

2002 Periodic Emissions Inventory
for
Carbon Monoxide

for the
Maricopa County, Arizona, Nonattainment Area

June 2004

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1. Introduction

1.1 Overview

This 2002 periodic carbon monoxide (CO) emissions inventory was developed to meet requirements set forth in Title I of the Clean Air Act Amendments of 1990 (CAAA). The CAAA require development of a baseline emission inventory and periodic revisions for areas that fail to meet the National Ambient Air Quality Standards (NAAQS). A portion of Maricopa County is classified as serious nonattainment for carbon monoxide.

This inventory includes emission estimates for carbon monoxide (CO) from point, area, nonroad mobile, and onroad mobile sources. Note that totals shown in all tables may not equal the sum of individual values due to independent rounding.

1.2 Agencies responsible for the emissions inventory

Maricopa County Environmental Services Department (MCESD) has primary responsibility for preparing and submitting the 2002 Periodic Ozone Emissions Inventory for Maricopa County. Stationary point, area, and nonroad mobile source emission estimates for aircraft and locomotives were prepared by MCESD. The remaining nonroad mobile emission estimates were developed by ENVIRON International Corporation (Environ *et al.*, 2003), with additional work conducted by MCESD to develop estimates for the nonattainment area and a typical season day. The Maricopa Association of Governments (MAG) prepared the onroad mobile emissions estimates. Quality assurance and quality control (QA/QC) activities are described in each chapter. The persons responsible for inventory preparation and QA/QC activities for each chapter are listed in Table 1.2-1.

Table 1.2-1. Chapter authors and QA/QC contacts.

Chapter	Author(s)	QA/QC contact persons
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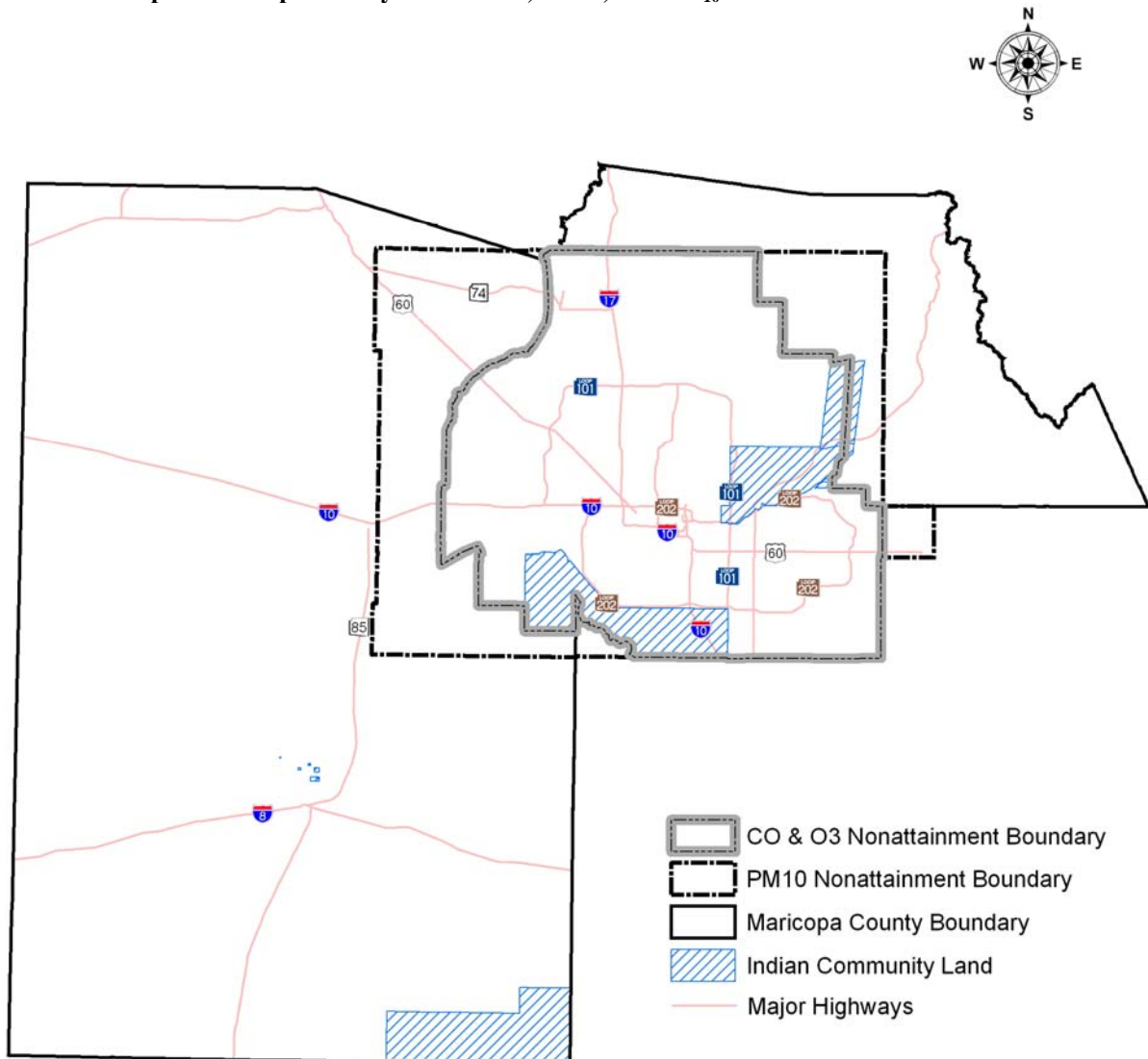
1.3 Temporal scope

Annual and CO season-day emissions were estimated for the year 2002, for Maricopa County and the Maricopa County CO nonattainment area (NAA). The three-month peak CO season for Maricopa County is defined as November through January. The CO season is based on CO exceedances from 1988 through 1991 and is consistent with the CO season in the 1990 base year inventory.

1.4 Geographic scope

This inventory includes emission estimates for Maricopa County and for the Maricopa County CO nonattainment area. Maricopa County encompasses approximately 9,223 square miles of land area, while the Maricopa County CO nonattainment area is approximately 1,946 square miles or approximately 21 percent of the Maricopa County land area. A map of Maricopa County and the CO nonattainment area is provided in Figure 1.4-1.

Figure 1.4-1. Map of Maricopa County and the CO, ozone, and PM₁₀ nonattainment areas.



1.5 Overview of local demographic and land-use data

Many of the emissions estimates generated in this report were calculated using demographic and land-use data provided by the Maricopa Association of Governments (MAG). These data were used to apportion and/or scale Maricopa County emissions estimates to the nonattainment area and vice versa. (For example, county-level emissions from residential natural gas usage in Maricopa County was apportioned to the nonattainment area using the ratio of occupied households in each area). Detailed explanations of how emission estimates were apportioned or scaled are presented in each of the following chapters, along with the data sources used.

1.5.1 Demographic data

The demographic data provided by MAG included population, housing and employment data for calendar year 2002, for Maricopa County and the nonattainment area. Table 1.5-1 provides an overview of the demographic data used in this report.

Table 1.5–1. Demographic profile of Maricopa County and the CO nonattainment area.

Demographic variable	Maricopa County	Within CO NAA	Percent within CO NAA
Total resident population	3,296,250	3,232,387	98.06%
Total non-resident population	253,443	249,420	98.41%
Total population:	3,549,693	3,481,807	98.09%
Occupied resident housing units	1,215,173	1,192,680	98.15%
Total non-resident households	146,664	144,419	98.47%
Total occupied households:	1,361,837	1,337,099	98.18%
Retail employment	438,674	431,973	98.47%
Office employment	392,383	390,375	99.49%
Industrial employment	383,938	376,610	98.09%
Public employment	221,676	213,061	96.11%
Other employment	232,614	227,953	98.00%
Total employment:	1,669,285	1,639,972	98.24%

1.5.2 Land-use data

The most recent land-use data available from MAG was for the year 2000. The 2000 land-use data was assumed to be representative of 2002. Table 1.5–2 presents a summary of the land-use categories and acreage used to develop emission estimates for this inventory.

Table 1.5–2. Land-use categories used to apportion emissions.

Description	Acreage in Maricopa County	Acreage within CO NAA	Percent within CO NAA
Active open space (e.g., parks)	127,792	90,038	70.46%
Passive open space (e.g., mountain preserves)	2,057,048	40,846	1.99%
General open space (not elsewhere classified)	849	782	92.16%
Golf courses	22,922	22,231	96.98%
Water	110,940	38,057	34.30%
Agriculture	415,473	185,029	44.53%
Vacant (e.g., developable land)	2,653,351	414,465	15.62%

1.6 Emissions overview by source category

1.6.1 Point sources

The point source category includes those stationary sources that emit a significant amount of pollution into the air such as power plants and large industrial facilities. As Maricopa County has an established annual reporting program for sources with air quality permits, the thresholds for defining a point source are lower than the minimums required by the US EPA. For the purposes of this inventory, a point source is a stationary operation within Maricopa County or within 25 miles of the CO nonattainment area, which in 2002 emitted:

- 25 English (short) tons or more of carbon monoxide (CO); or
- 10 tons or more of volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or
- 5 tons or more of particulate matter less than 10 microns (PM₁₀) or ammonia compounds (NH_x).

Table 1.6–1 summarizes annual and season-day emissions of the chief point source categories. A detailed breakdown of emissions calculations for all point sources is contained in Chapter 2.

Table 1.6–1. Summary of annual and season-day point source emissions, by source category.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Electricity generation	1,058.24	3,484.0	894.61	2,598.0
Commercial/institutional fuel combustion	45.63	329.7	45.63	329.9
Industrial fuel combustion	426.42	2,618.6	401.93	2,472.6
Industrial processes	82.08	565.5	82.07	565.5
Manufacturing processes	146.12	959.9	135.99	882.0
Waste disposal	64.39	343.8	56.41	299.9
All point sources:	1,822.88	8,301.5	1,616.64	7,147.9

1.6.2 Area sources

Area sources are facilities or activities whose individual emissions do not qualify them as point sources. Area sources represent numerous facilities or activities that individually release small amounts of a given pollutant, but collectively they can release significant amounts of a pollutant. Stationary sources with annual emissions lower than the point source thresholds described in Section 1.6.1 were included in the area source inventory. Examples of area source categories include residential wood burning, commercial cooking, waste incineration, and wildfires.

Table 1.6–2 summarizes annual and season-day emissions of the chief area source categories, for both Maricopa County and the CO nonattainment area. A detailed breakdown of emissions calculations for each area source category is contained in Chapter 3.

Table 1.6–2. Summary of annual and season-day area source emissions, by source category.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Fuel combustion	4,817.71	66,584.1	4,730.96	65,380.8
Industrial processes	412.98	2,398.4	407.74	2,369.6
Waste treatment/disposal	616.30	3,794.2	159.71	723.5
Miscellaneous area sources	2,976.99	2,537.6	243.43	1,472.8
All area sources:	8,823.98	75,314.2	5,541.86	69,946.8

1.6.3 Nonroad mobile sources

Nonroad mobile sources include off-highway vehicles and engines that move or are moved within a 12-month period. Table 1.6–3 summarizes annual and season-day emissions from nonroad mobile sources, for both Maricopa County and the CO nonattainment area. A detailed breakdown of emissions calculations for each source category is contained in Chapter 4.

Table 1.6–3. Summary of annual and season-day CO emissions from nonroad mobile sources.

Equipment category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Agricultural	632.96	861.9	281.86	383.8
Airport ground support equipment	3,471.09	19,071.9	3,384.31	18,595.1
Commercial	45,797.55	244,320.3	44,922.82	239,653.8
Construction & mining	15,584.58	70,666.5	15,286.91	69,316.8
Industrial	15,135.47	89,552.2	14,846.38	87,841.8
Lawn & garden	77,273.13	111,110.3	75,866.76	109,088.1
Logging	136.54	744.7	133.93	730.5
Pleasure craft	1,423.91	4,272.3	488.40	1,465.4
Railway maintenance	61.28	371.7	60.11	364.6
Recreational	9,788.20	32,092.5	987.63	3,238.1
Aircraft	10,097.03	55,478.2	9,888.43	54,332.0
Locomotives	344.35	1,886.8	160.78	881.0
All nonroad mobile sources:	179,746.09	630,429.3	166,308.32	585,891.0

1.6.4 Onroad mobile sources

Emission from onroad mobile sources were calculated for the CO nonattainment area located primarily within Maricopa County as well as for Maricopa County as a whole. A detailed breakdown of emissions calculations by vehicle class and roadway type is contained in Chapter 5.

Tables 1.6–4 summarizes annual and season-day emissions from onroad mobile sources for both Maricopa County and the CO nonattainment area.

Table 1.6–4. Annual and season-day emissions from onroad mobile sources in Maricopa County.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	352,821	1,925,867
CO NAA	322,867	1,763,151

1.6.5 Summary of emissions by source category

Figures 1.6–1 and 1.6–2 provide a graphical overview of the relative contributions of the major source categories (point, area, nonroad, and onroad) to CO emissions in the nonattainment area, on an annual and season-day basis, respectively.

Figure 1.6–1. Annual emissions in the CO nonattainment area, by source category (tons/yr).

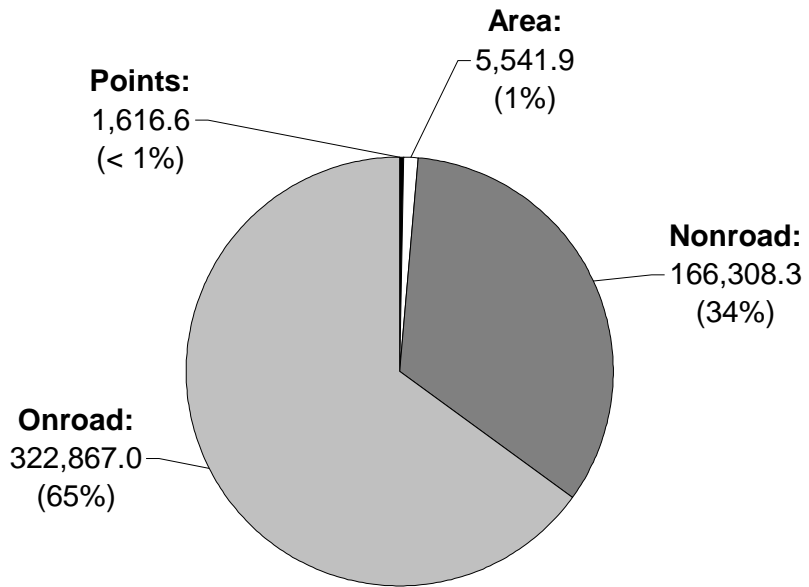
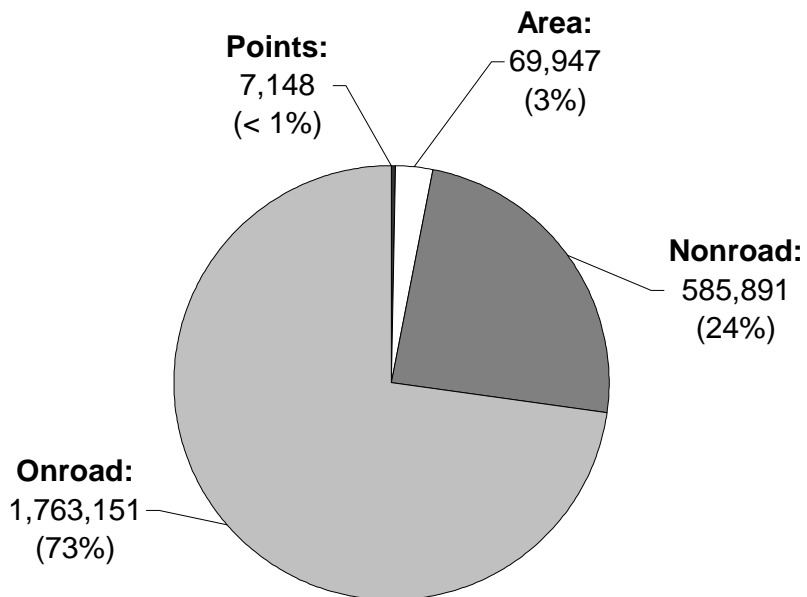


Figure 1.6–2. Season-day emissions in the CO nonattainment area, by source category (lbs/day).



Tables 1.6–5 and 1.6–6 provides a comparison between this inventory and earlier periodic CO emissions inventories for the CO nonattainment area. Note that figures may not be directly comparable as calculation methods, emission factors, and source category definitions (e.g., point vs. area sources) may have changed over time.

Table 1.6–5. Summary of annual CO emissions (tons/yr) in the CO nonattainment area, by source category, 1990–2002.

Source category	Inventory year				
	1990	1993	1996	1999	2002
Points	1,299	874	665	1,753	1,617
Area	13,338	14,231	3,730	5,840	5,542
Nonroad mobile	167,303	166,335	184,220	195,042	166,308
Onroad mobile*	n/a	n/a	n/a	n/a	322,867
Total	181,940	181,440	188,615	202,635	173,467 **

* Prior-year inventories did not include annual totals of onroad mobile emissions.

** Total does not include onroad mobile sources, to allow more direct comparison to prior-year inventories.

Table 1.6–6. Summary of CO season-day emissions (lbs/day) in the CO nonattainment area, by source category, 1990–2002.

Source category	Inventory year				
	1990	1993	1996	1999	2002
Points	17,400	14,800	12,600	18,180	7,148
Area	175,400	186,600	42,000	48,120	69,947
Nonroad mobile	476,000	460,000	904,000	1,147,900	585,891
Onroad mobile	1,615,410	1,220,223	1,120,508	1,080,829	1,763,151
Total	2,284,210	1,881,623	2,079,108	2,295,029	2,426,137

1.7 References

ENVIRON *et al.*, 2003. Maricopa County 2002 Comprehensive Emission Inventory for the Cap and Trade Oversight Committee, Final Rep. prepared for Arizona Dept. of Environmental Quality, October 9, 2003.

2. Point Sources

2.1 Introduction and scope

This carbon monoxide (CO) inventory is one of a number of emission inventory reports being prepared to meet US EPA reporting requirements. In addition to preparing periodic emissions inventories for the CO nonattainment area (NAA) as a commitment under the current CO State Implementation Plan (SIP), the federal Consolidated Emission Reporting Rule (CERR) requires that state and local agencies prepare emissions estimates on a county basis, and submit data electronically to the US EPA for inclusion in the National Emission Inventory (NEI) for 2002. This CO inventory is being developed concurrently with similar inventories for ozone precursors (VOC, NO_x and CO), and PM (including PM₁₀, PM_{2.5}, NO_x, SO_x, and NH₃), as part of Maricopa County's requirements under the respective SIPs.

In order to provide consistency among all these inventories, it was decided to standardize the definition of a “point source”. While the US EPA has defined minimum point source reporting thresholds for various pollutants, EPA guidance also notes that:

... we encourage organizations to provide facility-specific emissions data for all point sources, regardless of size, where they are already included in the S/L/T [state/local/tribal] emission inventory. (US EPA, 2003)

As Maricopa County has an established annual reporting program for sources with air quality permits, the thresholds for defining a point source are lower than the minimums required by EPA. For the purposes of this inventory, a point source is a stationary operation within Maricopa County or within 25 miles of the CO nonattainment area, which in 2002 emitted:

- 25 English (short) tons or more of carbon monoxide (CO); or
- 10 tons or more of volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or
- 5 tons or more of particulate matter less than 10 microns (PM₁₀) or ammonia compounds (NH_x).

While the above approach results in some anomalies (e.g., a facility treated as a point source may have very low, or no, emissions of a certain pollutant), a uniform definition of “point source” ensures that all data sets, which are prepared for a variety of purposes, will be comparable.

This point source inventory includes actual CO emissions for the year 2002 and a typical day during the CO season (defined as November through January). A description and map of the nonattainment area are provided in Chapter 1. Questions concerning point source emissions may be directed to Bob Downing of MCESD at (602) 506-6790.

Several tables have been constructed to provide the point source emissions and category totals. Table 2.2–1 summarizes all point sources by location and permitting authority. Table 2.2–2 provides an alphabetical list of all point sources and their location, while Table 2.3–1 shows the 2002 annual and average CO season-day emissions broken out by facility. Table 2.5–1 lists the 2002 annual and CO season-day emissions broken out by individual process types, and Table

2.6–1 summarizes point source CO emissions by source category. Note that totals shown in all tables may not equal the sum of individual values due to independent rounding.

2.2 Identification of CO point sources

Maricopa County Environmental Services Department (MCESD) identified point sources within Maricopa County through its permit system database and the 2002 annual emissions reports submitted to the department. In addition, the permit system was reviewed to locate new facilities that were not included in the previous emission inventory, and to identify sources that have ceased operations since the 1999 periodic inventory was compiled.

A total of 172 point sources were identified using the emission thresholds described in Section 2.1. Of the 172 stationary point sources, 111 MCSED-permitted sources reported some level of CO emissions – 97 within the CO nonattainment area, and 14 outside the CO NAA. There are 2 additional point sources (Hexcel Corp. and SRP Desert Basin Generating Station) within the 25-mile boundary around the CO nonattainment area, with permits issued by the Pinal County Air Quality Control District (PCAQCD). While the Arizona Department of Environmental Quality (ADEQ) retains permitting authority for a limited number of industrial source categories in Maricopa County, no ADEQ-permitted facilities are considered point sources, and are addressed instead as area sources.

Table 2.2–1. Number of stationary point sources by location and permitting authority.

Location	Total no. of facilities	Facilities reporting CO emissions
Within the CO nonattainment area:		
– Maricopa County-permitted sites	153	97
Outside the CO nonattainment area:		
– Maricopa County-permitted sites	17	14
– Pinal County-permitted sites	2	2
Total outside NAA:	19	16
Grand total:	172	113

Table 2.2–2 contains an alphabetical list of all point sources, including a unique business identification number, NAICS industry classification code, business name (including any changes from the 1999 periodic inventory), and physical address.

Table 2.2–2. Name and location of all point sources.

Within the CO nonattainment area:						
ID #	NAICS	Business name	Address	City	ZIP	
1074	22132	23rd Ave. Wastewater Treatment Plant (formerly <i>City of Phoenix 23rd Ave. WWTP</i>)	2470 S. 22nd Ave.	Phoenix	85009	
1075	22132	91st Ave. Wastewater Treatment Plant	5615 S. 91st Ave.	Tolleson	85353	
245	337122	A. F. Lorts Company Inc.	8120 W. Harrison St.	Tolleson	85353	
1952	811121	Adesa Phoenix LLC	400 N. Beck Ave.	Chandler	85226	
1239	332321	AG Products	2525 W. Broadway Rd..	Phoenix	85041	
35541	33121	Allied Tube & Conduit Corp.	2525 N. 27th Ave.	Phoenix	85009	
199	327332	Ameron Intl. Water Transmission Group (formerly <i>Ameron Pipe</i>)	2325 S. 7th St.	Phoenix	85034	

Table 2.2–2. Name and location of point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
292	325412	Anabolic Laboratories Inc. (formerly <i>Health Factors International Inc.</i>)	429 S. Siesta Ln.	Tempe	85281
3313	221112	APS West Phoenix Power Plant	4606 W. Hadley St.	Phoenix	85043
3938	332812	Arizona Galvanizing Inc.	15775 Elwood St.	Goodyear	85338
4364	61131	Arizona State University	1551 S. Rural Rd.	Tempe	85287
36485	54185	Billboard Poster Company Inc.	3940 W. Montecito Ave.	Phoenix	85019
43124	313230	Bonded Logic Inc.	411 E. Ray Rd.	Chandler	85225
3441	42471	BP West Coast Products LLC	5333 W. Van Buren St.	Phoenix	85043
458	32191	Bryant Industries Inc.	788 W. Illini St.	Phoenix	85041
217	327123	Building Products Co.	4850 W. Buckeye Rd	Phoenix	85043
3442	493190	Caljet (formerly <i>Caljet/Williams</i>)	125 N. 53rd Ave.	Phoenix	85043
60598	337211	Case Furniture & Design LLC	4645 W. Polk St.	Phoenix	85043
1317	321991	Cavco Industries LLC (35th Ave.)	2602 S. 35th Ave.	Phoenix	85009
1318	321991	Cavco Industries LLC (Litchfield Rd.)	1366 S. Litchfield Rd.	Goodyear	85338
1316	321991	Cavco Industries LLC (Durango Plant)	2502 W. Durango St.	Phoenix	85009
4145	61111	Cave Creek School District	33606 N. 60th St.	Cave Creek	85331
1267	32732	Cemex Mesa Plants #61 & #71	1901 N. Alma School Rd.	Mesa	85201
1266	212321	Cemex USA (Phoenix)	11701 W. Indian School	Phoenix	85063
1268	212321	Cemex USA (Sun City)	24004 N. 107th Ave.	Sun City	85373
1310	32311	Century Graphics LLC	2960 Grand Ave.	Phoenix	85017
1426	32311	Cesar Color Inc.	3433 E. Wood St.	Phoenix	85040
4401	32732	Chandler Ready Mix Inc.	6500 N. 115th Ave.	Glendale	85323
51073	52312	Charles Schwab & Co. Inc.	2121 S. Price Rd.	Chandler	85248
3297	42471	Chevron USA Inc.	5110 W. Madison St.	Phoenix	85043
3976	33711	Cholla Custom Cabinets Inc.	1727 E. Deer Valley Dr.	Phoenix	85024
4083	32191	Chris Fischer Productions Inc.	4741 W. Polk St.	Phoenix	85043
399	32739	Coreslab Structures (Ariz) Inc.	5026 S. 43rd Ave.	Phoenix	85041
1198	32311	Courier Graphics Corp.	2621 S. 37th St.	Phoenix	85034
4368	32191	Craftsmen in Wood Mfg.	5441 W. Hadley St.	Phoenix	85043
4023	321918	Creative Shutters Inc.	2009 W. Ironwood Dr.	Phoenix	85021
3744	325991	Desert Sun Fiberglass	21412 N. 14th Ave.	Phoenix	85027
130	331512	Dolphin Inc.	740 S. 59th Ave.	Phoenix	85043
508	337122	Eagle Industries LLC (formerly <i>Samuel Lawrence Furniture Co.</i>)	601 S. 65th Ave.	Phoenix	85043
45493	811121	Earnhardt Ford	7300 W. Orchid Ln.	Chandler	85226
3305	311812	Earthgrains Baking Companies Inc.	738 W. Van Buren St.	Phoenix	85007
26	423810	Empire Machinery Co.	1725 S. Country Club Dr.	Mesa	85210
1505	32191	Executive Door	3939 W. Clarendon Ave.	Phoenix	85019
544	321991	Fleetwood Homes of Arizona Inc. #21	6112 N. 56th Ave.	Glendale	85311
27728	334413	FlipChip International LLC (formerly <i>Flip Chip Technologies</i>)	3701 E. University Dr.	Phoenix	85034
41751	326121	GCR Truck Tire Center	2815 N. 32nd Ave.	Phoenix	85009
4050	311812	General Mills (formerly <i>Pillsbury Bakeries & Food Service</i>)	1120 W. Fairmont Dr.	Tempe	85282
4173	562212	Glendale Municipal Sanitary Landfill	11480 W. Glendale Ave.	Glendale	85301
781	62211	Good Samaritan Regional Medical Ctr.	1111 E. McDowell Rd.	Phoenix	85006
1418	326299	Goodrich Aircraft Interior Products (formerly <i>BF Goodrich Aircraft Evacuation Sys.</i>)	3414 S. 5th St.	Phoenix	85040
36772	212321	GTI Capital Holdings LLC	3636 S. 43rd Ave.	Phoenix	85009
699	212321	Hanson Aggregates of Arizona (Phoenix)	4002 S. 51st Ave.	Phoenix	85043
31565	32614	Henry Products Inc.	302 S. 23rd Ave.	Phoenix	85009
529	32614	Highland Products Inc.	43 N. 48th Ave.	Phoenix	85043
4543	32311	Hogue Printing Inc.	159 W. 1st Ave.	Mesa	85210
3536	311812	Holsum Bakery Inc.	2322 W. Lincoln St.	Phoenix	85009

Table 2.2–2. Name and location of point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
3802	311812	Holsum Bakery Tempe	710 W. Geneva Dr.	Tempe	85252
1059	336412	Honeywell Engines Systems & Service (formerly <i>Honeywell Aerospace Services</i>)	1944 E. Sky Harbor Cir.	Phoenix	85034
355	336412	Honeywell International Inc.	111 S. 34th St.	Phoenix	85034
354	331314	Imsamet of Arizona	3829 S. Estrella Pkwy.	Goodyear	85338
777	32614	Insulfoam	3401 W. Cocopah St.	Phoenix	85009
3966	334413	Intel Corp. Ocotillo Campus (Fab 12 & 22) (formerly <i>Intel Corp. Ocotillo Campus Fab 12</i>)	4500 S. Dobson Rd.	Chandler	85248
983	334419	Isola Laminate Systems Corp.	165 S. Price Rd.	Chandler	85224
3317	221112	Kyrene Generating Station (formerly <i>SRP Kyrene Steam Plant</i>)	7005 S. Kyrene Rd.	Tempe	85283
341	325991	L & M Laminates & Marble	813 E. University Dr.	Phoenix	85034
4182	337122	Legends Furniture Inc.	5555 N. 51st Ave.	Glendale	85301
857	334412	Litton Electro-Optical Systems	1215 S. 52nd St.	Tempe	85281
3300	92811	Luke Air Force Base	14002 W. Marauder St.	Glendale	85309
744	3325	M. E. Global Inc. (formerly <i>M. E. West Castings Inc.</i>)	5857 S. Kyrene Rd.	Tempe	85283
1248	325991	Maax Spas	25605 S. Arizona Ave.	Chandler	85248
31261	21231	Madison Granite Supplies	30600 N. 23rd Ave.	Phoenix	85027
4111	337121	Magic Woods Inc.	4210 N. 39th Ave.	Phoenix	85019
205	322232	Mail-Well Envelope	221 N. 48th Ave.	Phoenix	85043
353	326199	Marlam Industries Inc.	834 E. Hammond Ln.	Phoenix	85034
61268	327390	Master Block Inc.	12620 W. Butler Dr.	El Mirage	85335
62	33711	Mastercraft Cabinets Inc.	305 S. Brooks	Mesa	85202
3326	352991	Mesa Fully Formed Inc.	1111 S. Serrine St.	Mesa	85210
1414	212321	Mesa Materials Inc. (Mesa)	3410 N. Higley Rd.	Mesa	85205
1415	212321	Mesa Materials Inc. (Phoenix)	7845 W. Broadway Rd.	Phoenix	85043
29474	423930	Metal Management Arizona Inc.	3640 S. 35th Ave.	Phoenix	85009
1203	334413	Microchip Technology Inc. (Chandler)	2355 W. Chandler Blvd.	Chandler	85224
1875	334413	Microchip Technology Inc. (Tempe)	1200 S. 52nd St.	Tempe	85281
226	32739	Monier Lifetile LLC	1832 S. 51st Ave.	Phoenix	85043
882	311942	Morton Salt Glendale Facility	13000 W. Glendale Ave.	Glendale	85307
881	334413	Motorola Inc.	1300 N. Alma School Rd.	Chandler	85224
223	333112	MTD Southwest Inc.	550 N. 54th St.	Chandler	85226
693	333415	Munters Corp.	802 S. 59th Ave.	Phoenix	85043
34197	327420	National Gypsum Co.	1414 E. Hadley St.	Phoenix	85034
948	32614	Nesco Manufacturing Inc.	1510 W. Drake Dr.	Tempe	85283
1309	337122	New Directions Inc.	2940 W. Willetta St.	Phoenix	85009
1331	337122	Oak Canyon Manufacturing Inc. (formerly <i>Aspen II</i>)	3021 N. 29th Dr.	Phoenix	85017
3953	33711	Oakcraft Inc.	7733 W. Olive Ave.	Peoria	85345
27925	337122	Oasis Bedroom Co.	2022 N. 22nd Ave.	Phoenix	85009
52382	221112	Ocotillo Power Plant	1500 E. University Dr.	Tempe	85281
3982	32311	O'Neil Printing Inc.	366 N. 2nd Ave.	Phoenix	85003
3970	337122	Pacific Designs	2425 W. Sherman St.	Phoenix	85043
1344	321991	Palm Harbor Homes Inc.	309 S. Perry Ln.	Tempe	85281
733	811412	Pan-Glo West	2401 W. Sherman St.	Phoenix	85009
419	336412	Parker Hannifin GTFSD	7777 N. Glen Harbor Bd.	Glendale	85307
1341	33992	Penn Racquet Sports Inc.	306 S. 45th Ave.	Phoenix	85043
1014	327121	Phoenix Brick Yard	1814 S. 7th Ave.	Phoenix	85007
562	51111	Phoenix Newspapers Inc.	22600 N. 19th Ave.	Phoenix	85027
148	331528	Presto Casting Co.	5440 W. Missouri Ave.	Glendale	85301
60889	326212	Purcell's Western States Tire	420 S. 35th Ave.	Phoenix	85009
1030	32311	Quebecor World Phoenix Division	1850 E. Watkins St.	Phoenix	85034

Table 2.2–2. Name and location of point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
537	327999	Red Mountain Mining Inc.	4250 N. Bush Hwy.	Mesa	85215
1503	321991	Redman Homes Inc.	400 E. Ray Rd.	Chandler	85225
303	332431	Rexam Beverage Can Company	211 N. 51st Ave.	Phoenix	85043
4318	32732	River Ranch Plant	5159 N. El Mirage Rd.	Litchfield Pk	85340
759	32613	Rogers Corp. Advanced Circuit Materials	100 S. Roosevelt Ave.	Chandler	85226
1437	334412	Sanmina Phoenix Division (formerly <i>Hadco Phoenix Inc./Sanmina Phx. Div.</i>)	5020 S. 36th St.	Phoenix	85040
3315	221112	Santan Generating Station (formerly <i>Santan Generating Plant</i>)	1005 S. Val Vista Rd.	Gilbert	85296
266	332312	Schuff Steel Co.	420 S. 19th Ave.	Phoenix	85009
42636	62211	Scottsdale Health Care Hospital	7400 E. Osborn Rd.	Scottsdale	85251
4175	493190	SFPP LP	49 N. 53rd Ave.	Phoenix	85043
70634	42471	Shell Oil Phoenix Terminal (formerly <i>Texaco Phoenix Terminal</i>)	5325 W. Van Buren St.	Phoenix	85043
27933	562212	Skunk Creek Landfill	3165 W. Happy Valley Rd	Phoenix	85027
4471	332311	Skyline Steel Inc.	631 W. Commerce Ave.	Gilbert	85233
31627	115111	South Mountain Gin	6411 S. 51st Ave.	Laveen	85339
3316	221112	SRP Agua Fria	7302 W. Northern Ave.	Glendale	85303
4131	334413	ST Microelectronics	1000 E. Bell Rd.	Phoenix	85022
1444	327123	Staco Architectural Roof Tile	3530 E. Elwood St.	Phoenix	85040
582	337122	Stone Creek Inc.	4221 E. Raymond St.	Phoenix	85040
281	212321	Sun State Rock & Materials	11500 W. Beardsley Rd.	Sun City	85373
101	31161	Sunland Beef Co.	651 S. 91st Ave.	Tolleson	85353
52471	325188	Superior Lime & Chemical	320 S. 27th Ave.	Phoenix	85009
3978	337122	Team Two Design Assoc Inc.	310 S. 43rd Ave.	Phoenix	85009
249	336411	The Boeing Company	5000 E. McDowell Rd.	Mesa	85215
937	336211	The Heil Company	1500 S. 7th St.	Phoenix	85034
232	72111	The Phoenician Resort	6000 E. Camelback Rd.	Scottsdale	85251
1102	325412	The Procter & Gamble Mfg Co.	2050 S. 35th Ave.	Phoenix	85009
552	337122	Thornwood Furniture Mfg.	5125 E. Madison St.	Phoenix	85034
363	337122	Thunderbird Furniture	7501 E. Redfield Rd.	Scottsdale	85260
56	32739	TPAC Division of Kiewit Western Co.	3052 S. 19th Ave.	Phoenix	85009
1210	337122	Trendwood Inc. (15th Ave.)	2402 S. 15th Ave.	Phoenix	85007
1211	337122	Trendwood Inc. (University Dr.)	261 E. University Dr.	Phoenix	85004
819	336399	TRW Vehicle Safety Systems Inc.	11202 E. Germann Rd.	Queen Creek	85242
169	811111	U Haul Intl. Technical Center	11298 S. Priest Dr.	Tempe	85284
1228	325991	Ultra Installations Inc.	245 S. Mulberry	Mesa	85202
234	311514	United Dairymen of Arizona	2008 S. Hardy Dr.	Tempe	85282
260	212321	United Metro Plant #11	3640 S. 19th Ave.	Phoenix	85009
213	212321	United Metro Plant #12	11920 W. Glendale Ave.	Glendale	85307
403	331316	VAW of America	249 S. 51st Ave.	Phoenix	85043
2	32412	Vulcan Materials Co. (El Mirage)	14521 N. 115th Ave.	El Mirage	85335
90	32732	Vulcan Materials Co. (Phoenix)	4830 S. 43rd Ave.	Phoenix	85041
174	325998	W. R. Meadows of Arizona Inc.	2636 S. Sarival Ave.	Goodyear	85338
141	424910	Western Organics Inc.	2807 S. 27th Ave.	Phoenix	85009
4384	321918	Western Shutter LLC	4038 E. Madison St.	Phoenix	85034
2703	42471	Western States Petroleum	450 S. 15th Ave.	Phoenix	85007
20706	32614	Wincup Holdings Inc.	7980 W. Buckeye Rd.	Phoenix	85043
1382	33711	Woodcase Fine Cabinetry Inc. (formerly <i>McCarthy Cabinet Co.</i>)	3255 W. Osborn Rd.	Phoenix	85017
72	337122	Woodstuff Manufacturing Inc.	1635 S. 43rd Ave.	Phoenix	85009

Table 2.2–2. Name and location of point sources (continued).

The following point sources are **outside** the CO nonattainment area:

ID #	NAICS	Business name	Address	City	ZIP
31606	115111	Acme Gin Co. Inc.	7401 S. Wilson Rd.	Buckeye	85326
1874	212321	Alleco Stone LLC	10401 S. Miller Rd.	Buckeye	85326
31643	562212	Allied Waste Industries Inc.	24427 S. Hwy 85	Buckeye	85326
31637	115111	Anderson Clayton Corp. Valencia Gin	25500 W. Southern Ave.	Buckeye	85326
1218	562212	Butterfield Station	40404 S. 99th Ave.	Mobile	85239
1389	541380	DaimlerChrysler AZ Proving Grounds	33040 N. 203rd Ave.	Wittmann	85361
43063	221112	Duke Energy Arlington Valley LLC	39027 W. Elliot Rd.	Arlington	85322
1488	115111	Farmers Gin Inc.	8400 S. Turner St.	Buckeye	85326
10211		Hexcel Corp. †	1214 W. Gila Bend Hwy.	Casa Grande	85222
725	212321	Kilauea Crushers Inc.	Hwy 74	Wickenburg	85358
1879	562212	Northwest Regional Landfill	19401 W. Deer Valley Rd	Surprise	85374
98	221113	Palo Verde Nuclear Generating Station	5801 S. Wintersburg Rd.	Tonopah	85354
428	115111	Paloma Gin Properties LLC	I-8	GilaBend	85337
289	115111	Phoenix Agro Invest Inc.	51040 W. Valley Rd.	Aguila	85320
42956	221112	Pinnacle West Energy Corp.	11600 S. 363rd Ave.	Arlington	85322
44182	332312	Quincy Joist Company	22253 W. Southern Ave.	Buckeye	85326
246	321991	Schult Homes	231 N. Apache Rd.	Buckeye	85326
10469	221112	SRP Desert Basin Generating Station †	1872 N. Burris Rd.	Casa Grande	85222
398	212321	Wickenburg Facility	44605 Grand Ave.	Wickenburg	85390

† Source is located in Pinal County.

2.3 Procedures for estimating emissions from point sources

Both annual and average season-day CO emissions were estimated from annual source emission reports, MCESD investigation reports, permit files and logs, or telephone contacts with sources. For most of the sources, material balance methods were used for determining emissions. Emissions were estimated using the emission factors from AP–42, source tests, engineering calculations, or manufacturers' specifications.

MCESD distributes annual emissions survey forms to nearly all facilities for which MCESD has issued an operating permit. Facilities are required to report detailed information on stacks, control devices, operating schedules, and process-level information concerning their annual activities. (See Appendix 2.1 for a copy of the instructions to complete the emissions inventory.) These instructions include examples and explanations on how to complete the annual emissions reporting forms that facilities must submit to MCESD. Activity data reported for the December–February winter season is presumed to be representative of the November–January CO season.

After a facility has submitted an annual emissions report to MCESD, emissions inventory staff check all reports for missing and questionable data, and check the accuracy and reasonableness of all emissions calculations with AP–42, the Factor Information and REtrieval (FIRE) software, and other EPA documentation. Control efficiencies are determined by source tests when available, or by AP–42 factors, engineering calculations, or manufacturers' specifications. MCESD has conducted annual emissions surveys for permitted facilities since 1988, and the department's database system, EMS, contains numerous automated quality assurance/quality control checks for data input and processing.

2.3.1 Example 1: Ocotillo Power Plant

General Facility Information: Arizona Public Service (APS) operates a peaking electric generating plant with two steam units (gas/oil-fired boilers) and two natural-gas turbines. APS provided its total annual fuel consumption for each unit, as well as daily and seasonal operating activity. Total annual emissions from boilers and turbines are summed to obtain the facility's total annual CO emissions. The Ocotillo power plant provided the following information. The following data were used to calculate emissions from boilers and turbines:

SCC	Source type	Annual fuel consumption	CO emission factor	CO emissions (lbs/yr)
10100604	Natural gas boilers	3,406.56 MMCF	24 lb/ MMCF	81,757.0
20100201	Natural gas turbines	673.59 MMCF	83.64 lb/ MMCF	56,339.0

Calculation of annual CO emissions:

Annual emissions (lbs) = Annual fuel consumption × emission factor

$$\begin{aligned} \text{CO emissions from natural-gas boilers} &= 3,406.56 \text{ MMCF} \times 24 \text{ lb CO/MMCF} \\ &= 81,757 \text{ lbs CO/yr} \end{aligned}$$

$$\begin{aligned} \text{CO emissions from natural-gas turbines} &= 673.59 \text{ MMCF} \times 83.64 \text{ lb CO/MMCF} \\ &= 56,339 \text{ lbs CO/yr} \end{aligned}$$

$$\begin{aligned} \text{Total CO emissions} &= 81,757 \text{ lbs} + 56,339 \text{ lbs} \\ &= 138,096 \text{ lbs/yr} \\ &= 69.05 \text{ tons CO/yr} \end{aligned}$$

Calculation of CO season-day emissions:

APS provided seasonal operating data for each boiler and turbine. The activity reported for the December–February time period ranged from 14 to 37 percent among all natural-gas fired equipment. The average season-day emissions were calculated individually, as illustrated in the following example for Steam Unit No. 1 burning natural gas:

$$\begin{aligned} \text{CO season-day emissions} &= \text{annual emissions} \times \text{seasonal activity factor} \div (\text{days/week} \times \text{weeks/season}) \\ &= 50,986 \text{ lb CO} \times 19\% \div (7 \text{ days/wk} \times 13 \text{ wks/season}) \\ &= 106.5 \text{ lbs CO/season day} \end{aligned}$$

The daily calculations for each boiler and turbine were then summed to derive total CO season-day emissions.

2.3.2 Example 2: Imsamet of Arizona

General Facility Information: This secondary foundry facility has two electric arc furnaces (EAFs) and two heat treat furnaces. Carbon monoxide emissions of 21.5 lbs/hr of operation were calculated from stack tests conducted on the electric arc furnaces in 1999. Seasonal activity levels for each process are also reported annually.

Calculation of annual CO emissions:

$$\begin{aligned} \text{Annual emissions (lbs)} &= \text{Total hours of operation} \times \text{emission factor} \\ &= 7,503 \text{ hrs/yr} \times 21.5 \text{ lb CO/hr} \\ &= 161,315 \text{ lbs CO/yr} = 80.66 \text{ tons CO/yr} \end{aligned}$$

Calculation of CO season-day emissions:

$$\begin{aligned} \text{CO season-day emissions} &= \text{Annual emissions} \times \text{seasonal activity factor} \div (\text{days/week} \times \text{weeks/season}) \\ &= 161,315 \text{ lbs/yr} \times 26\% \div (7 \text{ days/wk} \times 13 \text{ wks/season}) \\ &= 460.9 \text{ lbs CO/day} \end{aligned}$$

Table 2.3–1 provides a list of annual and season-day CO emissions from those point sources that reported CO emissions, broken out by location (inside or outside the CO nonattainment area).

Table 2.3–1. Annual and CO season-day point source emissions, by facility.

Facilities within the CO nonattainment area:			Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
ID #	Business name	City		
1074	23rd Ave. Wastewater Treatment Plant	Phoenix	50.91	258.7
1075	91st Ave. Wastewater Treatment Plant	Tolleson	4.03	43.0
245	A F Lorts Company Inc.	Tolleson	0.01	0.1
1952	Adesa Phoenix LLC	Chandler	0.01	0.0
35541	Allied Tube & Conduit Corp.	Phoenix	0.33	1.9
199	Ameron Intl. Water Transmission Group	Phoenix	0.53	11.0
292	Anabolic Laboratories Inc.	Tempe	0.12	0.9
3313	APS West Phoenix Power Plant	Phoenix	116.58	429.6
3938	Arizona Galvanizing Inc.	Goodyear	2.98	17.8
4364	Arizona State University	Tempe	15.14	138.7
43124	Bonded Logic Inc.	Chandler	0.16	1.3
217	Building Products Co.	Phoenix	16.73	92.3
3442	Caljet	Phoenix	4.30	23.6
4145	Cave Creek School District	Cave Creek	3.21	24.8
1267	Cemex Mesa Plants #61 & #71	Mesa	2.14	10.4
1310	Century Graphics LLC	Phoenix	0.04	0.3
1426	Cesar Color Inc.	Phoenix	0.41	3.1
51073	Charles Schwab & Co. Inc.	Chandler	0.92	5.0
3976	Cholla Custom Cabinets Inc.	Phoenix	0.01	0.1
1198	Courier Graphics Corp.	Phoenix	0.20	1.4
4368	Craftsmen in Wood Mfg.	Phoenix	0.06	0.5
130	Dolphin Inc.	Phoenix	1.71	12.1
508	Eagle Industries LLC	Phoenix	0.02	0.2
3305	Earthgrains Baking Companies Inc.	Phoenix	1.53	9.8
26	Empire Machinery Co.	Mesa	21.16	110.6
27728	FlipChip International LLC	Phoenix	0.28	1.5
4050	General Mills	Tempe	0.67	4.1
4173	Glendale Municipal Sanitary Landfill	Glendale	1.67	12.9
781	Good Samaritan Regional Medical Ctr.	Phoenix	8.24	31.5
1418	Goodrich Aircraft Interior Products	Phoenix	1.51	15.4
31565	Henry Products Inc.	Phoenix	0.49	3.0
529	Highland Products Inc.	Phoenix	1.15	9.2
3536	Holsum Bakery Inc.	Phoenix	2.77	21.3
3802	Holsum Bakery Tempe	Tempe	0.89	7.1
1059	Honeywell Engines Systems & Service	Phoenix	1.99	18.2
355	Honeywell International Inc.	Phoenix	20.13	110.6
354	Imsamet of Arizona	Goodyear	80.66	460.9
777	Insulfoam	Phoenix	0.94	6.0
3966	Intel Corp. Ocotillo Campus (Fab 12 & 22)	Chandler	14.69	118.9
983	Isola Laminate Systems Corp.	Chandler	9.14	58.6
3317	Kyrene Generating Station	Tempe	39.17	18.7

Table 2.3–1. Annual and CO season-day point source emissions, by facility (continued).

ID #	Business name	City	Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
3300	Luke Air Force Base	Glendale	10.75	86.0
744	M. E. Global Inc.	Tempe	56.22	427.1
31261	Madison Granite Supplies	Phoenix	14.59	112.3
205	Mail-Well Envelope	Phoenix	0.71	3.6
353	Marlam Industries Inc.	Phoenix	0.02	0.2
61268	Master Block Inc.	El Mirage	0.22	1.4
62	Mastercraft Cabinets Inc.	Mesa	0.13	1.6
1414	Mesa Materials Inc. (Mesa)	Mesa	16.28	75.1
1415	Mesa Materials Inc. (Phoenix)	Phoenix	11.22	51.8
29474	Metal Management Arizona Inc.	Phoenix	0.16	1.0
1203	Microchip Technology Inc.	Chandler	1.94	10.9
1875	Microchip Technology Inc.	Tempe	3.60	20.6
226	Monier Lifetile LLC	Phoenix	0.79	5.0
882	Morton Salt Glendale Facility	Glendale	3.82	29.4
881	Motorola Inc.	Chandler	1.85	24.4
223	MTD Southwest Inc.	Chandler	46.12	355.7
693	Munters Corp.	Phoenix	0.15	1.1
34197	National Gypsum Co.	Phoenix	16.15	103.9
3953	Oakcraft Inc.	Peoria	0.07	0.5
52382	Ocotillo Power Plant	Tempe	69.05	343.9
733	Pan-Glo West	Phoenix	0.63	4.8
1341	Penn Racquet Sports Inc.	Phoenix	3.88	30.6
1014	Phoenix Brick Yard	Phoenix	34.27	188.3
562	Phoenix Newspapers Inc.	Phoenix	0.27	3.9
148	Presto Casting Co.	Glendale	0.95	7.3
60889	Purcell's Western States Tire	Phoenix	0.15	1.2
1030	Quebecor World Phoenix Division	Phoenix	39.99	328.1
537	Red Mountain Mining Inc.	Mesa	1.43	11.0
303	Rexam Beverage Can Company	Phoenix	4.29	23.6
759	Rogers Corp. Advanced Circuit Materials	Chandler	35.74	194.3
1437	Sanmina Phoenix Division	Phoenix	1.53	9.8
3315	Santan Generating Station	Gilbert	339.66	1,042.9
266	Schuff Steel Co.	Phoenix	0.74	4.7
42636	Scottsdale Health Care Hospital	Scottsdale	1.38	10.5
4175	SFPP LP	Phoenix	8.96	49.2
70634	Shell Oil Phoenix Terminal	Phoenix	0.28	1.6
27933	Skunk Creek Landfill	Phoenix	0.59	3.2
31627	South Mountain Gin	Laveen	0.12	1.6
3316	SRP Agua Fria	Glendale	330.15	762.9
4131	ST Microelectronics	Phoenix	4.46	24.5
1444	Staco Architectural Roof Tile	Phoenix	0.05	0.5
281	Sun State Rock & Materials	Sun City	0.73	4.7
101	Sunland Beef Co.	Tolleson	10.21	60.1
249	The Boeing Company	Mesa	1.50	11.5
232	The Phoenician Resort	Scottsdale	9.98	52.8
1102	The Procter & Gamble Mfg Co.	Phoenix	0.70	5.4
56	TPAC Division of Kiewit Western Co.	Phoenix	0.80	6.2
819	TRW Vehicle Safety Systems Inc.	QueenCreek	3.18	20.0
234	United Dairymen of Arizona	Tempe	27.51	157.1
260	United Metro Plant #11	Phoenix	16.52	65.0
213	United Metro Plant #12	Glendale	30.45	171.9
403	VAW of America Inc.	Phoenix	10.65	68.3
2	Vulcan Materials Co. (El Mirage)	El Mirage	2.03	10.4

Table 2.3–1. Annual and CO season-day point source emissions, by facility (continued).

ID #	Business name	City	Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
174	W. R. Meadows of AZ Inc.	Goodyear	0.16	2.0
20706	Wincup Holdings Inc.	Phoenix	11.19	56.6
72	Woodstuff Manufacturing Inc.	Phoenix	0.07	0.5
CO nonattainment area totals:			1,616.64	7,147.9
Facilities outside the CO nonattainment area:				
31606	Acme Gin Co. Inc.	Buckeye	0.02	0.3
1874	Alleco Stone LLC	Buckeye	3.89	24.9
31643	Allied Waste Industries Inc.	Buckeye	0.90	5.8
31637	Anderson Clayton Corp. Valencia Gin	Buckeye	0.07	0.3
1218	Butterfield Station	Mobile	8.25	45.6
1389	DaimlerChrysler AZ Proving Grounds	Wittmann	0.06	0.3
43063	Duke Energy Arlington Valley LLC	Arlington	23.74	148.9
1488	Farmers Gin Inc.	Buckeye	0.13	2.0
10211	Hexcel Corp.	Casa Grande	10.13	77.9
1879	Northwest Regional Landfill	Surprise	1.42	9.1
98	Palo Verde Nuclear Generating Station	Tonopah	16.13	88.6
428	Paloma Gin Properties LLC	Gila Bend	0.07	1.0
289	Phoenix Agro Invest Inc.	Aguila	0.01	0.3
42956	Pinnacle West Energy Corp.	Arlington	89.70	461.3
10469	SRP Desert Basin Generating Station	Casa Grande	50.20	275.8
398	Wickenburg Facility	Wickenburg	1.56	12.0
Total, outside the NAA:			206.27	1,154.1
Grand total:			1,822.90	8,301.9

2.4 Emission reduction credits

A major source or major modification planned in a nonattainment area must obtain emissions reductions as a condition for approval. These emissions reductions, generally obtained from existing sources located in the vicinity of a proposed source, must offset the emissions increase from the new source or modification. The obvious purpose of acquiring offsetting emissions decreases is to allow an area to move towards attainment of the national ambient air quality standards while still allowing some industrial growth.

Table 2.4–1 provides a list of emission reduction credits for carbon monoxide. Two facilities shut down their equipment prior to 2002 and requested that their emissions continue to be listed in the emission inventory for possible future use as emission reduction credits. A third facility shut down operations in 2002 and received a credit generation certificate for their emissions from the Arizona Emissions Bank. In order for these emission reductions to be available in the future for offsetting, they must be: 1) explicitly included and quantified as growth in projection year inventories required in rate of progress plans or attainment demonstrations that were based on 1990 actual inventories, and 2) meet the requirements outlined in MCESD Rule 240 (Permit Requirements for New Major Sources and Major Modification to Existing Major Sources).

Table 2.4–1. CO emission reduction credits.

Facility	CO emission reduction credits (tons)
Anderson Clayton Oilseed Plant	2.28
Motorola (Mesa)	17
The Scottsdale Princess Cogeneration Partnership	12.95
Total	32.23

2.5 CO point source emissions by process type

Table 2.5–1 lists annual and CO season-day emissions from the 113 point sources that reported CO emissions.

Table 2.5–1. Annual and CO season-day point source emissions, by process type.

CATEGORY		Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
ID #	Business name		
ELECTRICITY GENERATION:			
Fuel Combustion: Fuel Oil:			
3313	APS West Phoenix Power Plant	0.00	0.0
43063	Duke Energy Arlington Valley LLC †	0.11	3.5
3317	Kyrene Generating Station	0.00	0.0
98	Palo Verde Nuclear Generating Station	0.00	0.0
3316	SRP Agua Fria	0.01	0.1
Total Fuel Combustion: Fuel Oil		0.13	3.5
Fuel Combustion: Natural Gas			
3313	APS West Phoenix Power Plant	116.58	429.6
43063	Duke Energy Arlington Valley LLC †	23.63	145.4
3317	Kyrene Generating Station	39.17	18.7
52382	Ocotillo Power Plant	69.05	343.9
42956	Pinnacle West Energy Corp. †	89.70	461.3
3315	Santan Generating Plant	339.66	1,042.9
3316	SRP Agua Fria	330.13	762.8
10469	SRP Desert Basin Generating Station †	50.20	275.8
Total Fuel Combustion: Natural Gas		1,058.12	3,480.5
TOTAL ELECTRICITY GENERATION:		1,058.25	3,484.0
COMMERCIAL/INSTITUTIONAL FUEL COMBUSTION:			
Fuel Oil:			
1074	23rd Ave. Wastewater Treatment Plant	0.03	0.0
1075	91st Ave. Wastewater Treatment Plant	0.45	13.1
4364	Arizona State University	0.02	0.0
4145	Cave Creek School District	0.05	0.5
51073	Charles Schwab & Co. Inc.	0.92	5.0
781	Good Samaritan Regional Medical Ctr.	4.96	13.5
3300	Luke Air Force Base	0.71	5.5
42636	Scottsdale Health Care Hospital	0.44	3.9
Total Commercial/Institutional Fuel Oil:		7.58	41.6
Natural Gas:			
1074	23rd Ave. Wastewater Treatment Plant	0.76	7.3
4364	Arizona State University	15.12	138.7
4145	Cave Creek School District	3.16	24.3
781	Good Samaritan Regional Medical Ctr.	3.28	18.0
3300	Luke Air Force Base	4.20	36.9
42636	Scottsdale Health Care Hospital	0.94	6.6
232	The Phoenician Resort	9.98	52.8
Total Commercial/Institutional Natural Gas:		37.44	284.7
Other Fuels:			
3300	Luke Air Force Base	0.61	3.6
TOTAL COMMERCIAL/INSTITUTIONAL FUEL COMBUSTION:		45.63	329.9

† Source is outside the CO nonattainment area.

Table 2.5–1. Annual and CO season-day point source emissions, by process type (continued).

CATEGORY		Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
ID #	Business name		
INDUSTRIAL FUEL COMBUSTION:			
Industrial Fuel Oil:			
1874	Alleco Stone LLC †	3.89	24.9
199	Ameron Intl. Water Transmission Group	0.18	7.1
3938	Arizona Galvanizing Inc.	0.66	5.1
1218	Butterfield Station †	0.26	1.7
1267	Cemex Mesa Plants #61 & #71	2.14	10.4
26	Empire Machinery Co.	2.25	12.1
1418	Goodrich Aircraft Interior Products	0.02	0.4
3966	Intel Corp.-Ocotillo Campus (Fab 12 & 22)	1.16	44.6
31261	Madison Granite Supplies	14.59	112.3
1414	Mesa Materials Inc. (Mesa)	16.28	75.1
1415	Mesa Materials Inc. (Phoenix)	11.22	51.8
29474	Metal Management Arizona Inc.	0.16	1.0
1203	Microchip Technology Inc. (Chandler)	0.01	0.3
1875	Microchip Technology Inc. (Tempe)	0.02	0.9
882	Morton Salt Glendale Facility	2.37	18.3
881	Motorola Inc.	0.44	17.1
34197	National Gypsum Co.	0.06	0.8
1879	Northwest Regional Landfill	1.42	9.1
98	Palo Verde Nuclear Generating Station	14.27	78.4
537	Red Mountain Mining Inc.	1.43	11.0
266	Schuff Steel Co.	0.74	4.7
281	Sun State Rock & Materials	0.73	4.7
260	United Metro Plant #11	0.16	2.1
213	United Metro Plant #12	0.19	1.2
2	Vulcan Materials Co. (El Mirage)	1.98	10.2
398	Wickenburg Facility †	1.56	12.0
Total Industrial Fuel Oil:		78.22	517.2
Industrial Fuel Combustion: Natural Gas			
245	A F Lorts Company Inc.	0.01	0.1
1952	Adesa Phoenix LLC	0.01	0.0
35541	Allied Tube & Conduit Corp.	0.33	1.9
199	Ameron Intl. Water Transmission Group	0.35	3.9
292	Anabolic Laboratories	0.12	0.9
3938	Arizona Galvanizing Inc.	2.32	12.7
43124	Bonded Logic Inc.	0.16	1.3
217	Building Products Co.	16.73	92.3
1310	Century Graphics LLC	0.04	0.3
1426	Cesar Color Inc.	0.41	3.1
1198	Courier Graphics Corp.	0.20	1.4
4368	Craftsmen in Wood Mfg.	0.06	0.5
130	Dolphin Inc.	1.71	12.1
508	Eagle Industries LLC	0.02	0.2
3305	Earthgrains Baking Companies Inc.	1.53	9.8
26	Empire Machinery Co.	18.91	98.5
27728	FlipChip International LLC	0.28	1.5
4050	General Mills	0.67	4.1

† Source is outside the CO nonattainment area.

Table 2.5–1. Annual and CO season-day point source emissions, by process type (continued).

CATEGORY		Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
ID #	Business name		
INDUSTRIAL FUEL COMBUSTION: Natural Gas (cont'd.)			
1418	Goodrich Aircraft Interior Products	0.38	7.0
31565	Henry Products Inc.	0.49	3.0
529	Highland Products Inc.	1.15	9.2
3536	Holsum Bakery Inc.	2.77	21.3
3802	Holsum Bakery Tempe	0.89	7.1
1059	Honeywell Engines Systems & Service	0.80	10.5
355	Honeywell International Inc.	3.76	20.6
777	Insulfoam	0.94	6.0
3966	Intel Corp. Ocotillo Campus (Fab 12 & 22)	13.53	74.3
983	Isola Laminate Systems Corp.	9.14	58.6
744	M. E. Global Inc.	3.99	26.0
205	Mail-Well Envelope	0.71	3.6
353	Marlam Industries Inc.	0.02	0.2
61268	Master Block Inc.	0.22	1.4
62	Mastercraft Cabinets Inc.	0.13	1.6
1203	Microchip Technology Inc. (Chandler)	1.93	10.6
1875	Microchip Technology Inc. (Tempe)	3.52	19.3
226	Monier Lifetile LLC	0.79	5.0
882	Morton Salt Glendale Facility	0.57	4.4
881	Motorola Inc.	1.40	7.3
223	MTD Southwest Inc.	0.08	1.6
693	Munters Corp.	0.15	1.1
34197	National Gypsum Co.	16.09	103.1
3953	Oakcraft Inc.	0.07	0.5
428	Paloma Gin Properties LLC	0.07	1.0
733	Pan-Glo West	0.63	4.8
1341	Penn Racquet Sports Inc.	3.88	30.6
289	Phoenix Agro Invest Inc.	0.01	0.3
1014	Phoenix Brick Yard	34.27	188.3
562	Phoenix Newspapers Inc.	0.27	3.9
148	Presto Casting Co.	0.95	7.3
60889	Purcell's Western States Tire	0.15	1.2
1030	Quebecor World Phoenix Division	39.99	328.1
303	Rexam Beverage Can Company	4.29	23.6
759	Rogers Corp. Advanced Circuit Materials	35.74	194.3
1437	Sanmina Phoenix Division	1.53	9.8
70634	Shell Oil Phoenix Terminal	0.28	1.6
31627	South Mountain Gin	0.12	1.6
4131	ST Microelectronics	4.46	24.5
1444	Staco Architectural Roof Tile	0.05	0.5
101	Sunland Beef Co.	10.21	60.1
249	The Boeing Company	1.05	8.1
1102	The Procter & Gamble Mfg. Co.	0.70	5.4
56	TPAC Division of Kiewit Western Co.	0.80	6.2
819	TRW Vehicle Safety Systems Inc.	2.77	17.0
234	United Dairywomen of Arizona	27.51	157.1
260	United Metro Plant #11	16.36	62.9
213	United Metro Plant #12	30.25	170.7
403	VAW of America Inc.	8.03	51.5

† Source is outside the CO nonattainment area.

Table 2.5–1. Annual and CO season-day point source emissions, by process type (continued).

CATEGORY		Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
ID #	Business name		
INDUSTRIAL FUEL COMBUSTION: Natural Gas (cont'd.)			
2	Vulcan Materials Co. (El Mirage)	0.05	0.2
174	W. R. Meadows of AZ Inc.	0.16	2.0
20706	Wincup Holdings Inc.	11.19	56.6
72	Woodstuff Manufacturing Inc.	0.07	0.5
Total: Industrial Fuel Combustion: Natural Gas		343.21	2,068.0
Industrial Fuel Combustion: Other			
31606	Acme Gin Co. Inc. †	0.02	0.3
31643	Allied Waste Industries Inc. †	0.90	5.8
31637	Anderson Clayton Corp. Valencia Gin †	0.07	0.3
3976	Cholla Custom Cabinets Inc.	0.01	0.1
1389	DaimlerChrysler AZ Proving Grounds †	0.06	0.3
1488	Farmers Gin Inc. †	0.13	2.0
1418	Goodrich Aircraft Interior Products	1.10	8.0
882	Morton Salt Glendale Facility	0.87	6.7
98	Palo Verde Nuclear Generating Station	1.85	10.2
Total: Industrial Fuel Combustion: Other		5.01	33.7
TOTAL: ALL INDUSTRIAL FUEL COMBUSTION:		426.44	2,618.9
INDUSTRIAL PROCESSES:			
Engine Testing:			
1059	Honeywell Engines Systems & Service	1.19	7.6
355	Honeywell International Inc.	16.37	90.0
3300	Luke Air Force Base	5.12	39.4
223	MTD Southwest Inc.	46.04	354.1
249	The Boeing Company	0.29	2.3
Total Engine Testing:		69.01	493.3
Other:			
3442	Caljet	4.30	23.6
4175	SFPP LP	8.62	47.3
249	The Boeing Company	0.15	1.2
Total Other Industrial Processes:		13.06	72.1
TOTAL: ALL INDUSTRIAL PROCESSES		82.07	565.5
MANUFACTURING PROCESSES:			
Electrical Equipment:			
1875	Microchip Technology Inc.	0.06	0.3
Fabricated Metal Products:			
10211	Hexcel Corp.	10.13	77.9
Secondary Metal Products:			
354	Imsamet of Arizona	80.66	460.9
744	M. E. Global Inc.	52.24	401.1
403	VAW of America Inc.	2.62	16.8
Total: Manufacturing: Secondary Metal Products:		135.51	878.7
Other:			
819	TRW Vehicle Safety Systems Inc.	0.41	2.9
TOTAL: ALL MANUFACTURING:		146.12	959.9

† Source is outside the CO nonattainment area.

Table 2.5–1. Annual and CO season-day point source emissions, by process type (continued).

CATEGORY		Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
ID #	Business name		
WASTE DISPOSAL:			
Landfills:			
1218	Butterfield Station †	7.98	43.9
4173	Glendale Municipal Sanitary Landfill	1.67	12.9
27933	Skunk Creek Landfill	0.59	3.2
Total: Landfills		10.24	59.9
Publicly Owned Treatment Works (POTWs):			
1074	23rd Ave. Wastewater Treatment Plant	50.12	251.4
1075	91st Ave. Wastewater Treatment Plant	3.58	29.9
Total: POTWs		53.70	281.3
Site Remediation:			
3300	Luke Air Force Base	0.11	0.6
4175	SFPP LP	0.34	1.9
Total Site Remediation:		0.45	2.5
TOTAL: ALL WASTE DISPOSAL:		64.40	343.7
TOTAL: ALL POINT SOURCES:		1,822.90	8,301.9

† = Point source is outside the CO nonattainment area.

2.6 Summary of point source emissions

Table 2.6–1 provides an overview of source category contributions to total point source emissions.

Table 2.6–1. Summary of annual and season-day point source emissions, by source category.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Electricity generation	1,058.25	3,484.0	894.61	2,598.0
Commercial/institutional fuel combustion	45.63	329.9	45.63	329.9
Industrial fuel combustion	426.44	2,618.9	401.93	2,472.6
Industrial processes	82.07	565.5	82.07	565.5
Manufacturing processes	146.12	959.9	135.99	882.0
Waste disposal	64.40	343.7	56.41	299.9
All point sources:	1,822.90	8,301.9	1,616.64	7,147.9

2.7 Quality assurance / quality control procedures

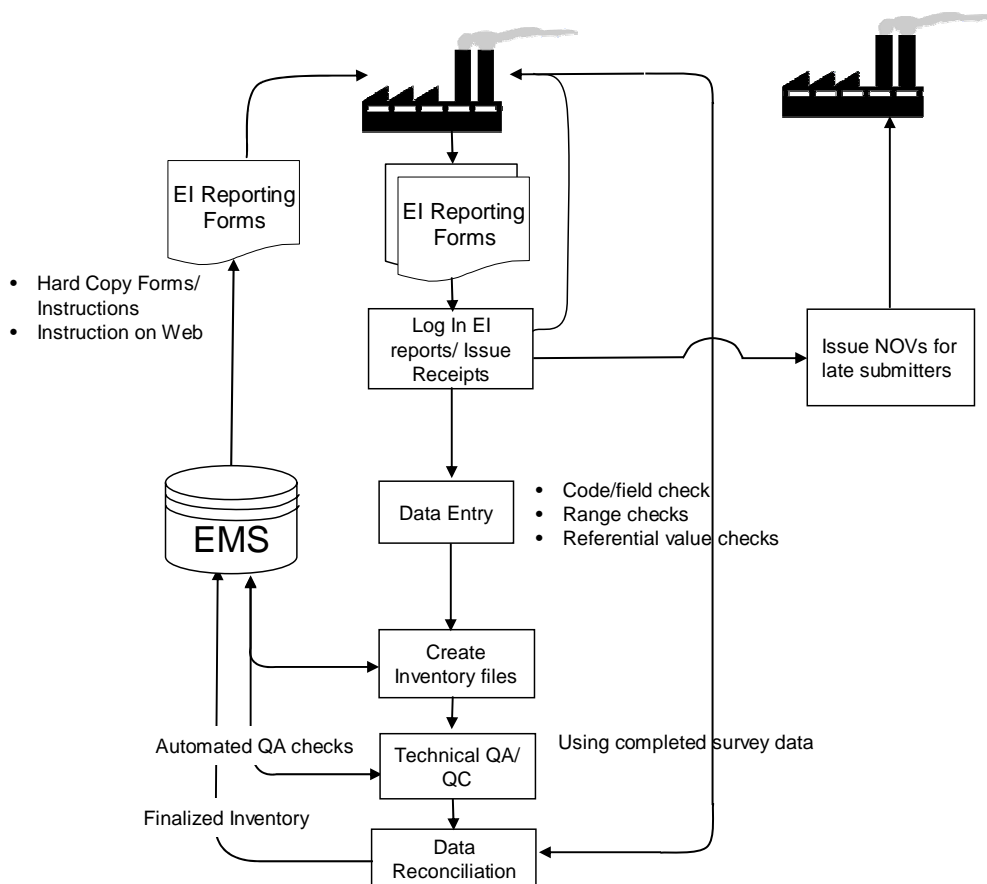
2.7.1 Emission survey preparation and data collection

The MCESD's Emissions Inventory (EI) Unit annually collects point source criteria pollutant emission data from sources in the county. MCESD annually reviews EPA guidance, documents from the Emission Inventory Improvement Program (EIIP), and other source materials to ensure that the most current emission factors and emission calculation methods are used for each year's survey. Each January, the EI Unit prepares a pre-populated hard copy of the preceding year's submissions and mails reporting forms to permitted sources, along with detailed instructions for completing the forms. (A copy of these instructions is included as Appendix 2.1). The EI Unit

asks sources to verify and update the data. The EI Unit also holds weekly workshops from January through April to assist businesses in completing EI forms.

The general data flow for data collection and inventory preparation is shown in Figure 2.7–1.

Figure 2.7–1. Data flow for annual point source emission inventory reporting.



2.7.2 Submission processing

Submitted EI reports are logged in as they are received, and receipts are issued for emissions fees paid. The data are input “as received” into the department's data base. During data entry, numerous automated quality control (QC) checks are performed, including:

- pull-down menus to minimize data entry errors (e.g., city, pollutant, emission factor unit, etc.)
- mandatory data field requirement checks (e.g., a warning screen appears if a user tries to save an emission record with a missing emission factor).
- range checks (e.g., were valid SCC, Tier, SIC, and NAICS codes entered?)
- referential value checks (e.g., emission factor units, annual throughput units)
- automatic formatting of date, time, telephone number fields, etc.

Automated quality assurance (QA) checks on the report that has been entered include the following:

- Comparing reported emission factors to SCC reference lists
- Comparing reported emission factors to material name reference list
- Checking the report for calculation errors. This includes annual throughput, emission factors, unit conversion factors (e.g., BTU to therms), capture efficiency, primary / secondary control device efficiency, and any offsite recycling credits claimed.
- Checking the report for completeness of required data.

When data entry is complete, an electronic version of the original data is preserved separately to document changes made during the technical review and QA/QC process.

When errors are flagged, the businesses are contacted and correct information is obtained and input to the EMS. Outstanding reporting issues are documented. Confidential business information (CBI) is identified by a checkbox on the form, and these data elements are flagged during data entry and are not transmitted to the EPA. To prepare the inventory for submittal to the National Emissions Inventory (NEI), the EI Unit runs Microsoft Access queries on the data in the EMS to pull fields for the NEI Input format (NIF) tables.

2.7.3 Analysis of annual point source emissions data for this inventory

Two environmental planners checked inventory accuracy and reasonableness, and assured that all point sources had been identified and that the methodology applied to calculate emissions was appropriate and that the calculations were correct. Other reasonableness checks were conducted by recalculating emissions using methods other than those used to make the initial emissions calculations and then comparing results. QA was conducted by checking all emissions reports submitted to MCESD for the year 2002 for missing and questionable data and by checking the accuracy and reasonableness of all emissions calculations made for such reports. Notes concerning follow-up calls and corrections to calculations were documented on each 2002 annual emissions report.

The QA point source coordinator reviewed checked calculations, identified errors, and performed completeness, reasonableness and accuracy checks.

2.8 References

US EPA, 2003. 2002 National Emission Inventory (NEI) Preparation Plan (draft). USEPA Office of Air Quality Planning and Standards, Dec. 19, 2003. Available at: <http://www.epa.gov/ttn/chief/net/2002inventory.html>

3. Area Sources

3.1 Scope and methodology

This chapter considers all stationary sources which are too small or too numerous to be treated as point sources. EPA guidance documents, including “Introduction to Area Source Inventory Development” (US EPA, 2001) as well as permit and emissions data in the MCESD’s Environmental Management System (EMS) database, and previous SIP inventories, were evaluated to develop the list of area source categories for inclusion. Some source categories were deemed “insignificant” because there are no large production facilities and/or very few small sources, and therefore emissions were not quantified. MCESD prepared the area source emission estimates for all area sources and provided quality assurance checks on all data. Table 3.1–1 contains a list of all area source categories, with Source Classification Codes (SCCs), addressed in this chapter.

Table 3.1–1. List of area source categories.

AMS code	Area source description	Section
Fuel combustion:		
2102006000	Industrial natural gas	3.2.1
2102004000	Industrial fuel oil	3.2.2
2103006000	Commercial/institutional natural gas	3.2.3
2103004000	Commercial/institutional fuel oil	3.2.4
2104006000	Residential natural gas	3.2.5
2104008000	Residential wood	3.2.6
2104004000	Residential fuel oil	3.2.7
Industrial processes:		
2301000000	Chemical manufacturing	3.3.1
2302002000	Commercial cooking	3.3.2
n/a	State-permitted portable sources	3.3.3
2399000000	Industrial processes not elsewhere classified	3.3.4
Waste treatment and disposal:		
2601000000	On-site incineration	3.4.1
2610000000	Open burning	3.4.2
2620000000	Landfills	3.4.3
Miscellaneous area sources:		
2810001000	Wildfires and brush fires	3.5.1.1
2810030000	Structure fires	3.5.1.2
2810050000	Vehicle fires	3.5.1.3
2810040000	Engine testing	3.5.1.4
2601020000	Health services (crematories)	3.5.2
2830000000	Accidental releases	3.5.3

For nearly all categories, emissions were calculated in one of the following ways:

- emissions estimates for some categories were developed by conducting surveys on local usage (e.g., natural gas consumption, pesticide usage) or derived from state-wide data (e.g., fuel oil use).
- for some widespread or diverse categories (e.g., consumer solvent use), emissions were calculated using published per-capita or per-employee emission factors.
- for source categories with some information available from annual emissions reports (e.g., bakeries), these data were combined with employment data to “scale up” reported emissions to reflect the entire source category.

- for those source categories with detailed emissions data available from most or all significant sources in the category, emissions were calculated based on detailed process and operational data provided by these sources.

The specific emissions estimation methodologies used for each source category (including any application of rule effectiveness) are described in greater detail in the respective sections.

3.2 Fuel combustion

Area source emissions for the following seven categories of fuel consumption were calculated: Industrial natural gas, industrial fuel oil, commercial/institutional natural gas, commercial institutional fuel oil, residential natural gas, residential wood, and residential fuel oil. Data for emissions calculations from natural gas combustion came from a survey of the four natural gas suppliers in Maricopa County. The following table summarizes the natural gas sales data received from Maricopa County natural gas suppliers.

Table 3.2–1. Natural gas sales data from Maricopa County natural gas suppliers.

Natural gas supplier	Sales by end user category (in MMCF/yr)					
	Electric Utilities	Industrial	Commercial/Institutional	Residential	Transport*	Other*
Southwest Gas	n/a	3,092.760	13,774.986	14,842.508	3,802.155	1,977.644
City of Mesa	80.169	386.692	1,486.877	1,112.936	59.924	n/a
El Paso	58,334.169	161.429	n/a	n/a	n/a	n/a
Black Mountain	n/a	n/a	142.561	464.084	n/a	n/a

* For emissions calculations, sales from these two categories were grouped with industrial sales.

Area source emissions for wood and fuel oil combustion were calculated from Arizona state-level sales and consumption data as described in the following subsections. Area source emissions from coal and liquid petroleum gas were not calculated as emissions from these categories were determined to be insignificant.

3.2.1 Industrial natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas distributed, by user category, within the county in 2002. Area source industrial natural gas usage for the county is based on the reported total volume of natural gas sold to industrial sources, minus natural gas used by industrial point sources:

$$\begin{aligned}
 \text{Area source industrial} &= \text{Reported industrial} & - & \text{Industrial point source} \\
 \text{natural gas usage} & \text{ natural gas sales} & & \text{natural gas usage} \\
 & = 9,480.60 \text{ MMCF} & - & 7,929.38 \text{ MMCF} \\
 & = 1,551.23 \text{ MMCF}
 \end{aligned}$$

Natural gas is used for both external combustion (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source natural gas usage derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal natural gas combustion reported by all industrial area sources in 2002.

Annual emissions for the county are calculated by multiplying natural gas usage by the respective AP-42 emission factors for external and internal combustion, as in this example for CO emissions from external natural gas combustion:

$$\begin{aligned}
 \text{Annual CO emissions from external natural gas combustion} &= \text{External industrial natural gas usage (MMCF)} \times \text{CO emission factor for external natural gas combustion (lb/MMCF)} \div 2,000 \text{ lb/ton} \\
 &= 1,527.09 \times 84 \div 2,000 \\
 &= 64.14 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–2. Emission factors and annual emissions from area-source industrial natural gas combustion, by combustion type.

Combustion type	% of total	Annual natural gas usage (MMCF)	CO emission factor (lbs/MMCF)	Annual emissions (tons/yr)
External	98.44	1,527.09	84	64.14
Internal	1.56	24.14	399	4.82
Totals:	100.00	1,551.23		68.95

Season-day emissions for the county are calculated by first multiplying annual emissions by the percentage of industrial natural gas sold used during the CO season. (Figures reported by natural gas suppliers for the December–February time period are assumed to be representative for the November–January CO season.) CO season emission totals are then divided by the number of days that activity occurs during the CO season:

$$\begin{aligned}
 \text{Season-day CO emissions from industrial natural gas} &= \text{Annual CO emissions (tons/yr)} \times \text{\% natural gas sold during CO season} \div (\text{days/week} \times \text{wks/season}) \times 2,000 \text{ lbs/ton} \\
 &= 68.95 \times 28.59 \% \div (6 \times 13) \times 2,000 \\
 &= 505.5 \text{ lbs/day}
 \end{aligned}$$

Annual and season-day emissions within the CO nonattainment area are calculated by applying the ratio of industrial employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{Emissions from area source industrial natural gas combustion in the CO NAA} &= \text{Annual county CO emissions (tons/yr)} \times \text{Industrial employment ratio} \\
 &= 68.95 \times 0.9809 \\
 &= 67.64 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–3. Annual and season-day emissions from area-source industrial natural gas combustion.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	68.95	505.5
CO NAA	67.64	495.9

3.2.2 Industrial fuel oil

Area source emissions from industrial fuel oil combustion are calculated by a multi-step process which allocates Arizona state-level industrial fuel oil sales data from the US Department of Energy, Energy Information Administration (US DOE, 2002b) to Maricopa County.

To derive industrial fuel oil usage in Maricopa County, reported Arizona sales of high-sulfur diesel for 2002 are first subtracted from Arizona state-level total industrial fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local air quality regulations and market conditions.

$$\begin{aligned}
 \text{State industrial fuel oil sales} &= \text{Reported state total} & - & \text{Reported state high-sulfur diesel sales} \\
 \text{other than high-sulfur diesel} & \text{ industrial fuel oil sales} & & \\
 \text{(in thousand gallons, or Mgal)} & = 61,748 \text{ Mgal} & - & 34,076 \text{ Mgal} \\
 & = 27,672 \text{ Mgal/yr} & &
 \end{aligned}$$

Arizona state industrial fuel oil sales (less high-sulfur diesel fuel) are then multiplied by the ratio of industrial employment in Maricopa County to Arizona state (0.71), as determined from data from the US Census (2003a) to estimate annual Maricopa County industrial fuel oil sales, as follows:

$$\begin{aligned}
 \text{Maricopa County} &= \text{Arizona industrial fuel oil} & \times & \text{Maricopa County:state} \\
 \text{industrial fuel oil sales} & \text{ sales less high-sulfur diesel} & \text{ industrial employment ratio} & \\
 & = 27,672 \text{ Mgal} & \times & 0.71 \\
 & = 19,647.12 \text{ Mgal/yr} & &
 \end{aligned}$$

To avoid double-counting, industrial fuel oil use attributable to stationary point sources (addressed in Chapter 2) and nonroad mobile sources (addressed in Chapter 4) are subtracted from County industrial fuel oil sales to estimate county fuel oil usage by area sources, as follows:

$$\begin{aligned}
 \text{Maricopa County industrial} &= \text{Maricopa County} & - & \text{Fuel oil used by industrial} & - & \text{Fuel oil used by industrial} \\
 \text{area source fuel oil sales} & \text{ industrial fuel oil sales} & \text{ nonroad mobile equipment} & \text{ stationary point sources} & & \\
 & = 19,647.12 \text{ Mgal} & - & 7,365.927 \text{ Mgal} & - & 2,021.10 \text{ Mgal} \\
 & = 10,260.097 \text{ Mgal/yr} & & & &
 \end{aligned}$$

Industrial fuel oil is used for both external combustion (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source industrial fuel oil sales derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal fuel oil combustion reported by all industrial area sources surveyed by MCESD in 2002 (shown in Table 3.2–4 below).

County-level annual emissions from this area source category were calculated by multiplying industrial fuel oil sales by the respective AP-42 emission factors for external and internal combustion, as in this example for CO emissions from external industrial fuel oil combustion:

$$\begin{aligned}
 \text{Annual CO emissions} &= \text{External industrial fuel} & \times & \text{CO emission factor for external} & \div & 2,000 \text{ lb/ton} \\
 \text{from external industrial} & \text{ oil sales (Mgal)} & \text{ fuel oil combustion (lb/Mgal)} & & & \\
 \text{fuel oil combustion} & & & & & \\
 & = 8,003.949 & \times & 5 & \div & 2,000 \\
 & = 20.01 \text{ tons CO/yr} & & & &
 \end{aligned}$$

Table 3.2–4. Emission factors and annual emissions from area-source industrial fuel oil combustion, by combustion type.

Combustion type	% of total	Annual fuel oil sales (Mgals)	CO emission factor (lbs/Mgals)	Annual emissions (tons/yr)
External	78.01	8,003.949	5	20.01
Internal	21.99	2,256.147	130	146.65
Totals:	100.00	10,260.097		166.66

Season-day emissions for the county are calculated by first multiplying annual emissions by 25% to estimate CO season emission totals. CO season emission totals are then divided by the number of days that activity occurs during the CO season, as recommended by EIIP guidance (US EPA, 2001a):

$$\begin{aligned}
 \text{CO season-day emissions from industrial fuel oil} &= \text{Annual CO emissions (tons/yr)} \times \% \text{ fuel oil sold during CO season} \div (\text{days/week} \times \text{wks/season}) \times 2,000 \text{ lbs/ton} \\
 &= 166.66 \times 25\% \div (6 \times 13) \times 2,000 \\
 &= 1,068.3 \text{ lbs/day}
 \end{aligned}$$

Annual and season-day emissions in the CO nonattainment area are calculated by applying the ratio of industrial employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{CO NAA emissions from area source industrial fuel oil combustion} &= \text{Annual county CO emissions (tons/yr)} \times \text{NAA:County industrial employment ratio} \\
 &= 166.66 \text{ tons/yr} \times 0.9809 \\
 &= 163.48 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–5. Annual and season-day emissions from area-source industrial fuel oil combustion.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	166.66	1,068.3
CO NAA	163.48	1,047.9

3.2.3 Commercial/institutional natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas distributed, by user category, within the county in 2002. Area source commercial and institutional (C&I) natural gas usage for the county is based on the reported total volume of natural gas sold to C&I sources, minus natural gas used by C&I point sources:

$$\begin{aligned}
 \text{County area source C\&I natural gas usage} &= \text{Reported C\&I natural gas sales} - \text{C\&I point source natural gas usage} \\
 &= 15,404.42 \text{ MMCF} - 725.35 \text{ MMCF} \\
 &= 14,679.07 \text{ MMCF}
 \end{aligned}$$

Natural gas is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source natural gas usage derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal natural gas combustion reported by all C&I area sources in 2002.

Annual emissions for the county and the CO nonattainment area are calculated by multiplying natural gas usage by the respective AP-42 emission factors for external and internal combustion, as in this example for CO emissions from external natural gas combustion:

$$\begin{aligned}
 \text{Annual CO emissions from external natural gas combustion} &= \text{External C\&I natural gas usage (MMCF)} \times \text{CO emission factor for external natural gas combustion (lb/MMCF)} \div 2,000 \text{ lb/ton} \\
 &= 14,434.79 \times 84 \div 2,000 \\
 &= 606.26 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–6. Emission factors and annual emissions from area-source commercial/institutional natural gas combustion, by combustion type.

Combustion type	% of total	Annual natural gas usage (MMCF)	CO emission factor (lbs/MMCF)	Annual emissions (tons/yr)
External	98.34	14,434.79	84	606.26
Internal	1.66	244.29	399	48.74
Totals:	100.00	14,679.07		655.00

Season-day emissions for the county are calculated by first multiplying annual emissions by the percentage of C&I natural gas sold used during the CO season. (Figures reported by natural gas suppliers for the December–February time period are assumed to be representative for the November–January CO season.) CO season emission totals are then divided by the number of days that activity occurs during the CO season:

$$\begin{aligned}
 \text{Season-day CO emissions from C\&I natural gas} &= \text{Annual CO emissions (tons/yr)} \times \text{\% natural gas sold during CO season} \div (\text{days/week} \times \text{wks/season}) \times 2,000 \text{ lbs/ton} \\
 &= 655.00 \times 33.31 \% \div (6 \times 13) \times 2000 \\
 &= 5,594.0 \text{ lbs/day}
 \end{aligned}$$

Annual and season-day emissions in the CO nonattainment area are calculated by applying the combined ratio of retail, office, public and other employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{Emissions from area source C\&I natural gas combustion in the CO NAA} &= \text{Annual county CO emissions (tons/yr)} \times \text{NAA:County C\&I employment ratio} \\
 &= 655.00 \times 0.9829 \\
 &= 643.80 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–7. Annual and season-day emissions from area-source commercial/institutional natural gas combustion.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	655.00	5,594.0
CO NAA	643.80	5,498.4

3.2.4 Commercial/institutional fuel oil

Area source emissions from commercial and institutional (C&I) fuel oil combustion are calculated by a multi-step process of allocating Arizona state-level C&I fuel oil sales as reported by the US Department of Energy, Energy Information Administration (US DOE, 2002a) to Maricopa County.

To derive commercial/institutional fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2002 are first subtracted from Arizona state-level total commercial/institutional fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local clean air act requirements and market conditions.

$$\begin{aligned}
 \text{State C\&I fuel oil sales} &= \text{Reported state total} & - & \text{Reported state high-sulfur diesel sales} \\
 \text{other than high-sulfur diesel} & \text{C\&I fuel oil sales} & & \\
 \text{(in thousand gallons, or Mgal)} & = 30,077 \text{ Mgal} & - & 71 \text{ Mgal} \\
 & = 30,006 \text{ Mgal/yr} & &
 \end{aligned}$$

Arizona state commercial/institutional fuel oil sales less high-sulfur diesel are then multiplied by the ratio of C&I employment in Maricopa County to Arizona state (0.71), as determined by data from the US Census (2003a), to estimate Maricopa County-level C&I fuel oil sales, as follows:

$$\begin{aligned}
 \text{Maricopa County} &= \text{Arizona C\&I fuel oil} & \times & \text{Maricopa County:state} \\
 \text{C\&I fuel oil sales} & \text{sales less high-sulfur diesel} & \text{C\&I employment ratio} & \\
 & = 30,006 \text{ Mgal} & \times & 0.71 \\
 & = 21,304.26 \text{ Mgal/yr} & &
 \end{aligned}$$

To avoid double-counting, commercial/institutional fuel oil use attributable to stationary point sources (addressed in Chapter 2) and nonroad mobile sources (addressed in Chapter 4) are subtracted from County C&I fuel oil sales to estimate county fuel oil usage used by C&I area sources, as follows:

$$\begin{aligned}
 \text{Maricopa County C\&I} &= \text{Maricopa County} & - & \text{Fuel oil used by C\&I} & - & \text{Fuel oil used by C\&I} \\
 \text{area source fuel oil sales} & \text{C\&I fuel oil sales} & \text{nonroad mobile equipment} & \text{stationary point sources} & & \\
 & = 21,304.26 \text{ Mgal} & - & 4,435.974 \text{ Mgal} & - & 190.672 \text{ Mgal} \\
 & = 16,677.614 \text{ Mgal/yr} & & & &
 \end{aligned}$$

Fuel oil is used for both external combustion (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source C&I fuel oil sales derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal fuel oil combustion reported by all commercial/institutional area sources surveyed by MCESD in 2002 (shown in Table 3.2–8 below).

Annual emissions for the county are calculated by multiplying C&I fuel oil sales by the respective AP-42 emission factors for external and internal combustion, as in this example for CO emissions from external C&I fuel oil combustion:

$$\begin{aligned}
 \text{Annual CO emissions from external C\&I fuel oil combustion} &= \text{External C\&I oil sales (Mgal)} \times \text{CO emission factor for external fuel oil combustion (lb/Mgal)} \div 2,000 \text{ lb/ton} \\
 &= 11,165.542 \times 5 \div 2,000 \\
 &= 27.91 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–8. Emission factors and annual emissions from area-source commercial/institutional fuel oil combustion, by combustion type.

Combustion type	% of total	Annual fuel oil sales (Mgals)	CO emission factor (lbs/Mgals)	Annual emissions (tons/yr)
External	66.95	11,165.542	5	27.91
Internal	33.05	5,512.072	130	358.28
Totals:	100.00	16,677.614		386.20

Season-day emissions for the county are calculated by first multiplying annual emissions by 35% to estimate CO season emission totals. CO season emission totals are then divided by the number of days that activity occurs during the CO season as recommended by EIIP guidance (US EPA, 2001a):

$$\begin{aligned}
 \text{CO season-day emissions from C\&I fuel oil use} &= \text{Annual CO emissions (tons/yr)} \times \text{\% fuel oil sold during CO season} \div (\text{days/week} \times \text{wks/season}) \times 2,000 \text{ lbs/ton} \\
 &= 386.20 \times 35\% \div (6 \times 13) \times 2,000 \\
 &= 3,465.9 \text{ lbs/day}
 \end{aligned}$$

Annual and season-day emissions within the CO nonattainment area are calculated by applying the combined ratio of retail, office, public and other employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{CO NAA emissions from area source C\&I fuel oil combustion} &= \text{Annual county CO emissions (tons/yr)} \times \text{NAA:County C\&I employment ratio} \\
 &= 386.20 \times 0.9829 \\
 &= 379.59 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–9. Annual and season-day emissions from area-source commercial/institutional fuel oil combustion.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	386.20	3,465.9
CO NAA	379.59	3,406.6

3.2.5 Residential natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas sold, by user category, within the county. Annual emissions from residential natural gas combustion emissions were calculated by multiplying residential natural gas sales by emission factors for residential natural gas combustion listed in AP-42 Tables 1.4-1 and 1.4-2 (US EPA, 1998), as follows:

$$\begin{aligned}
 \text{Annual emissions from residential natural gas combustion} &= \text{Residential natural gas annual sales (MMCF)} \times \text{Residential natural gas emission factor for CO (lbs/MMCF)} \div 2,000 \text{ lbs/ton} \\
 &= 16,419.53 \times 40 \div 2,000 \text{ lbs/ton} \\
 &= 328.39 \text{ tons CO/yr}
 \end{aligned}$$

CO season-day emissions are calculated by first multiplying reported natural gas usage during the CO season (5,989.84 MMCF) by the emission factor for CO for residential natural gas combustion to produce CO season emissions (natural gas usage reported for the months of December-February are assumed to represent CO season usage). CO season emissions are then divided by the number of days during the CO season that residential natural gas combustion occurs (US EPA, 2001a).

$$\begin{aligned}
 \text{Season-day emissions from residential natural gas combustion} &= \text{Residential natural gas seasonal sales (MMCF)} \times \text{Residential natural gas emission factor for CO (lbs/MMCF)} \div (\text{days/week} \times \text{weeks/season}) \\
 &= 5,989.84 \times 40 \div (7 \times 13) \\
 &= 2,632.9 \text{ lbs CO/day}
 \end{aligned}$$

Annual and season-day residential natural gas emissions in the CO nonattainment area are calculated by multiplying county-level emissions by the percentage of total occupied households (98.18%) in the CO nonattainment area as follows:

$$\begin{aligned}
 \text{Annual emissions from residential natural gas combustion in the NAA} &= \text{County annual emissions} \times \text{Percentage of occupied households in the NAA} \\
 &= 328.39 \text{ tons/yr} \times 98.18\% \\
 &= 322.41 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.2–10. Annual and season-day emissions from residential natural gas combustion.

Geographic area	Annual emissions (tons/year)	CO season-day emissions (lbs/day)
Maricopa County	328.39	2,632.9
CO NAA	322.41	2,585.0

3.2.6 Residential wood combustion

Area source emissions from residential wood combustion are calculated based on the amount of wood burned in fireplaces and woodstoves in Maricopa County, as recommended by EIIP guidance (US EPA, 2001b). Residential wood combustion in the county is estimated by multiplying data on statewide residential wood combustion usage from the US Department of Energy (2003) by the ratio of county to state households that report use of wood for heating from the US Census Bureau (2003c). The latest available data on residential wood use for household heating from the US Census Bureau is for the calendar year 2000. Since all fireplaces in homes constructed since 1999 are required by Arizona statute to be clean-burning, it is assumed that these new homes have negligible emissions. Thus, year 2000 data is assumed to be representative of 2002 emissions.

$$\begin{aligned}
 \text{Maricopa County residential wood usage (cords/yr)} &= \text{Arizona residential wood usage (cords/yr)} \times \text{Ratio of county:state households using wood for heat} \\
 &= 491,000 \times 1,655 / 39,842 \\
 &= 20,396 \text{ cords/yr}
 \end{aligned}$$

To calculate emissions, the amount of wood used is converted to tons by multiplying cords by the number of cubic feet of wood in a cord and by the density of the wood used (US EPA, 2001b). Wood density is determined by weighted average of types of wood used for residential combustion in Maricopa County, provided by the US Forest Service (USFS, 1993).

$$\begin{aligned}
 \text{County residential wood usage (tons/yr)} &= \text{County wood usage (cords)} \times \text{avg. ft}^3 \text{ wood/cord} \times \text{Wood density (lbs/ft}^3) \div 2,000 \text{ lbs/ton} \\
 &= 20,396 \times 79 \times 31.57 \div 2,000 \\
 &= 25,433.73 \text{ tons}
 \end{aligned}$$

Annual emissions from residential wood combustion are calculated by multiplying the tons of wood used by the CO emission factor for residential total woodstoves and fireplaces from EIIP Volume III, Chap. 2, Table 2.4-1 (US EPA, 2001b):

$$\begin{aligned}
 \text{Annual CO emissions from residential wood combustion (tons/yr)} &= \text{Residential wood usage (tons)} \times \text{CO emission factor (lbs/ton)} \div 2,000 \text{ lbs/ton} \\
 &= 25,433.73 \times 252.6 \div 2,000 \\
 &= 3,212.28 \text{ tons CO/yr}
 \end{aligned}$$

Following EIIP guidance, season-day CO emissions are calculated by apportioning wood burning activity based on heating degree days (i.e., the number of degrees per day that the daily average temperature is below 65°F). Data provided by Arizona State University (2003) indicated that there were a total of 776 heating degree days in Phoenix during 2002, with 586 heating degrees days reported during the CO season. By applying the ratio of CO season heating degree days to annual heating degree days, CO season-day emissions are calculated as follows:

$$\begin{aligned}
 \text{Season-day CO emissions from residential wood combustion (lbs/day)} &= \text{Annual emissions (tons/yr)} \times \text{Heating degree days (ratio)} \times 2,000 \text{ lbs/ton} \div \text{CO season-days/yr} \\
 &= 3,212.28 \times (586 / 776) \times 2,000 \div 91 \\
 &= 53,313.6 \text{ lbs/day}
 \end{aligned}$$

Annual and season-day emissions within the CO nonattainment area (NAA) are calculated by multiplying county totals by the ratio of total occupied housing units inside the nonattainment area (1,337,099) to total residential housing units in the county (1,361,837). See Section 1.5.1 for a further discussion of the housing data used.

$$\begin{aligned}
 \text{NAA annual emissions from residential wood combustion (tons/yr)} &= \text{County annual emissions (tons/yr)} \times \text{NAA:county residential housing ratio} \\
 &= 3,212.28 \times 0.9818 \\
 &= 3,153.82 \text{ tons/yr}
 \end{aligned}$$

Table 3.2–11. Annual and season-day emissions from residential wood combustion.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	3,212.28	53,313.6
CO NAA	3,153.82	52,343.3

3.2.7 Residential fuel oil

Emissions from residential fuel oil use were calculated using an approach similar to that used for residential wood combustion described in Section 3.2.6. County-level residential fuel oil use was derived from statewide totals using the ratio of county to state households that report fuel oil use from the US Census Bureau (2003b):

$$\begin{aligned}
 \text{Maricopa County residential fuel oil usage (Mgal/yr)} &= \text{Arizona residential fuel oil use (Mgal/yr)} \times \text{Ratio of county:state households reporting fuel oil use} \\
 &= 340 \times 490 / 1,813 \\
 &= 91.89 \text{ Mgal/yr}
 \end{aligned}$$

An AP-42 emission factor of 5 lbs CO/Mgal, and data on heating degree days and residential housing units described in Section 3.2.6, were used to calculate annual and daily CO emissions shown in Table 3.2–12.

Table 3.2–12. Annual and season-day emissions from residential fuel oil combustion.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	0.23	3.8
CO NAA	0.23	3.7

3.2.8 Summary of all area-source fuel combustion

Table 3.2–13. Summary of annual and season-day area source fuel combustion.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Industrial natural gas	68.95	505.5	67.64	495.9
Industrial fuel oil	166.66	1,068.3	163.48	1,047.9
Commercial/institutional natural gas	655.00	5,594.0	643.80	5,498.4
Commercial/institutional fuel oil	386.20	3,465.9	379.59	3,406.6
Residential natural gas	328.39	2,632.9	322.41	2,585.0
Residential wood	3,212.28	53,313.6	3,153.82	52,343.3
Residential fuel oil	0.23	3.8	0.23	3.7
Totals:	4,817.71	66,584.1	4,730.96	65,380.8

3.3 Industrial processes

3.3.1 Chemical manufacturing

Emissions from area-source chemical manufacturing were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census’ County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–1 shows the NAICS codes and employment data used to calculate emissions from chemical manufacturing.

Table 3.3–1. NAICS codes and descriptions for chemical manufacturing.

NAICS Code	Description	US Census employment data	Value used
32551	Paint & coating manufacturing	100–249	175
32591	Printing ink manufacturing	20–99	60
422910	Farm supplies, wholesale	298	298
325991	Custom compounding of purchased resin	100–249	175
325998	All other misc. chemical product & prep. manufacturing	316	316
325188	All other basic inorganic chemical manufacturing	100–249	175
325412	Pharmaceutical manufacturing	500–999	750
Total:			1,949

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

$$\begin{aligned}
 \text{Total area-source employment in chemical mfg.} &= \text{Total employment (from US Census' County Business Patterns)} - \text{Employment at point sources (from annual emission reports)} \\
 &= 1,949 - 191 \\
 &= 1,758 \text{ employees}
 \end{aligned}$$

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\begin{aligned}
 \text{Total area-source emissions} &= \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment} \\
 \text{Area-source CO emissions from chemical mfg.} &= \frac{0.03 \text{ tons/yr}}{744 \text{ employees}} \times 1,758 \text{ employees} \\
 &= 0.07 \text{ tons CO/yr}
 \end{aligned}$$

CO season-day emissions are calculated based on the operating schedule data reported by chemical manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\begin{aligned}
 \text{Season-day CO emissions from chemical mfg.} &= \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\
 &= \frac{0.07 \times 25\%}{5 \times 13} \times 2,000 \\
 &= 0.5 \text{ lbs CO/day}
 \end{aligned}$$

Annual and season-day emissions for the CO nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{CO emissions from area-source chemical mfg. in the CO NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment} \\
 &= 0.07 \text{ tons/yr} \times 98.09\% \\
 &= 0.07 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.3–2 summarizes annual and season-day emissions from chemical manufacturing in both Maricopa County and the CO nonattainment area.

Table 3.3–2. Annual and season-day emissions from area-source chemical manufacturing.

Geographic area	Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
Maricopa County	0.07	0.5
CO NAA	0.07	0.5

3.3.2 Commercial cooking

Emissions from commercial cooking were estimated for five source categories based on equipment type. These equipment types include: chain-driven (conveyorized) charbroilers (SCC 2302002100), under-fired charbroilers (2302002200), flat griddles (2302003100), clamshell griddles (2302003200), and deep-fat fryers (2302003000). Emission inventory methods outlined in EPA guidance (US EPA, 2004) for these source categories include emissions from all meat types (hamburger, steak, fish, pork, and chicken) and five restaurant types (ethnic, fast food, family, seafood, and steak & barbeque).

Data obtained from MCESD’s eating and drinking establishments permit database indicated that 9,038 restaurants operated in Maricopa County in 2002. The percent of restaurants in Maricopa County for the five restaurant types was obtained from a commercial business database (Harris InfoSource, 2003). The percent of restaurants for each restaurant type was multiplied by the total number of restaurants operated in Maricopa County in 2002 to derive the number of restaurants for each restaurant type as shown in Table 3.3–3.

Using the number of restaurants for each restaurant type, along with the default emission factors and equations from US EPA (2004), emissions for each combination of equipment type, restaurant type, and meat type were calculated, and the results were summed to estimate annual emissions for each type of cooking equipment, as shown in Table 3.3–4.

Table 3.3–3. Maricopa County restaurants, by type.

Restaurant category	Percentage	# of restaurants
Ethnic food	14.47	1,308
Fast food	15.35	329
Family	3.64	1,387
Seafood	0.61	55
Steak & barbecue	1.15	104
Unrelated restaurant types (e.g., lunchrooms, bars)	64.79	5,856
All restaurants:	100.00	9,038

Table 3.3–4. Annual emissions from commercial cooking, by equipment type.

Equipment type	Annual CO emissions (tons/yr)
Chain-driven charbroilers	60.75
Underfired charbroilers	196.43
Deep fat fryers	0.00
Flat griddles	16.32
Clamshell griddles	0.00
Total:	273.50

Commercial cooking is assumed to occur uniformly throughout the year, therefore, it was assumed that 25% of annual activity occurs during the CO season, and activity occurs 7 days/week.

Table 3.3–5. Season-day emissions from commercial cooking, by equipment type.

Equipment type	CO season-day emissions (lbs/day)
Chain-driven charbroilers	333.8
Underfired charbroilers	1,079.3
Deep fat fryers	0.0
Flat griddles	89.7
Clamshell griddles	0.0
Total:	1,502.8

Annual and season-day emissions for the CO nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage population within the nonattainment area (98.09%). (See Section 1.5.1 for a discussion of the population data used.) Table 3.3–6 summarizes the annual and season-day emissions from commercial cooking for Maricopa County and the CO NAA.

Table 3.3–6. Annual and season-day emissions from commercial cooking.

Equipment type	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Chain-driven charbroilers	60.75	333.8	59.59	327.4
Underfired charbroilers	196.43	1,079.3	192.68	1,058.7
Deep fat fryers	0.00	0.0	0.00	0.0
Flat griddles	16.32	89.7	16.01	88.0
Clamshell griddles	0.00	0.0	0.00	0.0
Totals:	273.50	1,502.8	268.28	1,474.1

3.3.3 State-permitted portable sources

The Arizona Department of Environmental Quality (ADEQ) retains the authority to permit certain categories of sources within Maricopa County, including portable sources. MCESD requested information from ADEQ for all ADEQ-permitted sources that reported any activity in Maricopa County during 2002. Annual total emissions for each pollutant were provided, along with information on the facility type, and information on the location of the site during the year. Permits were classified into four major types: asphalt batch, concrete batch, crushing/screening, and other (including soil remediation, generators, etc.). From this information, emissions that occurred within Maricopa County were estimated as in the following example.

Data provided:

Source information: Fisher Sand & Gravel - Arizona Crusher #1, ID 13464
 Permit type: Portable crushing/screening plant
 Operating schedule: Operated in Maricopa County 1/3/02 to 4/20/02, Gila County from 4/30/02 to 6/15/02 and 6/20/02 to 11/02/02, and in Greenlee County from 11/08/02 to 12/31/02
 Total annual emissions: 1.7592 tons CO/year

Using this information, calculations were made to determine:

Total operating days in 2002: 345 = 29 (Jan.) + 28 (Feb.) + ... + 31 (Dec.)
 Total operating days in Maricopa County: 108 = 29 (Jan.) + 28 (Feb.) + 31 (Mar.) + 20 (April)
 Any operating days in Maricopa County during CO season? (December–February): yes

All emissions were assumed to be equally distributed among all reported days of operation. First, the total emissions attributable to activity in Maricopa County was calculated as follows:

$$\begin{aligned} \text{Annual CO emissions in Maricopa County (tons/yr)} &= \text{Total annual emissions} \times \frac{\text{operating days in Maricopa County}}{\text{total operating days in 2002}} \\ &= 1.7592 \times \frac{108}{345} \\ &= 0.55 \text{ tons CO/yr} \end{aligned}$$

If the facility had any operations in Maricopa County during the December–February CO season, season-day emissions (lbs/day) were calculated as follows:

$$\begin{aligned} \text{Season-day emissions (lbs/day)} &= \frac{\text{total emissions attributable to activity in Maricopa County}}{\text{number of operating days in Maricopa County}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= \frac{0.55 \text{ tons}}{108 \text{ days}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= 10.2 \text{ lbs CO/day} \end{aligned}$$

Table 3.3–7 summarizes the annual and season-day emissions for all ADEQ-permitted portable sources that operated within Maricopa County at some point during 2002. Since no precise location data was available, all emissions are conservatively assumed to have originated within the CO nonattainment area, therefore emissions in Maricopa County and the CO nonattainment area are equal.

Table 3.3–7. Emissions from ADEQ-permitted portable sources, by permit type.

Permit type	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Asphalt batch	25.34	173.8
Concrete batch	7.25	15.8
Crushing/screening	105.56	696.5
Other	0.28	1.5
Totals:	138.43	887.6

3.3.4 Industrial processes not elsewhere classified (NEC)

Annual area-source emissions from other industrial processes not elsewhere classified (NEC) were derived from annual emissions reports from permitted facilities. Other industrial processes include a wide array of industrial activities that are often specific to the permitted facility that reported the process. For this reason, it is assumed there are no significant emissions from other industrial processes, other than those reported by permitted facilities on their annual emissions reports. CO season-day emissions are calculated based on operating schedule information provided by the facilities in their annual emissions report. All facilities that reported area-source emissions from other industrial processes are located inside the CO nonattainment area, therefore emissions for Maricopa County and the CO NAA are equal.

Table 3.3–8. Annual and season-day emissions from other industrial processes.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	0.98	7.5
CO NAA	0.98	7.5

3.3.5 Summary of all area-source industrial processes

Table 3.3–9 provides a summary of annual and season-day emissions from all industrial processes.

Table 3.3–9. Summary of annual and season-day area source industrial processes.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Chemical manufacturing	0.07	0.5	0.07	0.5
Commercial cooking	273.50	1,502.8	268.28	1,474.1
State-permitted portable sources	138.43	887.6	138.43	887.6
Industrial processes NEC	0.98	7.5	0.96	7.5
Totals:	412.98	2,398.4	407.74	2,369.6

3.4 Waste treatment and disposal

3.4.1 On-site incineration

This section includes emissions from on-site industrial incinerators, primarily burn-off ovens used to reclaim electric wire or other materials. Emissions from human and animal crematories are addressed in Section 3.5.2. There were no incinerators at residential (e.g., apartment complexes) or commercial/institutional facilities (e.g., hospitals, service establishments) in operation during 2002.

Emissions from on-site incineration were determined from annual emission inventory reports. Of the four incinerators under permit in 2002, two were surveyed and reported annual emissions. As all four facilities are roughly similar in terms of capacity, these survey results were doubled to estimate total annual and season-day emissions from all four incinerators in Maricopa County. All four facilities are located within the CO nonattainment area, thus total emissions for the county and NAA are equal.

Table 3.4-1. Annual and season-day emissions from on-site incineration.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	0.59	4.5
CO NAA	0.59	4.5

3.4.2 Open burning

Emissions from controlled open burning are regulated by MCESD Rule 314, which requires a burn permit for open burning in Maricopa County. Burn permits are issued primarily for purposes of agricultural ditch bank and fencerow burning, tumbleweed burning, land clearance, air curtain destructor burning of trees, and fire fighting training. Maricopa County's burn permit data base was used to identify all burn permits issued during 2002. A total of 140 permits were issued during the year; however, not all permit applications contained the information needed to calculate emissions. Where data were missing, activity data for each permit category was grown from those permits that contained information, as follows:

$$\text{Total activity} = \sum \text{activity reported} \times \frac{\text{total number of permits issued}}{\text{number of permits with activity data}}$$

Example:

$$\begin{aligned} \text{Total ditch -} & \\ \text{bank/fencerows} & = 973,885 \text{ linear ft} \times \frac{85 \text{ ditchbank/fencerow burn permits issued}}{29 \text{ permits with quantitative data}} = 2,854,491 \text{ linear ft} \end{aligned}$$

Reported and estimated activity data for each open burning category are summarized in Table 3.4-2. Permits issued for fire fighting training are addressed in Section 3.5.1.2, Structure fires.

Table 3.4–2. 2002 Maricopa County burn permit activity data.

Category	Unit of measure	Total reported activity	Number of permits with activity data	Total permits issued	Activity grown to total number of permits issued
Ditchbank/fencerow	Linear ft	973,885	29	85	2,854,491
Land clearance	Acres	1,345	17	34	2,690
Land clearance	Piles	69	8	34	293
Air curtain	Trees	200	1	2	400
Tumbleweeds	Piles	9	3	8	24

The above activity data were converted to tons material burned using fuel loading factors from AP-42, Table 2.5-5 (US EPA, 1992). The emission and loading factors used are shown in Table 3.4–3.

Table 3.4–3. Emission and fuel loading factors for open burning.

Category	CO emission factor (lb/ton burned)	Fuel loading factors
Weeds, unspecified	85	3.2 tons/acre
Russian Thistle (tumbleweeds)	309	0.1 tons/acre
Orchard Crops: Citrus	81	1.0 tons/acre

The following assumptions were made based on previous MCESD emission inventory work:

- Ditch banks and fence rows in Maricopa County average 7 feet in width and are burned twice per year (MCESD, 1999).
- A pile of tumbleweeds 15 feet in diameter and 5 feet high weighs 200 lbs (MCESD, 1993). This is equivalent to the AP-42 fuel loading factor for tumbleweeds – 0.1 tons/acre.
- The estimated weight of a mature, partially dried citrus tree, including trunk, limbs and bulk of root is 500 lbs per tree (MCESD, 1993).

To calculate the annual amount of material burned on ditch banks and fence rows in Maricopa County, MCESD estimated the area burned and then applied AP-42 fuel loading factor. The tons of material burned in ditch banks and fence rows in Maricopa County were estimated as follows:

$$\begin{aligned}
 &\text{Material burned} \\
 &\text{for ditch bank and} \\
 &\text{fence row burning} \\
 &= \frac{2,854,491 \text{ ft length} \times 7 \text{ ft width} \times 3.2 \text{ tons/acre} \times 2 \text{ times/year}}{43,560 \text{ ft}^2 / \text{acre}} \\
 &= 2,936 \text{ tons material burned/yr}
 \end{aligned}$$

Activity data for the other categories were similarly converted to material burned using AP-42 fuel loading factors.

Annual emissions were then calculated by multiplying the amount of material burned by emission factors listed in AP-42 (Table 3.4–3). To account for unpermitted illegal outdoor burning, the county's Air Quality Complaint data base was examined, which indicated 65 illegal outdoor open burning complaints (mostly residential) and 6 issued Notices of Violation. All calculated emissions estimates were thus increased by 10 percent, as a conservative estimate.

$$\begin{aligned}
 \text{Annual CO emissions from ditchbank and fence row burning} &= \text{Total material burned} \times \text{emission factor} \times \text{unit conversion factor} \\
 &= 2,936 \text{ tons} \times 85 \text{ lbs/ton} \times 1 \text{ ton} / 2,000 \text{ lbs} \\
 &= 124.78 \text{ tons CO/yr}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total annual CO emissions including unpermitted burning} &= \text{Calculated emissions from permit data} + \text{unpermitted burning adjustment factor} \\
 &= 124.78 \text{ tons/yr} + (10\% \times 124.78) \\
 &= 137.25 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.4–4 summarizes the annual emissions for Maricopa County from each open burning category.

Table 3.4–4. Annual emissions from open burning (tons/yr).

Category	CO emissions	
	Ton-equivalents	(tons/yr)
Ditchbank/fencerow	2,935.7	137.25
Land clearance	9,545.5	446.25
Air curtain	100.0	4.46
Tumbleweeds	2.4	0.41
Total:		588.36

Annual emissions for the nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the CO nonattainment area by the Maricopa County emission totals. (See Section 1.5.2 for a discussion of the land-use data used.) Table 3.4–5 summarizes the annual emissions for the CO nonattainment area.

Table 3.4–5. Surrogate land-use classes, ratios and annual emissions from open burning in the CO NAA.

Category	Surrogate land-use category	2000 NAA:county	
		land-use ratio	Emissions (tons/yr)
Ditchbank/fencerow	Agriculture	44.53 %	61.12
Land clearance	Vacant	15.62 %	69.70
Air curtain	agriculture and vacant	19.53 %	0.87
Tumbleweeds	agriculture and vacant	19.53 %	0.08
Total:			131.77

Ditch bank/fence row burning is not allowed from November to February, therefore daily emissions during the CO season are zero. For the other burning categories, it was assumed that open burning occurs 5 days per week (most burn permits are issued for weekdays but permits may be issued on weekends depending on circumstances) and open burning occurs evenly during the CO season months (November – December). A seasonal adjustment factor was derived as follows:

$$\text{Seasonal adjustment factor} = \frac{\# \text{ of permits issued Nov. – Dec. for the category}}{\text{total \# of permits issued in 2002 for the category}}$$

Example:

$$\begin{aligned}
 \text{Seasonal adjustment factor for tumbleweed burning} &= \frac{3 \text{ permits issued during Nov. – Dec. for tumbleweed burning}}{8 \text{ total permits issued in 2002 for tumbleweed burning}} \\
 &= 37.50 \%
 \end{aligned}$$

CO season-day emissions for Maricopa County are derived using the following formula:

$$\begin{aligned}
 \text{CO season-day emissions from tumbleweed burning} &= \frac{(\text{annual CO emissions lbs}) \times (\text{seasonal adjustment factor})}{(\text{\# of burn days/week}) \times (\text{\# of season weeks/year})} \\
 &= \frac{820 \text{ lbs} \times 0.3750}{5 \text{ days/wk} \times 13 \text{ wks/yr}} \\
 &= 4.73 \text{ lbs CO/day}
 \end{aligned}$$

CO season-day emissions for the nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the nonattainment area (listed in Table 3.4–5) by the total County season-day emissions. Table 3.4–6 summarizes the CO season-day emissions from open burning for both Maricopa County and the CO nonattainment area.

Table 3.4–6. Season-day emissions (lbs/day) from open burning.

Category	Maricopa County (lbs/day)	CO nonattainment area (lbs/day)
Ditchbank/fencerow	0.0	0.0
Land clearance	3,634.6	567.7
Air curtain	0.0	0.0
Tumbleweeds	4.7	0.9
Totals:	3,639.3	568.6

3.4.3 Landfills

Emissions from municipal solid waste (MSW) landfills come from uncontrolled landfill gas emissions as well as combustion from control measures, such as flares. Total emissions were calculated from annual emissions inventory reports from all landfills located within the county. Two MSW landfills (Butterfield Station and Allied Waste Industries Southwest Regional Facility) are considered point sources and are reported in Chapter 2. All other MSW landfills are reported here as area source landfills.

Since there are no area-source landfills located outside the CO nonattainment area, total emission values for the county and the CO nonattainment area are equal. Season-day emissions were calculated based on reported activity data (days per week) for each individual process, and then summed. Nearly all processes reported operating on a 7 day week. Emissions within the CO nonattainment area were identified using information on the location of each permitted facility. Annual and daily emissions are shown in Table 3.4–7.

Table 3.4–7. Annual and season-day emissions from landfills.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	27.35	150.3
CO NAA	27.35	150.3

3.4.4 Summary of all area-source waste treatment and disposal

Table 3.4–8. Summary of annual and season-day emissions from waste treatment and disposal.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
On-site incineration	0.59	4.5	0.59	4.5
Open burning	588.36	3,639.3	131.77	568.6
Landfills	27.35	150.3	27.35	150.3
Totals:	616.30	3,794.2	159.71	723.5

3.5 Miscellaneous area sources

3.5.1 Other combustion

3.5.1.1 Wildfires and brush fires

The Arizona Department of Environmental Quality, in cooperation with the United States Forest Service, reported that one wildfire burned 1000 acres in the Tonto National Forest in July 2002. The wildfire occurred within Maricopa County but outside of the nonattainment area. ADEQ also reported that negligible prescribed fires occurred in Maricopa County in 2002.

In addition, 2002 survey results from Maricopa County fire departments, the Bureau of Land Management, and the Arizona State Land Department were used to calculate emissions from brush fires. In some cases, the survey results included limited information on the average size of fires. Thus, when acreage data was incomplete or unclear, each reported brush fire was assumed to be equal to 0.1 acres. Survey results are included in Appendix 3.1. It was estimated that 7,054 brush fires occurred in Maricopa County in 2002 and burned approximately 1,656.5 acres.

Wildfire emission factors and fuel loading factors were obtained from the Western Regional Air Partnership’s (WRAP) 1996 Fire Emission Inventory (WGA/WRAP, 2002), while brush fire emission factor and fuel loading factors were obtained from AP-42 (US EPA, 1992). Both are listed in Table 3.5–1. Estimates of the material burned in are derived by multiplying the number of acres burned by the appropriate fuel loading factor. For wildfires, a “combustive efficiency” factor of 90% is included in the calculation to reflect the fact that not all available material (fuel) is consumed in a wildfire (WGA/WRAP, 2002).

Table 3.5–1. Emission and fuel loading factors for wildfires and brush fires.

Type of fire	Fires reported	Number of acres burned	Fuel loading factor (tons/acre)	CO emission factor (lbs/ton burned)
Wildfire (Calif. chaparral)	1	1,000	19.5	289
Brush fire (weeds)	7,054	1656.5	3.2	85

Annual emissions from wildfires in Maricopa County were calculated as follows:

$$\begin{aligned}
 \text{Annual CO emissions from wildfires in Maricopa County} &= \frac{\text{acres burned} \times \text{fuel loading factor} \times \text{combustive efficiency} \times \text{emission factor (lbs/ton)}}{2,000 \text{ lbs/ton}} \\
 &= \frac{1,000 \text{ acres burned} \times 19.5 \text{ tons/acre} \times 90\% \times 289 \text{ lbs/ton}}{2,000 \text{ lbs/ton}} \\
 &= 2,535.98 \text{ tons CO/yr}
 \end{aligned}$$

Because the 1,000-acre wildfire occurred in the Tonto National Forest, which is located outside of the nonattainment area, emissions from wildfires within the nonattainment area were determined to be zero. However, annual emissions from brush fires for the nonattainment area were calculated by multiplying the Maricopa County annual emissions by the percentage of vacant land located in the CO nonattainment area (15.62%), as shown in Table 3.5–2. (See Section 1.5.2 for a discussion of the land-use data used.)

$$\begin{aligned}
 \text{Annual CO emissions from brush fires within the CO NAA} &= \text{Annual CO emissions from brush fires, County total} \times \text{Percentage of vacant land within the NAA} \\
 &= 225.28 \text{ tons/yr} \times 15.62\% \\
 &= 35.19 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.5–2. Annual emissions from wildfires and brush fires (tons/yr).

Type of fire	Maricopa County	CO nonattainment area
Wildfire	2,535.98	0.00
Brush fire	225.28	35.19
Totals:	2,761.25	35.19

Because the 1,000-acre wildfire occurred in July 2002 and the CO season is November through January, it was presumed that no wildfires occurred during the CO season; therefore season-day emissions from wildfires were zero. It was assumed that brush fires occur evenly throughout the year. Thus, CO season-day emissions from brush fires were derived by dividing the annual emissions from brush fires for Maricopa County and the nonattainment area by a 365 days/yr, as follows:

$$\begin{aligned}
 \text{Season-day CO emissions from brush fires in Maricopa County} &= \frac{225.28 \text{ tons/yr}}{365 \text{ days/yr}} \times 2,000 \text{ lbs/ton} \\
 &= 1,234.41 \text{ lbs/day}
 \end{aligned}$$

Table 3.5–3. Season-day emissions from wildfires and brush fires (lbs/day).

Type of fire	Maricopa County	CO nonattainment area
Wildfire	0.0	0.0
Brush fire	1,234.4	192.8
Totals:	1,234.4	192.8

3.5.1.2 Structure fires

2002 structure fire data were obtained by surveying fire departments in Maricopa County and by querying Maricopa County's burn permit data base. The fire departments surveyed reported 3,597 structure fires in Maricopa County in 2002. The list of fire departments surveyed and survey results are contained in Appendix 3.1. Eleven open burn permits were issued in 2002 for fire training; these were included in the total number of estimated structure fires for 2002. It was estimated that 3,608 structure fires occurred in Maricopa County in 2002.

Estimates of the material burned in a structure fire were determined by multiplying the number of structure fires by a fuel loading factor of 1.15 tons of material per fire, which factors in percent structural loss and content loss (US EPA, 2001c). Tons of material burned were estimated as the follows:

$$\begin{aligned} \text{Material burned in} &= 3,608 \text{ fires} \quad \times \quad 1.15 \text{ tons/fire} \\ \text{structure fires (tons/yr)} &= 4,149.2 \text{ tons material burned/year} \end{aligned}$$

Table 3.5–4. Estimated material burned, emission and fuel loading factors for structure fires.

Structure fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	CO emission factor (lbs/ton)
3,608	1.15	4,149.20	60

Annual emissions were then calculated by multiplying the amount of material burned by the emission factors listed in Table 3.5–4 (US EPA, 2001c), as follows:

$$\begin{aligned} \text{Annual CO emissions} &= \text{Quantity of material burned} \quad \times \quad \text{emission factor} \quad \times \quad \text{unit conversion factor} \\ \text{from structure fires} & \\ \text{Maricopa County} &= 4,149.20 \text{ tons} \quad \times \quad 60 \text{ lbs/ton} \quad \times \quad (1 \text{ ton}/2,000 \text{ lbs.}) \\ &= 124.48 \text{ tons CO/yr} \end{aligned}$$

Annual emissions for the CO nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the CO nonattainment area (98.06%), as shown in the example below. See Section 1.5.1 for a discussion of the population data used.

$$\begin{aligned} \text{Annual CO emissions} &= \text{annual CO emissions} \quad \times \quad \text{percentage residential} \\ \text{within the CO NAA} & \quad \text{for Maricopa County} \quad \quad \text{population within the NAA} \\ &= 124.48 \text{ tons/year} \quad \times \quad 98.06 \% \\ &= 122.06 \text{ tons CO/yr} \end{aligned}$$

It was assumed that structure fires occur 7 days a week; however, structure fires vary seasonally and may increase during cold weather. Because local season-specific data were not available from the fire department surveys, seasonal occurrences of residential and non-residential structure fires reported by the Federal Emergency Management Agency (FEMA) were used to derive a seasonal adjustment factor for the CO season (US EPA, 2001c). FEMA reported that 29.6% of residential structure fires and 24.5% of non-residential structural fires occurred during

November, December, and January 1994. Thus, an average occurrence of 27.05% [(29.6% + 24.5%) ÷ 2] was used as a seasonal adjustment factor to estimate CO season-day emissions.

CO season-day emission for Maricopa County were derived using the following formula:

$$\begin{aligned}
 \text{CO season-day emissions from structure fires in Maricopa County} &= \frac{\text{annual CO emissions (lbs)} \times \text{seasonal adjustment factor (\%)}}{7 \text{ days/wk} \times 13 \text{ weeks/yr}} \\
 &= \frac{248,960 \text{ lbs} \times 27.05\%}{91} \\
 &= 740.04 \text{ lbs CO/day}
 \end{aligned}$$

CO season-day emissions for the nonattainment area are calculated by multiplying the Maricopa County season-day emissions by the percentage of total residential population within the CO nonattainment area (98.06%). Results are shown in Table 3.5–5.

Table 3.5–5. Annual and season-day emissions from structure fires.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	124.48	740.0
CO NAA	122.06	725.7

3.5.1.3 Vehicle fires

2002 vehicle fire data were obtained by surveying fire departments in Maricopa County. The fire departments surveyed reported 5,316 vehicle fires (4 boat fires were included in vehicle fires) in Maricopa County in 2002. The list of fire departments surveyed and survey results are presented in Appendix 3.1.

Annual emissions from vehicle fires are calculated by first multiplying the number of vehicle fires by a fuel loading factor of per vehicle fire to estimate the annual amount of material burned in vehicle fires. The amount of annual material burned in vehicle fires is then multiplied by emission factors for open burning of automobile components from AP-42 as listed in Table 3.5–6 (from US EPA, 1992).

$$\begin{aligned}
 \text{Annual CO emissions from vehicle fires} &= \text{annual number of vehicle fires} \times \text{fuel loading factor} \times \text{emission factor} \times \text{unit conversion factor} \\
 &= 5,316 \times 0.25 \text{ tons/vehicle} \times 125 \text{ lbs/ton} \times (1 \text{ ton} / 2,000 \text{ lbs}) \\
 &= 83.06 \text{ tons CO/yr}
 \end{aligned}$$

Table 3.5–6. Estimated material burned, emission and fuel loading factors for vehicle fires.

Vehicle fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	CO emission factor (lbs/ton)
5,316	0.25	1,329	125

Annual emissions for the CO nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the CO nonattainment area (98.06%). See Section 1.5.1 for a discussion of the population data used.

It was assumed that vehicle fires occur evenly throughout the year. Thus, CO season-day emissions were derived by dividing the Maricopa County and nonattainment area annual emissions by 365 days/year. The results are shown in Table 3.5–7 below.

Table 3.5–7. Annual and season-day emissions from vehicle fires.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	83.06	455.1
CO NAA	81.45	446.3

3.5.1.4 Engine testing

Annual emissions from engine testing facilities were derived from annual emission reports from permitted sources that were not considered point sources in this inventory. It was assumed that there were no significant unpermitted sources within Maricopa County. Season-day emissions were calculated based on operating schedule information provided in the facilities’ annual emission reports. Since all facilities considered in this section are located within the CO non-attainment area, total emission values for the county and the CO NAA are equal. Results are shown in Table 3.5–8.

Table 3.5–8. Annual and season-day emissions from engine testing.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	3.67	99.9
CO NAA	3.67	99.9

3.5.2 Health services: crematories

Emissions from human and animal crematories were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003a) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the Census’ County Business Patterns (CBP), for 2001 employment, were used. CBP employment data for NAICS code 81222 (cemeteries and crematories) indicated 683 employees in this industry in Maricopa County. This employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\begin{aligned}
 \text{Total area-source CO emissions from crematories} &= \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment} \\
 &= \frac{0.17 \text{ tons/yr}}{110} \times 683 \text{ employees} \\
 &= 1.06 \text{ tons CO/yr}
 \end{aligned}$$

Season-day emissions are calculated based on the operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\begin{aligned} \text{Season-day CO emissions from crematories} &= \frac{\text{Annual emissions (tons/yr)} \times \text{seasonal \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= \frac{1.06 \times 25\%}{5 \times 13} \times 2,000 \\ &= 8.2 \text{ lbs CO/day} \end{aligned}$$

As all facilities addressed in this source category are located within the CO nonattainment area, emission totals for both areas are equal. Annual and daily emissions are shown in Table 3.5–9.

Table 3.5–9. Annual and season-day emissions from crematories.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	1.06	8.2
CO NAA	1.06	8.2

3.5.3 Accidental releases

As part of its air quality permit compliance program, MCESD keeps an “upset log” for each calendar year, that records excess emissions and accidental releases at permitted facilities. Annual emissions inventory reports also provide for recording of accidental releases. Data from these two sources documented the release of 3.47 tons of CO for the year 2002. Season-day emissions of CO are assumed to be zero, as no recorded releases occurred during the CO season. Emissions in the CO nonattainment area are calculated based on locations of facilities that reported releases. In 2002, all recorded releases occurred outside the CO NAA.

Table 3.5–10. Annual and season-day emissions from accidental releases.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	3.47	0.0
CO NAA	0.00	0.0

3.5.4 Summary of all miscellaneous area sources

Table 3.5–11. Summary of annual and season-day emissions from all miscellaneous area sources.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Wildfires and brushfires	2,761.25	1,234.4	35.19	192.8
Structure fires	124.48	740.0	122.06	725.7
Vehicle fires	83.06	455.1	81.45	446.3
Engine testing	3.67	99.9	3.67	99.9
Crematories	1.06	8.2	1.06	8.2
Accidental releases	3.47	0.0	0.00	0.0
Totals:	2,976.99	2,537.6	243.43	1,472.79

3.6 Summary of area source emissions

Table 3.6–1 summarizes the total annual and CO season-day emissions from all area sources addressed in this chapter for both Maricopa County and the CO nonattainment area.

Table 3.6–1. Summary of annual and season-day area source emissions, by source category.

Source category	Maricopa County		CO nonattainment area	
	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Fuel combustion:				
Industrial natural gas	68.95	505.5	67.64	495.9
Industrial fuel oil	166.66	1,068.3	163.48	1,047.9
Commercial/institutional natural gas	655.00	5,594.0	643.80	5,498.4
Commercial/institutional fuel oil	386.20	3,465.9	379.59	3,406.6
Residential natural gas	328.39	2,632.9	322.41	2,585.0
Residential wood	3,212.28	53,313.6	3,153.82	52,343.3
Residential fuel oil	0.23	3.8	0.23	3.7
Total, all fuel combustion:	4,817.71	66,584.1	4,730.96	65,380.8
Industrial processes:				
Chemical manufacturing	0.07	0.5	0.07	0.5
Commercial cooking	273.50	1,502.8	268.28	1,474.1
State-permitted portable sources	138.43	887.6	138.43	887.6
Industrial process NEC	0.98	7.5	0.96	7.4
Total, all industrial processes:	412.98	2,398.4	407.74	2,369.6
Waste treatment/disposal:				
On-site incineration	0.59	4.5	0.59	4.5
Open burning	588.36	3,639.3	131.77	568.6
Landfills	27.35	150.3	27.95	150.3
Total, all waste treatment/disposal:	616.30	3,794.2	159.71	723.5
Miscellaneous area sources:				
Wildfires and brush fires	2,761.25	1,234.4	35.19	192.8
Structure fires	124.48	740.0	122.06	725.7
Vehicle fires	83.06	455.1	81.45	446.3
Engine testing	3.67	99.9	3.67	99.9
Health Services: crematories	1.06	8.2	1.06	8.2
Accidental releases	3.47	0.0	0.00	0.0
Total, all misc. area sources:	2,976.99	2,537.6	243.43	1,472.8
Total, all area sources:	8,823.98	75,314.2	5,541.86	69,946.8

3.7 Quality assurance / quality control procedures

Quality assurance and quality control (QA/QC) activities for the area source emissions inventory were driven by the goal of creating a comprehensive, accurate, representative and comparable inventory of area source emissions for Maricopa County and the nonattainment area. During each step of creating, building and reviewing the area source emissions inventory, quality checks and assurances were performed to establish confidence in the inventory structure and data.

Area source categories were selected for inclusion in the inventory based on the latest Emission Inventory Improvement Program (EIIP) guidance available. EPA's guidance for area source categories included in the draft 2002 National Emission Inventory (NEI) was also evaluated, as

area source emissions from this inventory will be submitted to EPA for the 2002 NEI. The list of area source categories developed based on these guidance documents was modified to fit the characteristics of Maricopa County, with some area source categories determined to be insignificant (such as industrial coal combustion and oil and gas production). The 1999 Maricopa County Periodic Ozone and Carbon Monoxide Emission Inventories and other regional emission inventories were also consulted to confirm the completeness of the area source categories chosen for inclusion.

Data for area source emission calculations were gathered from a wide universe of resources. Whenever applicable, local surveyed data (such as annual emissions report) was used as this data best reflects activity in the county and the nonattainment area. When local data was not available, state data from Arizona State agencies (such as the Arizona Department of Transportation) and regional bodies (such as the Western Regional Air Partnership {WRAP}) were used. National level data (such as the US Census Bureau) was used when no local, state or regional data was available. In addition, the most recent EIIP guidance for area sources was consulted for direction in determining the most relevant data source for use in emissions calculations.

Emissions calculations for area sources were performed by three air quality planners and one unit manager. All area source emission estimates were calculated in spreadsheets to ensure the calculations could be verified and reproduced. Whenever possible or available, the “preferred method” described in the most recent EIIP guidance documents for area sources was used to calculate emissions. Emissions were estimated using emission factors from EIIP guidance, AP-42, and local source testing. Local seasonal and activity data were used when available, with EPA and EIIP guidance used when no local seasonal or activity data existed. All calculations were evaluated to ensure that emissions from point sources were not being double-counted and to determine if rule effectiveness applied.

Once area source emission estimates had been produced, several quality control checks were performed to substantiate the calculations. Most area source calculations were peer-reviewed by two other planners, with all area sources being reviewed by at least one other planner. Peer review ensured that all emission calculations were reasonable and could be reproduced. Sensitivity analyses and computational method checks were performed on area sources when emissions seemed to be outside the expected ranges. When errors were found, the appropriate changes were made by the author of the calculations to ensure consistency of the emissions calculations. The peer-reviewed emissions estimates were combined into a draft area source chapter. This draft chapter was read through in its entirety by the unit manager and the three air quality planners for final review, with any identified errors corrected by the author of the section.

The draft version of the area source chapter was sent to the Arizona Department of Environmental Quality, the Arizona Department of Transportation, and the Maricopa Association of Governments for a quality assurance review. These agencies provided comments which were addressed and incorporated into the final area source chapter. Further quality analysis was performed by inputting the emission estimates into EPA’s “QA/QC basic format and content checker”, prior to submitting the data to the 2002 NEI.

The QA/QC activities described here have produced high levels of confidence in the area source emissions estimates detailed in this chapter, and represent the best efforts of the inventory preparers.

3.8 References

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4. Nonroad Mobile Sources

4.1 Introduction

Nonroad mobile sources are defined as those sources that move or are moved within a 12-month period and are not licensed or certified as highway vehicles. Nonroad mobile sources are vehicles and engines that fall under the following categories:

- Agricultural equipment, such as tractors, combines and balers;
- Airport ground support equipment, such as baggage tugs, and terminal tractors;
- Commercial equipment, such as generators and pumps;
- Industrial equipment, such as forklifts and sweepers;
- Construction and mining equipment, such as graders, back hoes and trenchers;
- Lawn and garden equipment, such as leaf blowers and lawn mowers;
- Logging equipment, such as shredders and large chain saws;
- Pleasure craft, such as power boats and personal watercraft;
- Railway maintenance equipment, such as rail straighteners;
- Recreational equipment, such as all-terrain vehicles and off-road motorcycles;
- Underground mining and oil field equipment, such as mechanical drilling engines (not present in Maricopa County);
- Aircraft, such as jet and piston engines; and
- Locomotives, such as switching and line haul trains.

Emission calculations for most nonroad mobile sources are derived from a Maricopa County nonroad emission inventory of certain visibility-impairing pollutants (PM₁₀, PM_{2.5}, NO_x and SO_x) developed by ENVIRON International Corp. for calendar year 2002 (ENVIRON et al., 2003). ENVIRON prepared the inventory for use and review by the Cap and Trade Oversight Committee (CTOC) formed by the Arizona Department of Environmental Quality (ADEQ). In the inventory prepared for the Cap and Trade Committee, EPA's NONROAD2002 model from EPA (Core Version 2.1d March, 2002) was used to estimate emissions for all categories except aircraft and locomotives. Nonroad modeling for the ENVIRON inventory was based on recent NONROAD modeling performed for the Western Regional Air Partnership (WRAP) for use in the development of a regional haze rule.

Since the modeling done for the CTOC was only annual totals for Maricopa County, additional work was needed to develop estimates for the CO nonattainment area and for an average CO season day. Emission calculations for this report differ from the CTOC work in one major area: emission estimates prepared for the CTOC were derived from season average weekday calculations, which were then multiplied by the number of days in each season to produce season totals, and then summed to produce annual emission totals. This approach assumes that activity levels of nonroad equipment are the same on weekdays and weekends.

For this report, ENVIRON re-ran the NONROAD2002 model to produce season totals, which are then summed to produce annual emission totals. The revised method used for this report results in annual emissions levels that are about 15% less than the method used for the CTOC inventory. The method used by ENVIRON for this report takes into account the different

activity levels experienced on weekdays versus weekends, which explains the lower annual emissions.

The NONROAD model define four seasons as follows: spring – March through May, summer – June through August, fall – September through November, and winter – December through February. Since the gasoline oxygen content in Maricopa County changes on September 30, emissions from the fall quarter were calculated for each month separately, and then summed. Seasonal emissions totals are then summed to produce annual emission totals.

The methods used to estimate CO season-day emissions are described in each section of this chapter. Emission estimates from the winter season (December–February) are assumed to represent emissions in the CO season (November–January).

Temperature and fuel-related inputs are required for the operation of the NONROAD2002 model. The inputs listed below were used by ENVIRON after ADEQ review:

Fuel volatility (Reid Vapor Pressure [RVP]), psi: 9.0 in winter, 8.1 in spring, 7.8 in summer and fall.

- Gasoline oxygen content (weight %): 3.36 from October through February, 0.0 otherwise.
- Gasoline sulfur content (ppm): 179 in fall and winter, 115 in spring and summer.
- Diesel sulfur content (ppm): 310 all seasons.
- Temperatures (minimum/average/maximum °F): 39/55/65 winter, 53/72/83 spring, 78/94/104 summer, 57/78/87 fall.

EPA recommends adjusting default NONROAD2002 model values (such as equipment population, activity levels of equipment, growth factors, etc.) where local data is available, as the default values in the model are derived from national averages. ENVIRON adjusted the NONROAD2002 model defaults in the following manner:

- The NONROAD model uses 1996 as a base year, and then projects emissions for any given year based on growth factors inherent in the model. The default growth factors in the model were zeroed out to reflect base year 1996 equipment population numbers. Arizona-specific growth factors developed for WRAP were then applied to the NONROAD2002 model outputs to produce 2002 year population numbers and associated emissions.
- Equipment population numbers and activity levels for commercial lawn and garden equipment were adjusted based on survey results of the commercial lawn and garden industry performed by ENVIRON as part of the CTOC work. Survey results show that for most categories of lawn and garden equipment, the equipment populations for Maricopa County are significantly lower than EPA default values, while the average annual hours of operation for most equipment types are slightly higher than EPA's values. Using these new local data results is a considerable decrease in emissions from this category, compared with earlier results using EPA default data.
- Equipment population numbers and activity levels for airport ground support equipment were adjusted based on Maricopa County-specific data provided by the Maricopa Association of Governments (MAG) for the CTOC inventory.

Spatial allocation factors were developed, based on EPA guidance documents, to apportion nonroad emissions to the CO nonattainment area. The approaches used are described in each section of this chapter.

Temporal allocations (used to calculate CO season-day emissions) for nonroad equipment categories modeled in the NONROAD2002 model come from EPA recommendations on weekday and weekend day activity levels for each nonroad equipment category (US EPA, 1999). Table 4.1–1 below lists the weighted activity level allocation fractions for each equipment class for weekdays and weekend days. For this report, the most conservative (highest) allocation fraction in each nonroad equipment class was used to calculate season-day emissions.

Table 4.1–1. Default weekday and weekend day activity allocation fractions.

Equipment category	Weekday	Weekend day
Agricultural	0.1666667	0.0833334
Airport ground support	0.1428571	0.1428571
Commercial	0.1666667	0.0833334
Construction and mining	0.1666667	0.0833334
Industrial	0.1666667	0.0833334
Lawn and garden (residential)	0.1111111	0.2222222
Lawn and garden (commercial)	0.1600000	0.1000000
Logging	0.1666667	0.0833334
Pleasure craft	0.0600000	0.3500000
Railway maintenance	0.1800000	0.0500000
Recreational	0.1111111	0.2222222

4.2 Agricultural equipment

Annual emissions from agricultural equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as discussed above. Emissions are reported by engine type: gasoline 2-stroke, gasoline 4-stroke, diesel, compressed natural gas (CNG), and liquid petroleum gas (LPG). Emissions from CNG and LPG equipment are reported in the gasoline 4-stroke category, as total emissions from these engine types were either trivial or none. County-wide results are shown in Table 4.2–1.

Table 4.2–1. Annual emissions from agricultural equipment in Maricopa County.

Source Classification Code (SCC)	Engine type	CO emissions (tons/year)
2260005000	Gasoline 2-stroke	2.12
2265005000	Gasoline 4-stroke	355.26
2270005000	Diesel	275.58
Total:		632.96

CO nonattainment area annual emissions were calculated based on EIIP guidance (US EPA, 2002) which recommends using the ratio of agricultural land inside the nonattainment area (185,029 acres) to agricultural land inside the county (415,473 acres). See Section 1.5.2 for a discussion of land-use data used.

$$\begin{aligned}
 \text{CO nonattainment area emissions from agricultural equipment} &= \text{County CO emissions} \times \text{Agricultural land-use allocation factor} \\
 &= 632.96 \text{ tons} \times 44.53\% \\
 &= 281.86 \text{ tons CO/yr}
 \end{aligned}$$

Table 4.2–2. Annual emissions from agricultural equipment in the CO nonattainment area.

SCC	Engine type	CO emissions (tons/year)
2260005000	Gasoline 2-stroke	0.94
2265005000	Gasoline 4-stroke	158.20
2270005000	Diesel	122.72
Total:		281.86

County season-day emissions were calculated by multiplying winter season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for agricultural equipment listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999), as follows:

$$\begin{aligned}
 \text{Maricopa County CO season-day emissions (lbs/day)} &= \text{Winter season CO emissions (tons/season)} \times 2000 \text{ (lb/ton)} \times \text{daily activity allocation factor for agricultural equipment expressed as (week/day)} \div 13 \text{ (weeks/season)} \\
 &= 33.61 \times 2000 \times 0.166667 \div 13 \\
 &= 861.8 \text{ lbs/day}
 \end{aligned}$$

Table 4.2–3. Total seasonal and season-day emissions from agricultural equipment in Maricopa County.

SCC	Engine type	Winter CO emissions (tons/season)	CO season-day emissions (lbs/day)
2260005000	Gasoline 2-stroke	0.11	2.7
2265005000	Gasoline 4-stroke	16.96	434.9
2270005000	Diesel	16.54	424.3
Total:		33.61	861.9

CO nonattainment area season-day emissions were calculated by multiplying county season-day emissions by the agricultural land-use allocation factor:

$$\begin{aligned}
 \text{CO nonattainment area season-day emissions} &= \text{Maricopa County CO season-day emissions} \times \text{Agricultural land-use allocation factor} \\
 &= 861.9 \text{ lbs/day} \times 44.53\% \\
 &= 383.8 \text{ lbs/day}
 \end{aligned}$$

Table 4.2–4. Season-day emissions from agricultural equipment in CO nonattainment area.

SCC	Engine type	CO emissions (lbs/day)
2260005000	Gasoline 2-stroke	1.2
2265005000	Gasoline 4-stroke	193.7
2270005000	Diesel	188.9
Total:		383.8

4.3 Airport ground support equipment

Annual emissions from airport ground support equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of the number of FAA landing and takeoff operations (LTO) in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 4.12 for a discussion of aircraft LTO data.

Table 4.3–1. Annual emissions from airport ground support equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260008000	Gasoline 2-stroke	0.00	0.00
2265008000	Gasoline 4-stroke	3,447.92	3,361.72
2270008000	Diesel	23.17	22.59
Totals:		3,471.09	3,384.31

County season-day emissions were calculated by first multiplying Maricopa County annual CO emissions by 25% to estimate CO season totals, as airport ground support equipment activity is assumed uniform throughout the year (US EPA, 1999). CO season totals were then multiplied by the most conservative weekday/weekend day activity allocation factor for airport ground support equipment (0.1428571) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on LTOs as described above.

Table 4.3–2. CO season-day emissions from airport ground support equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260008000	Gasoline 2-stroke	0.0	0.0
2265008000	Gasoline 4-stroke	18,944.6	18,471.0
2270008000	Diesel	127.3	124.1
Totals:		19,071.9	18,595.1

4.4 Commercial equipment

Annual emissions from commercial equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of industrial employment in the nonattainment area to Maricopa County-level totals, as data on the number of wholesale establishments recommended by EIP guidance (US EPA, 2002) was not available. See Section 1.5.1 for a discussion of the industrial employment data used.

Table 4.4–1. Annual emissions from commercial equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260006000	Gasoline 2-stroke	557.16	546.52
2265006000	Gasoline 4-stroke	44,729.37	43,875.04
2270006000	Diesel	511.02	501.26
Totals:		45,797.55	44,922.82

County season-day emissions were calculated by multiplying Maricopa County winter season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for commercial equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on industrial employment ratios as described above.

Table 4.4–2. CO season-day emissions from commercial equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260006000	Gasoline 2-stroke	3,070.5	3,011.9
2265006000	Gasoline 4-stroke	237,973.6	233,428.3
2270006000	Diesel	3276.2	3213.6
Totals:		244,320.3	239,653.8

4.5 Construction and mining equipment

Annual emissions from construction and mining equipment in Maricopa County were calculated using EPA’s NONROAD2002 model as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the EIIP-recommended allocation factor of total dollar value of construction was unavailable (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.5–1. Annual emissions from construction and mining equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260002000	Gasoline 2-stroke	1,170.13	1,147.78
2265002000	Gasoline 4-stroke	9,139.37	8,964.81
2270002000	Diesel	5,275.07	5,174.32
Totals:		15,584.58	15,286.91

County season-day emissions were calculated by multiplying Maricopa County winter season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for construction/mining equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on population ratios as described above.

Table 4.5–2. CO season-day emissions from construction and mining equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260002000	Gasoline 2-stroke	5,116.2	5,018.5
2265002000	Gasoline 4-stroke	38,335.4	37,603.2
2270002000	Diesel	27,214.9	26,695.1
Totals:		70,666.5	69,316.8

4.6 Industrial equipment

Annual emissions from industrial equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of industrial employment in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the number of employees in manufacturing recommended by EIIP guidance (US EPA, 2002) was not available. See Section 1.5.1 for a discussion of the industrial employment data used.

Table 4.6–1. Annual emissions from industrial equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260003000	Gasoline 2-stroke	7.23	7.09
2265003000	Gasoline 4-stroke	14,638.82	14,359.22
2270003000	Diesel	489.42	480.07
Totals:		15,135.47	14,846.38

County season-day emissions were calculated by multiplying Maricopa County winter-season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for industrial equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on industrial employment ratios as described above.

Table 4.6–2. CO season-day emissions from industrial equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260003000	Gasoline 2-stroke	39.9	39.1
2265003000	Gasoline 4-stroke	86,374.9	84,725.1
2270003000	Diesel	3,137.4	3,077.5
Totals:		89,552.2	87,841.8

4.7 Lawn and garden equipment

Annual emissions from lawn and garden equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. These results reflect new equipment population and usage estimates from survey work done in early 2003 for the Arizona Department of Environmental Quality (discussed further in Section 4.1). Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of housing units in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the housing data used.

Table 4.7–1. Annual emissions from lawn and garden equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260004000	Gasoline 2-stroke	4,677.47	4,592.34
2265004000	Gasoline 4-stroke	72,476.35	71,157.28
2270004000	Diesel	119.31	117.14
Totals:		77,273.13	75,866.76

County season-day emissions were calculated by multiplying Maricopa County winter-season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for lawn and garden equipment (0.1600000 for the commercial segment, 0.2222222 for residential) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on housing units as described above.

Table 4.7–2. CO season-day emissions from lawn and garden equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260004000	Gasoline 2-stroke	6,369.6	6,253.7
2265004000	Gasoline 4-stroke	104,564.5	102,661.4
2270004000	Diesel	176.2	173.0
Totals:		111,110.3	109,088.1

4.8 Logging equipment

Annual emissions from logging equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Logging equipment includes equipment such as large chain saws and shredders used by such entities such as city parks departments and large landscaping companies. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the number of employees in logging recommended by EIIP guidance was not available (US EPA, 2002). See Section 1.5.1 for a discussion of the population figures used.

Table 4.8–1. Annual emissions from logging equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260007000	Gasoline 2-stroke	34.30	33.64
2265007000	Gasoline 4-stroke	90.02	88.30
2270007000	Diesel	12.23	12.00
Totals:		136.54	133.93

County season-day emissions were calculated by multiplying Maricopa County winter-season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for logging equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on population as described above.

Table 4.8–2. CO season-day emissions from logging equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260007000	Gasoline 2-stroke	189.0	185.4
2265007000	Gasoline 4-stroke	477.2	468.1
2270007000	Diesel	78.5	77.0
Totals:		744.7	730.5

4.9 Pleasure craft

Annual emissions from pleasure craft equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of water surface area in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land use data used.

Table 4.9–1. Annual emissions from pleasure craft equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260007000	Gasoline 2-stroke	982.10	336.86
2265007000	Gasoline 4-stroke	439.26	150.67
2270007000	Diesel	2.55	0.87
Totals:		1,423.91	488.40

County season-day emissions were calculated by multiplying Maricopa County winter-season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for pleasure craft (0.3500000) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on water surface area as described above.

Table 4.9–2. CO season-day emissions from pleasure craft equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260007000	Gasoline 2-stroke	2,998.3	1,028.4
2265007000	Gasoline 4-stroke	1,264.5	433.7
2270007000	Diesel	9.5	3.3
Totals:		4,272.3	1,465.4

4.10 Railway maintenance equipment

Annual emissions from railway maintenance equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.10–1. Annual emissions from railway maintenance equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2285003015	Gasoline 2-stroke	0.00	0.00
2285004015	Gasoline 4-stroke	43.99	43.15
2285002015	Diesel	17.29	16.96
Totals:		61.28	60.11

County season-day emissions were calculated by multiplying Maricopa County winter season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for railway maintenance equipment (0.1800000) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on the population ratio as described above.

Table 4.10–2. CO season-day emissions from railway maintenance equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2285003015	Gasoline 2-stroke	0.0	0.0
2285004015	Gasoline 4-stroke	252.0	247.2
2285002015	Diesel	119.7	117.4
Totals:		371.7	364.6

4.11 Recreational equipment

Annual emissions from recreational equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the CO nonattainment area for this category were derived by applying the ratio of passive open space, golf courses and vacant land use in the nonattainment area to Maricopa County-level totals as recommended by EIIIP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land use data used.

Table 4.11–1. Annual emissions from recreational equipment.

SCC	Engine type	CO emissions (tons/year)	
		Maricopa County	Nonattainment area
2260001000	Gasoline 2-stroke	971.01	97.97
2265001000	Gasoline 4-stroke	8,803.03	888.23
2270001000	Diesel	14.16	1.43
Totals:		9,788.20	987.63

County season-day emissions were calculated by multiplying Maricopa County winter-season CO emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for recreational equipment (0.2222222) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the CO season (US EPA, 1999). CO nonattainment area season-day emissions were calculated based on land use as described above.

Table 4.11–2. CO season-day emissions from recreational equipment.

SCC	Engine type	CO emissions (lbs/day)	
		Maricopa County	Nonattainment area
2260001000	Gasoline 2-stroke	3,327.9	335.8
2265001000	Gasoline 4-stroke	28,706.4	2,896.4
2270001000	Diesel	58.2	5.9
Totals:		32,092.5	3,238.1

4.12 Aircraft

A survey of all 16 airports in Maricopa County was conducted to collect data on the total number of landing and take-off operations (LTO’s) as well as fleet mix to determine the types of aircraft used and idle times to calculate annual emissions. Of these airports, three locations (Buckeye Municipal Airport, Gila Bend Municipal Airport and Wickenburg Municipal Airport) are outside of the nonattainment area. Data provided by many airports were in the form of the US Federal Aviation Administration’s (FAA) monthly reporting Form 7230-1, which documents the traffic flow in four major activity categories: air carrier, air taxi, general aviation and military.

Emissions were derived from both computer modeling and National Emissions Inventory (NEI) default emission factors. For airports that provided complete survey data, the FAA’s latest airport Emissions and Dispersion Modeling Software (EDMS 4.1) was used to calculate emissions. Parameters required to apply this model include annual LTO figures, fleet mix of types of aircraft in each activity category, and average idle-in and idle-out times.

For those airports that provided only partial data, the EDMS model could not be used to calculate emissions. Instead, NEI default emission factors were used to calculate emissions. Examples of missing data were detailed fleet mix data or unknown idle times. For airports that did not respond to the survey, LTO figures and fleet mix were derived from an online database that provides free detailed aeronautical information on airports at <http://www.airnav.com>. The “Airport Operational Statistics” section of this database contains data on average daily aircraft operations at the airport by aircraft type (air carrier, air taxi, general aviation and military). These data were multiplied by 365 to derive annual LTO totals and was used to grow LTO’s and fleet mix. Since the EDMS model requires specific aircraft types to run and the Airport Operational Statistics only provide general aircraft type information, the NEI default emission factors shown in Table 4.12–1 were applied to these activity data to calculate emissions

Table 4.12–1. NEI default emission factors, by aircraft type.

Aircraft type	Abbreviation	SCC	CO emission factor (lbs/LTO)
Air taxi	AT	2275060000	28.130
General aviation	GA	2275050000	12.014
Military	ML	2275001000	28.130

Table 4.12–2 summarizes the data received from each airport, and the approach used (using the EDMS model or default emission factors from the 1999 NEI) to calculate emissions from each airport.

The following provides an example of how aircraft emissions were calculated using EDMS for Skyranch at Carefree, a small, general-aviation only airport with a mix of aircraft 12,500 lbs or less. Since the EDMS model requires an exact LTO value for each airframe considered in the model, and since the survey did not require respondents to supply exact LTO counts for each individual airframe, an averaging method was used. EDMS was run to produce an composite emission factor for an airport based on the most common type of aircraft using that facility. For Skyranch, a composite profile was created by selecting within EDMS 12 aircraft types likely to utilize the airport, based on data provided by the airport survey and follow-up correspondence. These 12 aircraft types are: Cessna 150, Commanche, Robin R 2160, Socata Tampico, Cessna 172 Skyhawk, Piper PA-28, Robin R 3000, Socata Tobago, Cherokee six, Robin DR 400, Rockwell Commander, and Spencer S-12 Air Car.

The EDMS model was run with the above 12 aircraft types and for ease of calculation, each aircraft was allocated 2000 LTO/year. It was then necessary to divide the lbs/LTO result by the 12 representative aircraft used to derive an emission factor for an “average” aircraft LTO.

Table 4.12–2. 2002 airport activity data and emission calculation methods.

Airport name	Activity category	Annual LTOs	LTO data source¹	Emission calculation method²
Arizona Army National Guard	ML	780	reported	NEI default
Buckeye Municipal Airport ³	GA	16,796	reported	EDMS
Chandler Municipal Airport	AT	914	reported	NEI default
	GA	80,689	reported	NEI default
	ML	10	reported	NEI default
Falcon Field	AT	1,319	AirNav	NEI default
	GA	125,350	AirNav	NEI default
	ML	5,278	AirNav	NEI default
Gila Bend Municipal Airport ³	GA	522	AirNav	NEI default
Glendale Municipal Airport	GA	59,352	reported	NEI default
Luke Air Force Base	ML	61,225	reported	EDMS
Phoenix Deer Valley Airport	AT	2,495	reported	NEI default
	GA	192,254	reported	NEI default
	ML	37	reported	NEI default
Phoenix Goodyear Airport	AC	131	reported	EDMS
	AT	270	reported	NEI default
	GA	68,317	reported	NEI default
	ML	569	reported	NEI default
Phoenix Sky Harbor Int'l. Airport	AC	187,125	reported	EDMS
	AT	57,570	reported	EDMS
	GA	26,204	reported	EDMS
	ML	1,987	reported	EDMS
Pleasant Valley Airport	GA	19,302	reported	EDMS
Scottsdale Airport	AT	5,026	reported	NEI default
	GA	92,365	reported	NEI default
	ML	291	reported	NEI default
Skyranch at Carefree	GA	2,453	reported	EDMS
Stellar Airpark	GA	22,000	reported	NEI default
Wickenburg Municipal Airport ³	AT	179	AirNav	NEI default
	GA	8,495	AirNav	NEI default
	ML	268	AirNav	NEI default
Williams Gateway Airport	AC	421	reported	EDMS
	AT	3,104	reported	EDMS
	GA	79,731	reported	EDMS
	ML	5,990	reported	EDMS

1. “reported” = using 2002 survey results supplied by the airport,
“AirNav” = using available data on average daily LTOs from www.airnav.com.
2. “EDMS” = emission factors were based on EDMS model calculations,
“NEI default” = NEI default emission factors Table 4.12–1 were used.
3. Airport is outside the nonattainment area.

For example, the model run with the 12 aircraft types resulted in total CO emissions of 211.69 tons (assuming each of the 12 aircraft types had 2000 LTOs during the period).

$$\begin{aligned} \text{Composite CO emission factor (lb/LTO)} &= \sum \text{modeled CO emissions (tons/yr)} \times 1 \text{ yr} \div 24,000 \text{ LTOs} \times 2000 \text{ lb/ton} \\ &= 17.64 \text{ lb CO/LTO} \end{aligned}$$

This composite emission factor was then multiplied by the actual number of LTOs at the airport to derive an annual CO emissions total:

$$\begin{aligned} \text{CO emissions (lb/ yr)} &= 2,453 \text{ LTO/yr} \times 17.64 \text{ lb CO/LTO} \\ &= 43,272.88 \text{ lb CO/yr} \end{aligned}$$

Table 4.12–1 lists the emission factors used. Table 4.12–3 lists the total annual emissions, and CO season-day emissions, for each airport and aircraft type. For all airports, activity is presumed to occur evenly over a 7-day week. To develop seasonal allocation factors, Phoenix Sky Harbor International Airport’s distribution of LTO’s for air carrier activity was used. Seasonal activity for the CO season (November – January) is thus calculated as $(15,245 + 15,865 + 15,091 \div 187,125 = 25\%)$.

Table 4.12–3. Emission factors, and annual and CO season-day emissions, by airport and aircraft type.

Facility	Activity category ¹	Lbs/LTO	Annual CO emissions (tons/yr)	Season-day CO emissions (lbs/day)
Arizona Army Natl. Guard	ML	28.130	10.97	60.3
Chandler Municipal Airport	AT	28.130	12.86	70.6
	GA	12.014	484.70	2,663.2
	ML	28.130	0.14	0.8
Falcon Field	AT	28.130	18.55	101.9
	GA	12.014	752.98	4,137.2
	ML	28.130	74.24	407.9
Glendale Municipal Airport	GA	12.014	356.53	1,958.9
Luke Air Force Base	ML	13.827	423.28	2,325.7
Phoenix Deer Valley Airport	AT	28.130	35.09	192.8
	GA	12.014	1,154.87	6,345.4
	ML	28.130	0.52	2.9
Phoenix Goodyear Airport	AC	7.615	0.50	2.7
	AT	28.130	3.80	20.9
	GA	12.014	410.38	2,254.8
	ML	28.130	8.00	44.0
Phoenix Sky Harbor Int'l. Airport	AC	43.267	4,048.17	22,242.7
	AT	14.996	431.66	2,371.8
	GA	6.838	89.59	492.3
	ML	0.643	0.64	3.5
Pleasant Valley Airport	GA	0.529	5.11	28.1
Scottsdale Airport	AT	28.130	70.69	388.4
	GA	12.014	554.84	3,048.6
	ML	28.130	4.09	22.5
Skyranch at Carefree	GA	17.641	21.64	118.9
Stellar Airpark	GA	12.014	132.15	726.1
Williams Gateway Airport	AC	6.960	1.47	8.1
	AT	14.996	23.27	127.9
	GA	18.234	726.91	3994.0
	ML	10.288	30.81	169.3
CO nonattainment area totals:			9,888.43	54,332.0
Airports outside the nonattainment area:				
Buckeye Municipal Airport	GA	17.641	148.15	814.0
Gila Bend Municipal Airport	GA	12.014	3.14	17.2
Wickenburg Municipal Airport	AT	28.130	2.52	13.8
	GA	12.014	51.03	280.4
	ML	28.13	3.77	20.7
Maricopa County totals:			10,097.03	55,478.2

1. AC = air carrier, GA = general aviation, AT = air taxi, ML = military.

4.13 Locomotives

Annual emissions from locomotives were calculated based on diesel fuel usage provided by Burlington Northern/Santa Fe Railway (BNSF) and Union Pacific Railway (UP). Railway operations from these companies fall into two categories: Class I haul lines and yard/switching operations (no Class II or Class III haul lines operated in Maricopa County in 2002). Annual emissions from Class I haul operations and yard/switching operations were calculated by multiplying diesel fuel usage by EPA emission factors for CO (US EPA, 1997).

$$\begin{aligned}
 \text{Emissions from UP} &= \text{Diesel fuel used (gals)} \times \text{EPA emission factor (lbs/gal)} \div 2000 \text{ lbs/ton} \\
 \text{Class I haul lines} & \quad \quad \quad \text{for CO} \\
 &= 9,204,320 \text{ gallons} \times 0.059 \text{ lbs/gal} \div 2000 \text{ lbs/ton} \\
 &= 271.53 \text{ tons of CO/yr}
 \end{aligned}$$

Table 4.13–1. Fuel use, emission factors, and annual emissions from locomotives in Maricopa County.

Locomotive type	Diesel fuel used (gals)	CO emission factor (lbs/gal)	CO emissions (tons/year)
BNSF Class I haul line	824,339	0.059	24.32
UP Class I haul line	9,204,320	0.059	271.53
BNSF yard/switch operations	824,900	0.084	34.65
UP yard/switch operations	329,960	0.084	13.86
Totals:	11,183,519		344.35

CO nonattainment area emissions were calculated by multiplying Maricopa County emissions by the percentage of track miles inside the CO nonattainment area, determined by GIS mapping:

$$\begin{aligned}
 \text{CO nonattainment area emissions} &= \text{County CO emissions} \times \text{Percentage of track in} \\
 \text{from UP Class I haul lines} & \quad \quad \quad \text{the nonattainment area} \\
 &= 271.53 \text{ tons} \times 37.95\% \\
 &= 103.04 \text{ tons CO/year}
 \end{aligned}$$

Table 4.13–2. Annual CO nonattainment area emissions from locomotives.

Locomotive type	County CO emissions (tons/year)	Track in nonattainment area (%)	CO nonattainment area emissions (tons/year)
BNSF Class I haul line	24.32	37.95	9.23
UP Class I haul line	271.53	37.95	103.04
BNSF yard/switch operations	34.65	100.00	34.65
UP yard/switch operations	13.86	100.00	13.86
Totals:	344.35		160.78

CO season-day emissions for both the county and the CO nonattainment area were calculated by dividing annual totals by 365 days per year, as locomotive activity is assumed to be uniform throughout the year.

$$\begin{aligned}
 \text{CO season-day} &= \text{Annual County CO emissions (tons)} \times 2000 \text{ lbs/ton} \div 365 \text{ days} \\
 \text{emissions from haul lines} & \\
 &= 295.85 \text{ tons} \times 2000 \text{ lbs/ton} \div 365 \text{ days} \\
 &= 1,621.1 \text{ lbs/day}
 \end{aligned}$$

Table 4.13–3. CO season-day emissions from locomotives.

SCC	Activity type	County CO season-day emissions (lbs/day)	CO nonattainment area season-day emissions (lbs/day)
2285002005	Line haul	1,621.1	615.2
2285002010	Yard/switch operations	265.7	265.7
Totals:		1,886.8	881.0

4.14 Summary of all nonroad mobile source emissions

Table 4.30 summarizes the annual and season-day emissions of carbon monoxide from nonroad mobile sources in Maricopa County and the CO nonattainment area.

Table 4.14–1. Summary of annual and season-day CO emissions from nonroad mobile sources.

Equipment category	Annual emissions (tons/yr)		Season-day emissions (lbs/day)	
	Maricopa County	CO nonattainment area	Maricopa County	CO nonattainment area
Agricultural	632.96	281.86	861.9	383.8
Airport ground support equipment	3,471.09	3,384.31	19,071.9	18,595.1
Commercial	45,797.55	44,922.82	244,320.3	239,653.8
Construction & mining	15,584.58	15,286.91	70,666.5	69,316.8
Industrial	15,135.47	14,846.38	89,552.2	87,841.8
Lawn & garden	77,273.13	75,866.76	111,110.3	109,088.1
Logging	136.54	133.93	744.7	730.5
Pleasure craft	1,423.91	488.40	4,272.3	1,465.4
Railway maintenance	61.28	60.11	371.7	364.6
Recreational	9,788.20	987.63	32,092.5	3,238.1
Aircraft	10,097.03	9,888.43	55,478.2	54,332.0
Locomotives	344.35	160.78	1,886.8	881.0
Totals:	179,746.09	166,308.32	630,429.3	585,891.0

4.15 Quality assurance procedures

Established procedures were used to check, and correct when necessary, the off-road mobile sources emissions estimates. All NONROAD model input and output files, and Excel spreadsheets used to calculate the emissions, were checked by personnel who were not involved in the development of the modeling inputs/outputs and spreadsheets. In addition, the emissions estimates were reviewed for reasonableness by external agency staff.

4.16 References

- ENVIRON *et al.*, 2003. Maricopa County 2002 Comprehensive Emission Inventory for the Cap and Trade Oversight Committee, Final Rep. prepared for Arizona Dept. of Environmental Quality, October 9, 2003.
- ERG, 2001. Documentation for the Draft 1999 Base Year Aircraft, Commercial Marine Vessels, and Locomotive National Emissions Inventory for Criteria and Hazardous Air Pollutants. Prepared by Eastern Research Group, Morrisville, NC for the US Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, Oct. 29, 2001. Internet address: <http://www.epa.gov/ttn/chief/eidocs/partllsec4.pdf>

- US EPA, 2002. Geographic Allocation of State Level Nonroad Engine Population Data to the County Level. EPA Office of Transportation and Air Quality, Rep. EPA420-P-02-009, July. Internet address: <http://www.epa.gov/otaq/models/nonrdmdl/p02009.pdf>.
- US EPA, 1999. Weekday and Weekend Day Temporal Allocation of Activity in the NONROAD Model. EPA Office of Transportation and Air Quality, Rep. EPA420-P-99-033, March. Internet address: <http://www.epa.gov/otaq/models/nonrdmdl/p99033.pdf>.
- US EPA, 1997. Emission Factors for Locomotives. Office of Mobile Sources. Techn. Highlights, (Table 9) Rep. EPA420-F-97-051, Dec. 1997. Internet address: <http://www.epa.gov/otaq/regs/nonroad/locomotv/frm/42097051.pdf>

5. Onroad Mobile Sources

5.1 Introduction

The Maricopa Association of Governments (MAG) prepared the onroad mobile source emission estimates for the 2002 Periodic Carbon Monoxide Emissions Inventory for the Maricopa County Nonattainment Area and for Maricopa County. Onroad mobile source emission estimates have been calculated for carbon monoxide (CO) for the 2002 Periodic CO Inventory. These onroad mobile source estimates are for the CO nonattainment area within Maricopa County and also for Maricopa County as a whole. Emission estimates were developed for both the carbon monoxide season and also for 2002 as a whole.

Emission estimates were calculated for the following eight vehicle classes: light duty gas vehicles (LDGV), light duty gas trucks of gross vehicle weight under 6000 pounds (LDGT1/LDGT2) or over 6000 pounds (LDGT3/LDGT4), heavy duty gas vehicles (HDGV), light duty diesel vehicles (LDDV), light duty diesel trucks (LDDT), heavy duty diesel vehicles (HDDV), and motorcycles (MC). Emission factors for these vehicle classes were calculated using MOBILE6.2, the latest version in a series of models developed by the US Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. The resulting emission factors were multiplied by the estimates of vehicle miles of travel (VMT) to generate emission estimates.

The main reference sources for preparing the onroad mobile source portion of the inventory were as follows:

- Emission Inventory Requirements for Carbon Monoxide State Implementation Plans, EPA-450/4-91-011, March 1991, (hereinafter referred to as EPA Guidance),
- Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, US EPA, January 2002,
- User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010, August 2003, (hereinafter referred to as User's Guide), and
- Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81-026d (Revised), 1992.

5.2 VMT estimation procedure

MAG prepared the 2002 vehicle miles of travel (VMT) estimates for the carbon monoxide non-attainment area and Maricopa County. The source of data for these estimates is the 2002 Highway Performance Monitoring System (HPMS) data (see Appendix 5.1) submitted to the US Department of Transportation, Federal Highway Administration (FHWA) by the Arizona Department of Transportation (ADOT). The ADOT contact person for the HPMS VMT estimates is Mark Catchpole (602-712-8596).

Each year, ADOT coordinates the collection of HPMS data, including the annual average daily traffic (AADT) estimates which are utilized to develop HPMS VMT estimates. ADOT provides the AADT for the state highway system routes including interstates, urban freeways, and principal arterials in Maricopa County. AADTs for other non-local facilities are provided by local

jurisdictions. ADOT merges the Maricopa County data with information from other Arizona counties to create the statewide HPMS dataset submitted to FHWA each year.

HPMS contains a number of data elements which describe roadway characteristics and performance for every non-local roadway in Arizona. All non-local roadways have been divided into sections which are 0.3 to 10 miles in length, in accordance with HPMS criteria. These sections are called HPMS universe sections. HPMS contains additional data elements which provide more detailed information on a randomly-selected set of sample sections. The VMT estimates which ADOT submits to FHWA each year are generated from HPMS universe data for all interstates, urban freeways, and principal arterials. Sample section data are expanded to estimate VMT on all other non-local systems.

VMT on local streets in the urbanized portion of Maricopa County is estimated using traffic counts collected on 50 randomly-selected local streets in June-July of 1994. These counts resulted in an AADT of 587 for local roads in the urbanized area. To calculate VMT, this AADT was applied to local road mileage in 1994 obtained from the Maricopa County street centerline coverage. In 1994, an AADT of 150 was assumed for local roads which are in the “donut” area. The “donut” area is an HPMS term referring specifically to the area inside the PM₁₀ nonattainment area, but outside the Phoenix urbanized area boundary. Since 1994, the AADTs on local streets have been increased annually on the basis of the rate of population growth in the Maricopa County population; the mileage on local streets is updated annually by the local jurisdictions in Maricopa County. VMT for the CO nonattainment area, based on the 2002 HPMS data ADOT submitted to FHWA, is summarized by area type and facility type in Table 5.2–1.

Table 5.2–1. 2002 HPMS VMT by area type and facility type for the CO nonattainment area (annual average daily traffic).

Facility type:	Area type					Total
	1	2	3	4	5	
Interstate / Freeway	1,129,051	9,046,583	6,240,489	4,525,653	2,678,544	23,620,320
Principal Arterial / Minor Arterial	1,087,462	8,834,531	9,795,953	6,923,412	2,670,291	29,311,650
Collector	1,046,993	2,727,290	1,694,159	872,616	955,062	7,296,120
Local	195,247	1,991,136	2,564,545	1,689,510	855,772	7,296,210
Totals:	3,458,753	22,599,539	20,295,146	14,011,191	7,159,670	67,524,300

Notes:

1. Area Type = f(DENSITY of a planning district) where:
 DENSITY = (Population + 2 × Employment) / Area
 For Area Type 1, DENSITY = 20,001+ (Central Business District)
 For Area Type 2, DENSITY = 10,001–20,000 (Outlying Central Business District)
 For Area Type 3, DENSITY = 5,001–10,000 (Mixed Urban)
 For Area Type 4, DENSITY = 1,001–5,000 (Suburban)
 For Area Type 5, DENSITY = 0–1,000 (Rural)
2. Total VMT by facility type is extracted from the appropriate HPMS templates, with the urbanized area VMT reduced by 1 percent and the donut area VMT reduced by 28 percent.
3. VMT is split up into Area Types using data from MAG 2002 EMME/2 travel demand modeling results.
4. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

The 2002 HPMS System Length and Daily Vehicle Travel for individual urbanized areas (in Appendix 5.1) was submitted to FHWA by ADOT in October 2003. This table reported a 2002 average daily VMT (AADT) for the Phoenix urbanized area (#33) of 63.338 million. In comparison, the 2002 urbanized area VMT for the CO nonattainment area used in the periodic emissions inventory is 62.705 million. The one percent difference between these totals is attributable to small sections of the Phoenix urbanized area (i.e. Apache Junction) which are not located in the CO nonattainment area and Maricopa County. The HPMS System Length and Daily Vehicle Travel, donut area data for individual NAAQS nonattainment areas, (in Appendix 5.1), reported a 2002 VMT for the “donut” area (#33) of 6.694 million. The factors (i.e. 99 percent for the urbanized area and 72 percent for the donut area) used to determine the allocation of HPMS VMT to the CO nonattainment area were derived from the report, “Maricopa Association of Governments Highway Performance Monitoring System Update Study”, January 1995. These factors were also used to derive VMT for the CO tracking area in Chapter Three of the “MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area”, June 1999. The total 2002 daily VMT for the urbanized and “donut” areas in the CO nonattainment area is 67.524 million, as shown in Table 5.2–1. It is important to note that the 2002 HPMS daily VMT for the CO nonattainment area is within one percent of the 2002 VMT estimated by the MAG EMME/2 travel demand models for the same domain (after conversion of EMME/2 estimates from average weekday traffic to annual average daily traffic).

The distribution of VMT by facility type for the CO nonattainment area in Table 5.2–1 was derived from the 2002 HPMS data, while the distribution by area type was derived from a MAG EMME/2 travel demand model run for 2002. The output of this traffic assignment was evaluated using GIS to obtain VMT by area type and facility type for the Phoenix urbanized and “donut” areas. The area type distributions from the EMME/2 assignment were applied to the 2002 HPMS VMT estimates by facility type for the urbanized and “donut” areas to create Table 5.2–1.

VMT estimates for all of Maricopa County were also developed by ADOT. The VMT division by area type for all of Maricopa County were developed by applying all additional VMT for each facility type to the Area Type 5 (rural) category, since all VMT outside of the CO nonattainment area but inside Maricopa County is expected to be in a rural setting. The total VMT estimated for Maricopa County is 73.579 million miles per day for an annual average day. The VMT estimates for Maricopa County are shown in Table 5.2–2.

Table 5.2–2. 2002 HPMS VMT by area type and facility type for Maricopa County (annual average daily traffic)

Facility type:	Area Type					Total
	1	2	3	4	5	
Interstate / Freeway	1,129,051	9,046,583	6,240,489	4,525,653	5,662,224	26,604,000
Principal Arterial / Minor Arterial	1,087,462	8,834,531	9,795,953	6,923,412	3,738,642	30,380,000
Collector	1,046,993	2,727,290	1,694,159	872,616	2,390,942	8,732,000
Local	195,247	1,991,136	2,564,545	1,689,510	1,422,562	7,863,000
Totals:	3,458,753	22,599,540	20,295,146	14,011,191	13,214,370	73,579,000

Notes:

1. For the definition of “Area Type”, see Table 5.2–1, Note 1.
2. VMT is split up into Area Types using data from MAG 2002 EMME/2 travel demand modeling results. All VMT outside of the HPMS urbanized and donut areas were applied to Area Type 5.
3. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

Although HPMS reports vehicle mix data for urban and rural areas of Arizona, there are insufficient classification stations in the Phoenix urbanized area to justify use of this information in calculating VMT by vehicle class. In addition, the HPMS vehicle class data do not discriminate between gas and diesel vehicles. Therefore, MOBILE6.2 model defaults, representing the fraction of total VMT for each vehicle class, were applied to VMT estimates for each facility type and area type.

5.3 Speed estimation procedure

MAG prepared the average daily speeds for the onroad mobile sources portion of the 2002 periodic CO emissions inventory. The average daily speeds were developed from several sources representing the latest planning assumptions for 2002.

For the Interstate/Freeway category and for the Principal/Minor Arterial category, the speeds were developed using data in the February 11, 2004 draft report 2002-2003 MAG Regional Travel Time & Travel Speed Study. This report contained data for the functional classifications “HOV”, “Freeway”, “Expressway”, “6 Leg Arterial”, and “Major Arterial”. Speeds for the first three categories were combined through a weighted average to develop the average speed for the Interstate/Freeway category used in the Periodic Inventory. Similarly, the two arterial categories contained in the speed study were combined through a weighted averaging to obtain a Principal Arterial/Minor Arterial category speed. In both of these categories, speeds were unique by area type.

The third facility type included in the periodic inventory is collectors. To develop speed estimates for this facility type, speeds were extracted from the latest 2002 travel demand model run created using the EMME/2 software. In the EMME/2 runs performed by MAG, some traffic links that are classified as “locals” would actually be classified as “collectors” by HPMS. The EMME/2 runs also contain artificial links that are categorized as locals. Since the HPMS collector category includes some EMME/2 collector links and some EMME/2 locals, the EMME/2 speeds for locals and collectors were averaged and the result was used for the HPMS category of collectors. Like the speeds for the Interstate/Freeway and Principal/Minor Arterials categories, the speeds for Collectors were calculated separately for each of the five area types.

The fourth of the HPMS facility types is local roadways. The MOBILE6.2 model assumes a set speed of 12.9 miles per hour for local roadways. This speed was incorporated into the current analysis for all local roadways, regardless of area type.

Table 5.3–1. Average daily speeds (mph) for the 2002 periodic emissions inventory.

Facility type:	Area Type *				
	1	2	3	4	5
Interstate / Freeway	59.7	60.3	63.2	64.8	64.2
Principal Arterial / Minor Arterial	30.3	34.4	36.1	39.0	42.6
Collector	18.2	19.1	24.4	24.7	28.2
Local	12.9	12.9	12.9	12.9	12.9

* For the definition of “Area Type”, see Table 5.2–1, Note 1.

5.4 Monthly VMT factors

In the development of annual emissions totals for this inventory, emission factor estimates were estimated independently for each month, with month-specific meteorological and fuel data. Since average daily VMT varies by month, and the number of days in each month varies, these monthly average emission factors were weighted to more appropriately represent an annual average emission factor. Similarly, the conversion of annual average day traffic to the three months of the peak CO season utilized the monthly VMT factors listed below.

Average daily VMT estimate factors were developed from the 1998 MAG Regional Congestion Study and the monthly factors are as follows:

Table 5.4-1. Average daily VMT adjustment factors by month.

Month	Avg daily VMT estimate factor	Month	Avg daily VMT estimate factor
January	0.98	July	0.94
February	1.03	August	0.96
March	1.03	September	0.99
April	1.03	October	1.02
May	0.99	November	1.02
June	0.98	December	1.04

These factors indicate, as an example, that an average day in February has three percent more traffic than an average month while an average day in June has two percent less traffic than average. Separately, the different number of days in a month will effect the weighting of monthly emission factors to an annual average. For instance, if each month had the same number of days, each monthly emission factor would be equally weighted by 1/12 (0.0833). Since each month does not have the same number of days, the monthly emission factors are weighted accordingly, with January being weighted 31/365 (0.0849), February being weighted 28/365 (0.0767), etc. Combining the two sets of adjustments, the February emission factors would be weighted by 1.03×0.0767 in the development of the annual emission factors.

These weightings are applied by the FORTRAN program “NEIProgram”, which was created by MAG. NEIProgram reads in the individual MOBILE6.2 output files for all twelve months and for the I/M versus non-I/M scenarios. NEIProgram weighs those 24 sets of MOBILE6.2 output files to a single set of annual average emission factors. The complete source code for NEIProgram may be found in Appendix 5.6.

The same monthly factors were used to convert the annual average daily traffic estimates from the HPMS system to reflect an average day during the peak CO season. The peak CO season reflects the three consecutive months when peak CO concentrations occur. For consistency with the 1999 carbon monoxide inventory, the three consecutive months selected were November 2002 through January 2003, in accordance with EPA guidance. Averaging the monthly factors for November through January results in a factor of 1.01.

Table 5.4-2. Average daily VMT during 2002 carbon monoxide season for the CO nonattainment area (November 2002–January 2003).

Facility type:	Area Type					Total
	1	2	3	4	5	
Interstate / Freeway	1,140,342	9,137,049	6,302,894	4,570,910	2,705,329	23,856,523
Principal Arterial / Minor Arterial	1,098,337	8,922,876	9,893,913	6,992,646	2,696,994	29,604,765
Collector	1,057,463	2,754,563	1,711,101	881,342	964,613	7,369,081
Local	197,199	2,011,047	2,590,190	1,706,405	864,330	7,369,172
Totals:	3,493,341	22,825,535	20,498,098	14,151,303	7,231,266	68,199,541

Notes:

1. For the definition of “Area Type”, see Table 5.2–1, Note 1.
2. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

Table 5.4-3. Average daily VMT during 2002 carbon monoxide season for Maricopa County (November 2002–January 2003).

Facility type:	Area Type					Total
	1	2	3	4	5	
Interstate / Freeway	1,140,342	9,137,049	6,302,894	4,570,910	5,718,846	26,870,041
Principal Arterial / Minor Arterial	1,098,337	8,922,876	9,893,913	6,992,646	3,776,028	30,683,800
Collector	1,057,463	2,754,563	1,711,101	881,342	2,414,851	8,819,320
Local	197,199	2,011,047	2,590,190	1,706,405	1,436,788	7,941,629
Totals:	3,493,341	22,825,535	20,498,098	14,151,303	13,346,513	74,314,790

Notes:

1. For the definition of “Area Type”, see Table 5.2–1, Note 1.
2. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

5.5 Emission factor estimation procedure

5.5.1 Emission factor model

CO vehicle exhaust emission factors were calculated using MOBILE6.2, the latest version in a series of models developed by the US EPA for the purpose of estimating motor vehicle emission factors. The resulting emission factors were combined with vehicle miles of travel (VMT) estimates to produce emission estimates for carbon monoxide. The MOBILE6.2 runs were executed by the Maricopa Association of Governments. The contact person for the MOBILE6.2 emission estimates is Roger Roy (602-254-6300).

For the CO season analysis, two MOBILE6.2 runs were executed for a typical day (24-hour period) during the three-month period of November through January. For the annual emissions estimates, two MOBILE6.2 runs were executed for each month of the year using month specific fuel and temperature data, reflecting vehicles registered locally (subject to the I/M program) and those not registered locally (not participating in the I/M program).

The emission factors estimated with these runs were combined to reflect the actual proportions of vehicles subject to the specified levels of inspection. The term “I/M vehicles” denotes vehicles which are required to undergo an emission test and/or inspection under the Arizona Vehicle Inspection/Maintenance Program. It is important to note that participation in the I/M program is required for all vehicles registered in the nonattainment area, with the exception of

certain model year and vehicle classes. However, it is assumed that of the vehicles which are of an age and type subject to an I/M program, only 91.7 percent of the vehicles operating within the nonattainment area participate in the I/M program. The remaining 8.3 percent do not participate in the program. These percentages reflect the control measures “Tougher Registration Enforcement” and “Expansion of Area A Boundaries”, described in the Revised MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area, MAG, March 2001. In the absence of any additional data, this percentage split is assumed to apply directly to VMT as well. Refer to Appendix 5.2 for portions of the actual input and output files and a spreadsheet showing the emission factor calculations.

5.5.2 Development of model inputs

The inputs to MOBILE6.2 are grouped into three categories: Header inputs, run inputs, and scenario inputs. The input values used in the MOBILE6.2 runs are specified and explained below. This next section looks like it maybe should be an appendix section. Humidity was not used as an input to these runs. After reviewing the MOBILE6.2 guidance on the use of local humidity data (see page 7 of <http://www.epa.gov/otaq/models/mobile6/m6techgd.pdf>), it does not appear that inputting specific humidity values would be appropriate for the development of an annual average emissions inventory of this type.

Header Section

1. **MOBILE6 INPUT FILE:** indicates that the MOBILE6.2 input file is a regular command file rather than a batch file.
2. **POLLUTANTS: CO** indicates that the only pollutant for which output is desired is carbon monoxide for this analysis. For the annual CO emissions estimate, the monthly MOBILE6.2 runs performed did not include this flag because other emission factor estimates in addition to CO were desired.

Run Data Section

1. **NO REFUELING:** indicates that refueling emissions are excluded from the MOBILE6.2 outputs. This command is included for completeness, but does not affect carbon monoxide outputs.
2. **I/M PROGRAM: 1 1977 2050 1 T/O LOADED IDLE** indicates the program start and end dates, frequency of testing, and test type. There are five components of the I/M program modeled; a loaded idle test for heavy duty gasoline vehicles (shown in the example in Appendix 5.2), a transient idle test (I/M240 modeled as a surrogate for the I/M147 test) for light duty cars and trucks through model year 1995, a loaded idle test for light duty cars and trucks of model years 1967 to 1980, an on-board diagnostic (OBD) exhaust test for model year 1996 and newer vehicles, and an OBD evaporative test for the same vehicles. The remaining four occurrences of this command are as follows:

I/M PROGRAM: 2 1977 2050 2 T/O IM240 - relating to the transient idle I/M240 program modeled as a surrogate for the I/M147 program.

I/M PROGRAM: 3 1977 2050 1 T/O LOADED IDLE - relating to the loaded idle program for model year 1967-1980 light duty cars and trucks.

I/M PROGRAM: 4 2001 2050 2 T/O OBD I/M - relating to the exhaust portion of the OBD test.

I/M PROGRAM: 5 2001 2050 2 T/O EVAP OBD & GC - relating to the evaporative and gas cap portion of the OBD test.

3. **I/M MODEL YEARS: 1 1967 2050** indicates the first and last model years affected by the given component of the I/M program. The inputs shown above indicate that model years 1967 and newer are tested by component 1 of the I/M program. The remaining four occurrences of this command are as follows:

I/M MODEL YEARS: 2 1981 1995 - relating to the transient idle I/M240 program modeled as a surrogate for the I/M147 program.

I/M MODEL YEARS: 3 1967 1980 - relating to the loaded idle program for model year 1967-1980 light duty cars and trucks.

I/M MODEL YEARS: 4 1996 2050 - relating to the exhaust portion of the OBD test.

I/M MODEL YEARS: 5 1996 2050 - relating to the evaporative and gas cap portion of the OBD test.

4. **I/M VEHICLES: 1 11111 22222222 2** indicates that for the first component of the I/M program (1), the five vehicle categories LDGV, LDGT1, LDGT2, LDGT3, and LDGT4 are not subject to this portion of the I/M program (indicated by "1") while HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B, and gasoline buses are covered (indicated by "2"). The remaining four occurrences of this command are as follows:

I/M VEHICLES: 2 22222 11111111 1 indicates that the opposite vehicle classes are subject to the transient idle I/M240 program modeled as a surrogate for the I/M147 program. This selection of vehicle classes is also applied to the remaining three portions of the I/M program.

5. **I/M STRINGENCY: 1 28.0** indicates that the initial test failure rate for pre-1981 LDGVs and pre-1984 LDGTs is 28.0 percent. This stringency rate is also applied to the remaining portions of the I/M program.

6. **I/M COMPLIANCE: 1 97.0** indicates that the fraction of the total vehicle fleet subject to the I/M program that passes the I/M test or receives a waiver is 97.0 percent. This compliance rate is also applied to the remaining portion of the I/M program.
7. **I/M WAIVER RATES: 1 1.3 1.0** indicates that the fraction of vehicles that fail the I/M program is 1.3 for pre-1981 model years and 1.0 percent for 1981 and later model years. These waiver rates are also applied to the remaining portion of the I/M program.
8. **I/M GRACE PERIOD: 1 5** indicates that vehicles less than 5 years old are exempted from the I/M program. This exemption is identical for all portions of the I/M program.
9. **I/M CUTPOINTS: 2 CUTcmp03.d** indicates that for the CO peak season analysis, MOBILE6.2 reads the external data file "CUTcmp03.d" for the I/M cutpoint values for HC, CO, and NO_x. There are 25 values for each vehicle class and pollutant, for the most recent 25 model years, starting with the youngest vehicle. This data is only input for the I/M240 program. For the monthly MOBILE6.2 runs performed to develop the annual CO emissions estimates, the file CUTcmp02.d was used for the January through September 2002 analyses and CUTcmp03.d was used for October through December.
10. **ANTI-TAMP PROGRAM: 87 75 80 22222 22222222 2 11 097. 22111222** indicates the nature of the anti-tampering program. Specifically, this portion of the anti-tampering program began in 1987 and covers model year vehicles 1975 to 1980. Vehicle classes subject to the inspection (indicated by a "2") include LDGV, LDGT1, LDGT2, LDGT3, LDGT4, HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B, and gasoline powered buses. The test is performed annually. The test has a 97 percent compliance rate. The parameters tested include air pump disablement, catalyst removal, evaporative system disablement, PCV system disablement, and missing gas cap. The parameters not tested are fuel inlet restrictor disablement, tailpipe lead deposit test, and EGR disablement. A second data line indicates that the same test is also performed on model year 1981 to 1995 vehicles, but with the LDGV, LDGT1, LDGT2, LDGT3, and LDGT4 classes omitted because those vehicles are subject to the transient I/M or OBD test.
11. **REG DIST: 02reg03.d** indicates that for the CO peak season analysis, vehicle registration distributions by age for the 16 composite vehicle types are read by MOBILE6.2 from an external data file, called 02reg03.d. The raw data upon which the registration distributions and diesel fractions are based may be found in Appendix 5.3. The file 02reg02.d was used for the months January through September, 2002. The file 02reg03.d was used for the remaining months of October 2002 through December 2002 because those analyses are closer to a January 2003 scenario than a July 2002 scenario.
12. **DIESEL FRACTIONS:** indicates the user-supplied diesel sales fractions. This input is followed by 350 fractional values representing the fraction of the 14 vehicle classes internally examined by MOBILE6.2 and 25 most recent model years that are diesel vehicles. As an example, the first value, 0.0050, indicates that for the most recent model year of light duty vehicles, 0.5 percent of the vehicles sold are diesel.

Scenario Section

1. **SCENARIO RECORD:** Allows the user to enter a name to identify the scenario being run.
2. **CALENDAR YEAR: 2003** was input because the applicable three-month period for the CO season inventory is November and December of 2002 and January 2003. To be consistent with the User's Guide, the calendar year 2003 was chosen to model conditions representative of the applicable period. For the annual emission estimates, the calendar year 2002 was chosen for the months January through September while for the months of October through December, the calendar year 2003 was chosen because a January 2003 scenario more closely matches those months than a January 2002 scenario.
3. **EVALUATION MONTH: 1** indicates that the month to be modeled for the peak CO season inventory is January. For the annual emissions estimates, the months January through March and October through December were run with this setting while the remaining months were processed with the evaluation month set to July. January and July are the only settings allowed for the evaluation month.
4. **ALTITUDE:1** indicates the geographic area modeled was low altitude.
5. **MIN/MAX TEMPERATURE: 45.0 73.** provides the model with the daily minimum and maximum temperatures for the peak CO season day modeled. The temperatures used are consistent with those modeled for the previous carbon monoxide periodic inventories. For the monthly analyses used to estimate annual emissions, temperatures were derived from the appropriate Sky Harbor Airport Local Climatological Data (LCD) reports. The raw meteorological data may be found in Appendix 5.4.
6. **AVERAGE SPEED: various speeds analyzed** indicates to MOBILE6.2 the average speed to be modeled for each facility type and area type combination. All facility and area type combinations with unique speeds will be modeled in this manner.
7. **VMT BY FACILITY: allfwy.def** indicates to MOBILE6.2 that the external file allfwy.def is to be referenced for the ratio of VMT by hour by facility type. The file allfwy indicates that all VMT is occurring on the MOBILE6.2 facility type freeways for use in developing the emission factors for the periodic inventory functional classifications Interstates/Freeways/Expressways. Similarly, the external file allart.def is called when estimating the emission factors for the arterials or collectors, and allloc.def is called when estimating the emission factors for the periodic inventory category locals.
8. **FUEL RVP: 8.5** Indicates that the average Reid Vapor Pressure of the gasoline sold is 8.5 pounds per square inch for the peak CO season day modeled. This estimate is based upon raw gasoline data provided by the Arizona Department of Weights and Measures. Specifically, this value represents the average RVP of 138 samples collected during November and December of 2002. For the annual emissions estimates, monthly RVP estimates were derived from the Arizona Department of Weights and Measures data table for use in the monthly MOBILE6.2 analyses incorporated into this analysis. Monthly

fuel qualities, including RVP, sulfur content, and ethanol content, are summarized in Appendix 5.7.

9. **FUEL PROGRAM: 4** Indicates that the model is to be run with user-supplied gasoline sulfur levels. The following four lines include 32 numbers, the first 16 listing the average gasoline sulfur value in parts per million for the years 2000 through 2015 and the second 16 indicate the maximum gasoline sulfur content vehicles of model year 2000 through 2015 will be exposed. For the purposes of this analysis, the gasoline data from the time period of November and December 2002 was examined and the average sampled sulfur values during that time period were entered for all time periods. Similarly, the gasoline data for all of 2002 was examined and the maximum sulfur value during that time period was entered for each model year of 2000 through 2015. Those values were 45.6 for average sulfur content and 338.0 ppm for a maximum sulfur content. For the monthly MOBILE6.2 analyses incorporated into this analysis, the average monthly sulfur content from the Arizona Department of Weights and Measures data table were used for the average sulfur value while the 338.0 ppm estimate was used for each month as the maximum sulfur content.

10. **OXYGENATED FUELS: 0.000 1.000 0.000 0.031 1** Indicates that the 0 percent of the gasoline sold during the CO season modeled used MTBE as an oxygenate and 100 percent of the gasoline used ethanol as an oxygenate. The average MTBE content was 0.0 percent by weight and the average ethanol content was 3.1 percent by weight. The number “1” indicates that no RVP waiver has been granted to allow for the “splash” blending of ethanol oxygenates. For the monthly MOBILE6.2 analyses incorporated into this analysis, the average monthly oxygenate content from the Arizona Department of Weights and Measures data table were used, with the exception of January through March 2003, a time period during which no oxygenate data were available. For those months, an average of the oxygenate data from the months November and December were used.

5.5.3 *Model outputs*

MOBILE6.2 was executed with the inputs described above to obtain composite emission factors in grams per mile (g/mi) for exhaust CO. These values were obtained for the eight vehicle classes described in section 5.1 for the various speeds as described in item six of the **Scenario Section**, described on the preceding page. The emission factors generated for 2002 are presented in the following section. Representative output runs are contained in Appendix 5.2. These values were subsequently used in developing emission estimates.

5.5.4 *Summary of emission factors*

Refer to Appendix 5.2 for the emission factors developed for CO for each facility and area type.

5.5.5 Emission estimates

MOBILE6.2 was used to generate CO emission factors for vehicle class, facility, and area type. Daily VMT for the CO season (Table 5.4–2 and 5.4–3) or for a monthly average day (Table 5.2–1 and 5.2–2) was then multiplied by the VMT mix by vehicle class and the appropriate CO emission factor (Appendix 5.2) to estimate CO emissions on a kilogram per day (kg/day) basis. VMT mix refers to the fraction of total onroad vehicle miles of travel from a particular vehicle type. For example, since the EPA MOBILE6.2 model estimates that 42.2 percent of onroad VMT was from light duty gasoline vehicles, the VMT Mix value for LDGVs is 0.422. An example calculation is given below, reflecting light duty gasoline vehicles on interstates, free-ways, and expressways in area type 1 (see Table 5-4(a) at this time, 5-4(a) can not be changed to 5.4–4 and on:

$$\begin{aligned}
 \text{CO emissions} &= \text{DMVT} \times \text{VMT mix} \times \text{CO emission factor} \div \text{unit conversion factor} \\
 (\text{kg/day}) & & & (\text{g/mi}) & & (\text{g/kg}) \\
 &= 1,140,342 \times 0.422 \times 12.446 \div 1,000 \\
 &= 5,991 \text{ kg CO/day}
 \end{aligned}$$

$$\begin{aligned}
 \text{CO emissions} &= \text{CO emissions} \div \text{unit conversion factor} \\
 (\text{lb/day}) & \quad (\text{kg/day}) \quad (\text{kg/lb}) \\
 &= 5,991 \text{ kg} \div 0.4536 \\
 &= 13,208 \text{ lb CO/day}
 \end{aligned}$$

Tables 5.5–1 through 5.5–4 show daily VMT data, associated speed estimates, MOBILE6.2 emission factors, and the calculated CO emissions for each vehicle class, facility type, and area type for the CO season runs and the annual average runs for the CO nonattainment area and Maricopa County, respectively.

Table 5.5–1. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (peak CO season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 42.2%	1	59.7	12.446	1,140,342	13,208.0	5,991.2
		2	60.3	12.496	9,137,049	106,262.3	48,200.6
		3	63.2	12.526	6,302,894	73,477.5	33,329.4
		4	64.8	12.526	4,570,910	53,286.5	24,170.7
		5	64.2	12.526	2,705,329	31,538.0	14,305.7
	LDGT1 with VMT mix of 28.7%	1	59.7	16.382	1,140,342	11,804.6	5,354.6
		2	60.3	16.442	9,137,049	94,931.3	43,060.8
		3	63.2	16.483	6,302,894	65,647.8	29,777.9
		4	64.8	16.483	4,570,910	47,608.3	21,595.1
		5	64.2	16.483	2,705,329	28,177.4	12,781.3
	LDGT2 with VMT mix of 13.4%	1	59.7	17.857	1,140,342	5,998.2	2,720.8
		2	60.3	17.928	9,137,049	48,251.3	21,886.8
		3	63.2	17.969	6,302,894	33,360.4	15,132.3
		4	64.8	17.969	4,570,910	24,193.2	10,974.0
		5	64.2	17.969	2,705,329	14,319.0	6,495.1
	HDGV with VMT mix of 3.6%	1	59.7	10.036	1,140,342	898.3	407.5
		2	60.3	10.289	9,137,049	7,378.8	3,347.0
		3	63.2	10.450	6,302,894	5,170.0	2,345.1
		4	64.8	10.450	4,570,910	3,749.3	1,700.7
		5	64.2	10.450	2,705,329	2,219.1	1,006.6
LDDV with VMT mix of 0.2%	1	59.7	1.258	1,140,342	7.0	3.2	
	2	60.3	1.268	9,137,049	56.2	25.5	
	3	63.2	1.275	6,302,894	39.0	17.7	
	4	64.8	1.275	4,570,910	28.3	12.8	
	5	64.2	1.275	2,705,329	16.7	7.6	
LDDT with VMT mix of 2.3%	1	59.7	0.655	1,140,342	37.7	17.1	
	2	60.3	0.661	9,137,049	304.9	138.3	
	3	63.2	0.666	6,302,894	211.9	96.1	
	4	64.8	0.666	4,570,910	153.7	69.7	
	5	64.2	0.666	2,705,329	91.0	41.3	
HDDV with VMT mix of 9.2%	1	59.7	2.287	1,140,342	528.4	239.7	
	2	60.3	2.324	9,137,049	4,302.6	1,951.6	
	3	63.2	2.349	6,302,894	2,999.9	1,360.8	
	4	64.8	2.349	4,570,910	2,175.6	986.8	
	5	64.2	2.349	2,705,329	1,287.6	584.1	
MC with VMT mix of 0.5%	1	59.7	16.110	1,140,342	202.5	91.9	
	2	60.3	16.790	9,137,049	1,691.2	767.1	
	3	63.2	17.230	6,302,894	1,197.2	543.0	
	4	64.8	17.230	4,570,910	868.2	393.8	
	5	64.2	17.230	2,705,329	513.9	233.1	

Table 5.5–1. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (peak CO season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	9.753	1,098,337	9,969.5	4,522.1
PRINCIPAL	LDGV	2	34.4	9.832	8,922,876	81,642.3	37,032.9
ARTERIALS	with VMT	3	36.1	9.933	9,893,913	91,463.1	41,487.7
and	mix of	4	39.0	10.157	6,992,646	66,101.4	29,983.6
MINOR	42.2%	5	42.6	10.451	2,696,994	26,230.9	11,898.3
ARTERIALS		1	30.3	13.315	1,098,337	9,240.9	4,191.7
	LDGT1	2	34.4	13.423	8,922,876	75,683.6	34,330.1
	with VMT	3	36.1	13.544	9,893,913	84,675.4	38,408.7
	mix of	4	39.0	13.816	6,992,646	61,049.4	27,692.0
	28.7%	5	42.6	14.151	2,696,994	24,115.6	10,938.8
		1	30.3	14.437	1,098,337	4,670.8	2,118.7
	LDGT2	2	34.4	14.545	8,922,876	38,228.1	17,340.3
	with VMT	3	36.1	14.685	9,893,913	42,798.7	19,413.5
	mix of	4	39.0	14.989	6,992,646	30,873.3	14,004.1
	13.4%	5	42.6	15.373	2,696,994	12,212.7	5,539.7
		1	30.3	8.457	1,098,337	729.1	330.7
	HDGV	2	34.4	7.578	8,922,876	5,307.4	2,407.4
	with VMT	3	36.1	7.335	9,893,913	5,696.0	2,583.7
	mix of	4	39.0	7.011	6,992,646	3,848.2	1,745.6
	3.6%	5	42.6	6.829	2,696,994	1,445.6	655.7
		1	30.3	1.311	1,098,337	7.0	3.2
	LDDV	2	34.4	1.231	8,922,876	53.3	24.2
	with VMT	3	36.1	1.207	9,893,913	57.9	26.3
	mix of	4	39.0	1.173	6,992,646	39.8	18.0
	0.2%	5	42.6	1.147	2,696,994	15.0	6.8
		1	30.3	0.688	1,098,337	38.2	17.3
	LDDT	2	34.4	0.638	8,922,876	287.4	130.4
	with VMT	3	36.1	0.622	9,893,913	310.7	140.9
	mix of	4	39.0	0.601	6,992,646	212.2	96.2
	2.3%	5	42.6	0.584	2,696,994	79.5	36.1
		1	30.3	2.472	1,098,337	550.1	249.5
	HDDV	2	34.4	2.195	8,922,876	3,968.5	1,800.1
	with VMT	3	36.1	2.110	9,893,913	4,230.0	1,918.7
	mix of	4	39.0	1.993	6,992,646	2,823.8	1,280.9
	9.2%	5	42.6	1.901	2,696,994	1,038.8	471.2
		1	30.3	10.210	1,098,337	123.6	56.1
	MC	2	34.4	9.250	8,922,876	909.9	412.7
	with VMT	3	36.1	8.930	9,893,913	974.0	441.8
	mix of	4	39.0	8.460	6,992,646	652.2	295.8
	0.5%	5	42.6	8.040	2,696,994	239.0	108.4

Table 5.5–1. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (peak CO season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	10.314	1,057,463	10,150.3	4,604.2
	LDGV	2	19.1	10.220	2,754,563	26,198.8	11,883.8
	with VMT	3	24.4	9.873	1,711,101	15,722.5	7,131.7
	mix of	4	24.7	9.853	881,342	8,081.8	3,665.9
	42.2%	5	28.2	9.777	964,613	8,776.6	3,981.1
		1	18.2	13.974	1,057,463	9,337.4	4,235.4
	LDGT1	2	19.1	13.870	2,754,563	24,141.4	10,950.6
	with VMT	3	24.4	13.455	1,711,101	14,547.7	6,598.8
	mix of	4	24.7	13.443	881,342	7,486.6	3,395.9
	28.7%	5	28.2	13.347	964,613	8,135.6	3,690.3
		1	18.2	15.262	1,057,463	4,753.9	2,156.4
	LDGT2	2	19.1	15.127	2,754,563	12,273.8	5,567.4
	with VMT	3	24.4	14.628	1,711,101	7,372.8	3,344.3
	mix of	4	24.7	14.607	881,342	3,792.1	1,720.1
	13.4%	5	28.2	14.480	964,613	4,114.4	1,866.3
		1	18.2	14.457	1,057,463	1,199.9	544.3
	HDGV	2	19.1	13.758	2,754,563	2,974.5	1,349.2
	with VMT	3	24.4	10.571	1,711,101	1,419.8	644.0
	mix of	4	24.7	10.430	881,342	721.5	327.3
	3.6%	5	28.2	9.095	964,613	688.6	312.3
	1	18.2	1.803	1,057,463	9.2	4.2	
LDDV	2	19.1	1.748	2,754,563	23.4	10.6	
with VMT	3	24.4	1.490	1,711,101	12.4	5.6	
mix of	4	24.7	1.479	881,342	6.3	2.9	
0.2%	5	28.2	1.365	964,613	6.4	2.9	
	1	18.2	1.000	1,057,463	53.4	24.2	
LDDT	2	19.1	0.965	2,754,563	134.2	60.9	
with VMT	3	24.4	0.802	1,711,101	69.3	31.4	
mix of	4	24.7	0.795	881,342	35.4	16.0	
2.3%	5	28.2	0.723	964,613	35.2	16.0	
	1	18.2	4.183	1,057,463	896.3	406.5	
HDDV	2	19.1	3.991	2,754,563	2,227.5	1,010.4	
with VMT	3	24.4	3.095	1,711,101	1,073.1	486.7	
mix of	4	24.7	3.055	881,342	545.6	247.5	
9.2%	5	28.2	2.661	964,613	520.1	235.9	
	1	18.2	15.100	1,057,463	176.0	79.8	
MC	2	19.1	14.550	2,754,563	441.8	200.4	
with VMT	3	24.4	12.080	1,711,101	227.9	103.4	
mix of	4	24.7	11.980	881,342	116.4	52.8	
0.5%	5	28.2	10.800	964,613	114.8	52.1	

Table 5.5–1. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (peak CO season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	11.118	197,199	2,040.4	925.5
	LDGV	2	12.9	11.118	2,011,047	20,808.2	9,438.6
	with VMT	3	12.9	11.118	2,590,190	26,800.6	12,156.8
	mix of	4	12.9	11.118	1,706,405	17,656.1	8,008.8
	42.2%	5	12.9	11.118	864,330	8,943.2	4,056.6
		1	12.9	14.927	197,199	1,860.0	843.7
	LDGT1	2	12.9	14.927	2,011,047	18,968.8	8,604.2
	with VMT	3	12.9	14.927	2,590,190	24,431.4	11,082.1
	mix of	4	12.9	14.927	1,706,405	16,095.3	7,300.8
	28.7%	5	12.9	14.927	864,330	8,152.6	3,698.0
		1	12.9	16.431	197,199	954.4	432.9
	LDGT2	2	12.9	16.431	2,011,047	9,733.3	4,415.0
	with VMT	3	12.9	16.431	2,590,190	12,536.3	5,686.5
	mix of	4	12.9	16.431	1,706,405	8,258.9	3,746.2
	13.4%	5	12.9	16.431	864,330	4,183.3	1,897.5
		1	12.9	20.082	197,199	310.8	141.0
	HDGV	2	12.9	20.082	2,011,047	3,169.9	1,437.8
	with VMT	3	12.9	20.082	2,590,190	4,082.7	1,851.9
	mix of	4	12.9	20.082	1,706,405	2,689.7	1,220.0
	3.6%	5	12.9	20.082	864,330	1,362.4	618.0
		1	12.9	2.236	197,199	2.1	1.0
	LDDV	2	12.9	2.236	2,011,047	21.8	9.9
	with VMT	3	12.9	2.236	2,590,190	28.1	12.7
	mix of	4	12.9	2.236	1,706,405	18.5	8.4
	0.2%	5	12.9	2.236	864,330	9.4	4.3
	1	12.9	1.275	197,199	12.7	5.8	
LDDT	2	12.9	1.275	2,011,047	129.5	58.7	
with VMT	3	12.9	1.275	2,590,190	166.7	75.6	
mix of	4	12.9	1.275	1,706,405	109.8	49.8	
2.3%	5	12.9	1.275	864,330	55.6	25.2	
	1	12.9	5.688	197,199	227.3	103.1	
HDDV	2	12.9	5.688	2,011,047	2,317.8	1,051.3	
with VMT	3	12.9	5.688	2,590,190	2,985.2	1,354.1	
mix of	4	12.9	5.688	1,706,405	1,966.7	892.1	
9.2%	5	12.9	5.688	864,330	996.2	451.9	
	1	12.9	20.110	197,199	43.7	19.8	
MC	2	12.9	20.110	2,011,047	445.8	202.2	
with VMT	3	12.9	20.110	2,590,190	574.2	260.5	
mix of	4	12.9	20.110	1,706,405	378.3	171.6	
0.5%	5	12.9	20.110	864,330	191.6	86.9	

Table 5.5–2. Daily CO emissions in Maricopa County, by vehicle class, facility type and area type (peak CO season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 42.2%	1	59.7	12.446	1,140,342	13,208.0	5,991.2
		2	60.3	12.496	9,137,049	106,262.3	48,200.6
		3	63.2	12.526	6,302,894	73,477.5	33,329.4
		4	64.8	12.526	4,570,910	53,286.5	24,170.7
		5	64.2	12.526	5,718,846	66,668.8	30,241.0
	LDGT1 with VMT mix of 28.7%	1	59.7	16.382	1,140,342	11,804.6	5,354.6
		2	60.3	16.442	9,137,049	94,931.3	43,060.8
		3	63.2	16.483	6,302,894	65,647.8	29,777.9
		4	64.8	16.483	4,570,910	47,608.3	21,595.1
		5	64.2	16.483	5,718,846	59,564.7	27,018.5
	LDGT2 with VMT mix of 13.4%	1	59.7	17.857	1,140,342	5,998.2	2,720.8
		2	60.3	17.928	9,137,049	48,251.3	21,886.8
		3	63.2	17.969	6,302,894	33,360.4	15,132.3
		4	64.8	17.969	4,570,910	24,193.2	10,974.0
		5	64.2	17.969	5,718,846	30,269.1	13,730.1
	HDGV with VMT mix of 3.6%	1	59.7	10.036	1,140,342	898.3	407.5
		2	60.3	10.289	9,137,049	7,378.8	3,347.0
		3	63.2	10.450	6,302,894	5,170.0	2,345.1
		4	64.8	10.450	4,570,910	3,749.3	1,700.7
		5	64.2	10.450	5,718,846	4,690.9	2,127.8
LDDV with VMT mix of 0.2%	1	59.7	1.258	1,140,342	7.0	3.2	
	2	60.3	1.268	9,137,049	56.2	25.5	
	3	63.2	1.275	6,302,894	39.0	17.7	
	4	64.8	1.275	4,570,910	28.3	12.8	
	5	64.2	1.275	5,718,846	35.4	16.0	
LDDT with VMT mix of 2.3%	1	59.7	0.655	1,140,342	37.7	17.1	
	2	60.3	0.661	9,137,049	304.9	138.3	
	3	63.2	0.666	6,302,894	211.9	96.1	
	4	64.8	0.666	4,570,910	153.7	69.7	
	5	64.2	0.666	5,718,846	192.3	87.2	
HDDV with VMT mix of 9.2%	1	59.7	2.287	1,140,342	528.4	239.7	
	2	60.3	2.324	9,137,049	4,302.6	1,951.6	
	3	63.2	2.349	6,302,894	2,999.9	1,360.8	
	4	64.8	2.349	4,570,910	2,175.6	986.8	
	5	64.2	2.349	5,718,846	2,721.9	1,234.7	
MC with VMT mix of 0.5%	1	59.7	16.110	1,140,342	202.5	91.9	
	2	60.3	16.790	9,137,049	1,691.2	767.1	
	3	63.2	17.230	6,302,894	1,197.2	543.0	
	4	64.8	17.230	4,570,910	868.2	393.8	
	5	64.2	17.230	5,718,846	1,086.3	492.7	

Table 5.5–2. Daily CO emissions in Maricopa County, by vehicle class, facility type and area type (peak CO season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	9.753	1,098,337	9,969.5	4,522.1
PRINCIPAL	LDGV	2	34.4	9.832	8,922,876	81,642.3	37,032.9
ARTERIALS	with VMT	3	36.1	9.933	9,893,913	91,463.1	41,487.7
and	mix of	4	39.0	10.157	6,992,646	66,101.4	29,983.6
MINOR	42.2%	5	42.6	10.451	3,776,028	36,725.5	16,658.7
ARTERIALS		1	30.3	13.315	1,098,337	9,240.9	4,191.7
	LDGT1	2	34.4	13.423	8,922,876	75,683.6	34,330.1
	with VMT	3	36.1	13.544	9,893,913	84,675.4	38,408.7
	mix of	4	39.0	13.816	6,992,646	61,049.4	27,692.0
	28.7%	5	42.6	14.151	3,776,028	33,764.0	15,315.3
		1	30.3	14.437	1,098,337	4,670.8	2,118.7
	LDGT2	2	34.4	14.545	8,922,876	38,228.1	17,340.3
	with VMT	3	36.1	14.685	9,893,913	42,798.7	19,413.5
	mix of	4	39.0	14.989	6,992,646	30,873.3	14,004.1
	13.4%	5	42.6	15.373	3,776,028	17,098.9	7,756.0
		1	30.3	8.457	1,098,337	729.1	330.7
	HDGV	2	34.4	7.578	8,922,876	5,307.4	2,407.4
	with VMT	3	36.1	7.335	9,893,913	5,696.0	2,583.7
	mix of	4	39.0	7.011	6,992,646	3,848.2	1,745.6
	3.6%	5	42.6	6.829	3,776,028	2,024.0	918.1
		1	30.3	1.311	1,098,337	7.0	3.2
	LDDV	2	34.4	1.231	8,922,876	53.3	24.2
	with VMT	3	36.1	1.207	9,893,913	57.9	26.3
	mix of	4	39.0	1.173	6,992,646	39.8	18.0
	0.2%	5	42.6	1.147	3,776,028	21.0	9.5
		1	30.3	0.688	1,098,337	38.2	17.3
	LDDT	2	34.4	0.638	8,922,876	287.4	130.4
	with VMT	3	36.1	0.622	9,893,913	310.7	140.9
	mix of	4	39.0	0.601	6,992,646	212.2	96.2
	2.3%	5	42.6	0.584	3,776,028	111.3	50.5
		1	30.3	2.472	1,098,337	550.1	249.5
	HDDV	2	34.4	2.195	8,922,876	3,968.5	1,800.1
	with VMT	3	36.1	2.110	9,893,913	4,230.0	1,918.7
	mix of	4	39.0	1.993	6,992,646	2,823.8	1,280.9
	9.2%	5	42.6	1.901	3,776,028	1,454.5	659.7
		1	30.3	10.210	1,098,337	123.6	56.1
	MC	2	34.4	9.250	8,922,876	909.9	412.7
	with VMT	3	36.1	8.930	9,893,913	974.0	441.8
	mix of	4	39.0	8.460	6,992,646	652.2	295.8
	0.5%	5	42.6	8.040	3,776,028	334.7	151.8

Table 5.5–2. Daily CO emissions in Maricopa County, by vehicle class, facility type and area type (peak CO season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	10.314	1,057,463	10,150.3	4,604.2
	LDGV	2	19.1	10.220	2,754,563	26,198.8	11,883.8
	with VMT	3	24.4	9.873	1,711,101	15,722.5	7,131.7
	mix of	4	24.7	9.853	881,342	8,081.8	3,665.9
	42.2%	5	28.2	9.777	2,414,851	21,971.7	9,966.4
		1	18.2	13.974	1,057,463	9,337.4	4,235.4
	LDGT1	2	19.1	13.870	2,754,563	24,141.4	10,950.6
	with VMT	3	24.4	13.455	1,711,101	14,547.7	6,598.8
	mix of	4	24.7	13.443	881,342	7,486.6	3,395.9
	28.7%	5	28.2	13.347	2,414,851	20,367.0	9,238.5
		1	18.2	15.262	1,057,463	4,753.9	2,156.4
	LDGT2	2	19.1	15.127	2,754,563	12,273.8	5,567.4
	with VMT	3	24.4	14.628	1,711,101	7,372.8	3,344.3
	mix of	4	24.7	14.607	881,342	3,792.1	1,720.1
	13.4%	5	28.2	14.480	2,414,851	10,300.2	4,672.2
		1	18.2	14.457	1,057,463	1,199.9	544.3
	HDGV	2	19.1	13.758	2,754,563	2,974.5	1,349.2
	with VMT	3	24.4	10.571	1,711,101	1,419.8	644.0
	mix of	4	24.7	10.430	881,342	721.5	327.3
	3.6%	5	28.2	9.095	2,414,851	1,723.8	781.9
	1	18.2	1.803	1,057,463	9.2	4.2	
LDDV	2	19.1	1.748	2,754,563	23.4	10.6	
with VMT	3	24.4	1.490	1,711,101	12.4	5.6	
mix of	4	24.7	1.479	881,342	6.3	2.9	
0.2%	5	28.2	1.365	2,414,851	16.0	7.3	
	1	18.2	1.000	1,057,463	53.4	24.2	
LDDT	2	19.1	0.965	2,754,563	134.2	60.9	
with VMT	3	24.4	0.802	1,711,101	69.3	31.4	
mix of	4	24.7	0.795	881,342	35.4	16.0	
2.3%	5	28.2	0.723	2,414,851	88.2	40.0	
	1	18.2	4.183	1,057,463	896.3	406.5	
HDDV	2	19.1	3.991	2,754,563	2,227.5	1,010.4	
with VMT	3	24.4	3.095	1,711,101	1,073.1	486.7	
mix of	4	24.7	3.055	881,342	545.6	247.5	
9.2%	5	28.2	2.661	2,414,851	1,302.0	590.6	
	1	18.2	15.100	1,057,463	176.0	79.8	
MC	2	19.1	14.550	2,754,563	441.8	200.4	
with VMT	3	24.4	12.080	1,711,101	227.9	103.4	
mix of	4	24.7	11.980	881,342	116.4	52.8	
0.5%	5	28.2	10.800	2,414,851	287.5	130.4	

Table 5.5–2. Daily CO emissions in Maricopa County, by vehicle class, facility type and area type (peak CO season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	11.118	197,199	2,040.4	925.5
	LDGV	2	12.9	11.118	2,011,047	20,808.2	9,438.6
	with VMT	3	12.9	11.118	2,590,190	26,800.6	12,156.8
	mix of	4	12.9	11.118	1,706,405	17,656.1	8,008.8
	42.2%	5	12.9	11.118	864,330	8,943.2	4,056.6
		1	12.9	14.927	197,199	1,860.0	843.7
	LDGT1	2	12.9	14.927	2,011,047	18,968.8	8,604.2
	with VMT	3	12.9	14.927	2,590,190	24,431.4	11,082.1
	mix of	4	12.9	14.927	1,706,405	16,095.3	7,300.8
	28.7%	5	12.9	14.927	864,330	8,152.6	3,698.0
		1	12.9	16.431	197,199	954.4	432.9
	LDGT2	2	12.9	16.431	2,011,047	9,733.3	4,415.0
	with VMT	3	12.9	16.431	2,590,190	12,536.3	5,686.5
	mix of	4	12.9	16.431	1,706,405	8,258.9	3,746.2
	13.4%	5	12.9	16.431	864,330	4,183.3	1,897.5
		1	12.9	20.082	197,199	310.8	141.0
	HDGV	2	12.9	20.082	2,011,047	3,169.9	1,437.8
	with VMT	3	12.9	20.082	2,590,190	4,082.7	1,851.9
	mix of	4	12.9	20.082	1,706,405	2,689.7	1,220.0
	3.6%	5	12.9	20.082	864,330	1,362.4	618.0
		1	12.9	2.236	197,199	2.1	1.0
	LDDV	2	12.9	2.236	2,011,047	21.8	9.9
	with VMT	3	12.9	2.236	2,590,190	28.1	12.7
	mix of	4	12.9	2.236	1,706,405	18.5	8.4
	0.2%	5	12.9	2.236	864,330	9.4	4.3
	1	12.9	1.275	197,199	12.7	5.8	
LDDT	2	12.9	1.275	2,011,047	129.5	58.7	
with VMT	3	12.9	1.275	2,590,190	166.7	75.6	
mix of	4	12.9	1.275	1,706,405	109.8	49.8	
2.3%	5	12.9	1.275	864,330	55.6	25.2	
	1	12.9	5.688	197,199	227.3	103.1	
HDDV	2	12.9	5.688	2,011,047	2,317.8	1,051.3	
with VMT	3	12.9	5.688	2,590,190	2,985.2	1,354.1	
mix of	4	12.9	5.688	1,706,405	1,966.7	892.1	
9.2%	5	12.9	5.688	864,330	996.2	451.9	
	1	12.9	20.110	197,199	43.7	19.8	
MC	2	12.9	20.110	2,011,047	445.8	202.2	
with VMT	3	12.9	20.110	2,590,190	574.2	260.5	
mix of	4	12.9	20.110	1,706,405	378.3	171.6	
0.5%	5	12.9	20.110	864,330	191.6	86.9	

Table 5.5–3. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (annual average daily traffic).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY		1	59.7	13.108	1,129,051	14,710.1	6,672.5
	LDGV	2	60.3	13.177	9,046,583	118,484.5	53,744.6
	with VMT	3	63.2	13.222	6,240,489	82,011.2	37,200.3
	mix of	4	64.8	13.222	4,525,653	59,475.2	26,977.9
	45.1%	5	64.2	13.222	2,678,544	35,200.8	15,967.1
		1	59.7	16.711	1,129,051	11,737.2	5,324.0
	LDGT1	2	60.3	16.788	9,046,583	94,474.3	42,853.5
	with VMT	3	63.2	16.840	6,240,489	65,373.4	29,653.4
	mix of	4	64.8	16.840	4,525,653	47,409.3	21,504.9
	28.2%	5	64.2	16.840	2,678,544	28,059.6	12,727.8
		1	59.7	18.807	1,129,051	5,223.8	2,369.5
	LDGT2	2	60.3	18.890	9,046,583	42,041.0	19,069.8
	with VMT	3	63.2	18.943	6,240,489	29,081.1	13,191.2
	mix of	4	64.8	18.943	4,525,653	21,089.8	9,566.3
	11.2%	5	64.2	18.943	2,678,544	12,482.2	5,661.9
		1	59.7	12.791	1,129,051	1,133.4	514.1
	HDGV	2	60.3	13.109	9,046,583	9,306.8	4,221.6
	with VMT	3	63.2	13.317	6,240,489	6,521.7	2,958.2
	mix of	4	64.8	13.317	4,525,653	4,729.6	2,145.3
	3.6%	5	64.2	13.317	2,678,544	2,799.2	1,269.7
		1	59.7	1.243	1,129,051	6.8	3.1
	LDDV	2	60.3	1.254	9,046,583	55.0	25.0
	with VMT	3	63.2	1.261	6,240,489	38.2	17.3
	mix of	4	64.8	1.261	4,525,653	27.7	12.6
	0.2%	5	64.2	1.261	2,678,544	16.4	7.4
	1	59.7	0.664	1,129,051	35.7	16.2	
LDDT	2	60.3	0.671	9,046,583	288.8	131.0	
with VMT	3	63.2	0.675	6,240,489	200.6	91.0	
mix of	4	64.8	0.675	4,525,653	145.5	66.0	
2.2%	5	64.2	0.675	2,678,544	86.1	39.0	
	1	59.7	2.449	1,129,051	554.1	251.3	
HDDV	2	60.3	2.489	9,046,583	4,511.0	2,046.2	
with VMT	3	63.2	2.515	6,240,489	3,144.3	1,426.2	
mix of	4	64.8	2.515	4,525,653	2,280.2	1,034.3	
9.1%	5	64.2	2.515	2,678,544	1,349.6	612.2	
	1	59.7	21.115	1,129,051	268.0	121.6	
MC	2	60.3	22.030	9,046,583	2,240.5	1,016.3	
with VMT	3	63.2	22.630	6,240,489	1,587.6	720.2	
mix of	4	64.8	22.630	4,525,653	1,151.4	522.3	
0.5%	5	64.2	22.630	2,678,544	681.4	309.1	

Table 5.5–3. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (annual average daily traffic) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	9.686	1,087,462	10,469.1	4,748.8
PRINCIPAL	LDGV	2	34.4	9.835	8,834,531	86,363.5	39,174.5
ARTERIALS	with VMT	3	36.1	9.982	9,795,953	97,190.5	44,085.6
and	mix of	4	39.0	10.157	6,923,412	69,893.5	31,703.7
MINOR	45.1%	5	42.6	10.538	2,670,291	27,969.8	12,687.1
ARTERIALS		1	30.3	12.995	1,087,462	8,791.1	3,987.7
	LDGT1	2	34.4	13.205	8,834,531	72,572.5	32,918.9
	with VMT	3	36.1	13.375	9,795,953	81,506.2	36,971.2
	mix of	4	39.0	13.593	6,923,412	58,544.9	26,556.0
	28.2%	5	42.6	14.022	2,670,291	23,291.6	10,565.1
		1	30.3	14.894	1,087,462	3,984.5	1,807.4
	LDGT2	2	34.4	15.091	8,834,531	32,797.5	14,876.9
	with VMT	3	36.1	15.270	9,795,953	36,798.8	16,691.9
	mix of	4	39.0	15.509	6,923,412	26,415.6	11,982.1
	11.2%	5	42.6	15.966	2,670,291	10,488.4	4,757.5
		1	30.3	10.773	1,087,462	919.4	417.0
	HDGV	2	34.4	9.660	8,834,531	6,697.0	3,037.8
	with VMT	3	36.1	9.346	9,795,953	7,184.5	3,258.9
	mix of	4	39.0	8.936	6,923,412	4,854.9	2,202.2
	3.6%	5	42.6	8.701	2,670,291	1,823.4	827.1
		1	30.3	1.296	1,087,462	6.8	3.1
	LDDV	2	34.4	1.217	8,834,531	52.1	23.6
	with VMT	3	36.1	1.193	9,795,953	56.7	25.7
	mix of	4	39.0	1.160	6,923,412	38.9	17.7
	0.2%	5	42.6	1.133	2,670,291	14.7	6.7
		1	30.3	0.698	1,087,462	36.1	16.4
	LDDT	2	34.4	0.647	8,834,531	272.1	123.4
	with VMT	3	36.1	0.631	9,795,953	294.2	133.4
	mix of	4	39.0	0.609	6,923,412	200.8	91.1
	2.2%	5	42.6	0.592	2,670,291	75.3	34.1
		1	30.3	2.647	1,087,462	576.7	261.6
	HDDV	2	34.4	2.350	8,834,531	4,160.2	1,887.1
	with VMT	3	36.1	2.260	9,795,953	4,435.5	2,012.0
	mix of	4	39.0	2.134	6,923,412	2,960.6	1,342.9
	9.1%	5	42.6	2.036	2,670,291	1,089.2	494.1
		1	30.3	13.080	1,087,462	159.9	72.5
	MC	2	34.4	11.765	8,834,531	1,168.5	530.1
	with VMT	3	36.1	11.328	9,795,953	1,247.6	565.9
	mix of	4	39.0	10.694	6,923,412	832.4	377.6
	0.5%	5	42.6	10.114	2,670,291	303.6	137.7

Table 5.5–3. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (annual average daily traffic) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	10.040	1,046,993	10,448.3	4,739.3
	LDGV	2	19.1	9.940	2,727,290	26,946.0	12,222.7
	with VMT	3	24.4	9.609	1,694,159	16,180.2	7,339.3
	mix of	4	24.7	9.595	872,616	8,321.6	3,774.7
	45.1%	5	28.2	9.559	955,062	9,074.1	4,116.0
		1	18.2	13.268	1,046,993	8,641.7	3,919.9
	LDGT1	2	19.1	13.167	2,727,290	22,338.1	10,132.5
	with VMT	3	24.4	12.875	1,694,159	13,568.5	6,154.7
	mix of	4	24.7	12.863	872,616	6,982.4	3,167.2
	28.2%	5	28.2	12.859	955,062	7,639.7	3,465.4
		1	18.2	15.380	1,046,993	3,961.5	1,796.9
	LDGT2	2	19.1	15.251	2,727,290	10,232.5	4,641.4
	with VMT	3	24.4	14.841	1,694,159	6,185.5	2,805.7
	mix of	4	24.7	14.827	872,616	3,182.9	1,443.8
	11.2%	5	28.2	14.777	955,062	3,472.0	1,574.9
		1	18.2	18.423	1,046,993	1,513.7	686.6
	HDGV	2	19.1	17.524	2,727,290	3,750.6	1,701.3
	with VMT	3	24.4	13.463	1,694,159	1,789.9	811.9
	mix of	4	24.7	13.282	872,616	909.5	412.6
	3.6%	5	28.2	11.581	955,062	868.0	393.7
		1	18.2	1.786	1,046,993	9.1	4.1
	LDDV	2	19.1	1.731	2,727,290	22.9	10.4
	with VMT	3	24.4	1.474	1,694,159	12.1	5.5
	mix of	4	24.7	1.463	872,616	6.2	2.8
	0.2%	5	28.2	1.350	955,062	6.3	2.8
	1	18.2	1.015	1,046,993	50.6	23.0	
LDDT	2	19.1	0.979	2,727,290	127.2	57.7	
with VMT	3	24.4	0.813	1,694,159	65.6	29.8	
mix of	4	24.7	0.806	872,616	33.5	15.2	
2.2%	5	28.2	0.733	955,062	33.3	15.1	
	1	18.2	4.479	1,046,993	939.7	426.3	
HDDV	2	19.1	4.274	2,727,290	2,335.5	1,059.4	
with VMT	3	24.4	3.314	1,694,159	1,125.0	510.3	
mix of	4	24.7	3.271	872,616	572.0	259.5	
9.1%	5	28.2	2.849	955,062	545.3	247.3	
	1	18.2	19.735	1,046,993	232.3	105.4	
MC	2	19.1	18.983	2,727,290	582.0	264.0	
with VMT	3	24.4	15.626	1,694,159	297.6	135.0	
mix of	4	24.7	15.480	872,616	151.9	68.9	
0.5%	5	28.2	13.874	955,062	149.0	67.6	

Table 5.5–3. Daily CO emissions in the CO nonattainment area, by vehicle class, facility type and area type (annual average daily traffic) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	10.904	195,247	2,116.1	959.8
	LDGV	2	12.9	10.904	1,991,136	21,579.8	9,788.6
	with VMT	3	12.9	10.904	2,564,545	27,794.3	12,607.5
	mix of	4	12.9	10.904	1,689,510	18,310.8	8,305.8
	45.1%	5	12.9	10.904	855,772	9,274.8	4,207.0
		1	12.9	14.157	195,247	1,719.5	780.0
	LDGT1	2	12.9	14.157	1,991,136	17,535.4	7,954.1
	with VMT	3	12.9	14.157	2,564,545	22,585.3	10,244.7
	mix of	4	12.9	14.157	1,689,510	14,879.1	6,749.1
	28.2%	5	12.9	14.157	855,772	7,536.6	3,418.6
		1	12.9	16.521	195,247	793.5	360.0
	LDGT2	2	12.9	16.521	1,991,136	8,092.6	3,670.8
	with VMT	3	12.9	16.521	2,564,545	10,423.1	4,727.9
	mix of	4	12.9	16.521	1,689,510	6,866.7	3,114.7
	11.2%	5	12.9	16.521	855,772	3,478.1	1,577.7
		1	12.9	25.590	195,247	392.1	177.9
	HDGV	2	12.9	25.590	1,991,136	3,998.6	1,813.8
	with VMT	3	12.9	25.590	2,564,545	5,150.1	2,336.1
	mix of	4	12.9	25.590	1,689,510	3,392.9	1,539.0
	3.6%	5	12.9	25.590	855,772	1,718.6	779.5
		1	12.9	2.216	195,247	2.1	1.0
	LDDV	2	12.9	2.216	1,991,136	21.4	9.7
	with VMT	3	12.9	2.216	2,564,545	27.6	12.5
	mix of	4	12.9	2.216	1,689,510	18.2	8.2
	0.2%	5	12.9	2.216	855,772	9.2	4.2
	1	12.9	1.294	195,247	12.0	5.5	
LDDT	2	12.9	1.294	1,991,136	122.7	55.6	
with VMT	3	12.9	1.294	2,564,545	158.0	71.7	
mix of	4	12.9	1.294	1,689,510	104.1	47.2	
2.2%	5	12.9	1.294	855,772	52.7	23.9	
	1	12.9	6.090	195,247	238.3	108.1	
HDDV	2	12.9	6.090	1,991,136	2,429.9	1,102.2	
with VMT	3	12.9	6.090	2,564,545	3,129.7	1,419.6	
mix of	4	12.9	6.090	1,689,510	2,061.8	935.2	
9.1%	5	12.9	6.090	855,772	1,044.4	473.7	
	1	12.9	26.555	195,247	58.3	26.4	
MC	2	12.9	26.555	1,991,136	594.4	269.6	
with VMT	3	12.9	26.555	2,564,545	765.6	347.3	
mix of	4	12.9	26.555	1,689,510	504.4	228.8	
0.5%	5	12.9	26.555	855,772	255.5	115.9	

Table 5.5-4. Daily CO emissions in Maricopa County, by vehicle class, facility type and area type (annual average daily traffic).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	13.108	1,129,051	14,710.1	6,672.5
		2	60.3	13.177	9,046,583	118,484.5	53,744.6
		3	63.2	13.222	6,240,489	82,011.2	37,200.3
		4	64.8	13.222	4,525,653	59,475.2	26,977.9
		5	64.2	13.222	5,662,224	74,411.7	33,753.2
	LDGT1 with VMT mix of 28.2%	1	59.7	16.711	1,129,051	11,737.2	5,324.0
		2	60.3	16.788	9,046,583	94,474.3	42,853.5
		3	63.2	16.840	6,240,489	65,373.4	29,653.4
		4	64.8	16.840	4,525,653	47,409.3	21,504.9
		5	64.2	16.840	5,662,224	59,315.7	26,905.6
	LDGT2 with VMT mix of 11.2%	1	59.7	18.807	1,129,051	5,223.8	2,369.5
		2	60.3	18.890	9,046,583	42,041.0	19,069.8
		3	63.2	18.943	6,240,489	29,081.1	13,191.2
		4	64.8	18.943	4,525,653	21,089.8	9,566.3
		5	64.2	18.943	5,662,224	26,386.3	11,968.8
	HDGV with VMT mix of 3.6%	1	59.7	12.791	1,129,051	1,133.4	514.1
		2	60.3	13.109	9,046,583	9,306.8	4,221.6
		3	63.2	13.317	6,240,489	6,521.7	2,958.2
		4	64.8	13.317	4,525,653	4,729.6	2,145.3
		5	64.2	13.317	5,662,224	5,917.3	2,684.1
LDDV with VMT mix of 0.2%	1	59.7	1.243	1,129,051	6.8	3.1	
	2	60.3	1.254	9,046,583	55.0	25.0	
	3	63.2	1.261	6,240,489	38.2	17.3	
	4	64.8	1.261	4,525,653	27.7	12.6	
	5	64.2	1.261	5,662,224	34.6	15.7	
LDDT with VMT mix of 2.2%	1	59.7	0.664	1,129,051	35.7	16.2	
	2	60.3	0.671	9,046,583	288.8	131.0	
	3	63.2	0.675	6,240,489	200.6	91.0	
	4	64.8	0.675	4,525,653	145.5	66.0	
	5	64.2	0.675	5,662,224	182.0	82.5	
HDDV with VMT mix of 9.1%	1	59.7	2.449	1,129,051	554.1	251.3	
	2	60.3	2.489	9,046,583	4,511.0	2,046.2	
	3	63.2	2.515	6,240,489	3,144.3	1,426.2	
	4	64.8	2.515	4,525,653	2,280.2	1,034.3	
	5	64.2	2.515	5,662,224	2,852.9	1,294.1	
MC with VMT mix of 0.5%	1	59.7	21.115	1,129,051	268.0	121.6	
	2	60.3	22.030	9,046,583	2,240.5	1,016.3	
	3	63.2	22.630	6,240,489	1,587.6	720.2	
	4	64.8	22.630	4,525,653	1,151.4	522.3	
	5	64.2	22.630	5,662,224	1,440.5	653.4	

Table 5.5–4. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average daily traffic) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	9.686	1,087,462	10,469.1	4,748.8
PRINCIPAL	LDGV	2	34.4	9.835	8,834,531	86,363.5	39,174.5
ARTERIALS	with VMT	3	36.1	9.982	9,795,953	97,190.5	44,085.6
and	mix of	4	39.0	10.157	6,923,412	69,893.5	31,703.7
MINOR	45.1%	5	42.6	10.538	3,738,642	39,160.1	17,763.0
ARTERIALS		1	30.3	12.995	1,087,462	8,791.1	3,987.7
	LDGT1	2	34.4	13.205	8,834,531	72,572.5	32,918.9
	with VMT	3	36.1	13.375	9,795,953	81,506.2	36,971.2
	mix of	4	39.0	13.593	6,923,412	58,544.9	26,556.0
	28.2%	5	42.6	14.022	3,738,642	32,610.3	14,792.0
		1	30.3	14.894	1,087,462	3,984.5	1,807.4
	LDGT2	2	34.4	15.091	8,834,531	32,797.5	14,876.9
	with VMT	3	36.1	15.270	9,795,953	36,798.8	16,691.9
	mix of	4	39.0	15.509	6,923,412	26,415.6	11,982.1
	11.2%	5	42.6	15.966	3,738,642	14,684.6	6,661.0
		1	30.3	10.773	1,087,462	919.4	417.0
	HDGV	2	34.4	9.660	8,834,531	6,697.0	3,037.8
	with VMT	3	36.1	9.346	9,795,953	7,184.5	3,258.9
	mix of	4	39.0	8.936	6,923,412	4,854.9	2,202.2
	3.6%	5	42.6	8.701	3,738,642	2,552.9	1,158.0
		1	30.3	1.296	1,087,462	6.8	3.1
	LDDV	2	34.4	1.217	8,834,531	52.1	23.6
	with VMT	3	36.1	1.193	9,795,953	56.7	25.7
	mix of	4	39.0	1.160	6,923,412	38.9	17.7
	0.2%	5	42.6	1.133	3,738,642	20.5	9.3
		1	30.3	0.698	1,087,462	36.1	16.4
	LDDT	2	34.4	0.647	8,834,531	272.1	123.4
	with VMT	3	36.1	0.631	9,795,953	294.2	133.4
	mix of	4	39.0	0.609	6,923,412	200.8	91.1
	2.2%	5	42.6	0.592	3,738,642	105.4	47.8
		1	30.3	2.647	1,087,462	576.7	261.6
	HDDV	2	34.4	2.350	8,834,531	4,160.2	1,887.1
	with VMT	3	36.1	2.260	9,795,953	4,435.5	2,012.0
	mix of	4	39.0	2.134	6,923,412	2,960.6	1,342.9
	9.1%	5	42.6	2.036	3,738,642	1,524.9	691.7
		1	30.3	13.080	1,087,462	159.9	72.5
	MC	2	34.4	11.765	8,834,531	1,168.5	530.1
	with VMT	3	36.1	11.328	9,795,953	1,247.6	565.9
	mix of	4	39.0	10.694	6,923,412	832.4	377.6
	0.5%	5	42.6	10.114	3,738,642	425.1	192.8

Table 5.5–4. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average daily traffic) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	10.040	1,046,993	10,448.3	4,739.3
	LDGV	2	19.1	9.940	2,727,290	26,946.0	12,222.7
	with VMT	3	24.4	9.609	1,694,159	16,180.2	7,339.3
	mix of	4	24.7	9.595	872,616	8,321.6	3,774.7
	45.1%	5	28.2	9.559	2,390,942	22,716.5	10,304.2
		1	18.2	13.268	1,046,993	8,641.7	3,919.9
	LDGT1	2	19.1	13.167	2,727,290	22,338.1	10,132.5
	with VMT	3	24.4	12.875	1,694,159	13,568.5	6,154.7
	mix of	4	24.7	12.863	872,616	6,982.4	3,167.2
	28.2%	5	28.2	12.859	2,390,942	19,125.5	8,675.3
		1	18.2	15.380	1,046,993	3,961.5	1,796.9
	LDGT2	2	19.1	15.251	2,727,290	10,232.5	4,641.4
	with VMT	3	24.4	14.841	1,694,159	6,185.5	2,805.7
	mix of	4	24.7	14.827	872,616	3,182.9	1,443.8
	11.2%	5	28.2	14.777	2,390,942	8,691.9	3,942.6
		1	18.2	18.423	1,046,993	1,513.7	686.6
	HDGV	2	19.1	17.524	2,727,290	3,750.6	1,701.3
	with VMT	3	24.4	13.463	1,694,159	1,789.9	811.9
	mix of	4	24.7	13.282	872,616	909.5	412.6
	3.6%	5	28.2	11.581	2,390,942	2,173.0	985.7
		1	18.2	1.786	1,046,993	9.1	4.1
	LDDV	2	19.1	1.731	2,727,290	22.9	10.4
	with VMT	3	24.4	1.474	1,694,159	12.1	5.5
	mix of	4	24.7	1.463	872,616	6.2	2.8
	0.2%	5	28.2	1.350	2,390,942	15.7	7.1
	1	18.2	1.015	1,046,993	50.6	23.0	
LDDT	2	19.1	0.979	2,727,290	127.2	57.7	
with VMT	3	24.4	0.813	1,694,159	65.6	29.8	
mix of	4	24.7	0.806	872,616	33.5	15.2	
2.2%	5	28.2	0.733	2,390,942	83.5	37.9	
	1	18.2	4.479	1,046,993	939.7	426.3	
HDDV	2	19.1	4.274	2,727,290	2,335.5	1,059.4	
with VMT	3	24.4	3.314	1,694,159	1,125.0	510.3	
mix of	4	24.7	3.271	872,616	572.0	259.5	
9.1%	5	28.2	2.849	2,390,942	1,365.0	619.2	
	1	18.2	19.735	1,046,993	232.3	105.4	
MC	2	19.1	18.983	2,727,290	582.0	264.0	
with VMT	3	24.4	15.626	1,694,159	297.6	135.0	
mix of	4	24.7	15.480	872,616	151.9	68.9	
0.5%	5	28.2	13.874	2,390,942	372.9	169.2	

Table 5.5–4. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average daily traffic) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	10.904	195,247	2,116.1	959.8
	LDGV	2	12.9	10.904	1,991,136	21,579.8	9,788.6
	with VMT	3	12.9	10.904	2,564,545	27,794.3	12,607.5
	mix of	4	12.9	10.904	1,689,510	18,310.8	8,305.8
	45.1%	5	12.9	10.904	1,422,562	15,417.6	6,993.4
		1	12.9	14.157	195,247	1,719.5	780.0
	LDGT1	2	12.9	14.157	1,991,136	17,535.4	7,954.1
	with VMT	3	12.9	14.157	2,564,545	22,585.3	10,244.7
	mix of	4	12.9	14.157	1,689,510	14,879.1	6,749.1
	28.2%	5	12.9	14.157	1,422,562	12,528.1	5,682.8
		1	12.9	16.521	195,247	793.5	360.0
	LDGT2	2	12.9	16.521	1,991,136	8,092.6	3,670.8
	with VMT	3	12.9	16.521	2,564,545	10,423.1	4,727.9
	mix of	4	12.9	16.521	1,689,510	6,866.7	3,114.7
	11.2%	5	12.9	16.521	1,422,562	5,781.7	2,622.6
		1	12.9	25.590	195,247	392.1	177.9
	HDGV	2	12.9	25.590	1,991,136	3,998.6	1,813.8
	with VMT	3	12.9	25.590	2,564,545	5,150.1	2,336.1
	mix of	4	12.9	25.590	1,689,510	3,392.9	1,539.0
	3.6%	5	12.9	25.590	1,422,562	2,856.8	1,295.8
		1	12.9	2.216	195,247	2.1	1.0
	LDDV	2	12.9	2.216	1,991,136	21.4	9.7
	with VMT	3	12.9	2.216	2,564,545	27.6	12.5
	mix of	4	12.9	2.216	1,689,510	18.2	8.2
	0.2%	5	12.9	2.216	1,422,562	15.3	6.9
	1	12.9	1.294	195,247	12.0	5.5	
LDDT	2	12.9	1.294	1,991,136	122.7	55.6	
with VMT	3	12.9	1.294	2,564,545	158.0	71.7	
mix of	4	12.9	1.294	1,689,510	104.1	47.2	
2.2%	5	12.9	1.294	1,422,562	87.6	39.8	
	1	12.9	6.090	195,247	238.3	108.1	
HDDV	2	12.9	6.090	1,991,136	2,429.9	1,102.2	
with VMT	3	12.9	6.090	2,564,545	3,129.7	1,419.6	
mix of	4	12.9	6.090	1,689,510	2,061.8	935.2	
9.1%	5	12.9	6.090	1,422,562	1,736.1	787.5	
	1	12.9	26.555	195,247	58.3	26.4	
MC	2	12.9	26.555	1,991,136	594.4	269.6	
with VMT	3	12.9	26.555	2,564,545	765.6	347.3	
mix of	4	12.9	26.555	1,689,510	504.4	228.8	
0.5%	5	12.9	26.555	1,422,562	424.7	192.6	

5.6 Summary of CO emissions from onroad mobile sources

Tables 5.6–1 through 5.6–4 summarize the calculated CO emissions by vehicle class, area, and facility type. Total daily CO emissions from onroad mobile sources for the CO nonattainment area in the 2002 carbon monoxide season are estimated to be 799,751 kilograms per day or 1,763,151 pounds per day. Total CO emissions from daily onroad mobile sources for all of Maricopa County for the 2002 carbon monoxide season are estimated to be 873,558 kilograms per day or 1,925,867 pounds per day.

Similarly, total CO emissions were estimated for all of 2002. For the carbon monoxide nonattainment area, onroad estimates are 322,867 English tons per year. For all of Maricopa County, onroad emissions are estimated to be 352,821 English tons per year.

Table 5.6–1. Daily CO emissions (kg/day) in the CO nonattainment area from onroad mobile sources by vehicle class, area type and facility type (winter day).

Facility type	Area type	Vehicle class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	5,991.2	5,354.6	2,720.8	407.5	3.2	17.1	239.7	91.9	14,825.8
	2	48,200.6	43,060.8	21,886.8	3,347.0	25.5	138.3	1,951.6	767.1	119,377.8
	3	33,329.4	29,777.9	15,132.3	2,345.1	17.7	96.1	1,360.8	543.0	82,602.3
	4	24,170.7	21,595.1	10,974.0	1,700.7	12.8	69.7	986.8	393.8	59,903.8
	5	14,305.7	12,781.3	6,495.1	1,006.6	7.6	41.3	584.1	233.1	35,454.6
	Total	125,997.5	112,569.6	57,209.0	8,806.9	66.7	362.5	5,123.0	2,029.0	312,164.3
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,522.1	4,191.7	2,118.7	330.7	3.2	17.3	249.5	56.1	11,489.3
	2	37,032.9	34,330.1	17,340.3	2,407.4	24.2	130.4	1,800.1	412.7	93,478.1
	3	41,487.7	38,408.7	19,413.5	2,583.7	26.3	140.9	1,918.7	441.8	104,421.3
	4	29,983.6	27,692.0	14,004.1	1,745.6	18.0	96.2	1,280.9	295.8	75,116.3
	5	11,898.3	10,938.8	5,539.7	655.7	6.8	36.1	471.2	108.4	29,655.1
	Total	124,924.7	115,561.4	58,416.2	7,723.1	78.5	420.9	5,720.5	1,314.9	314,160.1
COLLECTOR	1	4,604.2	4,235.4	2,156.4	544.3	4.2	24.2	406.5	79.8	12,055.1
	2	11,883.8	10,950.6	5,567.4	1,349.2	10.6	60.9	1,010.4	200.4	31,033.3
	3	7,131.7	6,598.8	3,344.3	644.0	5.6	31.4	486.7	103.4	18,346.0
	4	3,665.9	3,395.9	1,720.1	327.3	2.9	16.0	247.5	52.8	9,428.4
	5	3,981.1	3,690.3	1,866.3	312.3	2.9	16.0	235.9	52.1	10,156.9
	Total	31,266.6	28,871.1	14,654.5	3,177.2	26.2	148.5	2,387.1	488.5	81,019.7
LOCAL	1	925.5	843.7	432.9	141.0	1.0	5.8	103.1	19.8	2,472.8
	2	9,438.6	8,604.2	4,415.0	1,437.8	9.9	58.7	1,051.3	202.2	25,217.9
	3	12,156.8	11,082.1	5,686.5	1,851.9	12.7	75.6	1,354.1	260.5	32,480.2
	4	8,008.8	7,300.8	3,746.2	1,220.0	8.4	49.8	892.1	171.6	21,397.8
	5	4,056.6	3,698.0	1,897.5	618.0	4.3	25.2	451.9	86.9	10,838.4
	Total	34,586.3	31,528.9	16,178.2	5,268.8	36.3	215.2	3,852.5	741.0	92,407.2
GRAND TOTALS:		316,775.2	288,531.0	146,457.9	24,975.9	207.6	1,147.2	17,083.0	4,573.4	799,751.2

Table 5.6–2. Daily CO emissions (kg day) in Maricopa County from onroad mobile sources by vehicle class, area type and facility type (winter day).

Facility type	Area type	Vehicle class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	5,991.2	5,354.6	2,720.8	407.5	3.2	17.1	239.7	91.9	14,825.8
	2	48,200.6	43,060.8	21,886.8	3,347.0	25.5	138.3	1,951.6	767.1	119,377.8
	3	33,329.4	29,777.9	15,132.3	2,345.1	17.7	96.1	1,360.8	543.0	82,602.3
	4	24,170.7	21,595.1	10,974.0	1,700.7	12.8	69.7	986.8	393.8	59,903.8
	5	30,241.0	27,018.5	13,730.1	2,127.8	16.0	87.2	1,234.7	492.7	74,948.1
	Total	141,932.9	126,806.9	64,443.9	9,928.1	75.2	408.5	5,773.6	2,288.6	351,657.8
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,522.1	4,191.7	2,118.7	330.7	3.2	17.3	249.5	56.1	11,489.3
	2	37,032.9	34,330.1	17,340.3	2,407.4	24.2	130.4	1,800.1	412.7	93,478.1
	3	41,487.7	38,408.7	19,413.5	2,583.7	26.3	140.9	1,918.7	441.8	104,421.3
	4	29,983.6	27,692.0	14,004.1	1,745.6	18.0	96.2	1,280.9	295.8	75,116.3
	5	16,658.7	15,315.3	7,756.0	918.1	9.5	50.5	659.7	151.8	41,519.7
	Total	129,685.1	119,937.9	60,632.6	7,985.5	81.2	435.4	5,909.0	1,358.2	326,024.8
COLLECTOR	1	4,604.2	4,235.4	2,156.4	544.3	4.2	24.2	406.5	79.8	12,055.1
	2	11,883.8	10,950.6	5,567.4	1,349.2	10.6	60.9	1,010.4	200.4	31,033.3
	3	7,131.7	6,598.8	3,344.3	644.0	5.6	31.4	486.7	103.4	18,346.0
	4	3,665.9	3,395.9	1,720.1	327.3	2.9	16.0	247.5	52.8	9,428.4
	5	9,966.4	9,238.5	4,672.2	781.9	7.3	40.0	590.6	130.4	25,427.2
	Total	37,251.9	34,419.2	17,460.4	3,646.7	30.5	172.6	2,741.8	566.8	96,290.0
LOCAL	1	925.5	843.7	432.9	141.0	1.0	5.8	103.1	19.8	2,472.8
	2	9,438.6	8,604.2	4,415.0	1,437.8	9.9	58.7	1,051.3	202.2	25,217.9
	3	12,156.8	11,082.1	5,686.5	1,851.9	12.7	75.6	1,354.1	260.5	32,480.2
	4	8,008.8	7,300.8	3,746.2	1,220.0	8.4	49.8	892.1	171.6	21,397.8
	5	6,743.4	6,147.3	3,154.3	1,027.3	7.1	42.0	751.1	144.5	18,016.9
	Total	37,273.1	33,978.2	17,435.0	5,678.1	39.1	231.9	4,151.7	798.6	99,585.6
GRAND TOTALS:		346,142.9	315,142.2	159,971.9	27,238.4	226.0	1,248.3	18,576.1	5,012.3	873,558.1

Table 5.6–3. Daily CO emissions (kg/day) in the CO nonattainment area from onroad mobile sources by vehicle class, area type and facility type (annual average day).

Facility type	Area type	Vehicle class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	6,672.5	5,324.0	2,369.5	514.1	3.1	16.2	251.3	121.6	15,272.3
	2	53,744.6	42,853.5	19,069.8	4,221.6	25.0	131.0	2,046.2	1,016.3	123,107.9
	3	37,200.3	29,653.4	13,191.2	2,958.2	17.3	91.0	1,426.2	720.2	85,257.7
	4	26,977.9	21,504.9	9,566.3	2,145.3	12.6	66.0	1,034.3	522.3	61,829.6
	5	15,967.1	12,727.8	5,661.9	1,269.7	7.4	39.0	612.2	309.1	36,594.3
	Total	140,562.4	112,063.6	49,858.8	11,108.9	65.3	343.2	5,370.2	2,689.4	322,061.9
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,748.8	3,987.7	1,807.4	417.0	3.1	16.4	261.6	72.5	11,314.5
	2	39,174.5	32,918.9	14,876.9	3,037.8	23.6	123.4	1,887.1	530.1	92,572.3
	3	44,085.6	36,971.2	16,691.9	3,258.9	25.7	133.4	2,012.0	565.9	103,744.6
	4	31,703.7	26,556.0	11,982.1	2,202.2	17.7	91.1	1,342.9	377.6	74,273.2
	5	12,687.1	10,565.1	4,757.5	827.1	6.7	34.1	494.1	137.7	29,509.3
	Total	132,399.6	110,998.8	50,115.9	9,742.9	76.8	398.5	5,997.6	1,683.8	311,413.9
COLLECTOR	1	4,739.3	3,919.9	1,796.9	686.6	4.1	23.0	426.3	105.4	11,701.5
	2	12,222.7	10,132.5	4,641.4	1,701.3	10.4	57.7	1,059.4	264.0	30,089.4
	3	7,339.3	6,154.7	2,805.7	811.9	5.5	29.8	510.3	135.0	17,792.2
	4	3,774.7	3,167.2	1,443.8	412.6	2.8	15.2	259.5	68.9	9,144.6
	5	4,116.0	3,465.4	1,574.9	393.7	2.8	15.1	247.3	67.6	9,882.9
	Total	32,192.1	26,839.7	12,262.8	4,006.1	25.6	140.7	2,502.7	640.8	78,610.5
LOCAL	1	959.8	780.0	360.0	177.9	1.0	5.5	108.1	26.4	2,418.5
	2	9,788.6	7,954.1	3,670.8	1,813.8	9.7	55.6	1,102.2	269.6	24,664.4
	3	12,607.5	10,244.7	4,727.9	2,336.1	12.5	71.7	1,419.6	347.3	31,767.3
	4	8,305.8	6,749.1	3,114.7	1,539.0	8.2	47.2	935.2	228.8	20,928.1
	5	4,207.0	3,418.6	1,577.7	779.5	4.2	23.9	473.7	115.9	10,600.5
	Total	35,868.7	29,146.4	13,451.1	6,646.3	35.6	203.9	4,038.9	988.0	90,378.9
GRAND TOTALS:		341,022.9	279,048.5	125,688.5	31,504.3	203.3	1,086.3	17,909.5	6,002.0	802,465.3

Table 5.6-4. Daily CO emissions (kg/day) in Maricopa County from onroad mobile sources by vehicle class, area type and facility type (annual average day).

Facility type	Area type	Vehicle class								
		LDGV	LDGT1	LDGT2	HDTV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	6,672.5	5,324.0	2,369.5	514.1	3.1	16.2	251.3	121.6	15,272.3
	2	53,744.6	42,853.5	19,069.8	4,221.6	25.0	131.0	2,046.2	1,016.3	123,107.9
	3	37,200.3	29,653.4	13,191.2	2,958.2	17.3	91.0	1,426.2	720.2	85,257.7
	4	26,977.9	21,504.9	9,566.3	2,145.3	12.6	66.0	1,034.3	522.3	61,829.6
	5	33,753.2	26,905.6	11,968.8	2,684.1	15.7	82.5	1,294.1	653.4	77,357.5
	Total	158,348.5	126,241.4	56,165.7	12,523.3	73.6	386.7	6,052.1	3,033.7	362,825.0
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,748.8	3,987.7	1,807.4	417.0	3.1	16.4	261.6	72.5	11,314.5
	2	39,174.5	32,918.9	14,876.9	3,037.8	23.6	123.4	1,887.1	530.1	92,572.3
	3	44,085.6	36,971.2	16,691.9	3,258.9	25.7	133.4	2,012.0	565.9	103,744.6
	4	31,703.7	26,556.0	11,982.1	2,202.2	17.7	91.1	1,342.9	377.6	74,273.2
	5	17,763.0	14,792.0	6,661.0	1,158.0	9.3	47.8	691.7	192.8	41,315.7
	Total	137,475.6	115,225.8	52,019.3	10,073.9	79.4	412.1	6,195.3	1,738.9	323,220.2
COLLECTOR	1	4,739.3	3,919.9	1,796.9	686.6	4.1	23.0	426.3	105.4	11,701.5
	2	12,222.7	10,132.5	4,641.4	1,701.3	10.4	57.7	1,059.4	264.0	30,089.4
	3	7,339.3	6,154.7	2,805.7	811.9	5.5	29.8	510.3	135.0	17,792.2
	4	3,774.7	3,167.2	1,443.8	412.6	2.8	15.2	259.5	68.9	9,144.6
	5	10,304.2	8,675.3	3,942.6	985.7	7.1	37.9	619.2	169.2	24,741.1
	Total	38,380.3	32,049.7	14,630.5	4,598.0	29.9	163.5	2,874.6	742.4	93,468.8
LOCAL	1	959.8	780.0	360.0	177.9	1.0	5.5	108.1	26.4	2,418.5
	2	9,788.6	7,954.1	3,670.8	1,813.8	9.7	55.6	1,102.2	269.6	24,664.4
	3	12,607.5	10,244.7	4,727.9	2,336.1	12.5	71.7	1,419.6	347.3	31,767.3
	4	8,305.8	6,749.1	3,114.7	1,539.0	8.2	47.2	935.2	228.8	20,928.1
	5	6,993.4	5,682.8	2,622.6	1,295.8	6.9	39.8	787.5	192.6	17,621.4
	Total	38,655.1	31,410.6	14,496.0	7,162.6	38.3	219.8	4,352.7	1,064.8	97,399.8
GRAND TOTALS:		372,859.4	304,927.4	137,311.5	34,357.8	221.3	1,182.0	19,474.6	6,579.8	876,913.9

5.7 Quality assurance process

5.7.1 VMT estimates

Normal quality assurance procedures, including extensive automated consistency checks, were used by ADOT in developing the 2002 HPMS data. These data were submitted to the Federal Highway Administration in October 2003.

5.7.2 Emission factor estimates

The quality assurance (QA) process performed on the MOBILE6.2 analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, a system was used that included a two-layer, independent reviewer set-up. All hard copy and computer-based data entries as well as all calculations procedures were checked independently for accuracy and completeness by two different reviewers. Any errors found were corrected and the changes were then rechecked by the reviewers.

The entire onroad mobile source portion of the 2002 periodic CO inventory was reviewed by MAG staff that did not directly participate in its development. All comments were addressed.

5.7.3 Quality review of 2002 periodic CO emissions inventory

The draft onroad mobile source portion of the 2002 periodic carbon monoxide emissions inventory was reviewed using published EPA quality review guidelines for base year emission inventories (EPA Document 450/4-91-022, September 1991). The procedural review (Levels I, II, and III) included checks for completeness, consistency, and the correct use of appropriate procedures.

Additionally, the draft onroad mobile source portion of the 2002 periodic carbon monoxide emissions inventory for the carbon monoxide nonattainment area was compared with the onroad mobile source portions of the 1990, 1993, 1996, and 1999 base year and periodic emissions inventories. The results are in Table 5.7–1. Estimates for Maricopa County in its entirety were not prepared for previous inventories, so no comparison is possible.

Table 5.7–1. Comparison of CO emissions from onroad mobile sources and vehicle miles traveled (VMT) in the CO nonattainment area, 1990–2002.

Year of analysis	CO emissions from onroad mobile sources (lb/yr)	Vehicle miles traveled (VMT)
1990	1,615,410	45,877,773
1993	1,220,223	48,153,240
1996	1,120,508	53,091,273
1999	1,080,829	57,853,980
2002	1,763,151	68,199,542

While the VMT increases over time, the modeled onroad CO emissions decrease between 1990 and 1999 because of the implementation of control measures designed to reduce onroad emissions such as I/M program, cleaner gasoline, cleaner vehicle technologies, etc. This decline would have continued if MOBILE5a had been used for the 2002 inventory. Significant increase is modeled between 1999 and 2002 due to the use of MOBILE6.2 in the 2002 analysis versus MOBILE5a in the 1999 and previous analyses. It is also important to note that the base case emissions from the Serious Area CO Plan may not match those in the periodic inventories because of a different year modeled and different modeling domain size.

As an additional QA check, the average miles per gallon estimate was derived using average annual daily VMT estimates and gasoline sales from ADOT. The results of that QA check may be found in Appendix 5.5.

5.8 References

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