

## MEMORANDUM

**DATE:** February 13, 2020

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**SUBJECT:** **Comparison of MOSERS Spreadsheet Tool and FHWA’s CMAQ Toolkit**  
Contract No 21853  
Deliverable for Subtask 2.2 – Mobile Source Emissions Reduction  
Strategies Analysis Support

This memorandum summarizes the findings of the work performed by Texas A&M Transportation Institute (TTI) staff under Subtask 2.2 (Transportation Control Measures [TCMs] Analysis Support) of the TTI-TxDOT Air Quality and Conformity Interagency Contract. The focus of this effort was to conduct a high-level comparison of TxDOT’s *MOSERS spreadsheet tool* with FHWA’s *CMAQ<sup>1</sup> Emissions Calculator Toolkit* and summarize the findings. An overview of the MOSERS spreadsheet tool and FHWA’s CMAQ Toolkit is provided below, followed by a summary comparison of these tools according to their scopes, intended applications, features, and other characteristics.

### MOSERS Spreadsheet Tool

The Texas *Guide to Accepted Mobile Source Emission Reduction Strategies*, also known as the **MOSERS guide**, is a toolkit consisting of guidance documents and a spreadsheet tool developed by TTI for the Texas Department of Transportation (TxDOT). The MOSERS documents provide an introduction to transportation air quality and contain a comprehensive set of emissions calculations methods for evaluation of emissions reductions from a list of mobile source emission reduction strategies. For over 15 years, the MOSERS guide’s emissions estimation equations have been the standard approach for estimating emissions benefits of off-model transportation strategies in Texas.

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<sup>1</sup> Congestion Mitigation and Air Quality (CMAQ) Improvement Program

As part of an on-going update and upgrade of the MOSERS guide, TTI has developed a MOSERS spreadsheet tool, an MS Excel®-based workbook with built-in equations capable of estimating vehicle activity changes necessary for a select number of strategies recommended by the Texas Technical Working Group for Mobile Source Emissions (TWG). The development of the MOSERS spreadsheet tool was initiated in response to a request from the TWG members for a user-friendly tool that provides a set of standardized methodologies for estimation of vehicle activity parameters needed for calculating emissions benefits using MOSERS guide emissions equations. Figure 1 shows a screenshot of the MOSERS spreadsheet tool and the generated PDF report.

In addition to estimating activity changes, the tool uses regional-specific MOVES emission rates for seven metropolitan areas of Texas<sup>2</sup> to estimate the expected emissions benefits. These emission rates are stored in a web-hosted data table and dynamically downloaded based on users' selection of area, analysis year, and road classification. Using a web-hosted data table, emission rates can be updated with no need for releasing a new version of the spreadsheet tool. The MOSERS spreadsheet tool is available through the [Texas Air Quality Portal](#)<sup>3</sup>.

## FHWA CMAQ Emission Calculator Toolkit

Volpe National Transportation Systems Center (Volpe) has assisted FHWA in developing the CMAQ Toolkit since 2015. The toolkit was initiated in response to a realization that many potential CMAQ project sponsors may not have the technical capacity to develop independent air quality benefit estimates. This toolkit consists of a series of MS Excel-based spreadsheet tools to calculate representative air quality benefits for most common CMAQ projects. Figure 2 shows a screenshot from one of the workbooks. The tool uses *national-level annual-average* MOVES emission rates for emission calculation purposes. These emission rates are embedded in the tool, and any update of emission rates requires the release of a new version of the individual workbooks.

The CMAQ Toolkit spreadsheets are available through a webpage on FHWA's website ([https://www.fhwa.dot.gov/environment/air\\_quality/cmaq/toolkit/](https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/)). FHWA has stated that the CMAQ toolkit "is only offered as an additional resource to assist DOTs, MPOs, and project sponsors in the project justification process. Agencies and individuals using a preferred methodology to generate air quality benefit information are welcome to continue their current practice."<sup>4</sup>

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<sup>2</sup> Austin, Corpus Christi, El Paso, Dallas-Fort Worth, Houston, San Antonio, Waco

<sup>3</sup> [https://txaqportal.org/mosers\\_tools\\_and\\_docs#/](https://txaqportal.org/mosers_tools_and_docs#/)

<sup>4</sup> Congestion Mitigation and Air Quality Improvement Program Emission Reductions Calculator, [https://www.fhwa.dot.gov/ENVIRONMENT/air\\_quality/conformity/highlights/high1116.cfm](https://www.fhwa.dot.gov/ENVIRONMENT/air_quality/conformity/highlights/high1116.cfm) (updated 5/17/2017)

**Table 1. Comparison of FHWA’s CMAQ and TxDOT’s MOSERS Spreadsheet Tools.**

		FHWA CMAQ Toolkit	MOSERS Spreadsheet Tool
<b>Purpose and Applications</b>	<b>CMAQ Projects’ Eligibility</b>	✓	✓
	<b>CMAQ Reporting Activities</b>	✓	✓
	<b>CMAQ Performance Measurement</b>	✓	✓
	<b>Transportation Conformity</b>	x	✓*
	<b>State Implementation Plan</b>	x	✓*
<b>Intended Users</b>		DOTs, MPOs, and project sponsors across the U.S.	TxDOT, Texas MPOs, and Texas transportation air quality practitioners undertaking air quality planning and evaluation of mobile source emissions reduction strategies
<b>Scope</b>	<b>Format</b>	Multiple macro-enabled MS Excel workbooks. Emission rates embedded inside the tool.	Single macro-enabled MS Excel Workbook. Emission rates downloaded from a web-hosted data table on-demand.
	<b>Strategies</b>	The most frequently encountered CMAQ projects (18 strategies as of Feb. 2020)	The most frequently encountered Mobile Source Emission Reduction projects -- (8 Strategies as of Feb. 2020 – two more strategies will be added by June 2020)
	<b>Vehicle Activity Changes</b>	✓	✓
	<b>Emission Changes</b>	✓ (NO <sub>x</sub> , VOC, PM <sub>2.5</sub> , PM <sub>10</sub> , CO, CO <sub>2</sub> -eq, Energy)	✓ (NO <sub>x</sub> , VOC, PM <sub>10</sub> , CO, CO <sub>2</sub> )
	<b>Emission Rates – Analysis Years</b>	2019 – 2030 (embedded within the tool)	2014 – 2040 ** (dynamically downloaded)
	<b>Emission Rates – Spatial Coverage</b>	National-Level Annual Average ***	Local-Specific ** - Maximum between Summer and Winter
	<b>Default Values</b>	✓	✓
<b>Features and Capabilities</b>	<b>Link to User Guide</b>	✓	✓
	<b>Project information input</b>	x	✓
	<b>Users can review all calculations</b>	x	✓
	<b>Generate standardized PDF report</b>	x	✓

\* When [vehicle activity results](#) combined with MOSERS guide emissions equations and official local-specific MOVES emissions rates. The capability of loading official local-specific emissions rates is planned for a future release. The emissions result using these official emissions rates will be valid for conformity and SIP purposes.

\*\* TTI has started work on generating updated MOVES emission rates for analysis years 2020 to 2050. The inclusion of these emission rates into the MOSERS tool is planned for a future release. Local-specific input parameters are from input files used for regulatory inventory analyses by TxDOT and TCEQ.

\*\*\* MOVES’ default values are used for all inputs.

## MOSERS

### MOBILE SOURCE EMISSION REDUCTION STRATEGIES

#### Strategy 2.1 - HOV Facilities

Main Menu
Save Report as PDF
View Report
Project Information
Open Strategy Documentation

Input Data		Variable	Value	Units
Region	Metropolitan Area	Select	Austin	-
Year	Analysis Year	Select	2025	-
Road Type	Urban or rural with restricted or unrestricted access			
Facility Geographic Information	Area Type			
	Corridor Length			
	Facility Type			
	Peak Time of the Day			
Facility Existing Traffic Information	Annual Average Daily Traffic along the Facility			
HOV Lane Strategy	Service Hours	Number of General Purpose Lanes		
	Number of Lanes	Number of Additional HOV Lanes		

  

Default Data	
Default Occupancy	General Purpose Lane Auto Occupancy
	HOV Lane Auto Occupancy
Existing Facility Traffic Information	Volumes of Peak Hours
	Peak-Hour Hourly Traffic Volume
Default Service Hours	Peak Service Hours per Day

  

Daily Emissions Reduction	
Description	Variable
Daily Emissions Reduction	A + B + C + D

  

Description	Variable	Emission Factor
Speed-based running exhaust emission factor for affected roadway before implementation	$EF_B$	
Speed-based running exhaust emission factor on general purpose lanes after implementation of HOV facility (estimate)	$EF_{GP,A}$	
Speed-based running exhaust emission factor on HOV facility (estimate)	$EF_{H,A}$	
Auto trip-end emission factor	$TEF_{AT70}$	

  

Description	Variable	Emission Factor
Change in running exhaust emissions from vehicles shifting from general purpose lanes to HOV lanes	$A = V_{H,A} * (EF_B - EF_{H,A}) * N_{HT} * L$	
Change in running exhaust emissions of vehicles in general purpose lanes as a result of vehicles shifted away from general purpose lanes	$B = (V_{GP,B} * EF_B - V_{GP,A} * EF_{GP,A}) * N_{HT} * L$	
Reduction in auto start exhaust emissions from trip reductions	$C = V_{T,R} * TEF_{AT70}$	
Reduction in auto running exhaust emissions from trip reductions	$D = VMI_R * EF_B$	

### MOSERS

#### Mobile Source Emission Reduction Strategies

Project Title: **Project 1.1**

Project Type: **Transit System/Service Expansion**

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**Summary of Estimated Project Emission Benefits**

Air Emission Compound	Reduction in Kg/day
Nitrogen Oxides (NO <sub>x</sub> )	1,335
Volatile Organic Compounds (VOCs)	2,024
Particulate Matter (PM <sub>10</sub> )	0.014
Carbon Monoxide (CO)	38,938
Carbon Dioxide (CO <sub>2</sub> )	3,448

  

**Estimated Project Emission Reductions Due to Strategy**

  

Project Number: **0011-45-6789**

Project Location: Project 1.1 location description

Metro Area: Austin

County: Williamson

Analysis Year: **2024**

**Project Description:**  
Expansion of bus service in Williamson County

Compound	NOx	VOC	PM10	CO	CO2	Units
Change in running exhaust emissions from vehicles shifting from general purpose lanes to HOV lanes	4,687	2,623	270	119,377	26,990,068	grams / day
Change in running exhaust emissions of vehicles in general purpose lanes as a result of vehicles shifted away from general purpose lanes	3,694	5,204	69	48,739	679,951	grams / day
Reduction in auto start exhaust emissions from trip reductions	8,284	2,821	353	173,297	29,814,399	grams / day

**Figure 1. MOSERS Tool - Partial View of a Strategy Page and Title Page of the Generated PDF Report.**

# New Managed Lane Facilities

This calculator will estimate the reduction in emissions from implementing new managed lane (ML) facilities, such as high-occupancy vehicles (HOV) and high-occupancy toll (HOT) lanes. Users can select continuous access, buffer zones, and physical barriers between the managed and general purpose (GP) lanes.

**Navigator**

[New Facilities](#)

[Lane Conversions](#)

**INPUT**

[User Guide](#)

(1) What is your project evaluation year?  [Reset to Default Values](#)

(2) Choose your type of managed lane (ML) facility:  
Note: Separation between managed and general purpose (GP) lanes will help determine project effectiveness.

(3a) How many general purpose (GP) lanes does the facility have?   
 (3b) How many managed lanes will the facility have?

	BEFORE		AFTER		Traffic Flow (vphpl)	Free Flow Speed (mph)
	GP Lane(s)	ML(s)	GP Lane(s)	ML(s)		
(4) Please enter the typical peak hour traffic flow (total vehicles per hour per lane) and free flow speed (miles per hour) for the GP lanes before completion and both the ML(s) and GP lanes after	<input type="text" value="Enter"/>	<input type="text" value="Enter"/>	<input type="text" value="Enter"/>	<input type="text" value="Enter"/>		
	<input type="text" value="Select"/>	<input type="text" value="Select"/>	<input type="text" value="Select"/>	<input type="text" value="Select"/>		

Note: Please consult the tool's user guide and its appendix for methodology on developing appropriate traffic flow and free flow speed estimates.

(5) What percentage of traffic in the GP lanes is from heavy-duty vehicles?

(6a) Indicate peak or non-peak hour analysis for the ML facility:   
 (6b) How many peak/non-peak hours each day is the facility

(7) What is the length of the facility (in miles)?

(8) Is the facility on an urban or rural highway?

**OUTPUT**

[Calculate Output](#)

**NETWORK PERFORMANCE**

Derived Average Speed and Travel Time Estimates for the ML and GP Lanes Before and After Project Completion	BEFORE		AFTER		Average Speed (mph)	Average Travel Time (minutes)
	GP Lanes	ML(s)	GP Lanes	ML(s)		
	0.00	0.00	0.00	0.00		
	0.00	0.00	0.00	0.00		

**EMISSION REDUCTIONS**

Pollutant	Total (kg/day unless otherwise noted)
Carbon Monoxide (CO)	0.0000
Particulate Matter <2.5 μm (PM <sub>2.5</sub> )	0.0000
Particulate Matter <10 μm (PM <sub>10</sub> )	0.0000
Nitrogen Oxide (NO <sub>x</sub> )	0.0000
Volatile Organic Compounds (VOC)	0.0000
Carbon Dioxide Equivalent (CO <sub>2e</sub> ) (MMBTU/day)	0.0000

Figure 2. CMAQ Toolkit – View of a Strategy Page.