Chapter 5

Future Air Quality

South Coast Air Quality Management District

Cleaning the air that we breathe...

AQMD

CHAPTER 5

FUTURE AIR QUALITY

INTRODUCTION

Air quality modeling is an integral part of the planning process to achieve clean air. The attainment demonstrations provided in this Final 2012 AQMP reflect the updated baseline emissions estimates, new technical information, enhanced air quality modeling techniques, and the control strategy provided in Chapter 4 for 24-hour PM2.5. Projections for progress towards meeting the annual PM2.5 standard by 2014 and the 1997 8-hour ozone standard by 2023 are also presented in this chapter. These latter two requirements are addressed in the 2007 AQMP.

The Basin is currently designated nonattainment for PM2.5, and extreme nonattainment for ozone. The District's goal is to develop an integrated control strategy which: 1) ensures that ambient air quality standards for all criteria pollutants are met by the established deadlines in the federal Clean Air Act (CAA); and 2) achieves an expeditious rate of progress towards attaining the state air quality standards. The overall control strategy is designed so that efforts to achieve the standard for one criteria pollutant do not cause unnecessary deterioration of another. A two-step modeling process which is consistent with the approach used in the 2007 AQMP has been conducted for the Final 2012 AQMP. First, future year 24-hour PM2.5 levels are simulated for 2014 and 2019 to determine the earliest possible date of attainment. If attainment cannot be demonstrated by 2014, U.S. EPA can grant up to an additional five years to demonstrate attainment of the 24-hour standard. However, the length of the extension is contingent upon the earliest year beyond 2014 that the 24-hour average PM2.5 standard can be achieved implementing all feasible control measures.

BACKGROUND

During the development of the 2007 AQMP, the District convened a panel of seven experts to independently review the regional air quality modeling. The consensus of the panel was for the District to move to the more current state-of-the-art dispersion platforms and chemistry modules. In keeping with the recommendations of the expert panel as well as the Scientific Technical Modeling Peer Review Committee, the Final 2012 AQMP has continued to move forward to incorporate the current state-of-the-art modeling platforms to conduct regional modeling analyses in support of the PM2.5 attainment demonstrations and ozone update. The Final 2012 AQMP PM2.5 attainment demonstration has been developed using the U.S. EPA supported Community Multiscale Air Quality (CMAQ) (version 4.7) modeling platform with SAPRC99 chemistry, and the Weather Research and Forecasting Model (WRF) (version 3.3) meteorological fields. Supporting PM2.5 and ozone simulations were also conducted using the most current and publicly available version of CAMx (version 5.3), which also used SAPRC99 chemistry and WRF meteorology, to ensure smooth transition from the CAMx platform used in the 2007 AQMP to CMAQ. The model analyses were conducted on an expanded domain, with increased resolution in the vertical structure, and a finer 4 km grid size.

Detailed information on the modeling approach, data gathering, model development and enhancement, model application, and interpretation of results is presented in Appendix V. The following sections summarize the results of the 24-hour PM2.5 attainment demonstration modeling effort and provide an update to the annual PM2.5 and future projected Basin ozone levels given new emissions, design values and modeling tools.

MODELING APPROACH

Design Values and Relative Response Factors (RRF)

As first employed in the 2007 AQMP, the Final 2012 AQMP modeling approach to demonstrate attainment of the air quality standards relies heavily on the use of design values and relative response factors (RRF) to translate regional modeling simulation output to the form of the air quality standard. Both PM2.5 and ozone have standards that require three consecutive years of monitored data, averaged according to the form of the standard to derive a design value, to assess compliance. The 24-hour PM2.5 design value is determined from the three-year average of the 98th percentile of all 24-hour concentrations sampled at a monitoring site. The annual PM2.5 design value is based on quarterly average PM2.5 concentrations, averaged by year, for a three-year period. In the case of ozone, compliance with the standard is determined from a three-year average of the 4th highest daily ozone 8-hour average concentration.

Design Value Selection

U.S. EPA guidance recommends the use of multiple year averages of design values, where appropriate, to dampen the effects of single year anomalies to the air quality trend due to factors such as adverse or favorable meteorology or radical changes in the local emissions profile. The trend in the Basin 24-hour PM2.5 design values, determined from routinely monitored Federal Reference Monitoring (FRM), from 2001 through 2011 (Figure 5-1) depicts sharp reductions in concentrations over the period. The 24-hour PM2.5 design value for 2001 was 76 $\mu g/m^3$ while the 2008 design value (based on data from 2006, 2007 and 2008) is 53 $\mu g/m^3$. Furthermore, the most current design value computed for 2011 has been reduced to 38 $\mu g/m^3$. The annual PM2.5 design value has demonstrated a reduction of 13.6 $\mu g/m^3$ over the 10-year period from 2001 through 2011. In each case, the trend in PM2.5 is steadily moving in the direction of air quality improvement. The trend of Basin ozone design values is presented in Figure 5-2. The design values have averaged a reduction of approximately three parts per billion over the 14-year period; however the most recent design value (107 ppb) continues to exceed the 1997 8-hour ozone standard (80 ppb) by 34 percent and the 2006 ozone standard by 43 percent (75 ppb).

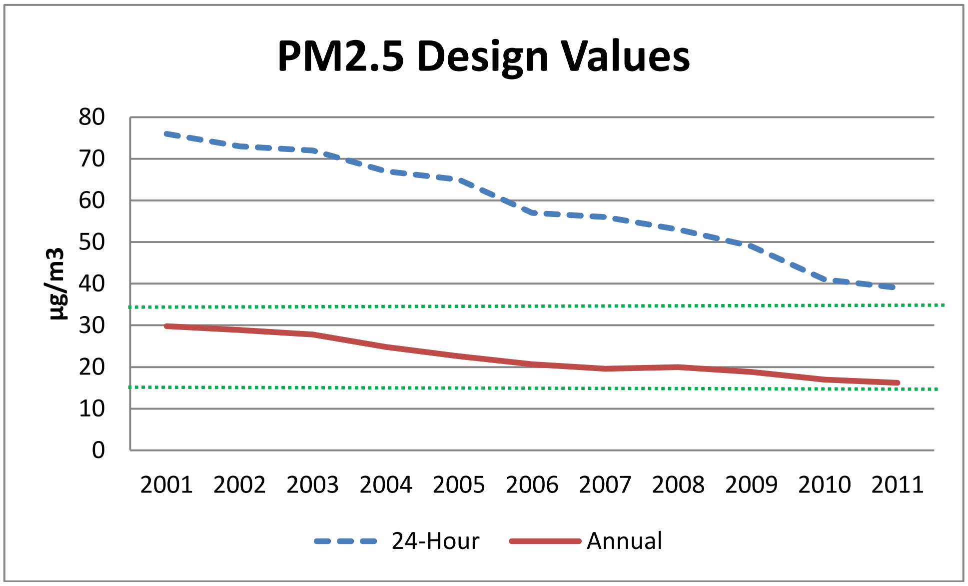

FIGURE 5-1

South Coast Air Basin 24-Hour Average and Annual PM2.5 Design Values
Note: Each value represents the 3-year average of the highest annual average PM2.5 concentration

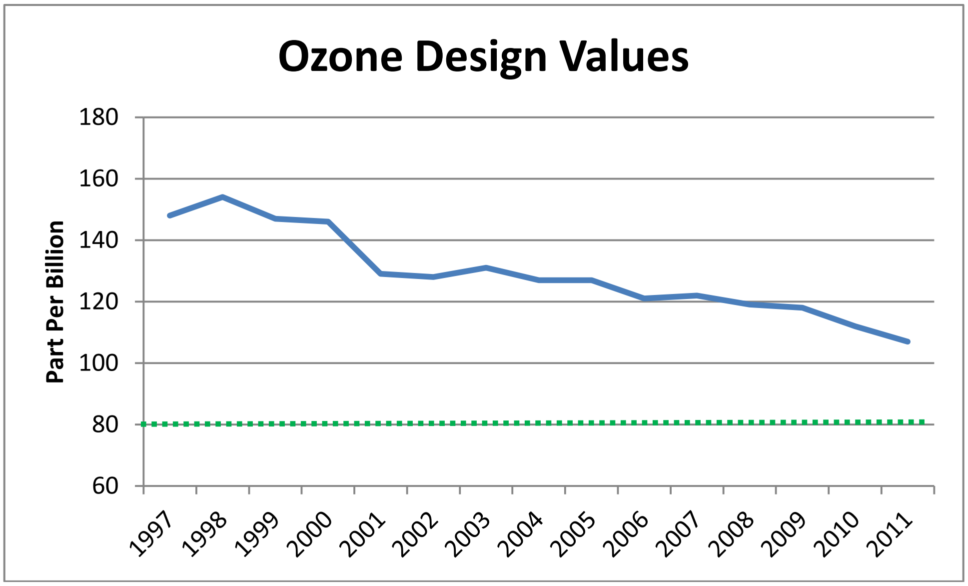

FIGURE 5-2

South Coast Air Basin 8-Hour Average Ozone Design Values
Note: Each value represents the 3-year average of the 4th highest 8-Hour Average Ozone concentration

The Final 2012 AQMP relies on a set of five years of particulate data centered on 2008, the base year selected for the emissions inventory development and the anchor year for the future year PM2.5 projections. In July, 2010, U.S. EPA proposed revisions to the 24-hour PM2.5 modeling attainment demonstration guidance. The new guidance suggests using five years of data, but instead of directly using quarterly calculated design values, the procedure requires the top 8 daily PM2.5 concentrations days in each quarter to reconstruct the annual 98th percentile. The logic in the analysis is twofold: by selecting the top 8 values in each quarter the 98th percentile concentration is guaranteed to be included in the calculation. Second, the analysis projects future year concentrations for each of the 32 days in a year (160 days over five years) to test the response of future year 24-hour PM2.5 to the proposed control strategy. Since the 32 days in each year include different meteorological conditions and particulate species profiles it is expected those individual days will respond independently to the projected future year emissions profile and that a new distribution of PM2.5 concentrations will result. Overall, the process is more robust in that the analysis is examining the impact of the control strategy implementation for a total of 160 days, covering a wide variety of potential meteorology and emissions combinations.

Table 5-1 provides the weighted 2008 annual and 24-hour average PM2.5 design values for the Basin.

TABLE 5-1

2008 Weighted 24-Hour PM2.5 Design Values (µg/m^3)

MONITORING SITE	24-HOURS
Anaheim	35.0
Los Angeles	40.1
Fontana	45.6
North Long Beach	34.4
South Long Beach	33.4
Mira Loma	47.9
Rubidoux	44.1

Relative Response Factors and Future Year Design Values

To bridge the gap between air quality model output evaluation and applicability to the health-based air quality standards, U.S. EPA guidance has proposed the use of relative response factors (RRF). The RRF concept was first used in the 2007 AQMP modeling attainment demonstrations. The RRF is simply a ratio of future year predicted air quality with the control strategy fully implemented to the simulated air quality in the base year. The mechanics of the attainment demonstration are pollutant and averaging period specific. For 24-hour PM2.5, the top 10 percentile of modeled concentrations in each quarter of the simulation year are used to determine the quarterly RRFs. For the annual average PM2.5, the quarterly average RRFs are used for the future year projections. For the 8-hour average ozone simulations, the aggregated response of multiple episode days to the implementation of the control strategy is used to develop an averaged RRF for projecting a future year design value. Simply stated, the future year design value is estimated by multiplying the non-dimensional RRF by the base year design value. Thus, the simulated improvement in air quality, based on multiple meteorological episodes, is translated as a metric that directly determines compliance in the form of the standard.

The modeling analyses described in this chapter use the RRF and design value approach to demonstrate future year attainment of the standards.

PM2.5 Modeling

Within the Basin, PM2.5 particles are either directly emitted into the atmosphere (primary particles), or are formed through atmospheric chemical reactions from precursor gases (secondary particles). Primary PM2.5 includes road dust, diesel soot, combustion products, and other sources of fine particles. Secondary products, such as sulfates, nitrates, and complex carbon compounds are formed from reactions with oxides of sulfur, oxides of nitrogen, VOCs, and ammonia.

The Final 2012 AQMP employs the CMAQ air quality modeling platform with SAPRC99 chemistry and WRF meteorology as the primary tool used to demonstrate future year attainment of the 24-hour average PM2.5 standard. A detailed discussion of the features of the CMAQ approach is presented in Appendix V. The analysis was also conducted using the CAMx modeling platform using the "one atmosphere" approach comprised of the SAPRC99 gas phased chemistry and a static two-mode particle size aerosol module as the particulate modeling platform. Parallel testing was conducted to evaluate the CMAQ performance against CAMx and the results indicated that the two model/chemistry packages had similar performance. The CAMx results are provided in Appendix V as a component of the weight of evidence discussion.

The Final 2012 modeling attainment demonstrations using the CMAQ (and CAMx) platform were conducted in a vastly expanded modeling domain compared with the analysis conducted for the 2007 AQMP modeling attainment demonstration. In this analysis, the PM2.5 and ozone base and future simulations were modeled simultaneously. The simulations were conducted using a Lambert Conformal grid projection where the western boundary of the domain was extended to 084 UTM, over 100 miles west of the ports of Los Angeles and Long Beach. The eastern boundary extended 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 (3543 UTM). The grid size has been reduced from 5 kilometers squared to 4 kilometers squared and the vertical resolution has been increased from 11 to 18 layers.

The final WRF meteorological fields were generated for the identical domain, layer structure and grid size. The WRF simulations were initialized from National Centers for Environmental Prediction (NCEP) analyses and run for 3-day increments with the option for four dimensional data assimilation (FDDA). Horizontal and vertical boundary conditions were designated using a “U.S. EPA clean boundary profile.”

PM2.5 data measured as individual species at six-sites in the AQMD air monitoring network during 2008 provided the characterization for evaluation and validation of the CMAQ annual and episodic modeling. The six sites include the historical PM2.5 maximum location (Riverside- Rubidoux), the stations experiencing many of the highest county concentrations (among the 4-county jurisdiction including Fontana, North Long Beach and Anaheim) and source oriented key monitoring sites addressing goods movement (South Long Beach) and mobile source impacts (Central Los Angeles). It is important to note that the close proximity of Mira Loma to Rubidoux and the common in-Basin air flow and transport patterns enable the use of the Rubidoux speciated data as representative of the particulate speciation at Mira Loma. Both sites are directly downwind of the dairy production areas in Chino and the warehouse distribution centers located in the northwestern corner of Riverside County. Speciated data monitored at the selected sites for 2006-2007 and 2009-2010 were analyzed to corroborate the applicability of using the 2008 profiles.

Day-specific point source emissions were extracted from the District stationary source and RECLAIM inventories. Mobile source emissions included weekday, Saturday and Sunday profiles based on CARB’s EMFAC2011 emissions model, CALTRANS weigh-in-motion profiles, and vehicle population data and transportation analysis zone (TAZ) data provided by SCAG. The mobile source data and selected area source data were subjected to daily temperature corrections to account for enhanced evaporative emissions on warmer days. Gridded daily biogenic VOC emissions were provided by CARB using BEIGIS biogenic emissions model. The simulations benefited from enhancements made to the emissions inventory including an updated ammonia inventory, improved emissions characterization that split organic compounds into coarse, fine and primary particulate categories, and updated spatial allocation of primary paved road dust emissions.

Model performance was evaluated against speciated particulate PM2.5 air quality data for ammonium, nitrates, sulfates, secondary organic matter, elemental carbon, primary and total particulate mass for the six monitoring sites (Rubidoux, Central Los Angeles, Anaheim, South Long Beach, Long Beach, and Fontana).

The following section summarizes the PM2.5 modeling approach conducted in preparation for this Plan. Details of the PM2.5 modeling are presented in Appendix V.

24-Hour PM2.5 Modeling Approach

CMAQ simulations were conducted for each day in 2008. The simulations included 8784 consecutive hours from which daily 24-hour average PM2.5 concentrations (0000-2300 hours) were calculated. A set of RRFs were generated for each future year simulation. RRFs were generated for the ammonium ion (NH_4), nitrate ion (NO_3), sulfate ion (SO_4), organic carbon (OC), elemental carbon (EC) and a combined grouping of crustal, sea salts and metals (Others). A total of 24 RRFs were generated for each future year simulation (4 seasons and 6 monitoring sites).

Future year concentrations of the six component species were calculated by applying the model generated quarterly RRFs to the speciated 24-hour PM2.5 (FRM) data, sorted by quarter, for each of the five years used in the design value calculation. The 32 days in each year were then re-ranked to establish a new 98th percentile concentration. The resulting future year 98th percentile concentrations for the five years were subjected to weighted averaging for the attainment demonstration.

In this chapter, future year PM2.5 24-hour average design values are presented for 2014, and 2019 to (1) demonstrate the future baseline concentrations if no further controls are implemented; (2) identify the amount of air quality improvement needed to advance the attainment date to 2014; and (3) confirm the attainment demonstration given the proposed PM2.5 control strategy. In addition, Appendix V will include a discussion and demonstration that attainment will be satisfied for the entire modeling domain.

Weight of Evidence

PM2.5 modeling guidance strongly recommends the use of corroborating evidence to support the future year attainment demonstration. The weight of evidence demonstration for the Final 2012 AQMP includes brief discussions of the observed 24-hour PM2.5, emissions trends, and future year PM2.5 predictions. Detailed discussions of all model results and the weight of evidence demonstration are provided in Appendix V.

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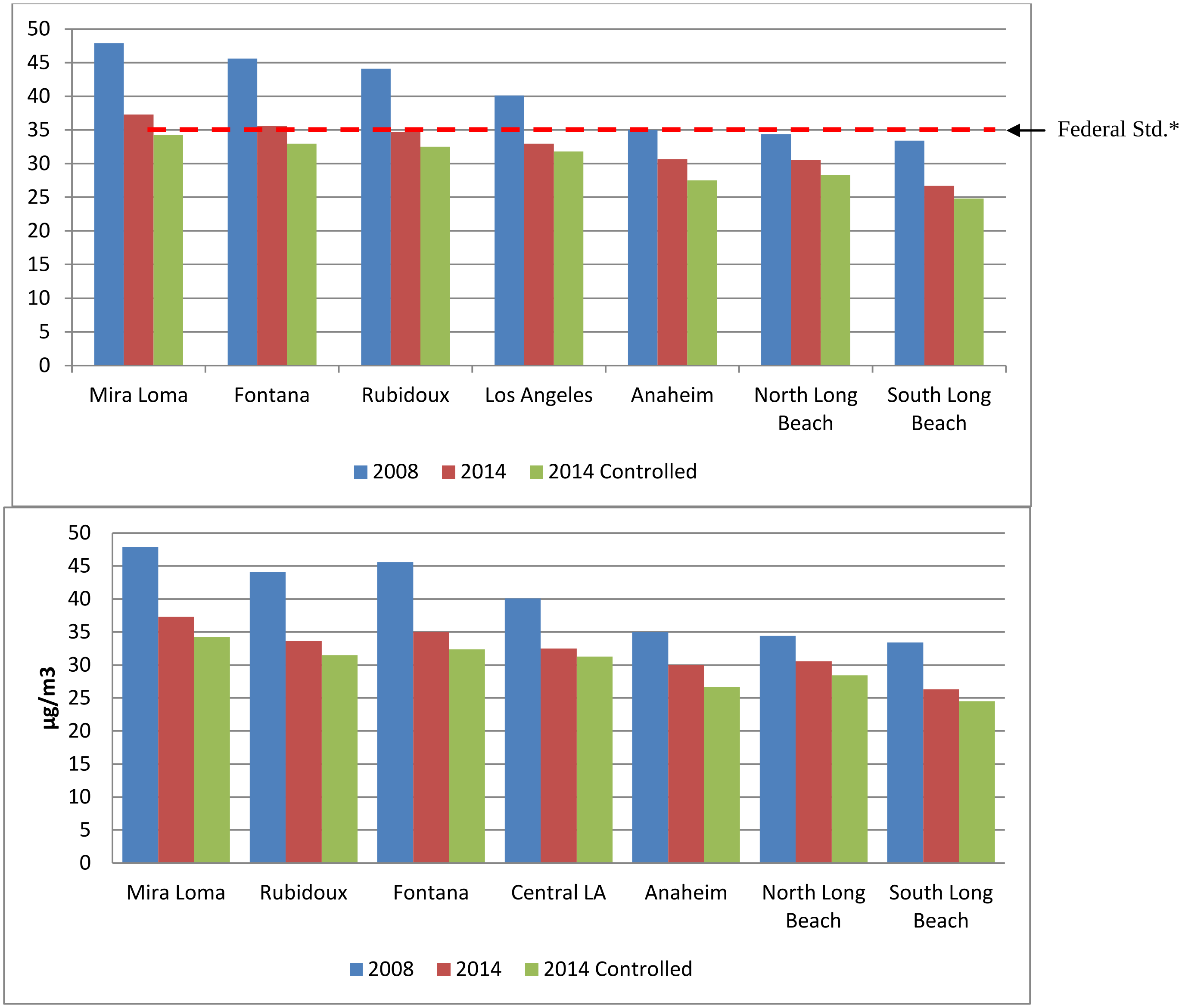
Under the federal Clean Air Act, the Basin must comply with the federal PM2.5 air quality standards by December, 2014 [Section 172(a)(2)(A)]. An extension of up-to five years (until 2019) could be granted if attainment cannot be demonstrated any earlier with all feasible control measures incorporated.

24-Hour PM2.5

A simulation of 2014 baseline emissions was conducted to substantiate the severity of the 24-hour PM2.5 problem in the Basin. The simulation used the projected emissions for 2014 which included all adopted control measures that will be implemented prior to and during 2014, including mobile source incentive projects under contract (Proposition 1B and Carl Moyer Programs). The resulting 2014 future-year Basin design value (37.3$\mu g/m^3$) failed to meet the federal standard. As a consequence additional controls are needed.

Simulation of the 2019 baseline emissions indicates that the Basin PM2.5 will attain the federal 24-hour PM2.5 standard in 2019 without additional controls. With the control program in place, the 24-hour PM2.5 simulations project that the 2014 design value will be 34.3 $\mu g/m^3$ and that the attainment date will advance from 2019 to 2014.

Figure 5-3 depicts future 24-hour PM2.5 air quality projections at the Basin design site (Mira Loma) and six PM2.5 monitoring sites having comprehensive particulate species characterization. Shown in the figure, are the base year design values for 2008 along with projections for 2014 with and without control measures in place. All of the sites with the exception of Mira Loma will meet the 24-hour PM2.5 standard by 2014 without additional controls. With implementation of the control measures, all sites in the Basin demonstrate attainment.



**No such state standard.*

FIGURE 5-3

Maximum 24-Hour Average PM2.5 Design Concentrations:
2008 Baseline, 2014 and 2014 Controlled

Spatial Projections of PM2.5 Design Values

Figure 5-4 provides a perspective of the Basin-wide spatial extent of 24-hour PM2.5 impacts in the base year 2008, with all adopted rules and measures implemented. Figures 5-5 and 5-6 provide a Basin-wide perspective of the spatial extent of 24-hour PM2.5 future impacts for baseline 2014 emissions and 2014 with the proposed control program in place. With no additional controls, several areas around the northwestern portion of Riverside and southwestern portion of San Bernardino Counties depict grid cells with weighted PM2.5 24-hour design values exceeding 35 µg/m^3. By 2014, the number of grid cells with concentrations exceeding the federal standard is restricted to a small region surrounding the Mira Loma monitoring station in northwestern Riverside County. With the control program fully implemented in 2014, the Basin does not exhibit any grid cells exceeding the federal standard.

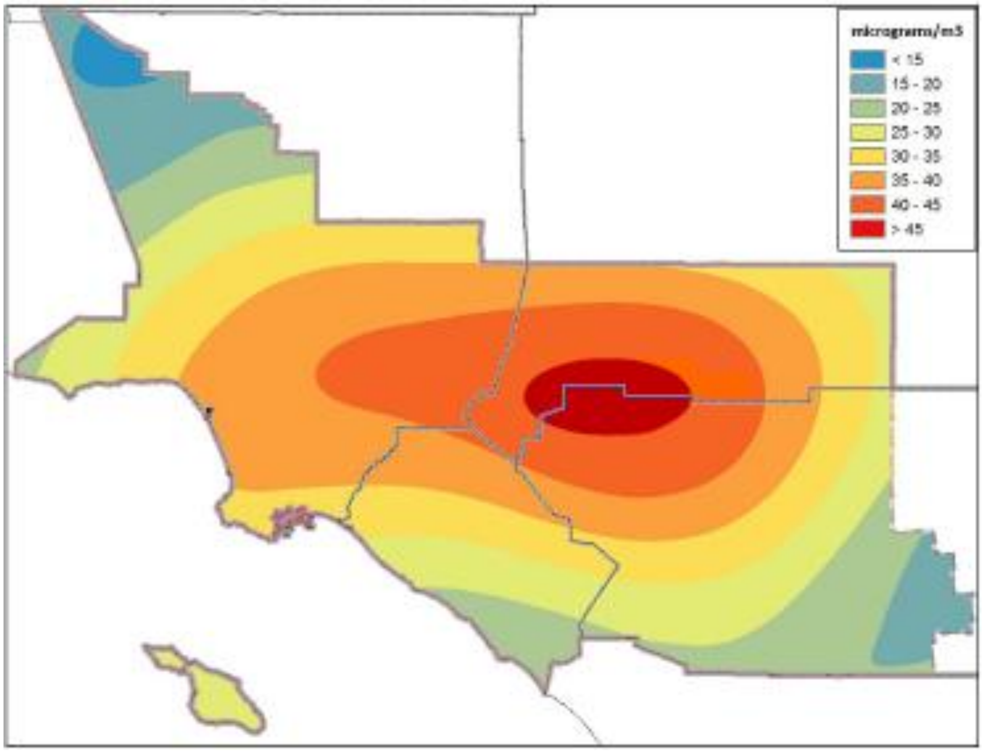


FIGURE 5-4

2008 Baseline 24-Hour PM2.5 Design Concentrations (µg/m^3)

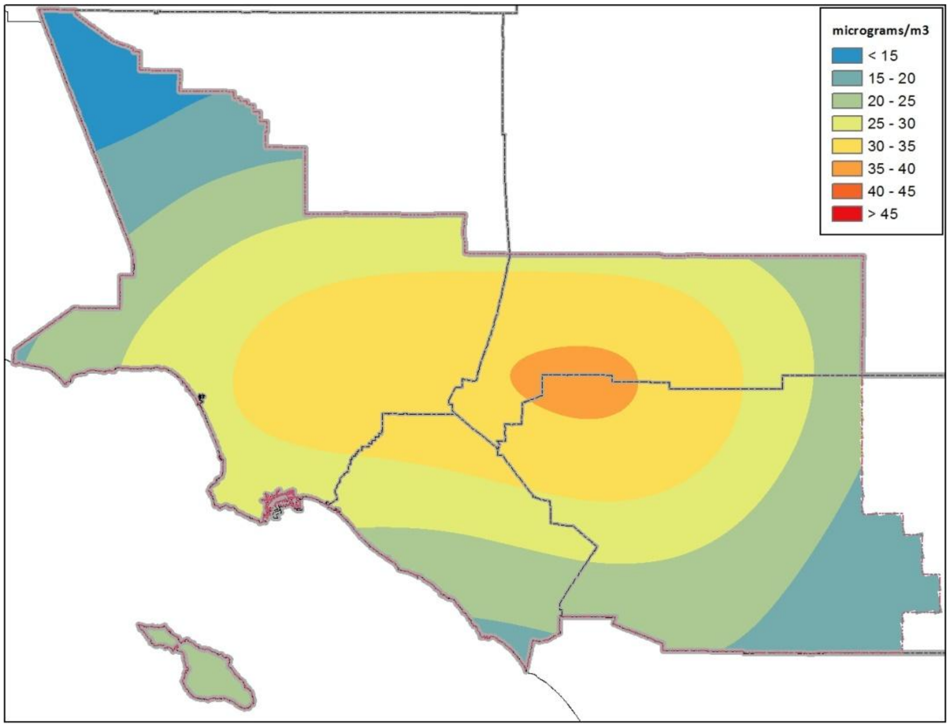


FIGURE 5-5

2014 Baseline 24-Hour PM2.5 Design Concentrations (µg/m^3)

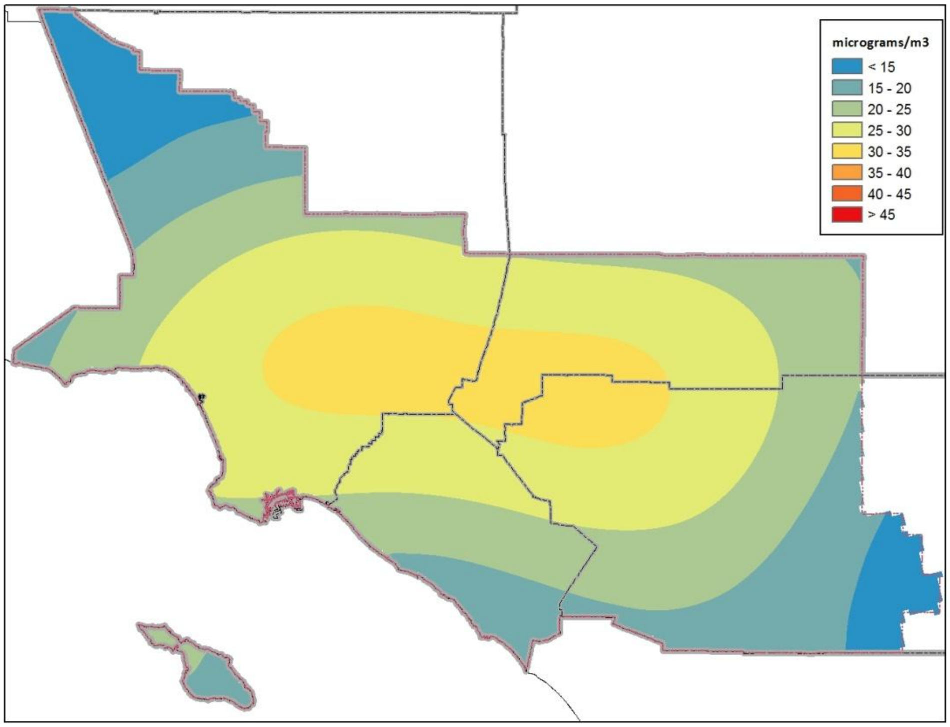


FIGURE 5-6

2014 Controlled 24-Hour PM2.5 Design Concentrations (µg/m^3)

Weight of Evidence Discussion

The weight of evidence discussion focuses on the trends of 24-hour PM2.5 and key precursor emissions to provide justification and confidence that the Basin will meet the federal standard by 2014.

Figure 5-7 depicts the long term trend of observed Basin 24-hour average PM2.5 design values with the CMAQ projected design value for 2014. Also superimposed on the graph is the linear best-fit trend line for the observed 24-hour average PM2.5 design values. The observed trend depicts a steady 49 percent decrease in observed design value concentrations between 2001 and 2011. The rate of improvement is just under 4 $\mu g/m^3$ per year. If the trend is extended beyond 2011, the projection suggests attainment of the PM2.5 24-hour standard in 2013, one year earlier than determined by the attainment demonstration. While the straight-line future year approximation is aggressive in its projection, it offers insight to the effectiveness of the ongoing control program and is consistent with the attainment demonstration.

Figures 5-8 depicts the long term trend of Basin NOx emissions for the same period. Figure 5-9 provides the corresponding emissions trend for directly emitted PM2.5. Base year NOx inventories between 2002 (from the 2007 AQMP) and 2008 experienced a 31 percent reduction while directly emitted PM2.5 experienced a 19 percent reduction over the 6-year period. The Basin 24-hour average PM2.5 design value experienced a concurrent 27 percent reduction between 2002 and 2008. The projected trend of NOx emissions indicates that the PM2.5 precursor associated with the formation of nitrate will continue to be reduced though 2019 by an additional 48 percent. Similarly, the projected trend of directly emitted PM2.5 projects a more moderate reduction of 13 percent through 2019. However, as discussed in the 2007 AQMP and in a later section of this chapter, directly emitted PM2.5 is a more effective contributor to the formation of ambient PM2.5 compared to NOx. While the projected NOx and direct PM2.5 emissions trends decrease at a reduced rate between 2012 and 2019, it is clearly evident that the overall significant reductions will continue to result in lower nitrate, elemental carbon and direct particulate contributions to 24-hour PM2.5 design values.

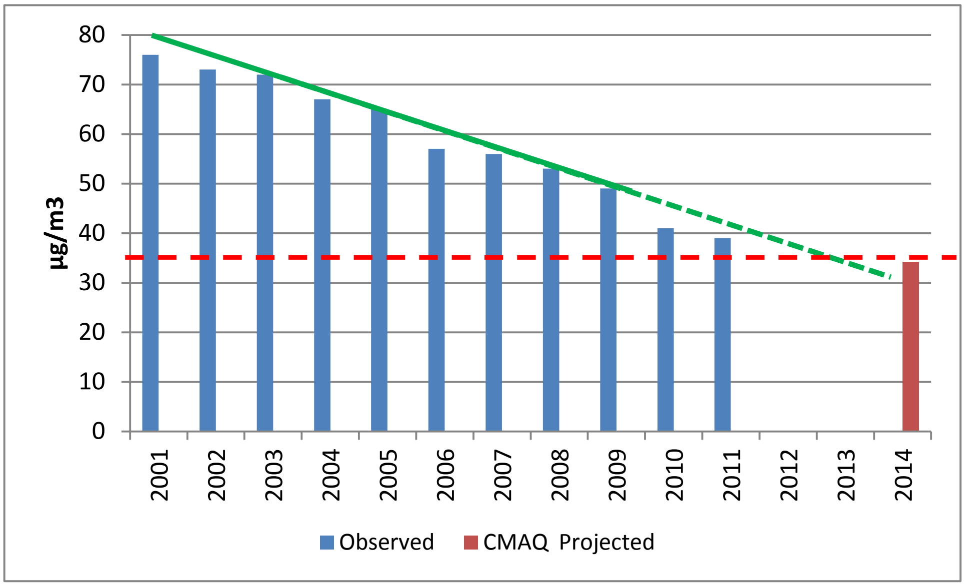


FIGURE 5-7

Basin Observed and CMAQ Projected
Future Year PM2.5 Design Concentrations (µg/m^3)

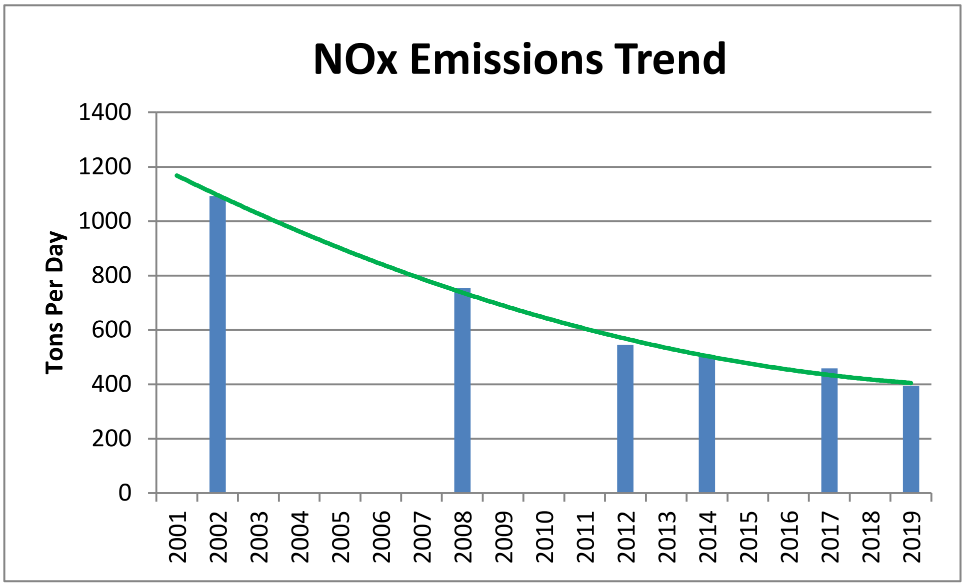


FIGURE 5-8

Trend of Basin NOx Emissions (Controlled)

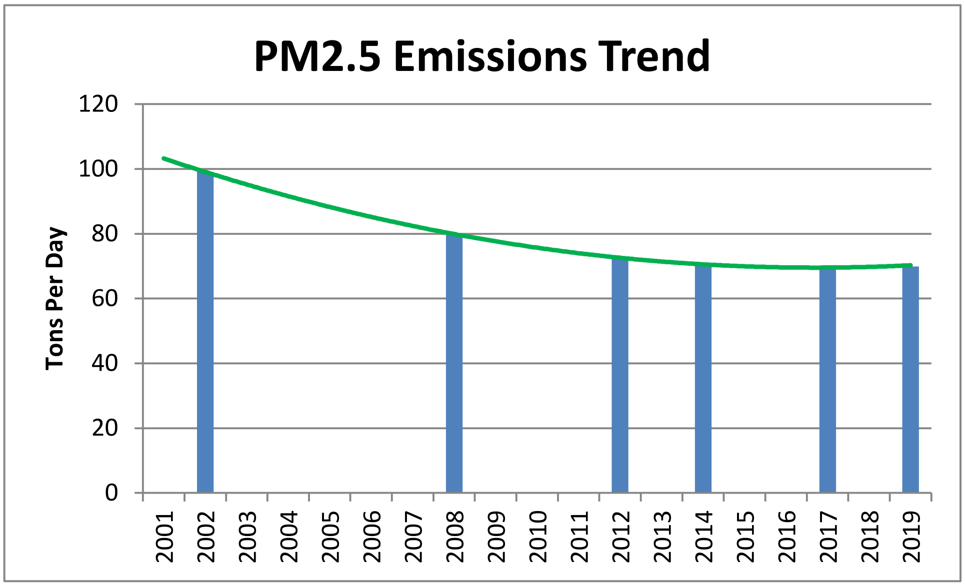


FIGURE 5-9

Trend of Basin PM2.5 Emissions (Controlled)

Control Strategy Choices

PM2.5 has five major precursors that contribute to the development of the ambient aerosol including ammonia, NOx, SOx, VOC, and directly emitted PM2.5. Various combinations of reductions in these pollutants could all provide a path to clean air. The 24-hour PM2.5 attainment strategy presented in this Final 2012 AQMP relies on a dual approach to first demonstrate attainment of the federal standard by 2019 and then focuses on controls that will be most effective in reducing PM2.5 to accelerate attainment to the earliest extent. The 2007 AQMP control measures since implemented will result in substantial reductions of SOx, direct PM2.5, VOC and NOx emissions. Newly proposed short-term measures, discussed in Chapter 4, will provide additional regional emissions reductions targeting directly emitted PM2.5 and NOx.

It is useful to weigh the value of the precursor emissions reductions (on a per ton basis) to microgram per cubic meter improvements in ambient PM2.5 levels. As presented in the weight of evidence discussion, trends of PM2.5 and NOx emissions suggest a direct response between lower emissions and improving air quality. The Final 2007 AQMP established a set of factors to relate regional per ton precursor emissions reductions to PM2.5 air quality improvements based on the annual average concentration. The Final 2012 AQMP CMAQ simulations provided a similar set of factors, but this time directed at 24-hour PM2.5. The analysis determined that VOC emissions reductions have the lowest return in terms of micrograms reduced per ton reduction, one third of the benefit of NOx reductions. SOx emissions were about eight times more effective than NOx reductions. However, directly emitted PM2.5 reductions were approximately 15 times more effective than NOx reductions. It is important to note that the contribution of ammonia emissions is embedded as a component of the SOx and NOx factors since ammonium nitrate and ammonium sulfate are the resultant particulates formed in the ambient chemical process. Table 5-2 summarizes the relative importance of precursor emissions reductions to 24-hour PM2.5 air quality improvements based on the analysis. . (A comprehensive discussion of the emission reduction factors is presented in Attachment 8 of Appendix V of this document). Emission reductions due to existing programs and implementation of the 2012 AQMP control measures will result in projected 24-hour PM2.5 concentrations throughout the Basin that meet the standard by 2014 at all locations. Basin-wide curtailment of wood burning and open burning when the PM2.5 air quality is projected to exceed 30 $\mu g/m^3$ in Mira Loma will effectively accelerate attainment at Mira Loma from 2019 to 2014. Table 5-3 lists the mix of the four primary precursor's emissions reductions targeted for the staged control measure implementation approach.

TABLE 5-2

Relative Contributions of Precursor Emissions Reductions to Simulated Controlled Future-Year 24-hour PM2.5 Concentrations

PRECURSOR	PM2.5 COMPONENT (μg/m^3)	STANDARDIZED CONTRIBUTION TO AMBIENT PM2.5 MASS
VOC	Organic Carbon	Factor of 0.3
NOx	Nitrate	Factor of 1
SOx	Sulfate	Factor of 7.8
PM2.5	Elemental Carbon & Others	Factor of 14.8

TABLE 5-3

Final 2012 AQMP
24-hour PM2.5 Attainment Strategy
Allowable Emissions (TPD)

YEAR	SCENARIO	VOC	NOx	SOx	PM2.5
2014	Baseline	451	506	18	70
2014	Controlled	451	490	18	58*

*Winter episodic day emissions

ADDITIONAL MODELING ANALYSES

As a component of the Final 2012 AQMP, concurrent simulations were also conducted to update and assess the impacts to annual average PM2.5 and 8-hour ozone given the new modeling platform and emissions inventory. This update provides a confirmation that the control strategy will continue to move air quality expeditiously towards attainment of the relevant standards.

Annual PM2.5

Annual PM2.5 Modeling Approach

The Final 2012 AQMP annual PM2.5 modeling employs the same approach to estimating the future year annual PM2.5 as was described in the 2007 AQMP attainment demonstrations. Future year PM2.5 annual average air quality is determined using site and species specific quarterly averaged RRFs applied to the weighted quarterly average 2008 PM2.5 design values per U.S. EPA guidance documents.

In this application, CMAQ and WRF were used to simulate 2008 meteorological and air quality to determine Basin annual average PM2.5 concentrations. The future year attainment demonstration was analyzed for 2015, the target set by the federal CAA. The 2014 simulation relies on implementation of all adopted rules and measures through 2014. This enables a full year-long demonstration based on a control strategy that would be fully implemented by January 1, 2015. It is important to note that the use of the quarterly design values for a 5-year period centered around 2008 (listed in Table 5-4) continue to be used in the projection of the future year annual average PM2.5 concentrations. The future year design reflects the weighted quarterly average concentration calculated from the projections over five years (20 quarters).

TABLE 5-4

2008 Weighted Annual PM2.5 Design Values* (µg/m^3)

MONITORING SITE	ANNUAL*
Anaheim	13.1
Los Angeles	15.4
Fontana	15.7
North Long Beach	13.6
South Long Beach	13.2
Mira Loma	18.6
Rubidoux	16.7

* Calculated based on quarterly observed data between 2006 – 2010

Future Annual PM2.5 Air Quality

The projections for the annual state and federal standards are shown in Figure 5-10. All areas will be in attainment of the federal annual standard (15.0 µg/m^3) by 2014. The 2014 design value is projected to be 9 percent below the federal standard. However, as shown in Figure 5-10, the Final 2012 AQMP does not achieve the California standard of 12 µg/m^3 by 2014. Additional controls would be needed to meet the California annual PM2.5 standard.

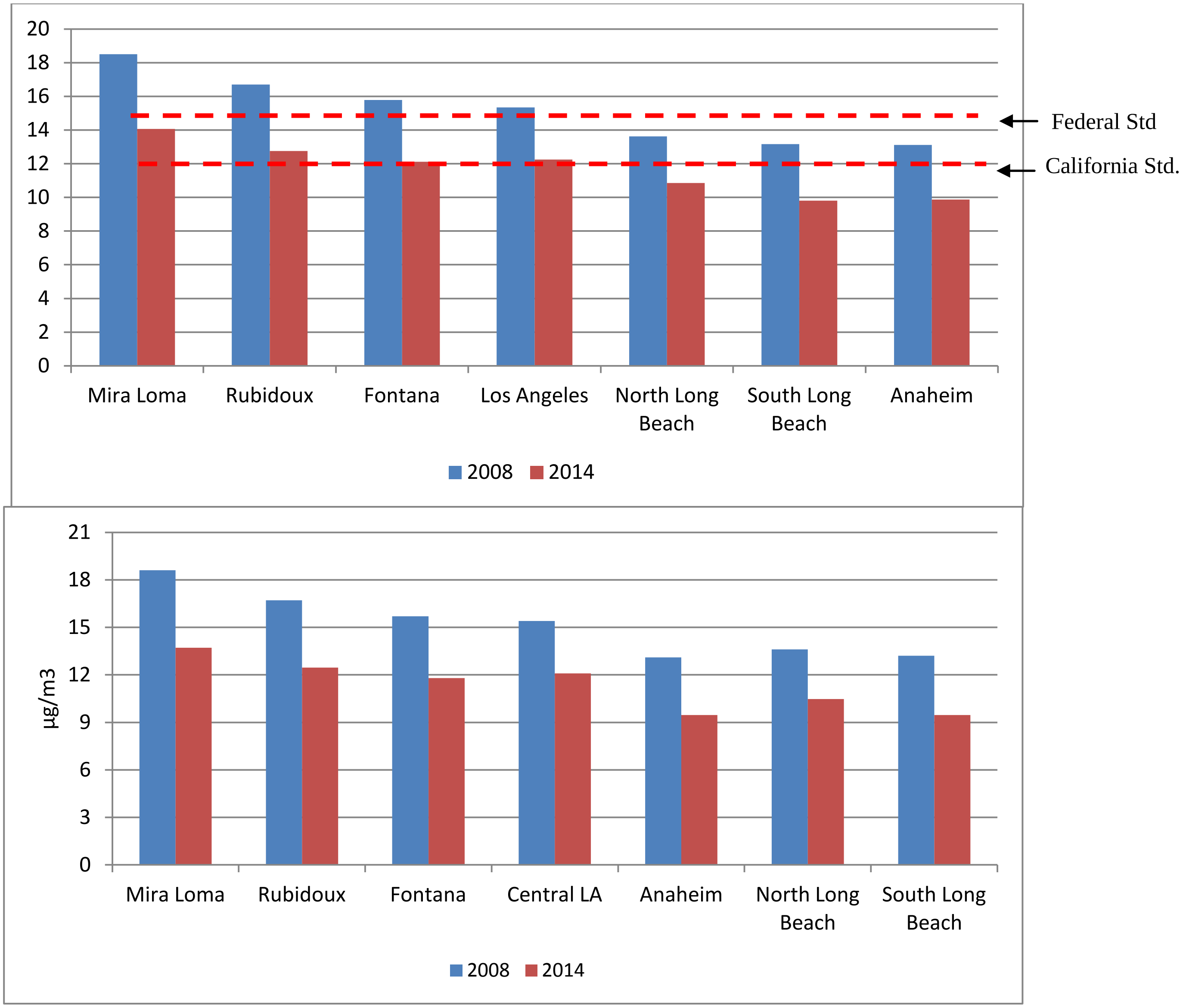


FIGURE 5-10

Annual Average PM2.5 Design Concentrations:
2008 and 2014 Controlled

Ozone Modeling

The 2007 AQMP provided a comprehensive 8-hour ozone analysis that demonstrated future year attainment of the 1997 federal ozone standard (80 ppb) by 2023 with implementation of short-term measures and CAA Section 182(e)(5) long term emissions reductions. The analysis concluded that NOx emissions needed to be reduced approximately 76 percent and VOC 22 percent from the 2023 baseline in order to demonstrate attainment. The 2023 base year VOC and NOx summer planning emissions inventories included 536 and 506 TPD, respectively.

As presented in Chapter 3, the Final 2012 AQMP controlled 2023 emissions of both precursor pollutants are estimated to be lower than the 2023 baseline established in the 2007 AQMP. The 2023 baseline VOC and NOx emission summer planning emissions have been revised to 438 and 319 TPD, respectively. The emissions revision incorporated changes made to the on-road truck and off-road equipment categories that resulted from CARB rulemaking. The new emissions inventory also reflects the impact of the economic slowdown and revisions to regional growth estimates. As a consequence, it is important to revisit the projections of 2023 baseline ozone to investigate the impact of the inventory revision on the attainment demonstration and equally important, what is the impact on the size of the proposed long term NOx emissions reduction commitment.

Ozone Representativeness

As a component of the PM2.5 attainment demonstration, the CMAQ modeling provided Basin-wide ozone air quality simulations for each hour in 2008. Past ozone attainment demonstrations evaluated a set of days characterized by restrictive meteorology or episodes occurring during concurrent intensive field monitoring programs. Of great importance, these episodic periods needed to be rated in terms of how representative they were in reference to the ozone standard being evaluated. For the now revoked 1-hour ozone standard, the attainment demonstration focused on a limited number of days closely matching the annual design value. Typically, the analysis addressed fewer than 5 days of simulations. The 2007 AQMP was the first to address the 8-hour ozone standard and the use of the RRFs in the future year ozone projection. To provide a robust characterization of the RRFs for use in the attainment demonstration, the analysis simulated 36 days. The ozone modeling guidance recommends that a minimum of 5-days of simulations meeting modeling acceptance criteria be used in a future year RRF calculation, but recommends incorporating as many days as possible to fully capture both the meteorological variations in the ozone season and the response of ozone formation for different daily emissions profiles.

This update to the future year ozone projection focuses on 91 days of ozone air quality observed during June through August 2008. During this period, seven well defined multiday ozone episodes occurred in the Basin with 75 total days having daily Basin-wide maximum concentrations of 80 ppb or higher. More importantly, when adjusted by a normalized meteorological potential using a regression based weighting covering 30-years of data (1998-2010), summarized in the 2003 AQMP, 8 days during the 2008 period were ranked above the 95th percentile in the long term distribution and another 19 were ranked between the 90th and 94th percentile.

Figure 5-11 depicts the time series of the daily Basin 8-hour maximum and Crestline (the Basin design station) daily maximum 8-hour ozone air quality during the three month period in 2008. The seven primary meteorological episodes which occur primarily between mid June and August are highlighted in the figure. It is important to note that the analysis not only focused on the seven periods or Crestline specifically. All station days meeting the acceptance criteria for calculating a daily RRF were included in the analysis. Several locations in the San Bernardino and Riverside Valleys exhibit similar transport and daily patterns of ozone formation as Crestline. The peak Basin 2008 8-hour average ozone concentration was observed at Santa Clarita on August 2nd at a value of 131 ppb, along a distinctly different transport route.

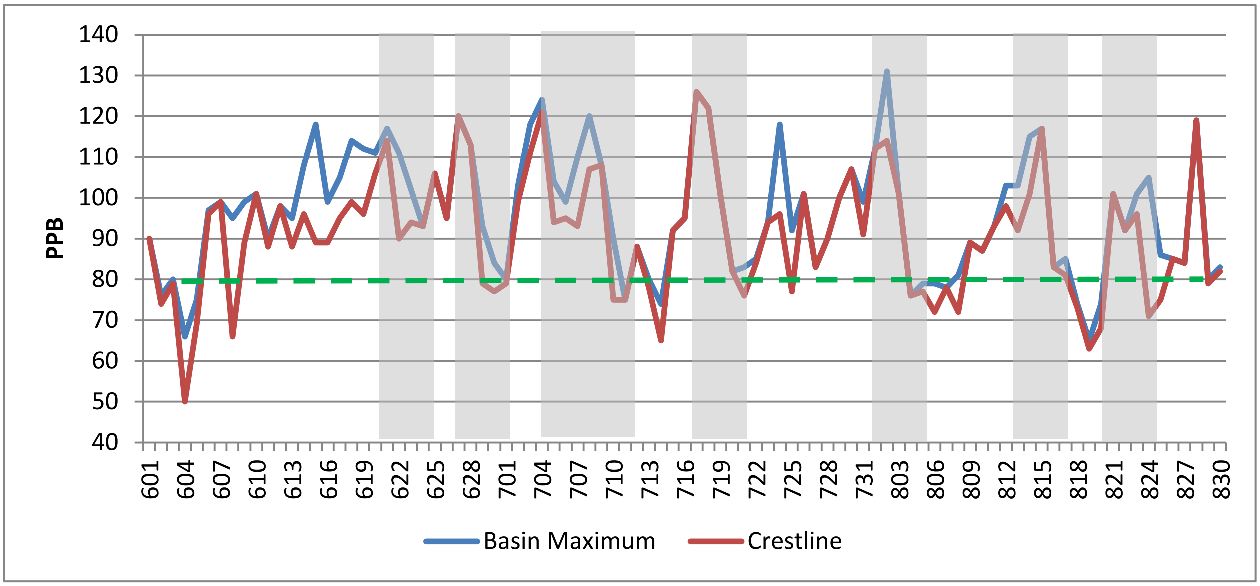


FIGURE 5-11

Observed Basin and Crestline Daily Maximum 8-Hr Average Ozone Concentrations

(Shaded areas indicate multiple day regional ozone episodes)

Overall, the 91-day period provides a robust description of the 2008 ozone-meteorological season. Table 5-4 lists the number of days each Basin station exceeded the 8-hour ozone standard during the June through August 2008 period. Also listed in Table 5-4 are the 2008, 5-year weighted design values used in the future year ozone projections.

TABLE 5-4

2008 Basin Weighted Design Values* and Number of Days Daily Maximum Concentrations Exceeded 80 ppb

STATION	2008 5-YEAR WEIGHTED DESIGN (PPB)	NUMBER OF DAYS IN 2008 WITH OBSERVED 8-HR AVERAGE MAXIMUM OZONE > 80 PPB
Azusa	94	16
Burbank	88	10
Reseda	94	16
Pomona	97	19
Pasadena	90	7
Santa Clarita	101	41
Glendora	106	26
Rubidoux	101	39
Perris	104	47
Lake Elsinore	99	39
Banning Airport	102	49
Upland	106	31
Crestline	116	66
Fontana	107	36
San Bernardino	109	46
Redlands	109	50

*Stations having design values greater than 80 ppb

Ozone Modeling Approach

The ozone modeling approach used in this update follows the same criteria employed for the 2007 AQMP attainment demonstration. Briefly, the set of 91 days from June 1 through August 30, 2008, simulated as a subset of the annual PM2.5 simulations, were analyzed to determine daily 8-hour average maximum ozone for the 2008 and 2023 emissions inventories. A separate 2023 simulation was conducted to assess future year ozone with VOC and NOx emissions specified at the levels defined by the 2007 AQMP attainment demonstration carrying capacity (420 TPD VOC and 114 TPD NOx). Finally, a set of simulations with incremental VOC and NOx emissions reductions from 2023 baseline emissions was generated to create ozone isopleths for each station in the Basin. The ozone isopleths provide updated guidance to the determination of the future control strategy, particularly in light of the challenge in meeting the current 75 ppb standard which will require an attainment demonstration to be submitted to U.S. EPA in 2015.

The ozone RRFs were calculated using the ratio methodology described for the PM2.5 modeling. Individual station day inclusion in the analysis was determined by three basic criteria: (1) the observed ozone concentration had to be ± 30 percent of the station's weighted design value; (2) the absolute prediction accuracy of the base 2008 simulation for that day was required to be within 20 percent; and (3) the observed daily maximum concentration needed to be greater than 84 ppb. The criteria were designed to eliminate extreme values from entering the analysis and to only focus on station days where model performance met the long-standing criteria for acceptance used in previous attainment demonstrations. Finally, only station days where ozone exceeded the 84 ppb threshold established to demonstrate attainment of the 1997 ozone standard, as specified in the U.S. EPA Modeling Attainment Guidance Document, were included in the analysis.

Future Ozone Air Quality

Table 5-5 summarizes the results of the updated ozone simulations. Included for general comparison are the 2023 ozone baseline and 2023 controlled ozone projections from the 2007 AQMP ozone attainment demonstration modeling analysis approved by U.S. EPA as part of the SIP The Final 2012 AQMP baseline ozone simulations reflect the changes made to the 2023 baseline inventory. The Final 2012 summer planning inventory has a higher ratio between VOC and NOX emissions, 1.39 vs. 1.05, although total tonnages of both precursor emissions are lower than presented in the 2007 AQMP. The higher VOC to NOx ratio is indicative of a more reactive pollutant mix with average projected ozone design concentrations 9 percent higher than previously projected. One implication of this simulation is that moderate VOC emissions reductions in the years between 2014 and 2023 will benefit regional ozone concentrations. Yet, the projected 2023 baseline design value of 108 ppb continues to exceed the federal standard by 35 percent. With the implementation of the Final 2012 AQMP short term control measures and the Section 185(e)(5) long-term control measures, (defined in this update as the difference between the Final 2012 AQMP 2023 base year VOC and NOx emissions and the corresponding Basin 2007 AQMP ozone attainment demonstration carrying capacity), projected regional ozone design values closely match those defined in the 2007 AQMP ozone attainment demonstration. Regardless, it will still require a 64 percent reduction in NOx emissions and an additional 3 percent reduction in VOC emissions to attain the 1997 ozone standard.

With controls in place, the updated analysis corroborates the approved 2007 AQMP ozone attainment demonstration in that it is expected that all stations in the Basin will meet the federal 8-hour ozone standard. The east Basin stations in the San Bernardino Valley continue to have among the highest projected 8-hour controlled design values for this update. The 2023 controlled ozone design value at Glendora is also projected to exceed 80 ppb, but all stations show attainment with the federal 8-hour ozone standard (≤84ppb). Glendora, Upland, Fontana and San Bernardino are downwind receptors along the primary wind transport route that moves precursor emissions and developing ozone eastward by the daily sea breeze. The higher projected design value at Glendora reflects the higher VOC to NOx ratio observed in the baseline inventory relative to the 2007 AQMP 2023 baseline inventory. The 2023 controlled design value at Glendora for the Final 2012 AQMP actually represents a greater response to emissions reductions than in the 2007 AQMP attainment demonstration. Future year projections of ozone for this update along the northerly transport route through the San Fernando Valley indicate that the ozone design value in the Santa Clarita Valley will be approximately 15 percent below the standard.

TABLE 5-5

Model-Predicted 8-Hour Ozone Concentrations

LOCATION	2007 OZONE SIP-2023 BASELINE DESIGN (PPB)	2007 OZONE SIP-2023 CONTROLLED DESIGN (PPB)	FINAL 2012 AQMP-UPDATED 2023* BASELINE DESIGN (PPB)	FINAL 2012 AQMP- UPDATED* 2023*CONTROLLED DESIGN (PPB)
Azusa	82	80**	95	77
Burbank	86	70**	88	72
Reseda	86	68	90	73
Pomona	85	75	100	80
Pasadena	78	74**	92	76
Santa Clarita	95	74	94	73
Glendora	91	79	107	84
Riverside	92	78	100	77
Perris	94	78***	88	66
Lake Elsinore	80	64	85	66
Banning	88	70	94	73
Upland	92	78	106	83
Crestline	100	83	107	81
Fontana	97	81	104	81
San Bernardino	92	78	108	83

TABLE 5-5 (concluded)

Model-Predicted 8-Hour Ozone Concentrations

LOCATION	2007 OZONE SIP-2023 BASELINE DESIGN (PPB)	2007 OZONE SIP-2023 CONTROLLED DESIGN (PPB)	FINAL 2012 AQMP-UPDATED 2023* BASELINE DESIGN (PPB)	FINAL 2012 AQMP- UPDATED* 2023*CONTROLLED DESIGN (PPB)
Redlands	98	81	103	77

* Informational purpose only based on draft emissions inventories and across-the-board reductions.

** Based on the city-station specific RRF’s determined from the 19 episode day average.

*** Based on the average of the RRF’s determined from the stations meeting the criteria having more than 5 episode days.

Note: Attainment with the 1997 Federal 8-hour ozone standard requires 84 ppb or less

Spatial Projections of 8-Hour Ozone Design Values

The spatial distribution of ozone design values for the 2008 base year is shown in Figure 5-12. Future year ozone air quality projections for 2024 with and without implementation of all control measures are presented in Figures 5-13 and 5-14. The predicted ozone concentrations will be significantly reduced in the future years in all parts of the Basin with the implementation of proposed control measures in the South Coast Air Basin.

Appendix V provides base year model performance statistics, grid level spatial plots of simulated ozone (base cases and future year controlled) as well as weight of evidence discussions to support the modeling attainment demonstration.

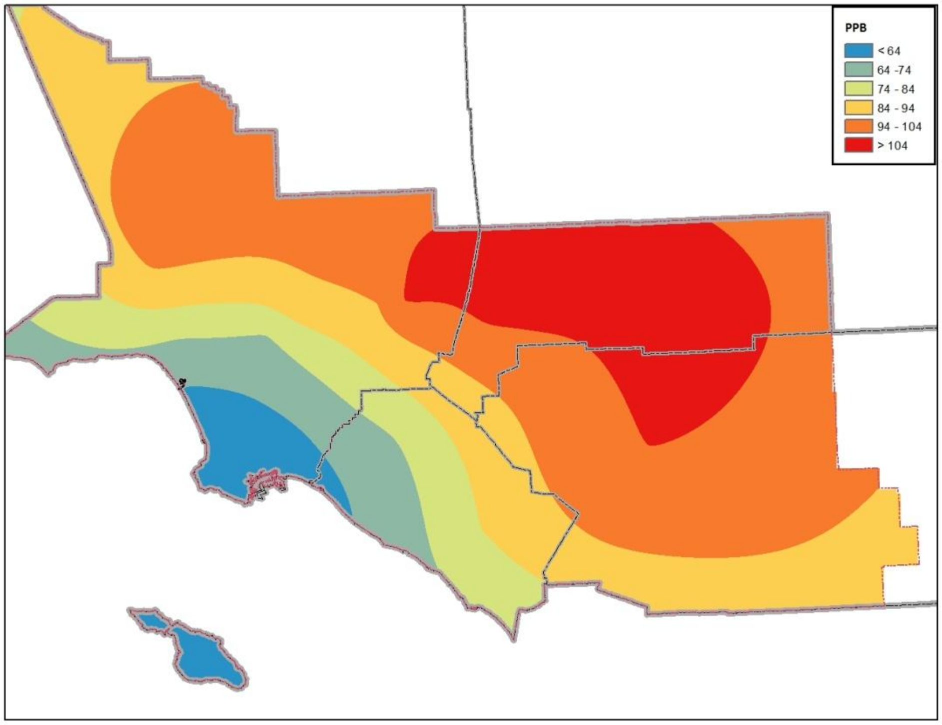


FIGURE 5-12

2008 Baseline 8-Hour Ozone Design Concentrations (ppb)

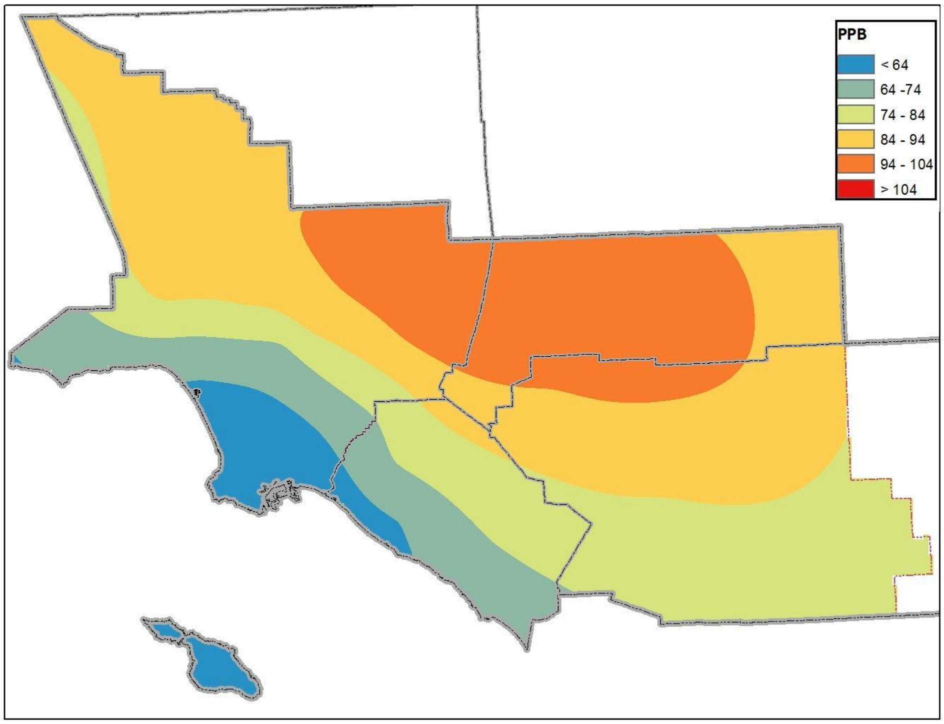


FIGURE 5-13

Model-Predicted 2023 Baseline 8-Hour Ozone Design Concentrations (ppb)

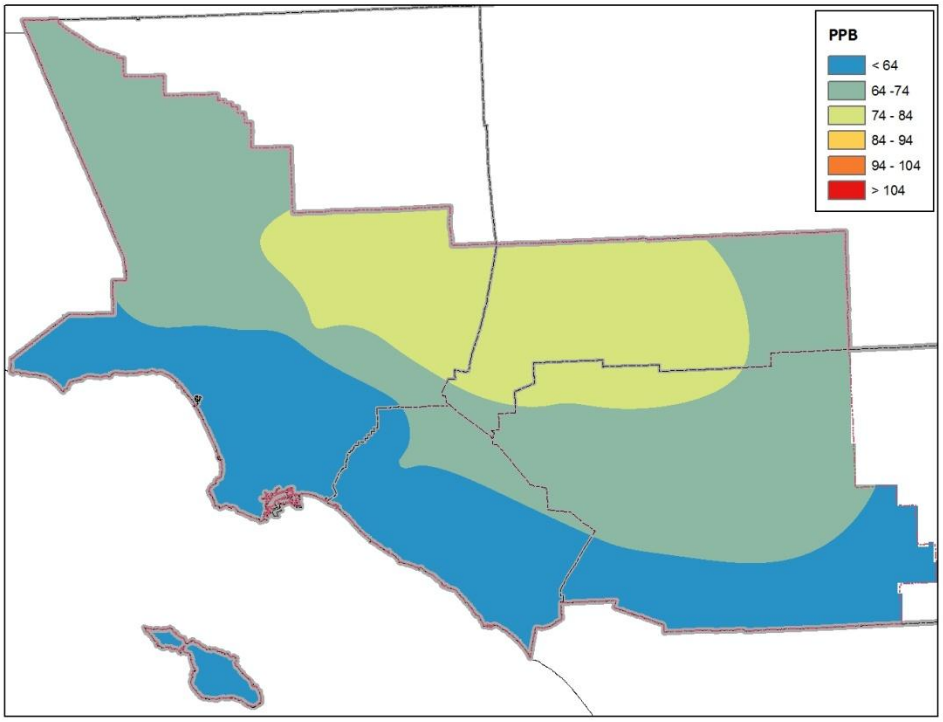


FIGURE 5-14

Model-Predicted 2023 Controlled 8-Hour Ozone Design Concentrations (ppb)

<u>A First Look at Attaining the 2006 8-Hour Ozone Standard</u>

In 2006, the U.S. EPA lowered the federal 8-hour ozone standard to 75 ppb. Recent 8-hour ozone rule implementation guidance requires that a SIP revision with an updated attainment demonstration and control strategy be submitted to U.S. EPA no later than December 2015. The Basin has been designated as an extreme non-attainment area for the new standard, consistent with the classification of the 80 ppb standard. Thus, the deadline for attainment of the 75 ppb standard is 2032, 8-years after the attainment date for the previous 80 ppb federal standard in 2024. It is critical to conduct preliminary analyses to assess the need for potential adjustments to the overall control strategy considering this new standard and deadline

The preliminary projections, based upon a modeling evaluation of how VOC and NOx reductions affect the Basin's ozone levels (ozone "isopleths") indicates that that a 75 percent reduction in NO_X emissions beyond the 2023 baseline is needed to meet the 75 ppb level in 2032. The resulting 2032 Basin NOx carrying capacity could be as low as to 85 tpd. Further discussion of the ozone isopleths and a glance at the potential impact to the control strategy and carrying capacity for potential future revisions to the 8-hour ozone standard is presented in Chapter 8.

SUMMARY AND CONCLUSIONS

Figure 5-15 shows the 2008 observed and model-predicted regional peak concentrations for 24-hour average and annual PM2.5 as percentages of the most stringent federal standard, for 2014. The federal 24-hour and annual PM2.5 standards are predicted to be met in 2014 with implementation of the Final 2012 AQMP control strategy. The California annual PM2.5 standard will not be attained before 2019. (See Figure 5-16).

Given the changes made to the modeling platform, the number of episodes evaluated, and the distinct changes in the projected Final 2012 AQMP 2023 baseline inventory, projected 8-hour ozone design values with implementation of the short- and long-term controls are very consistent with those presented in the 2007 AQMP attainment demonstration. Again, an approximate 65 percent reduction in NOx emissions in 2023 will be required to meet the 1997 80 ppb standard by 2024.

The challenges of meeting potential future standards for 8-hour ozone and a proposed federal annual PM2.5 standard between 12 and 13 $\mu g/m^3$ are discussed in Chapter 8 of this document.

The challenge of future year attainment of proposed revisions to the federal annual PM2.5 standard at a value between 12 and 13 $\mu g/m^3$ are discussed in Chapter 8 of the Draft Final 2012 AQMP.

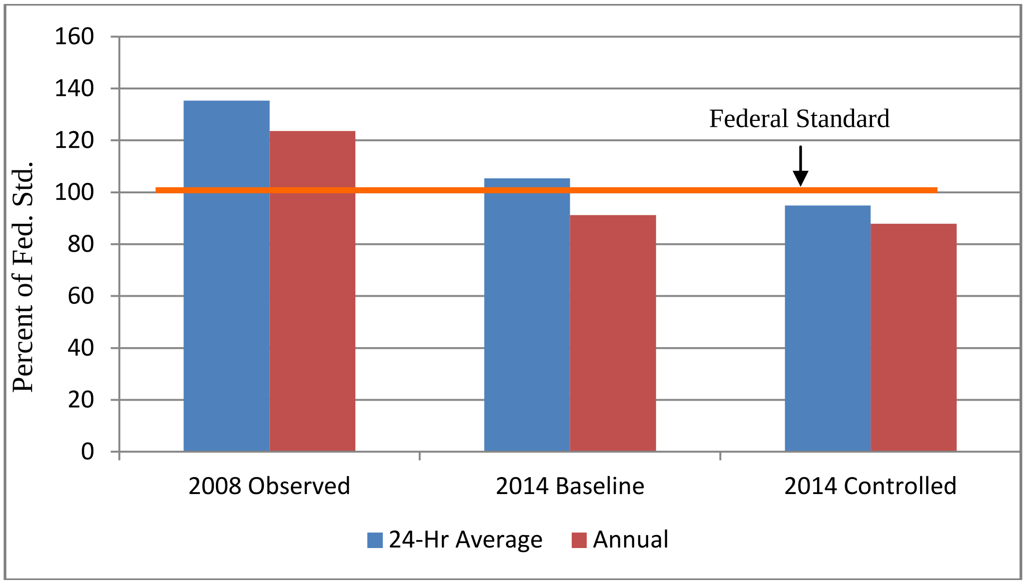


FIGURE 5-15

Projection of Future Air Quality in the Basin in Comparison
with the Federal Standards.

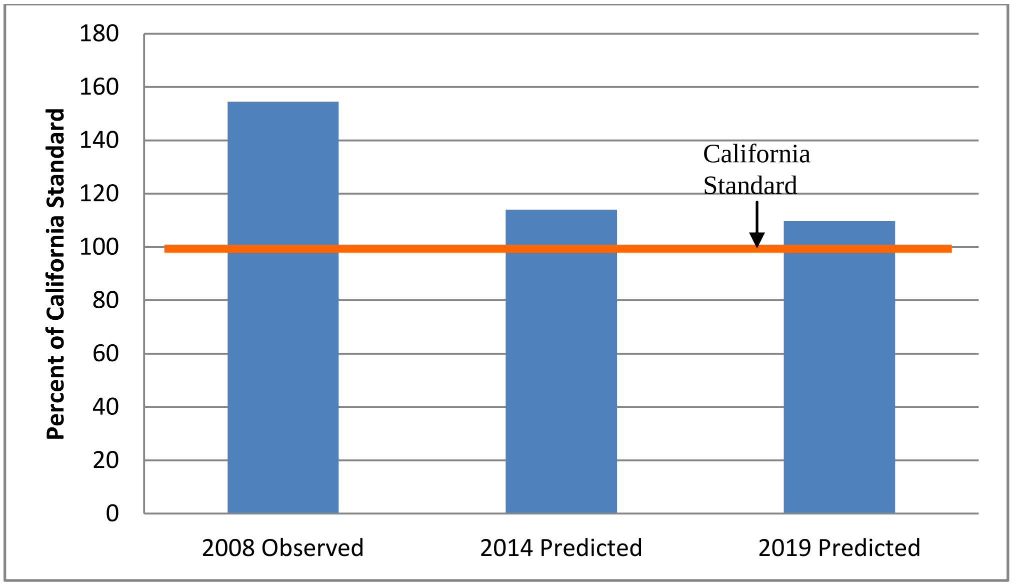


FIGURE 5-16

Projection of Future PM2.5 in the Basin in Comparison with California State Standard