2000 On-Road Mobile Source Episode-Specific Emissions Inventories for the Houston-Galveston Ozone Nonattainment Area

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TO: Mary McGarry-Barber, Project Manager
Texas Natural Resource Conservation Commission

DATE: 31 March, 2002

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SUBJECT: 2000 On-Road Mobile Source Episode Specific Emissions Inventories for the Houston-Galveston Ozone Nonattainment Area
(Umbrella Contract 9880077500-12: Task 2) - **Review Draft**

INTRODUCTION

This Technical Note documents the methods used to develop the Houston-Galveston area (HGA) ozone nonattainment August 2000 base case episode-specific on-road mobile source emissions estimates (2007 attainment date analyses documentation associated with this task are provided in a separate Technical Note). The HGA counties are: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller. The period for emissions estimates for these eight counties includes 11 days, three prior to the ozone episode, August 22, 23, and 24; and the ozone episode days, August 25, 26, 27, 28, 29, 30, 31, and September 1.

Emissions of volatile organic compounds (VOC), carbon monoxide (CO) (not required for ozone modeling, but included for review), and oxides of nitrogen (NOx), are estimated for each day on an hourly basis. The hourly estimates are computed by network link for which the geographical coordinates are provided. Emissions are categorized by 28 vehicle types and 14 pollutant-specific emissions types.

Documented within are the methods relating to calculating inventory elements including link-based vehicle miles traveled (VMT) estimates from Houston-Galveston Area Council's (HGAC) travel demand model (TDM), August day-of-week-adjusted Highway Performance Monitoring System (HPMS) VMT control totals, VMT mix, speeds, MOBILE6 emissions factors, and the emissions estimates.

ACKNOWLEDGMENTS
Mary McGarry-Barber and Chris Kite, both with the Texas Natural Resource Conservation Commission (TNRCC), and Martin Boardman and Charles Bell, both of the Texas Transportation Institute (TTI), contributed to the development of the MOBILE6 emissions factors input data parameter values. Boardman produced the MOBILE6 model setups used, and performed the emissions factors analyses. Ranga T. Kandalam of HGAC provided the 2000 Houston-Galveston area network traffic assignment and intrazonal trips. Dennis Perkinson, Ph.D., of TTI, developed seasonally adjusted HPMS VMT control totals and VMT mix. Bell prepared VMT and modeled operational speeds. Bell and Boardman performed the emissions estimations. L.D. White of TTI performed quality assurance checks, and each member of the assigned TTI staff contributed to the quality assurance of the emissions inventory elements by cross checking each others work. Dr. Perkinson was the principle investigator for this project. This work was performed by TTI under contract to TNRCC. Mary McGarry-Barber was the TNRCC project technical manager.

Deliverables
Interim deliverables are an informal Technical Note (a narrative in memorandum format that explains the task, the approaches used, and the findings) provided to the Project Manager in WordPerfect 6/7/8 format, which is supported by electronic document files. All pertinent data are being submitted in specified electronic format. (There is no FORTRAN source code or executable files developed under this task.) CD-ROM or other electronic media is used to record the final data and supporting documentation. TTI is providing five copies of the final report. One of the copies is an unbound original suitable for copying. Electronic copies of all materials related to the task report, to document results and conclusions (e.g., data, work files, text files, etc.), or developed as work products under this contract are provided as requested by the TNRCC staff.

The 2000 ozone episode base case emissions inventory datasets on CD-ROM were submitted to the TNRCC, Technical Analysis Division on March 28, 2002. Appendix A lists the CD-ROM volume names and the data set file names and descriptions contained on each CD.

SUMMARY OF VMT AND EMISSIONS
A summary of 24-hour HGA network total VMT, average speed, and emissions of for each of the eleven analysis days is presented in Table 1.

TABLE 1
HGA All Counties August 2000 Ozone Episode Day*
On-Road Mobile Source VMT, Average Speed (mph), and Emissions (tons per day)

Day	VMT	Speed	VOC	CO	NOx
Tuesday, August 22	124,033,918	39.5	137.6	1,954.5	243.9
Wednesday, August 23	124,033,918	39.5	135.5	1,885.4	242.1
Thursday, August 24	124,033,918	39.5	135.1	1,872.2	242.0
Friday, August 25	135,297,532	38.6	154.9	2,134.9	224.6
Saturday, August 26	111,965,181	40.5	113.4	1,708.0	158.2
Sunday, August 27	92,456,016	41.8	93.8	1,457.5	121.0
Monday, August 28	124,033,918	39.5	143.6	2,025.5	245.2
Tuesday, August 29	124,033,918	39.5	145.1	2,035.9	245.3
Wednesday, August 30	124,033,918	39.5	149.5	2,095.6	245.8
Thursday, August 31	124,033,918	39.5	155.0	2,167.0	246.9
Friday, September 01	135,297,532	38.6	165.8	2,323.0	228.2

* August 22-24 are pre-ozone episode days.

OVERVIEW OF METHODOLOGY

To develop the HGA ozone episode emissions estimates, a directional link-based, hourly, methodology was applied. Emissions estimates were calculated at the roadway network link-level for each hour of each analysis day.

The MOBILE6 model was used to develop hourly emissions factors by MOBILE6 road type and 28 vehicle types. (Only the speed sensitive freeway and arterial emissions factors were applied.) The activity basis was the Houston-Galveston TDM link-based and intrazonal VMT, adjusted to August 2000 day-of-week HPMS VMT control totals. Automatic traffic recorder (ATR) data were used to produce the seasonal (August) day-of-week VMT adjustment factors. Hourly travel fractions were developed and applied to allocate the August day-of-week VMT by hour-of-day. Hourly operational speeds were modeled by link. Vehicle classification data were used to estimate time-of-day VMT mixes for apportioning fleetwide link-VMT to the 28 U.S. Environmental Protection Agency (EPA) vehicle types. Link-level emissions by vehicle type were calculated by hour. For the geographical allocation of emissions, the link endpoints (designated by network node numbers for which X-Y coordinates are provided) were recorded with the hourly link emissions.

TTI previously developed a series of computer programs for the development of detailed on-road mobile source emissions inventories. These computer programs (described in Appendix B) encompass the overall emissions estimation methodology as applied for this analysis.

ESTIMATION OF VMT

The outputs of the VMT estimation process are estimates of county VMT (and speeds, as discussed in a following section) by day-of-week (average Monday through Thursday, Friday, Saturday, and Sunday), hour, and direction for each link of the Houston-Galveston TDM network and for each of the added intrazonal links. For each county, link-based VMT estimates were adjusted to consistency with the 2000 HPMS VMT, August 2000 day-of-week activity control total for that county. The adjusted VMT were then allocated by hour of day. The HGAC traffic assignments were directional traffic assignments.

For each county, there are four VMT estimates, Friday VMT, Saturday VMT, Sunday VMT, and Weekday (average Monday through Thursday) VMT.

Data Sources

The HGA 2000, directional four time-of-day period, equilibrium traffic assigned network and intrazonal trips and zonal radii (assumed intrazonal trip length) were provided by HGAC. These TDM data, which cover the HGA eight county area, were used as the basis for developing the link-based August 2000 episode VMT estimates. Because the intrazonal trips are not assigned to the network, the intrazonal trips and zonal radii were needed to estimate the intrazonal VMT. To adjust the 2000 Houston-Galveston TDM VMT and allocate it as needed for the August 2000 episode days, several other sources of data were required.

HPMS VMT estimates are based on traffic count data collected according to a statistical sampling procedure specified by the Federal Highway Administration (FHWA) designed to estimate VMT (as well as lane miles and centerline miles). A wide range of traffic data is collected under the HPMS program. For the purpose of this study, county total HPMS Annual Average Daily Traffic (AADT) VMT were used to ensure that by county, travel model VMT were 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 inventories should be consistent with that reported through HPMS.)

ATR vehicle counts are collected by the Texas Department of Transportation (TxDOT) at selected locations on a continuous basis throughout Texas. These counts are available by season, month, and weekday, as well as on an annual average daily basis (i.e., AADT). Since they are continuous, they are especially well suited for making seasonal, day-of-week comparisons (i.e., adjustment factors), even though there may be relatively few ATR data collection locations in any given area. Data from the ATR stations in the HGA were grouped for this analysis. These ATR count data were used to produce the August day-of-week adjustment factors.

HGA time-of-day factors from previous HGA emissions inventory analyses were processed to estimate the hourly travel fractions for this study. (TXDOT vehicle classification count data were used to develop the VMT mix, or VMT fractions, for the 28 EPA vehicle types, discussed in a following section.)

August 2000 Day-of-Week VMT Control Totals

To obtain August day-of-week-specific, 2000 HPMS consistent link-based VMT, VMT control totals were used. ATR-based August day-of-week adjustment factors were developed and applied to each county's 2000 HPMS AADT VMT estimate. The results, presented in Table 2, are four August 2000 VMT control totals for each county; one each for Weekday, Friday, Saturday, and Sunday VMT estimates. (The Houston-Galveston TDM link-VMT for each county were then scaled to these control totals to reflect both August day-of-week-specific activity and consistency with 2000 HPMS VMT.)

Aggregated ATR data (for 1999 and 2000) from the HGA ATR-stations were used. The eight-county area August day-of-week factors were produced by dividing the average day-of-week traffic count by the AADT traffic count. The August day-of-week factors are: Weekday 1.07223, Friday 1.16960, Saturday 0.96790, and Sunday 0.79925.

TABLE 2
HGA County August 2000 VMT Control Totals
(Rounded to whole numbers)

County	AADT	Weekday*	Friday	Saturday	Sunday
Brazoria	5,284,407	5,666,100	6,180,643	5,114,778	4,223,563
Chambers	2,081,471	2,231,816	2,434,489	2,014,656	1,663,616
Fort Bend	6,418,376	6,881,976	7,506,933	6,212,346	5,129,887
Galveston	5,820,799	6,241,235	6,808,007	5,633,952	4,652,274
Harris	85,667,980	91,855,778	100,197,270	82,918,038	68,470,133
Liberty	1,923,087	2,061,992	2,249,243	1,861,356	1,537,027
Montgomery	6,856,031	7,351,242	8,018,814	6,635,952	5,479,683
Waller	1,626,312	1,743,781	1,902,135	1,574,108	1,299,830
HGA	115,678,465	124,033,920	135,297,532	111,965,186	92,456,013

* Average Monday through Thursday

Thus, four control total-consistent link-VMT datasets were produced for each county. The TDM assignment link-VMT were adjusted to control total consistency by multiplying by the ratio of, on a county basis, control total VMT to the TDM assignment VMT total.

Hourly Travel Factors

Hourly time-period volume factors developed for a previous HGA air quality analysis were processed to produce factors for apportioning VMT by hour for this analysis.

Previously, time-of-day volume factors were applied to apportion HGAC TDM VMT from a single 24-hour assignment to the hours (24) of the day (HGA MOBILE5b 2007 emissions analysis, TTI, December 2000). The single assignment hourly volume factors are a set of factors by 24 time periods, five HGAC TDM area types (see Table 3), the13 HGAC TDM network functional classes (see Table 4), and the four day-of-week periods. The VMT factors may be grouped by four area types (by combining Central Business District and Urban area types) and by three functional groups.

TABLE 3
HGAC Network Area Types

1. Central Business District (CBD)
2. Urban
3. Urban Fringe
4. Suburban
5. Rural

TABLE 4
HGAC Functional Classification to Functional Group Table of Equals for Application of Hourly VMT Factors

Functional Group	Network Functional Classifications
1. Freeways, Interstates	1. Urban Interstate Freeways 2. Urban Other Freeways 10. Rural Interstate Freeways 11. Rural Other Freeways
2. Arterials, Major Collectors	5. Urban Principal Arterials 6. Urban Other Arterials 12. Rural Principal Arterials 13. Rural Other Arterials 14. Rural Major Collectors
3. Collectors, Locals	7. Urban Collectors 8. Locals (Centroid Connectors) 15. Rural Collectors 16. Locals (Intrazonals)

For this August 2000 base case analysis, HGAC provided a four-period time-of-day 2000 network assignment. Table 5 shows the assignment time-of-day travel periods.

TABLE 5
HGAC Time-of-Day Travel Periods

Period	Hours
AM Peak	6:00 a.m. - 9:00 a.m.
Midday	9:00 a.m. - 3:00 p.m.
PM Peak	3:00 p.m. - 7:00 p.m.
Overnight	7:00 p.m. - 6:00 a.m.

To produce the hourly volume fractions for allocating the four-period 2000 assignment VMT to the hours of day, the hourly factors (from the prior single assignment analysis) by area type and functional group were grouped within their corresponding four time-of-day periods and then normalized within each period. This procedure was performed on the prior 24-hour assignment assessment hourly volume factors from each of the day-of-week periods to produce the hourly

VMT allocation factors for Weekday, Friday, Saturday, and Sunday, as summarized in the tables in Appendix C. These hourly volume fractions were applied to the adjusted four-period time-of-day link-VMT and intrazonal VMT by functional group and area type to allocate the VMT to each hour of the day.

ESTIMATION OF LINK SPEEDS

The operational speeds by direction and time-of-day period were calculated on each freeway, arterial, and collector link using the Houston speed model that uses a "speed reduction factor" approach in calculating the link-speeds. For locals streets (which include centroid connector and intrazonal functional classifications), no speed model was used to estimate speeds. These methods are documented in the TTI Research Report 1279-9, "Texas Mobile Source Emissions Software, Version 2.0: User's Guide," February 1995.

The Houston speed model calculates the operational link speeds by direction and time period as a function of the link's estimated freeflow speed, estimated Level of Service (LOS) E speed, and volume-to-capacity (V/C) ratio-based speed reduction factors (SRF). The SRFs describe the decay from a freeflow speed (i.e., the uncongested speed for a V/C ratio approaching 0.0) to an LOS E speed (i.e., the congested speed for a V/C ratio of 1.0). The values of the SRFs vary from 0.0 to 1.0.

To assist in calculating capacity factors and speed factors required to estimate the operational link speeds, the network functional classifications were regrouped into the five functional groups as shown in Table 6.

TABLE 6
Functional Classification to Functional Group Table of Equals for Application of Capacity and Speed Factors

Functional Group	Corresponding Network Functional Classifications
1. Freeways, Interstates	1. Urban Interstate Freeways 2. Urban Other Freeways 10. Rural Interstate Freeways 11. Rural Other Freeways
2. Principal Arterials	5. Urban Principal Arterials 12. Rural Principal Arterials
3. Other Arterials, Major Collectors	6. Urban Other Arterials 13. Rural Other Arterials 14. Rural Major Collectors
4. Collectors	7. Urban Collectors 15. Rural Collectors
5. Locals	8. Locals (Centroid Connectors) 16. Locals (Intrazonals)

The V/C ratios by time period were required for each link. Directional time period link volumes were calculated by multiplying the associated directional link VMT[1] by the time period volume factor divided by the link distance. The directional time-period link capacities were calculated by multiplying the time period directional link capacity by the time period capacity factor. The capacity factors for each time period (shown in Appendix D) are the same for each area type and functional class. The time period link V/C ratios were then calculated by dividing the directional link volume by the directional link capacity.

To estimate the link freeflow and LOS E speeds, the link equilibrium assignment speeds, indexed by functional group and area type, were multiplied by a pair of speed factors corresponding to each functional group and area type. These speed factors (shown in Appendix D) were developed by dividing the distance-weighted average equilibrium assignment input speeds into the average modeled freeflow speeds (V/C = 0.0), and the average modeled LOS E speeds (V/C = 1.0). These factors were produced on a functional group and area type basis. The estimated link freeflow and LOS E speeds were assumed the same in each direction.

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

[1] From one of the four time of day directional assignments used.

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

where:

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

$S_{0.0}$ = estimated freeflow 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

$SRF_{V/C}$ = speed reduction factor 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, the model extension discussed below is used.)

The speed extension model used for V/C > 1.0 is:

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

where:

$S_{v/c}$ = estimated directional speed for the forecast V/C ratio on the link in the subject 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 is computed for the V/C ratio of 1.5.

These models were applied, dependent on the link V/C ratio, to estimate the speeds at the link level for freeways, arterials, and collectors. The speed reduction factors by V/C ratio for each functional group (except local streets) are presented as four figures in Appendix D.

Capacity data are not used, however, for the centroid connector and intrazonal functional classifications that make up the locals road type. The centroid connector traffic assignment input speeds were thus used as the centroid connector operational speeds estimates. Operational speeds for the intrazonal trips category were estimated by zone as the average of the zone's centroid connector speeds.

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

ESTIMATION OF VMT MIX

VMT mix was estimated using TxDOT weekday vehicle classification data for 1997-2000. As was the case with the seasonal adjustment factor and VMT estimation procedure, these data were aggregated to the HGA (i.e., all eight HGAC counties).

TxDOT classification counts classify vehicles into the standard FHWA vehicle classifications (based on vehicle length/number of axles) using best practice vehicle classification count methods.

C	Passenger vehicles
P	Two-axle, four-tire single-unit trucks
B	Buses
SU2	Six-tire, two-axle single-unit vehicles
SU3	Three-axle single-unit vehicles
SU4	Four or more axle single-unit vehicles
SE4	Three or four axle single-trailer vehicles
SE5	Five-axle single-trailer vehicles
SE6	Six or more axle single-trailer vehicles
SD5	Five or less axle multi-trailer vehicles
SD6	Six-axle multi-trailer vehicles
SD7	Seven or more axle multi-trailer vehicles

EPA and MOBILE use a different vehicle classification scheme than the FHWA categories. The 28 EPA vehicle categories are defined as a function of gross vehicle weight rating (GVWR) and fuel type. (See Table 7.) The FHWA axle/vehicle length based classification categories must be converted into 28 MOBILE GVWR/fuel type based categories.

TABLE 7
EPA Vehicle Types - 28 Categories

Category	Description	GVWR
LDGV	Light duty gasoline vehicle	≤ 6,000
LDGT1	Light duty gasoline truck	≤ 6,000
LDGT2	Light duty gasoline truck	≤ 6,000
LDGT3	Light duty gasoline truck	6,001 - 8,500
LDGT4	Light duty gasoline truck	6,001 - 8,500
HDGV2b	Heavy duty gasoline vehicle	8,501 - 10,000
HDGV3	Heavy duty gasoline vehicle	10,001 - 14,000
HDGV4	Heavy duty gasoline vehicle	14,001 - 16,000
HDGV5	Heavy duty gasoline vehicle	16,001 - 19,500
HDGV6	Heavy duty gasoline vehicle	19,501 - 26,000
HDGV7	Heavy duty gasoline vehicle	26,001 - 33,000
HDGV8a	Heavy duty gasoline vehicle	33,001 - 60,000
HDGV8b	Heavy duty gasoline vehicle	> 60,000
HDGB	Heavy duty gasoline bus	all
LDDV	Light duty diesel vehicle	≤ 6,000
LDDT12	Light duty diesel truck	≤ 6,000
LDDT34	Light duty diesel truck	6,001 - 8,500
HDDV2b	Heavy duty diesel vehicle	8,501 - 10,000
HDDV3	Heavy duty diesel vehicle	10,001 - 14,000
HDDV4	Heavy duty diesel vehicle	14,001 - 16,000
HDDV5	Heavy duty diesel vehicle	16,001 - 19,500
HDDV6	Heavy duty diesel vehicle	19,501 - 26,000
HDDV7	Heavy duty diesel vehicle	26,001 - 33,000
HDDV8a	Heavy duty diesel vehicle	33,001 - 60,000
HDDV8b	Heavy duty diesel vehicle	> 60,000
HDDBS	Heavy duty diesel school bus	all
HDDBT	Heavy duty diesel transit bus	all
MC	Motorcycle	all

The FHWA category counts (based on number of axles or vehicle length) are first converted into eight EPA categories (based on GVWR). Vehicle classification counts are first aggregated into two intermediate groups.

PV	C + P
HDV	SU2 + SU3 + SU4 + SE4 + SE5 + SE6 + SD5 + SD6 + SD7

This is followed by a second intermediate allocation that separates light-duty vehicles (LDV) into passenger cars and light-duty trucks (LDT) based on county registration data.

LDV	0.712 × PV (Harris County 2000 registration data shown)
LDT	0.288 × PV (Harris County 2000 registration data shown)

A third intermediate allocation further separates light-duty trucks into LDT1 and LDGT2. (Note that LDT1 is itself intermediate and is further divided into LDGT1 and LDDT.)

LDT1	0.842 × LDT (Harris County 2000 registration data shown)
LDGT2	0.158 × LDT (Harris County 2000 registration data shown)

Next, the remaining FHWA categories and this intermediate group are disaggregated into the eight EPA vehicle groups, as shown. Note that TxDOT vehicle classification count procedures do not distinguish between gasoline and diesel light-duty trucks consequently, MOBILE defaults for the year of interest are used. As before, actual Texas county vehicle registration data are used to separate gasoline from diesel heavy-duty trucks. Note also that motorcycles are not counted separately and are included as a default (subtracted from LDGV).

LDGV	0.9977179 × LDV (MOBILE6 default for 2000 shown)
LDDV	0.0022821 × LDV (MOBILE6 default for 2000 shown)
LDGT1	0.9944118 × LDT1 (MOBILE6 default for 2000 shown)
LDDT	0.0055882 × LDT1 (MOBILE6 default for 2000 shown)
LDGT2	0.158 × LDT (Harris County 2000 registration data shown, as above)
HDGV	0.369 × HDV (Harris County 2000 registration data shown)
HDDV	0.631 × HDV (Harris County 2000 registration data shown)
MC	0.001 of total (subtracted from LDGV)

This converts the FHWA axle count-based categories into GVWR categories. This part of the conversion procedure is summarized schematically in Table 8. Starting with the TxDOT vehicle classification data, these date themselves provide sufficient information to complete the first step in the conversion process, the allocation of vehicles into passenger vehicles (PV) and heavy-duty vehicles (HDV). Steps 2 and 3 further allocate these categories using county registration data. Finally, Step 4 allocates light-duty vehicles by fuel type using EPA MOBILE diesel fractions and motorcycles are separated from light-duty gas vehicles using a nominal constant.

TABLE 8
Initial Vehicle Classification Conversion Procedure

<table>
<tr><th>Start</th><th>Step 1</th><th>Step 2</th><th>Step 3</th><th>Step 4</th></tr>
<tr><td rowspan="8">Total Vehicles</td><td rowspan="5">PV</td><td rowspan="3">LDV</td><td rowspan="2">LDGV</td><td>MC</td></tr>
<tr><td>LDGV</td></tr>
<tr><td colspan="2">LDDV</td></tr>
<tr><td rowspan="3">LDT</td><td rowspan="2">LDT1</td><td>LDGT1</td></tr>
<tr><td>LDDT</td></tr>
<tr><td colspan="2">LDGT2</td></tr>
<tr><td rowspan="2">HDV</td><td colspan="3">HDGV</td></tr>
<tr><td colspan="3">HDDV</td></tr>
</table>

MOBILE6 requires 28 vehicle classification categories (as opposed to the eight in MOBILE5). The 28-category typology is a subset of the eight-category typology. A combination of EPA MOBILE6 defaults and Texas vehicle registration data are used to expand the basic EPA eight-category model. Thus, the procedures employed to expand the EPA eight-category scheme to the 28-category scheme are largely incremental extensions of the eight-category procedure, involving the disaggregation of the HDGV, LDGT, HDDV, and LDDT categories and the addition of three bus categories.

For the 28-category EPA scheme, heavy-duty vehicles (HDGV and HDDV) are separated into eight categories each. These 16 categories are separated from total heavy-duty vehicle counts (HDV), which have been separated by fuel type using county registration data. Each HDV category (HDGV and HDDV) is then divided into sub-categories based on regionally grouped TxDOT county vehicle registration data.

The 28-category EPA scheme also further divides the two light-duty truck categories based in part on assumed loading. The previous LDGT1 and LDGT2 categories (previously defined as GVWR $\leq$ 6,000 and GVWR > 6,000 to 8,500, respectively) are separated into subcategories in terms of adjusted loaded vehicle weight. Adjusted loaded vehicle weight is the average of vehicle curb weight and GVWR. Thus, two new intermediate categories are introduced. These are light light-duty trucks (LLDT) and heavy light-duty trucks (HLDT), which are defined as:

- LLDT - Any light-duty truck rated through 6,000 pounds GVWR, and
- HLDT - Any light-duty truck rated greater than 6,000 pounds GVWR.

These two new intermediate categories are then used to define the four light-duty truck categories using EPA MOBILE6 defaults for the year of interest. The four LDT categories are:

- LDGT1 - light light-duty trucks through 3,750 pounds loaded vehicle weight,
- LDGT2 - light light-duty trucks greater than 3,750 pounds loaded vehicle weight,
- LDGT3 - heavy light-duty trucks to 5,750 pounds adjusted loaded vehicle weight, and
- LDGT4 - heavy light-duty trucks greater than 5,750 pounds adjusted loaded vehicle weight.

Similarly, the LDDT category is sub-divided into two categories based on GVWR (less than or equal to 6,000 GVWR and 6,000 to 8,500 GVWR). This is accomplished using EPA MOBILE6 default values for the year of interest.

Finally the three bus categories are separated from the TxDOT classification counts bus category using EPA MOBILE6 default values. (Under MOBILE6 the HDV category does not include buses.) The VMT mix estimation procedure is summarized in Table 9 followed by explanatory notes.

This procedure is performed as described for weekdays. TxDOT vehicle classification data are only collected for weekdays (Monday through Thursday), consequently other data is used to estimate VMT mix for Fridays, Saturdays, and Sundays. (No seasonal changes in vehicle classification distribution are assumed.) The procedure used to estimate Friday, Saturday, and Sunday VMT mix relies on extensive vehicle classification data collected in the Houston area over several years. The ratio of weekday VMT mix to Friday, Saturday, and Sunday VMT mix is applied to the weekday VMT mix to produce region-specific Friday, Saturday, and Sunday VMT mix.

TABLE 9
VMT Mix Estimation Procedure Summary

EPA-8	EPA-28	Conversion
LDGV	LDGV	.9977 × LDV
LDGT1	LDGT1	.2310 × LLDT
	LDGT2	.7690 × LLDT
LDGT2	LDGT3	.6850 × HDLT
	LDGT4	.3150 × HDLT
HDGV	HDGV2b	.513 × HDGV
	HDGV3	.193 × HDGV
	HDGV4	.089 × HDGV
	HDGV5	.038 × HDGV
	HDGV6	.092 × HDGV
	HDGV7	.037 × HDGV
	HDGV8a	.034 × HDGV
	HDGV8b	.004 × HDGV
	HDGB	.2045 × B
LDDV	LDDV	.0023 × LDV
LDDT	LDDT12	.1623 × LDDT
	LDDT34	.8377 × LDDT
HDDV	HDDV2b	.253 × HDDV
	HDDV3	.132 × HDDV
	HDDV4	.077 × HDDV
	HDDV5	.050 × HDDV
	HDDV6	.159 × HDDV
	HDDV7	.105 × HDDV
	HDDV8a	.178 × HDDV
	HDDV8b	.046 × HDDV
	HDDBT	.3253 × B
	HDDBS	.4702 × B
MC	MC	MC

Notes to VMT Mix Estimation Procedure Summary

Intermediate category factors and sources:

LDV	.712 * PV (by county, Harris County 2000 registration data shown)
LDT	.288 * PV (by county, Harris County 2000 registration data shown)
LDT1	.842 * LDT (by county, Harris County 2000 registration data shown)
HLDT	.158 * LDT (by county, Harris County 2000 registration data shown)
LLDT	.9944 * LDT1 (EPA MOBILE6 default)
LDDT	.0056 * LDT1 (EPA MOBILE6 default)
HDV	SU2+SU3+SU4+SE3+SE4+SE5+SE6+SD5+SD6+SD7
HDGV	.369 * HDV (by county, Harris County 2000 registration data shown)
HDDV	.631 * HDV (by county, Harris County 2000 registration data shown)

Category conversion factors and sources:

LDGV	.9977 * LDV (EPA MOBILE6 default)
LDGT1	.2310 * LLDT (EPA MOBILE6 default)
LDGT2	.7690 * LLDT (EPA MOBILE6 default)
LDGT3	.6850 * HLDT (EPA MOBILE6 default)
LDGT4	.3150 * HLDT (EPA MOBILE6 default)
HDGV2a	.513 * HDGV (Regional registration data)
HDGV3	.193 * HDGV (Regional registration data)
HDGV4	.089 * HDGV (Regional registration data)
HDGV5	.038 * HDGV (Regional registration data)
HDGV6	.092 * HDGV (Regional registration data)
HDGV7	.037 * HDGV (Regional registration data)
HDGV8a	.034 * HDGV (Regional registration data)
HDGV8b	.004 * HDGV (Regional registration data)
HDGB	.2045 * B (EPA MOBILE6 default)
LDDV	.0023 * LDV (EPA MOBILE6 default)
LDDT12	.1623 * LDDT (EPA MOBILE6 default)
LDDT34	.8377 * LDDT (EPA MOBILE6 default)
HDDV2b	.253 * HDDV (Regional registration data)
HDDV3	.132 * HDDV (Regional registration data)
HDDV4	.077 * HDDV (Regional registration data)
HDDV5	.050 * HDDV (Regional registration data)
HDDV6	.159 * HDDV (Regional registration data)
HDDV7	.105 * HDDV (Regional registration data)
HDDV8a	.178 * HDDV (Regional registration data)
HDDV8b	.046 * HDDV (Regional registration data)
HDDBT	.3253 * B (EPA MOBILE6 default)
HDDBS	.4702 * B (EPA MOBILE6 default)
MC	MC (default subtracted from LDGV, no conversion)

For this analysis, the HGA regional mixes were developed by the four time-of-day travel periods and three functional classification groups. The VMT mixes are shown in Table 10-13.

TABLE 10
HGA Weekday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.6276763	0.0573346	0.1908653	0.0344063	0.0158222	0.0118662	0.0044643	0.0020587	0.0008790
2	AM_Peak	Col	0.5411781	0.0688742	0.2292803	0.0459848	0.0211467	0.0156386	0.0058835	0.0027131	0.0011584
3	AM_Peak	Fway	0.6539035	0.0531817	0.1770403	0.0305747	0.0140602	0.0118251	0.0044488	0.0020515	0.0008759
4	Mid_Day	Art	0.5899229	0.0539002	0.1794324	0.0322804	0.0148446	0.0224853	0.0084594	0.0039010	0.0016656
5	Mid_Day	Col	0.5098221	0.0645629	0.2149282	0.0431115	0.0198254	0.0264665	0.0099572	0.0045916	0.0019605
6	Mid_Day	Fway	0.6195840	0.0505174	0.1681711	0.0291083	0.0133858	0.0211431	0.0079544	0.0036681	0.0015662
7	Ovr_Nite	Art	0.6258909	0.0573916	0.1910550	0.0343741	0.0158074	0.0125953	0.0047386	0.0021851	0.0009330
8	Ovr_Nite	Col	0.5576924	0.0709778	0.2362830	0.0473891	0.0217925	0.0111875	0.0042089	0.0019409	0.0008287
9	Ovr_Nite	Fway	0.6388346	0.0519594	0.1729713	0.0299059	0.0137526	0.0160085	0.0060227	0.0027773	0.0011858
10	PM_Peak	Art	0.6270796	0.0576340	0.1918620	0.0345923	0.0159077	0.0119659	0.0045018	0.0020759	0.0008864
11	PM_Peak	Col	0.5422065	0.0689709	0.2296021	0.0460498	0.0211766	0.0152871	0.0057513	0.0026522	0.0011324
12	PM_Peak	Fway	0.6533583	0.0534162	0.1778210	0.0308405	0.0141824	0.0118384	0.0044538	0.0020538	0.0008769

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0021281	0.0008558	0.0007865	0.0000925	0.0014380	0.0002264	0.0107870	0.0056280	0.0032830	0.0021318
2	0.0028046	0.0011279	0.0010365	0.0001219	0.0012401	0.0002720	0.0133387	0.0069593	0.0040596	0.0026361
3	0.0021207	0.0008529	0.0007837	0.0000922	0.0014980	0.0002100	0.0102132	0.0053286	0.0031084	0.0020184
4	0.0040324	0.0016217	0.0014903	0.0001753	0.0013516	0.0002129	0.0202510	0.0105657	0.0061633	0.0040022
5	0.0047464	0.0019089	0.0017541	0.0002064	0.0011684	0.0002550	0.0228311	0.0119119	0.0069486	0.0045121
6	0.0037918	0.0015249	0.0014013	0.0001649	0.0014195	0.0001995	0.0182175	0.0095048	0.0055445	0.0036003
7	0.0022588	0.0009084	0.0008348	0.0000982	0.0014339	0.0002267	0.0115259	0.0060135	0.0035079	0.0022778
8	0.0020063	0.0008069	0.0007415	0.0000872	0.0012779	0.0002803	0.0096480	0.0050337	0.0029364	0.0019067
9	0.0028709	0.0011546	0.0010610	0.0001248	0.0014635	0.0002052	0.0139316	0.0072686	0.0042400	0.0027533
10	0.0021459	0.0008630	0.0007931	0.0000933	0.0014366	0.0002276	0.0108380	0.0056546	0.0032985	0.0021419
11	0.0027416	0.0011026	0.0010132	0.0001192	0.0012425	0.0002724	0.0131888	0.0068811	0.0040140	0.0026065
12	0.0021231	0.0008538	0.0007846	0.0000923	0.0014967	0.0002110	0.0102240	0.0053342	0.0031116	0.0020205

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0067792	0.0044768	0.0075893	0.0019613	0.0010000	0.0008782	0.0013973	0.0020195	0.0011684
2	0.0083828	0.0055358	0.0093846	0.0024252	0.0010000	0.0013114	0.0020864	0.0030156	0.0014035
3	0.0064186	0.0042387	0.0071856	0.0018569	0.0010000	0.0008238	0.0013106	0.0018943	0.0010837
4	0.0127269	0.0084045	0.0142477	0.0036820	0.0010000	0.0004258	0.0006774	0.0009791	0.0010984
5	0.0143484	0.0094754	0.0160630	0.0041511	0.0010000	0.0004453	0.0007085	0.0010240	0.0013157
6	0.0114490	0.0075606	0.0128171	0.0033123	0.0010000	0.0004834	0.0007691	0.0011117	0.0010294
7	0.0072435	0.0047835	0.0081091	0.0020956	0.0010000	0.0003153	0.0005017	0.0007251	0.0011695
8	0.0060634	0.0040041	0.0067879	0.0017542	0.0010000	0.0003922	0.0006240	0.0009019	0.0014464
9	0.0087554	0.0057819	0.0098017	0.0025330	0.0010000	0.0005270	0.0008385	0.0012119	0.0010588
10	0.0068113	0.0044980	0.0076252	0.0019706	0.0010000	0.0005975	0.0009507	0.0013741	0.0011745
11	0.0082886	0.0054736	0.0092791	0.0023980	0.0010000	0.0012565	0.0019990	0.0028892	0.0014055
12	0.0064253	0.0042431	0.0071931	0.0018589	0.0010000	0.0006334	0.0010077	0.0014565	0.0010885

TABLE 11
HGA Friday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.6768806	0.0527257	0.1755222	0.0318949	0.0146673	0.0067688	0.0025465	0.0011743	0.0005014
2	AM_Peak	Col	0.5951202	0.0645844	0.2149997	0.0434673	0.0199890	0.0090962	0.0034222	0.0015781	0.0006738
3	AM_Peak	Fway	0.7017880	0.0486730	0.1620310	0.0282076	0.0129716	0.0067131	0.0025256	0.0011647	0.0004973
4	Mid_Day	Art	0.6505390	0.0506850	0.1687290	0.0305989	0.0140713	0.0131154	0.0049342	0.0022754	0.0009715
5	Mid_Day	Col	0.5727330	0.0618447	0.2058792	0.0416285	0.0191434	0.0157256	0.0059163	0.0027282	0.0011649
6	Mid_Day	Fway	0.6780090	0.0471406	0.1569298	0.0273810	0.0125915	0.0122382	0.0046042	0.0021232	0.0009065
7	Ovr_Nite	Art	0.6754745	0.0528186	0.1758317	0.0318895	0.0146648	0.0071902	0.0027051	0.0012474	0.0005326
8	Ovr_Nite	Col	0.6067369	0.0658483	0.2192070	0.0443179	0.0203802	0.0064380	0.0024221	0.0011169	0.0004769
9	Ovr_Nite	Fway	0.6915093	0.0479624	0.1596655	0.0278274	0.0127968	0.0091660	0.0034484	0.0015902	0.0006790
10	PM_Peak	Art	0.6761282	0.0529925	0.1764105	0.0320622	0.0147442	0.0068245	0.0025675	0.0011840	0.0005055
11	PM_Peak	Col	0.5958704	0.0646338	0.2151642	0.0435011	0.0200046	0.0088861	0.0033431	0.0015416	0.0006582
12	PM_Peak	Fway	0.7010989	0.0488804	0.1627214	0.0284487	0.0130825	0.0067197	0.0025281	0.0011658	0.0004978

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0012139	0.0004882	0.0004486	0.0000528	0.0015460	0.0002086	0.0072103	0.0037619	0.0021944	0.0014250
2	0.0016313	0.0006561	0.0006029	0.0000709	0.0013595	0.0002555	0.0090914	0.0047434	0.0027670	0.0017967
3	0.0012039	0.0004842	0.0004449	0.0000523	0.0016028	0.0001925	0.0067941	0.0035448	0.0020678	0.0013427
4	0.0023521	0.0009459	0.0008692	0.0001023	0.0014859	0.0002005	0.0138415	0.0072216	0.0042126	0.0027355
5	0.0028202	0.0011342	0.0010422	0.0001226	0.0013084	0.0002446	0.0158962	0.0082937	0.0048380	0.0031415
6	0.0021948	0.0008827	0.0008111	0.0000954	0.0015485	0.0001865	0.0123564	0.0064468	0.0037606	0.0024420
7	0.0012895	0.0005186	0.0004765	0.0000561	0.0015427	0.0002089	0.0077101	0.0040227	0.0023465	0.0015237
8	0.0011546	0.0004643	0.0004267	0.0000502	0.0013860	0.0002605	0.0065059	0.0033944	0.0019801	0.0012858
9	0.0016438	0.0006611	0.0006075	0.0000715	0.0015793	0.0001897	0.0093473	0.0048768	0.0028448	0.0018473
10	0.0012239	0.0004922	0.0004523	0.0000532	0.0015442	0.0002096	0.0072433	0.0037791	0.0022045	0.0014315
11	0.0015936	0.0006409	0.0005889	0.0000693	0.0013612	0.0002557	0.0089835	0.0046871	0.0027341	0.0017754
12	0.0012051	0.0004847	0.0004454	0.0000524	0.0016012	0.0001933	0.0068003	0.0035480	0.0020697	0.0013439

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0045314	0.0029924	0.0050729	0.0013110	0.0010000	0.0005010	0.0009340	0.0013499	0.0010761
2	0.0057136	0.0037731	0.0063963	0.0016530	0.0010000	0.0007628	0.0014221	0.0020554	0.0013182
3	0.0042698	0.0028197	0.0047801	0.0012353	0.0010000	0.0004677	0.0008719	0.0012602	0.0009934
4	0.0086988	0.0057445	0.0097383	0.0025166	0.0010000	0.0002484	0.0004630	0.0006692	0.0010345
5	0.0099901	0.0065972	0.0111839	0.0028902	0.0010000	0.0002646	0.0004933	0.0007130	0.0012623
6	0.0077655	0.0051281	0.0086934	0.0022466	0.0010000	0.0002798	0.0005217	0.0007540	0.0009621
7	0.0048455	0.0031998	0.0054245	0.0014018	0.0010000	0.0001800	0.0003356	0.0004850	0.0010780
8	0.0040887	0.0027001	0.0045773	0.0011829	0.0010000	0.0002257	0.0004208	0.0006082	0.0013440
9	0.0058744	0.0038793	0.0065763	0.0016995	0.0010000	0.0003018	0.0005626	0.0008131	0.0009789
10	0.0045521	0.0030061	0.0050960	0.0013170	0.0010000	0.0003408	0.0006354	0.0009183	0.0010816
11	0.0056458	0.0037283	0.0063204	0.0016334	0.0010000	0.0007304	0.0013616	0.0019680	0.0013192
12	0.0042737	0.0028223	0.0047844	0.0012364	0.0010000	0.0003595	0.0006703	0.0009688	0.0009977

TABLE 12
HGA Saturday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.7007641	0.0518353	0.1725582	0.0294448	0.0135406	0.0042606	0.0016029	0.0007392	0.0003156
2	AM_Peak	Col	0.6223779	0.0641373	0.2135113	0.0405350	0.0186406	0.0057837	0.0021759	0.0010034	0.0004284
3	AM_Peak	Fway	0.7248724	0.0477408	0.1589277	0.0259808	0.0119476	0.0042159	0.0015861	0.0007314	0.0003123
4	Mid_Day	Art	0.6833575	0.0505577	0.1683052	0.0286615	0.0131804	0.0083762	0.0031513	0.0014532	0.0006205
5	Mid_Day	Col	0.6076439	0.0623047	0.2074108	0.0393816	0.0181101	0.0101435	0.0038162	0.0017598	0.0007514
6	Mid_Day	Fway	0.7090872	0.0468163	0.1558501	0.0255349	0.0117426	0.0077818	0.0029277	0.0013501	0.0005764
7	Ovr_Nite	Art	0.6996105	0.0519490	0.1729369	0.0294525	0.0135441	0.0045278	0.0017035	0.0007855	0.0003354
8	Ovr_Nite	Col	0.6300409	0.0649309	0.2161533	0.0410365	0.0188712	0.0040646	0.0015292	0.0007052	0.0003011
9	Ovr_Nite	Fway	0.7181579	0.0473004	0.1574618	0.0257703	0.0118508	0.0057877	0.0021774	0.0010041	0.0004287
10	PM_Peak	Art	0.6998615	0.0520884	0.1734008	0.0295940	0.0136092	0.0042950	0.0016158	0.0007451	0.0003181
11	PM_Peak	Col	0.6229131	0.0641607	0.2135893	0.0405503	0.0186476	0.0056479	0.0021248	0.0009798	0.0004184
12	PM_Peak	Fway	0.7240576	0.0479374	0.1595822	0.0261990	0.0120480	0.0042194	0.0015874	0.0007320	0.0003125

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0007641	0.0003073	0.0002824	0.0000332	0.0016022	0.0002045	0.0045381	0.0023677	0.0013812	0.0008969
2	0.0010372	0.0004171	0.0003833	0.0000451	0.0014233	0.0002530	0.0057801	0.0030157	0.0017592	0.0011423
3	0.0007561	0.0003041	0.0002794	0.0000329	0.0016573	0.0001883	0.0042663	0.0022259	0.0012985	0.0008432
4	0.0015022	0.0006041	0.0005552	0.0000653	0.0015625	0.0001994	0.0088391	0.0046117	0.0026902	0.0017469
5	0.0018191	0.0007316	0.0006723	0.0000791	0.0013896	0.0002457	0.0102525	0.0053492	0.0031203	0.0020262
6	0.0013956	0.0005613	0.0005158	0.0000607	0.0016212	0.0001847	0.0078562	0.0040989	0.0023910	0.0015526
7	0.0008120	0.0003266	0.0003001	0.0000353	0.0015996	0.0002049	0.0048548	0.0025329	0.0014775	0.0009594
8	0.0007289	0.0002932	0.0002694	0.0000317	0.0014408	0.0002561	0.0041071	0.0021428	0.0012500	0.0008117
9	0.0010380	0.0004174	0.0003836	0.0000451	0.0016419	0.0001866	0.0059016	0.0030791	0.0017961	0.0011663
10	0.0007702	0.0003098	0.0002847	0.0000335	0.0016002	0.0002055	0.0045581	0.0023781	0.0013872	0.0009008
11	0.0010129	0.0004074	0.0003743	0.0000440	0.0014245	0.0002531	0.0057092	0.0029787	0.0017376	0.0011283
12	0.0007567	0.0003043	0.0002796	0.0000329	0.0016554	0.0001891	0.0042696	0.0022276	0.0012994	0.0008438

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0028520	0.0018834	0.0031928	0.0008251	0.0010000	0.0003153	0.0005878	0.0008496	0.0010550
2	0.0036325	0.0023989	0.0040666	0.0010509	0.0010000	0.0004850	0.0009041	0.0013068	0.0013053
3	0.0026812	0.0017706	0.0030016	0.0007757	0.0010000	0.0002937	0.0005475	0.0007913	0.0009716
4	0.0055550	0.0036684	0.0062188	0.0016071	0.0010000	0.0001586	0.0002957	0.0004274	0.0010290
5	0.0064433	0.0042550	0.0072132	0.0018641	0.0010000	0.0001707	0.0003182	0.0004599	0.0012680
6	0.0049373	0.0032605	0.0055273	0.0014284	0.0010000	0.0001779	0.0003317	0.0004794	0.0009528
7	0.0030510	0.0020148	0.0034156	0.0008827	0.0010000	0.0001134	0.0002113	0.0003054	0.0010573
8	0.0025811	0.0017045	0.0028896	0.0007467	0.0010000	0.0001425	0.0002656	0.0003839	0.0013215
9	0.0037089	0.0024493	0.0041521	0.0010730	0.0010000	0.0001905	0.0003552	0.0005134	0.0009627
10	0.0028645	0.0018917	0.0032069	0.0008287	0.0010000	0.0002145	0.0003998	0.0005779	0.0010601
11	0.0035880	0.0023694	0.0040167	0.0010380	0.0010000	0.0004642	0.0008653	0.0012507	0.0013058
12	0.0026833	0.0017720	0.0030039	0.0007763	0.0010000	0.0002258	0.0004208	0.0006083	0.0009756

TABLE 13
HGA Sun VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.6606961	0.0617395	0.2055291	0.0336572	0.0154777	0.0028750	0.0010816	0.0004988	0.0002130
2	AM_Peak	Col	0.5785760	0.0753252	0.2507554	0.0456868	0.0210097	0.0038483	0.0014478	0.0006676	0.0002851
3	AM_Peak	Fway	0.6869306	0.0571537	0.1902630	0.0298495	0.0137267	0.0028594	0.0010758	0.0004961	0.0002118
4	Mid_Day	Art	0.6495421	0.0607086	0.2020973	0.0330288	0.0151887	0.0056982	0.0021438	0.0009886	0.0004221
5	Mid_Day	Col	0.5698677	0.0738183	0.2457390	0.0447782	0.0205919	0.0068086	0.0025615	0.0011812	0.0005043
6	Mid_Day	Fway	0.6764809	0.0564225	0.1878291	0.0295339	0.0135816	0.0053133	0.0019990	0.0009218	0.0003936
7	Ovr_Nite	Art	0.6596408	0.0618781	0.2059903	0.0336677	0.0154825	0.0030555	0.0011495	0.0005301	0.0002263
8	Ovr_Nite	Col	0.5832893	0.0759438	0.2528149	0.0460619	0.0211822	0.0026933	0.0010133	0.0004673	0.0001995
9	Ovr_Nite	Fway	0.6825854	0.0567942	0.1890663	0.0296955	0.0136559	0.0039371	0.0014812	0.0006830	0.0002916
10	PM_Peak	Art	0.6595621	0.0620144	0.2064443	0.0338132	0.0155495	0.0028969	0.0010899	0.0005026	0.0002146
11	PM_Peak	Col	0.5789553	0.0753373	0.2507958	0.0456947	0.0210133	0.0037571	0.0014135	0.0006518	0.0002783
12	PM_Peak	Fway	0.6859015	0.0573676	0.1909751	0.0300891	0.0138369	0.0028607	0.0010762	0.0004963	0.0002119

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0005156	0.0002074	0.0001905	0.0000224	0.0015136	0.0002427	0.0030625	0.0015978	0.0009321	0.0006052
2	0.0006901	0.0002776	0.0002551	0.0000300	0.0013258	0.0002961	0.0038461	0.0020067	0.0011706	0.0007601
3	0.0005128	0.0002062	0.0001895	0.0000223	0.0015736	0.0002246	0.0028938	0.0015098	0.0008807	0.0005719
4	0.0010219	0.0004110	0.0003777	0.0000444	0.0014881	0.0002386	0.0060136	0.0031375	0.0018302	0.0011885
5	0.0012210	0.0004911	0.0004513	0.0000531	0.0013058	0.0002901	0.0068823	0.0035908	0.0020946	0.0013601
6	0.0009529	0.0003832	0.0003521	0.0000414	0.0015497	0.0002218	0.0053645	0.0027989	0.0016327	0.0010602
7	0.0005480	0.0002204	0.0002025	0.0000238	0.0015112	0.0002432	0.0032763	0.0017094	0.0009971	0.0006475
8	0.0004830	0.0001943	0.0001785	0.0000210	0.0013365	0.0002985	0.0027217	0.0014200	0.0008283	0.0005379
9	0.0007061	0.0002840	0.0002609	0.0000307	0.0015637	0.0002232	0.0040148	0.0020947	0.0012219	0.0007934
10	0.0005195	0.0002089	0.0001920	0.0000226	0.0015110	0.0002438	0.0030746	0.0016042	0.0009358	0.0006076
11	0.0006738	0.0002710	0.0002490	0.0000293	0.0013266	0.0002961	0.0037982	0.0019817	0.0011560	0.0007506
12	0.0005130	0.0002063	0.0001896	0.0000223	0.0015713	0.0002255	0.0028949	0.0015104	0.0008811	0.0005721

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0019247	0.0012710	0.0021546	0.0005568	0.0010000	0.0002128	0.0003967	0.0005734	0.0012522
2	0.0024171	0.0015962	0.0027060	0.0006993	0.0010000	0.0003227	0.0006016	0.0008695	0.0015277
3	0.0018186	0.0012010	0.0020360	0.0005261	0.0010000	0.0001992	0.0003714	0.0005367	0.0011591
4	0.0037793	0.0024958	0.0042309	0.0010934	0.0010000	0.0001079	0.0002012	0.0002908	0.0012312
5	0.0043253	0.0028563	0.0048421	0.0012513	0.0010000	0.0001146	0.0002136	0.0003087	0.0014971
6	0.0033714	0.0022264	0.0037742	0.0009754	0.0010000	0.0001215	0.0002265	0.0003274	0.0011443
7	0.0020590	0.0013597	0.0023051	0.0005957	0.0010000	0.0000765	0.0001426	0.0002061	0.0012550
8	0.0017105	0.0011295	0.0019149	0.0004948	0.0010000	0.0000944	0.0001760	0.0002544	0.0015402
9	0.0025232	0.0016662	0.0028247	0.0007300	0.0010000	0.0001296	0.0002416	0.0003493	0.0011519
10	0.0019323	0.0012760	0.0021632	0.0005590	0.0010000	0.0001447	0.0002697	0.0003898	0.0012577
11	0.0023870	0.0015763	0.0026722	0.0006906	0.0010000	0.0003088	0.0005757	0.0008321	0.0015279
12	0.0018194	0.0012015	0.0020368	0.0005264	0.0010000	0.0001531	0.0002853	0.0004124	0.0011635

ESTIMATION OF EMISSIONS FACTORS

The MOBILE6 model was applied to calculate HGA county-specific grams/mile emissions factors of VOC, CO, and NOx for each of the 11 analysis days by speed, emissions type (i.e., emissions factor subcomponent), hour, MOBILE6 road type, and vehicle type.

The MOBILE6 model is equipped with national (or EPA) default modeling values for a wide range of conditions that affect emissions factors, such that the only actual input data parameter values required to run the model are fuel Reid Vapor Pressure (RVP), temperature, and calendar year. Default modeling parameters may be overridden in MOBILE6 through the use of MOBILE6 commands and their associated inputs and options. For this analysis, particular MOBILE6 defaults were replaced by local input values that were developed to yield emissions factors characteristic of HGA August 2000 ozone episode conditions.

The following emissions factors documentation discusses the MOBILE6 input/output files, summarizes the control programs modeled, describes the classification-level of the applied MOBILE6 emissions factors, and briefly describes all of the MOBILE6 commands that may affect emissions factor calculations and identifies those that were applied for this analysis. The section also identifies the non-default local inputs applied (requires use of a command) and which EPA default inputs were used (no command required), and details the procedures used for developing the locality-specific inputs.

MOBILE6 Input and Output Files

The MOBILE6 commands and particular model input data are entered in the MOBILE6 command file. Other input parameters (and in some cases, commands) are applied to MOBILE6 from external data files.

The POLFAC6 program (see program descriptions in Appendix B) was applied to run MOBILE6 with the user-input command and external data files to produce VOC, CO, and NOx emissions factor (g/mi) output tables. (RATEADJ6 was applied to POLFAC6 output where post-processing of emissions factors was required, discussed later.) The final product of the emissions factor modeling is 88 emissions factor files (i.e., one hourly emissions factor table for each county for each day). (Daily 24-hour emissions factor tables were also produced for quality assurance purposes, but were not applied otherwise for this analysis.)

All of the MOBILE6 input files (command files and external data files) and output files (MOBILE6 emissions factor tables developed with POLFAC6 and RATEADJ6) were previously provided to TNRCC electronically (on CD-ROM). The CD-ROM volume names and MOBILE6 input and output file names are listed in Appendix A.

Control Programs Modeled (And Emissions Factor Post Processing)

All of the federal motor vehicle control programs were modeled (this is the MOBILE6 default). Reformulated gasoline (RFG), the vehicle Inspections and Maintenance (I/M) programs and Anti-Tampering Programs (ATP) administered during 2000 were modeled. Also modeled were the programs to offset heavy-duty diesel (HDDV) defeat device effects: the low emissions rebuild

program, and the HDDV 2004 standard pull-ahead program. The only post-processing of emissions factors performed for this analysis was required to account for the full effects of the Harris County ATP. This post-processing procedure is detailed later with the description of the MOBILE6 ATP set-ups.

Classification of MOBILE6 Emissions Factors

Each POLFAC6 emissions factor table, for a particular county and calendar day, provides the emissions factors by:

- 28 vehicle types,
- 4 road types,
- 14 speeds (except for two MOBILE6 road types, each with one average speed),
- 15 pollutant-specific emissions types, and
- 24 hourly time periods.

MOBILE6 vehicle type, roadway type, and emissions type classifications are described in Tables 11 through 13. Tables 14 and 15 show the speeds and sequence for hourly time periods, respectively.

The 28 MOBILE6 vehicle types as defined by fuel-type (gasoline or diesel) and GVWR category, are shows in sequence by EPA vehicle type number in Table 14.

TABLE 14
Complete MOBILE6 Vehicle Classifications

Number	Abbreviation	Description
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater
6	HDGV2b	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8a	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8b	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)
15	LDDT12	Light-Duty Diesel Trucks 1and 2 (0-6,000 lbs. GVWR)
16	HDDV2b	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
22	HDDV8a	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8b	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

Source: MOBILE6 User's Guide (EPA, January 2002)

The MOBILE6 emissions types classifications are shown in Table 15. Expanding these emissions types by individual pollutant yields 12 pollutant-specific emissions types. In addition to

these 12 pollutant-specific emissions types, the POLFAC6 emissions factor tables contain the three composite emissions factors (i.e., one for each pollutant). Thus, POLFAC6 calculates MOBILE6 emissions factors for up to 15 pollutant-specific emissions types. For this analysis, MOBILE6 emissions factors were calculated for all of the 15 pollutant-specific emissions types except for refueling emissions, which are accounted for as an area source emissions category.

TABLE 15
MOBILE6 Emission Type Classifications

Number	Abbreviation	Description	Pollutants	Vehicle Classes
1	Running	Exhaust Running Emissions	HC,CO,NO_x	All
2	Start	Exhaust Engine Start Emissions (trip start)	HC,CO,NO_x	LD plus MC
3	Hot Soak	Evaporative Hot Soak Emissions (trip end)	HC	Gas, inc. MC
4	Diurnal	Evaporative Diurnal Emissions (heat rise)	HC	Gas, inc. MC
5	Resting	Evaporative Resting Loss Emissions (leaks and seepage)	HC	Gas, inc. MC
6	Run Loss	Evaporative Running Loss Emissions	HC	Gas, less MC
7	Crankcase	Evaporative Crankcase Emissions (blow-by)	HC	Gas, inc. MC
8	Refueling	Evaporative Refueling Emissions (fuel displacement and spillage)	HC	Gas, less MC

Source: MOBILE6 User's Guide (EPA, January 2002)

MOBILE6 calculates emissions factors reflective of driving cycles observed on four roadway types, as well as emissions factors for those emissions types that are not directly applicable to the driving cycles. The driving cycle (or roadway type) descriptions are provided in Table 16 (see numbers one through four). The fifth roadway type, according to MOBILE6 is "none." None, or roadway type number 5, is the index for the emissions types that do not apply to the driving cycles, and thus are not sensitive to, or do not vary by roadway type or speed.

The POLFAC6 emissions factor table, however, categorizes all of the pollutant-specific emissions types by MOBILE6 roadway types one through four: Freeway, Arterial, Local, and Ramp. That is, in POLFAC6 tables, the MOBILE6 g/mi emissions factors corresponding to the "None" roadway type are tabulated as emissions factors corresponding to each of the four actual roadway types. This allocation of all emissions types to the MOBILE6 freeway, arterial, local, and ramp road types is performed in POLFAC6 to facilitate the geographical allocation of the link-emissions estimates by the roadway link coordinates.

TABLE 16
MOBILE6 Roadway Classifications

Number	Abbreviation	Description
1	Freeway	High-Speed, Limited-Access Roadways
2	Arterial	Arterial and Collector Roadways
3	Local	Urban Local Roadways
4	Fwy Ramp	Freeway on and off ramps
5	None	Not Applicable (For start and some evaporative emissions)

Source: MOBILE6 User's Guide (EPA, January 2002)

The 14 speeds for which the MOBILE6 freeway and arterial emissions factors are calculated and tabulated are presented in Table 17. Later in the emissions estimation process, emissions factors for average speeds that are not represented in the 14 as tabulated, are calculated by interpolation, for speeds greater than and less than the MOBILE6 bounding speeds of 65 mph and 2.5 mph, for which the emissions factors corresponding to those bounding speeds are applied, respectively. The MOBILE6 local and ramp road type emissions factors are not speed sensitive and are each characterized by one average speed. (Although calculated, the single-speed local and ramp emissions factors are not used in this analysis.)

TABLE 17
Speeds for POLFAC6 produced MOBILE6 Emissions Factors

Number	Speed
1	2.5 mph
2	5 mph
3	10 mph
4	15 mph
5	20 mph
6	25 mph
7	30 mph
8	35 mph
9	40 mph
10	45 mph
11	50 mph
12	55 mph
13	60 mph
14	65 mph

MOBILE6 uses several hourly input parameters (e.g., hourly temperatures) to model hourly emissions factors. The sequence that MOBILE6 requires for hourly inputs is most commonly that as shown in Table 18. (In some cases, however, particular overnight hours are grouped together.) For this analysis, hourly input values are representative of the calendar day. The hourly temperature inputs for each MOBILE6 run, for instance, are from one calendar day, as opposed to values spanning two days from 6 a.m. on one day to 6 a.m. on the next day.

TABLE 18
Hour of Day Sequence for HOURLY TEMPERATURE Inputs

Number	Abbreviation	Description
1	6 a.m.	6 a.m. through 6:59 a.m.
2	7 a.m.	7 a.m. through 7:59 a.m.
3	8 a.m	8 a.m. through 8:59 a.m.
4	9 a.m.	9 a.m. through 9:59 a.m.
5	10 a.m.	10 a.m. through 10:59 a.m.
6	11 a.m.	11 a.m. through 11:59 a.m.
7	12 Noon	12 Noon through 12:59 p.m.
8	1 p.m.	1 p.m. through 1:59 p.m.
9	2 p.m.	2 p.m. through 2:59 p.m.
10	3 p.m.	3 p.m. through 3:59 p.m.
11	4 p.m.	4 p.m. through 4:59 p.m.
12	5 p.m.	5 p.m. through 5:59 p.m.
13	6 p.m.	6 p.m. through 6:59 p.m.
14	7 p.m.	7 p.m. through 7:59 p.m.
15	8 p.m.	8 p.m. through 8:59 p.m.
16	9 p.m.	9 p.m. through 9:59 p.m.
17	10 p.m.	10 p.m. through 10:59 p.m.
18	11 p.m.	11 p.m. through 11:59 p.m.
19	12 Midnight	12 Midnight through 12:59 a.m.
20	1 a.m.	1 a.m. through 1:59 a.m.
21	2 a.m.	2 a.m. through 2:59 a.m.
22	3 a.m.	3 a.m. through 3:59 a.m.
23	4 a.m.	4 a.m. through 4:59 a.m.
24	5 a.m.	5 a.m. through 5:59 a.m.

Application of MOBILE6 Commands and Associated Input Parameters
All of the MOBILE6 commands that may affect the calculation of emissions factors are documented and described in the following six categorical tables (commands that only affect the output format and content are excluded these tables): Table 19, External Conditions; Table 20, Vehicle Fleet Characteristics; Table 21, Activity; Table 22, State Programs; Table 23, Fuel, and; and Table 24, Alternative Emissions Regulations and Control Measures. In these tables, parameters associated with each MOBILE6 command are labeled (as applied for this analysis) as either EPA default, locality-specific, NOT APPLIED, or are otherwise described.

The procedures used to develop the locality-specific MOBILE6 inputs as applied in this analysis, are detailed following the six MOBILE6 input category tables.

TABLE 19
MOBILE6 External Conditions

Command	Function/Description	Input Parameter Values
CALENDAR YEAR	Identifies calendar year for which emissions factors are to be calculated. (**Required** to run model).	**2000**
EVALUATION MONTH	Provides option of calculating January 1 or July 1 emission factors for the calendar year of evaluation.	**7** (for July)
MIN/MAX TEMPERATURE	Sets minimum and maximum daily temperatures. (**Required** to run model if the HOURLY TEMPERATURES command is not used.)	**NOT APPLIED**. (See HOURLY TEMPERATURES.)
HOURLY TEMPERATURES	Allows temperatures input for each hour of day (**Required** to run model if MIN/ MAX TEMPERATURE command is not used.)	**Locality Specific**. Hourly temperatures by county for each episode day.
ALTITUDE	Specifies high - or low-altitude for modeling area.	**EPA default** (low altitude).
ABSOLUTE HUMIDITY	Used to specify daily average humidity (which directly affects NOx emissions). (MOBILE6 also converts absolute humidity to heat index which affects HC and CO emissions for portion of fleet that MOBILE6 determines is using air conditioning.)	**Locality Specific**. One daily absolute humidity input value in terms of grains of water per pound of dry air, by county for each episode day.
<u>Environmental Effects on Air Conditioning</u>:	Commands used by MOBILE6 to model the extent of vehicle air-conditioning usage.	
CLOUD COVER	Specifies average percent cloud cover for given day.	**EPA default**.
PEAK SUN	Specifies midday hours with peak sun intensity.	**EPA default**.
SUNRISE/SUNSET	Allows user to specify time of sunrise, sunset.	**Locality Specific**.

TABLE 20
MOBILE6 Vehicle Fleet Characteristics

Command	Function/Description	Input Parameter Values
REG DIST	Allows the user to supply registration distributions by age for any of the 16 composite (combined gasoline and diesel) vehicle types.	**Locality Specific**. July 2001 TxDOT registrations are applied except for buses for which MOBILE6 default is used.
DIESEL FRACTIONS	Permits user to supply locality specific diesel fractions for 14 of the 16 composite vehicle categories by age.	**EPA default/Locality Specific**. TxDOT registrations specify gasoline and diesel for eight heavy duty classes. EPA defaults are applied for the other six classes.
MILE ACCUM RATE	Allows the user to supply the annual mileage accumulation rates by vehicle type and age.	**EPA default**.
NGV FRACTION	Lets user specify percent of natural gas vehicles in the fleet by type and age certified to operate on either compressed or liquefied natural gas.	**EPA default**. (The EPA default percentage of NGV vehicles in the fleet is zero.)
NGV EF	Permits the user to enter alternate NGV emission factors for each of the 28 vehicle types, for running and start emissions.	**EPA default**. (EPA default is none.)

TABLE 21
MOBILE6 Activity

Command	Function/Description	Input Parameter Values
VMT FRACTIONS	Used in MOBILE6 to weight the emissions of various vehicle types into average rates for groupings of vehicle classes.	**POST-PROCESSED.** VMT mix fractions are applied to link VMT later in the emissions estimation process.
VMT BY FACILITY	VMT fractions by MOBILE6 road types are used to combine the four individual road type emissions factors into the "all road types" emissions factors.	**Locality Specific**. Not used for hourly emissions estimates; developed and applied to produce "all road types" daily emissions factors for QA checks against hourly results.
VMT BY HOUR	Lets user allocate VMT fractions by hour of day; applied in conversion of g/hr to g/mi, as well as in weighting of hourly g/mi rates to get daily emissions factors.	**Locality specific**. This input, total VMT fractions by hour, was produced from PREPIN output (post-processed travel model output) for application at the county level.
SPEED VMT	Allows user to allocate VMT by average speed (14 preselected: 2.5 and 5 through 65 at 5 mph increments) for arterials and freeways for each hour of the day.	Internally applied by POLFAC6 for the calculation of emissions factors by the 14 MOBILE6 speeds for individual MOBILE6 freeway and arterial road types.
AVERAGE SPEED	Allows a single average speed for combined freeways and arterial for the entire day.	**NOT APPLIED**.
STARTS PER DAY	Lets user specify the average number of engine starts per vehicle per day by vehicle types for weekend days and weekdays.	**EPA default**. Used weekday and weekend specific values.
START DIST	Allows user to allocate engine starts by hour of the day for weekend days and weekdays.	**EPA default**. Used weekday and weekend values.
SOAK DISTRIBU-TION	Allows the user to enter alternate vehicle soak duration distributions for weekend days and weekdays.	**EPA default**. Used weekday and weekend values.
HOT SOAK ACTIVITY	Allows users to specify a hot soak duration distribution for each of 14 daily time periods for weekend days and for weekdays.	**EPA default**. Used weekday and weekend values.
DIURN SOAK ACTIVITY	Lets user set diurnal soak time distributions for each of 18 daily time periods.	**EPA default**.
WE DA TRI LEN DI	Specifies alternate fractions of VMT that occur during trips of various durations at each hour of the average weekday.	**Locality Specific**. Used latest distributions developed by HGAC.
WE EN TRI LEN DI	Same as WE DA TRI LEN DI, but for weekend days.	**NOT APPLIED**. Used weekday distributions developed by HGAC for all days.
WE VEH US	Lets user to direct MOBILE6 to use weekend activity data for calculating emissions factors.	Applied this command for weekend day analyses (i.e., August 26, and 27).

TABLE 22
MOBILE6 State Programs

Command	Function/Description	Input Parameter Values
STAGE II REFUELING	Allows modeling of at-the-pump refueling emissions.	**NOT APPLIED**. Accounted for as an area source category.
ANTI-TAMP PROG	Allows user to model impacts of an anti-tampering program (ATP).	**Locality Specific**. Program design, by county.
<u>I/M Commands</u>:		
I/M PROGRAM	Required for exhaust/evaporative I/M programs.	
I/M MODEL YEARS	Required for exhaust/evaporative I/M programs.	
I/M VEHICLES	Required for exhaust/evaporative I/M programs.	
I/M STRINGENCY	Required for exhaust. Don't use for evaporative.	
I/M COMPLIANCE	Required for exhaust. Optional for evaporative.	
I/M WAIVER RATES	Required for exhaust. Optional for evaporative.	**Locality Specific**. Program design, by county.
I/M CUTPOINTS	Optional for exhaust (but required for IM240). Don't use with evap.	
I/M EXEMPTION AGE	Optional for both exhaust and evaporative.	
I/M GRACE PERIOD	Optional for both exhaust and evaporative.	
NO I/M TTC CREDITS	Optional for exhaust. Do not use with evaporative.	
I/M EFFECTIVENESS	Optional for exhaust. Do not use with evaporative.	
I/M DESC FILE	Optional for both.	

TABLE 23
MOBILE6 Fuels

Command	Function/Description	Input Parameter Values
FUEL PROGRAM	Allows users to specify: **1)** Conventional Gasoline East Tier 2 sulfur phase-in schedule (includes Texas), **2)** Reformulated Gasoline (RFG), **3)** Conventional Gasoline West Tier 2 sulfur geographical phase-in area (GPA) schedule (not applicable to Texas), or **4)** sulfur content for gasoline after 1999.	**Option 2.** Applied RFG (EPA parameters) for the southern volatility region.
SULFUR CONTENT	Allows user to apply alternate sulfur content to conventional gasoline for calendar years through 1999.	**NOT APPLIED**. (For pre-2000 years of evaluation only.)
OXYGENATED FUELS	Permits the user to model the effects of oxygenated gasoline on exhaust emissions for all gasoline-fueled vehicle types.	**NOT APPLIED**. (See FUEL PROGRAM, above)
FUEL RVP	Allows user to specify fuel RVP for area being modeled (**required** to run model).	**Locality Specific**. Actual HGA RVP estimate for summer 2000.
SEASON	Identifies effective season for RFG calculation regardless of month modeled.	**EPA Default**. EPA default is summer for July month of evaluation.

TABLE 24
MOBILE6 Alternative Emissions Regulations and Control Measures

Command	Function/Description	Input Parameter
NO CLEAN AIR ACT	Models vehicle emissions as if the Federal Clean Air Act Amendments of 1990 had not been implemented.	**NOT APPLIED**
HDDV NOx Off-Cycle Emissions Effects:		
NO DEFEAT DEVICE	Turns off the effects of the HDD vehicle NOx off-cycle emission effects (defeat device emissions).	**NOT APPLIED**
NO NOX PULL AHEAD	Turns off HDD NOx emission reduction effects of Pull Ahead program.	**NOT APPLIED**
NO REBUILD	Turns off HDD NOx emission reduction effects of Rebuild program.	**NOT APPLIED**
REBUILD EFFECTS	Lets user change Rebuild program effectiveness rate.	**Locality Specific**
Tier 2 Emission Standards and Fuel Requirements:	Allow the overriding of the default Tier 2 emissions standards and fuel requirements settings.	**NOT APPLIED**
NO TIER2	Disables Tier 2 requirements.	
T2 EXH PHASE-IN	Allows alternate Tier 2 exhaust standard phase-in schedules.	
T2 EVAP PHASE-IN	Allows alternate Tier 2 evap. standard phase-in schedules.	
T2 CERT	Lets user specify alternate Tier 2 50,000 mile certification standards.	
94+ LDG IMPLEMENTATON	Allows use of alternate 1994 and later fleet penetration fractions for light-duty gasoline vehicles under the Tier 1, NLEV (or California LEV 1), and Tier 2 emission standard programs.	**NOT APPLIED**
NO 2007 HDDV RULE	Disables 2007 heavy duty vehicle emission standards.	**NOT APPLIED**

External Conditions – Locality Specific Inputs to MOBILE6

MOBILE6 local inputs for hourly temperatures, daily average humidity, and sunrise and sunset times were developed and applied by calendar day based on local (central daylight) time. TNRCC developed these data and TTI formatted them for input to MOBILE6.

Temperatures (HOURLY TEMPERATURES Command)

TNRCC developed ambient hourly temperatures (degrees Fahrenheit) for input to MOBILE6 by county for each of the analysis days, August 22, 2000 to September 1, 2000. The temperatures are hourly averages from monitoring stations within the HGA counties. Each county with more than one monitoring station uses the hourly average temperatures from the monitoring stations within its border. Counties without monitoring stations (Fort Bend, Liberty, Waller), use average hourly temperatures from monitoring stations from adjacent counties.

The MOBILE6 User's Guide states that the 24 hourly temperature inputs are to be entered from 6 a.m. continuing through 5 a.m. of the "next day." The emissions estimation method applied by TTI, however, applies the hourly input data by "calendar day." This calendar day method simplifies the emissions estimation process, especially when modeling consecutive calendar days exhibiting different hourly travel activity. Thus, the hourly average temperatures for each calendar day provided by TNRCC were sequenced starting with 6 a.m. through 11 p.m. followed by 12 a.m. through 5 a.m. of the same calendar day. The temperatures input are for central daylight time (local time).

Modeling eight counties for 11 days results in 88 hourly temperature datasets. The temperatures are input in the MOBILE6 command file. A summary of the temperatures used are found in Appendix E.

Humidity (ABSOLUTE HUMIDITY Command)
The ABSOLUTE HUMIDITY command was applied to specify a daily average humidity value for each of the analysis days. The units for absolute humidity are grains of water per pound of dry air.

TNRCC developed and provided the average daily humidity inputs by county for each day for input to MOBILE6. Hourly relative humidity, barometric pressure, and temperature data were required to develop the absolute humidity input. In counties where no barometric or relative humidity data were available, data from adjacent counties were applied. Special care was taken to ensure that the absolute humidity value and the temperature range for each day would not result in a relative humidity exceeding 100 percent.

The humidity value is input in the MOBILE6 command file. The 88 humidity values used (one per county per day) are summarized in Appendix F.

Sunrise and Sunset Times (SUNRISE/SUNSET Command)
The SUNRISE/SUNSET Command allows the user to specify the time of sunrise and sunset. This feature affects only the air-conditioning correction.

TNRCC provided the sunrise and sunset times which are the same for all counties and days. The times are 7 a.m. and 8 p.m. central daylight time

Vehicle Fleet Characteristics – Locality Specific Inputs to MOBILE6
County-specific vehicle age distributions and diesel fractions inputs to MOBILE6 were developed for vehicle types for which TxDOT registrations data were available.

Vehicle Registration Distributions (REG DIST Command)
The user-supplied vehicle registration distributions input to MOBILE6 are by vehicle age for any of the 16 composite (combined gas and diesel) vehicle types as shown in Table 25. (EPA default distributions are applied for vehicle classes for which the user does not input alternate values.) The input values for each vehicle class are 25 age fractions representing the fraction of vehicles by age for that particular vehicle class as of July of the evaluation year. These age fractions start with the evaluation year as the 1st age fraction and work back in annual increments to end with the 25th

fraction, which represents the fraction of vehicles of age 25 years and older. The fractions are calculated as the by-model-year registrations in a class divided by the total vehicles registered in that class.

TABLE 25
Composite Vehicle Classes for Vehicle Registration Data
(REG DIST Command)

Number	Abbreviation	Description
1	LDV	Light-Duty Vehicles (Passenger Cars)
2	LDT1	Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDT2	Light-Duty Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDT3	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW*)
5	LDT4	Light-Duty Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
6	HDV2B	Class 2b Heavy-Duty Vehicles (8,501-10,000 lbs. GVWR)
7	HDV3	Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)
8	HDV4	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)
9	HDV5	Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)
10	HDV6	Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)
11	HDV7	Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)
12	HDV8A	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)
13	HDV8B	Class 8b Heavy-Duty Vehicles (>60,000 lbs. GVWR)
14	HDBS	School Buses
15	HDBT	Transit and Urban Buses
16	MC	Motorcycles (All)

* ALVW = Alternative Loaded Vehicle Weight: The adjusted loaded vehicle weight is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR).
Source: MOBILE6 User's Guide (EPA, January 2002)

TTI developed county-specific MOBILE6 age distributions fractions input for all vehicle types except for the two bus categories for which EPA defaults were applied. To develop these distributions, TTI used three datasets provided by TxDOT. The TxDOT registrations data provided are summarized as:

- July 2001 registrations:
  LDV, LDT12, LDT34, MC, HDGT, HDDT;
- February 2002 registrations:
  gas: HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B; and
- February 2002 registrations:

diesel: HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B.

The July 2001 registrations are for total: automobiles, light duty trucks (LDT12, corresponding to MOBILE6 classes LDT1 and LDT2), heavier light-duty trucks (LDT34, corresponding to MOBILE6 classes LDT3 and LDT4), motorcycles, heavy-duty gas trucks (> 8,500 lbs. GVWR), and heavy duty diesel trucks (> 8,500 lbs. GVWR). The February 2002 HDV gasoline and diesel class registrations are subsets of the July 2001 total HDGT and total HDDT classes, respectively, and correspond to the HDV weight classes for numbers six through 13 in Table 25.

There were four main steps to developing the county-specific MOBILE6 registration distribution inputs for vehicle types one through 13 and 16 (Table 25). The first step in the process transforms the February 2002 HDV registrations to July, 2001 registrations. The 2002 registrations were dropped from the data set; mid-year scaling factors were then applied to the resulting approximated end-of-year 2001 HDV registrations. These scaling factors (one for gasoline and one for diesel registrations) were developed from the HDGT and HDDT registrations from the mid-year 2001 data. The scaling factors are current year (July 2001) registrations divided by total registrations from the July 2001 data set for each fuel type. The appropriate factors (by fuel type) were then applied to the 2001 (end-of-year 2001, after dropping the 2002 registrations) individual eight HDV class registrations for each fuel type to obtain the mid-year 2001 registrations estimates for the 16 HDV classes. No vehicle scrappage estimates or vehicle migration estimates were made for the period from July 2001 to February 2002.

The next step results in estimated July 2001 registrations by 25 age groups for the MOBILE6 eight HDV classes and the LDVs, LDTs, and MCs. (The HDGT and HDDT registrations from the July 2001 original data set were not used.) The 16 HDV class registrations were combined into the MOBILE6 eight composite (gas and diesel) classes by summing the individual fuel type registrations by age within each weight category. For the remaining registrations data (eight HDVs, LDVs, LDT12s, LDT34s, and MCs), the 1977 and older registrations were summed to yield the “age 25 and older” registrations.

The next step converts the registrations from numbers of vehicles to MOBILE6 required fractions of vehicles by age. This was accomplished for each vehicle class by dividing the registrations for each age by the total registrations. MOBILE6 requires that the age distribution fractions for each vehicle class sum to one. In this step the age distribution fractions for each class were summed; for sums not equal to one (due to rounding error), the largest registration fraction was adjusted to make the fractions sum to one.

Finally, the age distribution fractions were formatted by MOBILE6 specifications. The LDT12 age fractions, were used for both the MOBILE6 LDT1 and LDT2 classes; the LDT34 age fractions were used in MOBILE6 for both the LDT3 and LDT4 classes. The MOBILE6 vehicle registration distributions are input from external data files. A total of eight input datasets were developed, one per county for the evaluation year.

Diesel Fractions (DIESEL FRACTIONS Command)
The DIESEL FRACTIONS Command allows the user to specify diesel fractions for 14 of the 16

composite (gasoline and diesel) vehicle categories by vehicle age. MOBILE6 assumes that urban/transit buses are 100% diesel, and that motorcycles are all gasoline fueled, so these two categories do not require diesel fractions. The diesel fraction represents the portion of diesels in a composite (gasoline and diesel) vehicle class for any vehicle age. When diesel fractions are entered as input by the user, all 14 sets of fractions are required. Each set of fractions contains the diesel fractions for 25 vehicle ages from the evaluation year back through the 25th fraction, which represents vehicle ages of 25 years and older.

The MOBILE6 default fractions vary by age for model years 1972 through 1996. For 1971 and earlier model years, the default diesel fractions are assumed to be the same as the 1972 model year fractions; for the 1997 and later model years, the default diesel fractions are assumed to be the same as the 1996 model year fractions.

TTI used a combination of county-specific diesel fractions and EPA default diesel fractions to model this 2000 ozone episode base case. Table 26 shows the MOBILE6 diesel fractions input categories and the source of the data that the fractions for this analysis were derived from. The county specific diesel fraction estimates were calculated based on TxDOT individual diesel and gasoline vehicle registrations for the eight HDV (HDV2b through HDV8b) weight classes, as shown in Table 26. As discussed previously, these TxDOT registrations data were adjusted to represent registrations as of July, 2001 (see registrations distributions discussion, above). To obtain the county-specific HDV diesel fractions by model year, the diesel registrations were divided by the sum of the gasoline and diesel registrations. This calculation was performed by county, HDV composite vehicle class, and model year.

The HDV diesel fractions (derived from estimated mid-year 2001 county-specific HDV registration distributions) were combined with the July 2000 EPA default diesel fractions for the remaining vehicle classes, formatted for input to MOBILE6, and applied as the 2000 base case episode modeling emissions inventories HGA fleet diesel fractions. Diesel fractions are entered in the MOBILE6 command file. A total of eight diesel fractions datasets were developed, one per county for the evaluation year.

TABLE 26
Source of Diesel Fractions for Composite Vehicle Types
(DIESEL FRACTIONS Command)

Number	Abbreviation	Description	Source of Fractions
1	LDV	Light-Duty Vehicles	EPA MOBILE6 Default
2	LDT1	Light-Duty Trucks 1	EPA MOBILE6 Default
3	LDT2	Light-Duty Trucks 2	EPA MOBILE6 Default
4	LDT3	Light-Duty Trucks 3	EPA MOBILE6 Default
5	LDT4	Light-Duty Trucks 4	EPA MOBILE6 Default
6	HDV2B	Class 2b Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
7	HDV3	Class 3 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
8	HDV4	Class 4 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
9	HDV5	Class 5 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
10	HDV6	Class 6 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
11	HDV7	Class 7 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
12	HDV8A	Class 8a Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
13	HDV8B	Class 8b Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
14	HDBS	School Buses	EPA MOBILE6 Default

Source: MOBLE6 User's Guide (EPA, January 2002)

Activity – Locality Specific Inputs to MOBILE6

The locality specific activity inputs applied to develop the MOBILE6 hourly emissions factors for this analysis are the fleet total hourly VMT fractions (by county), and average hourly weekday trip length distributions (for the area).

Additionally, fractions of hourly VMT across road types, hourly fractions of VMT by speed (14) for arterials and freeways. Weekend day hourly vehicle usage rates (MOBILE6 defaults) for certain parameters were applied for the Saturday and Sunday episode days.

For this analysis, hourly activity inputs represent a calendar day and are input starting from 6 a.m. through 11:59 p.m. followed by 12 a.m. through 5:59 a.m. of the same calendar day.

VMT Fractions (also known as VMT mix)

These sets of fractions (VMT fractions attributable to individual vehicle classes) are an input to MOBILE6, however, the method for this study calls for the application of the VMT mix (or mixes) later in the emissions calculation process. VMT mix development is discussed elsewhere.

VMT Distributions by Road Type (VMT BY FACILITY Command)
These distributions were not used to calculate the emissions factors applied for estimating the hourly 2000 base case emissions factors. (TTI developed and applied these MOBILE6 inputs to produce composite "daily all roads" emissions factors for use in quality assurance checks.

The inputs for the VMT BY FACILITY command are fractions for each hour of the day of VMT across the four MOBILE6 road types (freeway, arterial, local, ramp). Each hourly set of fractions sums to one. The VMT by facility fractions are by vehicle type, thus 28 sets of hourly VMT fractions across facilities may be entered.

These inputs were produced for each county by day-of-week. The hourly link VMT were summed by hour into two categories: freeway, and non-freeway. The hourly VMT fractions were calculated for these two groups as freeway VMT divided by the total VMT and non-freeway VMT divided by total VMT. As the MOBILE6 Local and Ramp road type emissions factors are not applied in this analysis, their corresponding VMT fractions by hour were set to zero. The same distributions were used for each of the 28 vehicle types. The VMT by facility fractions are entered as an external data file. A total of 32 input datasets were developed, one for each of the four day-of-week VMT estimates for each of the eight counties.

Total VMT by Hour (VMT BY HOUR Command)
Hourly fleet total VMT distributions are input to MOBILE6 through use of the VMT BY HOUR command. These fractions are used by MOBILE6 to convert the units of the non-travel related hourly emissions factors (e.g., hot soak, diurnal, start, etc.) to units of g/mi. (The VMT by hour fractions are also used to produce the daily emissions factors as composites of the hourly emissions factors.)

The VMT by hour fractions were developed by county by dividing the county hourly link-VMT total by the county daily link-VMT total. These hourly VMT fractions were developed for each of the Weekday (Monday through Thursday average), Friday, Saturday, and Sunday VMT estimates.

These fractions are input to MOBILE6 as an external data file. A total of 32 input datasets were developed, one for each of the four day-of-week VMT estimates for each of the eight counties.

VMT Distribution by Average Speed on Freeways and Arterials (SPEED VMT Command)
The VMT distributions by average speed inputs are called by the SPEED VMT command, but are accommodated internally by the POLFAC6 program (that is, no user input commands or data parameter values are required when producing MOBILE6 emissions factors tables with POLFAC6).

With this command MOBILE6 requires the hourly VMT distributions (fractions) by each of the 14 MOBILE6 speed bin average speeds for freeways and arterials. For example, the fraction of VMT occurring within the speed range (or "bin") 37.5 to 42.5, corresponds to the 40 mph speed bin. This amounts to 24 sets of 14 VMT fractions for each of the two road types. Each set of hourly VMT distributions by the 14 speed bin speeds must sum to 1.0.

POLFAC6 uses the SPEED VMT inputs to produce the individual freeway and arterial emissions factors indexed by the 14 MOBILE6 speed bin speeds. Thus, POLFAC6 creates 14 temporary SPEED VMT external data files, one for each of the 14 speeds. Each of these 14 files distributes the total freeway VMT and total arterial VMT to one of the 14 speeds. POLFAC6 uses these inputs to calculate the individual MOBILE6 emissions factors for freeways and arterials for each of the individual 14 speed bin average speeds. (Later in the emissions calculation procedure, emissions factors corresponding to the estimated hourly operational link speeds which lie between speed bin speeds are calculated by interpolation.)

Trip Length Distributions by Hour of Day (WE DA TRI LEN DI Command)
The trip length distributions input to MOBILE6 is called by the WE DA TRI LEN DI (for weekdays) command, or by the WE EN TRI LEN DI (for weekend days) command. Trip length distributions specify the percentage of average weekday (or weekend) VMT that occurs during trips of different durations at each hour of the day.

The VMT distributions are entered as percentages for six trip length ranges, and must sum to 100 percent. The percentage values correspond to VMT accumulated within the trip durations:

- Under 10 minutes,
- 11-20 minutes,
- 21-30 minutes,
- 31-40 minutes,
- 41-50 minutes, and
- 51 minutes and longer.

HGA regional trip length distributions (TLD) were applied for this analysis (Table 27). These TLDs were taken from the report “Conformity Determinations for The 2022 Metropolitan Transportation Plan and the 2000-2022 Transportation Improvement Program for Houston-Galveston Transportation Management area,” March 23, 2000 prepared by HGAC. No weekend day TLD data were available, thus the weekday values shown in Table 27, were applied to all of the analysis days. The HGA area-wide hourly TLD data were input to MOBILE6 in an external data file.

TABLE 27
HGA Percent of VMT by Trip Length, Hourly

Hour	Trip Length Ranges (minutes)					
	< 10	**11-20**	**21-30**	**31-40**	**41-50**	**>51**
6 a.m.	13.1	28.4	24.0	14.9	08.4	11.2
7 a.m.	08.9	21.5	23.2	18.6	12.6	15.2
8 a.m.	08.9	21.5	23.2	18.6	12.6	15.2
9 a.m.	13.9	29.8	24.4	14.5	07.8	09.6
10 a.m.	13.9	29.8	24.4	14.5	07.8	09.6
11 a.m.	13.9	29.8	24.4	14.5	07.8	09.6
12 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
1 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
2 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
3 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
4 p.m.	11.1	24.6	23.1	16.8	10.8	13.6
5 p.m.	11.1	24.6	23.1	16.8	10.8	13.6
6 p.m.	11.1	24.6	23.1	16.8	10.8	13.6
7 p.m. through 5 a.m.	13.1	28.4	24.0	14.9	08.4	11.2

Weekend Day Vehicle Usage (WE VEH US Command)
MOBILE6 supplies default weekend day vehicle usage rates for the hourly: start distributions, soak distributions, hot soak activity, and trip length distributions. For the Saturday and Sunday episode days (August 26, 27) the WE VEH US command was applied to model the EPA default weekend usage rates for these data parameters, except for the TLDs for which the region-specific average weekday HGAC-developed input data were used.

State Programs
The state programs inputs to MOBILE6 models the effects of exhaust and evaporative vehicle I/M and vehicle ATP which apply to the gasoline fueled vehicle classes, except motorcycles. During calendar year 2000, Harris County administered an ATP and exhaust and evaporative I/M,

whereas the other seven counties administered the evaporative I/M. The ATP and I/M programs modeled for 2000 started January 1 of the program start years. The I/M and ATP modeling setups were developed with information from the I/M SIP (TNRCC, December 2000) and discussions with TNRCC Technical Analysis Division.

Vehicle ATP (ANTI-TAMP PROG Command)
Table 28 describes the ATP setups and the emissions factor post-processing procedure required due to MOBILE6's limit of one ATP per modeling run. The post-processing procedure is from the HGA original 1990 base year emissions inventory as developed and documented by HGAC in 1992. For 2000, ATP credit was modeled for Harris County only. The MOBILE6 ATP set ups are inputs of the MOBILE6 command file.

TABLE 28
Harris County 2000 ATP:
MOBILE6 Command, Data Parameter Values, and Post-processing Procedure

Post-processing requirements: Three MOBILE6 modeling runs are required to model the Harris County ATP program, which consists of two subprograms. To account both parts of the ATP (ATP1, ATP2), a run with no ATP command is required as well as one run for each of the two ATPs. The following emissions factor post-processing calculation is performed:

$$EF_{ATP1} + EF_{ATP2} - EF_{NO\ ATP} = EF_{FINAL}$$

where:

EF_{ATP1} = emissions factor (EF) with ATP1 credits,
EF_{ATP2} = EF with ATP2 credits,
$EF_{NO\ ATP}$ = EF with no ATP credits,
EF_{FINAL} = EF with estimated credits for both ATP1 and ATP2.

MOBILE6 Inputs: The command and data parameter values for ATP1 and ATP2, repectively, are:

ANTI-TAMP PROG
84 76 83 22222 22222222 2 11 096. 21112222
ANTI-TAMP PROG
84 84 98 22222 22222222 2 11 096. 22112222

Data parameter value definitions:

- the first number is the last two digits of the program start year.
- the second number is the last two digits of earliest model year covered by the program. The program is designed to cover 24 year old vehicles and newer.
- the third number is the final model year covered by the program. Vehicles less than two years old are exempt from the program.
- the next 14 values are on/off toggles to identify the vehicle types covered (1=no, 2=yes). The vehicle are in input string order are: LDGV, LDGT1, LDGT2, LDGT3, LDGT4; and HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B; and GAS BUS.
- the next entry must be one (EPA no longer supports additional credit for test only program). A “2" will cause ATP credit to be discontinued.
- the next data parameter is the program inspection frequency (1= annual, 2= biennial).
- the next number is the program compliance rate in percent.
- the last eight data parameters in the input string are on/off toggles (1=no, 2=yes) indicating which checks are performed, in the following order: 1) air pump disablement, 2) catalyst removal, 3) fuel inlet restrictor removal, 4) tailpipe lead deposit, 5) exhaust gas recirculation disablement, 6) evaporative system disablement, 7) positive crankcase ventilation system disablement, and 8) missing gas cap.

I/M Programs

Table 29 describes the HGA I/M setups (commands and data parameter values) for 2000. For 2000, Harris County administered both exhaust and evaporative I/M programs, whereas the other seven HGA counties operated only the evaporative I/M program. Thus, for 2000, three I/M programs are modeled (MOBILE6 will model up to seven different I/M programs in one run). All I/M programs modeled for 2000 started in January of the program start years. The I/M data were input in an external data file called from the command file using the I/M DESC FILE command.

TABLE 29
MOBILE6 I/M Commands and Data Parameter Values for HGA 2000

Geographic coverage: Harris County: Programs 1 and 2; other seven counties: Program 3.

MOBILE6 inputs: The commands (in bold) with their corresponding data parameters values as defined by program design, are described below. Except for the I/M EFFECTIVENESS command, the first data value following each command identifies the program number to which the command and its associated parameters apply. Where used below, "#" means that that command and its data parameter values are input for each of the three programs modeled.

I/M STRINGENCY: 1 20 (percent stringency level for pre-1981 cars and light trucks)
I/M COMPLIANCE: # 96 (percent compliance)
I/M WAIVER RATES: # 3 3 (pre-1981 and post-1980 waiver rates in percent)
I/M EFFECTIVENESS: 1 1 1 (fractional exhaust I/M effectiveness for HC, CO, and NOx)
The I/M PROGRAM command is entered for each of the three subsequent program descriptions:
I/M PROGRAM:

1 1997 2050 1 TRC 2500/IDLE
2 1997 2050 1 TRC GC
3 2000 2050 1 TRC GC

where the parameters, by numerical order, are defined as:

2nd and 3rd are the program start and end years, respectively,
4th is the program frequency (1=annual, 2=biennial),
5th is the program type (TRC= test and repair computerized),
6th is inspection type (2500/IDLE=test at idle, 2500 rpm; GC=gas cap pressure check).

I/M MODEL YEARS: # 1976 1998
I/M VEHICLES: # 22222 22222222 2

The14 data parameters are on/off toggles (1=no, 2=yes) indicating which vehicle types are subject to inspection. The 14 corresponding vehicle types, in input order are: LDGV, LDGT1, LDGT2, LDGT3, LDGT4; and HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B; and GAS BUS.

Fuels – Locality Specific Inputs to MOBILE6
Fuel effects modeling for HGA 2000 includes only the summer RFG. The RVP of gasoline is required input to run MOBILE6, but is not used in the emissions factor calculations, as it is overridden by the MOBILE6 RFG option modeled.

Fuel Program (FUEL PROGRAM Command)
The MOBILE6 FUEL PROGRAM command provides the user four options for modeling fuels effects. The second option, RFG (with the southern volatility region indicated), was modeled for all eight counties for 2000. This option directs MOBILE6 to model the effects of RFG as defined by the EPA default parameters for the southern volatility region, summer RFG. For this option, EPA default RFG parameter values used in MOBILE6 for 2000 are:

- RVP, South region - 6.7 pounds per square inch;
- Ether Oxygen Content - 2.1 % by weight;
- Ether Market Share - 100 %;
- Sulfur Content, average - 150 parts per million; and
- Sulfur Content, maximum experienced by model year:
    - Model Year 2000: 1,000 parts per million, and
    - Model Year < 1999: not applicable.

The selected FUEL PROGRAM option is entered in the MOBILE6 command file.

Gasoline RVP (FUEL RVP Command)
Although the gasoline RVP input to MOBILE6 is overridden by the selected FUEL PROGRAM command option described above for RFG, the estimated actual RVP for 2000 was input to MOBILE6. This estimated actual average summertime RVP value for 2000 for the city of Houston is 6.8 pounds per square inch as calculated by TNRCC. TNRCC used procedures found in Procedures for Emissions Inventory Preparation, Volume IV (EPA, 1992), and gasoline survey data from TRW Petroleum Technologies to estimate the HGA average summertime RVP for 2000. The RVP value is entered in the MOBILE6 command file.

MOBILE6 Alternative Emissions Regulations and Control Measures Commands
The only non-default input and associated command applied in this part of MOBILE6 relates to heavy-duty diesel vehicle NOx off-cycle emissions effects.

In the late 1980s and most of the 1990s HDDV engines were built with “defeat devices” allowing in-use engine emissions to be higher than emissions as specified under Federal Test Procedure conditions. MOBILE6 includes estimates of these excess HDDV emissions as well as the emissions offsetting effects of two programs: early pull-ahead of 2004 HDDV emissions standards, and low emissions rebuilds of existing engines.

TNRCC obtained information from EPA that lead to the conclusion that the best estimate for the effectiveness rate for 2000 for the low NOx emissions rebuilds program for heavy duty diesels is 1.0%. The information provided by EPA showed that number of low NOx rebuild kits supplied (as of January, 2002) to the affected population is 0.97 %.

Thus, in MOBILE6 the effectiveness rate for the low NOx emissions rebuild program was set at 1.0% through the REBUILD EFFECTS command in the command file.

EMISSIONS CALCULATIONS

Hourly emissions were calculated by county for each of the eleven analysis days. With the day-of-week-specific VMT and emissions factors (g/mi) for each hour, emissions were calculated for each of the 28 vehicle types and each of 14 pollutant-specific emission types on each network link (only the MOBILE6 freeway and arterial emissions factors were used). For each day, 195 files were output from the emissions calculations: 192 hourly link emissions files (24 hours multiplied by eight counties), a summary file of county-level and area total hourly and 24-hour emissions estimates cross-classified by vehicle type and road type, a tab-delimited version of the emissions summary file, and the file that logged the execution of the emissions calculation programs. These files were previously provided to TNRCC on CD-ROM (see Appendix A).

Hourly Link Emissions

For each analysis day, the emissions were calculated by hour for each network link (indexed to county and road type) using the following basic inputs:

- MOBILE6 hourly freeway and arterial emissions factors indexed by speed for 28 vehicle types, developed with POLFAC6;
- Records associating the MOBILE6 freeway emissions factors to the freeway links, and the MOBILE6 arterial emissions factors to the non-freeway links;
- Link data from the assignment results as developed (for each hour) using the PREPIN program including: county number, road type number, VMT on link, operational link-speed estimate, link node (end point) numbers, and link distance; and
- VMT mix (to allocate link VMT by each of the 28 vehicle types) by time period and roadway type.

For each hour, the emissions estimates were computed by vehicle type for each link. The emissions factors, discussed previously, were tabulated by hour, road type, vehicle type, and 14 speeds (2.5 mph and 5 mph to 65 mph at 5 mph intervals). VMT mix correlated to link VMT (by day-of-week, functional classification group, and hour) were multiplied by the fleet total link VMT to produce link-VMT estimates by the 28 vehicle types. Emissions factors were then matched with link-level VMT (freeway emissions factors to freeway links, and arterial emissions factors to non-freeway links), based on vehicle class and speed. Emissions factors for link speeds that are not represented in the set of 14 MOBILE6 speed bin speeds were calculated by interpolation (see example calculation, below) using the method MOBILE6 uses. For link-speeds greater than or less than the MOBILE6 bounding speeds of 65 mph and 2.5 mph, the emissions factors corresponding to those bounding speeds were applied, respectively. The link-VMT were then multiplied by the emissions factors to produce the link-level emissions estimates. County-level, link-emissions files were produced including the following data for each link: link a-node and b-node identification numbers, network functional classification code, pollutant-specific emissions type, and emissions estimates for each of the 28 vehicle types.

Example Emissions Factor Interpolation
To calculate emissions factors for average operational link speeds that fall between two of the 14 MOBILE6 speed bin speeds, MOBILE6 interpolates each emissions factor using a factor developed from the inverse link speed and the inverse high and low bounding speed bin speeds (Section 5.3.4, MOBILE6 User's Guide, January 2002).

Using the MOBILE6 emissions factors tabulated by the 14 speeds, the IMPSUM6 program uses the MOBILE6 method to interpolate emissions factors as shown in the following example. This example interpolates an emissions factor corresponding to an average link-speed of 41.2 mph:

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

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

where:

$EF_{LowSpeed}$ = emission factor (EF) corresponding to tabulated speed below the average link speed,

$EF_{HighSpeed}$ = EF corresponding to tabulated speed above the average 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,
$Speed_{high}$ = 45 mph.

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

$$EF_{Interp} = 0.7413 \text{ g/mi} - (0.26214) \times (0.7413 \text{ g/mi} - 0.7274 \text{ g/mi})$$

$$= 0.7377 \text{ g/mi}$$

Episode Day Hourly and 24-hour Emissions Summaries

For each analysis day, by individual county and for all counties, the link-emissions estimates were summed for each hour, and the hourly emissions were summed for each day. The resulting composite VOC, CO, and NOx emissions estimates are summarized by road type (HGAC network functional classification), vehicle type, road-type and vehicle-type cross-classification. VMT, vehicle hours traveled (VHT), VMT-weighted speeds, and other inventory data are included with the emissions summaries. These files (*.LST and a tab delimited version, *.TAB) were previously provided to TNRCC on CD-ROM (see Appendix A).

APPENDIX A
ELECTRONIC SUBMITTAL DATASET NAMES AND DESCRIPTIONS

Electronic Submittal Data Set Names and Descriptions -
HGA 2000 On-road Mobile Source Episode Specific Emissions Inventories

This appendix provides the electronic data submittal CD-ROM volume names and the names and descriptions of the datasets contained on each.

TTI porvided 13 CD-ROMs to TNRCC on March 28, 2002. The number of CDs by data content category are: 1) 11 CDs containing the link-emissions files and inventory summary report files, 2) one CD containing the HGAC 2000 travel model network node coordinates, and 3) one CD containing the MOBILE6 input files (command and external data) and output files (POLFAC6 and RATEADJ6 produced MOBILE6 emissions factors tables).

The CDs and contents by data category (emissions, coordinates, emissions factors) are described below. The file format for the link emissions files is included (see Tables 1 and 2).

Emissions (11 CD-ROMs)
One CD for each analysis day contains the following (195) files in a ZIP file:

- county level hourly link-emissions files (192 ASCII files with .y00 extension);
- IMPSUM6 county-level hourly emissions inventory data summaries to include VMT mix, VMT, VHT, Average Speed, and emissions cross-classified by vehicle type and road type; IMPSUM6 hourly "all counties" emissions inventory data summaries; SUMALL6 county-level and "all counties" 24-hour emissions inventory data summaries (1 ASCII file with .lst extension);
- a tab delimited version of second bullet above (1 ASCII file with .tab extension); and
- a log of the emissions estimation program runs (1 ASCII file with .log extension).

The CD-ROM names, zip file names and data set file names follow the convention:

H***ddmmm***00 (CD-ROM name)
hg***ddmmm***00.zip
hga***ddmmm***.tab
hga***ddmmm***.lst
hga***ddmmm***.log
countyname.t***hr***.lnkemis.***mmmdd***.y00

where: ***dd*** is the day date for each of the 11 days for the period 22AUG through 01SEP;
mmm is the month, AUG or SEP, corresponding to the episode date day (***dd***);
countyname is brazoria, chambers, fortbend, galveston, harris, liberty, montgomery, waller; and
hr is 01... 24 representing the hours 12 a.m. through 11 p.m.

Coordinates (1 CD-ROM)
The CD name is XY2000. The CD contains one file named all2000.srt, which contains UTM zone 15 X-Y coordinates in meters for the HGA 2000 network nodes (link endpoints and zone centroids). The order of the data is: network node number, X-coordinate, Y-coordinate.

- UTM Zone 15 X-Y coordinates for the network nodes (1 file, all2000.srt)

Emissions Factors (1 CD-ROM)
The CD name is HG00M6. The MOBILE6 input and output files on the CD are in the ZIP file named HG00M6.zip. The ZIP file contents are described below:

Number of Files:
The MOBILE6 input and output files consist of:

- MOBILE6 command input files (110);
- MOBILE6 external data input files (75);
- POLFAC6 and RATEADJ6 hourly emissions factor output files (121); and
- POLFAC6 and RATEADJ6 daily emissions factor output files (121).

Additionally, the following files were included:

- diesel fractions files which are included in the MOBILE6 command files (8).

This CD-ROM included a total of 435 files. (Please disregard the extra empty file of extension .LST).

File Naming Conventions:
CTY7 is the first four letters of county name for each of the 7 non-Harris counties;
CTY8 is the first four letters of county name for each of the 8 counties;
mmmdd is the month/day date for the 11 days (AUG22... SEP01);
HARR is Harris County;
is 0, 1, 2 representing no ATP, ATP1 and ATP2, respectively; and
kk is wk, fr, sa, su which represents the four days-of-week.

MOBILE6 command input files:
CTY7 00***mmmdd***.in (77 files); and
HARR00***mmmdd***a***#***.in (33 files).

MOBILE6 external data input files:
UrRu00.im (1 I/M file for the seven non-Harris counties);
Harr00.im (1 I/M file for Harris county);
hgaSIP.tld (1 I/M file for regional trip length distributions);
CTY8 00.rgd (8 registration distributions files);
CTY8 00***kk***.vfc (32 VMT BY FACILITY files); and
CTY8 00***kk***.vhr (32 VMT BY HOUR files).

Files containing the diesel fractions:

Dsf_***CTY8***.y00 (8 files, not actual input files -- data are command file input).

MOBILE6 Hourly (.rat) and Daily (.rtd) Emissions Factors Files (output):

CTY700***mmmdd***.rat;
HARR00***mmmdd***a**#**.rat;
HARR00***mmmdd***ATPadj.rat;
CTY700***mmmdd***.rtd;
HARR00***mmmdd***a**#**.rtd; and
HARR00***mmmdd***ATPadj.rtd.

TABLE 27
Link Emissions Data File Format

Abbreviation	Columns	Format Type	Description
A Node	1 - 6	I6	A-Node of link
B Node	7 - 12	I6	B-Node of link
FC	13 - 15	I3	Functional Classification of Link
EMISS	17 - 19	A3	"VOC", or "CO", or "NOx"
ETYPE	21 - 31	A11	See TABLE XX EMISSION SUB-COMPONENT TYPE
LDGV	32 - 41	F10.?[1]	LDGV link emissions in grams
LDGT1	42 - 51	F10.?	LDGT1 link emissions in grams
LDGT2	52 - 61	F10.?	LDGT2 link emissions in grams
LDGT3	62 - 71	F10.?	LDGT3 link emissions in grams
LDGT4	72 - 81	F10.?	LDGT4 link emissions in grams
HDGV2B	82 - 91	F10.?	HDGV2B link emissions in grams
HDGV3	92 - 101	F10.?	HDGV3 link emissions in grams
HDGV4	102 - 111	F10.?	HDGV4 link emissions in grams
HDGV5	112 - 121	F10.?	HDGV5 link emissions in grams
HDGV6	122 - 131	F10.?	HDGV6 link emissions in grams
HDGV7	132 - 141	F10.?	HDGV7 link emissions in grams
HDGV8A	142 - 151	F10.?	HDGV8A link emissions in grams
HDGV8B	152 - 161	F10.?	HDGV8B link emissions in grams
LDDV	162 - 171	F10.?	LDDV link emissions in grams
LDDT12	172 - 181	F10.?	LDDT12 link emissions in grams
HDDV2B	182 - 191	F10.?	HDDV2B link emissions in grams
HDDV3	192 - 201	F10.?	HDDV3 link emissions in grams
HDDV4	202 - 211	F10.?	HDDV4 link emissions in grams
HDDV5	212 - 221	F10.?	HDDV5 link emissions in grams
HDDV6	222 - 231	F10.?	HDDV6 link emissions in grams
HDDV7	232 - 241	F10.?	HDDV7 link emissions in grams
HDDV8A	242 - 251	F10.?	HDDV8A link emissions in grams
HDDV8B	252 - 261	F10.?	HDDV8B link emissions in grams
MC	262 - 271	F10.?	MC link emissions in grams
HDGB	272 - 281	F10.?	HDGB link emissions in grams
HDDBT	282 - 291	F10.?	HDDBT link emissions in grams
HDDBS	292 - 301	F10.?	HDDBS link emissions in grams
LDDT34	302 - 311	F10.?	LDDT34 link emissions in grams

TABLE 28
Emissions Sub-Component Type

Sub-Component Abbreviation	Comments
COMPOSITE	Total emissions
EXH_RUNNING	Exhaust running emissions
START	Start emissions
Hot_Soak	Hot Soak VOC emissions
Diurnal	Diurnal VOC emissions
Rest_Loss	Resting loss VOC emissions
Run_Loss	Running loss VOC emissions
Crankcase	Crankcase VOC emissions
Refueling	Refueling loss VOC emissions

APPENDIX B
EMISSIONS ESTIMATION METHODOLOGY

EMISSIONS ESTIMATION METHODOLOGY

The following is a summary of the series of programs developed by TTI for developing link-based, time-of-day, on-road mobile source emissions estimates for air quality analyses.

These programs produce emissions factors with the latest version of EPA's MOBILE emissions factor model, and apply them to travel model-based activity estimates to calculate emissions at user-specified temporal and spatial scales. The location of emissions by grid, or travel network link coordinates, may also be specified.

The emissions estimation programs are: PREPIN, POLFAC6, RATEADJ6, RATEADJV6, IMPSUM6, and SUMALL6. PREPIN prepares activity input, POLFAC6 prepares emissions factor input, the RATEADJ programs make special adjustments to emissions factors when required, IMPSUM6 calculates emissions by time period, and SUMALL6 summarizes emissions at various levels by 24-hour period.

PREPIN

The PREPIN program post-processes travel model output to produce time-of-day-specific, on-road vehicle fleet, link VMT and speed estimates for emissions inventory applications. The PREPIN program was developed for use in urban areas that do not have all of the time-of-day assignments and operational speeds available as may be required for air quality analyses of particular temporal scales (e.g., hourly). For example, PREPIN reads a travel demand model traffic assignment data set from a directional four period time-of-day assignment (another common assignment read by PREPIN is the nondirectional or directional 24-hour assignment). PREPIN initially scales the assignment volumes on each link to the appropriate VMT (seasonal, day-of-week specific, for instance). Time-of-day (hourly, for example) factors (and directional split factors, in the case of a nondirectional assignment) are applied to the adjusted assignment results on each link to estimate the directional time-of-day travel on the link. Speed models, originally developed for the Houston-Galveston region, are used to estimate the operational time-of-day speeds by direction on the links. Special intrazonal links are defined (as intrazonal links are not a feature of travel demand models), and the VMT and speeds for intrazonal trips are estimated. These VMT and speeds by link are subsequently input to the IMPSUM6 program for the application of MOBILE6 emissions factors.

POLFAC6

The POLFAC6 program is used to apply the EPA's MOBILE6 program to obtain the on-road mobile emissions factors. The MOBILE6 emissions factors are obtained for each of 15 emissions types (i.e., the composite, exhaust running, and exhaust start for VOC, CO, and NOx rates; plus the six VOC evaporative rates), 28 vehicle types, four MOBILE6 functional classifications (freeway, arterial/collector, local, and ramp), 14 speeds (i.e., 2.5 mph, and 5 mph through 65 mph at 5 mph increments for freeway and arterial functional classifications — MOBILE6 local and ramp functional classification rates are single speed only, 12.9 mph, and 34.6 mph, respectively), and each of the 24 hours of the day. These emissions factors are tabulated individually by county and analysis day for the evaluation year. These emissions factors are output to an ASCII file for subsequent input to the IMPSUM6 program. The IMPSUM6 program is then used to apply the

hourly emissions factors to hourly VMT estimates by link. (POLFAC6 also optionally produces a set of daily emissions factors.)

RATEADJ6
RATEADJ6 is a special utility program that produces a new set of emissions factors by linearly combining the emissions factors from multiple applications of POLFAC6. There is one set of linear factors. Each factor is applied to all emissions rates in a single data set.

RATEADJV6
RATEADJV6 is a special utility program that produces a new set of emissions factors by linearly combining the emissions factors from multiple applications of POLFAC6 or RATEADJ6 or RATEADJV6. There are 420 linear equations; one for each of 15 emissions types and 28 vehicle types.

IMPSUM6
The IMPSUM6 program applies the emissions factors obtained from POLFAC6 (or from one of the RATEADJ programs, when used) and VMT mixes (fractions of fleet VMT attributable to each vehicle classification in the study) to the time-of-day fleet VMT and speed estimates to calculate emissions by the specified time periods. The five primary inputs to IMPSUM6 are:

- MOBILE6 emissions factors developed with POLFAC6 (or a RATEADJ6, if used);
- abbreviated assignment results by link (for the subject time period), developed using the PREPIN program. (The PREPIN program allows the user to estimate the VMT and speed on each link by time period.) For each link, the following information is input to IMPSUMA: county number, roadway type number, VMT on link, operational link-speed estimate, and link distance;
- VMT mix by time period, county and roadway type;
- X-Y coordinates; and
- data records associating the MOBILE6 roadway type (freeway, arterial, local, ramp) emissions factors (or percentages thereof) to specific travel model functional classifications. These MOBILE6 roadway type emissions factor percentages (valid from zero to 100) must sum to 100% for each travel model functional classification.

Using these input data, the VMT for each link is stratified by MOBILE6 emissions factor-specific road types and the 28 vehicle types. The MOBILE6 emissions factors matched to link VMT by road type and vehicle type are interpolated (for the link speed that falls between the 14 MOBILE6 speeds) and multiplied by the link VMT to estimate the mobile source emissions for that link. Emissions factors for 65 mph are used for links with speeds greater than 65 mph; emissions factors for 2.5 mph are used for links with speeds lower than 2.5 mph. The emissions for the county and emissions type are reported by both roadway type and vehicle type (i.e., cross

classified by roadway type and vehicle type) for each of the subject time periods. A data set is produced for subsequent input to the SUMALLA6 program. X-Y coordinates are optionally used to produce gridded emissions. Also, link emissions may be written by county. The link emissions are for 15 emissions types and 28 vehicle types and include the "a" node and "b" node (endpoints) of the links for which X-Y coordinates may be obtained.

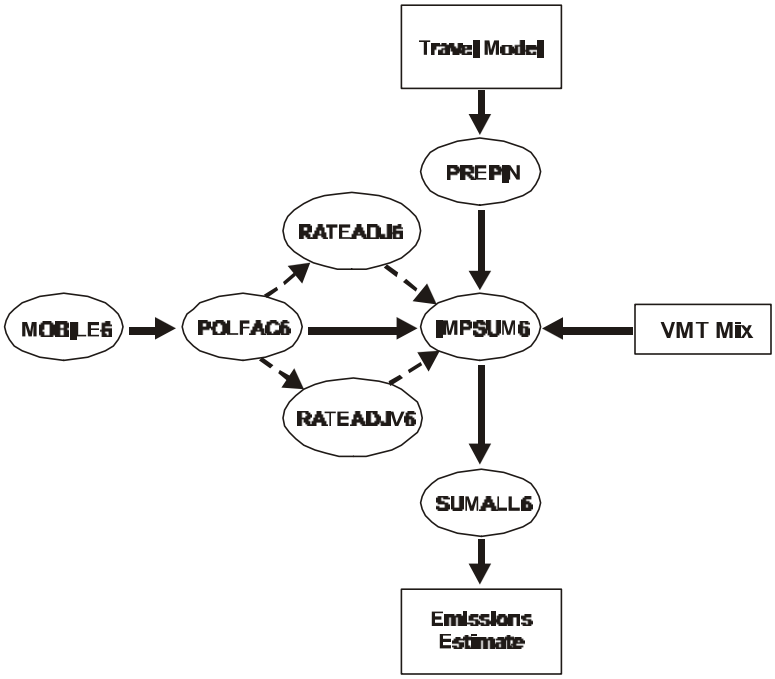
A tab-delimited output is optionally produced. This output has all 28 vehicle types (or eight vehicle types in the compressed format) across a single output line. Each field in the output is separated by a tab character.

SUMALL6

The SUMALL6 program is used to sum the emissions estimates for the time-of-day periods (e.g., 24 periods in the case of hourly analyses) to develop 24-hour emissions estimates. The emissions by pollutant type are reported by roadway type and 28 vehicle types (or optionally condensed to eight vehicle types).

A tab-delimited output is optionally produced. This output has all 28 vehicle types (or eight vehicle types in the compressed format) across a single output line. Each field in the output is separated by a tab character.

The process overall emissions estimate process flow is shown in the diagram below.



APPENDIX C
HOURLY TIME PERIOD VOLUME FACTORS

Weekday Houston Galveston Area Hourly Time Period Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.302055914	0.225632139	0.324597644	0.322400903
	07:00	0.391873901	0.456962542	0.358319391	0.359297162
	08:00	0.306070185	0.317405319	0.317082966	0.318301935
Midday	09:00	0.158978411	0.140704491	0.152370360	0.159575180
	10:00	0.157050538	0.152643762	0.157726685	0.157032997
	11:00	0.165865452	0.168161125	0.165206547	0.162696432
	12:00	0.165685682	0.171929802	0.168822374	0.165763594
	13:00	0.170973392	0.177241611	0.174393200	0.171127945
	14:00	0.181446526	0.189319210	0.181480834	0.183803853
PM Peak	15:00	0.239373748	0.230505625	0.240582574	0.228155595
	16:00	0.271320441	0.271091032	0.254713427	0.254734230
	17:00	0.284788273	0.295613115	0.264894118	0.274629456
	18:00	0.204517538	0.202790228	0.239809882	0.242480719
Overnight	19:00	0.203863566	0.224047230	0.207782628	0.219489308
	20:00	0.161840473	0.182633853	0.164377778	0.164340464
	21:00	0.146819307	0.157694255	0.144263436	0.139186685
	22:00	0.126333231	0.134805356	0.115186163	0.107246956
	23:00	0.087673161	0.097483633	0.082998298	0.068630074
	00:00	0.049374812	0.048218183	0.049417020	0.037755605
	01:00	0.031572310	0.029167641	0.035011579	0.025375902
	02:00	0.028732316	0.025110084	0.031269852	0.022855537
	03:00	0.023482484	0.018397827	0.027876479	0.023666951
	04:00	0.033864833	0.022801225	0.039290180	0.044437291
	05:00	0.106443506	0.059640713	0.102526587	0.147015226

Weekday Houston Galveston Area Hourly Time Period Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.242861810	0.240506246	0.359462008	0.322400903
	07:00	0.395512755	0.386812073	0.380406843	0.359297162
	08:00	0.361625435	0.372681681	0.260131149	0.318301935
Midday	09:00	0.154046951	0.140688905	0.159906308	0.159575180
	10:00	0.146773744	0.130783258	0.155516686	0.157032997
	11:00	0.169958745	0.165747780	0.164081480	0.162696432
	12:00	0.177038157	0.184755749	0.165532402	0.165763594
	13:00	0.171929000	0.186493743	0.168946926	0.171127945
	14:00	0.180253402	0.191530565	0.186016198	0.183803853
PM Peak	15:00	0.236708196	0.228844435	0.224988384	0.228155595
	16:00	0.272666422	0.258867808	0.268548642	0.254734230
	17:00	0.278413548	0.276744346	0.284933411	0.274629456
	18:00	0.212211834	0.235543411	0.221529563	0.242480719
Overnight	19:00	0.228914550	0.234232509	0.209361757	0.219489308
	20:00	0.178506543	0.193810969	0.160667124	0.164340464
	21:00	0.158917116	0.164785465	0.133880558	0.139186685
	22:00	0.132517321	0.123066744	0.098643335	0.107246956
	23:00	0.088185784	0.082027084	0.064052138	0.068630074
	00:00	0.045501668	0.046750737	0.034344181	0.037755605
	01:00	0.029894791	0.030065860	0.021228790	0.025375902
	02:00	0.025111624	0.026657496	0.016184044	0.022855537
	03:00	0.016284321	0.017006995	0.018511658	0.023666951
	04:00	0.021796254	0.021760422	0.053530375	0.044437291
	05:00	0.074370028	0.059835719	0.189596040	0.147015226

Weekday Houston Galveston Area Hourly Time Period Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.268323895	0.268323895	0.268323895	0.332178880
	07:00	0.391369115	0.391369115	0.391369115	0.391796017
	08:00	0.340306990	0.340306990	0.340306990	0.276025103
Midday	09:00	0.145691334	0.145691334	0.145691334	0.169614239
	10:00	0.141057850	0.141057850	0.141057850	0.163719094
	11:00	0.151990562	0.151990562	0.151990562	0.150472611
	12:00	0.168267255	0.168267255	0.168267255	0.148227195
	13:00	0.199352059	0.199352059	0.199352059	0.162689017
	14:00	0.193640940	0.193640940	0.193640940	0.205277844
PM Peak	15:00	0.219198029	0.219198029	0.219198029	0.200150392
	16:00	0.248822411	0.248822411	0.248822411	0.265447509
	17:00	0.282155142	0.282155142	0.282155142	0.299180856
	18:00	0.249824419	0.249824419	0.249824419	0.235221244
Overnight	19:00	0.271429147	0.271429147	0.271429147	0.230213047
	20:00	0.203102383	0.203102383	0.203102383	0.164065915
	21:00	0.150354742	0.150354742	0.150354742	0.134619139
	22:00	0.101488442	0.101488442	0.101488442	0.100685369
	23:00	0.046737393	0.046737393	0.046737393	0.053127879
	00:00	0.025049411	0.025049411	0.025049411	0.034570785
	01:00	0.017421196	0.017421196	0.017421196	0.024727294
	02:00	0.017353968	0.017353968	0.017353968	0.023629956
	03:00	0.018940566	0.018940566	0.018940566	0.024852837
	04:00	0.037652555	0.037652555	0.037652555	0.046757740
	05:00	0.110470196	0.110470196	0.110470196	0.162750039

Friday Houston Galveston Area Hourly Time Period Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.297131911	0.223883714	0.315342382	0.321128804
	07:00	0.394236840	0.451744674	0.359900816	0.359431094
	08:00	0.308631249	0.324371612	0.324756802	0.319440102
Midday	09:00	0.151885595	0.131565910	0.143100799	0.147112900
	10:00	0.155020667	0.150129144	0.155806465	0.153781341
	11:00	0.165688412	0.167140769	0.164658623	0.163917121
	12:00	0.170092079	0.174827157	0.170684271	0.171089848
	13:00	0.172595888	0.180644137	0.179024444	0.177207023
	14:00	0.184717358	0.195692883	0.186725398	0.186891768
PM Peak	15:00	0.250312361	0.238352884	0.247168193	0.231656829
	16:00	0.274476752	0.268979235	0.251998134	0.251802146
	17:00	0.271549078	0.280666802	0.256950448	0.267068852
	18:00	0.203661809	0.212001079	0.243883226	0.249472173
Overnight	19:00	0.204212165	0.225567348	0.215469826	0.234794832
	20:00	0.163222524	0.185730905	0.170905018	0.176599484
	21:00	0.144546826	0.162711820	0.146774509	0.144376227
	22:00	0.129709686	0.134269438	0.118580837	0.112070283
	23:00	0.102397235	0.117584664	0.103509302	0.082170543
	00:00	0.048778554	0.042398399	0.045967609	0.037097674
	01:00	0.031355981	0.025747842	0.031251552	0.023714730
	02:00	0.028961539	0.023117457	0.027146346	0.019518347
	03:00	0.022593449	0.014760101	0.024038776	0.019477004
	04:00	0.030573363	0.019413531	0.033273576	0.035133848
	05:00	0.093648678	0.048698495	0.083082649	0.115047029

Friday Houston Galveston Area Hourly Time Period Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.235534471	0.245972563	0.353278084	0.321128804
	07:00	0.397641106	0.368797415	0.383437805	0.359431094
	08:00	0.366824423	0.385230022	0.263284111	0.319440102
Midday	09:00	0.147016673	0.134035817	0.145777782	0.147112900
	10:00	0.149636042	0.146320837	0.155312524	0.153781341
	11:00	0.173491308	0.167846400	0.165351204	0.163917121
	12:00	0.180594538	0.183970842	0.168795325	0.171089848
	13:00	0.175412558	0.185555095	0.173527655	0.177207023
	14:00	0.173848882	0.182271009	0.191235510	0.186891768
PM Peak	15:00	0.252060518	0.235562992	0.233250661	0.231656829
	16:00	0.271763054	0.261421808	0.269978894	0.251802146
	17:00	0.263024060	0.270428250	0.271897813	0.267068852
	18:00	0.213152368	0.232586950	0.224872632	0.249472173
Overnight	19:00	0.209693450	0.224150550	0.215790771	0.234794832
	20:00	0.164523918	0.188068206	0.163948365	0.176599484
	21:00	0.152178356	0.162582658	0.140358412	0.144376227
	22:00	0.143014399	0.138132669	0.112374433	0.112070283
	23:00	0.115945193	0.111815346	0.084797637	0.082170543
	00:00	0.051444496	0.042100229	0.037161329	0.037097674
	01:00	0.033297723	0.027689747	0.021607713	0.023714730
	02:00	0.030380866	0.023148262	0.018846904	0.019518347
	03:00	0.018365072	0.013811605	0.017289750	0.019477004
	04:00	0.021374828	0.017438138	0.039591023	0.035133848
	05:00	0.059781700	0.051062592	0.148233663	0.115047029

Friday Houston Galveston Area Hourly Time Period Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.248252236	0.248252236	0.248252236	0.309883735
	07:00	0.390755605	0.390755605	0.390755605	0.395197627
	08:00	0.360992159	0.360992159	0.360992159	0.294918638
Midday	09:00	0.143587863	0.143587863	0.143587863	0.153460733
	10:00	0.148623871	0.148623871	0.148623871	0.157794209
	11:00	0.158205879	0.158205879	0.158205879	0.161225019
	12:00	0.186063567	0.186063567	0.186063567	0.165879008
	13:00	0.176804016	0.176804016	0.176804016	0.170670364
	14:00	0.186714804	0.186714804	0.186714804	0.190970667
PM Peak	15:00	0.233490515	0.233490515	0.233490515	0.225803004
	16:00	0.239308852	0.239308852	0.239308852	0.263357581
	17:00	0.265154297	0.265154297	0.265154297	0.268116520
	18:00	0.262046336	0.262046336	0.262046336	0.242722895
Overnight	19:00	0.273021852	0.273021852	0.273021852	0.240980422
	20:00	0.197259242	0.197259242	0.197259242	0.170723111
	21:00	0.142940348	0.142940348	0.142940348	0.127253819
	22:00	0.102001222	0.102001222	0.102001222	0.101406864
	23:00	0.068966082	0.068966082	0.068966082	0.073162137
	00:00	0.031086830	0.031086830	0.031086830	0.038531945
	01:00	0.021759548	0.021759548	0.021759548	0.030298733
	02:00	0.018494592	0.018494592	0.018494592	0.025245365
	03:00	0.019864560	0.019864560	0.019864560	0.025155126
	04:00	0.035090095	0.035090095	0.035090095	0.044045104
	05:00	0.089515629	0.089515629	0.089515629	0.123197372

Saturday Houston Galveston Area Hourly Time Period Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.268109383	0.272595665	0.248561171	0.256676195
	07:00	0.335639259	0.326493966	0.332514491	0.326379684
	08:00	0.396251358	0.400910369	0.418924338	0.416944122
Midday	09:00	0.141881335	0.109105642	0.138860838	0.140115422
	10:00	0.157094066	0.144538058	0.160311921	0.163468429
	11:00	0.169826221	0.175150133	0.171240228	0.174544365
	12:00	0.179293716	0.186661227	0.177204017	0.175245241
	13:00	0.175814211	0.190920999	0.177975334	0.175047226
	14:00	0.176090451	0.193623941	0.174407663	0.171579317
PM Peak	15:00	0.262857141	0.251292942	0.256056699	0.253633313
	16:00	0.251928000	0.258083976	0.256013387	0.257040868
	17:00	0.248307149	0.254122246	0.252556355	0.254439856
	18:00	0.236907710	0.236500836	0.235373560	0.234885963
Overnight	19:00	0.171051909	0.199654652	0.192636098	0.207482860
	20:00	0.152069439	0.173289350	0.157857370	0.167130266
	21:00	0.145476107	0.155934039	0.143334013	0.152360430
	22:00	0.132176004	0.133707988	0.122093563	0.121990207
	23:00	0.105173601	0.109294499	0.100120811	0.092650344
	00:00	0.078759024	0.062285696	0.076096130	0.063036240
	01:00	0.053007905	0.042109928	0.049822502	0.040423113
	02:00	0.048308697	0.036658918	0.041272792	0.032466208
	03:00	0.030687522	0.023439341	0.029871940	0.025657199
	04:00	0.029666553	0.022331555	0.032291878	0.032470126
	05:00	0.053623240	0.041294034	0.054602902	0.064333006

Saturday Houston Galveston Area Hourly Time Period Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.212583118	0.189222972	0.303641691	0.256676195
	07:00	0.332081279	0.325851957	0.315939346	0.326379684
	08:00	0.455335603	0.484925072	0.380418963	0.416944122
Midday	09:00	0.137136956	0.123892879	0.143450590	0.140115422
	10:00	0.156638485	0.146702463	0.161238842	0.163468429
	11:00	0.172838489	0.168945567	0.172510445	0.174544365
	12:00	0.179065247	0.184578831	0.173173803	0.175245241
	13:00	0.177554564	0.189368414	0.173241769	0.175047226
	14:00	0.176766260	0.186511846	0.176384551	0.171579317
PM Peak	15:00	0.265631077	0.263238522	0.248779946	0.253633313
	16:00	0.249548720	0.257061307	0.246898836	0.257040868
	17:00	0.242532899	0.245297543	0.263660960	0.254439856
	18:00	0.242287304	0.234402628	0.240660258	0.234885963
Overnight	19:00	0.176654879	0.191306371	0.196834267	0.207482860
	20:00	0.148245048	0.171522309	0.164075571	0.167130266
	21:00	0.141519211	0.152740621	0.145812322	0.152360430
	22:00	0.139339482	0.132316819	0.123066341	0.121990207
	23:00	0.119618581	0.110757220	0.093642641	0.092650344
	00:00	0.079456868	0.074863328	0.062317647	0.063036240
	01:00	0.056316388	0.053926365	0.042462254	0.040423113
	02:00	0.053263431	0.045859476	0.034010767	0.032466208
	03:00	0.028576477	0.023536978	0.022440692	0.025657199
	04:00	0.023453774	0.018066684	0.032530692	0.032470126
	05:00	0.033555861	0.025103830	0.082806805	0.064333006

Saturday Houston Galveston Area Hourly Time Period Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.210087071	0.210087071	0.210087071	0.241936066
	07:00	0.314870519	0.314870519	0.314870519	0.330359400
	08:00	0.475042410	0.475042410	0.475042410	0.427704533
Midday	09:00	0.145501909	0.145501909	0.145501909	0.152719021
	10:00	0.168577753	0.168577753	0.168577753	0.167874565
	11:00	0.174772675	0.174772675	0.174772675	0.176980527
	12:00	0.175292205	0.175292205	0.175292205	0.172726339
	13:00	0.171099058	0.171099058	0.171099058	0.166034418
	14:00	0.164756400	0.164756400	0.164756400	0.163665130
PM Peak	15:00	0.256302790	0.256302790	0.256302790	0.242371488
	16:00	0.246663563	0.246663563	0.246663563	0.255782935
	17:00	0.258415396	0.258415396	0.258415396	0.255647231
	18:00	0.238618251	0.238618251	0.238618251	0.246198345
Overnight	19:00	0.233217161	0.233217161	0.233217161	0.212267133
	20:00	0.193068465	0.193068465	0.193068465	0.167043760
	21:00	0.157101239	0.157101239	0.157101239	0.152836153
	22:00	0.115580826	0.115580826	0.115580826	0.112579279
	23:00	0.086480483	0.086480483	0.086480483	0.086732807
	00:00	0.058072217	0.058072217	0.058072217	0.065614251
	01:00	0.039775716	0.039775716	0.039775716	0.042308686
	02:00	0.024102476	0.024102476	0.024102476	0.032407499
	03:00	0.022917243	0.022917243	0.022917243	0.026884307
	04:00	0.023853826	0.023853826	0.023853826	0.035119391
	05:00	0.045830347	0.045830347	0.045830347	0.066206732

Sunday Houston Galveston Area Hourly Time Period Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.270650692	0.305443509	0.245145125	0.257235112
	07:00	0.318853329	0.312888758	0.318681698	0.313467190
	08:00	0.410495979	0.381667733	0.436173177	0.429297698
Midday	09:00	0.119473515	0.083786651	0.104212824	0.105814252
	10:00	0.144050654	0.129360917	0.132181075	0.130693362
	11:00	0.157104331	0.173123620	0.158867089	0.159123892
	12:00	0.184486852	0.195127027	0.190787287	0.191776696
	13:00	0.195526632	0.208504316	0.203723193	0.205360811
	14:00	0.199358015	0.210097470	0.210228531	0.207230987
PM Peak	15:00	0.251304809	0.265397551	0.250575963	0.251090537
	16:00	0.245764900	0.257186407	0.255651622	0.254832324
	17:00	0.255617314	0.250085326	0.260465480	0.259151795
	18:00	0.247312977	0.227330715	0.233306935	0.234925344
Overnight	19:00	0.180508962	0.217030220	0.216669628	0.220749894
	20:00	0.164338459	0.182607268	0.179398041	0.177223663
	21:00	0.152579788	0.140551268	0.151496918	0.149379377
	22:00	0.124296175	0.097456171	0.114482705	0.107920047
	23:00	0.081810126	0.060576112	0.085483223	0.067961238
	00:00	0.086719418	0.090698145	0.074786040	0.069149150
	01:00	0.064156576	0.060947217	0.051343582	0.050734631
	02:00	0.058780917	0.053318071	0.042491491	0.070748975
	03:00	0.031274581	0.030793932	0.026915142	0.023489823
	04:00	0.022954590	0.025715647	0.023330081	0.023044814
	05:00	0.032580408	0.040305949	0.033603148	0.039598388

Sunday Houston Galveston Area Hourly Time Period Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.237771856	0.209537026	0.322375601	0.257235112
	07:00	0.318421728	0.311848127	0.292835442	0.313467190
	08:00	0.443806416	0.478614847	0.384788957	0.429297698
Midday	09:00	0.110579005	0.105368333	0.108105532	0.105814252
	10:00	0.141015870	0.135447126	0.136473015	0.130693362
	11:00	0.162414627	0.162079160	0.164329190	0.159123892
	12:00	0.191797866	0.194703540	0.183764671	0.191776696
	13:00	0.194785551	0.202027218	0.198312395	0.205360811
	14:00	0.199407081	0.200374622	0.209015198	0.207230987
PM Peak	15:00	0.254878924	0.261357313	0.237304169	0.251090537
	16:00	0.252374074	0.259230869	0.245219456	0.254832324
	17:00	0.253096059	0.250175976	0.268299275	0.259151795
	18:00	0.239650942	0.229235842	0.249177100	0.234925344
Overnight	19:00	0.171852812	0.166032015	0.227880479	0.220749894
	20:00	0.156044328	0.154884220	0.189065952	0.177223663
	21:00	0.141553991	0.142532050	0.148016946	0.149379377
	22:00	0.121963943	0.112435601	0.109856412	0.107920047
	23:00	0.090433415	0.075560881	0.066423962	0.067961238
	00:00	0.095273816	0.105793671	0.068309644	0.069149150
	01:00	0.073022781	0.082832592	0.048282903	0.050734631
	02:00	0.068395383	0.074574005	0.037884403	0.070748975
	03:00	0.033487683	0.038361529	0.023191344	0.023489823
	04:00	0.022109033	0.023490226	0.024960760	0.023044814
	05:00	0.025862815	0.023503211	0.056127195	0.039598388

Sunday Houston Galveston Area Hourly Time Period Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.185789757	0.185789757	0.185789757	0.251447327
	07:00	0.309437056	0.309437056	0.309437056	0.307790001
	08:00	0.504773187	0.504773187	0.504773187	0.440762671
Midday	09:00	0.121971310	0.121971310	0.121971310	0.116055969
	10:00	0.132695544	0.132695544	0.132695544	0.132904325
	11:00	0.158371223	0.158371223	0.158371223	0.158857861
	12:00	0.198316691	0.198316691	0.198316691	0.188206959
	13:00	0.194771136	0.194771136	0.194771136	0.204791007
	14:00	0.193874097	0.193874097	0.193874097	0.199183878
PM Peak	15:00	0.246623018	0.246623018	0.246623018	0.247278418
	16:00	0.246871380	0.246871380	0.246871380	0.235632427
	17:00	0.263307852	0.263307852	0.263307852	0.269491221
	18:00	0.243197750	0.243197750	0.243197750	0.247597933
Overnight	19:00	0.263884591	0.263884591	0.263884591	0.251976111
	20:00	0.217267432	0.217267432	0.217267432	0.198233529
	21:00	0.151333883	0.151333883	0.151333883	0.157833037
	22:00	0.095099353	0.095099353	0.095099353	0.101295260
	23:00	0.050807035	0.050807035	0.050807035	0.059481896
	00:00	0.069964417	0.069964417	0.069964417	0.063468485
	01:00	0.047704380	0.047704380	0.047704380	0.044833854
	02:00	0.030871836	0.030871836	0.030871836	0.034848288
	03:00	0.021022415	0.021022415	0.021022415	0.023591138
	04:00	0.019157383	0.019157383	0.019157383	0.023518585
	05:00	0.032887275	0.032887275	0.032887275	0.040919818

APPENDIX D
CAPACITY FACTORS, SPEED FACTORS, AND SPEED REDUCTION FACTORS

Capacity Factors

Time of Day Assignment	Capacity Factor[1]
AM Peak	0.3333333
Midday	0.1666667
PM Peak	0.2500000
Overnight	0.0909091

Freeflow (Volume=1) Speed Factors for Houston-Galveston Speed Model

Functional Group	Area Type				
	CBD	Urban	Urban Fringe	Suburban	Rural
Freeways, Interstates	1.4295	1.3363	1.2332	1.2301	1.2083
Principal Arterials	1.3059	0.9203	1.0213	1.1480	1.2877
Other Arterials, Major Collectors	1.4189	0.9048	0.9170	1.1285	1.2830
Collectors	1.0655	0.7844	0.7921	1.3045	1.3867
Locals	1.0000	1.0000	1.0000	1.0000	1.0000

[1] 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	0.8841	0.7687	0.7887	0.9021	0.8536
Principal Arterials	0.8000	0.6668	0.7905	0.8939	1.0500
Other Arterials, Major Collectors	0.9140	0.6814	0.7066	0.8652	1.0767
Collectors	0.6320	0.5615	0.6283	1.0132	1.1857
Locals	1.0000	1.0000	1.0000	1.0000	1.0000

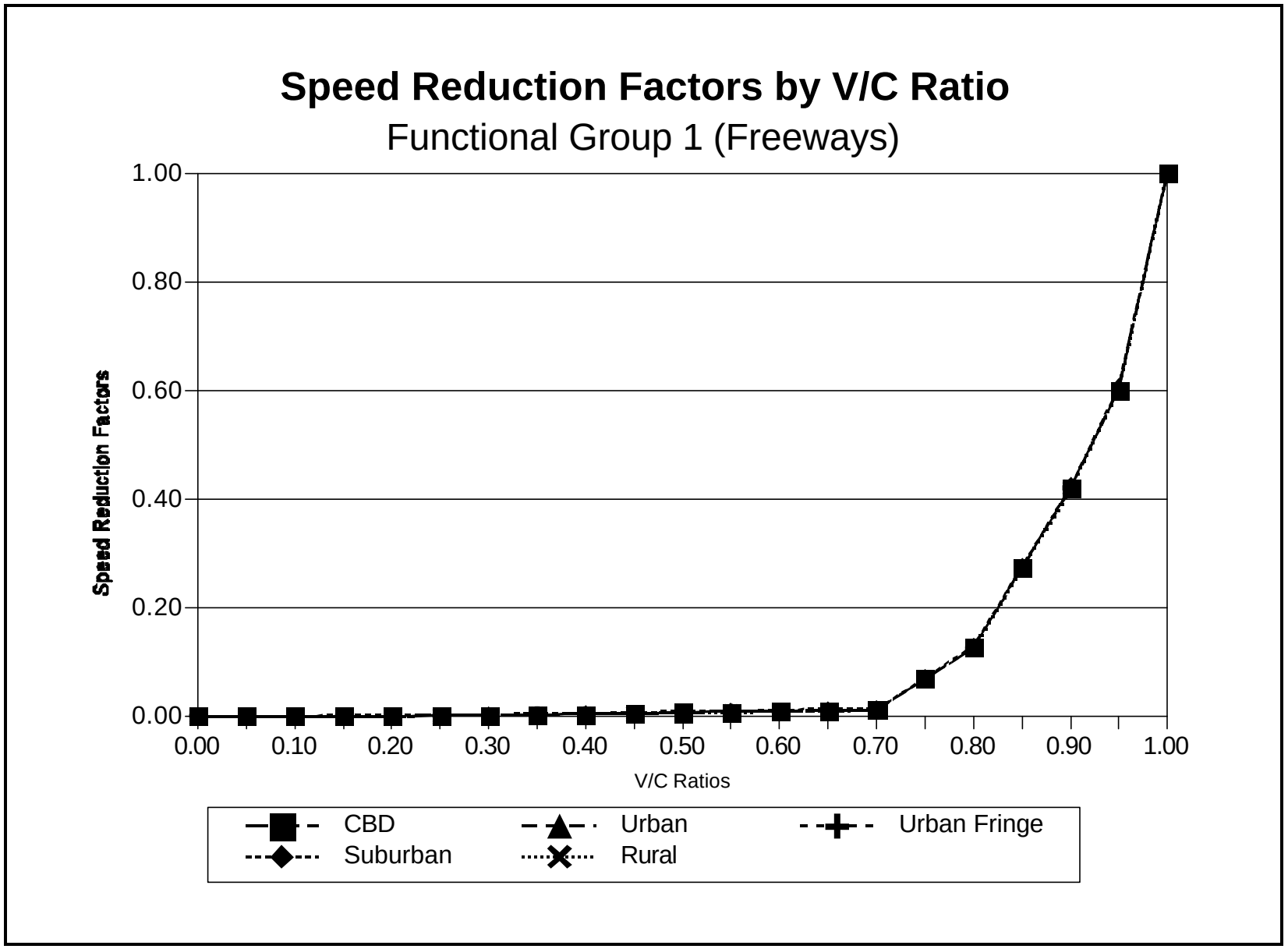


FIGURE 1. Freeway Speed Reduction Factors by V/C Ratio

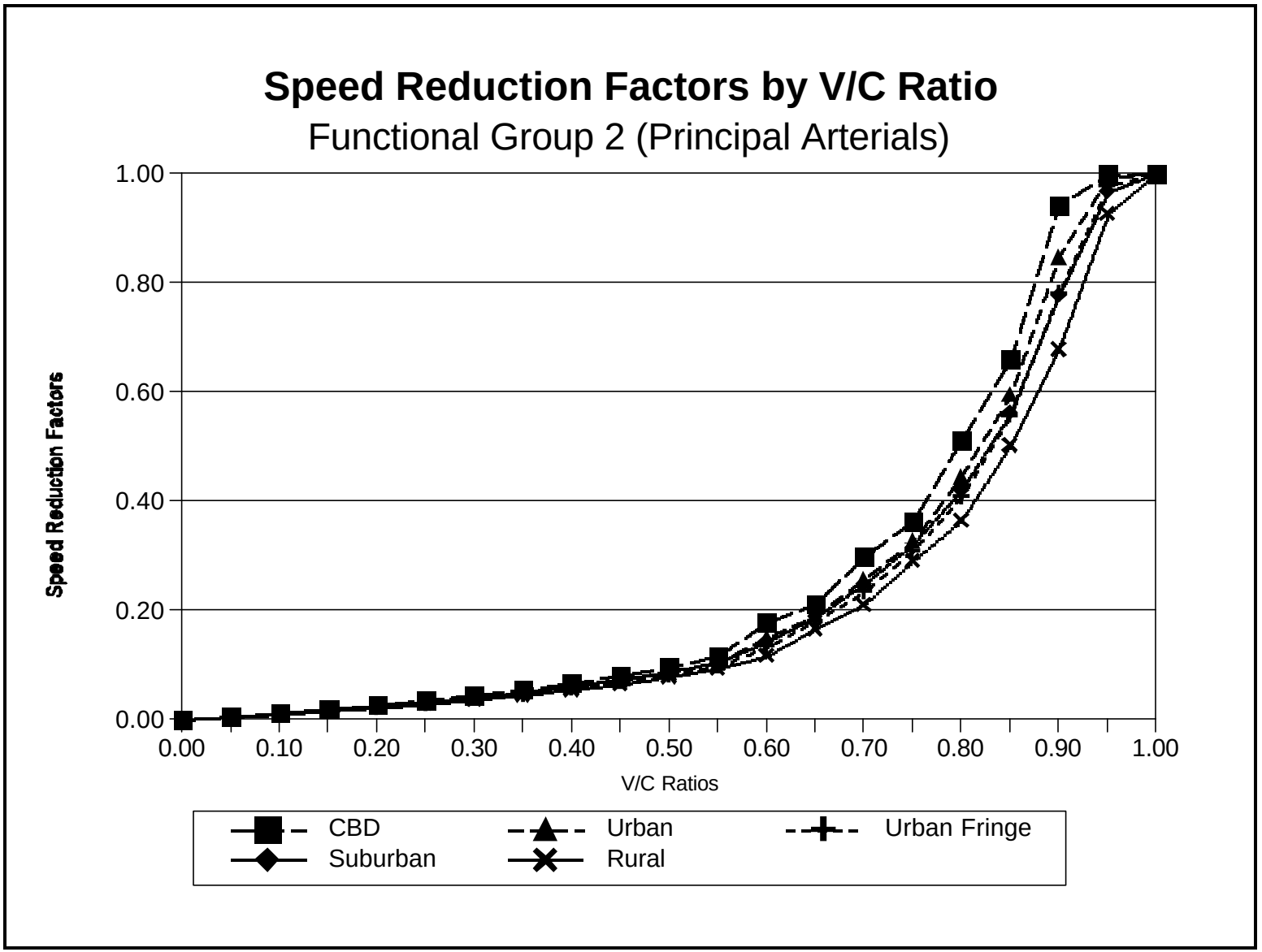


FIGURE 2. Principal Arterial Speed Reduction Factors by V/C Ratio

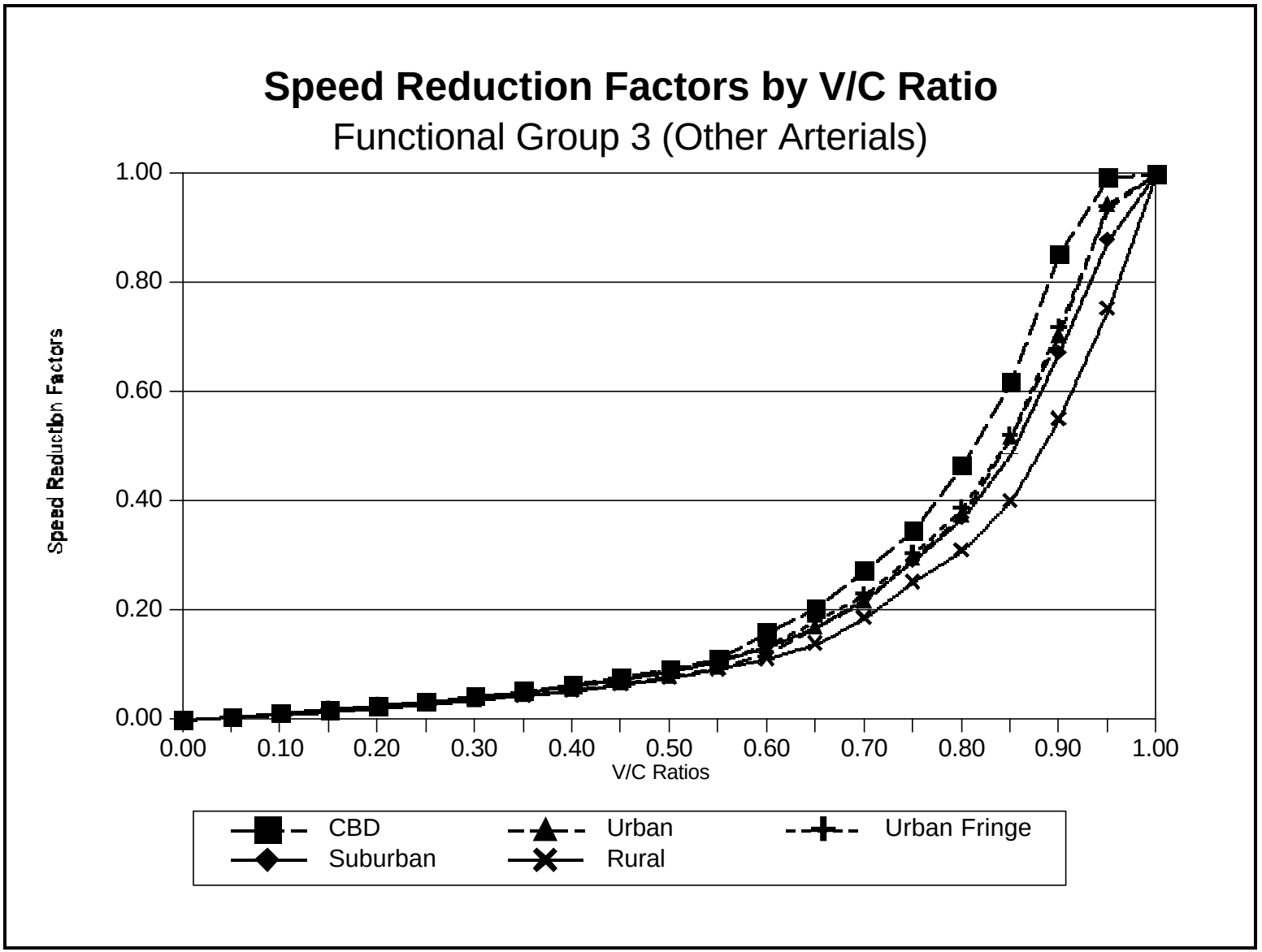


FIGURE 3. Other Arterial Speed Reduction Factors by V/C Ratio

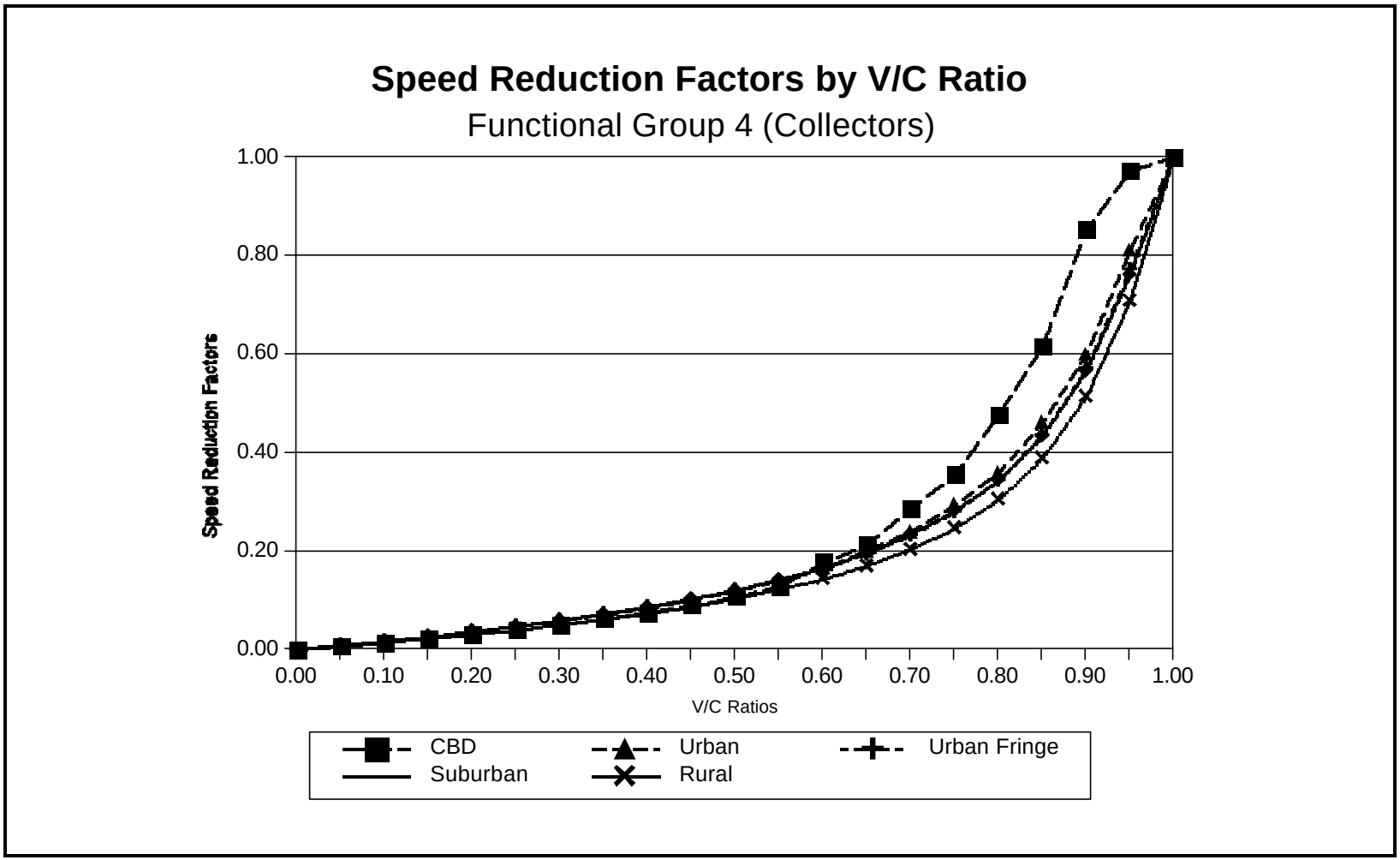


FIGURE 4. Collector Speed Reduction Factors by V/C Ratio

APPENDIX E
HGA COUNTY AUGUST 2000 EPISODE DAY HOURLY TEMPERATURES INPUT TO MOBILE6

HGA County August 2000 Episode Day Hourly Temperatures (degrees F) Input to MOBILE6
Central Daylight (Local) Time (calendar day temperatures; ordered as 6am to 12am, 12am to 6am)

BRAZ = Brazoria
CHAM = Chambers
FORT = Fort Bend
GALV = Galveston
HARR = Harris
LIBE = Liberty
MONT = Montgomery
WALL = Waller

AUG22

BRAZ
HOURLY TEMPERATURES: 79.2 80.6 81.8 81.2 83.2 85.7 88.5 89.4 89.9 89.8 88.8 87.5 85.3 83.5 81.5 80.6 79.7 78.7 79.1 77.8 78.1 77.8 77.0 77.3

CHAM
HOURLY TEMPERATURES: 76.9 77.6 80.7 84.7 85.6 85.7 84.0 81.3 83.4 86.3 88.9 89.0 87.1 85.2 82.9 81.8 80.9 79.8 78.5 80.6 79.7 79.1 77.9 77.3

FORT
HOURLY TEMPERATURES: 77.4 78.8 82.5 85.1 87.3 86.4 80.2 83.2 87.9 89.7 89.8 89.2 88.7 87.4 85.7 83.9 82.5 81.3 80.0 80.4 79.5 78.9 78.2 77.7

GALV
HOURLY TEMPERATURES: 83.3 82.7 84.0 84.9 85.4 85.7 85.4 85.3 86.0 86.7 86.9 86.5 86.1 85.5 85.0 84.6 84.7 84.8 84.5 84.4 84.2 84.1 84.0 83.8

HARR
HOURLY TEMPERATURES: 78.8 79.7 82.1 84.6 85.6 84.6 82.9 83.5 85.7 87.3 88.5 88.9 88.2 86.3 84.6 83.5 82.8 81.8 80.9 81.2 80.4 79.9 79.3 79.0

LIBE
HOURLY TEMPERATURES: 74.0 75.1 78.9 83.2 85.4 85.0 81.5 78.8 78.7 81.5 84.2 85.8 85.2 83.4 80.8 79.5 79.1 77.5 76.3 77.1 76.4 75.4 74.6 74.4

MONT
HOURLY TEMPERATURES: 73.3 77.3 81.4 84.4 86.5 88.9 80.6 77.3 74.0 77.1 80.2 82.1 81.1 79.8 78.4 76.6 76.7 75.8 74.3 76.7 74.7 73.8 72.5 72.1

WALL
HOURLY TEMPERATURES: 78.4 78.3 80.9 85.5 87.7 90.0 92.4 87.7 89.0 89.2 89.8 90.4 91.8 89.6 86.9 84.5 83.9 82.5 80.6 79.8 78.8 77.9 77.4 77.5

AUG23

BRAZ
HOURLY TEMPERATURES: 77.1 79.2 83.3 84.4 81.9 80.5 83.0 83.9 86.8 88.2 88.0 86.1 84.3 82.1 80.4 78.9 78.2 77.8 77.7 79.9 79.3 78.8 76.8 76.7

CHAM
HOURLY TEMPERATURES: 74.2 75.2 78.1 81.8 78.6 76.0 77.1 78.9 80.7 83.1 85.7 85.6 85.3 83.9 82.6 82.1 81.3 79.5 77.8 77.2 76.1 75.3 74.5 74.0

FORT
HOURLY TEMPERATURES: 76.9 77.4 80.5 81.6 82.3 85.8 85.7 84.1 85.5 87.5 89.5 89.9 88.5 87.2 85.3 83.6 82.1 80.6 79.7 79.0 78.3 77.7 77.0 76.6

GALV
HOURLY TEMPERATURES: 81.0 79.2 80.2 82.3 83.6 82.0 80.0 80.5 82.1 83.3 84.4 85.4 85.4 84.4 83.8 83.6 83.8 83.8 83.7 84.4 84.3 84.0 83.9 83.4

HARR
HOURLY TEMPERATURES: 76.8 77.2 79.5 81.6 80.8 81.6 82.6 83.4 84.4 85.6 86.7 87.0 86.2 84.8 83.2 82.5 81.6 80.7 80.1 80.3 79.4 78.9 78.1 77.2

LIBE
HOURLY TEMPERATURES: 74.1 74.2 75.9 79.0 80.8 81.4 82.6 79.2 79.1 83.0 84.9 84.9 83.6 82.6 81.4 80.1 78.4 77.0 76.1 75.7 74.8 74.6 74.1 73.8

MONT
HOURLY TEMPERATURES: 72.3 73.0 76.8 79.8 83.8 86.0 82.0 80.2 80.3 82.6 82.7 82.2 80.5 79.1 76.8 74.5 72.8 71.1 69.9 76.6 75.1 74.7 72.4 71.8

WALL
HOURLY TEMPERATURES: 78.7 77.9 79.8 84.4 85.5 87.0 89.9 90.8 89.7 88.9 89.8 90.3 89.0 86.7 84.2 82.9 81.0 80.1 79.6 79.1 77.8 77.5 77.4 78.1

AUG24

BRAZ

HOURLY TEMPERATURES: 75.7 79.8 83.4 86.1 86.9 87.5 85.0 81.7 79.5 79.0 79.6 80.2 80.3 79.2 78.7 77.4 76.8 76.4 75.7 77.4 76.7 77.2 76.8 75.2

CHAM

HOURLY TEMPERATURES: 75.2 75.8 78.7 83.7 86.2 87.2 88.0 84.2 77.9 74.3 76.2 77.9 78.5 78.5 77.3 76.6 75.7 75.6 75.3 76.8 76.2 75.8 75.6 75.2

FORT

HOURLY TEMPERATURES: 76.3 77.4 81.5 85.2 87.2 88.6 90.9 93.3 91.6 85.8 85.2 83.3 82.3 81.6 80.4 79.9 78.9 78.0 77.3 79.0 78.1 77.6 77.0 76.6

GALV

HOURLY TEMPERATURES: 79.9 79.3 80.8 82.9 84.1 81.0 83.6 86.3 84.1 82.3 81.3 80.3 80.4 81.2 81.2 81.2 81.2 81.5 81.4 83.9 83.8 83.6 83.0 81.6

HARR

HOURLY TEMPERATURES: 77.7 78.6 81.2 84.2 86.1 88.2 89.5 89.3 84.3 81.3 80.2 80.0 80.0 79.6 78.8 78.2 77.7 77.3 77.3 79.5 78.8 78.2 77.4 77.5

LIBE

HOURLY TEMPERATURES: 73.9 74.4 77.3 81.5 84.6 86.0 86.4 86.5 83.1 82.2 79.5 79.9 79.6 78.9 77.5 76.8 76.1 75.4 74.7 75.5 75.4 74.9 74.6 74.3

MONT

HOURLY TEMPERATURES: 68.0 70.9 73.7 78.8 81.2 88.0 90.1 92.5 91.2 89.6 84.8 84.0 81.5 79.1 77.4 76.3 74.7 73.3 72.9 70.2 69.0 68.7 68.5 67.3

WALL

HOURLY TEMPERATURES: 77.6 77.7 79.2 84.5 87.5 91.3 93.0 95.3 96.3 97.3 83.1 83.9 82.8 82.0 81.7 81.8 82.6 82.8 82.7 78.1 78.2 78.1 77.5 77.5

AUG25

BRAZ

HOURLY TEMPERATURES: 75.6 79.8 82.9 84.9 87.1 84.6 87.2 88.5 89.8 89.4 88.7 86.3 84.3 81.8 79.8 78.3 77.5 76.4 75.7 75.5 75.8 75.1 74.1 73.5

CHAM

HOURLY TEMPERATURES: 73.1 73.4 76.3 79.8 83.4 85.8 87.8 89.8 91.1 91.3 90.7 89.1 87.4 85.1 83.2 82.0 80.2 79.2 78.6 74.6 74.1 73.5 73.3 73.3

FORT

HOURLY TEMPERATURES: 74.9 76.4 80.6 84.8 86.5 88.4 90.5 93.0 94.6 94.5 93.0 93.1 92.2 89.2 86.3 84.1 82.2 80.6 79.2 76.6 75.9 75.3 75.2 74.9

GALV

HOURLY TEMPERATURES: 78.5 78.7 80.8 81.5 82.8 84.6 85.8 86.5 87.4 87.8 87.7 87.4 86.7 85.4 84.3 83.9 83.5 83.2 83.1 81.4 80.6 79.5 78.9 78.7

HARR

HOURLY TEMPERATURES: 76.3 77.4 79.8 82.8 84.9 87.3 88.8 90.4 91.6 92.7 92.4 91.3 89.5 87.1 84.9 83.2 81.7 80.6 79.5 77.1 76.4 76.0 75.7 75.9

LIBE

HOURLY TEMPERATURES: 72.3 72.7 75.2 79.1 82.4 84.9 86.8 89.0 90.8 91.6 91.4 90.6 89.0 86.4 83.6 81.5 79.9 78.7 77.7 73.9 73.3 72.7 72.6 72.3

MONT

HOURLY TEMPERATURES: 70.7 72.9 78.0 82.7 85.6 88.0 90.7 92.8 94.5 95.3 94.8 93.9 91.4 88.1 84.9 82.9 80.9 79.0 77.3 72.0 71.9 70.8 70.6 70.3

WALL

HOURLY TEMPERATURES: 82.3 82.3 79.7 83.8 87.1 87.8 92.5 94.8 95.3 97.6 97.5 97.0 95.0 92.0 89.0 86.7 84.5 82.1 80.8 83.1 82.1 82.2 82.4 82.1

AUG26

BRAZ

HOURLY TEMPERATURES: 75.4 79.4 83.3 85.4 86.9 89.8 90.9 91.0 91.2 90.4 89.7 88.2 85.6 83.4 82.0 81.3 79.2 78.6 78.4 75.9 75.8 75.2 74.8 73.9

CHAM

HOURLY TEMPERATURES: 74.4 74.6 77.9 82.1 84.9 87.0 88.0 90.4 92.1 92.6 92.1 90.4 88.1 85.7 84.1 82.7 81.7 79.9 78.5 78.4 78.0 77.5 76.3 75.1

FORT

HOURLY TEMPERATURES: 74.4 75.4 81.0 85.0 87.5 89.7 92.0 93.3 93.7 96.4 96.8 94.9 93.0 89.9 86.5 83.9 81.9 80.3 78.9 78.2 77.5 76.8 75.5 74.9

GALV

HOURLY TEMPERATURES: 79.0 79.0 79.6 82.4 84.1 85.0 85.8 86.7 87.6 88.6 88.7 88.2 87.2 85.8 84.7 84.3 84.1 83.8 83.6 82.8 82.0 80.3 79.7 78.8

HARR

HOURLY TEMPERATURES: 76.3 77.3 80.5 84.0 86.6 88.7 90.5 92.1 93.3 93.9 93.5 92.4 90.6 87.9 85.1 83.1 81.7 80.5 79.5 78.5 77.7 77.2 76.5 76.0

LIBE

HOURLY TEMPERATURES: 72.5 72.9 76.6 80.7 83.7 86.3 88.4 90.2 92.0 92.7 92.8 92.0 90.0 86.8 84.0 82.0 80.3 78.4 77.3 76.7 75.7 74.8 73.7 72.9

MONT

HOURLY TEMPERATURES: 70.9 75.1 79.1 83.9 86.9 90.2 91.6 94.6 96.3 96.2 96.7 95.2 92.1 89.0 86.2 83.3 81.1 78.5 76.6 75.3 74.1 73.1 71.5 70.7

WALL

HOURLY TEMPERATURES: 79.9 77.9 79.3 84.4 88.8 91.2 93.3 95.2 97.7 98.7 99.4 99.6 98.1 93.3 89.6 87.4 84.8 82.7 81.2 79.9 79.0 78.3 79.0 79.7

AUG27

BRAZ

HOURLY TEMPERATURES: 78.6 82.3 85.1 87.0 88.2 90.9 91.0 92.1 91.0 89.9 89.0 87.2 84.8 82.7 81.5 80.0 79.3 77.9 77.9 77.7 77.9 77.6 78.1 77.5

CHAM

HOURLY TEMPERATURES: 75.7 76.2 78.8 82.6 85.8 87.8 90.7 91.8 91.6 91.4 90.6 89.5 87.7 85.5 84.1 83.5 82.7 82.6 82.3 77.5 77.5 77.2 76.8 76.3

FORT

HOURLY TEMPERATURES: 75.1 76.1 81.6 85.7 88.0 90.7 92.9 94.9 96.1 95.4 95.8 93.8 91.7 89.2 86.4 84.1 82.4 81.1 79.8 78.1 77.2 76.4 76.0 75.3

GALV

HOURLY TEMPERATURES: 82.7 81.2 82.0 84.4 86.0 87.3 88.4 88.7 89.2 89.1 88.8 88.1 87.0 85.8 85.0 84.5 84.3 84.3 84.2 83.4 83.4 83.3 83.3 83.0

HARR

HOURLY TEMPERATURES: 76.9 78.2 81.4 84.4 87.2 89.8 91.6 93.0 93.3 93.4 93.0 91.7 89.8 87.3 85.0 83.3 82.2 81.4 80.4 78.9 78.4 78.0 77.6 77.0

LIBE

HOURLY TEMPERATURES: 71.9 72.7 77.0 81.9 84.9 87.7 90.3 92.0 92.4 92.9 92.5 91.3 88.9 86.1 83.7 82.2 80.7 79.7 78.9 76.3 75.1 74.1 73.4 72.4

MONT

HOURLY TEMPERATURES: 70.3 75.3 80.7 85.7 88.2 91.3 93.6 95.9 96.1 96.6 96.5 94.1 90.6 87.5 85.1 83.0 80.5 79.0 77.2 74.5 72.1 70.6 70.2 69.2

WALL

HOURLY TEMPERATURES: 78.1 76.7 80.4 86.4 88.5 92.1 94.3 96.1 98.1 99.9 100.8 97.2 95.6 92.0 89.3 87.1 84.8 83.1 82.2 79.7 78.9 78.3 78.2 78.0

AUG28

BRAZ

HOURLY TEMPERATURES: 77.0 82.1 85.2 87.7 90.0 91.0 91.8 92.2 92.4 91.5 89.7 88.1 85.2 82.7 81.1 80.0 79.0 78.3 77.2 76.9 76.5 76.5 76.2 75.6

CHAM

HOURLY TEMPERATURES: 76.9 76.7 80.2 84.3 85.7 87.9 89.3 90.8 92.5 92.9 91.6 90.1 88.1 85.5 83.7 82.5 82.1 79.9 78.8 81.7 80.4 79.0 78.1 77.8

FORT

HOURLY TEMPERATURES: 75.7 76.8 81.7 86.0 88.8 91.1 93.0 94.9 96.2 97.9 98.2 96.6 93.8 90.6 87.1 84.6 82.7 81.2 80.1 78.8 78.1 77.2 76.8 76.2

GALV

HOURLY TEMPERATURES: 82.3 81.5 81.9 83.0 85.2 87.0 88.4 89.6 90.2 89.9 89.4 88.4 87.5 86.0 85.0 84.6 84.3 84.2 84.0 84.2 84.0 83.8 83.7 83.3

HARR

HOURLY TEMPERATURES: 77.4 78.8 82.3 85.5 87.8 90.2 92.1 93.8 94.6 95.0 94.7 93.3 91.1 88.2 85.3 83.4 82.3 81.2 80.2 79.8 79.2 78.7 78.1 77.5

LIBE

HOURLY TEMPERATURES: 72.9 73.5 77.7 82.6 85.6 88.0 89.6 91.2 92.7 93.5 93.3 91.9 89.9 86.7 83.8 81.7 80.3 78.5 77.6 78.2 76.7 75.1 74.2 73.5

MONT

HOURLY TEMPERATURES: 71.5 76.1 81.1 85.1 88.6 90.6 92.7 96.3 95.5 96.9 96.6 95.4 92.7 89.0 85.6 83.9 81.2 79.7 77.9 75.6 74.7 72.5 72.1 70.4

WALL

HOURLY TEMPERATURES: 81.6 80.9 81.1 87.1 89.9 92.8 95.2 96.4 99.0 99.0 99.1 100.6 98.8 93.9 90.0 87.6 85.3 83.6 82.5 81.2 80.6 80.2 80.4 80.8

AUG29

BRAZ

HOURLY TEMPERATURES: 77.8 82.6 85.4 87.3 89.6 91.7 92.7 94.4 93.5 92.3 91.0 88.6 85.8 82.9 82.0 80.1 77.8 78.0 76.9 76.6 76.6 76.1 75.7 75.7

CHAM

HOURLY TEMPERATURES: 75.3 74.8 78.4 82.6 86.3 89.0 91.3 93.4 94.5 95.1 94.6 93.1 90.6 87.1 84.5 82.3 80.6 79.8 79.2 78.6 78.4 77.5 76.3 75.3

FORT

HOURLY TEMPERATURES: 75.3 76.1 81.3 85.9 88.3 90.7 93.4 95.8 97.7 99.2 99.5 98.4 94.6 91.0 87.8 85.7 83.8 82.3 81.0 79.0 78.3 77.7 76.5 75.7

GALV

HOURLY TEMPERATURES: 80.4 79.1 81.3 83.8 85.6 87.7 87.9 88.5 89.5 89.6 89.5 89.3 88.5 87.0 86.0 85.1 84.8 84.2 83.5 83.9 83.8 83.8 82.9 81.5

HARR

HOURLY TEMPERATURES: 76.9 78.0 81.4 85.1 88.0 90.6 92.8 94.7 96.2 97.3 96.9 95.1 92.6 89.4 86.3 84.5 83.0 81.7 80.5 79.2 78.5 77.9 77.3 76.9

LIBE

HOURLY TEMPERATURES: 72.7 72.8 77.2 81.7 85.1 87.9 90.4 92.7 94.4 95.8 96.4 95.3 93.1 89.2 85.8 83.2 81.1 79.8 79.3 76.8 76.2 75.2 73.6 73.0

MONT

HOURLY TEMPERATURES: 71.0 76.1 80.9 85.2 88.2 91.9 94.9 96.2 98.3 99.6 100.0 99.1 96.1 92.9 88.8 86.4 84.1 82.6 82.0 76.4 75.3 73.5 71.2 70.4

WALL

HOURLY TEMPERATURES: 79.7 79.8 79.0 85.9 89.7 93.6 95.8 97.2 99.2 101.9 102.5 102.1 100.9 96.4 91.7 89.0 86.8 84.9 82.9 81.4 80.8 80.6 80.8 80.3

AUG30

BRAZ
HOURLY TEMPERATURES: 76.5 79.7 83.4 86.5 89.7 92.8 95.7 97.9 99.4 98.2 95.2 91.9 88.7 85.9 84.4 82.7 80.9 79.1 78.8 76.3 75.3 74.2 75.4 75.2

CHAM
HOURLY TEMPERATURES: 75.5 75.8 78.9 83.1 86.7 90.2 93.3 96.2 98.6 100.2 100.3 99.5 97.1 91.7 87.9 84.9 83.5 83.2 82.2 78.8 78.2 78.1 77.8 76.8

FORT
HOURLY TEMPERATURES: 76.7 77.2 80.0 83.1 86.9 90.1 93.9 97.7 100.3 101.8 102.5 103.3 101.8 98.3 93.2 90.1 87.9 86.1 84.3 80.2 79.3 78.2 77.8 77.3

GALV
HOURLY TEMPERATURES: 77.8 77.2 78.4 81.1 85.0 88.7 91.5 92.9 93.3 94.0 93.9 93.2 91.2 88.2 86.3 85.5 84.6 84.0 82.8 82.0 81.1 79.8 78.7 78.4

HARR
HOURLY TEMPERATURES: 78.1 78.8 81.1 84.3 87.9 91.1 94.4 97.2 99.3 100.9 101.6 101.1 98.9 94.6 90.3 88.0 86.4 85.2 83.8 79.8 79.1 78.3 78.0 77.9

LIBE
HOURLY TEMPERATURES: 74.8 75.0 77.8 81.5 85.4 89.0 92.5 95.7 98.1 100.0 100.8 100.5 98.8 93.8 88.9 86.6 84.9 83.7 82.4 78.7 77.8 76.5 75.8 75.4

MONT
HOURLY TEMPERATURES: 76.8 78.2 82.0 85.6 88.7 92.7 96.2 99.5 100.7 102.2 102.8 102.5 97.2 92.9 91.5 87.4 87.1 86.3 84.6 80.2 78.8 77.7 76.6 76.5

WALL
HOURLY TEMPERATURES: 81.8 81.6 80.3 83.5 89.1 93.7 97.6 100.8 103.5 105.5 105.6 105.7 104.8 100.7 95.8 93.1 91.2 88.6 85.8 81.3 80.5 80.3 79.9 80.2

AUG31

BRAZ

HOURLY TEMPERATURES: 77.4 80.2 84.4 89.2 92.5 96.3 99.3 100.9 102.0 102.4 100.9 97.6 92.9 89.2 86.5 84.0 82.6 80.9 79.9 77.8 77.4 76.8 76.3 76.0

CHAM

HOURLY TEMPERATURES: 78.3 78.5 81.9 86.2 90.9 95.4 98.9 101.2 103.2 104.1 104.0 103.2 100.4 95.1 92.0 90.0 88.6 87.1 84.0 79.9 79.5 79.9 79.6 78.3

FORT

HOURLY TEMPERATURES: 78.0 78.0 80.9 85.4 90.2 95.2 99.7 102.5 103.7 104.9 105.7 105.8 104.1 101.2 97.9 94.7 91.4 88.7 86.5 82.7 81.5 80.3 79.6 78.9

GALV

HOURLY TEMPERATURES: 78.4 77.9 78.8 82.7 87.2 92.1 96.1 98.5 98.9 98.6 97.9 96.8 94.8 91.9 89.9 88.7 87.7 86.1 84.8 81.0 79.8 80.5 79.6 79.1

HARR

HOURLY TEMPERATURES: 78.7 79.8 83.4 87.5 92.2 96.5 100.0 102.2 103.6 104.5 104.6 104.3 102.1 98.6 95.4 92.8 90.7 88.4 86.5 82.7 81.7 80.8 80.3 79.5

LIBE

HOURLY TEMPERATURES: 76.0 76.4 80.6 85.8 91.2 95.6 98.6 100.9 102.7 103.5 103.9 103.8 101.6 96.5 91.6 90.0 88.4 86.5 84.5 81.2 80.1 79.4 78.2 76.8

MONT

HOURLY TEMPERATURES: 74.7 81.3 86.6 92.0 96.6 100.3 102.7 102.7 104.7 104.4 104.5 103.8 98.6 93.8 91.4 89.8 86.8 88.8 87.1 83.5 80.5 78.0 76.1 74.4

WALL

HOURLY TEMPERATURES: 76.2 76.6 81.5 89.4 95.3 99.7 102.5 105.1 107.4 107.9 108.1 108.5 107.3 103.8 99.0 94.9 92.3 89.2 86.9 83.2 81.2 80.2 78.7 77.3

SEP01

BRAZ

HOURLY TEMPERATURES: 77.0 80.3 84.4 88.4 91.4 94.7 96.9 98.4 98.0 97.7 96.1 93.3 89.5 86.7 86.3 83.7 83.2 82.1 83.0 79.2 78.4 77.8 77.4 76.8

CHAM

HOURLY TEMPERATURES: 77.7 78.5 82.6 86.1 90.8 94.2 96.7 99.6 101.5 102.9 104.0 95.0 87.2 84.6 82.7 81.8 80.8 81.1 82.0 82.3 80.9 79.0 77.3 76.5

FORT

HOURLY TEMPERATURES: 79.8 80.0 82.2 85.5 89.0 92.9 96.6 100.0 102.2 102.8 102.6 103.6 99.2 88.4 84.7 84.0 84.1 82.7 82.0 84.9 83.7 82.5 81.4 80.3

GALV

HOURLY TEMPERATURES: 80.7 79.5 80.5 83.3 86.6 89.8 92.3 93.6 93.4 92.8 92.5 92.9 93.1 91.2 90.1 89.8 88.1 86.1 85.4 83.6 82.1 80.8 80.4 81.4

HARR

HOURLY TEMPERATURES: 80.5 81.2 83.9 87.5 91.0 94.2 97.5 100.5 102.5 103.4 102.3 100.0 90.4 86.2 85.8 85.3 84.4 83.4 83.3 85.1 83.6 82.3 81.4 80.6

LIBE

HOURLY TEMPERATURES: 77.6 78.1 81.9 86.2 90.2 93.9 96.8 99.3 101.1 101.7 101.3 90.0 85.4 85.1 82.6 81.4 80.8 80.2 80.8 82.5 82.1 80.2 78.4 76.9

MONT

HOURLY TEMPERATURES: 78.7 83.2 87.4 92.2 96.2 100.0 102.8 104.1 104.7 104.5 96.3 90.1 87.9 86.1 84.1 82.3 80.0 80.4 80.2 83.1 81.4 79.4 77.9 76.9

WALL

HOURLY TEMPERATURES: 79.7 78.8 83.2 89.9 95.2 98.7 102.4 104.3 106.4 107.8 107.4 104.6 88.0 86.6 87.5 88.2 86.7 85.1 83.5 85.6 83.8 81.9 81.2 80.8

APPENDIX F
HGA COUNTY AUGUST 2000 EPISODE DAY ABSOLUTE HUMIDITY INPUTS TO MOBILE 6

Daily Absolute Humidity (grains water per pound dry air)

Highest hourly value which will not allow a relative humidity to exceed 100 for any hour of the 24-hour period (calculated by TNRCC).

County Codes Key:
BRAZ = Brazoria
CHAM = Chambers
FORT = Fort Bend
GALV = Galveston
HARR = Harris
LIBE = Liberty
MONT = Montgomery
WALL = Waller

AUG22
BRAZ
ABSOLUTE HUMIDITY : 138.3
CHAM
ABSOLUTE HUMIDITY : 137.6
FORT
ABSOLUTE HUMIDITY : 140.1
GALV
ABSOLUTE HUMIDITY : 167.6
HARR
ABSOLUTE HUMIDITY : 147.1
LIBE
ABSOLUTE HUMIDITY : 124.4
MONT
ABSOLUTE HUMIDITY : 116.5
WALL
ABSOLUTE HUMIDITY : 140.0

AUG23
BRAZ
ABSOLUTE HUMIDITY : 136.5
CHAM
ABSOLUTE HUMIDITY : 124.5
FORT
ABSOLUTE HUMIDITY : 136.4
GALV
ABSOLUTE HUMIDITY : 148.7
HARR
ABSOLUTE HUMIDITY : 137.2
LIBE
ABSOLUTE HUMIDITY : 123.6
MONT
ABSOLUTE HUMIDITY : 112.5
WALL
ABSOLUTE HUMIDITY : 140.0

AUG24
BRAZ
ABSOLUTE HUMIDITY : 129.8
CHAM
ABSOLUTE HUMIDITY : 126.1
FORT
ABSOLUTE HUMIDITY : 134.9
GALV
ABSOLUTE HUMIDITY : 149.4
HARR
ABSOLUTE HUMIDITY : 139.8
LIBE
ABSOLUTE HUMIDITY : 124.4
MONT
ABSOLUTE HUMIDITY : 98.5
WALL
ABSOLUTE HUMIDITY : 140.6

AUG25
BRAZ
ABSOLUTE HUMIDITY : 122.6
CHAM
ABSOLUTE HUMIDITY : 121.0
FORT
ABSOLUTE HUMIDITY : 128.4
GALV
ABSOLUTE HUMIDITY : 145.2
HARR
ABSOLUTE HUMIDITY : 132.3
LIBE
ABSOLUTE HUMIDITY : 117.6
MONT
ABSOLUTE HUMIDITY : 109.5
WALL
ABSOLUTE HUMIDITY : 151.5

AUG26
BRAZ
ABSOLUTE HUMIDITY : 124.3
CHAM
ABSOLUTE HUMIDITY : 126.2
FORT
ABSOLUTE HUMIDITY : 126.5
GALV
ABSOLUTE HUMIDITY : 146.9
HARR
ABSOLUTE HUMIDITY : 133.7
LIBE
ABSOLUTE HUMIDITY : 118.1
MONT
ABSOLUTE HUMIDITY : 111.0
WALL
ABSOLUTE HUMIDITY : 142.5

AUG27
BRAZ
ABSOLUTE HUMIDITY : 140.4
CHAM
ABSOLUTE HUMIDITY : 132.1
FORT
ABSOLUTE HUMIDITY : 129.3
GALV
ABSOLUTE HUMIDITY : 159.5
HARR
ABSOLUTE HUMIDITY : 137.5
LIBE
ABSOLUTE HUMIDITY : 115.8
MONT
ABSOLUTE HUMIDITY : 105.3
WALL
ABSOLUTE HUMIDITY : 136.7

AUG28
BRAZ
ABSOLUTE HUMIDITY : 131.8
CHAM
ABSOLUTE HUMIDITY : 136.8
FORT
ABSOLUTE HUMIDITY : 132.1
GALV
ABSOLUTE HUMIDITY : 160.8
HARR
ABSOLUTE HUMIDITY : 140.2
LIBE
ABSOLUTE HUMIDITY : 119.8
MONT
ABSOLUTE HUMIDITY : 109.8
WALL
ABSOLUTE HUMIDITY : 154.1

AUG29
BRAZ
ABSOLUTE HUMIDITY : 132.1
CHAM
ABSOLUTE HUMIDITY : 128.3
FORT
ABSOLUTE HUMIDITY : 130.2
GALV
ABSOLUTE HUMIDITY : 148.3
HARR
ABSOLUTE HUMIDITY : 137.5
LIBE
ABSOLUTE HUMIDITY : 119.2
MONT
ABSOLUTE HUMIDITY : 109.8
WALL
ABSOLUTE HUMIDITY : 147.9

AUG30
BRAZ
ABSOLUTE HUMIDITY : 125.6
CHAM
ABSOLUTE HUMIDITY : 131.4
FORT
ABSOLUTE HUMIDITY : 136.9
GALV
ABSOLUTE HUMIDITY : 139.1
HARR
ABSOLUTE HUMIDITY : 142.4
LIBE
ABSOLUTE HUMIDITY : 128.0
MONT
ABSOLUTE HUMIDITY : 135.7
WALL
ABSOLUTE HUMIDITY : 152.5

AUG31
BRAZ
ABSOLUTE HUMIDITY : 133.3
CHAM
ABSOLUTE HUMIDITY : 144.4
FORT
ABSOLUTE HUMIDITY : 143.0
GALV
ABSOLUTE HUMIDITY : 142.5
HARR
ABSOLUTE HUMIDITY : 146.7
LIBE
ABSOLUTE HUMIDITY : 133.3
MONT
ABSOLUTE HUMIDITY : 126.2
WALL
ABSOLUTE HUMIDITY : 134.5

SEP01
BRAZ
ABSOLUTE HUMIDITY : 137.0
CHAM
ABSOLUTE HUMIDITY : 136.0
FORT
ABSOLUTE HUMIDITY : 152.1
GALV
ABSOLUTE HUMIDITY : 150.6
HARR
ABSOLUTE HUMIDITY : 155.8
LIBE
ABSOLUTE HUMIDITY : 137.9
MONT
ABSOLUTE HUMIDITY : 137.7
WALL
ABSOLUTE HUMIDITY : 146.9

1. The F10.? Format is either F10.0, F10.1, F10.2, F10.3, or F10.4. The format selected for a field is based on the value of the field.