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Final Report

WINTERTIME GASOLINE FUEL SPECIFICATIONS STUDY

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January 17, 2008

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1. INTRODUCTION

1.1 BACKGROUND

The U.S. Environmental Protection Agency (EPA) has established two National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO): 35 parts per million (ppm) averaged over one hour; and 9 ppm averaged over eight hours. CO cannot exceed the 8-hour NAAQS at any monitoring site more than once per year, meaning that the annual second-highest concentration above the NAAQS defines an exceedance and is used to establish the design value (DV) for the area. Because of the rounding convention used by EPA, a concentration of 9.5 ppm is needed to violate the 8-hour standard.

The Las Vegas Valley has historically violated the 8-hour CO standard during the winter months. The 1-hour CO standard has never been exceeded. During cold, clear, stagnant periods, pollutants emitted in the evening and morning hours are trapped within the valley in very shallow layers near the ground, and slowly move with overnight drainage flows into the lowest areas of the basin. Subsequent to the Clean Air Act Amendments of 1990, the EPA designated the valley as a "moderate" nonattainment area for 8-hour CO. Ultimately, the area was reclassified as a "serious" area in the mid-1990's after continued exceedances of the CO standard.

The resulting 2000 CO State Implementation Plan (SIP) for Clark County contained local measures for attaining the standards, and in June 2005 the EPA found that the valley had attained the standards by the applicable date of December 31, 2000. The 2000 CO SIP includes three control measures that affect Clark County gasoline specifications during the CO season (October – March); oxygenated fuel using 10% ethanol by volume and at least 3.5% oxygen content by weight; 9.0 psi Reid Vapor Pressure (RVP) requirement with a 1.0 psi waiver for >9% ethanol; and Cleaner Burning Gasoline (CBG) specifications to reduce emissions of sulfur and aromatic hydrocarbons.

Later, Clark County submitted a 2005 CO SIP Revision, which included revised and improved methodologies for estimating on-road mobile source emissions (the chief component of CO emissions in the valley), and extended future year estimates of CO concentrations out to 2030 to demonstrate maintenance of the standards and to establish conformity emission budgets for multiple "out" years. No changes in actual control regulations were incorporated into the 2005 CO SIP Revision.

1.2 PROJECT CONCEPT

The Clark County Department of Air Quality and Environmental Management (DAQEM) commissioned an independent analysis of the current wintertime gasoline specifications that apply in the Las Vegas Valley, as well as an evaluation of possible changes to those specifications, and/or their period of applicability. The DAQEM contracted with ENVIRON International Corporation and Sierra Research, Inc. to assist in this wintertime gasoline study.

ENVIRON and Sierra performed the following analyses, and results are documented in this report as noted:

- Summarized the historical CO trends in the Las Vegas Valley from 1990 through 2005 (Section 2);
- Evaluated various wintertime gasoline options available to Clark County in light of EPA's regulations limiting "boutique" fuels (Section 3);
- Evaluated various options for addressing the transitions to and from winter gasolines available to Clark County (Section 4);
- Estimated on-road mobile source CO emission totals and assessed future year CO concentration peaks using the Urban Airshed Model (UAM) for two gasoline options in a manner consistent with the 2005 SIP Revision (Section 5);
- Summarized the regulatory impacts associated with each of the identified wintertime gasoline options (Section 6).

2. HISTORICAL CARBON MONOXIDE TRENDS

This section presents a summary of ENVIRON's analysis of ambient CO trends in the Las Vegas Valley between 1990 and 2006. This analysis was based on 8-hour CO data provided by the Clark County DAQEM.

2.1 THE DATA

CO data presented below were measured by the Las Vegas Valley carbon monoxide air-monitoring network that was initially administered by the Air Quality Division of the Clark County Health District, and later by the DAQEM. For this analysis, continuous daily 8-hour CO data were extracted from the EPA Air Quality System (AQS) by DAQEM for the entire period of January 1990 through Spring 2006, and provided to ENVIRON. Daily maximum 8-hour CO concentrations were extracted from these data over each CO season, which extends from October through March. Each monitor in the network continuously measures ambient CO levels using a Dasibi Carbon Monoxide Analyzer (Model 3003) which employs the Gas Filter Correlation technique. Figure 2-1 shows the Las Vegas Valley CO monitoring system as of 2000 (upper panel) and 2005 (lower panel). These figures are taken from the Las Vegas CO State Implementation Plans (Clark County Board of Commissioners, 2000; 2005) and do not show all monitors that recorded data during the 1990-2005 period. Note in particular the location of the City Center monitor, as this is the monitor with the longest continuous ambient CO time series. A full accounting of all stations and the times during which they were active is given in Tables 2-1 and 2-2.

2.2 RESULTS

The first and second CO concentration maxima for each monitor for each year during the time period 1990-2006 are shown in tabular form in Tables 2-1 and 2-2. While CO concentrations are measured year-round, ambient data were analyzed over the October-March CO season each year, and the year label indicates the October 1 start date. For example, the year 1995 indicates the October 1995 – May 1996 period. The 1st and 2nd maxima (taken over all monitors) for each year are shown in graphical form in Figure 2-2. The 8-hour NAAQS of 9 ppm[1] is shown in red in Figure 2-2. Both the first and second maxima show a steadily declining trend during the 1990-2006 period. The first and second maxima have not exceeded the 8-hour CO standard since 1998. The most recent value of the first maximum (5.3 ppm) is well below the 8-hour standard, as is the most recent value of the 2nd maximum (5.0 ppm).

Figures 2-3 and 2-4 show the monthly 1st and 2nd maximum CO concentration taken over all Las Vegas monitors as a function of time and month. Only the months of the CO season (October-March) are shown. The 1st (Figure 2-3) and 2nd (Figure 2-4) maxima are each represented by a surface. The surfaces are domed across the months, indicating that yearly maximum CO concentrations generally occurred during December-January. This is consistent with the cold temperatures and strong atmospheric stability frequently occurring during these months, as these

[1] Note that when rounding is taken into account, the CO concentration required to exceed the 8-hour standard is 9.5 ppm.

conditions are conducive to high CO concentrations. Note that the only exceedance of the 8-hour CO standard during the months of March or October came in March of 1996. During the last 10 years, then, there has not been a single exceedance of the 8-hour standard during October or March. The downward slope of the 1st and 2nd maximum surfaces as time progresses from 1990-2006 indicates the overall reduction in CO concentrations in the Las Vegas Valley. The 1st and 2nd maximum CO values have declined for all months from 1990 to 2006.

Figure 2-5 shows the first maximum 8-hour ambient CO level by monitor as a function of year. By examining these time series, we can evaluate whether there are shifts in the locations of peak CO concentrations over the years. The only monitors that exceeded the 8-hour CO standard are the East Charleston and the Sunrise Acres monitors. Comparison of Figure 2-5 and Figure 2-2 shows that the highest 1st maximum 8-hour CO times series over all monitors (Figure 2-2) is simply the 1st maximum CO at East Charleston from 1990-1996 and the 1st maximum CO at Sunrise Acres from 1997-2005. There are no significant shifts in the location of the peak CO concentrations over the years. Monitors with relatively high maximum CO (Sunrise Acres, E. Sahara) at the beginning of the period are the monitors with highest maximum CO concentrations throughout, and the monitors with relatively low CO maxima (Pittman, Craig Road) at the start of their operation show relatively low CO maxima throughout.

There is only one monitor with a continuous time series extending from 1990-2005. The City Center monitor shows a trend of decreasing CO over the period of interest. This decreasing trend is apparent in nearly all of the other monitors. The only monitor to show an increase in CO over the lifetime of the monitor is Craig Road, and its first maximum 8-hour value never rises above 2 ppm, which is well below the 8-hour standard.

Several of the monitors in the Las Vegas Valley showed an increase in 1st maximum CO concentrations during the 1996-1998 period (e.g. Sunrise Acres, City Center, S. LV Blvd.), but all of these returned to a decreasing trend in the 1999-2005 period.

Figure 2-6 shows the number of exceedances of the 8-hour CO standard across all monitors in the Las Vegas Valley monitoring network during the period 1990-2006. From a high value of 13 in 1990, the number of exceedances has shown an overall declining trend, with some interannual variability likely due to weather conditions. Since 1998, there have been no exceedances of the 8-hour CO standard.

In summary, the 8-hour CO trend data show that the 1st and 2nd maxima CO concentrations in the Las Vegas Valley have decreased significantly during the 1990-2005 time period. This result is not sensitive to the choice of location within the Valley or to the month of the CO season examined. Peak CO values generally occurred during the months of December and January. No exceedances of the 8-hour CO standard have occurred since 1998.

Table 2-1. Annual 1st maximum 8-hour ambient CO concentrations from Clark County, NV.

Annual 1st Maximum 8-Hour CO Concentrations in Clark County, Nevada
(Based on October to March Data)

Monitor	Site	1st Maximum 8-Hour Concentration (ppm)																
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
0007	S.E. Valley	---	---	---	---	---	---	---	---	2.1	1.8	1.5	1.4	1.4	1.1	---	---	---
0016	City Center	8.6	7.4	7.4	7.4	7.6	6.9	6.8	5.7	7.7	5.7	5.1	4.4	4.0	3.7	3.7	3.7	2.9
0557	East Charleston	15.9	12.6	12.1	11.9	10.9	10.3	10.3	6.7	---	---	---	---	---	---	---	---	---
0561	Sunrise Acres	---	---	---	---	---	---	8.3	10.0	10.3	8.6	7.3	6.5	6.6	5.5	5.8	5.3	5.3
0020	Craig Road	---	---	---	---	---	0.9	1.7	1.7	2.0	1.2	1.5	1.4	1.8	0.9	---	---	---
0043	Paul Meyer Park	---	---	---	---	---	---	---	---	1.7	2.1	1.8	1.1	1.9	1.2	---	---	---
0107	Pittman	---	---	---	---	---	2.7	3.0	2.7	2.5	2.5	2.3	2.5	2.3	---	---	---	---
0298	Green Valley	---	---	---	---	---	---	---	---	2.1	2.0	1.8	1.6	1.4	1.3	---	---	---
0538	Winterwood	---	---	---	---	---	---	---	---	6.3	5.7	4.1	4.5	3.6	3.9	3.3	3.7	2.9
0539	E. Sahara	---	---	---	---	---	---	---	---	7.9	7.0	5.8	6.3	4.9	5.1	5.2	4.6	4.2
0562	Crestwood	---	---	---	---	---	---	6.5	6.0	6.4	6.3	5.2	4.5	3.8	---	---	---	---
0601	Boulder City	---	---	---	---	---	---	---	---	0.7	0.6	1.2	0.7	0.7	0.3	---	---	---
1022	E. Flamingo	---	---	---	---	---	4.6	5.0	4.5	5.3	5.7	5.1	4.3	3.5	---	---	---	---
1023	S. LV Blvd.	---	---	---	---	---	---	4.8	5.2	5.6	5.0	3.9	3.7	3.0	3.0	2.9	2.3	2.0
2002	J.D. Smith	---	---	---	---	---	---	---	---	6.8	6.1	4.7	5.6	4.7	4.9	3.8	4.1	3.7
0563	Freedom Park	---	---	---	---	---	---	---	---	---	---	5.5	5.3	5.2	5.0	4.9	4.6	---
0021	Shadow Lane	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1021		---	---	---	---	---	---	---	---	---	---	---	---	4.0	3.6	4.1	4.2	3.1
Maximum 1st Max 8-Hour Concentration		15.9	12.6	12.1	11.9	10.9	10.3	10.3	10.0	10.3	8.6	7.3	6.5	6.6	5.5	5.8	5.3	5.3

Table 2-2. Annual 2nd maximum 8-hour ambient CO concentrations from Clark County, NV.

Annual 2nd Maximum 8-Hour CO Concentrations in Clark County, Nevada
(Based on October to March Data)

Monitor	Site	2nd Maximum 8-Hour Concentration (ppm)																
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
0007	S.E. Valley	---	---	---	---	---	---	---	---	2.0	1.7	1.5	1.3	1.3	1.0	---	---	---
0016	City Center	7.8	7.1	6.1	7.2	7.2	6.4	6.6	5.5	7.3	5.7	4.7	4.3	3.8	3.6	3.5	3.6	2.9
0557	East Charleston	14.2	12.1	11.0	11.1	10.6	9.4	10.1	6.5	---	---	---	---	---	---	---	---	---
0561	Sunrise Acres	---	---	---	---	---	---	8.1	9.0	10.1	8.2	7.1	6.3	6.0	5.3	5.1	5.2	5.0
0020	Craig Road	---	---	---	---	---	0.8	1.6	1.5	1.8	0.8	1.4	1.3	1.0	0.9	---	---	---
0043	Paul Meyer Park	---	---	---	---	---	---	---	---	1.7	1.9	1.6	1.0	1.5	1.2	---	---	---
0107	Pittman	---	---	---	---	---	2.6	2.8	2.6	2.5	2.4	2.1	2.3	2.2	---	---	---	---
0298	Green Valley	---	---	---	---	---	---	---	---	1.8	1.9	1.7	1.5	1.3	1.3	---	---	---
0538	Winterwood	---	---	---	---	---	---	---	---	5.1	5.4	3.7	3.9	3.5	3.8	3.1	3.2	2.5
0539	E. Sahara	---	---	---	---	---	---	---	---	6.8	6.9	5.7	5.6	4.8	4.9	4.7	4.5	3.9
0562	Crestwood	---	---	---	---	---	---	5.4	5.9	6.2	5.8	4.7	4.3	3.8	---	---	---	---
0601	Boulder City	---	---	---	---	---	---	---	---	0.7	0.6	1.0	0.6	0.7	0.3	---	---	---
1022	E. Flamingo	---	---	---	---	---	4.5	4.4	4.3	5.0	5.4	4.7	4.1	3.2	---	---	---	---
1023	S. LV Blvd.	---	---	---	---	---	---	4.6	4.9	5.1	4.4	3.7	3.4	2.9	3.0	2.6	2.3	1.9
2002	J.D. Smith	---	---	---	---	---	---	---	---	6.6	5.8	4.7	5.1	4.5	4.8	3.7	3.9	3.5
0563	Freedom Park	---	---	---	---	---	---	---	---	---	---	5.2	5.5	4.8	4.5	4.8	4.1	
0021	Shadow Lane	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1021	Katie Ave.	---	---	---	---	---	---	---	---	---	---	---	---	3.6	3.5	3.7	3.8	3.0
Maximum 2nd Max 8-Hour Concentration		14.2	12.1	11.0	11.1	10.6	9.4	10.1	9.0	10.1	8.2	7.1	6.3	6.0	5.3	5.1	5.2	5.0

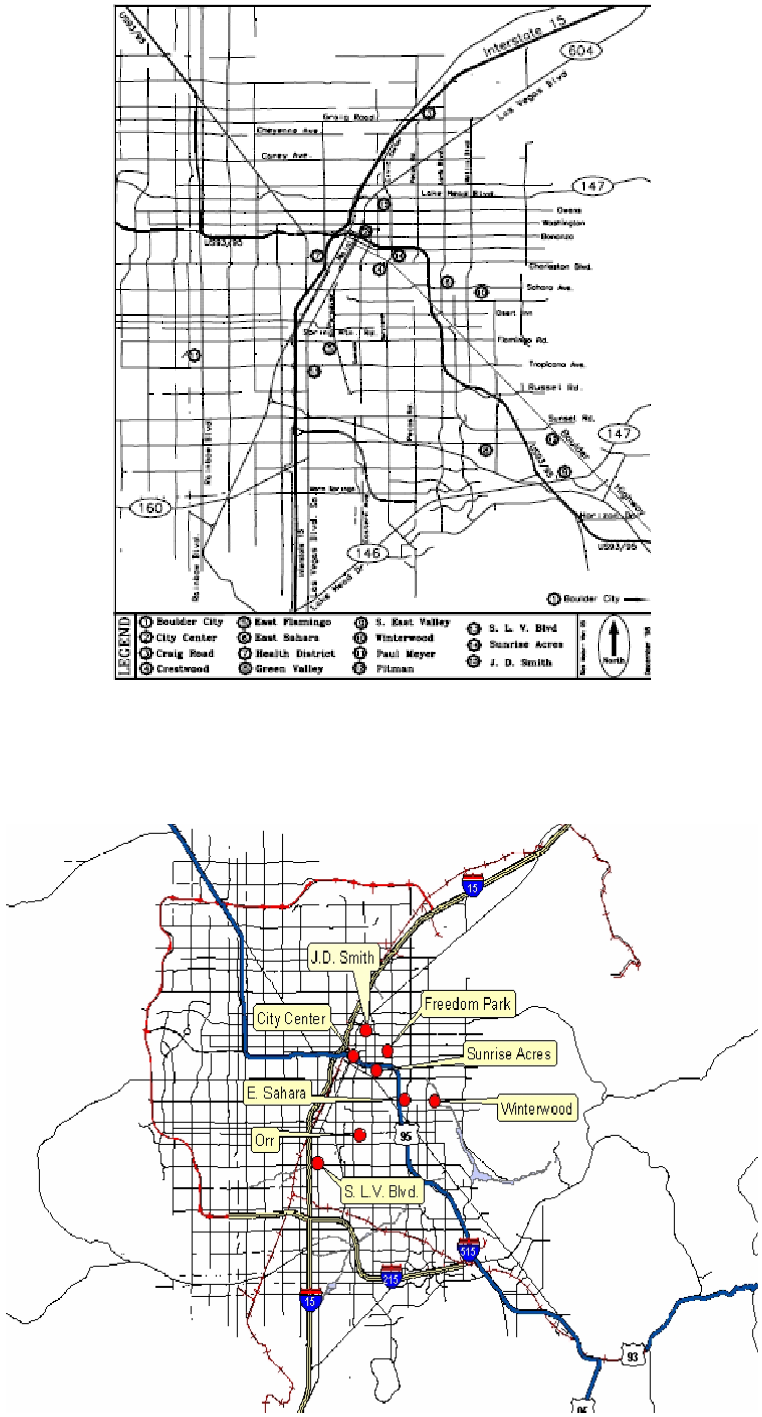

Figure 2-1. Upper panel: Las Vegas Valley carbon monoxide monitoring site as of the year 2000. Figure from the Carbon Monoxide State Implementation Plan for the Las Vegas Valley (Clark County Board of Commissioners, 2000). Lower panel: Las Vegas Valley carbon monoxide monitoring site as of the year 2005. Figure from the Carbon Monoxide State Implementation Plan for the Las Vegas Valley (Clark County Board of Commissioners, 2005).

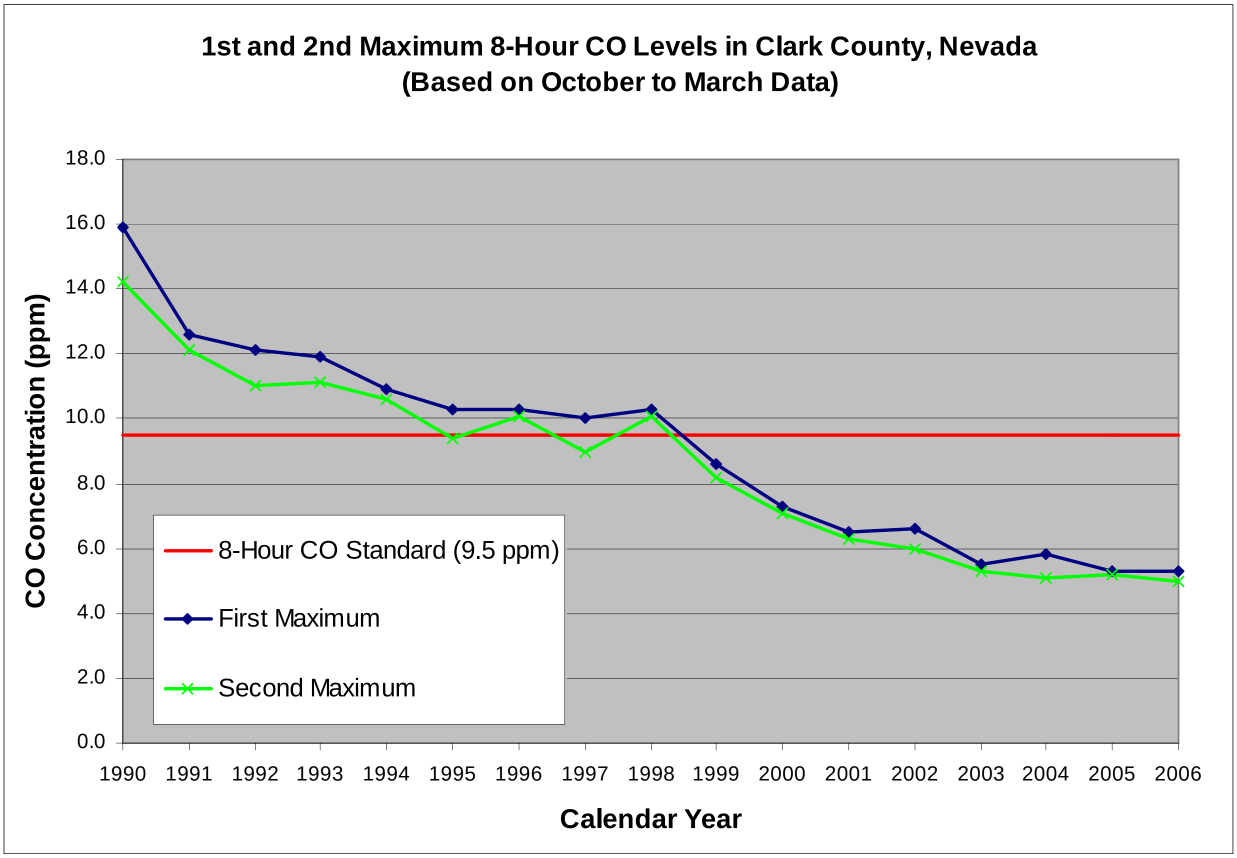

Figure 2-2. Time series of 1st and 2nd maximum 8-hour ambient CO concentrations for Clark County, NV. Data are analyzed during the October-March CO season, and the year label indicates the October start date. For example, the year 1995 indicates the October 1995- May 1996 time period.

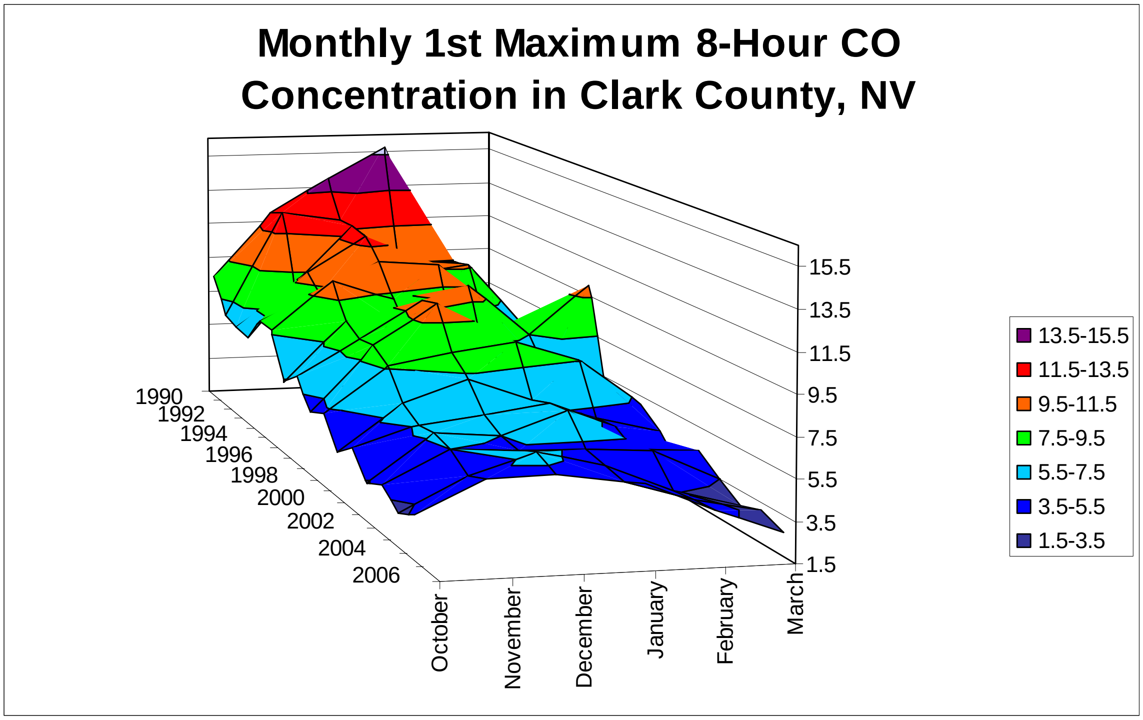

Figure 2-3. Monthly 1st maximum 8-hour CO concentration in Clark County, Nevada.

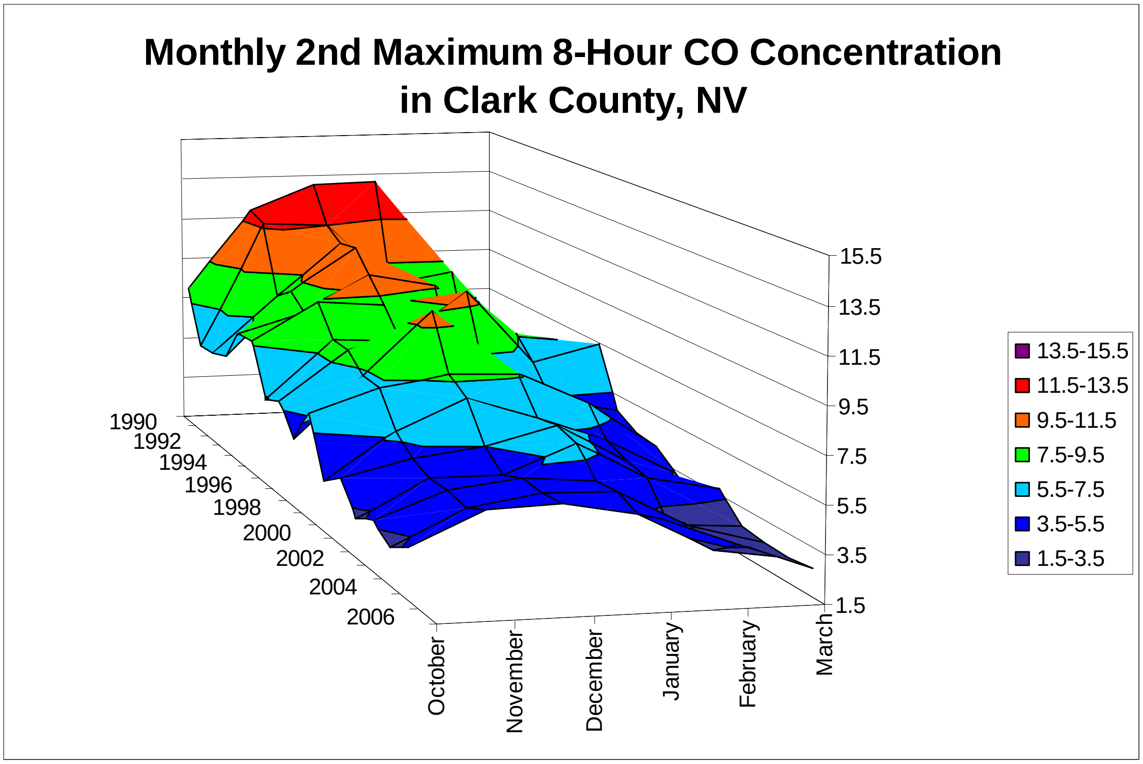

Figure 2-4. Monthly 2nd Maximum 8-Hour CO Concentration in Clark County, Nevada.

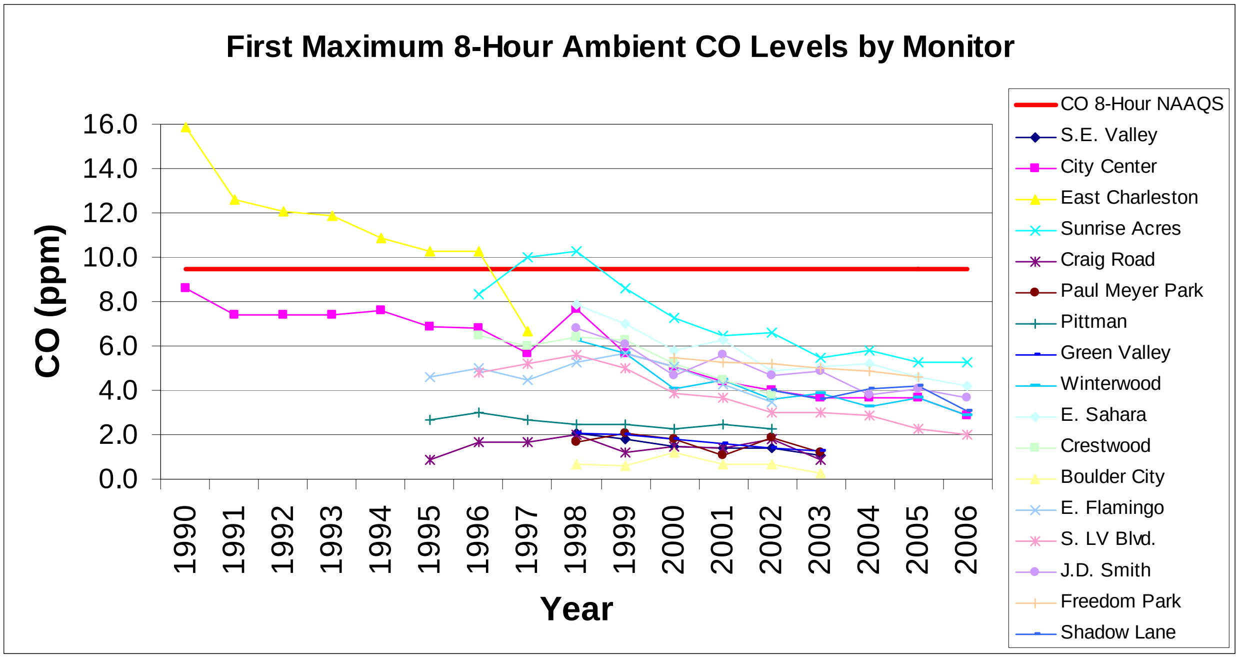

Figure 2-5. First maximum 8-hour ambient CO concentration at each monitor in the Las Vegas Valley over the time period 1990-2006.

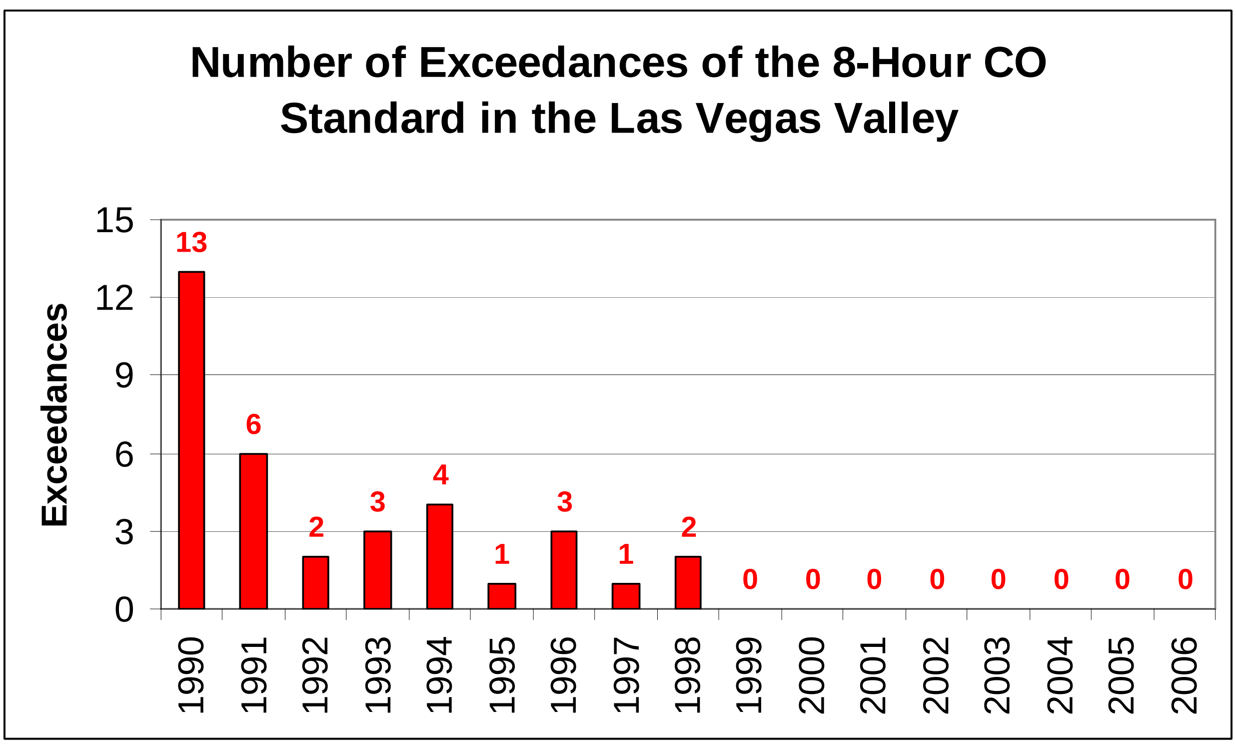

Figure 2-6. Number of exceedances of the 8-hour CO standard at monitors in the Las Vegas Valley during the period 1990-2006.

3. WINTERTIME GASOLINE OPTIONS

Sierra Research assessed the on-road vehicle carbon monoxide (CO) emissions impacts of possible reformulations of the Clark County wintertime gasoline specifications. After a review of recently promulgated federal regulations regarding "boutique" fuels and consultation with DAQEM, several agreed-upon fuel scenarios were analyzed. In this analysis, the impacts of the different fuel scenarios on fleet average CO emission factors generated by MOBILE6.2 were investigated. Based on these results, DAQEM selected two fuel scenarios for a more detailed evaluation using the methodology documented in the 2005 CO SIP Revision for air quality planning purposes in Clark County.

3.1 BACKGROUND

Winter gasoline sold in Clark County is currently subject to RVP limits as well as specifications for oxygenate, sulfur, and aromatic content. The RVP specification is imposed by Nevada statute, while oxygenate, aromatic, and sulfur content specifications are imposed by sections 53 and 54 of the Clark County Air Quality Regulations. The current wintertime gasoline fuel requirements in Clark County are summarized in Table 3-1.

Table 3-1. Wintertime gasoline fuel requirements for Clark County.

Fuel Property	Standard
Reid Vapor Pressure (RVP)	Max 9.0 psi (10.0 psi for fuel with 9+ vol % EtOH)
Sulfur Content	Max 80 ppmw; Flat limit of 40 ppmw
Aromatic Content	Max 30 vol %; Flat limit of 25 vol %
Oxygen Content	Min 3.5 wt %

According to recently promulgated federal regulations (Federal Register, 2006), winter gasoline sold in Clark County is considered to be a "boutique" fuel due to the sulfur and aromatic limits imposed by sections 53 and 54. These regulations, which are intended to restrict the creation of new boutique fuels, preclude any changes to the Clark County winter aromatic and sulfur limits except for their elimination. Further, once eliminated these limits cannot be reinstated.

Given the restrictions on boutique fuels, Clark County has limited options with respect to changes in its wintertime gasoline specifications, which are summarized below.

1. With respect to the sulfur and aromatics limits, the only choices are retention of the existing limits or their elimination. It should be noted that the existing sulfur limit has been rendered obsolete by the more stringent federal Tier 2 gasoline limit on sulfur content.

2. Because Clark County is still designated as a "serious" nonattainment area with respect to attainment of the eight-hour CO NAAQS, winter gasoline is still required by the Clean Air Act to contain at least 2.7% oxygen by weight, which limits the changes that can be made to the existing 3.5 wt% oxygen requirement. However, it is possible that

redesignation of Clark County to attainment with respect to the CO NAAQS could allow the elimination of the oxygenate requirement.

3. Finally, there are no impediments to changes in the winter RVP limit for Clark County gasoline other than the necessity of demonstrating, via a SIP revision or as part of maintenance plan if redesignation occurs, that such changes will not lead to nonattainment of the CO NAAQS.

3.2 FUEL SCENARIOS

Based on the above, the following matrix of fuel scenarios was developed for analysis:

1. Elimination of the 9 psi winter RVP requirement in favor of enforcement of the ASTM limit for gasoline sold in Clark County during the winter months, which can go as high as 15 psi (ASTM, 2006);
2. Relaxation of the 3.5 wt% oxygen limit to 2.7 wt%;
3. Elimination of the vapor pressure requirement and relaxation of the oxygenate requirement (combination of scenarios 1 and 2);
4. Elimination of the aromatic and sulfur content requirements;
5. Elimination of the aromatic, sulfur, and RVP requirements (combination of scenarios 1 and 4);
6. Elimination of the aromatic and sulfur requirements and relaxation of the oxygenate requirement to 2.7 wt% (combination of scenarios 2 and 4);
7. Elimination of the RVP, aromatic, and sulfur requirements with relaxation of the oxygenate requirement (combination of scenarios 1, 2, and 4); and
8. Elimination of all wintertime gasoline requirements (i.e., using no oxygenates in the gasoline along with eliminating the aromatic, sulfur and RVP requirements).

3.3 ANALYSIS METHODOLOGY

The different fuel scenarios were analyzed for winter conditions during the years 2006, 2010, 2015, 2020, 2025, and 2030. Each winter year assumes a fleet distribution equivalent to January of the following year (e.g., winter 2006 = January 2007). This analysis focused on effects of the fuel scenarios on fleet-average CO emission factors, which have units of grams per mile.

For changes in RVP and oxygenate content, CO impacts were assessed using EPA's MOBILE6.2 emission factor model[2] using Clark County specific input data derived from the latest CO SIP (Clark County Board of Commissioners, 2005). The runs reflected area-specific winter temperatures, registration distribution, distribution of vehicle miles traveled (VMT) by vehicle class and hour of day, distribution of vehicle starts by hour of day, and inspection and maintenance (I/M) parameters.

This was done by inputting the 2006 winter fuel properties for Clark County and estimating the CO effects of revising the aromatics content to reflect the 2006 nationwide average. Winter gasoline fuel properties for Clark County and the nationwide average aromatic level were taken from Winter 2006 Alliance of Automobile Manufacturers (AAM) Fuel Survey Data (AAM, 2006). The Clark County gasoline properties are shown in Table 3-2. The average nationwide aromatic content was 23.1%.

Table 3-2. Inputs for Clark County (winter 2006 gasoline).

Fuel Property	Clark County Gasoline
MTBE (wt% oxygen)	0
ETBE (wt% oxygen)	0
Ethanol (wt% oxygen)	3.47
TAME (wt% oxygen)	0
Sulfur (ppm)	31
RVP (psi)	8.8
E200 (%)	46.4
E300 (%)	78.7
Aromatics (vol%)	20.2
Olefins (vol%)	6.7
Benzene (vol%)	0.60

3.4 RESULTS

Figure 3-1 shows a graphical illustration of the on-road vehicle CO emission impacts for all the fuel scenarios, and Table 3-3 summarizes the percentage increase in emissions associated with all the fuel scenarios. As one would expect, eliminating all wintertime gasoline fuel requirements in Scenario 8 leads to the highest CO emissions, which are 20% to 30% higher than the baseline depending on the year.

The largest single impact on CO emissions is associated with eliminating the RVP requirement, which leads to an increase of 16% to 18%. It should be noted that the MOBILE6 algorithm for modeling RVP impacts on CO emissions is quite dated and has been shown to be of questionable validity for the later model-year vehicles that dominate this analysis (Sierra Research, 2005). Therefore, the impact of elimination of the RVP requirement on CO emissions based on MOBILE6 is likely to be considerably overstated.

[2] Version 6.2.03 dated September 2003.

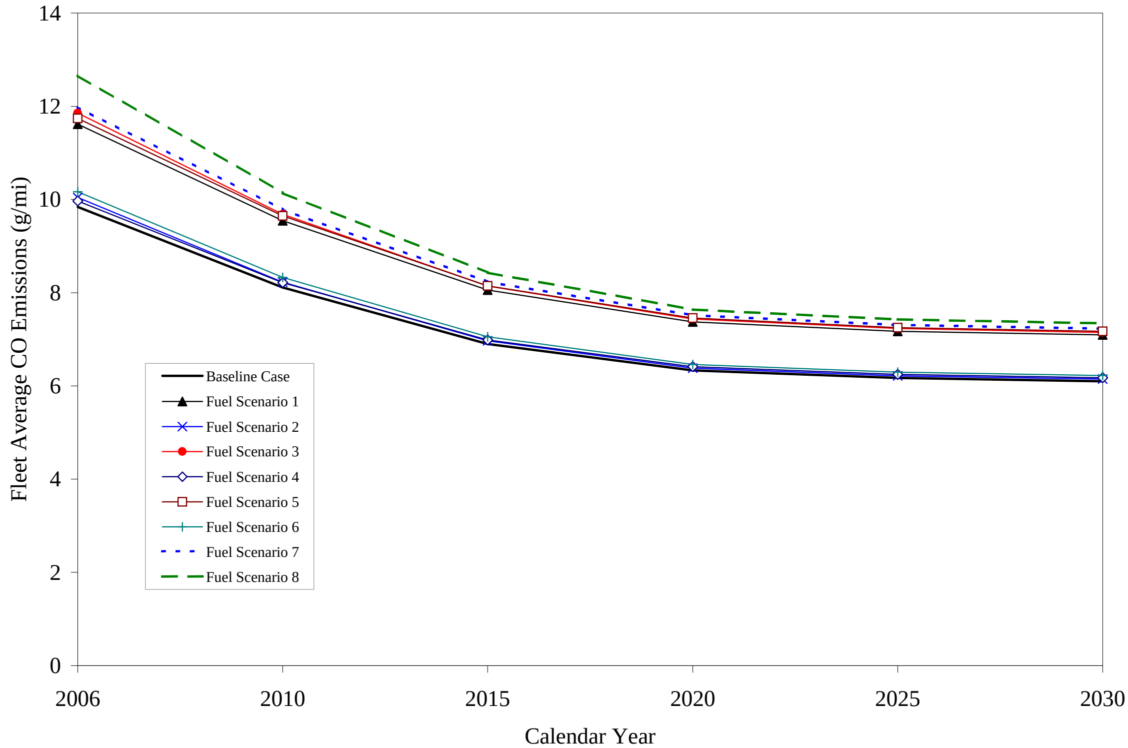

Figure 3-1. On-road mobile CO effects of Clark County winter gasoline fuel reformulation.

Table 3-3. Approximate increase in CO g/mi emissions associated with Clark County winter gasoline fuel scenarios.

Scenario	2006	2010	2015	2020	2025	2030
1. Eliminate RVP Requirement	18%	18%	17%	16%	16%	16%
2. Relax Oxy Requirement	2%	1%	1%	1%	1%	1%
3. Eliminate RVP + Relax Oxy Requirement	20%	19%	18%	17%	17%	17%
4. Eliminate Aromatics + Sulfur Requirement	1%	1%	1%	1%	1%	1%
5. Eliminate Aromatics + Sulfur + RVP Requirement	19%	19%	18%	18%	18%	18%
6. Eliminate Aromatics + Sulfur Requirement and Relax Oxy Requirement	3%	3%	2%	2%	2%	2%
7. Eliminate RVP + Aromatics + Sulfur and Relax Oxy Requirement	22%	21%	19%	19%	18%	18%
8. Eliminate All Requirements[a]	29%	25%	22%	21%	20%	20%

[a] Clark County will need to be redesignated to attainment for CO during the winter to allow for the use of no oxygenates.

As shown in Figure 3-1 and Table 3-3, eliminating the aromatics and sulfur limits would have a very small impact on CO emissions, as would relaxing the 3.5 wt% oxygen content requirement to 2.7 wt%. Based on the data presented in Table 3-3, complete elimination of the oxygenate requirement would increase CO emissions by about 10% in 2006, but that would drop to about 2% by 2030 due to turnover of the fleet.

4. EVALUATION OF TRANSITIONAL PERIOD GASOLINE OPTIONS

The availability of gasoline in Clark County during the winter is affected by the specifications imposed on that fuel by state and local requirements. At present, winter gasoline sold in Clark County is subject to controls on RVP and oxygenate, sulfur, and aromatic content. The current specifications and control periods are summarized in Table 4-1.

Table 4-1. Wintertime Gasoline Fuel Requirements for Clark County.

Fuel Property	Standard	Control Period
RVP	Max 9.0 psi (10.0 psi for fuel with 9+ vol % EtOH[a])	10/1 – 3/31
Oxygen Content	Min 3.5 wt %	10/1 – 3/31
Sulfur Content	Max 80 ppmw; Flat limit of 40 ppmw	11/1 – 3/31
Aromatic Content	Max 30 vol %; Flat limit of 25 vol %	11/1 – 3/31

[a] Nevada statutes impose a limit of 10% ethanol by volume for on-road gasoline.

The winter RVP specification in Clark County is imposed by Nevada statute[3] between October 1 and March 31, and the statute provides no transition period. The minimum oxygen content requirement is set forth in Section 53 of the Clark County Air Quality Regulations and applies between October 1 and March 31; the aromatic and sulfur content specifications are set forth in Section 54 of the Clark County Air Quality Regulations and apply between November 1 and March 31. Both Sections 53 and 54 have enforcement provisions that effectively require gasoline being delivered to retail stations to meet the requirements 15 days before the actual effective date.

Based on a review of the regulations, examination of AAM fuel survey data for Los Angeles, Phoenix, and Las Vegas, discussions with fuel suppliers, and review of the Kinder Morgan pipeline system in the Pacific Region, it is the winter fuel specifications themselves, particularly the RVP and oxygenate requirements, rather than the transition periods, that present the greatest issues with respect to fuel supply in Clark County.

Beginning with the RVP requirement, Clark County and Phoenix are the only two areas that enforce a low wintertime RVP requirement. In addition, both Clark County and Phoenix are generally supplied with gasoline from refineries in southern California. The low RVP requirement leads to tightened gasoline supply in Clark County (and Phoenix) because it precludes the sale in Clark County of the conventional and reformulated gasoline sold throughout the rest of the U.S., including California, during the winter. The fact that most of the low RVP gasoline sold in Clark County and Phoenix comes from southern California refineries leaves gasoline supply to those areas vulnerable to refinery upsets.

Clark County's high oxygen content requirement and relatively long winter oxygenate period increase the amount of ethanol that has to be available for the production of compliant gasoline. To the extent that ethanol supplies are limited or become disrupted, the supply of gasoline in Clark County will also be similarly impacted.

[3] Nevada Administrative Code § 590.065

As described in Section 3, the Clark County winter sulfur content requirement became superfluous with the implementation of the federal Tier 2 gasoline sulfur limits and the winter aromatic content requirements do not appear to impose any significant burden on fuel suppliers. Therefore, these requirements are not a significant issue with respect to the supply of gasoline to Clark County.

As discussed in Section 3, the emissions impacts of eight potential winter gasoline scenarios in Clark County were analyzed, and the potential impact of all eight scenarios on the availability of gasoline in Clark County were reviewed. Because each of the scenarios relaxes current constraints on the specifications of gasoline sold in Clark County, there should in general be no adverse impacts relative to current gasoline supply if any of the scenarios are selected for implementation.

As discussed above, elimination of the winter RVP requirement is the scenario that is likely to have the greatest positive impact on gasoline supply to Clark County. There are several reasons for this. First, it would allow C4 and C5 hydrocarbons to be blended into gasoline destined for Clark County, thereby increasing the volume of available gasoline. Secondly, it would greatly increase the supply pool of gasoline that could be shipped to Clark County during the winter months.

As also discussed above, elimination, rather than relaxation, of the oxygen content requirement would also be expected to remove a potential limitation on the supply of gasoline to Clark County. Note that eliminating the requirement would not prohibit the sale of oxygenated gasoline in Clark County, it would merely not require it, which would provide suppliers with greater flexibility. It should also be noted that while Clark County cannot completely eliminate the winter oxygenate requirement without being redesignated as in attainment with the NAAQS for CO and demonstrating the ability to maintain compliance with the NAAQS without oxygenated gasoline, the number of months when oxygenated gasoline is required could be reduced. Based on the analysis of winter CO concentrations in Section 2, it appears that, at a minimum, oxygenate requirements could be eliminated during the months of October, February, and March. The Clean Air Act requires a minimum of four months of oxygenate use during the CO nonattainment period, but would allow less time if "the State can demonstrate that because of meteorological conditions, a reduced period will assure that there will be no exceedances of the carbon monoxide standard outside of such reduced period."

5. CO EMISSIONS INVENTORY AND UAM MODELING

This section presents an assessment of CO emissions and UAM modeling for two of the eight wintertime gasoline options presented to the Clark County (DAQEM) as described in Section 3. ENVIRON ran the MOBILE6 on-road emission factor model for the current wintertime gasoline and two fuel options for the following years: 2006, 2010, 2015, 2020, and 2030. These three sets of emissions data were combined with year-specific traffic pattern data developed as part of the 2005 CO SIP revision (referred to hereafter as the "CO SIP") to derive several sets of UAM model-ready basin-wide gridded on-road emission input files per future year. The on-road inventories were then combined with pre-existing model-ready stationary and non-road CO emissions files (also from the CO SIP) so that the UAM could be run to project the resulting CO emissions into CO concentration distributions. Following the CO SIP, UAM was run for the various future year emission scenarios using meteorological inputs representative of the historical December 8-9, 1996 CO episode.

The modeling reported here was performed to show that the two wintertime fuel options selected for analysis will not result in exceedances of the EPA 8-hour CO NAAQS in any of the future years listed above, given the projected roadway network and traffic activity projections assumed in the CO SIP.

5.1 CO EMISSIONS PROCESSING APPROACH

Sierra Research presented the DAQEM with eight wintertime gasoline options as part of its work described in Section 3. In consultation with DAQEM staff, two of these options were selected for the development of UAM CO emission inventories and air quality model projections:

#1: Elimination of the 9 psi winter RVP requirement in favor of enforcement of the 13.5 psi ASTM limits for gasoline sold in Clark County during the winter months; and

#8: Elimination of all wintertime gasoline requirements.

ENVIRON quantified emission impacts of each option. The starting point for this analysis was the on-road mobile source emissions processing tools, scripts, and programs developed by Clark County and ENVIRON during the development of the CO SIP. The current wintertime gasoline and each of the two gasoline options were first defined in the inputs to the EPA's MOBILE6.2 on-road emission factor model using the various fuel parameters listed in Section 3. The current wintertime gasoline was re-run through the standard EPA MOBILE6.2 model to replicate the CO SIP numbers. For both fuel scenarios #1 and #8, two versions of the MOBILE6.2 model were run; the standard version from EPA, and a modified version from Sierra Research that improved the estimates of RVP effects for late model vehicles (Sierra Research, 2003). The modified model uses alternative RVP correction factors for later model vehicles (post 1990 model year vehicles) derived from available "paired" test data at the time (i.e., test data from the same vehicle tested on two different fuels with different RVP levels while holding other fuel parameters constant to the extent possible). On-road emission inventory results from both models are shown to provide a direct comparison of the effect.

The MOBILE model was run in a manner exactly equivalent to the approach used in developing the SIP emissions inventory, with each run at 1-degree temperature intervals. All other inputs remained identical to the assumptions and parameters defined in the SIP processing. The output from the matrix of MOBILE runs were then combined with link-specific traffic activity, trip lengths, volumes, and speeds derived from pre-existing output from the Regional Transportation Commission's TRANSCAD traffic demand model to generate gridded, hourly on-road mobile source emission rates on the CO SIP modeling grid. The DAQEM and ENVIRON staff worked together closely to develop a very detailed and complex methodology to apply MOBILE emission factors to the various data provided by TRANSCAD. Hence, ENVIRON already possessed all of the necessary TRANSCAD output, and processing tools/scripts from the previous work, from which to develop the mobile source emissions in a manner that was completely consistent with the emission budgets reported in the CO SIP.

5.2 CO EMISSION RESULTS

Mobile emission totals relative to the SIP on-road emissions inventory were tabulated for each of the future years: 2006, 2010, 2015, 2020, and 2030. Table 5-1 compares the domain-wide emissions for just the on-road components for: (1) the re-generated CO SIP case ("SIP") using EPA's MOBILE6.2; (2) scenario #1 using EPA's MOBILE6.2; (3) scenario #1 using Sierra's MOBILE6.2; (4) scenario #8 using EPA's MOBILE6.2; and (5) scenario #8 using Sierra's MOBILE6.2. Table 5-2 compares the total on-road CO inventory for the entire domain and the total on-road CO inventory for just the central portion of the modeling domain that covers the most urbanized portion of the grid[4]. We refer to this smaller area of the grid as the central sub-domain.

Comparison of the re-generated "SIP" on-road emission values in Table 5-1 against the actual CO SIP values[5] shows that the re-generated start emissions on Monday, December 9 are approximately 5 TPD higher than the CO SIP start emissions. We tracked this back to a small error in the emissions processing conducted for the CO SIP modeling application; therefore, the values in Table 5-1 are correct. Table 5-3 shows the total (on-road + non-road + stationary) CO inventories for the entire UAM modeling domain. Figure 5-1 shows these results graphically for Monday, December 9.

5.3 UAM MODELING RESULTS

ENVIRON conducted a "roll-forward" projection of future CO concentrations that would result from the two gasoline options. The future years of 2006, 2010, 2015, 2020, and 2030 were analyzed. Specifically, we identified how each option would impact the forecasts of the

[4] See Section 4.4 of the 2005 CO SIP Technical Support Document for a definition of this sub-domain (Clark County Board of Commissioners, 2005).
[5] Table 2-15, Section 2.3.6 of the 2005 CO SIP Technical Support Document (Clark County Board of Commissioners, 2005).

Table 5-1. Domain-wide on-road CO emission components and totals (TPD) by future year.

		SIP EPA M6		Fuel#1 EPA M6		Fuel#1 Sierra M6		Fuel#8 EPA M6		Fuel# 8 Sierra M6	
Year	Category	8-Dec	9-Dec	8-Dec	9-Dec	8-Dec	9-Dec	8-Dec	9-Dec	8-Dec	9-Dec
2006	Intrazonal	0.56	0.89	0.65	1.05	0.58	0.94	0.74	1.18	0.66	1.06
	Starts	125.22	241.6	134.38	260.57	129.38	249.94	149.7	290.31	144.35	278.93
	Links	150.64	204.61	193.78	265.65	160.59	219.65	215.85	295.93	179.75	245.88
	Total	276.42	447.1	328.81	527.27	290.55	470.53	366.29	587.42	324.76	525.87
2010	Intrazonal	0.83	1.35	0.97	1.58	0.86	1.4	1.06	1.72	0.93	1.52
	Starts	136.04	262.55	145.31	281.71	138.75	268	154.49	299.46	147.67	285.17
	Links	150.26	205.29	195.65	267.98	157.66	215.44	212.54	291.14	171.83	234.84
	Total	287.13	469.19	341.93	551.27	297.27	484.84	368.09	592.32	320.43	521.53
2015	Intrazonal	0.67	1.08	0.78	1.27	0.68	1.1	0.84	1.35	0.72	1.16
	Starts	138.56	267.28	147.36	285.42	139.62	269.35	152.84	295.94	144.83	279.3
	Links	137.32	187.7	178.62	244.79	139.36	190.48	192.27	263.52	150.24	205.4
	Total	276.55	456.06	326.76	531.48	279.66	460.93	345.95	560.81	295.79	485.86
2020	Intrazonal	0.72	1.16	0.83	1.35	0.72	1.16	0.88	1.42	0.76	1.22
	Starts	139.35	268.58	147.88	286.13	139.77	269.41	150.67	291.37	142.35	274.24
	Links	133.15	182	173.12	237.18	134.03	183.21	184.39	252.67	142.89	195.37
	Total	273.22	451.74	321.83	524.66	274.52	453.78	335.94	545.46	286	470.83
2030	Intrazonal	0.71	1.14	0.82	1.34	0.71	1.14	0.86	1.39	0.74	1.19
	Starts	152.68	294.3	161.83	313.08	152.68	294.3	163.94	317	154.6	297.84
	Links	142.66	194.67	185.4	253.52	142.66	194.67	196.75	269.09	151.55	206.85
	Total	296.05	490.11	348.05	567.94	296.05	490.11	361.55	587.48	306.89	505.88

Table 5-2. Domain-wide and central sub-domain total on-road CO emissions (TPD) by future year. Only values for Monday, December 9 are shown.

Year		SIP EAP M6	Fuel #1 EPA M6	Fuel #1 Sierra M6	Fuel #8 EPA M6	Fuel #8 Sierra M6
2006	Total	447.10	527.27	470.53	587.42	525.87
	Sub-domain	352.43	415.63	370.94	463.08	414.61
2010	Total	469.19	551.27	484.84	592.32	521.53
	Sub-domain	350.36	412.19	362.18	443.01	389.68
2015	Total	456.06	531.48	460.93	560.81	485.86
	Sub-domain	323.73	378.27	327.23	399.30	345.09
2020	Total	451.74	524.66	453.78	545.46	470.83
	Sub-domain	311.48	363.14	312.94	377.83	324.92
2030	Total	490.11	567.94	490.11	587.48	505.88
	Sub-domain	320.50	373.17	320.50	386.39	331.11

Table 5-3. Total domain-wide CO emissions (TPD) by future year used for UAM modeling of each fuel scenario.

	SIP EPA M6		Fuel #1 EPA M6		Fuel #1 Sierra M6		Fuel #8 EPA M6		Fuel #8 Sierra M6	
Year	8-Dec	9-Dec	8-Dec	9-Dec	8-Dec	9-Dec	8-Dec	9-Dec	8-Dec	9-Dec
2006	392.65	587.26	446.04	667.42	407.79	610.69	483.53	727.57	441.90	666.03
2010	415.89	622.46	470.69	704.54	426.03	638.10	496.85	745.59	449.19	674.80
2015	417.84	624.20	468.06	699.62	420.94	629.07	487.22	728.95	437.07	654.00
2020	427.79	635.99	476.42	708.91	429.10	638.03	490.51	729.71	440.59	655.07
2030	477.39	706.83	529.39	784.66	477.38	706.83	542.89	804.22	488.23	722.60

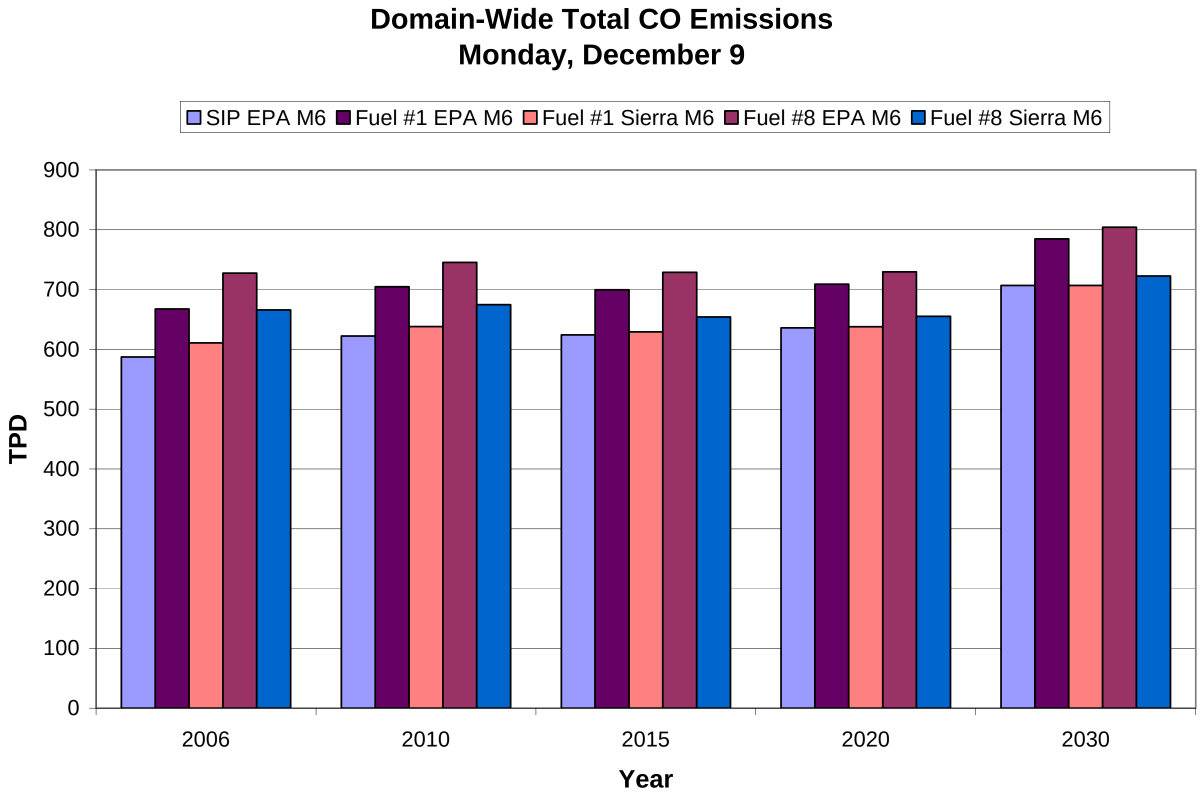

Figure 5-1. Total domain-wide CO emissions (TPD) by future year used for UAM modeling of each fuel scenario. Weekday values are shown.

historical exceedance-level CO episode in each future year as modeled in the CO SIP. The mobile source inventories for each gasoline option were first combined with the other stationary and non-road emission components, and the resulting total CO inventory was then run through the UAM. The modeled impact on simulated peak CO relative to the NAAQS is reported in Table 5-4. Note that the ~5 TPD error found for start emissions on December 9 has no impact on the peak CO reported for the "SIP" scenario, as these numbers are identical to the CO SIP values.

As this task was originally intended to demonstrate, in a general manner, the relationship between projected on-road emissions and resulting peak CO concentrations over the entire domain, hotspot and airport modeling were not regenerated for the fuel scenarios analyzed here. Furthermore, the procedure of separately scaling up on-road emissions within and outside of the central sub-domain was not performed as it was in the CO SIP[6].

The 2006 and 2010 "sub-domain" emission totals shown in Table 5-2 for Scenario #8 using the EPA MOBILE6 model are higher than the maximum scaled-up CO sub-domain budgets shown in Table 4-8 of the 2005 CO SIP Technical Support Document. One might expect that sub-

[6] Increasing on-road emissions within and outside of the central sub-domain was performed in the modeling conducted for the SIP revision to demonstrate continued maintenance of the CO standard while allowing for larger separate emission budgets within the sub-domain and in outer areas (see Table 4-8 of the 2005 CO SIP Technical Support Document).

Table 5-4. Peak predicted 8-hour CO (ppm) from the UAM CO SIP modeling system. The "SIP" column shows the replicated CO SIP values. The 8-hour CO NAAQS is 9 ppm.

Year	SIP EPA M6	Fuel #1 EPA M6	Fuel #1 Sierra M6	Fuel #8 EPA M6	Fuel #8 Sierra M6
2006	7.4	7.8	7.7	8.6	8.5
2010	7.2	7.6	7.4	8.1	7.9
2015	6.5	6.8	6.6	7.2	6.9
2020	6.7	7.1	6.7	7.2	6.8
2030	8.0	8.3	8.0	8.4	8.0

domain emissions that exceed the budgets established in Table 4-8 should result in peak CO exceeding the 9 ppm standard. Table 4-8 is based on the simple upward linear scaling of mobile source CO emissions according to the individual factors listed for each future year. However, the fuel scenarios run in the current assessment changed the spatial characterization of CO emissions. This is because removing the RVP limit leads to different effects to start and running exhaust emissions, and different start distributions are defined within the modeling domain (one for Las Vegas Boulevard, and one for everywhere else). Since the spatial start distribution causes a change in the spatial increase of CO emissions, it is possible to achieve higher sub-domain CO emissions than shown in Table 4-8 that result in peak CO concentrations below the 9 ppm standard. In other words, peak CO responds not only to emission increases, but also to *where* the CO is increased.

The higher sub-domain emissions shown in Table 5-2 for 2006 and 2010 under fuel Scenario #8 using EPA's MOBILE6 model also has ramifications for the hot-spot and airport modeling results reported in the 2005 CO SIP.[7] As stated above, we did not re-run the hot-spot and airport models for this analysis. Instead, we developed a simpler approach in which we scaled the 2006 and 2010 hot-spot and airport results from Tables 4-4 and 4-5 in the Technical Support Document by the relative increase in the on-road sub-domain emissions shown in Table 5-2 of this report. The resulting Scenario #8 scaling factors are 1.31 for 2006 and 1.27 for 2010, based on the weekday (December 9) emissions growth. For the hot-spot intersections, we scaled both the UAM and hot-spot model results since they are almost entirely associated with on-road CO emissions. For the airport results, we scaled only the UAM component, since the airport model results are dominated by CO emissions from aircraft and stationary CO sources that would not be impacted by a change in gasoline as in Scenario #8. Note that this scaling approach is conservative since it is based on on-road emissions growth only, while developing a scaling approach based on the total sub-domain emissions (to include stationary and area sources) would reduce the scaling factors.

Table 5-5 displays the scaled hot-spot modeling results and Table 5-6 displays the scaled airport model results to reflect Scenario #8 with the EPA MOBILE6 model. With the scaling applied, peak 8-hour CO concentrations remain well below the 9 ppm standard for both years.

[7] See Tables 4-4 and 4-5 in the 2005 CO SIP Technical Support Document.

Table 5-5. Peak 8-hour average CO concentrations (ppm) predicted by UAM, CAL3QHC, and UAM+CAL3QHC for each of the Five Points intersections. Note that peaks reported for each of the models and their combined effects occur over different 8-hour periods. Results are based on scaling factors developed from the sub-domain on-road emissions differences shown in Table 5-2 for fuel Scenario #8 using EPA MOBILE6.

Year	UAM	Eastern/Charleston		Eastern/Fremont		Fremont/Charleston	
		CAL3QHC	CAL3QCH+UAM	CAL3QHC	CAL3QHC+UAM	CAL3QHC	CAL3QHC+UAM
2006	6.41	2.15	8.04	1.68	7.41	0.93	6.67
2010	5.87	1.69	7.12	1.45	6.76	0.88	6.11

Table 5-6. Peak total UAM, EDMS, and total UAM+EDMS 8-hour CO concentrations (ppm) at all three airports evaluated. Values shown for McCarran airport occur at the peak publicly accessible receptor. Results are based on scaling factors developed from the sub-domain on-road emissions differences shown in Table 5-2 for fuel Scenario #8 using EPA MOBILE6.

Airport	2006	2010
McCarran Total (CO SIP)	7.47	7.14
EDMS (CO SIP)	6.21	5.89
UAM (CO SIP)	1.26	1.25
UAM (Scenario #8)	1.65	1.58
Scenario #8 Total	7.86	7.48
Henderson Executive (CO SIP)	1.12	1.36
EDMS (CO SIP)	0.42	0.42
UAM (CO SIP)	0.70	0.94
UAM (Scenario #8)	0.91	1.20
Scenario #8 Total	1.34	1.61
North Las Vegas (CO SIP)	5.01	5.04
EDMS (CO SIP)	0.40	0.36
UAM (CO SIP)	4.61	4.68
UAM (Scenario #8)	6.04	5.94
Scenario #8 Total	6.44	6.30

6. REGULATORY IMPACTS OF WINTER GASOLINE OPTIONS

After discussions with DAQEM on the preferred winter and transitional period gasoline options for Clark County, the regulatory impacts of select winter gasoline scenarios were evaluated. All relevant federal, state, and county regulations were reviewed, and the required modifications to address the winter gasoline scenarios and remove overlaps and conflicts between the laws, statutes, and regulations were identified. The following winter gasoline scenarios were selected for evaluation:

- Elimination of the 9 psi winter RVP requirement (Fuel Scenario 1);
- Elimination of RVP and oxygenate, aromatic and sulfur content requirements (Fuel Scenario 8); and
- Elimination of the RVP, aromatic and sulfur content requirements (Fuel Scenario 8) and a shortening of the winter oxygenate period to November through January.

The existing statutes and regulations and the required modifications associated with the aforementioned winter gasoline scenarios are discussed below.

6.1 REGULATIONS ON CLARK COUNTY GASOLINE

The current requirements imposed on winter gasoline in Clark County are summarized in Table 4-1. Following is a discussion of each fuel property standard on the federal, state, and local levels.

Reid Vapor Pressure (RVP): The RVP specification in Clark County is imposed by Nevada statute[8] between October 1 and March 31. The RVP limit of 9 psi (10.0 psi for summertime ethanol gasoline) is more stringent than the ASTM performance standards in Nevada during the winter, and no federal standards exist for winter conventional gasoline. Upon elimination of the RVP limit in the Nevada Administrative Code, the ASTM limits for southern Nevada would apply.

Oxygen Content: The minimum oxygen content of 3.5% by weight for Clark County winter gasoline is required under Section 53 of the Clark County Air Quality Regulations during the months of October through March. This requirement is more stringent than the federal winter oxygenate requirement for Clark County. Because the Las Vegas Valley within Clark County is designated under the Clean Air Act (CAA) as a "serious" nonattainment area for the eight-hour CO National Ambient Air Quality Standard (NAAQS) during the winter, a federal minimum oxygen content requirement of 2.7% by weight is mandated.[9] Within the same CAA section, a minimum four-month period of oxygenate use is required during the CO nonattainment period, unless "the State can demonstrate that because of meteorological conditions, a reduced period

[8] Nevada Administrative Code § 590.065
[9] Clean Air Act Title § 211(m)(2)

will assure that there will be no exceedances of the carbon monoxide standard outside of such reduced period."

Clark County has had no violations of the CO standard NAAQS since 1998 and it appears that the County could seek redesignation to attainment. Redesignation could allow the elimination of the winter oxygenate requirement.

Aromatics and Sulfur Content: The aromatic and sulfur content specifications for Clark County winter gasoline are found in Section 54 of the Clark County Air Quality Regulations, and apply between November 1 and March 31. According to recently promulgated federal regulations (Federal Register, 2006), winter gasoline sold in Clark County is considered to be a "boutique" fuel due to the local controls on sulfur and aromatics. These federal regulations, which are intended to restrict the creation of new boutique fuels, preclude any changes to the Clark County winter aromatic and sulfur limits except for their elimination. Further, once eliminated, these limits cannot be reinstated. The Clark County sulfur specification, however, has been rendered redundant by the more stringent federal Tier 2 sulfur standard.

6.2 REGULATORY IMPACTS OF GASOLINE OPTIONS

The regulatory impacts of the winter gasoline options affect the one Nevada statute and two Clark County Air Quality Regulations identified above. Any additional federal, state, or local statutes or regulations that would be impacted were not identified. The required changes to existing statues and regulations necessary to implement the selected scenarios are discussed below.

Elimination of 9 psi RVP Limit: The amendments to the Nevada Administrative Code (NAC) necessary to eliminate the existing 9 psi winter RVP limit in Clark County are shown in track changes in Appendix A. In addition, the language of the statute was updated to reflect the most recent version of the ASTM gasoline standards.

Elimination of Other Winter Gasoline Requirements: As noted above, the oxygenate, sulfur, and aromatic content requirements for winter gasoline in Clark County are specified in Sections 53 and 54 of the Clark County Air Quality Regulations. Elimination of these requirements could be achieved by the elimination of these two sections of the Clark County Air Quality Regulations. In addition to repeal of Sections 53 and 54, it is important to note that the Nevada State Implementation Plan (SIP), which was approved by EPA to include winter Cleaner Burning Gasoline, will need to be revised in accordance with Title 40 of the Code of Federal Regulations (CFR) Part 51 in order to completely eliminate the sulfur and aromatic requirements.

Shortening of the Winter Oxygenated Gasoline Period: Shortening of the winter oxygenated gasoline period to the months of November through January would require modifying Section 53 of the Clark County Air Quality regulations. The necessary modifications are shown in track changes in Appendix B.

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