Texas Transportation Institute

2007 On-Road Mobile Source Emissions Inventories for the Beaumont - Port Arthur Ozone Nonattainment Area

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TECHNICAL NOTE

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

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SUBJECT: 2007 On-Road Mobile Source Emissions Inventories for the Beaumont-Port Arthur Ozone Nonattainment Area
(Umbrella Contract 9880077500-13: Task 1) - **Revised Final**

INTRODUCTION

This Technical Note documents the methods the Texas Transportation Institute (TTI) used to develop the Beaumont-Port Arthur ozone nonattainment area (BPA) August 2007 on-road mobile source emissions estimates. These emissions forecasts are based on the August 2000 primary ozone episode meteorological conditions. (The August 2000 base-case, episode-specific, on-road mobile emissions estimates documentation, also produced under this task, are provided in a separate Technical Note.)

The three BPA counties are: Hardin, Jefferson, and Orange. The forecast period for the emissions estimates is the 11-day, base-year analysis sequence, Tuesday, August 22 through Friday, September 1. (Although the days-of-week are different for these dates in 2007, for modeling purposes, the base-year episode date and day-of-week sequences are maintained.)

Emissions of volatile organic compounds (VOC), carbon monoxide (CO), and oxides of nitrogen (NOx), are estimated for each county and day on an hourly basis. The hourly estimates are computed by network links (characterized by 28 facility types, including special intrazonal links) 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 related to calculating inventory elements including link-based 2007 vehicle miles traveled (VMT) estimates from the Beaumont-Port Arthur travel demand model (TDM), August day-of-week adjustments and Highway Performance Monitoring System

(HPMS) consistency adjustments to VMT, speeds, VMT mix, MOBILE6 emissions factors, and emissions estimates.

ACKNOWLEDGMENTS
Mary McGarry-Barber and Chris Kite, both with the Texas Natural Resource Conservation Commission (TNRCC), and Martin Boardman, L.D. White, and Charles Bell, all of the Texas Transportation Institute (TTI), contributed to the development of the MOBILE6 emissions factors input data parameter values. White produced the MOBILE6 model set-ups used, and performed the emissions factors analyses. The Texas Department of Transportation (TxDOT) provided the 2007 BPA network traffic assignment, intrazonal trips, and zonal radii. Dennis Perkinson, Ph.D., of TTI, developed August day-of-week and HPMS consistency VMT adjustment factors and VMT mix. Bell processed the VMT and modeled operational speeds. Boardman performed the emissions estimations. Each member of the assigned TTI staff contributed to the quality assurance of the emissions inventory elements. 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, and 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 2007 emissions inventory data sets on CD-ROM were received by the TNRCC Technical Analysis Division on July 12, 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
Table 1 presents a summary of 24-hour BPA network total VMT, average operational speeds, and emissions for each of the 11 analysis days.

Table 1
BPA All Counties August 2007
On-Road Mobile Source VMT, Average Speed (mph), and Emissions (tons per day)

Day	VMT	Speed	VOC	CO	NOx
Tuesday, August 22	12,438,297	37.4	10.6	140.9	20.4
Wednesday, August 23	12,438,297	37.4	10.5	139.5	20.3
Thursday, August 24	12,438,297	37.4	10.3	136.0	20.1
Friday, August 25	14,499,681	35.7	12.8	165.7	19.4
Saturday, August 26	12,161,001	37.6	9.4	131.8	13.4
Sunday, August 27	10,508,003	38.6	8.1	116.7	10.4
Monday, August 28	12,438,297	37.4	11.0	143.1	20.5
Tuesday, August 29	12,438,297	37.4	11.2	143.6	20.5
Wednesday, August 30	12,438,297	37.4	11.7	146.2	20.6
Thursday, August 31	12,438,297	37.4	12.1	148.4	20.7
Friday, September 01	14,499,681	35.7	13.3	172.2	19.7

OVERVIEW OF METHODOLOGY

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

The MOBILE6 model was used to develop hourly emissions factors by MOBILE6 road type (or drive cycle) and 28 vehicle types. Only the speed sensitive freeway and arterial emissions factors were applied - freeway drive cycle emissions factors to freeway links, and arterial drive cycle emissions factors to non-freeway links. The activity basis was the Beaumont-Port Arthur 2007 TDM link-based and intrazonal VMT, adjusted to August day-of-week activity and for consistency with HPMS VMT. Automatic traffic recorder (ATR) data were used to produce the seasonal (August) day-of-week VMT adjustment factors. Hourly travel fractions were developed based on the latest BPA regional travel survey and used to allocate the August day-of-week VMT by hour-of-day. Directional split factors were applied to allocate the hourly VMT by peak and off-peak direction. Hourly, directional, average operational speeds were modeled by link. Vehicle classification data were used to estimate time-of-day VMT mixes for apportioning fleetwide link-VMT for three road type groups 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 to develop detailed on-road mobile source emissions inventories. These computer programs were used to produce and apply the major emissions inventory elements (adjusted operational time-of-day link VMT by vehicle type, operational link-speeds, VMT mix, and MOBILE6 emissions factors) to calculate the emissions estimates. Appendix B describes these programs and their application.

ESTIMATION OF VMT

The outputs of the VMT estimation process are estimates of county 2007 VMT (and speeds, as discussed in a following section) by August day-of-week (average Monday through Thursday, Friday, Saturday, and Sunday), hour, and direction for each link of the Beaumont-Port Arthur 2007 TDM network and for each of the added intrazonal links. These link-based VMT estimates were also adjusted for consistency with HPMS VMT.

The PREPIN2 program (see description in Appendix B) was applied to produce the required link-VMT estimates as described above. The PREPIN2 program outputs 96 hourly link files (four day-of-week multiplied by 24 hours per day) containing the county-indexed and road type-indexed link data (VMT and speeds) for each day-of-week period.

Data Sources

The BPA 2007 nondirectional 24-hour, equilibrium traffic assigned network and intrazonal trips and zonal radii (assumed intrazonal trip length) were provided by TxDOT. These TDM data, which cover the BPA three-county area, were used as the basis for developing the link-based August 2007 VMT estimates. Because the estimated intrazonal trips are not assigned to the network, the intrazonal trips and zonal radii were needed to estimate the intrazonal VMT (which are classified as “local” road type VMT). The VMT output from the TDM represents average non-summer weekday travel (ANSWT). To adjust the 2007 Beaumont-Port Arthur TDM VMT and allocate it as needed for the August 2007 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. 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 the 2007 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 made consistent with that reported through HPMS.)

TxDOT collects ATR vehicle counts 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 BPA area were grouped for this analysis. These ATR count data were used to produce the August day-of-week adjustment factors. Individual county ATR counts were used in the development of the

HPMS adjustment factors.

BPA hourly VMT fractions estimated from the latest (1993) BPA travel survey were applied to estimate the hourly VMT, and directional split factors provided by TxDOT were used to further process the hourly nondirectional link-VMT into directional components. (TxDOT vehicle classification count data were used to develop the VMT mix, or VMT fractions, for the 28 EPA vehicle types, discussed in a later section.)

VMT Adjustments

The county-level unadjusted travel model VMT and the county-level August day-of-week VMT as adjusted for this analysis are summarized in Table 2. The travel model VMT was adjusted at the county level for consistency with HPMS, and at the regional level to August day-of-week-specific travel.

The county-specific HPMS factors were developed using the county-level VMT from the 1997 travel model validation, the 1997 county-level HPMS VMT reported by TxDOT, and 1997 BPA regional ATR data (to produce the ANSWT adjustment factor of the first equation below). The formula for the HPMS factor calculation, as applied for each BPA county is:

HPMS VMT (AADT) × ANSWT Adjustment Factor = HPMS VMT (ANSWT)

HPMS VMT (ANSWT) / Model VMT (ANSWT) = HPMS Factor

The ANSWT adjustment (a factor of 1.02135) to the HPMS AADT VMT (i.e., AADT to ANSWT) is used to produce seasonal, day-of-week consistency between the TDM VMT and HPMS VMT components of the HPMS factor. The actual values for the county HPMS factors are:

Hardin: 1,351,818 × 1.02135 = 1,380,679.3 (HPMS ANSWT VMT)
1,380,679.3 / 1,923,270.7 = 0.71825435 (HPMS Factor)

Jefferson: 6,964,338 × 1.02135 = 7,113,026.6 (HPMS ANSWT VMT)
7,113,026.6 / 6,923,119.9 = 1.02743080 (HPMS Factor)

Orange: 2,507,925 × 1.02135 = 2,561,469.2 (HPMS ANSWT VMT)
2,561,469.2 / 2,551,879.2 = 1.00375802 (HPMS Factor)

A similar procedure is used to calculate the August day-of-week factors. Aggregated ATR data (for 1999 and 2000) from the BPA ATR stations were used. Dividing the average day-of-week-specific traffic count by the ANSWT count produced the three-county area August day-of-

week factors. The August day-of-week factors are: Weekday 1.00387, Friday 1.17024, Saturday 0.98149, and Sunday 0.84808.

Table 2
BPA County August 2007 Travel Model and Adjusted VMT
(Rounded to Whole Numbers)

County	Travel Model VMT*	Weekday** VMT	Friday VMT	Saturday VMT	Sunday VMT
Jefferson	7,616,690	7,888,906	9,157,854	7,680,767	6,636,750
Hardin	2,052,466	1,479,898	1,725,759	1,446,905	1,250,233
Orange	3,078,965	3,102,493	3,616,668	3,033,329	2,621,020
BPA	12,748,120	12,438,297	14,499,681	12,161,001	10,508,003

* Unadjusted VMT totals from 24-hour traffic assignment including intrazonal VMT.
** Average Monday through Thursday

Hourly Travel Factors

The 1993 household travel survey (the most recent available) data for the BPA area were analyzed to develop the estimated portions of travel by hour (hourly VMT fractions), as well as to define the peak hours of travel and the off-peak travel periods. The processed survey data provided average school weekday VMT estimates in 15-minute increments. The incremental VMT were summed by hour and divided by the total VMT estimate to produce the hourly VMT fractions. The results are shown in Table 3. These hourly factors were applied to 24-hour link VMT to allocate VMT by hour-of-day.

Through identification of the morning and afternoon peak hours of travel, four travel periods are defined: AM Peak (7 a.m. - 8 a.m.), Mid-day (8 a.m. - 5 p.m.), PM Peak (5 p.m. - 6 p.m.), and Overnight (6 p.m. - 7 a.m.). These four time-of-day periods are used in the VMT mix and directional split analyses, discussed later.

Table 3
Hourly VMT Fractions

Hour	Fleet VMT Fraction
6 a.m.	0.06378
7 a.m. (AM Peak)	0.10402
8 a.m.	0.05990
9 a.m.	0.05081
10 a.m.	0.04852
11 a.m.	0.05545
12 p.m.	0.06233
1 p.m.	0.04939
2 p.m.	0.05275
3 p.m.	0.08219
4 p.m.	0.08472
5 p.m. (PM Peak)	0.09925
6 p.m.	0.05897
7 p.m.	0.03933
8 p.m.	0.02546
9 p.m.	0.02145
10 p.m.	0.00993
11 p.m.	0.00364
12 a.m.	0.00152
1 a.m.	0.00072
2 a.m.	0.00117
3 a.m.	0.00022
4 a.m.	0.00338
5 a.m.	0.02110

* Mid-day period is 8 a.m. to 5 p.m., Overnight period is 6 p.m. to 7 a.m.

Time of Day Directional Split Factors

The 24-hour link assignment volumes, adjusted for season and HPMS consistency and allocated by hour, are nondirectional volumes (i.e., the sum of the volumes in the two directions on a link). Directional splits were applied to estimate the portion of the travel that occurred in each direction. These directional volume estimates were used to estimate the directional speeds (discussed in the next section). Application of the directional split factors resulted in two link records for each network link: one record containing the estimated VMT and speed in the peak (or dominant) direction, and the second record containing the estimated VMT and speed in the opposite direction. This provided for the application of MOBILE6 emissions factors directionally by speed.

The BPA TDM network links may be categorized at different levels for the development and application of input parameters required in the process of estimating link-level emissions. For example, VMT mix is applied to link-VMT that is grouped into three functional classification levels. Directional splits, on the other hand, are applied by individual functional classification and area type combination, and speed factors and capacity factors are categorized by facility type and area type combination. Table 4 shows the link facility type codes correlated to functional classification, and functional group levels. Table 5 shows the correlation of county-specific area type to regional area type.

The directional travel fractions were estimated by time-of-day period (the Mid-Day and Overnight periods were grouped for this purpose) for each of the functional classification/regional area type combinations. The directional splits by BPA network functional classification/regional area type combination are shown by time period in Appendix C.

The time-of-day directional splits for area type and facility type used for these analyses were obtained from the Technical Note entitled “1996 Jefferson, Orange, and Hardin Counties Periodic Emission Inventory” (TTI, November 26, 1997). These data were provided by TxDOT’s Transportation Planning and Programming Division after collaboration with TxDOT’s Beaumont District and the Beaumont-Port Arthur Metropolitan Planning Organization.

Table 4
BPA 2007 Network Facility Types Correlated to Functional Classification and Functional Group

Functional Group*	Functional Classification**	Facility Type
IH and Freeway	IH and Freeway	1. Interstate Highway - 10
		2. Freeway - main lanes only
		3. Parkway
Arterial, Frontage Road, and Ramp	Principle Arterial Divided	9. Divided Principal Arterial
		10. Divided Principal Arterial with Left Turn Bay
		12. Divided Principal Arterial with Parking***
		13. One-Way Principal Arterial
	Principle Arterial Undivided	14. Undivided Principal Arterial
		15. Undivided Principal Arterial with Left Turn Bay
		16. Undivided Principal Arterial with Continuous Left Turn
	Minor Arterial Divided	17. Divided Minor Arterial
		18. Divided Minor Arterial with Left Turn Bay
		20. Divided Minor Arterial with Parking***
		21. One-Way Minor Arterial
	Minor Arterial Undivided	22. Undivided Minor Arterial
		23. Undivided Minor Arterial with Left Turn Bay
		19. Undivided Minor Arterial with Continuous Left Turn
		32. Undivided Minor Arterial with Parking***
	Frontage Road	28. Frontage Road One-Way
		33. Frontage Road Two-Way
	Ramp	29. Ramp
Collector and Local	Collector	24. Divided Collector
		26. Divided Collector with Left Turn Bay
		25. Undivided Collector
		31. Undivided Collector with Continuous Left Turn
		27. Gravel/Dirt Collector
	Centroid Connector	0. Centroid Connector
	Intrazonal	40. Intrazonal

* Functional groups for applying VMT mix
** For applying directional splits
*** Allowable parking that obstructs a normal traffic flow lane

Table 5
BPA 2007 Network Area Types

Regional Area Type	County-Specific Area Type
CBD	0. CBD Jefferson
CBD Fringe	1. CBD Fringe Jefferson
Urban	2. Urban Jefferson
	8. Urban Orange
	12. Urban Hardin
Suburban	3. Suburban Jefferson
	9. Suburban Orange
	13. Suburban Hardin
Suburban Fringe	4. Suburban Fringe Jefferson
	10. Suburban Fringe Orange
	14. Suburban Fringe Hardin
Rural	5. Rural Jefferson
	11. Rural Orange
	15. Rural Hardin

The VMT summaries by the three-county area, county, day, hour, facility type, and vehicle type are included with the emissions inventory data provided to TNRCC on CD-ROM. Appendix A lists the electronic data files with descriptions that were provided to TNRCC. Table 1 summarizes total VMT for each analysis day.

ESTIMATION OF LINK SPEEDS

The 24-hour capacity restraint assignments were performed using nondirectional 24-hour capacities. Time-of-day (i.e., hourly) capacity factors were applied to nondirectional capacity (or service volume) for the time period. In computing the directional volume/capacity (V/C) ratio for estimating the directional speeds, the directional split for capacity is assumed at 50-50. The network was processed to compute the average capacity per lane by Facility Type and Area Type. Appendix D summarizes the capacity factors by facility type/regional area type combination. Capacity factors are computed as follows:

$$Capacity\ Factor = \frac{(Hourly\ Capacity\ per\ Lane)(Length\ of\ the\ Time\ Period)}{24\ hour\ Capacity\ per\ Lane}$$

The model uses the following volume/delay equation:

$$Delay = Min\ [A e^{B(\frac{V}{C})}, M]$$

Where:

Delay	=	congestion delay (in minutes/mile);
A & B	=	volume/delay equation coefficients;
M	=	maximum minutes of delay per mile; and
V/C	=	time-of-day directional V/C ratio.

The delay model parameters (A, B, and M) were developed for the Dallas/Fort Worth area and verified by application in other Texas urban areas. These are shown in Table 6. The BPA network high capacity facility types are Interstate Highway, Freeway, and Parkway; the remaining facility types (except for centroid connector and intrazonal, which do not use capacity data) are low-capacity facilities (see Table 4, BPA Network Facility Types).

TABLE 6
Volume/Delay Equation Parameters

Facility Category	A	B	M
High Capacity Facilities (> 3,400 vehicles per hour [vph], e.g., Interstates and Freeways)	0.015	3.5	5.0
Low Capacity Facilities (≤ 3,400 vph, e.g., Arterials, Collectors and Locals)	0.050	3.0	10.0

The estimated freeflow speed is used in conjunction with the estimated directional delay (in minutes/mile) to compute the directional congested speed. Freeflow speed factors are used to convert travel demand model speeds (which are by definition level of service C) to level of service A speeds (freeflow). The freeflow speed factors used for BPA by facility type/regional area type combination are shown in Appendix D.

Given the estimated directional delay (in minutes/mile) and the estimated freeflow speed, the directional congested speed is computed as follows:

$$Congested\ speed = \frac{60}{\frac{60}{Freeflow\ speed} \%Delay}$$

This model is applied to each link, based on the link's area type and facility type combination, for each time period and each direction.

Capacity data are not used, however, for the centroid connector links and intrazonal links (intrazonal links are developed specifically for air emissions analyses). The centroid connector traffic assignment input speeds were 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 (network facility type) were provided electronically to TNRCC (see Appendix A for electronic data descriptions). Table 1 summarized the BPA network 24-hour average speeds.

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 of the VMT estimation procedure, these data were aggregated to the county level.

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 MOBILE6 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.

Passenger vehicles (PV)	C + P
Heavy-duty vehicles (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	0.652 × PV (Jefferson County 2000 registration data shown)
LDT	0.348 × PV (Jefferson 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	0.864 × LDT (Jefferson County 2000 registration data shown)
LDGT2	0.136 × LDT (Jefferson 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	0.9990 × LDV (MOBILE6 default for 2007 shown)
LDDV	0.0010 × LDV (MOBILE6 default for 2007 shown)
LDGT1	0.9948 × LDT1 (MOBILE6 default for 2007 shown)
LDDT	0.0052 × LDT1 (MOBILE6 default for 2007 shown)
LDGT2	0.136 × LDT (Jefferson County 2000 registration data shown, as above)
HDGV	0.354 × HDV (Jefferson County 2000 registration data shown)
HDDV	0.646 × HDV (Jafferson 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 data themselves provide sufficient information to complete the first step in the conversion process, the allocation of vehicles into passenger vehicles (PV), heavy-duty vehicles (HDV), and buses (B). 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>
<tr><td colspan="4">B</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 original 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. Buses are treated separately.

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,
- 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. No seasonal changes in vehicle classification distribution are assumed.

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. The procedure used to estimate Friday, Saturday, and Sunday VMT mix relies on extensive vehicle classification data collected in Texas urban areas 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.

For this analysis, BPA regional VMT mix estimates were developed for three functional classification groups (See Table 4). Tables 10 through 13 show the VMT mixes.

TABLE 9
VMT Mix Estimation Procedure Summary

EPA-8	EPA-28	Conversion
LDGV	LDGV	.9990 × LDV
LDGT1	LDGT1	.2310 × LLDT
	LDGT2	.7690 × LLDT
LDGT2	LDGT3	.6850 × HDLT
	LDGT4	.3150 × HDLT
HDGV	HDGV2b	.379 × HDGV
	HDGV3	.187 × HDGV
	HDGV4	.080 × HDGV
	HDGV5	.050 × HDGV
	HDGV6	.191 × HDGV
	HDGV7	.052 × HDGV
	HDGV8a	.060 × HDGV
	HDGV8b	.001 × HDGV
	HDGB	.0931 × B
LDDV	LDDV	.0010 × LDV
LDDT	LDDT12	.0337 × LDDT
	LDDT34	.9663 × LDDT
HDDV	HDDV2b	.258 × HDDV
	HDDV3	.103 × HDDV
	HDDV4	.058 × HDDV
	HDDV5	.034 × HDDV
	HDDV6	.136 × HDDV
	HDDV7	.065 × HDDV
	HDDV8a	.185 × HDDV
	HDDV8b	.161 × HDDV
	HDDBT	.3239 × B
	HDDBS	.5830 × B
MC	MC	MC

Notes to VMT Mix Estimation Procedure Summary

Intermediate category factors and sources:

LDV	.652 × PV (by county, Jefferson County 2000 registration data shown)
LDT	.348 × PV (by county, Jefferson County 2000 registration data shown)
LDT1	.864 × LDT (by county, Jefferson County 2000 registration data shown)
HLDT	.136 × LDT (by county, Jefferson County 2000 registration data shown)
LLDT	.9948 × LDT1 (EPA MOBILE6 default)
LDDT	.0052 × LDT1 (EPA MOBILE6 default)
HDV	SU2+SU3+SU4+SE3+SE4+SE5+SE6+SD5+SD6+SD7
HDGV	.354 × HDV (by county, Jefferson County 2000 registration data shown)
HDDV	.646 × HDV (by county, Jefferson County 2000 registration data shown)

Category conversion factors and sources:

LDGV	.9990 × 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	.379 × HDGV (Regional registration data)
HDGV3	.187 × HDGV (Regional registration data)
HDGV4	.080 × HDGV (Regional registration data)
HDGV5	.050 × HDGV (Regional registration data)
HDGV6	.191 × HDGV (Regional registration data)
HDGV7	.052 × HDGV (Regional registration data)
HDGV8a	.060 × HDGV (Regional registration data)
HDGV8b	.001 × HDGV (Regional registration data)
HDGB	.0931 × B (EPA MOBILE6 default)
LDDV	.0010 × LDV (EPA MOBILE6 default)
LDDT12	.0037 × LDDT (EPA MOBILE6 default)
LDDT34	.9963 × LDDT (EPA MOBILE6 default)
HDDV2b	.258 × HDDV (Regional registration data)
HDDV3	.103 × HDDV (Regional registration data)
HDDV4	.058 × HDDV (Regional registration data)
HDDV5	.034 × HDDV (Regional registration data)
HDDV6	.136 × HDDV (Regional registration data)
HDDV7	.065 × HDDV (Regional registration data)
HDDV8a	.185 × HDDV (Regional registration data)
HDDV8b	.161 × HDDV (Regional registration data)
HDDBT	.3239 × B (EPA MOBILE6 default)
HDDBS	.5830 × B (EPA MOBILE6 default)
MC	MC (default subtracted from LDGV, no conversion)

Table 10
2007 BPA Weekday VMT Mix by Time Period and Roadway Facility Type 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	0.5459149	0.0709611	0.2362244	0.0332672	0.0152987	0.0124702	0.0061528	0.0026322	0.0016451
2	AM_Peak	Col	0.5016736	0.0846567	0.2818161	0.0424503	0.0195218	0.0082608	0.0040759	0.0017437	0.0010898
3	AM_Peak	Fway	0.4948789	0.0638750	0.2126352	0.0289693	0.0133222	0.0243922	0.0120352	0.0051487	0.0032180
4	Mid_Day	Art	0.5144568	0.0680909	0.2266698	0.0320960	0.0147601	0.0193646	0.0095546	0.0040875	0.0025547
5	Mid_Day	Col	0.4945942	0.0834644	0.2778472	0.0418524	0.0192468	0.0115721	0.0057097	0.0024427	0.0015267
6	Mid_Day	Fway	0.4711543	0.0606346	0.2018483	0.0275131	0.0126526	0.0299612	0.0147830	0.0063243	0.0039527
7	Ovr_Nite	Art	0.5484058	0.0726996	0.2420119	0.0341365	0.0156985	0.0117442	0.0057946	0.0024790	0.0015494
8	Ovr_Nite	Col	0.5151438	0.0869252	0.2893680	0.0435878	0.0200449	0.0062360	0.0030768	0.0013163	0.0008227
9	Ovr_Nite	Fway	0.4167735	0.0541291	0.1801919	0.0245262	0.0112790	0.0415741	0.0205128	0.0087755	0.0054847
10	PM_Peak	Art	0.5549312	0.0729341	0.2427925	0.0343447	0.0157942	0.0102646	0.0050646	0.0021667	0.0013542
11	PM_Peak	Col	0.5080300	0.0857272	0.2853797	0.0429871	0.0197686	0.0074284	0.0036652	0.0015680	0.0009800
12	PM_Peak	Fway	0.4967140	0.0642861	0.2140038	0.0291430	0.0134021	0.0240962	0.0118892	0.0050863	0.0031789

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	0.0062845	0.0017110	0.0019742	0.0000329	0.0005482	0.0000541	0.0142835	0.0057023	0.0032110	0.0018823
2	0.0041631	0.0011334	0.0013078	0.0000218	0.0005038	0.0000645	0.0085414	0.0034100	0.0019202	0.0011256
3	0.0122926	0.0033467	0.0038616	0.0000644	0.0004970	0.0000487	0.0295330	0.0117903	0.0066392	0.0038919
4	0.0097589	0.0026569	0.0030656	0.0000511	0.0005166	0.0000519	0.0222230	0.0088720	0.0049959	0.0029286
5	0.0058319	0.0015877	0.0018320	0.0000305	0.0004967	0.0000636	0.0119652	0.0047768	0.0026899	0.0015768
6	0.0150992	0.0041108	0.0047432	0.0000791	0.0004732	0.0000462	0.0362970	0.0144907	0.0081598	0.0047833
7	0.0059186	0.0016113	0.0018592	0.0000310	0.0005507	0.0000554	0.0132094	0.0052735	0.0029696	0.0017408
8	0.0031427	0.0008556	0.0009872	0.0000165	0.0005173	0.0000663	0.0064478	0.0025741	0.0014495	0.0008497
9	0.0209516	0.0057041	0.0065817	0.0001097	0.0004187	0.0000413	0.0503131	0.0200862	0.0113107	0.0066304
10	0.0051729	0.0014083	0.0016250	0.0000271	0.0005572	0.0000556	0.0116643	0.0046567	0.0026222	0.0015372
11	0.0037436	0.0010192	0.0011760	0.0000196	0.0005102	0.0000654	0.0076808	0.0030664	0.0017267	0.0010122
12	0.0121435	0.0033061	0.0038147	0.0000636	0.0004989	0.0000490	0.0291874	0.0116523	0.0065615	0.0038464

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0075293	0.0035986	0.0102421	0.0089134	0.0010000	0.0006439	0.0022394	0.0040303	0.0015524
2	0.0045025	0.0021519	0.0061247	0.0053301	0.0010000	0.0010765	0.0037439	0.0067380	0.0018520
3	0.0155678	0.0074405	0.0211768	0.0184295	0.0010000	0.0004236	0.0014732	0.0026513	0.0013974
4	0.0117144	0.0055988	0.0159351	0.0138678	0.0010000	0.0003389	0.0011786	0.0021212	0.0014896
5	0.0063072	0.0030145	0.0085797	0.0074667	0.0010000	0.0002513	0.0008741	0.0015731	0.0018259
6	0.0191333	0.0091446	0.0260269	0.0226504	0.0010000	0.0003364	0.0011699	0.0021055	0.0013265
7	0.0069631	0.0033279	0.0094718	0.0082431	0.0010000	0.0001550	0.0005392	0.0009704	0.0015904
8	0.0033988	0.0016244	0.0046234	0.0040236	0.0010000	0.0000000	0.0000000	0.0000000	0.0019016
9	0.0265216	0.0126758	0.0360772	0.0313969	0.0010000	0.0005355	0.0018624	0.0033519	0.0011842
10	0.0061486	0.0029387	0.0083640	0.0072789	0.0010000	0.0003447	0.0011987	0.0021574	0.0015955
11	0.0040488	0.0019351	0.0055075	0.0047930	0.0010000	0.0004923	0.0017121	0.0030814	0.0018754
12	0.0153856	0.0073534	0.0209289	0.0182138	0.0010000	0.0002598	0.0009034	0.0016259	0.0014064

Table 11
2007 BPA Friday VMT Mix by Time Period and Roadway Facility Type 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	0.6009797	0.0666134	0.2217512	0.0314801	0.0144769	0.0072612	0.0035827	0.0015327	0.0009579
2	AM_Peak	Col	0.5515321	0.0793619	0.2641900	0.0401152	0.0184480	0.0048036	0.0023701	0.0010140	0.0006337
3	AM_Peak	Fway	0.5640513	0.0620757	0.2066458	0.0283797	0.0130511	0.0147040	0.0072550	0.0031037	0.0019398
4	Mid_Day	Art	0.5771172	0.0651316	0.2168185	0.0309480	0.0142322	0.0114896	0.0056690	0.0024252	0.0015158
5	Mid_Day	Col	0.5466584	0.0786618	0.2618597	0.0397614	0.0182852	0.0067650	0.0033379	0.0014280	0.0008925
6	Mid_Day	Fway	0.5458336	0.0598923	0.1993771	0.0273948	0.0125982	0.0183570	0.0090574	0.0038748	0.0024218
7	Ovr_Nite	Art	0.6015772	0.0680034	0.2263785	0.0321881	0.0148025	0.0068142	0.0033621	0.0014384	0.0008990
8	Ovr_Nite	Col	0.5611440	0.0807424	0.2687859	0.0408131	0.0187689	0.0035930	0.0017728	0.0007584	0.0004740
9	Ovr_Nite	Fway	0.5009511	0.0554664	0.1846439	0.0253342	0.0116506	0.0264250	0.0130382	0.0055778	0.0034862
10	PM_Peak	Art	0.6066475	0.0679893	0.2263315	0.0322736	0.0148418	0.0059353	0.0029285	0.0012528	0.0007830
11	PM_Peak	Col	0.5561037	0.0800185	0.2663759	0.0404471	0.0186006	0.0043009	0.0021221	0.0009078	0.0005674
12	PM_Peak	Fway	0.5653282	0.0623856	0.2076772	0.0285088	0.0131105	0.0145047	0.0071567	0.0030617	0.0019136

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	0.0036593	0.0009963	0.0011495	0.0000192	0.0006016	0.0000509	0.0097459	0.0038908	0.0021909	0.0012843
2	0.0024208	0.0006591	0.0007605	0.0000127	0.0005522	0.0000606	0.0058201	0.0023235	0.0013084	0.0007670
3	0.0074102	0.0020174	0.0023278	0.0000388	0.0005647	0.0000474	0.0208615	0.0083284	0.0046898	0.0027492
4	0.0057903	0.0015764	0.0018189	0.0000303	0.0005777	0.0000497	0.0154508	0.0061684	0.0034734	0.0020362
5	0.0034093	0.0009282	0.0010710	0.0000178	0.0005473	0.0000601	0.0081965	0.0032723	0.0018426	0.0010802
6	0.0092512	0.0025186	0.0029061	0.0000484	0.0005465	0.0000457	0.0260596	0.0104036	0.0058584	0.0034342
7	0.0034341	0.0009349	0.0010788	0.0000180	0.0006022	0.0000519	0.0089811	0.0035855	0.0020190	0.0011836
8	0.0018107	0.0004930	0.0005688	0.0000095	0.0005618	0.0000617	0.0043533	0.0017379	0.0009786	0.0005737
9	0.0133171	0.0036256	0.0041834	0.0000697	0.0005016	0.0000424	0.0374738	0.0149605	0.0084243	0.0049384
10	0.0029912	0.0008143	0.0009396	0.0000157	0.0006072	0.0000519	0.0079035	0.0031553	0.0017767	0.0010415
11	0.0021675	0.0005901	0.0006809	0.0000113	0.0005567	0.0000611	0.0052110	0.0020804	0.0011715	0.0006867
12	0.0073098	0.0019901	0.0022963	0.0000383	0.0005660	0.0000476	0.0205878	0.0082192	0.0046283	0.0027131

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0051374	0.0024554	0.0069884	0.0060818	0.0010000	0.0003749	0.0015280	0.0027500	0.0014596
2	0.0030679	0.0014663	0.0041733	0.0036319	0.0010000	0.0006260	0.0025511	0.0045912	0.0017389
3	0.0109968	0.0052558	0.0149589	0.0130182	0.0010000	0.0002554	0.0010406	0.0018728	0.0013602
4	0.0081446	0.0038927	0.0110791	0.0096418	0.0010000	0.0002011	0.0008195	0.0014748	0.0014271
5	0.0043207	0.0020650	0.0058774	0.0051149	0.0010000	0.0001469	0.0005988	0.0010777	0.0017236
6	0.0137369	0.0065654	0.0186862	0.0162620	0.0010000	0.0002061	0.0008400	0.0015117	0.0013123
7	0.0047342	0.0022627	0.0064399	0.0056045	0.0010000	0.0000900	0.0003666	0.0006598	0.0014900
8	0.0022947	0.0010967	0.0031215	0.0027166	0.0010000	0.0000000	0.0000000	0.0000000	0.0017692
9	0.0197536	0.0094411	0.0268708	0.0233848	0.0010000	0.0003404	0.0013872	0.0024965	0.0012153
10	0.0041662	0.0019912	0.0056672	0.0049320	0.0010000	0.0001993	0.0008122	0.0014618	0.0014897
11	0.0027469	0.0013129	0.0037366	0.0032519	0.0010000	0.0002850	0.0011616	0.0020906	0.0017533
12	0.0108525	0.0051868	0.0147626	0.0128474	0.0010000	0.0001564	0.0006372	0.0011469	0.0013669

Table 12
2007 BPA Saturday VMT Mix by Time Period and Roadway Facility Type 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	0.6284977	0.0661514	0.2202134	0.0293560	0.0135001	0.0046169	0.0022780	0.0009745	0.0006091
2	AM_Peak	Col	0.5749063	0.0785546	0.2615027	0.0372866	0.0171472	0.0030443	0.0015021	0.0006426	0.0004016
3	AM_Peak	Fway	0.6041325	0.0631321	0.2101622	0.0271031	0.0124640	0.0095747	0.0047242	0.0020210	0.0012632
4	Mid_Day	Art	0.6110889	0.0654871	0.2180020	0.0292200	0.0134375	0.0073966	0.0036495	0.0015613	0.0009758
5	Mid_Day	Col	0.5716766	0.0781140	0.2600362	0.0370775	0.0170510	0.0043013	0.0021223	0.0009079	0.0005674
6	Mid_Day	Fway	0.5914770	0.0616244	0.2051432	0.0264688	0.0121723	0.0120933	0.0059669	0.0025527	0.0015954
7	Ovr_Nite	Art	0.6274175	0.0673491	0.2242004	0.0299351	0.0137664	0.0043209	0.0021320	0.0009121	0.0005700
8	Ovr_Nite	Col	0.5812149	0.0794151	0.2643672	0.0376951	0.0173350	0.0022626	0.0011164	0.0004776	0.0002985
9	Ovr_Nite	Fway	0.5580177	0.0586624	0.1952830	0.0251606	0.0115707	0.0178940	0.0088290	0.0037771	0.0023607
10	PM_Peak	Art	0.6313837	0.0671947	0.2236863	0.0299520	0.0137742	0.0037558	0.0018531	0.0007928	0.0004955
11	PM_Peak	Col	0.5779167	0.0789652	0.2628696	0.0374815	0.0172368	0.0027175	0.0013408	0.0005736	0.0003585
12	PM_Peak	Fway	0.6048413	0.0633783	0.2109818	0.0271969	0.0125072	0.0094347	0.0046551	0.0019915	0.0012447

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	0.0023267	0.0006334	0.0007309	0.0000122	0.0006298	0.0000504	0.0061961	0.0024736	0.0013929	0.0008165
2	0.0015342	0.0004177	0.0004819	0.0000080	0.0005762	0.0000598	0.0036881	0.0014724	0.0008291	0.0004860
3	0.0048252	0.0013137	0.0015158	0.0000253	0.0006054	0.0000481	0.0135829	0.0054226	0.0030535	0.0017900
4	0.0037276	0.0010148	0.0011710	0.0000195	0.0006124	0.0000499	0.0099457	0.0039706	0.0022359	0.0013107
5	0.0021677	0.0005901	0.0006809	0.0000113	0.0005729	0.0000595	0.0052109	0.0020803	0.0011714	0.0006867
6	0.0060945	0.0016592	0.0019145	0.0000319	0.0005928	0.0000469	0.0171660	0.0068531	0.0038590	0.0022622
7	0.0021776	0.0005928	0.0006841	0.0000114	0.0006287	0.0000513	0.0056944	0.0022734	0.0012801	0.0007504
8	0.0011403	0.0003104	0.0003582	0.0000060	0.0005825	0.0000605	0.0027412	0.0010943	0.0006162	0.0003612
9	0.0090178	0.0024551	0.0028328	0.0000472	0.0005593	0.0000447	0.0253733	0.0101296	0.0057041	0.0033438
10	0.0018928	0.0005153	0.0005946	0.0000099	0.0006327	0.0000512	0.0050007	0.0019964	0.0011242	0.0006590
11	0.0013695	0.0003728	0.0004302	0.0000072	0.0005792	0.0000601	0.0032922	0.0013143	0.0007401	0.0004339
12	0.0047547	0.0012945	0.0014936	0.0000249	0.0006061	0.0000483	0.0133901	0.0053457	0.0030102	0.0017646

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0032662	0.0015610	0.0044430	0.0038666	0.0010000	0.0002384	0.0009714	0.0017483	0.0014453
2	0.0019441	0.0009292	0.0026446	0.0023015	0.0010000	0.0003967	0.0016166	0.0029094	0.0017163
3	0.0071600	0.0034221	0.0097397	0.0084762	0.0010000	0.0001663	0.0006775	0.0012194	0.0013794
4	0.0052427	0.0025057	0.0071316	0.0062064	0.0010000	0.0001295	0.0005275	0.0009493	0.0014308
5	0.0027468	0.0013128	0.0037365	0.0032518	0.0010000	0.0000934	0.0003807	0.0006851	0.0017067
6	0.0090487	0.0043248	0.0123090	0.0107121	0.0010000	0.0001358	0.0005533	0.0009958	0.0013464
7	0.0030017	0.0014346	0.0040832	0.0035535	0.0010000	0.0000570	0.0002325	0.0004183	0.0014715
8	0.0014450	0.0006906	0.0019656	0.0017106	0.0010000	0.0000000	0.0000000	0.0000000	0.0017351
9	0.0133751	0.0063925	0.0181940	0.0158337	0.0010000	0.0002305	0.0009392	0.0016904	0.0012817
10	0.0026360	0.0012599	0.0035858	0.0031206	0.0010000	0.0001261	0.0005139	0.0009249	0.0014681
11	0.0017354	0.0008294	0.0023607	0.0020544	0.0010000	0.0001801	0.0007339	0.0013208	0.0017253
12	0.0070584	0.0033735	0.0096015	0.0083559	0.0010000	0.0001017	0.0004145	0.0007459	0.0013847

Table 13

2007 BPA Sunday VMT Mix by Time Period and Roadway Facility Type 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

OBS										
1	AM_Peak	Art	0.5852758	0.0778247	0.2590729	0.0331442	0.0152421	0.0030772	0.0015183	0.0006495	0.0004060
2	AM_Peak	Col	0.5255335	0.0907227	0.3020096	0.0413265	0.0190050	0.0019919	0.0009828	0.0004204	0.0002628
3	AM_Peak	Fway	0.5709795	0.0753790	0.2509314	0.0310564	0.0142820	0.0064767	0.0031956	0.0013671	0.0008544
4	Mid_Day	Art	0.5726073	0.0775223	0.2580661	0.0331957	0.0152659	0.0049605	0.0024476	0.0010471	0.0006544
5	Mid_Day	Col	0.5235977	0.0903892	0.3008993	0.0411746	0.0189351	0.0028198	0.0013913	0.0005952	0.0003720
6	Mid_Day	Fway	0.5630982	0.0741150	0.2467236	0.0305506	0.0140494	0.0082400	0.0040657	0.0017393	0.0010871
7	Ovr_Nite	Art	0.5826577	0.0790155	0.2630369	0.0337048	0.0155000	0.0028720	0.0014171	0.0006062	0.0003789
8	Ovr_Nite	Col	0.5292933	0.0913706	0.3041662	0.0416216	0.0191407	0.0014748	0.0007277	0.0003113	0.0001946
9	Ovr_Nite	Fway	0.5402744	0.0717501	0.2388509	0.0295335	0.0135817	0.0123993	0.0061179	0.0026173	0.0016358
10	PM_Peak	Art	0.5859199	0.0787777	0.2622454	0.0336997	0.0154976	0.0024946	0.0012308	0.0005266	0.0003291
11	PM_Peak	Col	0.5273312	0.0910325	0.3030407	0.0414676	0.0190699	0.0017748	0.0008757	0.0003746	0.0002341
12	PM_Peak	Fway	0.5711864	0.0756118	0.2517063	0.0311386	0.0143199	0.0063768	0.0031464	0.0013460	0.0008413

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	0.0015508	0.0004222	0.0004872	0.0000081	0.0005877	0.0000591	0.0041301	0.0016488	0.0009285	0.0005443
2	0.0010038	0.0002733	0.0003153	0.0000053	0.0005278	0.0000688	0.0024133	0.0009635	0.0005425	0.0003180
3	0.0032640	0.0008886	0.0010253	0.0000171	0.0005733	0.0000572	0.0091887	0.0036684	0.0020657	0.0012109
4	0.0024999	0.0006806	0.0007853	0.0000131	0.0005750	0.0000588	0.0066706	0.0026631	0.0014996	0.0008791
5	0.0014210	0.0003869	0.0004464	0.0000074	0.0005258	0.0000686	0.0034164	0.0013639	0.0007680	0.0004502
6	0.0041526	0.0011306	0.0013045	0.0000217	0.0005654	0.0000562	0.0116972	0.0046698	0.0026296	0.0015415
7	0.0014474	0.0003940	0.0004547	0.0000076	0.0005850	0.0000600	0.0037852	0.0015112	0.0008509	0.0004988
8	0.0007433	0.0002024	0.0002335	0.0000039	0.0005315	0.0000693	0.0017869	0.0007134	0.0004017	0.0002355
9	0.0062487	0.0017012	0.0019630	0.0000327	0.0005426	0.0000544	0.0175833	0.0070197	0.0039528	0.0023172
10	0.0012572	0.0003423	0.0003949	0.0000066	0.0005883	0.0000598	0.0033217	0.0013261	0.0007467	0.0004377
11	0.0008944	0.0002435	0.0002810	0.0000047	0.0005296	0.0000691	0.0021504	0.0008585	0.0004834	0.0002834
12	0.0032137	0.0008749	0.0010095	0.0000168	0.0005735	0.0000574	0.0090510	0.0036134	0.0020347	0.0011928

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0021771	0.0010405	0.0029615	0.0025773	0.0010000	0.0001589	0.0006475	0.0011654	0.0016945
2	0.0012721	0.0006080	0.0017305	0.0015060	0.0010000	0.0002596	0.0010578	0.0019038	0.0019753
3	0.0048437	0.0023150	0.0065888	0.0057340	0.0010000	0.0001125	0.0004583	0.0008249	0.0016412
4	0.0035163	0.0016806	0.0047832	0.0041627	0.0010000	0.0000868	0.0003538	0.0006367	0.0016879
5	0.0018009	0.0008607	0.0024497	0.0021319	0.0010000	0.0000612	0.0002496	0.0004492	0.0019680
6	0.0061660	0.0029470	0.0083876	0.0072994	0.0010000	0.0000925	0.0003770	0.0006785	0.0016137
7	0.0019953	0.0009536	0.0027142	0.0023621	0.0010000	0.0000379	0.0001545	0.0002781	0.0017204
8	0.0009419	0.0004502	0.0012813	0.0011151	0.0010000	0.0000000	0.0000000	0.0000000	0.0019894
9	0.0092687	0.0044299	0.0126082	0.0109725	0.0010000	0.0001597	0.0006509	0.0011714	0.0015622
10	0.0017510	0.0008369	0.0023818	0.0020728	0.0010000	0.0000838	0.0003414	0.0006144	0.0017152
11	0.0011335	0.0005418	0.0015419	0.0013419	0.0010000	0.0001176	0.0004793	0.0008627	0.0019820
12	0.0047711	0.0022803	0.0064900	0.0056481	0.0010000	0.0000687	0.0002802	0.0005042	0.0016463

ESTIMATION OF EMISSIONS FACTORS

The MOBILE6 model was applied to calculate BPA 2007 county-specific emissions factors (g/mi) 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. In fact, the only actual data parameters requiring user-input values to run the model are fuel Reid Vapor Pressure (RVP), temperature, and calendar year. Many MOBILE6 default-modeling parameters may be overridden by using 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 the BPA August 2000 primary ozone episode climatic conditions, a 2007 vehicle fleet, 2007 activity, and 2007 emissions control programs.

The following emissions factors documentation discusses the MOBILE6 input/output files, summarizes the control programs modeled, describes the aggregation level of the applied MOBILE6 emissions factors, briefly describes all of the MOBILE6 commands that may affect emissions factor calculations, and identifies the commands that were used. The non-default (i.e., local) and EPA default inputs are identified. The details of the development of the locality-specific inputs are provided. Additionally, the emissions factor post-processing procedure is described.

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 (described 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 output tables. (RATEADJV6 was applied to POLFAC6 output where post-processing of emissions factors was required, discussed later.) The final product of the emissions factor modeling is 33 emissions factor files (i.e., one table of hourly emissions factors for each county for each day). (A corresponding set of average 24-hour emissions factors was also produced for quality assurance purposes.)

All of the MOBILE6 input files and output files (MOBILE6 emissions factor tables developed with POLFAC6 and RATEADJV6) 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 Summary)

All federal motor vehicle control programs were modeled (this is the MOBILE6 default). Also modeled were the federal programs to offset heavy-duty diesel (HDDV) defeat device effects—the low emissions rebuild program, and the HDDV 2004 standard pull-ahead program (this is the

MOBILE6 default). The Texas Low-Emissions Diesel Fuel Program was modeled as well.

Post-processing of MOBILE6 emissions factors was required to properly model the impacts of the low-emissions diesel fuel. The limit of MOBILE6 as related to the diesel fuel modeling requirements for this analysis, and the post-processing procedures applied to overcome this limit are discussed in more detail later.

Aggregation Level 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, emissions type, and roadway type classifications are described in Tables 14 through 16. Tables 17 and 18 show the speeds and sequence for hourly time periods, respectively.

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

Table 14
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 eight MOBILE6 emissions type 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, 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 classified 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 emissions factors corresponding to the "None" roadway type are tabulated as emissions factors under each of the four actual roadway types. This allocation of the MOBILE6 "None" road type emissions factors to the Freeway, Arterial, Local, and Ramp MOBILE6 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 link speeds that are not represented in the 14 speeds as tabulated, are calculated by interpolation (except for those link speeds higher than the MOBILE6 maximum speed, and those lower than the MOBILE6 minimum speed, in which case the emissions factors corresponding to these 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 and tabulated by POLFAC6, the single-speed Local and Ramp drive cycle emissions factors are not applied in this analysis.)

Table 17
Speeds for POLFAC6-Tabulated 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, hourly VMT fractions, etc.) to model hourly emissions factors. MOBILE6 requires that hourly input parameters be sequenced starting from the 6 a.m. hour. In some cases, however, particular overnight hours are grouped together as a single time period.

For this analysis, hourly input values to MOBILE6 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 shows the MOBILE6 sequence for hourly inputs and the resulting chronological order for calendar day hourly input as applied for this analysis.

TABLE 18
General Sequence for Calendar Day Hourly* Inputs to MOBILE6

MOBILE6 Input Sequence Number	Abbreviation	Description	Chronological Order
1	6 a.m.	6 a.m. through 6:59 a.m.	7
2	7 a.m.	7 a.m. through 7:59 a.m.	8
3	8 a.m	8 a.m. through 8:59 a.m.	9
4	9 a.m.	9 a.m. through 9:59 a.m.	10
5	10 a.m.	10 a.m. through 10:59 a.m.	11
6	11 a.m.	11 a.m. through 11:59 a.m.	12
7	12 Noon	12 p.m. through 12:59 p.m.	13
8	1 p.m.	1 p.m. through 1:59 p.m.	14
9	2 p.m.	2 p.m. through 2:59 p.m.	15
10	3 p.m.	3 p.m. through 3:59 p.m.	16
11	4 p.m.	4 p.m. through 4:59 p.m.	17
12	5 p.m.	5 p.m. through 5:59 p.m.	18
13	6 p.m.	6 p.m. through 6:59 p.m.	19
14	7 p.m.	7 p.m. through 7:59 p.m.	20
15	8 p.m.	8 p.m. through 8:59 p.m.	21
16	9 p.m.	9 p.m. through 9:59 p.m.	22
17	10 p.m.	10 p.m. through 10:59 p.m.	23
18	11 p.m.	11 p.m. through 11:59 p.m.	24
19	12 Midnight	12 a.m. through 12:59 a.m.	1
20	1 a.m.	1 a.m. through 1:59 a.m.	2
21	2 a.m.	2 a.m. through 2:59 a.m.	3
22	3 a.m.	3 a.m. through 3:59 a.m.	4
23	4 a.m.	4 a.m. through 4:59 a.m.	5
24	5 a.m.	5 a.m. through 5:59 a.m.	6

* For some MOBILE6 hourly input parameters, overnight hours are grouped.

Application of MOBILE6 Commands and Associated Input Parameters

Tables 19 through 24 list and describe all of the MOBILE6 commands that may affect emissions calculation factors (excluding commands such as those that affect only the output format or content). Respectively, these six tables are: MOBILE6 External Conditions, MOBILE6 Vehicle

Fleet Characteristics, MOBILE6 Activity, MOBILE6 State Programs, MOBILE6 Fuels, and MOBILE6 Alternative Emissions Regulations and Control Measures.

In these tables, parameters associated with each MOBILE6 command are labeled as either EPA default, locality-specific, NOT APPLIED, or are otherwise described. The tabulated commands where the associated input parameters are labeled only as "EPA default" are not input for this analysis—MOBILE6 does not require a user-input command to apply these MOBILE6 default values.

The procedures used to develop the locality-specific inputs to MOBILE6 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).	2007
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, by county for each episode day from the August 2000 ozone episode.
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 the portion of the fleet that MOBILE6 determines is using air conditioning.	Locality Specific. One daily absolute humidity value in terms of grains of water per pound of dry air, by county and episode day from the August 2000 episode.

Environmental Effects on Air Conditioning:	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 Mid-day 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/EPA default. July 2001 TxDOT registrations (as used for the August 2000 ozone episode emissions analysis) 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.	Locality Specific/EPA default. TxDOT registrations specify gasoline and diesel for eight HDV classes. HDV diesel fractions applied for the August 2000 base analysis were adjusted and applied for 2007. EPA defaults were 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 to produce "all road types" daily emissions factors for QA checks against hourly results.
VMT BY HOUR	Allows VMT fractions allocation by hour of day; applied in conversion of g/hr to g/mi, as well as in weighting of hourly g/mi rates to obtain daily emissions factors.	Locality specific. This input, total VMT fractions by hour, was produced from BPA regional travel survey data.
SPEED VMT	Allows user to allocate VMT by average speed (14 pre-selected: 2.5 and 5 through 65 at 5 mph increments) for arterials and freeways for each hour of the day.	Internally applied by POLFAC6 to calculate emissions factors by the 14 MOBILE6 speeds for MOBILE6 freeway and arterial road types.
AVERAGE SPEED	Allows a single average speed for combined freeways and arterials 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 DISTRIBUTION	Allows use of 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	Allows 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.	EPA default.
WE EN TRI LEN DI	Specifies hourly alternate fractions of VMT for trips of various lengths for weekend days.	NOT APPLIED. EPA default is same as for WE DA TRI LEN DI.
WE VEH US	Allows 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).	NOT APPLIED.
I/M Commands: I/M PROGRAM I/M MODEL YEARS I/M VEHICLES I/M STRINGENCY I/M COMPLIANCE I/M WAIVER RATES I/M CUTPOINTS I/M EXEMPTION AGE I/M GRACE PERIOD NO I/M TTC CREDITS I/M EFFECTIVENESS I/M DESC FILE	 Required for exhaust/evaporative I/M programs. Required for exhaust/evaporative I/M programs. Required for exhaust/evaporative I/M programs. Required for exhaust. Do not use for evaporative. Required for exhaust. Optional for evaporative. Required for exhaust. Optional for evaporative. Optional for exhaust (but required for IM240). Do not use with evaporative. Optional for both exhaust and evaporative. Optional for both exhaust and evaporative. Optional for exhaust. Do not use with evaporative. Optional for exhaust. Do not use with evaporative. Optional for both.	NOT APPLIED.

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 1.
SULFUR CONTENT	Allows user to apply alternate sulfur content to conventional gasoline through calendar year 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. Used the regulated limit (7.8 psi) per EPA guidance for areas without gasoline survey data (Procedures For Emissions Inventory Preparation, Vol. 1V, EPA 1992).
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 emissions effects (defeat device emissions).	NOT APPLIED
NO NOX PULL AHEAD	Turns off HDD NOx emissions reduction effects of Pull Ahead program.	NOT APPLIED
NO REBUILD	Turns off HDD NOx emissions reduction effects of Rebuild program.	NOT APPLIED
REBUILD EFFECTS	Allows user change Rebuild program effectiveness rate.	EPA Default (0.90 command file input)
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 evaporative standard phase-in schedules.	
T2 CERT	Allows 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 emissions 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 the values and TTI formatted them for input to MOBILE6. These are the same MOBILE6 inputs that were used in developing the August 2000 base-case ozone episode on-road mobile source emissions inventories (developed previously under this task).

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 BPA counties. TNRCC obtained the

monitoring data from the EPA Aerometric Information Retrieval System, the National Weather Service, and TNRCC Monitoring Operations. Each county with more than one monitoring station uses the hourly average temperatures from the monitoring stations within its border. Counties without monitoring stations (i.e., Hardin), 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.

A total of 33 hourly temperature data sets are produced by modeling three counties for 11 days. The temperatures are input in the MOBILE6 command file. Appendix E shows a summary of the temperatures used.

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 33 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
Regional (i.e., BPA three-county group) vehicle registration (age) distributions and diesel fractions inputs to MOBILE6 were developed for vehicle types for which TxDOT registrations data were available. These fleet characteristics inputs were developed at the regional level to overcome the sparseness of data (zero registered HDGV8b) for the rural counties (Hardin and Orange). For MOBILE6 to calculate emissions factors for a vehicle class, that vehicle class must be represented in the fleet characteristics inputs.

The regional age distributions developed for the BPA 2000 ozone episode base-case emissions estimates were applied for this 2007 analysis. The regional diesel fractions for 2007 were forecast from the diesel fractions developed for the 2000 ozone episode base-case emissions analysis assuming the most recent fractions, by vehicle type, were the same for the future years (mid-year 2001 fractions were applied to 2002 through 2007).

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 internally applied by MOBILE6 for vehicle classes for which the user does not provide 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 model year-specific 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 = Adjusted 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 regional MOBILE6 age distributions fractions input for all vehicle types except for the two bus categories. EPA defaults were used for the two bus categories. To develop these distributions, TTI used two county-level data sets provided by TxDOT. The TxDOT registrations data provided are summarized as:

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

The July 2001 registrations are for: 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 gasoline HDV classes and diesel HDV classes comprise the July 2001 HDGT and HDDT classes represented in the July 2001 data set, respectively, and correspond to the HDV weight classes for numbers six through 13 in Table 25.

After combining the Jefferson, Hardin, and Orange registrations into BPA regional data sets, there were four main steps to developing the regional MOBILE6 registration distribution inputs for the 14 non-bus vehicle classes. The first step in the process transforms the 16 HDV (eight gasoline and eight diesel) February 2002 registrations to estimated July, 2001 registrations. The next step results in July 2001 registrations by the 25 age groups for 12 of the 16 composite (by fuel) vehicle classes (eight HDV, LDV, LDT12, LDT34, MC). The third step converts the registrations from numbers of vehicles registered, to fractions registered by age for each of the 12 classes. The registrations are then expanded from 12 classes to 14.

To estimate July 2001 HDV registrations from the 2002 HDV registrations data, the 2002 registrations were dropped from the data set to yield approximate end-of-year 2001 registrations. Mid-year scaling factors were then applied to the approximate end-of-year 2001 HDV registrations. These scaling factors (particular to fuel type) are the July 2001 registrations divided by the sum total of the HDV sub-class, end-of-year 2001 registrations. The July 2001 scaling factors were then applied to the 2001 model year (approximate end-of-year) individual eight HDV class registrations, as appropriate by fuel type, to obtain the mid-year 2001 registrations estimates for the 16 HDV fuel-type specific classes. No vehicle scrappage estimates or vehicle migration estimates were made for the period from July 2001 to February 2002.

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. The 1977 and older registrations were summed to yield the “age 25 and older” registrations for the 12 composite vehicle classes: eight HDVs, LDV, LDT12, LDT34, and MC. (The HDGT and HDDT registrations from the July 2001 original data set were not used.)

Conversion of the registrations from numbers of vehicles to fractions of vehicles by age was performed 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.

The resulting July 2001 estimated regional registration distribution fractions for the 12 composite classes were expanded to 14 classes: LDV, LDT1, LDT2, LDT3, LDT4, MC, HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B. The LDT12 age fractions, were used for both the MOBILE6 LDT1 and LDT2 classes and 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. One regional data set (external data files) was developed for all three counties. Table 26 shows the registration distribution.

Table 26
BPA Regional Vehicle Registration Distributions

```
*  Calculated from July 2001 Registration data and February 2002 HDV data
*  LDV
    1  0.05276 0.08974 0.08234 0.07730 0.07467 0.07016 0.07607 0.06342 0.05952 0.05339
       0.04907 0.04467 0.04018 0.03239 0.02554 0.02156 0.02011 0.01637 0.00965 0.00664
       0.00509 0.00406 0.00480 0.00363 0.01687
*  LDT1
    2  0.06598 0.07421 0.07760 0.07409 0.07482 0.06445 0.06772 0.06863 0.05249 0.04860
       0.04964 0.03963 0.04125 0.03244 0.02258 0.02435 0.02210 0.02012 0.01299 0.01349
       0.01120 0.00568 0.00714 0.00641 0.02239
*  LDT2
    3  0.06598 0.07421 0.07760 0.07409 0.07482 0.06445 0.06772 0.06863 0.05249 0.04860
       0.04964 0.03963 0.04125 0.03244 0.02258 0.02435 0.02210 0.02012 0.01299 0.01349
       0.01120 0.00568 0.00714 0.00641 0.02239
*  LDT3
    4  0.12758 0.13367 0.17215 0.06690 0.09758 0.07437 0.06471 0.04088 0.03890 0.03088
       0.02000 0.01801 0.02013 0.01342 0.00767 0.01281 0.01164 0.01103 0.00678 0.00609
       0.00390 0.00274 0.00473 0.00377 0.00966
*  LDT4
    5  0.12758 0.13367 0.17215 0.06690 0.09758 0.07437 0.06471 0.04088 0.03890 0.03088
       0.02000 0.01801 0.02013 0.01342 0.00767 0.01281 0.01164 0.01103 0.00678 0.00609
       0.00390 0.00274 0.00473 0.00377 0.00966
*  HDV2B
    6  0.16620 0.12813 0.17178 0.07614 0.07707 0.04457 0.04550 0.02786 0.02878 0.01950
       0.02228 0.02507 0.01671 0.02136 0.01578 0.02043 0.01486 0.01114 0.00557 0.01114
       0.00371 0.01300 0.00371 0.00371 0.02600
*  HDV3
    7  0.07371 0.11355 0.11355 0.03984 0.08765 0.05578 0.09960 0.05578 0.05378 0.03586
       0.02988 0.02390 0.03586 0.03386 0.00996 0.00996 0.01195 0.00797 0.00797 0.01394
       0.01394 0.00199 0.01195 0.00598 0.05179
*  HDV4
    8  0.03150 0.07874 0.16141 0.06693 0.13780 0.07874 0.09055 0.03543 0.03150 0.03543
       0.03543 0.05512 0.01575 0.00787 0.01969 0.00787 0.00394 0.00000 0.00394 0.01181
       0.00000 0.01181 0.00787 0.01181 0.05906
*  HDV5
    9  0.10811 0.13514 0.10135 0.03378 0.08108 0.01351 0.04730 0.01351 0.06081 0.03378
       0.00676 0.00676 0.04730 0.04054 0.00676 0.02703 0.00676 0.03378 0.02027 0.01351
       0.04730 0.00000 0.01351 0.02703 0.07432
*  HDV6
   10  0.02891 0.07653 0.10036 0.05782 0.05952 0.04762 0.05272 0.03912 0.05952 0.04422
       0.05952 0.03401 0.02551 0.02551 0.02891 0.01701 0.03231 0.02891 0.01190 0.02381
       0.03401 0.01871 0.01361 0.02381 0.05612
*  HDV7
   11  0.02553 0.07234 0.05106 0.09787 0.03404 0.03830 0.07660 0.04255 0.07234 0.07660
       0.04255 0.06383 0.00851 0.01702 0.02553 0.00851 0.05106 0.02128 0.00426 0.02979
       0.02128 0.01702 0.02979 0.02128 0.05106
*  HDV8A
   12  0.01257 0.01975 0.05027 0.02154 0.01257 0.03052 0.04668 0.06463 0.07540 0.05745
       0.05566 0.06643 0.08078 0.04309 0.03950 0.03591 0.04847 0.04129 0.01077 0.02334
       0.03591 0.02693 0.03411 0.02873 0.03770
*  HDV8B
   13  0.10750 0.12750 0.16000 0.13750 0.06000 0.12500 0.18500 0.06250 0.00250 0.00500
       0.00750 0.00250 0.00500 0.00000 0.00250 0.00500 0.00250 0.00000 0.00000 0.00000
```

```
      0.00000 0.00000 0.00000 0.00000 0.00250
*   HDBS is MOBILE6 default
*   HDBT is MOBILE6 default
*  MC
   16  0.12083 0.15253 0.10296 0.07745 0.06339 0.06411 0.04766 0.03956 0.02669 0.02383
       0.01049 0.01144 0.01621 0.01597 0.01406 0.02502 0.02193 0.01787 0.01978 0.01907
       0.01621 0.01692 0.01358 0.00763 0.05481
```

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 percent 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 the user enters diesel fractions, 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 the same as the 1972 model year fractions. For the 1997 and later model years, the default diesel fractions are assumed the same as the 1996 model year fractions.

TTI used a combination of estimated regional diesel fractions and EPA default diesel fractions to model the 2007 attainment year emissions factors. Table 27 shows the MOBILE6 diesel fractions input categories and their data sources. The regional diesel fraction estimates were calculated based on TxDOT individual diesel and gasoline regional vehicle registrations for the eight HDV (HDV2b through HDV8b) weight classes. As discussed previously, these TxDOT registrations data were adjusted to represent registrations as of July, 2001 (see registrations distributions discussion). To obtain the regional HDV diesel fractions by model year, the diesel registrations were divided by the sum of the gasoline and diesel registrations. This calculation was by HDV composite vehicle class, and model year.

The HDV diesel fractions (derived from estimated mid-year 2001 county-specific HDV registration distributions) were forecast from 2001 to 2007 by applying the latest diesel fraction (2001) to each of the future years (2002 through 2007). These estimated 2007 HDV diesel fractions were then combined with the July 2007 EPA default diesel fractions for the remaining vehicle classes, formatted for input to MOBILE6, and applied as the 2007 future case episode modeling emissions inventories BPA fleet diesel fractions. Diesel fractions are entered in the MOBILE6 command file. One diesel fractions data set was developed for all three counties (Table 28).

Table 27
Source of Diesel Fractions for Composite Vehicle Types
(DIESEL FRACTIONS Command)

Number	Abbreviation	Description	Source of Fractions
1	LDV	Light-Duty Vehicles	EPA MOBILE6 Evaluation Year Default
2	LDT1	Light-Duty Trucks 1	EPA MOBILE6 Evaluation Year Default
3	LDT2	Light-Duty Trucks 2	EPA MOBILE6 Evaluation Year Default
4	LDT3	Light-Duty Trucks 3	EPA MOBILE6 Evaluation Year Default
5	LDT4	Light-Duty Trucks 4	EPA MOBILE6 Evaluation Year 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 Evaluation Year Default

Table 28
Diesel Fractions

```
*  HDV Diesel fractions are calculated from regional 7/01 data;
*  LDV, LDT, and Bus fractions are EPA defaults
DIESEL FRACTIONS   :
 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090
 0.00090 0.00090 0.00060 0.00010 0.00030 0.00060 0.00130 0.00040 0.00040 0.00010
 0.00270 0.00320 0.00970 0.01620 0.02410
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00070 0.00330 0.00480 0.01200 0.02230
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00070 0.00330 0.00480 0.01200 0.02230
 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720
 0.00820 0.01240 0.01350 0.01690 0.02090
 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720
 0.00820 0.01240 0.01350 0.01690 0.02090
 0.72626 0.72626 0.72626 0.72626 0.72626 0.72626 0.72626 0.76812 0.71892 0.63415
 0.56627 0.52083 0.18367 0.40000 0.48387 0.42857 0.37500 0.40741 0.27778 0.30435
 0.11765 0.40909 0.12500 0.16667 0.16667
 0.64865 0.64865 0.64865 0.64865 0.64865 0.64865 0.64865 0.59649 0.70175 0.65000
 0.59091 0.71429 0.42000 0.50000 0.40741 0.50000 0.40000 0.66667 0.55556 0.41176
 0.60000 0.20000 0.33333 0.25000 0.25000
 0.87500 0.87500 0.87500 0.87500 0.87500 0.87500 0.87500 0.95000 0.65854 0.58824
 0.85714 0.60000 0.34783 0.55556 0.75000 0.66667 0.66667 0.50000 0.50000 0.50000
 0.00000 0.00000 0.00000 0.00000 0.00000
 0.87500 0.87500 0.87500 0.87500 0.87500 0.87500 0.87500 0.85000 0.86667 0.60000
 0.75000 0.50000 0.28571 1.00000 0.77778 0.00000 1.00000 0.00000 0.57143 0.33333
 1.00000 0.50000 0.00000 0.00000 0.33333
 0.94118 0.94118 0.94118 0.94118 0.94118 0.94118 0.94118 0.71111 0.76271 0.88235
 0.60000 0.85714 0.41935 0.73913 0.77143 0.57692 0.62857 0.55000 0.60000 0.40000
 0.64706 0.50000 0.31579 0.41176 0.00000
 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 0.83333 0.95652
 0.62500 0.77778 0.38889 0.90000 0.64706 0.66667 0.80000 0.86667 1.00000 0.75000
 0.66667 1.00000 0.75000 1.00000 1.00000
 0.85714 0.85714 0.85714 0.85714 0.85714 0.85714 0.85714 0.90909 0.89286 0.91667
 0.85714 0.82353 0.61538 0.97222 0.80952 0.81250 1.00000 0.86486 1.00000 0.95833
 0.90909 0.95000 0.92593 0.91304 1.00000
 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000
 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 0.00000 1.00000 0.00000
 1.00000 1.00000 1.00000 0.00000 0.00000
 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850
 0.95850 0.95850 0.88570 0.85250 0.87950 0.99000 0.91050 0.87600 0.77100 0.75020
 0.73450 0.67330 0.51550 0.38450 0.32380
```

* Order of vehicle classes is a shown in Table 27.

Activity – Locality Specific Inputs to MOBILE6

The user-input, locality-specific activity parameters 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).

Additional activity inputs to the model were fractions of hourly VMT across road types, and hourly fractions of VMT by the 14 speeds, for arterials and freeways. Weekend day hourly vehicle usage rates (MOBILE6 defaults) for particular activity input parameters (see Table 21) 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. The hourly VMT fractions were developed based on the 1993 BPA Comprehensive Travel Survey and hourly VMT across road types were developed based on the 2007 TDM VMT estimates.

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 was discussed previously in this documentation.

VMT Distributions by Road Type (VMT BY FACILITY Command)

These distributions were not used to calculate the emissions factors applied for estimating the hourly 2007 emissions factors for this analysis. 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.

One VMT BY FACILITY input data set was developed per county from the 2007 link-VMT estimates. By hour, the 2007 link-VMT estimates were summed 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.

Total VMT by Hour (VMT BY HOUR Command)

Hourly fleet total VMT distributions are input to MOBILE6 by using 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.) Development of these fractions was previously discussed in the "Estimation of VMT" section.

The VMT by hour fractions were developed at the regional level based on data from the 1993 BPA Comprehensive Travel Survey. Travel survey estimates of VMT (average school season weekday) in 15-minute increments were summed within each hour of the day. Hourly VMT fractions were then calculated by dividing the hourly VMT totals by the 24-hour VMT total. The hourly VMT fractions applied for this analysis are the same as those applied for the 2000 base case analysis. One regional data set representative of an average school season weekday was developed and applied for all analysis days. These fractions are input to MOBILE6 as an external data file. Table 3 shows these fractions.

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 speed input commands or data parameter values are required when producing MOBILE6 emissions factors tables with POLFAC6). POLFAC6 uses the SPEED VMT inputs to produce the individual Freeway and Arterial emissions factors indexed by the 14 MOBILE6 speed bin speeds.

To model the freeway and arterial emissions factor for each of the individual 14 speeds, POLFAC6 produces 14 VMT by Speed external data file input setups, one for each of the 14 speeds. Each of the 14 input files, or setups, allocates 100 percent of the VMT to one of the 14 speeds (and thus 0 percent to the other 13) for both arterials and freeways. Execution of POLFAC6 produces the 14 speed scenario setups and the desired freeway and arterial emissions factors for each of the 14 MOBILE6 speed bin speeds.

Weekend Day Vehicle Usage (WE VEH US Command)
MOBILE6 supplies default weekend day hourly vehicle usage rates for start distributions, soak distributions, and hot soak activity. For Saturday and Sunday episode days, the WE VEH US command was applied to model the EPA default weekend usage rates for these parameters.

State Programs
For this analysis, no MOBILE6 State Programs (e.g., Inspection and Maintenance and Anti-tampering Programs) inputs were modeled.

The effects of the Texas Low-Emissions Diesel Fuel Program is applied to the MOBILE6 emissions factors, however, through a post-processing procedure required due to limits of the MOBILE6 program. This post-processing procedure is discussed later in this document.

Fuels – Locality Specific Inputs to MOBILE6
User input for fuel effects modeling for BPA 2007 includes only the FUELS PROGRAM and FUEL RVP commands and associated input parameters.

Fuel Program (FUEL PROGRAM Command)
The MOBILE6 FUEL PROGRAM command provides the user four options for modeling fuels effects. The first option, Conventional Gasoline East, which is also the MOBILE6 default, was modeled for all three counties. This option supplies post-1999 gasoline sulfur levels by year under the Tier 2 rule phase-in schedule for most states (including Texas). The FUEL PROGRAM option is entered in the MOBILE6 command file.

Gasoline RVP (FUEL RVP Command)
The BPA regulated RVP limit of 7.8 psi was applied for 2007, as was also the case for the 2000 analysis. No BPA gasoline sample survey data were available for comparison. Application of the regulated RVP limit follows EPA RVP determination guidance from Procedures for Emissions Inventory Preparation, Volume IV: Mobile Sources (EPA 1992).

MOBILE6 Alternative Emissions Regulations and Control Measures Commands
The only user-input value applied (which was not required because the EPA default was input) within this section of MOBILE6 commands, is related to the 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.

EPA provided information to TNRCC that lead to the conclusion that the best estimate for the effectiveness rate for the 2000 ozone episode base-case modeling for the low NOx emissions rebuilds program for heavy duty diesels was 1.0 percent. The information provided by EPA showed that the number of low NOx-rebuild kits supplied (as of January, 2002) to the affected population was 0.97 percent. However, no information was available to justify a non-default rebuild effects input value for 2007.

Thus, the 2007 effectiveness rate for the low NOx emissions rebuild program was set at the EPA default value (0.90, or 90 percent). This value and its associated command, REBUILD EFFECTS, are inputs to the MOBILE6 command file.

Emissions Factor Post-Processing Requirements and Procedures
There is one limitation of the MOBILE6 model, which required emissions factors post-processing for this analysis: MOBILE6 does not model user-specified alternate diesel fuel parameters.

For 2007, all BPA counties are to use Texas low-emissions diesel fuel. Thus, to produce the final emissions factor inputs to the emissions estimation process, one emissions factor post-

processing step was performed. To model the low-emissions diesel effects, no additional MOBILE6 runs were required. An adjustment factor was applied to the NOx emissions factors for all of the diesel-fueled vehicle classes.

Emissions Factor Post-Processing to Model Low-Emissions Diesel Effects
MOBILE6 does not have an alternate diesel fuel-modeling feature. To model the impacts of low-emissions diesel fuel, MOBILE6 diesel vehicle emissions factors were post-processed (with the RATADJV6 program, described in Appendix B). The NOx adjustment factor of 0.943 was multiplied by all of the diesel-fueled vehicle MOBILE6 NOx emissions factors for each county and analysis day. This adjustment corresponds to a reduction in NOx emissions factors of 5.7 percent. Development of this value is documented in the Eastern Research Group report, Revised SIP Modeling Procedures for the BPA Nonattainment Area, included as Appendix G of Houston/Galveston Attainment Demonstration and Post-1999 Rate-of-Progress SIP, TNRCC, October 2001.

Upon completion of this emissions factor post-processing procedure, the emissions factors are ready for input to the IMPSUM6 program to calculate estimated emissions. The emissions factors were provided to TNRCC on CD-ROM. See Appendix A for file names and descriptions.

EMISSIONS CALCULATIONS

Hourly emissions were calculated by county for each of the 11 analysis days using the IMPSUM6 program (Appendix B). 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, 75 files were output from the emissions calculations. These files include: 72 hourly link emissions files (24 hours multiplied by three 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 (drive cycle), vehicle type, and 14 speeds (2.5 mph and 5 mph to 65 mph at 5 mph intervals). Four period time-of-day VMT mix correlated to link VMT (by day-of-week, functional classification group [see Table 4], and hour [see Table 3]) was multiplied by the fleet total link VMT to produce link-VMT estimates by the 28 vehicle types. Based on vehicle class, road type, and speed, emissions factors were then matched with link-level VMT; the freeway emissions factors were matched to the "IH and Freeway" functional group (see Table 4) links, and the arterial emissions factors to all other (non-freeway) links. 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 in Appendix B). 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 was then multiplied by the emissions factors to produce the link-level emissions estimates.

County-level, hourly 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.

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 (BPA network functional type and intrazonals), vehicle type, and by cross-classification of road type and vehicle type. 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 DATA SET NAMES AND DESCRIPTIONS

ELECTRONIC SUBMITTAL DATA SET NAMES AND DESCRIPTIONS

This appendix describes the BPA 2007 modeling emissions inventory electronic data submittal.

The BPA 2007 modeling emissions inventories data are contained on four CDs. The number of CDs by data content category are: 1) two CDs containing the link-emissions files and inventory summary report files, 2) one CD containing the BPA 2007 travel model network node coordinates, and 3) one CD with the BPA 2007 MOBILE6 input files (command and external data) and output files (MOBILE6 emissions factors produced with POLFAC6 and RATEADJV6).

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 at end of this appendix).

Emissions (Two CD-ROMs)
The CD names and corresponding analysis days contained on each are: BPA07A (AUG22 through AUG27), BPA07B (AUG28 through SEP01).
There is one zip file for each analysis day containing the following 75 files:

- county level hourly link-emissions files (72 ASCII files with .y07 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);

- a log of the emissions estimation program runs (1 ASCII file with .log extension).

Zip file names and data set file names follow the convention:

BPA***ddmmm***07.zip
BPA***ddmmm***07.tab
BPA***ddmmm***07.lst
BPA***ddmmm***07.log
countyname.t***hr***.lnkemis..***mmmdd***.y07

where:
dd is the day date for each of the 11 days for the period August 22 through September 1;
mmm is the month, AUG or SEP, corresponding to the episode day date (***dd***);
countyname is Jefferson, Hardin, Orange; and
hr is 01... 24 representing the hours 12 a.m. through 11 p.m. (local time).

Coordinates (one CD-ROM)

The CD name is XY2007_BPA. The CD contains one file named "JO7COORS" that contains Longitude, Latitude in millionths of degrees for the BPA 2007 network nodes (link endpoints and zone centroids). The order of the data is: network node number, Longitude, Latitude.

Emissions Factors (one CD-ROM)
The CD name is BPA07M6. The MOBILE6 input and output files on the CD are in the ZIP file named BPA07M6.zip.

The MOBILE6 input and output files consist of the following 170 files:

- MOBILE6 command input files (33);
- MOBILE6 external data input files (5);
- MOBILE6 hourly emissions factor output files (66); and
- MOBILE6 daily emissions factor output files (66).

Where:
CNTY is the first four letters of county name for the BPA counties;
07 is the evaluation year, 2007;
mmmdd is the month/day date for the 11 days (AUG22... SEP01);

MOBILE6 command input files are:

CNTY07***mmmdd***.in (33 files)

MOBILE6 external data input files are:

RGNL07.rgd (1 regional registration distributions file);
CNTY 07.vfc (3 VMT BY FACILITY files); and
BPA.vhr (1 VMT BY HOUR file).

MOBILE6 Emissions Factors Files (hourly [.rat] and 24-hr [.rtd] output) are:

CNTY07***mmmdd***_adj.rat (33 files adjusted for Low Emissions Diesel);
CNTY07***mmmdd***_adj.rtd (33 files adjusted for Low Emissions Diesel).
CNTY07***mmmdd***.rat (33 files, unadjusted); and
CNTY07***mmmdd***.rtd (33 files, unadjusted).

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	Facility Type of Link (see Facility Type Code table below)
EMISS	17 - 19	A3	"VOC," or "CO," or "NOx"
ETYPE	21 - 31	A11	Emissions Sub-Component Type (see Emissions Type Code table below)
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

Facility Type Codes for BPA Link Emissions

Facility Group	Facility Type (Code and Name)
IH and Freeway	1. Interstate Highway - 10
	2. Freeway - main lanes only
	3. Parkway*
Principle Arterial Divided	9. Divided Principal Arterial
	10. Divided Principal Arterial with Left Turn Bay
	12. Divided Principal Arterial with Parking**
	13. One Way Principal Arterial
Principle Arterial Undivided	14. Undivided Principal Arterial
	15. Undivided Principal Arterial with Left Turn Bay
	16. Undivided Principal Arterial with Continuous Left Turn
Minor Arterial Divided	17. Divided Minor Arterial
	18. Divided Minor Arterial with Left Turn Bay
	20. Divided Minor Arterial with Parking**
	21. One Way Minor Arterial
Minor Arterial Undivided	22. Undivided Minor Arterial
	23. Undivided Minor Arterial with Left Turn Bay
	19. Undivided Minor Arterial with Continuous Left Turn
	32. Undivided Minor Arterial with Parking**
Frontage Road	28. Frontage Road 1-way
	33. Frontage Road 2-way
Ramp	29. Ramp
Collector	24. Divided Collector
	26. Divided Collector with Left Turn Bay
	25. Undivided Collector
	31. Undivided Collector with Continuous Left Turn
	27. Gravel/Dirt Collector
Local	30. Centroid Connector
	0. Intrazonal

* Parkway is a Freeway without any supporting Frontage Roads.

** Denotes allowable parking which obstructs a normal traffic flow lane.

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 PROGRAMS

TTI EMISSIONS ESTIMATION PROGRAMS

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 Dallas/Fort Worth Region or optionally 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 calculate the on-road mobile emissions factors. The MOBILE6 emissions factors may be produced for each of 15 pollutant-specific emissions types (i.e., the composite, exhaust running, and exhaust start for VOC, CO, and NOx rates plus the six sub-component VOC evaporative rates), 28 vehicle types, four MOBILE6 functional classifications (or drive cycles, i.e., 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. 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 IMPSUM: 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 drive cycle (Freeway, Arterial, Local, Ramp) emissions factors (or percentages thereof) to specific travel model functional classifications. These MOBILE6 drive cycle emissions factor percentages (valid from zero to 100) must sum to 100 percent for each travel model functional classification.

Using these input data, the VMT for each link is stratified by MOBILE6 drive cycle and the 28 vehicle types. The MOBILE6 emissions factors matched to link-VMT by drive cycle and vehicle type are interpolated (for the link speed that falls between the 14 MOBILE6 speeds; see the MOBILE6 interpolation methodology below) 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 and 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 SUMALL6 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.

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.

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 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 g/mi - (0.26214) × (0.7413 g/mi - 0.7274 g/mi)

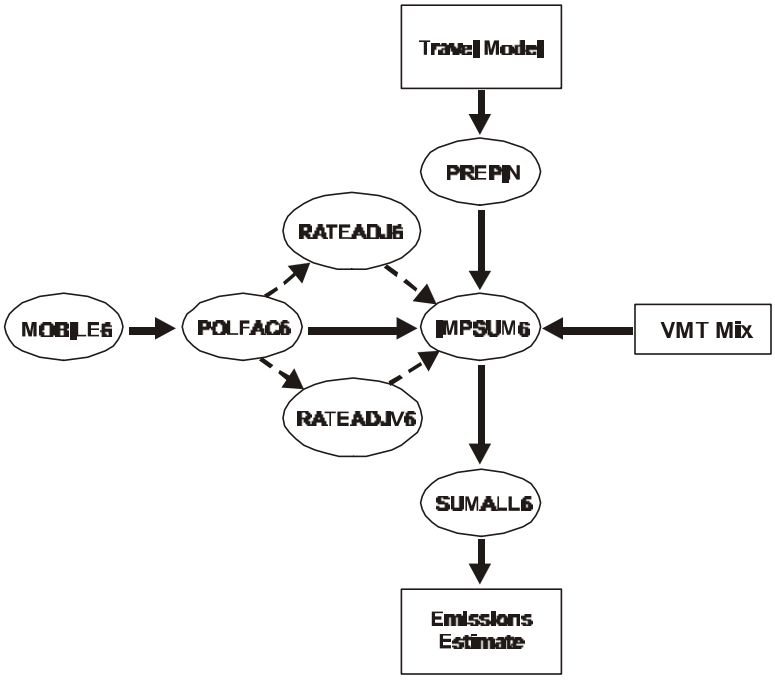
= 0.7377 g/mi

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


Travel Model
PREPIN
RATEADJ6
MOBILE6
POLFAC6
EMPSUM6
VMT Mix
RATEADJV6
SUMALL6
Emissions Estimate

APPENDIX C
DIRECTIONAL SPLIT ESTIMATES

AM Peak-Period Directional Split Estimates

AREA TYPES	FUNCTIONAL CLASSIFICATIONS								
	0	1	3	4	5	6	7	8	9
	Centroid Connector	IH and Freeway	Principle Arterial Divided	Principle Arterial Undivided	Minor Arterial Divided	Minor Arterial Undivided	Collector	Frontage Road	Ramp
1 CBD	54.0	50.0	65.0	65.0	58.0	58.0	64.5	50.0	50.0
2 CBD Fringe	87.0	50.0	60.0	60.0	59.0	59.0	63.0	50.0	50.0
3 Urban	85.0	60.0	62.0	62.0	58.0	58.0	53.0	60.0	60.0
4 Suburban	72.0	61.0	65.0	65.0	64.0	64.0	64.5	61.0	61.0
5 Suburban Fringe	80.0	65.0	68.0	68.0	66.0	66.0	62.5	67.0	67.0
6 Rural	78.0	70.0	71.0	71.0	68.0	68.0	75.0	70.0	70.0

* The 1997 BPA TDM network traffic assignment is based on facility type. The functional classification-to-facility type correlation is shown in Table 4 of the text.

Mid-Day and Overnight (Off-Peak) Directional Split Estimates

AREA TYPES	FUNCTIONAL CLASSIFICATIONS								
	0	1	3	4	5	6	7	8	9
	Centroid Connector	IH and Freeway	Principle Arterial Divided	Principle Arterial Undivided	Minor Arterial Divided	Minor Arterial Undivided	Collector	Frontage Road	Ramp
1 CBD	54.0	51.0	55.0	55.0	55.0	55.0	54.5	51.0	51.0
2 CBD Fringe	54.0	51.0	54.0	54.0	55.0	55.0	53.0	51.0	51.0
3 Urban	55.0	53.0	50.0	50.0	52.0	52.0	52.0	53.0	53.0
4 Suburban	55.0	51.0	57.0	57.0	56.0	56.0	57.0	51.0	51.0
5 Suburban Fringe	53.0	51.0	56.0	56.0	57.0	57.0	54.0	51.0	51.0
6 Rural	52.0	53.0	55.0	55.0	58.0	58.0	54.0	53.0	53.0

PM Peak-Period Directional Split Estimates

AREA TYPES	FUNCTIONAL CLASSIFICATIONS								
	0	1	3	4	5	6	7	8	9
	Centroid Connector	IH and Freeway	Principle Arterial Divided	Principle Arterial Undivided	Minor Arterial Divided	Minor Arterial Undivided	Collector	Frontage Road	Ramp
1 CBD	55.0	54.0	62.0	62.0	52.0	52.0	57.5	54.0	54.0
2 CBD Fringe	72.0	54.0	59.0	59.0	53.0	53.0	64.5	54.0	54.0
3 Urban	72.0	56.0	57.0	57.0	64.0	64.0	68.0	56.0	56.0
4 Suburban	72.0	67.0	60.0	60.0	65.0	65.0	62.5	67.0	67.0
5 Suburban Fringe	71.0	66.0	63.0	63.0	64.0	64.0	67.0	66.0	66.0
6 Rural	71.0	65.0	66.0	66.0	63.0	63.0	70.0	65.0	65.0

APPENDIX D
CAPACITY FACTORS AND SPEED FACTORS

Capacity Factors

Facility Type*	Regional Area Type					
	CBD	CBD Fringe	Urban	Suburban	Suburban Fringe	Rural
1	0.1034	0.1063	0.0942	0.1185	0.1330	0.1905
2	0.1034	0.1063	0.0942	0.1185	0.1330	0.1905
3	0.1034	0.1063	0.0942	0.1185	0.1330	0.1905
9	0.0724	0.0811	0.0903	0.1043	0.1351	0.1416
10	0.0724	0.0811	0.0903	0.1043	0.1351	0.1416
13	0.0724	0.0811	0.0903	0.1043	0.1119	0.1231
14	0.0685	0.0775	0.0870	0.1007	0.1077	0.1151
15	0.0685	0.0775	0.0870	0.1007	0.1077	0.1151
16	0.0685	0.0775	0.0870	0.1007	0.1077	0.1151
17	0.0809	0.0902	0.0969	0.1261	0.1543	0.1667
18	0.0809	0.0902	0.0969	0.1261	0.1543	0.1667
19	0.0769	0.0873	0.0943	0.1059	0.1140	0.1227
20	0.0809	0.0902	0.0969	0.1261	0.1543	0.1667
21	0.0809	0.0902	0.0969	0.1261	0.1543	0.1667
22	0.0769	0.0873	0.0943	0.1059	0.1140	0.1227
23	0.0769	0.0873	0.0943	0.1059	0.1140	0.1227
24	0.0750	0.0848	0.0962	0.1146	0.1280	0.1438
25	0.0727	0.0833	0.0978	0.1190	0.1350	0.1544
26	0.0750	0.0848	0.0962	0.1146	0.1280	0.1438
27	0.0727	0.0833	0.0978	0.1190	0.1350	0.1544
28	0.0482	0.0541	0.0579	0.0667	0.0721	0.0769
29	0.0726	0.0811	0.0865	0.1007	0.1306	0.1327
30	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
31	0.0727	0.0833	0.0978	0.1190	0.1350	0.1544
32	0.0769	0.0873	0.0943	0.1059	0.1140	0.1227
33	0.0719	0.0815	0.0871	0.0984	0.1287	0.1324

* See facility type name/number key at end of appendix**.**

Freeflow (Volume=1) Speed Factors for BPA

Facility Type*	Area Type												
	CBD Jefferson	CBD Fringe Jefferson	Urban Jefferson	Suburban Jefferson	Suburban Fringe Jefferson	Rural Jefferson	Urban Orange	Suburban Orange	Suburban Fringe Orange	Rural Orange	Suburban Hardin	Suburban Fringe Hardin	Rural Hardin
1	1.3333	1.2609	1.5128	1.3636	1.4773	1.2679	2.0345	1.4634	1.5854	1.5435	1.3333	1.3333	1.6905
2	1.3333	1.2609	1.5128	1.2766	1.4773	1.2241	1.3333	1.3333	1.3333	1.3333	1.4286	1.3333	1.6905
3	1.3333	1.3333	1.5128	1.3636	1.3333	1.2679	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
9	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
10	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
12	--	--	--	--	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
13	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
14	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
15	--	1.3333	1.3333	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
16	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
17	1.3333	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
18	1.3333	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
19	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
20	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
21	1.3333	1.3333	1.3333	1.3333	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
22	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
23	1.3333	1.3333	1.3333	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
24	1.3333	--	1.3333	1.3333	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
25	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333

* See facility type name/number key at end of appendix**.**

Freeflow (Volume=1) Speed Factors for BPA (continued)

Facility Type	Area Type												
	CBD Jefferson	CBD Fringe Jefferson	Urban Jefferson	Suburban Jefferson	Suburban Fringe Jefferson	Rural Jefferson	Urban Orange	Suburban Orange	Suburban Fringe Orange	Rural Orange	Suburban Hardin	Suburban Fringe Hardin	Rural Hardin
24	1.3333	--	1.3333	1.3333	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
25	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
26	1.3333	1.3333	1.3333	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
27	1.3333	--	--	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	---	1.3333
28	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
29	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
31	1.3333	1.3333	1.3333	1.3333	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
32	--	--	--	--	--	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333	1.3333
33	--	--	--	1.3333	1.3333	1.3333	--	--	1.3333	1.3333	1.3333		1.3333

* See facility type name/number key at end of appendix.

Key to Facility Types

1 Interstate Highway - 10
2 Freeway - main lanes only
3 Parkway
9 Divided Principal Arterial
10 Divided Principal Arterial with Left Turn Bay
12 Divided Principal Arterial with Parking
13 One-Way Principal Arterial
14 Undivided Principal Arterial
15 Undivided Principal Arterial with Left Turn Bay
16 Undivided Principal Arterial with Continuous Left Turn
17 Divided Minor Arterial
18 Divided Minor Arterial with Left Turn Bay
19 Undivided Minor Arterial with Continuous Left Turn
20 Divided Minor Arterial with Parking
21 One-Way Minor Arterial
22 Undivided Minor Arterial
23 Undivided Minor Arterial with Left Turn Bay
24 Divided Collector
25 Undivided Collector
26 Divided Collector with Left Turn Bay
27 Gravel/Dirt Collector
28 Frontage Road One-Way
29 Ramp
31 Undivided Collector with Continuous Left Turn
32 Undivided Minor Arterial with Parking
33 Frontage Road Two-Way

APPENDIX E
BPA AUGUST 2000 EPISODE DAY HOURLY TEMPERATURES INPUT TO MOBILE6

BPA County August 2000 Episode Day Hourly Temperatures (degrees F) Input to MOBILE6

Central Daylight (Local) Time (calendar day temperatures; ordered as 6 a.m. to 12 a.m., 12 a.m. to 6 a.m.)

County Codes Key:
HARD = Hardin
JEFF = Jefferson
ORAN = Orange

AUG22
HARD
HOURLY TEMPERATURES: 77.8 78.0 80.6 83.6 86.8 86.7 83.1 81.3 86.4 90.7 88.1 87.9 88.0 86.8 84.6 81.3 77.9 77.3 76.8 81.7 81.0 80.4 78.8 78.1

JEFF
HOURLY TEMPERATURES: 77.6 79.1 82.3 84.8 86.1 83.7 81.2 84.3 87.5 88.2 87.2 87.2 86.4 84.6 82.2 79.3 77.5 76.5 76.0 78.7 78.0 77.6 77.5 77.2

ORAN
HOURLY TEMPERATURES: 74.9 75.9 79.0 82.9 86.9 85.0 79.1 84.5 89.3 87.8 84.1 84.5 84.9 83.5 78.0 75.1 74.9 74.8 74.6 76.9 76.2 75.7 75.6 74.9

AUG23
HARD
HOURLY TEMPERATURES: 75.7 75.6 77.0 79.3 81.9 81.5 80.5 84.4 85.5 84.9 86.4 87.4 87.1 86.5 84.5 83.1 81.4 80.3 79.9 76.4 76.6 76.5 76.2 76.2

JEFF
HOURLY TEMPERATURES: 75.6 76.1 77.8 79.7 81.6 83.6 84.0 83.5 84.4 85.7 86.6 86.9 85.8 83.7 82.2 81.3 80.1 79.1 78.5 76.4 76.9 77.2 77.0 76.0

ORAN
HOURLY TEMPERATURES: 72.9 73.4 76.0 80.2 83.9 86.1 84.5 79.9 80.2 83.6 85.6 86.7 86.1 83.5 80.5 78.7 77.4 76.5 76.0 74.4 74.1 73.7 73.2 73.0

AUG24
HARD
HOURLY TEMPERATURES: 75.7 75.8 78.0 80.7 82.4 84.2 82.2 81.3 77.1 76.7 76.7 77.3 77.8 78.1 78.1 77.0 76.7 76.5 75.9 79.1 77.4 77.1 76.7 76.6

JEFF
HOURLY TEMPERATURES: 75.9 76.9 79.6 82.9 83.3 82.1 80.2 79.2 79.3 78.5 77.9 77.9 78.4 78.3 77.5 76.4 75.9 75.3 75.1 77.8 77.4 77.0 76.6 75.9

ORAN
HOURLY TEMPERATURES: 73.6 73.9 77.1 81.3 85.0 86.7 87.8 82.6 75.7 75.4 76.0 77.4 78.8 77.7 76.6 76.0 75.1 74.6 74.3 75.5 75.0 74.4 74.0 73.7

AUG25
HARD
HOURLY TEMPERATURES: 73.9 74.3 76.1 78.7 80.7 82.9 85.6 89.6 91.2 92.0 92.4 91.2 88.8 86.3 83.8 82.0 80.8 79.4 78.7 75.4 75.1 74.6 74.2 73.5

JEFF
HOURLY TEMPERATURES: 74.5 75.7 78.8 81.8 83.3 85.4 87.8 90.0 91.4 91.6 90.9 89.4 87.2 84.4 81.3 79.8 78.9 78.0 77.1 74.6 74.7 74.4 74.0 73.9

ORAN
HOURLY TEMPERATURES: 73.4 74.1 75.4 78.3 82.2 85.0 88.2 90.5 91.1 91.9 92.4 91.4 89.4 86.1 82.5 80.5 79.5 77.5 76.3 73.8 75.1 74.5 73.8 73.4

AUG26
HARD
HOURLY TEMPERATURES: 76.4 76.2 77.7 80.0 83.4 86.2 89.3 91.0 92.9 92.6 93.4 92.3 90.1 86.7 83.8 82.0 80.8 79.7 79.6 78.0 77.5 77.2 77.1 76.7

JEFF
HOURLY TEMPERATURES: 74.8 76.1 79.3 82.2 84.8 87.2 89.3 91.2 92.0 92.4 92.0 90.5 87.9 84.4 81.6 79.8 78.9 78.0 77.7 76.3 75.7 75.0 74.4 74.5

ORAN
HOURLY TEMPERATURES: 72.9 73.9 77.0 81.4 84.4 86.8 89.3 91.2 92.6 93.4 93.5 92.4 90.0 86.1 82.5 80.2 79.0 77.3 77.1 75.5 75.0 74.3 73.6 73.0

AUG27
HARD
HOURLY TEMPERATURES: 77.4 77.6 80.5 83.9 86.2 88.8 90.7 92.8 93.9 94.3 93.1 91.5 89.4 86.5 84.6 83.6 82.6 81.4 81.1 80.3 79.6 78.5 77.5 77.1

JEFF
HOURLY TEMPERATURES: 75.9 77.0 81.7 85.6 87.9 90.0 91.4 92.7 92.9 92.6 91.4 89.8 87.6 84.8 82.4 81.4 80.4 79.6 78.9 77.7 77.2 76.6 76.3 75.6

ORAN
HOURLY TEMPERATURES: 72.9 73.7 77.5 82.2 86.0 88.9 91.0 92.6 93.3 93.5 92.8 91.4 89.2 85.9 83.0 81.0 79.3 78.4 77.5 76.5 75.2 74.8 73.6 72.8

AUG28
HARD
HOURLY TEMPERATURES: 77.6 77.3 79.8 83.3 86.9 89.0 90.8 92.6 93.6 92.7 92.6 92.1 89.6 86.7 84.3 82.7 81.6 80.4 79.0 80.2 79.0 77.9 77.8 77.7

JEFF
HOURLY TEMPERATURES: 75.9 77.0 81.5 85.8 88.9 90.5 92.1 92.6 92.8 92.4 91.8 90.5 88.0 84.8 82.1 80.5 79.2 78.6 78.2 78.2 77.4 76.7 76.2 75.8

ORAN
HOURLY TEMPERATURES: 72.8 73.8 77.8 82.8 85.8 89.0 91.3 92.1 93.6 94.1 93.7 91.9 89.7 86.3 82.9 80.6 78.8 78.0 76.4 76.5 75.8 74.1 73.6 73.3

AUG29
HARD
HOURLY TEMPERATURES: 77.0 76.5 77.6 82.6 85.8 88.8 91.2 93.5 95.3 96.0 97.3 96.6 92.6 88.9 85.8 83.7 82.4 81.3 80.0 78.4 77.7 77.3 76.9 77.0

JEFF
HOURLY TEMPERATURES: 75.3 76.6 80.3 84.0 86.9 89.5 91.7 93.8 94.8 95.2 94.8 92.7 89.5 85.9 83.0 81.3 80.3 79.1 78.5 77.3 76.6 76.0 75.4 74.7

ORAN
HOURLY TEMPERATURES: 73.0 73.4 77.7 82.2 85.5 88.6 91.4 93.5 95.6 97.1 97.7 97.0 93.3 88.6 85.4 83.3 81.9 80.2 78.6 75.9 74.8 74.0 73.6 73.1

AUG30
HARD
HOURLY TEMPERATURES: 77.5 77.6 79.5 82.7 86.3 89.8 92.9 95.7 98.1 100.0 101.4 101.8 101.5 96.5 90.9 87.4 85.6 84.2 83.0 79.9 78.5 78.8 78.2 77.5

JEFF
HOURLY TEMPERATURES: 75.8 76.6 79.7 83.7 87.9 91.5 95.0 97.4 99.4 100.5 100.6 99.7 96.6 91.3 87.0 84.6 83.3 82.2 81.7 78.1 77.7 77.0 76.1 75.7

ORAN
HOURLY TEMPERATURES: 74.8 75.5 78.2 82.7 87.6 91.5 95.3 98.2 100.5 101.8 102.3 101.3 99.1 93.2 89.7 86.9 84.6 82.5 81.6 77.1 76.6 76.4 75.5 75.6

AUG31
HARD
HOURLY TEMPERATURES: 80.4 80.0 81.9 87.4 91.7 95.7 98.4 101.2 103.4 105.0 103.7 100.4 100.9 97.7 94.8 92.0 89.9 88.1 87.2 82.7 82.1 81.5 81.2 80.0

JEFF
HOURLY TEMPERATURES: 77.3 78.1 82.1 87.8 93.0 97.1 100.1 102.3 104.0 104.3 103.0 99.7 97.5 93.2 89.4 87.9 86.2 85.8 84.7 81.0 80.3 79.2 78.4 77.7

ORAN
HOURLY TEMPERATURES: 75.6 75.9 79.9 86.1 92.2 97.0 100.9 103.9 105.5 106.1 105.3 99.6 97.0 92.6 88.6 87.7 86.9 86.0 85.9 81.0 79.5 78.6 77.4 76.2

SEP01
HARD
HOURLY TEMPERATURES: 80.8 80.6 83.2 86.2 89.5 93.0 95.1 97.7 99.9 101.0 96.3 88.5 89.6 88.6 86.5 85.8 86.7 84.7 82.9 85.1 83.8 82.7 82.5 80.9

JEFF
HOURLY TEMPERATURES: 79.5 79.7 82.5 85.7 89.9 93.5 95.7 97.4 99.0 98.3 94.9 89.2 87.0 86.6 84.7 84.7 83.2 82.0 82.3 83.8 83.4 82.0 81.4 80.3

ORAN
HOURLY TEMPERATURES: 78.7 78.7 80.1 84.6 89.4 93.5 96.2 98.3 100.0 99.5 94.1 88.6 86.2 85.1 84.5 82.0 79.5 78.2 78.2 83.7 81.8 81.2 80.6 80.0

APPENDIX F
BPA 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:
HARD = Hardin
JEFF = Jefferson
ORAN = Orange

AUG22
HARD - ABSOLUTE HUMIDITY: 139.6
JEFF - ABSOLUTE HUMIDITY: 135.6
ORAN - ABSOLUTE HUMIDITY: 128.1

AUG23
HARD - ABSOLUTE HUMIDITY: 131.7
JEFF - ABSOLUTE HUMIDITY: 131.6
ORAN - ABSOLUTE HUMIDITY: 119.8

AUG24
HARD - ABSOLUTE HUMIDITY: 132.2
JEFF - ABSOLUTE HUMIDITY: 130.4
ORAN - ABSOLUTE HUMIDITY: 122.7

AUG25
HARD - ABSOLUTE HUMIDITY: 122.5
JEFF - ABSOLUTE HUMIDITY: 124.4
ORAN - ABSOLUTE HUMIDITY: 122.0

AUG26
HARD - ABSOLUTE HUMIDITY: 134.5
JEFF - ABSOLUTE HUMIDITY: 126.2
ORAN - ABSOLUTE HUMIDITY: 119.9

AUG27
HARD - ABSOLUTE HUMIDITY: 138.7
JEFF - ABSOLUTE HUMIDITY: 131.7
ORAN - ABSOLUTE HUMIDITY: 119.6

AUG28
HARD - ABSOLUTE HUMIDITY: 139.6
JEFF - ABSOLUTE HUMIDITY: 132.4
ORAN - ABSOLUTE HUMIDITY: 119.6

AUG29
HARD - ABSOLUTE HUMIDITY: 135.8
JEFF - ABSOLUTE HUMIDITY: 127.9
ORAN - ABSOLUTE HUMIDITY: 120.4

AUG30
HARD - ABSOLUTE HUMIDITY: 140.6
JEFF - ABSOLUTE HUMIDITY: 132.3
ORAN - ABSOLUTE HUMIDITY: 128.0

AUG31
HARD - ABSOLUTE HUMIDITY: 153.0
JEFF - ABSOLUTE HUMIDITY: 139.8
ORAN - ABSOLUTE HUMIDITY: 131.8

SEP01
HARD - ABSOLUTE HUMIDITY: 156.2
JEFF - ABSOLUTE HUMIDITY: 150.2
ORAN - ABSOLUTE HUMIDITY: 144.1