UTAH

PM_{10} Maintenance Provisions for Utah County

Section IX.A.12

Adopted by the Air Quality Board
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IX.A.12.a Introduction

The State of Utah is requesting that the U.S. Environmental Protection Agency (EPA) redesignate the Utah County nonattainment area to attainment status for the 24-hour PM10 National Ambient Air Quality Standard (NAAQS).

The foregoing Subsections 1-9 of Part IX.A of the Utah State Implementation Plans (SIP) were written in 1991 to address violations of the NAAQS for PM_{10} in both Utah County and Salt Lake County. These areas were each classified as Initial Moderate PM_{10} Nonattainment Areas, and as such required "nonattainment SIPs" to bring them into compliance with the NAAQS by a statutory attainment date. The control measures adopted as part of those plans have proven successful in that regard, and at the time of this writing (2015) each of these areas continues to show compliance with the federal health standards for PM_{10}.

This Subsection 12 of Part IX.A of the Utah SIP represents the second chapter of the PM_{10} story for Utah County, and demonstrates that the area has achieved compliance with the PM_{10} NAAQS and will continue to maintain that standard through the year 2030. As such, it is written in accordance with Section 175A (42 U.S.C. 7505a) of the federal Clean Air Act (the Act), and should serve to satisfy the requirement of Section 107(d)(3)(E)(iv) of the Act.

This section is hereafter referred to as the "Maintenance Plan" or "the Plan," and contains the maintenance provisions of the PM_{10} SIP for Utah County.

While the Maintenance Plan could be written to replace all that had come before, it is presented herein as an addendum to Subsections 1-9 in the interest of providing the reader with some sense of historical perspective. Subsections 1-9 are retained for historical purposes, as is the federally approved Subsection 10 (transportation conformity for Utah County).

In a similar way, any references to the Technical Support Document (TSD) in this section means actually Supplement IV-15 to the Technical Support Document for the PM_{10} SIP.

Background

The Act requires areas failing to meet the federal ambient PM_{10} standard to develop SIP revisions with sufficient control requirements to expeditiously attain and maintain the standard. On July 1, 1987, EPA promulgated a new NAAQS for particulate matter with a diameter of 10 microns or less (PM_{10}), and listed Utah County as a Group I area for PM_{10}. This designation was based on historical data for the previous standard, total suspended particulate, and indicated there was a 95% probability the area would exceed the new PM_{10} standard. Group I area SIPs were due in April 1988, but Utah was unable to complete the SIP by that date. In 1989, several citizens groups sued EPA (*Preservation Counsel v. Reilly*, civil Action (No. 89-C262-G (D, Utah)) for failure to implement a Federal Implementation Plan (FIP) under provisions of §110(c)(1) of the Clean Air Act (42 U.S.C. 7410(c)(1)).

A settlement agreement in January 1990 called for Utah to submit a SIP and for EPA to approve it by December 31, 1991. In August 1991, the parties voluntarily agreed to dismiss the lawsuit and the complaint and vacate the settlement agreement.

The Clean Air Act Amendments of November 1990 redesignated Group I areas as initial moderate nonattainment areas and required that SIPs be submitted by November 15, 1991. These moderate area SIPs were to require installation of Reasonably Available Control Measures (RACM) on industrial sources by December 10, 1993 and a demonstration the NAAQS would be attained no later than December 31, 1994.

(1) The PM_{10} SIP

On November 14, 1991, Utah submitted a SIP for Salt Lake and Utah Counties that demonstrated attainment of the PM_{10} standards in Salt Lake and Utah Counties for 10 years, 1993 through 2003. EPA published approval of the SIP on July 8, 1994 (59 FR 35036).

(2) Supplemental History of SIP Approval - PM_{10}

Utah's SIP included two provisions that promised additional action by the state: 1) a road salting and sanding program, and 2) a diesel vehicle emissions inspection and maintenance program.

On February 3, 1995, Utah submitted amendments to the SIP to specify the details of the road salting and sanding program promised as a control measure. EPA published approval of the road salting and sanding provisions on December 6, 1999 (64 FR 68031).

On February 6, 1996, Utah submitted to EPA a new SIP Section XXI, a diesel vehicle inspection and maintenance program.

Also, in April 1992, EPA published the "General Preamble," describing EPA's views on reviewing state SIP submittals. One of the requirements was that moderate nonattainment area states must submit contingency plans by November 15, 1993.

On July 31, 1994, Utah submitted an amendment to the PM_{10} SIP that required lowering the threshold for calling no-burn days as a contingency measure for Salt Lake, Davis and Utah Counties.

On July 18, 1997, EPA promulgated a new form of the PM_{10} standard. As a way to simplify EPA's process of revoking the old PM_{10} standard, EPA requested on April 6, 1998, that Utah withdraw its submittals of contingency measures. Utah submitted a letter requesting withdrawal on November 9, 1998, and EPA returned the submittals on January 29, 1999.

(3) Attainment of the PM_{10} Standard and Reasonable Further Progress

By statute, EPA was to determine whether Initial Moderate Areas were attaining the standard as of December 31, 1994. This determination requires an examination of the three previous calendar years of monitoring data (in this case 1992, 1993 and 1994). The 24-hour NAAQS allows no more than three expected exceedances of the 24-hour standard at any monitor in this 3-year period. Since the statutory deadline for the implementation of RACM was not until the end of 1993, it was reasonable to presume that the area might not be able to show attainment with a 3-year data set until the end of 1996 even if the control measures were having the desired effect. Presumably for this reason, Section 188(d) of the Act, (42 U.S.C. 7513(d)) allows a state to request up to two 1-year extensions of the attainment date. In doing so, the state must show that it has met all requirements of the SIP, that no more than one exceedance of the 24-hour PM_{10} NAAQS has been observed in the year prior to the request, and that the annual mean concentration for such year is less than or equal to the annual standard.

EPA's Office of Air Quality Planning and Standards issued a guidance memorandum concerning extension requests (November 14, 1994), clarifying that the authority delegated to the Administrator for extending moderate area attainment dates is discretionary. In exercising this discretionary authority, it says, EPA will examine the air quality planning progress made in the area, and in addition to the two criteria specified in Section 188(d), EPA will be disinclined to grant an attainment date extension unless a state has, in substantial part, addressed its moderate PM_{10} planning obligations for the area. The EPA will expect the State to have adopted and substantially implemented control measures submitted to address the requirement for implementing RACM/RACT in the moderate nonattainment area, as this was the central control requirement applicable to such areas. Furthermore it said, "EPA believes this request is appropriate, as it provides a reliable indication that any improvement in air quality evidenced by a low number of exceedances reflects the application of permanent steps to improve the air quality in the region, rather than temporary economic or meteorological changes." As part of this showing, EPA expected the State to demonstrate that the PM_{10} nonattainment area has made emission reductions amounting to reasonable further progress (RFP) toward attainment of the NAAQS, as defined in Section 171(1) of the Act.

On May 11, 1995, Utah requested one-year extensions of the attainment date for both Salt Lake and Utah Counties. On October 18, 1995, EPA sent a letter granting the requests for extensions, and on January 25, 1996, sent a letter indicating that EPA would publish a rulemaking action on the extension requests. On March 27, 1996, Utah requested a second one-year extension for Utah County.

Along with the extension requests in 1995, Utah submitted a milestone report as required under Section 172(1) of the Act, (42 U.S.C. 7501(1)) to assess progress toward attainment. This milestone report addressed two issues: 1) that all control measures in the approved plan had been implemented, and 2) that reasonable further progress (RFP) had been made toward attainment of the standard in terms of reducing emissions. As defined in Section 171(1), RFP means such annual incremental reductions in emissions of the relevant air pollutant as are required to ensure attainment of the applicable NAAQS by the applicable date.

On June 18, 2001, EPA published notice in the Federal Register (66 FR 32752) that Utah's extension requests were granted, that Salt Lake County attained the PM_{10} standard by December 31, 1995, and that Utah County attained the standard by December 31, 1996. The notice stated that these areas remain moderate nonattainment areas and are not subject to the additional requirements of serious nonattainment areas.

IX.A.12.b Pre-requisites to Area Redesignation

Section 107(d)(3)(E) of the Act outlines five requirements that must be satisfied in order that a state may petition the Administrator to redesignate a nonattainment area back to attainment. These requirements are summarized as follows: 1) the Administrator determines that the area has attained the applicable NAAQS, 2) the Administrator has fully approved the applicable implementation plan for the area under §110(k) of the Act, 3) the Administrator determines that the improvement in air quality is due to permanent and enforceable reductions in emissions resulting from implementation of the applicable implementation plan … and other permanent and enforceable reductions, 4) the Administrator has fully approved a maintenance plan for the area as meeting the requirements of §175A of the Act, and 5) the State containing such area has met all requirements applicable to the area under §110 and Part D of the Act.

Each of these requirements will be addressed below. Certainly, the central element from this list is the maintenance plan found at Subsection IX.A.11.c below. Section 175A of the Act contains the necessary requirements of a maintenance plan, and EPA policy based on the Act requires additional elements in order that such plan be federally approvable. Table IX.A.11. 1 identifies the prerequisites that must be fulfilled before a nonattainment area may be redesignated to attainment under Section 107(d)(3)(E) of the Act.

Table IX.A.12. 1 Prerequisites to Redesignation in the Federal Clean Air Act (CAA)

Category	**Requirement**	**Reference**	**Addressed in Section**
Attainment of Standard	Three consecutive years of PM_{10} monitoring data must show that violations of the standard are no longer occurring.	CAA §107(d)(3)(E)(i)	IX.A._12.b(1)
Approved State Implementation Plan	The SIP for the area must be fully approved.	CAA §107(d)(3)(E)(ii)	IX.A._12.b(2)
Permanent and Enforceable Emissions Reductions	The State must be able to reasonably attribute the improvement in air quality to emission reductions that are permanent and enforceable	CAA §107(d)(3)(E)(iii), Calcagni memo (Sect 3, para 2)	IX.A._12.b(3)
Section 110 and Part D requirements	The State must verify that the area has met all requirements applicable to the area under section 110 and Part D.	CAA: §107(d)(3)(E)(v), §110(a)(2), Sec 171	IX.A._12.b(4)
Maintenance Plan	The Administrator has fully approved the Maintenance Plan for the area as meeting the requirements of CAA §175A	CAA: §107(d)(3)(E)(iv)	IX.A._12.b(5) and IX.A._12.c

(1) The Area Has Attained the PM_{10} NAAQS

CAA 107(d)(3)(E)(i) - *The Administrator determines that the area has attained the national ambient air quality standard.* To satisfy this requirement, the State must show that the area is attaining the applicable NAAQS. According to EPA's guidance concerning area redesignations (Procedures for Processing Requests to Redesignate Areas to Attainment, John Calcagni to Regional Air Directors, September 4, 1992 [or, Calcagni]), there are generally two components involved in making this demonstration. The first relies upon ambient air quality data which should be representative of the area of highest concentration and should be collected and quality assured in accordance with 40 CFR 58. The second component relies upon supplemental air quality modeling. Each will be discussed in turn.

(a) Ambient Air Quality Data (Monitoring)

In 1987 EPA promulgated the National Ambient Air Quality Standard (NAAQS) for PM_{10}. The NAAQS for PM_{10} is listed in 40 CFR 50.6 along with the criteria for attaining the standard. The 24-hour NAAQS is 150 micrograms per cubic meter (ug/m^3) for a 24-hour period, measured from midnight to midnight. The 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m^3, as determined in accordance with Appendix K to that part, is equal to or less than one. In other words, each monitoring site is allowed up to three expected exceedances of the 24-hour standard within a period of three calendar years. More than three expected exceedances in that three-year period is a violation of the NAAQS.

There also had been an annual standard of 50 ug/m^3. The annual standard was attained if the three-year average of individual annual averages was less than 50 ug/m^3. None of Utah's areas was ever designated nonattainment for the annual NAAQS, and the annual average was not retained as a PM_{10} standard when the NAAQS was revised in 2006. Nevertheless, an annual average still provides a useful metric to evaluate long-term trends in PM_{10} concentrations here in Utah where short-term meteorology has such an influence on high 24-hour concentrations during the winter season.

40 CFR 58 Appendix K, Interpretation of the National Ambient Air Quality Standards for Particulate Matter, acknowledges the uncertainty inherent in measuring ambient PM_{10} concentrations by specifying that an *observed exceedance* of the (150 ug/m^3) 24-hour health standard means a daily value that is above the level of the 24-hour standard after rounding to the nearest 10 ug/m^3 (e.g., values ending in 5 or greater are to be rounded up).

The term *expected exceedance* accounts for the possibility of missing data. Missing data can occur when a monitor is being repaired, calibrated, or is malfunctioning, leaving a time gap in the monitored readings.

Expected exceedances are calculated from the (AQS) data base according to procedures contained in 40 CFR Part 50, Appendix K. The State relied on the expected exceedance values contained in the (AQS) Quick Look Report (AMP 450) to determine if a violation of the standard had occurred.

Data may also be flagged when circumstances indicate that it would represent an event in the data set and not be indicative of the entire airshed or the efforts to reasonably mitigate air pollution within. 40 CFR 50.14 "Treatment of air quality monitoring data influenced by exceptional events" anticipates this, and says that a State may request EPA to exclude data showing exceedances or violations… that are directly due to an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, from use in determinations. The protocol for data handling dictates that flagging is initiated by the state or local agency, and then the EPA either concurs or indicates that it has not concurred. Some discussion will be provided to help the reader understand the occasional occurrence of wind-blown dust events that affect these nonattainment areas, and how the resulting data should be interpreted with respect to the control measures enacted to address the 24-hour NAAQS.

Using the criteria from 40 CFR 58 Appendix K, data was compiled for all PM_{10} monitors within the Utah County nonattainment area that recorded a four-year data set comprising the years 2011 – 2014. For each monitor, the number of expected exceedances is reported for each year, and then the average number of expected exceedances is reported for the overlapping three-year periods. If this average number of expected exceedances is less than or equal to 1.0, then that particular monitor is said to be in compliance with the 24-hour standard for PM_{10}. In order for an area to be in compliance with the NAAQS, every monitor within that area must be in compliance.

As illustrated in the table below, the results of this exercise show that the Utah County PM_{10} nonattainment area is presently attaining the NAAQS.

Table IX.A.12. 2 PM_{10} Compliance in Utah County, 2011-2014

Lindon 49-049-4001	24-hr Standard	3-Year Average
	No. Expected Exceedances	No. Expected Exceedances
2011	0.0	
2012	0.0	
2013	0.0	0.0
2014	0.0	0.0

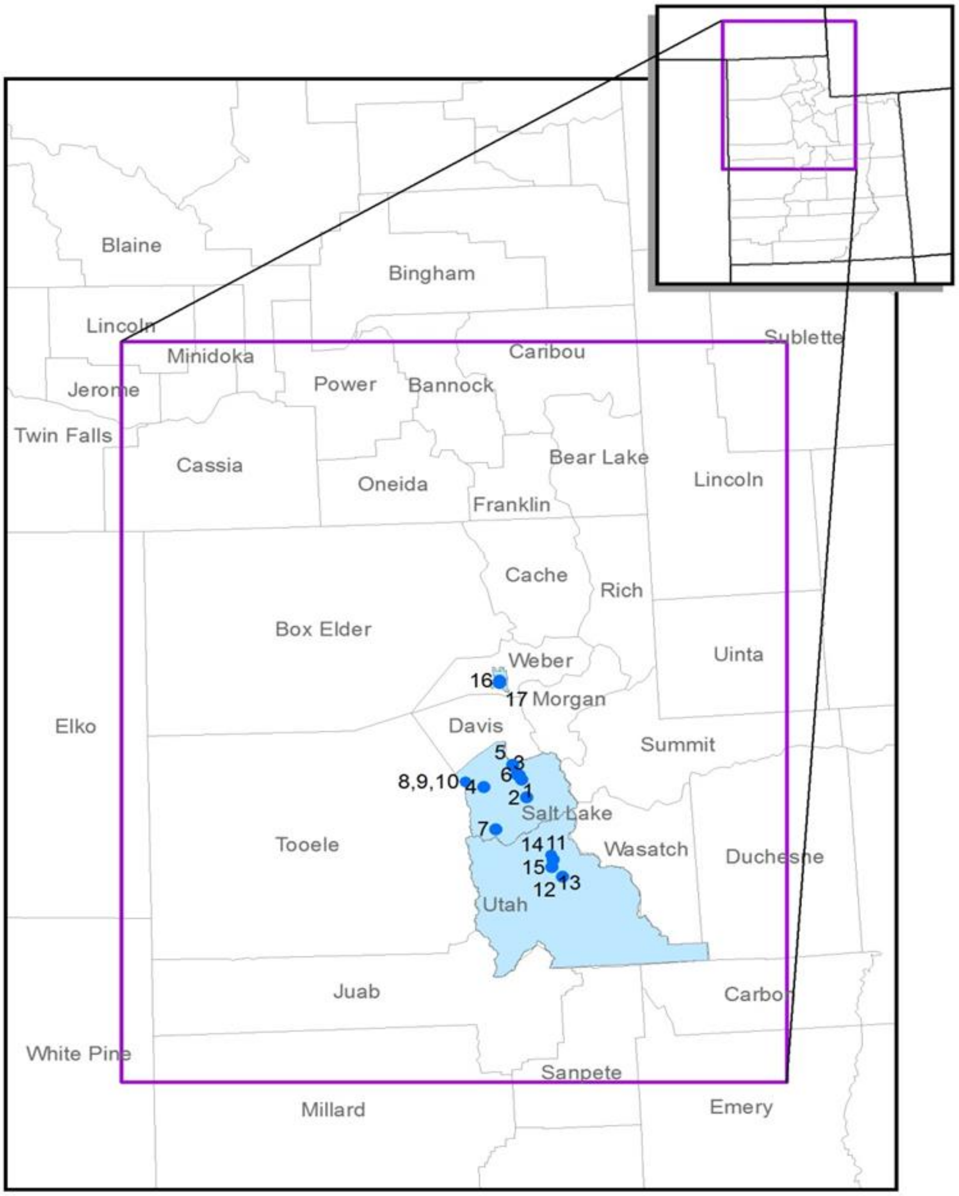
North Provo 49-049-0002	24-hr Standard	3-Year Average
	No. Expected Exceedances	No. Expected Exceedances
2011	0.0	
2012	0.0	
2013	0.0	0.0
2014	0.0	0.0

(b) PM_{10} Monitoring Network

The overall assessments made in the preceding paragraph were based on data collected at monitoring stations located throughout the nonattainment area. The Utah DAQ maintains a network of PM_{10} monitoring stations in accordance with 40 CFR 58. These stations are referred to as SLAMS sites, meaning that they are State and Local Air Monitoring Stations. In consultation with EPA, an Annual Monitoring Network Plan is developed to address the adequacy of the monitoring network for all criteria pollutants. Within the network, individual stations may be situated so as to monitor large sources of PM_{10}, capture the highest concentrations in the area, represent residential areas, or assess regional concentrations of PM_{10}. Collectively, these monitors make up Utah's PM_{10} monitoring network. The following paragraphs describe the network in each of Utah's three nonattainment areas for PM_{10}.

Provided in Figure IX.A.12. 1 is a map of the modeling domain that shows the existing PM_{10} nonattainment areas and the locations of the monitors therein. Some of the monitors at these locations are no longer operational, but they have been included for informational purposes.

Figure IX.A.12. 1 Modeling Domain



The following PM_{10} monitoring stations operated in the Salt Lake County PM_{10} nonattainment area from 1985 through 2015. They are numbered as they appear on the map:

1. Air Monitoring Center (AMC) (AIRS number 49-035-0010): This site was located in an urban city center, near an area of high vehicle use. It was closed in 1999 when DAQ lost its lease on the building.

2. Cottonwood (AIRS number 49-035-0003): This site was located in a suburban residential area. It collected data from 1986 - 2011. It was closed in 2011 due to siting criteria violations as well as safety concerns.

3. Hawthorne (AIRS number 49-035-3006): This site is located in a suburban residential area. It began collecting data in 1997 and is the NCORE site for Utah.

4. Magna (AIRS number 49-035-1001): This site is located in a suburban residential area. It was historically impacted periodically by blowing dust from a large tailings impoundment, and as such is anomalous with respect to the typical wintertime scenario that otherwise characterizes the nonattainment area. It has been collecting data since 1987.

5. North Salt Lake (AIRS number 49-035-0012): This site was located in an industrial area that is impacted by sand and gravel operations, freeway traffic, and several refineries. It was near a residential area as well. It collected data from 1985 - 2013. The monitor was situated over a sewer main, and service of that main required its removal in September 2013, and following the service, the site owner did not allow the monitor to return.

6. Salt Lake City (AIRS number 49-035-3001): This site was situated in an urban city center. It was discontinued in 1994 because of modifications that were made to the air conditioning on the roof-top.

7. Herriman #3 (AIRS number 49-035-3012): This site is located in a suburban residential area. It began collecting data in 2015.

8. Beach #2 (AQS number 49-035-0005): This site, from 1988-1990, was located near the Great Salt Lake.

9. Beach #3 (AQS number 49-035-2003): This site, from 1991-1992, was located at the Great Salt Lake Marina.

10. Beach #4 (AQS number 49-035-2004): This site, from 1991-1997, was located at the Great Salt Lake Marina.

The following PM_{10} monitoring stations operated in the Utah County PM_{10} nonattainment area from 1985 through 2015. They are numbered as they appear on the map:

11. Lindon (AIRS number 49-049-4001): This site is designed to measure population exposure to PM_{10}. It is located in a suburban residential area affected by both industrial and vehicle emissions. PM_{10} has been measured at this site since 1985, and the readings taken here have consistently been the highest in Utah County. Area source emissions, primarily wood smoke, also affect the site.

12. North Provo (AIRS number 49-049-0002): This is a neighborhood site in a mixed residential-commercial area in Provo, Utah. It began collecting data in 1986.

13. West Orem (AIRS number 49-049-5001): This site was originally located in a residential area adjacent to a large steel mill which has since closed. It is a neighborhood site. It was situated based on computer modeling, and has historically reported high PM_{10} values, but not consistently as high as those observed at the Lindon site. The site was closed at the end of 1997 for this reason.

14. Pleasant Grove (AQS number 49-049-2001): This site, from 1985-1987, was located in a suburban area.

15. Orem (AQS number 49-049-5004): This site, from 1991-1993, was located next to a through highway in a business area.

The following PM_{10} monitoring stations operated in the Ogden City PM_{10} nonattainment area from 1986 through 2015. They are numbered as they appear on the map:

16. Ogden 1 (AIRS number 49-057-0001): This site was situated in an urban city center. It was discontinued in 2000 because DAQ lost its lease on the building.

17. Ogden 2 (AIRS number 49-057-0002): This site began collecting data in 2001, as a replacement for the Ogden 1 location. It, too, is situated in an urban city center.

(c) Modeling Element

EPA guidance concerning redesignation requests and maintenance plans (Calcagni) discusses the requirement that the area has attained the standard, and notes that air quality modeling may be necessary to determine the representativeness of the monitored data.

Information concerning PM_{10} monitoring in Utah is included in the Annual Monitoring Plan and the 5-Year Monitoring Network Assessment. Since the early 1980's, the network review has been updated annually and submitted to EPA for approval. EPA has concurred with the annual network reviews and agreed that the PM_{10} network is adequate. EPA personnel have also visited the monitor sites on several occasions to verify compliance with federal siting requirements. Therefore, additional modeling will not be necessary to determine the representativeness of the monitored data.

The Calcagni memo goes on to say that areas that were designated nonattainment based on modeling will generally not be redesignated to attainment unless an acceptable modeling analysis indicates attainment.

Though none of Utah's three PM_{10} nonattainment areas was designated based on modeling, Calcagni also states that (when dealing with PM_{10}) dispersion modeling will generally be necessary to evaluate comprehensively sources' impacts and to determine the areas of expected high concentrations based upon current conditions. Air quality modeling was conducted for the purpose of this maintenance demonstration. It shows that all three nonattainment areas are presently in compliance, and will continue to comply with the PM_{10} NAAQS through the year 2030.

(d) EPA Acknowledgement

The data presented in the preceding paragraphs shows quite clearly that the Utah County PM_{10} nonattainment area is attaining the NAAQS. As discussed before, the EPA acknowledged in the Federal Register that both Utah County and Salt Lake County had already attained.

On June 18, 2001, EPA published notice in the Federal Register (66 FR 32752) that Utah's extension requests were granted, and that Utah County attained the standard by December 31, 1996. The notice stated that the area would remain a moderate nonattainment area and would not be subject to the additional requirements of serious nonattainment areas.

(2) Fully Approved Attainment Plan for PM_{10}

CAA 107(d)(3)(E)(ii) - *The Administrator has fully approved the applicable implementation plan for the area under section 110(k).*

On November 14, 1991, Utah submitted a SIP for Salt Lake and Utah Counties that demonstrated attainment for Salt Lake and Utah Counties for 10 years, 1993 through 2003. EPA published approval of the SIP on July 8, 1994 (59 FR 35036).

On July 3, 2002, Utah submitted a PM_{10} SIP revision for Utah County. It revised the existing attainment demonstration in the approved PM_{10} SIP based on a short-term emissions inventory, established 24-hour emission limits for the major stationary sources in the Utah County nonattainment area, and established motor vehicle emission budgets based on EPA's most recent mobile source emissions model, MOBILE6. It demonstrated attainment in the Utah County nonattainment area through 2003. The revised attainment demonstration extended through the year 2003. EPA published approval of this SIP revision on December 23, 2002 (67 FR 78181). It became effective on January 22, 2003.

Also, on March 9, 2015, Utah submitted a revision to the SIP, adding a new rule regarding trading of motor vehicle emission budgets (MVEB) for Utah County. The rule allows trading from the motor vehicle emissions budget for primary PM_{10} to the motor vehicle emissions budget for nitrogen oxides (NO_X), which is a PM_{10} precursor. The resulting motor vehicle emissions budgets for NO_X and PM_{10} may then be used to demonstrate transportation conformity with the SIP. The rule was approved by EPA and became effective on July 17, 2015.

(3) Improvements in Air Quality Due to Permanent and Enforceable Reductions in Emissions

CAA 107(d)(3)(E)(iii) - *The Administrator determines that the improvement in air quality is due to permanent and enforceable reductions in emissions resulting from implementation of the applicable implementation plan and applicable Federal air pollutant control regulations and other permanent and enforceable reductions.* Speaking further on the issue, EPA guidance (Calcagni) reads that the State must be able to reasonably attribute the improvement in air quality to emission reductions which are permanent and enforceable. In the following sections, both the improvement in air quality and the emission reductions themselves will be discussed.

(a) Improvement in Air Quality

The improvement in air quality with respect to PM_{10} can be shown in a number of ways. Improvement, in this case, is relative to the various control strategies that affected the airshed.

For the Utah County nonattainment area, these control measures were implemented as the result of the nonattainment PM_{10} SIP promulgated in 1991. As discussed below, the actual implementation of the control strategies required therein first exhibits itself in the observable data in 1994. The ambient air quality data presented below includes values prior to 1994 in order to give a representation of the air quality prior to the application of any control measures. It then includes data collected from then until the present time to illustrate the effect of these controls. In considering the data presented below, it is important to keep this distinction in mind: data through

1993 represents pre-SIP conditions, and data collected from 1994 through the present represents post-SIP conditions.

Additionally, a downturn in the economy is clearly not responsible for the improvement in ambient particulate levels in Salt Lake County, Utah County, and Ogden City areas. From 2001 to present, the areas have experienced strong growth. Data was analyzed for the Salt Lake City Metropolitan Statistical Area from the US Department of Commerce, Bureau of Economic Analysis. According to this data, job growth from 2011 through 2013 increased by 5.5 percent, population increased by 3 percent, and personal income increased by approximately 10 percent. The estimated VMT increase was 12 percent from 2011 to present.

Expected Exceedances – Referring back to the discussion of the PM_{10} NAAQS in Subsection IX.A.12.b(1), it is apparent that the number of expected exceedances of the 24-hour standard is an important indicator. As such, this information has been tabulated for each of the monitors located in each of the nonattainment areas. The data in Table IX.A.12. 3 below reveals a marked decline in the number of these expected exceedances, and therefore that the Utah County PM_{10} nonattainment area has experienced significant improvements in air quality. The gray cells indicate that the monitor was not in operation. This improvement is especially revealing in light of the significant growth experienced during this same period in time.

Table IX.A.12. 3 Utah County: Expected Exceedances Per-Year, 1986-2014

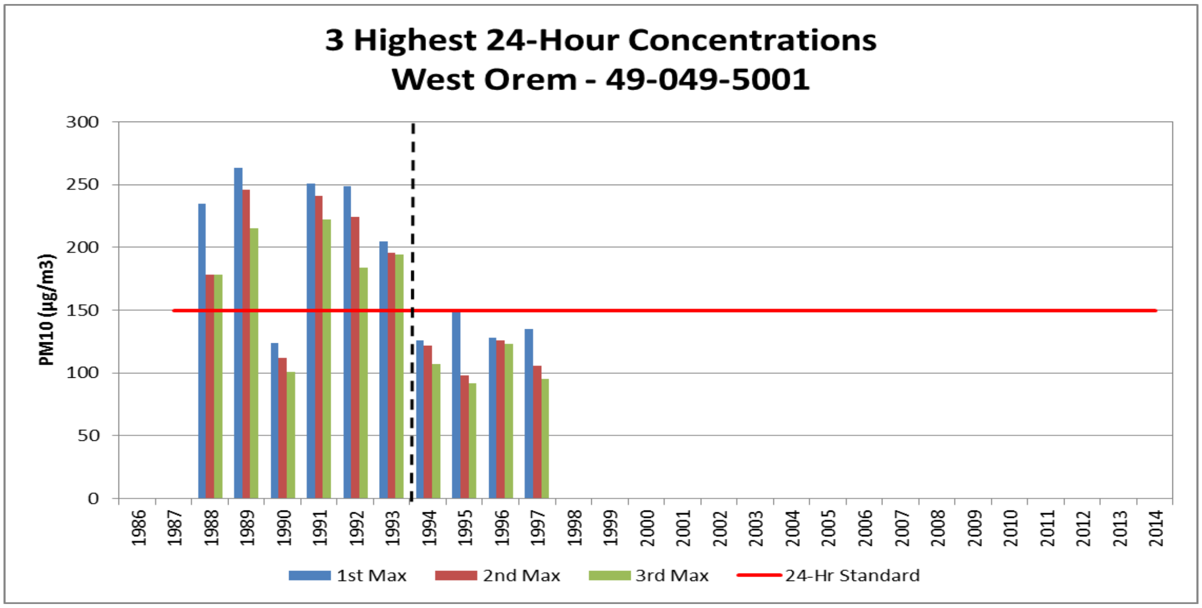
Utah County Nonattainment Area		
Monitor:	**North Provo**	**Lindon**
1986		
1987	0.0	0.0
1988	2.0	15.9
1989	8.0	22.2
1990	0.0	0.0
1991	7.3	11.7
1992	3.1	5.3
1993	4.1	5.2
1994	0.0	0.0
1995	0.0	0.0
1996	0.0	0.0
1997	0.0	0.0
1998	0.0	0.0
1999	0.0	0.0
2000	0.0	0.0
2001	0.0	0.0
2002	0.0	1.0
2003	0.0	0.0
2004	0.0	1.0
2005	0.0	0.0
2006	0.0	0.0
2007	0.0	0.0
2008	0.0	4.0
2009	0.0	2.1
2010	3.5	1.0
2011	0.0	0.0
2012	0.0	0.0
2013	0.0	0.0
2014	0.0	0.0

As discussed before in section IX.A.12.b(1), the number of expected exceedances may include data which had been flagged by DAQ as being influenced by an exceptional event; most typically, a wind-blown dust event. Data is flagged when circumstances indicate that it would not be indicative of the entire airshed or the efforts to reasonably mitigate air pollution within.

As such two things should be noted: 1) The focus of the control strategy developed for the 1991 PM_{10} SIP was directed at episodes characterized by wintertime temperature inversions, elevated concentrations of secondary aerosol, and low wind speed. Under these conditions, blowing dust is generally nonexistent. Therefore, in evaluating the effectiveness of these types of controls, the inclusion of several high wind events may bias the conclusion. 2) Even with the inclusion of these values, the conclusion remains essentially the same; that since 1994 when the 1991 SIP controls were fully implemented, there has been a marked improvement in monitored air quality.

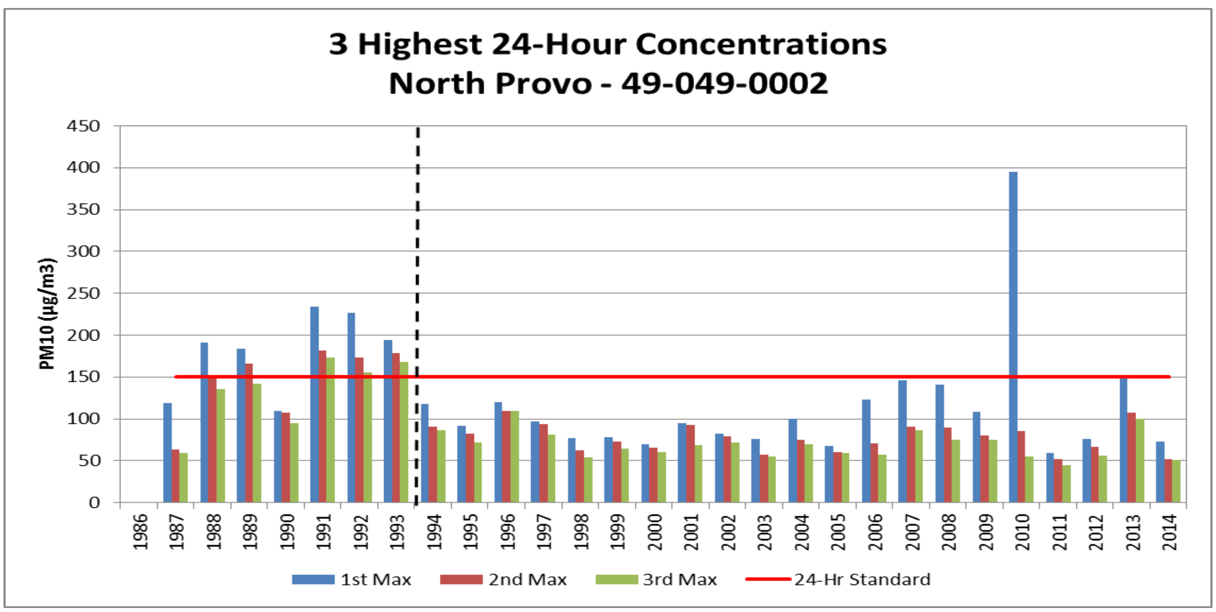
Highest Values – Also indicative of improvement in air quality with respect to the 24-hour standard, is the magnitude of the excessive concentrations that are observed. This is illustrated in Figures IX.A.12. 2-4, which show the three highest 24-hour concentrations observed at each monitor in a particular year.

Figure IX.A.12. 2   3 Highest 24-hr PM_{10} Concentrations; West Orem



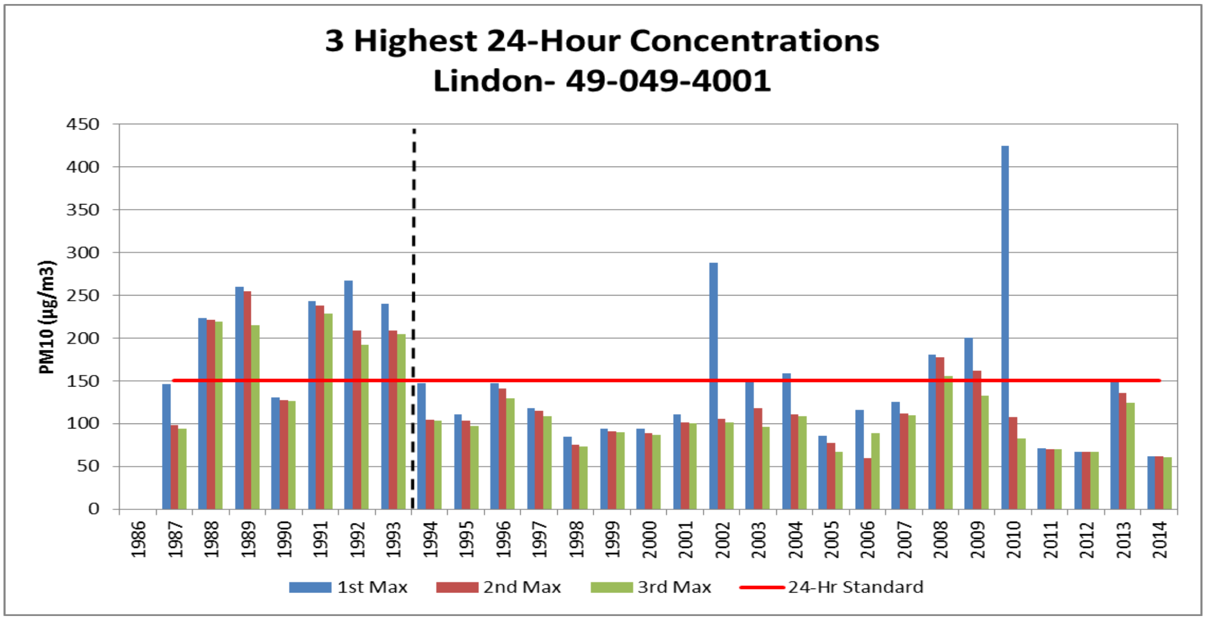
(Vertical dotted line indicates complete implementation of 1991 SIP control measures.)

Figure IX.A.12. 3   3 Highest 24-hr PM_{10} Concentrations; North Provo



(Vertical dotted line indicates complete implementation of 1991 SIP control measures.)

Figure IX.A.12. 4 3 Highest 24-hr PM_{10} Concentrations; Lindon

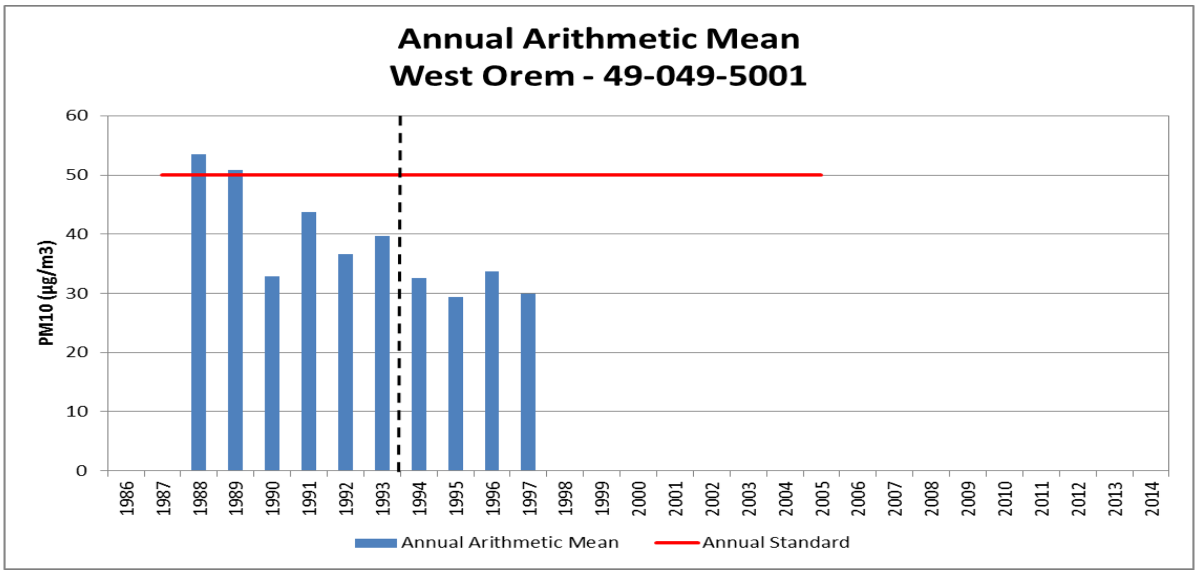


(Vertical dotted line indicates complete implementation of 1991 SIP control measures.)

Again there is a noticeable improvement in the magnitude of these concentrations. It must be kept in mind, however, that some of these concentrations may have resulted from windblown dust events that occur outside of the typical scenario of wintertime air stagnation. As such, the effectiveness of any control measures directed at the precursors to PM_{10} would not be evident.

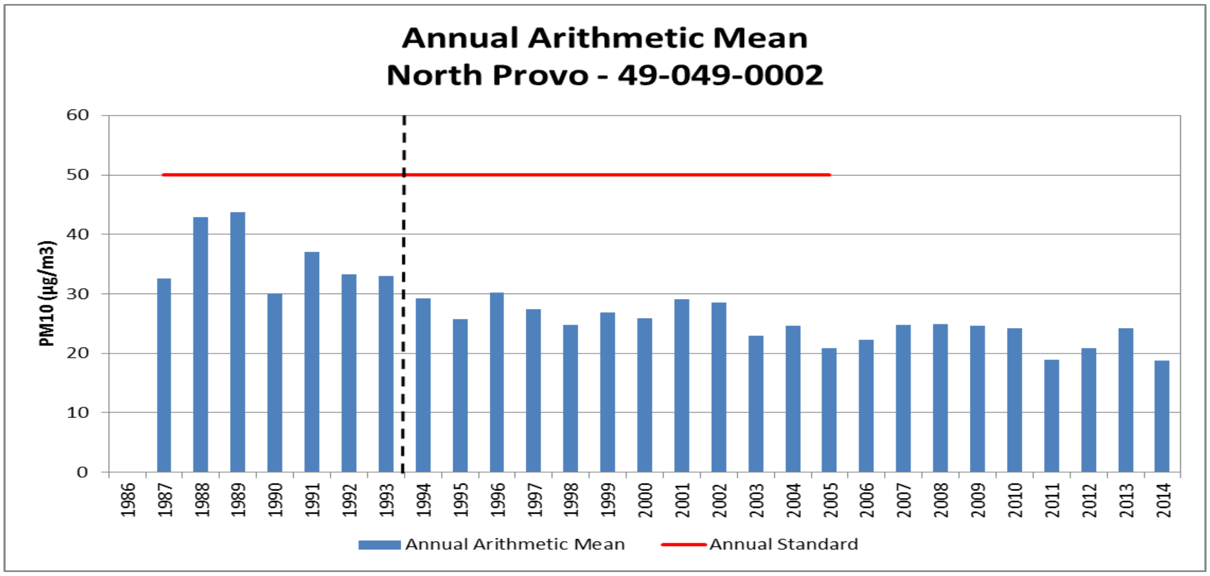
Annual Mean – Although there is no longer an annual PM_{10} standard, the annual arithmetic mean is also a significant parameter to consider. This is especially so given one of the assumptions made in the original nonattainment SIP for Utah County. The SIP was developed to address the 24-hour standard for PM_{10}, but it was assumed that by controlling for the wintertime 24-hour standard, the annual arithmetic mean concentrations would also be reduced such that the annual standard would be protected (even though it had never been violated). Annual arithmetic means have been plotted in Figures IX.A.12. 5-7, and the data reveals a noticeable decline in the values of these annual means. This supports the validity of the assumption made in the SIP, and indicates that there have been significant improvements in air quality in the Utah County nonattainment area.

Figure IX.A.12. 5 Annual Arithmetic Mean; West Orem



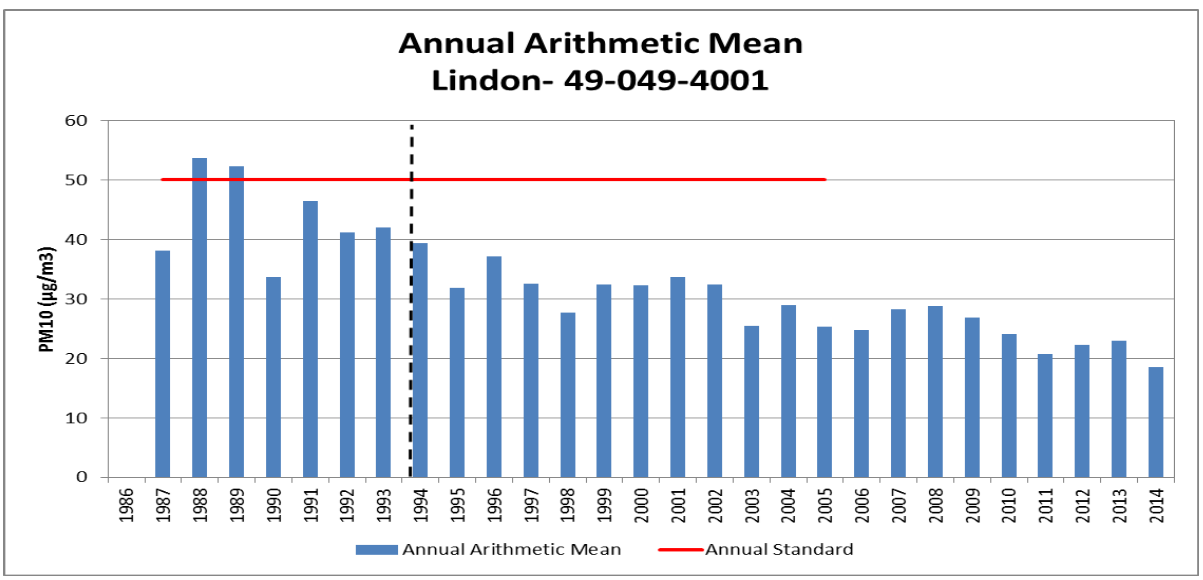
(Vertical dotted line indicates complete implementation of 1991 SIP control measures.)

Figure IX.A.12. 6 Annual Arithmetic Mean; North Provo



(Vertical dotted line indicates complete implementation of 1991 SIP control measures.)

Figure IX.A.12. 7 Annual Arithmetic Mean; Lindon



(Vertical dotted line indicates complete implementation of 1991 SIP control measures.)

As with the number of expected exceedances and the three highest values, the data in Figures IX.A.12. 5-7 may include data which had been flagged by DAQ as being influenced by wind-blown dust events. Nevertheless, the annual averaging period tends to make these data points less significant. The downward trend of these annual mean values is truly indicative of improvements in air quality, particularly during the winter inversion season.

(b) Reduction in Emissions

As stated above, EPA guidance (Calcagni) says that the State must be able to reasonably attribute the improvement in air quality to emission reductions that are permanent and enforceable. In making this showing, the State should estimate the percent reduction (from the year that was used to determine the design value) achieved by Federal measures such as motor vehicle control, as well as by control measures that have been adopted and implemented by the State.

In Utah County, the design values at each of the representative monitors were measured in 1988 or 1989 (see SIP Subsections IX.A.3-5).

As mentioned before, the ambient air quality data presented in Subsection IX.A.12.b(3)(a) above includes values prior to these dates in order to give a representation of the air quality prior to the application of any control measures. It then includes data collected from then until the present time to illustrate the lasting effect of these controls. In discussing the effect of the controls, as well as the control measures themselves, however, it is important to keep in mind the time necessary for their implementation.

The nonattainment SIPs for all initial moderate PM_{10} nonattainment areas included a statutory date for the implementation of reasonably available control measures (RACM), which includes reasonably available control technologies (RACT). This date was December 10, 1993 (Section 189(a) CAA). Thus, 1994 marked the first year in which these control measures were reflected in the emissions inventories for Utah County.

The nonattainment SIP for the Utah County PM_{10} nonattainment area included control strategies for stationary sources and area sources (including controls for woodburning, mobile sources, and road salting and sanding) of primary PM_{10} emissions as well as sulfur oxide (SO_X) and nitrogen oxide (NO_X) emissions, which are secondary sources of particulate emissions. This is discussed in SIP Subsection IX.A.6, and was reflected in the attainment demonstration presented in Subsection IX.A.3.

The RACM control measures prescribed by the nonattainment SIP and their subsequent implementation by the State were discussed in more detail in a milestone report submitted for the area.

Section 189(c) of the CAA identifies, as a required plan element, quantitative milestones which are to be achieved every 3 years, and which demonstrate reasonable further progress (RFP) toward attainment of the standard by the applicable date. As defined in CAA Section 171(1), the term *reasonable further progress* has the meaning of such annual incremental reductions in emissions of the relevant air pollutant as are required by Part D of the Act for the purpose of ensuring attainment of the NAAQS by the applicable date.

Hence, the milestone report must demonstrate that all measures in the approved nonattainment SIP have been implemented and that the milestone has been met. In the case of initial moderate areas for PM_{10}, this first milestone had the meaning of all control measures identified in the plan being sufficient to bring the area into compliance with the NAAQS by the statutory attainment date of December 31, 1994.

Section 188(d) of the Act allows States to petition the Administrator for up to two one-year extensions of the attainment date, provided that all SIP elements have been implemented and that the ambient data collected in the area during the year preceding the extension year indicates that the area is on-target to attain the NAAQS. Presumably this is because the statutory attainment date for initial moderate PM_{10} nonattainment areas occurred only one year after the statutory implementation date for RACM, the central control element of all implementation plans for such areas, and because three consecutive years of clean ambient data are needed to determine that an area has attained the standard. Because the milestone report and the request for extension of the attainment date both required a demonstration that all SIP elements had been implemented, as well as a showing of RFP, Utah combined these into a single analysis.

Utah's actions to meet these requirements and EPA's subsequent review thereof are discussed in a Federal Register notice from Monday, June 18, 2001 (66 FR 32752). In this notice, EPA granted two one-year extensions of the attainment date for the Utah County PM_{10} nonattainment area and determined that the area had attained the PM_{10} NAAQS by December 31, 1996. The key elements of that FR notice are reiterated below.

On May 11, 1995, Utah submitted a milestone report as required by sec.189(c)(2). On Sept.29, 1995, Utah submitted a revised version of the milestone report. It estimated current emissions from all source categories covered by the SIP, and compared those to actual emissions from 1988. Based on information the State submitted in 1995, EPA believes that Utah was in substantial compliance with the requirements and commitments in the SIP for the Utah County PM_{10} nonattainment area when Utah submitted its first extension request. The milestone report indicates that Utah had implemented most of its adopted control measures, and had therefore substantially implemented the RACM/RACT requirements applicable to moderate PM_{10} nonattainment areas. It showed that in Utah County, emissions of PM_{10}, SO_2 and NO_X had been reduced by approximately 3,129 tpy (from 25,920 down to 22,791). With its March 27, 1996 request for an additional extension year, Utah submitted another milestone report (and revised it again on May 17) which repeated this exercise using more current numbers. The results this time showed that emissions had been reduced by approximately 8,391 tpy. The effect of these emission reductions appears to be reflected in ambient measurements at the monitoring sites [and] this is evidence that the State's implementation of the PM_{10} SIP control measures resulted in emission reductions amounting to RFP in the Utah County PM_{10} nonattainment area.

This Federal Register notice (66 FR 32752), the milestone report from September 29, 1995, and the milestone report from May 17, 1996 have all been included in the TSD.

Furthermore, since these control measures are incorporated into the Utah SIP, the emission reductions that resulted are consistent with the notion of permanent and enforceable improvements in air quality. Taken together, the trends in ambient air quality illustrated in the preceding paragraph, along with the continued implementation of the nonattainment SIP for the Utah County nonattainment area, provide a reliable indication that these improvements in air quality reflect the application of permanent steps to improve the air quality in the region, rather than just temporary economic or meteorological changes.

(4) State has Met Requirements of Section 110 and Part D

CAA 107(d)(3)(E)(v) - The State containing such area has met all requirements applicable to the area under section 110 and part D. Section 110(a)(2) of the Act deals with the broad scope of state implementation plans and the capacity of the respective state agency to effectively administer such a plan. Sections I through VIII of Utah's SIP contain information relevant to these criteria. Part D deals specifically with plan requirements for nonattainment areas, and includes the requirements for a maintenance plan in Section 175A.

Utah currently has an approved SIP that meets the requirements of section 110(a)(2) of the Act. Many of these elements have been in place for several decades. In the March 9, 2001 approval of Utah's Ogden City Maintenance Plan for Carbon Monoxide, EPA stated:

> On August 15, 1984, we approved revisions to Utah's SIP as meeting the requirements of section 110(a)(2) of the CAA (see 45 FR 32575). Although section 110 of the CAA was amended in 1990, most of the changes were not substantial. Thus, we have determined that the SIP revisions approved in 1984 continue to satisfy the requirements of section 110(a)(2). For further detail, see 45 FR 32575 dated August 15, 1984 (Volume 49, No. 159) or 66 FR 14079 dated March 9, 2001 (Volume 66, No. 47.)

Part D of the Act addresses "Plan Requirements for Nonattainment Areas." Subpart 1 of Part D includes the general requirements that apply to all areas designated nonattainment based on a violation of the NAAQS. Section 172(c) of this subpart contains a list of generally required elements for all nonattainment plans. Subpart 1 is followed by a series of subparts (2-5) specific to various criteria pollutants. Subpart 4 contains the provisions specific to PM_{10} nonattainment areas. The general requirements for nonattainment plans in Section 172(c) may be subsumed within or superseded by the more specific requirements of Subpart 4, but each element must be addressed in the respective nonattainment plan.

One of the pre-conditions for a maintenance plan is a fully approved (non)attainment plan for the area. This is also discussed in section IX.A.12.b(2).

Other Part D requirements that are applicable in nonattainment and maintenance areas include the general and transportation conformity provisions of Section 176(c) of the Act. These provisions ensure that federally funded or approved projects and actions conform to the PM_{10} SIPs and Maintenance Plans prior to the projects or actions being implemented. The State has already submitted to EPA a SIP revision implementing the requirement of Section 176(c).

For Utah County, the Part D requirements for PM_{10} were first addressed in an attainment SIP approved by EPA on July 8, 1994 (59 FR 35036), and most recently addressed in a revision to the attainment SIP approved by EPA on December 23, 2002 (67 FR 78181).

(5) Maintenance Plan for PM_{10} Areas

As stated in the Act, an area may not request redesignation to attainment without first submitting, and then receiving EPA approval of, a maintenance plan. The plan is basically a quantitative showing that the area will continue to attain the NAAQS for an additional 10 years (from EPA approval), accompanied by sufficient assurance that the terms of the numeric demonstration will be administered by the State and by the EPA in an oversight capacity. The maintenance plan is the central criterion for redesignation. It is contained in the following subsection.

IX.A.12.c Maintenance Plan

CAA 107(d)(3)(E)(iv) - The Administrator has fully approved a maintenance plan for the area as meeting the requirements of section 175A. An approved maintenance plan is one of several criteria necessary for area redesignation as outlined in Section 107(d)(3)(E) of the Act. The maintenance plan itself, as described in Section 175A of the Act and further addressed in EPA guidance (Procedures for Processing Requests to Redesignate Areas to Attainment, John Calcagni to Regional Air Directors, September 4, 1992; or for the purpose of this document, simply "Calcagni"), has its own list of required elements. The following table is presented to summarize these requirements. Each will then be addressed in turn.

Table IX.A.12. 4 Requirements of a Maintenance Plan in the Clean Air Act (CAA)

Category	Requirement	Reference	Addressed in Section
Maintenance demonstration	Provide for maintenance of the relevant NAAQS in the area for at least 10 years after redesignation.	CAA: Sec 175A(a)	IX.A.12.c(1)
Revise in 8 Years	The State must submit an additional revision to the plan, 8 years after redesignation, showing an additional 10 years of maintenance.	CAA: Sec 175A(b)	IX.A.12.c(8)
Continued Implementation of Nonattainment Area Control Strategy	The Clean Air Act requires continued implementation of the nonattainment area control strategy unless such measures are shown to be unnecessary for maintenance or are replaced with measures that achieve equivalent reductions.	CAA: Sec 175A(c), CAA Sec 110(l), Calcagni memo	IX.A.12.c(7)
Contingency Measures	Areas seeking redesignation from nonattainment to attainment are required to develop contingency measures that include State commitments to implement additional control measures in response to future violations of the NAAQS.	CAA: Sec 175A(d)	IX.A.12.c(10)
Verification of Continued Maintenance	The maintenance plan must indicate how the State will track the progress of the maintenance plan.	Calcagni memo	IX.A.12.c(9)

(1) Demonstration of Maintenance - Modeling Analysis

CAA 175A(a) - Each State which submits a request under section 107(d) for redesignation of a nonattainment area as an area which has attained the NAAQS shall also submit a revision of the applicable implementation plan to provide for maintenance of the NAAQS for at least 10 years after the redesignation. The plan shall contain such additional measures, if any, as may be required to ensure such maintenance. The maintenance demonstration is discussed in EPA guidance (Calcagni) as one of the core provisions that should be considered by states for inclusion in a maintenance plan.

According to Calcagni, a State may generally demonstrate maintenance of the NAAQS by either showing that future emissions of a pollutant or its precursors will not exceed the level of the attainment inventory (discussed below) or by modeling to show that the future mix of sources and emission rates will not cause a violation of the NAAQS. Utah has elected to make its demonstration based on air quality modeling.

(a) Introduction

The following chapter presents an analysis using observational datasets to detail the chemical regimes of Utah's Nonattainment areas.

Prior to the development of this PM_{10} maintenance plan, UDAQ conducted a technical analysis to support the development of Utah's 24-hr State Implementation Plan for $PM_{2.5}$. That analysis included preparation of emissions inventories and meteorological data, and the evaluation and application of a regional photochemical model.

Outside of the springtime high wind events and wildfires, the Wasatch Front experiences high 24-hr PM_{10} concentrations under stable conditions during the wintertime (e.g., temperature inversion). These are the same episodes where the Wasatch Front sees its highest concentrations of 24-hr $PM_{2.5}$ that sometimes exceed the 24-hr $PM_{2.5}$ NAAQS. Most (60% to 90%) of the PM_{10} observed during high wintertime pollution days consists of $PM_{2.5}$. The dominant species of the wintertime PM_{10} is secondarily formed particulate nitrate, which is also the dominant species of $PM_{2.5}$.

Given these similarities, the $PM_{2.5}$ modeling analysis was utilized as the foundation for this PM_{10} Maintenance Plan.

The CMAQ model performance for the PM_{10} Maintenance Plan adds to the detailed model performance that was part of the UDAQ's previous $PM_{2.5}$ SIP process. Utah DAQ used the same modeling episode that was used in the $PM_{2.5}$ SIP, which is the 45-day modeling episode from the winter of 2009-2010. The modeled meteorology datasets from the Weather Research and Forecasting (WRF) model for the PM_{10} Plan are the same datasets used for the $PM_{2.5}$ SIP. Also, the CMAQ version (4.7.1) and CMAQ model setup (i.e., vertical advection module turned off) for the PM_{10} modeling matches the $PM_{2.5}$ SIP setup.

For this reason, much of the information presented below pertains specifically to the $PM_{2.5}$ evaluation. This is supplemented with information pertaining to PM_{10}, most notably with respect to the PM_{10} model performance evaluation.

The additional PM_{10} analysis is also presented in the Technical Support Document.

(b) Photochemical Modeling

Photochemical models are relied upon by federal and state regulatory agencies to support their planning efforts. Used properly, models can assist policy makers in deciding which control programs are most effective in improving air quality, and meeting specific goals and objectives. The air quality analyses were conducted with the Community Multiscale Air Quality (CMAQ) Model version 4.7.1, with emissions and meteorology inputs generated using SMOKE and WRF, respectively. CMAQ was selected because it is the open source atmospheric chemistry model co-sponsored by EPA and the National Oceanic Atmospheric Administration (NOAA), and thus approved by EPA for this plan.

(c) Domain/Grid Resolution

UDAQ selected a high resolution 4-km modeling domain to cover all of northern Utah including the portion of southern Idaho extending north of Franklin County and west to the Nevada border (Figure IX.A.12. 8). This 97 x 79 horizontal grid cell domain was selected to ensure that all of the major emissions sources that have the potential to impact the nonattainment areas were included. The vertical resolution in the air quality model consists of 17 layers extending up to 15 km, with higher resolution in the boundary layer.

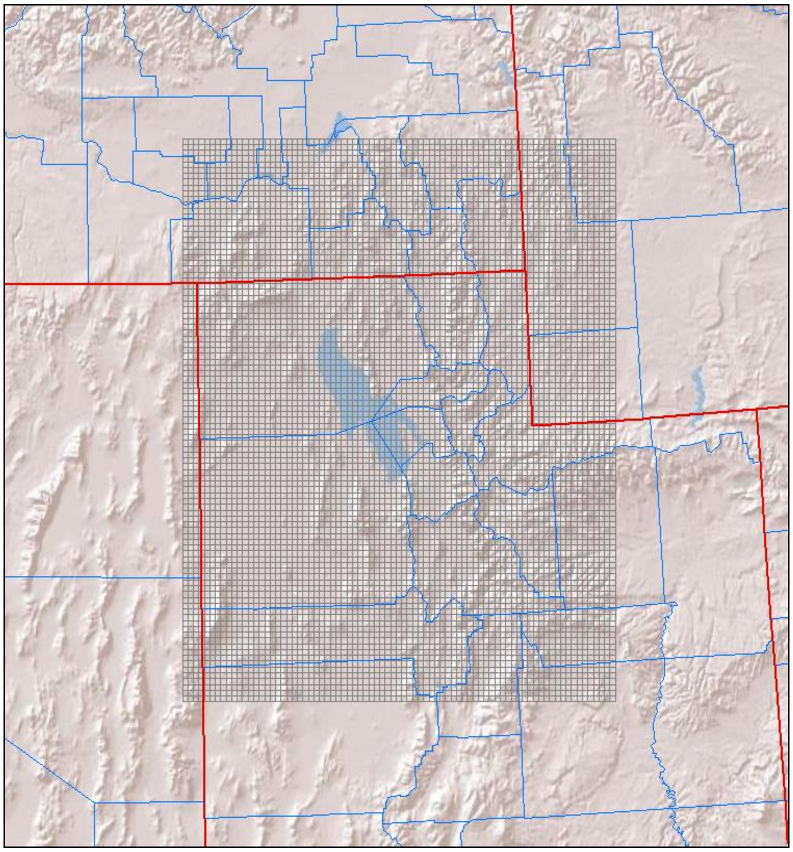


Figure IX.A.12. 8 Northern Utah photochemical modeling domain.

(d) Episode Selection

According to EPA's April 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," the selection of SIP episodes for modeling should consider the following 4 criteria:

1. Select episodes that represent a variety of meteorological conditions that lead to elevated $PM_{2.5}$.

2. Select episodes during which observed concentrations are close to the baseline design value.

3. Select episodes that have extensive air quality data bases.

4. Select enough episodes such that the model attainment test is based on multiple days at each monitor violating NAAQS.

In general, UDAQ wanted to select episodes with hourly $PM_{2.5}$ concentrations that are reflective of conditions that lead to 24-hour NAAQS exceedances. From a synoptic meteorology point of view, each selected episode features a similar pattern. The typical pattern includes a deep trough over the eastern United States with a building and eastward moving ridge over the western United States. The episodes typically begin as the ridge begins to build eastward, near surface winds weaken, and rapid stabilization due to warm advection and subsidence dominate. As the ridge centers over Utah and subsidence peaks, the atmosphere becomes extremely stable and a subsidence inversion descends towards the surface. During this time, weak insolation, light winds, and cold temperatures promote the development of a persistent cold air pool. Not until the ridge moves eastward or breaks down from north to south is there enough mixing in the atmosphere to completely erode the persistent cold air pool.

From the most recent 5-year period of 2007-2011, UDAQ developed a long list of candidate $PM_{2.5}$ wintertime episodes. Three episodes were selected. An episode was selected from January 2007, an episode from February 2008, and an episode during the winter of 2009-2010 that features multi-event episodes of $PM_{2.5}$ buildup and washout.

As noted in the introduction, these episodes were also ideal from the standpoint of characterizing PM_{10} buildup and formation.

Further detail of the episodes is below:

- **Episode 1: January 11-20, 2007**

A cold front passed through Utah during the early portion of the episode and brought very cold temperatures and several inches of fresh snow to the Wasatch Front. The trough was quickly followed by a ridge that built north into British Columbia and began expanding east into Utah. This ridge did not fully center itself over Utah, but the associated light winds, cold temperatures, fresh snow, and subsidence inversion produced very stagnant conditions along the Wasatch Front. High temperatures in Salt Lake City throughout the episode were in the high teens to mid-20's Fahrenheit.

Figure IX.A.12. 9 shows hourly $PM_{2.5}$ concentrations from Utah's 4 $PM_{2.5}$ monitors for January 11-20, 2007. The first 6 to 8 days of this episode are suited for modeling. The episode becomes less suited after January 18 because of the complexities in the meteorological conditions leading to temporary $PM_{2.5}$ reductions.

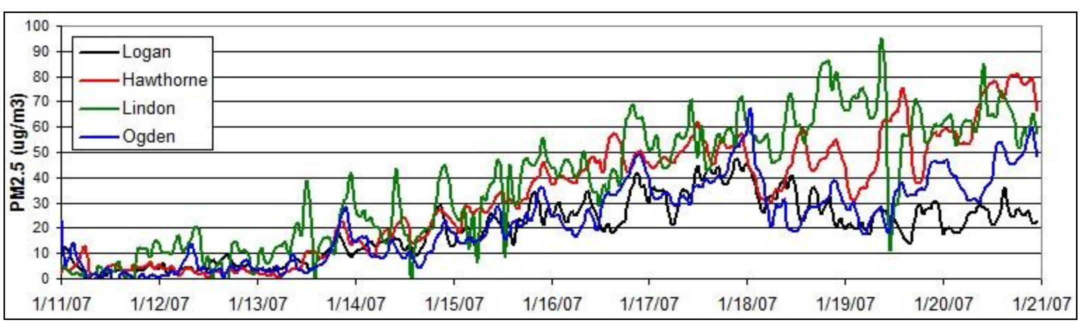


Figure IX.A.12. 9 Hourly $PM_{2.5}$ concentrations for January 11-20, 2007

- **Episode 2: February 14-18, 2008**

The February 2008 episode features a cold front passage at the start of the episode that brought significant new snow to the Wasatch Front. A ridge began building eastward from the Pacific Coast and centered itself over Utah on Feb 20th. During this time a subsidence inversion lowered significantly from February 16 to February 19. Temperatures during this episode were mild with high temperatures at SLC in the upper 30's and lower 40's Fahrenheit.

The 24-hour average $PM_{2.5}$ exceedances observed during the proposed modeling period of February 14-19, 2008 were not exceptionally high. What makes this episode a good candidate for modeling are the high hourly values and smooth concentration build-up. The first 24-hour exceedances occurred on February 16 and were followed by a rapid increase in $PM_{2.5}$ through the first half of February 17 (Figure IX.A.12. 10). During the second half of February 17, a subtle meteorological feature produced a mid-morning partial mix-out of particulate matter and forced 24-hour averages to fall. After February 18, the atmosphere began to stabilize again and resulted in even higher $PM_{2.5}$ concentrations during February 20, 21, and 22. Modeling the 14th through the 19th of this episode should successfully capture these dynamics. The smooth gradual build-up of hourly $PM_{2.5}$ is ideal for modeling.

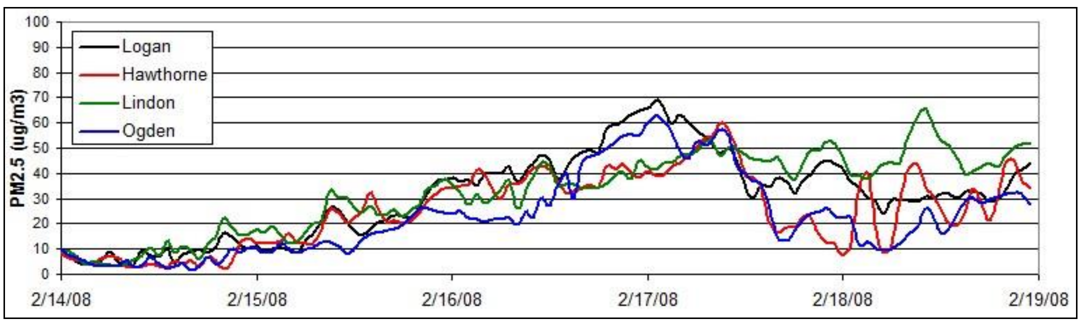


Figure IX.A.12. 10 Hourly $PM_{2.5}$ concentrations for February 14-19, 2008

- **Episode 3: December 13, 2009 – January 18, 2010**

The third episode that was selected is more similar to a "season" than a single $PM_{2.5}$ episode (Figure IX.A.12. 11). During the winter of 2009 and 2010, Utah was dominated by a semi-permanent ridge of high pressure that prevented strong storms from crossing Utah. This 35 day period was characterized by 4 to 5 individual $PM_{2.5}$ episodes each followed by a partial $PM_{2.5}$ mix out when a weak weather system passed through the ridge. The long length of the episode and repetitive $PM_{2.5}$ build-up and mix-out cycles makes it ideal for evaluating model strengths and weaknesses and $PM_{2.5}$ control strategies.

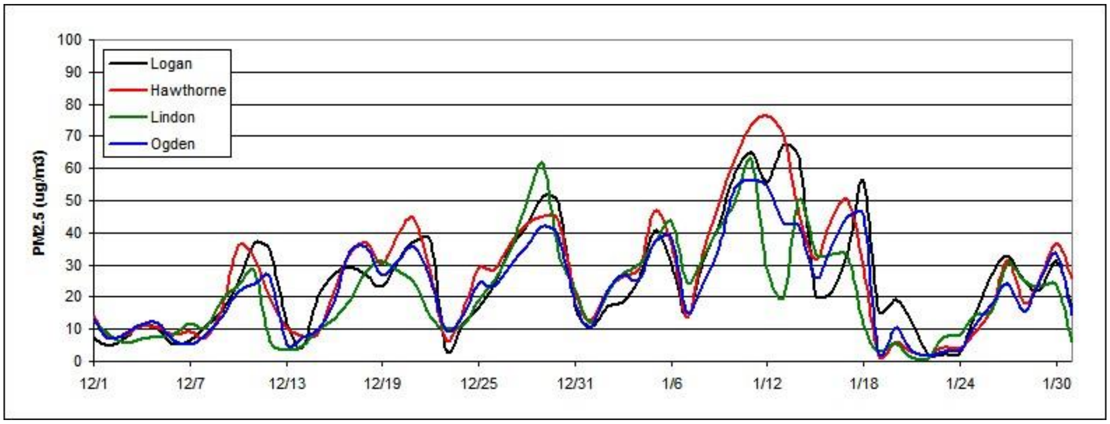


Figure IX.A.12. 11 24-hour average $PM_{2.5}$ concentrations for December-January, 2009-10

(e) Meteorological Data

Meteorological inputs were derived using the Advanced Research WRF (WRF-ARW) model version 3.2. WRF contains separate modules to compute different physical processes such as surface energy budgets and soil interactions, turbulence, cloud microphysics, and atmospheric radiation. Within WRF, the user has many options for selecting the different schemes for each type of physical process. There is also a WRF Preprocessing System (WPS) that generates the initial and boundary conditions used by WRF, based on topographic datasets, land use information, and larger-scale atmospheric and oceanic models.

Model performance of WRF was assessed against observations at sites maintained by the Utah Air Monitoring Center. A summary of the performance evaluation results for WRF are presented below:

- The biggest issue with meteorological performance is the existence of a warm bias in surface temperatures during high $PM_{2.5}$ episodes. This warm bias is a common trait of WRF modeling during Utah wintertime inversions.
- WRF does a good job of replicating the light wind speeds (< 5 mph) that occur during high $PM_{2.5}$ episodes.
- WRF is able to simulate the diurnal wind flows common during high $PM_{2.5}$ episodes. WRF captures the overnight downslope and daytime upslope wind flow that occurs in Utah valley basins.
- WRF has reasonable ability to replicate the vertical temperature structure of the boundary layer (i.e., the temperature inversion), although it is difficult for WRF to reproduce the inversion when the inversion is shallow and strong (i.e., an 8 degree temperature increase over 100 vertical meters).

(f) Photochemical Model Performance Evaluation

<u>$PM_{2.5}$ Results</u>

The model performance evaluation focused on the magnitude, spatial pattern, and temporal variation of modeled and measured concentrations. This exercise was intended to assess whether, and to what degree, confidence in the model is warranted (and to assess whether model improvements are necessary).

CMAQ model performance was assessed with observed air quality datasets at UDAQ-maintained air monitoring sites (Figure IX.A.12. 12). Measurements of observed $PM_{2.5}$ concentrations along with gaseous precursors of secondary particulate (e.g., NO_x, ozone) and carbon monoxide are made throughout winter at most of the locations in the figure. $PM_{2.5}$ speciation performance was assessed using the three Speciation Monitoring Network Sites (STN) located at the Hawthorne site in Salt Lake City, the Bountiful site in Davis County, and the Lindon site in Utah County.

PM_{10} data is also collected at Logan, Bountiful, Ogden2, Magna, Hawthorne, North Provo, and Lindon.

PM_{10} filters were collected at Bountiful, Hawthorne and Lindon, and analyzed with the goal comparing CMAQ modeled speciation to the collected PM_{10} filters. While analyzing the PM_{10} filters, most of the secondarily chemically formed particulate nitrate had been volatized, and thus could not be accounted for. This is most likely due to the age of the filters, which were collected over five years ago. Thus, a robust comparison of CMAQ modeled PM_{10} speciation to PM_{10} filter speciation could not be made for this modeling period.

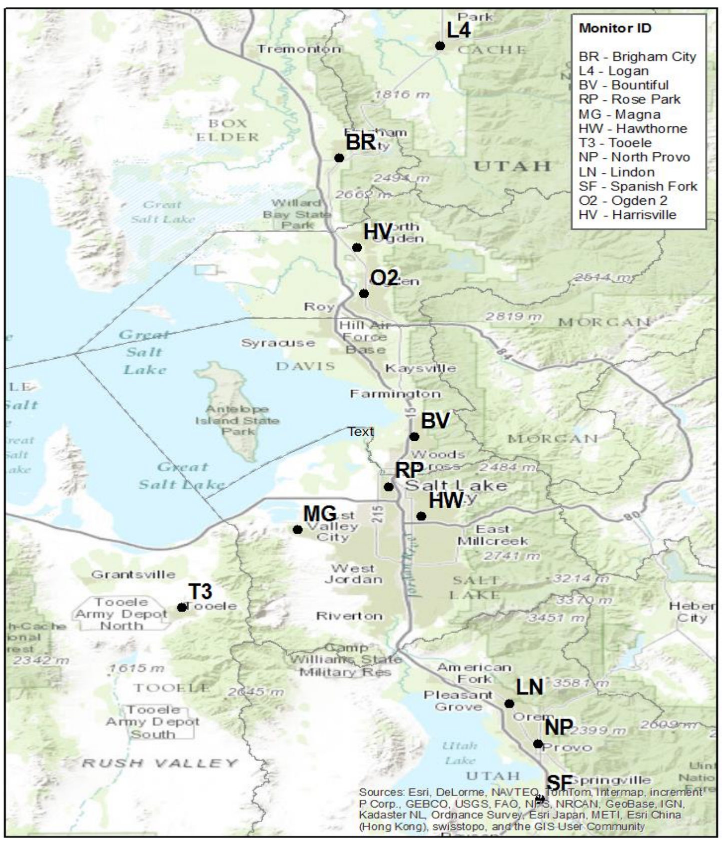


Figure IX.A.12. 12 UDAQ monitoring network.

A spatial plot is provided for modeled 24-hr $PM_{2.5}$ for 2010 January 03 in Figure IX.A.12. 13. The spatial plot shows the model does a reasonable job reproducing the high $PM_{2.5}$ values, and keeping those high values confined in the valley locations where emissions occur.

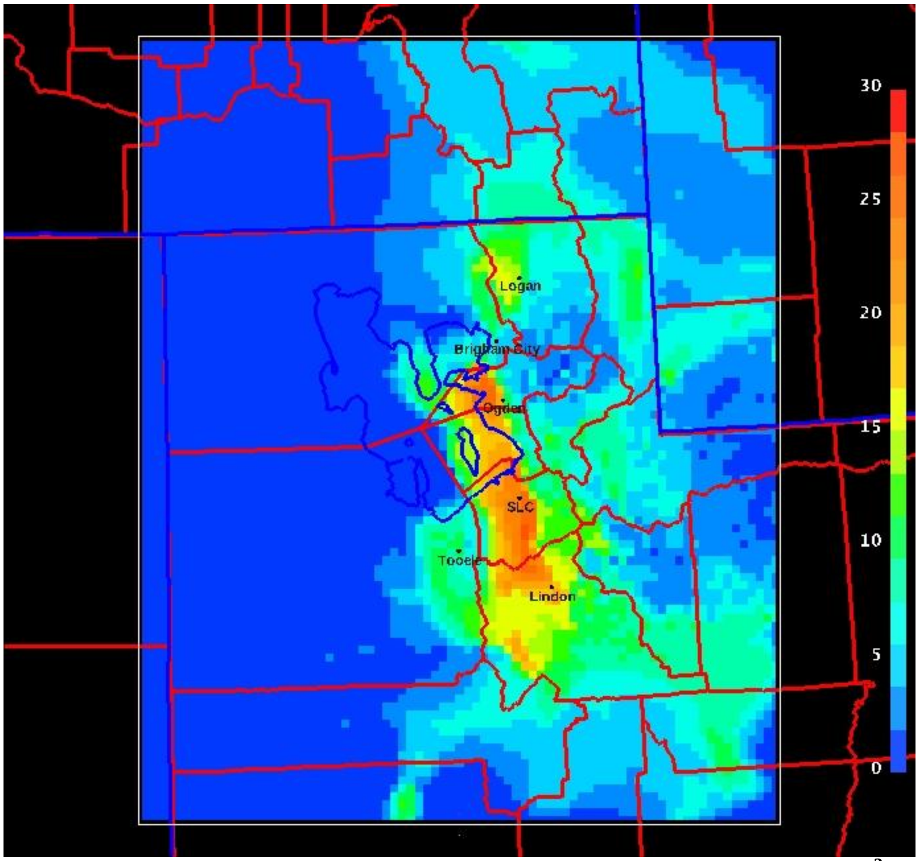


Figure IX.A.12. 13 Spatial plot of CMAQ modeled 24-hr $PM_{2.5}$ ($\mu g/m^3$) for 2010 Jan. 03.

Time series of 24-hr $PM_{2.5}$ concentrations for the 13 Dec. 2009 – 15 Jan. 2010 modeling period are shown in Figs. IX.A.12. 14-17 at the Hawthorne site in Salt Lake City, the Ogden site in Weber County, the Lindon site in Utah County, and the Logan site in Cache County.   For the most part, CMAQ replicates the buildup and washout of each individual episode. While CMAQ builds 24-hr $PM_{2.5}$ concentrations during the 08 Jan. – 14 Jan. 2010 episode, it was not able to produce the > 60 $\mu g/m^3$ concentrations observed at the monitoring locations.

It is often seen that CMAQ "washes" out the $PM_{2.5}$ episode a day or two earlier than that seen in the observations. For example, on the day 21 Dec. 2009, the concentration of $PM_{2.5}$ continues to build while CMAQ has already cleaned the valley basins of high $PM_{2.5}$ concentrations. At these times, the observed cold pool that holds the $PM_{2.5}$ is often very shallow and winds just above this cold pool are southerly and strong before the approaching cold front. This situation is very difficult for a meteorological and photochemical model to reproduce. An example of this situation is shown in Fig. IX.A.12. 18, where the lowest part of the Salt Lake Valley is still under a very shallow stable cold pool, yet higher elevations of the valley have already been cleared of the high $PM_{2.5}$ concentrations.

During the 24 – 30 Dec. 2009 episode, a weak meteorological disturbance brushes through the northernmost portion of Utah. It is noticeable in the observations at the Ogden monitor on 25 Dec. as $PM_{2.5}$ concentrations drop on this day before resuming an increase through Dec. 30. The meteorological model and thus CMAQ correctly pick up this disturbance, but completely clears out the building $PM_{2.5}$; and thus performance suffers at the most northern Utah monitors (e.g. Ogden, Logan). The monitors to the south (Hawthorne, Lindon) are not influence by this disturbance and building of $PM_{2.5}$ is replicated by CMAQ. This highlights another challenge of modeling $PM_{2.5}$ episodes in Utah. Often during cold pool events, weak disturbances will pass through Utah that will de-stabilize the valley inversion and cause a partial clear out of $PM_{2.5}$. However, the $PM_{2.5}$ is not completely cleared out, and after the disturbance exits, the valley inversion strengthens and the $PM_{2.5}$ concentrations continue to build. Typically, CMAQ completely mixes out the valley inversion during these weak disturbances.

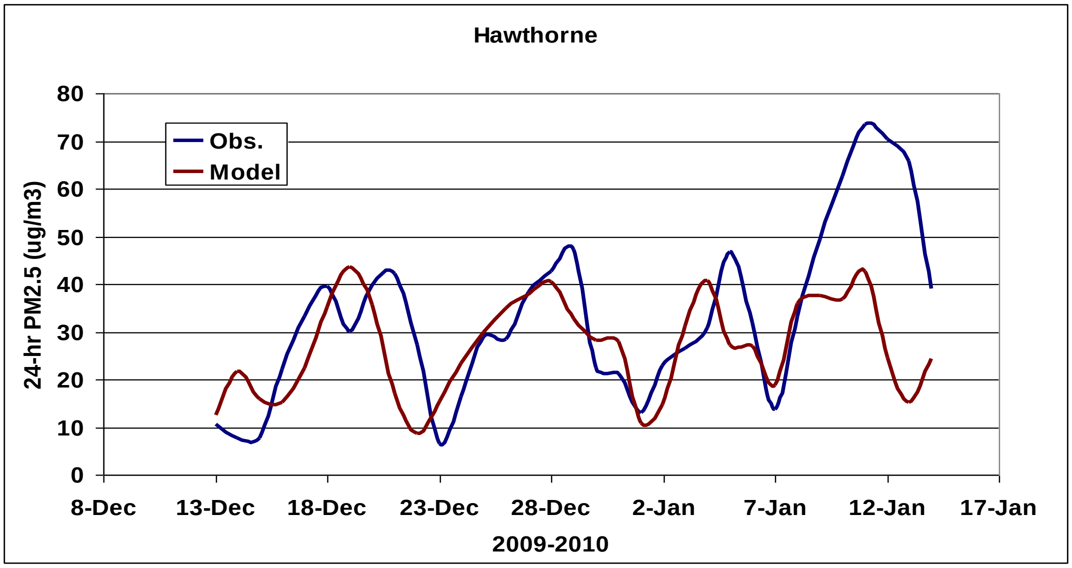


Figure IX.A.12. 14 24-hr $PM_{2.5}$ time series (Hawthorne). Observed 24-hr $PM_{2.5}$ (blue trace) and CMAQ modeled 24-hr PM2.5 (red trace).

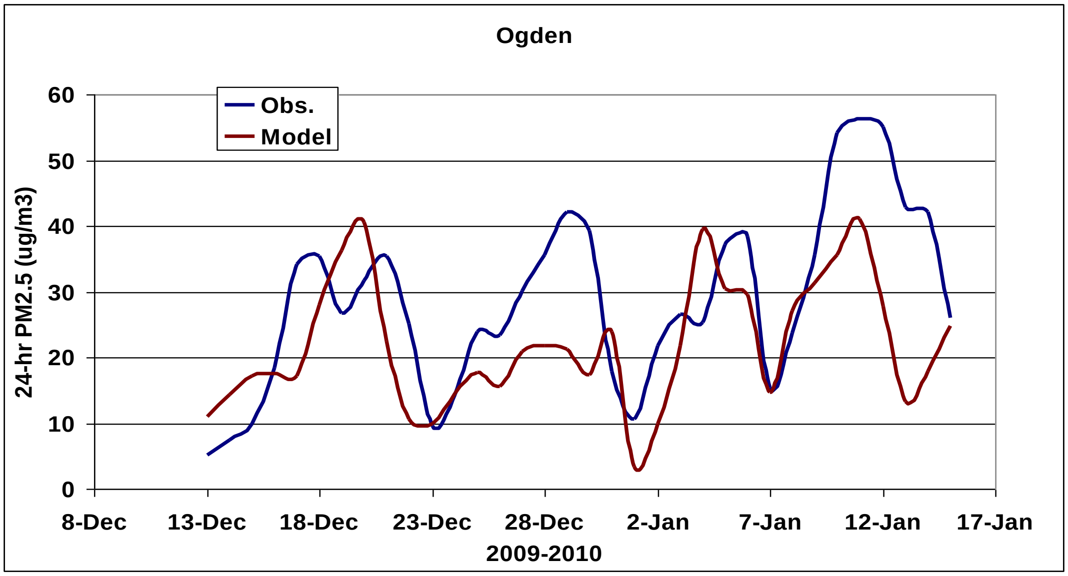


Figure IX.A.12. 15 24-hr $PM_{2.5}$ time series (Ogden). Observed 24-hr $PM_{2.5}$ (blue trace) and CMAQ modeled 24-hr $PM_{2.5}$ (red trace).

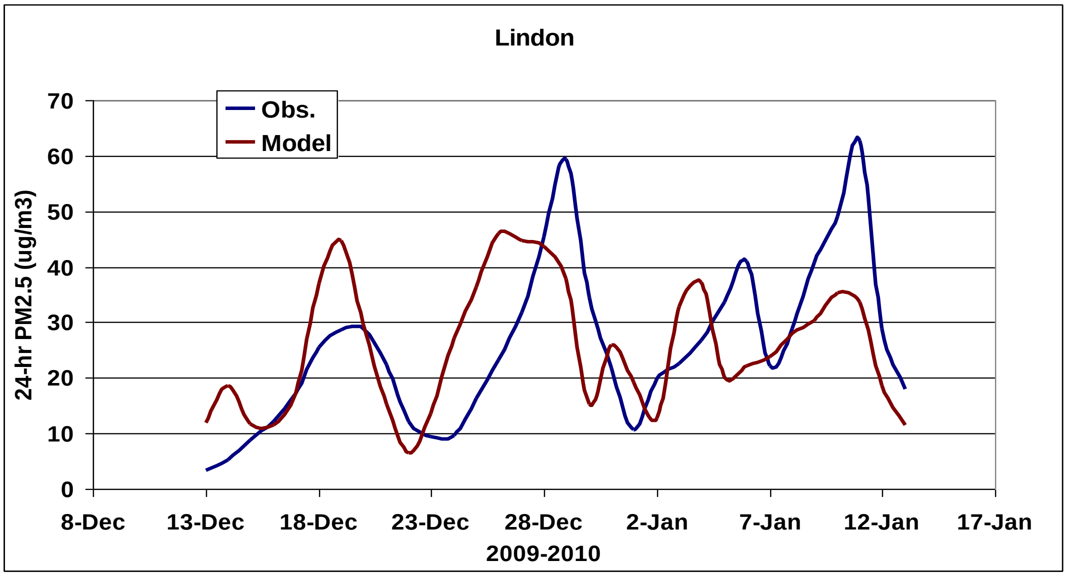


Figure IX.A.12. 16 24-hr $PM_{2.5}$ time series (Lindon). Observed 24-hr $PM_{2.5}$ (blue trace) and CMAQ modeled 24-hr $PM_{2.5}$ (red trace).

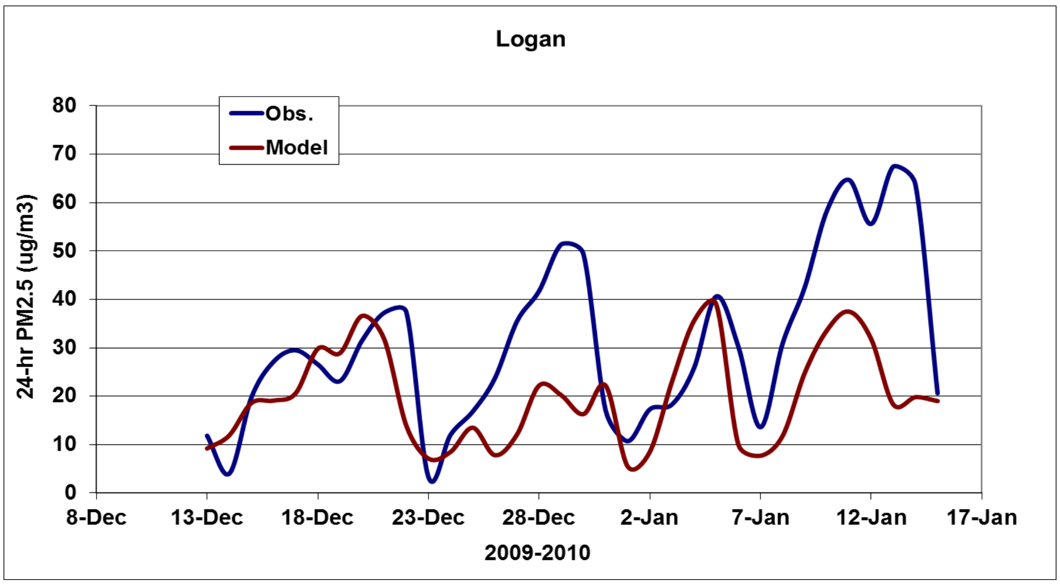


Figure IX.A.12. 17 24-hr $PM_{2.5}$ time series (Logan). Observed 24-hr $PM_{2.5}$ (blue trace) and CMAQ modeled 24-hr $PM_{2.5}$ (red trace).

Figure IX.A.12. 18 An example of the Salt Lake Valley at the end of a high $PM_{2.5}$ episode. The lowest elevations of the Salt Lake Valley are still experiencing an inversion and elevated $PM_{2.5}$ concentrations while the $PM_{2.5}$ has been 'cleared out' throughout the rest of the valley. These 'end of episode' clear out periods are difficult to replicate in the photochemical model.

Generally, the performance of CMAQ to replicate the buildup and clear out of $PM_{2.5}$ is good. However, it is important to verify that CMAQ is replicating the components of $PM_{2.5}$ concentrations. $PM_{2.5}$ simulated and observed speciation is shown at the 3 STN sites in Figures IX.A.12. 19-21. The observed speciation is constructed using days in which the STN filter 24-hr $PM_{2.5}$ concentration was > 35 µg/m^3. For the 2009-2010 modeling period, the observed speciation pie charts were created using 8 filter days at Hawthorne, 6 days at Lindon, and 4 days at Bountiful.

The simulated speciation is constructed using modeling days that produced 24-hr $PM_{2.5}$ concentrations > 35 µg/m^3. Using this criterion, the simulated speciation pie chart is created from 18 modeling days for Hawthorne, 14 days at Lindon, and 14 days at Bountiful.
At all 3 STN sites, the percentage of simulated nitrate is greater than 40%, while the simulated ammonium percentage is at ~15%. This indicates that the model is able to replicate the secondarily formed particulates that typically make up the majority of the measured $PM_{2.5}$ on the STN filters during wintertime pollution events.

The percentage of model simulated organic carbon is ~13% at all STN sites, which is in agreement with the observed speciation of organic carbon at Hawthorne and slightly overestimated (by ~3%) at Lindon and Bountiful.

There is no STN site in the Logan nonattainment area, and very little speciation information available in the Cache Valley. Figure IX.A.12. 22 shows the model simulated speciation at Logan. Ammonium (17%) and nitrate (56%) make up a higher percentage of the simulated $PM_{2.5}$ at Logan when compared to sites along the Wasatch Front.

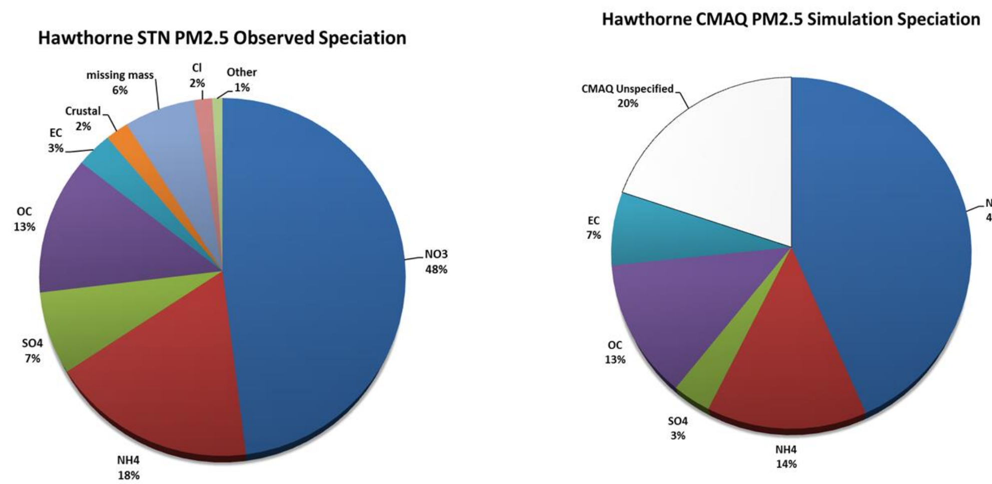


Figure IX.A.12. 19   The composition of observed and model simulated average 24-hr $PM_{2.5}$ speciation averaged over days when an observed and modeled day had 24-hr concentrations > 35 µg/m^3 at the Hawthorne STN site.

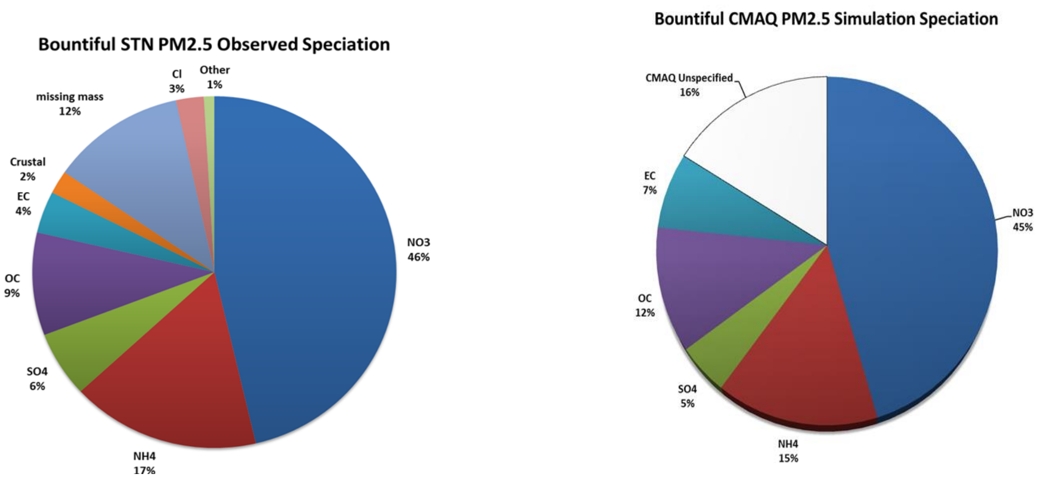


Figure IX.A.12. 20   The composition of observed and model simulated average 24-hr $PM_{2.5}$ speciation averaged over days when an observed and modeled day had 24-hr concentrations > 35 µg/m^3 at the Bountiful STN site.

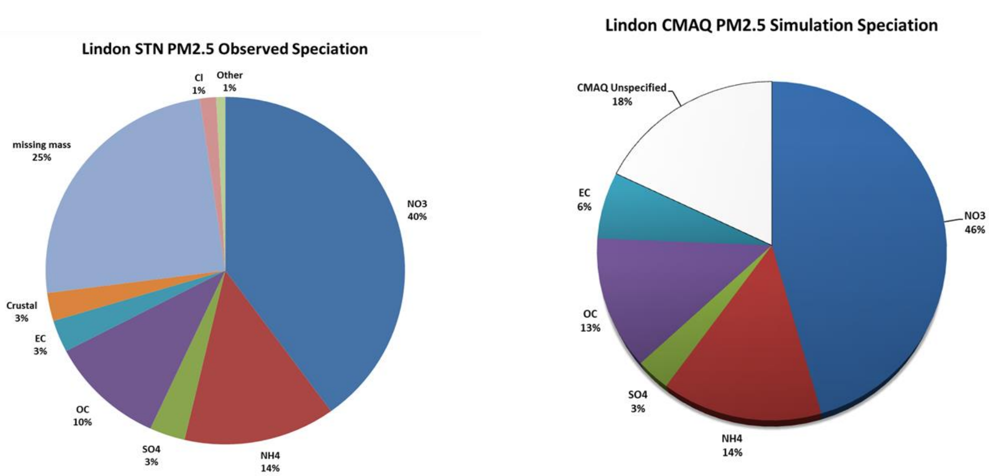


Figure IX.A.12. 21 The composition of observed and model simulated average 24-hr $PM_{2.5}$ speciation averaged over days when an observed and modeled day had 24-hr concentrations > 35 µg/m^3 at the Lindon STN site.

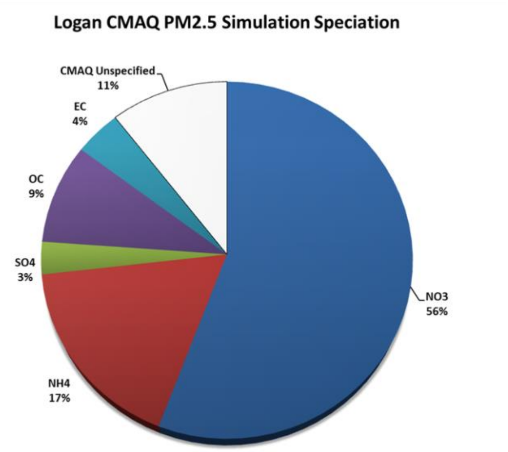


Figure IX.A.12. 22 The composition of model simulated average 24-hr $PM_{2.5}$ speciation averaged over days when a modeled day had 24-hr concentrations > 35 µg/m^3 at the Logan monitoring site. No observed speciation data is available for Logan.

PM_{10} Results

As mentioned previously, the bulk of the performance for CMAQ modeled Particulate Matter (PM) for the 2009 – 2010 episode was done for the 24-hr $PM_{2.5}$ SIP. The detailed model performance was shown using time series, statistical metrics, and pie charts. For the CMAQ performance of PM_{10} in particular, UDAQ has updated the model versus observations time series plots to show PM_{10}, in addition to the prior times series using $PM_{2.5}$. For the 2009 – 2010 episode, UDAQ collected PM_{10} observational data at Hawthorne and Magna in Salt Lake County; Lindon and North Provo in Utah County; and for Ogden City.

The PM_{10} model versus observation time series is shown in Figures IX.A.12. 23-28.

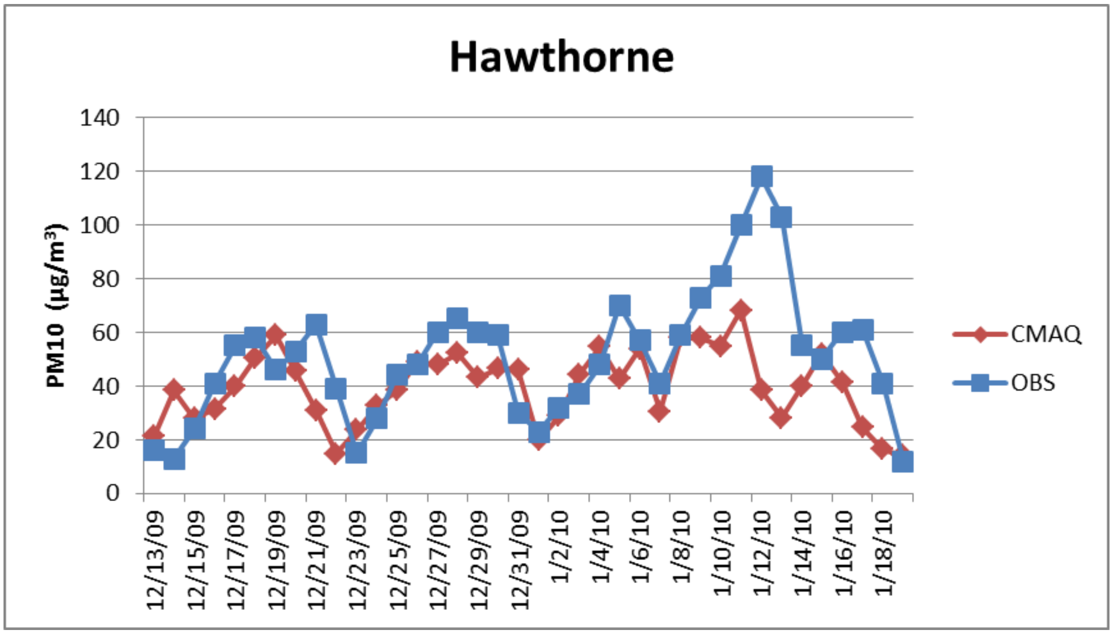


Figure IX.A.12. 23 Time Series of total PM10 (ug/m3) for Hawthorne for the 2009-2010 modeling. CMAQ results are shown in the red trace and the observations are the blue trace.

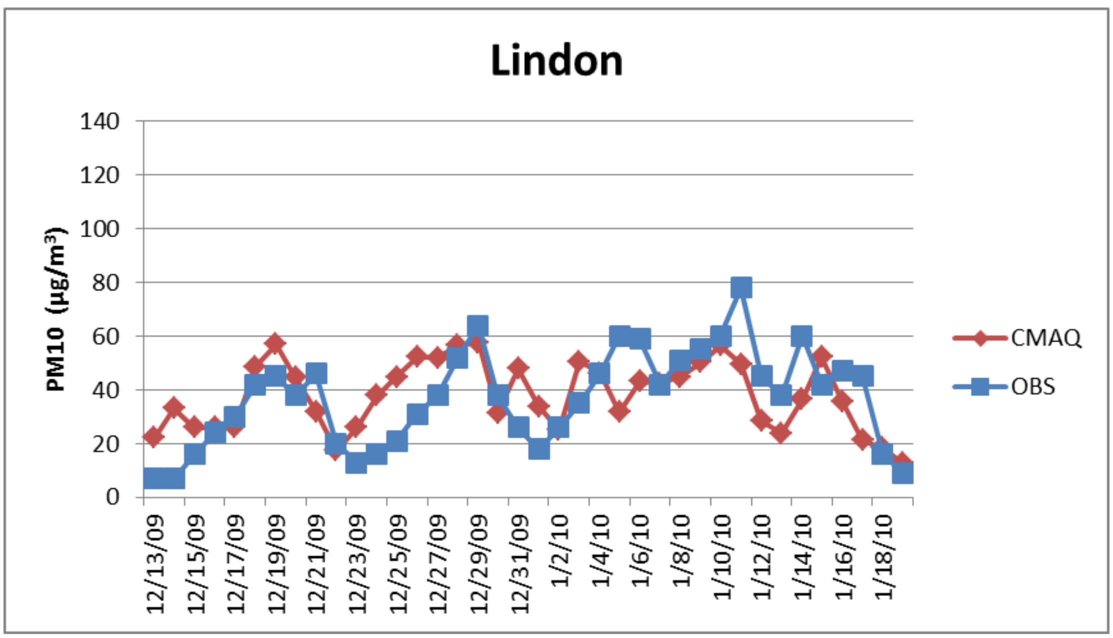


Figure IX.A.12. 24 Time Series of total PM10 (ug/m3) for Lindon for the 2009-2010 modeling. CMAQ results are shown in the red trace and the observations are the blue trace.

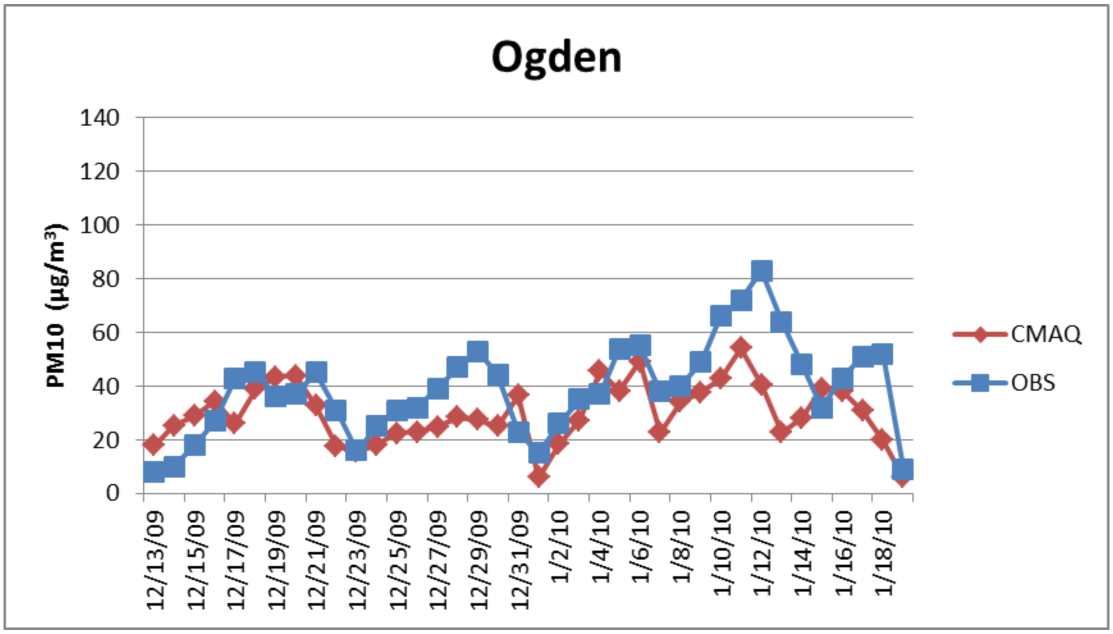


Figure IX.A.12. 25 Time Series of total PM10 (ug/m3) for Ogden for the 2009-2010 modeling. CMAQ results are shown in the red trace and the observations are the blue trace.

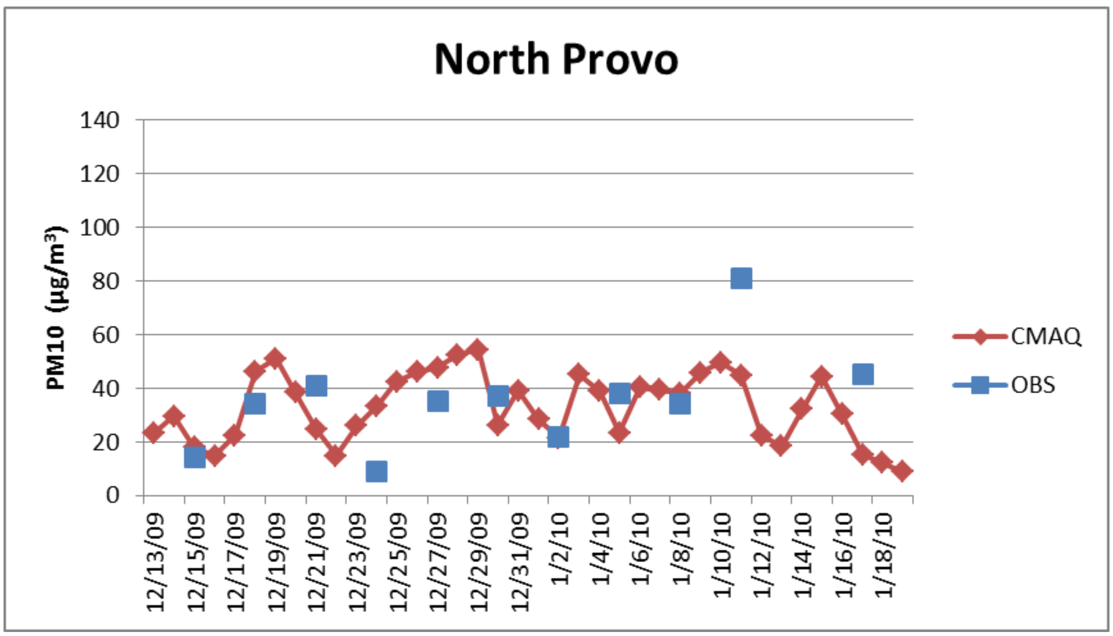


Figure IX.A.12. 26 Time Series of total PM10 (ug/m3) for North Provo for the 2009-2010 modeling. CMAQ results are shown in the red trace and the observations are the blue trace.

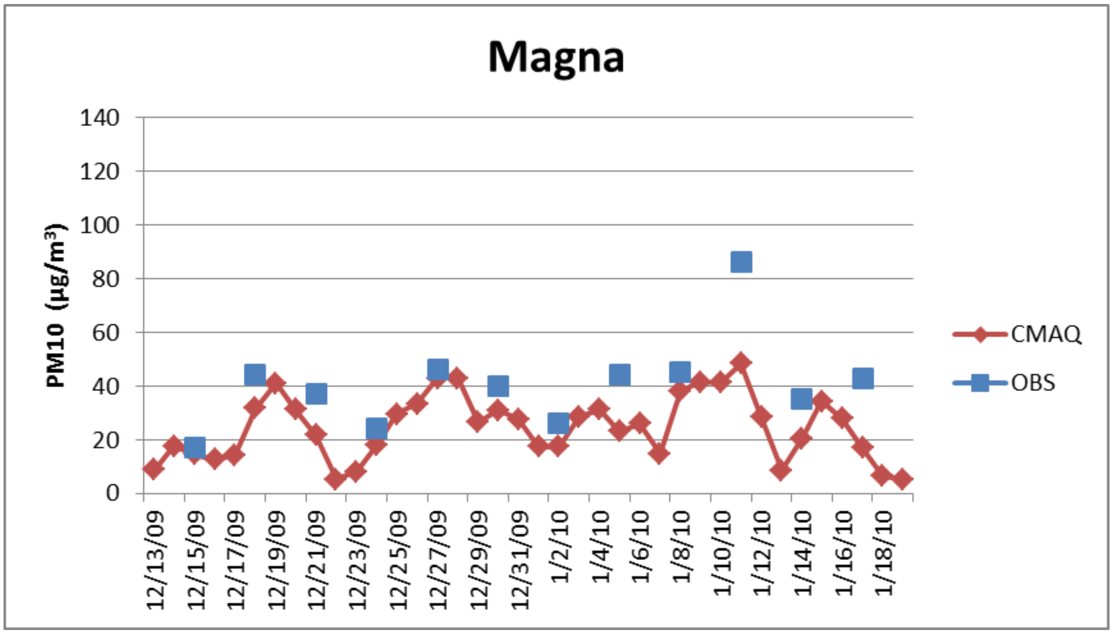


Figure IX.A.12. 27 Time Series of total PM10 (ug/m3) for Magna for the 2009-2010 modeling. CMAQ results are shown in the red trace and the observations are the blue trace.

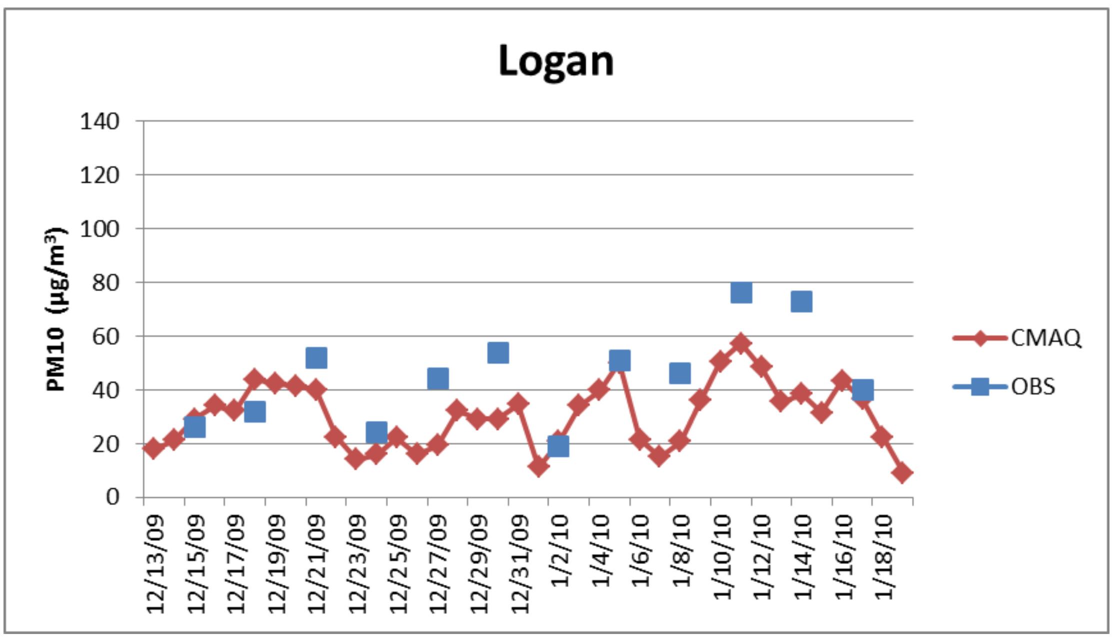


Figure IX.A.12. 28 Time Series of total PM10 (ug/m3) for Logan for the 2009-2010 modeling. CMAQ results are shown in the red trace and the observations are the blue trace.

As noted before, a robust comparison of CMAQ modeled PM_{10} speciation to PM_{10} filter speciation could not be made for this modeling period because most of the secondarily chemically formed particulate nitrate had been volatized from the PM_{10} filters and thus could not be accounted for. It should be noted that CMAQ was able to produce the secondarily formed nitrate when compared to $PM_{2.5}$ filters during the previous $PM_{2.5}$ SIP work. Therefore, UDAQ feels CMAQ shows good replication of the species that make up PM_{10} during wintertime pollution events.

(g) Summary of Model Performance

Model performance for 24-hr $PM_{2.5}$ is good and generally acceptable and can be characterized as follows:

- Good replication of the episodic buildup and clear out of $PM_{2.5}$. Often the model will clear out the simulated $PM_{2.5}$ a day too early at the end of an episode. This clear out time period is difficult to model (i.e., Figure IX.A.12. 18).

- Good agreement in the magnitude of $PM_{2.5}$, as the model can consistently produce the high concentrations of $PM_{2.5}$ that coincide with observed high concentrations.

- Spatial patterns of modeled 24-hr $PM_{2.5}$, show for the most part, that the $PM_{2.5}$ is being confined in the valley basins, consistent to what is observed.

- Speciation and composition of the modeled $PM_{2.5}$ matches the observed speciation quite well. Modeled and observed nitrate are between 40% and 50% of the $PM_{2.5}$. Ammonium is between 15% and 20% for both modeled and observed $PM_{2.5}$, while modeled and observed organic carbon falls between 10% to 13% of the total $PM_{2.5.}$

For PM_{10} the CMAQ model performance is quite good at all locations along Northern Utah. CMAQ is able to re-produce the buildup and washout of the pollution episodes during the 2009 – 2010 winter. CMAQ is also able to re-produce the peak PM_{10} concentrations during most episodes. The exception being the 2010 Jan. 08 – 14 episode, where CMAQ fails to build to the extremely high PM_{10} concentration (>80 ug/m3) seen at the monitors. This episode in particular featured an “early model washout,” and these results are similar to the results found in $PM_{2.5}$ modeling.

Several observations should be noted on the implications of these model performance findings on the attainment modeling presented in the following section. First, it has been demonstrated that model performance overall is acceptable and, thus, the model can be used for air quality planning purposes. Second, consistent with EPA guidance, the model is used in a relative sense to project future year values. EPA suggests that this approach “should reduce some of the uncertainty attendant with using absolute model predictions alone.”

(h) Modeled Attainment Test

- **Introduction**

With acceptable performance, the model can be utilized to make future-year attainment projections. For any given (future) year, an attainment projection is made by calculating a concentration termed the Future Design Value (FDV). This calculation is made for each monitor included in the analysis, and then compared to the NAAQS (150 $\mu g/m^3$). If the FDV at every monitor located within a nonattainment area is smaller than the NAAQS, this would demonstrate attainment for that area in that future year.

A maintenance plan must demonstrate continued attainment of the NAAQS for a span of ten years. This span is measured from the time EPA approves the plan, a date which is somewhat uncertain during plan development. To be conservative, attainment projections were made for 2019, 2028, and 2030. An assessment was also made for 2024 as a "spot-check" against emission trends within the ten year span.

- **PM_{10} Baseline Design Values**

For any monitor, the FDV is greatly influenced by existing air quality at that location. This can be quantified and expressed as a Baseline Design Value (BDV). The BDV is consistent with the form of the 24-hour PM_{10} NAAQS; that is, that the probability of exceeding the standard should be no greater than once per calendar year. Quantification of the BDV for each monitor is included in the TSD, and is consistent with EPA guidance.

Hourly PM_{10} observations are taken from FRM filters spanning five monitors in three maintenance areas: Salt Lake County, Utah County, and the city of Ogden.

In Table IX.A.12. 5, baseline design values are given for Ogden, Hawthorne, Magna, Lindon, and North Provo. These values were calculated based on data collected during the 2011-2014 time period.

Table IX.A.12. 5: Baseline design values listed for each monitor.

Site	Maintenance Area	2011-2014 BDV
Ogden	Ogden City	88.2 $\mu g/m^3$
Hawthorne	Salt Lake County	100.9 $\mu g/m^3$
Magna	Salt Lake County	70.5 $\mu g/m^3$
Lindon	Utah County	111.4 $\mu g/m^3$
North Provo	Utah County	124.4 $\mu g/m^3$

- **Relative Response Factors**

In making future-year predictions, the output from the CMAQ 4.7.1 model is not considered to be an absolute answer. Rather, the model is used in a relative sense. In doing so, a comparison is made using the predicted concentrations for both the year in question and a pre-selected base-year, which for this plan is 2011. This comparison results in a Relative Response Factor (RRF). RRFs are calculated as follows:

1) Modeled PM_{10} concentrations are calculated for each grid cell in the modeling domain over the 39-day wintertime 2009-2010 episode. Of particular interest are the nine grid cells (3x3 window) that are collocated with each monitor. The monitor, itself is located in the window's center cell.

2) For every simulated day, the maximum daily PM_{10} concentration for each of these nine-cell windows is identified.

3) For each monitor, the top 20% of these 39 values are averaged to formulate a modeled PM_{10} peak concentration value (PCV).

4) At each monitor, the RRF is calculated as the ratio between future-year PCV and base-year PCV: **RRF = FPCV / BPCV**

- **Future Design Values and Results**

Finally, for each monitor, the FDV is calculated by multiplying the baseline design value by the relative response factor: **FDV = RRF * BDV**. These FDV's are compared to the NAAQS in order to determine whether attainment is predicted at that location or not. The results for each of the monitors are shown below in Table IX.A.12. 6.

Table IX.A.12. 6: Baseline design values, relative response factors, and future design values for all monitors and future years. Units of design values are μg/m^3, while RRF's are dimensionless.

Monitor	2011 BDV	2019 RRF	2019 FDV	2024 RRF	2024 FDV	2028 RRF	2028 FDV	2030 RRF	2030 FDV
Ogden	88.2	1.05	92.6	1.04	91.7	1.04	91.7	1.05	92.6
Hawthorne	100.9	1.09	110.0	1.09	110.0	1.11	112	1.12	113.0
Magna	70.5	1.14	80.4	1.13	79.7	1.14	80.4	1.15	81.1
Lindon	111.4	1.16	129.2	1.12	124.8	1.14	127.0	1.16	129.2
North Provo	124.4	1.15	143.1	1.12	139.3	1.13	140.6	1.15	143.1

For all future-years and monitors, no FDV exceeds the NAAQS. Therefore continued attainment is demonstrated for all three maintenance areas.

(2) Attainment Inventory

The attainment inventory is discussed in EPA guidance (Calcagni) as another one of the core provisions that should be considered by states for inclusion in a maintenance plan.

According to Calcagni, the stated purpose of the attainment inventory is to establish the level of emissions during the time periods associated with monitoring data showing attainment.

In cases such as this, where a maintenance demonstration is founded on a modeling analysis that is used in a relative sense, the baseline inventory modeled as the basis for comparison with every projection year model run is best suited to act as the attainment inventory. For this analysis, a baseline inventory was compiled for the year 2011. This year also falls within the span of data representing current attainment of the PM_{10} NAAQS.

Calcagni speaks about the projection inventory as well, and notes that it should consider future growth, including population and industry, should be consistent with the base-year attainment inventory, and should document data inputs and assumptions. Any assumptions concerning emission rates must reflect permanent, enforceable measures.

Utah compiled projection inventories for use in the quantitative modeling demonstration. The years selected for projection included 2019, 2024, 2028, and 2030. The emissions contained in the inventories include sources located within a regional area called a modeling domain. The modeling domain encompasses all three areas within the state that were designated as nonattainment areas for PM_{10}: Salt Lake County, Utah County, and Ogden City, as well as a bordering region see Figure IX.A.12. 1.

Since this bordering region is so large (owing to its creation to assess a much larger region of $PM_{2.5}$ nonattainment), a "core area" within this domain was identified wherein a higher degree of accuracy would be important. Within this core area (which includes Weber, Davis, Salt Lake, and Utah Counties), SIP-specific inventories were prepared to include seasonal adjustments and forecasting to represent each of the projection years. In the bordering regions away from this core, the 2011 National Emissions Inventory was downloaded from EPA and inserted to the analysis. It remained unchanged throughout the analysis period.

There are four general categories of sources included in these inventories: large stationary sources, smaller area sources, on-road mobile sources, and off-road mobile sources.

For each of these source categories, the pollutants that were inventoried included: particulate matter with an aerodynamic diameter of ten microns or less (PM_{10}), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), volatile organic compounds (VOC), and ammonia. SO_2 and NO_X are specifically defined as PM_{10} precursors, that is, compounds that, after being emitted to the atmosphere, undergo chemical or physical change to become PM_{10}. Any PM_{10} that is created in this way is referred to as secondary aerosol. The CMAQ model also considers ammonia and VOC to be contributing factors in the formation of secondary aerosol.

The unit of measure for point and area sources is the traditional tons per year, but the CMAQ model includes a pre-processor that converts these emission rates to hourly increments throughout each day for each episode. Mobile source emissions are reported in terms of tons per day, and are also pre-processed by the model.

The basis for the point source and area inventories, for the base-year attainment inventory as well as all future-year projection inventories, was the 2011 tri-annual inventory of actual emissions that had already been compiled by the Division of Air Quality.

Area sources, off-road mobile sources, and generally also the large point sources were projected forward from 2011, using population and economic forecasts from the Governor’s Office of Management and Budget.

Mobile source emissions were calculated for each year using MOVES2010 in conjunction with the appropriate estimates for vehicle miles traveled (VMT). VMT estimates for the urban counties were based on a travel demand model that is only run periodically for specific projection years. VMT for intervening years were estimated by interpolation.

Since this SIP subsection takes the form of a maintenance plan, it must demonstrate that the area will continue to attain the PM_{10} NAAQS throughout a period of ten years from the date of EPA approval. It is also necessary to “spot check” this ten-year interval. Hence, projection inventories were prepared for the following years: 2019, 2024, 2028, (the ten-year mark from anticipated EPA approval), and 2030. 2011 was established as the baseline period.

The following tables are provided to summarize these inventories. As described, they represent point, area, on-road mobile, and off-road mobile sources in the modeling domain. They include PM_{10}, SO_2, NO_X, VOC, and ammonia.

The first Table IX.A.12. 7 shows the baseline emissions for each of the areas within the modeling domain. The second Table IX.A.12. 8 is specific to this nonattainment area, and shows the emissions from the baseline through the projection years.

Table IX.A.12. 7 Baseline Emissions throughout the Modeling Domain

2011 Baseline	NA-Area	Source Category	PM10	SO2	NOx	VOC	NH3
2011 Baseline Sum of Emissions (tpd)	Ogden City NA-Area	Area Sources	0.85	0.08	2.12	5.67	0.86
		NonRoad	0.90	0.00	1.32	0.91	0.00
		Point Source	0.00	0.00	0.00	0.00	0.00
		Mobile Sources	2.09	0.05	12.18	8.58	0.22
		Provo NA Total	**3.84**	**0.13**	**15.62**	**15.16**	**1.08**
	Salt Lake County NA-Area	Area Sources	~~4.61~~	~~0.05~~	~~0.73~~	~~32.62~~	~~1.53~~
		NonRoad	7.12	0.32	11.71	6.38	0.00
		Point Source	4.04	8.90	15.56	2.97	0.20
		Mobile Sources	10.95	0.28	57.96	35.35	1.14
		Salt Lake City NA Total	~~**26.72**~~	~~**9.55**~~	~~**85.96**~~	~~**77.32**~~	~~**2.87**~~
	Utah County NA-Area	Area Sources	~~2.19~~	~~0.02~~	~~0.22~~	~~1.16~~	~~0.83~~
		NonRoad	3.53	0.02	4.24	2.31	0.00
		Point Source	0.28	0.29	1.03	0.18	0.18
		Mobile Sources	4.90	0.13	24.64	11.89	0.49
		Surrounding Areas Total	~~**10.90**~~	~~**0.46**~~	~~**30.13**~~	~~**15.54**~~	~~**1.50**~~
	Surrounding Areas	Area Sources	~~537.49~~	~~13.60~~	~~228.31~~	~~629.52~~	~~331.22~~
		NonRoad	34.53	0.10	60.77	72.57	0.01
		Point Source	17.64	283.15	538.86	63.96	6.08
		Mobile Sources	22.80	193.52	434.92	6.47	1.67
		Surrounding Areas Total	~~**612.46**~~	~~**490.37**~~	~~**1262.86**~~	~~**772.52**~~	~~**338.98**~~
		2011 Total	**653.92**	**500.51**	**1394.57**	**880.54**	**344.43**

2011 Baseline	NA-Area	Source Category	PM10	SO2	NOx	VOC	NH3
2011 Baseline Sum of Emissions (tpd)	Ogden City NA-Area	Area Sources	0.85	0.08	2.12	5.67	0.86
		NonRoad Sources	0.90	0.00	1.32	0.91	0.00
		Point Sources	0.00	0.00	0.00	0.00	0.00
		Mobile Sources	2.09	0.05	12.18	8.58	0.22
		Ogden City NA Total	**3.84**	**0.13**	**15.62**	**15.16**	**1.08**
	Salt Lake County NA-Area	Area Sources	5.50	0.37	9.14	30.35	3.82
		NonRoad Sources	7.12	0.32	11.71	6.38	0.00
		Point Sources	4.04	8.90	15.56	2.97	0.20
		Mobile Sources	10.95	0.28	57.96	35.35	1.14
		Salt Lake County NA Total	**27.61**	**9.87**	**94.37**	**75.05**	**5.16**
	Utah County NA-Area	Area Sources	3.90	0.28	5.61	13.02	6.62
		NonRoad Sources	3.53	0.02	4.24	2.31	0.00
		Point Sources	0.28	0.29	1.03	0.18	0.18
		Mobile Sources	4.90	0.13	24.64	11.89	0.49
		Utah County NA Total	**12.61**	**0.72**	**35.52**	**27.40**	**7.29**
	Surrounding Areas	Area Sources	534.89	13.02	214.51	619.93	323.14
		NonRoad Sources	34.53	0.10	60.77	72.57	0.01
		Point Sources	17.64	283.15	538.86	63.96	6.08
		Mobile Sources	22.80	193.52	434.92	6.47	1.67
		Surrounding Areas Total	**609.86**	**489.79**	**1,249.06**	**762.93**	**330.90**
		2011 Total	**653.92**	**500.51**	**1,394.57**	**880.54**	**344.43**

Table IX.A.12. 8 Salt Lake County Nonattainment Area; Actual Emissions for 2011 and Emission Projections for 2019, 2024, 2028, and 2030.

Year	NA-Area	Source Category	PM10	SO2	NOx	VOC	NH3
2011 Baseline	Utah County NA-Area	Area Sources	~~2.19~~	~~0.02~~	~~0.22~~	~~1.16~~	~~0.83~~
		NonRoad	3.53	0.02	4.24	2.31	0.00
		Point Source	0.28	0.29	1.03	0.18	0.18
		Mobile Sources	4.90	0.13	24.64	11.89	0.49
		2011 Total	~~**10.90**~~	~~**0.46**~~	~~**30.13**~~	~~**15.54**~~	~~**1.50**~~
2019	Utah County NA-Area	Area Sources	~~2.19~~	~~0.02~~	~~0.22~~	~~1.16~~	~~0.83~~
		NonRoad	4.80	0.02	3.04	1.95	0.01
		Point Source	0.87	0.44	3.24	0.86	0.43
		Mobile Sources	6.04	0.17	13.77	6.43	0.46
		2019 Total	~~**13.90**~~	~~**0.65**~~	~~**20.27**~~	~~**10.40**~~	~~**1.73**~~
2024	Utah County NA-Area	Area Sources	~~2.19~~	~~0.02~~	~~0.22~~	~~1.16~~	~~0.83~~
		NonRoad	5.19	0.02	2.45	1.90	0.01
		Point Source	0.92	0.47	3.42	0.91	0.43
		Mobile Sources	6.37	0.16	9.01	5.22	0.48
		2024 Total	~~**14.67**~~	~~**0.67**~~	~~**15.10**~~	~~**9.19**~~	~~**1.75**~~
2028	Utah County NA-Area	Area Sources	~~2.19~~	~~0.02~~	~~0.22~~	~~1.16~~	~~0.83~~
		NonRoad	5.68	0.02	2.17	1.92	0.01
		Point Source	0.96	0.49	~~0.00~~	0.96	0.43
		Mobile Sources	6.97	0.16	7.28	4.60	0.51
		2028 Total	~~**15.80**~~	~~**0.69**~~	~~**9.67**~~	~~**8.64**~~	~~**1.78**~~
2030	Utah County NA-Area	Area Sources	~~2.19~~	~~0.02~~	~~0.22~~	~~1.16~~	~~0.83~~
		NonRoad	6.25	0.02	2.07	1.94	0.01
		Point Source	0.99	0.49	3.67	0.98	0.43
		Mobile Sources	7.66	0.16	6.81	4.54	0.54
		2030 Total	~~**17.09**~~	~~**0.69**~~	~~**12.77**~~	~~**8.62**~~	~~**1.81**~~

Year	NA-Area	Source Category	PM10	SO2	NOx	VOC	NH3
2011 Baseline	Utah County NA-Area	Area Sources	3.90	0.28	5.61	13.02	6.62
		NonRoad	3.53	0.02	4.24	2.31	0.00
		Point Sources	0.28	0.29	1.03	0.18	0.18
		Mobile Sources	4.90	0.13	24.64	11.89	0.49
		2011 Total	**12.61**	**0.72**	**35.52**	**27.40**	**7.29**
2019	Utah County NA-Area	Area Sources	3.79	0.29	2.15	10.68	6.47
		NonRoad	4.80	0.02	3.04	1.95	0.01
		Point Sources	0.87	0.44	3.24	0.86	0.43
		Mobile Sources	6.04	0.17	13.77	6.43	0.46
		2019 Total	**15.50**	**0.92**	**22.20**	**19.92**	**7.37**
2024	Utah County NA-Area	Area Sources	2.83	0.35	1.80	11.66	5.98
		NonRoad	5.19	0.02	2.45	1.90	0.01
		Point Sources	0.92	0.47	3.42	0.91	0.43
		Mobile Sources	6.37	0.16	9.01	5.22	0.48
		2024 Total	**15.31**	**1.00**	**16.68**	**19.69**	**6.90**
2028	Utah County NA-Area	Area Sources	3.06	0.27	1.81	12.49	5.92
		NonRoad	5.68	0.02	2.17	1.92	0.01
		Point Sources	0.96	0.49	3.58	0.96	0.43
		Mobile Sources	6.97	0.16	7.28	4.60	0.51
		2028 Total	**16.67**	**0.94**	**14.84**	**19.97**	**6.87**
2030	Utah County NA-Area	Area Sources	3.17	0.18	1.78	12.90	5.89
		NonRoad	6.25	0.02	2.07	1.94	0.01
		Point Sources	0.99	0.49	3.67	0.98	0.43
		Mobile Sources	7.66	0.16	6.81	4.54	0.54
		2030 Total	**18.07**	**0.85**	**14.33**	**20.36**	**6.87**

More detail concerning any element of the inventory can be found at the appropriate section of the Technical Support Document (TSD). More detail about the general construction of the inventory may be found in the Inventory Preparation Plan.

(3) Emissions Limitations

As discussed above, the larger sources within the nonattainment areas were individually inventoried and modeled in the analysis.

A subset of these "large" sources was subsequently identified for the purpose of establishing emission limitations as part of the Utah SIP. This subset includes any source located within any of the three current nonattainment areas for PM_{10}: Salt Lake County, Utah County, or Ogden City whose actual emissions of PM_{10}, SO_2, or NOx exceeded 100 tons in 2011, or who had the potential to emit 100 tpy of any of these pollutants. A source might also be included in the subset if it was currently regulated for PM_{10} under section IX, Part H of the Utah SIP. There were several sources in Davis County that were close enough to the border so as to have originally been included in the original PM_{10} SIP.

As discussed before, the emission limits for these sources had already been reflected in the projected emissions inventories used in the modeling analysis. Only those limits for which credit is being taken in the SIP have been incorporated specifically into the SIP. Many of these limits appear in state issued Approval Orders or Title V Operating Permits. Such regulatory documents typically include many emission limits and operating restrictions. However, the limits found in the SIP cannot be changed unless the State provides, and EPA approves, a SIP revision.

These limits are incorporated in the Utah SIP at Section IX, Part H (formerly Sections 1 and 2 of Appendix A to Section IX, Part A), and as such are federally enforceable.

These conditions support a demonstration of maintenance through 2030.

(4) Emission Reduction Credits

Under Utah's new source review rules in R307-403-8, banking of emission reduction credits (ERCs) is permitted to the fullest extent allowed by applicable Federal Law as identified in 40 CFR 51, Appendix S, among other documents. Under Appendix S, Section IV.C.5, a permitting authority may allow banked ERCs to be used under the preconstruction review program (R307-403) as long as the banked ERCs are identified and accounted for in the SIP control strategy.

Existing Emission Reduction Credits, for PM_{10}, SO_2, and NOx, were included in the modeled demonstration of maintenance outlined in Subsection IX.A.12.c(1).

The subsequent crediting of any emission reduction of PM_{10}, or precursors thereto, whether pre-existing or established subsequent to the approval of this SIP revision, remains permissible. In general, credits must be in excess and must be established by actual, verifiable, and enforceable reductions in emissions. Additionally, these ERCs cannot be used to offset major new sources or major modifications at existing sources in $PM_{2.5}$ nonattainment areas.

Once Utah County is redesignated to attainment for PM_{10}, permitting new PM_{10} sources or major modifications to existing PM_{10} sources will be conducted under the rules of the Prevention of Significant Deterioration program.

(5) Additional Controls for Future Years

Since the emission limitations discussed in subsection IX.A.12.c.(3) are federally enforceable and, as demonstrated in IX.A.12.c(1) above, are sufficient to ensure continued attainment of the PM_{10} NAAQS, there is no need to require any additional control measures to maintain the PM_{10} NAAQS.

(6) Mobile Source Budget for Purposes of Conformity

The transportation conformity provisions of section 176(c)(2)(A) of the Clean Air Act (CAA) require regional transportation plans and programs to show that "…emissions expected from implementation of plans and programs are consistent with estimates of emissions from motor vehicles and necessary emissions reductions contained in the applicable implementation plan…" EPA's transportation conformity regulation (40 CFR 93, Subpart A, last amended at 77 FR 14979, March 14 2012) also requires that motor vehicle emission budgets must be established for the last year of the maintenance plan, and may be established for any years deemed appropriate (see 40 CFR 93.118((b)(2)(i)). If the maintenance plan does not establish motor vehicle emissions budgets for any years other than the last year of the maintenance plan, the conformity regulation requires that a "demonstration of consistency with the motor vehicle emissions budget(s) must be accompanied by a qualitative finding that there are not factors which would cause or contribute to a new violation or exacerbate an existing violation in the years before the last year of the maintenance plan." The normal interagency consultation process required by the regulation (40 CFR 93.105) shall determine what must be considered in order to make such a finding.

Thus, for a Metropolitan Planning Organization's (MPO's) Regional Transportation Plan (RTP), analysis years that are after the last year of the maintenance plan (in this case 2030), a conformity determination must show that emissions are less than or equal to the maintenance plan's motor vehicle emissions budget(s) for the last year of the implementation plan.

EPA's MOVES2014 was used to calculate mobile source emissions, and road dust projections were calculated using the January 2011 update to AP-42 Method for Estimating Re-Entrained Road Dust from Paved Roads (Chapter 13, released 76 FR 6329 February 4, 2011).

(a) Utah County: Mobile Source PM_{10} Emissions Budgets

In this maintenance plan, Utah is establishing transportation conformity motor vehicle emission budgets (MVEB) for PM_{10} (direct) and NOx for 2030.

(i) Direct PM_{10} Emissions Budget

Direct (or "primary") PM_{10} refers to PM_{10} that is not formed via atmospheric chemistry. Rather, direct PM_{10} is emitted straight from a mobile or stationary source. With regard to the emission budget presented herein, direct PM_{10} includes road dust, brake wear, and tire wear as well as PM_{10} from exhaust.

As presented in the Technical Support Document for on-road mobile sources, the estimated on-road mobile source emissions for Utah County, in 2030**,** of direct sources of PM_{10} (road dust, brake wear, tire wear, and exhaust particles) were 7.66 tons per winter-weekday. These mobile source PM_{10} emissions were included in the maintenance demonstration in Subsection IX.A.12.c.(1) which estimates a maximum PM_{10} concentration of 143.1 $\mu g/m^3$ in 2030 within the Utah County portion of the modeling domain. The above PM_{10} mobile source emission figure of 7.66 tons per day (tpd) would traditionally be considered as the MVEB for the maintenance plan.

However, and as discussed below, the modeled concentration is 6.9 $\mu g/m^3$ below the NAAQS of 150 $\mu g/m^3$, and indicates the potential for PM_{10} emissions to be considered for allocation to the PM_{10} MVEB.

EPA's conformity regulation (40 CFR 93.124(a)) allows the implementation plan to quantify explicitly the amount by which motor vehicle emissions could be higher while still demonstrating compliance with the maintenance requirement. These additional emissions that can be allocated to the applicable MVEB are considered the “safety margin.” As defined in 40 CFR 93.101, safety margin represents the amount of emissions by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for demonstrating maintenance. The implementation plan can then allocate some or all of this "safety margin" to the applicable MVEBs for transportation conformity purposes.

The safety margin for the Utah County portion of the domain equates to 6.9 $\mu g/m^3$.

To evaluate the portion of safety margin that could be allocated to the PM_{10} MVEB, modeling was re-run for 2030 with additional emissions attributed to the on-road mobile sources.

Using the same emission projections for point and area and non-road mobile sources, the SMOKE 3.6 emissions model was re-run using 12.28 tons of PM_{10} per winter-weekday for mobile sources (and 8.34 tons/winter-weekday of NO_X). The revised maintenance demonstration for 2030 still shows maintenance of the PM_{10} standard.

It estimates a maximum PM_{10} concentration of 148.0 $\mu g/m^3$ in 2030 within the Utah County portion of the modeling domain. This value is 2.0 $\mu g/m^3$ below the NAAQ Standard of 150 $\mu g/m^3$, but 4.9 $\mu g/m^3$ higher than the previous value.

This shows that the safety margin is at least 4.62 tons/day of PM_{10} (12.28 tons/day minus 7.66 tons/day) and 1.53 tons/day of NO_X (8.34 tons/day minus 6.81 tons/day). This maintenance plan allocates this portion of the safety margin to the mobile source budgets for Utah County, and thereby sets the direct PM_{10} MVEB for 2030 at 12.28 tons/winter-weekday.

(ii) NO_X Emissions Budget

Through atmospheric chemistry, NO_X emissions can substantially contribute to secondary PM_{10} formation. For this reason, NOx is considered a PM10 precursor.

As presented in the Technical Support Document for on-road mobile sources, the estimated on-road mobile source NO_X emissions for Utah County in 2030 were 6.81 tons per winter-weekday. These mobile source PM_{10} emissions were included in the maintenance demonstration in Subsection IX.A.12.c.(1) which estimates a maximum PM_{10} concentration of 143.1 $\mu g/m^3$ in 2030 within the Utah County portion of the modeling domain. The above NOx mobile source emission figure of 6.81 tons per day (tpd) would traditionally be considered as the MVEB for the maintenance plan. However, and as discussed below, the modeled concentration is 6.9 $\mu g/m^3$ below the NAAQS of 150 $\mu g/m^3$, and indicates the potential for NOx emissions to be considered for allocation to the NOx MVEB.

EPA's conformity regulation (40 CFR 93.124(a)) allows the implementation plan to quantify explicitly the amount by which motor vehicle emissions could be higher while still demonstrating compliance with the maintenance requirement. These additional emissions that can be allocated to the applicable MVEB are considered the “safety margin.” As defined in 40 CFR 93.101, safety margin represents the amount of emissions by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for demonstrating maintenance. The implementation plan can then allocate some or all of this "safety margin" to the applicable MVEBs for transportation conformity purposes.

The safety margin for the Utah County portion of the domain equates to 6.9 μg/m^3.

To evaluate the portion of safety margin that could be allocated to the PM_{10} MVEB, modeling was re-run for 2030 with additional emissions attributed to the on-road mobile sources.

Using the same emission projections for point and area and non-road mobile sources, the SMOKE 3.6 emissions model was re-run using 8.34 tons of NO_X per winter-weekday for on-road mobile sources (and 12.28 tons/winter-weekday of PM_{10}). The revised maintenance demonstration for 2030 still shows maintenance of the PM_{10} standard.

It estimates a maximum PM_{10} concentration of 148.0 μg/m^3 in 2030 within the Utah County portion of the modeling domain. This value is 2.0 μg/m^3 below the NAAQ Standard of 150 μg/m^3, but 4.9 μg/m^3 higher than the previous value.

This shows that the safety margin is at least 1.53 tons/day of NO_X (8.34 tons/day minus 6.81 tons/day) and 4.62 tons/day of PM_{10} (12.28 tons/day minus 7.66 tons/day). This maintenance plan allocates this portion of the safety margin to the mobile source budgets for Utah County, and thereby sets the NO_X MVEB for 2030 at 8.34 tons/winter-weekday

(b) Net Effect to Maintenance Demonstration

Using the procedure described above, some of the identified safety margin indicated earlier in Subsection IX.A.12.c(6) has been allocated to the mobile vehicle emissions budgets. The results of this modification are presented below.

***(i)* Inventory: The emissions inventory was adjusted as shown below:**

in 2030: PM_{10} was adjusted by adding 4.62 ton/day (tpd) of safety margin to 7.66 tpd inventory for a total of 12.28 tpd, and

NO_X was adjusted by adding 1.53 tpd of safety margin to 6.81 tpd inventory for a total of 8.34 tpd,

***(ii)* Modeling:**

The effect on the modeling results throughout the domain is summarized in the following Table IX.A.12. 9 (which shows predicted concentrations in μg/m^3). It demonstrates that with the allocation of the safety margin, the NAAQS is still maintained through 2030 in all areas.

Table IX.A. IX.A.12. 9 Modeling of Attainment in 2030, Including the Portion of the Safety Margin Allocated to Motor Vehicles

Air Quality Monitor	Predicted Concentrations in 2030 μg/m3	
	A	B

Lindon	129.2	133.7
North Provo	143.1	148.0

Notes: Column A shows concentrations presented previously as part of the modeled attainment test. Column B shows concentrations resulting from allocation of a portion of the safety margin.

(7) Nonattainment Requirements Applicable Pending Plan Approval

CAA 175A(c) - *Until such plan revision is approved and an area is redesignated as attainment, the requirements of CAA Part D, Plan Requirements for Nonattainment Areas, shall remain in force and effect.* The Act requires the continued implementation of the nonattainment area control strategy unless such measures are shown to be unnecessary for maintenance or are replaced with measures that achieve equivalent reductions. Utah will continue to implement the emissions limitations and measures from the PM_{10} SIP.

(8) Revise in Eight Years

CAA 175A(b) - *Eight years after redesignation, the State must submit an additional plan revision which shows maintenance of the applicable NAAQS for an additional 10 years.* Utah commits to submit a revised maintenance plan eight years after EPA takes final action redesignating the Utah County area to attainment, as required by the Act.

(9) Verification of Continued Maintenance

Implicit in the requirements outlined above is the need for the State to determine whether the area is in fact maintaining the standard it has achieved. There are two complementary ways to measure this: 1) by monitoring the ambient air for PM_{10}, and 2) by inventorying emissions of PM_{10} and its precursors from various sources.

The State will continue to maintain an ambient monitoring network for PM_{10} in accordance with 40 CFR Part 58 and the Utah SIP. The State anticipates that the EPA will continue to review the ambient monitoring network for PM_{10} each year, and any necessary modifications to the network will be implemented.

Additionally, the State will track and document measured mobile source parameters (e.g., vehicle miles traveled, congestion, fleet mix, etc.) and new and modified stationary source permits. If these and the resulting emissions change significantly over time, the State will perform appropriate studies to determine: 1) whether additional and/or re-sited monitors are necessary, and 2) whether mobile and stationary source emission projections are on target.

The State will also continue to collect actual emissions inventory data from all sources of PM_{10}, SO_2, and NO_X in excess of 25 tons (in aggregate) per year, as required by R307-150.

(10) Contingency Measures

CAA 175A(d) - Each maintenance plan shall contain contingency measures to assure that the State will promptly correct any violation of the standard which occurs after the redesignation of the area to attainment. Such provisions shall include a requirement that the State will implement all control measures which were contained in the SIP prior to redesignation.

Utah has implemented all measures contained in the nonattainment plan, however for the purposes of this maintenance plan the list of stationary sources included in SIP Section IX. Part H. was updated. Some of the sources identified in the nonattainment SIP are no longer operational or no longer rise to the emission thresholds established for such inclusion. In such instances, the emission limits belonging specifically to these sources were not carried forward. Where such a source is still operational, the prior SIP limits from the nonattainment plan are identified below as potential contingency measures. Some of the specific limits within may no longer apply and would need to be reevaluated at that time.

This Contingency Plan for Utah County supersedes Subsection IX.A.8, Contingency Measures, which is part of the original PM_{10} SIP.

The contingency plan must also ensure that the contingency measures are adopted expeditiously once triggered. The primary elements of the contingency plan are: 1) the list of potential contingency measures, 2) the tracking and triggering mechanisms to determine when contingency measures are needed, and 3) a description of the process for recommending and implementing the contingency measures.

(a) Tracking

The tracking plan for the Salt Lake County, Utah County, and Ogden City areas consists of monitoring and analyzing PM_{10} concentrations. In accordance with 40 CFR 58, the State will continue to operate and maintain an adequate PM_{10} monitoring network in Salt Lake County, Utah County, and Ogden City.

(b) Triggering

Triggering of the contingency plan does not automatically require a revision to the SIP, nor does it necessarily mean the area will be redesignated once again to nonattainment. Instead, the State will normally have an appropriate timeframe to correct the potential violation with implementation of one or more adopted contingency measures. In the event that violations continue to occur, additional contingency measures will be adopted until the violations are corrected.

Upon notification of a potential violation of the PM_{10} NAAQS, the State will develop appropriate contingency measures intended to prevent or correct a violation of the PM_{10} standard. Information about historical exceedances of the standard, the meteorological conditions related to the recent exceedances, and the most recent estimates of growth and emissions will be reviewed. The possibility that an exceptional event occurred will also be evaluated.

Upon monitoring a potential violation of the PM_{10} NAAQS, including exceedances flagged as exceptional events but not concurred with by EPA, the State will take the following actions.

- The State will identify the source(s) of PM_{10} causing the potential violation, and report the situation to EPA Region VIII within four months of the potential violation.

- The State will identify a means of corrective action within six months after a potential violation. The maintenance plan contingency measures to be considered and selected will be chosen from the following list or any other emission control measures deemed appropriate based on a consideration of cost-effectiveness, emission reduction potential, economic and social considerations, or other factors that the State deems appropriate:

  - Re-evaluate the thresholds at which a red or yellow burn day is triggered, as established in R307-302;

  - Further controls on stationary sources

The State will then hold a public hearing to consider the contingency measures identified to address the violation. The State will require implementation of such corrective action no later than one year after the violation is confirmed. Any contingency measures adopted and implemented will become part of the next revised maintenance plan submitted to the EPA for approval.

It is also possible that contingency measures may be pre-implemented, where no violation of the 2006 PM_{10} NAAQS has yet occurred.