Carbon Monoxide

State Implementation Plan Revision

Las Vegas Valley Nonattainment Area

Clark County, Nevada

October 2005

**Clark County Department of Air Quality
and Environmental Management**

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EXECUTIVE SUMMARY

This document is a revision of the August 2000 *Carbon Monoxide State Implementation Plan, Las Vegas Valley Nonattainment Area, Clark County, Nevada* (2000 CO SIP). Its purpose is to update carbon monoxide motor vehicle emissions budgets using MOBILE6, the latest model approved by the U.S. Environmental Protection Agency (EPA) for use in transportation conformity determinations.

In the mid-1980s, portions of the Las Vegas Valley began violating the carbon monoxide (CO) National Ambient Air Quality Standards (NAAQS) during the winter months. The number and severity of these violations caused EPA to designate the valley as a "moderate" nonattainment area upon enactment of the Clean Air Act Amendments in November 1990. When Clark County did not attain the CO standards after a one-year extension to the required attainment date, EPA reclassified the valley as a "serious" CO nonattainment area. The county began development of a state implementation plan (SIP) to establish measures for attaining the standards by the end of 2000, and in August 2000 the Clark County Board of County Commissioners adopted the plan. EPA issued a final approval of the 2000 CO SIP in September 2004, and in June 2005 EPA found that the Las Vegas Valley had attained the standards by the applicable date of December 31, 2000.

During the past several years, the valley has experienced substantial improvement in air quality: no violations of the 8-hour CO standard have been recorded since 1998. There has been a similar reduction in the intensity of CO concentrations. CO exceedances (but not necessarily violations) often totaled 40 or more per year in the 1980s. During 1997 and 1998, the valley experienced only four unhealthful and three exceedance days. Exceedances and violations of the 8-hour CO standard eased by 1999, and there have been no recorded exceedances since then.

The greatest modeling effort in this CO SIP revision centered on updating the on-road mobile source inventory estimates. This revision focused on recalculating the emissions for on-road and non-road sources using the newer MOBILE6.2 and NONROAD2004 models, respectively, then running the Urban Airshed Model and the CAL3QHC model to determine if the Las Vegas Valley will continue to maintain the CO standards through 2030. The results, as Sections 5 and 6 describe, confirm continued maintenance: model runs for maximum CO levels using MOBILE6.2 do not show any violations through 2030.

DAQEM updated its CO modeling and conformity analysis for this 2005 CO SIP revision using the latest tools, data resources, and methodologies available. The 2000 CO SIP was based on computer modeling of the single best performing episode of the three originally modeled: the night of December 8-9 (Sunday-Monday), 1996. The EPA regional office approved this selection, along with a scaling factor that resulted in a maximum predicted concentration of 11.2 ppm. This SIP revision continues to rely on the December 8-9, 1996 episode as a base case, but uses new data on population and travel projections for conducting the MOBILE6.2 analysis. For the 1996 base year, the original TRANPLAN output was used to define traffic volume-related parameters. For all future years modeled, the Regional Transportation Commission of Southern Nevada provided output from the new TransCAD transportation demand model. Population projections (and actual population for 2000) were modified to reflect higher growth rates in the county.

EPA requires that SIPs also provide for maintaining health standards after attainment. This plan revision assures the public that implementation of the programs in the 2000 CO SIP and maintenance of the CO health standards will continue through 2030. Since Clark County has now reached attainment, and the primary source of CO is the on-road mobile sources category, projections for a 30-year horizon past the demonstration date have been forecast. With new planning tools and better predictive capabilities (such as MOBILE6) available, Clark County will continue to reanalyze and confirm long-term maintenance of the CO health standards.

Since additional modeling will likely be required for maintenance plan submittals from areas seeking redesignation, this SIP revision updates the mobile emission model analysis to provide a basis for development of a formal CO maintenance plan and a redesignation request in the near future. The Las Vegas Valley air quality implementation plan will remain in effect until superseded by an approved CO maintenance plan.

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ACRONYMS AND ABBREVIATIONS

Acronyms

CAAA	1990 Clean Air Act Amendments
CO	carbon monoxide
DAQEM	Clark County Department of Air Quality and Environmental Management
EDMS	Emissions and Dispersion Modeling System
EPA	U.S. Environmental Protection Agency
EPS3	Emission Processing System, version 3
I/M	inspection and maintenance (program)
MVEB	motor vehicle emission budget
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Station
RTC	Regional Transportation Commission of Southern Nevada
RTP	regional transportation plan
RVP	Reid Vapor Pressure
SIP	state implementation plan
SLAMS	State and Local Air Monitoring Station
TAZ	traffic analysis zone
TDM	transportation demand management
TSD	Technical Support Document (Appendix A)
UAM	Urban Airshed Model
VMT	vehicle miles traveled

Abbreviations

ppm	parts per million
TPD	tons per day
TPY	tons per year

1. INTRODUCTION

The 1990 Clean Air Act Amendments (CAAA) redefined the national air pollution abatement framework and established ambitious policies to carry out air quality planning and control activities. Two National Ambient Air Quality Standards (NAAQS) were established for carbon monoxide (CO): the 1-hour standard has a maximum allowable concentration of 35 parts per million (ppm), and the 8-hour standard has a maximum average of 9 ppm over an 8-hour period. Areas that violate one or both of the NAAQS more than two times in a two-year period are classified as CO nonattainment areas.

In the mid-1980s, portions of the Las Vegas Valley began violating the CO NAAQS during the winter months. Although the valley never exceeded the 1-hour standard, it exceeded the 8-hour standard at least once each year on a seasonal basis: in winter, local inversions would stagnate air masses and trap pollutants. The overnight buildup of pollutants caused violations of the 8-hour standard in a limited area surrounding the East Charleston (now Sunrise Acres) monitoring station.

The number and severity of these violations caused the U.S. Environmental Protection Agency (EPA) to automatically designate the valley as a “moderate” nonattainment area upon CAAA enactment in November 1990. The Clean Air Act and its amendments required that moderate nonattainment areas implement the following emission control measures as expeditiously as practicable to attain the CO NAAQS by December 31, 1995:

1. An oxygenated gasoline program during the winter months that requires gasoline to contain no less than 2.7 percent oxygen by weight.
2. An enhanced vehicle inspection and maintenance (I/M) program meeting Clean Air Act criteria.
3. Forecasts of vehicle miles traveled (VMT) in the region, procedures for annual updates and reports attesting to the accuracy of the forecasts, and estimates of actual VMT based on traffic counts on area roadways.
4. Contingency measures that must be implemented if actual VMT exceeds forecasted VMT or if the area fails to attain the standard by the applicable date.
5. Transportation control measures necessary to demonstrate attainment of the NAAQS (Clean Air Act Section 187(b)(2)).
6. Implementation of all Reasonably Available Control Measures as quickly as practicable.

Clark County implemented these controls and made significant progress towards attaining the CO NAAQS, but fell short of meeting the standard by the applicable date due to phenomenal population growth. Because of improved CO levels from the implementation of control measures, EPA granted Clark County a one-year extension to demonstrate compliance. However, the county did not succeed and, according to CAAA requirements, EPA reclassified the Las Vegas Valley as a “serious” CO nonattainment area.

EPA published the notice of violation reclassifying the area in the *Federal Register* on October 2, 1997. The agency set a deadline of May 1999 (18 months from the notice publication date) for submittal of an implementation plan that would demonstrate attainment of the CO NAAQS by December 31, 2000 (i.e., the *Carbon Monoxide State Implementation Plan, Las Vegas Valley Nonattainment Area, Clark County, Nevada,* approved in August 2000 [2000 CO SIP]). The CAAA requires that serious nonattainment areas meet all the requirements for moderate areas listed previously, in addition to implementing the following measures:

1. Gasoline sold during the winter months must contain the level of oxygen necessary to attain the standard, in combination with other measures.

2. Employers of 100 or more people must implement a mandatory travel reduction program that requires each company to increase average vehicle occupancy for commute trips by at least 25 percent over the regional average. This requirement can be avoided if the area can show that such a program is not needed to demonstrate attainment of the standard or that a comparable emission reduction can be achieved by other measures. Congress has since eliminated this requirement from the CAAA.

3. Areas can implement an economic incentive program containing fees and marketable permits if emission reduction milestones are not met by December 31, 2000.

Beginning in 1997, regional transportation plans (RTPs) had to specifically describe the transportation system for future horizon years. This requires the Regional Transportation Commission of Southern Nevada (RTC) to approve specific projects and programs for 2000, 2010, and 2020 (and for 2030 in the 2005 CO SIP revision).

1.1. PROBLEM STATEMENT

Federal transportation conformity regulations require use of the latest planning assumptions and EPA-approved emissions models each time a regional emissions analysis is conducted (after a one-year grace period from the time of final EPA approval). The RTC must conduct a new regional emissions analysis to update its conformity determinations as part of a new RTP. These conformity determinations must be based on budgets from the latest EPA-approved model (i.e., MOBILE6.2), and EPA must approve a revised motor vehicle emissions budget (MVEB) before the RTC submits the new RTP.

Section 1.2 of the 2000 CO SIP discusses the reasons for and requirements of the SIP at that time. This revision will not repeat this information, but simply reference the 2000 CO SIP.

1.2. PHYSICAL DESCRIPTION

The 2000 CO SIP provides a detailed physical description of the Las Vegas nonattainment area.

1.3. CLIMATOLOGICAL SETTING

The 2000 CO SIP provides a detailed description of the climatological setting of the Las Vegas Valley.

1.4. ORGANIZATION OF THIS REVISION

Each of the following seven sections addresses a specific topic. These generally follow the format of the 2000 CO SIP, with one exception: Section 7 of the 2000 SIP, "Additional Requirements of the CAAA," related to contingency measures needed if the valley did not attain the CO standard by the December 2000 deadline. Because the valley attained the standard, EPA stated in its June 2005 notice that contingency measures and the five percent per year reduction in CO emissions were no longer required; therefore, the discussion in Section 7 of the 2000 CO SIP is no longer necessary. The remainder of that section, a discussion of VMT projections and other control measures, is addressed in Section 7 of this SIP revision.

Section 2, "Carbon Monoxide Monitoring Network and Trends in Air Quality," provides updated information on the monitoring network and CO air quality trends.

Section 3, "Emission Inventory Summary," presents the 1996 base year emissions inventory for stationary, area, and mobile sources (on- and off-road), as required under the 1990 CAAA. This section was greatly expanded from the 2000 CO SIP to provide the reader with a better understanding of the changes required in the mobile source emissions inventory because of the MOBILE6.2 program. The section presents future year on-road mobile emissions estimates using MOBILE6.2 inputs, which are based on the transportation network defined in the RTC TransCAD transportation demand model (TDM).

Section 4, "Control Measures," briefly describes the control strategies that reduced CO emissions and led to attainment status.

Section 5, "Base Case Modeling," describes the modeling process for the base case simulations using the Urban Airshed Model (UAM), including the preparation of inputs and model performance.

Section 6, "Demonstration of Attainment," describes the modeling analysis demonstrating the continued attainment of the NAAQS and summarizes CO concentrations with implemented control measures. It also explains the use of MOBILE6.2 for conformity and other purposes.

Section 7, "SIP Commitments/Implementation," discusses the implementation of control measures, monitoring progress, emission budgets, and maintenance of CO attainment. It contains an additional discussion of conformity and mobile source emission budgets, including the use of new data.

Section 8, "References," identifies the reports and studies supporting the 2005 CO SIP revision.

Appendices contain the Technical Support Document (TSD) for the 2005 CO SIP revision and other supporting studies.

2. MONITORING NETWORK AND TRENDS IN AIR QUALITY

2.1. INTRODUCTION

This section provides a brief summary of the Las Vegas Valley CO monitoring network as of July 2005 and a discussion of the trends in air quality for CO over the past several years. The CO monitoring program demonstrates that air quality is improving, and the reasons for this positive development are briefly considered.

2.2. BACKGROUND

CO occurs in the atmosphere as the result of incomplete combustion of fuels. In Las Vegas, as in other urban areas, motor vehicles are the major source of CO emissions, comprising approximately 76 percent of total daily emissions in the base year. Stations usually record exceedances of the standard in the late afternoon and evening hours. For more details on the sources of CO emissions and a breakdown of contribution by category, see Table 3-11. EPA established specific standards for CO in 1971 to protect public health and the environment. The most stringent standard of 9 ppm is averaged over a rolling 8-hour period; the maximum allowable hourly concentration is 35 ppm. The Clean Air Act requires that EPA review the CO standard every five years. EPA has made no changes to the current standards.

2.3. MONITORING NETWORK

EPA has established ambient air quality monitoring requirements and standards for State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS). These provide for operating schedules, data quality assurance, and design and siting of CO samplers. Although EPA monitoring guidelines require only three CO monitors for areas such as Clark County, there were eight CO monitors at the beginning of 2005. Table 2-1 provides details about the monitoring sites. The monitoring schedule is continuous, and each monitoring station uses the Gas Filter Correlation technique.

By 1999, the CO monitoring network in the Las Vegas Valley had evolved into a system of 15 monitoring sites. Eight of these were SLAMS sites, and two were NAMS/SLAMS sites. By the beginning of 2005, this network had been reduced to eight sites (Table 2-1). The Clark County Department of Air Quality and Environmental Management (DAQEM) operates and administers the air monitoring system, which is governed by a set of quality assurance and quality control procedures approved by EPA and subject to periodic EPA performance audits. Air quality monitoring reports are prepared quarterly and submitted to EPA. All sites except the maximum concentration Sunrise Acres monitor have population exposure as their objective. Figure 2-1 shows the current CO monitoring locations.

Table 2-1. Las Vegas Valley CO Monitoring Site Locations and Descriptions

Site Name	Address	Type	Predominant Wind Direction
City Center	559 N. 7th Street	NAMS/SLAMS	Southwest
East Sahara	4001 E. Sahara Ave.	SLAMS	Southwest
Orr School	Maryland Pkwy. & Flamingo Road	SLAMS	Southwest
Winterwood	5483 Club House Dr.	SLAMS	Southeast
S. Las Vegas Blvd.	3799 South Las Vegas Blvd.	SLAMS	N.A.
Sunrise Acres	2501 S. Sunrise Ave.	SLAMS	Southwest
J.D. Smith	1301B East Tonopah	NAMS/SLAMS	Northwest
Freedom Park[1]	650 N. Mojave Rd.	SLAMS	Northwest

[1]Ceased operation April 30, 2005.

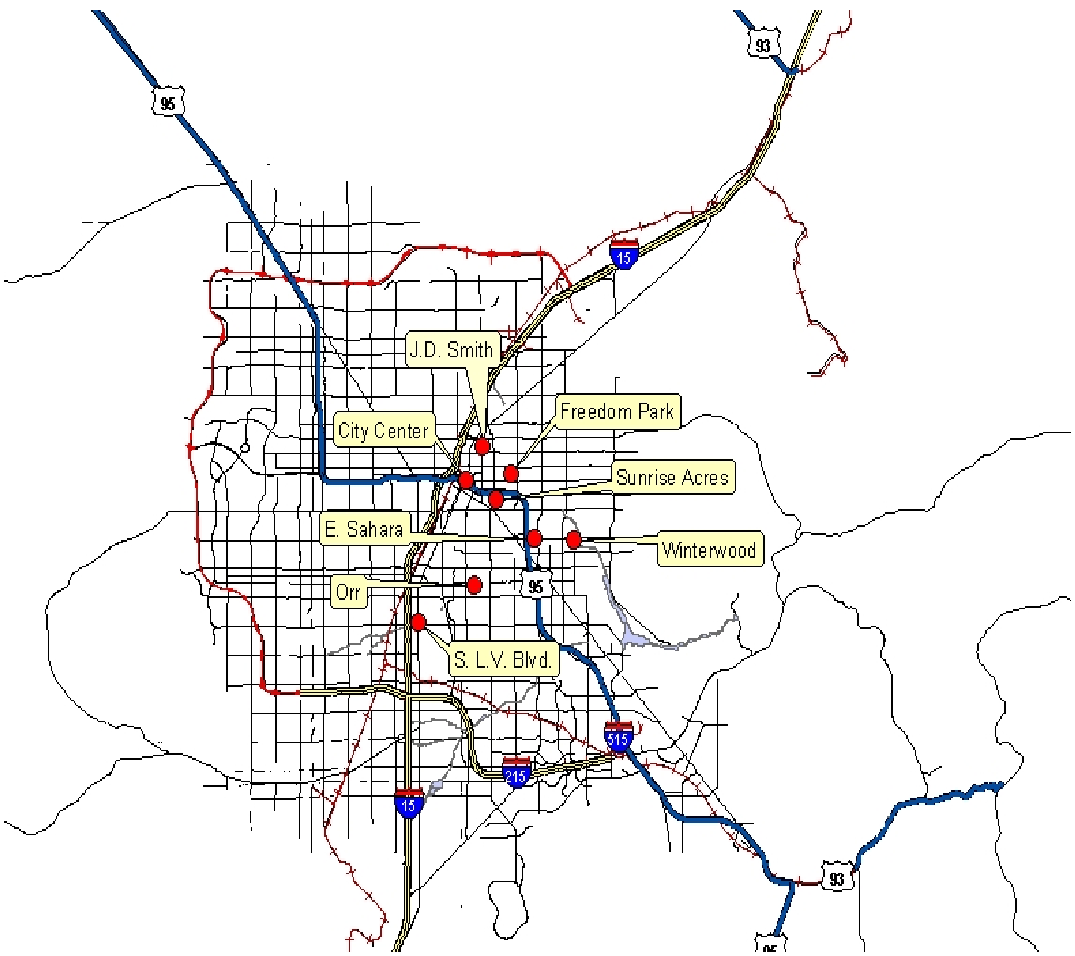

Figure 2-1. Las Vegas Valley CO Monitoring Sites – 2005.

2.4. TRENDS IN CARBON MONOXIDE AIR QUALITY

No site has ever recorded a violation of the 1-hour CO NAAQS (35 ppm) in the Las Vegas Valley; exceedance events are limited to the 8-hour national standard of 9 ppm. The East Charleston monitoring station recorded 10 violations during the 1991-1992 winter season, but the number of violations declined to one in 1995, three in 1996, one in 1997, and two in 1998. There were no violations from 1999 through 2004, the most recent data year. This downtrend is the direct result of implementing CO control measures. The East Charleston monitoring site (relocated and renamed Sunrise Acres in 2000) is adjacent to a junction of major transportation corridors where three state highways intersect, known as the Five Points area. The site also sits in a topographic bowl where air pollution collects. The highest 8-hour average CO concentration, measured at 10.2 ppm, occurred in the Five Points area during the 1996 season. The second highest 8-hour concentrations since that time have been 8.2 ppm in 1999, 7.1 ppm in 2000, 6.3 ppm in 2001, 5.8 ppm in 2002, 5.3 ppm in 2003, and 5.1 ppm in 2004.

During the past several years, the Las Vegas Valley has experienced substantial improvement in air quality: no violations of the 8-hour CO standard have been recorded since 1998. There has been a similar reduction in the intensity of CO concentrations. Figures 2-2 and 2-3 illustrate this improved CO air quality.

Apart from recent winter seasons with fewer inversions, annual reductions in the number of events and in CO concentrations can be attributed to the following factors:

1. Improved motor vehicle emissions control technology and the continued replacement of older, poorly maintained vehicles with newer, cleaner vehicles.
2. The wintertime oxygenated, cleaner-burning gasoline program.
3. Reduced gasoline Reid Vapor Pressure (RVP).
4. Requirements for annual smog tests for motor vehicles, including medium- and heavy-duty gasoline vehicles.
5. A computerized traffic signal management program.
6. Use of the east leg (I-515) freeway and other roadway improvements.
7. Alternative fuel vehicle programs.
8. Voluntary rideshare programs.

CO exceedances (but not necessarily violations) of the NAAQS frequently totaled 40 or more per year in the 1980s. During 1997 and 1998, the Las Vegas Valley experienced only four unhealthful and three exceedance days, all recorded at the Sunrise Acres station. Exceedances and violations of the 8-hour CO standard eased by 1999, and there have been no recorded exceedances of the CO standard since then.

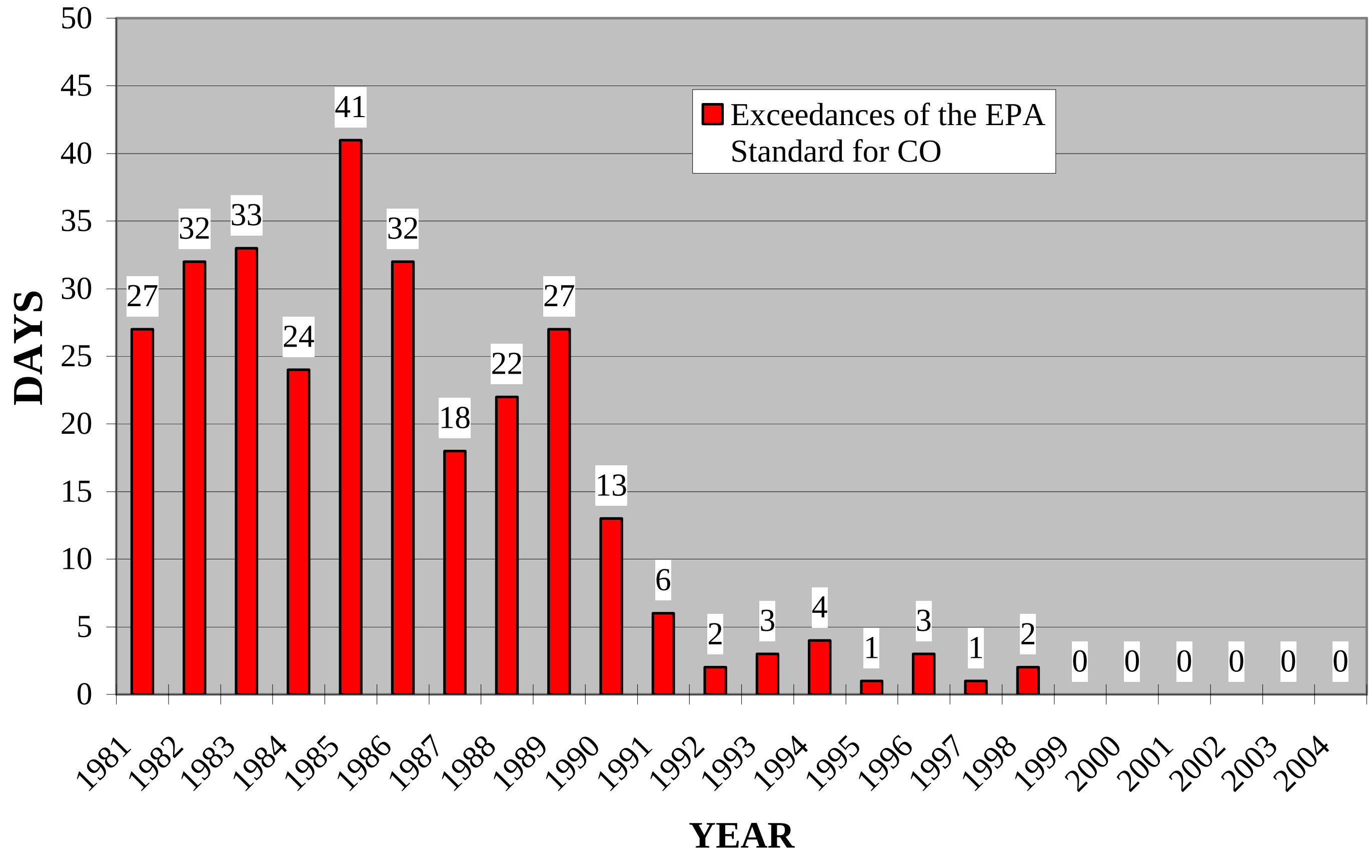

Figure 2-2. Las Vegas Valley CO Air Quality Trends, Number of Exceedances – 1981-2004.

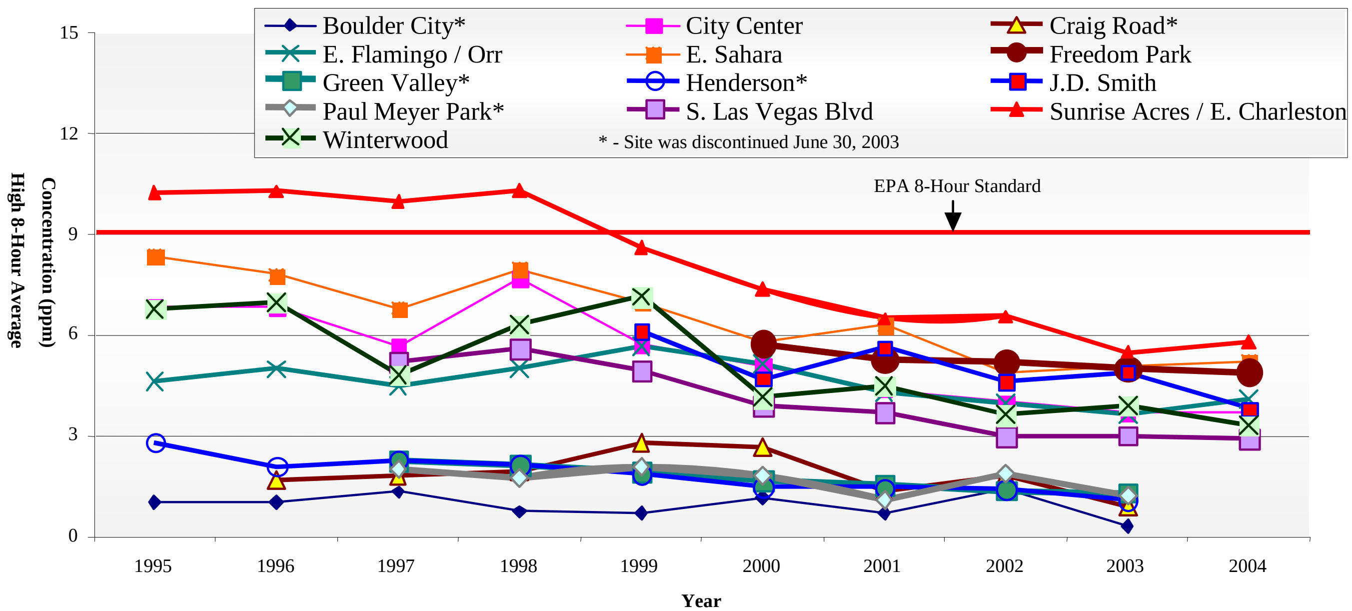

Figure 2-3. Las Vegas Valley CO Air Quality Trends, Annual Peak Concentrations by Station – 1981-2004.

2.5. CARBON MONOXIDE SATURATION STUDY

From November 2001 through January 2002, DAQEM conducted an intensive saturation study throughout the Las Vegas Valley to measure CO during its historical peak level period (see Appendix B). The purpose was to learn about CO concentrations in the valley on a much larger geographical basis, to evaluate whether current CO monitors were representing the highest CO concentrations, and to better understand the relationship between land use, meteorology, and ambient CO concentrations. Beginning with an initial network of 32 continuous CO samplers, the program was expanded during the study to 63 stations. Staff operated a mobile van with a CO analyzer and positional recording systems during two intensive monitoring periods.

The study found that DAQEM monitoring sites generally represented the high concentration locations for CO in the Las Vegas Valley. Nearly all of the highest 8-hour average CO concentrations occurred near the Sunrise Acres site, in an area east of downtown Las Vegas. The highest averages were in the 6 ppm range, far below the 9 ppm 8-hour NAAQS for CO. The study confirmed that meteorological conditions (e.g., cold winter nights with poor atmospheric dispersion) led to the accumulation of CO within 100 feet of the ground in the area around Sunrise Acres. At the same time, areas with similar emission sources did not experience high CO levels, further confirming the pooling of pollutants in the Sunrise Acres area. A special microscale saturation study site near the Fremont Street casino and parking garage area recorded the highest one-hour CO level of 18.3 ppm, which is only half the one-hour NAAQS.

This saturation study confirmed the proper locations for CO monitors in the valley, assisted staff in evaluating the results of the modeling work constituting part of this SIP revision, and supported decisions about which CO monitors could be safely removed from the Clark County air monitoring network in subsequent years.

3. EMISSION INVENTORY SUMMARY

3.1. INTRODUCTION

The CAAA requires that all nonattainment areas prepare a base year inventory that is comprehensive, accurate, and current with respect to actual emissions in the area (Section 182(a)(1)). The peak season and modeling CO inventories are based on this inventory. This section summarizes the 1996 base year CO inventory for the Las Vegas Valley nonattainment area, which addresses CO emissions from four major type categories: stationary point sources, area sources, on-road mobile sources, and non-road mobile sources. This section provides a brief overview of the source categories and the methodologies employed to estimate emissions. For the mobile sources, it includes a discussion of changes from the 2000 CO SIP modeling effort that used MOBILE5b, which was replaced by MOBILE6.2.03. During the development of the 2000 CO SIP, CO emissions from on-road mobile sources (by far the largest contributor to the overall emission inventory for Las Vegas) were estimated using a combination of MOBILE5b, the Direct Travel Impact Model, and volume/roadway link information provided by the RTC in its TRANPLAN model. Appendix A provides more detailed information pertaining to this inventory.

The Clark County Health District was the agency originally responsible for preparing and submitting the Las Vegas Valley nonattainment area 1996 base year CO emissions inventory. Several other local agencies contributed information necessary for preparing emissions estimates, including the RTC, the Clark County Department of Aviation, and the Clark County Fire Department. The Nevada Department of Transportation, the U.S. Forest Service, and Southwest Gas Corporation also provided information for these estimates.

The 1996 point source inventory was prepared primarily from a mail survey by the Health District. Survey results were supplemented by information obtained through personal contacts during compliance inspections, and the RTC provided VMT data necessary to calculate on-road mobile source emissions. The MOBILE5b model was run to determine vehicle emission factors from on-road mobile sources. Table 3-1 contains the Clark County demographic information used in the 2000 CO SIP.

Table 3-1. Demographic Data Used in Developing Emission Inventories and to Project Activity in the 2000 CO SIP[1]

January	Population	Employment	VMT
1996	1,037,844	493,213	22,469,020
2000	1,269,600	609,400	24,929,485
2010	1,790,700	859,500	38,022,330
2020	2,406,500	1,115,100	57,492,333

[1]Data is based on RTC 1997 estimates and projections.

The 2000 CO SIP was based on computer modeling (using UAM) of the single best performing episode of the three originally modeled: the night of December 8-9 (Sunday-Monday), 1996. The

2000 CO SIP and its appendices provide technical documentation for the models, application methodologies, performance evaluations, and future year modeling assessments. This SIP revision continues to rely on the December 8-9, 1996 episode.

This 2005 CO SIP revision uses new data on population and VMT projections, especially for conducting the MOBILE6.2 analysis. For the 1996 base year, the RTC's original TRANPLAN output was used to define link-based volume (in VMT) and other traffic volume-related parameters. No trip tables were available, which allow for the separate estimation of start versus running emissions, so 1996 start emissions were spatially allocated using 2000 TransCAD trip data, as described later in this section. All original ancillary information, including vehicle fleet mix, seasonal/day-of-week adjustment factors, and hourly activity profiles, remained the same as in the original model.

For all future years modeled in this update, the RTC provided output from the new TransCAD TDM, which includes link volumes and trip tables for each year. Population projections (and actual population for 2000) were modified to reflect higher growth rates in the county. Table 3-2 contains this new data, including the revised 1996 daily VMT.

Table 3-2. Demographic Data Used in Developing Emission Inventories and to Project Activity in the 2005 CO SIP Revision

January	Population[1]	Modeled DVMT[2]
1996	1,037,844	22,395,251
2006	1,923,420	37,076,414
2010	2,281,380	47,170,180
2015	2,687,055	53,973,132
2020	2,999,953	58,181,118
2030	3,410,332	65,586,340

[1]Data obtained from the UNLV Center for Business and Economic Research in July 2005.
[2]RTC 2005 TransCAD TDM.

3.2. EMISSIONS SUMMARY BY CATEGORY

This section is greatly expanded from the original 2000 CO SIP to provide a better understanding of the changes required to develop the mobile source emissions inventory. The 1996 base year and future year inventories for the point source and area source categories remain essentially the same as those reported in the 2000 CO SIP, although direct comparison with Table 3-2 is difficult because the 2000 CO SIP tables used average daily CO season emissions and this SIP revision contains daily emissions for the two episode days of Sunday and Monday. The non-road and on-road mobile source inventories have been greatly revised to reflect new, updated data inputs, new models, and a format to accommodate the MOBILE6.2.03 modeling requirements. Appendix A provides an expanded explanation of the methodology and results of the mobile source inventory changes.

3.2.1. On-Road Mobile Emissions

The greatest effort in this CO modeling update has focused on the on-road mobile source inventory estimates. The model used in the 2000 CO SIP effort (MOBILE5b) was replaced by the latest version of the model (MOBILE6.2.03). This version updates CO emission rates for low-emission and Tier 2 vehicles, along with many other changes. The Air Improvement Resource, Inc. version of this model was used because it provides the capability to create a condensed database of composite emission factors. This is important for applications where numerous MOBILE6 scenarios must be run to generate lookup factors for link-level emissions estimates, such as this one.

For the 1996 base year, the RTC's original TRANPLAN output was used to define link-based volume (in VMT) and other traffic volume-related parameters. All original ancillary information, including vehicle fleet mix, seasonal/day-of-week adjustment factors, and hourly activity profiles, remained the same as in the original model.

Since the output data and formats for MOBILE6 are significantly different from those of its predecessor, the original program used to estimate link-level CO emissions (i.e., the Direct Travel Impact Model) was replaced by two new programs. The first processes link-based emissions, and the second processes emissions based on traffic analysis zones (TAZs). Both programs produce inputs for the Emission Processing System, version 3 (EPS3). EPS3 is the latest version of the EPS program suite used in the original CO SIP model to generate gridded, time-resolved, UAM-ready CO emission input files.

For all future years modeled in this SIP revision, the RTC provided output from the new TransCAD TDM, which includes link volumes and trip tables for each year. Base year TRANPLAN intrazonal data were provided as volumes by TAZ with a trip length from which VMT was calculated. Future year TransCAD intrazonal data were provided as trips by TAZ only. The intrazonal trips were assumed to have a trip length of 1 mile, from which VMT was calculated. VMT was multiplied by the running exhaust emission factors, then spatially distributed using gridded surrogates developed from the definition of the future year TransCAD TAZs.

For both the base and future year link-level emissions, VMT was calculated from the transportation model output (link volume multiplied by link length) for each period of the day and allocated to each hour using an hourly distribution for each day of the episode. VMT was then multiplied by the hourly running exhaust emission factors (in grams per mile) from MOBILE6.2, and the total hourly emissions by link were spatially distributed according to the link endpoint coordinates.

Start emissions were calculated by multiplying hourly estimates of link-level VMT by hourly MOBILE6.2 start emission factors in grams per mile. The link-level start emissions were then totaled over the entire network and spatially distributed using the period-specific transportation model trip origin data by TAZ. Since no TRANPLAN trip data by TAZ were available for the 1996 base year, 1996 start emissions were spatially allocated using 2000 TransCAD trip data.

3.2.1.1. Base Year Estimates

Section 2.2 of Appendix A describes the methodology to develop on-road mobile emissions in detail. Total on-road mobile source emissions consist of link-level running exhaust emissions, start emissions, and emissions from intrazonal trips. The following subsections briefly summarize how these emissions were estimated.

3.2.1.1.1. MOBILE6 Modeling

Two sets of MOBILE6 runs were performed. The first used start distribution emission factors applied to the entire domain, with the exception of a small area along South Las Vegas Boulevard. To better understand specific weekday start emission factors along the boulevard, a second set of MOBILE6 runs was conducted. Start activity in this region is not typical of commute activity profiles, since trips start in casino/resort parking lots rather than in residential areas. Based on the two runs, it was decided to apply the modified start distribution for the fraction of the 2000 TransCAD origin trips that occur in the TAZs along South Las Vegas Boulevard for the base year and all future years. Figure 2-2 in Appendix A shows the results of these runs.

The effectiveness of the Clark County I/M program was set to 100 percent in the MOBILE6 emission runs. Appendix C justifies this assumption.

3.2.1.1.2. Link-Level Running Exhaust Emissions

The 1996 TRANPLAN activity data were adjusted for season, day, hour, and transit activity to provide the data for the link-level emissions. The TRANPLAN link activity data consisted of the annual daily average volume for each link in the network classified by RTC facility type code. Table 3-3 cross-references RTC facility type codes and MOBILE6.2 roadway types.

Table 3-3. Cross-Reference Between RTC and MOBILE6.2 Facility Types

RTC Facility Code	Description	MOBILE6.2 Roadway Type
0	Externals	Freeway
1	System Ramps	Ramp
2	Minor Arterials	Arterial
3	Major Arterials	Arterial
4	Freeway Ramps	Ramp
5	Interstates	Freeway
6	Freeways	Freeway
7	Expressways	Freeway
8	Collectors	Arterial
9	Centroid Connectors[1]	Local
10	Intrazonal	Local

[1]Centroid connectors were treated as local roads; VMT on the centroid connectors was multiplied by MOBILE6 local road emission factors.

Running exhaust emissions for the base year were generated using the Air Improvement Resource, Inc. version of MOBILE6. This version takes the standard MOBILE6 database output and condenses it across model years for each vehicle class.

In summary, the link-level running exhaust emissions processing steps were:

1. Adjust daily volumes to hourly volumes using the profiles in Figure 2-3 of Appendix A.
2. Adjust link speeds using the hourly volume to capacity ratio in the Bureau of Public Roads curve (see Section 2.2.2.3 of Appendix A for details).
3. Calculate the hourly link VMT as the hourly volume multiplied by the link length.
4. Calculate the link emissions as the link VMT multiplied by the MOBILE6.2 composite emission factor for the link roadway type, hour, and adjusted link speed.
5. Spatially allocate the link emissions to the modeling grid.
6. Use EPS3 to adjust emissions to an average December day, to Sunday or Monday, and for transit activity.

Table 3-4 shows the tabulations of 1996 VMT by facility type, as reported by TRANPLAN and after adjustment.

Table 3-4. 1996 VMT by Facility Type

Group Code	Facility Type	Modeled 1996 DVMT	DVMT Adjusted to December	DVMT Adjusted for Transit	Sunday DVMT	Monday DVMT
0	External Connector	640,605	654,058	655,988	507,734	670,419
1	System Ramp	69,247	70,701	70,910	54,884	72,470
2	Minor Arterial	7,469,952	7,626,821	7,649,320	5,920,574	7,817,605
3	Major Arterial	3,655,890	3,732,664	3,743,675	2,897,605	3,826,036
4	Freeway On- or Off-Ramp	267,725	273,348	274,154	212,195	280,185
5	Interstate	3,825,715	3,906,055	3,917,578	3,032,205	4,003,764
6	Freeway	1,202,253	1,227,501	1,231,122	952,888	1,258,207
7	Expressway	214,096	218,592	219,237	169,690	224,060
8	Collector	2,776,772	2,835,084	2,843,448	2,200,828	2,906,003
9	Centroid Connector	2,185,691	2,231,591	2,238,174	1,732,347	2,287,414
	Intrazonal	87,303	89,136	89,399	69,195	91,366
Daily Total[1]		**22,395,251**	**22,776,414**	**22,843,605**	**17,680,950**	**23,346,164**
Transit Adjustment		1.00295				
December Adjustment		1.021				
Sunday Adjustment		0.774				
Monday Adjustment		1.022				

[1]Totals are shown as output by TRANPLAN and after seasonal, day-of-week, and public transit adjustments.

3.2.1.1.3. Base Year Start Emissions

The daily link-level VMT from TRANPLAN was allocated to hourly values using the day-specific hourly VMT profile shown in Figure 2-3 of Appendix A. The base year start emissions were calculated from the product of hourly link VMT and hourly MOBILE6.2 start emission factors. To remain consistent with how future year start emissions would be developed, base year start emissions were translated from link-level to TAZ level. A month/season adjustment factor of 1.021 was applied to the start emissions to adjust from an average annual day to an average December day.

Day-of-week adjustment factors were applied to adjust from an average annual day to Sunday and Monday. The factors used were 0.774 for Sunday and 1.022 for Monday, the same factors used in the 2000 CO SIP. The hourly TAZ start emissions were spatially allocated to the grid cell containing the TAZ centroid and the 24 surrounding cells in a "wedding cake" fashion: the grid cell containing a TAZ centroid received 25 percent of the start emissions from that TAZ, the surrounding 8 grid cells received 60 percent of the start emissions (7.5 percent per cell), and the outside 16 grid cells received 15 percent of the start emissions (0.9375 percent per cell). Both the EPA Region 9 office and the Office of Transportation and Air Quality reviewed this approach (EPA 2005). Figure 2-5 in Appendix A shows the spatial distribution of start exhaust emissions for the 1996 base case.

3.2.1.1.4. Base Year Total Emissions

Table 3-5 lists the component and total on-road mobile source emissions for the 1996 base year. Figure 2-6 of Appendix A presents the spatial distribution of the total on-road mobile source emissions for December 9, 1996.

Table 3-5. Component and Total On-Road Mobile Source CO Emissions (TPD[1]) for the 1996 Base Year

	Links - Running	Starts	Intrazonal	Total
Sunday 12/8	202.75	126.42	0.78	329.95
Monday 12/9	269.31	241.21	1.03	511.55

[1]Tons per day.

3.2.1.2. Future Year Estimates

The RTC provided TransCAD model output for each of the future years (2006, 2010, 2015, 2020, and 2030). The TransCAD model output provided link-level volumes (number of vehicles), along with trip origins and destinations, for the following seven time periods: midnight to 7 a.m., 7 a.m. to 9 a.m., 9 a.m. to 2 p.m., 2 p.m. to 4 p.m., 4 p.m. to 6 p.m., 6 p.m. to 8 p.m., and 8 p.m. to midnight. The following subsections briefly summarize how future year emissions were estimated.

3.2.1.2.1. Future Year MOBILE6 Inputs

Table 2-6 of Appendix A details how external files were used. Eight input files were created for each future year (2006, 2010, 2015, 2020, and 2030), one for weekdays and one for weekends for each of the four roadway types: freeway, arterial, local, and ramp. Values from a 2002 Clark County traffic study yielded VMT for five vehicle types, which were further broken down into sixteen vehicle types based on the MOBILE6 default VMT mix for 2002. Because Clark County does not have future year forecasts for vehicle VMT mix, seasonal/day-of-week adjustments, or hourly activity profiles, the base year information for these variables was used for all future years.

3.2.1.2.2. Link-Level Running Exhaust Emissions

Link volumes were first adjusted to observed traffic counts by facility type, then adjustments were made for month/season and day of the week. TransCAD volume data is for an average weekday, so Sunday activities were adjusted by a 0.774 day-of-week factor. Monday was not adjusted because the TransCAD data represent an average weekday. Hourly and speed adjustments were made as in the base year approach.

3.2.1.2.3. Future Year Start Emissions

Future year start emissions were calculated the same way as base year start emissions. For Monday, the hourly VMT was estimated by disaggregating the period VMT to hourly VMT using the day-specific hourly VMT profile shown in Figure 2-3 of Appendix A. Tables 2-10 through 2-14 of Appendix A show the resulting VMT by facility type for 2006, 2010, 2015, 2020, and 2030. Start emissions were calculated by multiplying the hourly VMT by the hourly MOBILE6 start emission factors.

3.2.1.2.4. Future Year Intrazonal Activity

Intrazonal VMT was calculated assuming a default length of 1 mile for each intrazonal trip, as described in Chapter 5 of the fiscal year 2004-2005 RTP documentation (RTC 2004).

3.2.1.2.5. Future Year Total Emissions

Table 3-6 lists the component and total on-road mobile source emissions for all future years on the second Sunday of December.

Table 3-6. Component and Total On-Road Sunday Mobile Source CO Emissions (TPD) for All Future Years

Sunday	2006	2010	2015	2020	2030
Links - Running	149.64	150.26	137.32	133.15	142.66
Starts	125.10	135.93	138.46	139.23	152.54
Intrazonal	0.57	0.82	0.66	0.71	0.70
Total	**275.30**	**287.01**	**276.44**	**273.09**	**295.90**

Table 3-7 lists the component and total on-road mobile source emissions for all future years on the second Monday of December.

Table 3-7. Component and Total On-Road Monday Mobile Source Co Emissions (TPD) for All Future Years

Monday	2006	2010	2015	2020	2030
Links - Running	204.62	205.29	187.70	182.00	194.67
Starts	235.73	257.33	262.53	264.10	289.81
Intrazonal	0.88	1.33	1.07	1.14	1.13
Total	**441.23**	**463.95**	**451.30**	**447.24**	**485.61**

3.2.2. Non-Road Mobile Emissions

3.2.2.1. Airports

The Las Vegas Valley contains three major civil airports (McCarran International, North Las Vegas, and Henderson) and one large military airport (Nellis Air Force Base). In 1999, Clark County sponsored an Emissions and Dispersion Modeling System (EDMS) project for the three civil airports. The years modeled included the 1996 base year and the future years of 2000, 2010, and 2020. UAM results were added to the EDMS receptor concentrations to provide an estimate of background concentrations. In 2003, Clark County sponsored an updated modeling project for the three civil airports using the latest version of EDMS. On-road mobile sources were estimated using Clark County runs of MOBILE6.2. EDMS was run for 2000, 2005, 2010, 2015, and 2020, but UAM results were not added to the EDMS receptor results. The 1996 base year was not included in this revision because the EDMS contributions to the UAM for the 1996 base year are zero: the 10 EDMS receptors used in this analysis showed that no emissions from McCarran were dispersed and that McCarran was isolated from the main Las Vegas CO cloud that existed well to the north. The revised modeling resulted in predictions above the 8-hour CO standard at several receptors in all years; however, these were located in areas not generally accessible to the public, primarily aircraft docking areas, the aircraft apron, etc. EPA has indicated it will accept the removal of receptors in non-public access areas from consideration, since the sites do not fall under the Clean Air Act definition of "public access."

To properly account for the contributions of airports to the valley-wide distribution of CO during the December 8-9 episode, UAM had to include the updated EDMS airport emissions within the gridded inventory. Airport emissions for 1996 were taken from the original EDMS estimates, and emissions for the 2010, 2015, and 2020 future years were taken from the 2003 updated EDMS estimates. Table 3-8 shows the annual airport emissions. Values for 2006 were interpolated from 2005 and 2010 EDMS estimates; values for 2030 were extrapolated from the rate of growth in the 2015 to 2020 EDMS estimates. The original 2000 CO SIP emission estimates for Nellis Air Force Base were retained in the UAM modeling. All these estimates, in tons per year (TPY), had to be disaggregated to December, Sunday and Monday, and each hour of the day. Clark County provided activity data for the civil airports on which to base the disaggregation from annual to hourly emission rates, listed in Table 3-2 of Appendix A.

Table 3-8. Annual Airport CO Emission Estimates (TPY) for the 1996 Base Year[1] and for Future Years 2010, 2015, and 2020[2] (2006 and 2030 Estimated)

Year	McCarran	Henderson	North Las Vegas
1996	10,022	536	2,727
2006	11,600	646	1,848
2010	13,494	762	1,880
2015	15,482	949	1,924
2020	17,553	1,220	1,971
2030	21,695	1,762	2,063

[1]Ricondo 1999.
[2]Ricondo 2003.

Airport emissions were placed evenly across the grid cells in which the airports reside. Figures 3-1 and 3-2 in Appendix A illustrate details on hourly activity for the three civil airports.

3.2.2.2. Locomotives

In Clark County, only Union Pacific operates locomotives. Two switching facilities are located in the county, the downtown (Civic Center) yard and a yard at the Boulder Junction Wye. Updated railroad emissions for 2001 based on a recent non-road study (MACTEC 2003) were incorporated into this SIP revision. The base year emissions estimates were taken from the 2000 CO SIP. Locomotive emissions from the non-road study included both line haul and switching; for switching, emissions were placed at the same two facilities previously modeled.

The locomotive activity unit most useful for emission evaluation is fuel consumption. Projected fuel consumption from locomotive use is difficult to estimate, especially for a given track segment like the one through Clark County. Fuel consumption depends on factors not restricted exclusively to number of trains, tons of freight, or business indicators because of efficiency improvements to trains or operations.

To project locomotive activity increases due to growth in business, a time series plot of available data on fuel consumption was used. Emission factors were projected using EPA estimates of the effect of fleet turnover. Table 3-3 in Appendix A shows the percent reduction in emissions for line-haul and switching engines. Locomotive emissions for future years were based on projected growth in fuel consumption and reduced by expected emission reductions from new engine controls.

3.2.2.3. Other Non-Road Categories

Equipment emission estimates for non-road categories other than aircraft and locomotives during weekdays and weekends were performed using EPA's NONROAD model. For the Clark County base year inventory, the period type was set to the winter season and emissions were reported as tons per day. Airport ground support equipment was removed from the NONROAD emissions estimates because it was estimated separately using EDMS, as described previously. Recreational marine estimates were also removed because the major water areas in Clark County lie outside the modeling domain. Railroad maintenance emissions for the 1996 base case were extracted from the NONROAD output and processed with locomotive emissions.

Table 3-9 summarizes NONROAD model equipment CO emissions estimates for the base year and all future years evaluated in the 2005 CO SIP modeling. The emissions shown in this table are for the modeling domain only.

Table 3-9. Clark County CO NONROAD Gridded Emission Estimates (TPD)

Second Sunday in December	**Base**	**2006**	**2010**	**2015**	**2020**	**2030**
Recreational	2.47	2.40	2.44	2.52	2.58	2.72
Construction and Mining	17.47	1.28	0.99	0.80	0.68	0.59
Industrial	1.80	1.34	0.95	0.41	0.25	0.24
Lawn and Garden	33.56	32.61	36.28	39.97	43.58	50.70
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	10.82	12.91	14.86	16.98	19.12	23.23
Total	**66.13**	**50.53**	**55.52**	**60.68**	**66.22**	**77.48**
Second Monday in December	**Base**	**2006**	**2010**	**2015**	**2020**	**2030**
Recreational	1.24	1.20	1.22	1.26	1.29	1.36
Construction and Mining	34.94	2.56	1.98	1.60	1.36	1.18
Industrial	3.36	2.54	1.74	0.69	0.46	0.43
Lawn and Garden	42.22	42.24	46.32	51.03	55.66	64.78
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	21.64	25.82	29.72	33.97	38.24	46.45
Total	**103.40**	**74.36**	**80.98**	**88.55**	**97.02**	**114.20**

Sections 3.1.3.2 and 3.1.3.3 of the TSD (Appendix A) provide additional information on base and future year gridding surrogates used for these non-road sources.

3.2.3. Point Sources

This SIP revision used the 1996 base year point source inventory from the original 2000 CO SIP. Clark County provided an updated point source emission inventory for future years that included updated stack parameters and emissions based on potential-to-emit levels for seven specific facilities. UAM future year inventories included potential-to-emit levels plus a 70-TPY buffer for these sources. All future year modeling used the same future year point source data. Tables 3-14 and 3-15 of Appendix A provide future year emissions of these seven facilities and the modeled CO point source emission estimates.

3.2.4. Area Sources

The 1996 base year area source estimates were taken from the 2000 CO SIP with no changes. Base year emissions were projected by growth factors to determine future year emissions for the major area source categories. Table 3-10 summarizes episode-specific area source CO emissions for the base and project years by eleven subcategories. Table 3-2 of the 2000 CO SIP contains information on these subcategories, but only on an average daily CO season emission basis. The data in Table 3-10 are for the peak episode in the 1996 base year, so are not directly comparable.

3.3. TOTAL ANNUAL EMISSIONS

Table 3-11 summarizes the percent contribution to total episodic daily emissions of the four major emission categories for the base year (1996) and a future year (2030), based on the modeling performed in this SIP revision.

Table 3-12 summarizes total daily CO emissions by source category for the 1996 base year and all future years.

Figure 3-1 shows the spatial distribution of total CO emissions for the 1996 base case. Figure 3-2 shows a similar spatial distribution for the 2030 projection year.

Table 3-10. Clark County CO Area Source Gridded Emissions Estimates (TPD) After Season and Day-of-Week Adjustments

Second Sunday in December	Base	2006	2010	2015	2020	2030
Electric Utility Generation	0.558	0.687	0.734	0.787	0.840	0.946
Small Stationary	2.701	3.412	3.680	3.981	4.283	4.885
Boiler Emissions	0.385	0.486	0.524	0.567	0.610	0.696
Industrial Natural Gas	0.148	0.186	0.201	0.218	0.234	0.267
Commercial Natural Gas	0.041	0.051	0.055	0.059	0.063	0.070
Residential Natural Gas	0.308	0.360	0.380	0.398	0.416	0.452
Fireplaces	3.033	4.556	5.233	6.133	7.033	8.832
Brush Fires	1.262	1.896	2.178	2.552	2.927	3.675
Cigarette Smoking	0.044	0.066	0.076	0.089	0.102	0.128
Structural Fires	0.646	0.971	1.115	1.307	1.499	1.882
Vehicular Fires	0.054	0.081	0.093	0.110	0.126	0.158
Total	**9.181**	**12.753**	**14.270**	**16.200**	**18.131**	**21.991**

Table 3-10. Clark County CO Area Source Gridded Emissions Estimates (TPD) After Season and Day-of-Week Adjustments (continued)

Second Monday in December	Base	2006	2010	2015	2020	2030
Electric Utility Generation	0.558	0.687	0.734	0.787	0.840	0.946
Small Stationary	2.701	3.412	3.680	3.981	4.283	4.885
Boiler Emissions	0.385	0.486	0.524	0.567	0.610	0.696
Industrial Natural Gas	0.369	0.466	0.503	0.544	0.585	0.667
Commercial Natural Gas	0.103	0.127	0.138	0.148	0.157	0.176
Residential Natural Gas	0.308	0.360	0.380	0.398	0.416	0.452
Fireplaces	3.033	4.556	5.233	6.133	7.033	8.832
Brush Fires	1.262	1.896	2.178	2.552	2.927	3.675
Cigarette Smoking	0.044	0.066	0.076	0.089	0.102	0.128
Structural Fires	0.646	0.971	1.115	1.307	1.499	1.882
Vehicular Fires	0.054	0.081	0.093	0.110	0.126	0.158
Total	**9.464**	**13.109**	**14.654**	**16.615**	**18.576**	**22.497**

Table 3-11. Percent Daily Emissions by Source Category and Year

Source Category	Base Year – 1996		Future Year - 2030	
	Sunday	Monday	Sunday	Monday
On-Road	74	76	62	68
Non-Road	23	21	30	26
Point	<1	<1	3	3
Area	2	1	4	2

Table 3-12. Summary of Total Daily CO Emissions (TPD) in the UAM CO SIP Revision

Second Sunday in December	**Base**	**2006**	**2010**	**2015**	**2020**	**2030**
On-Road Running (Links)	202.75	149.40	150.18	137.31	133.18	142.80
On-Road Starts	126.42	125.10	135.93	138.46	139.23	152.54
On-Road Intrazonal	0.78	0.57	0.82	0.66	0.71	0.70
Henderson Airport	1.12	1.35	1.59	1.99	2.55	3.69
McCarran Airport	24.69	28.57	33.24	38.14	43.24	53.44
Nellis Air Force Base	2.86	2.86	2.86	2.86	2.86	2.86
North Las Vegas Airport	7.58	5.13	5.22	5.35	5.48	5.73
Area Sources	9.18	12.75	14.27	16.20	18.13	21.99
Non-road - NONROAD	66.13	50.49	55.50	60.66	66.21	77.44
Point Sources	3.13	15.82	15.82	15.82	15.82	15.82
Railway - Line Haul	0.14	0.17	0.19	0.20	0.22	0.27
Railway - Maintenance	0.03	0.04	0.04	0.04	0.05	0.06
Total	**444.81**	**392.49**	**415.73**	**417.71**	**427.65**	**477.19**
Second Monday in December	**Base**	**2006**	**2010**	**2015**	**2020**	**2030**
On-Road Running (Links)	269.31	204.62	205.29	187.70	182.00	194.67
On-Road Starts	241.09	235.73	257.33	262.53	264.10	289.81
On-Road Intrazonal	1.03	0.88	1.33	1.07	1.14	1.13
Henderson Airport	0.88	1.07	1.26	1.57	2.01	2.91
McCarran Airport	24.69	28.57	33.24	38.14	43.24	53.44
Nellis Air Force Base	2.86	2.86	2.86	2.86	2.86	2.86
North Las Vegas Airport	5.98	4.05	4.12	4.22	4.32	4.52
Area Sources	9.46	13.11	14.65	16.62	18.58	22.50
Non-road - NONROAD	103.40	74.30	80.94	88.52	96.99	114.17
Point Sources	3.13	15.82	15.82	15.82	15.82	15.82
Railway - Line Haul	0.14	0.17	0.19	0.20	0.22	0.27
Railway - Maintenance	0.11	0.14	0.15	0.16	0.18	0.21
Total	**662.08**	**581.31**	**617.17**	**619.41**	**631.46**	**702.31**

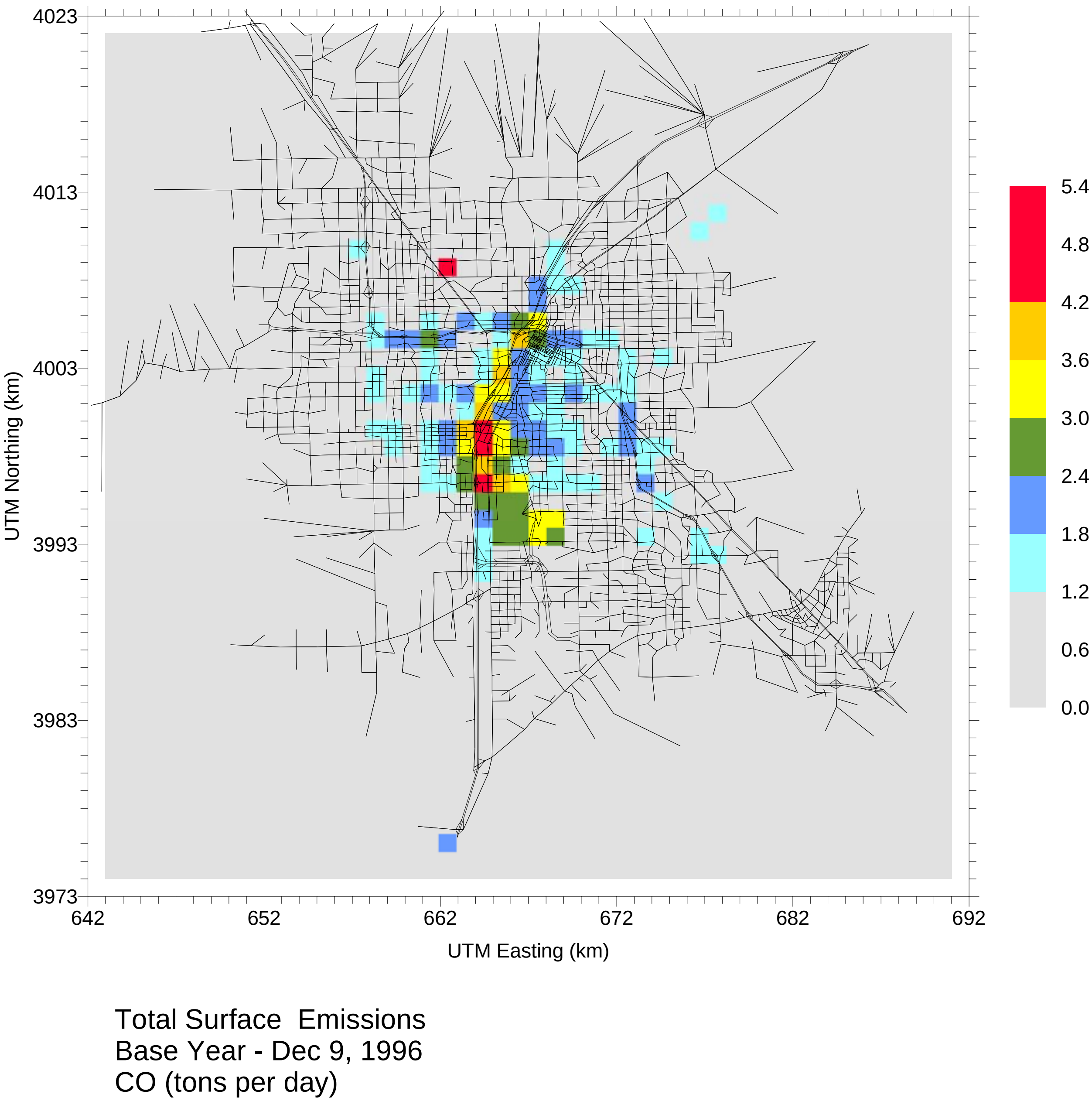

Figure 3-1. Spatial Distribution of Total CO Emissions for the 1996 Base Case.

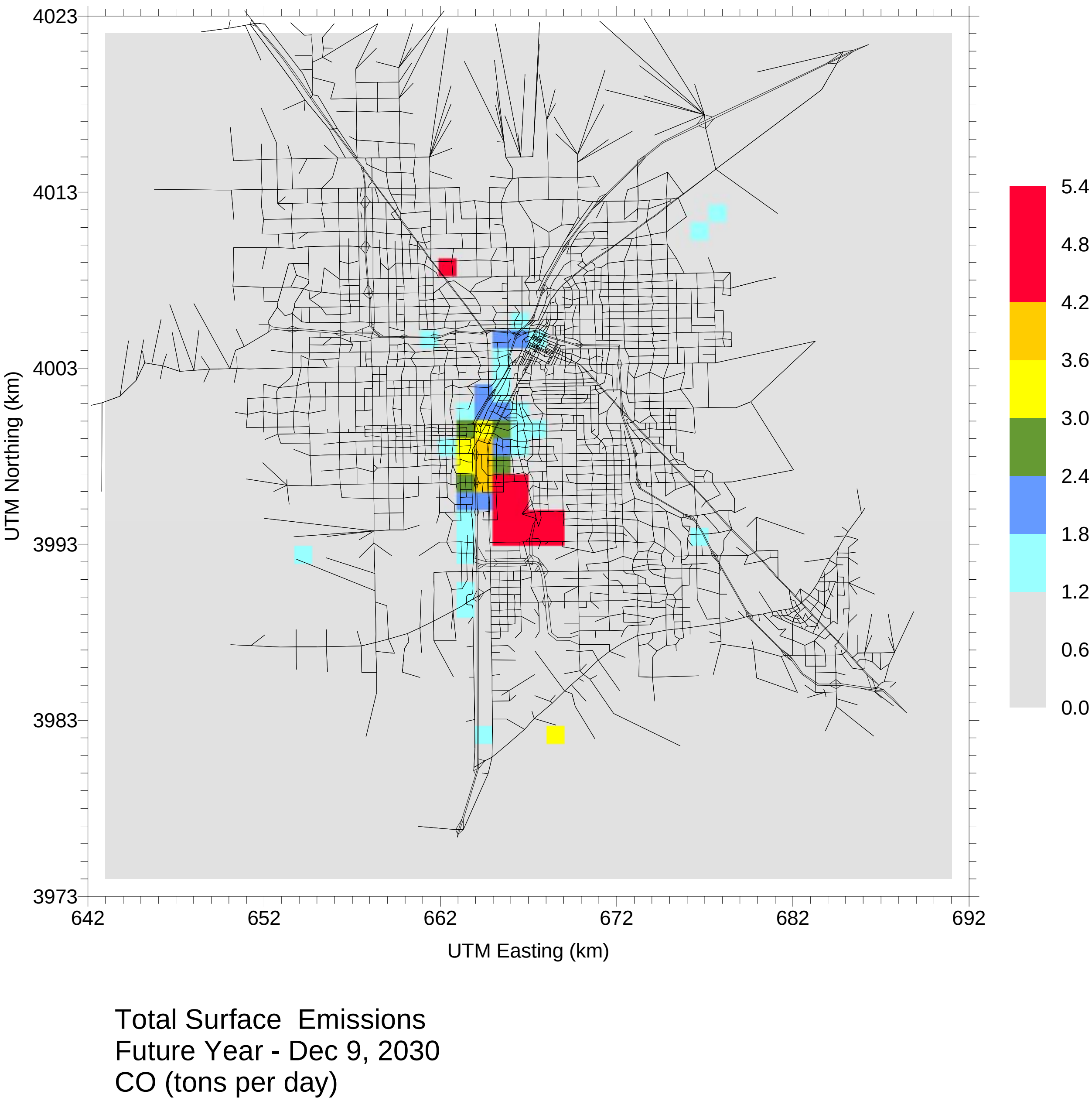

Figure 3-2. Spatial Distribution of Total Surface Gridded CO Emissions for the 2030 Future Year.

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4. CONTROL MEASURES

4.1. INTRODUCTION

This SIP revision focused on recalculating the emissions for on-road and non-road sources using the newer MOBILE6.2 and NONROAD2004 models, respectively, and then running the UAM to determine if the Las Vegas Valley will continue to maintain the CO standards through 2030. The results, as Sections 5 and 6 describe in detail, confirm continued maintenance. Accordingly, no new control measures are required in this SIP revision, so this section primarily references relevant portions of Section 4 of the 2000 CO SIP with some summary information. The impacts of the four CO control measures in the 2000 CO SIP were not recalculated in this revision.

The 2000 CO SIP noted that about 86 percent of the CO emissions in the Las Vegas Valley in 1996 were produced by on-road motor vehicles. Non-road mobile sources contributed about 11 percent, and stationary point and area sources accounted for the remaining 3 percent. The proportions have changed slightly in this SIP revision due to the new models employed and a focus on emissions for a December Sunday-Monday peak episode rather than on average seasonal CO emissions. The 1996 base year proportions under the new modeling analysis are about 75 percent from on-road sources, 22 percent from non-road mobile sources, and the remaining 3 percent from stationary area and point sources. On-road source proportions are less in 2030 due to improved vehicle emission controls: they only make up about 65 percent of CO emissions. Non-road emissions increase to 28 percent, point sources to 3 percent, and area sources to about 4 percent. These data can be examined in detail in Tables 3-11 and 3-12.

In developing the 2000 CO SIP, Clark County examined the potential for additional control measures on each of the four major source categories. After reviewing the impacts on CO attainment from each category and the additional measures available to further reduce CO, the county decided to focus new control measures on the major on-road category of the emissions inventory. Four new control measures were adopted and implemented. Several additional CO control measures adopted in the 1967 to 1995 time frame continue to support achievement of the CO standards.

4.2. CARBON MONOXIDE CONTROL MEASURES

Regulations and resolutions in support of the control measures necessary for CO attainment were adopted prior to submittal of the 2000 CO SIP and became effective at the end of 1999. Control measures and programs from previous plans, listed in Tables 4-1 and 4-2, served as the foundation to which the four new measures were added to achieve attainment of the standard. When fully implemented, the four control measures proposed in the 2000 CO SIP, along with all the control measures previously implemented, reduced CO emissions from on-road motor vehicles by over 22 percent between 1996 and 2000. These measures were a major reason Clark County could offset extraordinary population growth and vehicle usage during the 1990s and attain the standards by 2001. Section 4.2.1 of the 2000 CO SIP describes in detail the four on-road mobile source control measures. Since the control measures have not changed and 2000 emission reductions remain as projected by MOBILE5b, Table 4-1 simply summarizes the control measures. Descriptions of the control measures, legislative history, and acceptance criteria are provided in Chapter 4 of the 2000 CO SIP.

Table 4-1. Adopted CO Control Measures to Reduce On-Road Mobile Source Emissions

Control Measure	Year 2000 Emission Reduction %	Daily CO Benefit (TPD)	Adoption Date	Implementing Agency
Cleaner Burning Gasoline Program	9.80%	31.9	1999	DAQEM
Voluntary TDM and Transportation Control Measures	0.08%	0.3	1999/On-going	RTC
I/M Technician Training	2.95%	10.4	1996 (enhanced)	NV Department of Motor Vehicles & Public Safety
Alternative Fuels for Government Fleets	0.12%	0.4	1995-2001	NV Division of Environmental Protection
Combined Effect of Controls	**12.2%**	**43.1**		

None of the four control measures were rerun individually as part of the MOBILE6.2 analysis. It was unnecessary because the measures have been approved and adopted as part of the 2000 CO SIP, and UAM runs for maximum CO levels using MOBILE6.2 do not show any violations through 2030.

Section 4.3 of the 2000 CO SIP describes controls on off-road mobile sources. It identifies the only direct proactive controls affecting off-road sources, mobile and otherwise, as the Wintertime Cleaner Burning Gasoline and Oxygenated Fuel programs. Since this category contributes only about 11 percent of the total CO emissions for the Las Vegas Valley, the 2000 SIP determined that further controlling these emissions would not be cost-effective or practical.

Section 4.4 of the 2000 CO SIP notes that only 3 percent of CO emissions in the area come from stationary point and area sources. Except for permit-related controls resulting from New Source Review and New Source Performance standards, no new controls on point and area sources were included in the 2000 CO SIP or in this SIP revision.

Section 4.5 of the 2000 CO SIP discusses previously adopted control measures from the 1995 CO SIP and how they continue to assist in air quality improvement efforts. Fleet turnover, partly from high annual increases in vehicle registrations and new model year vehicles, continues to be a major factor in reducing mobile source CO emissions. In 1997, Clark County increased the oxygenated fuels weight control regulation from the 2.7 percent credited in the 1995 CO SIP to 3.5 percent. The I/M program for motor vehicles, in effect since 1978, continues to provide a major reduction in CO emissions. As Appendix C points out, the Nevada Legislature modified that program slightly in 2005. Table 4-2 lists previously adopted and enforceable CO control measures.

Table 4-2. Control Measures Adopted for the 1995 CO SIP and Included as Part of the 2000 CO SIP and 2005 CO SIP Revision

Control Measure	Adoption Date
Oxygenated Fuels	1991/1995
Reduced RVP Gasoline	1995
Motor Vehicle I/M Program	1978
Fleet Turnover	1967

In summary, the primary control measures in the 1995 and 2000 CO SIPs have been adopted and implemented. This 2005 CO SIP revision suggests no new measures, since the area attained the CO standards and EPA approved the 2000 CO SIP. Furthermore, the modeling conducted as part of this revision demonstrates continued attainment of CO standards through at least 2030.

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5. BASE CASE MODELING

5.1. INTRODUCTION

This section summarizes the modeling performed to establish that current CO emission inventory projections result in continued maintenance of the 8-hour average NAAQS for CO in the Las Vegas nonattainment area. Appendix A provides detailed technical documentation of the models used for this 2005 CO SIP revision.

The CAAA requires that serious CO nonattainment areas like the Las Vegas Valley use EPA-approved models to demonstrate attainment. The current models of choice for CO attainment demonstrations are (1) the UAM, an urban-scale, three-dimensional, grid-type, numerical simulation model; and (2) CAL3QHC, a microscale roadway intersection (i.e., "hot spot") plume model. Since EPA has identified the UAM and CAL3QHC as effective tools for evaluating emission control programs, they were selected to demonstrate attainment in the 2000 CO SIP.

DAQEM updated its UAM CO modeling for this 2005 CO SIP revision using the latest tools, data resources, and methodologies available. It based the revised models on the modeling data sets developed in the 2000 CO SIP for the December 8-9, 1996 historical event. Section 3 describes specific updates to the emissions inventories, which include modifications to on-road mobile sources, non-road mobile sources, civil airports, railroads, and point sources. Emissions estimates for all remaining categories (mainly area sources and Nellis Air Force Base) were taken from the previous modeling detailed in the 2000 CO SIP, although new spatial distributions were developed for area sources from updated land use projections.

5.2. BASE CASE SCENARIO MODELING

The December 1996 base case in the 2000 CO SIP included in its emissions inventory the existing I/M program, the 3.5 percent oxygenated fuel program, low RVP gasoline (9 pounds per square inch), and other control measures in place or mandated by the CAAA. For the 2005 CO SIP revision base case, the UAM was used to simulate the emission and transport of CO throughout the Las Vegas Valley during the night of December 8-9, 1996 (Sunday-Monday). Specifically, the UAM was run from 1500 local standard time on December 8 to 1100 local standard time on December 9 to cover the coldest, most stagnant and stable portion of the episode during which CO was observed to build up. Two base case simulations were run:

A. With revised on-road emission estimates, keeping all the point, area, and non-road emissions the same as the 2000 CO SIP model (see Section 4.1.1 of the TSD).

B. With both revised on-road and non-road emission estimates, keeping all point and area emissions the same as the 2000 CO SIP model (see Section 4.1.2 of the TSD).

In both cases, estimated 1996 airport emissions from Ricondo (1999) were included in the emissions inventory.

Figure 5-1 shows the UAM-predicted episode maximum 8-hour CO concentrations (in ppm) from the base case simulation using the revised on-road and non-road emissions summarized in Section 3 and documented in Sections 2 and 3 of the TSD (Appendix A). The two distinct areas of CO maxima in the simulation are located near where U.S. Highway 95 makes a sharp turn southward in northeast Las Vegas (called the "elbow") and along South Las Vegas Boulevard near the Spring Mountain Road intersection. The peak in the domain is 11.4 ppm along South Las Vegas Boulevard. According to the RTC TransCAD model, this is due to the high concentration of parking structures in the area. The secondary maximum reaches more than 9 ppm along U.S. 95 during the morning commute hours on Monday, December 9. Overall, the spatial pattern of predicted 8-hour maximum CO agrees with the previous modeling in the 2000 CO SIP and with the distribution of observed CO for this period. Unlike the modeling documented in the 2000 CO SIP, no external scaling was applied to the UAM results in these revised runs.

Modeling for the on-road and non-road revisions was performed using standard and EPA criteria model performance statistics; Table 5-1 shows the statistics used for this simulation. The statistics are based on pairings of 8-hour CO predictions and observations across all available monitoring sites for the period, which include standard EPA-method monitoring conducted by Clark County and special saturation monitoring performed for the Las Vegas Phase II field monitoring study. The saturation study was conducted during the winter of 1996-97 and supplemented the 14 existing CO sites in the county. These statistics show that UAM performance is quite good and should be considered acceptable.

Table 5-1. Summary Performance Statistics for the December 8-9, 1996 Base Case with Updated On-Road and Non-Road Mobile Source Emissions

Peak 8-hour Observation	9.6 ppm, Marnel Field
Unpaired Peak	11.4 ppm
Paired Peak	8.1 ppm
Statistical Measures	
Unpaired Peak Accuracy	**19%**[1]
Paired Peak Accuracy	-15%
Peak Timing Error	1 hr
Average Peak Bias > 5 ppm	-3%
Average Peak Error > 5 ppm	**13%**
Average Peak Timing Bias > 5 ppm	2 hr
Average Peak Timing Error > 5 ppm	**2 hr**
Overall Bias > 5 ppm	-6%
Overall Error > 5 ppm	15%
[1]Bold/colored metrics denote EPA criteria statistics. Blue indicates a number within the acceptance criteria and red indicates a number outside the acceptance criteria.	

Figure 4-6 of Appendix A shows a time series of observed and predicted hourly CO concentrations at each of the 28 available monitoring sites during the 1996-97 study period.

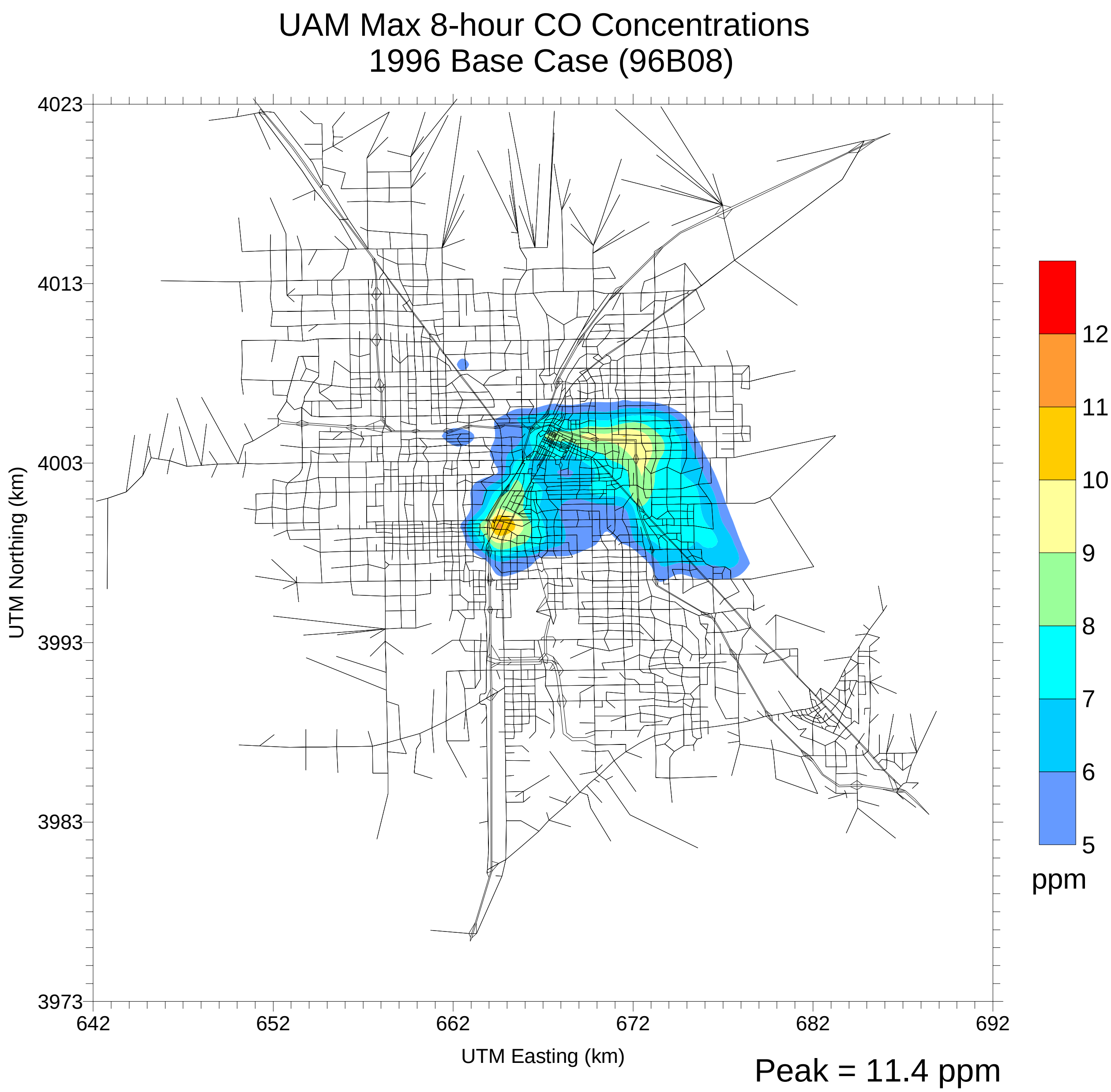

Figure 5-1. Spatial Distribution of UAM Predicted 8-Hour Maximum CO Concentrations (ppm) for the December 8-9, 1996 Base Case with Updated On-Road and Non-Road Mobile Emissions.

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6. DEMONSTRATION OF ATTAINMENT

6.1. INTRODUCTION

Air quality modeling is an integral part of the air quality planning process to attain the NAAQS. Section 6 in the 2000 CO SIP summarized the application of the UAM and CAL3QHC models in demonstrating attainment of the CO NAAQS by December 31, 2000. The primary purpose for conducting UAM area-wide and CAL3QHC roadway intersection modeling is to demonstrate the effectiveness of control strategies in attaining the 8-hour average NAAQS for CO. The attainment demonstration consists of four parts:

1. Developing an attainment-year base case emission inventory that reflects the net effect of existing required controls and growth projections for all source categories.
2. Developing future-year emission strategies.
3. Performing attainment year model simulations to assess control strategies.
4. Using results from the UAM and CAL3QHC modeling to demonstrate attainment.

EPA requires the estimated 8-hour average concentrations be below the 9 ppm standard when using the UAM area-wide model to demonstrate attainment. EPA also recommends that the CAL3QHC model be applied to intersections at potential hot-spot locations. The hot-spot modeling analysis combines concentrations from the UAM with those from the CAL3QHC microscale model.

This section outlines the approach taken to incorporate emissions updates into the UAM data set and perform revised UAM urban-scale modeling for the future years of 2006, 2010, 2015, 2020, and 2030. Additionally, EDMS results from the Ricondo (2003) analyses were combined with revised UAM model predictions for the future years of 2006, 2010, 2015, and 2020 to estimate 8-hour CO concentrations for the duration of the episode on and around the three civil airport properties in the valley. The following sections provide details on each of these components.

6.2. URBAN AIRSHED MODEL ATTAINMENT DEMONSTRATION

As described below, the UAM used updated emission inventories for point, on-road mobile, and non-road mobile sources for the December 8-9, 1996 historical CO event. All other environmental parameters were taken from the original modeling documented in the 2000 CO SIP. A similar model performance evaluation was conducted for the base year (Table 5-1). The UAM was then run with the updated future year inventories for 2006, 2010, 2015, 2020, and 2030 to determine peak 8-hour CO levels in the valley using the same December 8-9, 1996 conditions. Figures 6-1 and 6-2 display predicted 8-hour maximum CO concentrations in the modeling domain for the years 2006 and 2030, respectively. Section 4.2 of the TSD (Appendix A) contains similar displays of UAM maximum 8-hour concentrations for future years 2010, 2015, and 2020. UAM predictions show that the 8-hour CO standard of 9 ppm will not be violated anywhere within the domain. As Table 6-1 shows, peak 8-hour CO decreases in each year until 2015 and then begins to increase out to 2030.

Table 6-1. Peak 8-Hour CO Concentrations in Future Years

Year	Peak 8-hour CO
2006	7.4
2010	7.2
2015	6.5
2020	6.7
2030	8.0

Figures 6-1 and 6-2 show that the contribution of McCarran International Airport to local CO concentrations increases steadily during this period due to the projected growth in airport activities reported by Ricondo (2003). In each successive year through 2020, the contribution from on-road mobile sources diminishes and the peak moves from the U.S. 95 "elbow" in northeast Las Vegas to the northern boundary of McCarran along Tropicana Boulevard. As in the 1996 base case, a lower secondary peak occurs in the South Las Vegas Boulevard area near Spring Mountain Road. That area possesses a high concentration of parking structures, which leads to a local maximum in trip starts in the RTC TransCAD model and a local maximum in vehicle start emissions in the modeling emission inventory. This poses the potential for an actual local emissions hot spot in this area, and Clark County undertook a saturation study in 2002 to address this possibility (Appendix B). Although the TransCAD, EPS3, and UAM models show a potential emissions hot spot at Spring Mountain Road and South Las Vegas Boulevard, the 2002 saturation study showed no hot spot at all in that location.

The UAM was then used to undertake several sensitivity tests to refine the estimation of future year on-road mobile CO emission budgets for the central, most urbanized portion of the modeling domain. Table 6-2 defines this central urban subdomain, and Figure 6-3 outlines the subdomain in relation to the total modeling domain.

Table 6-2. Grid Definition of the Central Urban Subdomain

	Column	Row	UTM[1] East	UTM North
Low-Left	11	19	652.000	3991.000
Upper-Right	36	45	678.000	4018.000

[1]Universal Transverse Mercator.

The first analysis tested the assertion that the emissions inventory outside the central urban subdomain has no significant impact on CO concentrations downtown, along South Las Vegas Boulevard, and in traditional hot-spot areas. Emissions in the outer grid area were doubled for each future year, and the UAM was run to show the incremental impact on peak CO concentration. As Table 6-3 demonstrates, peak 8-hour CO concentrations changed by a maximum of only 0.07 ppm. The location of the predicted peak did not change at all.

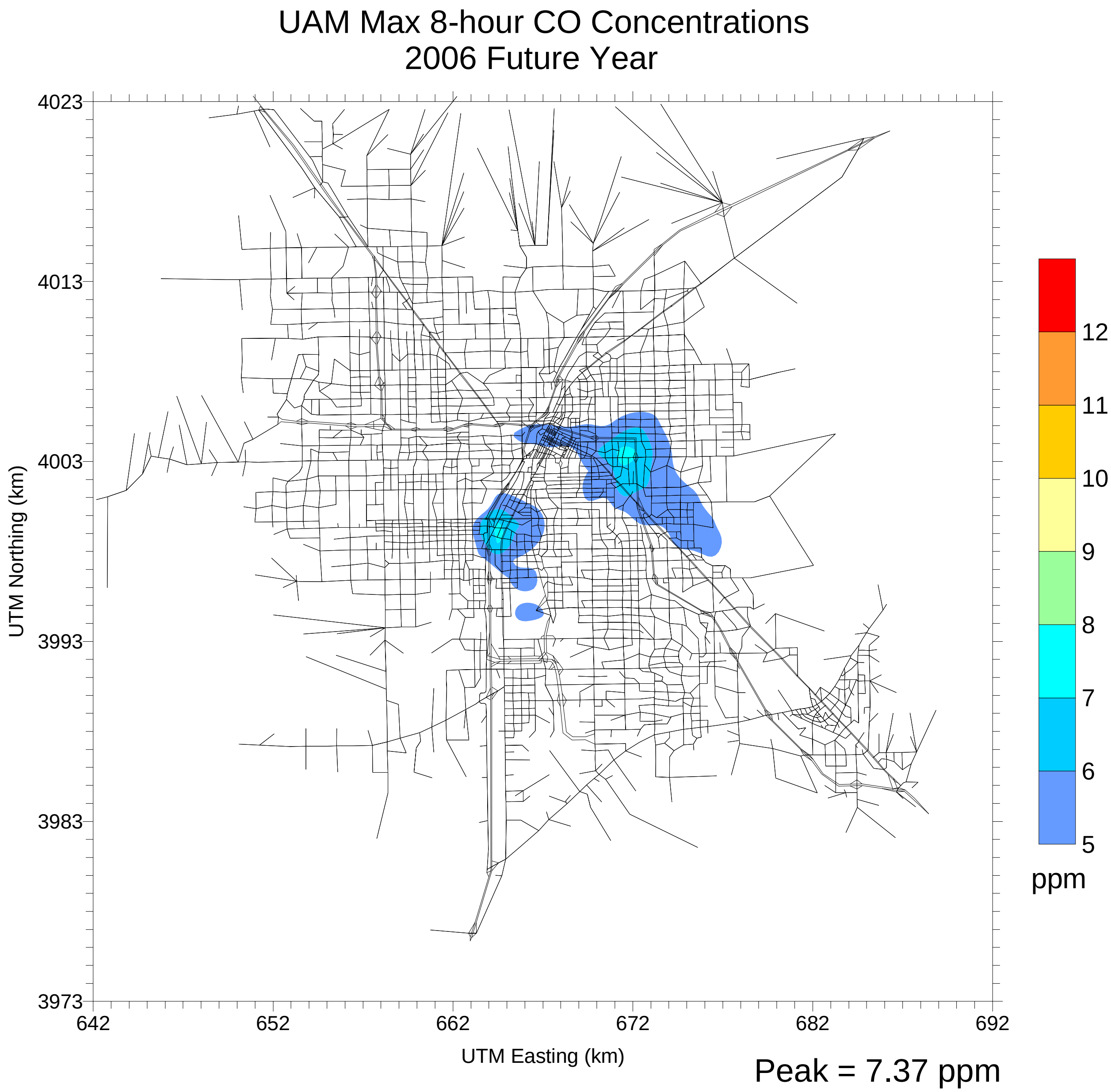

Figure 6-1. Spatial Distribution of UAM-Predicted 8-Hour Maximum CO Concentrations (ppm) for the December 8-9, 1996 Episode Using Emissions Forecasts for 2006.

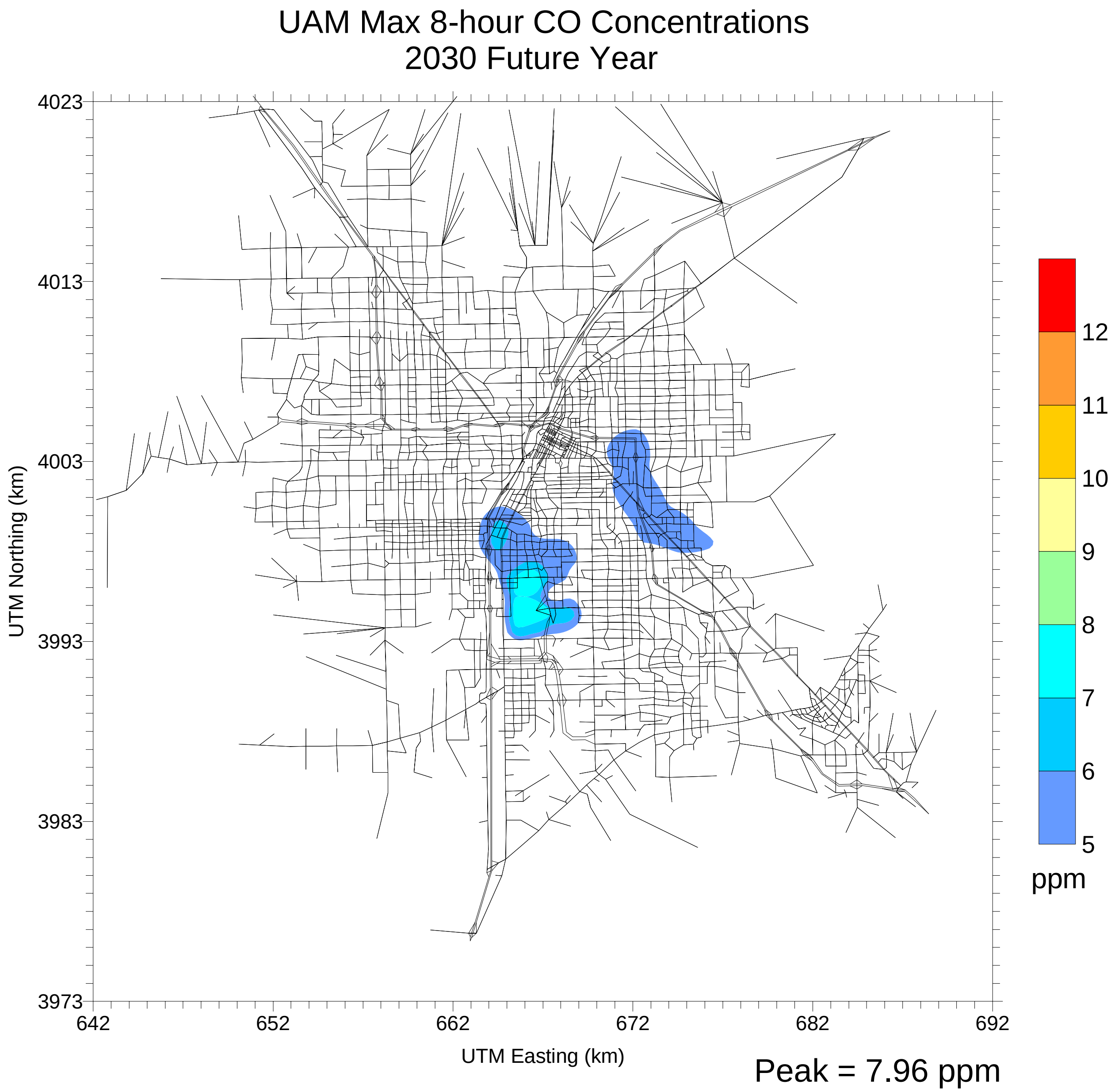

Figure 6-2. Spatial Distribution of UAM-Predicted 8-Hour Maximum CO Concentrations (ppm) for the December 8-9, 1996 Episode Using Emissions Forecasts for 2030.

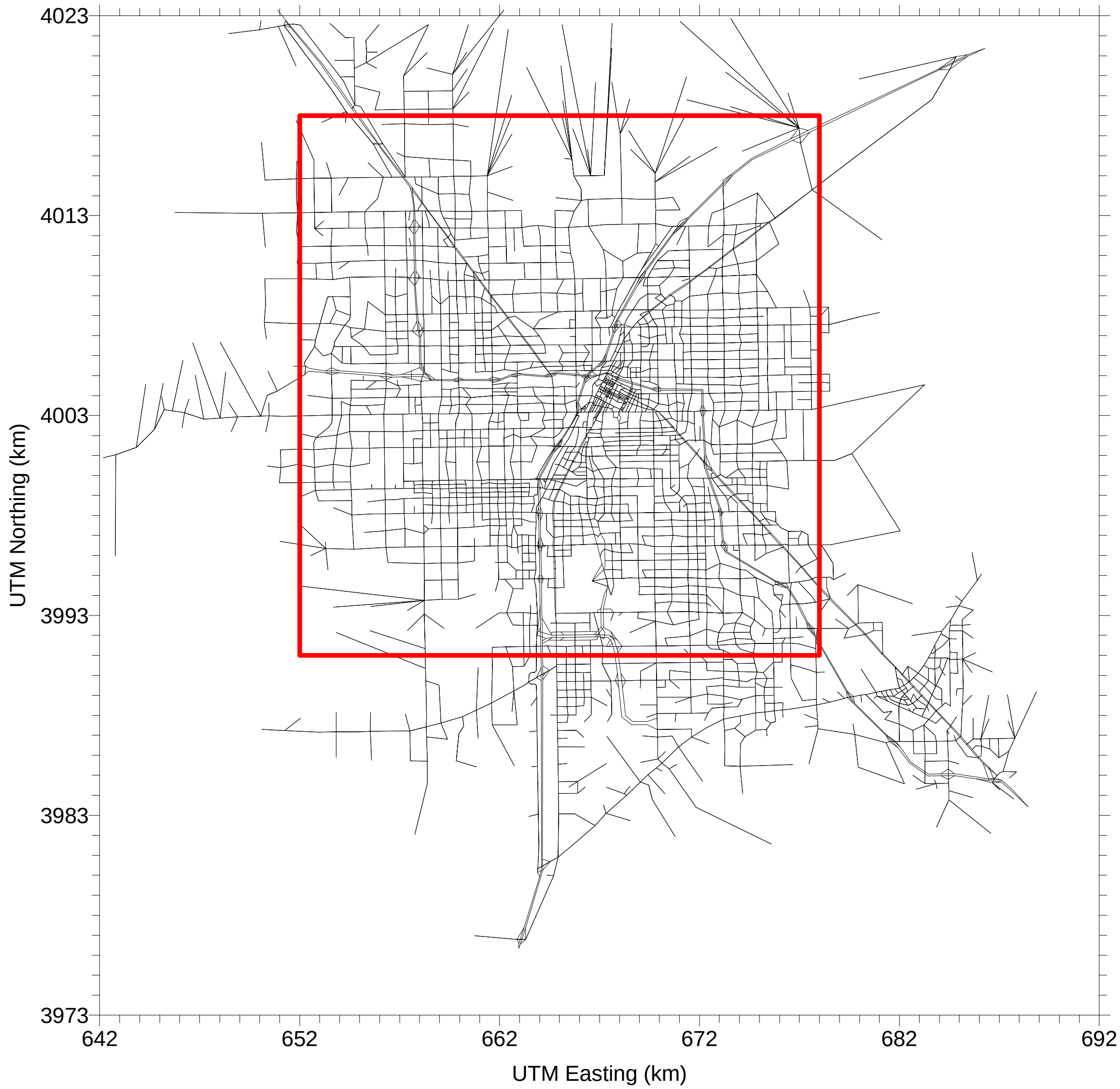

Figure 6-3. Boundaries of the Outer Domain and Subdomains.

Table 6-3 demonstrates that the model-predicted peak CO is driven by local emission sources in the central urban subdomain, and is therefore insensitive to large changes in emissions in outer areas.

Table 6-3. Change in Peak 8-Hour CO from Doubling the Total CO Emissions Inventory Outside the Central Urban Subdomain

Year	Peak 8-hour CO (ppm)	
	From Table 6-1	Doubled Outer Emissions
2006	7.37	7.41
2010	7.17	7.24
2015	6.47	6.54
2020	6.74	6.80
2030	7.96	8.03

In the second analysis, future year on-road mobile source emissions were scaled up across the entire modeling domain to the point at which the peak 8-hour CO concentration reached 8.9 ppm. The on-road mobile source emissions outside the central urban subdomain were then increased by an additional 70 percent in each year to reach a maximum peak 8-hour CO concentration of just under 9.0 ppm (Table 6-4). Figures 4-13 through 4-17 of Appendix A show plots of daily maximum CO concentrations for each future year. There was no change in the location of the predicted peak. No additional hot spots were generated anywhere in the domain by increasing the on-road mobile source emissions in the outer portion of the domain by 70 percent.

Table 6-4. Weekday On-Road Emissions Increases, UAM-Predicted Peak CO, and Resulting Emissions Budget for Each Future Year

Year	UAM	Eastern/Charleston		Eastern/Fremont		Fremont/Charleston	
		CAL3QHC	CAL3QHC+UAM	CAL3QHC	CAL3QHC+UAM	CAL3QHC	CAL3QHC+UAM
2006	4.89	1.64	6.14	1.28	5.66	0.71	5.09
2010	4.62	1.33	5.61	1.14	5.32	0.69	4.81
2015	4.19	1.16	4.97	0.96	4.76	0.51	4.31
2020	3.97	1.05	4.67	0.88	4.48	0.49	4.07
2030	4.07	1.03	4.83	0.84	4.58	0.50	4.20

Once EPA approves them, the total domain emissions in Table 6-4 will become the MVEBs the RTC uses in future conformity analyses.

6.3. MICROSCALE MODELING

Future year UAM simulation results provided estimates of background ambient CO levels for microscale modeling of the Five Points area hot spot and the three civil airports in the modeling domain (McCarran, Henderson, and North Las Vegas). UAM concentrations from the appropriate grid cells were simply added to the concentrations predicted at each microscale receptor to obtain a total (background + microscale) CO concentration.

6.3.1. CAL3QHC Intersection Modeling

As previously stated, EPA recommends that a microscale hot-spot analysis be conducted as part of the attainment demonstration. Selection criteria for intersections to be analyzed include high traffic volume, poor levels of service, and close proximity to the monitoring station recording exceedances. The Five Points area, which meets all three criteria, was selected for modeling to meet the microscale and attainment demonstration requirements.

For hot-spot modeling, the CAL3QHC model was used to model three intersections: Charleston and Eastern, Charleston and Fremont, and Eastern and Fremont (Figure 6-4). EPA (1992, 1995) guidance for screening-level modeling of these three intersections was followed. The UAM/CAL3QHC model for the 2000 CO SIP provided the ambient temperature for each hour of the episode, needed to estimate emissions with the MOBILE6.2 model, and the wind speed and direction needed for the CAL3QHC estimates. The CAL3QHC model output was added to the background UAM levels to estimate 8-hour CO concentrations for the duration of the episode.

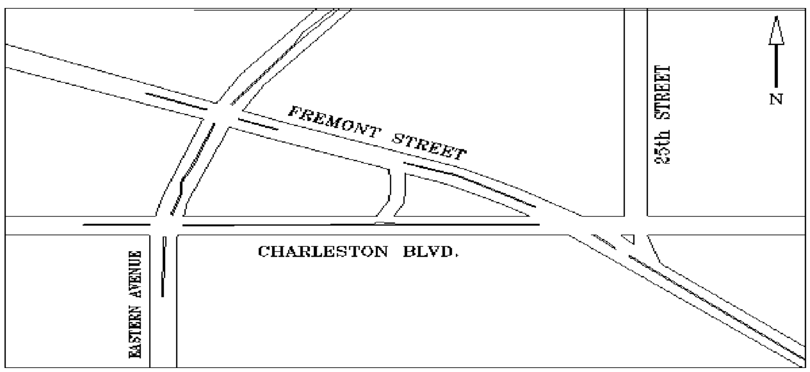

Figure 6-4. CAL3QHC Intersection Location Diagram.

Table 6-5 presents the peak UAM + CAL3QHC 8-hour average CO concentrations predicted in each of the future years for each of the three intersections in the Five Points area. All values are well below the 9 ppm standard.

Table 6-5. Peak UAM + CAL3QHC 8-Hour Average CO Concentrations (ppm) Predicted for Each Future Year and for Each Intersection

Year	Eastern/Charleston	Eastern/Fremont	Fremont/Charleston
2006	7.14	6.65	6.12
2010	6.70	6.43	5.94
2015	6.53	6.30	5.88
2020	6.43	6.23	5.83
2030	6.49	6.22	5.85

6.3.2. Airport Modeling Using the Emissions and Dispersion Modeling System

For microscale airport modeling, the UAM was run for all future years with exactly the same inputs described in Section 4.2 of Appendix A; however, airport emissions for the three civil airports in the domain were removed from the UAM inventory to avoid double counting. Clark County provided EDMS simulations for these airports for 2005, 2010, 2015, and 2020 (Ricondo 2003). All receptors above the 9 ppm standard in all future years evaluated were located within areas that are not publicly accessible, as defined by Ricondo (2005). Disregarding receptors in restricted areas, which EPA has indicated is acceptable, removes all exceedance estimates. Table 6-6 lists the peak total 8-hour CO concentrations at all three civil airports for each future year evaluated. Values for McCarran are taken from the peak publicly accessible receptor. All peak CO concentrations are below the 9 ppm standard in all years.

Table 6-6. Peak Total UAM + EDMS 8-Hour CO Concentrations (ppm) at All Three Airports and for All Three Future Years Evaluated

Airport	2005	2010	2015	2020
McCarran	7.76	7.47	8.09	8.98
Henderson Executive	1.28	1.61	2.74	3.96
North Las Vegas	6.07	6.28	6.14	6.08

[1]Values shown for McCarran occur at the peak publicly accessible receptor.

7. IMPLEMENTATION AND STATE IMPLEMENTATION PLAN COMMITMENTS

The purpose of this 2005 CO SIP revision is to assure the public that implementation of the programs in the 2000 CO SIP and maintenance of the CO health standards will continue through 2030. As noted earlier, EPA has approved the 2000 CO SIP and determined that it attained its goal of achieving the CO NAAQS by the end of 2000. However, with new planning tools and better predictive capabilities (such as MOBILE6) available, Clark County will continue to reanalyze and confirm long-term maintenance of the CO health standards. In addition to the practical aspects of meeting the transportation conformity regulatory requirements for new emission models, this SIP revision also lays the foundation for development of a formal CO maintenance plan and a redesignation request to EPA. The rest of this section describes how the 2000 CO SIP control measures are being implemented and tracked, and how the revised emission budget for mobile sources will provide a basis for the valley to continue to meet federal transportation requirements.

7.1. IMPLEMENTATION, MONITORING, AND REPORTING

Implementation of the control measures specified in Section 4 is necessary for the Las Vegas Valley to continue maintaining the CO NAAQS. The responsibility for implementing these control measures lies with DAQEM, the Nevada Division of Environmental Protection, and the RTC. Each entity has the personnel, funding, and authority to implement its respective part of the proposed primary control measures. Table 4-1 provides the adoption and implementation status of each of the four key on-road mobile source control measures.

In addition to continued implementation of control measures, the 1990 CAAA requires continual air quality monitoring. As Section 2 noted, DAQEM currently has eight monitoring sites to observe CO levels and will notify the state and EPA of any NAAQS violations or exceedances. This coverage is more than adequate for an area and population such as Clark County; EPA requires only three monitoring sites for similar-size areas. This network will continue to operate in accordance with the requirements of 40 CFR 58, and DAQEM will continue to submit quarterly reports to EPA as mandated. DAQEM provided EPA with its 2004 annual NAMS/SLAMS report in May 2005.

7.2. MAINTENANCE

EPA requires that implementation plans also provide for maintaining the standard after attainment. Since Clark County has now reached attainment, and the primary source of CO is the on-road mobile sources category, VMT projections for a 30-year horizon past the demonstration date have been forecast. Since additional modeling will likely be required for maintenance plan submittals from areas seeking redesignation, this 2005 CO SIP revision updated the mobile emission model analysis to provide a basis for development of a formal CO maintenance plan and a redesignation request in the near future. The Las Vegas Valley air quality implementation plan will remain in effect until superseded by an approved CO maintenance plan.

7.3. MOBILE SOURCE EMISSIONS BUDGET

Under Section 176(c) of the Clean Air Act, transportation plans, programs, and projects in maintenance areas that are funded or approved under Title 23 of the U.S. Code or the Federal Transit Act must conform to the on-road MVEBs specified in the applicable SIP. 40 CFR 93.118 provides the criteria and procedures for MVEBs.

The MVEB establishes a cap on motor vehicle-related emissions that cannot be exceeded by predicted transportation system emissions. The emissions budget applies as a ceiling on emissions in the year for which it is defined and for all subsequent years until a different budget is defined for another year or a SIP revision modifies the budget. Without a clearly indicated intent otherwise expressed in the SIP, the estimate of future transportation network emissions used in the milestone or attainment demonstration acts as the MVEB.

The emissions analysis for conformity determinations must include emissions from the entire transportation network within the nonattainment area. In the case of Las Vegas, the nonattainment area encompasses both the air quality modeling domain and the transportation planning domain.

The decision on what years to propose for the CO MVEB is a joint policy call between various stakeholders, state and federal transportation agencies, and state and local air quality agencies. One choice is to identify motor vehicle emissions in the year of the next conformity finding (2006) and maintain the budget for all subsequent analysis years (i.e., the interim year conformity analyses, the horizon year, and all years beyond the horizon year). In the case of Las Vegas, that would mean a total domain budget of 623 TPD in the initial 2006-2009 time frame.

Table 7-1 reflects the calculated MVEBs based on MOBILE6.2 in this 2005 CO SIP revision. Section 6 and Appendix A of this SIP revision provide specific information on how these multiyear budget values were derived; DAQEM determined that it would be more accurate to establish multiyear budgets for modeling. The MVEBs in Table 7-1 are the budgets Clark County proposes for EPA approval and, subsequently, for RTC use in making conformity determinations for the next RTP.

Table 7-1. 2006 – 2020 MVEB in the Las Vegas Valley

Years	Peak 8-hr CO (ppm)	MVEB (TPD)
2006-2009	8.96	623
2010-2014	8.98	690
2015-2019	8.98	768
2020+	8.97	817

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