Gridded Mobile Source Emissions Estimates for the Houston-Galveston Nonattainment Counties to Support the Attainment Demonstration SIP

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OVERVIEW OF METHODOLOGY

This technical note documents the procedures used by the TTI in developing the Houston-Galveston Nonattainment Counties Mobile Source Emissions Inventories for FY2007. The technical note documents the mobile source emissions inventory developed to represent typical summer weekday (Monday-Thursday) vehicle miles of travel (VMT). The temperatures used in the emissions rate calculations are for the Wednesday September 8, 1993 episode day used for the photochemical dispersion model calibration.

The software used for these procedures is described in Research Report 1279-9: "Texas Mobile Source Emissions Software Version 2.0: User's Manual," TTI, February 1995.

The purpose of this report is to document procedures supporting State Implementation Plan (SIP) submittals produced for and in cooperation with TNRCC. The SIP-related materials being submitted to the Environmental Protection Agency (EPA) by TNRCC are prepared in English units. Because this report is to document procedures supporting SIP submittals, English units have been used to maintain consistency.

For the development of the emissions inventory, a 24-hour assignment was performed for the HGAC counties for FY2007. Summer VMT, speeds, and mobile source emissions estimates were developed for this assignment. The following briefly describes the methodology used in developing the estimates. The 2007 travel model network includes all of the eight-county nonattainment area. The emissions estimates are developed by county.

A series of programs developed by TTI to facilitate the estimation of mobile source emissions was used for the emissions inventory analyses. The three programs used for computing the mobile source emissions are:

PREPIN2 — The PREPIN2 program inputs a 24-hour assignment and applies VMT adjustment factors and time-of-day factors to estimate time-of-day travel. The HGAC speed model was used to estimate the operational and directional time-of-day speeds on the links. The intrazonal VMT and speeds for intrazonal trips are estimated. The directional VMT and speeds by link are subsequently input to the IMPSUMA program for estimating emissions.

POLFC5B — The POLFC5B program is used to apply the EPA's MOBILE5B program to obtain the emissions factors. The MOBILE5B emissions factors are obtained for eight vehicle types and 63 speeds (i.e., 3 mph through 65 mph) for each vehicle type. There are 504 factors (8 x 63 = 504) for each pollution type for each county. Emissions factors rates were computed for VOC, CO and NOx. The emissions factors are output to an ASCII file for subsequent input to the IMPSUMA program. POLFC5B is applied for each time-of-day period.

IMPSUMA The IMPSUMA program applies the emissions rates and VMT mixes to the time-of-day directional VMT and speed estimates to estimate the emissions. The basic inputs to IMPSUMA are:

54. Data specifying the number of counties in the region and their names.
55. Names of the roadway types used in the study. These roadway types are used to summarize the emissions results.
56. VMT mix by roadway type.
57. MOBILE5B emissions factors.
58. Specification of the units for reporting emissions (grams, pounds, or tons).
59. Travel model trip assignment results by link input for the subject time period. For each link, the following information is input to IMPSUMA: county number, roadway type number, VMT on link, operational speed estimate, and link distance.

Using the PREPIN2 software, the 24-hour assignment was used to develop adjusted time-of-day for weekday (Monday-Thursday) VMT and speed estimates for 24 time-of-day periods corresponding to the 24 hours of the day. The VMT from the travel model trip assignment was adjusted by county to the 2007 VMT reported in HGAC's March 23, 2000 conformity document.

The POLFC5B program was applied to develop the emissions factors for each time-of-day period for 2007. The September 8, 1993 episode day temperatures were input for the POLFC5B application of MOBILE5B. A separate 24-hour application of MOBILE5B was used to develop the diurnal emissions rates.

Finally, IMPSUMA was applied to estimate the emissions for each of the 24 one hour time-of-day periods. The 24-hour diurnal estimates were computed using the 24-hour diurnal rates. The county emissions estimates for each of the time-of-day periods and the diurnal estimates were summed to develop the final emissions estimates. The emissions were gridded into 4-kilometer grids for each of the 24 one-hour time-of-day periods and for the 24-hour period.

The gridded emissions were posted to the TTI FTP site for use by the TNRCC photochemical modeling staff.

This technical note documents the mobile source emissions estimation methodology used in developing the FY2007 emissions inventories for the HGAC counties. The description of the methodology is divided into three sections. The first section describes the methodology used to estimate the time-of-day VMT and associated operating speeds. The second section describes the methodology used to estimate emissions factors. The third section describes the methodology used to estimate emissions.

ESTIMATION OF TIME-OF-DAY VMT AND SPEED

The time-of-day VMT and speed estimates were developed using the PREPIN2 program. The program inputs a 24-hour assignment and applies the VMT adjustment factors. The time-of-day factors are applied to the adjusted 24-hour assignment results to estimate the directional time-of-day travel. The HGAC speed model was used to estimate the operational time-of-day speeds by direction on the links. Intrazonal links are defined and the VMT and speeds for intrazonal trips are estimated. These VMT and speeds by link are subsequently input to the IMPSUMA program for the application of MOBILE5B emissions rates.

For the development of gridded emissions, the HGAC 24-hour assignment was used as input to the PREPIN2 program. For a given application, 24 applications of PREPIN2 are run to estimate the directional VMT and speeds for each of the 24 one-hour time periods comprising the 24-hour period.

The PREPIN2 applications were used to develop VMT and speed estimates for a typical summer weekday (Monday - Thursday). The weekday PREPIN2 applications are used in conjunction with the Wednesday, September 8, 1993 episode temperatures in the POLFC5B application to produce emissions factors and with the IMPSUMA application to develop gridded emissions.

For a given application of PREPIN2 the following data or factors were input:

1. County table of equals;
2. Area type table of equals (obtained from a field on the link data);
3. VMT adjustment factor;
4. Time-of-day factor;
5. Directional split factors;
6. Time-of-day capacity factors;
7. Freeflow (LOS A) speed factors;
8. Congested (LOS E) speed factors;
9. Speed reduction factors;
10. Intrazonal trip tables by zone;
11. Zonal radii data; and
12. Equilibrium assignment link volumes.

The remainder of this section discusses the essential input data used in the HGAC area PREPIN2 applications to prepare the time-of-day VMT and speed estimates. The primary output of PREPIN2 is a data set for the subject time period containing two records for each link (i.e., one record specifying the estimated time-of-day VMT and speed in the peak, or principal, direction and the second record specifying the estimated VMT and speed in the opposite direction). This data set is subsequently input to the IMPSUMA program which applies the MOBILE5B emissions rates (developed using the POLFC5B program) to estimate the mobile source emissions for each link. VMTSUM calculates the VMT by time period for input into IMPSUMA to incorporate the diurnal emissions into the appropriate

time period. Finally, the SUMALL program combines the time-of-day emissions estimates to obtain 24-hour gridded emissions.

County Specifications

The PREPIN2 program can process an assignment comprised of up to eight counties. Various summaries are produced by county and for the entire region. For a given application, the counties are numbered sequentially starting with one. The county table-of-equals data input to PREPIN2 specifies the zone numbers contained in each county. The HGAC study area is comprised of eight counties (Harris, Brazoria, Fort Bend, Waller, Montgomery, Liberty, Chambers, and Galveston). The zone-to-county table of equals was provided by HGAC.

Each link in the network is assigned an associated zone number. Using the link's associated zone number, the county within which the link is located is determined using these input data. The county number is included in the link record output data set produced by PREPIN2. The specification of the county number in these data allows the IMPSUMA program to accumulate and report the mobile source emissions estimates by county and/or grid.

Area Type Specifications

PREPIN2 allows various factors to be specified by area type number and functional classification number. The HGAC travel model uses the area types shown in Table 1. The HGAC network area type table-of-equals specifies the zones contained in each of the five area types. The area type for a link is determined by using the link's associated zone number.

TABLE 1
Area Types

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

VMT Adjustment Factors

For this application the 2007 VMT forecast developed by HGAC for the March 23, 2000 conformity analysis was used. This VMT forecast is documented in the report "Conformity Determinations for the 2022 Metropolitan Transportation Plan and the 2000-2020 Transportation Improvement Program for Houston-Galveston Transportation Management Area," March 23, 2000. The VMT documented in

this report for 2007 is 129,362,381 VMT per day. The VMT from the 2007 traffic assignment provided to TTI by HGAC was adjusted by county to match this "control total" VMT for each county. The adjustment factors by county are shown in Table 2.

TABLE 2
VMT Adjustment Factors

County	VMT from 2007 24-hour assignment	VMT for 2007 from conformity report	VMT adjustment factor
Brazoria	5,247,695.60	5,103,879	0.972594065
Chambers	2,785,338.90	2,684,527	0.963806495
Ft. Bend	8,498,678.50	8,083,012	0.951090478
Galveston	4,793,629.30	5,032,143	1.049756161
Harris	90,454,347.00	94,611,517	1.045958776
Liberty	2,204,443.60	2,408,401	1.092521088
Montgomery	9,857,840.90	9,883,268	1.002579457
Waller	1,498,273.20	1,555,634	1.038284648
Total	125,340,247.00	129,362,381	

Time-of-Day Travel Factors

Field traffic volume counts were used to estimate time-of-day volume factors by area type and functional classification. GET_PER, a FORTRAN program developed specifically to compile field data, was used to obtain 24 sets of PERFAC records for each hour of the day for input into PREPIN2. This program was run for weekday application. The time-of-day travel factors are presented in Tables 3 through 7. The time-of-day factors used are identical to the factors estimated from the field study. No attempt was made to estimate peak spreading. Peak spreading refers to the tendency of travelers to change trip start times to off-peak or shoulder-peak periods as the amount of traffic congestion in the peak hour increases.

TABLE 3
Time-of-Day Factors by Period for Area Type 1 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	0.010101	0.010101	0.008866	0.008866	0.005589	0.005589	0.010101	0.010101	0.008866	0.008866	0.008866	0.005589	0.005589
2	0.006459	0.006459	0.005825	0.005825	0.003887	0.003887	0.006459	0.006459	0.005825	0.005825	0.005825	0.003887	0.003887
3	0.005878	0.005878	0.004893	0.004893	0.003872	0.003872	0.005878	0.005878	0.004893	0.004893	0.004893	0.003872	0.003872
4	0.004804	0.004804	0.003173	0.003173	0.004226	0.004226	0.004804	0.004804	0.003173	0.003173	0.003173	0.004226	0.004226
5	0.006928	0.006928	0.004247	0.004247	0.008401	0.008401	0.006928	0.006928	0.004247	0.004247	0.004247	0.008401	0.008401
6	0.021776	0.021776	0.014491	0.014491	0.024648	0.024648	0.021776	0.021776	0.014491	0.014491	0.014491	0.024648	0.024648
7	0.059444	0.059444	0.045344	0.045344	0.040888	0.040888	0.059444	0.059444	0.045344	0.045344	0.045344	0.040888	0.040888
8	0.077120	0.077120	0.073845	0.073845	0.059638	0.059638	0.077120	0.077120	0.073845	0.073845	0.073845	0.059638	0.059638
9	0.060234	0.060234	0.067518	0.067518	0.051857	0.051857	0.060234	0.060234	0.067518	0.067518	0.067518	0.051857	0.051857
10	0.051292	0.051292	0.052463	0.052463	0.042857	0.042857	0.051292	0.051292	0.052463	0.052463	0.052463	0.042857	0.042857
11	0.050670	0.050670	0.049986	0.049986	0.041494	0.041494	0.050670	0.050670	0.049986	0.049986	0.049986	0.041494	0.041494
12	0.053514	0.053514	0.057882	0.057882	0.044710	0.044710	0.053514	0.053514	0.057882	0.057882	0.057882	0.044710	0.044710
13	0.053456	0.053456	0.060293	0.060293	0.049498	0.049498	0.053456	0.053456	0.060293	0.060293	0.060293	0.049498	0.049498
14	0.055162	0.055162	0.058553	0.058553	0.058642	0.058642	0.055162	0.055162	0.058553	0.058553	0.058553	0.058642	0.058642
15	0.058541	0.058541	0.061388	0.061388	0.056962	0.056962	0.058541	0.058541	0.061388	0.061388	0.061388	0.056962	0.056962
16	0.066065	0.066065	0.065776	0.065776	0.072409	0.072409	0.066065	0.066065	0.065776	0.065776	0.065776	0.072409	0.072409
17	0.074882	0.074882	0.075768	0.075768	0.082195	0.082195	0.074882	0.074882	0.075768	0.075768	0.075768	0.082195	0.082195
18	0.078599	0.078599	0.077365	0.077365	0.093206	0.093206	0.078599	0.078599	0.077365	0.077365	0.077365	0.093206	0.093206
19	0.056445	0.056445	0.058969	0.058969	0.082526	0.082526	0.056445	0.056445	0.058969	0.058969	0.058969	0.082526	0.082526
20	0.041706	0.041706	0.044604	0.044604	0.060561	0.060561	0.041706	0.041706	0.044604	0.044604	0.044604	0.060561	0.060561
21	0.033109	0.033109	0.034782	0.034782	0.045316	0.045316	0.033109	0.033109	0.034782	0.034782	0.034782	0.045316	0.045316
22	0.030036	0.030036	0.030965	0.030965	0.033547	0.033547	0.030036	0.030036	0.030965	0.030965	0.030965	0.033547	0.033547
23	0.025845	0.025845	0.025821	0.025821	0.022644	0.022644	0.025845	0.025845	0.025821	0.025821	0.025821	0.022644	0.022644
24	0.017936	0.017936	0.017183	0.017183	0.010428	0.010428	0.017936	0.017936	0.017183	0.017183	0.017183	0.010428	0.010428

TABLE 4
Time-of-Day Factors by Period for Area Type 2 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	0.010101	0.010101	0.008866	0.008866	0.005589	0.005589	0.010101	0.010101	0.008866	0.008866	0.008866	0.005589	0.005589
2	0.006459	0.006459	0.005825	0.005825	0.003887	0.003887	0.006459	0.006459	0.005825	0.005825	0.005825	0.003887	0.003887
3	0.005878	0.005878	0.004893	0.004893	0.003872	0.003872	0.005878	0.005878	0.004893	0.004893	0.004893	0.003872	0.003872
4	0.004804	0.004804	0.003173	0.003173	0.004226	0.004226	0.004804	0.004804	0.003173	0.003173	0.003173	0.004226	0.004226
5	0.006928	0.006928	0.004247	0.004247	0.008401	0.008401	0.006928	0.006928	0.004247	0.004247	0.004247	0.008401	0.008401
6	0.021776	0.021776	0.014491	0.014491	0.024648	0.024648	0.021776	0.021776	0.014491	0.014491	0.014491	0.024648	0.024648
7	0.059444	0.059444	0.045344	0.045344	0.040888	0.040888	0.059444	0.059444	0.045344	0.045344	0.045344	0.040888	0.040888
8	0.077120	0.077120	0.073845	0.073845	0.059638	0.059638	0.077120	0.077120	0.073845	0.073845	0.073845	0.059638	0.059638
9	0.060234	0.060234	0.067518	0.067518	0.051857	0.051857	0.060234	0.060234	0.067518	0.067518	0.067518	0.051857	0.051857
10	0.051292	0.051292	0.052463	0.052463	0.042857	0.042857	0.051292	0.051292	0.052463	0.052463	0.052463	0.042857	0.042857
11	0.050670	0.050670	0.049986	0.049986	0.041494	0.041494	0.050670	0.050670	0.049986	0.049986	0.049986	0.041494	0.041494
12	0.053514	0.053514	0.057882	0.057882	0.044710	0.044710	0.053514	0.053514	0.057882	0.057882	0.057882	0.044710	0.044710
13	0.053456	0.053456	0.060293	0.060293	0.049498	0.049498	0.053456	0.053456	0.060293	0.060293	0.060293	0.049498	0.049498
14	0.055162	0.055162	0.058553	0.058553	0.058642	0.058642	0.055162	0.055162	0.058553	0.058553	0.058553	0.058642	0.058642
15	0.058541	0.058541	0.061388	0.061388	0.056962	0.056962	0.058541	0.058541	0.061388	0.061388	0.061388	0.056962	0.056962
16	0.066065	0.066065	0.065776	0.065776	0.072409	0.072409	0.066065	0.066065	0.065776	0.065776	0.065776	0.072409	0.072409
17	0.074882	0.074882	0.075768	0.075768	0.082195	0.082195	0.074882	0.074882	0.075768	0.075768	0.075768	0.082195	0.082195
18	0.078599	0.078599	0.077365	0.077365	0.093206	0.093206	0.078599	0.078599	0.077365	0.077365	0.077365	0.093206	0.093206
19	0.056445	0.056445	0.058969	0.058969	0.082526	0.082526	0.056445	0.056445	0.058969	0.058969	0.058969	0.082526	0.082526
20	0.041706	0.041706	0.044604	0.044604	0.060561	0.060561	0.041706	0.041706	0.044604	0.044604	0.044604	0.060561	0.060561
21	0.033109	0.033109	0.034782	0.034782	0.045316	0.045316	0.033109	0.033109	0.034782	0.034782	0.034782	0.045316	0.045316
22	0.030036	0.030036	0.030965	0.030965	0.033547	0.033547	0.030036	0.030036	0.030965	0.030965	0.030965	0.033547	0.033547
23	0.025845	0.025845	0.025821	0.025821	0.022644	0.022644	0.025845	0.025845	0.025821	0.025821	0.025821	0.022644	0.022644
24	0.017936	0.017936	0.017183	0.017183	0.010428	0.010428	0.017936	0.017936	0.017183	0.017183	0.017183	0.010428	0.010428

TABLE 5
Time-of-Day Factors by Period for Area Type 3 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	0.009899	0.009899	0.010740	0.010740	0.005589	0.005589	0.009899	0.009899	0.010740	0.010740	0.010740	0.005589	0.005589
2	0.005988	0.005988	0.006907	0.006907	0.003887	0.003887	0.005988	0.005988	0.006907	0.006907	0.006907	0.003887	0.003887
3	0.005155	0.005155	0.006124	0.006124	0.003872	0.003872	0.005155	0.005155	0.006124	0.006124	0.006124	0.003872	0.003872
4	0.003777	0.003777	0.003907	0.003907	0.004226	0.004226	0.003777	0.003777	0.003907	0.003907	0.003907	0.004226	0.004226
5	0.004681	0.004681	0.004999	0.004999	0.008401	0.008401	0.004681	0.004681	0.004999	0.004999	0.004999	0.008401	0.008401
6	0.012244	0.012244	0.013746	0.013746	0.024648	0.024648	0.012244	0.012244	0.013746	0.013746	0.013746	0.024648	0.024648
7	0.038290	0.038290	0.036543	0.036543	0.040888	0.040888	0.038290	0.038290	0.036543	0.036543	0.036543	0.040888	0.040888
8	0.077547	0.077547	0.058773	0.058773	0.059638	0.059638	0.077547	0.077547	0.058773	0.058773	0.058773	0.059638	0.059638
9	0.053864	0.053864	0.056626	0.056626	0.051857	0.051857	0.053864	0.053864	0.056626	0.056626	0.056626	0.051857	0.051857
10	0.045773	0.045773	0.046060	0.046060	0.042857	0.042857	0.045773	0.045773	0.046060	0.046060	0.046060	0.042857	0.042857
11	0.049657	0.049657	0.042817	0.042817	0.041494	0.041494	0.049657	0.049657	0.042817	0.042817	0.042817	0.041494	0.041494
12	0.054705	0.054705	0.054264	0.054264	0.044710	0.044710	0.054705	0.054705	0.054264	0.054264	0.054264	0.044710	0.044710
13	0.055931	0.055931	0.060487	0.060487	0.049498	0.049498	0.055931	0.055931	0.060487	0.060487	0.060487	0.049498	0.049498
14	0.057659	0.057659	0.061056	0.061056	0.058642	0.058642	0.057659	0.057659	0.061056	0.061056	0.061056	0.058642	0.058642
15	0.061588	0.061588	0.062705	0.062705	0.056962	0.056962	0.061588	0.061588	0.062705	0.062705	0.062705	0.056962	0.056962
16	0.069080	0.069080	0.066580	0.066580	0.072409	0.072409	0.069080	0.069080	0.066580	0.066580	0.066580	0.072409	0.072409
17	0.081243	0.081243	0.075315	0.075315	0.082195	0.082195	0.081243	0.081243	0.075315	0.075315	0.075315	0.082195	0.082195
18	0.088592	0.088592	0.080516	0.080516	0.093206	0.093206	0.088592	0.088592	0.080516	0.080516	0.080516	0.093206	0.093206
19	0.060774	0.060774	0.068529	0.068529	0.082526	0.082526	0.060774	0.060774	0.068529	0.068529	0.068529	0.082526	0.082526
20	0.045996	0.045996	0.053810	0.053810	0.060561	0.060561	0.045996	0.045996	0.053810	0.053810	0.053810	0.060561	0.060561
21	0.037494	0.037494	0.044524	0.044524	0.045316	0.045316	0.037494	0.037494	0.044524	0.044524	0.044524	0.045316	0.045316
22	0.032374	0.032374	0.037856	0.037856	0.033547	0.033547	0.032374	0.032374	0.037856	0.037856	0.037856	0.033547	0.033547
23	0.027675	0.027675	0.028272	0.028272	0.022644	0.022644	0.027675	0.027675	0.028272	0.028272	0.028272	0.022644	0.022644
24	0.020013	0.020013	0.018844	0.018844	0.010428	0.010428	0.020013	0.020013	0.018844	0.018844	0.018844	0.010428	0.010428

TABLE 6
Time-of-Day Factors by Period for Area Type 4 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	0.012058	0.012058	0.007230	0.007230	0.005589	0.005589	0.012058	0.012058	0.007230	0.007230	0.007230	0.005589	0.005589
2	0.008543	0.008543	0.004469	0.004469	0.003887	0.003887	0.008543	0.008543	0.004469	0.004469	0.004469	0.003887	0.003887
3	0.007630	0.007630	0.003407	0.003407	0.003872	0.003872	0.007630	0.007630	0.003407	0.003407	0.003407	0.003872	0.003872
4	0.006802	0.006802	0.003897	0.003897	0.004226	0.004226	0.006802	0.006802	0.003897	0.003897	0.003897	0.004226	0.004226
5	0.009587	0.009587	0.011269	0.011269	0.008401	0.008401	0.009587	0.009587	0.011269	0.011269	0.011269	0.008401	0.008401
6	0.025017	0.025017	0.039913	0.039913	0.024648	0.024648	0.025017	0.025017	0.039913	0.039913	0.039913	0.024648	0.024648
7	0.053346	0.053346	0.069782	0.069782	0.040888	0.040888	0.053346	0.053346	0.069782	0.069782	0.069782	0.040888	0.040888
8	0.058888	0.058888	0.073848	0.073848	0.059638	0.059638	0.058888	0.058888	0.073848	0.073848	0.073848	0.059638	0.059638
9	0.052111	0.052111	0.050499	0.050499	0.051857	0.051857	0.052111	0.052111	0.050499	0.050499	0.050499	0.051857	0.051857
10	0.049725	0.049725	0.047721	0.047721	0.042857	0.042857	0.049725	0.049725	0.047721	0.047721	0.047721	0.042857	0.042857
11	0.051473	0.051473	0.046411	0.046411	0.041494	0.041494	0.051473	0.051473	0.046411	0.046411	0.046411	0.041494	0.041494
12	0.053914	0.053914	0.048967	0.048967	0.044710	0.044710	0.053914	0.053914	0.048967	0.048967	0.048967	0.044710	0.044710
13	0.055094	0.055094	0.049400	0.049400	0.049498	0.049498	0.055094	0.055094	0.049400	0.049400	0.049400	0.049498	0.049498
14	0.056912	0.056912	0.050419	0.050419	0.058642	0.058642	0.056912	0.056912	0.050419	0.050419	0.050419	0.058642	0.058642
15	0.059225	0.059225	0.055513	0.055513	0.056962	0.056962	0.059225	0.059225	0.055513	0.055513	0.055513	0.056962	0.056962
16	0.063828	0.063828	0.066804	0.066804	0.072409	0.072409	0.063828	0.063828	0.066804	0.066804	0.066804	0.072409	0.072409
17	0.067577	0.067577	0.079738	0.079738	0.082195	0.082195	0.067577	0.067577	0.079738	0.079738	0.079738	0.082195	0.082195
18	0.070278	0.070278	0.084603	0.084603	0.093206	0.093206	0.070278	0.070278	0.084603	0.084603	0.084603	0.093206	0.093206
19	0.063623	0.063623	0.065777	0.065777	0.082526	0.082526	0.063623	0.063623	0.065777	0.065777	0.065777	0.082526	0.082526
20	0.050700	0.050700	0.044074	0.044074	0.060561	0.060561	0.050700	0.050700	0.044074	0.044074	0.044074	0.060561	0.060561
21	0.040109	0.040109	0.033823	0.033823	0.045316	0.045316	0.040109	0.040109	0.033823	0.033823	0.033823	0.045316	0.045316
22	0.035201	0.035201	0.028184	0.028184	0.033547	0.033547	0.035201	0.035201	0.028184	0.028184	0.028184	0.033547	0.033547
23	0.028106	0.028106	0.020766	0.020766	0.022644	0.022644	0.028106	0.028106	0.020766	0.020766	0.020766	0.022644	0.022644
24	0.020252	0.020252	0.013484	0.013484	0.010428	0.010428	0.020252	0.020252	0.013484	0.013484	0.013484	0.010428	0.010428

TABLE 7
Time-of-Day Factors by Period for Area Type 5 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	0.008329	0.008329	0.008329	0.008329	0.007435	0.007435	0.008329	0.008329	0.008329	0.008329	0.008329	0.007435	0.007435
2	0.005598	0.005598	0.005598	0.005598	0.005318	0.005318	0.005598	0.005598	0.005598	0.005598	0.005598	0.005318	0.005318
3	0.005042	0.005042	0.005042	0.005042	0.005082	0.005082	0.005042	0.005042	0.005042	0.005042	0.005042	0.005082	0.005082
4	0.005221	0.005221	0.005221	0.005221	0.005345	0.005345	0.005221	0.005221	0.005221	0.005221	0.005221	0.005345	0.005345
5	0.009803	0.009803	0.009803	0.009803	0.010056	0.010056	0.009803	0.009803	0.009803	0.009803	0.009803	0.010056	0.010056
6	0.032432	0.032432	0.032432	0.032432	0.035002	0.035002	0.032432	0.032432	0.032432	0.032432	0.032432	0.035002	0.035002
7	0.058440	0.058440	0.058440	0.058440	0.063302	0.063302	0.058440	0.058440	0.058440	0.058440	0.058440	0.063302	0.063302
8	0.065128	0.065128	0.065128	0.065128	0.074663	0.074663	0.065128	0.065128	0.065128	0.065128	0.065128	0.074663	0.074663
9	0.057697	0.057697	0.057697	0.057697	0.052601	0.052601	0.057697	0.057697	0.057697	0.057697	0.057697	0.052601	0.052601
10	0.050154	0.050154	0.050154	0.050154	0.045776	0.045776	0.050154	0.050154	0.050154	0.050154	0.050154	0.045776	0.045776
11	0.049355	0.049355	0.049355	0.049355	0.044185	0.044185	0.049355	0.049355	0.049355	0.049355	0.049355	0.044185	0.044185
12	0.051135	0.051135	0.051135	0.051135	0.040610	0.040610	0.051135	0.051135	0.051135	0.051135	0.051135	0.040610	0.040610
13	0.052099	0.052099	0.052099	0.052099	0.040004	0.040004	0.052099	0.052099	0.052099	0.052099	0.052099	0.040004	0.040004
14	0.053785	0.053785	0.053785	0.053785	0.043907	0.043907	0.053785	0.053785	0.053785	0.053785	0.053785	0.043907	0.043907
15	0.057769	0.057769	0.057769	0.057769	0.055401	0.055401	0.057769	0.057769	0.057769	0.057769	0.057769	0.055401	0.055401
16	0.064759	0.064759	0.064759	0.064759	0.064946	0.064946	0.064759	0.064759	0.064759	0.064759	0.064759	0.064946	0.064946
17	0.072303	0.072303	0.072303	0.072303	0.086134	0.086134	0.072303	0.072303	0.072303	0.072303	0.072303	0.086134	0.086134
18	0.077950	0.077950	0.077950	0.077950	0.097080	0.097080	0.077950	0.077950	0.077950	0.077950	0.077950	0.097080	0.097080
19	0.068825	0.068825	0.068825	0.068825	0.076326	0.076326	0.068825	0.068825	0.068825	0.068825	0.068825	0.076326	0.076326
20	0.048420	0.048420	0.048420	0.048420	0.049511	0.049511	0.048420	0.048420	0.048420	0.048420	0.048420	0.049511	0.049511
21	0.036254	0.036254	0.036254	0.036254	0.035285	0.035285	0.036254	0.036254	0.036254	0.036254	0.036254	0.035285	0.035285
22	0.030705	0.030705	0.030705	0.030705	0.028952	0.028952	0.030705	0.030705	0.030705	0.030705	0.030705	0.028952	0.028952
23	0.023659	0.023659	0.023659	0.023659	0.021654	0.021654	0.023659	0.023659	0.023659	0.023659	0.023659	0.021654	0.021654
24	0.015140	0.015140	0.015140	0.015140	0.011426	0.011426	0.015140	0.015140	0.015140	0.015140	0.015140	0.011426	0.011426

Time-of-Day Directional Split Estimates

The 24-hour link assignment volumes are nondirectional volumes (i.e., the sum of the volumes in the two directions on a link). The adjustment factor and time-of-day travel factor are applied to estimate the adjusted time-of-day volume on a link. The PREPIN2 program provides for the application of directional splits to estimate the portion of the travel expected to occur in each direction. These directional volume estimates are used to estimate the directional speeds. The PREPIN2 program outputs two link records for a link: a link record containing the estimated VMT and speed in the peak (or dominant) direction and a link record containing the estimated VMT and speed in the off-peak (or opposite) direction. This allows the IMPSUMA program to apply the MOBILE5B emissions rates directionally by speed.

Field data traffic volume counts were used to obtain time-of-day directional split estimates by area type and functional classification. The program GET_SPLT, the FORTRAN program developed by TTI for this application, was used to obtain 24 sets of these factors (i.e., a set for each of the 24 one-hour periods). These results were entered into SPLIT records for input to PREPIN2. The directional split factors used are presented in Tables 8 through 12. The directional split factors are unchanged from the factors developed from the field studies.

TABLE 8
Directional Split Factors by Period for Area Type 1 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Time Period
1	52.19880	52.19880	64.01890	64.01890	75.87070	75.87070	52.19880	52.19880	64.01890	64.01890	64.01890	75.87070	75.87070
2	52.86750	52.86750	66.00890	66.00890	74.40840	74.40840	52.86750	52.86750	66.00890	66.00890	66.00890	74.40840	74.40840
3	53.91080	53.91080	65.38020	65.38020	79.30230	79.30230	53.91080	53.91080	65.38020	65.38020	65.38020	79.30230	79.30230
4	52.49740	52.49740	63.09400	63.09400	73.98310	73.98310	52.49740	52.49740	63.09400	63.09400	63.09400	73.98310	73.98310
5	53.77120	53.77120	64.15790	64.15790	69.63330	69.63330	53.77120	53.77120	64.15790	64.15790	64.15790	69.63330	69.63330
6	55.13440	55.13440	67.76630	67.76630	75.38650	75.38650	55.13440	55.13440	67.76630	67.76630	67.76630	75.38650	75.38650
7	54.02580	54.02580	69.45290	69.45290	77.25600	77.25600	54.02580	54.02580	69.45290	69.45290	69.45290	77.25600	77.25600
8	53.37670	53.37670	68.72790	68.72790	65.87060	65.87060	53.37670	53.37670	68.72790	68.72790	68.72790	65.87060	65.87060
9	53.21530	53.21530	65.42840	65.42840	65.97560	65.97560	53.21530	53.21530	65.42840	65.42840	65.42840	65.97560	65.97560
10	52.49430	52.49430	59.58130	59.58130	64.27310	64.27310	52.49430	52.49430	59.58130	59.58130	59.58130	64.27310	64.27310
11	51.71550	51.71550	56.86130	56.86130	60.55200	60.55200	51.71550	51.71550	56.86130	56.86130	56.86130	60.55200	60.55200
12	51.44190	51.44190	57.97210	57.97210	60.90190	60.90190	51.44190	51.44190	57.97210	57.97210	57.97210	60.90190	60.90190
13	51.02330	51.02330	56.40580	56.40580	58.11410	58.11410	51.02330	51.02330	56.40580	56.40580	56.40580	58.11410	58.11410
14	50.98520	50.98520	56.87580	56.87580	59.17030	59.17030	50.98520	50.98520	56.87580	56.87580	56.87580	59.17030	59.17030
15	51.22640	51.22640	57.69340	57.69340	59.71810	59.71810	51.22640	51.22640	57.69340	57.69340	57.69340	59.71810	59.71810
16	52.05240	52.05240	60.95350	60.95350	55.10250	55.10250	52.05240	52.05240	60.95350	60.95350	60.95350	55.10250	55.10250
17	52.25850	52.25850	63.99890	63.99890	56.66530	56.66530	52.25850	52.25850	63.99890	63.99890	63.99890	56.66530	56.66530
18	52.62830	52.62830	63.81940	63.81940	60.07770	60.07770	52.62830	52.62830	63.81940	63.81940	63.81940	60.07770	60.07770
19	52.09090	52.09090	62.12740	62.12740	57.91410	57.91410	52.09090	52.09090	62.12740	62.12740	62.12740	57.91410	57.91410
20	52.38810	52.38810	60.46770	60.46770	56.64520	56.64520	52.38810	52.38810	60.46770	60.46770	60.46770	56.64520	56.64520
21	52.14170	52.14170	63.17760	63.17760	58.06080	58.06080	52.14170	52.14170	63.17760	63.17760	63.17760	58.06080	58.06080
22	52.24880	52.24880	64.58590	64.58590	61.56790	61.56790	52.24880	52.24880	64.58590	64.58590	64.58590	61.56790	61.56790
23	52.55520	52.55520	63.63590	63.63590	59.75560	59.75560	52.55520	52.55520	63.63590	63.63590	63.63590	59.75560	59.75560
24	52.90530	52.90530	63.55340	63.55340	63.49810	63.49810	52.90530	52.90530	63.55340	63.55340	63.55340	63.49810	63.49810

TABLE 9
Directional Split Factors by Period for Area Type 2 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	52.19880	52.19880	64.01890	64.01890	75.87070	75.87070	52.19880	52.19880	64.01890	64.01890	64.01890	75.87070	75.87070
2	52.86750	52.86750	66.00890	66.00890	74.40840	74.40840	52.86750	52.86750	66.00890	66.00890	66.00890	74.40840	74.40840
3	53.91080	53.91080	65.38020	65.38020	79.30230	79.30230	53.91080	53.91080	65.38020	65.38020	65.38020	79.30230	79.30230
4	52.49740	52.49740	63.09400	63.09400	73.98310	73.98310	52.49740	52.49740	63.09400	63.09400	63.09400	73.98310	73.98310
5	53.77120	53.77120	64.15790	64.15790	69.63330	69.63330	53.77120	53.77120	64.15790	64.15790	64.15790	69.63330	69.63330
6	55.13440	55.13440	67.76630	67.76630	75.38650	75.38650	55.13440	55.13440	67.76630	67.76630	67.76630	75.38650	75.38650
7	54.02580	54.02580	69.45290	69.45290	77.25600	77.25600	54.02580	54.02580	69.45290	69.45290	69.45290	77.25600	77.25600
8	53.37670	53.37670	68.72790	68.72790	65.87060	65.87060	53.37670	53.37670	68.72790	68.72790	68.72790	65.87060	65.87060
9	53.21530	53.21530	65.42840	65.42840	65.97560	65.97560	53.21530	53.21530	65.42840	65.42840	65.42840	65.97560	65.97560
10	52.49430	52.49430	59.58130	59.58130	64.27310	64.27310	52.49430	52.49430	59.58130	59.58130	59.58130	64.27310	64.27310
11	51.71550	51.71550	56.86130	56.86130	60.55200	60.55200	51.71550	51.71550	56.86130	56.86130	56.86130	60.55200	60.55200
12	51.44190	51.44190	57.97210	57.97210	60.90190	60.90190	51.44190	51.44190	57.97210	57.97210	57.97210	60.90190	60.90190
13	51.02330	51.02330	56.40580	56.40580	58.11410	58.11410	51.02330	51.02330	56.40580	56.40580	56.40580	58.11410	58.11410
14	50.98520	50.98520	56.87580	56.87580	59.17030	59.17030	50.98520	50.98520	56.87580	56.87580	56.87580	59.17030	59.17030
15	51.22640	51.22640	57.69340	57.69340	59.71810	59.71810	51.22640	51.22640	57.69340	57.69340	57.69340	59.71810	59.71810
16	52.05240	52.05240	60.95350	60.95350	55.10250	55.10250	52.05240	52.05240	60.95350	60.95350	60.95350	55.10250	55.10250
17	52.25850	52.25850	63.99890	63.99890	56.66530	56.66530	52.25850	52.25850	63.99890	63.99890	63.99890	56.66530	56.66530
18	52.62830	52.62830	63.81940	63.81940	60.07770	60.07770	52.62830	52.62830	63.81940	63.81940	63.81940	60.07770	60.07770
19	52.09090	52.09090	62.12740	62.12740	57.91410	57.91410	52.09090	52.09090	62.12740	62.12740	62.12740	57.91410	57.91410
20	52.38810	52.38810	60.46770	60.46770	56.64520	56.64520	52.38810	52.38810	60.46770	60.46770	60.46770	56.64520	56.64520
21	52.14170	52.14170	63.17760	63.17760	58.06080	58.06080	52.14170	52.14170	63.17760	63.17760	63.17760	58.06080	58.06080
22	52.24880	52.24880	64.58590	64.58590	61.56790	61.56790	52.24880	52.24880	64.58590	64.58590	64.58590	61.56790	61.56790
23	52.55520	52.55520	63.63590	63.63590	59.75560	59.75560	52.55520	52.55520	63.63590	63.63590	63.63590	59.75560	59.75560
24	52.90530	52.90530	63.55340	63.55340	63.49810	63.49810	52.90530	52.90530	63.55340	63.55340	63.55340	63.49810	63.49810

TABLE 10
Directional Split Factors by Period for Area Type 3 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	53.61130	53.61130	60.69210	60.69210	75.87070	75.87070	53.61130	53.61130	60.69210	60.69210	60.69210	75.87070	75.87070
2	54.65830	54.65830	61.60590	61.60590	74.40840	74.40840	54.65830	54.65830	61.60590	61.60590	61.60590	74.40840	74.40840
3	55.65620	55.65620	62.43900	62.43900	79.30230	79.30230	55.65620	55.65620	62.43900	62.43900	62.43900	79.30230	79.30230
4	56.48530	56.48530	60.38790	60.38790	73.98310	73.98310	56.48530	56.48530	60.38790	60.38790	60.38790	73.98310	73.98310
5	56.17220	56.17220	61.74460	61.74460	69.63330	69.63330	56.17220	56.17220	61.74460	61.74460	61.74460	69.63330	69.63330
6	59.76620	59.76620	66.59560	66.59560	75.38650	75.38650	59.76620	59.76620	66.59560	66.59560	66.59560	75.38650	75.38650
7	66.70040	66.70040	69.36470	69.36470	77.25600	77.25600	66.70040	66.70040	69.36470	69.36470	69.36470	77.25600	77.25600
8	74.13610	74.13610	68.03360	68.03360	65.87060	65.87060	74.13610	74.13610	68.03360	68.03360	68.03360	65.87060	65.87060
9	68.26680	68.26680	64.48270	64.48270	65.97560	65.97560	68.26680	68.26680	64.48270	64.48270	64.48270	65.97560	65.97560
10	59.12840	59.12840	59.62300	59.62300	64.27310	64.27310	59.12840	59.12840	59.62300	59.62300	59.62300	64.27310	64.27310
11	56.23540	56.23540	57.09830	57.09830	60.55200	60.55200	56.23540	56.23540	57.09830	57.09830	57.09830	60.55200	60.55200
12	55.69260	55.69260	55.51360	55.51360	60.90190	60.90190	55.69260	55.69260	55.51360	55.51360	55.51360	60.90190	60.90190
13	52.61690	52.61690	55.81770	55.81770	58.11410	58.11410	52.61690	52.61690	55.81770	55.81770	55.81770	58.11410	58.11410
14	51.73740	51.73740	56.03740	56.03740	59.17030	59.17030	51.73740	51.73740	56.03740	56.03740	56.03740	59.17030	59.17030
15	54.86510	54.86510	56.06570	56.06570	59.71810	59.71810	54.86510	54.86510	56.06570	56.06570	56.06570	59.71810	59.71810
16	61.62560	61.62560	57.10790	57.10790	55.10250	55.10250	61.62560	61.62560	57.10790	57.10790	57.10790	55.10250	55.10250
17	66.59620	66.59620	59.33190	59.33190	56.66530	56.66530	66.59620	66.59620	59.33190	59.33190	59.33190	56.66530	56.66530
18	69.38360	69.38360	60.33020	60.33020	60.07770	60.07770	69.38360	69.38360	60.33020	60.33020	60.33020	60.07770	60.07770
19	58.88450	58.88450	58.55780	58.55780	57.91410	57.91410	58.88450	58.88450	58.55780	58.55780	58.55780	57.91410	57.91410
20	55.31890	55.31890	56.91840	56.91840	56.64520	56.64520	55.31890	55.31890	56.91840	56.91840	56.91840	56.64520	56.64520
21	57.00790	57.00790	57.51680	57.51680	58.06080	58.06080	57.00790	57.00790	57.51680	57.51680	57.51680	58.06080	58.06080
22	55.10670	55.10670	58.74060	58.74060	61.56790	61.56790	55.10670	55.10670	58.74060	58.74060	58.74060	61.56790	61.56790
23	53.98280	53.98280	58.89930	58.89930	59.75560	59.75560	53.98280	53.98280	58.89930	58.89930	58.89930	59.75560	59.75560
24	57.35990	57.35990	60.79010	60.79010	63.49810	63.49810	57.35990	57.35990	60.79010	60.79010	60.79010	63.49810	63.49810

TABLE 11
Directional Split Factors by Period for Area Type 4 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	56.59160	56.59160	59.97490	59.97490	75.87070	75.87070	56.59160	56.59160	59.97490	59.97490	59.97490	75.87070	75.87070
2	56.36910	56.36910	59.75870	59.75870	74.40840	74.40840	56.36910	56.36910	59.75870	59.75870	59.75870	74.40840	74.40840
3	55.30040	55.30040	61.53710	61.53710	79.30230	79.30230	55.30040	55.30040	61.53710	61.53710	61.53710	79.30230	79.30230
4	54.17430	54.17430	63.48720	63.48720	73.98310	73.98310	54.17430	54.17430	63.48720	63.48720	63.48720	73.98310	73.98310
5	60.47800	60.47800	67.38310	67.38310	69.63330	69.63330	60.47800	60.47800	67.38310	67.38310	67.38310	69.63330	69.63330
6	64.72670	64.72670	71.15790	71.15790	75.38650	75.38650	64.72670	64.72670	71.15790	71.15790	71.15790	75.38650	75.38650
7	64.81190	64.81190	58.17040	58.17040	77.25600	77.25600	64.81190	64.81190	58.17040	58.17040	58.17040	77.25600	77.25600
8	61.25710	61.25710	56.38190	56.38190	65.87060	65.87060	61.25710	61.25710	56.38190	56.38190	56.38190	65.87060	65.87060
9	58.72470	58.72470	55.15700	55.15700	65.97560	65.97560	58.72470	58.72470	55.15700	55.15700	55.15700	65.97560	65.97560
10	56.44670	56.44670	54.40530	54.40530	64.27310	64.27310	56.44670	56.44670	54.40530	54.40530	54.40530	64.27310	64.27310
11	54.17740	54.17740	53.57970	53.57970	60.55200	60.55200	54.17740	54.17740	53.57970	53.57970	53.57970	60.55200	60.55200
12	52.00020	52.00020	52.52930	52.52930	60.90190	60.90190	52.00020	52.00020	52.52930	52.52930	52.52930	60.90190	60.90190
13	51.60200	51.60200	52.55630	52.55630	58.11410	58.11410	51.60200	51.60200	52.55630	52.55630	52.55630	58.11410	58.11410
14	51.36340	51.36340	53.36160	53.36160	59.17030	59.17030	51.36340	51.36340	53.36160	53.36160	53.36160	59.17030	59.17030
15	52.50920	52.50920	53.18980	53.18980	59.71810	59.71810	52.50920	52.50920	53.18980	53.18980	53.18980	59.71810	59.71810
16	54.77510	54.77510	55.40890	55.40890	55.10250	55.10250	54.77510	54.77510	55.40890	55.40890	55.40890	55.10250	55.10250
17	56.19180	56.19180	55.14910	55.14910	56.66530	56.66530	56.19180	56.19180	55.14910	55.14910	55.14910	56.66530	56.66530
18	56.48830	56.48830	56.78330	56.78330	60.07770	60.07770	56.48830	56.48830	56.78330	56.78330	56.78330	60.07770	60.07770
19	56.09840	56.09840	56.24190	56.24190	57.91410	57.91410	56.09840	56.09840	56.24190	56.24190	56.24190	57.91410	57.91410
20	55.84830	55.84830	54.38120	54.38120	56.64520	56.64520	55.84830	55.84830	54.38120	54.38120	54.38120	56.64520	56.64520
21	57.43050	57.43050	56.25390	56.25390	58.06080	58.06080	57.43050	57.43050	56.25390	56.25390	56.25390	58.06080	58.06080
22	57.71440	57.71440	56.17140	56.17140	61.56790	61.56790	57.71440	57.71440	56.17140	56.17140	56.17140	61.56790	61.56790
23	55.89740	55.89740	57.46400	57.46400	59.75560	59.75560	55.89740	55.89740	57.46400	57.46400	57.46400	59.75560	59.75560
24	56.54920	56.54920	58.01130	58.01130	63.49810	63.49810	56.54920	56.54920	58.01130	58.01130	58.01130	63.49810	63.49810

TABLE 12
Directional Split Factors by Period for Area Type 5 (weekdays)

Time Period	Urban Interstate	Urban Other Freeway	Urban Principal Arterial	Urban Other Arterial	Urban Collector	Local (Central Conn.)	Rural Interstate	Rural Other Freeway	Rural Principal Arterial	Rural Other Arterial	Rural Major Collector	Rural Collector	Local
1	66.26050	66.26050	66.26050	66.26050	66.66240	66.66240	66.26050	66.26050	66.26050	66.26050	66.26050	66.66240	66.66240
2	62.94880	62.94880	62.94880	62.94880	63.96040	63.96040	62.94880	62.94880	62.94880	62.94880	62.94880	63.96040	63.96040
3	61.55550	61.55550	61.55550	61.55550	68.38000	68.38000	61.55550	61.55550	61.55550	61.55550	61.55550	68.38000	68.38000
4	60.40700	60.40700	60.40700	60.40700	67.23130	67.23130	60.40700	60.40700	60.40700	60.40700	60.40700	67.23130	67.23130
5	66.56860	66.56860	66.56860	66.56860	70.38720	70.38720	66.56860	66.56860	66.56860	66.56860	66.56860	70.38720	70.38720
6	67.50410	67.50410	67.50410	67.50410	70.53380	70.53380	67.50410	67.50410	67.50410	67.50410	67.50410	70.53380	70.53380
7	64.96990	64.96990	64.96990	64.96990	67.54770	67.54770	64.96990	64.96990	64.96990	64.96990	64.96990	67.54770	67.54770
8	61.73610	61.73610	61.73610	61.73610	65.57410	65.57410	61.73610	61.73610	61.73610	61.73610	61.73610	65.57410	65.57410
9	59.70730	59.70730	59.70730	59.70730	61.92110	61.92110	59.70730	59.70730	59.70730	59.70730	59.70730	61.92110	61.92110
10	57.46820	57.46820	57.46820	57.46820	61.65020	61.65020	57.46820	57.46820	57.46820	57.46820	57.46820	61.65020	61.65020
11	56.43390	56.43390	56.43390	56.43390	59.58490	59.58490	56.43390	56.43390	56.43390	56.43390	56.43390	59.58490	59.58490
12	55.67710	55.67710	55.67710	55.67710	59.34490	59.34490	55.67710	55.67710	55.67710	55.67710	55.67710	59.34490	59.34490
13	55.31080	55.31080	55.31080	55.31080	60.17820	60.17820	55.31080	55.31080	55.31080	55.31080	55.31080	60.17820	60.17820
14	54.78790	54.78790	54.78790	54.78790	59.23490	59.23490	54.78790	54.78790	54.78790	54.78790	54.78790	59.23490	59.23490
15	54.31620	54.31620	54.31620	54.31620	57.07360	57.07360	54.31620	54.31620	54.31620	54.31620	54.31620	57.07360	57.07360
16	55.54800	55.54800	55.54800	55.54800	54.45970	54.45970	55.54800	55.54800	55.54800	55.54800	55.54800	54.45970	54.45970
17	56.42730	56.42730	56.42730	56.42730	55.36670	55.36670	56.42730	56.42730	56.42730	56.42730	56.42730	55.36670	55.36670
18	58.00540	58.00540	58.00540	58.00540	57.38310	57.38310	58.00540	58.00540	58.00540	58.00540	58.00540	57.38310	57.38310
19	58.30010	58.30010	58.30010	58.30010	56.28080	56.28080	58.30010	58.30010	58.30010	58.30010	58.30010	56.28080	56.28080
20	55.69660	55.69660	55.69660	55.69660	54.55360	54.55360	55.69660	55.69660	55.69660	55.69660	55.69660	54.55360	54.55360
21	57.62300	57.62300	57.62300	57.62300	55.91980	55.91980	57.62300	57.62300	57.62300	57.62300	57.62300	55.91980	55.91980
22	58.99440	58.99440	58.99440	58.99440	55.64030	55.64030	58.99440	58.99440	58.99440	58.99440	58.99440	55.64030	55.64030
23	60.76490	60.76490	60.76490	60.76490	55.72510	55.72510	60.76490	60.76490	60.76490	60.76490	60.76490	55.72510	55.72510
24	64.60540	64.60540	64.60540	64.60540	58.80610	58.80610	64.60540	64.60540	64.60540	64.60540	64.60540	58.80610	58.80610

Time-of-Day Capacity Factors

The 24-hour equilibrium assignment was performed using nondirectional 24-hour capacities. The nondirectional capacities, included in the assignment data set, are input to PREPIN2. Time-of-day capacity factors were applied to the nondirectional capacity (or service volume) for the subject time period. In computing the directional volume/capacity (v/c) ratio for estimating the directional speeds, PREPIN2 assumes the directional split for capacity to be 50-50.

The HGAC networks use 13 functional classifications. To facilitate the application of the speed model, the functional classifications were aggregated into five functional groups. The five functional groups and their corresponding functional classifications are shown in Table 13.

TABLE 13
Functional Classification to Functional Group Table of Equals

Aggregated Functional Groups	Corresponding Network Functional Classifications
1. Freeways	1. Urban Interstate Freeways 2. Urban Other Freeways 10. Rural Interstate Freeways 11. Rural Other Freeways
2. Principal Arterials	5. Urban Principal Arterials 12. Rural Principal Arterials
3. Other Arterials	6. Urban Other Arterials 13. Rural Other Arterials 14. Rural Major Collectors
4. Collectors	7. Urban Collectors 15. Rural Collectors
5. Locals (Centroid Connectors)	8. Locals (Centroid Connectors) 16. Locals (Intrazonals)
6. Unused	0. Unused 3. Unused 4. Unused 9. Unused

The HGAC networks were processed to compute the average capacity per lane by functional group and area type. Table 14 summarizes the typical 24-hour capacities per lane used in the HGAC highway networks. Table 15 summarizes the estimated hourly capacities per lane used in developing the capacity factors.

The capacity factors for a given time period are computed as follows:

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

The length of the time period is specified in hours. Capacity factors (stratified by area type and functional group) were computed for each of the 24 one-hour time periods.

TABLE 14
24-Hour Capacities/Lane

AREA TYPE	FUNCTIONAL GROUP				
	0,5	**1**	**2**	**3**	**4**
	Locals (Centroid Connectors)	**Freeways**	**Principal Arterials**	**Other Arterials**	**Collectors**
CBD	0.0	24,130.5	7,083.8	7,258.6	6,519.7
Urban	0.0	26,214.4	8,195.6	7,752.5	5,843.3
Urban Fringe	0.0	22,873.5	8,348.4	6,936.0	5,024.6
Suburban	0.0	18,617.9	8,280.7	6,032.3	3,413.6
Rural	0.0	13,802.4	6,588.1	4,847.1	1,825.8

TABLE 15
Estimated Hourly Capacity/Lane

AREA TYPE	FUNCTIONAL GROUP				
	0,5	1	2	3	4
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterials	Collectors
CBD	0.0	2,185.6	806.9	801.2	739.5
Urban	0.0	2,210.9	836.8	809.6	652.2
Urban Fringe	0.0	2,199.1	865.5	795.9	586.0
Suburban	0.0	2,242.1	890.6	783.0	500.6
Rural	0.0	2,231.9	879.8	767.7	407.8

Speed Factors

The HGAC speed model was used to estimate the directional link speeds. The application of the HGAC speed models requires an estimate of the freeflow (level-of-service [LOS] A) speed on the link. These freeflow speed estimates are computed using the 24-hour speeds input on the link data. The freeflow speed factors (stratified by area type and functional group) are applied to the 24-hour nondirectional link speeds to estimate the freeflow speed. The freeflow speed is assumed the same in each direction.

Table 16 summarizes the 24-hour speeds used in the FY2007 HGAC highway networks. These speeds were developed during travel model calibration so that the travel model produced the correct link volumes, consequently, they are not operational speeds. For emissions calculation, an estimated operational speed is desired. The speeds shown in Tables 17 and 18 were developed to estimate freeflow speed factors and LOS E speed factors respectively for use by PREPIN2. These factors are developed separately for each functional group and area type.

The Table 17 freeflow speeds are divided by the Table 16 24-hour speeds to calculate a freeflow speed factor. The freeflow speed factor is multiplied by the coded link 24-hour speed to estimate the link freeflow speed. Similarly, the Table 18 LOS E speeds are divided by the Table 16 24-hour speeds to estimate a LOS E speed factor. The LOS E speed factor is multiplied by the coded link 24-hour speed to estimate the link LOS E speed. The speed values in Tables 17 and 18 were developed to be compatible with speed logic used in the HGAC travel model calibration. The speed factors are input to the PREPIN2 program using SPD2FAC records.

TABLE 16
24-Hour Speeds

Area Type	FUNCTIONAL GROUP					
	0	1	2	3	4	5
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterials	Collectors	Locals
CBD	0.0	38.84	17.10	16.28	19.24	10.33
Urban	0.0	45.61	30.97	29.10	29.26	18.56
Urban Fringe	0.0	50.55	35.18	33.13	32.42	20.78
Suburban	0.0	55.14	38.91	36.20	32.48	25.15
Rural	0.0	58.75	50.64	48.12	38.66	37.46

TABLE 17
Speeds Used for Calculating Freeflow LOS A (V/C = 0) Speed Factors

Area Type	FUNCTIONAL GROUP					
	0	1	2	3	4	5
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterials	Collectors	Locals
CBD	0.0	55.52	22.33	23.10	20.50	10.33
Urban	0.0	60.95	28.50	26.33	22.95	18.56
Urban Fringe	0.0	62.34	35.93	30.38	25.68	20.78
Suburban	0.0	67.83	44.67	40.85	42.37	25.15
Rural	0.0	70.99	65.21	61.74	53.61	37.46

TABLE 18
Speeds Used for Calculating Average Congested LOS E (V/C = 1) Speed Factors

Area Type	FUNCTIONAL GROUP					
	0	1	2	3	4	5
	Locals (Centroid Connectors	Freeways	Principal Arterials	Other Arterials	Collectors	Locals
CBD	0.0	34.34	13.68	14.88	12.16	10.33
Urban	0.0	35.06	20.65	19.83	16.43	18.56
Urban Fringe	0.0	39.87	27.81	23.41	20.37	20.78
Suburban	0.0	49.74	34.78	31.32	32.91	25.15
Rural	0.0	50.15	53.17	51.81	45.84	37.46

Speed Model Formulation

The speed models are based on speed estimation procedures suggested in a report entitled "Highway Vehicle Speed Estimation Procedures for Use in Emissions Inventories" (a report prepared for the EPA by Cambridge Systematics Inc., September 1991). These speed models are described in a technical memorandum entitled "Implementation and Calibration of a Speed Model for the Houston-Galveston Region" (prepared by TTI for HGAC, March 1993). The model approach used to estimate freeway speeds in these speed models may be described as a "speed reduction factor" approach. This "speed reduction factor" approach was incorporated into the speed models that are part of the PREPIN2 software.

The speed factors are applied to each link to estimate the link's freeflow speed (i.e., the speed for a v/c ratio of 0.0) and the LOS E speed (i.e., the speed for a v/c ratio of 1.0). Speed reduction factors are used to estimate the link speeds for v/c ratios between 0.0 and 1.0. The model used for v/c ratios from 0.00 to 1.00 may be described a follows:

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

where:

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

$S_{0.0}$ = estimated freeflow speed for the v/c ratio equal to 0.0.

$S_{1.0}$ = estimated LOS E speed for the v/c ratio equal to 1.0.

$SRF_{V/C}$ = speed reduction factor for the forecast v/c ratio.

$_{V/C}$ = forecast v/c ratio on the link. The v/c ratio can be 0.0 to 1.0. For v/c ratios greater than 1.0, the model extension discussed below is used.

The speed reduction factors that essentially describe the shape of the speed curve are input to the PREPIN2 program by area type and functional group. The factors are input for v/c ratios from 0.0 to 1.0 in increments of 0.05. The speed reduction factors for v/c ratios between these points are estimated by linear interpolation.

To estimate the speed reduction factors, the HGAC speed model was applied to estimate the directional speeds on each link for v/c ratios ranging from 0.0 to 1.0 in increments of 0.05 (i.e., v/c ratios of 0.00, 0.05, 0.10, 0.15, ..., 0.90, 0.95, and 1.00). These speeds were accumulated by the average speeds by v/c ratio for each area type and functional group to estimate the speed reduction factors used as input to PREPIN2. The speed reduction factors computed are displayed graphically in Figures 1 through 4.

Capacity data are not used for centroid connectors and intrazonals (i.e., Functional Group 5 representing local streets). Hence, for Functional Group 5, the freeflow speed factors and LOS E speed factors are set to 1.0 and the speed reduction factors are all set to zero.

Because traffic assignments can produce v/c ratios greater than 1.0, a model extension is used. The extension is based on the well-known Bureau of Public Roads (BPR) model. For links with a v/c ratio greater than 1.0, the following model extension is used to estimate the link's speed:

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

where:

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

$S_{1.0}$ = estimated LOS E speed for the v/c ratio equal to 1.0.

$_{V/C}$ = forecast v/c ratio on the link. The v/c ratio can be 1.0 to 1.5. For v/c ratios greater than 1.5, the speed is computed using the v/c ratio of 1.5.

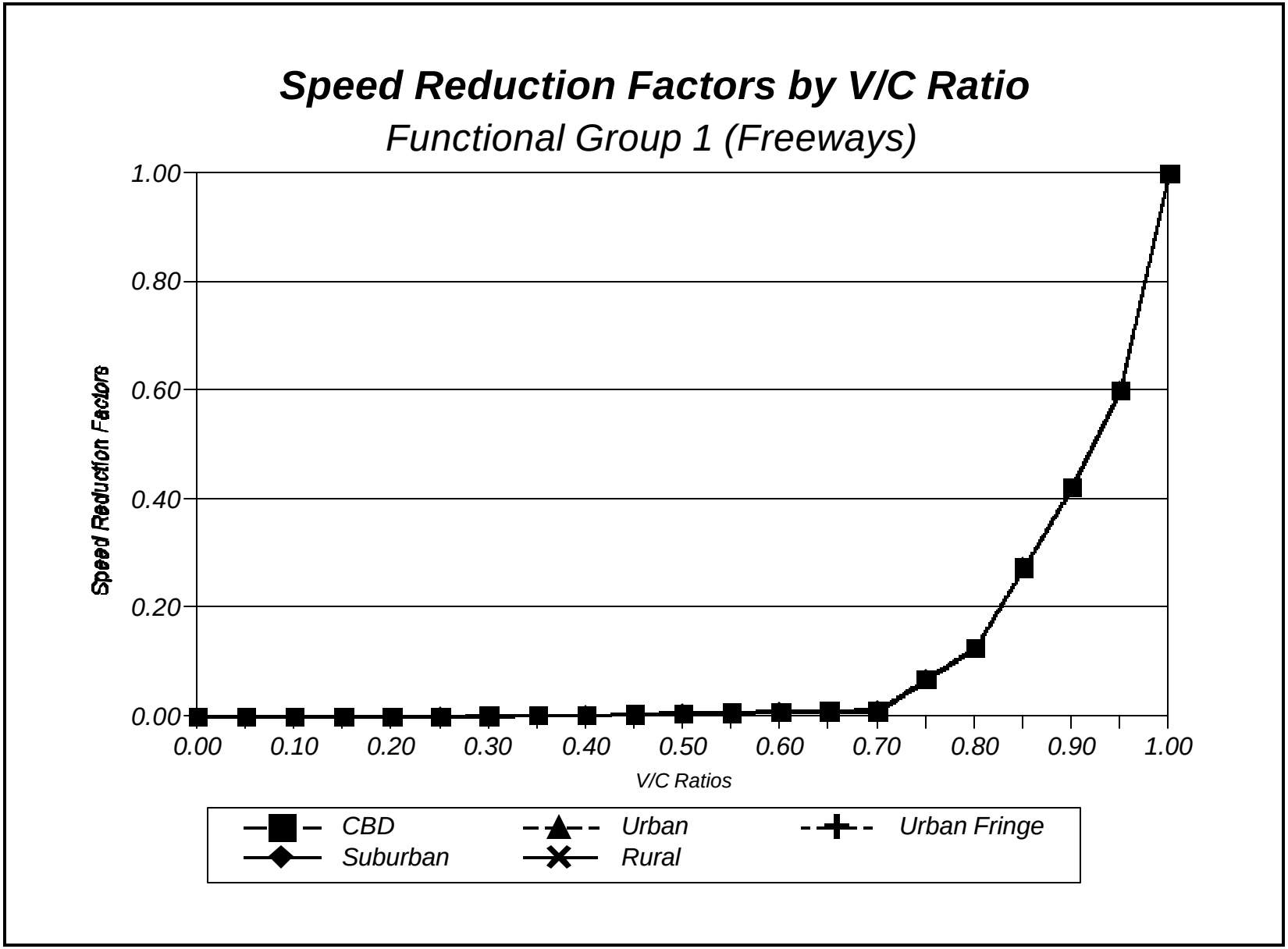

FIGURE 1. Freeway Speed Reduction Factors by V/C Ratio

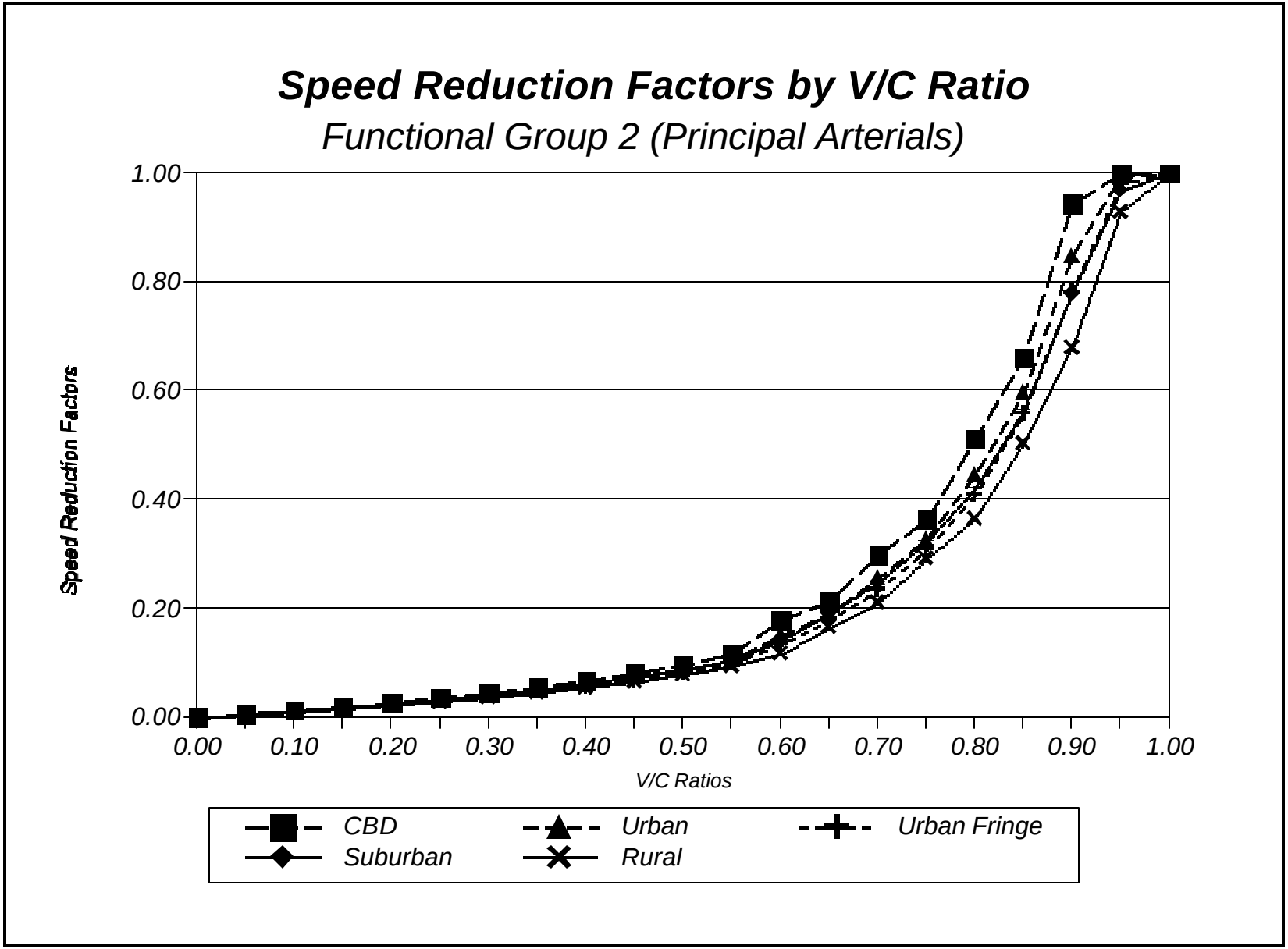

FIGURE 2. Principal Arterial Speed Reduction Factors by V/C Ratio

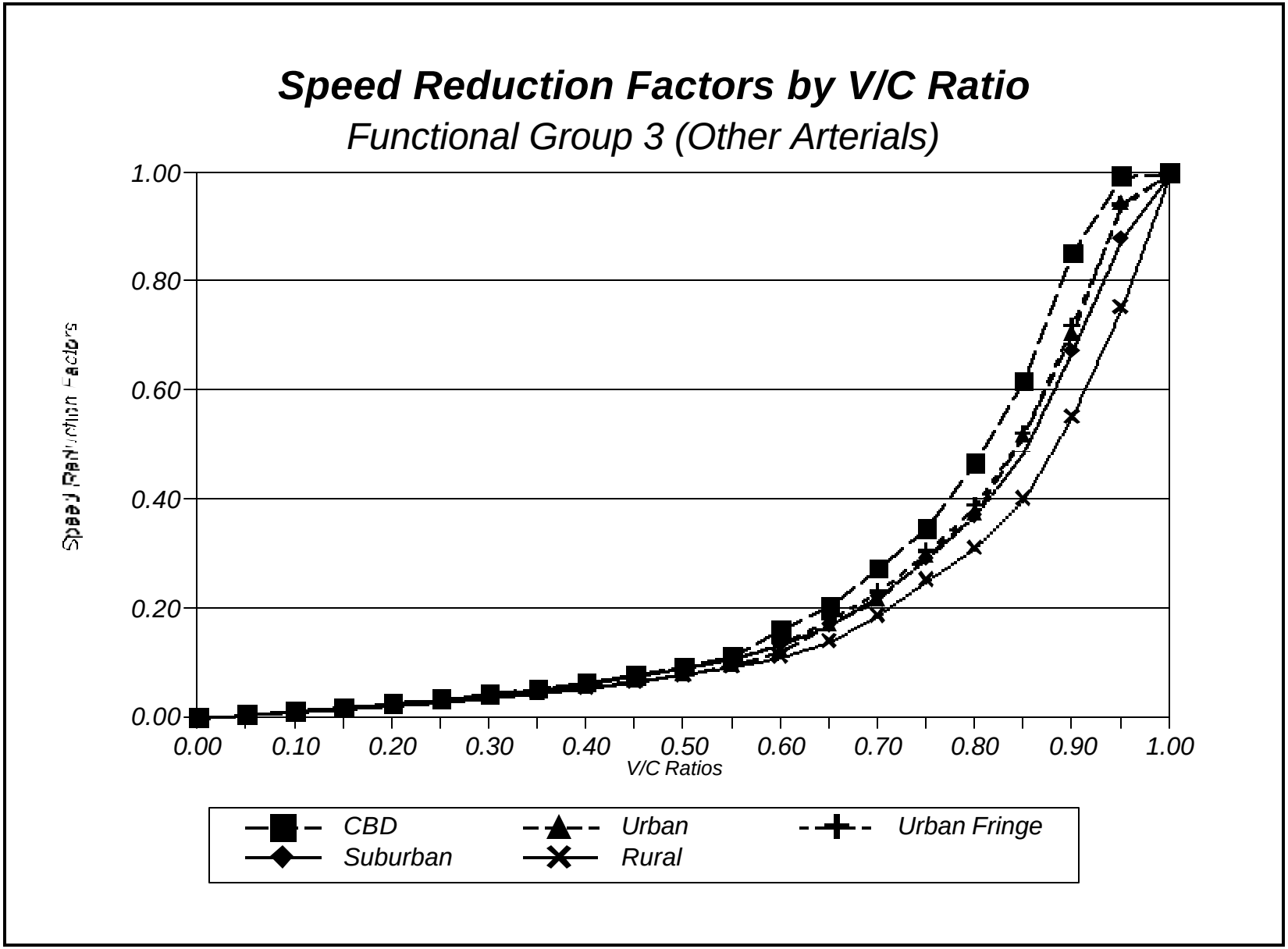

FIGURE 3. Other Arterial Speed Reduction Factors by V/C Ratio

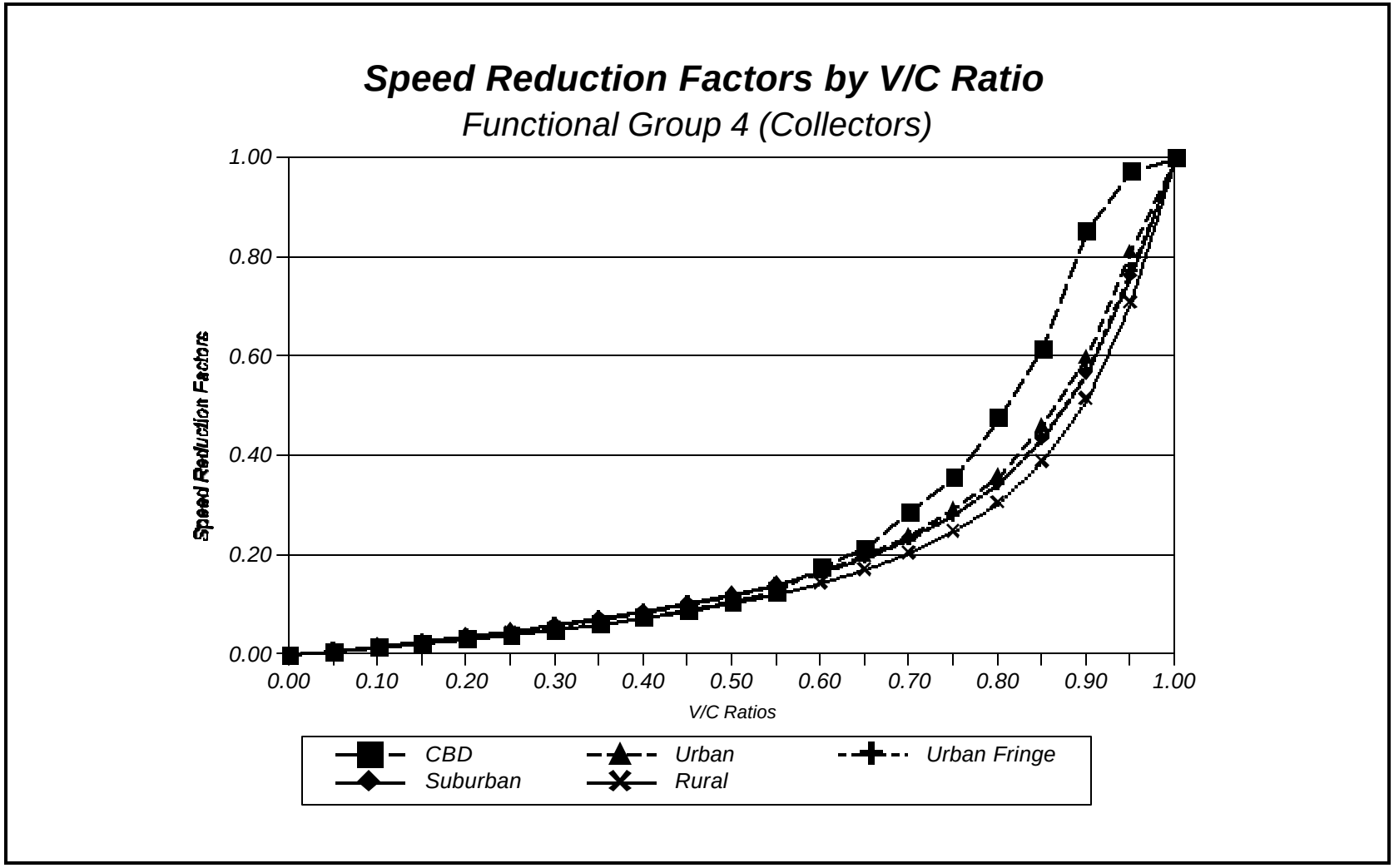

FIGURE 4. Collector Speed Reduction Factors by V/C Ratio

Other Input Data

The remaining data inputs to the PREPIN2 program are:

- The 24-hour Assignment Data Set: This network data set with assignment results was produced by the EMM2 program. The EMME2 assignment was converted to an ASCII file. This ASCII file was combined with another ASCII file containing speed and capacity data and the combined file was input to PREPIN2. PREPIN2 uses this data set to obtain the following information for each link: A-node and B-node numbers, functional classification, distance, 24-hour speed, and the equilibrium assignment volume.

- The Intrazonal Trip Volumes: PREPIN2 reads the 24-hour intrazonal trips for each zone from this data set.

- The Zonal Radii Data: These data are the zonal radii estimates used as input to the trip distribution model. These zonal radii estimates are used by PREPIN2 to estimate the average trip length of intrazonal trips.

ESTIMATION OF EMISSIONS RATES

MOBILE5B was used to compute the mobile source emissions factors. MOBILE5B was applied using POLFC5B to estimate the emissions factors by speed for each of the 24 one-hour time-of-day periods. The emissions rates are obtained for eight vehicle types and 63 speeds (i.e., 3 mph through 65 mph) for each vehicle type. For each time period, there are 504 factors (i.e., 8 x 63 = 504) for each pollution type and county. Three pollution types are computed: VOC, CO, and NOx. The VOC emissions are broken down further into six components: exhaust hydrocarbons, running loss hydrocarbons, resting loss hydrocarbons, crankcase hydrocarbons, hot soak hydrocarbons, and diurnal hydrocarbons. For each county and each time period there are 4,536 emissions factors (i.e. 504 x 9 = 4,536). These emissions factors are output to an ASCII file for subsequent input to the IMPSUMA program.

Summary of Control Programs Modeled

Control programs for inspection and maintenance (I/M), anti-tampering program (ATP) and pressure test were included. Full credits were taken for the I/M and ATP programs. Only 40% of the credit was taken for the pressure test program. Credits for the federal emission standards for heavy-duty gasoline vehicles (HDGV) were included using the EPA guidance. Credits were taken for the proposed very low-sulfur (15 parts per million) gasoline program and for the low-emissions diesel fuel control. Credits for these programs were provided by Eastern Research Group, Inc. (ERG). These credits are 0.80% NOx reduction for gasoline-fueled vehicles and 5.74% NOx reduction for diesel-fueled vehicles. Credits for the federal Tier 2 light-duty emissions standard were applied using factors provided by ERG.

I/M, ATP, pressure test, and the federal emission standards for HDGV were input into MOBILE5B. The emissions factors with the low-sulfur gasoline, low-emissions diesel fuel and Tier 2 light-duty emissions standards credits were calculated using the RATEADJV program. RATEADJV is a program developed by TTI to post process emissions factors produced by POLFC5B.

Estimation of Temperatures by Time Period

Temperature data provided by TNRCC were input to MOBILE5B. The temperature data are the hourly temperatures that occurred on the Wednesday, September 8, 1993 episode day. The temperatures for each of the 24 one-hour periods and the minimum and maximum temperatures were computed using these data.

Diurnal emission rates were computed using a separate application of POLFC5B. Each application of MOBILE5B requires three temperature inputs: low temperature, high temperature, and ambient temperature. To avoid computing diurnals for the 24 one-hour time periods, the same temperature was input for the low, the high and the ambient temperatures. Table 19 lists the temperature inputs for each of the 24 one-hour time periods and the 24-hour diurnal applications for Harris, Fort Bend, Waller, Montgomery, and Liberty counties. Table 20 lists the temperature inputs for the 24 one-hour time periods and the 24-hour diurnal applications for Galveston, Brazoria, and Chambers counties.

TABLE 19
Temperature Inputs for Harris, Fort Bend, Waller, Montgomery, and Liberty Counties

	Wednesday, September 8, 1993		
	Low	**High**	**Ambient**
Time Period 1	73.8	73.8	73.8
Time Period 2	72.7	72.7	72.7
Time Period 3	72.7	72.7	72.7
Time Period 4	71.6	71.6	71.6
Time Period 5	71.1	71.1	71.1
Time Period 6	70.0	70.0	70.0
Time Period 7	70.3	70.3	70.3
Time Period 8	75.2	75.2	75.2
Time Period 9	81.0	81.0	81.0
Time Period 10	86.0	86.0	86.0
Time Period 11	89.2	89.2	89.2
Time Period 12	91.8	91.8	91.8
Time Period 13	93.7	93.7	93.7
Time Period 14	95.4	95.4	95.4
Time Period 15	95.4	95.4	95.4
Time Period 16	95.5	95.5	95.5
Time Period 17	94.8	94.8	94.8
Time Period 18	91.8	91.8	91.8
Time Period 19	87.8	87.8	87.8
Time Period 20	84.9	84.9	84.9
Time Period 21	83.8	83.8	83.8
Time Period 22	82.8	82.8	82.8
Time Period 23	81.7	81.7	81.7
Time Period 24	80.8	80.8	80.8
24-Hour Diurnal	70.0	95.5	87.0

TABLE 20
Temperature Inputs for Galveston, Brazoria, and Chambers Counties

	Wednesday, September 8, 1993		
	Low	**High**	**Ambient**
Time Period 1	75.9	75.9	75.9
Time Period 2	75.0	75.0	75.0
Time Period 3	73.9	73.9	73.9
Time Period 4	73.9	73.9	73.9
Time Period 5	73.9	73.9	73.9
Time Period 6	73.0	73.0	73.0
Time Period 7	73.0	73.0	73.0
Time Period 8	75.9	75.9	75.9
Time Period 9	81.0	81.0	81.0
Time Period 10	84.9	84.9	84.9
Time Period 11	87.1	87.1	87.1
Time Period 12	89.1	89.1	89.1
Time Period 13	90.0	90.0	90.0
Time Period 14	90.0	90.0	90.0
Time Period 15	91.0	91.0	91.0
Time Period 16	90.0	90.0	90.0
Time Period 17	90.0	90.0	90.0
Time Period 18	88.0	88.0	88.0
Time Period 19	86.0	86.0	86.0
Time Period 20	84.9	84.9	84.9
Time Period 21	84.9	84.9	84.9
Time Period 22	84.0	84.0	84.0
Time Period 23	84.0	84.0	84.0
Time Period 24	84.0	84.0	84.0
24-Hour Diurnal	73.9	91.0	85.0

Vehicle Registration Distributions

Vehicle registration distributions are an input to MOBILE5B. The 1999 vehicle registration data for Harris, Brazoria, Fort Bend, Waller, Montgomery, Liberty, Chambers, and Galveston counties were obtained from the Texas Department of Transportation (TxDOT). The vehicle registration data used were the total automobiles, total motorcycles, light-duty gasoline trucks 1 (LDGT1), light-duty gasoline trucks 2 (LDGT2), heavy-duty gasoline trucks (HDGT), and heavy-duty diesel trucks (HDDT) vehicle types by year. The vehicle registration data for 1975 and older vehicles were summed and used as the 25th year. The percentage vehicle distributions by model year were then obtained by dividing the vehicle registration for a given year by the total vehicle registrations. The percentage vehicle distribution data were then rounded to four significant digits and summed. Residual rounding resulted in the sum of the percentage vehicle distribution being slightly smaller or greater than 1.0. The difference between the sum and 1.0 was then added to the largest value to adjust the total percentage vehicle distribution data of the rounded values to 1.0000. The distributions for total automobiles were used for both light-duty gasoline vehicles (LDGV) and light-duty diesel vehicles (LDDV) vehicle types. The distributions for LDGT1 were also used for the light-duty diesel vehicle trucks (LDDT) vehicle type. For motorcycles, the vehicles registered which were older than 12 years were added to the 12-year-old vehicles. This was done because MOBILE5B has zero mileage for motorcycles older than 12 years. The vehicle registration distribution for each county can be found in the sample 24-hour diurnal setups, Tables 33 to 40.

Trip Length Distributions

Trip length distributions are an input to MOBILE5B. The trip length distributions used to estimate emission factors for the 24 one-hour time periods and 24 hour diurnal time period are shown in Table 21. The trip length distributions were obtained from the report "Conformity Determinations for The 2022 Metropolitan Transportation Plan and the 2000-2022 Transportation Improvement Program for Houston-Galveston Transportation Management Area," March 23, 2000 prepared by HGAC.

Operating Mode Fractions

Operating mode fractions are an input to MOBILE5B. The operating mode fractions used to estimate emission factors for the 24 one-hour time periods and the 24 hour diurnal time period are shown in Table 22. The same operating mode fractions were used for all eight counties. The operating mode fractions were obtained from the report "Conformity Determinations for The 2022 Metropolitan Transportation Plan and the 2000-2022 Transportation Improvement Program for Houston-Galveston Transportation Management Area," March 23, 2000 prepared by HGAC.

MOBILE5B Inputs

The MOBILE5B flag settings, local area parameter records, scenario description, low-emissions vehicles (LEV) program parameter record, 2005 HDGV NOx standards, I/M program description record, alternate effectiveness record, ATP descriptive record, and pressure test descriptive record, for the eight counties are shown in Tables 23 through 32. The inputs for I/M, ATP, and pressure test are different for Harris County and the urban and rural counties. The urban counties are Brazoria, Fort

Bend, Montgomery, and Galveston. The rural counties are Chambers, Liberty, and Waller. These tables show the model parameter description, the assigned value for that parameter, and the methodology description. The assigned values were developed by TNRCC, ERG, and ENVIRON. The MOBILE5B applications were performed by TTI.

The MOBILE5B setups for calculation of the 24 hour diurnal emission rates are presented in Tables 33-40. For calculation of the time-period emissions factors, the MOBILE5B setups were modified for each time period. Different temperature, trip length distribution, and operating mode fraction data were used for each time and diurnal application.

TABLE 21
Trip Length Distributions by Time Period

Time Period	MOBILE5 Trip Length Record	
1	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
2	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
3	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
4	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
5	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
6	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
7	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
8	8.9 21.5 23.2 18.6 12.6 15.2	Trip Length AM Peak
9	8.9 21.5 23.2 18.6 12.6 15.2	Trip Length AM Peak
10	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
11	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
12	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
13	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
14	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
15	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
16	13.9 29.8 24.4 14.5 7.8 9.6	Trip Length Midday
17	11.1 24.6 23.1 16.8 10.8 13.6	Trip Length PM Peak
18	11.1 24.6 23.1 16.8 10.8 13.6	Trip Length PM Peak
19	11.1 24.6 23.1 16.8 10.8 13.6	Trip Length PM Peak
20	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
21	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
22	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
23	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
24	13.1 28.4 24.0 14.9 8.4 11.2	Trip Length Dist. Overnight
24-Hour Diurnal	13.7 26.9 22.6 15.1 9.1 12.6	Trip Length Dist. 24 Hours

TABLE 22

Operating Mode Fractions by Time Period

Time Period	MOBILE5 Operating Mode Fraction Record	
1	12.2 11.2 23.7	Operating Mode Overnight
2	12.2 11.2 23.7	Operating Mode Overnight
3	12.2 11.2 23.7	Operating Mode Overnight
4	12.2 11.2 23.7	Operating Mode Overnight
5	12.2 11.2 23.7	Operating Mode Overnight
6	12.2 11.2 23.7	Operating Mode Overnight
7	12.2 11.2 23.7	Operating Mode Overnight
8	27.8 6.7 28.1	Operating Mode AM-Peak
9	27.8 6.7 28.1	Operating Mode AM-Peak
10	11.1 20.1 21.2	Operating Mode Midday
11	11.1 20.1 21.2	Operating Mode Midday
12	11.1 20.1 21.2	Operating Mode Midday
13	11.1 20.1 21.2	Operating Mode Midday
14	11.1 20.1 21.2	Operating Mode Midday
15	11.1 20.1 21.2	Operating Mode Midday
16	11.1 20.1 21.2	Operating Mode Midday
17	14.5 13.9 22.6	Operating Mode PM-Peak
18	14.5 13.9 22.6	Operating Mode PM-Peak
19	14.5 13.9 22.6	Operating Mode PM-Peak
20	12.2 11.2 23.7	Operating Mode Overnight
21	12.2 11.2 23.7	Operating Mode Overnight
22	12.2 11.2 23.7	Operating Mode Overnight
23	12.2 11.2 23.7	Operating Mode Overnight
24	12.2 11.2 23.7	Operating Mode Overnight
24-Hour Diurnal	15.1 14.3 23.3	Operating Mode 24 Hours

TABLE 23
MOBILE5B Flag Settings

Model Parameter Description	Assigned Value	Methodology Description
PROMPT	5	Used to indicate that national low-emitting vehicles (NLEV) input parameters will be used.
PROJID	Modeler's choice	No effect on results.
TAMFLG	1	Use MOBILE default tampering rates.
SPDFLG	4	User input: one speed for all vehicle types. Since POLFC calculates rates from 3 mph to 65 mph, this value has no effect on results.
VMFLAG	1	No VMTMIX input. Since POLFC calculates rates from 3 mph to 65 mph for all vehicle types, this value has no effect on results.
MYMRFG	3	Use MOBILE default average mileage accumulation rates (AMARs) as there are currently no HGAC-specific AMARs available. Use county specific registration distributions.
NEWFLG	2	Tier 1 federal motor vehicle control program (FMVCP) is turned on; and use user specified basic emissions rates (BERs) for diesel vehicles consistent with the new diesel standards (HDDV)going into effect in 2004 and new HDGV standards going into effect in 2005. Additional input is required as described in Table 26
IMFLAG	6	I/M program included with the effect of a technician training program.
ALHFLG	1	No load corrections done in modeling calculations.
ATPFLG	5	Include input to model an ATP and a pressure test.
RLFLAG	5	No refueling emissions calculated. Refueling emissions calculated as part of the area source inventory.
LOCFLG	Modeler's discretion	No effect on results.
TEMFLG	1	MOBILE will calculate temperature corrections from minimum and maximum temperature.
OUTFMT	Modeler's discretion	No effect on results.
PRTFLG	Modeler's discretion	No effect on results.

TABLE 23 (continued)
MOBILE5B Flag Settings

Model Parameter Description	Assigned Value	Methodology Description
IDLFLG	1	No idle emissions calculated.
NMHFLG	3	Hydrocarbon emission factors should be for VOC.
HCFLAG	Modeler's discretion	Diurnal runs will need to have appropriate flag settings. Otherwise use the value appropriate for obtaining output in the format needed for emissions calculation models.

TABLE 24
MOBILE5B Local Area Parameter Record

General Comments: None		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Scenario Name	Modeler's discretion	No effect on results.
American Society of Testing Materials (ASTM) Class	B	ASTM regional map.
Minimum daily temperature	Use values consistent with minimum, maximum, 24 one-hour temperatures for September 8, 1993 episode.	Episode minimum, maximum, 24 one-hour temperatures.
Maximum daily temperature	Use values consistent with minimum, maximum, 24 one-hour temperatures for September 8, 1993 episode.	Episode minimum, maximum, 24 one-hour temperatures.
Period 1 Reid Vapor Pressure (RVP)	8.3	Regulated value minus 0.3, as per MOBILE guidance.
Period 2 RVP	7.8	Regulated value, as per MOBILE guidance. Value will not affect results when reformulated gasoline (RFG) is on.
Period 2 start year	92	Per 1992 RVP regulation.
Oxygenated fuel flag	1(default)	No oxygenated fuels program in Houston.
Diesel sales fraction flag	1(default)	No alternate diesel sales fractions will be used.
RFG flag	2	Turn on RFG. RFG is part of the emissions control strategy and should be turned on only for control strategy

		model runs.

TABLE 25
MOBILE5B Scenario Input - Record 1 Scenario Description

General Comments: None		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Region	4	Used when the input file will contain low-emitting vehicles (LEV) or NLEV information.
Calendar Year of Evaluation	07 for 2007	Inventory definition.
Average speed	Xxxx	Set to xxxx when creating emissions factors from 3 mph to 65 mph using POLFC.
Ambient temperature	Use values consistent with ambient temperatures for September 8, 1993.	Episode ambient temperatures used.
Operating mode fractions	Use values consistent with March 23, 2000 HGAC conformity.	The values are for time period and diurnal.
Month of evaluation	7	Ozone season is being modeled so July is the appropriate month.

TABLE 26
MOBILE5B Scenario Input - Record 2 LEV Program Parameter Record

General Comments:	Used only for the control strategy inventory. PROMPT must be set to 5. Region in the scenario record must be set to 4.	
Model Parameter Description	**Assigned Value**	**Methodology Description**
LEV start year	01	NLEV program will start in 2001.
I/M Flag	1	No I/M program for the NLEV vehicles.

TABLE 27
MOBILE5B 2005 Revised Heavy-Duty Gas Vehicle Standards Record Descriptions

Model Parameter Description	Record 1	Record 2	Record 3	Record 4	Record 5	Record 6	Record 7	Record 8	Record 9	Record 10
Altitude		1	1	1	1	1	1	1	1	1
Vehicle Type		7	7	7	7	4	4	4	4	4
Pollutant		3	3	3	3	3	3	3	1	1
Starting model year		90	91	98	04	05	08	09	05	09
Ending model year		90	97	03	20	07	08	50	07	50
New zero-mile value		05.639	04.598	03.679	01.840	01.120	01.090	01.060	00.690	00.680
New deterioration rate		00.000	00.000	00.000	00.000	00.020	00.020	00.020	00.090	00.090

Note:

The Record 1 value of 009 means that more lines of records will follow
Altitude - 1 = low altitude
Vehicle Type - 7 = HDDV; 4 = HDGV
Pollutant - 3 = Nox, 1 =- VOC
Methodology description for Records 2-5: Heavy-duty diesel standards phase-in definition. These inputs are documented in EPA's MOBILE Information Sheet #5. The information sheet is available on the EPA Internet site. Methodology description for Records 6-10: the new heavy-duty gasoline vehicle standard.

TABLE 28
MOBILE5B Second I/M Program Descriptive Input Record

General Comments: Harris County began a two-speed idle I/M program in 1997 as part of the TMC program. For 2002 the Harris County test type was changed to acceleration simulation mode (ASM). For 2003 the ASM program was geographically expanded to include the four urban nonattainment counties. For 2004 the ASM program was geographically expanded again to include the three rural nonattainment counties. This modeling protocol is based on discussions with the TNRCC Mobile Source Section.		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Program start year	97 Harris County 03 Urban Counties (Brazoria County, Fort Bend County, Montgomery County, and Galveston County) 04 Rural Counties (Chambers County, Liberty County, and Waller County)	Harris County began a 2-speed idle I/M program in 1997, the program was geographically expanded in 2003 and 2004.
Stringency level	20	I/M program audit report.
First model year	83	Program definition, 24 year rolling window.
Last model year	95	1996 and newer vehicles have on-board diagnostics (OBD) and will be modeled with IM 240 program.
Waiver rate, pre-1981 my vehicles	03	I/M program definition.
Waiver rate, my 1981 and later	03	I/M program definition.
Compliance rate	96	I/M program definition.
Program type	2	Decentralized test and repair, program definition.
Alternate effectiveness flag (only in MOBILE5B)	2	Alternate effectiveness flag indicating that one alternate effectiveness record will immediately follow the last I/M program descriptive record.
Inspection frequency	1	Annual testing, program definition.
Vehicle types subject to inspection	2222	All gasoline vehicles tested.
Test type	5	ASM test based upon Houston program design, user must input cut points.
Non-default cut points flag	2	User input cut points.
Alternative I/M credit flags	11	Use the IMDATA.d credit file as received from EPA.
HC cut point	25.	Houston program design, Two Mode 2525/5015 ASM with start up cutpoints.
CO cut point	50.	Houston program design, Two Mode 2525/5015 ASM with start up cutpoints.
NOx cut point	2.	Houston program design, Two Mode 2525/5015 ASM

		with start up cutpoints.

TABLE 29
MOBILE5B Second I/M Program Descriptive Input Record

General Comments: Harris County began a two-speed idle I/M program in 1997 as part of the TMC program. For 2002 the Harris County test type was changed to ASM. For 2003 the ASM program was geographically expanded to include the four urban nonattainment counties. For 2004 the ASM program was geographically expanded again to include the three rural nonattainment counties. This modeling protocol is based on discussions with the TNRCC Mobile Source Section.		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Program start year	97 Harris County 03 Urban Counties (Brazoria County, Fort Bend County, Montgomery County, and Galveston County) 04 Rural Counties (Chambers County, Liberty County, and Waller County)	Harris County began a 2-speed idle I/M program in 1997, the program was geographically expanded in 2003 and 2004.
Stringency level	20	I/M program audit report.
First model year	96	1995 and older vehicles do not have OBD and are modeled with the ASM program designed by the TNRCC Mobile Source Section.
Last model year	05	Program definition, two year new vehicle exemption.
Waiver rate, pre-1981 my vehicles	03	I/M program definition.
Waiver rate, my 1981 and later	03	I/M program definition.
Compliance rate	96	I/M program definition.
Program type	2	Decentralized test and repair, program definition.
Alternate effectiveness flag (only in MOBILE5B)	2	Alternate effectiveness flag indicating that one alternate effectiveness record will immediately follow the last I/M program descriptive record.
Inspection frequency	1	Annual testing, program definition.
Vehicle types subject to inspection	2222	All gasoline vehicles tested.
Test type	4	I/M 240 test is used to calculate credit for ASM with OBD, user must input cut points.
Non-default cut points flag	2	User input cut points.
Alternative I/M credit flags	11	Use the IMDATA.d credit file as received from EPA.
HC cut point	0.80	I/M 240 test is used to calculate credit for ASM with OBD, use phase-in cutpoints.
CO cut point	15.0	I/M 240 test is used to calculate credit for ASM with

		OBD, use phase-in cutpoints.
NOx cut point	2.00	I/M 240 test is used to calculate credit for ASM with OBD, use phase-in cutpoints.

TABLE 30
MOBILE5B Alternate Effectiveness Record

General Comments: 100% of the benefits for the I/M program and ATP program. The pressure test used in TMC program has been determined to receive only 40% of the pressure test emissions reduction in MOBILE credit file.		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Effectiveness of the I/M program in reducing HC	1.00	100% of the benefits for the I/M program in HC.
Effectiveness of the I/M program in reducing CO	1.00	100% of the benefits for the I/M program in CO.
Effectiveness of the I/M program in reducing NOx	1.00	100% of the benefits for the I/M program in NOx.
Effectiveness of test-and repair ATP program	1.00	100% of the benefits for the ATP program.
Effectiveness of test-and-repair functional pressure test program	0.40	40% of the benefits for the pressure test program.

TABLE 31
MOBILE5B ATP Descriptive Input Record

General Comments: Since 1984 Harris County has had an ATP. The Harris County ATP was modified in 1997 as part of the TMC I/M program. The TMC was geographically expanded for 2003 to include the four urban non-attainment counties and again for 2004 to include the three rural non-attainment counties.		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Program start year	84 Harris County 03 Urban Counties 04 Rural Counties	Operation began in early 1984 in Harris County, geographically expanded in 2003 and 2004.
First model year	83	24 year rolling window.
Last model year	05	Two year new car exemption.
Vehicle types subject to inspection	2222	All gasoline vehicles tested.
Program type	2	Decentralized test and repair.
Inspection frequency	1	Annual inspections required.
Compliance rate	96	Program design.
Air pump system check flag	2	Program design.
Catalyst check flag	2	Program design.
Fuel inlet restrictor check flag	1	Program design.
Tailpipe lead deposit test flag	1	Program design.
EGR system check flag	2	Program design.
Evaporative control system check flag	2	Program design.
PCV system check flag	2	Program design.
Gas cap check flag	2	Program design.

TABLE 32
MOBILE5B Pressure Test Descriptive Input Record

General comments: Harris County began a pressure test in 1997 as part of the TMC program. The TMC was geographically expanded for 2003 to include the four urban non-attainment counties and again for 2004 to include the three rural non-attainment counties. The pressure test used in TMC program has been determined to get only 40% of the pressure test emission reduction in MOBILE credit file.		
Model Parameter Description	**Assigned Value**	**Methodology Description**
Program start year	97 Harris County 03 Urban Counties 04 Rural Counties	Program began in Harris County in 1997, the urban counties began in 2003 and the rural counties in 2004.
First model year	83	Program definition, 24 rolling window.
Last model year	05	Program definition, two year new vehicle exemption.
Vehicle types subject to inspection	2222	All gasoline vehicles tested.
Program type	2	Decentralized test and repair
Inspection frequency	1	Annual testing
Compliance rate	96	I/M program audit report.

TABLE 33
Brazoria County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Brazoria County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0195.0814.0835.0813.0777.0851.0699.0709.0593.0592  LDGV    BRAZORIA      1999
.0515.0518.0415.0320.0281.0259.0196.0121.0086.0067  LDGV
.0048.0059.0042.0028.0167                           LDGV
.0238.0924.0766.0872.0700.0754.0729.0585.0520.0539  LDGT1
.0487.0497.0405.0293.0324.0280.0257.0137.0148.0109  LDGT1
.0061.0082.0069.0048.0176                           LDGT1
.0916.2969.1057.1384.0546.0476.0373.0208.0138.0220  LDGT2
.0169.0216.0193.0094.0157.0106.0126.0063.0090.0114  LDGT2
.0067.0075.0059.0039.0145                           LDGT2
.0000.0303.0216.0173.0390.0758.0173.0238.0368.0390  HDGV
.0390.0346.0476.0281.0346.0411.0455.0346.0455.0390  HDGV
.0693.0714.0476.0368.0844                           HDGV
.0195.0814.0835.0813.0777.0851.0699.0709.0593.0592  LDDV
.0515.0518.0415.0320.0281.0259.0196.0121.0086.0067  LDDV
.0048.0059.0042.0028.0167                           LDDV
.0238.0924.0766.0872.0700.0754.0729.0585.0520.0539  LDDT
.0487.0497.0405.0293.0324.0280.0257.0137.0148.0109  LDDT
.0061.0082.0069.0048.0176                           LDDT
.0120.0553.0733.0409.0397.0457.0313.0517.0481.0755  HDDV
.0481.0661.0601.0457.0349.0565.0421.0240.0373.0349  HDDV
.0216.0180.0156.0048.0168                           HDDV
.0301.0921.0734.0683.0658.0615.0560.0484.0369.0267  MC
.0259.4149.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
03 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00          I/M Prog1
03 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00          I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
03 83 05 2222 21  096 22112222                              ATP
03 83 05 2222 21  096                                       Pressure Test
```

```
NHR   WED Diurn  B 73.0 91.0  8.3  7.8 92 1 1 2                LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 85.0 15.1 14.3 23.3  7                             HWY  WED    DRN
01 1                                                         NLEV, start 2001,
```

TABLE 34
Chambers County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Chambers County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0112.0577.0885.0886.0827.0885.0704.0739.0591.0542  LDGV    CHAMBERS      1999
.0523.0505.0417.0315.0270.0263.0244.0141.0114.0090  LDGV
.0050.0065.0047.0039.0169                           LDGV
.0162.0768.0874.0945.0712.0833.0781.0632.0583.0510  LDGT1
.0477.0444.0388.0250.0295.0276.0226.0142.0144.0125  LDGT1
.0070.0090.0062.0039.0172                           LDGT1
.1097.2939.1322.1222.0748.0474.0274.0150.0125.0100  LDGT2
.0100.0150.0100.0050.0224.0125.0200.0100.0075.0075  LDGT2
.0025.0050.0100.0050.0125                           LDGT2
.0000.0857.0000.0000.0000.0857.0286.0286.0000.1143  HDGV
.0286.0571.0857.0286.0286.0857.0000.0000.0286.0286  HDGV
.0857.0571.0571.0000.0857                           HDGV
.0112.0577.0885.0886.0827.0885.0704.0739.0591.0542  LDDV
.0523.0505.0417.0315.0270.0263.0244.0141.0114.0090  LDDV
.0050.0065.0047.0039.0169                           LDDV
.0162.0768.0874.0945.0712.0833.0781.0632.0583.0510  LDDT
.0477.0444.0388.0250.0295.0276.0226.0142.0144.0125  LDDT
.0070.0090.0062.0039.0172                           LDDT
.0706.0822.0471.0588.0235.0353.0706.0471.0235.0235  HDDV
.0353.0824.0706.0235.0588.0471.0706.0118.0471.0588  HDDV
.0000.0000.0118.0000.0000                           HDDV
.0072.0761.0725.0616.1051.0761.0507.0471.0217.0072  MC
.0217.4530.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
```

```
2 1 2 1
04 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00          I/M Prog1
04 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00          I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
04 83 05 2222 21  096 22112222                              ATP
04 83 05 2222 21  096                                       Pressure Test
NHR   WED Diurn  B 73.0 91.0  8.3  7.8 92 1 1 2              LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 85.0 15.1 14.3 23.3  7                             HWY  WED    DRN
01 1                                                         NLEV, start 2001,
```

TABLE 35
Fort Bend County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Fort Bend County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0223.0851.0969.0939.0876.0931.0744.0719.0615.0580  LDGV    FORT BEND     1999
.0513.0419.0348.0259.0214.0195.0148.0085.0071.0051  LDGV
.0034.0039.0033.0021.0123                           LDGV
.0243.1143.0989.1034.0739.0772.0725.0595.0479.0461  LDGT1
.0418.0398.0334.0247.0255.0236.0211.0114.0133.0099  LDGT1
.0055.0073.0056.0046.0145                           LDGT1
.1120.2841.1082.1301.0648.0577.0291.0329.0154.0154  LDGT2
.0181.0220.0132.0088.0104.0165.0093.0060.0088.0055  LDGT2
.0038.0082.0060.0027.0110                           LDGT2
.0194.0155.0116.0116.0233.1240.0194.0194.0271.0388  HDGV
.0233.0426.0465.0233.0504.0271.0504.0310.0581.0504  HDGV
.0465.0659.0271.0349.1124                           HDGV
.0223.0851.0969.0939.0876.0931.0744.0719.0615.0580  LDDV
.0513.0419.0348.0259.0214.0195.0148.0085.0071.0051  LDDV
.0034.0039.0033.0021.0123                           LDDV
.0243.1143.0989.1034.0739.0772.0725.0595.0479.0461  LDDT
.0418.0398.0334.0247.0255.0236.0211.0114.0133.0099  LDDT
.0055.0073.0056.0046.0145                           LDDT
.0128.0965.0867.0587.0281.0485.0421.0689.0370.0587  HDDV
.0612.0651.0485.0434.0421.0434.0319.0191.0242.0281  HDDV
.0128.0102.0128.0077.0115                           HDDV
.0145.1127.1013.0829.0864.0667.0645.0469.0338.0246  MC
.0268.3389.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
```

```
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
03 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00           I/M Prog1
03 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00           I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
03 83 05 2222 21  096 22112222                               ATP
03 83 05 2222 21  096                                        Pressure Test
HAR   WED Diurn  B 70.0 95.5  8.3  7.8 92 1 1 2               LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 87.0 15.1 14.3 23.3  7                              HWY  WED    DRN
01 1                                                          NLEV, start 2001,
```

TABLE 36
Galveston County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Galveston County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0180.0820.0800.0785.0744.0823.0703.0700.0608.0588  LDGV    GALVESTON     1999
.0539.0502.0414.0334.0301.0275.0217.0121.0094.0069  LDGV
.0051.0066.0051.0035.0180                           LDGV
.0235.0964.0789.0887.0656.0718.0708.0603.0522.0510  LDGT1
.0482.0478.0405.0286.0307.0279.0285.0153.0163.0113  LDGT1
.0059.0082.0074.0055.0187                           LDGT1
.1036.3007.1005.1186.0624.0562.0318.0250.0125.0200  LDGT2
.0169.0181.0119.0081.0094.0131.0144.0069.0094.0112  LDGT2
.0106.0119.0062.0062.0144                           LDGT2
.0214.0357.0071.0821.0321.0500.0179.0286.0179.0214  HDGV
.0179.0321.0286.0250.0321.0286.0357.0321.0429.0250  HDGV
.0607.0821.0357.0679.1394                           HDGV
.0180.0820.0800.0785.0744.0823.0703.0700.0608.0588  LDDV
.0539.0502.0414.0334.0301.0275.0217.0121.0094.0069  LDDV
.0051.0066.0051.0035.0180                           LDDV
.0235.0964.0789.0887.0656.0718.0708.0603.0522.0510  LDDT
.0482.0478.0405.0286.0307.0279.0285.0153.0163.0113  LDDT
.0059.0082.0074.0055.0187                           LDDT
.0162.0603.0766.0348.0302.0186.0348.0441.0836.0719  HDDV
.0789.0487.0418.0464.0441.0626.0603.0162.0186.0348  HDDV
.0255.0209.0116.0046.0139                           HDDV
.0164.1203.0844.0664.0780.0565.0472.0449.0289.0215  MC
```

```
.0289.4066.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
03 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00          I/M Prog1
03 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00          I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
03 83 05 2222 21  096 22112222                              ATP
03 83 05 2222 21  096                                       Pressure Test
NHR   WED Diurn  B 73.0 91.0  8.3  7.8 92 1 1 2               LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 85.0 15.1 14.3 23.3  7                             HWY  WED    DRN
01 1                                                         NLEV, start 2001,
```

TABLE 37
Harris County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Harris County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - Harris county I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0286.0963.0854.0795.0739.0805.0652.0647.0584.0581  LDGV    HARRIS        1999
.0537.0490.0418.0333.0288.0255.0198.0117.0089.0064  LDGV
.0047.0054.0042.0029.0133                           LDGV
.0275.1098.0889.0929.0674.0739.0676.0579.0497.0473  LDGT1
.0437.0441.0379.0277.0286.0266.0239.0135.0155.0115  LDGT1
.0062.0081.0071.0053.0174                           LDGT1
.0823.2229.0916.1194.0643.0735.0559.0437.0288.0249  LDGT2
.0271.0219.0191.0121.0149.0135.0130.0076.0143.0103  LDGT2
.0099.0088.0067.0038.0097                           LDGT2
.0167.0544.0293.0517.0447.1766.0447.0233.0315.0303  HDGV
.0346.0293.0286.0284.0338.0328.0272.0192.0289.0264  HDGV
.0338.0486.0371.0221.0660                           HDGV
.0286.0963.0854.0795.0739.0805.0652.0647.0584.0581  LDDV
.0537.0490.0418.0333.0288.0255.0198.0117.0089.0064  LDDV
.0047.0054.0042.0029.0133                           LDDV
.0275.1098.0889.0929.0674.0739.0676.0579.0497.0473  LDDT
```

```
.0437.0441.0379.0277.0286.0266.0239.0135.0155.0115  LDDT
.0062.0081.0071.0053.0174                           LDDT
.0454.1363.0864.0683.0586.0525.0561.0575.0478.0567  HDDV
.0587.0460.0398.0310.0255.0264.0229.0095.0164.0165  HDDV
.0093.0136.0070.0046.0072                           HDDV
.0299.1432.1008.0794.0783.0661.0521.0482.0307.0212  MC
.0217.3284.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
97 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00          I/M Prog1
97 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00          I/M Prog2/ASM/imdata4.d
1.00 1.00 1.00 1.00 0.40
84 83 05 2222 21  096 22112222                              ATP
97 83 05 2222 21  096                                       Pressure Test
HAR   WED Diurn  B 70.0 95.5  8.3  7.8 92 1 1 2              LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 87.0 15.1 14.3 23.3  7                            HWY  WED    DRN
01 1                                                        NLEV, start 2001,
```

TABLE 38
Liberty County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Liberty County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0146.0705.0772.0770.0742.0794.0600.0628.0527.0575  LDGV    LIBERTY       1999
.0536.0543.0458.0377.0357.0331.0256.0177.0135.0098  LDGV
.0075.0100.0076.0037.0185                           LDGV
.0217.0881.0833.0900.0692.0739.0647.0545.0476.0489  LDGT1
.0433.0440.0400.0261.0308.0293.0312.0187.0207.0148  LDGT1
.0078.0124.0099.0074.0217                           LDGT1
.0999.3741.1265.1110.0566.0388.0189.0144.0067.0178  LDGT2
.0166.0089.0122.0111.0133.0100.0033.0044.0078.0100  LDGT2
.0055.0067.0055.0067.0133                           LDGT2
.0067.0604.0268.0268.0000.0604.0134.0134.0134.0268  HDGV
```

```
.0470.0604.0134.0268.0537.0268.0403.0201.0403.0604  HDGV
.0805.0671.0470.0403.1278                           HDGV
.0146.0705.0772.0770.0742.0794.0600.0628.0527.0575  LDDV
.0536.0543.0458.0377.0357.0331.0256.0177.0135.0098  LDDV
.0075.0100.0076.0037.0185                           LDDV
.0217.0881.0833.0900.0692.0739.0647.0545.0476.0489  LDDT
.0433.0440.0400.0261.0308.0293.0312.0187.0207.0148  LDDT
.0078.0124.0099.0074.0217                           LDDT
.0609.0393.1375.0884.0747.0668.1531.0825.0472.0295  HDDV
.0236.0255.0196.0098.0118.0216.0177.0118.0177.0255  HDDV
.0020.0059.0059.0079.0138                           HDDV
.0114.1182.1045.0500.0750.0591.0477.0455.0250.0136  MC
.0136.4364.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
04 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00          I/M Prog1
04 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00          I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
04 83 05 2222 21  096 22112222                              ATP
04 83 05 2222 21  096                                       Pressure Test
HAR   WED Diurn  B 70.0 95.5  8.3  7.8 92 1 1 2              LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 87.0 15.1 14.3 23.3  7                             HWY  WED    DRN
01 1                                                         NLEV, start 2001,
```

TABLE 39
Montgomery County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Montgomery County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0218.0850.0908.0895.0818.0852.0707.0686.0579.0557  LDGV    MONTGOMERY    1999
.0510.0464.0382.0295.0260.0233.0185.0110.0087.0060  LDGV
```

```
.0047.0059.0043.0030.0165                                LDGV
.0253.1066.0914.1004.0717.0780.0676.0578.0472.0462  LDGT1
.0415.0400.0345.0247.0293.0258.0239.0135.0149.0115  LDGT1
.0059.0094.0077.0058.0194                                LDGT1
.1120.2898.1290.1250.0590.0490.0327.0227.0170.0130  LDGT2
.0143.0120.0117.0087.0093.0093.0103.0093.0133.0093  LDGT2
.0067.0087.0083.0063.0133                                LDGT2
.0047.0376.0282.0565.0235.0824.0212.0259.0424.0400  HDGV
.0376.0282.0259.0259.0212.0353.0447.0306.0376.0424  HDGV
.0541.0588.0541.0376.1036                                HDGV
.0218.0850.0908.0895.0818.0852.0707.0686.0579.0557  LDDV
.0510.0464.0382.0295.0260.0233.0185.0110.0087.0060  LDDV
.0047.0059.0043.0030.0165                                LDDV
.0253.1066.0914.1004.0717.0780.0676.0578.0472.0462  LDDT
.0415.0400.0345.0247.0293.0258.0239.0135.0149.0115  LDDT
.0059.0094.0077.0058.0194                                LDDT
.0277.0904.0511.0862.0468.0415.0489.0479.0383.0436  HDDV
.0628.0436.0383.0340.0404.0436.0564.0223.0351.0362  HDDV
.0202.0170.0128.0064.0085                                HDDV
.0346.1141.1131.0823.0733.0629.0543.0422.0284.0207  MC
.0207.3534.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                                MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
03 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00           I/M Prog1
03 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00           I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
03 83 05 2222 21  096 22112222                               ATP
03 83 05 2222 21  096                                        Pressure Test
HAR   WED Diurn  B 70.0 95.5  8.3  7.8 92 1 1 2               LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                        Trip Length Diurnal
4 07 XXXX 87.0 15.1 14.3 23.3  7                              HWY  WED    DRN
01 1                                                          NLEV, start 2001,
```

TABLE 40
Waller County MOBILE5B 24-Hour Diurnal Setups

```
5          PROMPT
Waller County 2007 for COAST Redo USE MOBILE5B
1           Tamflg - Default Tampering Rates
4           Spdflg - One speed for all scenarios + trip length distribution
1           VMflg  - default VMT mix
3           Mymrflg- County Specific Reg Dist
2           Newflg - new HDGV emission standards
6           IMflg  - I/M program
1           Alhflg - No additional correction factors
5           ATPflg - ATP and Pressure test
5           Rlfflg - Zero-out refueling emissions
2           Locflg - One LAP for all scenarios
1           Tempflag  Mobile calculates exhaust temperature
4           Outfmt - 80 column output format
```

```
4           Prtflg - Print HC emission factors only
1           Idflg  - No Idle factors calculated
3           Nmhflg - Print HC = VOC
2           HCflg  - Print Total HC
.0137.0635.0762.0761.0730.0810.0579.0650.0561.0565  LDGV    WALLER        1999
.0543.0481.0483.0334.0335.0322.0315.0188.0167.0104  LDGV
.0084.0106.0078.0056.0214                           LDGV
.0211.0978.0852.0857.0823.0730.0676.0546.0471.0420  LDGT1
.0395.0430.0368.0276.0267.0276.0255.0170.0202.0149  LDGT1
.0094.0124.0123.0065.0242                           LDGT1
.0768.3448.1404.1554.0655.0412.0337.0169.0056.0169  LDGT2
.0112.0094.0112.0019.0112.0131.0037.0037.0075.0075  LDGT2
.0037.0000.0037.0019.0131                           LDGT2
.0122.0732.0488.0122.0122.0488.0366.0366.0244.0488  HDGV
.0122.0244.0122.0000.0244.0366.0244.0244.0488.0732  HDGV
.0732.0732.0122.0488.1582                           HDGV
.0137.0635.0762.0761.0730.0810.0579.0650.0561.0565  LDDV
.0543.0481.0483.0334.0335.0322.0315.0188.0167.0104  LDDV
.0084.0106.0078.0056.0214                           LDDV
.0211.0978.0852.0857.0823.0730.0676.0546.0471.0420  LDDT
.0395.0430.0368.0276.0267.0276.0255.0170.0202.0149  LDDT
.0094.0124.0123.0065.0242                           LDDT
.0367.1655.0917.0367.0367.0275.0550.0275.0550.0367  HDDV
.0550.0550.0275.0459.0367.0183.0275.0275.0092.0459  HDDV
.0275.0275.0000.0092.0183                           HDDV
.0193.0725.0628.0531.0531.0676.0338.0821.0242.0338  MC
.0290.4687.0000.0000.0000.0000.0000.0000.0000.0000  MC
.0000.0000.0000.0000.0000                           MC
009
1 7 3 90 90 05.639 00.000
1 7 3 91 97 04.598 00.000
1 7 3 98 03 03.679 00.000
1 7 3 04 50 01.840 00.000
1 4 3 05 07 01.120 00.020
1 4 3 08 08 01.090 00.020
1 4 3 09 50 01.060 00.020
1 4 1 05 07 00.690 00.090
1 4 1 09 50 00.680 00.090
2 1 2 1
04 20 83 95 03 03 096 221 2222 5211 25.0 50.0 2.00          I/M Prog1
04 20 96 05 03 03 096 221 2222 4211 0.80 15.0 2.00          I/M Prog2/ASM/IMdata4.d
1.00 1.00 1.00 1.00 0.40
04 83 05 2222 21  096 22112222                              ATP
04 83 05 2222 21  096                                       Pressure Test
HAR   WED Diurn  B 70.0 95.5  8.3  7.8 92 1 1 2              LAP  WEDNESDAY
 13.7 26.9 22.6 15.1  9.1 12.6                       Trip Length Diurnal
4 07 XXXX 87.0 15.1 14.3 23.3  7                            HWY  WED    DRN
01 1                                                        NLEV, start 2001,
```

Low-Sulfur Gasoline Program

MOBILE5B is unable to estimate emissions factors that include credit for the proposed low-sulfur gasoline program. Credits for the low-sulfur gasoline program were estimated by applying the NOx reduction factors shown in Table 41 to emissions factors calculated using MOBILE5B. This program impacts only gasoline-powered vehicles. The factors shown in Table 41 were provided to TTI by ERG and are documented in a separate memorandum prepared by ERG.

Low-Emissions Diesel Program

MOBILE5B is unable to estimate emissions factors that include credit for the proposed low-emissions diesel program. Credits for the low-emissions diesel program were estimated by applying the NOx reduction factors shown in Table 41 to emissions factors calculated using MOBILE5B. This program impacts only diesel-powered vehicles. The factors shown in Table 41 were provided to TTI by ERG and are documented in a separate memorandum prepared by ERG.

TABLE 41
NOx Reduction Factors for the Low-Sulfur Gasoline and Low-Emissions Diesel Programs

Low-Sulfur Gasoline								
Vehicle Type	**LDGV**	**LDGT1**	**LDGT2**	**HDGV**	**LDDV**	**LDDT**	**HDDV**	**MC**
Factor	0.992	0.992	0.992	0.992	1.000	1.000	1.000	1.000
Low-Emissions Diesel								
Factor	1.000	1.000	1.000	1.000	0.943	0.943	0.943	1.000

Federal Tier 2 Program

MOBILE5B is unable to estimate emissions factors that include credit for the federal Tier 2 motor vehicle emissions standards program. The Tier 2 credits used for this application were developed by ERG and are documented in a separate ERG memorandum. The reduction factors for the Tier 2 program are shown in Table 42. The factors were applied to the applicable emissions rates calculated using MOBILE5B.

TABLE 42
Tier 2 Reduction Factors for the HGAC Area

County	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
	NOx							
Harris	0.761	0.781	0.826	0.949	0.539	0.527	1.000	1.000
Brazoria	0.761	0.781	0.826	0.959	0.591	0.576	1.000	1.000
Fort Bend	0.761	0.781	0.826	0.959	0.554	0.544	1.000	1.000
Galveston	0.761	0.781	0.826	0.955	0.552	0.540	1.000	1.000
Montgomery	0.761	0.781	0.826	0.957	0.601	0.593	1.000	1.000
Liberty	0.761	0.781	0.826	0.960	0.646	0.641	1.000	1.000
Chambers	0.761	0.781	0.826	0.962	0.786	0.765	1.000	1.000
Waller	0.761	0.781	0.826	0.958	0.711	0.704	1.000	1.000
	VOC							
Harris	0.879	0.877	0.890	0.977	0.219	0.279	1.000	1.000
Brazoria	0.827	0.838	0.890	0.980	0.101	0.174	1.000	1.000
Fort Bend	0.879	0.837	0.890	0.984	0.406	0.219	1.000	1.000
Galveston	0.832	0.841	0.890	0.983	0.190	0.241	1.000	1.000
Montgomery	0.822	0.834	0.890	0.980	0.046	0.122	1.000	1.000
Liberty	0.879	0.838	0.890	0.983	0.290	0.094	1.000	1.000
Chambers	0.879	0.846	0.890	0.977	0.224	0.094	1.000	1.000
Waller	0.837	0.877	0.890	0.982	0.046	0.063	1.000	1.000

EMISSIONS CALCULATIONS

Estimation of Gridded Time-of-Day Emissions

The gridded emissions for each of the 24 one-hour time periods were computed using the IMPSUMA program. The inputs for the gridded emissions applications of IMPSUMA for HGAC were:

- Data specifying the number of counties in the region and their names.
- Names of the road types used in the study. These road types are used to summarize the emissions results. The roadway types used in the gridded emissions estimates are the functional classifications used in the networks.
- VMT mix by functional classification group.
- Emissions factors from POLFC5B or RATEADJV by county.
- Specification of the units for reporting emissions (grams, pounds or tons).
- Link records providing the estimated VMT and speeds. For each link record, the following information must be provided: county number, road type number, VMT, operational speed estimate, and center line miles. These data were prepared using the PREPIN2 program.
- Coordinates for nodes and zones for calculation of gridded emissions.

The emissions rates produced using MOBILE5B are stratified by eight vehicle types. To apply the emissions rates, VMT for a link record is disaggregated into the VMT for each of the eight vehicle types by applying VMT mixes. A VMT mix is a distribution of VMT by vehicle type. The software provides for the input of VMT mix data by county and by roadway type.

VMT mix was estimated using TxDOT weekday vehicle classification data for each county for 1997, 1998, 1999, the most recent years for which data are available. A summary of the estimation procedure is provided. TxDOT classification counts classify vehicles into the standard FHWA vehicle 13 classifications shown in Table 43. Motorcycles are not counted separately and are included as a default (subtracted from LDGV). The eight EPA vehicle classes are defined primarily by gross vehicle weight rating (GVWR):

LDGV	light-duty gasoline vehicles
LDGT1	light-duty gasoline trucks up to 6,000 pounds (GVWR)
LDGT2	light-duty gasoline trucks from 6,001 to 8,500 pounds (GVWR)
HDGV	heavy-duty gasoline vehicles over 8,500 pounds (GVWR)
LDDT	light-duty diesel trucks
LDDV	light-duty diesel vehicles
HDDV	heavy-duty diesel vehicles over 8,500 pounds (GVWR)
MC	motorcycles

Vehicle classification counts are first aggregated into three intermediate vehicle groups as follows (see Table 44):

LDT	0.80 * P
LDGT2	(0.20 * P) + (0.20 * B) + (0.20 * SU2)
HDV	(0.80 * B) + (0.80 * SU2) + (SU3+SU4+SE3+SE4+SE5+SE6+SD5+SD6+SD7)

Next, the remaining FHWA categories and these three intermediate groups are disaggregated into the eight EPA vehicle groups as shown below and in Table 45. TxDOT vehicle classification count procedures do not distinguish between gasoline and diesel light-duty trucks, consequently, MOBILE5B defaults for the year of interest are used. Texas county vehicle registration data are used to separate gasoline and diesel heavy-duty trucks. Motorcycles are not counted directly and are included as a default, subtracted from LDGV.

LDGV	0.997 * C (MOBILE5B default, 1999 shown)
LDDV	0.003 * C (MOBILE5B default, 1999 shown)
LDGT1	0.994 * LDT (MOBILE5B default, 1999 shown)
LDDT	0.006 * LDT (MOBILE5B default, 1999 shown)
LDGT2	(0.20 * P) + (0.20 * B) + (0.20 * SU2)
HDGV	0.333 * HDV (County registration data, 1999 state aggregate shown)
HDDV	0.667 * HDV (County registration data, 1999 state aggregate shown)
MC	0.001 of total (subtracted from LDGV)

TABLE 43
FHWA Vehicle Types

Vehicle Type Description	FHWA Label	TxDOT Label	TxDOT Code
Motorcycles and passenger vehicles	C	none	1
Two axle four tire single unit trucks	P	none	2
Buses	B	none	3
Six tire single unit vehicles	SU2	none	4
Three axle single unit vehicles	SU3	none	5
Four or more axle single unit vehicles	SU4	none	6
Three axle single trailer	SE3	2S1	7
Four axle single trailer	SE4	2S2, 3S1	8
Five axle single trailer	SE5	3S2, 2S3	9
Six or more axle single trailer	SE6	3S3, 3S4	10
Five or less axle multi trailer	SD5	2S1-2	11
Six axle multi trailer	SD6	2S2-2, 3S1-2	12
Seven or more axle multi trailer	SD7	3S2-2	13

TABLE 44
FHWA Vehicle Types Grouping

FHWA Vehicle Types	EPA Vehicle Types		
	LDT	LDGT2	HDV
Passenger cars (C)	NA	NA	NA
2-axle, 4-tire single unit (P)	0.80	0.20	
Buses (B)		0.20	0.80
2-Axle, 6-tire, single unit (SU2)		0.20	0.80
3-Axle single unit (SU3)			1.00
4-Axle or more single unit (SU4)			1.00
3-Axle single trailer (SE3)			1.00
4-Axle single trailer (SE4)			1.00
5-Axle single trailer (SE5)			1.00
6-Axle or more single trailer (SE6)			1.00
5-Axle or less multi-trailer (SD5)			1.00
6-Axle multi-trailer (SD6)			1.00
7-Axle or more multi-trailer (SD7)			1.00

TABLE 45
MOBILE5B Vehicle Types

FHWA Vehicle Types	MOBILE5B Vehicle Types							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Passenger cars (C)	0.996				0.003			0.001
2-axle, 4-tire single unit (P)		0.80	0.20					
Buses (B)			0.20	0.266			0.534	
2-Axle, 6-tire, single unit (SU2)			0.20	0.266			0.534	
LDT		0.994				0.006		
HDV				0.333			0.667	

The procedure described was applied to TxDOT vehicle classification data for the eight HGAC counties. Similarities in VMT mix between functional classifications (such as between principal arterials and other arterials and between locals and collectors) allowed the VMT mix data to be aggregated across functional classifications to make the best use of the available classification data. Similarities in VMT mix between counties allowed the VMT mix data to be aggregated across counties. The aggregated functional classifications consist of freeway, principal arterials and other arterials, and collectors/locals. Tables 38 shows the VMT mix data by aggregated functional classification. The same VMT mix data was used for each county.

TABLE 46
2007 VMT Mix

Aggregated Functional Classification	Vehicle Types							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Freeway	0.744	0.131	0.040	0.019	0.002	0.002	0.062	0.001
Arterial	0.699	0.170	0.050	0.021	0.002	0.002	0.055	0.001
Collector/Local	0.590	0.242	0.072	0.032	0.002	0.003	0.059	0.001

The aggregated VMT mix data were applied by the IMPSUMA software using the aggregated functional classifications and network functional classifications shown in Table 47.

TABLE 47
Aggregated Functional Classification and Network Functional Classification Equivalences

Aggregated Functional Classifications	Network Functional Classifications
1. Freeways	1. Urban Interstate Freeway 2. Urban Other Freeway 10. Rural Interstate Freeway 11. Rural Other Freeway
2. Arterials Principal and Other	5. Urban Principal Arterial 6. Urban Other Arterial 12. Rural Principal Arterial 13. Rural Other Arterial
3. Collectors/Locals	7. Urban Collector 8. Centroid Connector 14. Rural Major Collector 15. Rural Collector 0. Intrazonal

The emissions estimates are computed for each link by multiplying the appropriate emissions factors corresponding to the link's roadway type and the link's estimated directional speed. For non-integer speed estimates, the emissions factors are computed by interpolating between the emissions factors for the integer speeds on either side of the subject speed. The interpolation is performed using the reciprocals of the corresponding speeds rather than the speeds themselves. The emissions results are accumulated for each county by vehicle type and roadway type.

The 24-hour diurnal emissions rates were scaled to the one-hour time periods where diurnal emissions occurred. Diurnal emissions occur due to temperature rises. However, there is a two-hour lag between when the temperature rise occurs and when the resulting diurnal emissions occur. The one-hour time periods when diurnal emissions occur were identified when the temperature data were processed for input into POLFC5B. To appropriately scale the 24-hour diurnal emissions rates, it was necessary to calculate the VMT occurring in each of the 24 one-hour time periods for each county. VMTSUM, a program written by TTI, calculated the VMT by time period for each of the counties. The VMT by time period for each of the counties and the relative temperature rise was used by IMPSUMA to scale the 24-hour diurnal emissions rates. IMPSUMA also combined the diurnal emissions rates into the VOC emissions rates for the respective county and one-hour time period.

24-Hour Gridded Emissions

The PREPIN2, POLFC5B, and IMPSUMA programs were applied to estimate the gridded mobile source emissions for each of the 24 one-hour time periods. Individual applications of MOBILE5B were used to calculate the 24-hour diurnal emissions rates for each county. IMPSUMA was executed to produce gridded emissions estimates for each one-hour time period.

The SUMALLA program was used to compute the 24-hour gridded emissions estimates. The SUMALLA program sums the results from the IMPSUMA applications (i.e., the time-of-day applications). The 24-hour tabular summaries produced by the SUMALLA program are essentially the same as those produced for the individual time-of-day time periods by the IMPSUMA program.

MOBILE5B is not structured to compute diurnal emissions for less than a 24-hour time period; therefore, a separate run of POLFC5B was made to calculate the diurnal emissions. Diurnal emissions are produced by LDGV, LDGT1, LDGT2, HDGV, and MC vehicle types. Diesel vehicle types do not produce diurnal emissions. Multiple diurnal emissions are produced by LDGV, LDGT1, LDGT2, and HDGV. POLFC5B produces diurnal emissions rates on a grams per mile basis by vehicle type.

The 2007 VOC and NOx emissions for the eight counties are summarized in Tables 48.

TABLE 48
2007 Emissions by County (tons per day)

County	VOC	NOx
Harris	56.76	126.20
Brazoria	2.74	7.87
Fort Bend	4.56	11.34
Waller	0.92	2.73
Montgomery	5.28	15.22
Liberty	1.43	3.81
Chambers	1.44	5.08
Galveston	2.88	7.20
Total	**76.00**	**179.46**

Transmittal of Emissions

The gridded emissions estimates for each of the 24 one-hour time periods were transmitted to TNRCC electronically. Gridded emissions estimates were provided for VOC, CO, NOx, exhaust hydrocarbons, running loss hydrocarbons, resting loss hydrocarbons, crankcase hydrocarbons, hot soak hydrocarbons, and diurnal hydrocarbon emissions.

Impact of Speed Limit Changes

In the application of the speed model, speed limits are used to estimate the operational speeds for a given v/c ratio on various types of roadways. In the same way, speed limits, revised per the proposed speed limit controls, were used to estimate the freeflow and LOS E speed information needed to prepare the freeflow speed factors and the LOS E speed factors for each functional classification and area type. These factors are required inputs to the PREPIN2 software used to estimate the operational speeds and travel by time-of-day time periods as discussed in the speed model section. This analysis was performed by post processing the output of the travel model.

Consequently the VMT is the same for all analyses. The assumption explicit in this approach is that travelers will not change their travel patterns as a result of changes in speed limits. A more comprehensive approach to this analysis would be to revise the highway and transit system networks to reflect the increases in travel time and then to rerun the trip distribution, mode split, and trip distribution steps of the travel model. Time and staff resources were not available to perform this more comprehensive analysis procedure.

The research team evaluated two speed limit proposals. One proposal reduced the speed limit by 5 mph for all links that have speed limits greater than 55 mph. The second proposal reduced the speed limit to 55 mph for all links that have a speed limit great than 55 mph. The resulting freeflow speed and LOS E speed for each functional class and area type for the speed limits proposals are shown in Tables 49 through 52.

TABLE 49
Speeds Used for Calculating Freeflow (V/C = 0) Speed Factor
Scenario: Max Speed Limit 55 mph

Area Type	Functional Group					
	0	1	2	3	4	5
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterial	Collectors	Locals
CBD	0.0	53.88	22.33	23.10	20.50	10.33
Urban	0.0	57.39	28.50	26.32	22.95	18.56
Urban Fringe	0.0	57.13	35.71	30.34	25.64	20.78
Suburban	0.0	58.70	43.62	40.09	42.11	25.15
Rural	0.0	60.38	57.09	56.51	52.07	37.46

TABLE 50
Speeds Used for Calculating LOS E (V/C = 1) Speed Factor
Scenario: Max Speed Limit 55 mph

Area Type	Functional Group					
	0	1	2	3	4	5
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterial	Collectors	Locals
CBD	0.0	34.34	13.68	14.88	12.16	10.33
Urban	0.0	35.06	20.65	19.83	16.43	18.56
Urban Fringe	0.0	39.85	27.67	23.39	20.35	20.78
Suburban	0.0	49.69	34.07	30.82	32.76	25.15
Rural	0.0	50.15	47.42	47.95	44.68	37.46

TABLE 51
Speeds Used for Calculating Freeflow (V/C = 0) Speed Factor
Scenario: Speed Limits Over 55 mph Reduced by 5 mph

Area Type	Functional Group					
	0	1	2	3	4	5
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterial	Collectors	Locals
CBD	0.0	53.88	22.33	23.10	20.50	10.33
Urban	0.0	58.14	28.50	26.33	22.95	18.56
Urban Fringe	0.0	59.95	35.79	30.36	25.64	20.78
Suburban	0.0	64.41	44.10	40.49	42.17	25.15
Rural	0.0	67.29	62.21	59.42	52.63	37.46

TABLE 52
Speeds Used for Calculating LOS E (V/C = 1) Speed Factor
Scenario: Speed Limits Over 55 mph Reduced by 5 mph

Area Type	Functional Group					
	0	1	2	3	4	5
	Locals (Centroid Connectors)	Freeways	Principal Arterials	Other Arterial	Collectors	Locals
CBD	0.0	34.34	13.68	14.88	12.16	10.33
Urban	0.0	35.06	20.65	19.83	16.43	18.56
Urban Fringe	0.0	39.86	27.72	23.40	20.35	20.78
Suburban	0.0	49.71	34.41	31.08	32.79	25.15
Rural	0.0	50.15	51.11	50.13	45.10	37.46

With the freeflow speed factor, LOS E speed limit factor, and speed reduction factor, the PREPIN2 software can estimate the operational speed for each link. The resulting operational speed estimates and VMT estimates for each link in the 2007 network for each time period were used to estimate emissions. The estimated emissions for all current speed limits and the proposed speed limit changes are shown in Table 53.

The analysis shows that:

- the proposal for reducing speed limit to 55 mph (maximum speed limit 55 mph) has the lowest free flow speed and LOS E speed. The current speed limit scenario has the highest free flow and LOS E speed.
- the proposed changes in speed limits have more impact on NOx emissions than on VOC emissions.
- the proposal to reduce the speed limit to 55 mph (maximum speed limit 55 mph) has the lowest emissions, the current speed limits have the highest emissions, and the emissions for the proposal to reduce the speed limits over 55 mph by 5 mph are in between.

The emissions for the two speed limit proposals were gridded and provided electronically to TNRCC.

Table 53
Impact of Speed Limit Reduction Alternatives on Eight-County HGAC Area in 2007

	October 10, 2000 No reduction in speed limits			November 21, 2000 Speed limits greater than 55 mph reduced by 5 mph			October 18, 2000 Speed limits greater than 55 mph reduced to 55 mph		
	VMT	**VOC**	**NOx**	**VMT**	**VOC**	**NOx**	**VMT**	**VOC**	**NOx**
Harris	94,611,516.1	56.76	126.20	94,611,516.1	56.31	122.46	94,611,516.1	55.62	118.52
Brazoria	5,103,876.5	2.74	7.87	5,103,876.5	2.72	7.69	5,103,876.5	2.65	7.22
Ft. Bend	8,083,011.7	4.56	11.34	8,083,011.7	4.54	11.12	8,083,011.7	4.46	10.51
Waller	1,555,634.3	0.92	2.73	1,555,634.3	0.91	2.67	1,555,634.3	0.87	2.45
Montgomery	9,883,269.8	5.28	15.22	9,883,269.8	5.22	14.78	9,883,269.8	5.10	13.76
Liberty	2,408,400.4	1.43	3.81	2,408,400.4	1.40	3.65	2,408,400.4	1.36	3.41
Chambers	2,684,527.5	1.44	5.08	2,684,527.5	1.43	5.02	2,684,527.5	1.37	4.59
Galveston	5,032,141.9	2.88	7.20	5,032,141.9	2.87	7.09	5,032,141.9	2.82	6.66
Total	**129,362,378.2**	**76.00**	**179.46**	**129,362,378.2**	**75.40**	**174.48**	**129,362,378.2**	**74.24**	**167.12**

APPENDIX A:
Data Set Names and Transmittal Dates

DATA SETS PROVIDED TO TNRCC

Files Sent on 10/9/2000 - Current Speed Model
The ZIP file WKDY7NEW.ZIP contains the directional VMT by time period files.

```
2083559    10-04-00  17:58    WEEKDAY7.T01
                    .
                    .
                    .
2083559    10-04-00  18:00    WEEKDAY7.T24
```

The Zip file WKDY7LST.ZIP contains the listing of the JOB which produced the directional VMT by time period.

```
   76513    10-04-00  18:00    WKDYNEW.LOG
6979887    10-04-00  18:00    WKDYNEW.LST
   19541    10-04-00  17:58    WKDYNEW.JCF
```

The Zip file WED7RAT.ZIP contains the Tier2 adjusted emissions rates for eight counties and 24 time periods, diurnal emissions rates and 24-hour emissions rates. The file names for the time period emissions rates are in the form *CCC*7WD*hr*.TR2 where *CCC* is a three-character county abbreviation (see table below). The *hr* is a two-character number between 01 and 24 which is the time period. File names of the type *CCC*7WDDR.TR2 are diurnal emissions rates, the *CCC* is a county abbreviation (see table below). File names of the type *CCC*24WED.TR2 are 24-hour emissions rates, these files are intended to be used in cross checking of results.

Abbreviation	**County Name**
BRA	Brazoria
CHA	Chambers
FOR	Fort Bend
GAL	Galveston
HRS	Harris
LIB	Liberty
MON	Montgomery
WAL	Waller

The file names in the WED7RAT.ZIP are:

```
26076   10-06-00  09:43   FOR7WD01.TR2
                  .
                  .
                  .
26076   10-06-00  09:43   FOR7WD24.TR2
   82   10-06-00  09:43   FOR7WDDR.TR2
26076   10-06-00  09:43   FOR24WED.TR2
                  .
                  .
                  .
26076   10-06-00  09:30   BRA7WD24.TR2
   82   10-06-00  09:30   BRA7WDDR.TR2
26076   10-06-00  09:30   BRA24WED.TR2
                  .
                  .
                  .
26076   10-06-00  09:29   CHA7WD24.TR2
   82   10-06-00  09:29   CHA7WDDR.TR2
26076   10-06-00  09:29   CHA24WED.TR2
                  .
                  .
                  .
26076   10-06-00  09:39   HRS7WD24.TR2
   82   10-06-00  09:39   HRS7WDDR.TR2
26076   10-06-00  09:39   HRS24WED.TR2
                  .
                  .
                  .
26076   10-06-00  09:40   MON7WD24.TR2
   82   10-06-00  09:40   MON7WDDR.TR2
26076   10-06-00  09:40   MON24WED.TR2
                  .
                  .
                  .
26076   10-06-00  09:41   GAL7WD24.TR2
   82   10-06-00  09:41   GAL7WDDR.TR2
26076   10-06-00  09:41   GAL24WED.TR2
                  .
                  .
                  .
26076   10-06-00  09:42   LIB7WD24.TR2
   82   10-06-00  09:42   LIB7WDDR.TR2
26076   10-06-00  09:42   LIB24WED.TR2
```

.
.
.

26076	10-06-00	09:43	WAL7WD24.TR2
82	10-06-00	09:43	WAL7WDDR.TR2
26076	10-06-00	09:43	WAL24WED.TR2

The Zip file GRWDHG07.ZIP contains the gridded emissions for 24 time periods and the sum of the 24 time periods by nine emission types, and eight vehicle types, and total of the eight vehicle types. The emissions abbreviations are:

Emissions Abbreviation	**Description**
VOC	Volatile Organic Compound
CO	Carbon Monoxide
NOx	Nitrogen oxide
EXHS	Exhaust VOC
RNLS	Running loss VOC
RSTL	Resting loss VOC
CC	Crankcase VOC
HTSK	Hot Soak VOC
DIRN	Diurnal VOC

The file names in the GRWHG07.ZIP file are:

3869216	10-09-00	10:42	GRIDV.T01

.
.
.

3869216	10-09-00	10:48	GRIDV.T24
4352868	10-09-00	10:48	GRIDV24.TOT

The Zip file HGC7LST.ZIP contains the listing and log file of the emission output for 24 time periods and the 24-hour sum.

164589	10-09-00	10:48	SEP7VWED.LOG
12660340	10-09-00	10:48	SEP7VWED.LST
55756	10-09-00	09:41	SEP7VWED.JCF

Files Sent on 10/18/2000 - 55 mph Limit Speed Limit Model
The zip file HGC7LST.ZIP contains the emissions results for the 55 MPH speed model runs.

```
   164589  10-17-00  16:52    SEP7SWED.LOG
12660340  10-17-00  16:52    SEP7SWED.LST
    55997  10-16-00  17:00    SEP7SWED.JCF
```

The zip file WKDY7S55.ZIP contains the listing and log file of the emissions output for24 time periods and the 24-hour sum for the 55 mph speed model runs.

The Zip file WKDY7S55.ZIP contains the directional link VMT by time period files.

```
2083559    10-17-00  16:41    WKDY7S55.T01
                      .
                      .
                      .
2083559    10-17-00  16:42    WKDY7S55.T24
```

The Zip file GRWSHG07.ZIP contains the gridded emissions by time period and 24-hour gridded emissions for the 55 mph speed model runs.

```
3869216    10-17-00  16:46    GRIDV55S.T01
                      .
                      .
                      .
3869216    10-17-00  16:51    GRIDV55S.T24
4352868    10-17-00  16:52    GRD55S24.TOT
```

The Zip file WKDY55PR.ZIP contains the listing of the JOB (and the JCF control file) which prepared the link VMT by 24 time periods.

```
   76513    10-17-00  16:42    WKDY55SL.LOG
6891792    10-17-00  16:42    WKDY55SL.LST
   19567    10-17-00  16:27    WKDY55SL.JCF
```

Files Sent on 11/21/2000 - Speed Limit Greater than 55 mph Reduced by 5 mph Speed Model
The ZIP file WKDY5M.ZIP contains the directional link VMT by time period files for the speed limit greater than 55 mph reduced by 5 mph speed model.

```
2083559   11-16-00  10:55    WKDY7M5.T01
                      .
                      .
                      .
2083559   11-16-00  10:57    WKDY7M5.T24
```

The zip file WKDY7M5.ZIP contains the listing of the JOB which produced the directional VMT for the speed limit greater than 55 mph reduced by 5 mph speed model.

```
   76513    11-16-00  10:57    WKDY5MI.LOG
6891792    11-16-00  10:57    WKDY5MI.LST
   19517    11-16-00  10:54    WKDY5MI.JCF
```

The zip file SEP7S5PR.ZIP contains the emission results for the speed greater than 55 mph reduced by 5 mph speed model.

```
    55769    11-16-00  11:12    SEP7S5.JCF
   164589    11-16-00  11:45    SEP7S5.LOG
12660340    11-16-00  11:45    SEP7S5.LST
```

The zip file GRW5MHG7.ZIP contains the gridded emission results by nine emissions types and vehicle type for the speed greater than 55 mph reduced by 5 mph speed model.

```
3869216  11-16-00  11:38    GRIDV5M.T01
                     .
                     .
                     .
3869216  11-16-00  11:45    GRIDV5M.T24
4352868  11-16-00  11:45    GRD5M24.TOT
```