TECHNICAL SUPPORT DOCUMENT FOR ON-ROAD MOBILE SOURCES: $PM_{2.5}$ EMISSIONS INVENTORY FOR 2016 BASELINE YEAR AND PROJECTION YEARS 2017, 2019, and 2020 FOR THE SALT LAKE CITY, UTAH $PM_{2.5}$ NONATTAINMENT AREA AND SURROUNDING MODELING DOMAIN WITHIN UTAH

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Planning Branch/Mobile Sources

Abstract

This report discusses the on-road mobile source section of the $PM_{2.5}$ SIP baseline and projection inventories for the Salt Lake City, Utah $PM_{2.5}$ nonattainment area covering Box Elder, Davis, Salt Lake, Tooele and Weber Counties and the remaining 24 counties within the state of Utah.

On-road inventories were calculated using the EPA MOVES2014a (Motor Vehicle Emission Simulator). $PM_{2.5}$ and PM_{10} fugitive paved roads road dust were calculated using AP-42 Chapter 13.2.1, "Introduction to Fugitive Dust Sources, section 13.2.1, "Paved Roads" (published in Federal Register on Feb. 4, 2011).

Baseline and projection year on-road mobile source emissions inventories were developed by the following agencies:

Salt Lake City, Utah $PM_{2.5}$ nonattainment area Counties:
Wasatch Front Regional Council (WFRC): Box Elder, Davis, Salt Lake, Tooele and Weber Counties

Surrounding Modeling Domain:
Cache Metropolitan Planning Organization (CMPO): Cache County
Mountainland Association of Governments (MAG): Utah County
Utah Division of Air Quality (UDAQ): Beaver, Carbon, Daggett, Duchesne, Emery, Garfield, Grand, Iron, Juab, Kane, Millard, Morgan, Piute, Rich, San Juan, Sanpete, Sevier, Summit, Uintah, Wasatch, Washington, and Wayne Counties

The on-road mobile source baseline and projection inventories were developed from meteorological conditions from three $PM_{2.5}$ episodes: 2011 January 1-12, 2013 December 7-19, and 2016 February 1-17. Hourly average temperature, relative humidity, and precipitation profiles were used to reflect the atmospheric conditions that represent the $PM_{2.5}$ season.

Local activity travel data inputs were developed and implemented to characterize winter travel conditions for a weekday Monday-Friday, Saturday, and Sunday expressed as Vehicle Miles of Travel (VMT).

Summary on-road emissions table inventories for a representative winter weekday are located at the end of the TSD for the following years: 2016, 2017, 2019, and 2020.

3.e.ii) ON-ROAD MOBILE SOURCES PM10 EMISSIONS INVENTORIES

LIST OF TABLES

ii. Overview

The purpose of this document is to explain what emissions modeling assumptions were used to develop the on-road mobile emissions estimates for the Baseline and Projection Inventories for the $PM_{2.5}$ SIP for the Salt Lake City Utah $PM_{2.5}$ nonattainment area. The emissions estimates included in this analysis follow the $PM_{2.5}$ Emission Inventory Preparation Plan (IPP May 11 2017), an outline that describes the specific procedures used to compile an emissions inventory for a modeling domain that includes three separate $PM_{2.5}$ areas.

Emission estimates are based on meteorological conditions that occurred during three $PM_{2.5}$ episodes: 2011 January 1-12, 2013 December 7-19, and 2016 February 1-17. The $PM_{2.5}$ SIP covers the baseline year of 2016 and future years: 2017, 2019, and 2020. Inventory estimations were created at the county level for all twenty nine counties within the state of Utah representing an average January weekday, Saturday, and Sunday.

Emission estimates are confined to the EPA approved MOVES2014a (Oct 2015) emissions model. This model produces emissions estimates for on-road vehicles by providing emissions profiles for exhaust, evaporative, and wear conditions. Inputs include speeds, vehicle fuel profiles and specifications, vehicle miles traveled (VMT), Inspection and Maintenance program profiles, VMT mix, vehicle age distributions, and meteorological conditions. PM_{10} and $PM_{2.5}$ fugitive dust emissions from paved roads emissions are estimated by the EPA approved calculation identified in AP-42 Chapter 13.2 (2011). Inputs include VMT, precipitation, and average vehicle weight.

The following agencies developed on-road mobile source emissions inventories:

<u>$PM_{2.5}$ SIP for the Salt Lake City Utah $PM_{2.5}$ nonattainment area Counties:</u>
WFRC: Box Elder, Davis, Salt Lake, Tooele, and Weber Counties

<u>Surrounding Modeling Domain:</u>
CMPO: Cache County
MAG: Utah County
UDAQ: Beaver, Carbon, Daggett, Duchesne, Emery, Garfield, Grand, Iron, Juab, Kane, Millard, Morgan, Piute, Rich, San Juan, San Pete, Sevier, Summit, Uintah, Wasatch, Washington, and Wayne Counties.

iii. MOVES Modeling Procedure

The discussion below identifies the procedures followed to model the episodic inventories.

1. MOVES Default Database Enhancement for Local Roads

The local road enhancement allows the EPA MOVES2014a model to produce emissions results according to the Highway Performance Monitoring System (HPMS) utilized by the Federal Highway Administration, Utah Department of Transportation, Wasatch Front Regional Council (WFRC), Cache Metropolitan Planning Organization (CMPO), Mountainland Association of Governments (MAG), and the Utah Division of Air Quality (UDAQ). Arterial and local roads have very different travel characteristics. This simplified approach allows each road type to have specific vmt, speed and vehicle distribution by road type (vehicle mix) inputs. Modeling specific road types creates an inventory approach that matches the HPMS road types that are reported within local transportation plans.

Modifications to Local Road Tables

Table Names	Data Columns	Description of Changes
avgspeeddistribution	roadTypeID	Road types rural local(32) and urban local(52) added.
drivescheduleassoc	avgSpeedBinID	
hourvmtfraction	driveScheduleID	
roadtype	hourVMTFraction	
roadtypedist	roadDesc	
zoneroadtype	roadTypeVMTFraction	

2. MOVES2014 Daily Pollutants

(a) Pollutants selected for analysis:

- Ammonia (NH3)
- Benzene
- Carbon Monoxide(CO)
- Chloride
- Methane
- Nitrogen Oxide(NO)
- Oxides of Nitrogen (NOx)
- $PM_{2.5}$ (Elemental Carbon, Organic Carbon, Sulfate Particulate)
- $PM_{2.5}$ & PM_{10} (Primary Exhaust, Brake, & Tire)
- Sulfur Dioxide (SO2)
- Toluene
- Non-methane Hydrocarbons
- Total Energy
- Total Gaseous Hydrocarbons
- Total Organic Gases
- Volatile Organic Compounds
- Xylene

3. MOVES2014 Input Development

(a) County Data Manager Development

MOVES organizes data inputs into databases called County Data Manager (CDM) tables. CDMs were developed for all 29 counties for each year: 2016, 2017, 2019, and 2020 for an average weekday, Saturday, and Sunday.

(1) Average Speed Distribution

WFRC method:
WFRC created a program titled TDM2MOVES to generate MOVES input files from the Cube 6.4 travel demand model output. The TDM2MOVES program creates speed profiles, road type distribution, ramp fractions, VMT by vehicle type, and vehicle population data files to be used in the MOVES model. WFRC has detailed MOVES input files extracted from travel demand model results for the years 2011 and 2019. The speed profile from the 2011 data set was used to model SIP years 2016 and 2017; the speed profile for 2019 was used to model SIP years 2019, 2020.

CMPO method:
Cache MPO obtained average speed distributions from its Travel Demand Model. The TDM analyzes over 3,290 separate traffic segments called "links" that together comprise the network of roads in Cache County. Each link is assigned, for each of the four major time periods during the day (AM peak, midday, PM peak and nighttime), an average speed, an increment of VMT and an increment of VHT (vehicle hours traveled). A specific number of links are assigned to each of the UDOT HPMS functional classes (road types, e.g., rural local, urban local, rural minor arterial, urban minor arterial, and so on). In effect, average speeds, VMT and VHT for each of the functional classes are combined to obtain average speed, VMT and VHT for rural arterials, urban arterials, rural local roads and urban local roads. (There are no interstates in Cache County).

MAG method:
MAG utilized the 2015 Utah County Average Speed Distribution file the TDM produces in the format appropriate for use in the MOVES model.

UDAQ method:
The "Easy Mobile Inventory Tool" (EMIT) created by FHWA was used to create a MOBILE6 speed input file utilizing the Highway Capacity Manual method. UDOT Division of Systems Planning and Programing provided 2014 lane miles and VMT by county for the calculation.

(2) AVFT (Diesel and Gasoline Fractions)

WFRC,CMPO, and MAG method:
The MOVES default file for AVFT (alternative vehicle and fuel technology) was updated with 2015 State DMV data on fuel type for registered light duty vehicles (passenger cars and light duty trucks). The DMV fractions were applied to all model years. MOVES2014a default AVFT values were used for all remaining source type vehicles. This local data shows a higher percentage of diesel fueled vehicles among the light duty trucks (vehicle types 31 and 32, or SUV's and pickup trucks) than the default AVFT data. This difference is even more pronounced in counties with a greater proportion of rural population (Box Elder and Tooele Counties).

UDAQ method:
MOVES2014a default AVFT values were used.

(3) Fuel

WFRC, CMPO, MAG, and UDAQ method:
MOVES2014a default fuel parameter values were used for the year 2014. MOVES 2014a default fuel parameters for diesel and CNG were used for 2017-2020. MOVES2014a default fuel parameter values for tier 2 gasoline from the year 2016 were used for 2017-2020. The fuel supply table was adjusted to contain fuel formulations from 2016 to meet this fuel specification. This adjustment was made for the following reasons:

1. For the years 2017-2020 small volume refiners that serve Utah are not required to comply with federal Tier 3 gasoline requirements.

2. For the years from 2020 forward there are no current federal or state requirements guaranteeing that Tier 3 fuel will be available in the marketplace as refiners can use the averaging, banking and trading program to meet federal Tier 3 gasoline requirements.

   However if the state of Utah receives a guarantee from the local refineries that tier 3 fuel sales will be guaranteed in the marketplace the MOVES2014a default value for Tier 3 gasoline value will be utilized.

(4) HourVMTFraction

WFRC, CMPO, MAG, and UDAQ method:
MOVES2014a default Hour VMT Fraction values were used.

(5) HPMSvTypeYear (VMT)

WFRC method:
For 2014 VMT estimates, WFRC used the HPMS data reported by the Utah Department of Transportation. A review of this data showed a large jump from 2014 to 2015 as shown in the table below. Based on a review of HPMS data for the urbanized counties of northern Utah (Cache, Box Elder, Weber, Davis, Salt Lake, Tooele, and Utah) from 1994 to 2015, the HPMS data is typically growing about 2.1% annually. The HPMS data below shows the growth from 2014 to 2015 to be almost three times that rate. After discussing this anomaly with UDOT personnel responsible for the HPMS data, the abrupt increase from 2014 to 2015 is not due to a sudden growth of VMT in 2015 but rather it is due to undercounting in 2014. The HPMS data is based on a relatively few number of permanent and portable counting stations. When a station reports an unusual change in counts, this change is not included in the final data until it is confirmed by subsequent counts in future years. This eliminates aberrations in the data, but also can postpone reporting real growth in traffic volumes by as much as three years. That appears to be the case with the abrupt increase in VMT reported in 2015.

HPMS VMT – AADT

	2011	2012	2013	2014	2015
Cache	2,346,733	2,400,832	2,409,992	2,461,422	2,614,440
Box Elder	2,413,435	2,403,800	2,451,381	2,494,889	2,665,711
Davis	6,865,827	6,920,842	6,950,795	7,091,459	7,671,676
Salt Lake	23,825,042	23,951,856	24,315,465	24,856,962	25,917,196
Tooele	2,226,402	2,253,293	2,242,074	2,250,906	2,364,434
Weber	4,390,708	4,415,756	4,378,705	4,509,744	4,775,688
Utah	10,324,856	10,488,668	10,831,331	11,183,981	12,057,270
Total	52,393,004	52,835,048	53,579,743	54,849,363	58,066,415
Growth Rate		0.8%	1.4%	2.4%	5.9%

Rather than assigning most of the growth in VMT to the 2014-2015 period, WFRC interpolated the growth from 2011-2015 for a more uniform growth rate. This results in the 2014 VMT being about 1,800,000 greater (or 2.5%) than reported. This adjusted value for 2014 VMT was used in the SIP development.

Adjusted HPMS VMT - AADT

	2011	2012	2013	2014	2015
Cache	2,346,733	*2,413,660*	*2,480,587*	*2,547,514*	2,614,440
Box Elder	2,413,435	*2,476,504*	*2,539,573*	*2,602,642*	2,665,711
Davis	6,865,827	*7,067,289*	*7,268,752*	*7,470,214*	7,671,676
Salt Lake	23,825,042	*24,348,081*	*24,871,119*	*25,394,158*	25,917,196
Tooele	2,226,402	*2,260,910*	*2,295,418*	*2,329,926*	2,364,434
Weber	4,390,708	*4,486,953*	*4,583,198*	*4,679,443*	4,775,688
Utah	10,324,856	*10,757,959*	*11,191,063*	*11,624,167*	12,057,270
Total	52,393,004	*53,811,357*	*55,229,710*	*56,648,062*	58,066,415
Growth Rate		*2.7%*	*2.6%*	*2.6%*	*2.5%*

The adjusted HPMS data represents AADT values. These values need to be corrected to winter traffic and to weekday, Saturday, and Sunday variations. Using seasonal factors and day of week factors the following 2014 VMT estimates were used for counties in the WFRC region.

Adjusted Winter AWKDT - 2014

	AWKDT
Box Elder	2,655,265
Davis	7,660,233
Salt Lake	27,336,995
Tooele	2,389,674
Weber	4,779,205

For the other years in the SIP inventory (2017, 2019, 2020), WFRC began with existing travel demand model data sets for the years 2011 and 2019. The VMT used in the existing data sets was then interpolated for all the intervening years including the years to be modeled for SIP inventories. The average annual VMT growth rate from 2015 to 2026 was then determined for each county as summarized in the table below.

Average Annual VMT Growth

Compound Annual Increase	HPMS 2011-2015	WFRC Model 2015-2026
Box Elder	2.517%	2.001%
Davis	2.813%	1.626%
Salt Lake	2.127%	1.747%
Tooele	1.515%	2.526%
Weber	2.123%	1.633%
WE-DA-SL	2.582%	1.633%
TOTAL	2.236%	1.765%

The annual growth rate was then applied to the 2015 HPMS data for the corresponding county to project VMT out to the year 2026. These AADT projections were then converted to winter season weekdays, Saturdays, and Sundays. In addition, based on the 5.9% growth rate anomaly in HPMS data identified from 2014 to 2015, the projected VMT values for each county and each year was increased by 5% to allow for unanticipated fluctuations in future VMT estimates.

Emission estimates for 2016 were performed at a later date (April 2018) than the modeling described above. At the time of the 2016 modeling HPMS data for 2016 was available. The 2016 HPMS data is reported in AADT and was converted to AWKDT to be consistent with other modeling assumptions. However, the 5% growth factor described in the paragraphs above was not applied to the 2016 HPMS data (but probably should have been included).

CMPO method:
CMPO utilized UDOT HPMS 2014 counts.

MAG method:
MAG utilized UDOT HPMS 2016 counts.

UDAQ method:
The Utah Department of Transportation (UDOT) provided HPMS VMT data reported as average annual day traffic (AADT) for calendar years 1996-2015. An adjustment was made to the HPMS VMT data for 2014. To account for this increase in the base year and future projection years UDOT HPMS values were interpolated between 2011 and 2015 by HPMS facility class. VMT was projected to the year 2050 via linear regression for positive growth and curvilinear fit for negative growth. UDOT provided average vmt daily adjustment factors (2012) to provide winter month and daily activity detail.

(6) I/M Coverage: Davis, Salt Lake, Utah, and Weber Counties

UDAQ constructed I/M Program coverages in consultation with the local county health departments in Cache, Davis, Salt Lake, Utah, and Weber Counties. Years that were covered include 2016, 2017, 2019, and 2020. The Cache County I/M program exempts the first six model years and perform a biennial test on vehicles begining in the seventh model year. Davis, Salt Lake, Utah and Weber Counties I/M programs exempt the first two model years, biennially test the third through sixth model years, and perform an annual test on the remaining vehicles. Vehicles older than 1995 undergo a Two Speed Idle (TSI) test and vehicles newer than 1996 undergo On Board Diagnostic Testing (OBD). Below is a summary covering I/M programs in the year 2016.

Summary of the I/M Programs for Davis, Salt Lake, Utah, and Weber Counties covering 2016.

Summary of the I/M Program for Cache County

Year	Vehicle Type	Beg Model Year	End Model Year	Frequency	I/M Test
2016	Cars & Trucks	1968	1995	Biennial	TSI
2016	Cars & Trucks	1996	2007	Biennial	OBD
2016	Cars & Trucks	2008	2010	Biennial	OBD

Year	Vehicle Type	Beg Model Year	End Model Year	Frequency	I/M Test
2016	Cars & Trucks	1968	1995	Annual	TSI
2016	Cars & Trucks	1996	2007	Annual	OBD
2016	Cars & Trucks	2008	2010	Annual	OBD
2016	Cars & Trucks	2011	2014	Biennial	OBD

Summary of additional I/M Program coverage test procedures

County	Beg Model Year	End Model Year	I/M Test
Salt Lake	1968	1995	ASM (Only calendar Year 2011)
Davis	1990	1995	Gas Cap Pressure Test
Salt Lake	1968	2001	Gas Cap Pressure Test
Weber	1968	2001	Gas Cap Pressure Test

(7) Road Type Distribution

WFRC method:
The TDM2MOVES program discussed in the Speed Profile section also generates road distribution files to be used in the MOVES model. Road distribution files from the 2011 data set were used to model SIP years 2016 and 2017; the road distribution for 2019 was used to model SIP years 2019 and 2020.

CMPO method:
UDOT Division of Systems Planning and Programming provided 2014 VMT travel fractions for FHWA vehicle classes grouped by Gross Vehicle Weight Rating (GVWR) ranges. The travel fractions were obtained by county from automated pneumatic counters that detect axle spacing and "weigh-in motion" (WIM) counters placed on arterial, interstate, and local roads. CMPO TDM 2014 VMT and Vehicle Mix data were used to construct road type distribution and VMT by sourcetype by year.

MAG method:
MAG utilized the 2015 Utah County RoadtypeDistribution file the TDM produces in the format appropriate for use in the MOVES model. The file is reported as percentage of vehicle activity on each road type with the sum for each vehicle type equal to 100%.

UDAQ method: UDOT Division of Systems Planning and Programming provided 2014 VMT travel fractions for FHWA vehicle classes grouped by Gross Vehicle Weight Rating (GVWR) ranges. The travel fractions were sorted according to MOVES vehicle types and adjusted to default MOVES travel fractions. UDOT 2014 HPMS VMT and Vehicle Mix data were used to construct road type distribution and VMT by sourcetype by year.

(8) Source Type Age Distribution

WFRC method:
The vehicle age distribution data for vehicle types 11, 21, 31, 32, and 54 (motorcycles, passenger cars, passenger trucks, light duty commercial trucks, and motor homes) was based on DMV registration data for 2014. For other vehicle types the age distribution used MOVES default values because the state DMV data is an incomplete source for these vehicle types. The age distribution was prepared for each county in the WFRC region and held constant for all years modeled in the SIP.

CMPO method:
Utah Department of Motor Vehicle (DMV) provided a single age distribution for passenger cars (21) and light trucks (31,32) for 2015. MOVES2014a default age distribution values were used for all remaining source type vehicles. The EPA age distribution tool was used to calculate future age distributions for source types 21,31, and 32.

MAG method:
MAG utilized DMV and local IM data and UDOT HPMS data in combination with MOVES age default for truck data for the appropriate year

UDAQ method:
MOVES2014a default Age Distribution values were used.

(9) Source Type Year (Vehicle Population)

WFRC method: WFRC estimates vehicle population as a function of estimated vehicle miles traveled (VMT). The WFRC estimates VMT using a sophisticated travel demand model which is based on projections for employment, population, land use, mode choice, and other factors. By associating vehicle population with travel demand model VMT estimates, the resulting vehicle population estimates will reflect to some degree the variations in future socio-economic factors, as well as shifts in mode choice resulting from transportation plans that emphasize alternative modes of travel. For example, a transportation plan that invests in an increase in transit mode choice should also result in some reduction in the number of vehicles.The WFRC compiled an inventory of 2014 vehicle population using State DMV data, State School bus reports, Utah Transit Authority annual reports, and MOVES defaults.

For MOVES vehicle types 21, 31, and 32 (passenger cars, and light duty trucks), the DMV total was multiplied by the MOVES default percentage for these vehicle types. This eliminates vehicle classification discrepancies between the MOVES default and the state classification. The vehicle population values were then divided by the 2014 VMT interpolated from HPMS data for the years 2011 to 2015 to create a vehicle population factor for each vehicle type.

CMPO and UDAQ method:
MOVES2014a default Source Type values were used.

MAG method:
MAG utilized historical DMV and local IM data & growth factors combined with UDOT HPMS counts for the appropriate year and MOVES default for truck distribution & growth

(10) ZoneMonthHour (Meteorological Data)

WFRC, CMPO, MAG, UDAQ method:

The UDAQ Technical Analysis Section provided metrological conditions from Meso West University of Utah from three $PM_{2.5}$ episodes: 2011 January 1-12, 2013 December 7-19, and 2016 February 1-17. The UDAQ modeling section provided hourly temperature and relative humidity profiles from representative weather stations in Box Elder, Cache, Davis, Salt Lake, Tooele, Utah, and Weber counties. The meteorology data represents the hour by hour average for all of the days in the 2011 January 1-12, 2013 December 7-19, and 2016 February 1-17 PM2.5 episodes. The average of all the hourly temperatures and relative humidity readings over the three episodes for each representative weather station was used to reflect the atmospheric conditions that represent the PM 2.5 season.

iv. Nonattainment Modeling Procedure

WFRC provided countywide emissions estimates for Box Elder, Davis, Salt Lake, Tooele, and Weber Counties for the DAQ modeling demonstration to show attainment of the NAAQS. For the purposes of transportation conformity DAQ determined that the Motor Vehicle Emissions Budget (MVEB) consist of the Salt Lake $PM_{2.5}$ non-attainment area boundary only. DAQ requested that WFRC prepare a revised inventory of emissions for 2017, 2019, and 2020 excluding portions of Box Elder and Tooele Counties that extend beyond the Salt Lake PM2.5 non-attainment area boundary.

WFRC prepared the MVEB emissions estimates with the following assumptions:

Percentage of County Population and VMT within the Salt Lake $PM_{2.5}$ Non-attainment Area

County	Population	VMT
Box Elder	88.1%	83.1%
Tooele	94.2%	47.2%

WFRC created a GIS definition for the Salt Lake $PM_{2.5}$ Non-attainment Area Boundary and used this to filter population and VMT data from the travel demand model. Population data is used as a surrogate for vehicle population. Tooele County data reveals that 94% of the population (and presumably the vehicle population) is within the non-attainment boundary, but only 47% of the VMT is accumulated within the boundary. This is due to the fact that only 26% of the Tooele County freeway traffic falls within the boundary. Using the factors above, the VMT and vehicle population input files for Tooele County and Box Elder County for the years 2017, 2019, and 2020 were modified. The MOVES model was then applied using the modified inputs and the resulting emissions were reported to DAQ.

v. Fugitive Dust Procedure

1. Fugitive Dust Emissions

(1) Method

PM_{10} and $PM_{2.5}$ fugitive dust emissions from paved roads ("re-entrained road dust") calculated according to Chapter 13 of AP-42 dated January 2011.

The hourly basis equation was used to estimate dust emissions:

= [k(sL)^0.91(W)^1.02][1 - (1.2P/N)]

Inventories of fugitive dust from paved roads are in units of tons per year as requested by UDAQ Technical Analysis Section.

1. Precipitation

UDAQ Technical Analysis Section provided precipitation data from MesoWest University of Utah. Number of hours per day with precipitation greater than 0.01 inch were collected for the following counties: Box Elder, Davis, Cache, Salt Lake, Tooele, Utah, and Weber. County specific precipitation data was collected and combined for each of the three $PM_{2.5}$ episodes: 2011 January1-12, 2013 December 7-19, and 2016 February 1-17. The Salt Lake precipitation profiles were utilized for the remaining 22 rural counties within the state of Utah to provide relative background emissions for on-road fugitive dust emissions. County specific fugitive dust emissions estimates were configured for an average weekday, Saturday, and Sunday using precipitation data from all the episodes.

2. Average Vehicle Weight

In general, average vehicle weight is highest on interstates and lowest on local roads. In rural counties, average vehicle weight is often a factor of three or four times higher than in large urban counties due to the relatively higher percentage of large trucks in rural areas compared to urban areas with large volumes of commuter traffic.

3. Silt Loading Factors

Default silt loading factors were used.

vi. PM2.5 SIP On-road Mobile Sources Inventory 2016-2020 Winter Weekday Emissions (Tons per Winter Weekday)* +++

Year		Modeling Area	NH3	NOx	PM10**	PM25***	SO2	VOC	VOC Refueling	PM10 Dust****	PM25 Dust****	VMT
2016	Base Year	PM2.5 NAA Counties +	1.56	67.37	5.73	5.73	0.49	34.57	1.83	4,498	1,124	47,693,290
2016	Base Year	Modeling Domain Counties ++	1.38	102.17	6.78	6.78	0.44	30.81	1.68	5,510	1,377	
2017	Milestone Year	PM2.5 NAA Counties +	1.58	64.22	5.86	5.86	0.52	33.56	1.77	4,750	1,187	50,719,736
2017	Milestone Year	Modeling Domain Counties ++	1.28	95.82	6.6	6.6	0.44	27.52	1.52	5,604	1,401	
2019	Attainment Year	PM2.5 NAA Counties +	1.52	53.78	5.5	5.5	0.52	29.63	1.53	4,956	1,239	52,970,766
2019	Attainment Year	Modeling Domain Counties ++	1.25	81.76	6.04	6.04	0.45	23.4	1.36	5,900	1,475	
2020	Milestone Year	PM2.5 NAA Counties +	1.5	49.3	5.35	5.35	0.51	27.59	1.43	5,029	1,257	53,740,393
2020	Milestone Year	Modeling Domain Counties ++	1.24	75.57	5.82	5.82	0.45	21.7	1.3	6,016	1,504	

* Tier 2 Fuel 30 ppm Sulfur

** PM 10 Exhaust + Brake and Tire Wear

*** PM 2.5 Exhaust (Elemental Carbon, Organic Carbon, Sulfate Particulate) + Brake and Tire Wear

**** PM10 PM2.5 Dust Emission are in Tons Per Year

+ Box Elder, Davis, Salt Lake, Tooele, Weber Counties within the PM2.5 Nonattainment Area

++ Beaver, Cache, Carbon, Daggett, Duchesne, Emery, Garfield, Grand, Irion, Juab, Kane, Millard, Morgan, Piute, Rich, San Juan, Sanpete, Sevier, Summit, Uintah, Utah, Wasatch, Washington, Wayne Counties

The mobile source emissions estimates above are representative of countywide emissions estimates within and outside the PM2.5 Nonattainment area.

vii. Appendix: Episodic Year Inventories For $PM_{2.5}$ SIP

Input files will be furnished upon request:

viii. References

The following documents were used as references in creating the on-road mobile source $PM_{2.5}$ SIP emissions inventories:

1. Federal Register, Friday, February 4, 2011, "Official Release of the January 2011 AP–42 Method for Estimating Re-Entrained Road Dust From Paved Roads", Announcement of Availability, https://www.federalregister.gov/documents/2011/02/04/2011-2422/official-release-of-the-january-2011-ap-42-method-for-estimating-re-entrained-road-dust-from-paved

2. U.S. Environmental Protection Agency, Office of Transportation and Air Quality (OTAQ), Assessment and Standards Division, "MOVES2014a User Guide", EPA-420-B-095, November 2015, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NNCY.txt

3. U.S. Environmental Protection Agency, OTAQ, Transportation and Regional Programs Division, "MOVES2014 and 2014a Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity", EPA-420-B-15-093), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NN9L.txt , November 2015.

4. I/M Programs

a. Davis County Health Department, Environmental Health Services Division, Davis County Testing Center, 20 North 600 West, Kaysville, UT 84037, 801-546-8860.

b. Salt Lake County Health Department, Environmental Health, Air Pollution Control, I/M Tech Center, 788 East Woodoak Lane (5380 South), Murray, UT 84107-6369, 385-468-4837.

c. Utah County Health Department, Utah County Environment Health, Bureau of Air Quality, I/M Tech Center, 3255 North Main Street, Spanish Fork, UT, 84660, 801-851-7600.

d. Weber-Morgan Health Department, Environmental Health, 477 23rd Street, 2nd floor, Ogden, UT 84401, 801-399-7160.

e.Bear River Health Department, 655 East 1300 North. Logan, UT 84341, 801-792-6500

5. MESOWEST UTAH, (met data archive), University of Utah, Department of Atmospheric Sciences, http://mesowest.utah.edu/.