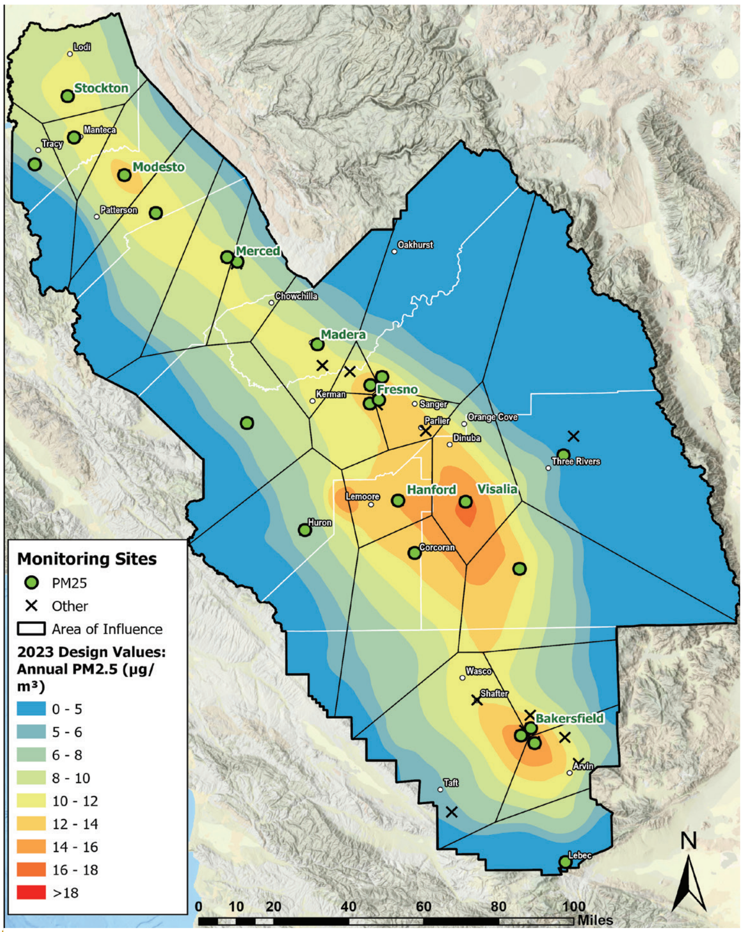
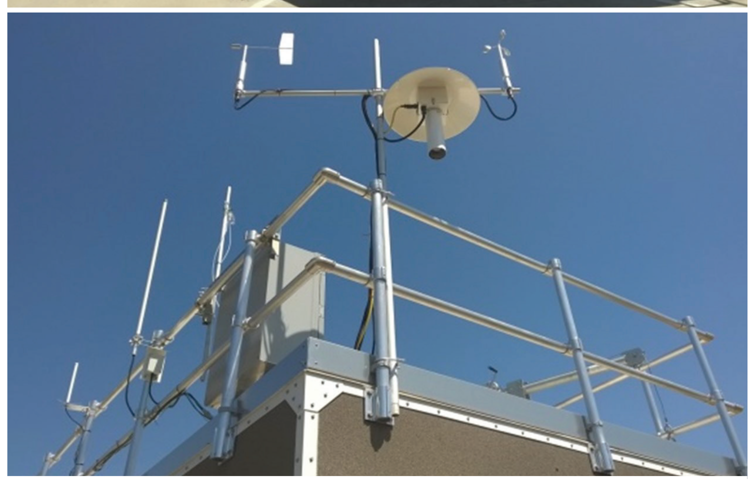
San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

2025 Air Monitoring Network Assessment





San Joaquin Valley Air Pollution Control District

2025 Air Monitoring Network Assessment

June 30, 2025

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1. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) created the National Ambient Air Monitoring Strategy (NAAMS) with the purpose of optimizing U.S. air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of the public and environmental health and welfare. An important element of NAAMS is a plan for periodic network assessments at national, regional, and local levels. A periodic network assessment includes (1) re-evaluation of air monitoring objectives, (2) evaluation of a monitoring network's effectiveness and efficiency relative to its objectives, and (3) recommendations for network reconfigurations and improvements.

EPA requires a multi-level network assessment to be conducted every five years, starting July 1, 2010. The San Joaquin Valley Air Pollution Control District (District) submitted its most recent network assessment report to EPA in 2020. As such, this current report satisfies the five-year assessment requirement for 2025 and satisfies all other network assessment requirements in 40 CFR Part 58 Subpart B, § 58.10(d). For additional details about District's air monitoring network, refer to the most District air monitoring network plan[1], which is published after submittal to EPA.

1.1 BACKGROUND

Ambient air quality conditions, demographic patterns, and regulatory requirements will generally shift over time, motivating air quality agencies to reevaluate ambient air monitoring networks. Several factors such as improvements in air quality, shifts in population distribution, updates to the National Ambient Air Quality Standards (NAAQS), and advancements in the scientific understanding of air quality phenomena, as well as advancements in air monitoring technology, can all influence reevaluation of monitoring networks.

Changes in recent year for NAAQS such as particulate matter less than 2.5 microns (PM2.5) and ozone (O3), along with persistent challenges in reducing these pollutants and their precursors, have led air quality agencies to refocus their monitoring resources in more strategic ways. Emerging priorities also include air toxics designing networks for a multi-pollutant approach to serving regulatory objectives as well as responding to broader public health and research needs.

A well-designed network supports trends tracking, regulatory compliance, community protection, and other types of air quality studies like photochemical modeling and analysis of emission inventories. Conducting a network assessment provides an opportunity to re-evaluate a network's effectiveness and efficiency relative to its objectives and costs, and to provide the recommendations and resources for possible future network reconfigurations and improvements.

[1] San Joaquin Valley Air Pollution Control District, Air Monitoring web page, https://ww2.valleyair.org/air-quality-information/air-monitoring/

1.2 NETWORK ASSESSMENT OBJECTIVES

The San Joaquin Valley (SJV) is an area with rich agricultural resources, abundant industry, major goods movement corridors, diverse industrial activity, and a growing population that all contribute to complex air quality challenges. The District operates a comprehensive air monitoring network to support a range of objectives:

- Ensure compliance with the NAAQS,
- Track long term air quality trends and control strategy effectiveness,
- Provide data for photochemical modeling and emissions inventory development,
- Support daily air quality forecasting, and
- Communicate current conditions to the public and inform of actions to reduce health-risks during air pollution episodes.

This five-year network assessment evaluates whether the District's current criteria pollutant, Photochemical Assessment Monitoring Station (PAMS), and meteorological monitoring network are ideally located and operated in a manner that meets the District's network objectives. Specifically, this assessment evaluates whether the network meets the following goals:

- Determine the highest criteria pollutant concentrations expected to occur in the area covered by the network,

- Measure typical concentrations in areas of high population density,

- Determine the impact of significant sources or source categories on air quality,

- Determine general background concentration levels, and

- Determine the extent of regional pollutant transport among populated areas.

In addition, the assessment identifies potential gaps, redundant sites, and opportunities to improve network efficiency or enhance data quality, whether through site changes, monitor upgrades, or incorporating new technologies.

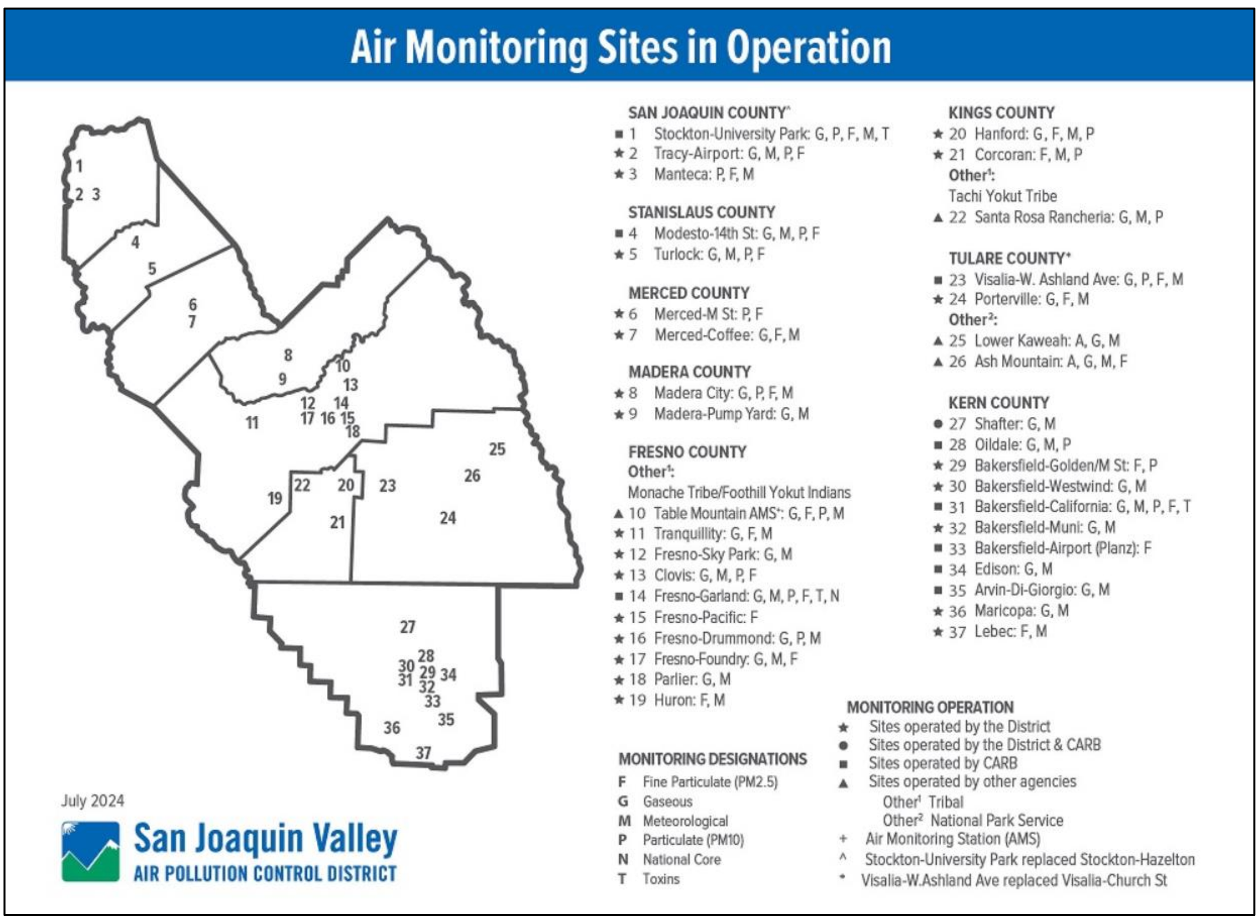
1.3 NETWORK OVERVIEW

The San Joaquin Valley (Valley) covers an area of approximately 23,500 square miles and is home to over 4 million residents. The Valley faces some of the most difficult air quality challenges in the nation. The region includes major metropolitan areas, vast expanses of agricultural land, industrial sources, major goods movement corridors, and sensitive receptors such as schools and residential communities.

The Valley is designated as an attainment area for the federal lead (Pb), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO) NAAQS. EPA has found that the Valley has attained the 1997 PM2.5 standards based on 2020 design value data for the 24-hour NAAQS and 2024 design value data for the annual NAAQS. EPA has also found that the Valley has attained the revoked federal 1-hour ozone standard. In addition, the Valley is designated as a maintenance area for the 1987 24-hour PM10 standard. The Valley is currently designated as a nonattainment area for the remaining federal PM2.5 standards (the 2006 24-hour standard and the 2012 annual standard). For the new 2024 annual PM2.5 standard, EPA has not yet finalized area designations. In addition, the Valley is designated as a nonattainment area for the 1997, 2008 and 2015 federal 8-hour ozone (O3) standards.

To support the air quality needs of this large and diverse region, the District operates a comprehensive, federally-compliant air monitoring program that provides essential information to the public. The District's air monitoring network measures a variety of pollutants and there is a long record of criteria pollutant data for all areas of the Valley. A map of the District's air monitoring network and the boundaries of the San Joaquin Valley Air Basin is provided in Figure 1-1. In addition to District-operated sites, the network is comprised of sites operated by other agencies (California Air Resources Board – CARB and National Park Service – NPS) as well as other jurisdictions (federally-recognized tribes).

Figure 1-1 Monitoring Sites Operating in the San Joaquin Valley



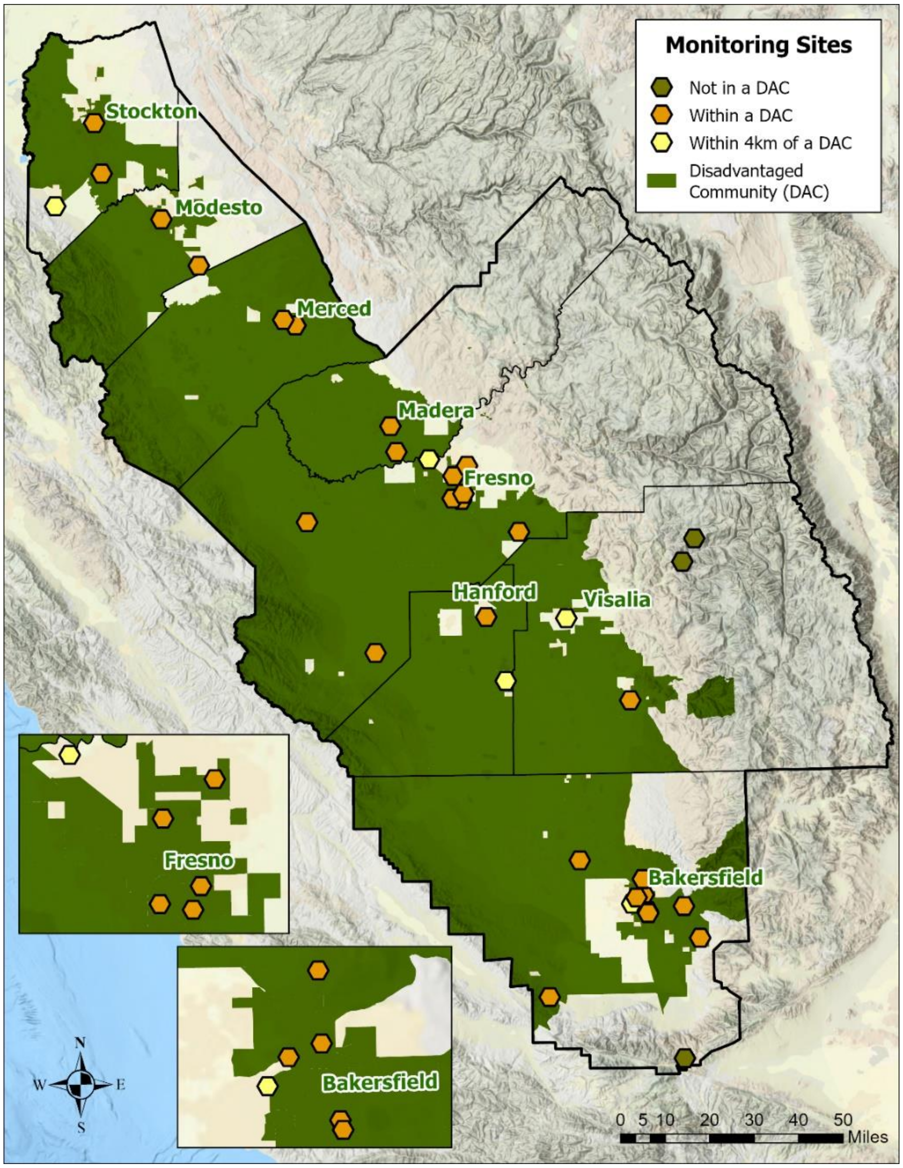
1.4 EVALUATION OF AREAS WITH SUSCEPTIBLE INDIVIDUALS AND OTHER AT-RISK POPULATIONS

Pursuant to requirements for a network assessment in 40 CFR part 58.10(d), an assessment must consider whether sites support air quality characterization for areas with relatively high populations of susceptible individuals (*e.g.,* children with asthma) and other at-risk populations. In January 2017, the California Office of Environmental Health Hazard Assessment (OEHHA), on behalf of the California Environmental Protection Agency (CalEPA), released the California Communities Environmental Health Screening Tool (CalEnviroScreen)[2] to help identify areas that are disproportionately burdened by, and vulnerable to, the effects of multiple sources of pollution, including air quality. The tool produces scores based on environmental, health, and socioeconomic data for every census tract in the state. The OEHHA identifies the top 25% scoring areas from CalEnviroScreen as meeting the criteria for susceptible individuals and at-risk populations, including high amounts of pollution and large populations of low-income or minority households.

Figure 1-2 shows the Valley air monitoring sites compared to a map of areas meeting the CalEnviroScreen criteria in the San Joaquin Valley. Data used for the map includes 2022 census tract areas, 2022 federal tribal areas, and 2024 additional tribal areas. The labels for the monitoring site locations indicate which sites are in, are within 4 km of, or are not within an area with susceptible individuals or at risk populations. In the SJV, a majority of the air monitoring sites are within the specific areas or are within 4 km. There are three sites that are not located in or within 4 km of an area meeting these requirements.

[2] State of California OEHHA, CalEnviroScreen, https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40

Figure 1-2 Proximity of Air Monitoring Sites to Areas with Susceptible Individuals and Other At-Risk Populations



1.5 GUIDE TO THIS REPORT

The following sections of this report present the approach, analysis, and findings from this network assessment. Each section focuses on a key component of the District's monitoring network:

- Section 2: Criteria pollutant monitoring,
- Section 3: Photochemical Assessment Monitoring Stations (PAMS),
- Section 4: Meteorological monitoring, and
- Section 5: Findings and Recommendations.

2. TECHNICAL APPROACH AND FINDINGS – CRITERIA POLLUTANT AIR MONITORING NETWORK ASSESSMENT

This air monitoring network assessment evaluates data from monitoring sites across the District to determine whether the network continues to meet the monitoring objectives outlined in Appendix D of 40 CFR Part 58.10(d). The assessment examines whether new sites may be needed, whether any existing sites can be retired, and whether new technologies ay be considered for integration into the ambient monitoring network.

Table 2-1 outlines the specific analyses conducted to evaluate the monitoring objectives described in Section 1.2, and to address the following key questions. The analyses included in this assessment are a subset of the analysis methods detailed in EPA's *Ambient Air Monitoring Network Assessment Guidance Document* (Raffuse et al., 2007)[3].

Key questions evaluated with this assessment:

- Which sites provide the most value in terms of the number of pollutants measured, the length of data record, and data quality?
- Are sites appropriately located to determine the highest pollutant concentrations expected to occur in the area covered by the network?
- Are sites appropriately located to measure typical pollutant concentrations in areas of high population density?
- Are sites appropriately located to determine the impact of significant sources or source categories on air quality?
- Are sites appropriately located to determine general background concentration levels?
- Are sites appropriately located to determine the extent of regional pollutant transport among populated areas?
- Are there potentially redundant sites in the network?
- Are there areas where new sites may be needed?
- Are there new technologies that may add value to the air monitoring network?

[3] EPA: Ambient Air Monitoring Network Assessment Guidance Document (Raffuse et al., 2007), https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/20070201_oaqps_epa-454_d-07-001_aq_network_assessment_guidance.pdf

Table 2-1 Summary of the Analyses Performed and the Monitoring Objectives or Questions Addressed

Objective or Question	Site-by-Site Analyses									Bottom-Up Analysis	
	Data Above the Method Detection Limit (MDL)	Number of Parameters Measured	Length of Trend Record	Measured Concentrations	Deviation from NAAQS	Wind Rose Analyses	Area-Served	Population Served	Correlation Analyses	Population Density / Population Change	Emission Inventory
Which sites provide the most value in terms of the number of pollutants measured, the length of data record, and data quality?	X	X	X								
Are sites appropriately located to determine the highest pollutant concentrations expected to occur in the area covered by the network?				X	X		X	X		X	
Are sites appropriately located to measure typical pollutant concentrations in areas of high population density?		X					X	X		X	
Are sites appropriately located to determine the impact of significant sources or source categories on air quality?											X
Are sites appropriately located to determine general background concentration levels?				X			X				X
Are sites appropriately located to determine the extent of regional pollutant transport among populated areas?				X			X	X		X	
Are there potentially redundant sites in the network?							X	X	X	X	
Are there areas where new sites may be needed?							X	X		X	X
Is the meteorological network adequate for characterizing regional surface and upper-air meteorology?		X				X			X		

2.1 TECHNICAL APPROACH AND FINDINGS – CRITERIA POLLUTANTS

A network assessment comprises several analysis methods that address specific objectives. This section of the report (Section 2.1) presents the technical approach and findings for the site-by-site and bottom-up analyses for the criteria pollutant network.

The site-by-site analyses focus on assessing individual air monitoring sites in the SJV. The analyses include evaluation of: the number of parameters monitored, the data completeness, the percentage of data above the method detection limit (MDL), the measured concentrations, the deviation from NAAQS, and the length of data record for each site. While all sites in the SJV air monitoring network were evaluated, any findings and recommendations are generally focused on items within the control and jurisdictional authority of the District.

2.1.1 Data Sources

The following data sources were used to perform the air monitoring network assessment:

- **Air quality data:** Ambient air quality data were obtained from EPA's Air Quality System (AQS)[4]. Analyses of criteria pollutant monitoring (Section 2) are based on data from the 2023 calendar year. Photochemical Assessment Monitoring Stations (PAMS) analyses (Section 3) use data from the 2024 calendar year.

- **Population data:** Spatially resolved population data for the San Joaquin Valley were acquired from the U.S. Census Bureau's 2020 block group polygons[5]. These data were normalized to a 1 km grid using a geographic information system (GIS) to allow consistent spatial analysis over time, accounting for changes in block group boundaries between censuses. Population estimates for 2024 were obtained from the California Department of Finance[6] and are detailed in the subsection *San Joaquin Valley 2024 Population* later in this report.

- **Emission Inventory data:** Emissions data were obtained from CARB, specifically the *2022 - San Joaquin Valley PM2.5 Nonattainment Area Version 1.00* (updated January 25, 2024)[7].

2.1.2 Number of Parameters Monitored

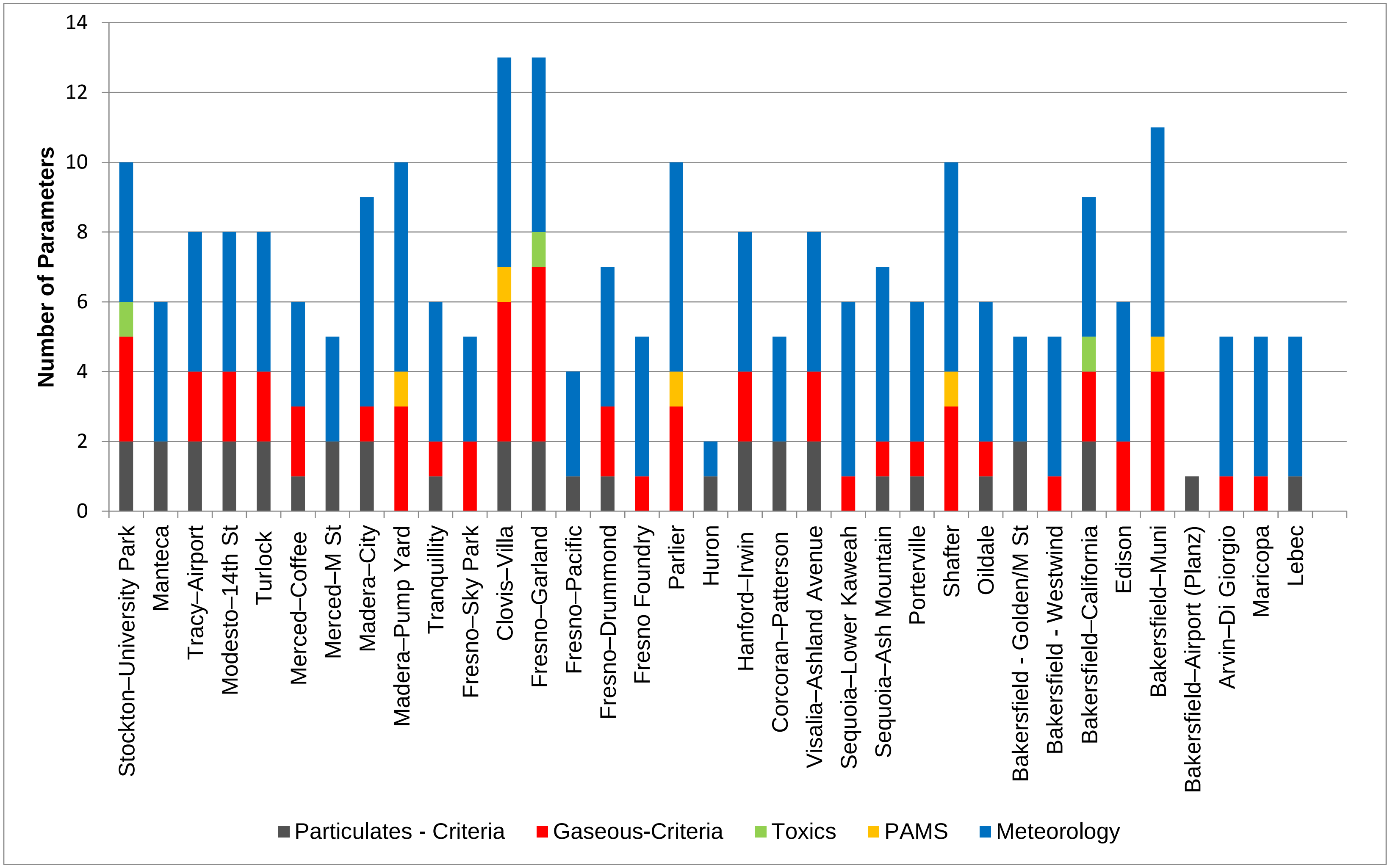
Air quality monitoring sites with instruments that measure many pollutants and meteorological parameters are generally more valuable than sites that measure fewer parameters. In addition, sites that measure several pollutants are generally more cost effective to operate. Figure 2-1 shows the number of parameters monitored across all sites in the SJV. The height of each column in the chart represents the total number of

[4] U.S. EPA, Air Quality System (AQS), https://www.epa.gov/aqs
[5] U.S. Census Bureau, Year 2020 Data, https://data.census.gov/
[6] State of California Department of Finance, https://dof.ca.gov/forecasting/demographics/estimates-e1/
[7] Emission Inventory data source is CEPAM v.1.00.

parameters monitored at that site. The parameters monitored at the PAMS and toxic sites are not individually counted in the chart below due to the large number of parameters collected.

Site names are organized from left to right along the x-axis according to their geographic locations in the SJV, from north to south (left to right). The PAMS sites (Madera-Pump Yard, Clovis-Villa, Parlier, Bakersfield-Muni, and Shafter) are valuable sites because they measure the most parameters. Stockton-University Park, Fresno-Garland, and Bakersfield-California are important sites for criteria pollutants because they also measure several parameters.

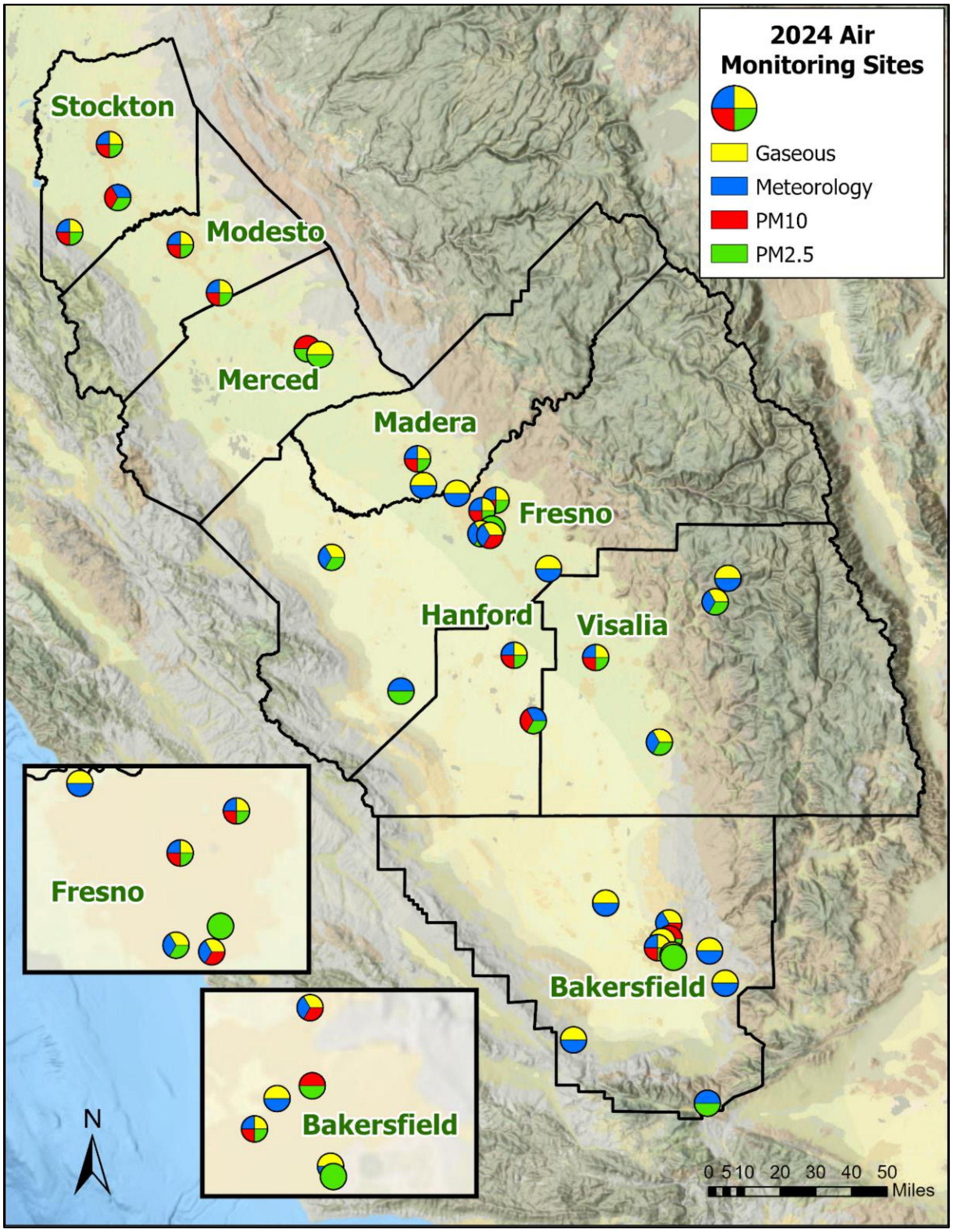
Figure 2-1 Number of Pollutant Parameters Measured at SJV Air Monitoring Sites in 2023



* PAMS and toxics parameters are counted as 1 paramter in the chart above due to the large numbers of parameters collected.

Figure 2-2 depicts the location of each monitor and the associated criteria pollutants measured (tribal monitors are not shown). Proper network analyses rely on the location of these monitoring sites relative to other monitors, nearby cities, influential geographic features, surrounding population, and meteorology.

Figure 2-2 San Joaquin Valley Air Monitoring Site Locations and Criteria Pollutant Parameters Monitored



2.1.3 Data Completeness, Data above MDL, Measured Concentrations, and Deviation from NAAQS Analyses

This section discusses the approach and results of several site-by-site analyses including data completeness, percent above the MDL, measured concentrations, and the deviation from the NAAQS.

Data Completeness

Sites with complete data sets are more valuable for air quality analysis and tracking than sites that have long periods of missing or invalidated data. Data completeness is a measure of the number of actual data records collected and reported at a monitoring site relative to the number of expected data records based on the sampling interval and frequency for a given parameter or pollutant. Data completeness is calculated by dividing the actual number of data records reported by the expected number of data records. The expected number of data records for a given pollutant is based on the length of monitoring season and the sampling frequency. For example, a continuous ozone monitor operating year-round would be expected to have 8,760 data records for one year of operation (1 measurement per hour x 24 hours x 365 days per year = 8,760).

Data completeness is presented as the percent of data records reported taking into account the sampling frequency. Generally, EPA recommends that data completeness of 75% is considered good for a given site, indicating that there are enough data to perform robust data analyses assuming the data are of high quality. See the appendices of 40 CFR Part 50 for completeness requirements for specific criteria pollutants. Because of instrument calibration, data completeness will generally be 95-97% depending on how frequently an instrument is calibrated.

Percent Above the MDL

The MDL is a value at which a measured concentration is considered statistically distinguishable from zero. An assessment of the percent of data above the MDL is performed to identify the number of samples in a data set that are considered to have concentration values statistically distinguishable from zero. Percent above MDL analysis provides an indicator of data quality and the usefulness of the data collected for performing air quality analyses.

Measured Concentrations

Measured concentrations analysis identifies sites that consistently measure high pollutant concentrations. For this analysis, the average and maximum concentration values were evaluated. Results of this analysis were used to determine whether each site is meeting monitoring objectives. For example, if the objective of a particular site is to measure high pollutant concentrations but that site routinely measures low concentrations, then we may conclude that the objective of the site should be changed or the site should be relocated to an area of high pollutant concentrations in order to meet its objective.

Deviation from NAAQS

The deviation from NAAQS analysis helps with identifying sites that are important for monitoring NAAQS compliance. Sites routinely reporting concentrations close to the NAAQS (within +/-15%) are considered important for meeting the monitoring objective of determining NAAQS attainment. The deviation from the NAAQS is the difference between the pollutant-specific design value at the site and the NAAQS compliance value.

Summary and Discussion of Results

Table 2-2 through Table 2-11 provide a summary of the results of the analyses for data completeness, percent above MDL, measured concentrations, and deviation from NAAQS for sulfur dioxide, ozone, nitrogen dioxide, PM10, PM2.5, and carbon monoxide for all sites in the SJV.

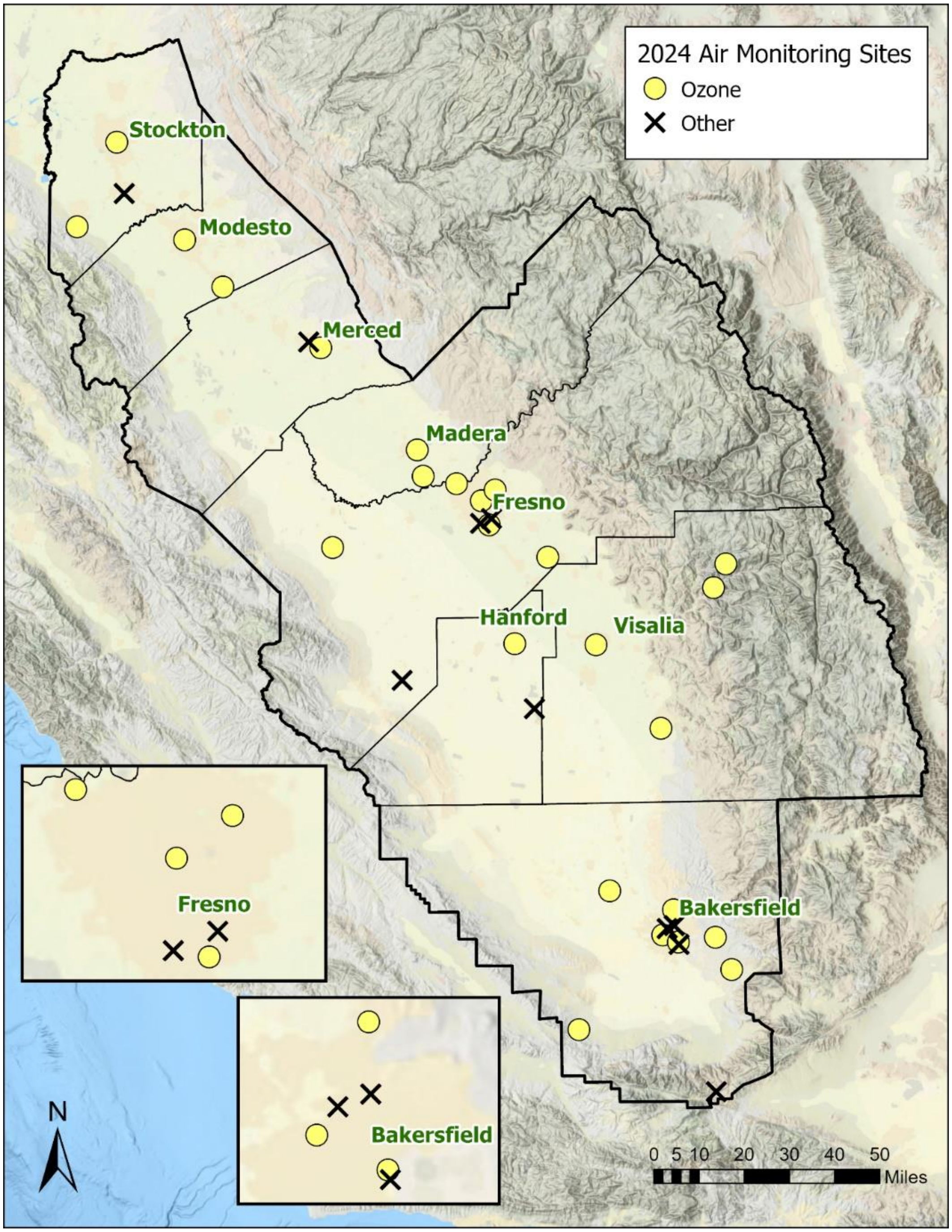
In Table 2-2 through Table 2-11, the cells shaded:

- Green show sites with a percent complete value less than 85%
- Orange show sites with a percent above MDL value less than 85%
- Blue show sites with a deviation from NAAQS value that is within 15% of the NAAQS for the pollutant indicated.

2.1.3.1 Ozone (O3)

Figure 2-3 shows the SJV ozone monitoring network. Table 2-2shows the percent above MDL and maximum 1-hour ozone concentrations for all Valley ozone sites.

Figure 2-3 Location of Ozone Monitoring Sites in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (PM), gaseous pollutants, and/or meteorology, but do not measure Ozone.

Table 2-2 Percent Above MDL and Maximum Concentrations – Ozone (1-hour)

Site Name	% Above MDL	Maximum 1-hour O3 Value (2023) ppb
Stockton-University Park	100	86
Tracy-Airport	100	75
Modesto-14th St	100	99
Turlock	100	102
Merced-Coffee	100	96
Madera-City	100	100
Madera-Pump Yard	100	87
Tranquillity	100	73
Fresno-Sierra Sky Park	100	101
Clovis-Villa	100	102
Fresno-Garland	100	101
Fresno-Drummond	100	102
Parlier	100	99
Hanford-Irwin	100	91
Visalia-W. Ashland	100	100
Sequoia-Lower Kaweah	100	93
Sequoia-Ash Mountain	100	99
Porterville	100	102
Shafter	100	90
Oildale	100	89
Bakersfield-California	100	88
Edison	100	107
Bakersfield-Muni	100	98
Arvin-Di Giorgio	100	109
Maricopa	100	91

Ozone MDL = 0.6 ppb for Madera-City, Madera-Pump Yard, Fresno-Sierra Sky Park, Clovis-Villa, Fresno-Drummond, Parlier, Hanford-Irwin, and Bakersfield-Muni; 5 ppb for Stockton-University, Tracy-Airport, Modesto-14th St, Turlock, Merced-Coffee, Tranquillity, Fresno-Garland, Visalia-W. Ashland, Sequoia-Lower Kaweah, Sequoia-Ash Mountain, Porterville, Shafter, Oildale, Bakersfield-California, Edison, Arvin-Di Giorgio, and Maricopa.

The deviation from NAAQS analysis for 8-hour average ozone in Table 2-3 indicates that Stockton-University Park, Tracy-Airport, Modesto-14th St, Turlock, Merced-Coffee, Madera-City, Madera-Pump Yard, Tranquillity, Fresno-Sierra Sky Park, Fresno-Garland, Hanford-Irwin, Shafter, Bakersfield-California, and Maricopa are particularly important sites for NAAQS comparability because they measure ozone concentration values that are close to the 8-hour ozone NAAQS (within 15% of 70 ppb).

Table 2-3 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – Ozone (8-hour)

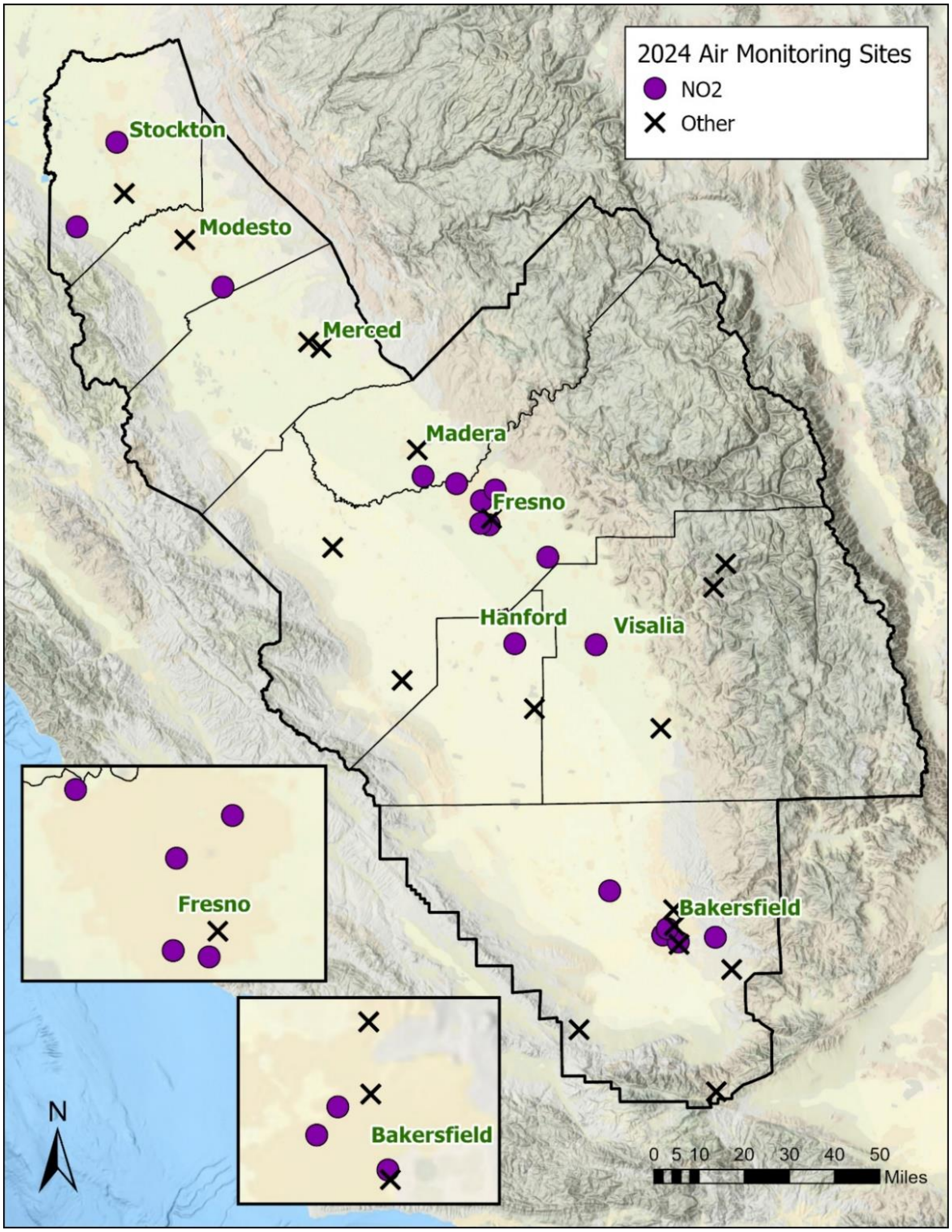
Site Name	% Complete	Maximum Value (ppb)	Design Value 2021-2023 (ppb)	Deviation From NAAQS (ppb)
Stockton-University Park	84	68	64	-6
Tracy-Airport	93	63	64	-6
Modesto-14thSt	95	83	73	3
Turlock	94	85	79	9
Merced-Coffee	95	79	75	5
Madera-City	96	86	80	10
Madera-Pump Yard	94	77	75	5
Tranquillity	95	65	66	-4
Fresno-Sierra Sky Park	88	79	79	9
Clovis-Villa	94	83	82	12
Fresno-Garland	95	84	79	9
Fresno-Drummond	94	88	82	12
Parlier	93	87	84	14
Hanford-Irwin*	64	83	76	6
Visalia-W. Ashland	93	87	88	18
Sequoia-Lower Kaweah*	98	82	50	-20
Sequoia-Ash Mountain	98	88	88	18
Porterville	93	89	87	17
Shafter	94	79	75	5
Oildale	82	82	82	12
Bakersfield-California	95	79	74	4
Edison	95	91	90	20
Bakersfield-Muni	91	84	83	13
Arvin-Di Giorgio	94	95	85	15
Maricopa	92	84	75	5

*Hanford-Irwin did not record valid Ozone data for three months between March and June due to poor quality assurance flagging.
*Sequoia-Lower Kaweah only runs during summer months. Data completeness calculated for April – October.
Maximum value equals the maximum daily 8-hour average ozone concentration.
Design Value 2021-2023: 3-year average of the annual fourth-highest maximum daily 8-hour ozone concentration.
The deviation from the NAAQS is the difference between the pollutant-specific design value observed at the site and the most stringent 8-hour ozone NAAQS (70 ppb).
Cells shaded in blue in the Deviation from NAAQS column indicate sites that are valuable for determining NAAQS attainment (DV is +/-15% of the NAAQS)
Cells shaded in green in the % complete column indicates a site with less than 85% data completeness

2.1.3.2 Nitrogen Dioxide (NO2)

Figure 2-4 shows the location of the NO2 sites in the SJV, including the Fresno-Foundry and Bakersfield-Westwind near-road NO2 sites. The NO2 analysis in Table 2-4 shows high percent above MDL values. The “Deviation from 1-hour NAAQS” values are the difference between the pollutant-specific 1-hour design value (which is the three-year average of the annual 98th percentile values), and the 1-hour NAAQS of 100 ppb. The “Deviation from Annual NAAQS” values are the difference between the pollutant-specific annual design value (which is the three-year average of the annual mean values) and the annual NAAQS of 53 ppb. Sites are considered valuable for determining NAAQS compliance for the 1-hour and/or annual NAAQS if the Deviation from NAAQS values are ±15% from the specific NAAQS. There are no sites in this range in Table 2-4. The data and analyses for the 1-hour and annual NAAQS in Table 2-4 indicate that both the 1-hour and annual mean NO2 concentrations are well below the standard at all sites.

Figure 2-4 Location of NO2 Monitoring Sites in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (PM), gaseous pollutants, and/or meteorology, but do not measure NO2.

Table 2-4 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – NO2

Site Name	% Complete	% Above MDL	2023 Max Value (ppb)	1-hr Design Value 2021-2023 (ppb)	Deviation from 1-hr NAAQS (ppb)	2023 Annual Mean (ppb)	Deviation from Annual NAAQS (ppb)
Stockton-University Park	76	99	45.0	37	-63	8	-45
Tracy-Airport	93	100	32.2	25	-75	4	-49
Turlock	95	100	47.0	37	-63	8	-45
Merced-Coffee	95	100	37.1	33	-67	6	-47
Madera-Pump Yard	94	100	32.2	26	-74	5	-48
Fresno-Sierra Sky Park	88	100	40.6	30	-70	6	-47
Clovis-Villa	94	100	47.9	41	-59	8	-45
Fresno-Garland	94	100	47.9	42	-58	8	-45
Fresno-Foundry	86	100	61.6	54	-46	17	-36
Fresno-Drummond	94	100	58.1	51	-49	10	-43
Parlier	94	100	36.4	26	-74	6	-47
Hanford-Irwin	91	100	55.2	40	-60	7	-46
Visalia-W. Ashland	93	100	39.9	39	-61	7	-46
Shafter	94	100	41.5	32	-68	7	-46
Bakersfield-California	94	100	57.7	46	-54	10	-43
Edison	95	100	41.7	27	-73	5	-48
Bakersfield-Muni	92	100	63.5	48	-52	11	-42
Bakersfield-Westwind	96	100	55.8	53	-47	19	-34

Nitrogen Dioxide MDL = 1.0 ppb at Stockton-University Park, Visalia-W. Ashland, Shafter, Bakersfield-California, and Edison; 2.7 ppb at Tracy-Airport, Turlock, Merced-Coffee, Madera-Pump Yard, Fresno-Sierra Sky Park, Clovis-Villa, Fresno-Drummond, Parlier, Hanford-Irwin, and Bakersfield-Muni; 0.05 ppb at Fresno-Garland; 0.04 at Fresno-Foundry and Bakersfield-Westwind.
Maximum value equals the annual, 1-hour maximum concentration.
The 2021-2023 1-hour design value is the three-year average of the 98th percentile of the daily maximum 1-hour concentrations
The 2023 Annual Mean is the annual average of the hourly concentration values to be comparable to the annual NAAQS.
Cells shaded in green in the % complete column indicates a site with less than 85% data completeness

2.1.3.2.1 Near-Road NO2 Sites

Per Section 4 of Appendix D in 40 CFR Part 58, one microscale, near-road NO2 monitor is required in each CBSA with a population of 1,000,000 or more and must be located near a major road segment with a high annual average daily truck traffic (AADTT) count. An additional near-road NO2 monitor is required in CBSAs with populations of 2,500,000 or more or in CBSAs with populations of 1,000,000 or more that have one or more road segments with 250,000 or more AADTT count.

Currently, Fresno is the only CBSA within the District that is comprised of more than 1,000,000 people, and as such, an NO2 monitor is operating in Fresno CBSA at the Fresno-Foundry near-road NO2 monitoring station. The District is also operating a near-road NO2 monitor in the Bakersfield CBSA as the Bakersfield-Westwind monitoring station as the Bakersfield MSA population is nearing 1,000,000. An additional near-road NO2 monitor is not required at this time for either the Fresno or Bakersfield CBSA because both CBSAs have not reached a population of 2,500,000 and do not have road segments with 250,000 or more AADTT count.

Table 2-5 San Joaquin Valley 2024 Population

County		Total County Population*	Major Urban Area Pop > 100,000	Urban Area Pop < 100,000 and > 50,000
San Joaquin		791,408	Stockton	Lodi, Manteca, Tracy
Stanislaus		548,744	Modesto	Turlock
Merced		287,303	—	Merced
Madera		159,328	—	Madera
Fresno		1,017,431	Fresno, Clovis	—
Kings		152,627	—	Hanford
Tulare		478,918	Visalia	Porterville, Tulare
Kern	Valley Portion**	773,755	Bakersfield	Delano
Kern	Entire County	910,300	Bakersfield	Delano
San Joaquin Valley Total* **		4,209,514		

* Data from California Department of Finance E-1 Population Estimates for Cities, Counties and the State, January 1, 2024, Released May 1, 2024.

** Population estimate for Kern County (Valley Portion) calculated using census tract data for the population living within the District's boundaries.

***The "San Joaquin Valley Total" population includes the "Kern (Valley Portion)" population only.

2.1.3.3 Particulate Matter (PM10)

Figure 2-5 shows the PM10 monitoring sites in the SJV. The summary of the PM10 monitoring data in Table 2-6 indicates that data completeness and percent above MDL are very good. Note that the values found in Table 2-6 include all data for the year 2023, including values influenced by exceptional events such as high-wind events and wildfires. The highest observed maximum concentration PM10 occurred at Oildale.

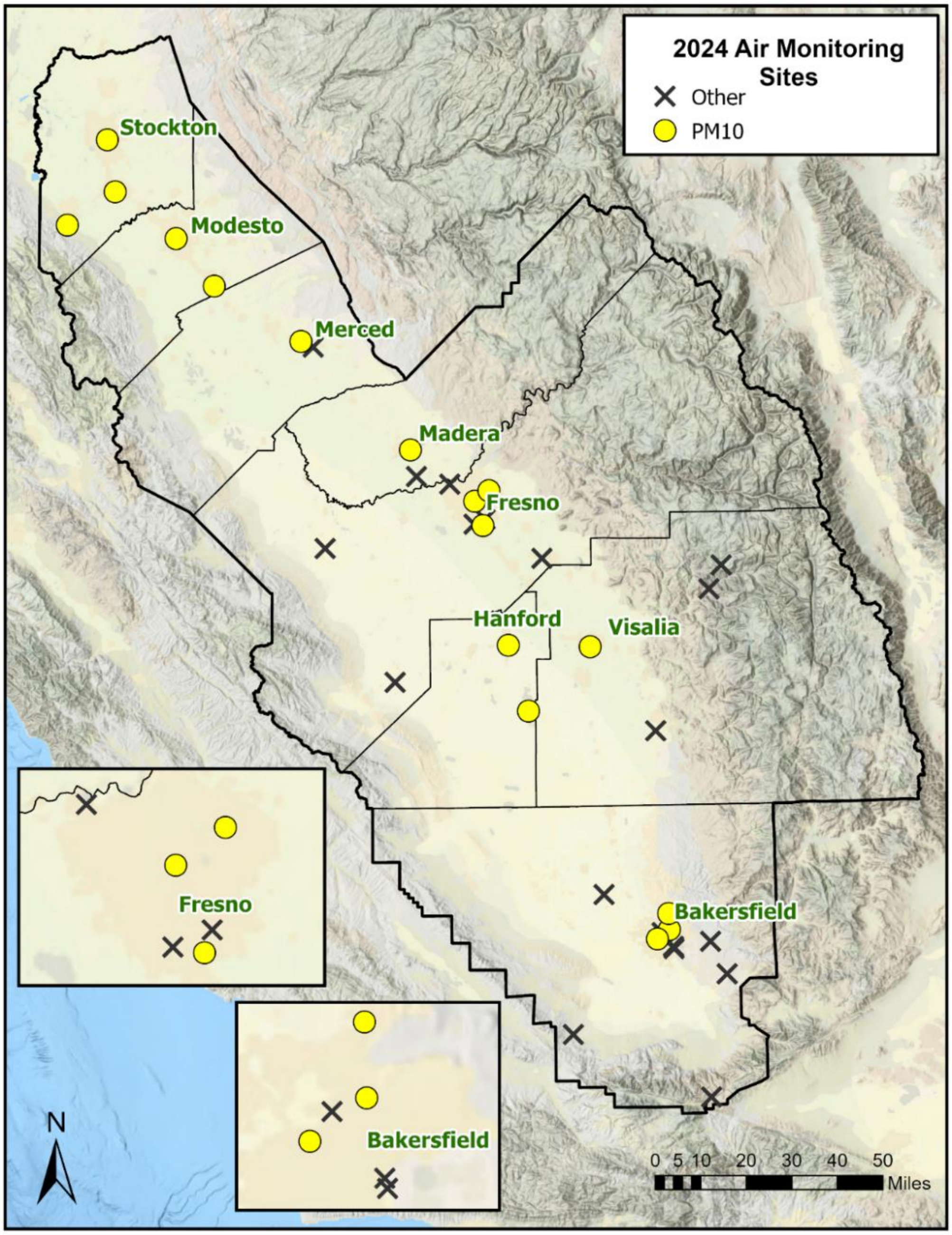
The PM10 compliance level for the 1987 24-hour PM10 NAAQS is 150 micrograms per cubic meter ($\mu g/m^3$), rounded to the nearest 10 $\mu g/m^3$. Compliance with the standard is met when the three-year average of the expected number of PM10 exceedances at a site, calculated per 40 CFR part 50, appendix K, is less than or equal to one.[8]

The "Deviation from the NAAQS" is the difference between the pollutant-specific maximum 24-hour observed value at the site and the 24-hour NAAQS value of 150 $\mu g/m^3$. Note that the Deviation from NAAQS analysis is not meant to determine NAAQS

[8] Appendix K to Part 50, Title 40, Interpretation of the National Ambient Air Quality Standards for Particulate Matter, https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50/appendix-Appendix%20K%20to%20Part%2050

compliance but to identify those sites that routinely measure concentrations close to the NAAQS (+/- 15% of the NAAQS). Cells shaded in blue in the "Deviation from NAAQS" column indicate sites that are valuable for determining NAAQS compliance. Cells shaded in green indicate sites with less than 85% completeness.

Figure 2-5 Location of PM10 Monitoring Sites in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (specifically PM2.5), gaseous pollutants, and/or meteorology, but do not measure PM10.

Table 2-6 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – PM10

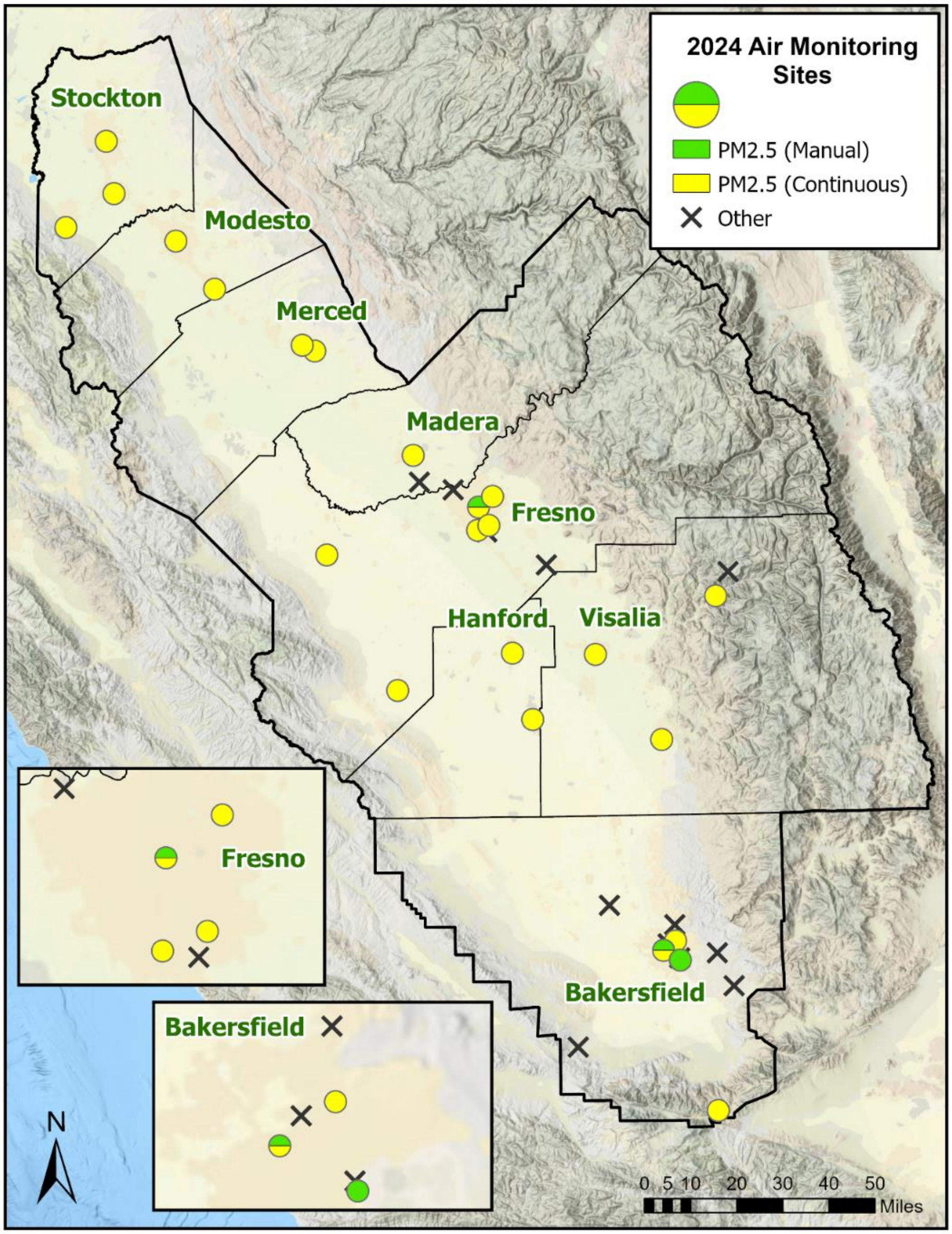
Site Name	% Complete	% Above MDL	Mean Value (µg/m³)	Maximum Measured Value (µg/m³)	Deviation from NAAQS (µg/m³)	# of PM10 Exceedances 2023
Manteca	98	100	25.7	192	37	1
Stockton-University	89	100	23.5	81	-74	0
Tracy-Airport	97	99	19.1	72	-83	0
Modesto-14th St	95	100	23.8	97	-58	0
Turlock	98	100	28.8	129	-26	0
Merced-M. St	98	100	31.3	109	-46	0
Madera-City	99	99	33.6	137	-18	0
Clovis-Villa	99	99	30.2	104	-51	0
Fresno-Garland	98	100	32.0	109	-46	0
Fresno-Drummond	90	99	43.3	131	-24	0
Hanford-Irwin	99	100	43.4	157	2	1
Corcoran-Patterson	98	100	42.4	146	-9	0
Visalia-W. Ashland	97	100	38.5	108	-47	0
Bakersfield-Golden / M St.*	84	99	51.8	236	81	1
Bakersfield-California	98	100	39.4	181	26	1
Oildale	97	100	39.1	270	115	1

*Bakersfield-Golden / M St. PM10 data was not available for January 2023
PM10 MDL for TEOM instrument = 4 µg/m³
Maximum measured value equals the maximum daily 24-hour average for the year.
Some values in this table may be influenced by exceptional events such as high winds and wildfires.
Cells shaded in green in the % complete column indicates a site with less than 85% data completeness

2.1.3.4 Particulate Matter (PM2.5)

Table 2-7 and Table 2-8 show site-by-site "Deviation from the NAAQS," which is the difference between the pollutant-specific design values for each site and the annual NAAQS (9.0 µg/m³) and 24-hour NAAQS (35 µg/m³). Note that although area designations for the 2024 annual PM2.5 NAAQS have not yet been finalized, this assessment evaluates PM2.5 data against the 9 µg/m³ annual standard to act as a reference for, and assist with potential future decisions that may be required for the SJV PM2.5 monitoring network. Table 2-8 shows continuous and manual PM2.5 monitors throughout the SJV.

Figure 2-6 Location of PM2.5 Monitoring Sites in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (specifically PM10), gaseous pollutants, and/or meteorology, but do not measure PM2.5.

Table 2-7 shows that all FRM PM2.5 manual filter sites demonstrated good data completeness and percent above MDL comparison. The measured concentrations and deviation from NAAQS analyses indicate that concentrations at many sites in the Valley are still above the annual and 24-hour standards, while some sites are closer to attainment than others.

Table 2-7 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – PM2.5 (FRM)

Site Name	% Complete	% Above MDL	Maximum Value (µg/m³)	24-hour Design Value 2021-2023 (µg/m³)	Deviation from 24-hour NAAQS (µg/m³)	Annual Design Value 2021-2023 (µg/m³)	Deviation from Annual NAAQS (µg/m³)
Fresno-Garland	95	100	42.7	43	8	13.0	4.0
Bakersfield-California	95	100	63.7	47	12	14.8	5.8
Bakersfield-Airport (Planz)	96	100	58.8	46	11	16.2	7.2

PM2.5 MDL = 2 µg/m³ for 24-hour filter-based monitors.
Maximum value equals the annual maximum daily PM2.5 value.
Design Value: three-year average of the annual mean (2021-2023).
Some values in this table may be influenced by exceptional events such as wildfires and fireworks celebrations.

Analysis of continuous (1-hour) PM2.5 data is summarized in Table 2-8. All sites show good data completeness. Cells shaded in blue in the "Deviation from NAAQS" column indicate sites that are valuable for determining NAAQS attainment (values are within ± 15% of the NAAQS). Annual concentrations are higher than the new, 2024 annual standard at all sites within the Valley except for Tranquillity, which had a 2023 annual DV below 9 ug/m³. The Manteca and Merced-Coffee sites are valuable sites for determining 24-hour PM2.5 NAAQS attainment while Clovis-Villa, Madera-City, Merced-M St., Merced-Coffee, Turlock, Modesto-14th St, Manteca, and Stockton-University Park are valuable sites for determining Annual PM2.5 NAAQS attainment. Note that the Deviation from NAAQS analysis is not meant to determine NAAQS compliance but to identify those sites that routinely measure concentrations close to the NAAQS.

Table 2-8 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – Continuous PM2.5 (1-hour)

Site Name	% Complete	% Above MDL	Maximum Value (µg/m³)	Annual Mean (µg/m³)	24-Hr Design Value 2021-2023 (µg/m³)	Deviation from 24-hr NAAQS (µg/m³)	Annual Design Value 2021-2023 (µg/m³)	Deviation from Annual NAAQS (µg/m³)
Stockton-University Park	90	100	40.6	11.0	36.7	1.7	11.2	-0.8
Manteca	98	100	38.1	8.0	33.3	-1.7	9.5	-2.5
Modesto-14th St	98	100	43.2	10.6	37.3	2.3	13.0	1.0
Turlock	98	100	41.3	10.3	36.6	1.6	11.3	-0.7
Merced-Coffee	99	100	38.6	9.7	32.7	-2.3	9.8	-2.2
Merced-M St.	99	100	38.6	9.7	34.7	-0.3	10.4	-1.6
Madera-City	99	100	37.0	10.0	35.4	0.4	10.9	-1.1
Clovis-Villa	98	100	34.7	8.7	35.5	0.5	11.4	-0.6
Fresno-Garland	98	100	39.2	10.6	43.3	8.3	13.0	1.0
Fresno-Pacific	99	100	47.5	12.7	43.5	8.5	13.3	1.3
Fresno-Foundry	98	100	51.4	12.5	42.9	7.9	14.9	2.9
Tranquillity	98	99	26.2	4.8	25.0	-10.0	6.8	-5.2
Hanford-Irwin	98	100	54.4	12.6	45.4	10.4	14.1	2.1
Corcoran-Patterson	98	99	43.2	10.0	41.1	6.1	13.2	1.2
Visalia-W. Ashland	98	100	42.9	11.8	48.0	13.0	14.3	2.3
Bakersfield-Golden/M St.	98	100	58.3	13.6	48.7	13.7	16.0	4.0

Non-Regulatory Sites	% Complete	% Above MDL	Maximum Value (µg/m³)	Annual Mean (µg/m³)
Tracy-Airport	95	97	31	4.5
Huron	99	99	27	6.6
Porterville	98	99	28	9.5
Sequoia-Ash Mountain	93	98	123	10.1
Lebec	96	97	31	5.1

The Bakersfield-California non-FEM continuous PM2.5 monitor is not included in the non-regulatory table above as it has a regulatory counterpart that is included in the regulatory table.
PM2.5 MDL = 5 µg/m³ for 1-hour continuous monitors that are operating in the District, except the Sequoia-Ash Mountain non-FEM monitor's MDL is 10 µg/m³.
Some values in this table may be influenced by exceptional events such as wildfires or fireworks celebrations.
Annual Design Value 2021-2023: three-year average of annual mean values. 24 -hour Design Value 2021-2023: three-year average of the 98th percentile, daily 24-hour averages.
Maximum value is the maximum daily, 24-hour average.
Cells shaded in blue in the Deviation from NAAQS column indicate sites that are valuable for determining NAAQS attainment (+/-15%)

2.1.3.4.1 Near-Road Sites (PM2.5)

Per Section 4 of Appendix D in 40 CFR Part 58, Core-Based Statistical Areas (CBSAs) with a population of 1,000,000 or more persons are required to have at least one PM2.5 monitor collocated at a near-road NO2 station. Currently, Fresno is the only CBSA within the District that is comprised of more than 1,000,000 people. As such, the District began PM2.5 monitoring at the Fresno-Foundry near-road station on January 1, 2020. Table 2-9 below shows high percent completeness and high percent of values above the MDL.

Table 2-9 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – Near-Road Continuous PM2.5 (1-hour)

	% Complete	% Above MDL	Maximum Value ($\mu g/m^3$)	Annual Mean ($\mu g/m^3$)	24-Hr Design Value ($\mu g/m^3$)	Deviation from 24-hr NAAQS ($\mu g/m^3$)	Annual Design Value ($\mu g/m^3$)	Deviation from Annual NAAQS ($\mu g/m^3$)
Fresno-Foundry	98	100	51.4	12.4	42.9	7.9	14.9	2.9

2.1.3.5 Carbon Monoxide (CO)

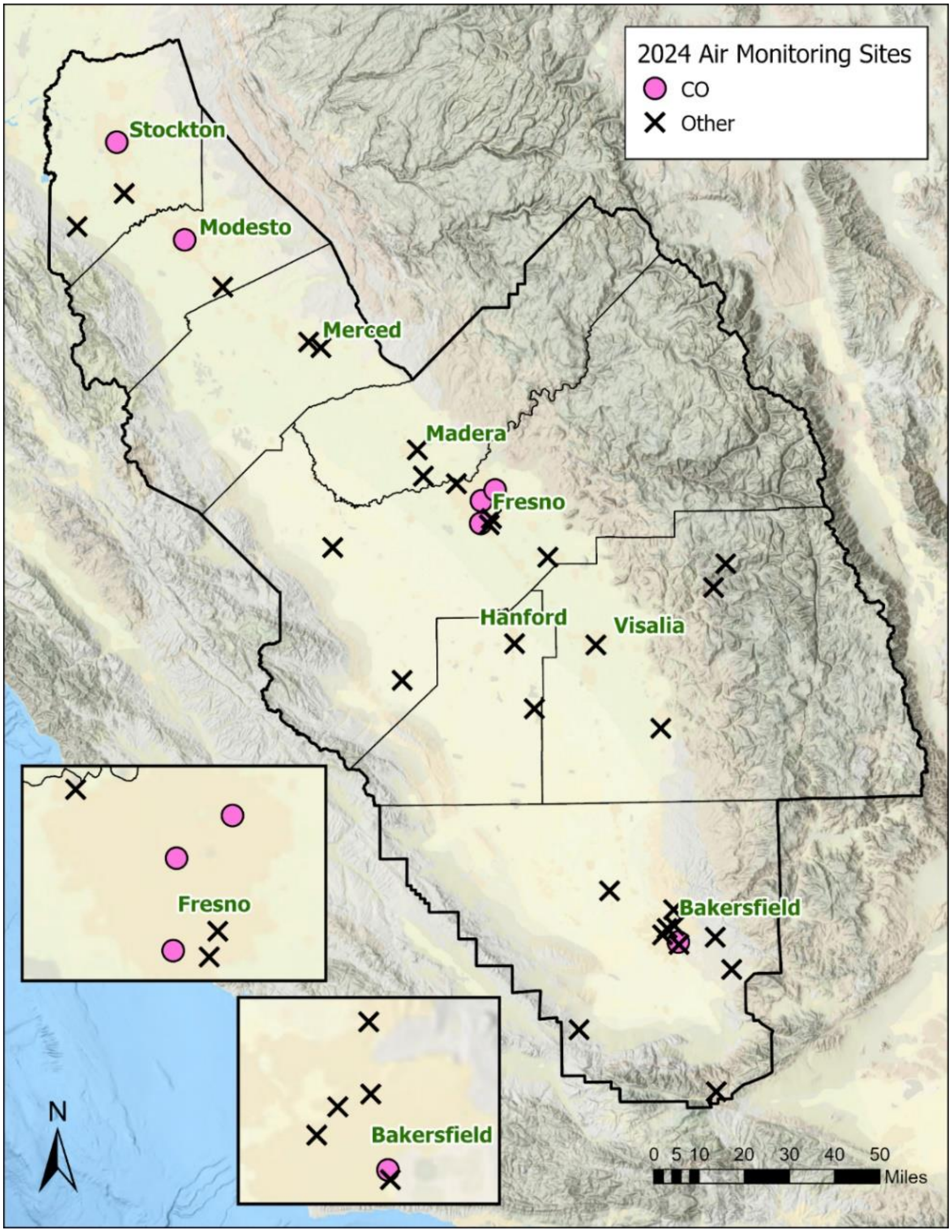
Although the District has long been designated as an attainment area for CO, there are some remaining CO monitors operating in the SJV for compliance with various requirements. Monitoring requirements for CO are specified in 40 CFR Part 58 as follows:

- CO monitors are required at all NCore sites. At least one NCore site is required in every state.
- One CO monitor is required to be placed at a near-road NO2 monitoring station in a Core-Based Statistical Area (CBSA) with population of 1,000,000 or more.
- CO must be monitored at PAMS Type 2 sites with a trace level CO monitor.

Figure 2-7 shows the location of CO monitors in the SJV. Fresno County has three CO monitors: one at Clovis-Villa (an enhanced ozone monitoring PAMS), one at Fresno-Garland (an NCORE site), and one at Fresno-Foundry (near-road NO2 monitoring station in a CBSA > 1,000,000 population). Kern County has one CO monitor located at the Bakersfield-Muni (an enhanced ozone monitoring PAMS PAMS). There are two additional CO monitors in the SJV, one operating in San Joaquin County at the Stockton-University site, and the other in Stanislaus County operating at the Modesto-14th Street site. CARB is scheduled to stop monitoring CO at these site. See the District's 2025 Air Monitoring Network Plan for addition details on CO monitoring.

Table 2-7 demonstrates that data completeness and % above MDL for CO is good at all sites. The deviation from the NAAQS is the difference between the pollutant-specific maximum value observed at the site and the 8-hour average NAAQS value of 9 ppm.

Figure 2-7 Location of CO Monitoring Sites in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (PM), gaseous pollutants, and/or meteorology, but do not measure CO.

Table 2-10 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – CO (8-hour)

Site Name	% Complete	% Above MDL	Maximum Value (ppm)	Deviation From NAAQS (ppm)
Stockton-University Park	82	100	1.4	-7.6
Modesto-14th St	95	100	1.4	-7.6
Clovis-Villa	93	100	1.3	-7.7
Fresno-Garland	95	100	1.7	-7.3
Fresno-Foundry	85	100	1.4	-7.6
Bakersfield-Muni	92	100	0.9	-8.1

CO MDL = 0.011 ppm at Fresno-Garland; 0.02 ppm at Stockton-University Park and Modesto-14th St; 0.04 ppm at Clovis-Villa, Fresno-Foundry, and Bakersfield-Muni.
Maximum Value equals the maximum daily 8-hour average CO value at a site for 2023.
Cells shaded in green indicate sites with a percent complete value less than 85%

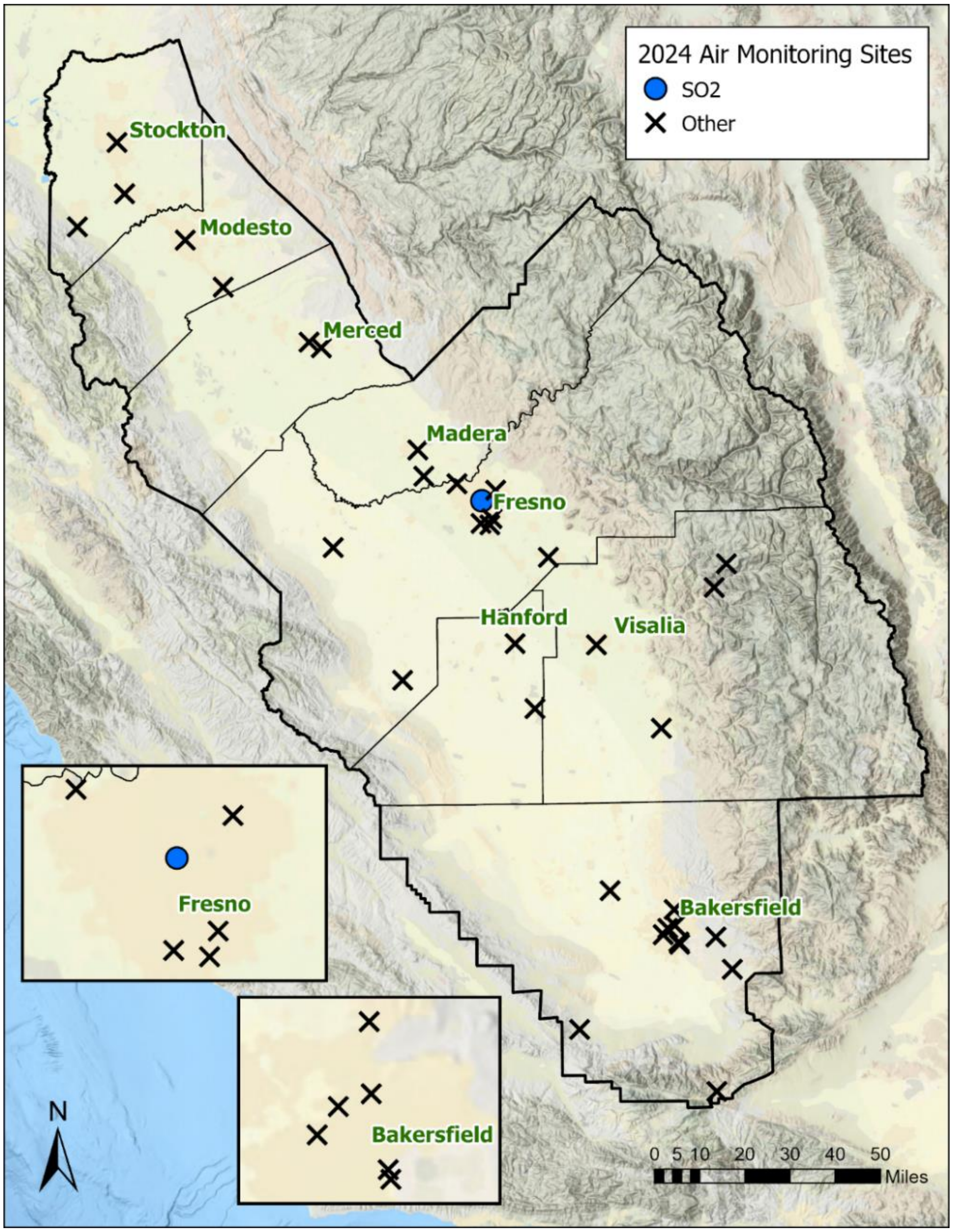
2.1.3.5.1 Near-Road Sites (CO)

Per Section 4 of Appendix D in 40 CFR Part 58, CBSAs with a population of 1,000,000 or more are required to have at least one CO monitor collocated at a near-road NO2 station. Currently, Fresno is the only CBSA within the District that has more than 1,000,000 people. The District began CO monitoring at the Fresno-Foundry near-road site on January 1, 2020.

2.1.3.6 Sulfur Dioxide (SO2)

Figure 2-8 shows the location of the sole SO2 monitor in the SJV, which is located at the Fresno-Garland air monitoring station. Table 2-11 reports good data completeness and % above MDL for SO2 at the Fresno-Garland site.

Figure 2-8 Location of SO2 Monitoring in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (PM), gaseous pollutants, and/or meteorology, but do not measure SO2.

Table 2-11 Summary of Data Completeness, Measured Concentrations, and Deviation from NAAQS – 1-hour SO2

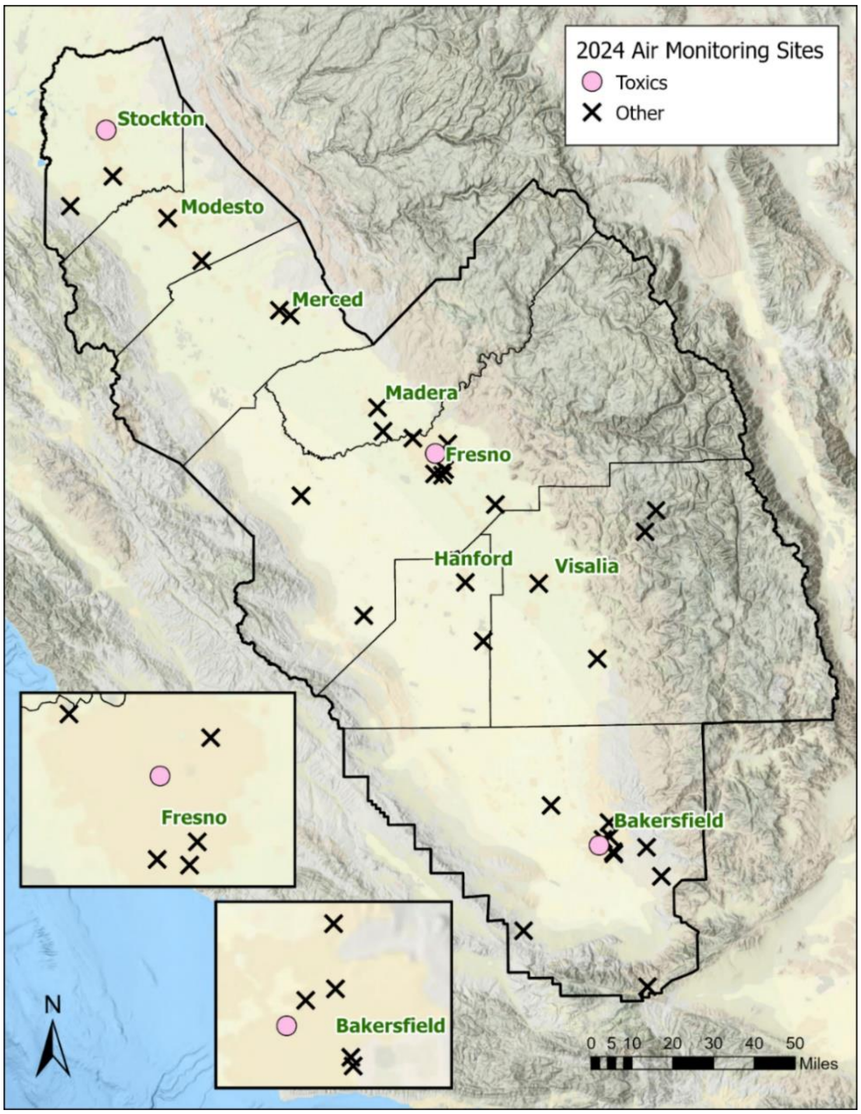
Site Name	% Complete	% Above MDL	Maximum Value (ppb)	Deviation From NAAQS (ppb)
Fresno-Garland	94	100	5.0	-70

SO2 MDL = 0.2 ppb.
Maximum value equals the annual maximum 1-hour average value for 2023.

2.1.3.7 Toxics

Toxics monitoring in the SJV is conducted by CARB at Stockton-University Park, Fresno-Garland, and Bakersfield-California. Figure 2-9 shows where the toxics monitoring sites are located in the SJV.

Figure 2-9 Location of Toxics Monitoring Sites in the San Joaquin Valley



"X Other" indicates additional sites in the Valley that monitor particulate matter (PM), gaseous pollutants, and/or meteorology, but do not measure for Toxics.

2.1.4 Length of Trend Record Analysis

Monitors that have long-term data records are valuable for tracking pollutant trends and evaluating effectiveness of emissions control strategy. For the length of trend record analysis, the values in Table 2-12 show the total number of years of data collection for each air monitoring site and criteria pollutant parameter. Table 2-12 shows the trend length by site and pollutant. The total number of years of meteorology (met.) parameter collection is also shown in the table.

Table 2-12 Length of Monitoring (Number of Years) through 2025

Site Name	O3	1-hr PM10	Total Historic PM10[1]	1-hr PM2.5	Total Historic PM2.5[1]	NO2	CO	PAMS	SO2	Met
Stockton-University Park*	44	15+	40+	15+	40+	44	10+	0	0	10+
Tracy-Airport	15+	15+	15+	15+	15+	15+	0	0	0	15+
Manteca	0	15+	15+	15+	15+	0	0	0	0	15+
Modesto-14th St	25+	10+	10+	15+	25+	0	10+	0	0	30+
Turlock	30+	4	30+	15+	15+	30+	0	0	0	30+
Merced-M St	0	3	25+	5	25+	0	0	0	0	2
Merced-Coffee/Vierra*	30+	0	0	15+	15+	30+	0	0	0	30+
Madera-City	15+	15+	15+	10+	10+	0	0	0	0	15+
Madera-Pump Yard	25+	0	0	0	0	25+	0	25+	0	25+
Fresno-Sierra Sky Park	35+	0	0	0	0	35+	0	0	0	35+
Tranquillity	15+	0	0	15+	15+	0	0	0	0	15+
Clovis-Villa	35	5+	30+	15+	30+	35+	35+	30+	0	35+
Fresno-Foundry	0	0	0	5	5	5+	5	0	0	5+
Fresno-Garland*	10+	10+	10+	10+	10+	10+	10+	0	10+	10+
Fresno-Pacific	0	0	0	4	25+	0	0	0	0	2
Fresno-Drummond	40+	3	35+	0	0	40+	0	0	0	40+
Parlier	40+	0	0	0	0	30+	0	30+	0	35+
Huron	0	0	0	15+	15+	0	0	0	0	15
Hanford-Irwin	30+	15+	15+	15+	30+	30+	0	0	0	30+
Corcoran-Patterson	0	15+	25+	15+	25+	0	0	0	0	25+
Sequoia-Lower Kaweah	35+	0	0	0	0	0	0	0	0	35+
Sequoia-Ash Mountain*	25+	0	0	30+	30+	0	0	0	0	20+
Visalia-W. Ashland Avenue*	45+	10+	35+	20+	25+	45+	0	0	0	25+
Porterville	15+	0	0	15+	15+	0	0	0	0	15+
Shafter	35+	0	0	0	0	35+	0	30+	0	35+
Oildale	40+	10+	35+	0	0	0	0	0	0	10+
Bakersfield-Golden/M St*	0	15+	30+	15+	25+	0	0	0	0	30+
Bakersfield-Westwind	0	0	0	0	0	6	0	0	0	6
Bakersfield-California	30+	10+	30+	20+	25+	30+	0	0	0	30+

Site Name	O3	1-hr PM10	Total Historic PM10[1]	1-hr PM2.5	Total Historic PM2.5[1]	NO2	CO	PAMS	SO2	Met
Bakersfield-Muni	10+	0	0	0	0	10+	10+	10+	0	10+
Bakersfield-Airport (Planz)	0	0	0	0	25+	0	0	0	0	25+
Edison	40+	0	0	0	0	45+	0	0	0	10+
Arvin-Di Giorgio	15+	0	0	0	0	0	0	0	0	10+
Maricopa	35+	0	0	0	0	0	0	0	0	30+
Lebec	0	0	0	15+	15+	0	0	0	0	15+

* Site closures and replacements. Data have been combined to show the continuous length of time the pollutants have been monitored prior to site closure and after site replacement.
[1] FRM monitors were replaced by FEM monitors over time. The Historic Totals represent the combined number of years that FRM monitors were in operation and the number of years FEM monitors have operated following the transition."

2.2 AREA-SERVED, POPULATION-SERVED, POPULATION CHANGE, AND EMISSIONS-SERVED ANALYSES

The purpose of the area-served analysis is to estimate the spatial coverage of each monitoring site to identify potential spatial gaps or redundancies in the overall monitoring network. Performing the area-served analysis is a multi-step process. The first step in the area-served analysis was to compile a map of the air monitoring sites that are operated by the District and other agencies within and around the District's jurisdiction. The map was compiled using ArcGIS Pro software, then Thiessen polygons were used to define each site's area of influence or representativeness (the area geographically closest to each site).

After establishing the area-served boundaries for each site and pollutant, a population-served analysis was conducted to assess the population represented by each monitoring site. The population-served analyses highlight sites located in high-density population areas and considered areas in the SJV that experienced significant population growth in recent years.

Building from there, an emissions-served analysis was performed to evaluate the proximity of air monitoring sites to emissions sources. This analysis was performed by overlaying spatially resolved emissions (or activity) data onto the area-served boundaries to assess the potential emissions impacts within each site's coverage area.

The following sections discuss the findings of the area-, population-, and emissions-served analyses for PM2.5 and ozone, the two criteria pollutants for which the District is currently designated non-attainment. Because an individual monitoring site may measure a number of pollutants, the analyses were conducted separately for each pollutant-specific network. The emissions-served analyses also includes emissions data for NOx compared separately to the PM2.5 and ozone networks since NOx is an important precursors for both PM2.5 and ozone in the SJV.

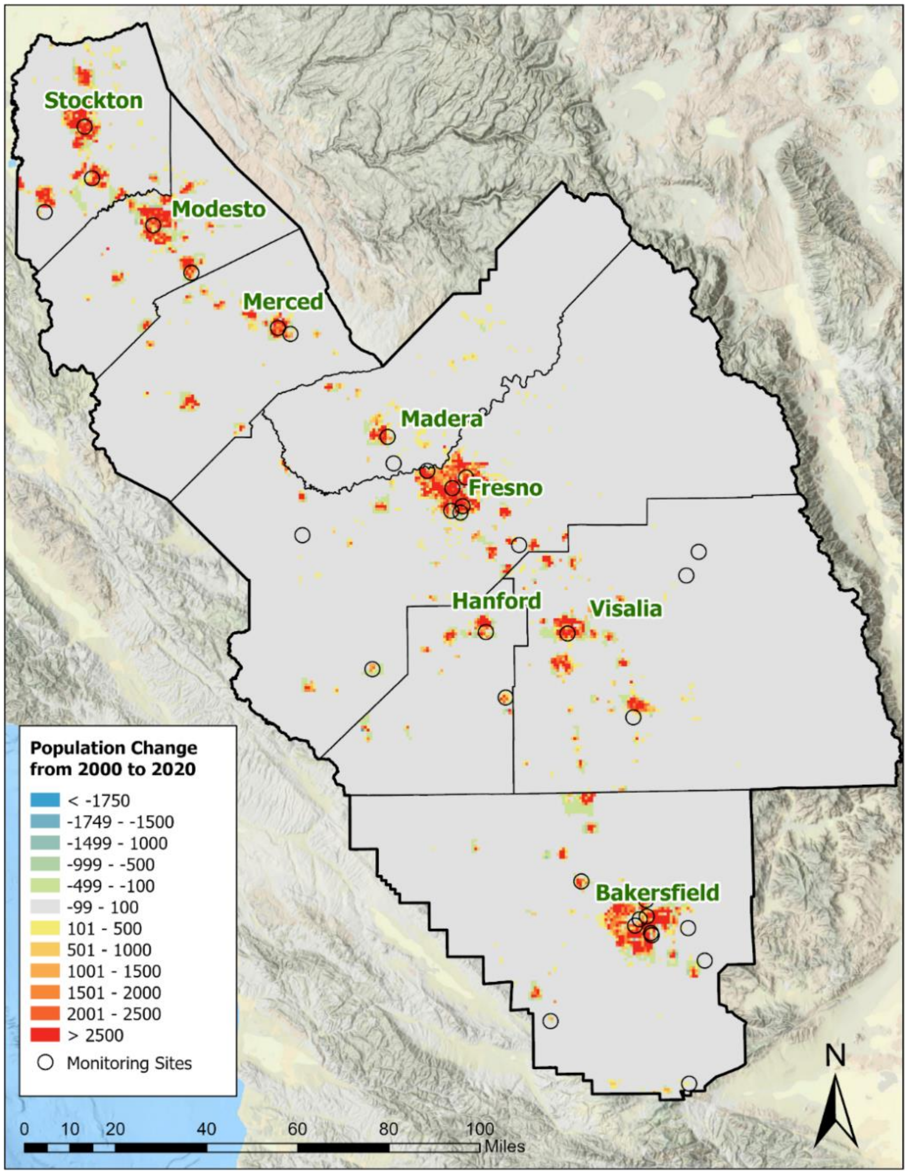
2.2.1 Population Change

Figure 2-10 shows the population change across the SJV relative to District's air monitoring site locations. Between 2000 and 2020, the Valley experienced substantial population growth in metropolitan areas and rural communities. During this period, Fresno county passed the threshold for a million population, becoming the most populous county in the Valley.

As population increases, associated emissions from residential, commercial, and transportation activities may also rise, potentially altering the air quality characteristics observed at nearby monitoring sites. For example, a site originally established in a sparsely populated rural area may now function more like an urban site due to significant local development and population growth.

Given these demographic shifts, the District may consider opportunities to expand or adapt the air monitoring network to maintain adequate coverage and ensure continued representation of population exposure across the Valley.

Figure 2-10 Population Change from 2000-2020 Relative to SJV Monitoring Sites



2.2.2 Area and Emissions-Served Analyses – PM10 Network

PM10 monitoring in the SJV is aimed at measuring representative pollutant concentrations on both a neighborhood and an urban scale. The minimum number of required PM10 monitoring stations is based on population and the maximum observed 24-hour PM10 concentration for each population area. By analyzing area-served boundaries in relation to both maximum PM10 concentrations and the populations within those boundaries, the District can assess the effectiveness of the current PM10 monitoring network in capturing peak exposures and representing population-based air quality conditions.

Figure 2-11 shows the areas of representativeness of the SJV PM10 monitoring sites for the 2021-2023 county maximum PM10 concentrations, both including and excluding concentrations that were impacted by exceptional events. The highest PM10 concentrations observed in the SJV are typically associated with high wind events or wildfire smoke impacts.

Figure 2-12 compares the area polygons for the SJV PM10 monitoring network and the population density in 1 kilometer grids across the SJV. The maps in the figure also indicate the 2021-2023 county maximum 24-hour average PM10 concentrations with event impacts removed. This comparison helps with assessing whether or not air monitoring sites adequately represent pollution levels in populated areas.

Figure 2-11 Left: Map of areas served by PM10 monitoring sites and county maximum PM10 concentrations; Right: Map of areas served by PM10 monitoring sites and county maximum PM10 concentrations excluding event-impacted data

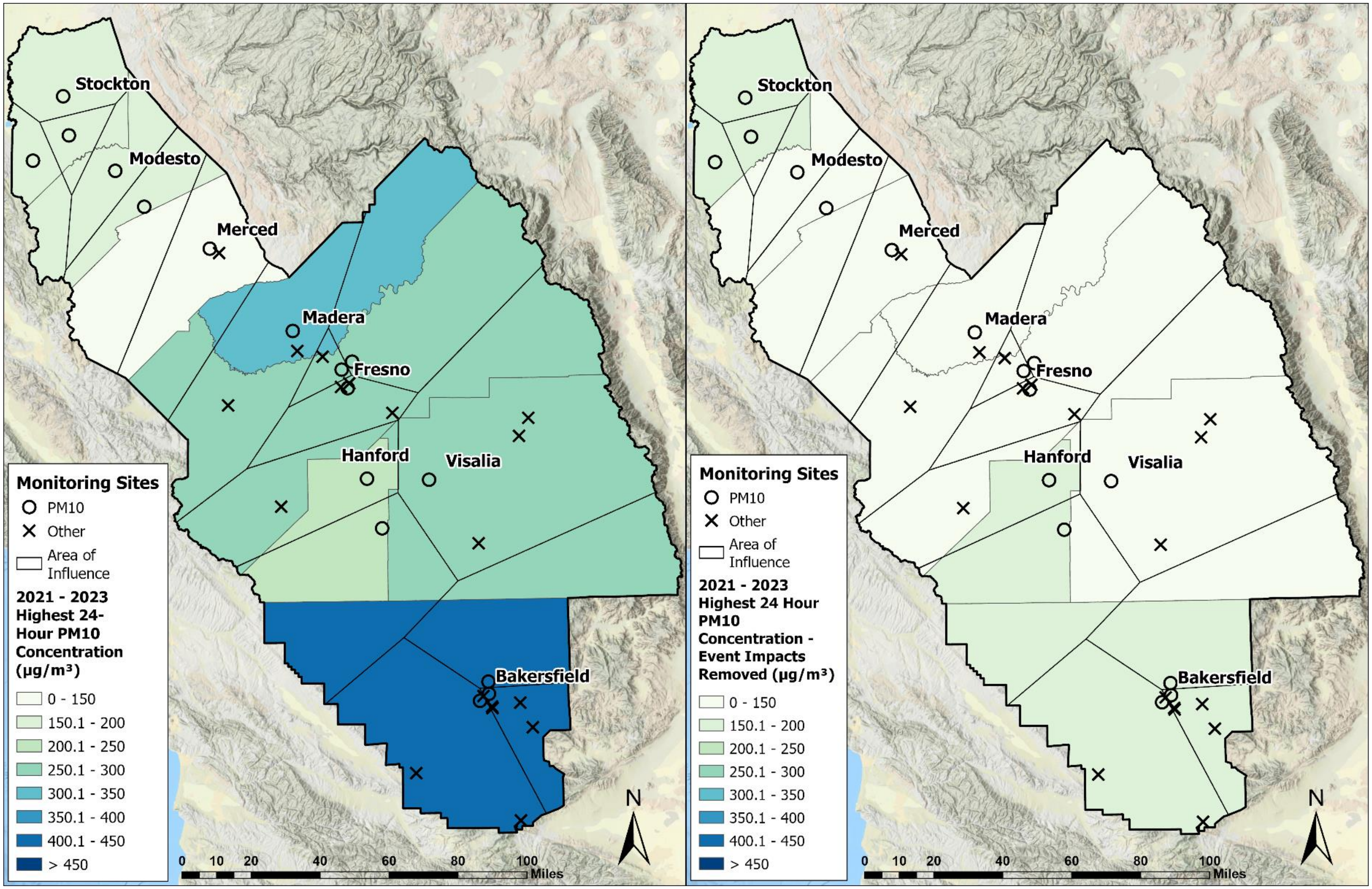
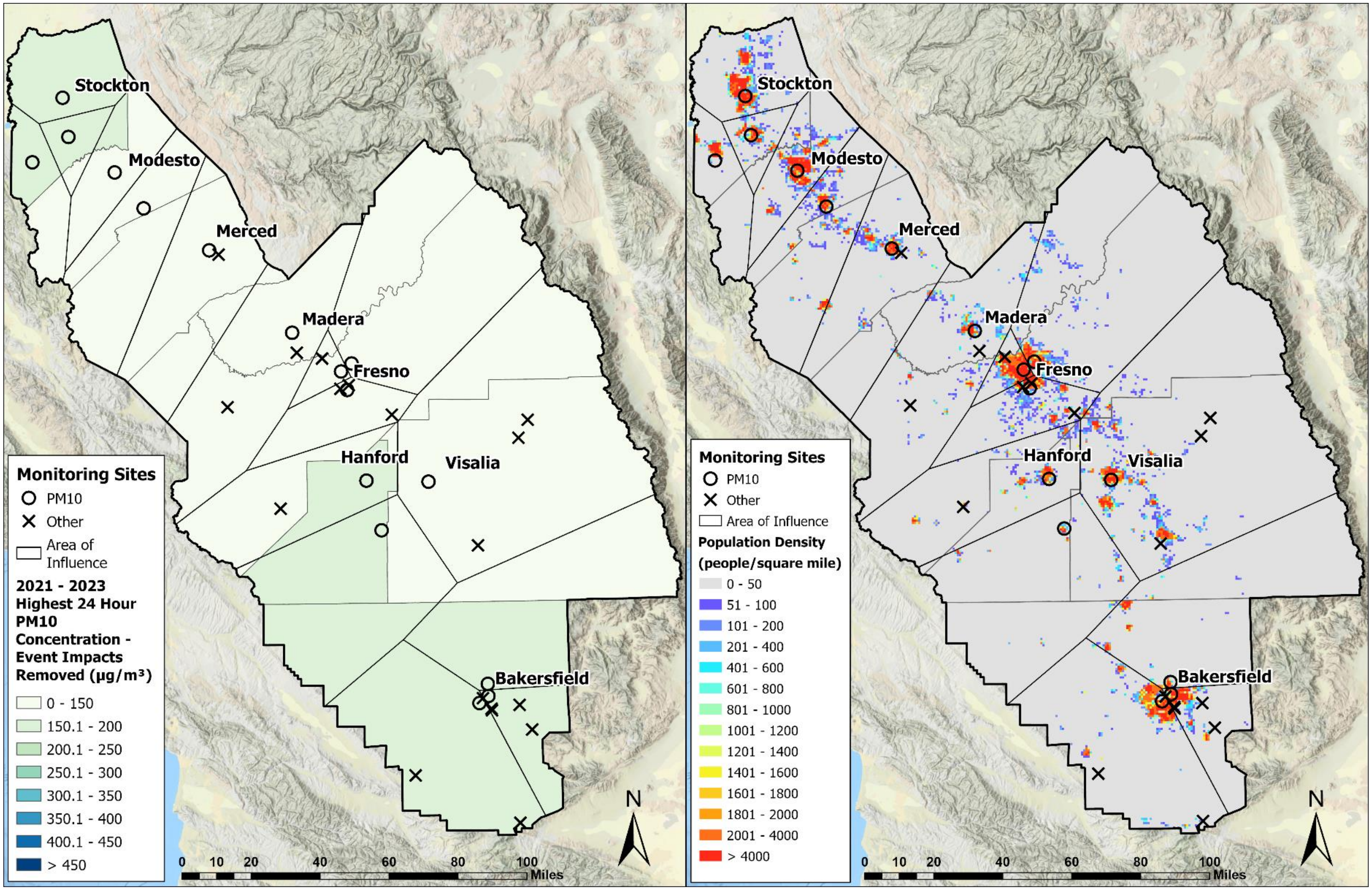


Figure 2-12 Left: Map of areas served by PM10 monitoring sites and county maximum PM10 concentrations excluding event-impacted data; Right: Map area polygons for the PM10 network and population density



2.2.3 Area and Emissions-Served Analysis – PM2.5 Network

PM2.5 monitoring in the SJV is aimed at measuring representative pollutant concentrations on both a neighborhood and an urban scale. By evaluating area-served boundaries in relation to average PM2.5 concentrations and nearby population density, the District can assess how effectively the current PM2.5 monitoring network captures representative air quality conditions and population exposure across the Valley.

Figure 2-13 shows the area polygons for the SJV PM2.5 monitoring network and the population density in 1 kilometer grids across the SJV. The maps in the figure also show the modeled 2021-2023 county PM2.5 design value for each grid cell. The PM2.5 values for each grid cell in the map were developed based on photochemical modeling results. This comparison helps with assessing whether or not air monitoring sites adequately represent pollution levels in populated areas. Areas with high PM2.5 emissions typically correspond with more densely-populated areas.

Figure 2-13 Left: Map of areas served by PM2.5 monitoring sites and annual design values; Right: Map of area polygons for the PM2.5 network and population density

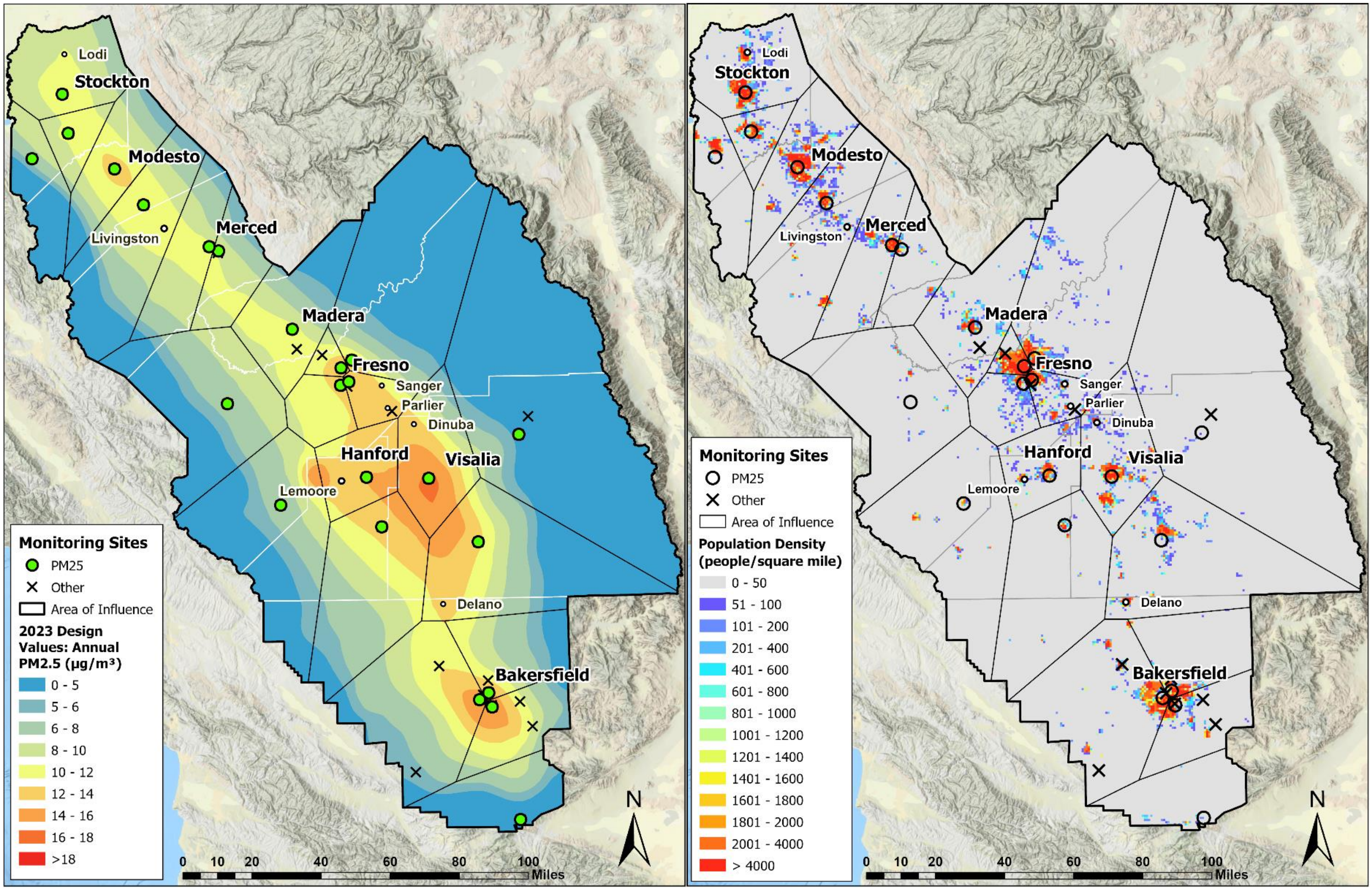
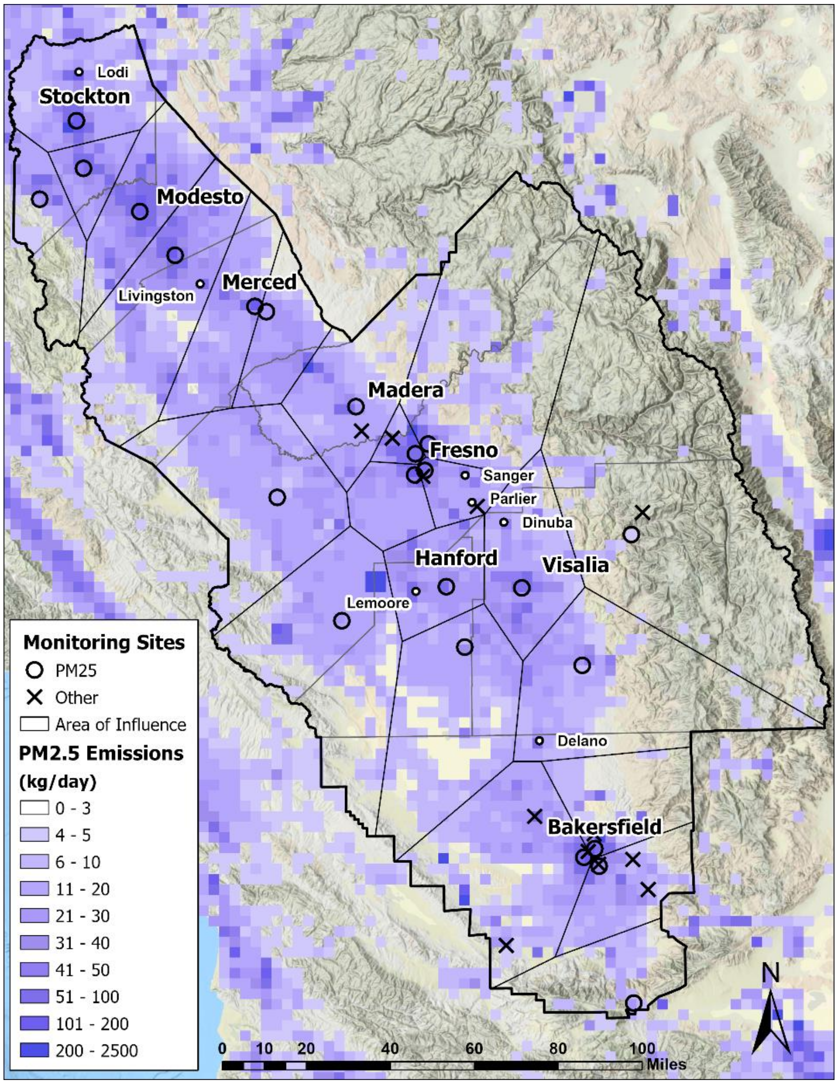


Figure 2-14 shows the locations of the PM2.5 monitors in relation to PM2.5 emissions levels. The emissions data is from Emissions Inventory Version 1.00[9]

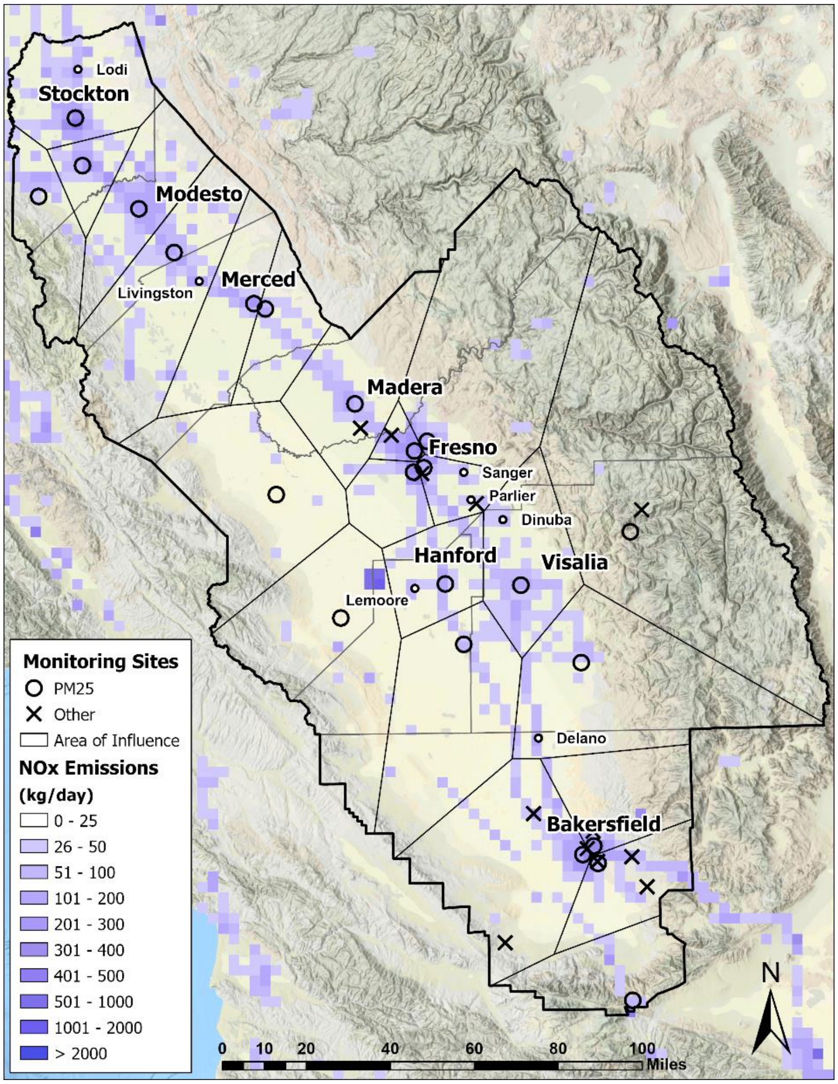
Figure 2-14 Map of areas served by PM2.5 monitoring sites and California PM2.5 Emissions Data



Analysis of the District's PM2.5 network compared to NOx emissions can also help determine if the PM2.5 network adequately serves locations subject to high NOx emissions. High NOx emissions are associated with sources such as freeways, airports, and densely populated areas. Figure 2-15 shows the amount of NOx emissions per day throughout the Valley in relation to the location of PM2.5 monitoring sites in the District's network.

[9] Emission Inventory data source is CEPAM v.1.00.

Figure 2-15 Map of areas served by PM2.5 monitoring sites and California NOx Emissions Data

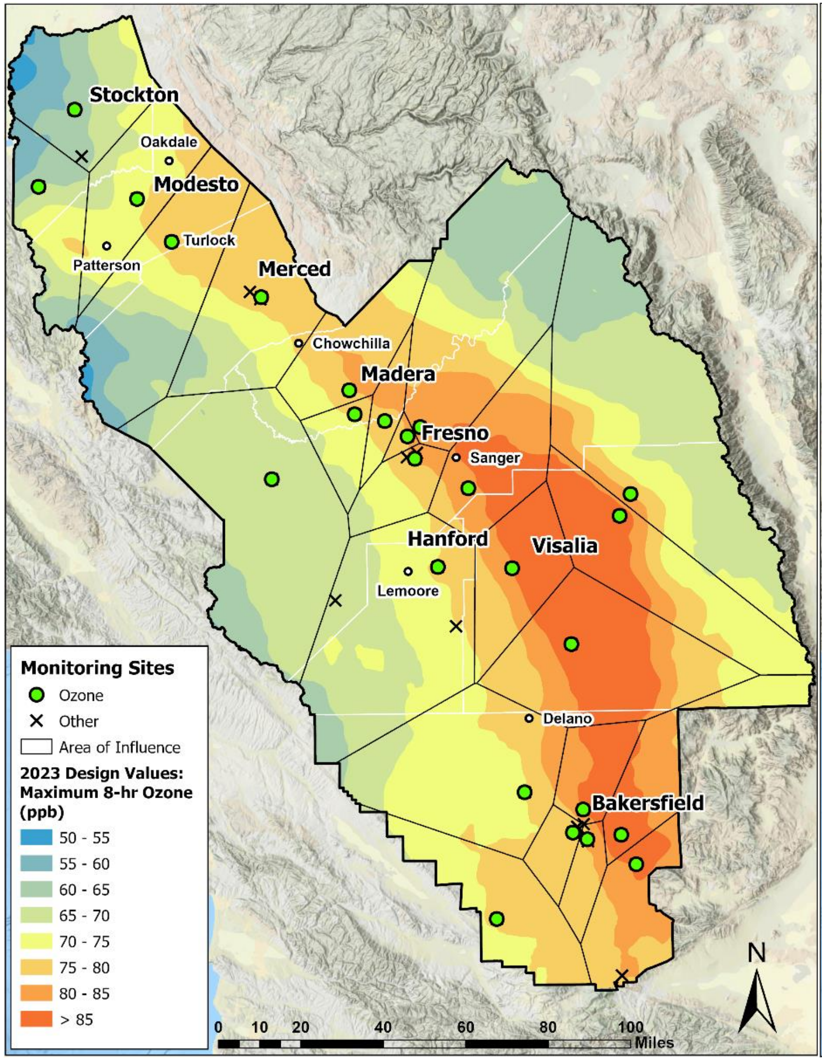


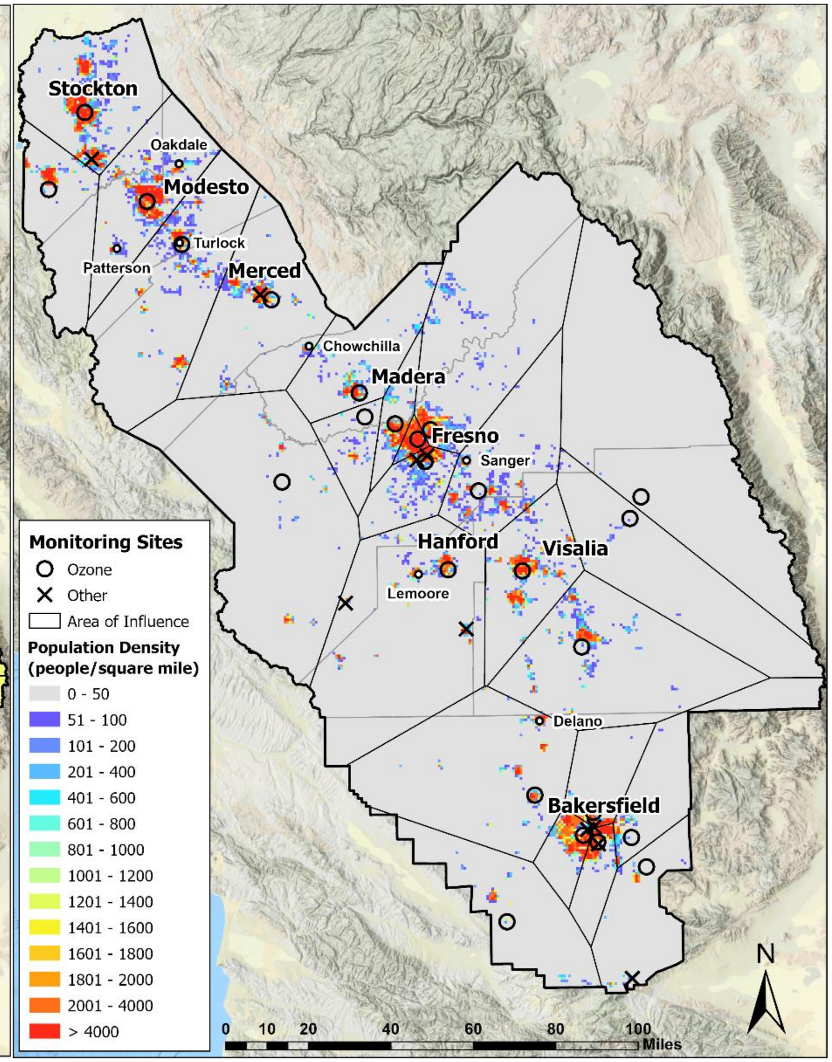
2.2.4 Area and Emissions-served – Ozone Network

Ozone monitoring in the SJV is aimed at measuring representative pollutant concentrations on both a neighborhood and an urban scale to better understand the local and regional causes, effects, and solutions to the non-attainment ozone challenges faced by the District.

The maps in Figure 2-16 show the areas served by the ozone monitoring sites in the District's network in relation to the 2023 maximum 8-hour average ozone design values as well as the population density. By evaluating area-served boundaries in relation to ozone concentrations and nearby population density, the District can assess how effectively the current ozone monitoring network captures representative air quality conditions and population exposure across the Valley

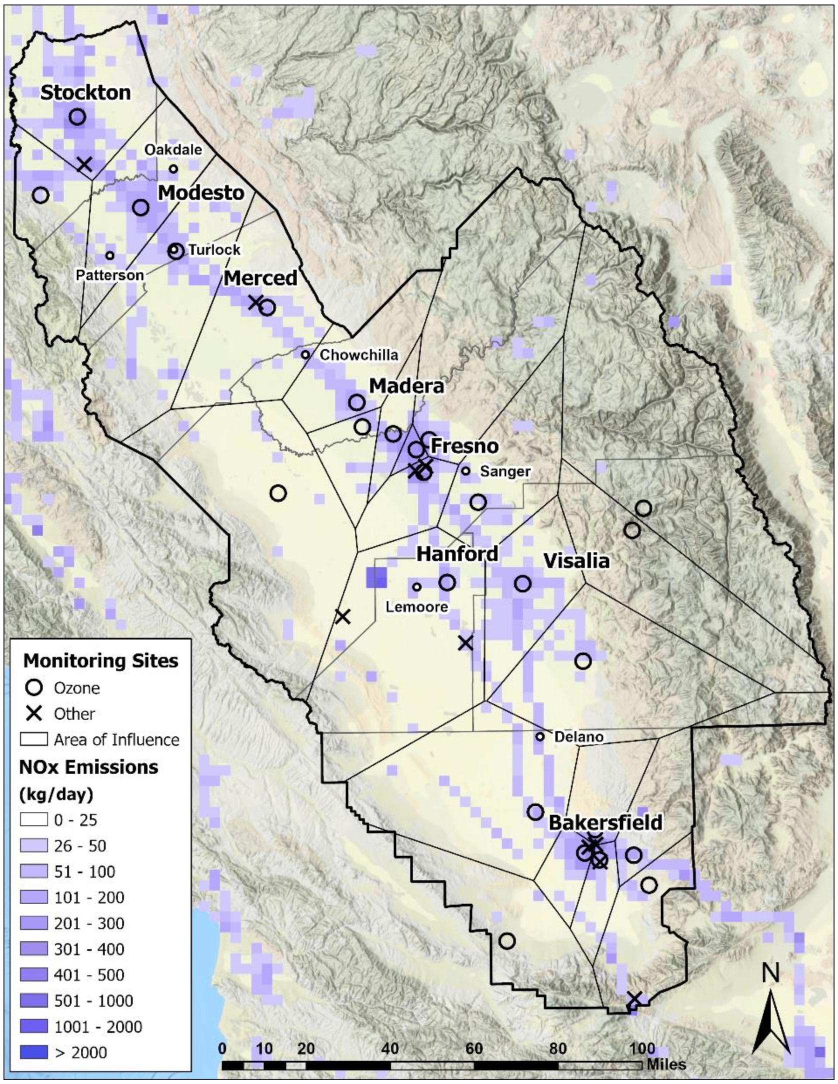
Figure 2-16 Left: Map of areas served by the ozone monitoring sites and 2023 8-hour ozone design values; Right: Map of area polygons for the ozone network and population density





Analysis of the District's ozone network compared to NOx emissions can also help determine if the ozone network adequately serves locations subject to high NOx emissions. High NOx emissions are associated with sources such as freeways, airports, and densely populated areas. Figure 2-17 shows the amount of NOx emissions per day throughout the Valley in relation to the location of ozone monitoring sites in the District's network.

Figure 2-17 Map of areas served by ozone monitoring sites and California NOx Emissions Data



2.2.5 Site-to-Site Correlation Analyses

To identify possible redundancies in the pollutant monitoring network, the District used EPA's NetAssess2025 v1.1, Ambient Air Monitoring Network Assessment Tools[10] to

[10] EPA NetAssess2025 Tool: https://rconnect-public.epa.gov/NetAssess2025/

create correlation matrices for 2021-2023 maximum daily 8-hour average ozone and 2021-2023 24-hour average PM2.5 concentrations. The correlation matrix analyses are displayed in Figure 2-18 through Figure 2-24. The following list provides details for interpreting the information gathered from the EPA NetAssess2025 tool:

- R-values are shaded with a blue gradient where 1.00 is the maximum and -1.00 is the minimum in the range. 1 is represented by the lightest blue and -1 is represented by the darkest blue.
- Mean absolute difference (MAD) values are shaded with a red gradient with the highest MAD values represented by darker red and the lowest MAD values represented by lighter red.
- Each site's design value is presented diagonally in the white squares. Ozone design values are presented in ppm (part per million), consistent with the units used for the NAAQS. Other ozone values in this report are generally presented in units of ppb (parts per billion)
- In the correlation matrices, the values within the squares in the upper-right side of the figure represent the distances between the sites in kilometers.
- In the correlation matrices, the values within the square in the lower-left side of the figure represent the number of observations included in the correlation analysis.

The District also analyzed air quality data from EPA's Air Quality System (AQS) for 2021-2023, using daily maximum 8-hour average ozone and 24-hour average PM2.5 values to calculate Pearson correlation coefficients (R) between pairs of monitoring sites. The R-value quantifies the strength and direction of the linear relationship between two datasets and ranges from –1.00 to 1.00. An R-value of 1.00 indicates a perfect positive linear correlation, suggesting that two sites measure highly similar trends, which may point to potential redundancy, especially for sites located near one another. The calculated R-values for each site pairing are presented in Table 2-13 through Table 2-15 below.

2.2.5.1 Correlation Analyses – Ozone

Figure 2-18 through Figure 2-20 show the 8-hour ozone correlations between sites in the District's ozone monitoring network. Sites are grouped by area in the San Joaquin Valley with sites in the northern, central, and southern portions grouped separately.

Figure 2-18 8-Hour Ozone Correlation Matrix for the sites in Northern Counties in the San Joaquin Valley

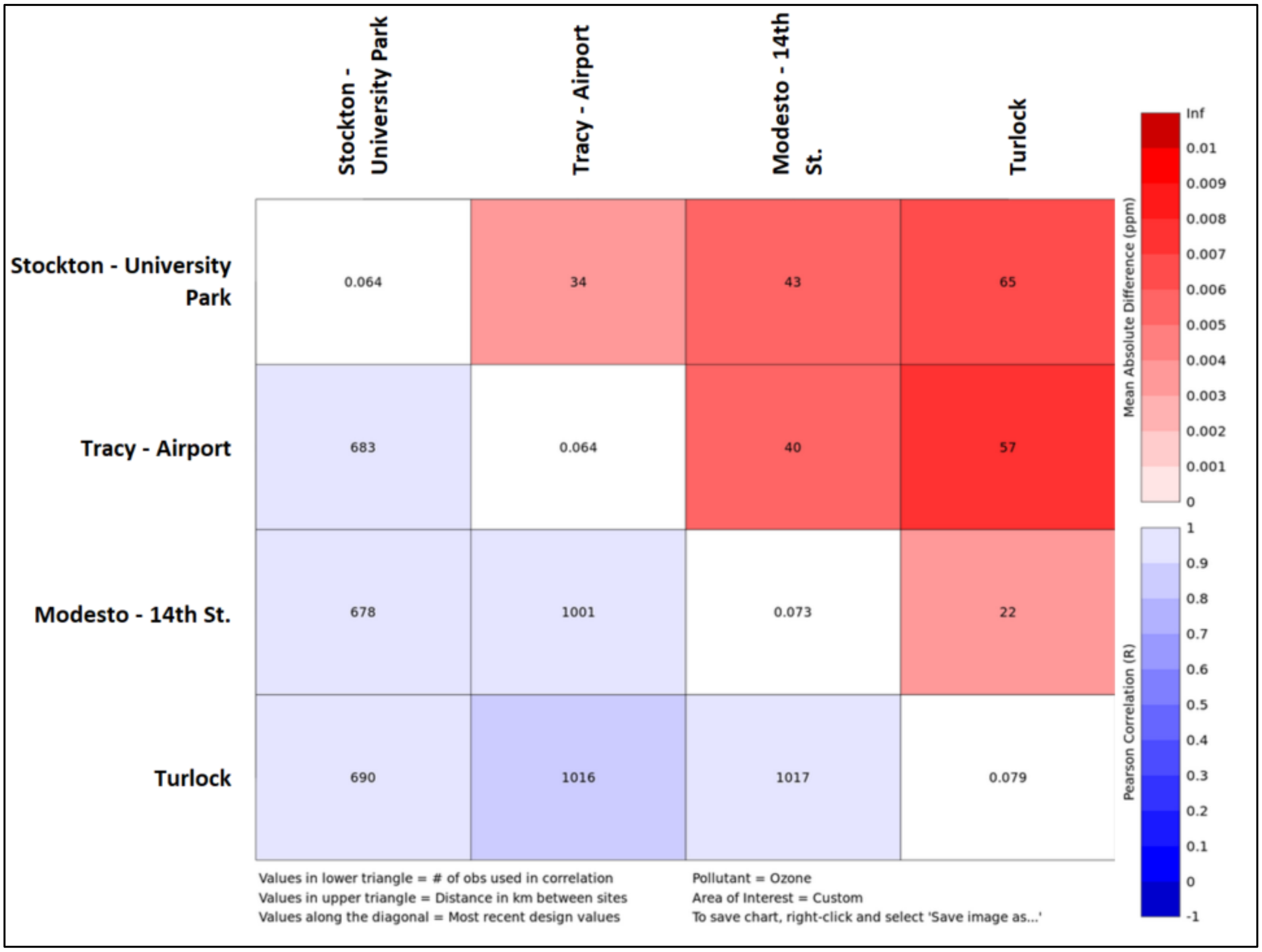


Figure 2-19 8-Hour Ozone Correlation Matrix for the sites in Central Counties in the San Joaquin Valley

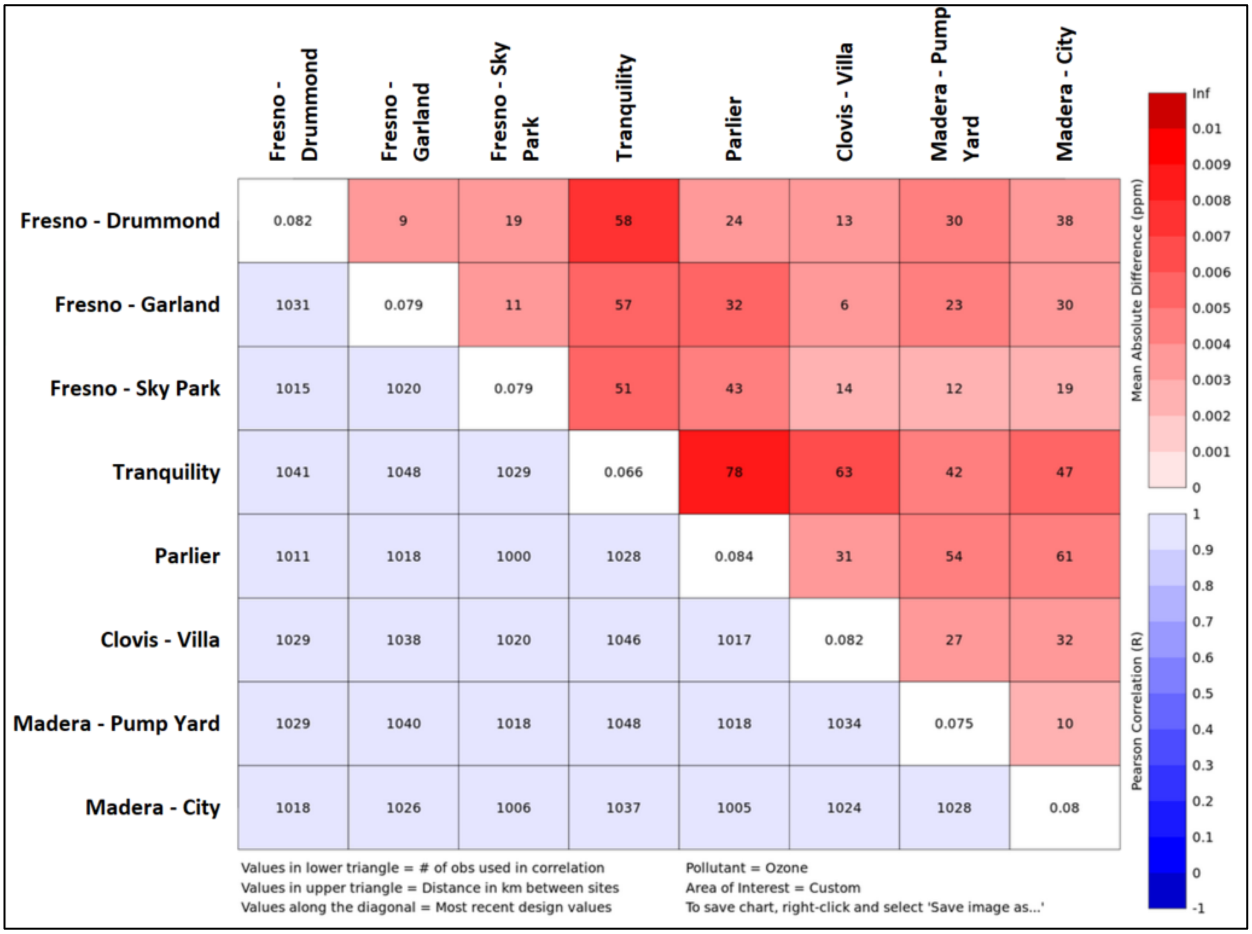
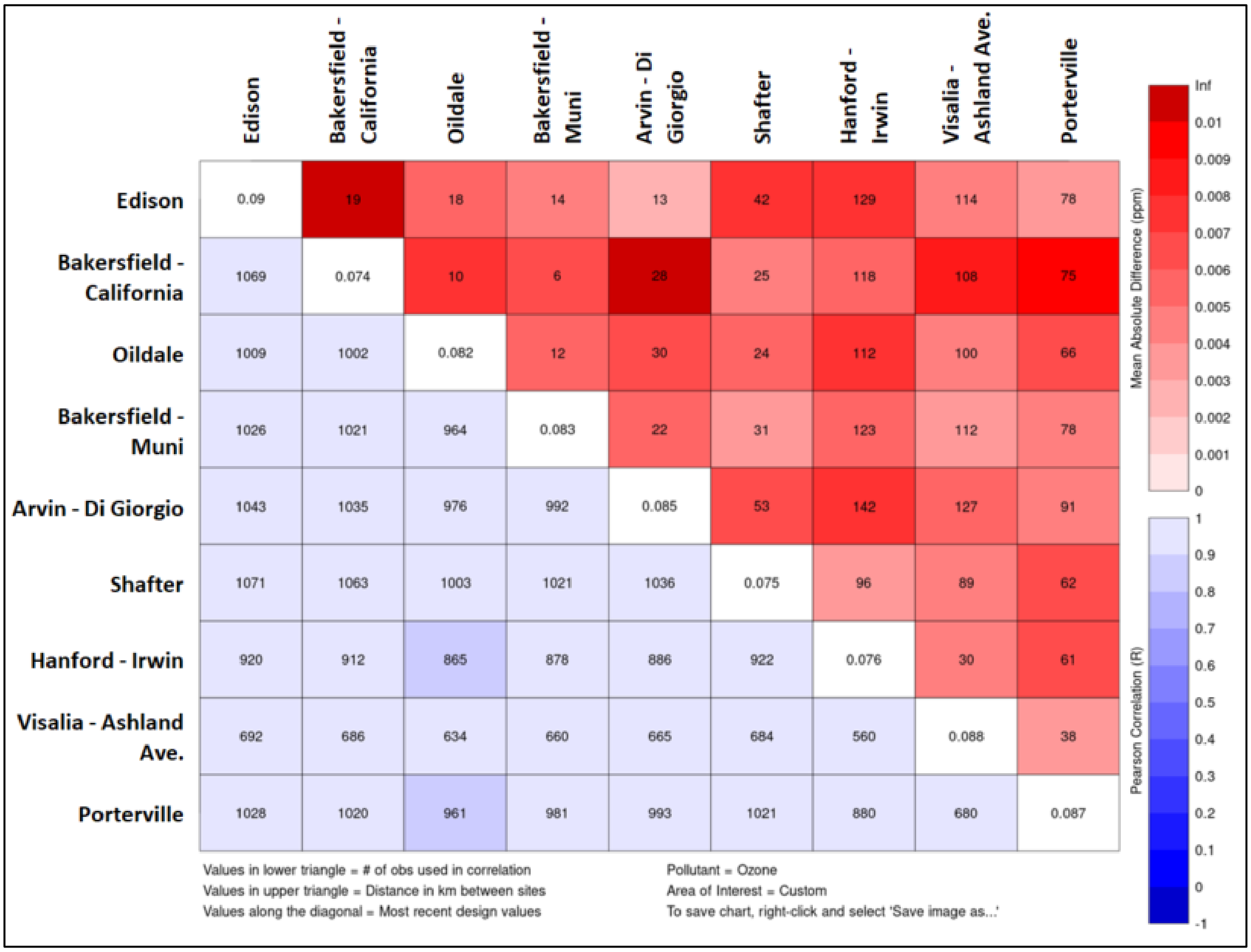


Figure 2-20 8-Hour Ozone Correlation Matrix for the sites in Southern Counties in the San Joaquin Valley



As described in the area- and emissions-served analysis section above, the District's ozone monitors are strategically placed in large-population areas and high emissions areas to better understand the transport of pollution across the Valley as well as how ozone levels vary from one place to another. Table 2-13 shows the R values which reveal the degree of correlation between the sites in the District's ozone monitoring network. Analyses were conducted separately for sites located on the Valley floor and sites in foothill and mountainous areas.

Table 2-13 2021-2023 8-Hour Ozone Pearson Correlations (R) for Valley Floor Sites

	Stockton-University Park	Tracy-Airport	Modesto-14th St.	Turlock	Merced-Coffee	Madera-City	Madera-Pump Yard	Fresno-Sky Park	Clovis-Villa	Fresno-Garland	Fresno-Drummond	Tranquility	Parlier	Hanford-Irwin	Visalia-W. Ashland Avenue	Porterville	Shafter	Oildale	Bakersfield-California	Edison	Bakersfield-Muni
Tracy-Airport	0.91	-																			
Modesto-14thSt.	0.95	0.92	-																		
Turlock	0.91	0.89	0.97	-																	
Merced-Coffee	0.87	0.86	0.94	0.97	-																
Madera-City	0.85	0.85	0.91	0.94	0.96	-															
Madera-Pump Yard	0.85	0.84	0.91	0.92	0.95	0.98	-														
Fresno-Sky Park	0.84	0.83	0.90	0.92	0.94	0.98	0.98	-													
Clovis-Villa	0.82	0.82	0.89	0.92	0.94	0.96	0.95	0.97	-												
Fresno-Garland	0.82	0.82	0.90	0.92	0.94	0.96	0.95	0.97	0.98	-											
Fresno-Drummond	0.83	0.82	0.90	0.92	0.94	0.96	0.96	0.97	0.97	0.97	-										
Tranquility	0.85	0.87	0.91	0.93	0.94	0.94	0.94	0.93	0.92	0.92	0.92	-									
Parlier	0.81	0.79	0.87	0.90	0.91	0.94	0.94	0.95	0.96	0.95	0.97	0.90	-								
Hanford-Irwin	0.84	0.83	0.89	0.91	0.93	0.95	0.95	0.96	0.96	0.96	0.97	0.92	0.96	-							
Visalia-W. Ashland Avenue	0.77	0.79	0.83	0.88	0.90	0.93	0.91	0.93	0.95	0.94	0.95	0.89	0.97	0.96	-						
Porterville	0.77	0.77	0.84	0.88	0.90	0.92	0.91	0.92	0.93	0.93	0.94	0.88	0.96	0.95	0.96	-					
Shafter	0.79	0.79	0.85	0.88	0.90	0.91	0.91	0.92	0.92	0.92	0.92	0.90	0.93	0.94	0.94	0.95	-				
Oildale	0.75	0.70	0.76	0.81	0.82	0.84	0.83	0.85	0.88	0.86	0.85	0.83	0.88	0.88	0.93	0.89	0.92	-			
Bakersfield-California	0.73	0.77	0.82	0.86	0.88	0.89	0.87	0.90	0.91	0.91	0.90	0.89	0.92	0.91	0.92	0.94	0.95	0.92	-		
Edison	0.76	0.77	0.83	0.86	0.88	0.90	0.89	0.90	0.92	0.91	0.92	0.88	0.94	0.93	0.95	0.96	0.95	0.92	0.96	-	
Bakersfield-Muni	0.78	0.77	0.83	0.86	0.88	0.90	0.89	0.91	0.92	0.91	0.92	0.88	0.94	0.93	0.95	0.95	0.96	0.92	0.96	0.98	-
Arvin-Di Giorgio	0.75	0.74	0.81	0.84	0.87	0.89	0.88	0.90	0.91	0.90	0.90	0.86	0.93	0.92	0.94	0.95	0.95	0.92	0.95	0.98	0.97

Pearson Correlation (R)

0.0 - 0.09	0.1 - 0.19	0.2 - 0.29	0.3- 0.39	0.4 - 0.49	0.5 - 0.59	0.6 - 0.69	0.7 - 0.79	0.8 - 0.89	0.9 - 1.00

Figure 2-21 and Table 2-14 show the correlation matrix and R values for the sites at higher elevations within the District's network. The Ash Mountain and Lower Kaweah sites are located in the Sierra Nevada Mountains in Tulare County, and Maricopa site is located in the Temblor Mountain Range in southwestern Kern County. The Lower Kaweah site does not measure ozone year-round so there are fewer observations available for comparison.

Figure 2-21 8-Hour Ozone Correlation Matrix for the sites in Mountain and Foothill areas

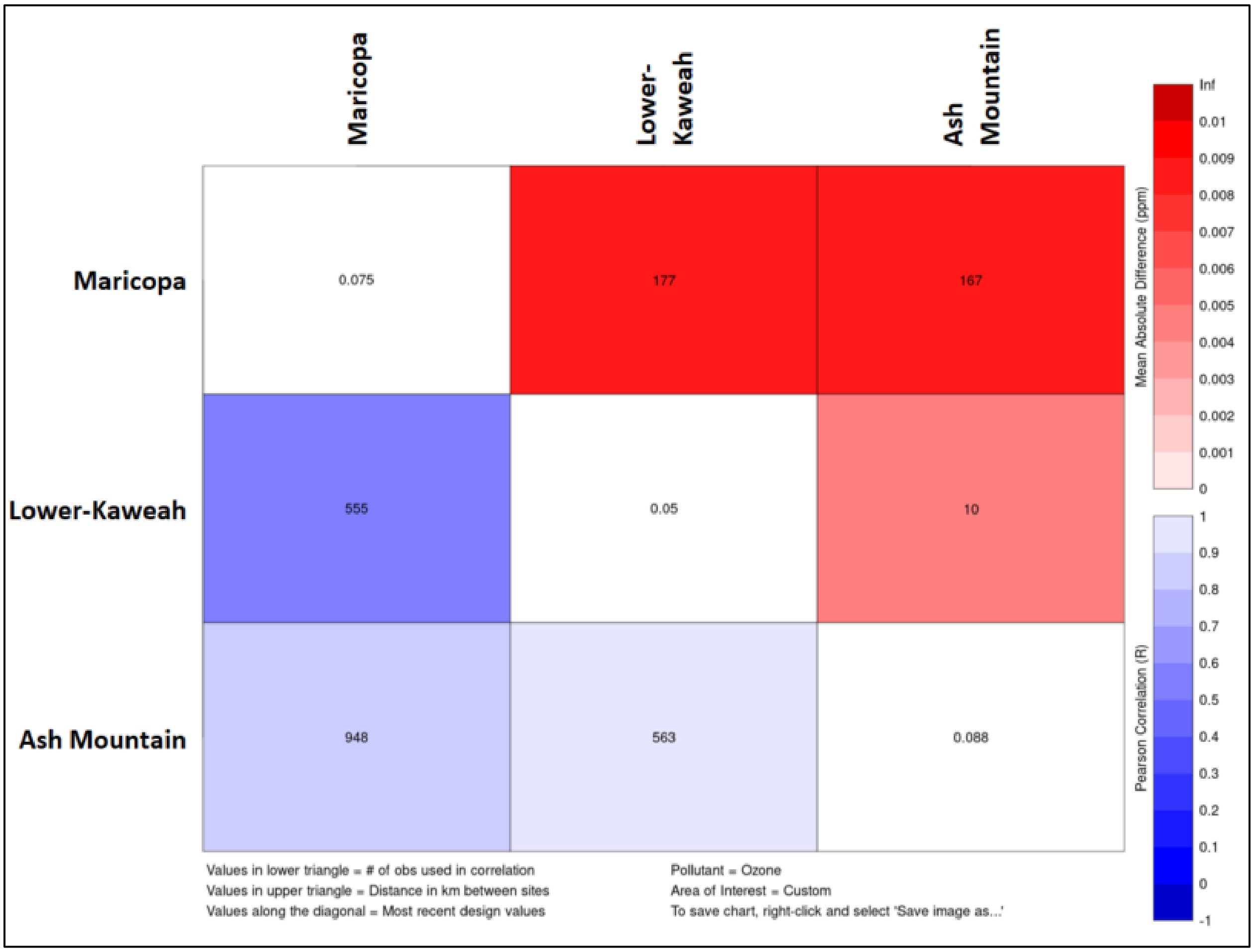


Table 2-14 8-Hour Ozone Pearson Correlations (R) for the Mountain and Foothill Sites in the District's Network

	Ash Mountain	Lower Kaweah
Lower Kaweah	0.92	-
Maricopa	0.82	0.59

Pearson Correlation (R)

0.0 - 0.09	0.1 - 0.19	0.2 - 0.29	0.3 - 0.39	0.4 - 0.49	0.5 - 0.59	0.6 - 0.69	0.7 - 0.79	0.8 - 0.89	0.9 - 1.00

2.2.5.2 Particulate Matter (PM2.5)

Figure 2-22 through Figure 2-24 show the 24-hour average PM2.5 correlations between regulatory sites in the northern, central, and southern SJV, respectively. For this section, only FRM & FEM monitors are included. Non-FEM monitors are not included since those do not meet the criteria for NAAQS-comparability.

Figure 2-22 PM2.5 Correlation Matrix for the sites in in Northern Counties in the San Joaquin Valley

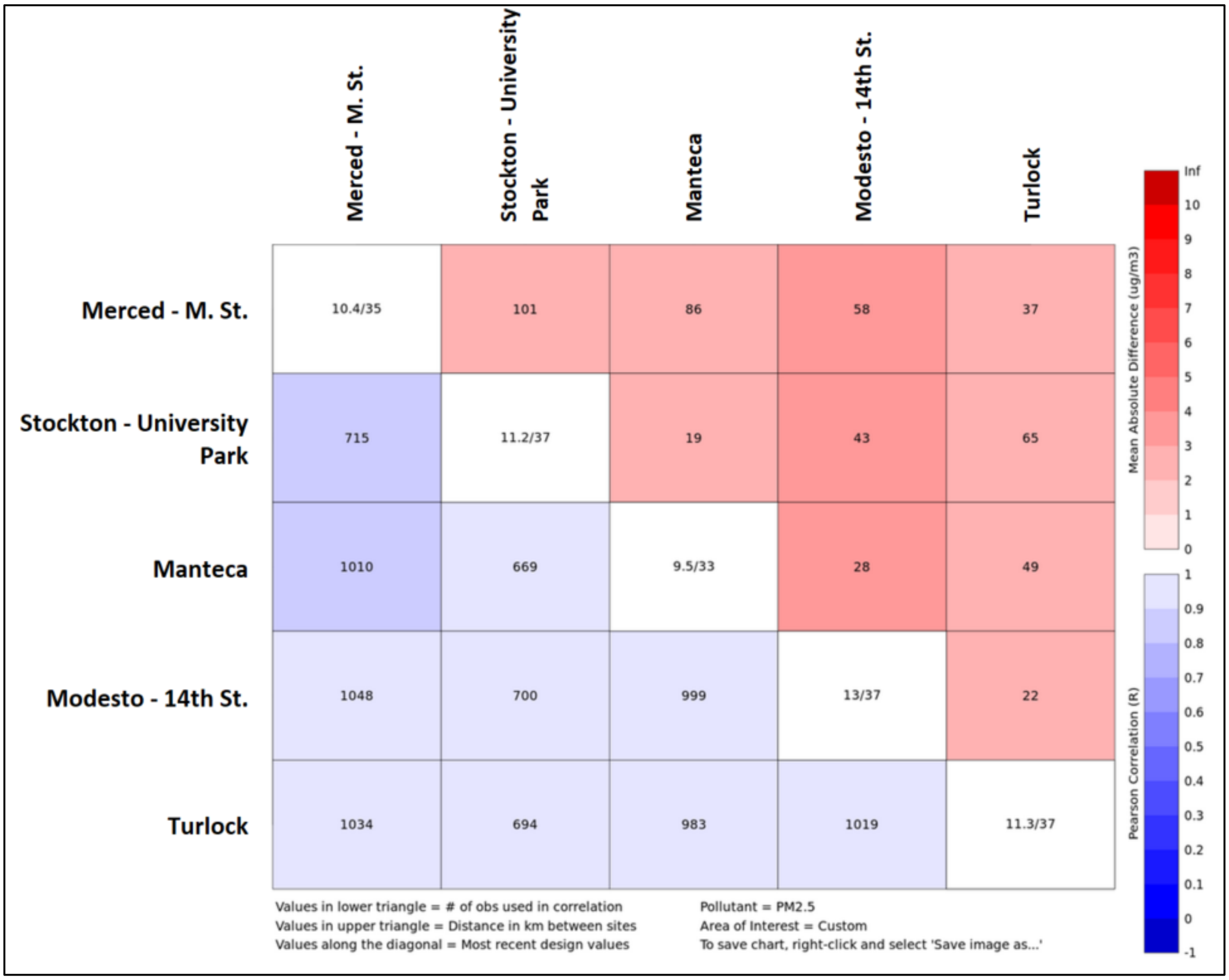


Figure 2-23 PM2.5 Correlation Matrix for the sites in in Central Counties in the San Joaquin Valley

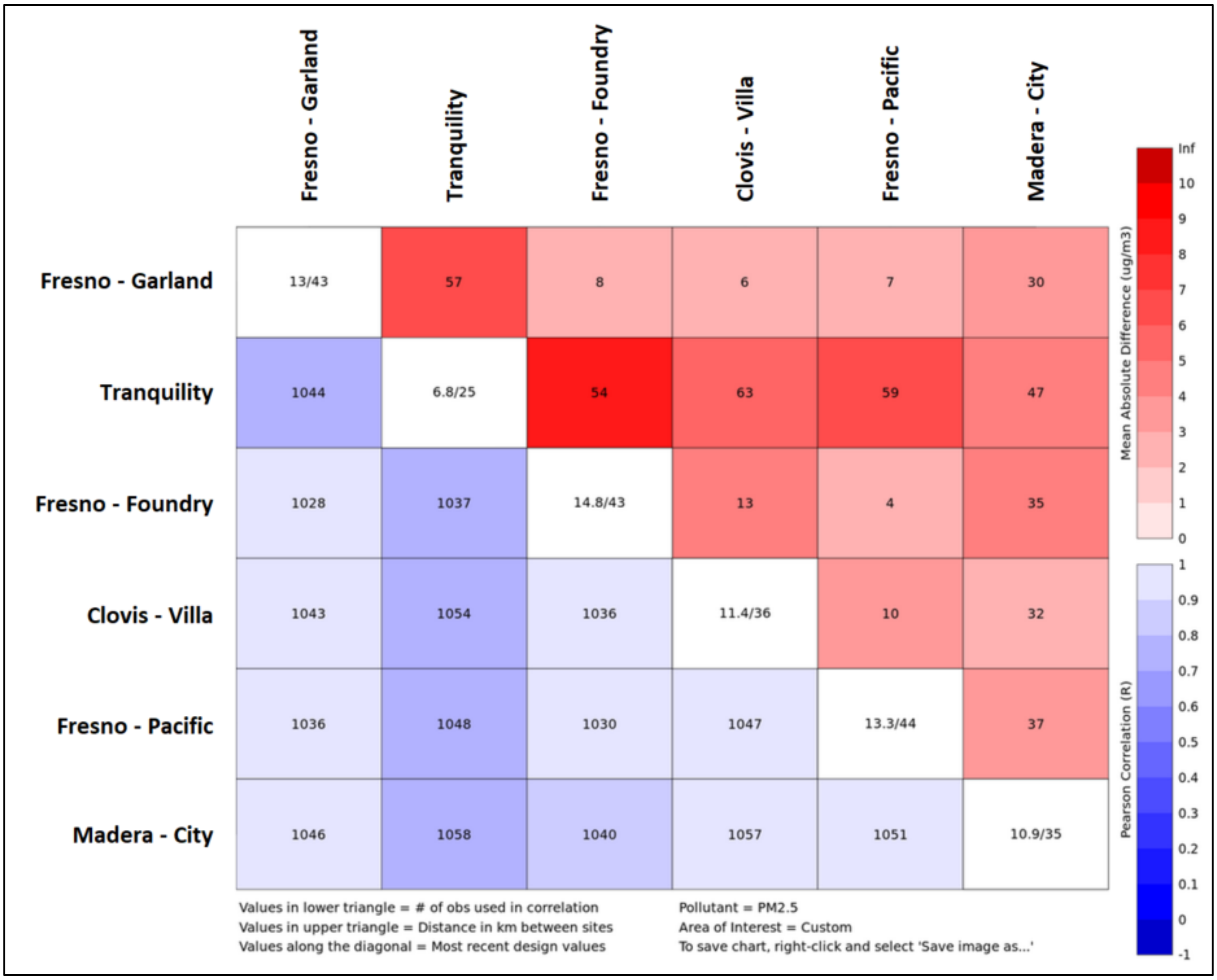
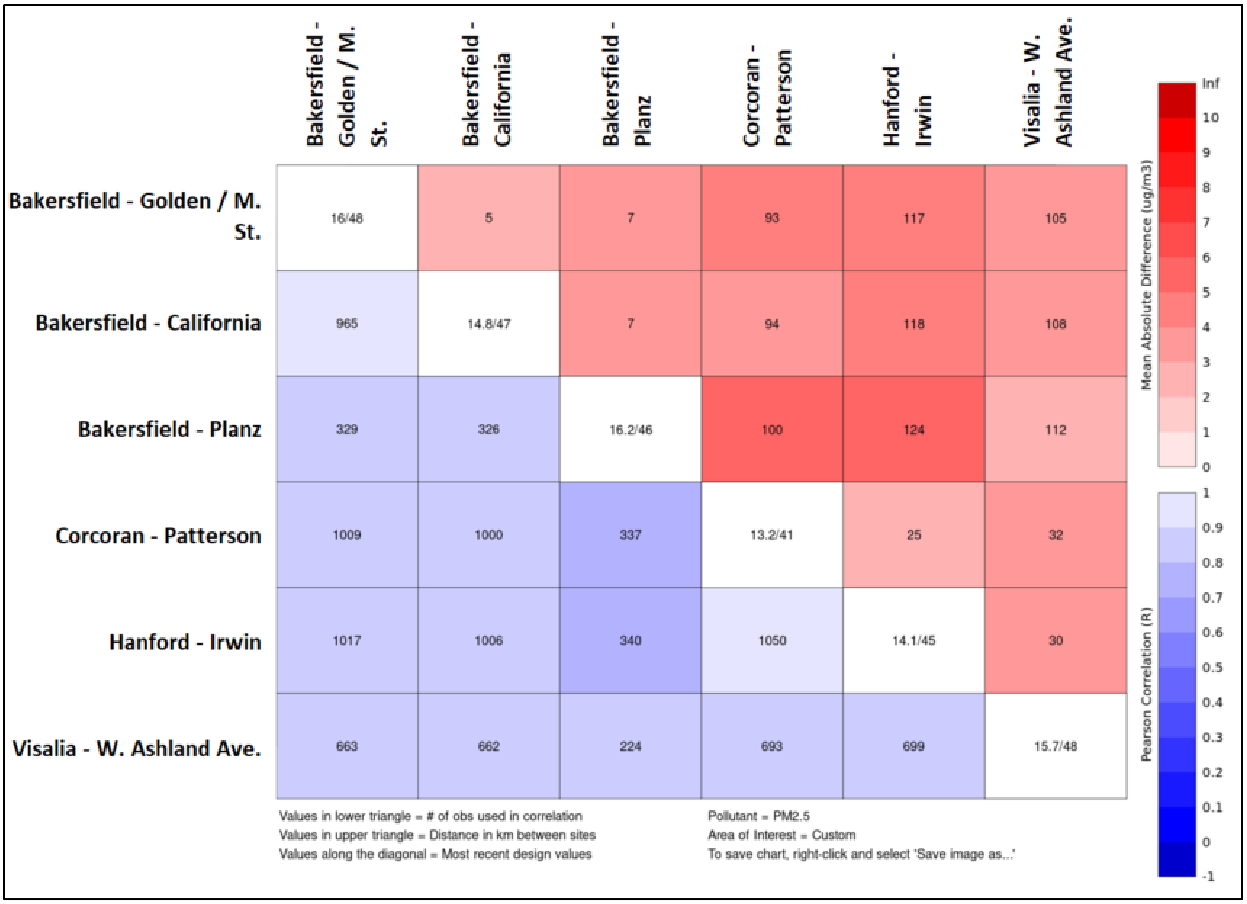


Figure 2-24 PM2.5 Correlation Matrix for the sites in in Southern Counties in the San Joaquin Valley

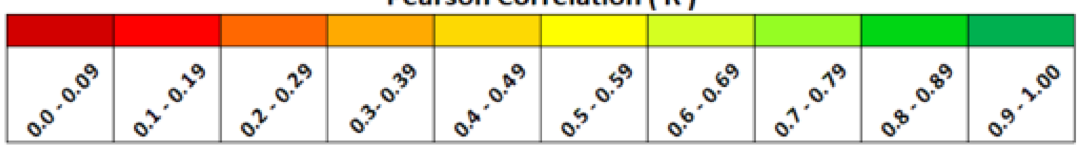


The R-values in Table 2-15 show fairly good correlation among the regulatory Valley floor PM2.5 sites and reveals the best correlations are found between sites that are located close to each other.   Analyses were conducted separately for sites located on the Valley floor and sites in foothill and mountainous areas.

Table 2-15 2021-2023 24-Hour Average PM2.5 Pearson Correlations (R) for Valley Floor Sites

	Stockton-University Park	Manteca	Modesto-14th St.	Turlock	Merced-M St.	Merced-Coffee	Madera-City	Clovis-Villa	Fresno-Garland	Fresno-Pacific	Fresno-Foundry	Tranquility	Hanford-Irwin	Visalia-W. Ashland Avenue	Corcoran-Patterson	Bakersfield-Golden / M St.	Bakersfield-California
Manteca	0.90	-															
Modesto-14th St.	0.91	0.94	-														
Turlock	0.91	0.91	0.95	-													
Merced-M St.	0.88	0.85	0.90	0.93	-												
Merced-Coffee	0.84	0.84	0.87	0.91	0.96	-											
Madera-City	0.77	0.75	0.78	0.84	0.89	0.92	-										
Clovis-Villa	0.74	0.73	0.77	0.80	0.83	0.86	0.93	-									
Fresno-Garland	0.79	0.77	0.82	0.85	0.88	0.88	0.92	0.94	-								
Fresno-Pacific	0.80	0.76	0.82	0.85	0.89	0.87	0.90	0.91	0.95	-							
Fresno-Foundry	0.82	0.80	0.85	0.87	0.89	0.88	0.89	0.91	0.96	0.96	-						
Tranquility	0.68	0.77	0.78	0.79	0.78	0.81	0.78	0.75	0.73	0.71	0.72	-					
Hanford-Irwin	0.83	0.80	0.84	0.86	0.85	0.84	0.84	0.84	0.90	0.90	0.94	0.71	-				
Visalia-W. Ashland Avenue	0.73	0.73	0.76	0.77	0.83	0.81	0.83	0.90	0.90	0.91	0.92	0.67	0.89	-			
Corcoran-Patterson	0.77	0.77	0.81	0.82	0.82	0.80	0.81	0.82	0.87	0.88	0.90	0.71	0.95	0.88	-		
Bakersfield-Golden/M St.	0.72	0.69	0.72	0.72	0.75	0.74	0.75	0.78	0.81	0.83	0.84	0.66	0.82	0.86	0.84	-	
Bakersfield-California	0.71	0.70	0.73	0.74	0.76	0.74	0.75	0.77	0.82	0.84	0.85	0.66	0.84	0.87	0.87	0.95	-
Bakersfield-Airport (Planz)	0.64	0.57	0.61	0.62	0.63	0.62	0.64	0.70	0.72	0.72	0.74	0.53	0.73	0.85	0.74	0.81	0.82

Pearson Correlation (R)



3. TECHNICAL APPROACH AND FINDINGS – PAMS MONITORING NETWORK ASSESSMENT

The Photochemical Assessment Monitoring Stations (PAMS) program collects ambient air measurements in areas classified as serious, severe, or extreme ozone nonattainment, as required by Section 182(c)(1) of the Clean Air Act[11]. The District is currently operating enhanced ozone monitoring in the San Joaquin Valley under the PAMS Alternative Network Plan Revision of 1994[12]. Due to the severity of the ozone concentrations in the San Joaquin Valley, the SJVAPCD operates five enhanced ozone monitoring sites within the nonattainment area to help increase understanding of ozone formation and transport in the Valley. To provide long term data records for the wide range of parameters collected, the SJVAPCD intends to continue operating all enhance ozone monitoring sites.

3.1 Overview of the Enhanced Ozone Monitoring Network

The monitoring objective of Photochemical Assessment Monitoring Stations is “research support”. Federal regulations (Clean Air Act Section 182 and 40 CFR 58) require serious, severe, and extreme ozone nonattainment areas to have PAMS sites measure speciated ozone precursors in order to better understand the effect of precursors and photochemistry as well as control strategies on ozone formation.

The Districts enhanced ozone monitoring sites measure ozone, carbon monoxide (CO), nitrogen oxide (NO), nitrogen dioxide (NO2), oxides of nitrogen (NOx), and non-methane hydrocarbon (NMH) as well as some meteorology. Although the San Joaquin Valley (Valley) does not exceed federal or state standards for NO2, NOx reductions contribute to air quality improvement for both ozone and particulate matter (PM).

There are four possible classifications of PAMS:

- Type 1: **Background sites** upwind of urban areas, where ozone concentrations are presumed not to be influenced by nearby urban emissions.
- Type 2: **Maximum ozone precursor emissions sites**, typically located in an urban center, where emissions strengths are the greatest.
- Type 3: **Maximum ozone concentration sites**, intended to show the highest ozone concentrations.
- Type 4: **Downwind ozone monitoring sites,** intended to capture concentrations of transported ozone and precursor pollutants, and determine possible areas from which most of the transport may originate. Type 4 sites are currently not required for the Valley.

[11] 42 U.S.C. § 7511a(c)(1) (2018), https://www.law.cornell.edu/uscode/text/42/7511a

[12] U.S. Environmental Protection Agency, *Ambient Air Quality Surveillance Siting Criteria for Open Path Analyzers*, 59 Fed. Reg. (August 18, 1994), https://www.govinfo.gov/app/details/FR-1994-08-18/94-20042.

As shown in Table 3-1, the District has six enhanced ozone monitoring sites configured as two networks, one for the Fresno Metropolitan Statistical Area (MSA) and one for the Bakersfield MSA. In May 2016, the EPA approved the relocation of the ozone air monitoring station formerly at Arvin-Bear Mountain to the Arvin-Di Giorgio location in Kern County. PAMS sampling did not continue at the Arvin-Di Giorgio air monitoring site due to space limitations. Updates to the Arvin-DiGiorgio site were completed in January 2024 and plans for resuming enhanced ozone monitoring at Arvin are pending (see *Planned Changes/Improvements* section of the District's Annual Air Monitoring Network Plan). Based on regulatory requirements for operating PAMS, CARB will begin operations at the Fresno-Garland NCore monitoring site in Fresno County in June 2025.

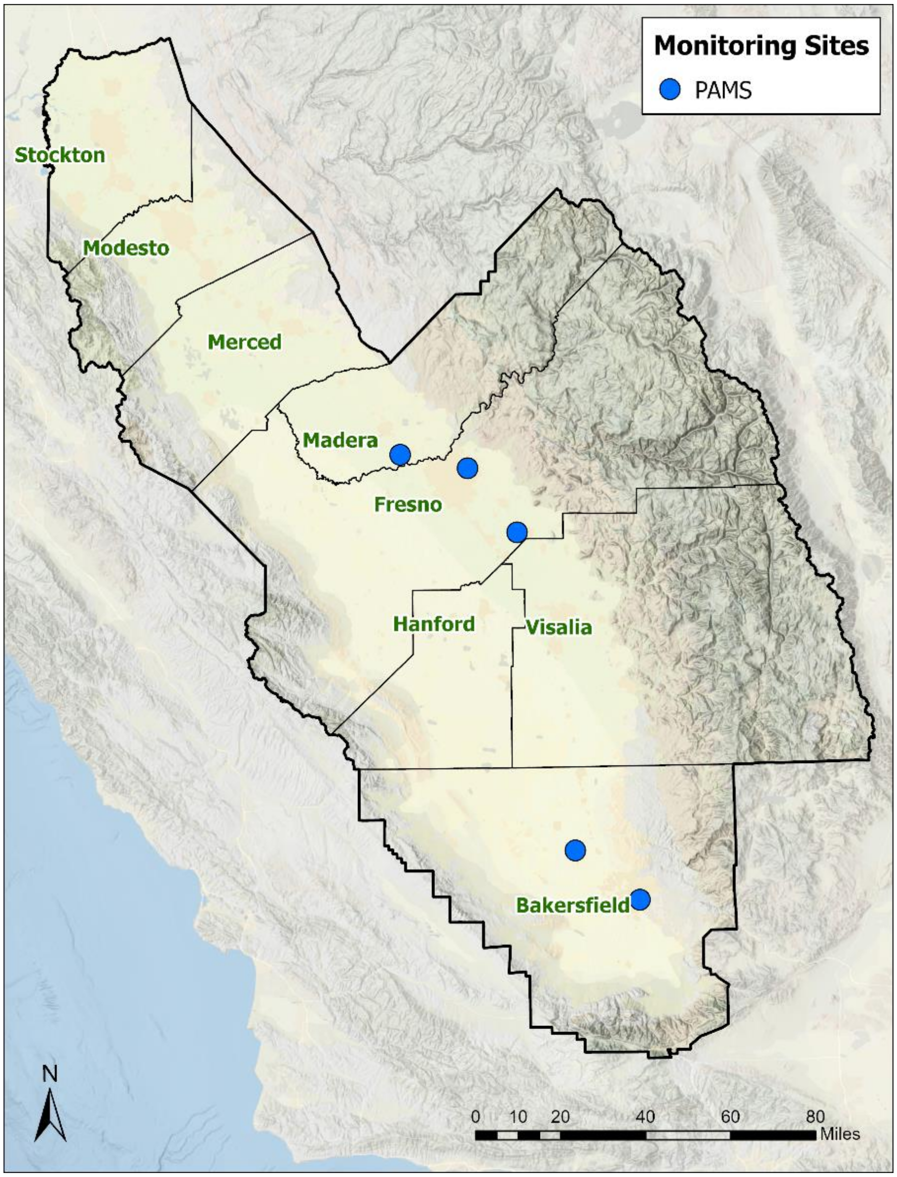
Every year the District's enhanced ozone monitoring program operates from June 1 through August 31 on a 1-in-3 day sampling schedule. At least four, three-hour integrated samples are collected each sampling day (referred to as a "Trend Day"). Additional samples are collected on "Episode Days" which are days forecasted to have high ozone concentrations. The goal is to sample on three to five multi-day episodes each ozone season. Additional measurements are collected at these sites to support the enhanced ozone monitoring networks (e.g., ozone, NO2, and non-methane hydrocarbon analyzers which operate on an hourly basis year round).

Table 3-1 San Joaquin Valley Enhanced Ozone Monitoring Networks

MSA	Site	Site Type
Fresno	Madera-Pump Yard	Type 1: Upwind/Background site
	Clovis-Villa	Type 2: Maximum precursor emissions
	Parlier	Type 3: Maximum ozone concentrations
Bakersfield	Shafter	Type 1: Upwind/Background site
	Bakersfield-Muni	Type 2: Maximum precursor emissions
	Arvin-Di Giorgio*	Type 3: Maximum ozone concentrations

* ARB and the District will review resuming Type 3 PAMS monitoring at the Arvin-Di Giorgio site. Updates on any changes to the PAMS network for the Bakersfield area will be included in future SJV Air Monitoring Network Plans.

Figure 3-1 Location of Enhanced Ozone Monitoring Sites in the SJV



3.2 Requirements for 8-Hour Ozone Enhanced Monitoring Plan

As a part of the October 1, 2015 revisions to the PAMS requirements in 40 CFR Part 58, Appendix D, areas that are classified as Moderate nonattainment or above for 8-hour ozone must develop and implement an Enhanced Monitoring Plan (EMP) explaining how continued measurements of ozone and ozone precursors will assist in understanding the formation of ozone in the area. CARB is responsible for submitting the EMP for the state of California, which includes the SJV Air Basin, and the California 2025 Enhanced Monitoring Plan satisfied the requirements of paragraph 5(h) of Appendix D to 40 CFR part 58.

3.3 PAMS Data Analyses

As part of the enhanced ozone monitoring network assessment, the District performed analyses to show how well the network is operating and meeting objectives. As described in 40 CFR Appendix B to Part 136, the Method Detection Limit (MDL) evaluation was completed for the PAMS compounds. Table 3-2 shows that a majority of values for the PAMS compounds were reported above the MDL with most sites demonstrating a percent above MDL over 85%.

Table 3-2 Summary of Percent above MDL – Enhanced Ozone Networks

Percent Above MDL					
Target PAMS Compounds	**Madera-Pump Yard**	**Clovis-Villa**	**Parlier**	**Shafter**	**Bakersfield-Muni**
Trans-2-Pentene	100%	91%	93%	100%	93%
Trans-2-Butene	100%	91%	100%	100%	93%
Total NMOC	87%		77%	41%	93%
Toluene	69%	49%	57%	94%	87%
Styrene	56%	66%	73%	100%	60%
Propylene	100%	91%	100%	100%	93%
Propane	100%	91%	100%	100%	93%
P-Ethyltoluene	100%	91%	100%	100%	93%
P-Diethylbenzene	100%	91%	100%	100%	93%
O-Xylene	56%	63%	71%	63%	56%
O-Ethyltoluene	100%	91%	100%	100%	93%
N-Undecane	100%	91%	100%	100%	93%
N-Propylbenzene	100%	91%	100%	100%	93%
N-Pentane	100%	91%	100%	100%	93%
N-Octane	100%	91%	100%	100%	93%
N-Nonane	100%	91%	100%	100%	93%
N-Hexane	100%	91%	100%	100%	93%
N-Heptane	100%	91%	100%	100%	93%
N-Decane	100%	91%	100%	100%	93%
N-Butane	100%	91%	100%	100%	93%
M-Ethyltoluene	100%	91%	100%	100%	93%
Methylcyclopentane	100%	91%	100%	100%	93%
Methylcyclohexane	100%	91%	100%	100%	93%
M-Diethylbenzene	100%	91%	100%	100%	93%
M/P Xylene	50%	43%	49%	56%	66%
Isopropylbenzene	100%	91%	100%	100%	93%
Isoprene	100%	91%	100%	100%	93%

Percent Above MDL					
Target PAMS Compounds	Madera-Pump Yard	Clovis-Villa	Parlier	Shafter	Bakersfield-Muni
Isopentane	100%	91%	100%	100%	93%
Isobutane	100%	91%	100%	100%	93%
Formaldehyde		96%			96%
Ethylene	100%	91%	100%	100%	93%
Ethylbenzene	19%	37%	42%	44%	33%
Ethane	100%	91%	100%	100%	93%
Cyclopentane	100%	91%	100%	100%	93%
Cyclohexane	100%	91%	100%	100%	93%
Cis-2-Pentene	100%	91%	100%	100%	93%
Cis-2-Butene	100%	91%	100%	100%	93%
Benzene	100%	91%	100%	100%	93%
Acetylene	100%	91%	100%	100%	93%
Acetone		93%			80%
Acetaldehyde		96%			90%
3-Methylpentane	100%	91%	100%	100%	93%
3-Methylhexane	100%	91%	100%	100%	93%
3-Methylheptane	100%	91%	100%	100%	93%
2-Methylpentane	100%	91%	100%	100%	93%
2-Methylhexane	100%	91%	100%	100%	93%
2-Methylheptane	100%	91%	100%	100%	93%
2,4-Dimethylpentane	100%	91%	100%	100%	93%
2,3-Dimethylpentane	100%	91%	100%	100%	93%
2,3-Dimethylbutane	100%	91%	100%	100%	93%
2,3,4-Trimethylpentane	100%	91%	100%	100%	93%
2,2-Dimethylbutane	100%	91%	100%	100%	93%
2,2,4-Trimethylpentane	100%	91%	100%	100%	93%
1-Pentene	100%	91%	100%	100%	93%
1-Butene	100%	91%	100%	100%	93%
1,2,3-Trimethylbenzene	100%	91%	100%	100%	93%
1,2,4-Trimethylbenzene	100%	91%	100%	100%	93%
1,3,5-Trimethylbenzene	100%	91%	100%	100%	93%
Sum of PAMS Target Compounds	100%	91%	100%	100%	93%

Table reflects data from June, July, and August 2024. MDL for PAMS compounds Acetaldehyde = 0.2 ppbc, Acetone = 3 ppbc, Ethylbenzene and m/p Xylene = 1.6 ppbc, Xylene and Styrene = 0.8, Toluene = 1.4, and 0.1 for the remaining PAMS compounds.
Cells shaded in blue indicate sites with less than 85% of data reported above the MDL.
Blank cells indicate no data.

Data completeness quantifies the amount of valid data obtained from a monitoring network compared to the amount of data that was expected to be obtained As shown in Table 3-3, the PAMS data measured by the District's network during the 2024 PAMS season had a high percentage of completeness.

Table 3-3 Summary of Data Completeness – Enhanced Ozone Networks

Percent Completeness					
Street Address	**Madera-Pump**	**Clovis-Villa**	**Parlier**	**Shafter**	**Bakersfield-Muni**
Trans-2-Pentene	100%	91%	93%	100%	93%
Trans-2-Butene	100%	91%	93%	100%	93%
Toluene	100%	91%	93%	100%	93%
Styrene	100%	91%	93%	100%	93%
Propylene	100%	91%	93%	100%	93%
Propane	100%	91%	93%	100%	93%
P-Ethyltoluene	100%	91%	93%	100%	93%
P-Diethylbenzene	100%	91%	93%	100%	93%
O-Xylene	100%	91%	93%	100%	93%
O-Ethyltoluene	100%	91%	93%	100%	93%
N-Undecane	100%	91%	93%	100%	93%
N-Propylbenzene	100%	91%	93%	100%	93%
N-Pentane	100%	91%	93%	100%	93%
N-Octane	100%	91%	93%	100%	93%
N-Nonane	100%	91%	93%	100%	93%
N-Hexane	100%	91%	93%	100%	93%
N-Heptane	100%	91%	93%	100%	93%
N-Decane	100%	91%	93%	100%	93%
N-Butane	100%	91%	93%	100%	93%
M-Ethyltoluene	100%	91%	93%	100%	93%
Methylcyclopentane	100%	91%	93%	100%	93%
Methylcyclohexane	100%	91%	93%	100%	93%
M-Diethylbenzene	100%	91%	93%	100%	93%
M/P Xylene	100%	91%	93%	100%	93%
Isopropylbenzene	100%	91%	93%	100%	93%
Isoprene	100%	91%	93%	100%	93%
Isopentane	100%	91%	93%	100%	93%
Isobutane	100%	91%	93%	100%	93%
Formaldehyde		96%			97%
Ethylene	100%	91%	93%	100%	93%
Ethylbenzene	100%	91%	93%	100%	93%

Percent Completeness					
Street Address	**Madera-Pump**	**Clovis-Villa**	**Parlier**	**Shafter**	**Bakersfield-Muni**
Ethane	100%	91%	93%	100%	93%
Cyclopentane	100%	91%	93%	100%	93%
Cyclohexane	100%	91%	93%	100%	93%
Cis-2-Pentene	100%	91%	93%	100%	93%
Cis-2-Butene	100%	91%	93%	100%	93%
Benzene	100%	91%	93%	100%	93%
Acetylene	100%	91%	93%	100%	93%
Acetone		96%			97%
Acetaldehyde		96%			97%
3-Methylpentane	100%	91%	93%	100%	93%
3-Methylhexane	100%	91%	93%	100%	93%
3-Methylheptane	100%	91%	93%	100%	93%
2-Methylpentane	100%	91%	93%	100%	93%
2-Methylhexane	100%	91%	93%	100%	93%
2-Methylheptane	100%	91%	93%	100%	93%
2,4-Dimethylpentane	100%	91%	93%	100%	93%
2,3-Dimethylpentane	100%	91%	93%	100%	93%
2,3-Dimethylbutane	100%	91%	93%	100%	93%
2,3,4-Trimethylpentane	100%	91%	93%	100%	93%
2,2-Dimethylbutane	100%	91%	93%	100%	93%
2,2,4-Trimethylpentane	100%	91%	93%	100%	93%
1-Pentene	100%	91%	93%	100%	93%
1-Butene	100%	91%	93%	100%	93%
1,3,5-Trimethylbenzene	100%	91%	93%	100%	93%
1,2,3-Trimethylbenzene	100%	91%	93%	100%	93%
1,2,4-Trimethylbenzene	100%	91%	93%	100%	93%
Nitric Oxide	93%	58%	83%	30%	81%
Nitrogen Dioxide	93%	93%	92%	89%	93%
Oxides of Nitrogen	93%	93%	92%	89%	93%
Ozone	93%	93%	92%	87%	84%
Total NMOC	87%		77%	41%	93%

Table reflects data from June, July, and August 2024.
Blank cells indicate no data.
Cells shaded in green indicate sites with a percent complete value below 85%

As mentioned above, measuring speciated ozone precursors reveals the degree to which they influence ozone formation. As such, the District examined the 2024 speciated ozone precursor data to determine which enhanced ozone sites measured the highest precursor concentrations. Table 3-4 shows the degree of increase or decrease in precursor levels compared to the maximum ozone concentrations measured at those sites.

Table 3-4 Maximum Concentrations – Enhanced Ozone Networks

Year 2024						
Parameter	**Unit of Measure ***	**Madera-Pump Yard**	**Clovis-Villa**	**Parlier**	**Shafter**	**Bakersfield-Muni**
Ozone	ppb	99	108	111	96	109
1,2,3-Trimethylbenzene	ppbc	2.4	4	7.3	2.6	4.4
1,2,4-Trimethylbenzene	ppbc	54.5	40.3	202.2	138.5	117.1
1,3,5-Trimethylbenzene	ppbc	0.7	18.8	3.6	1.4	2.9
1-Butene	ppbc	0	0	3	0	2.9
1-Pentene	ppbc	0	0	0	0	1.4
2,2,4-Trimethylpentane	ppbc	1.7	2.9	5.3	3.2	10.6
2,2-Dimethylbutane	ppbc	0	0.5	0.5	0	2.7
2,3,4-Trimethylpentane	ppbc	0	0	0	0.8	3.4
2,3-Dimethylbutane	ppbc	0	2.4	1.8	0.6	10.1
2,3-Dimethylpentane	ppbc	3.7	4.2	1.8	4.1	8.8
2,4-Dimethylpentane	ppbc	1.7	1.8	16.4	0	4.6
2-Methylheptane	ppbc	0	1.4	1.5	0	1.5
2-Methylhexane	ppbc	1.3	1.8	1.5	1.4	12.5
2-Methylpentane	ppbc	0.9	3.7	4.5	3	42.4
3-Methylheptane	ppbc	0	1.2	0	0	1.7
3-Methylhexane	ppbc	2.2	2.5	3	2.6	12.9
3-Methylpentane	ppbc	0	8.4	2.4	1.8	29
Acetaldehyde	ppbc		15.7			13.1
Acetone	ppbc		43.9			18.3
Acetylene	ppbc	0.6	2.3	2.5	1.3	4.3
Benzene	ppbc	1.7	3.2	5.7	2.7	5.8
Cis-2-Butene	ppbc	0	0	0	0	0
Cis-2-Pentene	ppbc	0	0	0	0	0
Cyclohexane	ppbc	3.2	3.6	3.4	4	8.4

Year 2024						
Parameter	**Unit of Measure ***	**Madera-Pump Yard**	**Clovis-Villa**	**Parlier**	**Shafter**	**Bakersfield-Muni**
Cyclopentane	ppbc	0	0	0.7	0	4.6
Ethane	ppbc	5.6	15.1	864.3	12.3	34.8
Ethylbenzene	ppbc	1.3	1.6	2.5	1.5	2.8
Ethylene	ppbc	0.8	3.1	2.3	2.2	3.6
Formaldehyde	ppbc		12.5			4.6
Isobutane	ppbc	71.1	8	8.7	7.4	22.6
Isopentane	ppbc	58.7	11.1	36.9	10.6	76.9
Isoprene	ppbc	6.9	9.4	1.1	2.9	1.2
Isopropylbenzene	ppbc	0.9	1.5	1.7	1.5	1.4
M/P Xylene	ppbc	2.7	4	5.1	2.7	6.4
M-Diethylbenzene	ppbc	1.1	0.7	0.9	0	1.8
Methylcyclohexane	ppbc	0	6.5	2.3	1.2	5.1
Methylcyclopentane	ppbc	0	1.4	1.3	2.9	20.6
M-Ethyltoluene	ppbc	0.7	1.3	1.4	1.1	1.4
N-Butane	ppbc	1.2	7.6	19	11.9	62.6
N-Decane	ppbc	1.5	2.4	2.6	2	4.9
N-Heptane	ppbc	2.8	5.3	3.7	3.6	8.3
N-Hexane	ppbc	10.3	4.3	5.9	4.6	19.5
N-Nonane	ppbc	2.2	3.1	2.4	2.6	5.3
N-Octane	ppbc	2.4	4.4	2.7	2.8	7
N-Pentane	ppbc	1.1	2	7.4	5.1	35
N-Propylbenzene	ppbc	0	0	0.6	0	0
N-Undecane	ppbc	1.4	2.1	3.3	2.6	4
O-Ethyltoluene	ppbc	0	0	0	0	0
O-Xylene	ppbc	1.2	1.7	1.9	1.5	2.3
P-Diethylbenzene	ppbc	0	1.5	1	0.6	0.9
P-Ethyltoluene	ppbc	0	0	1	0	1
Propane	ppbc	52.8	30.7	62.5	14.2	84.8
Propylene	ppbc	0	1	1.1	0.6	1.5
Styrene	ppbc	1.7	3	7	2.5	3.8
Toluene	ppbc	2.6	5.3	11.3	4.4	16.6
Trans-2-Butene	ppbc	1.8	0	0	0	0
Trans-2-Pentene	ppbc	0	0	0	0	1.1
Nitric Oxide	ppb	17.1	3.8	17.9	23.8	22.2
Nitrogen Dioxide	ppb	18.4	15.2	22.1	27.3	42.8

Year 2024						
Parameter	Unit of Measure *	Madera-Pump Yard	Clovis-Villa	Parlier	Shafter	Bakersfield-Muni
Oxides Of Nitrogen	ppb	33.9	17	37.9	44.3	58.8
Total NMOC	ppm	0.47		0.16	15.75	1.34

ppbc - parts per billion carbon
ppb – parts per billion
ppm – parts per million
Blank cells indicate no data.

3.4 Analysis of Wind Roses for District's Enhanced Ozone Networks

Wind flow patterns play a significant role in the distribution of air pollutants in the San Joaquin Valley. Figure 3-2 shows wind roses for each site in the SJV enhanced ozone monitoring network. During the daytime, surface winds enter the San Joaquin Valley primarily from the northwest through the San Francisco Bay area, and from the west through passes in the Coastal Range. The air transports ozone precursors emitted in the Bay Area and transports them southeastward where they contribute to the formation of ozone in the SJV. In addition, precursor emissions from other upwind source areas in the SJV, such as those in San Joaquin, Stanislaus, and Merced counties, are also transported southward where they contribute to the formation of ozone in downwind areas such as those in Fresno, Tulare, and Kern counties.

Air essentially flows unobstructed through the Madera-Pump Yard site so its wind rose is representative of the prevailing northwesterly wind direction in the SJV. This general transport flow moves surface air southeastward from Stockton in the north toward Bakersfield in the south. The effect of the surface air transport is reflected in the emissions transport patter, from the northwest to the southeast.

The city of Parlier (southeast of the city of Fresno), and the communities of Edison and Arvin (east, south east of Bakersfield), often experience the highest ozone concentrations in the San Joaquin Valley. The mountains and protruding foothills in the southern part of the SJV portion of Kern County divert the northwesterly wind flow and causes it to become more southwesterly. This wind direction is seen in the Arvin-Di Giorgio wind rose plot.

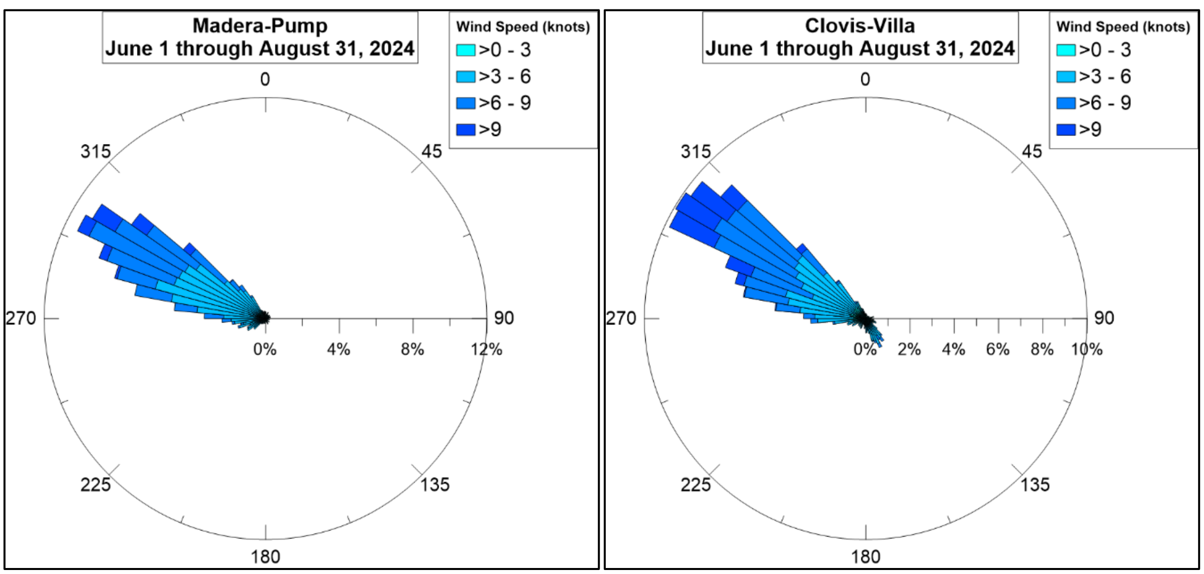
During the typical northwesterly airflow pattern, air leaves the southern end of the Valley during the day by flowing over the Tehachapi Mountains (southeast of Bakersfield) into the Mojave Desert. Pollutants are transported out of the SJV by this wind pattern. Heated air during daytime hours also allows uplift of the airmass away from the surface into the mountains. This mechanism also transports ozone and other pollutants up the Sierra Nevada and coastal mountains.

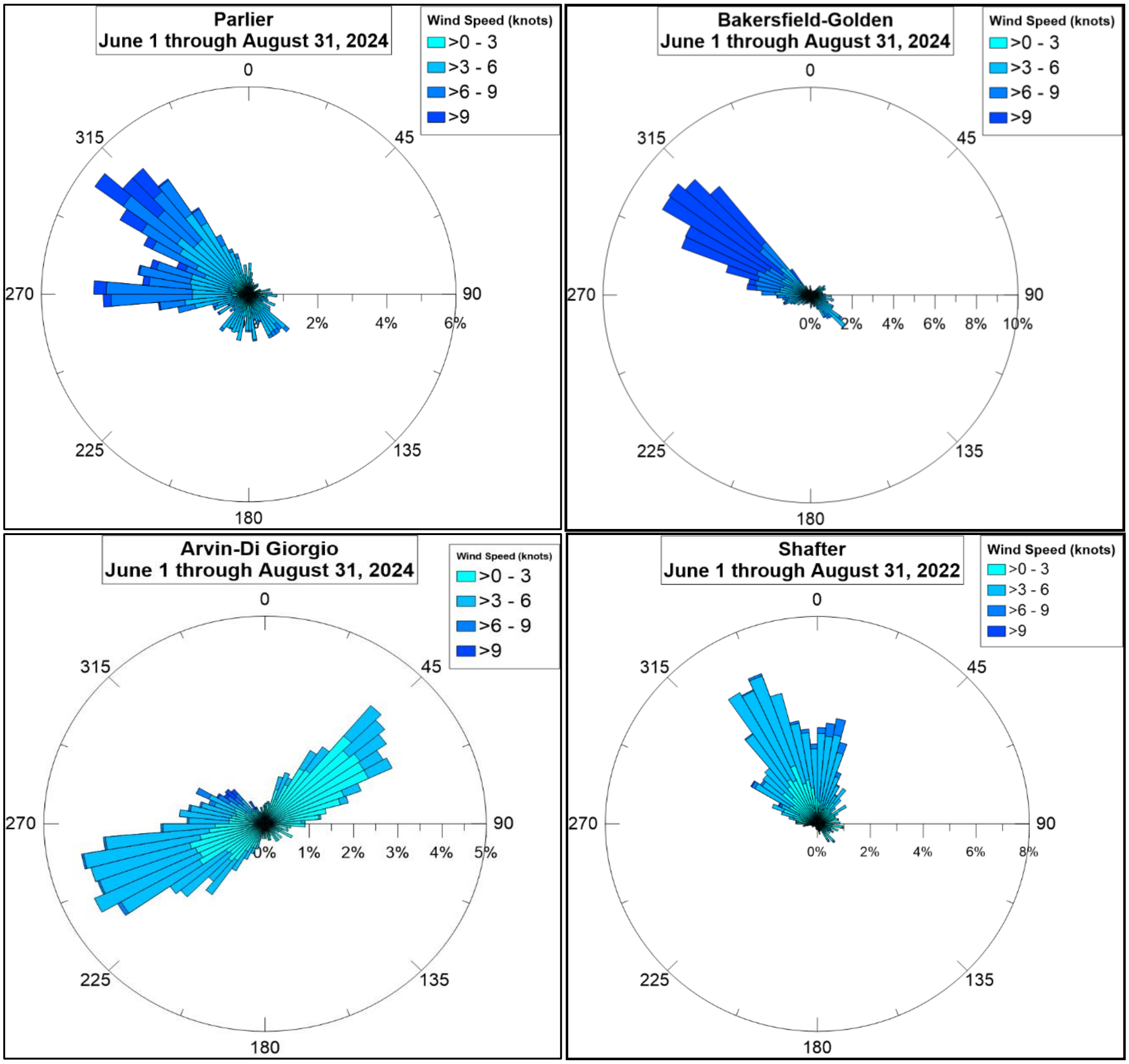
At night time, the same general wind flow pattern continues but the air is no longer able to exit the southern end of the SJV due to cooler surface temperatures preventing the airmass from rising. Cooler temperatures in the mountains also result in drainage winds transporting air from higher mountain elevations to lower valley floor elevations. Because of these topographic influences, wind directions are very different at the Arvin-Di Giorgio site as is depicted on the site's wind rose plot. As a result, the winds and pollutants are forced back toward the north which created a circular wind flow pattern in near Fresno and Tulare counties known as the Fresno eddy. The eddy circulates pollutants in a counterclockwise pattern, and returns polluted air to urban areas where more precursors are added the next day.

Another important difference about the nighttime winds in the San Joaquin Valley is that they typically are caused by a jet stream of fast moving air at an altitude of about 1000 feet and a speed of up to 30 mph. Lastly, some of the pollutants transported to higher altitudes from daytime heating return to the valley at night because of drainage winds from the mountains. During the next afternoon, with solar heating breaking the temperature inversion layer, pollution above the surface will mix down and fumigate.

Shafter and Bakersfield-Muni did not record usable wind speed and wind direction data during the 2024 PAMS sampling period. The Shafter wind rose uses the most recent data available for the Shafter monitoring site, using 2022 data as substitute to display expected wind direction and speed. 2024 data from the nearby Bakersfield-Golden / M St. site has been substituted for Bakersfield-Muni site below.

Figure 3-2 Wind Roses for District's Enhanced Ozone sites





Madera = Madera-Pump Yard, BFL-Golden = Bakersfield-Golden / M St.

4. TECHNICAL APPROACH AND FINDINGS – METEOROLOGICAL NETWORK ASSESSMENT

4.1 Meteorological Network Assessment Objectives

The goal of the meteorological network assessment presented in this section was to assess the number of meteorological parameters measured by the network, conduct wind rose and correlation analyses, and address the following questions:

- Are meteorological sites appropriately located to determine the extent of regional pollutant transport among populated areas?
- Are there potentially redundant meteorological sites in the network?

- Are there areas where new meteorological sites may be needed?
- Are there new technologies that may add value to the meteorological network?
- Is the meteorological network adequate for characterizing regional surface and lower atmosphere meteorology?

The remainder of this section describes the technical approach and findings of the meteorological network assessment.

4.2 Meteorological Parameters and Site Locations

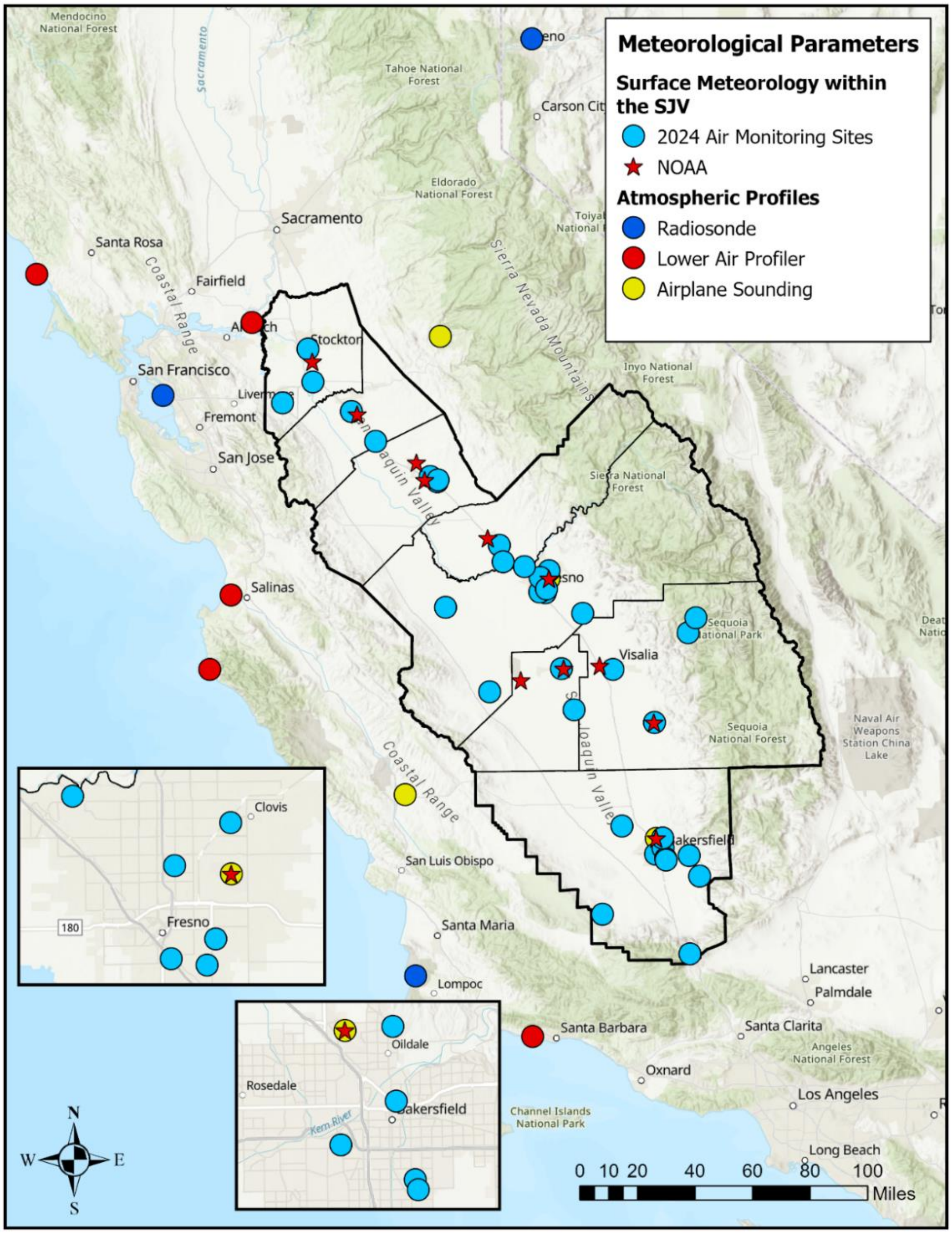
Accurate representation of the spatial and temporal characteristics of a region's meteorology is needed to understand the physical and chemical processes that influence air quality and to help determine ways to mitigate future air quality impacts. The main meteorological conditions that influence air quality include horizontal dispersion and transport of pollution by wind, recirculation of air by local wind patterns, variations in sunlight due to clouds and seasons, temperature, moisture, vertical mixing, and dilution of pollution within the atmospheric boundary layer.

A variety of meteorological parameters are measured for the various District objectives affected by the weather. Such objectives include air quality forecasting, PAMS analysis, exceptional events reporting, long-term air pollution control planning, and pollutant trend assessment. These efforts help protect public health and increase awareness of what can be done to reduce air pollution.

Figure 4-1 shows a map of the NOAA (National Oceanic and Atmospheric Administration) and air monitoring surface meteorological sites within the SJV. In addition, the airplane sounding and the atmospheric profile sites operating in and around the SJV are displayed. A majority of these meteorological sites in the San Joaquin Valley are located in or near populated areas, and tend to be around areas of higher pollution concentrations. The meteorological parameters measured by this network include outdoor temperature, wind speed, wind direction, barometric pressure, relative humidity, and solar radiation. The meteorological sites currently in operation are appropriately located to determine the extent of regional pollutant transport among populated areas.

Data from meteorological instruments in additional networks within and surrounding the SJV can also be used by the District to interpret atmospheric conditions around the SJV. These other meteorology networks include the California Irrigation Management Information System (CIMIS), CAL-Trans, Remote Automatic Weather Stations (RAWS), and public utilities companies such as PG&E.

Figure 4-1 Map of the locations measuring various meteorological parameters within and around the San Joaquin Valley



4.3 Upper Air Observations

Radiosondes[13] launched twice a day are meteorological instrument packs suspended beneath a six-foot wide hydrogen or helium balloon. Once the balloon is launched, meteorological measurements are recorded and transmitted to a ground receiver as the balloon ascends to high altitudes.

Airplane soundings are vertical temperature profiles, and sometimes other variables that are captured by a plane equipped with meteorological instruments, shown in Figure 4-2. The measurements are taken during portions of the plane's ascent or descent flight track.

Figure 4-2 Examples of Aircraft Monitoring Equipment and Output for Measuring Vertical Temperature Profiles

4.4 Meteorological Data Completeness

To evaluate the surface meteorological network, the District reviewed 2023 meteorological data from EPA's Air Quality System (AQS). The dataset included relative humidity, barometric pressure, outdoor temperature, wind speed, and wind direction collected by meteorological instruments at air monitoring sites throughout the San Joaquin Valley (SJV). This data was used to assess completeness at each site.

Table 4-1 lists the 31 SJV air monitoring sites with meteorological measurements, along with the operating agency and 2023 data completeness, based on the EPA AMP430 AQS Report. The report showed that 25 of the 31 sites achieved more than 75% completeness across all measured meteorological parameters.

The report also showed that some site had less than 75% completeness for some meteorological parameters. Operation of the met instruments at the Shafter site shifted from the District to CARB during 2023. As a result, some data loss occurred while instrument were offline during the transition.

[13] NWS Radiosonde Observations – Factsheet: https://www.weather.gov/upperair/factsheet

Table 4-1 Data Completeness for Meteorology Measurements at Air Monitoring Sites

Site Name	Site Operator[+]	Data Completeness (%)					
		Relative Humidity	Barometric Pressure	Solar Radiation	Outdoor Temp.	Wind Speed*	Wind Direction*
Stockton-University Park	CARB	83			84	^	^
Manteca	SJVAPCD				100	100	100
Tracy-Airport	SJVAPCD		95		95	47	47
Modesto-14th St	CARB	100			100	100	100
Turlock	SJVAPCD		100		100	100	100
Merced-Coffee	SJVAPCD				100	46	46
Merced-M St	SJVAPCD				94	93	93
Madera-City	SJVAPCD	98	98	98	98	98	98
Madera-Pump Yard	SJVAPCD	99	99	99	99	99	99
Tranquillity	SJVAPCD		100		100	100	100
Fresno-Sky Park	SJVAPCD				99	99	99
Clovis-Villa	SJVAPCD	100	100	100	99	100	100
Fresno-Garland	CARB	100	98		100	99	99
Fresno-Pacific	SJVAPCD				72	69	69
Fresno-Drummond	SJVAPCD	100	100			100	100
Fresno-Foundry	SJVAPCD		100		100	100	100
Parlier	SJVAPCD	100	100	100	100	99	99
Huron	SJVAPCD		100				
Hanford-Irwin	SJVAPCD		100		95	79	79
Corcoran-Patterson	SJVAPCD				99	99	99
Visalia-W. Ashland	CARB	93			93	96	96
Porterville	SJVAPCD		98		96	90	90
Sequoia-Ash Mountain	NPS	99			99	91	91
Sequoia-Lower Kaweah[1]	NPS	99			99	97	97
Shafter	CARB	20	20	20	20	20	20
Oildale	CARB	85			85	85	85
Bakersfield-Golden / M St.	SJVAPCD				76	70	70

Site Name	Site Operator[+]	Data Completeness (%)					
		Relative Humidity	Barometric Pressure	Solar Radiation	Outdoor Temp.	Wind Speed*	Wind Direction*
Bakersfield-California	CARB	100			100	98	98
Bakersfield-Westwind	SJVAPCD		100		100	100	100
Edison	CARB	92			92	94	94
Bakersfield-Muni	SJVAPCD	100	100	100	100	100	100
Arvin-Di Giorgio	CARB	99			99	99	99
Maricopa	SJVAPCD		98		98	82	82
Lebec	SJVAPCD				98	53	53

Blank cells indicate that a parameter was not measured at the site.
Cells shaded green indicate data completeness was below the 75% target.
[+] SJVAPCD = San Joaquin Valley APCD, CARB = California Air Resources Board, NPS = National Park Service
[^] 2023 wind data was not available.
[*] Wind parameters are Resultant.
[1] Sequoia-Lower Kaweah operates seasonally measuring meteorology during the summer months only.

4.5 Surface Meteorological Network Assessment

A comparison of surface meteorological parameters shows the expected amount of variability between sites with no redundancy within the District's surface meteorological network. Valley floor sites that measure outdoor temperature correlate well with one another, especially as the distance between the sites decreases, while correlations for the other meteorological parameters vary a bit more from site to site.

4.5.1 Site-to-Site Correlation Analyses

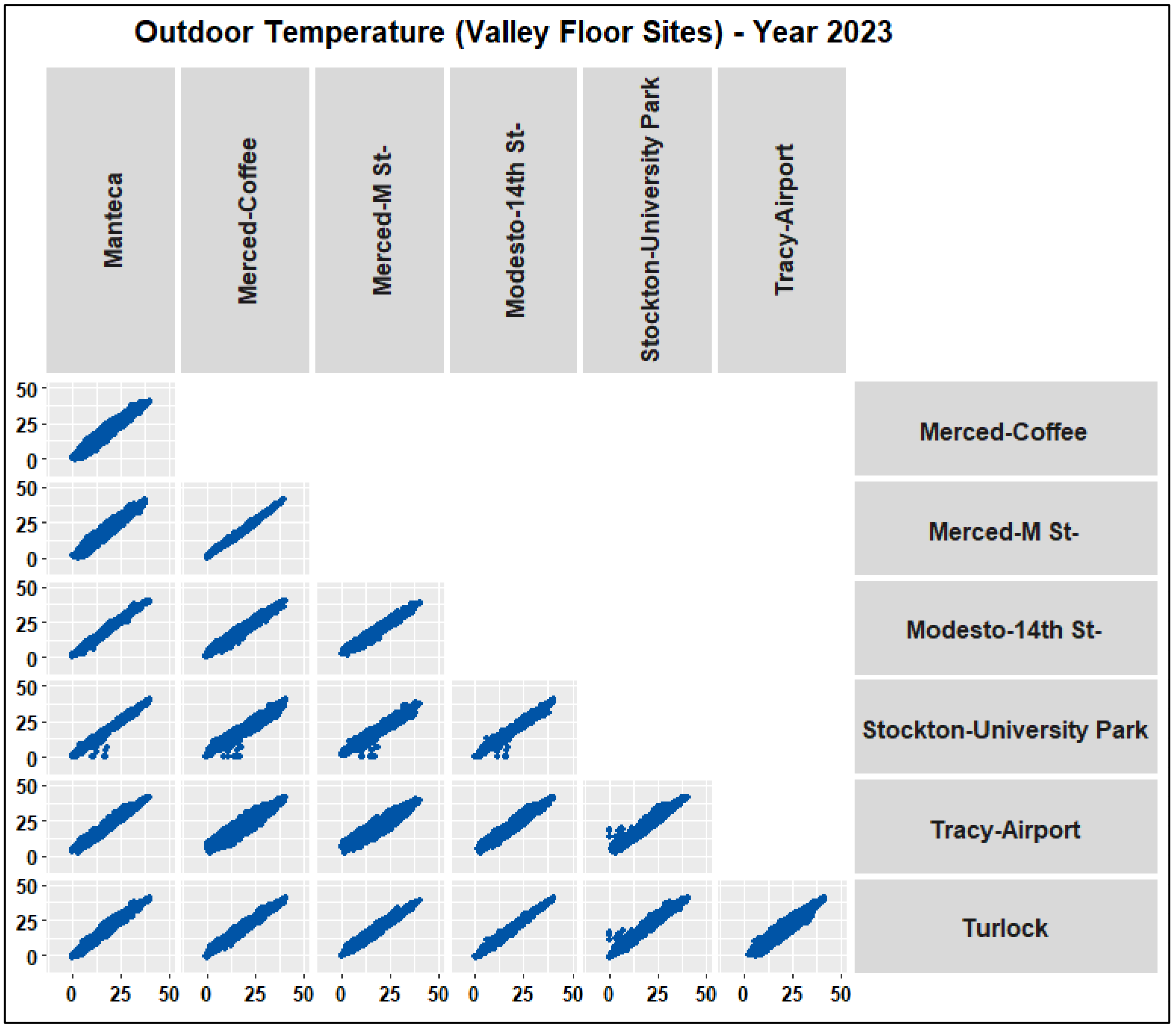
To identify possible redundancies in the surface meteorological network, the District conducted Pearson correlation analyses for hourly outdoor temperature, relative humidity, and solar radiation from 2023 AQS data. The Pearson correlation coefficient (R) is a measure of the linear relationship between two variables and ranges from -1.00 to 1.00. An R value of 1.00 means that there is a positive linear relationship between the data from two sites which could indicate a redundancy in the monitoring network for sites near each other. Figure 4-3 through Figure 4-7 and Table 4-2 through Table 4-6 below show the results of the correlation analyses.

4.5.2 Outdoor Temperature

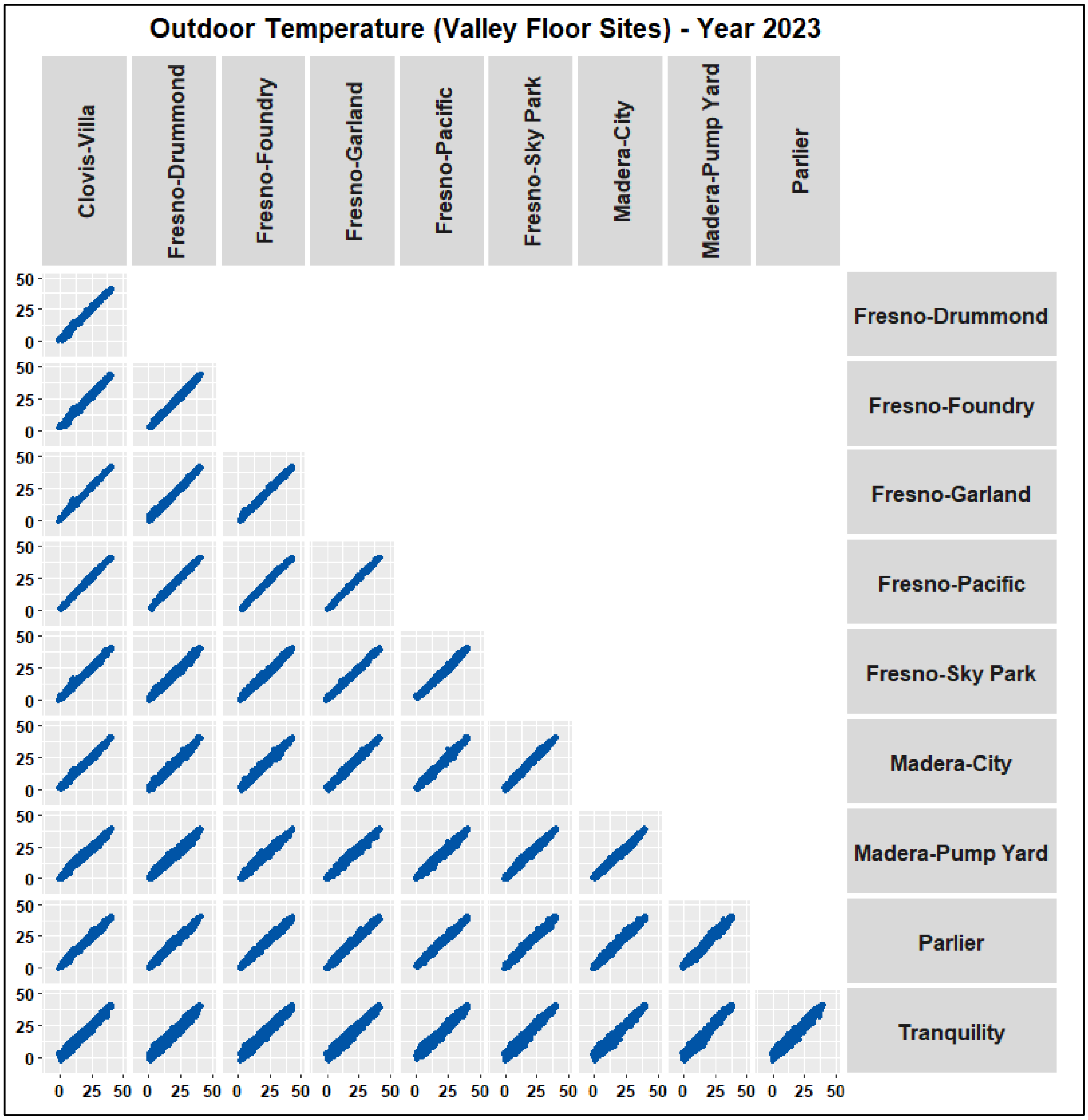
The outdoor temperature correlations are quite good, and reflect the geographic and environmental characteristics of the SJV. As shown in Table 4-2 below, the correlation analysis indicates a strong linear relationship between the outdoor temperature parameter and location for sites located on the Valley floor. Due to the regional nature of temperatures, high correlations among sites are expected. Table 4-3 shows that the correlations for the foothill and mountain sites are also good, and represent expected similarities at those sites.

Figure 4-3 Outdoor Temperature Correlations for Valley Floor Sites (Celsius)

a. Northern SJV Counties



b. Central SJV Counties



c. Southern SJV Counties

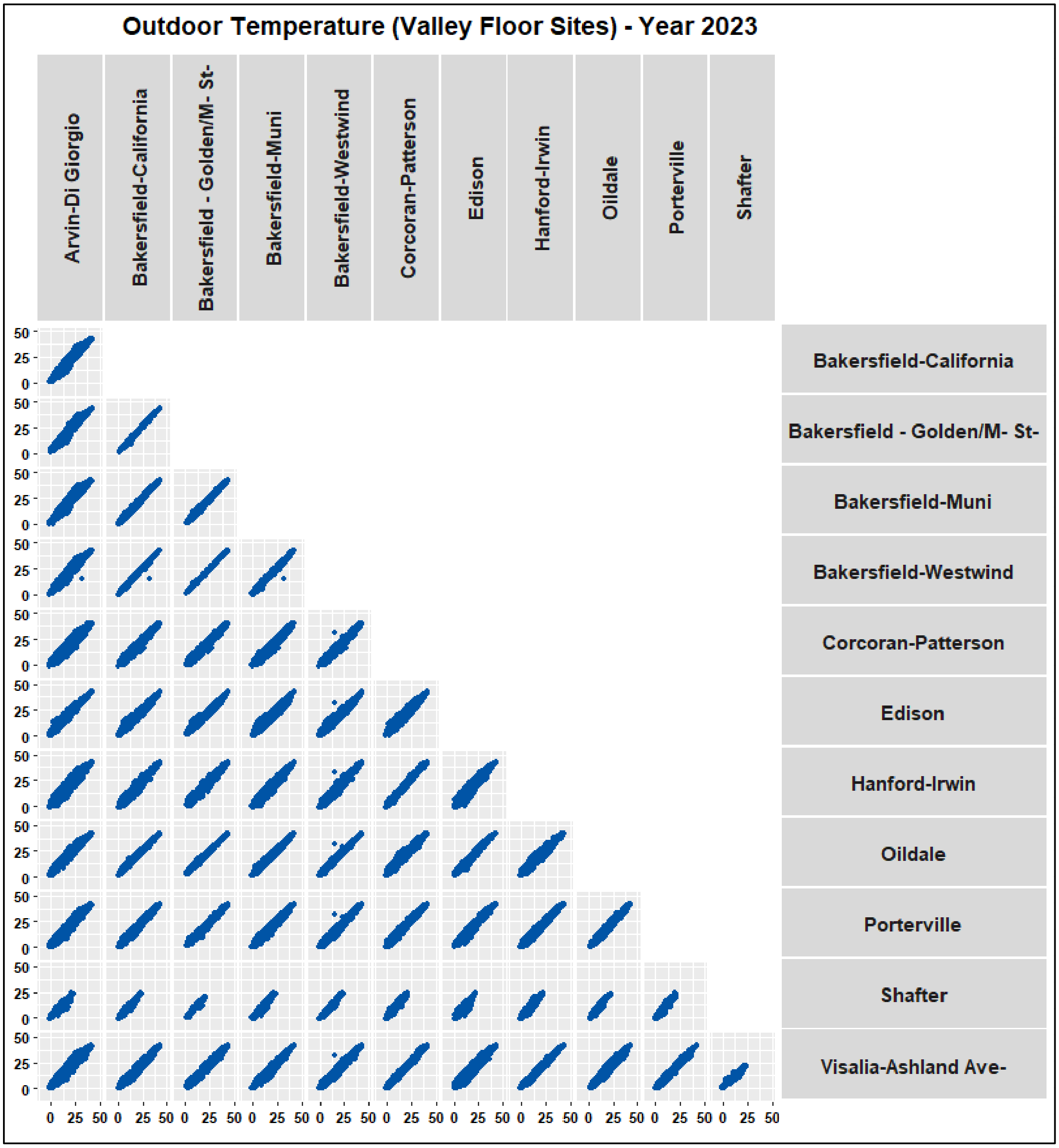


Table 4-2 Outdoor Temperature R-Values for Valley Floor Sites

Year 2023																												
Pearson Correlation Coefficients																												
	Arvin-Di Giorgio	Bakersfield - Golden / M St	Bakersfield-California	Bakersfield-Muni	Bakersfield-Westwind	Clovis-Villa	Corcoran-Patterson	Edison	Fresno-Drummond	Fresno-Foundry	Fresno-Garland	Fresno-Pacific	Fresno-Sky Park	Hanford-Irwin	Madera-City	Madera-Pump Yard	Manteca	Merced-Coffee	Merced-M St.	Modesto-14th St.	Oildale	Parlier	Porterville	Shafter	Stockton-University Park	Tracy-Airport	Tranquility	Turlock
Bakersfield – Golden / M St	0.97	-																										
Bakersfield-California	0.97	0.99	-																									
Bakersfield-Muni	0.97	0.99	0.99	-																								
Bakersfield-Westwind	0.97	0.99	0.99	0.99	-																							
Clovis-Villa	0.96	0.98	0.98	0.98	0.98	-																						
Corcoran-Patterson	0.96	0.98	0.98	0.98	0.98	0.99	-																					
Edison	0.98	0.98	0.98	0.98	0.98	0.97	0.97	-																				
Fresno-Drummond	0.95	0.98	0.98	0.98	0.98	0.99	0.99	0.97	-																			
Fresno-Foundry	0.96	0.98	0.98	0.97	0.98	0.99	0.99	0.97	0.99	-																		
Fresno-Garland	0.96	0.98	0.98	0.97	0.98	0.99	0.99	0.97	0.99	0.99	-																	
Fresno-Pacific	0.97	0.98	0.98	0.98	0.98	0.99	0.99	0.97	0.99	0.99	0.99	-																
Fresno-Sky Park	0.96	0.98	0.98	0.97	0.98	0.99	0.98	0.97	0.99	0.99	0.99	0.99	-															
Hanford-Irwin	0.96	0.98	0.98	0.98	0.98	0.99	0.99	0.97	0.99	0.99	0.99	0.99	0.98	-														
Madera-City	0.96	0.98	0.98	0.97	0.98	0.99	0.98	0.97	0.99	0.99	0.99	0.99	0.99	0.98	-													
Madera-Pump Yard	0.96	0.97	0.97	0.96	0.97	0.98	0.98	0.96	0.98	0.99	0.99	0.99	0.99	0.98	0.99	-												
Manteca	0.93	0.95	0.95	0.94	0.95	0.97	0.96	0.94	0.96	0.96	0.96	0.96	0.97	0.96	0.97	0.97	-											
Merced-Coffee	0.95	0.97	0.97	0.97	0.97	0.99	0.98	0.96	0.98	0.98	0.99	0.98	0.99	0.98	0.99	0.99	0.97	-										
Merced-M St.	0.95	0.96	0.97	0.95	0.96	0.98	0.97	0.96	0.97	0.98	0.98	0.98	0.98	0.97	0.98	0.98	0.97	0.99	-									
Modesto-14th St.	0.94	0.96	0.96	0.95	0.96	0.98	0.97	0.95	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.97	0.99	0.98	0.98	-								
Oildale	0.97	0.99	0.99	0.98	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.98	0.97	0.97	0.94	0.97	0.96	0.95	-							
Parlier	0.97	0.98	0.98	0.98	0.98	0.99	0.99	0.97	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.96	0.98	0.98	0.97	0.98	-						
Porterville	0.97	0.99	0.98	0.98	0.98	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.95	0.97	0.97	0.96	0.98	0.98	-					
Shafter	0.95	0.97	0.97	0.96	0.98	0.92	0.95	0.92	0.93	0.93	0.93	0.93	0.94	0.95	0.93	0.93	0.86	0.92	0.93	0.87	0.94	0.94	0.95	-				
Stockton-University Park	0.93	0.95	0.95	0.93	0.94	0.97	0.96	0.94	0.95	0.96	0.96	0.96	0.96	0.95	0.96	0.97	0.99	0.97	0.97	0.98	0.94	0.96	0.95	0.86	-			
Tracy-Airport	0.91	0.94	0.94	0.93	0.94	0.96	0.94	0.93	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.98	0.96	0.95	0.98	0.94	0.94	0.95	0.79	0.97	-		
Tranquility	0.96	0.97	0.97	0.97	0.97	0.98	0.98	0.96	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.99	0.98	0.98	0.97	0.98	0.97	0.93	0.97	0.96	-	
Turlock	0.94	0.96	0.96	0.96	0.96	0.98	0.98	0.95	0.98	0.98	0.98	0.98	0.98	0.97	0.98	0.98	0.98	0.99	0.98	0.99	0.96	0.97	0.97	0.89	0.98	0.97	0.98	-
Visalia-W. Ashland Avenue	0.96	0.98	0.98	0.98	0.98	0.99	0.99	0.97	0.99	0.99	0.99	0.99	0.98	0.99	0.98	0.98	0.95	0.98	0.97	0.96	0.98	0.99	0.99	0.95	0.95	0.94	0.97	0.97

Pearson Correlation (R)

0.0 - 0.09	0.1 - 0.19	0.2 - 0.29	0.3 - 0.39	0.4 - 0.49	0.5 - 0.59	0.6 - 0.69	0.7 - 0.79	0.8 - 0.89	0.9 - 1.00

Figure 4-4 Outdoor Temperature Correlations for the Foothill and Mountain Sites

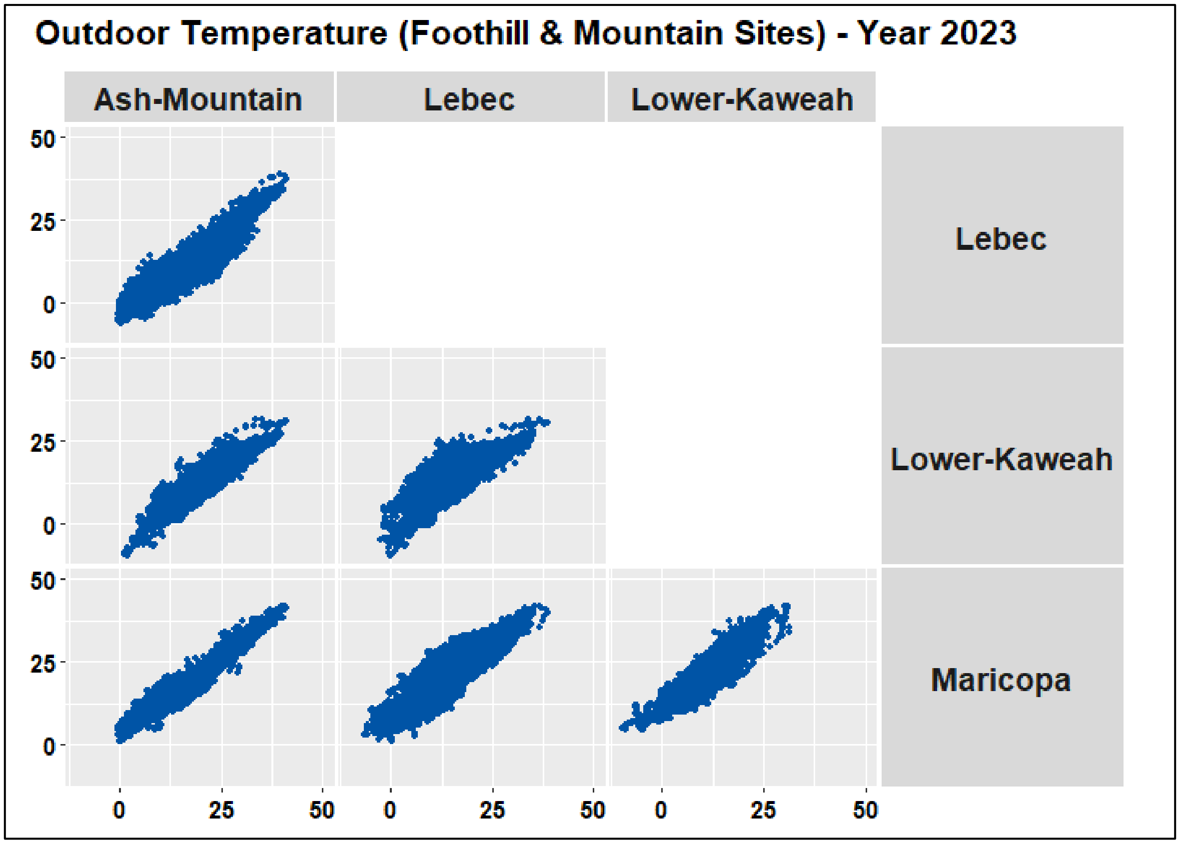


Table 4-3 Outdoor Temperature R-Values for the Foothill and Mountain Sites

Year 2023			
Pearson Correlation Coefficients			
	Ash Mountain	Lebec	Lower Kaweah
Lebec	0.93	-	
Lower-Kaweah	0.92	0.81	-
Maricopa	0.97	0.92	0.91

Pearson Correlation (R)

0.0 - 0.09	0.1 - 0.19	0.2 - 0.29	0.3- 0.39	0.4 - 0.49	0.5 - 0.59	0.6 - 0.69	0.7 - 0.79	0.8 - 0.89	0.9 - 1.00

4.5.3 Relative Humidity

Figure 4-5 and Figure 4-6 show results from the relative humidity correlation analysis for the valley floor sites and the foothill and mountain sites. Relative humidity will typically vary more by location depending on various factors and changes significantly depending on location, time of day, and season.

Figure 4-5 Relative Humidity Correlations for Valley Floor Sites

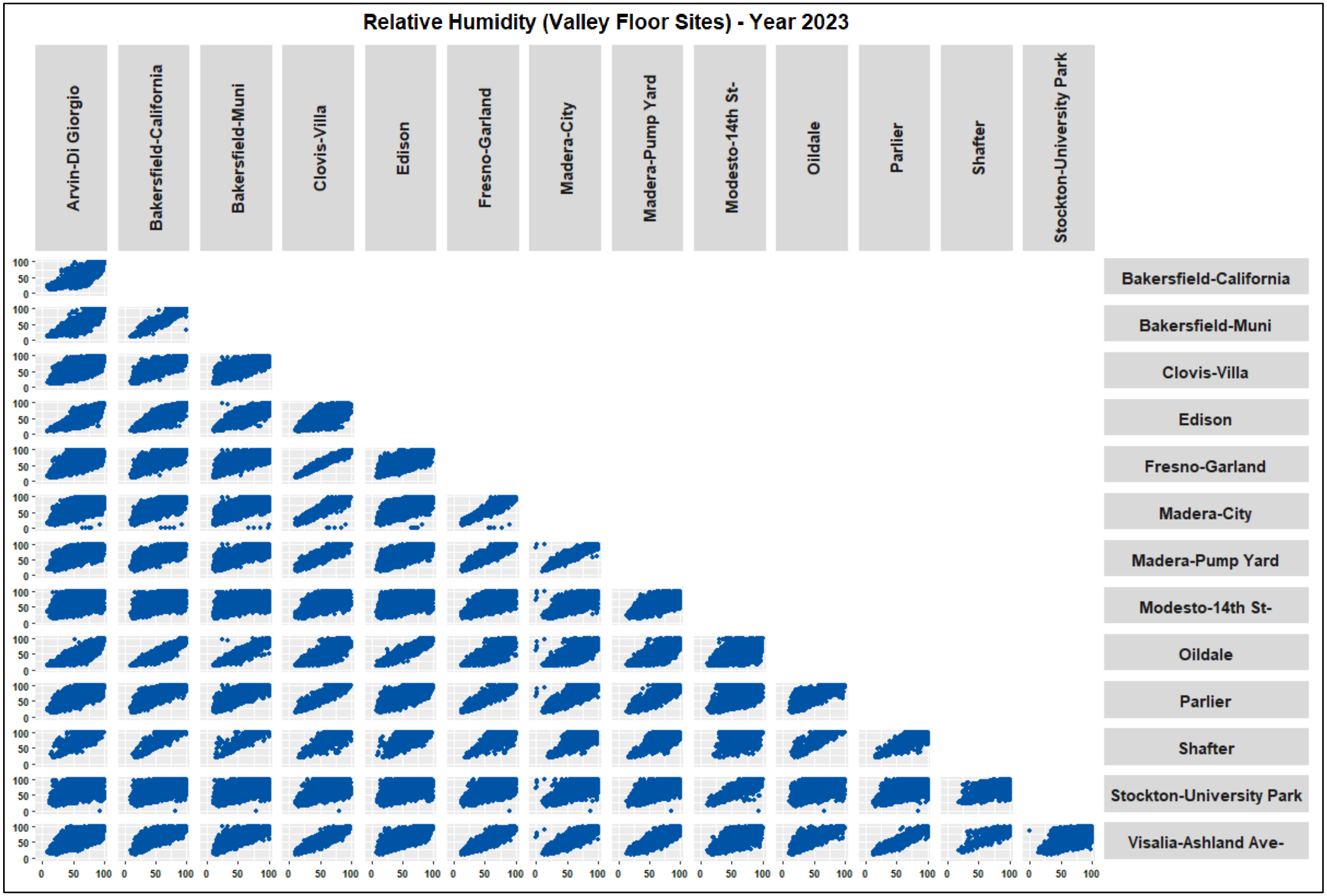


Figure 4-6 Relative Humidity Correlations for the Foothill and Mountain Sites

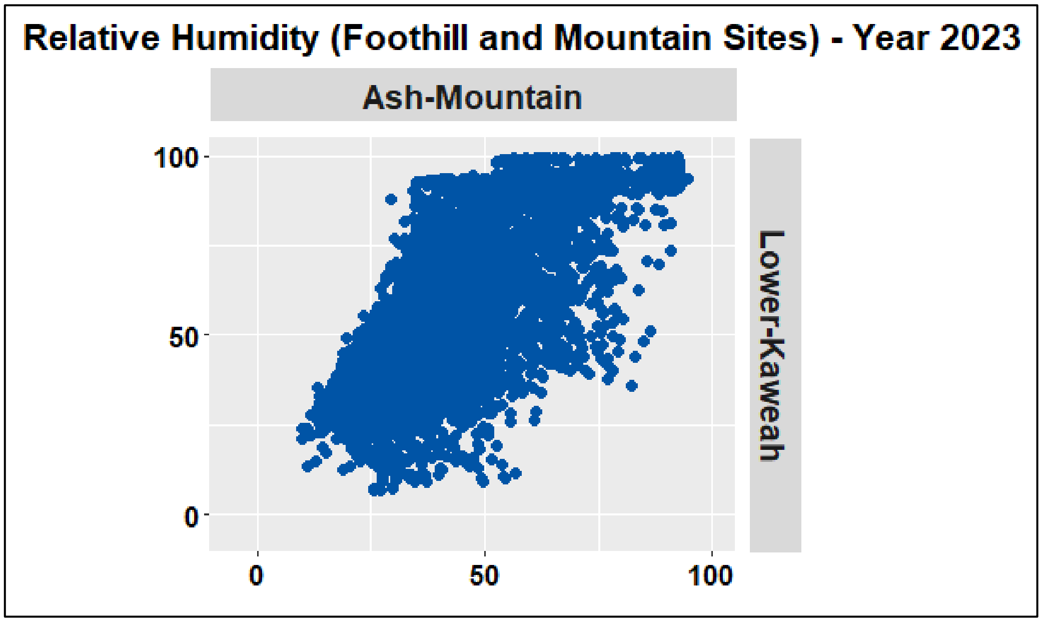


Table 4-4 Relative Humidity R-Values for the Valley Floor Sites

Year 2023													
Pearson Correlation Coefficients													
	Arvin-Di-Giorgio	Bakersfield-California	Bakersfield-Muni	Clovis-Villa	Edison	Fresno-Garland	Madera-City	Madera-Pump Yard	Modesto-14th St.	Oildale	Parlier	Shafter	Stockton-University Park
Bakersfield-California	0.90	-											
Bakersfield-Muni	0.90	0.97	-										
Clovis-Villa	0.83	0.89	0.88	-									
Edison	0.89	0.90	0.90	0.83	-								
Fresno-Garland	0.84	0.90	0.87	0.98	0.82	-							
Madera-City	0.82	0.87	0.86	0.96	0.79	0.96	-						
Madera-Pump Yard	0.83	0.85	0.84	0.94	0.78	0.95	0.95	-					
Modesto-14th St.	0.71	0.77	0.75	0.84	0.68	0.85	0.86	0.85	-				
Oildale	0.86	0.94	0.93	0.86	0.95	0.85	0.83	0.80	0.71	-			
Parlier	0.84	0.88	0.88	0.95	0.80	0.94	0.93	0.93	0.81	0.82	-		
Shafter	0.86	0.91	0.90	0.83	0.78	0.84	0.83	0.84	0.68	0.85	0.85	-	
Stockton-University Park	0.69	0.73	0.70	0.78	0.63	0.80	0.80	0.81	0.94	0.65	0.76	0.65	-
Visalia-W. Ashland Avenue	0.84	0.90	0.90	0.95	0.82	0.95	0.92	0.91	0.82	0.86	0.96	0.87	0.77

Pearson Correlation (R)

0.0 - 0.09	0.1 - 0.19	0.2 - 0.29	0.3 - 0.39	0.4 - 0.49	0.5 - 0.59	0.6 - 0.69	0.7 - 0.79	0.8 - 0.89	0.9 - 1.00

Table 4-5 Relative Humidity R-Value for the Foothill and Mountain Sites

Year 2023	
Pearson Correlation Coefficients	
	Ash-Mountain
Lower-Kaweah	0.72

4.5.4 Solar Radiation

Figure 4-7 and Table 4-6 show that the results of the solar radiation correlation analysis for the valley floor sites are very good. The range of values shown in the analysis is representative of expected differences that occur depending on the daily diurnal pattern of daylight hours and effects of cloud cover and seasonal changes in sun angle. Due to the regional nature of solar radiation, high correlations among sites is expected.

Figure 4-7 Solar Radiation Correlations for the Valley Floor Sites

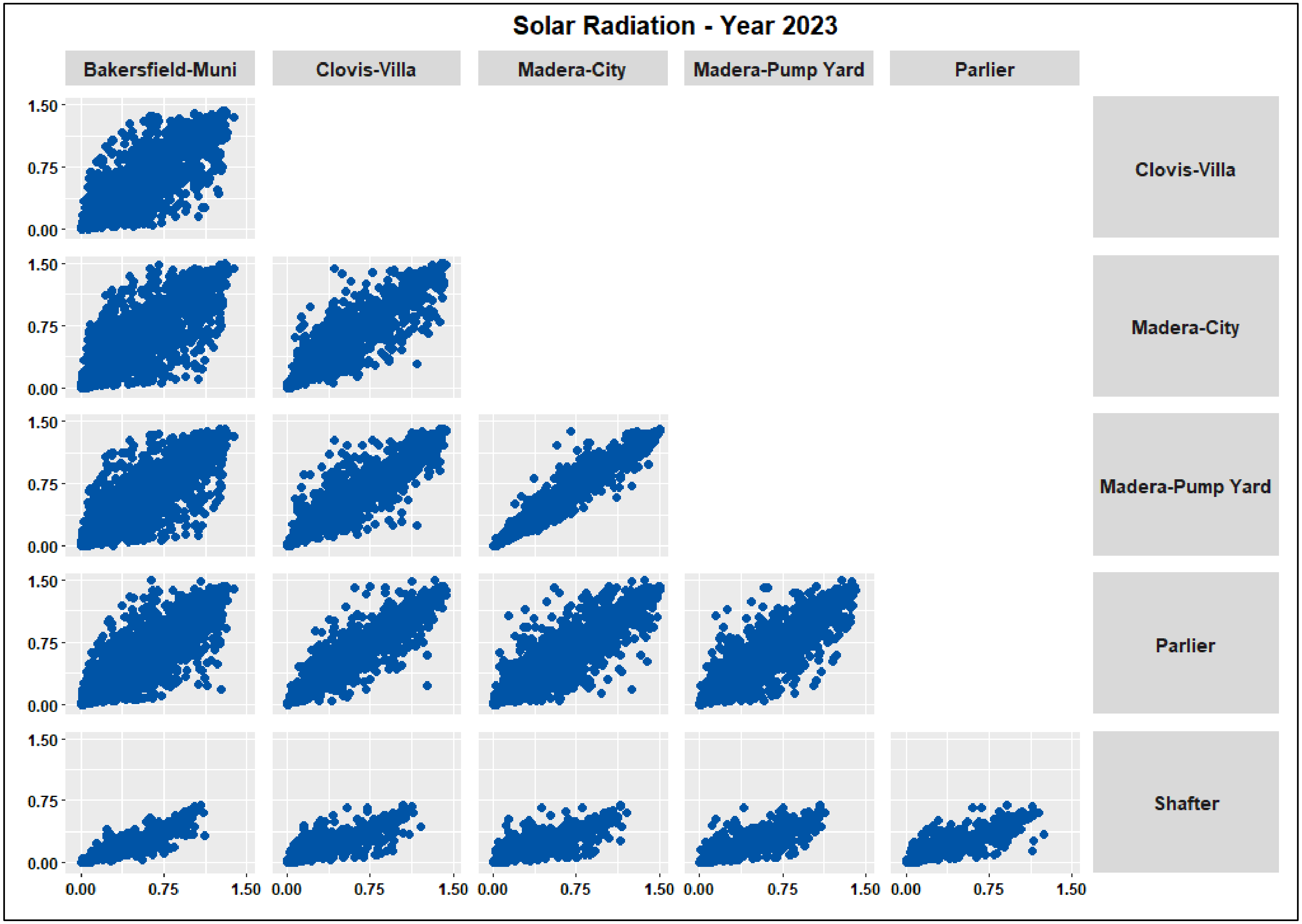


Table 4-6 Solar Radiation R Values for the Valley Floor Sites

Year 2023					
Pearson Correlation Coefficients					
	Bakersfield-Muni	Clovis-Villa	Madera-City	Madera-Pump Yard	Parlier
Madera-City	0.96	0.98	-		
Madera-Pump Yard	0.96	0.98	0.99	-	
Parlier	0.97	0.98	0.98	0.98	-
Shafter	0.95	0.92	0.91	0.91	0.93

Pearson Correlation (R)

0.0 - 0.09	0.1 - 0.19	0.2 - 0.29	0.3- 0.39	0.4 - 0.49	0.5 - 0.59	0.6 - 0.69	0.7 - 0.79	0.8 - 0.89	0.9 - 1.00

4.6 Wind and Pollution Rose Analyses

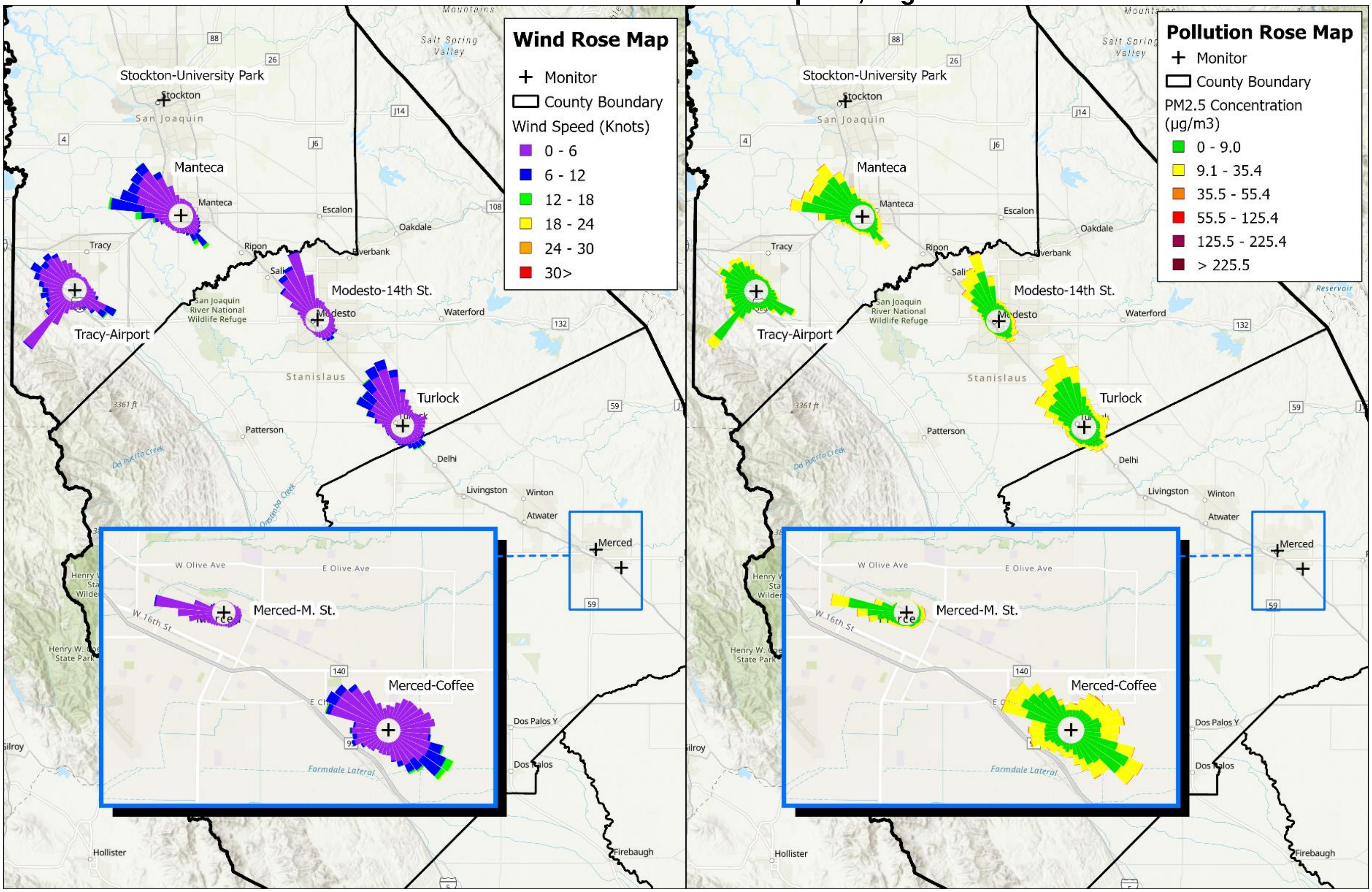
Meteorological parameters such as wind speed and direction can vary significantly due to weather patterns, geography, and topography. While a simple correlation analysis may indicate general similarities or differences between monitoring sites, it does not capture spatial variations in wind behavior. To better assess wind flow patterns and their influence on pollutant transport across the San Joaquin Valley (SJV), the District incorporated 2023 wind, $PM_{2.5}$, PM_{10}, and ozone data into the online WebR REPL App to generate wind and pollution roses. These visual tools provided a clearer picture of seasonal and regional variability throughout the year.

While a simple correlation analysis may show general similarities or differences between sites, it does not capture the spatial variability in wind patterns across the region. To address this, the District used the 2023 wind, PM2.5, PM10, and ozone data to generate wind and pollution roses. These were overlaid on a regional map of air monitoring sites, allowing for a spatially-resolved visualization of wind behavior and pollutant transport across the San Joaquin Valley (see Figure 4-8below).

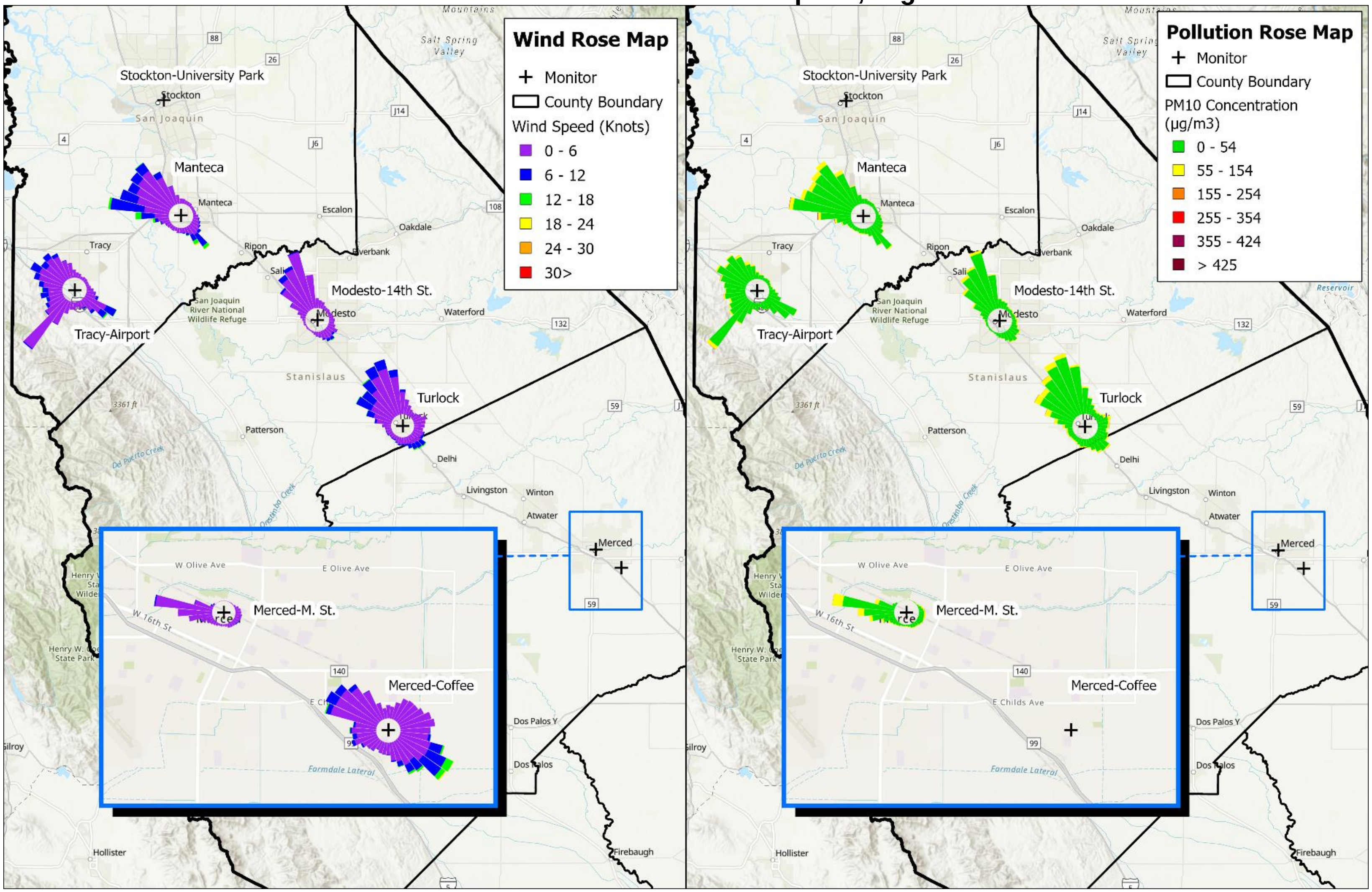
The wind roses show that the prevailing wind direction at the majority of valley floor sites in the District's network is from the northwest. The wind patterns also tend to shift seasonally and become southeasterly during the winter months. The wind direction at sites at higher elevations are subject to topographic influences as well as diurnal variations such as winds flowing upslope during the day and downslope at night.

Figure 4-8 Wind Roses and PM2.5, PM10, and Ozone Pollution Roses for the San Joaquin Valley

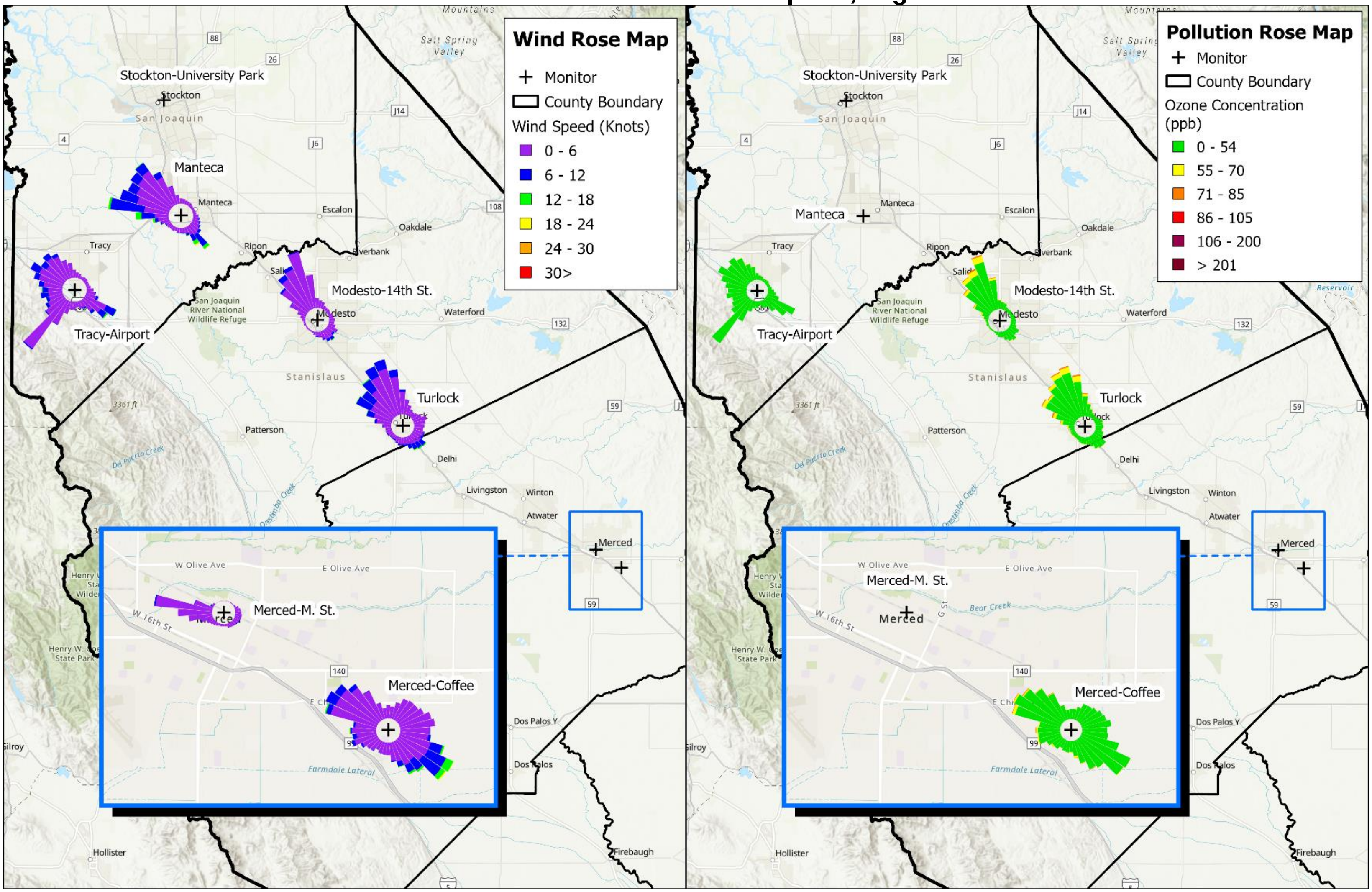
a. Northern Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and PM2.5



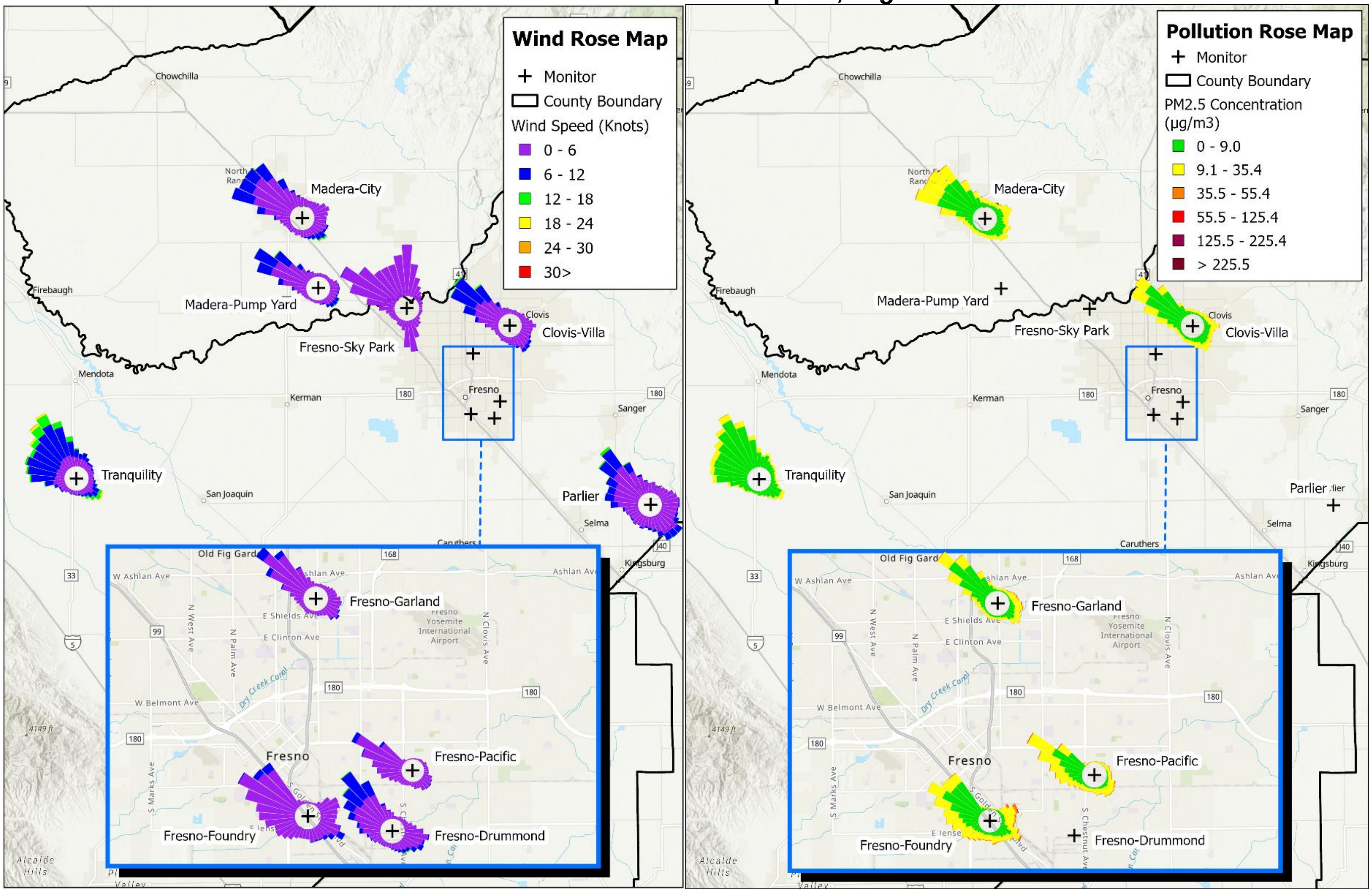
b. Northern Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and PM10



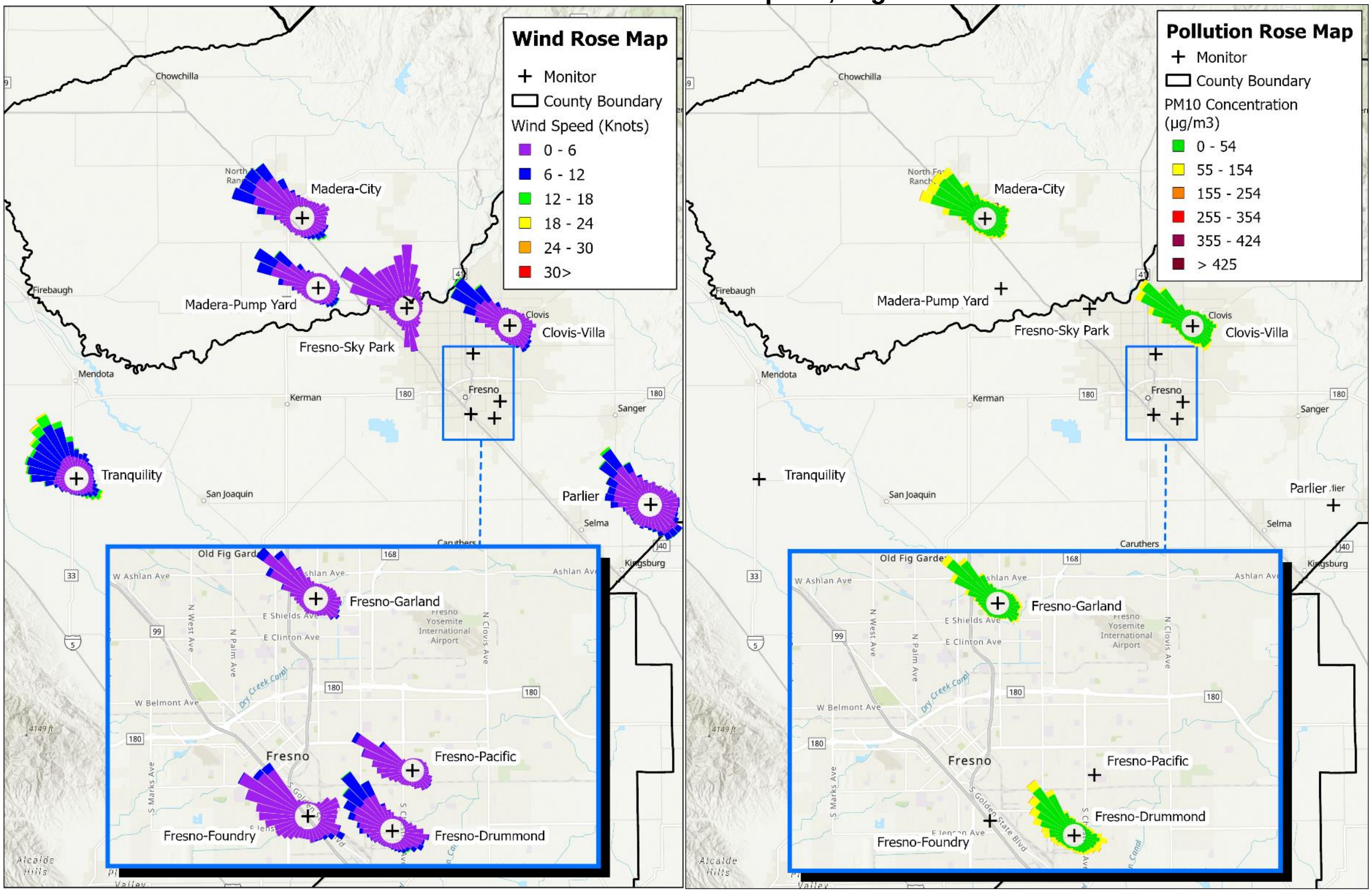
c. Northern Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and Ozone



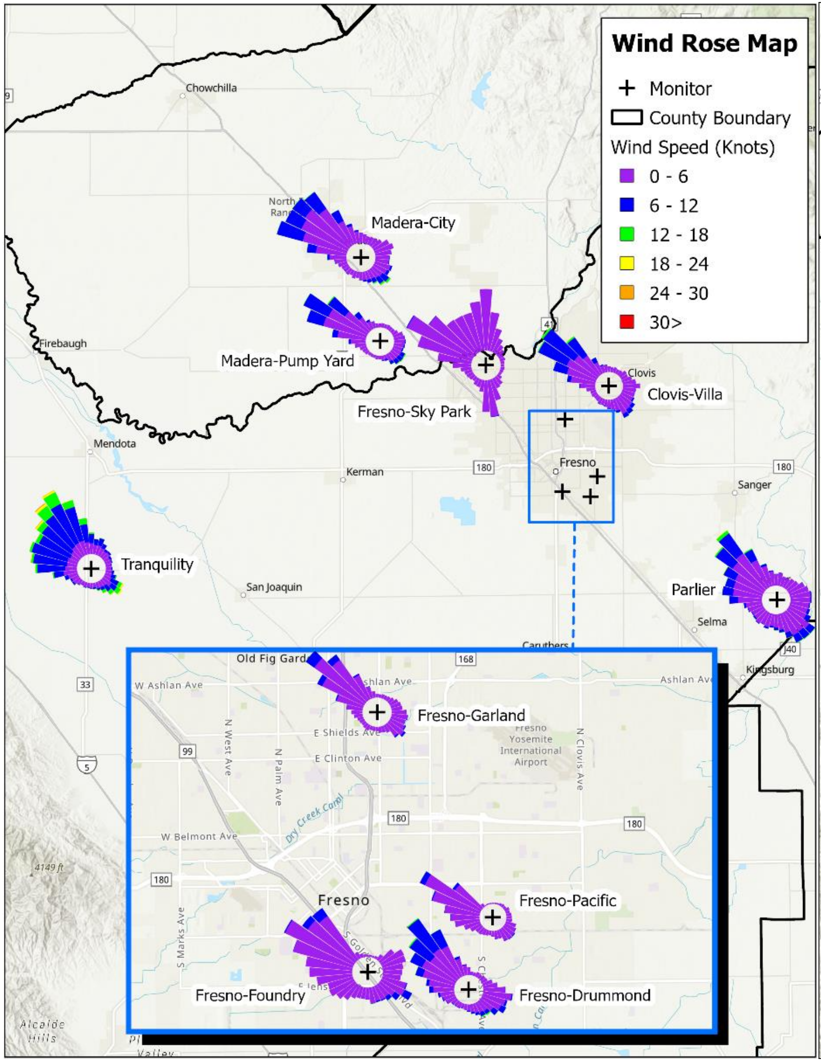
d. Central Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and PM2.5

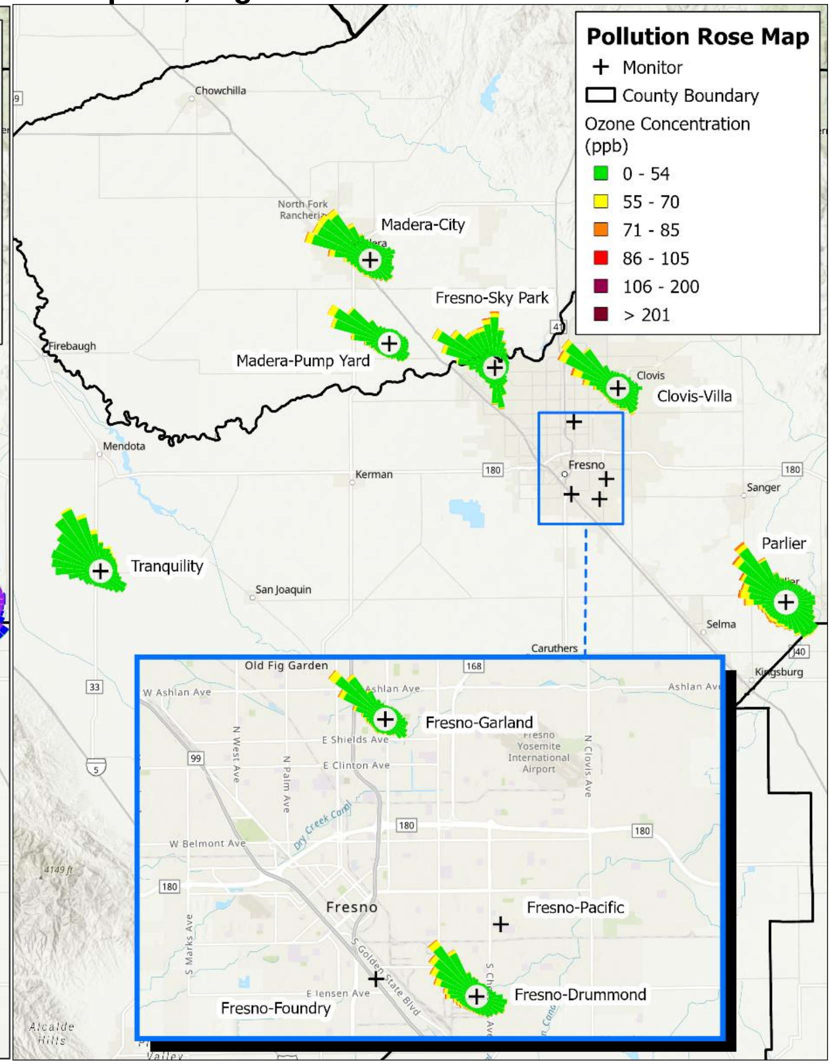


e. Central Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and PM10

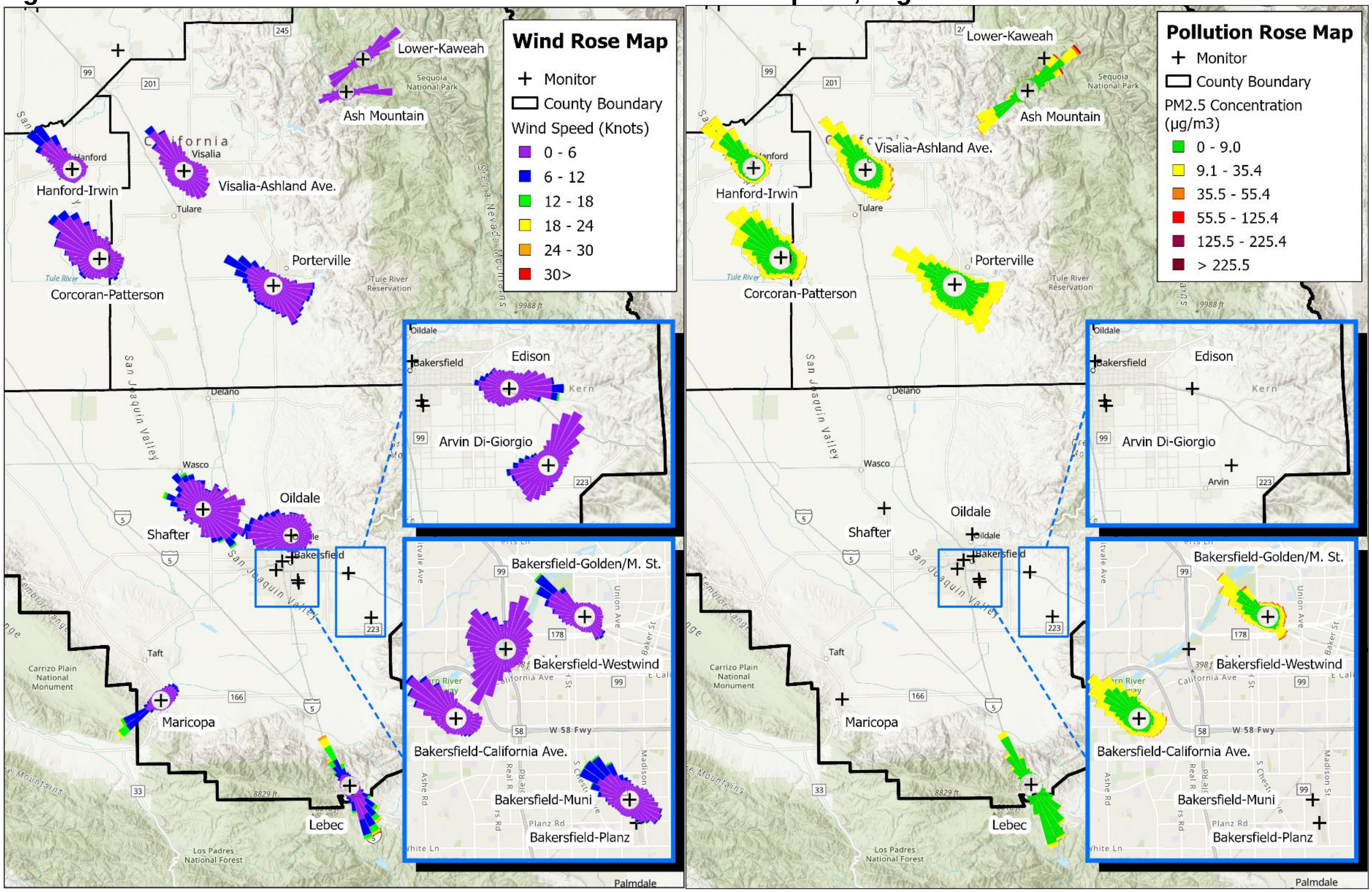


f. Central Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and Ozone

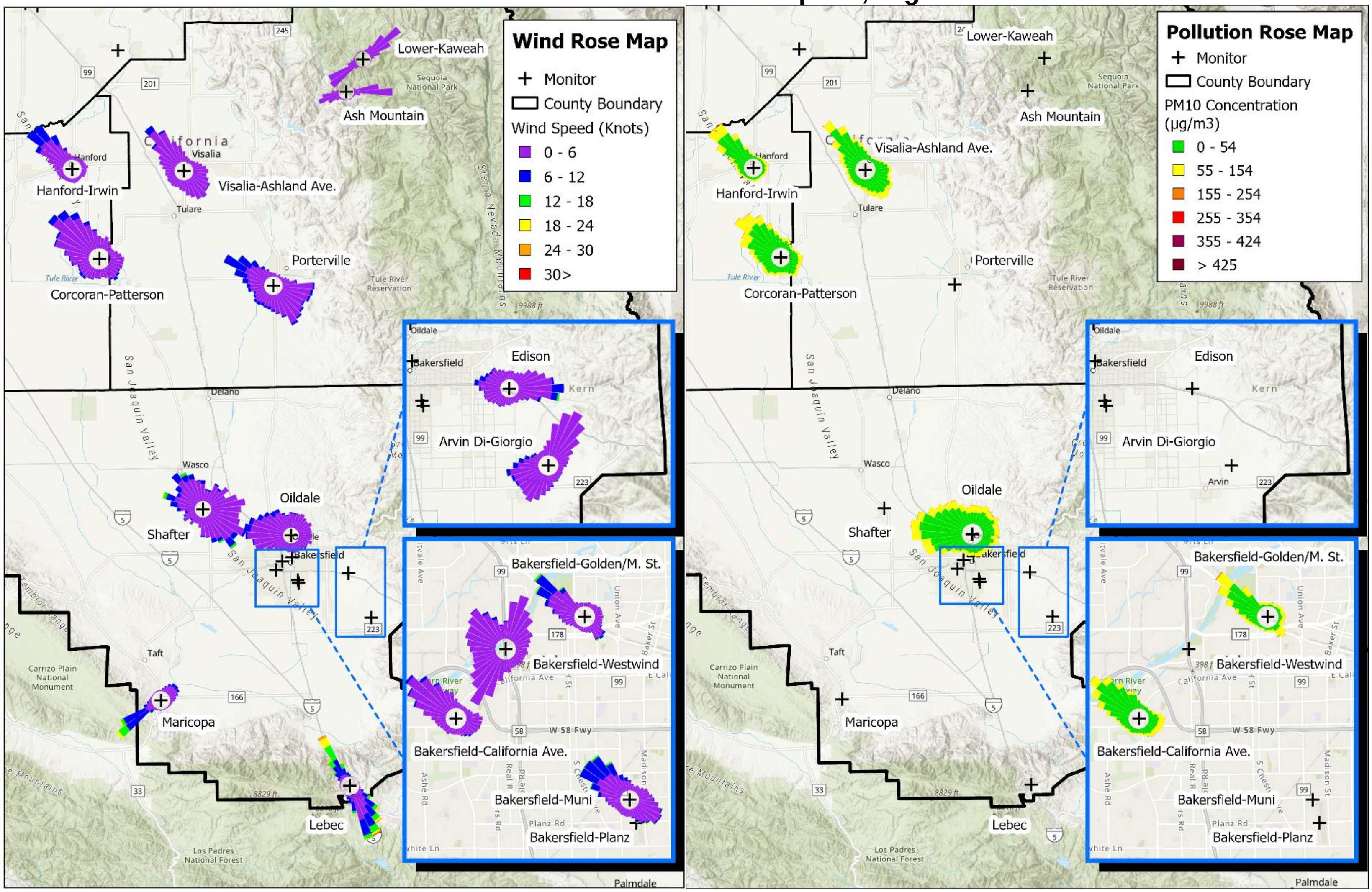




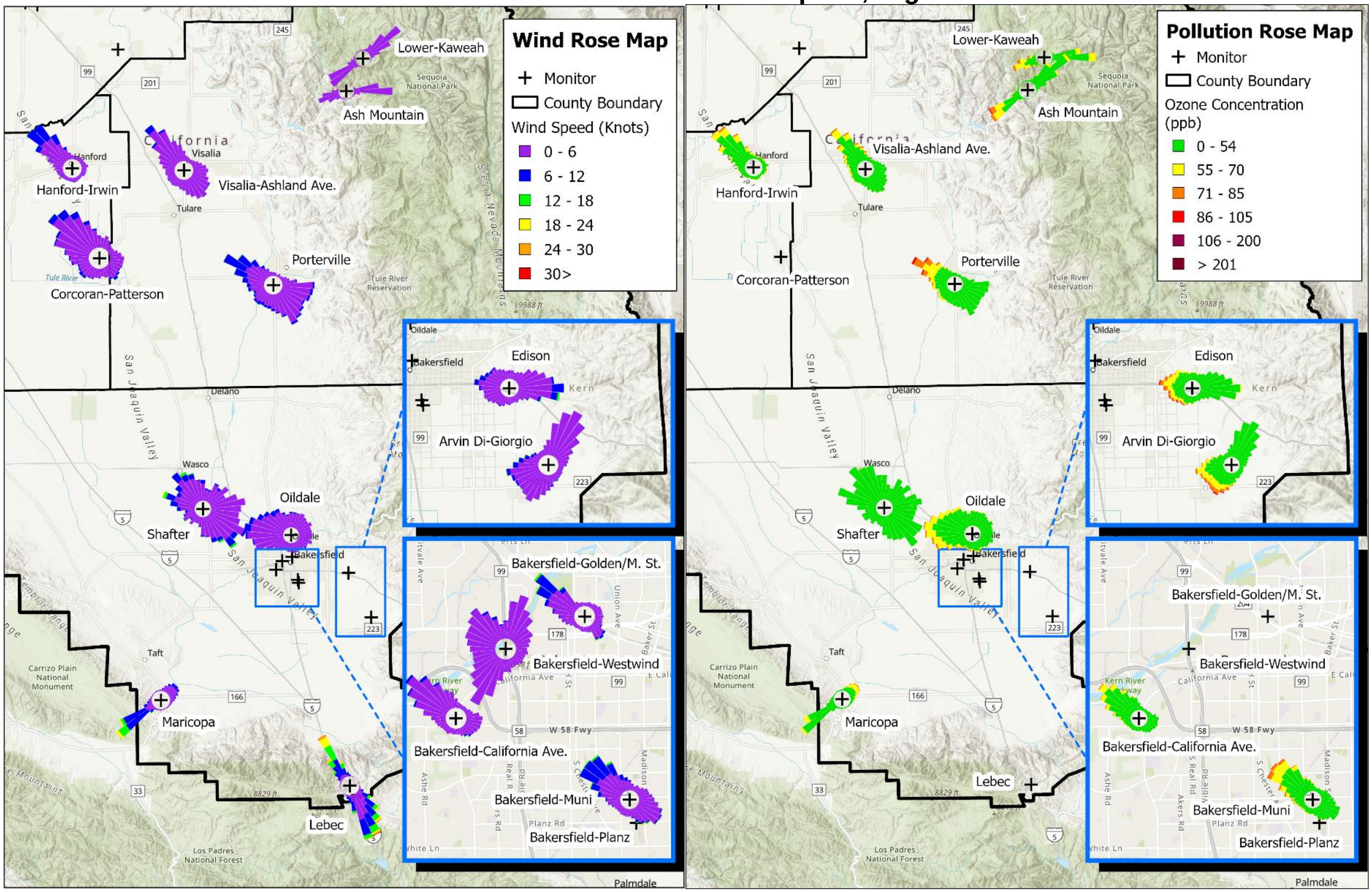
g. Southern Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and PM2.5



h. Southern Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and PM10



i. Southern Counties in the SJV: Left: Wind Direction and Speed; Right: Wind Direction and Ozone



5. AIR MONITORING NETWORK ASSESSMENT RECOMMENDATIONS

Criteria Pollutants

- Population-served analysis indicates that the majority of District monitors are either in or within 4 km of areas with relatively high populations of susceptible individuals (*e.g.,* children with asthma) and other at-risk populations.
- Sites such as Stockton-University Park, Fresno-Garland, and Bakersfield-California that measure many pollutants are generally more valuable and cost effective compared to sites that measure fewer parameters.
- Several sites in the SJV have long data records for multiple parameters such as the Tracy-Airport, Modesto -14th St., Turlock, Madera-Pump Yard, Clovis–Villa, Fresno-Garland, Parlier, Hanford-Irwin, Porterville, Shafter, Bakersfield–California, and Bakersfield-Muni sites.
- Overall, the percent above Method Detection Limit (MDL) results are good for all sites and criteria pollutant parameters.
- The deviation from National Ambient Air Quality Standards (NAAQS) analysis for 8-hour average ozone indicates that Stockton-University Park, Tracy-Airport, Modesto-14th St, Turlock, Merced-Coffee, Madera-City, Madera-Pump Yard, Tranquillity, Fresno-Sierra Sky Park, Fresno-Garland, Hanford-Irwin, Shafter, Bakersfield-California, and Maricopa are particularly important sites for determining NAAQS attainment because they measure concentration values that are close to (within 15%) the 8-hr ozone NAAQS.
- The PM2.5 concentrations measured at sites within the SJV during 2023 showed high percent completeness and high percent above MDL values. Data analyses indicate that PM2.5 concentrations are mostly within 15% of the NAAQS, making many sites important sites for attainment purposes.
- Data and analyses indicate that 1-hour and annual mean NO2 concentrations are well below the standard at all sites, and no sites in the SJV are within the ±15% deviation from the NAAQS range.
- NO2 measurements are valuable to support ozone measurements and in some instances NO2 remains a required parameter due to near-road monitoring requirements and NCORE site requirements for example.
- Currently, there are two established near-road NO2 monitoring stations in the District, located in the Fresno and Bakersfield CBSAs. Additional near-road NO2 monitoring stations are not required at this time as both CBSAs have not reached a population of 2,500,000 yet.
- PM10 monitoring data shows good data completeness. Madera-City, Corcoran-Patterson, and Hanford-Irwin are within the ±15% deviation from the NAAQS range, therefore are valuable for determining NAAQS compliance.
- Monitoring has shown that the Valley's CO concentrations have not exceeded the NAAQS for over a decade. The data completeness and deviation analyses performed on all CO sites currently in operation in the District show that data completeness and % above MDL for CO is good at all sites.

- CO measurements will be stopped at the CARB sites in Stockton and Modesto.
- CO measurements will continue at sites to meet requirements for PAMS, NCORE, and near-road sites.
- SO2 monitoring at the Fresno-Garland NCORE site shows good data completeness, and high percent above MDL values. The high “Deviation from the NAAQS” value of -70 ppb is due to the very low SO2 concentrations in the SJV.
- Toxics are monitored at Stockton-University Park, Fresno-Garland, and Bakersfield-California.
- Area- and population-served analyses for PM10, PM2.5, and ozone monitoring networks indicate there are no redundant monitors.
- The current network accurately represents populated areas impacted by PM10, PM2.5, and ozone pollution and meets regulatory requirements.
- The MDL and data completion analyses indicate good data quality for the current criteria pollutant network.

PAMS

- The analyses of data completion for 2024 data shows an overall high percentage of completion for all of the District’s enhanced ozone monitoring sites.
- CARB will begin PAMS monitoring at the Fresno-Garland site as the Fresno CBSA population has grown over the one million mark.

Meteorology

- Statistical correlation analyses among the sites measuring meteorological parameters in the San Joaquin Valley and adjacent foothill and mountain areas is quite good and indicates that there are no redundant monitors in the District’s meteorological network.
- Data completeness reports show that 25 of the 31 meteorological sites in the District’s network had 75% or more meteorological data completeness for the year 2023. Five of the sites experienced technical issues that led to extended periods of invalid data, and one of the sites was offline due to a change in responsibilities for the monitors between the District and CARB.
- Wind roses show that the prevailing wind direction in the Valley is from the northwest and pollution roses show that the transport of pollution plumes in the Valley correlate with the prevailing wind direction depicted on the wind roses.
- Seasonal changes in wind direction are also represented in the wind roses wherein the predominant wind direction for valley floor sites is from the northwest and winds from the southeast tend to occur in the Valley during the winter season.