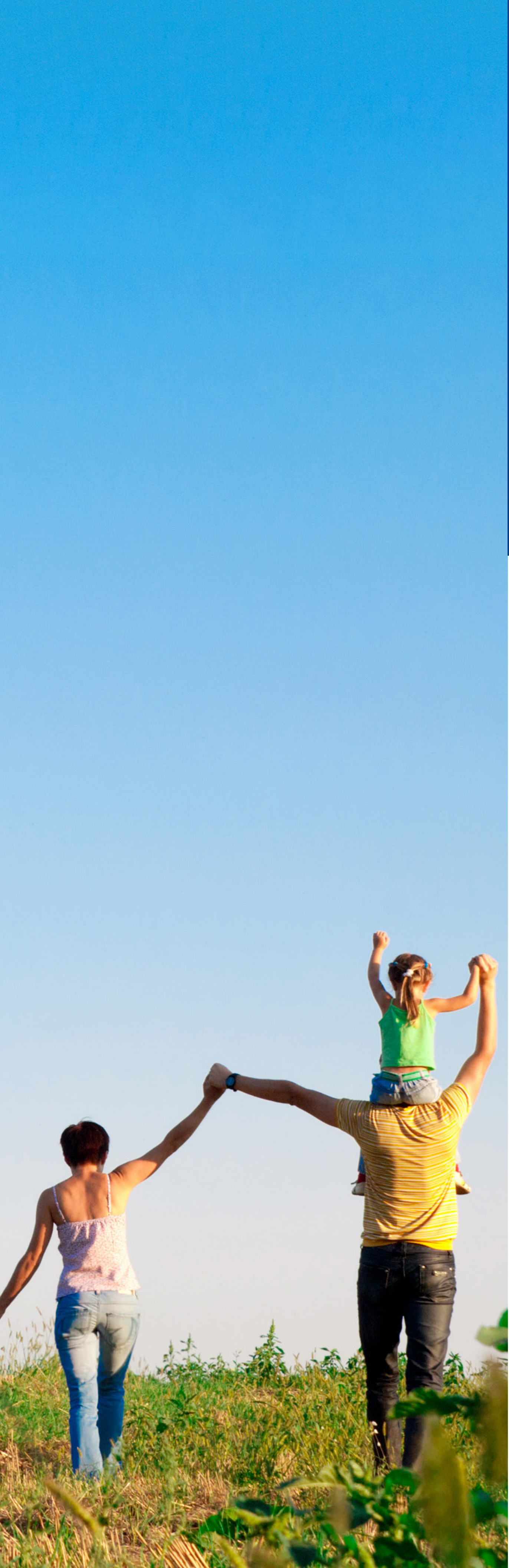


CHAPTER 5

Future Air Quality

- Modest additional emission reductions are required for the Basin to attain the 2012 annual PM2.5 standard in 2030.

- The emissions of direct PM2.5, NOx, and ammonia must be reduced by 1.4, 34.9, and 3.2 tons per day respectively, beyond the 2030 baseline levels to attain the standard in 2030.

- The control strategy discussed in Chapter 4 provides a path to attain the standard by 2030, with a design value at our highest monitoring site of 12.0 µg/m³.

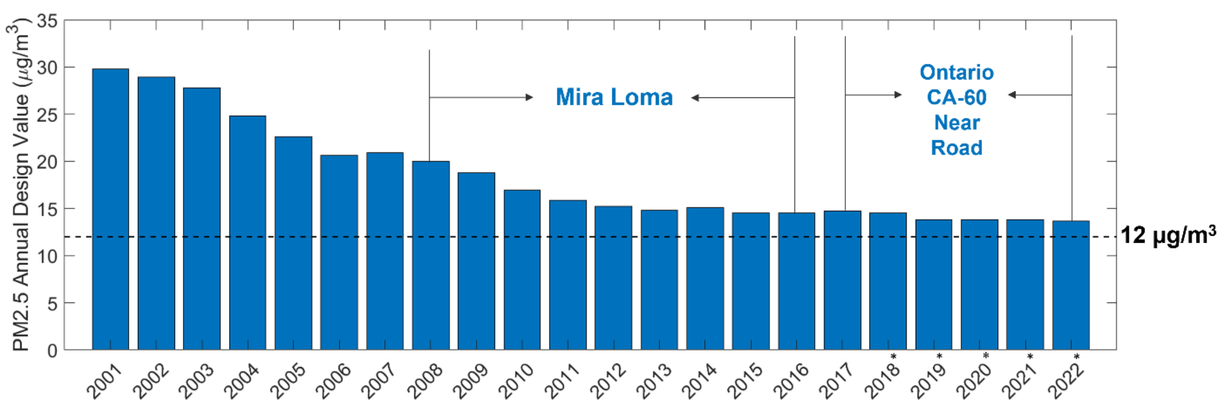
- With the control strategy outlined in Chapter 4 of this Plan, it is anticipated that annual PM2.5 levels in all areas of the Basin will be below 12.0 µg/m³ by 2030.

Introduction

The primary objective of the 2024 PM2.5 Plan is to address attainment of the federal 2012 annual average PM2.5 standard, set at 12 µg/m^3. Air quality modeling to demonstrate future attainment of the PM2.5 standard is an integral part of the planning process to achieve clean air. Attainment demonstration is the modeling exercise that shows how emission reductions will result in lower concentrations of air pollutants, presenting the path to attainment. The demonstration reflects updated emissions estimates, new technical information, enhanced air quality modeling techniques, updated attainment demonstration methodology, and the control strategy.

Base Design Value

A design value is a statistical metric used to show whether a region is in attainment with the NAAQS. The base design value is the starting point of the modeling analysis to show the pathway to attainment. U.S. EPA guidance recommends the use of multiple year averages of design values where appropriate in establishing the base design value. This approach helps mitigate the impacts of single-year anomalies on air quality trends, which may arise due to factors including exceptional or adverse meteorological conditions or radical changes in local emissions profiles. The trend in the Basin's annual PM2.5 design values, determined from routine Federal Reference Method (FRM) samples, from 2001 through 2022 reveal substantial reductions in concentrations over this timeframe (see Figure 5-1). However, it's noteworthy that the rate of decrease in annual design values has decelerated since 2012.



*Data likely to be approved as exceptional events by U.S. EPA removed from analysis.

FIGURE 5-1

SOUTH COAST AIR BASIN ANNUAL PM2.5 DESIGN VALUES FROM 2001 TO 2022

Overall, since 2001, the annual PM2.5 design values have decreased by over 50%, from 30 μg/m^3 in 2001 to 13.7 μg/m^3 in 2022. The deceleration in PM2.5 reduction in recent years can be attributed to a variety of factors, including meteorology, increased activities at ports, and additional sources of PM2.5 precursors. Additionally, in January 2015, two new near-road monitors started operating and providing valid data: the Ontario CA-60 and the Long Beach I-710 near-road monitors. PM2.5 concentrations are often higher at near road monitors, reflecting higher levels of resuspended dust, vehicle exhaust and brake and tire wear. Since 2017, the Ontario CA-60 near-road station has served as the design site in the basin.

Modeling Base Design Value Calculation

The PM2.5 annual design value for a specific year is determined by averaging the annual PM2.5 concentrations over a three-year period that includes the given year and the two preceding years. However, U.S. EPA guidance on modeling the attainment demonstration[1] recommends using a 5-year weighted design value centered on the base year selected for the attainment demonstration as the modeling Base Design Value (DVB). This 5-year weighted average approach recommended by EPA is to reduce year-to-year variability compared to a single 3-year design value. In the context of this plan, the DVB for each monitoring station is calculated as the average of the design values for 2018 through 2020 (denoted as DV 2018, DV 2019, and DV 2020 in Figure 5-2). This calculation covers a 5-year period from 2016 through 2020, centered at the base year 2018. Under certain circumstances, the U.S. EPA allows modification of DVB calculation, such as in the case of exceptional events. Figure 5-2 presents the U.S. EPA-recommended DVB calculation on the left. The 2020 DV calculation includes the year 2020, which was marked by several extraordinary events that significantly altered PM2.5 concentrations in the basin. These events include the COVID-19 pandemic and associated changes in human activity, and record-setting wildfires. More details on the exceptionality of 2020 are discussed in Chapter 5 of Appendix II. To address this anomalous year this PM2.5 plan uses a modified DVB for 2018 that excludes the 2020 DV from DVB calculations and replaces it with the average of 2018 and 2019 annual means (Figure 5-2, right). In addition, exceptional events on July 4 and 5 due to Fourth of July fireworks are also excluded. Justification to exclude these days from DVB calculations is included in Appendix II.

[1] Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, U.S. EPA, November 2018. Available at: https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

2018 Base Design Value (DVB)

DV 2018	DV 2019	DV 2020
2016-2018	2017-2019	2018-2020

Average = DVB =
$$\frac{(DV\ 2018) + (DV\ 2019) + (DV\ 2020)}{3}$$

2018 Base Design Value (DVB)

DV 2018	DV 2019	DV Modified
2016-2018	2017-2019	2018-2019

Average = DVB =
$$\frac{(DV\ 2018) + (DV\ 2019) + \left(\frac{Avg2018 + Avg2019}{2}\right)}{3}$$

FIGURE 5-2
PM2.5 5-YEAR WEIGHTED AVERAGE FOR 2018 BASE DESIGN VALUE.
U.S. EPA'S DEFAULT METHODOLOGY (LEFT PANEL) AND MODIFIED METHODOLOGY TO EXCLUDE YEAR 2020 (RIGHT PANEL). DV REFERS TO A 3-YEAR DESIGN VALUE.

Table 5-1 shows the annual 2018 DVB values for all monitoring stations within the Basin, and it includes the 2012 DVB presented in the 2016 AQMP. Notably, the Ontario CA-60 near-road monitor has the highest design value in 2018 (13.98 $\mu g/m^3$) making it the designated design site for this PM2.5 plan. Mira Loma was the design site in the 2016 AQMP before data from the Ontario CA-60 near-road was available, but its DVB in 2018 is the second highest, with a decline from 14.87 $\mu g/m^3$ in 2012 to 13.53 $\mu g/m^3$. In general, the stations reported in the 2016 AQMP experienced a decrease in DVB from 2012 to 2018. While the DVB values for 2012 included the exceptional events of Fourth of July fireworks, which might amplify the reductions in DVB from 2012 to 2018 slightly, trends show that the annual PM2.5 concentrations keep improving.

TABLE 5-1
WEIGHTED ANNUAL PM2.5 DESIGN VALUES FOR 2012 FROM THE 2016 AQMP AND FOR 2018 CALCULATED FOR THE PM2.5 PLAN (µg/m^3)

Monitoring Site	Annual 2012 DVB from the 2016 AQMP	Annual 2018 DVB*
Anaheim-Pampas Lane	10.57	10.55
Azusa	-	10.13
Big Bear	-	6.35
Los Angeles-North Main Street	12.43	11.97
Compton-700 North Bullis Road	-	12.25
Fontana-Arrow Highway	12.60	11.35
Long Beach-Route 710 Near Road	-	12.28
North Long Beach	-	10.53
Mira Loma Van Buren	14.87	13.53
Mission Viejo-26081 Via Pera	-	7.94
Ontario- Route 60 Near Road	-	13.98
Pasadena-S Wilson Avenue	-	9.68
Pechanga	-	6.36
Pico Rivera-4144 San Gabriel	-	11.87
Reseda	-	9.74
Riverside-Rubidoux	13.13	12.13
South Long Beach	-	10.58
San Bernardino-4th Street	-	10.87

* Calculated based on the modified methodology illustrated in Figure 5-2

PM2.5 Speciation

PM2.5 species profiles for the base year are required to project future design values of PM2.5. The PM2.5 species required in the calculation of future design values are the following: sulfate (SO4), nitrate (NO3), ammonium (NH4), elemental carbon (EC), sea salts (Salt), crustal species, organic carbon (OC), particle-bound water (PBW), and a blank. There are a total of four monitoring stations from the Chemical Speciation Network (CSN) that routinely measure PM2.5 speciation data in the Basin. These CSN monitors are collocated where their corresponding FRM monitors are located. With one site in each county, the four CSN sites are strategically located to represent aerosol characteristics in the four counties within the Basin. Historically, Riverside-Rubidoux served as the design site, a location with the highest annual PM2.5 concentration in the Basin. Fontana and Anaheim experienced elevated concentrations within their respective counties, and the Central Los Angeles site was intended to capture the characteristics of an emission source area.

The measurements of individual species obtained from the CSN sites may differ from the retained mass of a specific species in the FRM filter, due to the inherent differences in the measurement techniques. To reconcile the expected differences between speciated and FRM measurements, species are adjusted following the SANDWICH method[2], which is described in the U.S. EPA modeling guidance.[3] This adjustment results in reduced nitrates (relative to the amount measured by routine speciation networks), higher mass associated with sulfates and nitrates (reflecting water included in gravimetric FRM measurements), and an estimate of organic carbonaceous mass, which is derived from the difference between FRM-measured PM2.5 and the sum of all components except measured organic carbon. EPA's mas balance method sets a ceiling for OC mass (OCM) to be 80 percent of the total PM2.5 mass. However, based on scientific literature on PM2.5 speciation data taken in the greater Los Angeles area,[4,5] this ceiling was set as the 50 percent of PM2.5 FRM mass. EPA's guidance also sets a floor value for OCM to be the measured OC value. However, the sum of individual species measured from CSN is sometimes larger than the FRM mass. Under this condition, the measured OC as floor would erroneously exaggerate the OC fraction while reducing the other species, therefore, the OC floor was scaled by the ratio of FRM mass divided by the total CSN mass.

Directly measured ammonium (associated with nitrate and sulfate) at CSN stations, which is equivalent to particulate ammonium retained on FRM filters, was used for the speciation profiles. These measurements, however, were capped with fully neutralized ammonium, which is calculated as follows:

$$Ammonium\ ceiling = 0.375 \times sulfate + 0.29 \times retained\ nitrate$$

PBW was estimated using a polynomial regression equation fitted to the equilibrium model Aerosol Inorganic Matter (AIM) as a function of sulfate, nitrate, and adjusted ammonium concentrations. Most

[2] Frank, Neil. (2006). Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities. Journal of the Air & Waste Management Association (1995). 56. 500-11. 10.1080/10473289.2006.10464517.

[3] Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, U.S. EPA, November 2018. Available at: https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

[4] Hayes et al., 2013. Organic aerosol composition and sources in Pasadena, California, during the 2010 CalNex campaign. Journal of Geophysical Research, 118, 9233-9257

[5] Shirmohammadi et al., 2016. Fine and Ultrafine Particulate Organic Carbon in the Los Angeles Basin: Trends in Sources and Composition. Science of Total Environment, 541, 1083-1096

FRM monitors in the Basin lack a co-located CSN monitor. Thus, as recommended by EPA guidance[6], the individual speciation components from nearby CSN monitors were interpolated to the locations of FRM monitors that do not have a co-located CSN monitor using Inverse Distance Squared Weights. The interpolated speciated component at a given unmonitored location in the Basin is calculated using a weighted average of CSN monitor values, with weights of a monitor calculated as a function of the inverse squared distance from said monitor.

Figure 5-3 and Figure 5-4 compare PM2.5 speciation fraction profiles estimated for the 2016 AQMP and the current PM2.5 Plan at the Central LA and Riverside-Rubidoux monitoring stations, respectively. Speciated monitor data from 2017 through 2019 was used for the PM2.5 Plan speciation fraction profile, while the 2016 AQMP speciation profile was calculated using the data collected in 2012. Generally, nitrate, elemental carbon (EC), and ammonium fractions have declined between the 2016 AQMP and the PM2.5 Plan across all seasons. This reduction reflects the effect of existing rules and regulations aimed at reducing primary PM2.5 and its precursor emissions.

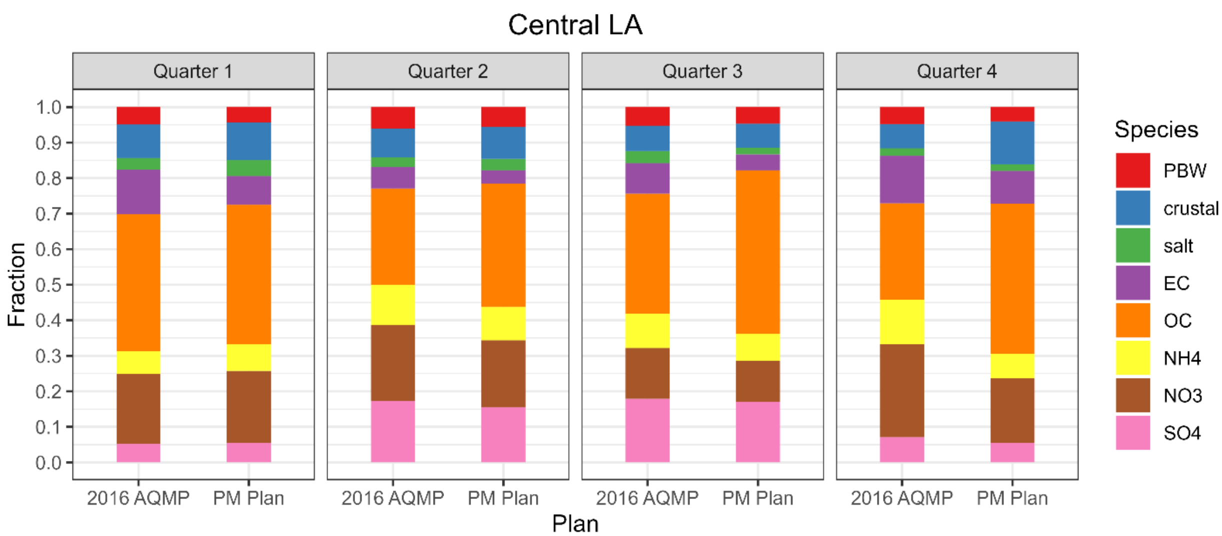


FIGURE 5-3

COMPARISON OF CENTRAL LA PM2.5 SPECIATION FRACTION PROFILE INCLUDED IN THE 2016 AQMP AND THE PM2.5 PLAN

[6] Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, U.S. EPA, November 2018. Available at: https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

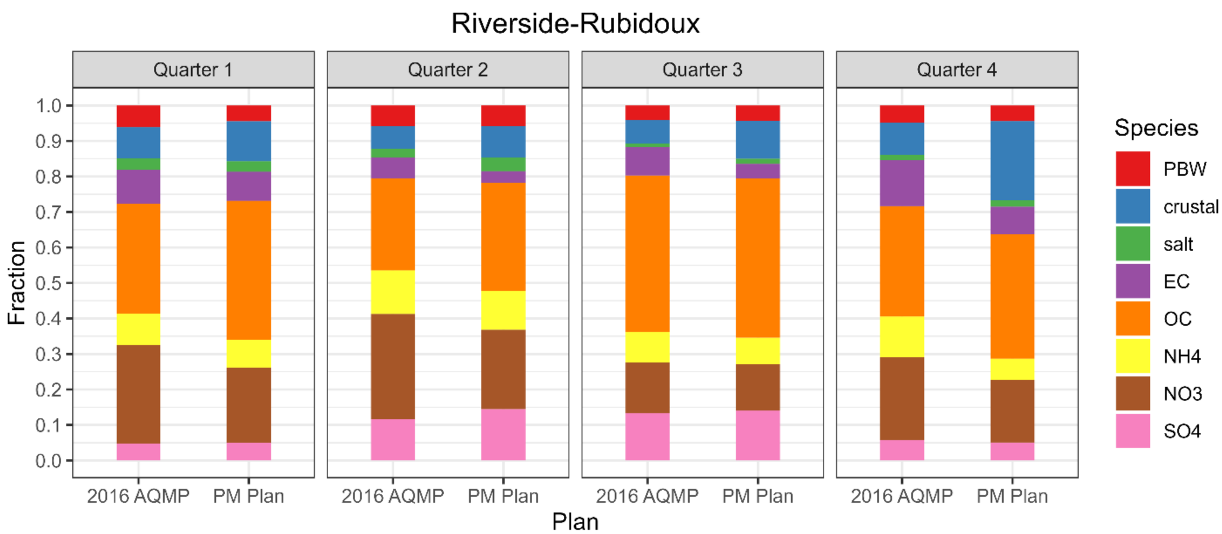


FIGURE 5-4
COMPARISON OF RIVERSIDE PM2.5 SPECIATION FRACTION PROFILE INCLUDED IN THE 2016 AQMP AND THE PM2.5 PLAN

Annual PM2.5 Modeling Approach

Simulations for PM2.5 concentrations were conducted for the 2018 base year and the 2030 attainment year. CMAQ simulations covered the entire year of 2018 (from January 1st to December 31st). These simulations encompassed 8,760 consecutive hours from which daily 24-hour average PM2.5 concentrations were calculated. PM2.5 is divided into primary particles – which are directly emitted into the atmosphere – and secondary particles – which are formed from precursor gases. Sources of primary PM2.5 include but are not limited to road dust, diesel soot, and combustion products. Secondary products, such as sulfates, nitrates, and complex organic carbon compounds, are formed through chemical reactions involving oxides of sulfur (SOx), oxides of nitrogen (NOx), VOCs, and ammonia (NH3). The following section summarizes the PM2.5 modeling approach adopted for this Plan. The comprehensive modeling system used for this Plan includes photochemical reactions involved in the formation of PM2.5, horizontal and vertical transport, and removal mechanisms such as deposition. More detailed information on the PM2.5 modeling is presented in Appendix II.

Meteorology, Emissions, and Air Quality Model Configuration

The emissions inventory and meteorological conditions were developed for 2018, which was selected as the base year for emissions and meteorology. U.S. EPA requires the base year to be one of the three years of which DV was used in designation/re-classification,[7] and 2018 was the year that U.S. EPA relied on to re-classify the Basin from "moderate" to "serious" non-attainment area.[8] In addition, the Multiple Air Toxics Exposure Study V (MATES V)[9] conducted during 2018 involved comprehensive monitoring and numerical modeling. This effort contributed to the development of a robust dataset to evaluate modeling performance and to improve capabilities for modeling year 2018.

The PM2.5 Plan attainment demonstration framework is an upgrade from the modeling platform used in the 2022 AQMP and more recent SIP revisions. The framework uses the U.S. EPA-supported CMAQ modeling platform (version 5.3.3), incorporating the Statewide Air Pollution Research Center (SAPRC) 07 chemistry, and uses meteorological fields from the Weather Research and Forecasting Model (WRF). The modeling platform tracks primary pollutants, including precursors of ozone and particulate matter (PM2.5) as well as the formation of secondary pollutants like ozone and particles that result from chemical reactions occurring in the atmosphere. The simulations were conducted over an area with a western boundary over 100 miles west of the Ports of Los Angeles and Long Beach. The eastern boundary extends slightly beyond the Colorado River, while the northern and southern boundaries of the domain extend to the San Joaquin Valley and the Northern portions of Mexico, respectively. CMAQ was performed at a 4 km by 4 km grid resolution. For the PM2.5 Plan, WRF was updated to the most recent version (4.4.2) available at the time of protocol preparation. The WRF simulations were initialized using National Centers for Environmental Prediction (NCEP) re-analysis data[10] and run for three-day increments with four-dimensional data assimilation (FDDA).

Spatial and temporal allocation of emissions followed the same methodology used in the 2022 AQMP. Point source emissions were extracted from the South Coast AQMD's Annual Emissions Reporting Program and were allocated to specific days of the year using temporal allocation factors developed by CARB. On-road mobile source emissions were calculated using CARB's EMFAC2021 emissions model, incorporating vehicle travel activity data provided by Southern California Association of Governments (SCAG). Vehicle emissions accounted for meteorological effects on operational and evaporative emissions (temperature and relative humidity effects) which were derived from daily meteorological variables predicted with WRF. In addition, hourly vehicle activity profiles based on the California Department of Transportation (Caltrans) Performance Measurement System (PeMS) were used to refine the temporal variation of vehicle emissions. Spatial and temporal allocation of emissions from area sources and most off-road emissions sources were calculated using the latest spatial and temporal surrogates developed by CARB, which were released in January 2021. In addition, ocean-going vessel emissions were spatially allocated using data from the Automated Identification System (AIS), and aircraft emissions from major airports within the basin were allocated using aircraft location information data derived from the Aircraft Communication Addressing and Reporting System (ACARS). Gridded hourly biogenic emissions were calculated using the Model of Emissions of Gases and Aerosols from Nature version 3.0 (MEGAN3.0)

[7] 40 CFR 51.1008
[8] 85 FR 40026
[9] http://www.aqmd.gov/docs/default-source/planning/mates-v/mates-v-final-report-9-24-21.pdf?sfvrsn=6.
[10] NCEP Reanalysis data provided by the NOAA/OAR/ESRL PSL, Boulder, Colorado, USA, from their Web site at: https://psl.noaa.gov/data/gridded/data.narr.html.

driven by the meteorological inputs from WRF. More details on the modeling approach, data retrieval, model development and enhancement, model application, emissions inventory development, and interpretation of results is presented in Appendix II.

Design Values and Relative Response Factors (RRF)

To bridge the gap between air quality model predictions and measurements, U.S. EPA guidance[11] has recommended the use of relative response factors (RRFs). In this approach, future year concentration predictions require two elements: base year design values and RRFs. The RRF is simply a ratio of the future year predicted air quality to the simulated air quality in the base year, representing the model predicted change in air quality in response to predicted emissions changes. For the annual PM2.5 attainment demonstration, base year and future modeled concentrations are calculated as a quarterly average of a 3-by-3 grid centered at each station for each specific component. The ratio of base to future year quarterly mean concentrations for each component is the RRF for that component. Individual RRFs are calculated for NH4, NO3, SO4, EC, OC, salt, and a combined grouping of crustal compounds and metals (Others). Future year design values were calculated by multiplying species- and site-specific RRFs by the corresponding quarterly design values. Once the future values for NH4, NO3 and SO4 are calculated using RRFs, future PBW quarterly values are computed using the same polynomial fitting used in the SANDWICH method. The total future quarterly values at each site are then calculated by adding all the individual components and the blank. The four quarterly average concentrations are then averaged at each site to determine the future annual design values.

Model Performance Evaluation

The U.S. EPA recommends operational evaluations to assess how accurately the model predicts observed concentrations. The basis for this recommendation is that if the model can characterize base year PM2.5, then greater confidence can be placed in the model-prediction of future concentrations. Figure 5-5 depicts the modeled and measured daily PM2.5 concentrations at stations of Los Angeles, Compton, Mira Loma, and Ontario CA-60 near-road during January 1 through December 31 of 2018. PM2.5 mass was measured every day for all stations in this Figure, except Compton at which PM2.5 was measured every three days. CMAQ predicts daily PM2.5 mass and seasonal variation of PM2.5 reasonably well with overestimation in winter months and underestimation in summer months. A comprehensive model performance evaluation for PM2.5, NH4, NO3, SO4, organic matter (OM), EC, and crustal species concentrations is presented in Appendix II.

Figure 5-6 shows the modeled (orange) and measured (blue) annual PM2.5 species concentrations at Anaheim, Central Los Angeles, Fontana, and Riverside in 2018. The model tends to overestimate

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[11] Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM and Regional Haze. Available at: https://www.epa.gov/sites/default/files/2020-10/documents/draft-o3-pm-rh-modeling_guidance-2014.pdf

concentrations at Central Los Angeles, which is near major sources of emissions. Conversely, the model tends to underestimate PM2.5 species concentrations at inland stations in Fontana and Riverside. Overall, the model predicts NH4 ion, SO4, nitrate, EC, and OM concentrations reasonably well. Model results accurately capture the relative contributions of PM2.5 species and show that nitrate and OM are the largest contributors to total PM2.5.

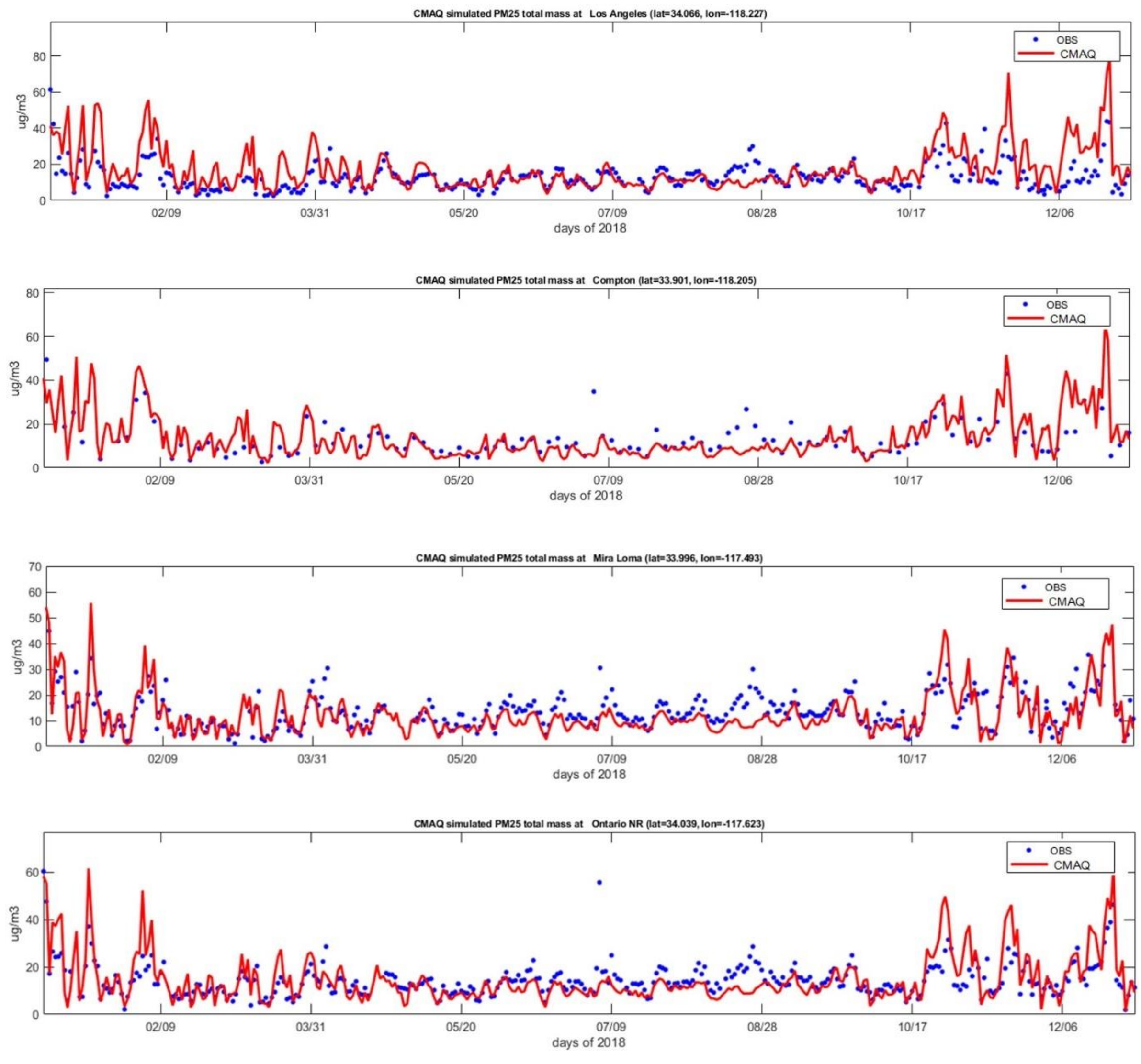

FIGURE 5-5

MODELED AND OBSERVED DAILY PM2.5 CONCENTRATIONS AT (TOP TO BOTTOM) LOS ANGELES, COMPTON, MIRA LOMA, ONTARIO NEAR-ROAD DURING JAN 1 THROUGH DEC 31, 2018

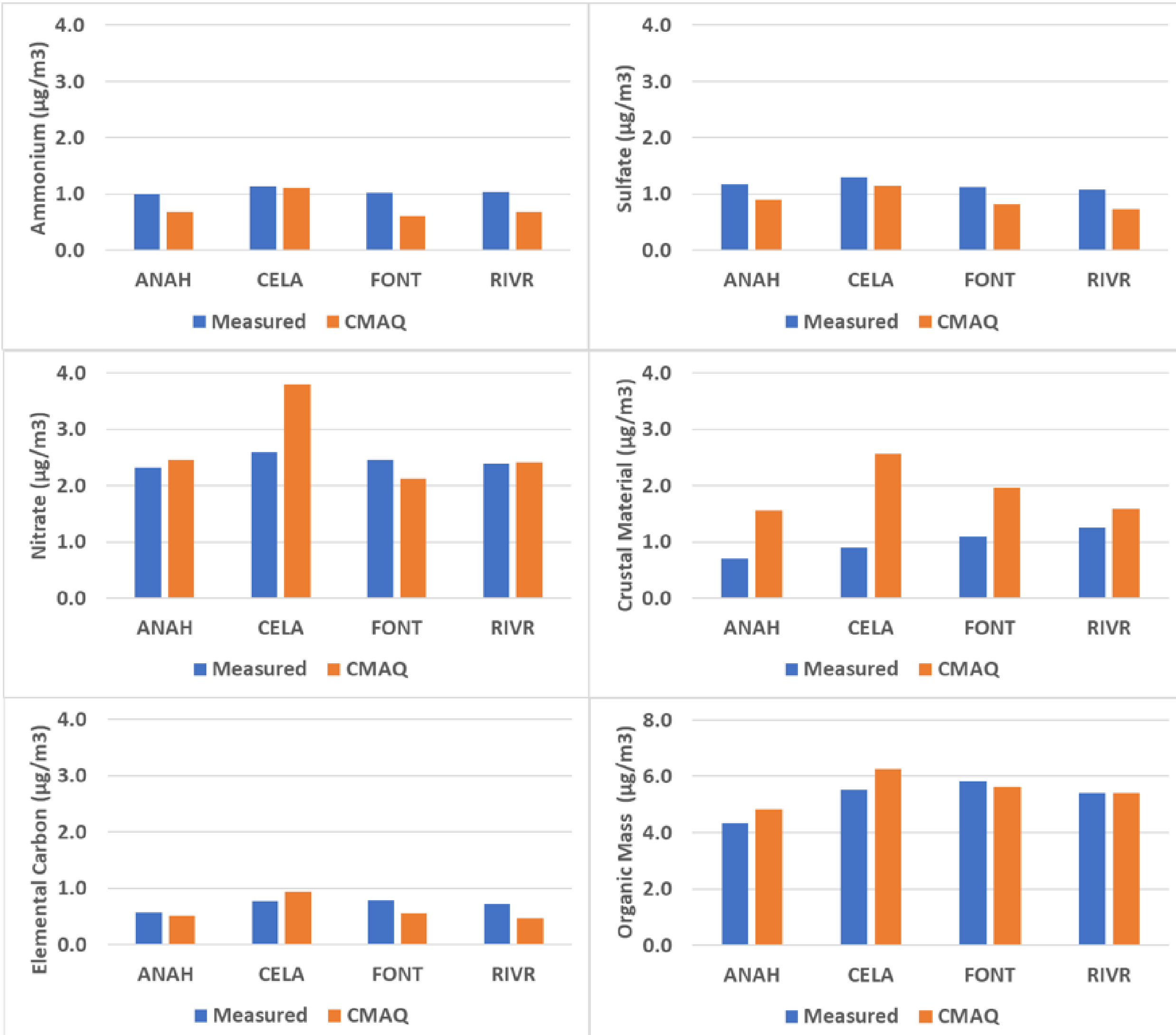

FIGURE 5-6

MODELED (ORANGE) AND OBSERVED (BLUE) ANNUAL PM2.5 SPECIES CONCENTRATIONS IN ANAHEIM (ANAH), CENTRAL LOS ANGELES (CELA), FONTANA (FONT), RIVERSIDE (RIVR) DURING 2018

Figure 5-7 shows the modeled (orange) and observed (blue) seasonal variation of nitrate and OM concentrations at Anaheim, Central Los Angeles, Fontana, and Riverside in 2018. The model predicts the seasonality of nitrate (top) and OM (bottom), accurately capturing peak nitrate and OM concentrations during winter months, and their subsequent drops during the summer. This is due to increased humidity, cooler temperatures, and frequent nocturnal inversions, conditions which favor the formation of ammonium nitrate, a significant component of secondary PM2.5. Summer months, in contrast, increase the volatility of nitrate, leading to relatively lower pollutant concentrations.

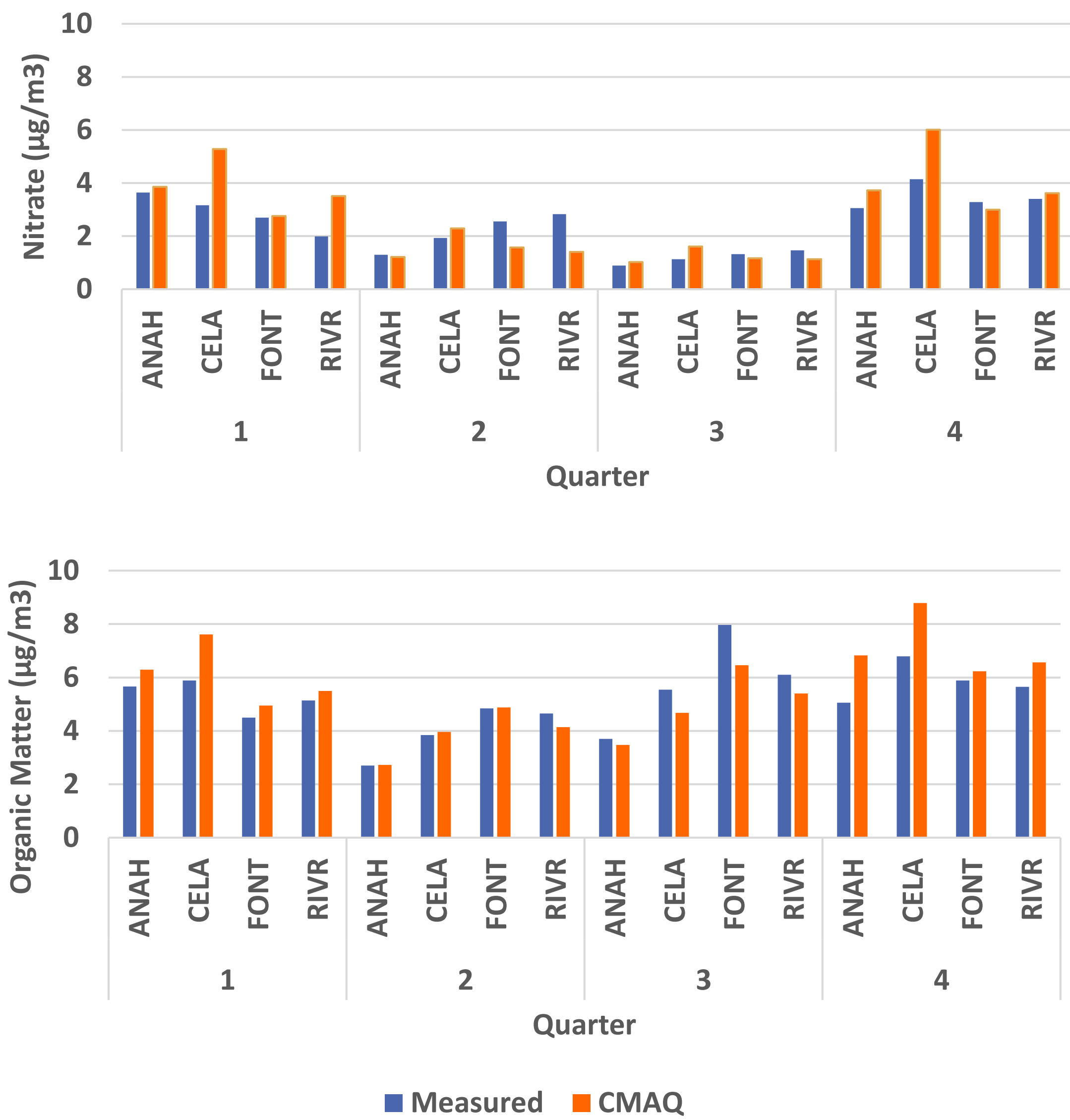

FIGURE 5-7

MODELED AND OBSERVED SEASONAL VARIATION OF NITRATE AND ORGANIC MATTER AT ANAHEIM (ANAH), CENTRAL LOS ANGELES (CELA), FONTANA (FONT), RIVERSIDE (RIVR) IN 2018

CMAQ performance evaluation segments the modeling domain into several sub-regions or zones. Table 5-2 lists the station locations and their assigned performance evaluation zone used to assess base-year simulation performance. Figure 5-8 maps the location of each station in the Basin. The “Urban Source” region typically has the highest emissions of PM2.5 and its precursors in the Basin, whereas the “Urban Receptor” region tends to experience high concentrations of secondary pollutants. Table 5-3 shows the model performance for daily PM2.5 in 2018 in each zone. While CMAQ underestimates PM2.5 mass in the San Fernando region and overestimates PM2.5 in over the Foothills and Urban Source regions, it shows the best model performance over the Urban Receptor region, which includes the Basin’s design site.

TABLE 5-2
STATION INFORMATION OF PERFORMANCE EVALUATION ZONES

Station Location	Performance Evaluation Zone
Long Beach	Coastal
Mission Viejo	Coastal
South Long Beach	Coastal
Azusa	Foothills
Pasadena	Foothills
Reseda	San Fernando
Fontana	Urban Receptor
Mira Loma	Urban Receptor
Ontario Near Road	Urban Receptor
Riverside	Urban Receptor
San Bernardino	Urban Receptor
Anaheim	Urban Source
Compton	Urban Source
Los Angeles	Urban Source
Pico Rivera	Urban Source

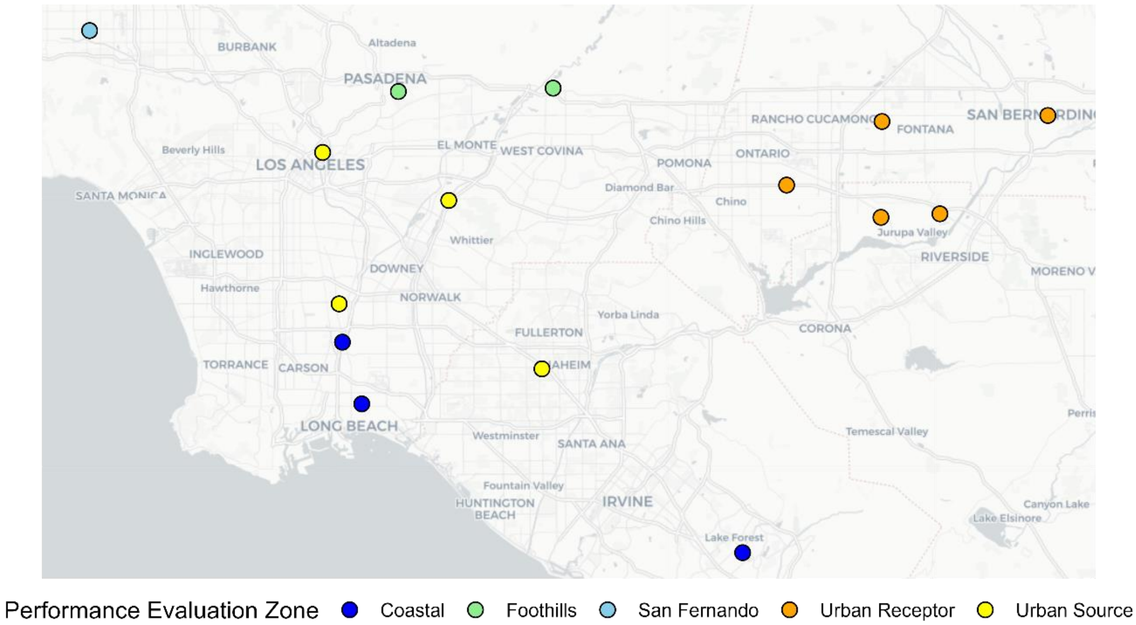

FIGURE 5-8
MAP OF PERFORMANCE EVALUATION ZONES

TABLE 5-3
MODEL PERFORMANCE FOR DAILY PM2.5 OF 2018

	Observation (µg/m³)	Simulation (µg/m³)	Correlation R2	Normalized Mean Bias (%)	Normalized Mean Error (%)
Coastal	10.5	11.4	0.66	7.8	43.0
San Fernando	10.5	10.1	0.53	-3.5	33.1
Foothills	10.6	15.1	0.49	38.5	56.8
Urban Source	12.7	14.4	0.68	12.4	41.4
Urban Receptor	12.7	12.9	0.68	0.6	33.8

Future PM2.5 Air Quality

Annual concentrations of PM2.5 were simulated for the base year 2018 and two future milestone years: 2025 and 2030. Both baseline and control scenarios were analyzed for 2030, the future attainment year. The outcomes are detailed in Figure 5-9 and Table 5-4.

The CA-60 Ontario near-road monitor is the base year's design site with a value of 13.98 $\mu g/m^3$ and is predicted to maintain the highest PM2.5 concentrations in the basin based on the baseline simulations for 2025 and 2030 (Figure 5-9). The projected design values at that site for 2025 is 13.09 $\mu g/m^3$, failing to meet the standard of 12 $\mu g/m^3$. Similarly, Mira Loma is projected to exceed the standard in 2025, with a design value of 12.62 $\mu g/m^3$. This demonstrates that the basin requires additional time beyond 2025 to meet the annual PM2.5 standard.

The simulation of the 2030 baseline also indicates that Ontario CA-60 near-road and Mira Loma will still exceed the annual PM2.5 standard. The 2030 baseline includes emission reductions of 173 tons per day of NOx, 58 tons per day of VOC, and 2 tons per day of PM2.5 with respect to 2018 base year emissions. As shown in Table 5-4, CA-60 Ontario near-road remains with the highest design value of 12.88 $\mu g/m^3$ under the 2030 baseline scenario. Additionally, the Mira Loma site is projected to exceed the 2012 annual PM2.5 standard with a design value of 12.48 $\mu g/m^3$. As a result, the 2030 baseline scenario falls short of demonstrating attainment, underscoring the need of additional emission reductions.

The strategy to attain the annual PM2.5 standard by 2030 is provided in Chapter 4 and Table 4-12, which includes co-benefits from the ozone strategy in the 2022 AQMP, as well as other proposed control measures within this PM2.5 Plan. However, the ozone strategy outlined in the 2022 AQMP includes 182(e)(5) measures that are permitted in the SIP/AQMP for ozone 'extreme' non-attainment status, but that are not permitted in this PM2.5 Plan. Thus, the 2030 attainment scenario outlined in this PM2.5 Plan relies on defined control measures and excludes 182(e)(5) measures from the 2022 AQMP, such as reductions from ocean-going vessels by 2030. Reflecting control measures presented in Chapter 4, emissions of NOx, NH3, and PM2.5 decrease by 17%, 4% and 3%, respectively.

Measures targeting mobile source emissions are the primary drivers of NOx emissions reductions as over 80% of the NOx in the Basin are from these sources. Reductions of PM2.5 are equally attributable to measures directed at reducing stationary and mobile source emissions. See Table 4-12 for the emission reductions of NOx and PM2.5 included in the attainment scenario. Detailed descriptions of control measures and their expected reductions are also outlined in Chapter 4 and Appendix II. These reductions guarantee attainment of the 2012 federal annual PM2.5 standard by 2030 at all stations except CA-60 Ontario. The demonstration of attainment at the Ontario CA-60 near-road monitor requires a specific methodology that better represents the impact of on-road emissions on the near-road monitor. This novel methodology for the attainment demonstration at near-road sites is summarized in the following section.

We explored whether attaining the standard earlier would be possible with 2029 baseline emissions. Assuming a linear progress in the emission reductions resulting from the measures in this Plan between milestone years 2028 and 2030, the approximate emissions reductions with respect to the 2029 baseline would be 24 and 0.9 tons per day of NOx and PM2.5, respectively. These reductions are from linear interpolation, not a commitment by either South Coast AQMD or CARB. Actual reductions from a rule or control measure often occur as stepwise function, not in a linear context. Our modeling system indicates that a change of one ton per day in NOx and PM2.5 emissions corresponds to roughly 0.006 μg/m^3 and 0.121 μg/m^3 changes in the annual PM2.5 design value at Mira Loma. Applying this response rate and the expected emission reductions in 2029, the design value at Mira Loma is projected to be 12.15 μg/m^3 in 2029. This demonstrates that the earliest attainment of the annual PM2.5 standard would be in 2030.

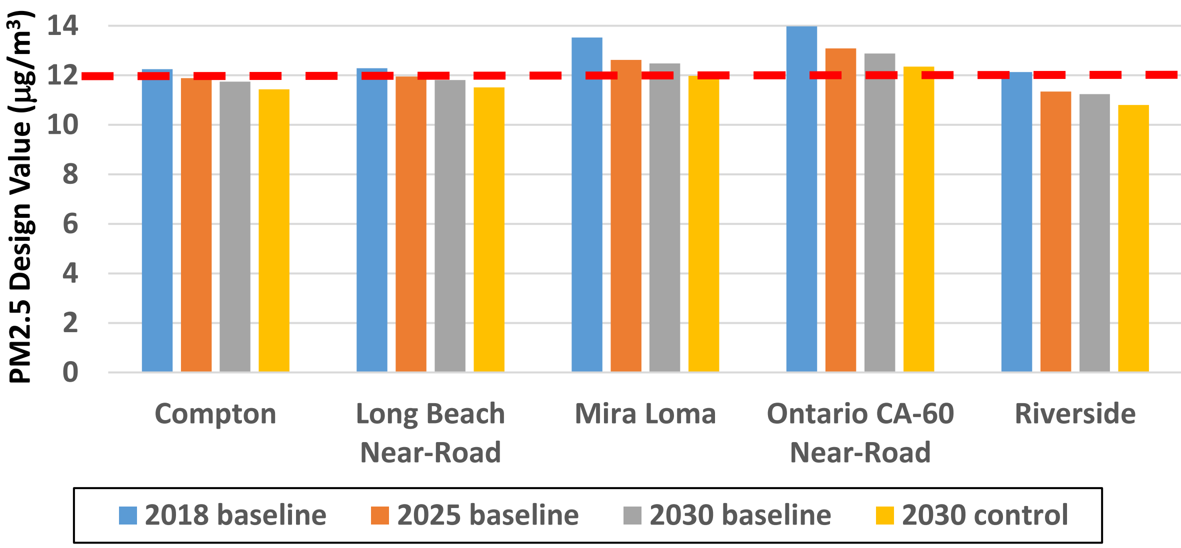

FIGURE 5-9
ANNUAL PM2.5 DESIGN VALUES. THE 2012 ANNUAL PM2.5 NAAQS IS DENOTED WITH A HORIZONTAL RED DASHLINE

TABLE 5-4
RRF-BASED ANNUAL PM2.5 DESIGN VALUES FOR BASE AND FUTURE YEARS ($\mu g/m^3$)

Station	2018	2025 Baseline	2030 Baseline	2030 Attainment Scenario
Anaheim	10.54	10.22	10.15	9.90
Azusa	10.13	9.7	9.54	9.23
Big Bear	6.34	5.87	5.86	5.67
Los Angeles	11.96	11.48	11.36	11.02
Compton	12.25	11.89	11.75	11.44
Fontana	11.35	10.66	10.51	10.04
Long Beach near-road	12.28	11.95	11.81	11.51
Long Beach	10.53	10.25	10.14	9.90
Mira Loma	13.52	12.62	12.48	11.98
Mission Viejo	7.95	7.61	7.51	7.31
Ontario Near-road	13.98	13.09	12.88	11.59*
Pasadena	9.68	9.31	9.22	8.95
Pico Rivera	11.87	11.48	11.32	10.99
Reseda	9.73	9.06	9.01	8.73
Riverside	12.13	11.35	11.24	10.80
South Long Beach	10.57	10.31	10.21	9.96
San Bernardino	10.88	10.12	10.00	9.56

*Design Value from the hybrid approach for the Ontario Near-Road monitor. If the CMAQ based RRF is used, the future DV would be 12.35 $\mu g/m^3$

Attainment Demonstration for the Near-Road Monitor

The current design site in the basin is the near-road monitor located by CA-60 freeway in Ontario. The monitor is sited just 16 meters away from the freeway, as shown in Figure 5-10, and is heavily influenced by the emissions released from vehicles as well as resuspended particles caused by moving traffic. The Ontario CA-60 near-road monitor was established before 2015 and the monitored data became available for regulatory purposes since 2015. Since then, the station recorded the highest annual average PM2.5 concentration in the basin. This monitor surpassed the concentrations at the previous design site in Mira Loma, which is located approximately 12 km eastward. However, the differences in annual PM2.5 concentrations between Mira Loma and CA-60 near-road have narrowed since 2015, as shown in Figure 5-11. This trend can be attributed to the fact that emissions from on-road sources have decreased substantially more than all other sources in the basin (see Figure 5-12), and as a result, PM2.5 concentrations at near-road monitors are decreasing faster than concentrations at regional monitors that represent air quality of wider areas.

FIGURE 5-10
LOCATION OF THE ONTARIO CA-60 NEAR-ROAD MONITOR

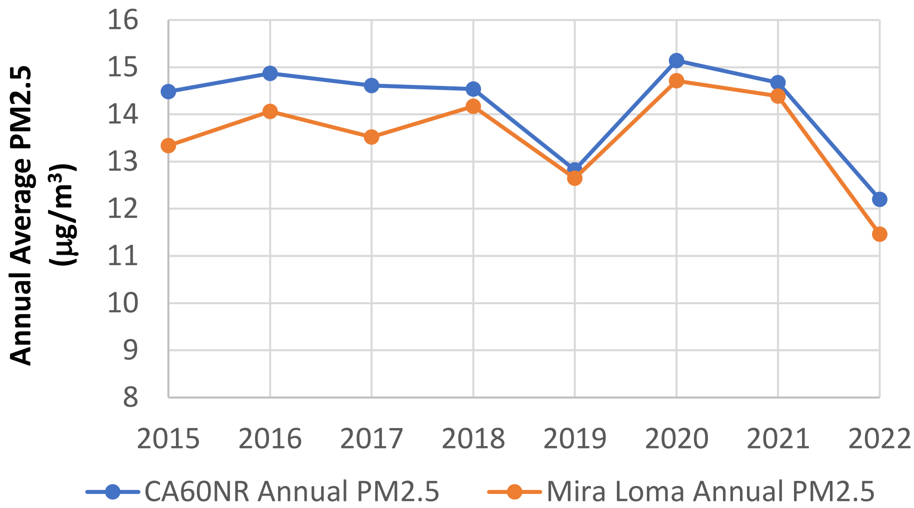

FIGURE 5-11
ANNUAL AVERAGE PM2.5 CONCENTRATIONS AT THE CA-60 NEAR-ROAD AND MIRA LOMA MONITORS SINCE THE DEPLOYMENT OF THE CA-60 NEAR-ROAD MONITOR

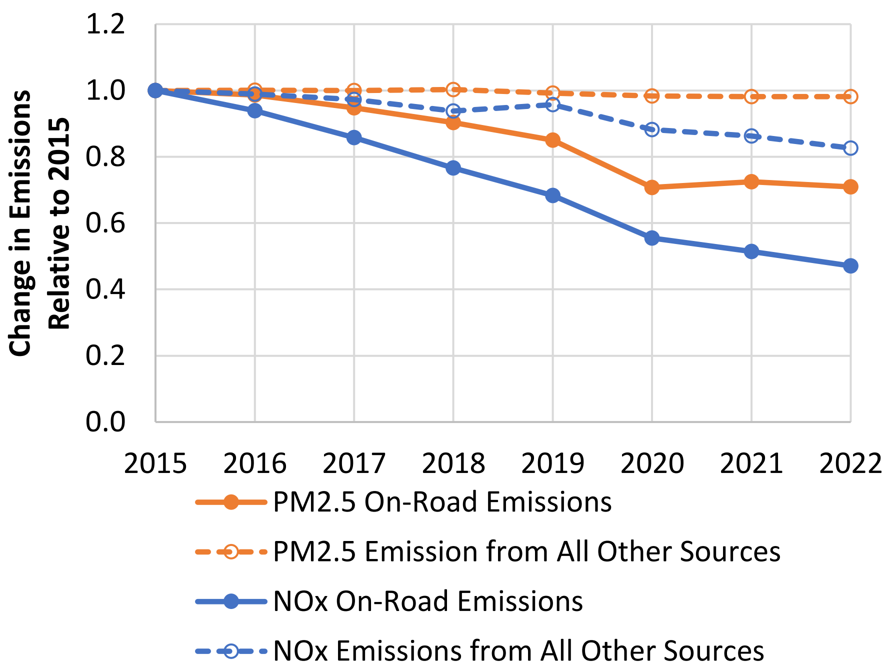

FIGURE 5-12
TRENDS IN EMISSIONS OF DIRECT PM2.5 AND NOX FROM ON-ROAD COMPARED TO THE REST OF EMISSION SOURCES FROM 2015 TO 2022

Regional chemical transport modeling is designed to calculate air quality that is representative at the grid resolution of the model. This attainment demonstration uses a model resolution of 4 km by 4 km grid, and thus, should model concentration at monitors that are representative of a similar area. Near-road sites are heavily impacted by near-road sources and thus, are not representative of the overall grid. For monitors affected by localized sources like the CA-60 Ontario near-road site, the U.S. EPA modeling guidance suggests additional modeling techniques that would support the attainment demonstration. These techniques include increasing model resolution to a finer grid or using dispersion modeling to assess the impact of primary PM2.5 emissions from near sources on the monitor.

Approach to Model the Effect of Near-road Sources

As the modeling guidance suggests, a regional chemical transport model may not be sufficient to represent the large gradients in PM2.5 concentrations at near-road monitors. As depicted in Figure 5-13, measurements at the near-road monitor observe a large contribution from near-road sources, whereas a regional model only observes those near-road impacts averaged over the entire area of the modeling grid. Thus, regional modeling is used to represent the air quality resulting from all regional sources plus the grid-average impacts of the near-road sources, whereas dispersion modeling is used to represent the near-road increment (NRI) that is the result from the monitor being next to freeway CA-60. Because of the proximity of the monitor to the freeway, it is reasonable to assume that the NRI is primarily due to direct PM2.5 emissions and that contribution of secondary PM2.5 to this NRI is negligible.

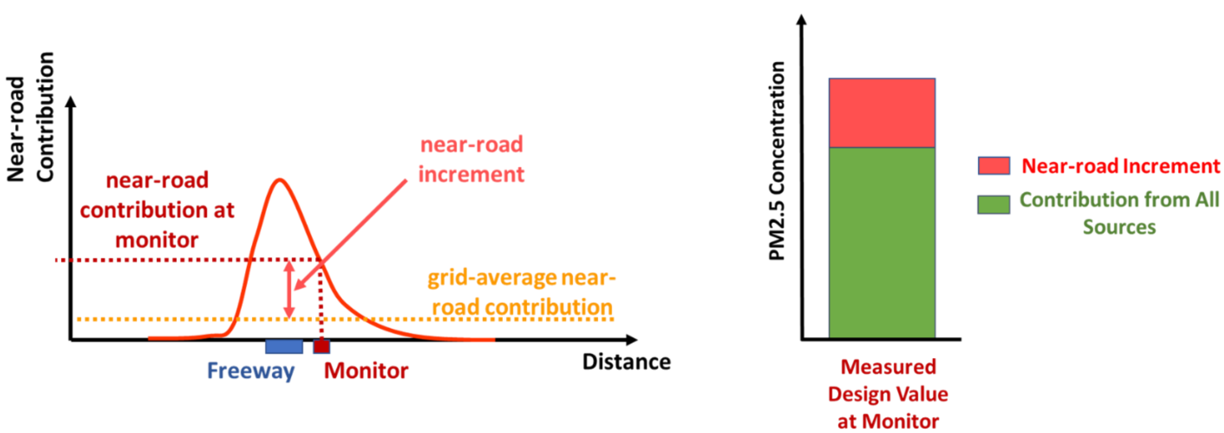

FIGURE 5-13
ILLUSTRATION OF THE NEAR-ROAD INCREMENT MODELED BY DISPERSION MODELING

The dispersion modeling is conducted using AERMOD, which is one of the official EPA dispersion models recommended for State Implementation Plan (SIP) revisions for existing sources and for New Source Review (NSR) and Prevention of Significant Deterioration (PSD) programs.[12] The modeling set-up only includes the emission sources along freeway CA-60 and its on- and off-ramps. Emission sources are grouped into 10 groups so that each category is modeled using distinctive emissions temporal and chemical profiles that can be tracked throughout the modeling. These emissions are derived from SCAG's vehicle activity dataset, which is also used in the regional modeling set-up. SCAG's dataset includes vehicle activity for 5 different vehicle classes: light and medium duty vehicles, light heavy-duty trucks, medium heavy-duty trucks, heavy heavy-duty trucks, and buses. EMFAC 2021 is used to calculate an aggregated emissions factor on a per-mile basis for these 5 groupings that includes exhaust, and tire and brake wear emissions. In addition, road dust emissions are estimated by using SCAG's vehicle activity and road information dataset and by using the road dust methodology described in Attachment H of Appendix III from the 2022 AQMP. In total, five vehicle categories and two emission processes per vehicle class for a total of ten sources of emissions are modeled using AERMOD. Detailed description of the AERMOD modeling setup is presented in Chapter 6 of Appendix II of this plan.

The estimated contributions of the near-road sources to annual PM2.5 at the CA60NR monitor determined by AERMOD for both 2018 and the 2030 attainment case are presented in Figure 5-14, by individual PM2.5 species. The annual average contribution of near-road sources at the monitor calculated using AERMOD in the 2018 base year is 3.13 $\mu g/m^3$, which represents 22% of the base year design value. The contribution of near-road sources in the 2030 attainment case is projected to be 2.32 $\mu g/m^3$, which corresponds to an overall 26% decrease from 2018. These results are used to determine the RRF for each PM2.5 species for the portion of the base year design value associated to the NRI.

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[12] Air Quality Dispersion Modeling - Preferred and Recommended Models, Support Center for Regulatory Atmospheric Modeling (SCRAM), U.S. EPA, https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models

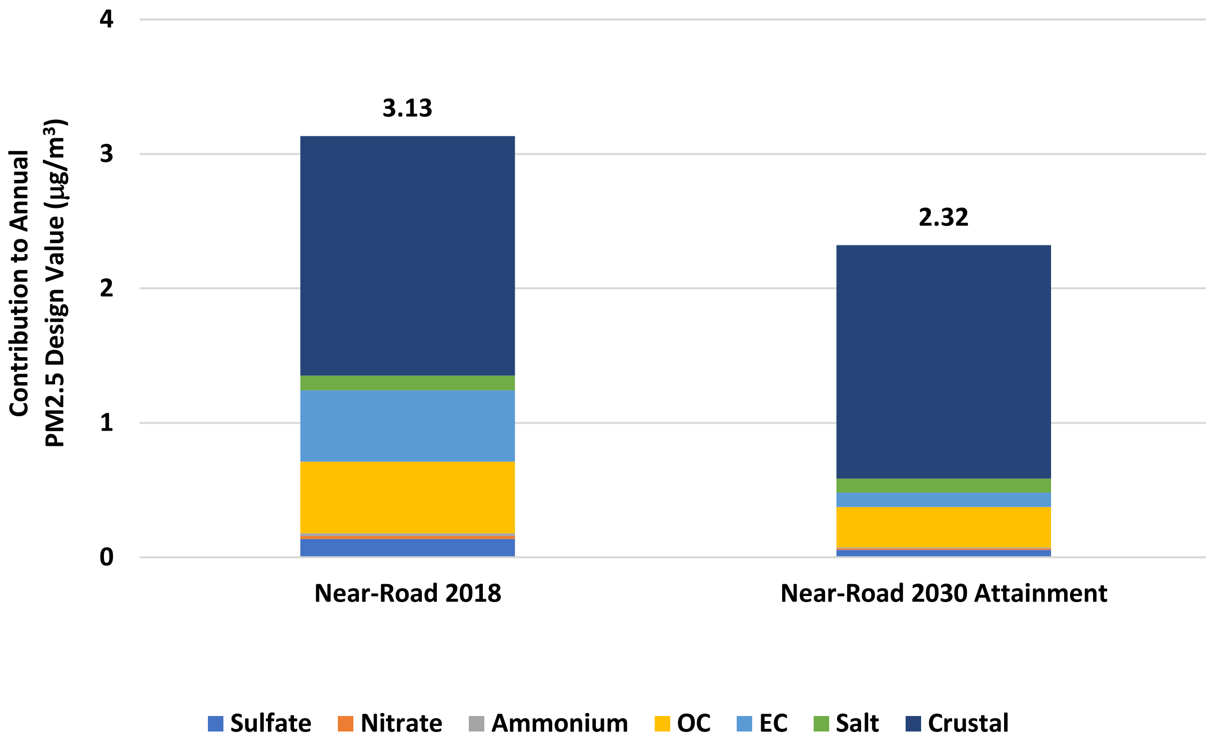

FIGURE 5-14
AERMOD ESTIMATED CONTRIBUTIONS FROM NEAR-ROAD SOURCES FOR 2018 AND THE 2030 ATTAINMENT CASE

The NRI is calculated using the concentration at the monitor estimated with AERMOD and the grid cell average contribution of near road sources determined by modeling PM2.5 concentrations with CMAQ. The near-road contribution averaged over the CMAQ grid cell where the monitor is located at is 0.15 $\mu g/m^3$, which subtracted from the near-road source contribution at the monitor (3.13 $\mu g/m^3$) results in an annual average NRI of 2.98 $\mu g/m^3$. Alternative approaches to determine the NRI are discussed in Chapter 6 of Appendix II of this Plan. More conservative estimates for NRI lower the values down to 1.64 $\mu g/m^3$.

Once the NRI is disaggregated from the regional air quality impacts contribution, the future design value can be estimated by applying two differentiated RRF values to these two components. As illustrated in Figure 5-15, the regional air quality impacts are projected using the quarterly RRF calculated from regional air quality modeling, and the NRI portion is projected using the quarterly RRF calculated using the dispersion modeling results. The resulting design value for Ontario CA-60 using this hybrid approach is 11.59 $\mu g/m^3$. The future design value calculated using this hybrid approach is sensitive to the magnitude of NRI. Because emissions from on-road sources are expected to decline faster than the overall emissions in the basin, the NRI portion is projected to decline faster than the overall design value. With more conservative estimates of NRI, the projected design value calculated using this hybrid modeling tends to be higher. Using the most conservative NRI of 1.64 μg/m³, the resulting DV at Ontario CA-60 is projected to be 11.91 μg/m³, still demonstrating attainment of the annual PM2.5 standard. A more comprehensive description of the hybrid modeling methodology and calculation of design values using this novel approach is described in Chapter 6 of Appendix II.

Unlike the conventional modeling method, which suggests that the CA-60 near-road monitor would not meet the standard under the 2030 control scenario, this hybrid approach, specifically tailored to account for the sharp PM2.5 concentration gradients around the freeway, indicates that the projected annual PM2.5 concentration will remain below 12 μg/m³.

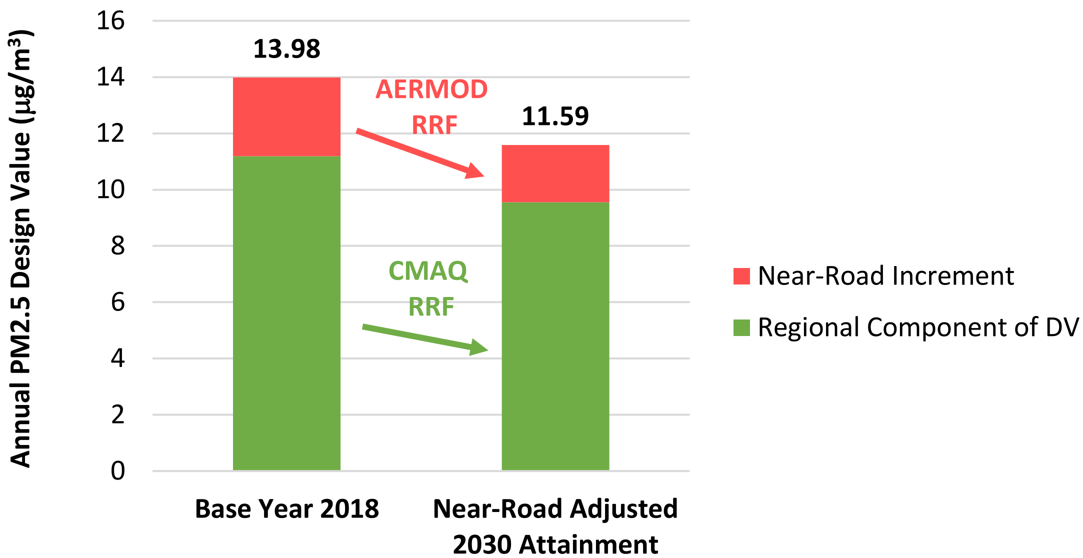

FIGURE 5-15
COMPARISON OF DESIGN VALUE PROJECTIONS BETWEEN THE TRADITIONAL APPROACH AND THE HYBRID APPROACH TO ADJUST FOR NEAR-ROAD SOURCES

Spatial Projections of Annual PM2.5 Design Values

Figure 5-16 shows the Basin-wide spatial distribution of annual PM2.5 design values in the base year 2018 calculated based on interpolated design values using inverse distance-weighting of monitored DVs and model gradient-adjustment. Figures 5-17 and 5-18 show the Basin-wide spatial distribution of RRF-based annual PM2.5 design values for both the 2030 baseline and 2030 attainment scenario, respectively. By 2030 under baseline conditions (business-as-usual, Figure 5-17), design values exceeding the 12 μg/m^3 federal standard are confined to a small region surrounding the Mira Loma and Ontario CA-60 monitoring stations in the northwestern boundary of Riverside and San Bernardino Counties. With the PM2.5 precursors reductions associated with the control measures proposed in this PM2.5 plan (Figure 5-18), the Basin is expected to meet the federal PM2.5 standard throughout the Basin.

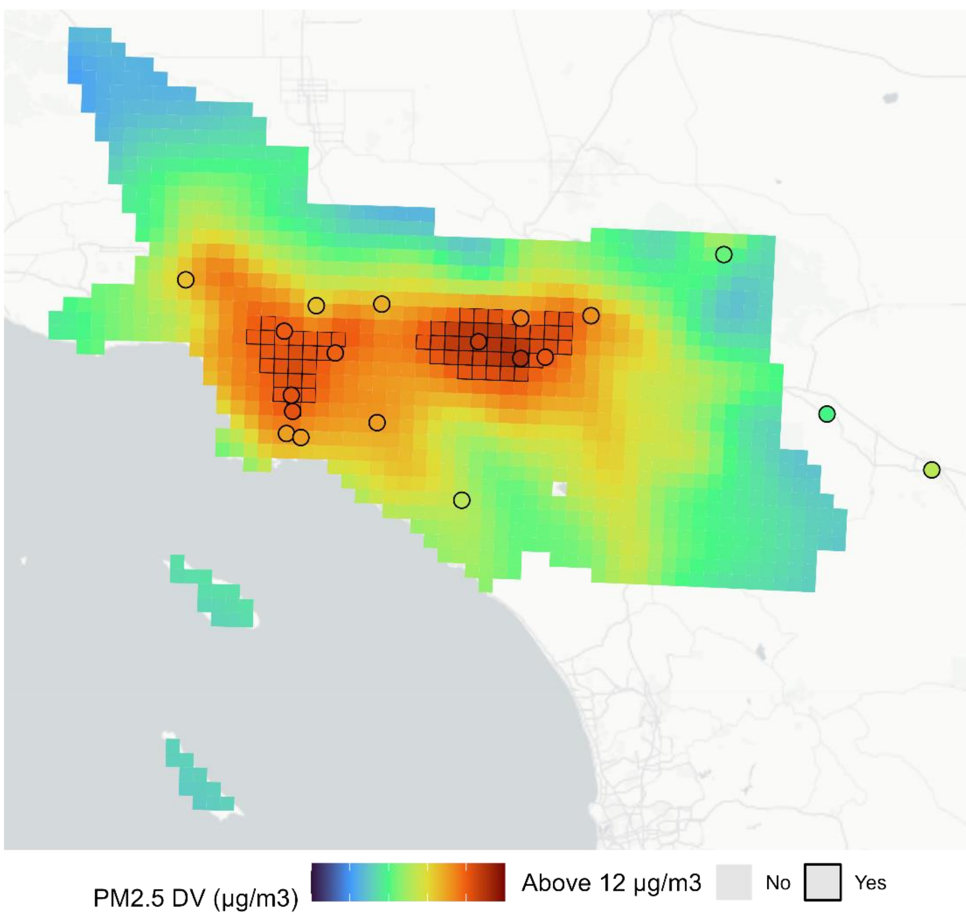

FIGURE 5-16
ANNUAL PM2.5 DESIGN VALUES (μg/m^3) FROM THE 2018 BASELINE SCENARIO. CELLS EXCEEDING 12 μg/m^3 ARE OUTLINED IN BLACK.

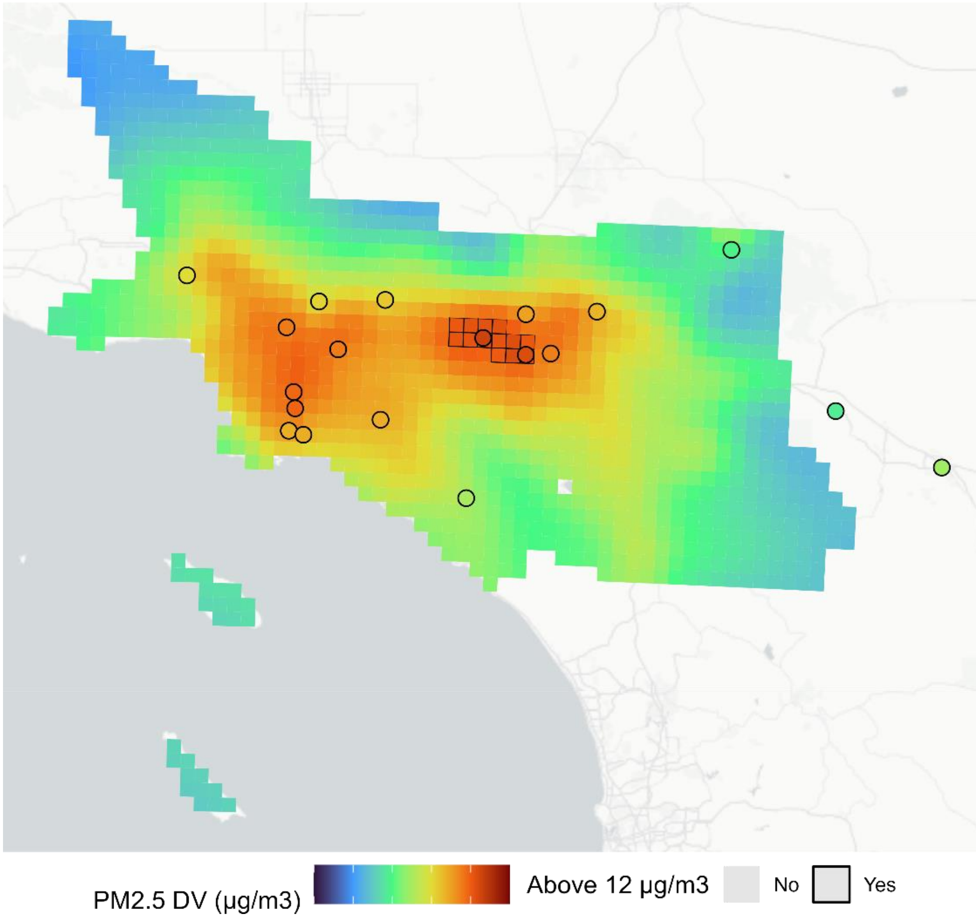

FIGURE 5-17

ANNUAL PM2.5 DESIGN VALUES (µg/m^3) FROM THE 2030 BASELINE SCENARIO. CELLS EXCEEDING 12 µg/m^3 ARE OUTLINED IN BLACK.

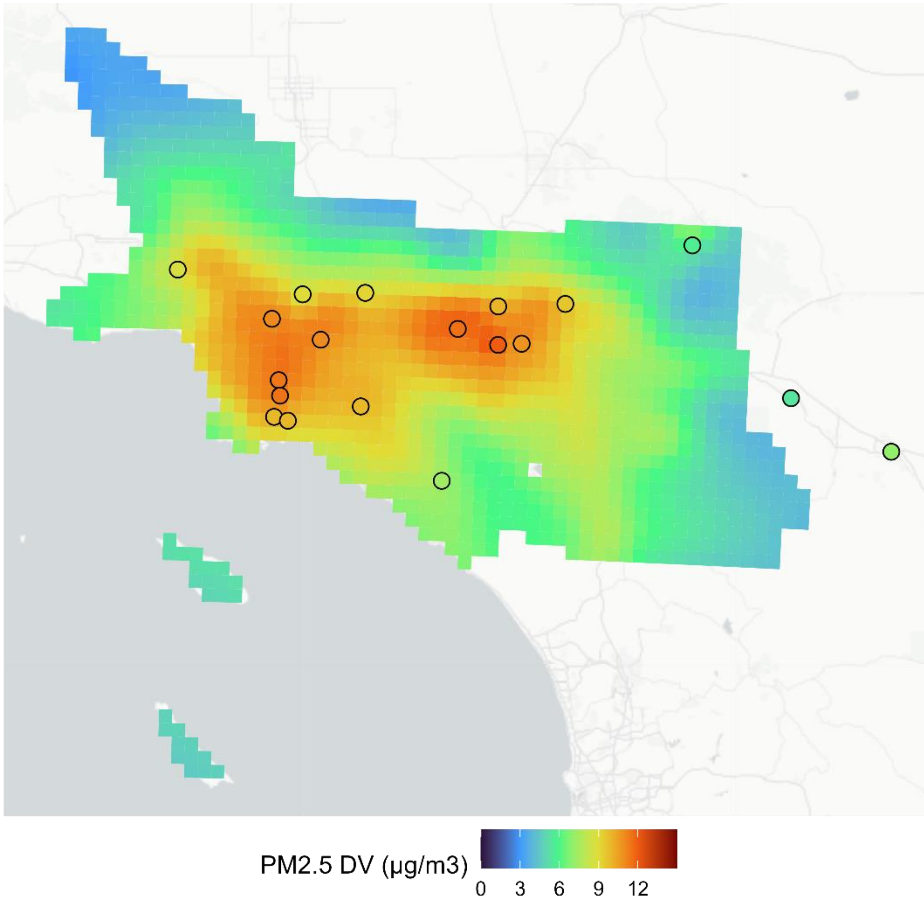

FIGURE 5-18
2030 ATTAINMENT ANNUAL PM2.5 RRF DESIGN VALUE CONCENTRATIONS.

Summary and Conclusions

Figure 5-19 presents the 2018 observed and 2030 projected future design values for annual PM2.5. Mira Loma and Ontario CA-60 near-road stations are expected to exceed the annual PM2.5 standard under the 2030 baseline scenario. This 2030 baseline scenario projects emissions based on the rules that are in place by the cutoff date of this plan and represents a 'business-as-usual' projection. The emissions reductions beyond the baseline emission levels proposed in this Plan would enable the Basin to meet the 2012 annual PM2.5 standard. Table 5-5 summarizes the design values at the Mira Loma and Ontario CA-60 monitors, the two stations with the highest PM2.5 annual levels in the 2018 base year and the 2030 attainment year. Based on the design values for 2030 and model sensitivity analyses, the design value for 2029 at Mira Loma is projected to be above 12.04 µg/m^3, exceeding the 2012 annual PM2.5 standard. Therefore, the earliest that the PM2.5 standard can be met in the South Coast Air Basin is projected to be 2030.

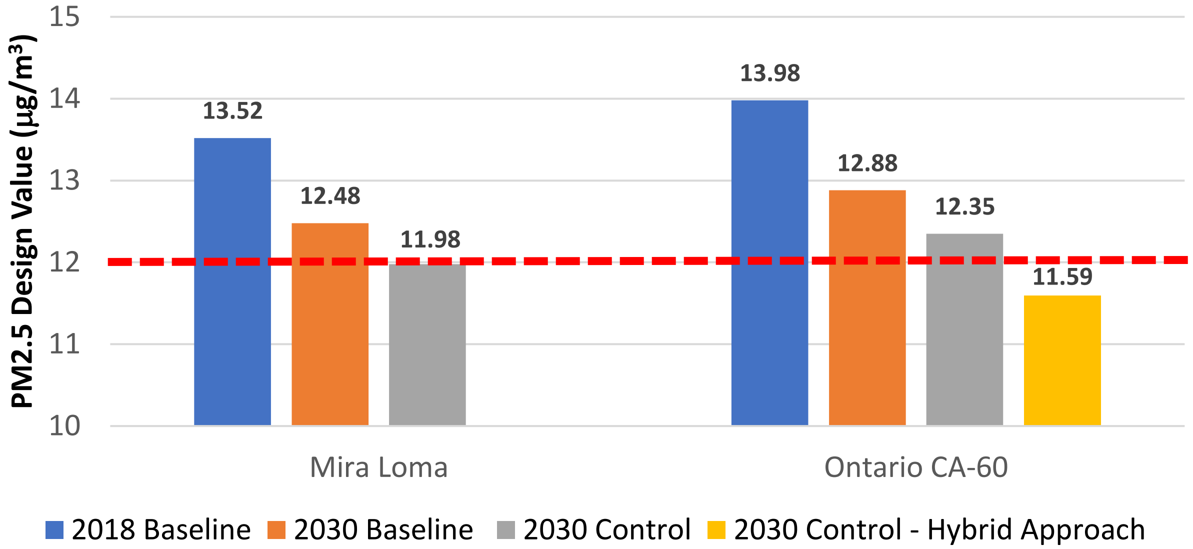

FIGURE 5-19
PROJECTION OF FUTURE ANNUAL PM2.5 AIR QUALITY IN THE BASIN IN COMPARISON WITH 2012 FEDERAL ANNUAL PM2.5 STANDARDS

TABLE 5-5
FUTURE DESIGN VALUES OF ANNUAL AVERAGE PM2.5 AT MIRA LOMA AND ONTARIO CA-60 (in µg/m³)

	Mira Loma		Ontario CA-60	
Calendar Year	Baseline	with Controls	Baseline	with Controls
2025	12.6	--	13.1	--
2030	12.5	12.0	12.9	11.6