

**PROPOSAL BY REGIONAL AIR QUALITY COUNCIL  
8/26/05**

**DRAFT CARBON MONOXIDE MAINTENANCE PLAN  
FOR THE DENVER METROPOLITAN AREA**

**Approved by:  
Colorado Air Quality Control Commission  
-----, 2005**

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# Table of Contents

## Revised Maintenance Plan

A.	Continued Attainment of the Carbon Monoxide Standard.....	3
B.	Maintenance Plan Control Measures.....	11
C.	Emission Inventories.....	12
D.	Maintenance Demonstration.....	16
E.	Mobile Source Carbon Monoxide Emissions Budget.....	19
F.	Monitoring Network / Verification of Continued Attainment.....	22
G.	Contingency Provisions. ....	22
H.	Subsequent Maintenance Plan Revisions.....	24

# CARBON MONOXIDE MAINTENANCE PLAN FOR THE DENVER METROPOLITAN AREA

The State of Colorado, in coordination with the Regional Air Quality Council (RAQC), is submitting this Carbon Monoxide (CO) Maintenance Plan Revision to provide for maintenance of the CO National Ambient Air Quality Standard (NAAQS) for an additional 10-year period following the first ten-year period after redesignation to attainment as required by the Clean Air Act (CAA) 176A(b) and the U.S. Environmental Protection Agency (EPA).

The previously approved Denver Metro Area Carbon Monoxide Maintenance Plan, which was submitted by the Governor on May 10, 2000, was formally approved by the EPA (66 FR 64751) on December 14, 2001 (effective date January 14, 2002). In that action the Denver Metro Area was redesignated by the EPA from a “serious” CO non-attainment area to attainment of the CO NAAQS. In addition, the approved Plan demonstrated maintenance of the standard for a ten-year period after redesignation to attainment as required by CAA 175A(a).

In response to EPA issued policy guidance (January 2002) for states and local areas to use when developing SIP revisions using MOBILE 6 (*“Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity,” January 18, 2002*), the State of Colorado in coordination with the RAQC developed a revised CO Maintenance Plan based on the procedures outlined in this guidance. The revised maintenance plan was approved by the EPA on September 16, 2004. The revised maintenance plan merely replaced the existing MOBILE5 maintenance plan motor vehicle emissions inventories with MOBILE6 base (attainment) and maintenance year inventories, while maintaining the strategies reflected in the previously approved maintenance plan.

In developing this CO maintenance plan revision to provide for maintenance of the CO NAAQS for an additional 10-year period, the RAQC and the State conducted a comprehensive reevaluation of mobile source control programs with MOBILE6.2 and the latest transportation data sets from Denver Regional Council of Governments’ (DRCOG) 2030 Regional Transportation Plan. This revision removes the Air Quality Regulations No. 11 (Inspection/Maintenance) and No. 13 (Oxygenated Fuels) from the Denver metro area CO State Implementation Plan (SIP).

Since this revision to the Denver area SIP includes the 2013 maintenance year contained in the previously approved maintenance plan, 2013 must remain as an interim budget year in this revised maintenance plan. The maintenance year for this revision is 2021.

The most recent three years (2002-04) of monitored data, which are presented in Section A, show the Denver area has maintained attainment of the standard since the redesignation was approved.

Finally, the following sections contain the core elements EPA has established as necessary for approval of maintenance plans:

1. Description of the control measures for the maintenance period
2. Emission inventories for current and future years
3. Maintenance demonstration

4. Mobile source emissions budget
5. Approved monitoring network
6. Verification of continued attainment
7. Contingency plan
8. Subsequent maintenance plan revisions

This maintenance plan revision follows the same format as the previously approved maintenance plan.

## **A. CONTINUED ATTAINMENT OF THE CARBON MONOXIDE STANDARD**

Attainment of the national ambient air quality standard for carbon monoxide is demonstrated when two consecutive years of monitoring data for each site show no more than one exceedance per year of the 8-hour (9 ppm) and 1-hour (35 ppm) standards. Monitoring data for 2000-04 demonstrates that the Denver metropolitan area continues to attain/maintain the national standard for carbon monoxide as required by 40 CFR 50.8. Data from 2000 through 2004 are provided to demonstrate continual attainment/maintenance since the previously approved maintenance plan was adopted (December 14, 2001). This is based on quality assured monitoring data representative of the location of expected maximum concentrations of carbon monoxide in the area (downtown Denver).

The current carbon monoxide ambient monitoring network consists of 7 sites operated by the Colorado Air Pollution Control Division. The sites are listed along with summary data from 2000 through 2004 in Tables 1 and 2.

The monitoring data presented in Tables 1 and 2 verify that the Denver area continues to attain the national standard for carbon monoxide. Data recovery rates for the monitors exceed the 75% completeness requirements for all years, and all state and federal quality assurance procedures have been complied with, further substantiating their validity as indicators of ambient carbon monoxide levels in the Denver metropolitan area. Figure 1, Historical Monitoring Data for the CO NAAQS by Monitor Site, includes long term monitoring records of each monitoring site which demonstrate that the Denver area has been in attainment with the national ambient air quality standard for carbon monoxide since 1996 and has had a continuous downward trend in CO levels since 1992. Figure 2 shows the geographic distribution of the monitors.

**Table 1:**  
**2000-2004, 1-Hour Carbon Monoxide Summary for the Denver Metropolitan Area**  
Standards: 1-hour = 35 ppm\*; 8-hour = 9 ppm\*\*

Site Name	1-Hour 1 <sup>st</sup> Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 <sup>th</sup> Ave. & Steele St.	4.3	6.1	4.8	5.4	4.2
Boulder, 2150 28 <sup>th</sup> St.	10.0	9.1	5.0	4.8	4.7
Denver – CAMP, 2105 Broadway***	17.1	14.4	7.4	15.0	8.7
Denver – NJH, 14 <sup>th</sup> Ave. & Albion St.	8.7	9.7	6.3	6.7	7.3
Denver – Carriage, 23 <sup>rd</sup> Ave. & Julian St.	5.8	7.1	4.9	4.5	5.3
Denver – Firehouse #6, Speer & Auraria	9.3	7.8	8.5	7.8	5.9
Arvada, 57 <sup>th</sup> Ave. & Garrison St.	7.1	6.2	4.9	7.1	4.3

Site Name	1-Hour 2 <sup>nd</sup> Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 <sup>th</sup> Ave. & Steele St.	4.3	5.8	4.4	5.2	4.0
Boulder, 2150 28 <sup>th</sup> St.	9.6	6.8	5.0	4.7	4.5
Denver – CAMP, 2105 Broadway***	12.8	9.3	7.4	14.9	8.7
Denver – NJH, 14 <sup>th</sup> Ave. & Albion St.	7.6	8.5	6.0	6.5	6.8
Denver – Carriage, 23 <sup>rd</sup> Ave. & Julian St.	5.6	6.5	4.6	4.5	4.9
Denver – Firehouse #6, Speer & Auraria	8.6	7.0	7.5	6.1	5.8
Arvada, 57 <sup>th</sup> Ave. & Garrison St.	6.2	5.0	4.7	4.7	3.7

\* Due to mathematical rounding, a value of 35.5 ppm or greater is necessary to exceed the standard.

\*\* Due to mathematical rounding, a value of 9.5 ppm or greater is necessary to exceed the standard.

\*\*\* Site was closed for part of 2000 for reconstruction.

**Table 2:**  
**2000-2004, 8-Hour Carbon Monoxide Summary for the Denver Metropolitan Area**  
Standards: 1-hour = 35 ppm\*; 8-hour = 9 ppm\*\*

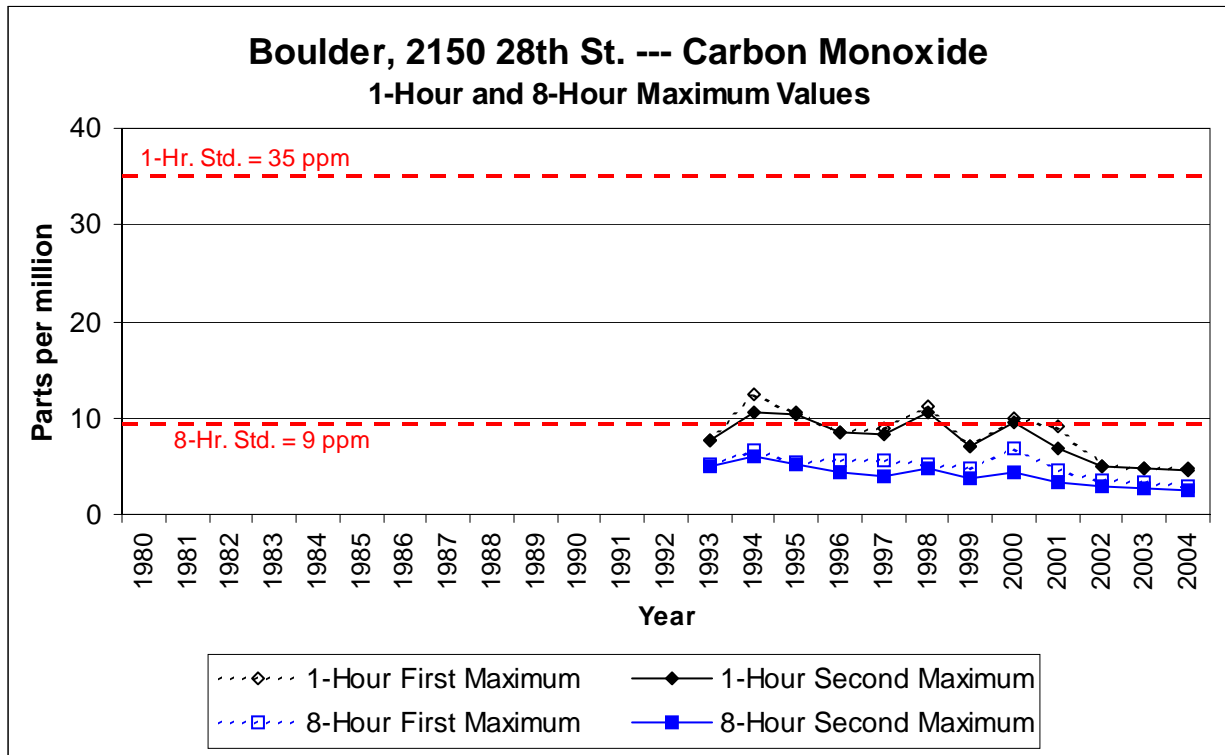
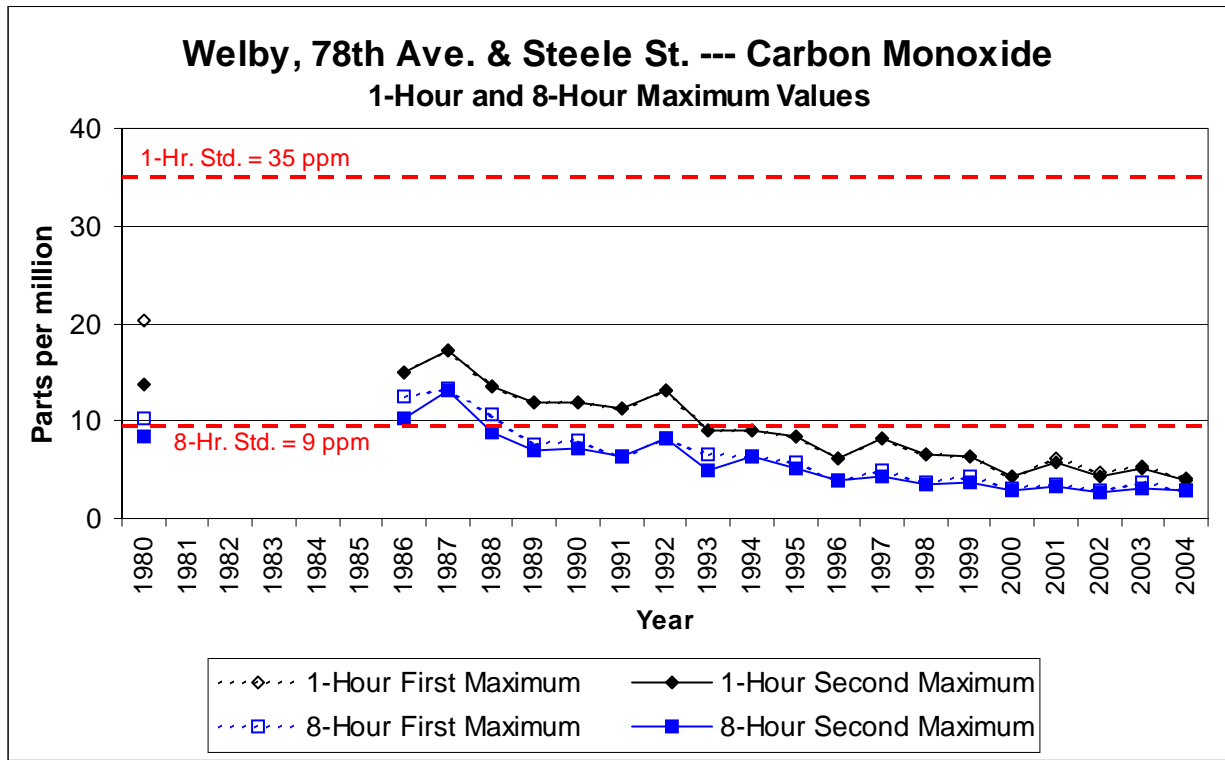
Site Name	8-Hour 1 <sup>st</sup> Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 <sup>th</sup> Ave. & Steele St.	3.0	3.4	2.8	3.6	2.9
Boulder, 2150 28 <sup>th</sup> St.	6.8	4.5	3.5	3.3	2.9
Denver – CAMP, 2105 Broadway***	8.5	4.4	3.7	6.3	4.4
Denver – NJH, 14 <sup>th</sup> Ave. & Albion St.	4.8	4.0	3.5	3.5	3.6
Denver – Carriage, 23 <sup>rd</sup> Ave. & Julian St.	4.1	3.8	3.7	3.9	3.7
Denver – Firehouse #6, Speer & Auraria	5.0	4.6	3.9	3.5	3.7
Arvada, 57 <sup>th</sup> Ave. & Garrison St.	3.9	3.1	3.0	2.5	2.7
Site Name	8-Hour 2 <sup>nd</sup> Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 <sup>th</sup> Ave. & Steele St.	2.9	3.3	2.6	3.0	2.8
Boulder, 2150 28 <sup>th</sup> St.	4.3	3.4	3.0	2.7	2.5
Denver – CAMP, 2105 Broadway***	5.4	4.1	3.7	4.5	4.1
Denver – NJH, 14 <sup>th</sup> Ave. & Albion St.	4.7	3.9	3.1	3.3	3.4
Denver – Carriage, 23 <sup>rd</sup> Ave. & Julian St.	3.4	3.7	2.7	3.2	3.4
Denver – Firehouse #6, Speer & Auraria	4.6	4.0	3.6	3.4	3.6
Arvada, 57 <sup>th</sup> Ave. & Garrison St.	3.8	3.0	2.6	2.3	2.6

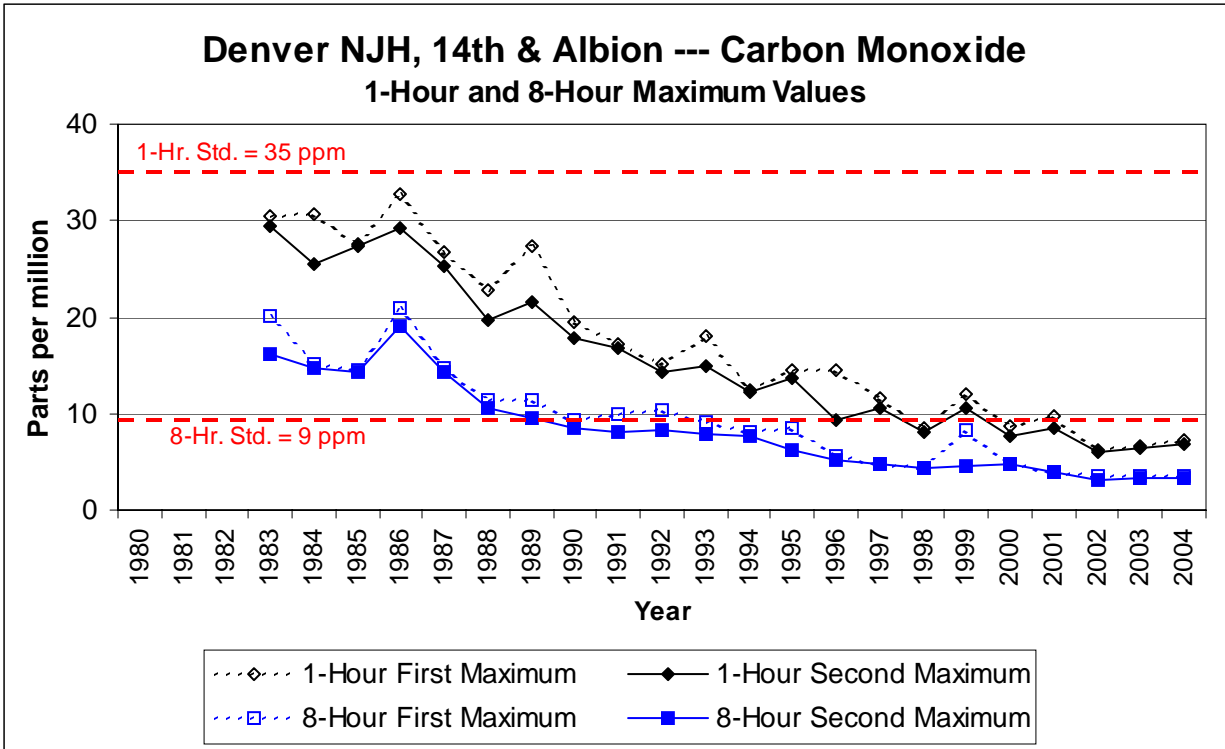
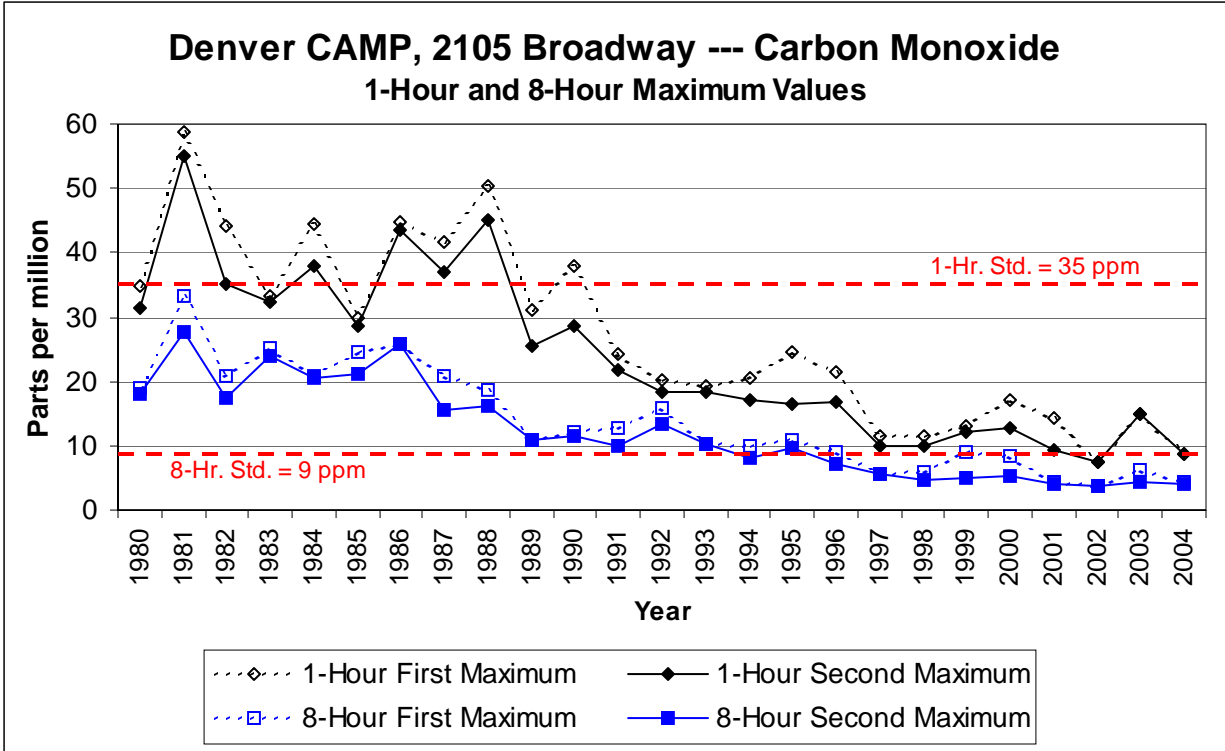
\* Due to mathematical rounding, a value of 35.5 ppm or greater is necessary to exceed the standard.

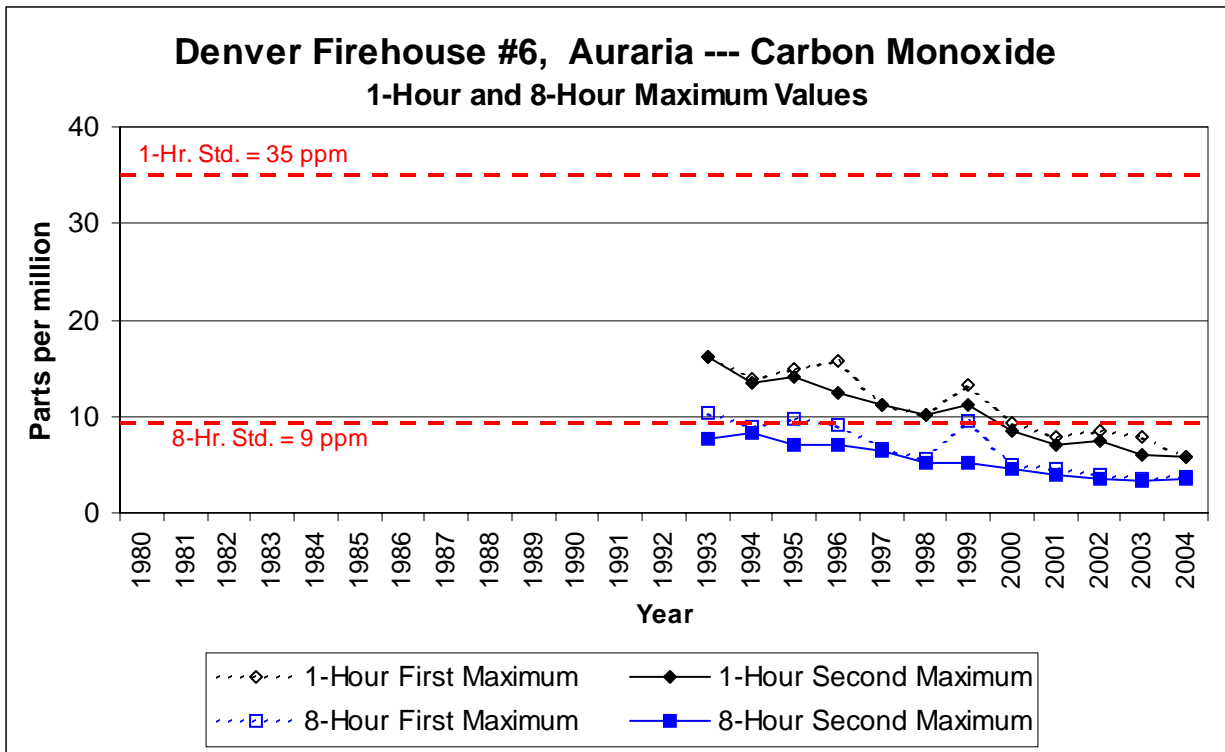
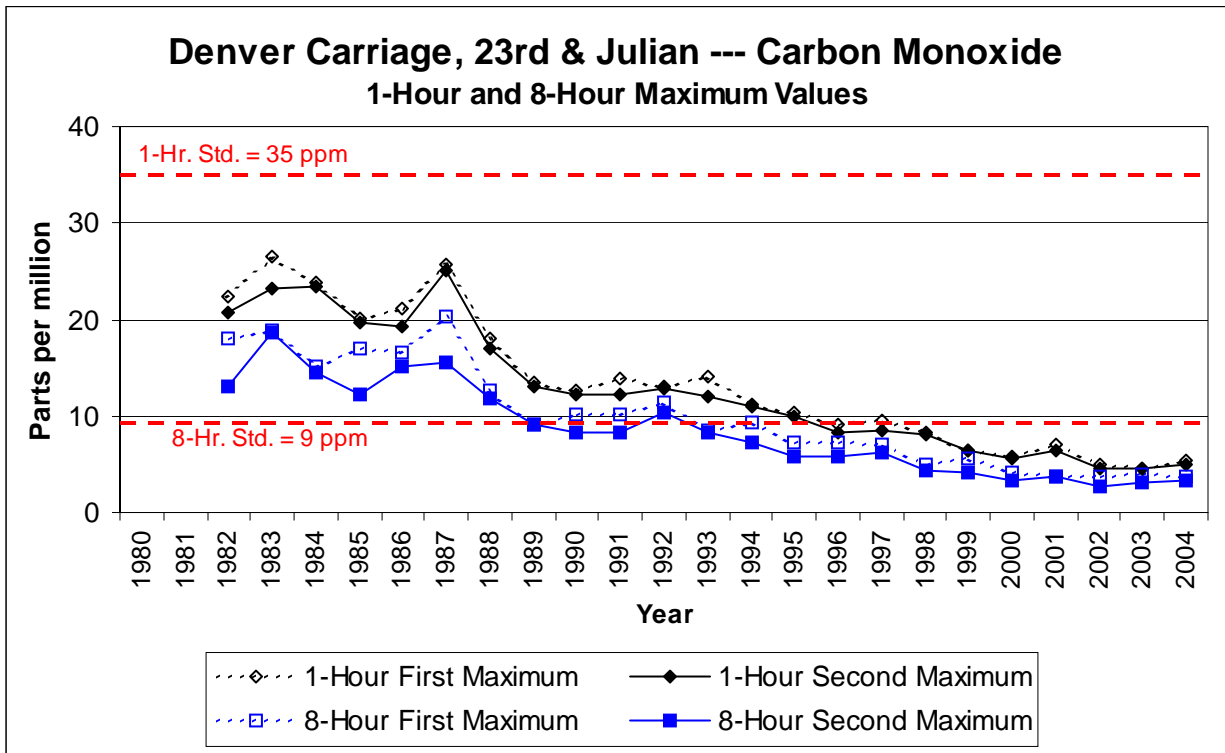
\*\* Due to mathematical rounding, a value of 9.5 ppm or greater is necessary to exceed the standard.

\*\*\* Site was closed for part of 2000 for reconstruction.

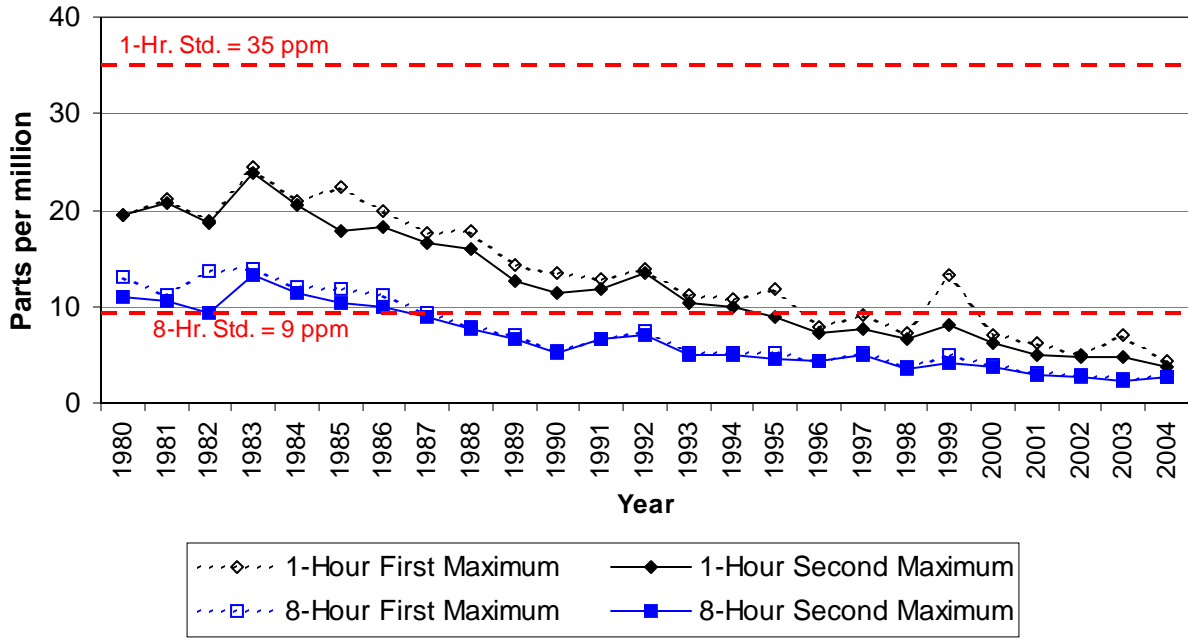
**Figure 1:  
Historical Monitoring Data for the CO NAAQS by Monitor Site**



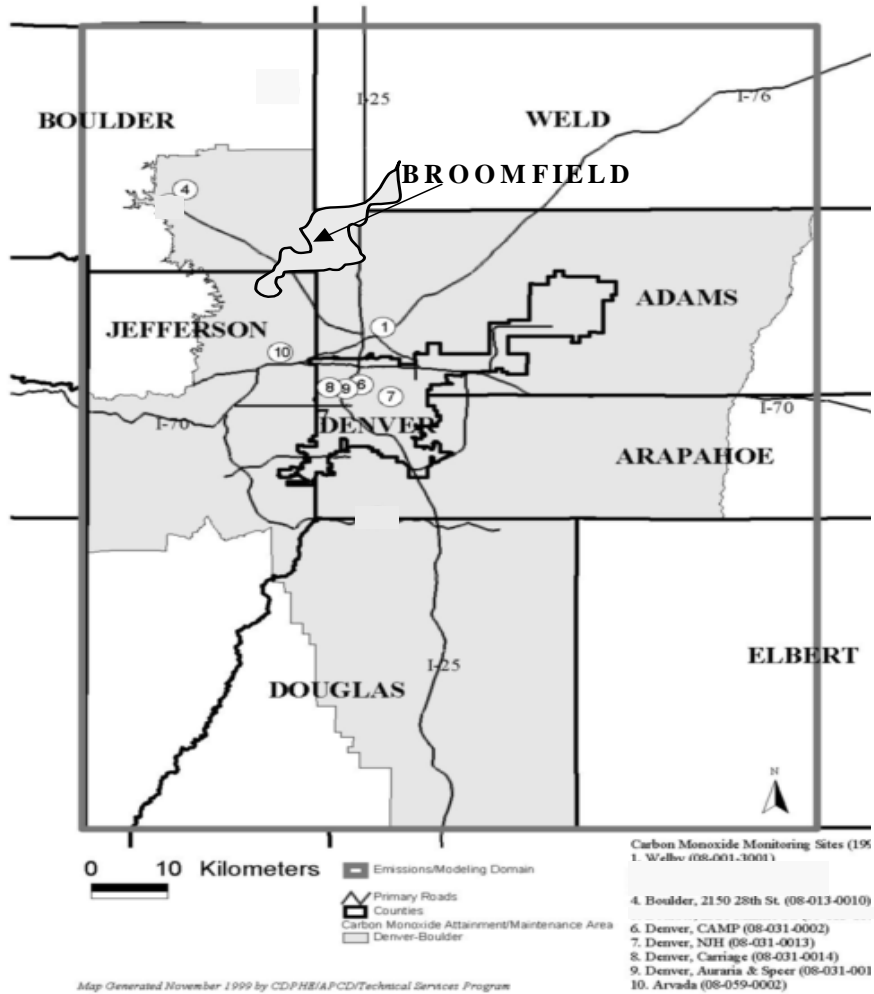




### Arvada, 57th & Garrison --- Carbon Monoxide 1-Hour and 8-Hour Maximum Values



**Figure 2:**  
**Map of Denver Metropolitan Attainment/Maintenance Area, Modeling Domain, and Location of Carbon Monoxide Monitors**



## **B. MAINTENANCE PLAN CONTROL MEASURES**

The Inspection/Maintenance (AQR No.11) and Oxygenated Fuels (AQR No.13) programs will be removed from Denver metro area CO SIP effective December 31, 2007. With the removal of these regulations from the SIP, the Denver metropolitan area will continue to rely on other control programs contained in the maintenance plan approved on September 16, 2004 to demonstrate maintenance of the carbon monoxide standards through 2021.

No emission reduction credit has been taken in the maintenance demonstration for any other current State or local control programs and no other such programs, strategies, or regulations shall be incorporated or deemed as enforceable measures for the purposes of this maintenance demonstration.

The specific enforceable control measures that continue to be a part of the maintenance plan until December 31, 2007 are listed below:

1. Air Quality Control Commission Regulation No. 11 -- covering the Automobile Inspection and Readjustment (A.I.R.) Program. This maintenance plan makes no revisions to this regulation but does remove this regulation from the Denver metro area SIP effective December 31, 2007.
2. Air Quality Control Commission Regulation No. 13 -- covering the oxygenated gasoline program. This maintenance plan makes no revisions to this regulation but does remove this regulation from the Denver metro area SIP effective December 31, 2007.

The specific enforceable control measures that continue to be a part of the maintenance plan through 2021 are listed below:

1. Federal tailpipe standards and regulations, including those for small engines and non-road mobile sources. Credit is taken for these federal requirements but they are not part of the Colorado SIP.
2. Air Quality Control Commission Regulation No. 4 -- covering residential wood burning control programs. The Maintenance plan makes no revisions to residential wood burning control programs.
3. Air Quality Control Commission Regulations No. 3, No. 6 and Common Provisions -- covering industrial source control programs. The Common Provisions, and Parts A and B of Regulation No. 3, are already included in the approved SIP. Regulation No. 6, and Part C of Regulation No. 3, implement the federal standards of performance for new stationary sources and the federal operating permit program. The maintenance plan makes no revisions to these regulations. This reference to Regulation No. 6 and Part C of Regulation No. 3 shall not be construed to mean that these regulations are included in the SIP.
4. In accordance with State and federal regulations and policies, the State and federal nonattainment New Source Review (NSR) requirements in effect for the Denver area reverted to the State and federal attainment Prevention of Significant Deterioration (PSD) permitting requirements once EPA approved the redesignation request and maintenance

plan. This maintenance plan revision makes no changes to these PSD permitting requirements.

## **C. EMISSION INVENTORIES**

This section presents the emission inventories portion of the maintenance plan. Emission inventories are provided for the 2001 attainment year, the 2009, 2010, the 2013 budget year from the recent revision, 2015, 2020 and the 2021 maintenance year (see Table 3).

The 2001 attainment year inventory is based on the actual control levels in place at that time. The 2009 through 2021 inventories incorporate the maintenance plan control measures described above in Section B. For purposes of the demonstration of maintenance of the CO NAAQS, the I/M 240 program and the oxygenated fuel program are assumed to be removed on January 1, 2008. The phase-out of residual I/M 240 program benefits is estimated in the 2009 and 2010 analysis years. January 1, 2009 will have half the benefit of a biennial I/M 240 program and January 1, 2010 will have no residual benefit due to the I/M 240 program.

All of the inventories are for the Denver metropolitan area carbon monoxide attainment/maintenance area (see Figure 2) and provide emissions estimates for a weekday during the winter carbon monoxide season (November through February). The carbon monoxide attainment/maintenance area is used to establish the mobile source emissions budgets for the region as discussed in subsequent sections of this plan.

The inventories presented in this plan to support continued maintenance of the CO NAAQS in the Denver-Boulder area were developed using EPA-approved emissions modeling methods. The transportation and demographic data for this revised maintenance plan have been updated with the most recently available data sets from the Denver Regional Council of Governments 2030 Regional Transportation Plan (adopted in January 2005). The technical support document for this revised maintenance plan summarizes information on the assumed methodology, growth surrogate and/or control assumptions for each non-motor vehicle (point and area) source category.

Table 3 summarizes the inventories for this plan revision.

**Table 3:  
Emission Inventories for the Denver Carbon Monoxide Attainment Area  
Carbon Monoxide Emissions (tons/day)**

	2001	2009	2010	2013	2015	2020	2021
<b>Area Sources</b>							
Aircraft	13.8	17.6	18.0	19.1	19.9	21.7	22.0
Commercial Cooking	1.0	1.0	1.1	1.1	1.2	1.3	1.3
Fuel Combustion	8.2	9.2	9.4	9.8	10.1	11.0	11.0
Railroads	0.6	0.8	0.8	0.9	0.9	1.0	1.0
Structure Fires	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Woodburning	50.2	51.4	51.5	52.0	52.3	53.2	53.4
<b>Total Area Sources</b>	<b>74.1</b>	<b>80.5</b>	<b>81.2</b>	<b>83.4</b>	<b>84.9</b>	<b>88.7</b>	<b>89.4</b>
<b>NonRoad Sources</b>							
Agricultural Equipment	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Airport Equipment	27.4	34.0	35.3	37.3	38.9	42.9	43.6
Commercial Equipment	116.0	148.2	151.1	159.6	165.2	174.8	176.8
Construction and Mining Equipment	14.4	15.1	15.0	14.1	13.4	12.0	11.9
Industrial Equipment	21.4	15.7	13.5	7.3	4.9	3.2	3.1
Lawn and Garden Equipment (Commercial)	17.4	22.1	22.4	23.3	24.0	25.5	26.0
Lawn and Garden Equipment (Residential)	1.0	0.8	0.9	0.9	0.9	1.0	1.0
Other Oil Field Equipment	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Railroad Equipment	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Recreational Equipment	1.3	2.2	2.3	2.4	2.4	2.4	2.4
<b>Total NonRoad Sources</b>	<b>199.4</b>	<b>239.0</b>	<b>241.3</b>	<b>245.6</b>	<b>250.4</b>	<b>262.6</b>	<b>265.6</b>
<b>Point Sources</b>							
Stack>=25 meters	4.9	5.6	5.8	6.3	6.8	7.9	8.1
Stack<25 meters	10.4	12.5	12.7	13.5	13.6	15.0	15.2
<b>Total Points</b>	<b>15.3</b>	<b>18.1</b>	<b>18.5</b>	<b>19.8</b>	<b>20.4</b>	<b>22.9</b>	<b>23.3</b>
<b>Total Area-Non-Road-Point</b>	<b>288.8</b>	<b>337.7</b>	<b>341.0</b>	<b>348.8</b>	<b>355.7</b>	<b>374.2</b>	<b>378.2</b>
<b>Mobile Sources</b>	<b>1708.1</b>	<b>1476.8</b>	<b>1523.9</b>	<b>1429.2</b>	<b>1416.0</b>	<b>1362.7</b>	<b>1372.1</b>
<b>Grand Total</b>	<b>1997.0</b>	<b>1814.5</b>	<b>1864.9</b>	<b>1778.1</b>	<b>1771.7</b>	<b>1736.9</b>	<b>1750.3</b>

*Note: The significant figures in this table are used to show the small contribution of certain source categories. They are not intended to indicate a level of accuracy in the inventories. Totals may not add due to rounding.*

**1. Demographic and Transportation Data**

The most recent planning assumptions for the Denver metropolitan area are incorporated in the Denver Regional Council of Government's 2030 Regional Transportation Plan. Table 4 summarizes the population, households and employment estimates for 2001-2030 for the Denver-Boulder attainment area from this plan. These estimates are used as the basis for the emission inventory development.

**Table 4:  
Demographic Data Used to Develop  
The DRCOG 2030 Regional Transportation Plan  
(Based on the 2000 census)**

<b>Period</b>	<b>Population</b>	<b>Households</b>	<b>Employment</b>
2001	2,304,700	916,480	1,306,800
2005	2,454,300	988,000	1,267,100
2015	2,853,200	1,156,300	1,612,300
2020	3,099,300	1,262,300	1,721,300
2030	3,591,600	1,474,400	1,939,500

**2. Methodology and Control Assumptions for Source Categories**

**a. Mobile Sources**

The mobile source emission estimates contained in this revised maintenance plan are also based on 2030 Regional Transportation Plan travel demand modeling provided by DRCOG (see Table 5).

**Table 5:  
2030 RTP Transportation Vehicles Miles Traveled Used  
To Develop this Revised Maintenance Plan**

<b>Year</b>	<b>VMT</b>
2001	57,984,600
2005	61,842,200
2015	77,544,600
2020	84,765,600
2030	98,499,600

Mobile source inventories in this proposed revision are also based on MOBILE6.2 emissions factors, Denver metro area vehicle registration and vehicle-type mix miles traveled estimates. The 2001 inventory is based on MOBILE6.2 credits for the inspection/maintenance and oxygenated gasoline programs that were in use on January 1, 2001. The analysis years of 2009 and 2010 are included in this maintenance demonstration to account for the phase-out of the emissions reduction

due to the removal of the I/M and oxygenated gasoline programs effective December 31, 2007. On January 1, 2009 the residual benefit of the I/M program will be one-half the benefit of to the biennial I/M 240 program. On January 1, 2010 it is assumed that there will be no residual benefit due to the I/M 240 program. No benefit from the oxygenated gasoline program is assumed for the 2009 analysis year and beyond. The analysis years at 2010 and later do not include an I/M program or oxygenated fuel program.

The Technical Support Document contains documentation of the modeling methodology using MOBILE6.2.

**b. Point Sources**

Point source inventories were estimated using data from the CDHPE Air Pollution Control Division APEN reporting system. Urban Airshed Modeling done for a previously approved plan indicates that elevated point sources have little or no impact of the maintenance demonstration since the mixing height on the worst-case days is very shallow. In addition, the larger sources of elevated CO emissions are not located near the Denver central business district. Consequently, carbon monoxide emitted above 25 meters AGL are excluded from the inventory of ground level carbon monoxide sources inventory used for the grid analysis portion of the attainment demonstration. However, elevated source are included in the inventory totals for the Denver-Boulder attainment/maintenance area. Carbon monoxide emissions from point sources emitted below 15 AGL are included in the grid analysis portion of the attainment demonstration. This treatment of carbon monoxide point sources is consistent with the historical treatment of such sources for the for previous Denver-Boulder attainment area plans.

Specific information for point sources in the attainment/maintenance area is summarized in the technical support document for this maintenance plan revision, including the number of new sources permitted since the previously approved maintenance plan was developed.

**c. Non-road and Area Sources**

The area sources, with the exception of the residential woodburning, are based on National Emission Inventory methodologies and data. Residential woodburning emissions are based the Metropolitan Denver Woodburning Survey (2002). The non-road mobile source emissions were estimated using the EPA Nonroad Model (2004). The emission inventories for both non-road and area sources are documented in the Technical Support Document.

**d. Aircraft and Airport Services**

In conjunction with this plan revision, DIA has provided CDPHE updated emissions estimates to incorporate in the plan. The aircraft and airport equipment categories in Table 4 incorporate the updated estimates from DIA for the 2001 through 2021 time period as well as from all other airports in the Denver-Boulder attainment area. Summaries of the DIA inventories are included in the Technical Support document in the airport-related emissions discussions. The DIA inventory documentation is included as an Appendix in the Technical Support Document.

## D. MAINTENANCE DEMONSTRATION

This revision to the CO maintenance plan relies on gridded emissions inventory comparisons and selected intersection hot-spot analysis to demonstrate maintenance of the standard through the 2021 maintenance year as was done in the maintenance plan approved September 16, 2004, which replaced MOBILE5 estimates with MOBILE6.2 estimates.

The gridded emissions inventory comparisons address a nine-cell subset of Central Business District grid cells while gridded emissions for the entire modeling domain (geographical area defined in the 1995 CO SIP) are evaluated for areas of high growth.

The intersection modeling analysis includes background concentration roll forward modeling using Denver metro area ambient monitoring for 2000 through 2002 and modeling of the three highest volume and most congested intersections using CAL3QHC.

Additional details are provided below and in the TSD.

### 1. Gridded Emissions Inventory Comparison

#### a. Central Business District

The emissions inventories for a nine-cell subset of the Denver Central Business District grid cells (one square mile) for the 2001 attainment year have been compared to the future year emissions loadings in Table 6. As can be seen the future year emissions loadings are well below the 2001 emissions load.

**Table 6:**  
**Comparison of 2001 Baseline Attainment Year Nine-Cell Gridded Inventory**  
**with Interim, Interim Budget & Maintenance Year Inventories**  
*(tons per day)*

Year	TPD
2001	67.9
2010	59.2
2013	53.9
2021	50.0

#### b. High Growth Areas

Additionally, the gridded emissions for the entire modeling domain (defined in the 1995 CO SIP and shown in Figure 2) have been evaluated for areas of high growth with a roll forward analysis to

assure that the CO NAAQS is maintained in all future years. Background CO levels for high growth areas have been estimated with monitored ambient concentrations where possible. Background CO levels for high growth areas without applicable ambient monitoring are estimated from the UAM modeling for the 2001 maintenance plan from the initial CO SIP (1995). The 2001 monitored or modeled CO concentrations have been scaled to 2010 (the highest future emissions year), 2013 and 2021 using the ratio of the 2010, 2013 or 2021 nine-cell gridded inventory level to the 2001 base inventory as shown in the following Table 7 for a typical high growth area, Parker Road & I-225.

**Table 7:**  
**Typical High Growth Area**  
**Parker and I-225**  
 (2001 UAM background = 2.1 ppm)

Year	TPD	CO ppm
2001	11.1	2.1
2010	14.0	2.6
2013	12.4	2.3
2021	10.9	2.1

Typically, the areas of high growth rates are in suburban areas where background conditions are low. The roll forward analysis for the high growth as shown above indicates that the CO NAAQS is protected in future years. Additional details for areas of high growth areas provided in the technical support document.

**2. Intersection Modeling Analysis**

A modeling analysis, including background roll forward modeling and intersection modeling has been performed for future years 2010, 2013 and 2021 on intersections identified by DRCOG as the current three highest volume and three most congested intersections in the DMA and the Denver Central Business District.

The highest volume intersections are as follows:

- University Boulevard and 1<sup>st</sup> Avenue
- Wadsworth Boulevard and Alameda Avenue
- University Boulevard and Belleview Avenue

The most congested intersections are as follows:

- 28<sup>th</sup> Street and Arapahoe Road (Boulder)
- University Boulevard and Belleview Avenue
- Foothills Parkway and Arapahoe Road (Boulder)

**a. Background Concentration Roll Forward Modeling**

The background concentrations for the intersection modeling demonstration are estimated in a manner consistent with the methodology used to estimate background concentrations for the most recent CO SIP revision based on MOBILE6.2. This methodology utilizes the Denver metro ambient monitoring for 2000 through 2002. The maximum second-maximum monitored ambient concentration from the 2000-2002 monitoring period is used to define the baseline (2001) background concentration. The following Table 8 shows the eight-hour average ambient carbon monoxide maximum and second maximum values for each monitoring location.

**Table 8:  
2000-2002 8-hr Average Ambient Carbon Monoxide  
Maximum and 2<sup>nd</sup> Maximum**

Location	Area Type	2000	2001	2002
CAMP	CBD	8.5 / <b>5.4</b>	4.4 / 4.1	3.7 / 3.7
Speer & Auraria	CBD	5.0 / 4.6	4.6 / 4.0	3.9 / 3.6
Carriage	Fringe	4.1 / 3.4	3.8 / 3.7	3.7 / 2.7
National Jewish Hospital	Fringe	4.8 / <b>4.7</b>	4.0 / 3.9	3.5 / 3.1
Arvada	Urban/Suburban	<b>3.9 / 3.8</b>	3.1 / 3.0	3.0 / 2.6
Boulder	Urban/Suburban	6.8 / <b>4.3</b>	4.5 / 3.4	3.5 / 3.0

Background concentrations for intersection locations by area type have been scaled to future years by applying the ratio of the future year nine-cell inventory level and 2001 nine-cell base inventory to the baseline (2001) background concentration.

**b. Intersection Modeling**

The intersection modeling has been performed for the identified intersections, in general using the CAL3QHC model, as described in the Technical Support Document (TSD) for the Carbon Monoxide Redesignation Request and Maintenance Plan for the Denver Metropolitan Area (see Section 3.9). The CAL3QHC input data has been derived as described in Section 3.9.2 of the above noted TSD. The traffic growth between 2001 and future years, 2010, 2013 and 2021 have been estimated from DRCOG's 2030 RTP. The mobile source emission factors for the intersection modeling have been adapted to the MOBILE6.2 paradigm. Additional details are included in the technical support document for this revision.

**c. Summary of Intersection Analysis**

The background concentrations and intersection modeling for the selected intersections has been summarized in the following Table 9 for 2010 (year of maximum estimated emissions). As can be seen the totals at all selected intersection locations are below the CO NAAQS of 9.0 ppm.

**Table 9:  
Intersection Modeling Analysis for 2010**

Intersection	Background ppm	CAL3QHC ppm	Total ppm
<b>28<sup>th</sup> &amp; Arapahoe (Boulder)</b>	3.4	4.1	7.5
<b>University &amp; Belleview</b>	3.2	3.9	7.1
<b>University &amp; 1<sup>st</sup> Ave.</b>	3.8	3.3	7.1
<b>Foothills &amp; Arapahoe (Boulder)</b>	3.7	3.4	7.1
<b>Wadsworth &amp; Alameda</b>	2.9	3.1	6.0
<b>20<sup>th</sup> &amp; Broadway (CAMP)</b>	5.0	1.4	6.4

Similar analysis of interim budget year 2013 and maintenance year 2021 indicates that the total concentrations are also below the standard as shown in the following Table 10, therefore, demonstrating maintenance of the standard through 2021.

**Table 10:  
Summary Intersection Modeling Analysis for Future Years**

Intersection	2010 Total ppm	2013 Total ppm	2021 Total ppm
<b>28<sup>th</sup> &amp; Arapahoe (Boulder)</b>	7.5	6.6	5.7
<b>University &amp; Belleview</b>	7.1	6.1	5.4
<b>University &amp; 1<sup>st</sup> Ave.</b>	7.1	6.2	5.3
<b>Foothills &amp; Arapahoe (Boulder)</b>	7.1	6.4	5.6
<b>Wadsworth &amp; Alameda</b>	6.0	5.3	4.5
<b>20<sup>th</sup> &amp; Broadway (CAMP)</b>	6.4	5.7	5.4

## **E. CARBON MONOXIDE MOTOR VEHICLE EMISSIONS BUDGET**

### **1. Requirements for Establishing Emission Budgets**

The transportation conformity provisions of section 176(c)(2)(A) of the 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 93.118, August 15, 1997) also requires that motor vehicle emission budget(s) must be established for the last year of the maintenance plan, and may be established for any other years deemed appropriate. 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 a "demonstration of consistency with the motor vehicle emissions budget(s) must be accompanied by a qualitative finding that there are no 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 shall determine what must be considered in order to make such a finding.

EPA policy indicates the last year of a previously approved maintenance plan must be kept as an interim budget year in a revision to the maintenance plan.

For transportation plan analysis years after the last year of the maintenance plan (in this case, 2021), 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 maintenance plan.

EPA's conformity regulation (40 CFR 93.124) also 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. The implementation plan can then allocate some or all of this additional "safety margin" to the emissions budget(s) for conformity purposes.

EPA's "Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity," (dated January 18, 2002), notes "that regardless of the technique used for attainment or maintenance demonstrations, a more rigorous assessment of the SIP's demonstration may be necessary if a State decides to reallocate possible excess emission reductions to the motor vehicle emissions budget as a safety factor". Since this plan allocates available excess emissions reductions to the motor vehicle emissions budget, the EPA recommended a "more rigorous assessment" to ensure allocation of excess emissions will still demonstrate maintenance in 2013 and 2021 throughout the region. This methodology is described in more detail below.

## **2. Revised Motor Vehicle Emissions Budget for Interim Budget Year (2013) and Maintenance Year (2021) and Beyond**

This maintenance plan establishes a revised motor vehicle emissions budget for the period 2013 through 2020 and establishes a motor vehicle emissions budget from the last year of the maintenance plan (2021) and beyond. The budgets are established for the boundaries of the attainment/maintenance area.

As shown in the emissions inventories earlier in this plan, the 2013 and 2021 total emissions inventories for carbon monoxide are below the level necessary to demonstrate continued maintenance of the CO standard. As a result, the maintenance plan may allocate some or all of the additional "safety margin" to the emission budget for conformity purposes, consistent with EPA's conformity regulation.

This maintenance plan estimates the available "safety margin" using the EPA recommended "more rigorous assessment" methodology (see Table 11) and allocates a portion of the available safety margin to the motor vehicle emission budget in 2013 and 2021 as illustrated in Table 12 below. This maintenance plan allocates 196 tons per day of the potential "safety margin" to the motor

vehicle emission budget in 2013. The remaining 23 tons in 2013 are reserved to account for future point and area source growth, including growth at Denver International Airport, and other modeling uncertainties.

In addition, this maintenance plan allocates 228 tons per day of the potential “safety margin” to the motor vehicle emission budget in 2021. The remaining 19 tons in 2021 are reserved to account for future point and area source growth, including growth at Denver International Airport, and other modeling uncertainties. Mobile source emissions based on MOBILE6.2 are expected to continue to decline during this period.

**Table 11:**  
**Justification of Available Safety Margin**  
**2013 and 2021 and Beyond**  
*Based on 2001 Background Concentration and Intersection Modeling*

Intersection	2013 Total ppm	2021 Total ppm
<b>28<sup>th</sup> &amp; Arapahoe (Boulder)</b>	7.8	7.3
<b>University &amp; Belleview</b>	7.1	6.8
<b>University &amp; 1<sup>st</sup> Ave.</b>	7.5	7.1
<b>Foothills &amp; Arapahoe (Boulder)</b>	7.3	6.9
<b>Wadsworth &amp; Alameda</b>	6.5	6.0
<b>20<sup>th</sup> &amp; Broadway (CAMP)</b>	6.6	6.5

The “more rigorous assessment” includes the 2001 background concentration and the intersection modeling analysis similar to that performed in both the original attainment SIP and the previously approved maintenance plan and described in this maintenance plan in section D.2 Intersection Modeling Analysis. Since all of the intersections selected for modeling have concentrations below the CO standard in 2013 and 2021 (see Table 11) all of the available safety margin in each year may be allocated to the motor vehicle emission budget (MVEB) or reserved for future growth as discussed above. Subtracting the point and area source emissions and the emissions reserved for point and area source growth from the total 2001 baseline inventory results in the mobile source emissions budget estimate. Further subtraction of the estimated mobile source emissions indicates the excess emissions that have been allocated to the MVEB as shown in Table 12 as follows:

**Table 12:**  
**Proposed Motor Vehicle Emissions Budget (TPD)**  
**2013 and 2021 and Beyond**  
*Based on allocation of available safety margin*

	<b>2013</b>	<b>2021</b>
<b>2001 Total Inventory</b>	<b>1997</b>	<b>1997</b>
<b>Area &amp; Point Source Emissions</b>	<b>-349</b>	<b>-378</b>
<b>Reserved for A/Pt Growth</b>	<b>-23</b>	<b>-19</b>
<b>Motor Vehicle Emissions Budget in 2013 and 2021 and beyond</b>	<b>1625</b>	<b>1600</b>
<b>Mobile Source Emissions</b>	<b>-1429</b>	<b>-1372</b>
<b>Safety Margin</b>	<b>196</b>	<b>228</b>

The interim motor vehicle emissions budget of 1625 tons per day for 2013 and a motor vehicle emissions budget of 1600 tons per day for 2021 and beyond will be used to determine whether plans, programs, and projects comply with the SIP in applicable horizon years. The 2013 interim budget will take effect for future transportation conformity determinations upon EPA approval of this maintenance plan revision. The 2021 motor vehicle budget will take effect upon a determination of adequacy by the EPA.

Future maintenance plan revisions may reevaluate the motor vehicle emissions budget and may make adjustments as necessary based on the most recent information and future emission projections.

Until such time the budget takes effect pursuant to this section, the carbon monoxide emissions budget for the Denver carbon monoxide attainment/maintenance area shall remain at 1520 tons per day for the years 2013 and beyond. Upon approval of the interim 2013 emissions budget contained in this maintenance plan revision, the 1520 tons per day budget shall expire.

## **F. MONITORING NETWORK / VERIFICATION OF CONTINUED ATTAINMENT**

Since the Denver metropolitan area has been redesignated to attainment status by EPA, the APCD operates and continues to operate an appropriate air quality monitoring network of NAMS and SLAMS monitors in accordance with 40 CFR Part 58 to verify the continued attainment of the carbon monoxide standard. If measured mobile source parameters (e.g., vehicle miles traveled, congestion, fleet mix, etc.) change significantly over time, the APCD will perform the appropriate studies to determine whether additional and/or re-sited monitors are necessary. Annual review of the NAMS/SLAMS air quality surveillance system will be conducted in accordance with 40 CFR 58.20(d) to determine whether the system continues to meet the monitoring objectives presented in Appendix D of 40 CFR Part 58.

## **G. CONTINGENCY PROVISIONS**

Section 175A(d) of the CAA requires that the maintenance plan contain contingency provisions to assure that the State will promptly correct any violation of the carbon monoxide standard which occurs after redesignation to attainment. Attainment areas are not required to have preselected contingency measures, and this plan removes any commitment to contingency measures contained in the 1994 Denver Carbon monoxide nonattainment SIP Element.

The contingency plan must also ensure that the contingency measures are adopted expeditiously once the need is 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.

The triggering of the contingency plan does not automatically require a revision of the SIP, nor is the area necessarily redesignated once again to nonattainment. Instead, the State will normally have an appropriate time-frame to correct the violation by implementing one or more of the contingency measures. In the event that violations continue to occur after contingency measures have been implemented, additional contingency measures will be implemented until the violations are corrected.

### **1. List of Potential Contingency Measures**

Section 175A(d) of the CAA requires the maintenance plan to include as potential contingency measures all of the carbon monoxide control measures contained in the SIP before redesignation which were relaxed or modified through the maintenance plan. For the Denver metropolitan area, this includes the following measures:

- A 3.1% oxygenated fuels program from November 8 through February 7, with 2.0% oxygen content required from November 1 through November 7.
- An enhanced vehicle inspection and maintenance program as described in AQCC Regulation No. 11 prior to the modifications adopted on January 10, 2000 as part of the maintenance plan approved by EPA on December 14, 2001 with the addition of any onboard diagnostic components as required by Federal law.
- Transportation control measures that were included in the 1994 attainment SIP as contingency measures, but were required to be implemented because growth in vehicle miles traveled exceeded SIP projections. These measures include transportation management associations, financial incentives for EcoPass, Auraria transit pass, and improved traffic signalization.<sup>1</sup>

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<sup>1</sup>The 1994 attainment SIP also included as a potential contingency measure the conversion of the Broadway/Lincoln bus lanes to bus/HOV lanes, but this measure was never implemented due to the high volume of buses still using these lanes even after the light-rail line from Broadway and I-25 to downtown became operational.

In addition to this list of potential contingency measures, the State may evaluate other potential strategies in order to address any future violations in the most appropriate and effective manner possible.

## **2. Tracking and Triggering Mechanisms**

### **a. Tracking**

The primary tracking plan for the Denver metropolitan area consists of continuous carbon monoxide monitoring by APCD as described above. APCD will notify EPA, the AQCC, the RAQC, and local governments in the Denver area of any exceedance of the carbon monoxide standard within 30 days of occurrence.

The ongoing regional transportation planning process carried out by the Denver Regional Council of Governments, in coordination with the RAQC, APCD, AQCC, and EPA, will serve as another means of tracking mobile source carbon monoxide emissions into the future.

Since revisions to the region's transportation improvement programs are prepared every two years, and must go through a transportation conformity finding, this process will be used to periodically review progress toward meeting the VMT and mobile source emissions projections in this maintenance plan.

### **b. Triggering**

An exceedance of the carbon monoxide standard (any value over 9.5 ppm) may trigger a voluntary, local process by the RAQC and APCD to identify and evaluate potential contingency measures. However, the only federally-enforceable trigger for mandatory implementation of contingency measures shall be a violation of the carbon monoxide standard. Specifically, a violation shall be an officially recorded second value of 9.5 ppm or higher at the same monitor during any calendar year.

## **3. Process for Recommending and Implementing Contingency Measures**

The State will move forward with mandatory implementation of contingency measures under the SIP if a violation (a second exceedance in a calendar year) of the carbon monoxide standard occurs.

No more than 60 days after being notified by the APCD that a violation of the carbon monoxide standard has occurred, the RAQC, in coordination with the APCD and AQCC, will initiate a subcommittee process to begin evaluating potential contingency measures. The subcommittee will present recommendations to the RAQC within 120 days of notification and the RAQC will present recommended contingency measures to the AQCC within 180 days of notification.

The AQCC will then hold a public hearing to consider the contingency measures recommended by the RAQC, along with any other contingency measures the Commission believes may be appropriate to effectively address the violation. The necessary contingency measures will be adopted and implemented within one year after a violation occurs.

## **H. SUBSEQUENT MAINTENANCE PLAN REVISIONS**

The previously approved maintenance plan addressed the period 2001 through 2013 and demonstrated, as required in CAAA 175A(a), that the CO standard will be maintained for the initial ten-year period (through 2011) after redesignation in 2001. In accordance with CAA 176A(b) it is required that a maintenance plan revision be submitted to the EPA within eight years after the original redesignation to address maintenance of the standard for a second ten-year period beyond redesignation. The purpose of this maintenance plan revision is to provide for maintenance of the CO standard for the additional ten years (through 2021) following the first ten-year period.

No additional revisions of the CO maintenance plan are anticipated at this time. If future changes in mobile source models or other unforeseen considerations raise potential issues with maintaining the CO standard, the State and the RAQC will address the need to revise the maintenance plan at that time.