

Motor Vehicle Emission Simulator (MOVES)

User Guide Version, MOVES2010b

Motor Vehicle Emission Simulator (MOVES)

User Guide Version, MOVES2010b

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

Table of Contents

	<u>Page</u>
Preface	<i>i</i>
1.0. Getting Started with MOVES	1
1.1 About MOVES	1
1.2 MOVES Documentation	2
1.2.1 About this Manual	2
1.2.2 Other Documentation and Online Help	2
1.2.3 What's next? Working with MOVES	3
1.3 Installation	4
1.3.1 System Requirements	4
1.3.2 Starting and Testing Your Installation	5
1.4 Executing Example Run Specification	5
1.4.1 Step-by-Step Example Run	6
1.4.2 MOVES Execution Database	6
1.4.3 MOVES Output Structure	7
2.0 Using MOVES	10
2.1 Overview of MOVES User Interface	11
2.2 Navigation Panel	13
2.2.1 Description	14
2.2.2 Scale	15
2.2.2.1 Domain/Scale	15
2.2.2.2 Calculation Type	17
2.2.3 Time Spans	18
2.2.3.1 Time Aggregation Level	19
2.2.3.2 Years	19
2.2.3.3 Months	20
2.2.3.4 Days	20
2.2.3.5 Hours	20
2.2.4 Geographic Bounds	20
2.2.5 Vehicles/Equipment	27
2.2.6 Road Type	30
2.2.7 Pollutants and Processes	31
2.2.7.1 Processes	36
2.2.7.2 Pollutants	36
2.2.8 Manage Input Data Sets	42
2.2.9 Creating and Using Internal Control Strategies	43
2.2.9.1 Adding Strategy Files	44
2.2.9.2 Deleting Strategy Files	44
2.2.9.3 Exporting Strategy Files	45
2.2.9.4 Naming Strategy Files	45
2.2.9.5 Saving and Transferring Strategy Files	45
2.2.9.6 AVFT Strategy Conversion	45
2.2.9.7 Managing On-Road Vehicle Retrofit Data	46

2.2.9.8 Importing Retrofit Data	47
2.2.9.9 Rate of Progress Calculation	48
2.2.10 Output	49
2.2.10.1 Specifying Database, Time Period, and Units in Output	49
2.2.10.1.1 Output Database	49
2.2.10.1.2 Units	50
2.2.10.1.3 Activity	50
2.2.10.2 Specifying Emission Distinctions in Output	51
2.2.10.2.1 Always	52
2.2.10.2.2 For All Vehicle/Equipment Categories	53
2.2.10.2.3 On-Road/Off Road	53
2.2.10.2.4 Estimate Uncertainty	54
2.2.11 Advanced Performance Features	54
2.3 Main Menu Bar	55
2.3.1 File	56
2.3.2 Edit	56
2.3.3 Pre Processing	56
2.3.3.1 Database	58
2.3.3.2 RunSpec Summary	59
2.3.3.3 Tools	60
2.3.3.4 Data Managers (Importers)	62
2.3.3.4.1 Meteorology Data Importer	68
2.3.3.4.2 Source Type Population Importer	68
2.3.3.4.3 Age Distribution Importer	69
2.3.3.4.4 Vehicle Type VMT and VMT Fractions	69
2.3.3.4.5 Average Speed Distribution Importer	71
2.3.3.4.6 Road Type Distribution Importer	72
2.3.3.4.7 Ramp Fraction Importer	73
2.3.3.4.8 Fuel	74
2.3.3.4.9 Fueltype and Technologies	76
2.3.3.4.10 Zone Importer	77
2.3.3.4.10.1 Zone Table	77
2.3.3.4.10.2 ZoneRoadType Table	78
2.3.3.4.10.3 SCCRoadTypeDistribution Table	78
2.3.3.4.11 Links Importer	78
2.3.3.4.12 Link Source Types Importer	79
2.3.3.4.13 Operating Mode Distribution Importer	80
2.3.3.4.14 Link Drive Schedules Importer	80
2.3.3.4.15 Off-Network Importer	80
2.3.3.4.16 I/M Programs Importer	81
2.3.4 Action	82
2.3.5 Post Processing	83
2.3.5.1 Run MySQL Script on Output Database	83
2.3.5.2 Produce Summary Report	85
2.3.5.3 Produce State/County Map	89
2.3.6 Tools	91
2.3.6.1 Multiple RunSpec Creator	92
2.3.6.2 Process DONE Files	96
2.3.6.3 Database Converter	96
2.3.7 Settings	97
2.3.7.1 Configure MOVES	98
2.3.8 Help	99

Appendix A - Using MOVES to Generate Lookup Tables	A-1
Appendix B – Working with the MySQL Data	B-1
Appendix B1 - Linking To MySQL Tables from MS OFFICE 2007	B-1
Appendix B2 – Guide To Linking To MySQL from MS Office 2003	B-18
Appendix C - Running MOVES from the Command Line	C-1
Appendix D - Creating an On-Road Retrofit Input File	D-2
Appendix E - Best Practices	E-1
Appendix F – Stage II Refueling Control Programs	F-1
Appendix G - MOVES Project Level Example	G-1
Appendix H - County Data Manager Example	H-1
Appendix I – MOVES Decoder	I-1
Appendix J – Configuring MOVES	J-1

Preface

MOVES2010b, released in March 2012, and MOVES2010a, released in August 2010, are minor updates to MOVES2010, EPA's state-of-the-art tool for estimating emissions from highway vehicles. EPA released MOVES2010a to allow MOVES users to easily account for emissions under new car and light truck energy and greenhouse gas standards and to benefit from several improvements to MOVES general performance.

MOVES2010a incorporated new car and light truck greenhouse gas emissions standards affecting model years 2012-and-later (published May 7, 2010¹) and updated effects of corporate average fuel economy standards affecting model years 2008-2011.² MOVES2010a included reductions in greenhouse gases associated with those standards in future calendar years, and small reductions in refueling and sulfur-related emissions associated with the reductions in vehicle fuel consumption.

MOVES2010a also included a number of other improvements. Major changes are listed in the table below. The net impact of these changes on criteria pollutant emissions was small. Compared to MOVES2010 (released in December 2009), most regional inventory runs should see an increase in methane emissions and a small decrease in the associated Volatile Organic Compound (VOC) and air toxics emissions. However, comparisons for runs that focus on a particular project or sourcetype may vary.

Instructions for downloading and installing MOVES2010b are available on the MOVES web page <http://www.epa.gov/otaq/models/moves/>. Note that users will find that RunSpecs and input databases developed with MOVES2010 and/or MOVES2010a may need modification to run with MOVES2010b. Regenerate fuelFormulation input strategy files. Output databases will need to be recreated with a new name since several new tables have been added. You should always specify which version of MOVES was used to create emissions results.

MOVES2010b is faster and works better on networks. It is about 10% faster for county inventory runs. Additional debugging features and improvements in error recovery during network faults have been made which make networked operation more efficient. MOVES2010b also allows up to 8 worker processes on an individual computer. Actual benchmark tests have shown that 2 - 4 workers result in significantly improved run times.

Improvements to the data managers make MOVES2010b easier to use. Additional error checks have been added to the County Data Manager (CDM) and the Project Data Manager (PDM) to help prevent run failures due to conflicts between RunSpec parameters and user data. Also, the Alternative Vehicle and Fuel Technologies (AVFT) input has been moved from the Strategies panel to CDM and PDM. This makes data entry consistent with other user inputs and takes advantage of the CDM and PDM error checks.

¹ <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2009-0472-11424>

² <http://www.regulations.gov/#!documentDetail;D=NHTSA-2006-24309-0007> and <http://www.regulations.gov/#!documentDetail;D=NHTSA-2009-0062-0001>

Custom domain improvements may reduce the number of runs needed and increase functionality. The Custom domain option now allows users to define separate zones, with separate Vehicle Miles Travelled (VMT) and some other activity inputs for each zone. Users can also setup a multi-county custom code domain with individual counties defined as separate zones. MOVES2010b output will give emission results separately for each zone. In previous versions of MOVES, users could not specify different activities in different parts of a custom domain or get separate results for different parts of a custom domain. In addition, SCC output option is now fully functional in custom domain runs.

MOVES2010b has added functionality to the emission rates option to make it easier to use. Refueling emissions have been added to the RatePerDistance and the RatePerVehicle tables. In previous versions of MOVES, refueling emissions could only be calculated using inventory mode. The calculation of extended idle emissions in SCC output has been improved. And, the RunSpec options that are not applicable for emissions rates calculations are now grayed-out in the GUI.

More detailed pollutant output has been added. This will improve the use of MOVES results in air quality modeling. Also, Naphthalene now splits into two parts: gaseous and particulate fractions to improve output to air quality modeling.

In MOVES2010b, Air Toxics emissions calculations have been improved. Note that minor changes to standard air toxics coefficients may result in small changes to air toxics emissions.

MOVES2010b has been updated to use newer versions of Java (version 1.7.0) and MySQL (version 5.5.12). The MOVES2010b Installation Suite installs the correct versions of Java and MySQL, the MOVES2010b code and a new default MOVES database. Some changes to MOVES and the MOVES default database will make existing RunSpecs and user input to the CDM and PDM databases created in previous versions of MOVES incompatible with MOVES2010b. Converters have been created to convert those RunSpecs and databases to MOVES2010b format.

In MOVES2010b, new fields, T50 and T90, which provide more detailed measures of fuel volatility, have been added to the default fuel formulation tables. These fields allow for more detailed modeling of specific fuel effects for users who need this capability. However, most users will not need to change field specifications in MOVES, but existing user input databases created with previous versions of MOVES will still need to be converted.

MOVES2010b also includes some other minor model improvements. New counties in Alaska and Colorado created after 2000 have been added to the list of available counties. However, no default data is available for these counties and they are not included in national scale runs. Also, additional warning messages have been added to guide users. The I/M importer was removed from preprocessor menu options and is now only accessible from the CDM and PDM. Fixes to minor errors in certain national scale runs have also been made.

1.0. Getting Started with MOVES

MOVES is the U.S. Environmental Protection Agency's (EPA) Motor Vehicle Emission Simulator. It helps the user to answer "what if" questions, such as "How would particulate matter emissions decrease in my state on a typical weekday if truck travel was reduced during rush hour?" or "How does the total hydrocarbon emission rate change if my fleet switches to gasoline from diesel fuel?" The purpose of the tool is to provide an accurate estimate of emissions from mobile sources under a wide range of user-defined conditions.

In the modeling process, the user specifies vehicle types, time periods, geographical areas, pollutants, vehicle operating characteristics, and road types to be modeled. The model then performs a series of calculations, which have been carefully developed to accurately reflect vehicle operating processes, such as cold start or extended idle, and provide estimates of bulk emissions or emission rates. Specifying the characteristics of the particular scenario to be modeled is done by creating a Run Specification, or RunSpec.

The MOVES model is different from previous EPA mobile source emissions models in that it was deliberately designed to work with databases. With this design, new data that may become available can be more easily incorporated into the model. In addition, MOVES allows and facilitates the import of data specific to a user's unique needs.

The MOVES model includes a "default" database that summarizes emission relevant information for the entire United States. The data for this database comes from many sources including EPA research studies, Census Bureau vehicle surveys, Federal Highway Administration travel data, and other federal, state, local, industry and academic sources. The MOVES team continually works to improve this database, but, for many uses, up-to-date local inputs will be more appropriate, especially for analyses supporting State Implementation Plans (SIPs) and conformity determinations.

1.1 About MOVES

MOVES2010b is the latest version of the MOVES emissions modeling tool. MOVES2010b builds on the functionality of previous MOVES versions: MOVES2004, MOVESDemo, DraftMOVES2009, MOVES2010 and MOVES2010a. MOVES2010b can be used to estimate national, state, and county level inventories of criteria air pollutants, greenhouse gas emissions, and some mobile source air toxics from highway vehicles. Additionally, MOVES can make projections for energy consumption (total, petroleum-based, and fossil-based).

MOVES2010b may be used for official use, although users are not required to do so. Please see the MOVES2010b policy statement available on the EPA's MOVES web site <http://www.epa.gov/otaq/models/moves/index.htm> for EPA's policy on selecting appropriate models for official mobile source emission estimates.

MOVES is distributed free of charge by EPA pursuant to the GNU General Public License (GPL). It is written in Java™ and uses the MySQL relational database management system. Oracle Corporation owns, operates, and supports MySQL, and allows distribution of the database system pursuant to the GNU GPL. The principal user inputs and outputs, and the internal working storage locations for MOVES are MySQL databases. The MOVES model

includes a "default" input database, which uses national data and allocation factors to approximate results for the 3,222 counties in the United States, District of Columbia, Puerto Rico, and the U.S. Virgin Islands. MOVES is capable of modeling emissions for the calendar years 1990 and 1999-2050.

With MOVES2010b, MOVES has been migrated from the 5.1.32 version of MySQL to version 5.5.12 and from the Java Runtime for version 1.6.0_12 to the Java Runtime version 1.7.0.

MOVES is set up to run both a "Master" and one or more "Workers". This allows users to operate MOVES on a single computer system or on a network of computers. See **Appendix J - MOVES Configurations** for more information on configuring MOVES for multicomputer setups.

1.2 MOVES Documentation

The following section highlights the contents of this manual, how best to use the manual, and where additional information may be found.

1.2.1 About this Manual

The MOVES User Guide focuses on operating MOVES software to create and execute Run Specifications (RunSpecs).

Throughout this document, information may be highlighted to make it easier to find solutions to problems or to avoid errors using the following prompts:

⚠ CAUTION! Cautions must be observed to avoid errors in execution or to ensure the intended execution will occur.

💡 NOTE Notes contain important information about the panel being described.

! TIP Tips contain hints for input or better operation of the run.

The MOVES2010b User Guide is accessible as a .pdf file under the **Help** menu in the MOVES interface.

1.2.2 Other Documentation and Online Help

Additional documentation covering the following topics is available for MOVES2010b.

Installation: An Installation Suite is available for MOVES2010b. It guides the user through the MOVES system requirements and the process for installing the MOVES program and associated software.

Software Design: An updated MOVES Software Design and Reference Manual (SDRM) will be available on the MOVES website in 2012. The SDRM will cover the basic concepts and functional design of the software and the underlying MySQL database, including technical specifications for all calculations performed in the model. It is intended to answer more detailed and substantive questions about the MOVES software than those addressed in this guide.

MOVES Database Documentation: More detailed documentation of the MOVES database can be found within the README folder of the database itself. For example, C:\MySQL\data\movesdbyyyymmdd\readme

1.2.3 What's next? Working with MOVES

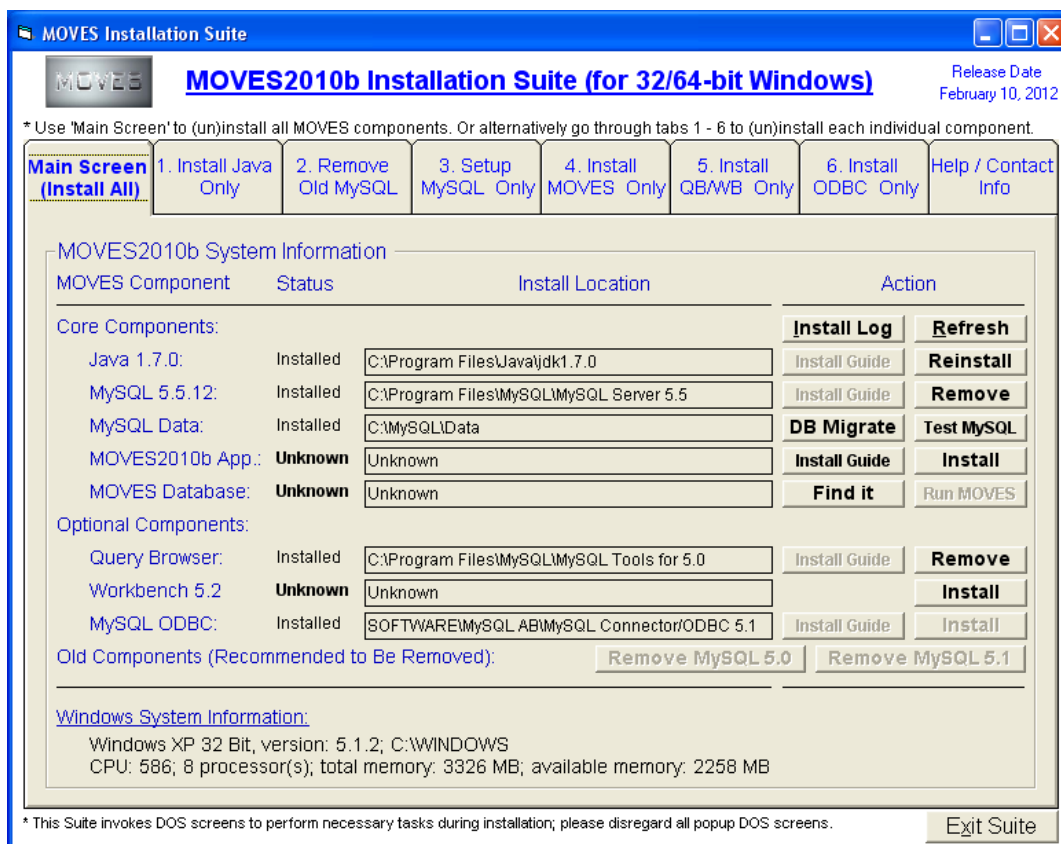
Depending on the status of your installation and how familiar you are with MOVES, you have several options for next steps to get up and running with MOVES.

- ⇒ If you have just installed MOVES or are uncertain about your installation, follow the instructions in **Starting and Testing Your Installation – Section 1.3.2**.
- ⇒ If MOVES is installed and operational on your computer, you should run the example to become more familiar with the tool before moving on. See **Executing Example Run Specification - Section 1.4**.
- ⇒ If you have questions about the MOVES Graphical User Interface (GUI) or executing a run, see **Overview of MOVES User Interface - Section 2.1** of this guide.
- ⇒ If you are ready to begin using MOVES, see **Using MOVES – Section 2**.
- ⇒ If you would like to work through an example, a set of sample scenarios are included in the Appendices.
- ⇒ If you would like to get started using MOVES for regular work, advice and guidance on using MOVES is available on the MOVES website.

The rest of this guide provides information on using the MOVES2010b model.

1.3 Installation

Step-by-step instructions on installation are supplied by EPA in the MOVES2010b Installation Suite. The MOVES2010b Installation Suite consists of the required installation programs (MySQL 5.5.12, Java 1.7.0, MOVES2010b, MySQL Query Browser, and MySQL ODBC).



1.3.1 System Requirements

MOVES is a 32-bit application and has been developed to work with Microsoft Windows XP, VISTA, and Windows 7 environments.

NOTE Installing MOVES with Microsoft Vista or Windows 7 may require changes to the User Access Control (UAC) security settings. The computer(s) used to run either of the MOVES application programs must have at least 512 MB of RAM, although it is recommended that additional memory be available to improve execution times. Because execution run time performance is a constraint with MOVES, a high speed processor(s) is highly recommended.

The MOVES program is open source and is written in JAVA and MySQL.

The MOVES Default database distributed with MOVES2010b requires approximately 1.0 GB of disk storage. MOVES Worker and Output databases are often large, so several additional gigabytes of disk space should be available on all machines used to run either the MOVES Master and/or the MOVES Worker programs. Users who conduct many MOVES runs will want to use late-model, high-performance microcomputer systems.

1.3.2 Starting and Testing Your Installation

After all the necessary components of the MOVES2010b Installation Suite have been executed, test the installation with the following steps.

1. Double-click the **MOVES Master** program icon. When starting the **MOVES Master** program, the **About MOVES** panel will appear.
2. Click the **OK** button to continue.



NOTE This panel identifies the version of MOVES that is in use and includes the version date, the EPA copyright, and a link for the GNU General Public License (GPL) website. Also included is the Computer ID or name. This panel will appear only at start-up.

3. Execute the Example Run Specification (MOVES2010bExample.mrs) as described in the following section.

1.4 Executing Example Run Specification

The MOVES2010b Example Run Specification (**MOVES2010bExample.mrs**) models the entire U.S. for one year (1999) at the most aggregate level. It estimates total energy consumption and emissions of methane and nitrous oxide for the running, start, and extended idle processes for all vehicle (use) types (gasoline, diesel, and CNG transit buses) and roadway types. Vehicle Miles Traveled (VMT) is also estimated.

1.4.1 Step-by-Step Example Run

If MySQL and MOVES2010b have been installed, the MySQL server and the **MOVES Master** program have been started, and the **MOVES Worker** program(s) are operational, the example RunSpec can be executed as follows:

1. Select **File, Open** on the Main Menu Bar.
2. Navigate, if necessary, to the top level of the MOVES directory.
3. Select the **MOVES2010bExample.mrs** file.
4. Select **Output**, then **General Output** on the Navigation Panel, which is the left-side panel. Select or click on Create Database to establish a database into which results should be placed. Select or enter a database name.

NOTE Many MOVES features request that the user create input or output databases. These database names must be consistent with MySQL naming conventions. In general, this means they may contain letters, numbers, "_" (underscore) and "\$". They may not contain spaces, special characters, or be "reserved words" (SQL words such as "select", "where", "delete", etc.). See **Best Practices – Appendix E** for additional advice on naming MOVES databases.

5. Select **Action, Execute** on the Main Menu Bar to start the RunSpec. The GUI will ask you if you want to save the RunSpec before executing. You may choose Yes, No or Cancel. The RunSpec will execute if either Yes or No are chosen, but selecting Cancel will not execute and will allow users to make changes to the RunSpec. The RunSpec may take up to 15 minutes to process.
6. The output will be saved in the MySQL relational database named in Step 4. The output can be reviewed using the Post-Processing menu options described in **Section 2.3.5** or by viewing the database directly using MySQL commands, either through the command prompt window or through MySQL Query Browser.

1.4.2 MOVES Execution Database

After **Execute** has been selected, MOVES begins to compile and populate all the necessary tables in the **MOVES Execution** database. This database is similar in many respects to the default database, but there are several key differences.

The **MOVES Execution** database is the location where conflicts are resolved between the default database and user input databases. First, information is pulled from the **Domain Input Database** on the **Geographic Bounds** panel (see **Section 2.2.4**). MOVES makes note of the tables and key fields within the tables that are imported and uses that to limit what is imported from database tables that are lower in the hierarchy. Added next to the **MOVES Execution** database are user input databases listed on the **Manage Input Data Sets** panel (see **Section 2.2.8**), with the last database listed taking priority over those listed above it. Finally, MOVES uses the default database to populate the remaining tables not provided by the user.

Also, the **MOVES Execution** database contains data in tables that are empty in the default database and additional tables that are not present in the default database. These tables are often not complete. To save memory, much of the additional data is cleared after it is used in calculations. Users can save more of this data by checking one or more **Save Data** boxes on the **Advanced Performance Features** panel (see **Section 2.2.11**).

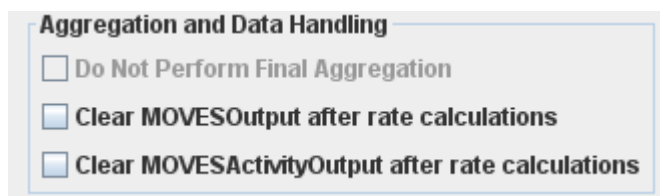
NOTE The **Save Data** process lengthens run time and the tables it produces are often difficult to interpret correctly.

1.4.3 MOVES Output Structure

The output database will typically contain eleven tables:

1. MOVESOutput: This table contains the inventory emission results (emissionQuant) of the run disaggregated by parameters such as Year, Month, Day, Source Type, County, Fuel, Model-Year, Road-type, SCC, and Emission Process.

Caution! If the **Emission Rates** calculation type is selected on the **Scale** panel, the emissionQuant values will represent an intermediate step in the rates calculations rather than the real emissions for that time and place. To reduce the size of the MOVESOutput table, use the **Aggregation and Data Handling** panel on the **Advanced Performance Features** screen to select **Clear MOVESOutput after rate calculations**. The user may also clear the MOVESActivityOutput by selecting **Clear MOVESActivityOutput after rate calculations**.



2. movesactivityoutput: This table provides information on the vehicle activity generated and used in the run. It is disaggregated by parameters such as Year, Month, Day, County, Fuel, Model-Year, Road-type, and SCC. Activity is not distinguished by pollutant and process. If a certain activity type (see **Activity - Section 2.2.10.1.3**) is not needed for the emission processes in a run, it is not generated.

NOTE In the movesactivityoutput table, population always has month, day & hour keys of zero (i.e. “doesn’t matter”) because population is assumed constant in time across an entire year. This scheme reduces table size, but requires care when filtering results and when joining to other tables. Also, if you assign some VMT to a road type, but then do not select that road type in the RunSpec, the population will be lower than it should be. This is because the assigned VMT is not used when calculating population. Users should model all road types (where VMT is allocated) to ensure proper calculations.

- 3. movesrun:** This table contains information about the date and time of the run, information about the run specifications, and the name of the units in which MOVES outputs are represented. These include units for energy (i.e., joules), emissions (i.e., tons), VMT (i.e., miles), and time units (i.e., months, days, hours, etc.).
- 4. moveserror:** This table contains any error messages or diagnostic information that might be generated if the MOVES run is unsuccessful.
- 5. movesworkersused:** This table contains information as to which copy of the MOVES Worker Program processed portions of the run. It is of interest if the run is executed on a multi-computer configuration.
- 6. activitytype:** This table lists the activity types that can be reported in the movesactivityoutput table and provides their activitytypeid. In MOVES2010b, this table lists: distance traveled, source hours, extended idle hours, source hours operating, source hours parked, population, and starts (See **Activity - Section 2.2.10.1.3**).
- 7. moveeventlog:** This table is used by MOVES programmers for storing diagnostic results. It contains no information useful to users.
- 8. rateperdistance:** When **Emission Rates** is selected on the **Scale** panel, the ratePerDistance table stores emissions as rates per distance (e.g. grams per mile) with the units depending on those selected in the run specification. This table includes rates for exhaust and evaporative emissions that occur while vehicles are on “real roads”. These include running loss evaporative emissions, evaporative permeation, and liquid leaks that occur while the vehicle is operating on the road. It also includes refueling emissions for the portion that is allocated to road operation (i.e., fuel consumed during running operation on the road). It does not include rates for starts, extended idle, diurnal and hot soak operation or refueling and permeation emissions associated with a parked vehicle or a vehicle start.
- 9. rateperprofile:** When **Emission Rates** is selected on the **Scale** panel, the ratePerProfile table stores vapor venting emissions from parked vehicles as rates per vehicle (e.g. grams per vehicle). Note that the denominator is the total vehicle population—not just the vehicles that are parked. The **temperature profile id** in this table refers to a particular daily pattern of temperatures, important because vapor venting depends on temperatures in both the current and previous hours.
- 10. ratepervehicle:** When **Emission Rates** is selected on the **Scale** panel, the ratePerProfile table stores emissions from starts and extended idle, and some evaporative emissions (permeation and liquid leaks) from parked vehicles as rates per vehicle (e.g. grams per vehicle). Note that the denominator for national and county level runs is the total vehicle population—not just the vehicles that are parked. However, for project-level runs the denominator for start emission rates is the number of starts in the hour, and the denominator for extended idle emission rates is the vehicle-hours of extended idle activity in the hour.

11. movestablesused: This table contains a list of the tables used when executing the RunSpec and the source database for each table. The numbering of the tableUseSequence is such that lower numbers take priority. Some tables may be listed more than once; this occurs when information comes from both the user and default databases.

12. bundletracking: This table contains information about data that is processed by the MOVES master and workers. It is mainly used by the MOVES developers for tracking MOVES performance.

2.0 Using MOVES

Using MOVES, the user can model various scenarios in order to determine specific emissions profiles. To use MOVES, the user prepares a Run Specification (RunSpec) to define the place, time, vehicle, road, fuel, emission producing process, and pollutant parameters. The RunSpec is an XML file that can be edited and executed manually or with the MOVES Graphical User Interface (GUI). This section of the User Guide gives an overview of the screen layout and navigation functions of the GUI and provides details on how to create and modify a RunSpec.

Running MOVES from the Command Line - Appendix C provides instructions for how MOVES can be executed without running its graphical user interface. This may be useful in situations where repeated or unattended runs are needed, or when another computer program is used to execute MOVES. This "batch mode" or "command line" interface presumes that a MOVES RunSpec file has been prepared.

Although a full range of default data is available in MOVES, the allocation of the default data down to the county level is based on a generalized algorithm and will not be the most recent nor best available local data. Therefore, MOVES is designed to allow the user to customize the model. The primary reasons a user would customize MOVES are:

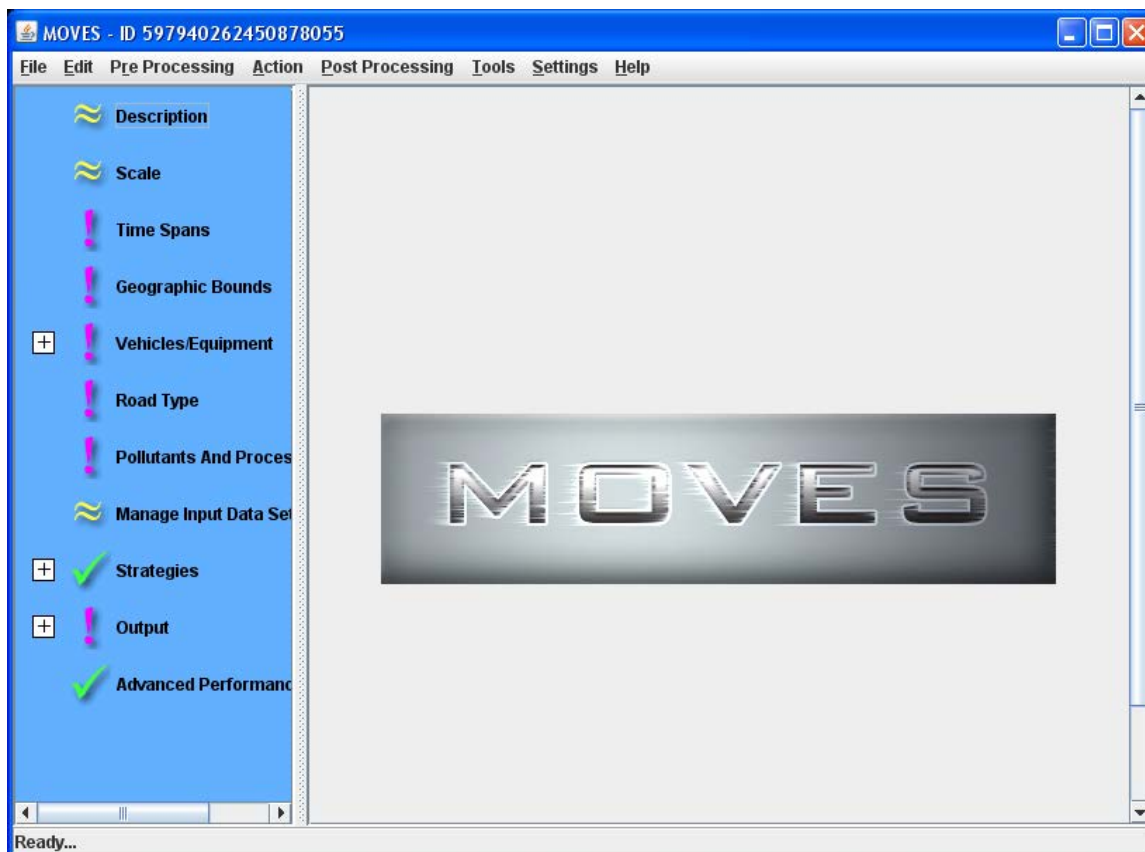
- To better represent conditions and vehicle activity in a local area, especially for use in conformity demonstrations or for SIP purposes; and,
- To alter inputs for "what-if" analysis, such as the use of different I/M or fuel scenarios.

Several components of the model are intended to facilitate customization. These include the **Strategies** procedures described below. MOVES also allows users to provide **User Input Databases** and to use various **Importers** with the **County Data Manager**, and **Project Data Manager** described later in this document.

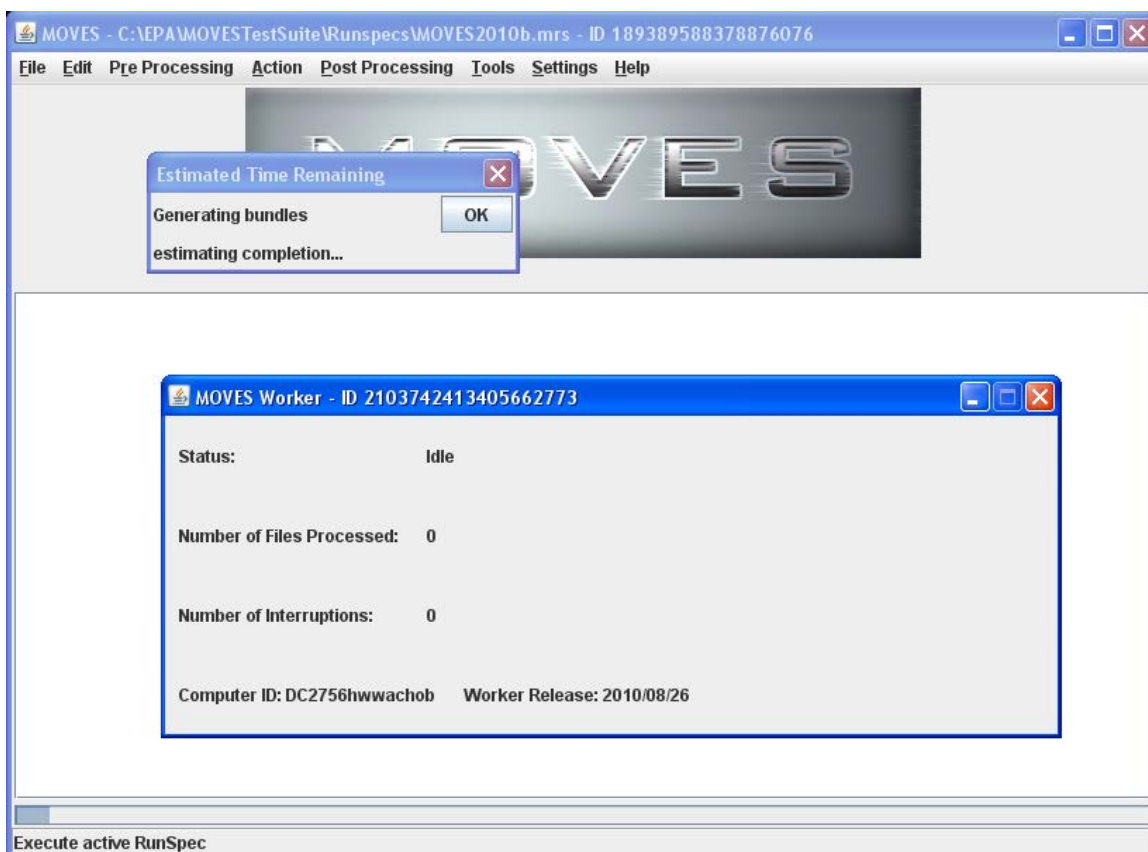
NOTE Many MOVES features request that the user create input or output databases. These database names must be consistent with MySQL naming conventions. In general, this means they may contain letters, numbers, "_" (underscore) and "\$". They may not contain spaces, special characters, or be "reserved words" (SQL words such as "select", "where", "delete", etc.). See **Best Practices – Appendix E** for additional advice on naming MOVES databases.

2.1 Overview of MOVES User Interface

The MOVES Graphical User Interface (GUI) consists of a Main Menu Bar, a Navigation Panel, and a Detail Panel. The Main Menu Bar and Navigation Panel are available on every screen as the user prepares for execution of the RunSpec. When the user selects a menu item from the Navigation Panel, the Detail Panel displays data elements specific to the parameter(s) defined by the menu item, and provides a platform for user input of parameter specifications.



During execution of a RunSpec, a progress indicator will appear on the screen.



The Main Menu Bar will remain available, allowing the user to pause, resume, or stop (cancel) the RunSpec during execution.

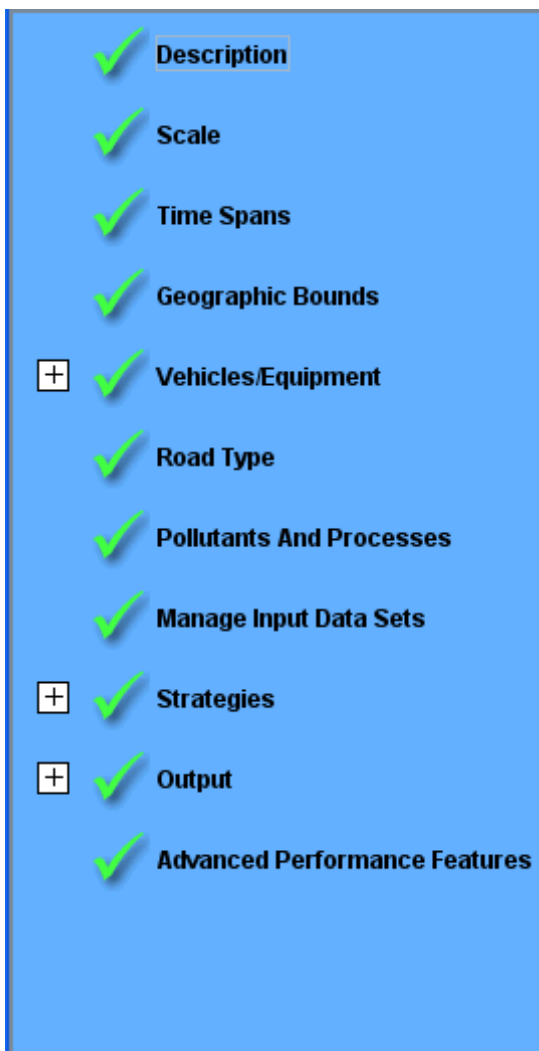
The MOVES model features "mouse hover" user help throughout the model. To use it, the user simply places the mouse over a particular MOVES GUI icon or command and keeps it still. A small help box will appear with a brief text message; for example, the readiness status of a Navigation Panel icon, the keyboard combination required to execute a command from the Main Menu Bar, or a brief description of a Detail Panel icon.



Most panels use buttons and scroll or drop down list boxes, typified by the **Select All**, **Delete**, and **Add** buttons. These buttons will be enabled or disabled based upon selection in the associated list box. For example, a **Delete** button will be disabled until a selection is made in the associated list box.

Note When a selection is identified (e.g., by highlighting one state or county in a **Geographic Bounds** list box), the user must click the **Add** button to add the selection to the RunSpec. The user can consult the associated icon in the Navigation Panel to determine if the parameter has been sufficiently defined. If the parameter icon changes from exclamation point to check mark, the parameter definition is sufficient to allow the RunSpec to be executed.





2.2 Navigation Panel

The Navigation Panel appears on the left side of the MOVES screen and includes parameters the user must consider when setting up a RunSpec.



Selecting an item from the Navigation Panel will open a user interface in the Detail Panel in the center of the MOVES screen. In some cases, the RunSpec parameter listed on the Navigation Panel is split into sub-topics; these items are shown with an icon ( or ) that allows the list of sub-topics to be expanded or collapsed. The user must click on the sub-topic for the user interface to be opened.

The Navigation Panel includes icons that display the readiness status of the various RunSpec parameters. A RunSpec will not be executable if an exclamation mark is shown for any parameter.

Icon	Meaning
	Needs additional user supplied data.
	Sufficiently filled in to run.
	Default data present, but otherwise sufficiently filled in to run.
	Parameter expand/collapse.

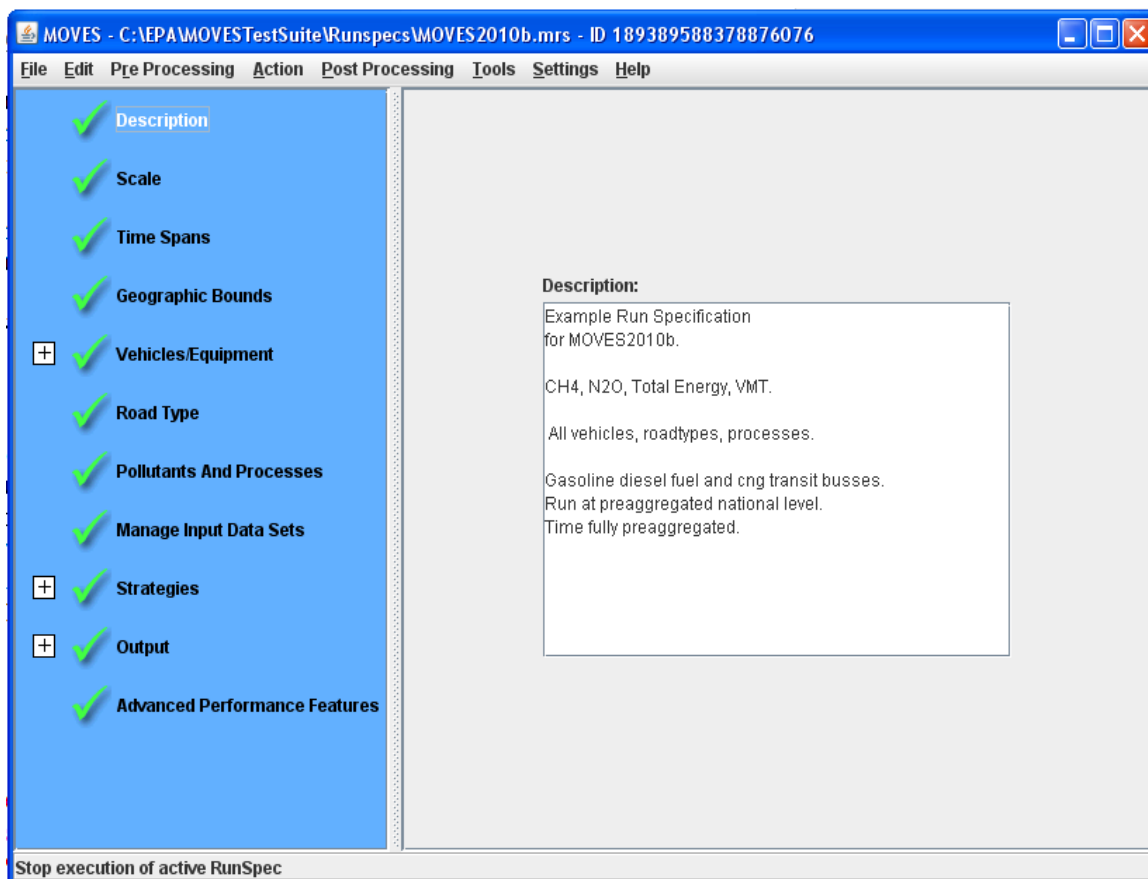
Note Parameters may be visited in any order; however some choices affect the choices available in other screens. In particular, changing the Scale parameters can impact other parameter choices. You may wish to save your RunSpec before switching Scales and to pay attention to the Navigation Panel icons after making any selection to make sure it did not affect another parameter.

Tip The icons shown on the sample GUI in this document do not necessarily indicate which sections/subsections will have default data available.

Tip A RunSpec cannot be executed until all necessary data are supplied.

2.2.1 Description

Select **Description**, the first item on the Navigation Panel, to open a scrollable text window that allows the user to give the RunSpec a particular textual description. This is useful for keeping track of various RunSpecs or providing information for someone else looking at the file (such as "This run produces annual total energy consumption for the nation in 1999"). The text entered in the Description Panel is for documentation purposes only. Its contents are reported for each run in the MOVESRun table.



⚠Caution! Do not use double quote, ampersand, or back slash characters (“, &, or /) as part of the Description. Up to 5,000 characters of text may be entered to describe the RunSpec.

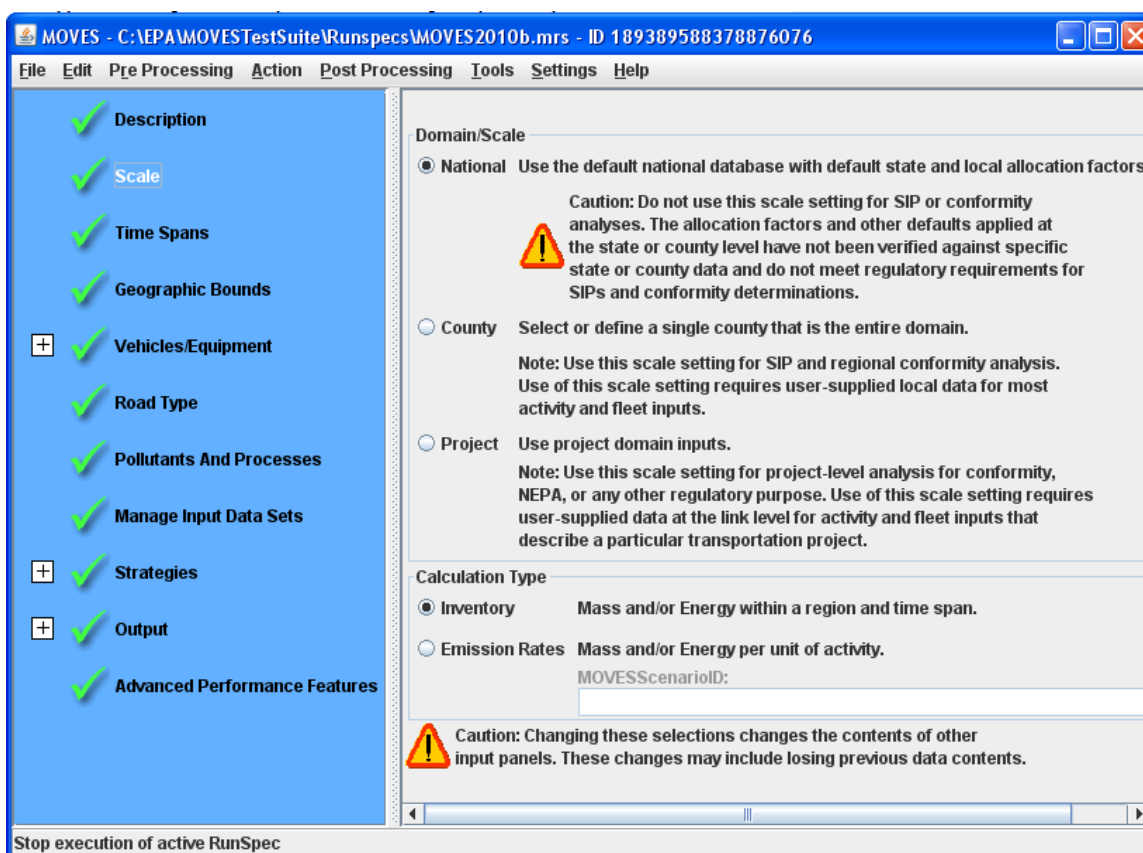
!Tip The default Description is blank and the MOVES model can be run without a Description. However, it is considered a best practice to carefully describe each and every version of a RunSpec. This will assist in documenting the purpose of that particular MOVES run. See **Best Practices – Appendix E** for additional information.

2.2.2 Scale

Select **Scale** on the Navigation Panel to choose the level of detail represented by the MOVES input database and whether the model will calculate emissions *sum* or emissions *rate* data.

2.2.2.1 Domain/Scale

National Domain/Scale is the default selection in MOVES. If **National Domain/Scale** is selected, data collected on a nation-wide level is apportioned or allocated to states or counties. This data will differ from data collected for a specific state or county. For example, consider vehicle miles traveled. If using the **National Domain/Scale**, the primary input is national VMT data which is then allocated to a county or state. The allocation does not take into account factors that may differ between areas of the country (e.g. age distribution). Consequently, a model run for two states or counties that uses the **National Domain/Scale** may not provide an accurate portrayal of specific emission differences between these counties or states that would occur due to dissimilar vehicle age distributions or other factors. For these reasons, the **National Domain/Scale** cannot be used by states for preparing SIP or conformity analyses.



For a finer level of detail about a particular area, the user can choose the **County Domain/Scale**. With this scale choice, the model will replace national default allocations with user-supplied data. Only one year and one county (or custom domain) can be selected in the **Time Span** and **Geographic Bounds** panels, respectively. By supplying local data through the County Data Manager, you can provide more accurate information about a particular state or county than would be provided using the **National Domain/Scale**. The **County Domain/Scale** is intended to be used when doing SIP or regional conformity analyses.

Project Domain/Scale is the finest level of modeling in MOVES. It allows the user to model the emission effects from a group of specific roadway links and/or a single off-network location. The definition of a roadway link is a section of any road where a vehicle is moving for more than three seconds. An off-network location is an area of activity that is not a roadway, for example a parking lot where vehicle starts and extended idling emissions are produced. The use of the Project Domain/Scale requires the user to completely define the individual project (i.e., specify all individual roadway links and/or the off-network area). All of the project level data is entered in the Project Data Manager. If specified correctly, the MOVES Project Domain/Scale will utilize MOVES emission rates and other factors to correctly calculate emission inventory results for the user's defined project.

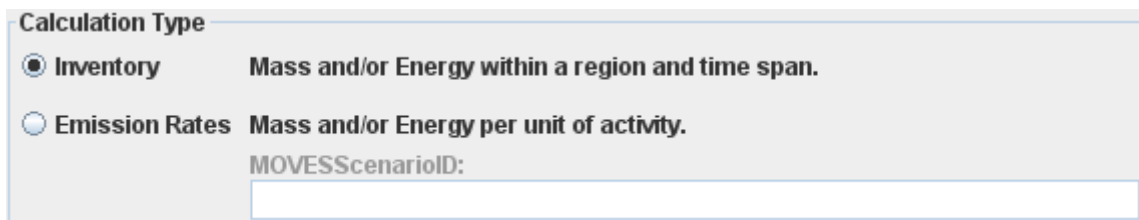
Note MOVES2010b is not capable of modeling any evaporative emission processes when using **Project Domain/Scale**. EPA plans to add this feature in future versions of MOVES.

Note that switching scales is a major change to the RunSpec. It affects the operation of other Navigation Panel items and may cause previous RunSpec specifications to be changed or lost. You may wish to save your RunSpec before switching scales. Also, the choice the user makes on the **Domain/Scale** panel affects the selections that will be presented in the **Geographic Bounds** detail panel. These differences are covered in greater detail in **Geographic Bounds - Section 2.2.4**.

2.2.2.2 Calculation Type

In this section of the panel, you can choose the type of calculation that will occur in the RunSpec. MOVES will calculate the quantity of emissions and/or energy used within a region and time span if the user selects the **Inventory** button. This output is stored in the MOVESOutput and the Movesactivityoutput tables.

The rate at which emissions occur (the mass and/or energy per unit of activity) is calculated if the user selects the **“Emission Rates”** button. This output is stored in the RatePerDistance, RatePerProfile and RatePerVehicle Tables.



Calculation Type

☒ **Inventory** Mass and/or Energy within a region and time span.

☐ **Emission Rates** Mass and/or Energy per unit of activity.

MOVESScenarioID:

If you select Emission Rates, you must assign a MOVESScenarioID which will be used in the rates tables. The MOVESScenarioID should be a unique identifier for the scenario for which the rates apply.

See **Appendix A - Using MOVES to Generate Lookup Tables** for more information on defining scenarios.

⚡ Caution! Do not type in a Scenario ID longer than 40 characters.

⚡ Caution! Do not use double quote, ampersand, or back slash characters (“ , & , or /) as part of the MOVES Scenario ID.

🔗 Note Calculating **Emission Rates** requires more run time and more output space than inventory calculations, so this choice should be selected with care. See **Appendix A - Using MOVES to Generate Lookup Tables** for advice on using the Emission Rates option to develop a “lookup table” of rates.

🔗 Note While activity is “divided out” in the **Emission Rates** output, the amount of time spent driving affects the evaporative emission rates. Therefore, it is important to input realistic VMT, Population, Average Speed Distribution and Road Type Distribution information.

Note If **Emission Rates** is selected as the **Calculation Type**, then several other panels are affected:

1) If **National Domain/Scale** is selected, only **Zone & Link** can be chosen in the **Region** section of the **Geographic Bounds** panel, or 1b) if **County or Project Domain/Scale** is selected, only **Zone & Link** or **Custom Domain** can be chosen;

2) The **Distance Traveled** and **Population** boxes on the **General Output** panel are automatically checked; and

3) The **Road Type** and **Emission Process** boxes are automatically selected on the **Output Emission Detail** panel.

2.2.3 Time Spans

MOVES can be set to model specific time periods by selecting **Time Spans** on the Navigation Panel. Clicking **Time Spans** will open the panel shown below.

This panel is divided into five sections with boxes, buttons, or drop-down menus in each, allowing the user to select specific aggregation levels, years, months, days, and hours. These panel sections are used to define the time period for which emissions will be modeled in the RunSpec. In the screenshot depicted above, the user has specified that the RunSpec should calculate emissions for the two hours from 10 am to noon on a typical January weekday in the year 2000. The emissions for each hour will be calculated separately.

2.2.3.1 Time Aggregation Level

Click in the **Time Aggregation Level** section to set the level of pre-aggregation that is desired. Only one choice can be selected. The default level is **Hour** and implies no pre-aggregation of the MOVES data by time. If the user chooses a longer aggregation level time period such as **Year**, **Month**, or **Day**, the model will pre-aggregate (i.e., compute a weighted average of) all underlying MOVES internal data that are differentiated by hour (e.g., temperatures, VMT distributions, etc) prior to execution of the run. For example, if the user chooses **Month**, the model will average the temperatures of all selected days and hours into an average **Month** set (it may be a set because the temperatures will not necessarily be averaged by geography unless that has also been pre-aggregated), and perform the simulation with these average values. Pre-aggregation sacrifices precision to improve model run time.

Note Once the user has selected a higher aggregation level than **Hour**, the model's GUI will automatically fill in the required lower GUI inputs. For example, if the user selects the **Month** button in the **Time Aggregation Level** panel, the model will fill in all of the hours and days input. After the initial automatic selection, the user may de-select particular hours, days, or months. If such a de-selection is done, the user will end up with results that are based on aggregations that do not include de-selected hours, days, or months. For example, if the user selects **Months** in the **Time Aggregation Level** panel and de-selects **Weekends**, the final emission result will represent a monthly aggregation that includes **Weekdays** only.

Note The proper levels of time aggregation for SIP and conformity analysis have been addressed in guidance documents.

Caution! Because of non-linearity in the general MOVES algorithm, differences may arise between aggregated results and non-aggregated results. For example, the emission results from a run where all 24 hours are selected and the **Time Aggregation Level** is set to **Hour** may not match the results from a run where the **Time Aggregation Level** is set to **Day**.

2.2.3.2 Years

Select a calendar year(s) in the **Years** section and click on the **Add** button. Select a year by clicking the black triangle to see a drop-down list of calendar years and select an individual year. Click on **Add** to have that year appear in the **Year** selection pane. This can be repeated to select as many years as desired if **National Domain/Scale** has been chosen. However, if **County or Project Domain/Scale** was chosen on the **Scale** panel, only 1 year can be selected in the **Year** pane. Use the **Remove** button to deselect years.

Tip At least one calendar year must appear in the **Years** Selection panel to obtain a valid **Time Spans** input.

2.2.3.3 Months

Click one or more individual months to model to select the appropriate boxes in the **Months** section. At least one **Month** box must be selected. Click the **Select All** button to select all of the months. Similarly, the **Clear All** button removes all of the previously chosen months.

Note If the **Project Domain/Scale** is selected, the RunSpec may cover only a single month.

2.2.3.4 Days

Click one or more kinds of days of the week to model to select the appropriate boxes in the **Days** section. At least one kind of **Day** box must be selected. Click **Select All** button to select all of the days. Similarly, the **Clear All** button removes all of the previously chosen day types.

Note If the **Project Domain/Scale** is selected, the RunSpec may cover only a single type of day.

2.2.3.5 Hours

The default time resolution for MOVES at both **National** and **County Domain/Scale** is hourly, with hours expressed in military time ranging from midnight - 12:59 am (expressed as 00:00 - 00:59) to 11 pm - 11:59 pm (23:00 - 23:59). Use the drop down menu to select the appropriate Start and End hours from the list. Click the **Select All** button to select all of the hours of the day. Similarly, the **Clear All** button removes all of the previously selected hours of the day.

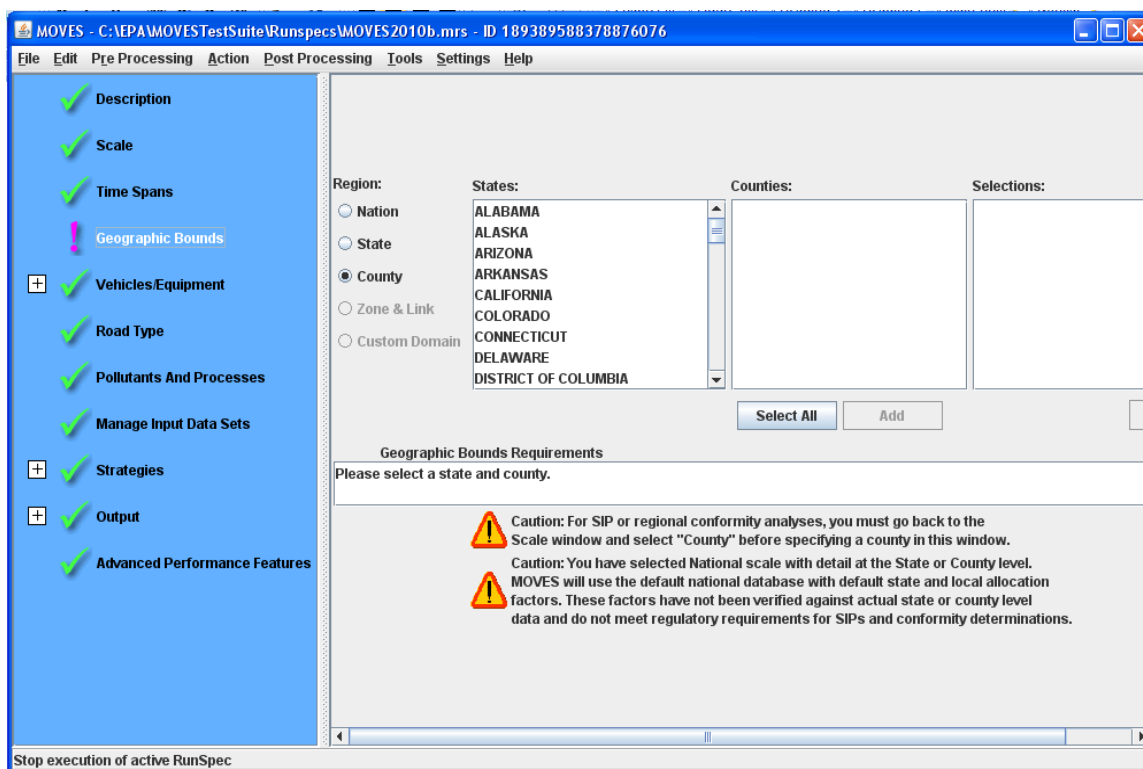
Tip The times selected are relative to the time zone so that 7:00 to 9:59 AM is 7:00 to 9:59 AM in each selected county-state combination.

Tip If only one hour of output is desired, select the same entry for start time and end time (i.e., 0-0:59 and 0-0:59). This will produce one hour of output.

Note The hours selected are run for all chosen days, so it is not possible, for example, to model only from 11:00 PM on Friday to 01:59 AM on Saturday. It is also not possible to run the model for a group of months that span a year end. That is, the user cannot run the model for just December of 2003 through January 2004. However, the model can be run multiple times with different RunSpec time spans to accomplish these tasks, or it can be run for multiple days or years and then manually post-processed to eliminate the un-needed times.

2.2.4 Geographic Bounds

Selecting **Geographic Bounds** allows the user to define the region to model. The options available on this panel depend on the choice of **Domain/Scale** and **Calculation Type** (see **Scale - Section 2.2.2**). If the user has chosen **Inventory** calculations at the **National** scale, the following screen will appear:



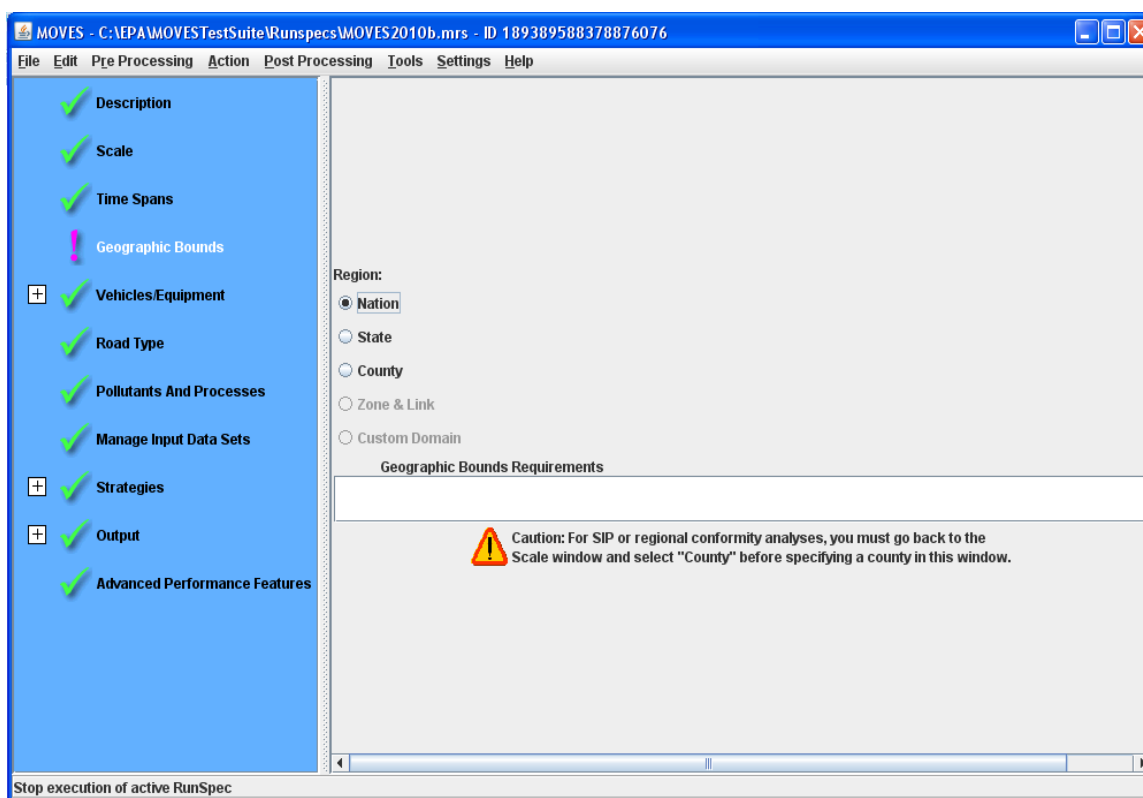
Three buttons, **Nation**, **State** and **County** are normally available. Choose the one appropriate for your desired run.

⚠ Caution! Your choice of "Region" will impact your results. If you choose the **Nation** or **State** input options, the model will pre-aggregate (i.e., compute a weighted average of) all underlying data that is a function of geography (temperatures, road types, etc) and execute the "National" or "State" run as if it were a single county run. Thus, a run at "Nation" or "State" level will be faster than a "County" level run for the same area, but it will be less accurate.

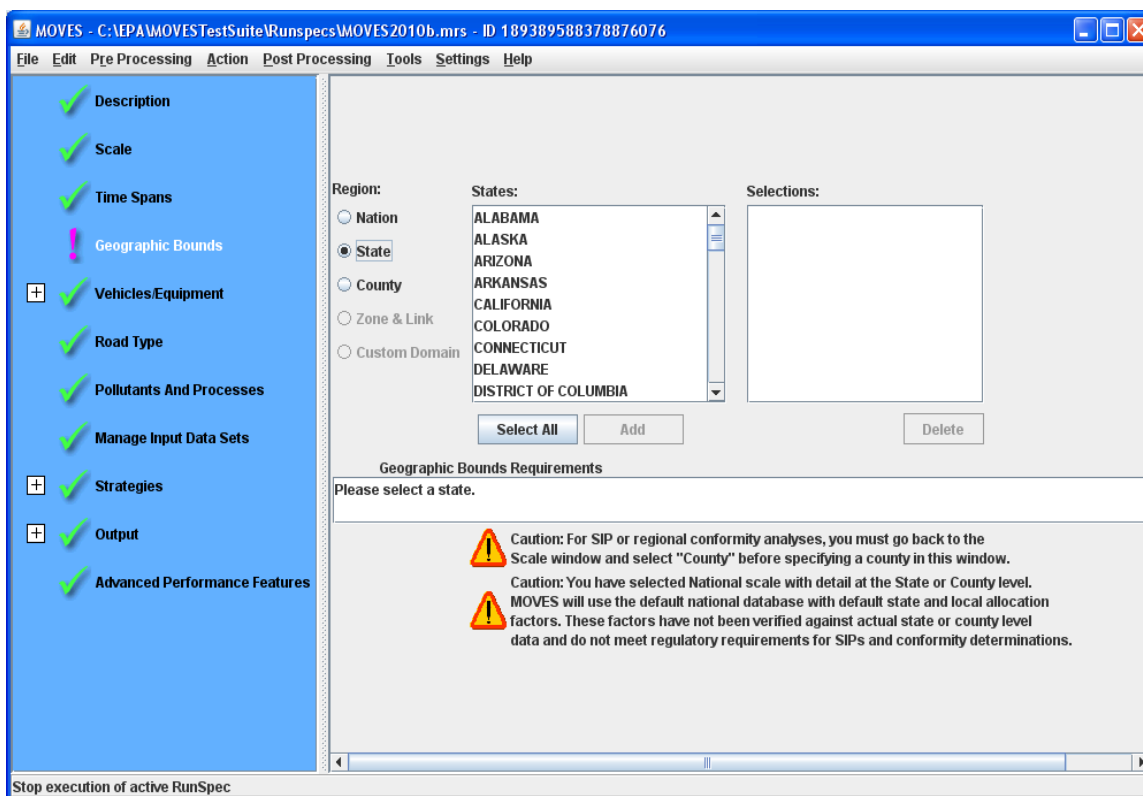
For example, if you choose **State** and **Michigan**, the model will average the temperatures of all Michigan counties into a single average set (it will be a set because the temperatures will not necessarily be averaged by time) and perform the simulation with these average values. The report "MOVES2004 Validation Results" includes a sensitivity analysis of different pre-aggregation levels. An alternative method of computing a state simulation is to select **County Region** and then selecting all the individual counties in the desired state. If you choose this option, no pre-aggregation will be done and the model will execute separate simulations for each county in the particular state. This option will likely produce a slightly different emission result than if the geographic specific data were first aggregated and then used because of non-linear calculations in some algorithms.

⚠ Caution! Be advised that if an entire state or nation is run at the county level, execution times may be quite long. For such runs, we generally recommend multiple-computer processing.

Nation: Choose **Nation** to run scenarios and compute emission inventory results for all counties/parishes in the United States and Territories. The **Nation** button is generally chosen if the user wishes to create a simple national U.S. emission inventory.



State: Choose **State** to run scenarios and compute emission inventories for particular States or Territories within the United States. This panel has two parts (**States** and **Selections**) and buttons for choosing the appropriate selections.



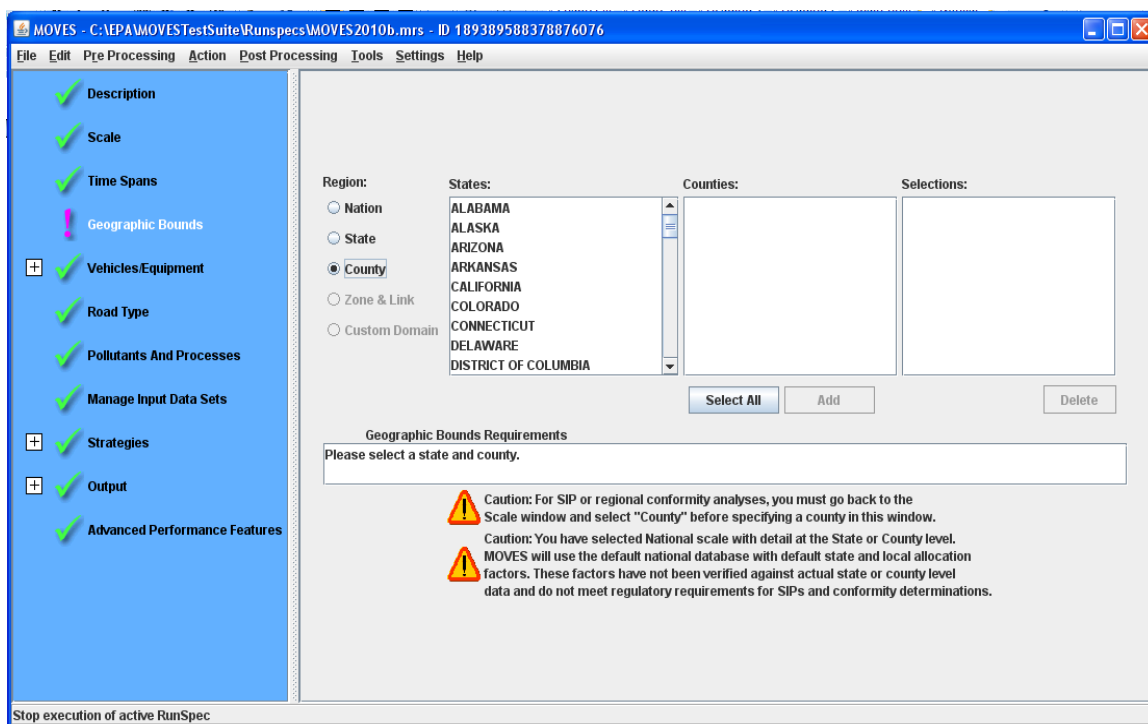
To choose the desired state(s):

1. Scroll to desired state in **States** box and click on it to highlight. Click the **Add** button under box. State will appear in the **Selections** box.
2. Click the **Select All** button to choose all U.S. states and territories available.

To remove a previously selected state, highlight it in **Selections** box and click the **Delete** button.

Note The **Add** and **Delete** buttons are inactive if no states are highlighted.

County: Choose **County** to run scenarios and compute emission inventories for specific counties within a state. If the **County** button is selected, a new bounds panel will show in the Detail Panel.



The process for selecting a specific county is similar to selecting a state, outlined above.

When using the **County** Domain/Scale and **Inventory** calculation type, the **Region** portion of the **Geographic Bounds** detail panel indicates **County** by default, and the user must specify the state and county in the manner detailed above.

When using the **Project** Domain/Scale and **Inventory** calculation type, the **Region** portion of the **Geographic Bounds** detail panel indicates **County** by default, and the user must specify the state and county in the manner detailed earlier.

When a user selects the **Emission Rates** calculation type on the **Scale** panel, the **Geographic Bounds** panel allows a choice of **Zone & Link** at the **National** scale, and **Zone & Link** or **Custom Domain** at the **County** and **Project** scales.

When either the **County** or **Project** is chosen on the **Scale** panel, the user can also define a "custom county" by selecting the **Custom Domain** option in the **Region** portion of the **Geographic Bounds** panel, as shown in the screen shot below.

MOVES - ID: 8235028274129369176

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description
☒ Scale
☐ Time Spans
☐ Geographic Bounds
☒ Vehicles/Equipment
☐ Road Type
☐ Pollutants And Processes
☒ Manage Input Data Sets
☒ Strategies
☒ Output
☒ Advanced Performance Features

Region: ☐ Nation ☐ State ☐ County ☐ Zone & Link ☒ Custom Domain

Generic County
 State ID: 99
 County ID: 1 1-999, labels the county within a state.
 Description:
 GPA Fraction: 0.0 Fraction of county within a fuel Geographic Phase-in Area
 Bar. Pressure: inHg (avg. for low altitude is 28.9, avg. for high is 24.6)
 Vapor Adjust: 0.0 Refueling Vapor Program Adjustment Fraction
 Spill Adjust: 0.0 Refueling Spill Program Adjustment Fraction

Domain Input Database
 The Project domain scale requires a database of detailed data.
 Server:
 Database: Refresh Enter/Edit Data

Geographic Bounds Requirements
 Please select a domain database.

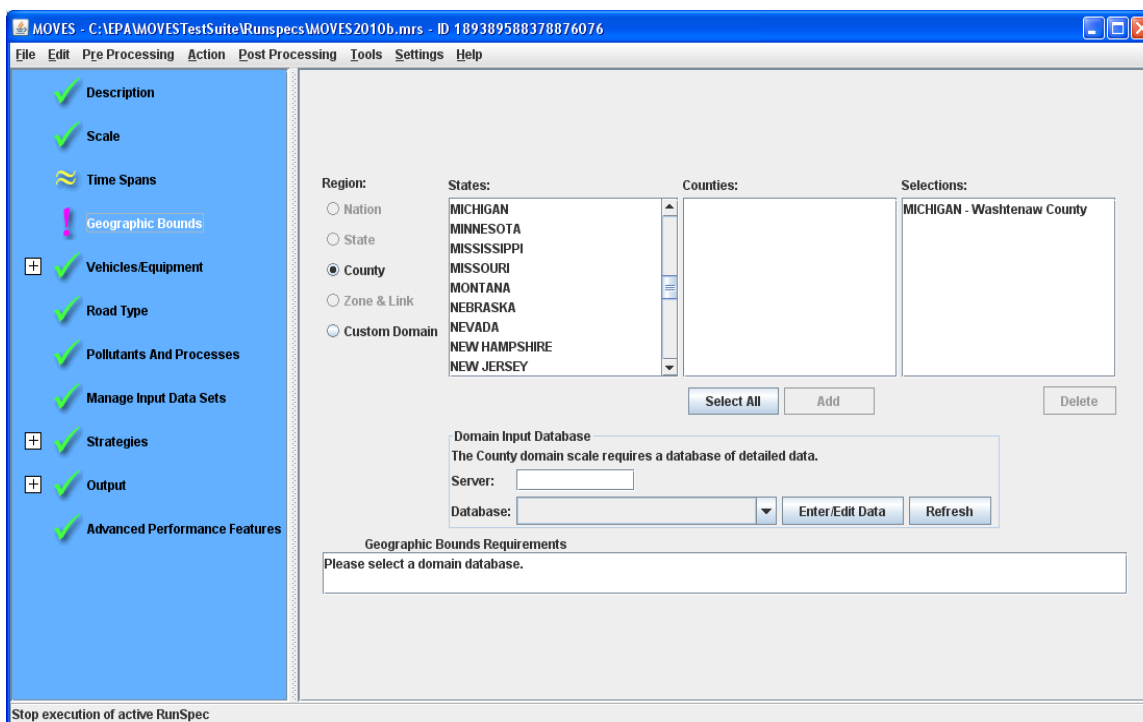
Ready...

In this case, the user must provide a short county identifier (1-999) that will combine with the state ID (99 for generic) to form the standard 5 digit county identifier used throughout MOVES. In addition, the user must provide a description and GPA (Geographic Phase-in Area) fraction. The Geographic Phase-in Area refers to a group of counties in the western U.S. that had special gasoline sulfur requirements under Tier 2 regulations (see 65 Fed. Reg. 6755-6759 for details on the GPA). The user must also provide the Barometric Pressure (in inches of mercury, in Hg) and the Vapor and Spill Adjustment factors, which describe the Stage II Refueling program in the area.

Note Barometric Pressure must be indicated by the user for two reasons: 1) it is a required input for some MOVES calculations; and 2) the area is assigned a “Low” or “High” altitude depending on the user’s input (areas with pressure less than or equal to 25.8403 are high altitude; areas with pressure greater than 25.8403 are low altitude).

Tip A user might want to use the **Custom Domain** option to represent an area that encompasses a portion of a county, multiple counties, or an area that crosses state boundaries (a nonattainment area may have these characteristics).

When either the **County** or **Project** is chosen on the **Scale** panel, the **Geographic Bounds** panel will contain an area in which to define the **Domain Input Database** for the model, as shown in the following screenshot.



For both the **County** and **Custom Domain option**, the user must specify the user-supplied database that will contain county-specific data. For Project scale, a database of detailed information on the project is required (see **Data Managers (Importers) - Section 2.3.3.4**). In most cases, this database will be located on the server "localhost" (generally the user's own machine). However, the user can specify a different host server in the **Server** box. After specifying a server, identify a database to receive the data that will be imported. If a database has already been created, it can be selected by clicking on the drop-down arrow adjacent to the **Database** box and making a selection from the drop-down list. If the database has not been created or if database changes must be made, click the **Enter/Edit Data** button to open the **County Data Manager**.

!Tip Be sure to fill out all panels and fields to define the RunSpec before using the **County Data Manager** or **Project Data Manager**. The selections in the RunSpec are used by the **County Data Manager** to define the data needed for the county data to be complete, and to filter the data used when creating export or template files.

⚡Caution! Defaults that are exported from the MOVES database are generally not appropriate for SIP or conformity analyses. See MOVES Policy Guidance document for more information.

🔗 Note A database created for a specific county by the County Data Manager can't be used as the Custom Domain Input database.

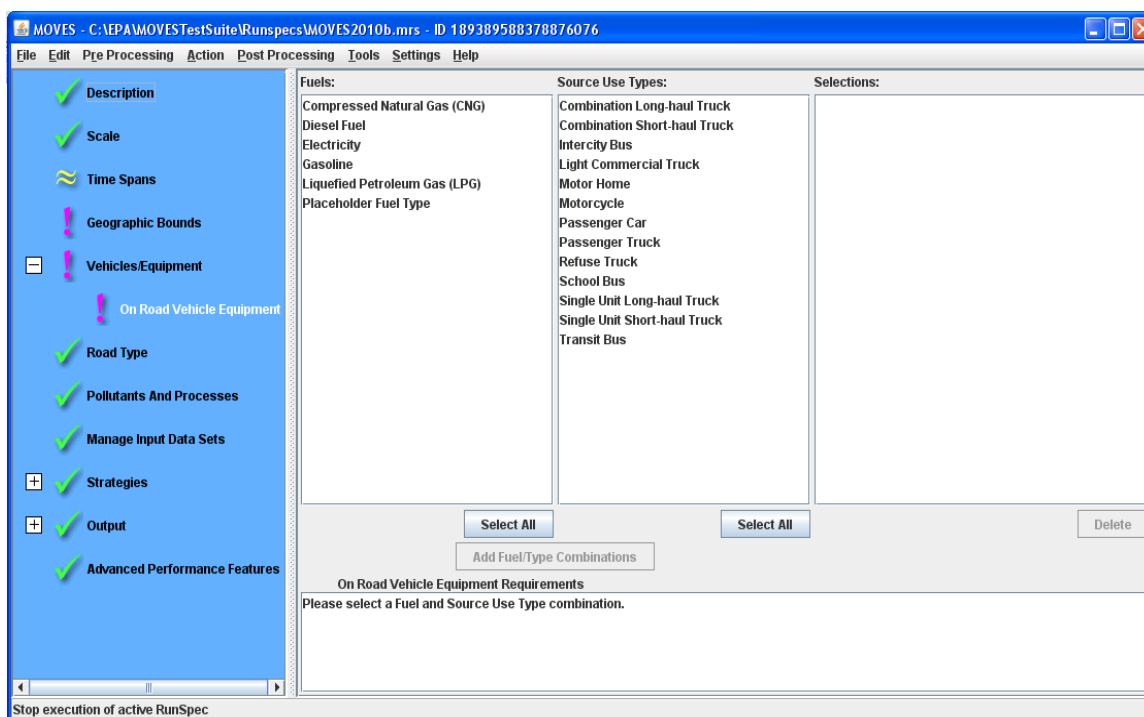
🔗 Note If **Custom Domain** is selected, the **County Data Manager** will not export any default data; therefore, the required information is necessary to use this option.

The user can clear the selected database and update the list of available databases by clicking the **Refresh** button.

The **Geographic Bounds** panel includes the text box, **Geographic Bounds Requirements**, which defines what is expected of the user on the panel.

2.2.5 Vehicles/Equipment

To select which on-road vehicles are to be modeled, click on **Vehicles/Equipment** in the Navigation Panel. This will open the **On Road Vehicle Equipment** Detail Panel. Two lists (**Fuels** and **Source Use Types**) appear to the left of this panel to allow distinct selections for the vehicles/equipment.



1. Click and highlight the **Fuels** choice or click the **Select All** button to choose all the choices.
2. Click and highlight the **Source Use Types** choice or click the **Select All** button to choose all the choices.
3. Click **Add Fuel/Type Combinations** button to move the selected choices to the **Selections** box.

To clear highlighted selections from Selections box, click **Delete**.

Note No default selection will appear on this panel, and the model cannot be run without a selection made.

Note The **On Road Vehicle Equipment** panel contains a small subpanel at the bottom that reminds the user that they are required to select a Fuel and Source Use type. This panel disappears after a valid **Fuel** and **Source Use Type** selection is made. If a selected combination is not in the database, the subpanel will notify the user that the combination is invalid (e.g. “Diesel fuel/Motorcycle combination is not in the database”). These non-existent combinations do not need to be removed from the RunSpec, but no results are reported for such vehicles.

Note Source use type is a combination of body style and how the vehicle is used. For example, long haul and short haul trucks will tend to be very similar in size and design, but the way they are used defines their source use type. However, the use of the vehicle can affect the types of vehicles in the classification. For example, light commercial trucks would include panel vans (without windows) that would not normally appear in the passenger truck category, even though both vehicles are four tire trucks.

Since the size and design of some categories are similar, their emission impacts will also be similar. This makes it less critical that you be able to discern the differences between long and short haul trucks, as long as you have accurate estimates for total populations and vehicle activity for that general classification of truck.

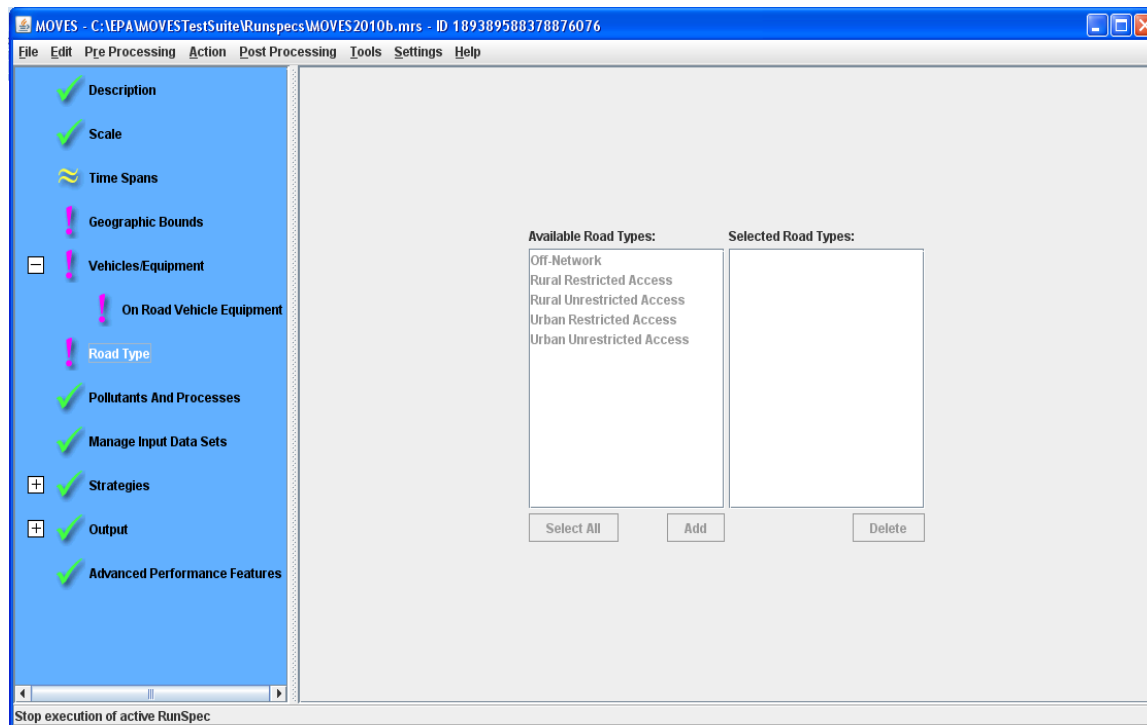
One exception to that thinking is long haul combination trucks. These trucks are subject to federal rules about rest periods and MOVES estimates how long these vehicles are stopped and idling during rest periods. This extra idling can be a significant contribution to vehicle emissions.

Below are the Source Use Types and their descriptions:

Source Type ID	Source Use Type	Description
11	Motorcycle	Vehicles with less than four wheels.
21	Passenger Car	Four wheel, two axle vehicles whose primary function is passenger transport.
31	Passenger Truck	Four wheel, two axle trucks whose primary functional design is for cargo, but are used primarily for passenger transport.
32	Light Commercial Truck	Four wheel, two axle trucks used primarily for cargo transport.
41	Intercity Bus	Passenger vehicles with a capacity of 15 or more persons primarily used for transport between cities.
42	Transit Bus	Passenger vehicles with a capacity of 15 or more persons primarily used for transport within cities.
43	School Bus	Passenger vehicles with a capacity of 15 or more persons used primarily for transport of students for school.
51	Refuse Truck	Trucks primarily used to haul refuse to a central location.
52	Single Unit Short-haul Truck	Single unit trucks with more than four tires with a range of operation of up to 200 miles.
53	Single Unit Long-haul Truck	Single unit trucks with more than four tires with a range of operation of over 200 miles.
54	Motor Home	Trucks whose primary functional design is to provide sleeping quarters.
61	Combination Short-haul Truck	Combination tractor/trailer trucks with more than four tires with a range of operation of up to 200 miles.
62	Combination Long-haul Truck	Combination tractor/trailer trucks with more than four tires with a range of operation of over 200 miles.

2.2.6 Road Type

If any vehicle has been selected (see **Vehicles/Equipment - Section 2.2.5**), the **Road Type** panel becomes available on the Navigation Panel, allowing the selection of road type. All **Road Type** panel controls are disabled otherwise.



!Tip You must select at least one road type.

1. Click and highlight the desired **Road Types** from the list.
2. Click the **Select All** button to select all **Road Types** in list.
3. Click the **Add** button to move choice to the **Selected Road Types** box.

Click the **Delete** button to clear the highlighted selections.

🔗 Note The list of **Road Types** is the complete list of roadway types present in the underlying MOVES database. The default database has **Road Types** that represent urban and rural driving on roads with restricted and unrestricted vehicle access. Restricted access roadtypes are usually used to model freeways and interstates; ramps are considered part of restricted access roadtypes. The **Ramp Fraction** tab of the CDM (see **Data Managers (Importers) - Section 2.3.3.4**) will only become available if an unrestricted road type (i.e. 2 or 4) is selected.

🔗 Note **Off Network** is automatically selected when start or extended idle processes are selected on the **Pollutants and Processes** panel. All **Road Types** are automatically selected when any evaporative or refueling processes are selected on the **Pollutants and Processes** panel.

!Tip All **Road Types** in an area on which VMT is allocated should be selected to correctly calculate population.

⚠Caution! Selected **Road Types** may or may not exist in the geographic bounds of the RunSpec. For example, a county may have no urban roads. MOVES will display results only for road types that exist in the selected geographic area.

2.2.7 Pollutants and Processes

To select the pollutants and processes to include in the RunSpec, choose **Pollutants and Processes** on the Navigation Panel. A matrix will appear in the Detail Panel, with **Pollutants** listed as rows and **Processes** listed as columns. When a pollutant/process combination is selected by clicking a check box, it is included in the RunSpec. When the RunSpec is run, the model will compute emissions for that pollutant/process combination.

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor Venting	Evap Fuel Leaks	Crankcase Running Exhaust
<input checked="" type="checkbox"/> Total Gaseous Hydrocarbons	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Non-Methane Hydrocarbons	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Non-Methane Organic Gases	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Total Organic Gases	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Volatile Organic Compounds	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Carbon Monoxide (CO)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Oxides of Nitrogen (NOx)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Ammonia (NH3)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Nitrogen Oxide (NO)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Nitrogen Dioxide (NO2)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Nitrous Acid (HONO)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Sulfur Dioxide (SO2)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary Exhaust PM10 - Total	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM10 - Organic Carbon	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM10 - Elemental Carbon	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM10 - Sulfate Particulate	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM10 - Brakewear Particulate			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
<input checked="" type="checkbox"/> Primary PM10 - Tirewear Particulate				<input checked="" type="checkbox"/>				
<input checked="" type="checkbox"/> Primary Exhaust PM2.5 - Total	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM2.5 - Organic Carbon	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM2.5 - Elemental Carbon	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM2.5 - Sulfate Particulate	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Primary PM2.5 - Brakewear Particulate			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
<input checked="" type="checkbox"/> Primary PM2.5 - Tirewear Particulate				<input checked="" type="checkbox"/>				
<input checked="" type="checkbox"/> Total Energy Consumption	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
<input checked="" type="checkbox"/> Petroleum Energy Consumption	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
<input checked="" type="checkbox"/> Fossil Fuel Energy Consumption	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
<input checked="" type="checkbox"/> Brake Specific Fuel Consumption (BSFC)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
<input checked="" type="checkbox"/> Methane (CH4)		<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Nitrous Oxide (N2O)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Atmospheric CO2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> CO2 Equivalent	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Benzene	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Ethanol	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> MTBE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Naphthalene Particle	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> 1,3-Butadiene	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Formaldehyde	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Acetaldehyde	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Acrolein	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Naphthalene gas	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

There is no limit to the number of boxes that may be checked; however, at least one box must be checked to produce a valid MOVES RunSpec input.

🔗 Note It may be necessary to scroll the **Pollutants and Processes** panel to see all of the Process columns or Pollutant rows.

🔗 Note Checking the box on the left side of the panel will select all of the processes for that pollutant. The box on the left side of the panel will also show a check if any process is

selected. Additionally, unchecking the box on the left side of the panel will deselect all processes for that pollutant.

Note In order to compare results to MOBIL6.2 runs, all processes except extended idle need to be selected.

Caution! Users are cautioned that the number of check boxes selected will affect execution time. Large runs calculating many pollutant/process combinations may require processing times of several hours, so users are advised to begin with only a few pollutant/process combinations.

A **Pollutant/Process Requirements** box is included at the bottom of the Detail Panel. Text in this box actively responds to pollutant/process combination selections made in the matrix. In some cases, a specific pollutant/process calculation depends upon another pollutant/process calculation, and the user must select the base pollutant/process combination in order to be able to select the dependent combination. An error message will appear in the Pollutant/Process Requirements box should the user not select the base combination. Not all Processes apply to all Pollutants; therefore the matrix above is sparse. The following table displays the complete list allowable Pollutant – Process combinations allowable where ‘X’ checkmarks are displayed.

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor Venting	Evap Fuel Leaks	Crankcase Running Exhaust	Crankcase Start Exhaust	Crankcase Extended Idle Exhaust	Refueling Displacement Vapor Loss	Refueling Spillage Loss	Extended Idle Exhaust	Well-To-Pump
Total Gaseous Hydrocarbons	X	X			X	X	X	X	X	X	X	X	X	
Non-Methane Hydrocarbons	X	X			X	X	X	X	X	X	X	X	X	
Non-Methane Organic Gases	X	X			X	X	X	X	X	X	X	X	X	
Total Organic Gases	X	X			X	X	X	X	X	X	X	X	X	
Volatile Organic Compounds	X	X			X	X	X	X	X	X	X	X	X	
Carbon Monoxide (CO)	X	X						X	X	X			X	
Oxides of Nitrogen (NOx)	X	X						X	X	X			X	
Ammonia (NH3)	X	X						X	X	X			X	
Nitrogen Oxide (NO)	X	X						X	X	X			X	
Nitrogen Dioxide (NO2)	X	X						X	X	X			X	
Nitrous Acid (HONO)	X	X						X	X	X			X	
Sulfur Dioxide (SO2)	X	X						X	X	X			X	
Primary Exhaust PM10 - Total	X	X						X	X	X			X	
Primary PM10 - Organic Carbon	X	X						X	X	X			X	

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor Venting	Evap Fuel Leaks	Crankcase Running Exhaust	Crankcase Start Exhaust	Crankcase Extended Idle Exhaust	Refueling Displacement Vapor Loss	Refueling Spillage Loss	Extended Idle Exhaust	Well-To-Pump
Primary PM10 - Elemental Carbon	X	X						X	X	X			X	
Primary PM10 - Sulfate Particulate	X	X						X	X	X			X	
Primary PM10 - Brakewear Particulate			X											
Primary PM10 - Tirewear Particulate				X										
Primary Exhaust PM2.5 - Total	X	X						X	X	X			X	
Primary PM2.5 - Organic Carbon	X	X						X	X	X			X	
Primary PM2.5 - Elemental Carbon	X	X						X	X	X			X	
Primary PM2.5 - Sulfate Particulate	X	X						X	X	X			X	
Primary PM2.5 - Brakewear Particulate			X											
Primary PM2.5 - Tirewear Particulate				X										
Total Energy Consumption	X	X											X	

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor Venting	Evap Fuel Leaks	Crankcase Running Exhaust	Crankcase Start Exhaust	Crankcase Extended Idle Exhaust	Refueling Displacement Vapor Loss	Refueling Spillage Loss	Extended Idle Exhaust	Well-To-Pump
Petroleum Energy Consumption	X	X											X	
Fossil Fuel Energy Consumption	X	X											X	
Brake Specific Fuel Consumption (BSFC)	X													
Methane (CH ₄)	X	X						X	X	X	X	X	X	
Nitrous Oxide (N ₂ O)	X	X						X	X					
Atmospheric CO ₂	X	X											X	
CO ₂ Equivalent	X	X											X	
Benzene	X	X			X	X	X	X	X	X	X	X	X	
Ethanol	X	X			X	X	X	X	X		X	X		
MTBE	X	X			X	X	X	X	X		X	X		
Naphthalene particle	X	X						X	X	X			X	
1,3-Butadiene	X	X						X	X	X			X	
Formaldehyde	X	X						X	X	X			X	
Acetaldehyde	X	X						X	X	X			X	
Acrolein	X	X						X	X	X			X	
Naphthalene gas	X	X			X	X	X	X	X	X	X	X	X	

2.2.7.1 Processes

In MOVES, “Process” refers to the mechanism by which emissions are created. Engine operation creates **Running Emissions Exhaust**, **Start Emissions Exhaust** (the addition to running emissions caused by the engine start), and **Extended Idle Emissions Exhaust** (i.e., “hotelling” emissions from a combination, long-haul truck). MOVES also distinguishes **Crankcase Running Exhaust**, **Crankcase Start Exhaust**, and **Crankcase Extended Idle Exhaust** to describe the exhaust gases that escape around the piston rings and enter the crankcase during normal operation.

MOVES models evaporative emissions, situations in which unburned fuel escapes the vehicle's fuel system, through the **Evap Fuel Vapor Venting**, **Evap Permeation**, and **Evap Fuel Leaks** processes. In addition, vehicle refueling can cause **Refueling Spillage Loss** and **Refueling Displacement Vapor Loss**. **Brakewear** and **Tirewear** describe the non-exhaust particulate emissions that result from brake use and tire wear.

It's worthwhile to mention there are Process dependencies on other Processes or other conditions that apply to all pollutants that share the process association. The first three dependencies relate to the Time Spans panel, suggesting that all hours must be selected to run the process for any selected pollutant:

- Evap Permeation requires all hours to be selected.
- Evap Fuel Vapor Venting requires all hours to be selected.
- Evap Fuel Leaks requires all hours to be selected.

The last three dependencies relate to other processes that need to be selected as a pre-requisite to running the selected process for the pollutant in question:

- Crankcase Running Exhaust <Pollutant> requires Running Exhaust <Pollutant>
- Crankcase Start Exhaust <Pollutant> requires Start Exhaust <Pollutant>
- Crankcase Extended Idle Exhaust <Pollutant> requires Extended Idle Exhaust <Pollutant>

2.2.7.2 Pollutants

MOVES calculates emissions of criteria pollutants, greenhouse gases and selected air toxics associated with motor vehicle operation. MOVES also calculates energy consumption. For many pollutants, the emissions calculation is based on the prior calculation of another pollutant emission. As noted earlier, the **Pollutant/Process Requirements** box will display an error message if the user selects a dependent pollutant but not the base pollutant. Pollutants and base pollutants are listed in the table below.

The available processes and their processID numbers are listed below.

processID	processName
1	Running Exhaust
2	Start Exhaust
9	Brakewear
10	Tirewear
11	Evap Permeation
12	Evap Fuel Vapor Venting
13	Evap Fuel Leaks
15	Crankcase Running Exhaust
16	Crankcase Start Exhaust
17	Crankcase Extended Idle Exhaust
18	Refueling Displacement Vapor Loss
19	Refueling Spillage Loss
90	Extended Idle Exhaust
99	Well-to-Pump

Pollutant Name	Short Name	Parent	Child
1 Total Gaseous Hydrocarbons	Total Gas HC		5 Methane (CH ₄) 79 Non-Methane Hydrocarbons
2 Carbon Monoxide (CO)	CO		
3 Oxides of Nitrogen (NO _x)	NO _x		32 Nitrogen Oxide (NO) 33 Nitrogen Dioxide (NO ₂) 35 Nitrous Acid (HONO)
5 Methane (CH ₄)	CH ₄	1 Total Gaseous Hydrocarbons	86 Total Organic Gases
6 Nitrous Oxide (N ₂ O)	N ₂ O		
20 Benzene		87 Volatile Organic Compounds	
21 Ethanol		87 Volatile Organic Compounds	
22 Methyl-t-butyl Ether (MTBE)	MTBE	87 Volatile Organic Compounds	
23 Naphthalene Particle	Naphthalene P	100 Primary Exhaust PM ₁₀ - Total	
24 1,3-Butadiene		87 Volatile Organic Compounds	
25 Formaldehyde	CH ₂ O	87 Volatile Organic Compounds	
26 Acetaldehyde		87 Volatile Organic Compounds	
27 Acrolein	C ₃ H ₄ O	87 Volatile Organic Compounds	
30 Ammonia (NH ₃)	NH ₃		
31 Sulfur Dioxide (SO ₂)	SO ₂	91 Total Energy Consumption	
32 Nitrogen Oxide (NO)	NO	3 Oxides of Nitrogen (NO _x)	
33 Nitrogen Dioxide (NO ₂)	NO ₂	3 Oxides of Nitrogen (NO _x)	
35 Nitrous Acid (HONO)	HONO	3 Oxides of Nitrogen (NO _x)	
40 2,2,4-Trimethylpentane			
41 Ethyl Benzene	C ₈ H ₁₀		
42 Hexane	C ₆ H ₁₄		
43 Propionaldehyde			
44 Styrene			
45 Toluene			
46 Xylene			
60 Mercury Elemental Gaseous			
61 Mercury Divalent Gaseous			
62 Mercury Particulate			
63 Arsenic Compounds			
64 Chromium 3+			
65 Chromium 6+			

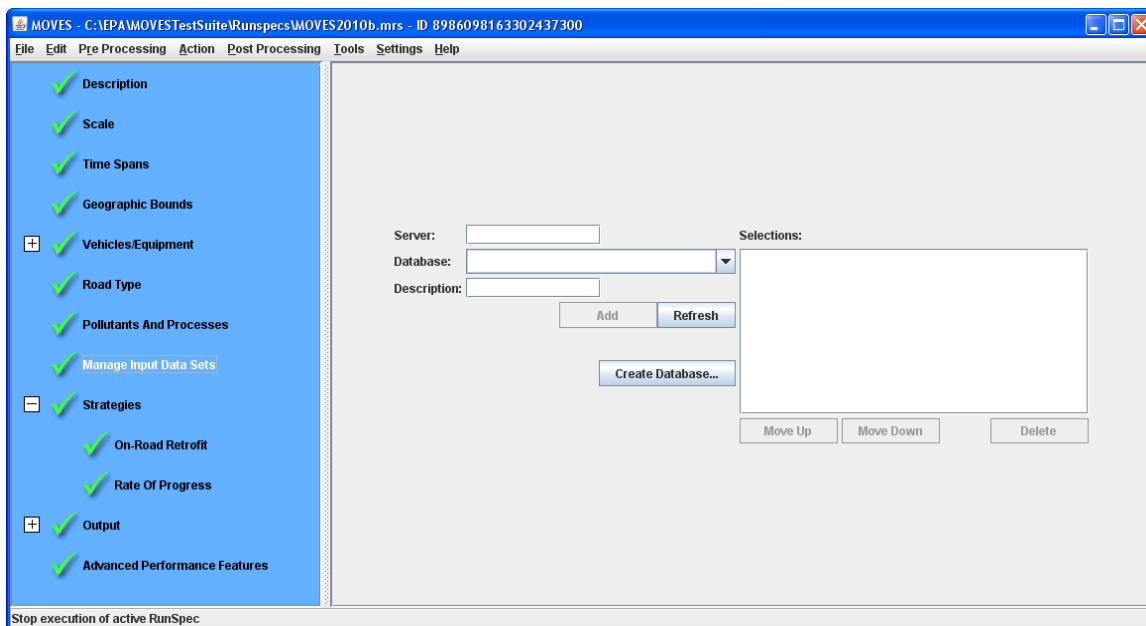
Pollutant Name	Short Name	Parent	Child
66 Manganese Compounds			
67 Nickel Compounds			
68 Dibenzo(a,h)anthracene particle			
69 Fluoranthene particle			
70 Acenaphthene particle			
71 Acenaphthylene particle			
72 Anthracene particle			
73 Benz(a)anthracene particle			
74 Benzo(a)pyrene particle			
75 Benzo(b)fluoranthene particle			
76 Benzo(g,h,i)perylene particle			
77 Benzo(k)fluoranthene particle			
78 Chrysene particle			
79 Non-Methane Hydrocarbons	Non-Methane Hydrocarbons	1 Total Gaseous Hydrocarbons	80 Non-Methane Organic Gases 87 Volatile-Organic-Compounds
80 Non-Methane Organic Gases	Non-Methane Organic Gases	79 Non-Methane Hydrocarbons	86 Total Organic Gases
81 Fluorene particle			
82 Indeno(1,2,3,c,d)pyrene particle			
83 Phenanthrene particle			
84 Pyrene particle			
86 Total Organic Gases	TOG	5 Methane (CH ₄) 80 Non-Methane Organic Gases	
87 Volatile Organic Compounds	VOC	79 Non-Methane Hydrocarbons	20 Benzene 21 Ethanol 22 MTBE 24 1,3-Butadiene 25 Formaldehyde 26 Acetaldehyde 27 Acrolein 185 Naphthalene gas
90 Atmospheric CO ₂	Atmos CO ₂	91 Total Energy Consumption	98 CO ₂ Equivalent

Pollutant Name	Short Name	Parent	Child
91 Total Energy Consumption	Total Energy		31 Sulfur Dioxide (SO2) 90 Atmospheric CO2 92 Petroleum Energy Consumption 93 Fossil Fuel Energy Consumption 105 Primary PM10 - Sulfate Particulate 115 Primary PM2.5 - Sulfate Particulate
92 Petroleum Energy Consumption	Petrol Energy	91 Total Energy Consumption	
93 Fossil Fuel Energy Consumption	Fossil Energy	91 Total Energy Consumption	
98 CO2 Equivalent	CO2 Equivalent	90 Atmospheric CO2	
99 Brake Specific Fuel Consumption (BSFC)	BSFC		
100 Primary Exhaust PM10 - Total	PM10 - Total Exh	101 Primary PM10 - Organic Carbon 102 Primary PM10 - Elemental Carbon 105 Primary PM10 - Sulfate Particulate	23 Naphthalene particle
101 Primary PM10 - Organic Carbon	PM10 - Organic C		100 Primary Exhaust PM10 - Total
102 Primary PM10 - Elemental Carbon	PM10 - Elem C		100 Primary Exhaust PM10 - Total
105 Primary PM10 - Sulfate Particulate	PM10 - Sulfate	91 Total Energy Consumption	100 Primary Exhaust PM10 - Total
106 Primary PM10 - Brakewear Particulate	PM10 - Brakewear	116 Primary PM2.5 - Brakewear Particulate	
107 Primary PM10 - Tirewear Particulate	PM10 - Tirewear	117 Primary PM2.5 - Tirewear Particulate	
110 Primary Exhaust PM2.5 - Total	PM2.5 - Total Exh	111 Primary PM2.5 - Organic Carbon 112 Primary PM2.5 - Elemental Carbon 115 Primary PM2.5 - Sulfate Particulate	
111 Primary PM2.5 - Organic Carbon	PM2.5 - Organic C		110 Primary Exhaust PM2.5 - Total
112 Primary PM2.5 - Elemental Carbon	PM2.5 - Elem C		110 Primary Exhaust PM2.5 - Total
115 Primary PM2.5 - Sulfate Particulate	PM2.5 - Sulfate	91 Total Energy Consumption	110 Primary Exhaust PM2.5 - Total
116 Primary PM2.5 - Brakewear Particulate	PM2.5Brakewear		106 Primary PM10 - Brakewear Particulate

	Pollutant Name	Short Name	Parent	Child
117	Primary PM2.5 - Tirewear Particulate	PM2.5 - Tirewear		107 Primary PM10 - Tirewear Particulate
130	1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin			
131	Octachlorodibenzo-p-dioxin			
132	1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin			
133	Octachlorodibenzofuran			
134	1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin			
135	1,2,3,7,8-Pentachlorodibenzo-p-Dioxin			
136	2,3,7,8-Tetrachlorodibenzofuran			
137	1,2,3,4,7,8,9-Heptachlorodibenzofuran			
138	2,3,4,7,8-Pentachlorodibenzofuran			
139	1,2,3,7,8-Pentachlorodibenzofuran			
140	1,2,3,6,7,8-Hexachlorodibenzofuran			
141	1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin			
142	2,3,7,8-Tetrachlorodibenzo-p-Dioxin			
143	2,3,4,6,7,8-Hexachlorodibenzofuran			
144	1,2,3,4,6,7,8-Heptachlorodibenzofuran			
145	1,2,3,4,7,8-Hexachlorodibenzofuran			
146	1,2,3,7,8,9-Hexachlorodibenzofuran			
168	Dibenzo(a,h)anthracene gas			
169	Fluoranthene gas			
170	Acenaphthene gas			
171	Acenaphthylene gas			
172	Anthracene gas			
173	Benz(a)anthracene gas			
174	Benzo(a)pyrene gas			
175	Benzo(b)fluoranthene gas			
176	Benzo(g,h,i)perylene gas			
177	Benzo(k)fluoranthene gas			
178	Chrysene gas			
181	Fluorene gas			
182	Indeno(1,2,3,c,d)pyrene gas			
183	Phenanthrene gas			
184	Pyrene gas			
185	Naphthalene gas		87 Volatile Organic Compounds	

2.2.8 Manage Input Data Sets

In general, the **County Domain Manager** and the **Project Data Manager** are used to enter data. However, you may select **Manage Input Data Sets** on the Navigation Panel to specify specialized user-supplied data to be read by the model during execution. Databases entered using this feature will overlay existing databases tables (or portions of a table, if a table containing only a subset of records is provided) in the MOVES default database tables, if they exist. No default selections exist for this panel and the model can be run without any selections on this panel.



Note Each database added through this feature can consist of one or more MOVES input database tables.

Note These databases must adhere to the MOVES schema and use the database management system (DBMS) used by MOVES. In practice this means that individual tables in the user-supplied database must have identical names as the MOVES default input database and the individual fields in the tables must have identical lengths and types as MOVES default tables. For details regarding the MOVES database schema see the Software Design Reference Manual.

Tip The data in user input databases take priority over data from the MOVES default database.

Note Entries in the **Manage Input Data Sets** panel are used in the run, but will not change the values in the MOVES default database.

To create a new database with empty tables of the proper schema on an existing local or remote server, type the server and a new database name and click the **Create Database** button. Leaving the server box blank creates the new database on the localhost server.

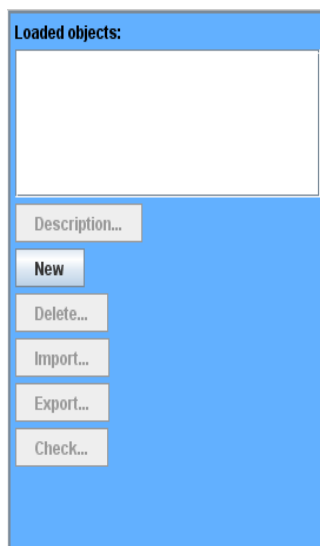
You can use database tools outside of MOVES, such as MySQL, to populate new database tables with alternate values. Within MOVES, the **Data Importer**, **County Data Manager**, and **Project Data Manager** also aid in creating and populating User Input databases (see **Data Manager (Importers) - Section 2.3.3.4**).

!Tip Databases created with the **County Data Manager** or **Project Data Manager** are selected in the **Domain Input Database** pane of the **Geographic Bounds** panel rather than the **Manage Input Data Sets** panel.

To choose a database, select it from the dropdown list, and click the **Add** button to add the new or existing database to the input databases, shown in the Selections window. MOVES will first validate that the combination of server and database are unique within the selections. The same server-database combination cannot be added more than once. Click the **Move Up** or **Move Down** buttons to modify the order in which a particular database selection is used. To remove a database, highlight it and click the **Delete** button.

!Tip The order in which these databases are applied to the default data is important. If two or more alternate databases are specified in the **Selections** list, the one that appears last in the list will replace any previous ones in cases where the internal tables and records of each database overlap.

2.2.9 Creating and Using Internal Control Strategies



In MOVES, "Strategies" are sets of parameters that replace MOVES defaults, and thus allow modeling of different future scenarios. The **On-Road Retrofit** strategy allows you to enter information about diesel trucks and buses that have been retrofitted with emission control equipment. The use of control strategies is optional; if you do not select any strategy, the RunSpec will use data from the MOVES default database.

The selection of the strategy opens a split panel on the screen. The left side of the panel is called the **Strategies Management** panel (see screen shot on left), and contains buttons that enable the user to add, import, export, delete, and check data. Detailed information specific to the strategy appears to the right, on the **Strategies Detail** panel.

The buttons on the **Strategies Management** panel are used to manipulate the strategy data sets, or "objects", needed for each RunSpec, as explained below.

⚡Caution! A RunSpec may have only one **On-Road Retrofit** strategy. The **New** button cannot be selected without first clicking **Delete** to remove any existing loaded object. If a

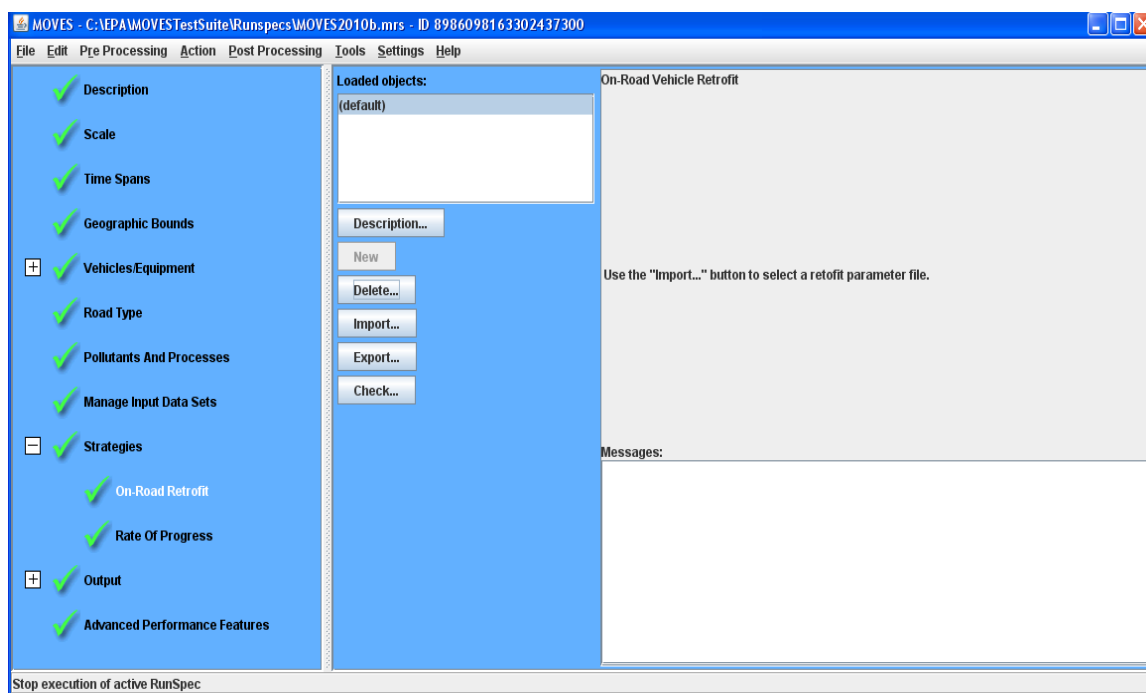
strategy data set is already loaded and the user imports a new file, the import action will overwrite the existing data set.

2.2.9.1 Adding Strategy Files

Users can add new strategy data to a RunSpec by clicking the **New** button or the **Import** button.

Clicking the **New** button creates a new strategy data set, which is added to the RunSpec. The new strategy data appears on the list of **Loaded Objects** as **(default)**. However, in MOVES, the **Loaded Objects** window does not function as intended and should be ignored.

Clicking the **Import** button allows you to import an appropriate input file. The On Road Retrofit Strategy allows you to import XML, tab-delimited text, and Microsoft Excel files. The On-Road Retrofit Strategy allows you to import Microsoft Excel (.xls), tab-delimited text files, or comma-delimited text. Typically, the import file is created by exporting a template file, editing it in a spreadsheet, saving the edited version as a tab-delimited text file, and importing this text file.



2.2.9.2 Deleting Strategy Files

You may delete a strategy data set from the RunSpec by clicking the **Delete** button. MOVES will prompt for confirmation before actually removing the data set.

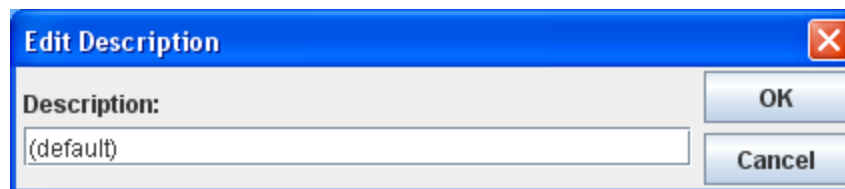
2.2.9.3 Exporting Strategy Files

The **Export** button allows you to write strategy parameter sets to file for storage. When you click **Export**, a standard Windows file browser appears from which you can name a file to which to write the data as tab-delimited text.

To create a template file for the On-Road Retrofit strategies, choose **New**, and then export a file containing only headers. The On-Road Retrofit Strategy allows you to export previously imported files.

2.2.9.4 Naming Strategy Files

By clicking the **Description** button, the dialog box shown below is displayed:



Changing the description will change the text shown in the **Loaded Objects** window. However, importing different files will not change the description.

!Tip The **Description** text can be misleading since it must be manually updated if new strategy files are loaded. You may wish to leave it blank.

2.2.9.5 Saving and Transferring Strategy Files

Strategies may exist inside and outside of a RunSpec, that is, the parameters can be saved as part of a RunSpec and/or as a separate file that can be re-used from one RunSpec to the next. This feature can help create a set of RunSpecs that use a consistent set of strategy settings. The **Import** and **Export** buttons allow for the transfer of strategy data between RunSpecs.

Using the **File** menu to save and open RunSpecs automatically saves and loads the **Strategies** embedded within the RunSpecs. The files containing the strategies do not need to be imported separately. However, the version of the file embedded within the RunSpec is set at the time of the import; in other words, if any change are made to the strategy file outside of MOVES, the file must again be imported for the RunSpec to reflect the changes made.

2.2.9.6 AVFT Strategy Conversion

In MOVES2010B, the AVFT Strategy GUI has been removed for all new RunSpecs and for all old RunSpecs that have no AVFT Strategy. However, for purposes of backward compatibility, an option box is displayed on the AVFT Strategy GUI when an old RunSpec is loaded that contains an AVFT Strategy. The resulting panel only permits the AVFT data to be exported to a user supplied database, and the AVFT Strategy to be deleted from the RunSpec.

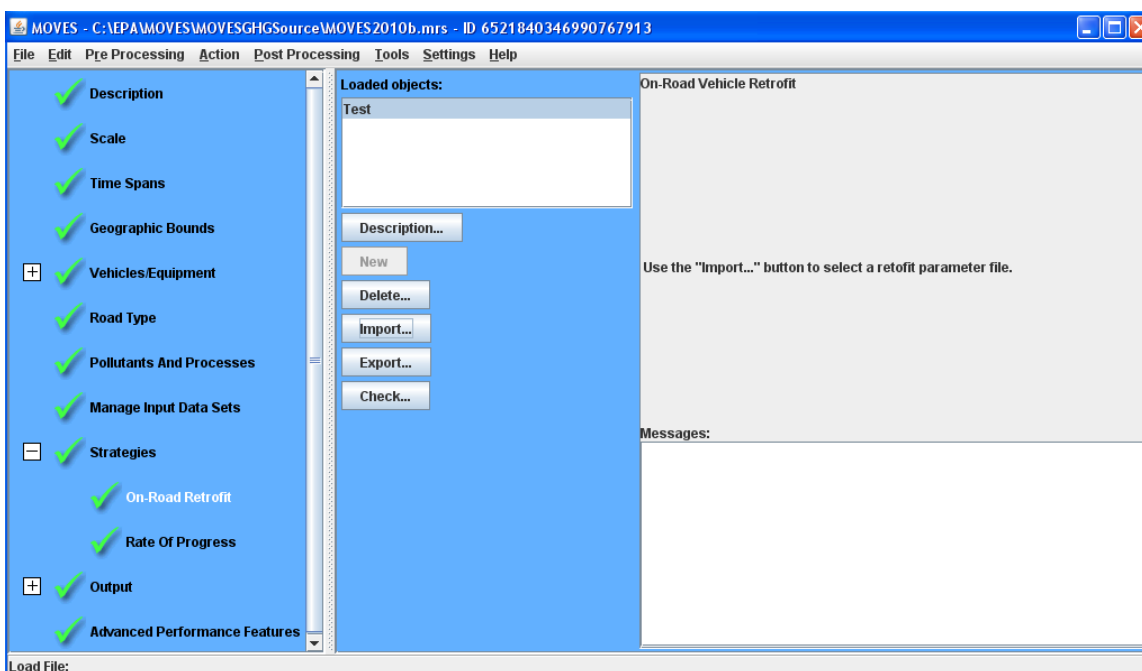
Specific instructions on the use of the converter and the resulting database are given on the GUI. Old RunSpecs that contain an AVFT strategy cannot be executed by MOVES. Old RunSpecs that do not contain an AVFT strategy are unaffected. Since this feature has now been deprecated, you must enter all AVFT data (fuel distributions) in the new Fuel Type and Technology Importer (see **Fueltype and Technologies - Section 2.3.3.4.9**).

2.2.9.7 Managing On-Road Vehicle Retrofit Data

MOVES has the capability to model on-road vehicle retrofit strategies for all exhaust pollutants for diesel trucks and buses. **Appendix D – Creating an On-Road Retrofit Input File** provides detailed instructions for creating an **On-Road Retrofit** data file.

To add on-road vehicle retrofit data, the user should click the **On-Road Retrofit** option under **Strategies** on the Navigation Panel. This will open the **On-Road Retrofit** panel, which displays the **Strategies Management** Panel on the left side of the panel as described earlier in the **Strategies** section. The **Description**, **New**, **Export**, **Delete**, and **Check** buttons work as described earlier.

Note The Retrofit Strategy only works for non-passenger diesel trucks and buses. Importing a strategy for motorcycles, cars, passenger trucks or for other fuel types will generate an error.



2.2.9.8 Importing Retrofit Data

When you click on **On-Road Retrofit**, the Detail Panel to the right of the **Strategies Management Panel** instructs you to click the **New** button first and then click the **Import** button to select a retrofit parameter file. The **Import** button enables you to import On-Road Retrofit data as a tab delimited, comma separated (.csv), or .xls file. When you click on **Import**, a standard Windows file browser window appears from which you can select the file. If an .xls file is imported, MOVES will prompt you to specify a worksheet from which the data should be imported.

Once data are imported, the display in the Detail Panel will show the name and location of the imported file ("Data Source"). A **Reload** button that will also appear next to the file name can be clicked on to capture any changes to the imported data file.

Importing retrofit data automatically saves the data to the RunSpec, but it does not automatically apply the retrofit parameters to the emission results that MOVES produces. To apply the retrofit parameters to the emission results, check the **Use the On-Road Retrofit Settings** box that appears at the top of the On-Road Retrofit panel. This allows you to turn retrofit on and off without reloading the files.

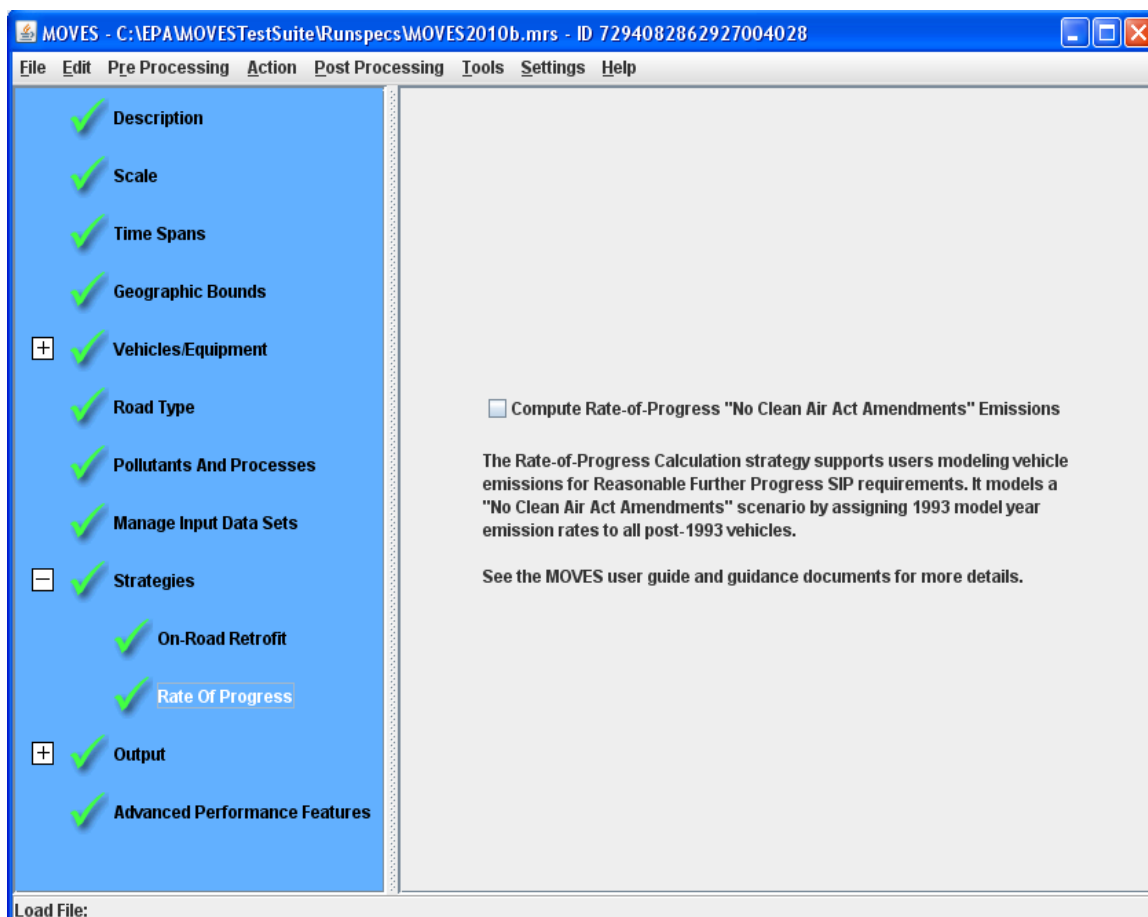
CAUTION! If you do not select **Use the On-Road Retrofit Settings**, the retrofit inputs will not be used.

If there are any data format or consistency issues in a file you're trying to import (e.g., incorrect number of columns or data that are inconsistent with what you selected elsewhere in the MOVES GUI), a message(s) will appear in the **Messages** window at the bottom of the panel.

Importing data for retrofits requires that you enter the description of the field (e.g. NOX rather than pollutant 3).

2.2.9.9 Rate of Progress Calculation

The Rate-of-Progress Calculation strategy supports users modeling vehicle emissions for Reasonable Further Progress SIP requirements.



If you select **Compute Rate-of-Progress 'No Clean Air Act Amendments' Emissions**, the MOVES model will assign 1993 model year emission rates to all post-1993 vehicles.

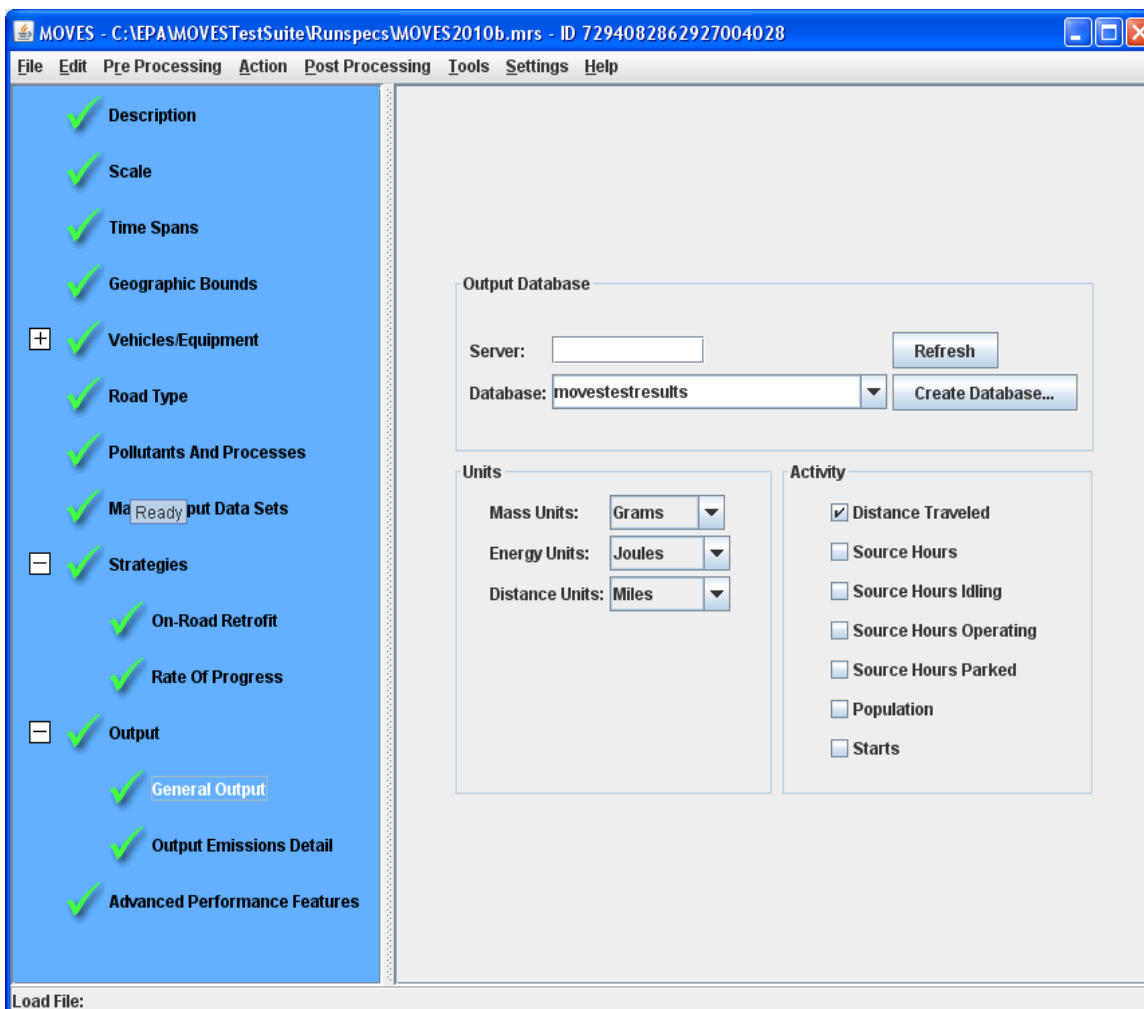
Under the Clean Air Act, some State Implementation Plans (SIPs) must include a demonstration that the state is making “reasonable further progress” in reducing hydrocarbon and NOx emissions. To compute the rate of progress to this goal, the Act requires calculating emissions with and without the impact of the Clean Air Act Amendments of 1990. To perform the highway vehicle portion of these calculations with MOVES, you should use the Rate of Progress feature. You should also set inspection maintenance programs and fuel programs to appropriate parameters. For more information, see MOVES Technical Guidance.

2.2.10 Output

Selecting **Output** on the Navigation Panel expands to show **General Output** and **Output Emissions Detail**. Each of these panels allows you to specify aspects of the output data.

2.2.10.1 Specifying Database, Time Period, and Units in Output

Click on the **General Output** panel to specify the output database, the units, and the activity types reported. The panel has three sub-panels: **Output Database**, **Units**, and **Activity**.



2.2.10.1.1 Output Database

The first box, **Output Database**, contains input boxes for the server name and the output database name. A blank server box is the default and it indicates that the localhost (the MySQL data folder located on your computer) is to be used. Most users should leave this blank. The second box contains the name of the MySQL output database where you desire the MOVES output to be written. You must select an existing MOVES output database or create a new MOVES output database into which the results should be placed. If the output database already exists and

contains rows within its output tables, a warning icon is displayed. A new run of the MOVES model will add its results to an existing MOVES output database, and automatically give them the next available MOVES Run identification number. MOVES output records in an existing output database cannot be deleted or replaced from within the MOVES GUI.

A user choosing to create a new MOVES output database must choose a unique name and may click the "**Create Database**" button. All new output databases begin with a MOVES Run identification number of one.

⚡ Caution! Never attempt to create a new output database with the same name as the MOVES default database or of any user-supplied MOVES input databases.

!Tip The output database should follow a naming convention to differentiate it from other databases; typically, using “_out” at the end of the database name is recommended.

2.2.10.1.2 Units

The **Units** box contains choices for the mass, energy, and distance units in which the results will be reported. The choices for mass are kilograms, grams, pounds, or US tons (short tons). The available energy units are Joules, Kilojoules, or Million BTUs (British Thermal Units). The available distance units are miles or kilometers. You may choose only one unit for each of the three measurement types. The units are reported in the output database in the MySQL output table "movesrun."

!Tip Make sure to choose units of the appropriate magnitude for your RunSpec. For instance, if the RunSpec is very narrow spatially, temporally, and in terms of vehicle and road types, then choosing **Tons** as the **Mass Units** may not give you the desired level of detail.

2.2.10.1.3 Activity

The Activity panel allows you to choose which vehicle activity to report in the Movesactivityoutput table.

If **Emission Rates** is selected on the **Scale** panel, **Distance Traveled** and **Population** will be selected automatically since their values are needed for the rates calculations.

⚡ Caution! If the calculation type **Emission Rates** is selected on the **Scale** panel, the activity values will represent an intermediate step in the rates calculations rather than the real activity for that time and place. To reduce file size, use the **Aggregation and Data Handling** panel on the **Advanced Performance Features** screen to select **Clear Movesactivityoutput after rate calculations**.

🔗 NOTE In the movesactivityoutput table, population always has month, day & hour keys of zero (i.e. “doesn’t matter”) because population is assumed constant in time across an entire year. This scheme reduces table size, but requires care when filtering results and when joining to other tables. Also, if you assign some VMT to a road type, but then do not select that road type in the RunSpec, the population will be lower than it should be. This

is because the missing VMT is not used when calculating population. You should model all road types (where VMT is allocated) to ensure proper calculations.

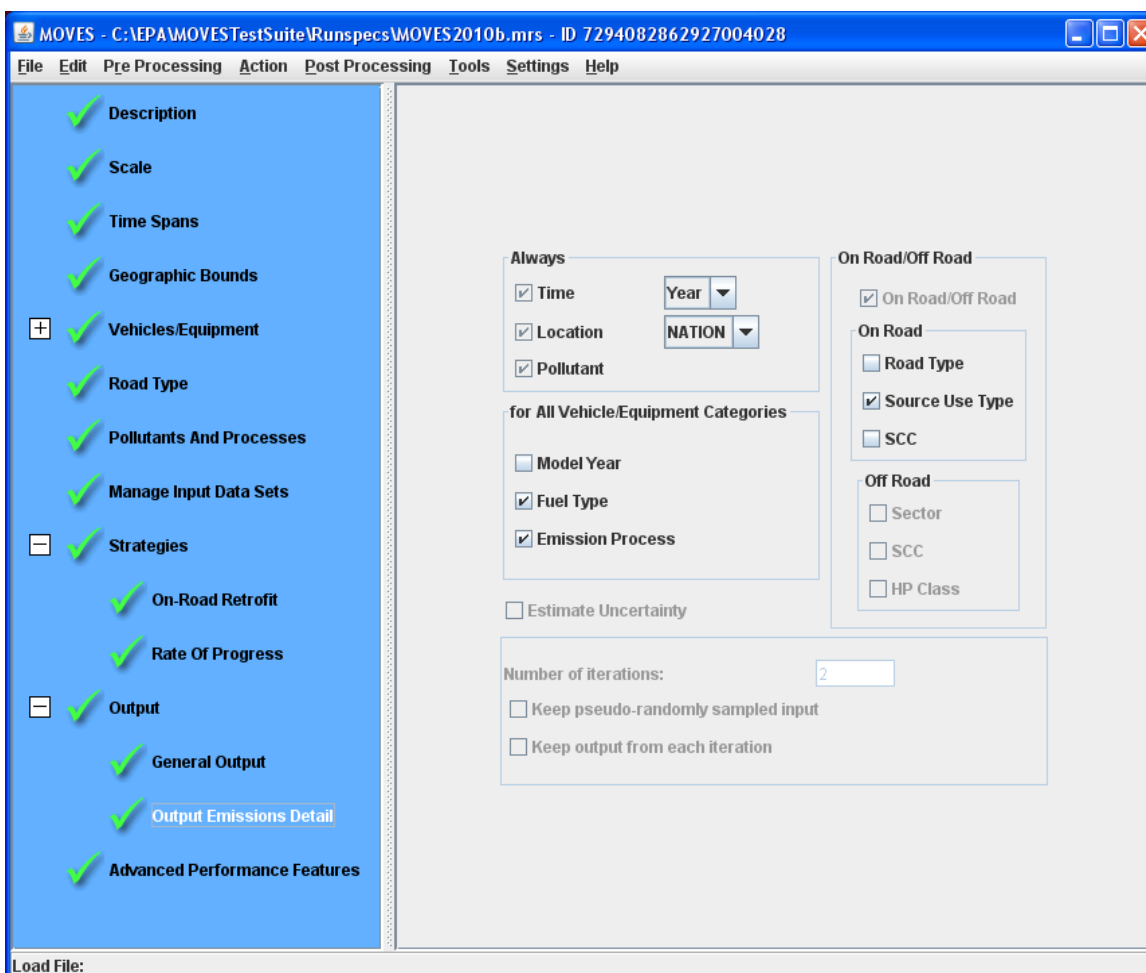
NOTE Activity is generated only when at least one process that uses that activity is chosen on the Pollutants/Processes panel. If you choose an activity but do not choose the associated process, the Movesactivityoutput table will not include the desired results.

The following **table**, Activity Types lists and describes the activities MOVES can output, their units, and the processes that generate their information.

ActivityTypeID	Description	Units	ProcessID	Notes
1	Distance traveled	Distance units as set in a RunSpec	1	Also needed for proper calculation of evaporative emissions when doing “Rates” calculations
2	Source Hours (population times the number of hours)	Hours, regardless of time unit aggregation	11, 12, 13	
3	Source Hours Idling (the number of hours that combination long haul trucks spent in extended idle mode)	Hours, regardless of time unit aggregation	90	Off network roads only
4	Source Hours Operating (the number of hours that vehicles spent operating)	Hours, regardless of time unit aggregation	1, 9, 10, 11, 12, 13	
5	Source Hours Parked (the number of hours that vehicles were parked)	Hours, regardless of time unit aggregation	11, 12, 13	Off network roads only
6	Population (the number of vehicles—assumed constant for each year)	SourceUseType count	1, 2, 9, 10, 11, 12, 13, 90	
7	Starts (the number of engine starts)	Number of starts	2	Off network roads only

2.2.10.2 Specifying Emission Distinctions in Output

Select **Output Emissions Detail** on the Navigation Panel (after expanding **Output**) to specify distinctions desired in the output data. The **Output Emissions Detail** Panel consists of four sub-panels: **Always, for All Vehicle/Equipment Categories, On Road/Off Road**, and **Estimate Uncertainty**.



Note Selecting detailed output here and using MySQL post-processing to aggregate the output to the desired level allows control over the aggregation level without re-running the model. This is often the best choice for initial investigation of a question and smaller runs. However, if a run includes many times, locations, source types, etc., you may want to reduce the number of items selected on this screen to avoid producing unmanageably large output files and longer post-processing queries.

2.2.10.2.1 Always

The **Always** box is a reminder that the output data will always contain dimensions for time, location, and pollutant. The **Always** box also contains two buttons that allow the user to specify the level of output aggregation by time and location level.

By default, the **Time** button will report the same time level as selected in the **Time Spans** panel. The user may change the time level in the **Time** button to a value that is equal or longer than the **Time Aggregate Level** specified in the **Time Spans** panel. For example, if the **Time Aggregate Level** is set to **Hour** in the **Time Spans** panel, then the **Time** button can be set to **Hour**, **24-Hour Day**, **Portion of Week**, **Month**, or **Year**.

The **24-Hour Day** selection does not select a particular day of the week but a *kind of day of the week* and the results are for one day of each kind of day requested in the RunSpec (e.g. one weekend day and/or one weekday). Similarly, the **Hour** selection will result in hourly output for each kind of day requested in the RunSpec. In the default case where the MOVES input database specifies two kinds of days, reporting by **Portion of Week** reports weekday results as a total of five weekdays and weekend results as a total of two weekend days.

Note The behavior of the aggregation function of the **Time** selection may cause unexpected results. For example, if only two hours of the day are selected in the **Time Spans** panel, but **24-Hour Day** is selected in the **Output** panel, the daily results will only be the sum of the two selected hours, not all 24. Similarly, selecting only weekdays in the **Time Spans** panel, but selecting **Month** in the **Output** panel will result in a monthly total that only includes weekdays. See the MOVES Software Design Reference Manual for more information about how MOVES aggregates output.

By default, the **Location** button will report the same geographic aggregation level as selected in the **Geographic Bounds** panel. The user may change the aggregation level in the **Location** button to a value that is equal to or larger than the level set in the **Geographic Bounds** panel. For example, if the **Geographic Bounds** panel is set to **County**, then the **Location** button can be set to **County**, **State**, or **Nation**.

Note The choice of **State** or **Nation** will aggregate results from the areas chosen in the **Geographic Bounds** panel. For example, if only two counties from a state are specified in a RunSpec, the output results for **State** will be the sum of the emissions from only these two counties.

A **Pollutant** button is not available because MOVES pollutants are always reported separately in the output. Where aggregation of pollutants is available, the aggregate is listed as a separate pollutant on the **Pollutants and Processes** panel. (e.g. **Primary Exhaust PM2.5 – Total**).

2.2.10.2.2 For All Vehicle/Equipment Categories

The dimensions that apply to both on road and off road sources are **Model Year**, **Fuel Type**, and **Emission Process**. Checking any or all of these items means that the output will be distinguished by that factor. For example, if **Emission Process** is checked, the output will be distinguished by the emissions processes selected, such as Running Exhaust, Start Exhaust, etc.

2.2.10.2.3 On-Road/Off Road

MOVES does not include the ability to model Off Road emissions, as yet. Thus, within the **On Road/Off Road** only the **On Road** section is functional. In the **On Road** box, options are available to report by **Road Type**, **Source Use Type**, or **Source Classification Code (SCC)**. If none of these options are checked, no vehicle or road classification distinctions will be made in the output. Instead, the results will be reported as summed across all vehicle and road classes.

Tip **Source Use Type** and **SCC** are mutually exclusive. **Source Use Types** are native to MOVES, so this is the preferred option. MOVES can report by Source Classification Code

(SCC), but this introduces an additional approximation step in the calculations to convert output by **Source Use Type** to **SCC**.

⚡ **Caution!** If **Custom Domain** is chosen on the **Geographic Bounds** panel and output is distinguished by **SCC**, you will import the SCC mapping through the **County Data Manager Zone** tab, and input it as a user-input database in the **Manage Input Data Sets** panel. The default database contains no default data about custom domains. Additionally, while there is default information for individual counties, you may want to review the “sccRoadTypeDistribution” table to determine how the MOVES road types translate to the SCC roads types for the county of interest.

Several interdependencies exist among these items. For example, reporting by SCC implies that FuelTypes, but not RoadTypes will be distinguished. (The SCC includes an indication of both the fuel type and the roadway classification.)

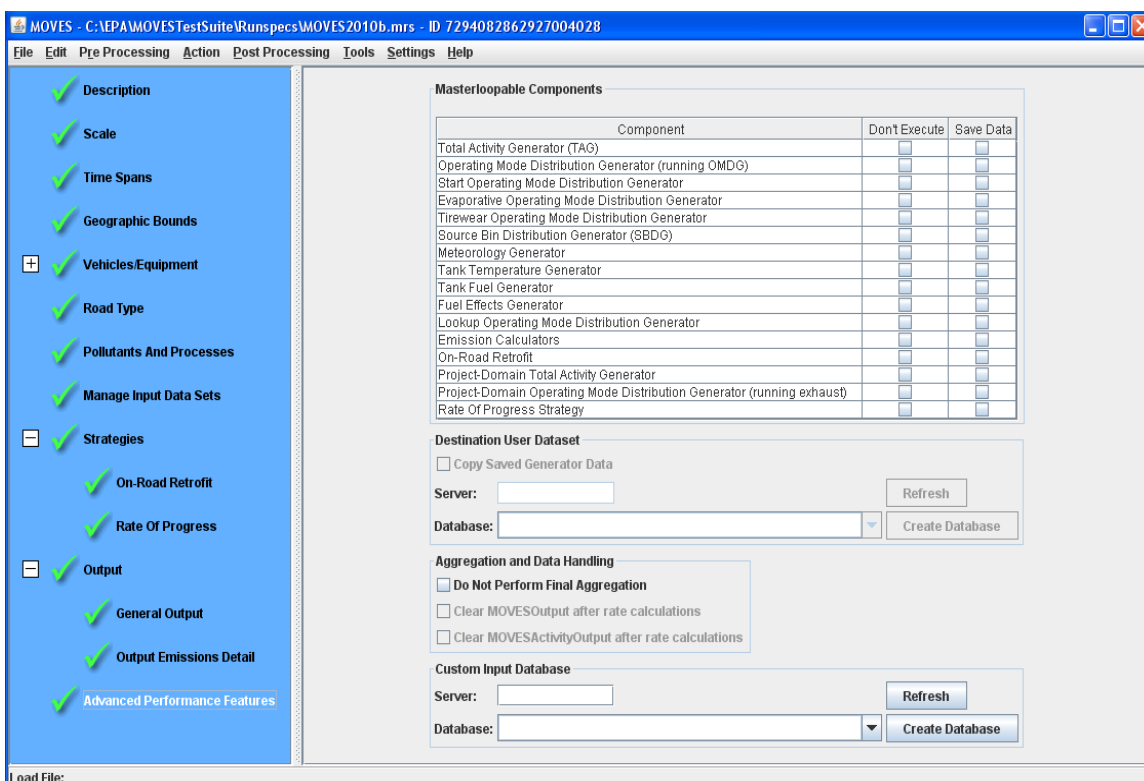
2.2.10.2.4 Estimate Uncertainty

The **Estimate Uncertainty** function is not available.

2.2.11 Advanced Performance Features

The **Advanced Performance Features** panel contains a variety of options that may be of use to some users. Some of these features may require specialized knowledge to configure.

Many of these are features which may be used to diagnose problems with the model software, or to improve the run time for long model runs by saving and reusing intermediate results. Use of these features requires knowledge of the detailed software components of the MOVES program, the inputs they require, and the outputs they produce.



This panel allows you to save intermediate results from various portions of the model and to turn off portions of the model code.

This panel also allows you to "turn off" final aggregation of MOVES results. Selecting the **Do Not Perform Final Aggregation** option can reduce execution time for large runs. When this option is selected, the MOVES output tables may include rows with duplicate key fields. The results from these rows must then be summed to produce useful output. Use this feature with great care.

When the **Emission Rates** calculation type is selected on the **Scale** panel, the user may choose to **Clear MOVESOutput after rate calculations** and **Clear MOVESActivityOutput after rate calculations**. These options are recommended because the tables they affect may be quite large, and the values the tables hold represent only an intermediate step in the rates calculations rather than the real activity for that time and place.

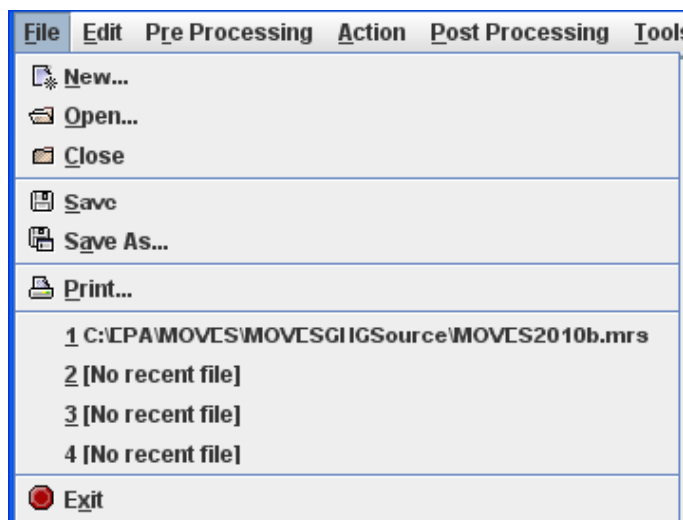
Finally, this panel includes a sub-panel where the user can specify an input database to be used instead of the MOVES default input database. Most users will not need this option.

2.3 Main Menu Bar

The Main Menu Bar runs across the top of the screen and contains eight drop down menus: **File, Edit, Pre Processing, Action, Post Processing, Tools, Settings, and Help**. Menus can be opened by either clicking on the menu command, or by using a keyboard combination, defined as ALT and the underlined letter of the menu command (e.g., ALT + F for the **F**ile menu, ALT + R for the **P**re Processing menu).

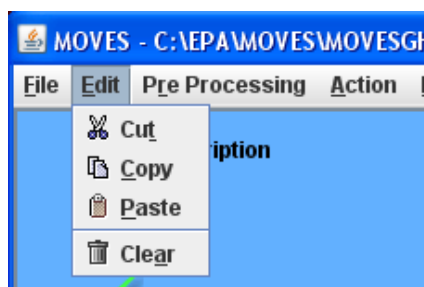
2.3.1 File

File provides a drop-down menu typical of those used when manipulating documents. Click **File** to open the drop down menu and then on a menu item to select **New**, **Open**, **Close**, **Save**, **Save As**, **Print**, **Exit**, or to choose to open recently opened files. Use the **File** commands to create, load, and save RunSpec objects. The Example RunSpec may be opened from this menu (see **Executing Example Run Specifications - Section 1.4**). Note that the Print command prints the XML version of the RunSpec, not a screen shot.



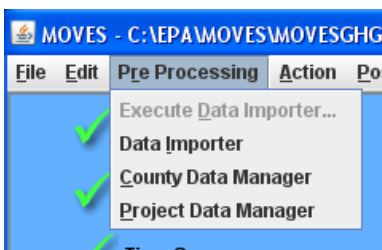
2.3.2 Edit

Edit provides the usual cut/copy/paste commands. These commands are only available in text entry sections of MOVES RunSpec. Keyboard combinations are available to execute edit commands when the Edit drop-down box is opened, and can be identified using the "mouse hover" feature.



2.3.3 Pre Processing

The **Pre Processing** menu contains three active options, **Data Importer**, **County Data Manager**, and **Project Data Manager**. Each option enables you to access importers for individual tables in order to create user-supplied databases for direct entry of data into MOVES. The **Project Data Manager**, in particular, requires you to provide virtually all of the data required to model a specific project.



The **County Data Manager (CDM)** and the **Project Data Manager (PDM)** are where you can define the county-specific or project-specific data required if you select **County Domain/Scale** or **Project Domain/Scale** when defining the **Scale** parameter of the RunSpec. Neither the **County Data Manager** nor the **Project Data Manager** menu options will be enabled unless you have made the **County Domain/Scale** or **Project Domain/Scale** choice.

The **County Data Manager** and **Project Data Manager** are designed to specify all the inputs required for certain kinds of runs

!Caution! All tabs/fields in the **County Data Manager** and **Project Data Manager** should be completed to ensure the output generated is correct. In some cases, a RunSpec may execute even though all the tabs in the **County Data Manager** or **Project Data Manager** were not completed; however, the results from such RunSpecs may populate the incomplete tabs with default data, which may not be appropriate due to how MOVES generates, calculates, and allocates various data.

!Tip You do not have to specify a database containing county or project data that was created with the **County Data Manager** or **Project Data Manager** in the **Manage Input Data Sets** panel. These databases only have to be selected in the **Domain Input Database** pane of the **Geographic Bounds** panel. However, databases created with the **Data Importer** should be input using the **Manage Input Data Sets** panel.

There are three major differences between working with importers through the **Data Importer** and working with the same importers through the **County Data Manager** and the **Project Data Manager**. First, as "domain managers" the **County Data Manager** and **Project Data Manager** indicate whether you have imported all of the data that is needed to establish a new domain. The **County Data Manager** and the **Project Data Manager** will identify the parameters where data is needed by displaying red "x-circles" on the importer tabs (shown below). Green checks indicate where data has been properly and completely imported. The **Data Importer** does not display such information.

Due to the level of detail required and the structure of the underlying data tables, the **County Data Manager** restricts the RunSpec to a single county and single calendar year, and the **Project Data Manager** restricts the RunSpec to a single hour, day type, month and county. The **Data Importer** can be used with any RunSpec.

The **Data Importer** is generally used to import data for a RunSpec at the **National Domain/Scale**. Therefore, when importing **Population** or **Vehicle Type VMT** at the **National**

Domain/Scale, these inputs should be national values even if only a small number of counties are selected. MOVES will use the default allocation factors for the counties selected in the RunSpec to apportion data to each county.

When you select one of the data manager options, the manager window will open. This window contains several tabs to aid in defining the data source, destination, and database structure for the imported data. **Importer** tabs provide templates for collecting user-provided data.

2.3.3.1 Database

The **Database** tab is the default initial tab for the **Data Importer** menu option. It contains: a text box where you can select an input database from a drop-down list or name a new database; three buttons to aid in the creation and management of the database; and a scrollable log detailing the success of the data import and other helpful diagnostics.

Note Data cannot be imported until an input database is identified.

The screenshot shows the 'MOVES County Data Manager' window with the 'Database' tab selected. The window has a blue title bar and a standard Windows-style interface. At the top, there are several tabs: 'Source Type Population', 'Vehicle Type VMT', 'I/M Programs', 'Generic' (which is active), and 'Tools'. Below these are more specific tabs: 'Fuel', 'Meteorology Data', 'Ramp Fraction', 'Road Type Distribution', 'RunSpec Summary', 'Database' (selected), 'Age Distribution', 'Average Speed Distribution', and 'Fueltype and Technologies'. The main area of the window contains the text 'Select or create a database to hold the imported data.' Below this text are three input fields: 'Server:' with 'localhost' entered, 'Database:' with a drop-down arrow, and 'Log:'. To the right of these fields are three buttons: 'Refresh', 'Create Database', and 'Clear All Imported Data'. At the bottom of the window, there is a green bar with the word 'Database' in white text, and a 'Done' button in the bottom right corner.

By default, the host server for the receiving database is "localhost" (generally the MySQL data folder on the user's own machine). You can specify a different host server by entering the name of the alternate server in the **Server** box. The input database can be identified by clicking on the drop-down arrow adjacent to the **Database** box and making a selection from the list. You can

also create a new database by typing a database name in the **Database** box and clicking the **Create Database** button. Clicking the **Refresh** button will clear the database selection from the **Database** box display, refresh the list of databases in the drop-down list, and clear the **Log**. The final button is the **Clear All Imported Data** button, which clears all the imported data (but not all the tables in the input tables as some are “core” tables that are populated based on the selections in the RunSpec at the time the database was created).

⚠ Caution! Never attempt to create a new input database with the same name as the MOVES default database or of any user-supplied MOVES output databases.

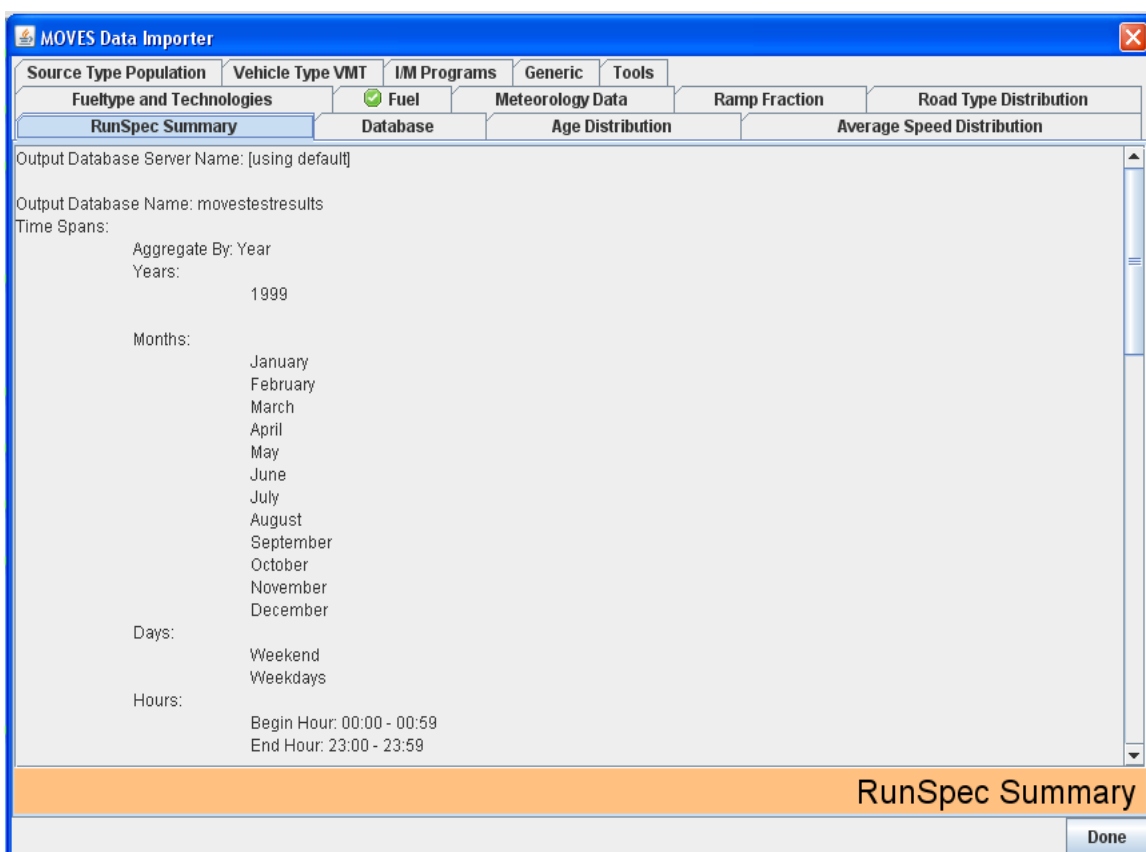
!Tip The input database should follow a naming convention to differentiate it from other databases; typically, using “_in” at the end of the database name is recommended.

⚠ Caution! When a database is created for a RunSpec at the **County** or **Project Domain/Scale**, a year table is automatically created with the year selected in the RunSpec. If any files are imported with a different year in a field, MOVES will add this year as an additional record in the year table. However, even if the incorrect data is cleared using the importer, the year table will not be changed, and MOVES will not execute. Take care not to import different years into an input database, but if this occurs there are currently two solutions: Create and populate a new database with corrected files; or Use MySQL or the MySQL Browser to view and delete the row from the table. The MySQL queries to do this are: **SELECT * FROM** [database_in].year;
DELETE FROM [database_in].year **WHERE** yearID=[undesired_year];

The Database tab also contains a **Log** panel. This panel is used by the system to display the results of the import process. Once you choose either the **Tools** or an **Importer** tab to import data into the selected database, you can refer to the **Log** panel in the **Database** window to view the results of the import process. The **Log** panel also includes the description of the imported file, if one was entered.

2.3.3.2 RunSpec Summary

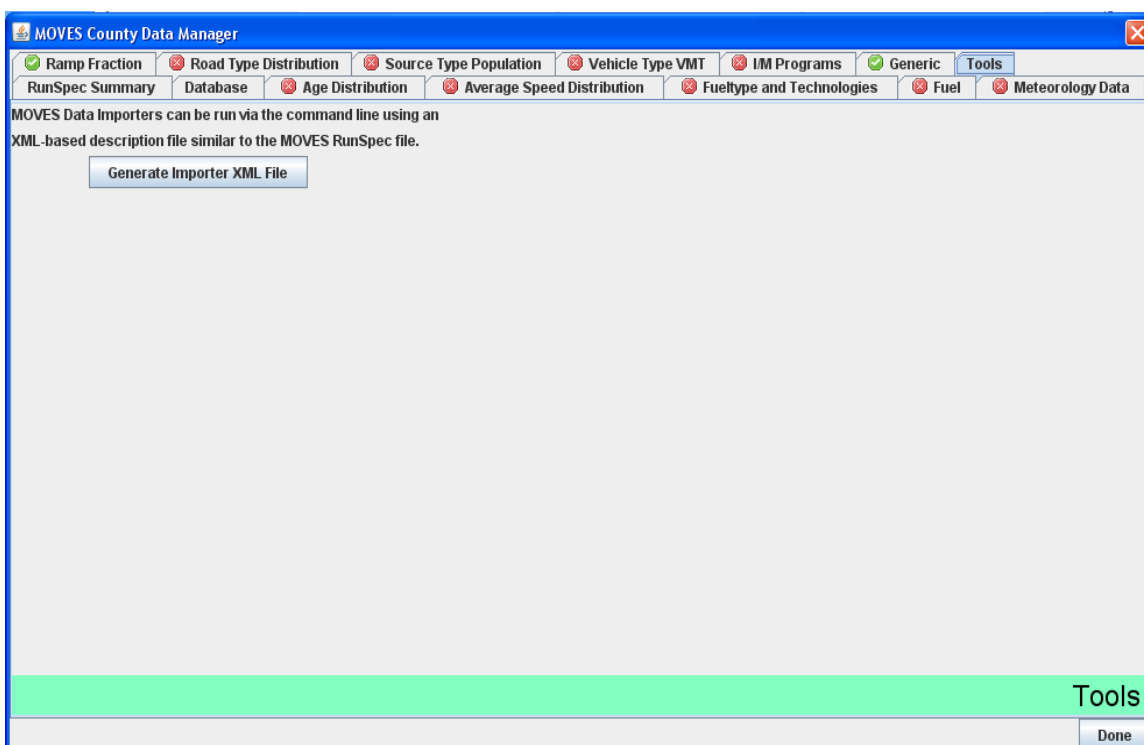
The **RunSpec Summary** provides a summary of RunSpec parameters defined by the user. You cannot view the **Navigation** panels of the GUI without closing the **Importer**, but doing so may impact your ability to effectively employ **Generate Importer XML File** in the **Tools** tab. Therefore, you should choose this tab to see an overview of the RunSpec. In setting up the RunSpec, you define modeling parameters that limit the scope of the modeling process; templates and export files created with the **Data Importer** will be limited by choices the user made in defining the RunSpec.



The **RunSpec Summary** panel of the **Data Importer** displays the geographic, time span, road type, vehicle, pollutant and process, and input data set choices made by the user. The panel is auto-generated and does not accept user input.

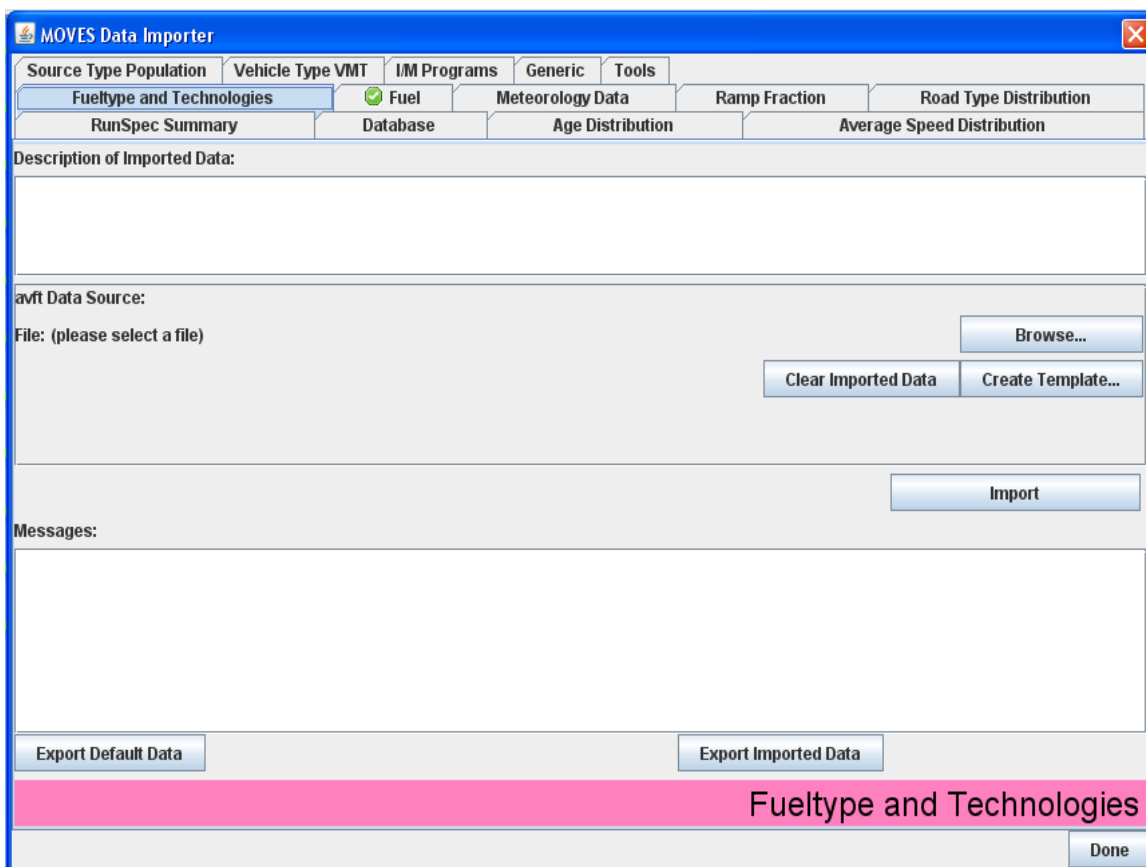
2.3.3.3 Tools

The **Tools** tab is provided to facilitate batch input of imported data into the MOVES system, such as a series of data import files representing all the counties in a state. When you click the **Generate Importer XML File** button after completing an import, the system will write an importer instruction file in Extensible Markup Language (XML), containing a statement that replicates the import done through the GUI. The XML file only includes files that have been imported during the active session so the XML must be generated before you close the **Data Importer**.



Using an XML or text editing program, you can copy and edit the importer XML file to create a series of similar, but not identical import statements; therefore, naming conventions are important to use this tool effectively. The resulting XML files can be called from the command line, generating a series of user-input databases. For more information on running MOVES from the command line (see **Running MOVES from the Command Line - Appendix C**).

2.3.3.4 Data Managers (Importers)



The remaining tabs in the **Data Importer** menu option are **Data Manager** or **Importer** tabs. These tabs contain templates and rules that aid the user in bringing specific types of data into the model and ensuring it has the correct format. By choosing a **Manager** or **Importer**, you gain access to several tools that will help create a successful data import.

!Tip Be sure to fill out all fields in defining the RunSpec before using the **County Data Manager** or the **Project Data Manager**, as a filter is used when exporting default data that depends on selections the user makes when defining the RunSpec. Only the county, year, months, vehicles, road types, etc. that have been selected are exported. Some data may not be exported if the **Export Default Data** button is used before fully defining the Run Spec.

!Tip EPA has developed MOBILE6 converters to help users prepare import-ready data files from their existing MOBILE6 files. These converters are available on the MOVES website.

Select a **Manager** or **Importer** tab to choose a specific importer to assist with specialized data file structure definition and to complete the import process. Importers for the following tables are included in MOVES:

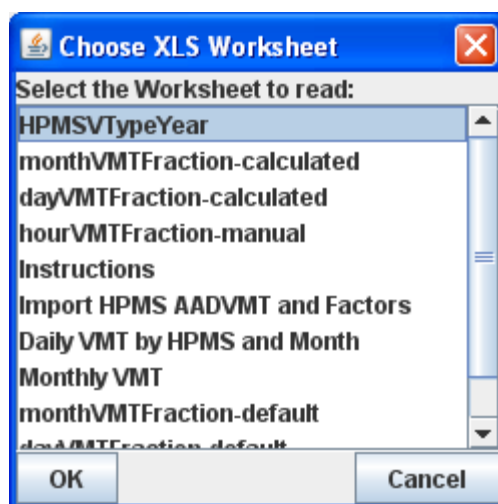
MOVES Table	Data Importer	County Data Manager	Project Data Manager
RampFraction	X	X	
RoadTypeDistribution	X	X	
SourceTypePopulation	X	X	
VehicleTypeVMT	X	X	
Zone	X (Custom Domain Only)	X (Custom Domain Only)	
AgeDistribution	X	X	X
AverageSpeedDistribution	X	X	
Fuel	X	X	X
Fuel Type and Technologies	X	X	X
MeteorologyData	X	X	X
I/M Programs	X	X	X
OperatingModeDistribution			X
LinkSourceType			X
LinkDriveSchedules			X
Off-Network			X

When you select one of these tabs, a panel opens allowing you to define the import parameters. Each **Importer** tab is organized in the same way, with a place for a description of the data; a place where the corresponding MOVES default database table and an input file are identified; buttons to browse for data files, create templates, clear, import, and export data; and a space for messages indicating the success or potential errors with the import process.

Near the top of each importer panel is a text box that allows a description of the data or file being imported. Any text entered here will be reported and saved in the Database Log. Just below the Description box is the Data Source section of the window. Along the left side of this section is text that states: [MOVESTable] Data Source. The [MOVESTable] corresponds to the name of the table in the MOVES default database for which the tab will import data. In most cases, the tab header and MOVESTable name are similar, but in some cases they are not (e.g. **Meteorology Data** corresponds to the ZoneMonthHour table because temperatures are defined for each zone, month, and hour). Refer to the MOVESTable in the MOVES default database to learn more about that table, its structure, and the data contained within it.

Note The default database table may contain more fields than the template or exported default files (described below). There are several reasons why these additional fields may exist in the default table (e.g., the population and VMT tables each include a growth factor that is not used in the **County Domain/Scale** because only a single year can be modeled). Be aware that if the fields do not exist in the template or exported default data file, then these fields should not be added or populated.

Also in the Data Source section of the window are the **Browse**, **Clear Imported Data**, and **Create Template** buttons. After clicking the **Browse** button, you can search through the computer's (or network's) drives to identify the file containing the data to be imported. Upon selecting a file, you may be prompted to select a worksheet:



The correct worksheet should be highlighted before the **OK** button becomes active.

Click the **Create Template** button to create an import template file and a set of reference files. After selecting the **Create Template** button, define the file, file path and extension (e.g., .xls for an Excel file) and click the **Save** button. The template and reference files will be specific to the RunSpec. The template will include required data field names and often will be populated with the required key fields, as specified in the Run Spec. The reference files will provide lists and descriptions of the relevant MOVES ID fields (i.e., countyID codes, fuelformulationID codes, roadtypeID codes, hourDayID codes, and sourcetypeID codes). You can then edit the template with a spreadsheet application or other tool before importing the data files into MOVES.

Although the meaning of many data element names may seem clear, consult the reference tables provided with the template to determine appropriate content for the fields. For example, although fuelYearID might seem to refer to the calendar year, it actually refers to "fuelyear" and does not have a one-to-one mapping with calendar year (the latest fuelyear in MOVES2010b is 2012).

In many cases, you can import duplicate information by using "wildcards" in the input files. See **Table 2.3.3.4b**. For example, using the word "ALL" in a sourceTypeID column of the input file will result in records with the same information for each source type selected in the runspec.

⚠ Caution! "ALL" produces inputs only for all the sourcetypes in the RunSpec rather than all the sourcetypes in the default database. For this reason, you are strongly urged to create a comprehensive RunSpec prior to using the importers.

The hourDayID column supports a special form of the "ALL" wildcard. It allows you to populate all 48 hour intervals (24 x 2 day types) or just the hours in a given day type. Remember, these are constrained by the RunSpec day and hour selections.

The affected fields are:

Column	Wildcard
dayID	ALL
hourID	ALL
hourDayID	ALL ALL Weekday ALL 5 5* *5 ALL Weekend ALL 2 2* *2
monthID	ALL
yearID	ALL <i>Note: Only one year is allowed in the CDM.</i>
roadTypeID	ALL
sourceTypeID	ALL 1* - Applies to all motorcycles 2* - Applies to all passenger cars 3* - Applies to all passenger trucks 4* - Applies to all buses 5* - Applies to all single unit trucks 6* - Applies to all combination trucks
hpmsVTypeID	ALL
countyID	ALL <i>Note: Only one county is allowed in the CDM.</i>
zoneID	ALL

In the receiving database, wildcard data is fully expanded. Importing a file that uses wildcards and then exporting again will produce a file with the full data set.

Once a correctly formatted source file is created, use the **Browse** button to find and open the source file. The file path and name of the selected import file will appear in the panel.

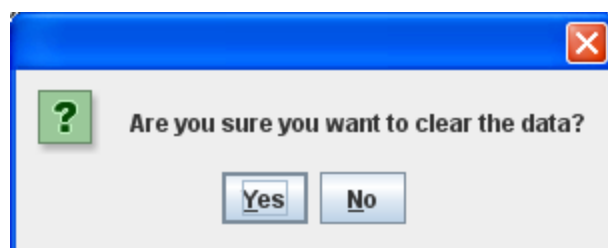
!Tip Make sure to save any changes made to a source file before you import it.

¶ Note Warning messages do not necessarily mean that the imported data is incorrect. For example, you may receive a warning if data for a source types, month, etc. are imported, but that source type or month is not selected in the RunSpec. On the other hand, error messages indicate situations where the source file should be amended to correct the problem, the data should be cleared, and the file re-imported.

Once a file has been selected for import, click the **Import** button to bring the data into MOVES via the file and path defined in the **Database** window. If the file contains multiple worksheets, you are prompted to select the appropriate worksheet as well. Refer to the **Messages** box in the **Importer** tab or the **Log** panel in the **Database** window to determine the status of data import.

!Tip See the **Messages** box for information on import problems and basic information for fixing problematic import files.

Imported data can be cleared from the database by clicking the **Clear Imported Data** button, which is in the Data Source section of the window. When the **Clear Imported Data** button is clicked, the following message box will pop-up:



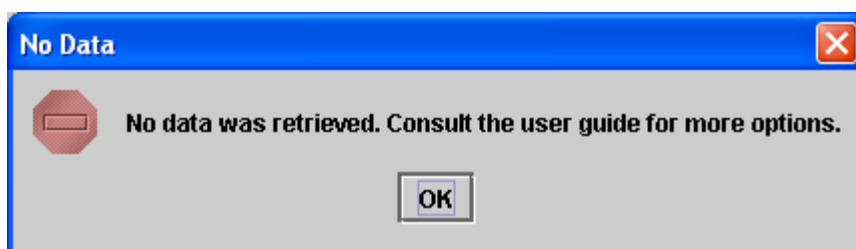
Clicking **Yes** clears the data, while clicking **No** cancels the action and allows you to export the imported data, as described below.

!Tip You should **Clear Imported Data** before reattempting to import a file that resulted in an error message.

Data files can be exported to an Excel spreadsheet or text file using either the **Export Default Data** or **Export Imported Data** button; however, not all tabs in the **County Data Manager** have the **Export Default Data** button. These exceptions are noted in the sections below. Also, some tabs in the **Project Data Manager** include an additional export button, **Export Most Recent Execution Data**. Use of this button requires a previous execution of the MOVES model in order to generate the data which is to be exported.

Clicking on an **Export** button will cause the **Export [Importer] Data** window to open. Define the file path, file name and file extension in the **Export Data** window, and click the **Save** button to export the data to the specified location.

Occasionally, clicking an **Export** button may result in the following pop-up window:



This message simply means that there was no data available to export.

2.3.3.4.1 Meteorology Data Importer

The **Meteorology Data Importer** allows you to import temperature and humidity data for months, zones, counties, and hours that are included in the RunSpec. While the MOVES model contains 30-year average temperature and humidity data for each county, month, and hour, you should enter data specific to the modeled location and time.

2.3.3.4.2 Source Type Population Importer

The **Source Type Population Importer** allows you to input the number of vehicles in the geographic area which is to be modeled for each vehicle or "source type" selected in the RunSpec. While the MOVES table that this importer populates (SourceTypeYear) includes fields for sales growth rate and migration factor, neither of these fields should be imported. They are extraneous because the importer sets the selected year as a base year and defines the population.

⚠ Caution! Vehicle Type VMT, Source Type Population, and Age Distribution are the three tables that MOVES needs to define a base year. If any one of these tables is imported, then all three must be imported, otherwise MOVES may not generate output. However, this requirement does not apply to the **Project Domain/Scale**.

This tab does not have the **Export Default Data** button and you are required to acquire/generate this data independently if the **County Domain/Scale** is chosen. Data must be supplied for each source type (e.g., passenger car, passenger trucks, light commercial trucks, etc.) selected in the RunSpec.

2.3.3.4.3 Age Distribution Importer

The **Age Distribution Importer** allows you to enter data that provides the distribution of vehicle counts by age for each calendar year (yearID) and vehicle type (sourceTypeID). The distribution of ageIDs (the variable for age) must sum to one for each vehicle type and year.

⚡ Caution! Vehicle Type VMT, Source Type Population, and Age Distribution are the three tables that MOVES needs to define a base year. If any one of these tables is imported, then all three must be imported, otherwise MOVES may not generate output. However, this requirement does not apply to the **Project Domain/Scale**.

This tab does not have the **Export Default Data** button and you are required to acquire/generate this data independently if either the **County** or **Project Domain/Scale** are chosen.

2.3.3.4.4 Vehicle Type VMT and VMT Fractions

The **Vehicle Type VMT** importer allows you to enter yearly vehicle miles traveled (VMT) and the monthly, type of day, and hourly VMT fractions. These values will represent national values for the general **Data Importer** and county-specific values for the **County Data Manager**. MOVES requires that yearly VMT be imported regardless of the time span selected for the run, although the VMT Fraction tables can be modified such that the value does not have to actually represent the VMT for the entire year in the area being modeled. Note that the appearance of this table differs from other tabs as multiple data sources are listed in the data source section. Expand the size of the CDM window or use the scroll bar to view all the data sources and buttons.

!Tip The MOVES website has spreadsheet tools to calculate yearly VMT from Average Annual Weekday VMT (AADVMT) and to convert MOBILE6 formatted VMT data into MOVES format.

!Caution! Vehicle Type VMT, Source Type Population, and Age Distribution are the three tables that MOVES needs to define a base year. If any one of these tables is imported, then all three must be imported, otherwise MOVES may not generate output. However, this requirement does not apply to the **Project Domain/Scale**.

The **Export Default Data** button for this tab exports the default monthVMTFraction, dayVMTFraction, and hourVMTFraction tables. An HPMSVTypeYear table with values of zero for all HPMS classes is also exported, which can serve as a template that you can edit before importing, but you are required to acquire/generate the VMT data independently if the **County Domain/Scale** is chosen. Data must be supplied for each HPMSVType (e.g., passenger cars, combination trucks, etc.) implied by the Source Use Types selected in the RunSpec.

Each of the VMT Fraction tables must sum to 1 across a varying set of fields. The monthVMTFraction table must sum to 1 for each sourcetype. The dayVMTFraction table must sum to 1 for each source type-month-road type combination. The hourVMTFraction must sum to 1 for each source type-road type-type of day combination. In the monthVMTFraction table, you must also correctly identify whether the year being modeling is (Y) or is not (N) a leap year in the 'isLeapYear' field.

⚡ Caution! For all the VMTFraction tables (month, day, and hour), a warning message will appear if the fractions provided by the user sum to less than 1, and the tab header will erroneously turn to a green check. This should be an error message, and the tab header should be red. Enter VMTFraction tables that sum to 1 even if not all 12 months, 2 types of day, or all 24 hours are being modeled.

Modeling a portion of a year has two options: import a true yearly VMT value (i.e. a value defining VMT for all months, days, and hours) and give the desired allocation to the time periods being modeled and populate the other months, day, or hours with placeholder values such that the each of the VMTFraction tables correctly sums to 1. Or, import only the amount of VMT appropriate for the time period being modeled and may assign values that correctly allocate this VMT over the modeled time periods. You may also enter data only in the HPMSVTypeYear Data Source importer and ignore the month, day and hour fraction importers. If this is done, MOVES will apply default fractions for month, day and hour.

The Import button will import the file identified for each data source at once. Therefore, you can, but are not required to, select all four files before importing. You can also clear one data source file at a time by clicking the Clear Imported Data button associated with each data source.

!Tip The overall **Import** button on the **Vehicle Type VMT** importer should not be depressed until all of the desired individual imports have been selected using the respective **Browse** buttons.

2.3.3.4.5 Average Speed Distribution Importer

The **Average Speed Distribution Importer** allows you to input average speed data specific to vehicle type (sourceTypeID), road type (roadTypeID), and time of day/type of day (hourdayID). MOVES defines 16 "speed bins" which describe the average driving speed on a roadtype or link. You must enter the fraction of driving time in each speed bin (avgSpeedFraction) for each hour/day type, vehicle type, road type, and average speed (avgspeedbinid), where the fractions sum to unity for each combination of vehicle type, road type, and hour/day type specified in the RunSpec. If desired, use wildcards to apply one set of fractions for all hour/day combinations for a specific vehicle type and road type. Note that MOVES uses a time-based distribution, whereas MOBILE6.2 used a VMT-based speed distribution. You need to adjust your travel model post-processing code in order to generate the new distributions. Default values may be exported in the County Data Manager.

MOVES Data Importer

Source Type Population | Vehicle Type VMT | **I/M Programs** | Generic | Tools

Fueltype and Technologies | **Fuel** | Meteorology Data | Ramp Fraction | Road Type Distribution

RunSpec Summary | Database | Age Distribution | **Average Speed Distribution**

Description of Imported Data:

avgSpeedDistribution Data Source:

File: (please select a file) Browse...

Clear Imported Data Create Template...

Import

Messages:

Export Default Data Export Imported Data

Average Speed Distribution

Done

2.3.3.4.6 Road Type Distribution Importer

The **Road Type Distribution Importer** allows you to enter data relating to the vehicle miles traveled by road type (roadTypeVMTFraction) for the domain being modeled. This data is entered as a distribution across road types (roadTypeID), where only road types selected in the RunSpec are included in the distribution. The distribution must sum to 1 for each source type.

Note When comparing input roadtype distributions to the VMT output in the **MOVESActivityOutput** table, it may not appear that the road type distribution was applied properly if you look only at individual hourly or daily VMT results. However, you must compare the input road type distribution to the total weekly VMT by weighting the VMT results by the number of each type of day (5 weekdays, 2 weekend days). The VMT should be compared at a weekly level because of the effect of the dayVMTFraction table on the VMT output. For example, in the default DayVMTFraction table, the weekend fraction for rural roads is slightly higher than the weekend fraction for urban roads. If these default dayVMTFraction values are applied, the VMT in MOVES output by daytype will show a slightly higher-than-average fraction of total VMT on urban roads on weekdays, and on rural roads on weekends.

The screenshot shows the 'MOVES Data Importer' window with the 'Road Type Distribution' tab selected. The window has a menu bar with 'Source Type Population', 'Vehicle Type VMT', 'I/M Programs', 'Generic', and 'Tools'. Below the menu bar are several sub-tabs: 'Fueltype and Technologies', 'Fuel' (with a green checkmark), 'Meteorology Data', 'Ramp Fraction', 'Road Type Distribution' (highlighted), 'RunSpec Summary', 'Database', 'Age Distribution', and 'Average Speed Distribution'. The main area contains a 'Description of Imported Data' text box, a 'roadTypeDistribution Data Source:' section with a 'File: (please select a file)' label and a 'Browse...' button, and buttons for 'Clear Imported Data', 'Create Template...', and 'Import'. Below this is a 'Messages:' section with a large text box and an 'Export Imported Data' button. A cyan banner at the bottom reads 'Road Type Distribution', and a 'Done' button is in the bottom right corner.

This tab does not have the **Export Default Data** button and you are required to acquire/generate this data independently if the **County Domain/Scale** is chosen.

2.3.3.4.7 Ramp Fraction Importer

The **Ramp Fraction Importer** allows you to modify the fraction of ramp driving time on selected road types. Only limited access roadtypes (freeways and interstates) may have their ramp fractions modified. Thus, this **Importer** is only active if you select a limited access road type when defining the RunSpec.

The **County Data Manager** automatically applies default values of 0.08 (8%) for this parameter if you do not provide input, so importing ramp fractions is optional when **County Domain/Scale** is chosen.

Note The **Ramp Fraction** tab will only become available if a restricted road type (i.e. 2 or 4) is selected in the RunSpec.

2.3.3.4.8 Fuel

The **Fuel Formulation** and the **Fuel Supply** importers should be used together to input appropriate fuel data. The **Fuel Formulation** importer allows you to select an existing fuel in the MOVES database and change its properties, or create a new fuel formulation with different fuel properties. All fuel formulations imported in the **Fuel Supply** importer must exist in the MOVES default FuelFormulation table or be imported. If you define a new fuel, all of the fields except the last three (BioDiesel, Cetane and PAHContent) are required. Biodiesel may be modeled by entering a biodiesel volume in the Fuel Formulation table and a 'marketshare' for the new biodiesel fuel in the Fuel Supply table. The inputs for the Cetane and PAHContent variables are currently inactive in MOVES.

The **Fuel Formulation** importer allows you to change the following fuel properties:

Property	Description
FuelFormulationID	Fuel formulation identification number. Must be greater than 100 and less than 25000
Fuel Sub-Type	Fuel Sub-type coding—see Template File
RVP	Reid vapor pressure in psi
Sulfur Level	Fuel sulfur level in ppm Sulfur
ETOH Volume	Ethanol Volume (% vol)
MTBE Volume	MTBE Volume (% vol)
ETBE Volume	ETBE Volume (% vol)
TAME Volume	TAME Volume (% vol)
Aromatic Content	Aromatic content (% wt)
Olefin Content	Olefin content (% wt)
Benzene Content	Benzene content (% wt)
E200	Lower volatility percentage (%)
E300	Upper volatility percentage (%)
VolToWtPercentOxy	Constant based on oxygenate type
BioDieselEsterVolume	BioDiesel Ester Volume (%)
Cetane Index	Not Implemented - NULL
PAHContent	Not Implemented - NULL
T50	Temperature (F) where 50% of the fuel is vapor
T90	Temperature (F) where 90% of the fuel is vapor

Table 2.3.3.4.2 Fuel Formulation

The **Fuel Supply** importer allows you to assign existing fuels to counties, months, and years, and to assign the associated market share for each fuel. The market share for a given fuel type (gasoline, diesel, etc.) must sum to 1 for each county, fuelyear (i.e., calendar year), and month. In MOVES, you may select fuels from those available in the default database or create your own fuel inputs. Any new fuels which are added to the **Fuel Supply** importer must either be added in the **Fuel Formulation** importer or must already exist in the default MOVES database. You must be sure to identify a fuel formulation for all vehicle-fuel type combinations selected in the **On Road Vehicle Equipment** panel.

This importer also allows you to supply a data element, "marketShareCV", which is the coefficient of variation for the market share. This would be used if uncertainty calculations were enabled. For MOVES the value is not required and may be left blank.

⚠ Caution! Although fuelYearID might seem to refer to the calendar year, the year table in the MOVES default database maps all years 2012 through 2050 to the "fuelyear" 2012; thus for years 2012 through 2050, the fuelyearid 2012 should be used.

!Tip Modeling different fuels in different years (2012-and later) can be done with a separate run for each year, assigning different fuels to the 2012 fuelyearid for each run.

2.3.3.4.9 Fueltype and Technologies

The **Fueltype and Technologies** importer is a new feature in MOVES2010B. It replaces the previous **Strategy** called **Alternative Vehicle and Fuel Technologies (AVFT)**. It allows you to specify the distribution of fuel types in the model. Specifically, this importer allows you to supply the fleet distribution fraction by fuel type, source type, model year, and engine technology. A value of '1' designating "conventional internal combustion" for engine technology is generally supplied. Data for the fuel types specified in the Runspec should be supplied. The data entry fuelEngFraction must sum to unity across all the fuel types for a given source type, model year, and engine technology. No single entry may be less than zero or greater than one. For both the **County Domain Manager** and the **Project Domain Manager**, you can export a complete set of default values.

⚡ Caution! When entering data in the Fueltype and Technologies Importer, select in the **Vehicles/Equipment – On Road Vehicles** panel, all of the fuel types for each vehicle source type they wish to model. For example, if it is desired to model a fleet of 100 percent diesel transit buses, select gasoline and CNG transit buses in their RunSpec. Otherwise, MOVES will compute an incorrect number of buses in the fleet.

2.3.3.4.10 Zone Importer

In MOVES2010b, the **Zone Road Activity Importer** is now the **Zone Importer**. It is used (*and will only appear*) if the **Custom Domain** option is chosen in the **County Domain Manager**. Currently, MOVES only has the capability to model one offnetwork zone at a time within a **Custom Domain**, though **multiple zones containing non-offnetwork road types are supported**.

The Zone Importer contains three separate tables that need to be supplied by the user. These are the Zone table, the ZoneRoadType table and the SCCRoadTypeDistribution table. None of these tables have the **Export Default Data** button, so first create a file template to populate the tables.

2.3.3.4.10.1 Zone Table

The **Zone** table contains the startAllocFactor, the idleAllocFactor and the SHPAllocFactor for each zoneID / countyID. All of these factors must sum to unity across all custom zones.

2.3.3.4.10.2 ZoneRoadType Table

The **ZoneRoadType** table contains the SHOAllocFactor for each zoneID and roadTypeID. The data must be entered for each roadTypeID in the RunSpec. Typical input should be four rows of data with the SHOAllocFactor set to unity in all cases.

2.3.3.4.10.3 SCCRoadTypeDistribution Table

The Source Classification Code **SCCRoadTypeDistribution** table contains the sccRoadTypeFraction. A value must be submitted for each zoneID, roadTypeID and sccRoadTypeID. There must be an entry for each road type selected in the RunSpec and a value for each of the twelve sccRoadTypeIDs. The sum across the twelve sccRoadTypeIDs for a given roadtype must be unity for each custom zone.

2.3.3.4.11 Links Importer

The **Links Importer** is used only in the **Project Data Manager**. It allows you to define individual roadway links. The MOVES links need not correspond to traffic modeling "links", but each link should be uniform in its activity as described its MOVES parameters. Each link requires a linkID (i.e., a unique integer between 1 and 99999 that is used to reference the link in the program). Other required inputs for each link are countyID, zoneID, and roadTypeID (these same entries must be specified in the RunSpec or an error will occur), the length of the roadway link in units of miles, the traffic volume on the roadway link in units of vehicles per hour, the average speed of all of the vehicles on the roadway link in the given hour, and the average road grade % of a particular link. The link description field is a text field included for reference and has no impact on the calculations.

In addition to roadway links, a project may include a single "off-network" (parking lot or other non-road) link. For an off-network link, enter a value of zero for link length, link volume, link average speed and link average grade (percent grade).

For Project level modeling, you have a choice of ways to describe the speed, acceleration and power of the vehicles being modeled. Depending on the information available for each roadway link, you may enter an operating mode distribution, a drive schedule or an average speed. For a given roadway link, a user-supplied operating mode distribution input will take calculation precedence over an imported drive schedule, which will take calculation precedence over an average link speed input when more than one is entered for a given link.

Use of a link average speed input in the **Links Importer** requires the least amount of road link data to be provided by you. All that is required is an average link speed and an average link road grade (in units of percent grade). The model will use built-in driving schedules and an interpolation algorithm to produce a default operating mode distribution.

Table 2.3.3.4.11 shows the allowable ranges for the average speed inputs in Project level runs. You may enter any speed in units of miles per hour (mph) within the given range. Average link speed inputs outside of the speed range will cause the closest available drive cycle to be selected, and issue a warning message to the user.

These average speed ranges exist in MOVES project level because these ranges represent the extent of the available driving cycle data in the MOVES model. The MOVES model does not extrapolate beyond its built-in data. Should you desire to model a link with an average speed that is less than the minimum or greater than the maximum, you must supply the second by second driving schedule or an equivalent operating mode distribution.

Allowable Average Speed Input Range for Project Level Input By Source Type			
sourceTypeID	sourceTypeName	Minimum Speed (mph)	Maximum Speed (mph)
11	Motorcycle	2.5	73.8
21	Passenger Car	2.5	73.8
31	Passenger Truck	2.5	73.8
32	Light Commercial Truck	2.5	73.8
41	Intercity Bus	4.6	72.8
42	Transit Bus	15.0	72.8
43	School Bus	15.0	72.8
51	Refuse Truck	2.2	71.7
52	Single Unit Short-haul Truck	4.6	72.8
53	Single Unit Long-haul Truck	4.6	72.8
54	Motor Home	4.6	72.8
61	Combination Short-haul Truck	5.8	71.7
62	Combination Long-haul Truck	5.8	71.7

Table 2.3.3.4.11 Allowable Average Speed

2.3.3.4.12 Link Source Types Importer

The **Link Source Types Importer** is used only in the **Project Data Manager**. It is used to enter the fraction of the link traffic volume which is driven by each source type. It is not used to enter off-network data, and is not required if the Project contains only an off-network link. For each linkID, the sourceTypeHourFraction must sum to one across all source types. If you enter data for source types which are not selected in the RunSpec, MOVES will ignore that data. The Project level calculator will not re-normalize the fractions to omit the contribution of source types which are not selected in the RunSpec.

2.3.3.4.13 Operating Mode Distribution Importer

The **Operating Mode Distribution Importer** is used only in the **Project Data Manager**. It allows you to import operating mode fraction data for source types, hour / day combinations, roadway links and pollutant / process combinations that are included in the RunSpec and Project domain. This data is entered as a distribution across operating modes. Operating modes are modes of vehicle activity that have a distinct emission rate. For example, running activity has modes that are distinguished by their Vehicle Specific Power and instantaneous speed. Start activity has modes that are distinguished by the time the vehicle has been parked prior to the start ("soak time"). See EPA technical reports for additional information on operating modes. For a given source type, hour/day combination, roadway link and pollutant / process combination, the operating mode distribution must sum to one.

The Operating Mode Distribution Importer must be entered directly into the **Project Data Manager** when modeling any 'non-running emission' process. The start process has eight operating modes that require data and tire wear has sixteen operating modes. It is optional for modeling 'running emission' processes. But if chosen, data for all twenty-three running exhaust operating modes must be entered. For the running processes, **Operating Mode Importer data** has precedent over data entered in the **Link Drive Schedules Importer** and the **Links Importer** average speed input if conflicting data are entered.

2.3.3.4.14 Link Drive Schedules Importer

The **Link Drive Schedules Importer** is used only in the **Project Data Manager**. It allows you to define the precise speed and grade as a function of time (seconds) on a particular roadway link. The time domain is entered in units of seconds, the speed variable in miles per hour and the grade variable in percent grade (i.e., vertical distance / lateral distance; 100% grade equals a 45 degree slope).

This **Importer** is used for the **Project Data Manager** only when modeling 'running emission' processes when the **Link Drive Schedules Importer** is used. For a given roadway link, an operating mode distribution input will take calculation precedence over an imported drive schedule. An imported drive schedule will take calculation precedence over an average link speed input when more than one is entered for a given link. However, at least one of three (an operating mode distribution, a link drive schedule or a link average speed) must be entered for each of the defined roadway links.

2.3.3.4.15 Off-Network Importer

The **Off-Network Importer** is used only in the **Project Data Manager**. It provides information about vehicles which are not driving on the project links, but still contribute to the project emissions. For each source type in the RunSpec, **vehicle population** is the average number of "off-network" vehicles during the hour being modeled. The **start fraction** field is a number from 0 to 1.0 which specifies the fraction of this population which has a 'start' operation in the given hour. The **extendedIdle fraction** field is a number from 0 to 1.0 which specifies the fraction of the population which has had an 'extended idle' operation in the given hour.

When using a Custom Domain, the off-network information is applied to each custom zone. It is important to include exactly one off-network link regardless the number of custom zones.

For example, a vehicle population of 10 long-haul combination trucks with a start fraction of 0.5 and, an extended idle fraction of 0.25 includes the emissions associated with 5 starts, 150 minutes of extended idling (10 vehicles * 60 minutes * 0.25) and 300 minutes of parking (10 vehicles * 60 minutes * 0.5) for this sourcetype.

Note MOVES computes extended idle emissions only for long-haul combination trucks, not for other sourcetypes; thus the extendedIdleFraction is ignored for sourceTypeIDs other than 62.

Note MOVES does not compute evaporative emissions at the Project Domain/Scale; thus, the parked vehicle fraction is ignored.

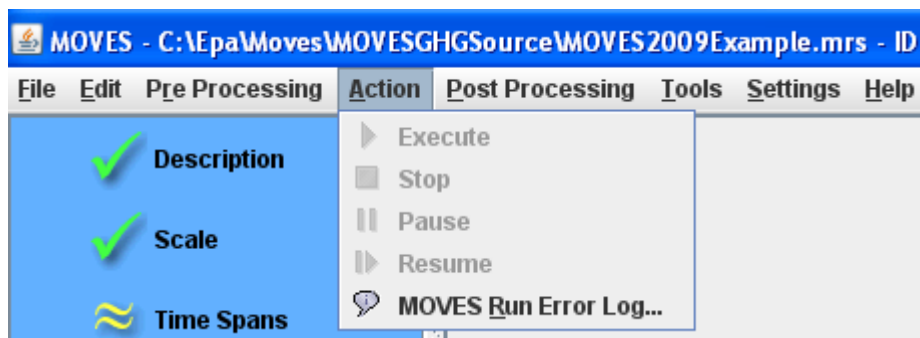
2.3.3.4.16 I/M Programs Importer

The **I/M Programs Importer** is used in both the **County Domain Manager** and **Project Data Manager**. It allows you to specify the level of compliance and general effectiveness of your I/M program design. The compliance factor input is a multiplicative factor that encompasses I/M program performance metrics such as waiver rates, exemptions, special training programs and general effectiveness. It can range from 0 percent (a program that has no effectiveness or merit) to 100 percent (highest possible success). The compliance factor is entered as a function of pollutant-process, location, source type, model year range, fuel type and specific I/M test types. The variable “useIMyn” is a yes/no status that controls the use of the data. The lack of data in this importer will lead to the modeling of a “no I/M” scenario.

When using the county data manager, the **I/M Programs** input tab will never automatically supply I/M Coverage data to the county input database. This is indicated by the red ‘x’ mark, and is true even if the selected county has an I/M program. The MOVES program will successfully run with a no I/M program scenario if the I/M Coverage tab has a red ‘x’ mark. If you desire to utilize the default I/M data for a given county, you must select the **Export Default Data Button** to export the default data to a spreadsheet and then **import** the data back into the county input database. The new “No I/M program” check box will clear all existing I/M data from the county input database and set the database to a no I/M status.

2.3.4 Action

Action provides a drop-down menu with the choices **Execute**, **Stop**, **Pause**, **Resume**, and **MOVES Run Error Log**.



After satisfying the RunSpec input requirements. All check marks in the Navigation Panel must be set to green checks or yellow tildes (see **Navigation Panel** – Section 2.2). Choose **Execute** to begin the MOVES simulation. Choose **Stop** or **Pause** in the **Action** menu to stop or pause the execution of the MOVES program. These two items will only be active if the MOVES program is running. You may also resume a paused MOVES simulation by clicking the **Resume** item.

Note A program that has been stopped cannot be resumed.

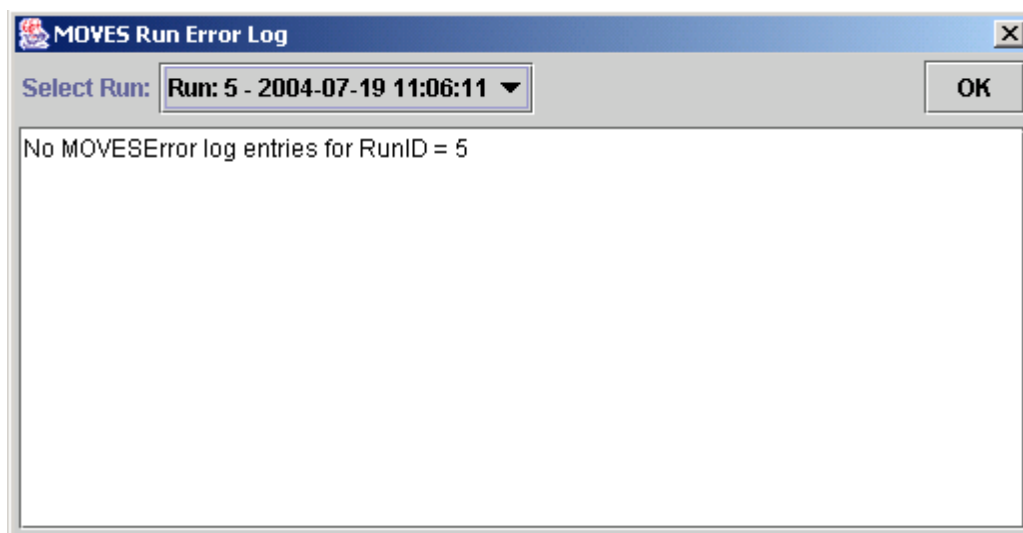
Note Depending upon where the MOVES program is in its processing, the Stop Command may not end a MOVES run immediately. If necessary, MOVES can be terminated by clicking the X in the upper right hand corner of the MOVES GUI or the MOVES command line window.

Click **MOVES Run Error Log** to display information on the processing outcome of the execution in the **MOVES Run Error Log** window. Alternatively, the log can be displayed by selecting the ALT and R keys when the Action menu option is open.

Note The **MOVES Run Error Log** option is available only if a MOVES Output database has been created.

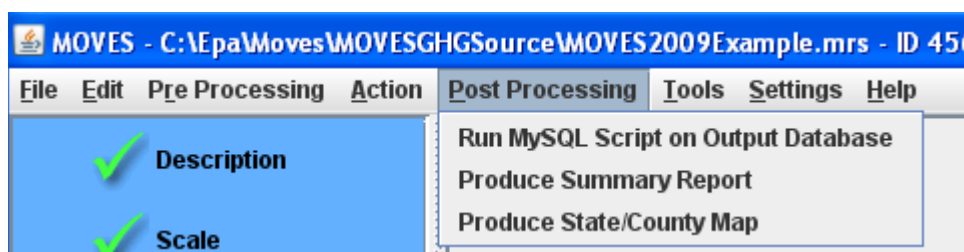
Typically, you should select **MOVES Run Error Log** immediately after the MOVES program has completed its execution. The window (shown below) will contain either a message stating that the run was successful and that no errors occurred, or it will report a brief error message. The example shows a successful run, indicating the run number (Run 5) and the time and date of the run. You can also view the Run Error Log for the error status of previous runs by clicking the down arrow on the right side of the **Select Run** button.

Note Not all error log messages indicate invalid results. For example, "Warning: RunSpec doesn't have all the RoadTypes", indicates a problem with the RunSpec only if you had intended to include all roadtypes.



2.3.5 Post Processing

MOVES output databases can be viewed and processed directly using MySQL Query Browser or other database tools. In addition, MOVES provides a few simple options to post-process and view the MOVES results. **Post Processing** contains three menu options, **Run MySQL Script on Output Database**, **Produce Summary Report**, and **Produce State/County Map**. These features can be used after a successful execution of a MOVES RunSpec to further process the MOVES results into more aggregate or easy-to-use formats.



2.3.5.1 Run MySQL Script on Output Database

The **Run MySQL Script on Output Database** menu option enables you to select from a set of MySQL scripts to further process the MOVES output databases stored in the MySQL database format. After selecting this menu option, click the arrow in the scroll down box to view all the available scripts. Several scripts are distributed with MOVES (described in more detail below). Select a post-processing script by clicking to highlight it. To execute the script, click the **OK** button. The script will run on the output database that is selected in the General Output panel of the RunSpec.

The first script, **DecodeMOVESOutput.sql**, is an example script that decodes the SourceUseType and FuelType fields from numerical code classification to the full text description. The script produces two new output tables with the expanded text descriptions: decodedmovesactivityoutput and decodedmovesoutput.

Caution! Note that the MOVES Decode script uses the default database supplied with MOVES to decode the numeric values in the tables. If the default database has been replaced, the Decode script will need to be modified with the new database name.

A second script, **TabbedOutput.sql**, takes three MOVES MySQL output tables (MOVESOutput, MOVESActivityOutput and MOVESRun) and converts them into tab-delimited text files that can be read by a spreadsheet program such as Excel or Lotus123. This is useful if you do not want to work with the results in the MySQL relational database format. In MOVES, this can also be done with the **Summary Reporting** feature. Both scripts work with **Inventory** output, not **Emission Rate** output.

A third script, **EmissionRates.sql**, divides the emission totals in the MOVESOutput table by the distance traveled totals in the MOVESActivityOutput table. The resulting values are in units of grams/vehicle-mile. A rate will be produced for each line of output. Depending on what was selected in the Output Emission Detail panel of the RunSpec, this could be one aggregate rate, or many disaggregate rates (e.g., one rate for each source type, fuel type, and model year). The script produces a new table in the output database called emissionrates.

The remaining scripts were developed to automate the process of calculating emission factors for use in air quality modeling. Once MOVES has been run at the project-level, the scripts may be used to appropriately sum emissions from each of the relevant processes into one aggregate link emission rate. For CO analyses, the following three scripts are available:

CO_Grams_Per_Hour.sql, **CO_Grams_Per_Veh_Mile.sql**, and **CO_CAL3QHC_EmissionFactors.sql**. Each script automates the post-processing steps described in Section 2.5 of the EPA guidance document, "Using MOVES in Project-Level Carbon Monoxide Analyses" (EPA420-B-10-041, December 2010). Depending on the purpose of the CO analysis, you can choose to generate link specific emission rates for CO as either grams per hour or grams per vehicle-mile. Additionally, a script is available that produces both free flow emission rates (grams per vehicle-mile) and idle emission rates (grams per vehicle-hour) which may be used in the CAL3QHC dispersion model. Running a script will produce a table in the output database that matches the name of the selected script (e.g., CO_grams_per_hour).

For PM analyses, the following four scripts are available: **PM25_Grams_Per_Veh_Mile.sql**, **PM25_Grams_Per_Hour.sql**, **PM10_Grams_Per_Veh_Mile.sql**, and **PM10_Grams_Per_Hour.sql**. Each script automates the post-processing steps described in Section 4.6 of the EPA guidance document: "Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM_{2.5} and PM₁₀ Nonattainment and Maintenance Areas" (EPA420-B-10-040, December 2010). You can generate link-specific emission rates or PM_{2.5} and PM₁₀ as either grams per vehicle-mile or grams per hour, whichever may be needed for dispersion modeling. Running a script will produce a table in the output database that matches the name of the selected script (e.g., PM25_grams_per_veh_mile).

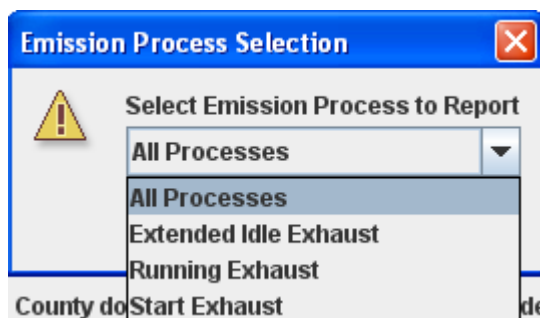
Each script has limited error checking and you should ensure that you follow all recommendations in the relevant EPA guidance document when running MOVES and executing a post-processing script.

!Tip The **Run MySQL Script on Output Database** Post Processing feature of MOVES also allows you to run user-created MySQL scripts. Each user-created post-processing script must be a text file containing Structured Query Language (SQL) commands, and containing a .SQL file extension. Detailed instructions on writing a MySQL script are beyond the scope of this document. To access a user-created script from the tool bar, the completed script must be saved to the OutputProcessingScripts subfolder of the Database subfolder of the MOVES program folder. In other words, the path should be similar to the following: C:\...\MOVES\Database\OutputProcessingScripts.

2.3.5.2 Produce Summary Report

The **Produce Summary Report** menu option allows you to summarize and report the output of one or more MOVES runs in a variety of ways. Reports can be viewed on the screen, printed, or saved in an ASCII text form that is easily imported into other software formats such as Microsoft Excel. The Summary Reporter makes it easy to display and print summary reports of MOVES Output information and convert them to ASCII text files. For the Summary Reporter to operate properly, the RunSpec which produced the output, or one sufficiently similar to it, needs to be loaded in MOVES.

When **Produce Summary Report** is selected and suitable RunSpec has been loaded, a pop-up appears asking you to specify an emission process to be reported. The default option (which is the only option if the run did not distinguish results by emission process) is to combine the output results for all emission processes included in the RunSpec. But in many cases, you will want to select an emission process from the drop down list.



Clicking **OK** allows you to specify the content and level of report aggregation.

Specify Parameters for Summary Report

Specify Report for Emission Process: Total of All

Report Description: Summary Report

Report Table Name: SummaryReport

Run Number(s)

Run: 1 Time: 2012-02-02 10:02:27.0 examplecity_2013_july

Categories

yearID
sourceTypeID
fuelTypeID
MOVESRunID

Data Items

Distance
Methane (CH4)
Nitrous Oxide (N2O)
Total Energy Consumption
Total Gaseous Hydrocarbons

Add **Add All** **Add** **Add All** **Add** **Add All**

Selection **Selection** **Selection**

Remove **Remove All** **Remove** **Remove All** **Remove** **Remove All**

OK **Cancel**

This screen allows you to:

1. Give the report a title. The default title is "Summary Report", but you may change this in the text field.
2. Specify the base portion of the table names which will be used to store various portions of the report. The default file name root is "Summary Report", but you should change this in the text field.

Caution! Files which already have this base file name will be overwritten without warning if reports are generated with the same base file name.

3. Select the Run Number(s), Categories, and Data Items to be reported. The **Add** or **Add All** buttons may be used to select the Run Number(s), Categories and Data Items. Highlighting one entry and pressing the **Add** button will move the selected item to the **Selection** box below. Pressing the **Add All** button selects all items and moves them to the **Selection** box below. The order in the Selection boxes for Categories and Data Items may be changed using the up and down arrows to the right of the Selection boxes. Similarly, the items in the Selection boxes may be removed by using the **Remove** or the **Remove All** buttons below the **Selection** boxes.
4. Choose the categories to be distinguished in the report. At least one category must be selected. The category list is based on the run specification. The fewer categories selected, the more aggregate the report will be. Dimensions not distinguished when the run was made are not included. In this example, one category, **MOVESRunID**, has been selected.

!Tip If multiple runs are included in the report, you may wish to select the "**MOVESRunID**" category. Otherwise, the results of the multiple runs will be combined in the report. Conversely, if only a single run is included in the report, there is little reason to select the **MOVESRunID** category.

5. Select the data items to be included in the report. At least one data item besides **Distance** must be selected.

In the following example, Run 1, Distance, Total Energy Consumption, Total Gaseous Hydrocarbons, and Methane have been selected. These items will be reported by yearID and sourceTypeID and FuelTypeID.

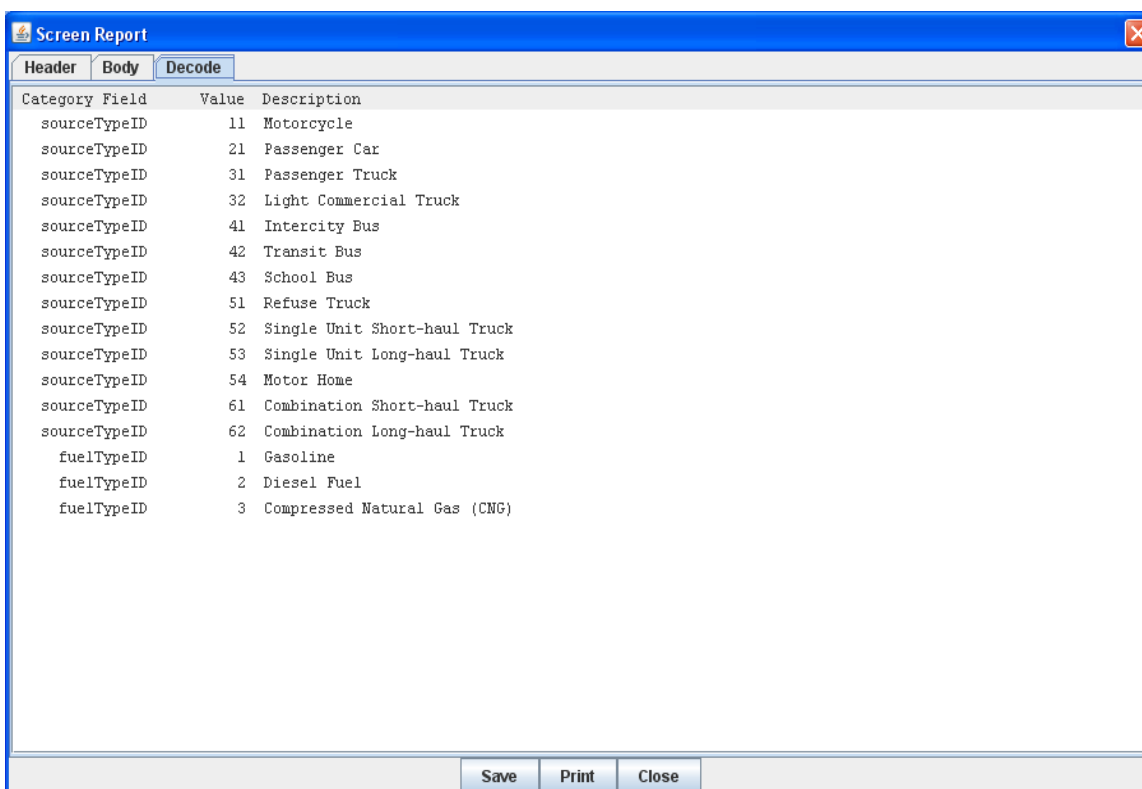
⚠Caution! If the output data is disaggregated by day or hour, the output database will contain results for only two days in each month - a weekday (dayID 5) and a weekend-day (dayID 2). In this case, Summary Reporter should not be used to display results for a month or year, since the current code erroneously simply sums these two days together. You should distinguish by dayID in the report and then externally weight the result according to the type of day to see meaningful result for a month (e.g. 22 weekdays and 9 weekend-days in a 31-day month) or year (e.g. 261 weekdays and 104 weekend-days in a 365-day year).

In the example shown above, all report options have been selected.

When **OK** is clicked, the screen report appears:

Screen Report						
Header Body Decode						
Year	Source	Fuel	Run	CH4	N2O	TotalHC
1999	11	1	2	874938816	54432328	27472619520
1999	21	1	2	88663293952	59442847744	1598635769856
1999	21	2	2	3619720	4495726	1675368960
1999	31	1	2	57848537088	50761465856	901355667456
1999	31	2	2	24973050	30540892	7075398656
1999	32	1	2	21132898304	16415342592	290852929536
1999	32	2	2	55232448	64629832	15077671936
1999	41	2	2	8842548	7004616	2241538816
1999	42	1	2	901927	444902	12170820
1999	42	2	2	3250926	2837879	845418816
1999	42	3	2	5354938	7409710	89545000
1999	43	1	2	486073664	65153484	4372100096
1999	43	2	2	8515191	9565705	1980975872
1999	51	1	2	13933925	4062813	291842304
1999	51	2	2	6527126	5723209	1808769408
1999	52	1	2	9912993792	1792169728	72474992640
1999	52	2	2	98257856	102186472	31260168192
1999	53	1	2	225449200	109511504	2632124928
1999	53	2	2	7795810	7923254	2214195712
1999	54	1	2	481020800	110483008	7628037120
1999	54	2	2	1654447	1552680	621737280
1999	61	1	2	138056400	13394930	3020263168
1999	61	2	2	158135776	133902168	44355325952
1999	62	2	2	157552064	132880176	38234284032

Note that the report consists of three tabs: **Header**, **Body**, and **Decode**. The **Body** tab is the default view; the other tabs are accessed by clicking on them. The body of the report contains columns for each of the category and data items selected. Clicking on the **Header** tab displays the report title, date and time the report was made, several items of information about the run specification, and the emission process covered by the report. Clicking on the **Decode** tab displays the decoded numeric codes included in the report.



The screenshot shows a window titled "Screen Report" with three tabs: "Header", "Body", and "Decode". The "Decode" tab is active, displaying a table with three columns: "Category", "Field", "Value", and "Description". The table lists various vehicle types and fuel types with their corresponding IDs and descriptions.

Category	Field	Value	Description
sourceTypeID		11	Motorcycle
sourceTypeID		21	Passenger Car
sourceTypeID		31	Passenger Truck
sourceTypeID		32	Light Commercial Truck
sourceTypeID		41	Intercity Bus
sourceTypeID		42	Transit Bus
sourceTypeID		43	School Bus
sourceTypeID		51	Refuse Truck
sourceTypeID		52	Single Unit Short-haul Truck
sourceTypeID		53	Single Unit Long-haul Truck
sourceTypeID		54	Motor Home
sourceTypeID		61	Combination Short-haul Truck
sourceTypeID		62	Combination Long-haul Truck
fuelTypeID		1	Gasoline
fuelTypeID		2	Diesel Fuel
fuelTypeID		3	Compressed Natural Gas (CNG)

At the bottom of the window, there are three buttons: "Save", "Print", and "Close".

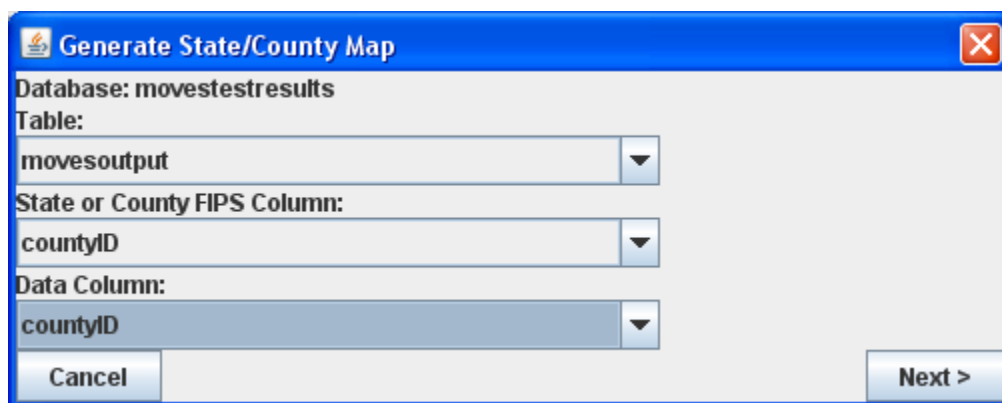
When you are done viewing the screen report, click **Save** to save the report, **Print** to print the report, or **Close** to close the Summary Reporter without printing.

Caution! The Summary Reporter does not store reporting options, other than the last report title and base file name used. Because information is not remembered between Summary Reporter runs, you should not close the report until the user is done viewing it.

2.3.5.3 Produce State/County Map

The **Produce State/County Map** menu option allows you to see the RunSpec output depicted in color-coded or gray-scaled maps. The maps can illustrate output at the county level, and represent value ranges of a single numerical variable which can be selected from a list by the user. It should be noted that this is a very basic mapping tool with very specific input requirements. For more sophisticated mapping options, you may want to apply GIS tools or other software to the MOVES database output.

For the **Produce State/County Map** tool to operate properly, the RunSpec which produced the output, or one that points to the same output file, needs to be loaded in MOVES. When you choose the **Produce State/County Map** menu option, the **Generate State/County Map** window opens and displays the name of the source database for the map generation at the top of the window. (The source database for the map generation is the database containing the output of the RunSpec.)



Generate State/County Map

Database: movestestresults

Table:
movesoutput

State or County FIPS Column:
countyID

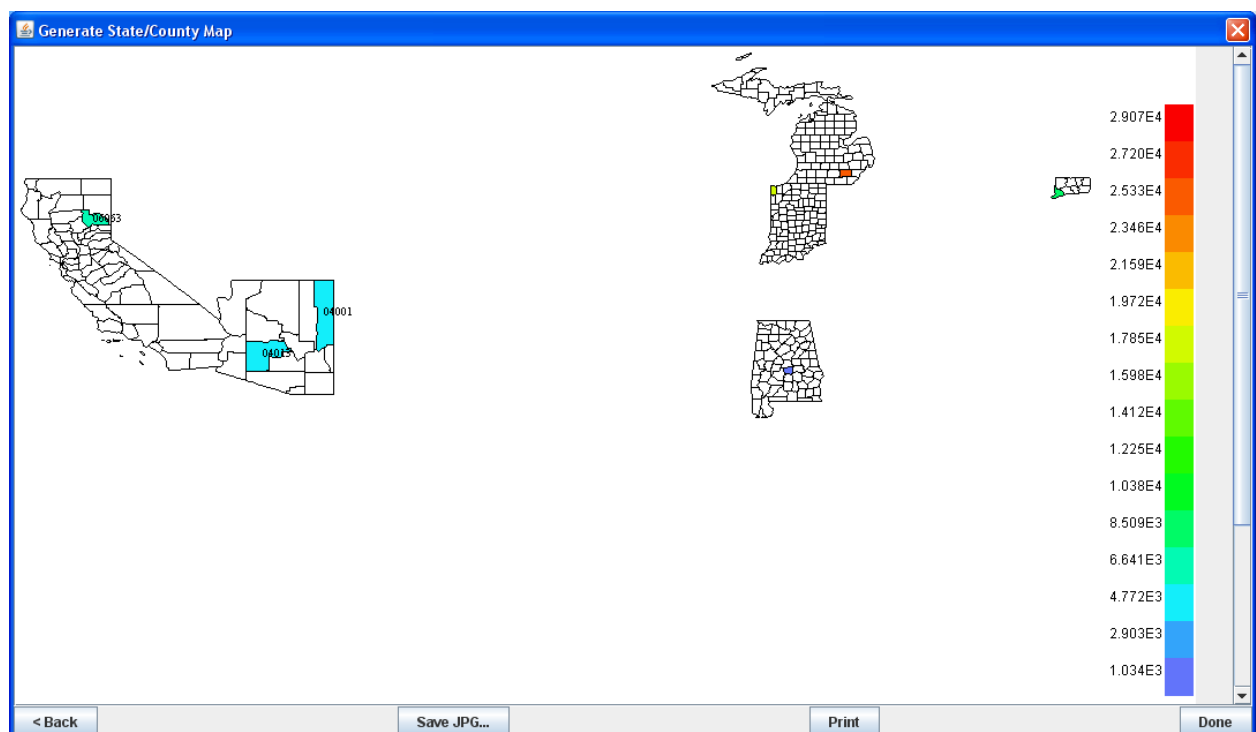
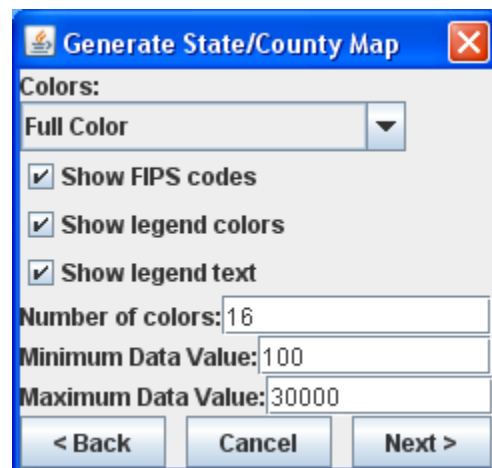
Data Column:
countyID

Cancel Next >

To view RunSpec output on a map, first choose a table contained in the output database that has **CountyID** or **StateID** as a column and associate each emission quantity with each county or state selected only once. In other words, if there are multiple entries for the same pollutant in the same county, then the **Produce State/County Map** tool cannot be used. For example, if all 24 hours were modeled and the level of output detail was chosen to be **Hour**, then there are at least 24 values for each pollutant in each county and the **MOVESOutput** table cannot be used. It is possible for the **MOVESOutput** table to be used if you have appropriately defined or aggregated your RunSpec; however, it is more likely that you will have to use the **Summary Reporter** to generate a table that fits the necessary criteria and save it into the output database indicated by the currently loaded RunSpec.

Once a table with the attributes described above is created, it can be selected in the **Table** drop-down menu. The State or County FIPS Column box will be automatically populated with **CountyID** or **StateID**, instructing the mapping tool to consider output data at the county or state level. Next, specify data to depict by selecting an output parameter in the **Data Column** dropdown menu. By choosing a column from the selected table, you instruct the mapping tool to use results from the RunSpec to generate the map output. After making selections in this window, click **Next**.

A window allowing you to define map attributes opens. You can choose **Full Color** or **Grayscale** using the **Colors** drop-down box, and can customize the map using the check boxes and defining minimum and maximum data values for the emissions output data. When you click **Next**, the map output is generated.



2.3.6 Tools

Tools provides a drop-down menu with the choice **Multiple RunSpec Creator**, **Process Done Files** and **Database Converter**.



This menu item contains a list of MOVES tools. Currently, the only tool on the list is the **Multiple RunSpec Creator**, which creates a set of new MOVES RunSpec files using the currently loaded RunSpec and a user-supplied control file as a template.

2.3.6.1 Multiple RunSpec Creator

The **Multiple RunSpec Creator** creates a set of new MOVES RunSpec files using the currently loaded RunSpec information, and additional information in the form of a user-supplied control file. The control file is a list of county, year and database data selections in the form of a Microsoft Excel spreadsheet file (.xls). The tool produces a set of MOVES RunSpecs and a batch (.BAT file) file that can execute the MOVES RunSpecs from the DOS command line (MOVES batch files cannot be executed from inside the MOVES GUI).

Before using the **Multiple RunSpec Creator**, load or create a viable (all green check marks) Runspec (the tool will accept an incomplete RunSpec, but will subsequently generate a set of incomplete RunSpecs which require further manual editing). The **Multiple RunSpec Creator** also requires the selection of at least one county and one year in the RunSpec.

If the menu item **Multiple RunSpec Creator** is selected, the **Multiple RunSpec Creator** panel opens. The top of the panel contains some reminders about the purpose of the tool and mentions the output .BAT file. Error messages and other feedback are provided in the messages area at the bottom of the window.

Multiple RunSpec Creator

Instructions

This tool creates new RunSpec files using the currently loaded information as a template, making substitutions for county, year, and database selections driven by a user-supplied control file. In addition, a BAT file is generated that illustrates how to automatically execute each created RunSpec from the command line.

Use the "Create Template..." button to get started with a control file that uses all the counties and years in the current RunSpec.

The final BAT file, located in your output directory, can be run as is, or can be edited manually for distribution onto multiple MOVES master machines.

RunSpec Template Control File

File: Browse...

Create Template...

File Name Prefix

Prefix:

RunSpec Output Directory

Folder: Browse...

Messages:

Create RunSpecs Done

Once the panel is opened, use the **Create Template** button to get started with a Control File that uses all the counties and years in the current RunSpec. The **Create Template** feature will fill the Control File with the information available in the RunSpec. However, you may edit the Control File and add additional rows and columns of information. You may add additional counties, years and database names. For each row in the Control File MOVES will create a new RunSpec.

The figure below shows a template Control File (an .XLS in this case) that will create RunSpecs for a list of counties, each with a different output database:

	A	B	C	D	E	F	G	H	I
1	CountyID	County Description	Year	Additional Text Name	Primary MOVES DB	Output DB	Domain DB	Advanced Features DB	User DB
2	26161	MICHIGAN - Washtenaw County	2009	Washtenaw	MOVESDB20090112	WashtenawOutput			
3	26163	MICHIGAN - Wayne County	2009	Wayne	MOVESDB20090112	WayneOutput			
4	26161	MICHIGAN - Washtenaw County	2010	Washtenaw	MOVESDB20090112	WashtenawOutput			
5	26163	MICHIGAN - Wayne County	2010	Wayne	MOVESDB20090112	WayneOutput			
6	26161	MICHIGAN - Washtenaw County	2011	Washtenaw	MOVESDB20090112	WashtenawOutput			
7	26163	MICHIGAN - Wayne County	2011	Wayne	MOVESDB20090112	WayneOutput			

!Tip If the *National SCALE* is selected, a set of RunSpecs will be generated for unique combinations of county, year and additional text name. Information from the other columns will be inserted into the RunSpecs. If the **County** or **Project SCALE** is selected, a set of RunSpecs will be generated only for unique combinations of county and year. Note, in all three cases, you must separately create the required input databases.

The Control File fields are:

Field	Notes
CountyID	Mandatory. The FIPS ID of the county or custom domain (generic county) in the format 99999
County Description	Describes the county. This is not mandatory but is helpful as it gets stored within each RunSpec. It will be the label for the generic county if the Custom Domain option is used.
Year	Mandatory. A year contained within the current MOVES default database, typically 1990 and 1999-2050 inclusive.
Additional Text Name	Optional, 20 characters max. Additional text to be included in both the file name of a RunSpec file and in the RunSpec description (which gets stored to the output database during simulation). Since this field is used as part of a file name, it cannot contain operating system special characters such as & : / \ * ?
Primary MOVES DB	Name of the primary MOVES database to be used with the RunSpec. If blank, the created RunSpec will use the “Custom Input Database” (as set on the Advanced Performance Features panel) of the current RunSpec, and if that is blank the created RunSpec will use the MOVES default database configured at the time it is executed. This input will never change the name of the Default Database in the MOVES Configuration File as shown in the pull down menu item “Settings – Configure MOVES”.
Output DB	Name of the database to store the created RunSpec output. If blank, the created RunSpec will use the output database of the currently loaded RunSpec, and if that is blank an error message will be shown and processing stopped.
Domain DB	When using County or Project domains, MOVES requires an input database specific to the domain. If blank, the model will use the database named in the RunSpec. If neither is available, an error message will be shown and processing stopped.
Advanced Features DB	If the “Copy Saved Generator Data” checkbox is marked on the Advanced Performance Features panel, this field specifies the database where the data should be saved.
User DB	The MOVES GUI allows users to supply their own custom data using the Manage Input Data Sets panel. On that panel, zero or more user databases are listed. Such databases can be specified in the Control File in the User DB column and the columns to the right of it. For example, if two databases are desired, fill the User DB column with the first database, and fill the next column with the second. MOVES places no limit on the number of such user databases.

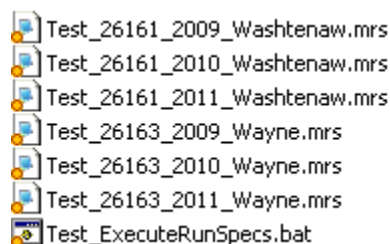
After successfully creating a template file, populating the file and saving it as a Control File, return to the **Multiple RunSpec Creator** panel and browse for and select the Control File. The name of the Control File will be echoed in the Multiple RunSpec Creator panel to the left of the first Browse button.

The next step is to enter a file name prefix in the File Name Prefix box. This input is a mandatory, 150 character limit field that gives a prefix to the file name of each created RunSpec and .BAT file. Good usage of this field, perhaps with a project number or metropolitan area name, will help preserve the usefulness of the created RunSpecs.

After setting a prefix, use the second Browse button for an output directory to hold the created RunSpecs and .BAT file. Remember that many files may be created, so it may be best to create a new directory to hold the new files.

The Create RunSpecs button will check input values (control file name, file prefix, and output directory), read the control file, report errors, and if there are no errors, create the BAT and RunSpec files. Files are only generated if there are no errors.

As an example, using the above control file and a prefix of “Test”, the files created are:



As can be seen, the naming convention is:

<prefix>_<countyID>_<year>[_<additional text>].mrs

<prefix>_ExecuteRunSpecs.bat

Note If RunSpecs are for the same county and year, it is important that the additional text be unique, otherwise, not all listed RunSpecs will be created.

The resulting BAT file from the example file is:

```
@echo off
rem Script generated by the MOVES Looping Tool
rem Based on control file:
C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\ControlFile.xls
rem -----
rem Command Line Notes:
rem "-e DEBUG" logs all types of messages to MOVESbatch.log
rem -----
echo Changing to the MOVES folder and compiling code...
C:
cd "C:\EPA\MOVES\MOVESGHGSource"
call setenv.bat
call ant compile
rem -----
echo Running Test_26161_2009_Washtenaw.mrs
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -e DEBUG -r
"C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\Test_26161_2009_Washtenaw.mrs"
echo Running Test_26163_2009_Wayne.mrs
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -e DEBUG -r
"C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\Test_26163_2009_Wayne.mrs"
echo Running Test_26161_2010_Washtenaw.mrs
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -e DEBUG -r
"C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\Test_26161_2010_Washtenaw.mrs"
echo Running Test_26163_2010_Wayne.mrs
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -e DEBUG -r
"C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\Test_26163_2010_Wayne.mrs"
echo Running Test_26161_2011_Washtenaw.mrs
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -e DEBUG -r
"C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\Test_26161_2011_Washtenaw.mrs"
echo Running Test_26163_2011_Wayne.mrs
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -e DEBUG -r
"C:\EPA\MOVES\MOVESGHGSource\Task910LoopingTool\Test_26163_2011_Wayne.mrs"
```

This .BAT file can be run as is (via the command line or by double-clicking), or can be edited manually for distribution onto multiple MOVES master machines.

2.3.6.2 Process DONE Files

The tool **Process DONE Files** is an advanced MOVES2010b tool that is not recommended for use by most users. The interested user should completely read **Configuring MOVES - Appendix J** before attempting to use this tool.

2.3.6.3 Database Converter

The structure of the county data manager and project data manager input databases are slightly different between MOVES2010a and MOVES2010b. To facilitate the migration of user work from MOVES2010a to MOVES2010b, a conversion tool has been developed. This new tool can be accessed in the MOVES Main Menu under the drop down menu item **Tools – Database Converter**.

A conversion script was created to convert MOVES2010a county and project domain databases to MOVES2010b format. This script is located under the database\ConversionScripts directory and is named Convert2010A_CDM_PDM.sql. This is the default script and the tool automatically selects it.

⚠ Caution! The GUI contains a **Browse** button that enables you to search and select an alternate conversion script file. This was done for future capability when more than one conversion script may be available. It is strongly recommended that you do not **Browse** and use an alternative conversion script for MOVES2010b.

The **Input Database** and the **New Database** boxes are required entries. The name of the MOVES2010a county or project database is entered in the **Input Database** box. The name of the MOVES2010b county or project database is entered in the **New Database** box. After these inputs are made, press **Convert Database**. This tool will create a new county or project input database, copy the contents of the MOVES2010a county or project database to the new county or project database, and make all necessary structural and data changes to the new database so that it runs on MOVES2010b.

If you have many county or project databases to convert, an **Ant** command line tool is available to run any conversion script. It must be presented with a MOVES2010a county or project input database, the name of a new database to be created, and the name of the conversion script to be run. An example command line is:

```
ant -Dinput=2010Ainput -Doutput=2010Binput -Dscript=Convert2010A_CDM_PDM.sql convert
```


Convert Database

Instructions

This tool converts MOVES 2010A County Domain and Project Domain databases into the MOVES2010B format.

Use the "Browse" button to select a database conversion script file, such as the standard file Convert2010A_CDM_PDM.sql located in the database/ConversionScripts directory.

Select a MOVES 2010A County Domain or Project Domain database as the "Input Database". This database must be on the same server as the MOVES 2010B default database in order for the script to copy required data.

Enter the name of a new database to receive the converted data as the "New Database".

Use the "Convert Database" button to execute the script file. When you've converted all the databases you care to, click "Done".

Conversion Script

File: Convert2010A_CDM_PDM.sql **Browse...**

Databases

Server: localhost **Refresh**

Input Database: examplecity_2013_july_in ▼

New Database: nuCity ▼

Messages:

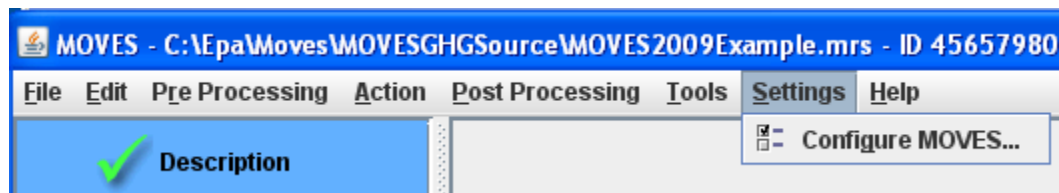
WARNING: custom county 99001 requires data in the sccRoadTypeDistribution table to obtain SCC results.

Conversion successful.

Convert Database **Done**

2.3.7 Settings

The **Settings** menu includes one option, **Configure MOVES**. This menu option allows you to set the basic MOVES operating configuration.



2.3.7.1 Configure MOVES

The screenshot shows the 'Configure MOVES' dialog box. It is titled 'Configure MOVES' with a standard Windows window border. On the right side, there are 'OK' and 'Cancel' buttons. The dialog is divided into three main sections. The first section, 'Default Input Database', contains a 'Server:' label followed by a text box containing 'localhost', and a 'Default Database:' label followed by a dropdown menu showing 'movesghgsourceA'. The second section, 'Default Output Database', contains a 'Server:' label followed by a text box containing 'localhost'. The third section, 'Shared Distributed Folder Path', contains a text box with the path 'C:\EPA\MOVES\movesghgsourceat\Shared\Work' and a 'Browse...' button to its right.

First, specify the default input database by identifying the default server on which the MOVES input database is stored and the name of the default database. In most cases, "localhost" (the MySQL data folder on your own machine) is the desired server, although you may input an alternate. Next, choose from a drop-down list to define the default database to be used as a data source for the MOVES RunSpec. In most cases, you will choose the default database distributed with MOVES. You can also select a server to house the default output database server under the **Settings→Configure** menu option; "localhost" is appropriate in most cases. The actual output database file is named on the **General Output** panel to specify output parameters as part of the MOVES RunSpec setup process.

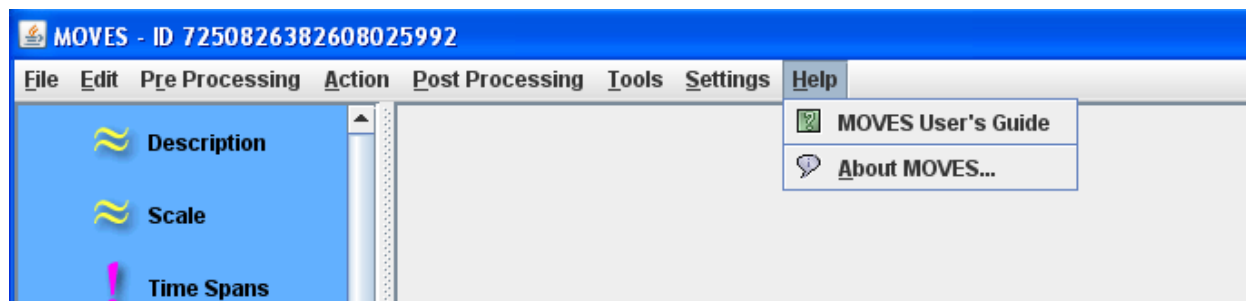
⚡ Caution! If the **Default Input Database** is changed, the program should be stopped and restarted. This is because the user interface program will have already connected to the previously specified database in order to construct the GUI displays; thus the GUI may not match the new input database.

Using the **Settings** menu option, you can also identify the **Shared Distributed Folder Path** for the MOVES Worker and MOVES Master program modules. This is the Windows folder where all intermediate and internal MOVES work files are stored during processing. This folder is installed as part of the MOVES program installation. Browse your system to find where this folder was installed and indicate the exact location. It may not be the same path as shown in the example above.

!Tip By changing the **Shared Distributed Folder Path**, you can take advantage of distributed processing by having the master and multiple worker computers on the same network “point” to a drive and folder that is accessible to all the computers involved.

2.3.8 Help

Help provides access to .pdf versions of the MOVES User Guide and supplies general information about the version of MOVES being used.



Choose **MOVES User Guide** to open the document in .pdf format.

Choose **About MOVES** in the **Help** menu to obtain the release date of the model. This indicates which version of MOVES is open. In addition to the version, the EPA copyright and GNU General Public License (GPL) information is provided. The GNU license grants the user, free of charge, complete access to the object and source code of the MOVES program for personal use. For specific details regarding the GNU license, consult the website <http://www.gnu.org/licenses/>.



Appendix A - Using MOVES to Generate Lookup Tables

MOVES can calculate emission inventories (in total quantity of emissions for a given time) or emission rates (emissions divided by distance or population), depending on the selection of **Inventory** or **Emission Rates** in the **Calculation Type** section of the **Scale** panel.

When modeling a single time and place, the emission rate calculations in MOVES are significantly more time consuming and require more computer memory than inventory calculations. However, for large scale projects, you may want to use the emission rate calculations to create a lookup table of rates that--though a post-processor--can be applied to many times and places, thereby reducing total MOVES run time. Successful application of this approach requires a clear understanding of the rates calculations in MOVES and careful planning. EPA is developing tools to automate the use of this feature to create inputs for EPA's Sparse Matrix Operator Kernel Emissions (SMOKE) model. This section describes the process more generally.

Defining a Scenario

A scenario defines the set of conditions to which the emission rates may be applied. A scenario typically defines a specific fuel mix and set of Inspection/Maintenance (I/M) programs. It also assumes a certain pattern of trip activity (number of trips per vehicle per day and the distribution of those trips in time).

Some characteristics of the scenario depend on your choices. If a given age distribution is part of the scenario definition, that is, if the lookup table is to be applied only to areas with one particular age distribution, the lookup output can be smaller because you do not need output by model year. On the other hand, detailing output by model year allows you to apply the lookup table to areas with diverse age distributions.

A scenario generally does not imply specific temperatures or speed distributions. Instead, these characteristics are key fields in the output used to match the emission rate with the appropriate vehicle activity.

The Emission Rate Output Tables

Selecting **Emission Rates** on the **Scale** panel populates three additional output tables: **RatePerDistance**, **RatePerVehicle** and **RatePerProfile**. The **RatePerDistance** table stores emission rates for emissions that occur while a vehicle is in regular operation. The **RatePerVehicle** and **RatePerProfile** tables store emissions that occur while a vehicle is stationary, on "off network" roadtypes. The latter two tables differ because the emissions in the **RatePerVehicle** depend on the hour and the temperature while emissions in the **RatePerProfile** table also depend on temperatures in previous hours.

The following table explains which tables will get results (emission rates) when particular emission processes are selected.

processID	processName	Emission Rate Table
1	Running Exhaust	RatePerDistance
2	Start Exhaust	RatePerVehicle
9	Brakewear	RatePerDistance
10	Tirewear	RatePerDistance
11	Evap Permeation	RatePerDistance/RatePerVehicle/ RatePerProfile
12	Evap Fuel Vapor Venting	RatePerProfile/RatePerDistance
13	Evap Fuel Leaks	RatePerDistance/RatePerVehicle/ RatePerProfile
15	Crankcase Running Exhaust	RatePerDistance
16	Crankcase Start Exhaust	RatePerVehicle
17	Crankcase Extended Idle Exhaust	RatePerVehicle
18	Refueling Displacement Vapor Loss	RatePerDistance/RatePerVehicle
19	Refueling Spillage Loss	RatePerDistance/RatePerVehicle
90	Extended Idle Exhaust	RatePerVehicle

1) RatePerDistance: Includes emissions for the processes that occur while vehicles are operating: running exhaust (includes emissions during normal idle at traffic signals, etc), tire wear, brake wear, evaporative permeation, evaporative fuel vapor venting, evaporative fuel leaks, crankcase running exhaust, refueling displacement and refueling spillage. The hour, day and month will not be relevant for most uses because the emissions are normalized with regard to activity. For national and county level runs, roadtype and avgSpeedbin will be relevant. For project-level runs, linkID will be important.

Fields:

MOVESScenarioID
 MOVESRunID
 yearID
 monthID
 dayID
 hourID
 linkID
 pollutantID
 processID
 sourceTypeID
 SCC
 fueltype ID
 model year ID
 roadtype ID
 avgSpeedBinID
 temperature
 relhumidity
 RatePerDistance

2) RatePerVehicle: Includes emissions for most processes that occur while vehicles are stationary: start exhaust, start crankcase, permeation, liquid leaks, and extended idle (long haul combination trucks only). The month will not be relevant for most uses since, in rate calculations, it serves primarily as an identifier for the fuel mix and will be redundant with MOVESScenarioID, but daytypeid and hourid are important key fields since start and other activity vary per vehicle per hour.

Fields:

MOVESScenarioID
MOVESRunID
yearID
monthID
dayID
hourID
zoneID
pollutantID
processID
sourceTypeID
SCC
fueltype ID
model year ID
temperature
RatePerVehicle

3) RatePerProfile: Includes emissions from the vapor venting process when vehicles are stationary. The daytypeid, hourid and temperatureprofileid are important key fields because the vapor venting emissions vary depending on activity and previous temperatures.

Fields:

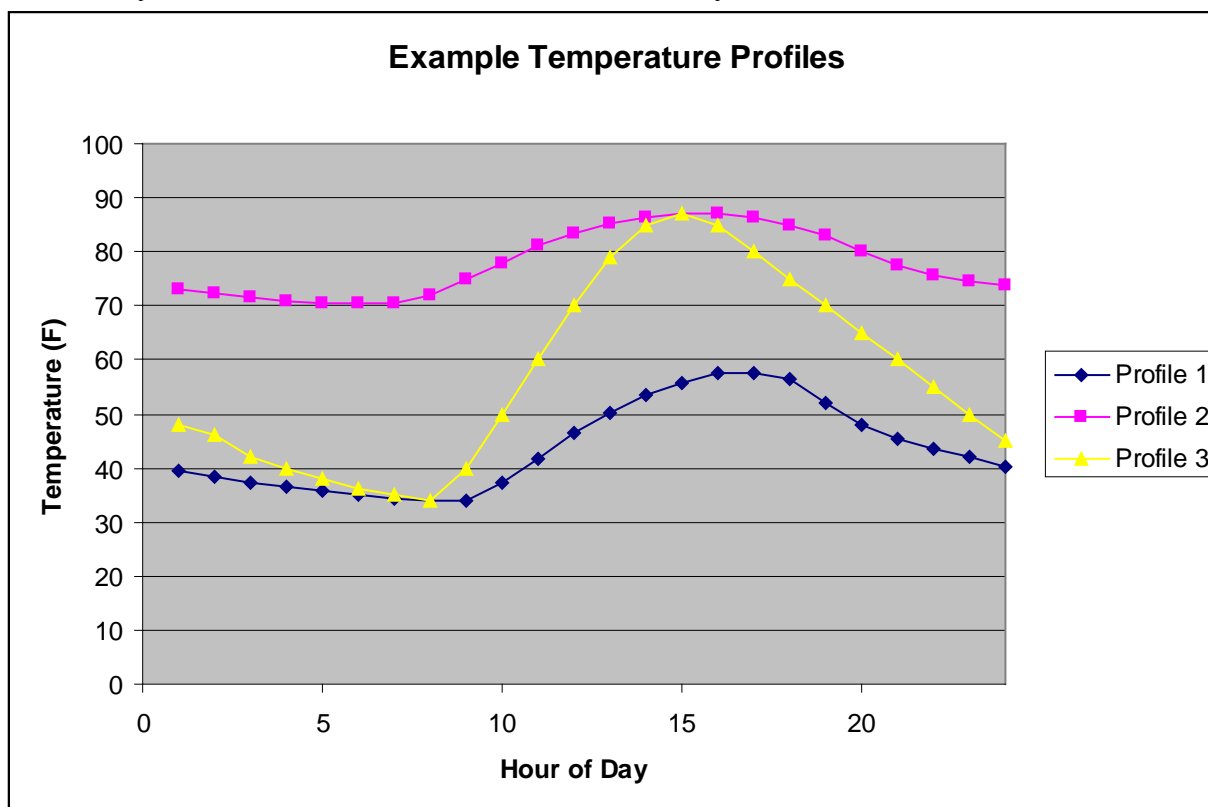
MOVES Scenario ID
MOVESRunID
TemperatureProfileID
yearID
dayID
hourID
pollutantID
processID
sourceTypeID
SCC
fueltypeID
modelyearID
temperature
RatePerVehicle

Setting Up Runs to Generate a Lookup Table

Setting up an emission rate lookup table for a single scenario requires a number of steps.

1) Define the scenario, and determine the counties, months, years and day-types in which it applies. Using the County Data Manager, you can set up a run for the desired county, year, fuel supply, age distribution and I/M program.

2) Determine the temperatures and temperature profiles to be covered by the lookup table. A “temperature profile” is a set of 24 temperatures over the course of a day. If modeling NO_x, it may also make sense to include relative humidity as a variable.



3) Determine which pollutants and processes are of interest. Note that the modeling of hydrocarbons is more complicated than the modeling of other pollutants due to the need to include evaporative processes, and thus the need to represent temperature profiles as well as hourly temperatures.

4) Organize inputs to generate the most rates in the shortest total runtime, while maintaining a manageable output size. If multiple similar calculations are required, it is generally a good idea to combine them in the same run. However, due to the different requirements for different emission processes, redundant calculations can often be avoided by splitting the task into multiple runs.

- a. For running exhaust, crankcase running exhaust, and refueling, hour doesn't matter, so 24 temperatures can be modeled as different hours in a single month. If more than 24 distinct temperatures are to be modeled, additional temperatures can

be modeled using additional months (as long as the fuel characteristics are set to be the same for each month). If this approach is used, the month field in the output essentially becomes a label for a group of temperatures, and does not represent an actual calendar month.

- b. For start, crankcase start exhaust, liquid leaks and evaporative permeation, hour and temperature matter. Sets of temperatures can be entered as individual “months”. Again, this creates output where “month” represents a group of temperatures rather than a calendar month. In the illustration above, the three temperature profiles could be modeled in a single run as three nominal months, one for each profile. Note, however, that Profile 3 shares an hour/temperature point with the each of the other profiles (in hour 8 and hour 15). For a lookup table with greater scope, it could be efficient to design the runs to eliminate such redundancy.
- c. Vapor venting emissions depend on hour, temperature and previous temperatures. For these emissions, we must model each profile as a separate month. Thus, within a given MOVESScenario, monthid becomes equivalent to temperatureprofileid. In some cases, it may be appropriate to “bin” similar temperature profiles and to apply the results from one profile to a group of similar profiles.

Temperatures (and humidities) can be entered into the MOVES ZoneMonthHour table, using MySQL commands or through the County Data Manager (see **Meteorology Data Importer - Section 2.3.3.4.1** for more information on entering this data).

Note While activity is “divided out” in the Emission Rates output, the amount of time spent driving affects the evaporative emission rates. Therefore, it is important to input realistic VMT, Population, Average Speed Distribution and Road Type Distribution information.

Running MOVES to generate Lookup Tables

MOVES can generate lookup table output using the menu-driven interface, but for large-scale modeling, you will probably want to automate execution of a series of runs. See **Running MOVES from the Command Line - Appendix C** and **Multiple Run Spec Creator - Section 2.3.6.1** for information on a tool for creating a set of similar RunSpecs.

Applying MOVES Emission Rate Output

To calculate an emissions inventory from emission rate output, rates in RatePerDistance values need to be multiplied by the appropriate Vehicle Miles Travelled (VMT), and rates in RatePerVehicle and RatePerProfile must be multiplied by appropriate vehicle population values. Doing this correctly can require a number of considerations.

- 1) Rather than simply summing all activity in a speed or temperature bin, it is usually appropriate to do an interpolation as the rates are applied. For example, to calculate the

total emissions from 100 miles of VMT with an average speed of 17.6 mph, a simplistic approach would be to multiply all of the VMT by the emission rate for speed bin 5 (17.5 mph-22.5 mph), however this approach is overly sensitive to even very small changes in speed. To reduce these boundary issues, instead interpolate between speed bins (in this example, between the rates for speed bin 4 (12.5-17.5) and speed bin 5) based on the average speeds for those speed bins.

- 2) Depending on how the runs were organized, take care not to double-count emissions with duplicate emission rates (e.g. if the three profiles illustrated above were each modeled as independent months, there would be duplicate values in the ratepervehicle table for 8am at 34F, and for 3pm at 87F). A simple join of the rates and population table using hour and temperature would create extra rows that you would need to be careful not to include in a sum.
- 3) Be aware that evaporative emissions are stored in all three tables, and all three need to be used to fully account for evaporative emissions that occur during both driving and parking. The rates in RatePerDistance need to be multiplied by the appropriate VMT, and the rates in RatePerVehicle and RatePerProfile need to be multiplied by the appropriate population. They can then be summed to calculate the total emissions.

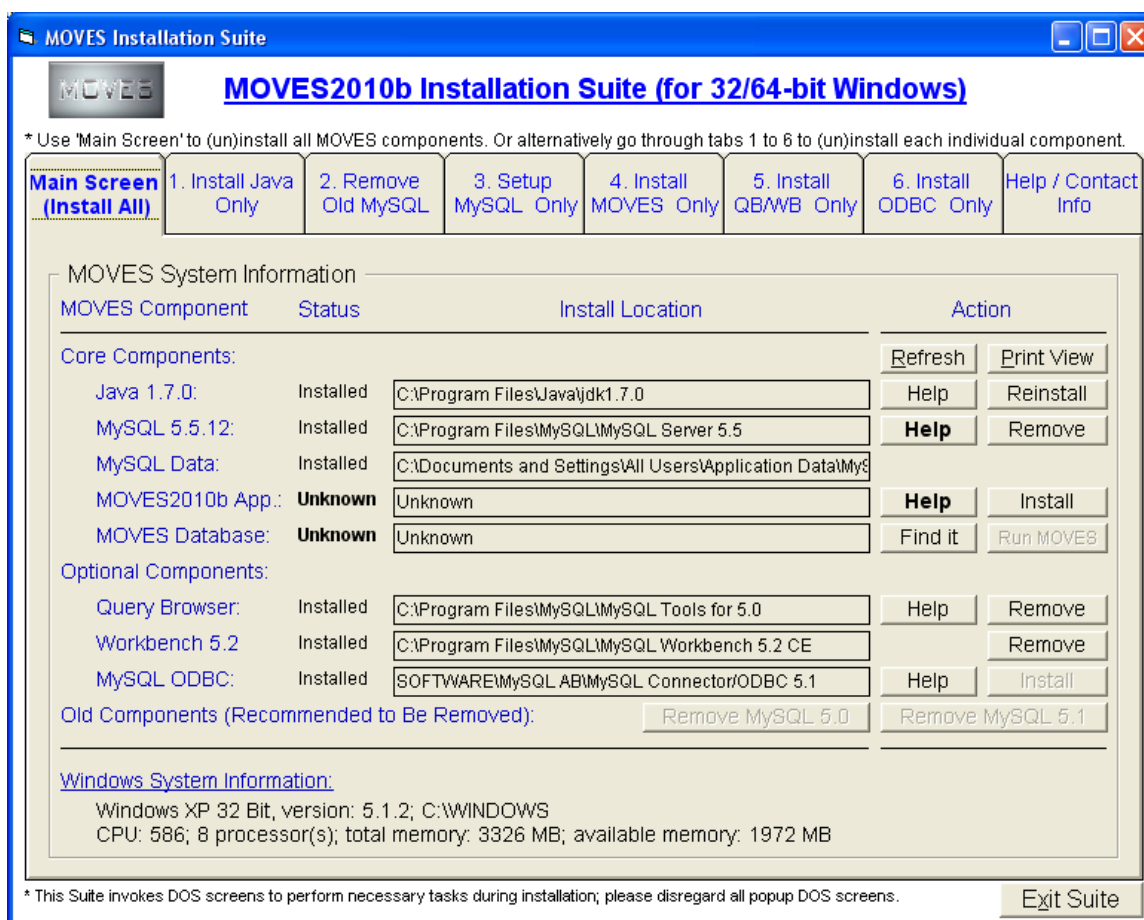
Appendix B – Working with the MySQL Data

Appendix B1 - Linking To MySQL Tables from MS OFFICE 2007

This appendix describes in detail how the user can transform MOVES MySQL tables into Microsoft ACCESS 2007 database tables or Microsoft Excel 2007 spreadsheets. This may be useful for those who wish to view or manipulate these tables in an alternate format. This appendix also explains how to use the Open Database Connectivity (ODBC) interface protocols and tools.

Adding a MySQL database as an ODBC User Data Source

1. Install MySQL driver, MyODBC-3.51.06.exe. This is part of the normal MOVES installation process and can be done by executing the MOVES2010b Installation Suite

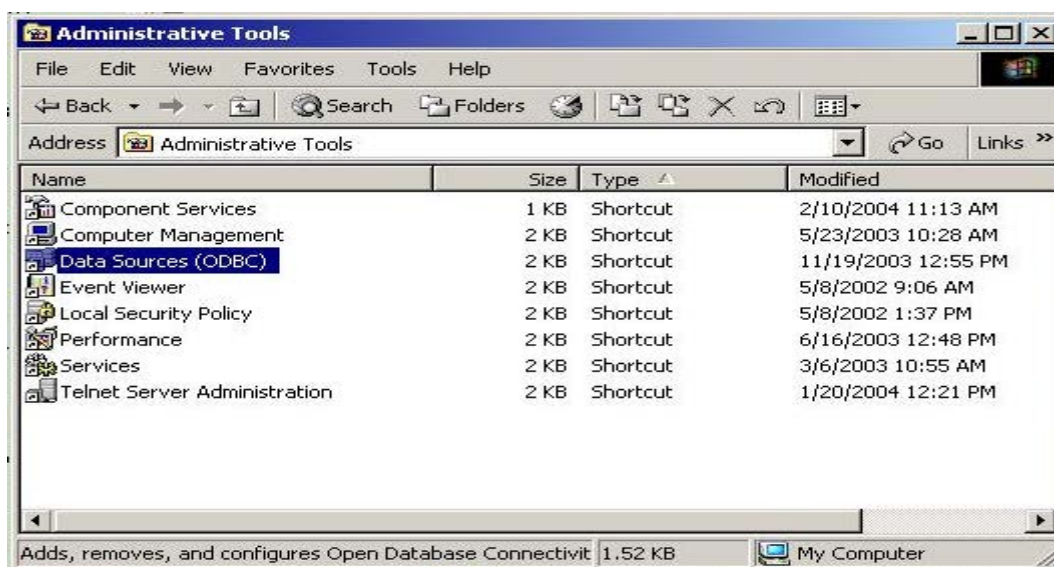


2. Create an ODBC data source with the same name as the folder which corresponds to the MySQL database.

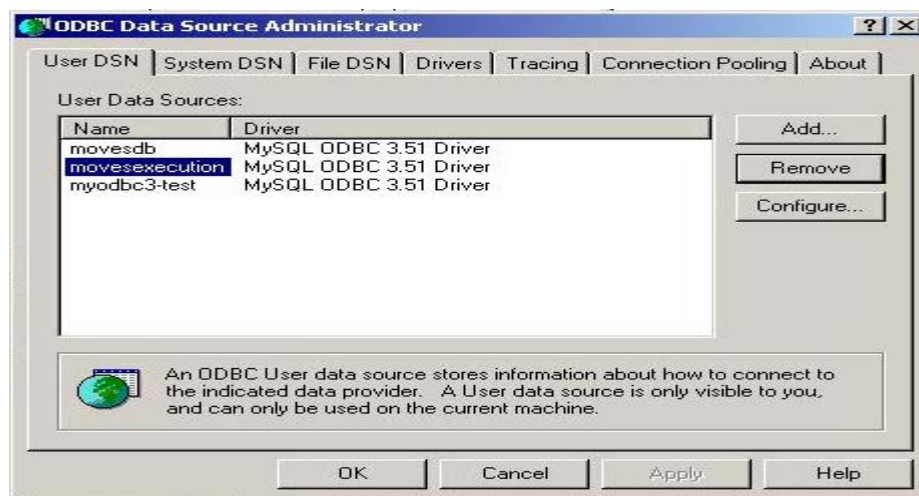
- a. In the Control Panel, select **Administrative Tools**:



- b. In the **Administrative Tools** menu, select **Data Sources (ODBC)**:



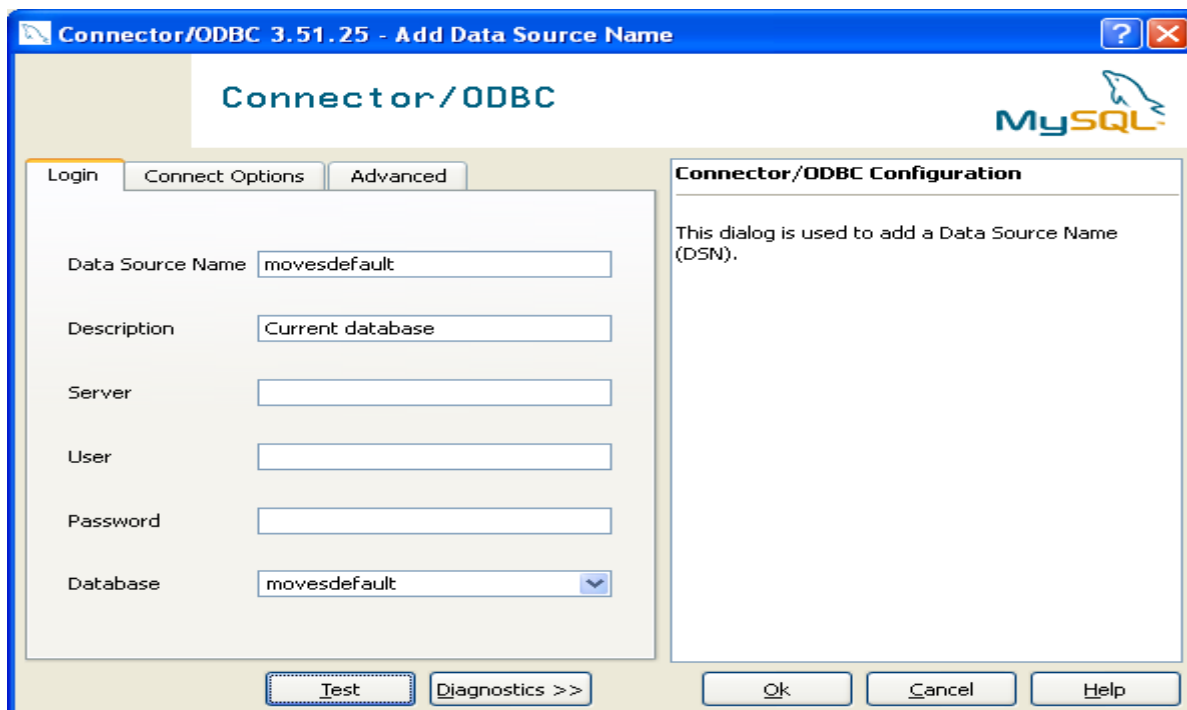
- c. In the **ODBC Data Source Administrator** dialog choose to **Add a User Data Source**.



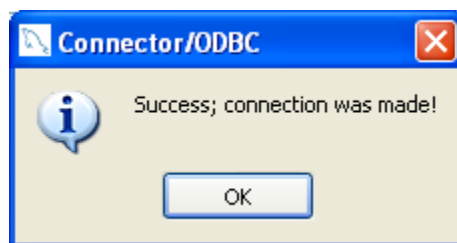
- d. The New Data Source should use the MySQL ODBC Driver that was installed earlier. Scroll through the list until the **MySQL ODBC 3.51 Driver** is found, click it, and click **Finish**.



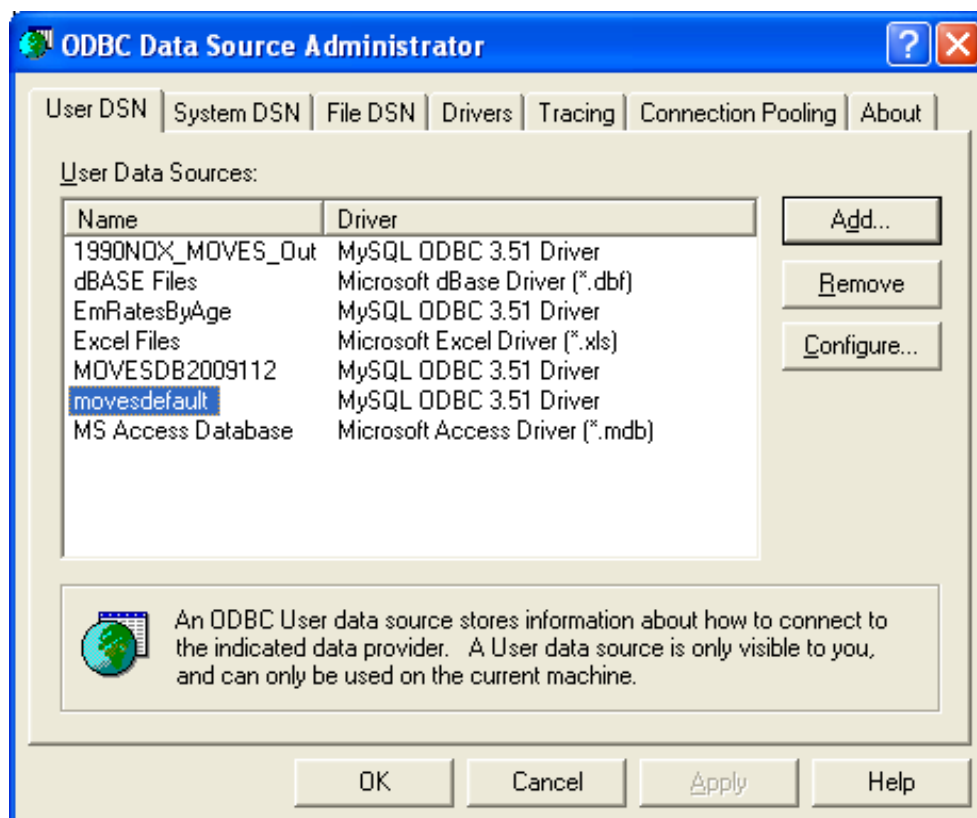
- e. Next, the database links need to be defined. The values shown below are for a database called "movesdefault". The database name should be the name of the folder which contains the desired MySQL database files (i.e., the MySQL database name).



- f. Once the database name and the data source name list an existing MySQL database name, the database connection can be checked by clicking **Test**.

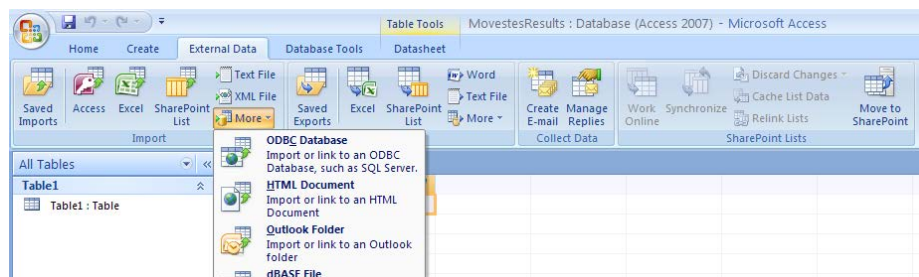
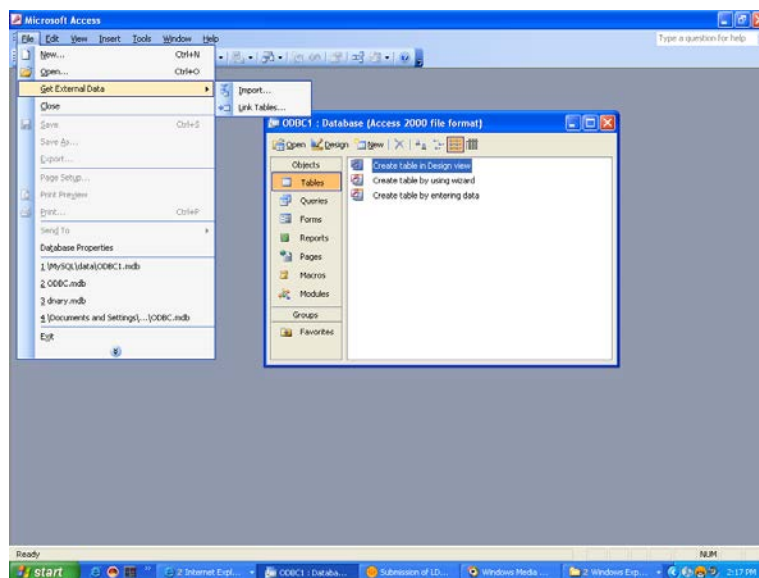


- g. The added data source will show up in the list of data sources in the **ODBC Data Source Administrator** dialog. This will finish the process of creating a new ODBC data source associated with a particular MySQL database.

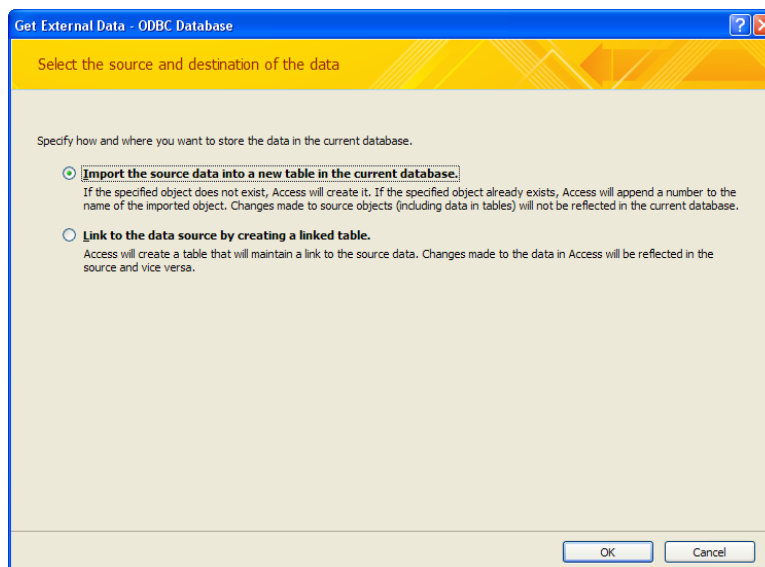


Using Microsoft Access with MySQL Tables

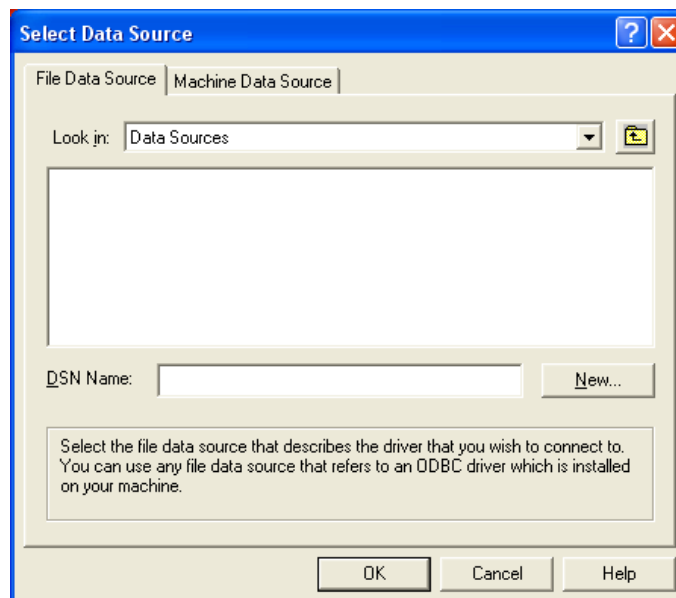
1. Run an Access .mdb (either a new one or an existing one).
2. On the top menu bar, look for menu items **External Data**, **More**, then **ODBC Database**, then **Link Tables ...** (see picture below). Click on the item **Link Tables...**



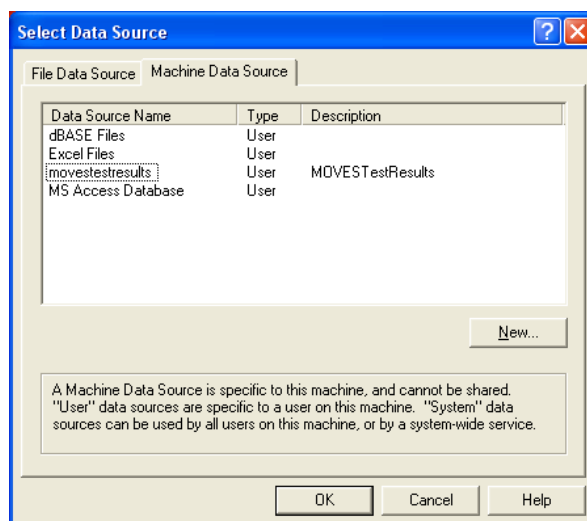
3. On the pop-up window like the one shown below, choose **Link to the datasource by creating a linked table**.



4. Another pop-up window similar to the one below will appear. Click on the tab **Machine Data Source**, to select a database of interest.

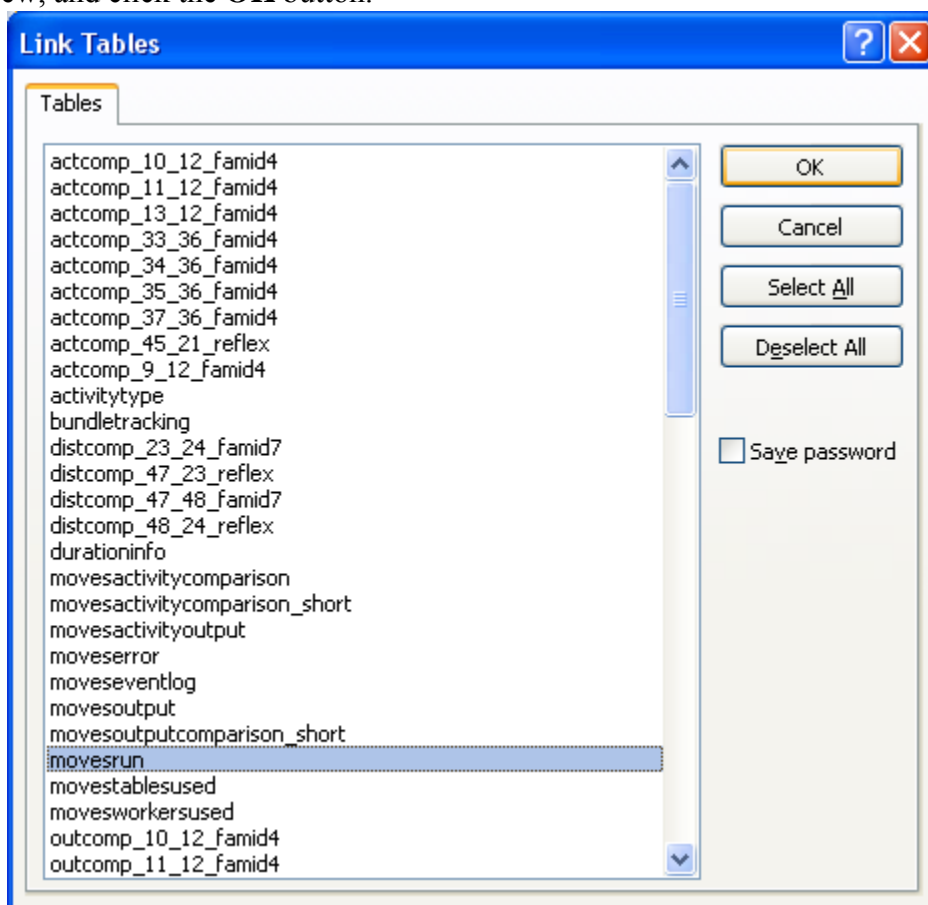


In this example movestestresults is chosen from the **Data Source Name** column. Select **OK** to load the data into Access.

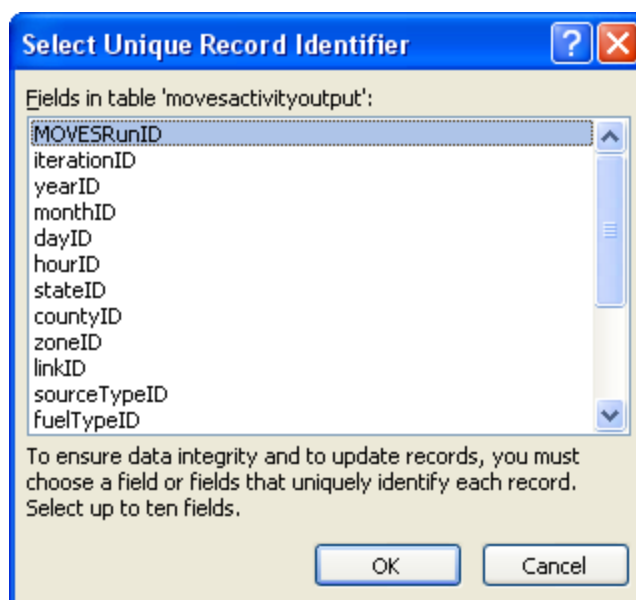


If the **Data Source Name** of the file is not listed, you must follow the instructions provided in the section, **How to create a DSN Connection to a MySQL database**, presented later in this appendix.

- Once the data is loaded into access, the **Link Tables** window shown below will appear. This screen displays all of the database tables that are visible in Access. Select the tables to view, and click the **OK** button.



For each table selected, choose the fields that uniquely identify the records in the table.



In the screenshot shown below, three tables have been shown to work with in MS Access: baseyearvmt, county, and state. The user can now work with these tables in MS Access.

⚡ Caution! Edits made to the tables or data in MS Access will not affect the original MySQL tables and cannot be used directly in MOVES.

The screenshot displays the Microsoft Access application window. The title bar indicates the database is 'MOVESTestResults : Database (Access 2007)'. The ribbon at the top includes 'Home', 'Create', 'External Data', 'Database Tools', and 'Datasheet' tabs. The 'Datasheet' tab is active, showing a table named 'MOVESrun'. The table is displayed in Datasheet view with the following columns: outputTime, timeUnits, distanceUnit, massUnits, energyUnits, runSpecFile, runSpecDesi, runSpecFile, runDateTim, and scale. The data rows show various test runs with times ranging from 25 hours to 49 hours, and distances in miles. The status column contains 'Inv' or 'Rates'.

outputTime	timeUnits	distanceUnit	massUnits	energyUnits	runSpecFile	runSpecDesi	runSpecFile	runDateTim	scale
25 Hour	hour	mi	g	KJ	Task208Base	Base test for St	#####	#####	Inv
26 Hour	hour	mi	g	KJ	Task208Reduce	Base test for St	#####	#####	Inv
27 Hour	hour	mi	g	KJ	Task209Base	Task 209 Base F	#####	#####	Inv
28 Hour	hour	mi	g	KJ	Task209Reduce	Task 209 Reduc	#####	#####	Inv
29 Hour	hour	mi	g	KJ	Task212Base	Base Test Suite	#####	#####	Inv
30 Hour	hour	mi	g	KJ	Task212LLRedu	Test Suite Calo	#####	#####	Inv
31 Hour	hour	mi	g	KJ	Task212PermR	Test Suite Calo	#####	#####	Inv
32 Hour	hour	mi	g	KJ	Task212TVVRe	Test Suite Calo	#####	#####	Inv
33 Hour	hour	mi	g	KJ	Task214BRPMR	BRPM reduced	#####	#####	Inv
34 Hour	hour	mi	g	KJ	Task214BSPMR	BSPM reduced	#####	#####	Inv
35 Hour	hour	mi	g	KJ	Task214BWPMP	BWPM reduced	#####	#####	Inv
36 Hour	hour	mi	g	KJ	Task214Base	For sample cal	#####	#####	Inv
37 Hour	hour	mi	g	KJ	Task214TWPMI	TWPM reduced	#####	#####	Inv
38 Hour	hour	mi	g	KJ	Task216Base	Test Suite run f	#####	#####	Inv
39 Hour	hour	mi	g	KJ	Task216Reduce	Test Suite run f	#####	#####	Inv
40 Hour	hour	mi	g	J	Task219Base	Test Suite run f	#####	#####	Inv
41 Hour	hour	mi	g	J	Task219Reduce	Test Suite run f	#####	#####	Inv
42 Hour	hour	mi	g	KJ	Test209_2	MOVES Test Su	#####	#####	Inv
43 Hour	hour	mi	g	KJ	Test209_3	Task 209 test r	#####	#####	Inv
44 Hour	hour	mi	g	KJ	TestMTBE	Tets MTBE	#####	#####	Inv
45 Hour	hour	mi	g	J	examplecity_2	Example City, J	#####	#####	Inv
46 Month	month	mi	g	J	lake_IN_2008	NEI Benchmark	#####	#####	Inv
47 Hour	hour	mi	g	J	Rates_WhereIs	Rates Pol Proc	#####	#####	Rates
48 Hour	hour	mi	g	J	TestRatesAll	Rates	#####	#####	Rates
49 Hour	hour	mi	g	KJ	Task214BRPMR	BRPM reduced	#####	#####	Inv

You can view data specific to a particular state by clicking on the StateName in the table.

Microsoft Access

File Edit View Insert Format Records Tools Window Help

Type a question for help

state : Table

FIPSStateId	StateName	StateAbbr	NLEVFileName	T2ExhPhaseInF	T2EvapPhaseInF	T2CertFileName	DataSourceId
1	ALABAMA	AL					401
2	ALASKA	AK					401
4	ARIZONA	AZ					401
5	ARKANSAS	AR					401
6	CALIFORNIA	CA	EPACA.nlv	EPACA	EPACA	EPACA	401
8	COLORADO	CO					401
9	CONNECTICUT	CT	EPACTPAR.nlv	EPA2008	EPA2008	EPA2008	401
10	DELAWARE	DE	10000.nlv				1006
11	DISTRICT OF C	DC	11000.nlv				1102
12	FLORIDA	FL					401
13	GEORGIA	GA					401
15	HAWAII	HI					401
16	IDAHO	ID					401
17	ILLINOIS	IL					401
18	INDIANA	IN					401
19	IOWA	IA					401
20	KANSAS	KS					401
21	KENTUCKY	KY					401
22	LOUISIANA	LA					401
23	MAINE	ME	EPAME.nlv	EPACA	EPACA	EPACA	401
24	MARYLAND	MD	24000.NLV				111
25	MASSACHUSETTE	MA	EPAMA.nlv	EPACA	EPACA	EPACA	9925
26	MICHIGAN	MI					401
27	MINNESOTA	MN					401
28	MISSISSIPPI	MS					401
29	MISSOURI	MO					401
30	MONTANA	MT					401
31	NEBRASKA	NE					401

Record: 1 of 53

Record: 1 of 21

Datasheet View

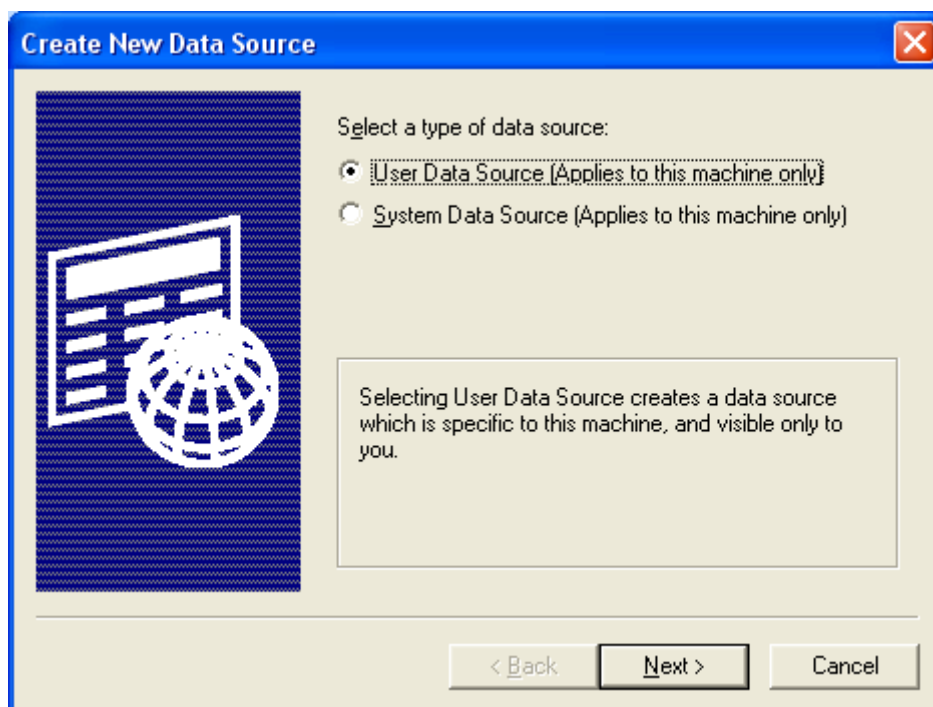
NUM SCRL

start

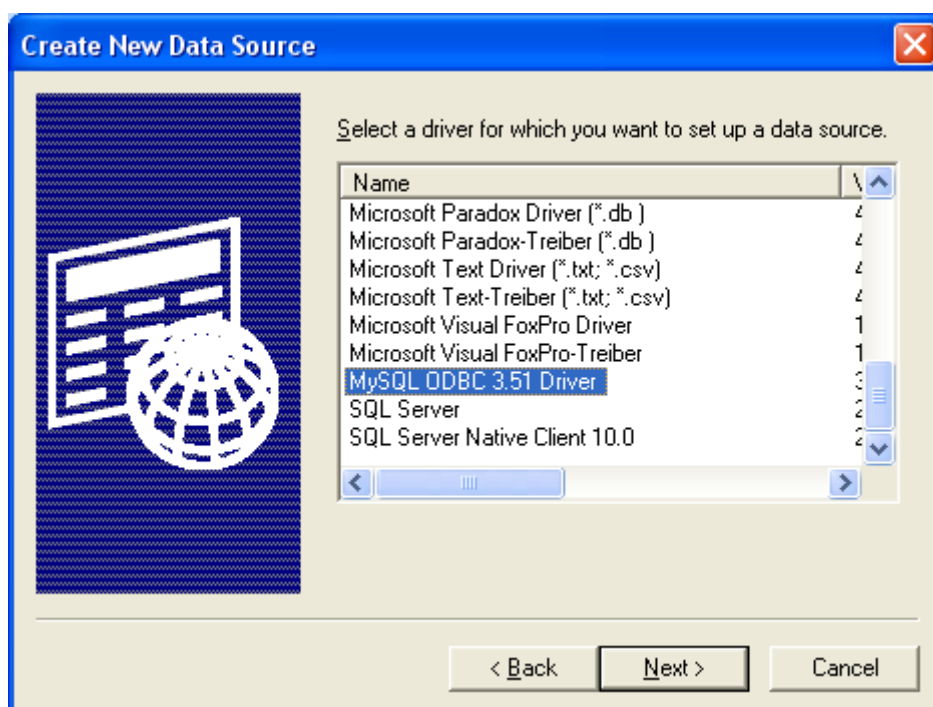
Internet... Microsoft... Submission... Windows M... 2 Window... Document1... 2:34 PM

How to create a DSN Connection to a MySQL database

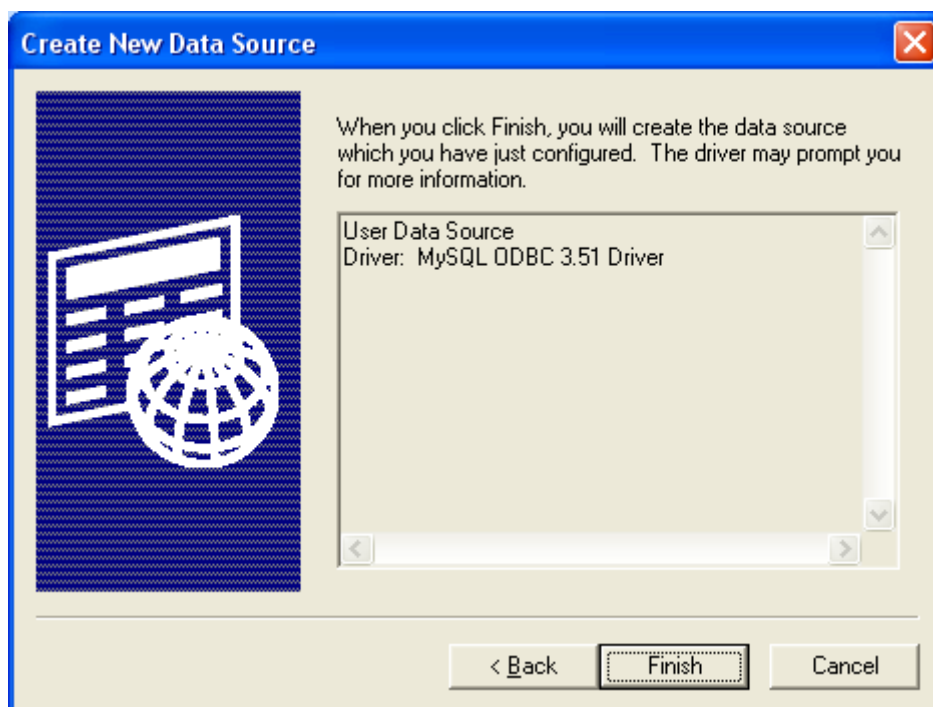
If you do not find the MySQL database referenced in the **Data Source Name** listing in MS Access, a DSN connection must be established. In order to do so, click on the **Machine Data Source** tab from the **Select Data Source** screen. Click the **New** button, and click **Next**.



At the Create New Data Source Dialog box, select **MySQL ODBC 3.51 Driver**. Click **Next**.

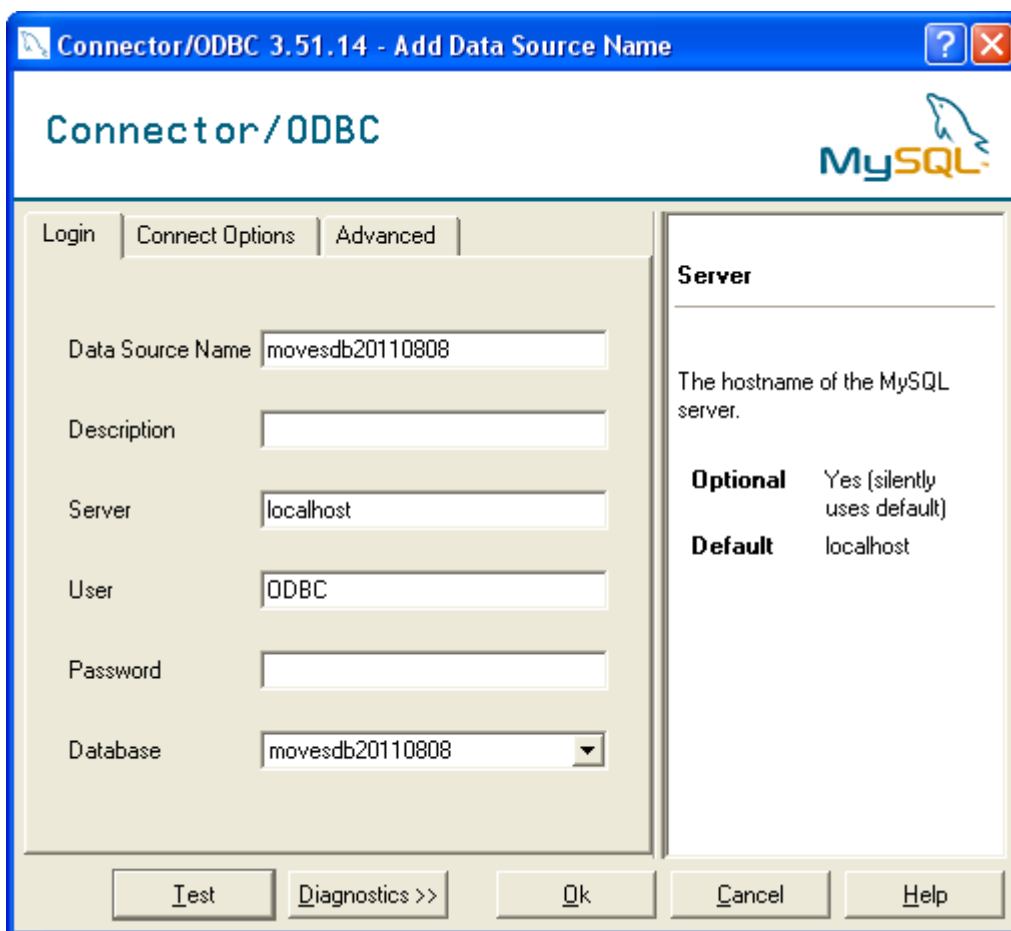


Click **Finish** to establish the connection.

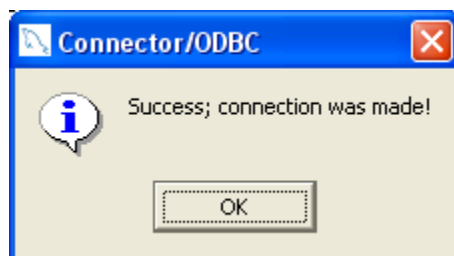


The **Connector/ODBC** screen is used to establish the connection from MS Access to the MySQL database. Use this screen to define the **Data Source Name**. Enter “localhost” for Server and “ODBC” as User, but leave the Password field blank.

Note Consider making the **Data Source Name** similar to the database name, such as DSN_DatabaseName. This will make it easier to find.



Once the **Data Source Name** has been created, click **Test**. The pop-up box **Connector/ODBC** should open, with the message, "Success; connection was made!" Press **OK**, and the pop-up box will disappear. Click **OK** to create the DSN connection.



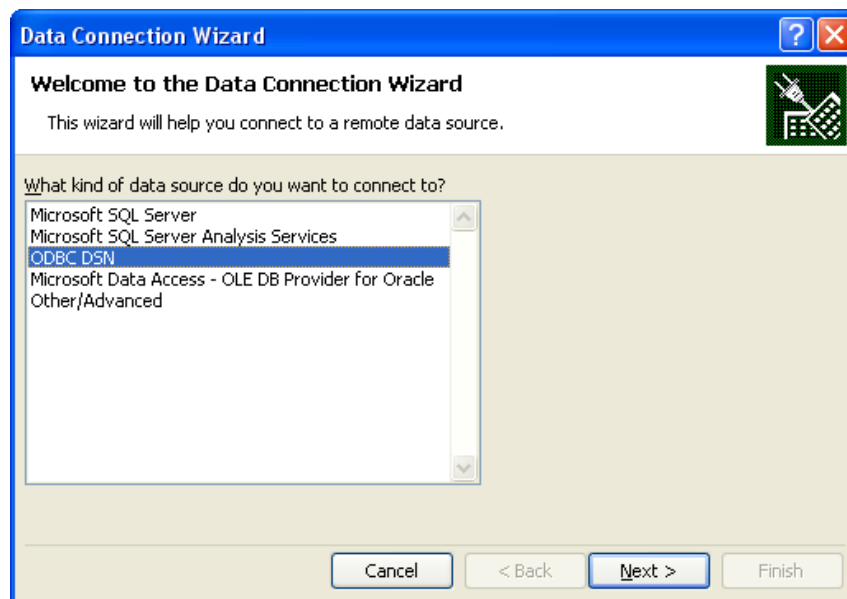
The **Data Source Name** will now be listed in the **Select Data Source** window.

Using Microsoft Excel with MySQL Tables

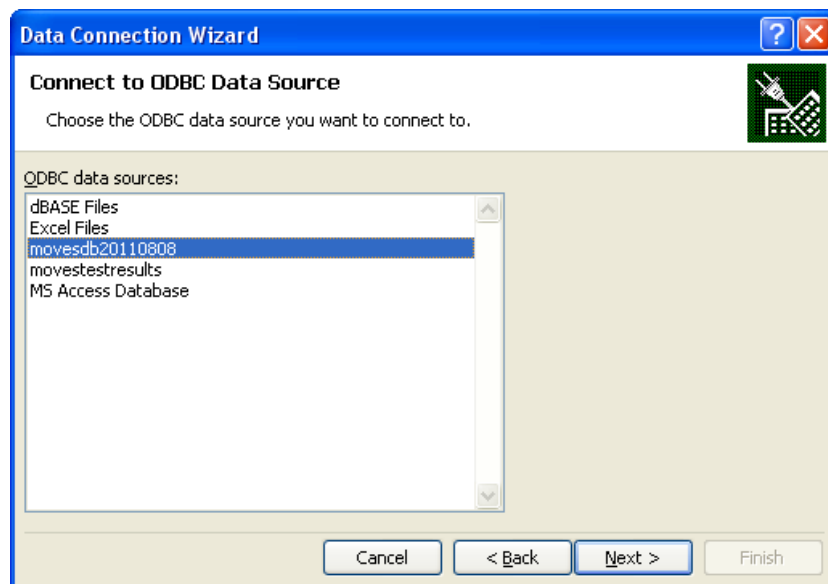
Note MySQL Query Browser can also be used to export MySQL database tables to Excel.

1. Follow the instructions in the **Adding a MySQL database as an ODBC User Data Source in Appendix B-2** for adding the desired MySQL database as an ODBC data source.

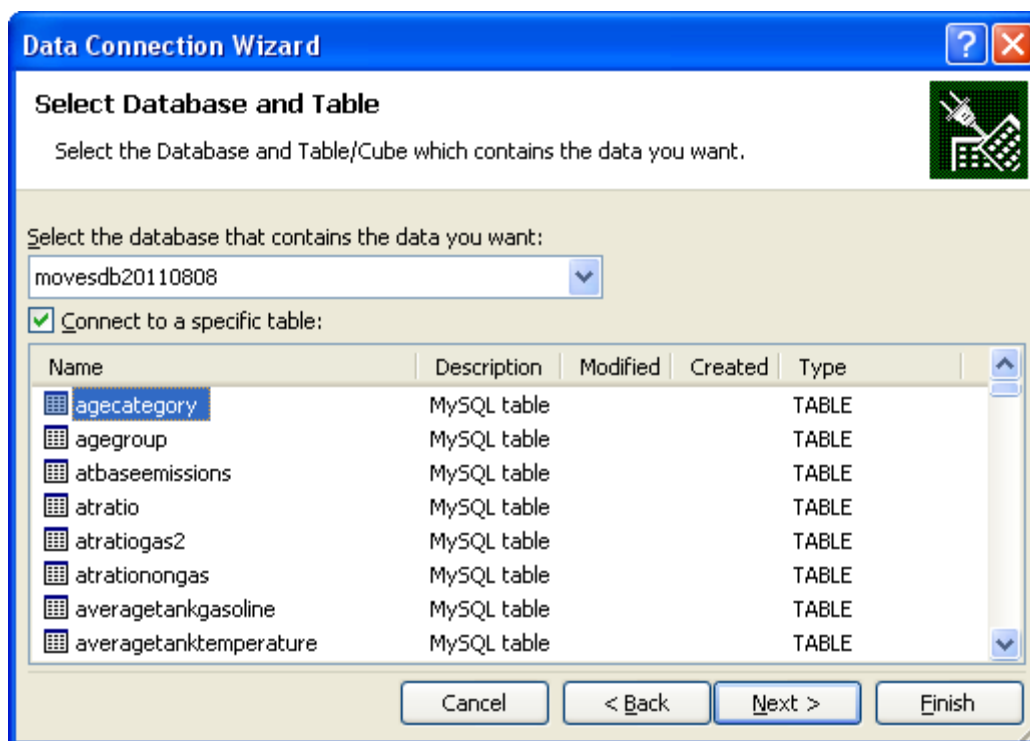
2. Open an Excel file. Click on **Data** from the top menu bar, and choose **From Other Sources**, then chose **ODBC DSN** from the dialog window shown below.



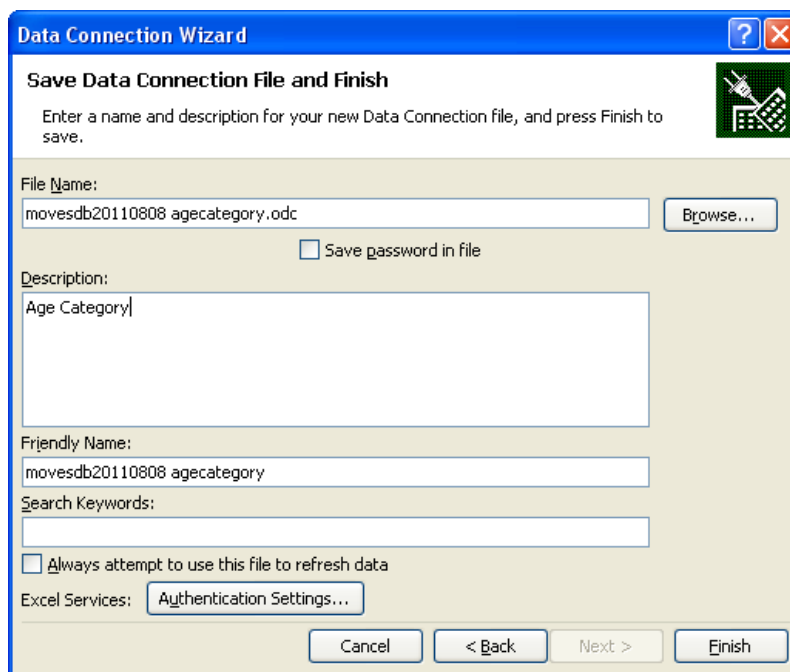
2. From the **Connect to ODBC Data Source** window, select the desired DSN from the list (e.g., "MOVESDB20110808"). Click **Next**.



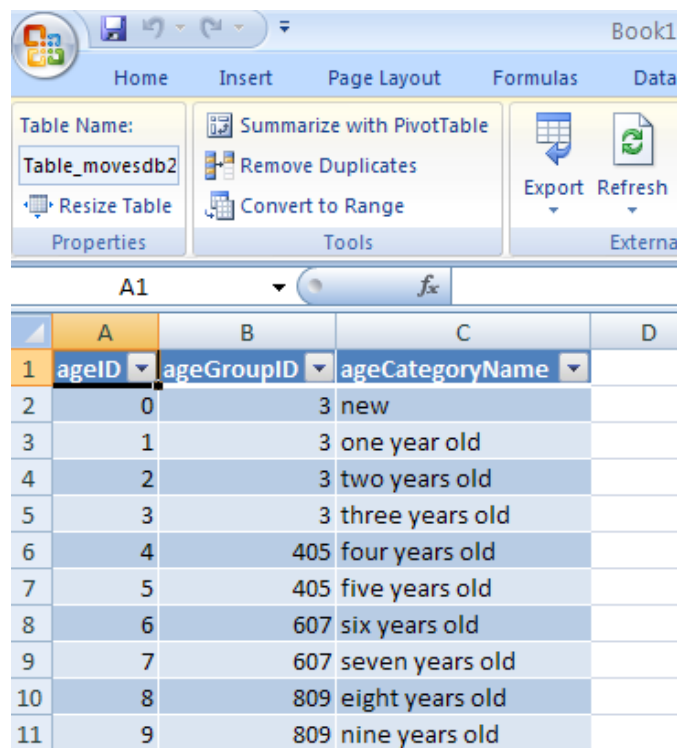
4. Continue by selecting the specific table to display after checking the **Connect to a specific table:** checkbox.



- Continue by accepting the **Connection File Name** and optionally entering a **Description**, then clicking the **Finish** button.



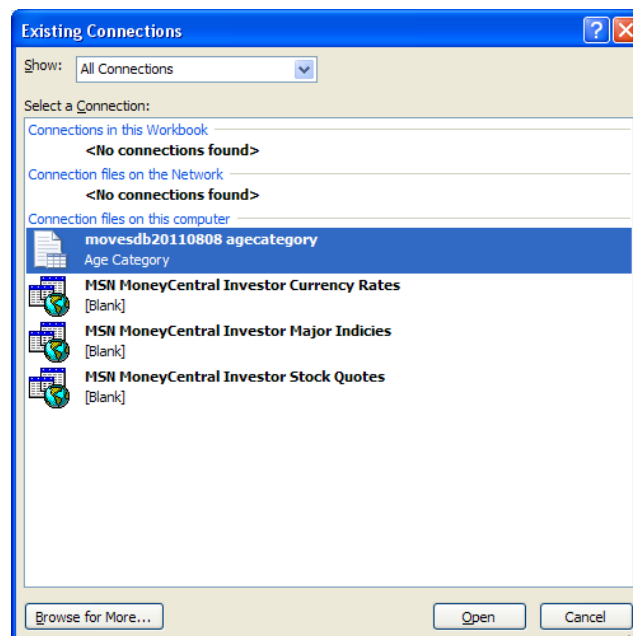
6. The data from the selected table will be displayed in Excel.



The screenshot shows the Excel ribbon with the 'Table' context menu open. The table name is 'Table_movesdb2'. The ribbon includes 'Properties', 'Tools' (with 'Summarize with PivotTable', 'Remove Duplicates', and 'Convert to Range'), and 'ExternalData' (with 'Export' and 'Refresh'). The table data is displayed in the worksheet below.

	A	B	C	D
1	ageID	ageGroupID	ageCategoryName	
2	0	3	new	
3	1	3	one year old	
4	2	3	two years old	
5	3	3	three years old	
6	4	405	four years old	
7	5	405	five years old	
8	6	607	six years old	
9	7	607	seven years old	
10	8	809	eight years old	
11	9	809	nine years old	

7. To reopen the table next time, there is no need to re-invoke the Data Connection Wizard. Instead, simply click on **Existing Connections** to re-select the table data.

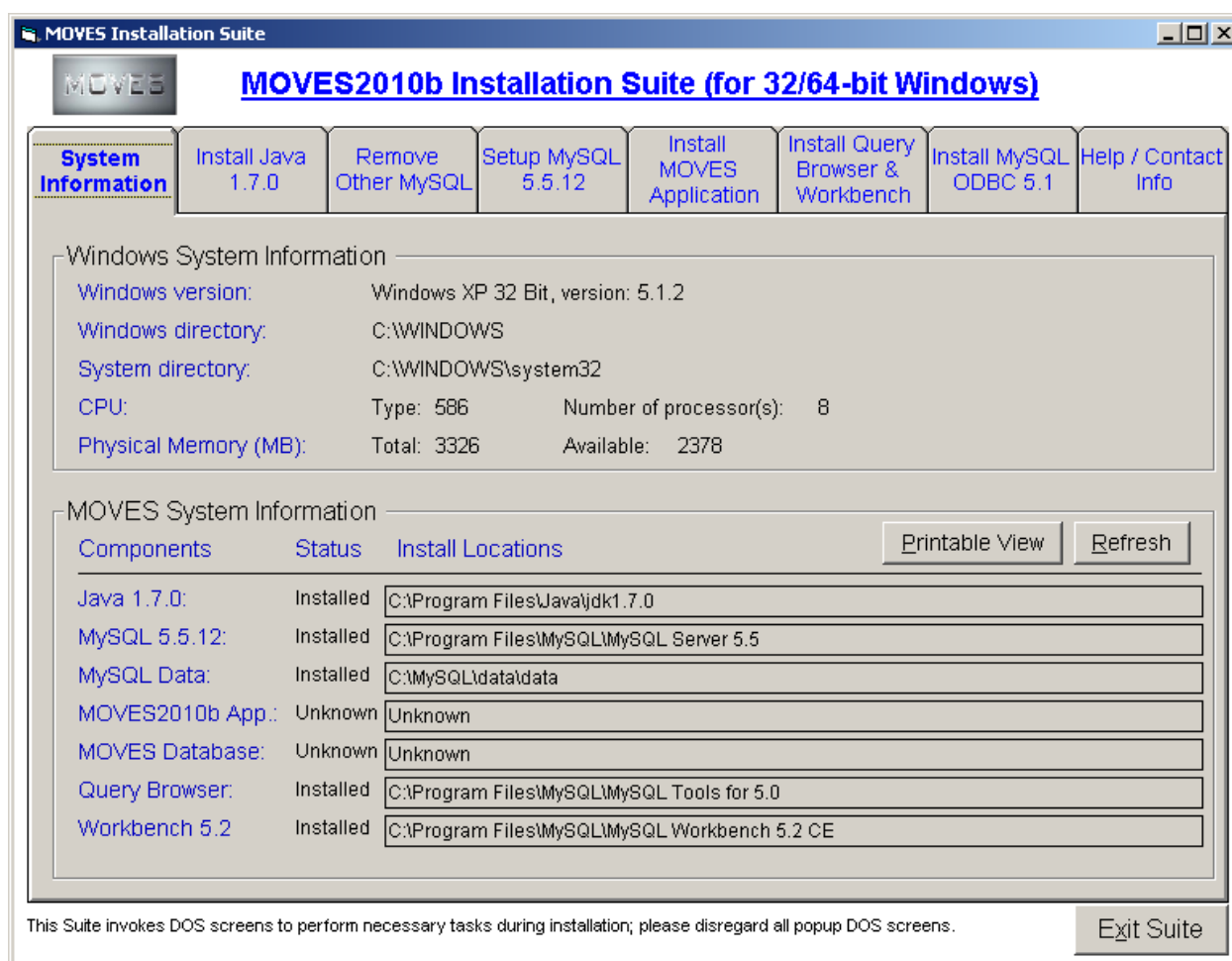


Appendix B2 – Guide To Linking To MySQL from MS Office 2003

This appendix describes in detail how to transform MOVES MySQL tables into Microsoft ACCESS database tables or Microsoft Excel spreadsheets. This may be useful for those who wish to view or manipulate these tables in an alternate format. This appendix also explains how to use the Open Database Connectivity interface protocols and tools.

Adding a MySQL database as an ODBC User Data Source

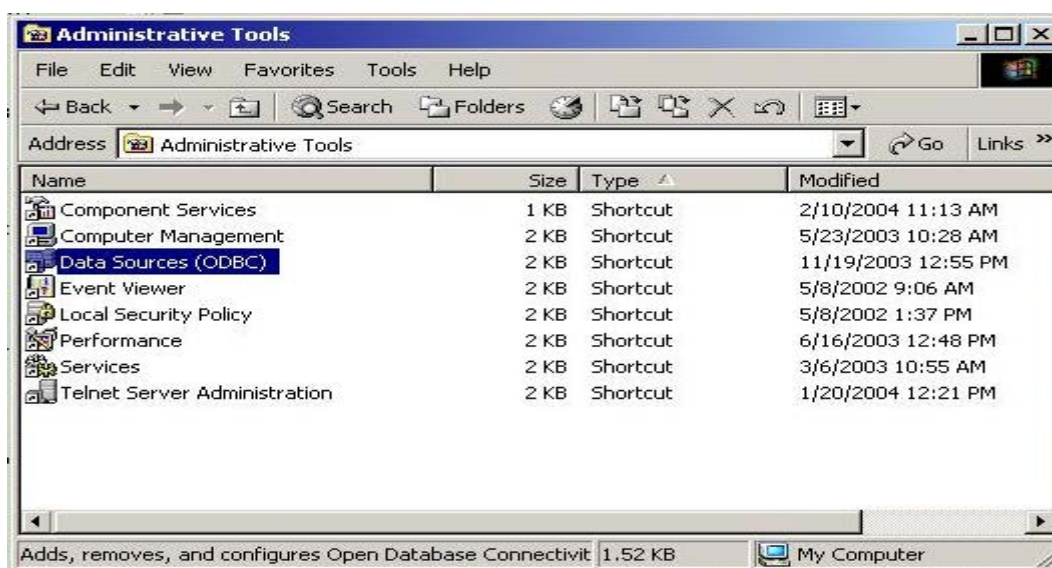
1. Install MySQL driver, MyODBC-3.51.06.exe. This is part of the normal MOVES installation process and can be done by executing the MOVES2010a Installation Suite



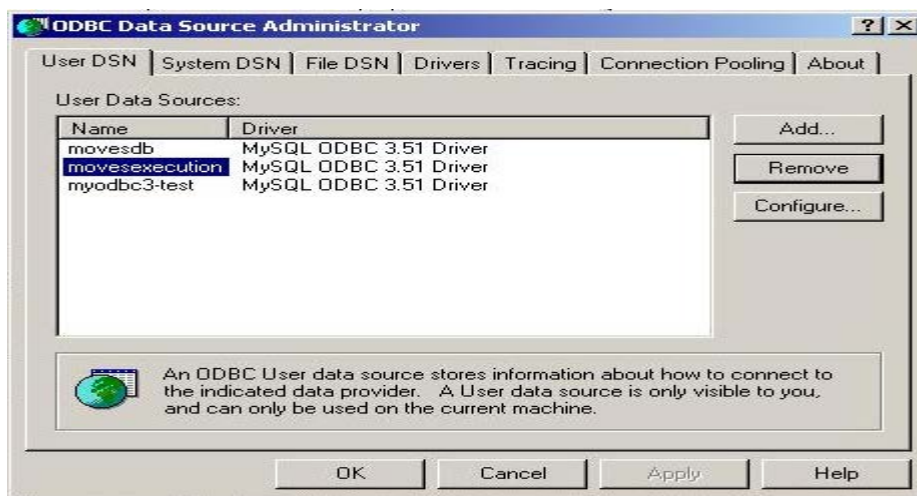
2. Create an ODBC data source with the same name as the folder which corresponds to the MySQL database.
 - a. In the Control Panel, select **Administrative Tools**.



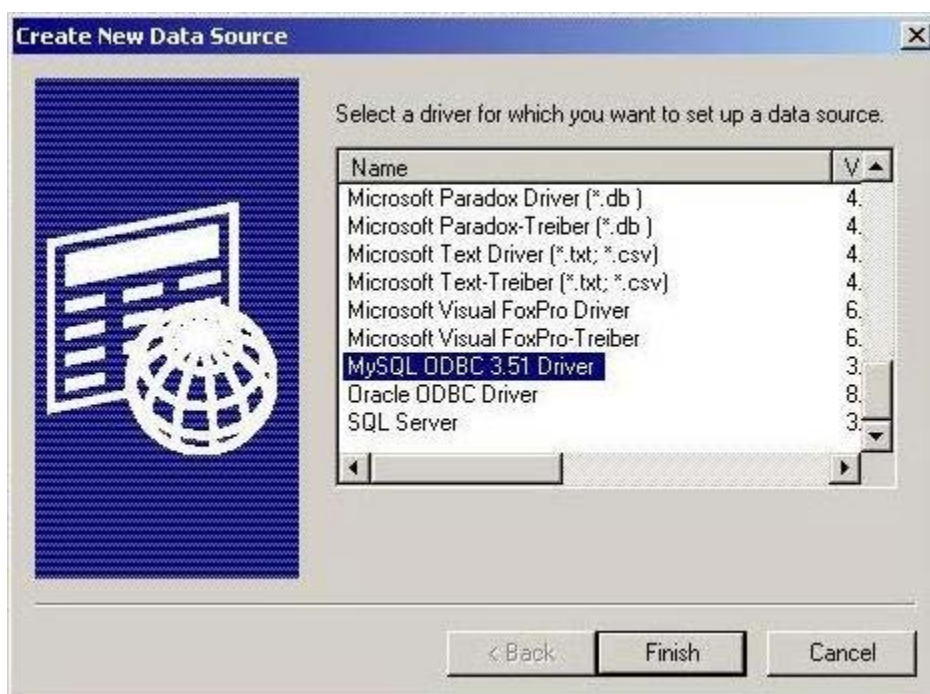
- b. In the **Administrative Tools** menu, select **Data Sources (ODBC)**.



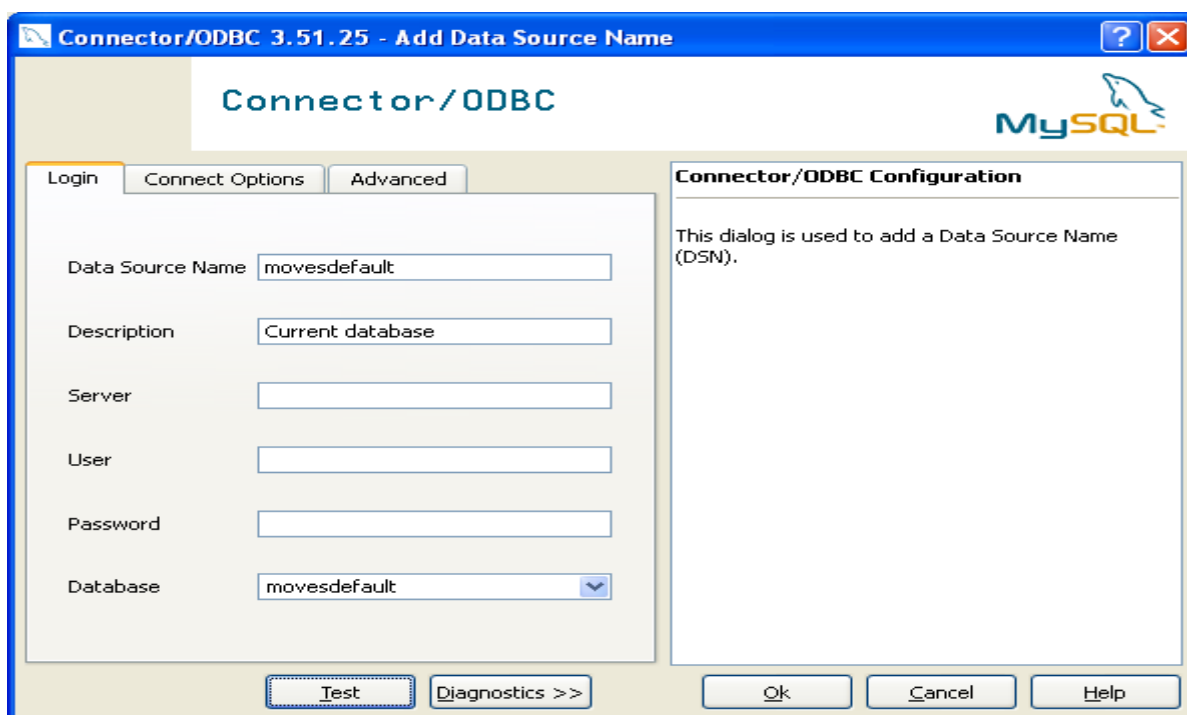
- c. In the **ODBC Data Source Administrator** dialog choose to **Add a User Data Source**.



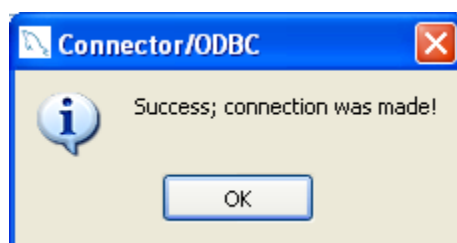
- d. The "New Data Source" should use the MySQL ODBC Driver that was installed earlier. Scroll through the list until the **MySQL ODBC 3.51 Driver** is found, click it, and click **Finish**.



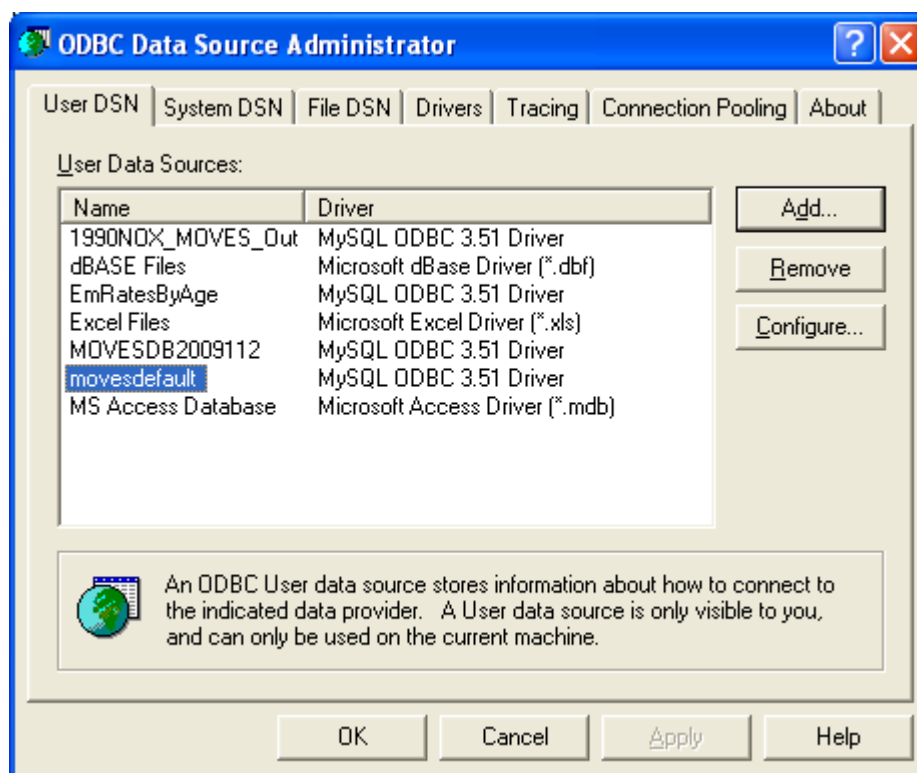
- e. Next, the database links need to be defined. The values shown below are for a database called "movesdefault". The database name should be the name of the folder which contains the desired MySQL database files (i.e., the MySQL database name).



- f. Once the database name and the data source name list an existing MySQL database name, the database connection can be checked by clicking **Test**.

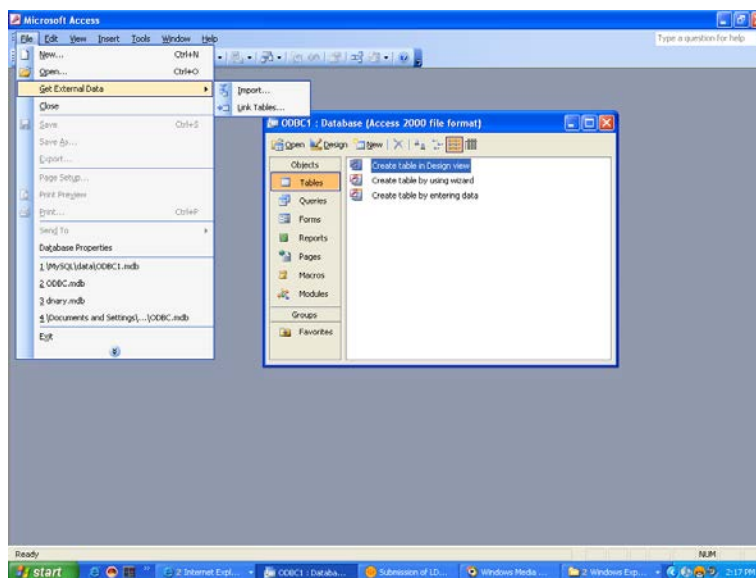


- g. The added data source will show up in the list of data sources in the **ODBC Data Source Administrator** dialog. This will finish the process of creating a new ODBC data source associated with a particular MySQL database.

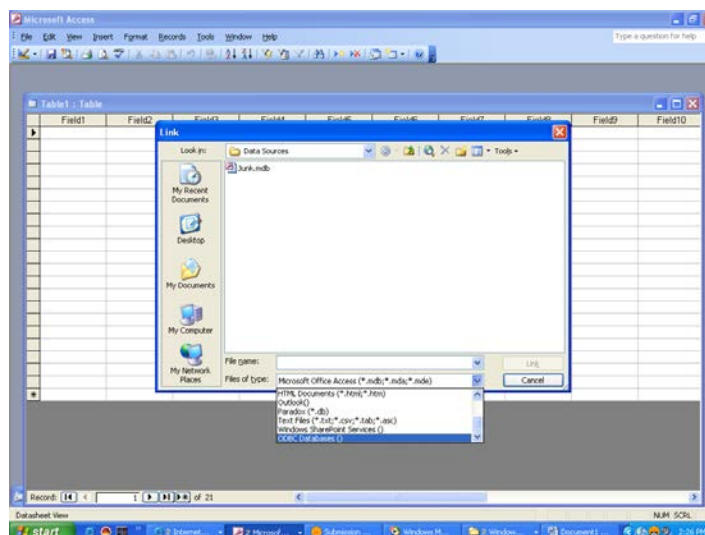


Using Microsoft Access with MySQL Tables

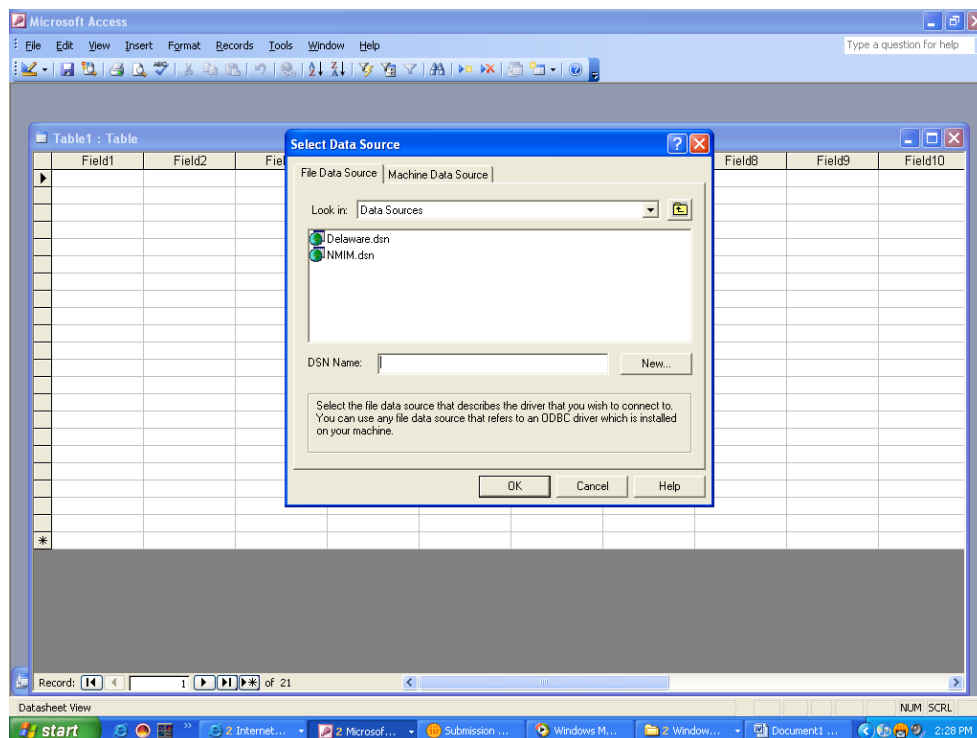
1. Run an Access .mdb (either a new one or an existing one).
2. On the top menu bar, look for menu items **File**, **Get External Data**, then click **Link Tables ...** (see picture below). Click on the item **Link Tables...**



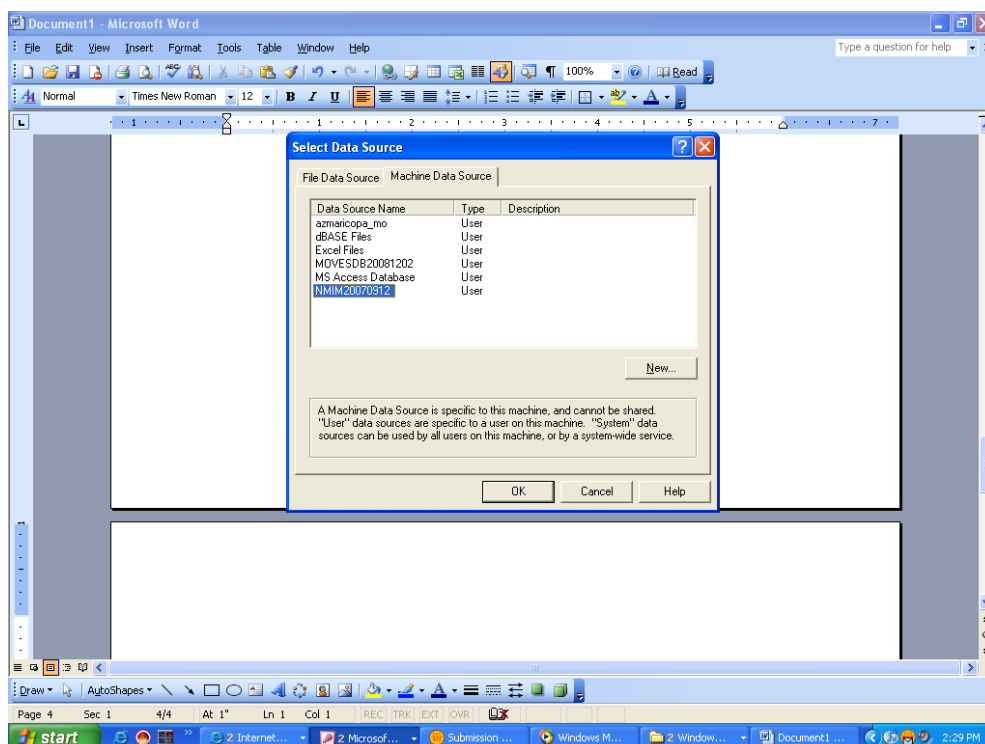
3. On the pop-up window like the one shown below, choose **ODBC Databases()** from the drop-down list which is located next to the label **Files of type**.



- Another pop-up window similar to the one below will appear. Click on the tab **Machine Data Source**, to select a database of interest.

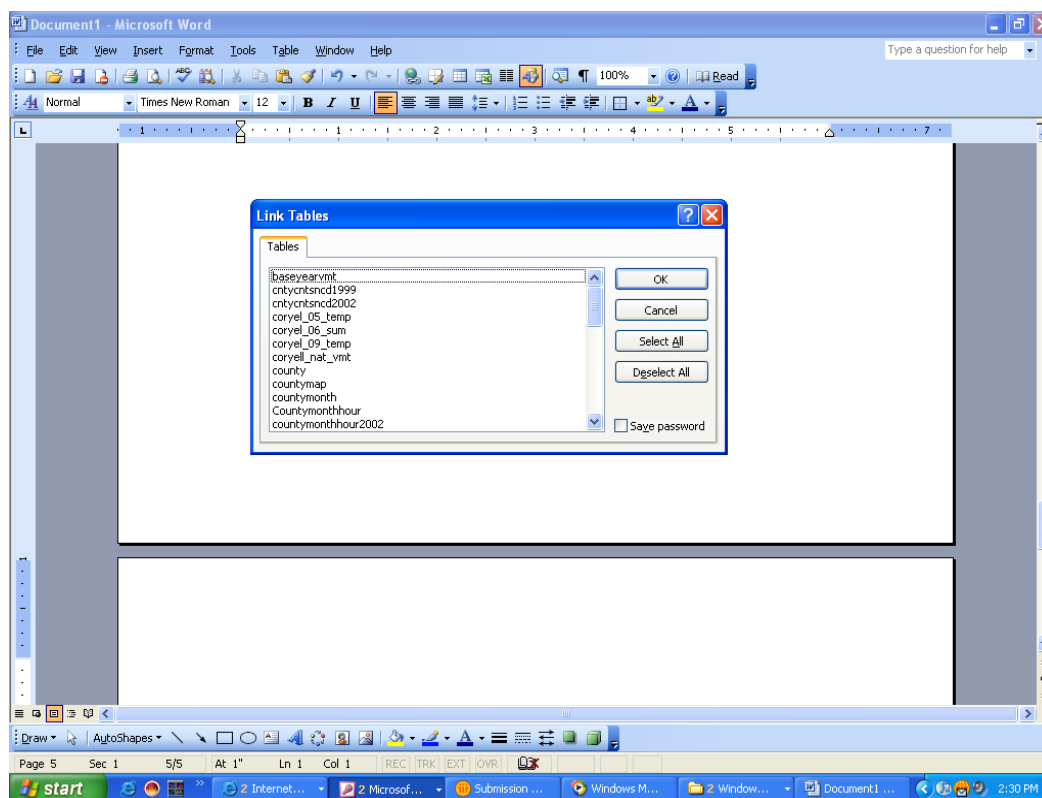


In this example NMIM20070812 is chosen from the **Data Source Name** column. Select **OK** to load the data into Access.



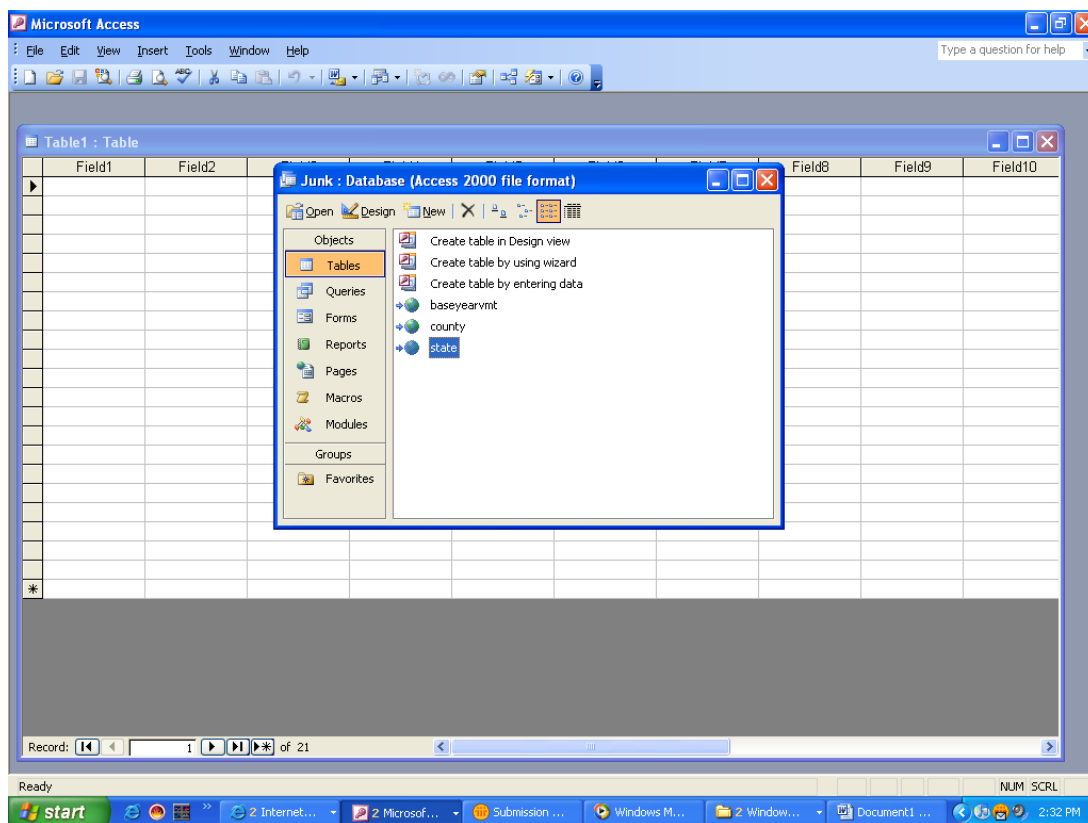
If the **Data Source Name** of the file is not listed, the user must follow the instructions provided in the section, **How to create a DSN Connection to a MySQL database**, presented later in this appendix.

5. Once the data is loaded into access, the **Link Tables** window shown below will appear. This screen displays all of the database tables that are visible in Access. Select tables to view, and click the **OK** button.



In the following screen shot, the user has chosen three tables to work with in MS Access: baseyearvmt, county, and state. The user can now work with these tables in MS Access.

⚡ Caution! Edits made to the tables or data in MS Access will not affect the original MySQL tables and cannot be used directly in MOVES.

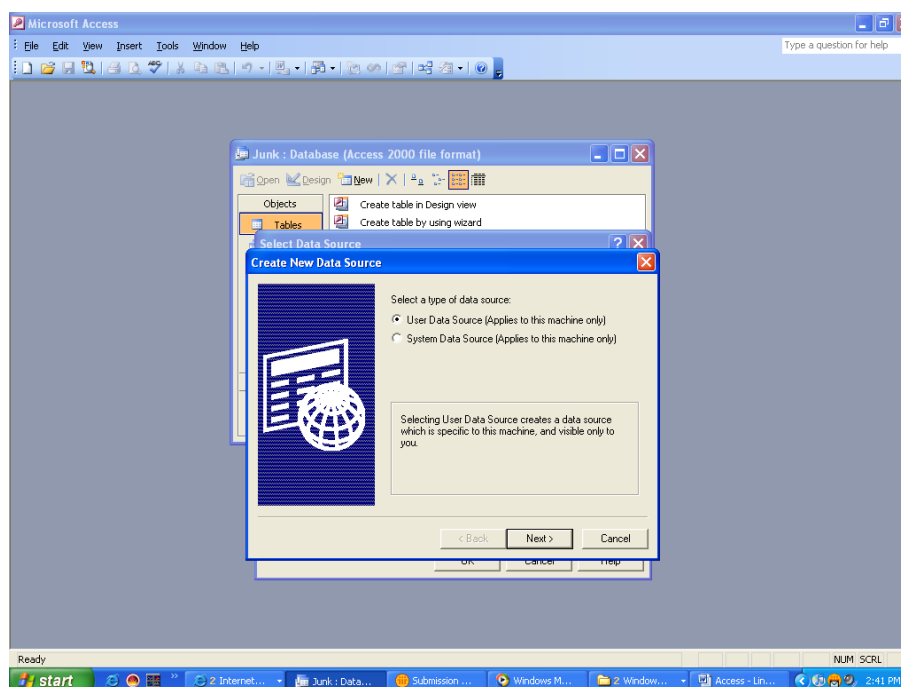


You can view data specific to a particular state by clicking on the StateName in the table.

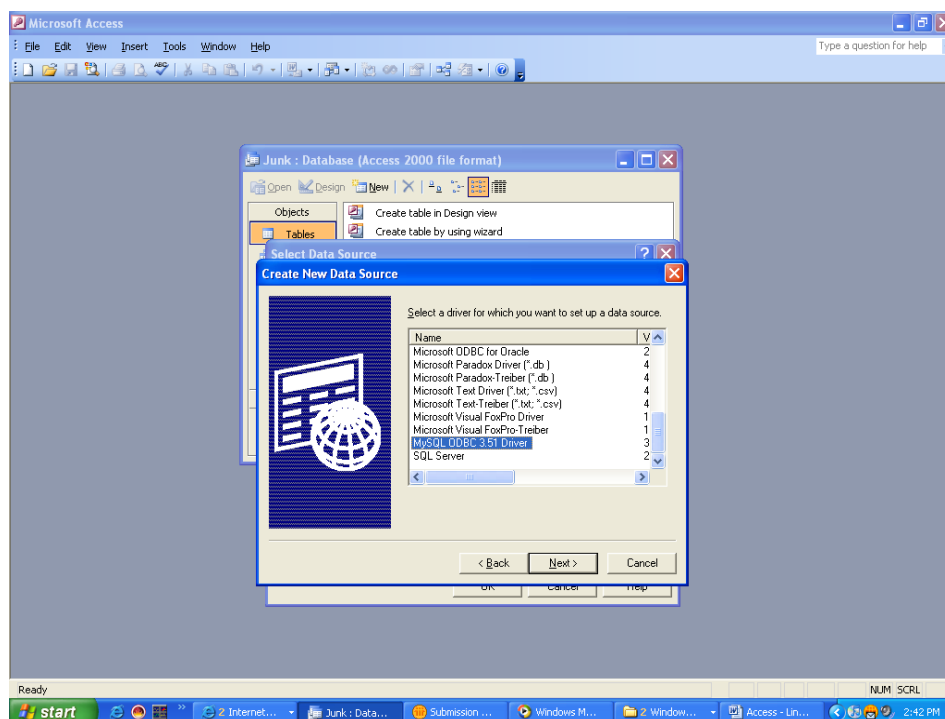
FIPSStateId	StateName	StateAbbr	NLEVFFileName	T2ExhPhaseInF	T2EvapPhaseInF	T2CertFileName	DataSourceId
1	ALABAMA	AL					401
2	ALASKA	AK					401
4	ARIZONA	AZ					401
5	ARKANSAS	AR					401
6	CALIFORNIA	CA	EPACA.nlv	EPACA	EPACA	EPACA	401
8	COLORADO	CO					401
9	CONNECTICUT	CT	EPACTPAR.nlv	EPA2008	EPA2008	EPA2008	401
10	DELAWARE	DE	10000.nlv				1006
11	DISTRICT OF C	DC	11000.nlv				1102
12	FLORIDA	FL					401
13	GEORGIA	GA					401
15	HAWAII	HI					401
16	IDAHO	ID					401
17	ILLINOIS	IL					401
18	INDIANA	IN					401
19	IOWA	IA					401
20	KANSAS	KS					401
21	KENTUCKY	KY					401
22	LOUISIANA	LA					401
23	MAINE	ME	EPAME.nlv	EPACA	EPACA	EPACA	401
24	MARYLAND	MD	24000.NLV				111
25	MASSACHUSETTE	MA	EPAMA.nlv	EPACA	EPACA	EPACA	9925
26	MICHIGAN	MI					401
27	MINNESOTA	MN					401
28	MISSISSIPPI	MS					401
29	MISSOURI	MO					401
30	MONTANA	MT					401
31	NEBRASKA	NE					401

How to create a DSN Connection to a MySQL database

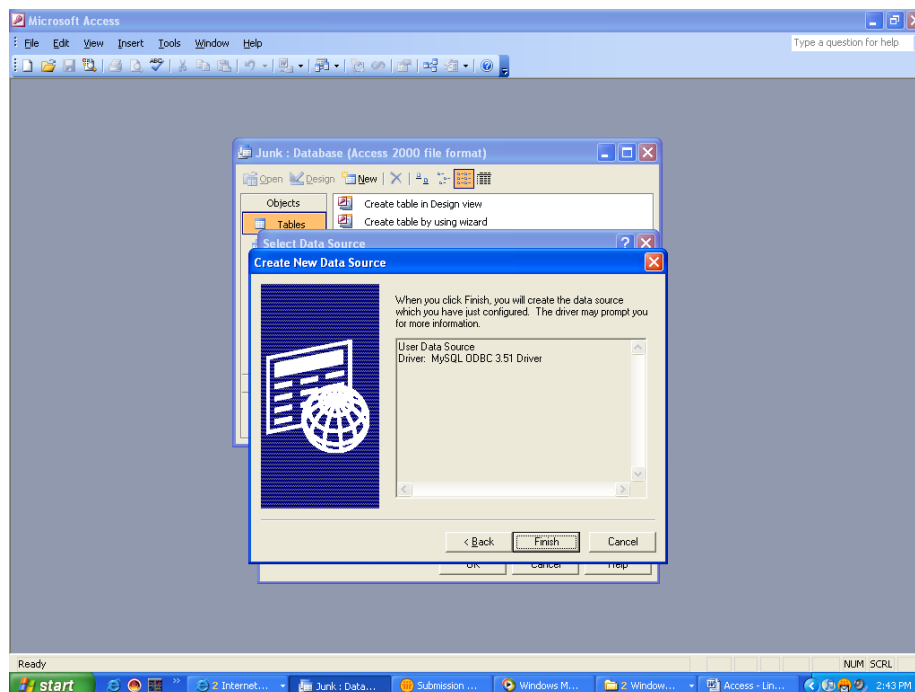
If you do not find the MySQL database referenced in the **Data Source Name** listing in MS Access, a DSN connection must be established. In order to do so, click on the **Machine Data Source** tab from the **Select Data Source** screen. Click **New**, and click **Next**.



At the **Create New Data Source Dialog** box, select **MySQL ODBC 3.51 Driver**. Click **Next**.

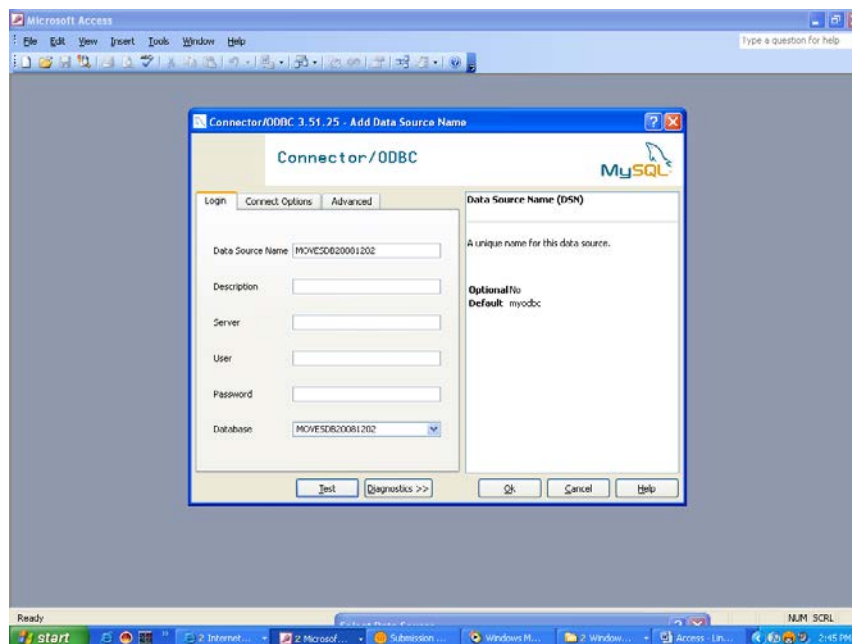


Click **Finish** to begin to establish the connection.

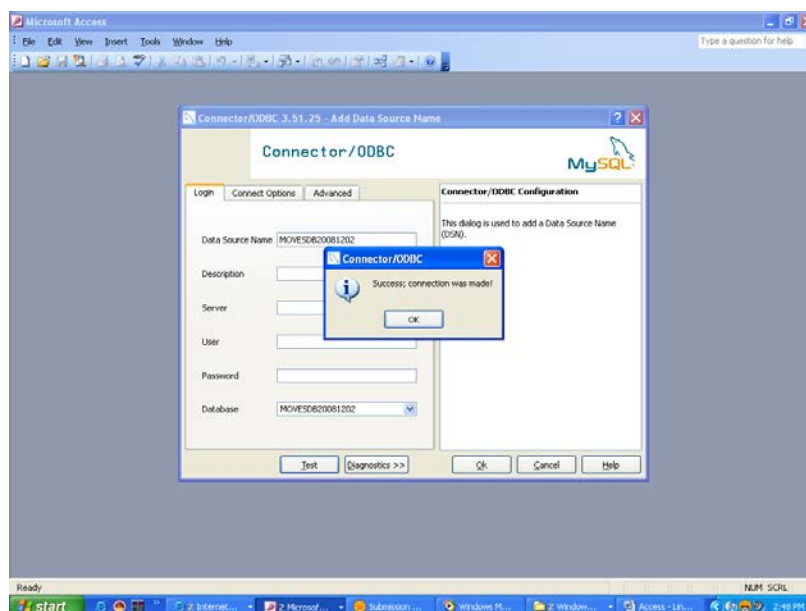


The **Connector/ODBC** screen is used to establish the connection from MS Access to the MySQL database. Use this screen to define the **Data Source Name**.

Note Consider making the **Data Source Name** similar to the database name, such as DSN_DatabaseName. This will make it easier to find.



Once the **Data Source Name** has been created, select the **Test** button. The pop-up box **Connector/ODBC** should open, with the message, "Success; connection was made!" Press **OK**, and the pop-up box will disappear. Click **OK** to create the DSN connection.

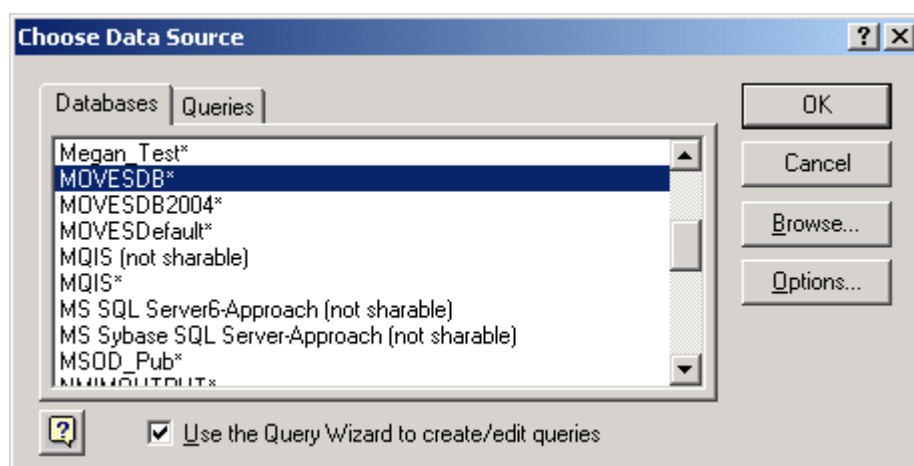


The **Data Source Name** will now be listed in the **Select Data Source** window.

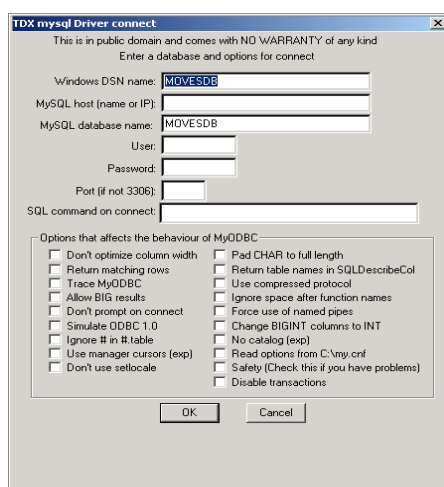
Using Microsoft Excel with MySQL Tables

Note MySQL Query Browser can also be used to export MySQL database tables to Excel.

1. Follow the instructions in the section, **Adding a MySQL Database as an ODBC User Data Source**, for adding the desired MySQL database as an ODBC data source.
2. Open an Excel file. Click on **Data** from the top menu bar, and choose **Import External Data**. Select **New Database Query** from the sub-menu window. This will open the **Choose Data Source** window.
3. From the **Choose Data Source** window, select the desired DSN from the list (e.g., "MOVESDB"), then click **OK**.



4. Click the **OK** button in the **mysql Driver connect** window.



5. Follow the instructions posted by the Wizard until finished.

Appendix C - Running MOVES from the Command Line

The MOVES command line allows MOVES2010b to be executed without running its graphical user interface. It is useful in situations where repeated or unattended runs are needed, or when another computer program executes MOVES. This interface presumes that a MOVES run specification file has been prepared and that you are running from the DOS prompt.

These instructions presume some familiarity with DOS commands. The DOS commands to execute the MOVES Command Line Interface are:

```
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r runspecfile
[OR]
java -XmxNNNm gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r runspecfile
[OR]
java gov.epa.otaq.moves.master.commandline.MOVESCommandLine -rl runspeclistfile
[OR]
java XmxNNNm gov.epa.otaq.moves.master.commandline.MOVESCommandLine -rl runspeclistfile
```

where

-XmxNNNm is an optional parameter and NNN is a three digit integer number. For example, **-Xmx200m** specifies you are asking Java to allocate 200 megabytes of heap memory for your runs. This optional parameter is required only if your MOVES runs need more heap memory than the default determined automatically by Java and your machine. The actual maximum amount of heap memory that you can ask for depends on your machine. You can increase or decrease the amount of heap memory as your machine allows. For example,

```
java -Xmx512m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -rl runspeclistfile
[OR]
java -Xmx512m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r runspecfile
```

"runspecfile" is the name of a file containing a saved MOVES run specification (e.g. "C:\YourPATHto\YourRunSpecName.mrs") and *"runspeclistfile"* is the name of a text file containing a list of run specification file names, with one per line. The rest of the syntax is literal. The spelling of "MOVESCommandLine" is case sensitive because it is a Java class name. When doing a batch run, you can identify the RunSpec list text file in the command line using quotes because it is located in a folder with spaces (e.g. "C:\My Documents"). However, the command line doesn't work if you put quotes in the RunSpec list file itself. The command line will think the file doesn't exist.

By executing one of these commands, you run the Java interpreter (java.exe). MOVESCommandLine is a DOS parameter telling java.exe which Java class file to begin executing, and the last two tokens are parameters passed to MOVESCommandLine. Either version of this command can be executed from a DOS batch file, and batch files can contain multiple commands. Prior to executing the command, the active directory should be set to the location where MOVES is installed, typically C:\Program Files\MOVES, and the SETENV.BAT file should be executed.

It can be difficult for DOS to find everything. For the command to work, three elements must be found:

- The Java interpreter.
- The MOVESCommandLine Java class.
- Any runspeclistfile and all runspecfiles.

Running SETENV.BAT insures that the Java interpreter is found. Running SETENV.BAT also insures that the procedure described in the next paragraph results in the MOVESCommandLine Java class being found. Java experts can also use the CLASSPATH environment variable more directly to locate Java class files.

If MOVES has been installed in the default location, C:\Program Files\MOVESyyyymmdd, then MOVESCommandLine.class is located at C:\Program Files\MOVESyyyymmdd\gov\epa\otac\moves\master\commandline. This can be made the active directory, or the command can specify whatever part of the path is needed. For example, if the active directory is C:\Program Files\MOVESyyyymmdd, the command line interface class would be specified as "gov.epa.otac.moves.master.commandline.MOVESCommandLine".

One way to insure that the runspecfile or the runspeclistfile is found is to specify the full path. If a simple file name is used the file should be located in the active DOS directory.

If the GUI is used to create an importer XML file (see **Tools - Section 2.3.3.3**), the XML file can be edited and executed via the command line. Remember that when using the command line, text output is not sent to the screen but instead stored in MOVESBatch.log. An example command line is:

```
java gov.epa.otac.moves.master.commandline.MOVESCommandLine  
-i importAllFromTemplates.xml
```

Be sure to place all of this on one line. The "-i" option directs MOVES to the XML file that describes the import actions to occur. Note that this XML file contains a summary of the RunSpec within it, thus allowing wildcards even when importing via the command line. For MOVES installations on Windows 2000 platforms, there may be a problem with the DOS command string length not allowing more than 126 characters. To resolve this, move MOVES to the root of C: drive (C:\MOVES\), so that the length of the command line string will be shorter. Note that Windows2000 is not a recommended or supported environment in which to run MOVES.

If the GUI is used to create an importer XML file (see **Tools - Section 2.3.3.3**), the XML file can be edited and executed via the command line. Remember that when using the command line, text output is not sent to the screen but instead stored in MOVESBatch.log.

Appendix D - Creating an On-Road Retrofit Input File

The On-Road Retrofit strategy allows you to enter information about diesel trucks and buses that have been retrofitted with emission control equipment. An On-Road Retrofit Parameters File must be input to the MOVES model to model on-road vehicle retrofit effects. This file can be in tab-delimited text, comma-delimited (*.csv), or Microsoft Excel (*.XLS) format. Create the Retrofit Parameters File by using either a text editor such as Wordpad or Notepad, or a spreadsheet such as Excel.

Header and Comment Rows

The first row of the Retrofit Parameter File must be a header row that contains the retrofit input parameter names separated by tabs. The remaining rows of the file contain the retrofit parameters. Comment rows are allowed if the first character in the row or the first cell in the tabbed file or *.XLS file is the '#' character.

Retrofit Parameter File Format

The Retrofit Parameter File must contain the following ten parameters in the order listed. Each parameter's possible values are provided.

1. Retrofit Pollutant

This column must contain the full MOVES pollutant name or the pollutant abbreviation for which you wish to model retrofit data. (In MOVES the user may not use the MOVES PollutantID number.) The data must appear exactly as shown in Table D-1 below, except that the pollutant abbreviation and/or full name input are not case sensitive.

Table D-1
Retrofit Parameter File Pollutants

PollutantID	Full MOVES Pollutant Name	Pollutant Abbreviation
1	Total Gaseous Hydrocarbons	HC
2	Carbon Monoxide (CO)	CO
3	Oxides of Nitrogen	NO _x
5	Methane (CH ₄)	CH ₄
6	Nitrous Oxide (N ₂ O)	N ₂ O
90	Atmospheric CO ₂	AT CO ₂
91	Total Energy Consumption	TotEnergy
92	Petroleum Energy Consumption	PetEnergy
93	Fossil Fuel Energy Consumption	FossilEnergy

(cont.)

Table D-1
Retrofit Parameter File Pollutants (cont.)

PollutantID	Full MOVES Pollutant Name	Pollutant Abbreviation
98	CO ₂ Equivalent	CO2EQ
101	Primary PM10 - Organic Carbon	PM10OC
102	Primary PM10 - Elemental Carbon	PM10EC
105	Primary PM10 - Sulfate Particulate	PM10Sulfate
106	Primary PM10 - Brakewear Particulate	PM10Brake
107	Primary PM10 - Tirewear Particulate	PM10Tire
111	Primary PM2.5 - Organic Carbon	PM25OC
112	Primary PM2.5 - Elemental Carbon	PM25EC
115	Primary PM2.5 - Sulfate Particulate	PM25Sulfate
116	Primary PM2.5 - Brakewear Particulate	PM25Brake
117	Primary PM2.5 - Tirewear Particulate	PM25Tire

2. Retrofit Emission Process Input

This column must contain the full MOVES process name or the ProcessID abbreviation for which you wish to model retrofit data. In MOVES, do not use MOVES ProcessID. The data must appear exactly as shown in Table D-2 below, except that the ProcessID abbreviation and full name are not case sensitive.

Table D-2
Retrofit Parameter File Processes

ProcessID	Full MOVES Process Name	Process Abbreviation
1	Running Exhaust	Running
2	Start Exhaust	Start
90	Extended Idle Exhaust	Extended Idle
9	Brakewear	Brake
10	Tirewear	Tire

3. Retrofit Fuel Type Input

This column must contain the full MOVES fuel name or the fuel abbreviation for which you wish to model retrofit data. In MOVES, do not use FuelTypeID. The data must appear exactly as shown in Table D-3 below, except that the fuel abbreviation and full name are not case sensitive.

Table D-3
Retrofit Parameter File Fuel Types

FuelTypeID	Full MOVES Fuel Type Name	Fuel Type Abbreviation
1	Gasoline	Gas
2	Diesel Fuel	Diesel
5	Ethanol (E85)	Ethanol

4. Retrofit Vehicle Source Type Input

This column must contain the Sourcetype abbreviation or the full MOVES Sourcetype name for which you wish to model retrofit data. In MOVES, do not use SourceTypeID number. The data must appear exactly as shown in Table D-4 below, except that the sourcetype abbreviation and full name input are not case sensitive.

In MOVES2010b, diesel (FuelTypeID = 2) vehicles with the following SourceTypeIDs are covered by the Retrofit Calculations: 32, 41, 42, 43, 51, 52, 53, 61, and 62.

Table D-4
Retrofit Parameter File Source Types

SourceTypeID	Full MOVES Vehicle SourceType Name	SourceType Abbreviation
11	Motorcycle*	MC
21	Passenger Car*	Car
31	Passenger Truck*	PTruck
32	Light Commercial Truck	ComTruck
51	Refuse Truck	RefuseTruck
52	Single Unit Short-Haul Truck	SUShortTruck
53	Single Unit Long-Haul Truck	SULongTruck
54	Motor Home	MH
43	School Bus	SBus
42	Transit Bus	TBus
41	Intercity Bus	IBus
61	Combination Short-haul Truck	CShortTruck
62	Combination Long-haul Truck	CLongTruck

* These sourcetypes should not be used in retrofit input files.

MOVES compares inputs for pollutant, process, fuel type, and source type with the stored retrofit possibilities and prompts you if an incorrect name, abbreviation or number for pollutant, process, fuel type, or source type is entered.

5. Initial Calendar Year of Retrofit Implementation

The Initial Calendar Year of the Retrofit Implementation is the first calendar year that a retrofit program is administered. Initial Calendar Year input must be equal to or less than the Final Calendar Year of Retrofit Implementation. All months within a calendar year are affected equally by the retrofit.

6. Final Calendar Year of Retrofit Implementation

The Final Calendar Year of the Retrofit Implementation is the last calendar year that a retrofit program is administered. Final Calendar Year input must be equal to or greater than the Initial Calendar Year of Retrofit Implementation.

7. Initial Model Year that will be Retrofitted

The Initial Model Year that will be Retrofit is the first model year of coverage for a particular vehicle class/pollutant combination. Valid entries for initial model year must meet the following mathematical requirement:

$$\text{Initial Model Year} \geq \text{Initial Calendar Year} - 30$$

The Initial Model Year cannot be greater than the Final Model Year that will be Retrofit.

8. Final Model Year that will be Retrofitted

The Final Model Year that will be retrofitted is the last model year of coverage for a particular vehicle class/pollutant combination. No retrofit will be performed on Final Model Year input which is larger than the Evaluation Calendar Year. Also, the Final Model Year input cannot be less than the Initial Model Year that will be retrofitted.

9. Percentage of the Fleet Retrofit per Year

The Percentage of the Fleet Retrofit per Year represents the percentage of VMT of a particular fleet of a particular vehicle class, retrofit calendar year group, model year group, and pollutant combination that is to be rebuilt in a given calendar year. For a successful retrofit simulation, a value greater than zero and less than or equal to 100.0% must be entered. MOVES checks to ensure that the product of the number of calendar years of retrofit coverage (Final Calendar Year of Retrofit Implementation - Initial Calendar Year of Retrofit Implementation) and the Percentage of the Fleet Retrofit per Year does not exceed 100%. For example, a retrofit simulation will be flagged as invalid, and an error message will appear, if the simulation has a retrofit program start in calendar year 2005, a program end in calendar year 2008, and a yearly Fleet Retrofit Percentage of 50% ($3 * 50\% > 100\%$).

10. Percentage Effectiveness of the Retrofit

The Percentage Effectiveness of the Retrofit is the percent emission reduction achieved by a retrofit. It is computed from a non-retrofit emission baseline. You must enter a retrofit effectiveness value for a particular vehicle class, retrofit calendar year group, model year group, and pollutant combination. All values up to 100% are valid. A negative value is permitted because it implies an emission increase as a result of retrofit, which can occur. A value greater than 100% is not permitted because it implies negative emissions will be generated. See also EPA's guidance on quantifying benefits from retrofits at <http://www.epa.gov/otaq/stateresources/transconf/policy.htm>.

Appendix E - Best Practices

There are several best practices that can assist in managing various aspects of the MOVES process. In particular, we have found it helpful to be careful and consistent in naming, managing & documenting RunSpecs and files.

NOTE MOVES database names must be consistent with MySQL naming conventions. In general, this means they may contain letters, numbers, "_" (underscore) and "\$" characters. They may not contain spaces, special characters, or be "reserved words" (SQL words such as "select", "where", "delete", etc.).

Table E-1
MOVES Best Practices

Suggestion	Rationale	Example
Name all your MOVES output databases with a code indicating that the database includes MOVES output.	Prevents overwriting input files; makes it easier to identify output files.	Washtenaw2008_MO (for MOVES Output) or Washtenaw2008_out
When testing MOVES, name output with "Temp" or other indicator.	Mysql/data folder can get cluttered. This allows you to clean up more easily.	Washtenaw2008_temp_MO
Name all your MOVES input databases and strategy files with a code indicating that the database contains MOVES alternate input data.	Helps you organize your inputs and prevents you from inadvertently damaging important input information.	Washtenaw2008_IN
Name all your MOVES RunSpec files with a code indicating that the file contains a MOVES RunSpec.	Helps you organize your input information and can be used to locate files using a search.	Washtenaw2008.mrs (for MOVES Run Specification) or Washtenaw2008_mrs.txt
Name all the files you use for a specific run using the same name, but with extensions to identify the parts (see file naming suggestions above).	Helps you organize your information.	Washtenaw2008_in, Washtenaw2008.mrs, Washtenaw2008_mo

Suggestion	Rationale	Example
Keep all of your RunSpecs in the same directory as the import files associated with that RunSpec. This folder should be outside the folders installed by MOVES so that it will not be overwritten when installing a new version of MOVES.	MOVES will first look in the location of the RunSpec when browsing for import files, so keeping them all in one place keeps you from searching for the files that will be imported.	My Documents\MOVES\ [CountyYear]
Decide on the Scale and Calculation Type you wish to use before making selections on any other panels.	Changing the Scale or Calculation Type option after making choices in other panels may require you to re-enter data for those panels.	
Using the description panel is helpful when trying to discriminate between several runs. Think about filling out some sort of repeatable formula such as date, relevant important parameters, who is doing the run, etc. Note that MOVES preserves these descriptions in the movesrun output table for future reference.	Documentation of the RunSpec is very important, especially if many scenarios are being processed.	2010_01_01; John Doe; Washtenaw County; 2010; July
Every run used for any official purpose should be archived completely. All batch files, RunSpecs, MOVES code and configuration files, supplemental code copied into MOVES by batch files, default database, user input databases, etc. should be saved. File location can be added as the "Description" when the file is imported.	Months or years later, the run can be reproduced by anyone opening the archive.	

Suggestion	Rationale	Example
If they are not too large, output related runs should be saved to the same MySQL database.	Combined with useful RunSpec descriptions, you can keep all the data, and its description in a single place. Looking at the Moves Run table in that database can be very informative.	
Always “GROUP BY” MOVESRunID, PollutantID, and DayID when summing output results.	If a table includes output from multiple runs, it is very easy to mistakenly sum them together, thereby drastically increasing emissions. Emissions from different pollutants should never be summed. The types of day must be correctly weighted before they can be summed.	SELECT MOVESRunID, DayID, PollutantID, sum(emissionquant) FROM MOVESOutput GROUP BY MOVESRunID, DayID, PollutantID;

Appendix F – Stage II Refueling Control Programs

Stage II refueling emission control programs are intended to reduce HC and associated air toxics emissions by reducing the amount of gasoline vapor that escapes to the atmosphere during refueling. The Refueling Displacement Vapor Losses and the Refueling Spillage Losses processes are affected by Stage II. Stage II controls reduce the amount of fuel spilled due to "spitback". No other emission processes should be affected by Stage II control programs. The amount of reduction depends on whether the vehicle has an onboard recovery system and the level of uncontrolled emissions. The uncontrolled emissions are calculated from inputs such as fuel RVP, vehicle fuel economy, and temperature parameters. Stage II programs are run by state, local or tribal governments and the effects of these programs will vary depending on the number of locations and the sales volume of stations equipped with Stage II recovery systems and their average state of repair.

The MOVES database contains information about all of the existing Stage II programs by county based on the parameters used for the 2005 National Emission Inventory (NEI). For the initial release of MOVES, the effects of Stage II programs can only be altered by manually editing the tables used by MOVES to obtain the Stage II control information. Future versions of MOVES are expected to include graphical user interface (GUI) tools to assist in altering Stage II program effects for individual counties. Until these tools are available, this appendix is intended to assist in making changes to the default parameters related to the effect of Stage II programs on refueling emissions.

Stage II refueling emission control programs can only affect refueling losses that occur during refueling. Onboard Refueling Vapor Recovery (ORVR) systems on modern vehicles are designed to minimize the refueling losses without Stage II controls. These reductions are already accounted for by MOVES, so that the additional control of Stage II will only affect the remaining refueling losses from these ORVR vehicles.

Only the most recent 31 model years of vehicles in the evaluation calendar year are simulated when MOVES is run. When the fleet is entirely composed of vehicles subject to ORVR rules, the only value of Stage II controls will be to control refueling vapors from vehicles with damaged ORVR systems. Until that time, having a Stage II control program always adds to the control of refueling losses, since there are always some vehicles without ORVR controls that will benefit from a Stage II program. The remaining Stage II benefits depend on the program design, including the scope (which stations have the program) and effectiveness (how much of the equipment is operational). MOVES does not account for any effects on the emissions from refueling station gasoline storage tanks when Stage II is used in combination with vehicles equipped with ORVR systems.

County Year Table

The MOVES database contains a table named CountyYear which contains information about each county for every calendar year. This table contains two fields that determine the Stage II program effects:

- refuelingVaporProgramAdjustment
- refuelingSpillProgramAdjustment

The refuelingVaporProgramAdjustment field is a number between zero and one (1.0) which indicates the fraction that is the reduction in full uncontrolled refueling displacement vapor losses that result from the Stage II recovery program that county in that calendar year. The refuelingSpillProgramAdjustment field is a number between zero and one (1.0) which indicates the fraction that is the reduction in full uncontrolled refueling fuel spillage losses that result from the Stage II recovery program that county in that calendar year. A value of zero would indicate that the program had no effect and a value of one would indicate that all uncontrolled vehicle refueling emissions had been eliminated.

Updating Refueling Adjustments Using MySQL Query Browser

The simplest way to change an existing Stage II program effect is to use the MySQL Query Browser application to open the appropriate table and manually change the existing values, but **NEVER** change values in a default MOVES database provided by EPA. MOVES is designed to easily provide replacement values for default values using MySQL tables via the **Manage Input Data Sets** panel on the MOVES graphical user interface (GUI). Using the **Manage Input Data Sets** panel, type the name you wish to use for the database which will hold your Stage II estimates into the Database drop-down box. Now click the **Create Database** button and you will create a database to hold your information. The name will have to meet the criteria for database names (no spaces, no special characters) and we suggest it include text to help you identify its contents and purpose (for example, StageII_Input).

Once you have an input database, you can open the MySQL Query Browser to work with the tables. If the Query Browser is already open, you may need to right-click in the Schemata panel and refresh the list of database. Once you find your database, double-click on the name and that will show you all of the tables it contains. The database will contain empty versions of every table used by MOVES. The table that contains the Stage II program adjustments is called CountyYear and contains only four fields:

- countyID
- yearID
- refuelingVaporProgramAdjustment
- refuelingSpillProgramAdjustment

Double click on the **CountyYear table** and the SQL Query Area panel should show an SQL command:

```
SELECT * FROM MOVESDB20100118.countyyear c;
```

You can execute that command by pressing the green "lightning bolt" button or by pressing the Ctrl-Return keys. This will execute the SQL command and display the contents of the table. There are thousands of lines for every county and year in the nation. You can edit the SQL command to select only your location. For Washtenaw County, Michigan, for the 2010 calendar year, the appropriate SQL command would be:

```
SELECT * FROM MOVESDB20100826.countyyear c where countyID=26161 and  
yearend=2010;
```

All SQL commands must end in a semi-colon.

If you create an alternate database, as suggested in the Appendix, the CountyYear table in that database will be empty. You can enter values into each field using the **Edit** button at the bottom of the panel. Once you click on the **Edit** button, you can double click on each empty cell and enter a value. Be sure to execute the **Apply Changes** button to save any alterations.

Now return to the Manage Input Data Sets panel and select your database from the drop-down menu. You can add additional description text and then click the add button. When you include this database in your run specification, MOVES will use your values in preference to any default values in the MOVES database.

The other empty tables may be deleted from your database. Leaving them will not harm your RunSpec (since the tables are empty), but they can be confusing. To delete empty tables, go to the Query Browser, double click on the database to show the tables and right click on the table you wish to delete. Choose **drop table** from the menu and the table will be removed from that database. Multiple tables can be selected by using the CTRL or Shift buttons.

Appendix G - MOVES Project Level Example

Definition of the MOVES Project

In this example RunSpec, MOVES was used to generate emission inventory estimates for a hypothetical scenario where heavy-duty vehicle traffic is entering and departing a parking lot using a single roadway. Since this example is only for illustration of the MOVES software features, it was kept simple intentionally. It does not represent any specific real-world project.

The Project constraints are:

1. There are only two links (inbound and outbound from a parking lot).
2. The two links and the off-network link are independent of each other.
3. A single off-network link contains all of the parking, extended idle and vehicle start operations.
4. Only heavy-duty vehicles operate on the roadway and are present in the off-network area.
5. The project example only models nitrogen oxide (NO_x).
6. One hour of operation was selected. If the user desired to model additional hours, then additional MOVES Projects need to be created.

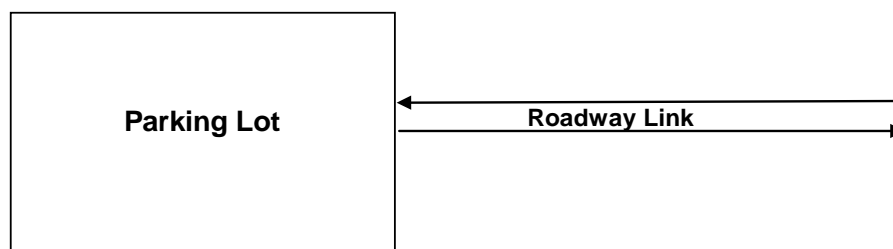


Figure G1 Basic Schematic of the Project

Figure G1 shows a basic schematic of the Project to be modeled. It consists of a parking lot and a two-way road link leading in and out of the parking lot. The specific modeling parameters are shown and discussed in Tables G1, G2 and G3 below.

Table G1
Summary of On-road Project Level Parameters

Location County	Washtenaw County, Michigan
Calendar Year	2009
Month	January
Time	11:00 PM to 11:59:59 PM (hour 24)
Weekday/Weekend	Weekday
Temperature	28.5 F
Humidity	69.5 %
Road type of links (link1 and link 2)	Rural Unrestricted Access – can represent any non freeway rural road
Roadway Link Length (both links)	0.997 miles
Link Traffic Volume – In (link 1)	100 vehicles per hour
Link Traffic Volume – Out (link 2)	10 vehicles per hour
Link Average Speed – In (link 1)	28.5 miles per hour
Link Average Speed – Out (link 2)	28.5 miles per hour
Average Road Grad – In (link1)	0.857 percent
Average Road Grad – Out (link2)	-0.857 percent
Number of Vehicle in Parking Lot (link 3)	200 vehicle on average

Only one county may be chosen for a given project level run. In this example, Washtenaw County, Michigan was chosen. Any of the 3,222 counties or a custom domain (defined by the user) may be chosen. Also, only one calendar year, one month and one hour may be chosen for a given project level run. If you desire to model more than one such entity (i.e., all 24 hours), then you must perform additional and separate project level runs. It is suggested for such runs that you employ MOVES batch mode features. A project level run may include either weekday activity, weekend activity or both. In this example, only weekday was run. A temperature of 28.5F and relative humidity of 69.5 % were also specified. These are the default MOVES values for this county, month and hour. However, any appropriate value may be entered for these parameters.

More than one pollutant/process combination may be modeled in a given project level run if the required inputs are entered. In MOVES, some pollutants are ‘chained’ to other pollutants. This means that they require the prerequisite calculation of another pollutant(s). If the pollutant to be modeled in the Project level is a ‘chained’ pollutant, then a complete set of Project level inputs must be entered for all of the required prerequisite pollutants. For example, if you wish to model total PM_{2.5} emissions, inputs must be entered for elemental carbon, organic carbon, sulfate and total energy pollutants.

Currently, MOVES Project level cannot model evaporative emission processes. However, this capability will be added to future model upgrades.

For each roadway link, you must specify a MOVES road type which best represents it. In this example, the rural unrestricted access road type was chosen to represent both links. Any of

the four roadtypes may be chosen to represent each Project link. You must also specify a link length in miles for each roadway link you wish to model. In this case, because the example is modeling the same roadway in and out of the parking lot, both links are 0.997 miles in length.

The traffic volume must also be specified for each link. This is the total average traffic flow from all vehicle types on the link during the hour period. In this simple example, all of the vehicles are heavy-duty trucks, but in general, any or all of the MOVES vehicle source types may be included at the same time in a project level run.

The average speed on each link must also be specified. In this example, where drive schedule inputs are used to represent activity of all of the roadway links, the average speed inputs in the Links spreadsheet/input GUI tab are used only for internal calculations in the project level model to determine the source hours operating (i.e., how long does it take to traverse the link). However, they should match the overall average speed(s) of the individual drive cycles as submitted in the LinkDriveSchedule tab. In this case, both the inbound and outbound links had the same average speed of 28.5 mph. It is your responsibility to ensure they match – no automatic checks are done.

The average road grade (in percent grade units) may also be specified for each link. This input represents the overall average grade of the entire link not one specific section of it. It is used only if a drive schedule input is not provided (i.e., it will NOT be used in this example). However, in this example, the values of 0.857 and -0.857 percent were entered as placeholders (the actual average of each second of the drive schedule inbound and outbound).

In this example, MOVES will use second-by-second driving schedules to model vehicle operation. If drive schedules are not provided, MOVES uses the average speed and average grade inputs plus default MOVES driving cycles to model the driving behavior. When drive schedules are entered, different emission results may be produced even if the average speed or average grade of the driving schedules match the average speed/grade input entered in the Links spreadsheet tab.

Figure G2 shows the two driving schedules of this example project in graphical form. Link 1 - inbound shown in blue, has vehicles entering the parking lot at 30 mph and eventually coming to a stop. Link 2 - outbound shown in dotted pink has driving starting at zero mph and accelerating to a 30 mph cruise. These are simple idealized cycles that are for illustration only. Note that the two cycles overlap each other at 30 mph on the figure, and are consequently hard to read. The driving schedule data and the chart are contained in the input workbook Project_Example1_input.xls in the worksheets DriveScheduleSecondLink and Link Drive Schedule Chart.

Figure G2



The distribution of the traffic by MOVES source type is an additional input. It is entered as the SourceTypeHourFraction in the LinkSourceType worksheet, and the LinkSourceType input tab. In this example, because only heavy-duty long-haul trucks are to be modeled, all of the values for SourceTypeHourFraction are set to unity.

For this example, the off-network parameters are shown in Table G2. These four parameters include a vehicle population of 200 vehicles in the parking lot on average during the hour period. This input is an average value over the one hour time period, because some vehicles may have been in the lot at all times while others entered or exiting during the hour period. In this example, the start fraction is set to three percent (0.03). This is the fraction of the average vehicle population which were started during the hour. If all of the vehicles in the lot on average are started, then this value is unity (1.0). It may also be greater than unity if large numbers vehicles are repeatedly started during the period.

The extended idle and parked vehicle fraction parameters were set to 0.90 and 0.09 respectively, for this example. The 90 percent input for extended idle reflects the fact that 90 percent of the total vehicle – hours (only one hour by definition) in the parking lot were spent in extended idle mode (vehicles are parked in a lot with their engines idling at higher than curb idle speeds). The 9 percent input for parking reflects the fact that 9 percent of the total vehicle – hours in the parking lot were spent in park mode (vehicle is parked and the engine is off). The sum of extended idling and parking cannot be greater than unity. *Currently, the parked vehicle input is not active in any of the calculations, but a valid entry must be provided anyway.*

Table G2
Summary of Off-Network Project Level Parameters

Average Vehicle Population	200 vehicles in the parking lot on average
Start Fraction	0.03
Extended Idle Fraction	0.90
Parked Vehicle Fraction	0.09

The operating mode distribution for the parking lot link must be entered. This is a distribution by AVERAGE vehicle ‘soak’ time (i.e., the time since a vehicle was last started). For example, Table G3 below shows that 5 percent of the vehicles in the parking lot have not been started for more than 720 minutes or 12 hours. Extended Idle operating model fraction is always set to unity (1.00) when it is present because it is the only operating mode of its type. This input should not be confused with the off network parameter called Extended Idle Fraction with a value of 0.90 that is shown in Table G2.

Table G3
Operating Mode Distribution Parameters for Start and Extended Idle Processes

OpmodelID Code	Operating Mode Description	Operating Mode Fraction
101	Soak Time < 6 minutes	0.00
102	6 minutes <= Soak Time < 30 minutes	0.05
103	30 minutes <= Soak Time < 60 minutes	0.30
104	60 minutes <= Soak Time < 90 minutes	0.10
105	90 minutes <= Soak Time < 120 minutes	0.50
106	120 minutes <= Soak Time < 360 minutes	0.00
107	360 minutes <= Soak Time < 720 minutes	0.00
108	720 minutes <= Soak Time	0.05
200	Extended Idle Operating Mode	1.00

Table G4 shows the source type age distribution for the vehicles in the project. In this example, there is only one source type (heavy-duty long haul trucks) present. Thus, only one age distribution is required. Additional age distributions would be required if additional source types were present. The age distribution runs from age zero (brand new) to 30 years. All ages greater than 30 years are included in the age 30 group. However, in this example, the fraction of vehicles from 20 to 30 years old is zero. The distribution must sum to unity within a source type. **Note that** the project level model does not allow separate age distributions for different fuel types if the same source type is selected. For example, the same age distribution would be used for both gasoline and diesel long haul trucks if both were present in the project.

Table G4		
Source Type Age Distribution		
Source Type	ageID	ageFraction
62	0	0.2
62	1	0.15
62	2	0.1
62	3	0.1
62	4	0.1
62	5	0.07
62	6	0.05
62	7	0.05
62	8	0.05
62	9	0.02
62	10	0.02
62	11	0.01
62	12	0.01
62	13	0.01
62	14	0.01
62	15	0.01
62	16	0.01
62	17	0.01
62	18	0.01
62	19	0.01
62	20	0
62	21	0
62	22	0
62	23	0
62	24	0
62	25	0
62	26	0
62	27	0
62	28	0
62	29	0
62	30	0

Example Data Creation and Input

A MOVES RunSpec (Project_Example1.mrs) was created to model this example MOVES Project level analysis. For this example, you should load the RunSpec – Project_Example1.mrs.

Note that a Project level run MUST contain only ONE:

- County
- Year
- Month
- Hour

The example RunSpec was further simplified to include only one sourcetype, two roadtypes, one weekday/weekend combination and three pollutant/process combinations. The RunSpec is provided as an example and you should use it to become more familiar with this example.

The Project level importer is accessed by either selecting **Project Data Manager** from the **Preprocessing** menu item at the top of the GUI, or pressing the **Enter/Edit Data** button on the **Geographic Bounds** panel. After one of these selections is made, the Project level importer screen will open.

⚠ Caution! In general, you should complete ALL of the RunSpec entries (i.e., Scale, Time, Geographic Bounds, etc) BEFORE accessing the Project Data Manager.

The first input step is to create the Project Level database where the imported data is stored. This is a MySQL database and it is named Project_Example1_input in this example.

Load the data into the Project Level database (i.e. Project_Example1_input) for each input tab by browsing for the individual file (use the **Browse** button), and once found, pressing the **Import** button to import the data into MOVES. A message diagnostic of “Import Complete” will be issued, and the GUI tab should turn from red to green if the data import was successful. This process is repeated for each of the tabs until no more red tabs are present. Various diagnostic messages are provided if the import was not successful. The data should be “Browsed” and “Imported” from the Excel workbook Project_Example1_input.xls.

The inputs are in the spreadsheets:

- DriveScheduleSecondLink
- OffNetworkLink
- ZoneMonthHour
- I/M
- LinkSourceTypeHour
- SourcetypeAgeDistribution
- Fuel
- Link
- OpModeDistribution

After the data loading process is complete, press **Done** to save the data in the database; this will exit the Project Level data manager. As a final step, you may be required to go to the **Geographic Panel** tab and choose the new Project Level database (Project_Example1_input) from a list of databases. If the new database is not visible, click **Refresh**.

The Excel input file Project_Example1.xls and the MOVES project level input database Project_Example1_input are provided in the MOVES package to assist you. If you “Browse” and “Import” data from the spreadsheet, Project_Example1.xls, your final database should be the same as Project_Example1_input.

In this example, all of the inputs for the Project Level were read from a single Excel workbook. This was done to make the process easier for the first time user, and to facilitate with

simple “Browse” and “Import” data entry. However, if you’re starting from scratch with a project, it is recommended you use the **Create Template** button or the **Export Default** button for each of the Project Level input tabs. This will create a set of Excel workbook templates or default data spreadsheets (with a set of individual worksheets - one for each input tab). Populate or modify these templates or data tables with the actual data. The spreadsheets within each template provide necessary descriptions of the data fields and moves codes (i.e., countyID codes, fuelformulationID codes, roadtypeID codes, hourDayID codes and sourcetypeID codes). The MOVES project level importer will show a list of all of the individual Excel worksheets from an Excel workbook. Pick the ‘active’ worksheet (usually the leftmost worksheet in the workbook or the first spreadsheet entry in the MOVES importer) as an input.

After using the Project level importer, notice that the DriveScheduleSecondLink and the opmodeDistribution table need not exist together for all of the roadtype links. In this example, the DriveScheduleSecondLink table contains an average speed-time ‘trace’ for both roadway links. It is used by MOVES to internally create an opmodeDistribution for each roadway link. A separate opmodeDistribution for the road links is not required to be supplied, but could have been supplied in-lieu of the DriveScheduleSecondLink data input. The opmodeDistribution is always required for the start operation parameters (table 3 contains the inputs). It contains the opmodeDistribution for the NOx emission starts. These values are used to differentiate start soak times.

Alternatively, either a DriveScheduleSecondLink or the OpModeDistribution table must be provided. You may simply specify an average speed for each link in the Links table. If this option is utilized, MOVES selects two default driving schedules and uses the average speed input to interpolate between the two cycles to create a new default cycle for that average speed.

MOVES Results for the Example

The results for this simple MOVES Project Level simulation are reported in the MySQL database ProjectLevel_Output. They are summarized in Table G5 by issuing the following MySQL command in the MySQL Query browser:

```
SELECT MOVESRunID, pollutantID, processID,
linkIDMOVESRunIDpollutantIDprocessIDlinkIDlinkID, sum(emissionquant)
as e FROM project_example1_output.movesoutput m
group by movesrunid, pollutantid, processid, linkid;
```

Table G5 MOVES Project Level Example Simulation Results		
LinkID	Link Description	NOx emissions (grams)
1	Inbound Road	1266.54
2	Outbound Road	57.73
3	Parking Lot (extended idle)	48841.61
3	Parking Lot (start)	18.92

The emissions are reported as an ‘inventory’ for the project and are broken down by linkID (roadway and off-network – you must specify that the results to be reported by roadway and process in the Runspec). In this example, the results are reported in units of grams of NO_x emissions. The time domain for the Project Level is always one hour. Remember that these results are **average** results over the one hour time domain and the geographic link domain. One reason project level reports ‘average’ results is because the model’s calculation methodology assumes (for simplicity) independence of the individual links in the project, and does not dynamically calculate traffic flows between links or residence times in off network (you must do this step **before** the data is entered into the MOVES project level simulator).

The large difference in NO_x emission inventories between two physically similar links (link 1 and link 2) is because of the large difference in traffic volumes. The traffic volume for link 1 is an order of magnitude greater than the traffic volume for link 2. The relatively small amount of NO_x emissions from the start process is the result of a very low start fraction input (i.e. 3 percent). The relatively large amount of emissions from the extended idle process reflects a fairly high fraction of extended idle operation (i.e. 90 percent). In comparison, the running operation of the inbound road contains half as many vehicles (100 vehicles versus 200 in extended idle), and the running operation on average lasts only about 2 minutes per vehicle versus the entire hour for 90 percent of the vehicles.

MOVES Project Example #2

This example (the inputs are in Excel Spreadsheet ProjectExample2_input.xls) has virtually all of the same inputs as Project Example #1 discussed in Sections 1 through 4. As a result none of the data and explanations will be repeated. The only difference between the two examples is the ACTIVE use of the Average Speed input in this example instead of the DriveSchedule inputs. The purpose of this brief example is to show that different results for roadway links are obtained from the two different methods of modeling vehicle operation.

In this example, the average speed input of 28.5 mph is imported and used for Link 1 and 28.5 mph is used for Link 2. Likewise, the average grade inputs for Link1 and Link2 are 0.857 percent and -0.857 percent, respectively. These inputs are in the Links tab. The average speed/average grade inputs become ACTIVE in MOVES when the specific drive schedule inputs shown in Figure 1 are **NOT** imported/used by the Driveschedule Importer GUI. If the drive schedule data (or operating mode distribution data for roadway links) are imported, they automatically over-ride the average speed inputs in the Links tab.

Instead of user supplied drive schedules being used to represent vehicle operation, built-in default drive schedules that bracket the average speed inputs (in this case 28.5 mph) are used when average speed inputs are entered. Likewise, the average grade values of 0.857 or -0.857 percent are assumed for the entire length of the links rather than the varying road grades used in Example 1. The results shown in Tables G5 and G5 for links 1 and 2 definitely show that the two input types (specific drive schedule and average speed/grade) are not necessarily equivalent.

Table G6		
MOVES Project Level Example Simulation Results		
LinkID	Link Description	NOx emissions (grams)
1	Inbound Road	1696.47
2	Outbound Road	117.47
3	Parking Lot (extended idle)	48841.61
3	Parking Lot (start)	18.92

MOVES Project Example #3

This example briefly presents and discusses several real world ramp cycles developed under contract for EPA. These are provided because the Project Level does not contain default data for modeling freeway ramps. Entering an average speed/grade in the Project Level **Links** importer will not model a freeway ramp. The only way you can model a freeway ramp using the Project Level is to enter a ramp drive schedule in the **DriveSchedule** importer or a roadway operating mode distribution using the OpmodeDistribution input tab.

The attached Excel spreadsheet, Ramp_Driving_Cycles.xls, contains several real world drive schedules for various ramp configurations. They are based on a 2004 Sacramento, California driving study. These schedules do not model any actual real world project, but serve as realistic examples of ramp operation. They also function as a starting point to develop actual cycles that precisely fit the needs of a specific project. They can be used in MOVES Project (or

modified for use) by defining a new ramp LinkID (i.e. Ramp1, Ramp2, etc) and populating the DriveSchedule importer with a speed-grade/time trace based on ramp driving operation.

The **Summary** table in the Ramp_Driving_Cycles.xls spreadsheet lists the ramp configuration type, the grade change toggle and the ramp metering designation. The table includes only “on-ramps”. No data is available for “off-ramps”. Ramps may be configured in several ways with different operating behavior occurring on each. The most prominent types are the “Diamond” configuration or the “Loop” or “Cloverloop” configuration. The “Diamond” configuration typically has higher speed and acceleration operation than the “Loop” configuration. A ramp may also be “metered” by a traffic light at the end of the ramp that controls access to the freeway. The final ramp configuration is the “Transition” ramp. It occurs when one freeway transitions to another freeway. The individual cycles are also denoted by the general grade change of the ramp. Three possibilities are provided for the “Diamond” and “Loop” configurations.

Open the Project Manager (under the **Pre-Processing** Menu) in the Link Drive Schedules, click **Create Template**. This will create a spreadsheet you can fill in using sample data from Ramp_Driving_Cycle spreadsheet. For instance, choose the OR_D-L tab and copy the Time and Speed column data into the Second ID and Speed columns of the template. Then use Link Id = 1 and Grade = 0. Save the template and use the Import button to bring into the RunSpec.

Appendix H - County Data Manager Example

Explanation of Scenario 3

The County Data Manager is expected to be used extensively, particularly by nonattainment or maintenance areas when conducting SIP or conformity analyses. This tool provides the ability to import and edit local data, rather than using MOVES defaults. This appendix also goes through the MOVESOutput table in the MySQL Query Browser to provide some basic queries used for your own analyses.

In this scenario, the County Data Manager is used to construct a RunSpec using area-specific data. The area being modeled will be a custom domain. While there are some differences between using the custom domain option and selecting an individual county, the basic operation of the County Data Manager is the same. Where differences exist, this scenario describes how a custom domain and a single county are treated differently.

Constructing the RunSpec

The custom domain in this scenario is named “Example City” and is an ozone nonattainment area, so the selections and use of the County Data Manager reflect that assumption. On the **Pollutants and Processes** panel, all processes for Volatile Organic Carbons (VOCs) and Oxides of Nitrogen (NO_x) are selected because these pollutants are associated with the formation of ground-level ozone. If VOCs are selected, several other pollutants and processes must be selected as well because they are needed when calculating VOC emissions. Therefore, this run contains a fair number of pollutant-processes and will take a fair amount of time to run (about 16 minutes on a computer with a dual-core processor), but the variety of the output will be useful later when analyzing the output in the MySQL Query Browser. If you simply want practice with the process of using the County Data Manager and importing files, it is recommended that you select only NO_x processes on the **Pollutants and Processes** panel as evaporative emissions of hydrocarbons take the most time in MOVES.

The RunSpec should be filled out in its entirety before the County Data Manager is used. In this example, selections are limited to reduce the run-time of the RunSpec, but some variation is included to emphasize how output can be post-processed in MySQL.

Open the file `examplecity_2013_july.mrs` (located in the `c:\Program Files\MOVES2010\18\USER_Guide_Example_Files\City Example folder`) to view the RunSpec and to create an output database using the General output panel (e.g. `examplecity_2013_july_out`). Then select the RunSpec **Geographic Bounds** panel and select Region Custom Domains. Notice that it requires you to provide additional information about the area. You can change any of these fields (except County ID, set to 1, because the input files have `countyID=99001`), but should be aware that doing so will result in different emission results. Next, click the **Enter/Edit Data** button to open the County Data Manager window.

Using the County Data Manager

With the County Data Manager open, name and create a user-input database (e.g. examplecity_2013_july_in).

⚡ Caution! If any changes are made to the RunSpec after the database has been created, the database may no longer be correct for the revised RunSpec. This is because some core tables are populated based on the selections in the RunSpec at the time of the creation of the database and these core tables can only be changed directly in MySQL (i.e., there are no tabs to edit these core tables). Take care in changing the RunSpec while using an existing database and always double-check the tab headers to ensure all the necessary data has been provided after making a change to the RunSpec.

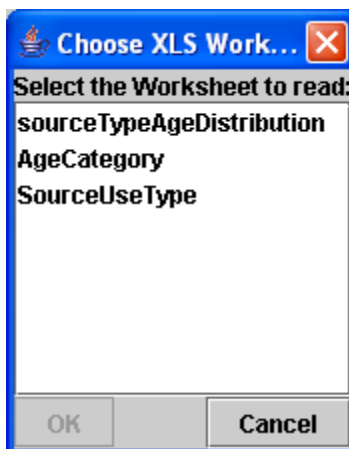
Next, notice that the **Generic**, **Ramp Fraction**, **Zone Road Activity**, and **I/M Programs** tabs all start with green checks for different reasons. For **Ramp Fraction**, the default fraction of 8% of VHT is applied if no data is imported on this tab, but you can import new values if desired. The **Zone Road Activity** tab erroneously shows a green check, but data **MUST** be imported for MOVES to calculate results properly; a value of 1 should be entered for the SHOAllocFactor for each road type so that all of the VMT input is assigned to the custom domain. Finally, the **I/M Programs** tab starts with a green check because there are no default programs in the custom domain that have to be accounted for. Of these 4 tabs, data will be imported for **Zone Road Activity** and **I/M Programs**.

For all other tabs, files containing the area-specific data must be imported. The importing process is the same for all the tabs, so it is explained generally in the next paragraph. The Excel files containing the example area-specific data are included as part of the MOVES installation pack and have the following naming convention:

- examplecity_2013_july_[TABNAME].xls

You can open the files before importing them to view how the data is formatted and can refer to the supporting worksheets for clarification on the numerical codes or abbreviations. Notice that for some files, wildcards are used to greatly reduce the number of rows that have to be entered (e.g. Average Speed Distribution - 64 with wildcards vs. 11,520 without).

To import the files, click the **Browse** button. Then, find where the file is saved, and select the appropriate file for the tab (i.e. if working in the **Age Distribution** tab, select the file “examplecity_2013_july_agedistribution.xls”). After the file has been selected, a small pop-up window appears:



Select the correct worksheet (in this example, it will generally be the first worksheet listed and will usually have a name similar to the tab name) and click **OK**. For the **Vehicle Type VMT** tab, there are four worksheets within the file “examplecity_2013_july_vehicletypevmt.xls” that should be imported: HPMSVTypeYear, monthVMTFraction, dayVMTFraction, and hourVMTFraction. The names of the worksheets correspond to the names of the database tables for which data is being provided.

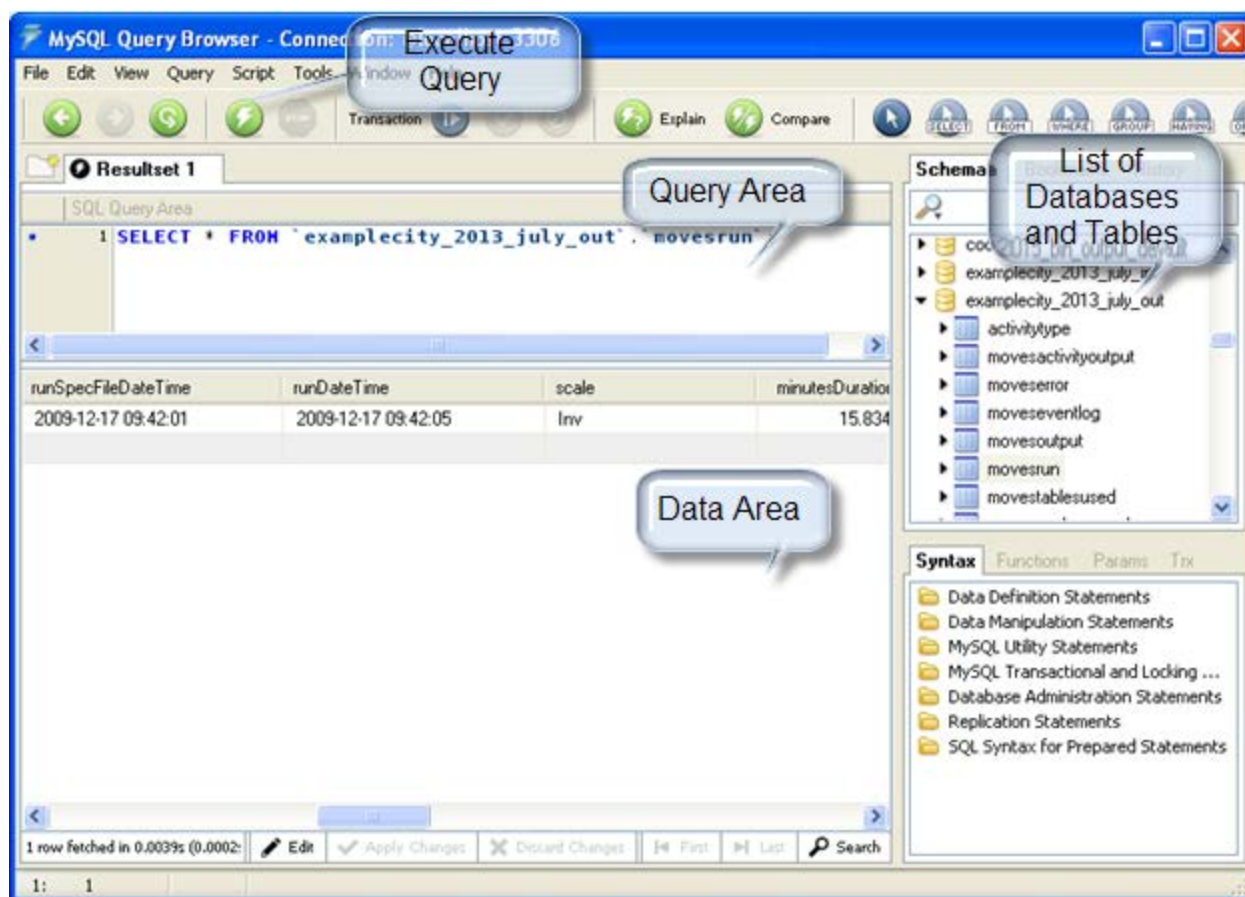
Next, click the **Import** button. The **Messages** box should say which table was imported and Import Complete. If there were problems with the import, error messages here would describe the problem. In case of error, revise the input file, save the changes, and then click the **Clear Imported Data** button before reattempting the import.

The above pop-up dialog box is an example where one worksheet is selected from one Excel file, which is typical. However, importing data from the **Vehicle Type VMT** tab requires that the vehicletypevmt.xls file be selected 4 times (once each for year, month day and hour data) and all 4 types of data are imported separately.

Once all the files are imported, the database tables are populated. Click **Done** in the County Data Manager to return to the **Geographic Bounds** panel. Make sure the user-input database is selected in the **Domain Input Database** section of the **Geographic Bounds** panel. The RunSpec and county-input database are completed, so the RunSpec can be executed by selecting **Execute** from the **Action** drop-down menu.

Analyzing the Results in the MySQL Query Browser

First, a brief summary of the major pieces of the **MySQL Query Browser**:



The top left box is the Query Area, bottom left is the Data Area, and top right is the List of Databases/Tables. The tables within a database can be revealed by clicking the black triangle just to the left of the database name. There are queries below that have the following syntax:

```
SELECT * FROM `examplecity_2013_july_out`.`[table]`;
```

These queries can be auto-generated by dragging the table name from the right-hand List of Tables and dropping it in the Query Area or Data Area. If the table name is dropped in the Query Area, the text for the query is generated, but the query itself is not executed; so you must either click the **Execute** button (lightning bolt) or press **CTRL + Enter**. However, if the table name is dropped in the Data Area, the query will be generated in the Query Area and auto-executed with results immediately appearing in the Data Area.

Now that some of the basics have been covered, the results from the example can be analyzed. Listed below are MySQL Queries and some discussion of the results they generate. You can copy and paste the queries into the Query Area of MySQL as long as the output database name is “examplecity_2013_july_out”; if you provided a different output database name, that name should be used wherever “examplecity_2013_july_out” appears.

1) `SELECT * FROM `examplecity_2013_july_out`.`moveserror`;`

Look at the MOVESError log to make sure the run executed normally. There should be no results from this query.

2) `SELECT * FROM `examplecity_2013_july_out`.`movesrun`;`

The MOVESRun table gives some basic information about the RunSpec, the description, the date and length of time, etc. If there are multiple runs in the database, there will be multiple MOVESRunID entries here.

3) `SELECT * FROM `examplecity_2013_july_out`.`movesactivityoutput`;`

The MOVESActivityOutput table contains all the activity results from the RunSpec and should have 1446 rows (there is a bar below the data area that tells you how many rows a query returns). In the RunSpec, the distance traveled and population options were selected. Both of these values were inputs, so ensure the input values were carried through to the output correctly. Population is easier, so look at that first.

4) `SELECT sourcetypeID, SUM(activity) AS population
FROM `examplecity_2013_july_out`.`movesactivityoutput`
WHERE activityTypeID=6
GROUP BY sourceTypeID
ORDER BY sourceTypeID;`

Notice the query became more complicated. The first line is the SELECT statement, which states the fields from the table that will be displayed. Since population is not time dependent and you're only looking at one county, the only important field is the sourcetypeID itself; however, a sum of the activity is required because output was differentiated by fuel type. The SUM(activity) is renamed in the resulting table "AS population". The second line is the FROM statement, which identifies the database and table that should be used. The third line is the WHERE clause, which specifies that only activityTypeID=6 should be used when querying the table (since you're just looking at population). The fourth line is the GROUP BY clause, which is used when a sum is calculated. Since the clause states, "GROUP BY sourceTypeID", all data of different source types are kept separated, but any data within the same source type is summed (so the different populations for each fuel type will be added together). The final row is the ORDER BY clause, which states the order in which the resulting information will appear.

The resulting table from this query should have just 3 rows and the populations should be (after rounding) 500,000; 300,000; and 50,000 for source types 21, 31 and 32, respectively. These values match the populations that were imported.

5) `SELECT dayIDdayIDdayID, sourceTypeID, SUM(activity)*dayID*31/7 AS
PortionofMonthVMT
FROM `examplecity_2013_july_out`.`movesactivityoutput`
WHERE sourceTypeID=21 AND activitytypeid=1
GROUP BY dayID
ORDER BY dayID;`

This statement is the first step to calculate the VMT for passenger cars (sourceTypeID=21), but doing so is not a straight-forward process and that can be seen in the SUM statement above. Notice that the GROUP BY clause only has dayID, because the WHERE clause identifies that only 1 sourceTypeID will be queried. Grouping by sourceTypeID is not necessary, but would not affect the query if it were included. The temporal output for the RunSpec is hour, so that means the VMT output was originally for one hour of one of the types of days; therefore, the VMT should be summed within the dayID to get the total for that type of day. Then, this query adds two additional steps: 1) by multiplying by the dayID, the product is the VMT on that type of day in a week; and 2) by multiplying by 31/7 (the number of days in July divided by the number of days in the days in a week), which is the number of weeks in July. This second product gives the VMT on that type of day in the entire month.

The resulting table should have just 2 rows as can be seen in the table below. An additional column has been added using an Excel spreadsheet to sum the VMT from the two types of days:

dayID	sourceTypeID	PortionofMonthVMT	MonthVMT
2	21	1.21E+08	
5	21	3.44E+08	4.65E+08

The monthVMTFraction table assigned a value of 1 to July, so the VMT that was input was essentially a monthly VMT for July and we can see that the MonthVMT is equal to the value that was input for HPMSVTypeID of 20 (examplecity_2013_july_vehicletypevmt.xls, worksheet “HPMSVTypeID=20”). There are ways to calculate the MonthVMT entirely within MySQL, but that involves either creating tables or using subqueries, which is beyond the scope of this example. Therefore, once you get to this point, use of an external spreadsheet tool is recommended, unless you’re familiar with more complex MySQL queries.

More detail is acquired using the query above as a template (e.g. adding “roadTypeID” to the SELECT, GROUP BY, and ORDER BY clauses to see the VMT on each road type to make sure the road type distribution was applied correctly; calculating VMT for HPMSVTypeID=30). You are encouraged to experiment with the query above to improve your MySQL skills and better understand how to compare inputs with outputs to ensure the results are logical.

6) `SELECT * FROM `examplecity_2013_july_out`.`movesoutput`;`

This table should contain 23432 rows and gives all the emissions output with a significant amount of detail since output is differentiated by fuel type, emission process, road type, and source type. Therefore, using MySQL to condense the results holds great potential for simplifying the post-processing.

7) `SELECT monthid, pollutantID, SUM(emissionquant) AS grams
FROM `examplecity_2013_july_out`.`movesoutput`
WHERE dayID=5 AND pollutantID IN (3,87)
GROUP BY dayID, pollutantID
ORDER BY pollutantID;`

This query will greatly simplify the original output table from 23,000 rows to 2, but a major reason for this is that not all the data is being reported:

monthid	pollutantID	grams
7	3	2.11E+07
7	87	1.21E+07

Some assumptions were made to reduce the reported output that may be similar to those you make in your analyses, such as only a single weekday is being looked at and the only pollutants of interest are NO_x (3) and VOCs (87). Notice that in the WHERE clause, a new command was used, “pollutantID in (3, 87)”. The IN command is a more concise way of saying “pollutantID=3 AND pollutantID=87” and can be used with any field that has multiple entries.

Once again, you are encouraged to vary this query to see the results for different conditions (e.g. choose other pollutants; see emission results from each source type or on the different road types; etc.).

Appendix I – MOVES Decoder

Many of the tables used by MOVES contain data that is identified using categorical values. These categorical values are described in various tables in the default MOVES database which contain text corresponding to the categorical values. This appendix lists some of the most useful descriptions of the categorical values used in MOVES tables.

Road Type	
roadTypeID	roadDesc
1	Off-Network
2	Rural Restricted Access
3	Rural Unrestricted Access
4	Urban Restricted Access
5	Urban Unrestricted Access

Fuel Type	
fuelTypeID	fuelTypeDesc
1	Gasoline
2	Diesel Fuel
3	Compressed Natural Gas (CNG)
4	Liquefied Petroleum Gas (LPG)
5	Ethanol
9	Electricity

Pollutant ID	Pollutant Name	Pollutant ID	Pollutant Name
1	Total Gaseous Hydrocarbons	90	Atmospheric CO2
2	Carbon Monoxide (CO)	91	Total Energy Consumption
3	Oxides of Nitrogen (NOx)	92	Petroleum Energy Consumption
5	Methane (CH4)	93	Fossil Fuel Energy Consumption
6	Nitrous Oxide (N2O)	98	CO2 Equivalent
20	Benzene	99	Brake Specific Fuel Consumption (BSFC)
21	Ethanol	100	Primary Exhaust PM10 - Total
22	MTBE	101	Primary PM10 - Organic Carbon
23	Naphthalene particle	102	Primary PM10 - Elemental Carbon
24	1,3-Butadiene	105	Primary PM10 - Sulfate Particulate
25	Formaldehyde	106	Primary PM10 - Brakewear Particulate
26	Acetaldehyde	107	Primary PM10 - Tirewear Particulate
27	Acrolein	110	Primary Exhaust PM2.5 - Total
30	Ammonia (NH3)	111	Primary PM2.5 - Organic Carbon
31	Sulfur Dioxide (SO2)	112	Primary PM2.5 - Elemental Carbon
32	Nitrogen Oxide (NO)	115	Primary PM2.5 - Sulfate Particulate
33	Nitrogen Dioxide (NO2)	116	Primary PM2.5 - Brakewear Particulate
40	2,2,4-Trimethylpentane	117	Primary PM2.5 - Tirewear Particulate
41	Ethyl Benzene	130	1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin
42	Hexane	131	Octachlorodibenzo-p-dioxin
43	Propionaldehyde	132	1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin
44	Styrene	133	Octachlorodibenzofuran
45	Toluene	134	1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin

Pollutant ID	Pollutant Name	Pollutant ID	Pollutant Name
46	Xylene	135	1,2,3,7,8-Pentachlorodibenzo-p-Dioxin
60	Mercury Elemental Gaseous	136	2,3,7,8-Tetrachlorodibenzofuran
61	Mercury Divalent Gaseous	137	1,2,3,4,7,8,9-Heptachlorodibenzofuran
62	Mercury Particulate	138	2,3,4,7,8-Pentachlorodibenzofuran
63	Arsenic Compounds	139	1,2,3,7,8-Pentachlorodibenzofuran
64	Chromium 3+	140	1,2,3,6,7,8-Hexachlorodibenzofuran
65	Chromium 6+	141	1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin
66	Manganese Compounds	142	2,3,7,8-Tetrachlorodibenzo-p-Dioxin
67	Nickel Compounds	143	2,3,4,6,7,8-Hexachlorodibenzofuran
68	Dibenzo(a,h)anthracene particle	144	1,2,3,4,6,7,8-Heptachlorodibenzofuran
69	Fluoranthene particle	145	1,2,3,4,7,8-Hexachlorodibenzofuran
70	Acenaphthene particle	146	1,2,3,7,8,9-Hexachlorodibenzofuran
71	Acenaphthylene particle	168	Dibenzo(a,h)anthracene gas
72	Anthracene particle	169	Fluoranthene gas
73	Benz(a)anthracene particle	170	Acenaphthene gas
74	Benzo(a)pyrene particle	171	Acenaphthylene gas
75	Benzo(b)fluoranthene particle	172	Anthracene gas
76	Benzo(g,h,i)perylene particle	173	Benz(a)anthracene gas
77	Benzo(k)fluoranthene particle	174	Benzo(a)pyrene gas
78	Chrysene particle	175	Benzo(b)fluoranthene gas
79	Non-Methane Hydrocarbons	176	Benzo(g,h,i)perylene gas
80	Non-Methane Organic Gases	177	Benzo(k)fluoranthene gas
81	Fluorene particle	178	Chrysene gas
82	Indeno(1,2,3,c,d)pyrene particle	181	Fluorene gas
83	Phenanthrene particle	182	Indeno(1,2,3,c,d)pyrene gas
84	Pyrene particle	183	Phenanthrene gas
86	Total Organic Gases	184	Pyrene gas
87	Volatile Organic Compounds	185	Naphthalene gas

Appendix J – Configuring MOVES

This appendix discusses some technical details associated with MOVES configuration, DOS Command Line instructions and ANT options.

MOVES may be configured beyond the default configuration built by the MOVES2010b Installation Suite (shown in Figure J.1). **Note that this appendix is meant for advanced users who are thoroughly familiar with MOVES and who desire ways to obtain maximum performance from MOVES.**

All MOVES application components may be installed on a single computer system as shown in Figure J.1.

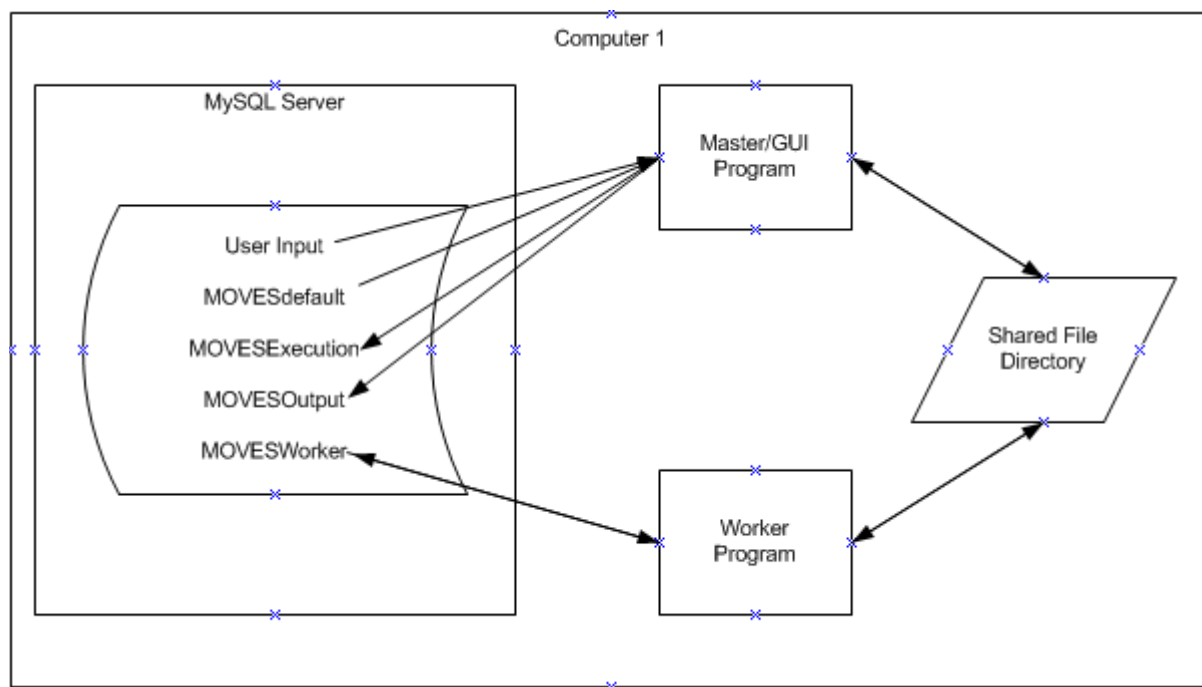


Figure J.1 MOVES Default configuration

MOVES may also be configured so that several computers work together to execute model simulation runs. This can significantly improve execution time performance of large simulations. Improvements diminish, however, as more worker computers are added. The number of worker computers needed to approach the minimal execution time for a model run depends on the specific nature of the run.

For several computers to work together on a MOVES run, all that is necessary is for the computers to have access to the SharedWork directory. For one computer, this file directory can be on its local hard drive; other computers must access the SharedWork directory via a computer network. The platform requirements of each MOVES component must still be satisfied by the computer(s) on which it is installed. A variety of network configurations are possible. The principal consideration is that each Master/GUI Program must have the MOVESDefault database on its computer and that each Worker Program must be able to create a MOVESWorker database on its computer.

Two text files, MOVESConfiguration.txt, and WorkerConfiguration.txt (versions of which are built by the MOVES installation program), are used by the MOVES Master/GUI program and the MOVES Worker program to locate their databases and the SharedWork directory. Figure J.2 shows a typical Multiple Computer configuration.

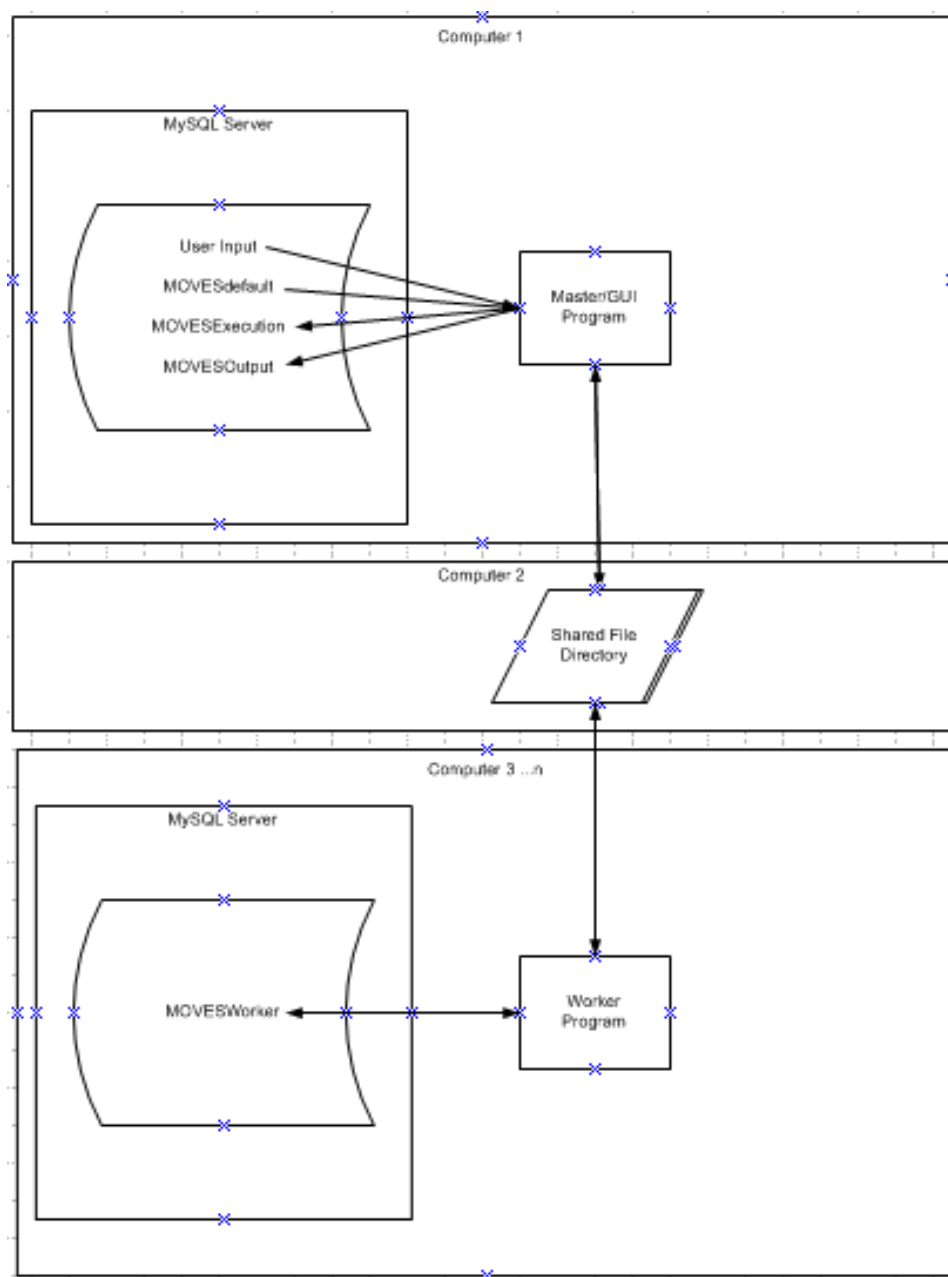


Figure J-2. Moves multi-computer configuration

New Advanced Grid Operations

The following new features were developed and added to MOVES to enhance LINUX cluster and GRID (PC-based) usage:

- All of the MOVES components, Master, Worker, and MySQL can run on separate computing nodes;
- MOVES can now work with a non-local MySQL server. This is useful for a centralized default database, but not recommended for multiple worker and master execution databases due to contention on the server's hard drive I/O bus;
- MOVES can start and/or stop a local MySQL server without needing MySQL to be pre-installed as a daemon/service and without requiring administrator privileges;
- MOVES can start a master that will only produce TODO files then exit (optionally combined with the start/stop of a local MySQL);
- MOVES can start N workers simultaneously on a single node and optionally have those workers quit when they run out of TODO files (optionally combined with the start/stop of a local MySQL);
- MOVES masters can process DONE files for other masters (optionally combined with the start/stop of a local MySQL), storing them to an output database (either local or centralized); and,
- MOVES now has simplified environment variables. Only Java and ANT must in the path and the ANT script sets the class path. This ensures that MOVES runs only need relative paths, hoping to make shell scripting MOVES easier. This also allows a work flow of TODO creation, TODO processing into DONE files, and DONE file storage, making batched/queued processing much easier to accomplish.

These features are implemented within the ANT script that MOVES uses (build.xml), making all features portable between Windows and Linux.

Configuring MOVES for Use with Multiple Workers

The following sections describe typical configurations and additional functionality that assist with using MOVES in the command line, batched, shared environment of a typical Linux-based or GRID cluster. These sections describe command line options for which there are often no GUI counterparts. A command line refresher may be found in **Appendix C - Running MOVES from the Command Line**. The setup of a local copy of MySQL, one that does not require a preinstalled service/daemon on each computing node, is also described.

Quick Setup of 2 Workers

To quickly start 2 concurrent workers on either Linux or Windows using the default MOVES configuration, follow these steps. Subsequent sections will outline other possible configurations.

- 1) Edit the "manyworkers.txt" file to use the same shared directory as is set in the "MOVESConfiguration.txt" file.
- 2) Start a command line and CD to the directory containing your MOVES installation, such as C:\EPA\MOVES\MOVESGHGSource\
- 3) At the command line, type: setenv.bat
- 4) At the command line, type: ant -Dnoshutdown=1 2workers

Two worker windows will start and stay running. Do not close the command line window.

Choosing a Configuration

Configuration 1: “Silo” with Local MySQL

A Silo configuration places both a master and one or more workers on a single computer. Variations include the number of concurrent workers and serial or concurrent execution of the master and worker(s). The default configuration of MOVES is a silo with local MySQL with one worker running concurrently with the master.

To implement Configuration 1 on a single computer node:

- 1) Ensure Java is available.
- 2) Edit maketodo.txt which was installed along with the MOVES source code. Ensure the defaultDatabaseName value is the name of the database you will be using. Ensure sharedDistributedFolderPath value is the correct location of the directory your master and workers will use.
- 3) Edit manyworkers.txt which was installed along with the MOVES source code ensuring the sharedDistributedFolderPath value is the correct location of the directory your master and workers will use.
- 4) Install MySQL onto the computing node you will be using or create a version that can be used without installation. A “no-installation” version is provided with the Windows version of MOVES (under the "mysql" folder within the MOVES base installation directory). But, installing on Linux will require compiling a version of MySQL that has default directories that are actually available on your computing node. Such compilation is beyond the scope of this document.
- 5) Within your MOVES code folder, create a PDSpec XML file named "pickupall.xml" suitable for use in your environment and name a specific database to hold the results. Set the <directory> entry to the name of your shared work folder. Such a file is:

```
<pdspec>
  <pentry>
    <masterid>*</masterid>
    <directory>c:\moves\sharedwork</directory>
    <output servername="" databasename="movesresults" />
  </pentry>
</pdspec>
```

To use Configuration 1:

- 1) Set the JAVA_HOME environment variable to the location of your Java installation, such as:
- 2) C:\Program Files (x86)\Java\jdk1.7.0.
- 3) Set the ANT_HOME environment variable to the location of your MOVES ant folder, such as:

- 4) C:\MOVES\ant.
- 5) Set the PATH environment variable to include JAVA_HOME\bin and ANT_HOME\bin.
- 6) Execute any of the MOVES ant commands such as “ant -r RUNSPEC”

Configuration 2: Silo with Local MySQL, Serial Master and Two Workers

The Silo with Local MySQL, Serial Master and Two Workers configuration places a single master, a MySQL instance, and two workers on a single computer. The workers execute after the master, allowing TODO and DONE files to be preserved as well as the output database. When the workers complete and DONE files picked up, no further calculations are needed on the RunSpec. An external scripting tool must be used to execute a series of RunSpecs. A single instance of MySQL is used, running on the same computer node that runs the master and workers. This limits network access and ensures the MySQL security system denies access from other network nodes - a benefit when securing a large cluster of machines.

To implement Configuration 2 on a single computer node:

- 1) Ensure Java is available.
- 2) Edit maketodo.txt which was installed along with the MOVES source code. Ensure the defaultDatabaseName value is the name of the database you will be using. Ensure sharedDistributedFolderPath value is the correct location of the directory your master and workers will use.
- 3) Edit manyworkers.txt which was installed along with the MOVES source code ensuring the sharedDistributedFolderPath value is the correct location of the directory your master and workers will use.
- 4) Install MySQL onto the computing node you will use or create a version that can be used without installation. A “no-installation” version is provided with the Windows version of MOVES (under the "mysql" folder within the MOVES base installation directory). But, installing on Linux will require compiling a version of MySQL that has default directories that are actually available on your computing node. Such compilation is beyond the scope of this document.
- 5) Within your MOVES code folder, create a PDSpec XML file named "pickupall.xml" suitable for use in your environment and name a specific database to hold the results. Set the <directory> entry to the name of your shared work folder. Such a file is:

```
<pdspec>
  <pentry>
    <masterid>*</masterid>
    <directory>c:\moves\sharedwork</directory>
    <output servername="" databasename="movesresults" />
  </pentry>
</pdspec>
```

To use Configuration 2:

- 1) Set the JAVA_HOME environment variable to the location of your Java installation, such as:

C:\Program Files (x86)\Java\jdk1.7.0.

- 2) Set the ANT_HOME environment variable to the location of your MOVES ant folder, such as:

C:\MOVES\ant.

- 3) Set the PATH environment variable to include JAVA_HOME\bin and ANT_HOME\bin.

- 4) Execute the "ant maketodo" command, passing your RunSpec name using the "-Drunspec=" parameter, such as:

ant -Drunspec=c:\myrunspecs\runspec1.mrs maketodo

- 5) If desired, save all *TODO files from your shared work folder.
- 6) Execute the "ant 2workers" command. This will start 2 concurrent workers which will terminate after completing all TODO files.
- 7) If desired, save all *DONE files from your shared work folder.
- 8) Execute the "ant pickup" command, passing your pickupall.xml filename using the "-Dpdspec=" parameter, such as:

ant -Dpdspec=pickupall.xml pickup

- 9) Copy your output database files to long term storage. The database is the one named in the pickupall.xml file, not the one used by the RunSpec.

Configuration 3: Worker Pool with Local MySQL

This configuration places multiple workers and an instance of MySQL on each computing node. An instance of MySQL is used running on the same computer node that runs the workers. This limits network access and ensures the MySQL security system denies access from other network nodes - a benefit when securing a large cluster of machines.

To implement Configuration 3:

- 1) Ensure Java is available.
- 2) Edit manyworkers.txt which was installed along with the MOVES source code. Ensure the sharedDistributedFolderPath value is the correct location of the directory

your masters and workers will use. This will be a network accessible directory since external masters will deposit TODO files and retrieve DONE files from this location.

- 3) Install MySQL onto each computing node you will be using or create a version that can be used without installation. Such a no-installation version is provided with the Windows version of MOVES (under the "mysql" folder within the MOVES base installation directory), but under Linux will require compiling a version of MySQL that has default directories that are actually available on your nodes. Such compilation is beyond the scope of this document.

To use Configuration 3:

- 1) Set the JAVA_HOME environment variable to the location of your Java installation, such as:

C:\Program Files (x86)\Java\jdk1.7.0.

- 2) Set the ANT_HOME environment variable to the location of your MOVES' ant folder, such as:

C:\MOVES\ant.

- 3) Set the PATH environment variable to include JAVA_HOME\bin and ANT_HOME\bin.
- 4) Execute the "ant 2workers" command with the "-Dnoshutdown=1" parameter. This will start 2 concurrent workers which will never terminate. Example:

ant -Dnoshutdown=1 2workers

New Ant Tasks and MOVES Command Line Options

MOVES2010b's use of Ant has been expanded to include features normally accomplished with shell scripts, thereby bringing these features to all platforms. In addition, production-related Ant tasks now set their class paths internally using relative directories. Such tasks, such as "2workers", only require the calling shell script to set a path to Java and Ant.

Ant Task	Description
Startmysql	Utility to start a local MySQL instance if another instance is not already running.
Stopmysql	Utility to stop any MySQL server using the standard localhost port 3306. This will stop MySQL started with the "startmysql" task or any preexisting MySQL service/daemon.
1worker	Use a local copy of MySQL and a single local worker using the manyworkers.txt configuration file and -autoshutdown worker command line option. The Ant flag "-Dnoshutdown=1" can also be given. See the full description in the multiple workers section below.
2workers 3workers 4workers 5workers 6workers 7workers 8workers	Use a local copy of MySQL and two or more local workers using the manyworkers.txt configuration file and -autoshutdown worker command line option. Example command line: ant 2workers The Ant flag "-Dnoshutdown=1" can also be given to cause the spawned workers to never shutdown even if no work is available, by omitting the "-autoshutdown" flag when spawning worker instances. Example command line: ant -Dnoshutdown=1 2workers

Table J-3 New ANT Tasks

maketodo	Start a local copy of MySQL and one master that is set to only generate TODO files without getting DONE files or deleting TODO, DONE, or InProgress files upon exiting. Before using, edit the maketodo.txt file to use your system's sharedDistributedFolderPath. Use "-Drunspec=" to specify the runspec. Example command line: ant -Drunspec=MyCounty2030.mrs maketodo
pickup	Start a local copy of MySQL and one master that will retrieve and process DONE files. Before using, edit the maketodo.txt file to use your system's sharedDistributedFolderPath. Use "-Dpdspec=" to name the required PDSpec XML file. Example command line: ant -Dpdspec=c:\myinfo\filestoget.xml pickup
master1worker	Start a local copy of MySQL with one master that is set to create one worker and wait for its DONE files. Before using, edit maketodo.txt and manyworkers.txt. Like maketodo, use "-Drunspec=" to specify the runspec. Example command line: ant -Drunspec=MyCounty2030.mrs master1worker

Table J-3New ANT Tasks (continued)

Note that several Ant tasks make use of a local MySQL instance. These tasks detect the presence of a running MySQL instance and will start, use, then stop a local MySQL instance, if one was not already running.

Master Command Line Options

The MOVES master supports the following command line options to its Java class (gov.epa.otaq.moves.master.commandline.MOVESCommandLine):

Option	Description
-i IMPORTXMLFILE	Perform all data import operations as specified in the import XML file. This allows automation of the operations normally performed via the GUI using the County Data Manager or Project Data Manager. An example import XML file can be obtained through these GUI panels. ⚡ Caution! Versions up to and including MOVES2010b require access to a graphical user interface, such as Windows or an X Windows server, to use this feature even though no graphical elements are displayed during the process.
-maketodo Or -onlytodo	Causes the command line master to only produce TODO files, ignoring DONE files and to not delete its TODO, InProgress, or DONE files upon exit. This is an essential feature for cluster computing where a master may not be allowed to run while workers process its TODO files. This mode also prevents a local worker from being started.
-noworker	Causes the command line master to not start a local worker. This behavior is automatic with the "-maketodo"/"-onlytodo" option.
- workerconfig=FILENAME	Specify an alternate configuration file to be used if a local worker is started. The new set of ANT tasks use the manyworkers.txt configuration file extensively. The default file used is WorkerConfiguration.txt.
-p PDSPECXMLFILE	Collect all DONE files specified in the PDSpec XML file. The master GUI has a tool to generate these XML files.
-r RUNSPEC	Run a single RunSpec file name (with optional path).
-rl RUNSPECLISTFILE	Specify a text file containing a list of RunSpec file names (with optional paths) to be run, one runspec per line. This is equivalent to using the "-r" option on each RunSpec named in the text file.

Table J-4 Master Command Line Options

Setting the Master Configuration File

The master loads its configuration file before its command line processing takes place. As such, there is no command line option for the master to alter its use of a configuration file. Instead, the master uses a Java Property named "MOVES_CONFIGURATION_FILE_NAME" to specify an alternate configuration file that should be read. When this property is set and set to non-empty, its value is used as the name and optional path to the master's configuration file.

Worker Command Line Options

The MOVES worker supports the following command line options to its Java class (gov.epa.otaq.moves.worker.WorkerCommandLine):

Option	Description
-autoshtutdown	Close the worker instance after no TODO or InProgress files were found in the worker's shared work folder for 2 minutes. Workers will continue to exist, idling, if there are InProgress files in the shared work folder, in case the workers performing the work in those files fail. This option is useful on a shared computer where workers cannot be left running indefinitely, as is their default without this command line option.
-longshutdown	Similar to -autoshtutdown but uses a 2 hour timeout instead of a 2 minute timeout.
-config=FILENAME	Specify an alternate configuration file to be used. The new set of ANT tasks use the manyworkers.txt configuration file extensively.

Table J-5 Worker Command Line Options

Configuration Files

MOVES uses several configuration files, all of which have case-sensitive names.

File	Purpose
MOVESConfiguration.txt	Default master configuration file. Rarely used with cluster computing. Used with the master GUI ("ant -rungui"). defaultServerName = localhost defaultDatabaseName = movesdb20100913 defaultUserName = defaultPassword = nrdefaultServerName = nrdefaultDatabaseName = nrdefaultUserName = nrdefaultPassword = executionServerName = localhost executionDatabaseName = MOVESExecution executionUserName = executionPassword = outputServerName = localhost outputDatabaseName = MOVESOutput outputUserName = outputPassword = sharedDistributedFolderPath = C:\EPA\MOVES\MOVESGHGSource\SharedWork computerIDPath = masterFolderPath = C:\EPA\MOVES\MOVESGHGSource saveTODOPath =
WorkerConfiguration.txt	Default worker configuration file. Rarely used with cluster computing. Used with the traditional worker GUI ("ant -runworker"). sharedDistributedFolderPath = C:\EPA\MOVES\MOVESGHGSource\SharedWork workFolderPath = C:\EPA\MOVES\MOVESGHGSource\WorkerFolder workerDatabaseName = MOVESWorker computerIDPath =

Table J-6 MOVES Configuration Files

maketodo.txt	<p>Master configuration file specified by Ant tasks for cluster computing. Modify this file to specify your system's shared folder for TODO and DONE files. Do not modify data server or database names in this file.</p> <pre> defaultServerName = localhost defaultDatabaseName = movesdb20100712 defaultUserName = defaultPassword = nrdefaultServerName = localhost nrdefaultDatabaseName = nrdefaultUserName = nrdefaultPassword = executionServerName = localhost executionDatabaseName = * executionUserName = executionPassword = outputServerName = localhost outputDatabaseName = MOVESOutput outputUserName = outputPassword = sharedDistributedFolderPath = C:\EPA\MOVES\MOVESGHGSource\SharedWork computerIDPath = masterFolderPath = . saveTODOPath = </pre>
manyworkers.txt	<p>Worker configuration file specified by Ant tasks for cluster computing. Modify this file to specify your system's shared folder for TODO and DONE files. Do not modify data server or database names in this file.</p> <pre> sharedDistributedFolderPath = C:\EPA\MOVES\MOVESGHGSource\SharedWork workFolderPath = manyworkers/workerfolder workerDatabaseName = * computerIDPath = workerServerName = localhost workerUserName = workerPassword = concurrentStatements = 1 </pre>

Table J-6 MOVES Configuration Files (continued)

Accessing Remote MySQL Servers

It may be desirable to centralize some of the databases used by MOVES, such as the default database and county - or project-specific input databases. Storing these databases on a single MySQL instance can make management easier, especially if the data is changed frequently, as often occurs during initial stages of data testing.

RunSpec files can contain the server name of input databases, county domain databases, project domain databases, and even output databases. These all have "servername" XML attributes that when left blank indicate use of "localhost". No user name or password is required or given when MOVES connects to these databases.

The default database used by the MOVES master can be set in MOVESConfiguration.txt and maketodo.txt. Both support providing not only the server name, but also a user name and password, if required. The relevant configuration entries are:

```
defaultServerName  
defaultDatabaseName  
defaultUserName  
defaultPassword
```

The database used by the master to store execution data can be stored on a remote MySQL server and is set within MOVESConfiguration.txt and maketodo.txt. The relevant configuration entries are:

```
executionServerName  
executionDatabaseName  
executionUserName  
executionPassword
```

The executionDatabaseName entry also supports use of a single asterisk ("*") to indicate use of an automatically assigned database name. If two or more masters wish to use the same MySQL instance (whether remote or local), each must have a different execution database name. This can be accomplished by manually configuring each to have a specific name or by setting each with "executionDatabaseName = *" in their configuration files.

The database used by each worker to store temporary calculations can be stored on a remote MySQL server and is set within WorkerConfiguration.txt and manyworkers.txt. The relevant configuration entries are:

```
workerServerName  
workerDatabaseName  
workerUserName  
workerPassword
```

The workerDatabaseName entry supports use of a single asterisk ("*") to indicate use of an automatically assigned database name. If two or more workers wish to use the same MySQL instance (whether remote or local), each must have a different worker database name. This can

be accomplished by manually configuring each to have a specific name or by setting each with "workerDatabaseName = *" in their configuration files.

Local MySQL

Ant can start a local instance of MySQL, one that has not been preinstalled and that runs entirely within the MOVES installation folder. When Ant uses such a local instance, it follows these steps:

- 1) Checks for an existing MySQL instance by checking the standard MySQL server TCP/IP port 3306.
- 2) If a local MySQL exists, then Ant performs the desired operation that uses MySQL, such as running a master or worker.
- 3) Otherwise, Ant starts the MySQL server process, performs the desired operation that uses MySQL, then shutdowns the MySQL server process.

It is important to note that with the above steps, Ant tasks that use a local MySQL instance will not shutdown a MySQL service/daemon that was already running. However, the Ant task "stopmysql" will stop an existing service/daemon, since the task has no information available about how MySQL was started.

When Ant launches a MySQL server process, the process is bound to the localhost/127.0.0.1 network only, making it inaccessible from other nodes. In addition, all security restrictions are removed for connections, meaning no MySQL users IDs or passwords need to be configured.

Before you can use the local MySQL features, MySQL files that are appropriate for your system must be provided, be it Windows or Linux, 32-bit or 64-bit. To begin this process, locate the "mysql" directory under the installation folder of MOVES. It contains a file called "my.ini". This is the local MySQL's configuration and you may update the contents to optimize the memory usage for your system. Do not, however, modify any directory paths in this file, especially the "basedir" and "datadir" entries. It is also advisable to edit manyworkers.txt and maketodo.txt to your system's shared work folder.

Creating TODO Files

The MOVES master has a mode that only generates TODO files without picking up, or processing DONE files. If using the direct command line, use the "-r" or "-rl" command line options along with the "-maketodo" option. If using Ant, use the "maketodo" task, such as:

```
ant -Drunspec=c:\myrunspecs\runspec1.mrs maketodo.
```

Before using the Ant "maketodo" task, configure your local MySQL and edit maketodo.txt to use your system's shared work folder. Do not alter server or database names in maketodo.txt.

Running More than 2 Workers on One Node

Multiple MOVES workers can be run on a single node. Each worker requires a unique database name and the easiest method of doing this is by setting the workerDatabaseName entry to "*" in WorkerConfiguration.txt and manyworkers.txt. There are technically other methods of accomplishing this with earlier versions of MOVES but they are substantially more error prone and will not be covered here.

The Ant "1worker", "2workers", and other tasks use the manyworkers.txt configuration file, passing it to the workers using the -config=FILE command line parameter along with the -autoshtutdown flag. Workers launched with these tasks will terminate gracefully after 2 minutes without TODO or InProgress files.

Before using the Ant tasks, configure your local MySQL and edit manyworkers.txt to use your system's shared work folder. Do not alter server or database names in manyworkers.txt.

Processing DONE Files - Command Line DONE Files

A MOVES master can pick-up DONE files created for other masters. When doing so, it creates records in its own output database (as opposed to the output database designated in the original runspec). The master "-p" command line option is used to automate the retrieval of these files. If using Ant, use the "pickup" task such as:

```
ant -Dpdspec=c:\myinfo\filestoget.xml pickup
```

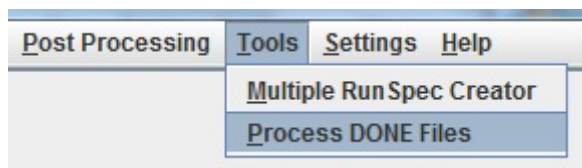
When using these options, you must provide a "PDSpec" XML file ("Pickup Done Specification"). An example file follows:

```
<pdspec>
  <pentry>
    <masterid>5880486781340065678</masterid>
    <directory>C:\EPA\MOVES\MOVESGHGSource\SharedWork</directory>
    <output servername="" databasename="PDTest" />
  </pentry>
  <pentry>
    <masterid>3686433322585912670</masterid>
    <directory>C:\EPA\MOVES\MOVESGHGSource\SharedWork</directory>
    <output servername="" databasename="PDTest" />
  </pentry>
</pdspec>
```

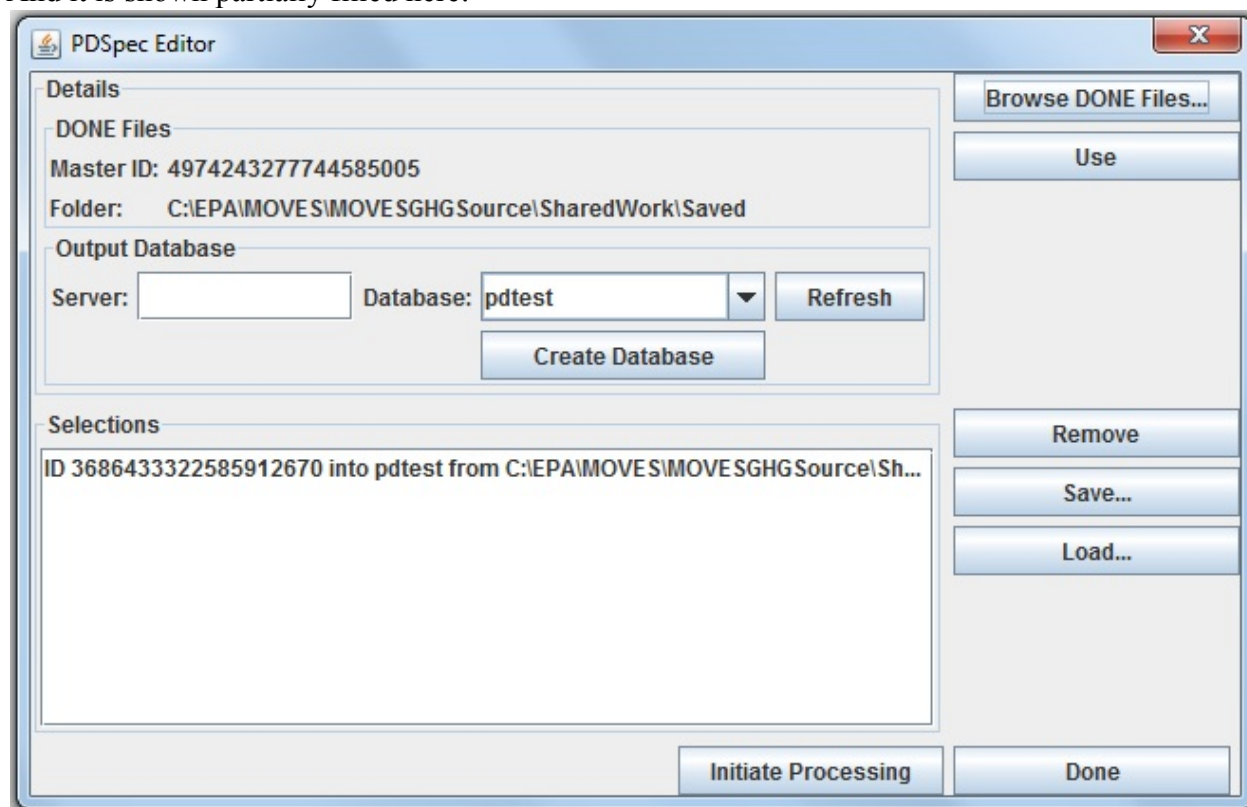
The above file shows two sets of DONE files that will be retrieved, both from the same folder and both destined for the same output database. Each will get a separate MOVESRun entry in the database.

Processing DONE Files - GUI DONE Files

MOVES has a GUI for creating these PDSpec XML files and for processing DONE files. The GUI is activated from the "Tools" menu:

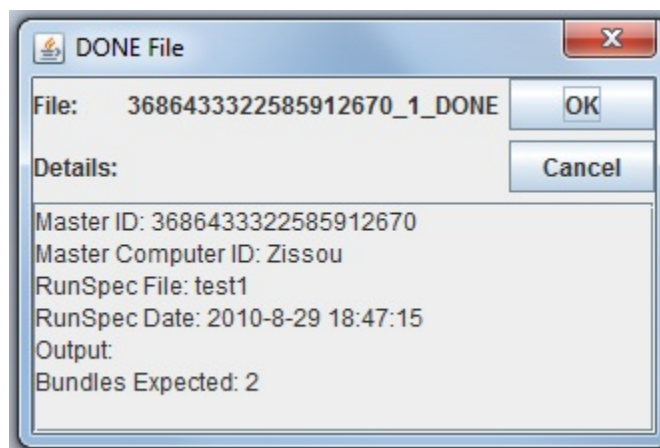


And it is shown partially filled here:



To use the GUI, click **Browse DONE Files** and select a DONE file.

You will be presented with details extracted from the bundle:



If the DONE file is desired, click **OK**. This will populate the "Master ID" and "Folder" fields in the PDSpec GUI. Next, specify the output database just as is done with the primary MOVES GUI then click the **Use** button.

Click the **Save** button to generate a PDSpec XML file from your selections.

Click the **Load** button to populate the selections list with the contents of an existing PDSpec XML file.

Click the **Done** button to close the GUI without processing the DONE files, but with the option to save your selections into an XML file for later use.

Click the Initiate **Processing** button to pick up the DONE files immediately.