TECHNICAL SUPPORT DOCUMENT
FOR ON-ROAD MOBILE SOURCES:
PM$_{2.5}$ EMISSIONS INVENTORY
FOR BASELINE YEAR OF 2014
COVERING UTAH COUNTY

April 2018
Utah Division of Air Quality
Planning Branch/Mobile Sources

Abstract

This report discusses the on-road mobile source section of the PM$_{2.5}$ SIP baseline inventories for the domain comprising Utah County.

On-road inventories were calculated using the EPA MOVES2014a (Motor Vehicle Emission Simulator) released October 2015. 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).

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

Mountainland Association of Governments (MAG): Utah County
Utah Division of Air Quality (UDAQ)

The baseline inventories meteorological conditions were developed 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 tables for 2014 on-road emissions inventories are located at the end of the Technical Support Document (TSD). The emissions are expressed in Tons Per Winter Weekday.

MOVES modeling files will be provided as requested.

i) ON-ROAD MOBILE SOURCES PM10 EMISSIONS INVENTORIES

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 2014 Baseline Inventories for Utah County. 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 $PM_{2.5}$ nonattainment areas. What appears below is a 2014 base line emissions estimates for the Provo, Utah $PM_{2.5}$ nonattainment area that have been extracted from the modeling domain described in the IPP. The MAG 2014 base line emissions inventories are being used to meet the requirements for a Clean Data Determination for the Provo, Utah $PM_{2.5}$ nonattainment area.

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 2014. Inventory estimations were created at the county level 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, fuel 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:

Mountainland Association of Governments (MAG): Utah County
Utah Division of Air Quality (UDAQ): Fuel and I/M parameters

iii. MOVES Modeling Procedure

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

1. <u>MOVES Default Database Enhancement for Local Roads</u>

  <u>Local Roads</u>

    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, and Mountainland Association of Governments (MAG). 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.

  <u>Modifications to Local Road Tables</u>

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

2. <u>MOVES2014 Daily Pollutants</u>

(a) <u>Pollutants selected for analysis:</u>
  - 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 2014 for an average Weekday, Saturday, and Sunday. MAG utilizes a regional Travel Demand Model to forecast and quantify on-road Mobile Sources activity in the non-attainment area. The Regional Travel Model Domain covers the area between the southern part of Box Elder in the north (the urban area), and Utah County to the south. The Regional Travel Demand Model (TDM) consists of roads and transit networks and uses socio-economic data which includes: population, employment, vehicle ownership, and household size information to help forecasting travel activities for current and future scenarios.

(1) Average Speed Distribution

MAG utilized the 2014 Utah County Average Speed Distribution file the TDM produces in the format appropriate for use in the MOVES model.

(2) AVFT (Diesel and Gasoline Fractions)

MAG utilized data from the Utah Department of Motor Vehicle (DMV) to construct passenger car (21) and light truck (31, 32) fuel type fractions for registered gasoline and diesel vehicles (2015). The DMV fractions were applied to all model years. MOVES2014a default AVFT values were used for all remaining source type vehicles.

(3) Fuel

UDAQ provided MOVES 2014a default fuel parameters for 2014.

(4) HourVMTFraction

MAG utilized the MOVES 2014a default hourly VMT Fractions.

(5) HPMSvTypeYear (VMT)

MAG utilized UDOT HPMS 2014 HPMS counts.

(6) <u>I/M Coverage: Utah, Counties</u>

UDAQ constructed I/M Program input files in consultation with the local county health department in Utah County.

Summary of the I/M Programs for Utah County

Year	Vehicle Type	Beg Model Year	End Model Year	Frequency	I/M Test
2014	Cars & Trucks	1968	1995	Annual	TSI
2014	Cars & Trucks	1996	2008	Annual	OBD
2014	Cars & Trucks	2009	2012	Biennial	OBD

(7) <u>Road Type Distribution (VMT Mix)</u>

MAG utilized the 2014 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%.

(8) <u>Source Type Age Distribution</u>

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

(9) <u>Source Type Year</u> (Vehicle Population)

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) <u>ZoneMonthHour</u> (Meteorological Data)

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 Utah County. Hourly average temperature and relative humidity profiles from these episodes were used to reflect the atmospheric conditions that represent the $PM_{2.5}$ season.

iv. 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. This data included the number of hours per day with precipitation greater than 0.01 inch. Utah County 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. Specific fugitive dust emissions estimates were configured for an average Weekday, Saturday, and Sunday.

        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.

v. PM2.5 SIP On-road Mobile Sources Inventory 2014 Winter Weekday Emissions (Tons per Winter Weekday)*

Year	FIPS	County	NH3	NOx	Total PM10**	Total_PM2.5***	SO2	VOC	VOC Refueling	PM10 Dust****	PM25 Dust****	Distance
2014	49049	Utah	0.523	26.811	2.135	1.157	0.132	12.051	0.703	1,180.83	295.21	12,059,285

*   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

vi. Appendix: Episodic Year Inventories for PM$_{2.5}$ SIP

Files will be furnished upon request

vii. 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. 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.

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