United States Environmental Protection Agency

Air and Radiation

EPA420-R-03-017
April 2003

National Mobile Inventory Model (NMIM) Base and Future Year County Database Documentation and Quality Assurance Procedures

EPA420-R-03-017
April 2003

National Mobile Inventory Model (NMIM) Base and Future Year County Database Documentation and Quality Assurance Procedures

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Prepared for EPA by
Eastern Research Group, Inc.
EPA Contract No. 68-C00-112
Work Assignment No. 3-05

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

To keep pace with new analysis needs, new modeling approaches, and new data, the EPA's Office of Transportation and Air Quality (OTAQ) is currently working the **M**ulti-scale M**O**tor **V**ehicles and equipment **E**mission **S**ystem (MOVES). MOVES will estimate emissions for on-road and off-road sources, cover a broad range of pollutants, and allow multiple scale analysis, from fine-scale analysis to national inventory estimation. When fully implemented, MOVES will replace both MOBILE6 and NONROAD. MOVES will not necessarily be a single piece of software, but instead will encompass the tools, algorithms, underlying data and guidance necessary for use in all official analyses associated with regulatory development, compliance with statutory requirements, and national/regional inventory projections. Additional detail on EPA's MOVES program can be found at http://www.epa.gov/otaq/ngm.htm.

EPA's National Mobile Inventory Model (NMIM) is an interim product supporting creation of MOVES. NMIM combines mobile sources emission factor modeling with area-specific data to produce national emission inventories at county level using MOBILE6.3 and NONROAD. NMIM inventories will support EPA regulatory analysis and policy setting activities.

To support development of NMIM, ERG created and populated a data set that contains the area-specific county-level data required for emissions inventory modeling. There are two distinct components of this data: complete "baseline" data for 1999, and the future-year (post-1999) data to project beyond the baseline. As an interim product, NMIM implements some MOVES architecture features. Specifically, the NMIM database is based on the MySQL open-source database management system, and the Java language is used as appropriate for software components. The NMIM data set ERG produced includes a MySQL-based database and also a set of non-database data files (primarily MOBILE6 input files). This report documents the development of a data set that contains the area-specific county-level data required for emissions inventory modeling, including "baseline" data for 1999, and the future-year (post-1999) data. Figure 1-1 presents a data relationship diagram illustrating the data set.

This report is organized as follows:

- Section 2.0: Reference Tables;
- Section 3.0: Fuel Tables;
- Section 4.0: Vehicle Tables;
- Section 5.0: Inspection and Maintenance (I/M) Tables;
- Section 6.0: Additional Tables; and
- Section 7.0: Internal QA/QC Tables.

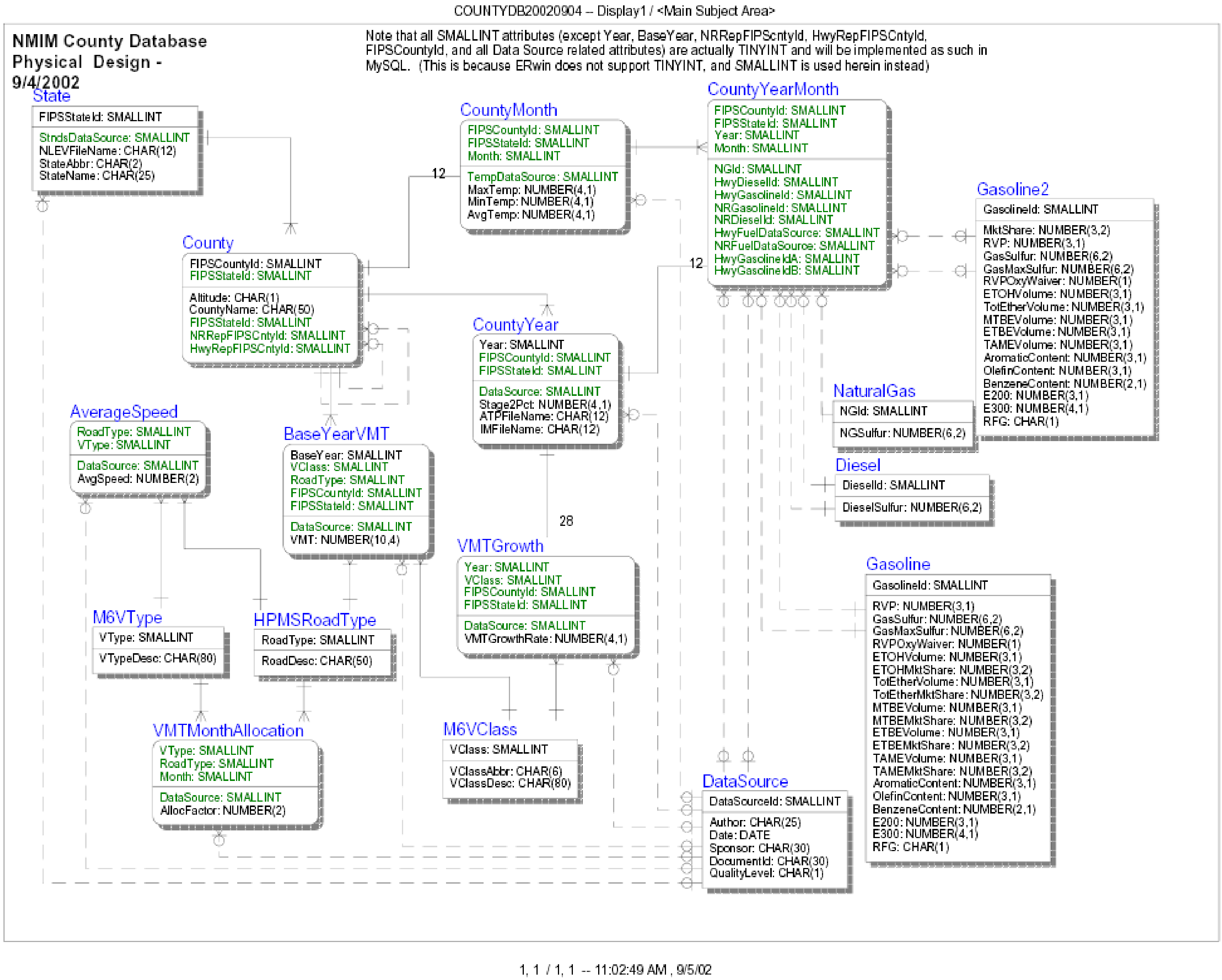

Figure 1-1. Data Relationship Diagram

2.0 REFERENCE TABLES

NMIM includes a series of reference, or look-up, tables that contain definitions of codes used in certain fields in other tables. Each of these reference tables are described below.

2.1 DataSource

The DataSource table contains reference information for the documents, data bases, and other sources of information used to populate NMIM data tables.

Data Source

Multiple references were reviewed to gather the information used to populate NMIM tables. DataSource provides additional detail associated with each reference.

Data Population Methodology

The DataSource table was populated manually as each NMIM table was added to the database.

Quality Assurance Procedures

The contents of the DataSource field in each table were visually compared with the contents of the DataSourceID field in the DataSource table verify that all sources were documented. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

2.2 HPMSRoadType

The HPMSRoadType table contains the 12 Highway Performance Monitoring System (HPMS) roadway types and the unique identifier assigned to each type.

Data Source

The HPMS roadway types were extracted from the vehicles2.xls file from the June 2002 National Emissions Inventory (NEI) update files.

Data Population Methodology

The data were exported from Microsoft Excel to a comma-separated value (csv) file. The csv file was then imported into the NMIM database. The original spreadsheet included 3-digit roadway types rather than 2-digit roadway types. This 3-digit roadway type was converted to the corresponding 2-digit roadway type before being imported into the NMIM database.

Quality Assurance Procedures

ERG compared the 12 HPMS roadway types against the corresponding portion of SCC codes retrieved from http://www.epa.gov/ttn/chief/codes/index.html, where SCC = [XX-AA-BBB-CC-D] and CC = HPMS roadway type. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

Table 2-1 presents the 12 roadway types contained in the HPMSRoadtype table.

TABLE 2-1
HPMSRoadtype Values

Roadway Type ID	Roadway Type Description
11	Interstate: Rural
13	Other Principal Arterial: Rural
15	Minor Arterial: Rural
17	Major Collector: Rural
19	Minor Collector: Rural
21	Local: Rural
23	Interstate: Urban
25	Other Freeways and Expressways: Urban
27	Other Principal Arterial: Urban
29	Minor Arterial: Urban
31	Collector: Urban
33	Local: Urban

2.3 M6VClass

The M6VClass table contains the 28 vehicle classes used in MOBILE6 and the unique identifier assigned to each.

Data Source

Vehicle classes were obtained from Section 1.2.3 of the MOBILE6 User Guide (EPA 420-R-02-028, October 2002), also available from http://www.epa.gov/otaq/m6.htm.

Data Population Methodology

Data were entered in a Microsoft Excel spreadsheet and then exported to a csv file. The csv file was then imported into the NMIM database.

Quality Assurance Procedures

The contents of M6VClass were printed and visually compared to the list of MOBILE6 vehicle classes from the MOBILE6 User's Guide. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

Table 2-2 presents the 28 vehicle classes contained in the M6VClass table.

TABLE 2-2
M6VClass Values

Vehicle Class ID	Vehicle Class Abbreviation	Vehicle Class Description
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5750 lbs. ALVW)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5751 lbs. and greater ALVW)
6	HDGV2B	Class 2b Heavy-Duty Gasoline Vehicles (8501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8A	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8B	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)
15	LDDT12	Light-Duty Diesel Trucks 1 and 2 (0-6,000 lbs. GVWR)
16	HDDV2B	Class 2b Heavy-Duty Diesel Vehicles (8501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)

TABLE 2-2
Continued

Vehicle Class ID	Vehicle Class Abbreviation	Vehicle Class Description
22	HDDV8A	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8B	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

2.4 M6VType

The M6VType table contains a list of the 16 consolidated vehicle types used in MOBILE 6 and the unique identifier assigned to each.

Data Source

Vehicle types were obtained from Table 1 of Appendix B of the MOBILE 6 User's Guide (EPA 420-R-02-028, October 2002), also available from http://www.epa.gov/otaq/m6.htm.

Data Population Methodology

Data were entered in a Microsoft Excel spreadsheet and then exported to a comma-delimited (csv) file. The csv file was then imported into the NMIM database.

Quality Assurance Procedures

The contents of M6VType were printed and visually compared to the list of MOBILE6 vehicle types from the MOBILE6 User's Guide. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

Table 2-3 presents the 16 vehicle types contained in the M6VType table.

TABLE 2-3
M6VType Values

Vehicle Type ID	Vehicle Type Description
1	Light-Duty Vehicles (Passenger Cars)
2	Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	Light-Duty Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	Light-Duty Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
6	Class 2b Heavy-Duty Vehicles (8,501-10,000 lbs. GVWR)
7	Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)
8	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)
9	Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)
10	Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)
11	Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)
12	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)
13	Class 8b Heavy-Duty Vehicles (>60,000 lbs. GVWR)
14	School Buses
15	Transit and Urban Buses
16	Motorcycles

3.0 FUEL TABLES

NMIM contains several tables used to describe base and future year fuel parameters, including fuel formulation information, market share information, fuel diesel content, and natural gas content. Each fuel table is described in detail below.

3.1 Diesel

The Diesel table specifies the sulfur content of various diesel fuels used in the base year, or anticipated to be used in future years.

Data Source

The Diesel sulfur values were extracted from the *Future* tab of a spreadsheet titled sulfur.xls, forwarded by Dave Brzezinski, USEPA, on September 19, 2002.

Data Population Methodology

Because of the limited number of diesel fuels in the baseline and future years, the Diesel table was populated manually. Two diesel records were added to the database as shown in Table 3-1.

TABLE 3-1
Diesel Sulfur Values

Diesel ID	Diesel Sulfur Value (parts per million (ppm))	Highway Applicability	NonRoad Applicability
1	500	Assigned to all counties for calendar years 1999 through 2003.	Not applicable.
2	11	Assigned to all counties for calendar years 1999 through 2004.	Assigned to all California counties for calendar years 2006 through 2008, assigned to all counties for calendar years 2009 through 2050.
3	2700	Not applicable.	Assigned to all counties except those in California for calendar years 1999 through 2005.
4	120	Not applicable.	Assigned to all California counties for calendar years 1999 through 2006.

Quality Assurance Procedures

The contents of Diesel were printed and visually compared to the diesel fuel specification information provided in the data sources listed above. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

3.2 GasMTBEPhsOut

The GasMTBEPhsOut table contains fuel formulation and market share information for base and future years.

Data Source

The baseline gasoline parameters used in this analysis were collected for calendar year 1999. The gasoline parameters and county fuel mappings were obtained from a U.S. EPA guidance document that described the toxics module of MOBILE6.2 (U.S. EPA, 2002a). These gasoline parameters were derived from several surveys: U.S. EPA's reformulated gasoline (RFG) survey (U.S. EPA, 2000), the U.S. EPA Oxygenated Fuel Program Summary (U.S. EPA, 2001), the TRW (previously NIPER) fuel survey (TRW, 1999), and the Alliance of Automobile Manufacturers' (AAMA) North American Gasoline and Diesel Fuel Survey (AAMA, 1999). The TRW fuel survey reports the data in several tables, including Table 9 (Motor Gasoline Survey, Season [Summer/Winter], Year [1999/2000], and Average Data for Different Brands) and Table 10 (Motor Gasoline Survey, Season [Summer/Winter], Year [1999/2000], and Average Data for Different Brands Containing Alcohols).

Data for the percent market share of oxygenated fuel sales were obtained from Oxygenate Type Analysis Tables (1995-2000) (U.S. EPA, 2001) and the Federal Highway Administration website (FHWA 1999).

The following section presents the methodologies and assumptions for selecting parameters by state.

Calendar Year 1999 - NMIM Base Year

The data sources used to develop data for the 1999 base year by state are described below.

<u>All States</u>

If methyl-tertiary butyl ether (MTBE) percent volume content was less than 0.1 percent, MTBE content was assumed to be zero, thus resulting in zero percent MTBE market share. If ethanol percent volume content was less than 0.1 percent, ethanol content was assumed to be zero and resulted in zero percent ethanol market share.

For any area that TRW reported MTBE, tert-amyl methyl ether (TAME), or ethyl tert-butyl ether (ETBE) content as non-zero, the model assumed the entire market is attributed to

MTBE because it was not possible to distinguish the market share between these specific oxygenates.

For any area that reported a FHWA gasohol sale fraction, in addition to TRW data for both regular gasoline and alcohol-containing gasoline, the fuel parameters for both sets of TRW were reported and assigned 100% market share MTBE or ethanol, respectively. The corresponding FHWA gasohol sale fractions were reported in a separate column.

Maximum sulfur values for 1999 through 2003 were assigned a value of 1,000 ppm based on Summer and Winter Reformulated Gasoline Parameters tables in Section 2.8.10.1 of the MOBILE6.2 User's Guide (U.S. EPA, 2002b)).

<u>Alabama</u>

The FHWA reported the ethanol market share as 0.16%. However, data from TRW Table 9 (District 3) with 100% MTBE market share were used to represent the entire state because TRW Table 10 did not report any alcohol-containing gasoline samples for District 3.

<u>Alaska</u>

All counties in Alaska were represented by fuel parameter data from the AAMA survey for Fairbanks, Alaska. MTBE market share was 90.8% and ethanol market share was 9.2% based on FHWA data.

<u>Arizona</u>

Two counties in the Phoenix area (Maricopa and Pinal) were represented by fuel parameter data from the AAMA survey for Phoenix, Arizona. Oxygenate fuel market share for these counties was 100% MTBE for the summer and 100% ethanol for the winter, as provided by the U.S. EPA Oxygenated Fuel Program Summary.

The remaining counties in Arizona were represented by fuel parameter data from TRW Table 9 (District 12). For this region, FHWA reported 100% ethanol market share for both summer and winter. This oxygenate market share data were consistent with the statewide annual average of 7.6% reported by FHWA.

Arkansas

All counties in Arkansas were represented by fuel parameter data from TRW Table 9 (District 3) with 100% MTBE market share.

California

Six California counties (Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura) were included as federal RFG program areas. In addition, California administers its own RFG program, but does not sample during the winter. Therefore, California fuel parameter data were obtained from the TRW survey and the AAMA survey.

Counties in the San Francisco Bay area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma) were represented by data from the AAMA survey for San Francisco, California, including a 50/50 split market share between MTBE and ethanol during summer and 100% MTBE market share during winter.

All other counties in California were represented by data from the AAMA survey for Los Angeles, including 100% MTBE market share for both summer and winter.

Colorado

Counties in the Denver area (Adams, Arapahoe, Denver, Douglas, and Jefferson) were represented by data from the AAMA survey for Denver, Colorado, including a year round 100% ethanol market share.

All other counties in Colorado were represented by data from TRW Table 9 (District 10) for the summer and TRW Table 10 (District 10) for the winter. These data include a 100% MTBE market share during summer and a 100% ethanol market share during winter, which were consistent with the annual 27.27% ethanol statewide average, as reported by FHWA.

Connecticut

All counties, except Fairfield County, were represented by data from the RFG survey for Hartford, Connecticut. These data include a 99.15% MTBE and 0.85% TAME market share for the summer and a 95% MTBE, 4% ethanol, and 1% TAME market share for the winter.

Fairfield County was represented by data from the RFG survey for New York-New Jersey-Long Island, including 100% MTBE market share for the summer and 98.14% MTBE and 1.86% ethanol market share for the winter. These data exhibit a small discrepancy with 2.27% ethanol for the state reported by FHWA.

Delaware

All counties, except Sussex County, were represented by data from the RFG survey for Philadelphia-Wilmington-Trenton, including 100% MTBE market share data for the summer and 98.55% MTBE and 1.45% ethanol market share for the winter.

Sussex County was represented by data from the RFG survey for Sussex County, Delaware, including 100% MTBE market share for both summer and winter.

District of Columbia

Washington D.C. was represented by data from the RFG survey for Washington D.C. including 100% MTBE market share. This was consistent with the 0% ethanol market share reported by FHWA.

Florida

Dade County was represented by data from the AAMA survey for Miami, FL, including 100% MTBE market share.

All other counties in Florida were represented by data from TRW Table 9 (District 4), including 100% MTBE market share. These data were consistent with 0% ethanol statewide as reported by FHWA.

Georgia

Counties in the Atlanta area (Barrow, Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, Pickens, Rockdale, Spalding, and Walton) were represented by data from the AAMA survey for Atlanta, Georgia, including 100% MTBE market share.

The remaining counties in Georgia were represented by data from TRW Table 9 (District 3), including 100% MTBE market share. These data were consistent with 0% ethanol statewide as reported by FHWA.

Hawaii

All counties in Hawaii were represented by fuel parameter data from TRW Table 9 (District 14-Northern California), including 100% MTBE market share.

Iowa

All counties in Iowa were represented by fuel parameter data from both TRW Table 9 and TRW Table 10 (District 7) for both summer and winter because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%.

FHWA survey data were used to assign market shares of 55.18% MTBE and 44.82% ethanol for all counties.

Idaho

All counties in Idaho were represented by fuel parameter data from TRW Table 9 (District 9), including 100% MTBE market share. This was consistent with 0% ethanol market share statewide, as reported by FHWA.

Illinois

Counties in the Chicago area (Cook, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will) were represented by data from the AAMA survey for Chicago-Lake County, Illinois, including 100% ethanol market share.

Counties in the St. Louis area (Clinton, Jersey, Madison, Monroe, and St. Clair) were represented by fuel parameter data from the AAMA survey for St. Louis, Missouri. Market share data from the RFG survey for St. Louis, Missouri were 80.34% MTBE and 19.66% ethanol for the summer and 54.95% MTBE and 45.05% ethanol for the winter.

The remaining counties were represented by fuel parameter data from both TRW Table 9 and TRW Table 10 (District 7, except Adams County uses data from District 5) for both winter and summer because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 50.78% MTBE and 49.22% ethanol for all counties.

Indiana

Lake and Porter counties were represented by data from the AAMA survey for Chicago-Lake County, Illinois, including 100% ethanol market share.

The remaining counties were represented by fuel parameter data from both TRW Table 9 and TRW Table 10 (District 6, except Adams County uses data from District 5) for both winter and summer because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 68.92% MTBE and 31.08% ethanol for all counties.

Kansas

All counties were represented by fuel parameter data from both TRW Table 9 and TRW Table 10 (District 7) for both winter and summer because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 96.39% MTBE and 3.61% ethanol for all counties.

Kentucky

Boone, Campbell, and Kenton counties were represented by data from the RFG survey for Covington, Kentucky. These data include 22.53% MTBE and 77.47% ethanol market share for the summer and 25.51% MTBE and 74.49% ethanol market share for the winter.

Bullitt, Jefferson, and Oldham counties were represented by data from the RFG survey for Louisville, Kentucky. These data include 76.25% MTBE and 23.75% ethanol market share for the summer and 72.61% MTBE and 27.39% ethanol market share for the winter.

All other counties were represented by data from TRW Table 9 (District 6), including 100% MTBE market share.

These data may slightly overestimate the ethanol sales when compared to FHWA's statewide market share estimate of 1.52% ethanol.

Louisiana

Parishes in the New Orleans area (Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, and St. Tammany) were represented by data from the AAMA survey for New Orleans, Louisiana, including a 100% MTBE market share.

All other counties were represented by TRW Table 9 (District 3) with 100% MTBE market share.

These data were slightly inconsistent with FHWA's estimate of 0.65% ethanol for the state.

Massachusetts

Berkshire, Franklin, Hampden, and Hampshire counties were represented by data from the RFG survey for Springfield, Massachusetts. This data includes 98.74% MTBE and 1.26% TAME market share for the summer and 95.83% MTBE and 4.17% ethanol market share for the winter.

All other counties were represented by fuel parameter data from the RFG and AAMA surveys for Boston-Worchester, Massachusetts. Market share data obtained from the RFG survey include 96.51% MTBE and 3.49% TAME market share for the summer and 91.67% MTBE, 4.17% ethanol, and 3.92% TAME market share for the winter.

Maryland

Cecil, Kent, and Queen Anne's counties were represented by fuel parameter data from the RFG survey for Philadelphia-Wilmington-Trenton, including 100% MTBE market share in the summer and 98.55% MTBE and 1.45% ethanol market share in the winter.

Calvert, Charles, Frederick, Montgomery, and Prince George's counties were represented by fuel parameter data from the RFG survey for Washington D.C., including 100% MTBE market share for both summer and winter.

Counties in the Baltimore area (Anne Arundel, Baltimore, Baltimore City, Carroll, Harford, and Howard) were represented by fuel parameter data from the RFG survey for Baltimore, Maryland. These data include 99.45% MTBE and 0.46% TAME market share for the summer and 99.44% MTBE and 0.56% ethanol market share for the winter.

All other counties were represented by data from TRW Table 9 (District 1) and 100% MTBE market share.

Maine

Seven counties in Maine (i.e., Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, and York counties) "opted-out" of the federal RFG program effective March 10, 1999; the RFG survey data were not used for these seven counties for 1999. These seven counties were represented by fuel parameter data from TRW Table 11 and 100% MTBE market share.

All other counties were represented by fuel parameter data from TRW Table 9 (District 1) and 100% MTBE market share. These assumptions were consistent with the 0% statewide ethanol consumption reported by FHWA.

Michigan

Counties in the Detroit area (Lapeer, Macomb, Monroe, Oakland, St. Clair, and Wayne) were represented by fuel parameter data from the AAMA survey for Detroit, Michigan and 100% ethanol market share.

All other counties were represented by data from both TRW Table 9 and TRW Table 10 (District 5) because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 93.07% MTBE and 6.93% ethanol for all counties.

Minnesota

Counties in the Minneapolis/St. Paul area (Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Ramsey, Scott, Sherburne, Washington, and Wright) were represented by data from the AAMA survey for Minneapolis/St. Paul, Minnesota and 100% ethanol market share for both summer and winter, based on low measured MTBE concentrations (0.1%).

All other counties were represented by data from both TRW Table 9 and TRW Table 10 (District 5) because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 8.26% MTBE and 91.74% ethanol for all counties for both summer and winter.

Missouri

Five counties in Missouri (Franklin, Jefferson, St. Charles, St. Louis, and the city of St. Louis) “opted-in” to the federal RFG program effective June 1, 1999. These five counties were represented by data from the RFG and AAMA surveys for St. Louis, including a market share of 80.34% MTBE and 19.66% ethanol in the summer and 54.95% MTBE and 45.05% in the winter.

Counties in the Kansas City area (Cass, Clay, Clinton, Jackson, Lafayette, Platte and Ray) were represented by fuel parameter data from the AAMA survey for Kansas City, Missouri and 100% MTBE market share.

The remaining counties were represented by data from TRW Table 9 (District 7) with 100% MTBE market share.

FHWA reported a 5.34% ethanol sale fraction for the entire state of Missouri.

Mississippi

Fuel parameter data from TRW Table 9 (District 3) and 100% MTBE market share were used to represent all counties in Mississippi. These data were consistent with FHWA's estimate of 0% ethanol sales market share.

Montana

Yellowstone County was represented by data from the AAMA survey for Billings, Montana and 100% MTBE market share for both summer and winter.

Missoula County was represented by data from TRW Table 10 with 100% ethanol market share in winter, per U.S. EPA's Oxygenated Fuel Program Summary.

All other counties were represented by fuel parameter data from TRW Table 9 (District 9) and 100% MTBE market share.

Nebraska

All counties in Nebraska were represented by data from both TRW Table 9 and TRW Table 10 (District 7) because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 74.78% MTBE and 25.22% ethanol for all counties.

Nevada

Clark and Nye counties were represented by data from the RFG survey for Las Vegas, Nevada. Based on the U.S. EPA Oxygenated Fuel Program Summary, these counties were assigned 100% ethanol market share for the winter. The summer market share was assigned a value of 100% MTBE to be more consistent with the FHWA estimate of 0% ethanol market share.

Carson City, Esmeralda, Lincoln, and Mineral counties were represented by data from TRW Table 9Se (District 12) for the summer TRW Table 10 (District 12) for the winter. Based on the U.S. EPA Oxygenated Fuel Program Summary, these four counties were assigned 100% ethanol market share for the summer and 100% MTBE market share for the winter. Note that the gas sulfur values were reported as 0 for these four counties.

All other counties were assigned data from TRW Table 9 (District 14) with 100% MTBE market share. This assumption allows the data to be more consistent with the FHWA estimate of 0% ethanol market share.

New Hampshire

Hillsboro and Merrimack counties were represented by fuel parameter data from the RFG survey for the Manchester, New Hampshire area. These data include 100% MTBE market share for the summer and 99.16% MTBE and 0.84% TAME market share in the summer.

Rockingham and Strafford counties were represented by data from the RFG survey for the Portsmouth-Dover, New Hampshire area. These data include 100% MTBE market share for both summer and winter.

All other counties were represented by data from TRW Table 9 (District 1) with 100% MTBE.

New Jersey

Atlantic and Cape May counties were represented by data from the RFG survey for Atlantic City, New Jersey, including 100% MTBE market share for summer and 96.84% MTBE and 2.11% ethanol market share for winter..

Warren County was represented by data from the RFG survey for Warren County, including 100% MTBE market share for both summer and winter.

Burlington, Camden, Cumberland, Gloucester, Mercer, and Salem counties were represented by data from the RFG survey for Philadelphia-Wilmington-Trenton. This includes 100% MTBE market share for the summer and 98.55% MTBE and 1.45% ethanol market share for the winter.

All other counties were represented by data from the RFG survey for the New York-New Jersey-Long Island-Connecticut region. These data include 100% MTBE market share for the summer and 98.14% MTBE and 1.86% ethanol market share for the winter.

These assumptions slightly underestimate the FHWA statewide estimate of 2.10% ethanol sales market share.

New Mexico

Bernalillo, Sandoval, and Valencia counties were represented by data from the RFG survey for the Albuquerque area. Based on the U.S. EPA Oxygenated Fuel Program description, these counties were assigned 100% ethanol market share for the winter. For the summer, 100% ethanol market share was assumed based on low measure concentrations of MTBE (0.1%) versus ethanol (0.8%).

All other counties were represented by data from TRW Table 9 (District 11) with 100% MTBE market share for the summer and TRW Table 10 (District 11) with 100% ethanol for the winter. There were no data for summer alcohol fuels in NIPER District and winter MTBE levels were measured as 0 in Table 9.

New York

Dutchess and Putnam counties were represented by data from the RFG survey for Poughkeepsie, New York with RFG survey market share. These data include 100% MTBE market share for the summer and 95.14% MTBE and 4.86% ethanol market share for the winter.

Counties in the New York City area (Bronx, Kings, Nassau, New York, Orange, Queens, Richmond, Rockland, Suffolk, and Westchester) were represented by data from the RFG survey data for the New York-New Jersey-Long Island-Connecticut region. These data include 100% MTBE market share for the summer and 98.14% MTBE and 1.86% ethanol market share for the winter.

The remaining counties were represented by data from TRW Table 9 (District 1) and 100% MTBE market share. TRW Table 10 was not provided in this data set.

North Carolina

All counties were represented by fuel parameter data from TRW Table 9 (District 2) and 100% MTBE market share. FHWA reported 7.47% gasohol sales in North Carolina, but the TRW survey did not collect any gasoline containing alcohol in this area.

North Dakota

All counties in North Dakota were represented by data from both TRW Table 9 and TRW Table 10 (District7) because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 87.64% MTBE and 12.36% ethanol for all counties.

Ohio

Counties in the Cleveland area (Ashtabula, Cuyahoga, Geauga, Lake, Lorain, and Medina) were represented by fuel parameter data from the RFG survey for Cleveland. The ethanol market share was assumed to be 100%, based on low measured concentrations of MTBE (~0.1%)

The remaining counties in Ohio were represented by data from both TRW Table 9 and TRW Table 10 (District 6) because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 60.26% MTBE and 39.74% ethanol for all counties.

Oklahoma

All counties in Oklahoma were represented by fuel parameter data from TRW Table 9 (District 8) and 100% MTBE market share. These data were consistent with FHWA's statewide estimate of 0% ethanol market share.

Oregon

Baker County was represented by from TRW Table 9 (District 9) and 100% MTBE market share.

All other counties in Oregon, with the exception of Clackamas, Columbia, Jackson, Josephine, Klamath, Multnomah, Washington, and Yamhill counties for the winter season, were represented by fuel parameter data from TRW Table 9 (District 13), including 100% MTBE market share.

For the summer season, these eight counties were represented by TRW Table 10 with 100% ethanol market share, based on U.S. EPA Oxygenated Fuel Program descriptions.

These assumptions were consistent with FHWA's statewide estimate of 7.3% ethanol market share.

Pennsylvania

Bucks, Chester, Delaware, Montgomery, and Philadelphia counties were represented by data from the RFG survey for Philadelphia. These data include 100% MTBE market share for the summer and 98.55% MTBE and 1.45% ethanol market share for the winter.

For the summer season only, Alleghany, Armstrong, Butler, Fayette, Washington, and Westmoreland counties were represented by data from the AAMA survey for the Pittsburgh region with 100% MTBE market share. For the winter season, these counties were represented by data from TRW Table 9 with 100% MTBE market share.

The remaining counties in Pennsylvania were represented by data from TRW Table 9 (District 1) with 100% MTBE market share. There were no alcohol-containing samples in the NIPER District 1 surveys, which contradicts FHWA's statewide estimate of 2.11% ethanol market share.

Rhode Island

All counties were represented by data from the RFG survey for the state of Rhode Island, including 100% MTBE market share for the summer and 97.52% MTBE and 2.48 ethanol market share for the winter.

South Carolina

Fuel parameter data from TRW Table 9 (District 3) and 100% MTBE market share were used to represent all counties in South Carolina. These data were consistent with FHWA's statewide estimate of 0% ethanol market share.

South Dakota

All counties in South Dakota were represented by data from both TRW Table 9 and TRW Table 10 (District 7) because the oxygenate market share was unknown. If the data originated from TRW Table 9, then MTBE market share was 100%. If the data originated from TRW Table 10, then ethanol market share was 100%. FHWA survey data were used to assign market shares of 57.32% MTBE and 42.68% ethanol for all counties.

Tennessee

Fuel parameter data from TRW Table 9 (District 3) and 100% MTBE market share were used to represent all counties in Tennessee. These data were consistent with FHWA's statewide estimate of 0% ethanol market share.

Texas

Bexar, Comal, Guadalupe, and Wilson counties were represented by data from the AAMA survey data for San Antonio, Texas. These counties were assigned 100% MTBE market share, based on low measured ethanol concentrations (~0.1%).

Collin, Dallas, Denton, and Tarrant counties were represented by data from the RFG survey data for the Dallas-Fort Worth region, including 100% MTBE market share in the summer and 94.15 MTBE% and 5.85% TAME market share in the winter.

Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties were represented by data from the RFG survey data for the Houston-Galveston area. These data include 97.69% MTBE and 1.82 ethanol market share for the summer and 99.53% MTBE and 0.47% ethanol market share for the winter.

Counties in the eastern part of the state were represented by data from TRW Table 9 for District 8. These counties were assigned 100% MTBE market share because District 8 does not have survey information for fuels with alcohol.

Counties in the western part of the state were represented by data from TRW Table 10 for District 11. These counties were assigned 100% ethanol market share for the winter season because measured MTBE levels were zero. These counties were assigned 100% MTBE market share during the summer season because District 11 does not have survey information for fuels with alcohol in the summer.

These assumptions, primarily the assumption that western counties use ethanol-based fuel in the winter, were relatively consistent with FHWA's statewide estimate of 4.95% ethanol market share.

Utah

Data from TRW Table 9 (District 10) with 100% MTBE market share were used to represent all counties in Utah, except Utah and Weber counties during the winter season. For this season, data from TRW Table 10 (District 10) were used to represent Utah and Weber counties. Utah and Weber counties were assigned with 100% ethanol market share, based on the U.S. EPA Oxygenated Fuel Program description. These assumptions may not fully account for FHWA's statewide estimate of 10.67% ethanol market share.

Virginia

Counties in the Washington D.C. area (Alexandria City, Fairfax City, Falls Church City, Manassas City, Manassas Park City, Arlington, Fairfax, Loudoun, Prince William, and Stafford) were represented by data from the RFG survey for Washington D.C. for both fuel parameters, including 100% MTBE market share.

Counties in the Richmond area (Colonial Heights City, Hopewell City, Richmond City, Hanover, and Henrico counties) were represented by data from the RFG survey for Richmond for both fuel parameters, including 100% MTBE market share.

Counties in the Norfolk area (Chesapeake City, Hampton City, Newport News City, Norfolk City, Poquoson City, Portsmouth City, Suffolk City, Virginia Beach, Williamsburg, Charles City, Chesterfield, James City, and York) were represented by data from the RFG survey for Norfolk-Virginia Beach for both fuel parameters, including 100% MTBE market share.

All other counties were represented by data from TRW Table 10 (District 6), including 100% ethanol market share.

The FHWA reported a statewide 8.61% ethanol market share for Virginia.

<u>Vermont</u>

Fuel parameter data from TRW Table 9 (District 1) and 100% MTBE market share were used to represent all counties in Vermont. These data were consistent with FHWA's statewide estimate of 0% ethanol market share.

<u>Washington</u>

Island, King, and Snohomish counties were represented by data from the AAMA survey for the Seattle, Washington area. These data include 100% ethanol market share during winter, based on low measured MTBE concentrations (0.1%), and 100% MTBE market share during summer.

Adams County was represented with data from TRW Table 9 (District 9) and 100% MTBE market share for both summer and winter.

Clark and Spokane counties were represented with data from TRW Table 10 (District 13) and 100% ethanol market share during winter per the Oxygen Fuel Program description. For the summer season, these counties were represented by data from TRW Table 9 (District 13) and 100% MTBE market share.

All other counties were represented by data from TRW Table 9 (District 13) and a 100% MTBE market share summer, but no defined market share for winter.

These assumptions may over predict the statewide ethanol market fraction when compared to the 9.93% as reported by FHWA.

Wisconsin

Kenosha, Milwaukee, Ozaukee, Racine, Washington, and Waukesha counties were represented by data from the RFG survey for the Milwaukee-Racine region for both fuel parameters and market share. These data include 100% ethanol market share, which accounts for the statewide 10.98% ethanol market share reported by FHWA.

All other counties were represented by data from TRW Table 9 (District 5), including 100% MTBE market share.

West Virginia

Fuel parameter data from TRW Table 9 (District 6) and 100% MTBE market share were used to represent all counties in West Virginia. These data were consistent with FHWA's statewide estimate of 0.01% ethanol market share.

Wyoming

Fuel parameter data from TRW Table 9 (District 9) and 100% MTBE market share were used to represent all counties in Wyoming. These data were consistent with FHWA's statewide estimate of 0% ethanol market share.

Puerto Rico and the U.S. Virgin Islands

Gasoline parameters and county fuel mappings for Puerto Rico and the U.S. Virgin Islands were not included in the U.S. EPA guidance document referenced above. It was assumed that gasoline in Puerto Rico and the U.S. Virgin Islands was similar to Hawaii.

Future Years

The future year gasoline parameters were calculated using adjustment factors that were applied to the base year gasoline parameters. In general, multiplicative adjustment factors were used to calculate future year gasoline parameters (i.e., future year parameter = base year parameter x adjustment factor). However, additive adjustment factors were used to calculate future year parameters for E200, E300, and oxygenate market shares (i.e., future year parameter = base year parameter + adjustment factor). The estimation of the future year gasoline parameters is described below:

Calendar Year 2000

For most counties, the 2000 gasoline parameters were identical to the 1999 gasoline parameters. The only exception was that updated U.S. EPA RFG survey data for 2000 replaced the 1999 gasoline parameters for the 154 non-California RFG area counties (U.S. EPA, 2000).

Calendar Years 2001 through 2003

The 1999 gasoline parameters (and 2000 gasoline parameters for the 154 non-California RFG area counties) were used to represent the 2001, 2002, and 2003 calendar years (i.e., multiplicative adjustment factors for these years were set to 1.0 and additive adjustment factors set to 0.0). The phase-in of Phase 3 RFG in California had initially been set to begin in 2003. However, this phase-in has since been pushed back by one year and is scheduled to begin in 2004. Therefore, multiplicative adjustment factors of 1.0 and additive adjustment factors of 0.0 were also applied to California for the 2001 through 2003 calendar years.

Calendar Year 2004

Beginning in 2004, Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements will be phased in throughout the country (Federal Register, 2000; Federal Register, 2001). Fuel parameters were obtained from cost analyses conducted for the National Petrochemical and Refiners Association (NPRA) (MathPro, 1998) and the American Petroleum Institute (API) (MathPro, 1999a). The NPRA analysis focused only on Petroleum Administration Defense District (PADD) IV (i.e., Montana, Idaho, Utah, Wyoming, and Colorado). The API analysis included PADDs I, II, and III (i.e., 38 Eastern and Plains states, Puerto Rico, and the U.S. Virgin Islands). US EPA staff indicated that data derived from the API analysis for PADDs I, II, and III should also be used for PADD V (i.e., Arizona, Nevada, Oregon, Washington, Alaska, and Hawaii; excluding California).

The Tier 2 sulfur standards include refinery average limits, corporate pool average limits, and per-gallon cap limits (Federal Register, 2000), and are applicable for most of the country, excluding the Geographic Phase-In Area (GPA) described below. The years of 2004 and 2005 are phase-in years with the final limits being implemented in 2006. Additional discussion with U.S. EPA staff indicated that appropriate “at the pump” sulfur contents were 120 parts per million (ppm), 90 ppm, and 30 ppm (for 2004, 2005, and 2006 and beyond, respectively) (Manners, 2002). With the exception of the GPA, the API gasoline parameter data for PADDs I, II, III, and V were used for the 2004 Tier 2 sulfur standards (MathPro, 1999a).

The API analysis contained modeled gasoline parameters for conventional gasoline (summer and winter) and RFG (summer and winter). The modeled gasoline parameters were based on a 2004 reference fuel and two 40 ppm sulfur content fuels (one modeled with the OCTGAIN process and the other with the CD TECH process). In addition to the expected 2004 sulfur content of 120 ppm, the other gasoline parameters were calculated by interpolation using the following equation:

$$P_{120} = P_{40} + ([S_{120} - S_{40}]/[S_{ref} - S_{40}]) \times (P_{ref} - P_{40})$$

Where
S_{ref} = sulfur content of reference fuel;
S_{120} = sulfur content of 120 ppm sulfur content fuel;
S_{40} = sulfur content of 40 ppm sulfur content fuel;
P_{ref} = value of other parameter for reference fuel;
P_{120} = value of other parameter for 120 ppm sulfur content fuel; and
P_{40} = value of other parameter for 40 ppm sulfur content fuel.

The sulfur content and other parameter values for the 40 ppm sulfur content fuel were averages of the OCTGAIN and CD TECH modeled fuels. This interpolation method was used to determine fuel parameter values for the 120 ppm sulfur content fuel. The multiplicative adjustment factor (MAF) for each relevant parameter was calculated by ratioing the 120 ppm sulfur content fuel parameter by the reference fuel parameter (i.e., MAF = P_{120}/P_{ref}). The additive adjustment factor (AAF) for each relevant parameter was calculated by subtracting the reference fuel parameter from the 120 ppm sulfur content fuel parameter (i.e., AAF = $P_{120} - P_{ref}$).

Four sets of adjustment factors were developed for 2004 fuel in PADDs I, II, III, and V (i.e., summer conventional, summer RFG, winter conventional, and winter RFG). A fifth set of adjustment factors were also developed for those conventional gasoline areas that use gasohol during the summer. These adjustment factors are identical to the summer conventional except that the oxygenate adjustment factors were set to 1.0.

Tier 2 – Geographic Phase-In Area (GPA)—Amendments to the Tier 2 sulfur standards provided for an additional phase-in year (i.e., 2006) in a defined Geographic Phase-In Area (GPA) (Federal Register, 2001). The GPA is established ensure a smooth transition to low sulfur gasoline nationally and to mitigate the potential of gasoline supply shortages in certain parts of the country. The GPA is defined as eight states (i.e., Montana, Idaho, Utah, Wyoming, Colorado, New Mexico, North Dakota, and Alaska) plus 74 adjacent counties in six other states (i.e., Washington, Oregon, Nevada, Arizona, South Dakota, and Nebraska). Additional discussion with U.S. EPA staff indicated that appropriate "at the pump" sulfur contents for the GPA were 150 ppm, and 30 ppm (for 2004-2006 and 2007 and beyond, respectively) (Manners, 2002). Because PADD IV roughly corresponds with the GPA, the NPRA gasoline parameter data for PADD IV were used for the 2004 Tier 2 sulfur standards in the GPA (MathPro, 1998).

The NPRA analysis contained modeled gasoline parameters for high and low sulfur gasolines (summer and winter). The modeled gasoline parameters were based on a 1996 baseline fuel and a 150 ppm sulfur content fuel. Pooled fuel parameters were estimated for both the baseline fuel and the 150 ppm sulfur content fuel assuming a pool fuel mix of 75 percent high sulfur gasoline and 25 percent low sulfur gasoline. The 2004 MAF and AAF values for PADD IV were calculated in similar manner to those in PADDs I, II, III, and V (i.e., MAF = P_{150}/P_{base} and AAF = $P_{150} - P_{base}$); the only significant difference is that fuel parameter interpolation was not needed because the NPRA analysis included the appropriate sulfur content fuel (i.e., 150 ppm).

Two sets of adjustment factors were developed for 2004 fuel in PADD IV (i.e., summer and winter). A third set of adjustment factors were also developed for those areas that use gasohol during the summer. These adjustment factors are identical to the summer conventional except that the oxygenate adjustment factors were set to 1.0.

California Phase 3 RFG—In addition to the phase-in of Tier 2 sulfur standards throughout the country, the phase-in of California Phase 3 RFG also begins in 2004. As previously mentioned, this phase-in was initially scheduled to begin in 2003, but was pushed back 1 year. In support of California Phase 3 RFG, a standard analysis was conducted for the California Energy Commission (CEC) that modeled 18 different fuel scenarios (MathPro, 1999b). The two fuel scenarios that were used were a MTBE-containing Phase 2 RFG fuel and a Phase 3 RFG fuel containing no oxygenates (i.e., representing the effects of an MTBE ban).

The 2004 MAF and AAF values for California were calculated in similar manner to those in PADDs I through V (i.e., $MAF = P_{Phase3}/P_{Phase2}$ and $AAF = P_{Phase3} – P_{Phase2}$). The 2004 MAF and AAF values were also used in two Arizona counties (Maricopa and Pinal) where a similar, but not identical, fuel will be implemented.

Calendar Year 2005

In 2005, the non-GPA sulfur content was reduced from 120 ppm to 90 ppm based upon discussions with U.S. EPA staff (Manners, 2002). The interpolation method described for 2004 non-GPA fuels was used to determine appropriate adjustment factors for the 2005 non-GPA fuels as well. The only change was basing the interpolation on a 90 ppm fuel instead of a 120 ppm fuel (i.e., $MAF = P_{90}/P_{ref}$ and $AAF = P_{90} – P_{ref}$). This resulted in five sets of adjustment factors for 2005 fuel in PADDs I, II, III, and V (i.e., summer conventional, summer RFG, winter conventional, winter RFG, and summer conventional with gasohol).

The 2005 GPA and California Phase 3 RFG fuels were unchanged relative to the 2004 fuels. As a result, the 2005 GPA and California adjustment factors are identical to 2004.

Calendar Year 2006

In 2006, the non-GPA sulfur content was reduced from 90 ppm to 30 ppm based upon discussions with U.S. EPA staff (Manners, 2002). The interpolation method described for 2004 non-GPA fuels was used to determine appropriate adjustment factors for the 2006 non-GPA fuels as well. The only change was basing the interpolation on a 30 ppm fuel instead of a 120 ppm fuel (i.e., MAF = P_{30}/P_{ref} and AAF = $P_{30} - P_{ref}$). This resulted in five sets of adjustment factors for 2006 fuel in PADDs I, II, III, and V (i.e., summer conventional, summer RFG, winter conventional, winter RFG, and summer conventional with gasohol).

The 2006 GPA and California Phase 3 RFG fuels were unchanged relative to the 2004 fuels. As a result, the 2006 GPA and California adjustment factors are identical to 2004.

Calendar Year 2007

In 2007, the GPA sulfur content was reduced from 150 ppm to 30 ppm based upon discussions with U.S. EPA staff (Manners, 2002). The interpolation method described for 2004 non-GPA fuels was used to determine appropriate adjustment factors for the 2007 GPA fuels as well. The only change was basing the interpolation on a 30 ppm fuel instead of a 120 ppm fuel (i.e., MAF = P_{30}/P_{base} and AAF = $P_{30} - P_{base}$). This resulted in three sets of adjustment factors for 2007 in the GPA (i.e., summer, winter, and summer with gasohol).

The 2007 non-GPA and California Phase 3 RFG fuels were unchanged relative to the 2006 fuels. As a result, the 2007 GPA and California adjustment factors were identical to 2006.

Calendar Years 2008 and 2009

In 2008 and 2009, it was assumed that there were no fuel changes for any fuels (i.e., non-GPA, GPA, and California). As a result, all gasoline parameters for 2008 and 2009 were identical to 2007.

Calendar Years 2010 through 2050

Beginning in 2010, a potential ban of MTBE-containing fuels was modeled. Fuel parameters were derived from detailed refinery modeling runs conducted for U.S. EPA (Abt, 2003). Gasoline parameters for the 2010 Reference #1a and 2010 RFS #2 modeled fuels (both conventional and RFG) were obtained separately for PADD I, II, and III. Weighted gasoline parameters were derived based upon volumes of MTBE- and ETOH-blended fuels in PADD II and III.

The MAF for each relevant parameter was calculated by ratioing the RFS #2 fuel parameter by the Reference #1a fuel parameter (i.e., MAF = $P_{RFS\#2}/P_{Ref\#1}$). The AAF for each relevant parameter was calculated by subtracting the Reference #1a fuel parameter from the RFS #2 fuel parameter (i.e., AAF = $P_{RFS\#2} - P_{Ref\#1}$). The oxygenate contents and market shares were then adjusted to represent expected conditions occurring due to a MTBE ban. The PADD II adjustment factors were applied to PADD V. No changes related to a MTBE ban were made to California (where MTBE was already phased-out as of 2004) or to the GPA.

Oxygenate Volume and Market Share Analysis for 2000 through 2050

Because oxygenate volume and market share data were not available for calendar years past 1999, an analysis of the average market share for each oxygenate at the PADD level was performed. The total weight percent oxygenate data available from the Future Year Fuel Data spreadsheet were used in combination with the MOBILE6 oxygenate conversion factors to determine individual oxygenate volumes. These PADD oxygenate volumes and market shares were then transferred to the future year spreadsheet prior to developing the gasoline table.

Data Population Methodology

The GasMTBEPhsOut data were populated using information from spreadsheets containing seasonal fuel data for various years as described in Section 3.2.1 and programming utilities written using Microsoft Access. These programming utilities prepared composite seasonal gasolines for counties that reported multiple winter and summer fuels, applied multiplicative or additive parameters for appropriate years, interpolated seasonal fuel parameters to monthly fuel parameters, determined the set of unique gasolines resulting from the interpolation program, and populated the Gasoline, Gasoline2, GASMTBEPhsOut, and CountyYearMonth tables. Each of these components is described in detail below.

Seasonal Fuel Data

The seasonal fuel data spreadsheets were populated using the data sources described in the Seasonal Fuel Data portion of this section.   The format of each is as follows:

- Future Year Fuel Data: This spreadsheet includes three worksheets – Factors, Gasoline Assignment, and Notes.

  Factors worksheet. This worksheet is divided into two sections. The upper section provides the gasoline parameters used to develop the multiplicative and additive factors for each PADD or area for future years. This portion of the spreadsheet includes the following columns: area, fuel type, fuel description, RVP, oxygen (weight %), aromatics (volume %), benzene (volume %), olefins (volume %), sulfur (parts per million), E200 (volume % off), and E300 (volume % off). The lower portion of the spreadsheet provides the additive and multiplicative factors to be applied to base year, year 2000, or year 2009 gasolines to determine future year gasoline parameters. It contains columns specifying the area, fuel type, factor or gasoline identifier (i.e., letters A through CC) and the additive or multiplicative factors for each gasoline parameter. The factors for the parameters listed for below for gasolines A through W are multiplicative:

  -RVP
  -Aromatics
  -Benzene

-Olefins

-MTBE

-ETBE

-TAME

-ETOH

The factors for the parameters listed for below for gasolines A through W are additive:

-MTBE_M

-ETBE_M

-TAME_M

-ETOH_M

-E200

-E300

Actual values rather than multiplicative or additive factors were provided for the parameters listed for below for gasolines A through W :

-Sulfur

The factors for the parameters listed for below for gasolines X through CC are multiplicative:

-RVP

-Aromatics

-Benzene

-Olefins

- Sulfur

The factors for the parameters listed for below for gasolines X through CC are additive:

-E200
-E300

Actual values rather than multiplicative or additive factors were provided for the parameters listed for below for gasolines A through W :

-MTBE
-MTBE_M
-ETBE
-ETBE_M
-TAME
-TAME_M
-ETOH
-ETOH_M

Gasoline Assignment Worksheet. This worksheet indicates for each county the source of gasoline data for winter and summer for each year from 1999 through 2050. These references include the 1999 Fuel Data spreadsheet, 2000 Fuel Data Spreadsheet, or Gasoline Identifier A through CC.

Notes Worksheet. This worksheet provides any special instructions for application of the factors and values provided in the Factors worksheet.

Seasonal Fuel Compositing

The fuel data available for several counties indicated that multiple formulations may be used in a given season. Information at this level of detail were available only from the sources consulted to prepare the 1999 Fuels Data spreadsheet, and are indicated by an entry in the

Percentage of Oxygenate Fuel Sale from Federal Highway Survey column. Because NMIM can only use a single fuel for each month in a particular county, a programming routine was developed that identified the counties with multiple fuels and composited the two fuels. The methodology used to calculate the composited fuel weighted the value of the fuel parameters RVP, Sulfur, Olefins, Aromatics, Benzene, E200, and E300 by the percentage of oxygenate fuel sale from Federal Highway Survey, as shown below:

$$\text{Composited parameter value} = \frac{(\text{Fuel 1 parameter} \times \text{Fuel 1 percentage of oxygenate fuel sale federal highway survey}) + (\text{Fuel 2 parameter} \times \text{Fuel 2 percentage of oxygenate fuel sale federal highway survey})}{100}$$

For the oxygenate volume and market share parameters, the composited values were set equal to the higher of the two possible values. The results of a sample calculation are provided in Table 3-2.

TABLE 3-2

Sample Calculation for Composited Seasonal Fuel for FIPS 39001: Adams, OH

	Fuel 1	Fuel 1	Fuel 2	Fuel 2	Composited Fuel	Composited Fuel
Season	summer	winter	summer	winter	summer	winter
RVP	9.45	14.17	8.59	13.86	8.93	13.98
Sulfur	297.7	249.1	406.2	384.5	363.08	330.69
Olefins	7.26	7.65	10.378	9.634	9.14	8.84
Aromatics	25.75	19.76	31.057	26.71	28.95	23.95
Benzene	0.98	0.92	1.26	1.1773	1.15	1.07
E200	55.84	60.10	46.72	53.80	50.34	56.30
E300	81.39	84.18	78.90	82.62	79.89	83.24
MTBE volume	0.02	0.01	4.41	1.33	4.41	1.33
MTBE market share	0	0	100	100	60.26	60.26
ETOH volume	10.06	9.93	0	0	10.06	9.93
ETOH market share	100	100	0	0	39.74	39.74
ETBE volume	0	0	0	0	0	0
ETBE market share	0	0	0	0	0	0
TAME volume	0	0	0	0.009	0	0
TAME market share	0	0	0	0	0	0
Oxygenate_Fuel_Sale_Percentage	39.74	39.74	60.26	60.26		

Interpolation

The fuels data provided by the sources described in Seasonal Fuel Data portion of this section were only available on a seasonal (i.e., summer or winter) basis. NMIM requires fuels data on a monthly basis. To distribute the seasonal fuels over the 12 months in a year, a programming utility was developed that interpolated the values in a manner similar to that used by Pechan Associates for RVP values in the 1999 NEI analysis. This methodology uses the Pechan ASTM RVP classifications by state from the NEI documentation and the RVP schedule for ASTM classes A through E. Although this methodology was applied to RVP values only in the Pechan analysis, it was applied to all fuel parameters for the NMIM effort.

This method was used for the RVP interpolation, because it minimized differences between NMIM and the NEI results. The RVP schedule presents a stepwise change in gasoline composition from summer to winter RVP conditions and back. Since the method was to be used for this key gasoline composition parameter, it was chosen for the other gasoline parameters in order to keep all the conversions on the most consistent basis possible. Applying the method in this manner provides stepwise changes in every gasoline parameter on the same schedule as RVP, over each parameter's winter through summer range of values. The results of a sample calculation are provided in Tables 3-3 through 3-5.

TABLE 3-3

ATSM RVP Class Assignment for FIPS 39001: Adams, OH

Month	ASTM RVP Class	ASTM RVP Schedule
January	E	15
February	E	15
March	D	13.5
April	D	13.5
May	C	11.5
June	C	11.5
July	C	11.5
August	C	11.5
September	C	11.5
October	C	11.5
November	D	13.5
December	E	15
Summer (June value)	C	11.5
Winter (January value)	E	15

Interpolation Factor Calculation

$$\text{Monthly Interpolation Factor} = \frac{(\text{Monthly RVP Class} - \text{Summer RVP class})}{(\text{Winter RVP Class} - \text{Summer RVP Class})}$$

TABLE 3-4

Monthly Interpolation Factor Calculation for FIPS 39001: Adams, OH

Month	ASTM RVP Class	ASTM RVP Schedule	Interpolation Factor
January	E	15	1
February	E	15	1
March	D	13.5	0.571
April	D	13.5	0.571
May	C	11.5	0
June	C	11.5	0
July	C	11.5	0
August	C	11.5	0
September	C	11.5	0
October	C	11.5	0
November	D	13.5	0.571
December	E	15	1
Summer (June value)	C	11.5	
Winter (January value)	E	15	

Monthly Interpolation Calculation

$$\text{Interpolated Monthly Value} = \text{summer value} + \text{monthly interpolation factor} \times (\text{winter value} - \text{summer value})$$

TABLE 3-5

Sample Monthly Interpolation for Olefins Calendar Year 1999 for

FIPS 39001: Adams, OH

Season/Month	Seasonal Volume Percent Olefins	Summer Volume Percent Olefins	Interpolation Factor	Winter Volume Percent Olefins - Summer Volume Percent Olefins	Interpolated Monthly Volume Percent Olefins
Summer	9.14				
Winter	8.84				
January		9.14	1	-0.3	8.84
February		9.14	1	-0.3	8.84
March		9.14	0.571	-0.3	8.97
April		9.14	0.571	-0.3	8.97
May		9.14	0	-0.3	9.14
June		9.14	0	-0.3	9.14
July		9.14	0	-0.3	9.14
August		9.14	0	-0.3	9.14
September		9.14	0	-0.3	9.14
October		9.14	0	-0.3	9.14
November		9.14	0.571	-0.3	8.97
December		9.14	1	-0.3	8.84

Identification of Unique Gasolines and Population of Gasoline

Following the generation of the full set of monthly gasoline parameters for all counties, the Microsoft Access programming utility identified the unique set of gasoline formulations, assigned each a gasoline identification number, and populated the Gasoline, Gasoline2, GasMTBEPhsOut, Gas2MTBEPhsOut, CountyYearMonth, and CYMMTBEPhsOut tables.

Quality Assurance Procedures

The results of the gasoline program were confirmed with “hand” calculations completed using a spreadsheet. Several base year and at least one future year gasoline calculation were verified. Oxygenate market share totals were verified by querying the database to determine if they added to 100 percent for gasolines based on gasoline assignments A through W in the Gasoline Assignment worksheet. In several cases, the sum of market share data were either slightly less than or slightly greater than 100%. Upon further investigation, it was also noted that there were cases where oxygenate volume data were greater than zero but the corresponding oxygenate market share data were equal to zero, as well as cases where the where oxygenate market share data were greater than zero but the corresponding oxygenate volume were equal to zero. Through a review of the raw data and interpolation methodology, it was determined that these issues were the result of the raw data that were available and the precision of NMIM database. For all gasolines where this was noted, the market share or volume data were reset to zero, and the sum of the market shares for the remaining oxygenates were renormalized to 100 percent.

In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

3.3 Gas2MTBEPhsOut

Multiple fuel formulation data for the same season were available for several counties in several states. These counties reported using multiple fuel formulations in the same season. Gasoline2 contains the fuel formulation and market share information for each individual gasoline. The design of this Gasoline2 table limits the number of fuels that can be associated with a county to a maximum of two fuels.

Data Source

The data sources used to prepare the fuel formulation information used to populate Gasoline2 are described in Section 3.2.

Data Population Methodology

To prepare the Gasoline table, counties for which multiple fuels were available for a specific season were combined into one fuel using a weighted average based on each fuel's market share. To prepare the Gasoline2 table, each of these fuels were interpolated separately and added to the table using the interpolation and unique gasoline identification methodology described in Section 3.2.

Quality Assurance Procedures

The results of the Gasoline2 program were confirmed with "hand" calculations completed using a spreadsheet. Market share totals were verified by querying the database to determine if they added to 100 percent. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

3.4 Natural Gas

The NaturalGas table specifies the sulfur content of various natural gas fuels used in the base year, or anticipated to be used in future years.

Data Source

The NaturalGas sulfur values were extracted from the *Pechan* tab of a spreadsheet titled sulfur.xls, forward from Dave Brzezinski, USEPA, on September 19, 2002.

Data Population Methodology

Because of the limited number of natural gas fuels in the baseline and future years, the NaturalGas table was populated manually. One record was added to the database as shown in Table 3-6.

TABLE 3-6
Natural Gas Sulfur Values

Natural Gas ID	Natural Gas Sulfur Value
1	30

Based on the information in sulfur.xls, Natural Gas ID 1 was inserted into CountyYearMonth for all counties for all years.

Quality Assurance Procedures

The contents of NaturalGas were printed and visually compared to the natural gas fuel specification information provided in the data source listed above. In addition, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

3.5 CountyYearMonth

The CountyYearMonth table includes for each month in the base and future years for each county, an indication of the fuel formulation, diesel formulation, natural gas formulation, and data source information for both on-road and non-road fuels. It also contains a reference to alternate gasoline formulation information for the base year where appropriate.

Data Source

The data sources and the Microsoft Access programming utility described in Section 3.2 were used to assign highway gasoline identification information in the CountyYearMonth table. The diesel identification information was populated using the Diesel table data sources. The natural gas identification information was populated using the NaturalGas table data sources.

Data Population Methodology

The Microsoft Access programming utility described in Section 3.2 was used to populate CountyYearMonth.

Quality Assurance Procedures

The gasoline assignments and corresponding formulation information for several counties over several years generated by the Microsoft Access programming utility were compared with results obtained using a spreadsheet calculation and verified for accuracy. Queries of base and future year diesel and natural gas assignments were completed and the results compared to the information available in the Diesel and NaturalGas data sources.

3.6 Fuel Tables Required to Model No MTBE Phase Out Scenario

To allow NMIM to model a nationwide scenario of no phase out of MTBE, the following additional fuels tables were developed: Gasoline, Gasoline2, and CountyYearMonth.

These tables were generated using a Microsoft Access utility based on the one used to generate GasMTBEPhsOut, Gas2MTBEPhsOut, an CYMMTBEPhsOut. The following modifications were made to the access utility:

- 2003 gasolines were copied forward as is through 2050 for all California counties.
- 2009 gasolines were copied forward as is through 2050 for all remaining counties.

3.6.1 Gasoline

The Gasoline table contains fuel formulation and market share information for base and future years.

Data Source

The data sources used to prepare the fuel formulation information used to populate Gasoline are described in Section 3.2 with the following exceptions:

- 2003 gasolines were copied forward as is through 2050 for all California counties.
- 2009 gasolines were copied forward as is through 2050 for all remaining counties.

Data Population Methodology

To prepare the Gasoline table, the interpolation and unique gasoline identification methodology described in Section 3.2 were followed up through calendar year 2003 for California and up through calendar year 2009 for the remaining counties in the United States.

Quality Assurance Procedures

The results of the gasoline program were confirmed with “hand” calculations completed using a spreadsheet. Several base year and at least one future year gasoline calculation were verified. At least one calendar year 2004 gasoline and one calendar year 2050 gasoline for a California county were verified to be the same as the 2003 gasoline for the same county. In addition, and at least one calendar year 2010 gasoline and calendar year 2050 gasoline for a non-California county were verified to be the same as the 2009 gasoline for the same county. Lastly, the null value, zero value, maximum and minimum value, parent-child, and child-parent QA/QC checks described in Section 7.0 were also completed for this table.

3.6.2 Gasoline2

The Gasoline2 table is identical to Gas2MTBEPhsOut table. Because Gas2MTBEPhsOut only includes gasolines for calendar year 1999, there are no differences between Gas2MTBEPhsOut and Gasoline2

Data Source

The data sources used to prepare the fuel formulation information used to populate Gasoline2 are described in Section 3.2.

Data Population Methodology

To prepare the Gasoline2 table, the interpolation and unique gasoline identification methodology described in Section 3.2 were followed.

Quality Assurance Procedures

The data were quality assured by comparing the parameters associated with several specific Gasoline Identification numbers between Gasoline2 and Gas2MTBEPhsOut to verify that no changes were made.

3.6.3 CountyYearMonth

The CountyYearMonth table includes for each month in the base and future years for each county, an indication of the fuel formulation, diesel formulation, natural gas formulation, and data source information for both on-road and non-road fuels for the MTBE phase out with no oxygenate replacement scenario. It also contains a reference to alternate gasoline formulation information for the base year where appropriate.

Data Source

The data sources and the Microsoft Access programming utility described in Section 3.2 were used to assign highway gasoline identification information in the CountyYearMonth table, with the exception of the following:

- 2003 gasolines were copied forward as is through 2050 for all California counties.

- 2009 gasolines were copied forward as is through 2050 for all remaining counties

The diesel identification information was populated using the Diesel table data sources. The natural gas identification information was populated using the NaturalGas table data sources.

Data Population Methodology

The Microsoft Access programming utility described in Section 3.2 was used to populate CountyYearMonth.

Quality Assurance Procedures

At least one calendar year 2004 gasoline assignment and one calendar year 2050 gasoline assignment for a California county were verified to be the same as the 2003 gasoline assignment for the same county. In addition, and at least one calendar year 2010 gasoline assignment and one calendar year 2050 gasoline assignment for a non-California county were verified to be the same as the 2009 gasoline assignment for the same county.

4.0 VEHICLE TABLES

Emissions inventory calculations are significantly impacted by vehicle population and travel data. The sources of this information in the NMIM database are described in the sections below.

4.1 AverageSpeed

The AverageSpeed table presents the average speed for each vehicle traveling on each HPMS roadway type.

Data Source

Modeling files for June 2002 update to the 1999 NEI, extracted from the VMT table, vmt99_f_m6_with8statesupdate.dbf.

Data Population Methodology

The data in the VMT table was extracted and run through two processing steps. The source data included speeds assigned to the 28 vehicle classes. The first processing step determined every unique combination of road type, vehicle class, and speed. The second step populated a table with speed based on the 16 vehicle classes and road type.

Quality Assurance Procedures

In the first processing step, checks verified that one and only one speed existed for each combination of road type and vehicle class. The overall effect of the second step was to "merge" gasoline and diesel vehicle classes into 16 vehicle types. Each type was then verified to confirm that the corresponding gasoline and diesel classes had the same speed, that there was exactly one combination of each, and that each required index combination in the output was populated.

4.2 BaseYearVMT

The BaseYearVMT table contains annual vehicle miles traveled (VMT) data for every county-level area, for every combination of vehicle class and road type. This is VMT for the NMIM “base year,” calendar year 1999.

Data Source

Base year VMT data were collected from two related sources. The first was the file vmt99_f_m6_with8statesupdate.dbf in the modeling files for June 2002 Update to the 1999 NEI . These data were used for all 50 states and Washington, DC. The second source was the file vmt99_n_m6.dbf in the modeling files for the Fall 2001 1999 NEI update. This second source was used for VMT for Puerto Rico and Virgin Islands.

Data Population Methodology

Three processes were used to populate the base year VMT table. For Washington, DC and all 50 states except California, the VMT information from the first data source was used as directly as possible. For these 50 state-level areas, a record was written for every record in the original table that included only the fields required for import to the NMIM table. The 3-digit NEI “SCCRT” field was converted to a two-digit road type code by extracting the first two digits.

For California, the source data were not allocated by road type. The road type allocation was made using a national average prepared from the data for the other 49 states and DC. Total VMT excluding California was calculated from the source data, and VMT fraction by road type and vehicle class was then calculated. Using the VMT fractions, each California record in the source data were processed. The total VMT was allocated to the 12 road types, and 12 base year VMT records were written. Table 4-1 lists the VMT road type fractions used.

TABLE 4-1

National-Average VMT Fraction by Road Type Used for California VMT Data

Vehicle Class	HPMS Roadway Type												Total
	11	13	15	17	19	21	23	25	27	29	31	33	
1	0.097	0.091	0.064	0.078	0.022	0.049	0.140	0.053	0.149	0.117	0.051	0.091	1.000
2	0.101	0.094	0.066	0.081	0.022	0.049	0.138	0.052	0.144	0.114	0.049	0.089	1.000
3	0.101	0.094	0.066	0.081	0.022	0.049	0.137	0.052	0.144	0.114	0.049	0.089	1.000
4	0.101	0.093	0.066	0.080	0.022	0.049	0.139	0.052	0.145	0.114	0.049	0.089	1.000
5	0.101	0.093	0.066	0.080	0.022	0.049	0.139	0.052	0.145	0.115	0.049	0.089	1.000
6	0.106	0.094	0.066	0.080	0.022	0.049	0.138	0.052	0.143	0.113	0.049	0.087	1.000
7	0.136	0.120	0.082	0.101	0.027	0.059	0.114	0.042	0.117	0.092	0.039	0.070	1.000
8	0.136	0.119	0.081	0.100	0.027	0.058	0.115	0.043	0.118	0.093	0.039	0.071	1.000
9	0.135	0.120	0.082	0.102	0.027	0.060	0.114	0.042	0.117	0.092	0.039	0.070	1.000
10	0.134	0.120	0.084	0.103	0.027	0.061	0.113	0.042	0.116	0.091	0.039	0.070	1.000
11	0.135	0.120	0.083	0.102	0.027	0.060	0.114	0.042	0.117	0.092	0.039	0.070	1.000
12	0.159	0.144	0.101	0.125	0.033	0.074	0.085	0.032	0.090	0.071	0.030	0.054	1.000
14	0.101	0.097	0.069	0.083	0.021	0.055	0.131	0.049	0.145	0.113	0.049	0.087	1.000
15	0.103	0.092	0.064	0.078	0.021	0.048	0.140	0.053	0.147	0.116	0.049	0.090	1.000
16	0.111	0.097	0.067	0.080	0.021	0.047	0.138	0.051	0.141	0.112	0.048	0.086	1.000
17	0.138	0.122	0.084	0.103	0.027	0.060	0.112	0.041	0.115	0.090	0.038	0.069	1.000
18	0.139	0.122	0.084	0.103	0.027	0.059	0.112	0.041	0.115	0.090	0.038	0.069	1.000
19	0.140	0.122	0.083	0.101	0.026	0.058	0.114	0.042	0.115	0.091	0.039	0.070	1.000
20	0.138	0.122	0.085	0.103	0.027	0.060	0.111	0.041	0.114	0.090	0.038	0.069	1.000
21	0.138	0.122	0.085	0.103	0.028	0.061	0.111	0.041	0.114	0.090	0.039	0.069	1.000
22	0.161	0.144	0.100	0.122	0.033	0.072	0.089	0.032	0.090	0.071	0.030	0.054	1.000
23	0.161	0.144	0.100	0.122	0.033	0.072	0.089	0.032	0.090	0.071	0.031	0.055	1.000
24	0.107	0.101	0.071	0.087	0.024	0.055	0.130	0.049	0.137	0.109	0.047	0.084	1.000
25	0.159	0.140	0.095	0.119	0.031	0.069	0.094	0.034	0.095	0.075	0.032	0.057	1.000
26	0.162	0.142	0.097	0.119	0.031	0.068	0.093	0.033	0.093	0.073	0.031	0.056	1.000
27	0.161	0.142	0.098	0.120	0.031	0.069	0.092	0.033	0.093	0.073	0.031	0.056	1.000
28	0.103	0.094	0.066	0.081	0.021	0.049	0.138	0.052	0.145	0.114	0.049	0.089	1.000

For Puerto Rico and Virgin Islands, data from the second source and the methodology described for the non-California data above was used. The source data were read and records were written for every Puerto Rico or Virgin Islands record, with the required index fields and with the SCCRT field corrected to a two-digit road type.

After the source data were imported to the final table for all areas, records with zero VMT were added for every combination of VMT and road type that was not represented in the source data. For the data imported directly from the first source, this was approximately 30% of all possible area-vehicle-road combinations.

Quality Assurance Procedures

The base year VMT data were checked for duplicate records, and VMT values were checked by testing several VMT sums against the source data. For state-level areas, the total VMT by vehicle class was compared. For county-level areas, total VMT, VMT by road type, and VMT by vehicle class were checked.

4.3 VMTGrowth

The VMTGrowth table contains percentage growth factors for scaling VMT from one calendar year to the following year. It holds growth factors for every vehicle class in every county, for every calendar year from 1999 to 2050. To calculate VMT for calendar year 2010 from calendar year 2009, the VMTGrowthRate data for calendar year 2010 is used. The growth factors for calendar year 1999 are zero. The factor is a positive or negative value representing the percentage change that a specific vehicle class in a specific county will change from the previous year to the year selected. To derive VMT for a calendar year 2025 case, the 1999 base VMT is obtained and then multiplied by 1 + VMTGrowthRate(year) for every year from calendar year 2000 to calendar year 2025.

Data Source

VMT growth data were collected from two primary sources:

- The BaseYearVMT table, based on data from the calendar year 1999 NEI modeling files; and
- VMT estimates for calendar year 2007, calendar year 2020, and calendar year 2030 provided by the EPA from appendix tables in the support documentation for the 2007 Heavy Duty Diesel Rule (HD2007) (files V-2.xls, V-3.xls, and V-4.xls).

Four state-level areas (AK, HI, PR, and VI) were not included in the HD2007 data. Future-year VMT for these areas was estimated based on average VMT growth in the other state-level areas.

Data Population Methodology

Several steps were required to prepare VMT Growth data. The overall process included: A) preparing complete sets of VMT data for “anchor” calendar years 1999, 2007, 2020, and 2030; B) interpolating between anchor years to derive complete sets of VMT for all years from 1999 through 2030; C) and extrapolating the 2030 VMT and preparing complete sets of data for 2031 through 2050; and D) computing a percentage VMT growth for each year from 2000 to 2050 using the VMT data.

Each of these overall processes involved several separate processing steps. Figure 4-1 shows an overall view of the processing.

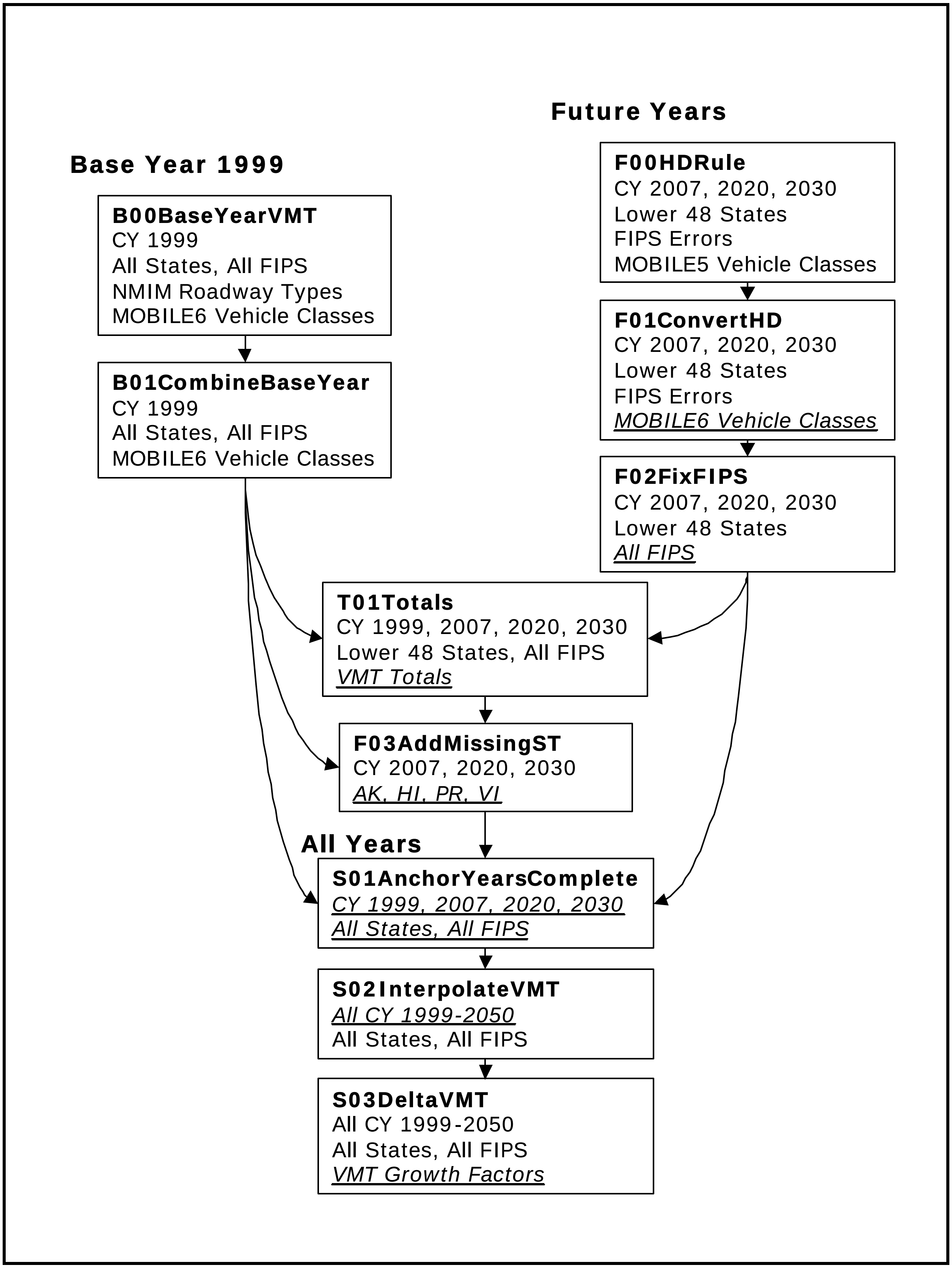

FIGURE 4-1. VMT Growth Data Sources and Methods

Base data "B00BaseYearVMT" is the data in the BaseYearVMT table, discussed in Section 4.1. **Base data "F00HDRule"** is the data from the HD2007 Rule appendices.

In step "B01BaseYearVMT" the BaseYearVMT table was queried for the sum of VMT by area and vehicle class, year, and area. This result was saved as the "complete" set of VMT for anchor year 1999. It included every required combination of vehicle class and area, on the same basis as other NMIM tables.

In step "F01ConvertHD" the HD2007 data were converted from a MOBILE5 vehicle class basis to a MOBILE6 vehicle class basis. The methodology presented in Section 5 of the MOBILE6 User's Guide was used to convert to the 16 MOBILE6 vehicle types, and relative VMT was calculated from MOBILE6 defaults to assign VMT for the 16 types into the 28 vehicle classes. There are some important aspects of the MOBILE6 User's Guide Chapter 5 method that impacted QA tests:

- The conversion method preserves total VMT for all vehicles;
- The method preserves VMT by MOBILE5 vehicle class for the five vehicle class "groupings" listed in section 5.3.2 of the MOBILE6 User's Guide;
- The method does not preserve VMT by the eight MOBILE5 vehicle classes because it involves a fuel independent sum that is distributed into classes based on MOBILE6 defaults; and
- The method allocates VMT to every MOBILE6 vehicle class for calendar year 2007, and all classes except LDDT12 for calendar year 2020 through 2030.

The conversion to fuel-independent vehicle groupings and then back to vehicle classes means that, in general, the MOBILE5 diesel-gasoline ratios are not preserved, and the QA checks had to compare with source data after at least one processing step. Also, this step cannot be reversed, there is no path to convert the VMT by 28 classes back to the source VMT by eight MOBILE5 classes.

In the MOBILE6 default population, vehicle class LDDT12 is not sold after model year 1986, and the last age-25 vehicles in this class are retired after calendar year 2010. LDDT12 VMT will be zero for calendar year 2011 and later. After converting the source data, calendar year 2007 included VMT for the class, and calendar years 2020 and 2030 did not.

The conversion method assigned VMT without any reference to the calendar year 1999 data. This created some conflicts where a class was not present in a specific area in calendar year 1999 but had VMT in calendar year 2007. These cases were located using QA checks, and a set of post-fixes was applied in step F01 after the basic vehicle class conversion. Table 4-2 lists the areas and vehicle classes that were included in the post-fixes. In the table, the "case" labels are in the form "NoVVVV" to indicate that VMT for class VVVV should be zeroed in future years, because it is zero in calendar year 1999. To zero the VMT for a class, its VMT was first added to the class with the same type but different fuel: for case "NoHDGV8a," the HDGV8a (gasoline) VMT was added to class HDDV8a (diesel), and then HDGV8a was set to zero. For the "NoLDDT" case, the LDDT12 VMT was allocated to LDGT1 and LDGT2 based on the existing relative VMT in the two classes. The same method was used for LDDT34, LDGT3, and LDGT4. For the "NoMC" case, the motorcycle VMT was added to the LDGV VMT.

TABLE 4-2

Post-fixes to Vehicle Class Conversions

Case	State FIPS	County FIPS
NoLDDT	6	3, 51, 91
NoLDDV	6	3, 91
NoMC	47	65
	6	3, 49, 91
NoHDGV8a	16	25
	20	33, 67, 71, 189, 199
	28	55
	30	19, 37, 59, 69
	31	5, 7, 9, 75, 91, 103, 113, 115, 117, 171, 183
	35	21
	38	87
	46	17
	48	23, 33, 75, 79, 169, 247, 261, 263, 269, 301, 311, 345, 357, 383, 393, 443, 495
	8	53

In step "F02FixFIPS" the differences between area FIPS code assignments were resolved by converting the HD2007 area assignments to the NMIM basis. The basis used for the FIPS reassignments was an NEI document provided by EPA. Most of the differences between HD2007 and NMIM FIPS codes were addressed in this document.

The VMT reassignments were handled as a set of special cases. There were a set of six cases for various types of area reassignments, including a base case with no conversion. Each county-level area in the F01 output was converted by one of the six cases and added to the step F02FixFIPS output. The cases were run independently and verified using QA checks. Some of the checks were specific to the conversion case, and others compared all of the input and output data. The cases include:

- Copy unchanged (base case): No FIPS code conversion, A -> A.

- Replace: The previous code is replaced with no other changes, A -> B.
- Split with one new: Area split in two, one part keeping the same code, A -> A+B.
- Split with both new: Area split in two, with previous code dropped, A -> B+C.
- Split two to three: New area split from two existing, B+C -> A+B+C.
- Split to two existing: Area reassigned to two other areas, A+B+C -> B+C.

The output for step F02FixFIPS was a set of complete VMT records for the anchor calendar years 2007, 2020, and 2030, for the "lower 49" state-level areas (the lower 48 states and Washington, DC).

In step "T01Totals" the VMT totals for the lower 49 were calculated for the anchor years, from the output of steps B01CombineBaseYear and F02FixFIPS. The result was total VMT by vehicle class for all four anchor years.

In step "F03AddMissingST" the future anchor year VMT for AK, HI, PR, and VI was estimated based on "national average" values from the lower 49 totals. The average VMT growth by vehicle class for 1999 through 2007 was calculated from the totals, and the calendar year 2007 VMT for each county-level area in AK, HI, PR, and VI was calculated from these growth factors and the base year VMT data. The same procedure was used to extrapolate the calendar year 2007 VMT to calendar year 2020, and for calendar year 2020 to calendar year 2030. The final output from step F03AddMissingST was a set of complete VMT values for the future anchor years, for the states not covered in the HD2007 data.

In step "S01AnchorYearsComplete" the anchor year VMT data from steps B01BaseYearVMT, F02FixFIPS, and F03AddMissingST were compiled to prepare for the following steps. QA checks that compared VMT changes from one anchor year to the next were run at this time. The VMT changes identified cases where the NEI data and the converted HD2007 data had conflicts for specific areas and vehicles, such as the list of special cases discussed in step F01ConvertHD. Completeness checks were run to verify that records for every county and every vehicle class in every anchor year existed.

In step "S02InterpolateVMT" the anchor year VMT was copied, and VMT data were interpolated or extrapolated for every additional calendar year from 2000 to 2050. The range of calendar years was handled as four "spans," calendar year 1999 through calendar year 2007, calendar year 2007 through calendar year 2020, calendar year 2020 through calendar year 2030, and calendar year 2030 through calendar year 2050. For the first three spans, VMT for intermediate years was interpolated, and for the final span the calendar year 2030 VMT was extrapolated.

The interpolation/extrapolation method assumes constant growth in VMT miles, rather than a constant growth ratio. In extrapolating, the annual VMT growth in miles from the last interpolated year was used for all following years. Figure 4-2 illustrates the handling of the calendar year spans. The VMT data plotted in the figure is for Cochran County, TX (FIPS 48017).

Figure 4-2. Anchor Years and Interpolation Spans for VMT Growth

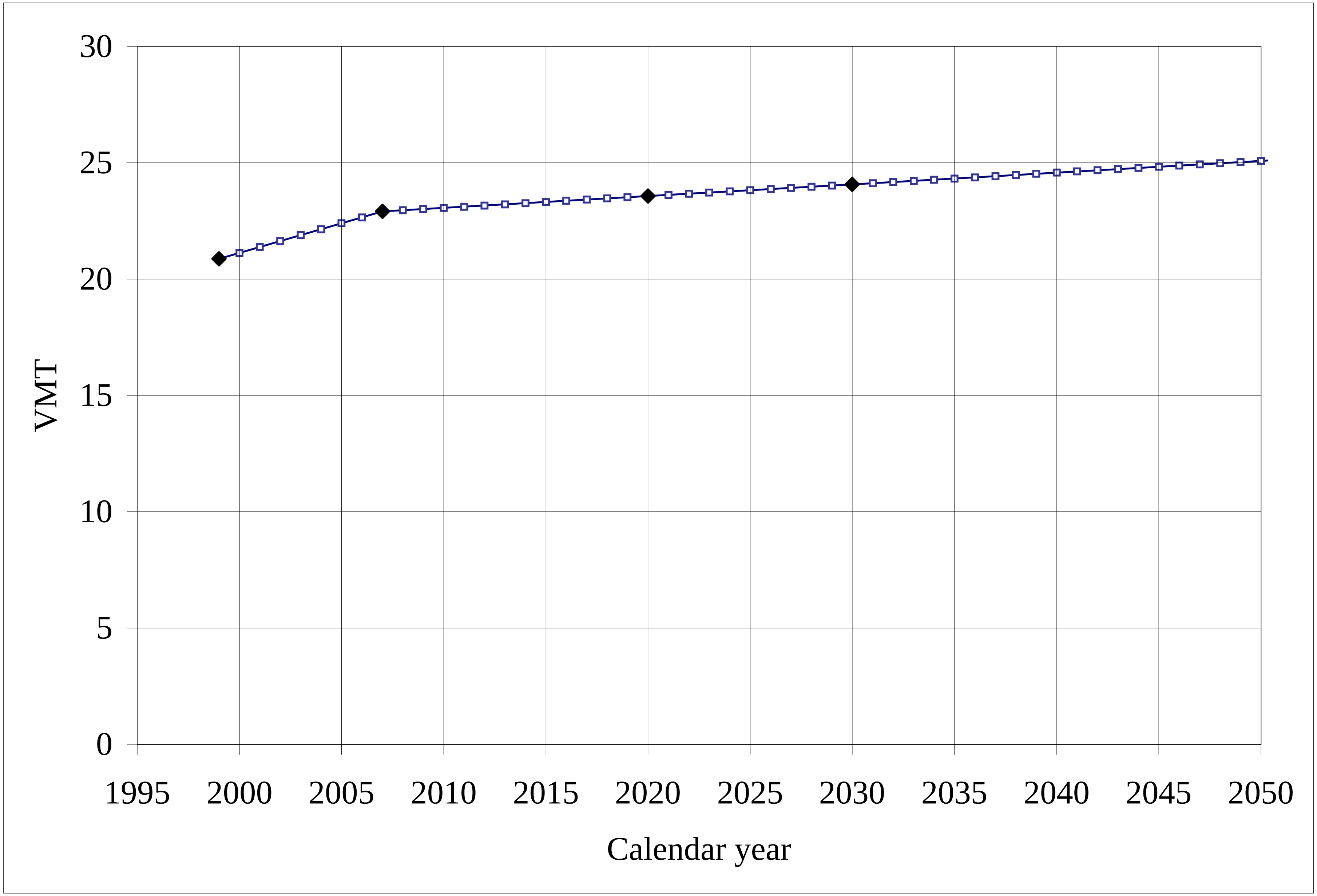

FIGURE 4-2. Anchor Years and Interpolation Spans for VMT Growth

In step "S03DeltaVMT" the VMT by calendar year results from S02InterpolateVMT were compared and growth rates were generated. The growth rates were set to zero for calendar year 1999, and calculated as a percentage change in VMT for each calendar year from 2000 through 2050. With a constant growth in VMT between spans, the percentage growth changed for each year. Figure 4-3 illustrates the growth factor change characteristics for the same data plotted in Figure 4-2.

Figure 4-3. Percentage Growth Rate for the VMT Growth Table

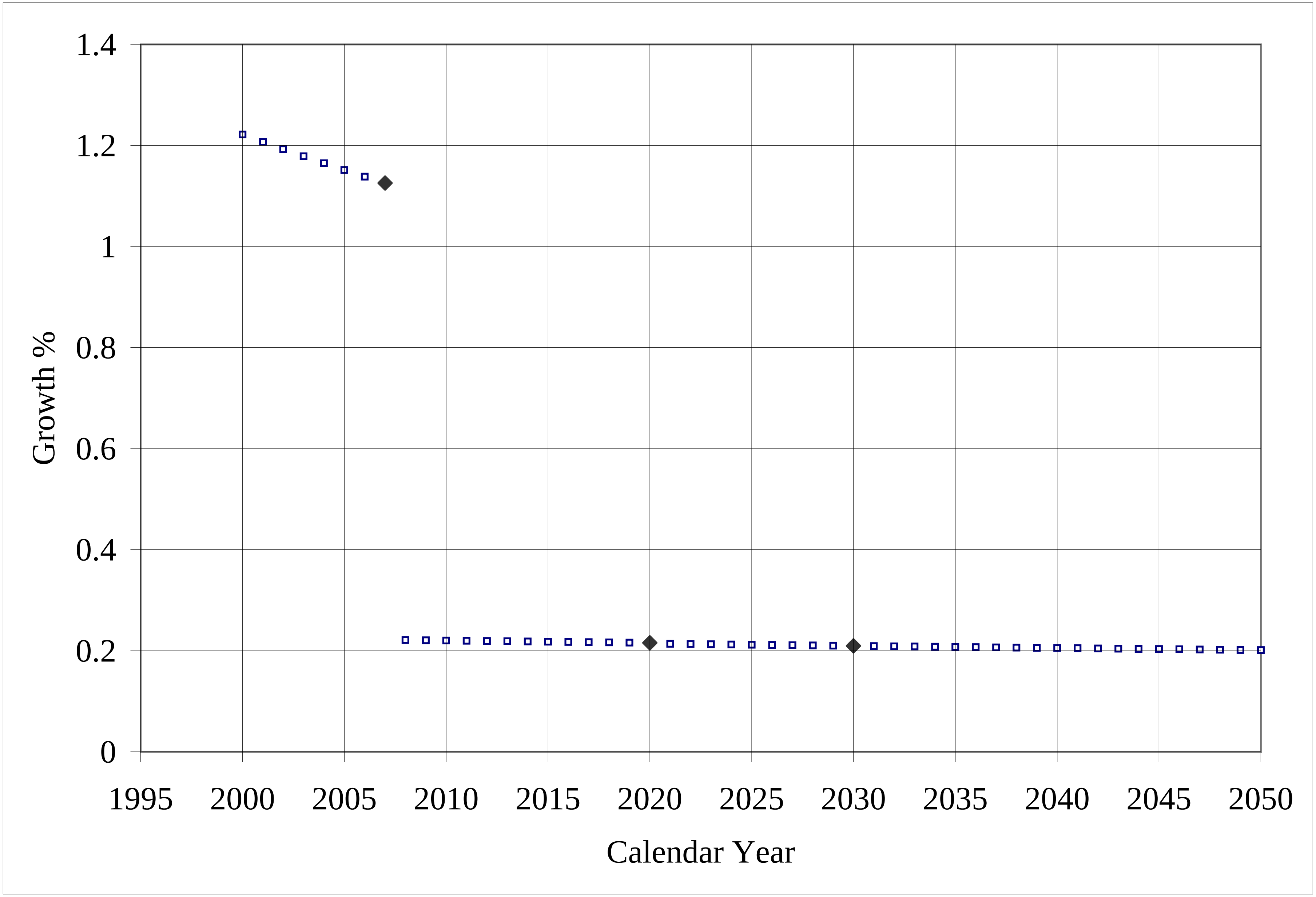

FIGURE 4-3. Percentage Growth Rate for the VMT Growth Table

Quality Assurance Procedures

A variety of QA checks were made in the overall process, because the individual processing steps were quite different and handled a number of special cases. Some of the QA checks can be summarized by processing step.

B01BaseYearVMT: VMT totals by vehicle were checked at the state level and the county level.

F01ConvertHD: The vehicle class conversion is not reversible, and does not preserve VMT by all 8 MOBILE5 classes. The output from this step was checked against the source data to confirm overall VMT totals at the state and county level. The source data were then processed into VMT totals by county for the five MOBILE5 vehicle “groupings” listed in the MOBILE 6 User’s Guide, and the corresponding totals were calculated and compared for the output data after the vehicle class post-fixes. The post-fixes preserved VMT by the five “groupings” for all cases except the “NoMC” case. For the four “NoMC” cases, the input motorcycle VMT was added to the input LDV VMT and checked against output LDV VMT.

F02FixFIPS: This step preserves total VMT by state, and it preserves total VMT by county for the “copy-unchanged” base case counties. Each individual FIPS correction preserves VMT for the counties involved. QA tests were made for total VMT by class at the state level. For the copy-unchanged counties and the renamed counties, the input and output VMT was compared directly by vehicle class at the county level. The other FIPS corrections involved one to three input counties and two to three output counties. For these cases, VMT was totaled over the input and output counties and then compared.

T01Totals: There were relatively few checks that could be made to this data. The distribution of VMT by vehicle class was calculated and compared to the distribution from the larger states. This was not an exact comparison, but was used to qualitatively assess the difference between the final VMT distribution and the distributions for individual states.

F03AddMissingST: This step was designed to preserve overall VMT growth exactly, and relative VMT growth by vehicle class only approximately. The total percentage VMT growth by county for the four states calculated was compared to the percentage VMT growth calculated from the T01Totals data.

S01AnchorYearsComplete: This step consisted of consolidating data from several preceding steps. There were no data manipulations in this step to be validated, but it was a convenient point to perform checks across all of the anchor year data. Checks were run for completeness to verify that every required combination of county and vehicle class was created in the F02FixFIPS and F03AddMissingST steps.

S02InterpolateVMT: The processing routines for this step compared adjacent anchor years for VMT by vehicle class and county. This comparison determined the cases where a vehicle class in a county was added or dropped from one anchor year to the next. Resolving these conflicts led to the set of post-fixes applied in the F01ConvertHD step. A separate test was run for the input and output data for this step, checking for a complete set of unique records for every state, county, and vehicle class. In this test, the state and county FIPS IDs were also compared to data read from the EPA CHIEF FIPS list.

S03DeltaVMT: Because the final calculated growth factors were stored with fixed numeric precision, it was not possible to perform exact comparisons between the input VMT and the cumulative growth factors. Qualitative checks verified that the input VMT, multiplied by appropriate growth factors, matched the output VMT within a reasonable error tolerance. The calculated growth factors were also checked against the range limits allowed for the VMTGrowthRate field in the database design. Also, growth factors of -100% were checked against the expected cases for dropped vehicle classes.

4.4 VMTMonthAllocation

This table contains, for a combination of vehicle class and road type, the fraction of annual VMT that should be allocated to each month of the year.

Data Source

The data were copied from a table in the October 2001 Draft 99 NEI documentation. In Table 4-3, the columns marked “Original” list the actual values copied from the source document.

TABLE 4-3

Original and Adjusted VMTMonthAllocation Values

Vehicles:	Light Duty (LDV, LDT, MC)				HDV	
Roadway:	Rural		Urban		All	
	Allocation Values					
Month	Original	Adjusted	Original	Adjusted	Original	Adjusted
Jan	0.0744	0.0744	0.0806	0.0806	0.0861	0.0862
Feb	0.0672	0.0672	0.0728	0.0728	0.0778	0.0778
Mar	0.0805	0.0805	0.0859	0.0860	0.0842	0.0842
Apr	0.0779	0.0779	0.0832	0.0833	0.0815	0.0815
May	0.0805	0.0805	0.0859	0.0860	0.0842	0.0842
Jun	0.0942	0.0942	0.0864	0.0865	0.0815	0.0815
Jul	0.0974	0.0975	0.0893	0.0894	0.0842	0.0842
Aug	0.0974	0.0974	0.0893	0.0894	0.0842	0.0842
Sep	0.0844	0.0844	0.0808	0.0809	0.0824	0.0824
Oct	0.0872	0.0872	0.0835	0.0836	0.0852	0.0852
Nov	0.0844	0.0844	0.0808	0.0809	0.0824	0.0824
Dec	0.0744	0.0744	0.0806	0.0806	0.0861	0.0862
Sum	0.9999	1.0000	0.9991	1.0000	0.9998	1.0000

Data Population Methodology

The source data had been published as fractions showing four decimal places. Because of rounding errors, the total annual allocation did not sum to one. In order to force the annual sums to be one, the original values were adjusted by a correction factor and then rounded again to four decimal places. In Table 4-3, the columns marked “Adjusted” list the adjusted values used in the database.

The source data included three 12-month allocation profiles that were each used for particular combinations of road type and vehicle class. In order to generate all of the input records required for the NMIM table, each of the allocation profiles was written out to all of the combinations of vehicle class and road type for which it applied. The light-duty/rural profile, for example, was written out for every combination of six light-duty vehicle types and six rural road types. Table 4-4 shows how the original combinations of vehicle type and road class were applied to the 16 vehicle types and 12 roadway types used in the database.

Quality Assurance Procedures

The QA check for completeness required that every combination of month, vehicle type, and road type identified a unique record with an allocation factor within the table's valid data range. The check for annual totals requires that, for every combination of vehicle and road, the twelve monthly allocation factors should sum to one. The source data were adjusted, as shown in Table 4-3, to meet this requirement.

TABLE 4-4
Conversion of Roadway and Vehicle Types for VMTMonthAllocation Data.

Vehicle Types	MOBILE6 VehicleTypes
LDV, LDT, MC	1: LDV
	2: LDT1
	3: LDT2
	4: LDT3
	5: LDT4
	16: MC
HDV	6: HDV2B
	7: HDV3
	8: HDV4
	9: HDV5
	10: HDV6
	11: HDV7
	12: HDV8A
	13: HDV8B
	14: HDBS
	15: HDBT
Roadways	**HPMS Codes**
Rural	11: Rural, Interstate
	13: Rural, Other Principal Arterial
	15: Rural, Minor Arterial
	17: Rural, Major Collector
	19: Rural, Minor Collector
	21: Rural, Local
Urban	23: Urban, Interstate
	25: Urban, Non-Interstate Freeway
	27: Urban, Other Principal Arterial
	29: Urban, Minor Arterial
	31: Urban, Collector
	33: Urban, Local

5.0 INSPECTION AND MAINTENANCE (I/M) PROGRAM TABLES

Several types of inspection and maintenance (I/M) program data are used by NMIM: Stage 2 refueling program efficiency, anti-tampering program information, an I/M program information for multiple vehicle classes over multiple years. The sections below describe this information.

5.1 County Year

The CountyYear table contains stage 2 refueling program efficiency data, references to external anti-tampering program files, and references to external I/M program files for all counties from calendar year 1999 through calendar year 2050. The data sources, data population methodologies, and QA procedures used for each type of data in CountyYear are described below.

Data Source

The Data Sources used to populate the CountyYear table are listed in Table 5-1.

TABLE 5-1
CountyYear Data Sources

Type of Data	Data Source
Stage 2 refueling program efficiency	NEI Fall 2001 Update files, stage2dat.xls and 00tables.wpd
Anti-tampering program file name and files	NEI Fall 2001 Update, MOBILE6 input files and Trends99_Pointer.dbf
I/M program file name and files	Base Year: NEI Fall 2001 Update MOBILE6 input files and Trends99_im.xls. OBD Schedules: File Model.wpd, "Major Elements of Operating I/M Programs (as of 3/02)". A 12/1999 version of this document is available on the EPA OTAQ Web site: http://www.epa.gov/otaq/epg/b99008.pdf. Other future programs: File Counties.wpd, “States and Counties with I/M programs”.

Data Population Methodology

The procedures used to populate the CountyYear table are described in the sections below.

<u>Stage 2 Refueling Efficiency</u>

The Stage 2 refueling efficiency programs were designated with either a “1" or a “0" in the spreadsheet stg2dat.xls for each county. The contents of 00Tables.wpd indicate that a value of "0" in stg2dat.xls means that Stage 2 refueling programs are not in effect and a 0% applies, while a values of “1" indicates that Stage 2 refueling programs are in effect and assumed to be 95% effective.

Records from the NEI Fall 2001 Update stg2dat.xls file were joined by FIPS code with records in the CountyYear table. For counties which had a Stage 2 refueling program in effect, the Stage2Pct field was populated with a 95. The base year Stage 2 refueling efficiency values were assumed to be in effect for all future years.

Fifteen mismatches between the NEI Fall 2001 Update stg2dat.xls spreadsheet and the FIPS codes in the CountyYear table were noted. The differences in FIPS codes were expected because the NEI data were based on FIPS numbering with several differences from the NMIM numbering. Table 5-2 lists the fifteen FIPS codes used in stg2dat.xls that were remapped or corrected for use in NMIM. If no information existed for a particular county, it was assumed no Stage 2 refueling program was in effect in that county.

TABLE 5-2
County FIPS Codes in NEI Stage 2 Refueling Data Not Used in NMIM.

County in stg2dat.xls			Comments
FIPS	**ST**	**COUNTYNM**	
02010	AK	Aleutian Islands Ed	Correct for new counties and post-1980 subdivision in AK.
02140	AK	Kobuk Ed	
02231	AK	Skagway-Yakutat Ed	
02990	AK	Upper Yukon Ed	
02991	AK	Seward Ed	
02992	AK	Kuskokwim Ed	
02993	AK	Bristol Bay Borough	
02994	AK	Angoon Ed	
02996	AK	Cordova-Mccarthy Ed	
02998	AK	Outer Kethcikan Ed	
02999	AK	Barrow Ed	
12025	FL	Dade Co	Dade renamed Miami-Dade County.
29193	MO	Ste. Genevieve Co	Corrected numbering to 29186, per 1979 FIPS correction.
30113	MN	Yellowstone Natl Par	Yellowstone NP assigned to neighboring counties.
46131	SD	Washbaugh Co	Washbaugh absorbed into neighboring counties.

Anti-tampering Program File Names and Files

The base year anti-tampering program data were retrieved by searching the NEI Fall 2001 Update MOBILE6 input files for the command "anti-tamp." For each MOBILE6 file that included this command, a corresponding anti-tampering program file was created by copying the series of parameters that followed the command into a new file. For example, the MOBILE6 input file N0202010.IN includes the following:

ANTI-TAMP
86 68 50 22222 11111111 1 22 095. 22112222

These data were copied to a text file and saved as atp02020.txt. The counties to which this anti-tampering program applied were determined using the Trends99_pointer.dbf file, which notes all of the counties that used the MOBILE6 input file from which the information was extracted.

Records from the Trends99_pointer.dbf file were joined by FIPS code with records in the CountyYear table. For counties that participated in the anti-tampering program, the ATPFileName field was populated with the appropriate file name. The base year anti-tampering program data were assumed to be in effect for all future years.

I/M Program File Names

The methods used to develop the I/M program file names and load the combination of file names and program schedules into table CountyYear are described below. The contents of the I/M files, and the I/M program implementation schedule that is reflected in CountyYear, is described in more detail in the following section.

The files that describe I/M programs in use in the base year were all derived from the NEI modeling files. The names of the files were preserved, although the file contents were updated as needed to reflect future year programs. For these files and I/M programs, the mapping of counties to I/M files in Trends99_im.xls is identical to the mapping defined in the CountyYear table, for the 1999 bas year only. After the base year, I/M programs are added, modified, and dropped, and the CountyYear data reflects this.

Additional files were required to describe programs implemented after 1999. The file names were developed on a case by case basis, but the naming conventions matched the NEI files as closely as possible.

The data used to load the IMFileName field was written using the information in the final schedule described below. The schedule table included every county that would implement a program in any year from 1999 forward. For every such county, records were generated for import to CountyYear for the first implementation year and all following years. I/M programs were assumed to remain in place indefinitely once started.

I/M Programs and Implementation Schedules

Several initial processing steps were performed on the I/M data. For the NEI I/M files, program ParseIM.awk was used to read all of the files and extract the I/M program details. Some minor changes were made to the files at this point to improve consistency between the programs. For example, in the ctim98.im file, the upper model year limit was increased from 2020 to 2050.

The program list in the "States and Counties with I/M programs" document (Counties.wpd) was reformatted and loaded into a spreadsheet-based table. A FIPS code was identified for all of the counties listed, and a simple program name was generated from the brief program description in the document.

A number of changes were made to the program list in the "Major Elements of Operating I/M Programs" document (Model.wpd) to help extract program descriptions. The table was exported to a spreadsheet and reformatted. Each "program" row in the original table represents a set of two to five I/M "programs" in MOBILE6 input data. A table of simplified program names was generated for use in merging the program descriptions.

As a start for resolving differences in the three sources, a table was prepared listing the states which had I/M programs defined in each source. There were differences for five states, and each one was examined to determine the source of the differences. There were cases in which the NEI data were missing post-1999 programs as expected (LA, NH), cases in which the NEI included discontinued programs not listed in the other sources (FL, MN), and one case in which the Counties list was missing a program that was included the other two sources (ID). At this point, a merged list of state programs was prepared that included all programs listed in the three sources.

The sources were then compared on a county-by-county basis, and the merged list of state programs was expanded to include all counties listed in the sources. All of the state-level and county-level differences in the merged list were resolved, so that each county was assigned to a specific state-level I/M program, and the state-level programs and county assignments were as consistent as possible with the data sources. The majority of the differences noted at this level could be tracked to the state-level differences, particularly the cases in which programs were added after 1999, and the cases in which the NEI data described programs not included in the other sources. In addition, there were a number of cases in which the Counties.wpd list was missing a county or had an error in county names. Table 5-3 lists the major differences between the data sources and the way that each was resolved.

This merged list of counties was next used as the starting point for generating a master schedule table. Each county was mapped to the first year in which it had a program, the year in which the program added OBD testing, and the year in which any other program changes were made. The specific program files to be used were also identified.

After cross-checking with the actual I/M files, the master schedule table was used to generate the data required for the CountyYear table.

To develop the contents of the I/M files, there were two general cases. For programs included in the 1999 base year, the base year NEI file was modified to add future-year changes (primarily OBD program and exhaust test changes). For new programs, the base year I/M files were used as examples in developing new files. “Generic” program files were first developed for Enhanced, LowEnhanced, and OTRLowEnhanced programs. These files were used to develop state- and program-specific I/M files. Table 5-4 lists the eight new program files that were developed.

TABLE 5-3
Examples of Differences in I/M Program Data

State	Differences and Resolution
Colorado	El Paso County (Colorado Springs) uses Denver program in NEI. Resolution: Re-assign to use the Colorado Springs file CO95C.IM.
Florida	No information on Florida in Counties/Model Resolution: I/M program discontinued after 1999.
Georgia	NEI files use 1992 program start, but Model says 10/1998 Resolution: Leave NEI start in place for better NMIM/NEI consistency.
Idaho	Not listed in Counties. Resolution: Use NEI/Model as-is.
Kentucky	Northern Kentucky counties: Not listed in Counties. Resolution: Use NEI/Model as-is.
Louisiana	Not listed in NEI. Resolution: Add new program 2002 start.
Maryland	Counties missing Baltimore City (likely a FIPS code issue) Resolution: Use NEI/Model as-is.
Massachusetts	Model indicates MA31 test, NEI uses Idle. Resolution: Transition to MA31 test in MA95.IM.
Minnesota	No information on Minnesota in Counties/Model Resolution: I/M program discontinued after 1999.
Missouri	Counties list does not include Franklin county. Resolution: Use NEI/Model as-is. Model indicates IM240 test, NEI uses Idle. Resolution: Transition to IM240 test.
New Hampshire	Not listed in NEI. Resolution: Add new OBD program 2002 start.
New Jersey	Model indicates ASM5015 test, NEI uses Idle. Resolution: Transition to ASM5015 test.
New York	Counties indicates OTR Low-Enhanced program for non-NYC counties. Resolution: Add separate program for upstate counties.
North Carolina	NEI and Counties show several differences in NC county list. Resolution: Add Cabarrus, Orange, Union counties to Basic. Retain NEI counties not in Counties list: Davidson, Davie, Granville.
Oregon	Counties includes Columbia, Yamhill counties. Resolution: Add counties to enhanced program.
Pennsylvania	Counties includes several counties added. Resolution: Add counties to new program.
Rhode Island	Model indicates RI2000 test, NEI uses Idle. Resolution: Transition to RI2000 test.
Utah	Counties indicates that Weber and Utah counties are in different programs, NEI and Model have Utah grouped with Weber. Resolution: Use NEI/Model data.

TABLE 5-4
New External IM Program Files

File	Comments
GA01.IM	Add counties to program in GA99.IM.
IN01.IM	Add county to program in IN97.IM.
LA00.IM	New OBD program.
NH02.IM	New OBD program.
NY01.IM	New program for upstate counties.
NC01.IM	Add counties to program in NC87.IM.
OR01P.IM	Add counties to program in OR98P.IM.
PA01OLE.IM	New program for additional counties.

To modify the base year file to add future year I/M programs, the "rewriteIM.awk" script was used. The base year details were read in, and a set of modified programs was written to the output file.

Quality Assurance Procedures

MySQL queries were run to ensure that there were 52 records for each of the 3,222 counties (one of each year), and 3,222 records for each of the 52 years.

The state-level and county-level program comparisons were checked manually against the source data. The master program schedule table was checked against the county-level comparison, and the file names in the schedule were checked against the trends99_im.xls data.

When the I/M files were prepared, a set of MOBILE6 runs were made that exercised every program file for calendar years 1999 and 2007. For the programs present in the NEI data, a baseline run was completed using the original I/M files for the same years. The ratio of emissions for the baseline results and the results with the new files was calculated, and a table of ratios by I/M file and emissions type was reviewed. For the base year, the ratios were 1.0 or were different for some special cases that were expected. When the NEI files were used as baseline for 2007, the modified files showed lower emissions in general, due primarily to the added OBD programs.

6.0 ADDITIONAL TABLES

NMIM includes several additional data tables that store county Federal Information Processing Standard (FIPS) codes, representative county mapping information, climate data, altitude data, and information about states using a non-standard phase-in for low emissions vehicles (LEV). Each of these tables is describe below.

6.1 County

The County table includes FIPS codes for each county or equivalent political subdivision of one of the states or territories of the USA, county altitude data, and representative county mapping information.

Data Source

The FIPS codes for each county or equivalent political subdivision of one of the states or territories of the USA were extracted from FIPSCNTY field in the EPA_CHIEF_county_fips.xls file retrieved from http://www.epa.gov/ttn/chief/codes/index.html.

Per the guidance specified in *Documentation for the Draft 1999 National Emissions Inventory for Criteria Air Pollutants Onroad Source Methodologies* (page 10) Colorado, Nevada, New Mexico, and Utah were designated as high altitude areas while all other states were designated as low altitude areas.

Representative county identification numbers were generated using a series of MySQL queries that determined unique counties based on a number of parameters.

Data Population Methodology

The procedures used to populate the County table are described in the sections below.

Altitude Data

Per the guidance specified in *Documentation for the Draft 1999 National Emissions Inventory for Criteria Air Pollutants Onroad Source Methodologies* (page 10) Colorado, Nevada, New Mexico, and Utah were designated as high altitude areas while all other states were designated as low altitude areas.

Representative County Mapping

In order to shorten the time required to complete a National run of NMIM, a smaller number of counties that "represent" the full complement of counties can be used. After MOBILE6 has been run for each of the representative counties, the results can then be mapped to each individual county during post processing, and the actual vehicle miles traveled (VMT) in each county could be used to generate the final emissions inventory.

The use of representative counties is a compromise between accuracy and computational time and effort. The degree to which counties much match in order for one to represent another can be altered in order to optimize the balance between accuracy and time. The remainder of this section describes the available criteria for matching counties and those that were used in the county mapping process.

Criteria 1: Same State—Due to the structure of the NMIM database, a county may only represent counties in the same state.

Criteria 2: Meteorological Data—The NMIM database currently stores the maximum, minimum, and average temperature for each county (table: CountyMonth). However, this information was only available at the state level, therefore each county in the same state has the same meteorological data. This information was not considered in the representative county mapping process.

Criteria 3: Inspection and Maintenance (IM) Program—The database stores the name of a file that describes the IM program to use for each county for each year (table: CountyYear; field: IMFileName). A representative county must use the same IM file name in database.

Criteria 4: Anti-Tampering Program (ATP)—The database stores the name of a file that describes the anti-tampering program in place for each county for each year (table: CountyYear; field: ATPFileName). ATP programs are typically associated with IM programs. The representative county mapping methodology assumed that if the IM program is similar, then the ATP program is also similar. This information was not considered in the representative county mapping process.

Criteria 5: Type of Fuel—The NMIM database contains nine fuel identification fields for each county by year and month (table: CountyYearMonth; fields HwyDieselID, HwyGasolineID, NRGasolineID, NRDieselID, HwyGasolineIdA, HwyGasolineIdB). The predominant fuel used in each county is described by the highway gasoline identification number (table: CountyYearMonth; field: HwyGasolineID); therefore this field only was used in the representative county mapping process.

Criteria 6: Time Frame—The intent of the NMIM database is to encompass all the data needed to run the model from 1999 through 2050. The current set of available data indicates that there are currently no meaningful changes after 2010. Therefore, the representative county mapping was performed using 1999 through 2010 data.

The number of unique combinations of the criteria described above were queried from the database. The counties were then grouped by each unique combination. All counties in a group were assigned a representative county ID based on the lowest FIPS county code associated with the counties in the group. Note that to support all of the functionality required to complete representative county mapping, the MySQL code was written in version 4.0.5 beta.

Quality Assurance Procedures

Several representative counties were verified visually to determine that the I/M program files and gasoline assignments were the same. In addition, a MySQL query was created to confirm that counties in only the four appropriate states were designated as high altitude.

6.2 CountyMonth

The CountyMonth table includes monthly climate information for each county. This table is not dependent on year.

Data Source

Monthly temperature data for each state were collected from the 1999 NEI Fall 2001 Update files using the Max# and Min# fields in mxmntp99.dbf and pr_vi_temps.xls. Each county within each state was assumed to experience the same monthly average temperatures.

Data Population Methodology

Records from the mxmntp99.dbf file were joined by FIPS code with records in the CountyMonth table. With the exception of California and Texas, each state had one record that was used to populate all months for all counties in each state. For California and Texas, which had two monthly temperature data records, the record containing higher temperatures was used. Monthly average temperatures for Puerto Rico and the Virgin Islands were populated in the same manner from the pr_vi_temps.xls file.

Quality Assurance Procedures

MySQL queries were run to ensure that there were 12 monthly records for each of the 3,222 counties, and 3,222 records for each month of the year. The monthly average temperature data were printed and visually compared to the data sources listed above.

6.3 State

The State table provides the Federal Information Processing Standard (FIPS) codes associated with each of the 50 states, as well as Puerto Rico and the Virgin Islands. The name of external data files required for states using a non-standard phase-in for low emissions vehicles (LEV) is also included.

Data Source

The state identification information was populated using the June 2002 NEI Update files.

The LEV indications were populated using the NEI Fall 2001 Update, MOBILE6 input files, and the Trends99_Pointer.dbf file.

Data Population Methodology

The LEV external data file name was retrieved by searching the NEI Fall 2001 Update MOBILE6 input files for the command "LDG IMP." For each MOBILE6 file that included this command, the corresponding LEV file name followed the command. For example, the MOBILE6 input file N5000110.IN includes the following:

```
LDG IMP
vtimp.d
```

These LEV files were copied to a central location. The counties to which this LEV program apply were determined using the Trends99_pointer.dbf file, which notes all of the counties that used the MOBILE6 input file from which the information was extracted.

Records from the trends99_im.xls file were joined by FIPS code with records in the State table. For states using an LEV program, the appropriate LEV program file names were copied into the NLEVFileName field.

Quality Assurance Procedures

A MySQL query was run to confirm the appropriate number of states contained an LEV filename. The State table was also printed and visually compared to the data sources listed above.

7.0 INTERNAL QUALITY ASSURANCE TABLES (NOT DELIVERED)

ERG created a series of internal quality assurance tables that presented basic statistics on the data contained in the NMIM database. These tables, which were reviewed for anomalies after each database repopulation, are described briefly below.

7.1 Minimum and Maximum Field Values

For each numeric field in each table, a record was inserted into a new table which contained the table name, field name, maximum value of the field, and minimum value of the field. The maximum and minimum values were compared with known maximum and minimum values for state FIPS; county FIPS; gasoline parameters such as E200, E300, and others listed in the MOBILE6 User's Guide; and from other sources.

7.2 Null Values

For each field in each table, a count was made of the number of records containing a null value. A record was inserted for each field which contained the table name, field name, and count of null values. These records were reviewed to ensure that fields for which null values were not expected were not included in the table.

7.3 Zero Values

For each numeric field in each table, a count was made of the number of records containing a zero value. A record was inserted in a new table for each field which contained the table name, field name, and count of zero values. These records were reviewed to ensure that fields for which zero values were not expected were not included in the table.

7.4 Table Relationships

For each field in each table with a Child to Parent relationship, a count was made of the number of records not having a matching parent record. A record was inserted in a new table for each field which contained table name, field name and count of records missing a parent record. These records were reviewed to ensure that tables for which missing parent records were not expected were not included in the table.

Likewise, for each field in each table with a Parent to Child relationship, a count was made of the number of records not having a matching child record. If this count was greater than zero, a record was inserted in a new table which contained the parent table name, child table name, field name, and the value of the field without a matching child record. These records were reviewed to ensure that tables for which missing child records were not expected were not included in the table.

8.0 REFERENCES

AAMA, 1999. North American Gasoline and Diesel Fuel Survey. Alliance of Automobile Manufacturers.

Abt, 2003. *Refinery Modeling: Legislative and Regulatory Developments – Effects on Gasoline Supply, Federal Oxygenate Case and Fuel Control Cases (Benzene, Toxics and Sulfur Control).* EPA Contract 68-C-01-164, Work Assignment 1-7 & 1-7.1, Sub-Tasks 3.2, 4.1, and 4.2 for 2010. Prepared for U.S. Environmental Protection Agency by Abt Associates Inc., Bethesda, Maryland. January 14.

Federal Register, 2000. Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements. Final Rule. 65 CFR 6698. February 10.

Federal Register, 2001. Control of Air Pollution From New Motor Vehicles; Amendment to the Tier 2/Gasoline Sulfur Regulations. Direct Final Rule. 66 CFR 19296. April 13.

FHWA, 1999. Federal Highway Administration (FHWA) website for oxygenated fuel sale percentage. Table MF-33E – Estimated Use of Gasohol and Table MF-21 – Motor-Fuel Use. Internet address: http://www.fhwa.dot.gov/ohim/hs99/mfpage.htm

Manners, 2002. Personal communication between Mary Manners (U.S. EPA, Ann Arbor, Michigan; 734-214-4873) and Marty Wolf (ERG). August 23.

MathPro, 1998. *Costs of Alternative Sulfur Content Standards for Gasoline in PADD IV*. Final Report. Prepared for the National Petrochemical and Refiners Association by MathPro Inc., West Bethesda, Maryland. December 30.

MathPro, 1999a. *Costs of Meeting 40 PPM Sulfur Content Standard for Gasoline in PADDS 1-3, Via Mobil and CD Tech Desulfurization Processes*. Final Report. Prepared for the American Petroleum Institute by MathPro Inc., West Bethesda, Maryland. February 26.

MathPro, 1999b. *Analysis of California Phase 3 RFG Standards*. Prepared for the California Energy Commission by MathPro Inc., West Bethesda, Maryland. December 7.

TRW, 1999. National Institute of Petroleum and Energy Research (NIPER or TRW) Fuel Survey.

U.S. EPA, 2000. Reformulated Gasoline Survey Data for 2000. U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Ann Arbor, Michigan. Internet address: http://www.epa.gov/otaq/consumer/fuels/mtbe/oxy-95-00.pdf.

U.S. EPA, 2001. U.S. EPA Oxygenated Fuel Program Summary, State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Ann Arbor, Michigan. October. Internet address: http://www.epa.gov/otaq/regs/fuels/oxy-area.pdf.

U.S. EPA, 2002a. *Technical Description of the Toxics Module for MOBILE6.2 and Guidance on Its Use for Emission Inventory Preparation*. EPA420-R-02-029. U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Ann Arbor, Michigan. November.

U.S. EPA, 2002b. *MOBILE6.2 User's Guide*. EPA 420-R-02-028. U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Ann Arbor, Michigan. October.

APPENDIX A
INDEX TO DATA FILES AVAILABLE ELECTRONICALLY

NMIM Table Name	**File Name**	**Description**
Reference Tables Folder		
HPMSRoadType	vehicles2.xls	The spreadsheet was taken from the June 2002 National Emissions Inventory (NEI) update files.
M6VType	Appendix B of MOBILE6 User's Guide	The 16 vehicle classes were obtained from Table 2 of Appendix B (pg 245) of the MOBILE6 User's Guide (EPA420-R-02-028, October 2002).
M6VClass	Appendix B of MOBILE6 User's Guide	The 16 vehicle classes were obtained from Section 1.2.3 (pg 14) of the MOBILE6 User's Guide (EPA420-R-02-028, October 2002).
Fuel Tables Folder		
CountyYearMonth Gasoline Gasoline2 CYMMTBEPhsOut GasMTBEPhsOut Gas2MTBEPhsOut	CYM_Gas.mdb CYM_GasMTBE.mdb	Access 97 databases which produces the CountyYearMonth, Gasoline, Gasoline2, CYMMTBEPhsOut, GasMTBEPhsOut, and Gas2MTBEPhsOut tables. The user can open the form *frmExecFunctions* in each database and click the buttons in order to re-create the data. The queries with names beginning "Export_" should be imported into the County database.
	030425_gasoline assignments and parameters.xls	Gasoline assignments and factors for 1999 through 2050.
	Final_Fuel1999V3_032703.xls	1999 seasonal gasoline parameters by county
	RFG_Fuel00_v1.xls	Updated seasonal gasoline parameters by county for year 2000.
Diesel	sulfur.xls	The spreadsheet contains the assumptions Pechan used for non-road sulfur content of diesel and CNG fuels, forwarded by Dave Brzezinski, EPA. [two additional records were added, where did they come from?]
NaturalGas	sulfur.xls	The spreadsheet contains the assumptions Pechan used for non-road sulfur content of diesel and CNG fuels, forwarded by Dave Brzezinski, EPA.
I/M Program Tables Folder		
CountyYear	stage2dat.xls 00tables.wpd trends99_pointer.dbf trends99_im.xls model.wpd counties.wpd	Fall 2001 update to the 1999 NEI files: Stage 2 refueling program efficiency (stage2dat.xls, 00tables.wpd), Anti-tampering program file name and files (trends99_pointer.dbf), I/M program file name and files (Trends99_im.xls), OBD Schedules (Model.wpd), other future programs (Counties.wpd).
	IMFiles*.*	Source of "cutpoint" file references in the I/M files.
	1999 Updated M6 Input Files*.*	Source for ATP Info.

NMIM Table Name	File Name	Description
Vehicle Tables Folder		
AverageSpeed	vmt99_f_m6_with_8StatesUpdate.DBF	Modeling files for June 2002 update to the 1999 NEI, extracted from the VMT table.
BaseYearVMT	vmt99_f_m6_with_8StatesUpdate.DBF vmt99_n_m6.dbf	Modeling files for June 2002 update to the 1999 NEI for the 50 state and Washington, DC, and Fall 2001 update to the 1999 NEI for Puerto Rico and the Virgin Islands.
VMTGrowth	BaseYearVMT table V-2.xls V-3.xls V-4.xls	VMT estimates for calendar year 2007, calendar year 2020, and calendar year 2030 provided by the EPA from appendix tables in the support documentation for the 2007 Heavy Duty Diesel Rule (HD2007).
VMTMonthAllocation		1999 NEI document "Onroad Source Methodologies" dated 10/2001
Additional Tables Folder		
County	EPA_CHIEF_county_fips.xls	The spreadsheet was retrieved from http://www.epa.gov/ttn/chief/codes/index.html.
CountyMonth	mxmntp99.dbf pr_vi_temps.xls	Fall 2001 update to the 1999 NEI.
State	trends99_pointer.dbf	June 2002 update to the 1999 NEI, and Fall 2001 update to the 1999 NEI. See 1999 Updated M6 Input Files*.* under CountyYear for source for NLEV file references.
DB Documentation Folder		
Not applicable	CountyDB.pdf CountyDB.rtf	County database documentation
SQLScripts Folder		
All NMIM Tables	Load_Data_Tables.sql Load_Data_BaseYearVMT.sql Load_Data_VMTGrowth.sql QA_Script_1.sql QA_Script_2.sql QA_Script_3.sql	Data Loading Scripts Quality Assurance Scripts
Data Files Folder		
Vehicle tables	GenerateVMTMoAlloc.awk	Code to Produce VMT Data
County	Rep_County_Mapping.sql	Representative County Mapping Code