



Useful Information

Mobile Source Air Toxics (MSAT) Emission Rate Look-up Tables (ERLT)

This document provides information on the use and development of the ERLT for the quantitative MSAT analysis.

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1.0 Background

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The Environmental Protection Agency (EPA) has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System¹. In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment². These are acetaldehyde (ACE), acrolein (ACROL), benzene (BENZ), 1,3-butadiene (BUTA), diesel particulate matter plus diesel exhaust organic gases (DPM), ethylbenzene (ETB), formaldehyde (FORM), naphthalene (NAP), and polycyclic organic matter (POM). While the Federal Highway Administration (FHWA) considers these the priority MSAT, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their 2016 Interim Guidance on MSAT Analysis in National Environmental Policy Act (NEPA).

According to FHWA, interim MSAT guidance and Texas Department of Transportation (TxDOT) guidance for addressing NEPA requirements, environmental documentation for certain categories of transportation projects that require federal action should include a qualitative or quantitative MSAT analysis³. The FHWA has developed updated interim guidance as to when and how to analyze MSAT in the NEPA process for highway projects⁴. Consistent with the FHWA interim guidance as implemented by TxDOT, a quantitative MSAT analysis should be conducted for projects located in proximity to populated areas that have an annual average daily traffic (AADT) volume greater than or equal to 140,000, or that create or significantly alter a major intermodal freight facility involving significant numbers of diesel vehicles. Quantitative MSAT analysis involves developing emission factors, identifying roadway links in an affected transportation network, and calculating emissions for the affected network for different analysis years.

The emission rate look-up tables (ERLT) for MSAT were developed for seven Texas metropolitan geographic areas which include Austin, Corpus Christi, Dallas-Fort Worth, El Paso, Houston, San Antonio, and Waco. The ERLT were developed using the data and assumptions documented in the pre-analysis consensus plan, which can be found in Appendix A.

2.0 Applying Running Exhaust Emissions for MSAT for Transportation Projects

2.1 Calculating free flow emissions

- These tables provide emission rates for MSAT analysis, which includes ACE, ACROL, BENZ, BUTA, DPM, ETB, FORM, NAP, and POM.
- These rates can be used for estimating emissions for transportation projects that require quantitative MSAT analysis.
- The emission rates in the ERLT are in grams /mile.

¹ <http://www.epa.gov/ncea/iris/index.html>

² <https://www.epa.gov/national-air-toxics-assessment>

³ <http://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/air-quality.html>

⁴ (https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/agtguidmem.cfm)

- The formula for estimating emissions is:

Emissions (lbs/day)_{Speed, roadway type} = Emission Rate_{Speed, roadway type} (grams/mile)* Vehicle Miles of Travel (miles/day)*1 lb/453.59237 grams,

Where VMT on a specific Link at modeled speed = Volume * Link Length.

2.2 Calculating idling emissions

- The formula for estimating idling emissions (except for 18-wheelers) is:

Emissions Rate (gram/hour) = Emission Rate (grams/mile)* 2.5 miles/hour.

3.0 Glossary

Emission Rate Lookup Tables – Tables of emission rates for various pollutants for varying speeds and years developed using the EPA MOVES2014 emissions model.

Mobile Source Air Toxics – Compounds emitted into the air from mobile sources that are known, or suspected, to cause cancer or other serious health and environmental effects.

Priority MSAT – Nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers according to EPA's 2011 National Air Toxics Assessment. The priority MSAT are: ACE, ACROL, BENZ, BUTA, DPM, ETB, FORM, NAP, and POM.

4.0 Abbreviations and Acronyms

AADT	Annual Average Daily Traffic
ACE	Acetaldehyde
ACROL	Acrolein
BENZ	Benzene
BUTA	1,3-Butadiene
DPM	Diesel particulate matter plus diesel exhaust organic gases
ERLT	Emission Rate Lookup Tables
EPA	Environmental Protection Agency
ETB	Ethylbenzene
FHWA	Federal Highways Administration
FORM	Formaldehyde
NAAQS	National Ambient Air Quality Standards
NAP	Naphthalene
NEPA	National Environmental Policy Act
POM	Polycyclic organic matter
TxDOT	Texas Department of Transportation

Appendix A: Pre-Analysis Consensus Plans for ERLT Development

TxDOT Austin District Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are acetaldehyde (ACE), acrolein (ACROL), benzene (BENZ), 1,3-butadiene (BUTA), diesel particulate matter plus diesel exhaust organic gases (DPM), ethylbenzene (ETB), formaldehyde (FORM), naphthalene (NAP), and polycyclic organic matter (POM). While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their 2016 Interim Guidance.

With the release of EPA's latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the TxDOT Austin District was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for TxDOT Austin District for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in Table 1 for TxDOT Austin District Area.

Table 1 Analysis Years and Counties TxDOT Austin District Area	
Requirement	Years
Base Year	2010, the first year of the mobility plan (as required).
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	Bastrop, Burnet, Caldwell, Hays, Travis, Williamson, Mason, Llano, Gillespie, Blanco and Lee.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Transportation Institute (TTI), and was applied to estimate MSAT.

Table 2 Hourly Distribution Factors Analysis Year 2011 TxDOT Austin District Area		
Hours	Summer	Winter

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12:00 a.m. – 12:59 a.m.	0.011752	0.010987
1:00 a.m. – 1:59 a.m.	0.007985	0.007781
2:00 a.m. – 2:59 a.m.	0.007443	0.007316
3:00 a.m. – 3:59 a.m.	0.006046	0.005971
4:00 a.m. – 4:59 a.m.	0.008254	0.008108
5:00 a.m. – 5:59 a.m.	0.021200	0.020646
6:00 a.m. – 6:59 a.m.	0.051097	0.050761
7:00 a.m. – 7:59 a.m.	0.064784	0.064309
8:00 a.m. – 8:59 a.m.	0.060195	0.059800
9:00 a.m. – 9:59 a.m.	0.055297	0.054543
10:00 a.m. – 10:59 a.m.	0.051948	0.052135
11:00 a.m. – 11:59 a.m.	0.055589	0.055865
12:00 p.m. – 12:59 p.m.	0.057944	0.058522
1:00 p.m. – 1:59 p.m.	0.058782	0.059973
2:00 p.m. – 2:59 p.m.	0.059842	0.062182
3:00 p.m. – 3:59 p.m.	0.063051	0.065895
4:00 p.m. – 4:59 p.m.	0.063413	0.065894
5:00 p.m. – 5:59 p.m.	0.062690	0.064393
6:00 p.m. – 6:59 p.m.	0.059810	0.060603
7:00 p.m. – 7:59 p.m.	0.049379	0.048754
8:00 p.m. – 8:59 p.m.	0.039679	0.037354
9:00 p.m. – 9:59 p.m.	0.035809	0.033464
10:00 p.m. – 10:59 p.m.	0.028266	0.026392
11:00 p.m. – 11:59 p.m.	0.019745	0.010987

Source: TTI

Useful Information Regarding MSAT ERLT

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information TxDOT Austin District Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the TxDOT Austin District Area.
Time Periods	Hourly	
Functional Class	Off-Network, Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	2.5-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles). Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates
Calendar Year	2010 and 2015 through 2040	Will also include the first (base) year of the mobility plan, as required
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Useful Information Regarding MSAT ERLT

Table 4 MOVES2014 Input Parameters and Source TxDOT Austin District Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2010 and 2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2010 and 2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2010 & 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2010 & 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2010 and 2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply TxDOT Austin District					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
178010000	2010	1	8549	0.09	NULL
178010000	2010	1	8551	0.91	NULL
178010000	2010	1	31001	1	NULL
178010000	2010	7	8555	0.09	NULL
178010000	2010	7	8557	0.91	NULL
178010000	2010	7	31001	1	NULL
178010000	2014	1	13067	1	NULL
178010000	2014	1	30002	1	NULL
178010000	2014	7	10702	1	NULL
178010000	2014	7	30002	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties TxDOT Austin District								
Fuel Year	2010					2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
fuelFormulationID	8549	8555	8551	8557	31001	13067	10702	30002
fuelSubtypeID	10	10	12	12	20	12	12	20
RVP	11.07	7.8	12.07	7.8	0	12.07	7.52	0
sulfurlevel	33.83	34.2	33.83	34.2	15	30	30.84	6.18
ETOHVolume	0	0	10	10	0	10	9.76	0
MTBEVolume	0	0	0	0	0	0	0	0
ETBEVolume	0	0	0	0	0	0	0	0
TAMEVolume	0	0	0	0	0	0	0	0
aromaticContent	22.94	25.25	19.29	23.23	0	19.29	22.65	0
olefinContent	12.54	12.98	10.46	12.52	0	10.46	11.75	0
benzeneContent	0.88	0.9	0.88	0.9	0	0.61	0.55	0
e200	49.42	43.79	54.3	45.64	0	54.3	49.82	0
e300	83.05	80.06	83.59	79.95	0	83.59	83.7	0
volToWtPercentOxy	0	0	0.3653	0.3653	0	0.3653	0.3653	0
BioDieselEsterVolume	NULL	NULL	NULL	NULL	0	NULL	NULL	NULL
CetaneIndex	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
PAHContent	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
T50	196.64	214.4	186.68	210.54	0	186.68	203.22	0
T90	329.38	340.54	326.93	341.04	0	326.93	322.54	0

^a For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.

Source: TTI

Useful Information Regarding MSAT ERLT

Table 5 MOVES2014 Hourly Meteorological Data Analysis Year 2012 TxDOT Austin District Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	77.58	50.99	73.11	66.77
1:00 a.m.	76.82	50.45	74.47	69.25
2:00 a.m.	75.81	50.02	79.30	70.38
3:00 a.m.	75.24	49.60	81.44	70.90
4:00 a.m.	74.87	49.26	82.87	71.06
5:00 a.m.	74.53	48.86	83.50	71.30
6:00 a.m.	74.22	48.63	84.78	70.03
7:00 a.m.	74.71	48.27	83.60	71.13
8:00 a.m.	76.37	49.17	79.15	68.22
9:00 a.m.	78.37	51.21	72.54	63.64
10:00 a.m.	80.67	53.53	64.63	59.04
11:00 a.m.	82.75	55.68	58.58	55.52
12:00 p.m.	84.61	57.47	53.67	51.63
1:00 p.m.	86.08	58.74	50.34	49.13
2:00 p.m.	87.51	59.71	45.70	47.47
3:00 p.m.	88.41	60.31	43.66	46.43
4:00 p.m.	88.66	59.97	42.94	46.85
5:00 p.m.	88.39	58.53	43.99	49.91
6:00 p.m.	87.57	56.60	45.25	52.94
7:00 p.m.	85.98	54.64	48.44	58.13
8:00 p.m.	83.50	53.55	55.18	60.93
9:00 p.m.	81.71	52.68	60.29	62.78
10:00 p.m.	80.10	51.99	64.61	64.83
11:00 p.m.	78.69	51.38	69.11	66.81

Source: TTI

Useful Information Regarding MSAT ERLT

Table 6 MOVES2014 I/M Descriptive Inputs TxDOT Austin District Travis and Williamson County I/M data					
I/M Program ID	140	121	151	160	Identifies program number with MOVES Database.
Pollutant Process ID	101, 102, 201, 202, 301, 302,	101, 102, 201, 202, 301, 302,	112	112	
Source Use Type	21, 31, 32	21, 31, 32	21, 31, 32	21, 31, 32	
Begin Model Year	1996	X	X	1996	
End Model Year	y	1995	1995	y	
Inspection Frequency	1	1	1	1	Annual testing; program specifications
Test Standards ID	51	12	41	45	Identifies program number with MOVES Database.
Test Standards Description	Exhaust OBD Check	Two-mode, 2500 RPM/Idle Test	Evaporative Gas Cap Check	Evaporative Gas Cap and OBD Check	
I/M Compliance	93.12% for source type 21, 91.26% for source type 31 and 86.6% for source type 32				Expected compliance (%) - MOVES Default
Begin Model Year and End Model year define the range of vehicle model years covered by I/M Program. Here Begin Model Year represented by "x" is calculated as YearID – 24 and End Model Year represented by "y" is calculated as YearID – 2.					

TxDOT Corpus Christi District Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are *acetaldehyde (ACE)*, *acrolein (ACROL)*, *benzene (BENZ)*, *1,3-butadiene (BUTA)*, *diesel particulate matter plus diesel exhaust organic gases (DPM)*, *ethylbenzene (ETB)*, *formaldehyde (FORM)*, *naphthalene (NAP)*, and *polycyclic organic matter (POM)*. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their *2016 Interim Guidance*.

With the release of EPA's latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the TxDOT Corpus Christi District was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for TxDOT Corpus Christi District for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in **Table 1** for TxDOT Corpus Christi District Area.

Table 1 Analysis Years and Counties TxDOT Corpus Christi District Area	
Requirement	Years
Base Year	2006 (Current) and 2012 (future base year), the first year of the mobility plan.
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	Aransas, Bee, Goliad, Jim Wells, Karnes, Kleberg, Live Oak, Nueces, Refugio, and San Patricio.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Traffic Institute (TTI), and was applied to estimate MSAT.

Table 2 Hourly Distribution Factors TxDOT Corpus Christi District Area		
Hours	Summer	Winter
12:00 a.m. – 12:59 a.m.	0.00811	0.00698
1:00 a.m. – 1:59 a.m.	0.00507	0.00453

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2:00 a.m. – 2:59 a.m.	0.00450	0.00417
3:00 a.m. – 3:59 a.m.	0.00401	0.00377
4:00 a.m. – 4:59 a.m.	0.00755	0.00756
5:00 a.m. – 5:59 a.m.	0.01956	0.02019
6:00 a.m. – 6:59 a.m.	0.04299	0.04555
7:00 a.m. – 7:59 a.m.	0.06381	0.07046
8:00 a.m. – 8:59 a.m.	0.05728	0.06235
9:00 a.m. – 9:59 a.m.	0.05006	0.05233
10:00 a.m. – 10:59 a.m.	0.05110	0.05240
11:00 a.m. – 11:59 a.m.	0.05729	0.05686
12:00 p.m. – 12:59 p.m.	0.06051	0.06007
1:00 p.m. – 1:59 p.m.	0.06093	0.06050
2:00 p.m. – 2:59 p.m.	0.06196	0.06210
3:00 p.m. – 3:59 p.m.	0.06748	0.06860
4:00 p.m. – 4:59 p.m.	0.07521	0.07797
5:00 p.m. – 5:59 p.m.	0.08867	0.09208
6:00 p.m. – 6:59 p.m.	0.06347	0.06342
7:00 p.m. – 7:59 p.m.	0.04517	0.04102
8:00 p.m. – 8:59 p.m.	0.03627	0.03033
9:00 p.m. – 9:59 p.m.	0.03058	0.02535
10:00 p.m. – 10:59 p.m.	0.02323	0.01875
11:00 p.m. – 11:59 p.m.	0.01523	0.01269

Source: TTI

Useful Information Regarding MSAT ERLT

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information TxDOT Corpus Christi District Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the TxDOT Corpus Christi District Area.
Time Periods	Hourly	
Functional Class	Off-Network, Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	1-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles). Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates.
Calendar Year	2010 and 2015 through 2040	Will also include the first (base) year of the mobility plan, as required.
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Useful Information Regarding MSAT ERLT

Table 4 MOVES2014 Input Parameters and Source TxDOT Corpus Christi District Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2006, 2012 and 2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2006, 2012 and 2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2006, 2012 and 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2006, 2012 and 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2006, 2012 and 2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply TxDOT Corpus Christi District Area					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
178010000	2014	1	13067	1	NULL
178010000	2014	1	30002	1	NULL
178010000	2014	7	10702	1	NULL
178010000	2014	7	30002	1	NULL
178010000	2012	1	8809	1	NULL
178010000	2012	1	31001	1	NULL
178010000	2012	7	8815	1	NULL
178010000	2012	7	31001	1	NULL
178010000	2006	1	8033	1	NULL
178010000	2006	1	31001	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties TxDOT Corpus Christi District Area									
Fuel Year	2006			2012			2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
Fuel Formulation ID	8033	8039	31001	8809	8815	31001	13067	10702	30002
Fuel Subtype ID	10	10	20	12	12	20	12	12	20
RVP	11.16	7.8	0	12.07	7.8	0	12.07	7.52	0
Sulfur level	78.94	77.85	296.6	30	30	5.92	30	30.84	6.18
ETOH Volume	0	0	0	10	10	0	10	9.76	0
MTBE Volume	0	0	0	0	0	0	0	0	0
ETBE Volume	0	0	0	0	0	0	0	0	0
TAME Volume	0	0	0	0	0	0	0	0	0
Aromatic Content	25.35	25.9	0	19.29	23.23	0	19.29	22.65	0
Olefin Content	12.88	12.83	0	10.46	12.52	0	10.46	11.75	0
Benzene Content	1.02	1.05	0	0.61	0.61	0	0.61	0.55	0
e200	48.76	45.73	0	54.3	45.64	0	54.3	49.82	0
e300	84.27	83.09	0	83.59	79.95	0	83.59	83.7	0
Vol To Wt Percent Oxy	0	0	0	0.3653	0.3653	0	0.3653	0.3653	0
Bi-Diesel Ester Volume	NULL	NULL	0	NULL	NULL	0	NULL	NULL	NULL
Cetane Index	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
PAH Content	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
T50	202.34	208.53	0	186.68	210.54	0	186.68	203.22	0

Useful Information Regarding MSAT ERLT

**Table 4.b
MOVES2014 Fuel Properties
TxDOT Corpus Christi District Area**

Fuel Year	2006			2012			2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
T90	323.65	329	0	326.93	341.04	0	326.93	322.54	0

^a For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.

Source: TTI

**Table 5
MOVES2014 Hourly Meteorological Data
TxDOT Corpus Christi District Area**

Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	81.60	56.20	80.84	79.53
1:00 a.m.	81.23	55.80	81.85	80.23
2:00 a.m.	80.79	55.41	83.02	80.84
3:00 a.m.	80.41	55.01	83.86	81.66
4:00 a.m.	80.05	54.66	84.66	82.06
5:00 a.m.	79.75	54.29	85.34	82.23
6:00 a.m.	79.46	54.00	85.77	82.36
7:00 a.m.	79.88	53.98	84.98	82.30
8:00 a.m.	81.93	55.07	79.11	80.49
9:00 a.m.	84.02	57.02	71.56	76.85
10:00 a.m.	86.11	59.14	64.46	71.86
11:00 a.m.	87.60	60.90	60.30	67.29
12:00 p.m.	88.61	61.99	58.01	64.26
1:00 p.m.	89.24	62.81	56.79	62.40
2:00 p.m.	89.50	63.27	56.11	61.81
3:00 p.m.	89.34	63.03	56.56	62.52
4:00 p.m.	88.72	62.00	58.01	64.81
5:00 p.m.	87.85	60.48	60.24	68.34
6:00 p.m.	86.68	58.96	63.25	72.04
7:00 p.m.	85.23	57.86	67.13	75.45
8:00 p.m.	83.57	57.32	72.97	77.19
9:00 p.m.	82.78	56.95	76.20	78.15
10:00 p.m.	82.35	56.74	77.97	78.56
11:00 p.m.	81.96	56.43	79.55	79.19

Source: TTI

Table 6
MOVES2010b I/M Descriptive Inputs
Corpus Christi Area

No inspection and maintenance (I/M) programs for Corpus Christi Area

Dallas-Fort Worth Metropolitan Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are *acetaldehyde (ACE)*, *acrolein (ACROL)*, *benzene (BENZ)*, *1,3-butadiene (BUTA)*, *diesel particulate matter plus diesel exhaust organic gases (DPM)*, *ethylbenzene (ETB)*, *formaldehyde (FORM)*, *naphthalene (NAP)*, and *polycyclic organic matter (POM)*. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their *2016 Interim Guidance*.

With the release of EPA's latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the Dallas-Fort Worth Metropolitan area was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in **Table 1** for Dallas - Fort Worth Metropolitan Area.

Table 1 Analysis Years and Counties Dallas-Fort Worth Metropolitan Area	
Requirement	Years
Base Year	2015.
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	Collin, Dallas, Denton, Ellis, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Traffic Institute (TTI), and was applied to estimate MSAT.

Table 2 Hourly Distribution Factors Analysis Year 2011 Dallas-Fort Worth Metropolitan Area		
Hours	Summer	Winter
12:00 a.m. – 12:59 a.m.	0.01048	0.00931

Useful Information Regarding MSAT ERLT

1:00 a.m. – 1:59 a.m.	0.00679	0.00614
2:00 a.m. – 2:59 a.m.	0.00629	0.00579
3:00 a.m. – 3:59 a.m.	0.00605	0.00559
4:00 a.m. – 4:59 a.m.	0.00990	0.00908
5:00 a.m. – 5:59 a.m.	0.02602	0.02394
6:00 a.m. – 6:59 a.m.	0.05379	0.05188
7:00 a.m. – 7:59 a.m.	0.06736	0.06878
8:00 a.m. – 8:59 a.m.	0.05942	0.06131
9:00 a.m. – 9:59 a.m.	0.05103	0.05111
10:00 a.m. – 10:59 a.m.	0.04932	0.04951
11:00 a.m. – 11:59 a.m.	0.05226	0.05282
12:00 p.m. – 12:59 p.m.	0.05492	0.05575
1:00 p.m. – 1:59 p.m.	0.05598	0.05732
2:00 p.m. – 2:59 p.m.	0.05878	0.06093
3:00 p.m. – 3:59 p.m.	0.06559	0.06847
4:00 p.m. – 4:59 p.m.	0.07235	0.07554
5:00 p.m. – 5:59 p.m.	0.07553	0.07818
6:00 p.m. – 6:59 p.m.	0.06124	0.06321
7:00 p.m. – 7:59 p.m.	0.04527	0.04442
8:00 p.m. – 8:59 p.m.	0.03587	0.03341
9:00 p.m. – 9:59 p.m.	0.03196	0.02893
10:00 p.m. – 10:59 p.m.	0.02580	0.02293
11:00 p.m. – 11:59 p.m.	0.01799	0.01568

Source: TTI

Useful Information Regarding MSAT ERLT

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information Dallas-Fort Worth Metropolitan Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the Dallas-Fort Worth Metropolitan Area.
Time Periods	Hourly	
Functional Class	Off-Network ,Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	1-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles). Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates
Calendar Year	2015 through 2040	Will also include the first (base) year of the mobility plan, as required
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Table 4 MOVES2014 Input Parameters and Source Dallas-Fort Worth Metropolitan Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply Dallas-Fort Worth Metropolitan Area					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
1370011000	2014	1	10104	1	NULL
1370011000	2014	1	30002	1	NULL
1370011000	2014	7	10704	1	NULL
1370011000	2014	7	30002	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties Dallas-Fort Worth Metropolitan Area			
Fuel Year	2014	2014	2014
Fuel Type	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
Fuel Formulation ID	10104	10704	30002
Fuel Subtype ID	12	12	20
RVP	10.85	7.1	0
Sulfur Level	35.09	28.47	6.18
ETOH Volume	10.09	9.7	0
MTBE Volume	0	0	0
ETBE Volume	0	0	0
TAME Volume	0	0	0
Aromatic Content	13.86	14.42	0
Olefin Content	11.02	13.36	0
Benzene Content	0.47	0.44	0
e200	58.39	49	0
e300	86.61	84.3	0
Vol To Wt Percent Oxy	0.3653	0.3653	0
Bio Diesel Ester Volume	NULL	NULL	NULL
Cetane Index	NULL	NULL	NULL
PAH Content	NULL	NULL	NULL
T50	155.64	203.6	0
T90	317.3	329.78	0

* For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.

Source: TTI

Useful Information Regarding MSAT ERLT

Table 5 MOVES2014 Hourly Meteorological Data Analysis Year 2012 Dallas-Fort Worth Metropolitan Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	79.03	47.33	68.91	68.50
1:00 a.m.	78.09	47.16	71.16	69.43
2:00 a.m.	77.25	46.75	73.10	70.44
3:00 a.m.	76.48	46.12	75.15	71.29
4:00 a.m.	75.70	45.73	77.07	72.28
5:00 a.m.	75.05	45.12	78.83	71.85
6:00 a.m.	74.38	44.86	80.32	72.13
7:00 a.m.	75.36	44.66	79.17	72.39
8:00 a.m.	77.72	45.82	73.79	69.86
9:00 a.m.	80.40	47.67	67.53	64.74
10:00 a.m.	82.78	49.89	61.95	59.99
11:00 a.m.	85.40	51.85	55.92	56.30
12:00 p.m.	87.31	53.69	51.86	53.34
1:00 p.m.	88.95	55.09	48.35	51.19
2:00 p.m.	90.01	56.07	46.08	49.53
3:00 p.m.	90.43	56.45	45.01	49.17
4:00 p.m.	90.62	55.94	44.37	49.73
5:00 p.m.	90.15	54.02	44.85	52.30
6:00 p.m.	89.21	52.53	46.32	56.81
7:00 p.m.	87.18	51.42	49.96	60.33
8:00 p.m.	85.49	50.43	52.89	61.59
9:00 p.m.	82.54	49.38	60.24	63.40
10:00 p.m.	81.24	48.60	63.40	65.35
11:00 p.m.	80.07	47.89	66.35	67.06

Source: TTI

Useful Information Regarding MSAT ERLT

Table 6 MOVES2014 I/M Descriptive Inputs Dallas-Fort Worth Metropolitan Area Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant I/M data					
I/M Program ID	140	130	151	160	Identifies program number with MOVES Database.
Pollutant Process ID	101, 102, 201, 202, 301, 302,	101, 102, 201, 202, 301, 302,	112	112	
Source Use Type	21, 31, 32	21, 31, 32	21, 31, 32	21, 31, 32	
Begin Model Year	1996	X	X	1996	
End Model Year	y	1995	1995	y	
Inspection Frequency	1	1	1	1	Annual testing; program specifications
Test Standards ID	51	23	41	45	Identifies program number with MOVES Database.
Test Standards Description	Exhaust OBD Check	ASM 2525/5015 Phase-in Cut Points	Evaporative Gas Cap Check	Evaporative Gas Cap and OBD Check	
I/M Compliance	93.12% for source type 21, 91.26% for source type 31 and 86.6% for source type 32				Expected compliance (%) - MOVES Default
Begin Model Year and End Model year define the range of vehicle model years covered by I/M Program. Here Begin Model Year represented by "x" is calculated as YearID – 24 and End Model Year represented by "y" is calculated as YearID – 2.					

TxDOT El Paso District Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are *acetaldehyde (ACE)*, *acrolein (ACROL)*, *benzene (BENZ)*, *1,3-butadiene (BUTA)*, *diesel particulate matter plus diesel exhaust organic gases (DPM)*, *ethylbenzene (ETB)*, *formaldehyde (FORM)*, *naphthalene (NAP)*, and *polycyclic organic matter (POM)*. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their *2016 Interim Guidance*.

With the release of EPA's latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the TxDOT El Paso District was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for TxDOT El Paso District for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in **Table 1** for TxDOT El Paso District Area.

Table 1 Analysis Years and Counties TxDOT El Paso District Area	
Requirement	Years
Base Year	2007 (Current) and 2012 (future base year), the first year of the mobility plan.
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	El Paso, Hudspeth, Culberson, Jeff Davis, Presidio and Brewster.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Transportation Institute (TTI), and was applied to estimate MSAT.

Table 2 Hourly Distribution Factors TxDOT El Paso District Area		
Hours	Summer	Winter
12:00 a.m. – 12:59 a.m.	0.010707	0.010707

Useful Information Regarding MSAT ERLT

1:00 a.m. – 1:59 a.m.	0.007026	0.007026
2:00 a.m. – 2:59 a.m.	0.005971	0.005971
3:00 a.m. – 3:59 a.m.	0.005420	0.005420
4:00 a.m. – 4:59 a.m.	0.007670	0.007670
5:00 a.m. – 5:59 a.m.	0.018850	0.018850
6:00 a.m. – 6:59 a.m.	0.038834	0.038834
7:00 a.m. – 7:59 a.m.	0.065309	0.065309
8:00 a.m. – 8:59 a.m.	0.063975	0.063975
9:00 a.m. – 9:59 a.m.	0.054502	0.054502
10:00 a.m. – 10:59 a.m.	0.052003	0.052003
11:00 a.m. – 11:59 a.m.	0.055351	0.055351
12:00 p.m. – 12:59 p.m.	0.058348	0.058348
1:00 p.m. – 1:59 p.m.	0.059471	0.059471
2:00 p.m. – 2:59 p.m.	0.061601	0.061601
3:00 p.m. – 3:59 p.m.	0.067148	0.067148
4:00 p.m. – 4:59 p.m.	0.072022	0.072022
5:00 p.m. – 5:59 p.m.	0.074261	0.074261
6:00 p.m. – 6:59 p.m.	0.060427	0.060427
7:00 p.m. – 7:59 p.m.	0.045971	0.045971
8:00 p.m. – 8:59 p.m.	0.037325	0.037325
9:00 p.m. – 9:59 p.m.	0.032779	0.032779
10:00 p.m. – 10:59 p.m.	0.026339	0.026339
11:00 p.m. – 11:59 p.m.	0.018690	0.018690

Source: TTI

Useful Information Regarding MSAT ERLT

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information TxDOT El Paso District Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the TxDOT El Paso District Area.
Time Periods	Hourly	
Functional Class	Off-Network, Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	1-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles). Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates
Calendar Year	2010 and 2015 through 2040	Will also include the first (base) year of the mobility plan, as required
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Useful Information Regarding MSAT ERLT

Table 4 MOVES2014 Input Parameters and Source TxDOT El Paso District Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2007, 2012 and 2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2007, 2012 and 2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2007, 2012 and 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2007, 2012 and 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2007, 2012 and 2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply TxDOT El Paso District Area					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
370010000	2014	1	13101	1	NULL
370010000	2014	1	30001	1	NULL
370010000	2014	7	10703	1	NULL
370010000	2014	7	30001	1	NULL
370010000	2012	1	8843	1	NULL
370010000	2012	1	31002	1	NULL
370010000	2012	7	8848	1	NULL
370010000	2012	7	31002	1	NULL
370010000	2007	1	10113	0.5	NULL
370010000	2007	1	10123	0.5	NULL
370010000	2007	1	30101	1	NULL
370010000	2007	7	10703	1	NULL
370010000	2007	7	30101	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties TxDOT El Paso District Area										
Fuel Year	2007				2012			2014		
Fuel Type	Summer Gasoline	Winter Gasohol (E8)	Winter Gasohol (E8)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Summer Gasohol (E10)	Winter Gasohol (E10)	Diesel
Fuel Formulation ID	10703	10113	10123	30101	8843	8848	31002	10703	13101	30001
Fuel Subtype ID	10	13	13	20	12	12	20	12	12	20
RVP	6.67	12.6	11.97	0	11.61	7	0	6.83	11.61	0
Sulfur Level ^a	212.1	127.09	81.15	73.9	30	30	5.43	14.84	30	3.56
ETOH Volume	0	8.28	8.56	0	10	10	0	9.77	10	0
MTBE Volume	0.115	0	0	0	0	0	0	0	0	0
ETBE Volume	0	0	0	0	0	0	0	0	0	0
TAME Volume	0.001	0	0	0	0	0	0	0	0	0
Aromatic Content	33.47	25.5	24.35	0	22.05	25.67	0	25.79	22.05	0
Olefin Content	11.78	11.13	9.07	0	7.05	9.42	0	8.39	7.05	0
Benzene Content	1.75	1.87	1.65	0	0.63	0.63	0	0.4	0.63	0
e200	42.42	59.47	61.08	0	53.74	45.16	0	47.21	53.74	0
e300	83.77	88.64	89.31	0	87.4	83.72	0	87.77	87.4	0
Vol To Wt Percent Oxy	0.1792	0.3653	0.3653	0	0.3653	0.3653	0	0.3653	0.3653	0
Bio Diesel	NULL	NULL	NULL	0	NULL	NULL	0	NULL	NULL	NULL

Useful Information Regarding MSAT ERLT

Table 4.b MOVES2014 Fuel Properties TxDOT El Paso District Area										
Fuel Year	2007				2012			2014		
Fuel Type	Summer Gasoline	Winter Gasohol (E8)	Winter Gasohol (E8)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Summer Gasohol (E10)	Winter Gasohol (E10)	Diesel
Ester Volume										
Cetane Index	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
PAH Content	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
T50	215.61	167.06	156.73	0	194.22	211.23	0	211.33	194.22	0
T90	321.08	304.4	301.9	0	310.28	324.92	0	306.75	310.28	0

^a For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.

Source: TTI

Table 5 MOVES2014 Hourly Meteorological Data TxDOT El Paso District Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	81.79	49.27	37.25	37.74
1:00 a.m.	81.05	47.90	38.45	40.16
2:00 a.m.	78.79	47.15	41.82	41.71
3:00 a.m.	77.71	46.66	44.20	42.80
4:00 a.m.	77.07	45.42	45.48	45.24
5:00 a.m.	75.45	44.76	48.25	46.03
6:00 a.m.	74.26	44.69	49.49	46.61
7:00 a.m.	74.18	43.97	50.23	48.80
8:00 a.m.	76.31	44.48	48.13	46.89
9:00 a.m.	79.20	46.24	44.01	44.21
10:00 a.m.	80.69	51.06	41.51	36.43
11:00 a.m.	85.32	54.70	34.30	32.54
12:00 p.m.	87.80	55.84	30.79	30.85
1:00 p.m.	89.00	59.56	28.89	26.26
2:00 p.m.	91.75	60.89	25.11	24.51
3:00 p.m.	92.79	61.52	23.67	23.94
4:00 p.m.	93.05	62.13	23.18	22.86
5:00 p.m.	92.99	60.64	23.10	24.14
6:00 p.m.	92.41	58.97	23.38	25.10
7:00 p.m.	91.92	55.61	23.68	29.12
8:00 p.m.	89.12	53.90	26.43	30.99
9:00 p.m.	86.76	53.17	29.57	32.04

Useful Information Regarding MSAT ERLT

Table 5 MOVES2014 Hourly Meteorological Data TxDOT El Paso District Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
10:00 p.m.	85.64	51.26	31.35	35.16
11:00 p.m.	83.13	49.82	34.91	36.73

Source: TTI

Table 6 MOVES2014 I/M Descriptive Inputs TxDOT El Paso District Area El Paso I/M data					
I/M Program ID	140	121	151	160	Identifies program number with MOVES Database.
Pollutant Process ID	101, 102, 201, 202, 301, 302,	101, 102, 201, 202, 301, 302,	112	112	
Source Use Type	21, 31, 32	21, 31, 32	21, 31, 32	21, 31, 32	
Begin Model Year	1996	X	X	1996	
End Model Year	y	1995	1995	y	
Inspection Frequency	1	1	1	1	Annual testing; program specifications
Test Standards ID	51	12	41	45	Identifies program number with MOVES Database.
Test Standards Description	Exhaust OBD Check	Two-mode, 2500 RPM/Idle Test	Evaporative Gas Cap Check	Evaporative Gas Cap and OBD Check	
I/M Compliance	93.12% for source type 21, 91.26% for source type 31 and 86.6% for source type 32				Expected compliance (%) - MOVES Default
Begin Model Year and End Model year define the range of vehicle model years covered by I/M Program. Here Begin Model Year represented by "x" is calculated as YearID – 24 and End Model Year represented by "y" is calculated as YearID – 2.					

Houston Galveston Bay Metropolitan Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are *acetaldehyde (ACE)*, *acrolein (ACROL)*, *benzene (BENZ)*, *1,3-butadiene (BUTA)*, *diesel particulate matter plus diesel exhaust organic gases (DPM)*, *ethylbenzene (ETB)*, *formaldehyde (FORM)*, *naphthalene (NAP)*, and *polycyclic organic matter (POM)*. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their *2016 Interim Guidance*.

With the release of EPA's latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the Houston Galveston Bay Metropolitan Area was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in **Table 1** for Houston Galveston Bay Metropolitan Area.

Table 1 Analysis Years and Counties Houston Galveston Bay Metropolitan Area	
Requirement	Years
Base Year	2015.
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery and Waller.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Transportation Institute (TTI), and was applied to estimate MSAT.

Table 2 Hourly Distribution Factors Analysis Year 2011 Houston Galveston Bay Metropolitan Area		
Hours	Summer	Winter
12:00 a.m. – 12:59 a.m.	0.00986	0.00902

Useful Information Regarding MSAT ERLT

1:00 a.m. – 1:59 a.m.	0.00696	0.00650
2:00 a.m. – 2:59 a.m.	0.00634	0.00602
3:00 a.m. – 3:59 a.m.	0.00662	0.00643
4:00 a.m. – 4:59 a.m.	0.01204	0.01174
5:00 a.m. – 5:59 a.m.	0.03089	0.03055
6:00 a.m. – 6:59 a.m.	0.05314	0.05262
7:00 a.m. – 7:59 a.m.	0.06325	0.06441
8:00 a.m. – 8:59 a.m.	0.05469	0.05591
9:00 a.m. – 9:59 a.m.	0.05074	0.05089
10:00 a.m. – 10:59 a.m.	0.05186	0.05217
11:00 a.m. – 11:59 a.m.	0.05545	0.05581
12:00 p.m. – 12:59 p.m.	0.05782	0.05844
1:00 p.m. – 1:59 p.m.	0.05887	0.05982
2:00 p.m. – 2:59 p.m.	0.06099	0.06217
3:00 p.m. – 3:59 p.m.	0.06646	0.06834
4:00 p.m. – 4:59 p.m.	0.07089	0.07295
5:00 p.m. – 5:59 p.m.	0.07284	0.07398
6:00 p.m. – 6:59 p.m.	0.05813	0.05927
7:00 p.m. – 7:59 p.m.	0.04489	0.04389
8:00 p.m. – 8:59 p.m.	0.03619	0.03375
9:00 p.m. – 9:59 p.m.	0.03094	0.02852
10:00 p.m. – 10:59 p.m.	0.02364	0.02169
11:00 p.m. – 11:59 p.m.	0.01651	0.01513

Source: TTI

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information Houston Galveston Bay Metropolitan Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the Houston Galveston Bay Metropolitan Area.
Time Periods	Hourly	
Functional Class	Off-network, Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	1-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles) . Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates
Calendar Year	2015 through 2040	Will also include the first (base) year of the mobility plan, as required
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Useful Information Regarding MSAT ERLT

Table 4 MOVES2014 Input Parameters and Source Houston Galveston Bay Metropolitan Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply Houston Galveston Bay Metropolitan Area					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
1370011000	2014	1	10104	1	NULL
1370011000	2014	1	30002	1	NULL
1370011000	2014	7	10704	1	NULL
1370011000	2014	7	30002	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties Houston Galveston Bay Metropolitan Area			
Fuel Year	2014	2014	2014
Fuel Type	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
Fuel Formulation ID	10104	10704	30002
Fuel Subtype ID	12	12	20
RVP	10.85	7.1	0
Sulfur Level ^a	35.09	28.47	6.18
ETOH Volume	10.09	9.7	0
MTBE Volume	0	0	0
ETBE Volume	0	0	0
TAME Volume	0	0	0
Aromatic Content	13.86	14.42	0
Olefin Content	11.02	13.36	0
Benzene Content	0.47	0.44	0
e200	58.39	49	0
e300	86.61	84.3	0
Vol To Wt Percent Oxy	0.3653	0.3653	0
Bio Diesel Ester Volume	NULL	NULL	NULL
Cetane Index	NULL	NULL	NULL
PAH Content	NULL	NULL	NULL
T50	155.64	203.6	0
T90	317.3	329.78	0

^a For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.

Source: TTI

Useful Information Regarding MSAT ERLT

Table 5				
MOVES2014 Hourly Meteorological Data				
Houston Galveston Bay Metropolitan Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	79.76	52.40	82.64	79.53
1:00 a.m.	79.21	52.07	84.10	80.50
2:00 a.m.	78.74	51.78	85.50	81.05
3:00 a.m.	78.35	51.55	86.44	81.68
4:00 a.m.	77.99	51.32	87.41	81.85
5:00 a.m.	77.70	51.12	88.11	82.13
6:00 a.m.	77.54	50.95	88.49	82.59
7:00 a.m.	78.54	51.08	86.19	82.69
8:00 a.m.	81.05	52.60	78.99	79.20
9:00 a.m.	83.28	54.66	72.08	73.88
10:00 a.m.	85.28	56.51	65.29	68.47
11:00 a.m.	86.86	58.06	60.18	64.26
12:00 p.m.	87.95	59.21	56.99	61.63
1:00 p.m.	88.53	60.01	55.32	59.84
2:00 p.m.	88.35	60.44	55.52	58.91
3:00 p.m.	88.22	60.26	56.43	59.23
4:00 p.m.	87.99	59.53	57.63	60.92
5:00 p.m.	87.51	58.05	58.92	64.35
6:00 p.m.	86.61	56.51	61.13	68.31
7:00 p.m.	85.16	55.35	65.05	71.46
8:00 p.m.	83.24	54.48	70.94	73.66
9:00 p.m.	81.94	53.82	75.12	75.46
10:00 p.m.	81.08	53.27	78.16	77.00
11:00 p.m.	80.39	52.78	80.45	78.42

Source: TTI

Useful Information Regarding MSAT ERLT

Table 6 MOVES2014 I/M Descriptive Inputs Houston Galveston Bay Metropolitan Area Brazoria, Fort Bend, Galveston and Montgomery County I/M data					
I/M Program ID	140	130	151	160	Identifies program number with MOVES Database.
Pollutant Process ID	101, 102, 201, 202, 301, 302,	101, 102, 201, 202, 301, 302,	112	112	
Source Use Type	21, 31, 32	21, 31, 32	21, 31, 32	21, 31, 32	
Begin Model Year	1996	X	X	1996	
End Model Year	y	1995	1995	y	
Inspection Frequency	1	1	1	1	Annual testing; program specifications
Test Standards ID	51	23	41	45	Identifies program number with MOVES Database.
Test Standards Description	Exhaust OBD Check	ASM 2525/5015 Phase-in Cut Points	Evaporative Gas Cap Check	Evaporative Gas Cap and OBD Check	
I/M Compliance	93.12% for source type 21, 91.26% for source type 31 and 86.6% for source type 32				Expected compliance (%) - MOVES Default
Begin Model Year and End Model year define the range of vehicle model years covered by I/M Program. Here Begin Model Year represented by "x" is calculated as YearID – 24 and End Model Year represented by "y" is calculated as YearID – 2.					

TxDOT San Antonio District Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are *acetaldehyde (ACE)*, *acrolein (ACROL)*, *benzene (BENZ)*, *1,3-butadiene (BUTA)*, *diesel particulate matter plus diesel exhaust organic gases (DPM)*, *ethylbenzene (ETB)*, *formaldehyde (FORM)*, *naphthalene (NAP)*, and *polycyclic organic matter (POM)*. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their *2016 Interim Guidance*.

With the release of EPA's latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the TxDOT San Antonio District was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for TxDOT San Antonio District for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in **Table 1** for TxDOT San Antonio District Area.

Table 1 Analysis Years and Counties TxDOT San Antonio District Area	
Requirement	Years
Base Year	2010, the first year of the mobility plan (as required).
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	Atascosa, Bandera, Bexar, Comal, Frio, Guadalupe, Kendall, Kerr, McMullen, Medina, Uvalde and Wilson counties.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Transportation Institute (TTI), and was applied to estimate MSAT.

Table 2 Hourly Distribution Factors Analysis Year 2011 TxDOT San Antonio District Area		
Hours	Summer	Winter
12:00 a.m. – 12:59 a.m.	0.009817	0.008826

Useful Information Regarding MSAT ERLT

1:00 a.m. – 1:59 a.m.	0.006493	0.006013
2:00 a.m. – 2:59 a.m.	0.005688	0.005385
3:00 a.m. – 3:59 a.m.	0.005443	0.005218
4:00 a.m. – 4:59 a.m.	0.008452	0.008155
5:00 a.m. – 5:59 a.m.	0.020000	0.019517
6:00 a.m. – 6:59 a.m.	0.050486	0.050686
7:00 a.m. – 7:59 a.m.	0.071262	0.072390
8:00 a.m. – 8:59 a.m.	0.059428	0.060392
9:00 a.m. – 9:59 a.m.	0.049299	0.048825
10:00 a.m. – 10:59 a.m.	0.048467	0.048157
11:00 a.m. – 11:59 a.m.	0.052209	0.052150
12:00 p.m. – 12:59 p.m.	0.054540	0.054831
1:00 p.m. – 1:59 p.m.	0.056197	0.056961
2:00 p.m. – 2:59 p.m.	0.059268	0.060970
3:00 p.m. – 3:59 p.m.	0.067715	0.070240
4:00 p.m. – 4:59 p.m.	0.077154	0.080107
5:00 p.m. – 5:59 p.m.	0.081120	0.082651
6:00 p.m. – 6:59 p.m.	0.061665	0.063741
7:00 p.m. – 7:59 p.m.	0.044313	0.043243
8:00 p.m. – 8:59 p.m.	0.035960	0.033102
9:00 p.m. – 9:59 p.m.	0.032213	0.029046
10:00 p.m. – 10:59 p.m.	0.025253	0.023282
11:00 p.m. – 11:59 p.m.	0.017558	0.016112

Source: TTI

Useful Information Regarding MSAT ERLT

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information TxDOT San Antonio District Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the TxDOT San Antonio District Area.
Time Periods	Hourly	
Functional Class	Off-Network, Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	1-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles). Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates
Calendar Year	2010 and 2015 through 2040	Will also include the first (base) year of the mobility plan, as required
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Useful Information Regarding MSAT ERLT

Table 4 MOVES2014 Input Parameters and Source TxDOT San Antonio District Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2010 and 2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2010 and 2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2010 & 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2010 & 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2010 and 2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply TxDOT San Antonio District					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
178010000	2010	1	8549	0.09	NULL
178010000	2010	1	8551	0.91	NULL
178010000	2010	1	31001	1	NULL
178010000	2010	7	8555	0.09	NULL
178010000	2010	7	8557	0.91	NULL
178010000	2010	7	31001	1	NULL
178010000	2014	1	13067	1	NULL
178010000	2014	1	30002	1	NULL
178010000	2014	7	10702	1	NULL
178010000	2014	7	30002	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties TxDOT San Antonio District								
Fuel Year	2010					2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
Fuel Formulation ID	8549	8555	8551	8557	31001	13067	10702	30002
Fuel Subtype ID	10	10	12	12	20	12	12	20
RVP	11.07	7.8	12.07	7.8	0	12.07	7.52	0
Sulfur Level	33.83	34.2	33.83	34.2	15	30	30.84	6.18
ETOH Volume	0	0	10	10	0	10	9.76	0
MTBE Volume	0	0	0	0	0	0	0	0
ETBE Volume	0	0	0	0	0	0	0	0
TAME Volume	0	0	0	0	0	0	0	0
Aromatic Content	22.94	25.25	19.29	23.23	0	19.29	22.65	0
Olefin Content	12.54	12.98	10.46	12.52	0	10.46	11.75	0
Benzene Content	0.88	0.9	0.88	0.9	0	0.61	0.55	0
e200	49.42	43.79	54.3	45.64	0	54.3	49.82	0
e300	83.05	80.06	83.59	79.95	0	83.59	83.7	0
Vol To Wt Percent Oxy	0	0	0.3653	0.3653	0	0.3653	0.3653	0
Bio Diesel Ester Volume	NULL	NULL	NULL	NULL	0	NULL	NULL	NULL
Cetane Index	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Useful Information Regarding MSAT ERLT

Table 4.b MOVES2014 Fuel Properties TxDOT San Antonio District								
Fuel Year	2010					2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
PAH Content	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
T50	196.64	214.4	186.68	210.54	0	186.68	203.22	0
T90	329.38	340.54	326.93	341.04	0	326.93	322.54	0

^a For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.
Source: TTI

Table 5 MOVES2014 Hourly Meteorological Data Analysis Year 2012 TxDOT San Antonio District Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	79.23	50.32	75.10	74.01
1:00 a.m.	78.13	49.69	77.32	75.83
2:00 a.m.	77.19	49.25	80.64	77.05
3:00 a.m.	76.57	48.82	82.67	77.24
4:00 a.m.	76.07	48.46	84.08	77.71
5:00 a.m.	75.61	48.26	85.69	78.08
6:00 a.m.	75.31	47.99	86.44	77.97
7:00 a.m.	75.72	47.77	85.56	76.73
8:00 a.m.	77.61	49.20	79.97	73.06
9:00 a.m.	79.95	51.41	72.99	69.32
10:00 a.m.	82.48	53.79	65.93	63.48
11:00 a.m.	85.18	55.88	57.85	58.28
12:00 p.m.	87.46	57.73	52.05	55.13
1:00 p.m.	89.35	59.35	48.82	51.56
2:00 p.m.	91.18	60.64	43.81	49.48
3:00 p.m.	92.33	61.30	41.59	48.71
4:00 p.m.	92.94	61.27	41.08	49.06
5:00 p.m.	93.05	59.87	40.99	52.42
6:00 p.m.	92.13	57.60	42.98	56.55
7:00 p.m.	90.12	55.42	47.46	61.52
8:00 p.m.	87.05	53.94	55.30	65.05
9:00 p.m.	84.63	52.80	60.60	67.54
10:00 p.m.	82.72	51.74	64.75	71.03
11:00 p.m.	80.78	50.94	70.63	72.91

Source: TTI

Table 6 MOVES2010b I/M Descriptive Inputs TxDOT San Antonio District Area
No inspection and maintenance (I/M) programs for San Antonio District Area

TxDOT Waco District Area

Project Description and Region

Mobile source air toxics (MSAT) are compounds known, or suspected, to cause cancer or other serious health and environmental effects. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (<http://www.epa.gov/ncea/iris/index.html>). In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 2011 National Air Toxics Assessment (NATA) (<https://www.epa.gov/national-air-toxics-assessment>). These are *acetaldehyde (ACE)*, *acrolein (ACROL)*, *benzene (BENZ)*, *1,3-butadiene (BUTA)*, *diesel particulate matter plus diesel exhaust organic gases (DPM)*, *ethylbenzene (ETB)*, *formaldehyde (FORM)*, *naphthalene (NAP)*, and *polycyclic organic matter (POM)*. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The FHWA adopts the EPA priority list in their *2016 Interim Guidance*.

With the release of EPA’s latest on-road model Motor Vehicle Emission Simulator MOVES2014 (Version October 2014), a new set of emission rate look-up tables (ERLT) are developed for MSAT. The ERLT for MSAT for the TxDOT Waco District was developed using the following data assumptions, in accordance with the pre-analysis consensus plan. Two runs for each analysis year was performed, one for summer season and one for winter season. As the magnitude of emission factors depends on the seasonal inputs, for conservative estimation, the higher value of emission factors among the two seasonal runs are selected to develop the ERLT for MSAT.

The ERLT are prepared for the analysis years and listed counties presented in **Table 1** for TxDOT Waco District Area.

Table 1 Analysis Years and Counties TxDOT Waco District Area	
Requirement	Years
Base Year	2010, the first year of the mobility plan (as required).
Future Analysis Year	2015 through 2040 with 1 year increments.
Interpolation Years	N/A
Counties	Bell, Bosque, Coryell, Falls, Hamilton, Hill, Lime Stone and McLennan.

1. Activity Detail

The following are vehicle activity details that were applied in the post processing modeling process. Diurnal Distribution of Vehicle Activity was provided by Texas A&M Transportation Institute (TTI), and was applied to estimate MSAT.

Useful Information Regarding MSAT ERLT

Table 2 Hourly Distribution Factors Analysis Year 2011 TxDOT Waco District Area		
Hours	Summer	Winter
12:00 a.m. – 12:59 a.m.	0.015164	0.009215
1:00 a.m. – 1:59 a.m.	0.011838	0.006381
2:00 a.m. – 2:59 a.m.	0.010167	0.005528
3:00 a.m. – 3:59 a.m.	0.010060	0.005056
4:00 a.m. – 4:59 a.m.	0.012389	0.007128
5:00 a.m. – 5:59 a.m.	0.019335	0.016715
6:00 a.m. – 6:59 a.m.	0.033760	0.038479
7:00 a.m. – 7:59 a.m.	0.050734	0.069687
8:00 a.m. – 8:59 a.m.	0.047796	0.066258
9:00 a.m. – 9:59 a.m.	0.048629	0.053961
10:00 a.m. – 10:59 a.m.	0.053505	0.052616
11:00 a.m. – 11:59 a.m.	0.058486	0.056323
12:00 p.m. – 12:59 p.m.	0.061143	0.059208
1:00 p.m. – 1:59 p.m.	0.063443	0.060440
2:00 p.m. – 2:59 p.m.	0.066028	0.063216
3:00 p.m. – 3:59 p.m.	0.067970	0.071350
4:00 p.m. – 4:59 p.m.	0.069513	0.075251
5:00 p.m. – 5:59 p.m.	0.070445	0.075182
6:00 p.m. – 6:59 p.m.	0.056819	0.060374
7:00 p.m. – 7:59 p.m.	0.047822	0.044028
8:00 p.m. – 8:59 p.m.	0.041546	0.034323
9:00 p.m. – 9:59 p.m.	0.034853	0.029968
10:00 p.m. – 10:59 p.m.	0.027473	0.023193
11:00 p.m. – 11:59 p.m.	0.021082	0.016120

Source: TTI

Useful Information Regarding MSAT ERLT

2. Emissions Modeling Details (MOVES Emission Factor Model Information)

Detailed MOVES input parameter data and sources are outlined in the following sections for consultation partners review.

Table 3 Modeling Information TxDOT Waco District Area		
Description	Input Parameter Values	Comment
MOVES Model Version	MOVES2014	Latest MOVES2014 (revised October 2014) is the model to be utilized for this analysis.
MOVES Model County	Travis	Regional applicable inputs will be applied to the surrogate county to represent the TxDOT Waco District Area.
Time Periods	Hourly	
Functional Class	Off-Network, Urban Restricted, Rural Restricted, Urban Unrestricted and Rural Unrestricted	
Speed	1-75 mph at 5 mph increments	
Pollutant	Acetaldehyde (ACE), Acrolein (ACROL), Benzene (BENZ), 1,3-butadiene (BUTA), Diesel Particulate Matter (DPM), Formaldehyde (FORM), Naphthalene (NAP), and Polycyclic Organic Matter (POM)	DPM is diesel emissions represented by PM ₁₀ total exhaust for diesel vehicles only (not gasoline vehicles). Although POM consists of 100s of compounds, which includes NAP, MOVES provides estimates for POM emissions using the most predominant POM pollutants, listed below, without NAP: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3,c,d)pyrene, Phenanthrene, and Pyrene.
VMT Mix	EPA's 23-vehicle class	Applied during post-processing of emission rates
Calendar Year	2010 and 2015 through 2040	Will also include the first (base) year of the mobility plan, as required
Evaluation Month	1 (Dec-Feb) 7 (June-Aug)	ERLT will represent annual average for all pollutants.

Useful Information Regarding MSAT ERLT

Table 4 MOVES2014 Input Parameters and Source TxDOT Waco District Area		
Input Parameter Name	Description	Source
Source Type Population	Input the number of vehicles in the geographic area which is to be modeled for each vehicle.	2010 and 2014 TXDMV registration data
Source Type Age Distribution	Input that provides the distribution of vehicle counts by age for each calendar year and vehicle type. TXDMV registration data is used to estimate the age distribution of vehicle types up to 30 years. The distribution of Age fractions should sum up to 1.0 for all vehicle types for each analysis year.	2010 and 2014 TXDMV registration data & MOVES default
Average Speed Distribution	Input average speed data specific to vehicle type, road type, and time of day/type of day into 16 speed bins. The sum of speed distribution to all speed bins for each road type, vehicle type, and time/day type would be 1.0.	MOVES Default
Road Type Distribution (VMT Fractions)	VMT by road type. VMT fraction is distributed between the road type and must sum to 1.0 for each source type.	MOVES Default
Fuel Supply	Existing fuels (gas & diesel) and associated market share for each fuel.	TTI Provided 2010 & 2014 Data (See table 4.a)
Fuel Formulation	Fuel properties in the MOVES database.	TTI Provided 2010 & 2014 Data (See Table 4.b)
Fuel usage Fraction	This specifies the fraction of E-85-capable vehicles using E-85 vs. conventional gasoline.	MOVES Default
Meteorology	Regional Specific data on temperature and humidity.	TTI Provided 2014 data (See Table 5)
I/M Coverage	Input I/M coverage record for each combination of pollutants, process, county, fuel type, regulatory class and model year are specified using this input.	See Table 6.
Alternative Vehicle Fuel Technology	Input fuel engine fractions (i.e. Gasoline vs. Diesel Engines types in the vehicle population) for all vehicle types.	2010 and 2014 TXDMV registration data & MOVES default

Useful Information Regarding MSAT ERLT

Table 4.a MOVES2010b Fuel Supply TxDOT Waco District					
Fuel Region ID	Fuel Year ID	Month Group ID	Fuel Formulation ID	Market Share	Market Share CV
178010000	2010	1	8549	0.09	NULL
178010000	2010	1	8551	0.91	NULL
178010000	2010	1	31001	1	NULL
178010000	2010	7	8555	0.09	NULL
178010000	2010	7	8557	0.91	NULL
178010000	2010	7	31001	1	NULL
178010000	2014	1	13067	1	NULL
178010000	2014	1	30002	1	NULL
178010000	2014	7	10702	1	NULL
178010000	2014	7	30002	1	NULL

Source: TTI

Table 4.b MOVES2014 Fuel Properties TxDOT Waco District								
Fuel Year	2010					2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
Fuel Formulation ID	8549	8555	8551	8557	31001	13067	10702	30002
Fuel Subtype ID	10	10	12	12	20	12	12	20
RVP	11.07	7.8	12.07	7.8	0	12.07	7.52	0
Sulfur Level	33.83	34.2	33.83	34.2	15	30	30.84	6.18
ETOH Volume	0	0	10	10	0	10	9.76	0
MTBE Volume	0	0	0	0	0	0	0	0
ETBE Volume	0	0	0	0	0	0	0	0
TAME Volume	0	0	0	0	0	0	0	0
Aromatic Content	22.94	25.25	19.29	23.23	0	19.29	22.65	0
Olefin Content	12.54	12.98	10.46	12.52	0	10.46	11.75	0
Benzene Content	0.88	0.9	0.88	0.9	0	0.61	0.55	0
e200	49.42	43.79	54.3	45.64	0	54.3	49.82	0
e300	83.05	80.06	83.59	79.95	0	83.59	83.7	0
Vol To Wt Percent Oxy	0	0	0.3653	0.3653	0	0.3653	0.3653	0
Bio Diesel Ester Volume	NULL	NULL	NULL	NULL	0	NULL	NULL	NULL
Cetane Index	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
PAH Content	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Useful Information Regarding MSAT ERLT

Table 4.b MOVES2014 Fuel Properties TxDOT Waco District								
Fuel Year	2010					2014		
Fuel Type	Winter Gasoline	Summer Gasoline	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel	Winter Gasohol (E10)	Summer Gasohol (E10)	Diesel
T50	196.64	214.4	186.68	210.54	0	186.68	203.22	0
T90	329.38	340.54	326.93	341.04	0	326.93	322.54	0

^a For modeling analysis year 2017 and later years, gasoline sulfur level value of 10 will be used.

Source: TTI

Table 5 MOVES2014 Hourly Meteorological Data Analysis Year 2012 TxDOT Waco District Area				
Hours	Temperature (°F)		Relative Humidity (%)	
	Summer	Winter	Summer	Winter
12:00 a.m.	78.16	48.26	70.70	70.76
1:00 a.m.	77.63	47.42	72.06	71.98
2:00 a.m.	76.15	46.96	75.86	72.67
3:00 a.m.	75.30	46.36	77.90	73.45
4:00 a.m.	74.50	46.41	80.18	74.37
5:00 a.m.	73.92	45.71	81.96	73.98
6:00 a.m.	73.10	45.23	85.99	76.35
7:00 a.m.	73.73	44.72	85.66	76.90
8:00 a.m.	77.39	46.19	77.9	72.88
9:00 a.m.	80.75	48.71	70.15	67.67
10:00 a.m.	83.56	51.34	63.27	62.23
11:00 a.m.	86.17	53.71	57.79	58.14
12:00 p.m.	88.38	55.28	53.26	55.10
1:00 p.m.	89.65	57.09	50.84	52.61
2:00 p.m.	91.48	58.34	46.98	50.83
3:00 p.m.	92.17	58.71	45.52	50.23
4:00 p.m.	92.52	57.73	44.10	51.17
5:00 p.m.	92.20	55.19	44.03	55.41
6:00 p.m.	90.67	53.42	45.85	58.50
7:00 p.m.	88.69	50.65	48.86	63.59
8:00 p.m.	84.36	49.62	56.56	67.58
9:00 p.m.	81.78	49.06	62.03	69.02
10:00 p.m.	80.45	48.61	65.16	70.02
11:00 p.m.	79.39	48.62	67.53	69.93

Source: TTI

**Table 6
MOVES2010b I/M Descriptive Inputs
TxDOT Waco District Area**

No inspection and maintenance (I/M) programs for Waco District Area

Appendix B: Ethyl Benzene Emission Factor Methodology

Ethyl Benzene Emission Factor Methodology

TxDOT had developed emission rate look-up tables (ERLT) for MSATs pollutants for seven Texas metropolitan geographic areas in 2015. On October 18, 2016 Federal Highway Administration (FHWA) updated interim guidance document “Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents”. This guidance reintroduced acetaldehyde (ACE) and added ethylbenzene (ETB) to be included in all future qualifying transportation projects for MSATs analysis. The ETB emission factors were not available in the previously developed MOVES outputs. Therefore for the development of Ethyl Benzene Emissions following methodology is being used:

1. Default MOVES model database provides ratios for ethyl benzene (ETB) emissions. These ratios can be multiplied to volatile organic compounds (VOC) emission factors to estimate ethyl benzene emission factors. These tables called minor hap-ratio and crank case emission ratio.
2. The minor hap-ratio contains ratios for the following list of emission processes. The ratio are available by fuel type.
 - a. Running Exhaust
 - b. Start Exhaust
 - c. Evap Permeation
 - d. Evap Fuel Vapor Venting
 - e. Evap Fuel Leaks
 - f. Extended Idle Exhaust
 - g. Auxiliary Power Exhaust
3. The crank case emission ratio contains ratios for the following list of emission processes. The ratios are available by fuel type and source type (vehicle type).
 - a. Crankcase Running Exhaust
 - b. Crankcase Start Exhaust
4. VMT-mix and Hour-mix are used to estimate weighted factors for ETB by road type. After applying weighted factors by source type, the ethyl benzene ratios by emission processes are listed in **Error! Reference source not found.**

Table 1 Ratios for Ethyl Benzene		
Emissions Process	Gasoline	Diesel
Running Exhaust	0.01660	0.00630
Start Exhaust	0.01660	0.01660
Evap Permeation	0.00100	-
Evap Fuel Vapor Venting	0.01721	-
Evap Fuel Leaks	0.01721	-
Crankcase Running Exhaust	0.01322	0.03700
Crankcase Start Exhaust	0.01319	0.03700
Extended Idle Exhaust	-	0.0063

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Auxiliary Power Exhaust	-	0.0027
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5. The above estimated ratio are then used with the VMT-mix factors (**Error! Reference source not found.**) to estimate for ethyl benzene ratios by road type and emission processes (**Error! Reference source not found.**).

Table 2 VMT-Mix Fuel Type and Road Type				
Fuel Type ID	2	3	4	5
1	0.7995	0.8487	0.9083	0.9159
2	0.2005	0.1513	0.0917	0.0841

Table 3 Ratios for Ethyl Benzene by Road Type					
Road Type ID	Running Exhaust Emission	Evap Permeation Emissions	Evap Fuel Vent Emissions	Evap Fuel Leak Emission	Crank Run Exhaust Emissions
2	0.0145	0.0008	0.0138	0.0138	0.0180
3	0.0150	0.0008	0.0146	0.0146	0.0168
4	0.0157	0.0009	0.0156	0.0156	0.0154
5	0.0157	0.0009	0.0158	0.0158	0.0152

6. Texas Commission Environmental Quality trend emissions are used to estimate percentage of emission contribution by emission processes for all available analysis years. Only emission processes connected to running emissions (**Error! Reference source not found.**) are used to estimate weighted ratios by road type (**Error! Reference source not found.**).

Useful Information Regarding MSAT ERLT

Table 4					
TCEQ Trend Emission Percentage Contribution by Emission Processes					
Year	Running Exhaust Emission	Evap Permeation Emissions	Evap Fuel Vent Emissions	Evap Fuel Leak Emission	Crank Run Exhaust Emissions
2007	54%	13%	26%	6%	1%
2008	50%	18%	23%	7%	1%
2009	49%	19%	23%	8%	1%
2010	48%	20%	23%	8%	1%
2011	45%	21%	23%	10%	1%
2012	42%	23%	23%	11%	1%
2013	40%	24%	23%	12%	1%
2014	39%	24%	24%	13%	1%
2015	37%	24%	24%	15%	1%
2016	34%	24%	24%	17%	1%
2017	29%	25%	26%	19%	1%
2018	28%	25%	26%	21%	1%
2019	27%	24%	27%	22%	1%
2020	24%	24%	27%	24%	0%
2021	23%	24%	28%	25%	0%
2022	22%	24%	28%	27%	0%
2023	21%	23%	28%	28%	0%
2024	20%	22%	28%	29%	0%
2025	19%	22%	28%	31%	0%
2026	18%	22%	26%	34%	0%
2027	18%	21%	26%	35%	0%
2028	18%	18%	27%	38%	0%
2029	17%	16%	26%	40%	0%
2030	17%	16%	26%	41%	0%
2031	15%	16%	26%	43%	0%
2032	15%	15%	25%	44%	0%
2033	15%	15%	24%	46%	0%
2034	15%	15%	23%	47%	0%
2035	15%	14%	23%	48%	0%
2036	15%	14%	22%	49%	0%
2037	15%	14%	22%	50%	0%
2038	15%	14%	21%	50%	0%
2039	15%	14%	21%	51%	0%
2040	15%	14%	21%	51%	0%

Useful Information Regarding MSAT ERLT

Table 5 Ratios for Ethyl Benzene		
Year	Road Type ID	Ethyl Benzene Ratio
2007	2	0.012570
2007	3	0.013108
2007	4	0.013761
2007	5	0.013844
2008	2	0.011834
2008	3	0.012343
2008	4	0.012961
2008	5	0.013040
2009	2	0.011678
2009	3	0.012183
2009	4	0.012796
2009	5	0.012873
2010	2	0.011567
2010	3	0.012071
2010	4	0.012682
2010	5	0.012760
2011	2	0.011465
2011	3	0.011973
2011	4	0.012589
2011	5	0.012667
2012	2	0.011078
2012	3	0.011578
2012	4	0.012186
2012	5	0.012263
2013	2	0.011049
2013	3	0.011554
2013	4	0.012167
2013	5	0.012245
2014	2	0.011031
2014	3	0.011542

Useful Information Regarding MSAT ERLT

2014	4	0.012162
2014	5	0.012240

7. Emission factors for ethyl benzene estimated as ratio from the VOC ERLT. (**Error! Reference source not found.****Error! Reference source not found.**).

Table 6 Emission Rates for Ethyl Benzene						
Area	Year	Road Type	Road Description	Average Speed	VOC	ETB
El Paso	2007	2	Rural Restricted Access	2.5	4.29362511	0.0539707
El Paso	2007	2	Rural Restricted Access	3	3.635938791	0.0457036
El Paso	2007	2	Rural Restricted Access	4	2.813830892	0.0353697
El Paso	2007	2	Rural Restricted Access	5	2.320566153	0.0291694
El Paso	2007	2	Rural Restricted Access	6	1.977972686	0.0248630
El Paso	2007	2	Rural Restricted Access	7	1.733263066	0.0217870
El Paso	2007	2	Rural Restricted Access	8	1.549730852	0.0194800
El Paso	2007	2	Rural Restricted Access	9	1.406983574	0.0176857
El Paso	2007	2	Rural Restricted Access	10	1.292785751	0.0162503
El Paso	2007	2	Rural Restricted Access	11	1.197631623	0.0150542
El Paso	2007	2	Rural Restricted Access	12	1.118336516	0.0140574
El Paso	2007	2	Rural Restricted Access	12	1.118336516	0.0140574
El Paso	2007	2	Rural Restricted Access	13	1.051240656	0.0132140
El Paso	2007	2	Rural Restricted Access	14	0.993729919	0.0124911
El Paso	2007	2	Rural Restricted Access	15	0.943887281	0.0118646
El Paso	2007	2	Rural Restricted Access	16	0.890645097	0.0111954
El Paso	2007	2	Rural Restricted Access	17	0.843666699	0.0106049
El Paso	2007	2	Rural Restricted Access	18	0.801908124	0.0100800

Appendix C Document Revision History

The following table shows the revision history for this guidance document.

Revision History	
Effective Date Month, Year	Reason for and Description of Change
June 2016	Version 1 was released.
January 2017	Version 2 was developed to incorporate two additional priority MSAT that were added by FHWA in their October 2016 interim MSAT guidance update.