# ATTACHMENT D

# MOVES2010B-BASED ON-ROAD INVENTORIES IN SUPPORT OF THE HGB OZONE NONATTAINMENT AREA REDESIGNATION SUBSTITUTE ANALYSIS

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This attachment provides the detailed documentation of the development of the on-road mobile source emissions inventories.

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

# MOVES2010b-Based On-Road Inventories in Support of the HGB Ozone Nonattainment Area Re-Designation Substitute Analysis

*Prepared by the* Texas A&M Transportation Institute

June 2014

# PRODUCTION OF 2011, 2014, 2017, 2020, 2023, AND 2026 ON-ROAD MOBILE SOURCE EMISSIONS INVENTORIES FOR THE EIGHT HOUSTON-GALVESTON AREA COUNTIES DESIGNATED AS NONATTAINMENT FOR THE ONE-HOUR OZONE STANDARD

**TECHNICAL REPORT**

**FINAL**

Prepared for the
Texas Commission on Environmental Quality
Air Quality Planning and Implementation Division

Prepared by the
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## EXECUTIVE SUMMARY

This project, performed by the Texas A&M Transportation Institute (TTI) for the Texas Commission on Environmental Quality (TCEQ), developed Motor Vehicle Emission Simulator (MOVES)2010b-based, on-road mobile, link-based emissions inventories for the eight Houston-Galveston-Brazoria (HGB) counties, designated as nonattainment for the one-hour ozone standard. These emissions inventories, reflecting average summer weekday conditions for analysis years 2011, 2014, 2017, 2020, 2023, and 2026, were needed to support the re-designation analysis for the eight HGB ozone nonattainment area counties required for the development of the HGB Re-Designation Substitute.

To support the development of the one-hour ozone re-designation substitute for the HGB area, inventories were required for a base year, a horizon year, and four years between the base and horizon years. These inventories provide a basis for establishing the inventory when attainment is achieved, the inventory for a horizon year at least 10 years after the re-designation, and the inventory trend between attainment and the horizon year. The inventory development included use of the latest planning assumptions and the most recent version of the U.S. Environmental Protection Agency's (EPA) emissions factor model for on-road sources (MOVES2010b). Emissions were estimated for volatile organic compounds (VOC), carbon monoxide (CO), oxides of nitrogen ($NO_x$), particulate matter (PM) with diameter of 10 microns or less ($PM_{10}$), PM with diameter of 2.5 microns or less ($PM_{2.5}$), and atmospheric carbon dioxide ($CO_2$).

**HGB Eight-County Area Re-Designation Substitute Inventories – Summer Weekday (Tons per Day).**

| Year | VMT | Speed[1] | VOC | CO | NOx | $PM_{10}$[2] | $PM_{2.5}$[2] | $CO_2$ |
|---|---|---|---|---|---|---|---|---|
| 2011 | 150,968,794 | 38.1 | 80.92 | 841.78 | 181.28 | 9.16 | 6.29 | 83,107.28 |
| 2014 | 144,916,411 | 38.1 | 60.43 | 683.38 | 127.70 | 7.34 | 4.58 | 78,299.45 |
| 2017 | 151,890,390 | 37.6 | 46.51 | 548.56 | 88.85 | 6.51 | 3.61 | 79,787.88 |
| 2020 | 159,509,450 | 37.3 | 40.51 | 517.38 | 69.80 | 6.07 | 3.02 | 80,770.44 |
| 2023 | 167,539,317 | 38.7 | 38.09 | 512.68 | 59.28 | 5.61 | 2.59 | 80,784.49 |
| 2026 | 176,004,008 | 38.3 | 36.93 | 520.36 | 54.51 | 5.69 | 2.47 | 82,950.63 |

[1] System speed in miles-per-hour.

[2] Within each size category, the PM estimates are the aggregate of the MOVES direct vehicle PM emissions (primary PM total exhaust plus brake wear and tire wear), i.e., re-suspended dust is not included.

The hourly, MOVES2010b rates-per-activity, detailed traffic demand model (TDM) link-based inventory method[1] was used (i.e., the same general method used in the fiscal year 2012

[1] *Update of On-Road Inventory Development Methodologies for MOVES2010b.* TTI, August 2013.

HGB area MOVES2010a-based SIP inventories[2]), with the latest available data, models, and procedures. The inventory results were estimated for each MOVES source use type and fuel type (SUT/FT) combination (i.e., vehicle type) and TDM roadway class. Data sets extracted from the latest, regional HGB travel models (extracted and provided by the Houston-Galveston Area Council), were used to estimate hourly, directional, link (roadway segment)-level vehicle miles of travel (VMT) and operational speeds for the emissions calculations. Using vehicle operating hours (VHT) estimates derived from these link-based activity estimates, and other data, hourly off-network activity factors were estimated for the off-network process calculations. These off-network activity factors are: source-hours-parked (SHP); starts; and source hours extended idling (SHI), for diesel long-haul combination trucks only. Post-processing MOVES2010b emissions and activity output produced all rates in pollutant mass per activity unit (e.g., grams/mile, grams/shp, grams/start, grams/shi), for multiplying with the associated activity factors in the emissions calculations.

The inventories were produced using utilities[3] developed by TTI to process on-road vehicle activity, off-network vehicle activity, and MOVES emissions rate data into spatially and temporally detailed emissions estimates. The EPA's *Technical Guidance*[4] is the primary technical reference used for guidance on appropriate inputs and use of MOVES.

[2] *HGB MOVES-Based RFP On-road Inventories and Control Strategy Reductions.* TTI, March 2012.
[3] *TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2010bUtl User's Guide.* TTI, August 2013.
[4] *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a, and 2010b.* EPA, April 2012.

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## PURPOSE

This project developed and produced Motor Vehicle Emission Simulator (MOVES)2010b-based, on-road mobile, link-based emissions inventories for the eight Houston-Galveston-Brazoria (HGB) counties, designated as nonattainment for the one-hour ozone standard, for analysis years 2011, 2014, 2017, 2020, 2023, and 2026. These emissions inventories were needed to support the re-designation analysis for the eight HGB ozone nonattainment area counties required for the development of the HGB Re-Designation Substitute.

## BACKGROUND

The Texas Commission on Environmental Quality (TCEQ) works with local planning districts, the Texas Department of Transportation (TxDOT) and the Texas A&M Transportation Institute (TTI) to provide on-road mobile source emissions inventories of air pollutants. TxDOT typically funds transportation conformity determinations required under 40 Code of Federal Regulations Part 93. TCEQ funds mobile source inventory work in support of federal Clean Air Act (CAA) requirements, such as attainment of the National Ambient Air Quality Standards (NAAQS), and the study and control of hazardous air pollutants, including those from motor vehicles and/or motor vehicle fuels (as mandated under CAA sections 202 and 211).

To support the development of the one-hour ozone re-designation substitute for the HGB area, inventories were developed for a base year, a horizon year, and four years between the base and horizon years. These inventories provide a basis for establishing the inventory when attainment is achieved, the inventory for a horizon year at least 10 years after the re-designation, and the inventory trend between attainment and the horizon year. The inventory development included use of the latest planning assumptions and the most recent version of the U.S. Environmental Protection Agency's (EPA) emissions factor model for on-road sources.

## PRODUCTION OF 2011, 2014, 2017, 2020, 2023, AND 2026 ON-ROAD MOBILE SOURCE EMISSIONS INVENTORIES FOR THE EIGHT HOUSTON-GALVESTON AREA COUNTIES DESIGNATED AS NONATTAINMENT FOR THE ONE-HOUR OZONE STANDARD

TTI produced hourly, link-based on-road mobile emissions inventory estimates for the eight Houston-Galveston counties designated as nonattainment for the one-hour ozone standard for analysis years 2011, 2014, 2017, 2020, 2023, and 2026. For the inventories to be consistent with inventory development for other State Implementation Plan (SIP) analyses, TTI used the most recent activity information, based on current travel demand modeling, and the newest version of the EPA's on-road emissions model. The inventories were produced based on methods agreed upon in consultation with the TCEQ. The methods used to produce the inventories were consistent with EPA guidance on the production of emissions inventories. The various inventory production parameters described below were used directly, or estimated as noted. TTI also adhered to the following.

- The emissions factor model used in developing inventories for this task was the most recent version of MOVES2010b; released January 2013 that includes an updated database dated 10/30/2012.

- Emissions inventories were developed for the eight HGB counties designated as nonattainment for the one-hour ozone standard. The counties are: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller.
- The pollutants included to complete this task were volatile organic compounds (VOC), carbon monoxide (CO), oxides of nitrogen ($NO_x$), carbon dioxide ($CO_2$), particulate matter with aerodynamic diameters equal to or less than 10 microns ($PM_{10}$), and particulate matter with aerodynamic diameters equal to or less than 2.5 microns ($PM_{2.5}$). Particulate matter is comprised of three exhaust pollutants – elemental carbon (EC), organic carbon (OC), and sulfate ($SO_4$) – breakwear, and tirewear.
- The day type for all the inventories was average summer weekday. Activity levels were adjusted for summer season and for average weekday, Monday through Friday.
- The temperatures were average summer 2011 temperatures and were provided by TCEQ.
- The humidity inputs were average summer 2011 humidity and were provided by TCEQ.
- The vehicle miles traveled (VMT) mixes were consistent with the EPA MOVES source use types (SUTs). The most current VMT mix for the HGB area was used.
- TTI used vehicle registration distributions developed from the Texas Department of Motor Vehicles (DMV) registration data as input for locality specific MOVES age distributions. For historical years, TTI used registration data for each historical year. For future analysis years, TTI used the most recent year vehicle registration distributions.
- TTI used a link-based, time-of-day emissions analysis methodology for all of the referenced counties.
- TTI developed control program parameters, including Reid Vapor Pressure (RVP) and fuel settings based upon HGB control strategies in effect for each analysis year.
- TTI used year-specific Texas Low Emissions Diesel (TxLED) adjustment factors developed using the benefit information described in the EPA *Memorandum on Texas Low Emission Diesel Fuel Benefits*, and the method as documented in previous Texas on-road inventory development reports.

The following activities were completed.

- Prepared county-level hourly and 24-hour day tables that provide SUT and fuel type combination (i.e., vehicle type) and roadway summaries of VMT, vehicle hours traveled (VHT), average speed, source hours parked (SHP), vehicle starts, source hours idling (SHI), and totals for the pollutants VOC, CO, $NO_x$, $PM_{2.5}$, $PM_{10}$, and $CO_2$ by associated emissions processes. These files are tab-delimited for ease of loading into spreadsheet software such as Microsoft® Excel.

- Prepared the inventory summaries in the uploadable format compatible with TCEQ's Texas Air Emissions Repository (TexAER), which is consistent with the EPA's National Emission Inventory Format (the Consolidated Emissions Reporting Schema [CERS] written in Extensible Markup Language [XML]), which required mapping the MOVES source use type-based inventories to EPA's source classification code (SCC) inventory reporting system. Two formats of the SCC-based inventory summaries were prepared, the NEI CERS XML format, and the tab-delimited summary file format.
- Prepared documentation, complete and self-contained, including electronic data files.

TTI will maintain a record of all electronic files developed or used in conjunction with the completion of this project. All pertinent data relating to project activities were submitted to TCEQ in the specified electronic format, in conjunction with supporting electronic document files, and copies of the this report. The electronic file submission is described in Appendix A – Electronic Data Submittal, and includes: a document listing all the files submitted and the file naming conventions; MOVES county database files (CDB), MOVES run spec files, and MySQL files used to process data files for MOVES runs; all pertinent data relating to task activities; two standard sets of activity and inventory summary files: one based upon MOVES SUTs, and one based upon the EPA's SCCs; and TexAER-ready formatted inventory files.

**Acknowledgments**

Dennis Perkinson, Ph.D., L.D. White, Stacey Schrank, and Martin Boardman, all of TTI, contributed to the development of the MOVES link-based emissions estimates. Dr. Perkinson produced the VMT mixes used to divide fleet VMT activity into MOVES SUT by fuel type categories, county VMT control totals, and hourly VMT factors. Houston-Galveston Area Council (H-GAC) staff provided data sets extracted from the latest available HGB 2011, 2014, 2017, and 2025 regional Travel Demand Models (TDMs). White processed roadway based activity (VMT and speeds) and produced the vehicle population estimates. Boardman produced MOVES model and MOVES output post-processor set-ups, and the MOVES-based emissions factors with adjustments for TxLED fuel. Schrank produced the off-network activity estimates and the emissions run set-ups and performed the emissions runs. Mary McGarry-Barber, of TCEQ, provided meteorological input data. Gary Lobaugh, of TTI, was responsible for editing, design, and production of this Technical Report. Each member of the assigned TTI staff contributed to the quality assurance of the inventory elements. Dr. Perkinson was the principle investigator for this project. This work was performed by TTI under contract to TCEQ. Mary McGarry-Barber was the TCEQ project technical manager.

The discussion is organized in the following sections: Summary of Results, Overview of Methodology, Development of VMT Mix, Estimation of VMT, Estimation of Link Speeds, Estimation of Off-Network Activity, Estimation of Emissions Factors, Emissions Calculations, Quality Assurance, and References.

## SUMMARY OF RESULTS

Table 1 summarizes the resulting emissions inventories estimated for the HGB region.

**Table 1. HGB Eight-County Area Re-Designation Substitute Inventories – Summer Weekday (Tons per Day).**

| Year | VMT | Speed[1] | VOC | CO | NOx | $PM_{10}$[2] | $PM_{2.5}$[2] | $CO_2$ |
|---|---|---|---|---|---|---|---|---|
| 2011 | 150,968,794 | 38.1 | 80.92 | 841.78 | 181.28 | 9.16 | 6.29 | 83,107.28 |
| 2014 | 144,916,411 | 38.1 | 60.43 | 683.38 | 127.70 | 7.34 | 4.58 | 78,299.45 |
| 2017 | 151,890,390 | 37.6 | 46.51 | 548.56 | 88.85 | 6.51 | 3.61 | 79,787.88 |
| 2020 | 159,509,450 | 37.3 | 40.51 | 517.38 | 69.80 | 6.07 | 3.02 | 80,770.44 |
| 2023 | 167,539,317 | 38.7 | 38.09 | 512.68 | 59.28 | 5.61 | 2.59 | 80,784.49 |
| 2026 | 176,004,008 | 38.3 | 36.93 | 520.36 | 54.51 | 5.69 | 2.47 | 82,950.63 |

[1] System speed in miles-per-hour.
[2] Within each size category, the PM estimates are the aggregate MOVES direct vehicle PM emissions (primary PM total exhaust plus brake wear and tire wear), i.e., re-suspended dust is not included.

Two methods are used to establish VMT, a federal system — the Highway Performance Monitoring System (HPMS) — and locality-specific TDMs. The HPMS is a federally-mandated program used by the Federal Highway Administration (FHWA) to provide data to Congress concerning the nation's streets and highways. Congress uses the data to allocate funds to the states. Every state collects, maintains, and reports specified data to the FHWA each year according to the methods prescribed in the *Highway Performance Monitoring System Field Manual*. For historical years, the HPMS data constitutes the official measurement of highway performance, including VMT. The TDM estimate of VMT distributes VMT to each roadway link within the local travel network, and, for future years, includes planned changes to the network. The TDM represents the best method for distributing VMT to the roadway links within the local travel network and for predicting future year VMT. To provide consistency between the estimates for the two systems, the TDM VMT estimates are adjusted to HMPS levels using an historical year for which the TDM was validated and for which the HPMS data has been made available. The TDM forecasts VMT growth from the TDM validation year.

As noted in the following, for 2011, 2014, 2017, 2020, 2023 and 2026, TDM VMT was developed, and adjusted for HPMS consistency, seasonality (i.e., summer), and day type (i.e., weekday). However, HPMS data exist for 2011, making it by definition a "historical" year. For years where HPMS data exist, the use of "historical" (i.e., actual) VMT data is mandated and supersedes the use of travel model estimated VMT. As a result of this procedural requirement, any difference between a series of TDM VMT forecasts provided by the travel modeling process and actual observed HPMS VMT is evident in the VMT for the historically-based years (in this case, 2011). In other words, the "historical" year is the intersection of observed conditions and the travel demand modeling process. The HPMS VMT for historical years may be inconsistent with projected TDM VMT trends. Despite inconsistency, 2011 HPMS VMT is mandated and TDM forecast VMT is mandated for all the future years.

Inventory estimates with more detail (e.g., by county, SUT/fuel type, road type) may be found in the electronic data submittal (see description in Appendix A).

## OVERVIEW OF METHODOLOGY

TTI used the established MOVES-based, detailed emissions inventory methodology, used in fiscal years 2012 and 2013, to produce on-road mobile inventories in support of the HGB Reasonable Further Progress (RFP) SIP[5] and its VMT offset analysis component,[6] and as originally used to develop baseline and base case modeling inventories in support of HGB attainment demonstration analyses.[7]

The method is the detailed, hourly, MOVES rates-per-activity, TDM link-based method, which produces hourly emissions estimates by vehicle type (Table 2), pollutant, and emissions process (Table 3) for each county inventory. It is an adaptation of the previous TDM link-based emissions inventory method used with MOBILE6, which applied emissions rates for all emissions processes in terms of miles-traveled activity (e.g., grams/mile).

In addition to the VMT-based calculations of roadway-based emissions estimates, the TTI MOVES emissions inventory uses off-network activity measures (i.e., starts, SHP, SHI) for the off-network-based emissions calculations. All emissions rates for the emissions calculations (roadway-based and off-network) are activity based – this is different from the standard MOVES off-network emissions rates output, which is in terms of mass-per-vehicle. The TTI method requires post-processing of MOVES emissions and activity data into rate tables with off-network process emissions rates based in units of starts, SHP, and SHI, rather than in "per vehicle" units.

[5] *HGB MOVES-Based RFP On-road Inventories and Control Strategy Reductions.* TTI, March 2012.
[6] *VMT-Offset Emissions Inventories for the HGB Eight-Hour Ozone Nonattainment Counties.* TTI, January 2013.
[7] *Development and Production of 2006 Base Case and 2008 Baseline On-Road Mobile Source Emissions Inventories for the HGB Nonattainment Area.* TTI, July 2011.

**Table 2. MOVES Source Use Type/Fuel Types (Vehicle Types).**

| Source Use Type ID | Source Use Type Description | Source Use Type Abbreviation[1] |
|---|---|---|
| 11 | Motorcycle | MC |
| 21 | Passenger Car | PC |
| 31 | Passenger Truck | PT |
| 32 | Light Commercial Truck | LCT |
| 41 | Intercity Bus | IBus |
| 42 | Transit Bus | TBus |
| 43 | School Bus | SBus |
| 51 | Refuse Truck | RT |
| 52 | Single Unit Short-Haul Truck | SUShT |
| 53 | Single Unit Long-Haul Truck | SULhT |
| 54 | Motor Home | MH |
| 61 | Combination Short-Haul Truck | CShT |
| 62 | Combination Long-Haul Truck | CLhT |

[1] The SUT/fuel type, or vehicle type, labels are the combined SUT abbreviation and fuel type names separated by an underscore (e.g., MC_Gas, RT_Diesel, and SBus_Gas are motorcycles, diesel-powered refuse trucks, and gasoline-powered school buses, respectively).

**Table 3. MOVES Model Emissions Processes.**

| Process ID | Process Name |
|---|---|
| 1 | Running Exhaust |
| 2 | Start Exhaust |
| 9 | Brake Wear |
| 10 | Tire Wear |
| 11 | Evaporative Permeation |
| 12 | Evaporative Fuel Vapor Venting |
| 13 | Evaporative Fuel Leaks |
| 15 | Crankcase Running Exhaust |
| 16 | Crankcase Start Exhaust |
| 17 | Crankcase Extended Idle Exhaust |
| 18[1] | Refueling Displacement Vapor Loss |
| 19[1] | Refueling Spillage Loss |
| 90 | Extended Idle Exhaust |
| 99[1] | Well-to-Pump |

[1] Not subject to on-road mobile emissions analysis.

Table 4 shows the emissions rate units with associated processes and activity factors used in this MOVES analysis.

**Table 4. Emissions Rates by Process and Activity Factor.**

| Emission Processes | Activity[1] | Emissions Factor Units |
|---|---|---|
| Running Exhaust<br>Crankcase Running Exhaust<br>Brake Wear<br>Tire Wear | VMT | grams/mile (g/mi) |
| Evaporative Permeation<br>Evaporative Fuel Vapor Venting<br>Evaporative Fuel Leaks | VMT | g/mi |
| | SHP | g/shp |
| Start Exhaust<br>Crankcase Start Exhaust | starts | g/start |
| Extended Idle Exhaust<br>Crankcase Extended Idle Exhaust | SHI | g/shi |

[1] SHI is for Combination Long-Haul Trucks only.

## Major Components

The county emissions inventory estimation process requires development of the following major inventory components. All are inputs to the emissions calculations, except vehicle populations, which are an intermediate input needed for calculating estimates of SHP and vehicle starts.

- District, four-period, time-of-day, vehicle type VMT mix;
- County, hourly, on-road fleet link VMT and average speeds;
- County vehicle type populations;
- County, hourly vehicle type SHP;
- County, hourly vehicle type starts;
- County, hourly combination long-haul truck SHI; and
- County, hourly vehicle type emissions rates: g/mile, g/SHP, g/start, and g/SHI.

The TTI utilities used to develop or process these inventory components are outlined and described in Appendix B, which also includes an inventory production process flow diagram.

## VMT Mix

The VMT mix designates the vehicle types included in the analysis, and specifies the fraction of on-road fleet VMT attributable to each vehicle type by MOVES road type.

The VMT mixes were estimated based on TTI's 24-hour average VMT mix method,[8] expanded to produce the four-period, time-of-day estimates. The VMT mix method sets Texas vehicle registration category aggregations for MOVES SUT categories to be used in the VMT mix estimates, as well as for developing other fleet parameter inputs needed in the process (e.g., vehicle age distributions). The current VMT mix method produced a set of four time-of-day period average vehicle type VMT allocations by MOVES road type, estimated for each TxDOT district associated with the eight-county HGB area (i.e., Houston and Beaumont districts). The data sources used were recent, multi-year TxDOT vehicle classification counts, year-end TxDOT/DMV registration data, along with MOVES default data where needed.

## On-Road Fleet Link-VMT and Speeds

Summer weekday fleet VMT and average operational speed inputs to the roadway-based emissions calculations (product of "mass per mile" emissions factors and VMT) were required.

TTI used data sets extracted from the latest, four-period, time-of-day, directional, regional HGB travel models (data sets extracted and provided by the H-GAC), along with growth (for inventories between TDM years), seasonal adjustment, and hourly allocation factors estimated by TTI to estimate the summer weekday hourly, directional, link-VMT (consistent with HPMS VMT) and associated average fleet speed inputs to the emissions calculations. The seasonal period, day type, and hourly distributions used were based on factors developed with TxDOT Automatic Traffic Recorder (ATR) data from the Houston area. The hourly average operational

[8] *Methodologies for Conversion of Data Sets for MOVES Model Compatibility*. TTI, August 2009.

fleet speeds were estimated corresponding to the link VMT estimates using the Houston speed model, which estimates operational speeds based on a link's estimated free-flow speed and congestion-related speed reduction.

### Vehicle Population and Off-Network Vehicle Activity Estimates

The non-roadway travel-related emissions estimates (e.g., from vehicle starts, parked vehicle evaporative permeation and tank vapor venting, and extended idling exhaust) were calculated as the product of the amount of associated activity and the pollutant mass per unit of activity (emissions factor units as shown in Table 4). To estimate the SHP and vehicle starts activity, vehicle type category population estimates were needed. SHI was based on HGB county-specific actual estimates.[9]

***Vehicle Type Populations***: TTI based vehicle population estimates on registration data, VMT mix-based vehicle population factors, and VMT-based growth estimates (for future years). For historical years, the vehicle type vehicle population estimates were based solely on mid-year TxDOT (or DMV) county registrations data and regional, all roads-weekday VMT mix-based population factors for the analysis year. For the future years, vehicle type populations were estimated as a function of base (e.g., latest available, mid-year) registrations, grown to the future value (growth as a function of base and future VMT), and all roads-weekday VMT mix-based vehicle type population factors applicable to the analysis year.

***SHP*****:** The SHP was estimated as a function of total hours (hours a vehicle exists) minus its source hours of operation (SHO) on roads (which is the same as VHT). The vehicle type SHP estimates were based on VMT mix, link VMT and speeds, and the vehicle population estimates. The VMT mix was applied to the link VMT to produce vehicle type-specific VMT estimates. Link VMT was divided by the associated speed to produce SHO estimates, which were subtracted from source hours resulting in SHP estimates. This was performed for each analysis year by county and hour.

***Starts***: Engine starts were based on the MOVES national default starts per vehicle, and the local, county vehicle type population estimates. MOVES default weekday starts per vehicle were used. The starts were calculated as the product of starts/vehicle from MOVES, and the county vehicle type population estimates. This was performed for each analysis year by county and hour.

***SHI***: The SHI (for Combination Long-Haul Trucks) was estimated based on information from a TCEQ extended idling study, and additional scaling factors developed by TTI. The 2004 idle activity study produced 2004 summer weekday (base year) SHI estimates by Texas county. TTI used the base year SHI estimates from this study in combination with 2004 base year and analysis year link VMT and VMT mixes (for producing the SHI scaling factors) to estimate county, hourly SHI activity for each of the analysis years. SHI hourly factors (estimated as the inverse of the hourly VMT factors) were used to allocate the 24-hour SHI to each hour of the day.

[9] *Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study*. ERG, August 2004.

## MOVES Emissions Factors

TTI post-processed the MOVES2010b output to calculate emissions rates in the needed activity units (as summarized in Table 4). A basic aspect of the emissions rates method is use of activity inputs to MOVES that are essentially MOVES defaults, which are later divided out (to unity) in the production of emissions rates, via post-processing of the MOVES activity and emissions output (i.e., emissions divided by activity). The actual, locality-specific, summer weekday activity estimates for each county are then used outside of MOVES in the emissions calculations.

Look-up tables of MOVES emissions factors were developed by pollutant, process, speed (for roadway-based processes), hour, road type (including a category for off-network emissions processes), and average vehicle type. MOVES outputs were post-processed in two ways: 1) to calculate the emissions rates from emissions and activity output (using the TTI post-processing utility MOVESratesCalc), and 2) to extract the rates for only those pollutants needed in the emissions calculations and to apply TxLED adjustments to each county's diesel vehicle $NO_x$ emissions rates (using the TTI post-processing utility MOVESratesAdj).

County-level emissions factors were developed for the MOVES weekday day type. Local emissions factor modeling input parameters were developed and used to produce emissions factors reflective of the local scenario conditions (e.g., weather and fleet characteristics, fuel properties, and inspection and maintenance (I/M) program).

## Emissions Calculations

Average summer weekday emissions were calculated (using the TTI utility, MOVESemscalc) for each county using the major inputs as described previously. These inputs are: TxDOT district-level time-of-day VMT mix by MOVES road type; county, hourly on-road fleet link VMT and speed estimates; county hourly off-network activity estimates by vehicle type of SHP, starts, and SHI (for CLHT diesel only); and the county-level look-up tables of hourly emissions rates by MOVES road type, speed bin, vehicle type (SUT/fuel type) and emissions process.

For the VMT-based calculations, county to TxDOT district, TDM network road type/area type to MOVES road type, and hour-of-day to time-of-day period designations were used to match the appropriate VMT mixes with the link VMT. The VMT mixes by MOVES road type were multiplied by the link fleet VMT to distribute each link's VMT to the 23 different vehicle type categories. Emissions rates for each link's average speed were interpolated (see procedure in Appendix B) from the appropriate set of look-up table emissions factors and corresponding index speeds (i.e., the average bin speeds of 2.5, 5.0, 10.0, 15.0, … 75.0 mph), bounding the link's average speed. For link speeds below or above the minimum and maximum average bin speeds of 2.5 and 75 mph, the rates for those bounding speeds were used. The estimated vehicle type and MOVES road type link speed-specific emissions factors for each pollutant process were then multiplied by the associated VMT to produce the link-based emissions estimates. This process was performed for each county, hour and analysis year.

For the off-network emissions calculations, which are county level, the vehicle type emissions factors were multiplied by the associated county total activity estimate, as determined by the pollutant process. This process was performed for each county, hour and analysis year.

The emissions estimates are organized in a tab-delimited output file for each county by pollutant/process, roadway type, and SUT/fuel type combination for each hour, and for the 24-hour period. This tab-delimited file also includes hourly and 24-hour summaries of the off-network activity, VMT, VHT, and speed by roadway. The inventories were also converted to NEI CERS XML-compatible format uploadable to TexAER. Appendix A contains more detailed output definitions and specifications.

TTI developed and maintains a series of computer utilities to calculate and summarize detailed on-road mobile source emissions inventories in various formats, such as those used in this analysis. Appendix B describes these applications.

## DEVELOPMENT OF VEHICLE TYPE VMT MIX

The vehicle type VMT mix is a major input to the MOVES link-based emissions estimation process. It is an estimate of the fraction of on-road fleet VMT attributable to each SUT by fuel type, and is used to subdivide the total VMT estimates on each link into VMT by vehicle type. These hourly VMT estimates by vehicle type are combined with the appropriate emissions factors in the link-emissions calculations.

On-road mobile emissions are dependent upon the VMT assigned to each vehicle category. The VMT mix is used to distribute link VMT values to each vehicle category. Since the VMT mix can vary by time-of-day (and thus have an effect of the emissions totals), the TTI VMT mix procedure allows the option to develop VMT mix by time period. Time period VMT mix (by MOVES roadway type and vehicle type) consists of four time periods: morning rush hour (AM peak), mid-day, evening rush hour (PM peak), and overnight.

TxDOT district-level, time period, day-of-week vehicle type VMT mixes (for gasoline-powered and diesel-powered vehicles) were estimated by the four MOVES road-type categories following the TTI methodology.[10] This methodology characterizes VMT by vehicle type for a region (or district) as follows.

- TxDOT Classification Counts by County and TxDOT District — This is the standard TxDOT classification data assembled and used for determining the in-use road fleet mix (e.g., VMT mix under MOBILE).
- Redefine Roadway Functional Classifications from FHWA/TxDOT to MOVES types — A straightforward transposition of FHWA/TxDOT roadway functional classifications in the classification count data into the five MOVES road types.
- Define MOVES vehicle categories. For example, PV21 – Passenger vehicles equivalent to FHWA C minus .001 for MCs.

[10] *Methodologies for Conversion of Data Sets for MOVES Model Compatibility*, TTI, August 2009, and *Update of On-Road Inventory Development Methodologies for MOVES2010b*, TTI, August 2013.

- Define MOVES vehicle categories - Passenger and Light Commercial Trucks — Separates FHWA light-truck category (P) into passenger trucks and light commercial vehicles using approximate (rounded) MOVES default values. Note this disaggregation is similar to the MOBILE6 distinction between the two primary LDT categories (LDT12 and LDT34).
- Define MOVES vehicle categories – Single-Unit Trucks RTF51 — These are refuse trucks. These are currently assigned a nominal default value (.001) taken from the combined FHWA single-unit truck category total (SU2, SU3, and SU4). To be modified as improved or locally-specific data become available.
- Define MOVES vehicle categories – Single-Unit Trucks Short-Haul versus Long-Haul (SUSH52 and SULH53) per SUT_SSHX — Separates single-unit trucks into short-haul and long-haul based on local (TxDOT district) registrations versus observed vehicles from the classification counts. District allocations verified against statewide allocation.
- Define MOVES vehicle categories – Single-Unit Trucks MH54 — These are motor homes/recreational vehicles. These are currently assigned a nominal default value (.001) taken from the combined FHWA single-unit truck category total (SU2, SU3, and SU4). To be modified as improved or locally-specific data become available.
- Define MOVES vehicle categories - Buses (approximate MOBILE6 defaults) — To be modified as improved or locally-specific data become available.
- Define MOVES vehicle categories - Combination Trucks Short-Haul versus Long-Haul (CSH61 and CLH62) per SUT_HDX9 and SUT_CSHX — Separates combination trucks into short-haul and long-haul based on local (TxDOT district) registrations versus observed vehicles from the classification counts. District allocations verified against statewide allocation.
- Define MOVES vehicle categories - MCs — Nominal default value taken from passenger cars (FHWA C). To be modified as improved or locally-specific data become available.
- Fuel Type Allocation - PV and LDT fuel type allocation per TxDOT registration data and MOVES defaults (21, 31, and 32) per AgeReg9X and MF_Fuel — Other fuel types currently treated as *de minimus*. Additional fuel types can be incorporated as local or regional data become available, or from the MOVES national default database (though this latter option is not recommended). Note allocation of fuel type varies with analysis year.
- Fuel Type Allocation - Single Unit and Combination Trucks per TxDOT registration data per SUT_HDV9 — As with PV and LDT, other fuel types currently treated as *de minimus*.
- Aggregate and Calculate MOVES SUTs and apply day-of-week factors from urban area classification count data (Friday, Saturday, and Sunday).

TxDOT district-level weekday vehicle type VMT mixes by MOVES road-type category (included as Appendix C) were produced based on recent multi-year vehicle classification counts and appropriate end-of-year TxDOT vehicle registrations data. Using the same data sets and a similar procedure, aggregate (i.e., all road-type categories) TxDOT district-level weekday vehicle type VMT mixes (used in the vehicle population estimation) were also produced and included as Appendix D. To ensure general applicability and consistency across all study areas, all VMT mixes were developed in five-year increments beginning with the year 2000 and applied to the analysis years based on Table 5.

**Table 5. VMT Mix Year/Analysis Year Correlations.**

| VMT Mix Year | Analysis Years |
|---|---|
| 2005 | 2003 through 2007 |
| 2010 | 2008 through 2012 |
| 2015 | 2013 through 2017 |
| 2020 | 2018 through 2022 |
| 2025 | 2023 through 2027 |
| 2030 | 2028 through 2032 |
| 2035 | 2033 through 2037 |

## ESTIMATION OF VMT

The detailed, hourly, link-based emissions process requires VMT estimates by hour and direction for each link in the TDMs. This analysis also required that VMT be adjusted for HPMS consistency and to reflect estimated levels characteristic of a typical summer weekday. The TRANSVMT utility (see Appendix B for a description of the utility), the latest available data sets from the HGB 2011, 2014, 2017, and 2025 TDMs, and post-processing factors developed from several other data sources, were used to produce this hourly VMT by direction. The hourly and 24-hour VMT and VHT summaries by county and road type were provided electronically to TCEQ (see Appendix A for electronic data descriptions).

### Data Sources

The latest available link data, trip matrix, and zonal radii data sets extracted from the HGB 2011, 2014, 2017, and 2025 TDMs (as provided by HGAC, dated February 21, 2014) were used to estimate the directional link VMT and speeds by hour. Since intrazonal VMT are not accounted for in the TDMs, the intrazonal VMT was estimated using the TDM's trip matrix and zonal radii data sets.

Several other data sources were used to adjust the VMT for HPMS consistency and to estimate the summer weekday VMT. The first data source is HPMS VMT estimates, which are based on traffic count data collected according to a statistical sampling procedure specified by the FHWA designed to estimate VMT. The county total HPMS Annual Average Daily Traffic (AADT) VMT was used to ensure the travel model VMT was consistent with the HPMS VMT estimates. (EPA and FHWA have endorsed HPMS as the appropriate source of VMT and require that VMT used to construct on-road mobile source emissions estimates be consistent with that reported through HPMS.)

The second data source is ATR vehicle counts, which are collected by TxDOT at selected locations throughout Texas on a continuous basis. These vehicle counts are available by season, month, and weekday, as well as on an annual average daily basis (i.e., AADT). The counts are very well suited for making seasonal, day-of-week, and time-of-day comparisons (e.g., seasonal adjustment and hourly allocation factors), even though there may be relatively few ATR data collection locations in any given area.

Multiple years (2000 through 2011) of data from the ATR stations were grouped for this analysis at different aggregation levels, depending upon the purpose. This data source was used to produce the day-type-specific adjustment factor, in which the data from the ATR stations within the Beaumont TxDOT District were combined for use with Chambers and Liberty counties and the ATR data was combined from those stations within the Houston TxDOT District for use with Harris, Galveston, Fort Bend, Brazoria, Montgomery, and Waller counties. This data source was also used to product the time-of-day (hourly) allocation factors, in which the data from the ATR stations within the eight-county region were combined.

## VMT Adjustments

For each analysis year, the designated TDM VMT (see Table 6) was adjusted for HPMS consistency and for seasonality (i.e., summer weekday). For 2011, which by definition is a historical year (i.e., HPMS VMT data exists for those years), county-level VMT control totals were used. For the remaining analysis years (2014, 2017, 2020, 2023, and 2026), which are considered future years (i.e., HPMS VMT data does not exist), a regional HPMS factor and seasonal weekday factors were used. However, a TDM does not exist for 2020, 2023, and 2026. For those analysis years, intermediate year factors were developed using the bounding TDMs (i.e., 2017 and 2025) and applied to the analysis year’s respective TDM. Since 2026 does not have bounding TDMs, intermediate year factors were developed using the 2017 and 2025 TDMs for a one year increment and applied to the 2025 TDM. Hourly travel factors were also applied to distribute this adjusted VMT over each hour of the day.

**Table 6. Analysis Year/TDM Year Designation.**

| Analysis Year | TDM Year |
|---|---|
| 2011 | 2011 |
| 2014 | 2014 |
| 2017 | 2017 |
| 2020 | 2017 |
| 2023 | 2025 |
| 2026 | 2025 |

### *2011 Historical Year Analysis – VMT Control Totals and VMT Adjustments*

To estimate the 2011 HPMS-consistent summer weekday VMT, county-level VMT control totals were used to develop county-level VMT adjustment factors. The VMT control totals are comprised of two key components: the 2011 county-level HPMS AADT VMT and AADT-to-summer weekday adjustment factors.

The AADT-to-summer weekday adjustment factors were developed using aggregated ATR data for the years 2000 through 2011. Since the HGB area spans two TxDOT districts, two summer weekday adjustment factors were developed. One factor was developed for Liberty and Chambers counties (which are located in the Beaumont TxDOT District) and one factor was developed for Harris, Galveston, Fort Bend, Brazoria, Montgomery, and Waller counties (which are located in the Houston TxDOT District). These regional factors were calculated by dividing the average day-of-week count by the AADT traffic count. Table 7 shows the HGB AADT-to-summer weekday factors used in developing the VMT control totals.

**Table 7. HGB AADT-to-Summer Weekday Factors for Control Total Development.**

| TxDOT District | Weekday Adjustment Factor |
|---|---|
| Beaumont[1] | 1.08988 |
| Houston[2] | 1.04772 |

[1] Only used for Liberty and Chambers counties.
[2] Only used for Harris, Galveston, Fort Bend, Brazoria, Montgomery, and Waller counties.

The VMT control totals were then developed by multiplying the 2011 HPMS AADT VMT for each county by the appropriate summer weekday adjustment factor to produce eight VMT control totals (one for each county). To develop the county-level VMT adjustment factors, each county's respective control total was divided by the total VMT (TDM assignment VMT plus intrazonal VMT estimate) from the 2011 TDM to produce eight county-level VMT adjustment factors. For each link in the TDM, the volume was multiplied by the corresponding VMT adjustment factor (based on the county where the link is located). The adjusted link volumes were then multiplied by the associated link lengths to produce the 2011 link-level HPMS consistent, summer weekday VMT estimates. Table 8 shows the weekday VMT control totals, the total TDM VMT, and the VMT adjustment factors for 2011.

**Table 8. HGB 2011 Weekday VMT Control Totals and VMT Adjustment Factors.**

| County | HPMS VMT (AADT) | Weekday Adjustment Factor | VMT Control Total | TDM VMT[1] | VMT Adjustment Factor |
|---|---|---|---|---|---|
| Harris | 105,002,898 | 1.04772 | 110,013,636 | 107,884,401 | 1.019736265 |
| Brazoria | 5,742,814 | 1.04772 | 6,016,861 | 7,096,309 | 0.847886057 |
| Fort Bend | 9,501,535 | 1.04772 | 9,954,948 | 10,808,375 | 0.921040232 |
| Waller | 1,940,095 | 1.04772 | 2,032,677 | 2,324,164 | 0.874583914 |
| Montgomery | 11,436,712 | 1.04772 | 11,982,471 | 11,656,769 | 1.027941101 |
| Liberty | 2,181,047 | 1.08988 | 2,377,080 | 2,756,459 | 0.862367198 |
| Chambers | 2,624,061 | 1.08988 | 2,859,912 | 3,032,092 | 0.943214051 |
| Galveston | 5,470,173 | 1.04772 | 5,731,209 | 6,082,752 | 0.942206561 |

[1] 2011 TDM, including intrazonal VMT.

*Future Year Analyses – HPMS Adjustment Factor*

For the future year analyses, an HPMS adjustment factor was used to adjust the total VMT (TDM assignment VMT plus intrazonal VMT estimate) from each TDM for HPMS consistency. While TTI typically calculates this factor, the HPMS factor used in this analysis (0.953956) was provided directly by HGAC.

*Future Year Analyses – Seasonal Adjustment Factors*

For the future year analyses, seasonal adjustment factors were used to adjust the TDM and estimated intrazonal VMT to summer weekday VMT. The seasonal adjustment factors were developed using aggregated ATR data for the years 2000 – 2011. Since the HGB area spans two TxDOT districts, two ozone season summer weekday adjustment factors were developed. One factor was developed for Liberty and Chambers counties (which are located in the Beaumont TxDOT District) and one factor was developed for Harris, Galveston, Fort Bend, Brazoria, Waller, and Montgomery counties (which are located in the Houston TxDOT District). These factors were calculated by dividing the average day-of-week (weekday) count by the annual non-summer weekday traffic (ANSWT) traffic count. Table 9 shows the seasonal adjustment factors by TxDOT district.

**Table 9. HGB Weekday Seasonal Adjustment Factors for Future Year Analyses.**

| TxDOT District | Weekday Seasonal Adjustment Factor |
|---|---|
| Beaumont[1] | 1.06229 |
| Houston[2] | 0.97550 |

[1] Only used for Liberty and Chambers counties.
[2] Only used for Harris, Galveston, Fort Bend, Brazoria, Montgomery, and Waller counties.

*Future Year Analyses – Intermediate Year Adjustment Factors*

For those analysis years where a TDM does not currently exist (i.e., 2020, 2023, and 2026), intermediate year adjustment factors were used to estimate the analysis year VMT from an existing TDM. These adjustment factors were developed using the bounding year TDMs (2017 and 2025) and applied to the TDM as specified in Table 6. However, the 2026 analysis year does not fall between the two available TDMs. For this analysis year, these adjustment factors were calculated for a one-year increment (i.e., 2018 from the 2017 TDM) and applied to the 2025 TDM. The intermediate year adjustment factors were based on the annually compounded growth rates between the 2008 and 2018 TDM. The annual growth rates were then converted into the intermediate year adjustment factors using the following equation:

$$\text{Intermediate Year Adj. Factor} = \text{Growth Rate}^{\text{Target Year - Base Year}}$$

Where:

| | | |
|---|---|---|
| Target Year | = | the desired intermediate year; |
| Base Year | = | the year of the TDM used for estimating the VMT; and |
| Growth Rate | = | the annual growth rate from the range of TDM years encompassing the Target Year. |

To maintain the consistency between counties and the four time periods in the TDM, these adjustment factors were developed for each time period and county. Appendix E shows the annually compounded growth rates and intermediate year adjustment factors for each analysis year without a TDM by county and time period.

*Future Year Analyses – VMT Summary*

For each future year (i.e., 2014, 2017, 2020, 2023, and 2026), the final HPMS-consistent, day-type specific VMT is comprised of two parts – the link-level VMT and the estimated intrazonal VMT. The volume for each link was multiplied by the HPMS factor, the seasonal adjustment factor, and the link's respective length to estimate the link-level VMT (hourly factors were applied to distribute the resulting VMT over each hour of the day, discussed in a later section). The HPMS and seasonal adjustment factors (as well as the hourly factors mentioned previously) were also applied to the estimated intrazonal VMT. For those future years where TDMs do not exist (i.e., 2020, 2023, and 2026), the appropriate intermediate year VMT factors were applied to the volume for each link prior to the VMT calculation and to the estimated intrazonal VMT. Table 10 and Table 11 show the TDM and ozone season weekday VMT summaries.

**Table 10. HGB 2014, 2017, and 2020 VMT Summary.**

| County | 2014 | | 2017 | | 2020[1] | |
|---|---|---|---|---|---|---|
| | TDM[2] | Weekday | TDM[2] | Weekday | TDM[2] | Weekday |
| Harris | 109,953,104 | 102,320,608 | 114,438,118 | 106,494,291 | 114,438,118 | 111,017,574 |
| Brazoria | 7,413,727 | 6,899,096 | 7,659,996 | 7,128,270 | 7,659,996 | 7,616,945 |
| Fort Bend | 11,571,891 | 10,768,617 | 12,586,031 | 11,712,360 | 12,586,031 | 12,687,044 |
| Waller | 2,367,705 | 2,203,349 | 2,469,012 | 2,297,623 | 2,469,012 | 2,439,173 |
| Montgomery | 11,960,042 | 11,129,825 | 13,207,544 | 12,290,730 | 13,207,544 | 13,138,881 |
| Liberty | 2,770,543 | 2,807,607 | 2,883,546 | 2,922,122 | 2,883,546 | 3,084,395 |
| Chambers | 3,059,936 | 3,100,872 | 3,175,034 | 3,217,509 | 3,175,034 | 3,442,501 |
| Galveston | 6,110,611 | 5,686,437 | 6,262,180 | 5,827,485 | 6,262,180 | 6,082,937 |

[1] Based on 2017 TDM with intermediate year VMT factors.
[2] Includes intrazonal VMT.

**Table 11. HGB 2023 and 2026 VMT Summary.**

| County | 2023[1] | | 2026[1] | |
|---|---|---|---|---|
| | TDM[2] | Weekday | TDM[2] | Weekday |
| Harris | 127,864,291 | 115,733,478 | 127,864,291 | 120,650,228 |
| Brazoria | 9,141,825 | 8,139,232 | 9,141,825 | 8,697,452 |
| Fort Bend | 15,576,420 | 13,742,879 | 15,576,420 | 14,886,625 |
| Waller | 2,895,765 | 2,589,452 | 2,895,765 | 2,749,000 |
| Montgomery | 15,780,350 | 14,045,746 | 15,780,350 | 15,015,401 |
| Liberty | 3,330,571 | 3,255,682 | 3,330,571 | 3,436,484 |
| Chambers | 3,802,182 | 3,683,251 | 3,802,182 | 3,940,863 |
| Galveston | 7,021,222 | 6,349,597 | 7,021,222 | 6,627,955 |

[1] Based on 2025 TDM with intermediate year VMT factors.
[2] Includes intrazonal VMT.

## Hourly Travel Factors

Hourly travel factors were used to distribute the TDM and intrazonal VMT to each hour of the day. These hourly travel factors were developed using multi-year (2000 through 2011) aggregated ATR station data for the eight-county HGB region. To maintain VMT proportions within each of the four assignment time periods, the hourly fractions were normalized within each time period to produce the time period hourly travel factors. Each factor (i.e., 24, or one for each hour of the day) was then multiplied by the link volume (in addition to the other VMT adjustment factors). These adjusted link volumes were then multiplied by their respective link lengths to estimate the link level, summer weekday VMT estimates for each analysis year.

These factors were also multiplied by the estimated intrazonal VMT to produce the final hourly-adjusted VMT.  Table 12 shows the weekday time period hourly travel factors.

**Table 12. Weekday Time Period Hourly Travel Factors.**

| Assignment | Hour | Base Factor | Time Period Factor[1] |
|---|---|---|---|
| AM Peak | 6:00 a.m. | 0.060211 | 0.320239 |
| | 7:00 a.m. | 0.069233 | 0.368223 |
| | 8:00 a.m. | 0.058575 | 0.311538 |
| Mid-Day | 9:00 a.m. | 0.051522 | 0.160241 |
| | 10:00 a.m. | 0.050119 | 0.155878 |
| | 11:00 a.m. | 0.052393 | 0.162950 |
| | 12:00 p.m. | 0.054283 | 0.168828 |
| | 1:00 p.m. | 0.055248 | 0.171830 |
| | 2:00 p.m. | 0.057963 | 0.180273 |
| PM Peak | 3:00 p.m. | 0.063605 | 0.238773 |
| | 4:00 p.m. | 0.069189 | 0.259735 |
| | 5:00 p.m. | 0.073321 | 0.275243 |
| | 6:00 p.m. | 0.060269 | 0.226249 |
| Overnight | 7:00 p.m. | 0.045769 | 0.204263 |
| | 8:00 p.m. | 0.035695 | 0.159303 |
| | 9:00 p.m. | 0.032094 | 0.143232 |
| | 10:00 p.m. | 0.025426 | 0.113473 |
| | 11:00 p.m. | 0.017292 | 0.077172 |
| | 12:00 a.m. | 0.009591 | 0.042804 |
| | 1:00 a.m. | 0.006332 | 0.028259 |
| | 2:00 a.m. | 0.005838 | 0.026054 |
| | 3:00 a.m. | 0.005606 | 0.025019 |
| | 4:00 a.m. | 0.010146 | 0.045280 |
| | 5:00 a.m. | 0.030281 | 0.135141 |

[1] Used in the VMT calculation process.

## ESTIMATION OF LINK SPEEDS

The operational speeds for each link, excluding centroid connectors and the special intrazonal links, were calculated using the Houston speed model. The Houston speed model calculates these speeds using the travel model speed, speed factors (consisting of a free-flow speed factor and level of service [LOS] E speed factor) and a volume-to-capacity (V/C) ratio-based speed reduction factor (SRF) for each link.

The speed factors were used to convert the travel model speed to a free-flow speed and an LOS E speed (i.e., application of these factors results in two speeds). These factors were grouped into seven functional groups. Appendix F shows the speed factors and the network functional class and functional group relationship.

The link-specific V/C ratio is calculated as the time period (hourly) volume divided by the time period capacity. The V/C ratio is expressed as:

$$\text{v/c ratio} = Vh / Ch$$

Where:

Vh = the hourly link volume (travel model × HPMS factor × seasonal adjustment factor × hourly time period factor; Weekend profile factor is included for Saturday and Sunday); and

Ch = the hourly link capacity (travel model capacity × hourly capacity factor). Appendix F shows the hourly capacity factors.

After the V/C ratio was calculated, the link-specific SRF was determined using the V/C ratio, the link-specific SRF area type, the link-specific SRF functional class, and the SRFs. The SRFs are for V/C ratios of 0 to 1 in 0.05 increments (i.e., 0, 0.05, 0.10, ... , 0.95, 1.0). Appendix F shows these SRFs. The link-specific SRF was calculated using linear interpolation. For V/C ratios greater than 1.0, a SRF is not required.

The speed model (for V/C ratios from 0.00 to 1.00) is expressed as:

$$S_{V/C} = S_{0.0} - SRF_{V/C} \times (S_{0.0} - S_{1.0})$$

Where:

$S_{V/C}$ = estimated directional speed for the forecast V/C ratio on the link in the given direction;

$S_{0.0}$ = estimated free-flow speed for V/C ratio equal to 0.0;

$S_{1.0}$ = estimated LOS E speed for V/C ratio equal to 1.0; and

$SRF_{V/C}$ = SRF for the V/C ratio on the link. The V/C ratio can be 0.0 to 1.0.

For V/C ratios greater than 1.0 and less than 1.5, the following speed model extension was used:

$$S_{V/C} = S_{1.0} \times (1.15/(1.0 + (0.15 \times (v/c)^4)))$$

Where:

$S_{v/c}$ = estimated directional speed for the forecast V/C ratio on the link in the given direction;

$S_{1.0}$ = estimated LOS E speed for the V/C ratio equal to 1.0; and

v/c = the forecast V/C ratio on the link. The V/C ratio can be 1.0 to 1.5.

For V/C ratios greater than 1.5, the speed was calculated using the previous speed model extension, except the V/C ratio was set to 1.5.

These speed models were applied to all functional classes excluding the centroid connector and intrazonal functional classes. For these functional classes, capacity data were not used. The centroid connector travel model input speeds were used as the centroid connector operational speeds estimates. Operational speeds for the intrazonal functional class were estimated by zone as the average of the zone's centroid connector speeds.

The hourly and 24-hour speed (VMT/VHT) summaries by county and road type were provided electronically to TCEQ (see Appendix A for electronic data descriptions).

## ESTIMATION OF OFF-NETWORK ACTIVITY

To estimate the off-network (or parked vehicle) emissions using the grams per activity emissions rates (i.e., grams per SHP, grams per start, and grams per SHI), county-level estimates of the SHP, starts, and SHI are required by hour and vehicle type for each analysis year and day type. One of the main components of the SHP and starts off-network activity estimation is the county-level vehicle population for each analysis year. Summaries of the vehicle population and 24-hour SHP, starts, and SHI off-network activity are included as Appendix G . Hourly SHP, starts, and SHI activity estimates are included with the detailed EI data provided (see inventory data file descriptions in Appendix A).

The county-level vehicle population estimates were developed using the MOVESpopulationBuild utility. The county-level SHP and starts by hour and SUT/fuel type estimates were developed using the ShpExtIdleStartActBld utility. The county-level SHI by hour and SUT/fuel type estimates were developed using the ExtIdleHrsCalc utility. Appendix B contains a description of the utilities.

### Estimation of Vehicle Population

The vehicle type population estimates are needed to estimate the SHP and starts off-network activity. The vehicle population estimates (included as Appendix G) were produced for each county and analysis year. The vehicle population estimates are a function of vehicle registration data (TxDMV registration data sets), population scaling factors (where applicable), and VMT mix.

For estimating vehicle populations, a historical analysis year is defined as any year where actual TxDMV registration data and HPMS VMT data (used in developing population scaling factors) exists. Therefore, the 2011 analysis year was considered a historical year and the vehicle population estimates were based on the TxDMV registration data for the analysis year. Since HPMS VMT data was not available for the 2014, 2017, 2020, 2023, and 2026 analysis years, these years were considered future analysis years (i.e., TxDMV registration data and HPMS VMT data do not exist). For the future analysis years, the vehicle population estimates were based on the most recent year (2011) TxDMV registration data set for which HPMS VMT data exists and analysis year population scaling factors.

The VMT mix used to estimate the vehicle population is the aggregate (i.e., all road-type categories) TxDOT district-level weekday VMT mix. The development of the VMT mix is described in more detail in the "Development of Vehicle Type VMT Mix" section and included as Appendix D.

*Historical Vehicle Population Estimates*

The county-level vehicle population estimates for the historical analysis year (2011) were calculated using the analysis year county-level, mid-year TxDMV vehicle registrations and the assigned aggregate VMT mix (see Table 5 and Appendix D). The vehicle population estimation process assumes that all of the non-long-haul SUT category populations for a county are represented in the county vehicle registrations data. This process also estimates the long-haul category populations as an expansion of the county registrations. There are three main steps in the vehicle population estimation process: registration data category aggregation, calculation of the vehicle type population factors, and estimation of the county-level vehicle population by vehicle type.

The first step in the vehicle estimation process is the registration data category aggregation. For each county, the analysis year vehicle registrations were aggregated into five categories. Table 13 shows these five categories.

**Table 13. Registration Data Categories.**

| Registration Data Category | Vehicle Registration Aggregation |
|---|---|
| 1 | Motorcycles |
| 2 | Passenger Cars (PC) |
| 3 | Trucks <= 8.5 K GVWR (pounds) |
| 4 | Trucks > 8.5 and <= 19.5 K GVWR |
| 5 | Trucks > 19.5 K GVWR |

The second step is calculating the vehicle type population factors. Using the assigned aggregate VMT mix, population factors were calculated for each vehicle type. For the non-long-haul SUT categories, the population factors were calculated by dividing the vehicle type VMT mix by the summed total of the VMT mix fractions in its associated vehicle registration data category. For example, the LCT_Diesel population factor using the VMT mix is LCT_Diesel/(PT_Gas + PT_Diesel + LCT_Gas + LCT_Diesel). For the long-haul SUTs, the vehicle type population factors were calculated by taking the ratio of the long-haul and short-haul VMT mix values. For example, the SULhT_Gas population factor using SUT mix fractions is SULhT_Gas/SUShT_Gas.  Table 14 shows the vehicle registration aggregations and their associated MOVES SUT/fuel types.

**Table 14. TxDMV Vehicle Registration Aggregations and Associated Vehicle Types for Estimating Vehicle Populations.**

| Vehicle Registration[1] Aggregation | Associated Vehicle Type[2] |
|---|---|
| Motorcycles | MC_Gas |
| Passenger Cars (PC) | PC_Gas; PC_Diesel |
| Trucks <= 8.5 K GVWR (pounds) | PT_Gas; PT_Diesel;<br>LCT_Gas; LCT_Diesel |
| Trucks > 8.5 and <= 19.5 K GVWR | RT_Gas; RT_Diesel<br>SUShT_Gas; SUShT_Diesel<br>MH_Gas; MH_Diesel<br>IBus_Diesel<br>TBus_Gas; TBus_Diesel<br>SBus_Gas; SBus_Diesel |
| Trucks > 19.5 K GVWR | CShT_Gas; CShT_Diesel |
| NA[1] | SULhT_Gas; SULhT_Diesel<br>CLhT_Gas; CLhT_Diesel |

[1] The four long-haul SUT/fuel type populations are estimated using a long-haul-to-short-haul weekday SUT VMT mix ratio applied to the short-haul SUT population estimate.
[2] The mid-year TxDMV county registrations data extracts were used (i.e., the three-file data set consisting of: 1 - light-duty cars, trucks, and motorcycles; 2 - heavy-duty diesel trucks; and 3 - heavy-duty gasoline trucks) for estimating the vehicle populations.

The third step is the estimation of the county-level vehicle type population.  The non-long-haul vehicle type populations were estimated by applying their vehicle type population factors to the appropriate registration data category.  For the CLht_Gas type, the vehicle population was set to 0.  For the remaining three long-haul SUT/fuel types (SULhT_Gas, SULhT_Diesel, and CLhT_Diesel), the vehicle populations were calculated as the product of the corresponding short-haul category vehicle population and the associated long-haul population factor (e.g., SULhT_Gas vehicle population = SUShT_Gas vehicle population x [SULhT_Gas SUT mix fraction/ SUShT_Gas SUT mix fraction]).

*Future Vehicle Population Estimates*

The process for estimating the county-level vehicle population estimates for the future analysis years (2014, 2017, 2020, 2023, and 2026) is very similar to the historical vehicle population estimates except that instead of using the analysis year registration data sets, the most recent (2011) mid-year TxDMV registration data sets for which HPMS data exists were used.  Using these registration data sets and the assigned VMT mix, the base vehicle type population for 2011 was calculated.  To estimate the future analysis year county-level vehicle populations, future year county-level vehicle population scaling factors were applied to the base vehicle type population for 2011.  These future year county-level vehicle population scaling factors were calculated as the ratio of the county-level weekday VMT for the analysis year to the county-level weekday VMT for the year of the most recent (2011) mid-year TxDMV registration data (i.e., vehicle population increases linearly with VMT).

## Estimation of SHP

The first activity measure needed to estimate the off-network emissions using the grams per activity emissions rates are county-level weekday estimates of SHP by hour and vehicle type for each analysis year. For each hour, the county-level vehicle type SHP was calculated by taking the difference between the vehicle type total available hours minus the vehicle type SHO. Since this calculation was performed at the hourly level, the vehicle type total available hours was set equal to the vehicle type population. The SHO was calculated using the link VMT and speeds and the TxDOT district-level vehicle type VMT mixes by MOVES road-type category (see the "Development of Vehicle Type VMT Mix" section for more details). Appendix G includes the 24-hour summaries of the county-level weekday estimates of SHP by hour and vehicle type for each analysis year (hourly summaries were provided electronically to TCEQ; see Appendix A for electronic data descriptions).

### *Vehicle Type Total Available Hours*

The vehicle type total available hours is typically calculated as the vehicle type population times the number of hours in the time period. Since this calculation was performed at the hourly level, the vehicle type total available hours for each analysis year was set equal to the vehicle type vehicle population for the analysis year.

### *Vehicle Type SHO*

To calculate the VHT (or SHO) for a given link, the VMT was allocated to each vehicle type using the TxDOT district-level vehicle type VMT mixes by MOVES road-type category, which was then divided by the link speed to calculate the link vehicle type SHO. These VMT mixes are the same VMT mixes used to estimate emissions in the emissions estimation process (see Table 5 and Appendix C). This SHO calculation was performed for each link in a given hour, aggregating the SHO to one value per vehicle type per hour.

## Estimation of Starts

The second activity measure needed to estimate the off-network emissions using the grams per activity emissions rates are county-level weekday estimates of starts by hour and vehicle type for each analysis year. The vehicle type hourly default starts per vehicle were multiplied by the analysis year county-level vehicle type vehicle population to estimate the county-level vehicle type starts by hour. Appendix G includes the 24-hour summaries of the county-level vehicle type starts by hour for each analysis year (hourly summaries were provided electronically to TCEQ; see Appendix A for electronic data descriptions).

## Estimation of SHI

The third activity measure needed to estimate the off-network emissions using the grams per activity emissions rates are county-level weekday estimates of vehicle type SHI by hour for each analysis year. These SHI estimates were for source type 62, fuel type 2 (CLhT_Diesel) only. The SHI was based on information from a TCEQ extended idling study, which produced 2004 summer weekday SHI estimates for each Texas county. SHI scaling factors (by analysis year) were applied to the base 2004 summer weekday SHI values from the study to estimate the 24-hour SHI by analysis year. SHI hourly factors were then applied to allocate the 24-hour SHI by analysis year to each hour of the day. To ensure valid hourly SHI values are used in the emissions estimation, the hourly SHI was compared to the CLhT_Diesel hourly SHP (i.e., hourly

SHI values cannot exceed the hourly SHP values). Appendix G incudes the 24-hour summaries of the county-level estimates of SHI by hour for each analysis year (hourly summaries were provided electronically to TCEQ; see Appendix A for electronic data descriptions).

*SHI Scaling Factors*

To estimate the county-level 24-hour SHI by analysis year, county-level SHI scaling factors were developed using county-level 2004 summer weekday link-level VMT and speeds, the TxDOT district-level base weekday vehicle type VMT mix (by MOVES road type), the county-level analysis year weekday link-level VMT and speeds, and the TxDOT district-level analysis year vehicle type VMT mix (by MOVES road type). The 2004 summer weekday link-level VMT and speeds were developed using a process similar to the historical analysis year summer weekday link-level VMT speed estimation, except using a 2004 summer weekday VMT control total. The vehicle type VMT mixes were the same VMT mixes used to estimate emissions in the emissions estimation process (see Table 5 and Appendix C). For the base weekday vehicle type VMT mix, the 2005 weekday vehicle type VMT mix was used.

For each link in the 2004 summer weekday link-level VMT and speeds, the link VMT was allocated to CLhT_Diesel using the base weekday vehicle type VMT mix. This VMT allocation was performed for each link and hour in the 2004 summer weekday link-level VMT and speeds, with the individual link VMT aggregated by hour to produce the CLhT_Diesel hourly and 24-hour 2004 summer weekday VMT. Using a similar allocation process, the analysis year CLhT_Diesel hourly and 24-hour VMT was calculated using the analysis year weekday link-level VMT and speeds and the analysis year vehicle type VMT mix. The county-level 24-hour SHI scaling factors by analysis year were calculated by dividing the analysis year and day type CLhT_Diesel 24-hour VMT by the CLhT_Diesel 24-hour 2004 summer weekday VMT.

*SHI Hourly Factors*

To allocate the analysis year weekday county-level 24-hour SHI to each hour of the day, SHI hourly factors were used. These SHI hourly factors were calculated as the inverse of the analysis year weekday CLhT_Diesel hourly VMT fractions. The analysis year weekday CLhT_Diesel hourly VMT fractions were calculated using the hourly analysis year weekday CLhT_Diesel VMT. The hourly analysis year weekday CLhT_Diesel VMT was converted to hourly fractions, therefore creating analysis year weekday CLhT_Diesel hourly VMT fractions. The inverse of these hourly VMT fractions were calculated and the inverse for each hour was divided by the sum of the inverse hourly VMT fractions across all hours to calculate the county-level analysis year weekday SHI hourly factors.

*County-Level CLhT_Diesel SHI by Hour Estimation*

The base analysis year weekday CLhT_Diesel SHI by hour was calculated by multiplying the 24-hour 2004 summer weekday SHI by the SHI scaling factor and by the SHI hourly factors. For each hour, the base analysis year weekday CLhT_Diesel SHI was then compared to the analysis year weekday CLhT_Diesel SHP to estimate the final analysis year weekday CLhT_Diesel SHI by hour. If the base analysis year weekday SHI value was greater than the analysis year weekday SHP value, then the final analysis year weekday CLhT_Diesel SHI for that hour was set to the analysis year weekday CLhT_Diesel SHP value. Otherwise, the final analysis year weekday CLhT_Diesel SHI for that hour was set to the base analysis year weekday SHI value. All calculations (scaling factors, SHI hourly factors, and SHI by hour calculations) were performed by county and analysis year (i.e., eight SHI scaling factors were calculated per analysis year).

## ESTIMATION OF EMISSIONS FACTORS

TTI developed the summer weekday emissions factors consistent with TTI's MOVES detailed link-based emissions estimation method that was established as an upgrade of the MOBILE6-based inventory process for producing SIP and conformity analysis quality emissions estimates. TTI used EPA's latest MOVES version, MOVES2010b (MOVES software and database [MOVESDB20121030], revised January 2013).[11]

The emissions factors were developed based on the TTI's *Update of On-road Inventories Methods for MOVES*[12] and the EPA's MOVES inventory development *Technical Guidance*[13] along with the MOVES *User's Guide.*[14] (Additional information may found in these main references, if desired.) TTI's MOVES output post-processing utilities, which were used to produce the emissions rate look-up table databases for input to the emissions calculations, are also summarized in Appendix B of this Technical Report.

The detailed link-based emissions estimation method of analysis requires emissions rates by speed in look-up table form; the MOVES emissions rate mode was selected to direct MOVES to output emissions rates, and the emissions and activity data from which the rates were derived, by the 16 MOVES speed bin average speeds (2.5, 5, 10….. 75 mph). The emissions estimation method required that all rates be in terms of mass per activity unit for the external emissions calculations (i.e., the off-network mass per vehicle rates from MOVES were not used). TTI post-processed the MOVES emissions and activity output to produce all emissions rates in mass/activity terms (see Table 15, which was included in a previous section, but is provided again here for convenience).

[11] Downloadable from http://www.epa.gov/otaq/models/moves/index.htm.
[12] *Update Of On-Road Inventory Development Methodologies for MOVES2010b.* TTI, July 2013.
[13] *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a, and 2010b.* EPA, April 2012.
[14] *Motor Vehicle Emission Simulator (MOVES) User Guide for MOVES1010b.* EPA, June 2012.

**Table 15. Emissions Rates by Process and Activity Factor.**

| Emission Processes | Activity[1] | Emissions Factor Units |
|---|---|---|
| Running Exhaust<br>Crankcase Running Exhaust<br>Brake Wear<br>Tire Wear | VMT | grams/mile (g/mi) |
| Evaporative Permeation<br>Evaporative Fuel Vapor Venting<br>Evaporative Fuel Leaks | VMT | g/mi |
| | SHP | g/shp |
| Start Exhaust<br>Crankcase Start Exhaust | starts | g/start |
| Extended Idle Exhaust<br>Crankcase Extended Idle Exhaust | SHI | g/shi |

[1] SHI is for Combination Long-Haul Trucks only.

The MOVES model is equipped with default modeling values for the range of conditions that affect emissions. MOVES defaults may be replaced by alternate input data sets that better reflect local scenario conditions. Where local data were available and consistent with the methodology, MOVES defaults were replaced by local input values via the MOVES Run Specification input file (RunSpec or MRS) and MOVES CDB (county input database). (The MRS, CDB, and MOVES default database provide the data for each local scenario model run.) Local inputs were developed and used to produce emissions factors characteristic of the June through August period average weather conditions, summer fuel properties, vehicle fleet characteristics, and emissions control programs. In the case of the activity input data to MOVES, the MOVES defaults were in general used, which is basic to the emissions rates method (i.e., default activity is divided out to unity in the emissions rates post-processing calculation, and these emissions rates are later multiplied by the actual local activity estimates to calculate emissions external to MOVES).

## MOVES Inputs, Outputs and Post-Processing

There is one RunSpec required per county and analysis year, and a corresponding number of CDBs and output databases (i.e., one output database per run). Therefore, for eight counties and six calendar years there are 48 each RunSpec input files, CDB inputs, MOVES output databases, MOVESRatesCalc output databases, and MOVESRatesAdj final rate output databases. MOVESratesadj produces the final rates by performing $NO_x$ TxLED effect adjustments to diesel vehicle $NO_x$ rates and extracting and storing the rates for the inventoried pollutants in a separate, smaller database for input to the emissions runs.

The utilities used to calculate the emissions rates from the MOVES emissions and activity output and to adjust the emissions rates, MOVESratescalc and MOVESratesadj, respectively, are described in Appendix B.

### Summary of Control Programs Modeled

Table 16 summarizes the control measures and modeling approaches (e.g., MOVES model, defaults or alternative local inputs, or post-processing of MOVES output).

**Table 16. Emissions Control Strategies and Modeling Approaches.**

| Individual Control Measures | Approach |
|---|---|
| Federal Motor Vehicle Control Program Standards | MOVES model – defaults. |
| Federal Heavy-Duty Diesel Engines Rebuild and 2004 Pull-Ahead Programs to Mitigate $NO_x$ Off-cycle Effects | MOVES model – defaults. |
| Reformulated Gasoline (RFG) | MOVES model – region-specific RFG fuel formulation inputs, based on the EPA's 2011 summer season Houston retail outlet RFG survey data for 2011, and based on EPA's latest available summer (2013) season Houston retail outlet RFG survey data for later years, with average sulfur content for 2017 and later set for consistency with the Tier 3 sulfur standard. |
| Texas Low-Emission Diesel | MOVES model – 2011 historical year sulfur content based on local summer season fuel survey data (TCEQ summer 2011 fuel survey); 2014 and later analysis years used MOVES default diesel sulfur content value, consistent with the federal (Ultra-Low Sulfur) rule.<br><br>Post-processing of MOVES output – diesel vehicle $NO_x$ emissions factors for all counties were adjusted using evaluation year and SUT-specific average $NO_x$ reduction factors produced following TCEQ's procedure (which calculates the average $NO_x$ percent reduction based on 4.8% and 6.2% reductions for 2002 and later, and 2001 and earlier model years, respectively). |
| Inspection and Maintenance (I/M) Program | MOVES model – locality specific inputs to model I/M effects for the five I/M Program counties (Brazoria, Fort Bend, Galveston, Harris, and Montgomery). Used available MOVES I/M parameters (in terms of MOVES I/M "teststandards" and associated "imfactors") pertaining to the domain of I/M vehicles, consistent with current program descriptions and latest I/M modeling protocols. |

## MOVES Emissions Factor Aggregation Levels

The MOVES model produces results at different aggregation levels that may be specified in the MRS. The detailed, hourly, rates-per-activity link-based inventory method, required MOVES weekday day type emissions rates at the following MOVES output detail level:

- Up to 13 source types (i.e., vehicle types);
- Up to 4 fuel types;
- Up to 5 road types (four actual MOVES road categories and “off-network”);
- Each of the 24 hours in a day;
- 16 speed bins (only included in miles-based rate tables);
- Up to 103 pollutants; and
- Up to 13 emissions processes.

The vehicle fleet was modeled as powered only by the predominant on-road fuels of gasoline or diesel (alternate fuels considered de minimis). The five MOVES road type categories are Off-Network (not actually a road type), Rural Restricted Access, Rural Unrestricted Access, Urban Restricted Access, and Urban Unrestricted Access. Of the two rate tables produced (using TTI MOVES post-processing utilities) for input to the emissions calculations, one rate table contains off-network rates, and the other includes rates for each of the four MOVES actual road types, indexed by 16 speeds. The speeds index corresponds to the 16 MOVES speed bin average speeds: 2.5, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, and 75 mph.

## MOVES Run Specifications

The MRS defines the place, time, vehicle, road, fuel, emissions producing process, and pollutant parameters for the modeling scenario. TTI built the analysis MRS files by first creating an MRS template using the MOVES GUI, then changing the template’s variable parameters to create one MRS for each county and year. Table 17 describes the MRS selections TTI used in the MOVES runs.

## Table 17. RunSpec Selections by MOVES GUI Navigation Panel.

| Navigation Panel | Detail Panel | Selection | | |
|---|---|---|---|---|
| Scale[1] | Domain/Scale; Calculation Type | County; Emissions Rates | | |
| Time Spans[1] | Time Aggregation Level; Years – Months – Days – Hours | Hour; 2011[1] - July - Weekday - All | | |
| Geographic Bounds[1] | Region; Selections; Domain Input Database | Zone and Link; Brazoria[1]; *<database name for county/year scenario>* | | |
| On-Road Vehicle Equipment | SUT/Fuel Combinations | SUT | Gasoline | Diesel |
| | | Motorcycle | X | - |
| | | Passenger Car | X | X |
| | | Passenger Truck | X | X |
| | | Light Commercial Truck | X | X |
| | | Intercity Bus | - | X |
| | | Transit Bus | - | X |
| | | School Bus | X | X |
| | | Refuse Truck | X | X |
| | | Single Unit Short-Haul Truck | X | X |
| | | Single Unit Long-Haul Truck | X | X |
| | | Motor Home | X | X |
| | | Combination Short-Haul Truck | X | X |
| | | Combination Long-Haul Truck | - | X |
| Road Type | Selected Road Types | Off-Network – Rural Restricted Access – Rural Unrestricted Access – Urban Restricted Access – Urban Unrestricted Access | | |
| Pollutants and Processes[2] | VOC; CO; $NO_x$; Atmospheric $CO_2$; $PM_{10}$: OC, EC, $SO_4$, Total Exhaust, Brakewear, Tirewear; $PM_{2.5}$: OC, EC, $SO_4$, Total Exhaust, Brakewear, Tirewear | Depending on pollutant, processes may include: Running Exhaust, Start Exhaust, Extended Idle Exhaust, Crankcase Running Exhaust, Crankcase Start Exhaust, Crankcase Extended Idle Exhaust, Evap Permeation, Fuel Vapor Venting, Fuel Leaks | | |
| Manage Input Data Sets | Additional Input Database Selections | None | | |
| Strategies | On-Road Retrofit; Rate-of-Progress | Not Applicable | | |
| General Output | Output Database; Units; Activity | *<database name for county/year/ scenario>*; Pounds, Kilojoules, Miles; Distance Traveled, Source Hours, Source Hours Idling, Source Hours Operating, Source Hours Parked, Population, Starts | | |
| Output Emissions Detail | Always; For All Vehicles/Equipment; On Road | Time: Hour – Location: Link – Pollutant; Fuel Type, Emissions Process; Source Use Type | | |
| Advanced Performance Measures | Aggregation and Data Handling | All check boxes are to be “un-checked” | | |

[1] County scale allows one county and year per run – the evaluation years and counties are 2011, 2014, 2017, 2020, 2023 and 2026; Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller.

[2] Chained pollutants require other pollutants (not listed in the table) to be selected (e.g., VOC requires Total Gaseous Hydrocarbons [THC] and Non-Methane Hydrocarbons: $CO_2$ requires Total Energy Consumption [TEC]).

*Scale, Time Spans, and Geographic Bounds*

The MOVES Domain/Scale “County” was selected as is required for SIP inventory analyses. The MOVES Calculation Type “Emissions Rates” was selected for MOVES to produce the activity and emissions output needed as input to the MOVES output post-processor that calculates the emissions rate look-up tables.

The Time Spans parameters were specified to provide the most detail available, which is the hourly aggregation level, for all hours of the day, for the selected year, month and day type. One analysis year per run was selected, as MOVES allows only one “Years” selection for the County Domain Scale. For TTI’s MOVES-based link emissions estimation process, which is for a single day, one “Months” (July) and one “Days” (Weekdays) selection was made.

Under Geographic Bounds for the County Domain Scale, only one county may be selected. The user-produced CDB containing the calendar year scenario-specific input data for the county was specified as the County Domain Input Database, and under Region, “Zone & Link” was selected as required for the emissions rates calculation type. With these required set-ups, one county, one year, one day type, and 16 (speed bin) average speeds were modeled per run.

*On-Road Vehicle Equipment and Road Type*

All of the SUTs associated with gasoline and diesel fuels were specified. Note that for this analysis, the MOVES default fuel/engine fractions were replaced with local inputs, which showed no compressed natural gas (CNG) vehicles in the fleet (the MOVES default database includes some CNG Transit Buses), and no gasoline Transit Buses. (The local vehicle type VMT mixes developed for the study define the SUT/fuel type combinations included in the MOVES runs.) For emissions rate calculations, all five MOVES road type categories were selected.

*Pollutants and Processes*

In addition to the required pollutants within the scope of the inventory, MOVES requires that additional pollutants be selected for particular “chained” pollutants (i.e., pollutants that are calculated as a function of another MOVES pollutant). Of the pollutants listed for the inventory, the following additional pollutants were selected, as required by the model, due to chaining: non-methane hydrocarbons and total gaseous hydrocarbons (for VOC), and total energy consumption (for $CO_2$ and $SO_4$). All of the associated processes available by the selected pollutants were included, including the two refueling emissions processes (although emissions for these “area source” category processes were not estimated for this inventory).

*Manage Input Data Sets and Strategies*

The Manage Input Datasets feature allows alternate inputs other than those included in the CDB. No additional inputs were included via the Manage Input Datasets panel.

The Strategies features are for modeling some alternate control program options, which was not applicable to this inventory analysis

*Output*

The output units were pounds (converted in a later step to grams), kilojoules, and miles. All of the activity categories were chosen for inclusion in the output database. The activity output was needed along with the emissions output to calculate the rates-per-activity emissions rates look-up tables via post-processing. The output detail level was by hour, link (i.e., county/road type/speed bin combination), pollutant, process, SUT, and fuel type.

Appendix A lists the electronic data files provided in support of this analysis, which includes the MRSs used.

**MOVES County Input Databases**

The locality-specific input data for the county scale runs were entered through the CDB. Additional user input data may be entered through separate databases via the Manage Input Datasets feature, although this feature was not used.

TTI developed procedures to facilitate building and checking CDBs for large scale emissions inventory projects. The basic procedure involved acquiring and preparing the input data for populating CDB tables, writing and running MySQL scripts to build the CDBs, and performing QA checks on the results.

To build all of the CDBs needed for the analysis, the required data were first prepared and organized. The input data for populating the CDBs includes local data from prepared text files and databases (e.g., for local fuels and weather data), and MOVES default data from MOVESDB20121030 (e.g., for default activity data), and some values provided directly in the CDB builder MySQL script.

An automated procedure was used to write MySQL scripts for building the CDBs. A MySQL script to build a CDB was first written and converted to a template by replacing particular scenario-specific values (e.g., year, input file paths, county name/FIPS) with variables. This CDB-script template was then changed (replacing the variables with the scenario-specific values) for each CDB to produce the MySQL scripts needed to create all of the required CDBs. After running the scripts to produce the CDBs, a CDB checker utility written by TTI was run to verify that all CDB tables were built and populated as intended.

Table 18 provides an outline and brief description of the CDBs, followed by discussion of the development of the local data and the defaults contained therein. Unless otherwise stated, the CDB table data applies to all counties and years.

## Table 18. CDB Input Tables.

| MOVES Input Table | Data Category | Notes |
|---|---|---|
| year | Time | Designates analysis year as a base year (base year means that local activity inputs are supplied rather than forecast by the model). |
| state | Geography | Identifies the state (Texas) for the analysis. |
| county | Geography/ Meteorology | Identifies county of analysis, local altitude and barometric pressure (barometric pressure data were provided by TCEQ). |
| zonemonthhour | Meteorology | Local, hourly temperature and relative humidity for the county (data were provided by TCEQ). |
| roadtype[1] | Activity | Lists the MOVES road types and associated ramp activity fractions. Road type ramp fractions were set to 0. |
| hpmsvtypeyear[2] | Activity (Defaults) | Used MOVES defaults – 1999 national annual VMT by HPMS vehicle category, except yearID was set to analysis year. |
| roadtypedistribution[2] | | Used MOVES default road type VMT fractions. |
| monthvmtfraction[2] | | Used MOVES default month VMT fractions. |
| dayvmtfraction[2] | | Used MOVES default day VMT fractions. |
| hourvmtfraction[2] | | Used MOVES default hour VMT fractions. |
| avgspeeddistribution[2] | | Used MOVES default average speed distributions. |
| sourcetypeyear[2] | Fleet (Defaults) | Used MOVES default – 1999 national SUT populations, except yearID was set equal to the analysis year value. |
| sourcetypeage-distribution | Fleet | TTI estimated SUT age fractions using TxDOT/DMV vehicle registration data and MOVES defaults, as needed. TTI used the 2011 mid-year registration data for 2011, and used the latest available (2013) mid-year registration data for 2014 and later years. |
| avft | Fleet | TTI estimated SUT fuel fractions using TxDOT/DMV vehicle registration data and defaults where needed. Local data sets used by analysis year were consistent with sourcetypeagedistribution tables. |
| zone | Activity | Start, idle, and SHP zone allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses). |
| zoneroadtype | Activity | SHO zone/roadtype allocation factors. County = zone, and all factors were set to 1.0 (required for county scale analyses). |
| fuelsupply | Fuel | The fuel supply, or market shares, reflected one gasoline and one diesel fuel formulation for each county and year. |
| fuelformulation | Fuel | For 2011, based on local retail outlet data (i.e., summer 2011 TCEQ survey [for diesel sulfur] and EPA summer 2011 RFG survey). For future year diesel sulfur content, MOVES default was used. For future year RFG, based on EPA summer 2013 RFG survey sample data. For 2017 and later, average sulfur content was set to the Tier 3 Rule annual average standard (10 ppm). |
| imcoverage | I/M | TTI prepared locality-specific set-ups to represent I/M program design/description for each county and analysis year based on current I/M rules, prior modeling set-ups, and available MOVES I/M parameters (in terms of MOVES I/M "teststandards" and associated "imfactors") for the I/M vehicles. Regulatory class adjustments were made per *MOVES Technical Guidance* (EPA, April 2012). |
| countyyear | Stage II | Table included in CDB as standard procedure, but not |

| MOVES Input Table | Data Category | Notes |
|---|---|---|
| | | applicable to analysis, and with no effect on resulting emissions inventories. |

[1] MOVES will not produce "ramp road type" rates in a single run with all road types. To calculate emissions for certain travel model links coded as ramps, MOVES Unrestricted Access road type emissions rates were used.
[2] Use of a default set of activity and population inputs for all MOVES runs is basic to the inventory method. The MOVES default activity is normalized in the emissions rates calculation post-processing procedure (i.e., MOVES activity output is divided into the MOVES emissions output to produce emissions rates in the desired "rates per activity" units), and actual local scenario-specific activity estimates are used in the external emissions calculations.

### User Inputs to MOVES via CDB

All inputs discussed in this section are input via the CDB. Unless otherwise stated, the inputs apply to all counties and years.

*Year, State, and County Tables*

The year, state, and county tables were populated with data identifying the year, state, and county of the run.

StateID "48" (Texas) was inserted in the state table. The yearID field of the "year" table was populated with the analysis year value, and the year was set as a base year (to specify that particular user-input fleet and activity data were to be used, rather than forecast by MOVES).

As part of designating the appropriate fuel supply for the modeling scenario, the fuelyearid in the year table was set: for analysis years prior to 2012, the analysis year value was used, and for 2012 and later analysis years, fuelyearid was set to 2012 (i.e., currently the fuel year in MOVES that applies to 2012 an later analysis years).

The county table identifies the county of analysis and contains barometric pressure and altitude information (discussed further with other meteorological inputs). The county data was selected from a prepared local "meteorology" database containing tables of weather data records (i.e., "county" and "zonemonthhour" tables) for the analysis.

*Roadtype Table*

Currently the MOVES model contains "ramp" emissions rates, but not a road type for ramps specifically. In the roadtype table, MOVES provides a field "rampFraction" for including a fraction of estimated ramp activity as a fraction of SHO on each of the MOVES road types. For this analysis, the MOVES default roadtype table data were used, but with the ramp fractions set to zero (i.e., 100 percent of activity on each MOVES road type was based on the road type drive cycles assigned to that road type by MOVES, exclusive of ramp activity; currently the MOVES Unrestricted Access road type rates are used with activity for particular ramp links in the external emissions calculations). The treatment of ramps for subsequent emissions inventory development projects will be updated to incorporate use of ramp rates.

*Default Activity and Population*

The activity and vehicle population input parameters under the methodology use the MOVES defaults. The tables are: hpmsvtypeyear, roadtpyedistribution, monthvmtfaction, dayvmtfraction, hourvmtfraction, avgspeeddistribution, and sourcetypeyear. Data for all of these tables were selected and inserted from the MOVES default database. For monthvmtfraction either leap year or non-leap year fractions were selected, consistent with each analysis year. For the two tables dependent on year (i.e., hpmsvtypeyear and sourcetypeyear include yearID), the 1999 default data were used, except the yearID value was updated to the analysis year value.

The zone and zoneroadtype tables contain zonal sub-allocation activity factors. For county scale analyses, county is equal to zone, therefore these allocation factors were set to 1.0.

*Local Fleet Age Distributions and Fuel Fractions*

The locality-specific fleet characteristics inputs to MOVES consist of county age distributions input datasets and statewide diesel fractions (or fuel/engine fractions) input data sets. The age distributions and fuel fractions inputs were calculated and written to text files in preparation for loading the data into the appropriate CDB input tables: the sourcetypeagedistribution table for vehicle age distributions, and the AVFT table for fuel/engine fractions. The MOVESfleetInputBuild utility was used to produce these fleet inputs to MOVES in the required formats (see utility description in Appendix B), and MySQL scripts were used to populate the CDB input tables.

The age distributions and fuel fractions were based on TxDOT mid-year county registrations data and MOVES model defaults, where needed. The fuel/engine fractions were developed consistent with the VMT mix (e.g., no CNG vehicles are in the VMT mix resulting in fuel/engine fractions for CNG of zero). Locality-specific SUT age distributions were produced based on the TxDOT county vehicle registration category aggregations, consistent with the vehicle registration category aggregations of the VMT mix (see Appendix B). Appendix H includes the age distributions and diesel fractions summaries.

Table 19 summarizes the data sources and aggregation levels used to estimate the HGB county sourcetypeagedistributions and fuel/engine fractions.

**Table 19. Data Sources and Aggregations for SUT Age Distributions and Fuel/Engine Fractions.**

| SUT Name | SUT ID | TxDOT Category[1] Aggregations for Age Distributions and Fuel/Engine Fractions | Geographic Aggregation for Age Distributions | Geographic Aggregation for Fuel/Engine Fractions[2] |
|---|---|---|---|---|
| Motorcycle | 11 | Motorcycles | County | NA – 100 percent gas, no Fuel/Engine Fractions |
| Passenger Car | 21 | Passenger | County | MOVES default |
| Passenger Truck | 31 | Total Trucks<=8500 | County | MOVES default |
| Light Commercial Truck | 32 | Total Trucks<=8500 | County | MOVES default |
| Single Unit Short-Haul Truck | 52 | >8500+ >10000+ >14000+>16000 | HGB Region | Texas Statewide |
| Single Unit Long-Haul Truck | 53 | >8500+ >10000+ >14000+>16000 | Texas Statewide | Texas Statewide |
| Refuse Truck | 51 | MOVES default | | |
| Motor Home | 54 | | | |
| Intercity Bus | 41 | | | |
| Transit Bus[2] | 42 | | | |
| School Bus | 43 | | | |
| Combination Short-Haul Truck | 61 | >19500+ >26000+ >33000+ >60000 | HGB Region | Texas Statewide |
| Combination Long-Haul Truck | 62 | >19500+ >26000+ >33000+ >60000 | Texas statewide | NA – 100 percent diesel, no Fuel/Engine Fractions |

[1] TxDOT mid-year 2011 and 2013 (latest available) county vehicle registrations data (i.e., composite fuel light-duty categories; heavy-duty gas by eight weight categories; and heavy-duty diesel by eight weight categories) were used for developing local inputs for 2011 and 2014 and later years, respectively (weights are in gross vehicle weight rating (GVWR) units of lbs.). Based on the current MOVES2010b model and MOVESDB20121030 database, TTI updated the MOVES default age distributions from EPA's MOVES tools webpage, http://www.epa.gov/otaq/models/moves/tools.htm (which were based on earlier MOVES version), and used the default updates in this analysis.

[2] MOVES default fuel/engine fractions for transit buses were revised to exclude the CNG and gasoline-fueled components, consistent with the local VMT mixes.

*County and Zonemonthhour Tables (Meteorological Inputs)*

The meteorological inputs, provided by TCEQ, were input via the "county" (barometric pressure) and "zonemonthhour" (temperature and relative humidity) tables. These input data (originally developed and applied in the TCEQ's 2011 HGB periodic emissions inventory analysis[15]) were developed as June 1 through August 31, 2011 hourly temperature and relative humidity, and 24-hour barometric pressure averages, using the hourly data from numerous weather stations within the HGB area. Altitude, also an input of the county table, was set to "low" for all counties. Table 20 summarizes the temperatures, relative humidity, and barometric pressure input values.

**Table 20. Meteorological Inputs to MOVES.**

| Hour | Temperature (Degrees Fahrenheit) | Relative Humidity (Percent) | Barometric Pressure (Inches of Mercury) |
|---|---|---|---|
| 1 | 81.78 | 77.92 | 29.9544 |
| 2 | 81.05 | 80.26 | |
| 3 | 80.42 | 82.41 | |
| 4 | 79.88 | 83.82 | |
| 5 | 79.38 | 85.06 | |
| 6 | 78.92 | 86.09 | |
| 7 | 78.66 | 86.78 | |
| 8 | 79.91 | 84.25 | |
| 9 | 82.99 | 76.56 | |
| 10 | 85.64 | 67.93 | |
| 11 | 88.01 | 59.29 | |
| 12 | 90.11 | 52.73 | |
| 13 | 91.82 | 48.13 | |
| 14 | 92.94 | 45.45 | |
| 15 | 93.60 | 43.78 | |
| 16 | 93.82 | 43.29 | |
| 17 | 93.55 | 43.99 | |
| 18 | 92.67 | 45.94 | |
| 19 | 91.15 | 49.19 | |
| 20 | 88.90 | 54.47 | |
| 21 | 86.34 | 61.24 | |
| 22 | 84.64 | 66.62 | |
| 23 | 83.45 | 71.05 | |
| 24 | 82.54 | 74.73 | |

[1] HGB area weather station data averages for 2011 June through August period.

[15] *2011 On-Road Mobile Source Actual Annual and Weekday Emissions Inventories: Houston Area.* TTI, August 2012.

*Fuelsupply and Fuelformulation Tables*

The local fuels inputs to MOVES were input in the CDB fuelsupply and fuelformulation tables. TTI produced the local fuel formulation input records with unique IDs (i.e., outside the range of MOVES default fuel formulation IDs). The summer season fuel supply for each county and year consisted of one average RFG and one average diesel fuel formulation (and therefore gasoline and diesel fuel supply market share values were 1.0 for each). The data sources for these fuel formulations were largely local survey data, although for average sulfur content, default values reflecting regulatory standards were used as the expected values for particular future years. TTI prepared the HGB fuels input data in spreadsheets, saved them to text files, and imported these local HGB fuels inputs to storage database tables (fuelformulation and fuelsupply). The T50 and T90 parameters, new with MOVES2010b, were included in the fuel formulation tables. County-fuel scenario data were selected from storage and inserted into the CDB fuelsupply and fuelformulation tables for input to MOVES emissions rate runs.

The following describes the procedure used to populate the CDB fuels tables for each CDB (county and year).

- Selected all MOVES default fuelsupply records associated with the county-fuel scenario (i.e., for the countyID, fuelyearID, monthgroupID, where for this analysis monthgroupID=7 [July] for summer season fuel) and set their market share field values to zero. (This was to prevent MOVES from applying its default fuels data in addition to the desired local fuels input data) and inserted the data into the CDB fuelsupply table.
- Selected the local fuel supply records for the county-fuel scenario from the storage database (i.e., the fuel formulation market shares of the specified locally developed fuel formulations for the analysis) and inserted the data into the CDB fuelsupply table.
- Selected all of the local fuel formulation records for the county-fuel scenario from the storage database, where stored fuelformulationID corresponded with the CDB fuelsupply table's fuelformulationID for which the market share field value is greater than zero (i.e., only looks up the intended local fuel formulations and none of the MOVES default IDs) and inserted the data into the CDB fuelformulation table.

**Data Sources –** The EPA provided TTI with the Houston RFG retail outlet survey samples by fuel grade (regular, mid-grade, premium) collected by the RFG Survey Association.[16] TTI processed the sample data to estimate the Houston summer season average RFG fuel property inputs by year, which were used for all counties. The Houston summer 2011 survey data set was the basis of the 2011 analysis year RFG input parameter values,[17] and the Houston summer 2013 data set (latest available) was the basis of the 2014 and later analysis year RFG input parameter values. For 2017 and later analysis years, the sulfur content value of the survey-based fuel property estimates was set for consistency with the Tier 3 rule gasoline sulfur standard (sulfur standard implementation date is January 1, 2017). For average diesel sulfur content, data sources include the TCEQ summer 2011 retail fuel survey summary (for 2011 analysis year) and

[16] For more information see: http://www.epa.gov/otaq/fuels/rfgsurvey.htm.
[17] Originally estimated for the Houston 2011 AERR summer weekday inventory (TTI, August 2012).

MOVES default (for 2014 and later analysis years). See the Table 21 and footnotes for data source specifics.

**Development of Fuel Formulations Inputs from RFG Survey Samples –** On average, each summer period survey data set included 257 total samples taken during June 1 – September 15 (by grade: Regular – 236, Mid-grade – 6, and Premium – 16). The RFG sample data used were already in the units specified for MOVES. TTI used the standard method of averaging the fuel properties by grade, and combining them into overall RFG averages using relative sales volumes by grade as weights. The relative sales volumes were estimated using annual average sales volumes per day through retail outlet statistics for Texas.[18] The 2011 fuel formulations are consistent with the Houston summer weekday MOVES2010a-based inventories of the AERR analysis,[19] although the T50 and T90 fields were added for this analysis, as required for MOVES2010b.

The fuel supply value for each fuel formulation used was 1.0, as previously stated, meaning that for each county modeling scenario there was only one diesel and one gasoline (RFG) fuel formulation. Table 21 shows the RFG fuel formulations used.

[18] Sales volumes by grade were from the Energy Information Administration's (EIA) Petroleum Marketing Annuals. 2009 sales (latest available at the time of original analysis) were used to produce the 2011 average RFG formulation, and 2011 sales (current latest available) were used for 2013 average RFG.

[19] Originally estimated for the Houston 2011 AERR summer weekday inventory (TTI, August 2012).

**Table 21. MOVES Gasoline Inputs – HGB Summer Emissions Rates Analysis.**

| Fuel Formulation Field | 2011[1] | 2014[2] | 2017 and Later Years[3] |
|---|---|---|---|
| fuelSubtypeID | 12 | 12 | 12 |
| RVP | 7.06 | 7.09 | 7.09 |
| sulfurLevel | 29.42 | 29.05 | 10 |
| ETOHVolume | 9.759 | 9.757 | 9.757 |
| MTBEVolume | 0 | 0 | 0 |
| ETBEVolume | 0 | 0 | 0 |
| TAMEVolume | 0 | 0 | 0 |
| aromaticContent | 14.648 | 14.439 | 14.439 |
| olefinContent | 13.270 | 12.732 | 12.732 |
| benzeneContent | 0.532 | 0.495 | 0.495 |
| e200 | 49.323 | 49.445 | 49.445 |
| e300 | 84.612 | 84.662 | 84.662 |
| volToWtPercentOxy | 0.3488 | 0.3488 | 0.3488 |
| BioDieselEsterVolume | \N | \N | \N |
| CetaneIndex | \N | \N | \N |
| PAHContent | \N | \N | \N |
| T50 | 201.910 | 202.042 | 202.042 |
| T90 | 328.881 | 327.641 | 327.641 |

[1] 2011 – based on EPA Houston Summer 2011 retail outlet RFG survey data.
[2] 2014 – based on EPA Houston Summer 2013 retail outlet RFG survey data.
[3] 2017 and later – based on EPA Houston Summer 2013 retail outlet RFG survey data except sulfur content was set to 10 ppm for Tier 3 gasoline sulfur standard consistency.

The diesel fuel formulations basically consist of average sulfur content. (The effects of TxLED were incorporated by emissions factor post-processing, discussed later.) The 2011 average sulfur content values, consistent with the Houston summer weekday 2011 AERR inventories, were based on the TCEQ summer 2011 diesel fuel survey data for Houston. The averages were by district: 6.04 parts-per-million (ppm) for Houston District counties; and 6.36 ppm for Beaumont District counties. For 2014 and later years, the MOVES default value of 11 ppm was used for all counties.

*Local I/M Inputs to MOVES*

The current I/M program is administered to reduce vehicle emissions in five of the eight HGB counties. MOVES calculates county emissions rates that reflect the emissions-reducing benefits of the I/M program designs reflected in parameters specified in the MOVES IMcoverage table. TTI produced a set of Texas I/M county MOVES imcoverage records to replace the MOVES default imcoverage table records for Texas (MOVES defaults were populated using information from the EPA's 2005 National Emissions Inventory).

The imcoverage table data parameters are:

- polProcessID (pollutant and emissions process affected by the program);
- stateID (state subject to the I/M program);
- countyID (county number);
- yearID (year administered);
- sourceTypeID (SUT covered);
- fuelTypeID (fuel type subject to the program);
- IMProgramID (arbitrary ID number);
- begModelYearID (first model year covered);
- endModelYearID (last model year covered);
- inspectFreq (inspection frequency for the program);
- testStandardsID (I/M test type);
- useIMyn (a Y/N [yes/no] switch that specifies whether or not to use the record); and
- complianceFactor (an adjustment factor reducing the effects for compliance rate, waiver rates, or other adjustments).

TTI previously produced the set of Texas counties imcoverage table input records for all MOVES analysis years and stored them in a database for use in building the CDBs for emissions rates modeling. In addition to selecting the appropriate local user-input imcoverage records for the modeling scenario from the Texas imcoverage database, all MOVES defaults for the modeling scenario had to be excluded. To prepare the appropriate county imcoverage inputs, the following two general steps were performed for all eight counties:

- Selected and inserted all MOVES default imcoverage records for the scenario's countyID and yearID into the CDB imcoverage table, and flagged them for non-use (i.e., set useIMyn = N) in the modeling run; and
- Selected the imcoverage records from the current Texas MOVES imcoverage database for the scenario's yearID and countyID and inserted the data into the CDB imcoverage table (with useIMyn = Y).

**Data Sources –** TTI produced the I/M coverage input parameters to best represent Texas I/M program designs as specified in the Texas I/M SIP and Texas rules (using current Texas I/M modeling protocol compliance and waiver rates), and where the I/M coverage modeling parameters existed in MOVES (e.g., only for SUT and fuel type categories for which MOVES contained I/M effects). The HGB I/M program requires annual emissions testing of gasoline vehicles within a 2-through-24 year vehicle age coverage window (motorcycles, military tactical vehicles, diesel-powered vehicles, and antique vehicles are excluded). A gas cap integrity test is required on all these vehicles, and for this analysis, depending on the vehicle class and model year, the vehicle emissions testing may utilize on-board diagnostics (OBD) or the Accelerated Simulated Mode (ASM-2) test. For additional Texas I/M program details, see the current I/M SIP revision.[20]

**Approach –** Following is the general approach used to build the current Texas imcoverage tables.

- Identified the MOVES I/M test standards applicable to Texas (see Table 22, column 5).
- Queried the MOVES default imfactor table (contains adjustments to emissions rates per various I/M scenarios by SUT/fuel type, age, etc.) on the Texas I/M test frequency and fuel type (i.e., annual and gasoline) and on the imteststandards applicable to Texas – from this query, listed the SUTs, test standards, pollutant, and emissions process combinations with non-zero MOVES imfactors and corresponding base rates with non-zero standard I/M difference (i.e., I/M effects) available in MOVES (see Table 22, note 4).
- Categorized counties and years in groups under the same MOVES test standards.
- Assigned MOVES improgramIDs such that: 1) all MOVES default improgramIDs were excluded, and 2) per MOVES User's Guide, for each yearID, each IMprogramID represented a unique combination of test standard, test frequency, begin model year, and end model year.

Table 22 and the associated table notes describe the MOVES imcoverage records developed and used for the HGB analyses. Note that a review of the pertinent MOVES data (IMfactors and mean base rates for non-I/M and reference-I/M) showed that in the current MOVES model there are no I/M effects included for heavy-duty vehicle categories (i.e., vehicles with GVWR > 8,500 pounds – see Table 22, note 4). Although the Texas I/M program design includes heavy-duty vehicles, the current version of MOVES provides no means to model a potential benefit.

[20] *Revision to the State Implementation Plan Mobile Source Strategies, Inspection and Maintenance State Implementation Plan Revision.* TCEQ, Adopted February 12, 2014.

**Table 22. MOVES IMCoverage Table Input Descriptions for HGB I/M Counties.**

| YearID[1] | IMprogamID[2] | begModel YearID[3] | endModel YearID[3] | testStandardsID | Sourcetypeid[4] |
|---|---|---|---|---|---|
| **Harris County** | | | | | 21 (PC – Passenger Car)<br>31 (PT – Passenger Truck)<br>32 (LCT – Light Commercial Truck) |
| 1999 through 4/2002 | 20 | X | X | 12 (2500 RPM/Idle) | |
| | 50 | X | X | 41 (Evp Cap) | |
| **Harris, Brazoria, Fort Bend, Galveston, Montgomery Counties** | | | | | |
| 5/2003 (5/2002, for Harris) through 2019 | 30 | X | 1995 | 23 (A2525/5015 Phase) | |
| | 51 | X | 1995 | 41 (Evp Cap) | |
| | 40 | 1996 | X | 51 (Exh OBD) | |
| | 60 | 1996 | X | 45 (Evp Cap, OBD) | |
| 2020 through 2050 | 41 | X | X | 51 (Exh OBD) | |
| | 61 | X | X | 45 (Evp Cap, OBD) | |

[1] County I/M implementation dates: Harris – 1/1/1997 with transition to the new I/M test types on 5/1/2002; Brazoria, Fort Bend, Galveston, Montgomery – 5/1/2003.

[2] Common parameters for Texas MOVES imcoverage records not shown include: annual test cycle, gasoline fuel type, use IMyn = Y. Aside from any non-standard adjustments, the compliancefactor values are common across areas: PC – 93.12%; PT – 87.53%; and LCT – 81.95%. Using the MOVES inventory development *Technical Guidance* compliance factor equation (Section 3.10.6), compliance factors were calculated as the product of the percent compliance rate, percent waiver rate, and the regulatory class coverage adjustment. The current Texas I/M program modeling protocol compliance and waiver rates are 96% and 3%. The regulatory class adjustments used were taken directly from the MOVES inventory *Technical Guidance*, and for PC, PT, and LCT, respectively are 100%, 94%, and 88%.

[3] begmodelyearid and endmodelyearid, which define the range of vehicle model years covered, where represented by "x" are calculated as YearID – 24, and YearID – 2, respectively.

[4] For heavy-duty gasoline vehicles (i.e., > 8,500 pounds GVWR) MOVES does not contain any combinations of I/M factors and mean base rates that yield I/M effects; for light-duty gasoline vehicles, MOVES includes both exhaust and evaporative I/M factors and mean base rates with I/M effects, therefore, only light-duty gasoline vehicles (SUTs 21, 31, and 32) were included in the user input imcoverage records. The processes/pollutants affected by I/M are exhaust running and exhaust start THC, CO, $NO_x$, and tank vapor venting THC.

The MOVES input files (MRSs and CDBs) were provided as a part of the electronic data submittal (Appendix A) of this Technical Note.

## Checks and Runs

After completing the input data preparation, the CDBs were checked to verify that all 20 tables were in the appropriate CDBs and the tables were populated with data as intended. The MOVES RunSpecs were run in batches using the MOVES command line tool. The batches were designed to write each MOVES run log to a text file for subsequent error/warning checks, of which none were found. The MOVES run summaries are included as Appendix I.

**Post-Processing Runs**

- *Rates Per Activity*: Using the MOVESratescalc utility, TTI calculated emissions rates for each county from the MOVES output (i.e., emissions divided by activity from the movesoutput and movesactivityoutput tables). The process created two emissions rate tables (per run) that were stored in a separate “ratescalc” output database: “ttirateperdistance” containing mass/mile emissions rates, and “ttirateperactivity” containing mass/SHP, mass/SHI, and mass/start emissions rates. This was performed for each county and year. See MOVESratescalc utility description in Appendix B for more details.
- *Rates Adjustments*: From the two calculated rate tables output from each MOVESratescalc run, emissions rates were extracted for only those pollutants needed in the emissions calculations. TxLED adjustments were applied to all diesel vehicle $NO_x$ emissions rates and the extracted and adjusted rate tables for each county and year (i.e., 48) were placed in separate “ratesadj” output databases for input to the emissions calculations.

**$NO_x$ Adjustment for TxLED Effects**

The TxLED $NO_x$ adjustment factors (see Table 23) were produced according to a TCEQ procedure that produces each diesel-powered source use type’s average adjustment factor as a combination of a 4.8% reduction and a 6.2% reduction for the 2002 and newer and for the 2001 and older model year vehicles, respectively.[21]

The procedure involves MOVES runs that produce by model year output data that are processed in a spreadsheet to calculate the aggregate, average $NO_x$ adjustment factors (across all model years). The resulting average $NO_x$ adjustment factors (by diesel SUT and calendar year of evaluation) are sensitive to the age distributions used in the analysis, affecting the relative $NO_x$ emissions between the earlier and later model year groups. Note that for 2011, Texas statewide vehicle age distribution estimates were used that were based on mid-year 2011 statewide vehicle registrations data; and for the 2014 and later years, Texas statewide age distribution estimates were based on the latest available mid-year (2013) statewide vehicle registrations data. (For more details on the procedure see analysis files at TCEQ’s ftp site listed in the note to Table 23. The adjustment factors were formatted into input file form for the TTI’s MOVESratesadj emissions rate table post-processing utility.

The TxLED adjustment factors for 2011 were produced by TCEQ and the values were formatted for input to MOVESratesadj by TTI. The 2014 and later year TxLED $NO_x$ adjustment factors were produced by TTI using the TCEQ procedure and calculation spreadsheet.

[21] “Memorandum: Texas Low Emission Diesel (LED) Fuel Benefits.” To Karl Edlund, EPA, Region VI, from Robert Larson, EPA, Office of Transportation and Air Quality (OTAQ), National Vehicle and Fuel Emissions Laboratory at Ann Arbor, Michigan. September 27, 2001.

**Table 23. Analysis Year TxLED Adjustment Factor Summary.**

| Vehicle Type | TxLED-Fueled Vehicle NOx Adjustment Factor | | | | | |
|---|---|---|---|---|---|---|
| | 2011[1] | 2014[2] | 2017 | 2020 | 2023 | 2026 |
| Passenger Car | 0.9494 | 0.9508 | 0.9516 | 0.9517 | 0.9518 | 0.9519 |
| Passenger Truck | 0.9456 | 0.9471 | 0.9489 | 0.9498 | 0.9504 | 0.9509 |
| Light Commercial Truck | 0.9460 | 0.9473 | 0.9486 | 0.9494 | 0.9502 | 0.9507 |
| Intercity Bus | 0.9418 | 0.9425 | 0.9436 | 0.9446 | 0.9454 | 0.9472 |
| Transit Bus | 0.9422 | 0.9428 | 0.9438 | 0.9453 | 0.9466 | 0.9486 |
| School Bus | 0.9423 | 0.9429 | 0.9439 | 0.9451 | 0.9459 | 0.9478 |
| Refuse Truck | 0.9431 | 0.9436 | 0.9448 | 0.9468 | 0.9480 | 0.9497 |
| Single Unit Short-Haul Truck | 0.9491 | 0.9502 | 0.9510 | 0.9515 | 0.9517 | 0.9518 |
| Single Unit Long-Haul Truck | 0.9487 | 0.9499 | 0.9508 | 0.9513 | 0.9515 | 0.9517 |
| Motor Home | 0.9445 | 0.9453 | 0.9462 | 0.9473 | 0.9479 | 0.9488 |
| Combination Short-Haul Truck | 0.9445 | 0.9458 | 0.9475 | 0.9489 | 0.9500 | 0.9508 |
| Combination Long-Haul Truck | 0.9445 | 0.9459 | 0.9479 | 0.9495 | 0.9505 | 0.9512 |

[1] Source: TCEQ. See ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/Statewide/mvs/txled/ for TCEQ's spreadsheet TxLED factor development analysis for the 2011 evaluation year (in *mvs10a-statewide-txled-2011-analysis-11-14-17-18-19-21.zip*.

[2] 2014 and later evaluation year TxLED factors were developed by TTI using the TCEQ procedure.

Appendix A describes the electronic data submittal for this inventory analysis, which includes the MRS files, CDBs, TxLED adjustment factor files used, and the final, adjusted emissions rate look-up database table inputs to the emissions calculations.

## EMISSIONS CALCULATIONS

TTI calculated hourly, summer weekday, link-based emissions inventories by county using the MOVESemscalc utility. The emissions calculations fall into two categories: VMT-based emissions calculations and off-network emissions calculations. The VMT-based emissions calculations use the TDM-based VMT and speeds to estimate emissions at the TDM network link (or roadway segment) level. The off-network emissions process calculations use off-network activity (SHP, starts, and SHI) to estimate emissions at the county level.

### Hourly Link-Based Emissions Calculations

The summer weekday, hourly link-based emissions, by county, for each analysis year, were calculated with the MOVESemscalc utility using the following major inputs:

- TxDOT district-level, four-period, time-of-day vehicle type VMT mix by MOVES roadway type;
- Time period designation – VMT mix time-of-day periods to hour-of-day designations;
- TDM link and intrazonal link fleet VMT and average operational speed estimates, which contain the link-specific, hourly, directional, operational VMT and speed estimates as developed by the TRANSVMT utility to include: A-node, B-node, county number, TDM road type (functional class) code, link length, congested (operational) speed, VMT, and TDM area type code;
- County-level, hourly, off-network activity estimates (SHP, starts, and SHI) by vehicle type;
- MOVES-based off-network (parked vehicle) emissions factors by pollutant, process, hour, SUT, and fuel type;
- MOVES-based "on-network" (VMT-based) emissions factors by pollutant, process, hour, average speed, MOVES road type, SUT, and fuel type; and
- TDM road type/area type code combinations to MOVES road type designations (and VMT mix road type and road type rates designations) (see Table 24).

The VMT-based emissions were calculated for each hour using the TxDOT district-level vehicle type VMT mix with time period-to-hour designations, the TDM link and intrazonal link VMT and speeds estimates, the MOVES-based "on-network" emissions factors, and the TDM road type/area type to MOVES road types designations. For each link, the link was assigned a MOVES road type (and VMT mix and road type rates, which for this analysis were the same as MOVES road type) based on the link's road type and area type. The link VMT was then distributed to each vehicle type using the appropriate VMT mix, based on the link's designated VMT mix road type, its associated TxDOT district, and time-of-day period to hour-of-day designation.

The emissions factors for each vehicle type for each hour were selected based on the link's designated road type rates code (same as MOVES road type code) and the link speed. For link speeds falling between MOVES speed bin average speeds, emissions factors were interpolated from bounding speeds. For link speeds falling outside of the MOVES speed range (less than 2.5 mph and greater than 75 mph), the emissions factors for the associated bounding speeds were used. For each pollutant and process, the g/mi rates were multiplied by the link VMT producing the link-level emissions estimates for each vehicle type.

**Table 24. H-GAC TDM Road Type/Area Type to MOVES Road Type Designations.**

| TDM Road Type (Code - Name)[1] | TDM Area Type (Code - Name)[1] | MOVES Road Type (Code - Name)[1, 2] |
|---|---|---|
| 3 - Toll Roads | 5 – Rural | 2 – Rural Restricted Access |
| 10 - Rural Interstate | 5 – Rural | |
| 11 - Rural Other Freeway | 5 – Rural | |
| 4 - Ramps (Fwy/Toll/Frnt) | 5 – Rural | 3 – Rural Unrestricted Access |
| 8 - Local (Centroid Connector) | 5 – Rural | |
| 12 - Rural Principal Arterial | 5 – Rural | |
| 13 - Rural Other Arterial | 5 – Rural | |
| 14 - Rural Major Collector | 5 – Rural | |
| 15 - Rural Collector | 5 – Rural | |
| 1 - Urban Interstate | 1 – CBD; 2 – Urban; 3 – Urban Fringe | 4 – Urban Restricted Access |
| 2 - Urban Other Freeway | 2 – Urban; 3 – Urban Fringe | |
| 3 - Toll Roads | 1 – CBD; 2 – Urban; 3 – Urban Fringe; 4 – Suburban | |
| 10 - Rural Interstate | 2 – Urban; 3 – Urban Fringe; 4 – Suburban | |
| 11 - Rural Other Freeway | 3 - Urban Fringe; 4 – Suburban | |
| 4 - Ramps (Fwy/Toll/Frnt) | 1 – CBD; 2 – Urban; 3 – Urban Fringe; 4 – Suburban | 5 – Urban Unrestricted Access |
| 5 - Urban Principal Arterial | 1 – CBD; 2 – Urban; 3 – Urban Fringe | |
| 6 - Urban Other Arterial | 1 – CBD; 2 – Urban; 3 – Urban Fringe; 4 – Suburban | |
| 7 - Urban Collector | 1 – CBD; 2 – Urban; 3 – Urban Fringe | |
| 8 - Local (Centroid Connector) | 1 – CBD; 2 – Urban; 3 – Urban Fringe; 4 – Suburban | |
| 12 - Rural Principal Arterial | 3 – Urban Fringe; 4 – Suburban | |
| 13 - Rural Other Arterial | 3 – Urban Fringe; 4 – Suburban | |
| 14 - Rural Major Collector | 3 – Urban Fringe; 4 – Suburban | |
| 15 - Rural Collector | 3 – Urban Fringe; 4 – Suburban | |
| 40 - Local (Intrazonal) | 40 – Local (Intrazonal) | |

[1] The TDM road type and area type code combinations are also correlated to VMT mix road type codes and emissions rate road type codes, which, for this analysis, are identical to the MOVES road type codes.

[2] The four period, time-of-day VMT mix to hour-of-day designations are: AM peak – three hours of 6 a.m. to 9 a.m.; mid-day – six hours of 9 a.m. to 3 p.m.; PM peak – four hours of 3 p.m. to 7 p.m.; and overnight – 11 hours of 7 p.m. to 6 a.m.

The off-network emissions were calculated for each hour using the hourly MOVES-based off-network emissions factors by vehicle type and the county-level hourly vehicle type off-network activity estimates (SHP, starts, and SHI). The emissions factors were multiplied by the appropriate off-network activity, as determined by the pollutant process-activity association (shown previously in Table 15).

The MOVESemscalc utility outputs consist of a listing file (summarizing information regarding running the utility), and a tab-delimited emissions report summary file for each run including both hourly and 24-hour activity and emissions estimates by vehicle type and TDM road type, with emissions tables of pollutant composites and individual emissions process totals.

### Conversion of Emissions Inventories to XML Format

TTI converted the 24-hour emissions and VMT results to the format compatible for uploading to the TCEQ's TexAER – the EPA's NEI CERS XML format, which uses EPA's Emissions Inventory System (EIS) inventory data codes. The TTI used its MOVESxmlFormat utility, which converts VMT and emissions from a tab-delimited tab-totals format (a particular 24-hour inventory summary extracted from the MOVESemscalc tab-delimited output files) to an XML format. This process requires conversion of the inventory data from EPA's MOVES category codes (e.g., MOVES source use types, road types, pollutants and processes) to EPA's EIS coding system (e.g., vehicle and road type SCCs, EIS pollutant codes). The inputs required include:

- Pollutants file – list of input pollutant labels, corresponding EIS codes, units and emissions type code for each pollutant to be included in the XML output. For aggregating, multiple input pollutants are associated with the same EIS pollutant code/emissions type code combination. The emissions type codes are X, E, B, and T, for exhaust, evaporative, brakewear, and tirewear, respectively.
- County file – lists each county to be processed to create the XML output.
- MOVES SUT/SCC Vehicle Type Fractions Input file – correlates the MOVES SUT/fuel type combinations to the SCC vehicle types – for each MOVES SUT/fuel type, lists an SCC vehicle type code and a factor, of which there may be multiple per MOVES SUT/fuel type, to disaggregate to multiple SCC vehicle types.
- Roadway Inventory Functional Classification Record (RIFCREC) files – HPMS VMT summaries used to distribute the VMT and emissions for the TDM-based counties to the SCC road types.
- XML input file – specifies the data used in the header portion of the XML output file, along with the reporting period and the VMT units.
- Emissions inventory tab-delimited data file to be converted – 24-hour summary by vehicle type and road type extracted from the MOVESemscalc tab-delimited inventory output.

TTI performed one MOVESxmlFormat utility run per inventory year, thereby producing one XML formatted inventory for each analysis year. The basic operation was as follows. Based on the county file, the input county data was located, and the VMT by TDM road type was aggregated to MOVES SUT/fuel type totals. The MOVES SUT/SCC vehicle type fractions were then applied to the MOVES SUT/fuel type VMT to convert the data to the SCC vehicle types. The RIFCREC (i.e., HPMS)-based SCC road type fractions were then used to distribute the VMT to SCC road types, at which point the VMT was in the SCC road type and vehicle type form. A similar process was used to convert the emissions to SCC format for the pollutants listed in the pollutant file. The off-network emissions, however, were converted to SCC vehicle types, using the appropriate MOVES SUT/SCC vehicle type fractions, and saved as the parking area SCC road type. The county-level SCC road type/vehicle type emissions data were then aggregated by pollutant code/emissions type code using the associations listed in the pollutants file, and converted to the output units. Using the XML input file information and appropriate EIS codes and CERS XML coding, the XML file was then written per EPA's NEI EIS CERS XML specifications, for compatibility with TCEQ's TexAER.

The utility outputs include a listing file (execution information, input/output file listings, input summaries including distribution factors, input and output totals summaries with differences), a tab-delimited text file containing summary tables of the input VMT and emissions and the output VMT and emissions (both by SCC vehicle type and SCC road type), and the resulting XML file.

See Appendix A (Electronic Data Submittal) for the listing and descriptions of emissions inventory data files submitted as a part of this project report. See Appendix B for additional MOVESemscalc utility information, and an emissions calculation process flow diagram.

## QUALITY ASSURANCE

Analyses and results were subjected to appropriate internal review and QA/QC procedures, including independent verification and reasonableness checks. All work was completed consistent with applicable elements of ANSI/ASQ E4-2004: *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Technology Programs* and the TCEQ Quality Management Plan.

Quality Assurance Project Plan (QAPP) Category II (Modeling for NAAQS Compliance) is the QAPP category that most closely matches these objectives and establishes QAPP requirements for projects involving applied research or technology evaluations. Internal review and quality control measures consistent with applicable NRML QAPP requirements, along with appropriate audits or assessments of data and reporting of findings, were conducted. These include, but are not limited to, the elements outlined in the following description.

### A. Project Management

The project management was as listed previously in the Acknowledgments section.

The definition and background of the problem addressed by this project, the project/task description, and project documents and records produced are as described previously in the Purpose and Background sections. No special training or certifications were required. The TTI project manager assured that the appropriate project personnel had and used the most current, approved version of the QAPP.

After receiving the Notice to Commence (NTC) from TCEQ, the TTI project manager provided a detailed pre-analysis plan to the TCEQ project manager for review and concurrence. Upon concurrence of the pre-analysis plan, the TTI project manager distributed the pre-analysis plan to the TTI inventory developers for use in both the inventory development and QA review process. TTI maintains records of the project QA checks as a part of the project archive, for at least five years.

The objective was to produce the emissions inventory product in the quality suited to its purpose as specified (i.e., inventories needed for HGB re-designation analyses purposes), informed by, and consistent with, the appropriate guidance and methods provided in the listed references, as detailed in the pre-analysis plan, and in consultation with the TCEQ project manager.

Basic criteria were used to assure that the acceptable quality of the product was met – product developers verified that the process and product were as specified, to include:

- The product met the purpose of the emissions analysis (i.e., for use in HGB eight-county area re-designation analysis);
- The full extent of the modeling domain (i.e., analysis years, geographic coverage, seasonal periods, days, sources, pollutants) was included;
- Agreed methods, models, tools, and data were used (i.e., as listed in the detailed pre-analysis plan);
- The required output data sets were produced in the appropriate formats in accordance with the pre-analysis plan;
- Any deficiencies found during development and end-product quality checks (as discussed in QAPP Section D) were corrected; and
- Aggregate emissions estimate results assessed for comparability with available, similarly produced emissions estimates.

## B. Data Generation and Acquisition

Note that no sampling of data was involved in the emissions inventory development, thus only existing data (non-direct measurements) were used for this project.

The data needed for project implementation were in the categories needed for development of emissions rate model inputs and adjustment factors, and development of the activity inputs for external emissions calculations. These emissions factor model inputs and activity inputs were developed using data sources as outlined previously and/or methods and procedures as detailed in the references listed, and as provided in the pre-analysis plan.

All data used either as direct input or to produce inputs (e.g., to the MOVES model or to TTI's emissions inventory development utilities used, which were listed in the pre-analysis plan) were reviewed by TTI for suitability before use. The data sets for the project were provided by TxDOT, a Metropolitan Planning Organization (MPO) or Council of Governments (COG), TCEQ, and/or the EPA, and in most cases were QA'd by the providing agency. The data needed may include: HPMS data (from TxDOT's RIFCREC report); regional travel demand model data; speed model data; vehicle registration data; ATR data; vehicle classification count data; meteorological data; fuels data; MOVES emissions model data; extended idling activity data; and vehicle I/M program design data.

Any significant problems found during data review, verification, and/or validation (see QA criteria and methods discussion in section D) were to be corrected, and the QA procedure was repeated until satisfied. No significant problems were found.

**Data Management:** TTI emissions inventory data developers work as a closely coordinated team. The assigned staff used the same electronic project folder structure on their individual workstations. As various scripts, inputs, and outputs were developed in the emissions inventory development process, data were shared within the team for crosschecking via an intra-net, flash drive, or external hard drive. To perform the MOVES model runs, a computer cluster (multiple computer) configuration or individual workstation configuration was used. After input data were QA'd, depending on the size of the data set, the data sets were backed up and stored in compressed files. These activities were performed throughout the process until the final products were produced.

For MOVES model runs to produce emissions factor look-up tables for the emissions inventories, all run files (MOVES model inputs and batch files) were produced on an individual workstation. After the MOVES input data and batch files (i.e., Run Files) were QA'd, they were either executed on an individual workstation, or they were copied (via external hard drive) to the cluster's Master computer and executed. Upon execution, completion, and error checking, the MOVES output databases and run log text files were (for cluster runs first copied to an individual workstation), archived and processed further in preparation for input to the emissions calculations.

After the final product was completed, all the project data archives were compiled on a set of optical data discs (CD-ROM or DVD, depending on size), or on an external drive for very large project data sets. A complete archive of the project data is kept by TTI (the computer models and emissions inventory development utilities used in the process are included). An electronic data submittal package (containing the project deliverables as listed in Appendix A) was produced along with data description (on CD-ROM, DVDs, or external hard drive, depending on needed storage space) and delivered to TCEQ.

## C. Assessment and Oversight

The following assessments were performed.

- Verified that the overall scope was met (consistent with the intended purpose, for specified temporal resolution and geographic coverage, for specified sources, pollutants, and emissions processes).
- Checked input data preparation, and model or utility execution instructions (e.g., run specifications, scripts, JCFs, command files) were prepared according to the plan; and

- Checked that correct output data were produced (includes interim output [output that becomes input to a subsequent step in the inventory development process], as well as the final product). Records were kept of the checks performed.

In the case that any inconsistencies or deficiencies were found, the issue was directly communicated to the responsible staff for corrections (or the outside agency staff involved, if provided from outside of TTI, if needed). After a correction was made, the QA checks were performed again to ensure that the additional work resulted in the intended quality assured result, and the correction was noted in the QA record (process was performed until QA check was satisfied).

In addition, technical systems audits were performed as appropriate. Audits of data quality at the requisite 25% level were performed for any data collected or produced as part of this study. QA findings were reported in this draft report and will also be in the final reports.

### D. Data Validation and Usability

Erroneous or improper inputs at any point during the emissions inventory development process may produce resulting emissions estimates that are inaccurate and may not be suitable for their intended purpose. Adherence to the inventory process flow with performance of the integrated QA checks at each step of the process was of the utmost importance to ensure that the results met the project objectives.

Therefore, the QA checks listed were performed until satisfied to ensure that the resulting emissions inventories met the TCEQ's requirements of intended use.

TTI verified that the overall scope of the emissions analysis has been met as prescribed in the pre-analysis plan, to include:

- Purpose of the emissions analysis (i.e., needed for HGB re-designation analysis);
- Extent of the modeling domain (e.g., analysis years, geographic coverage, seasonal periods, days, sources, pollutants);
- Methods, models, and data used (e.g., default versus local input data sources); and
- Procedures and tools used and all required emissions output data sets were produced.

TTI performed checks on input data preparation, model or utility execution instructions (e.g., run specifications, scripts, JCFs, command files), and output, as appropriate to the component:

- Input data preparation checks:
    - Verified the basis of input data sets against the pre-analysis plan: Actual historical or latest available data, validated model, expected values or regulated limits, regulatory program design, model defaults, surrogates, professional judgment; aggregation levels;
    - Data development: Depending on the procedure and particular input data set, calculations were verified (e.g., re-calculated independently and compared with

originally prepared values – if spot-checking a series of results, included extremes and intermediate values);

    - Completeness: Verified that input data sets were within the required dimensions, and all required fields were populated and properly coded or labeled;
    - Format: Verified that formats were within required specifications (e.g., field positions, data types and formats, and file formats), if any;
    - Reasonability checks: (discussed in the next section); and
    - Ensured that any inputs provided from external sources were quality assured, as listed previously.
- Checked the model or utility execution instructions:
    - Verified that the correct number of utility or model run specifications were prepared for each application (e.g., by year, county, season, day type); and
    - Verified that each utility or model run script included the correct modeling specifications (e.g., commands, input values, input and output file paths, output options) for the application per applicable user guide.
- Checked for the successful completion of model and utility executions:
    - Verified that the correct number of each type of output file was produced by the particular model or utility;
    - Checked for any unusual output file sizes;
    - Searched output (e.g., utility listing files or model execution logs that contain error and warning records) for warnings/errors; and
    - Checked the summary information provided in output listing files for any unusual results.

TTI performed further checks for consistency, completeness, and reasonability of data output from model or utility applications:

- Verified that the data distributions and allocation factors produced or used sum to 1.0, as appropriate (e.g., hourly travel factors within a time period, proportion of travel by vehicle categories on a particular roadway category);
- Verified that the required data fields were present, populated, and properly coded or labeled; verified that data and file formats were within specifications;
- Verified that any activity, emissions rate, or emissions adjustments were performed as intended (e.g., seasonal activity factor, emissions control program adjustment);
- For data sets prepared with temporal or geographic variation (e.g., activity distributions between weekends/weekdays, vehicle mix by day type, or average speeds between road types or time periods), compared and noted whether directional differences were as expected;
- Checked for consistency between data sets (e.g., compared detailed spatially and temporally disaggregated activity estimates [e.g., link VMT] to original aggregate totals,

activity total summaries between utility applications [e.g., link-VMT producer and emissions calculator], and input hourly distributions versus hourly summaries from the link activity output data);

- Calculated county, 24-hour, aggregate emissions rates (from aggregate VMT and emissions output) and compared the rates between counties examining the results for outliers while assessing the reasonability of any relative and directional differences (e.g., qualify based on activity distributions by road type and speed, mix of vehicles by road type, meteorological variation, control program coverage). Compared the results to results from previous emissions analyses where available; and
- Calculated county, 24-hour aggregate rates by vehicle class and compared between vehicle classes. Examined the results for consistent patterns.

Any additional data products required for the emissions analysis were subjected to the appropriate QA checks previously listed.

## REFERENCES


2008 NEI/EIS Implementation Plan, Section 2, Transitioning from National Emission Inventory Format to the 2008 NEI, available at http://www.epa.gov/ttn/chief/net/neip/.

2008 NEI/EIS Implementation Plan, Appendix 2, CERS and Examples, available at http://www.epa.gov/ttn/chief/net/neip/.

2008 NEI/EIS Implementation Plan, Appendix 6, Reporting Code Tables, available at http://www.epa.gov/ttn/chief/net/neip/.

EPA. *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*. EPA420-R-92-009, Emission Planning and Strategies Division, Office of Mobile Sources and Technical Support Division, Office of Air Quality Planning and Standards. December 1992.

EPA. "Memorandum: Texas Low Emission Diesel (LED) Fuel Benefits." To Karl Edlund, EPA, Region VI, from Robert Larson, EPA, Office of Transportation and Air Quality (OTAQ), National Vehicle and Fuel Emissions Laboratory at Ann Arbor, Michigan. September 27, 2001.

EPA. *Guidance for Quality Assurance Project Plans for Modeling*. EPA QA/G-5M, EPA/240/R-02/007, Office of Environmental Information. December 2002.

EPA. *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations*. EPA-454/R-05-001, issued by the Emissions Inventory Group, Emissions, Monitoring and Analysis Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. August 2005.

EPA. *Draft Motor Vehicle Emission Simulator (MOVES) 2009, Software Design and Reference Manual*. EPA420-B-09-007, Assessment and Standards Division Office of Transportation and Air Quality. March 2009.

EPA. *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity*. EPA420-B-10-023, Transportation and Regional Programs Division, Office of Transportation and Air Quality. April 2010.

EPA. *Motor Vehicle Emissions Simulator (MOVES), User Guide for MOVES2010b*. EPA420-B-12-001b, Assessment and Standards Division, Office of Transportation and Air Quality. June 2012.

Texas A&M Transportation Institute. *TTI Emissions Inventory Estimation Utilities Using MOVES: MOVES2010bUTL User's Guide*. August 2013.

# APPENDIX A:
# HGB RE-DESIGNATION ON-ROAD INVENTORIES ELECTRONIC DATA SUBMITTAL

**HGB MOVES2010b County-Level Emissions Inventories for the Re-Designation Substitute Analysis – Electronic Data Submittal**

This appendix contains a description of the electronic data package that TTI submitted to TCEQ, per Proposal for Grant Activities No. 582-11-11226-FY14-14.

The MOVES rates-per-activity, TDM link-based method was used to produce VOC, CO, $NO_x$, $PM_{10}$, $PM_{2.5}$, and $CO_2$ ozone season weekday emissions inventories. The HGB emissions inventories submitted consist of six analysis years – 2011, 2014, 2017, 2020, 2023, and 2026 – or 48 county-level emissions inventories.

**Electronic Media**

The electronic data submittal files and databases, summarized in the following, were compressed and submitted on one CD-ROM, entitled: "*HGB MOVES2010b- Based On-Road Mobile Source Emissions Inventories for Re-Designation Analysis – TTI FY2014.*" This includes:

- Emissions inventory files (tab-delimited output and extracts, spreadsheet, XML files);
- Emissions Factors (MOVES input files and final TxLED-adjusted emission rates); and
- Additional data files (vehicle population summaries, VHT and VMT summaries, etc.).

**File-Naming Conventions**

In the file and database names:

- ***YYYY*** is the analysis year (i.e., 2011, 2014, 2017, 2020, 2023, 2026), and
- ***FFFF*** is the county FIPS code (48039, 48071, 48157, 48167, 48201, 48339, 48473, respectively for Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller).

Note: databases are MySQL. Each database may include one "db.opt" file and one or more database tables, where each table is composed of three files: "*.frm," "*.MYD," and "*.MYI."

**Emissions Inventory Files**

The following lists the emissions inventory files contained in the electronic data submittal.

*Emissions Inventory Output* – There were 48 MOVESemscalc utility emissions inventory runs (one per county and year). Each run produced two output file types ("*.TAB" and "*.LST") compressed in "hgb_redes_mvs10b_emscalc.zip:"

- "hgb_redes_mvs10b_***FFFF***_ems_***YYYY***swkd.TAB" are tab-delimited text files of county emissions inventory data summary reports including hourly and 24-hour activity and emissions tables. For roadway-based processes by roadway and vehicle type (SUT/Fuel Type) the reports include VMT, VHT, average speed (VMT/VHT), and pollutant/process emissions totals. For off-network-based processes by vehicle type the reports include SHP, SHI, starts, and pollutant/process emissions totals (SHI for combination long-haul trucks only); and

- "*.LST" are utility execution listing text files corresponding to the above "*.TAB" files and have the same file name prefixes as the "*.TABs," listing the run execution times, run script, file locations, data descriptions, and varied data summaries including hourly and 24-hour activity, pollutant/process emissions totals, and average speed (VMT/VHT).

*Five Inventory Extracts and a Summary Spreadsheet* – inventory summaries for five different aggregations extracted (using MOVEStabfiletotals utility) from the MOVESemscalc tab-file output. Each inventory data extract (or "tabtots") file is a tab-delimited text file that contains county-level data for all eight counties. The "tabtots" and "*.LST" files from the extract runs were provided in "hgb_redes_mvs10b_tabtots.zip". The following 36 files were provided:

- "hgb_redes_mvs10b_***YYYY***swkd_tabtots.lst" (MOVEStabfiletotals execution record); and
- "hgb_redes_mvs10b_***YYYY***swkd_***????***.tab" (five different extract files per year).

Where the "***????***" descriptor is:

  - "tabtots" (24-hr totals of activity and emissions by pollutant and process);
  - "tabtots_Hr" (hourly totals of activity and emissions by pollutant and process);
  - "tabtots_HrST" (hourly, SUT/fuel type activity and emissions by pollutant and process);
  - "tabtots_RdType" (hourly, road type activity and emissions by pollutant and process); and
  - "tabtots_ST" (24-hr SUT/fuel type activity and emissions by pollutant and process).

The 24-hr, area level summary spreadsheet provided is:

  - "hgb_redes_tabtots_Summaries_22May2014.xlsx."

*TexAER-Ready XML Files and SCC-Based Inventory Summaries* – MOVESxmlformat utility output for each year consists of: one LST text file (execution record with input/output summaries including input/output comparisons), one XML file (inventory data coded as required for uploading to TCEQ's TexAER), and eight county-level SCC-based emissions summary files (each text file includes two summaries – one from data prior to XML coding and one from XML-coded results). The following 60 output files were provided in "hgb_redes_mvs10b_xmlformat.zip:"

- "hgb_redes_mvs10b_***YYYY***swkd_MOVESxmlFormat.lst;"
- "hgb_redes_mvs10b_***YYYY***swkd_MOVESxmlFormat_xml.xml;" and
- "hgb_redes_mvs10b_***YYYY***swkd_MOVESxmlFormat_***FFFF***_summary.tab."

**Emissions Factors – MOVES Input Files and Final TxLED-adjusted Emission Rates**
The following emissions factor files are contained in the electronic data submittal.

*MOVES Input Files* – The 48 MOVES runs required 48 MRS XML files and 48 CDBs. The default database (MOVESDB20121030), also required but not included in this submittal, is available from the EPA's MOVES website. The MRSs and CDBs were provided in: "hgb_redes_mvs10b_48MRSs.zip" and "hgb_redes_mvs10b_48CDBs.zip:"

- "MVS10B_HGB_REDES_***YYYY***SWKD_***FFFF***_ER.MRS," (48 MRS files); and
- "mvs10b_hgb_redes_***YYYY***swkd_***FFFF***_er_cdb_in" (48 CDBs each, containing 20 database tables, consisting of three files per table, plus one db.opt file per CDB).

*MySQL Scripts, Databases and Files for Building CDB*s – CDBs were built using MySQL scripts, data files and databases, included in "hgb_redes_mvs10b_CDBscripts_data.zip" (150 files):

- "CREATE_MVS10B_HGB_REDES_***YYYY***SWKD_***FFFF***_ER_CDB_IN.SQL" (48 text files containing MySQL scripts for building the CDBs);
- "MOVESDB20121030" (MOVES default database, not provided in this submittal);
- "mvs_2011_jun_jul_aug_area_county_MET" (database with meteorological inputs – county and zonemonthhour tables – and a readme file – 7 files); and individual "county" and "zonemonthhour" text file versions of the data ("*county.tab" and "*zonemonthhour.tab" and associated script – 17 files);
- "hgb_s***XXXX***_fuels" (three fuels inputs databases with fuelsupply and fuelformulation tables, where ***XXXX*** is 2011, 2013, and 2017 – 2011 data are for 2011, 2013 data are for 2014, and 2017 data are for 2017 and later years – survey data spreadsheets used to develop fuels inputs, data text files and scripts used to produce the databases, and "readme" file also included – 37 files total);
- "_tx1990_19992050_mvs10a_imcoverage_213132" (imcoverage database table used – 3 files);
- "mvs10b_Mdb20121030_HGB***FFFF_XXXX***j_SUTage.tab" and "*.LST" (tab-delimited, county sourcetypeagedistribution text files, where ***XXXX*** is 2011 and 2013, which are registration data years, and the associated "*.LST" text files are from each MOVESfleetbuilder utility run – 32 files); and
- "mvs10b_Mdb20121030_TX_***XXXX***j_SUTage.tab," "mvs10b_Mdb20121030_TX_***XXXX***j_SUTfef.tab," and "*.LST" (tab-delimited, statewide "sourcetypeagedistribution" files [SUTage] and "avft" files [fef] where ***XXXX*** is 2011 and 2013, which are registration data years, and the associated "*.LST" files are from each MOVESfleetbuilder utility run – 6 text files).

*Final MOVES-Based, TxLED-Adjusted Emissions Factor Look-Up Tables* – The MOVESratesAdj utility performed adjustments as specified (e.g., $NO_x$ TxLED effects), and produced the final emissions rates inputs to the emissions calculations – MySQL databases containing two emissions rate look-up tables, ttirateperdistance for roadway-based emissions processes, and ttirateperactivity for the "off-network" processes. The ttirateperactivity table fields are: pollutantID, processID, hourID, sourceTypeID, fuelTypeID, and rateperactivity. The ttirateperdistance table fields are: pollutantID, avgSpeedBinID, processID, hourID, roadTypeID, sourceTypeID, fuelTypeID, and ratePerDistance.

- "mvs10b_hgb_redes_***YYYY***swkd_***FFFF***_er_outratesadj," (48 MySQL database folders containing two tables each, consisting of three files per table, plus one db.opt file per database). Each database contains the ttirateperdistance and ttirateperactivity emissions rate look-up tables used in the emissions calculations. They are compressed in "hgb_redes_mvs10b_48RatesAdjDBs.zip."

*TxLED Factors* – The TxLED factor files used were provided along with a "readme" file and the development spreadsheets and other files. These files (21) were provided in "hgb_redes_mvs10b_txledFactors.zip." The TxLED factor input files used with MOVESRatesAdj are:

- "****YYYY***_NOx_txled*.*" (TxLED factor input text files by six analysis years).

Note that the MOVES output databases were post-processed in two main steps to calculate the final emissions rates used in the external emissions calculations:

1. Rate Calculations: Using the TTI's MOVESratesCalc utility, TTI calculated "rates-per-activity" as "emissions/activity" from the movesoutput (emissions) and movesactivityoutput (activity) tables, performed unit conversions, and produced two new tables in a "ratescalc" output database: "ttirateperdistance" with grams/mile rates, and "ttirateperactivity" with grams/SHP, grams/SHI, and grams/start rates.
2. Final Rates Adjustments: Using TTI's MOVESratesAdj utility, TTI-calculated rates were extracted for only those pollutants needed in the emissions calculations. TxLED adjustments were applied to diesel vehicle $NO_x$ rates for all analysis years, and the extracted and adjusted rate tables were placed in a separate database (by county and year) for input to the emissions calculations.

**Additional Data Files**

TTI post-processed external inventory activity and other data (e.g., vehicle registrations) to produce data summaries and some data (vehicle population and VMT factors) in MOVES-specified formats. (These data were not used in MOVES runs, but include or are based on data that were used externally in activity factor and emissions calculations).

The *MOVESpopulationbuild* utility runs produced the vehicle population estimates used externally in the emission estimation process. The following county-level text files were produced (contained in the zip file "hgb_redes_mvs10b VehPop.zip," with 192 files):

- "****FFFF***_VEHPOP_***YYYY***_sourcetypeyear.tab" (MOVES sourcetypeyear files);
- "****FFFF***_VEHPOP_ ***YYYY***_regdata.tab" (registrations by type and model year);

- “***FFFF**_*VEHPOP_ ***YYYY***_StFtPop.tab” (SUT/Fuel type population summaries); and
- “***FFFF**_*VEHPOP_ ***YYYY***.lst” (utility run list files).

The *MOVESactivityinputbuild* utility runs produced the MOVES table data tab-delimited text files listed (contained in the zip file “hgb_redes_mvs10b ActInput.zip,” with 432 files):

- Year: “***FFFF_YYYY***swkd_MOVESactinput_year.tab;”
- Roadtype: “***FFFF_YYYY***swkd_MOVESactinput_roadtypetable.tab;”
- Hpmsvtypeyear: “***FFFF_YYYY***swkd_MOVESactinput_hpmsvtypeyear.tab;”
- Roadtypedistribution: “***FFFF_YYYY***swkd_MOVESactinput_rtdist.tab;”
- Hourvmtfraction: “***FFFF_YYYY***swkd_MOVESactinput_hrvmtfract.tab;” and
- Avgspeeddistgribution: “***FFFF_YYYY***swkd_MOVESactinput_avgspddist.tab.”

Additional data summary output text files from the *MOVESactivityinputbuild* runs include:

- “***FFFF_YYYY***swkd_MOVESactinput.lst” (run list with various data summaries);
- “***FFFF_YYYY***swkd_MOVESactinput_linkVHTsumm.tab” (VHT by hour, road type, area type, and avgspeedbinID); and
- “***FFFF_YYYY***swkd_MOVESactinput_linkVMTsumm.tab” (VMT by hour, road type, area type).

# APPENDIX B:
# EMISSIONS ESTIMATION UTILITIES FOR MOVES-BASED EMISSIONS INVENTORIES

## TTI EMISSIONS ESTIMATION UTILITIES FOR MOVES BASED EMISSIONS INVENTORIES

The following is a summary of utilities developed by TTI (written in the Visual Basic programming language) for producing detailed, link-based, hourly, and 24-hour emissions estimates for on-road mobile sources using the latest version of EPA's MOVES model. These utilities produce inputs used with the MOVES model, make special adjustments to the emissions factors (when required), and multiply them with travel model link-based or Highway Performance Monitoring System (HPMS)-based (virtual link) activity estimates to produce emissions at user-specified temporal and spatial scales.

The main utilities for calculating hourly and 24-hour emissions using MOVES are TRANSVMT, VirtualLinkVMT, MOVESactivityInputBuild, MOVESpopulationBuild, MOVESfleetInputBuild, MOVESratesCalc, MOVESratesAdj, ShpExtIdleStartActBld, ExtIdleHrsCalc, MOVESemscalc, and MOVEStabcomb. The TRANSVMT and VirtualLinkVMT prepare the link VMT and speeds activity input. The MOVESactivityInputBuild, MOVESpopulationBuild, and MOVESfleetInputBuild utilities build inputs used in MOVES. The MOVESratesCalc utility calculates the emissions rates from the MOVES output in terms of grams per activity, rather than the grams per vehicle emissions rates produced by MOVES. The MOVESratesadj utility makes special adjustments to the emissions rates when required. The ShpExtIdleStartActBld utility builds the SHP and starts activity required to estimate emissions using the grams per activity emissions rates produced by the MOVESratesCalc utility. The ExtIdleHrsCalc utility builds the SHI activity required to estimate emissions using the grams per activity emissions rates produced by the MOVESratesCalc utility. The MOVESemscalc utility calculates emissions by hourly time periods, producing a tab-delimited summary file (including 24-hour totals) and hourly link emissions output files (optional). The MOVEStabcomb utility combines multiple MOVESemscalc tab-delimited output files into one regional tab-delimited output file.

A process flow diagram follows the utility descriptions.

### TRANSVMT

The TRANSVMT utility post-processes travel demand models (TDMs) to produce hourly, on-road vehicle, seasonal and day-of-week specific, directional link VMT, and speed estimates. The TRANSVMT utility processes a TDM traffic assignment by multiplying the link volumes by the appropriate HPMS, seasonal, or other VMT factors. Hourly factors are then used to distribute the link VMT to each hour in the day. The TTI speed model is used to estimate the operational time-of-day link speeds for each direction. Since intrazonal links are not included in the TDM, special intrazonal links are created and the VMT and speeds for these special links are estimated using the intrazonal trips from the trip matrix and the zonal radii. The link VMT and speeds produced by TRANSVMT are subsequently input to the MOVESemscalc utility for applying the MOVES-based emissions factors (as well as with other utilities to develop off-network activity estimates).

**VirtualLinkVMT**

The VirtualLinkVMT utility post-processes county HPMS average annual daily traffic (AADT) VMT, centerline miles, and lane miles by functional classification and area type (from the Texas Department of Transportation's [TxDOT's] annual Roadway Inventory Functional Classification Record [RIFCREC]) to produce hourly, on-road vehicle fleet, seasonal and day-of-week specific actual or projected VMT, and directional operational speed estimates. These estimated VMT and speeds are produced for up to 42 directional HPMS functional classification/area type combinations, or "links." The VirtualLinkVMT utility was developed for use in areas that do not have TDM networks, as well as for inventory applications for which network link-based detail is not required. The main inputs to VirtualLinkVMT are:

- County HPMS data sets, which include AADT VMT, centerline miles, and lane miles by HPMS area type and functional class;
- County-level VMT control totals;
- Hourly VMT distributions; and
- Speed model inputs to include volume/delay equation parameters adapted for HPMS, and free-flow speeds and lane capacities by HPMS functional classification and area type.

VirtualLinkVMT initially scales the county HPMS AADT VMT at the link level to the appropriate VMT (e.g., uses county-level VMT control total-to-AADT ratio to produce seasonal, day-of-week specific VMT). Hourly factors and directional split factors are applied to the adjusted VMT on each link to estimate the hourly, directional VMT (and volumes) by HPMS link. Congested speed models, each for the high- and low-capacity links, are used to estimate the hourly operational speeds by direction for each link. The operational speeds are based on volume/capacity (v/c)-derived directional delay (minutes/mile) applied to the estimated free-flow speeds for each link. The virtual link VMT and speeds produced using the VirtualLinkVMT utility are an input to the emissions calculation utility, MOVESemscalc (as well as with other utilities to develop off-network activity estimates).

**MOVESactivityInputBuild**

The MOVESactivityInputBuild utility builds the roadtypedistribution, hourvmtfraction, avgspeeddistribution, roadtype, hpmsvtypeyear, year, state, zone, zoneroadtype, monthvmtfraction, and dayvmtfraction data files in a format consistent with the MOVES input database tables using the link-based hourly VMT and speeds developed with the TRANSVMT or VirtualLinkVMT utility, the VMT mix, and the MOVES defaults. The primary inputs to this utility are:

- Link-based hourly VMT and speeds developed with the TRANSVMT or VirtualLinkVMT utility;
- County ID file which specifies the county number in the link-based hourly VMT and speeds for which the output will be calculated;
- VMT roadway type designations, which lists associations of the link roadway types/area type combination to the VMT mix, emissions rate, and MOVES roadway types (same as used with the MOVESemscalc utility);

- 24-hour or time period VMT mix by roadway type, MOVES source type, and MOVES fuel type (same as used with the MOVESemscalc utility);
- Day ID, which specifies the MOVES day ID for calculating the output;
- Year ID, which specifies the year for calculating the output;
- Link/Ramp designations, which designates each link roadway type/area type combination to either ramp or non-ramp; and
- MOVES default database.

For each link in the link-based hourly VMT and speeds in which the county number matches the desired county ID, the link VMT is saved in a VMT summary array based on hour, link functional class, and link area type. The link VHT (link VMT/link speed) is saved in a VHT summary array based on hour, link functional class, link area type, and MOVES average speed bin ID (determined using the MOVES average speed bins and the link speed). The link VHT is also saved in a road type VHT array based on link functional class and link area type, and, if the link is specified as ramp by the link/ramp designations specified by the user, the VHT is additionally saved in the ramp segment of the road type VHT array.

A MOVES roadway type (which can include the additional roadway type 6 to include ramps) array by MOVES roadway type is also formed using the data in the VMT summary array and VMT roadway type designations. An hourly VMT array (by MOVES SUT, MOVES roadway type, and hour) is formed using the data in the VMT summary array, the VMT roadway type designations, and the VMT mix. If the time period VMT mix is used, each hour is assigned a time period by the user. Otherwise, the same 24-hour VMT mix is used for all hours. An average speed distribution array (by MOVES SUT, MOVES roadway type, hour, and MOVES speed bin) is created using the VHT summary array and the VMT mix. Using the appropriate MySQL code, the MOVES roadtypedistribution, hourvmtfraction, and avgspeeddistribution default values are extracted and saved for later use.

The VMT in the hour VMT array is aggregated by hour to produce the roadway type distribution array by MOVES SUT and MOVES roadway type. This VMT is then converted to a distribution by MOVES SUT (i.e., the total for a SUT over the five MOVES roadway types should equal 1), with the distribution value for MOVES roadway type 0 (Off-Network) equal to 0. Using the appropriate MySQL code, the roadtypedistribution database table is written. A tab-delimited version is also written (optional).

The VMT in the hourly VMT array is added to the hourly VMT fraction array (by SUT, MOVES roadway type, and hour) and for those roadway types where the VMT for all hours is greater than 0, this VMT is converted to an hourly distribution. For those roadway types where the VMT is equal to 0, a value of 1 is placed in the first hour, followed by 0 in the remaining hours. Using the appropriate MySQL code, the hourvmtfraction database table is written. For those SUTs where the VMT mix is greater than 0, the hourly VMT fraction array is used. Otherwise, the MOVES hourvmtfraction default values are used. A tab-delimited version is also written (optional).

The VHT in the average speed distribution array is converted to a distribution by SUT, MOVES roadway type, hour/day (combination of hour and the day ID specified by the user), and MOVES average speed bin. Using the appropriate MySQL code, the avgspeeddistribution database table is written. For those SUTs where the VMT mix is greater than 0, the average speed distribution array is used. Otherwise, the MOVES avgspeeddistribution default values are used. A tab-delimited version is also written (optional).

The VHT in the road type VHT array is converted to a proportion of ramp VHT by dividing the ramp segment of the road type VHT array by the total VHT for the road type in the road type VHT. Using the appropriate MySQL code, the road type database table is written using the proportions from the road type VHT array. A tab-delimited version is also written (optional).

The VMT in the hourly VMT array is aggregated to form the HPMS vehicle type VMT array. Each SUT is assigned an HPMS vehicle type (SUT 11 is HPMS vehicle type 10; SUT 21 is HPMS vehicle type 20; SUTs 31 and 32 are HPMS vehicle type 30; SUTs 41, 42, and 43 are HPMS vehicle type 40; SUTs 51, 52, 53, and 54 are HPMS vehicle type 50; and SUTs 61 and 62 are HPMS vehicle type 60). Using the appropriate MySQL code, the hpmsvtypeyear database table is written using the VMT from the HPMS vehicle type VMT array, along with the user supplied year ID, the VMT growth factor (automatically set to "Null"), and the base year Off-Network VMT (automatically set to 0). A tab-delimited version is also written (optional).

Using the appropriate MySQL code, the fuel year ID is extracted from the MOVES default year database table for the user-supplied year ID and the new year database table is written using the user-supplied year ID and the extracted fuel year ID. The "isbaseYear" data is written as well (automatically set to "Y"). A tab-delimited version is also written (optional).

The utility also produces two tab-delimited summary output files. A tab-delimited VMT summary is output by hour, link road type, and link area type for the user-specified county. A tab-delimited VHT summary is output by hour, link road type, link area type, and MOVES average speed bin for the user-specified county.

The utility outputs five other database tables (state, zone, zoneroadtype, monthvmtfraction, and dayvmtfraction) using the appropriate MySQL code and the user-supplied inputs. For the state database table, a new state database table is created and the data from the MOVES default state database table is copied to the new table for the state ID of 48. For the zone database table, a new zone database table is created and the data from the MOVES default zone data base table is copied to the new table for the county ID greater than 48000 and county ID less than 49000. The start allocation factors, idle allocation factors, and SHP allocation factors are all then replaced with values of 1 in the new table.

For the zoneroadtype database table, a new zoneroadtype database table is created and the data from the MOVES default zoneroadtype data base table is copied to the new table for the zone ID greater than 480000 and zone ID less than 490000. The SHO allocation factors are all then replaced with values of 1 in the new table. For the monthvmtfraction database table, a new monthvmtfraction database table is created and the data from the MOVES default monthvmtfraction database table is copied to the new database table and the month VMT fraction is set to 1 for the user-supplied month ID and 0 for all other months. For the dayvmtfraction database table, a new dayvmtfraction database table is created and the data from the MOVES default dayvmtfraction database table is copied to the new and the day VMT fraction is set to 1 for the user-supplied day ID and 0 for all other months.

### MOVESpopulationBuild

The MOVESpopulationBuild utility builds the sourcetypeyear data files in a format consistent with the MOVES input database table and the SUT/fuel type population input file (can be used with the MOVESemscalc utility to estimate emissions or the ShpExtIdleStartActBld utility to estimate starts and SHP) using the VMT mix and the Texas Department of Motor Vehicles (TxDMV) registration data sets. The TxDMV registration data sets are three sets of registration data (an age registration data file, a gas trucks registration data file, and a diesel trucks registration data file) that list 31 years of registration data. The primary inputs to this utility are:

- County ID file, which specifies the county for which the output will be calculated;
- Age registration data file, which lists 31 years of registration data for the Passenger Vehicle, Motorcycles, Trucks <=6000, Trucks >6000 <=8500, Total Trucks <=8500, Gas Trucks >8500, Diesel Trucks >8500, Total Trucks >8500, and Total All Trucks vehicle categories;
- Gas trucks registration data file, which lists 31 years of registration data for the Gas >8500, Gas >10000, Gas >14000, Gas >16000, Gas >19500, Gas >26000, Gas >33000, Gas >60000, and Gas Totals gas truck categories;
- Diesel trucks registration data file, which lists 31 years of registration data for the Diesel >8500, Diesel >10000, Diesel >14000, Diesel >16000, Diesel >19500, Diesel >26000, Diesel >33000, Diesel >60000, and Diesel Totals diesel truck categories;
- VMT mix by TxDOT district, MOVES SUT, and MOVES fuel type;
- TxDOT district name file, which specifies the VMT mix TxDOT district;
- MOVES default database;
- Population factor file (optional); and
- Year ID file (optional, only used if population factors are used), which specifies the year for calculating the output.

For the desired county (from the county ID file), the age registration data (for the Passenger Vehicle, Motorcycles, Trucks <=6000, Trucks >6000 <=8500, and Total Trucks <=8500 vehicle categories) are saved in an age registration data array. The gas truck registration data (for the Gas >8500, Gas >10000, Gas >14000, Gas >16000, Gas >19500, Gas >26000, Gas >33000, and Gas >60000 gas truck categories) are saved in the gas truck section of the diesel/gas registration data array. The diesel truck registration data (for the Diesel >8500, Diesel >10000, Diesel >14000, Diesel >16000, Diesel >19500, Diesel >26000, Diesel >33000, and Diesel >60000 diesel truck categories) are saved in the diesel truck section of the diesel/gas registration data array. The age registration data array and the diesel/gas registration data array are combined to form the registration category data array (seven categories for 31 years of data and the total) using the combinations in Table 25.

**Table 25. Registration Categories.**

| Registration Category | Vehicle Category | Data Location |
|---|---|---|
| 1 | Passenger Vehicle | Age registration data array |
| 2 | Motorcycles | |
| 3 | Total Trucks <=8500 | |
| 4 | Diesel >8500, Diesel >10000, Diesel >14000, Diesel >16000 | Diesel/gas registration data array |
| 5 | Diesel >19500, Diesel >26000, Diesel >33000, Diesel >60000 | |
| 6 | Gas >8500, Gas >10000, Gas >14000, Gas >16000 | |
| 7 | Gas >19500, Gas >26000, Gas >33000, Gas >60000 | |

The registration category data array is used to fill the SUT population array (by SUT and fuel type) for all vehicles except long-haul trucks. Each SUT/fuel type combination is assigned the total registrations from one or more of the registration categories in the registration category data array. Table 26 shows the SUTs and their associated registration category in the registration category data array.

**Table 26. SUT/Registration Category Correlation.**

| SUT | Registration Category |
|---|---|
| 11 | 2 |
| 21 | 1 |
| 31, 32 | 3 |
| 41, 42, 43, 51, 52, 54 | 4 + 6 |
| 61 | 5 + 7 |

SUT population factors are calculated by SUT/fuel type using the data from the VMT mix input for all SUTs except motorcycles (SUT 11) and the long-haul trucks (SUTs 53 and 62) and saved in the SUT population factors array. For SUT 21, the fuel type VMT mix is divided by the total VMT mix for SUT 21. For SUT 31, the fuel type VMT mix is divided by the total VMT mix for SUTs 31 and 32. The same process applies to SUT 32. For SUT 41, the fuel type VMT mix is divided by the total VMT mix for SUTs 41, 42, 43, 51, 52, and 54. The same process applies to SUTs 42, 43, 51, 52, and 54. For SUT 61, the fuel type VMT mix is divided by the total VMT mix for SUT 61.

For SUT 11, the SUT population factor for fuel type 1 (gasoline) is set 1 with all other factors set to 0. For SUT 53, the SUT population factors by fuel type are calculated by dividing the fuel type VMT mix for SUT 53 by the fuel type VMT mix for SUT 52. For SUT 62, the

SUT population factors by fuel type are calculated by dividing the fuel type VMT mix for SUT 62 by the fuel type VMT mix for SUT 61, therefore creating a ratio of long-haul and short-haul trucks.

The SUT population factors and the population factor (if desired) are applied to the SUT population array for all SUTs except SUT 53 and 62. For SUT 53, the SUT population factors for SUT 53 are applied to the SUT population array for SUT 52. For SUT 62, the SUT population factors for SUT 62 are applied to the SUT population array for SUT 61.

Using the appropriate MySQL code, a new sourcetypeyear database table is created. The data in the SUT population array is aggregated by fuel type and used to fill the sourcetypeyear database table, along with the yearID, salesGrowthFactor, and migrationrate. For the yearID, the year of the registration data is used, unless a population factor is used, in which case the year from the year ID input is used. The salesGrowthFactor and migrationrate for each SUT is set 1. A text format of this database table is written by the utility as well. The SUT/fuel type population input file is written using the SUT population array.

**MOVESratesCalc**

The MOVESratesCalc utility estimates emissions rates in terms of grams per activity (i.e., grams per mile, grams per SHP, grams per start, and grams per SHI) using the data in the movesoutput (emissions output) and movesactivityoutput (activity output) database tables produced by a MOVES emissions rate run. The utility also has the option of calculating the SHP, starts, and SHI activity per vehicle using the movesactivityoutput database table. If not specified, emissions rates are calculated for each pollutant and process combination (excluding total energy) in the movesoutput database table. The utility also uses the movesrun database table to determine the units of the emissions in the movesoutput table, which will then be converted to grams per activity during the emissions rate calculations; therefore allowing the user to specify any of the units available in MOVES for the MOVES emissions rate run. The type of activity used for the emissions rate calculation is determined by the process, as Table 27 shows.

**Table 27. MOVES2010b Emissions Process and Corresponding Activity for Grams per Activity Emissions Rates.**

| MOVES2010b Emissions Process | Activity | Emissions Rate Units |
|---|---|---|
| Running Exhaust | Miles Traveled | Grams/Mile |
| Crankcase Running Exhaust | Miles Traveled | Grams/Mile |
| Start Exhaust | Starts | Grams/Start |
| Crankcase Start Exhaust | Starts | Grams/Start |
| Extended Idle Exhaust | Extended Idle Hours | Grams/Extended Idle Hour |
| Crankcase Extended Idle Exhaust | Extended Idle Hours | Grams/Extended Idle Hour |
| Evaporative Permeation | Miles Traveled<br>Source Hours Parked | Grams/Mile<br>Grams/ Source Hour Parked |
| Evaporative Fuel Vapor Venting | Miles Traveled<br>Source Hours Parked | Grams/Mile<br>Grams/ Source Hour Parked |
| Evaporative Fuel Leaks | Miles Traveled<br>Source Hours Parked | Grams/Mile<br>Grams/ Source Hour Parked |
| Brake Wear | Miles Traveled | Grams/Mile |
| Tire Wear | Miles Traveled | Grams/Mile |

For the distance-based emissions rates (i.e., grams per mile), the utility extracts the emissions data (by pollutant, emissions process, roadway type, average speed bin, SUT, and fuel type) from the movesoutput database for the specified pollutants (or all of the pollutants if not specified) and the corresponding miles traveled activity (MOVES activityTypeID = 1) from the movesactivityoutput database table. The utility divides the emissions data by the corresponding activity data, applies the appropriate units conversion factor, and saves the emissions rates in the ttirateperdistance database table.

For the off-network emissions rates (i.e., grams per SHP, grams per start, and grams per SHI) the utility calculates the emissions rates based on the emissions process. For processID = 12 (evaporative fuel vapor venting), the utility extracts the emissions data (by hour, pollutant, emissions process, SUT, and fuel type) from the movesoutput database table for the specified pollutants (or all of the pollutants if not specified) where roadTypeID = 1 (“off-network” emissions) and the corresponding SHP activity (activityTypeID = 5) from the movesactivityoutput database table. The utility divides the emissions data by the corresponding activity data, applies the appropriate units conversion factor, and saves the emissions rates in the ttirateperactivity database table.

Using the same calculation process, the utility also calculates the emissions rates for processID = 17 (crankcase extended idle exhaust) and processID = 90 (extended idle exhaust) using the corresponding SHI activity (activityTypeID = 3), for processID = 11 (evaporative permeation) and processID = 13 (evaporative fuel leaks) using the corresponding SHP activity (activityTypeID = 5), and for processID = 2 (start exhaust) and processID = 16 (crankcase start exhaust) using the corresponding starts activity (activityTypeID = 7).

For the SHP, starts, and SHI activity per vehicle, the utility extracts the SHP, starts, SHI, and population activity data (by hour, SUT, and fuel type) from the movesactivityoutput database table. The utility divides the SHP activity by the population and saves the SHP per vehicle in the ttiactpervehicle database table. Using the same calculation process, the utility also calculates the starts per vehicle and SHI per vehicle using the starts and SHI activity data.

**MOVESratesAdj**

The MOVESratesAdj utility applies emissions rate adjustments to an emissions rate database table produced by MOVES (rateperdistance, ratepervehicle, rateperprofile), the MOVESratesCalc utility (ttirateperdistance, ttirateperactivity) or by this utility to produce a new emissions rate database table in the same format as the input emissions rate database table. The emissions rate adjustments can be linear adjustments that are applied to all emissions rates or can be applied by SUT, fuel type, pollutant, and process (adjustments may also include roadway type, average speed bin, and hour). The user has the option of selecting which pollutants will be in the new emissions rate database table. Otherwise, all of the pollutants in the input emissions rate database table will be in the new emissions rate database table. The utility also has the option for combining multiple emissions rate database tables into one new emissions rate database table, if the input emissions rate database tables are in the same format.

For the first input emissions rate database table, the utility extracts the emissions rates for the specified pollutants (or all the pollutants if not specified) from the input database emissions rate table, applies the emissions rate adjustments (if necessary) and saves these adjusted emissions rates. If more than one emissions rate database table is input, then the utility performs a similar calculation process to the first input emissions rate database table for each input emissions rate database table. If pollutants are found in more than one input emissions rate database table, the adjusted emissions rates are summed to produce one emissions rate.

After processing all of the input emissions rate database tables, the utility creates a new emissions rate database table in the same format as the first input emissions rate database table and writes the adjusted emissions rates to this new emissions rate database table. A tab-delimited form of this database table may also be output that includes the text description of the pollutant, process, and roadway type instead of the MOVES codes that are included in the database tables.

**ShpExtIdleStartActBld**

The ShpExtIdleStartActBld utility calculates the SHP and starts activity by hour, SUT, and fuel type used to estimate emissions using the MOVESratesCalc emissions rates. The SHP is calculated using either the TDM or the virtual link based link VMT and speeds (same as used in the distance-based emissions estimation), the 24-hour or time period VMT mix (by roadway type and SUT/fuel type), and the SUT/fuel type population (from the MOVESpopulationBuild). The starts activity is calculated using the SUT/fuel type population and the starts per vehicle (typically from the ttiactpervehicle database table created by the MOVESratesCalc utility). The utility also has the option of calculating the SHI activity used to estimate emissions using the MOVESratesCalc emissions rates. However, this method of estimating the SHI is a direct function of the SHO and does not consider the availability of locations where extended idling may occur.  The suggested method for estimating the SHI is discussed in the "ExtIdleHrsCalc" section.

For each link in the first hourly VMT and speeds input that has the desired county code, the utility applies the appropriate VMT mix (either the 24-hour VMT mix or the appropriate time period VMT mix as assigned by the user) to distribute the link VMT to each SUT/fuel type, which is added to the hourly SUT/fuel type VMT.  The link VMT by SUT/fuel type is divided by the link speed to calculate the link VHT (or SHO) by SUT/fuel type, which is added to the SUT fuel/type VHT.  This calculation process is repeated for each VMT and speeds input; therefore producing 24-hourly values for VMT by SUT/fuel type and for VHT by SUT/fuel type.

The hourly SUT/fuel type speed, total hours (or source hours), and SHP are then calculated. For each hour and SUT/fuel type, the hourly SUT/fuel type VMT is divided by the hourly SUT/fuel type VHT to calculate the hourly SUT/fuel type speed.  The hourly SUT/fuel type total hours are set equal to the SUT/fuel type population.  The hourly SUT/fuel type SHP are calculated by subtracting the hourly SUT/fuel type VHT (or SHO) from the hourly SUT/fuel type total hours.

The hourly SUT/fuel type starts are calculated using the hourly starts per vehicle and the SUT/fuel type population.  For each hour, the hourly SUT/fuel type starts are calculated by multiplying the hourly starts per vehicle by the SUT/fuel type population.

The hourly SUT/fuel type SHIs are calculated for SUT 62, fuel type 2 (CLhT_Diesel) only. The CLhT_Diesel 24-hour SHI is calculated by multiplying the CLhT_Diesel 24-hour VHT (from the SHP calculation process) by the user-supplied extended idle factor, which represents the amount of extended idle time that must occur per SHO.  The hourly CLhT_Diesel VHT (from the SHP calculation process) is converted to hourly VHT fractions.  The hourly SHI fractions are calculated as the inverse of the hourly VHT fractions.  The hourly SHI fractions are then applied to the CLhT_Diesel 24-hour SHI to calculate the hourly SUT/fuel type SHI.

**ExtIdleHrsCalc**

The ExtIdleHrsCalc utility calculates the SHI activity by hour for SUT 62, fuel type 2 (CLhT_Diesel) used to estimate emissions using the MOVESratesCalc emissions rates.  This hourly SHI is calculated using a 24-hour base SHI for a specific year and day type, base link VMT and speeds, base 24-hour or time period VMT mix, future link VMT and speeds, future 24-hour or time period VMT mix, and the future tab-delimited hourly SHP by SUT/fuel type.  All of the base data should be from the same year and day type.  Although the term future data is used, the future data can be a year before the base data (i.e., historical year) and should be from the same year and day type.  The tab-delimited hourly SHP by SUT/fuel type is typically the output from the ShpExtIdleStartActBld utility.

For each link in the first base VMT and speeds input that has the desired county code, the utility applies the appropriate base VMT mix (either the 24-hour VMT mix or the appropriate time period VMT mix as assigned by the user) for CLhT_Diesel to the link VMT to calculate the link CLhT_Diesel VMT, which is added to the hourly CLhT_Diesel VMT.  The link CLhT_Diesel VMT is divided by the link speed to calculate the link CLhT_Diesel VHT, which is added to the hourly CLhT_Diesel VHT.  This calculation process is repeated for each base VMT and speeds input; therefore producing 24-hourly values for base CLhT_Diesel VMT and for base CLhT_Diesel VHT by SUT/fuel type.  The same calculation process is performed for the future data (future VMT and speeds, future VMT mix) to calculate the hourly future CLhT_Diesel VMT and the hourly future CLhT_Diesel VHT.

The 24-hour future SHI is calculated using the 24-hour base CLhT_Diesel VMT, the 24-hour future CLhT_Diesel VMT, and the 24-hour base SHI.  The scaling factor is calculated by the dividing the 24-hour future CLhT_Diesel VMT by the 24-hour base CLhT_Diesel VMT.  The scaling factor is multiplied by the 24-hour base SHI to estimate the 24-hour future SHI.

The 24-hour future SHI is distributed to each hour using SHI hourly factors.  The SHI hourly factors are calculated using the hourly CLhT_Diesel VMT.  The hourly CLhT_Diesel VMT is converted hourly CLhT_Diesel VMT fractions.  The SHI hourly factors are calculated by taking the inverse of the hourly CLhT_Diesel VMT fractions (i.e., more VMT implies less SHI).  The SHI hourly factors are applied to the 24-hour future SHI to calculate the initial hourly future SHI, therefore distributing the 24-hour future SHI to each hour of the day.

To form the final SHI activity by hour, the initial hourly future SHI is compared to the hourly CLhT_Diesel SHP.  If the initial hourly future SHI is greater than the hourly CLhT_Diesel SHP, then the final SHI activity for that hour is set to the hourly CLhT_Diesel SHP.  Otherwise, the final SHI activity for that hour is set to the initial hourly future SHI.  This comparison is performed for each hour.

**MOVESemscalc**

The MOVESemscalc utility estimates the hourly link emissions for one user-specified county using the emissions factors (either from MOVES, MOVESratesCalc or MOVESratesAdj), the 24-hour or time period VMT mix, the hourly link VMT and speeds activity estimates (either from TRANSVMT or VirtualLinkVMT), and the off-network activity (either vehicle population or SHP, starts, and SHI).  This utility produces a tab-delimited output summary (including hourly and 24-hour totals) and hourly link emissions output files (optional).  The primary inputs to MOVESemscalc are:

- Emissions factors from MOVES, MOVESratesCalc or MOVESratesAdj;
- Link-based hourly VMT and speeds developed with the TRANSVMT or VirtualLinkVMT utility.  For each link, the following information is input to MOVESemscalc: link start node, link end node, link county number, link roadway type number, link area type number, link VMT, and link operational speed estimate;
- 24-hour or time period VMT mix by roadway type, MOVES SUT, and MOVES fuel type;
- Off-network activity.  If the emissions factors are in grams per vehicle (i.e., the MOVES format), vehicle population by SUT/fuel type is required.  If the emissions factors are in grams per activity (i.e., the MOVESratesCalc format), the SHP, starts, and SHI by hour and SUT/fuel type are required; and

- VMT roadway type designations, which lists associations of the link roadway types/area type combination to the VMT mix, emissions rate, and MOVES roadway types.

The emissions estimation can be categorized by two basic types based on the type of emissions factors: the roadway-based emissions and the off-network based emissions. For the roadway-based emissions (rateperdistance or ttirateperdistance emissions factors), the VMT for each link is distributed to each of the SUT/fuel type combinations listed in the VMT mix by roadway type (as designated in the VMT roadway type designations). If the time period VMT mix is input, each hour is assigned a time period by the user. Otherwise, the 24-hour VMT mix is used for all hours. The emissions factors are selected based on the emissions rate roadway type (as designated in the VMT roadway type designations) and the link speed for each SUT/fuel type combinations listed in the VMT mix. For link speeds greater than 75 mph, the emissions factors for 75 mph are used. For link speeds less than 2.5 mph, the emissions factors for 2.5 mph are used. For those link speeds that fall between the 16 MOVES speeds, the emissions factors are interpolated using the emissions factor interpolation methodology in the following section. These SUT/fuel type combination-specific emissions factors are multiplied by the SUT/fuel type combination-specific VMT to estimate the mobile source emissions for that link by SUT/fuel type combination.

The off-network emissions calculation depends on the format of the input emissions factors. If the emissions factors are in the MOVES format (rateperprofile and ratepervehicle), the emissions factors by SUT/fuel type are multiplied by their associated vehicle population to estimate emissions. If the emissions factors are in the MOVESratesCalc format, the emissions factors by SUT/fuel type are multiplied by the appropriate activity, which is determined by the emissions process (see Table 27).

The emissions estimates are output in a tab-delimited file (including all of the SUT/fuel type combinations listed in the VMT mix on a single line, separated by a tab character) for the specified county by pollutant, link roadway type, and SUT/fuel type combination for each of the specified episode time periods. A 24-hour (or total if all 24 hours are not specified) output is also included in the tab-delimited file. This tab-delimited file also includes hourly and 24-hour summaries of the off-network activity and VMT, VHT, and speed by link road type. Link emissions may also be output by county, pollutant, process, and each SUT/fuel type combination.

*Emissions Factor Interpolation Methodology*

To calculate emissions factors for link speeds that fall between two of the 16 MOVES speed bin speeds, an interpolation methodology similar to the methodology used with MOBILE6 is used. This methodology interpolates each emissions factor using a factor developed from the inverse link speed and the inverse high and low bounding speed bin speeds. The following is an example for a link speed of 41.2 mph.

The interpolated emissions factor ($EF_{Interp}$) is expressed as:

$$EF_{Interp} = EF_{LowSpeed} - FAC_{Interp}\ H\ (EF_{LowSpeed} - EF_{HighSpeed})$$

Where:

$EF_{LowSpeed}$ = emissions factor (EF) corresponding to the speed below the link speed;

$EF_{HighSpeed}$ = EF corresponding to the speed above the link speed; and

$$FAC_{Interp} = \left(\frac{1}{Speed_{link}} - \frac{1}{Speed_{low}}\right) \Big/ \left(\frac{1}{Speed_{high}} - \frac{1}{Speed_{low}}\right)$$

Given that:

$EF_{LowSpeed}$ = 0.7413 g/mi;
$EF_{HighSpeed}$ = 0.7274 g/mi;
$Speed_{lnk}$ = 41.2 mph;
$Speed_{low}$ = 40 mph; and
$Speed_{high}$ = 45 mph.

$$FAC_{Interp} = \left(\frac{1}{41.2mph} - \frac{1}{40mph}\right) \Big/ \left(\frac{1}{45mph} - \frac{1}{40mph}\right) = \frac{-0.00073}{-0.00278} = 0.26214;$$

$EF_{Interp}$ = 0.7413 g/mi - (0.26214) H (0.7413 g/mi - 0.7274 g/mi);

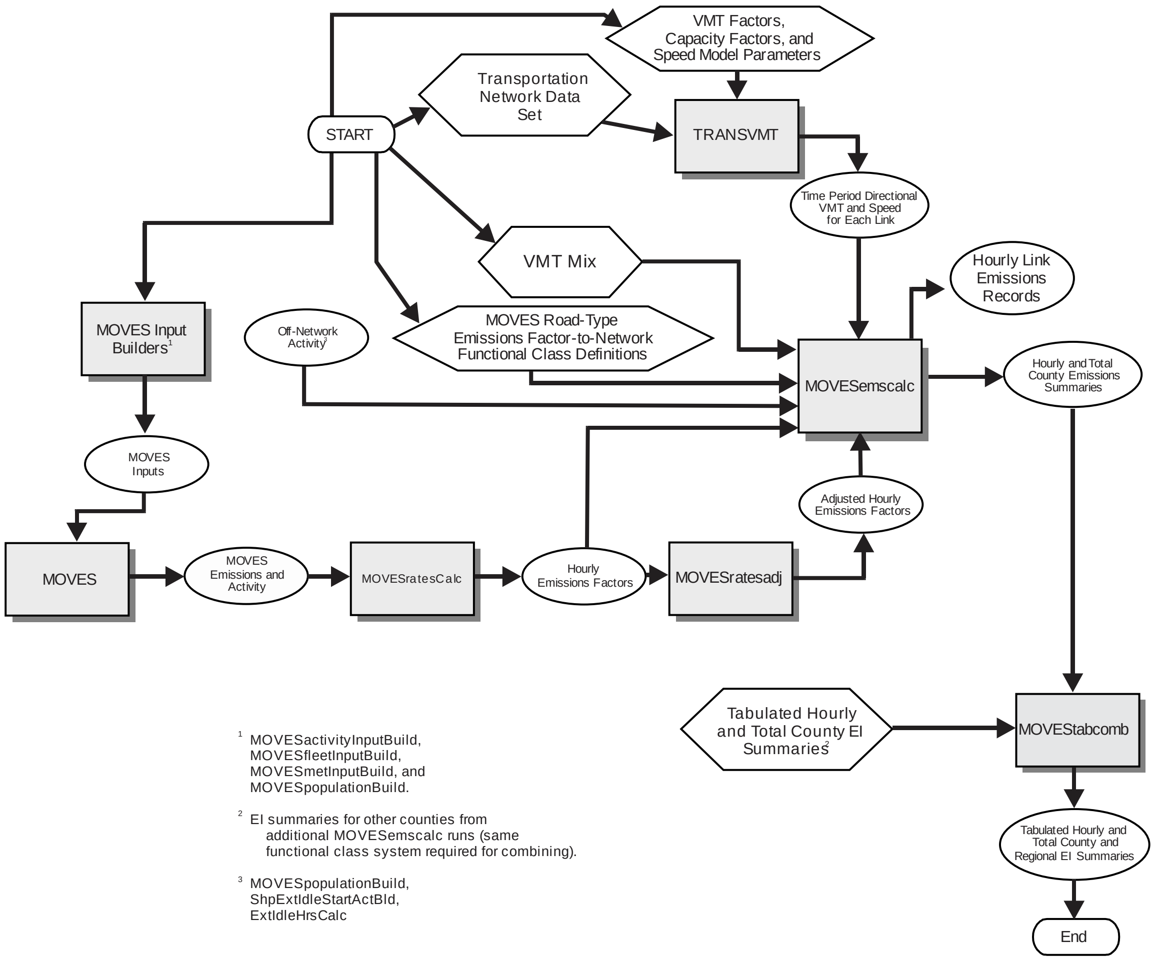
= 0.7377 g/mi.

**MOVEStabcomb**

The MOVEStabcomb utility combines the tab-delimited output from multiple runs of the MOVESemscac utility to produce a regional summary of the VMT, VHT, speed (VMT/VHT), off-network activity, and emissions for each hour along with a 24-hour summary. A maximum of 1,000 tab files can be combined in one run of the MOVEStabcomb utility. However, each tab file must have the same roadway types or the utility will not function properly.

The new regional tab-delimited file is in the same form as the individual county files taken as input, except that each time period includes the individual county data summaries plus the regional summary. The individual county summaries are taken directly from the input tab-delimited files. The regional data summaries are summations of the county data except for “speed,” which is calculated as regional VMT/regional VHT.

# Travel Demand Model Network Link-Based Hourly MOVES Emissions Estimates




[1] MOVESactivityInputBuild, MOVESfleetInputBuild, MOVESmetInputBuild, and MOVESpopulationBuild.

[2] EI summaries for other counties from additional MOVESemscalc runs (same functional class system required for combining).

[3] MOVESpopulationBuild, ShpExtIdleStartActBld, ExtIdleHrsCalc

# APPENDIX C
# TXDOT DISTRICT VMT MIX BY DAY OF WEEK

**TxDOT District/HGB Counties**

| TxDOT District | HGB County |
|---|---|
| Beaumont | Liberty |
| | Chambers |
| Houston | Harris |
| | Galveston |
| | Fort Bend |
| | Brazoria |
| | Montgomery |
| | Waller |

**VMT Mix Year/Analysis Year Correlations**

| VMT Mix Year | Analysis Years |
|---|---|
| 2000 | 1998 through 2002 |
| 2005 | 2003 through 2007 |
| 2010 | 2008 through 2012 |
| 2015 | 2013 through 2017 |
| 2020 | 2018 through 2022 |
| 2025 | 2023 through 2027 |

## 2010 Weekday VMT Mix - Beaumont TxDOT District (2011 Analysis Year)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00171 | 0.00165 | 0.00171 | 0.00193 | 0.00168 | 0.00166 | 0.00170 | 0.00189 | 0.00177 | 0.00182 | 0.00181 | 0.00200 | 0.00147 | 0.00166 | 0.00152 | 0.00178 |
| 21_G | 0.56725 | 0.54991 | 0.56942 | 0.64166 | 0.55917 | 0.55044 | 0.56386 | 0.62917 | 0.58857 | 0.60458 | 0.60137 | 0.66503 | 0.49014 | 0.55235 | 0.50581 | 0.59050 |
| 31_D | 0.00283 | 0.00362 | 0.00307 | 0.00359 | 0.00259 | 0.00346 | 0.00283 | 0.00348 | 0.00263 | 0.00366 | 0.00270 | 0.00365 | 0.00213 | 0.00349 | 0.00284 | 0.00439 |
| 31_G | 0.16339 | 0.20930 | 0.17742 | 0.20741 | 0.14975 | 0.19985 | 0.16393 | 0.20122 | 0.15190 | 0.21143 | 0.15635 | 0.21133 | 0.12307 | 0.20196 | 0.16393 | 0.25381 |
| 32_D | 0.00654 | 0.00837 | 0.00710 | 0.00830 | 0.00599 | 0.00800 | 0.00656 | 0.00805 | 0.00608 | 0.00846 | 0.00626 | 0.00846 | 0.00492 | 0.00808 | 0.00656 | 0.01016 |
| 32_G | 0.04887 | 0.06260 | 0.05306 | 0.06203 | 0.04479 | 0.05977 | 0.04903 | 0.06018 | 0.04543 | 0.06323 | 0.04676 | 0.06321 | 0.03681 | 0.06040 | 0.04903 | 0.07591 |
| 51_D | 0.00070 | 0.00093 | 0.00070 | 0.00053 | 0.00077 | 0.00092 | 0.00071 | 0.00069 | 0.00049 | 0.00063 | 0.00044 | 0.00039 | 0.00049 | 0.00064 | 0.00058 | 0.00038 |
| 51_G | 0.00017 | 0.00023 | 0.00017 | 0.00013 | 0.00019 | 0.00023 | 0.00017 | 0.00017 | 0.00012 | 0.00015 | 0.00011 | 0.00010 | 0.00012 | 0.00016 | 0.00014 | 0.00009 |
| 52_D | 0.03852 | 0.05121 | 0.03871 | 0.02914 | 0.04255 | 0.05115 | 0.03918 | 0.03809 | 0.02740 | 0.03503 | 0.02452 | 0.02178 | 0.02816 | 0.03648 | 0.03328 | 0.02197 |
| 52_G | 0.00951 | 0.01264 | 0.00956 | 0.00720 | 0.01050 | 0.01263 | 0.00967 | 0.00940 | 0.00677 | 0.00865 | 0.00605 | 0.00538 | 0.00695 | 0.00901 | 0.00822 | 0.00542 |
| 53_D | 0.00242 | 0.00321 | 0.00243 | 0.00183 | 0.00229 | 0.00275 | 0.00211 | 0.00205 | 0.00132 | 0.00169 | 0.00118 | 0.00105 | 0.00066 | 0.00086 | 0.00078 | 0.00052 |
| 53_G | 0.00060 | 0.00079 | 0.00060 | 0.00045 | 0.00056 | 0.00068 | 0.00052 | 0.00051 | 0.00033 | 0.00042 | 0.00029 | 0.00026 | 0.00016 | 0.00021 | 0.00019 | 0.00013 |
| 54_D | 0.00205 | 0.00273 | 0.00206 | 0.00155 | 0.00225 | 0.00270 | 0.00207 | 0.00201 | 0.00144 | 0.00184 | 0.00129 | 0.00115 | 0.00145 | 0.00187 | 0.00171 | 0.00113 |
| 54_G | 0.00051 | 0.00067 | 0.00051 | 0.00038 | 0.00056 | 0.00067 | 0.00051 | 0.00050 | 0.00036 | 0.00045 | 0.00032 | 0.00028 | 0.00036 | 0.00046 | 0.00042 | 0.00028 |
| 41_D | 0.00167 | 0.00330 | 0.00171 | 0.00162 | 0.00192 | 0.00202 | 0.00170 | 0.00130 | 0.00170 | 0.00083 | 0.00143 | 0.00117 | 0.00348 | 0.00123 | 0.00189 | 0.00107 |
| 42_D | 0.00052 | 0.00103 | 0.00053 | 0.00051 | 0.00060 | 0.00063 | 0.00053 | 0.00041 | 0.00053 | 0.00026 | 0.00045 | 0.00036 | 0.00109 | 0.00038 | 0.00059 | 0.00033 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00186 | 0.00368 | 0.00191 | 0.00181 | 0.00214 | 0.00225 | 0.00190 | 0.00146 | 0.00190 | 0.00092 | 0.00160 | 0.00130 | 0.00388 | 0.00137 | 0.00210 | 0.00120 |
| 43_G | 0.00002 | 0.00004 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00004 | 0.00001 | 0.00002 | 0.00001 |
| 61_D | 0.06087 | 0.03382 | 0.05213 | 0.01185 | 0.06604 | 0.03845 | 0.05883 | 0.01496 | 0.05208 | 0.01794 | 0.04747 | 0.00403 | 0.06676 | 0.02697 | 0.04991 | 0.00688 |
| 61_G | 0.00617 | 0.00343 | 0.00528 | 0.00120 | 0.00669 | 0.00390 | 0.00596 | 0.00152 | 0.00528 | 0.00182 | 0.00481 | 0.00041 | 0.00676 | 0.00273 | 0.00506 | 0.00070 |
| 62_D | 0.08327 | 0.04627 | 0.07131 | 0.01622 | 0.09839 | 0.05729 | 0.08765 | 0.02229 | 0.10330 | 0.03558 | 0.09417 | 0.00799 | 0.22058 | 0.08911 | 0.16491 | 0.02274 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00057 | 0.00055 | 0.00057 | 0.00064 | 0.00056 | 0.00055 | 0.00057 | 0.00063 | 0.00059 | 0.00061 | 0.00060 | 0.00067 | 0.00049 | 0.00055 | 0.00051 | 0.00059 |

## 2010 Weekday VMT Mix - Houston TxDOT District (2011 Analysis Year)

| SUF/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00211 | 0.00194 | 0.00233 | 0.00222 | 0.00193 | 0.00179 | 0.00219 | 0.00209 | 0.00214 | 0.00196 | 0.00235 | 0.00225 | 0.00183 | 0.00179 | 0.00221 | 0.00224 |
| 21_G | 0.70155 | 0.64524 | 0.77307 | 0.73794 | 0.64077 | 0.59388 | 0.72817 | 0.69339 | 0.71227 | 0.65262 | 0.78148 | 0.74717 | 0.60672 | 0.59620 | 0.73408 | 0.74437 |
| 31_D | 0.00247 | 0.00318 | 0.00208 | 0.00261 | 0.00264 | 0.00332 | 0.00229 | 0.00276 | 0.00250 | 0.00352 | 0.00217 | 0.00267 | 0.00221 | 0.00383 | 0.00231 | 0.00257 |
| 31_G | 0.14290 | 0.18394 | 0.12014 | 0.15118 | 0.15285 | 0.19171 | 0.13217 | 0.15960 | 0.14447 | 0.20359 | 0.12537 | 0.15417 | 0.12789 | 0.22126 | 0.13380 | 0.14872 |
| 32_D | 0.00581 | 0.00748 | 0.00489 | 0.00615 | 0.00622 | 0.00780 | 0.00538 | 0.00649 | 0.00588 | 0.00828 | 0.00510 | 0.00627 | 0.00520 | 0.00900 | 0.00544 | 0.00605 |
| 32_G | 0.04264 | 0.05489 | 0.03585 | 0.04511 | 0.04561 | 0.05721 | 0.03944 | 0.04763 | 0.04311 | 0.06075 | 0.03741 | 0.04600 | 0.03816 | 0.06603 | 0.03993 | 0.04438 |
| 51_D | 0.00043 | 0.00055 | 0.00033 | 0.00034 | 0.00050 | 0.00070 | 0.00045 | 0.00058 | 0.00027 | 0.00038 | 0.00021 | 0.00026 | 0.00035 | 0.00043 | 0.00025 | 0.00024 |
| 51_G | 0.00022 | 0.00029 | 0.00017 | 0.00018 | 0.00026 | 0.00036 | 0.00023 | 0.00030 | 0.00014 | 0.00020 | 0.00011 | 0.00013 | 0.00018 | 0.00022 | 0.00013 | 0.00012 |
| 52_D | 0.02050 | 0.02656 | 0.01585 | 0.01659 | 0.02482 | 0.03470 | 0.02235 | 0.02856 | 0.01345 | 0.01870 | 0.01035 | 0.01282 | 0.01875 | 0.02292 | 0.01330 | 0.01254 |
| 52_G | 0.01066 | 0.01381 | 0.00824 | 0.00862 | 0.01290 | 0.01804 | 0.01162 | 0.01484 | 0.00699 | 0.00972 | 0.00538 | 0.00666 | 0.00974 | 0.01191 | 0.00691 | 0.00652 |
| 53_D | 0.00447 | 0.00579 | 0.00345 | 0.00362 | 0.00455 | 0.00636 | 0.00410 | 0.00524 | 0.00249 | 0.00346 | 0.00191 | 0.00237 | 0.00190 | 0.00232 | 0.00135 | 0.00127 |
| 53_G | 0.00232 | 0.00301 | 0.00180 | 0.00188 | 0.00237 | 0.00331 | 0.00213 | 0.00272 | 0.00129 | 0.00180 | 0.00099 | 0.00123 | 0.00099 | 0.00121 | 0.00070 | 0.00066 |
| 54_D | 0.00125 | 0.00162 | 0.00097 | 0.00101 | 0.00147 | 0.00206 | 0.00133 | 0.00170 | 0.00080 | 0.00111 | 0.00061 | 0.00076 | 0.00104 | 0.00127 | 0.00073 | 0.00069 |
| 54_G | 0.00065 | 0.00084 | 0.00050 | 0.00053 | 0.00077 | 0.00107 | 0.00069 | 0.00088 | 0.00042 | 0.00058 | 0.00032 | 0.00040 | 0.00054 | 0.00066 | 0.00038 | 0.00036 |
| 41_D | 0.00086 | 0.00181 | 0.00175 | 0.00223 | 0.00090 | 0.00111 | 0.00116 | 0.00139 | 0.00089 | 0.00060 | 0.00125 | 0.00112 | 0.00102 | 0.00100 | 0.00109 | 0.00096 |
| 42_D | 0.00027 | 0.00056 | 0.00055 | 0.00070 | 0.00028 | 0.00035 | 0.00036 | 0.00043 | 0.00028 | 0.00019 | 0.00039 | 0.00035 | 0.00032 | 0.00031 | 0.00034 | 0.00030 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00096 | 0.00202 | 0.00195 | 0.00249 | 0.00100 | 0.00124 | 0.00129 | 0.00155 | 0.00099 | 0.00067 | 0.00139 | 0.00125 | 0.00114 | 0.00112 | 0.00121 | 0.00107 |
| 43_G | 0.00001 | 0.00002 | 0.00002 | 0.00003 | 0.00001 | 0.00001 | 0.00001 | 0.00002 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 |
| 61_D | 0.03326 | 0.02573 | 0.01421 | 0.00889 | 0.05189 | 0.03879 | 0.02290 | 0.01520 | 0.03076 | 0.01576 | 0.01132 | 0.00674 | 0.06141 | 0.01960 | 0.01864 | 0.00887 |
| 61_G | 0.00309 | 0.00239 | 0.00132 | 0.00083 | 0.00482 | 0.00360 | 0.00213 | 0.00141 | 0.00286 | 0.00146 | 0.00105 | 0.00063 | 0.00571 | 0.00182 | 0.00173 | 0.00082 |
| 62_D | 0.02285 | 0.01768 | 0.00976 | 0.00611 | 0.04278 | 0.03198 | 0.01888 | 0.01253 | 0.02728 | 0.01398 | 0.01004 | 0.00598 | 0.11428 | 0.03648 | 0.03470 | 0.01650 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00070 | 0.00065 | 0.00078 | 0.00074 | 0.00064 | 0.00060 | 0.00073 | 0.00070 | 0.00072 | 0.00066 | 0.00078 | 0.00075 | 0.00061 | 0.00060 | 0.00074 | 0.00075 |

## 2015 Weekday VMT Mix - Beaumont TxDOT District (2014 and 2017 Analysis Years)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00171 | 0.00165 | 0.00171 | 0.00193 | 0.00168 | 0.00166 | 0.00170 | 0.00189 | 0.00177 | 0.00182 | 0.00181 | 0.00200 | 0.00147 | 0.00166 | 0.00152 | 0.00178 |
| 21_G | 0.56725 | 0.54991 | 0.56942 | 0.64166 | 0.55917 | 0.55044 | 0.56386 | 0.62917 | 0.58857 | 0.60458 | 0.60137 | 0.66503 | 0.49014 | 0.55235 | 0.50581 | 0.59050 |
| 31_D | 0.00316 | 0.00405 | 0.00343 | 0.00401 | 0.00289 | 0.00386 | 0.00317 | 0.00389 | 0.00294 | 0.00409 | 0.00302 | 0.00408 | 0.00238 | 0.00390 | 0.00317 | 0.00491 |
| 31_G | 0.16306 | 0.20887 | 0.17706 | 0.20699 | 0.14944 | 0.19945 | 0.16359 | 0.20081 | 0.15159 | 0.21100 | 0.15604 | 0.21090 | 0.12282 | 0.20155 | 0.16360 | 0.25329 |
| 32_D | 0.00609 | 0.00781 | 0.00662 | 0.00774 | 0.00559 | 0.00745 | 0.00611 | 0.00751 | 0.00567 | 0.00789 | 0.00583 | 0.00788 | 0.00459 | 0.00753 | 0.00611 | 0.00947 |
| 32_G | 0.04931 | 0.06317 | 0.05355 | 0.06260 | 0.04519 | 0.06032 | 0.04947 | 0.06073 | 0.04584 | 0.06381 | 0.04719 | 0.06378 | 0.03714 | 0.06095 | 0.04948 | 0.07660 |
| 51_D | 0.00052 | 0.00070 | 0.00053 | 0.00040 | 0.00057 | 0.00069 | 0.00053 | 0.00051 | 0.00037 | 0.00047 | 0.00033 | 0.00029 | 0.00037 | 0.00048 | 0.00044 | 0.00029 |
| 51_G | 0.00013 | 0.00017 | 0.00013 | 0.00010 | 0.00014 | 0.00017 | 0.00013 | 0.00013 | 0.00009 | 0.00012 | 0.00008 | 0.00007 | 0.00009 | 0.00012 | 0.00011 | 0.00007 |
| 52_D | 0.03868 | 0.05143 | 0.03888 | 0.02927 | 0.04273 | 0.05136 | 0.03935 | 0.03825 | 0.02752 | 0.03518 | 0.02463 | 0.02187 | 0.02828 | 0.03664 | 0.03342 | 0.02207 |
| 52_G | 0.00955 | 0.01270 | 0.00960 | 0.00723 | 0.01055 | 0.01268 | 0.00972 | 0.00944 | 0.00679 | 0.00869 | 0.00608 | 0.00540 | 0.00698 | 0.00904 | 0.00825 | 0.00545 |
| 53_D | 0.00243 | 0.00322 | 0.00244 | 0.00184 | 0.00230 | 0.00276 | 0.00211 | 0.00206 | 0.00133 | 0.00170 | 0.00119 | 0.00105 | 0.00067 | 0.00086 | 0.00079 | 0.00052 |
| 53_G | 0.00060 | 0.00080 | 0.00060 | 0.00045 | 0.00057 | 0.00068 | 0.00052 | 0.00051 | 0.00033 | 0.00042 | 0.00029 | 0.00026 | 0.00016 | 0.00021 | 0.00019 | 0.00013 |
| 54_D | 0.00205 | 0.00273 | 0.00206 | 0.00155 | 0.00225 | 0.00270 | 0.00207 | 0.00201 | 0.00144 | 0.00184 | 0.00129 | 0.00115 | 0.00145 | 0.00187 | 0.00171 | 0.00113 |
| 54_G | 0.00051 | 0.00067 | 0.00051 | 0.00038 | 0.00056 | 0.00067 | 0.00051 | 0.00050 | 0.00036 | 0.00045 | 0.00032 | 0.00028 | 0.00036 | 0.00046 | 0.00042 | 0.00028 |
| 41_D | 0.00169 | 0.00334 | 0.00173 | 0.00164 | 0.00194 | 0.00204 | 0.00172 | 0.00132 | 0.00172 | 0.00084 | 0.00145 | 0.00118 | 0.00352 | 0.00124 | 0.00191 | 0.00109 |
| 42_D | 0.00050 | 0.00099 | 0.00051 | 0.00049 | 0.00058 | 0.00061 | 0.00051 | 0.00039 | 0.00051 | 0.00025 | 0.00043 | 0.00035 | 0.00104 | 0.00037 | 0.00057 | 0.00032 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00186 | 0.00368 | 0.00191 | 0.00181 | 0.00214 | 0.00225 | 0.00190 | 0.00146 | 0.00190 | 0.00092 | 0.00160 | 0.00130 | 0.00388 | 0.00137 | 0.00210 | 0.00120 |
| 43_G | 0.00002 | 0.00004 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00004 | 0.00001 | 0.00002 | 0.00001 |
| 61_D | 0.06087 | 0.03382 | 0.05213 | 0.01185 | 0.06604 | 0.03845 | 0.05883 | 0.01496 | 0.05208 | 0.01794 | 0.04747 | 0.00403 | 0.06676 | 0.02697 | 0.04991 | 0.00688 |
| 61_G | 0.00617 | 0.00343 | 0.00528 | 0.00120 | 0.00669 | 0.00390 | 0.00596 | 0.00152 | 0.00528 | 0.00182 | 0.00481 | 0.00041 | 0.00676 | 0.00273 | 0.00506 | 0.00070 |
| 62_D | 0.08327 | 0.04627 | 0.07131 | 0.01622 | 0.09839 | 0.05729 | 0.08765 | 0.02229 | 0.10330 | 0.03558 | 0.09417 | 0.00799 | 0.22058 | 0.08911 | 0.16491 | 0.02274 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00057 | 0.00055 | 0.00057 | 0.00064 | 0.00056 | 0.00055 | 0.00057 | 0.00063 | 0.00059 | 0.00061 | 0.00060 | 0.00067 | 0.00049 | 0.00055 | 0.00051 | 0.00059 |

## 2015 Weekday VMT Mix - Houston TxDOT District (2014 and 2017 Analysis Years)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00281 | 0.00259 | 0.00310 | 0.00296 | 0.00257 | 0.00238 | 0.00292 | 0.00278 | 0.00286 | 0.00262 | 0.00314 | 0.00300 | 0.00243 | 0.00239 | 0.00295 | 0.00299 |
| 21_G | 0.70085 | 0.64459 | 0.77230 | 0.73720 | 0.64013 | 0.59328 | 0.72744 | 0.69270 | 0.71156 | 0.65196 | 0.78070 | 0.74642 | 0.60611 | 0.59560 | 0.73334 | 0.74362 |
| 31_D | 0.00276 | 0.00356 | 0.00232 | 0.00292 | 0.00295 | 0.00371 | 0.00255 | 0.00308 | 0.00279 | 0.00394 | 0.00242 | 0.00298 | 0.00247 | 0.00428 | 0.00259 | 0.00287 |
| 31_G | 0.14261 | 0.18356 | 0.11990 | 0.15087 | 0.15254 | 0.19132 | 0.13190 | 0.15927 | 0.14418 | 0.20317 | 0.12512 | 0.15385 | 0.12763 | 0.22081 | 0.13353 | 0.14841 |
| 32_D | 0.00533 | 0.00686 | 0.00448 | 0.00564 | 0.00570 | 0.00715 | 0.00493 | 0.00595 | 0.00539 | 0.00759 | 0.00468 | 0.00575 | 0.00477 | 0.00825 | 0.00499 | 0.00555 |
| 32_G | 0.04313 | 0.05551 | 0.03626 | 0.04563 | 0.04613 | 0.05786 | 0.03989 | 0.04817 | 0.04360 | 0.06144 | 0.03784 | 0.04653 | 0.03860 | 0.06678 | 0.04038 | 0.04488 |
| 51_D | 0.00032 | 0.00041 | 0.00025 | 0.00026 | 0.00038 | 0.00053 | 0.00034 | 0.00043 | 0.00020 | 0.00028 | 0.00016 | 0.00019 | 0.00026 | 0.00032 | 0.00019 | 0.00018 |
| 51_G | 0.00017 | 0.00022 | 0.00013 | 0.00013 | 0.00020 | 0.00027 | 0.00018 | 0.00022 | 0.00011 | 0.00015 | 0.00008 | 0.00010 | 0.00014 | 0.00017 | 0.00010 | 0.00009 |
| 52_D | 0.02059 | 0.02668 | 0.01591 | 0.01666 | 0.02493 | 0.03485 | 0.02245 | 0.02868 | 0.01350 | 0.01878 | 0.01039 | 0.01287 | 0.01883 | 0.02302 | 0.01336 | 0.01259 |
| 52_G | 0.01070 | 0.01387 | 0.00827 | 0.00866 | 0.01296 | 0.01811 | 0.01167 | 0.01491 | 0.00702 | 0.00976 | 0.00540 | 0.00669 | 0.00978 | 0.01196 | 0.00694 | 0.00655 |
| 53_D | 0.00449 | 0.00582 | 0.00347 | 0.00363 | 0.00457 | 0.00639 | 0.00412 | 0.00526 | 0.00250 | 0.00347 | 0.00192 | 0.00238 | 0.00191 | 0.00233 | 0.00135 | 0.00128 |
| 53_G | 0.00233 | 0.00302 | 0.00180 | 0.00189 | 0.00238 | 0.00332 | 0.00214 | 0.00273 | 0.00130 | 0.00180 | 0.00100 | 0.00124 | 0.00099 | 0.00121 | 0.00070 | 0.00066 |
| 54_D | 0.00125 | 0.00162 | 0.00097 | 0.00101 | 0.00147 | 0.00206 | 0.00133 | 0.00170 | 0.00080 | 0.00111 | 0.00061 | 0.00076 | 0.00104 | 0.00127 | 0.00073 | 0.00069 |
| 54_G | 0.00065 | 0.00084 | 0.00050 | 0.00053 | 0.00077 | 0.00107 | 0.00069 | 0.00088 | 0.00042 | 0.00058 | 0.00032 | 0.00040 | 0.00054 | 0.00066 | 0.00038 | 0.00036 |
| 41_D | 0.00087 | 0.00183 | 0.00177 | 0.00226 | 0.00091 | 0.00113 | 0.00117 | 0.00140 | 0.00090 | 0.00061 | 0.00126 | 0.00114 | 0.00103 | 0.00102 | 0.00110 | 0.00097 |
| 42_D | 0.00026 | 0.00054 | 0.00052 | 0.00067 | 0.00027 | 0.00033 | 0.00035 | 0.00042 | 0.00027 | 0.00018 | 0.00037 | 0.00034 | 0.00031 | 0.00030 | 0.00033 | 0.00029 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00096 | 0.00202 | 0.00195 | 0.00249 | 0.00100 | 0.00124 | 0.00129 | 0.00155 | 0.00099 | 0.00067 | 0.00139 | 0.00125 | 0.00114 | 0.00112 | 0.00121 | 0.00107 |
| 43_G | 0.00001 | 0.00002 | 0.00002 | 0.00003 | 0.00001 | 0.00001 | 0.00001 | 0.00002 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 |
| 61_D | 0.03326 | 0.02573 | 0.01421 | 0.00889 | 0.05189 | 0.03879 | 0.02290 | 0.01520 | 0.03076 | 0.01576 | 0.01132 | 0.00674 | 0.06141 | 0.01960 | 0.01864 | 0.00887 |
| 61_G | 0.00309 | 0.00239 | 0.00132 | 0.00083 | 0.00482 | 0.00360 | 0.00213 | 0.00141 | 0.00286 | 0.00146 | 0.00105 | 0.00063 | 0.00571 | 0.00182 | 0.00173 | 0.00082 |
| 62_D | 0.02285 | 0.01768 | 0.00976 | 0.00611 | 0.04278 | 0.03198 | 0.01888 | 0.01253 | 0.02728 | 0.01398 | 0.01004 | 0.00598 | 0.11428 | 0.03648 | 0.03470 | 0.01650 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00070 | 0.00065 | 0.00078 | 0.00074 | 0.00064 | 0.00060 | 0.00073 | 0.00070 | 0.00072 | 0.00066 | 0.00078 | 0.00075 | 0.00061 | 0.00060 | 0.00074 | 0.00075 |

## 2020 Weekday VMT Mix - Beaumont TxDOT District (2020 Analysis Year)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00228 | 0.00221 | 0.00228 | 0.00257 | 0.00224 | 0.00221 | 0.00226 | 0.00252 | 0.00236 | 0.00243 | 0.00241 | 0.00267 | 0.00197 | 0.00222 | 0.00203 | 0.00237 |
| 21_G | 0.56668 | 0.54935 | 0.56885 | 0.64101 | 0.55861 | 0.54988 | 0.56329 | 0.62854 | 0.58798 | 0.60397 | 0.60077 | 0.66436 | 0.48965 | 0.55180 | 0.50530 | 0.58990 |
| 31_D | 0.00349 | 0.00447 | 0.00379 | 0.00443 | 0.00320 | 0.00427 | 0.00350 | 0.00430 | 0.00325 | 0.00452 | 0.00334 | 0.00451 | 0.00263 | 0.00431 | 0.00350 | 0.00542 |
| 31_G | 0.16273 | 0.20845 | 0.17670 | 0.20657 | 0.14914 | 0.19904 | 0.16326 | 0.20041 | 0.15128 | 0.21057 | 0.15572 | 0.21047 | 0.12257 | 0.20114 | 0.16327 | 0.25278 |
| 32_D | 0.00587 | 0.00752 | 0.00638 | 0.00746 | 0.00538 | 0.00718 | 0.00589 | 0.00723 | 0.00546 | 0.00760 | 0.00562 | 0.00760 | 0.00442 | 0.00726 | 0.00589 | 0.00912 |
| 32_G | 0.04953 | 0.06345 | 0.05379 | 0.06288 | 0.04540 | 0.06059 | 0.04969 | 0.06100 | 0.04605 | 0.06409 | 0.04740 | 0.06407 | 0.03731 | 0.06122 | 0.04970 | 0.07694 |
| 51_D | 0.00039 | 0.00052 | 0.00040 | 0.00030 | 0.00043 | 0.00052 | 0.00040 | 0.00039 | 0.00028 | 0.00035 | 0.00025 | 0.00022 | 0.00028 | 0.00036 | 0.00033 | 0.00022 |
| 51_G | 0.00010 | 0.00013 | 0.00010 | 0.00007 | 0.00011 | 0.00013 | 0.00010 | 0.00010 | 0.00007 | 0.00009 | 0.00006 | 0.00005 | 0.00007 | 0.00009 | 0.00008 | 0.00005 |
| 52_D | 0.03885 | 0.05165 | 0.03904 | 0.02939 | 0.04291 | 0.05158 | 0.03952 | 0.03842 | 0.02764 | 0.03533 | 0.02473 | 0.02196 | 0.02840 | 0.03679 | 0.03356 | 0.02216 |
| 52_G | 0.00959 | 0.01275 | 0.00964 | 0.00726 | 0.01059 | 0.01273 | 0.00976 | 0.00948 | 0.00682 | 0.00872 | 0.00611 | 0.00542 | 0.00701 | 0.00908 | 0.00829 | 0.00547 |
| 53_D | 0.00244 | 0.00324 | 0.00245 | 0.00184 | 0.00231 | 0.00277 | 0.00212 | 0.00206 | 0.00133 | 0.00170 | 0.00119 | 0.00106 | 0.00067 | 0.00087 | 0.00079 | 0.00052 |
| 53_G | 0.00060 | 0.00080 | 0.00060 | 0.00045 | 0.00057 | 0.00068 | 0.00052 | 0.00051 | 0.00033 | 0.00042 | 0.00029 | 0.00026 | 0.00017 | 0.00021 | 0.00020 | 0.00013 |
| 54_D | 0.00201 | 0.00267 | 0.00202 | 0.00152 | 0.00220 | 0.00265 | 0.00203 | 0.00197 | 0.00141 | 0.00180 | 0.00126 | 0.00112 | 0.00142 | 0.00183 | 0.00167 | 0.00110 |
| 54_G | 0.00050 | 0.00066 | 0.00050 | 0.00038 | 0.00054 | 0.00065 | 0.00050 | 0.00049 | 0.00035 | 0.00045 | 0.00031 | 0.00028 | 0.00035 | 0.00045 | 0.00041 | 0.00027 |
| 41_D | 0.00170 | 0.00336 | 0.00174 | 0.00165 | 0.00195 | 0.00205 | 0.00173 | 0.00133 | 0.00173 | 0.00084 | 0.00145 | 0.00119 | 0.00354 | 0.00125 | 0.00192 | 0.00109 |
| 42_D | 0.00049 | 0.00097 | 0.00050 | 0.00047 | 0.00056 | 0.00059 | 0.00050 | 0.00038 | 0.00050 | 0.00024 | 0.00042 | 0.00034 | 0.00102 | 0.00036 | 0.00055 | 0.00031 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00186 | 0.00369 | 0.00191 | 0.00181 | 0.00215 | 0.00226 | 0.00190 | 0.00146 | 0.00190 | 0.00093 | 0.00160 | 0.00130 | 0.00389 | 0.00137 | 0.00211 | 0.00120 |
| 43_G | 0.00002 | 0.00004 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00004 | 0.00001 | 0.00002 | 0.00001 |
| 61_D | 0.06087 | 0.03382 | 0.05213 | 0.01185 | 0.06604 | 0.03845 | 0.05883 | 0.01496 | 0.05208 | 0.01794 | 0.04747 | 0.00403 | 0.06676 | 0.02697 | 0.04991 | 0.00688 |
| 61_G | 0.00617 | 0.00343 | 0.00528 | 0.00120 | 0.00669 | 0.00390 | 0.00596 | 0.00152 | 0.00528 | 0.00182 | 0.00481 | 0.00041 | 0.00676 | 0.00273 | 0.00506 | 0.00070 |
| 62_D | 0.08327 | 0.04627 | 0.07131 | 0.01622 | 0.09839 | 0.05729 | 0.08765 | 0.02229 | 0.10330 | 0.03558 | 0.09417 | 0.00799 | 0.22058 | 0.08911 | 0.16491 | 0.02274 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00057 | 0.00055 | 0.00057 | 0.00064 | 0.00056 | 0.00055 | 0.00057 | 0.00063 | 0.00059 | 0.00061 | 0.00060 | 0.00067 | 0.00049 | 0.00055 | 0.00051 | 0.00059 |

## 2020 Weekday VMT Mix - Houston TxDOT District (2020 Analysis Year)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00281 | 0.00259 | 0.00310 | 0.00296 | 0.00257 | 0.00238 | 0.00292 | 0.00278 | 0.00286 | 0.00262 | 0.00314 | 0.00300 | 0.00243 | 0.00239 | 0.00295 | 0.00299 |
| 21_G | 0.70085 | 0.64459 | 0.77230 | 0.73720 | 0.64013 | 0.59328 | 0.72744 | 0.69270 | 0.71156 | 0.65196 | 0.78070 | 0.74642 | 0.60611 | 0.59560 | 0.73334 | 0.74362 |
| 31_D | 0.00305 | 0.00393 | 0.00257 | 0.00323 | 0.00327 | 0.00410 | 0.00282 | 0.00341 | 0.00309 | 0.00435 | 0.00268 | 0.00329 | 0.00273 | 0.00473 | 0.00286 | 0.00318 |
| 31_G | 0.14232 | 0.18319 | 0.11966 | 0.15056 | 0.15223 | 0.19093 | 0.13163 | 0.15895 | 0.14388 | 0.20276 | 0.12486 | 0.15354 | 0.12737 | 0.22036 | 0.13326 | 0.14811 |
| 32_D | 0.00514 | 0.00661 | 0.00432 | 0.00543 | 0.00549 | 0.00689 | 0.00475 | 0.00574 | 0.00519 | 0.00732 | 0.00451 | 0.00554 | 0.00460 | 0.00795 | 0.00481 | 0.00535 |
| 32_G | 0.04332 | 0.05576 | 0.03642 | 0.04583 | 0.04634 | 0.05812 | 0.04007 | 0.04838 | 0.04380 | 0.06172 | 0.03801 | 0.04674 | 0.03877 | 0.06708 | 0.04056 | 0.04508 |
| 51_D | 0.00024 | 0.00031 | 0.00019 | 0.00019 | 0.00028 | 0.00039 | 0.00025 | 0.00032 | 0.00015 | 0.00021 | 0.00012 | 0.00015 | 0.00020 | 0.00024 | 0.00014 | 0.00013 |
| 51_G | 0.00012 | 0.00016 | 0.00010 | 0.00010 | 0.00015 | 0.00021 | 0.00013 | 0.00017 | 0.00008 | 0.00011 | 0.00006 | 0.00008 | 0.00010 | 0.00013 | 0.00007 | 0.00007 |
| 52_D | 0.02068 | 0.02679 | 0.01598 | 0.01673 | 0.02503 | 0.03500 | 0.02254 | 0.02880 | 0.01356 | 0.01886 | 0.01043 | 0.01293 | 0.01891 | 0.02312 | 0.01342 | 0.01265 |
| 52_G | 0.01075 | 0.01392 | 0.00831 | 0.00869 | 0.01301 | 0.01819 | 0.01172 | 0.01497 | 0.00705 | 0.00980 | 0.00542 | 0.00672 | 0.00983 | 0.01201 | 0.00697 | 0.00657 |
| 53_D | 0.00451 | 0.00584 | 0.00348 | 0.00365 | 0.00459 | 0.00642 | 0.00414 | 0.00528 | 0.00251 | 0.00349 | 0.00193 | 0.00239 | 0.00192 | 0.00234 | 0.00136 | 0.00128 |
| 53_G | 0.00234 | 0.00304 | 0.00181 | 0.00190 | 0.00239 | 0.00334 | 0.00215 | 0.00275 | 0.00130 | 0.00181 | 0.00100 | 0.00124 | 0.00100 | 0.00122 | 0.00071 | 0.00067 |
| 54_D | 0.00123 | 0.00159 | 0.00095 | 0.00099 | 0.00144 | 0.00202 | 0.00130 | 0.00166 | 0.00078 | 0.00109 | 0.00060 | 0.00075 | 0.00101 | 0.00124 | 0.00072 | 0.00068 |
| 54_G | 0.00064 | 0.00083 | 0.00049 | 0.00052 | 0.00075 | 0.00105 | 0.00067 | 0.00086 | 0.00041 | 0.00057 | 0.00031 | 0.00039 | 0.00053 | 0.00064 | 0.00037 | 0.00035 |
| 41_D | 0.00087 | 0.00184 | 0.00178 | 0.00227 | 0.00092 | 0.00113 | 0.00118 | 0.00141 | 0.00090 | 0.00061 | 0.00127 | 0.00114 | 0.00104 | 0.00102 | 0.00111 | 0.00097 |
| 42_D | 0.00025 | 0.00053 | 0.00051 | 0.00065 | 0.00026 | 0.00033 | 0.00034 | 0.00041 | 0.00026 | 0.00018 | 0.00036 | 0.00033 | 0.00030 | 0.00029 | 0.00032 | 0.00028 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00096 | 0.00202 | 0.00195 | 0.00250 | 0.00101 | 0.00124 | 0.00129 | 0.00155 | 0.00099 | 0.00067 | 0.00139 | 0.00126 | 0.00114 | 0.00112 | 0.00122 | 0.00107 |
| 43_G | 0.00001 | 0.00002 | 0.00002 | 0.00003 | 0.00001 | 0.00001 | 0.00001 | 0.00002 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 |
| 61_D | 0.03326 | 0.02573 | 0.01421 | 0.00889 | 0.05189 | 0.03879 | 0.02290 | 0.01520 | 0.03076 | 0.01576 | 0.01132 | 0.00674 | 0.06141 | 0.01960 | 0.01864 | 0.00887 |
| 61_G | 0.00309 | 0.00239 | 0.00132 | 0.00083 | 0.00482 | 0.00360 | 0.00213 | 0.00141 | 0.00286 | 0.00146 | 0.00105 | 0.00063 | 0.00571 | 0.00182 | 0.00173 | 0.00082 |
| 62_D | 0.02285 | 0.01768 | 0.00976 | 0.00611 | 0.04278 | 0.03198 | 0.01888 | 0.01253 | 0.02728 | 0.01398 | 0.01004 | 0.00598 | 0.11428 | 0.03648 | 0.03470 | 0.01650 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00070 | 0.00065 | 0.00078 | 0.00074 | 0.00064 | 0.00060 | 0.00073 | 0.00070 | 0.00072 | 0.00066 | 0.00078 | 0.00075 | 0.00061 | 0.00060 | 0.00074 | 0.00075 |

## 2025 Weekday VMT Mix - Beaumont TxDOT District (2023 and 2026 Analysis Years)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00228 | 0.00221 | 0.00228 | 0.00257 | 0.00224 | 0.00221 | 0.00226 | 0.00252 | 0.00236 | 0.00243 | 0.00241 | 0.00267 | 0.00197 | 0.00222 | 0.00203 | 0.00237 |
| 21_G | 0.56668 | 0.54935 | 0.56885 | 0.64101 | 0.55861 | 0.54988 | 0.56329 | 0.62854 | 0.58798 | 0.60397 | 0.60077 | 0.66436 | 0.48965 | 0.55180 | 0.50530 | 0.58990 |
| 31_D | 0.00366 | 0.00468 | 0.00397 | 0.00464 | 0.00335 | 0.00447 | 0.00367 | 0.00450 | 0.00340 | 0.00473 | 0.00350 | 0.00473 | 0.00275 | 0.00452 | 0.00367 | 0.00568 |
| 31_G | 0.16256 | 0.20823 | 0.17652 | 0.20636 | 0.14899 | 0.19884 | 0.16309 | 0.20020 | 0.15113 | 0.21035 | 0.15556 | 0.21026 | 0.12245 | 0.20093 | 0.16310 | 0.25252 |
| 32_D | 0.00587 | 0.00752 | 0.00638 | 0.00746 | 0.00538 | 0.00718 | 0.00589 | 0.00723 | 0.00546 | 0.00760 | 0.00562 | 0.00760 | 0.00442 | 0.00726 | 0.00589 | 0.00912 |
| 32_G | 0.04953 | 0.06345 | 0.05379 | 0.06288 | 0.04540 | 0.06059 | 0.04969 | 0.06100 | 0.04605 | 0.06409 | 0.04740 | 0.06407 | 0.03731 | 0.06122 | 0.04970 | 0.07694 |
| 51_D | 0.00035 | 0.00046 | 0.00035 | 0.00026 | 0.00038 | 0.00046 | 0.00035 | 0.00034 | 0.00025 | 0.00031 | 0.00022 | 0.00019 | 0.00025 | 0.00032 | 0.00029 | 0.00019 |
| 51_G | 0.00009 | 0.00011 | 0.00009 | 0.00007 | 0.00009 | 0.00011 | 0.00009 | 0.00008 | 0.00006 | 0.00008 | 0.00005 | 0.00005 | 0.00006 | 0.00008 | 0.00007 | 0.00005 |
| 52_D | 0.03889 | 0.05170 | 0.03908 | 0.02942 | 0.04295 | 0.05164 | 0.03956 | 0.03846 | 0.02767 | 0.03537 | 0.02476 | 0.02199 | 0.02843 | 0.03683 | 0.03360 | 0.02218 |
| 52_G | 0.00960 | 0.01276 | 0.00965 | 0.00726 | 0.01060 | 0.01275 | 0.00977 | 0.00949 | 0.00683 | 0.00873 | 0.00611 | 0.00543 | 0.00702 | 0.00909 | 0.00829 | 0.00548 |
| 53_D | 0.00244 | 0.00324 | 0.00245 | 0.00184 | 0.00231 | 0.00277 | 0.00213 | 0.00207 | 0.00133 | 0.00171 | 0.00119 | 0.00106 | 0.00067 | 0.00087 | 0.00079 | 0.00052 |
| 53_G | 0.00060 | 0.00080 | 0.00060 | 0.00046 | 0.00057 | 0.00069 | 0.00052 | 0.00051 | 0.00033 | 0.00042 | 0.00029 | 0.00026 | 0.00017 | 0.00021 | 0.00020 | 0.00013 |
| 54_D | 0.00201 | 0.00267 | 0.00202 | 0.00152 | 0.00220 | 0.00265 | 0.00203 | 0.00197 | 0.00141 | 0.00180 | 0.00126 | 0.00112 | 0.00142 | 0.00183 | 0.00167 | 0.00110 |
| 54_G | 0.00050 | 0.00066 | 0.00050 | 0.00038 | 0.00054 | 0.00065 | 0.00050 | 0.00049 | 0.00035 | 0.00045 | 0.00031 | 0.00028 | 0.00035 | 0.00045 | 0.00041 | 0.00027 |
| 41_D | 0.00171 | 0.00338 | 0.00175 | 0.00166 | 0.00197 | 0.00207 | 0.00174 | 0.00134 | 0.00174 | 0.00085 | 0.00146 | 0.00119 | 0.00356 | 0.00126 | 0.00193 | 0.00110 |
| 42_D | 0.00048 | 0.00096 | 0.00050 | 0.00047 | 0.00056 | 0.00059 | 0.00049 | 0.00038 | 0.00049 | 0.00024 | 0.00042 | 0.00034 | 0.00101 | 0.00036 | 0.00055 | 0.00031 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00186 | 0.00367 | 0.00190 | 0.00180 | 0.00214 | 0.00225 | 0.00189 | 0.00145 | 0.00189 | 0.00092 | 0.00159 | 0.00130 | 0.00387 | 0.00137 | 0.00210 | 0.00119 |
| 43_G | 0.00002 | 0.00004 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00002 | 0.00001 | 0.00004 | 0.00001 | 0.00002 | 0.00001 |
| 61_D | 0.06087 | 0.03382 | 0.05213 | 0.01185 | 0.06604 | 0.03845 | 0.05883 | 0.01496 | 0.05208 | 0.01794 | 0.04747 | 0.00403 | 0.06676 | 0.02697 | 0.04991 | 0.00688 |
| 61_G | 0.00617 | 0.00343 | 0.00528 | 0.00120 | 0.00669 | 0.00390 | 0.00596 | 0.00152 | 0.00528 | 0.00182 | 0.00481 | 0.00041 | 0.00676 | 0.00273 | 0.00506 | 0.00070 |
| 62_D | 0.08327 | 0.04627 | 0.07131 | 0.01622 | 0.09839 | 0.05729 | 0.08765 | 0.02229 | 0.10330 | 0.03558 | 0.09417 | 0.00799 | 0.22058 | 0.08911 | 0.16491 | 0.02274 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00057 | 0.00055 | 0.00057 | 0.00064 | 0.00056 | 0.00055 | 0.00057 | 0.00063 | 0.00059 | 0.00061 | 0.00060 | 0.00067 | 0.00049 | 0.00055 | 0.00051 | 0.00059 |

## 2025 Weekday VMT Mix - Houston TxDOT District (2023 and 2026 Analysis Years)

| SUT/FT | AM Peak | | | | Mid-Day | | | | PM Peak | | | | Overnight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 | RT2 | RT3 | RT4 | RT5 |
| 21_D | 0.00281 | 0.00259 | 0.00310 | 0.00296 | 0.00257 | 0.00238 | 0.00292 | 0.00278 | 0.00286 | 0.00262 | 0.00314 | 0.00300 | 0.00243 | 0.00239 | 0.00295 | 0.00299 |
| 21_G | 0.70085 | 0.64459 | 0.77230 | 0.73720 | 0.64013 | 0.59328 | 0.72744 | 0.69270 | 0.71156 | 0.65196 | 0.78070 | 0.74642 | 0.60611 | 0.59560 | 0.73334 | 0.74362 |
| 31_D | 0.00334 | 0.00430 | 0.00281 | 0.00354 | 0.00358 | 0.00449 | 0.00309 | 0.00373 | 0.00338 | 0.00476 | 0.00293 | 0.00361 | 0.00299 | 0.00518 | 0.00313 | 0.00348 |
| 31_G | 0.14202 | 0.18281 | 0.11941 | 0.15026 | 0.15192 | 0.19054 | 0.13136 | 0.15863 | 0.14359 | 0.20234 | 0.12461 | 0.15323 | 0.12711 | 0.21991 | 0.13299 | 0.14781 |
| 32_D | 0.00509 | 0.00655 | 0.00428 | 0.00538 | 0.00544 | 0.00683 | 0.00471 | 0.00568 | 0.00514 | 0.00725 | 0.00446 | 0.00549 | 0.00455 | 0.00788 | 0.00476 | 0.00530 |
| 32_G | 0.04337 | 0.05582 | 0.03646 | 0.04588 | 0.04639 | 0.05818 | 0.04011 | 0.04844 | 0.04385 | 0.06179 | 0.03805 | 0.04679 | 0.03881 | 0.06715 | 0.04061 | 0.04513 |
| 51_D | 0.00021 | 0.00028 | 0.00016 | 0.00017 | 0.00025 | 0.00035 | 0.00023 | 0.00029 | 0.00014 | 0.00019 | 0.00010 | 0.00013 | 0.00018 | 0.00022 | 0.00013 | 0.00012 |
| 51_G | 0.00011 | 0.00014 | 0.00009 | 0.00009 | 0.00013 | 0.00018 | 0.00012 | 0.00015 | 0.00007 | 0.00010 | 0.00005 | 0.00007 | 0.00009 | 0.00011 | 0.00007 | 0.00006 |
| 52_D | 0.02070 | 0.02682 | 0.01600 | 0.01675 | 0.02506 | 0.03503 | 0.02257 | 0.02883 | 0.01358 | 0.01888 | 0.01044 | 0.01294 | 0.01893 | 0.02314 | 0.01343 | 0.01266 |
| 52_G | 0.01076 | 0.01394 | 0.00831 | 0.00870 | 0.01303 | 0.01821 | 0.01173 | 0.01499 | 0.00706 | 0.00982 | 0.00543 | 0.00673 | 0.00984 | 0.01203 | 0.00698 | 0.00658 |
| 53_D | 0.00451 | 0.00585 | 0.00349 | 0.00365 | 0.00460 | 0.00643 | 0.00414 | 0.00529 | 0.00251 | 0.00349 | 0.00193 | 0.00239 | 0.00192 | 0.00234 | 0.00136 | 0.00128 |
| 53_G | 0.00235 | 0.00304 | 0.00181 | 0.00190 | 0.00239 | 0.00334 | 0.00215 | 0.00275 | 0.00130 | 0.00181 | 0.00100 | 0.00124 | 0.00100 | 0.00122 | 0.00071 | 0.00067 |
| 54_D | 0.00123 | 0.00159 | 0.00095 | 0.00099 | 0.00144 | 0.00202 | 0.00130 | 0.00166 | 0.00078 | 0.00109 | 0.00060 | 0.00075 | 0.00101 | 0.00124 | 0.00072 | 0.00068 |
| 54_G | 0.00064 | 0.00083 | 0.00049 | 0.00052 | 0.00075 | 0.00105 | 0.00067 | 0.00086 | 0.00041 | 0.00057 | 0.00031 | 0.00039 | 0.00053 | 0.00064 | 0.00037 | 0.00035 |
| 41_D | 0.00088 | 0.00185 | 0.00179 | 0.00229 | 0.00092 | 0.00114 | 0.00118 | 0.00142 | 0.00091 | 0.00062 | 0.00128 | 0.00115 | 0.00104 | 0.00103 | 0.00112 | 0.00098 |
| 42_D | 0.00025 | 0.00053 | 0.00051 | 0.00065 | 0.00026 | 0.00032 | 0.00034 | 0.00040 | 0.00026 | 0.00017 | 0.00036 | 0.00033 | 0.00030 | 0.00029 | 0.00032 | 0.00028 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00096 | 0.00201 | 0.00194 | 0.00249 | 0.00100 | 0.00124 | 0.00129 | 0.00154 | 0.00099 | 0.00067 | 0.00139 | 0.00125 | 0.00114 | 0.00112 | 0.00121 | 0.00107 |
| 43_G | 0.00001 | 0.00002 | 0.00002 | 0.00003 | 0.00001 | 0.00001 | 0.00001 | 0.00002 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 |
| 61_D | 0.03326 | 0.02573 | 0.01421 | 0.00889 | 0.05189 | 0.03879 | 0.02290 | 0.01520 | 0.03076 | 0.01576 | 0.01132 | 0.00674 | 0.06141 | 0.01960 | 0.01864 | 0.00887 |
| 61_G | 0.00309 | 0.00239 | 0.00132 | 0.00083 | 0.00482 | 0.00360 | 0.00213 | 0.00141 | 0.00286 | 0.00146 | 0.00105 | 0.00063 | 0.00571 | 0.00182 | 0.00173 | 0.00082 |
| 62_D | 0.02285 | 0.01768 | 0.00976 | 0.00611 | 0.04278 | 0.03198 | 0.01888 | 0.01253 | 0.02728 | 0.01398 | 0.01004 | 0.00598 | 0.11428 | 0.03648 | 0.03470 | 0.01650 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00070 | 0.00065 | 0.00078 | 0.00074 | 0.00064 | 0.00060 | 0.00073 | 0.00070 | 0.00072 | 0.00066 | 0.00078 | 0.00075 | 0.00061 | 0.00060 | 0.00074 | 0.00075 |

# APPENDIX D:
# TXDOT DISTRICT AGGREGATE WEEKDAY VMT MIX

## TxDOT District/HGB Counties

| TxDOT District | HGB County |
|---|---|
| Beaumont | Liberty |
| | Chambers |
| Houston | Harris |
| | Galveston |
| | Fort Bend |
| | Brazoria |
| | Montgomery |
| | Waller |

## VMT Mix Year/Analysis Year Correlations

| VMT Mix Year | Analysis Years |
|---|---|
| 2000 | 1998 through 2002 |
| 2005 | 2003 through 2007 |
| 2010 | 2008 through 2012 |
| 2015 | 2013 through 2017 |
| 2020 | 2018 through 2022 |
| 2025 | 2023 through 2027 |

## Aggregate Weekday VMT Mix - Beaumont TxDOT District

| SUT/FT | 2010[1] | 2015[2] | 2020[3] | 2025[4] |
|---|---|---|---|---|
| 21_D | 0.00169 | 0.00169 | 0.00225 | 0.00225 |
| 21_G | 0.56200 | 0.56200 | 0.56144 | 0.56144 |
| 31_D | 0.00305 | 0.00340 | 0.00376 | 0.00394 |
| 31_G | 0.17610 | 0.17574 | 0.17538 | 0.17520 |
| 32_D | 0.00705 | 0.00657 | 0.00633 | 0.00633 |
| 32_G | 0.05267 | 0.05315 | 0.05339 | 0.05339 |
| 51_D | 0.00068 | 0.00051 | 0.00038 | 0.00034 |
| 51_G | 0.00017 | 0.00013 | 0.00009 | 0.00008 |
| 52_D | 0.03786 | 0.03802 | 0.03818 | 0.03822 |
| 52_G | 0.00935 | 0.00939 | 0.00943 | 0.00944 |
| 53_D | 0.00174 | 0.00175 | 0.00176 | 0.00176 |
| 53_G | 0.00043 | 0.00043 | 0.00043 | 0.00043 |
| 54_D | 0.00199 | 0.00199 | 0.00194 | 0.00194 |
| 54_G | 0.00049 | 0.00049 | 0.00048 | 0.00048 |
| 41_D | 0.00183 | 0.00185 | 0.00186 | 0.00187 |
| 42_D | 0.00057 | 0.00055 | 0.00054 | 0.00053 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00204 | 0.00204 | 0.00205 | 0.00204 |
| 43_G | 0.00002 | 0.00002 | 0.00002 | 0.00002 |
| 61_D | 0.04745 | 0.04745 | 0.04745 | 0.04745 |
| 61_G | 0.00481 | 0.00481 | 0.00481 | 0.00481 |
| 62_D | 0.08747 | 0.08747 | 0.08747 | 0.08747 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00056 | 0.00056 | 0.00056 | 0.00056 |

[1] 2011 Analysis Year.
[2] 2014 and 2017 Analysis Years.
[3] 2020 Analysis Year.
[4] 2023 and 2026 Analysis Years.

## Aggregate Weekday VMT Mix - Houston TxDOT District

| SUT/FT | 2010[1] | 2015[2] | 2020[3] | 2025[4] |
|---|---|---|---|---|
| 21_D | 0.00221 | 0.00295 | 0.00295 | 0.00295 |
| 21_G | 0.73461 | 0.73387 | 0.73387 | 0.73387 |
| 31_D | 0.00234 | 0.00261 | 0.00289 | 0.00316 |
| 31_G | 0.13514 | 0.13487 | 0.13459 | 0.13432 |
| 32_D | 0.00550 | 0.00504 | 0.00486 | 0.00481 |
| 32_G | 0.04033 | 0.04078 | 0.04097 | 0.04101 |
| 51_D | 0.00037 | 0.00028 | 0.00021 | 0.00018 |
| 51_G | 0.00019 | 0.00014 | 0.00011 | 0.00010 |
| 52_D | 0.01844 | 0.01851 | 0.01859 | 0.01861 |
| 52_G | 0.00958 | 0.00962 | 0.00966 | 0.00967 |
| 53_D | 0.00320 | 0.00322 | 0.00323 | 0.00323 |
| 53_G | 0.00166 | 0.00167 | 0.00168 | 0.00168 |
| 54_D | 0.00109 | 0.00109 | 0.00106 | 0.00106 |
| 54_G | 0.00056 | 0.00056 | 0.00055 | 0.00055 |
| 41_D | 0.00126 | 0.00128 | 0.00129 | 0.00130 |
| 42_D | 0.00039 | 0.00038 | 0.00037 | 0.00037 |
| 42_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 43_D | 0.00141 | 0.00141 | 0.00141 | 0.00141 |
| 43_G | 0.00001 | 0.00001 | 0.00001 | 0.00001 |
| 61_D | 0.02012 | 0.02012 | 0.02012 | 0.02012 |
| 61_G | 0.00187 | 0.00187 | 0.00187 | 0.00187 |
| 62_D | 0.01896 | 0.01896 | 0.01896 | 0.01896 |
| 62_G | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 11_G | 0.00074 | 0.00074 | 0.00074 | 0.00074 |

[1] 2011 Analysis Year.
[2] 2014 and 2017 Analysis Years.
[3] 2020 Analysis Year.
[4] 2023 and 2026 Analysis Years.

# APPENDIX E:
# ANNUALLY COMPOUNDED GROWTH RATES AND INTERMEDIATE YEAR ADJUSTMENT FACTORS

## AM Peak Annually Compounded Growth Rates

| County | 2008 TDM VMT[1] | 2018 TDM VMT[1] | Growth Rate |
|---|---|---|---|
| Harris | 25,672,613.62 | 28,692,722.75 | 1.013999427 |
| Brazoria | 1,745,715.39 | 2,106,777.60 | 1.023777679 |
| Fort Bend | 2,710,786.99 | 3,367,577.14 | 1.027490394 |
| Waller | 418,112.13 | 494,376.78 | 1.021164390 |
| Montgomery | 2,809,274.96 | 3,400,187.76 | 1.024150028 |
| Liberty | 557,617.35 | 647,236.01 | 1.018804372 |
| Chambers | 526,810.48 | 637,140.61 | 1.024053414 |
| Galveston | 1,367,626.37 | 1,541,109.03 | 1.015040188 |

[1] Includes the estimated intrazonal VMT.

## Mid-Day Annually Compounded Growth Rates

| County | 2008 TDM VMT[1] | 2018 TDM VMT[1] | Growth Rate |
|---|---|---|---|
| Harris | 32,094,772.43 | 35,612,268.31 | 1.013084491 |
| Brazoria | 2,090,484.46 | 2,457,113.86 | 1.020404329 |
| Fort Bend | 3,547,176.02 | 4,360,037.00 | 1.026126561 |
| Waller | 806,654.91 | 940,108.65 | 1.019321732 |
| Montgomery | 3,721,220.67 | 4,387,025.16 | 1.020788074 |
| Liberty | 861,858.95 | 994,566.91 | 1.01806317 |
| Chambers | 1,064,796.70 | 1,270,774.27 | 1.022351443 |
| Galveston | 1,747,391.40 | 1,954,997.92 | 1.014132061 |

[1] Includes the estimated intrazonal VMT.

## PM Peak Annually Compounded Growth Rates

| County | 2008 TDM VMT[1] | 2018 TDM VMT[1] | Growth Rate |
|---|---|---|---|
| Harris | 38,441,605.68 | 42,980,703.57 | 1.014049138 |
| Brazoria | 2,592,073.28 | 3,106,897.57 | 1.02290419 |
| Fort Bend | 4,154,509.17 | 5,159,422.29 | 1.027448753 |
| Waller | 732,042.06 | 859,362.68 | 1.020246367 |
| Montgomery | 4,314,969.30 | 5,178,495.04 | 1.023065011 |
| Liberty | 901,459.33 | 1,040,075.43 | 1.018039988 |
| Chambers | 927,837.31 | 1,116,742.37 | 1.023434717 |
| Galveston | 2,120,977.01 | 2,379,416.89 | 1.014476106 |

[1] Includes the estimated intrazonal VMT.

## Overnight Annually Compounded Growth Rates

| County | 2008 TDM VMT[1] | 2018 TDM VMT[1] | Growth Rate |
|---|---|---|---|
| Harris | 18,229,126.55 | 20,578,596.52 | 1.015269259 |
| Brazoria | 1,231,722.94 | 1,471,035.52 | 1.0224422 |
| Fort Bend | 2,173,558.46 | 2,689,383.33 | 1.026975713 |
| Waller | 512,202.98 | 601,917.26 | 1.020379763 |
| Montgomery | 2,362,079.22 | 2,814,642.05 | 1.022153427 |
| Liberty | 562,610.32 | 648,693.08 | 1.017955859 |
| Chambers | 655,589.04 | 777,525.03 | 1.021551667 |
| Galveston | 1,026,185.03 | 1,145,698.20 | 1.013866024 |

[1] Includes the estimated intrazonal VMT.

## 2020 Intermediate Year Adjustment Factors[1]

| County | AM Peak | Mid-Day | PM Peak | Overnight |
|---|---|---|---|---|
| Harris | 1.042588977 | 1.039769325 | 1.042742321 | 1.046510788 |
| Brazoria | 1.073042613 | 1.062470491 | 1.070298392 | 1.068848860 |
| Fort Bend | 1.084759121 | 1.080445309 | 1.084627240 | 1.083129835 |
| Waller | 1.064846446 | 1.059092398 | 1.061977147 | 1.062393757 |
| Montgomery | 1.074213842 | 1.063669639 | 1.070803286 | 1.067943476 |
| Liberty | 1.057480577 | 1.055174237 | 1.055102159 | 1.054840606 |
| Chambers | 1.073909859 | 1.068564258 | 1.071964580 | 1.066058433 |
| Galveston | 1.045802587 | 1.042998152 | 1.044060024 | 1.042177537 |

[1] Applied to 2017 TDM VMT (including intrazonal VMT) to estimate analysis year VMT.

## 2023 Intermediate Year Adjustment Factors[1]

| County | AM Peak | Mid-Day | PM Peak | Overnight |
|---|---|---|---|---|
| Harris | 0.972578312 | 0.974335813 | 0.972482959 | 0.970146960 |
| Brazoria | 0.954088557 | 0.960407218 | 0.955718702 | 0.956582580 |
| Fort Bend | 0.947206042 | 0.949725592 | 0.947282821 | 0.948155687 |
| Waller | 0.958978071 | 0.962448351 | 0.960704635 | 0.960453463 |
| Montgomery | 0.953394928 | 0.959685261 | 0.955418258 | 0.957123153 |
| Liberty | 0.963426084 | 0.964829441 | 0.964873381 | 0.965032872 |
| Chambers | 0.953574833 | 0.956752424 | 0.954728110 | 0.958251100 |
| Galveston | 0.970584889 | 0.972323929 | 0.971664543 | 0.972834270 |

[1] Applied to 2025 TDM VMT (including intrazonal VMT) to estimate analysis year VMT.

## 2026 Intermediate Year Adjustment Factors[1]

| County | AM Peak | Mid-Day | PM Peak | Overnight |
|---|---|---|---|---|
| Harris | 1.013999427 | 1.013084491 | 1.014049138 | 1.015269259 |
| Brazoria | 1.023777679 | 1.020404329 | 1.022904190 | 1.022442200 |
| Fort Bend | 1.027490394 | 1.026126561 | 1.027448753 | 1.026975713 |
| Waller | 1.021164390 | 1.019321732 | 1.020246367 | 1.020379763 |
| Montgomery | 1.024150028 | 1.020788074 | 1.023065011 | 1.022153427 |
| Liberty | 1.018804372 | 1.018063170 | 1.018039988 | 1.017955859 |
| Chambers | 1.024053414 | 1.022351443 | 1.023434717 | 1.021551667 |
| Galveston | 1.015040188 | 1.014132061 | 1.014476106 | 1.013866024 |

[1] Calculated as one year increment between 2017 and 2025 TDMs and applied to 2025 TDM VMT (including intrazonal VMT) to estimate analysis year VMT.

# APPENDIX F:
# CAPACITY FACTORS, SPEED FACTORS, AND SPEED REDUCTION FACTORS

**Capacity Factors**

| Time of Day Assignment | Capacity Factor[22] |
|---|---|
| AM Peak | 0.3333333 |
| Mid-Day | 0.1666667 |
| PM Peak | 0.2500000 |
| Overnight | 0.0909091 |

**Free-Flow (Volume = 1) Speed Factors for Houston/Galveston Speed Model**

| Functional Group | Area Type | | | | |
|---|---|---|---|---|---|
| | CBD | Urban | Urban Fringe | Suburban | Rural |
| Freeways, Interstates | 1.147400 | 1.177508 | 1.157272 | 1.197842 | 1.137903 |
| Principal Arterials | 1.136702 | 0.860413 | 0.887801 | 1.002511 | 1.018546 |
| Other Arterials, Major Collectors | 1.145946 | 0.811981 | 0.813370 | 0.813370 | 1.112661 |
| Collectors | 1.235367 | 0.857297 | 0.889344 | 0.974734 | 1.033400 |
| Toll Roads | 1.054545 | 1.100000 | 1.081379 | 1.057097 | 1.077846 |
| Ramps | 1.235367 | 0.857297 | 0.889344 | 0.974734 | 1.033400 |
| Locals | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |

[22] To obtain hourly capacities, a single capacity factor for each time-of-day assignment is used for all area types and function classes.

**LOS E (V/C = 1.0) Speed Factors for Houston/Galveston Speed Model**

| Functional Group | Area Type | | | | |
|---|---|---|---|---|---|
| | CBD | Urban | Urban Fringe | Suburban | Rural |
| Freeways, Interstates | 0.700000 | 0.768691 | 0.737693 | 0.715108 | 0.645161 |
| Principal Arterials | 0.703191 | 0.578709 | 0.633464 | 0.750628 | 0.458973 |
| Other Arterials, Major Collectors | 0.677477 | 0.560596 | 0.613733 | 0.870193 | 0.517909 |
| Collectors | 0.727049 | 0.567228 | 0.642497 | 0.761987 | 0.554081 |
| Toll Roads | 0.636364 | 0.636364 | 0.689705 | 0.645161 | 0.615385 |
| Ramps | 0.727049 | 0.567228 | 0.642497 | 0.761987 | 0.554081 |
| Locals | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |

**Functional Classification to Functional Group Relationship for the Application of and Speed Factors**

| Functional Group | Corresponding Network Functional Classifications |
|---|---|
| Freeways, Interstates | 1. Urban Interstate Freeways<br>2. Urban Other Freeways<br>10. Rural Interstate Freeways<br>11. Rural Other Freeways |
| Principal Arterials | 5. Urban Principal Arterials<br>12. Rural Principal Arterials |
| Other Arterials, Major Collectors | 6. Urban Other Arterials<br>13. Rural Other Arterials<br>14. Rural Major Collectors |
| Collectors | 7. Urban Collectors<br>15. Rural Collectors |
| Toll Roads | 3. Toll Roads |
| Ramps | 4. Ramps |
| Locals | 8. Locals (Centroid Connectors)<br>40. Locals (Intrazonals) |

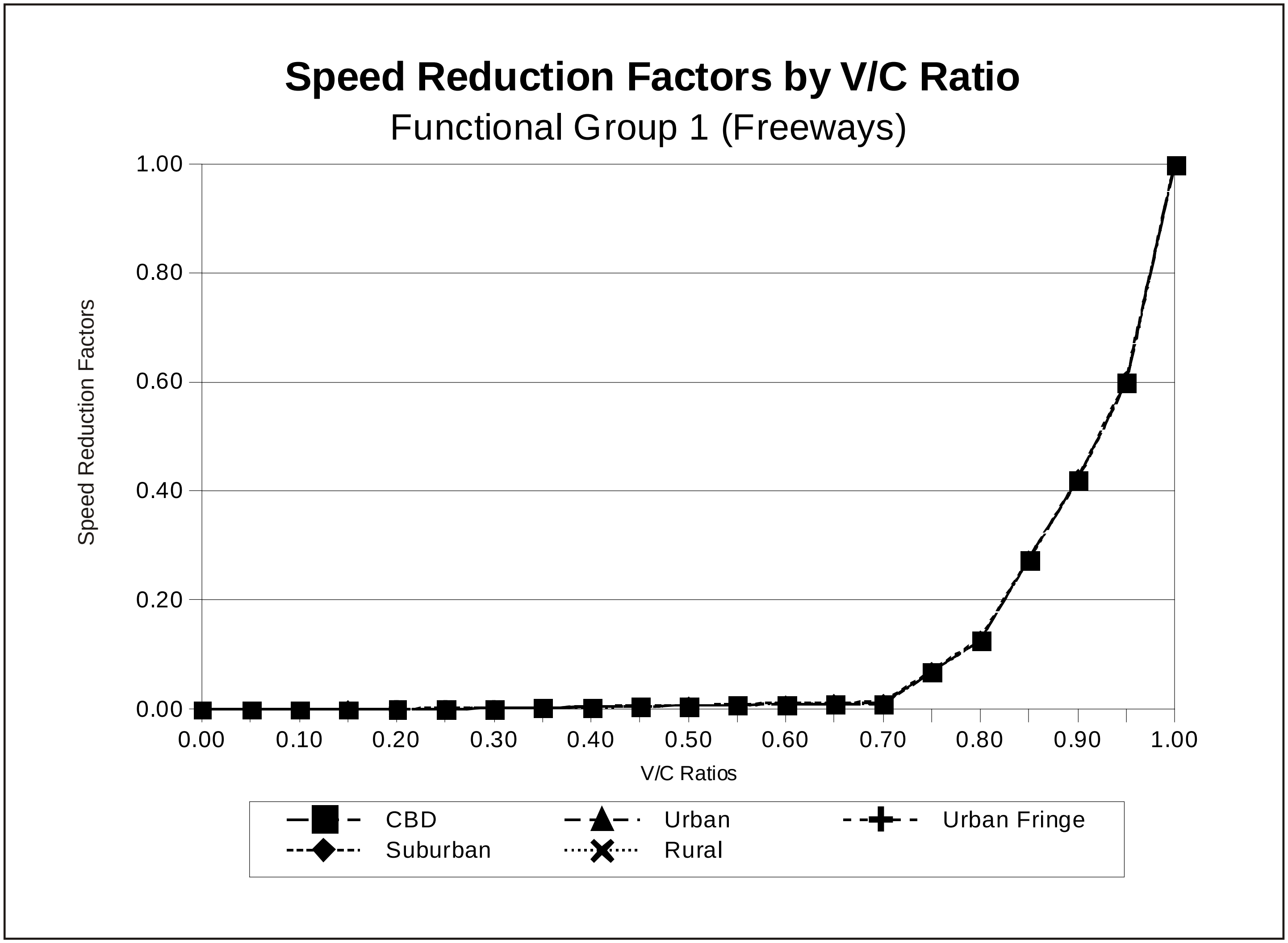



**Figure 1. Freeway Speed Reduction Factors by V/C Ratio.**

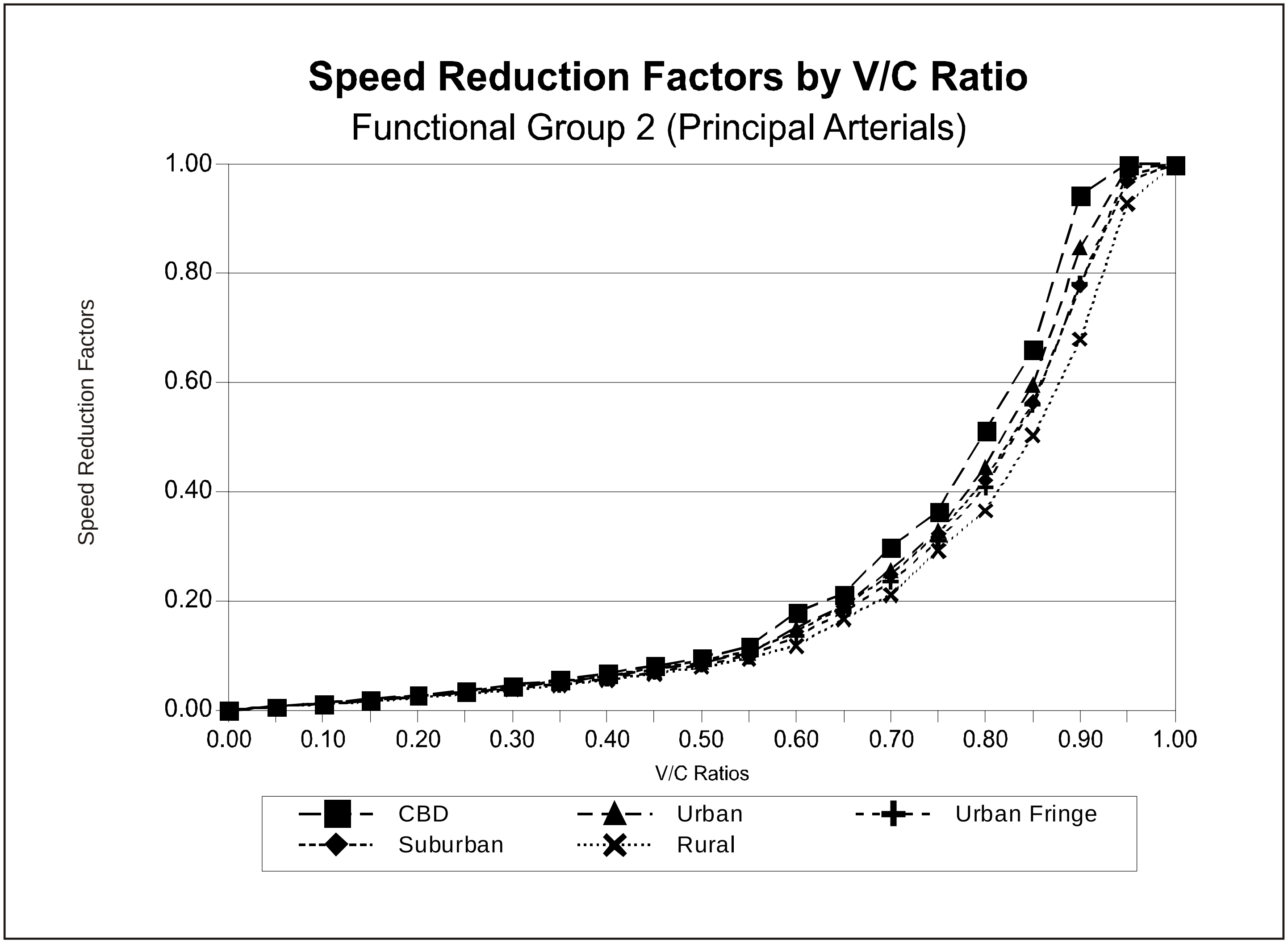



**Figure 2. Principal Arterial Speed Reduction Factors by V/C Ratio.**

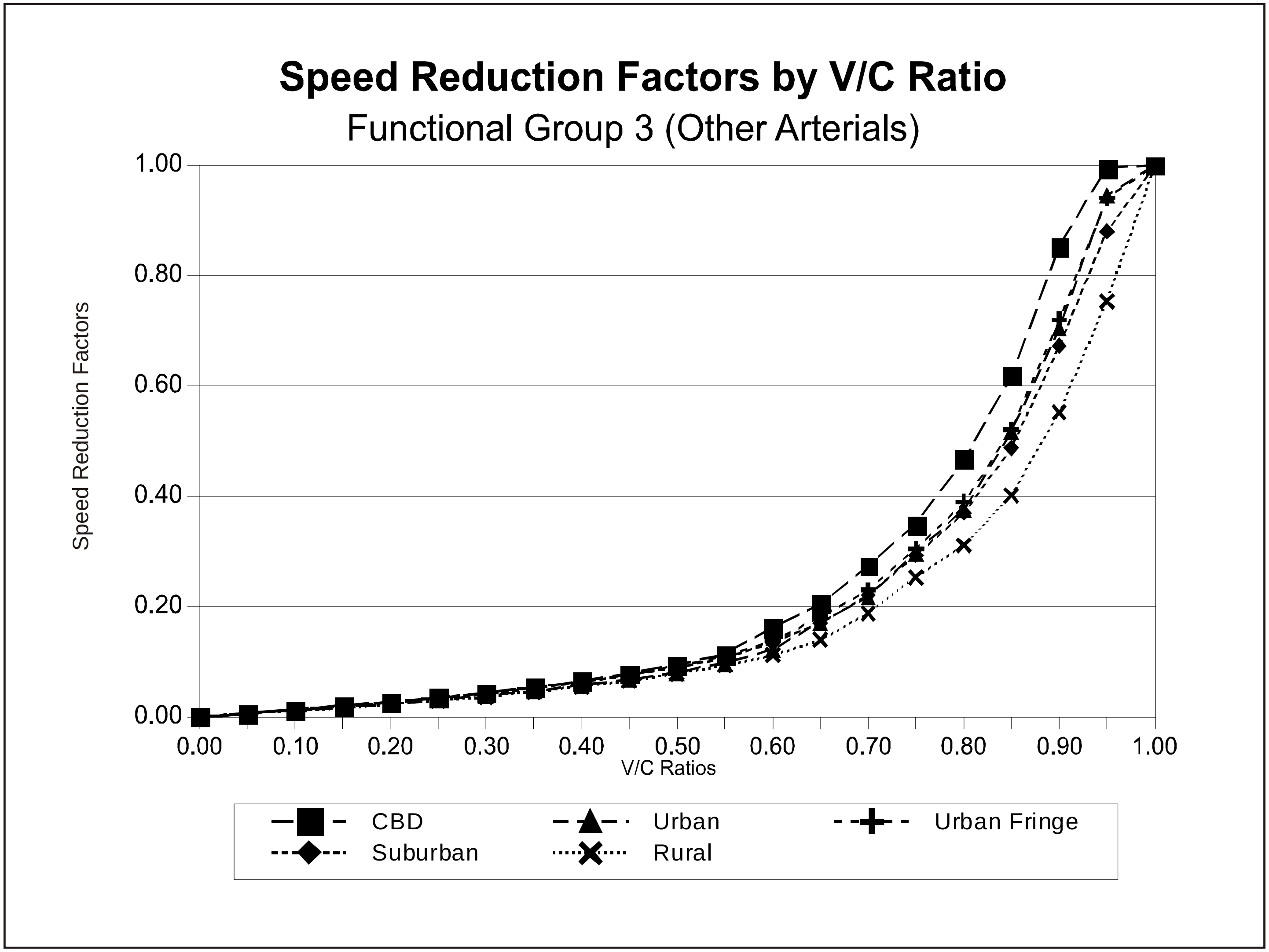



**Figure 3. Other Arterial Speed Reduction Factors by V/C Ratio.**

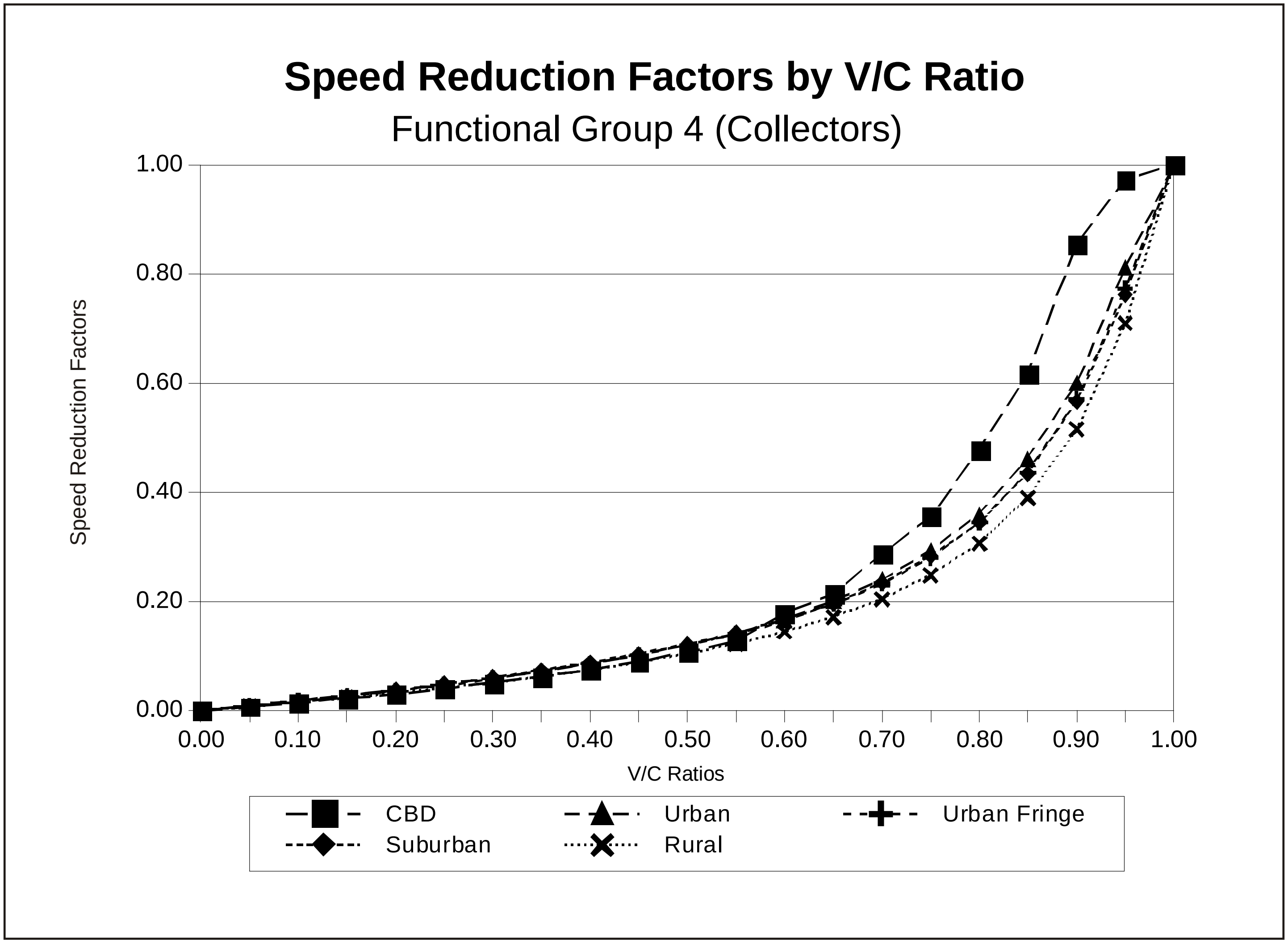



**Figure 4. Collector Speed Reduction Factors by V/C Ratio.**

**Functional Classification to Functional Group Relationship for the Application of Speed Reduction Factors**

| Functional Group | Corresponding Network Functional Classifications |
|---|---|
| 1. Freeways, Interstates | 1. Urban Interstate Freeways<br>2. Urban Other Freeways<br>3. Toll Roads<br>10. Rural Interstate Freeways<br>11. Rural Other Freeways |
| 2. Principal Arterials | 5. Urban Principal Arterials<br>12. Rural Principal Arterials |
| 3. Other Arterials, Major Collectors | 6. Urban Other Arterials<br>13. Rural Other Arterials<br>14. Rural Major Collectors |
| 4. Collectors | 4. Ramps<br>7. Urban Collectors<br>15. Rural Collectors |

# APPENDIX G:
# VEHICLE POPULATION ESTIMATES AND 24-HOUR SHP, STARTS, AND SHI SUMMARIES

## 2011 Vehicle Population Estimates

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 5,474 | 403 | 868 | 46 | 602 | 78 | 42 | 388 |
| 21_G | 1,819,720 | 134,072 | 288,459 | 15,195 | 199,974 | 26,041 | 13,995 | 128,978 |
| 31_D | 9,925 | 1,031 | 1,225 | 163 | 1,419 | 316 | 170 | 913 |
| 31_G | 573,212 | 59,514 | 70,721 | 9,442 | 81,959 | 18,253 | 9,826 | 52,745 |
| 32_D | 23,329 | 2,422 | 2,878 | 384 | 3,336 | 731 | 393 | 2,147 |
| 32_G | 171,064 | 17,761 | 21,105 | 2,818 | 24,459 | 5,459 | 2,939 | 15,741 |
| 51_D | 570 | 65 | 52 | 15 | 83 | 26 | 13 | 45 |
| 51_G | 293 | 33 | 27 | 8 | 43 | 6 | 3 | 23 |
| 52_D | 28,399 | 3,224 | 2,597 | 745 | 4,137 | 1,440 | 743 | 2,245 |
| 52_G | 14,754 | 1,675 | 1,349 | 387 | 2,149 | 356 | 183 | 1,166 |
| 53_D | 4,928 | 559 | 451 | 129 | 718 | 66 | 34 | 390 |
| 53_G | 2,557 | 290 | 234 | 67 | 372 | 16 | 8 | 202 |
| 54_D | 1,679 | 191 | 154 | 44 | 245 | 76 | 39 | 133 |
| 54_G | 862 | 98 | 79 | 23 | 126 | 19 | 10 | 68 |
| 41_D | 1,941 | 220 | 177 | 51 | 283 | 70 | 36 | 153 |
| 42_D | 601 | 68 | 55 | 16 | 87 | 22 | 11 | 47 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 2,172 | 247 | 199 | 57 | 316 | 78 | 40 | 172 |
| 43_G | 15 | 2 | 1 | 0 | 2 | 1 | 0 | 1 |
| 61_D | 16,005 | 844 | 1,122 | 195 | 1,153 | 372 | 145 | 513 |
| 61_G | 1,487 | 78 | 104 | 18 | 107 | 38 | 15 | 48 |
| 62_D | 15,082 | 795 | 1,057 | 184 | 1,086 | 686 | 268 | 484 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 47,961 | 7,223 | 7,748 | 870 | 10,976 | 1,829 | 1,010 | 7,923 |

## 2014 Vehicle Population Estimates

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 6,796 | 617 | 1,253 | 66 | 746 | 92 | 46 | 514 |
| 21_G | 1,690,766 | 153,575 | 311,722 | 16,455 | 185,558 | 30,757 | 15,174 | 127,842 |
| 31_D | 10,297 | 1,318 | 1,478 | 198 | 1,470 | 416 | 206 | 1,011 |
| 31_G | 532,093 | 68,107 | 76,353 | 10,214 | 75,979 | 21,516 | 10,632 | 52,231 |
| 32_D | 19,884 | 2,545 | 2,853 | 382 | 2,839 | 804 | 397 | 1,952 |
| 32_G | 160,886 | 20,593 | 23,086 | 3,088 | 22,973 | 6,507 | 3,216 | 15,793 |
| 51_D | 401 | 56 | 43 | 12 | 58 | 23 | 11 | 34 |
| 51_G | 201 | 28 | 21 | 6 | 29 | 6 | 3 | 17 |
| 52_D | 26,530 | 3,713 | 2,822 | 811 | 3,859 | 1,708 | 809 | 2,237 |
| 52_G | 13,788 | 1,930 | 1,467 | 421 | 2,006 | 422 | 200 | 1,163 |
| 53_D | 4,615 | 646 | 491 | 141 | 671 | 79 | 37 | 389 |
| 53_G | 2,394 | 335 | 255 | 73 | 348 | 19 | 9 | 202 |
| 54_D | 1,562 | 219 | 166 | 48 | 227 | 89 | 42 | 132 |
| 54_G | 803 | 112 | 85 | 25 | 117 | 22 | 10 | 68 |
| 41_D | 1,835 | 257 | 195 | 56 | 267 | 83 | 39 | 155 |
| 42_D | 545 | 76 | 58 | 17 | 79 | 25 | 12 | 46 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 2,021 | 283 | 215 | 62 | 294 | 92 | 43 | 170 |
| 43_G | 14 | 2 | 2 | 0 | 2 | 1 | 0 | 1 |
| 61_D | 14,885 | 967 | 1,213 | 211 | 1,071 | 440 | 158 | 509 |
| 61_G | 1,383 | 90 | 113 | 20 | 100 | 45 | 16 | 47 |
| 62_D | 14,027 | 912 | 1,143 | 199 | 1,009 | 811 | 290 | 480 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 44,607 | 8,282 | 8,381 | 943 | 10,195 | 2,160 | 1,095 | 7,861 |

## 2017 Vehicle Population Estimates

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 7,074 | 638 | 1,363 | 69 | 824 | 96 | 47 | 527 |
| 21_G | 1,759,732 | 158,677 | 339,041 | 17,159 | 204,912 | 32,012 | 15,745 | 131,012 |
| 31_D | 10,717 | 1,362 | 1,607 | 206 | 1,624 | 433 | 213 | 1,036 |
| 31_G | 553,797 | 70,370 | 83,044 | 10,652 | 83,904 | 22,393 | 11,032 | 53,527 |
| 32_D | 20,695 | 2,630 | 3,103 | 398 | 3,135 | 837 | 412 | 2,000 |
| 32_G | 167,449 | 21,277 | 25,110 | 3,221 | 25,370 | 6,772 | 3,337 | 16,185 |
| 51_D | 418 | 58 | 46 | 13 | 64 | 24 | 11 | 35 |
| 51_G | 209 | 29 | 23 | 6 | 32 | 6 | 3 | 17 |
| 52_D | 27,612 | 3,836 | 3,069 | 846 | 4,262 | 1,778 | 839 | 2,293 |
| 52_G | 14,350 | 1,994 | 1,595 | 439 | 2,215 | 439 | 207 | 1,192 |
| 53_D | 4,803 | 667 | 534 | 147 | 741 | 82 | 39 | 399 |
| 53_G | 2,491 | 346 | 277 | 76 | 384 | 20 | 9 | 207 |
| 54_D | 1,626 | 226 | 181 | 50 | 251 | 93 | 44 | 135 |
| 54_G | 835 | 116 | 93 | 26 | 129 | 23 | 11 | 69 |
| 41_D | 1,909 | 265 | 212 | 58 | 295 | 87 | 41 | 159 |
| 42_D | 567 | 79 | 63 | 17 | 87 | 26 | 12 | 47 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 2,103 | 292 | 234 | 64 | 325 | 95 | 45 | 175 |
| 43_G | 15 | 2 | 2 | 0 | 2 | 1 | 0 | 1 |
| 61_D | 15,493 | 999 | 1,320 | 220 | 1,183 | 458 | 163 | 522 |
| 61_G | 1,440 | 93 | 123 | 20 | 110 | 46 | 17 | 49 |
| 62_D | 14,599 | 942 | 1,244 | 208 | 1,114 | 844 | 301 | 492 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 46,427 | 8,557 | 9,116 | 983 | 11,258 | 2,248 | 1,136 | 8,056 |

## 2020 Vehicle Population Estimates

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 7,374 | 682 | 1,476 | 73 | 881 | 135 | 67 | 550 |
| 21_G | 1,834,477 | 169,555 | 367,255 | 18,216 | 219,053 | 33,756 | 16,829 | 136,756 |
| 31_D | 12,370 | 1,611 | 1,927 | 242 | 1,922 | 506 | 253 | 1,197 |
| 31_G | 576,089 | 75,034 | 89,763 | 11,284 | 89,503 | 23,588 | 11,779 | 55,754 |
| 32_D | 20,802 | 2,709 | 3,241 | 407 | 3,232 | 851 | 425 | 2,013 |
| 32_G | 175,365 | 22,841 | 27,324 | 3,435 | 27,245 | 7,181 | 3,586 | 16,972 |
| 51_D | 327 | 47 | 38 | 10 | 52 | 19 | 9 | 27 |
| 51_G | 171 | 24 | 20 | 5 | 27 | 4 | 2 | 14 |
| 52_D | 28,926 | 4,119 | 3,341 | 902 | 4,578 | 1,885 | 902 | 2,405 |
| 52_G | 15,031 | 2,141 | 1,736 | 469 | 2,379 | 466 | 223 | 1,250 |
| 53_D | 5,026 | 716 | 580 | 157 | 795 | 87 | 42 | 418 |
| 53_G | 2,614 | 372 | 302 | 82 | 414 | 21 | 10 | 217 |
| 54_D | 1,649 | 235 | 190 | 51 | 261 | 96 | 46 | 137 |
| 54_G | 856 | 122 | 99 | 27 | 135 | 24 | 11 | 71 |
| 41_D | 2,007 | 286 | 232 | 63 | 318 | 92 | 44 | 167 |
| 42_D | 576 | 82 | 66 | 18 | 91 | 27 | 13 | 48 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 2,194 | 312 | 253 | 68 | 347 | 101 | 48 | 182 |
| 43_G | 16 | 2 | 2 | 0 | 2 | 1 | 0 | 1 |
| 61_D | 16,151 | 1,068 | 1,430 | 234 | 1,264 | 483 | 175 | 545 |
| 61_G | 1,501 | 99 | 133 | 22 | 117 | 49 | 18 | 51 |
| 62_D | 15,219 | 1,006 | 1,347 | 220 | 1,191 | 890 | 322 | 513 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 48,399 | 9,144 | 9,874 | 1,044 | 12,035 | 2,373 | 1,216 | 8,409 |

**2023 Vehicle Population Estimates**

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 7,687 | 728 | 1,599 | 78 | 941 | 143 | 72 | 574 |
| 21_G | 1,912,402 | 181,181 | 397,819 | 19,338 | 234,172 | 35,630 | 18,006 | 142,751 |
| 31_D | 14,101 | 1,883 | 2,283 | 281 | 2,247 | 559 | 283 | 1,367 |
| 31_G | 599,388 | 80,022 | 97,044 | 11,955 | 95,494 | 24,873 | 12,590 | 58,085 |
| 32_D | 21,464 | 2,866 | 3,475 | 428 | 3,420 | 899 | 455 | 2,080 |
| 32_G | 183,003 | 24,432 | 29,629 | 3,650 | 29,156 | 7,580 | 3,837 | 17,734 |
| 51_D | 292 | 43 | 35 | 9 | 47 | 18 | 9 | 24 |
| 51_G | 162 | 24 | 19 | 5 | 26 | 4 | 2 | 14 |
| 52_D | 30,187 | 4,407 | 3,623 | 959 | 4,899 | 1,993 | 966 | 2,513 |
| 52_G | 15,686 | 2,290 | 1,882 | 498 | 2,546 | 492 | 239 | 1,306 |
| 53_D | 5,239 | 765 | 629 | 166 | 850 | 92 | 45 | 436 |
| 53_G | 2,725 | 398 | 327 | 87 | 442 | 22 | 11 | 227 |
| 54_D | 1,719 | 251 | 206 | 55 | 279 | 101 | 49 | 143 |
| 54_G | 892 | 130 | 107 | 28 | 145 | 25 | 12 | 74 |
| 41_D | 2,109 | 308 | 253 | 67 | 342 | 97 | 47 | 176 |
| 42_D | 600 | 88 | 72 | 19 | 97 | 28 | 13 | 50 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 2,287 | 334 | 274 | 73 | 371 | 106 | 52 | 190 |
| 43_G | 16 | 2 | 2 | 1 | 3 | 1 | 1 | 1 |
| 61_D | 16,837 | 1,141 | 1,549 | 248 | 1,351 | 510 | 187 | 569 |
| 61_G | 1,565 | 106 | 144 | 23 | 126 | 52 | 19 | 53 |
| 62_D | 15,866 | 1,075 | 1,459 | 234 | 1,273 | 940 | 345 | 536 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 50,455 | 9,771 | 10,696 | 1,108 | 12,866 | 2,505 | 1,301 | 8,778 |

## 2026 Vehicle Population Estimates

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 8,014 | 778 | 1,732 | 83 | 1,006 | 151 | 77 | 599 |
| 21_G | 1,993,647 | 193,607 | 430,927 | 20,529 | 250,338 | 37,609 | 19,265 | 149,009 |
| 31_D | 14,700 | 2,012 | 2,473 | 299 | 2,402 | 590 | 303 | 1,426 |
| 31_G | 624,852 | 85,510 | 105,120 | 12,692 | 102,086 | 26,254 | 13,471 | 60,631 |
| 32_D | 22,376 | 3,062 | 3,764 | 455 | 3,656 | 949 | 487 | 2,171 |
| 32_G | 190,777 | 26,108 | 32,095 | 3,875 | 31,169 | 8,001 | 4,105 | 18,512 |
| 51_D | 304 | 46 | 38 | 10 | 51 | 19 | 9 | 25 |
| 51_G | 169 | 25 | 21 | 5 | 28 | 4 | 2 | 14 |
| 52_D | 31,470 | 4,709 | 3,924 | 1,018 | 5,238 | 2,103 | 1,034 | 2,623 |
| 52_G | 16,352 | 2,447 | 2,039 | 529 | 2,722 | 519 | 255 | 1,363 |
| 53_D | 5,462 | 817 | 681 | 177 | 909 | 97 | 48 | 455 |
| 53_G | 2,841 | 425 | 354 | 92 | 473 | 24 | 12 | 237 |
| 54_D | 1,792 | 268 | 224 | 58 | 298 | 107 | 52 | 149 |
| 54_G | 930 | 139 | 116 | 30 | 155 | 26 | 13 | 78 |
| 41_D | 2,198 | 329 | 274 | 71 | 366 | 103 | 51 | 183 |
| 42_D | 626 | 94 | 78 | 20 | 104 | 29 | 14 | 52 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 2,384 | 357 | 297 | 77 | 397 | 112 | 55 | 199 |
| 43_G | 17 | 3 | 2 | 1 | 3 | 1 | 1 | 1 |
| 61_D | 17,552 | 1,219 | 1,677 | 264 | 1,445 | 538 | 200 | 594 |
| 61_G | 1,631 | 113 | 156 | 24 | 134 | 55 | 20 | 55 |
| 62_D | 16,540 | 1,149 | 1,581 | 248 | 1,361 | 992 | 369 | 559 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 52,598 | 10,441 | 11,586 | 1,177 | 13,754 | 2,644 | 1,392 | 9,163 |

## 2011 24-Hour Weekday SHP Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 124,841 | 9,362 | 20,265 | 1,015 | 13,809 | 1,776 | 919 | 8,986 |
| 21_G | 41,500,346 | 3,112,077 | 6,736,304 | 337,423 | 4,590,223 | 590,619 | 305,479 | 2,987,226 |
| 31_D | 230,770 | 24,295 | 28,675 | 3,796 | 33,226 | 7,380 | 3,926 | 21,523 |
| 31_G | 13,327,047 | 1,403,038 | 1,655,981 | 219,206 | 1,918,829 | 426,063 | 226,666 | 1,242,967 |
| 32_D | 542,401 | 57,102 | 67,397 | 8,922 | 78,095 | 17,057 | 9,075 | 50,587 |
| 32_G | 3,977,221 | 418,711 | 494,198 | 65,418 | 572,640 | 127,432 | 67,794 | 370,941 |
| 51_D | 12,654 | 1,490 | 1,151 | 339 | 1,874 | 580 | 284 | 1,026 |
| 51_G | 6,497 | 765 | 591 | 174 | 962 | 145 | 71 | 527 |
| 52_D | 631,010 | 74,279 | 57,370 | 16,908 | 93,427 | 32,274 | 15,814 | 51,157 |
| 52_G | 327,816 | 38,589 | 29,804 | 8,784 | 48,536 | 7,971 | 3,906 | 26,577 |
| 53_D | 109,057 | 12,867 | 9,922 | 2,933 | 16,175 | 1,475 | 720 | 8,857 |
| 53_G | 56,567 | 6,674 | 5,146 | 1,521 | 8,390 | 365 | 178 | 4,594 |
| 54_D | 37,292 | 4,390 | 3,391 | 1,000 | 5,522 | 1,696 | 831 | 3,024 |
| 54_G | 19,137 | 2,254 | 1,740 | 513 | 2,835 | 418 | 204 | 1,552 |
| 41_D | 42,495 | 5,094 | 3,912 | 1,178 | 6,405 | 1,573 | 755 | 3,478 |
| 42_D | 13,142 | 1,576 | 1,210 | 364 | 1,982 | 490 | 235 | 1,076 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 47,571 | 5,701 | 4,379 | 1,318 | 7,169 | 1,754 | 841 | 3,893 |
| 43_G | 324 | 40 | 30 | 9 | 50 | 17 | 8 | 27 |
| 61_D | 348,602 | 17,647 | 23,144 | 3,379 | 22,548 | 7,373 | 1,047 | 10,465 |
| 61_G | 32,400 | 1,640 | 2,151 | 314 | 2,096 | 747 | 106 | 973 |
| 62_D | 327,746 | 16,583 | 21,664 | 3,042 | 21,016 | 13,513 | 1,518 | 9,808 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 1,148,880 | 173,246 | 185,764 | 20,853 | 263,214 | 43,862 | 24,210 | 190,043 |

## 2014 24-Hour Weekday SHP Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 155,009 | 14,329 | 29,252 | 1,460 | 17,119 | 2,098 | 983 | 11,900 |
| 21_G | 38,561,383 | 3,564,718 | 7,277,146 | 363,293 | 4,258,770 | 697,832 | 326,988 | 2,960,387 |
| 31_D | 239,449 | 31,076 | 34,589 | 4,583 | 34,426 | 9,719 | 4,725 | 23,821 |
| 31_G | 12,373,389 | 1,605,828 | 1,787,381 | 236,811 | 1,778,950 | 502,376 | 244,216 | 1,230,933 |
| 32_D | 462,382 | 60,009 | 66,793 | 8,849 | 66,478 | 18,781 | 9,130 | 45,999 |
| 32_G | 3,741,256 | 485,545 | 540,439 | 71,603 | 537,890 | 151,936 | 73,860 | 372,190 |
| 51_D | 8,923 | 1,295 | 943 | 278 | 1,319 | 514 | 228 | 772 |
| 51_G | 4,451 | 646 | 470 | 139 | 658 | 131 | 58 | 385 |
| 52_D | 589,676 | 85,575 | 62,285 | 18,361 | 87,144 | 38,313 | 16,967 | 50,988 |
| 52_G | 306,460 | 44,474 | 32,370 | 9,542 | 45,290 | 9,462 | 4,191 | 26,499 |
| 53_D | 102,201 | 14,862 | 10,800 | 3,193 | 15,130 | 1,754 | 773 | 8,851 |
| 53_G | 52,996 | 7,707 | 5,600 | 1,656 | 7,846 | 431 | 190 | 4,590 |
| 54_D | 34,719 | 5,039 | 3,668 | 1,081 | 5,132 | 2,005 | 888 | 3,002 |
| 54_G | 17,817 | 2,587 | 1,882 | 555 | 2,634 | 494 | 218 | 1,541 |
| 41_D | 40,216 | 5,939 | 4,299 | 1,295 | 6,051 | 1,879 | 810 | 3,509 |
| 42_D | 11,937 | 1,763 | 1,276 | 384 | 1,796 | 559 | 241 | 1,042 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 44,299 | 6,542 | 4,736 | 1,426 | 6,665 | 2,072 | 893 | 3,865 |
| 43_G | 302 | 46 | 32 | 10 | 46 | 20 | 9 | 27 |
| 61_D | 323,548 | 20,188 | 24,924 | 3,513 | 20,738 | 8,675 | 990 | 10,341 |
| 61_G | 30,071 | 1,876 | 2,317 | 327 | 1,928 | 879 | 100 | 961 |
| 62_D | 303,960 | 18,962 | 23,320 | 3,124 | 19,270 | 15,890 | 1,272 | 9,686 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 1,068,544 | 198,648 | 200,945 | 22,601 | 244,483 | 51,806 | 26,245 | 188,558 |

## 2017 24-Hour Weekday SHP Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 161,279 | 14,787 | 31,795 | 1,523 | 18,891 | 2,175 | 1,023 | 12,176 |
| 21_G | 40,121,173 | 3,678,494 | 7,909,708 | 378,811 | 4,699,445 | 723,400 | 340,257 | 3,029,110 |
| 31_D | 249,150 | 32,085 | 37,594 | 4,777 | 38,007 | 10,096 | 4,907 | 24,391 |
| 31_G | 12,874,658 | 1,657,980 | 1,942,650 | 246,881 | 1,964,041 | 521,840 | 253,636 | 1,260,395 |
| 32_D | 481,114 | 61,957 | 72,595 | 9,226 | 73,395 | 19,509 | 9,482 | 47,100 |
| 32_G | 3,892,822 | 501,314 | 587,387 | 74,648 | 593,855 | 157,823 | 76,709 | 381,098 |
| 51_D | 9,281 | 1,336 | 1,023 | 290 | 1,456 | 532 | 237 | 789 |
| 51_G | 4,630 | 667 | 510 | 144 | 726 | 136 | 61 | 394 |
| 52_D | 613,312 | 88,272 | 67,580 | 19,138 | 96,183 | 39,686 | 17,670 | 52,126 |
| 52_G | 318,744 | 45,876 | 35,122 | 9,947 | 49,988 | 9,802 | 4,364 | 27,091 |
| 53_D | 106,298 | 15,329 | 11,716 | 3,328 | 16,698 | 1,816 | 806 | 9,048 |
| 53_G | 55,121 | 7,950 | 6,076 | 1,726 | 8,659 | 446 | 198 | 4,692 |
| 54_D | 36,111 | 5,198 | 3,979 | 1,127 | 5,664 | 2,077 | 925 | 3,069 |
| 54_G | 18,531 | 2,669 | 2,042 | 579 | 2,907 | 511 | 227 | 1,576 |
| 41_D | 41,833 | 6,128 | 4,667 | 1,350 | 6,676 | 1,948 | 845 | 3,586 |
| 42_D | 12,417 | 1,819 | 1,385 | 401 | 1,982 | 579 | 251 | 1,065 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 46,080 | 6,750 | 5,141 | 1,487 | 7,354 | 2,148 | 932 | 3,951 |
| 43_G | 314 | 47 | 35 | 10 | 51 | 21 | 9 | 27 |
| 61_D | 336,407 | 20,743 | 26,985 | 3,673 | 22,864 | 8,919 | 1,059 | 10,535 |
| 61_G | 31,266 | 1,928 | 2,508 | 342 | 2,125 | 904 | 107 | 979 |
| 62_D | 315,989 | 19,481 | 25,251 | 3,272 | 21,251 | 16,334 | 1,389 | 9,868 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 1,112,117 | 205,242 | 218,551 | 23,568 | 269,981 | 53,916 | 27,233 | 193,230 |

## 2020 24-Hour Weekday SHP Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 168,042 | 15,798 | 34,430 | 1,617 | 20,185 | 3,055 | 1,457 | 12,709 |
| 21_G | 41,803,085 | 3,930,030 | 8,565,182 | 402,113 | 5,021,432 | 762,563 | 363,539 | 3,161,605 |
| 31_D | 287,502 | 37,958 | 45,076 | 5,616 | 44,977 | 11,783 | 5,805 | 28,189 |
| 31_G | 13,388,790 | 1,767,719 | 2,099,175 | 261,521 | 2,094,556 | 549,603 | 270,763 | 1,312,773 |
| 32_D | 483,471 | 63,832 | 75,801 | 9,444 | 75,635 | 19,837 | 9,773 | 47,404 |
| 32_G | 4,075,633 | 538,105 | 639,002 | 79,609 | 637,596 | 167,313 | 82,427 | 399,616 |
| 51_D | 7,258 | 1,071 | 831 | 231 | 1,167 | 418 | 189 | 618 |
| 51_G | 3,800 | 561 | 435 | 121 | 611 | 99 | 44 | 324 |
| 52_D | 642,148 | 94,778 | 73,503 | 20,418 | 103,277 | 42,065 | 18,983 | 54,674 |
| 52_G | 333,678 | 49,250 | 38,194 | 10,610 | 53,666 | 10,390 | 4,689 | 28,411 |
| 53_D | 111,143 | 16,437 | 12,725 | 3,546 | 17,905 | 1,928 | 867 | 9,477 |
| 53_G | 57,808 | 8,549 | 6,618 | 1,844 | 9,313 | 471 | 211 | 4,929 |
| 54_D | 36,584 | 5,402 | 4,188 | 1,164 | 5,886 | 2,137 | 964 | 3,116 |
| 54_G | 18,984 | 2,803 | 2,173 | 604 | 3,054 | 529 | 239 | 1,617 |
| 41_D | 43,949 | 6,603 | 5,095 | 1,446 | 7,194 | 2,067 | 909 | 3,775 |
| 42_D | 12,601 | 1,893 | 1,460 | 415 | 2,063 | 601 | 264 | 1,083 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 48,009 | 7,215 | 5,565 | 1,580 | 7,860 | 2,279 | 1,002 | 4,125 |
| 43_G | 327 | 50 | 38 | 11 | 54 | 22 | 10 | 28 |
| 61_D | 350,396 | 22,156 | 29,183 | 3,899 | 24,399 | 9,405 | 1,136 | 10,991 |
| 61_G | 32,566 | 2,059 | 2,712 | 362 | 2,268 | 953 | 115 | 1,022 |
| 62_D | 329,145 | 20,810 | 27,313 | 3,473 | 22,685 | 17,226 | 1,483 | 10,297 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 1,159,331 | 219,312 | 236,735 | 25,020 | 288,609 | 56,910 | 29,137 | 201,700 |

## 2023 24-Hour Weekday SHP Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 175,477 | 16,919 | 37,357 | 1,718 | 21,604 | 3,240 | 1,558 | 13,297 |
| 21_G | 43,653,240 | 4,208,847 | 9,293,437 | 427,411 | 5,374,343 | 808,637 | 388,833 | 3,308,007 |
| 31_D | 328,056 | 44,400 | 53,464 | 6,523 | 52,616 | 13,064 | 6,511 | 32,218 |
| 31_G | 13,944,678 | 1,887,313 | 2,272,588 | 277,261 | 2,236,524 | 580,937 | 289,517 | 1,369,490 |
| 32_D | 499,354 | 67,584 | 81,381 | 9,929 | 80,089 | 20,989 | 10,460 | 49,041 |
| 32_G | 4,257,514 | 576,225 | 693,855 | 84,652 | 682,844 | 177,034 | 88,227 | 418,126 |
| 51_D | 6,481 | 982 | 772 | 210 | 1,069 | 398 | 181 | 554 |
| 51_G | 3,617 | 547 | 431 | 117 | 596 | 93 | 42 | 309 |
| 52_D | 671,765 | 101,629 | 80,049 | 21,721 | 110,734 | 44,711 | 20,341 | 57,353 |
| 52_G | 349,047 | 52,807 | 41,593 | 11,286 | 57,537 | 11,044 | 5,024 | 29,801 |
| 53_D | 116,156 | 17,608 | 13,847 | 3,768 | 19,178 | 2,048 | 928 | 9,932 |
| 53_G | 60,420 | 9,159 | 7,202 | 1,960 | 9,975 | 500 | 226 | 5,166 |
| 54_D | 38,232 | 5,786 | 4,556 | 1,237 | 6,304 | 2,269 | 1,032 | 3,265 |
| 54_G | 19,838 | 3,002 | 2,364 | 642 | 3,271 | 561 | 255 | 1,694 |
| 41_D | 46,323 | 7,129 | 5,594 | 1,547 | 7,762 | 2,203 | 976 | 3,987 |
| 42_D | 13,185 | 2,029 | 1,592 | 441 | 2,210 | 624 | 277 | 1,135 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 50,234 | 7,732 | 6,066 | 1,678 | 8,418 | 2,404 | 1,065 | 4,324 |
| 43_G | 342 | 54 | 41 | 12 | 58 | 24 | 10 | 30 |
| 61_D | 365,869 | 23,781 | 31,635 | 4,160 | 26,214 | 10,004 | 1,189 | 11,589 |
| 61_G | 34,005 | 2,210 | 2,940 | 387 | 2,437 | 1,014 | 121 | 1,077 |
| 62_D | 343,596 | 22,329 | 29,580 | 3,705 | 24,366 | 18,315 | 1,522 | 10,857 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 1,208,652 | 234,359 | 256,452 | 26,562 | 308,536 | 60,074 | 31,175 | 210,550 |

## 2026 24-Hour Weekday SHP Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 182,835 | 18,076 | 40,454 | 1,824 | 23,083 | 3,419 | 1,666 | 13,879 |
| 21_G | 45,483,750 | 4,496,817 | 10,063,924 | 453,699 | 5,742,394 | 853,287 | 415,889 | 3,452,804 |
| 31_D | 341,890 | 47,442 | 57,897 | 6,924 | 56,232 | 13,788 | 6,965 | 33,629 |
| 31_G | 14,532,704 | 2,016,587 | 2,461,025 | 294,331 | 2,390,241 | 613,108 | 309,717 | 1,429,476 |
| 32_D | 520,411 | 72,213 | 88,128 | 10,540 | 85,594 | 22,152 | 11,190 | 51,189 |
| 32_G | 4,437,046 | 615,694 | 751,387 | 89,863 | 729,776 | 186,838 | 94,383 | 436,441 |
| 51_D | 6,752 | 1,049 | 835 | 223 | 1,142 | 420 | 194 | 578 |
| 51_G | 3,768 | 584 | 467 | 124 | 637 | 98 | 45 | 322 |
| 52_D | 699,874 | 108,584 | 86,638 | 23,058 | 118,306 | 47,177 | 21,754 | 59,862 |
| 52_G | 363,653 | 56,420 | 45,017 | 11,981 | 61,471 | 11,653 | 5,373 | 31,104 |
| 53_D | 121,008 | 18,813 | 14,985 | 4,000 | 20,487 | 2,161 | 992 | 10,367 |
| 53_G | 62,944 | 9,785 | 7,794 | 2,081 | 10,656 | 527 | 242 | 5,392 |
| 54_D | 39,831 | 6,182 | 4,931 | 1,313 | 6,735 | 2,394 | 1,103 | 3,408 |
| 54_G | 20,668 | 3,208 | 2,558 | 681 | 3,494 | 592 | 273 | 1,768 |
| 41_D | 48,245 | 7,617 | 6,054 | 1,643 | 8,292 | 2,325 | 1,044 | 4,161 |
| 42_D | 13,732 | 2,168 | 1,723 | 468 | 2,360 | 659 | 296 | 1,184 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 52,318 | 8,260 | 6,565 | 1,781 | 8,993 | 2,537 | 1,139 | 4,513 |
| 43_G | 356 | 58 | 45 | 12 | 62 | 25 | 11 | 31 |
| 61_D | 381,079 | 25,399 | 34,213 | 4,415 | 27,964 | 10,550 | 1,276 | 12,093 |
| 61_G | 35,418 | 2,361 | 3,180 | 410 | 2,599 | 1,069 | 129 | 1,124 |
| 62_D | 357,899 | 23,851 | 31,998 | 3,932 | 26,003 | 19,318 | 1,625 | 11,330 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 1,259,976 | 250,432 | 277,792 | 28,199 | 329,833 | 63,410 | 33,355 | 219,780 |

## 2011 24-Hour Weekday Starts Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 32,140 | 2,368 | 5,095 | 268 | 3,532 | 460 | 247 | 2,278 |
| 21_G | 10,683,585 | 787,136 | 1,693,546 | 89,212 | 1,174,051 | 152,885 | 82,164 | 757,231 |
| 31_D | 57,274 | 5,946 | 7,066 | 943 | 8,189 | 1,824 | 982 | 5,270 |
| 31_G | 3,307,703 | 343,422 | 408,093 | 54,482 | 472,942 | 105,328 | 56,699 | 304,365 |
| 32_D | 140,366 | 14,573 | 17,318 | 2,312 | 20,070 | 4,397 | 2,367 | 12,916 |
| 32_G | 1,029,265 | 106,863 | 126,987 | 16,953 | 147,166 | 32,848 | 17,682 | 94,710 |
| 51_D | 2,137 | 243 | 195 | 56 | 311 | 97 | 50 | 169 |
| 51_G | 1,097 | 125 | 100 | 29 | 160 | 24 | 13 | 87 |
| 52_D | 198,539 | 22,539 | 18,156 | 5,207 | 28,919 | 10,067 | 5,193 | 15,694 |
| 52_G | 103,145 | 11,709 | 9,433 | 2,705 | 15,024 | 2,486 | 1,282 | 8,153 |
| 53_D | 21,127 | 2,398 | 1,932 | 554 | 3,077 | 284 | 146 | 1,670 |
| 53_G | 10,960 | 1,244 | 1,002 | 287 | 1,596 | 70 | 36 | 866 |
| 54_D | 950 | 108 | 87 | 25 | 138 | 43 | 22 | 75 |
| 54_G | 488 | 55 | 45 | 13 | 71 | 11 | 5 | 39 |
| 41_D | 5,370 | 610 | 491 | 141 | 782 | 193 | 99 | 424 |
| 42_D | 2,750 | 312 | 251 | 72 | 401 | 99 | 51 | 217 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 12,482 | 1,417 | 1,141 | 327 | 1,818 | 446 | 230 | 987 |
| 43_G | 89 | 10 | 8 | 2 | 13 | 4 | 2 | 7 |
| 61_D | 94,910 | 5,003 | 6,652 | 1,156 | 6,837 | 2,208 | 862 | 3,044 |
| 61_G | 8,821 | 465 | 618 | 107 | 635 | 224 | 87 | 283 |
| 62_D | 64,654 | 3,408 | 4,532 | 787 | 4,657 | 2,942 | 1,148 | 2,074 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 21,338 | 3,213 | 3,447 | 387 | 4,883 | 814 | 449 | 3,525 |

## 2014 24-Hour Weekday Starts Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 39,901 | 3,624 | 7,357 | 388 | 4,379 | 543 | 268 | 3,017 |
| 21_G | 9,926,494 | 901,642 | 1,830,122 | 96,605 | 1,089,409 | 180,575 | 89,087 | 750,558 |
| 31_D | 59,419 | 7,606 | 8,526 | 1,141 | 8,485 | 2,402 | 1,187 | 5,833 |
| 31_G | 3,070,423 | 393,011 | 440,590 | 58,942 | 438,435 | 124,155 | 61,353 | 301,400 |
| 32_D | 119,638 | 15,314 | 17,167 | 2,297 | 17,083 | 4,840 | 2,392 | 11,744 |
| 32_G | 968,025 | 123,906 | 138,907 | 18,583 | 138,227 | 39,152 | 19,347 | 95,024 |
| 51_D | 1,505 | 211 | 160 | 46 | 219 | 86 | 41 | 127 |
| 51_G | 752 | 105 | 80 | 23 | 109 | 22 | 10 | 63 |
| 52_D | 185,468 | 25,957 | 19,727 | 5,669 | 26,979 | 11,943 | 5,655 | 15,640 |
| 52_G | 96,391 | 13,490 | 10,252 | 2,946 | 14,021 | 2,950 | 1,397 | 8,128 |
| 53_D | 19,784 | 2,769 | 2,104 | 605 | 2,878 | 337 | 160 | 1,668 |
| 53_G | 10,261 | 1,436 | 1,091 | 314 | 1,493 | 83 | 39 | 865 |
| 54_D | 884 | 124 | 94 | 27 | 129 | 51 | 24 | 75 |
| 54_G | 454 | 64 | 48 | 14 | 66 | 12 | 6 | 38 |
| 41_D | 5,077 | 710 | 540 | 155 | 738 | 230 | 109 | 428 |
| 42_D | 2,493 | 349 | 265 | 76 | 363 | 113 | 54 | 210 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 11,616 | 1,626 | 1,236 | 355 | 1,690 | 527 | 249 | 980 |
| 43_G | 82 | 12 | 9 | 3 | 12 | 5 | 2 | 7 |
| 61_D | 88,273 | 5,736 | 7,196 | 1,253 | 6,350 | 2,607 | 934 | 3,020 |
| 61_G | 8,204 | 533 | 669 | 116 | 590 | 264 | 95 | 281 |
| 62_D | 60,133 | 3,908 | 4,902 | 853 | 4,326 | 3,475 | 1,245 | 2,057 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 19,846 | 3,685 | 3,729 | 420 | 4,536 | 961 | 487 | 3,497 |

## 2017 24-Hour Weekday Starts Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 41,529 | 3,745 | 8,001 | 405 | 4,836 | 565 | 278 | 3,092 |
| 21_G | 10,331,400 | 931,593 | 1,990,512 | 100,738 | 1,203,042 | 187,940 | 92,438 | 769,175 |
| 31_D | 61,842 | 7,858 | 9,274 | 1,189 | 9,370 | 2,500 | 1,232 | 5,977 |
| 31_G | 3,195,666 | 406,066 | 479,203 | 61,464 | 484,166 | 129,219 | 63,661 | 308,876 |
| 32_D | 124,518 | 15,822 | 18,672 | 2,395 | 18,865 | 5,037 | 2,482 | 12,035 |
| 32_G | 1,007,511 | 128,022 | 151,080 | 19,378 | 152,645 | 40,749 | 20,075 | 97,381 |
| 51_D | 1,566 | 218 | 174 | 48 | 242 | 89 | 42 | 130 |
| 51_G | 783 | 109 | 87 | 24 | 121 | 23 | 11 | 65 |
| 52_D | 193,033 | 26,819 | 21,456 | 5,911 | 29,793 | 12,430 | 5,868 | 16,028 |
| 52_G | 100,323 | 13,939 | 11,151 | 3,072 | 15,484 | 3,070 | 1,449 | 8,330 |
| 53_D | 20,591 | 2,861 | 2,289 | 631 | 3,178 | 351 | 166 | 1,710 |
| 53_G | 10,679 | 1,484 | 1,187 | 327 | 1,648 | 86 | 41 | 887 |
| 54_D | 920 | 128 | 102 | 28 | 142 | 53 | 25 | 76 |
| 54_G | 473 | 66 | 53 | 14 | 73 | 13 | 6 | 39 |
| 41_D | 5,284 | 734 | 587 | 162 | 815 | 239 | 113 | 439 |
| 42_D | 2,595 | 361 | 288 | 79 | 401 | 118 | 56 | 215 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 12,090 | 1,680 | 1,344 | 370 | 1,866 | 548 | 259 | 1,004 |
| 43_G | 86 | 12 | 10 | 3 | 13 | 5 | 3 | 7 |
| 61_D | 91,874 | 5,927 | 7,827 | 1,306 | 7,013 | 2,714 | 969 | 3,095 |
| 61_G | 8,539 | 551 | 727 | 121 | 652 | 275 | 98 | 288 |
| 62_D | 62,586 | 4,037 | 5,332 | 890 | 4,777 | 3,616 | 1,292 | 2,108 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 20,655 | 3,807 | 4,056 | 438 | 5,009 | 1,000 | 506 | 3,584 |

## 2020 24-Hour Weekday Starts Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 43,293 | 4,001 | 8,667 | 430 | 5,170 | 794 | 396 | 3,227 |
| 21_G | 10,770,223 | 995,457 | 2,156,158 | 106,944 | 1,286,059 | 198,179 | 98,803 | 802,893 |
| 31_D | 71,382 | 9,297 | 11,122 | 1,398 | 11,090 | 2,918 | 1,457 | 6,908 |
| 31_G | 3,324,304 | 432,979 | 517,975 | 65,112 | 516,474 | 136,115 | 67,973 | 321,729 |
| 32_D | 125,164 | 16,302 | 19,502 | 2,452 | 19,446 | 5,123 | 2,558 | 12,114 |
| 32_G | 1,055,141 | 137,429 | 164,406 | 20,667 | 163,930 | 43,206 | 21,576 | 102,117 |
| 51_D | 1,225 | 175 | 142 | 38 | 194 | 70 | 34 | 102 |
| 51_G | 642 | 91 | 74 | 20 | 102 | 17 | 8 | 53 |
| 52_D | 202,223 | 28,799 | 23,356 | 6,307 | 32,006 | 13,181 | 6,307 | 16,813 |
| 52_G | 105,082 | 14,965 | 12,136 | 3,277 | 16,631 | 3,255 | 1,558 | 8,737 |
| 53_D | 21,545 | 3,068 | 2,488 | 672 | 3,410 | 373 | 178 | 1,791 |
| 53_G | 11,206 | 1,596 | 1,294 | 349 | 1,774 | 91 | 44 | 932 |
| 54_D | 934 | 133 | 108 | 29 | 148 | 54 | 26 | 78 |
| 54_G | 484 | 69 | 56 | 15 | 77 | 13 | 6 | 40 |
| 41_D | 5,554 | 791 | 642 | 173 | 879 | 254 | 122 | 462 |
| 42_D | 2,636 | 375 | 304 | 82 | 417 | 122 | 58 | 219 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 12,611 | 1,796 | 1,457 | 393 | 1,996 | 582 | 278 | 1,049 |
| 43_G | 89 | 13 | 10 | 3 | 14 | 6 | 3 | 7 |
| 61_D | 95,777 | 6,333 | 8,478 | 1,387 | 7,496 | 2,864 | 1,037 | 3,231 |
| 61_G | 8,902 | 589 | 788 | 129 | 697 | 290 | 105 | 300 |
| 62_D | 65,244 | 4,314 | 5,775 | 945 | 5,107 | 3,817 | 1,382 | 2,201 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 21,532 | 4,068 | 4,393 | 464 | 5,354 | 1,056 | 541 | 3,741 |

## 2023 24-Hour Weekday Starts Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 45,132 | 4,276 | 9,388 | 456 | 5,526 | 838 | 424 | 3,369 |
| 21_G | 11,227,725 | 1,063,715 | 2,335,597 | 113,533 | 1,374,826 | 209,185 | 105,713 | 838,089 |
| 31_D | 81,370 | 10,863 | 13,174 | 1,623 | 12,964 | 3,228 | 1,634 | 7,885 |
| 31_G | 3,458,752 | 461,765 | 559,987 | 68,988 | 551,045 | 143,527 | 72,652 | 335,177 |
| 32_D | 129,146 | 17,242 | 20,909 | 2,576 | 20,575 | 5,407 | 2,737 | 12,515 |
| 32_G | 1,101,095 | 147,003 | 178,272 | 21,963 | 175,425 | 45,605 | 23,085 | 106,704 |
| 51_D | 1,095 | 160 | 131 | 35 | 178 | 66 | 32 | 91 |
| 51_G | 608 | 89 | 73 | 19 | 99 | 16 | 8 | 51 |
| 52_D | 211,040 | 30,807 | 25,326 | 6,702 | 34,252 | 13,930 | 6,756 | 17,569 |
| 52_G | 109,659 | 16,008 | 13,160 | 3,483 | 17,798 | 3,441 | 1,669 | 9,129 |
| 53_D | 22,461 | 3,279 | 2,695 | 713 | 3,645 | 393 | 191 | 1,870 |
| 53_G | 11,682 | 1,705 | 1,402 | 371 | 1,896 | 96 | 47 | 973 |
| 54_D | 973 | 142 | 117 | 31 | 158 | 57 | 28 | 81 |
| 54_G | 505 | 74 | 61 | 16 | 82 | 14 | 7 | 42 |
| 41_D | 5,835 | 852 | 700 | 185 | 947 | 270 | 131 | 486 |
| 42_D | 2,748 | 401 | 330 | 87 | 446 | 126 | 61 | 229 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 13,147 | 1,919 | 1,578 | 418 | 2,134 | 611 | 296 | 1,094 |
| 43_G | 93 | 14 | 11 | 3 | 15 | 6 | 3 | 8 |
| 61_D | 99,845 | 6,767 | 9,183 | 1,472 | 8,014 | 3,024 | 1,110 | 3,372 |
| 61_G | 9,280 | 629 | 854 | 137 | 745 | 306 | 112 | 313 |
| 62_D | 68,015 | 4,610 | 6,256 | 1,003 | 5,459 | 4,029 | 1,479 | 2,297 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 22,447 | 4,347 | 4,759 | 493 | 5,724 | 1,114 | 579 | 3,905 |

## 2026 24-Hour Weekday Starts Summaries

| SUT/FT | Harris | Brazoria | Fort Bend | Waller | Montgomery | Liberty | Chambers | Galveston |
|---|---|---|---|---|---|---|---|---|
| 21_D | 47,049 | 4,569 | 10,170 | 484 | 5,908 | 885 | 453 | 3,517 |
| 21_G | 11,704,715 | 1,136,669 | 2,529,977 | 120,529 | 1,469,738 | 220,802 | 113,107 | 874,830 |
| 31_D | 84,827 | 11,609 | 14,271 | 1,723 | 13,859 | 3,407 | 1,748 | 8,231 |
| 31_G | 3,605,690 | 493,435 | 606,592 | 73,239 | 589,087 | 151,497 | 77,733 | 349,871 |
| 32_D | 134,632 | 18,424 | 22,649 | 2,735 | 21,996 | 5,707 | 2,928 | 13,064 |
| 32_G | 1,147,874 | 157,085 | 193,109 | 23,316 | 187,536 | 48,138 | 24,699 | 111,382 |
| 51_D | 1,141 | 171 | 142 | 37 | 190 | 70 | 34 | 95 |
| 51_G | 634 | 95 | 79 | 21 | 106 | 17 | 8 | 53 |
| 52_D | 220,006 | 32,920 | 27,434 | 7,115 | 36,616 | 14,703 | 7,228 | 18,339 |
| 52_G | 114,318 | 17,106 | 14,255 | 3,697 | 19,026 | 3,632 | 1,785 | 9,529 |
| 53_D | 23,415 | 3,504 | 2,920 | 757 | 3,897 | 415 | 204 | 1,952 |
| 53_G | 12,179 | 1,822 | 1,519 | 394 | 2,027 | 101 | 50 | 1,015 |
| 54_D | 1,015 | 152 | 127 | 33 | 169 | 60 | 30 | 85 |
| 54_G | 527 | 79 | 66 | 17 | 88 | 15 | 7 | 44 |
| 41_D | 6,083 | 910 | 759 | 197 | 1,012 | 285 | 140 | 507 |
| 42_D | 2,864 | 429 | 357 | 93 | 477 | 134 | 66 | 239 |
| 42_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43_D | 13,706 | 2,051 | 1,709 | 443 | 2,281 | 645 | 317 | 1,142 |
| 43_G | 97 | 15 | 12 | 3 | 16 | 6 | 3 | 8 |
| 61_D | 104,087 | 7,231 | 9,948 | 1,563 | 8,567 | 3,191 | 1,187 | 3,520 |
| 61_G | 9,674 | 672 | 925 | 145 | 796 | 324 | 120 | 327 |
| 62_D | 70,905 | 4,926 | 6,776 | 1,065 | 5,836 | 4,253 | 1,582 | 2,398 |
| 62_G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11_G | 23,401 | 4,645 | 5,155 | 523 | 6,119 | 1,176 | 619 | 4,076 |

## 24-Hour Weekday SHI Summaries (CLhT_Diesel Only)

| County | 2011 | 2014 | 2017 | 2020 | 2023 | 2026 |
|---|---|---|---|---|---|---|
| Harris | 18,094 | 16,703 | 17,560 | 18,313 | 19,284 | 20,111 |
| Brazoria | 138 | 158 | 165 | 177 | 193 | 206 |
| Fort Bend | 3,410 | 3,650 | 4,020 | 4,352 | 4,915 | 5,321 |
| Waller | 1,986 | 2,152 | 2,255 | 2,394 | 2,529 | 2,685 |
| Montgomery | 4,311 | 4,016 | 4,427 | 4,727 | 5,043 | 5,386 |
| Liberty | 446 | 527 | 552 | 582 | 633 | 668 |
| Chambers | 1,414 | 1,239 | 1,336 | 1,425 | 1,483 | 1,582 |
| Galveston | 444 | 440 | 450 | 470 | 492 | 513 |

# APPENDIX H:
# SOURCE TYPE AGE AND FUEL ENGINE FRACTIONS INPUTS TO MOVES

## Brazoria County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.029489 | 0.041465 | 0.025332 | 0.025332 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.035165 | 0.059996 | 0.041857 | 0.041857 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.01 |
| 2 | 0.084868 | 0.058323 | 0.038005 | 0.038005 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.03 |
| 3 | 0.097743 | 0.088039 | 0.069630 | 0.069630 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.113526 | 0.091720 | 0.077310 | 0.077310 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.10 |
| 5 | 0.102174 | 0.081450 | 0.069196 | 0.069196 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.078222 | 0.075970 | 0.063213 | 0.063213 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.059532 | 0.065633 | 0.070261 | 0.070261 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.071577 | 0.061826 | 0.073680 | 0.073680 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.064655 | 0.060152 | 0.075947 | 0.075947 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.049702 | 0.054189 | 0.069147 | 0.069147 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.033504 | 0.053452 | 0.056586 | 0.056586 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.028243 | 0.043257 | 0.050776 | 0.050776 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.022290 | 0.034683 | 0.035564 | 0.035564 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.015368 | 0.027046 | 0.036060 | 0.036060 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.015921 | 0.020837 | 0.025890 | 0.025890 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.013014 | 0.019007 | 0.025506 | 0.025506 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.011076 | 0.013489 | 0.021554 | 0.021554 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.007615 | 0.010277 | 0.013849 | 0.013849 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.007061 | 0.007808 | 0.011582 | 0.011582 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.003323 | 0.006053 | 0.009291 | 0.009291 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.004015 | 0.004439 | 0.007457 | 0.007457 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.003738 | 0.003324 | 0.006937 | 0.006937 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.003600 | 0.002372 | 0.005215 | 0.005215 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.002769 | 0.001837 | 0.002564 | 0.002564 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.004984 | 0.001398 | 0.002973 | 0.002973 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.003600 | 0.001450 | 0.002155 | 0.002155 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.003600 | 0.001034 | 0.002329 | 0.002329 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.003184 | 0.000647 | 0.001102 | 0.001102 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.004430 | 0.000565 | 0.001028 | 0.001028 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.022013 | 0.008262 | 0.008002 | 0.008002 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

# Brazoria County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.034982 | 0.050847 | 0.027623 | 0.027623 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.050295 | 0.074346 | 0.044383 | 0.044383 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.043833 | 0.067139 | 0.048460 | 0.048460 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.035122 | 0.062875 | 0.043260 | 0.043260 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.078252 | 0.055591 | 0.036461 | 0.036461 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.088368 | 0.081505 | 0.066257 | 0.066257 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.100028 | 0.080990 | 0.071432 | 0.071432 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.093285 | 0.070534 | 0.065304 | 0.065304 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.071368 | 0.066263 | 0.058371 | 0.058371 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.055634 | 0.055904 | 0.065195 | 0.065195 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.062237 | 0.051368 | 0.066720 | 0.066720 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.058022 | 0.049852 | 0.069528 | 0.069528 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.042568 | 0.043034 | 0.062363 | 0.062363 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.027536 | 0.042227 | 0.050498 | 0.050498 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.025007 | 0.032425 | 0.044114 | 0.044114 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.019668 | 0.025295 | 0.030235 | 0.030235 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.013768 | 0.019451 | 0.030687 | 0.030687 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.014049 | 0.014505 | 0.021959 | 0.021959 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.011661 | 0.012682 | 0.021251 | 0.021251 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.008710 | 0.008724 | 0.017419 | 0.017419 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.005479 | 0.006671 | 0.011328 | 0.011328 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.005479 | 0.004724 | 0.009252 | 0.009252 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.003934 | 0.003736 | 0.007129 | 0.007129 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.003934 | 0.002734 | 0.005969 | 0.005969 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.003793 | 0.002198 | 0.005078 | 0.005078 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.002950 | 0.001649 | 0.003869 | 0.003869 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.002248 | 0.001496 | 0.001929 | 0.001929 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.004074 | 0.000897 | 0.002112 | 0.002112 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.003091 | 0.001134 | 0.001599 | 0.001599 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.002950 | 0.000870 | 0.001636 | 0.001636 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.027676 | 0.008334 | 0.008581 | 0.008581 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

## Chambers County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.016832 | 0.043599 | 0.026411 | 0.026411 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.028713 | 0.062691 | 0.040891 | 0.040891 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.01 |
| 2 | 0.086139 | 0.063048 | 0.046444 | 0.046444 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.03 |
| 3 | 0.094059 | 0.103227 | 0.077431 | 0.077431 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.130693 | 0.098597 | 0.083433 | 0.083433 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.10 |
| 5 | 0.109901 | 0.091757 | 0.075180 | 0.075180 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.080198 | 0.077652 | 0.066627 | 0.066627 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.068317 | 0.062122 | 0.075405 | 0.075405 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.075248 | 0.052148 | 0.073980 | 0.073980 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.067327 | 0.055639 | 0.069928 | 0.069928 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.045545 | 0.048372 | 0.067977 | 0.067977 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.039604 | 0.045166 | 0.051170 | 0.051170 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.040594 | 0.037900 | 0.045618 | 0.045618 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.023762 | 0.028924 | 0.031813 | 0.031813 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.010891 | 0.025219 | 0.031438 | 0.031438 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.011881 | 0.019377 | 0.022209 | 0.022209 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.006931 | 0.017953 | 0.024010 | 0.024010 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.008911 | 0.011968 | 0.020408 | 0.020408 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.007921 | 0.010401 | 0.013205 | 0.013205 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.003960 | 0.007053 | 0.010579 | 0.010579 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.004950 | 0.007124 | 0.008929 | 0.008929 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.001980 | 0.005486 | 0.007428 | 0.007428 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.003960 | 0.004203 | 0.006227 | 0.006227 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.002970 | 0.002208 | 0.004727 | 0.004727 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.001980 | 0.002636 | 0.002776 | 0.002776 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.001980 | 0.001781 | 0.002701 | 0.002701 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.001980 | 0.001781 | 0.002176 | 0.002176 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.003960 | 0.001282 | 0.002326 | 0.002326 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.000000 | 0.000427 | 0.001050 | 0.001050 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.002970 | 0.000712 | 0.000975 | 0.000975 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.015842 | 0.009546 | 0.006528 | 0.006528 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

## Chambers County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.029592 | 0.058847 | 0.032123 | 0.032123 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.055102 | 0.088664 | 0.051322 | 0.051322 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.041837 | 0.074544 | 0.057896 | 0.057896 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.035714 | 0.065217 | 0.044001 | 0.044001 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.076531 | 0.059635 | 0.043329 | 0.043329 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.079592 | 0.088467 | 0.072912 | 0.072912 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.107143 | 0.082556 | 0.078739 | 0.078739 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.102041 | 0.077039 | 0.069774 | 0.069774 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.065306 | 0.063181 | 0.060287 | 0.060287 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.064286 | 0.051162 | 0.066114 | 0.066114 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.067347 | 0.041771 | 0.065217 | 0.065217 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.043878 | 0.043216 | 0.060885 | 0.060885 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.037755 | 0.037699 | 0.058942 | 0.058942 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.045918 | 0.033955 | 0.043329 | 0.043329 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.035714 | 0.026599 | 0.038100 | 0.038100 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.017347 | 0.020951 | 0.026968 | 0.026968 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.007143 | 0.017339 | 0.025176 | 0.025176 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.013265 | 0.013595 | 0.016958 | 0.016958 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.007143 | 0.011165 | 0.019050 | 0.019050 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.012245 | 0.008407 | 0.016360 | 0.016360 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.007143 | 0.006371 | 0.011206 | 0.011206 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.006122 | 0.004466 | 0.007545 | 0.007545 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.003061 | 0.003875 | 0.006201 | 0.006201 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.004082 | 0.003218 | 0.006126 | 0.006126 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.005102 | 0.002693 | 0.004034 | 0.004034 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.003061 | 0.001576 | 0.004034 | 0.004034 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.001020 | 0.001314 | 0.001419 | 0.001419 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.002041 | 0.000854 | 0.001793 | 0.001793 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.002041 | 0.001117 | 0.001868 | 0.001868 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.001020 | 0.000722 | 0.001121 | 0.001121 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.020408 | 0.009786 | 0.007172 | 0.007172 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

# Fort Bend County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.043366 | 0.046518 | 0.029637 | 0.029637 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.048141 | 0.065960 | 0.053790 | 0.053790 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.018 |
| 2 | 0.102478 | 0.064906 | 0.044450 | 0.044450 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.033 |
| 3 | 0.101058 | 0.094485 | 0.079934 | 0.079934 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.120289 | 0.096165 | 0.088972 | 0.088972 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.100 |
| 5 | 0.103898 | 0.085778 | 0.072731 | 0.072731 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.079375 | 0.075541 | 0.066153 | 0.066153 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.059241 | 0.067667 | 0.078277 | 0.078277 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.067759 | 0.063112 | 0.078099 | 0.078099 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.056402 | 0.059721 | 0.078037 | 0.078037 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.043753 | 0.053351 | 0.065736 | 0.065736 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.032137 | 0.050441 | 0.050913 | 0.050913 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.028653 | 0.038721 | 0.042448 | 0.042448 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.019489 | 0.031594 | 0.032045 | 0.032045 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.011745 | 0.024350 | 0.029011 | 0.029011 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.011874 | 0.017987 | 0.019202 | 0.019202 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.008776 | 0.015595 | 0.018680 | 0.018680 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.006324 | 0.010355 | 0.015689 | 0.015689 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.007486 | 0.007780 | 0.010508 | 0.010508 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.003098 | 0.006066 | 0.008235 | 0.008235 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.002710 | 0.004559 | 0.006130 | 0.006130 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.001678 | 0.003633 | 0.005494 | 0.005494 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.002194 | 0.002202 | 0.004555 | 0.004555 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.002323 | 0.001756 | 0.003357 | 0.003357 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.002710 | 0.001362 | 0.002450 | 0.002450 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.002323 | 0.001013 | 0.002085 | 0.002085 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.002581 | 0.000971 | 0.001939 | 0.001939 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.002452 | 0.000847 | 0.001887 | 0.001887 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.002839 | 0.000591 | 0.001136 | 0.001136 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.003872 | 0.000505 | 0.001220 | 0.001220 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.018973 | 0.006470 | 0.007203 | 0.007203 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

## Fort Bend County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.046861 | 0.056946 | 0.036100 | 0.036100 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.073337 | 0.080976 | 0.056002 | 0.056002 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.052455 | 0.075174 | 0.060485 | 0.060485 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.046986 | 0.069048 | 0.053070 | 0.053070 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.085768 | 0.061432 | 0.040939 | 0.040939 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.084649 | 0.087198 | 0.073631 | 0.073631 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.107396 | 0.084907 | 0.079737 | 0.079737 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.089248 | 0.073453 | 0.065385 | 0.065385 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.067495 | 0.064076 | 0.059654 | 0.059654 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.049720 | 0.055394 | 0.068062 | 0.068062 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.058546 | 0.050132 | 0.067251 | 0.067251 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.047234 | 0.045911 | 0.067484 | 0.067484 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.037290 | 0.040168 | 0.055708 | 0.055708 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.028092 | 0.037235 | 0.043576 | 0.043576 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.024239 | 0.027172 | 0.035279 | 0.035279 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.017154 | 0.021925 | 0.026008 | 0.026008 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.010814 | 0.016351 | 0.024192 | 0.024192 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.009571 | 0.011550 | 0.015743 | 0.015743 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.007209 | 0.009502 | 0.015175 | 0.015175 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.005345 | 0.006372 | 0.012547 | 0.012547 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.005842 | 0.004489 | 0.008277 | 0.008277 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.003605 | 0.003554 | 0.006380 | 0.006380 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.002113 | 0.002781 | 0.004453 | 0.004453 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.001740 | 0.002192 | 0.004220 | 0.004220 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.002859 | 0.001453 | 0.003662 | 0.003662 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.002486 | 0.001144 | 0.002607 | 0.002607 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.002735 | 0.001010 | 0.001572 | 0.001572 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.002362 | 0.000723 | 0.001623 | 0.001623 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.001367 | 0.000770 | 0.001309 | 0.001309 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.002735 | 0.000580 | 0.001552 | 0.001552 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.022747 | 0.006381 | 0.008318 | 0.008318 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

## Galveston County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.025243 | 0.043574 | 0.026319 | 0.026319 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.037738 | 0.058903 | 0.049632 | 0.049632 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.01 |
| 2 | 0.100719 | 0.063386 | 0.042001 | 0.042001 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.03 |
| 3 | 0.098574 | 0.088516 | 0.079627 | 0.079627 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.108166 | 0.090634 | 0.082367 | 0.082367 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.10 |
| 5 | 0.097816 | 0.083909 | 0.072569 | 0.072569 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.080020 | 0.075971 | 0.063120 | 0.063120 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.058437 | 0.064917 | 0.073910 | 0.073910 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.073457 | 0.062605 | 0.074861 | 0.074861 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.059447 | 0.059629 | 0.076888 | 0.076888 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.044806 | 0.052487 | 0.068292 | 0.068292 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.034709 | 0.050206 | 0.051254 | 0.051254 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.030418 | 0.041696 | 0.045928 | 0.045928 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.020825 | 0.033502 | 0.032860 | 0.032860 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.015777 | 0.026784 | 0.031798 | 0.031798 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.016534 | 0.020083 | 0.022671 | 0.022671 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.009719 | 0.018745 | 0.021832 | 0.021832 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.008709 | 0.012337 | 0.017681 | 0.017681 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.007952 | 0.010034 | 0.012957 | 0.012957 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.004670 | 0.007490 | 0.008889 | 0.008889 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.004039 | 0.005813 | 0.007785 | 0.007785 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.003786 | 0.005017 | 0.007548 | 0.007548 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.004670 | 0.003564 | 0.005996 | 0.005996 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.004670 | 0.002427 | 0.004025 | 0.004025 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.003155 | 0.002056 | 0.002376 | 0.002376 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.004670 | 0.001778 | 0.002404 | 0.002404 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.003155 | 0.001662 | 0.002111 | 0.002111 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.002524 | 0.001376 | 0.002264 | 0.002264 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.003282 | 0.000873 | 0.001384 | 0.001384 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.005301 | 0.000657 | 0.001132 | 0.001132 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.027010 | 0.009369 | 0.007520 | 0.007520 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

## Galveston County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.033501 | 0.054760 | 0.035513 | 0.035513 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.055362 | 0.074828 | 0.045579 | 0.045579 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.041909 | 0.066753 | 0.050173 | 0.050173 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.035183 | 0.061454 | 0.047416 | 0.047416 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.089380 | 0.057399 | 0.040024 | 0.040024 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.082913 | 0.080199 | 0.072697 | 0.072697 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.097012 | 0.079924 | 0.075496 | 0.075496 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.090803 | 0.072493 | 0.067379 | 0.067379 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.069978 | 0.065943 | 0.057454 | 0.057454 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.050188 | 0.055302 | 0.066892 | 0.066892 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.064157 | 0.051326 | 0.067950 | 0.067950 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.054327 | 0.048239 | 0.068785 | 0.068785 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.040486 | 0.041820 | 0.061491 | 0.061491 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.033760 | 0.039268 | 0.044729 | 0.044729 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.028845 | 0.032082 | 0.040219 | 0.040219 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.018626 | 0.025070 | 0.027954 | 0.027954 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.015910 | 0.019294 | 0.026534 | 0.026534 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.014358 | 0.014386 | 0.018710 | 0.018710 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.009572 | 0.013345 | 0.018390 | 0.018390 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.006597 | 0.008639 | 0.014771 | 0.014771 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.006209 | 0.006456 | 0.009870 | 0.009870 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.005045 | 0.004909 | 0.007044 | 0.007044 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.003234 | 0.003860 | 0.006028 | 0.006028 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.003363 | 0.003260 | 0.005527 | 0.005527 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.003234 | 0.002422 | 0.004705 | 0.004705 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.003492 | 0.001807 | 0.003021 | 0.003021 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.002328 | 0.001402 | 0.002005 | 0.002005 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.004269 | 0.001294 | 0.001796 | 0.001796 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.003234 | 0.001142 | 0.001573 | 0.001573 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.001811 | 0.001012 | 0.001754 | 0.001754 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.030915 | 0.009911 | 0.008520 | 0.008520 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

# Harris County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.035445 | 0.047178 | 0.027418 | 0.027418 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.042013 | 0.057736 | 0.040492 | 0.040492 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.018 |
| 2 | 0.102145 | 0.052988 | 0.035349 | 0.035349 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.033 |
| 3 | 0.098830 | 0.078010 | 0.069539 | 0.069539 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.047 |
| 4 | 0.117470 | 0.082164 | 0.077581 | 0.077581 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.100 |
| 5 | 0.098789 | 0.076988 | 0.066823 | 0.066823 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.077021 | 0.071964 | 0.064280 | 0.064280 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.055649 | 0.062982 | 0.073246 | 0.073246 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.068660 | 0.060872 | 0.076613 | 0.076613 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.057818 | 0.061481 | 0.079337 | 0.079337 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.044703 | 0.058503 | 0.071480 | 0.071480 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.035425 | 0.057776 | 0.057650 | 0.057650 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.028273 | 0.046624 | 0.051219 | 0.051219 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.020850 | 0.039183 | 0.038065 | 0.038065 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.014449 | 0.031811 | 0.035592 | 0.035592 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.013490 | 0.024008 | 0.023130 | 0.023130 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.011238 | 0.021505 | 0.023112 | 0.023112 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.008924 | 0.015239 | 0.019319 | 0.019319 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.006484 | 0.011823 | 0.013504 | 0.013504 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.004962 | 0.009001 | 0.010016 | 0.010016 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.003419 | 0.006878 | 0.007798 | 0.007798 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.003482 | 0.005110 | 0.006732 | 0.006732 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.003336 | 0.003481 | 0.005890 | 0.005890 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.003607 | 0.002469 | 0.004190 | 0.004190 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.002877 | 0.001852 | 0.002588 | 0.002588 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.004253 | 0.001431 | 0.002746 | 0.002746 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.004024 | 0.001468 | 0.002465 | 0.002465 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.003440 | 0.001175 | 0.002283 | 0.002283 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.002648 | 0.000789 | 0.001410 | 0.001410 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.003982 | 0.000576 | 0.001734 | 0.001734 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.022289 | 0.006934 | 0.008398 | 0.008398 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

**Harris County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)**

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.048165 | 0.063212 | 0.032568 | 0.032568 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.072015 | 0.069616 | 0.044394 | 0.044394 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.049201 | 0.058950 | 0.047201 | 0.047201 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.035627 | 0.056279 | 0.038272 | 0.038272 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.087936 | 0.050638 | 0.033725 | 0.033725 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.082375 | 0.073496 | 0.066459 | 0.066459 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.102165 | 0.075434 | 0.072980 | 0.072980 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.085631 | 0.070365 | 0.063179 | 0.063179 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.067426 | 0.064575 | 0.060623 | 0.060623 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.049137 | 0.056109 | 0.068638 | 0.068638 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.059899 | 0.053280 | 0.070391 | 0.070391 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.051167 | 0.052046 | 0.072107 | 0.072107 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.037741 | 0.047651 | 0.063765 | 0.063765 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.029474 | 0.045782 | 0.050800 | 0.050800 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.024125 | 0.035902 | 0.044250 | 0.044250 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.017338 | 0.028917 | 0.031930 | 0.031930 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.011544 | 0.022849 | 0.030030 | 0.030030 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.011840 | 0.016499 | 0.019350 | 0.019350 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.009768 | 0.014116 | 0.019277 | 0.019277 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.008225 | 0.009614 | 0.015648 | 0.015648 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.005878 | 0.007304 | 0.010710 | 0.010710 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.003848 | 0.005365 | 0.007618 | 0.007618 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.002897 | 0.004141 | 0.005961 | 0.005961 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.003193 | 0.003092 | 0.005084 | 0.005084 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.002368 | 0.002109 | 0.004409 | 0.004409 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.002854 | 0.001579 | 0.003091 | 0.003091 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.002389 | 0.001234 | 0.001958 | 0.001958 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.003975 | 0.000963 | 0.002283 | 0.002283 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.003193 | 0.001004 | 0.001918 | 0.001918 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.002558 | 0.000829 | 0.001831 | 0.001831 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.026049 | 0.007054 | 0.009550 | 0.009550 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

# Liberty County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.023510 | 0.031586 | 0.022295 | 0.022295 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.029524 | 0.046288 | 0.032190 | 0.032190 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.018 |
| 2 | 0.083652 | 0.045982 | 0.031827 | 0.031827 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.03 |
| 3 | 0.092947 | 0.079865 | 0.065471 | 0.065471 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.107709 | 0.080018 | 0.072378 | 0.072378 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.100 |
| 5 | 0.109896 | 0.074275 | 0.065269 | 0.065269 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.082559 | 0.070868 | 0.054768 | 0.054768 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.061236 | 0.056013 | 0.062038 | 0.062038 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.061782 | 0.054520 | 0.069147 | 0.069147 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.064516 | 0.052950 | 0.070883 | 0.070883 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.057408 | 0.057736 | 0.069712 | 0.069712 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.041006 | 0.056893 | 0.054606 | 0.054606 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.035539 | 0.051725 | 0.051133 | 0.051133 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.025150 | 0.042536 | 0.042974 | 0.042974 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.019683 | 0.038707 | 0.044428 | 0.044428 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.015309 | 0.030476 | 0.030373 | 0.030373 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.009841 | 0.028294 | 0.032635 | 0.032635 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.007654 | 0.021134 | 0.027546 | 0.027546 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.006014 | 0.017191 | 0.017812 | 0.017812 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.003827 | 0.013668 | 0.016156 | 0.016156 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.002734 | 0.011716 | 0.011753 | 0.011753 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.002734 | 0.008002 | 0.010663 | 0.010663 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.004921 | 0.006394 | 0.009088 | 0.009088 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.004374 | 0.005054 | 0.007634 | 0.007634 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.002187 | 0.002948 | 0.004241 | 0.004241 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.009841 | 0.002259 | 0.003918 | 0.003918 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.003827 | 0.002106 | 0.003958 | 0.003958 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.004374 | 0.001646 | 0.003110 | 0.003110 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.003827 | 0.000536 | 0.001494 | 0.001494 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.001640 | 0.000689 | 0.001535 | 0.001535 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.020776 | 0.007925 | 0.008966 | 0.008966 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

## Liberty County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.029289 | 0.045159 | 0.028176 | 0.028176 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.040048 | 0.062915 | 0.044347 | 0.044347 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.039450 | 0.056348 | 0.043578 | 0.043578 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.029289 | 0.052276 | 0.033270 | 0.033270 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.085475 | 0.046297 | 0.031815 | 0.031815 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.072325 | 0.072673 | 0.062093 | 0.062093 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.096832 | 0.071719 | 0.064761 | 0.064761 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.096832 | 0.069262 | 0.060678 | 0.060678 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.078900 | 0.064419 | 0.052795 | 0.052795 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.054991 | 0.050295 | 0.058657 | 0.058657 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.058577 | 0.050992 | 0.064276 | 0.064276 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.061566 | 0.050149 | 0.066419 | 0.066419 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.054991 | 0.048204 | 0.065853 | 0.065853 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.039450 | 0.049562 | 0.050208 | 0.050208 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.031082 | 0.042775 | 0.046570 | 0.046570 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.023909 | 0.033273 | 0.038283 | 0.038283 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.016736 | 0.027844 | 0.038727 | 0.038727 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.012552 | 0.021791 | 0.025427 | 0.025427 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.007173 | 0.017792 | 0.027489 | 0.027489 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.010759 | 0.013610 | 0.022800 | 0.022800 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.005380 | 0.011079 | 0.014432 | 0.014432 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.004184 | 0.009245 | 0.010713 | 0.010713 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.001793 | 0.006713 | 0.009460 | 0.009460 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.002391 | 0.004219 | 0.007681 | 0.007681 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.006575 | 0.003595 | 0.006589 | 0.006589 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.002391 | 0.003082 | 0.005215 | 0.005215 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.001793 | 0.001944 | 0.002628 | 0.002628 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.005977 | 0.001064 | 0.002466 | 0.002466 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.002391 | 0.001761 | 0.002547 | 0.002547 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.001793 | 0.001504 | 0.002021 | 0.002021 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.025105 | 0.008438 | 0.010025 | 0.010025 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

# Montgomery County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.040452 | 0.047069 | 0.031806 | 0.031806 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.035805 | 0.066982 | 0.050435 | 0.050435 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.018 |
| 2 | 0.089468 | 0.060890 | 0.043266 | 0.043266 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.03 |
| 3 | 0.087281 | 0.093845 | 0.077591 | 0.077591 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.110787 | 0.092229 | 0.083330 | 0.083330 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.100 |
| 5 | 0.105047 | 0.083485 | 0.068758 | 0.068758 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.082088 | 0.074366 | 0.064179 | 0.064179 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.061771 | 0.066269 | 0.073435 | 0.073435 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.074708 | 0.060237 | 0.076143 | 0.076143 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.056669 | 0.058257 | 0.073597 | 0.073597 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.047103 | 0.052050 | 0.068659 | 0.068659 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.038539 | 0.049792 | 0.050687 | 0.050687 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.028972 | 0.040304 | 0.044102 | 0.044102 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.019679 | 0.032307 | 0.033524 | 0.033524 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.015853 | 0.025846 | 0.032391 | 0.032391 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.015306 | 0.018497 | 0.023396 | 0.023396 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.011935 | 0.017126 | 0.021777 | 0.021777 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.008746 | 0.012005 | 0.017801 | 0.017801 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.008200 | 0.009174 | 0.012323 | 0.012323 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.006013 | 0.007304 | 0.009139 | 0.009139 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.003462 | 0.005529 | 0.007088 | 0.007088 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.003371 | 0.004268 | 0.006494 | 0.006494 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.003644 | 0.003410 | 0.005325 | 0.005325 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.003735 | 0.002438 | 0.003562 | 0.003562 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.003098 | 0.001875 | 0.002276 | 0.002276 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.004191 | 0.001436 | 0.002546 | 0.002546 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.004282 | 0.001256 | 0.002393 | 0.002393 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.003735 | 0.001077 | 0.002357 | 0.002357 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.003735 | 0.000858 | 0.001520 | 0.001520 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.004191 | 0.000653 | 0.001250 | 0.001250 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.018130 | 0.009169 | 0.008851 | 0.008851 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

## Montgomery County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.049461 | 0.064148 | 0.035358 | 0.035358 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.062443 | 0.084007 | 0.055121 | 0.055121 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.047724 | 0.072113 | 0.058152 | 0.058152 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.035198 | 0.065880 | 0.048909 | 0.048909 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.078716 | 0.055675 | 0.038783 | 0.038783 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.079905 | 0.081246 | 0.069764 | 0.069764 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.097276 | 0.078603 | 0.073721 | 0.073721 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.088773 | 0.070231 | 0.062206 | 0.062206 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.070945 | 0.062976 | 0.058711 | 0.058711 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.054215 | 0.054581 | 0.067309 | 0.067309 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.065094 | 0.048842 | 0.066907 | 0.066907 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.051563 | 0.046094 | 0.065474 | 0.065474 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.041872 | 0.040694 | 0.059751 | 0.059751 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.030719 | 0.037566 | 0.044663 | 0.044663 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.025507 | 0.030169 | 0.037962 | 0.037962 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.017371 | 0.023285 | 0.028316 | 0.028316 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.012617 | 0.017963 | 0.027268 | 0.027268 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.011702 | 0.012426 | 0.018819 | 0.018819 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.009325 | 0.011606 | 0.017273 | 0.017273 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.007680 | 0.007905 | 0.014285 | 0.014285 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.006583 | 0.005844 | 0.009523 | 0.009523 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.004845 | 0.004314 | 0.007243 | 0.007243 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.003108 | 0.003623 | 0.005286 | 0.005286 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.003474 | 0.002721 | 0.004936 | 0.004936 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.003291 | 0.002198 | 0.004071 | 0.004071 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.003383 | 0.001722 | 0.002901 | 0.002901 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.002743 | 0.001305 | 0.001800 | 0.001800 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.004023 | 0.001067 | 0.001931 | 0.001931 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.003748 | 0.000916 | 0.001931 | 0.001931 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.003291 | 0.000834 | 0.001782 | 0.001782 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.023405 | 0.009449 | 0.009846 | 0.009846 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

# Waller County 2011 Age Distribution Inputs to MOVES

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.032184 | 0.023292 | 0.017334 | 0.017334 | 0.069073 | 0.061049 | 0.067376 | 0.028802 | 0.100184 | 0.104789 | 0.066877 | 0.022568 | 0.02 |
| 1 | 0.031034 | 0.039236 | 0.032092 | 0.032092 | 0.063576 | 0.056190 | 0.062014 | 0.027620 | 0.051441 | 0.054592 | 0.061554 | 0.023917 | 0.018 |
| 2 | 0.078161 | 0.041730 | 0.029125 | 0.029125 | 0.061072 | 0.053976 | 0.059571 | 0.027681 | 0.054203 | 0.051380 | 0.059130 | 0.035695 | 0.03 |
| 3 | 0.072414 | 0.072239 | 0.061138 | 0.061138 | 0.067253 | 0.059440 | 0.065601 | 0.031074 | 0.152909 | 0.148094 | 0.065115 | 0.047339 | 0.04 |
| 4 | 0.120690 | 0.071583 | 0.069415 | 0.069415 | 0.068818 | 0.060823 | 0.067127 | 0.032867 | 0.091936 | 0.091287 | 0.066630 | 0.108389 | 0.100 |
| 5 | 0.101149 | 0.070009 | 0.063012 | 0.063012 | 0.068082 | 0.060172 | 0.066409 | 0.054654 | 0.098539 | 0.100234 | 0.065917 | 0.079662 | 0.07 |
| 6 | 0.083908 | 0.068959 | 0.057469 | 0.057469 | 0.067348 | 0.059523 | 0.065693 | 0.048848 | 0.085962 | 0.091233 | 0.065206 | 0.068333 | 0.06 |
| 7 | 0.058621 | 0.055902 | 0.071133 | 0.071133 | 0.052749 | 0.046620 | 0.051452 | 0.038516 | 0.059676 | 0.063794 | 0.051071 | 0.051025 | 0.04 |
| 8 | 0.074713 | 0.054130 | 0.069806 | 0.069806 | 0.041523 | 0.036699 | 0.040503 | 0.028087 | 0.050670 | 0.051239 | 0.040203 | 0.042259 | 0.03 |
| 9 | 0.050575 | 0.059051 | 0.073007 | 0.073007 | 0.035696 | 0.031549 | 0.034819 | 0.028027 | 0.043809 | 0.040653 | 0.034561 | 0.043562 | 0.03 |
| 10 | 0.044828 | 0.059839 | 0.069962 | 0.069962 | 0.040316 | 0.035632 | 0.039325 | 0.029033 | 0.044015 | 0.042649 | 0.039034 | 0.056600 | 0.05 |
| 11 | 0.042529 | 0.062594 | 0.050051 | 0.050051 | 0.042925 | 0.037938 | 0.041871 | 0.040246 | 0.038221 | 0.034783 | 0.041560 | 0.064916 | 0.06 |
| 12 | 0.032184 | 0.054721 | 0.052393 | 0.052393 | 0.041615 | 0.036780 | 0.040592 | 0.044739 | 0.032016 | 0.031295 | 0.040291 | 0.057678 | 0.05 |
| 13 | 0.025287 | 0.043435 | 0.042008 | 0.042008 | 0.031537 | 0.043166 | 0.032034 | 0.033904 | 0.013503 | 0.014618 | 0.023687 | 0.044327 | 0.04 |
| 14 | 0.013793 | 0.038843 | 0.044741 | 0.044741 | 0.025659 | 0.039441 | 0.029841 | 0.027586 | 0.018346 | 0.016614 | 0.036470 | 0.036010 | 0.03 |
| 15 | 0.016092 | 0.033134 | 0.031233 | 0.031233 | 0.021215 | 0.036330 | 0.025734 | 0.058414 | 0.011306 | 0.009689 | 0.022582 | 0.030435 | 0.03 |
| 16 | 0.018391 | 0.031560 | 0.033497 | 0.033497 | 0.027572 | 0.029773 | 0.032872 | 0.066975 | 0.012102 | 0.010658 | 0.026644 | 0.040685 | 0.04 |
| 17 | 0.009195 | 0.024014 | 0.026860 | 0.026860 | 0.021230 | 0.025963 | 0.015864 | 0.041439 | 0.007387 | 0.006977 | 0.025405 | 0.025310 | 0.02 |
| 18 | 0.011494 | 0.020471 | 0.017569 | 0.017569 | 0.017475 | 0.021535 | 0.018944 | 0.035394 | 0.005165 | 0.005036 | 0.017483 | 0.022433 | 0.02 |
| 19 | 0.004598 | 0.016141 | 0.016710 | 0.016710 | 0.012872 | 0.018696 | 0.015280 | 0.015002 | 0.004240 | 0.003477 | 0.015336 | 0.016634 | 0.01 |
| 20 | 0.004598 | 0.012204 | 0.010541 | 0.010541 | 0.014586 | 0.018911 | 0.019505 | 0.040761 | 0.004278 | 0.003744 | 0.011408 | 0.016184 | 0.01 |
| 21 | 0.005747 | 0.008792 | 0.009916 | 0.009916 | 0.016370 | 0.027679 | 0.022030 | 0.034709 | 0.004124 | 0.003655 | 0.014943 | 0.014431 | 0.01 |
| 22 | 0.004598 | 0.007086 | 0.008745 | 0.008745 | 0.016236 | 0.021057 | 0.012570 | 0.027090 | 0.003726 | 0.003071 | 0.019303 | 0.012723 | 0.01 |
| 23 | 0.006897 | 0.005118 | 0.007340 | 0.007340 | 0.015106 | 0.016577 | 0.014946 | 0.036454 | 0.002698 | 0.002499 | 0.017121 | 0.009710 | 0.01 |
| 24 | 0.004598 | 0.004462 | 0.004919 | 0.004919 | 0.015702 | 0.015336 | 0.015140 | 0.029193 | 0.001747 | 0.001536 | 0.016722 | 0.007013 | 0.00 |
| 25 | 0.008046 | 0.001968 | 0.004216 | 0.004216 | 0.013171 | 0.012919 | 0.013214 | 0.036047 | 0.001824 | 0.001835 | 0.012329 | 0.004046 | 0.00 |
| 26 | 0.006897 | 0.002428 | 0.004216 | 0.004216 | 0.011504 | 0.011086 | 0.011346 | 0.018960 | 0.000951 | 0.001467 | 0.013089 | 0.003462 | 0.00 |
| 27 | 0.004598 | 0.002493 | 0.003904 | 0.003904 | 0.009052 | 0.008642 | 0.008761 | 0.019687 | 0.000784 | 0.001153 | 0.013278 | 0.003731 | 0.00 |
| 28 | 0.009195 | 0.001378 | 0.002342 | 0.002342 | 0.003572 | 0.008196 | 0.003201 | 0.005641 | 0.000450 | 0.000748 | 0.008601 | 0.001349 | 0.00 |
| 29 | 0.004598 | 0.001115 | 0.002577 | 0.002577 | 0.003011 | 0.004420 | 0.002344 | 0.006282 | 0.000642 | 0.001073 | 0.005022 | 0.001708 | 0.00 |
| 30 | 0.018391 | 0.012073 | 0.012727 | 0.012727 | 0.004084 | 0.003881 | 0.004023 | 0.006268 | 0.003148 | 0.006131 | 0.003427 | 0.007867 | 0.02 |

## Waller County 2013 Age Distribution Inputs to MOVES (2014, 2017, 2020, 2023, and 2026 Analysis Years)

| Age | MC | PC | PT | LCT | IBus | Tbus | Sbus | RT | SUShT | SULhT | MH | CShT | CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.032672 | 0.037873 | 0.023270 | 0.023270 | 0.072389 | 0.065587 | 0.070932 | 0.033029 | 0.062970 | 0.057821 | 0.070647 | 0.044145 | 0.04 |
| 1 | 0.061844 | 0.057670 | 0.037157 | 0.037157 | 0.069064 | 0.062574 | 0.067673 | 0.031943 | 0.156429 | 0.168999 | 0.067402 | 0.050366 | 0.05 |
| 2 | 0.042007 | 0.047833 | 0.040610 | 0.040610 | 0.064513 | 0.058451 | 0.063214 | 0.030530 | 0.108206 | 0.119519 | 0.062961 | 0.033024 | 0.03 |
| 3 | 0.036173 | 0.048325 | 0.036181 | 0.036181 | 0.059379 | 0.053799 | 0.058183 | 0.029277 | 0.039632 | 0.041136 | 0.057950 | 0.023436 | 0.01 |
| 4 | 0.070012 | 0.041931 | 0.028825 | 0.028825 | 0.056469 | 0.051163 | 0.055332 | 0.029049 | 0.041952 | 0.038867 | 0.055110 | 0.032853 | 0.03 |
| 5 | 0.067678 | 0.067384 | 0.057949 | 0.057949 | 0.060942 | 0.055215 | 0.059715 | 0.031957 | 0.115749 | 0.109703 | 0.059475 | 0.045381 | 0.04 |
| 6 | 0.108518 | 0.067507 | 0.063504 | 0.063504 | 0.061729 | 0.055929 | 0.060487 | 0.033459 | 0.068987 | 0.066910 | 0.060244 | 0.105335 | 0.09 |
| 7 | 0.086348 | 0.066954 | 0.061928 | 0.061928 | 0.060446 | 0.054766 | 0.059229 | 0.055072 | 0.074856 | 0.073722 | 0.058991 | 0.077765 | 0.07 |
| 8 | 0.085181 | 0.063695 | 0.050893 | 0.050893 | 0.059184 | 0.053623 | 0.057992 | 0.048719 | 0.064665 | 0.066726 | 0.057760 | 0.067581 | 0.06 |
| 9 | 0.056009 | 0.052444 | 0.067858 | 0.067858 | 0.046355 | 0.041999 | 0.045421 | 0.038414 | 0.045162 | 0.046885 | 0.045239 | 0.050622 | 0.04 |
| 10 | 0.057176 | 0.050046 | 0.066582 | 0.066582 | 0.036114 | 0.032720 | 0.035387 | 0.027724 | 0.038647 | 0.037809 | 0.035245 | 0.037072 | 0.03 |
| 11 | 0.047841 | 0.053243 | 0.068233 | 0.068233 | 0.030726 | 0.027839 | 0.030107 | 0.027379 | 0.032767 | 0.029776 | 0.029986 | 0.039288 | 0.03 |
| 12 | 0.040840 | 0.053366 | 0.065831 | 0.065831 | 0.034341 | 0.031114 | 0.033649 | 0.028067 | 0.032979 | 0.031226 | 0.033514 | 0.047980 | 0.04 |
| 13 | 0.029172 | 0.054780 | 0.048191 | 0.048191 | 0.036183 | 0.032783 | 0.035454 | 0.038501 | 0.028423 | 0.025178 | 0.035312 | 0.055608 | 0.05 |
| 14 | 0.032672 | 0.044697 | 0.048416 | 0.048416 | 0.035078 | 0.031782 | 0.034372 | 0.042800 | 0.023423 | 0.022513 | 0.034234 | 0.046361 | 0.04 |
| 15 | 0.022170 | 0.035475 | 0.034755 | 0.034755 | 0.026303 | 0.036907 | 0.026839 | 0.032093 | 0.010265 | 0.010778 | 0.019914 | 0.035964 | 0.03 |
| 16 | 0.009335 | 0.031479 | 0.039709 | 0.039709 | 0.021176 | 0.033367 | 0.024738 | 0.025837 | 0.013295 | 0.011889 | 0.030338 | 0.031490 | 0.03 |
| 17 | 0.019837 | 0.025023 | 0.029050 | 0.029050 | 0.017321 | 0.030408 | 0.021107 | 0.054129 | 0.007479 | 0.006508 | 0.018585 | 0.025609 | 0.02 |
| 18 | 0.010502 | 0.021457 | 0.027323 | 0.027323 | 0.022273 | 0.024655 | 0.026675 | 0.061402 | 0.008210 | 0.007162 | 0.021695 | 0.033620 | 0.03 |
| 19 | 0.012835 | 0.016354 | 0.021543 | 0.021543 | 0.016965 | 0.021269 | 0.012735 | 0.037582 | 0.004841 | 0.004575 | 0.020464 | 0.021945 | 0.02 |
| 20 | 0.009335 | 0.012235 | 0.013511 | 0.013511 | 0.013815 | 0.017451 | 0.015044 | 0.031755 | 0.003358 | 0.003265 | 0.013931 | 0.019090 | 0.02 |
| 21 | 0.003501 | 0.009407 | 0.013662 | 0.013662 | 0.010176 | 0.015151 | 0.012134 | 0.013459 | 0.002479 | 0.002182 | 0.012221 | 0.013295 | 0.01 |
| 22 | 0.005834 | 0.007747 | 0.009458 | 0.009458 | 0.011405 | 0.015159 | 0.015321 | 0.036173 | 0.002829 | 0.002519 | 0.008992 | 0.013465 | 0.01 |
| 23 | 0.001167 | 0.005103 | 0.008482 | 0.008482 | 0.012661 | 0.021945 | 0.017117 | 0.030467 | 0.002415 | 0.002214 | 0.011649 | 0.011420 | 0.01 |
| 24 | 0.005834 | 0.004058 | 0.007131 | 0.007131 | 0.012557 | 0.016695 | 0.009766 | 0.023779 | 0.002034 | 0.001779 | 0.015049 | 0.009374 | 0.01 |
| 25 | 0.004667 | 0.003259 | 0.004654 | 0.004654 | 0.011555 | 0.012999 | 0.011485 | 0.031647 | 0.001653 | 0.001514 | 0.013201 | 0.007500 | 0.00 |
| 26 | 0.003501 | 0.002152 | 0.003453 | 0.003453 | 0.011879 | 0.011893 | 0.011506 | 0.025065 | 0.001144 | 0.000953 | 0.012752 | 0.005241 | 0.00 |
| 27 | 0.003501 | 0.001045 | 0.003153 | 0.003153 | 0.009964 | 0.010019 | 0.010042 | 0.030950 | 0.001049 | 0.001136 | 0.009402 | 0.003025 | 0.00 |
| 28 | 0.003501 | 0.001660 | 0.003078 | 0.003078 | 0.008606 | 0.008502 | 0.008527 | 0.016098 | 0.000795 | 0.000980 | 0.009871 | 0.002727 | 0.00 |
| 29 | 0.002334 | 0.001783 | 0.002552 | 0.002552 | 0.006697 | 0.006554 | 0.006511 | 0.016530 | 0.000583 | 0.000785 | 0.009901 | 0.002642 | 0.00 |
| 30 | 0.028005 | 0.014018 | 0.013061 | 0.013061 | 0.003737 | 0.007680 | 0.003305 | 0.007113 | 0.002723 | 0.004971 | 0.007967 | 0.006775 | 0.01 |

## Texas Statewide 2011 Fuel Engine Fractions Summary

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.211 | 0.221 | 0.307 | 0.256 | 0.238 | 0.219 | 0.211 | 0.229 | 0.250 | 0.266 | 0.312 | 0.348 | 0.359 | 0.426 | 0.423 | 0.435 |
| SUShT | Diesel | 0.789 | 0.779 | 0.693 | 0.744 | 0.762 | 0.781 | 0.789 | 0.771 | 0.750 | 0.734 | 0.688 | 0.652 | 0.641 | 0.574 | 0.577 | 0.565 |
| SULhT | Gas | 0.211 | 0.221 | 0.307 | 0.256 | 0.238 | 0.219 | 0.211 | 0.229 | 0.250 | 0.266 | 0.312 | 0.348 | 0.359 | 0.426 | 0.423 | 0.435 |
| SULhT | Diesel | 0.789 | 0.779 | 0.693 | 0.744 | 0.762 | 0.781 | 0.789 | 0.771 | 0.750 | 0.734 | 0.688 | 0.652 | 0.641 | 0.574 | 0.577 | 0.565 |
| MH | Gas | 0.500 | 0.500 | 0.500 | 0.510 | 0.530 | 0.540 | 0.560 | 0.570 | 0.590 | 0.600 | 0.630 | 0.660 | 0.680 | 0.710 | 0.740 | 0.770 |
| MH | Diesel | 0.500 | 0.500 | 0.500 | 0.490 | 0.470 | 0.460 | 0.440 | 0.430 | 0.410 | 0.400 | 0.370 | 0.340 | 0.320 | 0.290 | 0.260 | 0.230 |
| CShT | Gas | 0.046 | 0.071 | 0.047 | 0.053 | 0.026 | 0.059 | 0.048 | 0.050 | 0.050 | 0.078 | 0.077 | 0.083 | 0.102 | 0.131 | 0.152 | 0.146 |
| CShT | Diesel | 0.954 | 0.929 | 0.953 | 0.947 | 0.974 | 0.941 | 0.952 | 0.950 | 0.950 | 0.922 | 0.923 | 0.917 | 0.898 | 0.869 | 0.848 | 0.854 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

## Texas Statewide 2011 Fuel Engine Fractions Summary - Continued

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1995 | 1994 | 1993 | 1992 | 1991 | 1990 | 1989 | 1988 | 1987 | 1986 | 1985 | 1984 | 1983 | 1982 | 1981 |
| PC | Gas | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.988 | 0.981 | 0.969 | 0.939 | 0.924 |
| PC | Diesel | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.012 | 0.019 | 0.031 | 0.061 | 0.076 |
| PT | Gas | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 | 0.992 | 0.995 | 0.990 | 0.978 | 0.983 | 0.985 | 0.979 | 0.960 | 0.982 |
| PT | Diesel | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 | 0.008 | 0.005 | 0.010 | 0.022 | 0.017 | 0.015 | 0.021 | 0.040 | 0.018 |
| PT | Gas | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 | 0.992 | 0.995 | 0.990 | 0.978 | 0.983 | 0.985 | 0.979 | 0.960 | 0.982 |
| PT | Diesel | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 | 0.008 | 0.005 | 0.010 | 0.022 | 0.017 | 0.015 | 0.021 | 0.040 | 0.018 |
| LCT | Gas | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 | 0.907 | 0.923 | 0.939 | 0.919 | 0.900 | 0.852 | 0.795 | 0.780 | 0.929 |
| LCT | Diesel | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 | 0.093 | 0.077 | 0.061 | 0.081 | 0.100 | 0.148 | 0.205 | 0.220 | 0.071 |
| LCT | Gas | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 | 0.907 | 0.923 | 0.939 | 0.919 | 0.900 | 0.852 | 0.795 | 0.780 | 0.929 |
| LCT | Diesel | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 | 0.093 | 0.077 | 0.061 | 0.081 | 0.100 | 0.148 | 0.205 | 0.220 | 0.071 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.114 | 0.147 | 0.121 | 0.010 | 0.090 | 0.124 | 0.229 | 0.250 | 0.266 | 0.327 | 0.485 | 0.615 | 0.676 | 0.674 | 0.736 |
| SBus | Diesel | 0.886 | 0.853 | 0.879 | 0.990 | 0.910 | 0.876 | 0.771 | 0.750 | 0.734 | 0.673 | 0.515 | 0.385 | 0.324 | 0.326 | 0.264 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.674 | 0.516 | 0.523 | 0.515 | 0.497 | 0.530 | 0.540 | 0.658 | 0.719 | 0.768 | 0.767 | 0.825 | 0.773 | 0.847 | 0.976 |
| SUShT | Diesel | 0.326 | 0.484 | 0.477 | 0.485 | 0.503 | 0.470 | 0.460 | 0.342 | 0.281 | 0.232 | 0.233 | 0.175 | 0.227 | 0.153 | 0.024 |
| SULhT | Gas | 0.674 | 0.516 | 0.523 | 0.515 | 0.497 | 0.530 | 0.540 | 0.658 | 0.719 | 0.768 | 0.767 | 0.825 | 0.773 | 0.847 | 0.976 |
| SULhT | Diesel | 0.326 | 0.484 | 0.477 | 0.485 | 0.503 | 0.470 | 0.460 | 0.342 | 0.281 | 0.232 | 0.233 | 0.175 | 0.227 | 0.153 | 0.024 |
| MH | Gas | 0.790 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| MH | Diesel | 0.210 | 0.180 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 |
| CShT | Gas | 0.306 | 0.112 | 0.123 | 0.164 | 0.161 | 0.153 | 0.124 | 0.170 | 0.148 | 0.250 | 0.239 | 0.284 | 0.384 | 0.311 | 0.626 |
| CShT | Diesel | 0.694 | 0.888 | 0.877 | 0.836 | 0.839 | 0.847 | 0.876 | 0.830 | 0.852 | 0.750 | 0.761 | 0.716 | 0.616 | 0.689 | 0.374 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2014 Fuel Engine Fractions Summary

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 1.000 | 1.000 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.000 | 0.000 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 |
| SUShT | Diesel | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 |
| SULhT | Gas | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 |
| SULhT | Diesel | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 |
| MH | Gas | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.510 | 0.530 | 0.540 | 0.560 | 0.570 | 0.590 | 0.600 | 0.630 | 0.660 | 0.680 |
| MH | Diesel | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.490 | 0.470 | 0.460 | 0.440 | 0.430 | 0.410 | 0.400 | 0.370 | 0.340 | 0.320 |
| CShT | Gas | 0.219 | 0.219 | 0.112 | 0.058 | 0.077 | 0.054 | 0.059 | 0.028 | 0.051 | 0.050 | 0.047 | 0.052 | 0.078 | 0.080 | 0.091 | 0.105 |
| CShT | Diesel | 0.781 | 0.781 | 0.888 | 0.942 | 0.923 | 0.946 | 0.941 | 0.972 | 0.949 | 0.950 | 0.953 | 0.948 | 0.922 | 0.920 | 0.909 | 0.895 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2014 Fuel Engine Fractions Summary - Continued

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1998 | 1997 | 1996 | 1995 | 1994 | 1993 | 1992 | 1991 | 1990 | 1989 | 1988 | 1987 | 1986 | 1985 | 1984 |
| PC | Gas | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.988 | 0.981 |
| PC | Diesel | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.012 | 0.019 |
| PT | Gas | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 | 0.992 | 0.995 | 0.990 | 0.978 | 0.983 | 0.985 |
| PT | Diesel | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 | 0.008 | 0.005 | 0.010 | 0.022 | 0.017 | 0.015 |
| PT | Gas | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 | 0.992 | 0.995 | 0.990 | 0.978 | 0.983 | 0.985 |
| PT | Diesel | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 | 0.008 | 0.005 | 0.010 | 0.022 | 0.017 | 0.015 |
| LCT | Gas | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 | 0.907 | 0.923 | 0.939 | 0.919 | 0.900 | 0.852 |
| LCT | Diesel | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 | 0.093 | 0.077 | 0.061 | 0.081 | 0.100 | 0.148 |
| LCT | Gas | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 | 0.907 | 0.923 | 0.939 | 0.919 | 0.900 | 0.852 |
| LCT | Diesel | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 | 0.093 | 0.077 | 0.061 | 0.081 | 0.100 | 0.148 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.114 | 0.147 | 0.121 | 0.010 | 0.090 | 0.124 | 0.229 | 0.250 | 0.266 | 0.327 | 0.485 | 0.615 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.886 | 0.853 | 0.879 | 0.990 | 0.910 | 0.876 | 0.771 | 0.750 | 0.734 | 0.673 | 0.515 | 0.385 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 | 0.517 | 0.472 | 0.557 | 0.568 | 0.648 | 0.707 | 0.738 | 0.741 | 0.816 |
| SUShT | Diesel | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 | 0.483 | 0.528 | 0.443 | 0.432 | 0.352 | 0.293 | 0.262 | 0.259 | 0.184 |
| SULhT | Gas | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 | 0.517 | 0.472 | 0.557 | 0.568 | 0.648 | 0.707 | 0.738 | 0.741 | 0.816 |
| SULhT | Diesel | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 | 0.483 | 0.528 | 0.443 | 0.432 | 0.352 | 0.293 | 0.262 | 0.259 | 0.184 |
| MH | Gas | 0.710 | 0.740 | 0.770 | 0.790 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| MH | Diesel | 0.290 | 0.260 | 0.230 | 0.210 | 0.180 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 |
| CShT | Gas | 0.131 | 0.146 | 0.140 | 0.284 | 0.121 | 0.117 | 0.165 | 0.165 | 0.147 | 0.109 | 0.151 | 0.162 | 0.255 | 0.230 | 0.291 |
| CShT | Diesel | 0.869 | 0.854 | 0.860 | 0.716 | 0.879 | 0.883 | 0.835 | 0.835 | 0.853 | 0.891 | 0.849 | 0.838 | 0.745 | 0.770 | 0.709 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2017 Fuel Engine Fractions Summary

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 |
| SUShT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 |
| SULhT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 |
| SULhT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 |
| MH | Gas | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.510 | 0.530 | 0.540 | 0.560 | 0.570 | 0.590 | 0.600 |
| MH | Diesel | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.490 | 0.470 | 0.460 | 0.440 | 0.430 | 0.410 | 0.400 |
| CShT | Gas | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.112 | 0.058 | 0.077 | 0.054 | 0.059 | 0.028 | 0.051 | 0.050 | 0.047 | 0.052 | 0.078 |
| CShT | Diesel | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.888 | 0.942 | 0.923 | 0.946 | 0.941 | 0.972 | 0.949 | 0.950 | 0.953 | 0.948 | 0.922 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2017 Fuel Engine Fractions Summary - Continued

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 | 1995 | 1994 | 1993 | 1992 | 1991 | 1990 | 1989 | 1988 | 1987 |
| PC | Gas | 0.996 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| PC | Diesel | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PT | Gas | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 | 0.992 | 0.995 | 0.990 |
| PT | Diesel | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 | 0.008 | 0.005 | 0.010 |
| PT | Gas | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 | 0.992 | 0.995 | 0.990 |
| PT | Diesel | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 | 0.008 | 0.005 | 0.010 |
| LCT | Gas | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 | 0.907 | 0.923 | 0.939 |
| LCT | Diesel | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 | 0.093 | 0.077 | 0.061 |
| LCT | Gas | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 | 0.907 | 0.923 | 0.939 |
| LCT | Diesel | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 | 0.093 | 0.077 | 0.061 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.114 | 0.147 | 0.121 | 0.010 | 0.090 | 0.124 | 0.229 | 0.250 | 0.266 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.886 | 0.853 | 0.879 | 0.990 | 0.910 | 0.876 | 0.771 | 0.750 | 0.734 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 | 0.517 | 0.472 | 0.557 | 0.568 | 0.648 | 0.707 |
| SUShT | Diesel | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 | 0.483 | 0.528 | 0.443 | 0.432 | 0.352 | 0.293 |
| SULhT | Gas | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 | 0.517 | 0.472 | 0.557 | 0.568 | 0.648 | 0.707 |
| SULhT | Diesel | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 | 0.483 | 0.528 | 0.443 | 0.432 | 0.352 | 0.293 |
| MH | Gas | 0.630 | 0.660 | 0.680 | 0.710 | 0.740 | 0.770 | 0.790 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| MH | Diesel | 0.370 | 0.340 | 0.320 | 0.290 | 0.260 | 0.230 | 0.210 | 0.180 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 |
| CShT | Gas | 0.080 | 0.091 | 0.105 | 0.131 | 0.146 | 0.140 | 0.284 | 0.121 | 0.117 | 0.165 | 0.165 | 0.147 | 0.109 | 0.151 | 0.162 |
| CShT | Diesel | 0.920 | 0.909 | 0.895 | 0.869 | 0.854 | 0.860 | 0.716 | 0.879 | 0.883 | 0.835 | 0.835 | 0.853 | 0.891 | 0.849 | 0.838 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2020 Fuel Engine Fractions Summary

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 |
| SUShT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 |
| SULhT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 |
| SULhT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 |
| MH | Gas | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.510 | 0.530 | 0.540 | 0.560 |
| MH | Diesel | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.490 | 0.470 | 0.460 | 0.440 |
| CShT | Gas | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.112 | 0.058 | 0.077 | 0.054 | 0.059 | 0.028 | 0.051 | 0.050 |
| CShT | Diesel | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.888 | 0.942 | 0.923 | 0.946 | 0.941 | 0.972 | 0.949 | 0.950 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

## Texas Statewide 2020 Fuel Engine Fractions Summary - Continued

| SUT | Fuel type | Model Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 | 1995 | 1994 | 1993 | 1992 | 1991 | 1990 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PT | Gas | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 |
| PT | Diesel | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 |
| PT | Gas | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 | 0.979 | 0.980 | 0.987 |
| PT | Diesel | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 | 0.021 | 0.020 | 0.013 |
| LCT | Gas | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 |
| LCT | Diesel | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 |
| LCT | Gas | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 | 0.930 | 0.932 | 0.916 |
| LCT | Diesel | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 | 0.070 | 0.068 | 0.084 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.114 | 0.147 | 0.121 | 0.010 | 0.090 | 0.124 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.886 | 0.853 | 0.879 | 0.990 | 0.910 | 0.876 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 | 0.517 | 0.472 | 0.557 |
| SUShT | Diesel | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 | 0.483 | 0.528 | 0.443 |
| SULhT | Gas | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 | 0.517 | 0.472 | 0.557 |
| SULhT | Diesel | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 | 0.483 | 0.528 | 0.443 |
| MH | Gas | 0.570 | 0.590 | 0.600 | 0.630 | 0.660 | 0.680 | 0.710 | 0.740 | 0.770 | 0.790 | 0.820 | 0.850 | 0.850 | 0.850 | 0.850 |
| MH | Diesel | 0.430 | 0.410 | 0.400 | 0.370 | 0.340 | 0.320 | 0.290 | 0.260 | 0.230 | 0.210 | 0.180 | 0.150 | 0.150 | 0.150 | 0.150 |
| CShT | Gas | 0.047 | 0.052 | 0.078 | 0.080 | 0.091 | 0.105 | 0.131 | 0.146 | 0.140 | 0.284 | 0.121 | 0.117 | 0.165 | 0.165 | 0.147 |
| CShT | Diesel | 0.953 | 0.948 | 0.922 | 0.920 | 0.909 | 0.895 | 0.869 | 0.854 | 0.860 | 0.716 | 0.879 | 0.883 | 0.835 | 0.835 | 0.853 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2023 Fuel Engine Fractions Summary

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2023 | 2022 | 2021 | 2020 | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 |
| SUShT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 |
| SULhT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 | 0.254 | 0.340 | 0.280 |
| SULhT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 | 0.746 | 0.660 | 0.720 |
| MH | Gas | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.510 |
| MH | Diesel | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.490 |
| CShT | Gas | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.112 | 0.058 | 0.077 | 0.054 | 0.059 |
| CShT | Diesel | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.888 | 0.942 | 0.923 | 0.946 | 0.941 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2023 Fuel Engine Fractions Summary - Continued

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 | 1995 | 1994 | 1993 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PT | Gas | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 |
| PT | Diesel | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 |
| PT | Gas | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 | 0.985 | 0.982 | 0.979 |
| PT | Diesel | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 | 0.015 | 0.018 | 0.021 |
| LCT | Gas | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 |
| LCT | Diesel | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 |
| LCT | Gas | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 | 0.881 | 0.898 | 0.915 |
| LCT | Diesel | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 | 0.119 | 0.102 | 0.085 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.114 | 0.147 | 0.121 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.886 | 0.853 | 0.879 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 |
| SUShT | Diesel | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 |
| SULhT | Gas | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 | 0.673 | 0.508 | 0.536 |
| SULhT | Diesel | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 | 0.327 | 0.492 | 0.464 |
| MH | Gas | 0.530 | 0.540 | 0.560 | 0.570 | 0.590 | 0.600 | 0.630 | 0.660 | 0.680 | 0.710 | 0.740 | 0.770 | 0.790 | 0.820 | 0.850 |
| MH | Diesel | 0.470 | 0.460 | 0.440 | 0.430 | 0.410 | 0.400 | 0.370 | 0.340 | 0.320 | 0.290 | 0.260 | 0.230 | 0.210 | 0.180 | 0.150 |
| CShT | Gas | 0.028 | 0.051 | 0.050 | 0.047 | 0.052 | 0.078 | 0.080 | 0.091 | 0.105 | 0.131 | 0.146 | 0.140 | 0.284 | 0.121 | 0.117 |
| CShT | Diesel | 0.972 | 0.949 | 0.950 | 0.953 | 0.948 | 0.922 | 0.920 | 0.909 | 0.895 | 0.869 | 0.854 | 0.860 | 0.716 | 0.879 | 0.883 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2026 Fuel Engine Fractions Summary

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2026 | 2025 | 2024 | 2023 | 2022 | 2021 | 2020 | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 | 0.895 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 |
| SUShT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 |
| SULhT | Gas | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.405 | 0.207 | 0.220 |
| SULhT | Diesel | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.595 | 0.793 | 0.780 |
| MH | Gas | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |
| MH | Diesel | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |
| CShT | Gas | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.219 | 0.112 | 0.058 |
| CShT | Diesel | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.888 | 0.942 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# Texas Statewide 2026 Fuel Engine Fractions Summary - Continued

| SUT | Fuel Type | Model Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 |
| PC | Gas | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| PC | Diesel | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 |
| PT | Gas | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.977 | 0.977 | 0.990 | 0.981 | 0.980 |
| PT | Diesel | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.023 | 0.023 | 0.010 | 0.019 | 0.020 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 |
| LCT | Gas | 0.895 | 0.895 | 0.895 | 0.913 | 0.921 | 0.891 | 0.819 | 0.867 | 0.843 | 0.827 | 0.877 | 0.833 | 0.962 | 0.864 | 0.911 |
| LCT | Diesel | 0.105 | 0.105 | 0.105 | 0.087 | 0.079 | 0.109 | 0.181 | 0.133 | 0.157 | 0.173 | 0.123 | 0.167 | 0.038 | 0.136 | 0.089 |
| IBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| TBus | Gas | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TBus | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| SBus | Gas | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| SBus | Diesel | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| RT | Gas | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| RT | Diesel | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 | 0.960 |
| SUShT | Gas | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 |
| SUShT | Diesel | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 |
| SULhT | Gas | 0.254 | 0.340 | 0.280 | 0.251 | 0.232 | 0.225 | 0.241 | 0.255 | 0.269 | 0.311 | 0.348 | 0.352 | 0.435 | 0.433 | 0.430 |
| SULhT | Diesel | 0.746 | 0.660 | 0.720 | 0.749 | 0.768 | 0.775 | 0.759 | 0.745 | 0.731 | 0.689 | 0.652 | 0.648 | 0.565 | 0.567 | 0.570 |
| MH | Gas | 0.500 | 0.500 | 0.510 | 0.530 | 0.540 | 0.560 | 0.570 | 0.590 | 0.600 | 0.630 | 0.660 | 0.680 | 0.710 | 0.740 | 0.770 |
| MH | Diesel | 0.500 | 0.500 | 0.490 | 0.470 | 0.460 | 0.440 | 0.430 | 0.410 | 0.400 | 0.370 | 0.340 | 0.320 | 0.290 | 0.260 | 0.230 |
| CShT | Gas | 0.077 | 0.054 | 0.059 | 0.028 | 0.051 | 0.050 | 0.047 | 0.052 | 0.078 | 0.080 | 0.091 | 0.105 | 0.131 | 0.146 | 0.140 |
| CShT | Diesel | 0.923 | 0.946 | 0.941 | 0.972 | 0.949 | 0.950 | 0.953 | 0.948 | 0.922 | 0.920 | 0.909 | 0.895 | 0.869 | 0.854 | 0.860 |
| CLhT | Diesel | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

[1] Conventional internal combustion engine technology only.

# APPENDIX I:
# MOVES RUN SUMMARIES

Appendix I is being transmitted electronically.