California Environmental Protection Agency

Air Resources Board

Public Meeting Agenda

REVISED
(5/13/08)

LOCATION (In-Person)
San Joaquin Valley Unified Air Pollution Control District
1990 East Gettysburg Avenue, Fresno, California 93726

or Via Video Conference (2 Locations)
District Northern Region Office
4800 Enterprise Way, Modesto, California 95356

District Southern Region Office
2700 M Street, Suite 275, Bakersfield, California 93301

This facility is accessible by public transit. For transit information, call (559) 621-1393, website http://faxtransit@fresno.gov/ (This facility is accessible to persons with disabilities.)

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING GO TO:
http://www.arb.ca.gov/lispub/comm/bclist.php

May 22, 2008
8:30 a.m.

Item #

08-5-1: Presentation by the San Joaquin Valley Air Pollution Control District on Healthy Air Living Initiative

The Board will hear a presentation on actions that individuals and businesses can take to reduce air pollution.

08-5-2: Public Meeting to Consider Approval of the San Joaquin Valley 2008 PM2.5 State Implementation Plan and Provide an Update on the Valley's Ozone Plan Progress

The Board will consider approval of the San Joaquin Valley Air Pollution District's federal attainment plan for the PM2.5 standard. This plan identifies the strategies that will bring the region into attainment by the 2014 deadline. Staff will also present an update to the Board on the Valley's ozone plan progress.

08-5-3: Public Hearing to Consider Approval of Proposition 1B: Grants for FY 2007-08 Funds to Reduce Emissions from Goods Movement

The Board will consider approval of a list of grant awards totaling up to $225 million in incentive funding for specific local agency projects to reduce freight-related emissions in the four trade corridors.

08-5-4: Public Meeting to Consider a Research Proposal

"Systemic Platelet Activation in Mice Exposed to Fine Particulate Matter," University of California, Davis, $300,000, Proposal No. 2658-260.

08-5-5: Report to the Board on a Draft Report on New Estimates of Premature Deaths Associated with Long-Term Exposures to PM2.5 in California

Staff will report to the Board on the methodology which provides improved estimates of premature deaths associated with PM2.5 exposures. Staff has developed a revised relationship between long-term exposures to PM2.5 and premature deaths based on the latest literature review. The new methodology used in calculating the estimated deaths has undergone peer review by outside experts. The draft report will be released for public comment following the Board meeting.

08-5-6: **Report to the Board on AB 32 Implementation: Update on Land Use, Transportation, and Vehicle Travel**

In one of a series of briefings on AB 32 Implementation, staff will brief the Board on the impact of land use and transportation planning on the State's greenhouse gas emissions. Staff will discuss the status of recent efforts to develop a framework for integrating land use and transportation decisions into the State's climate change efforts.

08-5-7: **THIS ITEM WILL BE RECALENDARED AT A LATER DATE:**
Report to the Board on the Strategic Plan for Enforcement of Diesel Emission Control Regulations Pursuant to AB 233, Jones (Chapter 592, Statutes of 2007)

AB 233, Jones requires ARB to review its enforcement of diesel emission control regulations and develop a strategic plan for consistent, comprehensive, and fair enforcement of these regulations. The bill requires that the plan be developed in conjunction with local air districts and the public and be reviewed by the Board in a public hearing. ARB is required to submit this plan to the California Legislature by January 1, 2009, and every 3 years thereafter.

CLOSED SESSION – LITIGATION

The Board will hold a closed session as authorized by Government Code section 11126(e) to confer with, and receive advice from, its legal counsel regarding the following pending litigation:

Central Valley Chrysler-Jeep, Inc. et al. v. Goldstene, U.S. District Court (E.D. Cal. - Fresno) Case No. 1:04-CV-06663-AWI-GWA.

Fresno Dodge, Inc. et. al. v. California Air Resources Board and Goldstene, Superior Court of California (Fresno County), Case No. 04CE CG03498, consolidated with General Motors Corp. et. al. v. California Air Resources Board and Goldstene, Superior Court of California (Fresno County), Case No. 05CE CG02787.

State of California by and through Arnold Schwarzenegger, Governor of the State of California, the California Air Resources Board, and Edmund G. Brown, Jr., Attorney General of the State of California v. U.S. Environmental Protection Agency and Stephen L. Johnson, Administrator, U.S. Court of Appeals (D.C. Cir.) Case No. 07-1457.

State of California by and through Arnold Schwarzenegger, Governor of the State of California, the California Air Resources Board, and Edmund G. Brown, Jr., Attorney General of the State of California v. U.S. Environmental Protection Agency and Stephen L. Johnson, Administrator, U.S. District Court (D.C.) Case No. 07-CV-o2024-RCL.

State of California by and through Arnold Schwarzenegger, Governor, and the California Air Resources Board v. U.S. Environmental Protection Agency, and Stephen L. Johnson, Administrator, U.S. Court of Appeals (9th Cir.) Case No. 08-70011.

State of California by and through Arnold Schwarzenegger, Governor of the State of California, the California Air Resources Board, and Edmund G. Brown, Jr., Attorney General of the State of California v. U.S. Environmental Protection Agency, U.S. Court of Appeals (D.C. Cir.) Case No. 08-1178.

Green Mountain Chrysler-Plymouth-Dodge-Jeep, et al. v. Crombie , 508 F.Supp.2d 295, U.S. District Court (Vermont) (2007), appeal to 2nd Circuit Court of Appeals pending, Docket Nos. 07-4342-cv(L) and 07-4360-cv(CON).

Association of International Automobile Manufacturers v. Sullivan, U.S. District Court (Rhode Island), C.A. No. 06-69T, consolidated with Lincoln Dodge, Inc. et al., U.S. District Court (Rhode Island), C.A. No. 06-70T.

Zangara Dodge, Inc. et al. v. Curry et al., U.S. District Court (New Mexico) Case No. CIV 07-1305 ACT/LFG.

OPPORTUNITY FOR MEMBERS OF THE BOARD TO COMMENT ON MATTERS OF INTEREST.

Board members may identify matters they would like to have noticed for consideration at future meetings and comment on topics of interest; no formal action on these topics will be taken without further notice.

OPEN SESSION TO PROVIDE AN OPPORTUNITY FOR MEMBERS OF THE PUBLIC TO ADDRESS THE BOARD ON SUBJECT MATTERS WITHIN THE JURISDICTION OF THE BOARD.

Although no formal Board action may be taken, the Board is allowing an opportunity to interested members of the public to address the Board on items of interest that are within the Board's jurisdiction, but that do not specifically appear on the agenda. Each person will be allowed a maximum of three minutes to ensure that everyone has a chance to speak.

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http://www.arb.ca.gov/lispub/comm/bclist.php

IF YOU HAVE ANY QUESTIONS,
PLEASE CONTACT THE CLERK OF THE BOARD
1001 I Street, 23rd Floor, Sacramento, CA 95814

(916) 322-5594
FAX: (916) 322-3928
ARB Homepage: www.arb.ca.gov

To request special accommodation or language needs, please contact the following:

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- **If you are a person with limited English and would like to request interpreter services to be available at the Board meeting, please contact ARB's Bilingual Manager at 916-323-7053.**

THE AGENDA ITEMS LISTED ABOVE MAY BE CONSIDERED IN A DIFFERENT ORDER AT THE BOARD MEETING.

SMOKING IS NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

REVISED

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LOCATION (In-Person)
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May 22, 2008
8:30 a.m.

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CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER THE APPROVAL OF THE SAN JOAQUIN VALLEY 2008 PM2.5 STATE IMPLEMENTATION PLAN AND PROVIDE AN UPDATE ON OZONE

The Air Resources Board (the Board or ARB) will conduct a public meeting at the time and place noted below to consider the approval of the proposed San Joaquin Valley 2008 PM2.5 State Implementation Plan (2008 PM2.5 Plan) to attain the federal standards for fine particulate matter (PM2.5). If approved, ARB will submit these elements to the United States Environmental Protection Agency (U.S. EPA) for its approval as a revision to the California State Implementation Plan (SIP). In this item, the Board will also hear a short update on the San Joaquin Valley's Ozone SIP.

DATE: May 22, 2008

TIME: 8:30 a.m.

PLACE: San Joaquin Valley Air Pollution Control District
1990 East Gettysburg Avenue
Fresno, California 93726

Or Via Videoconference (2 Locations)

District Northern Region Office
4800 Enterprise Way
Modesto, California 95356

District Southern Region Office
2700 M Street, Suite 275
Bakersfield, California 93301

This item will be considered at an one-day meeting of the Board, which will commence at 8:30 a.m., May 22, 2008. Please consult the agenda for the meeting, which will be available at least ten (10) days before May 22, 2008, to determine the schedule on which this item will be considered.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette or computer disk. Please contact ARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact ARB's Bilingual Manager at (916) 323-7053.

BACKGROUND

The federal Clean Air Act (the Act) establishes planning requirements for those areas that exceed the health-based National Ambient Air Quality Standards (NAAQS). These nonattainment areas must develop and implement a SIP that demonstrates how they will attain the standards by specified dates.

In July 1997, U.S. EPA promulgated new PM2.5 NAAQS, both an annual and a 24-hour standard. On April 5, 2005, the San Joaquin Valley Unified Air Pollution Control District (District or Valley) was designated nonattainment for the federal PM2.5 standards based on violations of both the annual and 24-hour standards. The Valley is required to submit a SIP demonstrating attainment will occur as expeditiously as practicable, but no later than April 2015. The Act also requires that the SIP include reasonable further progress, reasonably available control measures and technologies, contingency measures, comprehensive emissions inventories, and transportation conformity budgets. The District prepared the 2008 PM2.5 Plan to address these requirements and to attain the PM2.5 standard as expeditiously as practicable. The District Governing Board adopted the 2008 PM2.5 Plan on April 30, 2008.

The 2008 PM2.5 Plan relies on both District and ARB measures to demonstrate attainment. The ARB measures were adopted at the September 2007 Board hearing and include commitments to reduce nitrogen oxides and direct PM2.5 by 76 tons per day and 5 tons per day, respectively, in 2014. In addition, the 2008 PM2.5 Plan establishes county-level on-road motor vehicle emission transportation conformity budgets for each milestone year, as well as for the attainment year. The emissions budgets in the 2008 PM2.5 Plan reflect the latest planning assumptions and were developed with EMFAC2007.

Regarding the ozone update, at the November 15, 2007 ARB meeting, the Board directed staff to provide an update to the Board, by June 2008 at a meeting held in the Valley, on recent activities that may accelerate attainment of the federal ozone standard in the San Joaquin Valley. ARB staff will provide an update as an element of staff's presentation to the Board on this item.

PROPOSED ACTION

ARB staff has reviewed the District's 2008 PM2.5 Plan and concluded that it meets applicable federal requirements. ARB staff has also concluded that the implementation of the 2008 PM2.5 Plan would reduce PM2.5 levels throughout the San Joaquin Valley and result in attainment of the 1997 PM2.5 standards by April 2015. Staff is recommending that the Board approve the 2008 PM2.5 Plan, as well as the transportation conformity budgets, emission inventory, reasonable further progress, reasonably available control measures and technologies demonstration, contingency measures, and attainment demonstration as a revision to the California SIP, and to direct staff forward the 2008 PM2.5 Plan to U.S. EPA.

AVAILABILITY OF DOCUMENTS

ARB staff has prepared a written Staff Report. Copies of the Staff Report may be obtained from the Board's Public Information Office, 1001 "I" Street, 1st Floor, Environmental Services Center, Sacramento, California 95814, (916) 322-2990. This notice, the Staff Report, and the District's 2008 PM2.5 Plan may also be obtained from ARB's internet site http://www.arb.ca.gov/planning/sip/sjvpm25/sjvpm25.htm.

SUBMITTAL OF COMMENTS

Interested members of the public may also present comments orally or in writing at the meeting, and in writing or by e-mail before the meeting. To be considered by the Board, written comment submissions not physically submitted at the meeting must be received **no later than 12:00 noon, May 21, 2008,** and addressed to the following:

Postal mail:	Clerk of the Board, Air Resources Board 1001 I Street, Sacramento, California 95814
Electronic submittal:	http://www.arb.ca.gov/lispub/comm/bclist.php
Facsimile submittal:	(916) 322-3928

The Board requests, but does not require that 30 copies of any written statement be submitted and that written and e-mail statements be filed at least ten (10) days prior to the meeting so that ARB staff and Board members have time to fully consider each comment.

Please note that under the California Public Records Act (Government Code Section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

Further inquiries regarding this matter should be directed to Ms. Sylvia Zulawnick, Manager of the Particulate Matter Analysis Section, Planning and Technical Support Division, 1001 I Street, Sacramento, California 95814 or by e-mail at szulawni@arb.ca.gov, or Dr. Patricia Velasco, Staff Air Pollution Specialist, Planning and Technical Support Division at (916) 323-7560, 1001 I Street, Sacramento, California 95814 or by e-mail at pvelasco@arb.ca.gov.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: 4/25/08

State of California

California Environmental Protection Agency

AIR RESOURCES BOARD

Staff Report

Analysis of the San Joaquin Valley 2008 PM2.5 Plan

Release Date: May 7, 2008

Scheduled for Consideration: May 22-23, 2008

This document has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Electronic copies from this document are available for download from the Air Resources Board's Internet site at: http://www.arb.ca.gov/planning/sip/sjvpm25/sjvpm25.htm. In addition, written copies may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, 1st Floor, Visitors and Environmental Services Center, Sacramento, California 95814, (916) 322-2990.

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ACKNOWLEDGMENT

ARB staff thanks the staff of the San Joaquin Valley Unified Air Pollution Control District for the high level of coordination between the agencies in the development of the technical elements of this plan.

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EXECUTIVE SUMMARY

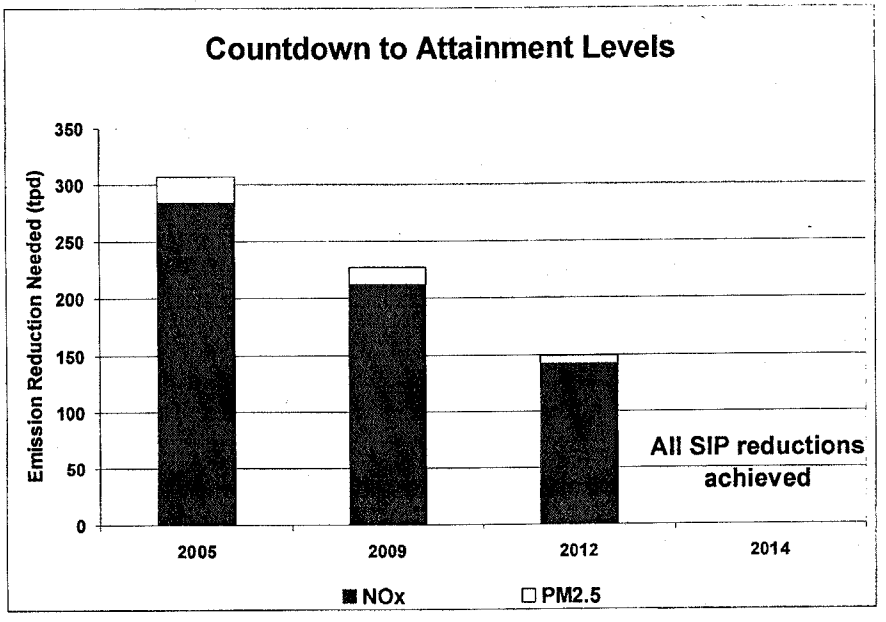
On April 30, 2008, the San Joaquin Valley Air Pollution Control District (District) adopted a PM2.5 Attainment Plan showing how the region will comply with the federal PM2.5 air quality standards set by the U.S. Environmental Protection Agency (U.S. EPA) in 1997. The staff of the Air Resources Board (ARB or Board) has reviewed the Plan and recommends that the Board approve it as a State Implementation Plan (SIP) revision to be submitted to U.S. EPA. The Plan shows that the region now meets the daily (24-hour) standard, and demonstrates how the more challenging annual standard will be met by 2014. The Plan documents that emissions of PM2.5 particles, and the pollutants that form PM2.5, are decreasing each year. A mid-course review of plan implementation will be done in 2011 as required by U.S. EPA

The Plan consists of adopted measures that provide increasing benefits each year, along with new emission reduction commitments from both ARB and the District. The Valley's particle pollution problem is well studied as a result of the $27 million invested in the California Regional Particulate Matter Study. This study provides the scientific foundation for the PM2.5 SIP by identifying the pollutants most important to formation of PM2.5 pollution. The results indicate that the key pollutants to reduce are NOx, SOx, and directly emitted PM2.5 particles. The Plan addresses these three pollutants consistent with U.S. EPA guidance. Emissions of VOC are also being reduced in the region as part of the ozone attainment strategy but are not required to be included in this SIP.

Overall, between 2005 and 2014, NOx emissions will decrease by almost 300 tons per day (tpd), direct PM2.5 emissions by over 20 tpd, and SOx by almost 3 tpd. Two thirds of the NOx and SOx reductions and one half of the PM2.5 reductions come from already adopted measures. A significant portion of the new commitments come from the ARB's State Strategy that was adopted in September 2007. The State Strategy provides an additional 76 tons of NOx reductions and 5 tons of PM2.5 reductions in 2014. The District has accelerated several measures in its 2007 Ozone Plan that are also part of the PM2.5 attainment strategy, and targeted a number of categories of PM2.5 for additional emission reductions, including residential wood burning and commercial cooking. Past District efforts to reduce impacts from residential wood burning have proven to be very effective, and continued reductions in this source category are expected to contribute significantly to further progress.

As emissions have decreased each year, parts of the Valley are already meeting the annual standard. The air quality modeling indicates that attaining the annual standard in the southern Valley is the biggest challenge, but all areas are projected to attain the standard by 2014. The Plan will also bring the region much closer to meeting a new federal PM2.5 standard that will apply to future SIP planning efforts. SIP planning for the newer standard will occur after U.S. EPA designates nonattainment areas and develops implementation rules.

The Plan demonstrates the rate of emission reductions that will occur between now and the attainment year. As shown below 307 tons per day of reductions are needed between 2005 and 2014. The Plan outlines how these reductions will be achieved. While the majority of the reductions are NOx, it is important to recognize that the PM2.5 reductions are also essential because air quality modeling shows each ton of direct PM2.5 is approximately nine times more effective ton per ton in the attainment year.



Staff's review indicates that the Plan meets the requirements of the Clean Air Act (Act) and U.S. EPA's PM2.5 implementation rule. The SJV 2008 PM2.5 Plan demonstrates attainment as expeditiously as practicable, no later than 2014, as required by the Act. The Plan also includes reasonable further progress calculations, reasonably available control measures and technologies, contingency measures, emission inventories, transportation conformity budgets, and a commitment for a SIP update in 2011. Additional reductions from adopted ARB measures will provide NOx reductions for contingency purposes should the region not attain in 2014.

The PM2.5 Plan is the result of a two year effort to update the emission inventories for each mobile, stationary, and area source category, conduct air quality modeling and data analysis, and to develop new control strategies. The 2011 SIP update will provide an important opportunity to assess air quality progress, update emission inventories, and check on the progress in achieving emission reductions.

Recommendations: Staff recommends that the Board approve the District's 2008 PM2.5 attainment Plan.

I. BACKGROUND

A. Profile of the San Joaquin Valley

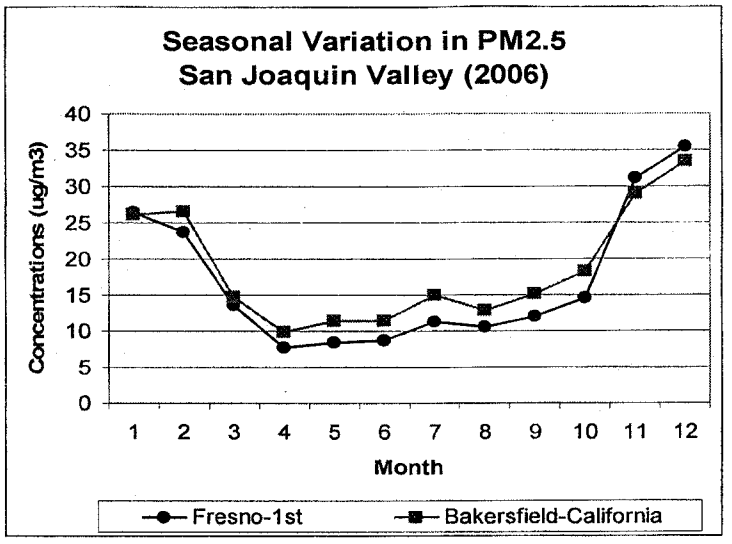
Covering nearly 25,000 square miles, the San Joaquin Valley is one of the dominant features in California's landscape. One of the fastest growing regions in the State, the Valley is home to more than 3.6 million people. The Valley has four large cities, Stockton, Modesto, Fresno, and Bakersfield, each with a population greater than 200,000. Numerous smaller cities and towns in the Valley are separated by large expanses of agricultural lands. With urbanization, agricultural lands continue to be converted to non-agricultural uses.

The San Joaquin Valley Air Basin is a lowland area bordered by the Sierra Nevada Mountains to the east, the Pacific Coast range to the west, and the Tehachapi Mountains to the south. The mountains act as air flow barriers, with the resulting stagnant conditions favoring the accumulation of emissions and pollutants. As a result, PM2.5 concentrations are higher in the southern and central portions of the Valley, where geography, emissions, and climate pose significant challenges to air quality progress.

PM2.5 is a complex mixture of many different species generated from a wide array of sources. PM2.5 can be either emitted directly into the air (primary particles) in forms such as soot, smoke, and the tiniest specs of dust, or it can be formed in the atmosphere (secondary particles or aerosol droplets) from the reactions of precursor gases, nitrogen oxides (NOx), sulfur oxides (SOx), reactive organic gases (ROG), and ammonia. NOx and ROG are also precursors of ozone pollution. Understanding the nature of the PM2.5 problem is key to designing an effective control strategy.

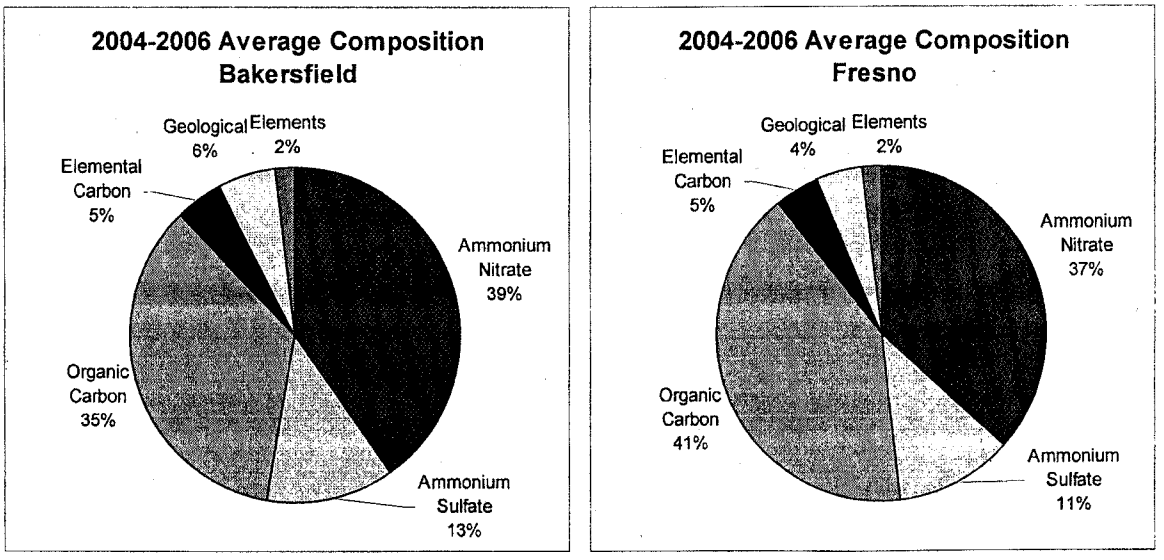
In the Valley, the levels and nature of PM2.5 concentrations typically differ by season (Figure 1). Higher PM2.5 concentrations occur during the winter, between late November and February during extended periods of stagnant weather with cold, damp, foggy conditions, which are conducive to the formation of secondary ammonium nitrate particulates. At these times, PM2.5 is dominated by ammonium nitrate formed from NOx and ammonia emissions, and directly emitted particles, such as wood smoke and other combustion sources.

Figure 1. Seasonal Variation in PM2.5 Concentrations in the San Joaquin Valley.



The elevated winter PM2.5 concentrations drive the annual average PM2.5 levels. On an annual basis, PM2.5 in the Valley consists mostly of ammonium nitrate, organic carbon, and ammonium sulfate (Figure 2). Ammonium nitrate is formed from chemical reactions of NOx emitted from motor vehicles and stationary combustion sources with ammonia. Burning activities, such as residential wood combustion, cooking, and direct tailpipe emissions from mobile sources are major sources of organic carbon. Ammonium sulfate is also formed in the atmosphere from chemical reactions of SOx emitted from combustion sources and ammonia. To a lesser extent, elemental carbon resulting from mobile and stationary combustion sources, and geological material from roads and other dust producing activities also contribute to PM2.5.

Figure 2. PM2.5 Composition in the San Joaquin Valley



B. PM2.5 Health Effects and Federal Air Quality Standards

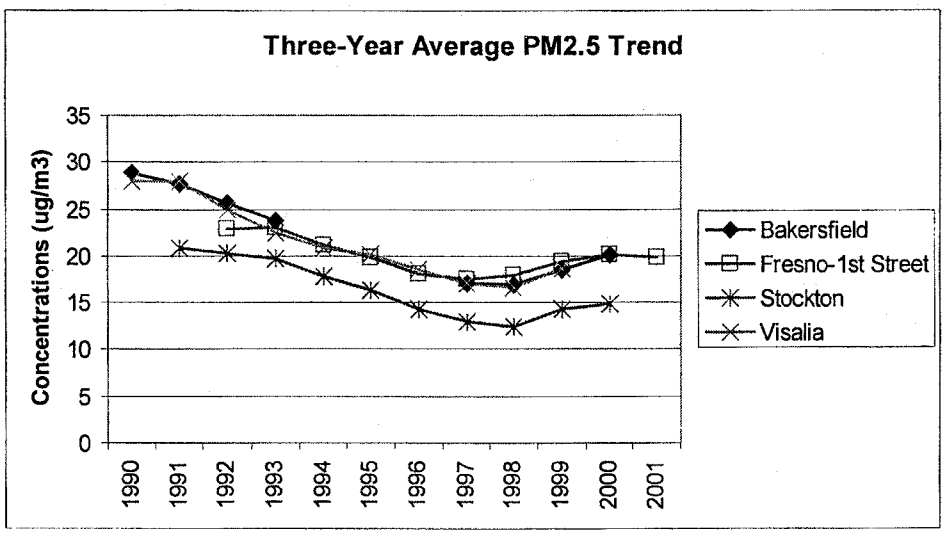
Extensive research over the last two decades has investigated the effects that breathing PM2.5 has on people's health. Research studies have consistently found a link between PM2.5 exposure and premature death in people with existing cardiac or respiratory disease. Studies of large populations have found that exposure to PM2.5 is associated with increased hospital admissions and emergency room visits due to frequent and severe asthma attacks, pneumonia, and acute and chronic bronchitis, primarily in people with chronic heart or lung diseases. Long-term exposure to PM2.5 has also been linked to an increase in lung cancer mortality risk. Those most at risk of experiencing adverse effects with PM2.5 exposure include infants, children, the elderly, and persons with pre-existing cardiopulmonary disease.

U.S. Environmental Protection Agency (U.S. EPA) adopted national ambient air quality standards (NAAQS) for PM2.5 in 1997, with a 24-hour PM2.5 standard of 65 micrograms per cubic meter ($\mu g/m^3$) and an annual standard of 15 $\mu g/m^3$. State Implementation Plans (SIPs) for areas designated nonattainment for these standards are due to U.S. EPA in 2008. The San Joaquin Valley is currently designated as nonattainment for the 1997 PM2.5 standards and the 2008 SJV PM2.5 Plan addresses these standards. In 2006, U.S. EPA adopted a new 24-hour PM2.5 standard that will apply to future SIP planning efforts. SIP planning for the newer standard will occur after U.S. EPA designates nonattainment areas and develops implementation rules

C. Air Quality

While the San Joaquin Valley has one of the most severe PM2.5 problems in the nation, PM2.5 air quality has shown considerable improvement. Initial efforts to monitor PM2.5 began in 1990. Annual average PM2.5 concentrations decreased between 20 to 30 percent during the period of 1990 through 2001. Due to the marked and complex variability in the Valley's meteorological conditions, some years are far more conducive to PM2.5 formation and accumulation than others. However, overall concentrations show a downward long-term trend (Figure 3).

Figure 3. Long-term Trends in PM2.5 Concentrations in the San Joaquin Valley



Since 1999, when monitoring for compliance with the federal PM2.5 standards began, PM2.5 annual average concentrations have dropped a further 19 to 29 percent. When the San Joaquin Valley was first designated nonattainment for the federal PM2.5 standards, the basin exceeded both the annual and the 24-hour PM2.5 standards. However, based on 2004-2006 data, the San Joaquin Valley now meets the federal 24-hour PM2.5 standard of 65 ug/m^3. Thus, this SIP focuses on what more is needed to attain the annual standard.

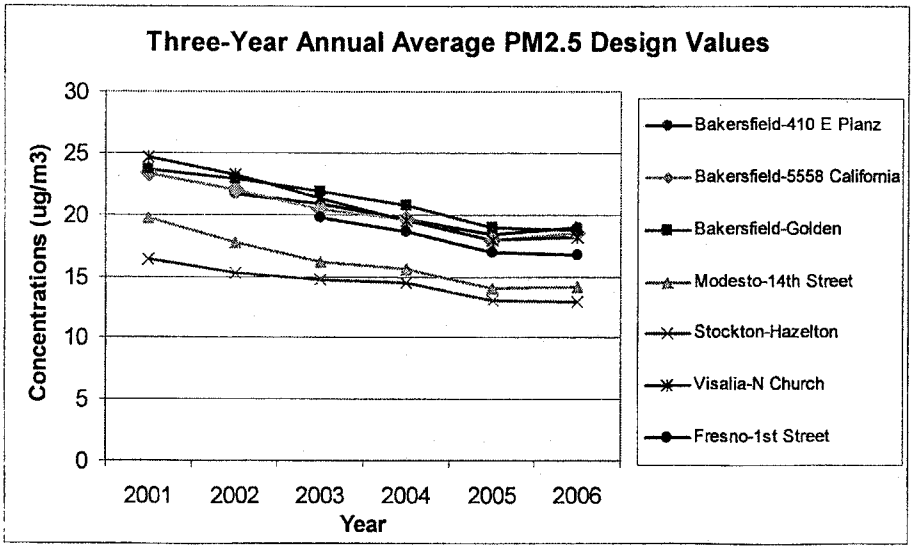
For planning purposes, U.S. EPA recommends using the average of the mean annual PM2.5 concentrations measured over a three year period. This is referred to as the "design value" and reduces the year to year variability. Table 1 provides the 2006 annual standard design values and the annual average values for 2004, 2005, and 2006 for each monitoring site with complete data. The northern portion of the Valley meets the annual PM2.5 standard, as indicated by the design values at Stockton, Modesto, and Merced. The highest PM2.5 annual design values are located in the southern and central portions of the basin, including Bakersfield and Visalia.

Table 1. PM2.5 Annual Average Concentrations and 2006 Design Values

Monitor	Annual Average (ug/m^3) 2004	2005	2006	2006 3-year Annual Average Design Value (ug/m^3)
Clovis-N Villa Avenue	15.8	16.0	16.8	16.2
Bakersfield-410 E Planz Road	17.4	19.9	19.3	**18.9**
Bakersfield-5558 California Avenue	19.0	17.9	18.7	18.5
Bakersfield-Golden State Highway	18.1	18.9	18.6	18.5
Corcoran-Patterson Avenue	17.3	17.6	16.7	17.2
Fresno-1st Street	16.4	16.9	16.8	16.7
Fresno-Hamilton and Winery	17.0	16.9	17.6	17.2
Merced-2334 M Street	15.3	14.1	14.8	14.7
Modesto-14th Street	13.6	13.9	14.8	14.1
Stockton-Hazelton Street	13.2	12.5	13.1	12.9
Visalia-N Church Street	17.0	18.8	18.8	18.2

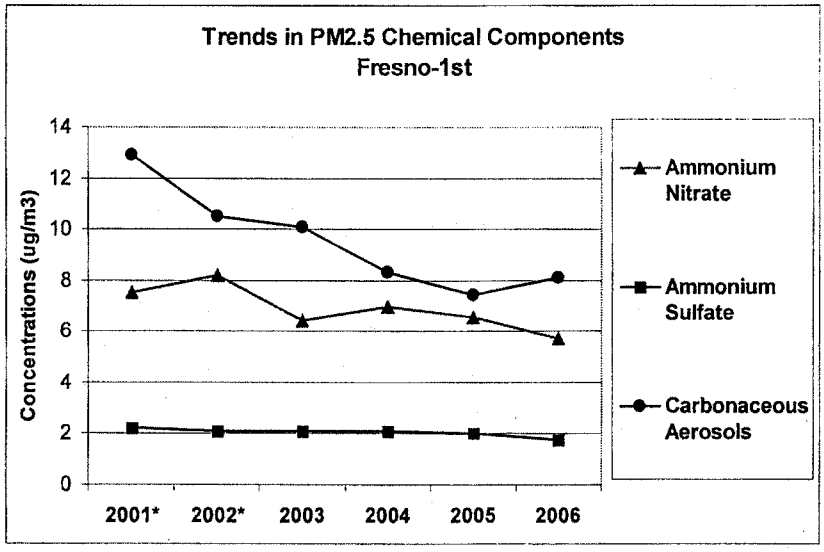
Trends in annual PM2.5 design values show that considerable progress has occurred in the San Joaquin Valley over the last five years (Figure 4). In 2001, all monitoring sites in the Valley had annual design values greater than 16 ug/m^3, with the Visalia site at approximately one and a half times the level of the standard. By 2006, design values decreased throughout the Valley, and only those sites in the southern and central portions of the Valley still have design values greater than 16 ug/m^3. Bakersfield–Planz is the current high site, with a design value which is 26 percent above the standard. The greatest rate of progress has occurred in the northern and central basin. These trends underscore the challenge the Valley faces in attaining the annual standard in the southern portions of the Valley. The surrounding mountains combined with the Valley's prevalent cold, damp, stagnant winters, create an environment very conducive to PM2.5 formation and buildup, especially in the southern end of the Valley.

Figure 4. Trends in Annual PM2.5 Design Values in the San Joaquin Valley



In addition to looking at trends in average concentrations of PM2.5, it is also useful to look at the trends of the different components that make up PM2.5. As stated earlier, PM2.5 is a complex mixture dominated by ammonium nitrate, organic carbon, and ammonium sulfate. Analysis of the trends in the different components of PM2.5 shows that over the last five years, decreases in carbonaceous aerosols and ammonium nitrate have had the greatest impact on declining PM2.5 levels. In Fresno, carbonaceous aerosols have declined by 37 percent and ammonium nitrate concentrations by 24 percent (Figure 5), while in Bakersfield, carbonaceous aerosols (organic plus elemental carbon) have declined by 16 percent and ammonium nitrate concentrations by 23 percent. During this same period, PM2.5 and NOx emissions, as well as NOx levels measured in the air also decreased. Longer-term records show concomitant decreases between ambient NOx and ammonium nitrate as well as between ambient SOx and ammonium sulfate. The combined downward trends in PM2.5 components, precursor concentrations, and emissions all indicate that the ongoing control program has had substantial benefits in improving air quality and that the reductions from measures in this Plan will provide continuing progress towards and attainment of the federal PM2.5 standards.

Figure 5. Trends in PM2.5 Key Chemical Components.



D. California Regional Particulate Matter Air Quality Study (CRPAQS)[1]

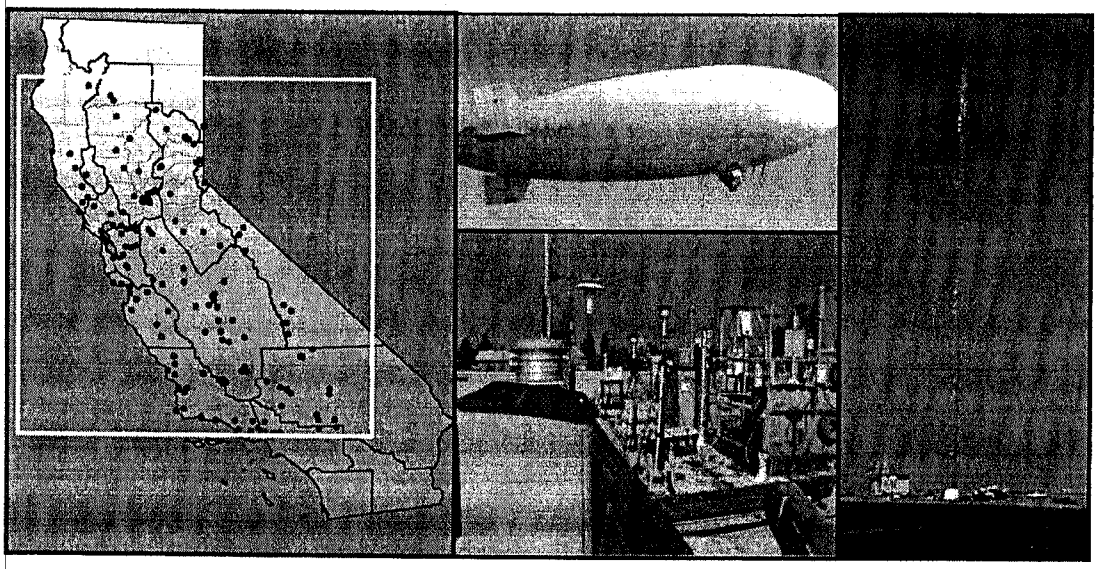
The California Regional Particulate Air Quality Study (CRPAQS) provides the scientific foundation upon which the PM2.5 SIP planning efforts are built. CRPAQS is a collaborative effort between the public and private sector designed to: 1) develop an improved understanding of particulate matter in central California; and, 2) provide

[1] http://www.arb.ca.gov/airways/ccaqs.htm

decision-makers with the tools needed to identify equitable and efficient control methods. The study is a comprehensive multi-year effort of meteorological and air quality monitoring, emission inventory development, data analysis, and air quality simulation modeling. The study reflects an investment of nearly 27 million dollars, coupled with extensive in-kind support from study sponsors, extending over a 15-year period. The resulting data and analytical tools are providing the most advanced scientific understanding available for SIP development.

CRPAQS is intended to evaluate the Valley's particulate matter challenges with respect to both the federal and State air quality standards for particulate matter smaller than 10 micrometers in diameter (PM10) and PM2.5. CRPAQS was designed to address annual particulate levels as well as fall and winter episodic conditions. Numerous teams of experts participated in the study. Data was collected for 14 months (December 1999 through February 2001) throughout the Valley and surrounding regions. The extensive field monitoring program collected data at the surface from hundreds of monitoring sites located throughout the study domain, and aloft with appropriately equipped air planes, blimp, specialized balloons, and towers (Figure 6). The effort resulted in millions of data records which have been housed in a world class data base. Focused efforts have also improved the emission inventory for the region. Finally, state-of–the-science air quality models have been tested with the extensive CRPAQS data base and are used in the CRPAQS and SIP modeling tasks.

Figure 6. CRAPQS Monitoring Program



II. AIR QUALITY PLANNING

A. Air Quality Planning Background

The federal Clean Air Act Amendments of 1990 (Act) establish the planning requirements for those areas that routinely exceed the health-based NAAQS. These nonattainment areas must adopt and implement a State Implementation Plan (SIP) that demonstrates how they will attain the standards by specified dates. Federal law holds each state responsible for implementing the provisions of the Act. California law assigns air quality planning responsibilities within the State. In the San Joaquin Valley, those responsibilities are shared among the San Joaquin Valley Air Pollution Control District (District), the Valley's metropolitan planning organizations, and the Air Resources Board (ARB).

In the air quality management process, many regulatory agencies in California work together to reduce air pollution levels. Each of these agencies is responsible for achieving emission reductions from a part of the inventory. ARB has primary regulatory authority over California's mobile sources, fuels, and consumer products. U.S. EPA sets new engine standards for sources including large farm and construction equipment and locomotives. Air districts have primary authority over stationary emission sources, including industrial and commercial equipment and area sources. The metropolitan planning organizations are responsible for developing the regional transportation plans that are used to estimate mobile source emissions. These transportation plans can also impact land use patterns, and the availability and attractiveness of transit alternatives.

The air districts develop and adopt local air quality plans. In this case, the District approved the SJV 2008 PM2.5 Plan on April 30, 2008. Upon approval by the ARB, SIPs are submitted to U.S.EPA for approval. Once approved by U.S. EPA, SIPs become enforceable.

B. Recent Air Quality Planning

Over the past decade, the District and ARB have adopted a series of regulations and measures to improve air quality in the Valley. New mobile source requirements, cleaner fuels, and multiple consumer products regulations have been adopted and are being implemented today. And, while California continues to face serious air quality challenges, it is important to recognize the progress made as a result of California's landmark air pollution control programs.

The District has implemented a successful PM10 attainment plan which has resulted in the Valley coming into attainment of the federal PM10 standard. U.S. EPA concurred with the District's attainment assessment, and on March 19, 2008, published a final affirmation of attainment of the PM10 standard for the Valley[2]. In addition, on

[2] Federal Register: March 19, 2008 (Volume 73, Number 54, pages 14687-14713)

April 25, 2008[3], U.S. EPA proposed approval of the District's plan to maintain the PM10 standard.

On April 2007, the District adopted the 2007 Ozone Plan. The ozone plan charts the course to attainment of the federal 8-hour ozone NAAQS in the Valley. ARB approved the ozone plan and submitted it to U.S. EPA as a SIP revision. Many of the measures in the PM10 and ozone plans are providing progress towards attainment of the PM2.5 standards.

On September 27, 2007, ARB adopted the 2007 State Strategy to achieve new emission reductions needed to bring areas of the State into attainment of both the federal PM2.5 and ozone air quality standards. The commitment for 2014 in the State Strategy includes reductions needed to attain the PM2.5 standards and provide progress towards meeting the ozone standard.

C. General Planning Requirements

On April 25, 2007, U.S. EPA finalized it's implementation rule for PM2.5[4]. The rule outlines the planning elements that the PM2.5 SIP must address. These include:

- base year and future year emission inventories for manmade sources of air pollution in the nonattainment area;
- air quality modeling that demonstrates attainment of the PM2.5 standards as expeditiously as practicable;
- weight of evidence - supplemental analysis of air quality, emission data, and trends supporting the primary modeled attainment demonstration;
- control strategies capable of meeting attainment;
- reasonable further progress (RFP) plan;
- contingency measures in the event the controls fall short of achieving needed reductions;
- demonstration that all reasonably available control technology (RACT) and reasonably available control measures (RACM) have been applied to existing sources;
- transportation conformity emission budgets to ensure transportation plans and projects are consistent with the SIP; and
- commitment for mid-course review.

[3] Federal Register: April 25, 2008 (Volume 73, Number 81, pages 22307-22318
[4] Federal Register: April 25, 2007 (Volume 72, Number 79, pages 20586-20587)

III. PLAN EVALUATION

A. Overview of the San Joaquin Valley PM2.5 Plan

The SJV 2008 PM2.5 Plan provides the technical foundation and control strategy for attaining the federal PM2.5 standards. The Plan demonstrates the Valley will attain the standards as expeditiously as practicable, no later than the 2014 deadline.

The Plan consists of adopted measures that provide increasing benefits each year, along with new emission reduction commitments from both ARB and the District. The Valley's particle pollution problem is well studied as a result of the $27 million invested in the California Regional Particulate Matter Study. This study provides the scientific foundation for the PM2.5 SIP by identifying the pollutants most important to formation of PM2.5 pollution. The results indicate that the key pollutants to reduce are NOx, SOx, and directly emitted PM2.5 particles. The Plan addresses these three pollutants consistent with U.S. EPA guidance. Emissions of VOC are also being reduced in the region as part of the ozone attainment strategy but are not required to be included in this SIP.

Overall, between 2005 and 2014, NOx emissions will decrease by almost 300 tons per day (tpd), direct PM2.5 emissions by over 20 tpd, and SOx by almost 3 tpd. Two thirds of the NOx and SOx reductions and one half of the PM2.5 reductions come from already adopted measures. A significant portion of the new commitments come from the ARB's State Strategy that was adopted in September 2007. The State Strategy provides an additional 76 tons of NOx reductions and 5 tons of PM2.5 reductions in 2014. The District has accelerated several measures in its 2007 Ozone Plan that are also part of the PM2.5 attainment strategy, and targeted a number of categories of PM2.5 for additional emission reductions, including residential wood burning and commercial cooking. Past District efforts to reduce impacts from residential wood burning have proven to be very effective, and continued reductions in this source category are expected to contribute significantly to further progress.

As emissions have decreased each year, the entire Valley already meets the daily standard and parts of the Valley are already attaining the annual standard. The air quality modeling indicates that attaining the annual standard in the southern Valley is the biggest challenge, but all areas are projected to attain the standard by 2014. The Plan will also bring the region much closer to meeting a new federal PM2.5 standard that will apply to future SIP planning efforts. SIP planning for the newer standard will occur after U.S. EPA designates nonattainment areas and develops implementation rules.

ARB staff has reviewed the 2008 PM2.5 Plan and the District's technical analysis and agrees that the Plan meets federal requirements. The following sections describe the major elements of the Plan.

B. Emission Inventory

An emission inventory consists of a systematic list of the sources of air pollutants with an estimate of amount of pollutants from each source or source category over a given period of time. The inventories used in this Plan were developed using the most recent planning assumptions and the best available technical information.

Air quality plans rely on emission inventories to help identify sources to control and as inputs to the photochemical models required for attainment demonstrations. Planning inventories which are aggregated by source type and inventory sector focus on anthropogenic sources and are expressed as annual average day and average seasonal day. In the case of PM2.5, ambient concentrations are highest in the winter so the planning inventory includes an estimate of average winter day emissions. This helps planners identify what source categories have the highest emissions during those periods when the PM2.5 ambient values are highest. Modeling inventories include both emissions from human activities (anthropogenic sources) and from natural sources (non-anthropogenic sources). Emissions are both spatially distributed geographically and represent hourly estimates for each grid cell in the modeling domain. The emission estimates also include the effects of climatic factors such as temperature and humidity. The models relate current air quality to current emissions levels of PM2.5 and its precursors, and simulate future air quality based on changes to the emissions as the result of new control measures. The current or baseline inventories used in the Plan reflect District and ARB controls adopted through 2006 and assume an estimated 24 percent growth in population and 14 percent growth in vehicle miles traveled in the estimated future year inventories. Baseline inventories do not include potential reductions from the new District measures identified in the SJV 2008 PM2.5 Plan or ARB measures in the adopted 2007 State Strategy.

1. Estimating Emissions

In California, computer models developed by ARB are used to estimate the emissions from on- and off-road mobile sources. Stationary source emissions estimates are developed by the Districts and derived from permit data. Area-wide emissions are estimated based on emission factors and information on expected activity from these diverse sources. Area-wide and off-road source emissions are estimated by ARB and the District. Emission inventories undergo routine reevaluation to ensure that they remain up to date and accurate.

Emission estimates used in the SJV PM2.5 2008 Plan take into account emission data, expected growth in activity, and ARB regulations and District rules adopted by December 2006. Mobile source emission inventories used in the Plan were developed using EMFAC2007, California's on-road motor vehicle emission factor model and OFFROAD2007 for emissions from mobile off-road vehicles and equipment. Transportation activity data was provided by the eight Valley Councils of Government (COGs) from their Regional Transportation Plans.

The District worked with ARB staff to update emission estimates from stationary and area source categories for which new and improved data became available. Improvements targeted the day-specific modeling inventory as well as the annual and winter planning inventories. Annual and winter planning inventory adjustments included District methodology revisions and impacts of adopted rules (e.g., open burning, wood burning fireplaces and heaters, cooking, manufacturing and industrial fuel combustion). A summary of a major District revision, as well as ARB updates follows:

- Non-point source manufacturing and industrial natural gas combustion.
District staff refined the methodology for estimating emissions from industrial natural gas combustion sources that are too small to fall into the District's permitting program. Using data from the California Energy Commission on natural gas deliveries, District staff estimates 2005 NOx emissions are 25 tpd less that previously estimated and in 2014 they are 29 tpd less.

- PM2.5 size fractions for fugitive dust sources.
ARB staff updated the estimates of dust in the PM2.5 size fraction based on PM size fraction profiles developed by the Western Regional Air Partnership (WRAP)[5,6] and PM2.5/PM10 ratios obtained from air quality measurements in California. Previously used profiles for dust emitting categories (e.g., paved and unpaved roads, construction and demolition, agricultural tilling) overestimated the amount of dust in the PM2.5 size fraction.

- Paved Road Dust
ARB staff refined PM2.5 emission estimates from paved road dust by subtracting PM2.5 emissions from vehicle exhaust, tire wear, and brake wear to avoid double counting. These emissions are already accounted for in the on-road motor vehicle emission inventory. In addition, ARB staff revised the rate at which emissions are grown from the base year to a future year to reflect projected lane miles of new road.

2. Summary of Baseline Emissions

Emission sources in the San Joaquin Valley are diverse. The San Joaquin Valley is an important transportation corridor for moving goods and people inside the State and beyond. In addition, it is one of the most productive agricultural regions in the world, as well as home to industrial and commercial activities. All of these sources contribute to the concentrations of pollutants in the Valley.

The following discussion focuses on the annual planning inventory used in the SJV 2008 PM2.5 Plan. Appendix B of the SJV 2008 PM2.5 Plan includes detailed

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[5] Cowherd, C. *Analysis of the Fine Fraction of Particulate Matter in Fugitive Dust*, Final Report. October 12, 2005. Midwest Research Institute. MRI Project No. 110397. phttp://www.wrapair.org/forums/dejf/documents/fffd/Final_Fractions_Dust_Report.pdf

[6] Cowherd, C., Proposed Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 7, 2005. Midwest Research Institute. MRI Project No. 110397

annual average and winter average daily planning inventories for directly emitted PM2.5, and the precursors NOx and SOx for 2005 and for each year from 2009 to 2014.

Table 2 lists the baseline annual planning inventory for 2005 and 2014 for directly emitted PM2.5, NOx, and SOx precursors in the San Joaquin Valley in 2005 and emissions projected for the 2014 attainment year split by source category.

Table 2. San Joaquin Valley Air Basin Baseline Emission Trends[a,b]

(Annual Planning Inventory in tons per day, tpd)

Pollutant	Emissions	Source Category			
		Stationary and Area-Wide	On-Road Vehicles	Off-Road Vehicles and Equipment	Total[b]
PM2.5	2005 (tpd)	64.9	12.1	9.0	86.0
	2014 (tpd)	59.5	8.9	6.6	75.0
	Change (tpd)	-5.4	-3.2	-2.4	-11.0
	Change (%)	-8%	-26%	-27%	-13%
NOx	2005 (tpd)	93.6	327.9	153.9	575.4
	2014 (tpd)	67.3	206.7	102.2	376.2
	Change (tpd)	-26.3	-121.2	-51.7	-199.2
	Change (%)	-28%	-37%	-34%	-35%
SOx	2005 (tpd)	21.3	2.6	2.4	26.4
	2014 (tpd)	22.9	0.7	0.8	24.5
	Change (tpd)	+1.6	-1.9	-1.6	-1.9
	Change (%)	+7%	-73%	-67%	-7%

a. Baseline emissions include State control measures and District controls adopted through 2006.
b. Numbers may not add up exactly due to rounding.

In summary, baseline PM2.5, NOx, and SOx emissions from all sources in the Valley show an overall downward trend due to already adopted regulations and programs. The slight increase in SOx from stationary sources is addressed in the Plan. Although motor vehicle miles traveled in the basin continue to increase, on-road vehicle emissions are dropping because of more stringent vehicle emission standards and fleet turnover. This trend will be strengthened between 2005 and 2014 as newer, lower-emitting vehicles become part of the fleet.

C. Air Quality Modeling

Air quality modeling guides the selection of the most effective pollutants to control and the magnitude of emission reductions needed from each of the pollutants. U.S. EPA's modeling guidance requires the use of air quality modeling to relate current PM2.5 levels to emissions (of PM2.5 and PM2.5 precursors) and meteorology in a region, and to simulate future air quality based on changes in emissions. PM2.5 air quality modeling uses day-specific grid-based emission inventories and meteorological measurements to establish this relationship. Model predictions combined with observed concentrations of PM2.5 and its individual components provide the foundation for the U.S. EPA-recommended attainment demonstration (Speciated Modeled Attainment Test). Rather than using air quality model predicted PM2.5 concentrations results directly, U.S. EPA Guidance calls for using models in a relative sense to develop relative response factors (RRFs) for each of the PM2.5 chemical species. The RRFs are calculated as the ratios of the future-year to reference-year model-simulated concentrations of PM2.5 species at a specific location. The impact that emission reductions have on the future-year modeled PM2.5 species is assumed to be proportional to the impact on the base-year PM2.5 design value. The attainment test provides reconciliation between speciated and bulk mass concentration measurements, and is the basis for a connection between observations, modeled PM2.5 concentrations, and the air quality standard.

ARB staff conducted the grid-based photochemical modeling used in the SJV 2008 PM2.5 Plan with input from the District. The modeling analysis is based on data acquired from the $27 million state-of-the-science CPRAQS study. Modeling procedures followed U.S. EPA guidelines. A brief summary is provided below with more information on the air quality modeling conducted by ARB staff in Appendix A to this report and Appendix F of the SJV 2008 PM2.5 Plan.

1. Grid-based Photochemical Modeling

Grid-based photochemical modeling supports attainment demonstrations of the annual and the 24-hour PM2.5 standards in the San Joaquin Valley. The modeling platforms and chemical mechanism used in the photochemical modeling are summarized below.

U.S. EPA's Community Multiscale Air Quality Modeling System (CMAQ) was selected to simulate air quality in the San Joaquin Valley. CMAQ is a state-of-the-science "one-atmosphere" system that treats major atmospheric and land processes and a range of

species in a comprehensive framework. CMAQ has been extensively peer-reviewed and is well documented. A meteorological model, the Mesoscale Model version 5 (MM5), was used to generate the meteorological fields for the CMAQ model. Modelers chose the most up-to-date and comprehensive chemical mechanism (SAPRC99) along with CMAQ aerosol code version 4 and aqueous phase chemistry to simulate the complex mixture of PM2.5 species in the San Joaquin Valley.

CMAQ was run for the year 2000 to provide the basis for the model performance evaluation. It was during 2000 that the CRPAQS took place. The study resulted in a wealth of data with which to evaluate model performance. As it is necessary to execute simulations for a model reference year and a future year to perform the recommended modeled attainment demonstration, 2005 and 2014 were also simulated. Simulations for all years were driven by the meteorological inputs for 2000, while emissions varied from year to year. Meteorological conditions during 2000 were very conducive to the formation and accumulation of PM2.5.

As recommended by U.S. EPA, the SMAT procedure was applied to Federal Reference Monitors (FRM) operating in the San Joaquin Valley. The 2006 design value (average of the 2004, 2005, and 2006 annual average PM2.5 concentrations) was used as a basis from which to project estimated future year design values for the year 2014 (average of the 2012, 2013, 2014 annual average PM2.5 concentrations). Speciation of the FRM mass was based on data from the Speciated Trends Network (STN) sites in the Valley and on analysis of CRPAQS data.

The attainment demonstration for the annual standard required modeling PM2.5 concentrations for each day of the reference year (2005) and future year (2014). The attainment demonstration for the 24-hour PM2.5 standard used only the top 25% of the measured and modeled days for each quarter instead of all available days.

ARB staff evaluated air quality model and meteorological model performance based on U.S. EPA guidance and other related methods in the published academic literature. As noted above, model performance evaluation benefited from use of the extensive CRPAQS data set, ensuring a robust modeling simulation.

2. Weight of Evidence

The Weight of Evidence (WOE) analysis provides a set of complementary analyses that supplement the SIP-required photochemical modeling. A WOE approach looks at the entirety of the information at hand to provide a more informed basis for the attainment strategy. Because all methods have inherent strengths and weaknesses, examining an air quality problem in a variety of ways offsets the limitations and uncertainty that are inherent in photochemical modeling. This approach also provides a better understanding of the overall problem and the level and mix of emissions controls needed for attainment.

Appendix H of the SJV 2008 PM2.5 Plan includes the initial draft of the WOE analysis. Appendix B of this staff report updates this analysis and summarizes the analyses that comprise the WOE assessment for the San Joaquin Valley. ARB staff evaluated air quality and emission trends; observational model results, including those of source receptor models, such as chemical mass balance (CMB) and positive matrix factorization (PMF); and evaluated diagnostic indicator species results. Along with the results from the photochemical modeling, District staff conducted a rollback modeling analysis to estimate the impacts of future emission reductions on resulting air quality. Rollback modeling combines source receptor model results with predicted emission inventory data that include emission reductions from adopted and proposed control measures to estimate future PM2.5 concentrations. Source receptor models use data on the concentrations of chemical species measured in ambient PM2.5 to identify the contributing sources. An extensive discussion of the rollback methodology and the results are provided in Chapter 3 of the SJV 2008 PM2.5 Plan.

3. Demonstrating Attainment

Modeling was used to establish emission reduction targets for developing the control strategy in the Plan. ARB staff used photochemical modeling to verify that the proposed control strategy would result in attainment of the PM2.5 standards throughout the basin in 2014. The emission reductions needed from new control measures to reach attainment throughout the Valley in 2014 are summarized in Table 3:

Table 3. Emissions and Emission Reductions[a]
(annual average emissions in tpd)

	Direct PM2.5	NOx	SOx
2014 Baseline Emissions	75.0	376.2	25.6
2014 Control Measure Emission Reduction Commitments	12.7	85.0	0.9
2014 Attainment Emissions	63.3	291.2	24.5

a. Numbers may not add up exactly due to rounding.

As mentioned earlier, based on 2004-2006 data, the Valley already meets the federal 24-hour standard. Modeling results for the five sites with highest 2006 design values show that further emission controls will result in even lower 24-hour design values in 2014 (Table 4), ensuring continued progress towards the strengthened 24-hour standard which will be addressed in future planning efforts.

Table 4. Reference and Future Year 24-hour Design Values (DV)[a]
(micrograms per cubic meter, $\mu g/m^3$)

Site	2006 DV	2014 "Controlled" DV
Bakersfield - California	62.4	46.2
Bakersfield - Planz	65.2	45.9
Bakersfield - Golden	64.4	45.3
Fresno - 1st Street	58.0	41.2
Fresno - Hamilton	58.5	41.7

a. Design values equal to or below 65.4 $\mu g/m^3$ meet the annual PM2.5 NAAQS.

Modeled design values demonstrate the San Joaquin Valley will attain the annual PM2.5 federal standard in 2014 at all monitoring sites (Table 5). The 2014 design value is the three-year average of modeled 2012, 2013, and 2014 values. For comparison, Table 5 also lists the 2006 design values calculated from measured PM2.5 concentrations and the impact of baseline emission reductions on modeled 2014 design values. Baseline emission reductions due to already adopted rules provide from 58 to 63 percent of progress towards attainment. Sites in the northern and central Valley would be expected to attain the standard in 2014 with baseline emission reductions. With the addition of the new State and local measures, the sites with the most severe problem – Visalia and Bakersfield – would also attain in 2014, with a maximum design value of 14.7 in Bakersfield. The linear rollback analyses showed similar results, providing a consistent assessment of attainment prospects. Modeling analyses also show that annual PM2.5 concentrations are more sensitive to reductions in directly emitted PM2.5 as compared to NOx in 2014. On average, reducing 1 tpd in PM2.5 emitted from combustion activities is approximately 9 times more effective than reducing 1 tpd of NOx.

Table 5. Reference and Future Year Annual Design Values[a]
($\mu g/m^3$)

Site	2006 DV	2014 Baseline DV	2014 "Controlled" DV
Bakersfield - California	18.51	15.86	14.28
Bakersfield - Planz	18.86	16.26	14.70
Bakersfield - Golden	18.64	15.98	14.39
Clovis	16.39	14.10	12.72
Corcoran	17.24	14.75	13.27
Fresno - 1st Street	16.68	14.43	13.01
Fresno - Hamilton	17.16	14.93	13.47
Merced	14.69	12.85	11.76
Modesto	14.10	12.52	11.44
Stockton	12.93	11.77	10.87
Visalia	18.20	16.05	14.47

a. Design values equal to or below 15.04 $\mu g/m^3$ meet the annual PM2.5 NAAQS.

The weight-of-evidence analyses provide a consistent assessment that the San Joaquin Valley will attain the annual average PM2.5 standard throughout the Valley in 2014. Significant progress has already occurred, a 6 ug/m^3 drop in annual average design value between 2001 and 2006, which represents two-thirds of the progress needed to attain the annual standard by 2014. Ammonium nitrate, ammonium sulfate, and carbon concentrations have responded positively to past reductions in NOx, SOx, and primary PM2.5 emissions. Substantial future emission reductions will occur due to both baseline commitments as well as new measures from NOx, and primary PM2.5 emissions that have worked in the past. Linear rollback analysis indicates attainment in 2014. Grid-based aerosol modeling also indicates attainment in 2014 at all sites in the District. However, attainment is expected to phase in starting in the northern portion of the Valley and spreading south, with more and more areas reaching attainment as we move towards 2014. As mentioned earlier, the mountains surrounding the Valley act as air flow barriers, with the resulting stagnant conditions favoring the accumulation of emissions and pollutants, making it harder for the southern portion of the Valley to reach attainment sooner.

4. Attainment Date

The Act requires nonattainment areas to attain the PM2.5 standards as expeditiously as practicable beginning in 2010, but no later than 2015. U.S. EPA guidance sets 2014 as the practical deadline for SIP planning purposes by requiring that the necessary emission reductions be achieved one year earlier. As required, the Plan identifies the proposed attainment date based on the severity of the PM2.5 problem and the availability and feasibility of control measures in the region. The District determined that feasible controls were not available to attain achieve the necessary emission reductions earlier than 2014. The State requests U.S. EPA approve April 5, 2015 as the deadline

consistent with its guidance that the SIP must provide for the necessary emission reductions by 2014. The request is based on:

- the magnitude of the remaining PM2.5 challenge in the San Joaquin Valley, as reflected by monitoring data;

- the significant amount of emission reductions required for reaching attainment
  - by 2014, on-going control programs will reduce direct PM2.5 emission by 13% from 2005 emission levels. To reach attainment, new measures need to reduce direct PM2.5 emissions by an additional 15%, plus
  - on-going control programs will reduce NOx emission by 35 % from 2005 emission levels. New measures need to reduce NOx emissions by an additional 15% to reach attainment; and

- the control strategy in the SJV 2008 PM2.5 Plan includes the District and State control measures that are available and feasible within the proposed attainment timeframe.

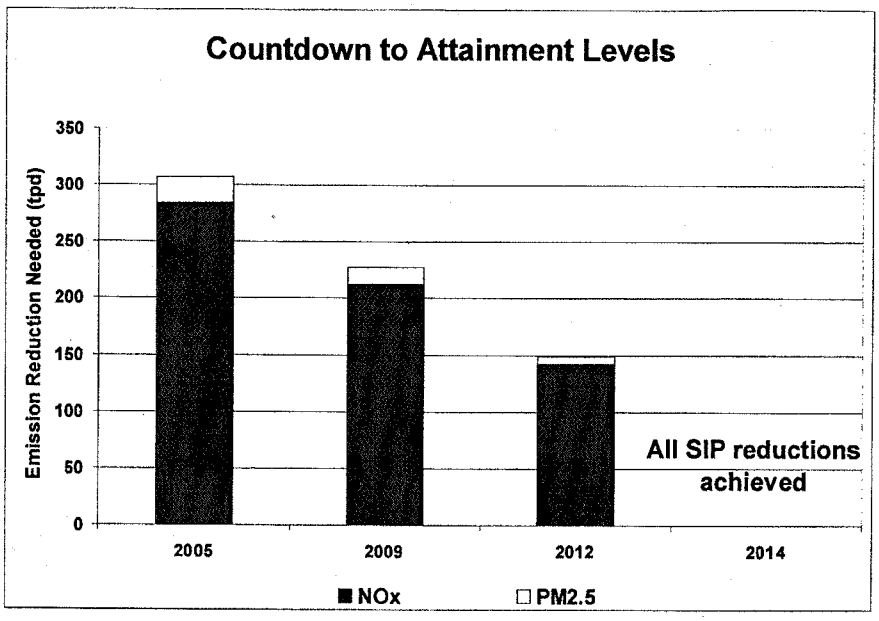
Considering the following factors, 2015 is identified as the earliest feasible attainment date: 1) baseline emission reductions that occur during the period up to 2014 are not sufficient alone to provide for attainment at all sites, and 2) the additional emission reductions resulting from the State Strategy will not phase in prior to 2014 due to the extraordinarily complex and innovative nature of developing and implementing these new measures.

ARB staff concurs with the District's assessment of the most expeditious and practicable attainment date for the San Joaquin Valley. As mentioned in the previous section, the results of the modeling and weight-of-evidence analyses, which include the impacts of control measures available and feasible at the District and State levels show the San Joaquin Valley will attain the PM2.5 standards in 2014.

D. Control Strategy

The SJV 2008 PM2.5 Plan integrates the NOx strategies adopted as part of the 2007 Ozone Plan. Among the guiding principles for developing the control strategy, the District gives precedence to NOx, which is also an ozone precursor. However, recognizing the importance of directly emitted PM2.5, additional measures to address this component have also been included. Directly emitted PM2.5 emission reductions are approximately nine times more effective than NOx reductions in the attainment year Overall, between 2005 and 2014, NOx emissions will decrease by almost 300 tons per day, direct PM2.5 emissions by over 20 tons per day, and SOx by almost 3 tons per day. Two thirds of the NOx and SOx reductions, and one half of the PM2.5 reductions come from already adopted measures. Figure 7 below illustrates the continuous progress in reducing NOx and PM2.5 emissions on the path towards attainment by 2014.

Figure 7



1. New District Measures

a. Rule Development Commitment

The Valley's approved PM2.5 Plan contains the District's commitment to develop and implement a suite of control measures for NOx, direct PM2.5, and SOx that in aggregate will achieve the total emission reductions specified in Table 6. Table 6 lists the 8 quantified measures, emission reductions in each reasonable further progress and attainment milestone years (2009, 2012, and 2014), and rule adoption timelines. By 2014, the District measures will reduce emissions by 9.0 tons per day of NOx, 6.7 tons per day of PM2.5, and 0.9 tons per day of SOx. Some of these measures may provide for additional emission reductions from other pollutants which are not quantified at this time. In addition, Table 7 lists 5 control measures for which the District has not specified emission reductions because work is currently underway to due to refine the emission inventory and assess current control efficiency. The District expects these measures to realize further emission reductions. All measures are to be developed by 2010, with implementation no later than 2012. The Plan shows attainment without the potential benefits of the measures.

The SJV 2008 PM2.5 Plan includes the 6 NOx control rules previously approved in the 2007 Ozone Plan. The District has accelerated adoption and implementation of one of the control measures. In addition, the District has added a new NOx control measure based on equipment attrition. The District has also made progress on two of the feasibility study measures from the Ozone Plan so that these are now control measures in this Plan.

Table 6
Summary of District Emission Reduction Commitments in the 2008 PM2.5 Plan
(Annual Average Planning tons per day)

CM#	Measure Name	Completion Date	Compliance Date	Reduction Start		Projected Reductions by Year					
						2009	2010	2011	2012	2013	2014
S-COM-5	Stationary Gas Turbines	2007 3Q	2012	2012	NOx	0	0	0	2.21	2.21	2.21
S-COM-1	Boilers, Steam Generators and Process Heaters (>5 MM Btu/hr)	2008 3Q	2012	2012	NOx	0	0	0	1.49	1.50	1.52
					PM2.5	0	0	0	0.23	0.24	0.24
					SOx	0	0	0	0.76	0.76	0.76
S-COM-7	Glass Melting Furnaces	2008 3Q	2009	2009	NOx	1.22	1.25	1.18	1.60	1.67	1.58
S-COM-9	Residential Water Heaters	2009 1Q	Attrition	2011	NOx	0	0	0.20	0.25	0.32	0.40
S-IND-9	Commercial Charbroiling	2009 2Q	2011	2011	PM2.5	0	0	2.17	2.21	2.25	2.28
S-COM-14	Wood Burning Fireplaces and Wood Burning Heaters	2009 3Q	2010	2010	NOx	0	0.04	0.08	0.07	0.07	0.06
					PM2.5	0	0.39	0.76	0.73	0.71	0.69
					SOx	0	0.01	0.02	0.02	0.02	0.02
S-COM-3	Boilers, Steam Generators and Process Heaters (0.075 to <2 MMBtu/hr)	2009 4Q	2011	2011	NOx	0	0	0.12	0.27	0.39	0.55
S-AGR-1	Open Burning	2010 2Q	2010	2009	NOx	1.21	1.95	2.68	2.67	2.66	2.65
					PM2.5	1.60	2.57	3.53	3.52	3.50	3.49
					SOx	0.06	0.10	0.14	0.14	0.14	0.14
TOTAL NOx REDUCTIONS						**2.43**	**3.24**	**4.26**	**8.56**	**8.82**	**8.97**
TOTAL PM2.5 REDUCTIONS						**1.60**	**2.96**	**4.46**	**6.69**	**6.70**	**6.70**
TOTAL SOx REDUCTIONS						**0.06**	**0.11**	**0.16**	**0.92**	**0.92**	**0.92**

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Table 7. Implementation Schedule of Additional District Control Measures

CM#	Measure Name	Completion Date	Compliance Date	Reduction Start
S-COM-2	Boilers, Steam Generators and Process Heaters (2 to 5 MMBtu/hr)	2008 3Q	2012	2012
S-IND-21	Flares	2009 2Q	2010	2010
M-TRAN-1	Employer Based Trip Reduction Programs	2009 4Q	2012	2011
S-COM-10	Natural Gas-Fired, Fan Type Residential Central Furnace	2010 2Q	Attrition	2012
S-COM-6	Reciprocating Internal Combustion Engines	2010 4Q	2012	2012

The SJV 2008 PM2.5 Plan also identifies 11 future study measures, which upon completion, could result in opportunities for additional emission reductions. These study measures seek to explore where and how additional reductions may be achieved in the future. The District is committing to release study reports by the dates listed in Table 8 and to incorporate additional measures identified as fruitful in future PM2.5 plans. The Plan shows attainment without the potential benefits of these measures.

Table 8. District Stationary Source Feasibility Study Implementation Schedule

CM#	Measure Name	Completion Date
S-AGR-2	Conservation Management Practices	2010
S-COM-4	Solid Fuel Boilers Steam Generators, Process Heaters	2009
S-COM-6A	Small Spark-Ignited Engines and Agricultural Spark-Ignited Engines	2008
S-COM-8	Lime Kilns	2011
S-COM-11	Dryers	2011
S-GOV-6	Prescribed Burning	2008
S-IND-8	Cotton Gins	2009
S-IND-4	Fugitive PM10 Prohibitions (Regulation VIII)	2009
M-OTH-8	Indirect Source Review (ISR) Enhancement	2010
M-OTH-9	Healthy Air Living	TBD
M-OTH-10	Fireworks	2012

ARB staff reviewed the District's rule development commitments and considered comments received regarding further opportunities for emission reductions. On a case-by-case basis, staff considered emission sources, their distribution in the San Joaquin Valley, and the applicability of emission control approaches to the different types of sources. A summary of staff's findings for specific source categories follows:

Glass Melting Furnaces
The Plan includes rule development commitment S-COM-7 with adoption scheduled in the third quarter of 2008. The District has already released a draft rule for public comment and held a public workshop on February 8, 2008. As currently proposed, the rule would result in greater NOx reductions than those estimated in the Plan for S-COM-7, as well as those cited in public comments.

Internal Combustion (IC) Engines
The District's current rule for IC engines is comparable to other IC engine rules in California. The Plan includes rule development commitment S-COM-6 for non-agricultural (non-ag) IC engines, with adoption scheduled in the fourth quarter of 2010. In the ozone plan, S-COM-6 was listed as a feasibility study to be completed in 2012. In addition, the Plan includes feasibility study S-COM-6A for agricultural (ag) IC engines to be conducted in 2008. The District is considering the more stringent South Coast IC Engine Rule 1110.2 which sets requirements in common for both ag and non-ag IC engines, but applies to very few ag IC engines. The cost-effectiveness and feasibility of electrifying all engines will need to be carefully evaluated with consideration of the availability of electricity in some of the more rural areas in the Valley.

Dryers
The District recently adopted a rule for large dryers. In the Plan, the District commits to further studying control options for small dryers in 2011 (feasibility study S-COM-11). Existing control technology may not be applicable to all small dryers. The South Coast Ozone/PM2.5 Plan includes a proposed control measure for small dryers, but considers that pursuing emission reductions as part of a measure requiring facilities to modernize equipment and processes with materials complying with the best available controls would be a better fit.

Large Boilers - rated 5 MMBTU/HR and above
The Plan includes rule development commitment S-COM-1 with adoption in the third quarter of 2008. The District has already released a draft rule for public comment and held a public workshop on March 1, 2008. The draft rule sets NOx emission limits which can be met with Selective Catalytic Reduction or ultra-low NOx burners. As proposed, rule implementation would result in greater reductions than those estimated in the Plan.

Medium Boilers-rated 2-5 MMBTU/HR
The Plan includes rule development commitment S-COM-2 with adoption scheduled in the third quarter of 2008. The District has already released a draft rule for public comment and held a public workshop on March 17, 2008. The draft rule proposes

removing the exemption for school boilers by initially controlling them through an incentive funding program.

Small Boilers-rated 0.75-2 MMBTU/HR
The Plan includes rule development commitment S-COM-3 with adoption scheduled in the fourth quarter of 2009. The District is considering accelerating the replacement of old units by 5 percent and exploring electrification. In the ozone plan, S-COM-3 was listed as a feasibility study to be completed in 2010.

Solid Fueled Boilers
The Plan includes feasibility study S-COM-4 to be conducted in 2009. The Valley sources currently operate with selective non-catalytic reduction with ammonia injection. The District will consider emission limits in the Sacramento AQMD rule, as previously recommended by ARB staff, and will evaluate the applicability of Selective Catalytic Reduction.

Prescribed Burning
The San Joaquin Valley's existing Smoke Management Program does not allow agricultural field burns to occur when air quality is forecasted to be unhealthy. The Plan includes feasibility study S-GOV-6 to be completed in 2008. As part of the study, the District will analyze incentive options and will examine alternatives to burning.

Wood Burning Fireplaces and Wood Burning Heaters
The Plan includes rule development commitment S-COM-14 with adoption scheduled in the third quarter of 2009. The District is considering strengthening the rule by lowering the threshold of their mandatory curtailment program. The current rule has been pivotal in reducing the PM2.5 impacts of residential burning and key to the Valley attaining the federal PM10 standard.

Other suggestions were to also address VOCs and fugitive dust control measures. However, reductions in VOC emissions are not effective in reducing PM2.5 concentrations in the Valley. Photochemical modeling analyses conducted in support of the Plan show that the secondary organic component contributes less than 0.5 percent to the organic carbon fraction of PM2.5. In addition, more recent precursor sensitivity analyses show that ammonium nitrate formation is not VOC, but rather NOx limited. As mentioned earlier, chemical composition analyses of ambient air quality monitoring samples show that dust is a small component of measured PM2.5 and therefore, dust controls would not be effective in accelerating PM2.5 attainment. However, it remains useful to conduct feasibility studies to gather better information on dust emitting sources.

b. Incentive-based Strategies

In the attainment demonstration, the SJV 2008 PM2.5 Plan also includes emission reduction benefits of District incentive programs for which funding has been secured. As part of the 2007 Ozone Plan, the District committed to specific incentive-based NOx reductions in 2012, 2020 and 2023. The SJV 2008 PM2.5 Plan takes credit for the

2012 emission reduction commitment of 1.4 tpd NOx. These emission reductions are funded through a combination of Indirect Source Review fees, Developer Mitigation Contract fees, and Department of Motor Vehicle Surcharge fees. Carl Moyer Program reductions are not credited here, as they are included in the ARB baseline emission adjustments.

In addition, the District lists potential future incentive funding that can be used for air quality programs and may lead to "SIP creditable" emission reductions. Among these is the Proposition 1B: Goods Movement Emission Reduction Program. On February 28, 2008, ARB approved the first distribution of the funds under this program.

2. Adopted State Strategy

Cleaning up the mobile source NOx and PM2.5 sources is the most critical component of the State's emission control effort to reduce PM2.5 concentrations in the Valley. Vehicles and equipment operating in California are subject to the most stringent tailpipe emission standards in the world. ARB has a long history of adopting successful programs to reduce emissions from mobile sources. These regulations will result in fewer emissions as vehicles and equipment units meeting the cleanest emission standards enter into service. However, the benefits of these cleanest engines are only realized as new engines enter service and older engines are retired, and diesel engines have very long useful lives.

On September 27, 2007, ARB adopted the 2007 State Strategy to achieve new emission reductions needed to bring areas of the State into attainment of both the federal PM2.5 and ozone air quality standards. The commitment for 2014 in the State Strategy includes reductions needed to attain the PM2.5 standards and provide progress towards meeting the ozone standard. The San Joaquin Valley is relying on NOx, SOx, and direct PM2.5 emission reductions for PM2.5 attainment.

Table 9 summarizes the estimated benefits for 2014 in the San Joaquin Valley from the mix of concepts in the 2007 State Strategy. The potential emission reduction benefits of individual measures are provided for informational purposes only. Additional details on the individual measures are available in the 2007 State Strategy, which is available on-line at: http://www.arb.ca.gov/planning/sip/2007sip/2007sip.htm

Table 9. Expected Emission Reductions from 2007 SIP State Strategy (tons per day)

San Joaquin Valley -- 2014

Proposed New State SIP Measures	NOx	ROG	Direct PM2.5	SOx
Passenger Vehicles	**3.8**	**6.5**	**0.1**	**--**
Smog Check Improvements (BAR)	3.3	2.9	0.05	--
Expanded Vehicle Retirement	0.5	0.7	0.01	--
Modifications to Reformulated Gasoline Program	--	2.9	--	--
Heavy-Duty Trucks	**61.4**	**6.4**	**3.6**	**--**
Cleaner In-Use Heavy-Duty Trucks	61.4	6.4	3.6	--
Goods Movement Sources	**7.2**	**0.5**	**0.2**	**--**
Ship Auxiliary Engine Cold Ironing & Clean Technology	--	--	--	--
Cleaner Main Ship Engines and Fuel	--	--	--	--
Port Truck Modernization	--	--	--	--
Accelerated Introduction of Cleaner Line-Haul Locomotives	7.2	0.5	0.2	--
Clean Up Existing Harbor Craft	--	NYQ	--	--
Off-Road Equipment	**3.7**	**0.9**	**0.8**	**--**
Cleaner In-Use Off-Road Equipment (over 25hp)	3.7	0.9	0.8	--
Cleaner In-Use Agricultural Equipment	NYQ	NYQ	NYQ	--
Other Off-Road Sources	**0.1**	**3.5**	**--**	**--**
New Emission Standards for Recreational Boats	0.1	1.3	--	--
Expanded Off-Road Rec. Vehicle Emission Standards	--	2.2	--	--
Additional Evaporative Emission Standards	--	NYQ	--	NYQ
Vapor Recovery for Above Ground Storage Tanks	--	NYQ	--	NYQ
Areawide Sources	**--**	**5.7**	**--**	**--**
Consumer Products Program	--	3.2	--	--
Pesticides: DPR Regulation	--	2.5	--	--
Reductions from Proposed New State Measures	**76**	**23**	**5**	**0**
Reductions from Adopted State Measures	**211**	**49**	**7**	**0**
Total Emission Reductions from State Strategy	**287**	**72**	**12**	**0**

NYQ = Not Yet Quantified. BAR = Bureau of Automotive Repair. DPR = Dept. of Pesticide Regulation
Locomotives measure relies on U.S. EPA's rulemaking and industry agreement to accelerate fleet turnover.
Note: Emission reductions reflect the combined impact of regulations and supportive incentive programs. Emission reduction estimates for each proposed measure are shown for informational purposes only. Actual emission reductions from any particular measure may be greater than or less than the amounts shown.

E. Reasonabl e Further Progress

The Act requires SIPs to provide for steady progress in reducing emissions during the years leading to the attainment date. This requirement provides a way to ensure continuous reductions prior to the attainment date. For PM2.5, U.S. EPA requires that the RFP plan show generally linear progress[7] for the precursor pollutants identified in the attainment demonstration, in this case, direct PM2.5, NOx, and SOx. Since the Valley will be in attainment in 2014, 2009 and 2012 are milestone years for RFP. Table 10 shows projected emission levels, showing continuous progress towards the attainment levels.

Table 10. Projected Emission Levels in Milestone Years
(in tpd)

Milestone Year	Direct PM2.5	NOx	SOx
2005	86.0	575.4	26.4
2009	78.2	498.5	22.9
2012	70.3	415.8	22.9
2014	63.3	291.2	23.6

The SJV 2008 PM2.5 Plan meets RFP by achieving generally linear emission reductions towards attainment in 2014 for direct PM2.5 and NOx from the 2005 baseline year through the milestone years 2009 and 2012. Percent year decreases in PM2.5 emissions range from 2 to 3 percent and in NOx emissions from 3 to 5 percent. SOx emissions in both milestone years are below the attainment level.

F. Contingency Measures

The Act requires attainment plans to provide for contingency measures in the event the nonattainment area fails to make RFP or fails to attain the PM2.5 standard by its attainment date. These contingency measures are to take effect without further ARB or District action. U.S. EPA has interpreted this to mean that the contingency measures must be from the pool of already adopted measures. The PM2.5 implementation rule language does not require any set percent of emission reductions for contingencies[8].

ARB's on-going mobile source program and the new measures in the State Strategy will achieve the bulk of the emission reductions needed to attain the standards in the San Joaquin Valley. Historically, ARB's mobile source program has been very successful in reducing emissions in the Valley and throughout California. In addition, ARB has a well established record of adopting and implementing mobile source regulations on time. The methods used in the SJV 2008 PM2.5 Plan to calculate emission reductions needed to meet the RFP goals withheld reductions from the

[7] 72 FR 20633
[8] 72 FR 20667

on-going mobile source control program as contingencies (SJV 2008 PM2.5 Plan, Chapter 8). For 2009 and 2012 RFP, 1 percent of PM2.5 and 3 percent of NOx baseline emissions are being reserved as contingencies, which result in reductions of about 1 tpd of PM2.5 and about 17 tpd of NOx. For attainment, the 2015 baseline emission reductions are relied upon to meet the contingency requirements. For NOx, baseline emission reductions provide for an additional 21 tpd in 2015. Between 2015 and 2017, an additional 60 tpd of additional NOx reductions will be achieved for contingency purposes.

The District supplements these contingency reductions with two additional contingency measures. These measures rely on fee- and incentive-based funding that the District will spend to achieve emission reductions. Funding sources include the federally-mandated 1-hour ozone nonattainment fee and incentive programs such as the Carl Moyer Program and Proposition 1B.

G. Reasonably Available Control Measure Analysis

Section 172 (c) of the Act requires each nonattainment area to demonstrate that it has adopted all reasonably available control measures (RACM), including reasonably available control technologies (RACT) for stationary sources, necessary to show that it will attain the federal standards as expeditiously as practicable and to meet RFP requirements. RACM and RACT are those measures that are technologically and economically feasible within the nonattainment area. As part of the RACM/RACT demonstration, the District must show that there are no additional reasonable measures available to the District that, when considered in aggregate, would advance the attainment date by at least one year. In PM2.5 plans, the RACM/RACT analysis must address direct PM2.5, NOx and SOx.

1. District RACM

The SJV 2008 PM2.5 Plan includes the District's RACM and RACT demonstration for direct PM2.5, NOx and SOx. The District followed U.S. EPA guidance for evaluating potential control measures as RACM. This RACM demonstration includes a comparison of stationary source measures the District has implemented or plans to implement with U.S. EPA's list of suggested PM2.5 control measures. A detailed description of the District's RACM analysis is found in Chapter 6 of the Plan. ARB staff has reviewed the analysis and concurs that the federal RACM/RACT requirement is met.

2. Metropolitan Planning Organizations RACM

Following U.S. EPA guidance in their RACM analysis, the Valley's Metropolitan Planning Organizations (MPO's) conducted a review of Transportation Control Measures (TCMs) for possible consideration as local RACM. The analysis built on the MPO's previous RACM analysis for the 2007 Ozone Plan and focused on NOx. The analysis found that the potential TCMs identified will not advance PM2.5 attainment by a

full year, thus the SJV 2008 PM2.5 Plan does not include commitments to adopt any TCM.

H. Transportation Conformity Budgets

Under section 176(c) of the Act, transportation activities that receive federal funding or approval must be fully consistent with the SIP. U.S. EPA's transportation conformity rule[9] details requirements for establishing motor vehicle emission budgets (budgets) in SIPs for the purpose of ensuring the conformity of transportation plans and programs with the SIP. The budgets act as a "ceiling" for future on-road mobile source emissions. Exceedances of the budgets indicate an inconsistency with the SIP, and could jeopardize the flow of federal funds for transportation improvements in the region. Transportation agencies compare projected regional on-road mobile source emissions to these budgets during the periodic updates of regional transportation plans and programs.

The SJV 2008 PM2.5 Plan establishes county-level on-road motor vehicle emission budgets for each milestone year, as well as for the attainment year (Table 11). Emission budgets for direct PM2.5 and the PM2.5 precursor NOx, were calculated using EMFAC2007 and reflect annual average emissions. Detailed calculations used to derive the transportation conformity budgets can be found in Chapter 7 and Appendix C of the SJV 2008 PM2.5 Plan. The emission budgets established in the SJV 2008 PM2.5 Plan fulfill the requirements of the Act and U.S. EPA regulations to ensure that transportation projects will not interfere with progress and attainment of the annual PM2.5 standard.

[9] U.S. EPA maintains online information on its transportation conformity program, including access to relevant rulemakings, policy guidance, and reports at: http://www.epa.gov/otaq/transp/traqconf.htm

Table 11. Transportation Conformity Budgets
(tons per annual average day)

County	2009		2012		2014	
	PM2.5 (tpd)	NOx (tpd)	PM2.5 (tpd)	NOx (tpd)	PM2.5 (tpd)	NOx (tpd)
Fresno	2.2	56.5	1.9	44.2	1.1	26.0
Kern (SJV)	3.4	87.7	3.0	74.2	1.4	41.6
Kings	0.7	17.9	0.6	14.6	0.3	8.1
Madera	0.6	14.1	0.5	11.4	0.3	6.7
Merced	1.5	33.6	1.2	26.7	0.6	14.8
San Joaquin	1.6	39.1	1.4	32.8	0.9	20.3
Stanislaus	1.0	25.8	0.9	20.8	0.5	12.4
Tulare	0.9	23.3	0.8	19.5	0.5	12.2

I. Environmental Impacts

The California Environmental Quality Act (CEQA) requires that State and local agency projects be assessed for potential significant environmental impacts. Air quality plans are "projects" that are potentially subject to CEQA requirements. The District staff found that the Plan would not have a significant effect on the environment and prepared an Initial Study/Negative Declaration. The District Governing Board approved this Initial Study/Negative Declaration on April 30, 2008.

IV. STAFF RECOMMENDATION

We recommend that the Board take the following actions:

1. Adopt the SJV 2008 PM2.5 Plan, including the emission inventory, local control strategy, attainment demonstration, attainment deadline request, reasonable further progress plan, contingency measures, RACT/RACM demonstration, transportation conformity emission budgets, and the commitment to conduct a mid-course review, as a revision to the California SIP

2. Direct the Executive Officer to submit the SJV 2008 PM2.5 Plan to U.S. EPA as a revision to the California SIP.

APPENDIX A

REGIONAL AIR QUALITY MODELING

Regional Air Quality Modeling and $PM_{2.5}$ Attainment Demonstration

Introduction

The San Joaquin Valley (SJV) is currently designated as nonattainment for $PM_{2.5}$. Addressing this issue properly requires rigorous long-term chemical transport modeling to support the development of a plan to attain the National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$. These modeling exercises serve to determine future year attainment status for the SJV given projected emissions scenarios and also the most effective emissions reduction pathways to control PM concentrations for different seasons and regions of the domain.

A complex interplay between meteorology and chemistry shapes the aerosol size and composition distribution. Atmospheric particulate matter is made up of both directly emitted particles, like road dust or soot, as well as secondary pollutants formed via chemical reactions with gas-phase compounds. Both primary particles and secondary particles (e.g., ammonium nitrate (NH_4NO_3) and ammonium sulfate ($(NH_4)_2SO_4$)) make up significant portions of the total $PM_{2.5}$ levels in the SJV. Strong seasonal variations and many different sources, pathways, and components make $PM_{2.5}$ in the region impossible to characterize simply. Effectively understanding the $PM_{2.5}$ problem in the SJV therefore requires comprehensive modeling with well-characterized emissions, meteorology, and chemistry in addition to a thorough knowledge of the observed concentrations of bulk $PM_{2.5}$ and its individual PM components. Model predictions combined with observed particulate concentrations provide the foundation for the EPA-recommended attainment demonstration for $PM_{2.5}$.

While model predictions represent a significant contribution to the attainment demonstration, it is recommended that models be used in a "relative" sense in conjunction with observations. Given that models may perform differently for each PM component, it may be generally assumed that models will be more successful at predicting concentration changes than absolute concentrations. To dampen the effects of varying degrees of performance amongst modeled species and the potential model bias in predicting absolute species concentrations, the EPA recommends that the models provide "relative response factors" (RRF) to quantify the effects of emissions changes between base and future years. These relative response factors in conjunction with speciated $PM_{2.5}$ measurements form the basis of the Speciated Modeled Attainment Test (SMAT).

In the following sections, the regional air quality modeling performed for use in the Speciated Modeled Attainment Test is outlined (EPA, 2007). Following a description of the modeling methodology and inputs, the steps of the EPA-recommended Speciated Modeled Attainment Test are described in detail. Finally the modeling results are presented alongside observational data in order to determine the future year attainment status for the San Joaquin Valley.

Regional Air Quality Methodology

As stipulated in the EPA Modeling Guidance, a grid-based photochemical model is necessary to perform the modeled attainment test for $PM_{2.5}$ (EPA, 2007). Such models offer the best available representation of important atmospheric processes and are an essential tool in analyzing the impacts of proposed emissions controls on pollutant concentrations. The EPA recommends guidelines for choosing a model for use in the attainment test. For example, the model source code should be free or low cost, modeling elements should have undergone rigorous scientific peer-review, and it should have been shown to perform well in the past for similar applications.

The Community Multiscale Air Quality Modeling System (CMAQ) has been selected for use in the $PM_{2.5}$ modeled attainment demonstration for the San Joaquin Valley Air Pollution Control District. CMAQ is a state-of-the-science "one-atmosphere" system that treats major atmospheric and land processes (e.g., advection, diffusion, gas phase chemistry, gas-particle mass transfer, nucleation, coagulation, wet and dry deposition, aqueous phase chemistry, etc.) and a range of species (e.g., anthropogenic and biogenic, primary and secondary, gaseous and particulate) in a comprehensive framework (EPA, 1999; CMAS, 2007).

CMAQ has been extensively peer-reviewed, is well-documented, and is regularly updated to reflect the latest changes in scientific understanding. CMAQ has been applied successfully in a range of environments and on many spatial and temporal scales. Given that CMAQ has also been applied successfully to episodic modeling in Central California, the CMAQ modeling system version 4.6 with California-specific updates, as described in Liang and Kaduwela (2005), was selected for use in support of the $PM_{2.5}$ modeled attainment demonstration.

Chemical Mechanism

There are a number of gas-phase chemical mechanisms readily available for application in CMAQ (e.g., CB-IV, CB-V, SAPRC-99). The user has the additional option of whether to couple the chosen gas phase mechanism with aerosol and/or aqueous phase chemical processes. In order to simulate the complex mixture of $PM_{2.5}$ species in the San Joaquin Valley, SAPRC99 coupled with CMAQ aerosol code version 4 and aqueous phase chemistry has been chosen for this application. SAPRC-99, a complete update of SAPRC-90, is a detailed mechanism describing the gas-phase reactions of volatile organic compounds (VOCs) and oxides of nitrogen (NOx) (Carter, 2000). AE4-AQ, the fourth-generation CMAQ aerosol code with aqueous phase chemistry, when coupled with a gas phase mechanism, represents such phenomena as gas–aerosol/aqueous phase mass transfer, chemical transformation of particulate

species and their gas phase precursors, and the evolution of the aerosol size distribution.

Model Inputs and Setup:

Domain Structure:

Two modeling domains were used for this work. The first modeling domain ("CCAQS") covers the Central Valley and its surroundings with 63x63 lateral 12x12 km^2 grid cells for each vertical layer. The CCAQS domain extends from the Pacific Ocean in the west to the Mojave Desert and western Nevada in the east and runs from the northern Sacramento Valley to the Tehachapi Mountains in the south. The second domain ("SJV") is nested within the CCAQS domain and covers the San Joaquin Valley with 80x89 lateral 4x4 km^2 grid cells for each vertical layer (Figure 1). The vertical structure for both domains is composed of 15 layers of varying thickness up to the top of the meteorological domain (100 mb). The finest resolution belongs to those layers closest to the surface and is determined largely by the vertical structure of the meteorological inputs. The surface layer is approximately 30 meters thick.

Initial and Boundary Conditions:

Boundary conditions for the CCAQS domain were taken from the global chemical transport Model for Ozone And Related chemical Tracers (MOZART). Model boundary conditions for major species were extracted for the Central California modeling domain from MOZART results representative of the year 2000. In addition to VOCs and inorganic gases, boundary conditions were extracted for ammonium, nitrate, sulfate, and organic and elemental carbon. Initial conditions were estimated as an average of the extracted boundary conditions for each species. The CCAQS domain provided the initial and boundary conditions for the SJV domain. All species reported in the three-dimensional output fields for the simulation over the CCAQS domain were included in the initial and boundary conditions for the SJV domain. While boundary conditions for the CCAQS domain were held constant for each month, boundary conditions for the SJV domain varied for each hour. The impact of initial conditions was minimized for each domain by simulating 8-day spin up periods prior to the simulation of each month of the year.

Emissions:

A spatially, temporally, and chemically resolved emissions inventory of combined area, mobile, and point sources was generated using the California Emissions Forecasting System (CEFS) version 1.06 with offline adjustments. The inventory includes emissions estimates for gaseous and particulate species of anthropogenic and biogenic origin. Gridded hourly emissions were developed for the CMAQ modeling domain for the years 2000, 2005, and 2014 (baseline).

Quality assurance checks of domain emissions totals and spatial distribution were performed at various steps in emissions processing in order to ensure that the CMAQ emissions input files were sound.

In order to better estimate future air quality, a second 2014 emissions sensitivity scenario was generated incorporating expected reductions from future state and local controls beyond the baseline. These were applied uniformly over the domain on a percentage basis. The percentage difference between baseline and "controlled" emissions was taken from the information in Table 1.

Meteorological Inputs:

The meteorological input fields to CMAQ were generated with the Meteorology-Chemistry Interface Processor (MCIP) version 3.0. MCIP serves as a link between meteorological models like MM5 or WRF with CMAQ and generates model-ready meteorological inputs like the wind and temperature fields necessary to drive the transport and chemistry calculations in CMAQ. Inputs to MCIP were generated using the PSU/NCAR Mesoscale Model (MM5) (version 3.6) (Grell et al, 1995). Planetary boundary layer and radiation characteristics were calculated in MCIP, and the Models-3 dry deposition routine (Pleim - with chlorine and mercury species) was chosen to represent dry deposition.

MM5 Simulation

MM5 is a limited area, terrain-following sigma coordinate model on Lambert Conformal projection that was developed by Penn State and NCAR as a community mesoscale model. The model is based on non-hydrostatic, fully compressible motions that allow users to study the atmospheric motions at small scales by explicitly treating the effects of convective motions on atmospheric circulations. The MM5 model has been improved over more than two decades by contributions from a broad scientific community.

MM5 was set up for a 14 month simulation (December 1999 – January 2001) with three nested grids using (70 x 70), (133 x 133), and (94 x 85) grid points in (x, y) or (south-north, west-east) direction with 36, 12, and 4 km horizontal resolution in each grid, respectively (Figure 2). The vertical structure of the domain was defined with 30 layers extending to 100 mb at the top of the domain. The first two coarse grids defined the atmospheric initial and boundary conditions for the area at large scale, while the innermost grid with 4 km horizontal resolution resolved the fine details of atmospheric motions within the SJV modeling domain. MM5 has several options to calculate the components of internal and external forces acting on a volume of air, such as those for radiation, convection, cloud microphysics, soil fluxes, and boundary layer physics. While many sensitivity studies were conducted using various model options to find the best agreement with observations, an effort was also made to use the same

model options from one simulation to the next. The Grell (1995) cumulus parameterization scheme for coarse grids was used along with the Blackadar boundary layer scheme for calculation of fluxes (Blackadar, 1979, Grell, 1995). The Dudhia simple ice scheme was used for the treatment of excess moisture (Dudhia, 1989) and the Dudhia cloud radiation scheme (Dudhia, 1993) was used for radiational heating and cooling of the atmosphere. The Blackadar multi-layer, force-restore method soil model (Blackadar, 1976) was used for soil physics in all grids.

Initial and boundary conditions were prepared using the analyses of observations prepared by the National Center for Environmental Prediction (NCEP) archived at NCAR. The 14-month period (December 1999 through January 2001) was first simulated using initial and boundary conditions (IC/BCs) with the analysis nudging option on the two coarse grids. Then, IC/BCs were prepared from the 12 km grid output for the initialization of the 4 km grid. The three-dimensional (3-D) wind and temperature values simulated by the model were compared against surface observations obtained from the four SJV stations (Fresno, Bakersfield, Arvin, and Parlier) to study the temporal and 3-D spatial structure of atmospheric motions as well as to evaluate the model performance within SJV. Figure 2 shows the MM5 domains employed to generate meteorological fields for the CMAQ simulation.

Model Years:

CMAQ was run for the year 2000 to provide the basis for the model performance evaluation. It was during 2000 that the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS) took place. The study resulted in a wealth of data with which to evaluate model performance. As it is necessary to execute simulations for a model reference year and a future year to perform the recommended modeled attainment demonstration, 2005 and 2014 were also simulated. Simulations for all years were driven by the meteorological inputs for 2000, while emissions varied from year to year.

Model Performance Evaluation:

To assure that the modeling system (emissions, meteorology, and air quality) is a satisfactory representation of the period modeled, the estimated emissions, meteorology, and air quality of the base-case simulation need to be compared with observations. Satisfactory performance of the model in simulating observed conditions and responses is a prerequisite for use of the modeling system to evaluate control strategies.

CRPAQS was an extensive and intensive measurement campaign designed to characterize the important chemical and physical processes involved in the formation and evolution of particulate matter in Central California (Chow et al. 2006). The CRPAQS measurement campaign extended from December 1999

through January 2001 and provided a wealth of data from diverse areas for model evaluation.

There are hourly and daily concentration data for a range of gaseous and particulate species at numerous sites available for comparison with CMAQ modeled concentrations. These data will be used to assess model performance temporally and spatially, with a focus on monthly average performance, as recommended for long-term model simulations. Appropriate goals for model performance will be based on the EPA Modeling Guidance and recommendations in the scientific literature on appropriate measures of model performance for long term PM simulations (EPA, 2007; Boylan and Russell, 2006). A model performance analysis is forthcoming which will be provided at a later date as an appendix to this work.

Speciated Modeled Attainment Test

Regional air quality modeling only represents a portion of the attainment test. In order to perform the EPA-recommended Speciated Modeled Attainment Test, or SMAT, the relative response between the modeled reference and future years must be considered in conjunction with observations. This approach minimizes the uncertainties in predicting future year attainment that result from potential model bias in predicting absolute species concentrations. In the following sections, the Speciated Modeled Attainment Test, as described in the EPA "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze", is outlined in general terms. Here the recommended procedure for combining model results (relative response factors (RRFs)) with speciated and bulk observations (STN and FRM measurements) in order to determine future year attainment status is explained. This is followed by a description of the application of the SMAT procedure to the San Joaquin Valley to determine future year $PM_{2.5}$ attainment status for the region.

General Procedure of SMAT

Step 1. Calculate the observed quarterly mean bulk $PM_{2.5}$ concentration and composition for each measurement site. The quarterly mean species concentrations can be calculated by multiplying the observed percentage contribution of each species against the quarterly mean bulk $PM_{2.5}$ design value. This design value is calculated from the bulk FRM concentrations averaged over a number of years (generally three but can be a weighted average spanning 5 years), one of which should be the modeled reference year. The procedure to speciate this bulk design value is described in the "SANDWICH" section below.

Step 2. Calculate the RRFs for each quarter and measurement site. Relative response factors are calculated using model results. For species i, site j, and quarter k, the RRF is given by the following equation:

$$RRF_{ijk} = ([C_{i,\ \text{quarter k of future year}}]/[C_{i,\ \text{quarter k of the base year}}])_j$$

C_i represents the quarterly modeled concentration (often averaged over a number of model cells near the location of the measurement site) for the reference year and the future year attainment target. The number of model cells recommended for use in the average depends on the size of the grid cell and is justified by the long $PM_{2.5}$ sampling times, the representative spatial scale of the monitors, and the desire to offset any potential errors stemming from the geometry of the superimposed grid system.

Step 3. Multiply the quarterly, site-specific model-based RRFs from step 2 and speciated observations from step 1 to estimate future quarterly species concentrations.

Step 4. Sum the future quarterly species concentration estimates from step 3 to estimate a future quarterly $PM_{2.5}$ estimate at each monitoring site and then average these for a projected future year annual $PM_{2.5}$ concentration for each monitoring site.

Step 5. Compare the future year annual average $PM_{2.5}$ concentrations from step 4 to the annual $PM_{2.5}$ standard of 15.0 $\mu g/m^3$. If all sites have projected $PM_{2.5}$ concentrations below the standard, the attainment test is passed.

These are the basic steps of SMAT. The following sections examine the attainment test in more detail, starting with the calculation of the base year design values against which the model-based RRFs are multiplied.

Speciated Base Year Design Values

Federal Reference Method

Federal Reference Method (FRM) $PM_{2.5}$ mass measurements provide the basis for nonattainment designations. For this reason it is recommended that the FRM data also be used to project future air quality and progress towards attainment of the health-based National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$. However, given the complex physicochemical nature of $PM_{2.5}$, it is necessary to consider individual species as well. While the FRM measurements give the mass of the bulk sample, a method for apportioning this bulk mass to individual $PM_{2.5}$ components is a first step towards determining the best targets for emissions controls in order to reach NAAQS levels in a timely manner.

The FRM measurement protocol finds its roots in the past epidemiological studies of health effects associated with $PM_{2.5}$ exposure. It is upon these studies that the NAAQS is based. The protocol is sufficiently detailed so that results might be easily reproducible and involves the measurement of filter mass before

and after sampling after equilibrating at narrowly defined conditions. Filters are equilibrated for more than 24 hours at a standard relative humidity between 30 and 40% and temperature between 20 and 23 ºC. Due to the sampler construction and a lengthy filter equilibration period, however, FRM measurements are subjected to a number of known positive and negative artifacts. FRM measurements do not necessarily capture the $PM_{2.5}$ concentrations in the atmosphere and can differ substantially from what is measured by speciation monitors (e.g., STN). Nitrate and semi-volatile organics can be lost from the filter during the equilibration process, and particle bound water associated with hygroscopic species like sulfate provides a positive artifact. These differences present an area for careful consideration when one attempts to utilize speciated measurements to apportion the bulk FRM mass to individual species.

Given that (1) attainment status is currently dependent upon FRM measurements and (2) concentrations of individual $PM_{2.5}$ species need to be considered in order to understand the nature of and efficient ways to ameliorate the $PM_{2.5}$ problem in a given region, a method has been developed to speciate bulk FRM $PM_{2.5}$ mass with known FRM limitations in mind. This method is referred to as the measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous material balance approach or "SANDWICH". SANDWICH is based on speciated measurements from other (often co-located) samplers, such as those from the Speciated Trends Network (STN), and the known sampling environment of the FRM. The approach serves to provide mass closure, reconciliation between speciated and bulk mass concentration measurements, and the basis for a connection between observations, modeled $PM_{2.5}$ concentrations, and the air quality standard.

SANDWICH

Given that the FRM is the basis for attainment status, the reconstructed $PM_{2.5}$ mass should be based on the composition of the mass measured by the FRM. SANDWICH was developed in order to attribute portions of the bulk FRM mass to different components using STN measurements while also considering the limitations of the FRM monitor. Nitrates are often lost from the FRM filter along with semivolatile organics, and water bound to the inorganics also comprises a portion of the FRM mass. The main steps in estimating the $PM_{2.5}$ composition are as follows:

(1) calculate the nitrate retained on the FRM filter using hourly relative humidity and temperature alongside STN nitrate measurements,

(2) calculate quarterly averages for retained nitrate, sulfate, elemental carbon, ammonium (or sulfate degree of neutralization, $[NH_4^+]/[SO_4^{2-}]$, if not using ammonium measurements directly),

(3) calculate particle bound water using the concentrations of ammonium, sulfate, and nitrate, using an equilibrium model like the Aerosol Inorganic Model or a polynomial equation derived from model output, and

(4) calculate organic carbon mass (OCM_{mb}) by difference, subtracting all inorganic species (including blank mass) from the $PM_{2.5}$ mass.

Total $PM_{2.5}$ mass is given by

$$PM_{2.5\ FRM} = [SO_4^{2-}] + [NO_3^-{}_{FRM}] + [NH_4^+{}_{FRM}] + [EC] + [Other\ ] + [OCM_{mb}] + [H_2O] + [blank\ mass = 0.5\ \mu g/m^3]$$

where all concentrations have units of $\mu g/m^3$ and

$[SO_4^{2-}]$ = measured sulfate

$[NO_3^-{}_{FRM}]$ = nitrate retained on the FRM filter

$[NH_4^+{}_{FRM}]$ = ammonium associated with the nitrate and sulfate on the FRM filter

[EC] = measured EC

Other = other inorganic mass; e.g., crustal material or sea salt

$[OCM_{mb}]$ = organic carbon mass calculated by difference by adding all inorganic species and subtracting from the FRM $PM_{2.5}$ mass. Organic carbon measurements may also be used if it seems that the OC by mass balance is clearly under or overestimated.

$[H_2O]$ = water bound to the hygroscopic species; here, calculated using a polynomial equation dependent on the concentrations of sulfate, nitrate, and ammonium or using an inorganic aerosol equilibrium model.

Blank mass represents the mass passively collected on the filter and is assumed to be held constant at a value of 0.5 $\mu g/m^3$.

SANDWICH may be applied directly in areas where FRM and speciation monitors are collocated. When that is not the case, the following calculations and adjustments may still be applied using spatially interpolated speciation data or some other means to estimate the speciation. The speciation concentrations referred to in the following paragraphs can be represented, therefore, by measurements from a speciation monitor collocated with the FRM or by interpolated values for the species measured by speciation monitors in the region.

The first step in estimating the speciation of the bulk sample is to assume that, due to the stability and nonvolatility of sulfate, sulfate measured by the speciation samplers is similar to the sulfate captured in the FRM sampler. The same is assumed for [EC]. As mentioned above, a passively collected mass of 0.5 $\mu g/m^3$ is assumed. Estimation of other species' contributions to the FRM mass is described in the following sections.

Adjusted Nitrate

The FRM does not retain all of the semi-volatile $PM_{2.5}$ mass, and at warmer temperatures, loss of particulate nitrate from filters has been widely observed (Chow et al., 2005). In order to estimate how much nitrate is retained on the FRM filter, simple thermodynamic equilibrium relations may be used. Necessary inputs include 24-hour average nitrate measurements and hourly temperature and relative humidity data. Frank (2006) suggests the following methodology for estimating retained nitrate:

(1) For each hour (i) of the day, calculate the dissociation constant, K_i, from ambient temperature and relative humidity.

For RH < 61%: $\ln(K) = 118.87 - (24084/T) - 6.025 \ln(T)$, where T is temperature in kelvins and K is in nanobars.

For RH >= 61%, K is replaced by: $K' = [P_1 - P_2 (1-a) + P_3 (1-a)^2] \times (1-a)^{1.75} \times K$, where a is "fractional" relative humidity and

$$\ln(P_1) = -135.94 + 8763/T + 19.12\ln(T)$$

$$\ln(P_2) = -122.65 + 9969/T + 16.22\ln(T)$$

$$\ln(P_3) = -182.61 + 13875/T + 24.46\ln(T)$$

(2) From that, calculate the nitrate retained on the filter:

$$\text{Retained Nitrate} = \text{STN nitrate} - [745.7/T_R \times (\kappa-\gamma) \times 1/24 \times \Sigma\ (i=1 \text{ to } 24)\ (K_i)^{0.5}]$$

where T_R is the daily average temperature for the sampled air volume (K), K_i is the dissociation constant for NH_4NO_3 at ambient temperature for hour i, and $(\kappa-\gamma)$ relates to the temperature rise of the filter and vapor depletion from the inlet surface and is assumed to have a value equal to 1 (Hering and Cass, 1999). For further details, please refer to Frank (2006).

Ammonium

All nitrate on the FRM filter is assumed to be neutralized by ammonium. Ammonium associated with nitrate on the FRM filter, therefore, is given by

$$[NH4]_{NO3,FRM} = 0.29 \times [NO3]_{FRM}$$

where $[NO_3]_{FRM}$ is the nitrate remaining on the FRM filter and 0.29 is the mass ratio of NH_4 to NO_3 if fully neutralized.

The form of $(NH_4)_2SO_4$, however, can vary depending on location and season. Sulfate may or may not be fully neutralized. In order to determine the amount of ammonium associated with the sulfate aerosol, the ammonium difference between the STN and FRM filter needs to be determined. Some studies point to a loss of STN NH_4 during sampling conditions where nitrate volatilization is favored. While the volatilized NO_3 will be recaptured on the basic nylon filter and reported as nitrate, the associated ammonium, not sharing the same affinity for the basic filter, may pass through. In some cases, an adjustment assuming a loss of STN NH_4 corresponds more closely with the NH_4 on the FRM filter; in other cases, the unadjusted measurement agrees better with FRM NH_4. For the calculations for the SJV, an area rich in NH_3, NH_4 on the filter is assumed to be the measured STN NH_4 minus any losses associated with fully neutralized nitrate (as NH_4NO_3) that may have volatilized off the FRM filter.

$$[NH4]_{FRM} = [NH4]_{STN} - 0.29 \times ([NO3]_{STN} - [NO3]_{FRM})$$

Here, $([NO3]_{STN} - [NO3]_{FRM})$ represents the amount of nitrate mass lost due to volatilization.

Particle Bound Water

At the FRM filter equilibration conditions, hygroscopic aerosol will retain its particle bound water (PBW) and be included in the observed FRM $PM_{2.5}$ mass. PBW can be calculated using an equilibrium model like the Aerosol Inorganics Model (AIM). AIM requires the concentrations of ammonium, nitrate, sulfate, and estimated H^+ as inputs. In addition to inorganic concentrations, the equilibration conditions are also necessary model inputs. In this case, a temperature of 294.15 K and 35% RH is recommended. For simplification, a polynomial regression equation may be constructed by fitting the calculated water concentration from an equilibrium model and the concentrations of nitrate, ammonium, and sulfate.

Other Species

Other components that may be represented on the FRM filter include elemental carbon, crustal material, sea salt, and passively collected mass. Depending on location, for example, certain species may be neglected (like sea salt for inland areas).

Carbonaceous Mass

While carbonaceous aerosol may make up a large portion of airborne aerosol, speciated measurements of carbonaceous PM are considered highly uncertain. This is due to the large number of carbon compounds in the atmosphere and the measurement uncertainties associated with samplers of different configurations. In the SANDWICH approach, organic carbonaceous mass is calculated by difference. The sum of all non-organic carbon components may be subtracted from the FRM $PM_{2.5}$ mass as an estimate of organic carbon.

After having calculated the species concentrations as outlined above, one can calculate the percentage contribution of each species to the measured FRM mass (minus the blank concentration of 0.5 $\mu g/m^3$) for each quarter of the years represented by the speciated data. One can then apply those percentages to the base year FRM design value, with the assumption that the years for which the speciation was calculated are representative of all years over which the design value is averaged. For the annual $PM_{2.5}$ attainment demonstration, the speciated reference year FRM design value for each quarter is multiplied by the RRF for each species at each site, averaged together, and summed to get a future year $PM_{2.5}$ concentration. Note that blank mass is kept constant at 0.5 $\mu g/m^3$ between the base and future years, and future year particle bound water needs to be calculated for the future year values of nitrate, ammonium, and sulfate. A numerical example of the SMAT for the annual $PM_{2.5}$ standard is given in the EPA modeling guidance on pp. 53-56 (U.S. EPA, 2007).

24-hour Attainment Test

The 24-hour attainment test is similar to the attainment test for the annual $PM_{2.5}$ standard. In the case of the 24-hour test, however, the goal is to have the future 24-hour $PM_{2.5}$ design value at or below 65 $\mu g/m^3$ for all sites. The test has the following steps:

Step 1. Identify the observed 98^{th} percentile 24-hour $PM_{2.5}$ average concentrations for each year (e.g., of the three year period that makes up the reference year design value) and the next highest concentrations for the other quarters.

Step 2. Using the SANDWICH methodology outlined above, calculate the species percentages of the bulk FRM samples for each site, quarter, and year. These fractions should be calculated using days at the high end of the distribution (i.e., days around or above the standard).

Step 3. Calculate RRFs for each species at each site for each quarter from modeled days at the high end of the $PM_{2.5}$ distribution (i.e., modeled days having $PM_{2.5}$ concentrations around or above 65 $\mu g/m^3$). As in the case of the

annual test, for species i, site j, and quarter k, the RRF is given by the following equation:

$$RRF_{ijk} = ([C_{i,\ quarter\ k\ of\ future\ year}]/[C_{i,\ quarter\ k\ of\ the\ base\ year}])_j$$

Step 4. Multiply the quarterly, site-specific model-based RRFs from step 3 and speciated observations from step 2 to estimate future quarterly species concentrations.

Step 5. Sum the future quarterly species concentration estimates from step 4 to estimate a quarterly "potential" 98th percentile $PM_{2.5}$ estimate at each monitoring site.

Step 6. Average the highest quarterly values for each year and then compare the future year design values at each site to the 24-hour $PM_{2.5}$ standard of 65 $\mu g/m^3$. If all sites are at or below the standard, the 24-hour $PM_{2.5}$ attainment test is passed.

A numerical example of an application of the 24-hour $PM_{2.5}$ attainment test is given on pp. 60-63 of the EPA Model Guidance (U.S. EPA, 2007).

SJV Attainment Demonstration for the Annual $PM_{2.5}$ Standard

The SMAT procedure as outlined above was applied for FRM monitors operating in the San Joaquin Valley with minimal deviations from the recommended procedure. The 2006 design value was used as a basis from which to project forward the future year design value. Speciation data for four STN (speciation) sites was used to speciate the FRM mass for all FRM sites. For those sites not collocated with STN monitors, "surrogate" speciation sites were determined based on analysis of CRPAQS data to determine which sites had similar speciation profiles. The composition was assumed to be the same at all three Bakersfield sites (BAC, BGS, and BEP). Similarly, the percent composition at the two Fresno sites (FSF and FSH) was assumed to be the same. In addition, Stockton (SOH), Clovis (CLO), Corcoran (COP), and Modesto (MRM), were assumed to have the same speciation as one of the four speciation sites based on CRPAQS data analysis. The results of that analysis are given in Table 2. For a list of all FRM sites and their associated speciation site, see Table 3.

The steps followed in order to determine future year design values for the FRM sites of the SJV were similar to those outlined above in the generalized description of the SMAT/SANDWICH procedure. Specific points to note are that in the speciation calculations, only days with all the necessary hourly temperature and relative humidity data in addition to values for all major components (ammonium ion, nitrate ion, sulfate ion, and elemental carbon) plus FRM mass were included in the species average calculations. Temperature and

relative humidity data were obtained from the ARB's Air Quality and Meteorological Information System (AQMIS, *www.arb.ca.gov/aqd/aqinfo.htm*) database for each monitoring station (collocated with the STN sites or nearby if the STN site was not available) for each available hour of the years 2004-2006.

Quarterly average species concentrations were calculated at each STN site using the SANDWICH procedure described above. In addition, a blank mass average of 0.5 $\mu g/m^3$ was assumed for each quarter and held constant into the future. Modeled concentrations for the reference year (2005) and future year (2014) for each component were extracted for the FRM sites as a nine-cell average. The relative response factors (as defined above) were calculated for each component for each quarter. These calculations were performed using all modeled days, as we assumed that the selected FRM measurements provided a stable quarterly average value. Finally, particle bound water was calculated using a polynomial algorithm provided by Dr. Bong-Mann Kim of the South Coast Air Quality Management District. Organic mass was calculated by difference between the average total FRM mass and the sum of all other species and blank.

These quarterly species percentages were then multiplied against the reference year design value for 2006 (the average FRM $PM_{2.5}$ concentrations for 2004, 2005, and 2006). The quarterly observed species concentrations were then multiplied by the RRFs and summed and averaged to get a future year $PM_{2.5}$ design value at each FRM site. See Table 3 for the predicted baseline and controlled 2014 $PM_{2.5}$ design values. For the "controlled" 2014 emissions sensitivity scenario described above, future annual $PM_{2.5}$ concentrations at all FRM sites are below the annual $PM_{2.5}$ NAAQS of 15.0 $\mu g/m^3$, and, therefore, the San Joaquin Valley has passed the speciated modeled attainment test for the annual $PM_{2.5}$ NAAQS.

SJV Attainment Demonstration for the 24-Hour $PM_{2.5}$ Standard

A similar procedure to the attainment demonstration for the annual $PM_{2.5}$ standard was followed for the 24-hour $PM_{2.5}$ standard attainment demonstration. The exception was that only the top 25% of the measured and modeled days for each quarter were used instead of all available days. The top 25% of the days are expected to be more representative of the 24-hour design value than would all available days for a given quarter.

Table 4 shows the projected future year 24-hour $PM_{2.5}$ design values for the top five 2006 design value sites for the controlled emissions sensitivity case. As shown, all sites in the SJV attained the 24-hour standard in 2006, and further emissions controls do not cause any monitors to become non-attainment.

Unmonitored peaks

EPA's modeling guidance (EPA, 2007) describes the "Unmonitored Area Analysis" as an analysis used to ensure that a proposed control strategy will be effective in reducing $PM_{2.5}$ at locations without air quality monitors so that attainment is shown throughout a nonattainment area. The purpose of the analysis is to use a combination of model output and ambient data to identify areas that might exceed the NAAQS if monitors were located there.

This analysis has four major steps. They are:

1. Interpolation of the base year design values to create a set of spatial fields
2. Adjustment of the spatial design value fields using gridded model output gradients (base year values)
3. Application of the gridded model RRFs to the gradient adjusted spatial design value fields
4. Determination if any unmonitored areas are predicted to exceed the NAAQS in the future

We will present a complete analysis of unmonitored areas in a future version of this document. A screening analysis that is designed to assess the possibility of unmonitored violations of the annual $PM_{2.5}$ NAAQS is presented here.

First, an annual-averaged modeled $PM_{2.5}$ field is generated for the entire modeling domain as shown in figure 3. This field is then scrutinized to see if there will be gradients in the field that would give rise to higher values away from monitors if this field were to be used to adjust the interpolated annual-averaged design value field. As seen from figure 3, there are no areas with steep gradients that would result in higher design values than those measured at monitors. That is, for the central and southern part of the Valley where design values are high, the highest modeled concentrations occur at monitors so that there can not be higher values away from monitors.

As mentioned before, this is a simple screening analysis and a complete analysis of the unmonitored areas will be presented in the future.

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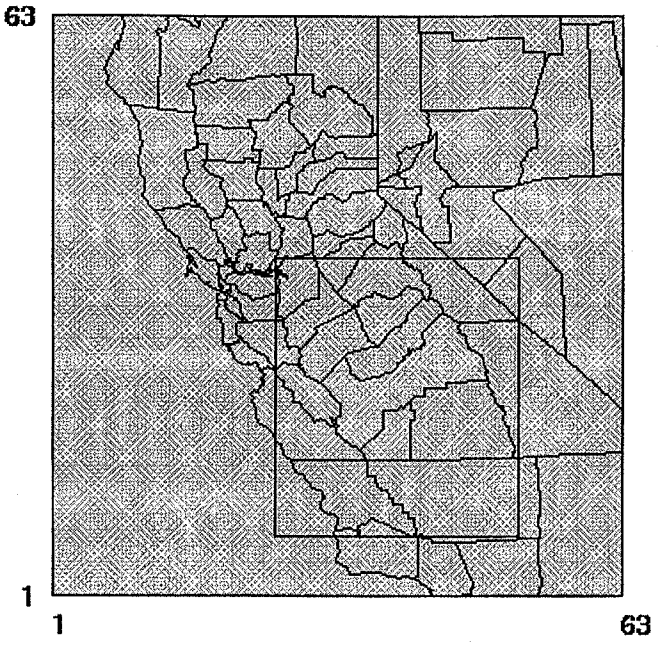


Figure 1. The CCAQS modeling domain with the SJV modeling domain inset.

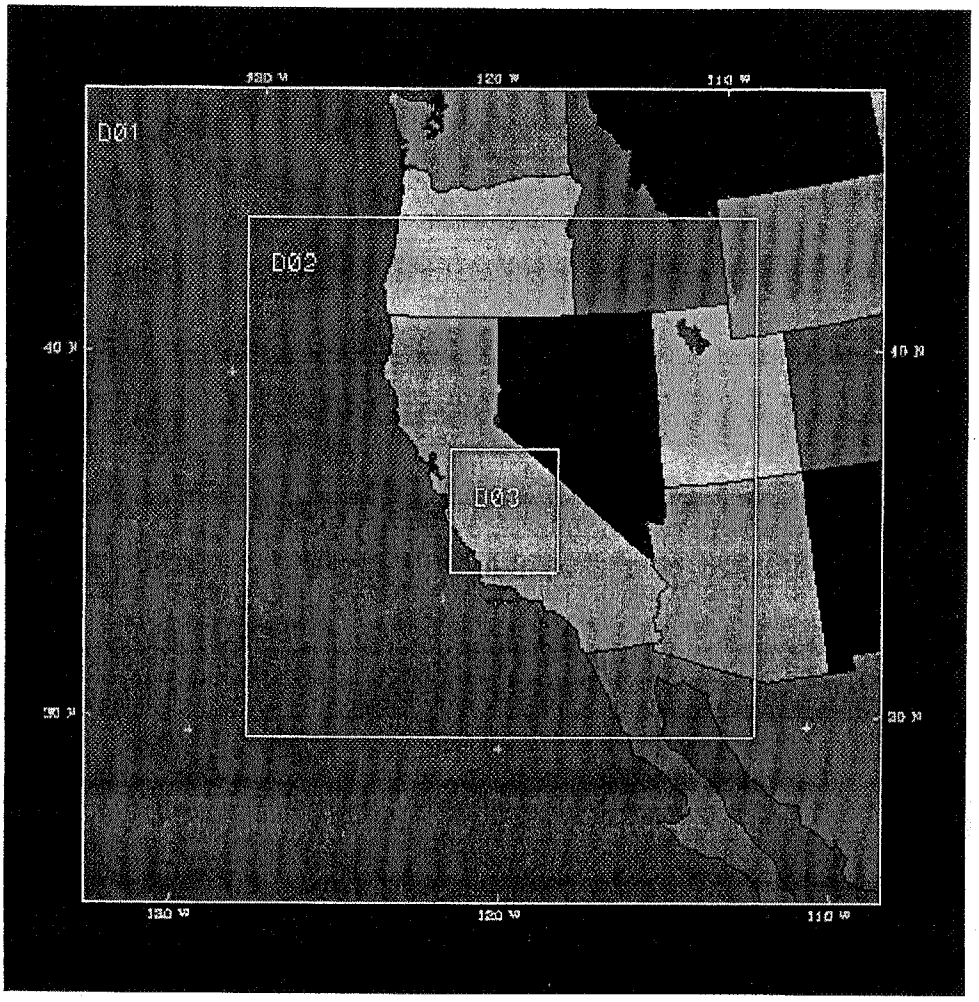


Figure 2. The location of the three nested grids adopted for the numerical modeling of SJV using MM5.

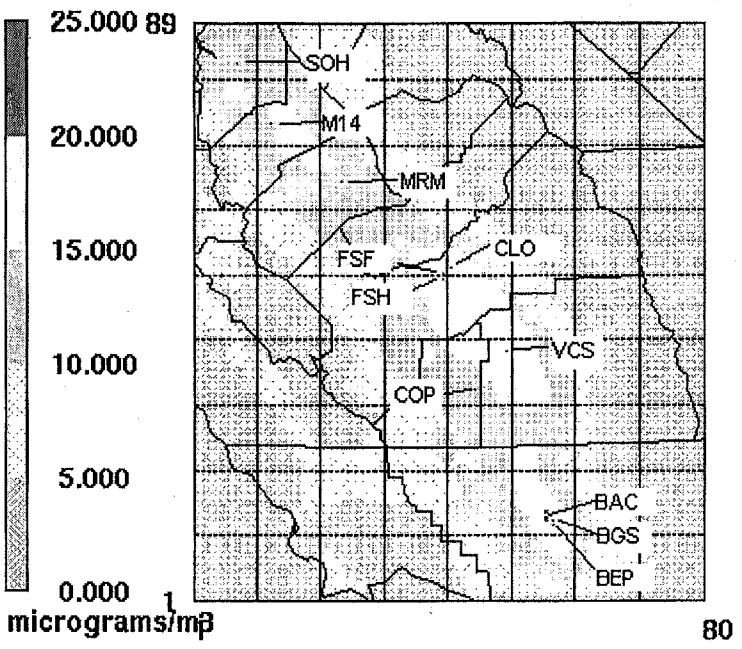


Figure 3. The annual-averaged modeled $PM_{2.5}$ concentrations in the domain.

Table 1. Percentage reduction between 2014 baseline and controlled emissions

	NOx	PM2.5	SOx	ROG
Defined State Measures (Strategy 4/26/07)	20	5	0	6
District Rules (Dft Plan 12/11/07)	4	8	4	0
Total Reduction	24	13	4	6

Table 2. Percent Composition Ratio Based on 2000 Average CRPAQS Data

Site	AmmNitrate	AmmSulfate	EC	OC	Geological	Elements
CLO %	30.78	9.09	10.49	43.22	4.14	2.27
FSF %	26.79	10.15	7.07	49.31	4.16	2.52
CLO to FSF Ratio	1.15	0.90	1.48	0.88	1.00	0.90
COP %	36.44	9.86	8.37	37.87	5.06	2.39
VCS %	35.38	9.53	9.04	39.53	4.37	2.14
COP to VCS Ratio	1.03	1.03	0.93	0.96	1.16	1.12
MRM %	29.33	9.08	10.92	45.50	2.82	2.35
M14 %	26.39	9.84	11.43	46.35	2.71	3.27
MRM to M14 Ratio	0.90	1.08	1.05	1.02	0.96	1.39
SOH %	24.80	11.76	13.13	44.07	2.93	3.31
M14 %	26.39	9.84	11.43	46.35	2.71	3.27
SOH to M14 Ratio	0.94	1.19	1.15	0.95	1.08	1.01

Table 3. Reference and future year annual design values for SJV FRM sites

Site	Code	Speciation	2006 DV	2014 Baseline DV	2014 "Controlled" DV
Bakersfield - 5558 California	BAC	BAC	18.51	15.86	14.28
Bakersfield - 410 E Planz Road	BEP	BAC	18.86	16.26	14.70
Bakersfield - Golden State	BGS	BAC	18.64	15.98	14.39
Clovis - N Villa Avenue	CLO	FSF	16.39	14.10	12.72
Corcoran - Patterson Avenue	COP	VCS	17.24	14.75	13.27
Fresno - 1st Street	FSF	FSF	16.68	14.43	13.01
Fresno - Hamilton and Winery	FSH	FSF	17.16	14.93	13.47
Merced - 2334 M Street	MRM	M14	14.69	12.85	11.76
Modesto - 14th Street	M14	M14	14.10	12.52	11.44
Stockton - Hazelton Street	SOH	M14	12.93	11.77	10.87
Visalia - N. Church Street	VCS	VCS	18.20	16.05	14.47

Table 4. Reference and future year 24-hour design values for SJV FRM sites

Site	Code	Speciation	2006 DV	2014 "Controlled" DV
Bakersfield - 5558 California	BAC	BAC	62.4	46.2
Bakersfield - 410 E Planz Road	BEP	BAC	65.2	45.9
Bakersfield - Golden State	BGS	BAC	64.4	45.3
Fresno - 1st Street	FSF	FSF	58.0	41.2
Fresno - Hamilton and Winery	FSH	FSF	58.5	41.7

APPENDIX B

WEIGHT OF EVIDENCE

SAN JOAQUIN VALLEY PM2.5 SUPPLEMENTAL ANALYSIS

1. INTRODUCTION

The State Implementation Plan or SIP serves as a demonstration of attainment for the national ambient air quality standards (NAAQS or federal standards). The attainment demonstration comprises analyses used to determine the set of control measures needed to meet the NAAQS by the attainment year. These analyses typically include air quality modeling, which generally guides the selection of the most effective pollutants to control and the magnitude of needed emissions reductions. The Weight of Evidence (WOE) analysis provides a set of complementary analyses that supplement the SIP-required modeling. These analyses can include consideration of measured air quality, emissions, and meteorological data, evaluation of other air quality indicators, and additional air quality modeling.

A WOE approach looks at the entirety of the information at hand to provide a more informed basis for the attainment strategy. Because all methods have inherent strengths and weaknesses, examining an air quality problem in a variety of ways offsets the limitations and uncertainty that are inherent in air quality modeling. This approach also provides a better understanding of the overall problem and the level and mix of emissions controls needed for attainment.

The United States Environmental Protection Agency (U.S. EPA) recognizes the importance of a comprehensive assessment of air quality data and modeling and encourages this type of broad assessment for all attainment demonstrations. In their modeling guidance, they further note that the results of supplementary analyses may be used in a WOE determination to show that attainment is likely despite modeled results which may be inconclusive (U.S. EPA 2007). Under the U.S. EPA guidance, future year modeled annual average design values that fall between 14.5 and 15.5 ug/m^3 should be accompanied by a WOE demonstration to determine whether attainment will occur. This range in modeled design values reflects the uncertainty in predicting absolute PM2.5 concentrations that is inherent in air quality modeling, and therefore recognizes that an improved assessment of attainment can be derived from examining a broader set of analyses.

U.S. EPA recommends that three basic types of analyses be included to supplement the primary modeling analysis in the WOE approach:

1) analyses of trends in ambient air quality and emissions,
2) observational models and diagnostic analyses, and
3) additional modeling.

Each analysis is weighted based on its ability to quantitatively assess the ability of the proposed control measures to yield attainment. The scope of the WOE

analysis is different for each nonattainment area. The level of detail appropriate for each area depends upon the complexity of the air quality problem, how far into the future the attainment deadline is, and the amount of data and modeling available. For example, less analysis is needed for an area that is projecting attainment near-term and by a wide margin, and for which recent air quality trends have demonstrated significant progress, than for areas with more severe air quality challenges. The following sections present the WOE assessment for PM2.5 in the San Joaquin Valley Air Basin for each of the areas outlined in the U.S. EPA guidance.

2. ASSESSMENT OF RECENT AIR QUALITY AND EMISSION TRENDS

a. Current Air Quality

According to U.S. EPA's guidance, even though air quality models are regarded as the most appropriate tool to assess impacts in emission changes, it is also possible to extrapolate future trends in PM2.5 based on measured historical trends of air quality and emissions. Strength of the evidence produced by emissions and air quality trends is increased if an extensive monitoring network exists and if there is good correlation between past emission reductions and current trends.

Along with the South Coast, the San Joaquin Valley Air Basin has one of the most severe PM2.5 problems in the nation and represents a considerable challenge in attaining the federal PM2.5 standards. These standards consist of both a 24-hour standard of 65 ug/m^3, and an annual average standard of 15 ug/m^3. While the majority of monitors with complete data in the San Joaquin Valley still exceed the annual PM2.5 standard, PM2.5 air quality has shown considerable improvement since 1999 when monitoring data for assessing compliance with the federal PM2.5 standard began. When the San Joaquin Valley was first designated nonattainment for the federal PM2.5 standards, the basin exceeded both the annual and the 24-hour PM2.5 standards. However, based on 2004-2006 data, the San Joaquin Valley meets the federal 24-hour PM2.5 standard of 65 ug/m^3 throughout the basin. Thus attaining the annual standard is the primary challenge in this State Implementation Plan.

The San Joaquin Valley Air Basin is a lowland area bordered by mountains to the east, west, and south. The mountains act as air flow barriers, with the resulting stagnant conditions favoring the accumulation of emissions and pollutants. To the north, the Valley borders the Sacramento Valley and Delta lowland, which allows for some level of pollutant dispersion. As a result, PM2.5 concentrations are higher in the southern and central portions of the Valley, where geography, emissions, and climate pose significant challenges to air quality progress. Chapter 3 and Appendix E of the District Plan provide detailed information on the conceptual model of PM2.5 formation in the Valley.

Currently, eleven sites routinely monitor PM2.5 in the Air Basin. Table 1 provides the 2006 annual standard design values and the annual average values for 2004, 2005, and 2006 for each monitoring site with complete data. The design value is a statistic that is used to describe the air quality status of a given area relative to the level of the federal standard. The annual design values represent the average of the mean annual PM2.5 concentrations measured during the three year period. Table 2 provides the 24-hour standard design value for each monitoring site with complete data and the yearly 98th percentile value of the 24-hour concentrations measured in 2004, 2005, and 2006. The 24-hour design value represents the average of the yearly 98th percentile of the 24-hour concentrations measured during the three year period. Attainment is reached when the design value is at or below the corresponding federal standard.

As shown in Table 1, current 2006 annual average design values (reflecting the 2004 through 2006 period) range from 12.9 ug/m^3 to 18.9 ug/m^3. The San Joaquin Valley monitoring sites with the highest PM2.5 annual design values are located in the southern and central portions of the basin, including Bakersfield and Visalia. Monitors located in the northern portion of the Valley, including Stockton, Modesto, and Merced have lower annual PM2.5 design values and attain the annual PM2.5 standard. As shown in bold in the table, the high site for the region is the Bakersfield–Planz monitor with a PM2.5 design value of 18.9 ug/m^3.

Table 1. PM2.5 Annual Average Values

	Annual Average (ug/m^3)			2006 3-year Annual Average Design Value (ug/m^3)
Monitor	**2004**	**2005**	**2006**	
Clovis-N Villa Avenue	15.8	16.0	16.8	16.2
Bakersfield-410 E Planz Road	17.4	19.9	19.3	**18.9**
Bakersfield-5558 California Avenue	19.0	17.9	18.7	18.5
Bakersfield-Golden State Highway	18.1	18.9	18.6	18.5
Corcoran-Patterson Avenue	17.3	17.6	16.7	17.2
Fresno-1st Street	16.4	16.9	16.8	16.7
Fresno-Hamilton and Winery	17.0	16.9	17.6	17.2
Merced-2334 M Street	15.3	14.1	14.8	14.7
Modesto-14th Street	13.6	13.9	14.8	14.1
Stockton-Hazelton Street	13.2	12.5	13.1	12.9
Visalia-N Church Street	17.0	18.8	18.8	18.2

Table 2. PM2.5 98th Percentile 24-hour Values

Monitor	Annual 98th Percentile (ug/m3)			2006 3-year Average of 98th Percentile Design Value (ug/m3)
	2004	2005	2006	
Clovis-N Villa Avenue	42.4	77.0	51.3	57
Bakersfield-410 E Planz Road	78.6	66.4	50.6	**65***
Bakersfield-5558 California Avenue	59.3	63.6	60.5	62
Bakersfield-Golden State Highway	53.8	74.9	64.4	64
Corcoran-Patterson Avenue	49.4	74.5	50.1	58
Fresno-1st Street	52.0	71.0	51.0	58
Fresno-Hamilton and Winery	49.4	71.2	55.0	59
Merced-2334 M Street	43.0	48.3	43.8	45
Modesto-14th Street	45.0	55.0	52.0	51
Stockton-Hazelton Street	36.0	44.0	42.0	41
Visalia-N Church Street	54.0	65.0	50.0	56

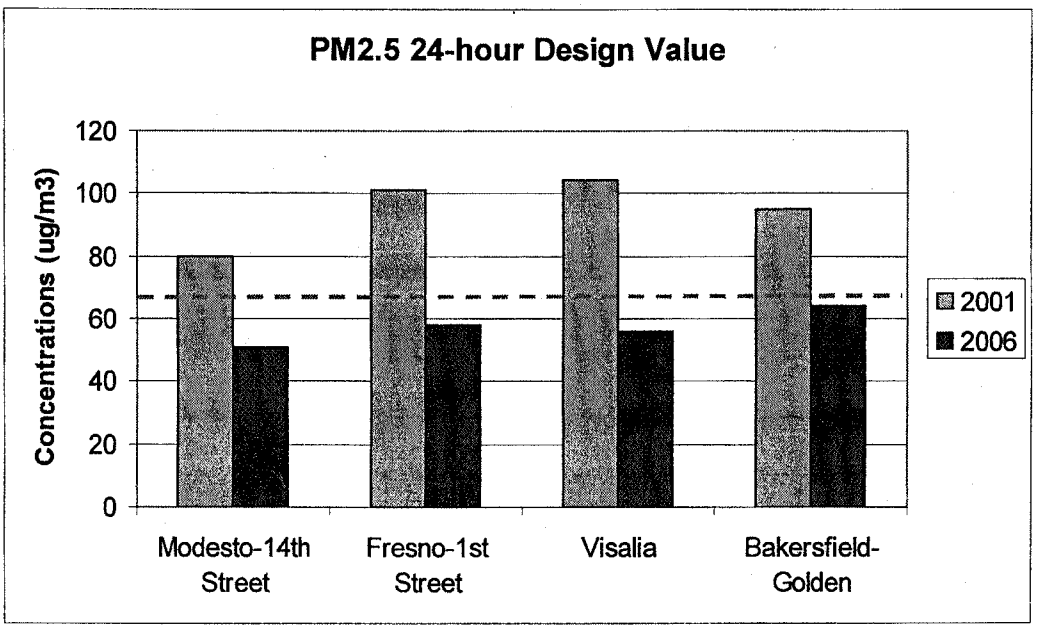
*The 24-hour standard is exceeded when the design value is over 65 ug/m3

As previously mentioned, all monitors in the San Joaquin Valley currently attain the federal 24-hour PM2.5 standard. As shown on Table 2, 2006 24-hour PM2.5 design values (reflecting the 2004 through 2006 period) range from 41 ug/m3 to 65 ug/m3. Monitoring sites with the highest 24-hour PM2.5 design values are located in the southern portion of the Valley, around Bakersfield. As shown in bold on the table, the high site for the region is Bakersfield-Planz with a 24-hour PM2.5 design value of 65 ug/m3.

b. Recent PM2.5 Mass Trends

Trends observed in the San Joaquin Valley show that considerable progress has occurred in the San Joaquin Valley over the last five years due to the ongoing emissions control program. As shown in Figure 1, 24-hour design values have decreased approximately 40 percent and, as discussed above, based on the 2004 through 2006 data, attain the federal standard at all sites in the Basin.

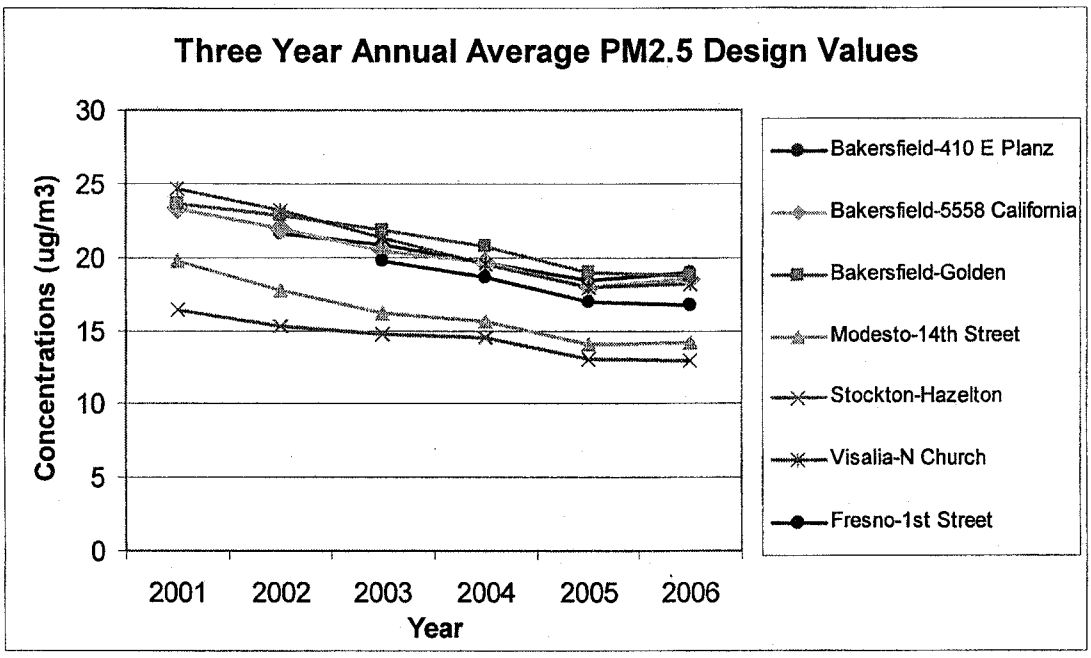
Figure 1: Comparison of 2006 to 2001 PM2.5 24-hour Design Values



All San Joaquin Valley monitors with complete data also show a significant decrease in annual average design values (Figure 2). In 2001, all monitoring sites in the Basin had annual design values greater than 16 ug/m^3, with the Visalia site at approximately one and a half times the level of the standard. By 2006, design values decreased throughout the basin, and only those sites in the southern and central portions of the Valley are still greater than 16 ug/m^3. Bakersfield–Planz is the current high site, with a design value which is 26 percent above the standard. The greatest rate of progress has occurred in the northern and central basin. From 2001 through 2006, the Modesto site design value dropped 28 percent, from 19.7 ug/m^3 to 14.1 ug/m^3, while the Visalia site design value dropped 26 percent from 24.7 ug/m^3 to 18.2 ug/m^3. As a result, all monitoring sites in the northern portion of the Valley now attain the annual PM2.5 standard of 15 ug/m^3. In contrast, the Bakersfield-Golden site dropped 22 percent from 23.6 ug/m^3 to 18.5 ug/m^3 and the Bakersfield-California site dropped 21 percent from 23.3 ug/m^3 to 18.5 ug/m^3. This trend is further illustrated in Figure 3 which depicts maps of the spatial variations in annual average concentrations in 2001 as compared to 2006.

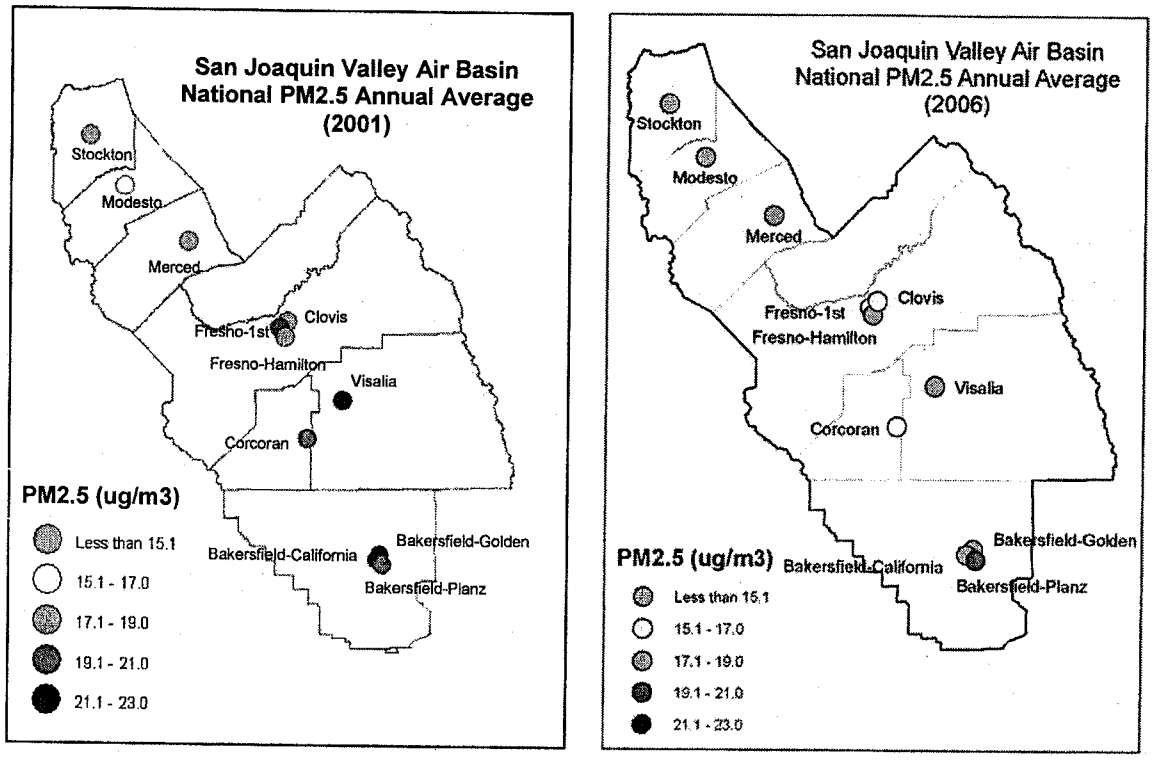
Trends in 24-hour and annual average design values were further evaluated using the nonparametric statistical analysis test, known as the Theil test, that U. S. EPA uses in national air quality trend analysis[1]. This method tests for whether upward or downward trends are real (significant) or a chance product of year-to-year variation (not significant). Theil test results indicate the 2001 to 2006 downward trends in 24-hour and three-year annual average PM2.5 concentrations are statistically significant.

Figure 2: Trends in Annual Average PM2.5 Design Values



[1] U.S. EPA , *National Air Quality and Emissions Trends Report,* Publication No. EPA 454/R-03-005, Office of Air Quality and Standards, Air Quality Strategies and Standards Division, Research Triangle Park, North Carolina. 2003. http://www.epa.gov/air/airtrends/aqtrnd03/

Figure 3: 2001 and 2006 Annual Average Values



The progress observed in both the annual and the 24-hour PM2.5 standards reflects the linkage between the two standards. The annual average is comprised of individual 24-hour samples which vary throughout the year. In the San Joaquin Valley, PM2.5 concentrations exhibit a pronounced seasonal variation, with significantly higher monthly average concentrations during the late fall and winter (November through January). PM2.5 concentrations from April through September are generally below 15 ug/m^3. Therefore 24-hour PM2.5 concentrations during the fall and winter seasons strongly drive the annual average concentrations. During the late fall and winter, stagnant air, cool temperatures, and high humidity can lead to a build-up of PM2.5 over a period of several days to weeks.

Analyses of the changes in the distribution of the 24-hour concentrations between 2001-2003 and 2004-2006 indicate that the decrease in both 24-hour and annual average concentrations is the result of the downward shift in the distribution of daily PM2.5 concentrations during the fall/winter period. This can be seen in the decrease in the monthly average concentrations during the fall/winter months between 2001 and 2006 at Bakersfield-California and Fresno (Figures 4 and 5).

Figure 4: Changes in Seasonal Pattern at the Bakersfield-California Monitoring Site

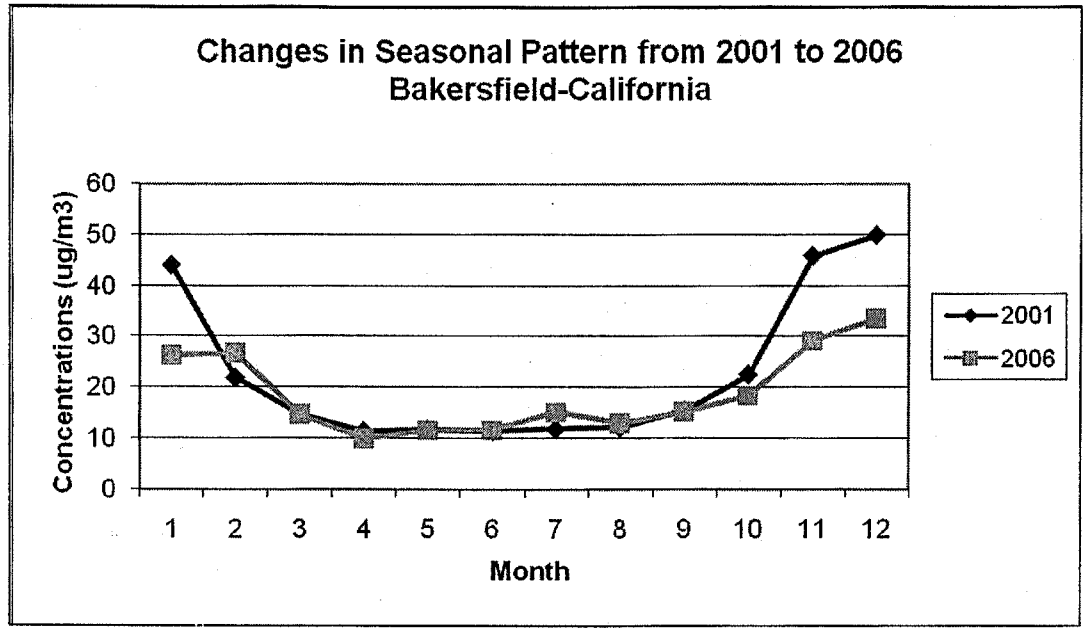
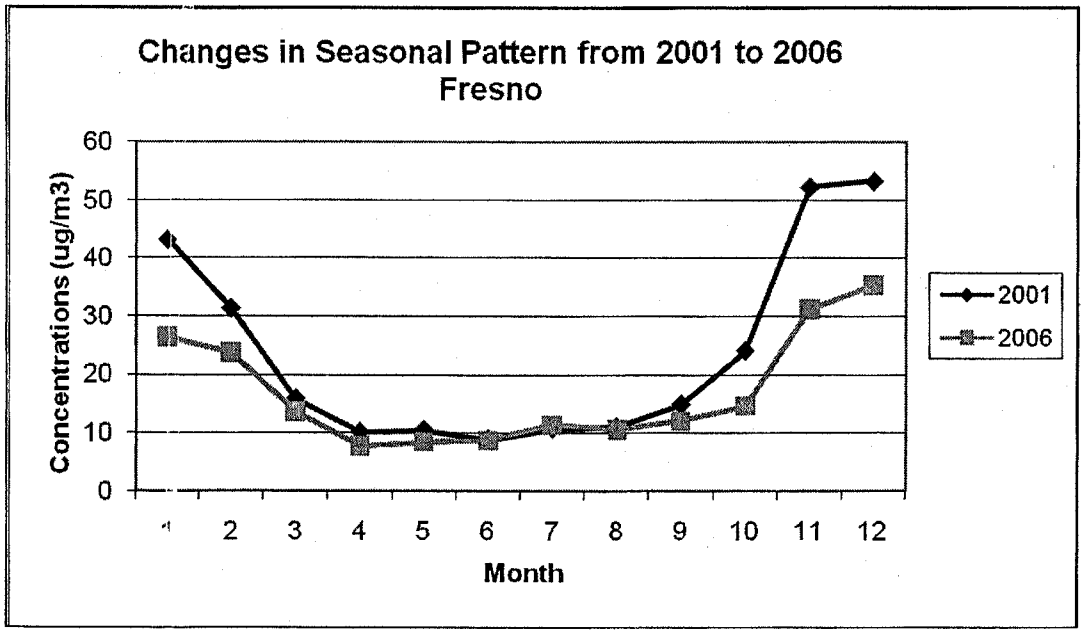


Figure 5: Changes in Seasonal Pattern at the Fresno Monitoring Site



A comparison of the changes in the frequency distribution of 24-hour concentrations over the last few years provides another means of understanding progress. Data collected from 24-hour samples during 1999-2001 at the Bakersfield site indicate that 6 percent of the samples had concentrations greater than 65 ug/m^3 (Figure 6). In comparison, during the 2004-2006 period, the number of samples with PM2.5 concentrations greater than 65 ug/m^3 fell to 1 percent. During both periods, 45 percent of the samples had concentrations above the level of the annual PM2.5 standard of 15 ug/m^3.

At the Fresno site data collected during the 1999–2001 period indicate that approximately 8 percent of the samples had concentrations greater than 65 ug/m^3 (Figure 7), while during the 2004-2006 period, only 1 percent of the samples had concentrations greater than 65 ug/m^3. In addition, during 1999-2001, 46 percent of the samples had concentrations above the level of the annual PM2.5 standard of 15 ug/m^3, while during the 2004-2006 period, the number of samples with concentrations greater than 15 ug/m^3 fell to 34 percent. This analysis, together with the analysis of monthly average PM2.5 trends, further illustrate that progress to date in the annual average is primarily linked to reductions in peak concentrations from October through March.

Figure 6: PM2.5 Concentrations at Bakersfield-California 1999-2001 versus 2004-2006

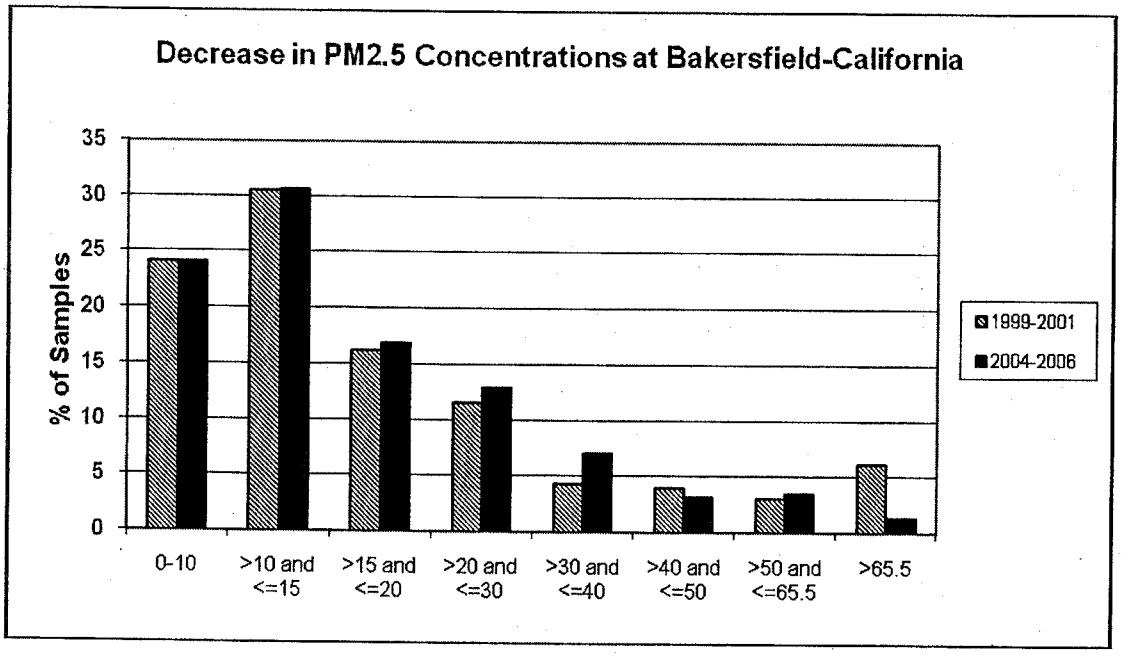
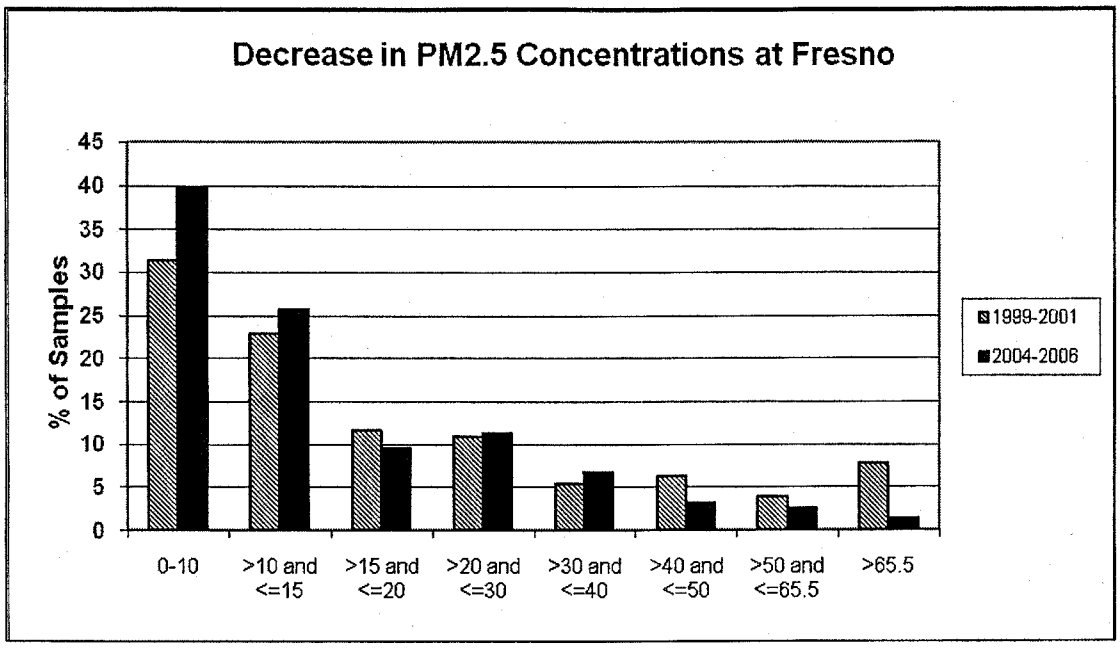


Figure 7: PM2.5 Concentrations at Fresno 1999-2001 versus 2004-2006

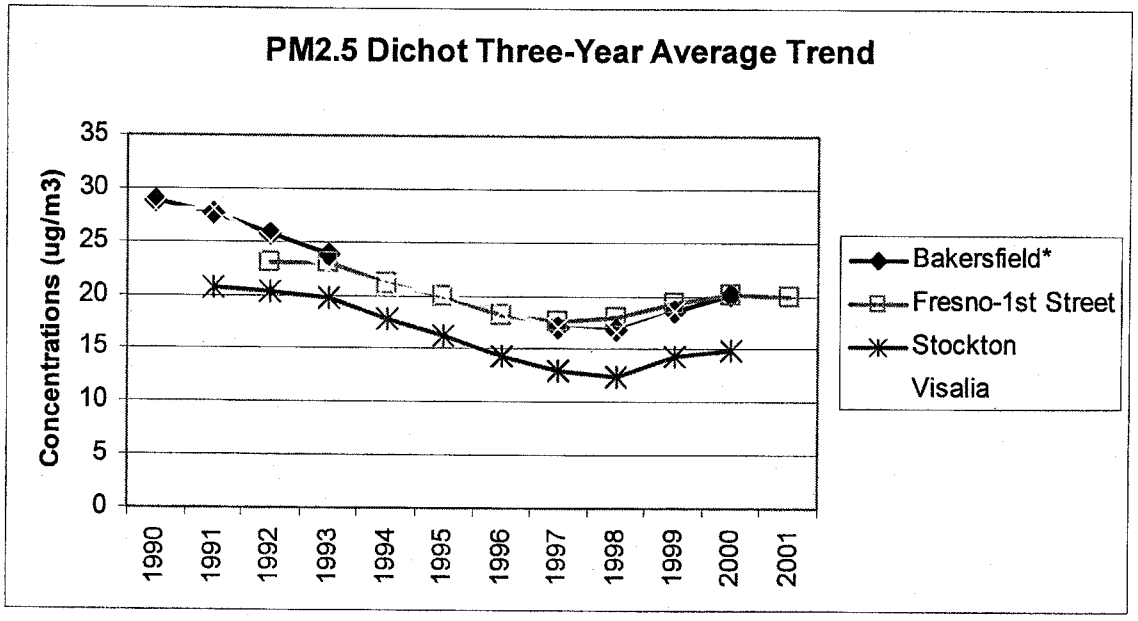


c. Historical PM2.5 Mass Trends

The PM2.5 Federal Reference Method (FRM) network that is used for comparison to the federal standard was deployed in 1998 and 1999. However, PM2.5 data have been routinely collected in the San Joaquin Valley Air Basin since the late 1980s using dichotomous samplers that were operated for research purposes. The PM2.5 dichotomous data correlate very well with the FRM data (r=0.98), but are biased lower than the FRM by 12 percent, therefore an absolute comparison to the FRM can not be made. However, the relative changes in the dichotomous data do provide a longer-term context for assessing progress. Figure 8 depicts PM2.5 concentrations at four sites. At all of these sites, the 3-year average concentrations decreased until 1998, then increased until 2000. At two of the three highest sites, Bakersfield and Visalia, the 3-year average concentrations decreased about 40 percent from 1990 to 1998 (the Bakersfield site trend has a gap from 1994 to 1996). PM2.5 concentrations at Bakersfield then increased 19 percent from 1998 to 2000. The dichotomous data record at the third high site, Fresno, started in 1992. From 1992 to 1998, PM2.5 concentrations decreased 21 percent, followed by a 12 percent increase from 1998 to 2000. PM2.5 concentrations at the low site, Stockton, decreased 40 percent from 1991 to 1998, followed by a 20 percent increase from 1998 to 2000. The period between 1999 and 2001 included a number of adverse winter episodes which likely lead to higher annual averages during this period. However, overall concentrations declined 20 to 30 percent over the period from

1990 through 2001. Looking at dichotomous data and FRM data together therefore illustrates an overall long-term improvement in PM2.5.

Figure 8: Trends in Three-Year Average PM2.5 Concentrations Measured with Dichotomous Samplers



d. Chemical Composition and Emissions Trends

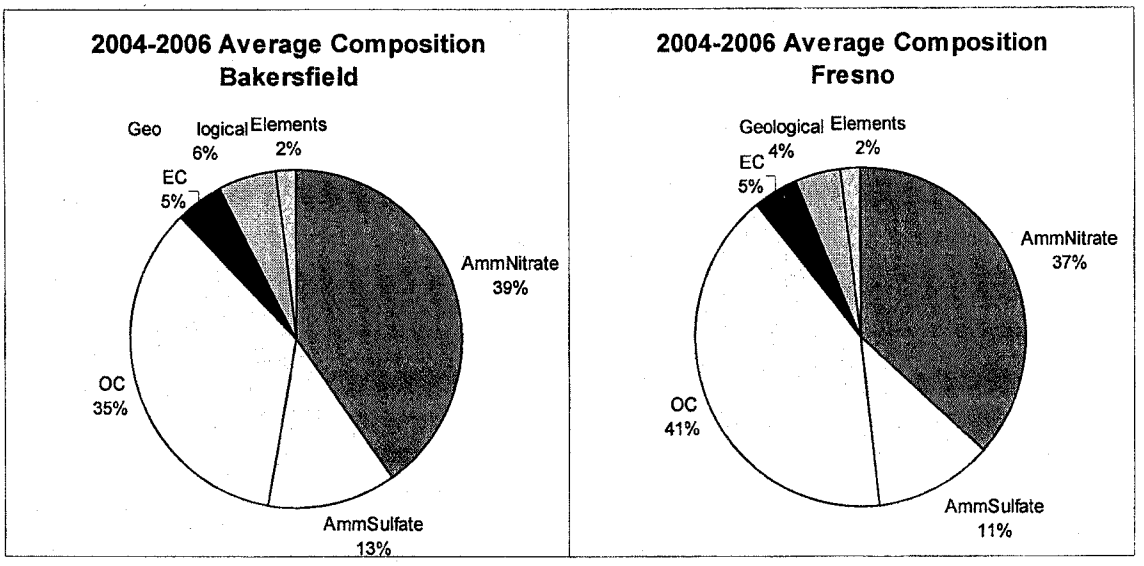
Current Chemical Composition

Particulate matter (PM) consists of many different chemical components. Investigating these different components and how they vary by site and season provides us with a better understanding of their complexity and responses to the emission control program. This mix of chemical components consists of both directly emitted PM such as geological material and elemental carbon (soot), known as primary PM, as well as PM formed in the atmosphere from the reactions of precursor gases, known as secondary PM. These precursor pollutants include nitrogen oxides (NOx), sulfur oxides (SOx), reactive organic gases (ROG), and ammonia. NOx, SOx, and ammonia combine to form secondary ammonium nitrate and sulfate. ROG can form secondary organic carbon, as well as participate in the production of secondary ammonium nitrate.

In the San Joaquin Valley, chemical components are routinely measured at four sites, Bakersfield, Fresno, Visalia, and Modesto. These sites represent urban areas in different portions in the air basin. The chemical composition of PM2.5, seasonal variability, and trends in these components at two of these sites,

Fresno and Bakersfield are discussed below to provide further insight into the linkage between observed progress and ongoing emission reductions. The annual average PM2.5 chemical composition for Bakersfield and Fresno is shown in Figure 9. Ammonium nitrate and organic carbon are the major constituents at both sites. However, at Bakersfield, ammonium nitrate constitutes a higher percentage (39 percent) of PM2.5 than organic carbon (35 percent), while the reverse (37 percent ammonium nitrate and 41 percent organic carbon) occurs in Fresno. Ammonium nitrate is formed in the atmosphere from chemical reactions of NOx emitted from motor vehicles and stationary combustion sources. Stagnant, cold, and damp conditions in the winter promote the formation and accumulation of ammonium nitrate. Burning activities, such as residential wood combustion, cooking, and direct tailpipe emissions from mobile sources are major sources of organic carbon. Ammonium sulfate is also formed in the atmosphere from chemical reactions of SOx emitted from combustion sources. Ammonium sulfate constitutes about one tenth of ambient PM2.5 at both sites. Elemental carbon resulting from mobile and stationary combustion sources, and geological material from roads and other dust producing activities also contribute to PM2.5 at both sites, but to a lesser extent.

Figure 9: 2004-2006 Average Chemical Composition of PM2.5 at Bakersfield and Fresno



Figures 10 and 11 illustrate the seasonal variability in chemical components that make up PM2.5 for the Bakersfield and Fresno sites averaged over 2004 through 2006. As discussed previously, PM2.5 concentrations are highest during the fall and winter. These higher concentrations are driven by increases in ammonium

nitrate and carbon. At the Bakersfield site (Figure 10), ammonium nitrate is highest during the fall and winter months (November through January) and lowest from April through September. Ammonium nitrate concentrations at Fresno follow the same trend. Cold and humid conditions during the fall and winter favor the formation of ammonium nitrate in the atmosphere from chemical reactions of nitrogen oxides emitted from mobile and stationary combustion sources. At the Fresno site (Figure 11), organic carbon has a similar trend as that of ammonium nitrate. At the Bakersfield site, organic carbon is also highest during the fall and winter months, but at this site organic carbon levels start high in January, decrease until April and then increase almost linearly until reaching a maximum in December. Increased activity in residential wood combustion during the fall/winter period is one cause of higher organic carbon concentrations. At both locations, elemental carbon component remains fairly constant throughout the year, while the ammonium sulfate component is more prevalent from May through September, and the geological components from April through October.

Figure 10: Seasonal Variation in PM2.5 Chemical Components at Bakersfield

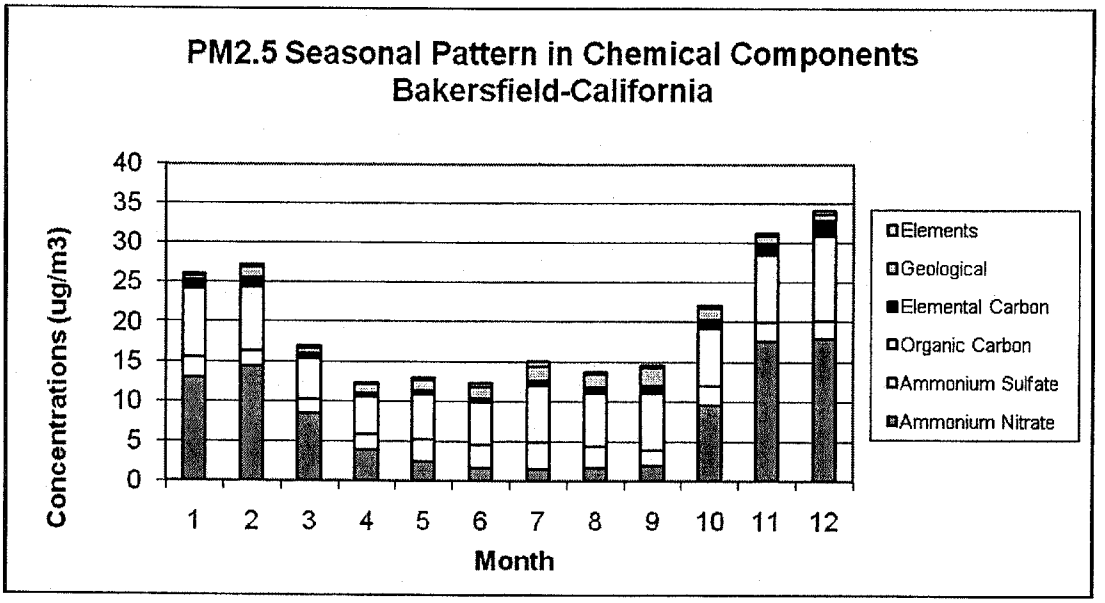
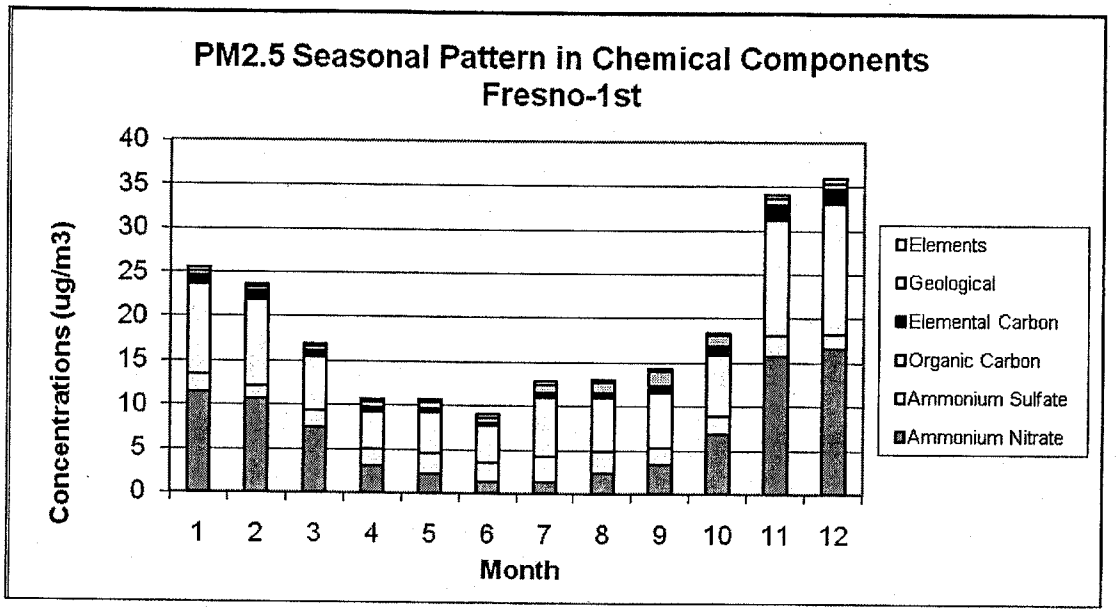


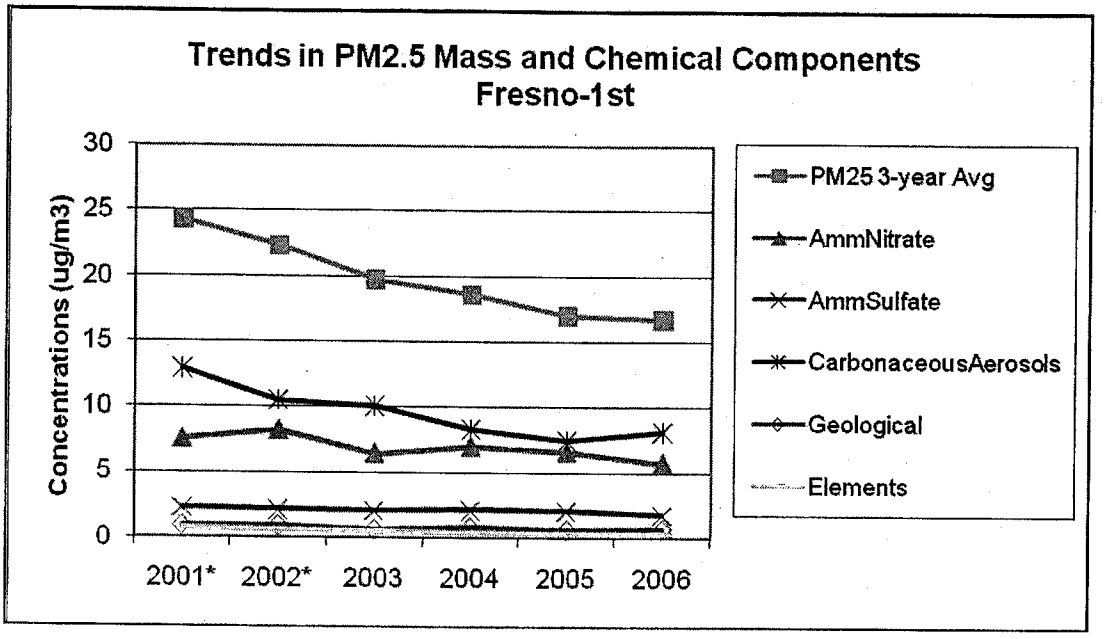
Figure 11: Seasonal Variation in PM2.5 Chemical Components at Fresno



Chemical Composition and Precursors Trends

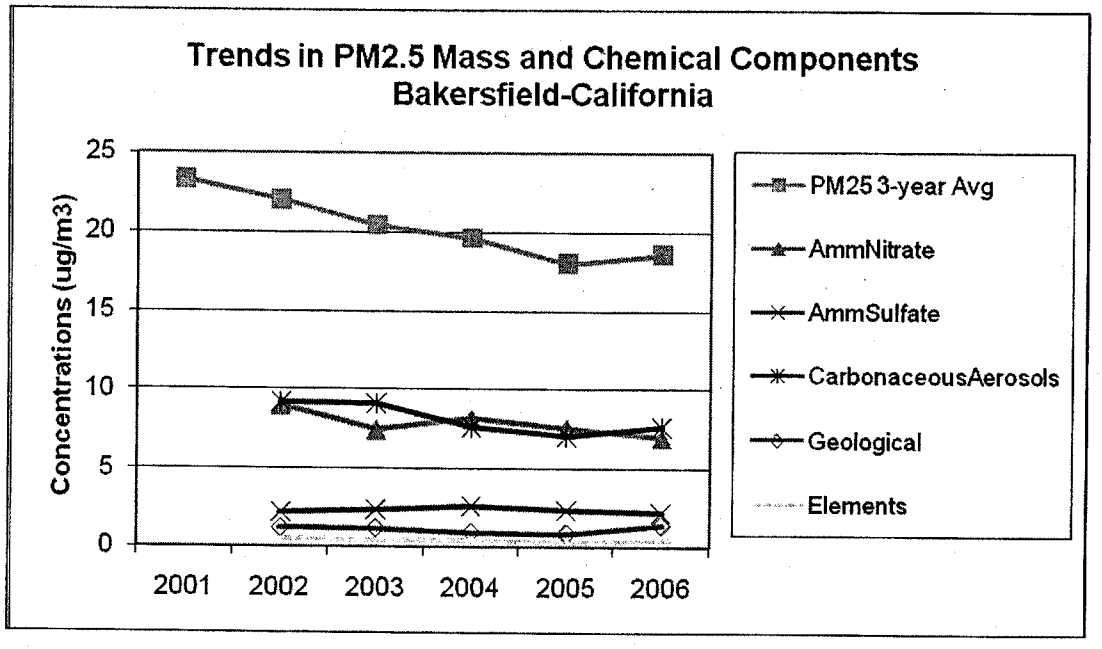
As discussed previously, monitoring sites in the San Joaquin Valley have shown PM2.5 concentrations decreasing from 2001 to 2006. Trends in individual chemical components and precursor concentrations, as well as emissions inventory trends were evaluated to understand the main chemical components responsible for this progress and to evaluate the response to our ongoing control program. Figures 12 and 13 illustrate recent trends in PM2.5 concentrations and its individual chemical components at Fresno and Bakersfield. Improvements in PM2.5 in the San Joaquin Valley can be mostly attributed to reductions in carbonaceous aerosols and ammonium nitrate. In Fresno, carbonaceous aerosols have dropped 37 percent, and ammonium nitrate concentrations have dropped 24 percent. The overall improvement in PM2.5 mass observed in Fresno is therefore due in most part to reductions in carbonaceous aerosols (63 percent), with a smaller portion of the remaining PM2.5 improvement due to reductions in ammonium nitrate (24 percent). In Bakersfield, carbonaceous aerosols have dropped by 16 percent and ammonium nitrate concentrations dropped by 23 percent since 2002. Therefore 41 percent of the overall reduction in PM2.5 mass is due to reductions in carbonaceous aerosols, while 59 percent is due to reductions in ammonium nitrate. Understanding the role of carbonaceous compounds in PM2.5 pollution, the San Joaquin Valley Air Pollution Control District made the Valley's Residential Wood Combustion Rule more stringent in 2003, which may have contributed to the observed decrease in carbonaceous aerosols.

Figure 12: Trends in PM2.5 Mass and Chemical Components at Fresno



* The three-year design value is not considered valid.

Figure 13: Trends in PM2.5 Mass and Chemical Components at Bakersfield-California



Concentrations in ambient NOx, a precursor to nitric acid and ammonium nitrate decreased steadily from 2001 through 2006. Figures 3-14 and 3-15 illustrate the

short-term trends in the Basin average NOx compared to ammonium nitrate concentrations in Fresno and Bakersfield. Ambient NOx concentrations in the Valley have shown a modest decrease of 15 percent. Ammonium nitrate concentrations were highest in 2002 at both sites, with a small decrease between 2001 and 2006 at Fresno of 7 percent.

While the short-term trends for ammonium nitrate have been modest, longer-term records show concomitant decreases between ambient NOx and ammonium nitrate as well as between ambient SO2 and ammonium sulfate. Figure 16 shows trends in the basin three-year average ambient NOx concentrations and the corresponding ambient nitrate measurements from the PM10 network extending back to the late 1980s. The hills and valleys in the ammonium nitrate concentrations reflect the effects of the varying meteorology on ammonium nitrate formation. Since 1987, ambient NOx has decreased 50 percent while ammonium nitrate decreased by 35 percent. Figure 17 shows the trends from 1987 to 1996 in the basin three-year average ambient SO2 concentrations and ammonium sulfate measurements from the PM10 network. During this period SO2 decreased by 42 percent with a concurrent decrease in PM10 sulfate of 39 percent.

Figure 14: PM2.5 Ammonium Nitrate Compared to NOx – Fresno

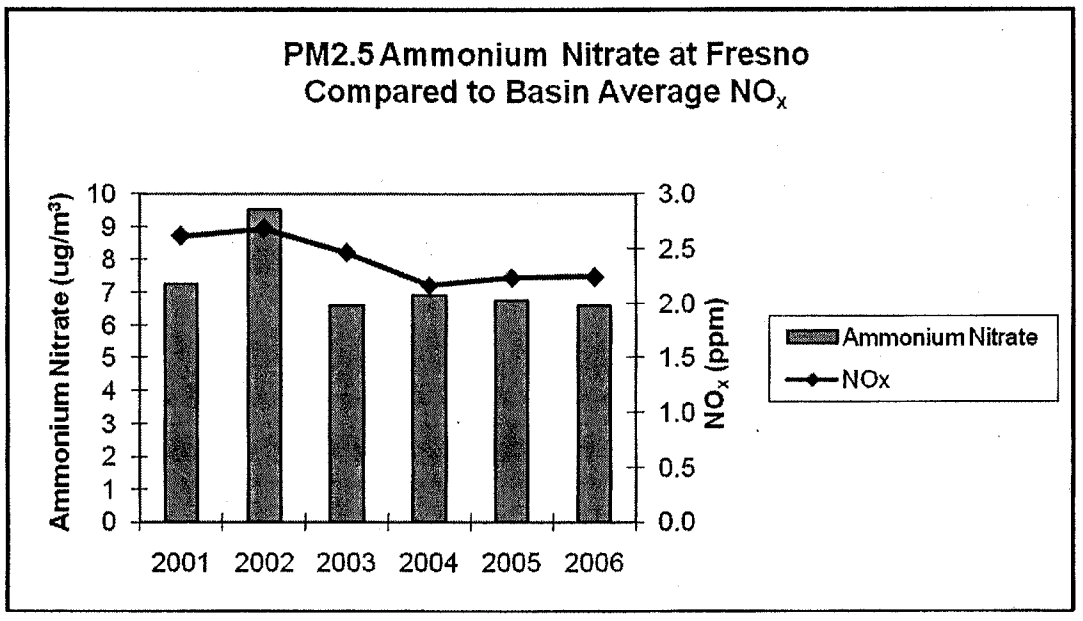


Figure 15: PM2.5 Ammonium Nitrate Compared to NOx - Bakersfield

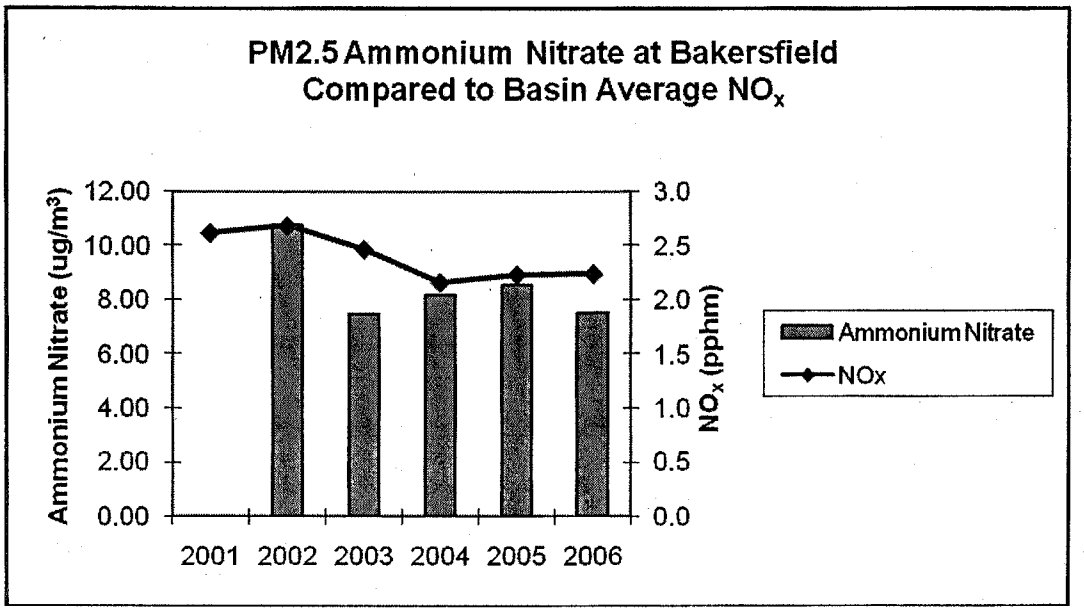


Figure 16: Long-Term Trends in Three-Year Average Concentrations of PM10 Nitrate and NOx in San Joaquin Valley

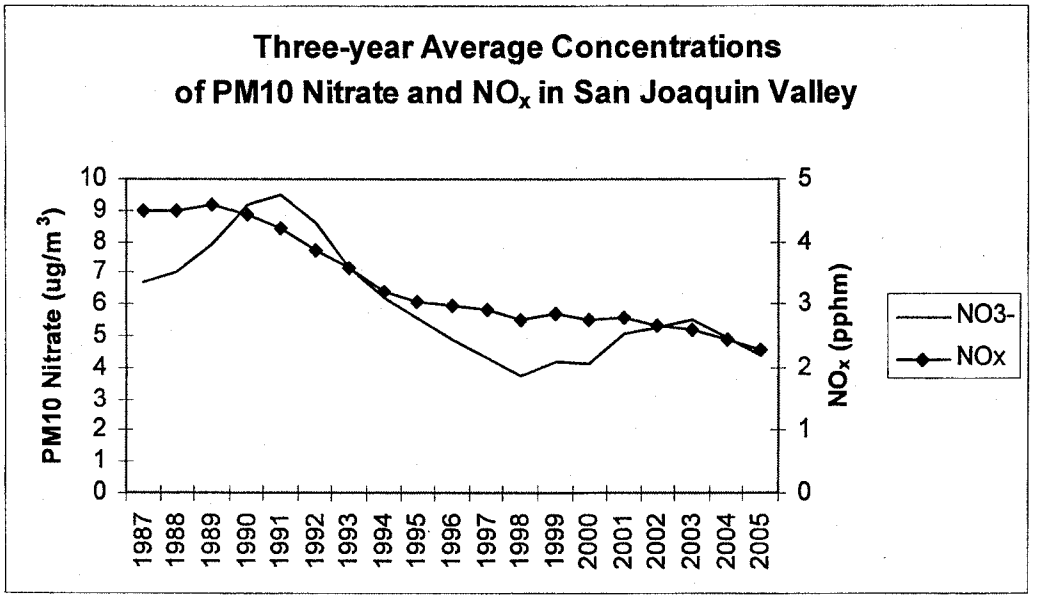
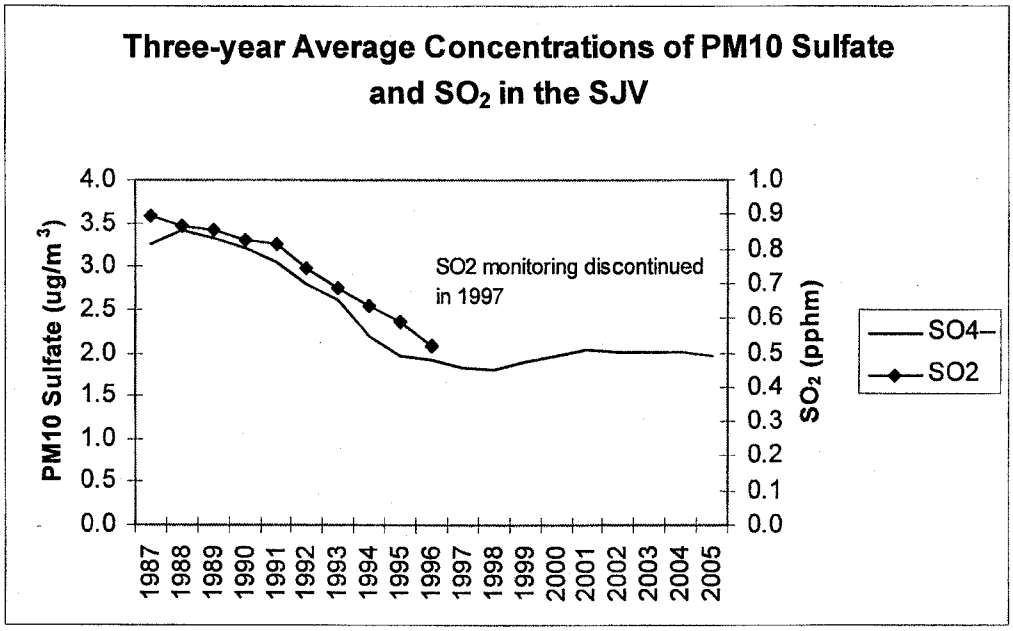


Figure 17: Long-Term Trends in Three-Year Average Concentrations of PM10 Sulfate and NOx in the San Joaquin Valley

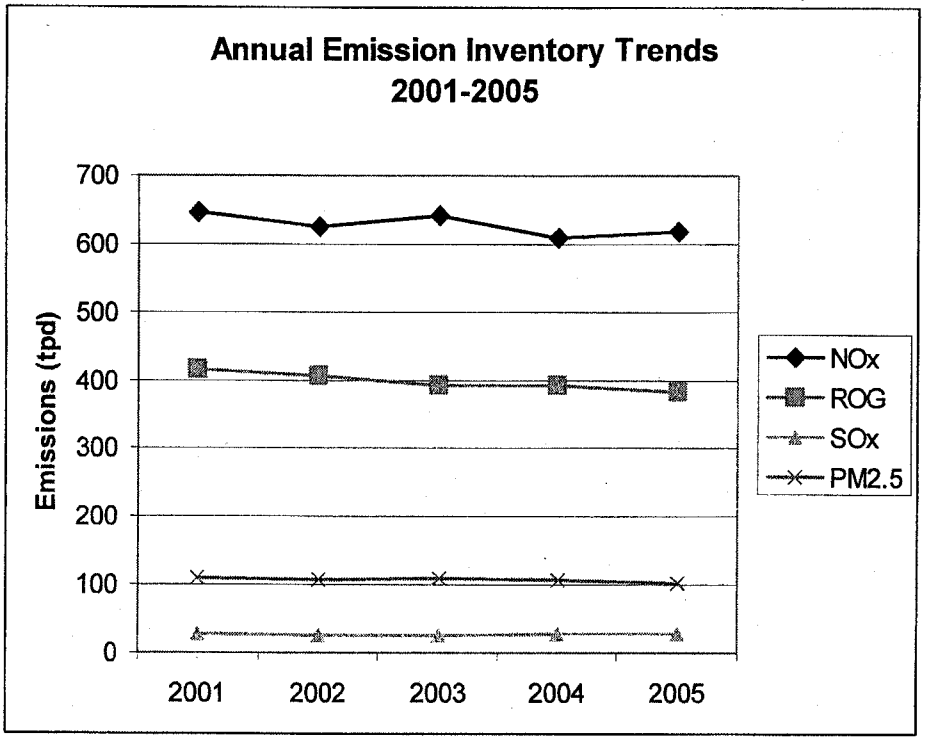


Emission Trends

At the same time that ambient concentrations have been declining, the emissions of pollutants that contribute to the different components of PM2.5 have been decreasing. Figure 18 illustrates the recent emission trends in the San Joaquin Valley air basin from 2001 through 2005. The greatest decrease in emissions occurred in ROG with a decrease of 33 tpd or 8 percent. NOx also decreased slightly, with a decline of 28 tpd, or 4 percent. Direct PM2.5 emissions showed a decrease of 7 tpd, or 7 percent, while SOx emissions did not change.

The combined downward trends in PM2.5 components, precursor concentrations, and emissions all indicate that over both in the short- and long-term the ongoing control program has had substantial benefits in improving air quality and that similar emission reductions in the future should provide continuing progress towards attaining the federal PM2.5 standards.

Figure 18: PM2.5 and PM2.5 Precursor Emission Trends in the San Joaquin Valley



3. OBSERVATIONAL MODELS AND DIAGNOSTIC ANALYSES

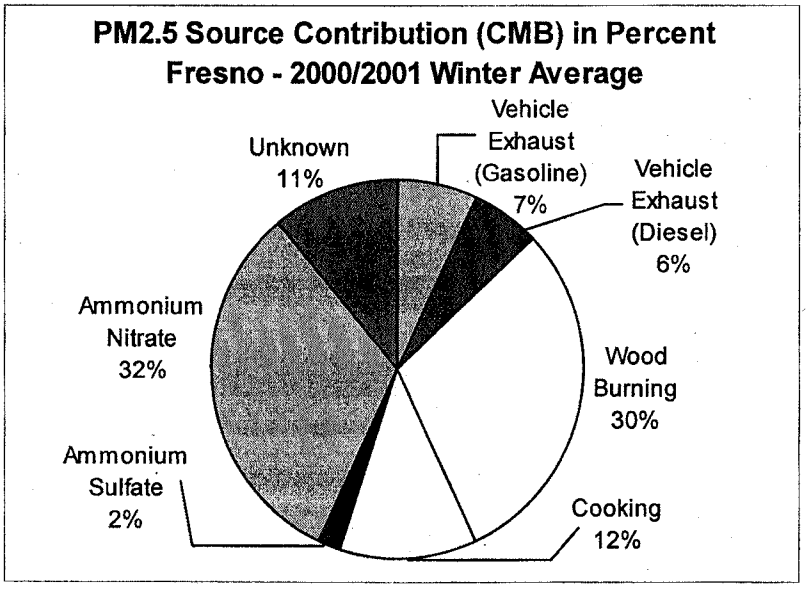
Observational models take advantage of monitored data to draw conclusions about the relative importance of different types of emissions and precursors as factors contributing to observed PM2.5 concentrations. According to U.S. EPA guidance, observational models can be used to corroborate the effects of prior control strategies, as well as identify the potential effectiveness of proposed control approaches. U.S. EPA recommends using both source apportionment (receptor models) and indicator species approaches. The two most widely applied receptor modeling approaches are multi-variate statistical models such as positive matrix factorization (PMF) and the chemical mass balance model (CMB). Receptor models are particularly useful in identifying the source contributions to directly emitted PM. This section summarizes results from prior source apportionment studies as well as both PMF and CMB applied to recent data. In addition, previous work using an indicator species approach to assess the limiting precursor in secondary nitrate formation in the San Joaquin Valley is discussed.

a. Observational Models

Prior Source Apportionment Studies

The Chemical Mass Balance (CMB), and the Positive Matrix Factorization (PMF) and UNMIX (named for its function, which is to "unmix" the concentrations of chemical species measured in the ambient air to identify the contributing sources) multivariate receptor models have been applied to PM2.5 data collected in the San Joaquin Valley. Chow, et al.[2] used the CMB source apportionment model to estimate the contribution of sources to PM2.5 in Fresno during high PM2.5 days occurring from December 15, 2000 through February 3, 2001 illustrated in Figure 19. Secondary ammonium nitrate is the most significant source, contributing 32 percent to the measured PM2.5. Residential wood combustion constitutes 30 percent of PM2.5. Vehicle emissions account for 13 percent of PM2.5, with similar contributions from gasoline (7 percent) and diesel (6 percent) fueled vehicles. Cooking accounts for 12 percent of PM2.5.

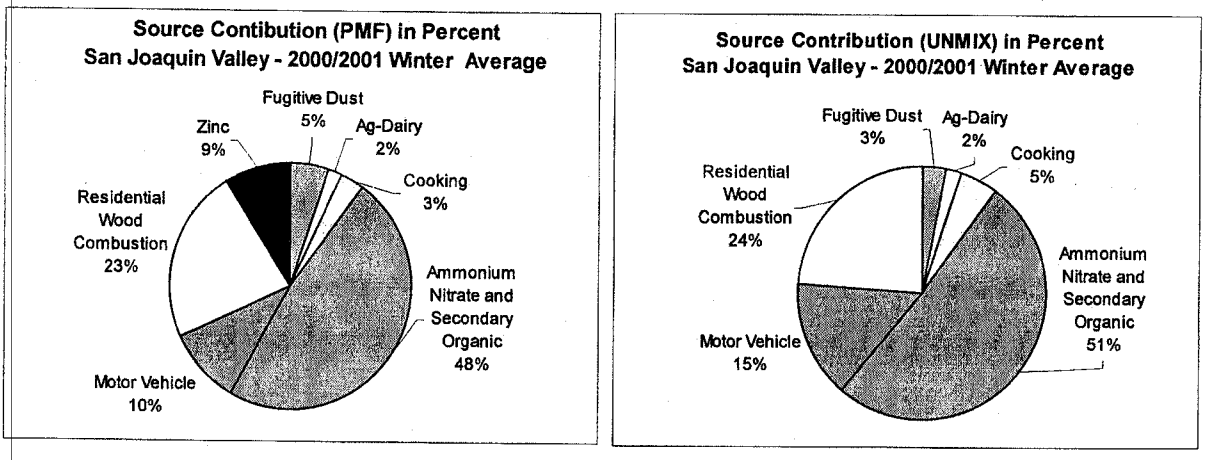
Figure 19: Source Contribution to PM2.5 Concentrations at Fresno Estimated Using the Chemical Mass Balance (CMB) Method



[2] J .C. Chow, J. G. Watson, D. H. Lowenthal, L.-W. A. Chen, B. Zelinska, L. R. Rinehart, and K. L. Magliano: Evaluation of organic markers for chemical mass balance source apportionment at the Fresno Supersite, Atmospheric Chemistry and Physics Discussions, 6, 10341 – 10372, 2006

Chen, et al.[3] applied the PMF and UNMIX models to chemically speciated PM2.5 measurements from 23 sites operated in the in the San Joaquin Valley during the 2000/2001 Central California PM Air Quality Study (CRPAQS) to estimate source contributions. Figure 20 illustrates the resulting source contribution throughout the Valley, estimated for the period when high PM2.5 concentrations occurred (November through January). PMF and UNMIX source contribution estimates are similar. Particles formed through chemical reactions in the atmosphere, including ammonium nitrate and secondary organic compounds are the major contributors, accounting for 48 percent (PMF) and 51 percent (UNMIX) of PM2.5. Residential wood combustion follows, with a contribution of 23 percent (PMF) and 24 percent (UNMIX). Particles directly emitted from motor vehicles account for 10 percent (PMF) and 15 percent (UNMIX) of PM2.5. In addition, the zinc component resulting from the PMF analysis is thought to be related to brake and tire wear and contributes 9 percent to PM2.5.

Figure 20: Source Contribution to PM2.5 in the San Joaquin Valley Estimated Using the Positive Matrix Factorization (PMF) and the UNMIX Models



Recent Studies

To evaluate the major PM2.5 sources and their contributions in the San Joaquin Valley using recent data, two different source apportionment techniques were applied to data collected in 2003 through 2006. The Chemical Mass Balance model (CMB) uses measured source profiles and chemical speciation data in combination to determine source contributions. A fundamental underlying assumption is that the source profiles used as input are appropriate and

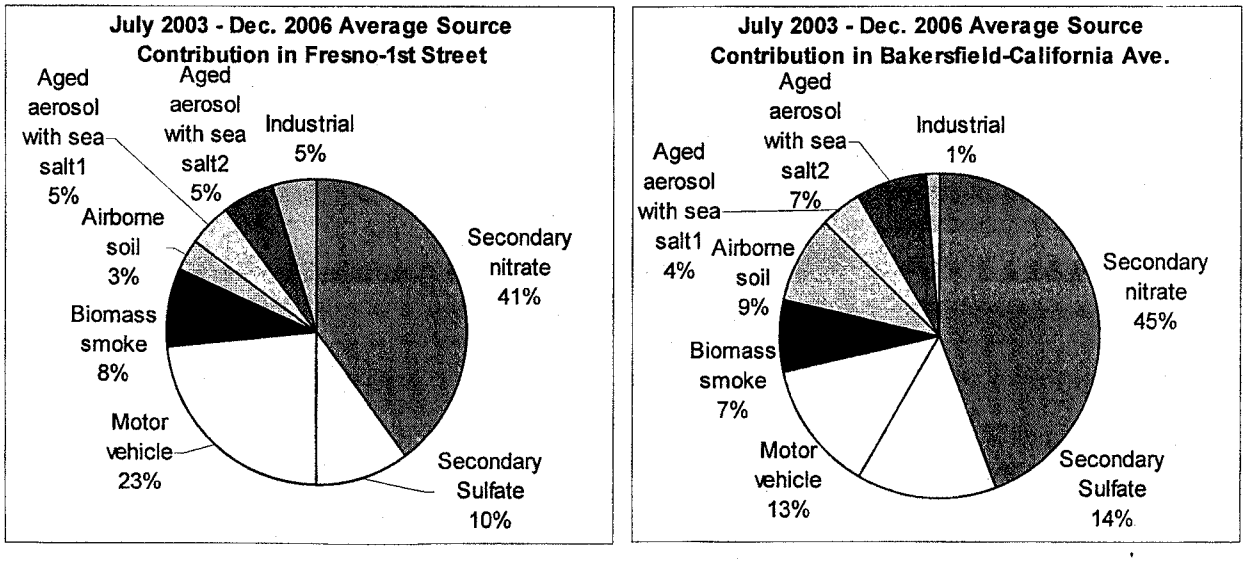
[3] L.-W. A. Chen, J. G. Watson, J. C. Chow, and K. L. Magliano: Quantifying PM2.5 Source Contributions for the San Joaquin Valley with Multivariate Receptor Models, submitted for publication, 2006.

representative for the region. In contrast, PMF does not require the input of source profiles, but rather evaluates the covariance of the chemical species to determine a set of factors, which are typically interpreted as source types. Source contributions are then calculated for each of the factors. Because the factors reflect species which vary in time in a similar manner, the factors may reflect the impacts of primary sources, as well the secondary species that have condensed on these primary particles. Since each technique has strengths and weaknesses, combined the two source apportionment techniques provide complementary results.

Positive Matrix Factorization

The PMF2 model was applied to chemically speciated PM2.5 data collected at the Fresno-First St. and Bakersfield-California Ave. Speciation Trends Network (STN) monitoring sites from July 2003 through December 2006. The average source contribution estimates illustrated in Figure 21 show ammonium nitrate is the major contributor to PM2.5 at both sites (41 percent at Fresno and 45 percent at Bakersfield). Biomass smoke contributes similar percentages at both sites (8 percent at Fresno, 7 percent at Bakersfield) as does the total aged aerosol (10 percent at Fresno, 11 percent at Bakersfield). The main differences in source contribution between the two sites include particles directly emitted from motor vehicles, which at Fresno account for 23 percent of PM2.5, the 2nd major component, while at Bakersfield account for 13 percent. Ammonium sulfate accounts for 10 percent of PM2.5 at Fresno and 14 percent at Bakersfield. Airborne soil is a minor contributor to PM2.5 at Fresno (3 percent), with a 9 percent contribution at Bakersfield.

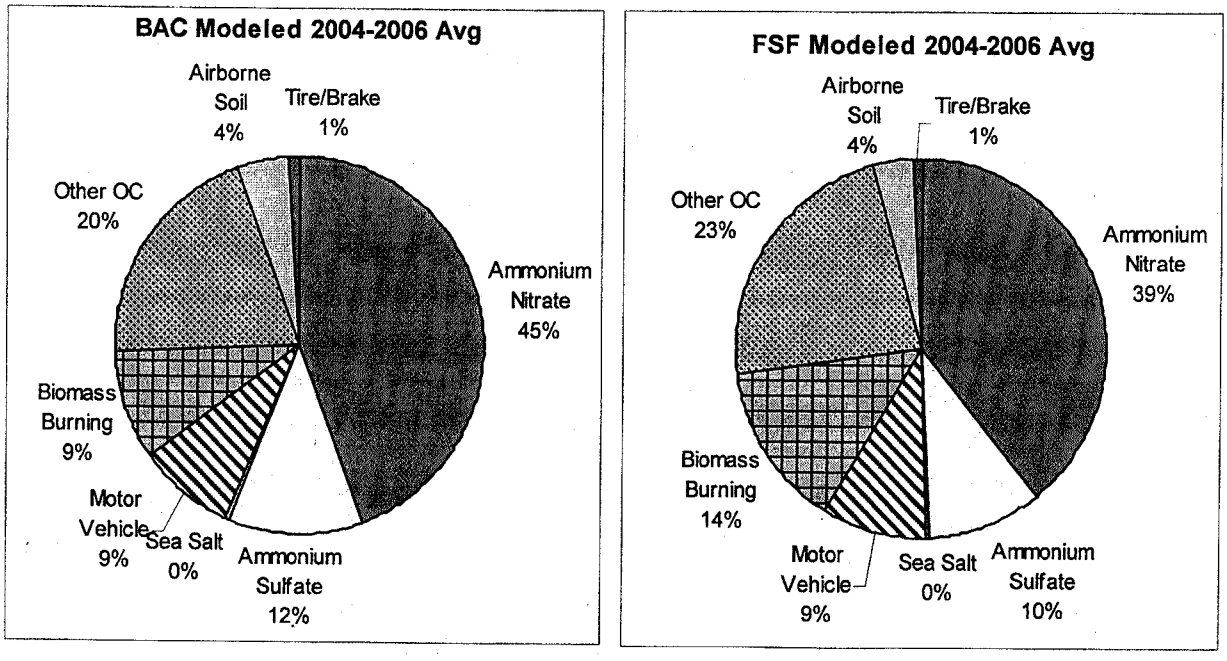
Figure 21. Average Source Contributions Estimated Using PMF2 (2003-2006)



Chemical Mass Balance Modeling

Annual average source contributions at Bakersfield-5558 California Avenue (BAC) and Fresno-1st Street (FSF) were also estimated by applying the Chemical Mass Balance (CMB 8.2) model to individual PM2.5 sample concentrations collected between January 1, 2004 and December 31, 2006 and using source profiles for PM2.5 developed during previous studies. Source contribution estimates were calculated based on the 2004-2006 annual average of the individual samples. Figure 22 shows the calculated contributions to ambient fine particulate matter made by sources included in the model. Ammonium nitrate was the most significant source contributing 44% and 39% of the PM2.5 mass at Bakersfield and Fresno, respectively. Ammonium sulfate accounted for 12% at Bakersfield and 10% at Fresno. The motor vehicle exhaust (diesel and gasoline combined) contribution was 9% at both sites. Vegetative burning, which included residential wood combustion and agricultural and prescribed burning, contributed 9% and 14%, respectively, of the PM2.5 mass. The sea salt contribution was negligible at both sites. The 'Other OC', which represents contributions from secondary organic carbon, other unidentified primary sources, and the possible positive sampling artifacts of organic carbon, accounted for 20% to 23% of the PM2.5 mass.

Figure 22. CMB Model Calculated 2004-2005 Average PM2.5 Source Contributions.



While the specific contributions vary to some extent, taken together these sources apportionment studies highlight the importance of secondary ammonium nitrate contributions to both the 24-hour and annual average concentrations. In addition, biomass burning and mobile sources were found to be significant contributors to primary PM2.5.

Diagnostic Analyses

Indicator Species Approach

As discussed in prior sections, trends in ammonium nitrate concentrations have tracked well with concurrent reductions in NOx, suggesting that NOx control is an effective approach for ensuring further reductions in ammonium nitrate. An indicator species approach provides an additional method to investigate which chemical precursor a secondary species such as ammonium nitrate is most responsive to control of. Ammonium nitrate is formed in the atmosphere through the reactions of precursor nitrogen oxides (NOx), reactive organic gases (ROG), and ammonia (NH3). The amount of each precursor in the atmosphere relative to each other determines how much ammonium nitrate is formed. The chemistry is complex, but essentially the precursor in shortest supply will limit how much ammonium nitrate is produced. Reducing emissions of this limiting precursor provides the best opportunity to cut ammonium nitrate levels. In simple terms, photochemical reactions of NOx and ROG form nitric acid (HNO3). Nitric acid then reacts with ammonia (NH3) to form ammonium nitrate. Lurmann, et al.[4] compared ammonia and nitric acid ambient concentrations measured in the San Joaquin Valley during the winter of 2000/2001, as part of CRPAQS. Figures 23 and 24 show the concentrations of nitric acid and ammonia measured at the rural Angiola site and at the urban Fresno site. At both sites ammonia concentrations are generally at least an order of magnitude higher than the nitric acid concentrations. These ammonia-rich conditions throughout the Valley indicate that, during the winter, nitric acid is the limiting precursor.

[4] F. W. Lurmann, S. G. Brown, M. C. McCarthy, and P. T. Roberts: Processes Influencing Secondary Aerosol Formation in the San Joaquin Valley during Winter, Journal of Air and Waste Management Association, 56, 1679-1693, 2006.

Figure 23: Comparison of Ammonia and Nitric Acid Concentrations Measured at Angiola during the Winter of 2000/2001 as Part of CRPAQS

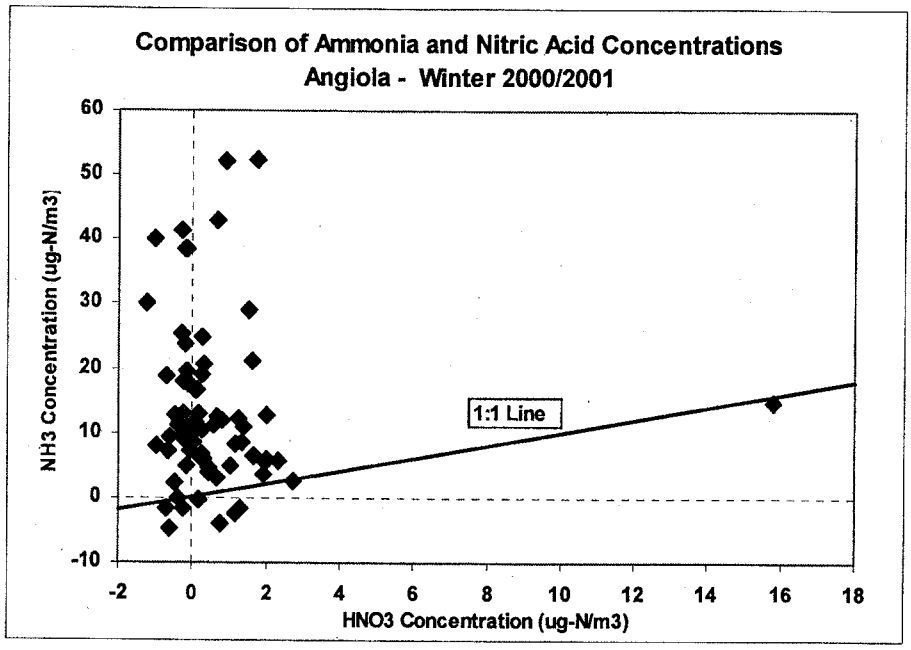
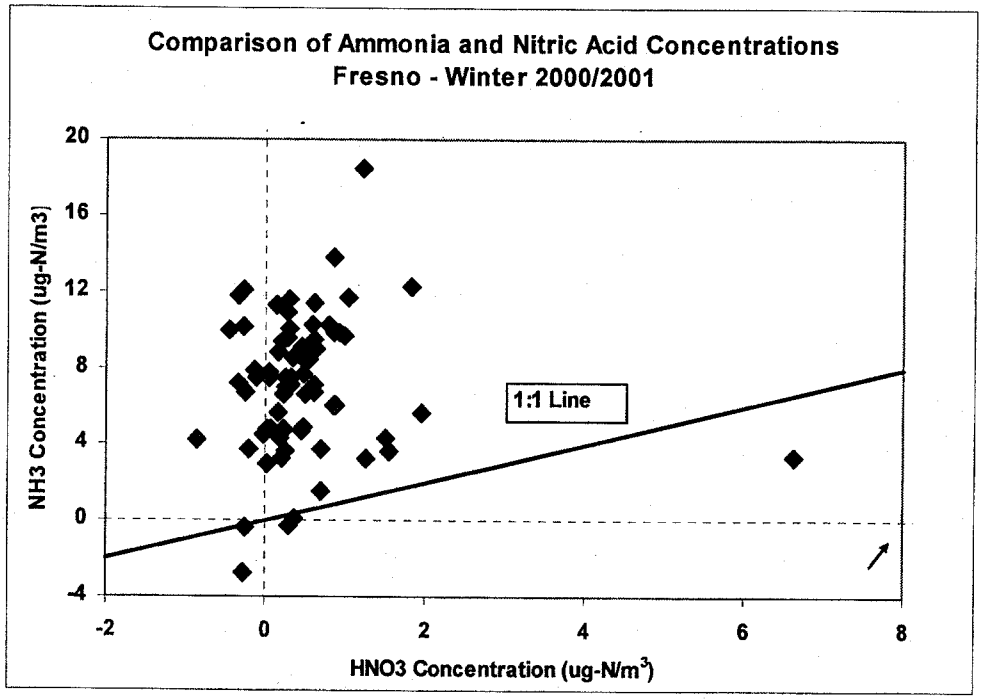


Figure 24: Comparison of Ammonia and Nitric Acid Concentrations Measured at Fresno during the Winter of 2000/2001 as Part of CRPAQS



4. AIR QUALITY MODELING

a. Rollback Modeling

In addition to the evaluation of air quality trends and the observational and diagnostic analyses, a rollback modeling analysis was conducted by the District to estimate the impacts of future emission reductions on resulting air quality. An extensive discussion of the rollback methodology and the results are provided in Chapter 3 and associated spreadsheets of the District Plan. The rollback modeling showed that Fresno and Corcoran would attain the annual PM2.5 standard with baseline emission reductions in 2014. With the addition of the ARB and District proposed control strategy, both Visalia and Bakersfield-Planz would attain in 2014 as well.

b. Grid-Based Modeling

As stipulated in the EPA Modeling Guidance, a grid-based photochemical model is necessary to perform the modeled attainment test for PM2.5 (EPA, 2007[5]). Such models offer the best available representation of important atmospheric processes and are an essential tool in analyzing the impacts of proposed emissions controls on pollutant concentrations. The EPA recommends guidelines for choosing a model for use in the attainment test. For example, the model source code should be free or low cost, modeling elements should have undergone rigorous scientific peer-review, and it should have been shown to perform well in the past for similar applications.

The Community Multiscale Air Quality Modeling System (CMAQ) has been selected for use in the $PM_{2.5}$ modeled attainment demonstration for the San Joaquin Valley Air Pollution Control District. CMAQ is a state-of-the-science "one-atmosphere" system that treats major atmospheric and land processes (e.g., advection, diffusion, gas phase chemistry, gas-particle mass transfer, nucleation, coagulation, wet and dry deposition, aqueous phase chemistry, etc.) and a range of species (e.g., anthropogenic and biogenic, primary and secondary, gaseous and particulate) in a comprehensive framework (EPA, 1999[6]; CMAS, 2007[7]).

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[5] U.S. Environmental Protection Agency. (2007) Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze. EPA-454/B-07-002

[6] U.S. Environmental Protection Agency (1999) Science Algorithms of the EPA Models-3 Community Multiscale Air Quality (CMAQ) Modeling System. EPA/600/R-99/030. http://www.epa.gov/asmdnerl/CMAQ/CMAQscienceDoc.html

[7] Community Modeling and Analysis System (2007) CMAQ v4.6 Operational Guidance Document. http://www.cmaq-model.org/op_guidance_4.6/manual.pdf

CMAQ was run for the year 2000 to provide the basis for the model performance evaluation. It was during 2000 that the California Regional PM10/PM2.5 Air Quality Study (CRPAQS) took place. The study resulted in a wealth of data with which to evaluate model performance. As it is necessary to execute simulations for a model reference year and a future year to perform the recommended modeled attainment demonstration, 2005 and 2014 were also simulated. Simulations for all years were driven by the meteorological inputs for 2000, while emissions varied from year to year.

Regional air quality modeling only represents a portion of the attainment test. In order to perform the EPA-recommended Speciated Modeled Attainment Test, or SMAT, the relative response between the modeled reference and future years must be considered in conjunction with observations. This approach minimizes the uncertainties in predicting future year attainment that result from potential model bias in predicting absolute species concentrations.

Federal Reference Method (FRM) PM2.5 mass measurements provide the basis for nonattainment designations. For this reason it is recommended that the FRM data also be used to project future air quality and progress towards attainment of the health-based National Ambient Air Quality Standard (NAAQS) for PM2.5. However, given the complex physicochemical nature of PM2.5, it is necessary to consider individual species as well. While the FRM measurements give the mass of the bulk sample, a method for apportioning this bulk mass to individual PM2.5 components is a first step towards determining the best targets for emissions controls in order to reach NAAQS levels in a timely manner. Given that (1) attainment status is currently dependent upon FRM measurements and (2) concentrations of individual PM2.5 species need to be considered in order to understand the nature of and efficient ways to ameliorate the PM2.5 problem in a given region, a method has been developed to speciate bulk FRM PM2.5 mass with known FRM limitations in mind. This method is referred to as the measured **S**ulfate, **A**djusted **N**itrate, **D**erived **W**ater, **I**nferred **C**arbonaceous material and estimated acidity (**H**+) approach or "SANDWICH". SANDWICH is based on speciated measurements from other (often co-located) samplers, such as those from the Speciated Trends Network (STN), and the known sampling environment of the FRM. The approach serves to provide mass closure, reconciliation between speciated and bulk mass concentration measurements, and the basis for a connection between observations, modeled PM2.5 concentrations, and the air quality standard.

The SMAT procedure was applied to FRM monitors operating in the San Joaquin Valley with minimal deviations from U.S. EPA's recommended procedure. The 2006 design value was used as a basis from which to project forward to estimated future year design values for the year 2014. Speciation data for four STN (speciation) sites was used to speciate the FRM mass for all FRM sites. For those sites not collocated with STN monitors, "surrogate" speciation sites were determined based on analysis of CRPAQS data to determine which sites

had similar speciation profiles. The composition was assumed to be the same at all three Bakersfield sites (BAC, BGS, and BEP). Similarly, the percent composition at the two Fresno sites (FSF and FSH) was assumed to be the same. In addition, Stockton (SOH), Clovis (CLO), Corcoran (COP), and Modesto (MRM), were assumed to have the same speciation as one of the four speciation sites based on CRPAQS data analysis.

Quarterly average species concentrations were calculated at each STN site using the SANDWICH procedure. Modeled concentrations for the reference year (2005) and future year (2014) for each component were extracted for the FRM sites as a nine-cell average. The relative response factors were calculated for each component for each quarter. These calculations were performed using all modeled days, as we assumed that the selected FRM measurements provided a stable quarterly average value.

These quarterly species percentages were then multiplied against the base year design value for 2006 (the average FRM PM2.5 concentrations for 2004, 2005, and 2006). The quarterly observed species concentrations were then multiplied by the RRFs and summed and averaged to get a future year PM2.5 design value at each FRM site. See Table 3 for the predicted baseline and controlled 2014 PM2.5 design values. For the "controlled" 2014 emissions sensitivity scenario described above, future annual PM2.5 concentrations at all FRM sites are below the annual PM2.5 NAAQS of 15.0 $\mu g/m^3$, and, therefore, the San Joaquin Valley has passed the speciated modeled attainment test for the annual PM2.5 NAAQS.

A similar procedure to the attainment demonstration for the annual PM2.5 standard was followed for the 24-hour PM2.5 standard attainment demonstration. The exception was that only the top 25% of the measured and modeled days for each quarter were used instead of all available days. The top 25% of the days are expected to be more representative of the 24-hour design value than would all available days for a given quarter.

Table 4 shows the predicted 2014, 24-hour PM2.5 design values for the top five 2006 design value sites for the controlled emissions case. As shown, all sites in the SJV attained the 24-hour standard in 2006, and further emissions controls do not cause any monitors to become non-attainment.

Table 3. Reference and future year annual design values for SJV FRM sites

Site	Code	Speciation	2006 DV	2014 Baseline DV	2014 "Controlled" DV
Bakersfield - 5558 California	BAC	BAC	18.51	15.86	14.28
Bakersfield - 410 E Planz Road	BEP	BAC	18.86	16.26	14.70
Bakersfield - Golden State	BGS	BAC	18.64	15.98	14.39
Clovis - N Villa Avenue	CLO	FSF	16.39	14.10	12.72
Corcoran - Patterson Avenue	COP	VCS	17.24	14.75	13.27
Fresno - 1st Street	FSF	FSF	16.68	14.43	13.01
Fresno - Hamilton and Winery	FSH	FSF	17.16	14.93	13.47
Merced - 2334 M Street	MRM	M14	14.69	12.85	11.76
Modesto - 14th Street	M14	M14	14.10	12.52	11.44
Stockton - Hazelton Street	SOH	M14	12.93	11.77	10.87
Visalia - N. Church Street	VCS	VCS	18.20	16.05	14.47

Table 4. Reference and future year 24-hour design values for SJV FRM sites

Site	Code	Speciation	2006 DV	2014 "Controlled" DV
Bakersfield - 5558 California	BAC	BAC	62.4	46.2
Bakersfield - 410 E Planz Road	BEP	BAC	65.2	45.9
Bakersfield - Golden State	BGS	BAC	64.4	45.3
Fresno - 1st Street	FSF	FSF	58.0	41.2
Fresno - Hamilton and Winery	FSH	FSF	58.5	41.7

5. SUMMARY

In summary, the San Joaquin Valley has experienced tremendous progress in reducing PM2.5 concentrations since initial monitoring began in 1990. Between 1990 and 1998, PM2.5 annual average concentrations dropped by approximately 40 percent throughout the Basin. Since 1999, when the official regulatory monitoring program for comparison to the federal PM2.5 standard began, PM2.5 annual average concentrations have dropped a further 19 to 29 percent. While the peak annual average design value in the basin was 24.7 ug/m^3 in 2001, approximately one and a half times the level of the standard, it has dropped to 18.9 ug/m^3 in 2006. Currently, annual design values in the northern portion of the Valley are below the standard. In addition, based on 2004-2006 data, the San Joaquin Valley attains the federal 24-hour standard of 65 ug/m^3. Although concentrations remain the highest in the central and southern portions of the

Valley, the rate of decrease in PM2.5 in response to ongoing control programs has been significant.

Unlike ozone, PM2.5 consists of many different components. Analysis of the trends in different components of PM2.5 has shown that over the last six years, decreases in carbonaceous aerosols and ammonium nitrate have had the greatest contribution to declining PM2.5 mass trends, with carbonaceous aerosol concentrations dropping by 16 to 37 percent and ammonium nitrate concentrations dropping by 23 to 24 percent. During this same time period, ambient NOx concentrations, a precursor to ammonium nitrate, decreased by 15 percent, while NOx emissions dropped by 4 percent. Looking back to the late 1980s, both ammonium nitrate and ammonium sulfate have declined significantly, along with concurrent declines in ambient NO_2 and SO_2 concentrations and NOx and SOx emissions. These significant trends in declining PM2.5 concentrations, ambient precursor concentrations, and associated emissions all suggest that a continuing focus on further NOx reductions, as well as sources which contribute to carbonaceous aerosols will provide significant further progress in attaining the annual PM2.5 standard.

In order to estimate the impact of further emission reductions on future PM2.5 concentrations, both linear rollback and grid-based aerosol modeling were conducted. PM2.5 annual average concentrations in 2014 based on emission reductions achieved from both the ongoing control program, as well as new State and local measures, were estimated with both methods. Substantial further emission reductions for all key pollutants will occur between 2005 and 2014.

Based on the grid-based modeling, several sites in the District would be expected to attain the annual standard in 2014 with baseline emission reductions. With the addition of the new State and local measures focusing on NOx, carbon, and directly-emitted combustion emissions, the sites with the most severe problems – Visalia and Bakersfield – would also attain in 2014 with a maximum predicted design value of 14.7 in Bakersfield. The linear rollback modeling showed similar results, providing a consistent assessment of attainment prospects. It also appears that 2014 is the earliest feasible attainment date. This is due to consideration of the following factors: 1) baseline emission reductions that occur during the period up to 2014 are not sufficient alone to provide for attainment at all sites, 2) the additional emission reductions that will result from the State Strategy will not phase in prior to 2014 due to the extraordinarily complex and innovative nature of developing and implementing these new measures, and 3) the San Joaquin Valley has experienced periods of slower air quality progress due to the influence of meteorology, suggesting that the full timeframe up to 2014 will be needed to ensure attainment.

Therefore, considering all of the information available, the weight-of-evidence analyses provide a consistent assessment that the San Joaquin Valley will attain

the annual average PM2.5 standard throughout the District in 2014. This is due to the following considerations:

- The significant progress that has already occurred, a 6 ug/m3 drop in annual average design value between 2001 and 2006, which represents two-thirds of the progress needed to attain the annual standard by 2014;

- The positive response of ammonium nitrate, ammonium sulfate, and carbon concentrations to past reductions in NOx, SOx, and primary PM2.5 emissions;

- The substantial future emission reductions that will occur due to both baseline commitments as well as new measures from NOx, and primary PM2.5 emissions that have worked in the past;

- Linear rollback modeling which indicates attainment in 2014; and,

- Grid-based aerosol modeling which also indicates attainment in 2014 at all sites in the District.

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER ADOPTION OF PROPOSITION 1B: GRANTS FOR FISCAL YEAR 2007-08 FUNDS TO REDUCE EMISSIONS FROM GOODS MOVEMENT

The Air Resources Board (the Board or ARB) will conduct a public hearing at the time and place noted below to consider adoption of Proposition 1B: Grants for Fiscal Year 2007-08 Funds to Reduce Emissions from Goods Movement.

DATE: May 22, 2008

TIME: 8:30 a.m.

PLACE: San Joaquin Valley Unified
Air Pollution Control District Headquarters
1990 East Gettysburg Avenue
Fresno, California 93726

Or Via Videoconference (2 Locations)

District Northern Region Office
4800 Enterprise Way
Modesto, California 95356

District Southern Region Office
2700 M Street, Suite 275
Bakersfield, California 93301

This item will be considered at a one-day meeting of the Board, which will commence at 8:30 a.m., May 22, 2008. Please consult the agenda for the meeting, which will be available at least 10 days before May 22, 2008, to determine the order of agenda items.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette or computer disk. Please contact ARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact ARB's Bilingual Manager at (916) 323-7053.

BACKGROUND

The movement of freight (goods movement) throughout California results in emissions of diesel particulate matter (diesel PM), nitrogen oxides (NOx), and other harmful pollutants. Goods movement involves the transporting of freight by heavy duty diesel trucks, locomotives, ocean-going cargo ships, harbor craft, and cargo handling equipment. ARB has identified diesel PM as a toxic air contaminant, and NOx contributes to regional ozone

and PM levels that exceed State and federal air quality standards. The emissions from these freight sources result in significant human health risks and adverse environmental effects, particularly in communities located near ports, rail yards, and high truck traffic areas. To reduce the emissions associated with goods movement, ARB has developed and is continuing to develop both regulatory and non-regulatory strategies for California.

Proposition 1B (the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006) authorized $1 billion in bond funding for incentives to cut diesel emissions from freight movement in four priority trade corridors. Senate Bill 88 (Stats. 2007, ch. 181) created the Goods Movement Emission Reduction Program (Program) and provided the first installment of $250 million to ARB as part of the State Fiscal Year FY2007-08 budget. Assembly Bill 201 (Stats. 2007, ch. 187) made a minor clarification to the Program.

Under the Program, ARB works in partnership with local public agencies (such as air quality management districts and ports) to address air pollution emissions and health risks from freight movement along California's priority trade corridors. Local agencies request funding from ARB to provide financial incentives to owners of equipment used in freight movement to upgrade to cleaner technologies.

On February 28, 2008, the Board held a public hearing and adopted the *Proposition 1B: Guidelines for Implementation of the Goods Movement Emission Reduction Program* to ensure that the bond monies accomplish the intended benefits, consistent with the implementing legislation. The Board also approved $25 million in specific "early grant" projects, as well as funding targets for each trade corridor and funding category.

On March 12, 2008, ARB released a Notice of Funding Availability (NOFA) to solicit applications from local agencies for the remaining $221 million in FY2007-08 funds. By the April 4, 2008 application deadline, ARB received 19 project proposals from nine agencies requesting over $730 million in funds.

ARB Staff is developing funding recommendations based on the funding targets and priorities adopted by the Board, together with the competitive process described in the Program Guidelines. Since local agencies submitted credible proposals in each corridor that equal or exceed the funding targets for each corridor, staff intends to recommend that the Board allocate the full $221 million according to those corridor targets. For each corridor, staff will be recommending the source categories and local agency projects that should be funded, and the level of such funding, consistent with the Guidelines.

Trade Corridor	**Corridor Target (Percent)**	**Proposed Allocation of Remaining * FY2007-08 Funds**
Los Angeles/ Inland Empire	55%	$122M
Central Valley	25%	$55M
Bay Area	14%	$31M
San Diego/ Border Region	6%	$13M
TOTAL	**100%**	**$221M**

* Approximately 1.6% ($4M) set aside for anticipated ARB administrative costs.

AVAILABILITY OF DOCUMENTS

Summary tables and of the complete applications submitted by the local agencies are available on the Program website at http://www.arb.ca.gov/bonds/gmbond/gmbond.htm along with the Program Guidelines and other relevant documents. ARB will post the competitive ranking results and preliminary staff recommendations for $221 million in FY2007-08 funds on April 25, 2008. Following public workshops in late April and early May, ARB will release a Staff Report by May 12, 2008 with proposed funding recommendations for consideration by the Board at the May 22 hearing.

Copies may also be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, 1st Floor, Sacramento, CA 95814, or by calling (916) 322-2990.

SUBMITTAL OF PUBLIC COMMENTS AND AGENCY CONTACT PERSON

Interested members of the public may present comments orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written comments not physically submitted at the meeting must be received **no later than 12:00 noon, May 21, 2008**, and addressed to the following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Facsimile submittal: (916) 322-3928

Please note that under the California Public Records Act (Government Code section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and other search engines.

The Board requests but does not require 30 copies of any written submission. Also, the ARB requests that written and e-mail statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment. Further inquiries regarding this matter should be directed to Program staff via the Goods Movement Information Line at (916) 44-GOODS (444-6637) or Cynthia Marvin, Assistant Division Chief, Planning and Technical Support Division, at (916) 322-5350.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: 4/25/08