

## **Development of Houston-Galveston-Brazoria (HGB), San Antonio (SAN), and Statewide On-Road Emissions Inventories for 2019, 2023, and 2026 – Final Electronic Data Submittal (July 1, 2021, revised July 12, 2021)**

### **Houston-Galveston-Brazoria (Deliverable 3.2)**

This appendix describes the final electronic data files deliverable for the HGB part of this link-based emissions inventory project, per Proposal for Grant Activities No. 582-21-21602-023. As with the reports, the final electronic data submittals for the three areas are separate Task deliverables.

For the HGB area, TTI produced 2019 and 2023 on-road mobile source and area source (Stage II) refueling emissions inventories, and TEC inventories, for the eight HGB area counties, for eight ozone season activity scenarios (four day-types of Monday through Thursday average Weekday, Friday, Saturday, and Sunday; and two periods: summer and school [non-summer]). On-road includes gaseous and PM pollutants (re-entrained dust emissions not included). Refueling includes only VOC. Pollutant emissions and TEC are reported in units of pounds or grams (depending on file type) and kilojoules, respectively.

Due to the large memory requirement and difficulty in sharing large files between remote offices (around 190 GB compressed with a maximum compressed file size of ~12 GB), these data files along with this description were delivered on an external hard drive. The zipped files are around 700 to 800 GBs uncompressed. Subsequent to submittal, weekend day analyses were corrected and all the data files were rezipped and resubmitted, with same zip file names except for the date.

### **Electronic Media**

The external drive contains:

- Emission inventory output data for on-road emissions and refueling emissions including summaries by TDM network link “a” and “b” nodes, and TEC inventory output summaries;
- TDM network node coordinates;
- Additional data files (local MOVES inventory mode input table data in text file form for all scenarios; and activity, vehicle registration, and population estimate summaries); plus
- A set of summer weekday MRSs and CDBs for use with MOVES in inventory mode.

### **Data File Labeling**

Depending on the file type, filenames may include the following identifying information (in zip files as well as data files):

- Project label: (i.e., “ad19hgb\_mvs31” indicates inventory type, area, base year of the analysis, and use of MOVES3.0.1);
- FIPS county code (e.g., 48201);
- Analysis year (e.g., 2019);
- Analysis period label or code (i.e., p1 for “school” and p2 for “summer”);
- Day-type (i.e., “wk”, “fr”, “sa”, “su” for the four day-types);
- MOVES day-type (e.g., wkd for a weekday);
- Delivery date, Etc.

## Inventory Output Data - On-Road and Refueling Emissions and TEC Data Files

*On-road emissions inventory outputs* – The following inventory files are by year, county and activity scenario:

- “\*ems.T##:” 24 network link emissions (grams) files per run (T## is T01, T02.... T24 for each hour where “T01” is midnight to 1 a.m., etc.). (See file format and data definitions in subsequent tables.);
- “\*ems.TAB:” one standard tab-delimited output file per run of hourly and 24-hour activity and emissions (pounds) summaries: by roadway and vehicle type (SUT/Fuel Type) for roadway processes – VMT, VHT, average speed (VMT/VHT), and associated pollutant/process emissions; by vehicle type for off-network processes – SHP, ONI, SHEI, and APU hours, starts, and associated pollutant/process (except refueling) emissions.

“\*link\_ems\_12Jul2021.zip” contains the hourly link-emissions files, and

“\*tabs\_12Jul2021.zip” contains the standard tab files.

A 24-hour, county totals, inventory by area (files include all counties) extracted from the standard tab output files was provided by year for each inventory activity scenario:

- “\*ems\_tabtots.TAB:” one standard tab-delimited output file per year and activity scenario of the area county totals, of 24-hour activity and emissions summaries (pounds): by FIPS county code, for roadway processes – VMT, VHT, average speed (VMT/VHT), and associated pollutant/process emissions; for off-network processes – SHP, ONI, SHEI, and APU hours, starts, and associated pollutant/process (except refueling) emissions.

“\*tabtots\_12Jul2021.zip” contains the area, county 24-hour totals files.

*Refueling emissions inventory outputs* -- The following are the refueling inventory files by year, county and activity scenario:

- “\*emsrf.T##:” 24 link emissions (grams) files per run (T## is T01, T02.... T24 for each hour where “T01” is midnight to 1 a.m., etc.). (See file format and data definitions in subsequent tables.);
- “\*emsrf.TAB:” one standard tab-delimited file per run of hourly and 24-hour activity and emissions (pounds) summaries by vehicle type of VMT, VHT, average speed (VMT/VHT), SHEI and APU Hours (combination long-haul trucks only), starts, and associated VOC pollutant refueling loss emissions.

“\*link\_emsrf\_12Jul2021.zip” contains the hourly link files, and

“\*tabs\_12Jul2021.zip” contains the standard tab “emsrf” files.

A 24-hour, county totals, refueling inventory by area (files include all counties) extracted from the refueling standard tab output files was provided by year for each inventory activity scenario:

- “\*emsrf\_tabtots.tab” (24-hr totals);
- “\*tabtots\_12Jul2021.zip” contains the summaries.

*TEC inventory output* -- by county activity scenario:

- “\*tec.TAB:” one standard tab-delimited file per run of hourly and 24-hour activity and TEC (kilojoules) summaries by vehicle type of VMT, VHT, average speed (VMT/VHT), SHEI and APU Hours, starts, ONI, and associated TEC estimates.

“\*tab\_12Jul2021.zip” contains the files.

A 24-hour, county totals, TEC inventory by area (files include all counties) extracted from the TEC standard tab output files was provided by year for each inventory activity scenario:

- “\*tec\_tabtots.TAB:” (24-hr totals).

“\*tabtots\_12Jul2021.zip” contains the summaries.

### **Travel Model Network Link (Node) Coordinates**

The coordinates (Longitude and Latitude) for the link nodes corresponding to the links for which emissions were calculated were provided in “\*2019\_NodeCoordinates.csv” and “\*2023\_NodeCoordinates.csv.” (Note that these files may include some additional coordinates that were not used in the analysis. The files are in “\*NodeCoords.zip”)

**Link Emissions Data Fields for Travel Model-Based County Analyses.**

<b>Field Name<sup>1</sup></b>	<b>Start Column</b>	<b>End Column</b>	<b>Maximum Length</b>	<b>Example<sup>1</sup></b>
Link Anode <sup>2</sup>	1	5	5	00487
Link Bnode <sup>2</sup>	7	11	5	08896
Link Roadway Classification Code <sup>3</sup>	13	14	2	08
MOVES Road Type Code	16	17	2	05 (see subsequent table)
MOVES Pollutant Code	19	21	3	087 (see subsequent table)
MOVES Process Code <sup>4</sup>	23	24	2	12 (see subsequent table)
SUT/Fuel Type Combination 1 Emissions	26	35	10 (includes decimal points)	4.38623E-4
SUT/Fuel Type Combination 2 Emissions	37	46	10	0.05706786
· ·	· ·	· ·	· ·	· ·
SUT/Fuel Type Combination N <sup>5</sup> Emissions	26 + 11(N-1)	35 + 11(N-1)	10	0.00000000
Units <sup>5</sup>	26+11(Z-1)	35 + 11(Z-1)	10	Grams

<sup>1</sup> Values of the first six fields (emissions indexes or codes) use the maximum field length as follows: the code is right-justified in the field, and any empty field columns are populated with “leading” zeros. (Codes for this analysis are listed in the four subsequent tables.)

<sup>2</sup> Link nodes are set to 99999 for the off-network emissions.

<sup>3</sup> Link roadway classification code is set to 99 for the off-network emissions.

<sup>4</sup> The process code for the pollutant composite emissions is 00 (this code is in addition to the MOVES process IDs).

<sup>5</sup> The emissions continue across the line until the utility writes emissions values for all “N” SUT/fuel type combinations in the SUT mix input file. The sequence of SUT/fuel type columns is by ascending order of numerical SUT/fuel type codes. For the last column, Units, Z = 1+N (for last SUT/fuel type combination).

**HGAC Travel Model Network Functional  
Classification Codes and Names**

<b>Code</b>	<b>Name</b>
1	Urban Interstate Freeway
2	Urban Other Freeway
3	Toll Road
4	Ramp (Frwy/Toll/Frontage)
5	Urban Principal Arterial
6	Urban Other Arterial
7	Urban Collector
8	Local (Centroid Connector) <sup>1</sup>
10	Rural Interstate Freeway
11	Rural Other Freeway
12	Rural Principal Arterial
13	Rural Other Arterial
14	Rural Major Collector
15	Rural Collector
40	Local (Intrazonal) <sup>1, 2</sup>

<sup>1</sup> Link inventory data for facility type codes 8 and 40 comprise the local road type estimate.

<sup>2</sup> Special links added for application of the intrazonal VMT estimate.

**Link Emissions Output – MOVES Road Type Codes**

<b>Road Type ID</b>	<b>Road Description</b>
1	Off-Network
2	Rural Restricted Access
3	Rural Unrestricted Access
4	Urban Restricted Access
5	Urban Unrestricted Access

### Link Emissions Output – MOVES Pollutants Codes

Pollutant ID	Pollutant Name	Short Name
2	Carbon Monoxide (CO)	CO
3	Oxides of Nitrogen (NO <sub>x</sub> )	NO <sub>x</sub>
5	Methane (CH <sub>4</sub> )	Methane (CH <sub>4</sub> )
6	Nitrous Oxide (N <sub>2</sub> O)	N <sub>2</sub> O
30	Ammonia (NH <sub>3</sub> )	NH <sub>3</sub>
31	Sulfur Dioxide (SO <sub>2</sub> )	SO <sub>2</sub>
32	Nitrogen Oxide (NO)	NO
33	Nitrogen Dioxide (NO <sub>2</sub> )	NO <sub>2</sub>
34	Nitrous Acid (HONO)	HONO
35	Nitrate (NO <sub>3</sub> )	PM2.5 NO <sub>3</sub>
36	Ammonium (NH <sub>4</sub> )	PM2.5 NH <sub>4</sub>
51	Chloride	PM2.5 Cl
52	Sodium	PM2.5 Na
53	Potassium	PM2.5 K
54	Magnesium	PM2.5 Mg
55	Calcium	PM2.5 Ca
56	Titanium	PM2.5 Ti
57	Silicon	PM2.5 Si
58	Aluminum	PM2.5 Al
59	Iron	PM2.5 Fe
87	Volatile Organic Compounds	VOC
90	Atmospheric CO <sub>2</sub>	Atmospheric CO <sub>2</sub>
91	Total Energy Consumption	Total Energy
100	Primary Exhaust PM <sub>10</sub> – Total	PM10 Total Exh
106	Primary PM <sub>10</sub> - Brakewear Particulate	PM10 Brakewear
107	Primary PM <sub>10</sub> - Tirewear Particulate	PM10 Tirewear
110	Primary Exhaust PM <sub>2.5</sub> – Total	PM2.5 Total Exh
111	Organic Carbon	PM2.5 OC
112	Elemental Carbon	PM2.5 EC
115	Sulfate Particulate	PM2.5 Sulfate
116	Primary PM <sub>2.5</sub> - Brakewear Particulate	PM2.5 Brakewear
117	Primary PM <sub>2.5</sub> - Tirewear Particulate	PM2.5 Tirewear
118	Composite – NonECPM	PM2.5 NonECPM
122	Non-carbon Organic Matter (NCOM)	PM2.5 NCOM

**Link Emissions Output MOVES Emissions Processes Included in Analysis**

<b>Process ID</b>	<b>Process Name</b>	<b>Occurs On Real Roads</b>	<b>Short Name</b>
1	Running Exhaust	Y	Running Exh
2	Start Exhaust	N	Start Exh
9	Brakewear	Y	Brakewear
10	Tirewear	Y	Tirewear
11	Evap Permeation	Y	Evap Permeation
12	Evap Fuel Vapor Venting	Y	Evap Fuel Vent
13	Evap Fuel Leaks	Y	Evap Fuel Leak
15	Crankcase Running Exhaust	Y	Crank Run Exh
16	Crankcase Start Exhaust	N	Crank Start Exh
17	Crankcase Extended Idle Exhaust	N	Crank Ext Idle
18	Refueling Vapor Displacement Loss	N	Refuel Disp Vap
19	Refueling Spillage Loss	N	Refuel Spillage
90	Extended Idle Exhaust	N	Ext Idle Exh
91	Auxiliary Power Exhaust	N	Aux Power Exh

**Additional Data Including MOVES Database Tables and Text Files in MOVES Formats**

TTI post-processed the local link-based inventory data (e.g., MOVES rate-mode CDBs, inventory activity and vehicle population output) to produce data in tab-delimited text files in 32 MOVES3 specified table formats, and other data summaries.

These MOVES 32 table input data sets were prepared for each county, year, and activity scenario. These are for use in MOVES inventory mode runs to produce results consistent (but not necessarily exactly the same) with the detailed, TDM link-based analysis. The files were provided in “ad19hgb\_mv31\_Elmode\_tabtxtfiles\_allCases\_12Jul2021.zip”

- "\_auditlog.tab"
- "\_avft.tab"
- "\_avgspeeddistribution.tab"
- "\_county.tab"
- "\_countyyear.tab"
- "\_dayofanyweek.tab"
- "\_dayvmtfraction.tab"
- "\_fuelformulation.tab"
- "\_fuelsupply.tab"
- "\_fuelusagefraction.tab"

- `"*_hotellingactivitydistribution.tab"`
- `"*_hotellinghourfraction.tab"`
- `"*_hotellinghoursperday.tab"`
- `"*_hotellingmonthadjust.tab"`
- `"*_hourvmtfraction.tab"`
- `"*_hpmsvtypeday.tab"`
- `"*_imcoverage.tab"`
- `"*_monthofanyyear.tab"`
- `"*_monthvmtfraction.tab"`
- `"*_roadtypedistribution.tab"`
- `"*_sourcetypeagedistribution.tab"`
- `"*_sourcetypeofdayvmt.tab"`
- `"*_sourcetypeyear.tab"`
- `"*_starthourfraction.tab"`
- `"*_startmonthadjust.tab"`
- `"*_startsperrypervehicle.tab"`
- `"*_state.tab"`
- `"*_totalidlefraction.tab"`
- `"*_year.tab"`
- `"*_zone.tab"`
- `"*_zonemonthhour.tab"`
- `"*_zoneroadtype.tab"`

Other data summary output files include the following VMT, VHT summaries for all county scenarios, and the following registration data, MOVES source type populations, and source type-fuel type populations estimates by county and year:

- `"*_VHT.tab"` (VHT by hour, road type, area type, and avgspeedbinID);
- `"*_VMT.tab"` (VMT by hour, road type, and area type);
- `"*_RegDat.tab"` (base registrations by vehicle type/model year used in population estimates);
- `"*_sourcetypeyear.tab"` (population estimates in MOVES input format);
- `"*_StFtPop.tab"` (population estimates by source type and fuel type).

`"*_VMTVHTVehPOPRegDat_files_12July2021.zip"` contains the files.

### **Additional MOVES Inputs for Summer Weekday Inventory Mode Runs**

TTI prepared an additional set of MRS files and CDBs designed for MOVES inventory mode runs, to produce MOVES inventory output consistent (but not necessarily identical) with the disaggregate, TDM link-based inventory results, for the summer weekday scenario for 2019 and 2023. TTI built and provided one CDB and MRS set for each year and each of the eight HGB county inventories, provided in `"*EImode_swkd_CDBsMRSs.zip"`: