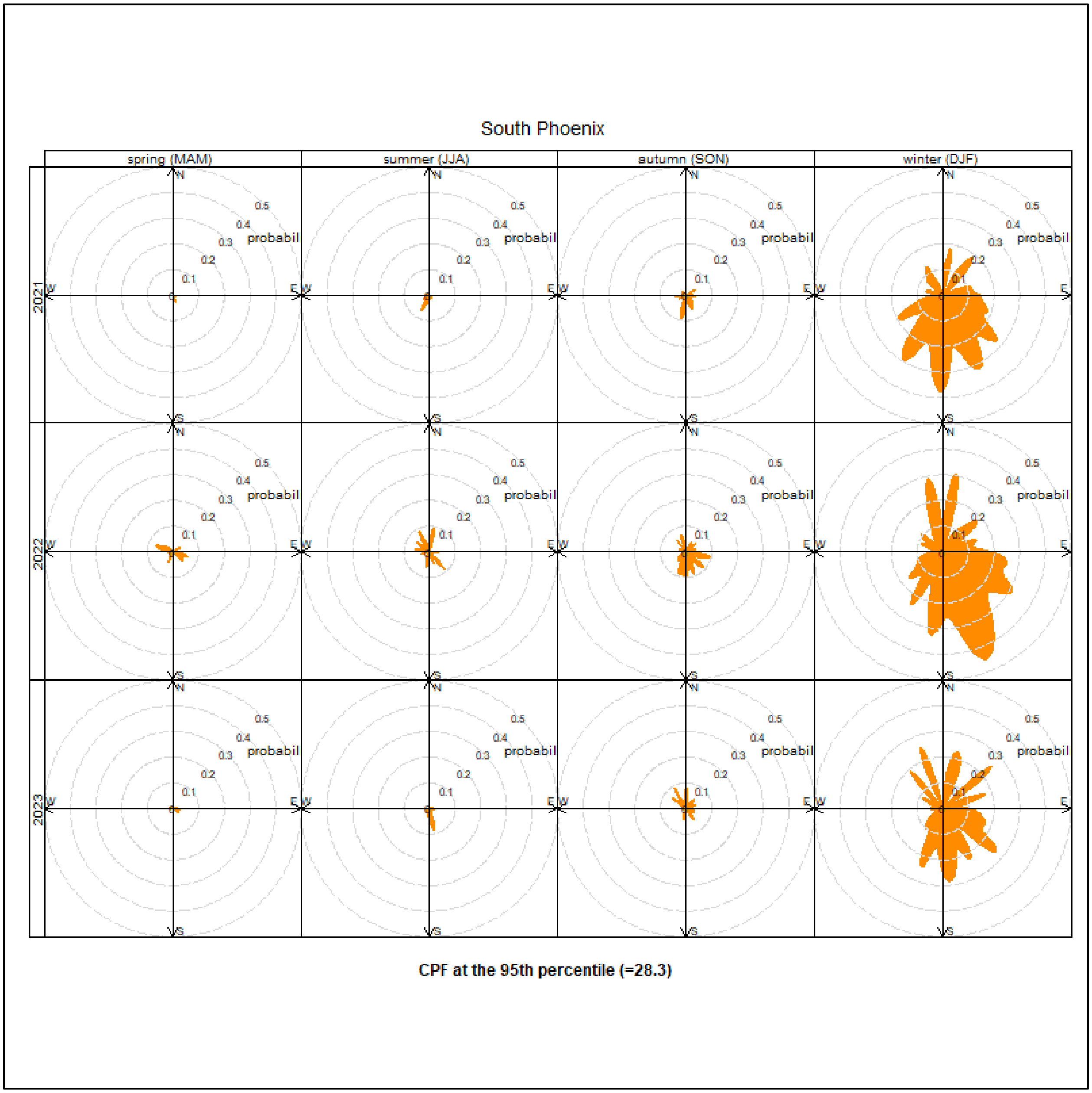


Figure 85: South Phoenix Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

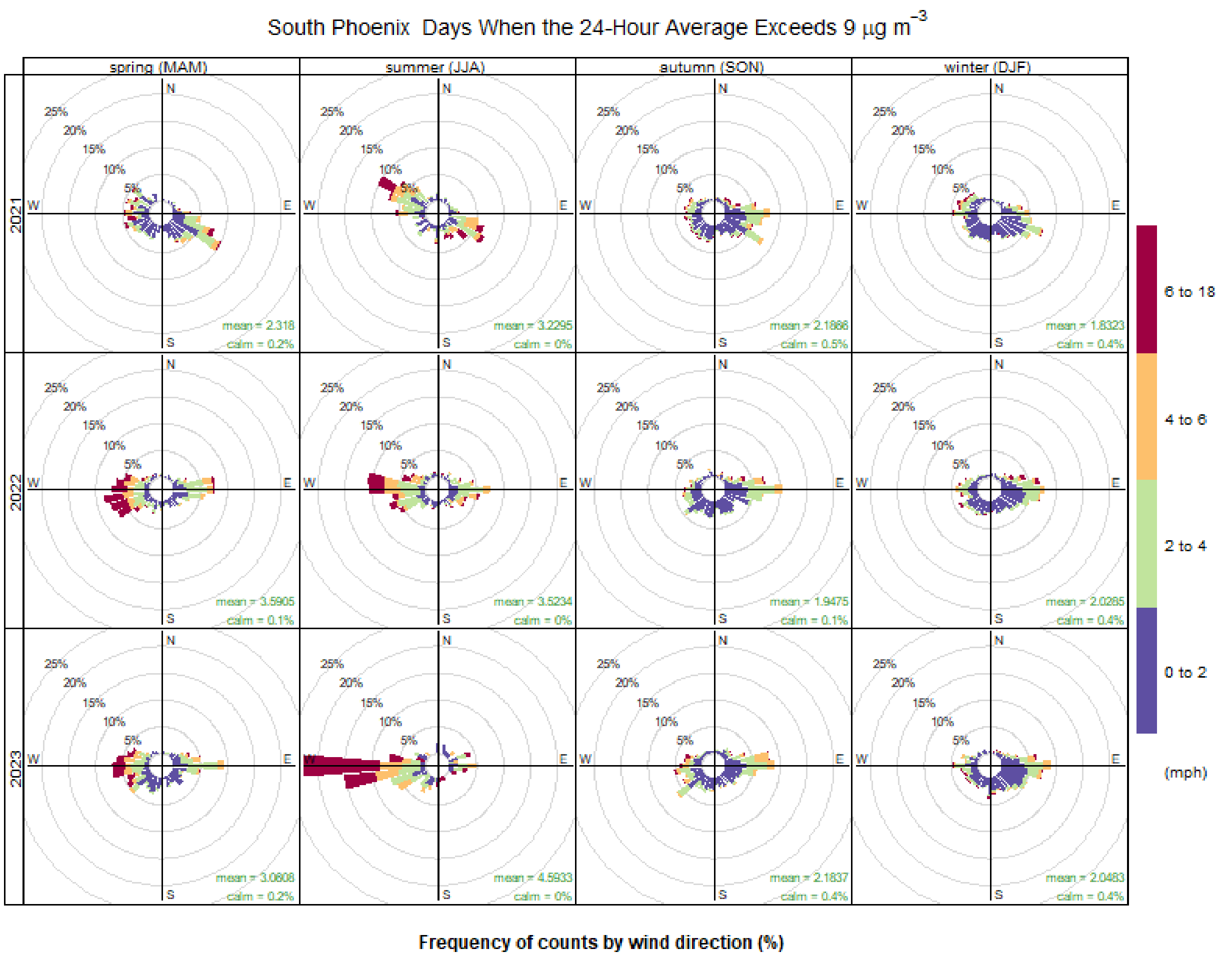


Figure 86: South Phoenix Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

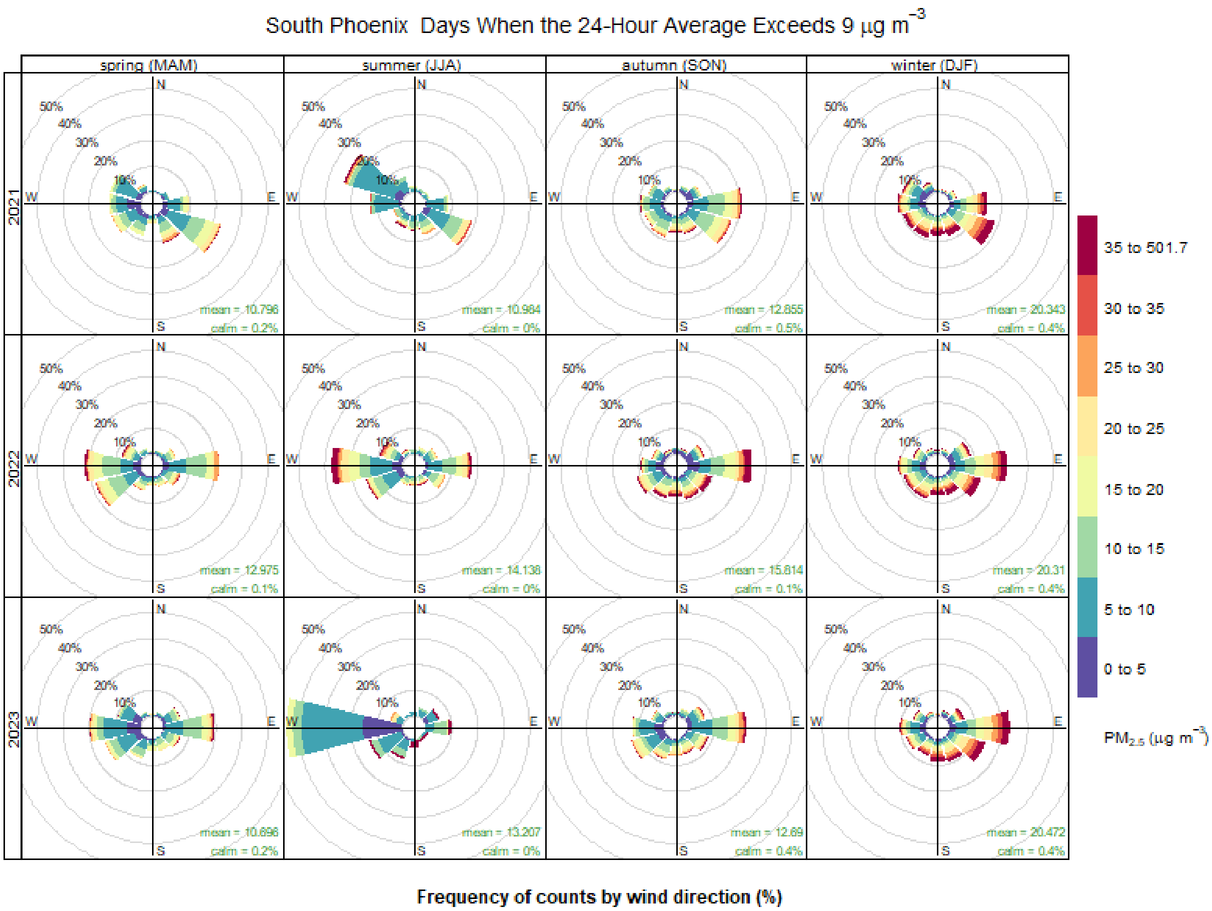


Figure 87: South Phoenix Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

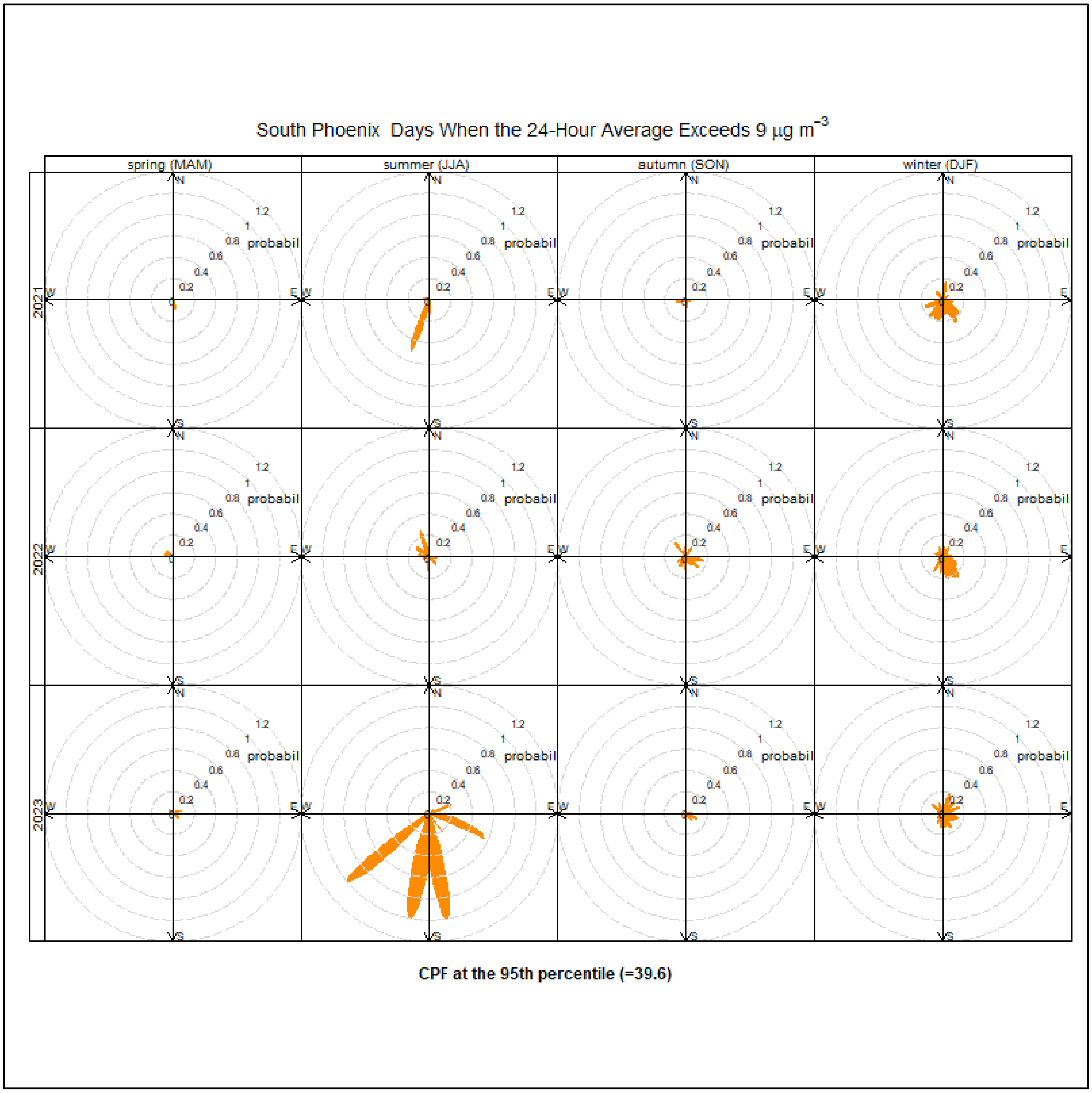


Figure 88: Tempe Wind Rose for All Data (2021-2023)

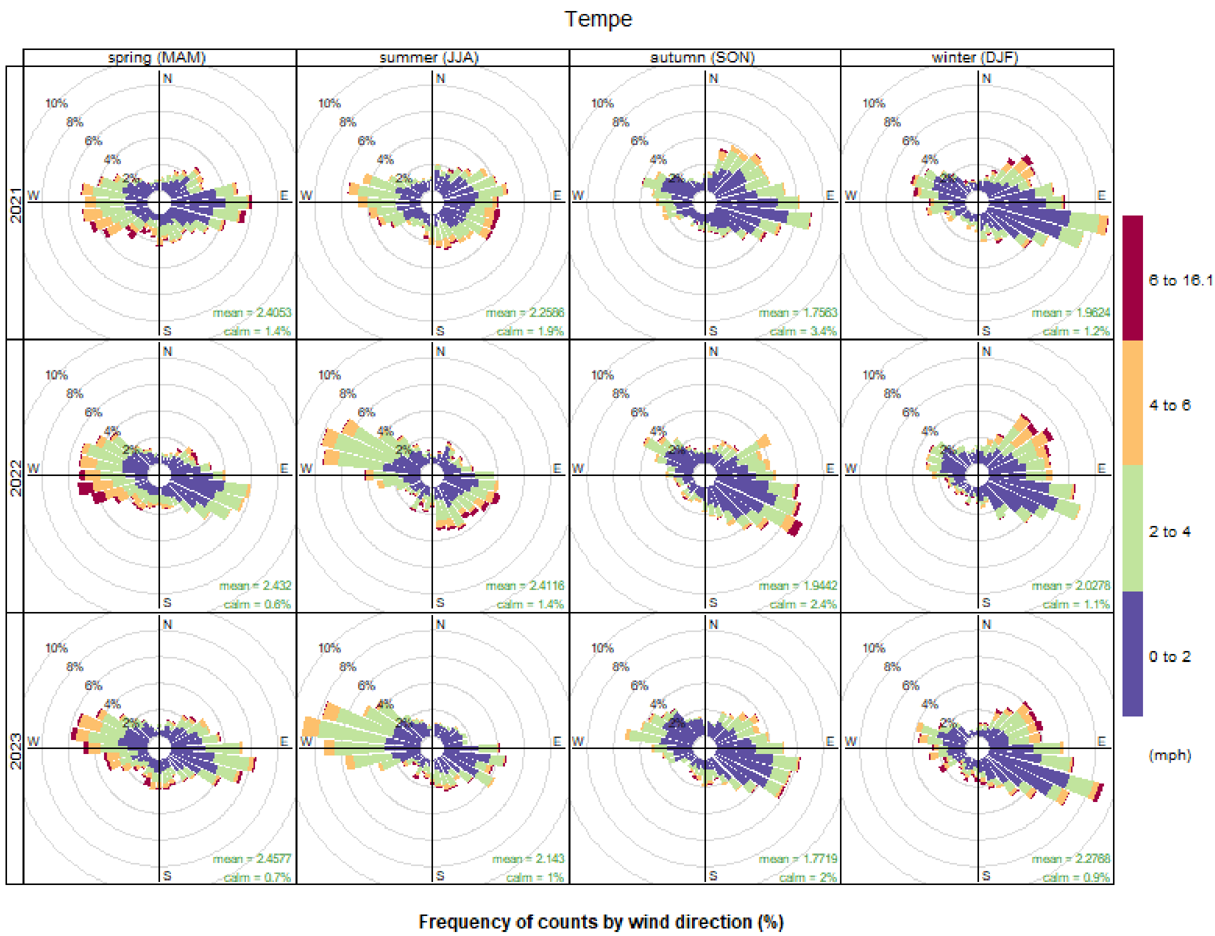


Figure 89: Tempe Pollution Rose for All Data (2021-2023)

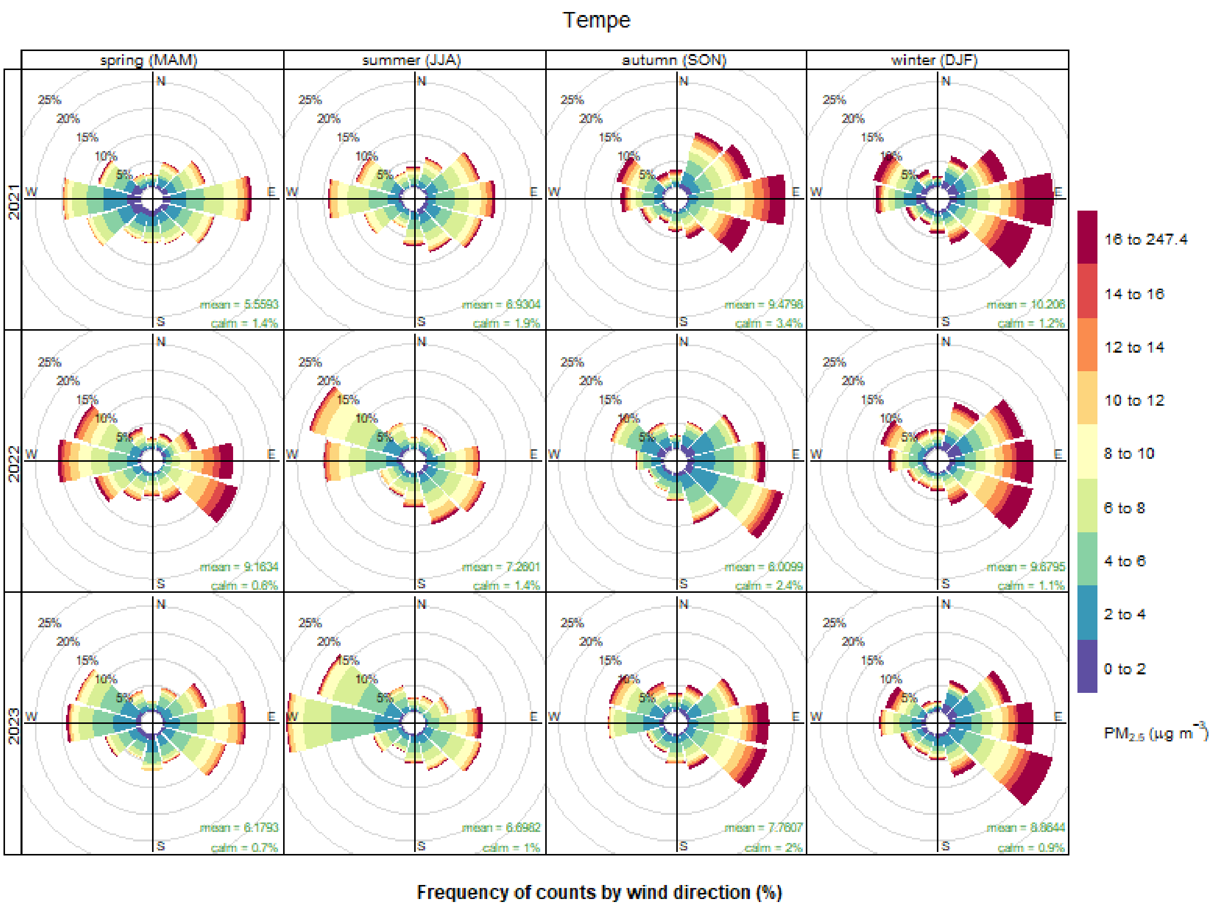


Figure 90: Tempe Percentile Rose for All Data (2021-2023)

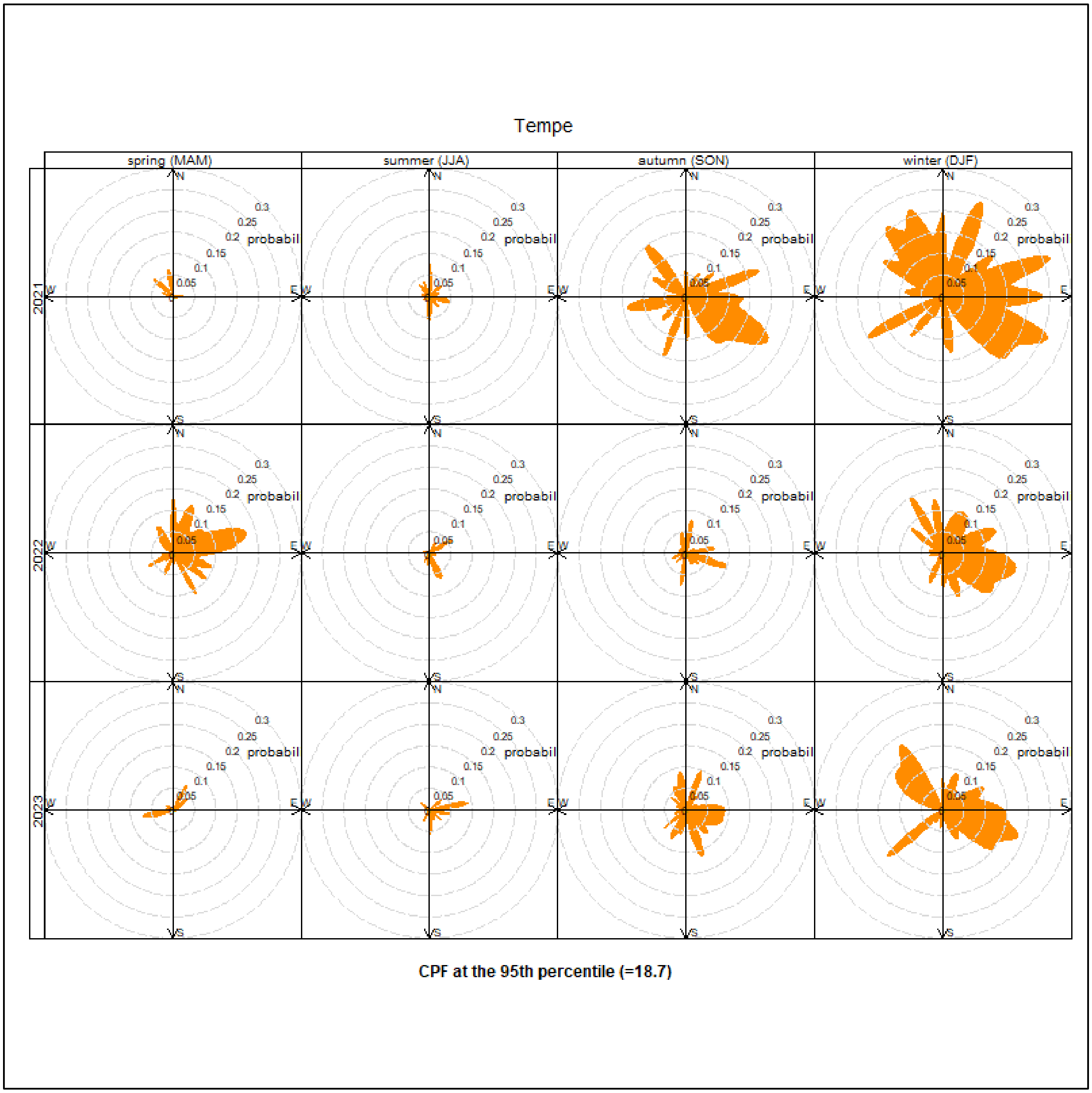


Figure 91: Tempe Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

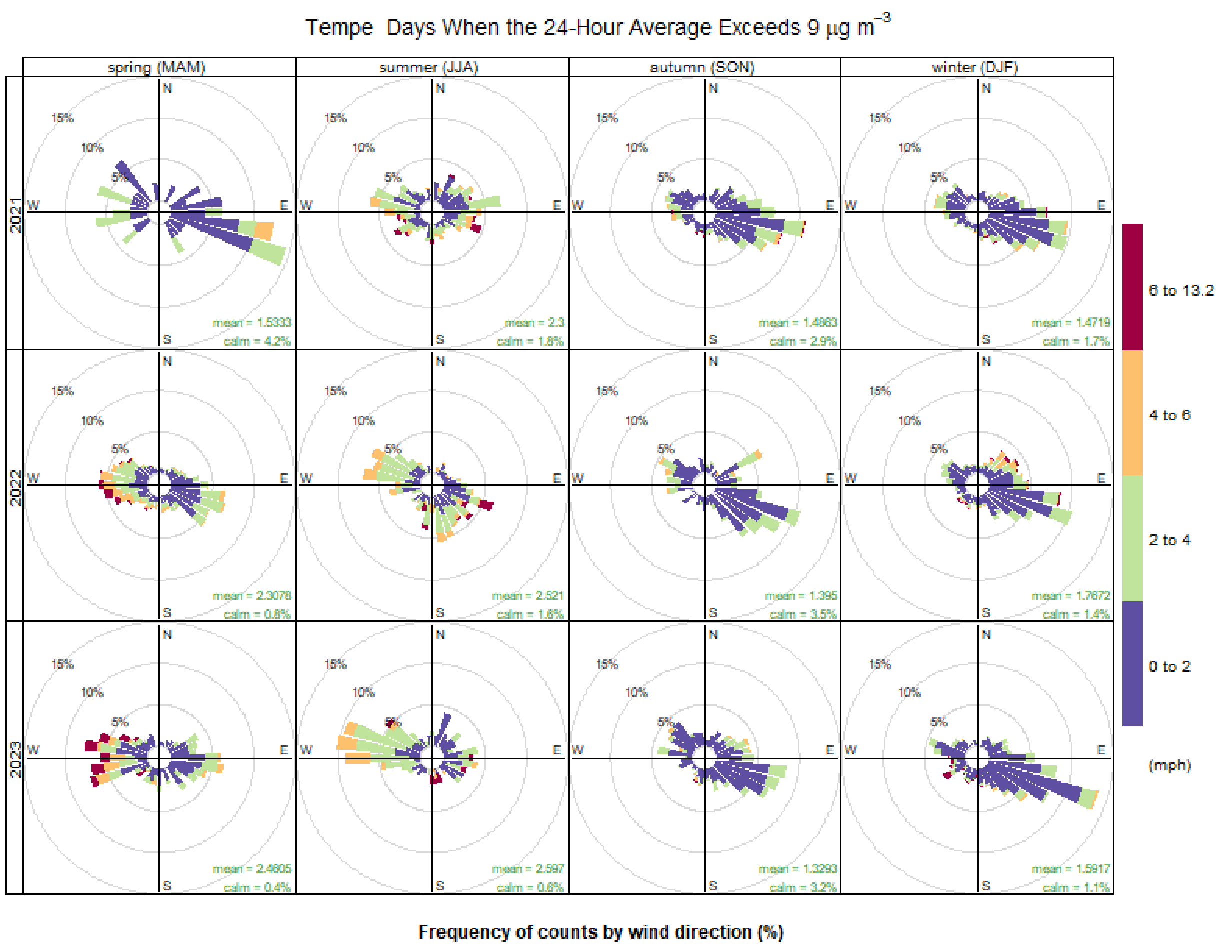


Figure 92: Tempe Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

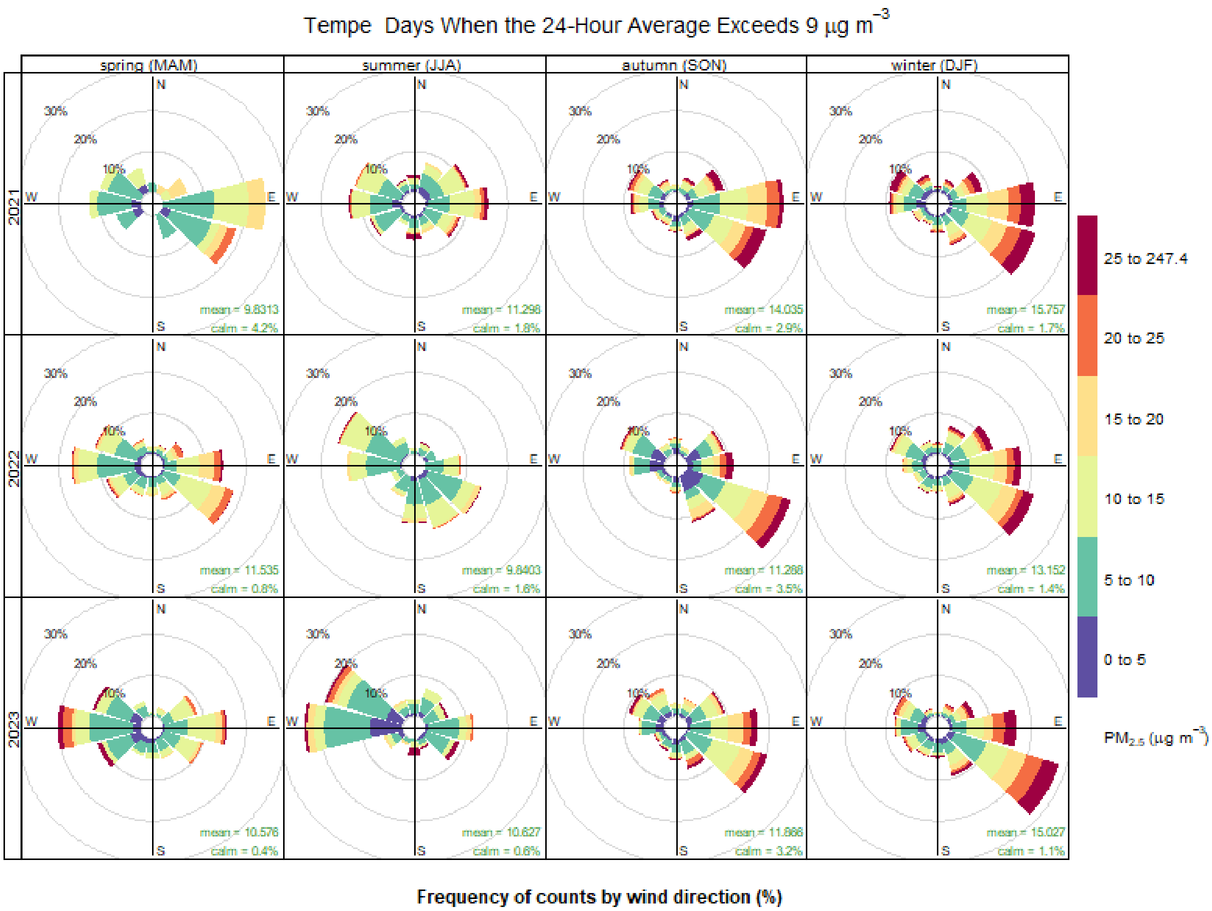


Figure 93: Tempe Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

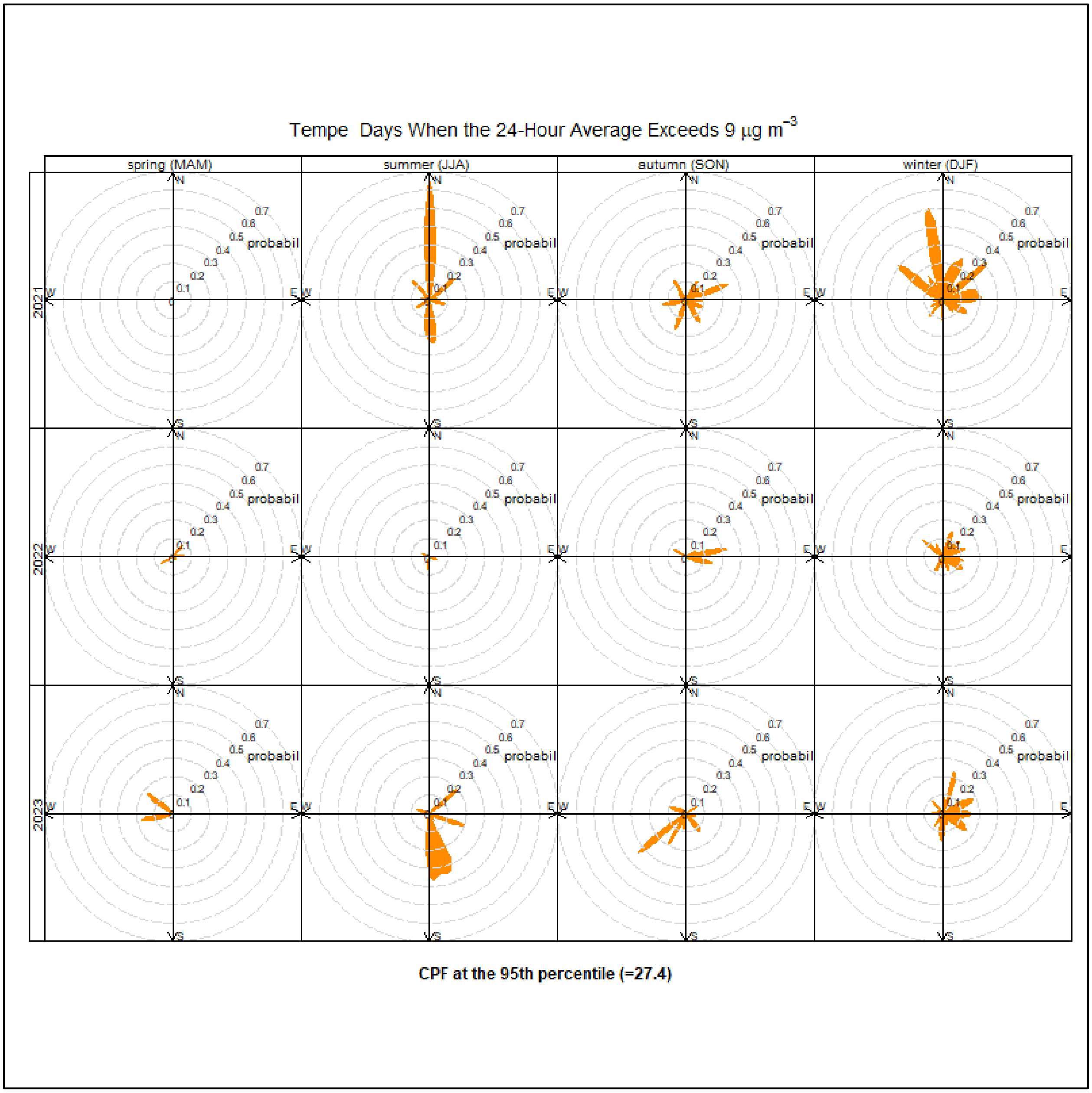


Figure 94: West Phoenix Wind Rose for All Data (2021-2023)

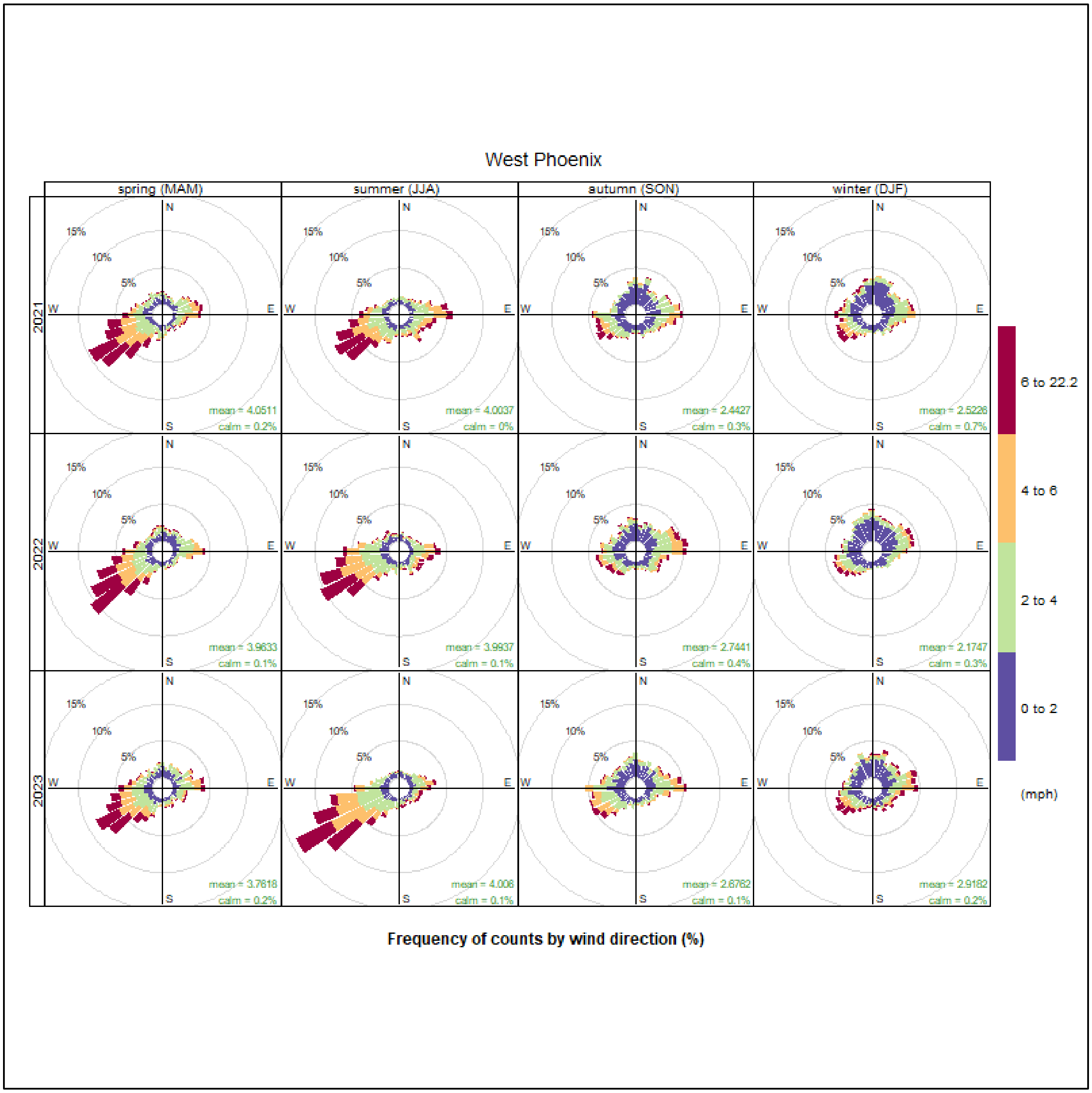


Figure 95: West Phoenix Pollution Rose for All Data (2021-2023)

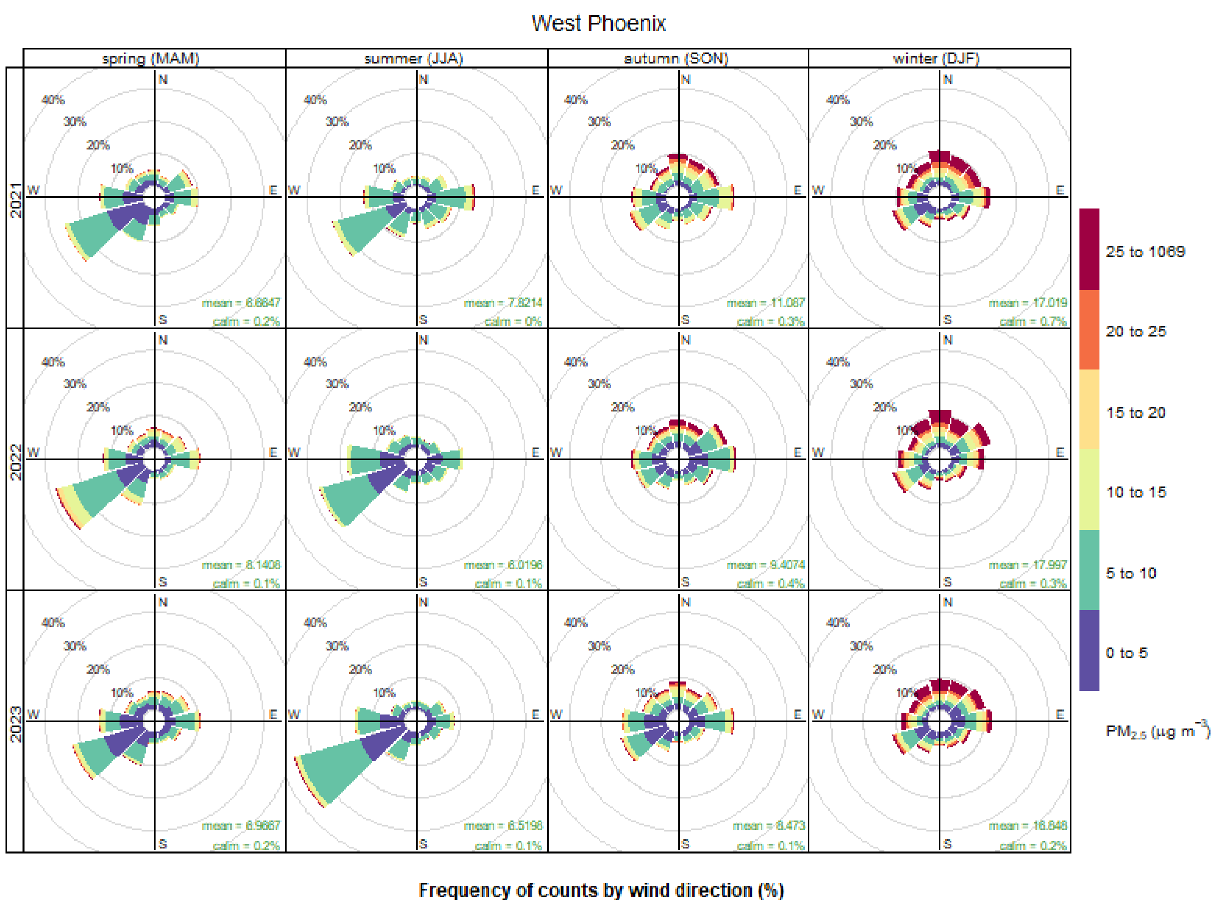


Figure 96: West Phoenix Percentile Rose for All Data (2021-2023)

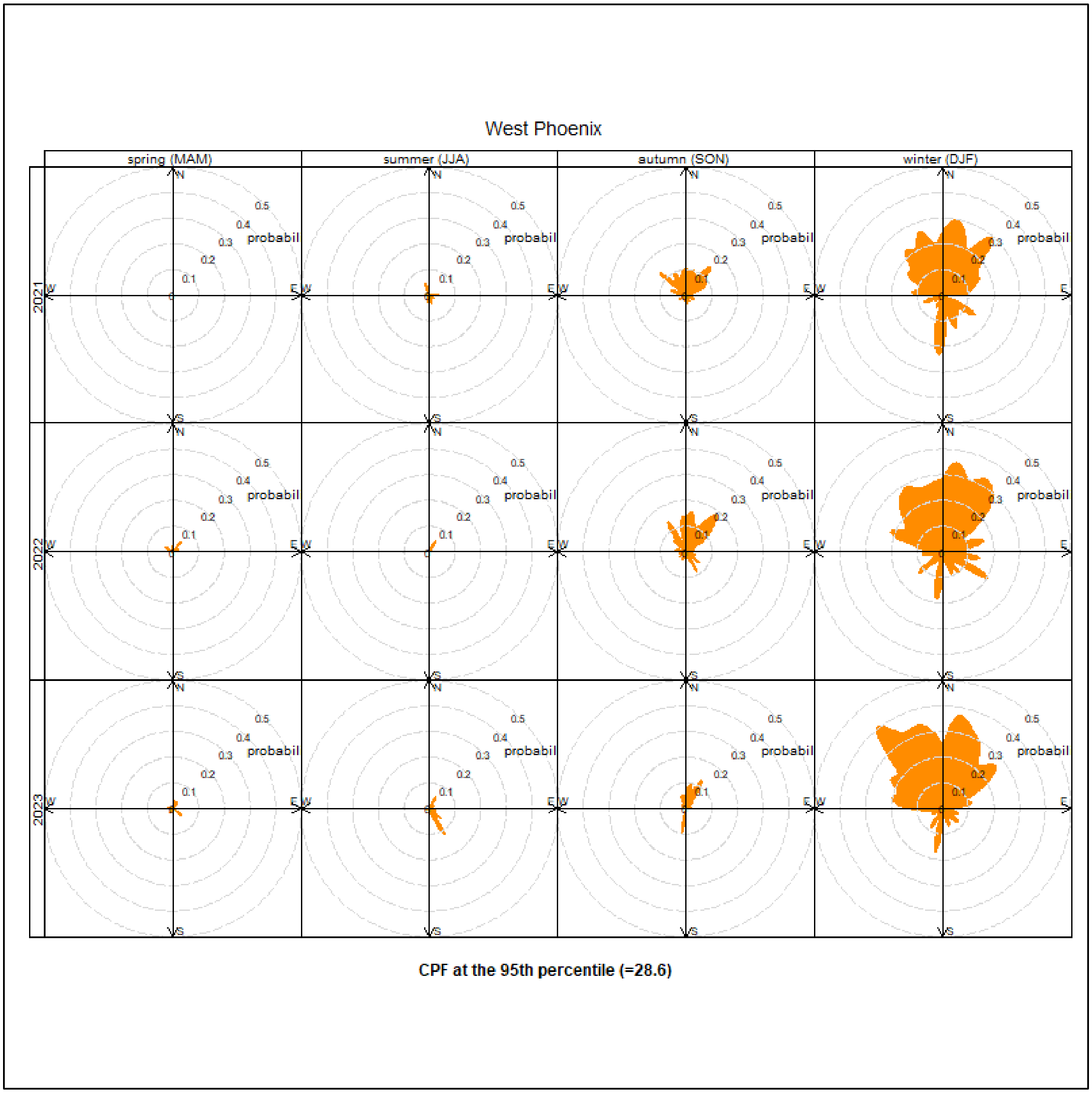


Figure 97: West Phoenix Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

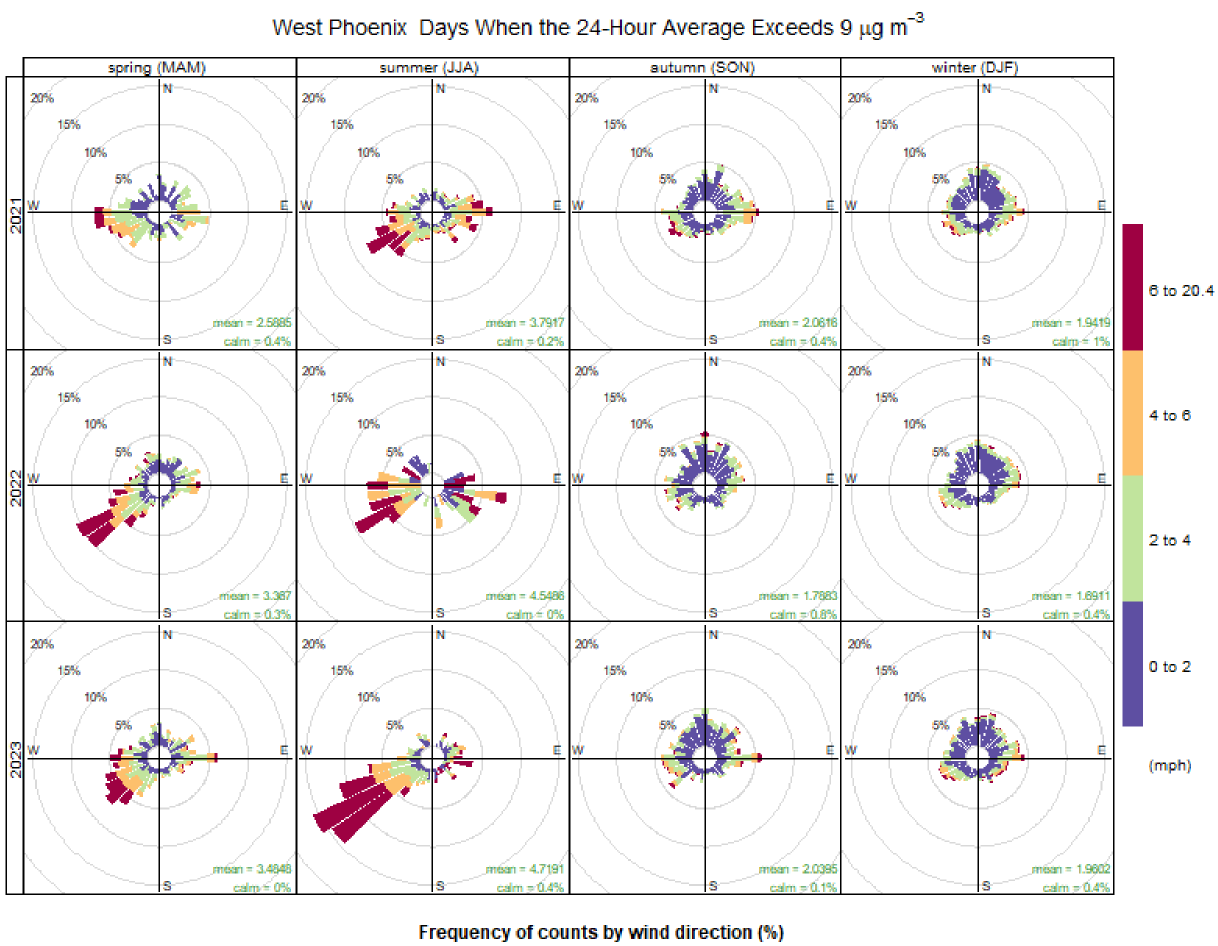


Figure 98: West Phoenix Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

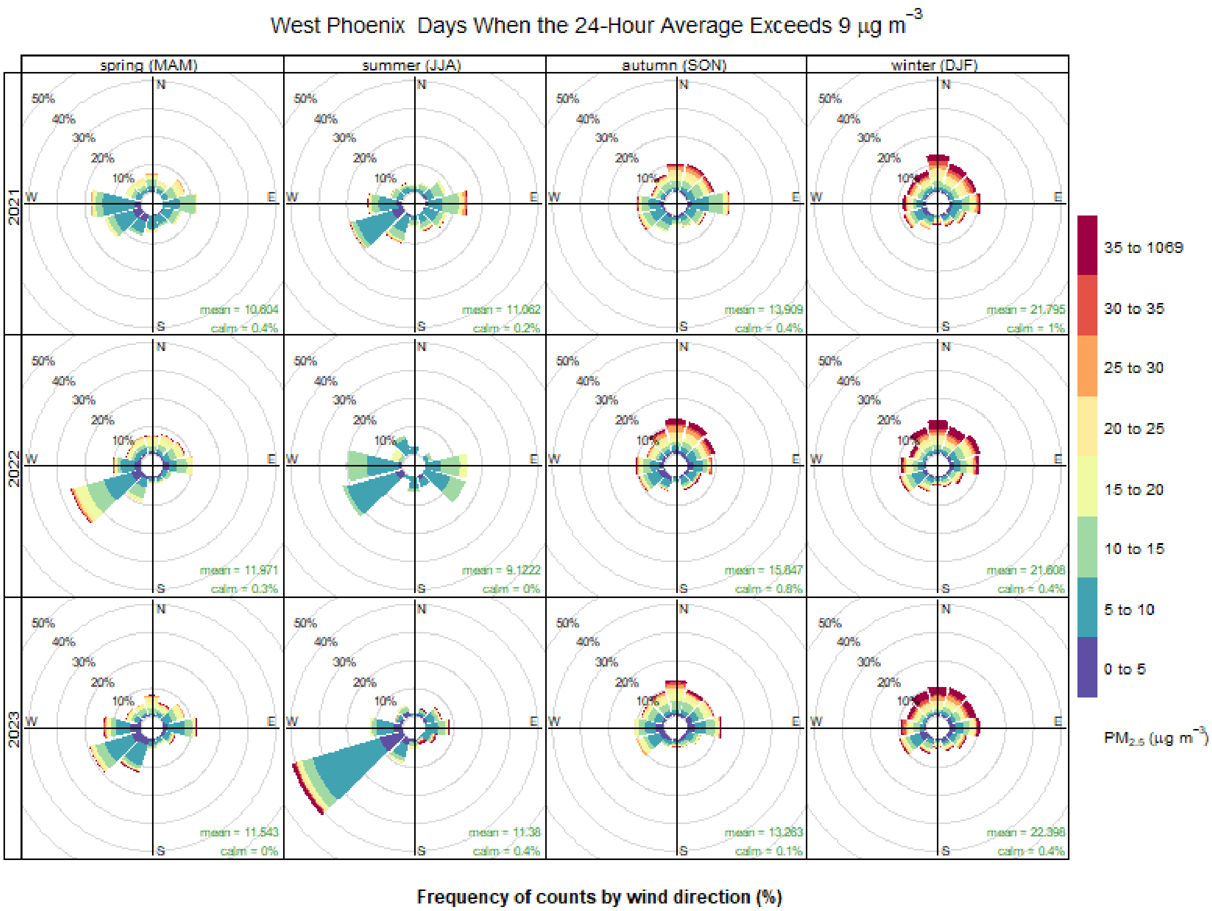


Figure 99: West Phoenix Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

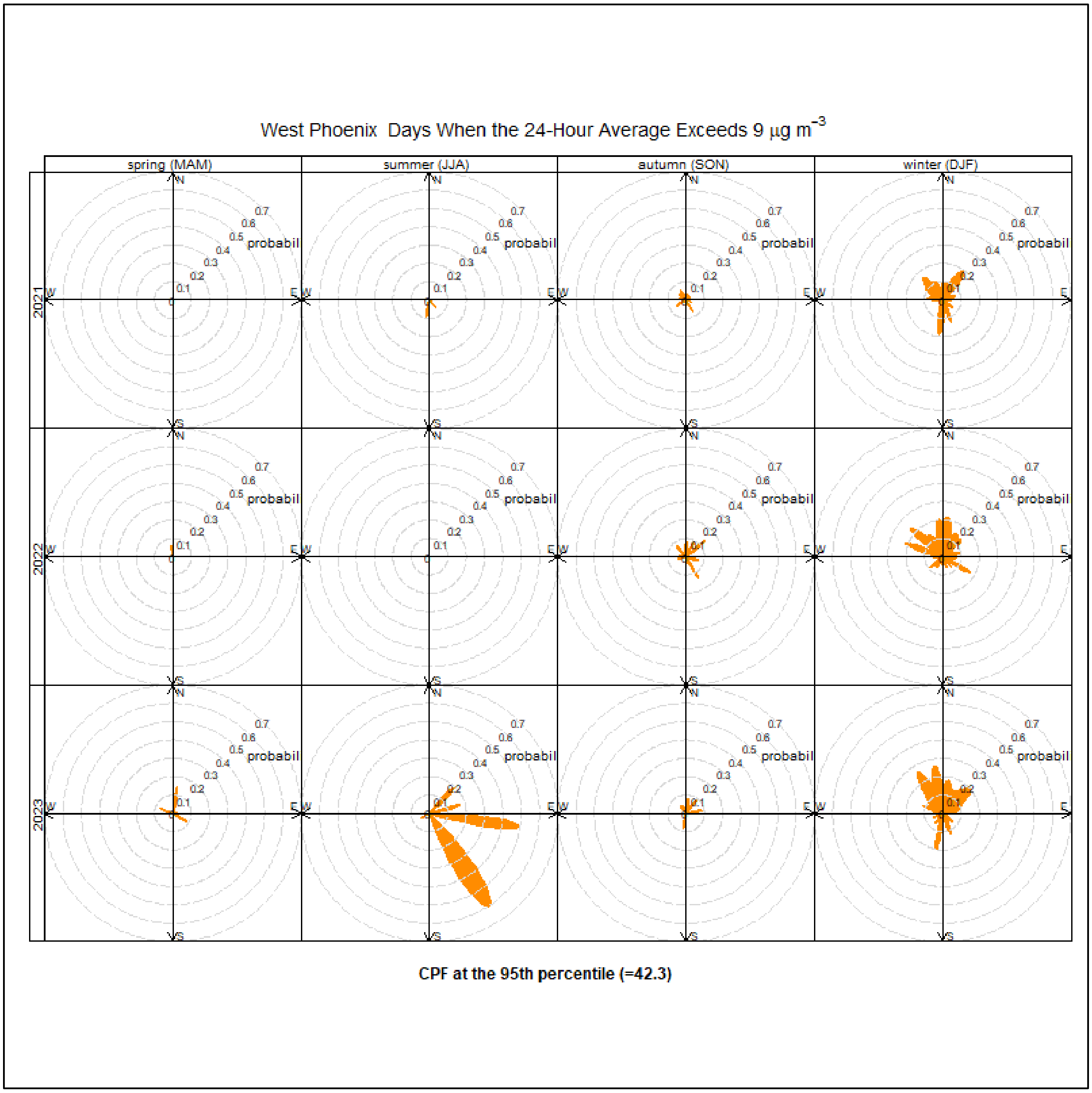


Figure 100: Eastwood Wind Rose for All Data (2021-2023)

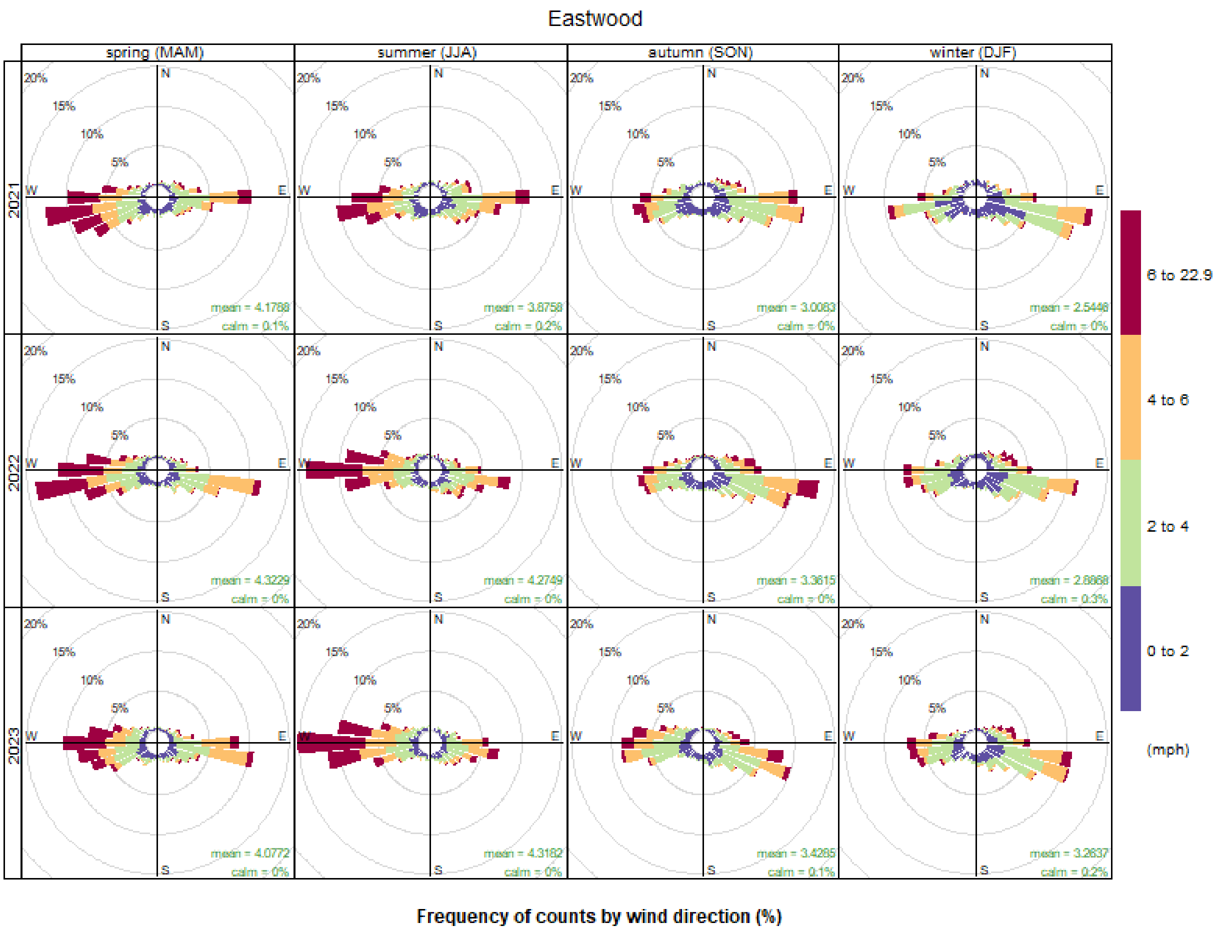


Figure 101: Eastwood Pollution Rose for All Data (2021-2023)

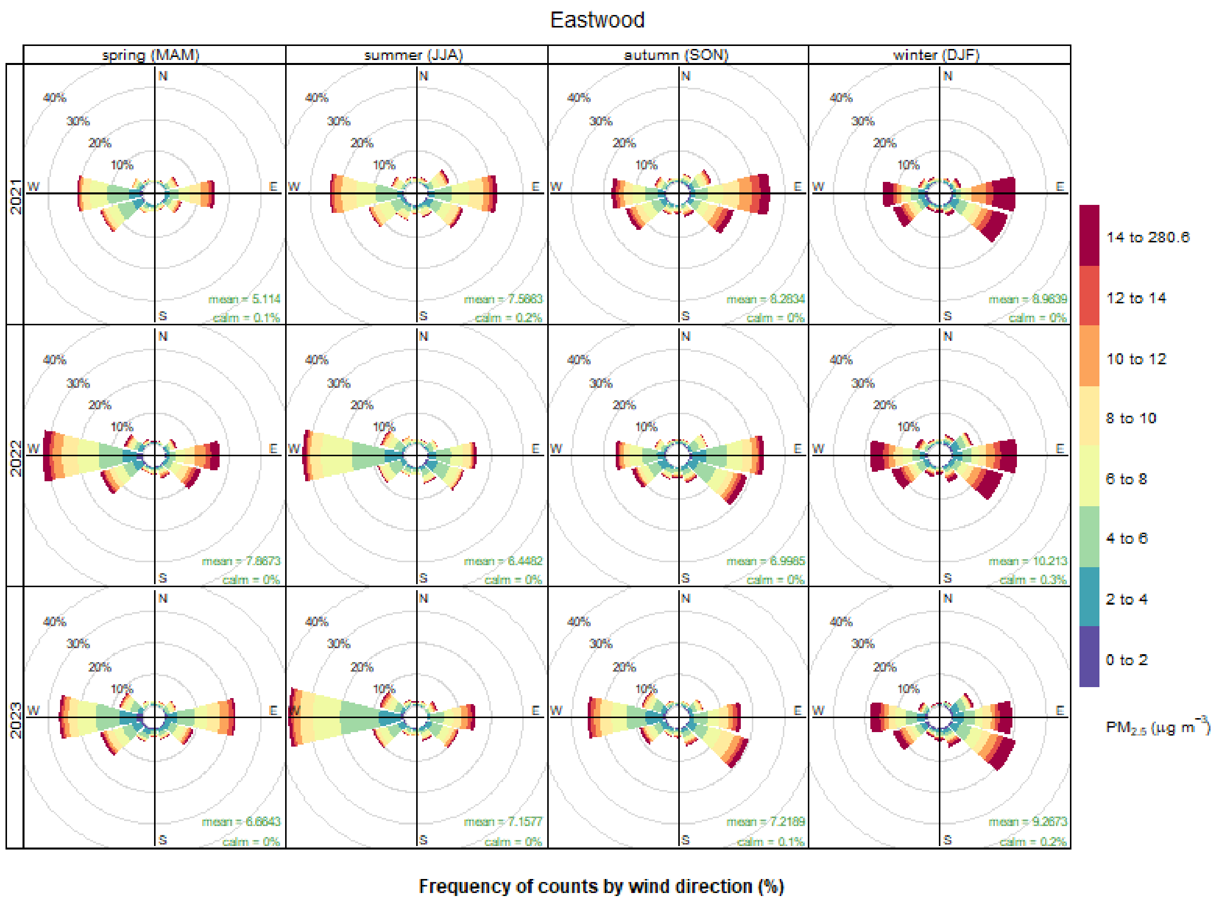


Figure 102: Eastwood Percentile Rose for All Data (2021-2023)

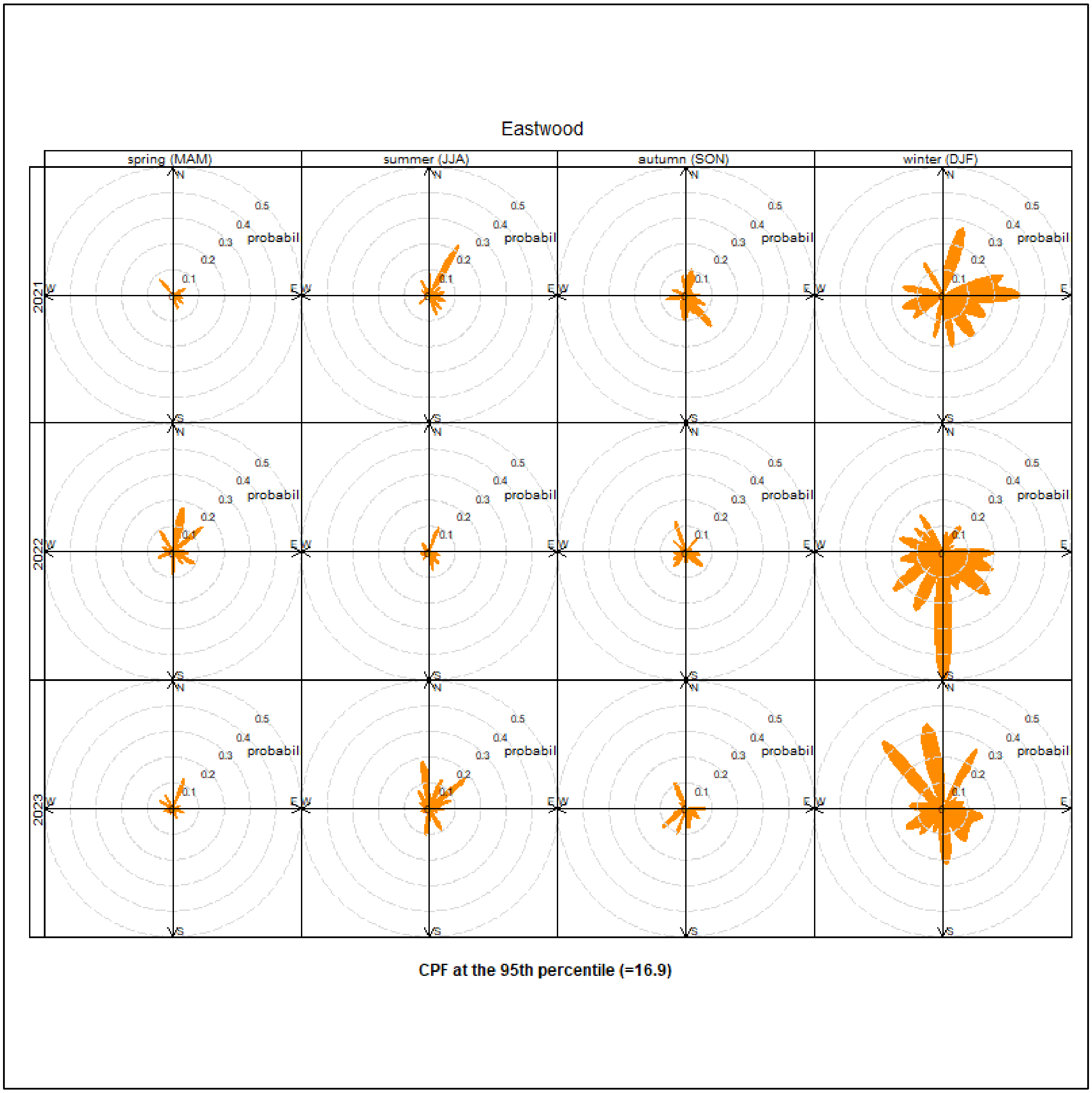


Figure 103: Eastwood Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

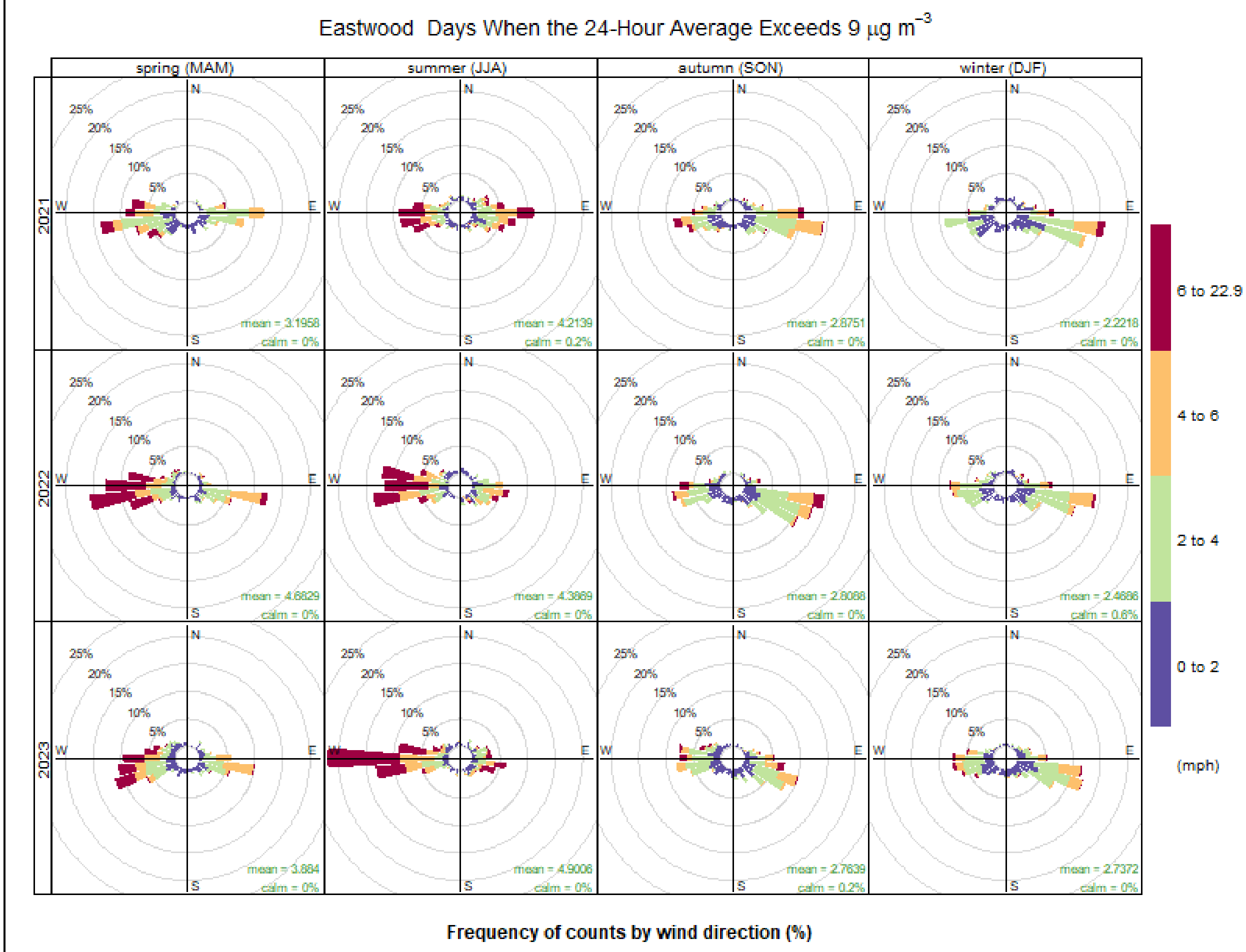


Figure 104: Eastwood Pollution Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)

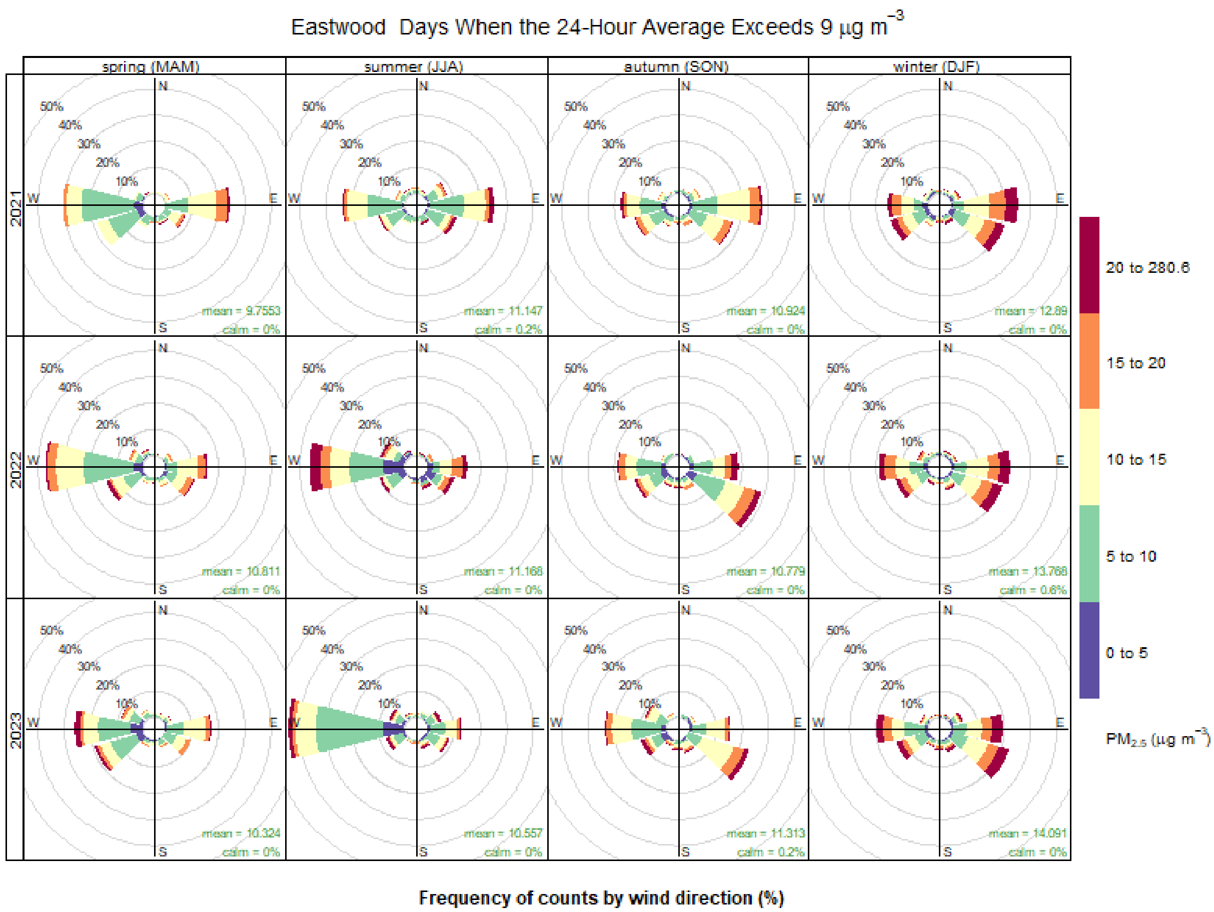
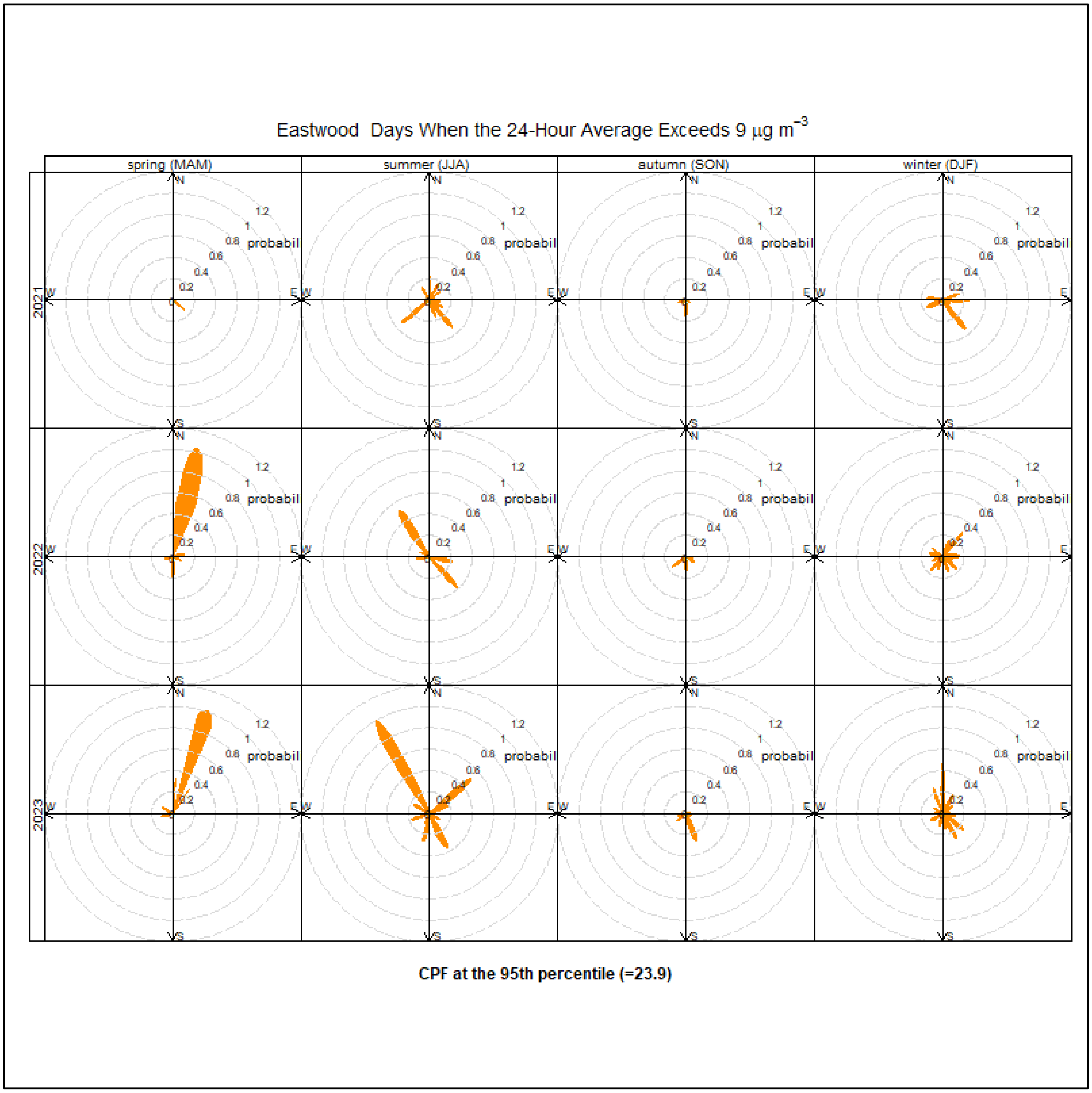


Figure 105: Eastwood Percentile Rose for Days When the 24-hour Average Exceeds the Annual Standard (2021-2023)



A4.2 Maricopa County Additional Analysis

In Maricopa County, a more comprehensive analysis of wind speed and direction was performed to provide additional insight on wind patterns where a lack of $PM_{2.5}$ monitors persists. Several monitors notated in Figure 39 by the green triangle symbol do not measure $PM_{2.5}$ pollution, only wind speed and direction. For example, Figure 106 represents the average windspeed and direction in Buckeye, AZ captured from all days in 2022 and 2023, further broken down by season. In addition to a review from all days in Buckeye during this two-year period, Figure 107, examines only day in 2022 and 2023 where the 24-hour $PM_{2.5}$ concentration exceeded the primary annual standard at any of the three violating PM_2 monitors.

Figure 106: Buckeye Wind Rose (2022-2023)

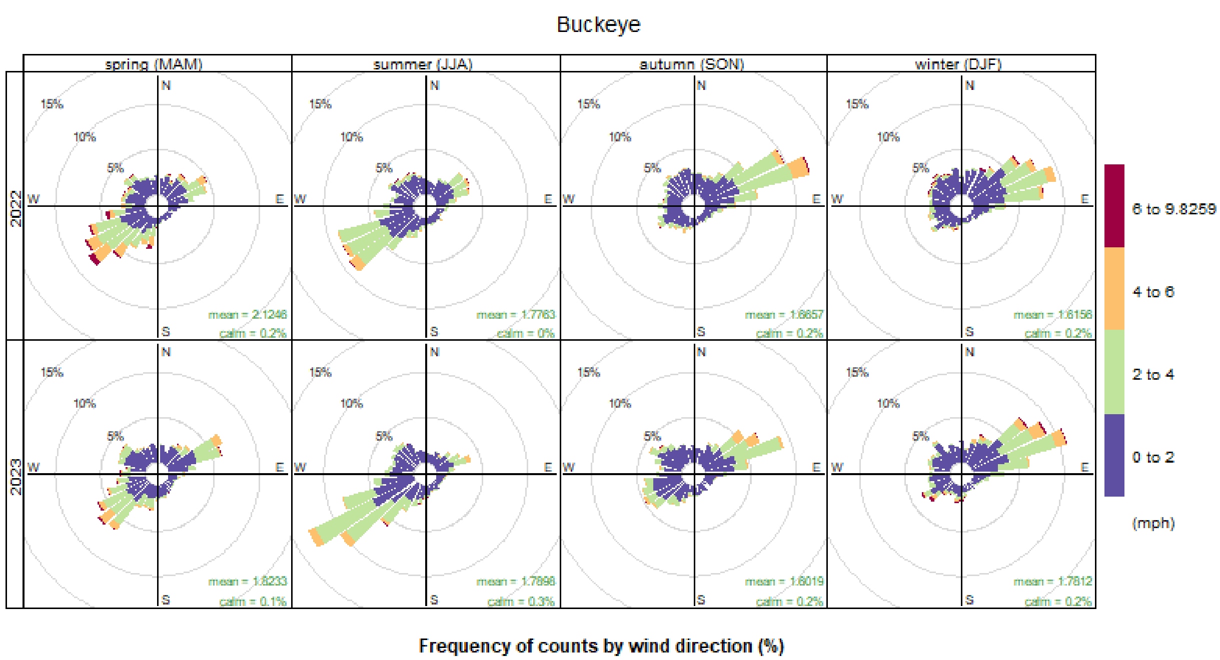


Figure 107: Buckeye Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)

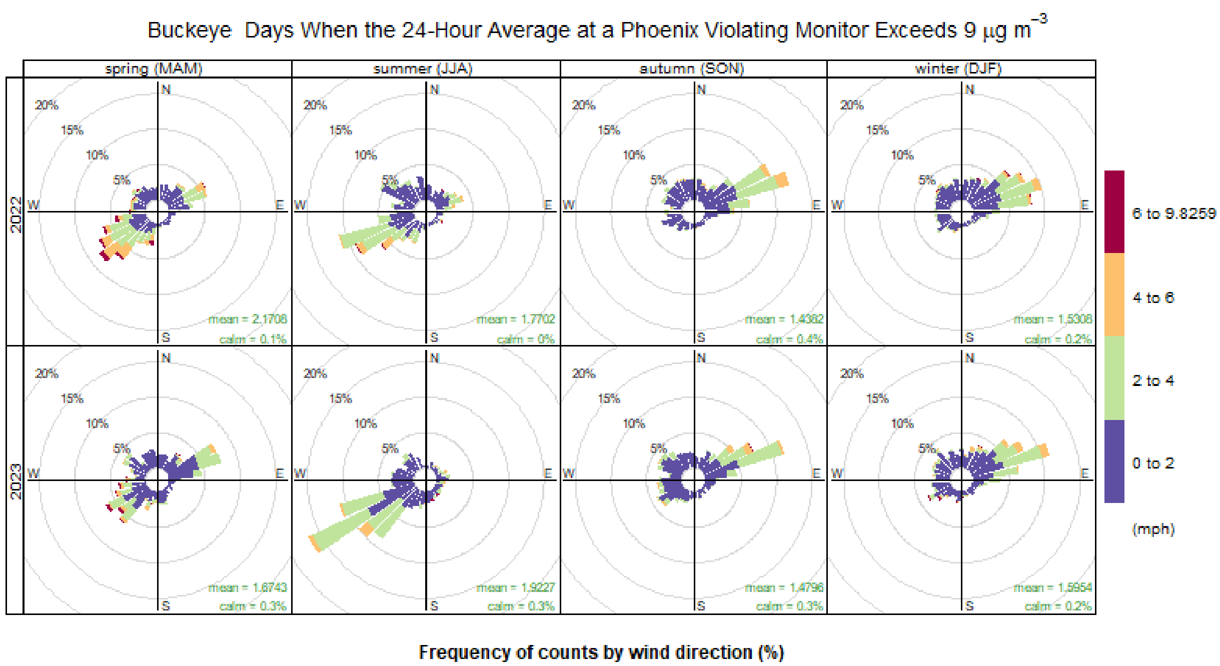


Figure 108: Dysart Wind Rose (2022-2023)

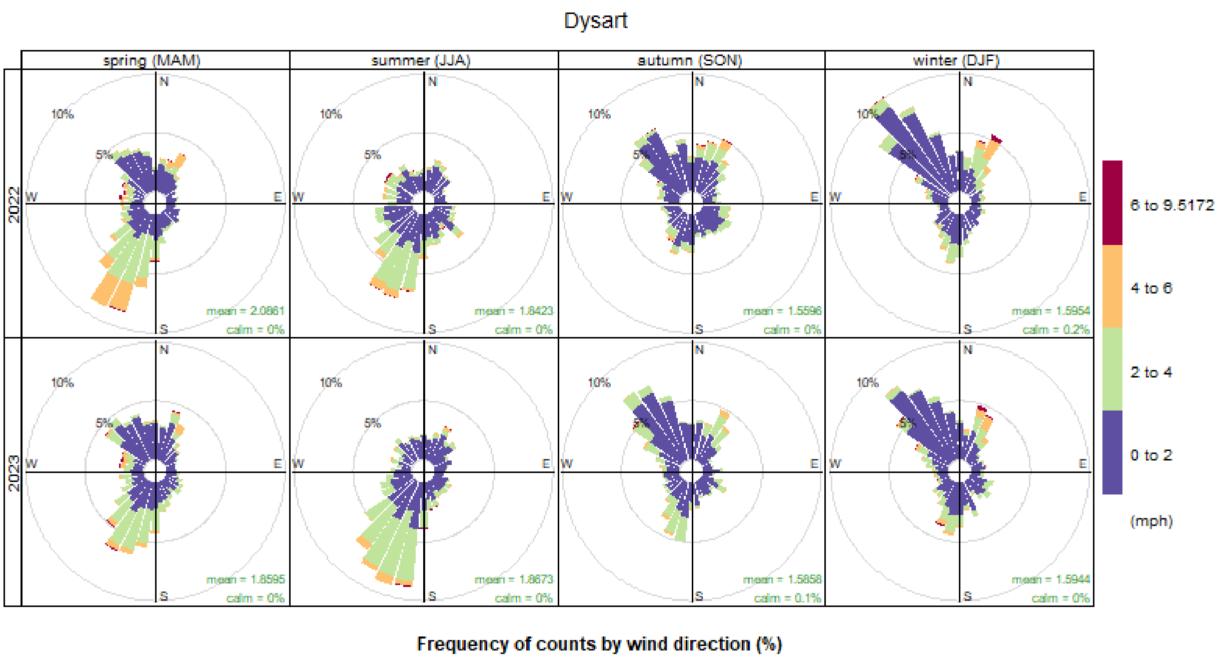


Figure 109: Dysart Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)

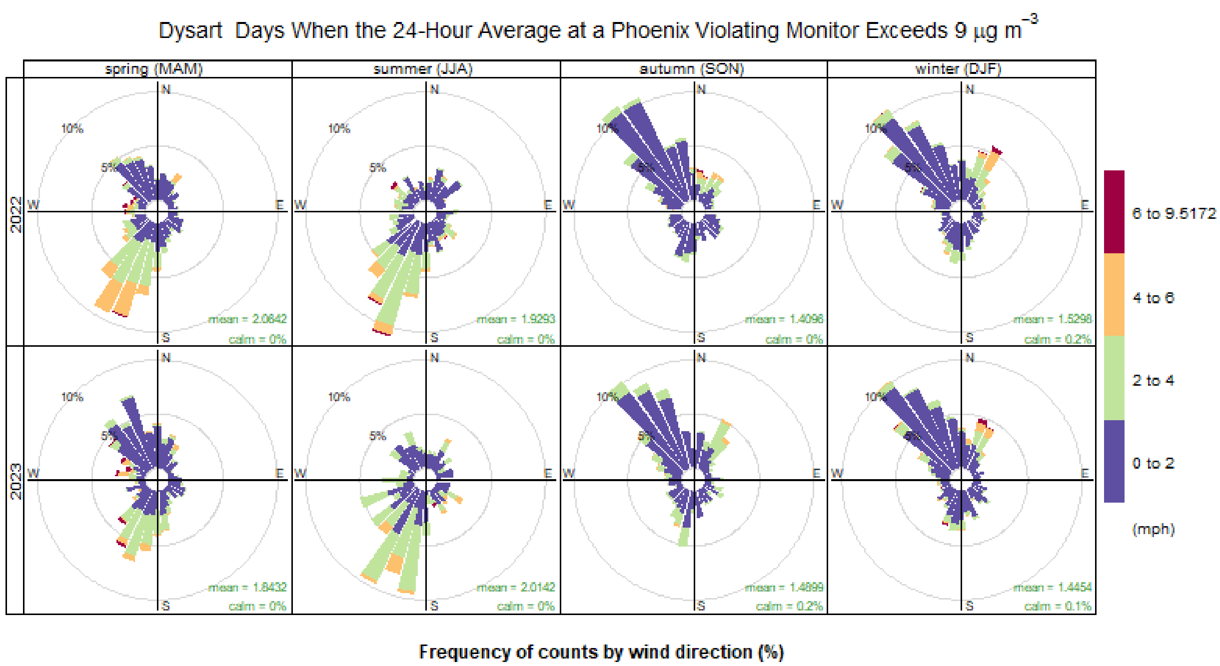


Figure 110: Higley Wind Rose (2022-2023)

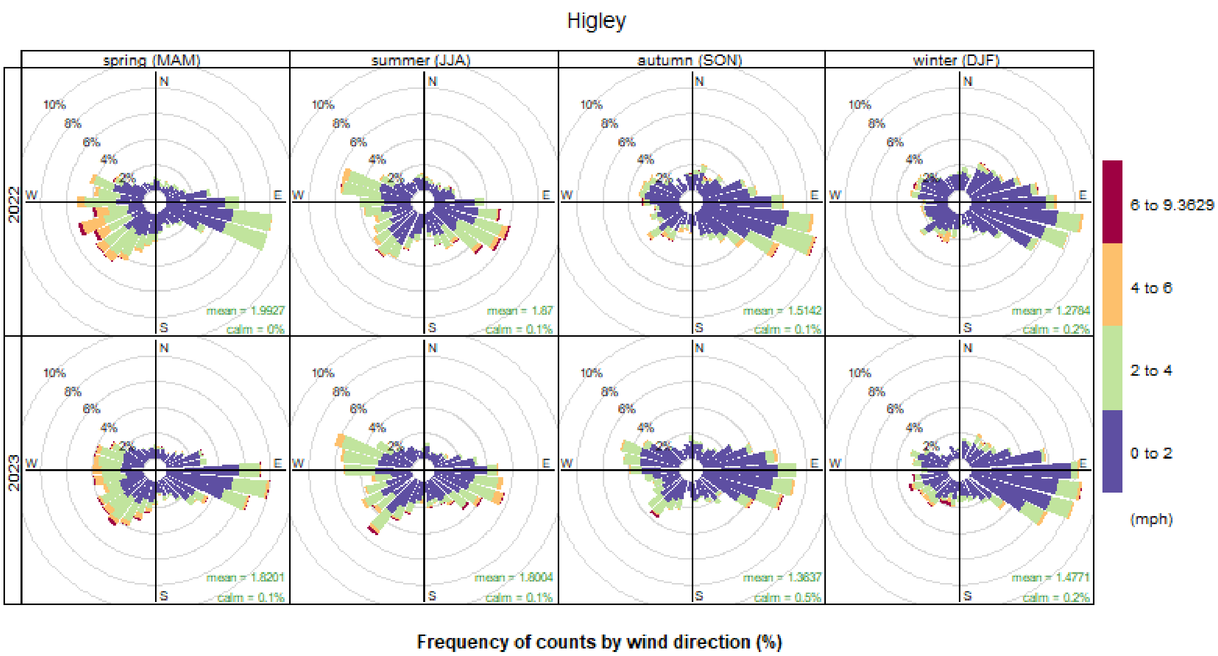


Figure 111: Higley Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)

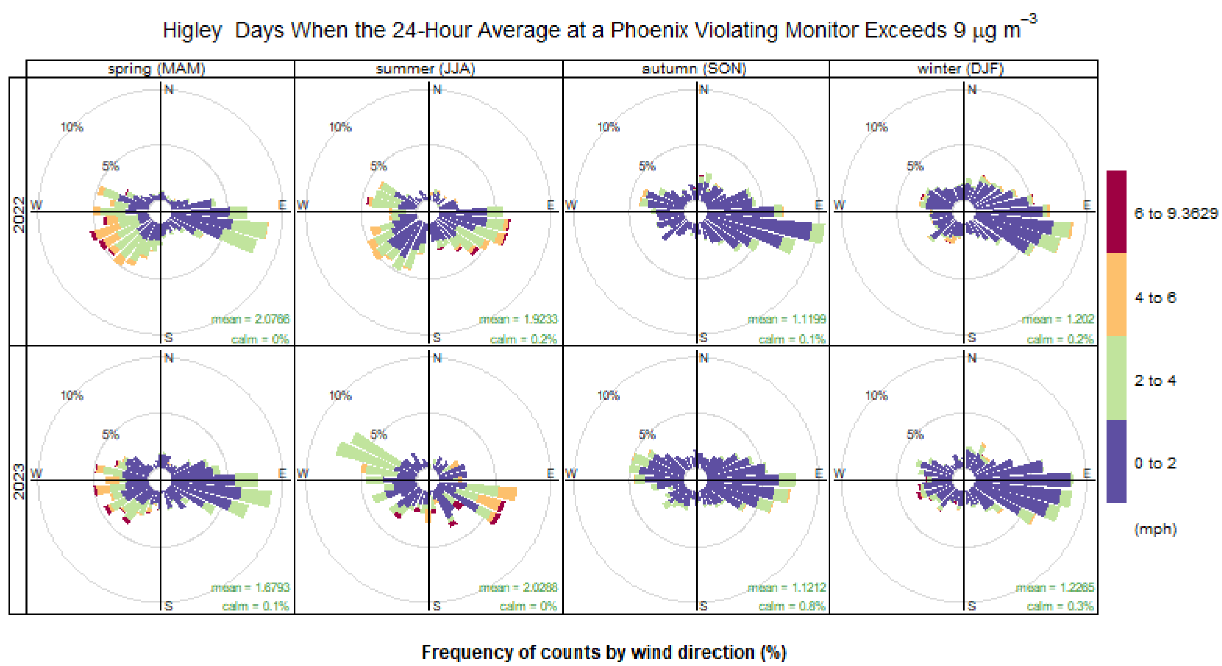


Figure 112: Pinnacle Peak Club House Wind Rose (2022-2023)

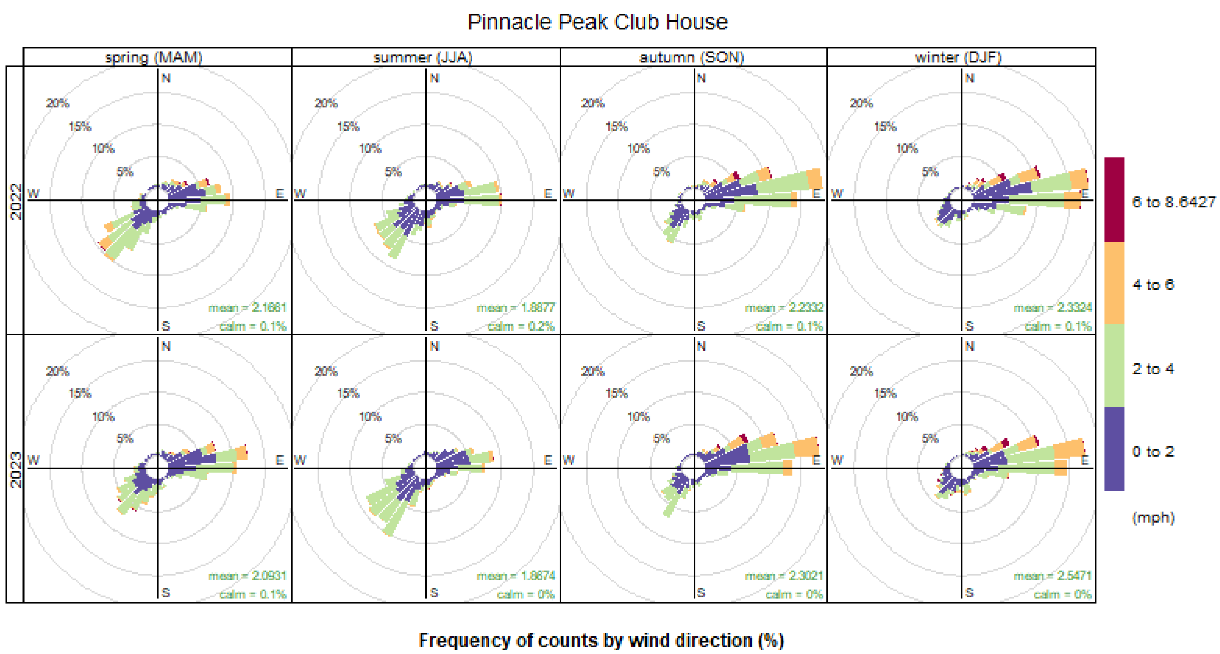


Figure 113: Pinnacle Peak Club House Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)

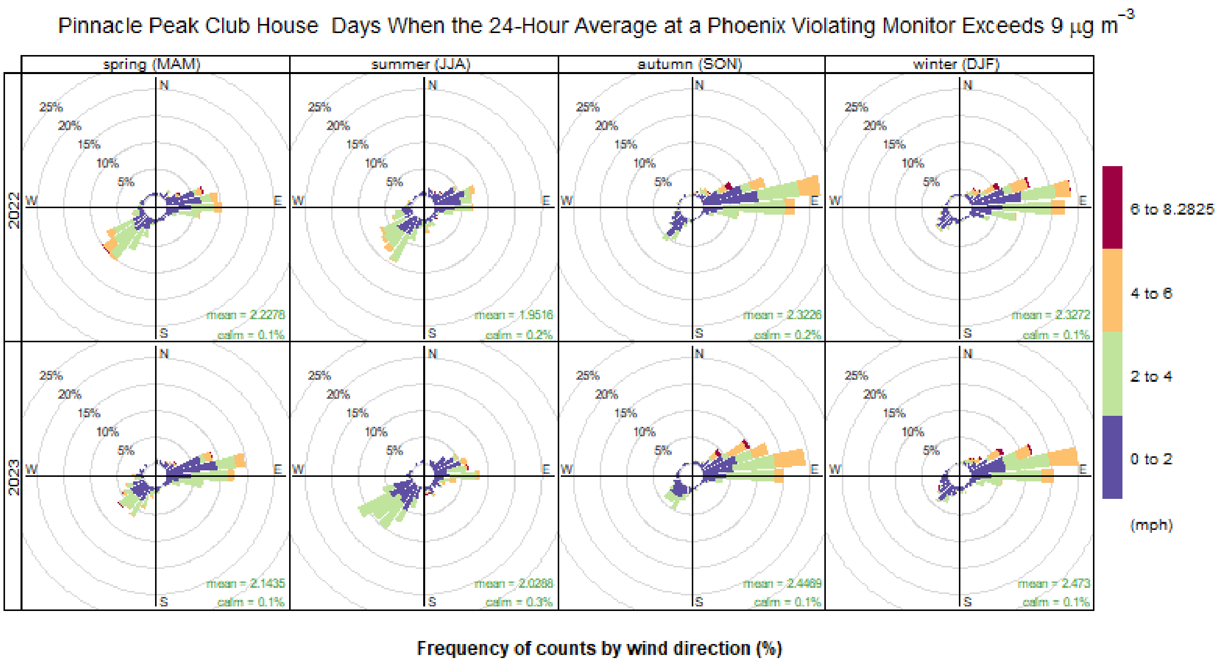


Figure 114: South Scottsdale Wind Rose (2022-2023)

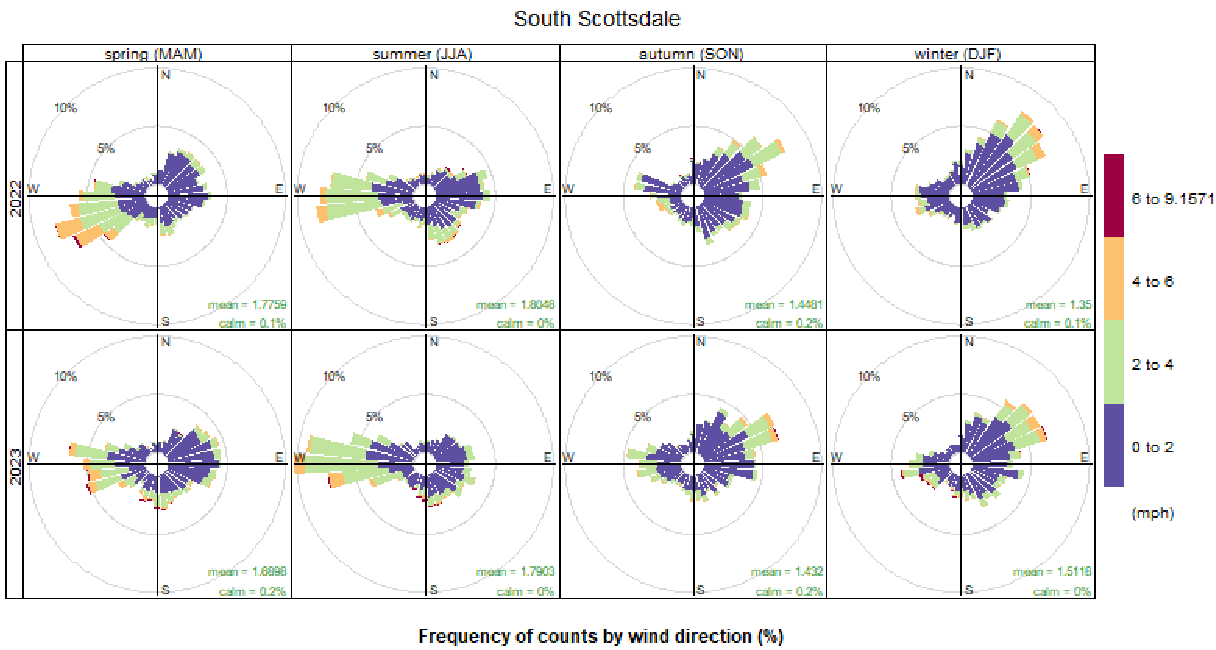


Figure 115: South Scottsdale Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)

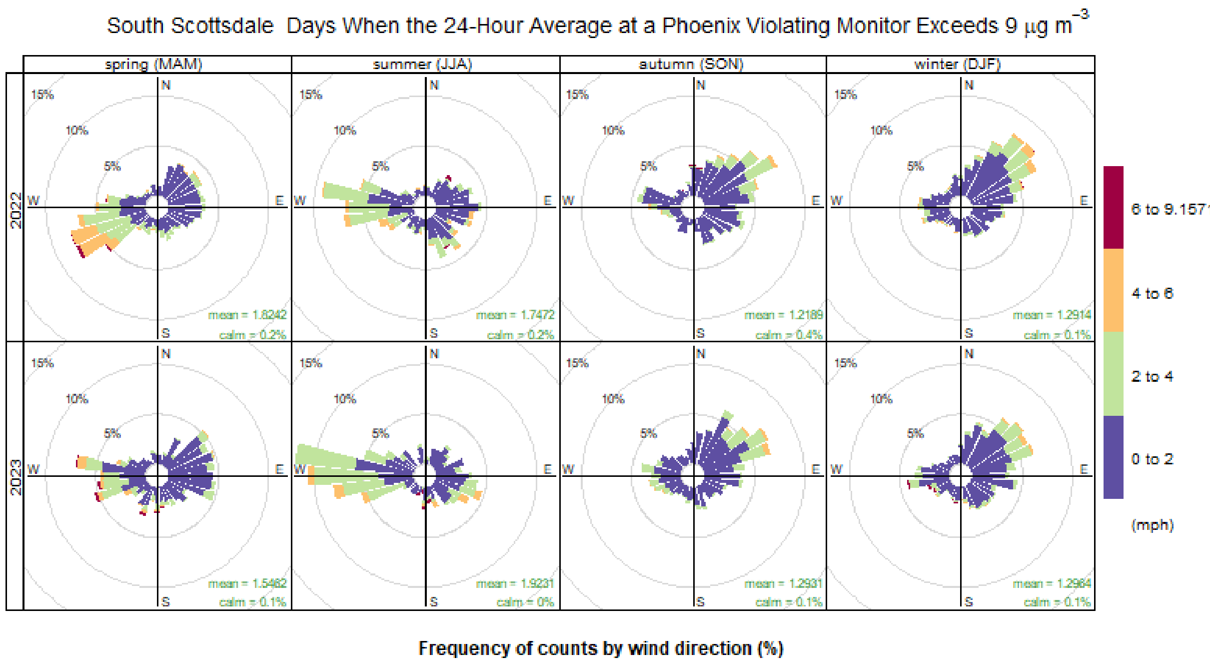


Figure 116: West Chandler Fire Station Wind Rose (2022-2023)

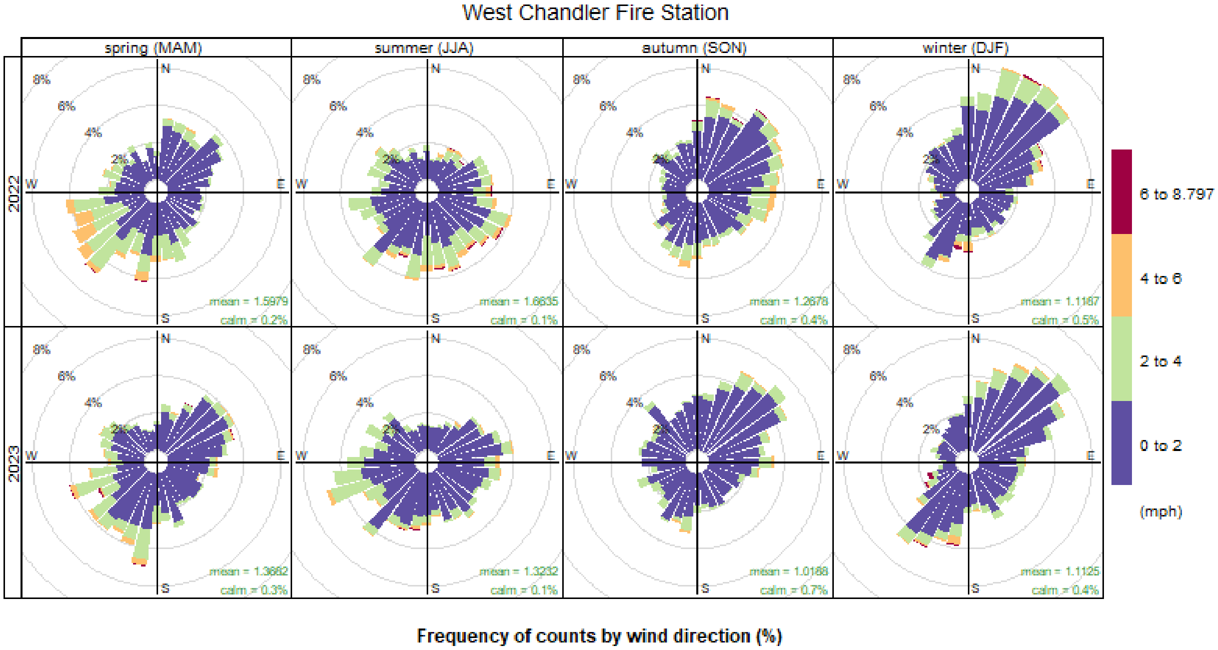


Figure 117: West Chandler Fire Station Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)

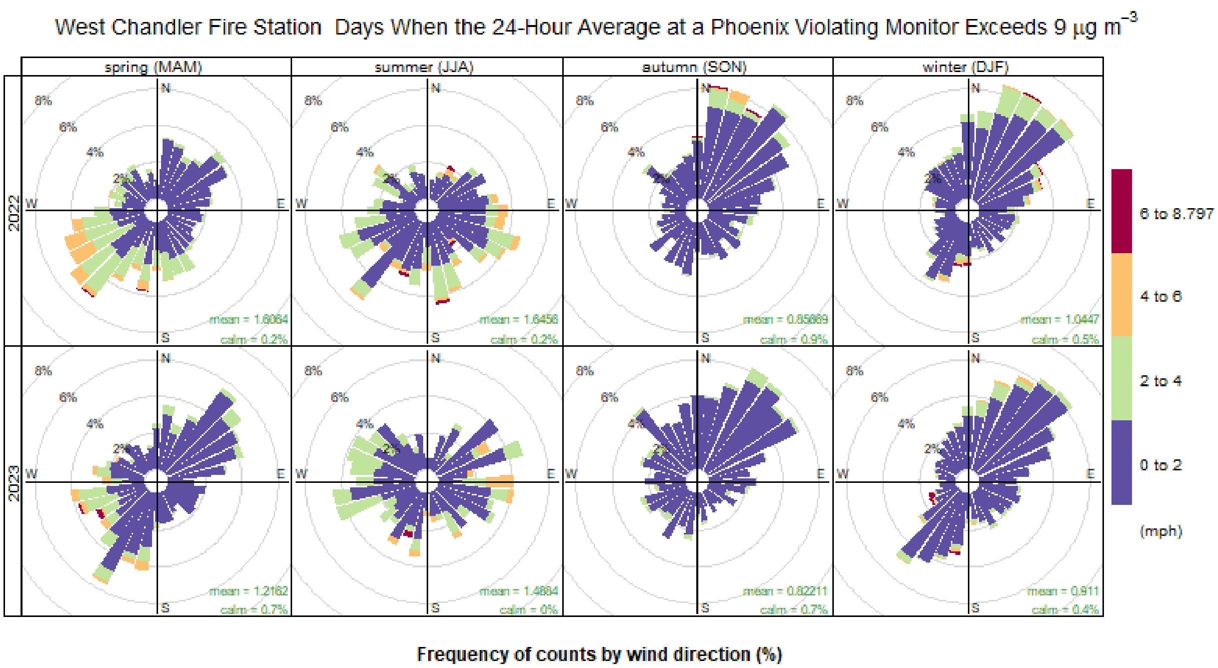


Figure 118: Zuni Hills Wind Rose (2022-2023)

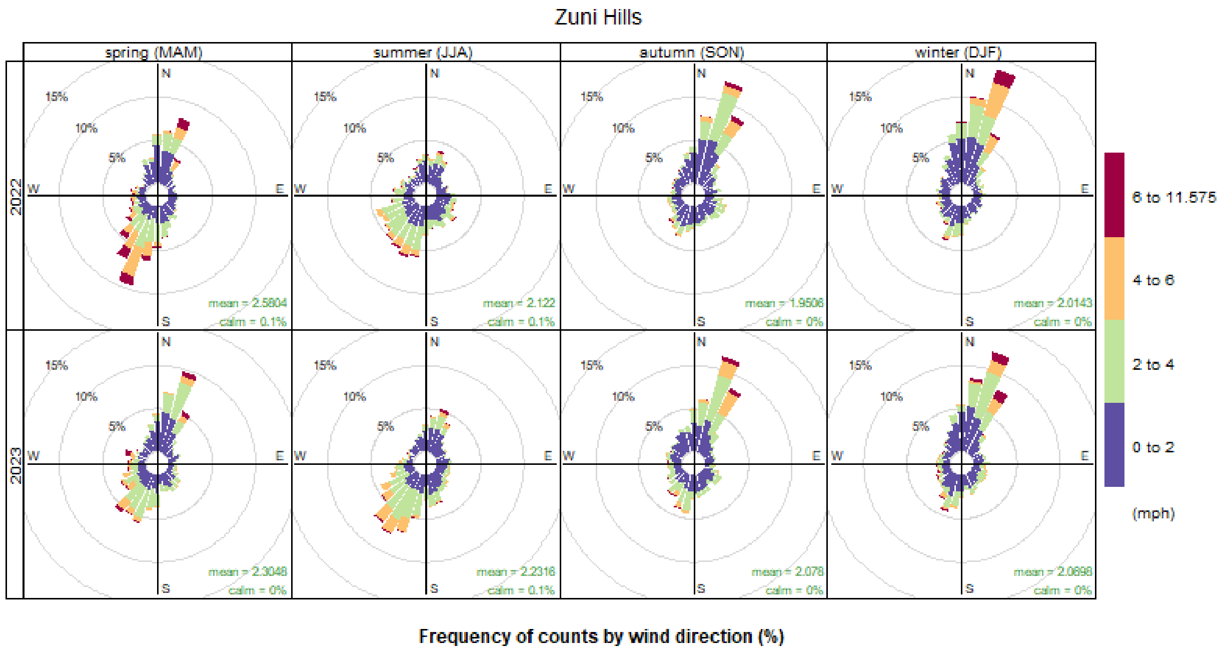
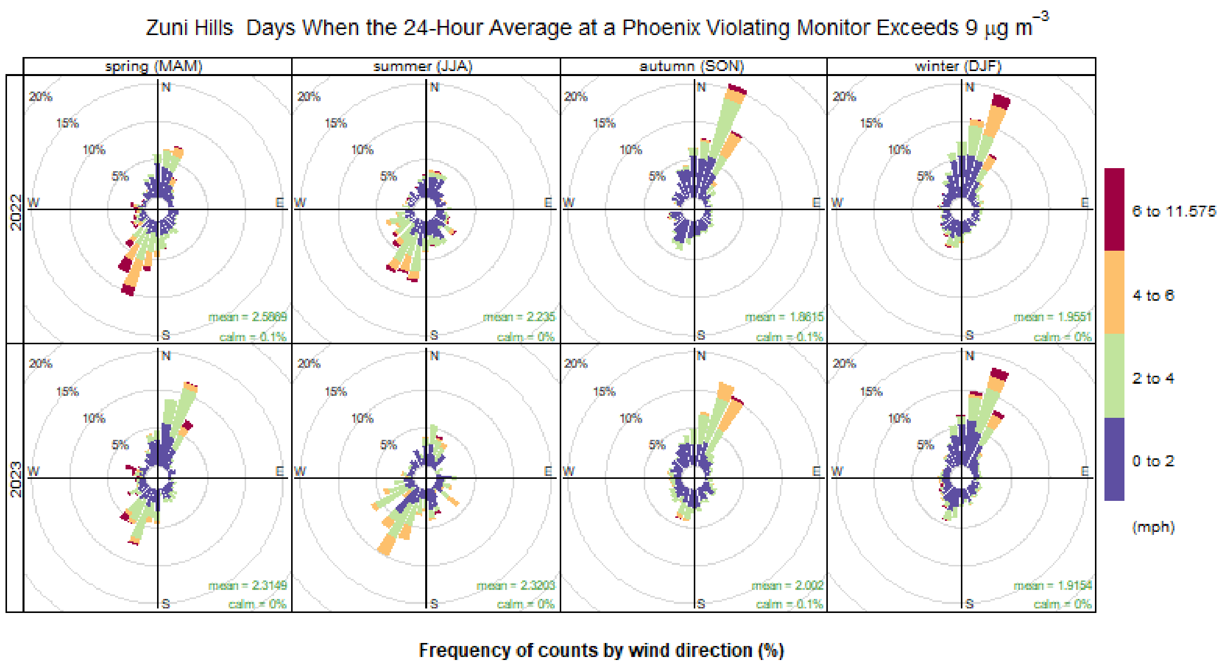


Figure 119: Zuni Hills Wind Rose for Days When the 24-hour Average Exceeds the Annual Standard (2022-2023)



A4.3 HYSPLIT Analysis

HYSPLIT 24-hour back trajectories were utilized to create maps of where air parcels at each violating monitor originated from over a period of 24-hours. Back trajectories were run twice a day from 2021-2023 for days above 9.0 ug/m^3 at a starting height of 500 meters above ground level. The parcels were released during the two peak hourly averages of $PM_{2.5}$ concentrations experienced at each monitor, shown in Table A-38.

Table A-38: HYSPLIT Back Trajectory Start Times

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
Hidden Valley	6:00:00 AM	7:00:00 PM
Nogales Post Office	7:00:00 AM	11:00:00 PM

To visualize the HYSPLIT results, ADEQ imported the HYSPLIT back trajectory endpoints into ArcGIS Pro and created vector feature classes for each violating monitor. 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 and was used by 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 120 through Figure 129.

Figure 120: 2021-2023 HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m³ at Durango Complex Monitor

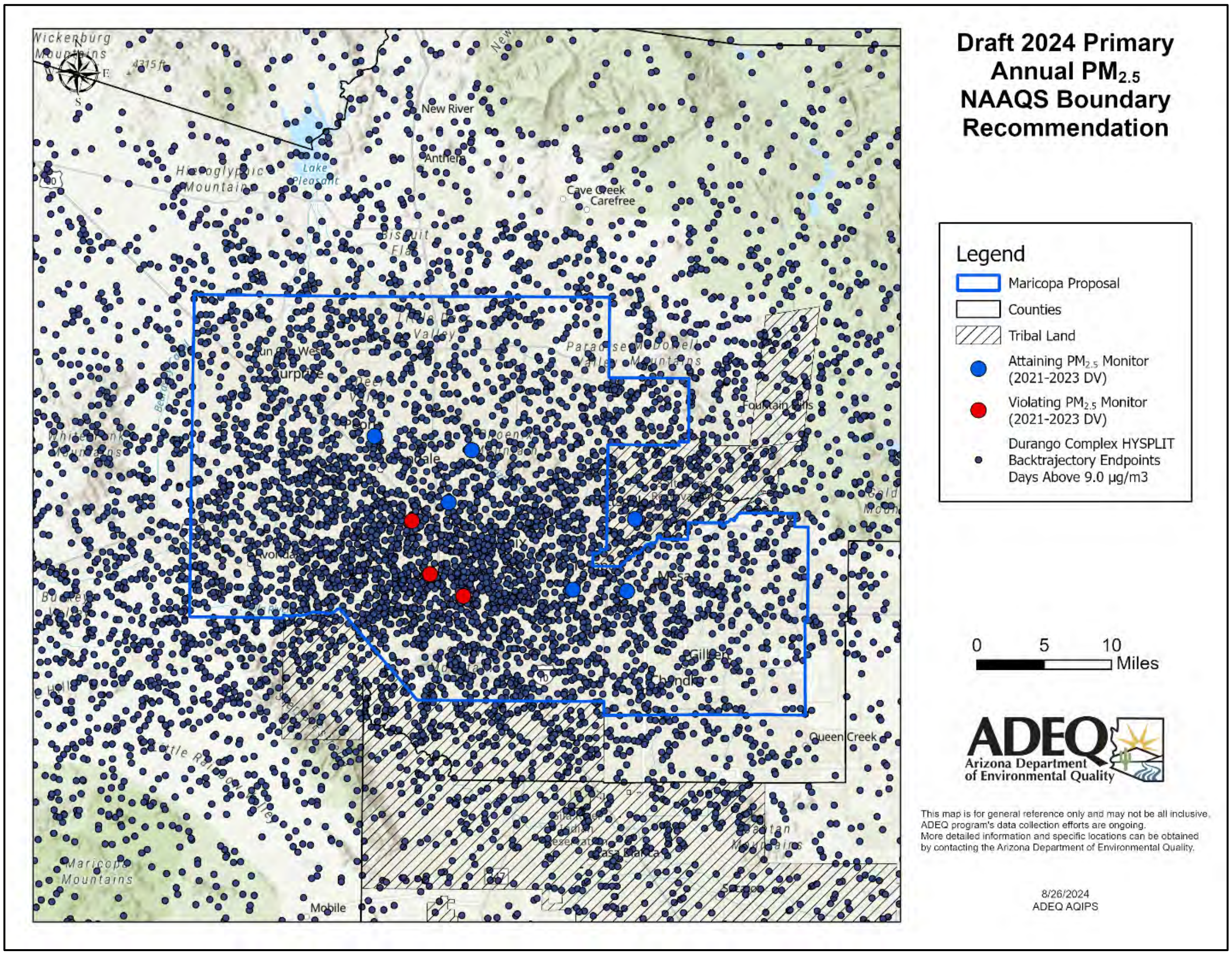


Figure 121: 2021-2023 Kernel Density Estimation Plots of HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m³ at Durango Complex Monitor

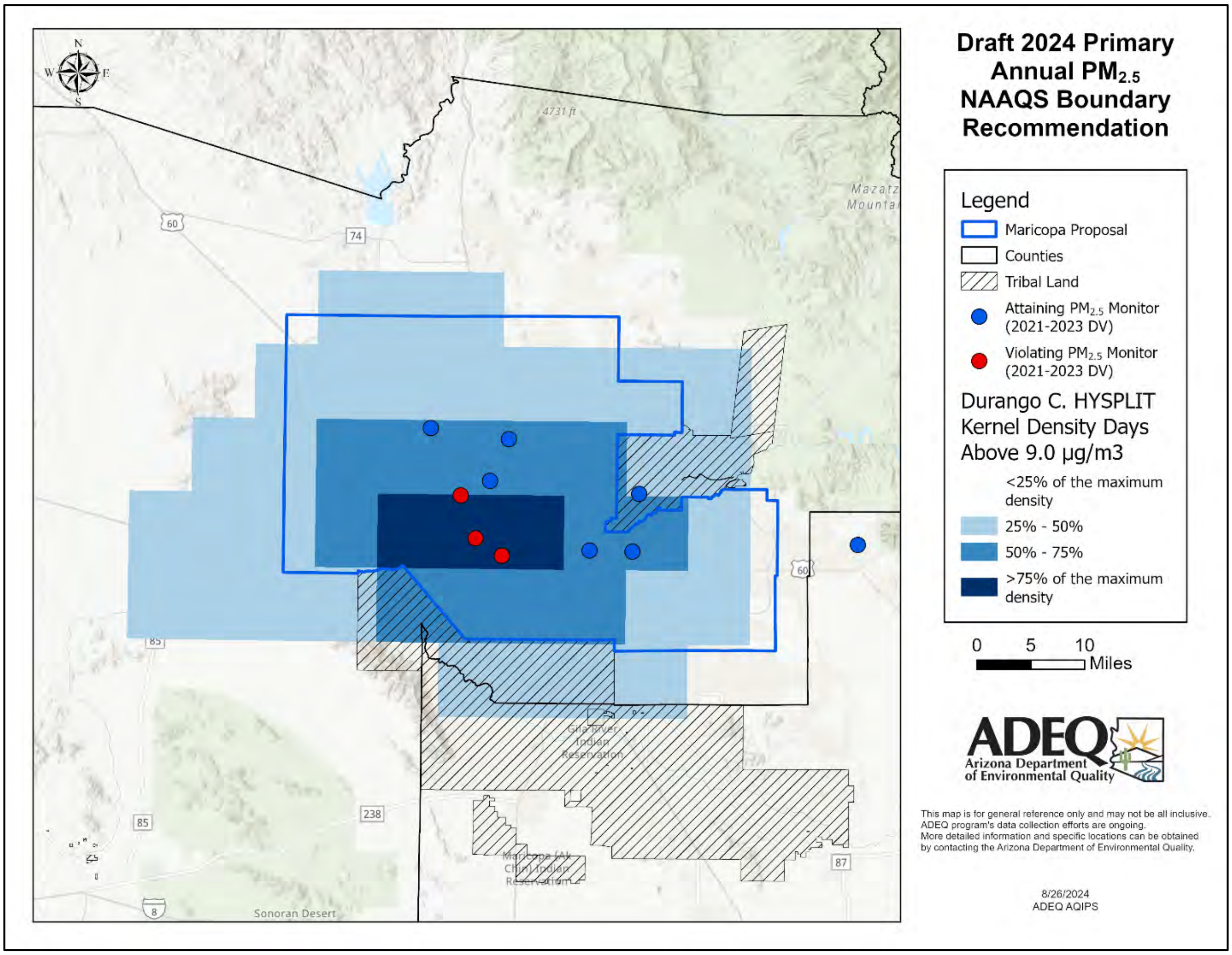


Figure 122: 2021-2023 HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m^3 at South Phoenix Monitor

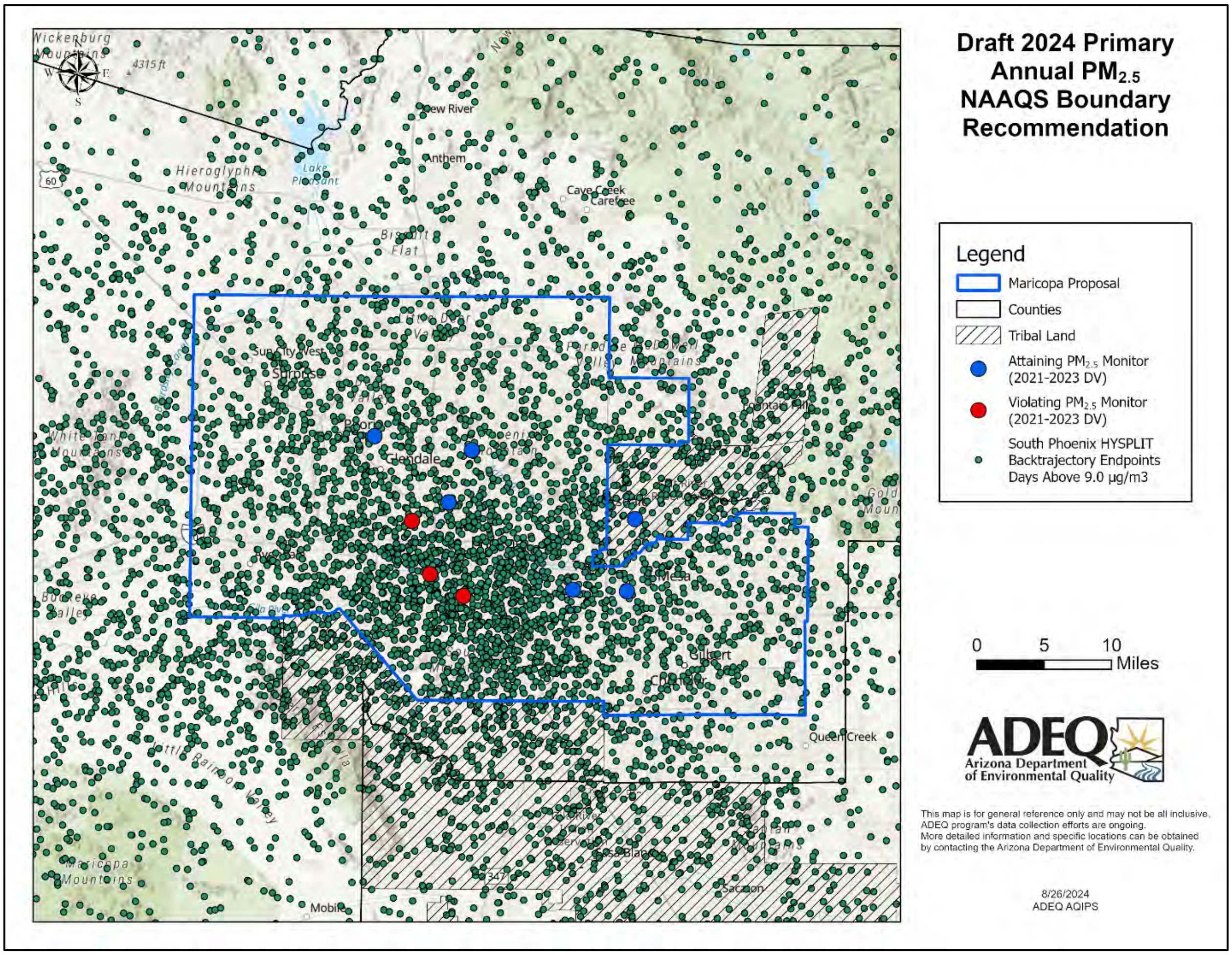


Figure 123: 2021-2023 Kernel Density Estimation Plots of HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m³ at South Phoenix Monitor

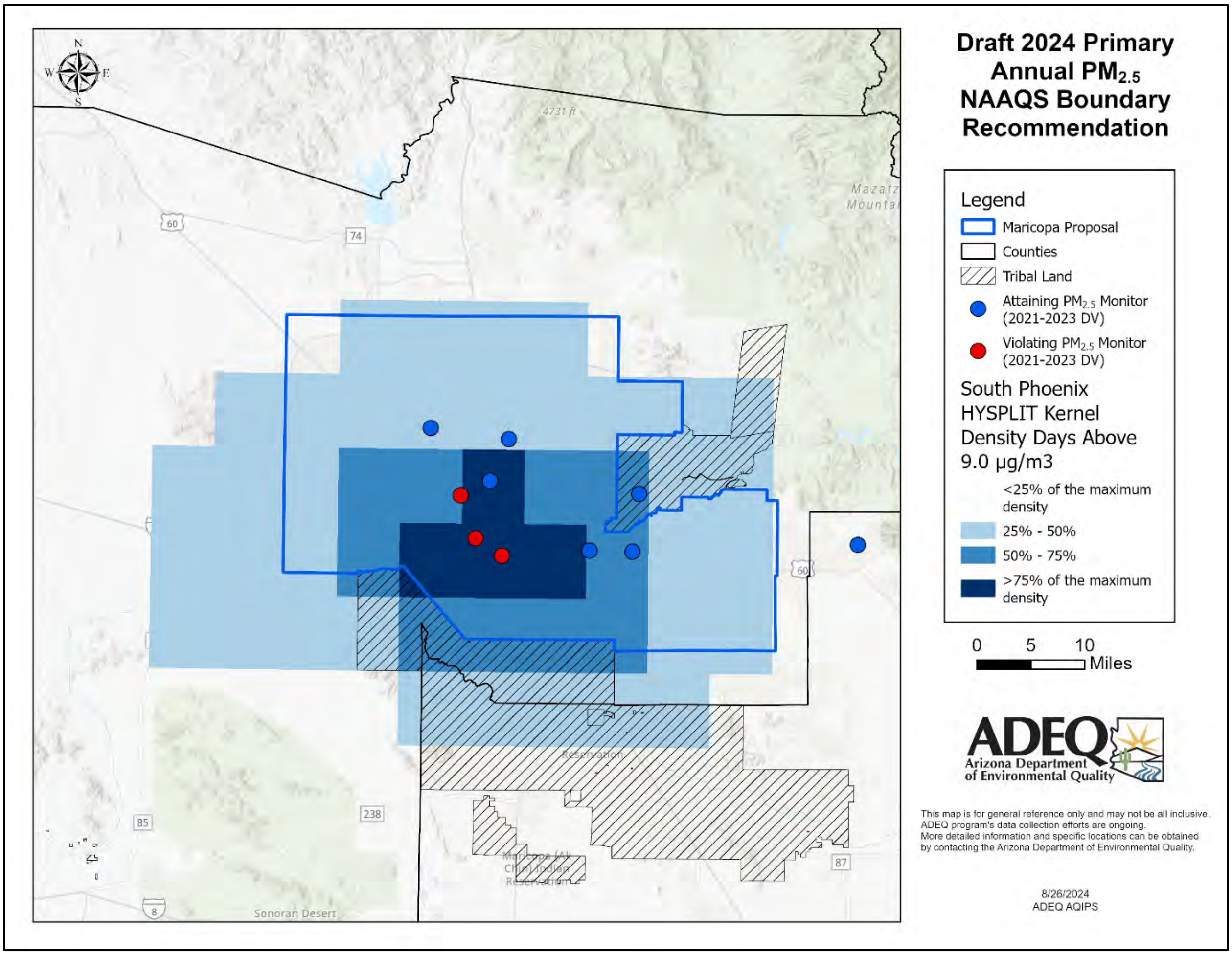


Figure 124: 2021-2023 HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m³ at West Phoenix Monitor

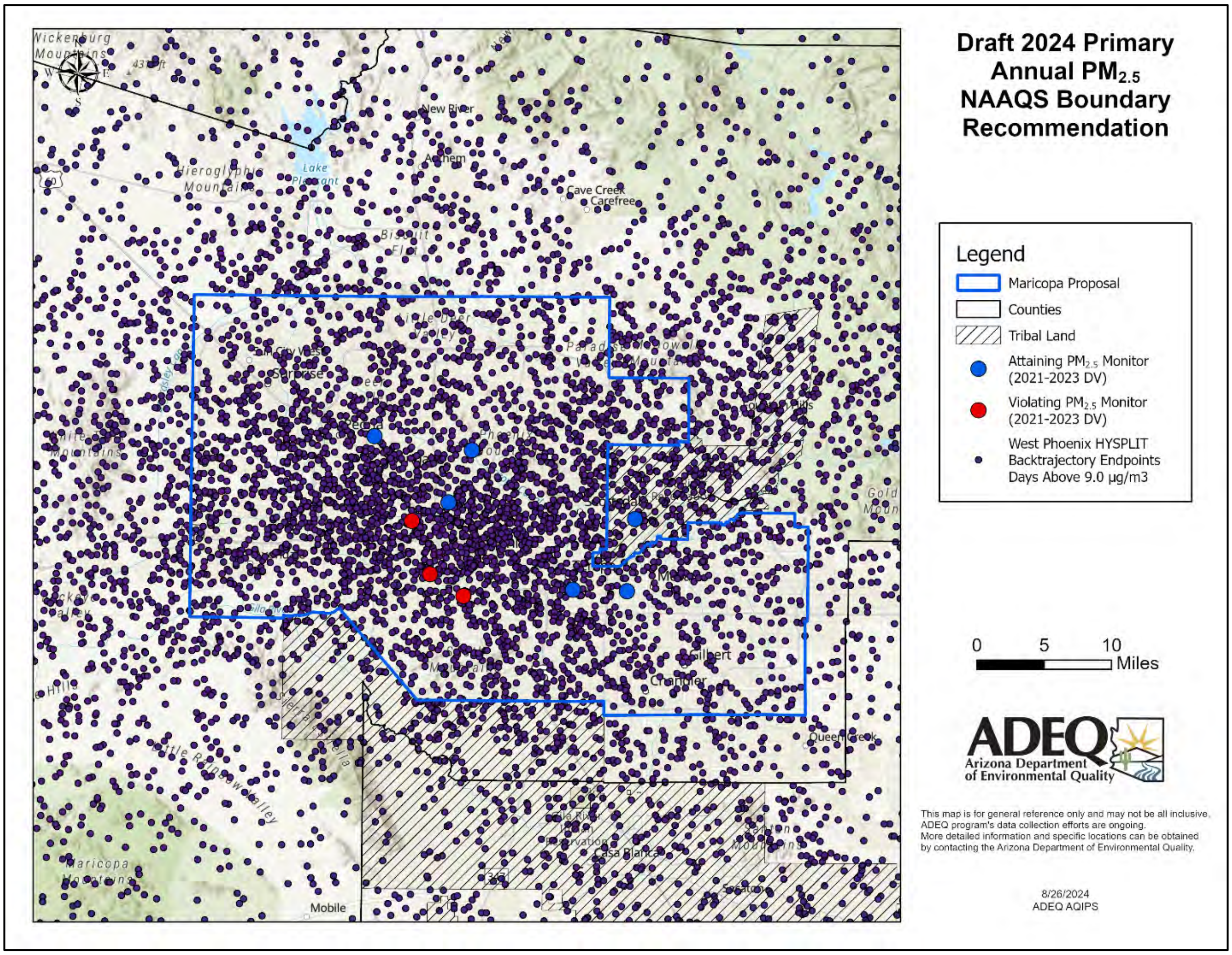


Figure 125: 2021-2023 Kernel Density Estimation Plots of HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m³ at West Phoenix Monitor

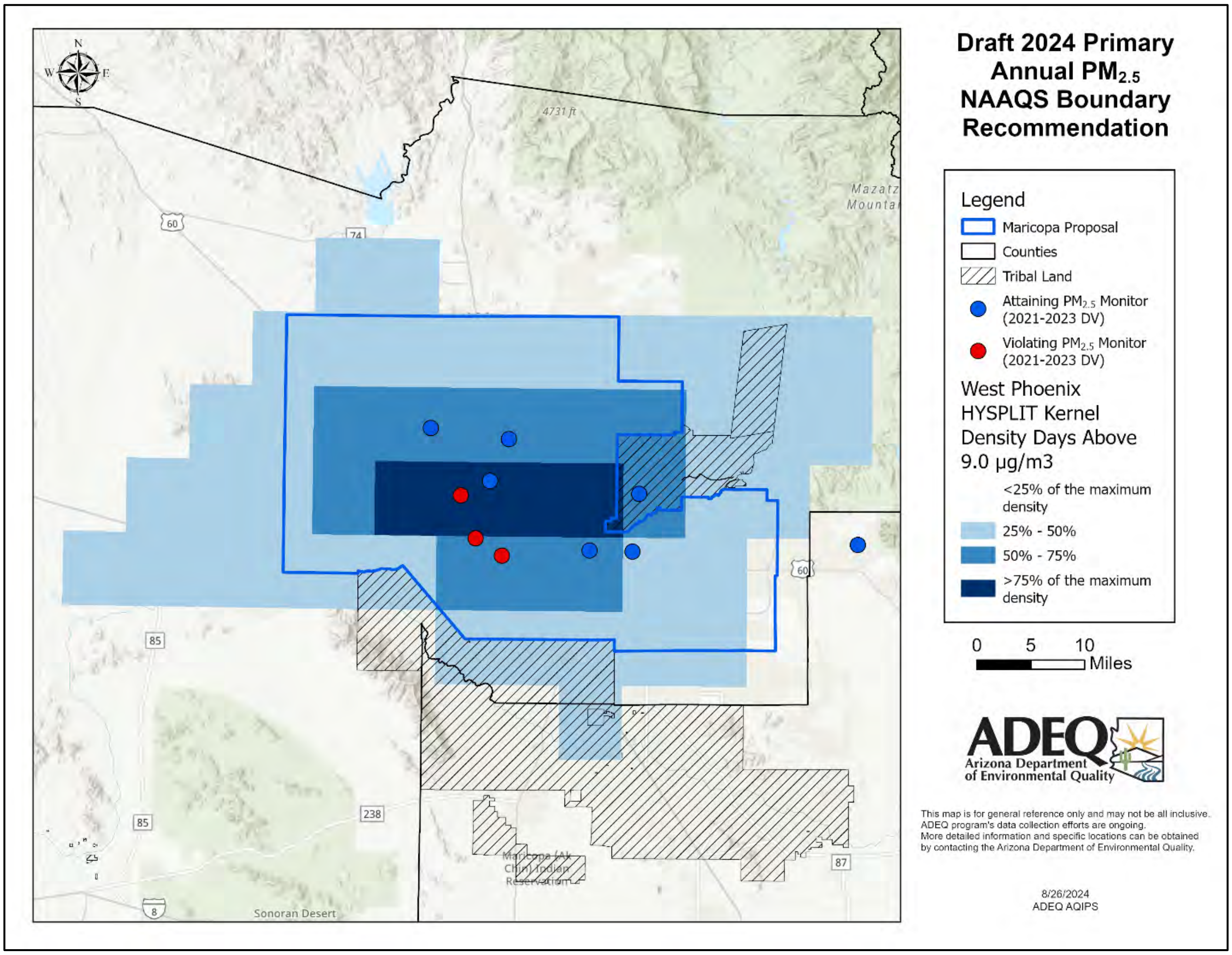


Figure 126: 2021-2023 HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m^3 at Hidden Valley Monitor

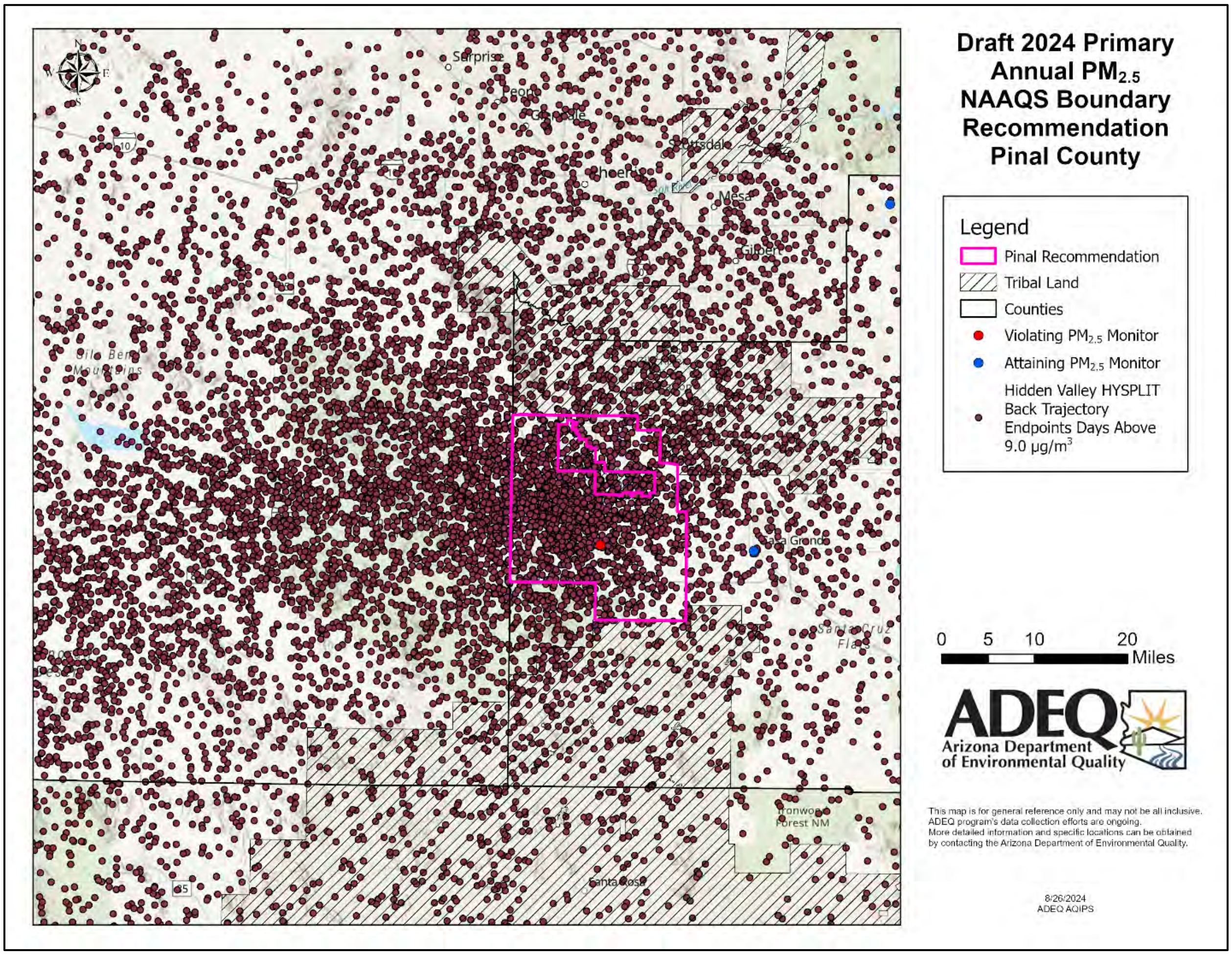


Figure 127: 2021-2023 Kernel Density Estimation Plots of HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m^3 at Hidden Valley Monitor

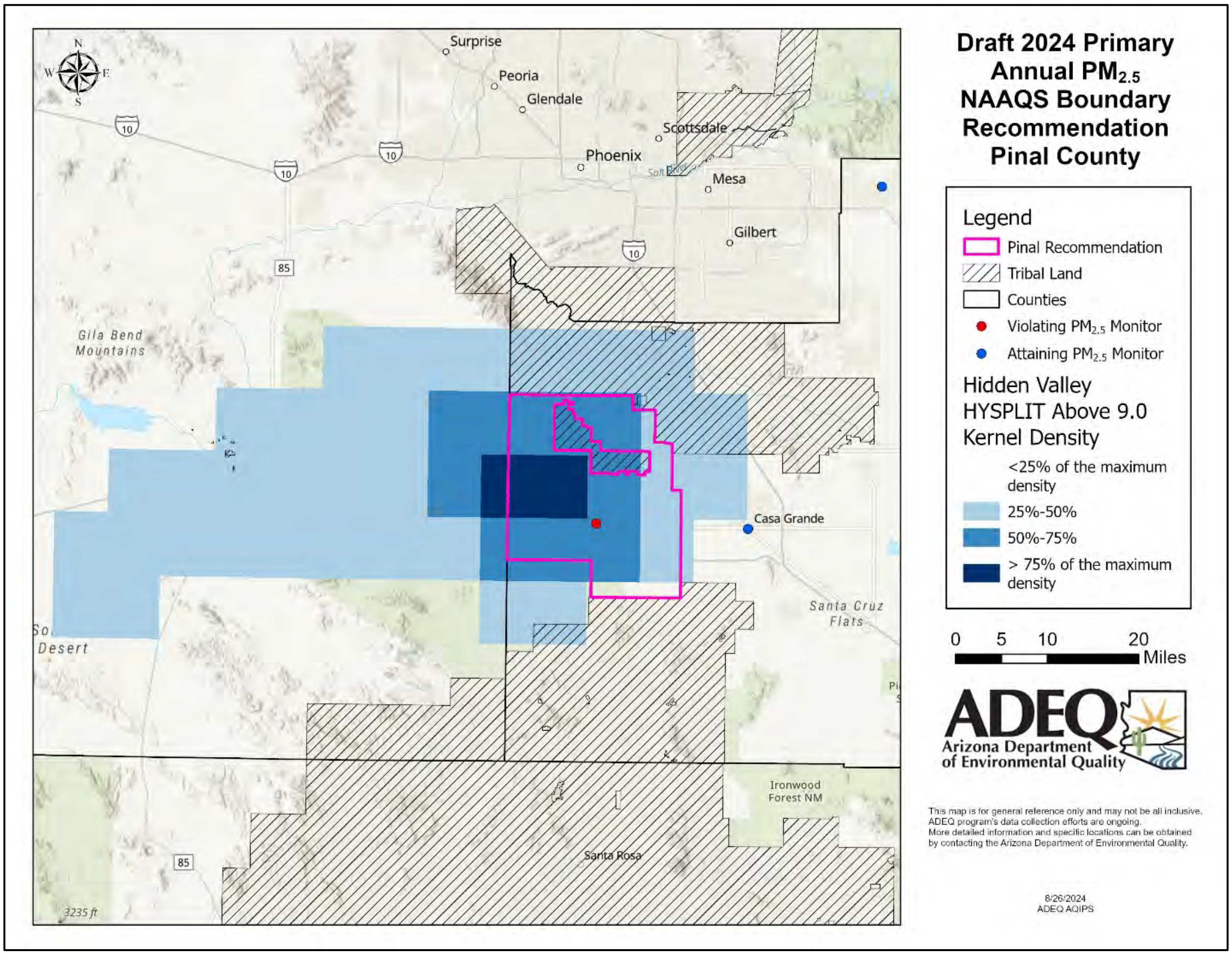


Figure 128: 2021-2023 HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m³ at Nogales Post Office Monitor

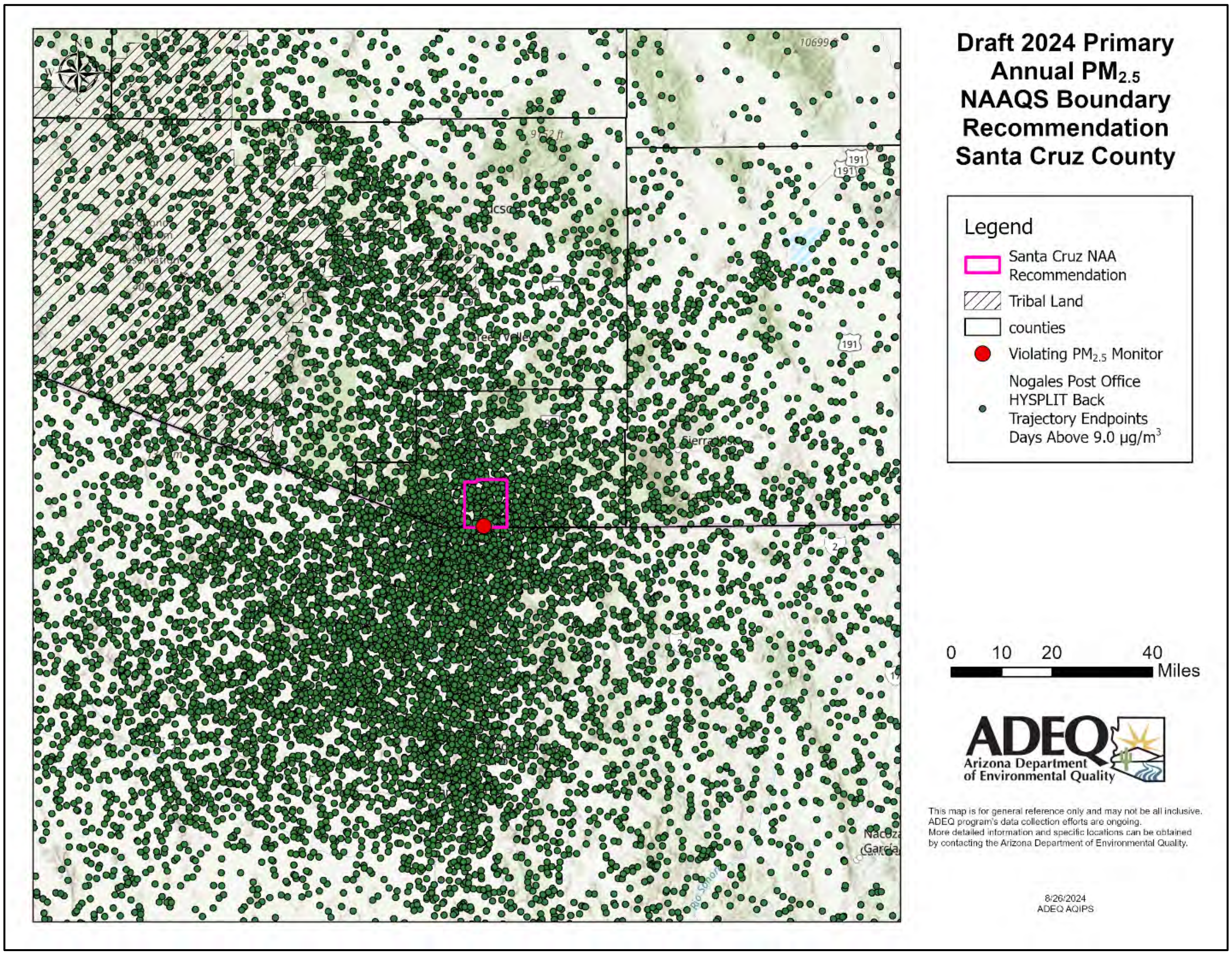


Figure 129: 2021-2023 Kernel Density Estimation Plots of HYSPLIT Back Trajectory Endpoints for Days Above 9.0 µg/m^3 at Nogales Post Office Monitor