DRAFT

Mendenhall Valley PM_{10} Emission Inventory

prepared for:

Alaska Department of Environmental Conservation

January 6, 2006

prepared by:

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EXECUTIVE SUMMARY

The Mendenhall Valley (Valley) is currently classified as a moderate PM_{10} nonattainment area. Despite this classification, no exceedances of either the annual or the 24-hour standard have been recorded in more than a decade (based on a review of EPA monitoring data between 1994 and 2004).[1] This is the result of planning and implementation efforts by both the state Department of Environmental Conservation (DEC) and the City and Borough of Juneau (CBJ). Those efforts, documented in a 1993 State Implementation Plan (SIP) submission,[2] identified the following key emission sources:

- Smoke from residential wood combustion (home heating);
- Fugitive dust from travel on unpaved roads; and
- Fugitive dust from travel on paved roads.

To reduce emissions from these sources, the SIP implemented a wood smoke control program and a fugitive dust abatement program. Elements of the wood smoke control program included an aggressive public education program; implementation of a real-time monitoring system linked to episodic controls of wood burning; prohibition of open burning (during winter months); new stove certification requirements; and enforcement of the CBJ woodsmoke ordinance. The fugitive dust abatement program focused on paving unpaved roads in the Valley. No emission inventories have been developed to track the impact of these programs since the SIP was prepared in 1993.

To document the status of the control programs and to provide a basis for developing a Maintenance Plan and redesignation request, the Alaska Department of Environmental Conservation (ADEC) commissioned the development of a base and horizon year (2004 and 2018) PM_{10} emission inventory for the Valley. A summary of the updated inventory for these years is presented in Table ES-1. It shows that fugitive dust from traffic operating on paved roads is the dominant source of PM_{10} emissions as it is estimated to account for 83% of the inventory in 2004 and 84% of the inventory in 2018. This is a sharp contrast with the 46% share estimated in the last emission inventory prepared for calendar year 1988. The increase reflects the success of the locally implemented control programs and changes in emission factors available to quantify the emissions of different source categories. It does not reflect a huge increase in traffic, as the growth rate in Juneau is very modest at an annualized rate of less than 1% per year.

Table ES-1 Summary of Mendenhall Valley PM_{10} Emissions By Season and Source Category (tons/day)		
Source Category	Calendar Year 2004	Calendar Year 2018
Winter PM_{10} Emissions		
On-Road	0.022	0.011
Non-Road	0.027	0.012
Area		
Residential – Wood	*0.091*	*0.099*
Residential – Pellet	*0.006*	*0.007*
Residential – Oil	*0.002*	*0.002*
Residential Burn Barrels	*0.000*	*0.000*
Paved Road Fugitive Dust	*1.478*	*1.612*
Unpaved Road Fugitive Dust	*0.161*	*0.176*
Other Area Sources	*0.182*	*0.181*
Area Subtotal	1.920	2.077
Point	0.000	0.000
Total All Sources	1.969	2.100
Summer PM_{10} Emissions		
On-Road	0.021	0.011
Non-Road	0.049	0.021
Area		
Residential – Wood	*0.031*	*0.034*
Residential – Pellet	*0.002*	*0.002*
Residential – Oil	*0.001*	*0.001*
Residential Burn Barrels	*0.057*	*0.062*
Paved Road Fugitive Dust	*4.135*	*4.510*
Unpaved Road Fugitive Dust	*0.190*	*0.207*
Other Area Sources	*0.182*	*0.183*
Area Subtotal	4.598	4.999
Point	0.155	0.155
Total All Sources	4.823	5.186
Annual Average	3.400	3.647

In the 1988, fugitive dust from unpaved roads was estimated to account for 40% of the overall inventory. In 2004, that share declined to 5.2% and is projected to be 5.3% in 2018. The projected level of emissions from unpaved roads in 2018 is based on the conservative assumption that all unpaved roads in the Mendenhall Valley in 2004 would remain unpaved in 2018. Efforts by CBJ and the State to continue to pave sections of unpaved roads in the Valley would reduce the emission contributions of unpaved roads in the future.

PM_{10} emissions from wood burning (both fireplaces and stoves) were estimated to account for almost 9% of the annual inventory in 1988. In 2004, that share declined to less than 2% and is projected to remain at roughly that level in 2018. Based on the results of an extensive survey of homeowners conducted in 2004, it is estimated that the combination of new technology, related shifts in wood use, and implementation of control measures reduced wood burning by 85% from 1993 to 2004.

Other trends of note are that emissions from both the on-road and non-road source categories represent a trivial portion of the overall inventory and that they are projected to decline despite the increase in activity projected to occur between 2004 and 2018. This is the result of replacing older, higher-emitting vehicles/equipment populations with newer, lower-emitting populations and federal requirements for cleaner fuels (lower sulfur gasoline and Diesel fuel).

According to ADEC, there is only one permitted source located in the Valley and its operations are limited to 5 months per year.

Overall, the inventory is estimated to have declined by almost 30% between 1993 and 2004.

###

1. INTRODUCTION

1.1 Background

The Mendenhall Valley, located nine miles from downtown Juneau, is the largest residential area in the region. Bounded by sharply rising mountains on the east and west and the Mendenhall Glacier to the north, the valley is well sheltered from prevailing winds. This topography, combined with a low winter sun angle that limits solar heating, supports the development of relatively severe temperature inversions. These inversions trap emissions close to the valley floor and in the past led to severe concentrations of airborne particulate matter that exceeded state and federal ambient air quality standards for PM_{10}.

The Mendenhall Valley is currently classified as a moderate PM_{10} nonattainment area. Despite this classification, no exceedances of either the annual or the 24-hour standard have been recorded in more than a decade (based on a review of EPA monitoring data between 1994 and 2004).[1] This is the result of planning and implementation efforts by both DEC and the City and Borough of Juneau (CBJ). Those efforts, documented in a 1993 State Implementation Plan (SIP) submission,[3] identified the following key emission sources:

- Smoke from residential wood combustion (home heating);
- Fugitive dust from travel on unpaved roads; and
- Fugitive dust from travel on paved roads.

To reduce emissions from these sources, the SIP implemented a wood smoke control program and a fugitive dust abatement program. Elements of the wood smoke control program included an aggressive public education program; implementation of a real-time monitoring system linked to episodic controls of wood burning; prohibition of open burning (during winter months); new stove certification requirements; and enforcement of the CBJ woodsmoke ordinance. The fugitive dust abatement program focused on paving unpaved roads in the Valley. Both programs have been successful and led to significant reductions in key emission sources within the Valley. Recent work by Sierra,[4] under contract to ADEC, indicates the introduction of new technology has also had a significant impact on home heating emissions. We estimate that collectively the combination of new technology, related shifts in wood use, and implementation of control measures has reduced PM_{10} emissions by 85% from 1993 to 2004. Key contributors to these reductions include the following:

- Initiatives (e.g., burn bans, public education, new stove requirements, etc.) implemented under the Juneau wood smoke control program;

- A drop in wood use per household from 1.8 cords per heating season in 1993 to 1.1 cords in 2004;
- Widespread use of direct vent type fuel oil heaters; and
- Reductions in emission factors for both fuel oil and wood burning.

1.2 Approach

Sierra followed the source-specific data collection and modeling procedures detailed in the EPA emission inventory guidance document "PM-10 Emission Inventory Requirements," Final Report, September 1994. As noted above, key emission sources identified in the previous inventory were smoke from residential wood combustion and fugitive dust from both paved and unpaved roads. Given the significance of these sources and the efforts placed on controlling their emissions, effort was focused on collecting new data to characterize activity levels for each of these sources. The home heating survey conducted last year provides detailed insight into the impact of both technology changes and related activity levels on residential heating emissions. No similar survey has been conducted to support an update of fugitive dust from paved and unpaved roads.

In order to prepare an accurate update to these source categories, Sierra contacted state (Alaska Department of Transportation and Public Facilities, or ADOT&PF) and local CBJ agencies to obtain data on the mileage of paved/unpaved roads in the Valley and recent traffic counts and related speed estimates. Aside from these activity estimates, another key element of fugitive dust calculations is the silt content of the roads. A review of the last emission inventory prepared for the Valley[5] shows that silt loadings were collected locally to support the preparation of fugitive dust emissions for unpaved roads and that national average silt loadings were used to estimate on-road levels. Since no controls have been targeted at controlling silt loadings for unpaved roads, Sierra sees no need to update those estimates. However, controls have been targeted at reducing the mileage of unpaved roads and a corollary benefit of these controls should be a reduction of silt loadings (i.e., and fugitive dust) on paved roads. For this reason, we developed a protocol to collect silt loadings for a representative sample of paved roads (samples will be distributed across both road type and traffic volume) and use the results along with recent traffic counts to support an update of fugitive dust emitted from this source category. A description of the methodology to be used on collecting the silt samples is presented in Appendix A.

1.3 Organization

The remainder of this report is organized to document the activity data, emission factors and emission estimates for each of the primary source categories: on-road, nonroad, area and point sources. The appendices include a copy of the Inventory Preparation and Quality Assurance Plan, Demographic Forecasts, and documentation of the emission calculations for each of the source categories.

###

2. ON-ROAD SOURCES

The calendar year 2004 and 2018 PM_{10} on-road mobile source inventories were prepared for Mendenhall Valley using EPA's latest vehicle emission factor model, MOBILE6.*
The model estimates the following PM_{10} pollutants from on-road motor vehicles:

- Sulfate (SO_4);
- Organic Carbon (OC) portion of Diesel exhaust particulate;
- Elemental Carbon (EC) portion of Diesel exhaust particulate;
- Total carbon (GASPM) portion of gasoline exhaust particulate;
- Lead (Pb) portion of exhaust particulate;†
- Brake-wear particulate emissions; and
- Tire-wear particulate emissions.

Separate inventories were prepared for winter (October to March) and summer (April to September) of each year, with corresponding modeling runs for each season. The MOBILE6 model inputs were customized to reflect the local traffic, fuel, and ambient characteristics as much as possible. The MOBILE6 model inputs and associated files are shown in Appendix A, and a discussion of the modeling procedures and results follows.

2.1 Modeling Parameters

The parameters needed for modeling on-road PM_{10} emissions from Mendenhall Valley using MOBILE6 were compiled by contacting local and state agencies and reviewing historical data on ambient conditions and local vehicle activity. There are a number of inputs that can be specified by the user to tailor a standard MOBILE6 run for a local area, and these are discussed below.

Temperature Data – Temperature data were compiled from www.weatherbase.com, which is a website that records historical climatological data for cities all over the world. The monthly average highs and lows for Juneau for the more than 40 years on record in the website database were obtained. The average highs and lows for summer (April to September) and winter (October to March) were estimated and are shown in Table 2-1.

* MOBILE6 version 6.2.03 dated September 24, 2003.

† Lead emissions are basically zero since Pb has been eliminated from gasoline fuels.

Table 2-1 Seasonal Ambient Temperature in Juneau(ºF)		
Season	Low	High
Summer	42.3	57.7
Winter	25.7	36.3

Registration Distribution – June 2000 Department of Motor Vehicle (DMV) registration data were used to estimate the vehicle age distribution for light-duty cars and trucks, which make up the majority of traffic in the Juneau area. However, the registration data were found to contain records for very old vehicles that are chronically unregistered (registration is not continuous over the last few years). These vehicles are not operated on a regular basis and tend to bias the registration fraction towards vehicles that are 25 years old and older—the oldest model year grouping in MOBILE6. Because of this, the light-duty vehicle registration fractions used for vehicles 25 years old and older were derived from the MOBILE6 default fractions instead of from the 2000 DMV registration data. The DMV registration fractions for the newer light-duty vehicles were renormalized in order to accommodate the default fractions in MOBILE6 for the oldest model year grouping. The MOBILE6 default registration fractions were used for the other vehicle classes in Juneau. Because no data are available to adjust the DMV registration data to reflect seasonal shifts in fleet mix, only one set of registration fractions was used for the Mendenhall Valley runs for the summer and winter seasons. In addition, it was assumed that the registration distribution used applies to the 2018 forecasted scenario as well. Appendix A shows the registration distribution used as model input in MOBILE6 for the model runs.

Mileage Accumulation Rates – Local data to estimate mileage accrual rates for Juneau were not available; therefore, the national average default rates in MOBILE6 were used for 2004 and 2018.

VMT by Vehicle Class – No local data were available to characterize the VMT by vehicle class; therefore the "default" MOBILE6 VMT fractions were used for modeling Mendenhall Valley. MOBILE6 calculates the "default" VMT distribution from national average and/or user-supplied local data for the registration distribution by age, registration distribution by vehicle class, mileage accrual rates, Diesel fractions, and the calendar year given in the model run. Therefore, for the model runs, the "default" VMT distribution is partly based on the local 2000 DMV registration data used in developing the registration distribution by age for the area. The resulting 2004 and 2018 VMT fractions used for the Mendenhall Valley are shown in Table 2-2. The fractions for the different vehicle classes sum to 1.000 for each season. Although the summer and winter model runs for the Valley used the same registration distribution by vehicle age, the resulting VMT fractions differ slightly within each calendar year because MOBILE6 ages the default fleet population by six months for the summer runs, which adjusts the model default annual mileage and average accumulation rates by vehicle age and affects the calculated "default" VMT fractions in the model.

Table 2-2 **Seasonal VMT Distributions by Vehicle Class**				
Vehicle Class	Calendar Year 2004		Calendar Year 2018	
	Winter	Summer	Winter	Summer
LDV	0.4463	0.4404	0.2986	0.2972
LDT1	0.0699	0.0705	0.0937	0.0936
LDT2	0.2321	0.2342	0.3121	0.3117
LDT3	0.0793	0.0801	0.1066	0.1066
LDT4	0.0369	0.0373	0.0496	0.0496
HDV2B	0.0417	0.0423	0.0429	0.0435
HDV3	0.0041	0.0041	0.0042	0.0043
HDV4	0.0033	0.0033	0.0035	0.0036
HDV5	0.0025	0.0025	0.0026	0.0027
HDV6	0.0093	0.0094	0.0097	0.0098
HDV7	0.0109	0.0111	0.0114	0.0115
HDV8A	0.0119	0.0121	0.0123	0.0125
HDV8B	0.0425	0.0431	0.0438	0.0444
HDBS	0.0017	0.0017	0.002	0.0021
HDBT	0.0014	0.0014	0.0011	0.0012
MC	0.0062	0.0063	0.0056	0.0057

Fuel Parameters – The fuel parameters that affect PM_{10} emissions, gasoline, and Diesel fuel sulfur content were customized to reflect the seasonal fuel properties in the Mendenhall Valley. The 2004 average fuel parameters were obtained from the 2004 Alliance of Automobile Manufacturers' (AAM) summer and winter fuel survey data. The Mendenhall fuel properties were based on fuel from Seattle, Washington, which is shipped into Juneau.

For 2018, gasoline fuel sulfur levels are assumed to fall within the requirements of the Tier 2 Gasoline Sulfur Rule, which in Alaska are currently required to be phased-in in 2007. The Diesel fuel sulfur in 2018 is assumed to follow the requirements of the EPA Low-Sulfur Diesel Rule, which takes effect in 2006. Although Alaska has been given the option by EPA to design an alternative low-sulfur transition plan to ease the hardships of converting both gasoline and Diesel to low sulfur within a relatively short time frame, it is assumed that the provisions of both the gasoline and Diesel low-sulfur rules are completely satisfied by 2018. Table 2-3 summarizes the characteristics of the fuel used for the Juneau area during the winter and summer of 2004 and 2018. The gasoline Reid vapor pressures (RVPs) used in the model runs are shown in Table 2-3 since it is a required input into MOBILE6; however, RVP does not affect PM_{10} levels from vehicles.

Table 2-3 Mendenhall Valley Gasoline and Diesel Fuel Characteristics				
Fuel Parameter	Calendar Year 2004		Calendar Year 2018	
	Winter	Summer	Winter	Summer
Gasoline RVP (psi)	13.6	7.8	13.6	7.8
Gasoline Avg Sulfur (ppm)	90	60	30	30
Gasoline Max Sulfur (ppm)	140	150	80	80
Diesel Avg Sulfur (ppm)	380	380	15	15

Other Modeling Considerations – For the MOBILE6 modeling of on-road vehicle emissions in Alaska, off-cycle effects or the Supplemental Federal Test Procedure (SFTP) Bag 4-equivalent were disabled during the winter runs. This was done because the aggressive driving represented by these effects is not observed with winter road conditions. In addition, the Valley was modeled as a low-altitude area.

Facility Types and Average Vehicle Speeds – The average daily VMT data for 2004 for the Mendenhall Valley were estimated as a function of average vehicle speeds, which were then used as inputs to the MOBILE6 model. In order to do this, the 2004 VMT and average speed estimates by facility were developed using local traffic data. Table 4 lists the VMT distribution and average speeds modeled by facility type for the Mendenhall Valley. No seasonal data were available to adjust any changes in VMT (i.e., possible VMT reduction in the winter), and the same average annual daily VMT by facility was used for both the summer and winter seasons as a conservative approach. MOBILE6 scenarios were created to result in PM_{10} emission factors for each combination of speed and facility type shown in Table 2-4 for the calendar years considered in the study (2004 and 2018). The detailed development of the facility VMT and speed data for the Mendenhall Valley is discussed in detail in the following section.

Table 2-4 VMT and Speeds by Facility Type for Mendenhall Valley			
Facility Type	Avg Speed (mph)	2004 VMT/day	% of Total VMT
Urban Collector	35.6	58,370	19%
Urban Minor Arterial	37.2	39,585	13%
Urban Principal Arterial	50.5	63,278	21%
Local Road	20.8	141,367	47%
ALL TOTAL		302,599	100%

2.2 Juneau Travel Activity

Once the input parameters were compiled and model runs were completed, the resulting PM_{10} emissions factors for each combination of facility type and average speed were combined with the local estimates of VMT in order to generate an emissions inventory. For the Mendenhall Valley, the 2004 VMT and average speed estimates by facility had to be developed by extrapolating average daily travel and speed data on Alaska Department of Transportation and Public Facilities (DOT&PF) monitored roadways to the rest of the roadways in the Valley. After this, the 2004 VMT estimates were forecasted to 2018 levels using yearly population data for the area. The data sources and analysis involved in this procedure are presented below.

Traffic Data Sources – The VMT and average speed by facility for the Mendenhall Valley were developed from traffic databases for monitored roadways and roadway mileage data obtained from DOT&PF and from the County and Borough of Juneau (CBJ).[6,7] The following four sources of roadway data were used in generating the most complete picture of on-road travel in the nonattainment area:

- The current DOT&PF routelist for Southeastern Alaska (2004 routelist), which includes Coordinated Data System (CDS) route numbers, route or roadway descriptions, mile points, functional class definitions or facility types, average daily traffic (ADT), length in miles, and the segment VMT for DOT&PF-managed roadway segments;
- A current DOT&PF record of routes with limited posted speed limit information for Southeastern Alaska (2004 speed list[*]) with CDS route number, mile points, roadway length in miles, and facility type;
- The current CBJ street inventory database, which lists the CBJ-managed streets, location within the borough, lengths, and surface description, but no traffic activity data; and
- The 1999 Juneau travel activity estimates developed by Sierra Research for the 1999 criteria pollutant inventory for Juneau (1999 routelist), which list CDS route numbers, mile points, lengths, facility types, and speeds for all routes on record for Juneau in 1999.[†]

Mendenhall Valley Roadway Inventory – In order to develop the average travel characteristics for the Valley, roadway segments located outside of the nonattainment area boundary were eliminated from the 2004 routelist and speed list. This was done based on the route descriptions, comparisons with area street maps, and the routes included in the 1999 routelist, which was already cleaned up during a previous analysis to include only roadways in the Borough of Juneau. This exercise showed that the 2004 routelist, 2004 speed list, and 1999 routelist do not map completely to each other

[*] Although this database is referred to as the "speed" list, only 66 of the 558 roadway segments in the complete database had speed limit data, and none of the segments with speed data are in the Mendenhall Valley nonattainment area.

[†] The 1999 Juneau travel activity estimates were developed following the same procedure outlined here using DOT&PF traffic data from 1999 for the roadways monitored at the time.

(beginning and ending mile points vary by roadway), and that various roadway segments were included in one source and not another. Therefore, a combined list of all roads in the Valley was created.

After eliminating the roadways outside the nonattainment area boundary in all the data sets, the 2004 routelist was used as the basis for creating the combined list of roadways for the Mendenhall Valley. First, the 2004 routelist was compared to the 2004 speed list, and segments missing from the former were added from the speed list in order to create a current list of roadways in the Valley—most with ADT data, and some with speed limit data. The resulting roadway listing was then compared to the 1999 routelist, and roadway segments found in the 1999 routelist that were not included in the 2004 lists of monitored routes within the nonattainment area were added to the combined list. Lastly, the CBJ-managed roadways located within the Valley were identified from the CBJ database and were added as local roads to the list. Table 2-5 summarizes the data included in the combined list of roadway segments by primary data source, and Table 2-6 summarizes the data in the combined list by facility type.[*] As shown in Table 2-6, the majority of roadway segments with missing speed and ADT data are local roads, most of which are CBJ-managed roads.

Table 2-5
Available Roadway Data for Mendenhall Valley by Source

Primary Data Source	No. of Segments	Length in Miles	Segments w/ Speed Data	Segments w/ ADT
2004 Routelist	70	30.5	36	70
2004 Speed List	198	35.3	0	0
1999 Routelist	15	12.7	13	15
CBJ database	272	55.0	0	0
ALL	555	133.4	49	85

Table 2-6
Available Roadway Data for Mendenhall Valley by Facility

Facility Type	No. of Segments	Length in Miles	Segments w/ Speed Data	Segments w/ ADT
Collector	48	19.9	23	44
Minor Arterial	10	3.2	10	10
Principal Arterial	6	3.5	6	6
Local	491	106.8	10	25
ALL	555	133.4	49	85

[*] Facility types included in the Juneau list of roadway segments include principal arterials, minor arterials, collectors, and locals.

ADT and Speed Estimates – After the combined list of roadway segments was developed, it was sorted by facility type, and a straight average of the known ADT levels was calculated for each facility type. In addition, VMT-based harmonic average speeds were developed for each facility type using the roadway segments with known speeds and VMT (VMT=ADT*length in miles). For the roadway segments that were derived from the 1999 routelist, the speed estimates were assumed to still apply, as no other source of traffic monitoring data for these segments were available. The average ADT and harmonic average speeds estimated was used to fill in the missing ADT and speed data for the roadway segments within each facility type. This resulted in a complete roadway segment data set—with ADT, length, VMT, and speed estimates.

Traffic Level Adjustment by Calendar Year – The ADT and VMT levels used from the 1999 routelist were adjusted to 2004 levels using yearly population estimates for the Mendenhall Valley. Details of deriving yearly population levels within the nonattainment area (1993, 2004, and 2018) are included in Appendix B. The 1999 population level was interpolated between the 2004 and 1993 levels. After complete VMT estimates by facility were developed for 2004, the VMT were then forecasted to 2018 using the population forecast. Table 2-7 shows the estimated borough population levels used in adjusting the estimated ADT and VMT in the roadways in the Mendenhall Valley.

Table 2-7
Mendenhall Valley Population Estimates

Calendar Year	Population
1999	12,724
2004	13,327
2018	14,535

Mendenhall Valley Nonattainment Area Travel Estimates – The estimated 2004 and 2018 average travel characteristics resulting from the combined Valley roadway segment data set are shown in Table 2-8 by facility type. As shown, the average ADT for local roads is higher than expected at 1,385 vehicles per day. This may stem from the small sample size of local roads with ADT data and from DOT&PF monitoring traffic counts on the larger, longer, and busier roadway segments, for which maintenance and improvements are more needed. No other data from local roadways were available to adjust this estimated average ADT, however, and the ADT for the local roads were kept as a conservative assumption.

The VMT-based harmonic average speeds shown in Table 2-8 were used in developing the MOBILE6 input files for the nonattainment area. The resulting PM_{10} emission factors from the model runs were then combined with the total daily VMT by calendar year and season to result in the average PM_{10} emissions for the area by facility type.

Table 2-8 **Mendenhall Valley Average Travel Estimates**				
Facility type	ADT	Harmonic Avg Speed (mph)	2004 Daily VMT	2018 Daily VMT
Collector	3,156	35.6	58,370	63,661
Minor Arterial	7,317	37.2	39,585	43,173
Principal Arterial	16,082	50.5	63,278	69,013
Local	995	20.8	141,367	154,180
ALL			302,599	330,028

2.3 PM_{10} Inventory Results

Tables 2-9 and 2-10 show the resulting 2004 and 2018 on-road mobile PM_{10} emission estimates for the Mendenhall Valley nonattainment area by pollutant, season, and facility type. The annual average emission inventories were estimated by weighting the summer and winter emission levels by the number of days in each season as defined by ADEC—183 for the summer and 182 for the winter. As shown in the tables, very little seasonal variation is seen in the PM_{10} emissions from on-road motor vehicles. All exhaust particulate emissions are reduced in 2018 as compared to the 2004 levels, even with increasing VMT, due to the more stringent standards on emissions for the later model year vehicles. Brake- and tire-wear emissions are based only on total miles driven; therefore, the increase in VMT for 2018 resulted in the increase in break- and tire-wear PM_{10} emissions.

Table 2-9 **2004 Mendenhall Valley Seasonal On-Road PM_{10} Emissions in Tons/Day[a]**							
Season	Facility	GASPM	EC	OC	SO4	Brake	Tire
Winter	Collector	3.1E-04	9.3E-04	4.7E-04	1.5E-04	5.5E-04	4.2E-04
	Minor Arterial	4.9E-04	1.5E-03	7.5E-04	2.4E-04	8.7E-04	6.7E-04
	Principal Arterial	1.1E-03	3.3E-03	1.7E-03	5.9E-04	1.9E-03	1.5E-03
	Local	4.5E-04	1.4E-03	6.9E-04	2.2E-04	8.0E-04	6.2E-04
	ALL TOTAL	0.0023	0.0071	0.0036	0.0012	0.0042	0.0032
Summer	Collector	3.1E-04	9.1E-04	4.6E-04	1.3E-04	5.5E-04	4.2E-04
	Minor Arterial	4.9E-04	1.5E-03	7.3E-04	2.1E-04	8.7E-04	6.8E-04
	Principal Arterial	1.1E-03	3.2E-03	1.6E-03	5.1E-04	1.9E-03	1.5E-03
	Local	4.5E-04	1.3E-03	6.8E-04	1.9E-04	8.0E-04	6.2E-04
	ALL TOTAL	0.0023	0.0069	0.0035	0.0010	0.0042	0.0032
Annual Average		0.0023	0.0070	0.0036	0.0011	0.0042	0.0032

[a] Lead emissions are zero for all scenarios.

Table 2-10
2018 Mendenhall Valley Seasonal On-Road PM_{10} Emissions in Tons/Day[a]

Season	Facility	GASPM	EC	OC	SO4	Brake	Tire
Winter	Collector	2.9E-04	2.1E-04	1.1E-04	3.5E-05	8.8E-04	6.8E-04
	Minor Arterial	2.0E-04	1.4E-04	7.1E-05	2.4E-05	5.9E-04	4.6E-04
	Principal Arterial	3.1E-04	2.3E-04	1.1E-04	3.8E-05	9.5E-04	7.4E-04
	Local	6.6E-04	5.1E-04	2.5E-04	1.0E-04	2.1E-03	1.6E-03
	ALL TOTAL	0.0015	0.0011	0.0005	0.0002	0.0045	0.0035
Summer	Collector	2.8E-04	2.0E-04	1.1E-04	3.5E-05	8.8E-04	6.8E-04
	Minor Arterial	1.9E-04	1.4E-04	7.1E-05	2.4E-05	5.9E-04	4.6E-04
	Principal Arterial	3.0E-04	2.2E-04	1.1E-04	3.8E-05	9.5E-04	7.4E-04
	Local	6.6E-04	4.9E-04	2.5E-04	1.0E-04	2.1E-03	1.6E-03
	ALL TOTAL	0.0014	0.0011	0.0005	0.0002	0.0045	0.0035
Annual Average		0.0014	0.0011	0.0005	0.0002	0.0045	0.0035

[a] Lead emissions are zero for all scenarios.

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3. NONROAD SOURCES

The nonroad mobile source inventories presented in this report were developed using EPA's draft NONROAD model.* This model calculates emissions from approximately 80 different types of nonroad equipment, and categorizes them by technology type (i.e., gasoline, diesel, LPG, CNG, 2-stroke, and 4-stroke) and horsepower range. Note that default model input was replaced with Juneau-specific data whenever possible, as described in the methodology section below.

For purposes of this inventory, the Alaskan summer and winter are defined as April through September, and October through March, respectively. Sierra performed NONROAD modeling runs for calendar years 2004 and 2018 and determined emissions, in tons per day, for both a typical winter and a typical summer day for the Mendenhall Valley community. Unless otherwise specified, NONROAD default activity and population inputs were used in the modeling associated with these nonroad inventories.

3.1 Calculation Methodology

The NONROAD model calculates tons of emissions for a given geographical area using the following factors:

- equipment population;
- an equipment-specific emission factor (in grams per horsepower-hour);
- the average horsepower rating of the equipment;
- the estimated annual equipment activity (hours per year); and
- the average load factor for the given engine.

In addition, seasonal (month or season) and day of week (i.e., weekend vs. weekday) adjustments are applied depending on whether the end-user requests an inventory estimate expressed on an annual, seasonal, or daily basis. The equipment populations are based on national averages, and then scaled down to represent smaller geographic areas on the basis of human population and proximity to recreational, industrial, and commercial facilities. It should be noted that the model has undergone dramatic revisions and corrections with regard to estimates of equipment populations and activity rates, which has resulted in reduced emissions estimates from some equipment categories. For example, the emissions attributed to summertime marine equipment, which formerly constituted a large percentage of the total summer inventory, have been reduced primarily

* U.S. EPA NONROAD Model, draft version 2.3c, released April 2004.

as a result of EPA's revised population estimates for Alaska, which are generally two orders of magnitude lower than in the previous version of the model.

Scaling Methodology for Mendenhall Valley Results – Because the NONROAD model provides output on a county-wide, or borough-wide basis only, we performed the runs for the City and Borough of Juneau, then scaled the results by the ratio of the number of households in the Borough vs. nonattainment area, as shown in Table 3-1 below. Population information for the Borough was obtained from U.S. Census data,* and the nonattainment area population was determined according to the methodology presented in Appendix B.

Table 3-1
Fraction of Households in City and Borough of Juneau vs. Mendenhall Valley Nonattainment Area

Calendar Year	# Mendenhall Valley Nonattainment Area Households	# City & Borough of Juneau Households	Nonattainment Area Housing Fraction
2002	4,608	12,422	0.37
2004	4,888	12,810	0.38
2018	5,331	14,491	0.37

3.2 Modifications to EPA's NONROAD Model Default Equipment Population and Activity Factors

Because EPA uses a top-down approach in developing populations and estimated annual activity factors for the equipment in the NONROAD model (i.e., distributed national equipment populations to individual states and counties based primarily on human population), it is recognized that locally generated data will improve the accuracy of the resulting NONROAD emissions estimates. As part of several studies completed for ADEC in the 2000 to 2002 calendar year timeframe,† it was possible to generate more accurate estimates for population and/or activity for a number of key summer and wintertime equipment categories (e.g., personal watercraft, lawn and garden equipment, snowmobiles) which operate in the Juneau area. ADEC staff and other local agencies provided key activity and population estimates that were used to adjust some of the more general NONROAD defaults. For example, there is little if any personal watercraft activity in the Juneau area during the summer months because of the cold water

* Juneau household population data for 1999 and 2002 was obtained from U.S. Census Data. 2004 and 2018 household population estimates were then calculated by increasing the 2002 population by the annual percent increase from 1999 to 2002 (i.e., 1.04 %).
† The "1995-2001 Fairbanks CO Inventory," the "1999 Air Toxics Emission Inventory," the "2000 Anchorage CO Inventory," and the "2002 Criteria Pollutant Emissions Inventory."

temperature of all surrounding bodies of water. With the exception of these modifications, described in greater detail below, the NONROAD model defaults were used for all modeling associated with the development of this Inventory.

Personal Watercraft (PWC)

Equipment Population – ADEC staff contacted the U.S. Coast Guard and obtained calendar year 2000 registration data for PWC in the Juneau area. According to ADEC, boating registration enforcement is fairly rigorous in Juneau, and although the geography is not a deterrent to PWC use in Juneau, seasonal constraints (in particular low water temperature and inclement weather) severely limit their use. Therefore, ADEC staff felt it was appropriate to assume that 50% of the PWC in Juneau are registered with the Coast Guard. Therefore, it was decided that registration data provided by the Coast Guard, with the 50% registration assumption discussed above, would provide a more accurate total. Note that the NONROAD estimate shown below was associated with the previous version of that model. However, because the current model defaults show PWC populations which appear to be unrealistically low (i.e., 26 units for Juneau), the populations shown below were used for this analysis, with minor adjustments to account for population increases between 2000 and 2018[*].

PWC Registered w/ Coast Guard	63
NONROAD PWC Estimate:	2,452
Modified PWC Population:	126

Note that the above population estimates refer to the Borough of Juneau; these totals were subsequently adjusted to represent the equipment population in the Mendenhall Valley nonattainment area, according to the methodology discussed previously.

Activity Estimates – Because there are no bodies of water within the boundaries of the Mendenhall Valley nonattainment area that would accommodate motorized watercraft, the activity for all pleasure craft (including PWCs) has been reduced to one hour per year for engine maintenance. The NONROAD default seasonal activity distribution[†] was also retained for all recreational marine categories.

Offroad Motorcycles and All Terrain Vehicles (ATVs)

Lacking more accurate data, we have retained the NONROAD assumptions for ATV activity and populations (with the requisite nonattainment area population adjustments), with the added assumption that all annual activity occurs during the summer months (i.e., April through September). ADEC staff believe the population numbers are too high, but

[*] According to U.S. Census data, the 2000 to 2002 population increase in Juneau was 0.18%.
[†]The default seasonal activity distribution for recreational marine equipment is 15% during the Spring and Fall, and 70% during the Winter (i.e., December through February).

have no local data to offer as a substitute. The 2004 and 2018 populations for offroad motorcycles and ATVs are shown below.

2004 ATV Population Estimate:	2,938
2004 Offroad Motorcycle Population Estimate:	756
2018 ATV Population Estimate:	5,261
2018 Offroad Motorcycle Population Estimate:	1,251

Snowmobiles

Equipment Population – ADEC staff obtained 1999 snowmobile registration from the Alaska DMV for use in developing the 2002 Criteria Pollutant Inventory. At that time, ADEC believed that assuming 50% of all operating snowmobiles are registered provided a more accurate population estimate than the defaults in the NONROAD model currently in use. Therefore, this logic was applied to the DMV registration totals. The revised population estimate is considered by ADEC staff to be more representative than either the current model defaults or those from the previous version of the NONROAD model – both of which appeared to be too high for Juneau. (According to ADEC staff, there are few areas to ride a snowmobile in Juneau due to the terrain and climate, and it is not possible to easily transport the equipment to neighboring areas outside the Borough as is routinely done in Anchorage and Fairbanks.) And, despite the fact that the current NONROAD population estimates do appear to be more reasonable than those in the preceding version of the model, we believe that the population estimates shown below remain the most accurate available, as they are based on actual Alaska DMV registration data. Accordingly, the population figures shown below were used for the current analysis, after adjustments for population increases between 1999 and 2002.

Old 1999 NONROAD Population Estimate:	368
Current 1999 NONROAD Population Estimate:	2,898
DMV Registration:	71
Modified Population	142

Note that, as discussed in earlier sections, the above population estimates refer to the Borough of Juneau; these population estimates were subsequently adjusted to represent the equipment population in the Mendenhall Valley nonattainment area, according to the methodology discussed previously.

Activity Estimates – According to ADEC staff, there are no areas within the confines of the nonattainment area that are suitable for snowmobile use. Therefore, we have assumed that the entire Juneau snowmobile population is used a total of 1.0 hours/year for maintenance purposes only, all of which occurs during the winter months.

Snowblowers

The default NONROAD assumptions regarding snowblower activity were retained, with the exception of seasonal distribution; for this analysis, it was assumed that all snowblower activity was evenly distributed throughout the winter season.

General Modifications – Lawn and Garden

Lacking more accurate data, the basic NONROAD assumptions for summertime lawn and garden activity and populations have been retained. ADEC staff believe the population numbers are too high, but have no local data to use as a replacement. However, some adjustments to these default inputs have been made, as described below.

Activity Estimates – Adjustments to the seasonal activity assumptions were made to reflect the fact that the weather patterns in Juneau effectively eliminate lawn and garden activity during a substantial portion of the year. Following the methodology used in previous inventory calculations, it was assumed that all lawn and garden activity takes place during the Alaska summer season, April through September. Using residential lawn mowers as an example, this gives the following estimated weekly activity factor:

58 hours/yr (NONROAD default for res. lawnmowers)	÷	26 weeks/yr	=	2.2 hours/week

Due to regional weather patterns, however, ADEC staff feel it is appropriate to limit the duration of lawn and garden activity to the 17.5 weeks from May 1 through August 31. This equates to approximately 17.5 weeks/yr of lawn and garden activity, rather than 26 weeks/yr. Distributing the 2.2 hours per week of residential lawnmower activity over this time period reduces the annual activity from 58 hours/week to 39 hours/week—a decrease of approximately 30%. This categorical decrease in the annual activity for all lawn and garden equipment seems appropriate, given that the NONROAD model default assumption is that 30% of all lawn and garden activity takes place during what we have defined as the Alaska winter. So, in essence, 30% of lawn and garden activity that the NONROAD model had assumed took place during the October through March time period was simply eliminated.

3.3 Emission Estimates

Table 3-2 below shows the summer and winter Nonroad inventory totals for Juneau for calendar years 2004 and 2018. These totals show a pattern of sustained, gradual decrease in PM_{10} emissions over time as older equipment is replaced with newer equipment.

Table 3-2
2004 and 2018 Nonroad PM_{10} Emissions

Calendar Year	Season	PM_{10} (tpd)
2004	Summer	0.05
	Winter	0.03
2018	Summer	0.02
	Winter	0.01

Tables 3-3 through 3-6 show a more detailed presentation of the calculated Nonroad emission totals. For each table, the equipment has been sorted in descending order of total PM_{10} emissions. The top 20 emission sources are listed individually, and the remaining sources are grouped together. These tables show that, generally, a handful of equipment types (e.g., snowmobiles and snowblowers in the winter, construction equipment in the summer) are responsible for the majority of the emissions for that season. However, it is important to note that the emissions from some of these key sources, particularly for the summer totals, are based on default equipment population and activity estimates in the current version of the NONROAD model, which may not be adequately representative of the Juneau equipment population and usage patterns, as discussed previously.

Table 3-3
2004 Mendenhall Valley Nonattainment Area Nonroad Emissions - Summer (tpd)

Equipment Description	Equipment Type	PM_{10}	Population (# units)	Activity (hrs/unit/month)
Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	0.0090	65	104
Recreational Equipment	All Terrain Vehicles	0.0057	1,121	268
Logging Equipment	Chain Saws > 6 HP	0.0051	119	25
Recreational Equipment	Motorcycles: Off-road	0.0044	288	267
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.0038	37	125
Construction and Mining Equipment	Skid Steer Loaders	0.0035	58	89
Construction and Mining Equipment	Rubber Tire Loaders	0.0025	15	84
Construction and Mining Equipment	Crawler Tractor/Dozers	0.0020	10	104
Construction and Mining Equipment	Excavators	0.0019	14	121
Construction and Mining Equipment	Off-highway Trucks	0.0014	2	182
Construction and Mining Equipment	Rough Terrain Forklifts	0.0011	12	73
Construction and Mining Equipment	Rollers	0.0007	10	83
Construction and Mining Equipment	Concrete/Industrial Saws	0.0005	11	67
Construction and Mining Equipment	Scrapers	0.0005	2	101
Construction and Mining Equipment	Graders	0.0005	3	107
Industrial Equipment	AC\Refrigeration	0.0004	10	123
Construction and Mining Equipment	Trenchers	0.0004	9	59
Commercial Equipment	Generator Sets	0.0004	157	12
Construction and Mining Equipment	Cranes	0.0004	4	107
Construction and Mining Equipment	Bore/Drill Rigs	0.0004	15	24
	All Other Equipment	0.0039		
TOTAL		0.05		

Table 3-4
2004 Mendenhall Valley Nonattainment Area Nonroad Emissions - Winter (tpd)

Equipment Description	Equipment Type	PM_{10}	Population (# units)	Activity (hrs/unit/month)
Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	0.0090	65	104
Logging Equipment	Chain Saws > 6 HP	0.0051	119	25
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.0019	37	63
Construction and Mining Equipment	Skid Steer Loaders	0.0017	58	45
Construction and Mining Equipment	Rubber Tire Loaders	0.0013	15	42
Construction and Mining Equipment	Crawler Tractor/Dozers	0.0010	10	52
Construction and Mining Equipment	Excavators	0.0009	14	61
Construction and Mining Equipment	Off-highway Trucks	0.0007	2	91
Construction and Mining Equipment	Rough Terrain Forklifts	0.0006	12	37
Commercial Equipment	Generator Sets	0.0004	157	12
Industrial Equipment	AC\Refrigeration	0.0004	10	100
Construction and Mining Equipment	Rollers	0.0004	10	42
Construction and Mining Equipment	Concrete/Industrial Saws	0.0003	11	34
Airport Ground Support Equipment	Airport Ground Support Equipment	0.0003	3	61
Construction and Mining Equipment	Scrapers	0.0003	2	51
Lawn and Garden Equipment	Snowblowers	0.0002	376	3
Construction and Mining Equipment	Graders	0.0002	3	54
Construction and Mining Equipment	Trenchers	0.0002	9	29
Commercial Equipment	Welders	0.0002	14	44
Construction and Mining Equipment	Cranes	0.0002	4	54
	All Other Equipment	0.0018		
TOTAL		0.03		

Table 3-5
2018 Mendenhall Valley Nonattainment Area Nonroad Emissions - Summer (tpd)

Equipment Description	Equipment Type	PM_{10}	Population (# units)	Activity (hrs/unit/month)
Logging Equipment	Chain Saws > 6 HP	0.0073	171	25
Recreational Equipment	Motorcycles: Off-road	0.0036	460	267
Construction and Mining Equipment	Skid Steer Loaders	0.0019	76	90
Recreational Equipment	All Terrain Vehicles	0.0019	1,935	268
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.0019	48	125
Construction and Mining Equipment	Concrete/Industrial Saws	0.0005	11	67
Construction and Mining Equipment	Rubber Tire Loaders	0.0004	20	84
Lawn and Garden Equipment	Chain Saws < 6 HP	0.0003	284	2
Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters	0.0003	760	1
Commercial Equipment	Generator Sets	0.0003	219	12
Lawn and Garden Equipment	Leafblowers/Vacuums	0.0003	400	2
Construction and Mining Equipment	Rough Terrain Forklifts	0.0003	16	73
Recreational Equipment	Specialty Vehicles/Carts	0.0002	114	11
Construction and Mining Equipment	Tampers/Rammers	0.0002	16	18
Commercial Equipment	Pumps	0.0002	56	20
Construction and Mining Equipment	Bore/Drill Rigs	0.0002	16	26
Commercial Equipment	Welders	0.0001	19	44
Construction and Mining Equipment	Crawler Tractor/Dozers	0.0001	14	104
Logging Equipment	Shredders > 6 HP	0.0001	1,056	4
Construction and Mining Equipment	Rollers	0.0001	12	83
	All Other Equipment	0.0010		
TOTAL		0.02		

Table 3-6
2018 Mendenhall Valley Nonattainment Area Nonroad Emissions – Winter (tpd)

Equipment Description	Equipment Type	PM_{10}	Population (# units)	Activity (hrs/unit/month)
Logging Equipment	Chain Saws > 6 HP	0.0073	171	25
Construction and Mining Equipment	Skid Steer Loaders	0.0010	76	45
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.0009	48	63
Lawn and Garden Equipment	Snowblowers	0.0003	467	3
Commercial Equipment	Generator Sets	0.0003	219	12
Construction and Mining Equipment	Concrete/Industrial Saws	0.0003	11	34
Construction and Mining Equipment	Rubber Tire Loaders	0.0002	20	42
Commercial Equipment	Pumps	0.0002	56	20
Commercial Equipment	Welders	0.0001	19	44
Construction and Mining Equipment	Rough Terrain Forklifts	0.0001	16	37
Logging Equipment	Shredders > 6 HP	0.0001	1,056	4
Recreational Equipment	Specialty Vehicles/Carts	0.0001	114	5
Construction and Mining Equipment	Tampers/Rammers	0.0001	16	9
Construction and Mining Equipment	Bore/Drill Rigs	0.0001	16	13
Construction and Mining Equipment	Crawler Tractor/Dozers	0.0001	14	52
Industrial Equipment	Forklifts	0.0001	11	134
Construction and Mining Equipment	Rollers	0.0001	12	42
Construction and Mining Equipment	Trenchers	0.0000	11	30
Commercial Equipment	Air Compressors	0.0000	12	51
Construction and Mining Equipment	Other Construction Equipment	0.0000	2	33
	All Other Equipment	0.0003		
TOTAL		0.01		

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4. AREA SOURCES

Area sources are small sources that individually emit a small quantity of emissions, but collectively can have a significant impact on regional air quality. The quantifiable area sources present in the Mendenhall Valley area that are integrated into this analysis include combustion sources generally used for heating and cooking, residential wood burning, fuel oil, propane, coal, and natural gas combustion, and structural fires.

Emissions from these sources are primarily based on activity estimates obtained from local agencies and/or fuel distributors. In cases where we were not able to procure current activity information for this analysis, it was necessary to extrapolate emission estimates from one community to another via human population, or to adjust past activity estimates from the four reports discussed in earlier sections[*] according to 2004 and 2018 population estimates.

The following is a description of the methodology used to calculate emissions from each area source.

4.1 Residential Fuel Use

Over the years, DEC has conducted several surveys of residential wood burning in the Mendenhall Valley. Past surveys, conducted in 1981, 1985, and 1993, however, did not address other sources of home heating. Recognizing that wood burning practices have shifted over the past decade, DEC commissioned a broader survey of home heating practices in the spring of 1994 to (a) update estimates of wood use, (b) document the influx of direct vent fuel oil stoves, and (c) quantify their combined impact on home heating emission estimates. A total of 435 homes participated in the survey, which represents almost 10% of the households located in the nonattainment area. Key findings from that effort[†] include the following:

- Initiatives (e.g., burn bans, public education, new stove certification requirements, etc.) implemented under the Juneau wood smoke control program were effectively implemented;

[*] The “1995-2001 Fairbanks CO Inventory,” the “1999 Air Toxics Emission Inventory,” the “2000 Anchorage CO Inventory,” and the “2002 Criteria Pollutant Emissions Inventory.”
[†] Memorandum to Alice Edwards, ADEC from Bob Dulla, Sierra Research, “Results of Juneau Home Heating Survey and Related PM_{10} Emission Estimates, July 19, 2004.

- Wood use per household dropped from 1.8 cords per heating season in 1993 to 1.1 cords in 2004;

- There is widespread use of direct vent-type fuel oil heaters, which were not addressed in previous surveys and had little market penetration in 1993; and

- Between 1993 and 2004, there were significant reductions in the AP-42 emission factors for both fuel oil and wood burning.

Collectively, these changes were estimated to reduce annual PM_{10} emissions from residential heating (for all fuels) by almost 85% from 152.0 tons/year in 1993 to 23.2 tons/year in 2004. The emission estimates produced in that effort, however, need to be revised to address the issues discussed below.

Differences in Seasonal Definitions – The survey collected data for the winter heating season, which was defined to last from October through May (a total of 243 days) and for the year. The seasonal definitions employed in this analysis are winter (October – March or 182 days) and summer (April – September or 183 days). The approach used to modify the survey data to match the seasonal definitions employed in this analysis was to proportion the 243-day winter survey data to the 182-day winter season on the basis of heating degree-days.* A summary of the degree-days and related proportions is presented in Table 4-1. It shows that on the basis of degree-days, the winter accounts for 71.8% of fuel use and the summer for 28.2%. It also shows that the October through March period accounts for 85% of the degree-days recorded during the October through May period addressed in the survey.

Table 4-1
Summary of Heating Degree Days for Juneau, Alaska
(April 2004 – March 2005)

Period	Degree Days	% of Year	% of Oct – May
April 2004 – Sept. 2004	2,229	28.2	-
Oct. 2004 – March 2005	5,680	71.8	85.0
April 2004 – March 2005	7,909	100.0	-
Oct. 2004 – May 2005	6,684	84.5	100.0

The survey collected data on the number of cords of wood, the number of 40-lb bags of wood pellets, and the gallons of distillate used in home heating for three different periods of time: winter, summer, and annual. Many respondents reported having multiple types of heaters. In some cases, it was easier for them to provide seasonal information and in others it was annual information. The challenge is correctly allocating the reported fuel use to the seasons being addressed in this analysis.

* Data on heating degree days for different periods of time are available at *http://www.wunderground.com/history/airport/PAJN/2004/10/1/CustomHistory.html*

Table 4-2 documents how the degree-day data were used to allocate the seasonal and annual fuel use data into two seasons:

- Winter – October – March, and
- Summer – April – September.

Table 4-2
Allocation of Survey Fuel Use to Summer & Winter Seasons
(fuel use by participating households)

Survey		Winter		Summer	
Season	Fuel Use	Adjustment	Fuel Used	Adjustment	Fuel Used
Wood (cords)					
Oct. – May	133	0.85	113.05	0.15	19.95
June – Sept.	19	-	-	1.00	19.00
Annual	1	0.72	0.72	0.28	0.28
Total	-	-	113.77	-	39.23
Fuel Use/Household		127 homes	0.90	127 homes	0.31
Pellets (40 lb bags)					
Oct. – May	1,291	0.85	1,097	0.15	194
June – Sept.	181	-	-	1.00	181
Annual	0	-	-	-	-
Total	-	-	1,097	-	375
Fuel Use/Household		22 homes	49.86	22 homes	17.05
Fuel Oil (gallons)					
Oct. – May	148,891	0.85	126,557	0.15	22,334
June – Sept.	51,944	-	-	1.00	51,944
Annual	35,403	0.72	25,420	0.28	9,984
Total	-	-	151,977	-	84,261
Fuel Use/Household		390 homes	389.68	390 homes	224.96

The winter survey data, which covers October – May, were adjusted by 85% to compute the amount of fuel used during the period of October – March. The remaining 15%, which covers April and May, was allocated to the summer season. Summer survey data, which covers the period of June – September, was fully allocated (100%) to the summer season. The annual survey data were allocated on the basis of winter (71.8%) and summer (28.2%) heating degree-day splits recorded over a 12-month period. The computed seasonal fuel-use values were then divided by the number of homes that reported wood, pellet, and fuel oil use in the survey to estimate fuel use per household.

A total of 435 homes participated in the overall survey. The proportion of homes reporting each fuel use was used to extrapolate the results of the survey to the overall population of homes in the Valley.

<u>More Recent Demographic Data</u> – At the time the survey was conducted, the most recent population estimates available for Juneau were for 2001, and a review of the growth rate suggested that there would be little growth between 2001 and 2004. Therefore, no adjustment was applied to account for the growth between 2001 and 2004. More recent demographic data have become available for Juneau and were used to prepare an updated estimate of the number of households in the nonattainment area in 2004 and a projection for 2018. A description of how those estimates were developed is presented in Appendix B. The 2001 estimate of households employed in the survey was 4,608. The number of households is projected to increase to 4,888 in 2003 and 5,331 in 2018.

Presented below is a brief summary of the approach used to compute home heating emissions using the fuel use and population data described above. A detailed listing of the calculations is presented in Appendix E.

<u>Wood-Use Heating</u> - The survey collected data on wood use by home and the types of wood burning devices in the home (e.g., pellet stoves, wood stoves, conventional fireplaces, modified fireplaces, etc.). Because wood use was reported on a per-household and not a per wood burning unit basis, and many households reported a mixture of wood burning devices, a method had to be developed to allocate wood use by type of wood burning device (i.e., those with different emission factors). This was accomplished by first determining the total number of wood heaters and then determining number of homes equipped with one or more non-pellet type wood heaters (i.e., getting rid of the overlap caused by homes having multiple heaters). The distribution of the total number of these heaters (which summed to 169) was normalized to the number of homes equipped with one or more heaters (which summed to 127), as shown in Tables 1 and 2 in Appendix E.* Total wood use was then distributed to the survey domain based on these percentages, and total emissions were calculated for the 435 households that participated in the survey using the appropriate AP-42 emission factors. The results were then extrapolated to represent emissions for the entire Valley. Because no detailed information regarding pellet stove technology was included in the survey, no similar distribution of pellet use by stove type was necessary.

The tables presented in Appendix E show the details of the calculations used to prepare wood burning emission estimates on both an annual and a winter seasonal basis. The general calculation method for residential wood combustion emissions has been used in a number of emissions inventories over the past few years, most recently for the 2003 Fairbanks Carbon Monoxide Maintenance Plan. The methodology is as follows:

(Cords of wood burned/day) x [EF (lbs CO/cord burned)] x (% homes w/ wood stoves)

* Of the 127 survey households, that reported the use of at least one type of wood stove or fireplace, 104 used only one unit and 23 used two units.

EPA's AP-42 contains emission factors for several specific types of wood-burning appliances. For example, AP-42* lists emission factors for conventional, noncatalytic, and catalytic type wood stoves. However, the 2004 survey includes information only for the more general "woodstove" category. In the absence of more detailed information regarding the mix of technology present in the Valley woodstoves, the general AP-42 woodstove emission factor (30.6 pounds/ton of wood burned) was used to calculate emissions for all Mendenhall Valley woodstoves, as shown in the tables in Appendix E.

Fireplaces are the other major source of PM_{10} emissions from wood combustion used in home heating. Although the 2004 survey contains information on both conventional and modified fireplaces, the most current available emission factor (23.6 pounds/ton of wood burned) is only for the more general "fireplace" category. This emission factor was included in a paper presented at EPA's 10th Annual Emissions Inventory Conference in May 2001.† The results documented in that paper show PM_{10} (and CO) emission factors for wood-burning fireplaces, which are significantly lower than those found in the most current AP-42 publication. (The study documented in this paper examined over a dozen more recent data sources for wood-burning fireplaces than contained in AP-42. PM_{10} emission factors were compiled from a database of 388 tests conducted on 112 fireplace models, which exceeds the number of tests and models on which the AP-42 factors are based.) In the absence of more detailed information, this fireplace emission factor was used to calculate emissions for all fireplace categories included in the 2004 survey, as well as those for the catch-all "any other wood device" survey category.

Both the woodstove and fireplace emission factors are given in units of pounds of PM_{10} produced per ton of wood burned. These were converted to units of pounds of PM_{10} per cord of wood burned by applying an assumed wood density of 30 pounds per cord, and a cord volume area of 80 cubic feet per cord. Both of these conversion factors were used in the 1988 PM_{10} Emission Inventory, and are the same as, or substantially similar to, conversion factors used in other recent ADEC reports. These converted emission factors were then applied to the total cords of wood used in the Valley, to give total PM_{10} emissions from wood burning sources. The actual conversions, and the overall emission calculations, are documented in Appendix E. A summary of the seasonal emissions in 2004 and 2018 is presented in Tables 4-3 and 4-4.

Emission factors for pellet stoves did not require any conversion, as total usage was given in pounds, which was then multiplied directly with AP-42 emission factors for pellet stoves, given in units of pounds of PM_{10} produced per ton of pellets burned. Specific seasonal and annual calculations are shown in Appendix E.

<u>Fuel Oil Heating</u> - In calculating emissions from Fuel Oil Combustion, AP-42 emission factors were again applied to seasonal and annual fuel-use totals collected in the recent survey. Because not all survey respondents provided fuel-use data, average fuel use by season was assumed to apply to the 390 fuel oil users recorded in the survey. These values were apportioned to Toyo/Monitor-type stoves and central oil furnaces according

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* Compilation of Air Pollutant Emission Factors, Volume I, Fifth Edition, Chapter 1.09, October 1996.

† J. E. Houck, J. Crouch and R. H. Huntley, "Review of Wood Heater and Fireplace Emission Factors," proceedings from U.S. Environmental Protection Agency's 10th Annual Emissions Inventory Conference, May 2001.

Table 4-3 PM_{10} Emission Estimates for Residential Heating Mendenhall Valley in 2004					
Fuel Type	Homes Equipped	Cords per Household	40 # bags per Household	Gallons per Household	Emissions (tons)
Winter					
Wood	1,427	0.90	-	-	16.60
Pellet	247	-	49.86	-	1.09
Oil	4,382	-	-	389.68	0.34
				Total	18.02
Summer					
Wood	1,427	0.31	-	-	5.72
Pellet	247	-	17.05	-	0.37
Oil	4,328	-	-	224.96	0.19
				Total	6.28
				Annual	24.30

Table 4-4 PM_{10} Emission Estimates for Residential Heating Mendenhall Valley in 2018					
Fuel Type	Homes Equipped	Cords per Household	40 # bags per Household	Gallons per Household	Emissions (tons)
Winter					
Wood	1,556	0.90	-	-	18.11
Pellet	270	-	49.86	-	1.18
Oil	4,780	-	-	389.68	0.37
				Total	19.66
Summer					
Wood	1,556	0.31	-	-	6.24
Pellet	270	-	17.05	-	0.40
Oil	4,780	-	-	224.96	0.21
				Total	6.85
				Annual	26.51

to the percentage of households that reported the use of each, normalized to account for households that operate more than one unit (using the same method described for the cord wood heaters).* Total emissions for the survey domain were then calculated, and the result was then adjusted to represent the Mendenhall Valley using the ratio of surveyed households vs. Valley households.

* Of the 390 survey households (90%) that reported use of either a fuel oil or kerosene heating source, 55 said they use more than one type.

Contrary to emission factors for wood burning sources, individual emission factors for each type of fuel oil heater are not available. Therefore, a single emission factor, which was suitable for all residential fuel oil furnaces (from EPA's AP-42, 0.4 pounds of PM_{10} per 1000 gallons of fuel burned), was used in both calculations. The results are shown in Appendix E and displayed in Tables 4-3 and 4-4.

Used Oil Combustion – Although we do not believe there is a significant amount of used oil combustion in Juneau, and were not able to procure any used oil throughput totals, it is likely that it is used for heating in some automotive repair shops, and other similar facilities where it is easily accessible. Therefore, following the methodology used in the 1999 Criteria Pollutant Inventory and 1999 Air Toxics report, national used oil consumption (not to be confused with *waste* oil, which is officially designated as hazardous waste and whose combustion is illegal in the state of Alaska) was allocated to Juneau based on population data. The total U.S. consumption for 1983 (590,000,000 gallons) was prorated to 2004 and 2018 Juneau levels (78,222 and 85,312 gallons, respectively) based on U.S. Census population data, and our projected 2018 population estimate for the Mendenhall Valley. PM_{10} emissions were then calculated by applying AP-42 emission factors (Table 1.3-1) to these activity totals. All used oil combustion was assumed to occur during the winter months.

Propane – In calculating emissions from Propane Combustion, AP-42 emission factors were again applied to monthly fuel use totals provided by local Juneau fuel distributors. The Juneau totals were apportioned to the Mendenhall Valley via human population. The surprisingly constant annual usage totals for propane indicate that this fuel is used more for cooking and waterheaters than for home heating, a theory that the Mendenhall Valley Survey seems to support.

Natural Gas – Juneau does not use natural gas as a heating source because the landlocked geography makes its distribution impractical.

Coal –According to ADEC staff, coal is not used as a heating source in Juneau.

4.2 Other Area Sources

Asphalt Plants – The only asphalt plant in the Mendenhall Valley is the AEDCO Asphalt Plant, which is classified as a point source as discussed in Section 5 of this analysis.

Asphalt Paving – All particulate emissions from asphalt paving are in the form of condensable hydrocarbons (i.e., TOG or VOC emission factors), as shown in AP-42 section 4.5 for Asphalt Paving Operations. These emissions are included in VOC or TOG emission inventories, and should not be double-counted in particulate emission inventories. Therefore, there are no PM_{10} emissions associated with asphalt paving.

Wildfires – There were no wildfires in the Mendenhall Valley in either 2002—as confirmed by the Western Regional Air Partnership's (WRAP) recently completed 2002 air emission inventory for fire—or in 2004. Therefore, there are zero emissions from this source in 2004. As wildfires are relatively rare in the Mendenhall Valley region, we are assuming that this will be the case as well in 2018.

Open Burning (Firefighter Training) – Local ADEC staff in Anchorage provided activity data for this emission source, which is assumed proportional to the activity in the Mendenhall Valley. In Anchorage, firefighter training was estimated to occur 28 times per year and to utilize 200 gallons of fuel per exercise, for a total of 5,600 total gallons burned during the summer months. This total was extrapolated to the Mendenhall Valley based on human population.

All fuel burned was assumed to be diesel. In the absence of any more accurate emission factors, the methodology used in the 1999 Air Toxics report was used to calculate emissions from this source; AP-42 emission factors for residential furnaces (Table 1.3-2) were applied to the activity data discussed above

Structural Fires – The total number of incidences for structural fires in 2004 was obtained from the Juneau Fire Marshal.[8] Only a borough-wide total of 27 structural fires in 2004 was available; however, the Fire Marshal estimated that 70% of these fires occurred in the Mendenhall Valley and that about 65% of the fires occurred in the wintertime and 35% occurred during the summer. Lacking projected estimates, the incidence level was assumed to be the same for calendar year 2018. Emission factors developed by the California Air Resources Board[*] (CARB) were applied to this activity estimate to generate the emission totals shown in Table 4-11.

Burn Barrels – Burn barrels are used in the Mendenhall Valley to supplement trash pick-up during the summer (use of burn barrels is prohibited during the winter). However, no data on the frequency and degree of use of burn barrels have been collected for the Juneau area. In order to estimate the potential emissions from these sources, a sensitivity analysis was performed. The analysis used an estimate of 2,137 lbs of refuse generated per household in a year, which was derived from estimates developed for California by CARB,[9] and assumed that 10% to 25% of the refuse is burned while the rest is picked up. The estimated PM_{10} emissions from burn barrels are shown in Table 4-5. As shown, burn barrels contribute 0.5% of the total PM_{10} area source emissions in the Valley at the 10% burning level estimate and about 1.2% of the total area source PM_{10} emissions at the 25% burning level estimate. Since the PM_{10} contribution from burn barrels becomes significant at the higher percentages of refuse burned, a survey effort should be undertaken to estimate the actual contribution from these sources in the Valley. As a conservative assumption, emissions from burning 25% of the total refuse generated were used in the area source emission summaries in Table 4-11 and in the Executive Summary.

Gasoline Distribution – This area source category is a source of VOC emissions only, and therefore is not included in this effort.

Surface Coatings – This area source category is a source of VOC emissions only, and therefore is not included in this effort.

[*] "Area Source Methodologies Manual," California Air Resources Board, March 1999.

Table 4-5 PM_{10} Emissions from Burn Barrels in the Mendenhall Valley (tons/day)				
Source	Summer 2004		Summer 2018	
	10% Burned	25% Burned	10% Burned	25% Burned
Burn Barrels	0.023	0.057	0.025	0.062
Total Area Sources	4.598	4.598	4.809	4.809
Burn Barrels as % of Total	0.5%	1.2%	0.5%	1.3%

4.3 Fugitive Dust

Paved and Unpaved Roads

Emissions of PM_{10} in the form of fugitive dust from paved and unpaved roads were developed for the Mendenhall Valley nonattainment area. The equations used for estimating both paved and unpaved road emissions on a per-VMT basis were derived from current procedures in the U.S. Environmental Protection Agency's (EPA's) AP-42 report.[10] Calendar year 2004 roadway miles of unpaved roads, along with the associated vehicle miles traveled (VMT), were estimated from local data and discussions with state and local agency staff. Paved roadway VMT was estimated by subtracting the unpaved road VMT from the total VMT for all roads. For calendar year 2018, VMT were estimated from the 2004 levels using projected population growth data for the Mendenhall Valley. It was conservatively assumed that the percentage of total VMT on unpaved roads (0.33%) remained the same in 2018 as in 2004. A discussion of the procedures, data sources, and inventory results follows.

Estimating Roadway Particulate Emissions - EPA's AP-42 is the agency's compilation of emission factors and procedures for estimating emissions from a variety of stationary sources. The methods described in the report for estimating fugitive dust emissions from unpaved and paved roads are summarized below.

Unpaved Roads – The equation in AP-42 for estimating particulate emissions from "dry" (no precipitation), unpaved publicly accessible roads dominated by light-duty vehicles is given as Equation 1 below:

Eqn. 1

$$E = \frac{k(s/12)(S/30)^{0.5}}{(M/0.5)^{0.2}} - C$$

where: E is the dry emission factor in lb/VMT;
k is a particle size empirical constant (1.8 for PM_{10}, 0.27 for $PM_{2.5}$);
s is the surface material % silt content;
M is the surface soil % moisture content;
S is the mean vehicle speed in miles per hour (mph); and

C is the 1980's motor vehicle particulate emission factor in lb/VMT (0.00047 for PM_{10}, 0.00036 for $PM_{2.5}$).*

Juneau- or Alaska-specific factors were used in Equation 1 as much as possible for estimating unpaved road emissions for the Mendenhall Valley. For the surface material silt content, 15% was used, which was the average from samples collected on unpaved streets in the Mendenhall Valley for a 1988 PM_{10} inventory prepared by Engineering Science for EPA.[5] The soil moisture content used in this analysis was 1.1%—the average found for measured unpaved roads in Region 10.[11] Based on discussions with the City and Borough of Juneau, the mean vehicle speed on unpaved roadways was estimated at 25 mph.

The fugitive dust emissions estimated using Equation 1 are during the average "dry" conditions of unpaved roads in a given area. That is, the natural mitigating effect of precipitation would need to be considered since any increase in moisture reduces the level of emissions from the roads. In order to account for the natural precipitation that control fugitive dust in the local areas, the dry emission factor E is adjusted using Equation 2 from AP-42

Eqn. 2

$$E_{unpaved} = E[(N - p)/N]$$

where: $E_{unpaved}$ is the final unpaved roads emission factor adjusted for natural mitigation in lb/VMT;
N is the total number of days in the study period (182 for summer and 183 for winter); and
p is the number of days in the study period with measurable amounts (at least 0.01 inch) of precipitation.

Locality-specific precipitation days for Juneau were derived from the monthly averages available from the Western Regional Climate Center (WRCC).[12] The WRCC keeps records for days per month with measurable precipitation (at least 0.01 inch) and has monthly averages over the last 50 years. The data for Juneau indicate that the area receives measurable precipitation for 117 days during the winter (October to March) and 106 days during the summer (April to September).

Paved Roads – Similar to unpaved roads, fugitive emissions from paved roads take into account road surface properties, traffic conditions and climate for natural mitigation. Equation 3 shows the equation from AP-42, which considers all these factors for estimating paved road emissions:

* The previous versions of the unpaved and paved road emission factor equations in AP-42 included exhaust, brake-wear, and tire-wear emissions from vehicles in the 1980 calendar year fleet. These emissions are now estimated as part of the on-road mobile emissions and have decreased since 1980 due to lower new vehicle emission standards and new fuel specifications. Therefore, this needs to be removed from the AP-42 paved and unpaved road emissions in order to prevent double-counting of emissions.

$$E_{paved} = \left[k\left(\frac{sL}{2}\right)^{0.65}\left(\frac{W}{3}\right)^{1.5} - C \right] \left[(4N - p)/4N\right] \qquad \textit{Eqn. 3}$$

where: E_{paved} is the final unpaved roads emission factor adjusted for natural mitigation in lb/VMT;
k is a particle size empirical constant (0.016 for PM_{10} and 0.004 for $PM_{2.5}$);
sL is the road surface silt loading in g/m^2;
W is the average weight of vehicle traveling the road in tons;
C is the 1980's motor vehicle particulate emission factor in lb/VMT (0.00047 for PM_{10}, 0.00036 for $PM_{2.5}$);
N is the total number of days in the study period (182 for summer and 183 for winter); and
p is the number of days in the study period with measurable (at least 0.01 inch) precipitation.

Equation 3 is analogous to the combination of Equations 1 and 2 for fugitive dust from unpaved roads. However, Equation 3 includes a factor of "4" in the natural precipitation mitigation effects because paved roads dry quicker than unpaved roads after precipitation events.

No paved road silt loading data are available from the Juneau area. Therefore, the road surface silt loading values for the paved roads in Mendenhall Valley were based on paved road samples collected from different roadway facility types in Anchorage in 1996.[13] The silt loading values used by season are shown in Table 4-6.* The average weight of the vehicle traveling on the roads was set to 2.0 tons, which was used for the Mendenhall Valley paved roads in the 1988 Engineering Science report for EPA.[5] The days per season with measurable precipitation were the same ones used for Equation 2.

Table 4-6
Seasonal Paved Roads Silt Loading (g/m^2) by Facility Type

Facility	Winter	Summer
Interstate/Major Arterial	2.6	20.4
Minor Arterial	1.1	6.7
Collector	2.9	9.4
Local Roads	4.7	18.4

* The paved road silt loadings used in this analysis are different from those used in a 1988 Engineering Science report prepared for the Mendenhall Valley, which applied national average default values in AP-42. Since the silt loading measurements taken in Anchorage represent at least state-specific measurements, these Anchorage silt loadings were deemed as better estimates for the paved road silt loading in the Mendenhall Valley than the national defaults.

Both the paved and unpaved road emission factors calculated using the AP-42 equations are expressed on a per VMT basis (lb/VMT). Therefore, the VMT for the paved and unpaved roadways in the nonattainment area need to be estimated. The following section describes the traffic data and sources used in estimating the VMT for the paved and unpaved roads in the Mendenhall Valley.

Roadway Activity Estimates and Data Sources **-** The total daily VMT for a road is calculated as the product of the annual average daily traffic (AADT) and the roadway length in miles (VMT = AADT × Road Length). First, the total daily VMT for all roads in the Valley were estimated. The VMT and associated emissions for the unpaved roads were then estimated using the unpaved road mileage and AADT. Lastly, the VMT for unpaved roads were subtracted from the Valley VMT, and the remaining VMT was used to estimate emissions from the paved roads.

Total Mendenhall Valley Nonattainment Area VMT – The total 2004 VMT estimates by facility were developed for the nonattainment area by extrapolating average daily travel on DOT&PF monitored roadways in the Mendenhall Valley to the rest of the network, and adjusting some 1999 VMT estimates to 2004 levels using yearly population data for the nonattainment area. After this, the 2004 VMT estimates were forecasted to 2018 levels using yearly population data for the area. This results in the 2004 and 2018 annual average total VMT shown in Table 4-7. The detailed development of the total Mendenhall Valley VMT levels is discussed as part of the *On-Road* section of this report. No seasonal data are available to reflect any seasonal variation in VMT; therefore, the average annual daily VMT was used for both the summer and winter seasons as a conservative approach.

Table 4-7
Mendenhall Valley Annual Average VMT/Day by Facility

Facility	2004 VMT	2018 VMT
Major/Principal Arterial	63,278	69,013
Minor Arterial	39,585	43,173
Collector/Intrazonal	58,370	63,661
Local	141,367	154,180
ALL TOTAL	302,599	330,028

Unpaved Roadway VMT – The 2004 pavement data from DOT&PF[14] were used to estimate the miles of unpaved roads in the Valley. In addition, DOT&PF provided data on unpaved roadways that were not included in the 2004 pavement data.[15] DOT&PF indicated that the pavement road data are up-to-date for the DOT&PF-maintained roadways, but that the information on roads maintained by other agencies may be outdated. Consequently, the CBJ was contacted for 2004 unpaved road data for roadways under their management,[7] and the CBJ data were compared with the DOT&PF data to eliminate duplicates and double counting. Because DOT&PF indicated that their information on roads maintained by other agencies might be outdated, more confidence was given to the CBJ data when conflicting information existed on paving status for some roadways between the DOT&PF and CBJ data sets. From these, 2004 unpaved roadway miles and VMT were estimated.

For VMT and AADT, data within the Mendenhall Valley are limited. Consequently, the only unpaved local road AADT available for Juneau comes from the 1988 PM_{10} emissions inventory prepared for the Mendenhall Valley by Engineering Science.[5] In the report, an AADT of 171 was obtained from counts performed on 12 local streets. This estimate was adjusted to 2004 levels using the Borough population growth between 1988 and 2004. The 1988 population was estimated by Engineering Science in the PM_{10} inventory report, while the 2004 Borough population came from the Alaska Department of Labor and Workforce Development (DLWD).* The resulting adjusted AADT applied to all unpaved local roadways in Juneau is 177 vehicles per day. This, combined with the total miles of unpaved roads in the Valley, resulted in a total unpaved road daily VMT of 995 in the Mendenhall Valley nonattainment area. In 2018, the conservative assumptions were made that the same stretch of local unpaved roadways in 2004 remained unpaved and the percentage of total VMT (forecasted to 2018 using population forecasts) on unpaved roads remained the same. This resulted in a total unpaved road daily VMT of 1,085 in 2018 for the nonattainment area.

A summary of the data sources, unpaved roadway miles, and VMT estimated for Mendenhall Valley is shown in Table 4-8. As shown, a total of 5.62 miles of unpaved roadways—all local roads—were found for the Mendenhall Valley for 2004. Of this, about 5.21 miles are gravel or aggregate roads, 0.14 miles are undeveloped dirt roads, and 0.28 miles are overlaid with recycled asphalt pavement (RAP).† The same distribution of unpaved surface types was assumed for 2018.

Table 4-8
Mendenhall Valley Unpaved Road VMT and Data Sources

Data Source	Facility Type	2004 Unpaved Roads		2018 Unpaved Roads	
		Miles	VMT	Miles	VMT
DOT&PF	Local	1.15	203	1.15	222
CBJ	Local	4.47	791	4.47	863
ALL TOTAL		5.62	995	5.62	1,085

* The 1998 population for just the Mendenhall Valley was not available; therefore, borough-wide population growth was used. The 1988 total borough population was 29,946, and the 2004 population was 30,966.

† Recycled asphalt pavement (RAP) is reprocessed pavement materials containing asphalt and aggregates that, when processed properly, consist of high-quality, well-graded aggregates coated by asphalt cement. RAP provides some, but not complete, control on fugitive dust emissions from unpaved roads.

Paved Roadway VMT – The resulting paved roadway VMT for the Mendenhall Valley nonattainment area after the unpaved roadway VMT were subtracted from the total VMT are shown in Table 4-9 by facility.

Table 4-9
2004 and 2018 Mendenhall Valley Paved Road VMT by Facility

Facility	2004 VMT	2018 VMT
Major/Principal Arterial	63,278	69,013
Minor Arterial	39,585	43,173
Collector/Intrazonal	58,370	63,661
Local	140,372	153,096
ALL TOTAL	301,605	328,943

PM_{10} Fugitive Dust Emission Inventories **-** The emission factors for paved and unpaved roads found using Equations 1 through 3 from AP-42 were combined with the paved and unpaved road VMT estimates to result in the PM_{10} fugitive dust emissions for Mendenhall Valley. The 2004 and 2018 seasonal PM_{10} inventories are shown in Table 4-10. The annual average emission inventories were estimated by weighting the summer and winter emission levels by the number of days in each season as defined by ADEC—183 for the summer and 182 for the winter.

Table 4-10
Seasonal Road Fugitive Dust Emissions in Mendenhall Valley

Calendar Year	Source	PM_{10} (tons/day)		
		Winter	Summer	Annual Avg
2004	Paved Roads	1.48	4.14	2.81
	Unpaved Roads	0.16	0.19	0.18
	TOTAL	1.64	4.33	2.99
2018	Paved Roads	1.61	4.51	3.07
	Unpaved Roads	0.18	0.21	0.19
	TOTAL	1.79	4.72	3.26

Wind Blown Dust

There are two categories of windblown dust included in this inventory: glacial riverbeds and cleared areas, both of which are discussed in detail below.

Glacial River Beds – This category includes sand bars along glacial rivers, which are large enough to generate significant emissions during periods of high winds. In developing the 1988 PM_{10} emissions inventory, Engineering Science examined aerial photographs of the Mendenhall Valley and concluded that only area where such emissions would occur is at the eastern shore of the Mendenhall Lake near the mouth of Nugget Creek. The sand bars located in that area were estimated to be 41 acres and produce 28.6 tons of PM_{10} per year. To be conservative, the acreage of sand bars was assumed to be unchanged. A review of AP-42 showed that the emission factor calculation methodology is unchanged; therefore, the previous estimates of emissions for this category are unchanged.

Cleared Areas – This category includes open areas where the vegetation has been destroyed and the surface material is susceptible to entrainment by wind. Engineering Science examined aerial photographs and determined that 154 acres of land were open and cleared for the 1988 PM_{10} emissions inventory. Using wind speed data collected from the Juneau Airport and silt loading values estimated from local bulk samples, they estimated this source category to produce a total of 4.4 tons of PM_{10} per year. Lacking any new data on the number of acres, the silt loadings or the wind speed, it has been conservatively assumed (since the amount of cleared land has dropped as development in the Valley has expanded) that the emissions for this source are unchanged.

4.4 PM_{10} Area Source Inventory

Table 4-11 shows the PM_{10} total area source emissions for the Mendenhall Valley Area, by source category, and illustrates the fact that fugitive and windblown dust comprises the majority (approximately 97%) of the average annual PM_{10} emissions in the Mendenhall Valley for both 2004 and 2018. Other source categories that show relatively high totals of PM_{10} emissions include woodstoves/fireplaces and burn barrels.

Table 4-11
2004 and 2018 PM_{10} Area Source Emissions for the Mendenhall Valley Nonattainment Area (tons/day)

	Calendar Year 2004			Calendar Year 2018		
Area Sources	Summer	Winter	Annual	Summer	Winter	Annual
Asphalt Production	N/A	N/A	0.0000	N/A	N/A	0.0000
Asphalt Paving	0.0000	N/A	0.0000	0.0000	N/A	0.0000
Gasoline Distribution	N/A	N/A	0.0000	N/A	N/A	0.0000
Used Oil Combustion	N/A	0.00004	0.00002	N/A	0.00004	0.00002
Fuel Oil Combustion	0.0010	0.0019	0.0014	0.0020	0.0011	0.0016
Surface Coatings	N/A	N/A	0.0000	N/A	N/A	0.0000
Wildfires	0.0000	N/A	0.0000	0.0000	N/A	0.0000
Open Burning (firefighter training)	0.0000003	N/A	0.0000002	0.0000003	N/A	0.0000002
Burn Barrels (refuse burning)	0.0571	0.0000	0.0286	0.0623	0.0000	0.0312
Woodstoves/Fireplaces	0.0333	0.0972	0.0652	0.0363	0.1060	0.0711
Propane Use	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Natural Gas Heating	N/A	N/A	0.0000	N/A	N/A	0.0000
Paved Road Fugitive Dust	4.1353	1.4785	2.8106	4.5102	1.6125	3.0653
Unpaved Road Fugitive Dust	0.1899	0.1612	0.1756	0.2071	0.1758	0.1915
Glacial/Cleared Areas Windblown Dust	0.1808	0.1808	0.1808	0.1808	0.1808	0.1808
Structural Fires	0.0002	0.0005	0.0004	0.0002	0.0005	0.0004
TOTAL	4.598	1.920	3.263	4.999	2.077	3.542

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5. POINT SOURCES

Discussions with ADEC staff confirmed that there is only one permitted source that is located in the Mendenhall Valley nonattainment area—an asphalt batch plant. The terms of the permit authorize the plant to operate continuously (24 hours per day) at a rate of 60 tons per hour for a 5-month period. There are two sources at the facility: a generator and a burner. The generator is rated at 400 hp/hr, and the burner has a maximum fuel rate of 180 gallons/hr. The activity rates, permitted limits, and daily emission rates are summarized in Table 5-1. It should be noted that the daily value is extremely conservative as it is based on the potential of the facility to emit.

Table 5-1
Mendenhall Valley Point Source Summary
Asphalt Batch Plant

Source	Activity Rate	5-Month PM_{10} Emission Limit (tons)	Daily Emissions PM_{10} (tons)
Generator	400 hp/hr	23.10	0.128
Burner	180 gallons/hr	4.86	0.027
Total		27.96	0.155

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6. REFERENCES

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3. Amendments to Volume II, Section III, Areawide Pollutant Control Program, Subpart D "Particulate Matter", 3. Control Plan for Mendenhall Valley of Juneau, Rev. 5/12/93.

4. Memo to Alice Edwards from Bob Dulla, "Results of Juneau Home Heating Survey and Related PM_{10} Emission Estimates," July 19, 2004.

5. "PM10 Emission Inventories for the Mendenhall Valley and Eagle River Areas," prepared for U.S. Environmental Protection Agency, Region X, by Engineering Science, February 1988.

6. Communication with Mary Ann Dierckman, Transportation Planner, Juneau Headquarters, Department of Transportation and Public Facilities (DOT&PF), May-June 2005.

7. Communication with Mike Scott, Streets Superintendent, City and Borough of Juneau, June 2005.

8. Communication with Richard Etheridge, Fire Marshal, Capital City Fire/Rescue Fire Department, Juneau, Alaska, August 2005.

9. "Staff Report: Initial Statement of Reasons for the Proposed Airborne Toxic Control Measure to Reduce Emissions of Toxic Air Contaminants from Outdoor Residential Waste Burning," California Air Resources Board, January 4, 2002.

10. "AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," Section 13.2.1-13.2.2 Paved and Unpaved Roads, Environmental Protection Agency, December 2003.

11. C. Cowherd, Jr., et al., "Improved Activity Levels for National Emission Inventories of Fugitive Dust from Paved and Unpaved Roads," Presented at the 11th International Emission Inventory Conference, Atlanta, Georgia, April 2002.

12. Average Number of Days with Measurable Precipitation for Alaska, Historical Climate Information, Western Regional Climate Center website, http://www.wrcc.dri.edu/htmlfiles/ak/ak.01.html, Updated to 2004.

13. "Identification, Quantification, and Control of PM-10 Sources in Anchorage," prepared by Midwest Research Institute for the Municipality of Anchorage, April 15, 1999.

14. Communication with Kathleen Ramage, Road Network Service Manager, Division of Program Development, Alaska Department of Transportation and Public Facilities (DOT&PF), May 2005.

15. Communication with David Hawes, Transportation Planner, Southeast Region, Department of Transportation and Public Facilities (DOT&PF), May 2005.

Appendix A
Inventory Preparation and Quality Assurance Plan

Inventory Preparation and Quality Assurance Plan
for
Juneau – Mendenhall Valley PM_{10} Emission Inventory

Prepared for:

Alaska Department of Environmental Conservation

June 3, 2005

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INTRODUCTION

Background

The Mendenhall Valley, located nine miles from downtown Juneau, is the largest residential area in the region. Bounded by sharply rising mountains on the east and west and the Mendenhall Glacier to the north, the valley is well sheltered from prevailing winds. This topography, combined with a low winter sun angle that limits solar heating, supports the development of relatively severe temperature inversions. These inversions trap emissions close to the valley floor and in the past led to severe concentrations of airborne particulate matter that exceeded state and federal ambient air quality standards for PM_{10}.

The Mendenhall Valley is currently classified as a moderate PM_{10} nonattainment area. Despite this classification, no exceedances of either the annual or the 24-hour standard have been recorded in more than a decade (based on a review of EPA monitoring data between 1994 and 2004).[1] This is the result of planning and implementation efforts by both DEC and the City and Borough of Juneau (CBJ). Those efforts, documented in a 1993 State Implementation Plan (SIP) submission,[2] identified the following key emission sources:

- Smoke from residential wood combustion (home heating);
- Fugitive dust from travel on unpaved roads; and
- Fugitive dust from travel on paved roads.

To reduce emissions from these sources, the SIP implemented a wood smoke control program and a fugitive dust abatement program. Elements of the wood smoke control program included an aggressive public education program; implementation of a real-time monitoring system linked to episodic controls of wood burning; prohibition of open burning (during winter months); new stove certification requirements; and enforcement of the CBJ woodsmoke ordinance. The fugitive dust abatement program focused on paving unpaved roads in the Valley. Both programs have been successful and led to significant reductions in key emission sources within the Valley. Recent work by Sierra,[3] under contract to ADEC, indicates the introduction of new technology has also had a significant impact on home heating emissions. Collectively, we estimate that the combination of new technology, related shifts in wood use, and implementation of control measures, reduced PM_{10} emissions by 85% from 1993 to 2004. Key contributors to these reductions include the following:

- Initiatives (e.g., burn bans, public education, new stove requirements, etc.) implemented under the Juneau wood smoke control program;
- A drop in wood use per household from 1.8 cords per heating season in 1993 to 1.1 cords in 2004;
- Widespread use of direct vent-type fuel oil heaters; and
- Reductions in emission factors for both fuel oil and wood burning.

Approach

Sierra will follow the source-specific data collection and modeling procedures detailed in the EPA emission inventory guidance document: "PM-10 Emission Inventory Requirements," Final Report, September 1994. As noted above, key emission sources identified in the previous inventory were smoke from residential wood combustion and fugitive dust from both paved and unpaved roads. Given the significance of these sources and the efforts placed on controlling their emissions, it is imperative that new activity information be collected to characterize current emission levels from each of these sources. The home heating survey conducted last year provides detailed insight into the impact of both technology changes and related activity levels on residential heating emissions. No similar survey has been conducted to support an update of fugitive dust from paved and unpaved roads.

In order to prepare an accurate update to these source categories, Sierra intends to collect information on the mileage of paved/unpaved roads in the Valley, and obtain recent traffic counts and related speed estimates. A description of the methodology is presented in the next section. Aside from these activity estimates, another key element of fugitive dust calculations is the silt content of the roads. A review of the last emission inventory prepared for the Valley[4] shows that silt loadings were collected locally to support the preparation of fugitive dust emissions for unpaved roads, and that national average silt loadings were used to estimate on-road levels. Since no controls have been targeted at controlling silt loadings for unpaved roads, Sierra sees no need to update those estimates. However, controls have been targeted at reducing the mileage of unpaved roads and a corollary benefit of these controls should be a reduction of silt loadings (i.e., fugitive dust) on paved roads. For this reason, we intend to collect silt loadings for a representative sample of paved roads (samples will be distributed across both road type and traffic volume) and use the results along with recent traffic counts to support an update of fugitive dust emitted from this source category. A description of the methodology to be used for collecting the silt samples is presented in Appendix X.

Organization

The remainder of this report is organized to address the methods that will be used to compute emissions from the data obtained in the surveys and the quality assurance procedures that will be employed in the development of the emission inventory estimates.

###

EMISSIONS DATA AND METHOLOGY

The development of an emissions inventory can be divided into two primary steps: (1) identifying and collecting the activity data needed to characterize source-specific operations, and (2) selecting and using methodologies to translate the activity measurements into emissions. Presented below is a review of the activity data needed to characterize each of the source categories and the methods that will be used to compute emissions for each source category.

Collection of Activity Data

On-Road Mobile Sources – For on-road mobile sources, this effort will focus on collecting information on vehicle activity data and identifying the miles of roadway in the Valley that remain unpaved. Juneau is not large enough to qualify as a metropolitan planning organization (MPO) and related funds for the development of a travel demand model. As a result, the only option for estimating vehicle miles of travel (VMT) is to obtain local traffic counts and related speed measurements, and to develop a method for extrapolating that information to represent all of the roads in the Valley. In a previous study,[5] Sierra contacted both CBJ and the Alaska Department of Transportation and Public Facilities (ADOT&PF) and obtained counts for information on the Juneau VMT data. Sierra received three data files from ADOT&PF:

- JunroutebyFC.txt - contains the route description, route number, mile points, termination name (end of segment), and functional class (FC). The functional classes are identified as any of these four descriptions: Urban Minor Arterial, Urban Other Principal Arterial, Urban Collector, or Urban Local Road.

- Juneau_vmt99.txt - contains the route number, route name, mile point, feature (landmark), Average Daily Traffic (ADT), length (miles), and the resulting VMT.

- Juneauspeed.prn - contains the route number, route name, beginning mile point, end mile point, length, and posted speed limit. Out of 720 segments, 614 segments have no posted speed limit.

These three data sets were used to prepare estimates of the functional class, VMT, and average speed for each Juneau roadway segment. Sierra plans to contact ADOT&PF to obtain updates to these files as part of a related NTP. Once that information is available, Sierra will then need to extract information for the roads located within the Valley. This will be accomplished by contacting CBJ and ADOT&PF staff for information on the miles of roadway that are unpaved within the Valley.

Non-Road Mobile Sources – For non-road mobile sources, Sierra has prepared estimates of activity and emissions for Juneau in the previously referenced study. Since little information is available to characterize local activity levels in Juneau, that effort focused on identifying those sources that actually exist and operate within the Valley. Examples of source categories that should be excluded are boats, locomotives, and aircraft.[*] Sierra plans to review each of the non-road source categories to determine if operation should be excluded on a seasonal basis and to determine if any local operating data are available to characterize activity levels.

Area Sources – For area sources, Sierra plans to use the activity and fuel use information collected in last year's home heating survey to quantify residential emissions. Data on the mixture of devices used to heat commercial businesses located within the Valley will be obtained through phone calls. To provide a conservative estimate of windblown dust emissions, the Engineering Science estimate of the acreage of cleared land located within the Valley in 1988 will be held constant.

Data collected from the Western Regional Climate Center (WRCC)[6] indicate that the Juneau area receives measurable precipitation for 117 days during the winter (October to March) and 106 days during the summer (April to September). In light of the extensive rainfall and lack of large scale agriculture within the nonattainment area, no emission estimates will be prepared for agricultural burning, prescribed burning, or wildfires.

Point Sources – Sierra will contact ADEC to obtain information on permits for point sources located within the Valley. Key variables to be obtained include the following:

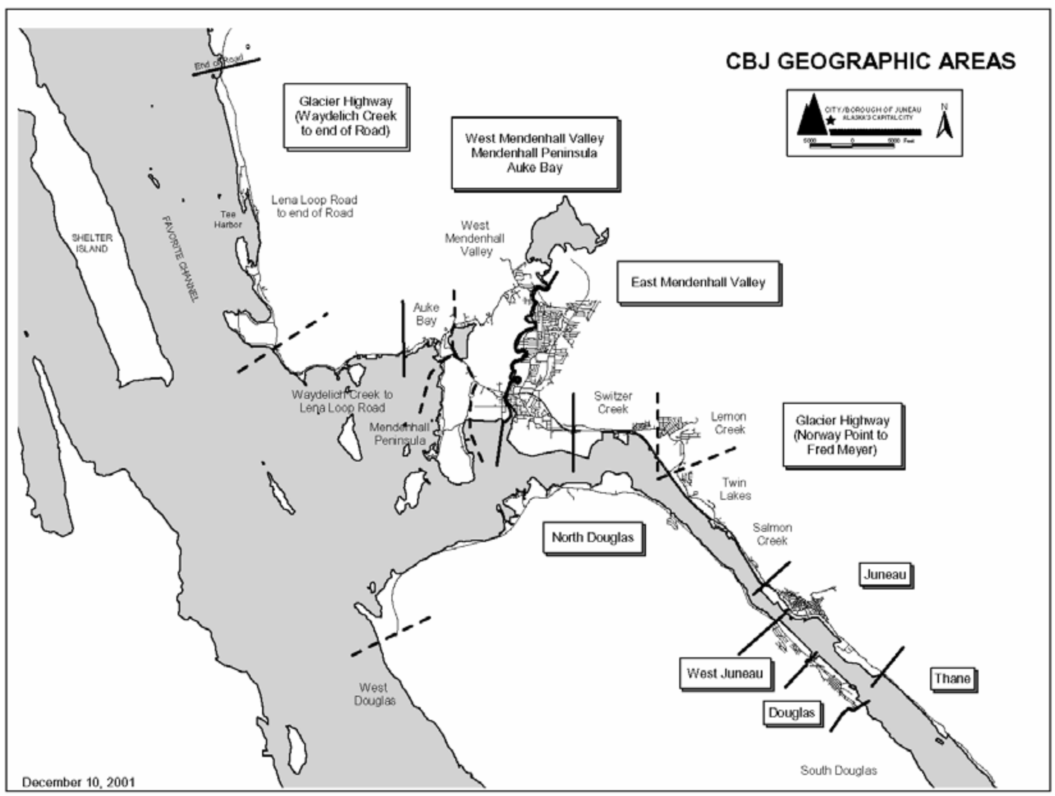
- Maximum allowable emission limit or federally enforceable permit limit;
- Actual or design capacity (whichever is greater) or federally enforceable permit limit; and
- Actual operating factor averaged over most recent two years.

Valley Demographics – In the course of preparing the estimate of Juneau home heating emissions, Sierra found that updating the population statistics to account for the growth that occurred since 1993 is not an easy task. This is because the boundaries of available demographic measurement systems (e.g., census tracts, etc.) do not match those of the Mendenhall Valley. We found that all available population metrics come from systems that bifurcate the Valley. Census Tract 2, for example, covers the eastern portion of the

[*]No water bodies, airports, or railroads are located within the boundaries of the nonattainment area. Therefore, boats and locomotives cannot contribute to the inventory. While an airport and heliport are adjacent to the southern boundary of the nonattainment area, aircraft and helicopter flights skirt the nonattainment area due to noise concerns and do not contribute to the inventory.

Valley. Census Tract 1, however, combines the western portion of the Valley with the Mendenhall Peninsula and Auke Bay. The western portion of the Mendenhall Peninsula and Auke Bay lie beyond the ridge that forms the western boundary of the Valley. No sources of population data could be identified for these areas (i.e., so that the population for the western portion of the Valley could be netted out of the available data). A further complicating factor is that portions of the south end of the Valley (i.e., the area surrounding the airport) were also excluded from the formal boundaries of the nonattainment area. No population data for this area could be identified either. A map of CBJ geographic areas presented in Figure 1 illustrates the problem.

Figure 1



In light of the inconsistency between Valley boundaries and demographic boundaries, we determined that the best method to update the population and dwelling estimates for the Valley was to assume that the growth experienced in the Valley was proportional to the growth experienced throughout the whole CBJ area. Borough-wide population statistics were obtained from the CBJ. Growth between 1988* and 2001 (the year most recently

* The emission inventory values reported in the 1993 SIP were the values produced in a 1988 report prepared by Engineering Science entitled "PM_{10} Emission Inventories for the Mendenhall Valley and Eagle River Areas." Emission calculations in that effort were based on 4,465 residential dwellings.

available) was determined to be 3.2%. This value was applied to the base estimates reported in the 1993 SIP. The resulting estimate of 4,608 dwellings was used to extrapolate the results of the survey to the rest of the Valley. Sierra plans to review the accuracy of these assumptions with CBJ staff to confirm their reasonableness for (a) estimating base year population levels in 2004 and (b) identifying appropriate growth indices for forecasting population levels in 2018.

Emission Calculation Methodologies

Annual and seasonal PM_{10} emissions will be computed on the basis of the activity data developed in Task 2 and emission factors derived from EPA's AP-42.[7] Emissions will be computed on an annual basis and on a 24-hour basis for average summer and winter days as requested in the RFP.

The method to be used to compute on-road emissions will distinguish between fugitive and vehicle exhaust, tire, and brake wear emissions. Since unpaved road characteristics have not changed since development of the 1993 PM_{10} attainment plan, the silt loadings published in the 1988 Engineering Science emission inventory and relied upon in the 1993 plan will be used to compute emissions for this source category. Estimates of the miles of unpaved roads and traffic levels will be updated with information obtained through contacts with relevant state and local agencies.

The fugitive dust source category in which substantial change has occurred, with respect to emission factor strength since 1993, is paved road travel. With the paving of a significant fraction of unpaved roads in the study region since 1993, the track-on of soil onto paved roads has declined substantially. Since the unpaved roads were the sources of much of the track-on material, the paving of these roads has resulted in the reduction of surface silt loadings during non-sanding periods to levels similar to those of average urban streets as reported in AP-42. Therefore, we will use average urban silt loadings in computing paved road emission factors for paved road travel, except during the road-sanding season. These values will be updated once the results of the silt survey become available.

Information on road sanding operations will be collected as a subtask under Task 2. Changes in abrasive composition, size distribution, and application rate will be identified through interviews of road maintenance agencies. Based on this information, adjustments to the silt loadings used in the 1993 emission inventory will be made and new emission factors for paved road travel during the road-sanding season will be developed.

Estimates of exhaust, tire, and brake wear emissions will be computed using MOBILE6.2. To develop these estimates, MOBILE6 will be configured to represent Juneau using average summer and winter temperature values, VMT by speed (using data collected in Task 2), Juneau-specific vehicle registration data, and VMT mix computed for Juneau. Available mileage accumulation rates (e.g., Anchorage, Fairbanks, national default, etc.) will be reviewed to determine the data source that most appropriately represents Juneau since the local data needed to characterize this profile is not currently available. The development of the Juneau profile will be prepared under a related NTP.

Area Source Emissions – Area source emissions will be computed for residential and commercial facilities located within the Valley. Sierra plans to use the results of last year's home heating survey and related emission calculations to quantify residential heating emissions in 2004. That effort prepared separate emission estimates for wood-use and fuel-oil heating. If the demographic information obtained in Task 2 revises the number of homes located in the Valley in 2004, the previous estimates will be adjusted to account for those revisions. The emission factors employed in that residential analysis will be combined with the number of commercial facilities and related fuel-use estimates to estimate commercial heating emissions.

Windblown dust emissions will be calculated using the emission factor methodology used by Engineering Science in the 1988 emission inventory report. The emission factor methodology relies on the current emission model described in AP-42, which will be configured using the soil particle size distribution data published in the 1988 emission inventory report.

Non-Road Emissions – Non-road emissions will be computed using EPA's NONROAD model. It calculates tons of emissions for a geographical area using the following factors:

- Equipment population;
- An equipment-specific emission factor (in grams per horsepower-hour);
- The average horsepower rating of the equipment;
- The estimated annual equipment activity factor (hours per year); and
- The average load factor for the engine.

In addition, seasonal (month or season) and day or week (i.e., weekday versus weekend) adjustments are applied depending on the requirements of the analysis. The equipment populations are based on national averages, and then scaled down to represent smaller geographic areas on the basis of human population and proximity to recreational, industrial, and commercial facilities.

Sierra is well aware that many of the national average default values employed in the NONROAD model do not well represent activity levels in Juneau (or Alaska). However, the development of location-specific information can be expensive and non-road equipment represents a relatively small portion of the Juneau PM_{10} inventory. For this reason, Sierra plans to focus on model assumptions about the equipment categories that are operating in Juneau during the summer and the winter based on data collected in Task 2 and making adjustments to assumed activity levels based on available Alaska- or Juneau-specific data.

Point Source Emissions – Point source emissions will be derived from permits obtained from ADEC for any sources that are currently operating within the Valley. If any sources are operating in the Valley, one issue that will need to be addressed is whether rule effectiveness has been applied to the emission calculations.

Demographic forecasts obtained in Task 2 will be used to support the extrapolation of activity levels from 2004 to 2018. Emission factors used to project emissions in 2018 will be updated from 2004 where information on the benefits of new control measures is available (e.g., MOBILE6).

###

QUALITY ASSURANCE PLAN

This section presents a review of the QA procedures to be employed during the development of the Mendenhall Valley PM_{10} emission inventory. It includes all of the critical elements recommended in the U.S. EPA document *Guidance for the Preparation of Quality Assurance Plans for Ozone/Carbon Monoxide State Implementation Plan Emission Inventories*,[8] as well as guidance provided through the Emission Inventory Improvement Program (EIIP).[9] It also provides written instructions for the technical and quality aspects associated with development of the new emission inventories. It is designed so that QA/QC procedures are implemented throughout the entire inventory development process. This will ensure that the inventory is as complete, accurate, comparable, and representative as possible.

Inventory tasks and QC procedures will include data checking by the inventory development team (IDT) throughout the development of the inventory and final emission report. These procedures include, but are not limited to, the following:

- The development and implementation of written procedures for data collection, data assessment, data handling, calculation of emissions, and reporting;

- Adequate management and supervision of the work;

- Review of all calculations for technical soundness and accuracy, including verification that the appropriate emission factors were used and the impacts of controls were correctly addressed;

- Correct assignment of Source Category Codes;

- Assignment of DARS scores;

- Use of technically sound approaches when developing results based on engineering judgment;

- Documentation of the data in a manner that will allow reconstruction of all inventory development activities; and

- Maintenance of an orderly master file of all the data gathered and a copy-ready version of the final inventory submitted to the Project Manager.

The emission inventories developed in accordance with this plan are for SIP development and are considered Level II, based on guidance provided by the 1996 EIIP. The estimates contained in the inventories will be used to make decisions about the need for and types of control strategies required to ensure attainment with the ambient PM_{10} standards. As a result, they must satisfy applicable quality assurance (QA) requirements.

The first step in this process is establishing the data quality objectives (DQO) for the new inventories. Table 1 summarizes of the procedures to be employed in meeting the DQOs. It shows that considerable effort will be focused on meeting accuracy, completeness, representativeness, and comparability objectives. Table 2 shows the data quality indicators (DQIs) that will be used to measure progress towards the DQOs. The Data Attribute Rating System (DARS)[10] will be used to verify the desired inventory accuracy.

Table 1
Data Quality Objectives

DQO	Procedure for Achieving Objective
Accuracy	For point and onroad mobile sources, the data generator will check 100% of the calculations, and another equally qualified inventory development team member will check 20% of the calculations. For area and nonroad mobile sources, the data generator will check 100% of the calculations, and another equally qualified IDT member will check 10% of the calculations. In all cases, the data validator will develop a written summary of his or her activities, and will conduct follow-up activities to ensure that data are corrected as needed. If more than 5% of the calculations checked by the data validator need to be revised, then 100% of the calculations will be checked.
Completeness	Extensive planning will be conducted prior to data collection to identify all applicable emission sources. After identifying these sources, the goal will be to determine 100% of the emissions from the largest emitting sources from each source category and as many of the minor sources as possible within the time frame allotted for the work. Those sources identified but not included in the inventory will be identified in the data file and final report.
Representativeness	Technical personnel will review all of the primary source data AND compare them to previous emission results and similar results from comparable regions to determine the reasonableness of the emissions estimates and representativeness of the data.
Comparability	To ensure that the data are comparable, standard procedures will be followed and results will be presented in the same units that were used in previous criteria and toxic pollutant inventories.

Table 2 Data Quality Indicators	
DQO	**Inventory DQI Target Values**
Accuracy	Achieve DARS score >= 0.7 for all area sources contributing >10% of total emissions of CO Achieve DARS score >=0.8 for all point sources >=70 tons per year (TPY). Achieve DARS score >=0.7 for onroad mobile source inventory. Achieve DARS score <=0.5 for nonroad mobile source inventory.
Completeness	100% of all point sources >= 70 tpy. 90% of all other point sources
Comparability	Results to be compared to the previous Mendenhall Valley inventory.

Managerial Responsibilities

Sierra will lead the preparation of the community emission inventories. Key assignments shall include those outlined below.

Source Inventory Development Managers – The source inventory development managers are responsible for planning and leading source-specific inventory development activities.

QA/QC Coordinator – The QA/QC Coordinator is responsible for ensuring that adequate QA/QC procedures are incorporated into the inventory development process. The QA Coordinator’s responsibilities and activities are as follows:

- Help develop the QAP;
- Provide QA training to inventory development and QA personnel;
- Attend inventory status meetings;
- Follow up on recommendation for corrective actions;
- Keep the Inventory Development Manager informed of actions;
- Work with the Project Manager to resolve any quality concerns that cannot be resolved at the inventory management level; and
- Maintain a file of findings and corresponding corrective actions.

The QA Coordinator reports directly to Sierra’s Project Manager overseeing the development of the inventory. These reporting lines help provide an objective approach to the implementation of the QA program and reporting of quality issues.

Schedule

Data collection activities are to be completed by early June. Emission inventory estimates will be completed and documented by the end of June.

General QA/QC Procedures

QA/QC procedures described in this QAP were developed to help ensure data accuracy, completeness, representativeness, and comparability. These procedures have been incorporated in the technical procedures, where applicable, and will be implemented by the IDT throughout the planning, data collection, emission estimation, and reporting phases of the inventory development program.

QC procedures will be implemented by the IDT during inventory development to meet the technical objectives and DQOs. These activities will be conducted at the following steps in the inventory development process:

- Data collection;
- Data documentation;
- Calculation of emissions;
- Data checking and DARS scoring;
- Reporting; and
- Maintenance of the master file.

Data collection will be conducted according to U.S. EPA-approved procedures. The approach and supporting documents or references will be thoroughly documented and included in the emissions report.

All activities conducted by the IDT will be documented. The traditional approach is to use bound notebooks with indices to facilitate the retrieval of recorded information. An alternate approach is to record activities electronically and make this information available to team members located in different parts of the state. To enhance communication and productivity, team members will be allowed to employ either approach but will be encouraged to track information relative to the development of the inventory electronically. This daily log of activities will help another IDT member reproduce the emission results and allow an evaluation of data accuracy and completeness.

The following procedures are to be followed when documenting data in the notebooks:

- Data will be recorded legibly and in black ink;

- Entries will be corrected by drawing a single line through the data and writing the correct data above or below the correction (with initials, date, and explanation of corrections to allow reconstruction of the work);

- Complete descriptions of all data sources will be included (references to be included in final inventory report);

- Units of measurements will provided for emission sources that are omitted from the final inventory (justification required in report);

- The procedures used to calculate emissions will be described and example calculations will be provided;

- The approach used to determine completeness for each source type will be described;

- Documents from which emission factors are taken will be identified and referenced; and

- The source, agency, group, or company providing information by telephone will be identified (include telephone number and date information was provided).

Worksheets and contact reports may also be used to maintain records of data sources or calculations; however, the same guidelines must be followed when recording information on them. A file will be developed specifically for these forms to ensure that they are retained and are easily located when the data are needed to calculate emissions. A contact report should include the date of contact; originator name, title, organization, and address of person contacted; and a summary. All worksheets, electronic spreadsheets, and notebooks will be reviewed periodically by the inventory development task leaders to determine whether the procedures described above are being followed. This review should be evidenced by a dated signature on the notebook pages or worksheets reviewed (i.e., reviewed by ________ on _______).

Data used in calculation emissions should be checked for data accuracy, reasonableness, and completeness. The results from data checking will be documented to further qualify the emission estimates. In addition to the DARS scores assigned, the number of data points checked assists reviewers in evaluating the accuracy of the completed emissions report. Documentation of DARS scoring and data checking should include descriptions of the rationale for scoring, the data checked, and the dated signature of the reviewer.

Data Reporting

Reporting will be accomplished by submitting written documentation and emissions summaries to the Project Manager. All supporting documentation, project notebooks, data sheets, and calculations shall be submitted for review.

The report will include summary tables, raw listings of equipment, activity levels and emissions from individual sources, and a QA documentation section. A detailed inventory report allows comparison of baseline inventories between one area and another and the evaluation of the impact of control strategies, and also facilitates updates to the inventory and development of projection inventories.

In addition to EIIP guidance, the U.S. EPA report *PM-10 Emission Inventory Requirements* will be followed. These documents provide guidance for presenting and documenting SIP emissions inventories, and contain examples of how to present and verify inventory development efforts. The QA documentation section of the emissions inventory will provide enough detail so that the inventory development described in the report can be compared to the information provided in this QAP. Any discrepancies will be identified and explained.

At a minimum, documentation should describe in general terms how the inventory data were collected and where they came from. The report will include the components listed below.

- A description of the geographic area included in the inventory, including documentation for any adjustments made to the original designated area. Documentation shall reference all sources of current or projected data, and include maps of borough boundaries for excluded areas.

- The base year of the emissions inventory.

- The population of the area, and the source of the population data.

- Efforts taken as part of the QA program.

- Procedures used to temporally allocate each source category (e.g., selection of the months comprising the seasons, seasonal variations in activity levels at sources, daily variation in activity levels, etc.).

The QA documentation section of the inventory report will describe each deviation from approved procedures or findings that could compromise the successful outcome of the inventory. Documentation of each finding will include a description of the action or data reviewed that led to the quality concern, along with a recommendation for corrective action. The QA documentation section of the inventory report will then discuss how the recommended corrective actions were implemented.

###

REFERENCES

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9. “Emission Inventory Improvement Program,” Volumes II-VI, prepared by State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), 1996.
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Appendix B

Demographic Estimates for City and Borough of Juneau, Mendenhall Valley

Demographic Estimates for

City and Borough of Juneau and Mendenhall Valley

Three separate demographic data sources are available for Juneau:

- U.S. Census Bureau (Census Bureau)
- Alaska Department of Labor and Workforce Development (DLWD)
- City and Borough of Juneau (CBJ)

The Census Bureau conducts detailed demographic surveys once every decade. The most recent census reports available are for 1990 and 2000. Additional population estimates are also available for more recent years. The Research and Analysis Section of the DLWD develops population growth forecasts for the state and individual Boroughs. The most current is for the period of 1998 – 2018. DLWD also has population and household estimates for recent years. CBJ has population estimates for the entire Borough and its subregions (e.g., Douglas, Lemon Creek, etc.). CBJ is the only source of population and household data for the nonattainment area; that estimate was prepared in 1993 for the "wood smoke control area of the Mendenhall Valley." A review of the 1993 SIP for the Mendenhall Valley shows that the boundaries of the wood smoke control area are the same as the boundaries of the nonattainment area.

The problem with developing demographic estimates for the Mendenhall Valley nonattainment area is that its boundaries do not match the boundaries of the demographic measurement systems (e.g., census tracts, Juneau subregions, etc.). Figure 1 displays CBJ geographic areas. It shows that the Mendenhall Valley is divided into two areas: east and west. The West Mendenhall Valley includes data for both the peninsula and for Auke Bay. The western portion of the Mendenhall Peninsula and Auke Bay lie beyond the ridge that forms the western boundary of the nonattainment area. The southern portion of the East Mendenhall Valley (the airport and adjacent areas) is below the southern boundary of the nonattainment area. Because of these inconsistencies, it is not possible to map population estimates from the available surveys to the nonattainment area.

The only approach available to prepare demographic estimates for the nonattainment area is to start with the 1993 CBJ estimates and assume that growth is proportional to the growth seen for the entire Borough. Implementing this assumption, however, is not straightforward as the population estimates available from DLWD and the Census Bureau are not always consistent. A summary of the demographic information needed to make the projections is presented by source in Table 1. The discussion is organized by calendar year.

Figure 1

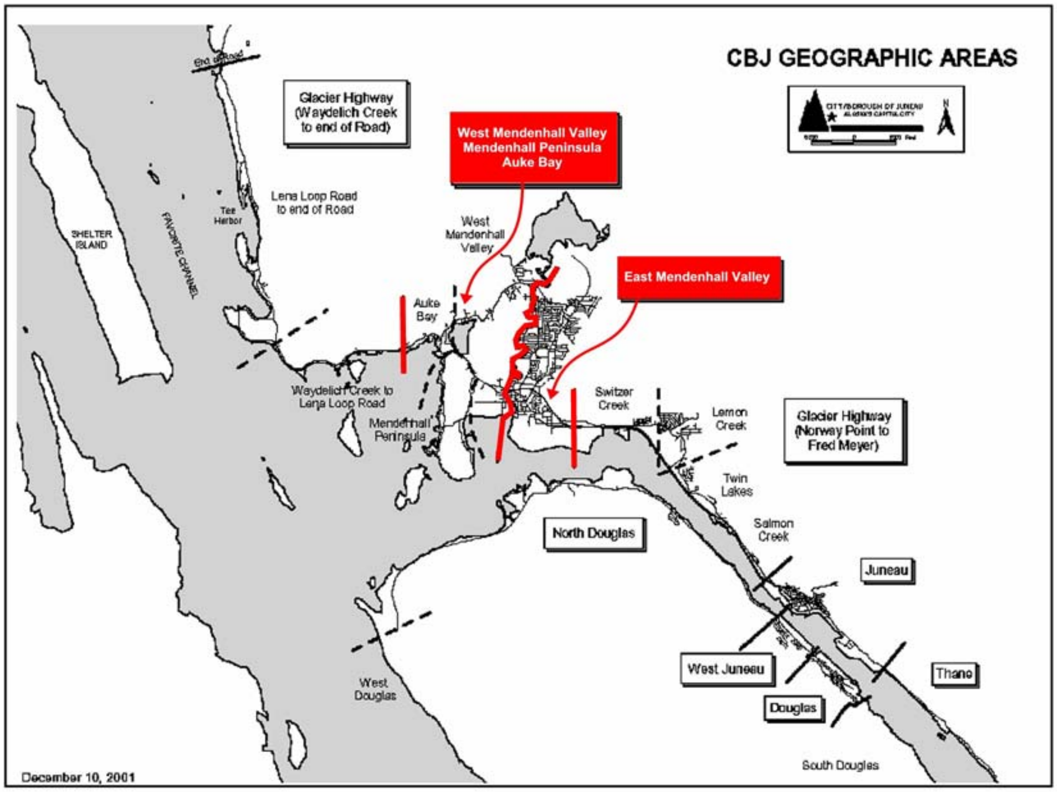

Table 1
Population and Housing Estimates for
City and Borough of Juneau and Mendenhall Valley Nonattainment Area

Year	City and Borough Juneau		Nonattainment Area	
	Population	Households	Population	Households
1988	29,946			**4,465**
1990	26,751	9,902		
1993	**27,882**		12,000	4,401
2000	30,711	11,543		
2002	**30,584**	**11,591**		
2004	30,966		**13,327**	**4,888**
2018	**33,774**		**14,535**	**5,331**

- 1988 – the year addressed in the Engineering Science PM_{10} emission inventory for the nonattainment area. Population estimates for the entire Borough are available from CBJ. The Engineering Science report did not present an estimate of either the number of households or the population of the nonattainment area. An estimate of the number of households, however, can be derived from fuel use information presented in the report.

- 1990 – year for which detailed census records are available.

- 1993 – year in which DEC conducted a wood smoke survey in the nonattainment area. Population and household estimates, prepared by CBJ for the nonattainment area (i.e., the wood smoke control area), were reported in the documentation[*] and used to support an evaluation of the survey coverage.

- 2000 – year for which detailed census records are available.

- 2002 – the year to be addressed in the criteria pollutant emission inventories for Anchorage, Fairbanks, and Juneau.

- 2004 – the base year of the PM_{10} emission inventory for the nonattainment area, also recent population estimates are available from DLWD and the Census Bureau.

- 2018 – the horizon year of the PM_{10} emission inventory for the nonattainment area.

All values obtained from the sources noted above are presented in a normal font. Derived values are presented in bold. Presented below is a description of the methodology used to prepare the derived values.

- The 1988 estimate of households was derived by dividing the total amount of fuel oil used for residential heating by the average amount of fuel use per home (2,179 x 10^3 gallons/800 gallons per home). The resulting estimate of 2,724 homes was increased to account for the fraction of homes that that did not use fuel oil (39%). The resulting estimate of 4,465 agrees very well with the CBJ value estimated for 1993. The difference between the estimates is 1% and the decline seen between 1988 and 1993 is consistent with the population decline reported over the same period.

- The 1993 City and Borough population estimate was derived by interpolating the annualized growth rate between the 1990 and 2000 Census values.

[*] 1993 Wood Heating Survey of Mendenhall Valley Residents, Alaska Department of Environmental Conservation, October 20, 1993

- The 2002 City and Borough population estimate was derived by selecting the mid-point between the 2000 Census value and the DLWD estimate for 2004. Surprisingly, the Census Bureau and DLWD offer different population estimates for 2004. (31,118 versus 30,966). The DLWD value was selected since that agency is focused exclusively on tracking Alaska demographic trends and is the sole source of growth projections for Juneau.

- The 2002 City and Borough household values were assumed to be proportional to the growth in population observed between 2000 and 2002. A review of the 1990 and 2000 Census values confirmed that housing growth tracks population growth very closely.

- The 2018 population projection for the City and Borough was derived from DLWD forecasts. Discussions with staff confirmed that the most current population forecast for Juneau was last prepared for the period 1998 – 2018.[*] A summary of the forecast is presented in Table 2. It shows that the growth rate for Juneau was projected to decline over the 20-year period addressed in the forecast. The annualized growth rate from 1998 – 2018 is 0.7% per year. Updates to this forecast are expected to be available later this year. As noted above, more current estimates of Juneau population levels are available (see the Department's website[†]). Those values, 30,966 for 2004 and 31,246 for 2003 show that population levels actually declined by 280 in 2004. Using the 2004 value as the baseline, options for projecting growth are to use (a) the Juneau-specific values employed in the somewhat dated 1998 – 2018 forecast or (b) the more current statewide forecast available at the above cited website. The current middle range forecast for the state is 1.0% per year for the period of 2004 – 2018. Since this value very closely matches the statewide forecast of 1.1% employed in the 1998 – 2018 forecast, the Juneau-specific forecast from 1998 – 2018 was used to project the 2004 base year population levels to 2018. The aggregate growth rate over this period is 9.0% (with an annualized rate of 0.62% per year) and the 2018 population level is forecasted to be 33,774.

Table 2
Mid-Range Population Forecasts for Juneau, Alaska

Year	Population	Growth Rate (%)
1998	30,236	-
2003	31,388	3.8
2008	32,413	3.3
2013	33,475	3.3
2018	34,447	2.9

[*] http://www.labor.state.ak.us/research/pop/pop-proj.pdf
[†] http://labor.state.ak.us/trends/feb05.pdf

- The 2018 population and household values for the nonattainment area were assumed to be proportional to the growth in Borough-wide population between 2004 and 2018.

###

Appendix C
On-Road Source Calculations

```
* CY2004 WINTER run for Mendenhall Valley Nonattainment Area
* PM10 Maintenance Plan

MOBILE6 INPUT FILE :
SPREADSHEET        :
PARTICULATES       :
RUN DATA           :

MIN/MAX TEMP       : 25.7 36.3
FUEL RVP           : 13.6
REG DIST           : jun_reg.prn

FUEL PROGRAM       : 4
338.0  338.0  338.0  160.0   90.0   90.0   60.0  60.0
 30.0   30.0   30.0   30.0   30.0   30.0   30.0  30.0
690.0  690.0  690.0  380.0  140.0  140.0  140.0  80.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0  80.0

SCENARIO RECORD    : Freeway - 50.5 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 1
AVERAGE SPEED      : 50.5 Freeway
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

SCENARIO RECORD    : Arterial - 37.2 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 1
AVERAGE SPEED      : 37.2 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

SCENARIO RECORD    : Arterial - 35.6 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 1
AVERAGE SPEED      : 35.6 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

SCENARIO RECORD    : Arterial - 20.8 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 1
AVERAGE SPEED      : 20.8 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

END OF RUN         :
```

```
* CY2004 SUMMER run for Mendenhall Valley Nonattainment Area
* PM10 Maintenance Plan

MOBILE6 INPUT FILE :
SPREADSHEET        :
PARTICULATES       :
RUN DATA           :

MIN/MAX TEMP       : 42.3 57.7
FUEL RVP           : 7.8
REG DIST           : jun_reg.prn

FUEL PROGRAM       : 4
338.0  338.0  338.0  160.0   60.0   60.0   60.0  60.0
 30.0   30.0   30.0   30.0   30.0   30.0   30.0  30.0
690.0  690.0  690.0  380.0  150.0  150.0  150.0  80.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0  80.0

SCENARIO RECORD    : Freeway - 50.5 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 7
AVERAGE SPEED      : 50.5 Freeway
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

SCENARIO RECORD    : Arterial - 37.2 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 7
AVERAGE SPEED      : 37.2 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

SCENARIO RECORD    : Arterial - 35.6 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 7
AVERAGE SPEED      : 35.6 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

SCENARIO RECORD    : Arterial - 20.8 mph
CALENDAR YEAR      : 2004
EVALUATION MONTH   : 7
AVERAGE SPEED      : 20.8 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 380

END OF RUN         :
```

```
* CY2018 WINTER run for Mendenhall Valley Nonattainment Area
* PM10 Maintenance Plan

MOBILE6 INPUT FILE :
SPREADSHEET        :
PARTICULATES       :
RUN DATA           :

MIN/MAX TEMP       : 25.7 36.3
FUEL RVP           : 13.6
REG DIST           : jun_reg.prn

FUEL PROGRAM       : 4
338.0  338.0  338.0  160.0   90.0   90.0   60.0  60.0
 30.0   30.0   30.0   30.0   30.0   30.0   30.0  30.0
690.0  690.0  690.0  380.0  140.0  140.0  140.0  80.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0  80.0

SCENARIO RECORD    : Freeway - 50.5 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 1
AVERAGE SPEED      : 50.5 Freeway
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

SCENARIO RECORD    : Arterial - 37.2 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 1
AVERAGE SPEED      : 37.2 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

SCENARIO RECORD    : Arterial - 35.6 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 1
AVERAGE SPEED      : 35.6 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

SCENARIO RECORD    : Arterial - 20.8 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 1
AVERAGE SPEED      : 20.8 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

END OF RUN         :
```

```
* CY2018 SUMMER run for Mendenhall Valley Nonattainment Area
* PM10 Maintenance Plan

MOBILE6 INPUT FILE :
SPREADSHEET        :
PARTICULATES       :
RUN DATA           :

MIN/MAX TEMP       : 42.3 57.7
FUEL RVP           : 7.8
REG DIST           : jun_reg.prn

FUEL PROGRAM       : 4
338.0  338.0  338.0  160.0   60.0   60.0   60.0  60.0
 30.0   30.0   30.0   30.0   30.0   30.0   30.0  30.0
690.0  690.0  690.0  380.0  150.0  150.0  150.0  80.0
 80.0   80.0   80.0   80.0   80.0   80.0   80.0  80.0

SCENARIO RECORD    : Freeway - 50.5 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 7
AVERAGE SPEED      : 50.5 Freeway
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

SCENARIO RECORD    : Arterial - 37.2 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 7
AVERAGE SPEED      : 37.2 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

SCENARIO RECORD    : Arterial - 35.6 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 7
AVERAGE SPEED      : 35.6 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

SCENARIO RECORD    : Arterial - 20.8 mph
CALENDAR YEAR      : 2018
EVALUATION MONTH   : 7
AVERAGE SPEED      : 20.8 Arterial
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15

END OF RUN         :
```

```
REG DIST
*
* JUNEAU AREA REGISTRATION DISTRIBUTION BY VEHICLE AGE
* (DATA SOURCE INDICATED AFTER VEHICLE CLASS)
*
* LDV         2000 DMV data
1     0.0366  0.0593  0.0553  0.0524  0.0465  0.0630  0.0611  0.0605  0.0590  0.0690
      0.0693  0.0654  0.0537  0.0469  0.0437  0.0418  0.0364  0.0214  0.0142  0.0091
      0.0072  0.0077  0.0058  0.0046  0.0102
* LDT1        2000 DMV data
2     0.0263  0.0495  0.0456  0.0557  0.0490  0.0638  0.0634  0.0500  0.0478  0.0522
      0.0615  0.0562  0.0396  0.0326  0.0416  0.0456  0.0424  0.0336  0.0248  0.0225
      0.0155  0.0183  0.0149  0.0116  0.0359
* LDT2        2000 DMV data
3     0.0263  0.0495  0.0456  0.0557  0.0490  0.0638  0.0634  0.0500  0.0478  0.0522
      0.0615  0.0562  0.0396  0.0326  0.0416  0.0456  0.0424  0.0336  0.0248  0.0225
      0.0155  0.0183  0.0149  0.0116  0.0359
* LDT3        2000 DMV data
4     0.0263  0.0495  0.0456  0.0557  0.0490  0.0638  0.0634  0.0500  0.0478  0.0522
      0.0615  0.0562  0.0396  0.0326  0.0416  0.0456  0.0424  0.0336  0.0248  0.0225
      0.0155  0.0183  0.0149  0.0116  0.0359
* LDT4        2000 DMV data
5     0.0263  0.0495  0.0456  0.0557  0.0490  0.0638  0.0634  0.0500  0.0478  0.0522
      0.0615  0.0562  0.0396  0.0326  0.0416  0.0456  0.0424  0.0336  0.0248  0.0225
      0.0155  0.0183  0.0149  0.0116  0.0359
* HDV2B       MOBILE62 default
6     0.0503  0.0916  0.0833  0.0758  0.0690  0.0627  0.0571  0.0519  0.0472  0.0430
      0.0391  0.0356  0.0324  0.0294  0.0268  0.0244  0.0222  0.0202  0.0184  0.0167
      0.0152  0.0138  0.0126  0.0114  0.0499
* HDV3        MOBILE62 default
7     0.0503  0.0916  0.0833  0.0758  0.069   0.0627  0.0571  0.0519  0.0472  0.043
      0.0391  0.0356  0.0324  0.0294  0.0268  0.0244  0.0222  0.0202  0.0184  0.0167
      0.0152  0.0138  0.0126  0.0114  0.0499
* HDV4        MOBILE62 default
8     0.0388  0.0726  0.0679  0.0635  0.0594  0.0556  0.052   0.0486  0.0455  0.0425
      0.0398  0.0372  0.0348  0.0326  0.0304  0.0285  0.0266  0.0249  0.0233  0.0218
      0.0204  0.0191  0.0178  0.0167  0.0797
* HDV5        MOBILE62 default
9     0.0388  0.0726  0.0679  0.0635  0.0594  0.0556  0.052   0.0486  0.0455  0.0425
      0.0398  0.0372  0.0348  0.0326  0.0304  0.0285  0.0266  0.0249  0.0233  0.0218
      0.0204  0.0191  0.0178  0.0167  0.0797
* HDV6        MOBILE62 default
10    0.0388  0.0726  0.0679  0.0635  0.0594  0.0556  0.052   0.0486  0.0455  0.0425
      0.0398  0.0372  0.0348  0.0326  0.0304  0.0285  0.0266  0.0249  0.0233  0.0218
      0.0204  0.0191  0.0178  0.0167  0.0797
* HDV7        MOBILE62 default
11    0.0388  0.0726  0.0679  0.0635  0.0594  0.0556  0.0520  0.0486  0.0455  0.0425
      0.0398  0.0372  0.0348  0.0326  0.0304  0.0285  0.0266  0.0249  0.0233  0.0218
      0.0204  0.0191  0.0178  0.0167  0.0797
* HDV8a       MOBILE62 default
12    0.0388  0.0726  0.0679  0.0635  0.0594  0.0556  0.0520  0.0486  0.0455  0.0425
      0.0398  0.0372  0.0348  0.0326  0.0304  0.0285  0.0266  0.0249  0.0233  0.0218
      0.0204  0.0191  0.0178  0.0167  0.0797
* HDV8b       MOBILE62 default
13    0.0388  0.0726  0.0679  0.0635  0.0594  0.0556  0.0520  0.0486  0.0455  0.0425
      0.0398  0.0372  0.0348  0.0326  0.0304  0.0285  0.0266  0.0249  0.0233  0.0218
      0.0204  0.0191  0.0178  0.0167  0.0797
* HDBS        MOBILE62 default
14    0.0393  0.0734  0.0686  0.0641  0.0599  0.0559  0.0522  0.0488  0.0456  0.0426
      0.0398  0.0372  0.0347  0.0324  0.0303  0.0283  0.0264  0.0247  0.0231  0.0216
      0.0201  0.0188  0.0176  0.0165  0.0781
* HDBT        MOBILE62 default
15    0.0307  0.0614  0.0614  0.0614  0.0614  0.0614  0.0614  0.0614  0.0614  0.0613
      0.0611  0.0607  0.0595  0.0568  0.0511  0.0406  0.0254  0.0121  0.0099  0.0081
      0.0066  0.0054  0.0044  0.0037  0.0114
* Motorcycles MOBILE62 default
16    0.1440  0.1680  0.1350  0.1090  0.0880  0.0700  0.0560  0.0450  0.0360  0.0290
      0.0230  0.0970  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
      0.0000  0.0000  0.0000  0.0000  0.0000
```

Appendix D
Nonroad Source Calculations

Summer 2004 Nonroad Model Output Details

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	1.6544	65	40,819
Recreational Equipment	All Terrain Vehicles	1.0435	1,121	1,802,858
Logging Equipment	Chain Saws > 6 HP	0.9268	119	18,092
Recreational Equipment	Motorcycles: Off-road	0.8007	288	461,470
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.6923	37	27,979
Construction and Mining Equipment	Skid Steer Loaders	0.6358	58	31,139
Construction and Mining Equipment	Rubber Tire Loaders	0.4662	15	7,762
Construction and Mining Equipment	Crawler Tractor/Dozers	0.3705	10	6,535
Construction and Mining Equipment	Excavators	0.3458	14	9,921
Construction and Mining Equipment	Off-highway Trucks	0.2573	2	1,873
Construction and Mining Equipment	Rough Terrain Forklifts	0.2026	12	5,400
Construction and Mining Equipment	Rollers	0.1276	10	4,834
Construction and Mining Equipment	Concrete/Industrial Saws	0.0988	11	4,537
Construction and Mining Equipment	Scrapers	0.0936	2	1,124
Construction and Mining Equipment	Graders	0.0826	3	2,086
Industrial Equipment	AC\Refrigeration	0.0819	10	7,686
Construction and Mining Equipment	Trenchers	0.0811	9	3,330
Commercial Equipment	Generator Sets	0.0766	157	11,331
Construction and Mining Equipment	Cranes	0.0765	4	2,385
Construction and Mining Equipment	Bore/Drill Rigs	0.0702	15	2,078
Lawn and Garden Equipment	Chain Saws < 6 HP	0.0561	162	4,490
Construction and Mining Equipment	Other Construction Equipment	0.0558	1	566
Recreational Equipment	Specialty Vehicles/Carts	0.0548	105	6,699
Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters	0.0545	434	7,248
Construction and Mining Equipment	Off-highway Tractors	0.0490	0	254
Construction and Mining Equipment	Pavers	0.0442	3	1,573
Lawn and Garden Equipment	Leafblowers/Vacuums	0.0427	228	5,282
Commercial Equipment	Welders	0.0402	14	3,613
Commercial Equipment	Pumps	0.0342	41	4,839
Construction and Mining Equipment	Tampers/Rammers	0.0341	16	1,731
Commercial Equipment	Air Compressors	0.0300	8	2,553
Industrial Equipment	Forklifts	0.0285	8	8,274
Construction and Mining Equipment	Signal Boards/Light Plants	0.0193	7	2,475
Logging Equipment	Shredders > 6 HP	0.0184	736	18,411
Construction and Mining Equipment	Crushing/Processing Equipment	0.0172	2	737
Lawn and Garden Equipment	Lawn and Garden Tractors	0.0165	367	25,303
Lawn and Garden Equipment	Lawn Mowers	0.0112	1,005	39,988
Construction and Mining Equipment	Paving Equipment	0.0111	13	1,746
Railroad Equipment	Railway Maintenance	0.0097	1	294
Industrial Equipment	Terminal Tractors	0.0086	0	273
Industrial Equipment	Other General Industrial Equipment	0.0080	2	721
Lawn and Garden Equipment	Chippers/Stump Grinders	0.0073	0	329
Construction and Mining Equipment	Surfacing Equipment	0.0070	2	772
Commercial Equipment	Pressure Washers	0.0066	63	3,642
Industrial Equipment	Sweepers/Scrubbers	0.0066	1	512
Pleasure Craft	Outboard	0.0052	75	63
Lawn and Garden Equipment	Front Mowers	0.0051	2	824
Lawn and Garden Equipment	Rotary Tillers < 6 HP	0.0051	105	4,341
Industrial Equipment	Aerial Lifts	0.0046	2	348
Construction and Mining Equipment	Cement and Mortar Mixers	0.0045	26	1,637
Construction and Mining Equipment	Plate Compactors	0.0044	14	2,023
Lawn and Garden Equipment	Turf Equipment	0.0038	5	4,548
Construction and Mining Equipment	Dumpers/Tenders	0.0023	3	402

Continued on following page

Summer 2004 Nonroad Model Output Details, Continued

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Construction and Mining Equipment	Dumpers/Tenders	0.0023	3	402
Agricultural Equipment	Agricultural Tractors	0.0020	0	34
Industrial Equipment	Other Material Handling Equipment	0.0012	0	30
Lawn and Garden Equipment	Rear Engine Riding Mowers	0.0011	54	2,935
Pleasure Craft	Personal Water Craft	0.0011	10	9
Lawn and Garden Equipment	Other Lawn and Garden Equipment	0.0009	21	1,870
Commercial Equipment	Gas Compressors	0.0005	0	82
Agricultural Equipment	Combines	0.0004	0	2
Lawn and Garden Equipment	Shredders < 6 HP	0.0001	1	103
Agricultural Equipment	Other Agricultural Equipment	0.0001	0	1
Pleasure Craft	Inboard/Sterndrive	0.0000	18	15
Agricultural Equipment	Sprayers	0.0000	0	1
Agricultural Equipment	Swathers	0.0000	0	0
Agricultural Equipment	Irrigation Sets	0.0000	0	1
Agricultural Equipment	Hydro-power Units	0.0000	0	1
Agricultural Equipment	Balers	0.0000	0	0
Agricultural Equipment	Tillers > 6 HP	0.0000	0	2
Agricultural Equipment	2-Wheel Tractors	0.0000	0	0
Agricultural Equipment	Agricultural Mowers	0.0000	0	0
Industrial Equipment	Other Oil Field Equipment	0.0000	-	-
Lawn and Garden Equipment	Snowblowers	0.0000	263	-
Recreational Equipment	Golf Carts	0.0000	-	-
Recreational Equipment	Snowmobiles	0.0000	1,347	-
	Total (tons/season)	8.90		
	Total (tons/day)	0.05		

Winter 2004 Nonroad Model Output Details

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	1.6544	65	40,819
Logging Equipment	Chain Saws > 6 HP	0.9268	119	18,092
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.3477	37	14,053
Construction and Mining Equipment	Skid Steer Loaders	0.3194	58	15,640
Construction and Mining Equipment	Rubber Tire Loaders	0.2341	15	3,898
Construction and Mining Equipment	Crawler Tractor/Dozers	0.1861	10	3,282
Construction and Mining Equipment	Excavators	0.1737	14	4,983
Construction and Mining Equipment	Off-highway Trucks	0.1292	2	941
Construction and Mining Equipment	Rough Terrain Forklifts	0.1018	12	2,712
Commercial Equipment	Generator Sets	0.0766	157	11,331
Industrial Equipment	AC\Refrigeration	0.0672	10	6,300
Construction and Mining Equipment	Rollers	0.0641	10	2,428
Construction and Mining Equipment	Concrete/Industrial Saws	0.0496	11	2,279
Construction and Mining Equipment	Scrapers	0.0470	2	564
Lawn and Garden Equipment	Snowblowers	0.0451	376	6,741
Construction and Mining Equipment	Graders	0.0415	3	1,048
Construction and Mining Equipment	Trenchers	0.0407	9	1,672
Commercial Equipment	Welders	0.0402	14	3,613
Construction and Mining Equipment	Cranes	0.0384	4	1,198
Construction and Mining Equipment	Bore/Drill Rigs	0.0353	15	1,044
Commercial Equipment	Pumps	0.0342	41	4,839
Commercial Equipment	Air Compressors	0.0300	8	2,553
Construction and Mining Equipment	Other Construction Equipment	0.0280	1	284
Recreational Equipment	Specialty Vehicles/Carts	0.0248	105	3,029
Construction and Mining Equipment	Off-highway Tractors	0.0246	0	127
Industrial Equipment	Forklifts	0.0234	8	6,782
Construction and Mining Equipment	Pavers	0.0222	3	790
Logging Equipment	Shredders > 6 HP	0.0184	736	18,411
Construction and Mining Equipment	Tampers/Rammers	0.0171	16	869
Railroad Equipment	Railway Maintenance	0.0097	1	294
Construction and Mining Equipment	Signal Boards/Light Plants	0.0097	7	1,243
Construction and Mining Equipment	Crushing/Processing Equipment	0.0086	2	370
Industrial Equipment	Terminal Tractors	0.0070	0	224
Commercial Equipment	Pressure Washers	0.0066	63	3,642
Industrial Equipment	Other General Industrial Equipment	0.0065	2	591
Construction and Mining Equipment	Paving Equipment	0.0056	13	877
Industrial Equipment	Sweepers/Scrubbers	0.0054	1	420
Industrial Equipment	Aerial Lifts	0.0038	2	285
Construction and Mining Equipment	Surfacing Equipment	0.0035	2	388
Recreational Equipment	Snowmobiles	0.0029	59	59
Construction and Mining Equipment	Cement and Mortar Mixers	0.0023	26	822
Construction and Mining Equipment	Plate Compactors	0.0022	14	1,016
Construction and Mining Equipment	Dumpers/Tenders	0.0011	3	202
Industrial Equipment	Other Material Handling Equipment	0.0010	0	24
Pleasure Craft	Outboard	0.0009	75	11
Agricultural Equipment	Agricultural Tractors	0.0008	0	13
Commercial Equipment	Gas Compressors	0.0005	0	82
Pleasure Craft	Personal Water Craft	0.0002	10	2
Agricultural Equipment	Combines	0.0002	0	1
Agricultural Equipment	Other Agricultural Equipment	0.0000	0	0
Agricultural Equipment	Sprayers	0.0000	0	0
Agricultural Equipment	Swathers	0.0000	0	0
Pleasure Craft	Inboard/Sterndrive	0.0000	18	3

Continued on following page

Winter 2004 Nonroad Model Output Details, Continued

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Agricultural Equipment	Irrigation Sets	0.0000	0	0
Agricultural Equipment	Hydro-power Units	0.0000	0	0
Agricultural Equipment	Balers	0.0000	0	0
Agricultural Equipment	Tillers > 6 HP	0.0000	0	1
Agricultural Equipment	2-Wheel Tractors	0.0000	0	0
Agricultural Equipment	Agricultural Mowers	0.0000	0	0
Recreational Equipment	All Terrain Vehicles	0.0000	1,121	-
Lawn and Garden Equipment	Chain Saws < 6 HP	0.0000	231	-
Lawn and Garden Equipment	Chippers/Stump Grinders	0.0000	1	-
Lawn and Garden Equipment	Front Mowers	0.0000	3	-
Recreational Equipment	Golf Carts	0.0000	-	-
Lawn and Garden Equipment	Lawn and Garden Tractors	0.0000	524	-
Lawn and Garden Equipment	Lawn Mowers	0.0000	1,436	-
Lawn and Garden Equipment	Leafblowers/Vacuums	0.0000	326	-
Recreational Equipment	Motorcycles: Off-road	0.0000	288	-
Lawn and Garden Equipment	Other Lawn and Garden Equipment	0.0000	31	-
Industrial Equipment	Other Oil Field Equipment	0.0000	-	-
Underground Mining Equipment	Other Underground Mining Equipment	0.0000	-	-
Lawn and Garden Equipment	Rear Engine Riding Mowers	0.0000	77	-
Lawn and Garden Equipment	Rotary Tillers < 6 HP	0.0000	150	-
Lawn and Garden Equipment	Shredders < 6 HP	0.0000	2	-
Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters	0.0000	620	-
Lawn and Garden Equipment	Turf Equipment	0.0000	7	-
	Total (tons/season)	4.92		
	Total (tons/day)	0.03		

Summer 2018 Nonroad Model Output Details

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Logging Equipment	Chain Saws > 6 HP	1.33	171	25,942
Recreational Equipment	Motorcycles: Off-road	0.66	460	736,252
Construction and Mining Equipment	Skid Steer Loaders	0.35	76	40,708
Recreational Equipment	All Terrain Vehicles	0.35	1,935	3,111,907
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.34	48	36,496
Construction and Mining Equipment	Concrete/Industrial Saws	0.09	11	4,639
Construction and Mining Equipment	Rubber Tire Loaders	0.07	20	10,143
Lawn and Garden Equipment	Chain Saws < 6 HP	0.06	284	3,854
Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters	0.06	760	6,223
Commercial Equipment	Generator Sets	0.05	219	15,844
Lawn and Garden Equipment	Leafblowers/Vacuums	0.05	400	4,540
Construction and Mining Equipment	Rough Terrain Forklifts	0.05	16	7,062
Recreational Equipment	Specialty Vehicles/Carts	0.04	114	7,759
Construction and Mining Equipment	Tampers/Rammers	0.03	16	1,759
Commercial Equipment	Pumps	0.03	56	6,729
Construction and Mining Equipment	Bore/Drill Rigs	0.03	16	2,497
Commercial Equipment	Welders	0.03	19	5,089
Construction and Mining Equipment	Crawler Tractor/Dozers	0.02	14	8,558
Logging Equipment	Shredders > 6 HP	0.02	1,056	26,399
Construction and Mining Equipment	Rollers	0.02	12	6,203
Lawn and Garden Equipment	Lawn and Garden Tractors	0.02	654	22,128
Construction and Mining Equipment	Trenchers	0.02	11	4,104
Construction and Mining Equipment	Other Construction Equipment	0.01	2	735
Industrial Equipment	Forklifts	0.01	11	10,662
Construction and Mining Equipment	Scrapers	0.01	2	1,472
Construction and Mining Equipment	Signal Boards/Light Plants	0.01	9	3,232
Commercial Equipment	Air Compressors	0.01	12	3,597
Construction and Mining Equipment	Off-highway Tractors	0.01	1	332
Lawn and Garden Equipment	Lawn Mowers	0.01	1,776	34,603
Commercial Equipment	Pressure Washers	0.01	87	5,030
Construction and Mining Equipment	Cranes	0.01	5	3,114
Pleasure Craft	Outboard	0.01	80	68
Railroad Equipment	Railway Maintenance	0.00	1	395
Lawn and Garden Equipment	Rotary Tillers < 6 HP	0.00	187	3,784
Construction and Mining Equipment	Paving Equipment	0.00	13	1,859
Lawn and Garden Equipment	Chippers/Stump Grinders	0.00	1	337
Industrial Equipment	Aerial Lifts	0.00	2	388
Industrial Equipment	AC\Refrigeration	0.00	14	10,404
Lawn and Garden Equipment	Turf Equipment	0.00	8	3,986
Construction and Mining Equipment	Pavers	0.00	4	1,989
Construction and Mining Equipment	Cement and Mortar Mixers	0.00	26	1,727
Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	0.00	56	34,736
Construction and Mining Equipment	Plate Compactors	0.00	15	2,258
Construction and Mining Equipment	Crushing/Processing Equipment	0.00	2	926
Construction and Mining Equipment	Surfacing Equipment	0.00	2	817
Lawn and Garden Equipment	Front Mowers	0.00	4	887
Construction and Mining Equipment	Excavators	0.00	18	12,992
Construction and Mining Equipment	Dumpers/Tenders	0.00	3	452
Industrial Equipment	Other General Industrial Equipment	0.00	1	574
Lawn and Garden Equipment	Rear Engine Riding Mowers	0.00	96	2,561
Industrial Equipment	Other Material Handling Equipment	0.00	0	35
Construction and Mining Equipment	Graders	0.00	4	2,732
Pleasure Craft	Personal Water Craft	0.00	11	9

Continued on following page

Summer 2018 Nonroad Model Output Details, Continued

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Lawn and Garden Equipment	Other Lawn and Garden Equipment	0.00	38	1,632
Commercial Equipment	Gas Compressors	0.00	0	114
Agricultural Equipment	Agricultural Tractors	0.00	0	44
Agricultural Equipment	Combines	0.00	0	3
Industrial Equipment	Sweepers/Scrubbers	0.00	1	613
Industrial Equipment	Terminal Tractors	0.00	1	362
Pleasure Craft	Inboard/Sterndrive	0.00	20	17
Lawn and Garden Equipment	Shredders < 6 HP	0.00	3	90
Agricultural Equipment	Sprayers	0.00	0	1
Agricultural Equipment	Swathers	0.00	0	0
Agricultural Equipment	Other Agricultural Equipment	0.00	0	1
Agricultural Equipment	Irrigation Sets	0.00	0	1
Agricultural Equipment	Balers	0.00	0	0
Agricultural Equipment	Tillers > 6 HP	0.00	0	2
Agricultural Equipment	Hydro-power Units	0.00	0	1
Agricultural Equipment	2-Wheel Tractors	0.00	0	0
Agricultural Equipment	Agricultural Mowers	0.00	0	0
Construction and Mining Equipment	Off-highway Trucks	-	2	2,452
Industrial Equipment	Other Oil Field Equipment	-	-	-
Lawn and Garden Equipment	Snowblowers	-	467	-
Recreational Equipment	Golf Carts	-	-	-
Recreational Equipment	Snowmobiles	-	2,028	-
Underground Mining Equipment	Other Underground Mining Equipmer	-	-	-
	Total (tons/season)	3.87		
	Total (tons/day)	0.02		

Winter 2018 Nonroad Model Output Details

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Logging Equipment	Chain Saws > 6 HP	1.33	171	25,942
Construction and Mining Equipment	Skid Steer Loaders	0.18	76	20,446
Construction and Mining Equipment	Tractors/Loaders/Backhoes	0.17	48	18,330
Lawn and Garden Equipment	Snowblowers	0.06	467	8,372
Commercial Equipment	Generator Sets	0.05	219	15,844
Construction and Mining Equipment	Concrete/Industrial Saws	0.05	11	2,330
Construction and Mining Equipment	Rubber Tire Loaders	0.04	20	5,095
Commercial Equipment	Pumps	0.03	56	6,729
Commercial Equipment	Welders	0.03	19	5,089
Construction and Mining Equipment	Rough Terrain Forklifts	0.02	16	3,547
Logging Equipment	Shredders > 6 HP	0.02	1,056	26,399
Recreational Equipment	Specialty Vehicles/Carts	0.02	114	3,508
Construction and Mining Equipment	Tampers/Rammers	0.02	16	884
Construction and Mining Equipment	Bore/Drill Rigs	0.02	16	1,254
Construction and Mining Equipment	Crawler Tractor/Dozers	0.01	14	4,298
Industrial Equipment	Forklifts	0.01	11	8,739
Construction and Mining Equipment	Rollers	0.01	12	3,116
Construction and Mining Equipment	Trenchers	0.01	11	2,061
Commercial Equipment	Air Compressors	0.01	12	3,597
Construction and Mining Equipment	Other Construction Equipment	0.01	2	369
Commercial Equipment	Pressure Washers	0.01	87	5,030
Railroad Equipment	Railway Maintenance	0.00	1	395
Construction and Mining Equipment	Scrapers	0.00	2	739
Recreational Equipment	Snowmobiles	0.00	89	89
Construction and Mining Equipment	Signal Boards/Light Plants	0.00	9	1,623
Construction and Mining Equipment	Off-highway Tractors	0.00	1	167
Industrial Equipment	Aerial Lifts	0.00	2	318
Industrial Equipment	AC\Refrigeration	0.00	14	8,528
Construction and Mining Equipment	Cranes	0.00	5	1,564
Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	0.00	56	34,736
Construction and Mining Equipment	Paving Equipment	0.00	13	934
Construction and Mining Equipment	Pavers	0.00	4	999
Construction and Mining Equipment	Cement and Mortar Mixers	0.00	26	867
Construction and Mining Equipment	Plate Compactors	0.00	15	1,134
Construction and Mining Equipment	Crushing/Processing Equipment	0.00	2	465
Construction and Mining Equipment	Surfacing Equipment	0.00	2	410
Construction and Mining Equipment	Excavators	0.00	18	6,526
Industrial Equipment	Other General Industrial Equipment	0.00	1	470
Pleasure Craft	Outboard	0.00	80	12
Industrial Equipment	Other Material Handling Equipment	0.00	0	29
Construction and Mining Equipment	Dumpers/Tenders	0.00	3	227
Commercial Equipment	Gas Compressors	0.00	0	114
Construction and Mining Equipment	Graders	0.00	4	1,372
Agricultural Equipment	Agricultural Tractors	0.00	0	17
Industrial Equipment	Sweepers/Scrubbers	0.00	1	503
Pleasure Craft	Personal Water Craft	0.00	11	2
Agricultural Equipment	Combines	0.00	0	1
Industrial Equipment	Terminal Tractors	0.00	1	297
Agricultural Equipment	Sprayers	0.00	0	0
Agricultural Equipment	Swathers	0.00	0	0
Pleasure Craft	Inboard/Sterndrive	0.00	20	3
Agricultural Equipment	Other Agricultural Equipment	0.00	0	0
Agricultural Equipment	Irrigation Sets	0.00	0	0

Continued on following page

Winter 2018 Nonroad Model Output Details, Continued

Equipment Description	Equipment Type	PM (tons/season)	Population (# units)	Activity (total hrs)
Agricultural Equipment	Balers	0.00	0	0
Agricultural Equipment	Tillers > 6 HP	0.00	0	1
Agricultural Equipment	Hydro-power Units	0.00	0	0
Agricultural Equipment	2-Wheel Tractors	0.00	0	0
Agricultural Equipment	Agricultural Mowers	0.00	0	0
Construction and Mining Equipment	Off-highway Trucks	-	2	1,232
Recreational Equipment	All Terrain Vehicles	-	1,935	-
Lawn and Garden Equipment	Chain Saws < 6 HP	-	284	-
Lawn and Garden Equipment	Chippers/Stump Grinders	-	1	-
Lawn and Garden Equipment	Front Mowers	-	4	-
Recreational Equipment	Golf Carts	-	-	-
Lawn and Garden Equipment	Lawn and Garden Tractors	-	654	-
Lawn and Garden Equipment	Lawn Mowers	-	1,776	-
Lawn and Garden Equipment	Leafblowers/Vacuums	-	400	-
Recreational Equipment	Motorcycles: Off-road	-	338	-
Lawn and Garden Equipment	Other Lawn and Garden Equipment	-	38	-
Industrial Equipment	Other Oil Field Equipment	-	-	-
Underground Mining Equipment	Other Underground Mining Equipment	-	-	-
Lawn and Garden Equipment	Rear Engine Riding Mowers	-	96	-
Lawn and Garden Equipment	Rotary Tillers < 6 HP	-	187	-
Lawn and Garden Equipment	Shredders < 6 HP	-	3	-
Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters	-	760	-
Lawn and Garden Equipment	Turf Equipment	-	8	-
	Total (tons/season)	2.13		
	Total (tons/day)	0.01		

Appendix E
Area Source Calculations

Used Oil Calculations:

1983 National burn rate (gallons/yr)	590,000,000
Prorated 2004 National burn rate (gallons/yr)	741,071,948
Prorated 2004 Mendenhall Consumption (gallons/yr)	33,632
Prorated 2018 Mendenhall Consumption (gallons/yr)	36,681

	2004	2018
AP-42 Table 1.3-1 EFs (lbs/1,000 gal)	0.4	0.4
Winter (lbs/season)	13	15
Winter (lbs/day)	0.07	0.08
Winter (tons/day)	0.000037	0.000040

Propane Calculations:

	Propane Throughput		
	2004 Juneau	2004 Mendenhall	2018 Mendenhall
gallons/year	711,392		
gallons/winter	366,321	157,503	171,779
gallons/summer	345,071	148,366	161,815

	PM10
PM10 EF (lbs/1000 gal)	0.4
2004 Winter (tpd)	0.00017
2004 Summer (tpd)	0.00016
2018 Winter (tpd)	0.00019
2018 Summer (tpd)	0.00018

Emission Factor: AP-42 Table 1.5-1, for Commercial Boilers

Open Burning (Firefighter Training) Calculations:

gallons burned/exercise:	200
Exercises/yr:	28
Total gallons burned/yr in MOA	5,600
Assumed gallons burned in 1999 in Mendenhall Valley:	273

	PM10
EFs (lbs/10^3 gal), AP-42 table 1.3-1	0.4
Summer tons	0.0001
Summer tpd	0.0000003

Structural Fires Calculations:

Data from Capital City Fire/Rescue Fire Marshal data on 2004 (Rich Etheridge, 907-586-0251, 8/18/05)

Incidences in 2004 (fires/year) =	27
% of fires in Valley =	70%
% of fires in Winter =	65%

	# fires/day
winter	0.0675
summer	0.0361

	PM10
EF (lbs/fire)	13.8
winter tpd	0.0005
summer tpd	0.0002

CARB's Index of Areawide Source Methodologies
Section 7.14: Structure and Automobile Fires (March 1999)

Fugitive Dust Calculations:

Windblown Dust (from 1988 PM10 Inventory)

glacial riverbeds	28.6	tons/yr
cleared areas	4.4	tons/yr
TOTAL Windblown Dust:	33.0	tons/yr

Calendar Year	Season	Paved Road PM10 (tpd)	Unpaved Road PM10 (tpd)	Windblown Dust (tpd)	TOTAL
2004	Winter	1.478	0.161	0.181	1.821
2004	Summer	4.135	0.190	0.181	4.506
2018	Winter	1.612	0.176	0.181	1.969
2018	Summer	4.510	0.207	0.181	4.898

<u>Burn Barrels Calculations:</u>

PM10 Emission Factor (lb/ton) =	16	EPA AP-42 Emissions from Municipal Refuse Burning, 10/92.	
Annual waste generation rate (lb/household) =	2137	CARB "ISOR Proposed ATCM to Reduce Emissions of TACs from Outdoor Residential Waste Burning," 1/4/02	
	CY2004	CY2018	
Total households in Valley =	4888	5331	
Other Assumptions:			
All burning in summer (prohibited in winter)			
Some percentage to trash pick up	90%	75%	
Sensitivity Analysis for range burned	10%	25%	
Summer PM10 Emissions (tpd) =	0.023	0.057	Summer 2004
Summer PM10 Emissions (tpd) =	0.025	0.062	Summer 2018

Winter 2004 Woodburning Emission Calculations:

Equipment Description	# Survey Households Equipped	% Survey Households Equipped*	Projected Valley Households Equipped	Cords Burned by Survey Households (cords/season)	Cords Burned by Valley Households (tons/season)	Tons Burned by Valley Households (tons/season)	PM10 (#/ton of wood burned)	PM10 (tons/day)
Wood Stove	93	16.8%	819	65.3	575	690.40	30.6	0.058
Conventional Fireplace	53	9.6%	467	37.2	328	393.45	23.6	0.025
Modified Fireplace	12	2.2%	106	8.4	74	89.08	23.6	0.006
Other Non-Pellet woodburning device	4	0.7%	35	2.8	25	29.69	23.6	0.002
Total	162	29.2%	1,427	113.8	1,002	1202.6		
Total # Homes Equipped with One or More Non-Pellet Woodburning Unit	127	29.2%	1,427					0.091

				# 40 lb Stove Pellet bags	tons Pellets burned per season	Tons Burned by Valley Households	PM10 (#/ton of Pellets burned)	PM10 (tons/day)
Pellet Stove	22	5.1%	247	1,097	21.9	246.61	8.8	0.006
Total	435	34.3%	4,888					

TOTAL (tpd): 0.097

Summer 2004 Woodburning Calculations:

Equipment Description	# Survey Households Equipped	% Survey Households Equipped*	Projected Valley Households Equipped	Cords Burned by Survey Households (cords/season)	Cords Burned by Valley Households (tons/season)	Tons Burned by Valley Households (tons/season)	PM10 (#/ton of wood burned)	PM10 (tons/day)
Wood Stove	93	16.8%	819	22.5	198	238.08	30.6	0.020
Conventional Fireplace	53	9.6%	467	12.8	113	135.68	23.6	0.009
Modified Fireplace	12	2.2%	106	2.9	26	30.72	23.6	0.002
Other Non-Pellet woodburning device	4	0.7%	35	1.0	9	10.24	23.6	0.001
Total	162	29.2%	1,427	39.2	346	414.7		
Total # Homes Equipped with One or More Non-Pellet Woodburning Unit	127	29.2%	1,427					0.031

				# 40 lb Stove Pellet bags	tons Pellets burned per season	Tons Burned by Valley Households	PM10 (#/ton of Pellets burned)	PM10 (tons/day)
Pellet Stove	22	5.1%	247	375	7.5	84.20	8.8	0.002
Total	435	34.3%	4,888					

TOTAL (tpd): 0.033

Winter 2018 Woodburning Emission Calculations:

Equipment Description	# Survey Households Equipped	% Survey Households Equipped*	Projected Valley Households Equipped	Cords Burned by Survey Households (cords/season)	Cords Burned by Valley Households (tons/season)	Tons Burned by Valley Households (tons/season)	PM10 (#/ton of wood burned)	PM10 (tons/day)
Wood Stove	93	16.8%	893	65.3	627	752.97	30.6	0.063
Conventional Fireplace	53	9.6%	509	37.2	358	429.11	23.6	0.028
Modified Fireplace	12	2.2%	115	8.4	81	97.16	23.6	0.006
Other Non-Pellet woodburning device	4	0.7%	38	2.8	27	32.39	23.6	0.002
Total	162	29.2%	1,556	113.8	1,093	1311.6		
Total # Homes Equipped with One or More Non-Pellet Woodburning Unit	127	29.2%	1,556					0.099

				# 40 lb Stove Pellet bags	tons Pellets burned per season	Tons Burned by Valley Households	PM10 (#/ton of Pellets burned)	PM10 (tons/day)
Pellet Stove	22	5.1%	270	1,097	21.9	268.96	8.8	0.007
Total	435	34.3%	5,331					

TOTAL (tpd): 0.106

Summer 2018 Woodburning Emission Calculations:

Equipment Description	# Survey Households Equipped	% Survey Households Equipped*	Projected Valley Households Equipped	Cords Burned by Survey Households (cords/season)	Cords Burned by Valley Households (tons/season)	Tons Burned by Valley Households (tons/season)	PM10 (#/ton of wood burned)	PM10 (tons/day)
Wood Stove	93	16.8%	893	22.5	216	259.66	30.6	0.022
Conventional Fireplace	53	9.6%	509	12.8	123	147.98	23.6	0.010
Modified Fireplace	12	2.2%	115	2.9	28	33.50	23.6	0.002
Other Non-Pellet woodburning device	4	0.7%	38	1.0	9	11.17	23.6	0.001
Total	162	29.2%	1,556	39.2	377	452.3		
Total # Homes Equipped with One or More Non-Pellet Woodburning Unit	127	29.2%	1,556					0.034

				# 40 lb Stove Pellet bags	tons Pellets burned per season	Tons Burned by Valley Households	PM10 (#/ton of Pellets burned)	PM10 (tons/day)
Pellet Stove	22	5.1%	270	375	7.5	91.83	8.8	0.002
Total	435	34.3%	5,331					

TOTAL (tpd): 0.036

2004 Fuel Oil Emission Calculations:

Equipment Description	# Survey Households Equipped	% Survey Households Equipped*	Projected Valley Households Equipped	Average Winter Fuel Use for Survey Households (gal/hhold/season)	Average Summer Fuel Use for Survey Households (gal/hhold/year)	Total Winter Fuel Use for Valley Households (103 gallons/season)	Total Summer Fuel Use for Valley Households (103 gallons/year)	# PM_{10} per 10^3 gallons burned	Winter PM_{10} Emissions (tons/season)	Summer PM_{10} Emissions (tons/season)
Direct Vent Heater (i.e., Toyo, Monitor)	147	31.5%	1,537							
Central Oil Furnace	272	58.2%	2,845							
Total	419	89.7%	4,382	390	216	1,708	947	0.4	0.34	0.19
Total # Homes Equipped with One or More Oil Heating Units	390	89.7%	4,382							
Totals	435		4,888					tons/day:	0.002	0.001

* Note that these percentages were normalized to 89.7% to account for homes with more than one type of unit.

2018 Fuel Oil Calculations:

Equipment Description	# Survey Households Equipped	% Survey Households Equipped*	Projected Valley Households Equipped	Average Winter Fuel Use for Survey Households (gal/hhold/season)	Average Summer Fuel Use for Survey Households (gal/hhold/year)	Total Winter Fuel Use for Valley Households (103 gallons/season)	Total Summer Fuel Use for Valley Households (103 gallons/year)	# PM_{10} per 10^3 gallons burned	Winter PM_{10} Emissions (tons/season)	Summer PM_{10} Emissions (tons/season)
Direct Vent Heater (i.e., Toyo, Mon	147	31.5%	1,677							
Central Oil Furnace	272	58.2%	3,103							
Total	419	89.7%	4,780	390	216	1,863	1,033	0.4	0.37	0.21
Total # Homes Equipped with One or More Oil Heating Units	390	89.7%	4,780							
Totals	435		5,331					tons/day:	0.002	0.001

* Note that these percentages were normalized to 89.7% to account for homes with more than one type of unit.