Chapter 2

AIR QUALITY CHALLENGES AND PROGRESS

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Chapter 2: Air Quality Challenges and Progress

2.1 PM2.5 CHALLENGES

The San Joaquin Valley (Valley) faces significant challenges in attaining ever-tightening federal national ambient air quality standards (NAAQS) due to the Valley's natural environment (including topography, meteorology, drought and wildfires). The Valley's natural environment supports one of the most productive agricultural regions in the country; the Sierra Nevada provides the necessary water for growing the abundance of crops, and a temperate climate provides a long growing season. However, these same natural factors present significant challenges for air quality: the surrounding mountains trap pollution and block airflow, and the mild climate keeps pollutant-scouring winds at bay most of the year. Temperature inversions, while present to some degree throughout the year, can last for days during the winter, holding in nighttime accumulations of pollutants. Emissions from wildfires can further impact public health and exacerbate the region's attainment challenges.

There are also social aspects to the Valley's air quality challenges. The Valley is experiencing more population growth than most other areas of California, and increased population can contribute to increases in air pollutant emissions as people drive more and use more consumer products. The Valley is home to major transportation corridors for goods movement. State and federal law limits the District's ability to regulate the vast majority of air pollutant emissions in the region.

Despite these challenges, the District is making progress in attaining the NAAQS and improving public health for Valley citizens. Due to the significant investments made by Valley businesses and residents and stringent regulatory programs by the District and the California Air Resources Board (CARB), the Valley's ozone and fine particulate matter (PM2.5) forming precursor emissions are at historically low levels, and air quality over the past few years has been better than any other time on record. Across all of the air monitoring sites operating in the Valley, the observed PM2.5 air quality index (AQI) data for the 2002-2022 timeframe shows an improvement in PM2.5 air quality. Over these 20+ years, the frequency of Good AQI days increased, coupled with a decrease in the frequency of the Moderate, Unhealthy for Sensitive Groups (USG), and Unhealthy AQI days, as shown in Appendix A.

This chapter discusses PM2.5 formation, the Valley's unique challenges, and the Valley's progress in reducing PM2.5 concentrations.

2.1.1 Nature and Formation of Primary and Secondary PM2.5

The nature and formation of PM2.5 in the Valley is highly complex, and attainment of a PM2.5 standard is not a one-size-fits-all effort. Significant regional differences in natural environments and the relative contribution of precursor emissions requires regionally-specific modeling and regionally-specific control strategies. Differences within PM2.5 itself (i.e., directly emitted PM2.5 versus secondary PM2.5 forming in the atmosphere through series of chemical reactions) adds to the complexity inherent in modeling and planning efforts.

This complexity is accounted for in the modeling and other scientific analyses conducted for this *2024 Plan for the 2012 PM2.5 Standard*. The District, CARB, and researchers have developed and refined these analytical tools, including regional modeling, over many years. The regional modeling protocol for this Plan notes that the Valley is one of the most studied airsheds in the world in terms of the number of publications in peer-reviewed scientific journals and other major reports. Such scientific analyses, and the field studies providing data for these analyses, are the foundation of the modeling efforts for this Plan. Public and private sector partnership through the Study Agency provided funding and coordination for many of these studies.

PM is a mixture of solid particles and liquid droplets in the air. PM10 refers to particulate matter that is 10 microns or less in diameter, and the PM2.5 subset includes smaller particles. Unlike ozone, which is a fairly simple molecule of three oxygen atoms, PM2.5 can be composed of any material that has a diameter of 2.5 microns or less.

PM2.5 can be emitted directly from an emission source, and can be solid, liquid, or gaseous. When PM2.5 is emitted directly from an emission source, it is known as primary PM2.5; however, PM2.5 can also be formed secondarily through chemical reactions in the atmosphere, usually downwind from the original emission source[1]. Naturally occurring emissions from biogenic sources, such as plants and trees, can also add to the formation of PM2.5. The resulting ambient PM2.5 mixture can include aerosols (fine airborne solid particles and liquid droplets) consisting of components of nitrates, sulfates, elemental carbon compounds, organic carbon compounds, acid aerosols, trace metals, geological materials, and more.

Some examples of emission sources of PM2.5 include: mobile on-road and off-road vehicles, residential wood burning, commercial cooking operations, and certain industrial processes and operations. For more information about emission sources and emission inventory data, please refer to Section 2.3.2 of this document.

Secondary PM2.5 can be formed in the atmosphere through reactions of gaseous precursors, like nitrogen oxides (NOx), sulfur oxides (SOx), and ammonia (NH3), which both come from mobile and industrial sources. The time needed for PM2.5 precursors to react and form PM2.5 is highly variable and dependent upon the precursor chemical, temperature, and humidity. The nature and formation of PM2.5 is also significantly different from season to season, with wintertime conditions being more favorable for formation of PM2.5.

[1] EPA. *Particulate Matter Basics*. Retrieved from: www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM

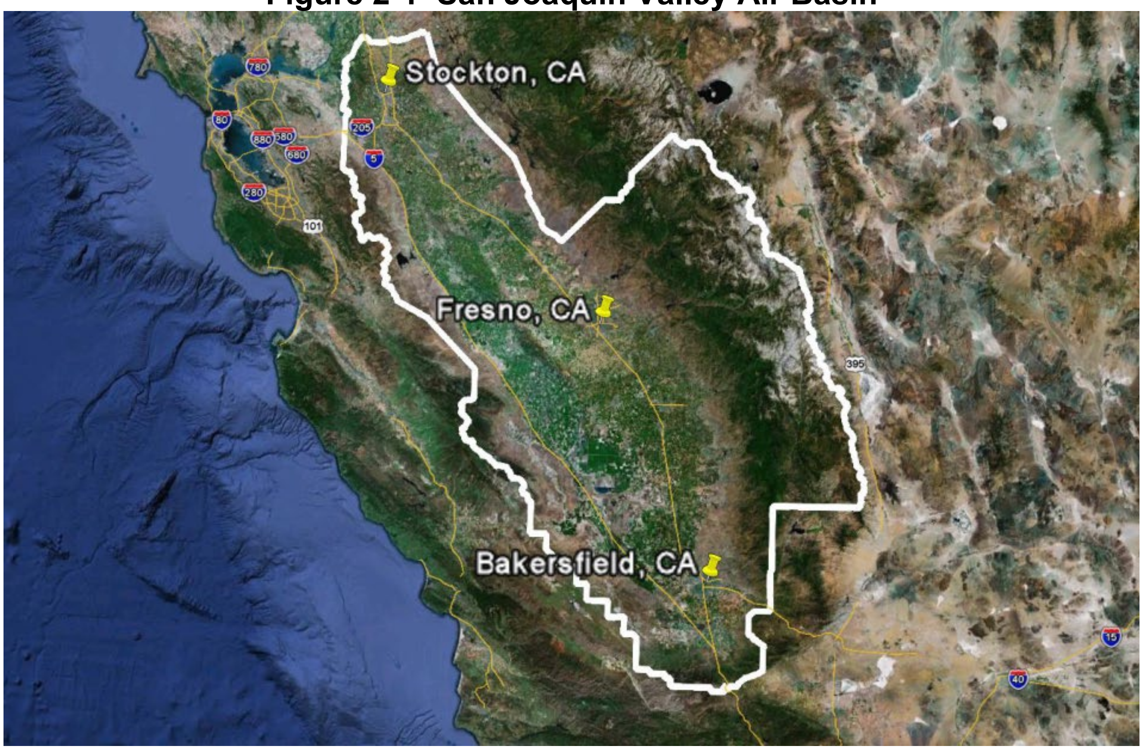
2.2 AIR QUALITY CHALLENGES

2.2.1 Challenges of the Valley's Natural Environment

2.2.1.1 Topography

The challenge to attaining the federal air quality standards in the Valley is grounded in the unique topographical and meteorological conditions found in the region. The Valley, as seen in Figure 2-1, is an inter-mountain valley encompassing nearly 25,000 square miles. Surrounded by mountain ranges to the west, east, and south; the airflow through the Valley can be blocked, leading to severely constrained dispersion. During the winter, high-pressure systems can cause the atmosphere to become stagnant for longer periods of time, where wind flow is calm and air movement is minimal. These stagnant weather systems can also cause severe nighttime temperature inversions, which exacerbate the build-up of PM2.5 and related precursors beneath the evening inversion layer.

Figure 2-1 San Joaquin Valley Air Basin



Under ideal conditions, temperature decreases with increasing altitude, but during temperature inversions the temperature gradient is reversed, with temperatures increasing with altitude, causing warmer air to be above cooler air. Temperature inversions prohibit vertical mixing of an air mass, thus trapping pollutants near the earth's surface. PM2.5 precursors can then react and form secondary PM2.5 species, which can in turn build up concentrations from day to day under a prolonged period of atmospheric stagnation.

Figure 2-2 shows that this reversal of the ideal pattern impedes the upward flow of air, causes poor dispersion, and traps pollutants near the earth's surface. When horizontal dispersion (surface winds) and vertical dispersion (rising air) are minimized, PM2.5 concentrations can build quickly. These naturally occurring meteorological conditions have the net effect of spatially concentrating direct PM2.5 emissions near their sources and promoting the formation and regional buildup of secondary species, particularly ammonium nitrate and chemically aged organic carbon species.

Given these hosts of challenges, the District continues to pursue more effective emissions reductions to attain the PM2.5 standards through its numerous air quality attainment plans, a regulatory control strategy and innovative non-regulatory emission reduction strategy that includes robust incentive programs, a comprehensive legislative platform, and rigorous outreach and education efforts.

Figure 2-2 Atmosphere with Temperature Inversion

2.2.1.2 The Valley's Carrying Capacity

In the context of air quality, "carrying capacity" refers to the density of emissions that an air basin can "absorb" or "carry" and still meet ambient air quality standards for a given pollutant. The key factors that shape variations in a regional carrying capacity include meteorology, climate, and topography. The Valley's carrying capacity for PM2.5 is greatly affected by prevailing weather during the winter months and the region's topography (surrounding mountains). Temperature inversions are common during the winter months in the Valley. During these sometimes-lengthy stagnant air episodes, PM2.5 emissions from daily activities rapidly build up to levels above the standard. When these events occur, or are forecasted to occur, the District's Residential Wood

Smoke Reduction program and the Real-Time Air Quality Advisory Network (RAAN) system are utilized to reduce PM2.5 emissions in the Valley.

2.2.1.3 Population Growth in the San Joaquin Valley

Although California remains, by far, the most populous state in the U.S., its population has been decreasing slightly over the past couple of years. In contrast to this, in the fiscal year 2021-2022, population growth remained positive in the Valley. Madera County's population grew by 943 persons, or 0.6% from January 1, 2022 to January 1, 2023. Both San Joaquin and Merced counties observed a growth of 0.4%, or 3,334 persons in San Joaquin County and 1,207 in Merced County, respectively, from January 1, 2022 to January 1, 2023.[2] Additional Valley population estimates are shown in Table 2-1.

The District will continue to monitor these short-term population trends, though short-term trends cannot replace longer-term trends for planning purposes. The Population Research Unit of the California Department of Finance (DOF) periodically releases population counts and growth estimates. The revised population growth projections in July 2021 demonstrate how significantly the Valley's population is expected to grow in the coming years.

Based on the revised 2020 to 2035 DOF data, the Valley's population is expected to increase by 13.9% from 2020 to 2035 (Table 2-1). In contrast, the total population for the State is projected to increase by 7.4% over the same time period. Increasing population generally means increases in air pollutant emissions as a result of increased consumer product use and more automobile and truck vehicle miles traveled (VMT). In addition to increased VMT resulting from increased Valley population, the Valley will also see increased vehicular traffic along the State's major goods and people movement arteries, both of which run the length of the Valley.

While increased population can lead to increased emissions that offset some of the benefits of regulation, directly emitted PM2.5 and PM2.5 precursor emissions have decreased significantly under CARB and District regulations. These emissions reductions have resulted in measurable improvements for the Valley's PM2.5 concentrations, as discussed later in this chapter. As PM2.5 concentrations decrease, the Valley's public health improves.

[2] California Department of Finance. *Demographic Research Unit. Report P-2A: Total Population Projections, California Counties, 2010-2060. Sacramento: California.* https://dof.ca.gov/forecasting/demographics/projections/

Table 2-1 Estimated Valley and State Populations by County, 2020-2035[3]

County	2020	2025	2030	2035
Fresno	1,026,358	1,053,955	1,096,638	1,135,837
Kern*	912,975	961,629	1,019,221	1,075,952
Kings	154,745	159,733	165,752	171,517
Madera	158,794	168,293	178,070	187,842
Merced	284,761	298,184	314,690	330,805
San Joaquin	776,068	810,495	853,661	891,642
Stanislaus	555,955	581,308	606,128	627,883
Tulare	480,788	496,657	516,810	535,463
VALLEY TOTAL	**4,350,444**	**4,530,254**	**4,750,970**	**4,956,941**
CALIFORNIA TOTAL	**39,782,419**	**40,808,001**	**41,860,549**	**42,718,403**

*Includes entire Kern County

While the bulk of the Valley's remaining emissions come from mobile sources outside of the District's regulatory authority, under the Clean Air Act (CAA), the responsibility to bring the region into attainment with the federal standards rests with the local air district. Additionally, the region will be subject to sanctions that will be devastating to the Valley's economy if mobile sources under federal regulatory authority are not adequately controlled. Given the enormity of the reductions needed for attainment, mobile sources, particularly in the goods movement sector, must transition to zero or near-zero emission levels through the implementation of transformative measures. The District does not have the authority to implement regulations requiring ultra-low tailpipe emissions standards on mobile sources. New state and federal regulations coupled with a robust incentive-based emission reduction strategy are necessary to achieve the enormous reductions that are necessary to attain the federal standards. The U.S. Environmental Protection Agency (EPA) must take responsibility for implementing regulatory and incentive-based measures for sources under their jurisdiction. The District continues to work closely with CARB to develop an attainment strategy that includes significant emissions reductions from mobile sources.

2.2.1.4 Environmental Justice Areas

Not all populations face the same environmental challenges. EPA defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and

[3] *California Department of Finance. Demographic Research Unit. Report P-2A: Total Population Projections, California Counties, 2010-2060. Sacramento: California.* https://dof.ca.gov/forecasting/demographics/projections/

policies.[4] Environmental injustices occur when a group of people bears a disproportionate share of negative environmental consequences.

Air pollution can have localized impacts in disadvantaged communities throughout California and beyond. Studies show that certain communities, including communities of color and low-income communities, tend to have higher air pollution burden. As identified by the California Office of Environmental Health Hazard Assessment's (OEHHA) CalEnviroScreen, seven of the ten most disadvantaged communities in California are located in the Valley.[5]

Federal, state, and regional agencies are all putting more focus on EJ issues than in the past. At the federal level, Executive Order 12898 directed federal agencies to develop EJ strategies to help federal agencies address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. At the state level, Senate Bill (SB) 535 and Assembly Bill (AB) 1550 designated CalEPA as the agency responsible for identifying "Disadvantaged Communities" (DACs) and established specific requirements for minimum funding levels allocated to DACs.

Several initiatives provide opportunities to improve air quality in the Valley's EJ areas. California AB 617 requires CARB and air districts to develop and implement additional emissions reporting, monitoring, reduction plans and measures in an effort to reduce air pollution exposure in disadvantaged communities. The District continues to work closely with four Valley communities – South Central Fresno, Shafter, Stockton, and Arvin/Lamont – to focus resources and implement community-identified clean air measures to reduce air pollution and increase community engagement at the local level. Additionally, the District established the Environmental Justice Advisory Group (EJAG) to work collaboratively to educate the public and stakeholders about current District activities and air quality awareness, and to review and provide feedback on overarching District programs and strategies.

Attainment plans like this *2024 Plan for the 2012 PM2.5 Standard* are, per federal legal requirements, focused on regional attainment of federal standards. However, air quality improvements under this plan will yield air quality benefits for the Valley's AB 617 and other EJ communities.

2.2.1.5 Summer Wildfires

Air pollution generated from wildfires is enormous and can well exceed the total industrial and mobile source emissions in the Valley, overwhelming all control measures and resulting in periods of excessively high particulate matter and ozone concentrations that cause significant impacts to public health. In addition to excessive fuel build-up in the state's wildlands due to decades of fire-suppression and widespread drought-driven

[4] EPA. "Learn About Environmental Justice". Retrieved from: https://www.epa.gov/environmentaljustice/learn-about-environmental-justice

[5] CalEnviroScreen 4.0; Retrieved from: https://oehha.ca.gov/calenviroscreen
https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40resultsdatadictionaryf2021.zip

tree mortality, higher temperatures and drier climate conditions in recent years have contributed to extended and more intense wildfire seasons in the western United States.

For example, nine of the top twenty largest wildfires in California history occurred in 2020 and 2021.[6] In 2020, over 8,600 wildfires were recorded in California with nearly 4.3 million acres burned,[7] and in 2021, over 7,300 wildfires and more than 2.5 million acres were burned statewide.[8] The District compiles up-to-date wildfire information on its website to keep the public informed about real-time air quality impacts from wildfires.[9] The District and CARB also assess long-term impacts through the attainment planning process. More information on the 2020-2022 wildfire seasons is available in Appendix A.

2.2.1.6 Drought in the San Joaquin Valley

Through daily forecasting as well as through longer-term analysis, the District tracks ongoing drought conditions and drought impacts on air quality across the Valley. In general, drought conditions are often associated with warmer temperatures and longer periods of poor dispersion, which can lead to higher concentrations of pollutants in the Valley.

According to the California Department of Water Resources, California is no stranger to drought, experiencing a 5-year event between 2012 and 2016.[10] The 2015-2016 winter season represented the fifth consecutive year of drought conditions in the Valley, and 2013-2014 was by far the driest winter during this time. Many cities in California, including those in the Valley, had record low rainfall totals during the 2013 calendar year, with some nearly 100-year old records being broken. On January 17, 2014, the Governor of California declared a drought emergency for all of California, that was finally lifted three years later, on April 7, 2017. Just four years later, beginning in April 2021 and through October 2021, the Governor of California declared a State of Emergency due to severe drought conditions and signed a set of four new emergency proclamations directing state agencies to take immediate action to bolster drought resilience across the state.[11,12,13]

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[6] CalFire. *Top 20 Largest Wildfires*. October 24, 2022 update. Retrieved from: https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/our-impact/fire-statistics/featured-items/top20_acres.pdf?rev=be2a6ff85932475e99d70fa9458dca79&hash=A355A978818640DFACE7993C432ABF81

[7] CalFire. *2020 Incident Archive*. Retrieved from: https://www.fire.ca.gov/incidents/2020/

[8] CalFire. *2021 Incident Archive*. Retrieved from: https://www.fire.ca.gov/incidents/2021/

[9] SJVAPCD. *Wildfire Prevention and Response*. Retrieved from: https://ww2.valleyair.org/air-quality-information/wildfire-information/

[10] CA Dept of Water Resources. Drought. Retrieved from: https://water.ca.gov/Water-Basics/Drought

[11] Executive Department, State of California. *State of Emergency Proclamation*. April 2021. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2021/04/4.21.21-Emergency-Proclamation-1.pdf

[12] Executive Department, State of California. *State of Emergency Proclamation*. May 2021. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2021/05/5.10.2021-Drought-Proclamation.pdf

[13] Executive Department, State of California. *State of Emergency Proclamation*. October 2021. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2021/10/10.19.21-Drought-SOE-1.pdf

According to the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) statewide climatological rankings,[14] the January 2022 to April 2022 period was one of the driest 4-month periods on record for California, with a 9.7 inch precipitation deficit (see Table 2-2). Further, the May 2019 to April 2022 period was the driest 36-month period on record with a 22.8 inch rainfall deficit. Figure 2-3 depicts the extent and severity of drought conditions affecting California between May 2021 and May 2022.

Above-normal winter precipitation between 2022-2023 brought major drought relief to the west coast, allowing for the roll back of many of the drought emergency provisions in California.[15,16] Increased precipitation amounts allowed for all of California to measure between no drought and moderate drought, with no drought indicated in the entire San Joaquin Valley in May of 2023. The District will continue to monitor these drought conditions for potential impacts to ozone and particulate matter concentrations.

Table 2-2 Rainfall Totals for Select Cities Across California

Region	City	1983-2019	2020	2021	2022	Record Low Rainfall (1983-2022)	
		Average (inches)	Total (inches)	Total (inches)	Total (inches)	Year	Total (inches)
Northern California [17]	Sacramento	18.13	6.81	18.90	11.19	2013	5.81
	San Francisco	19.46	5.86	21.83	13.42	2013	3.38
San Joaquin Valley [18]	Stockton	13.38	5.96	14.17	11.40	2013	4.59
	Modesto	12.35	5.25	13.76	9.06	2013	4.69
	Fresno	10.98	6.17	10.38	6.44	2013	3.01
	Hanford	8.17	4.98	8.22	5.43	2013	1.99
	Visalia	9.82	6.15	9.72	5.61	2013	1.41
	Bakersfield	6.13	5.35	5.58	4.22	1989	2.88
Southern California [19]	Los Angeles	12.03	9.04	12.09	6.40	2013	3.65
	San Diego	9.91	7.83	7.85	5.90	1989	3.83

[14] NOAA NCEI. California Precipitation Rankings, April 2022. Retrieved from: https://www.ncdc.noaa.gov/cag/statewide/rankings/4/pcp/202204

[15] National Integrated Drought Information System. *Water Year 2023 Snow Drought Conditions Summary and Impacts in the West.* June 15, 2023. Retrieved from: www.drought.gov/drought-status-updates/water-year-2023-snow-drought-conditions-summary-and-impacts-west-2023-06-15. Accessed 2023.

[16] Office of Governor. *Governor Newsom Eases Drought Restrictions.* March 24 2023. Retrieved from: www.gov.ca.gov/2023/03/24/governor-newsom-eases-drought-restrictions/.

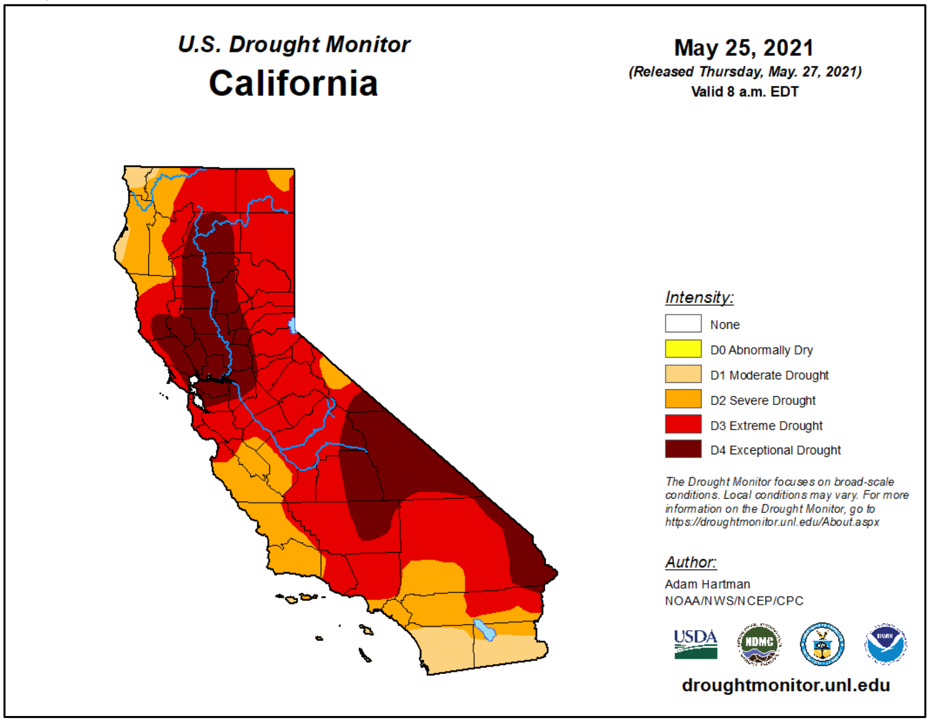
[17] NOWData – NOAA Online Weather Data. Retrieved March 6, 2023. https://nowdata.rcc-acis.org/sto/

[18] NOWData – NOAA Online Weather Data. Retrieved March 6, 2023. https://www.weather.gov/wrh/climate?wfo=hnx

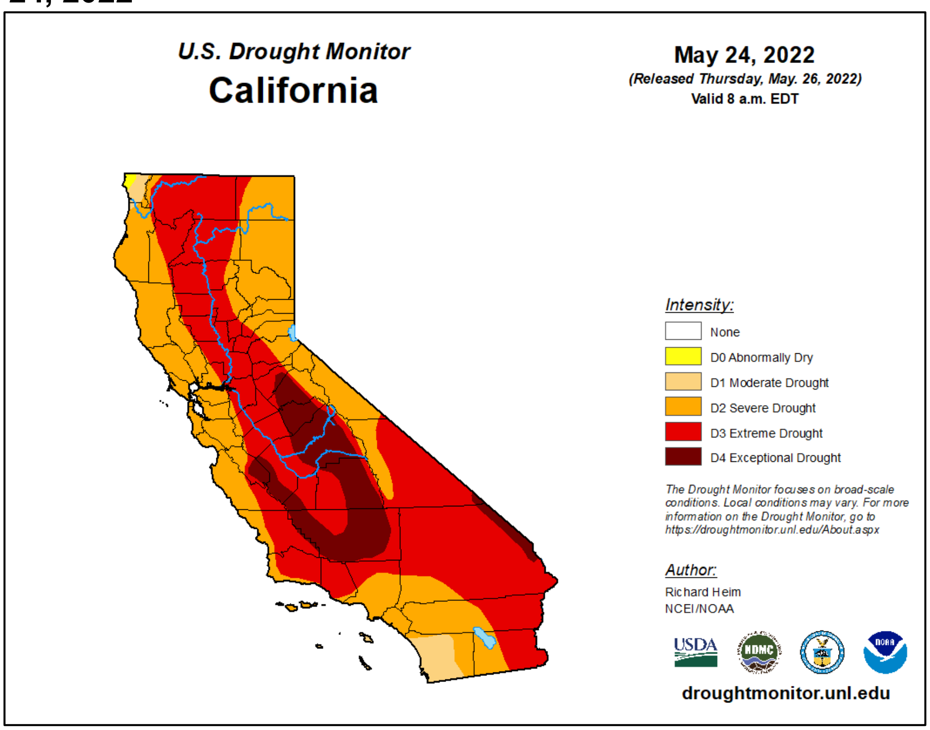
[19] NOWData – NOAA Online Weather Data. Retrieved March 6, 2023. https://nowdata.rcc-acis.org/lox/

Figure 2-3 (a-c) Drought Extent and Severity in California[20]

a) May 25, 2021

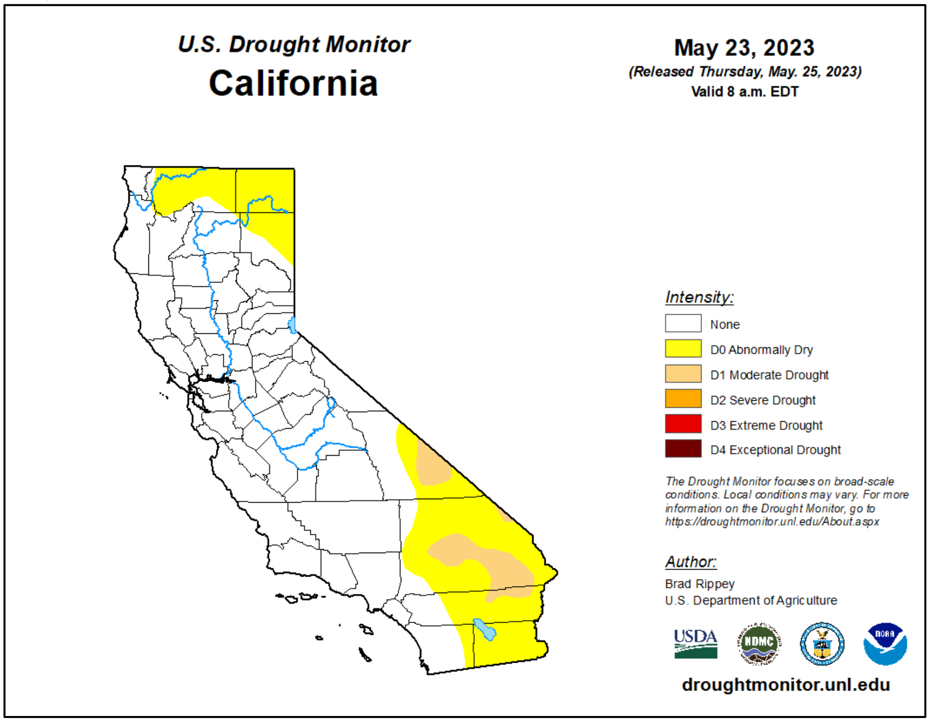


b) May 24, 2022



[20] U.S. Drought Monitor California. Retrieved May 25, 2023. https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

c) May 23, 2023



2.3 PM2.5 AIR QUALITY TRENDS

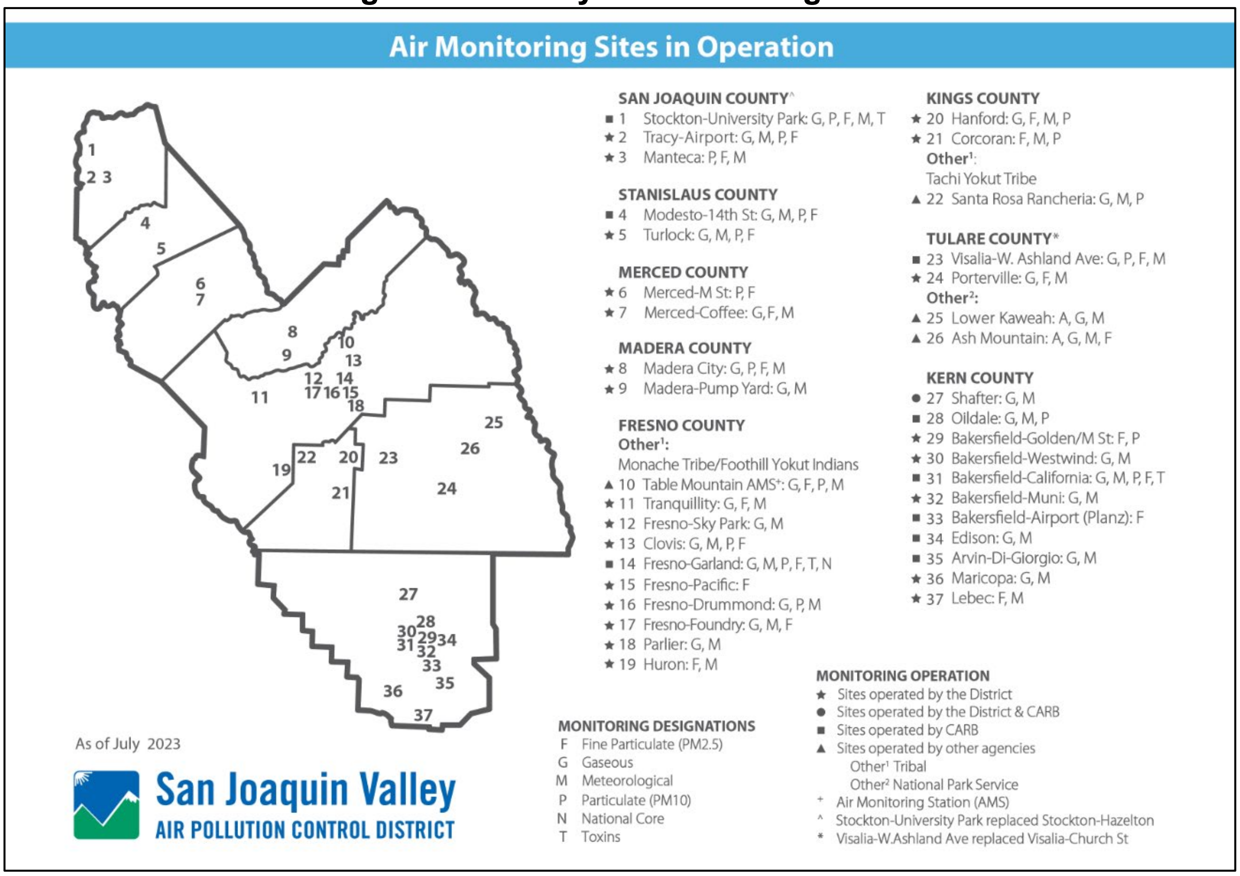
As a public health agency charged with monitoring Valley air quality and ensuring progress toward meeting national air quality standards, the District, CARB, and other agencies have established an extensive air monitoring network that provides ongoing data for evaluating such progress. Information from this monitoring network, which began measuring PM2.5 concentrations in 1999, allows the District to track air quality trends that show progress toward attainment and inform the planning process for reaching attainment.

2.3.1 Air Monitoring Network

Numerous pollutants and meteorological parameters are measured throughout the Valley on a daily basis using an extensive air-monitoring network managed by the District, CARB, and other agencies. This network measures pollutant concentrations necessary to show progress toward attainment of the NAAQS. The network also provides real-time air quality measurements used for daily air quality forecasts, Smoke Management System (SMS) burn allocations, hazard reduction and prescribed burning allocations, residential wood-burning declarations, Air Quality Alerts, and RAAN.

In general, air quality monitoring networks are designed to monitor areas with high population densities, areas with high pollutant concentrations, areas impacted by major pollutant sources, and areas representative of background concentrations. Together, the District, CARB, and other agencies operate 37 air-monitoring stations throughout the Valley (Figure 2-4). Most air monitoring sites in the Valley represent population exposures and/or maximum concentrations representative of neighborhood and regional scales. Of the 37 air monitoring stations throughout the Valley, there are 23 PM2.5 air-monitoring sites (see Table 2-3).

Figure 2-4 Valley Air Monitoring Sites



2.3.1.1 PM2.5 Monitoring Network

EPA requires air-monitoring agencies to include a variety of monitoring site types in their air monitoring networks. The monitoring site types within the District's PM2.5 monitoring network measure concentrations for population exposure, highest concentrations, regional transport, and background levels. Often more than one monitoring site type applies to a given location. The Valley's PM2.5 monitoring network includes: federal reference method (FRM) monitors, federal equivalent method (FEM) monitors, and non-FEM monitors. Four PM2.5 monitoring sites are non-FEM PM2.5 monitors that are not required by the EPA. The District operates these sites for various reasons, including complying with state laws (Huron), as a settlement to a lawsuit (Tracy-Airport), and for purposes of helping the District's RAAN and forecasting programs (Porterville and Lebec).

PM2.5 is measured and expressed as the mass of particles contained in a cubic meter of air (micrograms per cubic meter, or $\mu g/m^3$). The data collected from the network of

PM2.5 monitors in the Valley is used to track progress toward attainment of the federal standards and to calculate design values for the 24-hour and annual PM2.5 standards, as outlined in EPA guidance and regulations.[21] Table 2-3 identifies the monitoring site types for the PM2.5 monitoring sites operating in the Valley Air Basin.

Table 2-3 PM2.5 Monitoring Site Types in 2022

Site Name	Population Exposure	Highest Concentration
Stockton-University Park*	✓	✓
Tracy-Airport		
Manteca		✓
Modesto-14th Street*	✓	
Turlock	✓	✓
Merced-M St	✓	✓
Merced-Coffee	✓	
Madera City	✓	
Tranquillity	✓	
Clovis		✓
Fresno-Garland*		
Fresno-Pacific		✓
Fresno-Foundry		✓
Huron		
Hanford	✓	
Corcoran	✓	✓
Visalia-W. Ashland*	✓	✓
Porterville		
Ash Mountain^		
Bakersfield-Golden	✓	
Bakersfield-California*	✓	✓
Bakersfield-Airport (Planz)*	✓	✓
Lebec		

* Monitor operated by CARB
^ Monitor operated by the National Park Service

2.3.2 PM2.5 Emissions Inventory Trends

The emissions inventory is the foundation for the attainment planning process. The District and CARB maintain an accounting of PM2.5 and precursor emissions for the Valley based on known sources both within and outside of the region that influence Valley air quality (inter-region transport). The District requires detailed accounting of emissions from regulated sources throughout the Valley. CARB makes detailed estimations of emissions from mobile, area, and geologic sources using known emissions factors for each source or activity and accounting for relevant economic and population data. Together, these inform the emissions inventory that represents an estimate of how much direct pollution is entering the Valley air basin as a result of the pollutant-generating activities and sources.

[21] 40 CFR Part 50 www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50#ap40.2.50_119.n

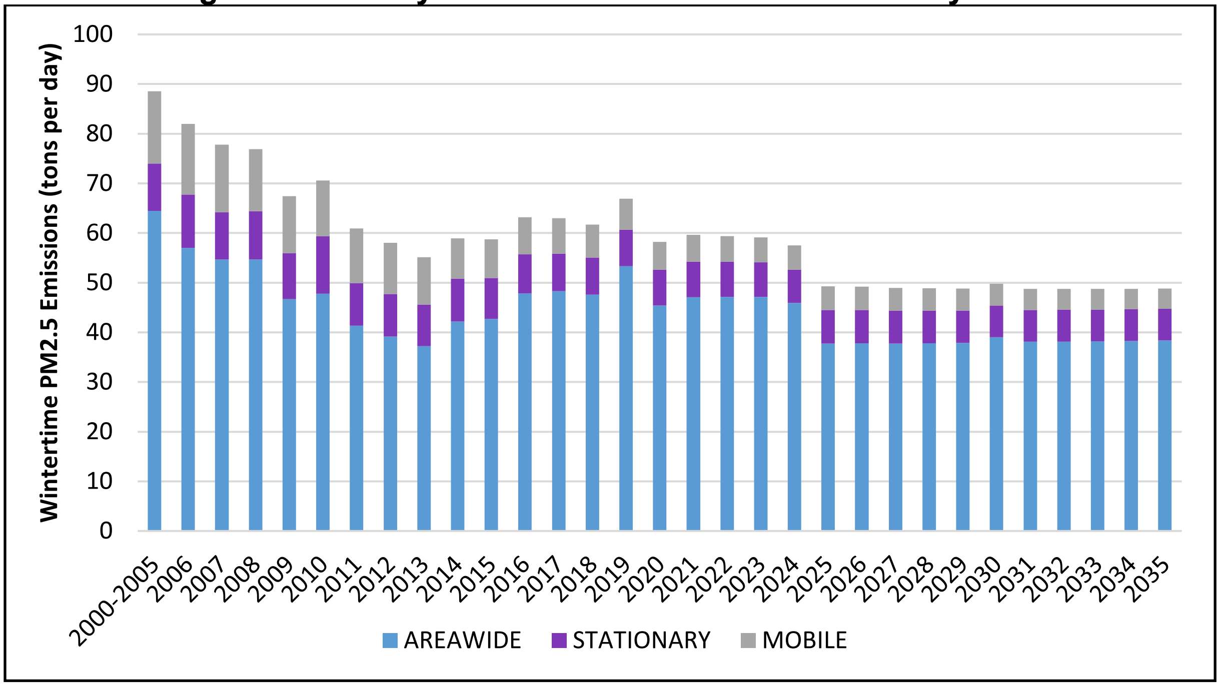
The District uses the emissions inventory to develop control strategies, determine the effectiveness of permitting and control programs, provide input into air quality modeling, fulfill reasonable further progress requirements, and screen regulated sources for compliance investigations.

The following general list represents the major inventory categories for which emissions are recorded and tracked. Appendix B to this Plan contains the detailed accounting of the emissions inventory with projected emissions based on anticipated growth of each source and the anticipated control (regulatory or non-regulatory) of each source, if applicable.

- **Mobile sources** – motorized vehicles
    - On-road sources include automobiles, motorcycles, buses, and trucks
    - Other or off-road sources include farm and construction equipment, lawn and garden equipment, forklifts, locomotives, boats, aircraft, and recreational vehicles
- **Stationary sources** – fixed sources of air pollution
    - Power plants, refineries, and manufacturing facilities
    - Aggregated point sources, i.e. facilities that are not typically inventoried individually, but are estimated as a group and reported as a single source category (such as gas stations and dry cleaners)
- **Area sources** – human activity that takes place over a wide geographic area
    - Includes consumer products, residential wood burning, controlled burning, tilling, and unpaved road dust
- **Natural sources** – naturally occurring emissions
    - Geologic sources, such as petroleum seeps
    - Biogenic sources, such as emissions from plants and trees
    - Wildfire sources

Emissions inventory trends show the progress made through progressive regulatory and non-regulatory activities; as rules are amended with tighter emission limits, or as reduction technologies improve, overall emissions decrease. Winter PM2.5 emissions have decreased significantly, in large part due to the effectiveness of Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) and the ongoing phase-out of open agricultural burning. Figure 2-5 shows the PM2.5 emissions inventory trend for the mobile, stationary, and area source categories.

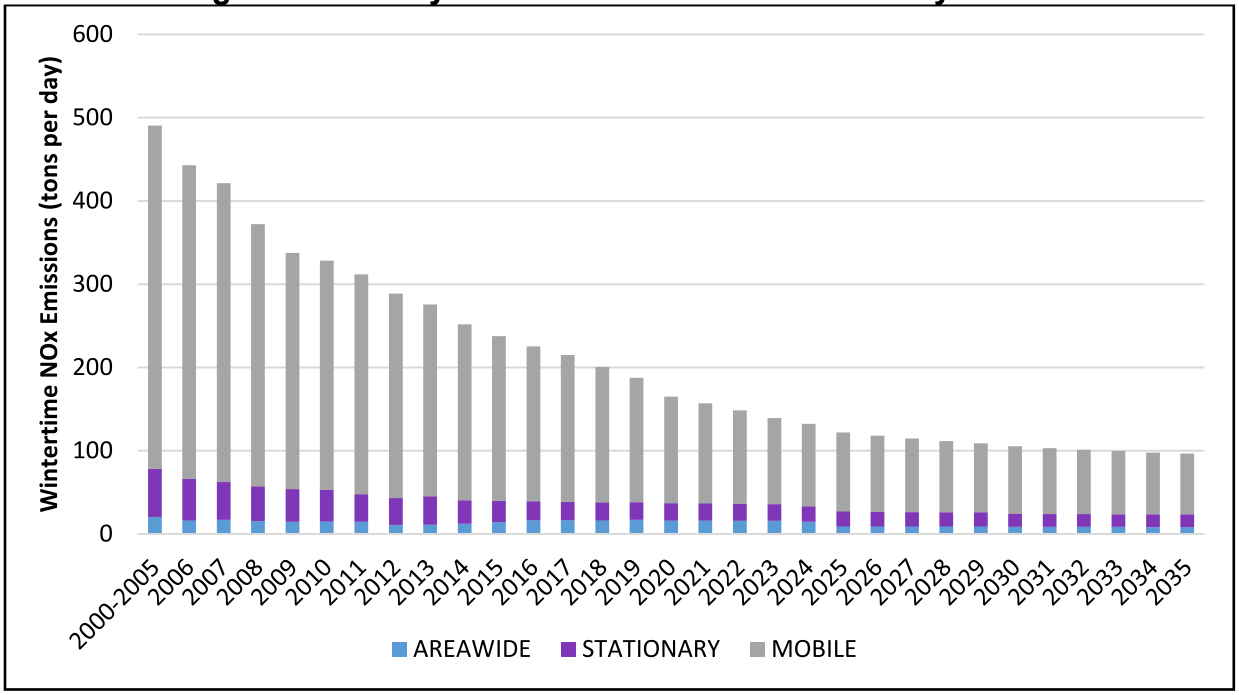
Figure 2-5 Valley PM2.5 Winter Emissions Inventory Trend[22]



Because NOx is a significant PM2.5 precursor, due to the Valley being NOx-limited for the formation of ammonium nitrate, which is a significant component of wintertime PM2.5, the District relies heavily on NOx emissions reductions to reduce PM2.5 emissions. Figure 2-6 summarizes the NOx emissions inventory trends for the mobile, stationary, and area source categories. District and CARB control strategies for NOx play a significant role and are a cornerstone in the strategies to reduce both ozone and PM2.5 concentrations.

[22] CEPAM: 2022 PM2.5 Plans - Baseline Emission Projections – Tool Panel. https://ww2.arb.ca.gov/criteria-pollutant-emission-inventory-data Retrieved March 23, 2023.

Figure 2-6 Valley Winter NOx Emissions Inventory Trend[23]



Continued emissions reductions are based on current control strategies that will continue to take effect into the future. In light of the Valley's projected increase in population, the projected emissions reductions highlight the success of the control measures adopted and enforced by the District, CARB, and other regulatory agencies.

2.3.3 Air Quality Progress

Air quality progress can be assessed in several ways. The calculation of design values is the official method used to determine whether an area is in attainment of a standard; however, other indicators, like the number of days the Valley exceeded the 2006 24-hour 35 µg/m³ standard, can reveal more about the progress being made toward attaining that standard. Comparing the days per year when each monitor exceeded the PM2.5 24-hour NAAQS from year to year shows the progress in reducing the number of days with the highest concentrations, while quarterly averages can help to show progress with respect to seasonal peaks in concentration levels.

Rather than using yearly maximum concentrations, as is the case for other federal standards, EPA requires the use of design values as the attainment metric for the PM2.5 standards, which represents a three-year average of air quality data. Details on how PM2.5 design values are calculated are provided in Appendix A of this Plan. As seen in Figure 2-7 and Figure 2-8, the Valley maximum 24-hour and annual average PM2.5 design value trends show that although there is some year-to-year variation, progress has been made in reducing PM2.5 concentrations over the long-term sampling record in the Valley. The Valley's peak 24-hour design value has decreased by over

[23] CEPAM: 2022 PM2.5 Plans - Baseline Emission Projections – Tool Panel. https://ww2.arb.ca.gov/criteria-pollutant-emission-inventory-data Retrieved March 23, 2023.

35% over the 1999-2022 period, while the peak annual design value has decreased by 25% over the same period.

The District strives to provide a comprehensive analysis of air quality in the Valley, and in order to do so, has developed a gap-filling method for determining historic 24-hour PM2.5 concentrations. This method is used to account for a previously less robust air monitoring network, and to provide a holistic perspective of historic air quality in the San Joaquin Valley. Figure 2-9 uses this gap filling methodology to compare the number of days over the 2006 24-hour standard between 2002-2022. For more information on gap-filling, see Appendix A.

The number of days a region exceeded the 2006 24-hour 35 μg/m³ standard is a good indicator of the air quality in the District, as a region may still be considered in attainment while experiencing a limited number of days above the standard. Figure 2-9 shows the trend of the number of days the Valley exceeded the 2006 24-hour PM2.5 standard of 35 μg/m³. There is an overall decrease in the number of exceedances of the 35 μg/m³ standard since PM2.5 has been monitored.

As these design value trends show, the District continues to progress toward attainment of the 2006 24-hour PM2.5 standard and 2012 annual PM2.5 standard, despite years influenced by drought, exceptionally poor dispersion conditions, and wildfires. It is important to note that recent years, namely 2020 and 2021, were heavily influenced by wildfire emissions which resulted in very high concentrations of PM2.5 across the Valley. In spite of these challenges, the design value trends show continued improvement, due in large part to the regulatory efforts by the District, CARB, and Valley businesses and residents. A more detailed discussion of design values in the Valley is available in Appendix A.

When observing the change in days over a long period when the Valley's counties exceeded the federal 24-hour PM2.5 standard of 35 μg/m³, a significant change is clear. As shown in Figure 2-10, when comparing the winter season of 2002-03 to the recent 2023-24 season, the number of days when the Valley's counties exceeded this standard decreased from 39% to only 5%, while the days when the federal standard was met increased from 61% to 95%. Similarly, when this comparison is focused on the calendar year of 2002 to 2023, the number of days exceeding the standard decreased from 19% to only 2%, while the number of days meeting this standard increased from 81% to 98%. With 98% of the days during the year 2023 meeting the 24-hour PM2.5 standard, this is indicative of the positive progress the Valley is making towards minimizing peak concentrations throughout the region.

Figure 2-7 Valley 24-hour PM2.5 Design Value Trend

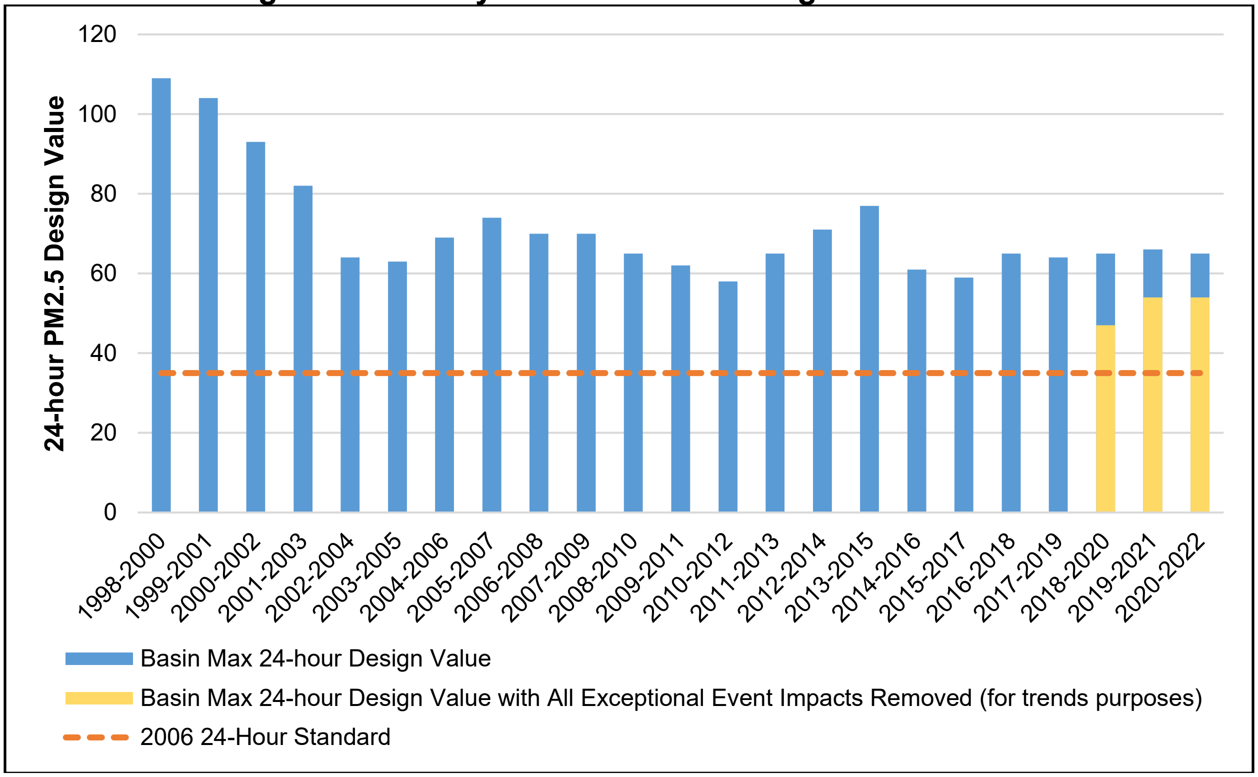


Figure 2-8 Valley Annual PM2.5 Design Value Trend

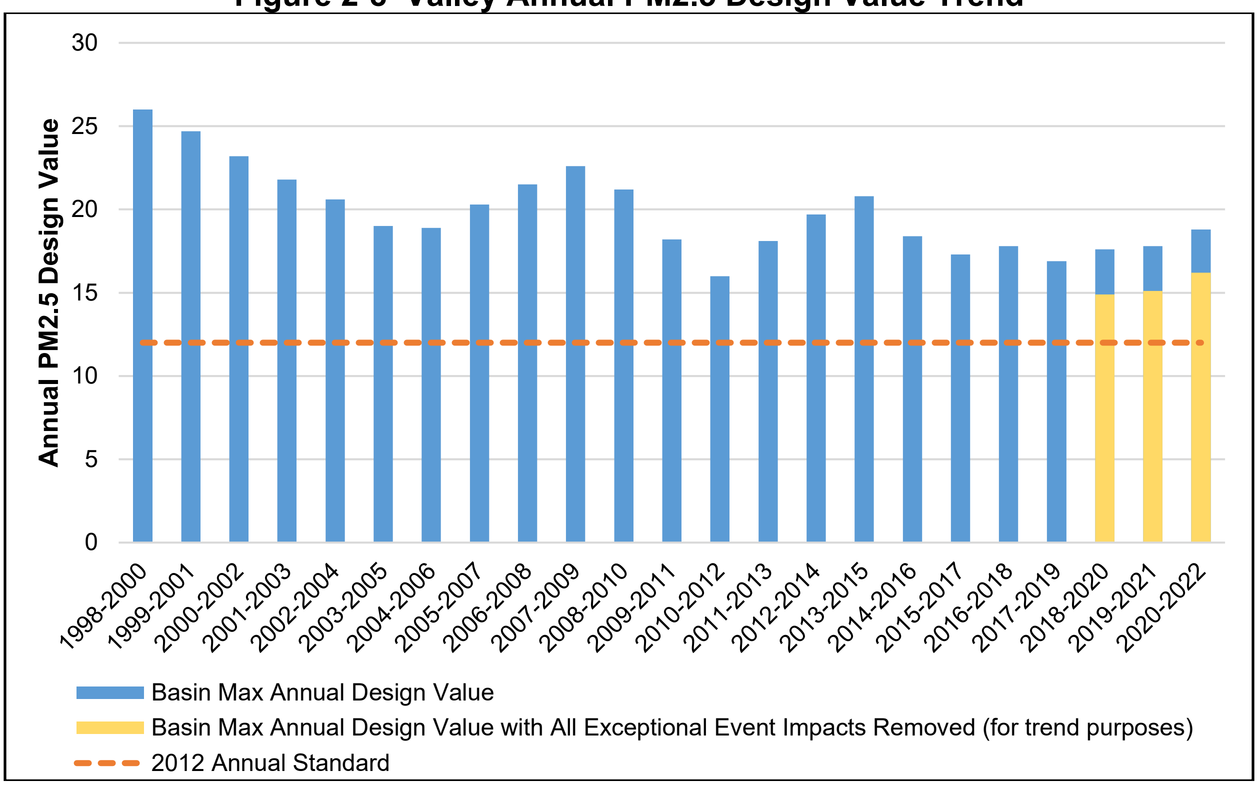


Figure 2-9 Number of Days Valley Exceeded the 24-hour 35 µg/m³ Standard

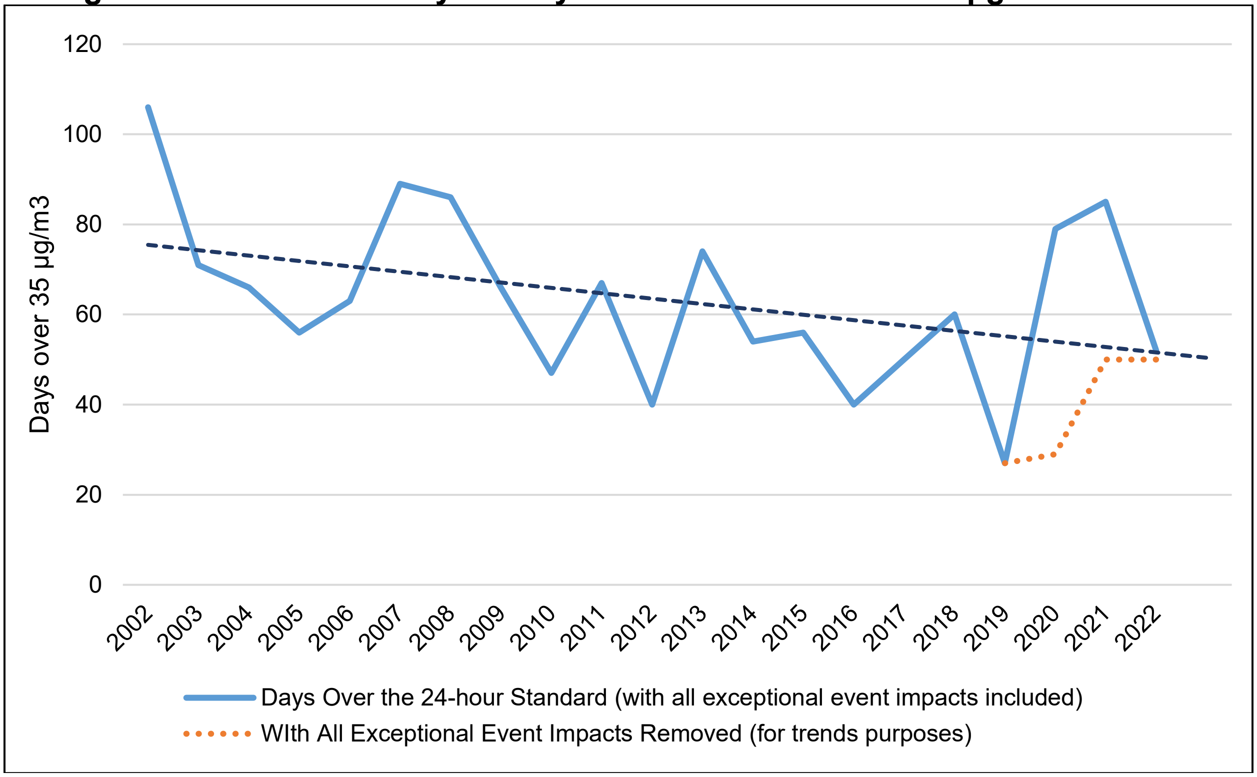
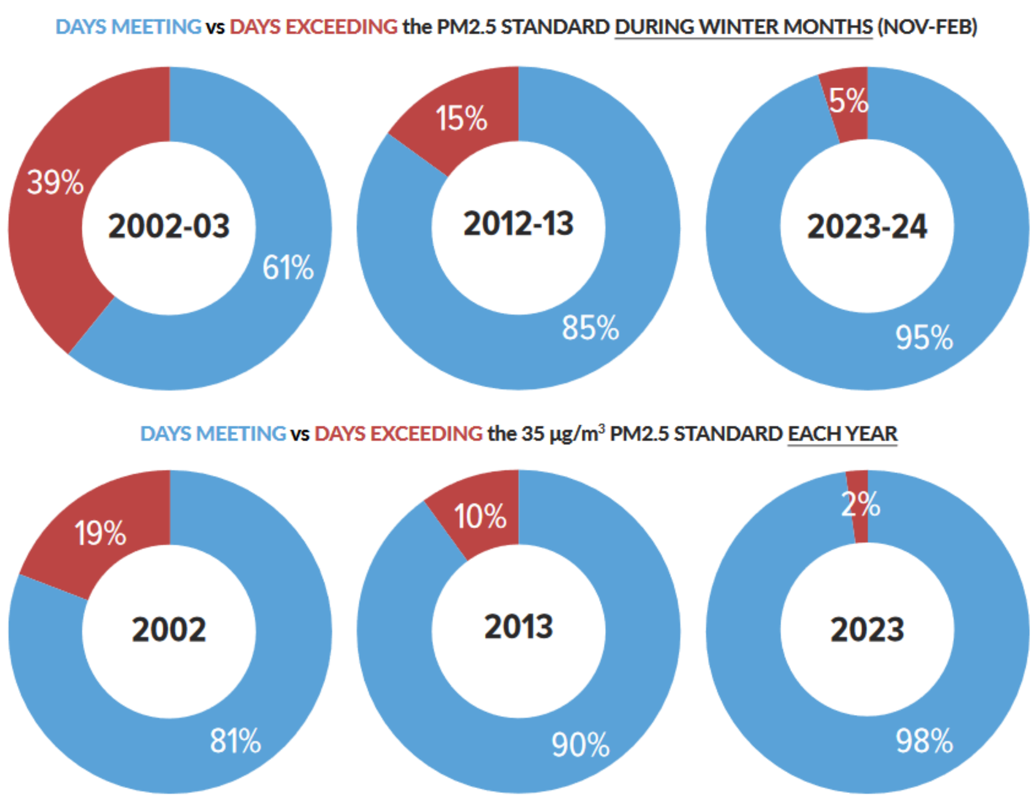
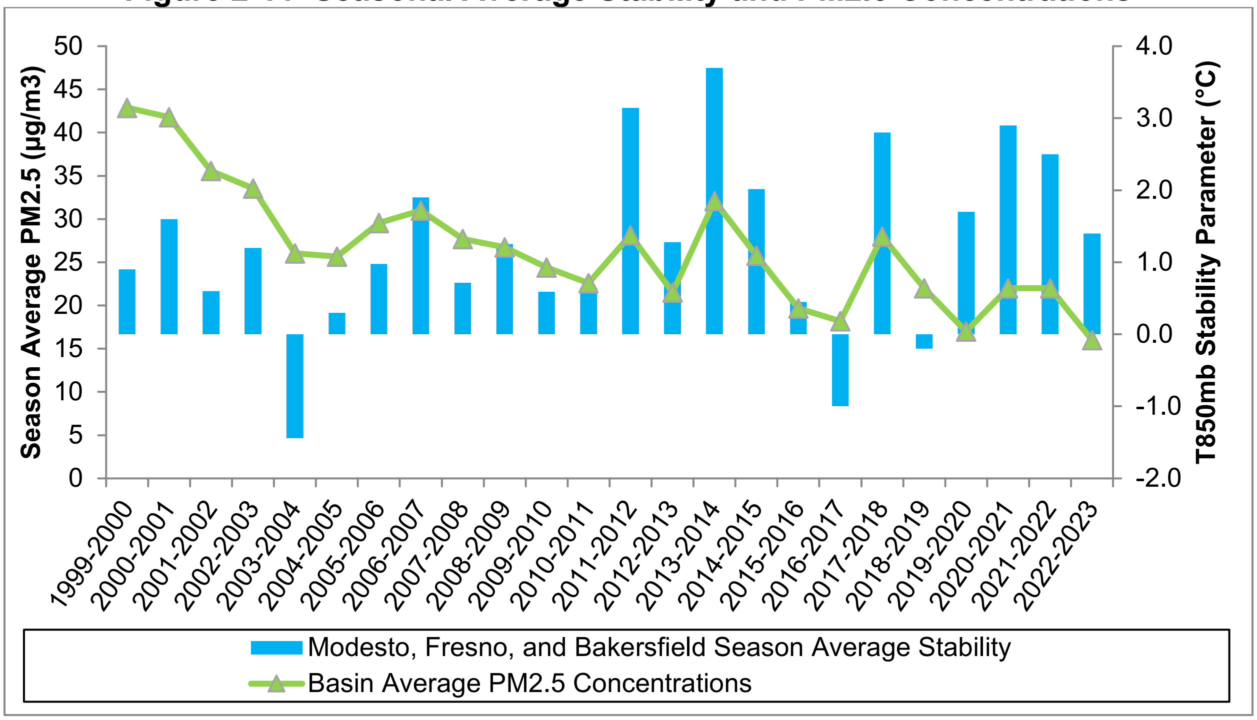


Figure 2-10 Progress in Reducing Days Exceeding 24-hour PM2.5 Standard



As demonstrated in Figure 2-11, the average PM2.5 concentration throughout the Valley has decreased over the period, despite low precipitation totals and elevated atmospheric stability in recent years. In this figure, the larger the stability parameter (blue bars), the more conducive the winter season meteorology is for the formation of high concentrations of PM2.5. Even with higher stability in recent winter seasons, overall PM2.5 concentrations have continued to decline (green line). This provides strong evidence that the District and CARB's comprehensive strategies have been achieving permanent emissions reductions.

Figure 2-11 Seasonal Average Stability and PM2.5 Concentrations



2.4 CONCLUSION

Although there are significant challenges in meeting the federal PM2.5 standards, the control measures and strategies adopted by the District and CARB have resulted in substantial emissions reductions, as reflected in the improving PM2.5 metrics above. Air quality will continue to improve as the measures and strategies discussed in this plan are implemented in the coming years.

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