Alaska Department of Environmental Conservation

Amendments to:

State Air Quality Control Plan

Vol. III: Appendices

Appendices to:
Volume II, Section II. Air Quality Control Program; and
Volume II, Section III.B Anchorage Transportation Control Program

Public Review Draft

May 24th, 2011

The State of Alaska's State Air Quality Control Plan Volume III, Appendix to Volume II of this plan, is amended to include the following documents:

Volume II, Section II. Air Quality Control Program is amended by removing the following regulations:

- 18 AAC 50 Air Quality Control as amended through April 13, 2011;

and replacing them with the following regulations currently under public review and comment:

- 18 AAC 50 Air Quality Control as amended through {*Adoption Date of Regulations*}.

Volume II, Section III.B Anchorage Transportation Control Program adopted into the State Air Quality Control Plan {*Adoption Date of Regulations*} is amended as follows:

- Appendix III.B.1 is amended by adding the following documents:
  - Anchorage Assembly Resolution No. 2011-xxx, dated May xx, 2011, a resolution of the Municipality of Anchorage adopting revisions to the Anchorage Carbon Monoxide Maintenance Plan (dated April 28, 2011).
- Appendix III.B.3 is amended by adding the following document:
  - Anchorage 2007 Carbon Monoxide Emission Inventory and 2007-2023 Emission Projections, prepared by the Municipality of Anchorage, dated April 2011.
- Appendix III.B.6 is amended by adding the following document:
  - Analysis of Probability of Complying with the National Ambient Air Quality Standard for Carbon Monoxide in Anchorage between 2007 and 2023, prepared by the Municipality of Anchorage, dated April 2011.
- Appendix III.B.10 is amended by adding the following document:

Note: After the close of the public comment period, Appendix III.B.10 will be amended to include the following documents:

- Alaska Department of Environmental Conservation's Affidavit of Oral Hearing; and
- Alaska Department of Environmental Conservation's response to written and oral comments on the Anchorage Carbon Monoxide Maintenance Plan and its appendices.

Alaska Department of Environmental Conservation

Amendments to:

State Air Quality Control Plan

Vol. III: Appendices

Appendix III.B.1

Placeholder for "Anchorage Assembly Resolution No. 2011-xxx"

Public Review Draft

May 24th, 2011

[Editor's note: The following document is proposed for inclusion in Volume III (Appendices to the State Air Quality Control Plan), Appendix III.B.1, after the close of the public comment process.]

Placeholder for:

- Anchorage Assembly Resolution No. 2011-xxx, dated May xx, 2011, a resolution of the Municipality of Anchorage adopting revisions to the Anchorage Carbon Monoxide Maintenance Plan (dated April 28, 2011).

Alaska Department of Environmental Conservation

Amendments to:
State Air Quality Control Plan

Vol. III: Appendices

Appendix III.B.3

"Anchorage 2007 Carbon Monoxide Emission Inventory and 2007-2023 Emission Projections, dated April 2011"

Public Review Draft

May 24th, 2011

Appendix to Section III.B.3

Anchorage 2007 Carbon Monoxide Emission Inventory and 2007-2023 Emission Projections

Municipality of Anchorage
Department of Health and Human Services
Air Quality Program

April 2011

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1 Introduction

This document provides technical support and justification for the methods used to prepare the maintenance demonstration for Anchorage, submitted as a revision to the Alaska State Implementation Plan (SIP). This is the latest of a succession of revisions to a document originally prepared in support of the Anchorage CO Maintenance Plan submitted in 2004 and last revised in March 2010. The March 2010 revision relied on a MOBILE6-based methodology to estimate and project CO emissions from mobile sources in Anchorage.* Since that document was prepared the EPA has mandated that all conformity analyses and SIP demonstrations utilize a new model called MOVES instead of MOBILE6 beginning in 2012. As a consequence, this document has been revised to utilize a new MOVES-based methodology to prepare new estimates of motor vehicle CO emissions during the 2007-2023 maintenance planning period. No changes have been made to the emissions estimates that do not rely on the MOVES or MOBILE6 models (e.g. point, non-road and area sources) and no substantive changes have been made to the narrative discussing these sources.

This document includes a comprehensive inventory of the sources of CO emissions for base year 2007. Historically, violations of the CO NAAQS have occurred most often on cold winter weekdays, therefore a 24-hour inventory was prepared that reflects ambient temperatures, traffic volumes and other emission source activity levels experienced on a typical winter "design day" in 2007.

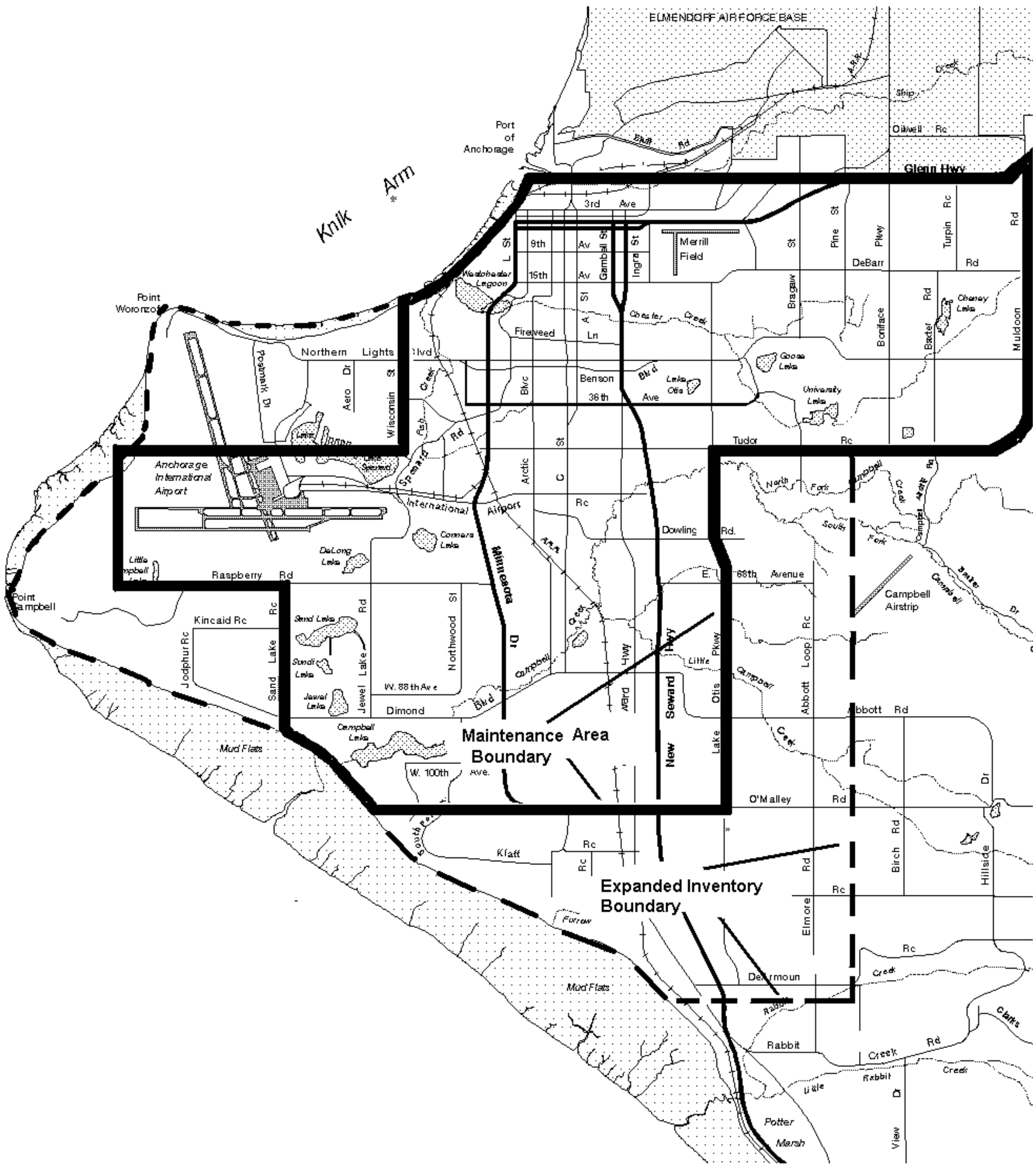
In April 2007 an air quality conformity analysis was prepared when the Anchorage Long Range Transportation Plan was amended to include the Knik Arm Crossing. The most recent population, employment, and land use assumptions and forecasts were used in the development of this analysis. Specific forecasts were developed for analysis years 2007, 2017 and 2027. This demographic data was used to generate the 2007 base year CO inventory for the maintenance plan revisions. In addition this data was used directly or interpolated to generate forecasts for 2009, 2011, 2013, 2015, 2017, 2019, 2021 and 2023.

* Actually a modified version of MOBILE6 called AK MOBILE6 was used. AK MOBILE6 differs from the conventional MOBILE6 model because it includes methods to estimate CO emissions from extended idling of light duty motor vehicles and the increased emission rates that occur from vehicles running before they are fully warm. This is explained later in more detail in Section 5.1.

2 Inventory Boundary

The Anchorage nonattainment area boundary was established in 1978. Upon EPA's approval of the maintenance plan in 2004, the area encompassed by this boundary became the maintenance area. The inventory boundary contains this maintenance area plus some additional area to the south and west where significant residential and commercial growth has occurred over the past two decades. For this reason, the inventory area was expanded slightly to encompass areas not included in the nonattainment area. The boundary of the maintenance area is shown along with the expanded inventory area in Figure 2-1. The inventory area encompasses approximately 200 square kilometers of the Anchorage Bowl.

Figure 2-1
Anchorage Maintenance Area with Expanded Inventory Boundary



3 Anchorage Transportation Model and Inventory Grid System

The CO inventory was based in large part on traffic activity outputs from the Anchorage Transportation Model. The Anchorage Transportation Model is used by the metropolitan planning organization in the Municipality of Anchorage known as AMATS[†] to evaluate transportation plans and programs. It was validated against measured traffic volumes in base year 2002 and utilizes the latest planning assumptions to forecast future travel activity. The model was developed using TransCAD travel demand modeling software. Because TransCAD is a GIS-based model, post-processing software can be used to overlay a grid system on the inventory area. The post-processor is used to disaggregate the inventory area into grid cells, each one square kilometer in size.

Transportation activity estimates (e.g., vehicle miles of travel, number of trip starts, and vehicle speeds) were produced for each of the cells. The grid location of every roadway link in the transportation network is known. Thus, the attributes of a particular roadway link (e.g., traffic volume and speed) can be assigned to a particular grid. If a roadway link crosses the boundary between two or more grids, its attributes are assigned to the appropriate grid in relation to the proportion of the length of link contained in each grid. In other words, if 80% of a roadway link lies within a particular grid, 80% of the vehicle travel is assigned to that grid and 20% to the other grid. The transportation model generates separate travel activity estimates for the AM peak (7 am – 9 am), PM peak (3 pm – 6 pm) and off-peak hours (9 am – 3 pm, 6 pm – 6 am) and travel activity estimates are further disaggregated by road facility type and trip purpose. [‡, §]

Demographic information (population, number of dwelling units, income, and employment information) is collected by census tract. Because most census tracts in Anchorage are larger in size than the one- kilometer grids the demographic characteristics of a particular grid must be estimated from lower resolution census tract data. If, for example, a particular census tract was comprised of three one kilometer grids, the population and employment in that census tract was divided equally among the three grids contained in the census tract. This demographic information was helpful in developing gridded estimates of non-vehicular source activities, like wood burning and space heating where the amount of activity (i.e. wood burning or residential space heating) was assumed to be related to the number of dwellings in a grid.

Emissions from other area sources such as Ted Stevens Anchorage International Airport, Merrill Field, marine vessel operations at the Port of Anchorage and railroad activity in the rail yard and haul routes were assigned to the grids where the activity takes place. Similarly, emissions from point sources such as electrical power plants were assigned to the grid where the source is located.

The Anchorage emission inventory grid system is shown in Figure 3-1.

[†] AMATS stands for Anchorage Metropolitan Area Transportation Solutions.

[‡] There are five road facility types defined in the Anchorage Transportation Model: (1) freeway/expressway; (2) major arterial; (3) minor arterial; (4) collector; and (5) local road.

[§] The Anchorage Transportation model categorizes travel into seven purposes: (1) home-based work, (2) home-based school, (3) home-based shopping, (4) home-based other, (5) non home-based work, (6) non home-based, non-work; and (7) freight-related truck trips. Thus, for each time period, the model produces estimates of the number of trip starts and VMT in each grid by trip purpose.

Figure 3-1
Anchorage Area Inventory Grid System

4 Time-of-Day Estimates of Emissions Activity

Separate estimates of mobile source CO emissions were prepared for the morning commute (7 a.m. – 9 a.m.), the evening commute (3 p.m. – 6 p.m.) and combined off-peak periods (6 p.m. – 7 a.m. and 9 a.m. – 3 p.m.). These estimates relied on time-of-day activity estimates (e.g., number of trip starts and VMT) generated by the Anchorage Transportation Model. A 24-hour inventory was compiled by summing the separate emission contributions from each time period.

Activity estimates for non-vehicular sources were available on a 24-hour basis only, however. Time-of-day estimates had to be developed from these 24-hour values. For some sources (e.g. airport, natural gas combustion), activity was assumed to be continuous throughout the day and emissions were apportioned accordingly. Fireplace and wood stove usage is more likely to occur in the evening after 6 p.m. For this reason, 90% of all wood burning activity was assumed to take place during the off peak time period.

Table 4-1 shows the specific time periods inventoried and gives examples of the types and levels of activity characteristic of those time periods. (Note that the 2-hour AM peak comprises 8.3% of a 24-hour day, the 3-hour PM peak comprises 12.5% of the day, and the 19-hour off peak period comprise 79.2% of the day.)

Table 4-1
Apportionment of CO Source Activity by Time Period

Source Category	AM Peak. 7 a.m. – 9 a.m.	PM Peak. 3 p.m. – 6 p.m.	Off-Peak 9 a.m. – 3 p.m. 6 p.m. – 7 a.m.	Comments
motor vehicle start and running emissions	From model (~20%)	From model (~25%)	From model (~55%)	Travel activity higher in AM and PM peak periods
Residential wood burning	3.0%	7.0%	90.0%	Most burning in evening
space heating	8.3%	12.5%	79.2%	Evenly distributed through day
Ted Stevens Int'l Airport	8.3%	12.5%	79.2%	Evenly distributed through day
Merrill Field	8.3%	12.5%	79.2%	Evenly distributed through day
Miscellaneous / Other *	8.3%	12.5%	79.2%	Evenly distributed through day
Point Sources	8.3%	12.5%	79.2%	Evenly distributed through day

5 Motor Vehicle Emissions

The EPA has mandated the use of MOVES for all SIP planning and conformity determinations beginning March 2012. In a preliminary analysis, Sierra Research showed that MOVES-based mobile source CO emissions estimates for the Anchorage CO inventory area were 50% or more greater than those produced by the current AK MOBILE6 model. This means that any conformity analysis performed after March 2012 will generate substantially higher estimates of emissions. If the current AK MOBILE6-based Anchorage CO emissions budget in the Alaska SIP is not amended before then Anchorage could exceed the allowable mobile source emission budget. For this reason, Anchorage has decided to re-estimate mobile source emissions during the 2007-2023 maintenance planning horizon and amend the existing budget using the new MOVES-based emission estimation methodology. This section describes how MOVES was utilized along with the Anchorage Transportation Model to develop an amended CO emission inventory and projections. This same methodology will be used to develop a new MOVES-based mobile source emission budget and for future conformity determinations.

5.1 Overview of Previously Used AK MOBILE6-based Emission Estimation Methodology

Mobile source CO emissions estimates previously relied on emission factors produced from a modified MOBILE6-based emissions factor model known as AK MOBILE6. These emission factors were applied to pertinent traffic activity outputs from the Anchorage Transportation Model to estimate emissions. Emission factors produced by AK MOBILE6 were applied to the activity estimates generated by the transportation model's post-processor to generate CO emissions estimates for each grid. AK MOBILE6 differed from the standard version of MOBILE6 because it included an off-model computation of start emissions that was based on local cold start emissions data collected in Alaska by Sierra Research. For Anchorage, these off-model computations were made with a spreadsheet model that allowed factors such as soak time, average idle duration and the proportion of vehicles that are plugged-in (i.e., using a block heater prior to start-up) to be accounted for in the estimation of start emissions. These factors varied by time of day and trip purpose. For example, during the AM peak, the assumed average idle duration for a home-based work trip (7 minutes) was longer than a non-home based, non-work trip (1 minute). The spreadsheet model was used to compute start emissions in a particular grid from the transportation model's estimate of the number of vehicle starts by each trip purpose in that grid and the assumed idle duration, soak time and block heater plug-in rates for those trips. Look-up tables containing start emission factors as a function of idle duration and soak time were used to estimate emissions for the starts in the grid.[**]

For running emissions, the "conventional" MOBILE6 model was used to generate spreadsheet lookup tables with gram per mile emission factors by speed and thermal state. MOBILE6 allowed the user to supply assumptions regarding the soak time distribution of the vehicles started by time-of-day and running emission factor estimates were very sensitive to these assumptions.[††] Modeled emissions were higher for those time periods when a large proportion of vehicles of a particular trip purpose were assumed to have had long soak times and lower when most soak times are short. For example, home-based work trips during the AM peak had higher CO emission rates because they included a large proportion of vehicles with long soak times.

[**] These look-up tables were developed by Sierra Research from emissions data collected in Alaska during the winter of 2000-2001. The spreadsheet also utilizes Sierra Research data to compute the CO reductions from block heater usage.

[††] Soak time is the amount of time that a vehicle has been parked with the engine off prior to startup. Sierra used six different soak time distributions to characterize the thermal state (i.e., how warmed up they were) of the vehicles operating on a road at a particular time.

Sierra Research defined six soak time distributions to characterize the thermal state of the fleet of vehicles operating in a particular grid during each of the three time periods. Travel model outputs were used to determine which of these six soak distributions was most appropriate for modeling the running emissions on a particular road facility type (e.g., freeway vs. collector) and trip purpose for each grid. The emission factors generated by MOBILE6 were then incorporated into a lookup table in the spreadsheet model. The spreadsheet could then identify an appropriate running emission factor based on the travel model's estimate of the average speed and thermal state of vehicles operating on the different road facility types within each grid. These emissions factor were multiplied by the VMT in the grid to compute running emissions from the VMT in that grid for each trip purpose and road facility type.

The spreadsheet computed CO emissions by summing the start and running emissions from all 200 grids in the inventory area. For conformity determinations these emissions were compared to the emission budget in the SIP. The CO maintenance demonstration examined emissions from a nine-grid sub-area surrounding the Turnagain CO monitor in west Anchorage, an area believed to be representative of the highest CO concentrations in the Anchorage area...

5.2 New MOVES-based Methodology

The new MOVES-based methodology used to develop the inventory and projections in this revised document mirrors the AK MOBILE6-based methodology in many ways. It still relies on the same basic grid-based travel activity outputs (e.g., vehicle starts, VMT, average speed) that the AK MOBILE6 method used. The MOVES methodology uses a modified version of the spreadsheet model previously employed, substituting MOVES-generated running and start emission factors for the AK MOBILE6 factors used previously.

Perhaps the biggest difference in the new MOVES vs. AK MOBILE6-based method is that the new spreadsheet model no longer relies on local emission test data produced by Sierra Research to calculate start emissions; it uses a single fleet-wide start emission factor that varies by hour of the day, generated by MOVES. This simplifies spreadsheet computations; the AK MOBILE6 spreadsheet generated seven separate start emission factors corresponding to each trip purpose because each trip purpose had different assumptions about the soak time and idle duration that could affect both start and running emissions. Although MOVES considers the soak distribution (by hour) in the computation of start emissions, the running emission rate is independent of both ambient temperature and soak time.

To model emissions, MOVES requires extensive user-supplied model inputs that reflect local conditions such as vehicle fleet characteristics, fuel composition, ambient temperature, I/M program characteristics, road type distribution. These inputs, and how they are be derived are discussed in the last section of this report (see MOVES Run Specifications and County Data Manager Inputs.

5.2.1 MOVES-based Start Emissions Computation

As noted earlier, the Anchorage Transportation Model provides estimates of the number of vehicle starts occurring in each of the 200 one-km^2 grids in the inventory area for three separate time periods: AM peak, PM peak and off-peak periods. In order to use this detailed information, our objective was to get MOVES to produce an emission factor that would provide estimate of average CO emissions per vehicle start (grams CO per start).

We have found that the simplest way to do this is to run MOVES and direct the model to output emissions and activity levels only for those processes relating to start and/or extended idle emissions.[‡‡] Specifically these processes are: (1) start exhaust; (2) crankcase start exhaust; (3) crankcase extended idle exhaust; and (4) extended idle exhaust. Although MOVES provides an *emission rates* computation option (in *Scale* on the Navigation Panel), we have found that running MOVES using the *inventory* option is an easier method of computing emission rates.

When MOVES is run using the inventory computation option, it generates a number of MYSQL output files. Two of these are of particular interest. The first details the level of process activity (e.g., number of vehicles starts, hours of extended idling by combination long haul trucks for each hour of the day and the second details the quantity of CO emitted each hour from each process activity.[§§] The emission factors required for the spreadsheet model (e.g., CO emitted per vehicle start) can then be easily computed on an hour-by-hour basis from the two MYSQL output files. A lookup file for these emission factors can be created from the MYSQL files for use in the spreadsheet model. An example of such a lookup file is shown in Table 5-1 below.

Table 5-1
Lookup File for Start and Extended Idle CO Emission Factors

MOVES Start & Idle EF 2007 Base Year with I/M				
Ending Hour	% of daily starts in hour	tailpipe + crankcase CO (g/start)	% of daily extended idling from long haul trucks in hour	extended idle CO g/ truck start
1	0.75%	67.36	6.28%	142.11
2	0.34%	115.21	6.11%	170.18
3	0.11%	144.20	5.77%	109.97
4	0.20%	139.88	5.26%	105.84
5	0.37%	172.69	4.58%	75.42
6	0.76%	190.40	4.07%	61.45
7	3.80%	190.41	3.57%	30.73
8	5.98%	166.07	3.06%	26.98
9	6.33%	149.02	2.89%	38.69
10	5.51%	101.19	2.55%	21.95
11	5.02%	103.63	2.38%	23.25
12	6.98%	101.78	2.21%	33.29
13	7.27%	89.94	2.21%	33.29
14	6.35%	104.91	2.21%	29.59
15	5.97%	103.30	2.38%	28.68
16	7.87%	115.08	2.55%	27.11
17	7.74%	108.91	3.23%	83.40
18	7.71%	123.00	3.74%	150.22
19	6.85%	118.64	4.58%	207.41
20	4.79%	111.59	5.26%	136.08
21	4.02%	131.62	5.94%	195.53
22	2.39%	111.08	6.28%	227.38
23	1.95%	135.95	6.45%	291.90
24	0.95%	133.77	6.45%	259.47

[‡‡] In MOVES extended idle emissions refer only to idle emissions from combination long haul trucks. Other extended idle emissions such as those that occur among passenger cars and trucks during long warm up periods prior to the morning commute are not included. Extended idle emissions from combination long haul trucks make up a very small portion of total CO emissions in Anchorage.

[§§] The Anchorage Transportation Model does not provide an estimate of the hours of extended idling among long haul trucks. It does, however, provide an estimate of the number of freight truck starts. Thus, the extended idle emission factor was related back to the MOVES estimate of long haul truck starts (MOVES source id = 62) rather than hours of extended idling. The resulting emission factor was therefore grams CO emitted per long haul truck start.

The spreadsheet model applies a weighted average emission factor from the lookup table above to the amount of start or extended idle activity estimated by the transportation model for the time period in question.*** For example, during the AM peak period (7 am – 9 am), the weighted average tailpipe + crankcase start emission factor is 157.3 g/start. If the transportation model estimated that there were 800 starts in a particular grid cell, computed start emissions in that grid would be 125,840 grams or 277 lbs. A different start emission factor would be used for PM and off-peak starts. For example, the start emission factor for the PM peak (3 pm – 6 pm) is lower (115.7 g/start) than the AM peak because vehicles started during that period, on average, have shorter soak times and warmer engines than those started in the morning.

The spreadsheet model assigns start and extended idle emissions to the grid cell where the transportation model determined the vehicle start to have occurred.†††

Even though the spreadsheet model has the capability of estimating the benefits of engine block heater usage, the previous CO maintenance plan did not take credit for these benefits. For consistency, this "MOVES-amended" 2007 base year inventory and maintenance projections does not either.

5.2.2 MOVES-based Running Emissions Computation

As is the case with start emissions, MOVES requires extensive user-supplied inputs to estimate running emissions. These inputs and the run specification used to generate running emissions are discussed in detail in Attachment to this appendix. As noted earlier, the Anchorage Transportation Model provides grid-based estimates of VMT and vehicle speed by road facility type three separate time periods. This subsection will discuss how MOVES is used to generate the running emission factors (grams per mile) necessary to estimate running emissions in each of the model grids from the transportation model estimates of travel activity.

We have found that the simplest way to generate running CO emission factors is to run MOVES in the *emission rates* rather than the *inventory* mode used to generate start and extended idle emission factors. MOVES includes two processes that relate to running emission factors: (1) running exhaust; and (2) crankcase running exhaust. Using the *emission rates* mode, we select these two pollutant processes and MOVES will generate emission factors by speed bin and road type for both processes. The emissions from both of these processes are independent of ambient temperature and time-of-day, so the MOVES model output is fairly simple. Because we are using the *emission rates* mode, MOVES generates a MYSQL output file, called *rateperdistance that* provides emission factors in grams per mile. A spreadsheet model lookup table can be derived from the MYSQL output file generated by the MOVES run. Because the MOVES output produces emission factors by speed bin, we use an interpolation process to produce emission factors in one mile per hour increments for use in the lookup table.

The Anchorage Travel Model produces estimates of the VMT in each grid disaggregated into five facility types. MOVES emission factors for restricted access road (road type = 4) is applied to transportation model estimates of the VMT accrued on freeways and expressways and MOVES emission factors for unrestricted access roads (road type = 5) are applied to VMT accrued on

*** The weighted average emission factor for each time period is determined by weighting the emission rate for each hour in the time by the MOVES proportion of starts that occur in those hours. Example:

AM peak start EF = (166.07 x 5.98% +149.02 x 6.33%)/(5.98% + 6.33%) = 157.3 g/start

††† MOVES defines start emissions as "the addition to running emissions caused by the engine start." Unless a vehicle spends a substantial time warming up, a large portion of these "start emissions" occur as the vehicle moves during the first part of its trip. Thus, it is likely that a portion of some start emissions occur in grid cells other than the one assigned by the model.

local, collector, minor arterial and major arterial roadways. ‡‡‡ The transportation model provides speed estimates for each of the five facility types within each grid. These speed estimates are used to select the appropriate running emission factor in the spreadsheet look-up table.§§§ The estimated VMT on the five road facility types in each grid is multiplied by the appropriate emission factor to estimate running emissions. Table 3 shows an example of a spreadsheet emission factor lookup table (portions of the look-up table have been cut so that it can fit on one page).

Table 5-2
Example Spreadsheet Lookup File for Running CO Emission Factors

Base Year 2007 MOVES Interpolated Running Emission Factors (with I/M) by Road Type			
Speed	speed bin	road type=4 urban restricted	road type=5 urban restricted
2.5	1	45.206	44.658
3.0	1	41.326	40.991
4.0	1	33.566	33.657
5.0	2	25.806	26.323
6.0	2	23.899	24.569
. . .	. . .	. . .	. . .
27.0	6	10.362	10.919
28.0	6	10.346	10.773
29.0	6	10.330	10.626
. . .	. . .	. . .	. . .
55.0	12	10.965	8.151
56.0	12	10.902	8.181
57.0	12	10.839	8.210
58.0	12	10.776	8.239
59.0	12	10.712	8.269
. . .	. . .	. . .	. . .
72.0	15	12.909	10.928
73.0	15	13.366	11.442
74.0	15	13.824	11.956
75.0	16	14.281	12.470

‡‡‡ MOVES actually has four road types (rural restricted access, rural unrestricted access, urban restricted access, and urban unrestricted access) but Anchorage only has the two urban-type roads in its CO inventory area.

§§§ Vehicle speed estimates generated by the Anchorage Transportation Model were significantly different than those measured in a travel time study conducted by the Municipality and the Alaska Department of Transportation in 1998. Empirical speed correction factors, derived from that travel time study are applied to transportation model speed estimates. To match travel time study estimates, transportation model estimates of speed for freeway/expressways are increased by 17% and speeds on collectors and minor and major arterial roadways are reduced by 17%. A "default" speed of 15 mph is assumed for VMT on local roads.

The lookup table is used in conjunction with Anchorage Transportation Model estimates of VMT and speed on each facility type within a grid to estimate running emissions within the grid. Table 4 shows a sample computation of running emissions for Grid Cell ID =1104 (an area near the intersection of Northern Lights Boulevard and Seward Highway) during the AM peak period in 2007.

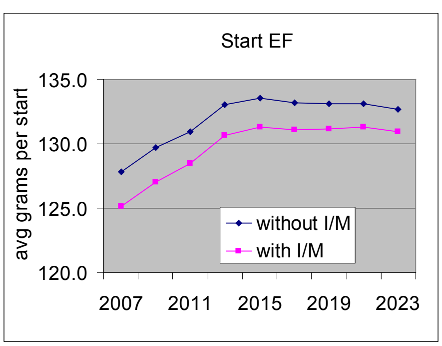
Table 5-3
Sample Computation of Running Emissions for Grid Cell 1104

Facility Type	MOVES Road Type	VMT (miles)	Speed (mph)	Emission Factor (g/mi)	CO Emissions (lbs)
Freeway/Expressway	4	1,751	57.4	10.8	42
Major Arterial	5	5,119	31.0	10.3	116
Minor Arterial	5	3,001	29.8	10.6	70
Collector	5	44	23.6	11.9	1
Local Streets	5	474	15.0	14.8	15
TOTAL	--	10,390			244

5.3 Summary of Motor Vehicle Emissions

Table 5-4 summarizes key motor vehicle activity (vehicle starts, truck starts and VMT) along with the emissions resulting from this activity. The vehicle inspection and maintenance program (I/M) was assumed to be operating in 2007 and 2009 with a 4-year grace period for new vehicles and with a 6-year grace period in 2011. The program was assumed to be discontinued in 2013 and beyond. Start emissions make up the greatest part of all motor vehicle emissions. They make up about 68% of motor vehicle emissions in base year 2007. Their contribution grows to about 78% by 2023.[****]

[****] When start and running emission rates during the period 2007-2023 were examined, running emission rates were found to decrease steadily (as expected) but start emission rates generated by MOVES actually *increased* between 2007 and 2015. Given the fact that the vehicle fleet is normally presumed to become newer and cleaner over time, especially with the phase-in of new EPA-mandated vehicle cold temperature emission standards in 2010, it suggested an anomaly in the model. We understand that EPA is investigating and that if a problem is found it will be remedied in a future release of MOVES. The impact on the overall emission trend analysis presented here and in the CO Maintenance Plan is relatively insignificant.



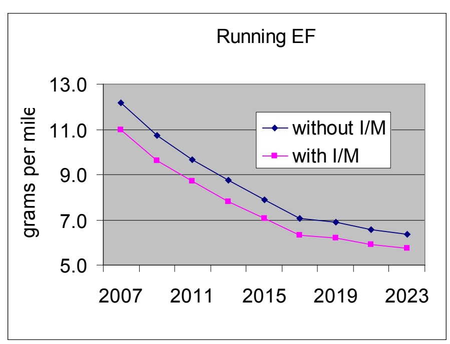


Table 5-4
Summary of Estimated Area-wide-Motor Vehicle CO Emissions in Anchorage

		Start Emissions		Extended Idle (Truck only)		Running Emissions		
Year	I/M status	Total Starts (per day)	Start Emissions (tons/day)	Truck Starts (per day)	Extended Idle Emission (lbs)	VMT (mi/day)	Running Emissions (tons/day)	Total CO Emissions (tons/day)
2007	yes	639,007	84.83	2,496	0.34	3,344,312	40.46	**125.62**
2009	yes	647,609	87.23	2,533	0.29	3,417,283	36.17	**123.70**
2011	yes	656,211	89.39	2,571	0.35	3,490,253	33.40	**123.14**
2013	no	664,813	93.80	2,608	0.36	3,563,224	34.28	**128.44**
2015	no	673,415	95.37	2,645	0.36	3,636,195	31.59	**127.32**
2017	no	682,017	96.33	2,682	0.37	3,709,166	28.84	**125.55**
2019	no	692,026	97.72	2,711	0.38	3,779,015	28.62	**126.71**
2021	no	702,035	99.14	2,739	0.39	3,848,865	27.78	**127.31**
2023	no	712,044	100.26	2,767	0.39	3,918,715	27.46	**128.11**

6 Aircraft Operation Emissions

In June of 2005 Sierra Research, Inc. prepared the "Alaska Aviation Inventory."†††† They compiled air pollutant emission estimates for airports across Alaska including Ted Stevens Anchorage International Airport (ANC) and Merrill Field Airport in Anchorage. Both summer and winter CO emissions associated with aircraft operation for various pollutants were estimated for the year 2002. Sierra collaborated with CH2MHill to collect the specific information on aircraft operations at ANC and Merrill Field necessary for input into the Federal Aviation Administration's EDMS Model (Version 4.2). EDMS was used to generate estimates of CO emissions from aircraft and aircraft support equipment. In EDMS, aircraft support equipment includes both ground support equipment (GSE) and on-board auxiliary power units (APUs) that are used to provide power to aircraft when on the ground. Winter season CO emissions estimates for ANC and Merrill are shown in Table 6-1.

Table 6-1
24-hour CO Emissions from ANC and Merrill Field in 2002

	Aircraft Support Equipment APU and GSE (tons per day)	Aircraft (tons per day)	TOTAL (tons per day)
ANC	8.21	3.32	11.53
Merrill	0.00	0.63	0.63

The ANC Master Plan contains an analysis of historical trends in aircraft operations and projections through 2027. The draft Plan projects an average annual growth rate of 2.4% between 2005 and 2027. Historical data on total operations in 2002 when Sierra prepared their emissions estimates were used along with the growth projections in the draft Master Plan to project future emissions from ANC. Emissions were presumed to grow in direct proportion to total operations. Results are shown in Table 6-2.

Table 6-2
Projected Aircraft Operations and CO Emissions at ANC

Calendar Year	Estimated or Projected Annual Aircraft	CO Emissions (tons per day)
2002 (base year of Sierra inventory)	309,236	11.53
2007	331,708	12.37
2009	347,845	12.97
2011	363,982	13.57
2013	379,810	14.16
2015	395,327	14.74
2017	410,845	15.32
2019	435,440	16.24
2021	460,036	17.16
2023	484,631	18.07

†††† Alaska Aviation Emission Inventory, prepared for the Alaska Department of Environmental Conservation, June 2005.

Winter CO emissions from Merrill Field were computed in a similar manner. Sierra's 2002 CO emissions estimate (0.633 tons/day) was scaled upward in proportion to the projected increase in aircraft operations at Merrill. The Merrill Field Master Plan (2000) contains growth projections for the period 1997 through 2020. Annual operations are projected to increase from 187,190 in 1997 to 270,800 in 2020. Assuming linear growth, CO emissions can be projected for the period 2007-2023. These projections are shown in Table 6-3.

Table 6-3

Projected Aircraft Operations and CO Emissions at Merrill Field Airport

Calendar Year	Estimated or Projected Aircraft Operations	CO Emissions (tons per day)
1997	187,190	
2002	**205,366**	**0.633**
2007	223,542	0.689
2009	230,813	0.711
2011	238,083	0.734
2013	245,353	0.756
2015	252,624	0.779
2017	259,894	0.801
2019	267,165	0.823
2021	274,435	0.846
2023	281,706	0.868

7 Residential Wood Burning Emissions

The basic assumptions used in the preparation of emission estimates from residential wood burning were not changed from those used in the Year 2000 Anchorage Attainment Plan. Assumptions regarding wood burning activity levels (i.e. the number of households engaging in wood burning on a winter season design day) were corroborated by a telephone survey conducted by Ivan Moore Research (IMR) in 2003. IMR asked approximately 600 Anchorage residents whether they had used their fireplace or woodstove during the preceding day. The survey was conducted when the preceding day had a minimum temperature between 5 and 15 degrees F. Survey results were roughly consistent with the assumptions used in the attainment plan inventory. The basic assumptions used to estimate wood burning were based on data from a telephone survey[‡‡‡‡] performed by ASK Marketing and Research in 1990.

The ASK survey asked Anchorage residents how many hours per week they burned wood in their fireplace or wood stove. Because the AP-42 emission factors for fireplaces and wood stoves are based on consumption in terms of the amount of wood (dry weight) burned, hourly usage rates from the survey had to be converted into consumption rates. Based on discussions between MOA and several reliable sources (OMNI Environmental Services, Virginia Polytechnic Institute, Colorado Department of Health), average burning rates (in wet weight) of 11 pounds per hour for fireplaces and 3.5 pounds per hour for wood stoves were assumed for the Anchorage area. Residential wood burning assumptions are detailed in Table 7-1.

Table 7-1
Residential Wood Burning CO Emission Factors for Anchorage

Appliance	Average use per weekday (hours per household per day)	Average dry weight of wood consumed (lbs per hour)*	Average amount of wood burned per household (dry lbs / day)	Estimated wood burning CO emissions per household (lbs/day)
Fireplaces	0.156	7.15 lbs/hr	1.11	0.141
Wood Stoves	0.032	2.275 lbs/hr	0.073	0.006
TOTAL Fireplaces + woodstoves	0.188	------	1.18	0.147

Survey results suggest wood burning rates are relatively low in the Anchorage area. The vast majority of wood burning is "pleasure burning;" very few residents need to burn wood for primary or supplemental heat. If the average fire in the fireplace and/or woodstove is assumed to last three hours, Table 9 suggests that about 1 in every 16 households in Anchorage burns wood on a typical winter weekday.

The Anchorage Transportation Model post-processor provided information on the number of households in each grid. The calculated CO emission rate of 0.147 lbs of CO per day was

‡‡‡‡ "Air Quality Survey of Anchorage Residents," prepared by ASK Marketing & Research for the Municipality of Anchorage, April 1990.

assigned to each household in a grid. Thus wood burning emissions were highest in grids with high housing density.

Projecting future trends in wood heating in Anchorage is difficult. On one hand, anecdotal evidence suggests that fewer wood burning appliances are being installed in new homes in Anchorage. This is consistent with trends being observed nationally. On the other hand, increases in natural gas prices could result in increases in wood heating. For the purpose of this inventory, residential wood burning was assumed to increase in direct proportion with the number of households in the Anchorage inventory area. Area-wide wood burning emissions for the period 2007 - 2023 are shown in Table 7-2.

Table 7-2
Anchorage-wide 24-hour CO Emissions from Residential Wood Burning

Calendar Year	Number of Households in Inventory Area	24-Hour Emissions (tons)
2007	84,936	6.24
2009	86,582	6.36
2011	88,229	6.48
2013	89,875	6.60
2015	91,522	6.72
2017	93,168	6.84
2019	94,045	6.91
2021	94,923	6.97
2023	95,800	7.04

8 Space Heating Emissions

A telephone survey conducted by ASK Marketing and Research in 1990 indicated that natural gas is the fuel used for virtually all space heating in Anchorage. ASK survey results are shown in Table 8-1.The methodology used to compute natural gas space heating emissions for this maintenance demonstration is identical to that used in the Year 2000 Anchorage CO Attainment Demonstration and the 2004 Anchorage CO Maintenance Plan.

Table 8-1
Methods of Home Heating in Anchorage
(ASK Marketing & Research, 1990)

Natural gas	88.2%
Electricity	9.2%
Fuel oil	0.2%
Wood / other	1.3%
Don't know	1.1%
Total	100.0%

Enstar distributes natural gas to Kenai, Anchorage and other parts of Southcentral Alaska. According to Enstar, in 1996 approximately 80% of their gas sales were to Anchorage.[§§§§] Table 11 indicates that about 88% of all homes in Anchorage are heated with natural gas. A small fraction of homes are heated by wood or fuel oil. Wood heating has already been quantified separately in the inventory. The consumption of fuel oil for space heating was small in 1990 and likely even smaller in 2007. Calculated area-wide CO emissions from space heating with fuel oil are negligible (less than 25 pounds per day) and are not included in the inventory. Finally, the emissions associated with electrical heating occur at the generation plant. These emissions are accounted for separately in the point source inventory.

A detailed report of natural gas sales to residential, commercial and industrial customers was available for calendar year 1990[*****] for Southcentral Alaska.[†††††] Peak winter usage rates were estimated for residential customers and for commercial/industrial customers from this report. Demographic data (i.e. number of households, number of employees) were used to estimate per household consumption rates for residential customers and per employee consumption for commercial/industrial customers. The most recent AP-42 CO emission factors (July 1998) for uncontrolled residential furnaces (40 lbs CO/ 10^6 $ft^{3)}$) and small boilers (84 lbs CO/ 10^6 $ft^{3)}$) were used to characterize residential and commercial space heating emission. Calculated peak natural gas consumption and emission rates are shown in Table 8-2.

[§§§§] Personal communication with Dan Dieckgraff, Enstar Natural Gas, March 22, 2001.

[*****] Although data from more recent years were available, the reporting format had changed and less detailed data were available. Unlike the 1990 report, natural gas consumption was not reported separately for residential, commercial/industrial, and power generation customers.

[†††††] FERC Form No. 2 (ED 12-88), submitted by ENSTAR Natural Gas Company, 1991.

Table 8-2
Peak Natural Gas Consumption and CO Emission Rates in Anchorage (1990)

	Consumption Rate per Day	AP-42 Emission Factor (lbs. per 10^6 ft^3)	CO Emission Rate (lbs per day)
Residential	658 ft^3 per household	40	0.0263 per household
Commercial/ Industrial	434 ft^3 per employee	84	0.0364 per employee

On an area-wide basis, CO emissions from natural gas combustion were calculated by multiplying the CO emission rates in Table 13 by the number of households and employees in the inventory area. Table 8-3 presents the results of this calculation for the period 2007 – 2023. Emissions resulting from the combustion of natural gas for power generation are excluded. These emissions are accounted for separately in the point source inventory.

Table 8-3
CO Emissions from Natural Gas Combustion

Calendar Year	Number of Households in Inventory Area	Number of Employees in Inventory Area	Calculated Total Natural Gas Consumption (mcf)	CO Emissions from Natural Gas Combustion* (tons/day)
2007	84,936	145,516	119,127	3.77
2009	86,582	146,755	120,749	3.82
2011	88,229	147,994	122,372	3.86
2013	89,875	149,234	123,994	3.91
2015	91,522	150,473	125,617	3.95
2017	93,168	151,712	127,238	3.99
2019	94,045	153,731	128,693	4.04
2021	94,923	155,750	130,148	4.09
2023	95,800	157,769	131,602	4.14

* excludes natural gas used by utilities for electrical power generation

CO emissions from natural gas combustion were also calculated on a grid-by-grid basis by multiplying the emission rate per household or per employee by the number of households or employees in each grid. Thus, grid cells with a large number of households and/or employees were assigned the greatest emissions.

9 Non-road Sources

Non-road sources include miscellaneous fuel burning sources such snowmobiles, chain saws, portable generators, snow blowers and other equipment used for snow removal. As a starting point for this analysis, the EPA NONROAD model (version 2005) was run for base year 2007. The model provides estimates of non-road equipment types and activity levels for Anchorage. These model outputs were reviewed carefully to assess whether or not non-road equipment populations and usage (i.e., hours per year) were reasonable. The NONROAD model uses a top-down approach in which state-level equipment populations are allocated to counties on the basis of activity indicators that are specific to certain equipment types. Anchorage is the major wholesale and retail distribution center for the state. Because the NONROAD model activity indicator is based on the number of businesses within a particular SIC code, the model has a tendency to over-allocate the equipment to Anchorage and ignore usage that occurs outside the Anchorage area. For example, the NONROAD estimate for generator sets is likely heavily skewed by sales to non-Anchorage customers who come to Anchorage to purchase a generator for use in areas outside of the power grid.

The default model outputs are given in terms of average monthly, year-round use. These outputs were adjusted to reflect the fact that activity levels for non-road sources would be expected to be reduced on a typical midwinter exceedance day when ambient temperatures are near 0 °F. The activity levels of all-terrain vehicles, motorcycles, pressure washers, air compressors and pumps are likely substantially reduced in midwinter. Pressure washer activity, for example, was assumed to be 10% of that estimated by NONROAD. Other sources were also adjusted significantly from the NONROAD model's default outputs. These local adjustment factors are shown in Table 14. It is important to note, that without adjustment, the NONROAD model's estimate of CO emissions from the sources listed in the table is 120.8 tons per day in 2007 nearly equal in magnitude to the MOVES estimate for motor vehicle emissions (125.7 tons per day). Given what is known about the CO problem in Anchorage, clearly something is amiss. After the activity adjustment factors are applied to the NONROAD model estimates, the total contribution from the sources listed in the table is 9.1 tons per day.

Default output emissions from commercial and residential snow blowers were also reduced. Anchorage climatological records indicate that CO exceedances are typically preceded by cold, clear weather without snow. Thus, snow blower activity is likely to be lower on elevated CO days. For this reason the NONROAD estimate of residential and commercial snow blower activity was cut by 50%.

The NONROAD model default estimate for the snowmobile population in Anchorage is 34,985. Although there are a considerable number of snowmobiles in Anchorage, virtually all use occurs outside of the nonattainment area. Snowmobile use in Anchorage is banned on public land throughout the Anchorage nonattainment area because of safety and noise issues. Although there is some use in surrounding parklands, (i.e., Chugach State Park) these areas are located at least three miles from the emission inventory area boundary. However, there is likely to be some small amount of engine operation for maintenance purposes, etc. This was assumed to average about 0.1 hours per unit per month inside the inventory area. This usage rate is about 50 times lower than the NONROAD default value.

Finally, some of the NONROAD model outputs were clearly unreasonable. For example, there is no commercial logging activity in the Anchorage bowl. Because there is no commercial logging in the CO maintenance area, the NONROAD estimate of CO emissions from logging equipment chain saws was disregarded and it was cut by 80% to reflect that little garden or home wood cutting activity is likely to take place in mid-winter.

Table 9-1
Estimation of NONROAD CO emissions in 2007

	Number of Units	EPA NONROAD Model Estimate of CO emissions (unadjusted)	Activity Adjustment Factor	Revised CO Inventory Estimate (tons/day)
air compressors	251	0.83	0.50	0.42
ATVs	14,481	0.90	0.02	0.02
Chainsaws	6,159	0.56	0.20	0.14
concrete saws	144	0.60	0.25	0.15
Forklifts	94	0.41	1.00	0.41
generator sets	4,758	7.13	0.25	1.78
pressure washers	1,898	3.08	0.10	0.31
Pumps	1,227	1.73	0.25	0.43
snowblowers commercial	864	2.26	0.50	1.13
snowblowers residential	9,517	1.02	0.50	0.51
Snowmobiles	34,985	96.73	0.02	1.93
Welders	419	2.10	0.50	1.05
Other	91,767	3.47	varies	0.84
TOTAL NONROAD		120.83		9.12

To estimate future year emissions, the sources listed in Table 9-1 were increased in proportion to growth in households or employment. If the non-road source was primarily related to household activities, the growth in emissions was assumed to mirror the projected growth in households. Household-related sources include snowmobiles and residential snow blowers. For sources primarily related to commercial activity such as welders, pumps and air compressors, growth in emissions was tied to growth in employment. Non-road emission projections are shown in Table 9-2.

Table 9-2
CO emissions from Non-road sources 2007-2023 (tons per day)

Calendar Year	CO Emissions from Non-road Sources
2007	9.12
2009	9.24
2011	9.35
2013	9.47
2015	9.59
2017	9.70
2019	9.82
2021	9.93
2023	10.04

10 Railroad Emissions

Because railroad emissions are a relatively insignificant source of CO, no changes have been made to the estimates or methodology originally employed in the 2004 CO Maintenance Plan. The Alaska Railroad (ARR) supplied data on line haul and switchyard fuel consumption to the Alaska Department of Environmental Conservation for calendar year 1999. Total fuel consumption in the Anchorage switchyard was estimated to be 370,000 gallons during calendar year 1999. ARR also provided data on line haul fuel consumption between milepost 64 and 146. Annual fuel consumption along this 82-mile section of track was estimated to be 771,000 gallons. Only 14 miles of track (roughly MP 104 through MP 118) are inside the emission inventory area. The proportionate share of consumption within the inventory area was estimated to be 131,600 gallons. Twenty-four hour consumption rates were calculated by dividing annual totals by 365.

EPA guidance‡‡‡‡‡ provides separate emission factors for yard and line haul emissions. These factors, expressed on a gram per gallon basis, were applied to ARR fuel consumption estimates to compute emissions.

Railroad fuel consumption and emissions are summarized in Table 10-1. Switchyard emissions were distributed to the three grid cells that encompass the rail yard in the Ship Creek area of Anchorage. The rail route in Anchorage crosses 15 grids cells in the Anchorage inventory area. Line haul emissions were distributed equally among these 15 grid cells.

Table 10-1
Alaska Railroad Emission Estimates 2007-2023

	Consumption (gal/year)	Consumption (gal/day)	Locomotive Emission Factor (grams/gal)	CO emissions (tons/day)
Yard	370,000	1,014	38.1	0.04
Line Haul	131,634	361	26.6	0.01
Total	501,634	1,375		0.05

Although railroad activity is expected to increase in future years, above the activity levels reported in 1999, the emissions increases that might be expected from this growth are likely to be offset by improvements in locomotive control technology. The Alaska Railroad recently replaced 28 of their 62 locomotives with new models that produce less pollution and are more fuel efficient. In addition, between 2002 and 2007, the railroad equipped two-thirds of their locomotives with devices that reduce the amount of time locomotives idle in the Anchorage switchyard and reduce fuel consumption. For the purpose of this analysis, CO emissions from the ARR were assumed to remain the same through 2023. Although this is a crude assumption, the significance of ARR emissions is very small. Hence, refining these future year projections would have a negligible effect on the overall inventory.

‡‡‡‡‡ EPA Technical Highlights Document, EPA 420-F-97-051, December 1997.

11 Marine Vessel Emissions

The Port of Anchorage serves primarily as a receiving port for goods such as containerized freight, iron, steel and wood products, and bulk concrete and petroleum. Commercial shipping lines, including Totem Ocean Trailer Express and Horizon Lines bring in four to five ships weekly into the Port. The Port is currently undergoing a significant expansion that is intended to modernize the facility and double its size. In 2005, over 5 million tons of commodities moved across the Port's docks.

Despite the magnitude of this activity at the Port, CO emissions are relatively small. In June 2005, Pechan and Associates prepared an emission inventory for the ADEC that estimated winter and summer season CO emissions from the Port for the year 2002.§§§§§ This report provided an estimate of total emissions that occur from all four modes of commercial marine activity for the winter (defined as October through March). These four modes include cruise, reduced speed zone (RSV), maneuvering, and hotelling. However, as defined for modeling purposes, the cruise and RSV modes occur far from Port. Cruise mode activity occurs more than 25 miles form Port and the RSV mode occurs 2 miles or more from Port. Because cruise and RSV mode CO emissions occur so far from Port and therefore have little or no influence on CO concentrations in the Anchorage CO maintenance area, these emissions were excluded from this inventory.****** In addition to the 2002 inventory, the Pechan inventory also includes a forecast of winter CO emissions for 2005 and 2018. Interpolation and extrapolation was used to estimate CO emissions from Port of Anchorage marine activity from 2007 – 2023. These estimates are shown in Table 11-1.

Table 11-1
Estimated CO Emissions from the Port of Anchorage

Year	Estimated CO emissions (tons per day)
2007	0.09
2009	0.10
2011	0.11
2013	0.12
2015	0.12
2017	0.13
2019	0.13
2021	0.13
2023	0.13

§§§§§ Commercial Marine Inventories for Select Alaska Ports, prepared for the Alaska Department of Environmental Conservation by E.H. Pechan and Associates, June 2005.

****** Cruise and RSV emissions account for about 56% of total winter CO emissions. Therefore only 44% of the emissions in the Pechan inventory were included in this inventory.

12 Point Source Emissions

Point source emissions estimates for the year 2005 served as the basis for the 2007 base year point source emission inventory prepared for this maintenance plan and projections through 2023. Point source emissions were expected to grow in relation to the number of households. Thus the emission estimates for 2005 were adjusted upward in proportion to the growth in the number of households in the inventory boundary area.

ADEC is responsible for issuing operating permits to all stationary sources that have fuel-burning equipment with a combined rating capacity of greater than 100 million Btu per hour. The MOA also issues operating permits to all point sources in Anchorage with a combined rating capacity of greater than 35 million Btu per hour. The ADEC and MOA permit systems were used to inventory all stationary sources that are required to obtain such permits in the Anchorage non-attainment area. In addition, point sources that produce more than 10 tons per year (TPY) of CO (minor sources) were individually quantified to achieve a more precise estimate of the minor source contribution to the overall emission inventory from stationary sources.

The identification of minor sources was accomplished by contacting fuel distributors in Anchorage. We determined whether any facilities consumed sufficient quantities of fuel to exceed the annual 10 TPY of CO threshold. Using EPA's emission factors, AP-42 (fifth edition), fuel quantities equivalent to 10 TPY of CO were compared to sales of fuel to large users. This identified potential 10+ TPY of CO point sources. This approach determined that only permitted sources in Anchorage emitted more than 10 TPY of CO.

The ADEC point source computations were based on annual information provided by the source. The emission factors were from the most current version of AP-42. The ADEC calculated daily point source emissions for a typical wintertime day during the peak CO season by dividing the annual activity levels by the number of days per year. Actual facility operating information was available for 2005. Source emission estimates were based on actual fuel consumption and operations rather than permit allowable emissions.

Based on ADEC-issued air quality permits, there are six point sources in the Anchorage non-attainment area. Estimated annual emissions from each source for 2005 and projected daily emissions for the 2007-2023 period are listed in the table at the end of this section. Three of the six point sources identified in the Anchorage inventory were gas-fired (primarily natural gas) electrical generating facilities. Other sources include a sewage sludge incinerator, and two bulk fuel storage facilities.

There are three point sources that are located outside the non-attainment area. Two are located on military bases at Elmendorf Air Force Base and Fort Richardson. These facilities were excluded from the base year inventory because the CO emissions on these two military facilities are not considered significant contributors to the Anchorage attainment problem. The third facility is Anchorage Municipal Light and Power Sullivan Power Plant. It is located approximately two kilometers east of the northwest corner boundary of the nonattainment area. Even though this source is located outside the boundaries of both the attainment area and emission inventory area, it is included in the inventory. Emissions from the Sullivan Plant were assigned to the furthest northwest grid in the inventory area. This grid is located approximately 2 kilometers west of the power plant.

The ADEC used facility-reported information and AP-42 emission factors to estimate emissions for each of the six point sources. The methodology and emission factors used to estimate actual emissions at each facility is available upon request.

The ADEC Operating Permit system results in the collection of the emission information through requirements for annual and triennial emission reports, on-site inspections, the reporting of source test data and quarterly production levels and fuel usage, and interactions with each source. In addition, there was no CO emission control equipment identified on any of the sources included in the inventory. Therefore, 100% of the emission estimates resulting from the application of the AP-42 factors identified above was assumed for the inventories. Thus the application of a Rule Effectiveness factor did not appear to be appropriate and was not included for any of the point sources included in this inventory.

The estimates of actual emissions for a typical winter day (in tons per day) at each point source for the year 2005 and the projections for 2007 through 2023 are provided in Table 12-1.

Table 12-1
Point Source CO Emissions Summary (tons per day)

	Projected Daily CO Emissions based on growth in number of households									
Owner	2005	2007	2009	2011	2013	2015	2017	2019	2021	2023
Tesoro Alaska Petroleum Company, Anchorage Terminals I & II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anchorage Water & Wastewater Utility, Point Woronzof, John Asplund Wastewater Treatment Facility	0.26	0.27	0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.30
Chugach Electric Association, International Station Power Plant	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Anchorage Municipal Light & Power, George Sullivan Plant Two	0.93	0.95	0.97	0.99	1.00	1.02	1.04	1.05	1.06	1.07
Anchorage Municipal Light & Power, Hank Nikkels Plant One	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
Flint Hills Resources Alaska, LLC	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
TOTAL POINT SOURCE EMISSIONS	1.28	1.31	1.33	1.36	1.38	1.41	1.43	1.45	1.46	1.47

13 Compilation of Area-wide Emissions Summary

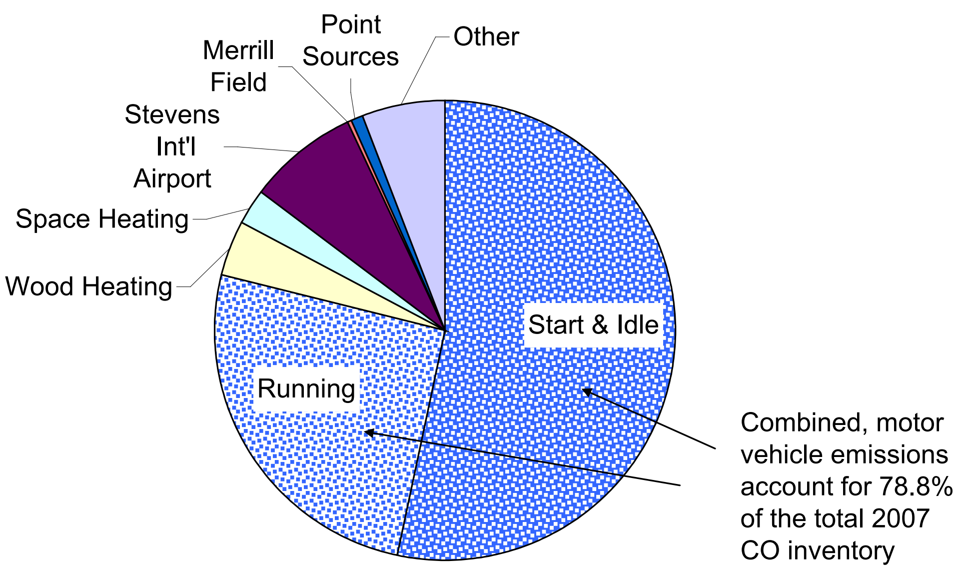
Based on the methodology outlined in the previous section, total CO emissions from all sources in the inventory area were calculated for a typical winter weekday in 2007, when conditions are conducive to elevated CO concentrations. Table 13-1 shows that total area-wide CO emissions are estimated to be 159.5 tons per day. Motor vehicles account for an estimated 78.8%. Figure 13-1 shows that most of these motor vehicle emissions are from start emissions.

Table 13-1.
Sources of Anchorage CO emissions in 2007 base year in Anchorage inventory area

Source Category	CO Emitted (tons per day)	% of total
Motor vehicles	125.6	78.8%
Aircraft Operations Ted Stevens Anchorage International and Merrill Field Airport	13.1	8.2%
Wood burning – fireplaces and wood stoves	6.2	3.9%
Space heating – natural gas	3.8	2.4%
Miscellaneous (snowmobiles, snow removal, welding, rail, marine, etc.)	9.3	5.8%
Point sources (power generation, sewage sludge incineration)	1.3	0.8%
TOTAL*	159.3	100.0%

* Total does not add to 100.0% because of rounding.

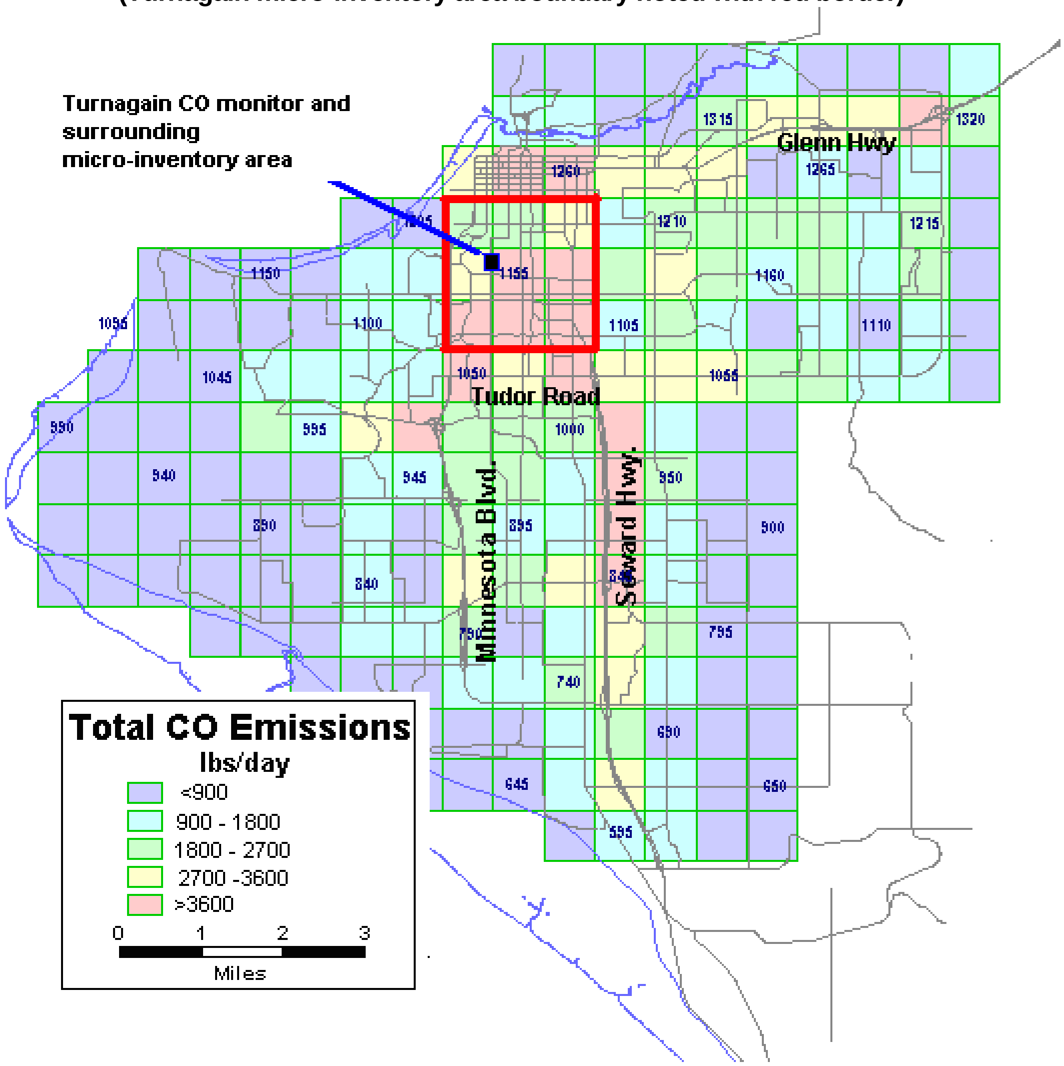
Figure 13-1
Estimated CO Emissions by Source in 2007



14 Compilation of Turnagain Area Micro-inventory

The area-wide CO inventory discussed in the previous section will be necessary to prepare the motor vehicle emission budget for use in future region-wide air quality conformity determinations. However, this "area-wide view" of emissions is not very useful in analyzing the factors leading to high CO concentrations at particular locations in Anchorage. Monitoring data, including a saturation monitoring study conducted in 1997-98 have demonstrated that CO concentrations vary widely throughout Anchorage and that some areas are more prone to high concentrations and have a greater potential to violate the national ambient air quality standard. The Turnagain monitoring station, located in a Spenard-area neighborhood (see Figure 14-1), has exhibited the highest CO concentrations of all the monitoring stations in Anchorage.

Figure 14-1
CO emissions distribution in Anchorage
(Turnagain micro-inventory area boundary noted with red border)



During the 1997-98 CO Saturation Study 8-hour CO concentrations at Turnagain were the highest among the 20 sites included in the study.†††††† Even though the probability of violating the CO NAAQS at Turnagain is estimated to be just 1-in-100, analysis suggests that the probability of violating the standard at other monitoring stations is much lower. ‡‡‡‡‡‡ For this reason, the Turnagain site is being used for the maintenance demonstration. In order to perform this demonstration, CO emissions in the area immediately surrounding the Turnagain site must be known for base year 2007 and projected through 2023.

Because the Anchorage inventory data is disaggregated into one-kilometer^2 grids, CO emissions can be analyzed in the area immediately surrounding the Turnagain station. A nine-square kilometer area including and surrounding the Turnagain site was selected for analysis. The area selected is shown in Figure 14-1. As can be seen in the figure, the emissions in the nine grids comprising this analysis area are among the highest in the inventory area. In 2007, this nine square kilometer area contained an estimated population of 19,776. Total estimated employment was 9,005. This area is one of the most densely populated areas in the Anchorage bowl.

Results of the 2007 base year micro-inventory for the nine-kilometer^2 area surrounding the Turnagain station are shown in Table 14-1 for a "design day" when conditions are conducive to the highest ambient CO concentrations. Emissions were modeled for a cold January weekday, when hourly temperatures vary from 2.6 to 6.2 deg F. Under these conditions total CO emissions in the micro-inventory area were estimated to be 10.23 tons per day. Motor vehicles account for an estimated 84.4% of the emissions in the area. Note, unlike the area-wide inventory, there is no contribution from aircraft operations or point sources in the area. Motor vehicles account for 84.4% of all CO emissions in the micro-inventory area.

Table14-1
Sources of CO Emissions in Turnagain Micro-inventory Area 2007 Base Year Design Day

Source Category	CO Emitted (tons per day)	% of total
Motor vehicles	8.61	84.4%
Wood burning – fireplaces and wood stoves	0.62	6.1%
Space heating – natural gas	0.28	2.7%
Miscellaneous (e.g.; snowmobiles, snow removal)	0.70	6.8%
TOTAL*	10.20	100.0%

*Total does not add to 10.20 tons per day because of rounding.

Projected emissions in the Turnagain micro-inventory area are tabulated for the period 2007-2023 in
Table 14-2. CO emissions increase slightly in 2013 due to the assumed termination of the I/M Program in 2012 but decline steadily thereafter. In contrast to the slight 6.6% increase in CO emissions projected area-wide between 2007 and 2023, emissions in the Turnagain area are expected to decline by about 5% during this same period. This is because slower rates of

†††††† Winter 1997-98 Anchorage Carbon Monoxide Saturation Study, Municipality of Anchorage Department of Health and Human Services, September 1998.

‡‡‡‡‡‡ Analysis of the Probability of Exceeding the CO Standard between 2007 and 2023, Municipality of Anchorage Department of Health and Human Services, February 2011.

growth in population and vehicle travel are projected in the Turnagain area than the Anchorage bowl as a whole.

Table 14-2
Estimated Total 24-hour CO Emissions CO on Design Day in Turnagain Micro-inventory Area (tons per day)

		Projected CO Emissions by Source					
		motor vehicles					
	projected population	start & extended idle	running	wood burning	space heating	other	**TOTAL**
2007	19,776	6.01	2.60	0.62	0.28	0.70	**10.20**
2009	20,090	6.14	2.28	0.63	0.28	0.71	**10.03**
2011	20,404	6.26	2.08	0.64	0.28	0.71	**9.97**
2010	20,247	6.20	2.18	0.63	0.28	0.71	**10.00**
2013	20,718	6.52	2.11	0.65	0.28	0.72	**10.29**
2015	21,032	6.59	1.92	0.66	0.29	0.73	**10.18**
2017	21,346	6.62	1.72	0.67	0.29	0.73	**10.03**
2019	21,536	6.58	1.64	0.68	0.29	0.74	**9.93**
2021	21,725	6.55	1.55	0.68	0.29	0.75	**9.82**
2023	21,915	6.49	1.48	0.69	0.30	0.76	**9.71**

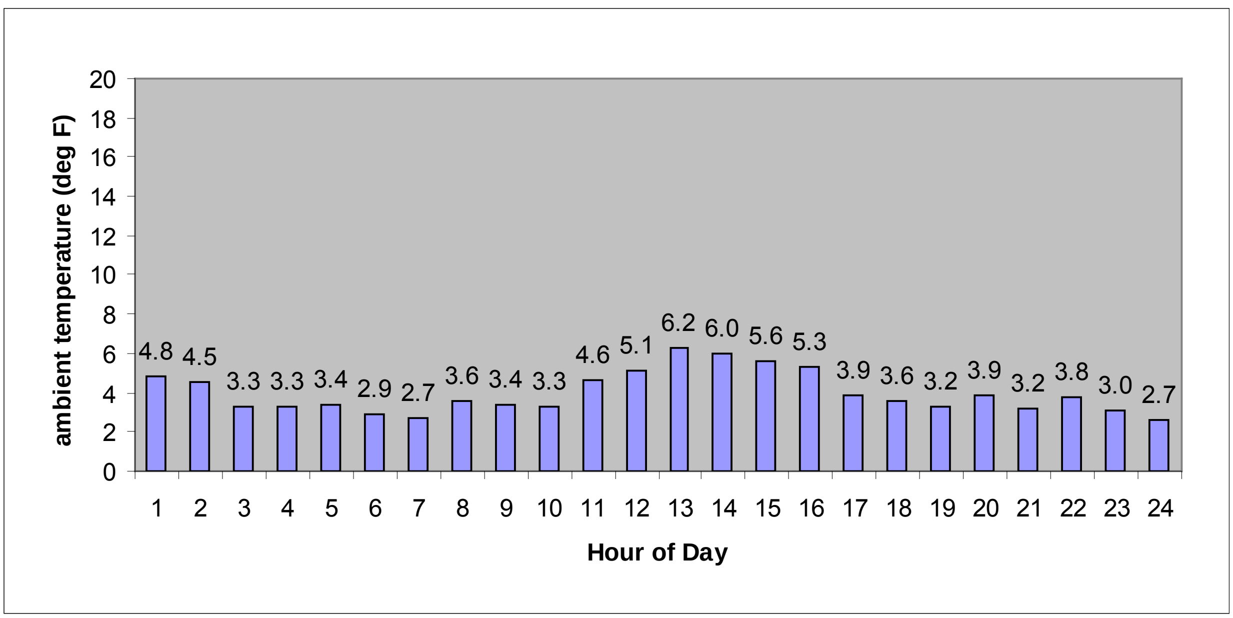
15 MOVES Run Specifications and County Data Manager Inputs

The EPA provides guidance on how MOVES should be run for SIP-related emission inventories and for conformity determinations in a guidance document.[24] It stipulates that MOVES should be run using the *County* domain scale. When MOVES is run under this domain scale it requires a series of user-supplied local data files, designated in the MOVES County Data Manager, that reflect the specific characteristics of the area being modeled. There are nine data files required. Each of these data files, and the origin of the data within them, is discussed. In addition, this section also discusses alternative vehicle fuels and technology (AVFT) inputs used to characterize the Anchorage gasoline vs. diesel fueled fleet in MOVES.

15.1 Meteorology Data

Anchorage experiences its highest CO in mid-winter. We examined hourly ambient temperature data on those days with the very highest 8-hour average CO (criteria ≥ 99th percentile) at the Turnagain monitor between 1999 and 2009.[25] The 21 days with the highest 8-hour average CO concentration were selected from this 11 year period and a composite diurnal temperature profile was developed from data collected by the NWS at Ted Stevens Anchorage International Airport. Note that there is very little variation over the course of the day.

Figure 15-1
Composite Hourly Temperatures on 99th Percentile CO Days in Anchorage



The hourly data above has been used as temperature inputs when MOVES is used to estimate starting emissions. (Ambient temperature assumptions have no effect on CO running emissions.) Although CO emissions estimates are unaffected by relative humidity (RH) assumptions, MOVES requires field for RH to be filled in; 80% was used.

[24] *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity,* EPA 420-B-09-046, December 2009

[25] The 99.5 percentile criterion was normalized to account for the downward trend in CO that has occurred over the past decade. In 1999 the 99.5 percentile concentration was 7.2 ppm; in 2009 it was 5.3 ppm.

15.2 Source Type Population

ADEC hired Sierra Research, Inc. to characterize the *source type population* or types of vehicles (e.g.; passenger car, passenger truck, combination long haul truck) in the Anchorage fleet by using a VIN (vehicle identification number) decoder to examine the Alaska DMV database narrowed to zip codes in the Anchorage CO inventory area. This effort has provided an excellent estimation of the number of vehicles in each of the 13 vehicle types defined by MOVES.

The result of this effort (excerpted from Sierra's report to ADEC) is shown in Table 15-1. Although the VIN decoder estimate revealed a motorcycle population of 8,446 in the inventory area, the effective population was assumed to be zero in January when CO emissions were modeled with MOVES.

Table 15-1
Anchorage Vehicle Populations by MOVES Source Type

Source Type ID	Source Type Description	**Vehicle Population**	**Assumed % Growth between 2007 and 2023**
11	Motorcycle	~~8,446~~ 0[a]	0.0%
21	Passenger Car	62,404	27.5%
31	Passenger Truck	122,558	27.5%
32	Light Commercial Truck	12,371	20.3%
41	Intercity Bus	195	13.3%
42	Transit Bus	242	27.5%
43	School Bus	328	13.3%
51	Refuse Truck	85	13.3%
52	Single Unit Short-haul Truck	1,370	13.3%
53	Single Unit Long-haul Truck	118	13.3%
54	Motor Home	5,499	0.0%
61	Combination Short-haul Truck	941	13.3%
62	Combination Long-haul Truck	601	13.3%
Total Vehicle Fleet		215,158	

[a] Motorcycle activity in Anchorage during the winter months was assumed to be zero.

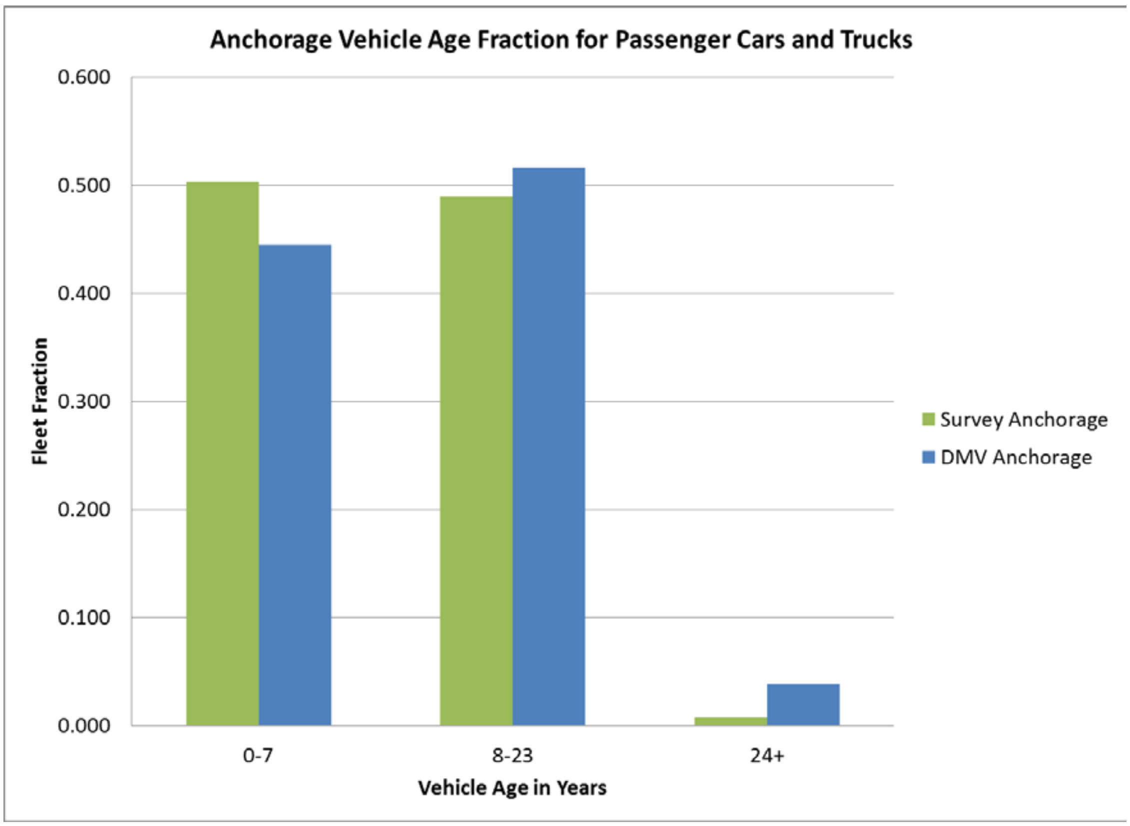
Vehicle populations (and the distribution among vehicle types) had to be projected through 2023. Historical I/M data were examined and that data suggested that the I/M eligible vehicle population (largely passenger cars and trucks) has been growing at an average rate of approximately 2.5% per year, about twice the rate of population growth in Anchorage. Absent any data on the expected growth of these vehicles by vehicle type, varying assumptions were made about growth in specific categories. For example, because of increases in the cost of fuel, the motor home population was expected remain constant throughout the planning period. The population in the Anchorage inventory area is projected to grow by 13.3% between 2007 and 2023. Table 15-3 shows the assumed growth in the vehicle populations during the same time period. It should be noted that MOVES emission estimates for composite fleet emissions are not particularly sensitive to these growth assumptions.

15.3 Age Distribution

Vehicles age distribution for each of the thirteen MOVES source types were estimated by Sierra Research using DMV, parking lot survey and MOVES default data. After the population for each source type was determined, the age distribution of vehicles in that source type was computed. Source types 41 through 62 (buses, heavy trucks and motor homes) relied on DMV data for their age distribution calculations.

Sierra observed that the apparent age distributions for passenger cars and trucks (source types 21, 31 and 32) estimated from parking lot survey data differed from the DMV data. Roughly half of the parking lot-surveyed vehicles fall into a category of model year 2004 and newer (Figure 15-2). The DMV data shows 10% fewer vehicles in the same age group. The parking lot survey data was relied upon to determine the age distribution for passenger cars, passenger trucks, light commercial trucks and motorcycles because it was believed to more accurately represent the active vehicle fleet in the winter CO season. DMV data were relied upon for age distributions of buses, short-haul, long-haul and refuse trucks, and motor homes.

Figure 15-2
Comparison of DMV and Survey-Based Vehicle Age Distributions of Passenger Cars and Passenger Trucks in Anchorage
(from Sierra Research memo to ADEC, 1/12/2011)



15.4 Vehicle Type VMT

15.4.1 HPMS Vehicle Type VMT Year

The ADOT&PF (Central Region 2007-2009) Traffic Volume Report.[26] includes traffic count data that can be easily mapped into the six basic (10, 20, 30, 40, 50, 60) MOVES vehicle VMT categories. Winter traffic count data from eleven count stations in the Anchorage inventory area were used to estimate the percentage of VMT accrued by each MOVES vehicle type.[27] The Anchorage Traffic Model estimates that daily weekday VMT in the inventory area is 3,344,312. An estimate of annual VMT can be made by scaling-up the daily weekday estimate as follows (DOT data suggests that Saturday traffic is about 90% of weekday and Sunday is about 75 %.)

Average daily VMT = ((3,344,312 x 5) + (3,344,312 x 0.9) + (3,344,312 x 0.75))/7 = 3,177,096
Average annual VMT = 1,159,640,186

Estimates of annual VMT used in MOVES modeling are shown below.

Table 15-2
DOT count-based estimates of Annual VMT by MOVES vehicle type (in 10^3 miles)

	MOVES Vehicle Type						
	10	20	30	40	50	60	All
% of VMT	0	405,020	677,962	5,676	33,832	98,184	1,220,674
Annual VMT	0.0%	33.2%	55.5%	0.5%	2.8%	8.0%	100%

15.4.2 Month VMT Fraction

The ADOT&PF Traffic Volume Report also includes data on traffic volumes by month... The table below shows January traffic count data from Anchorage roads relative to an "average" month in the year, where an average month is 100%. January traffic is 88.6% of average. On an average month, the fraction of annual of VMT accrued = 1/12 = 0.0833. The amount accrued in January is lower (0.866 x 0.0833 = 0.0752). This value was used in MOVES to model the January VMT fraction.

[26] Data from:
http://www.dot.alaska.gov/stwdplng/transdata/traffic/cen_reports/07_08_09ATVR_Final_9_2_2010.pdf

[27]. According to DOT these data may be somewhat unreliable in distinguishing between cars and pickup trucks because of counter limitations. For this reason, the relative proportions of cars vs. truck may be re-adjusted pending the results of the ADEC VIN decoder effort discussed above.

Table 15-3
January VMT Counts as a Percentage of an "Average" Month on Anchorage Roads

SANDLAKE ROAD	85.1%
OLD SEWARD HIGHWAY - NORTH OF SUNDOWN COURT	92.1%
A Street at Chester Creek	90.7%
C Street at Chester Creek	90.0%
Arctic Boulevard –South of 76th Avenue	87.0%
DeBarr Road –East of Wintergreen Street	88.4%
Dimond Boulevard –West of Arctic Boulevard	86.2%
Ingra and Gambell at Chester Creek	86.8%
International Airport Road – West of Fairbanks St	89.2%
Minnesota Drive at Chester Creek	88.1%
Minnesota Drive – NORTH OF DIMOND BOULEVARD (WIM)	92.1%
Minnesota Drive –South of Int'l Airport Road	89.9%
Northern Lights Blvd – East of LaTouche Street	89.0%
Northern Lights Blvd – West of Forest Park Drive	88.5%
O'Malley Road – East of Seward Highway	84.8%
TUDOR ROAD - WEST OF TUDOR CENTER DRIVE	89.6%
TUDOR ROAD - WEST OF PATTERSON STREET	87.9%
Average	**88.6%**
fraction of annual VMT occurring in January =	**0.0752**

15.4.3 Day VMT Fraction

Default data from MOVES was used to apportion weekend and weekday travel. These assumptions do not significantly affect estimates for running emissions because we are using emission factors along with Anchorage Transportation Model estimates of VMT to compute emissions. We will be estimating CO emissions for weekdays only.

15.4.4 Hour VMT Fraction

The ADOT&PF Traffic Volume Report also includes information that can be used to estimate the VMT fraction by hour of the day. The results of this analysis are shown below. These values were used as inputs in the MOVES modeling.

Table 15-4
Distribution of VMT by Hour on Anchorage Roads

Hour	Proportion of Daily VMT
1	0.01241
2	0.00794
3	0.00618
4	0.00447
5	0.00506
6	0.01141
7	0.02724
8	0.05124
9	0.04929
10	0.04447
11	0.04776
12	0.05824

Hour	Proportion of Daily VMT
13	0.06582
14	0.06594
15	0.06782
16	0.07529
17	0.08206
18	0.08153
19	0.06500
20	0.04953
21	0.04112
22	0.03571
23	0.02641
24	0.01835

15.5 Average Speed Distribution

Sierra Research examined speed estimates from the Anchorage Transportation Model and constructed a spreadsheet that converted these speed estimates into the speed distributions (16 speed bins) required by MOVES for each source types and road type by hour of the day. Although an effort was made to accurately reflect these speed distributions in the MOVES speed distribution input file, this information is less critical because will be using MOVES in the *emission rates* mode rather than the *inventory* mode when developing the inventory, emission budget and for performing conformity analyses. The spreadsheet model was used to estimate the average speed of vehicles traveling on the two road types within each grid and select an appropriate MOVES-based emission rate based on that speed.

15.6 Road Type Distribution

The Anchorage Transportation Model provides information of the amount of VMT accrued on five different road types and these five types can be mapped into the four road types required by MOVES. (The Anchorage inventory area has only two of these road types, urban unrestricted access and urban restricted access.) Transportation model estimates of VMT accrued on local, collector, minor arterial and major arterial roadways are combined to make up an estimate of the *urban unrestricted access* road type defined by MOVES. Freeway and expressway VMT estimates are simply re-defined as *urban restricted access* VMT. For 2007, the transportation model estimates that about 73% of travel occurs on unrestricted access roads and the remainder on restricted access.

15.7 Ramp Fraction

Absent better information, the MOVES default ramp fraction (8%) was used as the fraction for Anchorage.

15.8 Fuel Supply and Fuel Formulation

The MOVES defaults for fuel supply and formulation assume that market share of gasoline blended with 10% ethanol in Anchorage will increases to 100% by 2012. Tesoro Alaska, the main refiner and gasoline supplier in Anchorage has informed us that there is an exemption to the Renewable Fuel Standard (RFS) in Alaska and that they have no plans to blend ethanol in the gasoline in the foreseeable future.[28] For this reason, for modeling purposes, we "zeroed" out the market share of ethanol-blended gasoline. Tesoro also informed us that they met the ultra-low sulfur specification before 2007 and that they did not envision further changes in sulfur content in the coming years. Table 15-5 shows gasoline fuel formulation assumptions for the period 2007-2011 and for 2013-2023. The main difference in specification is the lowered benzene content after 2012. This change is unlikely to have an impact on modeled CO emissions. MOVES supplied defaults were used for the diesel fuel spec. Although there is some minimal use of other motor fuels such as natural gas, this was assumed to be zero for modeling purposes.

[28] E-mail communication from Kip Knudson, Tesoro Alaska 1/11/2011.

Table 15-5
Gasoline Fuel Formulation Assumptions Used in Anchorage MOVES Modeling

	Time Period	
	2007-2011	2013-2023
Fuel Formulation ID	8077	8859
Fuel Subtype ID	10	10
RVP	15.2457	15.2457
Sulfur Level	30	30
ETOH Volume %	0	0
MTBE Volume %	0	0
ETBE Volume %	0	0
TAME Volume %	0	0
Aromatic Content %	31.7475	29.8113
Olefin Content %	0.92	0.92
Benzene Content %	3.7	0.6445
e200	54.7901	57.0202
e300	91.781	93.8415

15.9 I/M

Table 15-6 shows the Vehicle Inspection and Maintenance (I/M) Program assumptions used in the MOVES modeling. In 2007, the Anchorage I/M program included a 4-year testing exemption or grace period for new cars. In 2011 this grace period was extended to 6 years. For modeling purposes the I/M program was assumed to be discontinued in 2012.

Table 15-6
I/M Assumptions Used in Anchorage MOVES Modeling

	Time Period			
	2007 - 2009	2011	2013-2023	Explanation of MOVES Codes
I/M in operation?	Yes	Yes	No	
Grace Period	4 yrs	6 yrs	-----	
Source Types	21, 31, 32	21, 31, 32	-----	Passenger cars = 21, passenger trucks = 31, light commercial trucks =32
I/M test standards MY <1996	12	12	-----	Two-mode, 2500 RPM/Idle Test =12
I/M test standards MY ≥ 1996	51	51	-----	Exhaust OBD Check = 51
Inspection frequency	2	2	-----	Biennial =2
Compliance Factor MY <1996	90%	90%	-----	
Compliance Factor MY ≥ 1996	93%	93%	-----	

15.10 Alternative Vehicle Fuels and Technology (AVFT) Inputs

Sierra Research observed differences in gasoline/diesel splits from MOVES default values varied from 1% to 30% for most source types and model years. Because these differences were relatively substantial in some instances, the MOVES *AVFT* option was used to input Anchorage-specific information on gasoline diesel splits when it was available. (Default values were used pre MY 1981 vehicles). Sierra found that Anchorage tended to have a higher diesel fraction than the default for most source types. As an example, the diesel fraction of the MOVES default or compared to Anchorage for passenger cars (source type 21) in Table 15-7.

Table 15-7
Comparison of Anchorage Fleet to MOVES Defaults
% of Diesel-Fueled Passenger Cars

Model Year	MOVES Default	Anchorage AVFT
1981	7.64%	22.43%
1982	6.09%	19.18%
1983	3.10%	8.29%
1984	1.88%	6.60%
1985	1.17%	4.92%
2001	0.38%	0.48%
2002	0.38%	0.86%
2003	0.38%	0.98%
2004	0.38%	0.74%
2005	0.38%	1.13%
2006	0.38%	1.79%
2007	0.38%	0.00%
2008	0.38%	0.06%
2009	0.38%	0.73%
2010	0.38%	0.73%

Alaska Department of Environmental Conservation

Amendments to:

State Air Quality Control Plan

Vol. III: Appendices

Appendix III.B.6

"Analysis of Probability of Complying with the National Ambient Air Quality Standard for Carbon Monoxide in Anchorage between 2007 and 2023, dated April 2011"

Public Review Draft

May 24th, 2011

Appendix to Section III.B.6, Anchorage Carbon Monoxide Maintenance Plan

Air Quality Program
Municipality of Anchorage
Department of Health and Human Services
April 2011

Analysis of the Probability of Complying with the National Ambient Air Quality Standard for Carbon Monoxide in Anchorage between 2007 and 2023

Background

In July 2008, the Anchorage Assembly directed the Municipal Department of Health and Human Services to work with the State of Alaska to remove the I/M Program as a requirement in the State Implementation Plan for air quality with a stipulation that it be retained as a local option and not be subject to a further SIP revision if further local action results in changes to or a discontinuation of the program. As a result a new probabilistic maintenance demonstration has been prepared that analyzes the impact of terminating I/M on prospects for future compliance with the national ambient air quality standard (NAAQS).*

Prior to the preparation of the previous Anchorage CO Maintenance Plan in 2004, the Municipality of Anchorage (MOA), the Alaska Department of Environmental Conservation (ADEC) and EPA Region 10 staff agreed that a probabilistic approach should be used in the Anchorage maintenance demonstration. The MOA, ADEC and EPA agreed that this demonstration must show a 90% or greater probability of meeting the national ambient air quality standard in each year during the 2007-2023 lifetime of the Maintenance Plan.

The MOA is using the same methodology used in the 2004 Plan in this revised maintenance demonstration. This methodology relies on conventional statistical methods to estimate the probability of complying with the NAAQS in the year 2007, the base year for the analysis. The "roll forward" technique, used in the previous maintenance demonstration, is used to estimate probability of complying with the standard in future years. This technique relies on CO emissions projections for years 2008 through 2023 to help estimate the probability of complying with the NAAQS during this time period.

This is a "technical revision" of an earlier document prepared in March 2010. This revised document substitutes CO emission estimates generated by the new EPA emissions model MOVES for previous estimates generated by AK MOBILE6. Although the computed probabilities of continued maintenance change slightly as a consequence, there is very little change in conclusions from the probability analysis regarding prospects for continued maintenance of the CO NAAQS. The analysis suggests that there is a very high probability of continued compliance with the NAAQS through 2023.

Method

Estimating the Probability of Complying with the NAAQS in Base Year 2007

The NAAQS for CO is set at 9 ppm for an 8-hour average not to be exceeded more than once per year. Because the NAAQS effectively disregards the highest 8-hour average in determining compliance, *the measure of whether a community meets the standard is determined by the magnitude of the second highest 8-hour average, or second maximum*. For this reason, this analysis focuses on the probability of the second maximum being above or below the 9 ppm NAAQS.

Standard regression analysis techniques can be used to estimate the probability of complying with the CO NAAQS in 2007. By definition, a violation occurs when the second maximum concentration is higher than 9 ppm. The probability that this will or will not occur can be computed using the prediction interval. The prediction interval is defined mathematically as follows:

Equation 1 $$y_p = y_h + t_{(\alpha;\, n\text{-}2)} \cdot s\{pred\}$$

$$s\{pred\} = \sqrt{MSE\left[1 + \frac{1}{n} + \frac{(X_h - \bar{X})^2}{\sum (X_i - \bar{X})^2}\right]}$$

* Even though I/M could continue as a local option program, CO reduction benefits were ignored because it is no longer a committed primary control measure in the SIP.

where

In this circumstance, we are interested only in the upper limit of the prediction interval†. In this case we want to compute the value corresponding to the upper 90th percentile interval in base year 2007. If 2007 could be "repeated" numerous times, with the "normal" variety of meteorological conditions and other variables that effect CO concentrations, the second maximum concentration would fall at or below this value 90% of the time. This value is the base year 2007 design value (2007 $DV_{90\%}$).

Over the past 30 years, CO monitoring has been conducted at ten permanent CO stations‡ and at numerous additional temporary stations throughout Anchorage and Eagle River. Data suggest that the Turnagain monitor, located in a residential area in west Anchorage, has the highest CO concentrations of the four monitors in the current network. (See analysis in the Attachment at the end of this report.) Although it is difficult to compare recent data from Turnagain with data collected from other sites a decade or more earlier, studies suggest that the CO concentrations at Turnagain are likely representative of the highest ambient CO concentrations encountered in Anchorage. For this reason, Turnagain was selected as the site for the maintenance demonstration.

First and second maximum 8-hour CO concentrations measured at Turnagain are shown in Table 1.§

Table 1
1st and 2nd Maximum CO Concentrations at Turnagain Station (1999-2008)

	Highest 8-hour average CO Concentration (ppm)	2nd Highest 8-hour average CO Concentration (ppm)
1999	10.1	7.6
2000	7.2	5.5
2001	9.8	7.7
2002	6.5	5.9
2003	8.3	6.7
2004	8.1	7.9
2005	5.7	4.6
2006	6.5	6.1
2007	5.5	5.3
2008	6.3	5.4

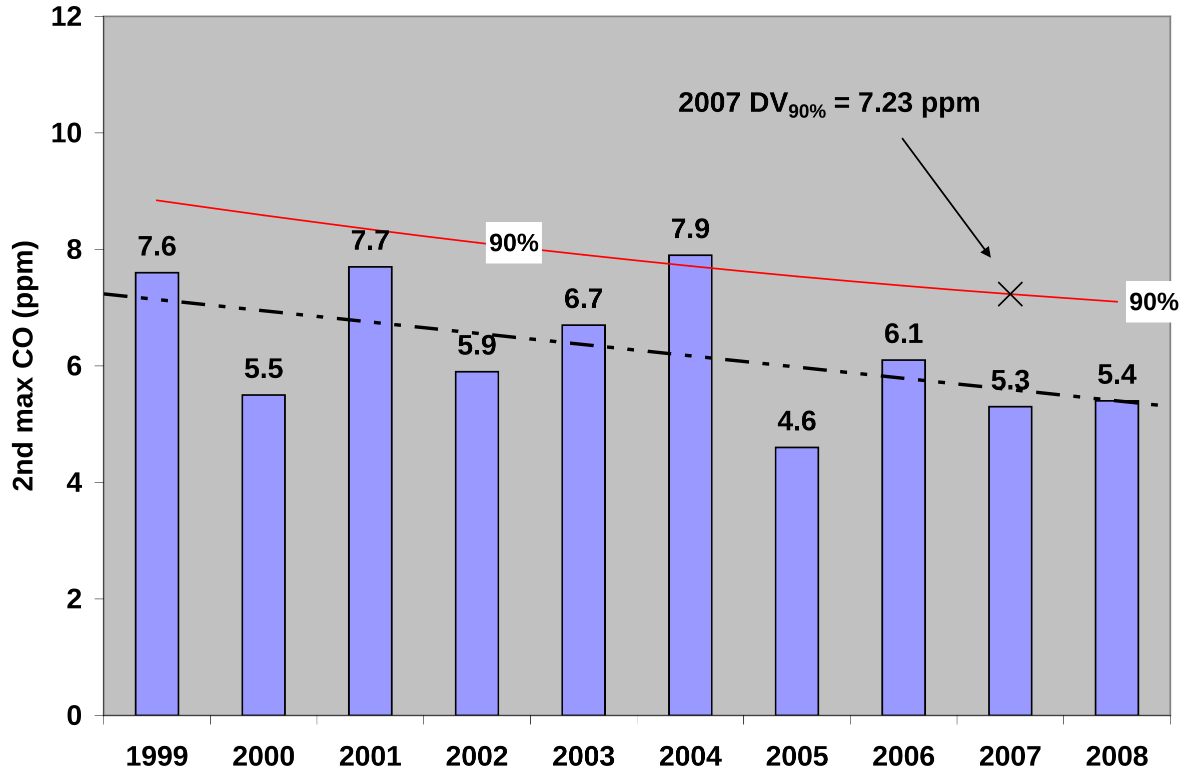
An Excel spreadsheet was used to compute the upper 90th percentile prediction interval from the second maximum concentrations at Turnagain using Equation 1. The results of this computation are plotted in Figure 1. Figure 1 shows that there was a 90% probability that the base year 2007 value would be less than or equal to 7.23 ppm. This computed concentration will serve as the base year 2007 design value for the roll forward analysis discussed later in this report.

Figure 1
90th Percentile Prediction Interval Computed from Turnagain 2nd Maximum

† This is known as a one-sided prediction interval. In this case we use the one-sided t-statistic when using Equation 1.

‡ For the purposes of this discussion, we define a permanent monitoring station as one that has employed Federal Reference Method monitors over the course of at least one CO season. Temporary monitoring was conducted with bag samplers in the 1980's and more recently with portable industrial hygiene-type CO monitors. Temporary monitoring has been conducted at more than 30 locations in the Municipality.

§ The Turnagain station began operation October 16, 1998; thus 1999 was the first complete year of data collected at this site.



The precise probability of complying with the 9 ppm NAAQS in 2007 was also estimated with the spreadsheet. The probability associated with a second maximum of less than or equal to 9.0 ppm can be estimated through iteration. The one sided t-statistic associated with various probabilities can be used in Equation 1 until the desired 9.0 ppm value is bracketed within two prediction intervals (see Table 2). In this case the desired 9.0 ppm value falls very nearly at the 99.0% interval. Thus, the probability of complying with the NAAQS in 2007 was estimated to be approximately 99%. The chance of violating the NAAQS in 2007 was about 1-in-100.

Table 2
Second Maximum CO Concentration Associated with Various Upper Bound Prediction Intervals

Probability that 2007 CO Concentration will be less than Computed 2nd Max Concentration	**Computed Second Maximum CO Concentration (ppm)**
80.0%	6.64
90.0%	7.23
95.0%	7.78
97.5%	8.30
99.0%	***8.99***
99.9%	10.88

Estimating the Probability of Complying with the NAAQS between 2007 - 2023

One assumption implicit in using the roll forward method is that the second maximum CO concentration in any future year will be proportional to the magnitude of the CO emissions in that year relative to base year emissions in 2007. In other words, if CO emissions in a future year are projected to decrease by 10% relative to base year 2007, the expected CO concentration in that future year will also decrease by 10%. If this occurs, there will be concurrent increase in the probability of complying with the NAAQS in that year.

CO emissions were estimated for the 9 kilometer^2 area surrounding the Turnagain CO monitoring station for base year 2007 using EPA-prescribed models such as the MOVES, NONROAD, AP-42 and the FHWA model EDMS to estimate CO emissions.[**]

CO emissions in 2007 were estimated to be 10.20 tons per day (tpd) in the “micro-inventory area” surrounding Turnagain. The computed 90th percentile concentration or 2007 $DV_{90\%}$ was 7.23 ppm. If one assumes that CO concentrations increase in direct proportion to emissions, the amount of CO that could be emitted in the Turnagain area and retain a 90% probability of complying with the standard can be computed as follows:

Amount of CO emissions associated with a 90% probability of complying with the NAAQS = *(9.0 ppm / 2007 DV_{2007}) x CO emissions in 2007*

= *(9.0 ppm/7.23 ppm) x 10.20 tpd =* ***12.70 tpd***

This computation suggests that if CO emissions in the Turnagain area increased from 10.20 tpd to 12.70 tpd, the probability of complying with the NAAQS would be 90%. In the same manner as shown above, the amount of emissions corresponding with other probabilities of compliance (i.e. 90%, 95%, 99%, etc.) can be readily computed with the spreadsheet. The spreadsheet was used to create a lookup table listing probabilities along with corresponding quantity of emissions. Table 3 shows the results of these spreadsheet computations. As would be expected, the probability of complying with the NAAQS increases with lower emission rates.

Table 3
CO Emission Rates Associated with Varying Probabilities of Compliance with the NAAQS at the Turnagain Station

Probability that 2nd Max CO Concentration will be less than 9.0 ppm	Corresponding CO Emission Rate (tpd)
99.9%	8.44
99.5%	9.15
99.0%	10.22
98.0%	10.77
97.0%	11.21
96.0%	11.50
95.0%	11.81
94.0%	11.98
93.0%	12.15
92.0%	12.33
91.0%	12.51
90.0%	12.70

[**] The MOVES model is used to estimate vehicle emissions, NONROAD us used to estimate various nonroad sources such as snowmobiles and portable electrical generators, EDMS is used for airport operations and AP-42 is used to estimate various area sources such as natural gas space heating, fireplaces and wood stoves. These models and emission inventory procedures are described more fully in the *Anchorage CO Emission Inventory and Emission Projections 2007-2023,* included as Appendix A of the Anchorage SIP submittal.

In addition to estimating base year 2007 CO emissions in the 9 kilometer^2 area surrounding Turnagain, emissions were projected through the year 2023. Projections were prepared using the aforementioned MOVES, NONROAD, AP-42, and EDMS modeling procedures. Population and employment forecasts prepared by the University of Alaska Institute of Economic and Social Research (ISER) were used to estimate key parameters necessary to estimate growth in vehicle travel[††], space heating, fireplace and woodstove use and other CO emission sources. The MOVES model was configured to reflect that the four-year new car exemption will be extended to six years beginning January 2010 and discontinued in 2012..

The results of this "micro-inventory" and forecast of CO emissions in the Turnagain area are shown in Table 4. The probability of complying with the NAAQS at the level of emissions projected for each year was determined from the lookup table (Table 3).

Table 4
Projected CO Emissions and Probabilities for Compliance with the NAAQS (2007-2023)

	CO Emissions from Various Sources in the 9 km^2 Area Surrounding the Turnagain Station (all emissions in tons per day)					
Year	Motor Vehicles	Fireplace or Woodstove	Space Heating	Other	**TOTAL CO EMISSIONS**	**Probability of Compliance**
2007	8.61	0.62	0.28	0.70	**10.20**	99.1%
2008	8.51	0.62	0.28	0.70	**10.12**	99.1%
2009	8.42	0.63	0.28	0.71	**10.03**	99.1%
2010	8.38	0.63	0.28	0.71	**10.00**	99.1%
2011	8.34	0.64	0.28	0.71	**9.97**	99.2%
2012	8.49	0.65	0.28	0.72	**10.13**	99.1%
2013	8.63	0.65	0.28	0.72	**10.29**	98.9%
2014	8.57	0.66	0.28	0.73	**10.24**	99.0%
2015	8.51	0.66	0.29	0.73	**10.19**	99.1%
2016	8.42	0.67	0.29	0.73	**10.11**	99.1%
2017	8.34	0.67	0.29	0.74	**10.03**	99.1%
2018	8.28	0.68	0.29	0.74	**9.99**	99.1%
2019	8.22	0.68	0.29	0.74	**9.94**	99.2%
2020	8.16	0.68	0.29	0.75	**9.88**	99.2%
2021	8.10	0.68	0.29	0.75	**9.83**	99.2%
2022	8.03	0.69	0.29	0.75	**9.77**	99.2%
2023	7.97	0.69	0.30	0.76	**9.71**	99.3%

Table 4 suggests that there is a very high likelihood of complying with the NAAQS at the Turnagain station. CO emissions are projected to increase slightly in 2013 if the I/M program is terminated as assumed, but the probability of compliance remains at or near 99% through the 2007-2023 period. Although not shown here, a similar analysis was performed for the Garden station. That analysis indicated that there is an even greater likelihood of compliance at that site. The probability of compliance was greater than 99.9% each year between 2007 and 2023.

Sensitivity Analysis

The roll forward probability analysis presented in the last section relies on modeled projections of future emissions. What happens to the estimated probabilities if these projections underestimated the growth in CO emissions between 2007 and 2023?

This sensitivity analysis investigates the sensitivity of the probability estimates presented in Table 4 to assumptions regarding:

[††] The Anchorage Transportation Model was used to provide information on vehicle travel. It relies in large part on ISER projections in the development of travel forecasts.

1. future growth in vehicle miles traveled (VMT), vehicle starts and idling, and;
2. future growth of wood stove and fireplace use.

For the purpose of this analysis, we will adjust initial assumptions regarding VMT, and wood stove and fireplace use and re-compute the estimated probability of complying with the NAAQS during the 2007-2023 period. The manner in which each of these assumptions was revised is described in the next section.

Revised Assumptions Used in Sensitivity Analysis:

Future Growth in VMT, Vehicle Starts and Idling

Imbedded in these emission computations is the assumption that amount of vehicle miles traveled (VMT) on streets in the 9 kilometer^2 area surrounding the Turnagain station will grow by about than 4% from 2007 levels. Although this appears to be a sensible assumption because the Turnagain area is an older area with little opportunity for significant growth in population, in this sensitivity analysis we will assume that the growth in VMT will be three times that projected by the Anchorage Transportation Model. In other words, we will assume that VMT and vehicle starts and idling will grow by 12% between 2007 and 2023 and determine how this affects the probability of compliance.

Future Growth in Wood Stoves and Fireplace Use

Woodstove and fireplace emissions were assumed to grow in proportion to the growth in the number of households in the Turnagain micro-inventory area. During the 2007-2023 inventory period, wood heating emissions were projected increase by about 11%. Although recent telephone data suggest that Anchorage households do not plan to change their habits with regard to wood burning, there is a possibility that wood burning rates could increase in the next decade if households decide to heat with wood to avoid rising costs of heating with natural gas. For the purpose of this analysis we will assume that wood heating will grow 2% per year per household during the inventory period.

Results of Sensitivity Analysis

The two revised assumptions used in this sensitivity analysis are summarized in Table 5. The *combined* impact of these revised assumptions on CO emissions in the Turnagain micro-inventory area and the consequent effect on probabilities of compliance during the 2007-2023 maintenance plan period is shown in Table 6.

Table 6 suggests that even when the assumptions used in the sensitivity analysis are combined to create a “worst case scenario”, the probability of compliance with NAAQS is well above 90% each year. Even with higher rates of growth in vehicle travel and wood burning, CO emissions continue to decline. The probability of compliance remains at 98% or higher even with these higher growth rates.

Table 5
Comparison of Original Assumptions used in Maintenance Demonstration with Revised Assumptions used in Sensitivity Analysis

	Original Assumptions used in Maintenance Demonstration and Probability Computations	**Revised “Worst Case” Assumptions Used in Sensitivity Analysis**
Growth in VMT and Vehicle Starts and Idling	4% increase between 2007 and 2023	12% increase between 2007 and 2023
Fireplace and Woodstove Use	No change in wood burning rates per household between 2007-2023	2% growth in wood heating per year

Table 6
Comparison of CO Emissions and Probabilities of Compliance with the NAAQS
Original Assumptions used in Maintenance Demonstration vs.
Revised Assumptions used in Sensitivity Analysis

	Original Assumptions		Revised Assumptions in Sensitivity Analysis	
	Estimated Total CO Emissions (tpd)	Probability of Compliance	Estimated Total CO Emissions (tpd)	Probability of Compliance
2007	10.20	99.1%	10.20	99.1%
2008	10.12	99.1%	10.16	99.1%
2009	10.03	99.1%	10.12	99.1%
2010	10.00	99.1%	10.14	99.1%
2011	9.97	99.2%	10.15	99.1%
2012	10.13	99.1%	10.36	98.8%
2013	10.29	98.9%	10.57	98.4%
2014	10.24	99.0%	10.57	98.4%
2015	10.19	99.1%	10.56	98.4%
2016	10.11	99.1%	10.53	98.5%
2017	10.03	99.1%	10.50	98.5%
2018	9.99	99.1%	10.49	98.5%
2019	9.94	99.2%	10.49	98.5%
2020	9.88	99.2%	10.47	98.6%
2021	9.83	99.2%	10.46	98.6%
2022	9.77	99.2%	10.45	98.6%
2023	9.71	99.3%	10.43	98.6%

Attachment A

Rank-Pair Order Comparison of CO Concentrations at Turnagain with Garden and Seward Highway Monitoring Stations

Permanent monitoring at Turnagain station began in October 1998 following the completion of a CO Saturation Monitoring Study during the winter of 1997-98. This study monitored CO concentrations at some 20 locations using temporary industrial hygiene-type monitoring devices. The saturation study indicated that the Turnagain site had the highest concentrations of all the sites in the study.

The permanent monitoring stations at Turnagain and Garden are located in older residential neighborhoods with relatively low traffic volumes on the roadways adjacent to the monitoring probe. The Seward Highway station (decommissioned in December 2004) was located at the intersection of two heavily traveled arterials, the Seward Highway and Benson Boulevard. In Anchorage CO monitoring is conducted at these permanent stations during the winter months defined as October through March.

Non-overlapping 8-hour maximum CO concentrations measured at the Turnagain, Garden and Seward Highway monitors were compared in rank-order to determine which site has the highest CO concentrations and the greatest potential for exceeding the national ambient air quality standard (NAAQS) for CO. A rank-order comparison involves sequentially ranking non-overlapping 8-hour average concentrations at the two sites being compared in descending order. In other words, the highest concentration measured at one site is compared to the highest concentration at the other, the second highest at the one site is compared to the second highest at the other, the third highest at one site is compared to the third highest at the other, and so on.

Rank-pair comparisons of data were performed only in time periods when data were available from both sites. In other words, in order to perform a fair comparison between two sites, the data compared was limited to periods when both sites were in operation and collecting valid data. Table 1 show the time periods when paired-data from Turnagain was compared to the other two stations.[‡‡]

Table A-1

Comparison Periods for Rank-Pair Analysis

Stations Compared	Comparison Period
Turnagain with Garden	10/16/98 – 12/31/07
Turnagain with Seward Hwy	10/16/98 – 12/31/05

A spreadsheet program was constructed to identify the highest 50 non-overlapping 8-hour maximum CO concentrations at each site for the comparison periods shown in Table 1.

[‡‡] The Turnagain site did not begin operating until October 16, 1998 and monitoring was discontinued at the Seward Highway site on December 31, 2004. Garden has been in more-or-less continuous operation since late 1970's. When data comparisons between two sites were performed the analysis was limited to time periods when both sites were collecting data.

Comparison of Turnagain and Garden Station CO Concentrations - October 1998 through December 2007

Results of the rank-order comparison between the Turnagain and Garden CO stations are shown in Figure 1. (Data used to construct this plot can be found at the end of this report.)

Figure A-1

Rank-Order Comparison of Highest Fifty Non-Overlapping 8-hour Average CO Concentrations Measured at the Turnagain and Garden Monitoring Stations October 1998–December 2007

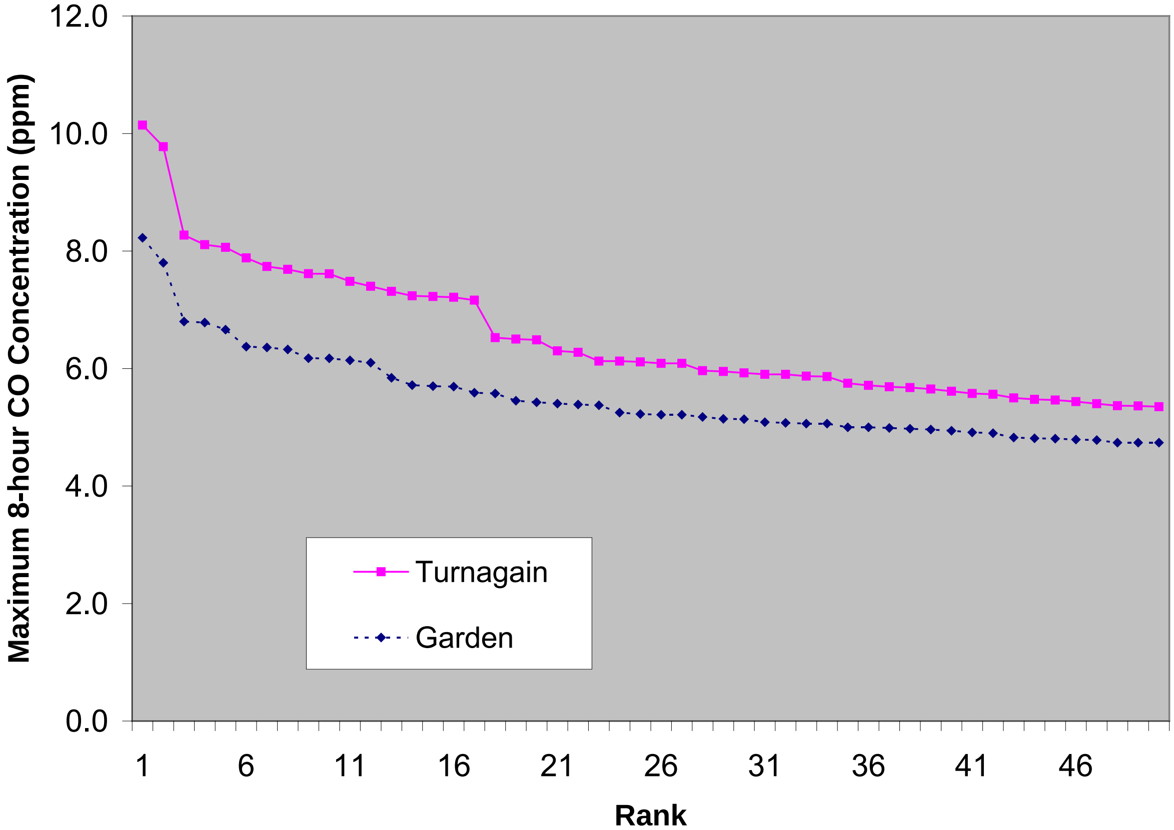


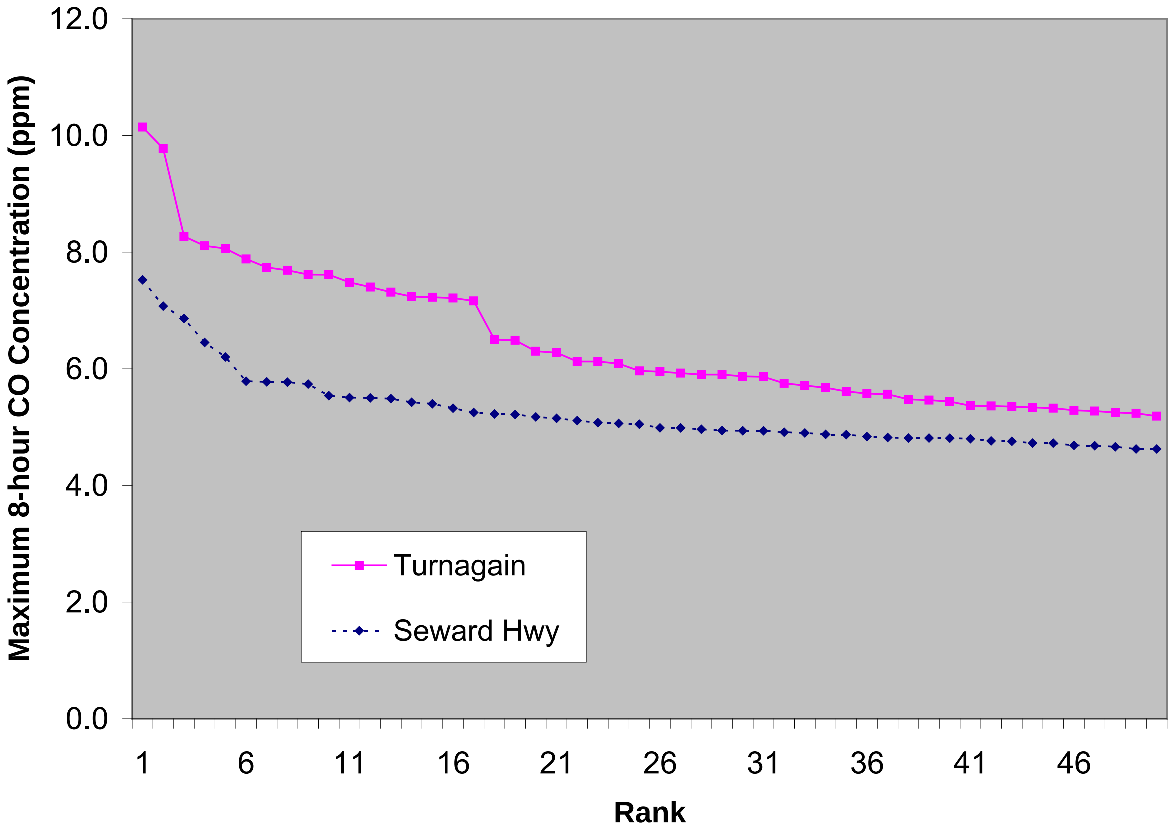
Figure 1 shows that the 50 highest 8-hour average concentrations at the Turnagain station are about 12% to 25% higher than the corresponding rank-pair value at Garden. The greatest differences occur among the highest ranks. For example the highest 8-hour concentration at Turnagain is 23% higher than the highest value at Garden while the 50^{th} highest value at Turnagain is 13% higher than the corresponding 50^{th} highest value at Garden. On a rank-pair basis, the values at Turnagain are significantly and consistently higher than those at Garden. This is particularly true at the extreme (i.e. highest) concentrations. This would suggest that Turnagain has a greater potential of exceeding or violating the NAAQS than Garden. For this reason, data from the Turnagain station were used to perform the probabilistic analysis for the maintenance demonstration.

Comparison of Turnagain and Seward Highway Station CO Concentrations
October 1998 through December 2004

A similar analysis was performed comparing data from the Turnagain station to Seward Highway. In this case the analysis was confined to the period October 16, 1998 to December 31, 2004 because the Seward Highway station was decommissioned at the end of 2004. The results of this analysis are shown in Figure 2.

Figure A-2

Rank-Order Comparison of Highest Fifty Non-overlapping 8-hour Average CO Concentrations measured at the Turnagain and Seward Highway Monitoring Stations
October 1998 – December 2004



Among the highest 50 paired 8-hour concentrations, concentrations at Turnagain are 12% to 38% higher than Seward. The largest differences between the two sites are observed in the very highest 8-hour concentrations where differences between rank-pairs are typically 30% or more. This would suggest that Turnagain has a considerably greater potential of exceeding or violating the NAAQS than Seward.

Conclusion

This analysis demonstrates that the Turnagain site exhibits the highest CO concentrations and greatest potential for violating the NAAQS in the Anchorage network. It is therefore appropriate to use this site for analysis of long-term prospects for continued compliance with the NAAQS.

Turnagain Oct 1998 – Dec 2007				Garden Oct 1998 – Dec 2007				
rank	8-hr avg (ppm)	date	end hour	**rank**	8-hr avg (ppm)	date	end hour	% Diff
1	10.14	1/6/99	19	1	8.23	1/6/99	18	23.3%
2	9.78	12/16/01	20	2	7.80	12/6/99	14	25.3%
3	8.27	12/6/03	1	3	6.80	12/24/98	19	21.6%
4	8.11	1/5/04	18	4	6.78	1/13/04	21	19.5%
5	8.06	12/24/98	23	5	6.66	2/12/99	12	21.0%
6	7.88	1/4/04	20	6	6.37	2/9/99	14	23.7%
7	7.74	11/14/01	12	7	6.36	1/3/04	21	21.7%
8	7.69	12/16/98	24	8	6.33	1/5/04	20	21.5%
9	7.61	1/3/04	21	9	6.18	1/27/99	13	23.3%
10	7.61	2/23/99	12	10	6.17	1/4/04	21	23.3%
11	7.48	1/1/04	22	11	6.14	12/5/03	23	21.9%
12	7.40	12/18/01	17	12	6.10	12/16/01	22	21.3%
13	7.31	2/8/99	11	13	5.84	1/1/04	23	25.2%
14	7.24	12/6/99	14	14	5.72	1/2/04	22	26.6%
15	7.23	12/5/01	15	15	5.70	11/27/99	24	26.8%
16	7.21	1/16/00	3	16	5.69	12/20/03	19	26.7%
17	7.16	11/28/99	1	17	5.59	10/22/98	11	28.2%
18	6.53	11/29/06	16	18	5.58	12/3/01	15	17.0%
19	6.50	2/23/99	3	19	5.45	1/15/04	14	19.2%
20	6.49	2/6/02	12	20	5.43	1/5/99	13	19.6%
21	6.30	12/3/01	16	21	5.40	1/7/04	14	16.6%
22	6.28	12/8/01	1	22	5.39	1/13/00	14	16.5%
23	6.13	2/18/01	6	23	5.38	1/12/00	15	14.0%
24	6.13	11/14/01	3	24	5.25	3/18/02	23	16.7%
25	6.11	1/24/06	12	25	5.23	2/22/99	12	17.0%
26	6.09	2/11/99	9	26	5.21	12/26/98	24	16.8%
27	6.09	1/17/06	14	27	5.21	2/11/00	15	16.8%
28	5.96	2/22/99	13	28	5.18	1/15/00	24	15.2%
29	5.95	12/4/01	16	29	5.14	1/14/99	14	15.7%
30	5.93	11/10/99	12	30	5.14	2/10/00	13	15.3%
31	5.90	1/4/99	24	31	5.09	11/29/01	15	16.0%
32	5.90	12/1/01	5	32	5.08	11/14/01	13	16.3%
33	5.87	1/13/04	1	33	5.06	2/13/99	1	16.0%
34	5.86	1/25/02	12	34	5.06	1/17/06	14	15.8%
35	5.75	12/27/98	4	35	5.00	11/22/99	14	15.0%
36	5.71	12/1/01	24	36	5.00	1/23/03	14	14.3%
37	5.69	1/28/05	11	37	4.99	2/10/99	12	14.1%
38	5.68	11/15/98	24	38	4.98	1/16/00	17	14.1%
39	5.65	11/25/06	12	39	4.96	12/4/01	16	13.9%
40	5.61	2/9/99	13	40	4.94	12/14/04	20	13.6%
41	5.58	12/14/01	15	41	4.91	11/20/98	15	13.5%
42	5.56	12/12/99	3	42	4.90	1/22/03	14	13.5%
43	5.50	12/19/07	14	43	4.83	11/10/99	13	14.0%
44	5.48	11/7/98	2	44	4.81	2/8/99	12	13.8%
45	5.46	1/12/00	13	45	4.81	1/18/05	13	13.7%
46	5.44	2/1/02	13	46	4.79	1/27/05	14	13.5%
47	5.40	11/25/06	3	47	4.78	1/7/04	23	12.9%
48	5.37	1/14/04	2	48	4.74	2/9/99	2	13.3%
49	5.36	12/26/03	16	49	4.74	12/18/01	16	13.2%
50	5.35	12/27/02	15	50	4.74	2/6/02	13	12.9%

Alaska Department of Environmental Conservation

Amendments to:

State Air Quality Control Plan

Vol. III: Appendices

Appendix III.B.10

Placeholder for “Affidavit of Oral Hearing & Response to Public Comments”

Public Review Draft

May 24th, 2011

[Editor's note: The following documents are proposed for inclusion in Volume III (Appendices to the State Air Quality Control Plan), Appendix III.B.10, after the close of the public comment process.]

Placeholder for:

ADEC Affidavit of Oral Hearing

&

ADEC Response to Oral and Written Public Comments on the Anchorage Carbon Monoxide Maintenance Plan.