Appendix C1

Technical support document for the development of MOVES3.0.4 nonroad mobile (except marine, airport, and railroad) emissions inventories for 2025 and 2030

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Projection Years 2025 & 2030 Inventories

Emissions inventories for nonroad sources for 2025 and 2030 were developed using EPA's MOVES3.0.4 model except for marine diesel vessels, aircrafts, and locomotives (MAR). No changes were made to emissions inventories for MAR sources for 2025 and 2030 in the 2017 plan.

Model runs were executed for the District, Maryland, and Virginia for both milestone years for July/Weekday, which represented an average ozone season weekday. All combinations of fuels and sectors were selected except for Virginia where Airport Ground Support Equipment (GSE) sector was not included. Virginia provided emissions for that sector for 2025 and 2030 for the 2017 plan using a different methodology and no changes were made to those emissions in this revised plan. MOVES2014a was used to develop Airport GSE emissions for both milestone years for the District and Maryland in the 2017 plan so those emissions were updated using MOVES3.0.4 for this revised plan.

Separate model runs were not necessary for individual Maryland and Virginia jurisdictions as inputs were same for all jurisdictions within a particular state. Therefore, two separate model runs were executed (one each for Maryland and Virginia) to develop emissions inventories for all jurisdictions in those two states for each milestone year.

The model generated emissions by Source Classification Code (SCC) for each jurisdiction.

Details of the methodology used to prepare inputs for model runs are provided below.

Meteorology

Meteorology data used for developing nonroad emissions for the 2017 plan was also used to develop nonroad model emissions for this revised plan.

For the 2017 plan, meteorology data was acquired from the National Climatic Data Center (NCDC). Hourly average temperature and dew point temperature data were collected from the Dulles airport (IAD) weather station for July 2014. Hourly relative humidity data was calculated using these two parameters. This data was also used for the 2025 and 2030 runs.

Fuel Parameters

Fuel parameters were supplied by the District, Virginia, and Maryland. The District decided to use the model default values for fuel parameters. Maryland decided to use the model default values for fuel parameters except for Gasohol (E10) for which it supplied local data. Virginia supplied local data.

MOVES3.0.4 nonroad input, output, and runspec files are being provided in Appendix C2.

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Summary of MOVES3.0.4 Nonroad Model Emissions Inventories by Jurisdiction

The table below provides nonroad model emissions inventories for VOC and NOx in tons per day for individual jurisdictions in the maintenance area.

Jurisdiction	2025		2030	
	VOC (tpd)	NOx (tpd)	VOC (tpd)	NOx (tpd)
The District	1.29	1.15	1.29	1.03
Calvert County	0.67	0.41	0.60	0.37
Charles County	1.08	0.66	1.00	0.58
Fredrick County	2.33	1.12	2.39	1.02
Montgomery County	8.72	3.34	8.98	3.14
Prince George's County	4.98	2.41	5.10	2.22
Arlington County	0.82	1.11	0.78	0.85
Fairfax County	9.08	4.17	9.02	3.67
City of Fairfax	0.32	0.10	0.32	0.10
City of Falls Church	0.19	0.06	0.19	0.05
Loudoun County	4.42	2.62	4.36	2.14
Prince William County	2.69	1.71	2.63	1.40
City of Manassas	0.13	0.09	0.13	0.09
City of Manassas Park	0.18	0.05	0.18	0.05
City of Alexandria	0.65	0.23	0.65	0.23
The District	**1.29**	**1.15**	**1.29**	**1.03**
Maryland	**17.78**	**7.94**	**18.07**	**7.33**
Virginia	**18.47**	**10.14**	**18.26**	**8.58**
Washington DC-MD-VA 2008 Ozone NAAQS Maintenance Area	**37.55**	**19.23**	**37.61**	**16.94**

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Appendix D1

Technical support document for the development of MOVES3.0.4 onroad mobile emissions inventories for 2025 and 2030

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National Capital Region
Transportation Planning Board

DEVELOPMENT OF OZONE ONROAD MOBILE EMISSIONS INVENTORIES

Prepared for the Updated 2008 Ozone National Ambient Air Quality Standards Maintenance Plan for the Washington, D.C. Metropolitan Region.

May 2023

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National Capital Region
Transportation Planning Board

DEVELOPMENT OF OZONE ONROAD MOBILE EMISSIONS INVENTORIES
May 2, 2023

ABOUT THE TPB
The National Capital Region Transportation Planning Board (TPB) is the federally designated metropolitan planning organization (MPO) for metropolitan Washington. It is responsible for developing and carrying out a continuing, cooperative, and comprehensive transportation planning process in the metropolitan area. Members of the TPB include representatives of the transportation agencies of the states of Maryland and Virginia and the District of Columbia, 24 local governments, the Washington Metropolitan Area Transit Authority, the Maryland and Virginia General Assemblies, and nonvoting members from the Metropolitan Washington Airports Authority and federal agencies. The TPB is staffed by the Department of Transportation Planning at the Metropolitan Washington Council of Governments (COG).

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1. INTRODUCTION

This report documents the development of onroad mobile emissions inventories used in the updated 2008 Ozone National Ambient Air Quality Standards (NAAQS) Maintenance Plan for the Washington, D.C. metropolitan region. The inventories were updated to reflect the use of the U.S. Environmental Protection Agency's (EPA) latest mobile emissions estimation tool, MOtor Vehicle Emissions Simulator 3 (MOVES3), for the development of new Motor Vehicle Emissions Budgets (MVEBs or mobile budgets). The inventories were developed by the National Capital Region Transportation Planning Board (TPB) staff. This report summarizes the planning assumptions and technical methods supporting the onroad inventory development and presents results at the jurisdiction level. The inventory addresses the ozone season pollutants, Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC). Pollutant estimates were prepared for 2025 and 2030 analysis years. The 2014 emissions estimates are from the original 2008 ozone maintenance plan dated December 20, 2017 (the "2017 plan").[1] A summary of results is included at the end of the report.

2. BACKGROUND

In 2012, EPA designated the Metropolitan Washington, DC-MD-VA region as a "moderate" nonattainment area for the 2008 Ozone NAAQS. In 2015, the region attained the 2008 standard, based on the readings from ambient air quality monitors. In 2017 the region developed a redesignation request and maintenance plan, which included MVEBs for NOx and VOC. This maintenance plan relied upon the MOVES2014a model to generate onroad mobile emissions estimates, which served as the basis for developing the MVEBs contained within the plan. In 2018, EPA found these mobile emissions budgets adequate for use in the region's air quality conformity analyses.

On January 7, 2021, the EPA officially released the MOVES3 model, and required its use in all State Implementation Plan (SIP) development and transportation conformity analyses by January 2023. TPB staff completed preliminary sensitivity test runs of the new model to determine the change in emissions from MOVES2014b to MOVES3. TPB staff conducted these initial tests by using the MOVES2014b assumptions from the analysis of the current Long-Range Transportation Plan (LRTP), known as the 2022 Update to Visualize 2045, and retained the same assumptions in MOVES3 (where possible). The sensitivity test runs showed the greatest change in estimated NOx emissions, with a 26% increase in 2030, a 52% increase in 2040, and a 54% increase in 2045 when using MOVES3 compared to using MOVES2014b. These findings were consistent with EPA's own findings in urban counties with congested roads and little truck hotelling activity.[2] TPB staff shared these results with the Metropolitan Washington Air Quality Committee Technical Advisory Committee (MWAQC TAC) in September 2022, and informed the committee that, with the change in MOVES

[1] Metropolitan Washington Council of Governments, "Maintenance Plan for the Washington DC-MD-VA 2008 Ozone NAAQS Nonattainment Area" (District of Columbia Department of the Environment, Maryland Department of the Environment, and Virginia Department of Environmental Quality, December 20, 2017), https://www.mwcog.org/documents/2017/09/18/washington-dc-md-va-2008-ozone-naaqs-marginal-nonattainment-area--redesignation-request-and-maintenance-plan-air-quality-air-quality-conformity-ozone/.

[2] USEPA, "Overview of EPA' s MOtor Vehicle Emission Simulator (MOVES3)." Assessment and Standards Division Office of Transportation and Air Quality, March 2021.

models, the region would find it challenging to remain below the current MVEBs which were established in the 2017 plan. The MWAQC TAC agreed to update the 2017 plan with new MVEBs.

3. OVERVIEW OF METHODS AND PLANNING ASSUMPTIONS

Mobile emission inventories are developed on a year-by-year basis using the regional travel demand forecasting model and the EPA MOVES model. Several sequential steps are undertaken for each year that is analyzed. First, the TPB's adopted travel demand model is used to formulate vehicle-miles-of-travel (VMT) at the network link level of analysis. The modeled VMT outputs are developed at the network link level by vehicle type and by four time-of-day periods. Next, a post processor is used to further refine link-level VMT link speeds into Vehicle-Hours-of-Travel (VHT) by facility type, hourly periods, and speed "bins." Finally, several data preparation steps are undertaken before the MOVES mobile emissions model is executed on a jurisdictional basis in order to compute mobile emissions. An overview of the travel model, post processor, and MOVES data preparation steps is presented below.

For the purposes of developing emissions inventories for the Updated 2008 Ozone National Ambient Air Quality Standards Maintenance Plan TPB staff used 2025 and 2030 travel demand-related inputs from the air quality conformity analysis of the 2022 Update to Visualize 2045,[3] the region's long-range transportation plan, which was approved by the Transportation Planning Board on June 15, 2022. The key planning assumptions and methods are listed in Table 1. These included the use of the TPB's currently adopted travel demand model, Gen2/Ver. 2.4 Model and the MOVES3.0.4 emissions model, which is being used for the first time. The land activity projections used in the travel demand modeling are based on the Round 9.2 Cooperative Forecasts of population, households, and employment.

Table 1 Travel-Related Assumptions/Methods Used in the Inventories

Land Activity:	COG Round 9.2 Cooperative Forecasts (for 2025 & 2030 analysis years)
Transportation Networks:	2022 Update to Visualize 2045
Travel Demand Model:	Gen2/Ver. 2.4 Travel Model
Mobile Emissions Model:	MOVES3.0.4
Vehicle Registration Data:	2020 Vehicle Registration Inventories

The non-travel related inputs to the MOVES3 model, relating to meteorology, vehicle inspection and maintenance programs, and fuel formulation and supply, were provided by the state air agencies in coordination with COG's Department of Environmental Programs (DEP). DEP staff provided MS-Excel files and databases containing MOVES3.0.4 inputs for fuel supply, fuel usage fraction, fuel formulation, meteorology, Stage II program, Alternative Vehicle Fuel Technology (AVFT) program, Inspection/Maintenance (I/M) program, and the California Low Emissions Vehicle (CAL-LEV) program (MD only) inputs in a January 20, 2023 e-mail (Attachment A). The non-travel related assumptions and methods underlying the ozone emissions inventories are listed in Table 2.

[3] Air Quality Conformity Analysis of the 2022 Update to Visualize 2045. Final Report. National Capital Region Transportation Planning Board, June 15, 2022. https://www.mwcog.org/documents/2022/06/15/air-quality-conformity-analysis-of-the-2022-update-to-visualize-2045-full-report/

Table 2 Non-Travel Related Assumptions and Methods Used in the Inventories

Inspection & Maintenance Programs:	Year-specific programs/MOVES3.0.4 format
Fuel Programs:	Year-specific programs/MOVES3.0.4 format
Meteorology:	July 2014 data from Dulles Airport

The Washington, D.C. region Ozone Maintenance Area includes the following jurisdictions: Washington, D.C., Montgomery County, Prince George's County, Frederick County, Charles County, Calvert County, the City of Alexandria, Arlington County, Fairfax County, Loudoun County, and Prince William County. The cities and towns within each jurisdiction are also included. The Ozone Maintenance Area and the area associated with travel modeling is shown in Figure 1.

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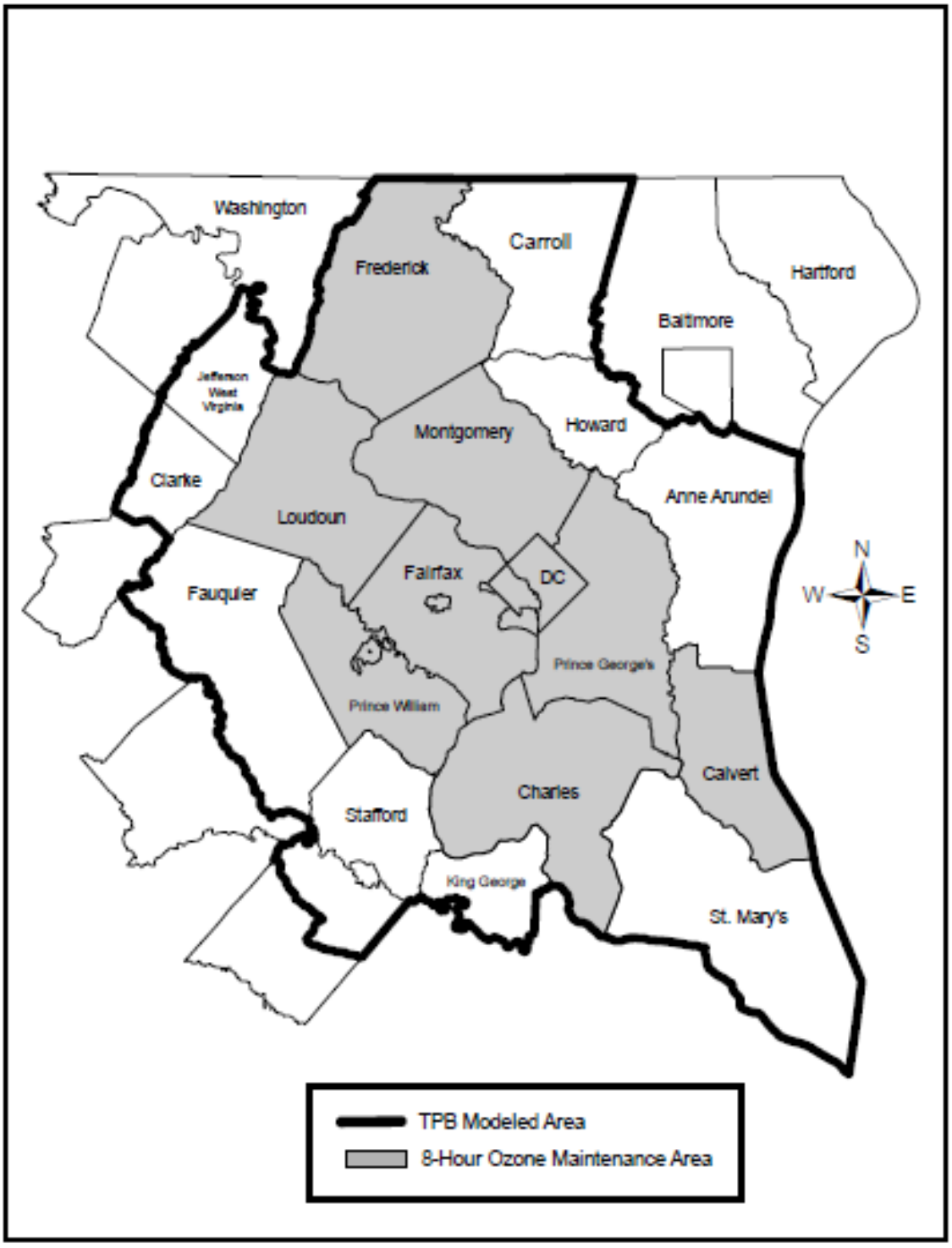
Figure 1 Washington DC-MD-VA Ozone Maintenance Area Map



4. TRAVEL DEMAND MODEL AND INPUTS

The Gen2/Ver. 2.4 Travel Model is an aggregate, trip-based (or four-step) forecasting process that operates on a 3,722 Transportation Analysis Zone (TAZ) system. The model was initially calibrated using the 2007/08 Household Travel Survey and several on-board transit surveys.[4] The model was subsequently revised and re-validated, most recently in 2021 using 2018 data.[5] The Gen2/Ver. 2.4 Model is documented in the most recent User's Guide.[6]

The COG Round 9.2 Cooperative Forecasts are projections of households, population, and employment (by type), prepared at the TAZ level. Household and employment summaries by jurisdiction for the specific Ozone Maintenance Plan analysis years are provided in Tables 3 and 4, respectively.

Table 3 Household Data by Jurisdiction by Year

JURISDICTIONS:	2014	2025	2030
DISTRICT OF COLUMBIA	291,038	341,019	362,524
MONTGOMERY COUNTY	371,608	405,654	422,320
PRINCE GEORGE'S COUNTY	317,731	343,865	355,494
ARLINGTON COUNTY	102,523	117,855	123,837
CITY OF ALEXANDRIA	70,573	82,725	88,238
FAIRFAX COUNTY	415,156	453,323	477,072
LOUDOUN COUNTY	117,776	151,668	165,451
PRINCE WILLIAM COUNTY	157,001	185,954	196,234
FREDERICK COUNTY	88,528	106,256	115,404
CHARLES COUNTY	53,176	65,529	72,911
CALVERT COUNTY	31,958	35,703	36,946
TOTAL	2,017,068	2,289,551	2,416,431

Source: Round 9.2 Cooperative Forecasts

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[4] Calibration Report for the TPB Travel Forecasting Model, Version 2.3, on the 3722-Zone Area System. Final Report. Washington DC: National Capital Region Transportation Planning Board, January 20, 2012. http://www.mwcog.org/transportation/activities/models/files/FY2012/V2.3_Calibration_Report_v14.pdf

[5] "Year-2018 Validation of TPB Version 2.4 Travel Model", Technical Memorandum from Meseret Seifu and Sanghyeon Ko to Feng Xie. August 17, 2021.

[6] User's Guide for the COG/TPB Gen2/Version 2.4 Travel Demand Forecasting Model, Washington, D.C.: Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board, March 15, 2021. https://www.mwcog.org/assets/1/6/mwcog_tpb_travel_model_v2.4_user_guide_final.pdf

Table 4 Employment Data by Jurisdiction and Year

JURISDICTIONS	2014	2025	2030
DISTRICT OF COLUMBIA	787,878	895,120	937,854
MONTGOMERY COUNTY	514,849	572,496	604,514
PRINCE GEORGE'S COUNTY	337,653	369,867	379,379
ARLINGTON COUNTY	212,145	232,928	250,398
CITY OF ALEXANDRIA	105,568	116,229	117,403
FAIRFAX COUNTY	681,005	786,119	832,957
LOUDOUN COUNTY	159,886	204,959	224,434
PRINCE WILLIAM COUNTY	170,075	217,246	238,111
FREDERICK COUNTY	105,437	121,981	127,370
CHARLES COUNTY	46,459	50,177	53,207
CALVERT COUNTY	33,727	31,206	32,318
TOTAL	3,154,682	3,598,328	3,797,945

Source: Round 9.2 Cooperative Forecasts; Includes Census Adjustment

The travel demand model produces a wide array of outputs including zonal origins and destinations by travel volumes and by travel network segments.[7] Modeled VMT is the most critical output of the travel model for the purpose of estimating onroad emissions. The 2025 and 2030 jurisdiction level VMT results estimated by the Gen2/Ver.2.4 Model, using the 2022 Update to Visualize 2045 networks and the Round 9.2 Cooperative Forecasts, are shown in Table 5. The VMT estimates shown reflect on-network travel only and do not include local road VMT. Since 2014 inventories are not being re-estimated, the 2014 figures are identical to those presented in the 2017 plan.

Table 5 Average Weekday Vehicle Miles Traveled by Jurisdiction and Year

JURISDICTIONS	2014*	2025	2030
DISTRICT OF COLUMBIA	8,179,181	8,272,579	8,422,634
MONTGOMERY COUNTY	21,650,210	21,723,799	22,576,902
PRINCE GEORGE'S COUNTY	23,235,228	23,595,386	24,231,754
ARLINGTON COUNTY	3,880,103	4,317,507	4,388,578
CITY OF ALEXANDRIA	2,459,323	2,264,186	2,322,399
FAIRFAX COUNTY	26,219,999	30,419,005	31,678,517
LOUDOUN COUNTY	7,434,601	8,291,614	8,700,457
PRINCE WILLIAM COUNTY	9,380,430	11,191,036	11,718,058
FREDERICK COUNTY	8,746,566	9,972,642	10,598,025
CHARLES COUNTY	3,010,776	3,564,726	3,846,739
CALVERT COUNTY	1,741,395	1,764,796	1,825,947
TOTAL	115,937,812	125,377,276	130,310,010

*2014 data are from the 2017 plan

[7] It should be noted, however, that the regional travel demand forecasting model is not validated to zone-level origins and destinations. Instead, the regional travel model is typically validated to the regional level, jurisdiction level, and to traffic screenlines. See the Gen2/Ver. 2.4 Model user's guide for more information.

5. MOVES MODEL INPUTS

This section reviews the data inputs that were prepared for the MOVES model. The MOVES model is currently executed on a year-specific basis, for each jurisdiction in the ozone maintenance area. As such, jurisdiction-level databases (or Excel files) are prepared in a format that is consistent with prescribed specifications in the software documentation. Some inputs are prepared as parameters that are indicated in MOVES-related scripting. TPB currently executes the MOVES3.0.4 model in the "inventory" mode. MOVES3.0.4 model does not require ramp fractions, an input required for earlier versions of MOVES, so that input was not used in the MOVES3.0.4 modeling work.

When EPA released initial versions of the MOVES emissions model, a regional task force was formed to provide guidance on MOVES-related inputs that would be acceptable to regional stakeholders. Staff from both transportation and environmental agencies served on the task force. During 18 monthly meetings, between August 2009 and January 2010, the task force agreed to an approach for developing emissions inventories using MOVES. A summary table of the approach is included as Attachment B.

5.1 Post Processor

A post processor is used to perform peak spreading of link-level travel demand, which results in adjustments to network link-level outputs by hour of day from the travel model. The post processor also reformats the travel model output into MOVES compatible format. The post processor is used to create vehicle hours of travel (VHT) and vehicle miles traveled (VMT) distributions by jurisdiction. The jurisdictional distributions are further distinguished by three vehicle types (passenger vehicles, commercial vehicles, and trucks), two facility types (freeways and arterials), and 14 speed groups or "bins."

The post processor aggregates six travel markets from the travel demand model outputs into three vehicle types as follows:

- Passenger Vehicles = SOV + HOV2 + HOV3 (or more) + Airport Passenger Trips;
- Commercial Vehicles = Commercial Vehicles;
- Heavy Duty Vehicles = Trucks;

Six facility types are grouped into two as follows:

- Freeway = freeway + expressway + freeway ramp; and
- Arterials = major arterial + minor arterial + collector.

The post processor is executed for each analysis year. The post processor yields hourly jurisdictional VMT and VHT distributions into 14 speed bins and two facility types. Figure 2 illustrates the post-processing of travel demand outputs. The post processor also includes provisions to add local-road VMT to the on-network VMT developed by the travel model, so that the full universe of travel is accounted for.

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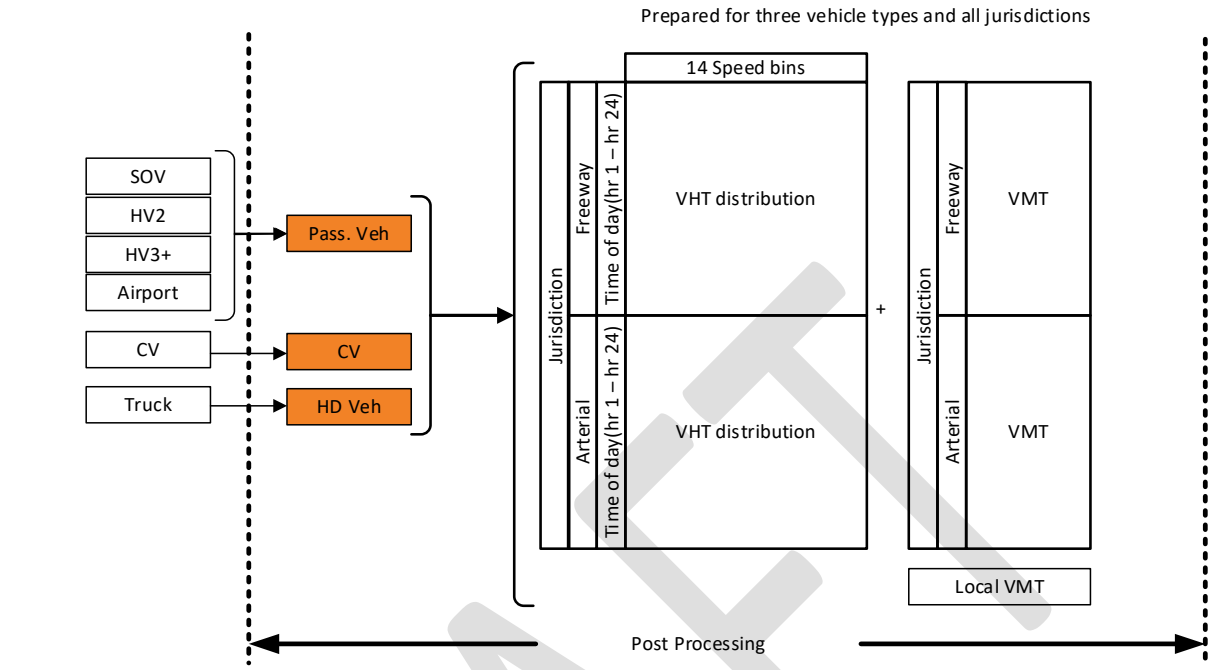
Figure 2 Post-Processing of Travel Demand Results



Pass. Veh = passenger vehicle
CV = commercial vehicle
Truck = heavy duty vehicle

Freeway = freeway, expressway & freeway ramp
Arterial = major/minor arterials, collectors & local roads

5.2 VMT/VHT Fractions

MOVES requires annual VMT by five Highway Performance Monitoring System (HPMS) vehicle types:

- Motorcycle (sourceTypeID = 10);
- Light-duty vehicle (sourceTypeID = 25);
- Buses (sourceTypeID = 40);
- Single-unit trucks (sourceTypeID = 50); and
- Combination trucks (sourceTypeID =60).

Average annual weekday VMT estimates include on-network data from the travel demand model outputs as well as local-road VMT estimates, which is added in exogenously. Auto access VMT for transit riders, estimated using data from a Metrorail Survey, is added to the VMT of Light-Duty Vehicles (sourceTypeID = 25). Modeled VMT is divided into three vehicle types: passenger vehicles, commercial vehicles, and heavy-duty vehicles. Local road VMT is developed by using a combination of observed and simulated data in the post-processing shown in Figure 2.

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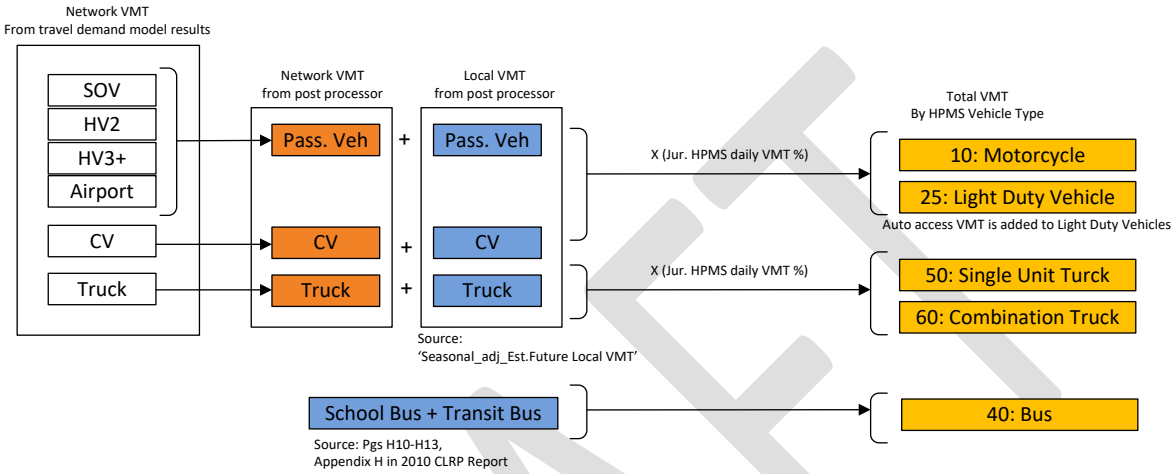
The local-road VMT shares are added to VMT from the travel model to produce total VMT. The resulting total VMT of the three vehicle types is then classified by five MOVES vehicle types using observed jurisdictional Highway Performance Monitoring System (HPMS) VMT percentages. Figure 3 illustrates the process of developing annual VMT for five HPMS vehicle types.

Figure 3 Annual VMT Calculation Process



The average annual weekday VMT total by five HPMS vehicle types is entered into an EPA AAD VMT converter to convert average weekday VMT into updated average annual weekday travel (AAWT). The converter includes local monthly adjustment factors and weekend-day adjustment factors. The converter generates two VMT fractions, 'monthVMTfraction,' and 'dayVMTfraction' as outputs. A local hourly VMT fraction, "hourlyVMTfraction," was fed into the modeling process.

5.3 Average Speed

MOVES requires speed distributions by vehicle type and time-of-day period. Vehicle Hours of Travel (VHT) distributions are selected as a suitable proxy for average speed distribution. MWCOG/TPB's regional travel demand model outputs are first processed to derive VHT distributions for six vehicle categories:

- Single-Occupant Vehicles (SOV);
- High-Occupancy Vehicles 2 (HOV2);
- High-Occupancy Vehicles 3+ (HOV3 or more);
- Commercial Vehicles;
- Trucks; and
- Airport Passenger Auto Driver Trips.

Through post-processing, six VHT distributions are developed for three vehicle types, MOBILE's 14 speed bins, hour of the day, and two facility types (i.e., freeways and arterials); and later reclassified into MOVES's 16 speed bins, hour of the day, day of the week (i.e., weekdays and weekend days),

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and four facility types. Six vehicle types from the travel demand model are reclassified into three vehicle types as follows:

- Passenger Vehicles = SOV + HOV2 + HOV3 (or more) + Airport Passenger Trips;
- Commercial Vehicles = Commercial Vehicles; and
- Heavy Duty Vehicles = Trucks.

MOVES requires: (1) 16 speed bins from 2.5 mph to 75 mph in increments of 5 mph; and (2) four road types, which are a combination of two facility types (i.e., restricted and unrestricted) and two environmental settings (i.e., urban and rural settings). The restricted facilities include freeways, expressways and freeway ramps, while the unrestricted facilities include major/minor arterials, collectors, and local roads. The following assumptions are used to develop average speed distributions fulfilling the MOVES requirements stated above:

1. VHT Distribution to Restricted Facilities:

    a. All vehicle types:
        - Weekday VHT Distribution:
            - All Day: Hourly distribution for all vehicles
        - Weekend VHT Distribution:
            - 11:00 am – 7:00 pm: Distribution across the 13 MOVES vehicle type categories reflecting the 3:00 pm hour on a weekday
            - 7:01 pm – 10:59 am: Distribution across the 13 MOVES vehicle type categories reflecting the 12:00 am hour on a weekday

2. VHT Distribution to Unrestricted Facilities:

    a. All vehicle types exclusive of refuse trucks, school buses and transit buses:
        - Weekday VHT Distribution:
            - All Day: Hourly distribution for all vehicles
        - Weekend VHT Distribution:
            - 11:00 am – 7:00 pm: Distribution reflecting the 3:00 pm hour on a weekday
            - 7:01 pm – 10:59 am: Distribution reflecting the 12:00 am hour on a weekday

    b. Refuse trucks: Refuse trucks operate on a 3-phase cycle: Phase 1 is the period of driving from the dispatch garage to trash collection sites; Phase 2 is the period of the actual trash/recycle collection; Phase 3 is the period of driving back to transfer stations. Using local data from Fairfax County, VA, the average speed of Phases 1 and 3 is assumed to be in the range of 22.5-27.5 miles per hour (i.e., MOVES Speed Bin 6), and the average speed of Phase 2 is assumed to be in the range of 2.5-7.5 miles per hour (i.e., MOVES Speed Bin 2). Based on the above assumptions, the refuse truck vehicle type VHT distributions are as follows:

        - Weekday VHT Distribution (see Table 6):

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- 5:00 am–5:00 pm (Trash Collection): VHT hourly distributions according to Phases 1, 2 and 3.
- 5:01 pm–5:00 am (On Road Phase): VHT hourly distribution consists of Phase 2.

- Weekend VHT Distribution:
  - All Day: VHT distribution made up of Phase 1 and Phase 3 (on road phases)

c. School buses:
   - Weekday VHT Distribution:
     -6:00 am – 6:00 pm: VHT distribution (see Table 7)
     -6:00 pm – 6:00 am: VHT distribution of heavy-duty vehicles

   - Weekend VHT Distribution:
     - 11:00 am–7:00 pm: VHT Distribution of heavy-duty vehicles at 3:00 pm on a weekday
     - 7:00 pm – 11:00 am: VHT Distribution of heavy-duty vehicles at 12:00 am on a weekday

d. Transit buses:
   - Weekday VHT Distributions (see Table 8):
     -6:00 – 9:00 am: Per WMATA's bus speed distribution of the AM peak period
     -9:00 am–3:00 pm: Per WMATA's bus speed distribution of the off-peak period
     -3:00 - 6:00 pm: Per WMATA's bus speed distribution of the PM peak period
     -6:00 pm - 6:00 am: Per WMATA's bus speed distribution of the off-peak period

   - Weekend VHT Distribution (see Table 8):
     -All Day: Per WMATA's bus speed distribution of the off-peak period.

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Table 6 Average Weekday VHT Distribution for Refuse Trucks
Source: Fairfax County, VA

Speed Bins	Speed Range	5:00 AM - 5:00 PM	5:01 PM - 4:59 AM
1	speed < 2.5mph	0.00%	0.00%
2	2.5mph <= speed < 7.5mph	62.65%	0.00%
3	7.5mph <= speed < 12.5mph	0.00%	0.00%
4	12.5mph <= speed < 17.5mph	0.00%	0.00%
5	17.5mph <= speed <22.5mph	0.00%	0.00%
6	22.5mph <= speed < 27.5mph	37.35%	100.00%
7	27.5mph <= speed < 32.5mph	0.00%	0.00%
8	32.5mph <= speed < 37.5mph	0.00%	0.00%
9	37.5mph <= speed < 42.5mph	0.00%	0.00%
10	42.5mph <= speed < 47.5mph	0.00%	0.00%
11	47.5mph <= speed < 52.5mph	0.00%	0.00%
12	52.5mph <= speed < 57.5mph	0.00%	0.00%
13	57.5mph <= speed < 62.5mph	0.00%	0.00%
14	62.5mph <= speed < 67.5mph	0.00%	0.00%
15	67.5mph <= speed < 72.5mph	0.00%	0.00%
16	72.5mph <= speed	0.00%	0.00%

Table 7 VHT Distribution of School Buses (6:00 am – 6:00 pm)
Source: Fairfax County, VA

avgSpeedBinID	avgBinSpeed	avgSpeedBinDesc	6:00AM-9:00AM	3:00PM-6:00PM	9:01AM-2:59PM/6:01PM-5:59AM
1	2.5	speed < 2.5mph	**9.94%**	**9.10%**	**7.92%**
2	5	2.5mph <= speed < 7.5mph	**13.79%**	**18.95%**	**14.49%**
3	10	7.5mph <= speed < 12.5mph	**34.07%**	**37.86%**	**31.36%**
4	15	12.5mph <= speed < 17.5mph	**28.52%**	**23.97%**	**29.17%**
5	20	17.5mph <= speed <22.5mph	**10.02%**	**5.92%**	**10.77%**
6	25	22.5mph <= speed < 27.5mph	**1.88%**	**1.84%**	**3.91%**
7	30	27.5mph <= speed < 32.5mph	**0.92%**	**0.85%**	**1.04%**
8	35	32.5mph <= speed < 37.5mph	**0.34%**	**0.60%**	**0.72%**
9	40	37.5mph <= speed < 42.5mph	**0.14%**	**0.50%**	**0.35%**
10	45	42.5mph <= speed < 47.5mph	**0.05%**	**0.15%**	**0.15%**
11	50	47.5mph <= speed < 52.5mph	**0.31%**	**0.28%**	**0.06%**
12	55	52.5mph <= speed < 57.5mph	**0.00%**	**0.00%**	**0.06%**
13	60	57.5mph <= speed < 62.5mph	**0.00%**	**0.00%**	**0.00%**
14	65	62.5mph <= speed < 67.5mph	**0.00%**	**0.00%**	**0.00%**
15	70	67.5mph <= speed < 72.5mph	**0.00%**	**0.00%**	**0.00%**
16	75	72.5mph <= speed	**0.00%**	**0.00%**	**0.00%**

Table 8 VHT Distribution of Transit Buses

Speed Bins	Speed Range	Bus Trip 1	Bus Trip 2	Bus Trip 3	Bus Trip 4	Bus Trip 5	Bus Trip 6	Bus Trip 7	Bus Trip 8	Bus Trip 9	Bus Trip 10	Bus Trip 11	Weighted Average
1	speed < 2.5mph	35.20%	24.30%	17.58%	14.65%	7.90%	16.11%	6.65%	18.30%	25.76%	16.18%	17.67%	**19.21%**
2	2.5mph <= speed < 7.5mph	10.87%	11.57%	6.45%	11.04%	29.89%	20.20%	44.83%	11.01%	9.68%	6.49%	9.12%	**14.39%**
3	7.5mph <= speed < 12.5mph	10.90%	9.35%	12.89%	6.50%	26.31%	17.69%	3.34%	9.12%	9.52%	6.69%	8.69%	**10.92%**
4	12.5mph <= speed < 17.5mph	8.81%	9.18%	8.59%	9.45%	6.00%	11.13%	23.76%	10.12%	9.98%	8.46%	10.32%	**10.37%**
5	17.5mph <= speed <22.5mph	5.01%	10.15%	5.18%	14.04%	3.04%	5.94%	4.09%	10.36%	7.57%	9.74%	12.02%	**8.30%**
6	22.5mph <= speed < 27.5mph	8.91%	8.55%	11.62%	12.59%	6.18%	5.30%	3.54%	7.29%	7.11%	8.87%	11.73%	**8.13%**
7	27.5mph <= speed < 32.5mph	8.79%	7.97%	14.36%	11.28%	5.86%	13.33%	6.35%	9.43%	5.37%	10.06%	10.20%	**9.41%**
8	32.5mph <= speed < 37.5mph	5.33%	9.10%	5.86%	13.43%	7.62%	3.32%	6.36%	13.79%	8.68%	12.04%	6.81%	**7.81%**
9	37.5mph <= speed < 42.5mph	3.43%	6.89%	8.69%	7.02%	4.80%	3.76%	1.07%	7.94%	9.79%	13.81%	8.16%	**7.22%**
10	42.5mph <= speed < 47.5mph	1.72%	2.44%	8.79%	0.00%	2.40%	2.87%	0.00%	1.31%	5.83%	5.15%	4.75%	**3.42%**
11	47.5mph <= speed < 52.5mph	0.68%	0.00%	0.00%	0.00%	0.00%	0.36%	0.00%	0.67%	0.31%	2.27%	0.36%	**0.59%**
12	52.5mph <= speed < 57.5mph	0.34%	0.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.67%	0.41%	0.24%	0.18%	**0.23%**
13	57.5mph <= speed < 62.5mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**
14	62.5mph <= speed < 67.5mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**
15	67.5mph <= speed < 72.5mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**
16	72.5mph <= speed	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**

Source: Washington Metropolitan Area Transit Authority (WMATA)

5.4 Road Type

The MWCOG/TPB travel demand model has six facility types; and these facilities are grouped into two, as follows, for MOVES:

- Restricted facility = freeway + expressway + freeway ramp; and
- Unrestricted facility = major arterial + minor arterial + collector.

Restricted and Unrestricted facilities are further divided into urban or rural facilities. Thus, five facility types were created as urban restricted, urban unrestricted, rural restricted, rural unrestricted, and off network.

5.5 Age Distribution

Every three years since 2005, the departments of motor vehicles of the District of Columbia, Maryland, and Virginia have been supplying MWCOG/TPB with vehicle registration data, also known as Vehicle Identification Number (VIN) data, for use in Air Quality Conformity (AQC) Determinations and State Implementation Plan (SIP) updates. The most recent 2020 VIN data are a snapshot of vehicle registrations by year, collected by Departments of Motor Vehicles in the three states. The VIN data contain a broad range of attributes of the vehicles registered in the jurisdictions of the Metropolitan Washington, D.C. area. The latest data are used in the development of future-year vehicle population profiles (e.g., vehicle age and vehicle type distribution) for all the analysis years in the Ozone Maintenance Plan.

Prior to using the VIN data as input to MOVES, the "raw" vehicle registration data were decoded using a commercial decoding software program.[8] Following EPA's guidelines, the data were decoded in two steps: (1) the "raw" data were decoded to a MOBILE 6.2 format; and (2) the MOBILE 6.2 format vehicle population distributions were converted to a MOVES format using an EPA converter.

[8] VinPower, Copyright; ESP Data Solutions Inc., Product version 4.0.0.16

Thus, 16 MOBILE vehicle types and 25 vehicle age categories were mapped into MOVES' 13 vehicle and 31 vehicle age categories. The vehicle population of the 2020 VIN data was reviewed by the MWCOG/TPB technical oversight committees prior to being approved for transportation planning applications.

5.6 Fuel Formulation

The state air agencies of the District of Columbia, the State of Maryland, and the Commonwealth of Virginia provided fuel characteristics data for the analysis years in a MOVES3.0.4 ready format. For year 2014, the gasoline sulfur content was 30 parts per million (ppm) or lower. For analysis years 2025 and 2030, the gasoline sulfur content used was 10 ppm or lower, which is an assumption that is consistent with EPA's 2014 Tier 3 rule.[9]

5.7 Meteorology Data

The atmospheric temperature and humidity data used for both the 2017 plan and the updated 2008 Ozone Maintenance Plan were developed using July 2014 meteorology data from Dulles International Airport.

5.8 Alternative Vehicle Fuel Technology (AVFT)

The Alternative Vehicle Fuel Technology (AVFT) table allows users to reflect the fraction of vehicles capable of using different fuels and technologies in each model year. Specifically, users may define in the AVFT table the split between diesel, gasoline, E-85, compressed natural gas (CNG), and electricity, for each vehicle type and model year. State air agencies provided local fractions for AVFT vehicles to be used for SIP analysis.

5.9 Road Type Distribution

Vehicle Miles Traveled (VMT) was distributed into MOVES 13 vehicle types and four road (facility) types. The method of developing VMT distributions was as follows:

1. Through post-processing of travel demand results, jurisdictional VMT distributions of six vehicle types were reclassified to VMT distributions by three vehicle types as follows:

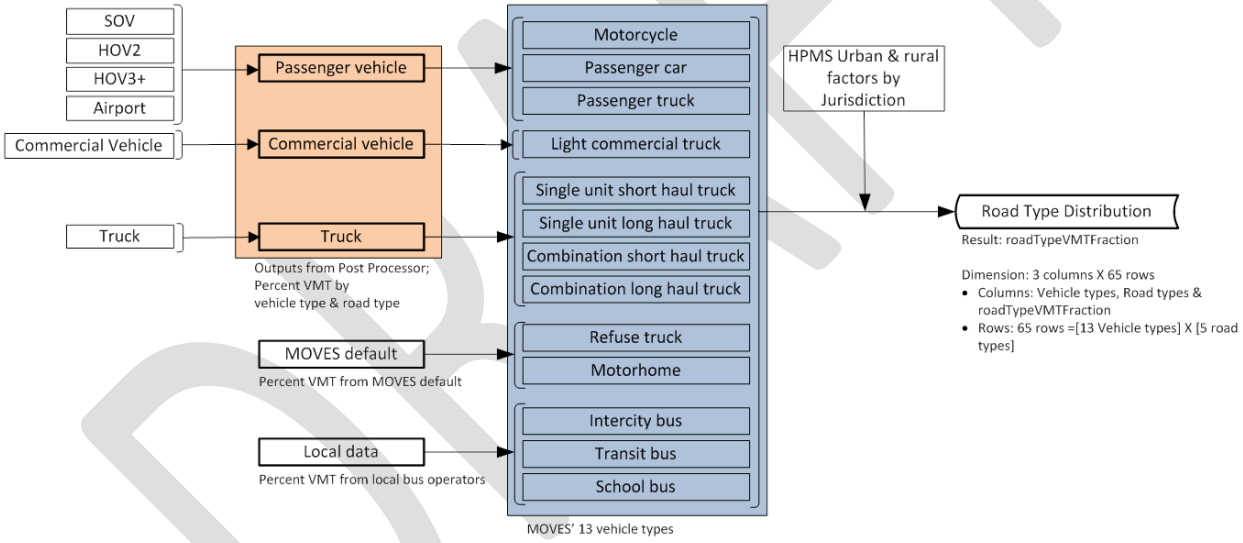
   - Passenger Vehicles = SOV + HOV2 + HOV3 (or more) + Airport Passenger Trips;
   - Commercial Vehicles = Commercial Vehicles; and
   - Heavy Duty Vehicles = Trucks.

2. VMT percentages by three vehicle types were allocated to MOVES vehicle types as follows:

[9] Office of Air and Radiation, "Final Rule for Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards," Other Policies and Guidance, U.S. Environmental Protection Agency, November 15, 2022, https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-air-pollution-motor-vehicles-tier-3.

- Passenger Vehicles: VMT percentages by facility type were applied to motorcycles, passenger cars and passenger trucks;
- Commercial Vehicles: VMT percentages by facility type were applied to commercial trucks;
- Heavy-Duty Vehicles: VMT percentages by facility type were applied to single-unit, short- and long-haul trucks, and combination short- and long-haul trucks;
- Refuse Trucks and Motor Homes: MOVES default percentage values;
- School, Transit and Intercity Buses (Tables 7 and 8): Local network percentages from local data sources (i.e., local bus operators); and
- Urban and rural percentage split factors were used to further allocate facility type VMT between urban and rural facilities. These factors vary by jurisdiction, and were based on the latest HPMS VMT data provided by the three state transportation agencies. Figure 5 illustrates the process of allocating VMT by vehicle type, facility type, and urban/rural split.

Figure 4 Road Type Distribution Development Process



5.10 Source Type (Vehicle) Population

Emissions source type population, or vehicle population, was acquired from the vehicle registration (VIN) data. The VIN decoding software output vehicle population totals by MOBILE 6.2 vehicle types. The vehicle population from the VIN data was then used to estimate vehicle population for each analysis year. Methods of estimating vehicle population vary by analysis year and availability of VIN data. For the 2014 analysis year, the 2014 vehicle population data were used. For 2025 and 2030, regression analysis was used to project future vehicle population totals based on available VIN data (collected from 2005 to 2020), which draws a "best fit" line among scattered VIN data points.

Table 9 shows vehicle population forecasts for each of the analysis years. Vehicle profiles of the 2020 VIN data are used to develop future-year vehicle profiles by jurisdiction. Vehicle profiles were

prepared in a Mobile format in this data processing first and then were converted to a MOVES vehicle type using a vehicle mapping table provided by EPA. The current VIN decoding software used in this process only provides data in Mobile format thus necessitating a conversion to MOVES format. Figure 5 shows the process of calculating source type population.

Table 9 MOVES Input Vehicle Population by Analysis Year

State	Jurisdiction	2014	2025	2030
District of Columbia	District of Columbia	291,662	332,960	351,656
	Total	291,662	332,960	351,656
Maryland	Calvert County	81,770	101,518	109,573
	Charles County	128,705	158,330	169,817
	Frederick County	206,817	258,395	276,724
	Montgomery County	724,567	835,332	877,516
	Prince George's County	623,283	687,155	714,392
	Total	1,765,142	2,040,731	2,148,022
Virginia	City of Alexandria	110,679	134,696	140,107
	Arlington County	142,002	154,320	158,999
	Fairfax County	906,630	1,053,008	1,116,226
	Loudoun County	282,436	357,187	393,583
	Prince William County	388,283	482,562	525,484
	Total	1,830,031	2,181,773	2,334,399
Regional Total		3,886,834	4,555,464	4,834,077

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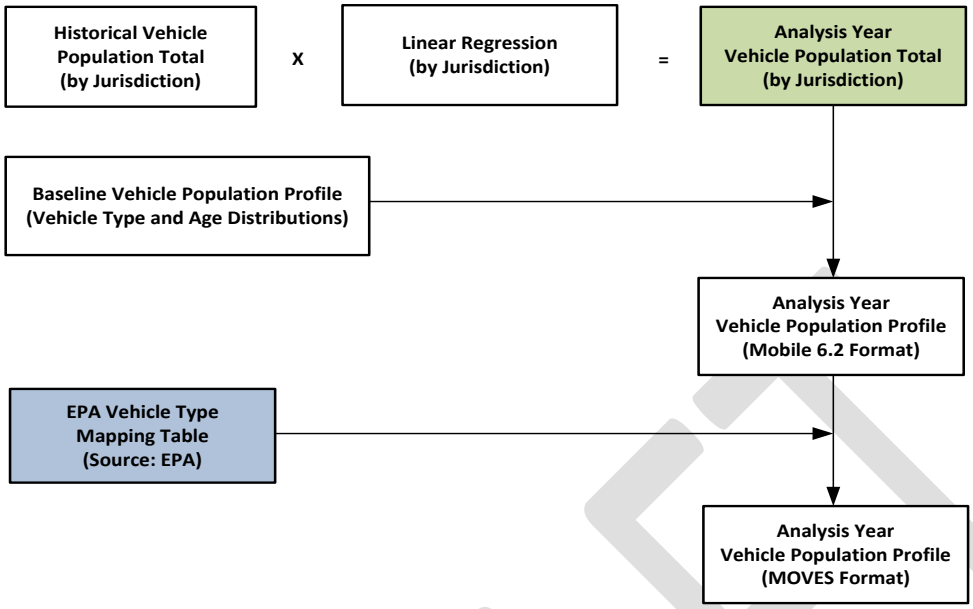
Figure 5 Source Type Population Development Process of Future Analysis Year



5.11 Inspection/Maintenance (I/M) Programs & Hoteling

The air agencies of the District of Columbia, Maryland, and Virginia provided details of Inspection/Maintenance (I/M) programs for all analysis years in a MOVES3.0.4 ready format.

5.12 Federal and State Specific Control Programs

In addition to the environmental inputs, there are state-specific programs that were taken into account in the analyses:

- Early NLEV: The District of Columbia, Maryland, and Virginia adopted an Early National Low Emission Vehicles (NLEV) program, which was reflected in all analysis years. Those input database files are named as moves304_early_nlev_DC, moves304_early_nlev_MD, and moves304_early_nlev_VA, respectively.
- CAL-LEV Programs: Maryland's California Low-Emission Vehicle (CAL-LEV) program, adopted in 2011, is reflected in all analysis years. The following auxiliary files, provided by the Maryland Department of the Environment (MDE), were used to model these programs in the Maryland jurisdictions: MOVES3.0.4 Cal-Lev Database File (moves304_caleviii2011_MD).
- Zero-Emission Vehicle (ZEV) or AVFT Programs: State air agencies provided local AVFT data for MOVES3.0.4, and the data are included in AVFT tab in an MS-Excel input file for each jurisdiction.
- Stage II Programs: Parameters for Stage II programs of Maryland and Virginia were provided in tabs titled "2025_countyyear" and "2030_countyyear" in a MS-Excel input file. For the District of Columbia, default data of MOVES3.0.4 were used.

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6.0 RESULTS

Onroad mobile inventories for the entire ozone maintenance area are shown in Tables 10 and 11. Table 10 provides the total inventories for the ozone maintenance area, and Table 11 summarizes the inventories by jurisdiction. The inventories were produced using MOVES2014a for 2014 and MOVES3.0.4 for 2025 and 2030, which reflects federal fuel and vehicle technology (Tier 3) programs.

Table 10 Ozone Maintenance Plan Onroad Emissions Inventories (short tons/day)

Pollutant	2014	2025	2030
Nitrogen Oxides (NOx)	136.84	46.52	34.26
Volatile Organic Compounds (VOC)	61.25	27.92	21.75

Table 11 Ozone Maintenance Plan Onroad Emissions Inventories by Jurisdiction

		VOC (in short tons/day)			NOx (in short tons/day)		
State	Jurisdiction	2014	2025	2030	2014	2025	2030
DC	District of Columbia	4.87	2.37	1.93	9.28	2.78	1.91
	Total	4.87	2.37	1.93	9.28	2.78	1.91
MD	Calvert County	1.45	0.67	0.50	2.34	0.87	0.60
	Charles County	2.26	1.05	0.80	4.67	1.68	1.23
	Frederick County	4.62	1.93	1.44	13.45	4.79	3.29
	Montgomery County	10.70	4.64	3.63	22.10	6.86	4.94
	Prince George's County	12.18	4.56	3.53	28.31	7.75	5.50
	Total	31.20	12.85	9.90	70.87	21.95	15.56
VA	City of Alexandria	1.40	0.67	0.51	2.64	0.76	0.57
	Arlington County	1.88	0.89	0.67	3.16	0.91	0.62
	Fairfax County	12.20	6.26	4.82	27.76	10.96	8.28
	Loudoun County	3.99	2.01	1.61	10.07	3.95	3.19
	Prince William County	5.71	2.87	2.30	13.05	5.21	4.13
	Total	25.18	12.70	9.91	56.68	21.79	16.79
Regional Total		61.25	27.92	21.75	136.84	46.52	34.26

A detailed listing of MOVES inputs, outputs, and configuration files is provided in Attachment C.

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ATTACHMENT A

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Non-travel Related MOVES Inputs:

MOVES3.0.4 inputs for 2025 and 2030 (2008 Ozone NAAQS MP Update)

Sunil Kumar

To Dusan Vuksan; Jane Posey; Jinchul Park; Daniel Son

Cc Mark Moran; Jennifer Desimone; Jeffrey King

Reply | Reply All | Forward

Fri 1/20/2023 12:05 PM

This message was sent with High importance.

Please find MS-Excel files and databases containing MOVES3.0.4 inputs for fuel supply, fuel usage fraction, fuel formulation, meteorology, Stage II program, AVFT program, I/M program, and CAL-LEV program (MD only) in the folder below for milestone years 2025 and 2030 for the 2008 ozone NAAQS Maintenance Plan Update analysis

The above set of input files have been placed in the folder – H:_SIP On-Road Emiss Inv\2008 Ozone MP Update.

Please see below a description of various control programs and other databases.

Early NELV Program Databases
DC: moves304_early_nlev_DC
MD: moves304_early_nlev_MD
VA: moves304_early_nlev_VA

CAL-LEV Program Database (MD Only)
MOVES3.0.4 CAL-LEV Database: moves304_caleviii2011_MD

Stage II Program Database
DC: MOVES3.0.4 defaults (Refueling Vapor Program Adjustment=0.9, Refueling Spill Program Adjustment=0.5) used so no input tab provided in MS-Excel input file
MD & VA: Parameters provided in tabs titled "2025_countyyear" and "2030_countyyear" in MS-Excel input files (Refueling Vapor Program Adjustment=0, Refueling Spill Program Adjustment=0)

AVFT Program Database
DC, MD, and VA supplied local data, parameters provided in tabs titled "AFVT" in MS-Excel input files
Parameters vary by jurisdiction in MD, but not in DC and VA

Meteorology Database
Parameters provided in tabs titled "Sum_zoneMonthHour" in MS-Excel input files
Met data available from the Dulles airport for the period July 2014 were used to develop onroad emissions inventories using MOVES2014a for the 2008 Ozone NAAQS Maintenance Plan. The same data will be used to develop onroad emissions inventories using MOVES3.0.4 for the 2008 Ozone NAAQS Maintenance Plan Update analysis.

Please use the following combination of "representative month/day of the week" for the MOVES3.0.4 runs for this analysis:

Month: July
Day: Weekdays

Thanks,

Sunil

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ATTACHMENT B

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MOVES TASK FORCE

Summary of Local Data Development for the County Data Manager (Emissions Inventory Approach)*

as of January 11, 2011

	LOCAL INPUT DATA CATEGORIES	DATA DESCRIPTION	DATA FORMAT	DATA DEVELOPMENT	LOCAL INPUT DATA APPROVAL DATE
			MOVES	METHODOLOGY	
1	**Age Distribution**	Registered vehicles stratified by age and vehicle type	31 Age Groups (covering 0-30+ years of vehicle age) 13 Vehicle Types	DTP used an EPA Converter to convert local registration data from MOBILE6.2 format to MOVES format	4/20/2010
2	**Average Speed Distribution**	Average vehicle speeds stratified by vehicle type, road type, time of day/type of day (i.e., weekday vs weekend)	Distributions of hourly average vehicle speeds by vehicle type, road type, and type of day (weekday/weekend)	DTP used MOBILE6.2 post-processor speed distribution augmented by local input data for school and transit buses and refuse trucks	Local VHT 7/20/2010 School Buses 9/21/2010 Refuse Trucks 9/21/2010 Transit Buses 10/19/2010
3	**Fuel Supply**	Market share of available fuels by county, month, year, state	MD/VA - EPA Methodology/local data in MOVES format DC - EPA Default Values	None Required (Direct Data Input from DC, MD, and VA air agencies)	Not Required
4	**Fuel Formulation**	Fuel formulation data stratified by state			
5	**I/M Programs**	Available Inspection/Maintenance Programs stratified by state			
6	**Meteorology Data**	Hourly temperature and relative humidity readings	Hourly Records of temperature and relative humidity in MOVES format Start Time: 12:00 am End Time: 11:00 pm	For Conformity Determinations - DEP converted meteorology data from existing SIPs to MOVES format using an EPA converter For Upcoming SIP Development - DEP compiled meteorology datasets from two weather stations based on a 3-yr period (2007-09) pending EPA approval	06/22/2010 (SIP for 2008 or Later Ozone Standard) 07/20/2010 (Conformity for Ozone & PM2.5 – 1997 Standards, CO – 1971 Standard)
7	**Ramp Fraction**	Percentage of driving time on ramps stratified by road type	8% of VHT (EPA National Default)	DTP tested local input data and found consistent with the EPA National Default value	7/20/2010
8	**Road Type Distribution**	Percentages of VMT allocated to each road type by vehicle type	VMT percentages by road type and vehicle type	DTP combined VMT from the travel demand model; and VMT distributions from the travel demand model, NEI data, and MOVES default data	4/20/2010
9	**Source Type Population**	Population of registered vehicles by county and vehicle type	13 Vehicle Types	DTP used vehicle registration and source type fractions	
10	**Vehicle Type VMT**	Annual VMT by HPMS vehicle type	Annual VMT allocated by HPMS vehicle type	DTP used daily VMT and an EPA converter	4/20/2010

*** The Task Force adopted the Emissions Inventory Approach (October 19, 2010)**

**** Documents can be found on the MOVES Task Forc** http://www.mwcog.org/committee/committee/documents.asp?COMMITTEE_ID=253

MOVES TASK FORCE

Summary of MOVES Data Development Documentation

as of January 11, 2011

	LOCAL INPUT DATA CATEGORIES	DATA DESCRIPTION	DATA DOCUMENTATION	
			METHODOLOGY	SENSITIVITY TESTING
1	**Age Distribution**	Registered vehicles stratified by age and vehicle type	Memorandum titled "Development of Local Transportation Data Inputs for MOVES2010 Model" D. Sivasailam Memorandum Drafted: 4/13/2010 Memorandum Presented: 4/20/2010 (Item 3) Memorandum Revised: 5/14/2010 (Item 3b)	Memorandum titled "Results of MOVES 2010 Model Sensitivity...", E. Lucas, Drafted/presented 4/20/2010 (Item 4) Memorandum titled "Results of MOVES2010 Model Sensitivity..." E. Lucas, Drafted/presented 5/18/2010 (Item 4a)
2	**Average Speed Distribution**	Average vehicle speeds stratified by vehicle type, road type, time of day/type of day (i.e., weekday vs weekend)	Memorandum titled "Local Vehicle Hours of Travel (VHT) Distributions," D. Sivasailam Drafted/presented 7/20/10 (Item 3b) Tables titled "School Bus Average Speed Distribution," Drafted/presented 9/21/2010 (Item 3a) Memorandum titled "Vehicle Hours of Travel (VHT) for Refuse Trucks," D. Sivasailam and E. Morrow, Drafted/presented on 9/21/2010 (Item 3a) Memorandum titled "MOVES Vehicle Hours of Travel (VHT) Distribution for Transit Buses," Y. Gao" Drafted/presented on 10/19/2010 (Item 3)	Memorandum titled "Results of MOVES2010 Model Sensitivity Tests: Final Scenario for Average Speed Testing," E. Lucas Memorandum Drafted: 10/16/2010 Memorandum Presented: 10/19/2010 (Item 4) Memorandum titled "Proposed Sensitivity Tests with Different Average Speed Distributions/SIP Temperatures" Drafted/presented 9/21/2010 (Item 3a)
3	**Fuel Supply**	Market share of available fuels by county, month, year, state	Memorandum titled "Development of Methodologies for Meteorology, I/M Program, and Fuel Inputs for Upcoming Ozone SIP (2008 or 2010 Standard) and Existing Conformity Analyses (Ozone & PM2.5 - 1997 Standards, CO - 1971 Standard)," S. Kumar Drafted/presented 6/22/2010 (Item 4a)	Memorandum titled "Results of MOVES2010 Model Sensitivity Tests:...Maryland Clean Car Program-ZEV," E. Lucas, Drafted/presented 5/18/2010 (Item 4a)
4	**Fuel Formulation**	Fuel formulation data stratified by state		
5	**I/M Programs**	Available Inspection/Maintenance Programs stratified by state		
6	**Meteorology Data**	Hourly temperature and relative humidity readings	Memorandum titled "Development of Methodologies for Meteorology, I/M Program, and Fuel Inputs for Upcoming Ozone SIP (2008 or 2010 Standard) and Existing Conformity Analyses (Ozone & PM2.5 - 1997 Standards, CO - 1971 Standard)," S. Kumar Drafted/presented 6/22/2010 (Item 4a) Memorandum titled "Development of Meteorology Inputs for existing Conformity Analyses (Ozone & PM2.5 – 1997 Standards, CO – 1971 Standard)",)," S. Kumar Drafted/presented 7/20/2010 (Item3a)"	Memorandum titled "Results of MOVES2010 Model Sensitivity Tests:...Maryland Clean Car Program-ZEV," E. Lucas, Drafted/presented 5/18/2010 (Item 4a)
7	**Ramp Fraction**	Percentage of driving time on ramps stratified by road type	Memorandum titled "Results of MOVES 2010 Model Ramp Analysis," E. Lucas, Drafted/presented 7/20/2010 (Item 4a)	Memorandum titled "Results of MOVES 2010 Model Ramp Analysis," E. Lucas, Drafted/presented 7/20/2010 (Item 4a)
8	**Road Type Distribution**	Percentages of VMT allocated to each road type by vehicle type	Memorandum titled "Development of Local Transportation Data Inputs for MOVES2010 Model," D. Sivasailam Memorandum Drafted: 4/13/2010 Memorandum Presented: 4/20/2010 (Item 3) Memorandum Revised: 5/14/2010 (Item 3b)	Memorandum titled "Results of MOVES 2010 Model Sensitivity...", E. Lucas, Drafted/presented 4/20/2010 (Item 4) Memorandum titled "Results of MOVES2010 Model Sensitivity..." E. Lucas, Drafted/presented 5/18/2010 (Item 4a)
9	**Source Type Population**	Population of registered vehicles by county and vehicle type		
10	**Vehicle Type VMT**	Annual VMT by HPMS vehicle type	Memorandum titled "Development of Annual VMT for MOVES2010,"D. Sivasailam Memorandum Drafted: 4/16/2010 Memorandum Presented: 4/20/2010 (Item 3) Memorandum Revised: 5/14/2010 (Item 3b)	Memorandum titled "Results of MOVES 2010 Model Sensitivity...", E. Lucas, Drafted/presented 4/20/2010 (Item 4) Memorandum titled "Results of MOVES2010 Model Sensitivity..." E. Lucas, Drafted/presented 5/18/2010 (Item 4a)

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ATTACHMENT C

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Input, Output, and "Runspec" Files for 2014, 2025, and 2030

(1) 2014

Input	Output	Runspec
Ozone_DC_2014_NAAQ_In	Ozone_DC_2014_NAAQ_Out	Ozone_DC_2014_NAAQ.MRS
Ozone_NoAVFT_CAL_2014_NAAQ_In	Ozone_NoAVFT_CAL_2014_NAAQ_Out	Ozone_NoAVFT_CAL_2014_NAAQ.MRS
Ozone_AVFT_CAL_2014_NAAQ_In	Ozone_AVFT_CAL_2014_NAAQ_Out	Ozone_AVFT_CAL_2014_NAAQ.MRS
Ozone_NoAVFT_CHL_2014_NAAQ_In	Ozone_NoAVFT_CHL_2014_NAAQ_Out	Ozone_NoAVFT_CHL_2014_NAAQ.MRS
Ozone_AVFT_CHL_2014_NAAQ_In	Ozone_AVFT_CHL_2014_NAAQ_Out	Ozone_AVFT_CHL_2014_NAAQ.MRS
Ozone_NoAVFT_FRD_2014_NAAQ_In	Ozone_NoAVFT_FRD_2014_NAAQ_Out	Ozone_NoAVFT_FRD_2014_NAAQ.MRS
Ozone_AVFT_FRD_2014_NAAQ_In	Ozone_AVFT_FRD_2014_NAAQ_Out	Ozone_AVFT_FRD_2014_NAAQ.MRS
Ozone_NoAVFT_MTG_2014_NAAQ_In	Ozone_NoAVFT_MTG_2014_NAAQ_Out	Ozone_NoAVFT_MTG_2014_NAAQ.MRS
Ozone_AVFT_MTG_2014_NAAQ_In	Ozone_AVFT_MTG_2014_NAAQ_Out	Ozone_AVFT_MTG_2014_NAAQ.MRS
Ozone_NoAVFT_PG_2014_NAAQ_In	Ozone_NoAVFT_PG_2014_NAAQ_Out	Ozone_NoAVFT_PG_2014_NAAQ.MRS
Ozone_AVFT_PG_2014_NAAQ_In	Ozone_AVFT_PG_2014_NAAQ_Out	Ozone_AVFT_PG_2014_NAAQ.MRS
Ozone_FFX_2014_NAAQ_In	Ozone_FFX_2014_NAAQ_Out	Ozone_FFX_2014_NAAQ.MRS
Ozone_LDN_2014_NAAQ_In	Ozone_LDN_2014_NAAQ_Out	Ozone_LDN_2014_NAAQ.MRS
Ozone_PW_2014_NAAQ_In	Ozone_PW_2014_NAAQ_Out	Ozone_PW_2014_NAAQ.MRS

(2) 2025

Input	Output	Runspec
OZN_DC_2025_MVEB_In	OZN_DC_2025_MVEB_Out	OZN_DC_2025_MVEB.MRS
OZN_CAL_2025_MVEB_In	OZN_CAL_2025_MVEB_Out	OZN_CAL_2025_MVEB.MRS
OZN_CHL_2025_MVEB_In	OZN_CHL_2025_MVEB_Out	OZN_CHL_2025_MVEB.MRS
OZN_FRD_2025_MVEB_In	OZN_FRD_2025_MVEB_Out	OZN_FRD_2025_MVEB.MRS
OZN_MTG_2025_MVEB_In	OZN_MTG_2025_MVEB_Out	OZN_MTG_2025_MVEB.MRS
OZN_PG_2025_MVEB_In	OZN_PG_2025_MVEB_Out	OZN_PG_2025_MVEB.MRS
OZN_FFX_2025_MVEB_In	OZN_FFX_2025_MVEB_Out	OZN_FFX_2025_MVEB.MRS
OZN_LDN_2025_MVEB_In	OZN_LDN_2025_MVEB_Out	OZN_LDN_2025_MVEB.MRS
OZN_PW_2025_MVEB_In	OZN_PW_2025_MVEB_Out	OZN_PW_2025_MVEB.MRS

(3) 2030

Input	Output	Runspec
OZN_DC_2030_MVEB_In	OZN_DC_2030_MVEB_Out	OZN_DC_2030_MVEB.MRS
OZN_CAL_2030_MVEB_In	OZN_CAL_2030_MVEB_Out	OZN_CAL_2030_MVEB.MRS
OZN_CHL_2030_MVEB_In	OZN_CHL_2030_MVEB_Out	OZN_CHL_2030_MVEB.MRS
OZN_FRD_2030_MVEB_In	OZN_FRD_2030_MVEB_Out	OZN_FRD_2030_MVEB.MRS
OZN_MTG_2030_MVEB_In	OZN_MTG_2030_MVEB_Out	OZN_MTG_2030_MVEB.MRS
OZN_PG_2030_MVEB_In	OZN_PG_2030_MVEB_Out	OZN_PG_2030_MVEB.MRS
OZN_FFX_2030_MVEB_In	OZN_FFX_2030_MVEB_Out	OZN_FFX_2030_MVEB.MRS
OZN_LDN_2030_MVEB_In	OZN_LDN_2030_MVEB_Out	OZN_LDN_2030_MVEB.MRS
OZN_PW_2030_MVEB_In	OZN_PW_2030_MVEB_Out	OZN_PW_2030_MVEB.MRS

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