Triangle Regional Travel Demand Model

Users' Guide

For TRMv6-2013

Prepared for

North Carolina Department of Transportation
Capital Area Metropolitan Planning Organization
Durham – Chapel Hill – Carrboro MPO
GoTriangle

Prepared By

Triangle Regional Model Service Bureau

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Contents

Tables

Figures

PREFACE

This document provides guidance for end-users of the Triangle Regional Model version 6 (TRMv6), run using TransCAD version 6. It describes how to install the model, create scenarios, execute the model, and find, interpret, and use the model's outputs.

For technical details or theoretical background on the TRMv6, please refer to the **Triangle Regional Model Version 6 Model Development Documentation**.

Computer and Software Requirements

The hardware and software requirements for running the TRMv6 are as follows:

- Computer: 64-bit
- Operating system: Windows 7 Pro (64-bit)
- MS Office: 64-bit
- TransCAD version: 6.0 r2 Build 9195 (64-bit)

A full run of the TRMv6 2013 base-year model (taking four feedback iterations to converge) executes in about ten hours on a quad-core Intel i7 2.93 GHz processor and 16 GB of RAM equipped 64-bit desktop computer. This is the only type of computer on which the model has been tested. Required hard drive disk spaces are approximately as follows:

Hard drive space needed	w/ some intermediate files deleted during model run	All files retained
w/o user-benefit files generated for Summit	29 GB	53 GB

If the "Delete temporary files after model run" box is checked in the main TRMv6 graphical user interface (GUI) before model execution, the total size of all the input and output files of a model run will be about 24 gigabytes less than without the box checked. However, since the temporary files are not deleted immediately after they are created, it would still be advisable to have at least 57 gigabytes of free disk space before starting a model run, the same as if all temporary files were retained.

Outline of the User's Guide

Chapter 1: Overview of the TRMv6
This chapter describes the TRMv6 application structure and data-flow and computer-resource requirements.

Chapter 2: Getting Started
This chapter provides instructions on how to prepare model setup files, create and install the TRMv6 user-interface, and setup TRMv6 model scenarios.

Chapter 3: Model Execution
This chapter provides step-by-step instructions for executing the TRMv6 2013 base-year scenario. Key input and output data files required for execution are listed, with each step including a description of the required directory structure.

Chapter 4: Input File Preparation
This chapter instructs the user how to prepare certain input files which often vary by model scenario and require manual preparation. It does not discuss other types of input files, the contents of which do not differ across model scenarios. Special consultation with the TRM Service Bureau (TRMSB) is recommended if one needs to make changes to these files.

Chapter 5: Data Dictionary for Input and Output Files
This last chapter provides detailed information about key input/output data.

Chapter 1. OVERVIEW OF TRM

The TRMv6 model is a major update of version 5 of the TRM (TRMv5). The official software platform used for developing the model is TransCAD version 6.0 r2 Build 9195 (64-bit). It was calibrated to a base year of 2013.

The model is implemented using a combination of TransCAD Transportation Modeling software and stand-alone FORTRAN application programs. TransCAD operates as both an integral component of the application and a shell for the management of scenarios and the calling of FORTRAN programs.

This chapter gives an overview of the TRMv6, with respect to its characteristics, structure, and data flows.

1.1 Model Characteristics

The TRMv6 is implemented on the platform of TransCAD, with a dedicated graphical user interface (GUI) developed using TransCAD's built-in scripting language, GISDK, as shown in Table 1-2. The GUI manages various model scenarios, automates the execution of the model, and evaluates model results.

The TRMv6 is a traditional four-step travel behavior model, with enhanced features designed to meet the evolving state of the practice in multi-modal travel demand modeling. Key techniques used in the model include:

- A multinomial logit trip production model and attraction share model;
- A multinomial logit destination choice model, with logsum fed back from the mode choice model;
- A binary logit non-motorized trip split model;
- A nested logit mode choice model, including a special trip type called auto-intercept; and
- An iterative feedback mechanism, which loops through the destination choice, non-motorized trip split, mode choice, and assignment modules and ensures that the model uses consistent travel costs between input and output for the peak period.

Major features of the model include:

- The TRMv6 forecasts both passenger trips and commercial vehicle trips.
- Passenger trips including those made by (1) the general population (excluding university students); and (2) university students.
- Forecasting of general population passenger trips is categorized into multiple market segments on the basis of household and person socioeconomic characteristics, as represented by five household strata and three person types (see details in Model Development Documentation).

- Work trips are modeled by employer establishment type and by traveler's work-related earning level (low or high).
- A four-step University Student Model (USM) represents university student trips (by students at the four major universities in the region) by student residence type (on- or off-campus). After the mode choice step, university student trips are combined with general population passenger trips to determine the total passenger trips.
- Passenger trips are forecasted for both private and public transportation modes.
- Private transportation modes modeled in the TRMv6 include single-occupant vehicles, 2-occupant vehicles, and 3+-occupant vehicles, in addition to non-motorized transportation.
- Public transportation modes modeled in the TRMv6 include local buses, express buses, and rail transit (rail transit only appears in future year forecasts, and not in the base-year model). Modes for accessing public transit include walk access, park and ride, and kiss and ride.
- Non-motorized trips are estimated after destination choice and before motorized mode choice, with bicycle trips and walk trips not distinguished from one another. Even though non-motorized trip distributions are estimated, no further mode split between bicycling and walking is estimated, nor is the trip assignment step performed for non-motorized trips.
- Commercial vehicle trips are forecasted for three vehicle types: light-duty vehicles, single-unit trucks (SUTs) and multi-unit trucks (MUTs).
- Parking analysis sub-areas (PASA) are defined by groups of selected TAZs on and around the four major university campuses (Duke, NCCU, NCSU, and UNC) and in the CBDs of five municipalities (Chapel Hill, Durham, Raleigh, Carrboro, and Hillsborough). PASA based weighted average parking cost and capacity constraints are applied to peak-period trips by trip purpose and parking facility user type (work commuters, university commuter students, or visitor).
- Road tolls are fully modeled. They are reflected in nearly all steps of the model, except trip generation. Tolls are incorporated with travel times, via the value of time, to form generalized costs of travel. With the capability of toll modeling, the TRMv6 can be used to investigate HOT lanes and other toll road alternatives.
- Land-based person travel to and from the Raleigh-Durham International Airport is explicitly modeled. Airport person trips are classified into home-based, work-based, private-residence-based (i.e., not the traveler's residence), and non-home-non-work-based categories.
- Highway traffic assignment forecasts traffic volumes on each roadway segment by the following vehicle types: single-occupant vehicles (SOV), high-occupancy vehicles (HOV), and trucks. SOV and HOV traffic produced in this step includes both passenger vehicle trips and commercial vehicle trips, with internal-to-internal (I-I), internal-to-external (I-E), external-to-internal (E-I), and external-to-external (E-E or "through") traffic aggregated together.
- The North Carolina Statewide Travel Model (NCSTM) is used to inform and clarify TRMv6 passenger and commercial vehicle external-to-internal (E-I), and external-to-external (E-E or "through") trips.
- Eight time-of-day periods are modeled in the TRMv6 divided up as follows: AM peak (6:00 - 10:00 am), PM peak (3:30 - 7:30 pm), mid-day (10:00 am - 3:30 pm), and

nighttime (7:30 pm - 6:00 am). There are three sub-periods within the AM peak period: pre-peak-hour shoulder (6:00 am - 7:30 am), peak hour (7:30 - 8:30 am), and post-peak-hour shoulder (8:30 - 10:00 am). Similarly, there are three sub-periods within the PM peak period: pre-peak-hour shoulder (3:30 - 5:00 pm), peak hour (5:00 - 6:00 pm) and post-peak-hour shoulder (6:00 - 7:30 pm).

1.2 Model Structure and Flow

The basic overall structure of the TRMv6 is shown in **Table 1-1**. Processes in this flow chart are grouped according to the stages and steps in the TRMv6 TransCAD GUI, which is shown in Table 1-2. The processes grouped into the dotted boxes in **Table 1-1** are stages, and the box labels match the stage names shown in the model GUI.

Feedback only occurs if the number of iterations is set to more than zero in the GUI. Assuming that the number of iterations is set high enough to achieve convergence, the model will loop back one more time after convergence is met to allow the distribution and mode choice models to run one final time with the converged travel times.

Without executing the feedback model, a full TRMv6 run starts from the step of Create Walk Access and ends at the step of Transit Assignment. A model run without the feedback model takes less time, but the results are not as robust. Feedback is always recommended for serious analyses.

There are three additional utilities provided in the GUI: Base Model Validation/Scenario Evaluation, Air Quality Analysis, and Summit User Benefit Analysis. Details on these are provided in Chapter 3.

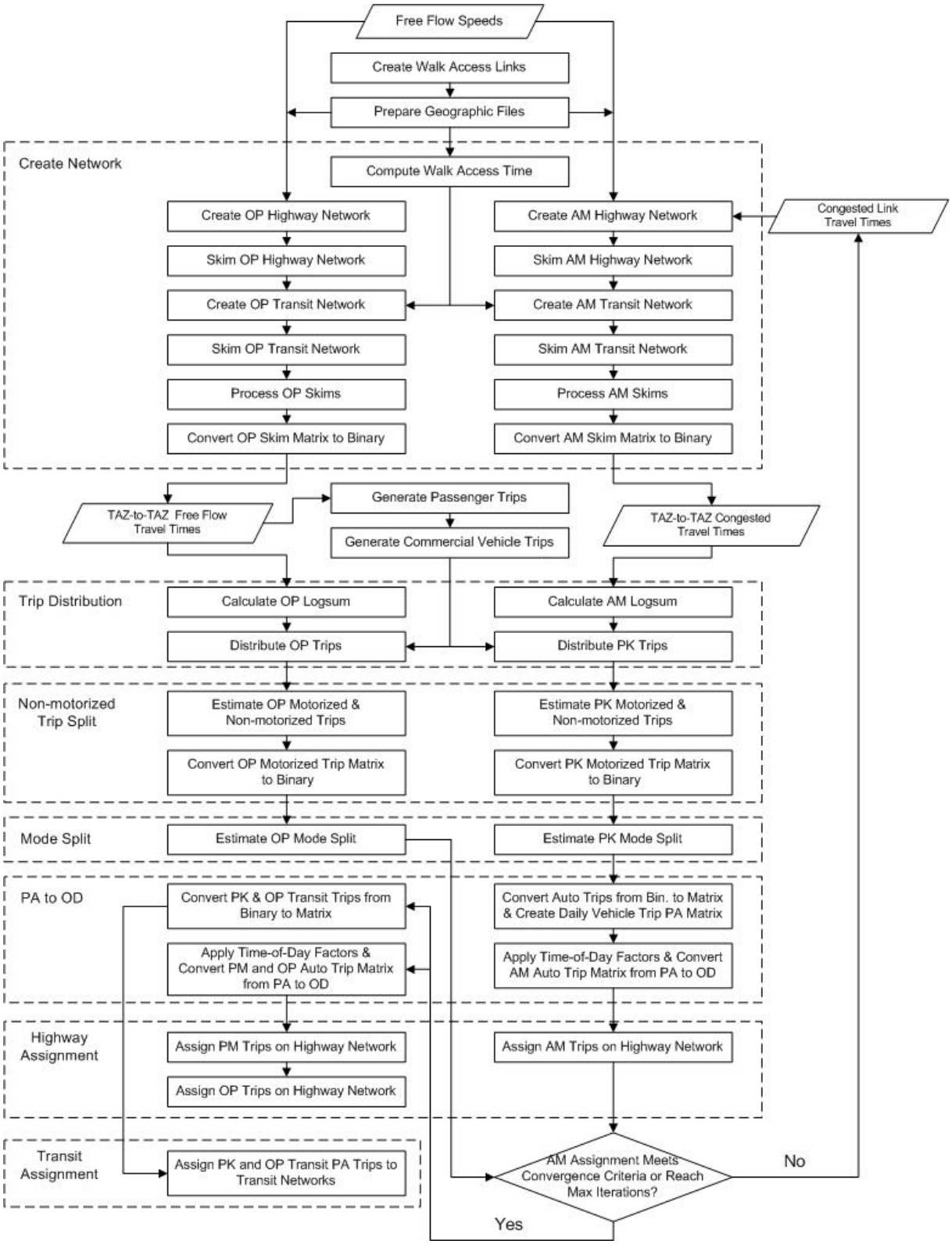


Table 1-1 TRMv6 Flow Chart

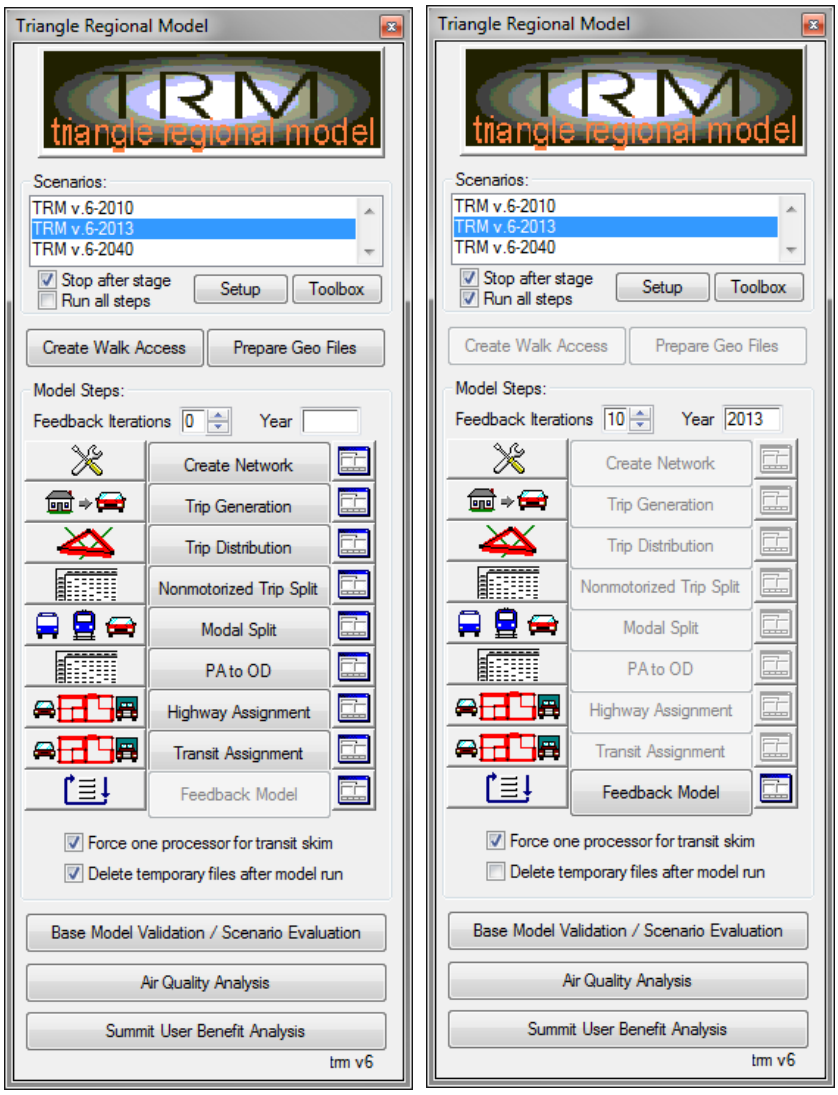


Table 1-2 TRMv6 Graphical User Interface for Step-by-Step and Feedback Model Runs

1.3 File Directories and Management

The TRMv6 file storage structure is simple and straightforward, as shown in the example in Figure 1-3. There are four file directories that need to be prepared manually: **Input**, **Interim**, **Output**, and **EvalModule**. The first three are required for any full model run, and the last one is required for model output evaluation (i.e., when the Base Model Validation/Scenario Evaluation button is clicked in the GUI).

In addition to the four manually prepared directories, there is an optional one called **Air Conformity**, which is created automatically when Air Quality Analysis is executed (i.e., when the Air Quality Analysis button is clicked in the GUI).

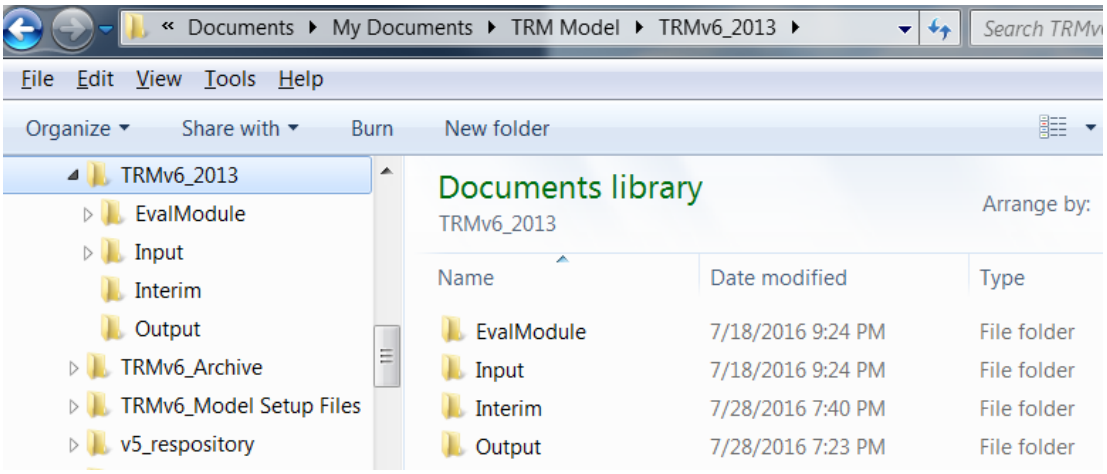


Table 1-3 TRMv6 File Directories

All input files required for a model run are grouped and stored in the **Input** directory (and subdirectories), as shown in Table 1-4. A summary of the directory contents is provided (refer to Chapter 3 for details).

Master highway network, master transit network, and regional TAZ system geographic files are stored in the **Master Geography** subdirectory.

Socioeconomic (SE) data and selected other TAZ data, highway network data (created from the master highway network), and time-of-day-specific transit network data (created from the master transit network) are stored in their own distinct subdirectories: **SEData**, **Highway**, and **Transit**, respectively.

Stored in the **Transit** subdirectory are also a bus-speed-equation lookup table, a transit mode table, a mode-to-mode (operator-to-operator) transfer fare table, time-of-day-specific timed-transfer wait-time tables, and SE data distribution weights for transit access.

Passenger external trip tables (E-E, E-I, and I-E) are in the **Extp** directory**.**

All commercial vehicle trip tables are in the **CommVeh** subdirectory.

The **Input\Programs** subdirectory contains FORTRAN executable files and control files with the coefficients, constants, and parameters for implementing trip generation and mode choice procedures, as well as the files AutoPct.txt, GCHPct.txt, GWrPct.txt, Non-Motorized Trip Split Models.dbf, PctIncSZ.txt, sch_adj.prn, shuttle_lot.txt, SizePct.txt, tg.bat, trmgen.ctl (trip generation Fortran program), and unc_zone.txt. Except on rare occasions, these files should not be modified. Under the **Programs**\ directory, the subdirectories of **64 bit exe**\ and **32 bit exe**\ store executable FORTRAN program files for 64-bit and 32-bit computers, respectively. Make sure to use the ones that are consistent with your computer type.

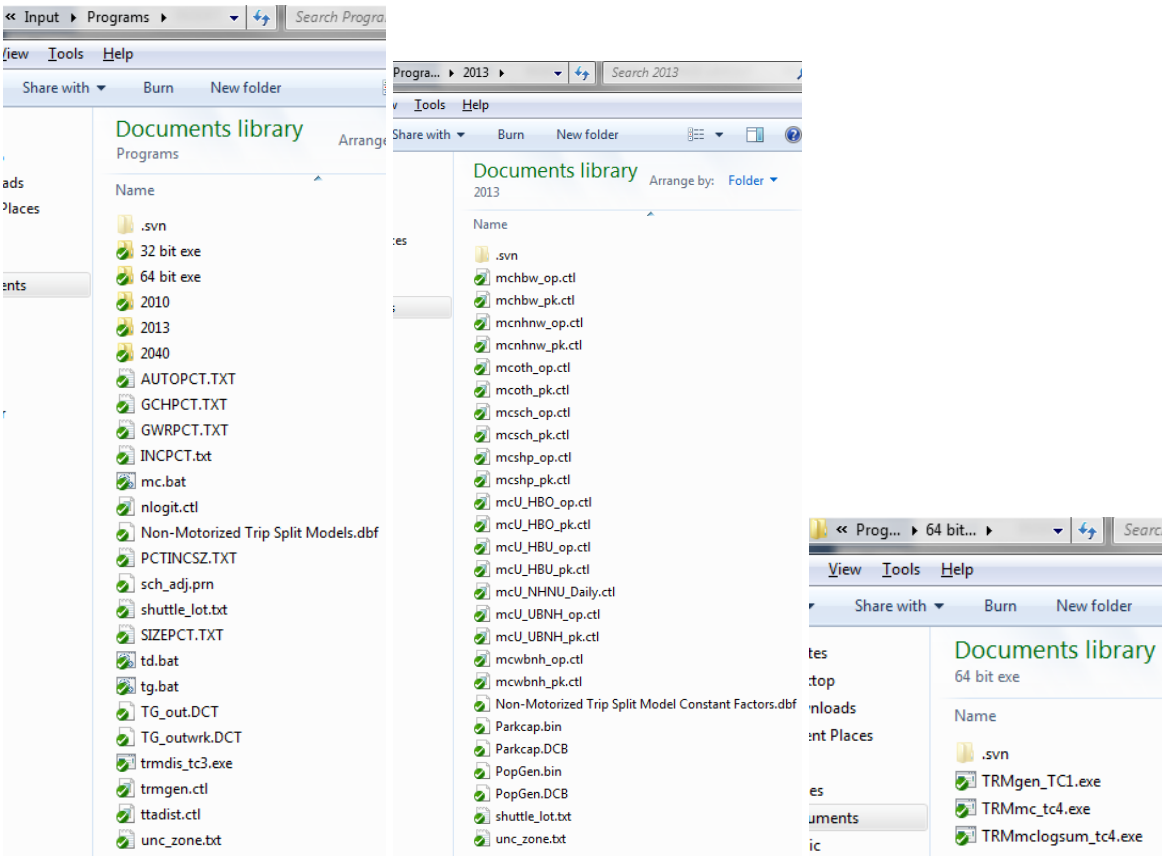


Table 1-4 TRMv6 – Example Views of files in Program Directories and Sub-Directories

The files in the **Input\Parameter** subdirectory include the speed-capacity lookup table, time-of-day hourly factor table. Like the files in the **Programs** subdirectory, these files should not be modified without careful model validation.

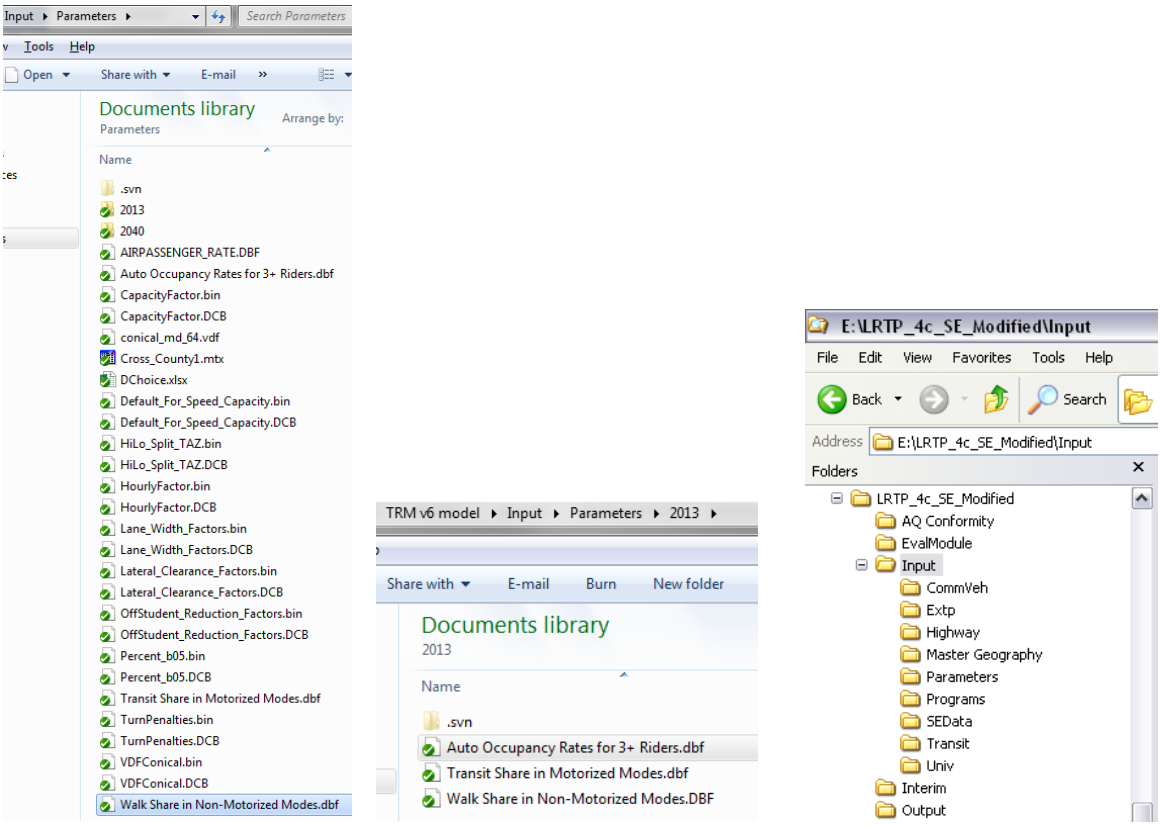


Table 1-5 TRMv6 Input File Directory and Its Contents

All of the final output files are saved in the **Output** directory. The key outputs include highway trip OD matrices, transit trip OD matrices, highway traffic assignment results, and transit assignment results. The results are stratified by time of day and transportation mode (including public transit access mode).

Files that are generated in the application for use in later modules go to the **Interim** directory. During model execution, over 53 GB of interim files are created and placed in this directory.

Nearly 1,300 files are involved in a model run, including input files, program files, parameter files, and output files. The TRMv6 includes a Scenario Manager at the top of the GUI to create and manage model scenarios (also called applications). While the Scenario Manager has to use a default definition file to initialize all input/output files and parameters, it provides the user with flexibility with respect to changing file names and paths and resetting parameters. Use of the Scenario Manager is described in greater detail in Chapter 2.

Details about the directory/subdirectories and files are provided in Chapter 3.

Chapter 2. GETTING STARTED

This chapter provides instructions for the steps that need to be taken prior to running the TRMv6. The key steps are: (1) installing TransCAD software; (2) preparing TRMv6 setup files; and (3) installing the TRMv6 graphical user interface (GUI).

Because we have to talk about directories and files throughout this Guide, to facilitate the presentation, we will refer to the file names indicated in the TRM60_MOD.bin file (this file will be described in Section 2.2.1), and also assume that:

- TransCAD version 6.0 r2 Build 9195 64-bit program is installed under **C:\Program Files\TransCAD 6.0**, and
- All model scenarios are stored under a master directory, **C:\TRMv6 Model**.

In case you have a different TransCAD directory name or it is installed in a different location (e.g., C:\TransCAD\), you will need to replace the text "C:\Program Files\TransCAD 6.0\" anywhere you see in this Guide with the correct directory for your case.

Similar substitutions must also be done with model scenario directories, if they are different from the ones assumed above.

2.1 Install TransCAD version 6.0 r2 Build 9195 (64-bit)

The official platform on which the TRMv6 runs is TransCAD version 6.0 r2 Build 9195 (64-bit).

Before setting up model files, you will have to make sure that TransCAD version 6.0 r2 Build 9195 has already been installed properly on your machine, such as under the directory of "C:\Program Files\TransCAD 6.0\".

If you already have other versions of TransCAD installed, that is not a problem, as you may install multiple versions of TransCAD on a given machine. However, each version has to be installed in a different directory, and the one that runs the TRMv6 has to be version 6.0 r2 Build 9195.

2.2 Preparing Model Directory and Setup Files

2.2.1 Files Needed for Setup

2.2.1.1 Data in the model distribution file set (Required)

This User's Guide accompanies the model distribution files set with all the files needed to run the TRMv6. The file storage structure in the model distribution file set is illustrated in Table 2-1.

Table 2-1 Data in model distribution file set (Required)

Directory Name	File Name	Description/Instructions
\TRM Script and GUI\	TRMv6 _TC60_Script.rsc	This is the TRMv6 script written in GISDK. It should be copied to your local computer and can be placed anywhere you like, as long as you can find it in case a recompilation is needed.
	trm_v6_ui.dbd and supporting files (i.e. trm_v6_ui.1 through trm_v6_ui.6)	These are the TRMv6 graphical user interface (GUI) files, which are created by compiling the model script TRMv6 _TC60_script.rsc. These files should be copied to the TransCAD program files directory (e.g., C:\Program Files\TransCAD 6.0\).
\Model Setup Files\	trm_v6.ini	This file provides the path information for the locations of (1) the GUI, (2) scenarios set up and stored earlier, (3) files providing the initial definitions for all input and output files and parameters, and (4) all the input files. This file should go in the TransCAD program files directory (e.g., C:\Program Files\TransCAD 6.0\).
	TRM_v6_MOD.bin & TRM_v6_MOD.DCB	These two files provide the initial definitions for all input and output files and parameters for the model. They define the names and paths for the files and the values of the parameters. They can be placed anywhere, as long as they are referenced correctly in the trm_v6.ini file. A good practice is to create a separate subdirectory under the master directory (e.g., C:\TRMv6 Model\Model Setup Files\).
Input*\2013\	A full copy of all input files for the base-year model	Files and directories are structured as illustrated in Figure 1-3. Under each \input\sub directory\, subdirectory \2013\ stores all input and parameter files for a base-year model run. Prior to a base-year model run, files under \2013\ need to be copied to the upper-level sub-directory. E.g., \Input\SEData\2013\SE_2013.bin needs to be copied to the directory of \Input\SEData\ prior to running the base-year model. Similarly, to run a 2045 model, the file \Input\SEData\2045\SE_2045.bin needs to first be copied to directory \Input\SEData\. Exception: Files in subdirectories of \Input\CommVeh\NCSTM Data\2009\ and \2045)\ do not need to be copied.
\Logo File\	triangle.bmp 	This is the TRMv6 logo. It is displayed at the top of the TRMv6 GUI when the model is launched. It should be copied to the TransCAD program files directory (e.g., C:\Program Files\TransCAD 6.0\).

2.2.1.2 Additional Data (Optional)

These additional files are not required for setting up and executing the TRMv6, but under certain circumstances they can facilitate the modeling work substantially. They are not included in the TRMv6 model distribution file set. Contact the TRMSB if they are needed.

Table 2-2 Additional Data (Optional)

Directory Name	File Name	Description/Instructions
\TRMv6 AQ Files\	Subdirectories named 2015, 2025, 2035, and Mobile6 Files, and file	This directory is **optiona**l and only needed for air quality analysis. It should be copied to the TransCAD program files directory

Directory Name	File Name	Description/Instructions
	County Emission Budgets and Compliance Rates.dbf	(e.g., C:\Program Files\TransCAD 6.0\). Details about the files in this directory are provided in Section 3.12.
\TRMv6 Summit\	Summit executable file (summit993.exe) and control file template	This directory is **optiona**l and only needed for Summit user benefit analysis. It should be copied to the TransCAD program files directory (e.g., C:\Program Files\TransCAD 6.0\). Details about the files in this directory are provided in Section 3.13.
\True Universe Highway Network\	True Universe Highway Network.dbd	The True Universe file has all roadway links (plus centroid connectors) in the TRMv6, including links associated with the future projects.
\All Coded Transit Routes\	All Transit Routes.rts	The Routes.rts file has all base-year and future-year transit-route related information, including stops, roadway links, and time-of-day-specific headways.
\Network Manager\	netmanager.dbd and supporting files (i.e., netmanager.1 through netmanager.6)	This tool creates and manages highway and transit network scenarios for the TRMv6.

2.2.2 Prepare Model Setup File

Below are the steps for preparing the initial model setup file on your computer:

1) Create the **TRMv6 Model** directory under the C drive (i.e., **C:\TRMv6 Model**), if it does not exist yet.
2) Create a subdirectory called **Model Setup Files** under **C:\TRMv6 Model**, and copy the files **TRM_v6_mod.bin** and **TRM_v6_mod.dcb** from the **TRMv6 Setup Files** directory in the model distribution file set to **C:\TRMv6 Model\Model Setup Files**.
3) Create a scenario directory \2013\ under C:\TRMv6 Model\. Copy all four directories under \TRM v6 Model\ from the model distribution file set to this directory, i.e., to **C:\TRMv6 Model\TRMv6_2013**.
4) Copy file **trm_v6.ini** from the **Model Setup Files** directory in the model distribution file set and file **trm_v6_ui.dbd** and its supporting files (i.e., trm_v6_ui.1 through trm_v6_ui.6) from the **TRM Script and GUI** directory in the model distribution file set to **C:\Program Files\TransCAD 6.0**.
5) Modify the **trm_v6.ini** file to reflect correct file locations. An example is shown below. Brackets and texts in the brackets should NOT be modified.

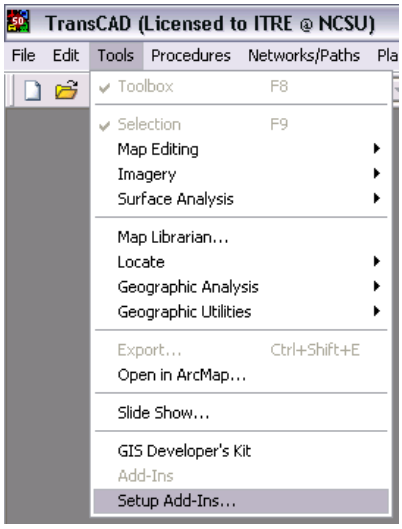
   The sixth line, [Scenario File], indicates the location of the **TRM_v6_MOD.arr** file, which is created by the TRMv6 Scenario Manager and stores full information on all scenarios created using the Scenario Manager.

[Model Table]
C:\TRMv6 Model\Model Setup Files\TRM_v6_mod.bin
[UI File]
C:\Program Files\TransCAD 6.0\trm_v6_ui.dbd
[Scenario File]
C:\TRMv6 Model\Model Setup Files\TRM_v6_mod.arr
[Data Directory]
C:\TRMv6 Model\TRMv6_2013\

2.3 Create TRMv6 Graphical User Interface

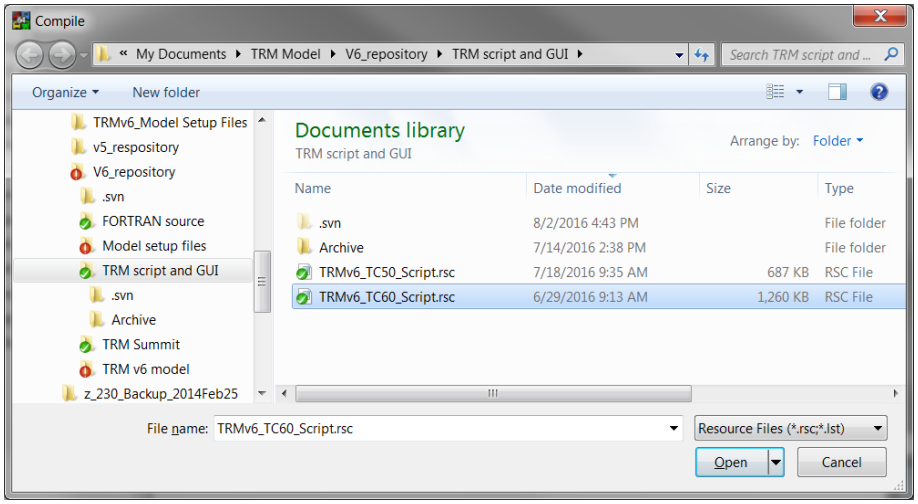
While a GUI is provided in the model distribution file set, in case the user needs to recompile the model script to create a new GUI, the following procedure needs to be followed.

1) From the main menu of TransCAD, choose **Tools → GIS Developer's Kit.**

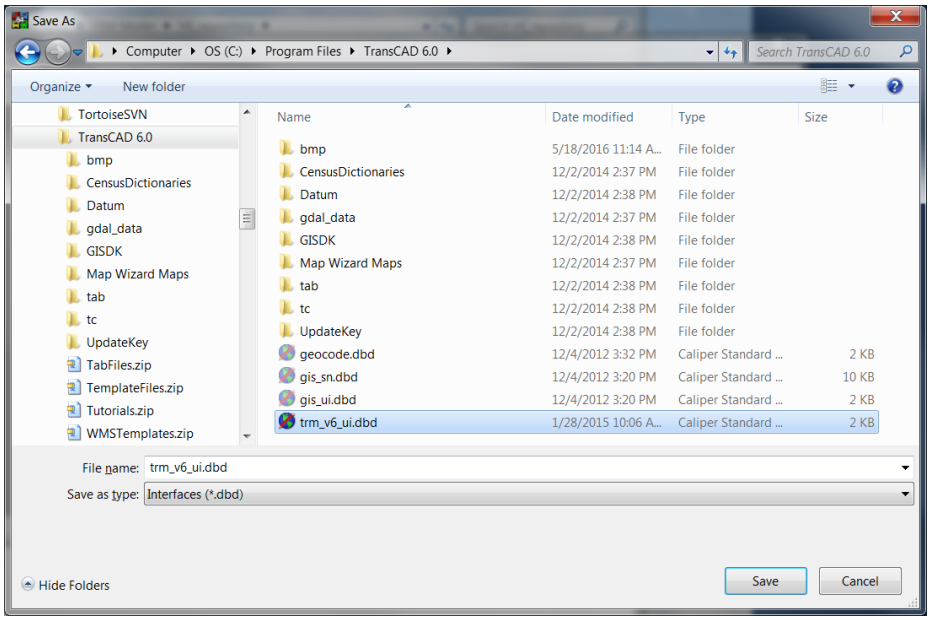


2) The "GISDK Toolbox" pops up. Click the third (middle)  button ("**Compile to UI**").

3) In the "Compile" dialog box, browse for the model script file **TRMv6 _TC60_Script.rsc** in the **TRM script and GUI**\ directory, highlight the file and click "**Open**".



4) In the "Save as" window, browse to the TransCAD directory **C:\Program Files\TransCAD 6.0**, and enter "**trm_v6_ui.dbd**" in the "File name" field, then click "**Save**". If trm_v6_ui.dbd already exists, simply highlight and overwrite it.



Now, the recompilation of the model script and the creation of a new GUI are completed.

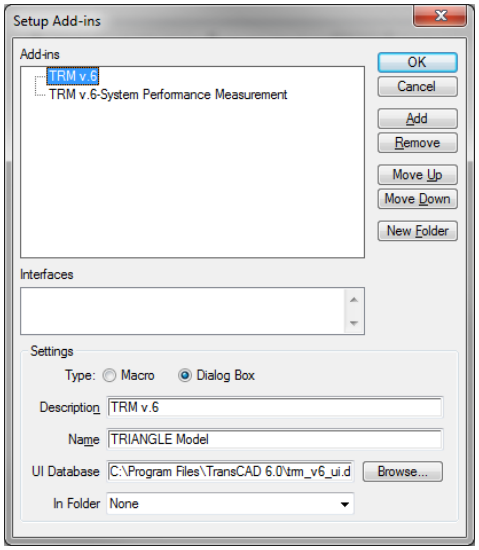
2.4 Install TRMv6 Graphical User Interface

The next step is to install the TRMv6 GUI by following the procedure below:

1) From the TransCAD main menu, click "**Tools**" → "**Setup Add-ins**".
2) In the "Setup Add-ins" dialog box, click "**Add**" button.

Under section "Settings":

a. In the "Type" row, select the radio button of "**Dialog Box**".
b. In the "Description" row, you can enter "**TRM v.6**" or anything else that makes sense.
c. In the "Name" row, you must enter "**TRIANGLE Model**" (case sensitive).
d. In the "UI Database" row, click the "Browse" button and then in the "Locate UI Database" dialog box browse for the TRMv6 UI (i.e., "trm_v6_ui.dbd" in C:\Program Files\TransCAD 6.0\) and click "Open".
e. Click OK in the "Setup Add-ins" dialog box.



Now you are ready to execute the TRMv6.

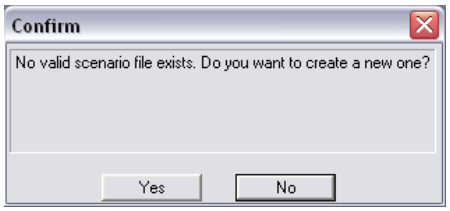
2.5 Use TRMv6 Graphical User Interface

By clicking TRM v.6 from the TransCAD Tools →Add-Ins menu, the TRMv6 GUI will pop up in the TransCAD window, as shown in the screenshot below. Since at this point you have not yet set up any model scenarios in the GUI, the Scenarios box is empty and most of the model execution buttons are not enabled.

2.5.1 Create a New Model Scenario

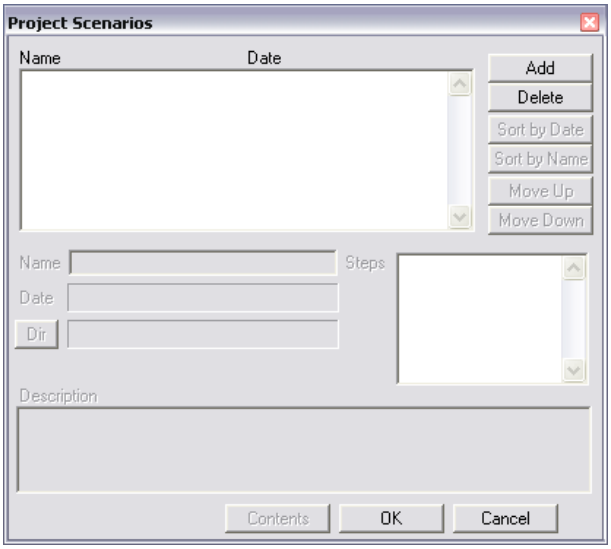
Assuming that you are going to set up the base-year 2013 model and you have copied the 2013 model files from the model distribution file set to the appropriate sub-directories under the **C:\TRMv6 Model\TRMv6_2013\Input** directory, the steps involved are as follows:

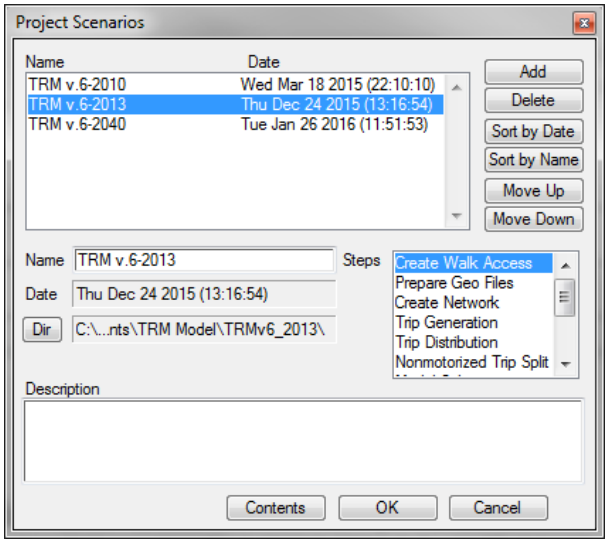
1) Click the "**Setup**" button in the Scenarios frame at the top of the UI.
2) If no model scenario exists yet, a message box titled "Confirm" will appear. Click "**Yes**" to start.



3) Now, the "Project Scenarios" dialog box appears, as shown below. Click "**Add**" to add a new scenario.

   - In the Name box, enter "**TRM v.6-2013**" or any other meaningful name.
   - If the file directory displayed to the right of the "**Dir**" button is not **C:\TRMv6 Model\2013**, click the "**Dir**" button and direct the UI to the **C:\TRMv6 Model\TRMv6_2013** directory, where the complete 2013 model files are stored.





4) The Steps scroll-down box now lists all TRMv6 modeling steps. These steps are the same as the buttons listed in the main model GUI. The steps include:

   - Create Walk Access
   - Prepare Geo Files
   - Create Network
   - Trip Generation
   - Trip Distribution;
   - Non-motorized Trip Split
   - Modal Split
   - PA to OD
   - Highway Assignment
   - Transit Assignment
   - Feedback Model

Now you are ready to specify all of the input and output files and parameters to be used in the base-year model run before clicking the "**OK**" button to conclude the setup of the scenario. Detailed information about how to check and specify model input and output files and parameters is provided in Section 2.5.2.

If you add more scenarios, make sure that each scenario has its own directory, and that the directory and its required subdirectories already exist. Scenarios can be added, deleted, and sorted. All scenarios will be listed in the list box with the date and time of creation. A box is provided for a detailed description of each scenario.

2.5.2 Specify Model Input and Output Files and Parameters

After specifying the name and directory of a new scenario in the Project Scenarios dialog box, the next step is to verify the names, paths, and existence of the model input files. If any input file is missing, the model run will not succeed.

All input and output files and model parameters get their names, paths, and/or values initialized by the GUI automatically, using the values stored in the **TRM_v6_mod.bin** file. However, all of them are changeable from this dialog box.

To verify the input files, you may double-click on each item in the Steps scroll-down box or click an item and then click the "**Contents**" button. A "Parameters For Step XXXXXX" dialog box will pop up, where XXXXXX represents the step name, such as "Parameters For Step Create Network". This dialog box contains two blocks of information: "Files" and "Parameters".

- **Files:** In the Files frame, the names, paths, and statuses of the input and output files associated with a given step are displayed. You can view either the input or the output files by selecting the appropriate radio button (i.e., "Input" or "Output"). When clicking on each file in the box, a brief description of that file is also displayed in the Help box.

  When a new scenario is initially created, the names and paths of all input and output files are defaulted to those preset in the **TRM_v6_mod.bin** file. If an input file that you use is different from the default one, click the "File" button to choose the desired file. If you want an output file to have a different name than the default or be placed in a different directory, click the "File" button and type the name and/or path that you want.

  The "Dir" button allows for changes to file directories without changes to file names. You can change the directory for one file or for multiple files at the same time. To select more than one file, you need to press and hold down the Shift key on your keyboard and then left-click the mouse.

  The "Open" button allows the user to open and view the contents of the selected file (or you may double-click the file name).

It is recommended that each scenario should have its own directory and subdirectories, with all input and output files stored or saved in them. Cross-scenario referencing of files could easily cause confusion and is not recommended.

Eventually, all input files should have a status of "Exists". This is required for a successful model run.

- **Parameters:** In the Parameters frame, you will see the parameters used in the selected step, their data type (scalar, list, or discrete), and a brief description for each parameter.

  If you want to use a different value than the default one for a parameter, you can simply change it in this frame by typing the values desired.

  Make sure that all parameters are meaningful. If you are not sure, use the default values.

Any changes you make to the input or output files or to the parameters are scenario-specific and only apply to the current scenario.

The following figures show sample views of these step-specific dialog boxes, with their corresponding file names and default parameter values. Some steps involve more files and/or parameters than may be seen in a single screenshot (i.e., you must scroll down to see all of them); therefore, for full, step-specific lists of all necessary input and output files and all default parameters, refer to Chapter 3. For all OP*.* (off-peak period) output files, there is a corresponding PK (peak period) set with similar file names, except replacing OP with PK.

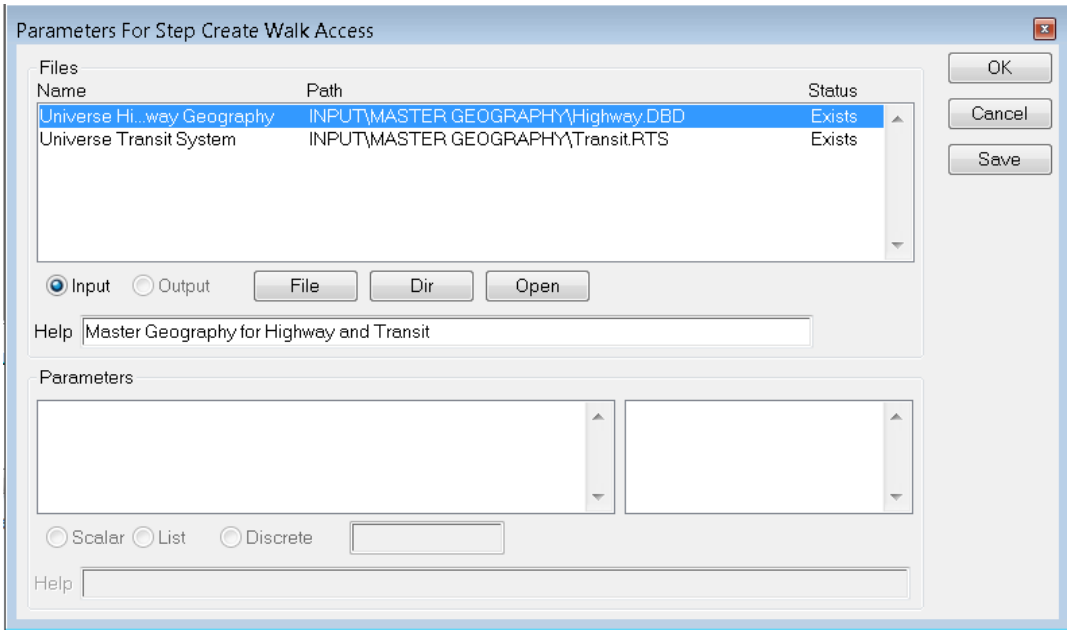


Table 2-3 Example View of "Parameters For Step Create Walk Access" Dialog Box

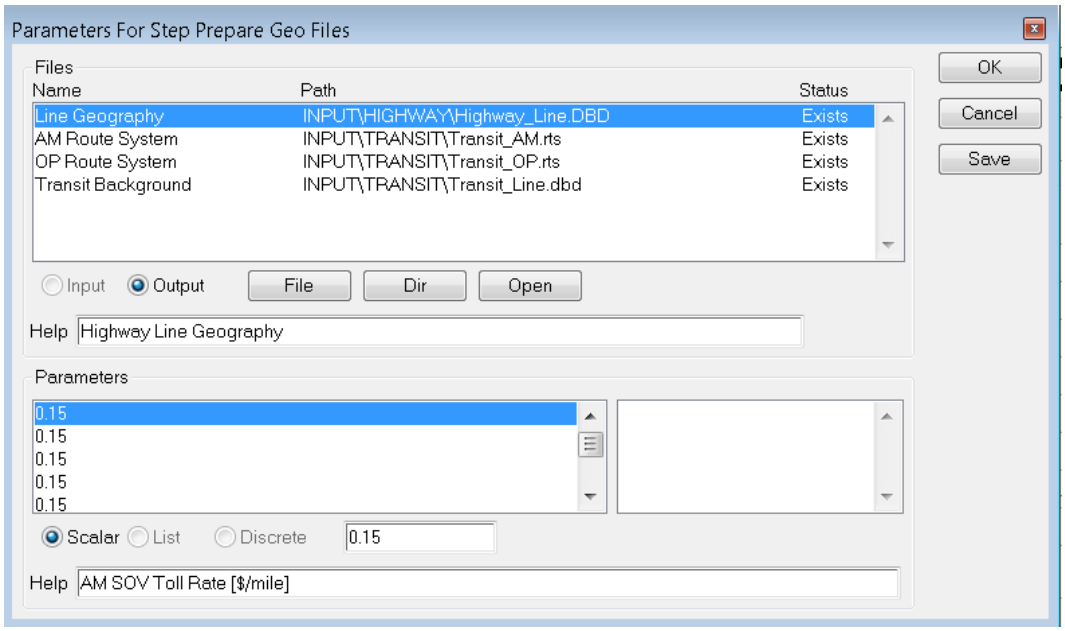


Table 2-4 Example View of "Parameters For Step Prepare Geo Files" Dialog Box

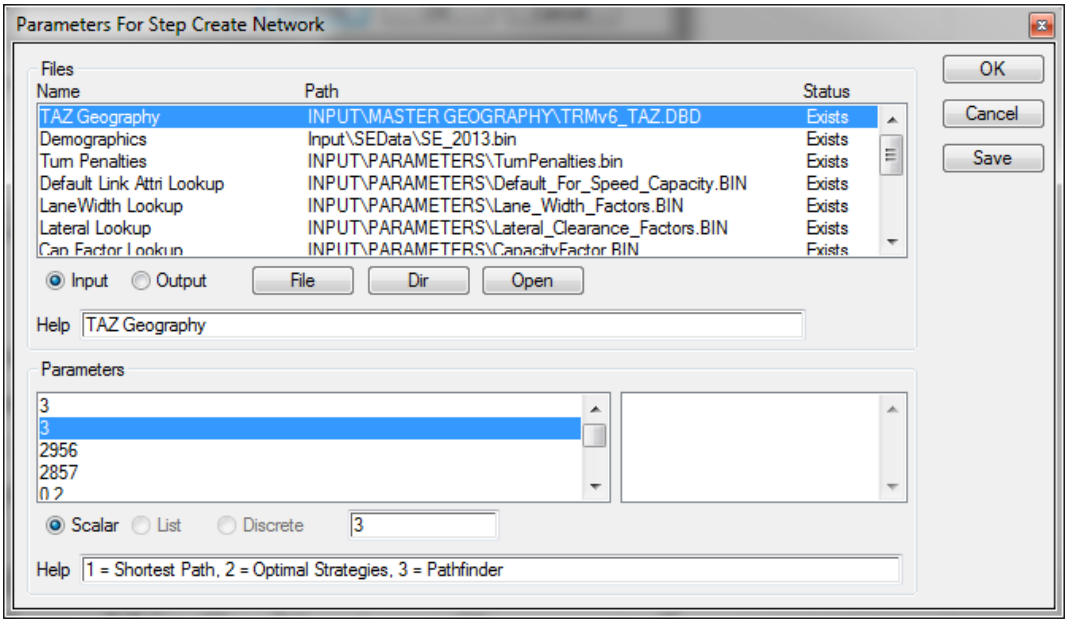


Table 2-5 Example View of "Parameters For Step Create Network" Dialog Box

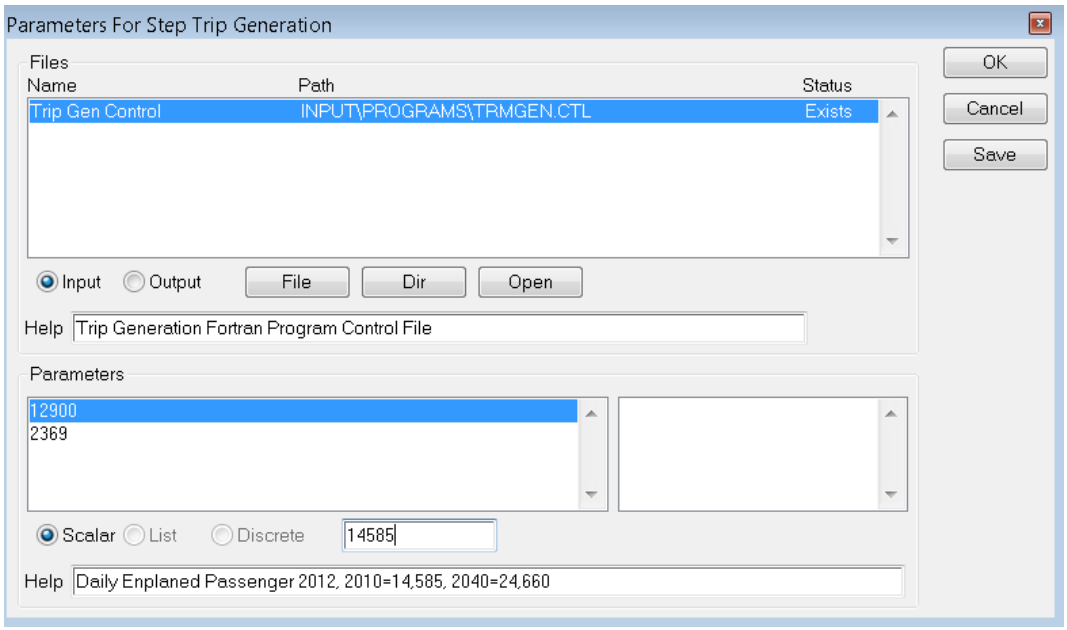


Table 2-6 Example View of "Parameters For Step Trip Generation" Dialog Box

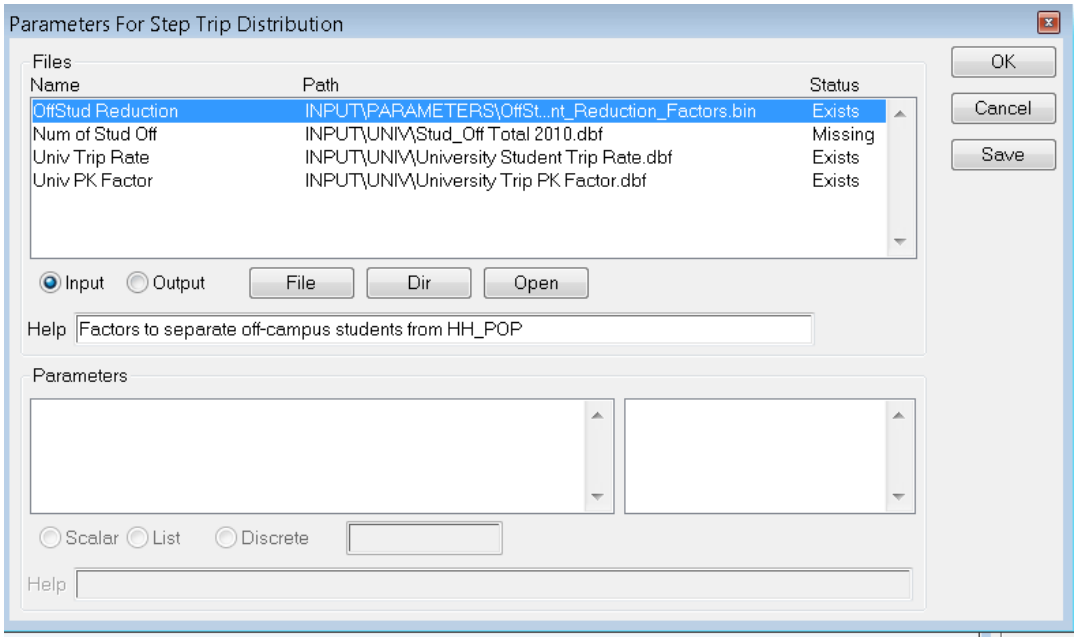


Table 2-7 Example View of "Parameters For Step Trip Distribution" Dialog Box

Special notes: Screenshots of "Parameters For Step Non-motorized Trip Split" and "Parameters For Step Modal Split" are not included among these figures because, as of this version, they are completely empty. This missing information will be added in the future version of TRMv6_Mod.bin file.

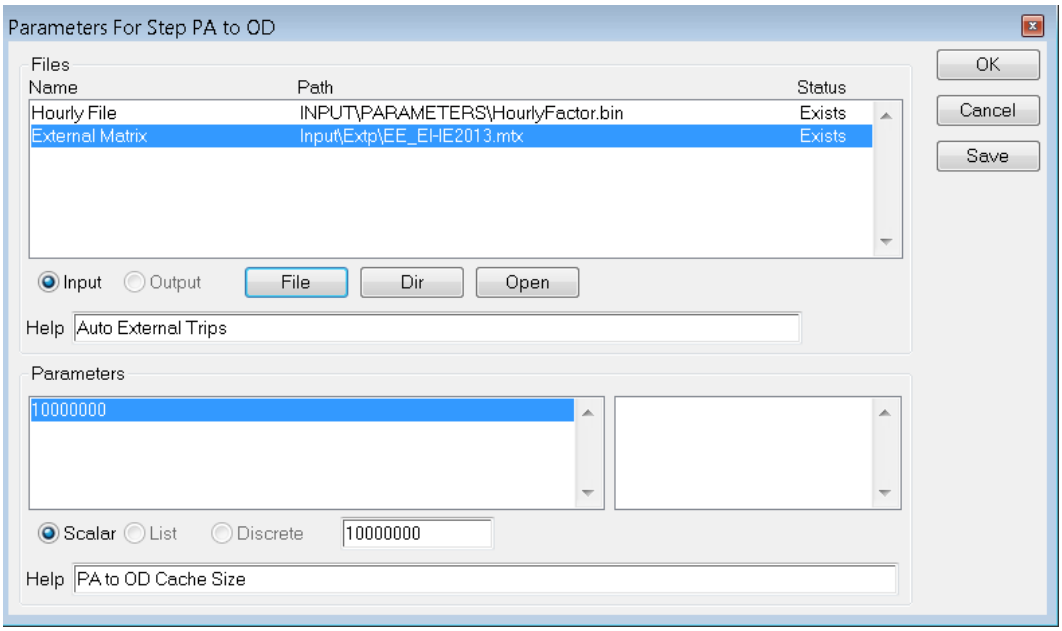


Table 2-8 Example View of "Parameters For Step PA to OD" Dialog Box

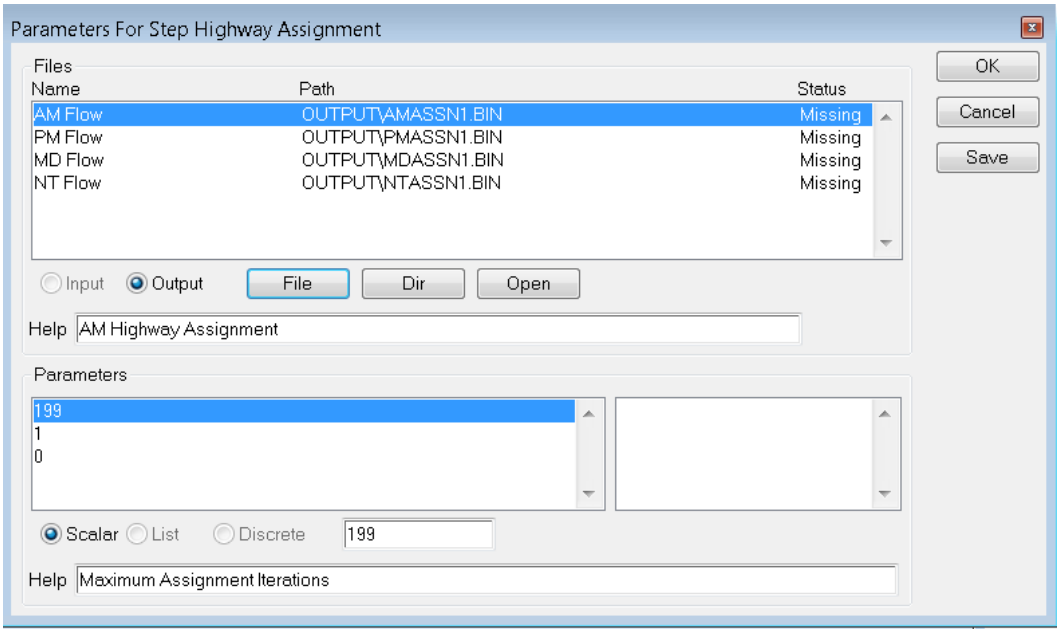


Table 2-9 Example View of "Parameters For Step Highway Assignment" Dialog Box

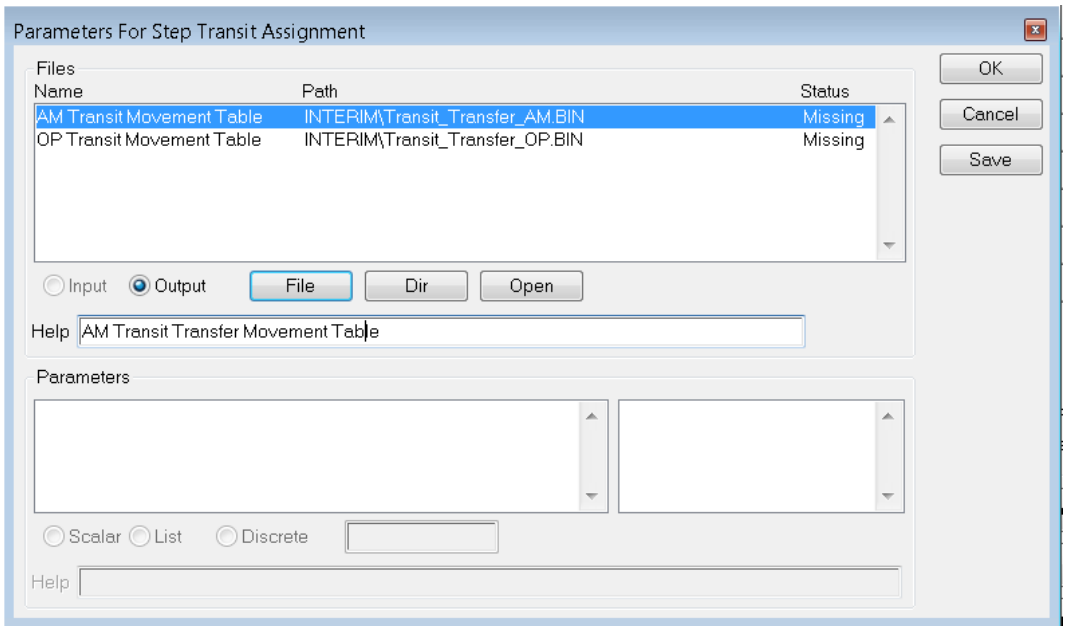


Table 2-10 Example View of "Parameters For Step Transit Assignment" Dialog Box

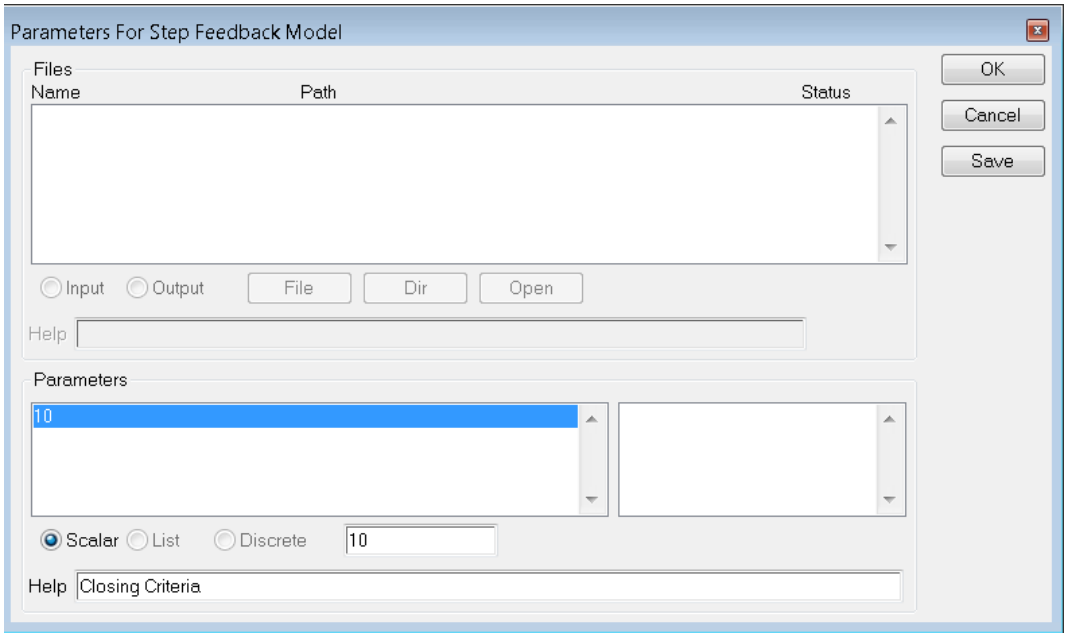


Table 2-11 Example View of "Parameters For Step Feedback Model" Dialog Box

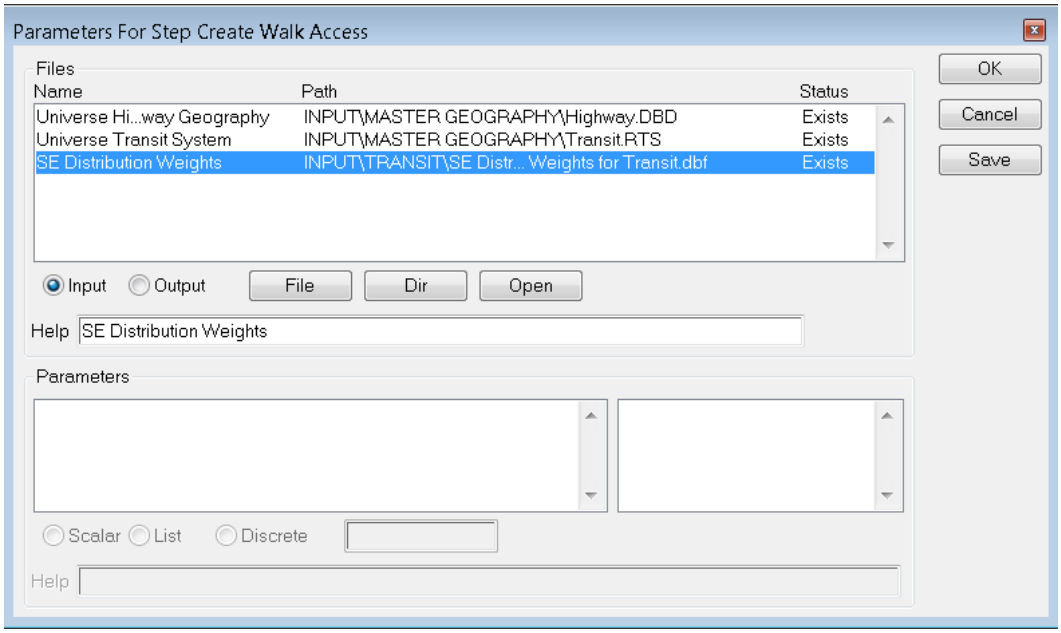


Table 2-12 Example View of "Parameters For Step Create Walk Access" Dialog Box

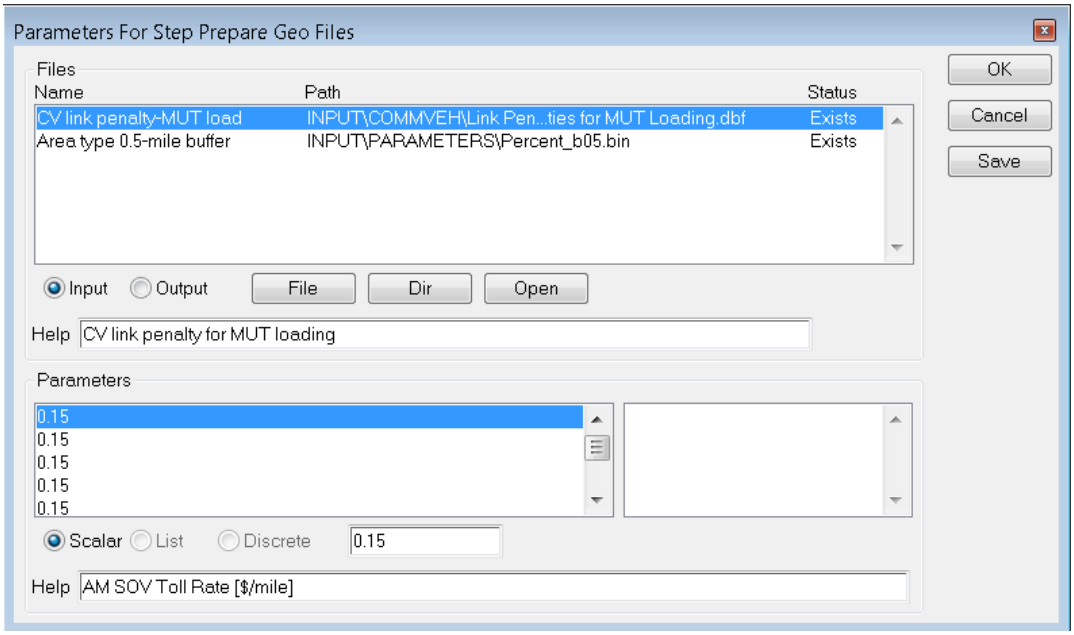


Table 2-13 Example View of "Parameters For Step Prepare Geo Files" Dialog Box

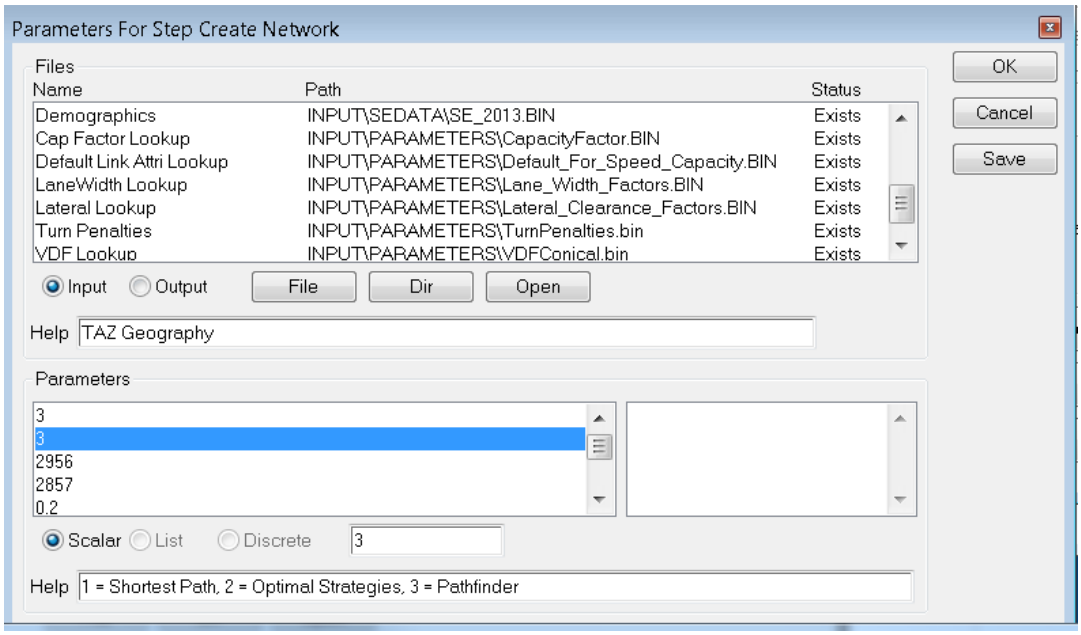


Table 2-14 Example View of "Parameters For Step Create Network" Dialog Box

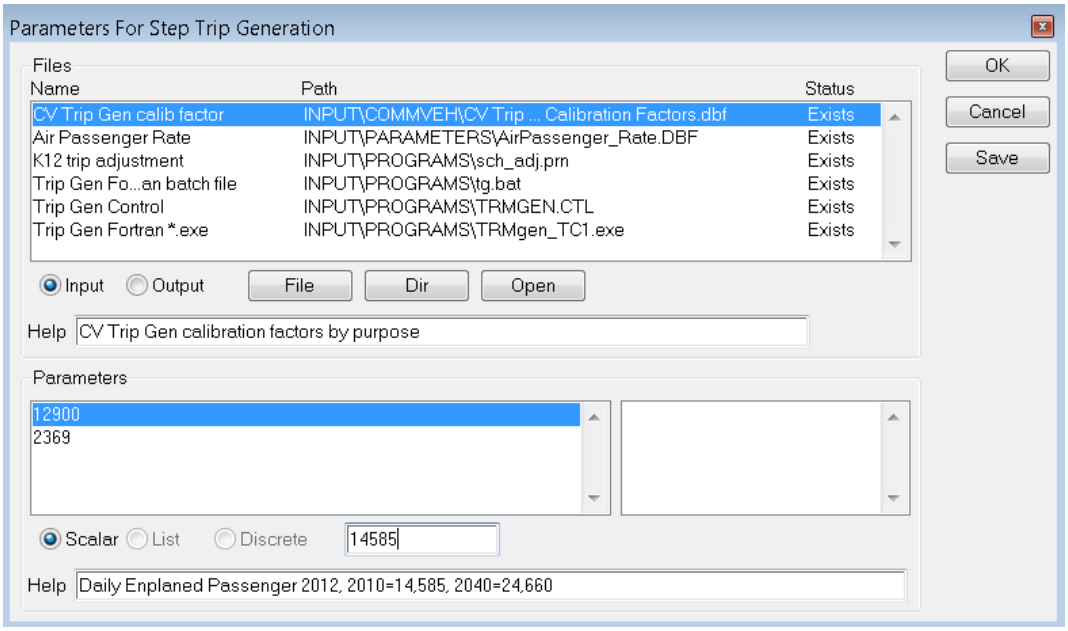


Table 2-15 Example View of "Parameters For Step Trip Generation" Dialog Box

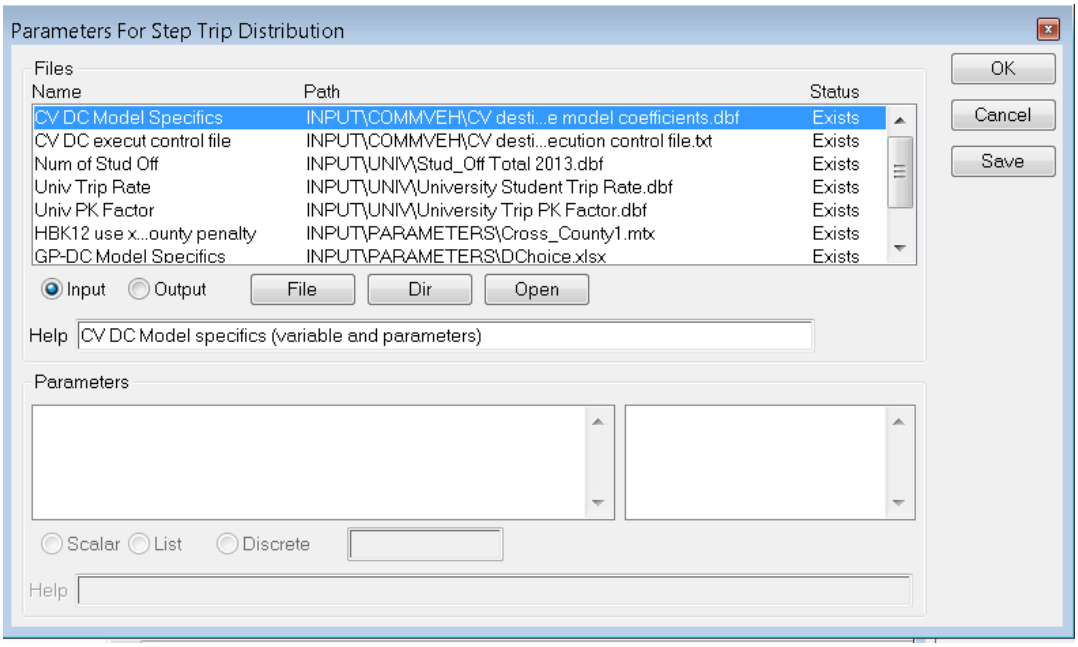


Table 2-16 Example View of "Parameters For Step Trip Distribution" Dialog Box

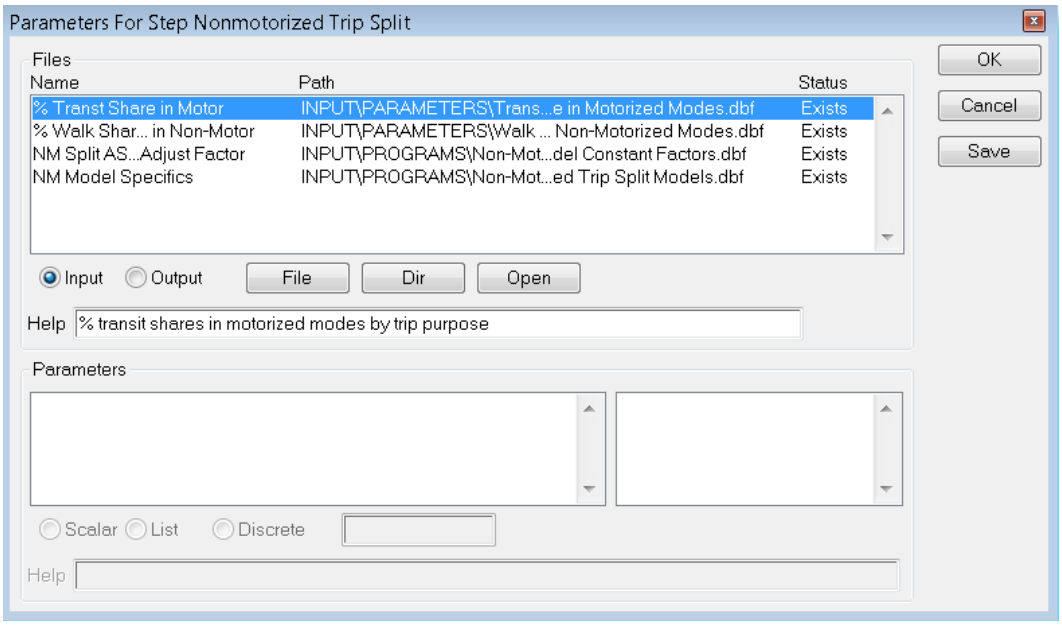


Table 2-17 Example View of "Parameters For Step Non-motorized Trip Split" Dialog Box

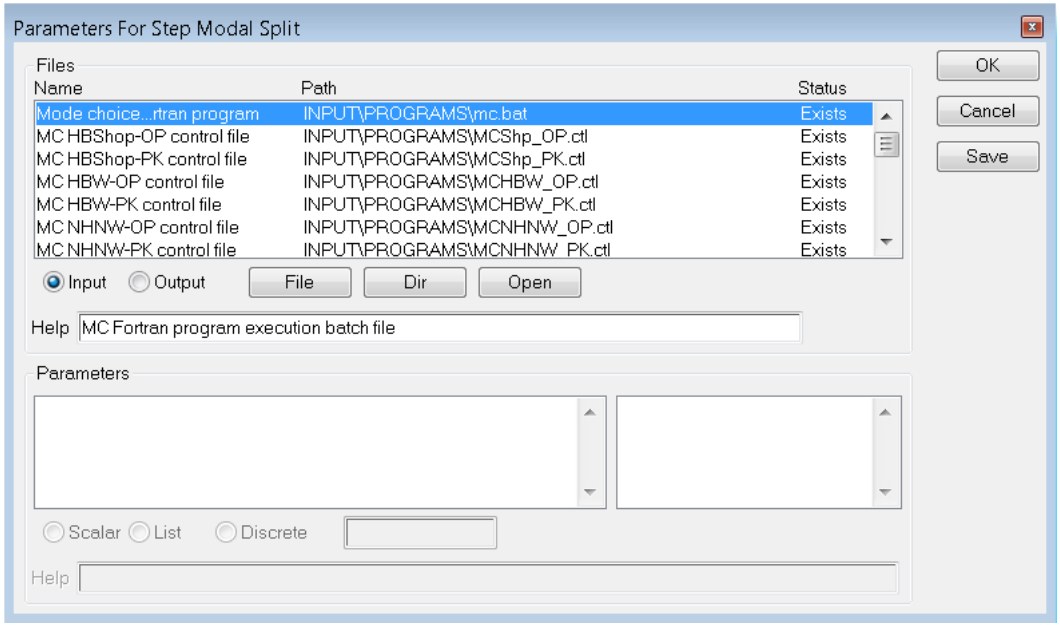


Table 2-18 Example View of "Parameters For Step Modal Split" Dialog Box

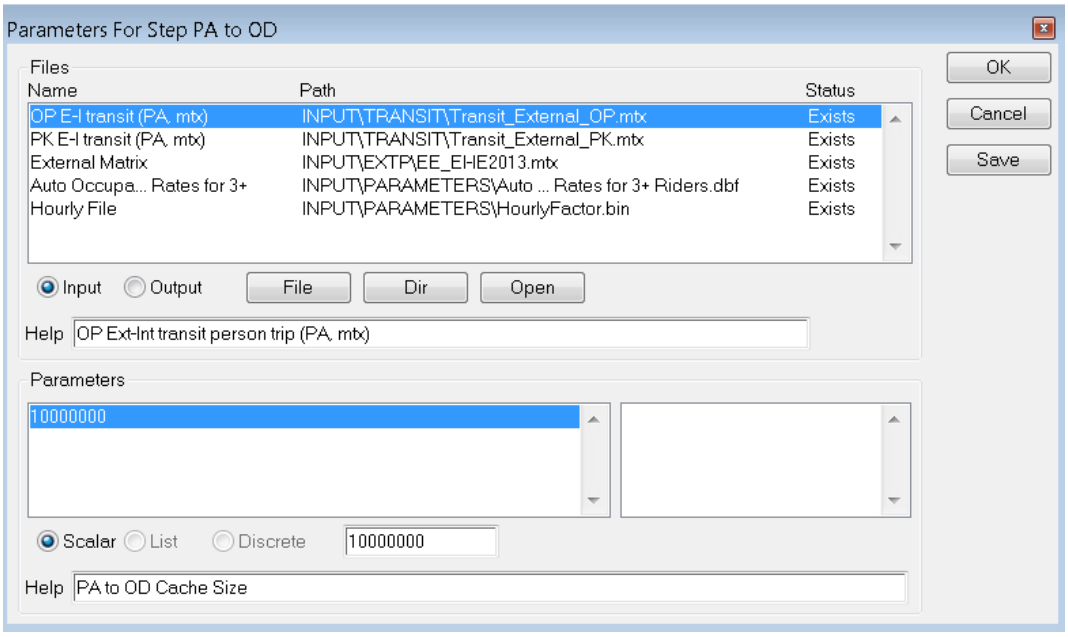


Table 2-19 Example View of "Parameters For Step PA to OD" Dialog Box

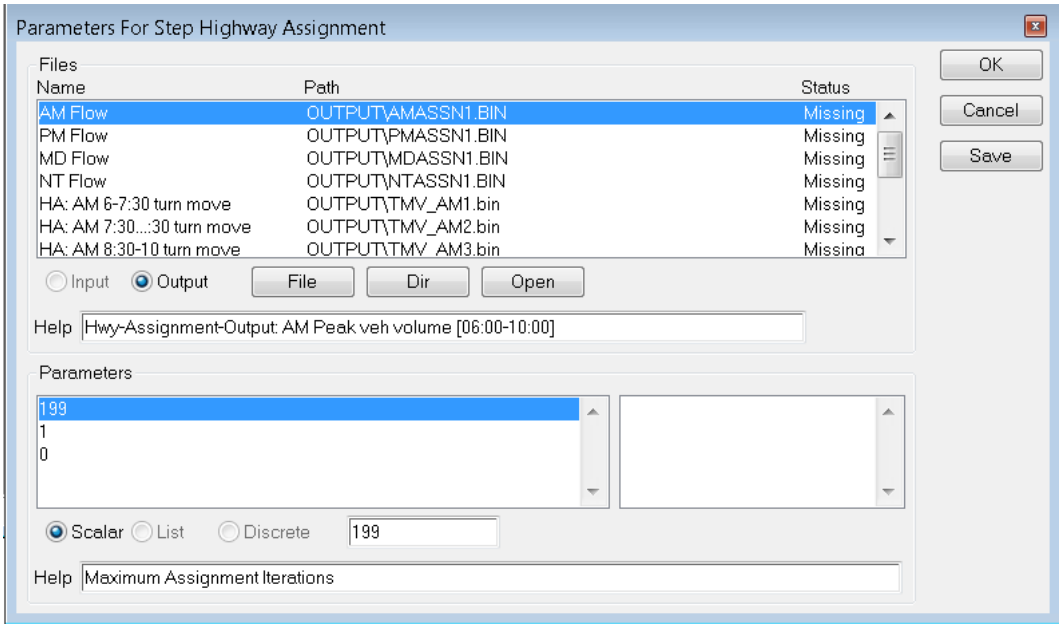


Table 2-20 Example View of "Parameters For Step Highway Assignment" Dialog Box

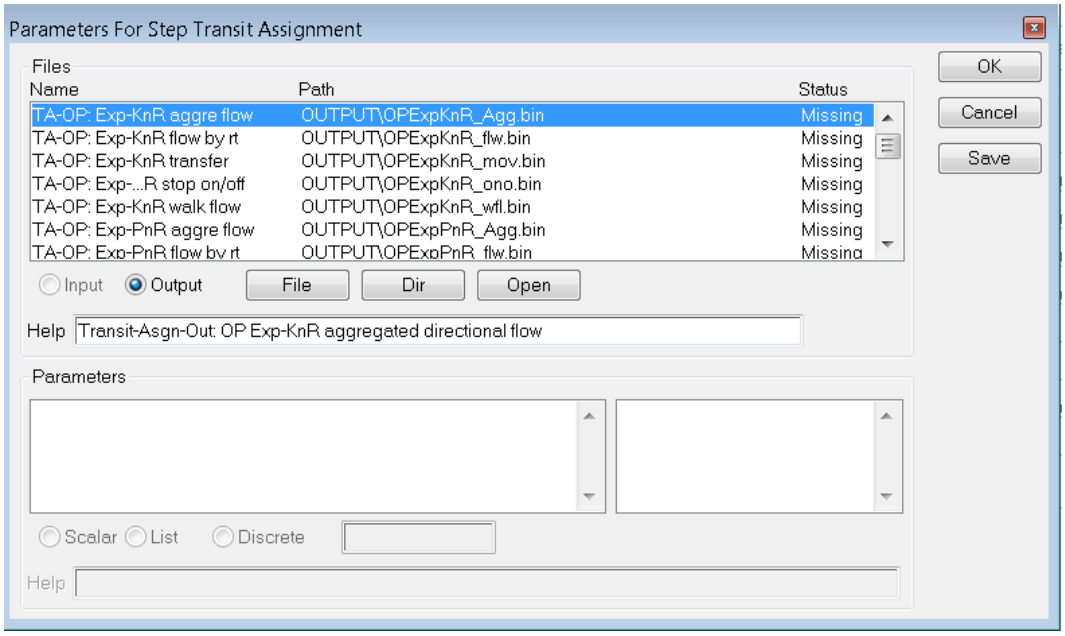


Table 2-21 Example View of "Parameters For Step Transit Assignment" Dialog Box

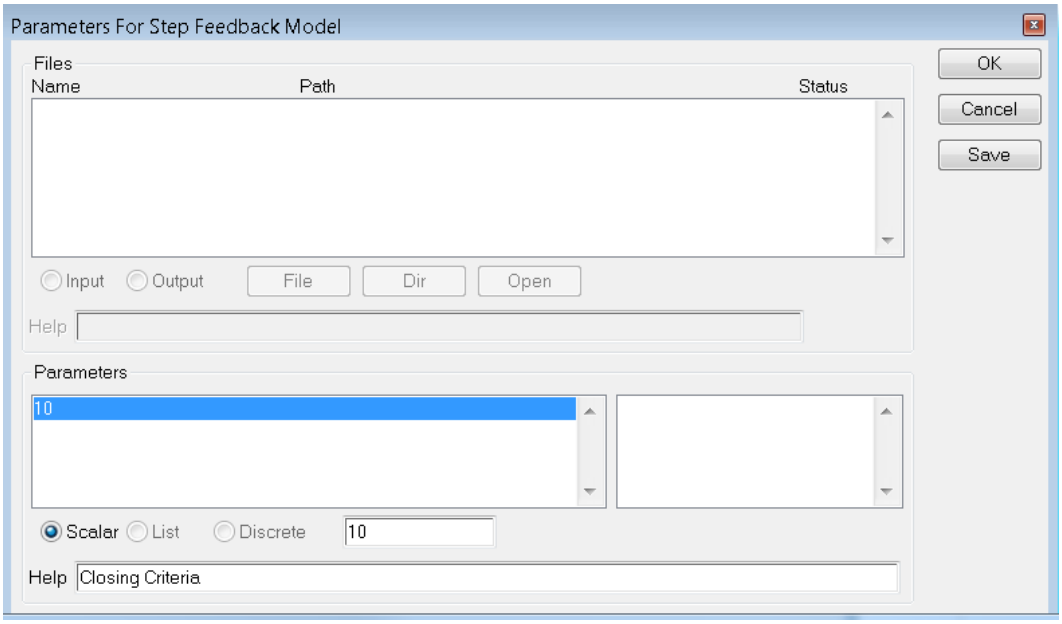


Table 2-22 Example View of "Parameters For Step Feedback Model" Dialog Box

As stated above, all information about default model file names, directory names, and parameters are stored in the **TRM_v6_mod.bin** file. This file is used as a blueprint each time a new scenario is created. This file can be viewed and edited in TransCAD, the same as any other binary file. However, making modifications to this file is NOT recommended, unless you are very familiar with the model. For an end user of the model, there is no need to change this file.

Eventually, all input, output, and parameter information the user specifies for a scenario using the GUI will be automatically stored in a file called **TRM_v6_mod.arr**. Later, this file is used by the model to load the full scenario information when the GUI is started or the scenario list in the GUI is updated. Any changes to the content of this file should be made through the GUI. **TRM_v6_mod.arr** is automatically saved to the directory as specified in the [Scenario File] section in the file trm_v6.ini.

If the **TRM_v6_mod.bin** file is modified after some scenarios have been set up in the GUI, the modifications will not affect those existing scenarios. Instead, they only affect scenarios yet to be created. If the modifications are structural, such as adding or removing an input or output file or a parameter, it is recommended to re-setup all existing scenarios, if there is any chance that the existing scenarios could be run again later. Otherwise, the scenario reruns could fail. Again, the end user making changes to **TRM_v6_mod.bin** is NOT recommended.

If **TRM_v6_mod.arr** is accidentally deleted or renamed, the model GUI will not be able to find it and therefore will not be able to load any scenario previously created. When this happens, you will have to recreate all of the scenarios.

If a scenario needs to be archived, it is recommended that the entire set of directories with the TRM_v6_Mod.bin and TRM_v6_Mod.arr files be archived together. This can help the user identify what settings were used for the archived scenario when reviewing the files later.

2.5.3 Edit an Existing Model Scenario

After setting up a scenario, you may want to modify it at a later time (e.g., use a new terminal travel time matrix file). To do this, select the scenario you want to modify from the Scenarios box in the GUI, then click the Setup button to make the Project Scenarios dialog box appear. Then, follow the instructions from Section 2.5.2 Specify Model Input and Output Files and Parameters.

Chapter 3. MODEL EXECUTION

This chapter describes a step-by-step process for executing the TRMv6. A description of each model step is provided, along with screenshots for illustration. Each step is presented from the following five perspectives: (1) key function(s), (2) input and output data, (3) step-by-step procedure, (4) GISDK macros involved, and (5) special notes (if any).

Before starting any TRMv6 runs, a few things need to by specified correctly in the GUI, including "Feedback Iterations" and a the following checkboxes: (1) Stop after stage; (2) Run all steps; (3) Force one processor for transit skim; and (4) Delete temporary files after model run.

Feedback Iterations: If you intend to run the model without feedback iterations (i.e., congested-travel-time outputs from traffic assignment are not fed back to trip distribution), specify "0" for number of iterations. Otherwise, specify a number greater than zero. TRMv6-2013 (the 2013 base-year scenario) converges after four feedback loops, but a larger number of iterations (e.g., ten) may be set to ensure a converged model run, in spite of case-by-case differences. More discussions on this Feedback functionality can be found in Section 3.10 Feedback Module.

Stop after stage: If the Feedback Iterations is also set to "0" in the GUI, checking this box ensures that only one clicked-upon step among those listed in in the GUI will be executed (e.g., Trip Generation), with an additional action by the user being required in order to proceed with the next step. If the number of Feedback Iterations is set to a number greater than zero, all steps of the model will be executed (all steps are grayed out, except the "Feedback Model" button), regardless whether this box is checked or not.

Run all steps: If the Feedback Iterations spinner is set to "0" in the GUI, checking this box ensures that model execution will start from the step the user clicks on and then run nonstop through to the last step (transit assignment). If the number of Feedback Iterations is set higher than zero, all steps of the model will be executed, regardless of whether this box is checked or not.

Force one processor for transit skim: The official software platform for the TRMv6, TransCAD 6.0, has some memory management issues with creating kiss-and-ride transit skims of the TRMv6 on multi-core/processor computers. This box needs to be checked when running the model on computers of that sort, in order to force the use of only one core/processor, which can eliminate the issue and lead to a successful model run.

Delete temporary files after model run: Many temporary files are created during TRMv6 execution. Most of these files are the binary (.bin) versions of matrix (.mtx) files; binary format is the required file format either input to or output from FORTRAN programs. These interim files become redundant after a model run finishes. Considering that temporary files produced during a model run cumulatively occupy over 24 GB of disk space, it is recommended to delete them after each model run. To do so, check this box.

3.1 Create Walk Access

3.1.1 Key Functions

KEY FUNCTIONS
This model step creates **walk access links** between TAZ centroids and adjacent transit route stops, so that transit users can access transit routes from the TAZ or egress transit routes and reach the TAZ. For the rules used to create these walk access links, please see the Model Documentation.

3.1.2 Inputs, Outputs, and Parameters

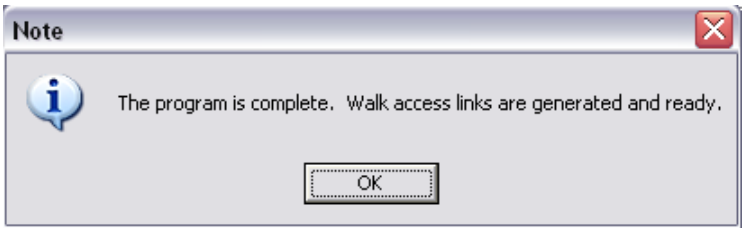
Table 3-1 Input and Output Files and Parameters: Create Walk Access

	File Descriptor	File Name and Location	Notes
Input	Universe Highway Geography	\input\Master Geography\Highway.dbd	
	Universe Transit System	\input\Master Geography\Transit.rts	
	SE Distribution Weights	\Input\Transit\ SE Distribution Weights for Transit.dbf	This file contains weights with the assumption that among ten area rings around a transit stop, the closer to the transit stop, the denser population and/or employment is/are.
Output	Walk Access Links	\Interim\walk_access_links.dbd	An intermediate file.
	Demographics	\Input\SEData\SE_2013.bin	This file contains TAZ socioeconomic data, as well as other TAZ-related data. The long-walk and short-walk percentage fields in the file are updated in this step if existing ones are detected to be outdated. For details about these data fields, see Chapter 5.

3.1.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Create Walk Access**" button, and the program will start to run.

2) When the program finishes, a message box will pop up indicating "The program is complete. Walk access links are generated and ready". Click "OK". The step is completed.



Note: To save model execution time, if this model step has been run already and no physical changes have been made to the highway or transit network since, there is no need to re-run this module when you rerun the overall model, such as when performing what-if policy tests.

3.1.4 GISDK Macros Invoked

- Macro "buildWalkAccess" (Args)
- Macro "walkAccess1"
- Macro "walkAccess2"
- Macro "walkAccess3" (Args)

Macro "buildWalkAccess" invokes the other three macros in sequence.

3.2 Prepare Geo Files

3.2.1 Key Functions

KEY FUNCTIONS
This model step creates four files that will be used in later steps. They include the highway line geographic file, the peak (AM) and off-peak (OP) transit route system files, and the underlying line layer file on which the transit route systems are based. At the beginning of this step, toll charges on toll roads by vehicle type (SOV, HOV, SUT, and MUT) and by time of day (AM peak, PM peak, and off-peak period) are calculated and populated to the corresponding data fields in the highway network geographic file.

3.2.2 Inputs, Outputs, and Parameters

Table 3-2 Input and Output Files and Parameters: Prepare Geo Files

	File Descriptor	File Name and Location	Notes
Input	Master Line Geography	\Input\Master Geography\ Highway.dbd	
	Transit Route System	\Input\Master Geography\Transit.rts	

	File Descriptor	File Name and Location	Notes
Output	Line Geography	\Input\Highway\Highway_Line.dbd	This file is a subset of the Master Line Geography file, only including links with a value of 3 or 99 in the MODE field. For details about the data fields, see Chapter 5.
	Transit Background	\Input\Transit\Transit_Line.dbd	This file is an exact copy of the Master Line Geography file, with all walk-access links produced in the Create Walk Access step incorporated.
	AM Transit Route System	\Input\Transit\Transit_AM.rts	This peak-period transit network file is a subset of the Transit Route System file in the Master Geography directory. It includes all routes with a non-null value in the AMPK_HDWY field.
	OP Transit Route System	\Input\Transit\Transit_OP.rts	This off-peak-period transit network file is a subset of the Transit Route System file. It includes all routes with a non-null value in the OP_HDWY field.

	Parameter Descriptor	Value	Notes
Parameters	AM SOV Toll Rate	0.15	Toll rate ($/mile) for SOVs in AM peak
	AM HOV Toll Rate	0.15	Toll rate ($/mile) for HOVs in AM peak
	AM SUT Toll Rate	0.15	Toll rate ($/mile) for Single-Unit Trucks in AM peak
	AM MUT Toll Rate	0.15	Toll rate ($/mile) for Multi-Unit Trucks in AM peak
	PM SOV Toll Rate	0.15	Toll rate ($/mile) for SOVs in PM peak
	PM HOV Toll Rate	0.15	Toll rate ($/mile) for HOVs in PM peak
	PM SUT Toll Rate	0.15	Toll rate ($/mile) for Single-Unit Trucks in PM peak
	PM MUT Toll Rate	0.15	Toll rate ($/mile) for Multi-Unit Trucks in PM peak
	Midday SOV Toll Rate	0.15	Toll rate ($/mile) for SOVs in midday
	Midday HOV Toll Rate	0.15	Toll rate ($/mile) for HOVs in midday
	Midday SUT Toll Rate	0.15	Toll rate ($/mile) for Single-Unit Trucks in midday
	Midday MUT Toll Rate	0.15	Toll rate ($/mile) for Multi-Unit Trucks in midday
	Night SOV Toll Rate	0.15	Toll rate ($/mile) for SOVs during nighttime
	Night HOV Toll Rate	0.15	Toll rate ($/mile) for HOVs during nighttime
	Night SUT Toll Rate	0.15	Toll rate ($/mile) for Single-Unit Trucks during nighttime
	Night MUT Toll Rate	0.15	Toll rate ($/mile) for Multi-Unit Trucks during nighttime

As can be seen from the output files, transit is modeled for two time periods in the TRMv6:

1) Peak period, which includes both AM-peak and PM-peak services; and

2) Off-peak period.

Transit network files for the peak period have "AM" in their names and descriptors to differentiate from those for the off-peak period, files for which have "OP" in their names and descriptors.

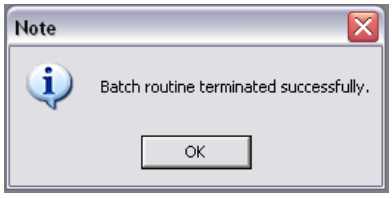
Additional note regarding the peak-period definition for public transit modeling: In the TRMv6, transit is modeled only for two time periods, the peak period and the off-peak period. Generally, the peak period includes both the morning peak and the evening peak, but in certain situations it

does not. A rule to follow is: **When the word "AM" appears in the name of a transit-trip-related file or file field, it refers to the entire peak period (i.e., morning peak and evening peak).** However, **when it appears in the name of a transit-skim-related (i.e., travel-time-related) file or file field, it only refers to the morning peak period**, since morning peak highway travel times are used to estimate AM peak transit travel times and then to create AM peak transit skims. The confusion caused by this naming scheme has been recognized and will be addressed in future versions of the TRM.

3.2.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Prepare Geo Files**" button. The model will start to run.

2) When the program finishes running, a message box will pop up indicating "Batch routine terminated successfully". Click "**OK**".



3) A batch routine report appears. Close it and the step is completed.

3.2.4 GISDK Macros Invoked

- Macro "CreateHighwayTransitLayers" (Args)

3.3 Create Network

As indicated in the dialog box below, which pops up from the GUI, this step calculates walk times on walk access/egress links, creates highway and transit network files, and generates highway and transit skims. As required by the trip generation and mode choice FORTRAN programs, this step also converts TransCAD skim matrix files to a binary file format for those programs to use later.

All networks and skims are created by time of day (i.e., morning peak period and off peak period). Highway networks and skims are also created by vehicle occupancy: single-occupant vehicles (SOVs) and high-occupancy vehicles (HOVs). Transit networks are also created by transit mode (local bus, express bus, and rail) and by access mode (walk, park-and-ride, and kiss-and-ride). TransCAD's Pathfinder approach is used to create transit skims.

3.3.1 Key Functions

KEY FUNCTIONS
Calculate walk-access times for walk access/egress links; Create highway networks and skim matrices by time of day and by vehicle occupancy (SOV and HOV); Create commercial vehicle highway skim matrices by time of day; Create transit networks and skim matrices by transit mode, access mode, and time of day; and Convert skim matrix files to a binary file format for FORTRAN programs to use later.

3.3.2 Inputs, Outputs, and Parameters

Table 3-3 Input and Output Files and Parameters: Create Network

	File Descriptor	File Name and Location	Notes
Input	TAZ Geography	\Input\Master Geography\ TRMv6_TAZ.dbd	TAZ geographic file.
	Demographics	\Input\SEData\ SE_2013.bin	TAZ socioeconomic data and other TAZ descriptive data.
	Line Geography	\Input\Highway\ Highway_line.dbd	Highway line layer; output from step "Prepare Geo Files" (Section 3.2).

	File Descriptor	File Name and Location	Notes
	Turn Penalties	\Input\Parameters\ TurnPenalties.bin	Highway turn penalty file; penalties are in minutes.
	Default Link Attri Lookup	\Input\Parameters\ Default_For_Speed_Capacity.bin	Facility & Area Type to Default link Attribute lookup table.
	Cap Factor Lookup	\Input\Parameters\ CapacityFactor.bin	Capacity factor lookup table.
	Lane Width Factor Lookup	\Input\Parameters\ Lane_Width_Factors.bin	Lane width factor lookup table.
	Lateral Clearance Factor Lookup	\Input\Parameters \Lateral_Clearance_Factors.bin	Lateral clearance factor lookup table.
	LOV Add Times	\Input\Parameters\ Auto_TerminalTime.mtx	Passenger vehicle terminal times in minutes. Values in this file change with TAZ area type, which is a function of TAZ population/households and employment.
	VDF Lookup Table	\Input\Parameters\ VDFConical.bin	Volume-delay function parameter lookup based on FCGroup.
	Transit Background	\Input\Transit\ Transit_Line.dbd	Transit background line layer to serve as base for transit route systems; output from step "Prepare Geo Files" (Section 3.2).
	AM (& OP) Transit Route System	\Input\Transit\ Transit_AM.rts Transit_OP.rts	AM peak (or off-peak) transit route system; output from step "Prepare Geo Files" (Section 3.2).
	Bus Equations Lookup	\Input\Transit\ BusSpeed_Equations.bin	Bus speed equations lookup table.
	Mode Table	\Input\Transit\ Modes.dbf	Transit mode table.
	Mode Transfer Table	\Input\Transit\ Modexfer_2035.dbf	Transit mode transfer table.
	AM (& OP) Transfer Wait Times	\Input\Transit\ TimedTransferWaitTime_AM_2013.bin TimedTransferWaitTime_OP_2013.bin	Fixed transit-transfer wait time in minutes in peak (or off-peak) period.
Output	Line Geography	\Input\Highway\ Highway_line.dbd	Highway line layer; output from step "Prepare Geo Files" (Section 3.2) and updated in this step with more attribute fields added.
	Network	\Output\ Highway.net	Highway .net file.
	Walk Time File	\Interim\ WalkTime.bin	Calculated walk-access link times for each TAZ, including short-walk, long-walk, and their average.
	AM (& OP) LOV (& HOV) Matrix	\Interim\AMLOV.mtx (AMLOV.BIN) OPLOV.mtx (OPLOV.BIN) AMHOV.mtx (AMHOV.BIN) OPHOV.mtx (OPHOV.BIN)	Highway skims for AM-peak (& off-peak) single-occupant vehicles (SOVs) or high-occupancy vehicles (HOVs), with composite travel time and travel distance. The binary files are converted from matrix files for use in trip generation, distribution, and/or mode choice FORTRAN programs.
	AM (& OP) LOV2 (& HOV2) Matrix	\Interim\AMLOV2.mtx OPLOV2.mtx	Highway skims for AM-peak (& off-peak) single-occupant vehicles

File Descriptor	File Name and Location	Notes
	AMHOV2.mtx OPHOV2.mtx	(SOVs) or high-occupancy vehicles (HOVs), with travel times, distances, and tolls.
AM Drive Skim	\Interim\AMDRIVE.mtx AMDRIVE.bin	Transit skims: AM-peak drive-access express bus and rail (TransCAD matrix and binary format).
AM (& OP) Walk Skim	\Interim\AMWALK.mtx AMWALK.bin OPWALK.mtx OPWALK.bin	Transit skims: AM-peak (& off-peak) walk-access express bus and rail (TransCAD matrix and binary format).
AM (& OP) Transit Network	\Output**TtAVpath.tnw** (e.g., AMWLpath.tnw) Transit network by sub-mode; output from step "Create Network**"** (Section 3.3) Two time periods: Tt $\in$ [AM, OP] AM = Peak periods (AM- and PM peak combined) OP = Off-peak Three access modes: A $\in$ [K, D, W] K = Kiss-and-Ride access D = Park-and-Ride access W = Walk access Three transit modes: V $\in$ [L, P, R] L = Local Bus P = Express Bus R = Rail	Transit network: by time of day, access mode, and transit sub-mode.
AM (& OP) Transit Skims	\Output**TtAVskim1.mtx** (e.g., AMKLskim1.mtx) Transit skims by time of day, access mode, and transit sub-mode; output from step "Create Network" (Section 3.3) Similar file name structure as Transit Network	Transit skims by time of day, access mode, and transit sub-mode.
AM (& OP) Transit Skims (all access modes)	\interim**TtV.mtx & TtV.bin** (e.g., AML.mtx & AML.BIN) Transit skims by sub-mode; output from step "Create Network" (Section 3.3) Two time periods: Tt $\in$ [AM, OP] Three transit modes: V $\in$ [L, P, R]	AM-peak (& off-peak) transit mode skims (all access modes combined) (TransCAD matrix and binary formats).
AM (& OP) Transit Origin-Parking Drive Access Times	\Output**origin_parking_TtAV.mtx** (e.g., origin_parking_AMDL.mtx) Transit drive access time by time of day, access mode, and transit sub-mode; output from step "Create Network" (Section 3.3) Two time periods: Tt $\in$ [AM, OP]	Origin-TAZ-to-parking-lot drive-time matrix by time of day and transit mode (park-and-ride local bus).

	File Descriptor	File Name and Location	Notes
		Three access modes: A ∈ [K, D, W] Three transit modes: V ∈ [L, P, R] Similar file name structure as Transit Network	
	AM (& OP) Transit Drive Access Parking Nodes	\Output**parking_TtAV.mtx** (e.g., parking_AMDL.mtx) Transit drive access parking nodes by time of day, access mode, and transit sub-mode; output from step "Create Network**"** (Section 3.3) Two time periods: Tt ∈ [AM, OP] Three access modes: A ∈ [K, D, W] Three transit modes: V ∈ [L, P, R] Similar file name structure as Transit Network	TAZ-to-TAZ parking lot (node) number matrix: AM-peak park-and-ride local bus.
	Interim file for use by FORTRAN programs	\Interim\amwp.bin & amdr.bin	Binary file format of amwalk.mtx (or amdr.mtx) in the same directory: transit skims for AM-peak walk-access (or drive-access) express bus and rail; for use as input to trip generation FORTRAN programs.

	Parameter Descriptor	Value	Notes
Parameters	Intra-zonal Neighbors	2	Used for calculating intra-zonal travel time and distance
	Transit Skim Method	3	Pathfinder method
	Number of Zones	2956	Total number of TAZs, including external stations
	Last Internal Zone	2857	Highest ID number of any internal TAZ
	SOV Value of Time	0.2	$/minute
	HOV Value of Time	0.3	$/minute
	SUT Value of Time	0.5	$/minute
	MUT Value of Time	0.5	$/minute

3.3.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Create Network**" button and the model will start to run.
2) When the run is completed, a message box appears reading "Batch routine terminated successfully."
3) Click "OK" and a batch routine report appears. Close it and the step is completed.

3.3.4 GISDK Macros Invoked

- Macro "Walk Access Time" (Args)
- Macro "Highway Network" (Args)
- Macro "AM Highway Skims"(Args)

- Macro "OP Highway Skims"(Args)
- Macro "Transit Network" (Args)
- Macro "Transit Skims" (Args)
- Macro "AM Transit Skims" (Args)
- Macro "Skim Processing" (Args)
- Macro "AM Skim Processing" (Args)
- Macro "Mtx to Bin" (Args)
- Macro "AM Mtx to Bin" (Args)

3.4 Trip Generation

In the TRMv6, there is a new University Student Model (USM) that was not in previous model versions. It parallels the general-population sub-model stream until after motorized mode choice split. The USM has its own separate approach for trip generation, destination choice, non-motorized trip split, and motorized mode choice (see TRMv6 Model Documentation for details).

In this step, TAZ daily person trips by the general population, including both motorized and non-motorized trips, are estimated for six trip purposes, five types of households stratified by their socioeconomic characteristics, three person types, and six employee types. The trip purposes include home-based work (HBW), home-based shopping (HBShop), home-based K-12 school (HBSchool), home-based other (HBO), work-based non-home (WBNH), and non-home non-work (NHNW). The household strata include zero-car households, low-income households with (a) car(s), medium-income households with at least one car yet fewer cars than workers, medium-income households with a non-zero number of cars that is equal to than or greater than the number of workers, and high-income households with (a) car(s). The person types are working adults, non-working adults, and children.

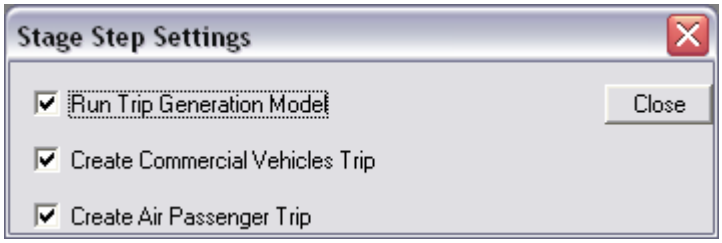
Person trips by university students are estimated for the four purposes of home-based university (HBU), home-based other (U_HBO), university-based non-home (UBNH) and non-home non-university (NHNU). There are two types of students, distinguished by residence location: on-campus and off-campus.

This module also estimates the number of daily TAZ commercial vehicle trips for three vehicle types: light-duty commercial vehicles (non-truck), single-unit trucks (SUTs), and multi-unit trucks (MUTs).

Airport person trips are classified as home-based, work-based, private-residence-based (excluding home-based), or non-home-non-work-based for estimation, and then merged into three general trip purposes: HBO, WBNH, and NHNW.

Multinomial logit models were developed and implemented in a FORTRAN program to estimate general population HBW, HBShop, HBK12, HBO, and NHNW person trips and university-student HBU, UBNH, U_HBO, and NHNU person trips, with motorized and non-motorized person trips not disaggregated.

Commercial vehicle trips and air passenger trips are calculated using a traditional cross-classification trip rate method implemented in GISDK. Due to the need to use HBW trip generation results as input, WBNH trip estimation utilizes a unique multinomial logit model routine which is implemented in GISDK.



3.4.1 Key Functions

KEY FUNCTIONS
Stratifies TAZ households by household income, household size, automobile ownership, number of workers, and number of children, based on PopGen output. Estimates TAZ general-population person I-I trip productions by trip purpose and household socioeconomic strata, using multinomial logit models. Estimates university-student trips. Estimates the probability that a trip attraction to a TAZ being fulfilled by someone from each of the five household socioeconomic strata, using a multinomial logit model. Estimates TAZ air-passenger trips using cross-classification trip-rate models. The total number regional enplaned passengers is an input supplied by the user, which produces total air-trip productions through the application of multipliers and factors. Estimates TAZ commercial vehicle I-I trips by vehicle type.

3.4.2 Inputs, Outputs, and Parameters

Table 3-4 Input and Output Files and Parameters: Trip Generation

	File Descriptor	File Name and Location	Notes
Input	Demographics	\Input\SEData\ SE_2013.bin	TAZ socioeconomic data and other TAZ descriptive data.
	Commercial Vehicle	\Input\CommVeh\ CV Trip Generation Model Coefficients.dbf	Commercial-vehicle-trip general model specifics: explanatory variables and parameters.
	Commercial Vehicle	\Input\CommVeh\ CV Trip Generation Calibration Factors.dbf	Commercial vehicle trip generation model factors.

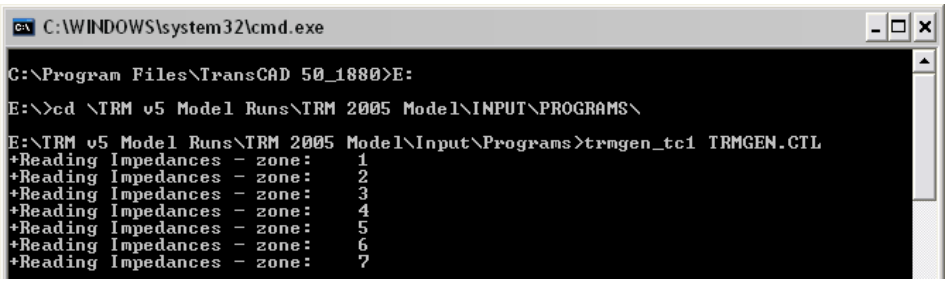
	File Descriptor	File Name and Location	Notes
	USM Trip Rates	\Input\University\ University Student Trip Rate.dbd	USM trip rates by purpose and student type.
	USM On-Off Campus Student Split Factor	\Input\University\ University Trip PK Factor.dbf	USM on- and off-campus split factor.
	USM Off-Campus Student	\Input\University\ Stud_Off Total 2013.dbf	Total off-campus student for USM.
	Air Passenger Rate	\Input\Parameters\ AirPassenger_Rate.DBF	Air-passenger trip rates by county and trip purpose. Rates by purpose are further refined by household income category and/or employment.
	Interim file for use by FORTRAN program	\Interim\ amwp.bin amdr.bin	AM peak walk-access (or drive-access express bus & rail) skims in binary file format; output from step "Create Network" (Section 3.3).
	Interim file for use by FORTRAN program	\Interim\ amlov.bin	AM peak SOV highway skims in binary file format; output from step "Create Network" (Section 3.3).
	Trip-Generation-use SE data	\Interim\ dm_tg.bin	TAZ socioeconomic data extracted from SE_2013.bin for trip generation Fortran program use. This is an interim TAZ socioeconomic data file prepared for working with the trip generation FORTRAN program. The file is created by the model automatically at the beginning of the Trip Generation step and then fed into the FORTRAN program.
	Interim file for use by FORTRAN program	\Interim\ dem_com.bin	This is an interim TAZ socioeconomic data file prepared for working with the commercial vehicle module. The file is created by the model automatically at the beginning of the Commercial Vehicles sub-step.
Program Files	Trip Generation FORTRAN Program	\Input\Programs\ TRMGen_tc1.exe	Trip generation FORTRAN program.
	Trip Gen FORTRAN Control File	\Input\Programs\ TRMGEN.ctl	Trip generation control file with all input and output files and parameters needed by the FORTRAN program. **The path of this file should NOT be changed.**
Output	Output files from FORTRAN Program	\Interim\ TGHH.txt	TAZ household stratification by income, size, and numbers of workers, children, and automobiles.
		\Interim\ HHStrata.txt	TAZ households in **five HH strata**: (1) zero car, (2) low income with car(s), (3) medium income with cars less than workers, (4) medium income with cars equal to or greater than workers, and (5) high income with car(s).
		\Interim\ hhbyinc.txt	TAZ households in income categories 1, 2, 3, and 4.
		\Interim\ hhby_suff_inc.txt	TAZ households by four income categories and two car-ownership groups (more-or-equal-car and less-car)
		\Interim\ **PurpEnd.asc**	General-population TAZ daily I-I person trip productions and attractions in 5 HH strata. E.g., WbnhEnd.asc

	File Descriptor	File Name and Location	Notes
			For six trip purposes: Purp ∈ [Wrk, Shp, Sch, Oth, WBNH, NHNW] Wrk = HBW Shp = HBShop Sch = HBK12 Oth = HBO
		\Interim\racc_str.dat	Accessibility measure for non-motorized model.
		\Interim\accstr.txt	Accessibility measure for attraction share model.
		\Output\TG.rep	Trip Generation Fortran Program Report.
	Air Passenger Trips	\Interim\AirP.bin	An output file with air-passenger trip-estimation-related TAZ input and output data. Input data include households by income category and employment, and output data include home-based (HB), work-based (WB), private-residence-based (PR), and non-home-non-work-based (NHNW) air-passenger trips before balanced to daily enplanement. They are converted to HBO, WBNH, and NHNW trips after balancing.

	Parameter Descriptor	Value	Notes
Parameters	Daily Enplaned Passenger	2013 Base Year = 12800 2025 = 18000 2035 = 22500 2045 = 27000	Number of daily enplaned passengers at RDU for the passenger airport model for 2013 base year, and future years of 2025, 2035 and 2045. During model scenario setup, this number should be checked by clicking on 'Contents' then 'Trip Generation", and correct value be manually typed into the the box after the button "Scaler". The information after the Help box provides the specific values to be used for each model year.
	Airport Zone ID	2369	ID of the TAZ where RDU airport is located.

3.4.3 Execution Procedure

1) In the TRMv6 GUI click the "**Trip Generation**" button.
2) After the model executes for a few seconds in TransCAD, the trip generation FORTRAN routine will be called and a DOS window will appear which indicates the program is running [The DOS window looks the same for TRM v.6 and TRM v.5].



3) After the FORTRAN routine finishes, the DOS window will close, but the execution continues with commercial-vehicle, university-student, and air-passenger models, with several progress bars appearing in the TransCAD window, one after another.
4) If nothing goes wrong, when the execution completes, a message box appears, reading "Batch routine terminated successfully."
5) Click "OK" and a Batch Routine Report pops up. Close it. The trip generation sub-model is now completed.

3.4.4 GISDK Macros Invoked

- Macro "Trip Generation" (Args)
- Macro "CV Trip Generation" (Args)
- Macro "University Trip Estimation" (Args, step)
- Macro "Air Passenger" (Args)
- Macro "Trip Generation" further invokes the trip generation FORTRAN program, trmgen_tc1.exe.

3.5 Trip Distribution

In this step, person I-I trips are distributed using destination choice models. An exception is air-passenger trips, which always start from or end at the TAZ where the primary airport in the region is located. Therefore, no distribution estimation is needed for air-passenger trips.

Time-of-day factors are applied by trip purpose to split daily trips into two time periods, peak and off-peak, where the peak period is the combination of the AM peak from 6:00 AM to 10:00 AM and the PM peak from 3:30 PM to 7:30 PM, and the off-peak period covers the remainder of the day.

Travel times and mode-choice logsum values are used as the primary travel impedances in the destination choice models. Travel distances are added to the destination choice model after model estimation as an adjustment factor for model calibration and application. Without feedback iterations, free-flow travel-time skims are used in both peak and off peak models; with feedback, congested travel times output from the traffic-assignment step during the previous iteration are used instead, which leads to more consistent results.

At this stage, motorized and non-motorized trips are still not separated.

3.5.1 Key Functions

KEY FUNCTIONS
Computes TAZ-to-TAZ logsum values using mode-choice model specifications, based on congested travel times from the traffic assignment step of previous iteration. Generates and distributes TAZ daily USM person I-I trips for four trip purposes of HBU, U_HBO, NHNU, and UBNH; distributes TAZ daily general population person I-I trips for six trip purposes of HBW, HBShop, HBSchool, HBO, WBNH, and NHNW, and for two time periods of peak (AM and PM peaks combined) and off-peak. Distributes commercial vehicle I-I and I-E/E-I trips and person I-E/E-I trips.

3.5.2 Inputs, Outputs, and Parameters

Table 3-5 Input and Output Files and Parameters: Trip Distribution

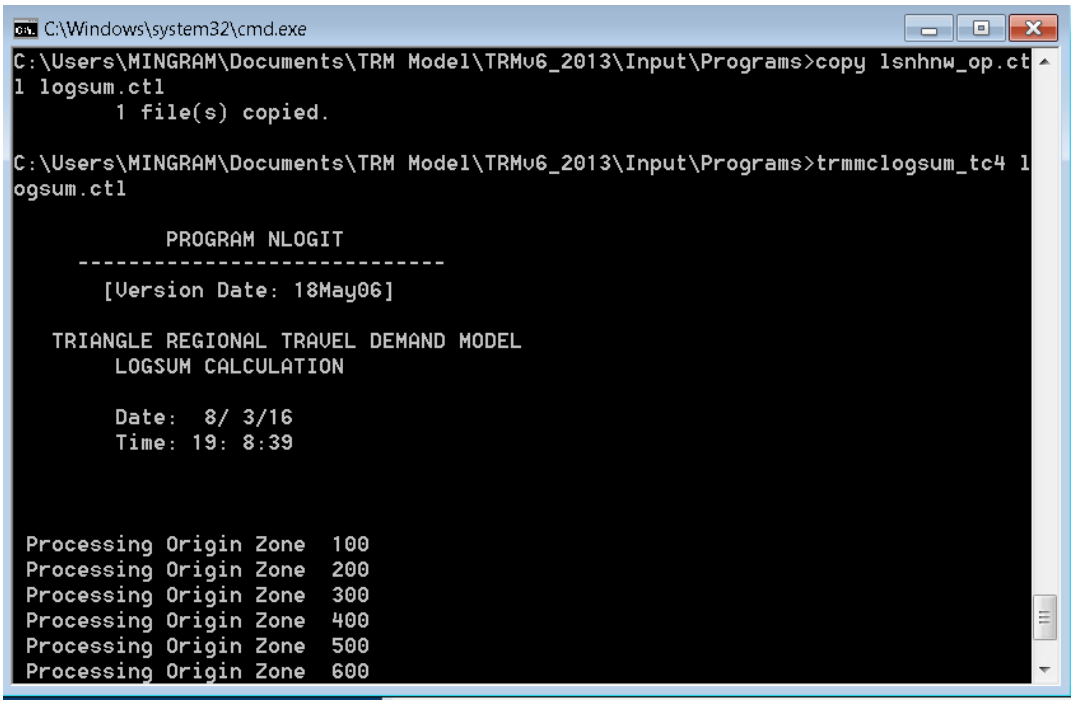
	File Name and Location	Notes
	\Input\Programs\trmmclogsum_tc4.exe	Mode choice logsum calculation FORTRAN Program.
Input	\Interim\ **PurpEnd.asc**	General population TAZ daily I-I person trip productions and attractions in five HH strata; output from step Trip Generation (Section 3.4). E.g., WbnhEnd.asc For six trip purposes: Purp ∈ [Wrk, Shp, Sch, Oth, WBNH, NHNW] Wrk = HBW Shp = HBShop Sch = HBK12 Oth = HBO
	\Interim\AMLOV.BIN OPLOV.BIN	SOV highway skims in binary file format; output from step "Create Network" (Section 3.3). For two time periods: AM = AM peak; OP = Off-peak
	\Interim\AMWP.BIN OPWP.BIN	Walk-access express-bus & rail skims in binary file format; output from step "Create Network" (Section 3.3).

	File Name and Location	Notes
		For two time periods (same as above).
	\Input\Parameters\ OffStudent_Reduction_Factors.bin	Off-campus student reduction factors
	\Input\Parameters\ DChoice.xlsx	General-population destination choice model coefficients by five trip purposes (HBShop, HBK12, HBO, WBNH and NHNW), five HH strata and peak/off-peak; for HBW trips, it is by two employee earning levels (high and low), five HH strata, and peak/off-peak.
	\Interim\ tdHBWHiPK.mtx tdHBWLoPK.mtx tdHBWHiOP.mtx tdHBWLoOP.mtx	General population HBW I-I person trip PA matrix by five HH strata for Peak (TransCAD matrix format). For four earning-level/time-of-day combinations: HiPK = High earning employee – Peak LoPK = Low earning employee – Peak HiOP = High earning employee – Off-Peak LoOP = Low earning employee – Off-Peak
Output	\Interim**tdPurpTt.mtx**	General population I-I person trip PA matrix by five HH strata for Peak (TransCAD matrix format). E.g., tdShpPK.mtx, tdNhnwOP.mtx For five trip purposes: Purp ∈ [Shp, Sch, Oth, WBNH, NHNW] Shp = HBShop Sch = HBK12 Oth = HBO Two time periods: Tt ∈ [PK, OP] PK = Peak periods (AM and PM peak combined) OP = Off-peak
	\Interim\ **Univ_DC_Uuu_Purp_Tt.mtx**	USM I-I person trip PA matrix by two student types by university (TransCAD matrix format); output from step "Trip Distribution" (Section 3.5). E.g., Univ_DC_Duke_HBU_PK.mtx Four universities: Uuu ∈ [Duke, NCCU, NCSU, UNC] Two time periods: Tt ∈ [PK, OP] Four trip purposes: Purp ∈ [HBU, HBO, NHNU, UBNH]
	\Interim\ University Destination Choice Model Report.csv	USM destination choice summary of (1) total trips at the university campus, (2) average travel times in minutes; and (3) average trip distances in miles by university (one of four), trip purpose (one of three), and student type (one of two) for peak period.
	\Interim\ University Trip Distribution Intermediate Results.mtx	USM destination choice miscellaneous summary – interim file.
	\Interim\ **CV II Trip Matrices by Veh Type and Purpose_Tt.mtx**	Commercial vehicle I-I trip matrices (Prod-Attr format) by time of day and vehicle type:

	File Name and Location	Notes
		E.g., CV II Trip Matrices by Veh Type and Purpose_AM.mtx Four time periods: Tt ∈ [AM, PM, MD, NT] AM = AM Peak PM = PM Peak MD = Midday NT = Nighttime
	\Output\ **LS_Purp_DC_Tt.rpt**	Logsum-calculation Fortran program report for peak and off-peak. E.g., LS_HBW_PK.rpt For five trip purposes (excl. HBK12): Purp ∈ [Wrk, Shp, Oth, NHNW, WBNH] Wrk = HBW Shp = HBShop Oth = HBO Two time periods: Tt ∈ [PK, OP] PK = Peak periods (AM and PM peak combined) OP = Off-peak

3.5.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Trip Distribution**" button, and the program will start to run.
2) After the program runs in the TransCAD window for a few seconds, a DOS window pops up indicating that the mode-choice-model logsum calculations have started and are in progress.
3) After logsum calculations finish, the destination choice model is started (by GISDK) and is in progress.



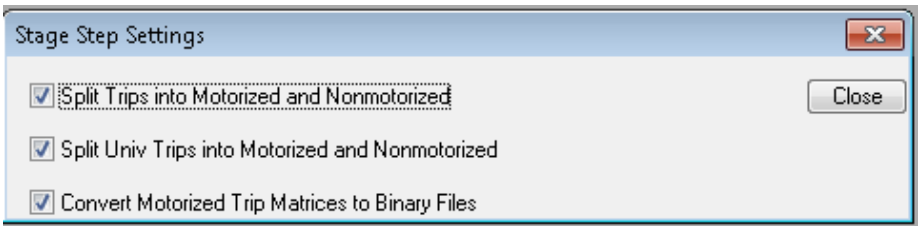
4) If nothing goes wrong, when the execution completes, a message box appears reading 'Batch routine terminated successfully."
5) Click on "OK" to show the Batch Routine Report.
6) Close the report. The trip distribution step is completed.

3.5.4 GISDK Macros Invoked

- Macro "Trip Distribution" (Args)
- Macro "PK Trip Distribution" (Args)
- Macro "Logsum Calculation" (Args, tod)
- Macro "University Trip Estimation" (Args, step)
- Both of the macros "Trip Distribution" and "PK Trip Distribution" further invoke the mode-choice-logsum-calculation FORTRAN program, trmmclogsum_tc4.exe.

3.6 Non-Motorized Trip Split

The binary-logit-based non-motorized trip split model estimates the probability of motorized modes or non-motorized modes being used for the trips between each TAZ pair and calculates the number of trips for either category of mode based on that estimated probability. Estimations are made for six general-population trip purposes (HBW, HBShop, HBK12, HBO, WBNH, and NHNW) and five household strata. They are also made for four USM trip purposes (HBU, U_HBO, UBNH, and NHNU) and two student types (on-/off-campus). Regardless of trip purpose, estimates are made for two time periods of the day, peak and off-peak.



3.6.1 Key Functions

KEY FUNCTIONS
Estimates TAZ-to-TAZ I-I trip split probability and numbers of trips by motorized and non-motorized modes by trip purpose, time of day, and HH strata (for general population) or student type (for USM). Converts motorized trip matrices to binary file format for use in the motorized mode choice model. Adds corresponding air-passenger trips to HBO, WBNH, and NHNW trip matrices (in binary file format) for peak and off-peak periods.

3.6.2 Inputs, Outputs, and Parameters

Table 3-6 Inputs, Outputs, and Parameters: Non-Motorized Trip Split

	File Name and Location	Notes
Input	\Input\Master Geography\ TRMv6_TAZ.dbd	TRMv6 TAZ geographic file.
	\Input\SEData\ SE_2013.bin	TAZ socioeconomic data and other TAZ descriptive data for base year 2013.
	\Input\Highway\ Highway_line.dbd	Highway line layer; output from step "Prepare Geo Files" (Section 3.2).
	\Interim\AMLOV2.mtx OPLOV2.mtx	SOV highway skim matrix; output from step "Create Network" (Section 3.3). For two time periods: Tt $\in$ [AM, OP] AM = AM peak; OP = Off-Peak
	\Interim\AML.bin OPL.bin	All-access-mode local bus skims in binary file format; output from step "Create Network" (Section 3.3). For two time periods (same as above).
	\Interim\AMP.bin OPP.bin	All-access-mode express bus skims in binary file format; output from step "Create Network" (Section3.3). For two time periods (same as above).
	\Interim\ hhbyinc.txt	TAZ households in income categories 1, 2, 3, and 4.
	\Interim \hhby_suff_inc.txt	TAZ households by four income categories and two car-ownership groups (more-or-equal-car and less-car).

	File Name and Location	Notes
	\Input\Programs\ Non-Motorized Trip Split Models.dbf	Non-motorized trip split model specifications by trip purpose and time of day for general population.
	\Input\Programs\ Non-Motorized Trip Split Model Constant Factors.dbf	Adjustment factors (multipliers) for non-motorized trip split model constants by trip purpose, time of day, and HH strata for general population.
	\Input\Parameters\ Transit Share in Motorized Modes.dbf	Transit-mode shares of motorized-mode trips by trip purpose, time of day, and HH strata for general population.
	\Input\Parameters\ Walk Share in Non-Motorized Modes.dbf	Walk-mode shares of non-motorized-mode trips by trip purpose for general population.
	\Interim\ **Univ_DC_Uuu_PurpTt.mtx**	USM I-I person-trip PA matrix by two student types by university (TransCAD matrix format); output from step "Trip Distribution" (Section 3.5): E.g., Univ_DC_Duke_HBU_PK.mtx For four universities: Uuu $\in$ [Duke, NCCU, NCSU, UNC] Four trip purposes: Purp $\in$ [HBU, HBO, NHNU, UBNH] Two time periods: Tt $\in$ [PK, OP] PK = Peak periods (AM- and PM-peak combined) OP = Off-Peak
	\Interim\ **PurpTt_Per.bin**	General-population I-I person-trip PA matrix by five household strata for peak period (in binary file format); output from step "Trip Distribution" (Section 3.5). E.g., WrkPK_Per.bin, WBNHOP_Per.bin For twelve combinations of trip purpose (six categories) and time of day (two categories): Six trip purposes: Purp $\in$ [Wrk, Shp, Sch, Oth, NHNW, WBNH] Two time periods: Tt $\in$ [PK, OP] PK = Peak periods (AM and PM peak combined) OP = Off-Peak
	\Interim\ AirP.bin	An output file with air-passenger trip-estimation-related TAZ input and output data. Input data include households by income category and employment category. Output data include home-based (HB), work-based (WB), and non-home-non-work (NHNW) air-passenger trip attractions before and after being balanced to productions.
Output	\Interim\ NM Shortest Distance and Time.mtx	TAZ-to-TAZ shortest distance and time for non-motorized modes.
	\Interim\ **PurpTt_Per.mtx**	General-population I-I person-trip PA matrix by five household strata; TransCAD matrix format, converted from corresponding input binary file. E.g., WrkPK_Per.mtx, WBNHOP_Per.mtx For twelve combinations of trip purpose (six categories) and time of day (two categories): Same trip purposes and times of day as PurpTt_Per.bin (above).
	\Interim\ **M_PurpTt_Per.mtx**	General-population motorized I-I person-trip PA matrix by five household strata; TransCAD matrix format.

	File Name and Location	Notes
		E.g., M_WrkPK_Per.mtx, M_NHNWOP_Per.mtx For twelve combinations of trip purpose (six categories) and time of day (two categories): Same trip purposes and times of day as above.
	\Interim\ **PurpTt_Per_M.bin**	General-population motorized I-I person-trip PA matrix by five household strata; binary files are converted from appropriate M_PurposePK/OP_Per.mtx files (above) for use in motorized mode choice model. E.g., WrkPK_Per_M.bin, NHNWOP_Per_M.bin For twelve combinations of trip purpose (six categories) and time of day (two categories) (same as above). Overall HBO, WBNH, and NHNW trip outputs also are updated in this step, with air-passenger trips added to the totals for each trip purpose.
	\Interim\ **Univ_Motorized_Purp.mtx**	USM motorized I-I person-trip PA matrix by two student types and by peak vs. off-peak period; TransCAD matrix format. E.g., Univ_Motorized_HBU.mtx For four trip purposes: Purp $\in$ [HBU, U_HBO, NHNU, UBNH]
	\Interim**U_Purp_Tt_Per_M.bin**	USM motorized I-I person-trip PA matrix by two student types; binary files are extracted and converted from Univ_Motorized_Purp.mtx for use in mode choice model. E.g., U_HBU_PK_Per_M.bin, U_NHNU_Daily_Per_M.bin For seven combinations of USM trip purpose (four categories) and time of day (three designations): Three time periods: Tt $\in$ [PK, OP, Daily] PK = Peak periods; OP = Off-Peak; Daily = no distinction made between PK and OP for NHNU trips Four trip purposes: Purp $\in$ [HBU, HBO, NHNU, UBNH]
	\Interim\ **NM_PurpTt_Per.mtx**	General-population non-motorized I-I person-trip PA matrix by five household strata; TransCAD matrix format. E.g., NM_WrkPK_Per.mtx For twelve combinations of trip purpose (six categories) and time of day (two categories): Two time periods: Tt $\in$ [PK, OP] Six trip purposes: Purp $\in$ [Wrk, Shp, Sch, Oth, NHNW, WBNH]
	\Interim\ **PurpTt_Per_NM.bin**	General-population non-motorized I-I person-trip PA matrix by five household strata; binary files are converted from the appropriate NM_PurpTt_Per.mtx files (above) for use in motorized mode choice model. E.g., WrkPK_Per_NM.bin, NHNW_OP_Per_NM.bin

	File Name and Location	Notes
		For twelve combinations of trip purpose (six categories) and time of day (two categories).
	\Interim **Univ_NonMotorized_Purp.mtx**	USM non-motorized I-I person-trip PA matrix by two student types and peak vs. off-peak distinction; TransCAD matrix format. E.g., Univ_NonMotorized_HBU.mtx For four trip purposes: Purp $\in$ [HBU, HBO, NHNU, UBNH]

3.6.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Nonmotorized Trip Split**" button to start the model run.
2) If nothing goes wrong, when it completes, a message box appears, reading "Batch routine terminated successfully". Click "OK".
3) Close the Batch Routine Report window. The non-motorized trip split step is completed.

3.6.4 GISDK Macros Invoked

- Macro "NonMotorized Split" (Args, tod)
- Macro "Split Motor Trip Mtx to Bin" (Args, tod)
- Macro "Add Air Passenger" (Args, tod)
- Macro "UnivTrip" (Args)

3.7 Modal Split

Modal split, also known as mode choice, estimates which of a set of available motorized travel modes a traveler uses for a trip. The probability of using each of the available motorized modes is estimated using discrete choice models.

The TRMv6 mode choice model is composed of nineteen nested logit models, one for each combination of trip purpose and time of day. For six general-population trip purposes (HBW, HBShop, HBK12, HBO, WBNH, and NHNW) and three USM trip purposes (HBU, U_HBO, and UBNH), the model estimates motorized-trip modal splits for two time periods: peak and off-peak; only motorized modal splits for the overall travel day are estimated for the NHNU trip purpose, due to low observed trip volumes.

The mode choice model uses a nested logit form. The model applies this structure with a market-segmentation strategy that portrays the various travel markets more accurately. Each model is nested into three levels, based on travel modes, as shown in Figure 3-1. Each general-population mode choice model has five sub-models, one for each socioeconomic stratum (i.e., five HH strata). Each USM mode choice model includes two sub-models, one for each student type (living on- or off-campus).

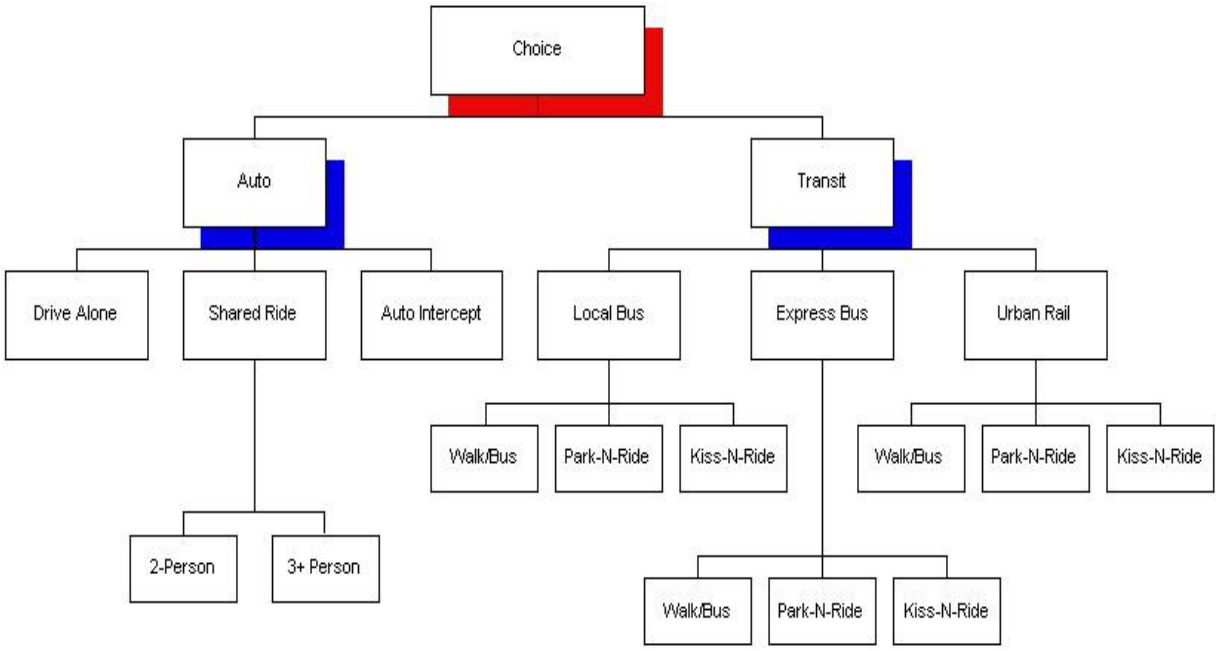


Table 3-7 TRMv6 Mode Choice Model Structure

3.7.1 Key Functions

KEY FUNCTIONS
Estimates TAZ-to-TAZ I-I trip mode choice for nine trip purposes (HBW, HBShop, HBK12, HBO, WBNH, NHNW, HBU, U_HBO, and UBNH) during each of two time periods (PK and OP), and for the NHNU trip purpose without a time-of-day distinction. Optionally outputs files by trip purpose and time of day for further FTA user-benefit analysis (SUMMIT). The 13 lowest-level traffic modes are modeled as choices, as shown in Figure 3-1, even though not all of them are available to all travelers. Applies peak-period parking-space-capacity constraints to automobiles traveling to selected TAZs within each of the predefined Parking Analysis Sub-Areas (PASAs), via a shadow price approach.

3.7.2 Inputs, Outputs, and Parameters

Table 3-8 Inputs, Outputs, and Parameters: Mode Choice

	File Name and Location	Notes
P, IO	\Input\Programs\TRMMC_tc4.exe	Mode choice Fortran program.

	File Name and Location	Notes
	\Input\Programs\ **MCPurp_Tt.ctl**	General-population mode choice Fortran program control file. E.g., MCHBW_PK.ctl, MCNHNW_OP.ctl For twelve combinations of trip purpose (six categories) and time of day (two categories): Two time periods: Tt $\in$ [PK, OP] PK = Peak periods; OP = Off-Peak Six trip purposes: Purp $\in$ [Wrk, Shp, Sch, Oth, NHNW, WBNH]
	\Input\Programs\ **MCU_Purp_Tt.ctl**	USM mode choice Fortran program control file by trip purpose and time of day. E.g., MCU_HBU_PK.ctl, MCU_NHNU_Daily.ctl For seven combinations of trip purpose (four categories) and time of day (three designations): Three time periods: Tt $\in$ [PK, OP, Daily] PK = Peak periods; OP = Off-Peak; Daily = no distinction made between PK and OP for NHNU trips Four trip purposes: Purp $\in$ [HBU, U_HBO, NHNU, UBNH]
Input	\Interim\ **PurpTt_Per_M.bin**	General-population motorized I-I person-trip PA matrix by five household strata (in binary file format); output from step "Nonmotorized Trip Split" (Section 3.6). E.g., WrkPK_Per_M.bin, NHNWOP_Per_M.bin For twelve combinations of trip purpose (categories) and time of day (two categories).
	\Interim**U_Purp_Tt_Per_M.bin**	USM motorized I-I person-trip PA matrix by two student types (in binary file format); output from step "Nonmotorized Trip Split" (Section 3.6). E.g., U_HBU_PK_Per_M.bin, U_NHNU_Daily_Per_M.bin For seven combinations of USM trip purpose (four categories) and time of day (three designations): Three time periods: Tt $\in$ [PK, OP, Daily] Four trip purposes: Purp $\in$ [HBU, U_HBO, NHNU, UBNH]
	\Interim**Tt_XOV.bin**	SOV (or HOV) highway skims in binary file format; output from step "Create Network" (Section 3.3). E.g., AMLOV.bin, OPHOV.bin For four combinations of vehicle-occupancy type (two categories) and time of day (two categories): Two times of day: Tt $\in$ [AM, OP] AM = AM peak; OP = Off-Peak Two vehicle occupancy types: XOV $\in$ [LOV, HOV] LOV = low-occupancy vehicle (or single-occupant vehicle) HOV = high-occupancy vehicle

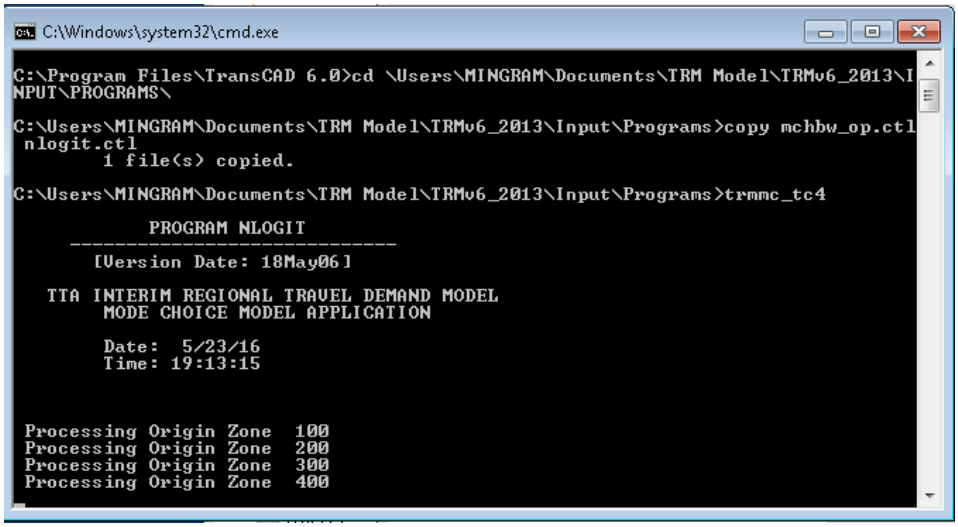
	File Name and Location	Notes
	\Interim**TtV.bin**	All-access-mode local bus, express bus, or rail transit skims in binary file format; output from step "Create Network" (Section 3.3). E.g., AML.bin, OPP.bin, AMR.bin Two times of day: Tt ∈ [AM, OP] AM = AM peak; OP = Off-Peak Three transit modes: V ∈ [L, P, R] L = Local bus; P = Premium/express bus; R = Rail
	\Interim\ MCWalk.bin	TAZ public transit short-walk access time and percentage of coverage and long-walk access time and percentage of coverage.
	\Interim\ ParkCost.bin	TAZ parking cost for TAZs in PASAs only; created from SE data file.
	\Input\Program\ ParkCap.bin	Peak-period parking capacity by Parking Analysis Sub-Area and trip purpose.
	\Input\Program\ ShadPrice.bin	TAZ shadow price by trip purpose.
Output	\Interim**PASAPurp_Tt.bin**	General-population automobile trip productions and attractions, summarized by Parking Analysis Sub-Area. E.g., PASAHBW_PK.bin, PASAWBNH_OP.bin For twelve combinations of trip purpose (six categories) and time of day (two categories). Two time periods: Tt ∈ [PK, OP] Six trip purposes: Purp ∈ [Wrk, Shp, Sch, Oth, NHNW, WBNH]
	\Interim**PASA_U_Purp_Tt.bin**	USM automobile trip productions and attractions, summarized by Parking Analysis Sub-Area. E.g., PASA_U_HBU_PK.bin, PASA_U+NHNU_Daily.bin For seven combinations of USM trip purpose (four categories) and time of day (three designations): Three time periods: Tt ∈ [PK, OP, Daily] Four trip purposes: Purp ∈ [HBU, U_HBO, NHNU, UBNH]
	\Interim**Purp_Tt.bin**	General-population I-I person-trip mode choice Fortran program output PA matrix for 15 modes (in binary file format). E.g., HBW_PK.bin, NHNW_OP.bin For twelve combinations of trip purpose (six categories) and time of day (two categories): Two time periods: Tt ∈ [PK, OP] Six trip purposes: Purp ∈ [Wrk, Shp, Sch, Oth, NHNW, WBNH]
	\Interim**U_Purp_Tt.bin**	USM I-I person-trip PA matrix for each mode (in binary file format). E.g., U_HBU_PK.bin, U_NHNU_Daily.bin For seven combinations of USM trip purpose (four categories) and time of day (three designations): Three time periods: Tt ∈ [PK, OP, Daily] Four trip purposes: Purp ∈ [HBU, U_HBO, NHNU, UBNH]
	\Interim\ **Purp_Tt.drv**	I-I auto-intercept person-trip PA matrix (in text file format):

	File Name and Location	Notes
		E.g., HBW_PK.drv, U_HBU_OP.drv For four combinations of trip purpose (two categories) and time of day (two categories): Two time periods: Tt $\in$ [PK, OP] Two trip purposes: Purp $\in$ [HBW, U_HBU]
	\Interim**Purp_Tt_DRV.asc**	I-I auto-intercept person-trip PA matrix (in text file format): automobile drive portion. E.g., HBW_PK_DRV.asc, U_HBU_OP_DRV.asc For four combinations of trip purpose (two categories) and time of day (two categories) (same as above).
	\Interim**Purp_Tt_TRN.Asc**	I-I auto-intercept person-trip PA matrix (in text file format): public transit portion. E.g., HBW_PK_RN.asc, U_HBU_OP_TRN.asc For four combinations of trip purpose (two categories) and time of day (two categories) (same as above).
	\Interim**UBPurp_Tt.bin**	General-population TAZ-to-TAZ travel information, such as mode choice logsums, in-vehicle travel times, trips by mode, and shares by mode, for user benefit analysis. E.g., UBHBW_PK.bin, UB_NHNW_OP.bin For twelve combinations of trip purpose (six categories) and time of day (two categories).
	\Interim**mc_Purp_Tt.mtx**	General-population I-I person-trip PA matrix for 15 motorized modes (in TransCAD matrix file format; converted from binary files). E.g., mc_HBW_PK.mtx, mc_WBNH_OP.mtx For twelve combinations of trip purpose (six categories) and time of day (two categories).
	\Interim\ **mc_U_Purp_Tt.mtx**	USM I-I person-trip PA matrix for each motorized mode (in TransCAD matrix file format; converted from binary files). E.g., mc_U_HBU_PK.mtx, mc_U_NHNU_Daily.mtx For seven combinations of USM trip purpose (four categories) and time of day (three designations).
	\Output**MC_Purp_Tt.rpt**	General-population mode choice Fortran program report. E.g., MC_HBW_PK.rpt, MC_NHNW_OP.rpt For twelve combinations of trip purpose (six categories) and time of day (two categories).
	\Output\ **MC_U_Purp_Tt.rpt**	USM mode choice Fortran program report. E.g., MC_U_HBU_PK.rpt, MC_U_NHNU_Daily.rpt

	File Name and Location	Notes
		For seven combinations of USM trip purpose (four categories) and time of day (three designations).

3.7.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Mode Split**" button.
2) The model runs in TransCAD window for a couple of seconds.
3) A DOS window appears, indicating the start and progress of the mode choice model.



4) If nothing goes wrong, when it completes, a message box appears, reading "Batch routine terminated successfully". Click "OK".
5) When the Batch Routine Report is opened up, close it. The motorized mode choice step is completed.

3.7.4 GISDK Macros Invoked

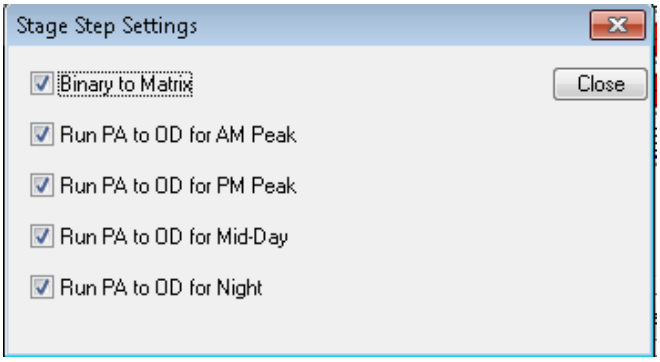
- Macro "Mode Split" (Args)
- Macro "PK Mode Split" (Args)
- Both "Mode Split" and "PK Mode Split" macros further invoke the mode choice FORTRAN program, trmmc_tc4.exe.

3.8 PA to OD

In all of the steps described above, trips and trip exchanges are estimated in a Production-Attraction (PA) format. To assign trips to the highway network, they have to be in an Origin-

Destination (OD) format. This step converts PA-formatted highway trip tables to OD-formatted trip tables, in preparation for highway assignment. Because the transit assignment procedure uses PA-formatted transit-trip tables, no PA-to-OD conversion is conducted for transit trip tables.

Another conversion task has to be accomplished before the PA-to-OD conversion can take place: converting the binary file format of trip exchanges to the TransCAD matrix file format. All trip exchanges were manipulated in a binary file format in the Mode Choice step by FORTRAN programs.



3.8.1 Key Functions

KEY FUNCTIONS
1. For motorized person trips (both automobile and public transit): Adds E-I transit-trip table to mode-choice output I-I transit-trip tables by trip purpose and time of day. Adds the driving portions of auto-intercept trips to the highway PA trip matrices and the public transit portions to the transit-trip matrices. Splits and converts peak-period person-trip PA matrices to AM-peak and PM-peak SOV and HOV vehicle-trip OD matrices, by applying directional time-of-day factors and vehicle occupancy rates. This conversion applies to all six general-population trip purposes and all four USM trip purposes. Converts off-peak-period person-trip PA matrices to SOV and HOV vehicle-trip OD matrices, by applying directional time-of-day factors and vehicle occupancy rates. This conversion applies to all six general population trip purposes and all four USM trip purposes. Slices and converts daily person E-E and I-E/E-I vehicle trip matrices into four time-of-day SOV and HOV matrices (AM peak, PM peak, midday, and night), by applying directional time-of-day factors and SOV and HOV percentages.

Collapses the model's ten trip purposes into one while maintaining SOV and HOV grouping and time-of-day distinctions, and then merges the collapsed SOV and HOV matrices with the E-E, I-E, and E-I SOV and HOV matrices to create complete person SOV and HOV OD matrices for the AM-peak, PM-peak, midday, and night periods.

The trip tables for the AM and PM peak periods, are further split into the three sub-periods of pre-peak-hour shoulder, peak hour, and post-peak-hour shoulder.

OP trip tables are further split into midday and nighttime periods.

For transit trips, no PA-to-OD conversion is needed, because trip matrices in a PA format are directly loaded onto transit routes. The only conversion conducted is converting trip matrices from a binary file format (output from mode-choice FORTRAN program) to the TransCAD matrix format.

2. For commercial vehicle trips:

Splits and converts daily commercial vehicle (light-duty CV, SUT, and MUT) trip PA matrices to the same eight time-of-day OD matrices as described above, by applying directional time-of-day factors.

3. Merging person-trip matrices and CV-trip matrices:

Commercial vehicle (CV) trips are merged with person SOV and HOV OD matrices. Then, the SUT and MUT trip matrices are combined with the merged person SOV and HOV OD matrices to produce the final OD matrices for highway traffic assignment. This final OD matrix file includes four matrices: SOV, HOV, SUT, and MUT (still named as CV in the file).

3.8.2 Inputs, Outputs, and Parameters

Table 3-9 Inputs, Outputs, and Parameters: PA to OD

	File Name and Location	Notes
Input	\Input\ExtP\EE_EI-IE2013.mtx	Through (E-E), Internal-External, and External-Internal passenger-vehicle-traffic OD matrix.
	\Input\Transit\ Transit_External_PK.mtx Transit_External_OP.mtx	Peak- and off-peak-period External-Internal transit person-trip productions and attractions (in TransCAD matrix file format).
	\Interim\ **Purp_Tt.bin**	General-population I-I person-trip PA matrix for 15 modes (in binary file format); output from step "Mode Split" (Section 3.7). E.g., HBW_PK.bin, NHNW_OP.bin For twelve combinations of trip purpose (six categories) and time of day (two categories): Two time periods: Tt $\in$ [PK, OP] PK = Peak periods; OP = Off-Peak Six trip purposes: Purp $\in$ [Wrk, Shp, Sch, Oth, NHNW, WBNH]
	\Interim**U_Purp_Tt.bin**	USM I-I person-trip PA matrix for each motorized mode (in binary file format); output from step "Mode Split" (Section 3.7).

	File Name and Location	Notes
		E.g., U_HBU_PK.bin, U_NHNU_Daily.bin For seven combinations of USM trip purpose (four categories) and time of day (three designations): Three time periods: Tt ∈ [PK, OP, Daily] PK = Peak periods; OP = Off-Peak; Daily = no distinction made between PK and OP for NHNU trips Four trip purposes: Purp ∈ [HBU, U_HBO, NHNU, UBNH]
	\Interim**Purp_Tt_DRV.ASC**	I-I auto-intercept person-trip PA matrix (in text file format): drive-access portion of trip; output from step "Mode Split" (Section 3.7). E.g., HBW_PK_DRV.asc, HBU_OP_DRV.asc For four combinations of trip purpose (two categories) and time of day (two categories): Two time periods: Tt ∈ [PK, OP] PK = Peak periods; OP = Off-Peak Two trip purposes: Purp ∈ [HBW, HBU]
	\Interim**Purp_Tt_TRN.asc**	I-I auto-intercept person-trip PA matrix (in text file format): public transit portion of trip; output from step "Mode Split" (Section 3.7). E.g., HBW_PK_TRN.asc, U_HBU_OP_TRN.asc For four combinations of trip purpose (two categories) and time of day (two categories) (same as above).
	\Input\Parameters\HourlyFactor.bin	Directional time-of-day factors for eight time periods: AM peak – shoulder 1 (pre-peak-hour): 06:00- 07:30 AM peak – peak hour: 07:30-08:30 AM peak – shoulder 2 (post-peak-hour): 08:30-10:00 Midday: 10:00-15:30 PM peak – shoulder 1 (pre-peak-hour): 15:30-17:00 PM peak – peak hour: 17:00-18:00 PM peak – shoulder 2 (post-peak-hour): 18:00-19:30 Night: 19:30 – 06:00 For I-I: Ten passenger trip purposes (HBW, HBShop, HBK12, HBO, WBNH, NHNW, HBU, U_HBO, UBNH, and NHNW) I-E, E-I, and E-E: Person automobile trips I-I: Six combinations of commercial vehicle type (light-duty CV (LCV), SUT, or MUT) and delivering goods/delivering services/other I-E, E-I, and E-E: Each of three commercial vehicle types (LCV, SUT, and MUT)
	\Interim\ **PurpTt_Per.bin**	General-population I-I person-trip PA matrix by five household strata for peak period (in binary file format); output from step "Trip Distribution" (Section 3.5). E.g., WrkPK_Per.bin, NHNWOP_Per.bin

	File Name and Location	Notes
		For twelve combinations of trip purpose (six categories) and time of day (two categories).
Output	\Interim**PurpTt_Per.mtx**	General-population I-I person-trip PA matrix by five household strata; TransCAD matrix format, converted from corresponding input binary file. E.g., WrkPK_Per.mtx, NHNWOP_Per.mtx For twelve combinations of trip purpose (six categories) and time of day (two categories).
	\Interim**Purp_pa.**.mtx	Daily I-I vehicle-trip PA matrix by vehicle occupancy (SOV or HOV); TransCAD matrix format. E.g., HBW_pa.mtx, U_UBNH_pa.mtx For ten trip purposes: Purp $\in$ [HBW, HBShp, HBSch, HBO, NHNW, WBNH, U_HBU, U_HBO, U_NHNU, U_UBNH]
	\Interim\ intercept_PK.mtx intercept_OP.mtx	I-I auto-intercept trips: transit portion of trip. The files are the sum of HBW_PK_TRN.ASC and UNV_PK_TRN.ASC; TransCAD matrix format. For two time periods, PK and OP.
	\Interim**PurpTt_OD.mtx**	Time-of-day passenger-vehicle I-I trip OD matrices by vehicle occupancy (SOV or HOV). E.g., HBWAM_OD.mtx, U_UBNUNT_OD.mtx For 32 combinations of trip purpose (ten categories) and time of day (four categories): Ten trip purposes: Purp $\in$ [HBW, HBshp, HBsch, HBO, WBNH, NHNW, U_HBU, U_HBO, U_UBNU, U_NHNU], and Four times of day: Tt $\in$ [AM, PM, MD, NT] AM = AM peak period, PM = PM peak period, MD = Midday, and NT = Night
	\Interim\ Final Disaggregated Subarea OD Matrix_LCV.mtx Final Disaggregated Subarea OD Matrix_MUT.mtx Final Disaggregated Subarea OD Matrix_SUT.mtx	Commercial-vehicle I-I trip matrices by time of day (eight time periods); one file each for LCV, SUT and MUT.
	\Output**TotTt_OD.mtx**	Final overall SOV, HOV, and truck (SUT and MUT) vehicle-trip OD matrices as input to highway assignment (TransCAD matrix format). E.g., TotAM_OD.mtx, TotNT_OD.mtx

	File Name and Location	Notes
		For four times of day: Tt ∈ [AM, PM, MD, NT] AM = AM peak [06:00-10:00] MD = Midday [10:00-15:30] PM = PM peak [15:30-19:30] NT = Night [19:00-06:00]
	\Output\ PK_TRN.mtx OP_TRN.mtx	Final person-trip PA matrices by transit mode. These trip matrix tables are input to transit assignment (TransCAD matrix format). For two time periods: PK = AM and PM peaks, combined OP = Off-Peak

	Parameter Descriptor	Value	Notes
Parameters	PA to OD Cache Size	10,000,000	Cache size used for PA-to-OD module computation; this value should not be changed.

3.8.3 Execution Procedure

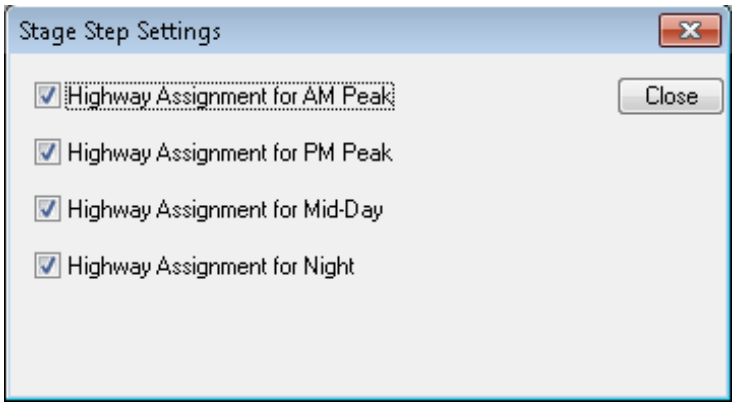
1) In the TRMv6 GUI, click "**PA to OD**" to start the model step.
2) If nothing goes wrong, when it completes, a message box appears, reading "Batch routine terminated successfully". Click "OK", and a Batch Routine Report pops up.
3) Close the Batch Routine Report file. The PA to OD step is completed.

3.8.4 GISDK Macros Invoked

- Macro "Hwy Bin to Mtx"(Args)
- Macro "Bin to Mtx"(Args)
- Macro "AM PA to OD" (Args)
- Macro "PM PA to OD" (Args)
- Macro "MD PA to OD" (Args)
- Macro "NT PA to OD" (Args)

3.9 Highway Assignment

This step loads vehicle-trip OD matrices onto the highway network using the multimodal multiclass user equilibrium method for eight times of day, AM peak (with sub-periods), PM peak (with sub-periods), midday, and nighttime, and four classes of vehicles, SOV, HOV, SUT, and MUT. The volume-delay function used in the assignment procedure is a conical function with a varying parameter, alpha, for different highway functional classes.



3.9.1 Key Functions

KEY FUNCTIONS
Assigns highway SOV, HOV, single-unit-truck, and multi-unit-truck vehicle trips for AM peak (with sub-periods), PM peak (with sub-periods), midday, and nighttime. For AM-peak and PM-peak traffic assignment, each period is further divided into three sequential time segments with the peak hour of the peak period in the middle and two 1.5-hour shoulder times on either side of the peak hour. Assignment is conducted for each time segment separately and results are then aggregated to the entire AM or PM peak period.

3.9.2 Inputs, Outputs, and Parameters

Table 3-10 Inputs, Outputs, and Parameters: Highway Assignment

	File Name and Location	Notes
Input	\Input\Highway\ Highway_line.dbd	Highway line layer; output from step "Prepare Geo Files" (Section 3.2), updated in step "Create Network" (Section 3.3).
	\Output\Highway.net	Highway .net file; output from step "Create Network" (Section 3.3).
	\Output\ **TotTt_OD.mtx**	Final overall SOV, HOV, SUT, and MUT vehicle-trip OD matrices; output from step "PA to OD" (Section 3.8) (TransCAD matrix format). E.g., TotAM_OD.mtx, TotNT_OD.mtx For four times of day: Tt $\in$ [AM, PM, MD, NT] AM = AM peak [06:00-10:00] MD = Midday [10:00-15:30] PM = PM peak [15:30-19:30] NT = Night [19:00-06:00]
	\Output\ **Tttt.bin**	Highway assignment results: flows, travel times, VMT, VHT, v/c ratios (binary format). E.g., AMP1.bin, PMP3.bin

	File Name and Location	Notes
Output		For six peak-period sub-periods (three per peak period): Tttt ∈ [AMP1, AMP2, AMP3, PMP1, PMP2, PMP3] AMP1 = AM-peak pre-peak-hour shoulder (06:00-07:30, 1.5-hour) AMP2 = AM-peak peak hour (07:30-08:30, 1-hour) AMP3 = AM-peak post-peak-hour shoulder (08:30-10:00, 1.5-hour) PMP1 = PM-peak pre-peak-hour shoulder (15:30-17:00, 1.5-hour) PMP2 = PM-peak peak hour (17:00-18:00, 1-hour) PMP3 = PM-peak post-peak-hour shoulder (18:00-19:30, 1.5-hour)
	\Output\ **TtAssn1.bin**	Aggregated (or averaged) highway assignment results for each time periods: flows, travel times, VMT, VHT, v/c ratios (binary format). E.g., AMAssn1.bin, NTAssn1.bin For four time periods of the day: Tt ∈ [AM, PM, MD, NT]
	\Output\ **TMV_Ttt.bin**	Highway turning movements at all intersections for two peak periods. E.g., TMV_AM1.bin, TMV_PM3.bin For six sub-periods within AM and PM peaks: Ttt ∈ [AM1, AM2, AM3, PM1, PM2, PM3]
	\Output\ Intersection Turning Movements_MD.bin Intersection Turning Movements_NT.bin	Highway turning movements at all intersections (binary format). For two off-peak time periods of the day: MD and NT

	Parameter Descriptor	Value	Notes
Parameters	Maximum Assignment Iterations	99 or any positive value	Number of iterations specified for assignment model convergence.
	Assignment method	1	1 = User Equilibrium (UE) Assignment

3.9.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Highway Assignment**" button to start the model run.
2) When it completes, a message box appears, reading "Batch routine terminated successfully". Click "OK" and a Batch Routine Report pops up.
3) Close the Batch Routine Report. The Highway Assignment step is completed.

3.9.4 GISDK Macros Invoked

- Macro "AM Highway Assignment" (Args)
- Macro "PM Highway Assignment" (Args)
- Macro "MD Highway Assignment" (Args)
- Macro "NT Highway Assignment" (Args)

3.10 Transit Assignment

This step loads the peak and off-peak transit-trip PA matrices onto the peak and off-peak transit-route systems, respectively, using the TransCAD pathfinder transit assignment procedure. The loading is carried out separately for nine combinations of three transit modes (local bus, express bus, and rail) and three access modes (walk-access, park-and-ride, and kiss-and-ride). The rail mode does not exist in the base-year 2013 transit network.

3.10.1 Key Functions

KEY FUNCTIONS
This step loads transit-trip PA matrices onto the peak and off-peak transit route systems for nine mode combinations (i.e., three transit modes, local bus, express bus, and rail, and three access modes, walk-access, park-and-ride, and kiss-and-ride). The output from this step includes: 1) Boarding and alighting at each stop of each transit route; 2) Transit flows (onboard passengers) by segment of each route; 3) Aggregated transit flows (across all routes) on highway links; 4) Transfers between transit routes and stops; 5) Walk (or drive) flows related to transit; and 6) Stop-to-stop transit flows. The output stop-to-stop flow matrices are indexed intensively using route names, operator names, and company/mode names in the transit-route system, providing flexibility for planners to analyze transit-passenger flows from different angles.

3.10.2 Inputs, Outputs, and Parameters

Table 3-11 Inputs, Outputs, and Parameters: Transit Assignment

	File Name and Location	Notes
Input	\Input\Transit\Transit_AM.rts Transit_OP.rts	Transit Route System; output from step "Prepare Geo Files" (Section 3.2). For two time periods: AM = Peak periods (AM and PM peak combined) OP = Off-Peak
	\Input\Transit\Transit_Line.dbd	Transit Line Geography; output from step "Prepare Geo Files" (Section 3.2).
	\Input\Transit\Mode.dbf	Transit mode table.

	File Name and Location	Notes	
	\Input\Transit\ModeXfer_2035.dbf	Transit mode transfer table (indicating possible transfers).	
	\Input\Transit\ Transit Operator and Company Dictionary.dbf	A dictionary file which explains what the numbers used in the Operator and Company fields in the transit route system (.rts) file mean.	
	\Output\ PK_Trn.mtx OP_Trn.mtx	Final person-trip PA matrices by transit mode; output from step "PA to OD" (Section 3.8). For two time periods: Tt ∈ [PK, OP] PK = Peak periods (AM and PM peak combined) OP = Off-Peak	
	\Output**TtAVpath.tnw**	Transit network by sub-mode; output from step "Create Network" (Section 3.3). E.g., AMKLpath.tnw, OPDPpath.tnw For eighteen combinations of time of day (2), access model (3), and transit mode (3): Two time periods: Tt ∈ [AM, OP] AM = Peak periods (AM and PM peak combined); OP = Off-Peak Three access modes: A ∈ [K, D, W] K = Kiss-and-Ride; D = Park-and-Ride; W = Walk Three transit modes: V ∈ [L, P, R] L = Local Bus; P = Express Bus; R = Rail	
Output	\Interim\ Transit_Transfer_AM.bin Transit_Transfer_OP.bin	Transit transfer movements. For two time periods: AM and OP	
	\Output**TtVehAcc_flw**.bin	For eighteen combinations of time of day (2), transit mode (3), and access mode (3): Two time periods: Tt ∈ [PK, OP] PK = Peak periods OP = Off-Peak period Three transit vehicle types (modes): Veh ∈ [Loc, Exp, Ral] Loc = Local Bus Exp = Express Bus Ral = Rail Three access modes: Acc ∈ [Wlk, PnR, KnR] Wlk = Walk PnR = Park-and-Ride KnR = Kiss-and-Ride	Stop-to-stop (milepost-to-milepost) transit flows by route for specific time of day, transit mode, and access mode. Additional results include Base IVTT and Cost. E.g., OPLocKnR_flw.bin
	\Output**TtVehAcc_agg.**bin		Aggregated directional transit and non-transit (access/egress/transfer) flows on each highway link by access/egress/transfer mode for specific time of day and transit mode. E.g., PKExpPnR_agg.bin
	\Output**TtVehAcc_ono**.bin		Modeled boardings and alightings at each stop in the regional transit-route system for specific time of day, transit mode, and access mode. E.g., PKLocWlk_ono.bin
	\Output**TtVehAcc_mov**.bin		Transfers from stops of one route to stops of all other routes, where possible, for specific time of day, transit mode, and access mode E.g., OPExpKnR_mov.bin

File Name and Location		Notes
\Output\ **TtVehAcc_wfl**.bin		Transit-related directional walk flows (access, transfer, and egress) on all walkable highway links for specific time of day, transit mode, and access mode. If the access mode is a drive-access mode, the file also includes directional drive-access flows on highway links. E.g., PKRalPnR_wfl.bin
\Output\ **TtVehAcc_s2s.mtx**		Stop-to-stop transit flows. The matrix explains how many passengers board at a specific stop and alight at another specific stop, basically a PA trip matrix between stops. This matrix is intensively indexed so that stop-to-stop flows can be easily viewed and summarized by route, operator, and company. E.g., PKLocWlk_s2s.mtx
\Output\ **origin_parking_TtAV.mtx**	For twelve combinations of time of day (2), access mode (2), and transit vehicle type (3): Two time periods: Tt ∈ [AM, OP] Two drive access modes: A ∈ [D, K] D = Park-and-Ride K = Kiss-and-Ride Three transit-vehicle types: V ∈ [L, P, R]	Drive-access origin-TAZ-to-parking-lot or bus stop drive time (in minutes). E.g., origin_parking_AMDL.mtx
\Output\ **parking_TtAV.mtx**		Drive-access origin-TAZ-to-destination-TAZ parking-lot choice. E.g., parking_OPKP.mtx

3.10.3 Execution Procedure

1) In the TRMv6 GUI, click the "**Transit Assignment**" button to start the model run.
2) If nothing goes wrong, when it finishes, a message box reading "Batch routine terminated successfully" appears. Click "OK" and a Batch Routine Report pops up.
3) Close the Batch Routine Report. The Transit Assignment step is completed.

3.10.4 GISDK Macros Invoked

- Macro "Transit Assignment" (Args)

3.11 Feedback Module

The feedback module, represented by the Feedback Model button in the GUI, allows the user to run the model with congested travel times output from the traffic assignment step being fed back to the trip distribution step. The advantage of using this feedback is that congested travel times are used to estimate destination and/or mode choices, which is more realistic than only using free-flow travel times.

In the TRMv6, feedbacks are only applied to the AM peak period. The PM peak, midday, and nighttime sub-models are still run without feedbacks.

The GUI allows a user to specify as many iterations as they want. This leads the user to wonder how many iterations are enough for a model to converge, the answer to which depends on the model and its scenarios and settings. The TRMv6 scenarios evaluated for the 2045 Metropolitan Transportation Plan (MTP) converged within 3-4 iterations, with the system-wide %RMSE of travel times between two successive iterations set to 10%. The user should expect more iterations to be necessary with a smaller %RMSE.

For technical details of the feedback model, refer to the TRMv6 Model Documentation.

3.11.1 Inputs, Outputs, and Parameters

Besides all of the input and output files and parameters that have been described in the previous sections of this chapter, there are only two additional parameters used in this step and no additional files involved or created, even though file contents are modified. These two parameters are the number of feedback iterations and the converging/closing criteria.

Table 3-12 Inputs, Outputs, and Parameters: Feedback Model

	Parameter Descriptor	Value	Notes
Parameters	Feedback Iterations	Integer ≥ 0	Number of iterations specified for feedback model convergence. It can take any non-negative value. If it is 0, there will be no feedback.
	Closing Criterion	Real number > 0	System-wide %RMSE of travel times between two successive iterations is used as the sole closing criterion. It can be any real number greater than 0. For base-year model calibration, a default value of 10% was used. For scenario comparison, smaller values are recommended, such as 5% or lower.

3.11.2 Execution Procedure

1) In the TRMv6 GUI, from the Scenarios box, choose the model scenario to be executed (e.g., base year 2013).

2) If a %RMSE value other than the default of 10% is preferred as a converging criterion, click the "Setup" button in the GUI and follow the instructions in Section 2.5 to make the change.

3) In the "Feedback Iterations" box, enter the number of iterations desired.

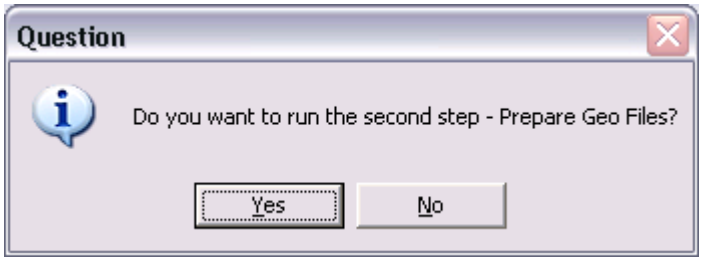
   When the number of feedback iterations is set to a value greater than 0, it does not matter if the boxes "Stop after stage" or "Run all steps" are checked or not. All steps will be executed in sequence.

4) Now click the "**Feedback Model**" button in the GUI to start the model run.

5) A message box, shown below, pops up immediately. If the current model scenario has not yet been executed since the time it was setup or any physical changes have been made to the master highway or transit networks since the last execution of the model, regardless of whether that execution was with or without feedback iterations, you must click "Yes" in this message box. If these conditions are not met, you may click "No" to avoid repetition and save time on the model run.

6) If you click "Yes", a full model run will start immediately, beginning with the "Create Walk Access" step.

7) If you click "No", a second message box will pop up asking if you want to run the second step, "Prepare Geo Files." If any attribute values in the master highway network or master transit network has been changed, you must click "Yes"; otherwise, you may click "No".



8) The model will run all steps with the feedback mechanism applied. The feedback loop will stop when either the converging criterion is met or the maximum number of iterations is reached.

9) When the execution completes, a message box appears, reading "Batch routine terminated successfully."

10) Click on "OK" to show the Batch Routine Report, and then close the report. The model run is finished.

To find out how many iterations it took for the model to converge and at what %RMSE level the model converged, look at the Report file that is created by TransCAD automatically. To find and open the Report file, select **Edit → Preferences** in the TransCAD main menu, and then choose the **Logging** tab in the **User Preferences** dialog box. Click the **Display** button under the Report text box. Search for the text "Percent RMSE for AM Feedback iteration", which will lead to the Report file.

3.11.3 GISDK Macros Invoked

- Macro "Feedback Model" (Args)

  – In the execution of this macro, it further invokes all of the macros and FORTRAN programs described in the previous sections of this chapter.

3.12 Model Validation and Scenario Evaluation

This module was developed to evaluate the performance of the base-year model and summarize the forecasts made by future-year model scenarios. The base-year model is evaluated by comparing model estimates with observed values; these are the comparisons that are most often of interest. However, even though it summarizes future-year forecasts, because the program is not customized for future-year models, it still only compares model-estimated values with the observed base-year values. Comparing future-year model-estimated values with base-year observed values would not make sense. Therefore, where future-year scenarios are concerned, focus on the summary statistics, instead.

Summary statistics include non-motorized and motorized trips by trip purpose and time of day (peak or off-peak); average trip length (duration in minutes) and distance (in miles) by trip purpose and time of day; total Vehicle Miles Traveled (VMT) and VMT by roadway federal functional class (FFC); traffic forecasts for pre-defined screen lines and cut lines; transit ridership by transit agency and time of day; and transportation mode share by trip purpose and time of day.

Measures of Effectiveness (MOE) include percent deviation of average trip duration and distance by trip purpose and time of day; percent deviation of total VMT and VMT by FFC; percent deviation of traffic forecasts for screen lines and cut lines; percent deviation of model-estimated daily traffic volumes by FFC and by volume group; the coefficient of determination (R^2) of region-wide traffic estimation; the %RMSE of model-estimated daily traffic volumes by FFC and by volume group; and transit ridership comparisons by transit agency and time of day.

3.12.1 Inputs, Outputs, and Parameters

Table 3-13 Inputs, Outputs, and Parameters: Model Validation and Evaluation

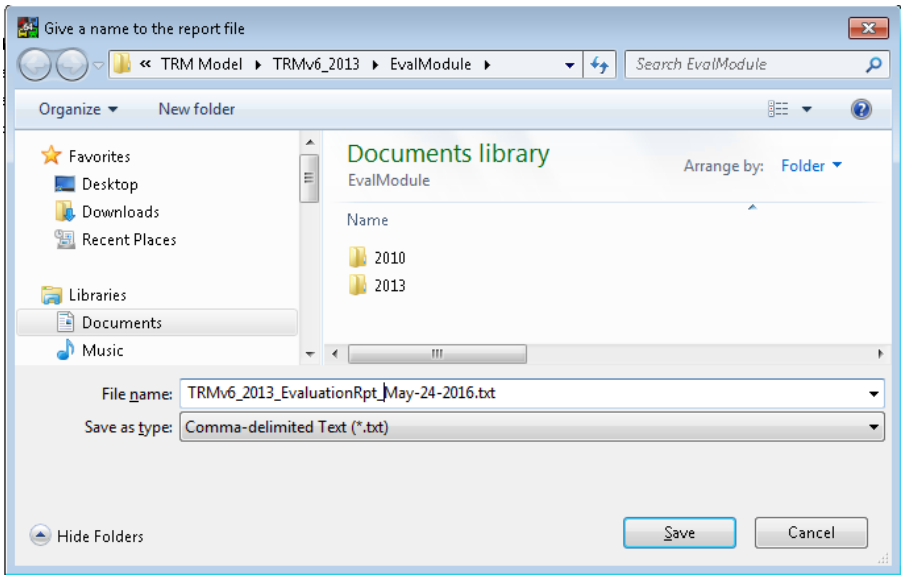
	File Name and Location	Notes
Input	\Input\SEData\SE_2013.bin	TAZ socioeconomic data.
	\Input\Highway\Highway_line.dbd	Highway line layer; output from step "Prepare Geo Files" (Section 3.2).
	\Input\Transit\ Transit_AM.rts Transit_OP.rts	Transit route system; output from step "Prepare Geo Files" (Section 3.2). Two time periods: Tt ∈ [AM, OP] AM = Peak period OP = Off-Peak period
	\Output\ **TtAssn1.bin**	Aggregated (or averaged) highway assignment results for each time periods: flows, travel times, VMT, VHT, v/c ratios (binary format); output from step "Highway Assignment" (Section 3.9). E.g., AMAssn1.bin, MDAssn1.bin For four times of day: Tt ∈ [AM, PM, MD, NT] AM = Entire AM peak, derived from AMP1.bin, AMP2.bin, and AMP3.bin. PM = Entire PM peak, derived from PMP1.bin, PMP2.bin, and PMP3.bin.
	\Interim\ AMLOV2.mtx OPLOV2.mtx	Highway skims for SOVs; output from step "Create Network" (Section 3.3). For two time periods: Tt ∈ [AM, OP]
	\EvalModule\ Observed_PersonTrips_PA_2013.mtx	Observed highway person-trip PA matrix by trip purpose and time of day for 2013.
	\EvalModule\ Non-Motorized Trip Split Observations_2013.dbf	Observed motorized and non-motorized trips by trip purpose and time of day for 2013.
	\EvalModule\ TrafficCount_Observed_2013.bin	Observed daily traffic-count data for 2013.
	\EvalModule\ Count_2013_TOD and Classification.dbd	Observed traffic counts by time of day for 2013.
	\EvalModule\ Transit_Ridership_Observed_2013.dbf	Observed transit-ridership data by agency and time of day for 2013.
	\EvalModule\Screenline & Cutline Dictionary.dbf	Screenline and cutline dictionary file.
	\Interim\ **PurpTt_Per.mtx**	General-population I-I person-trip PA matrix by five household strata; output from step "PA to OD" (Section 3.8). E.g., WrkPK_Per.mtx, WBNHOP_Per.mtx For twelve combinations of trip purpose (six categories) and time of day (two categories): Two time periods: Tt ∈ [PK, OP] PK = Peak periods; OP = Off-Peak Six trip purposes:

	File Name and Location	Notes
		Purp ∈ [Wrk, Shp, Sch, Oth, NHNW, WBNH]
	\Output\ **TtVehAcc_ono.bin**	Modeled boardings and alightings at each stop in the regional transit-route system by time of day, transit mode, and access mode; output from step "Transit Assignment" (Section 3.9). E.g., PKLocWlk_ono.bin, OPExpKnR_ono.bin For eighteen combinations of time of day (2), transit mode (3), and access mode (3): Two time periods: Tt ∈ [PK, OP] PK = Peak periods; OP = Off-Peak Three transit-vehicle types: Veh ∈ [Loc, Exp, Ral] Loc = Local Bus; Exp = Express Bus; Ral = Rail Three access modes: Acc ∈ [Wlk, PnR, KnR] Wlk = Walk; PnR = Park-and-Ride; KnR = Kiss-and-Ride
	\EvalModule\ EvaluationRpt.txt	This formatted text report contains all statistical summaries and MOEs (described above).

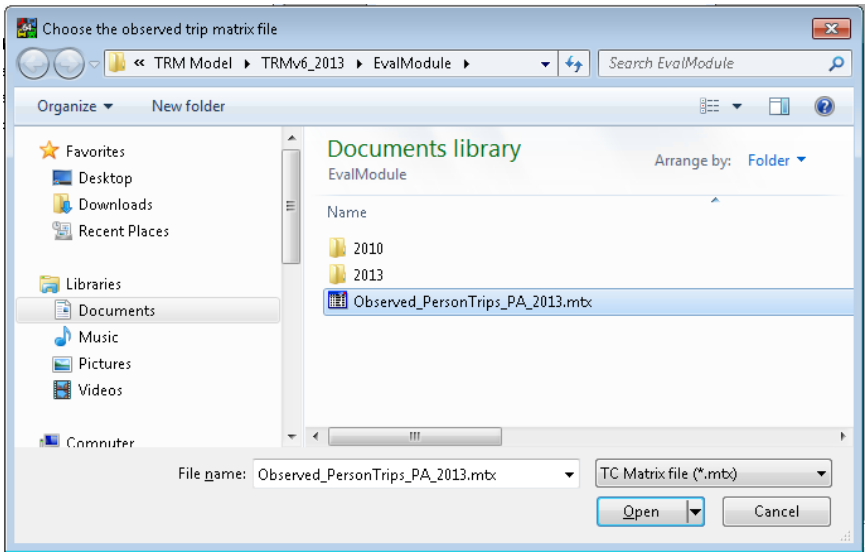
3.12.2 Execution Procedure

1) In the TRMv6 GUI, click the button titled "Base Model Calibration/Scenario Evaluation" to bring up the Evaluation Module dialog box, as shown below.

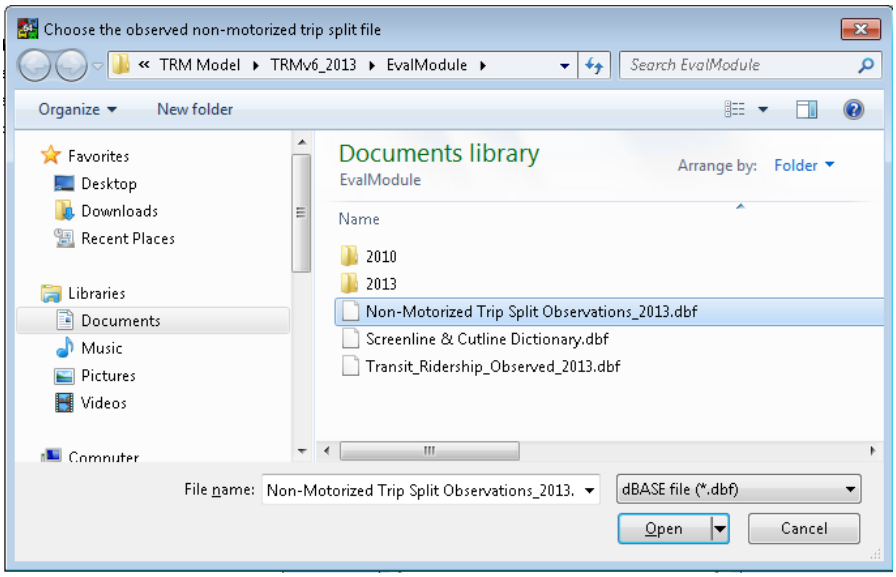
2) From the dropdown list, choose the model scenario to be evaluated.
3) Optionally, you may type a description of the scenario to be evaluated in the Title text box.
4) Click "OK" to execute.
5) A dialog box titled "Give a name to the report file" pops up immediately. Browse to the **EvalModule**\ directory of the current model scenario, accept the default file name or type in a new name for the report to be created, and click "Save". The report will be a plain text file.



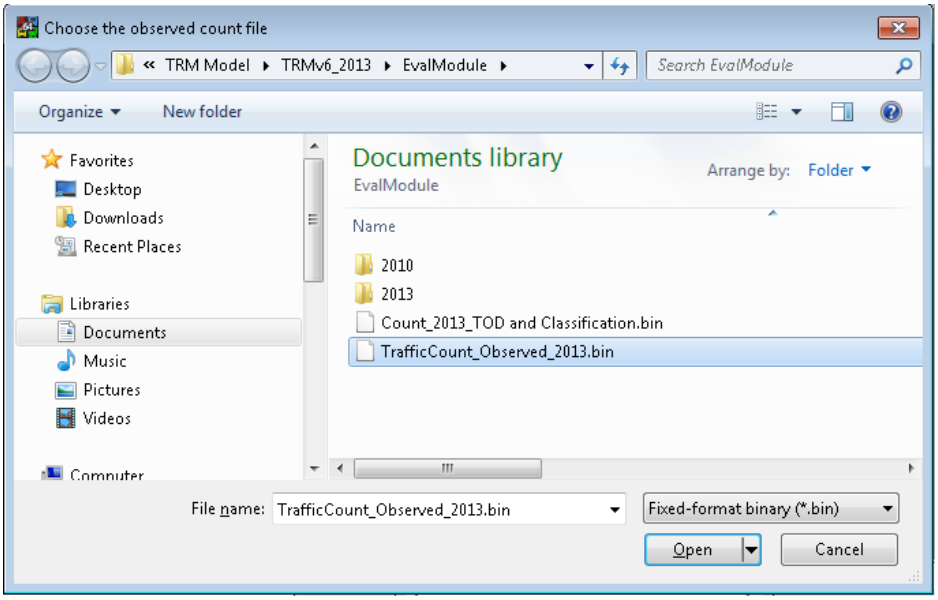
6) The dialog box "Chose the observed trip matrix file" opens. Browse to \EvalModule\, highlight the file "Observed_PersonTrips_PA_2013.mtx", and click "Open".



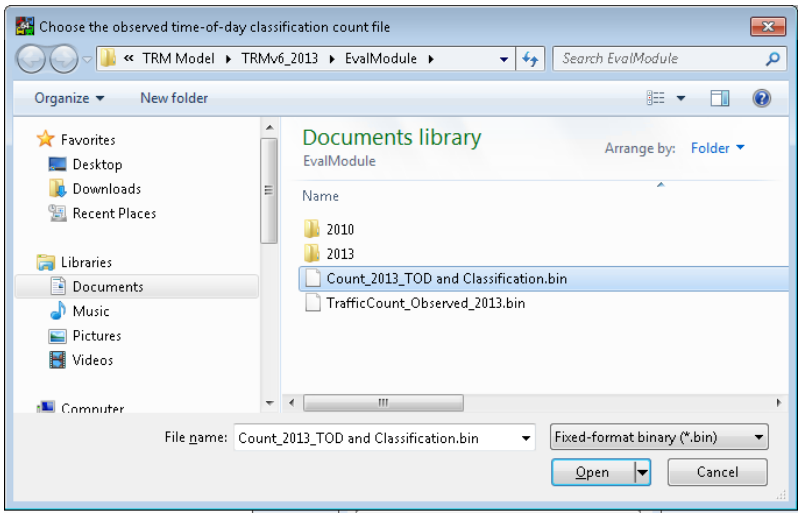
7) A dialog box titled "Choose the observed non-motorized trip split file" appears, asking for an observed motorized/non-motorized trips file. Browse to the \EvalModule\ directory, highlight the file "Non-Motorized Trip Split Observations_2013.dbf", and click "Open".



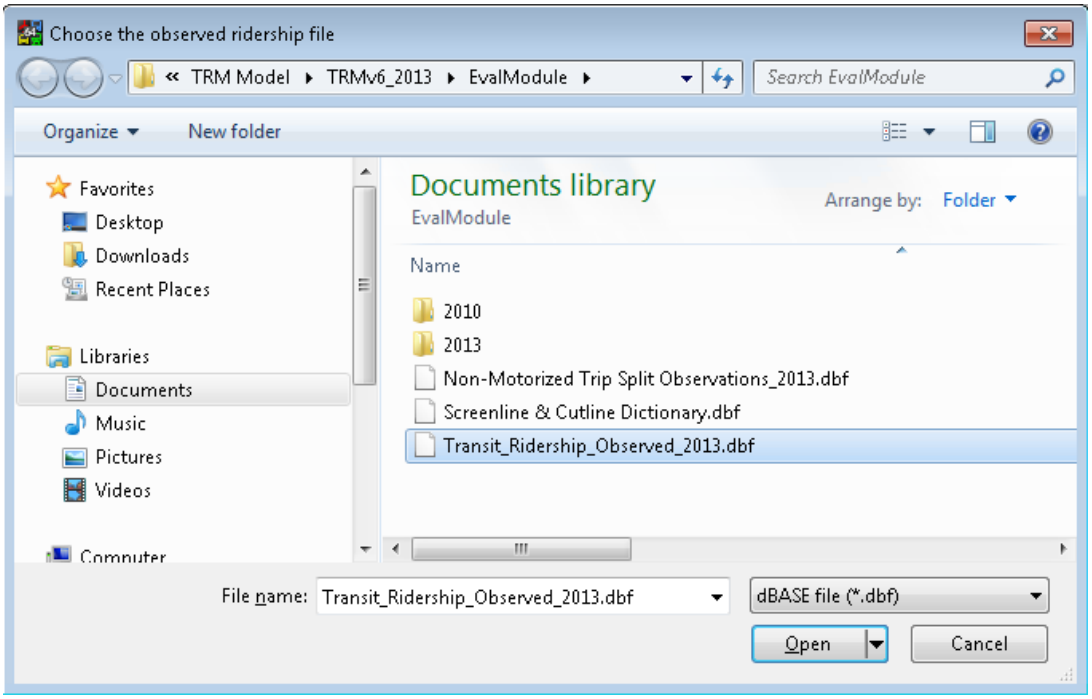
8) A fourth dialog box, titled "Choose the observed count file", appears, asking for a highway traffic-count data file. Browse to the \EvalModule\ directory, highlight the file "TrafficCount_Observed_2013.bin", and click "Open".



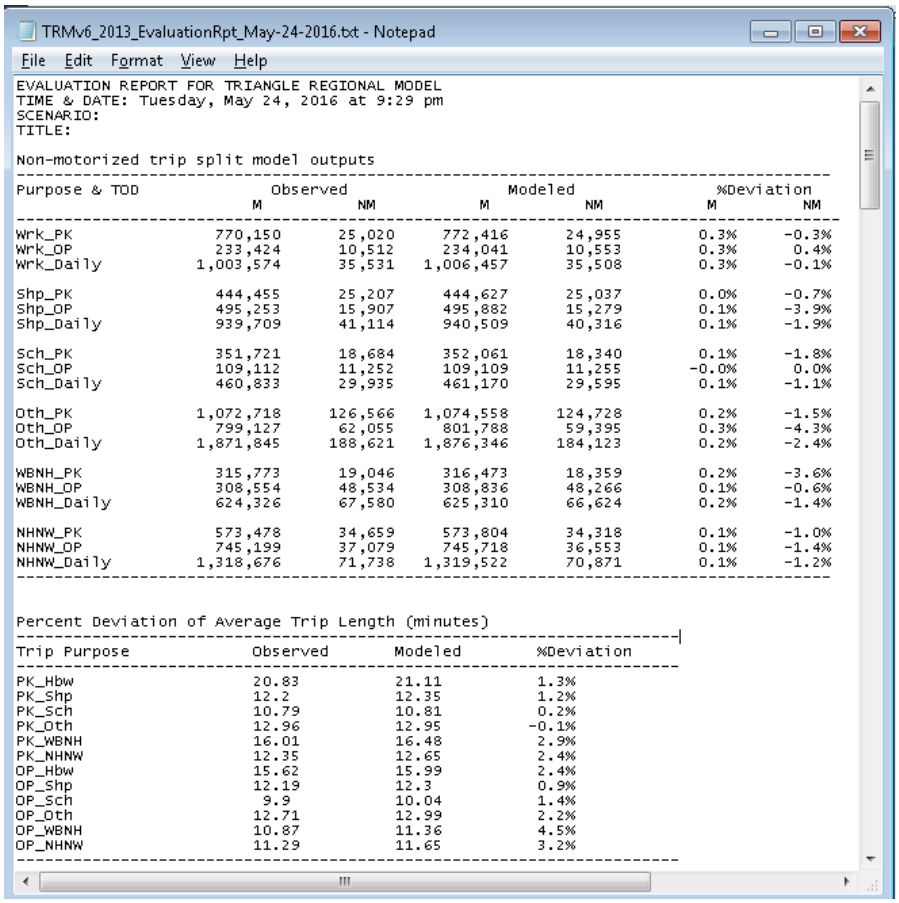
9) A fifth dialog box, titled "Choose the observed time-of-day count file", appears, asking for a time-of-day highway traffic-count data file. Browse to the \EvalModule\ directory, highlight the file "Count_2013_TOD and Classfication.bin", and click "Open".



10) A final dialog box, "Chose the observed ridership file", opens. Browse to \EvalModule\, highlight the file "Transit_Ridership_Observed_2013.dbf", and click "Open".



11) After all files have been correctly chosen, the program starts to run.
12) When the program run completes, a message box appears, reading "Congratulations!! You have completed the Model Validation Report. Do you want to open the report?" You may choose either "Yes" or "No". The report file will resemble the one below.



TRMv6_2013_EvaluationRpt_May-24-2016.txt - Notepad

File Edit Format View Help

```
EVALUATION REPORT FOR TRIANGLE REGIONAL MODEL
TIME & DATE: Tuesday, May 24, 2016 at 9:29 pm
SCENARIO:
TITLE:

Non-motorized trip split model outputs
-------------------------------------------------------------------------------------
Purpose & TOD              Observed                Modeled                %Deviation
                          M          NM           M          NM          M         NM
-------------------------------------------------------------------------------------
Wrk_PK                770,150      25,020     772,416      24,955       0.3%     -0.3%
Wrk_OP                233,424      10,512     234,041      10,553       0.3%      0.4%
Wrk_Daily           1,003,574      35,531   1,006,457      35,508       0.3%     -0.1%

Shp_PK                444,455      25,207     444,627      25,037       0.0%     -0.7%
Shp_OP                495,253      15,907     495,882      15,279       0.1%     -3.9%
Shp_Daily             939,709      41,114     940,509      40,316       0.1%     -1.9%

Sch_PK                351,721      18,684     352,061      18,340       0.1%     -1.8%
Sch_OP                109,112      11,252     109,109      11,255      -0.0%      0.0%
Sch_Daily             460,833      29,935     461,170      29,595       0.1%     -1.1%

Oth_PK              1,072,718     126,566   1,074,558     124,728       0.2%     -1.5%
Oth_OP                799,127      62,055     801,788      59,395       0.3%     -4.3%
Oth_Daily           1,871,845     188,621   1,876,346     184,123       0.2%     -2.4%

WBNH_PK               315,773      19,046     316,473      18,359       0.2%     -3.6%
WBNH_OP               308,554      48,534     308,836      48,266       0.1%     -0.6%
WBNH_Daily            624,326      67,580     625,310      66,624       0.2%     -1.4%

NHNW_PK               573,478      34,659     573,804      34,318       0.1%     -1.0%
NHNW_OP               745,199      37,079     745,718      36,553       0.1%     -1.4%
NHNW_Daily          1,318,676      71,738   1,319,522      70,871       0.1%     -1.2%
-------------------------------------------------------------------------------------


Percent Deviation of Average Trip Length (minutes)
-----------------------------------------------------------------------|
Trip Purpose              Observed        Modeled         %Deviation
-----------------------------------------------------------------------
PK_Hbw                    20.83           21.11           1.3%
PK_Shp                    12.2            12.35           1.2%
PK_Sch                    10.79           10.81           0.2%
PK_Oth                    12.96           12.95          -0.1%
PK_WBNH                   16.01           16.48           2.9%
PK_NHNW                   12.35           12.65           2.4%
OP_Hbw                    15.62           15.99           2.4%
OP_Shp                    12.19           12.3            0.9%
OP_Sch                     9.9            10.04           1.4%
OP_Oth                    12.71           12.99           2.2%
OP_WBNH                   10.87           11.36           4.5%
OP_NHNW                   11.29           11.65           3.2%
-----------------------------------------------------------------------
```

3.12.3 GISDK Macros Invoked

- DBox "EVALUATION"
- Macro "Calibration Routine" (Pars)

DBox "EVALUATION" invokes Macro "Calibration Routine".

3.13 Air Quality Analysis

Air Quality analysis for the MOVES model is now handled by an off-model tool.

The information here was inherited from TRM v.5 and not updated.

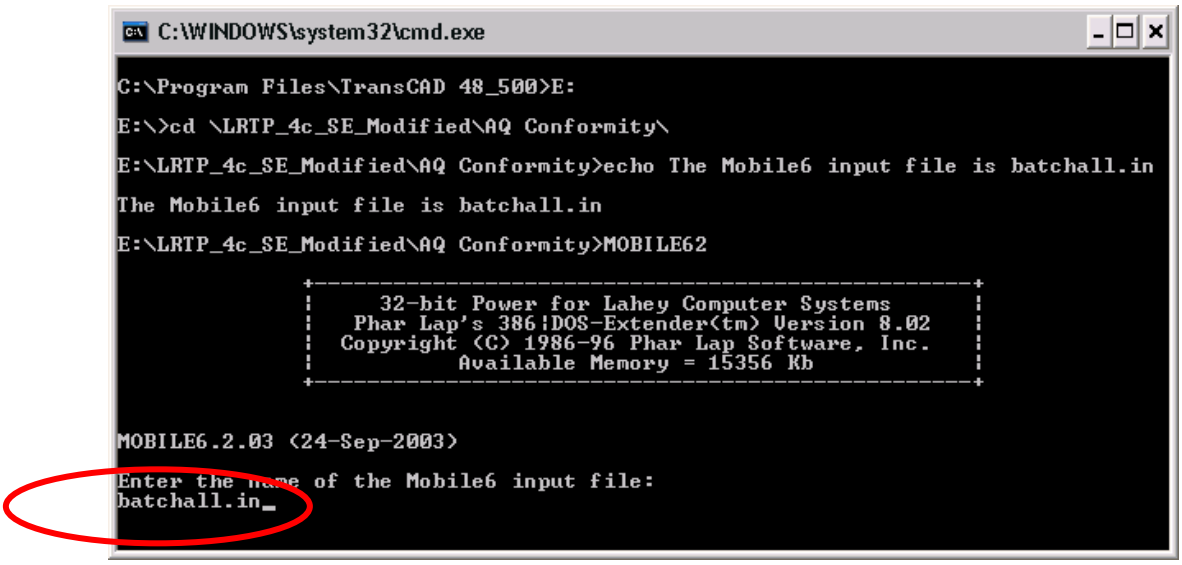
3.13.1 Input, Output, and Parameters

Table 3-14 Input, Output, and Parameters: Air Quality Analysis

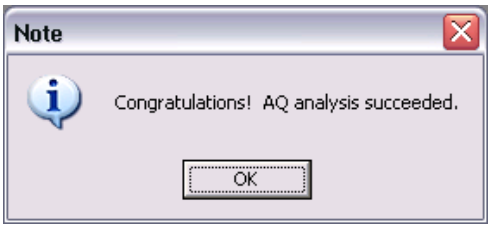
	File Name and Location	Notes
Input	\Input\Highway\Highway_line.dbd	Highway line layer; Output from step "Prepare Geo Files" (3.2). **Note: Make sure values in the fields "County" and "FCLASS" are correct** (see Universe Highway Geographic File in Chapter 5). This is critical for the AQ program to compute pollutants accurately.
	\Output\ **TtAssn1.bin**	Highway assignment results; Output from step "Highway Assignment" (§3.9) E.g., AMAssn1.bin For four time periods: Tt ∈ [AM, PM, MD, NT]
	C:\Programs\TransCAD 48\TRMv6 AQ Files\Mobile6 Files\MOBILE62.exe & all supporting files in the same directory	Mobile 6 executable file
	C:\Programs\TransCAD 48\TRMv6 AQ Files\County Emission Budgets and Compliance Rates.dbf	This file contains emission budgets by county by year (2015, 2025, and 2035) and county compliance rates.
	C:\Programs\TransCAD 48\TRMv6 AQ Files\YYYY*.in	YYYY = 2015, 2025, or 2035. This directory contains all the *.in files by county and pollutant type (NOx or CO)
Output	\Air Conformity\Modeled Emission Report for YYYY.dbf	YYYY is the year you chose on the "Air Quality Analysis" dialog box for analysis. This file contains estimated amount of pollutant emissions for all the counties and for both pollutants (NOx and CO).
	\Air Conformity*.TAB \Air Conformity*.TXT	One for each county and either pollutant
	\Air Conformity\VMT & VHT Results for AQ Analysis.bin	This file contains VMT, VHT, and average speed data by county, highway federal functional class, and time of day.

3.13.2 Execution Procedure

1) Click the "Air Quality Analysis" button on the TRMv6 GUI;
2) Choose an appropriate year from the pop-up dialog box, which is also titled "Air Quality Analysis";
3) Click the Run button from the dialog box;
4) After the module runs for a couple of seconds, a DOS window will appear on your screen with Mobile6 launched. Type "batchall.in" (do not include the quotation marks) in the blank line under the line "Enter the name of the Mobile6 input file:", and hit the Enter key on your keyboard;



5) Now the program starts to execute and it takes several minutes to finish. If all things have been set up correctly, you should have a message box pop up at the end of the execution indicating the completion, as shown in the picture below.



3.13.3 GISDK Macros Invoked

- Dbox "AQ Conformity", which invokes Mobile 6.

3.14 Summit User Benefit Analysis

The information here was inherited from TRM v.5 and not updated.

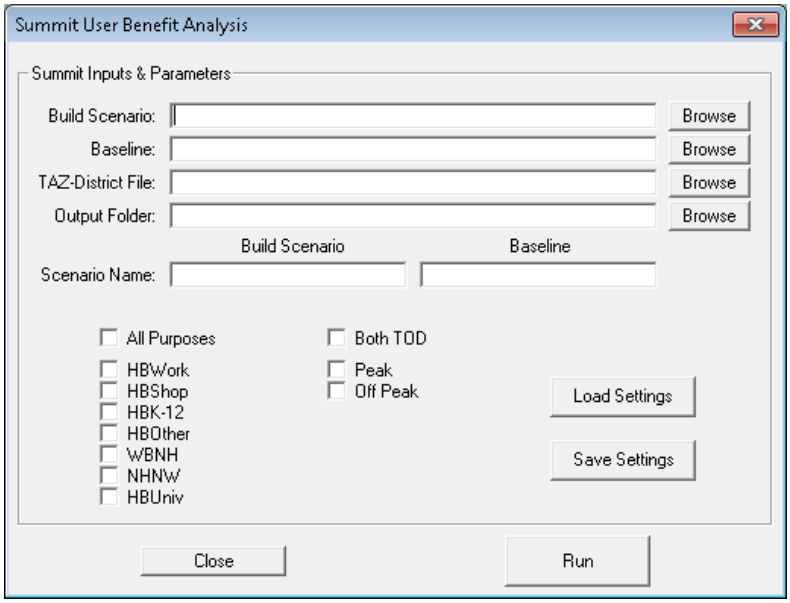
This section provides instructions on how to run the FTA Summit application from the TRMv6 model Graphic User Interface (GUI) to obtain user benefit estimates using TRMv6 model run results from any two specific scenarios. The integrated Summit Module in the TRMv6 script fully automates all the steps required for user benefit analysis, which include input data specification, error checking, and processing, control file creation, Summit execution, and input and output data organization.

However, to run this module, you need several extra input files that are specifically prepared for air quality analysis. These files include:

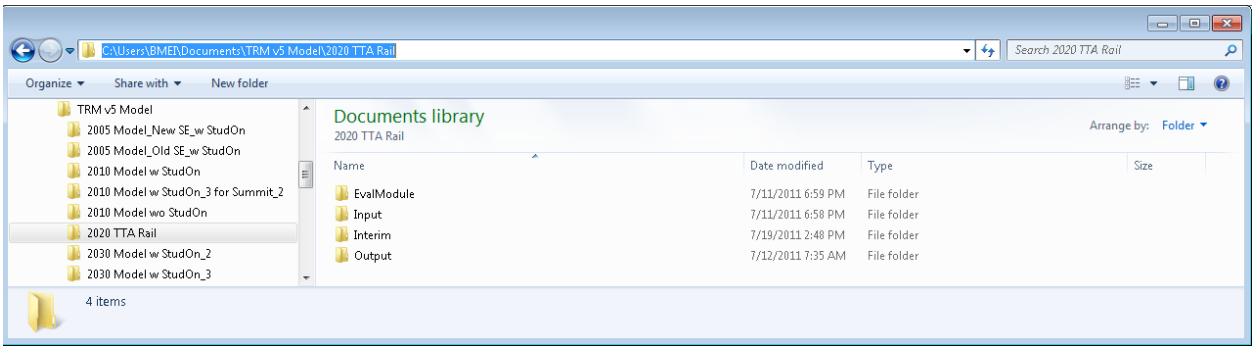
1) Summit executable file (e.g. summit993.exe);
2) Template control file named "TRMv6 summit control file template.ctl";
3) User benefit analysis input files from mode choice FORTRAN program:
   - UBHBW_PK.BIN & UBHBW_OP.BIN
   - UBSHP_PK.BIN & UBSHP_OP.BIN
   - UBSCH_PK.BIN & UBSCH_OP.BIN
   - UBOTH_PK.BIN & UBOTH_OP.BIN
   - UBWBNH_PK.BIN & UBWBNH_OP.BIN
   - UBNHNW_PK.BIN & UBNHNW_OP.BIN
   - UBUNV_PK.BIN & UBUNV_OP.BIN
4) One additional TRMv6 scenario. Unlike most of the TRMv6 model applications, Summit works on and needs inputs from two scenarios rather than a single one. It basically compares the two scenarios and calculates user benefits based on trip pattern changes between them. Files listed in item 3) above must exist for this scenario.
5) TAZ-district equivalency file. For user benefit analysis, TAZs should be aggregated into much larger districts to produce more meaningful information and more usable results. The TAZ-district equivalency file serves this purpose.

3.14.1 User Interface

Locate the button titled "Summit User Benefit Analysis" on the TRMv6 GUI. By clicking the button, dialog box "Summit User Benefit Analysis" pops up, as shown below.



Scenarios: On this dialog box, you can specify a Build Scenario for which the user benefit analysis is conducted against the Baseline. You can either type a path into the editable text box or click the Browse button to choose the directory from the Windows Browse for Directory dialog box. Given the TRMv6 model directory structure, a scenario (including the baseline) here refers to the top-level directory of a model run setup. For example, in the figure below each of the directories immediately under the TRMv6 Model directory can be specified as a scenario. If "2020 TTA Rail" is chosen as a scenario, the path "C:\Users\BMEI\Documents\TRMv6 Model\2020 TTA Rail" should be specified in the scenario text box on the dialog box window above.



Scenario Names: Now you need to give a short, meaningful, and easy-to-call name to either of the scenarios in the Scenario Name text box. These names will be used in Summit control files as well as output files and help you readily distinguish one scenario from the other.

TAZ-District File: After scenarios are chosen and name is provided, you need to specify a TAZ-district equivalency file. For user benefit analysis, TAZs should be aggregated into much larger districts to produce more meaningful information and more usable results. The TAZ-district equivalency file serves this purpose and its contents and structure will be described in detail in the Input Files section. As a note, this file is not in a format that can be used by the Summit program directly, but it is much easier for the user to produce. The TRMv6 Summit module will convert this user-supplied file (in DBASE format) into Summit-readable file (in text format). Again, you can either type in or browse for the file.

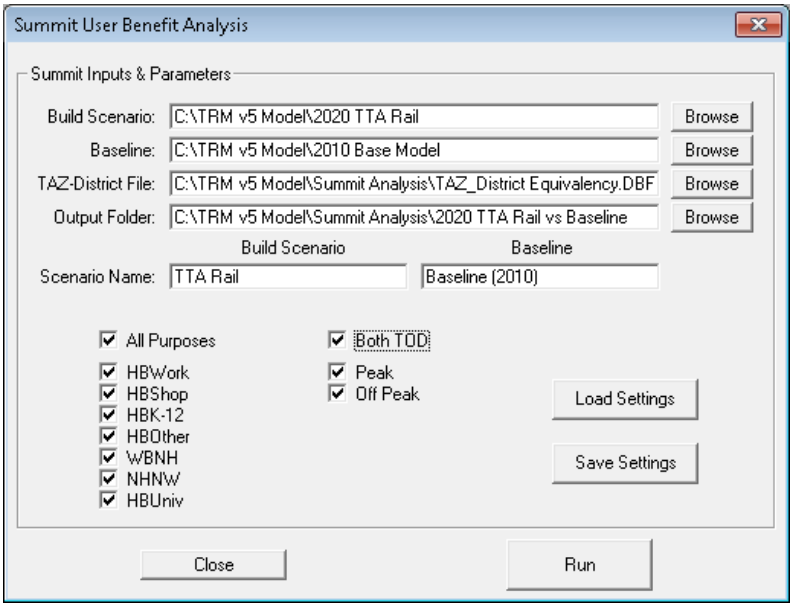
Output Directory: The Output Directory is where all the output files from Summit execution are stored, along with a few other files including Summit program control files, a batch file, and the converted TAZ-district equivalency file which are all created by the TRMv6 Summit module.

Trip Purpose and Time of Day Checkboxes: The next section on the dialog box is a group of checkboxes where you choose for what trip purpose(s) and what time(s) of day to run the Summit program. Check the one(s) you would like to run.

Save and Load Settings: After all the above information is specified on the dialog box, you can save the settings to a text file (with a .set extension), which can be used for reference later.

Saved settings can also be loaded to the dialog box from a previously saved file, which can save you a few seconds to re-specify the information manually.

An example fully specified dialog box is shown below:



3.14.2 Input Files

Input files required by the TRMv6 Summit module include:

1) TAZ-to-TAZ travel information

Unlike most of the TRMv6 model applications, Summit works on and needs inputs from two scenarios rather than a single one. It basically compares the two scenarios and calculates user benefits based on trip pattern changes and the respective benefits between them. Therefore, for both scenarios to be compared, the following input files need to exist before Summit can be started:

- UBHBW_PK.BIN & UBHBW_OP.BIN
- UBSHP_PK.BIN & UBSHP_OP.BIN
- UBSCH_PK.BIN & UBSCH_OP.BIN
- UBOTH_PK.BIN & UBOTH_OP.BIN
- UBWBNH_PK.BIN & UBWBNH_OP.BIN
- UBNHNW_PK.BIN & UBNHNW_OP.BIN
- UBUNV_PK.BIN & UBUNV_OP.BIN

These files contain zone-to-zone travel information, such as logsums, in-vehicle travel times, trips by mode, and shares by mode. These files should be produced by the mode choice FORTRAN program automatically with the USERBEN variable set to true (T) in the mode choice control files (e.g., mchbw.ctl). These files are stored in the **Interim** directory automatically by the FORTRAN program; that is the place where they have to be in order for the TRMv6 Summit module to run successfully.

2) TAZ-district equivalency file

This is the user-supplied TAZ-district equivalency file (in TRMv6, it is located at \EvalModule\). It contains at least two columns of data: TAZ centroid ID and the corresponding district numbers (additional fields are county name and FIPS codes, and Parking Analysis Sub-Area code). One district can have multiple TAZs, but one TAZ can only belong to one district. The number of districts must not exceed 17 as required by the Summit program. The file has to be in the **DBASE** (**.dbf**) file format, and the heading of the column for TAZs must be "**TAZ**" and the heading for districts must be "**District**". Both columns must be the **integer** data type. An example is shown below. As a note, presence of additional columns in the table is fine as long as the required two are there. This file can be stored anywhere on your computer, though a meaningful place is always preferred.

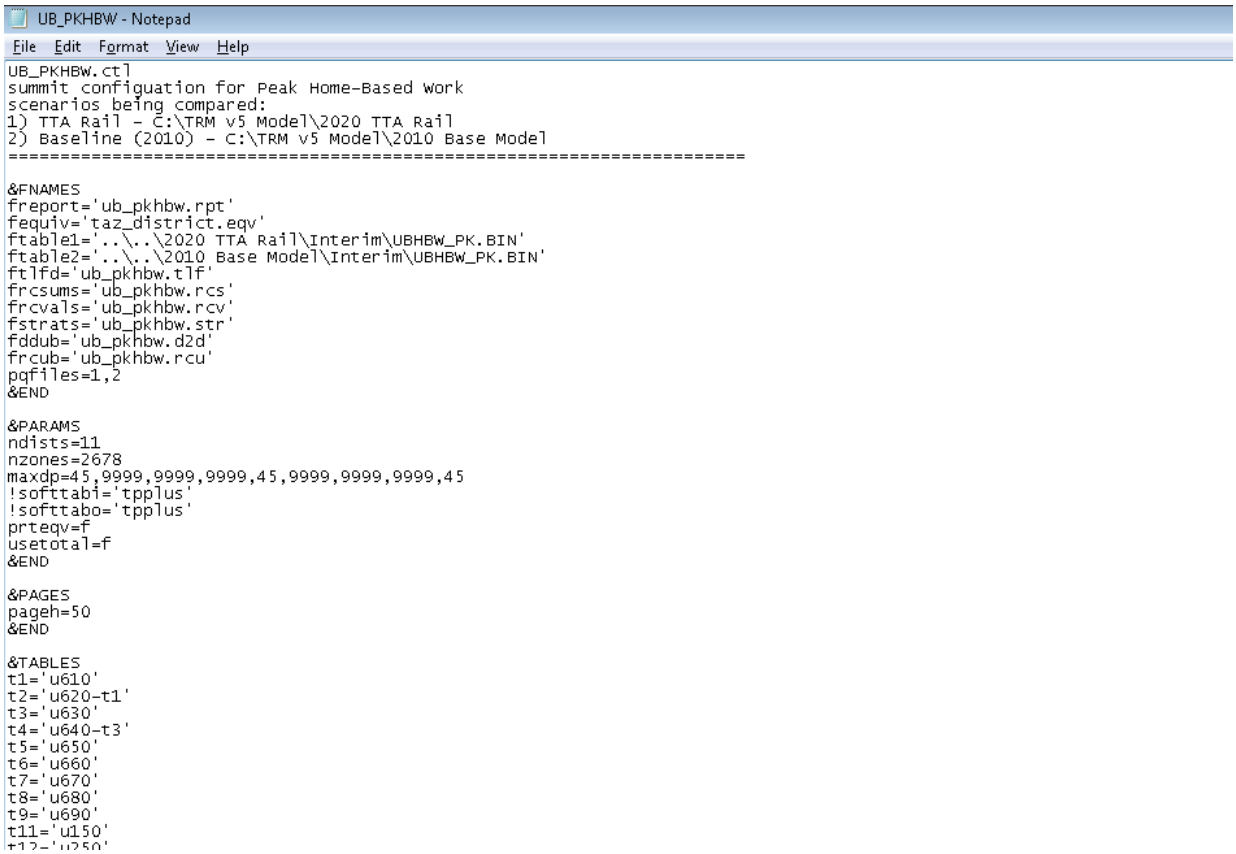
Dataview1 - TRMv6_TAZ_PASA_District_County_

TAZ_TRMv6	PASA_TRMv6	District_TRMv6	County	County_FIPS
1	0	3	Chatham	37037
2	0	8	Chatham	37037
3	0	7	Chatham	37037
4	0	7	Chatham	37037
5	0	7	Chatham	37037
6	0	7	Chatham	37037
7	0	7	Chatham	37037
8	0	8	Chatham	37037
9	0	8	Chatham	37037
10	0	8	Chatham	37037
11	0	8	Chatham	37037
12	0	8	Chatham	37037
13	0	7	Chatham	37037
14	0	7	Chatham	37037
15	0	7	Chatham	37037
16	0	7	Chatham	37037
17	0	7	Chatham	37037
18	0	7	Chatham	37037
19	0	7	Chatham	37037
20	0	8	Chatham	37037
21	0	8	Chatham	37037
22	0	8	Chatham	37037

3) Control files and template control file

Summit program control files are the places where input and output file names, parameter values, and tables contained in output files are specified. A screenshot of an example control file is shown below. For each combination of trip purpose and time of day, there has to be a control file. This means there should be 20 control files for 10 trip purposes and two times of day for the TRMv6 model. Fortunately, the user does not have to create the control files

manually, since all the control files are taken care of by the TRMv6 Summit module automatically based on a template control file. Created control files are automatically saved to the output directory as specified on the Summit User Benefit Analysis dialog box.



UB_PKHBW - Notepad

File Edit Format View Help

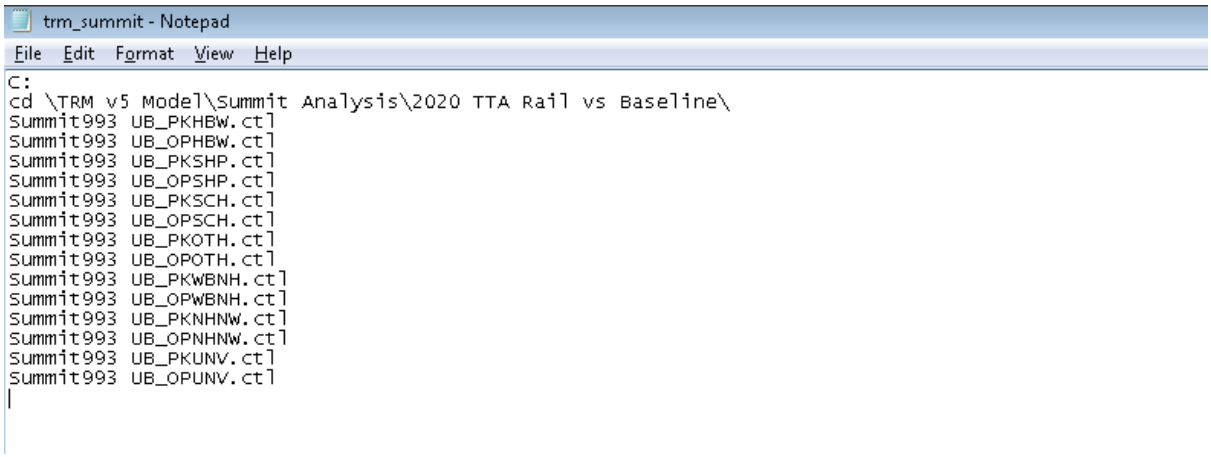
```
UB_PKHBW.ctl
summit configuation for Peak Home-Based Work
scenarios being compared:
1) TTA Rail - C:\TRM v5 Model\2020 TTA Rail
2) Baseline (2010) - C:\TRM v5 Model\2010 Base Model
=====================================================================

&FNAMES
freport='ub_pkhbw.rpt'
fequiv='taz_district.eqv'
ftable1='..\..\2020 TTA Rail\Interim\UBHBW_PK.BIN'
ftable2='..\..\2010 Base Model\Interim\UBHBW_PK.BIN'
ftlfd='ub_pkhbw.tlf'
frcsums='ub_pkhbw.rcs'
frcvals='ub_pkhbw.rcv'
fstrats='ub_pkhbw.str'
fddub='ub_pkhbw.d2d'
frcub='ub_pkhbw.rcu'
pqfiles=1,2
&END

&PARAMS
ndists=11
nzones=2678
maxdp=45,9999,9999,9999,45,9999,9999,9999,45
!softtabi='tpplus'
!softtabo='tpplus'
prteqv=f
usetotal=f
&END

&PAGES
pageh=50
&END

&TABLES
t1='u610'
t2='u620-t1'
t3='u630'
t4='u640-t3'
t5='u650'
t6='u660'
t7='u670'
t8='u680'
t9='u690'
t11='u150'
t12='u250'
```

The template control file, always named "TRMv6 summit control file template.ctl", is used as a blueprint by the TRMv6 Summit module to produce real control files for use with Summit. These real control files when created incorporate the information from the template as well as that specified on the Summit User Benefit Analysis dialog box. As an input, the template control file must be stored in the **TRMv6 Summit** sub-directory under the TransCAD program files directory. If the sub-directory does not exist, create it. An example path is C:\Program Files\TransCAD\TRMv6 Summit\TRMv6 summit control file template.ctl.

For details of the Summit control file, please refer to the User's Guide to Summit published by the FTA.

4) Batch file

The batch file, always named "trm_summit.bat", is also created automatically by the TRMv6 Summit module and stored in the output directory. An example of the contents of the file is shown below.



5) Summit executable file

Like the template control file, the Summit executable file (e.g. summit993.exe or newer version) must be stored in the **TRMv6 Summit** sub-directory under the TransCAD program files directory

3.14.3 Output Files

The FTA Summit program produces standard outputs, and all the output files are stored in the output directory as specified on the Summit User Benefit Analysis dialog box. For each combination of trip purpose and time of day, there are a set of output files named in the format of "UB_XXYYY.ZZZ", where UB stands for user benefit, XX is the time of day – PK or OP, and YYY is the trip purpose (which is four-letter for the WBNH and NHNW purposes). ZZZ is the file extension, as described below.

1) Report on control playback and district-to-district summaries
    a. control file specification: freport
    b. output file extension: .rpt
2) Trip length frequency distribution reports
    a. control file specification: ftlfd
    b. output file extension: .tlf
3) Row sums and column sums of TAZ-level user benefit tables
    a. control file specification: frcub
    b. output file extension: .rcu
4) District-to-district aggregations of standard user benefit tables
    a. control file specification: fddub
    b. output file extension: .d2d
5) Stratified TAZ-to-TAZ trip tables

   a. control file specification is fstrats
   b. output file extension: .str
6) Row and column sums from selected tables
   a. control file specification is frcsums
   b. output file extension: .rcs
7) Cell values from selected rows/columns of selected tables
   a. control file specification is frcvals
   b. output file extension: .rcv

For details of these output files, please refer to the User's Guide to Summit published by the FTA.

3.14.4 Execution Procedure

1) Make sure there is a sub-directory called "TRMv6 Summit" immediately under the TransCAD program files directory (where your TransCAD is launched from).
2) Make sure the following two files exist in the TRMv6 Summit sub-directory as mentioned above; one is the Summit executable file (e.g. summit993.exe or new version) and the other is the template control file named "TRMv6 summit control file template.ctl".
3) Now click the Summit User Benefit Analysis button on the TRMv6 GUI to pop up the Summit User Benefit Analysis dialog box.
4) Specify all the information needed on the dialog box.
5) Click the Run button on the dialog box to start the program.
6) If the run is successful, a message box indicating "Summit done!" will pop up at the end; otherwise, a "Summit failed!" box will appear. If everything is set up correctly (as described above), you should always have successful runs.

3.14.5 GISDK Macros Invoked

- Dbox "FTASummit"

3.15 When the Delete-Temporary-Files Box Is Checked

If the "Delete temporary files after model run" box is checked in the model GUI, the files listed below will be deleted automatically at the end of model execution. These are intermediate files containing either TAZ-to-TAZ trip interchanges or travel times/skims with one record for each OD pair, stored in a TransCAD binary file format. Most importantly, many of these files already

have corresponding TransCAD-matrix-format versions; the binary files are only created for running Fortran programs that cannot read TransCAD matrix files, after which step the information they contain is redundant. Because the TRMv6 has over 8.7 million OD pairs (2956 x 2956 one for each TAZ-to-TAZ matrix), these files are very large. When a model run finishes, the mission of these intermediate (and redundant) files is finished, too, and they can therefore be safely deleted. Deleting them will not affect any further analysis, including performance-measurement statistics.

Details about these files are in Section 3.5 and Chapter 5.

- Interim\AMLOV (HOV).bin and AMLOV (HOV).dcb
- Interim\AML(P and R).bin and AML (P and R).dcb
- Interim\AMDR (WP).bin and AMDR (WP).dcb
- Interim\OPL (P and R).bin and OPL (P and R).dcb
- Interim\OPDR (WP).bin and OPDR (WP).dcb
- Interim\ all **PurpTt_PER (IMP).bin** and **PurpTt_PER(IMP).dcb**
  where
  Purp $\in$ [Wrk, Shp, Sch, Oth, WBNH, NHNW] and Tt $\in$ [PK, OP]

Chapter 4. INPUT FILE PREPARATION

This chapter instructs the user how to prepare those input files that vary by planning model scenario (often involving changes in land use, socioeconomic data, highway and transit networks and/or project sets, etc.) and require manual preparation. This chapter does not cover any other input files, the contents of which do not frequently vary across different model scenarios. Special consultation with the TRMSB is recommended if changes to those files are needed.

A list of those input files that often need to be prepared by the model user is provided below.

1) Universe highway geographic file (Highway.dbd) and transit-route system file (transit.rts), in the Input\Master Geography\ directory;
2) Socioeconomic data file (SE_ModelYear.bin), in Input\SEData\;
3) Synthesized population data file (PopGen.bin), in Input\Programs\;
4) Automobile terminal time matrix (Auto_TerminalTime.mtx), in Input\Parameters\;
5) Timed transfer wait time tables for both AM peak and off-peak periods (TimedTransferWaitTime_AM_ModelYear.bin and TimedTransferWaitTime_OP_ModelYear.bin), in Input\Transit\;
6) Mode choice FORTRAN program control files (mchbw_op.ctl, mchbw_pk.ctl, etc.), in Input\Programs\;
7) External-transit-trip matrix files (Transit_External_PK.mtx and Transit_External_OP.mtx), in Input\Transit\; and
8) Parking capacity file (ParkCap.bin) and parking cost in SE_year.bin file.

4.1 Universe Highway Network Geographic File and Transit-Route System File

Users have two options for the preparation of highway and transit networks. The first option is to use the Map Editing toolbox and Route System toolbox provided by TransCAD. These two toolboxes provide many functions that will be needed in the creation or revision of a highway or transit network. However, in some cases, the second option may save users a significant amount of time. The second option is to use Network Manager, a network editing and management tool developed by the TRMSB. Users first need to use Network Manager to create a True Universe line layer, which includes all base-year network links and all future-year projects. Once the True Universe line layer has been established, users can create a network by simply selecting which future projects should be included. That is to say, all future projects only need to be coded once, and can then be included in or excluded from any network to avoid time-consuming, repetitive coding efforts. Network Manager is a powerful tool and can be used in the preparation of both highway and transit networks.

It is suggested that TransCAD toolboxes should be employed when users want to revise the network with minor changes, and that Network Manager should be employed when users want to create a totally new network or revise the network with major changes. A change is regarded

as "major" if users would need more than one day to complete the network preparation using TransCAD toolboxes.

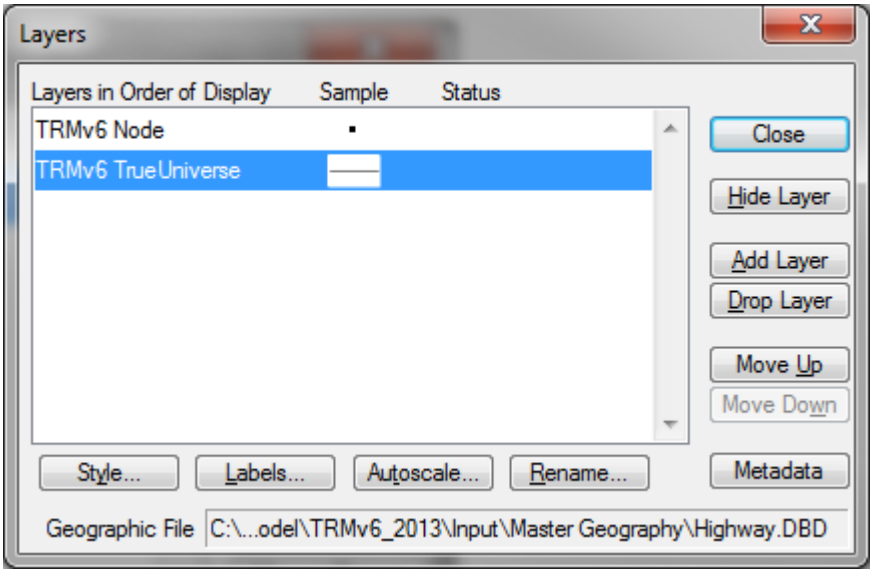
4.1.1 Preparation of Networks Using TransCAD Toolboxes

Sometimes, users will need to make minor changes to the networks associated with a chosen future scenario to get the network they want to test, such as by editing highway-link attributes, adding/removing highway links, or changing the attributes or routing of transit services. In such cases, it is suggested to use TransCAD toolboxes to prepare the networks. This section describes how to make these changes. Even if users are already familiar with the Map Editing and Route System toolboxes provided by TransCAD, this section still provides notes that are likely to be helpful to them.

Any network revisions should be made to the geographic files under the directory of \Input\Master Geography\. If users make any geographic changes to the highway network (adding/removing links, revising the shapes of links), they need to make sure that the transit network still works on the revised highway network. For details, refer to Section 4.1.1.3.

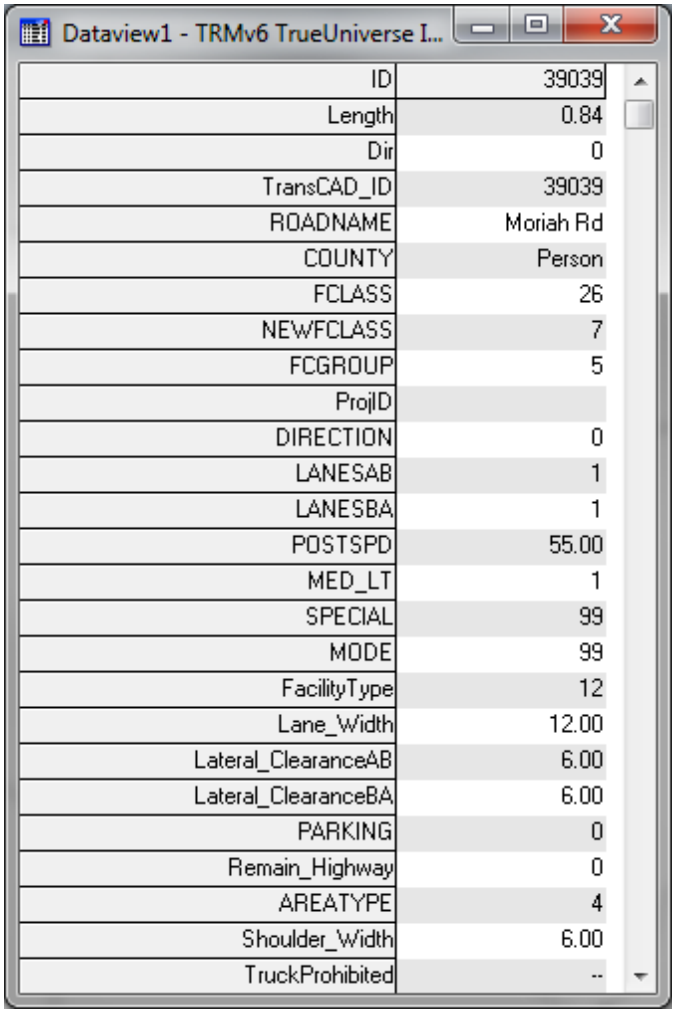
4.1.1.1 How to Edit Highway Link Attributes

1) Open highway.dbd, within "Model Scenario Folder\Input\Master Geography\".
2) It is suggested to show the node layer, so that the start and end points of links are clear (Hint: click the  button on the menu). Make sure to make the line layer the active layer in TransCAD, after making the node layer visible.



3) Zoom to the link that is to be edited, using the  and  tools in the default "Tools" toolbox, usually located on the right side of the screen.

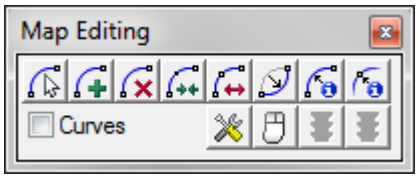
4) Click the button in the "Tools" toolbox, and then click on a network link. A "dataview" window will pop up. In this window, link attributes can be modified by double-clicking on the attribute to be modified. Only the second column (with a grey-and-white background) is editable. To see how attributes are coded, refer to Section 5.1.



ID	39039
Length	0.84
Dir	0
TransCAD_ID	39039
ROADNAME	Moriah Rd
COUNTY	Person
FCLASS	26
NEWFCLASS	7
FCGROUP	5
ProjID	
DIRECTION	0
LANESAB	1
LANESBA	1
POSTSPD	55.00
MED_LT	1
SPECIAL	99
MODE	99
FacilityType	12
Lane_Width	12.00
Lateral_ClearanceAB	6.00
Lateral_ClearanceBA	6.00
PARKING	0
Remain_Highway	0
AREATYPE	4
Shoulder_Width	6.00
TruckProhibited	--

4.1.1.2 How to Add/Delete Highway Links

1) Open highway.dbd, within "\Input\Master Geography\".
2) It is suggested to show the node layer, so that the start and end points of links are clear (Hint: click the button on the menu). Make sure to make the line layer the active layer in TransCAD, after making the node layer visible.
3) Open the Map Editing Toolbox by clicking "Tools"→ "Map Editing"→ "Toolbox" (or by clicking the button). If the necessary "Toolbox" menu item is greyed out, make sure that the link layer is the active layer. The Map Editing Toolbox looks like this:



4) The functions of each tool in the Map Editing Toolbox are briefly described below. For more detailed information, refer to the TransCAD User's Guide.

Tool	Name	How to use it
	Modify line	Click on a line to show its editing handles; drag handles to edit.
	Add line	Click on the map to add a new line.
	Delete line	Click on a line to delete it.
	Join lines	Click on an endpoint where exactly two lines meet to join the lines.
	Split line	Click on a shape point to split the line in two, or click on an endpoint to separate lines from each other.
	Replace line	Click on a line to change its shape without changing its endpoints.
	Configure Settings	Click to change settings.
	Save edits	Click to save edits.
	Cancel edits	Click to cancel edits.

Note:

- The following attributes are required for a model run and must have values: "Dir", "FClass", "NewFClass", "FCGroup", "Direction", "LanesAB", "LanesBA", "PostSpd", "Med_Lt", "Special", "Mode", "FacilityType", "Lane_Width", "Lateral_ClearanceAB", "Lateral_ClearanceBA", "PARKING", "Remain_Highway", and "Shoulder_Width". The attributes of "AreaType" and "FacilityType" will be assigned when the model runs. It is also suggested to fill in a value for "County" for AQ analysis.

- Before any joining/splitting action (using the "Join", "Split", or "Add" tools), make sure to configure the geographic editing settings first. "Add" could be a joining/splitting action, because if the starting or ending point of a new line is close enough to another line in the layer, TransCAD automatically splits the existing line to ensure that the existing line and the new line meet. The geographic editing settings tell TransCAD how to deal with link attributes for joining/splitting actions. For example, when a link is split into two parts, you might want to assign the same road name to both new links.

  To configure geographic editing settings, click , then click the "update" button in the "Configure Geographic Editing Settings" window.

- After a new link has been added, make sure that it has been connected to other links in the manner expected.

- Be mindful of which direction on a link is the AB direction and which is the BA direction.

Each link has a topology direction, pointing from a starting point to an ending point, when the link is created. The topology direction is designated "AB" and the opposite direction is designated "BA".

- Dir = 0 means the link is a two-way link, so that LanesAB > 0 and LanesBA > 0.
- Dir = 1 means the link is a one-way link and the flow direction is the same as the topology direction, so that LanesAB > 0 and LanesBA = 0.
- Dir = -1 means the link is a one-way link and the flow direction is against the topology direction, so that LanesAB = 0 and LanesBA > 0.

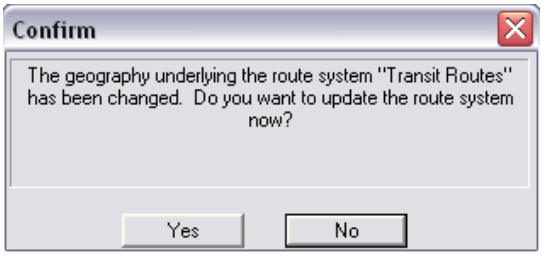
It is important to make sure that each combination of the values of Dir, LanesAB, and LanesBA are consistent with the above rules. In a TRMv6 model run, upon seeing the error message "referenced memory illegally", the first thing to check is whether Dir, LanesAB, and LanesBA are consistent.

For one-way links, it is important to verify that the traffic direction is correct, as not all one-way links' traffic directions are the same as their topology directions.

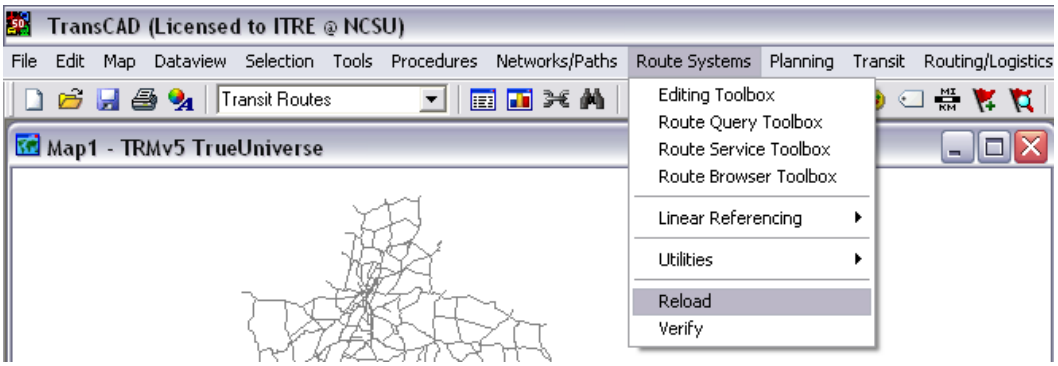
To show the topology or flow direction of a link, click the  button on the TransCAD main menu, choose the appropriate line layer, click "Style" button, and then choose an "Arrowheads" option in the "Style" window.

4.1.1.3 How to Check if Transit Network Is Affected by Highway Network Editing

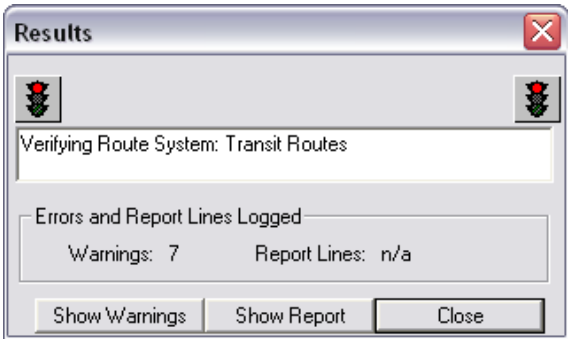
1) Keep a copy of the transit network from before any geographic editing (such as adding/deleting links), by copying the entire folder "\Input\Master Geography\" to another location.
2) Open transit.rts, within "\Input\Master Geography\". Open the file with a file type of "Route System (*.rts)", instead of "Geographic File (*.cdf;*.dbd)". Do not open *.rts files from "\Input\Transit\".
3) If any geographic editing has been done, a popup window will appear when you open the transit.rts file, as shown below. Click the "Yes" button to update the route system.



4) Choose "Route Systems" → "Reload" to reload the route systems.



5) Choose "Route Systems" → "Verify" to verify connectivity, link directions, and route stops.
6) If there are any problems in the transit-route system, TransCAD will present a warning window.



7) To check the error messages, click "Show Warnings". Internet Explorer will be opened. Scroll down to the end of the resulting screen to see the error messages. An example error message is shown below.

```
TransCAD 4.8 session started by cwang on TRM159 at Thu Jan 03 14:46:33 2008
          Thu Jan 03 14:57:02 2008
               Route 187 is not connected near link 21818
               Route 188 is not connected near link 10786
               Route 189 is not connected near link 10786
               Route 190 is not connected near link 21818
          Verifying Route System: Transit Routes
               Route 190 is not connected near link 21818 .  Click OK to continue.

Reference info: tcroute, 1482, 0.
```

In this example, four routes are not connected, near links 10786 and 21818. The user has to use the Route System Editing toolbox to fix these problems. For more details, refer to Section 4.1.1.5.

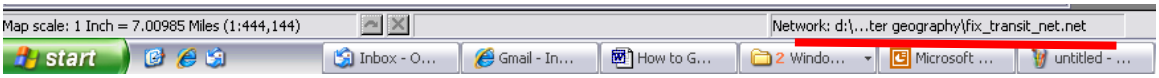
4.1.1.4 How to Edit Transit-Route Attributes

1) Open transit.rts, within "Model Folder\Input\Master Geography\".

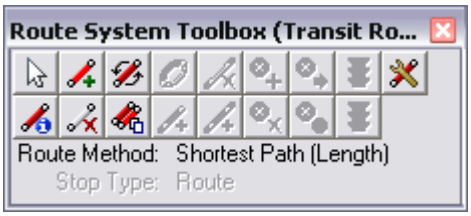
2) Make sure that the transit route layer is the active layer. Open the transit route layer's dataview window by clicking on  in the menu.
3) Users can edit any cell in the dataview by clicking on it and entering a new value. To see how these attributes are coded, refer to Section 5.1.

4.1.1.5 How to Make Geographic Changes to a Transit Route System

1) Open transit.rts, within "Model Folder\Input\Master Geography\".
2) Choose "Procedures" → "Networks/Paths" to activate the "Networks/Paths" menu (if there is already a check sign next to "Networks/Paths" under "Procedures", skip this step).
3) Create a network file by choosing "Networks/Paths" → "Create".
4) In the "Create Network" window, do not change anything; just click the "OK" button to save the network file. After creating the network file, it will open automatically, although the user will not be able to see any changes other than a line at the bottom of the window.



5) Choose "Route Systems" → "Editing Toolbox" to open the Route System toolbox.



6) The functions of frequently-used tools within this toolbox are briefly described below. For more details, refer to the TransCAD User's Guide.

Tool	Name	Function
	Select	Selects one or more routes or stops on a route.
	Delete Section	Deletes a section of a route.
	Add Section	Inserts a new section into a route.
	Add a Stop	Adds a stop to a route.
	Move a Stop	Moves a stop on a route.
	Set Options	Sets route-system edit options.
	Save edits	Saves changes made to a route.
	Cancel edits	Discards changes made to a route.

7) Choose "Route Systems" → "Reload" and "Route Systems" → "Verify" to check if the transit network is working properly.

Note:

Before adding a new route section to repair a disconnected route with the "Add Section" tool, it is suggested to change the edit options via "Set Options", use the "Click Segments" method, and

uncheck "Editing uses route direction", so that users can click links one-by-one to define the route section, without having to consider whether they are consistent or inconsistent with the route direction (TransCAD determines the direction, based on the rest of the route).

4.1.2 Preparation of Networks Using Network Manager

Network Manager was developed for creating and managing different scenarios of highway and transit networks for the Triangle Regional Model. More information on Network Manager may be found in the separate *User's Guide for NetManager 2.0*.

The tool consists of two major components, one each for highway network and transit network management. The highway tool operates on the True Universe line layer, while the transit tool operates on the scenario highway network, which can be created using the highway tool.

The highway tool consists of two components, one for creating and managing highway projects, and the other for creating and managing scenario highway networks. The former is called "Create Project" and the latter is called "Create Scenario". Examples of highway projects are adding new highway links, closing highway links, changing link attributes (such as adding a lane), adding centroid connectors, or adding transit-only links (including light rail lines). Each highway project can be regarded as a group of changes to the True Universe line layer, and it is the basic unit that can be used to build up a scenario highway network. A scenario highway network includes not only highway links, but also links that serve as underlying lines for transit routes (such as light rail lines). It becomes the "highway.dbd" file within the "Master Geography" folder for the TRMv6 model. It can be created by selecting highway projects and adding them to the base-year highway network.

The transit tool also consists of two components. One is called "Create Transit Route System". It creates and manages transit routes, one by one. It should be used when the underlying scenario highway network is not significantly changed. If the underlying scenario highway network is significantly changed, the other component of the transit tool, "Re-create Transit Route System", should be used.

The TRMSB created the *User's Guide for NetManager 2.0*, which describes the functions and procedures of Network Manager in great detail. This section only focuses on the concept and basic ideas of the tool and how it is used to develop transit networks for the TRMv6 model. For specific functions and procedures, the *User's Guide for NetManager 2.0* must be referred to.

4.1.2.1 Highway Tool

The highway tool operates on the True Universe line layer (TrueU). A True Universe line layer for the TRMv6 is maintained by the TRMSB. It includes the base-year network (2013), all 2045 MTP projects, and some CTP projects. It also includes some projects for public-transit purposes, serving as underlying lines for future transit routes.

Network Manager is a powerful tool, and users can employ it to complete network preparations in any way they choose. Figure 4-1 shows a typical flow chart for using Network Manager to create a scenario highway network; the words in quotation marks are functions provided in Network Manager. For specific functions and procedures, the *User's Guide for NetManager 2.0* must be referred to.

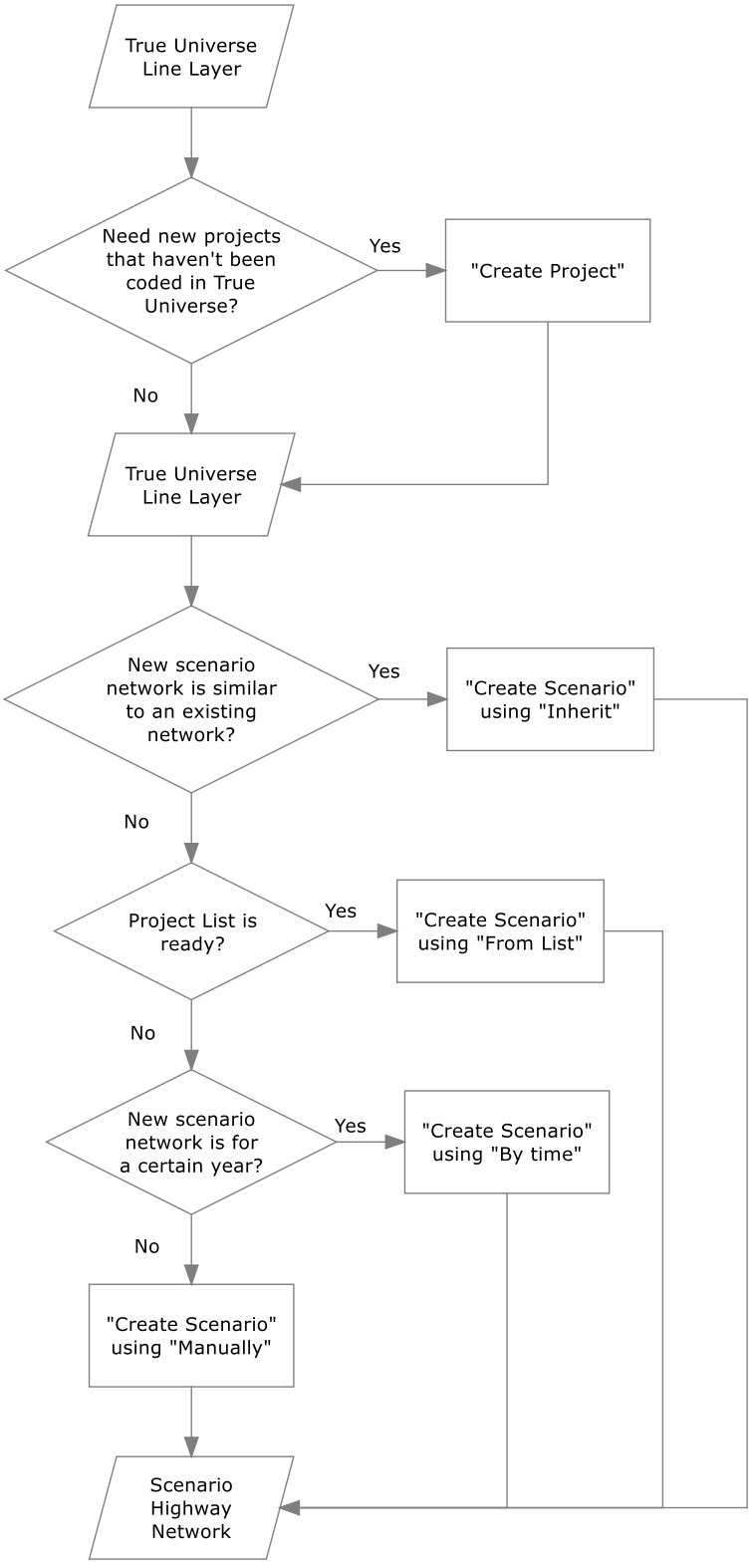
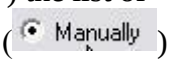
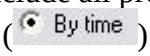


Table 4-1 Flow Chart for Using Network Manager to Create a Scenario Highway Network

Figure 4-1 shows that if the True Universe line layer does not include the projects the user wants to test, they must first code the projects in the True Universe line layer, using the "Create Project" function (icon = ) in Network Manager. Users have several choices with regard to creating a scenario highway network (icon = ). If a new scenario network is similar to an existing network whose "Project List.bin" file exists, users can "inherit" (

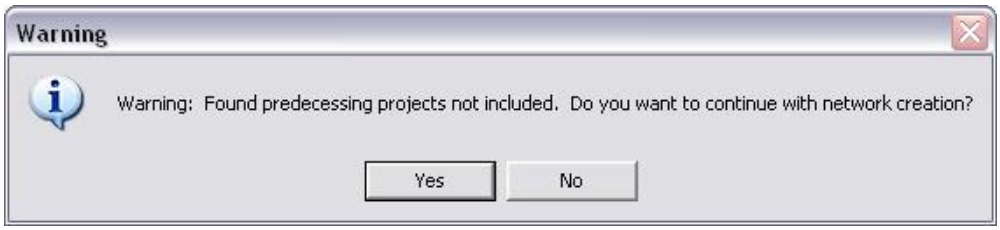
) the list of projects from the existing network and make any necessary changes by "manually" (

) selecting which projects should be included or removed. If users are able to create a list of IDs of projects that they want to include in the scenario highway network, they can use the "From List" function (

). If users want to include all projects from before a certain year (such as 2017), they can use the "By time" function (

). Users can always modify the list of projects using the "manually" function. After clicking the "Create" button, a scenario highway network (named "highway.dbd") is created, as well as a file called "Project List.bin", which is a list of projects included in the scenario highway network.

A common warning message in the creation of scenario highway networks is shown below:



This warning message is related to predecessors, projects without which building a particular other project would be impossible or not make sense. A typical situation is one where a project has multiple phases, and phase II cannot be built until phase I is completed. After clicking the "No" button on the warning message, Network Manager will show the project IDs of the predecessors.

When selecting projects to be included in a scenario highway network, users need to pay special attention to transit-related projects. These could be transit-only links (such as community roads that are too small to be included in the highway network but are used by local buses), rail lines, or park-and-ride links. Although automobiles will not run on these links, they are important underlying lines for building the transit network. Such transit-related projects are normally not LRTP projects, and users need to make sure that they are included in the scenario highway network.

In the current True Universe line layer, some general coding rules were followed for assigning project IDs. Although these rules were not followed for all projects due to certain historical reasons, they can help users get some information from project IDs. The major coding rules are listed in Table 4-1.

Table 4-2 General Project ID Coding Rules

Project ID Coding Rule	Examples	Notes
Number only	76, 77.1	DCHC MTP projects
"A" + number (+ letter(s))	A10, A135a	CAMPO MTP projects (excluding freeway projects) in Wake County
"F" + number (+ letter(s))	F3, F44a	CAMPO freeway MTP projects in Wake County
"Frnk" + number	Frnk1	CAMPO MTP projects in Franklin County
"Grnv" + number (+ letter(s))	Grnv105, Grnv84c	CAMPO MTP projects in Granville County
"Hrnt" + number	Hrnt3	CAMPO MTP projects in Harnett County
"Jhns" + number (+ letter(s))	Jhns1a, Jhns7	CAMPO MTP projects in Johnston County
"CAMPO" + number	CAMPO01	CAMPO projects that are not in the MTP project list
"DCHC" + number	DCHC02	DCHC projects that are not in the MTP project list
SnDns05		Changes of signal density, based on 2005 field-data collection
Speed05		Changes of posted speed limit, based on 2005 field-data collection
Lanes05		Changes of number of lanes, based on 2005 field-data collection
MedLT05		Changes of median/left-turn-lane information, based on 2005 field-data collection
SpeedAdj		Speed adjustment due to lane use (reduce speed limit, considering urbanization in 2020)
"FLY" + number	FLY1	Flyover project on I-40 for transit purpose (coded by MAB)
"STAC" + number (+ letter(s))	STAC4, STAC17C	Underlying lines for transit services planned in STAC (coded by MAB)
Transit agency + number (and/or letter(s))	CAT8C, CHT-CL	Underlying lines for transit services of given transit agency

4.1.2.2 Transit Tool

The transit tool operates on the scenario highway network, which can be created using the highway tool. A highway network derived from other sources or using other methods can also serve as a scenario highway network. For example, users can follow the instructions in Section 4.1.1 to modify a highway network using TransCAD toolboxes and use that modified network as a scenario highway network.

Users may employ Network Manager to complete network preparations in any way that they choose. Figure 4-2 shows a typical flow chart for using Network Manager to create a transit network. The words in quotation marks are functions provided in Network Manager. For specific functions and procedures, the *User's Guide for NetManager 2.0* must be referred to.

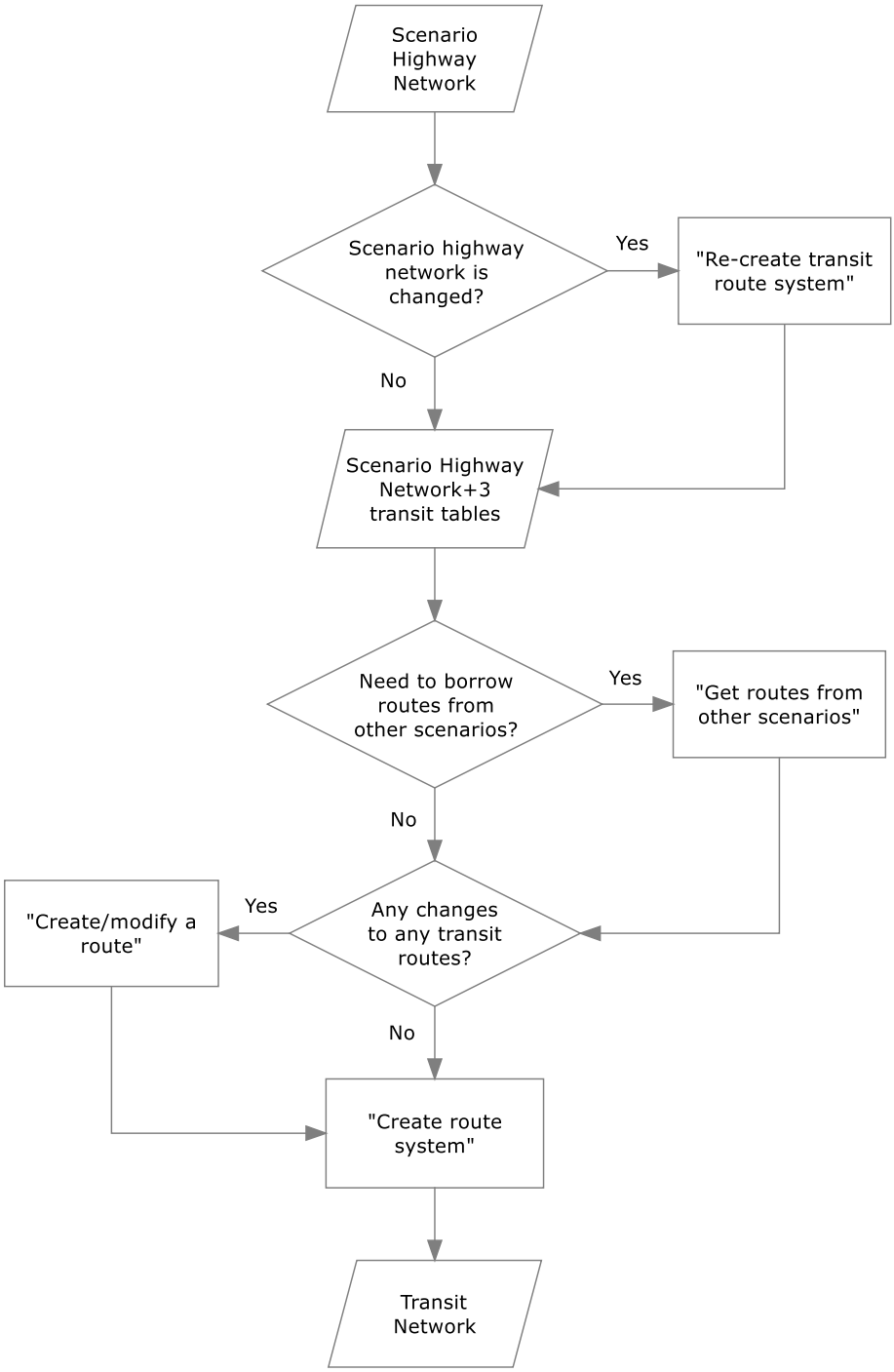
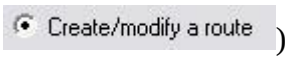


Table 4-3 Flow Chart for Using Network Manager to Create a Transit Network

Figure 4-2 shows that if the scenario highway network has not been modified, users can go directly to the step of borrowing routes. Transit routes coded by the TRMSB can be borrowed for any scenario highway network to save the time, using the "Get routes from other scenarios" function (Get routes from other scenarios). Users can code new routes, remove or modify existing routes, or change route attributes with the "Create/modify a route" function (



). Whenever routes are changed, three transit-related tables are modified to record the changes: "Route_Table.bin", "Link_Table.bin", and "Stop_Table.bin". In the final step, "create route system" (icon = ), Network Manager creates a transit network based on these three tables and the scenario highway network.

Figure 4-2 also shows that if the scenario highway network has been modified, users can employ the "re-create transit route system" function (icon = ). To use this function, users need an existing scenario highway network and the three transit-related tables discussed above. The "re-create transit route system" function modifies these three tables to fit the modified scenario highway network. "Create route system" can then be used to produce a transit network.

The TRMv6 may detect errors in the highway or transit network during the "Create Network" step, causing the model to stop. In that event, users must use the information in the error message to modify the route system in Network Manager and recreate the transit network. This process may be time-consuming, because it usually takes about two hours for the TRMv6 to run from its first step ("Create Walk Access") to the point where it fails during the "Create Network" step. Therefore, you should attempt to fix all errors in one iteration.

4.2 Socioeconomic Data File

Socioeconomic (SE) data (in \Input\SEData\) are normally provided by local planners. For the types of SE data that are needed in the TRMv6, refer to Section 5.1.

If not enough information is available or the schedule is very tight, SE data can also be created by interpolation, if users think such data can meet the modeling need in question. SE data for two model years (e.g., 2013 and 2045) are required to interpolate SE data for a given model year (e.g., 2017).

The TRMSB developed a GISDK script, "Check SE Check and Network Attributes", to help in the preparation of socioeconomic data. Users can apply this tool to check if the relationships between the fields in the new SE data table are reasonable. The tool can be accessed by selecting the "Toolbox" button in the TRM GUI.

The tool checks SE data using the following criteria. If any errors are found, a message pops up, showing the type of error. Users must to go into the SE data file to fix any problems.

- No data fields should contain negative values
- Households, HH_Pop, and mean income for a TAZ should either all be zero or all not be zero
- Each off-campus student is counted as one person in the population (HH_Pop); therefore, the number of off-campus students should always be less than or equal to population

- The average household size for a TAZ should either be zero or greater than one (usually between 2 and 3), but should not be greater than five if the TAZ has at least six households
- The percentage of commercial vehicle trips in ADT (PCTAV) should not be greater than 100
- The percentage of EE trips among automobile trips (PCTAUTOEE) should not be greater than 100
- The percentage of EE trips among commercial vehicle trips (PCTCVEE) should not be greater than 100

The area-type field "ATYPE" in the SE data file is calculated and filled automatically during the model run, via a GISDK script. It is calculated using the following equation:

$$LUD_i = \frac{DWELLUNIT_i + UBEDS_i + \frac{\sum_j TotalHH_j}{\sum_j TotalEmp_j} \times TotalEmp_i}{Area_i}$$

If $LUD_i \geq 2000$, Area Type for TAZ i is 1,

If $150 \leq LUD_i < 2000$, Area Type for TAZ i is 2, and

If $LUD_i < 150$, Area Type for TAZ i is 3,

where

LUD_i = Land Use Density of TAZ i,

$Area_i$ = area of TAZ i,

$TotalHH_j$ = total households in TAZ j,

$\sum_j TotalHH_j$ = total household in the region,

$TotalEmp_j$ = total employment (Industry + Retail + Office + Service_RateLow + Service_RateHigh) in TAZ j, and

$\sum_j TotalEmp_j$ = total employment in the region.

4.3 Preparing Synthesized Population

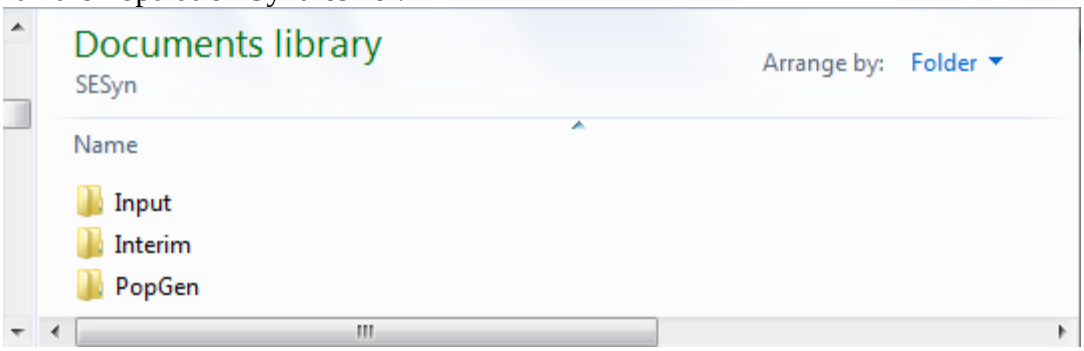
TRMv6 includes a module for synthesizing households and persons living in the model region. Preparing the synthesized population uses the PopGen tool developed by Arizona State University and installation of PopGen is described at the end of the User's Guide. There

are three parts to the process: 1) preparation of household marginal values, 2) running PopGen, and 3) processing the PopGen output for use in trip generation.

4.3.1 Preparation of Household Marginal Values

Population synthesis in TRMv6 uses PopGen to develop a synthesized population with household and person characteristics (size of household, number of children, workers, seniors, household income, and type of employment). PopGen requires these household and person controls at the desired level of geography (TAZs for TRMv6). The creation of the control total input files is based on the application of a disaggregate model. The disaggregate model uses files of households by size and households by income for each TAZ to generate additional household and person characteristics that are associated with similar household by size and income combinations contained in the 2006-2010 Public Use Microdata Sample data. For 2010, the households by size for each TAZ were developed from households by size at the census block level using 2010 census SF1 tables. Households by income for each TAZ were developed from American Community Survey (ACS) data for 2006-2010 at the census block group level. Preparing forecast households by size and households by income tables for scenarios is the first step in preparing forecast synthesized population. The tables can be prepared in any way appropriate for the forecast scenario.

The first step to prepare the household marginal values is to run the disaggregate model script. Running the script requires a directory structure of: /[TRM scenario folder]/SESyn. The file set delivered with TRMv6 contains the directory structure and programs needed to run the Population Synthesizer.



To access the Disaggregate Model script in the TRMv6 user interface, select "**Toolbox" → "Create Synthesized Population" → "Run Disaggregate Model"**. During the model run, you will be prompted to select the Model Year SESyn directory, the Model Year Socio-economic data file (usually under SESyn/Input/SEData), and the Model Year Traffic Analysis Zone file (usually under SESyn/Input/Master Geography). Note that the households in the socio-economic file and household population should be consistent with the number of households in the household size file. The household population in the socio-economic file should be calculated including the average size for six-plus person households at the county level or lower level geography if available. Once the input items have been selected, the script automatically begins to generate the control totals that will be used for the next step of converting the control totals to a format compatible with PopGen. The disaggregate model takes approximately 40 minutes to complete.

The second step in creating the household marginal values is to convert the control totals into two files for use as input to PopGen; household and person control files. The disaggregate model creates an output file called "TAZMarginalControls.dbd" located in the SESyn/Input/Master Geography directory. This is used for input to the conversion process.

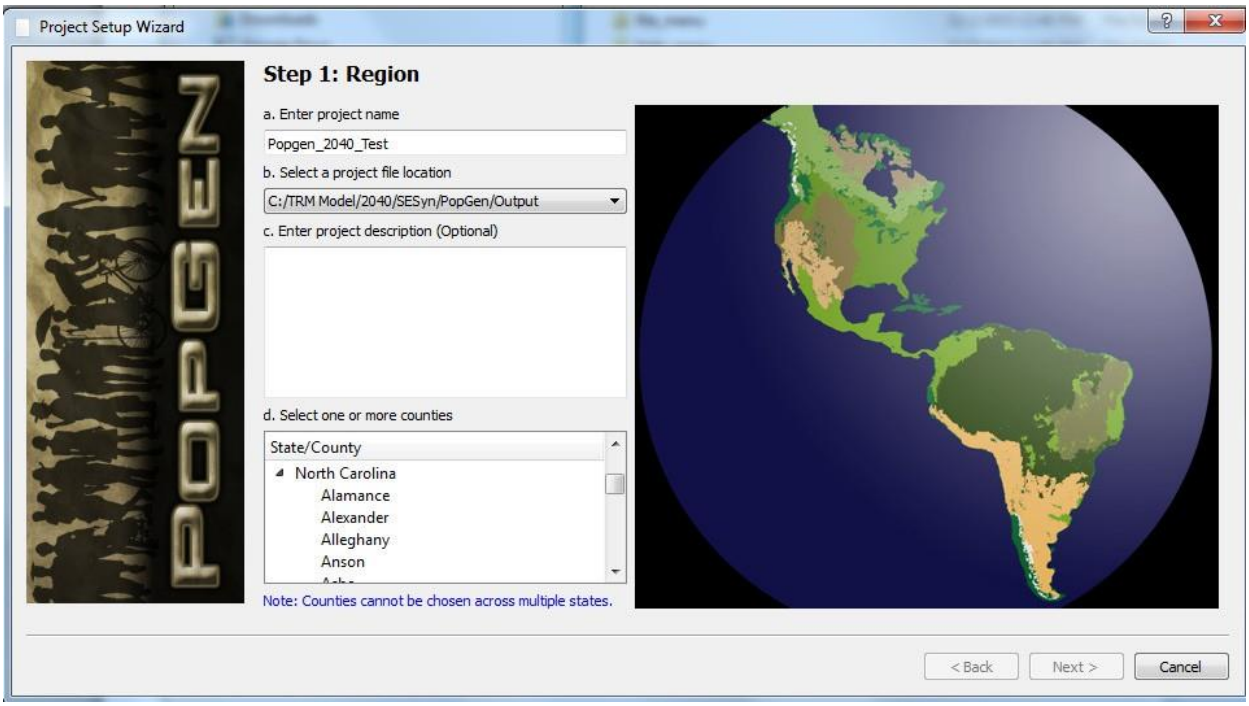
To access the Conversion script in TRMv6, select "**Toolbox→Create Synthesized Population→Create PopGen Input Files**." During the macro run, you will be prompted to select the Model Year SEData directory the TAZMarginalControls.bin file, the Interim file directory (this directory can be located anywhere), and the Model Year PopGen Input directory. The conversion process should take less than one minute to complete. Once complete, the next step is to run PopGen. PopGen is a separate application that runs outside the TRM user interface. This must be completed before proceeding with the final step in the Population Synthesizer Toolbox (Convert PopGen Outputs). The next section will describe how to start a PopGen model run. If you have not already installed PopGen, please see installation instructions at end of this User's Guide.

4.3.2 Completing a PopGen Model Run

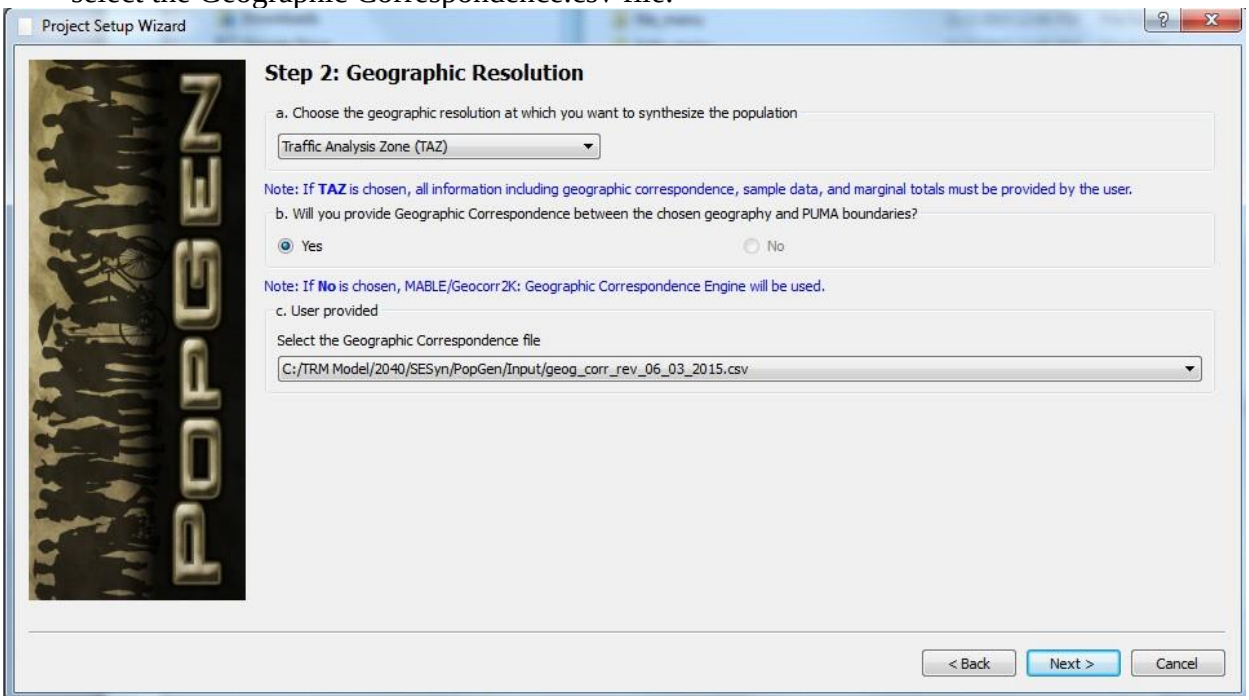
Once the conversion step is complete, the next step is to complete a PopGen model run. The output of the conversion script are five files:

- Geographic Correspondence.csv
- hh_marginals.csv
- per_marginals.csv
- hh_sample.csv
- per_sample.csv

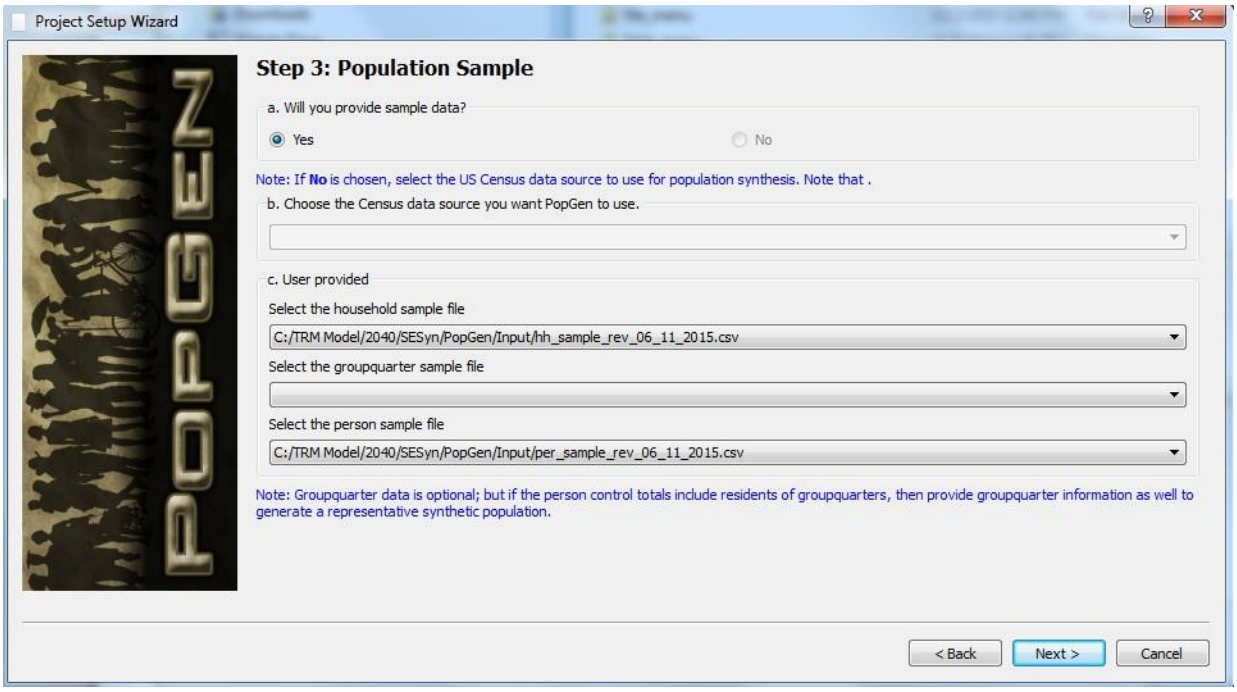
These files are located in the SESyn/PopGen/Input directory and are used as inputs for the PopGen model run. Start PopGen from Windows and when open, create a new project by choosing **File→New Project**. Next, select a project name, choose a location to save the project outputs (usually **dir:/Model Year/SESyn/PopGen/Outputs**) and select the counties that make up the Triangle Model Region (Chatham, Durham, Franklin, Granville, Harnett, Johnston, Nash, Orange, Person, Wake). Hold down the Ctrl key to select multiple counties.



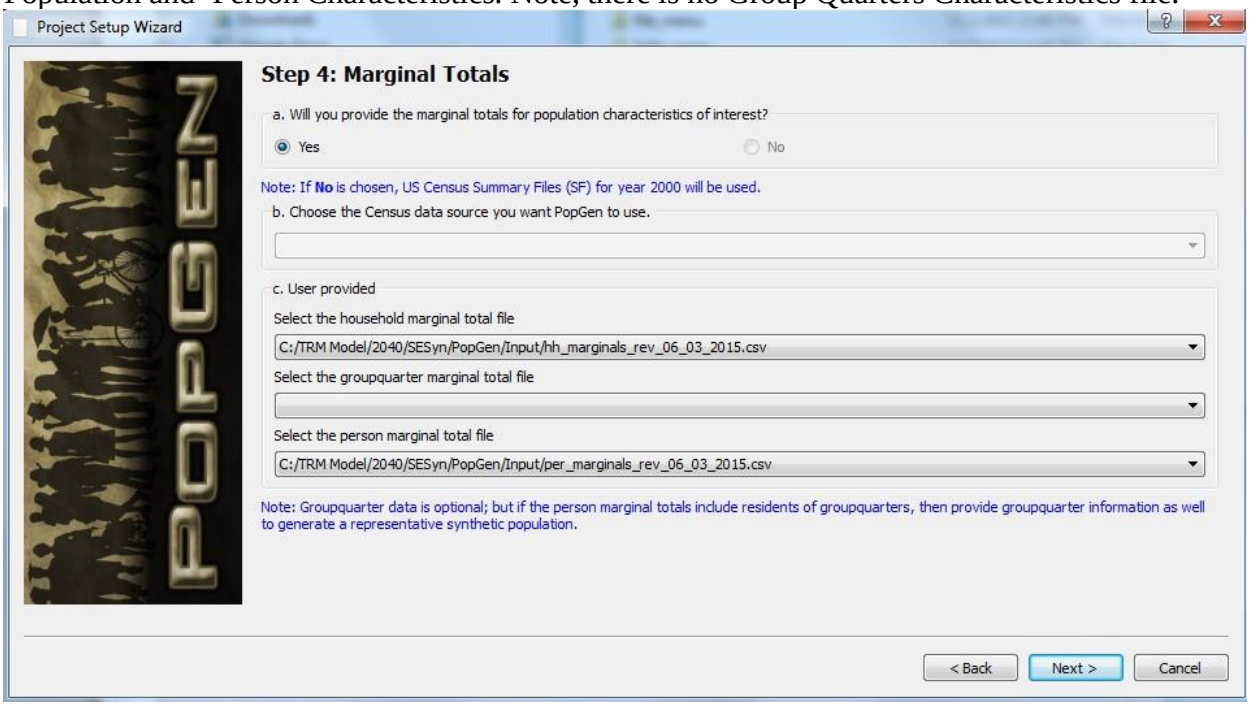
Next, choose the Geographic Resolution at which the population would be synthesized: for TRMv6 the geography is TAZ. Select 'Yes' to option B since you will be providing the Geographic Correspondence file that relates TAZs to PUMA boundaries. Then browse to select the Geographic Correspondence.csv file.



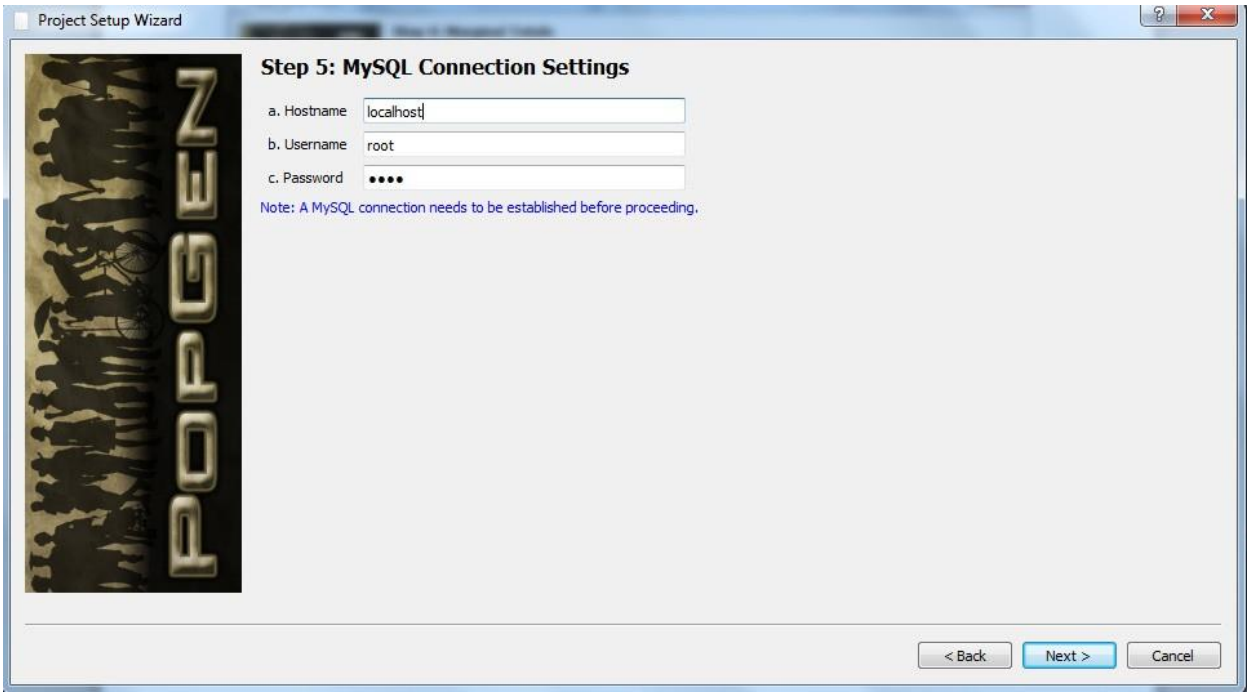
Next, select the household and person sample files. There is no Group Quarters Sample file.



Next, select the household and person marginal files that will be used to identify the Population and Person Characteristics. Note, there is no Group Quarters Characteristics file.

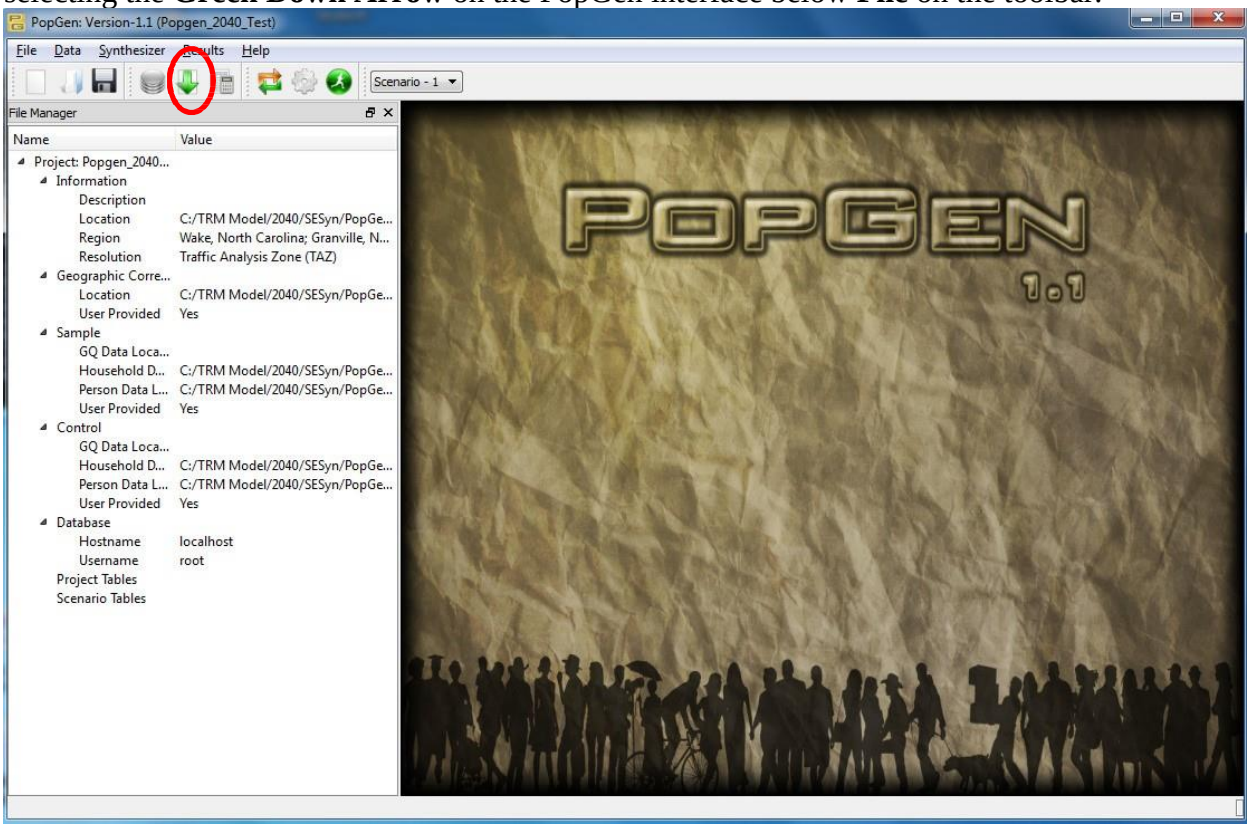


Next, provide the connection string information required to connect to the database that was created during the installation of PopGen (usually **Hostname:** localhost, **User:** root, and password).

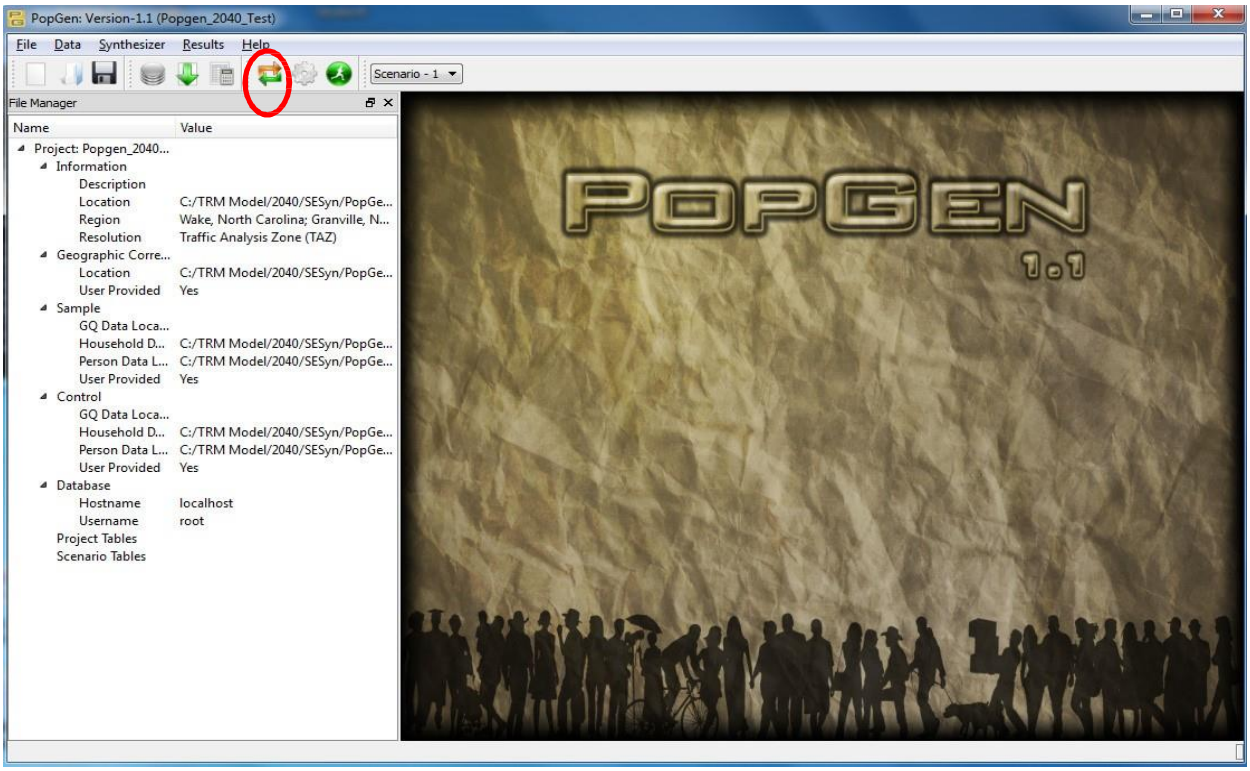


Next, review the summary settings to make sure they are correct and click **Finish**.

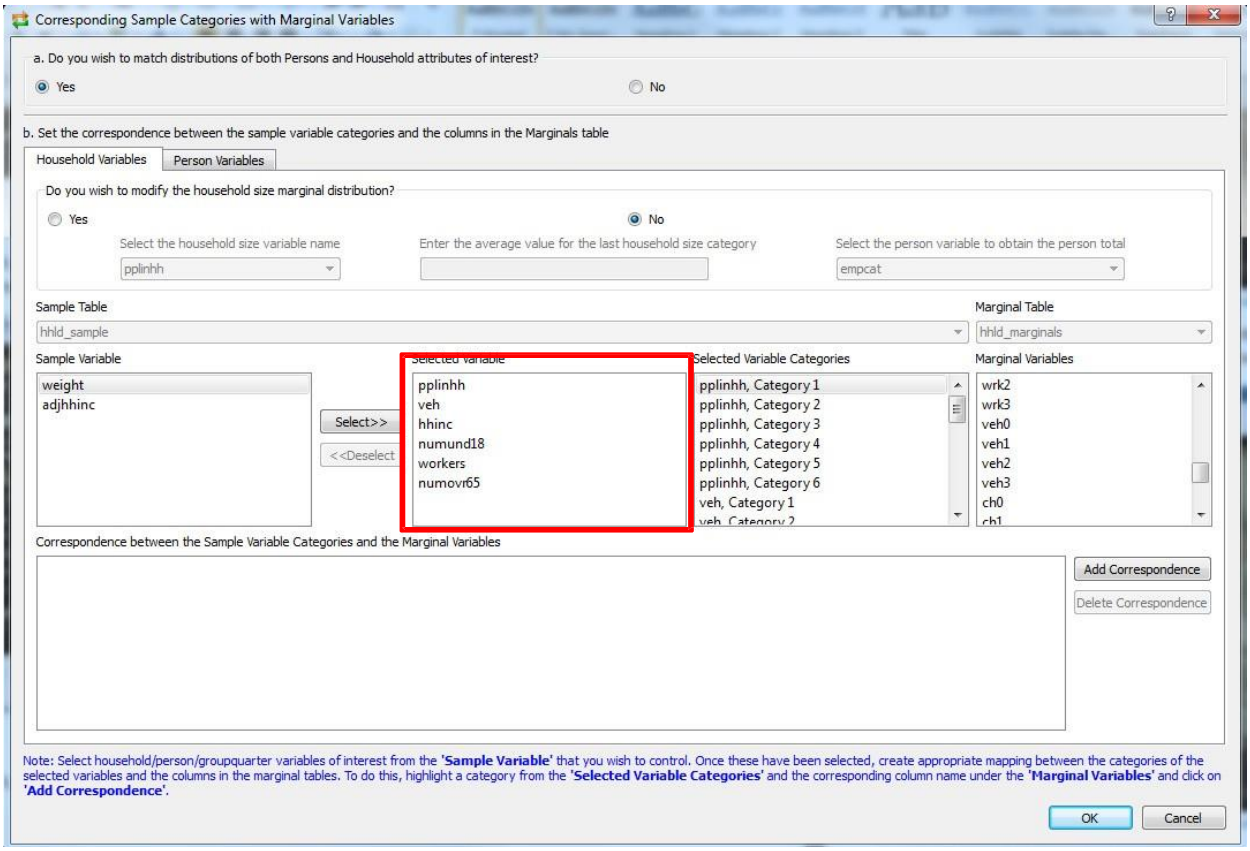
The next step is to import the data into the MySQL database, and this is accomplished by selecting the **Green Down Arrow** on the PopGen interface below **File** on the toolbar.



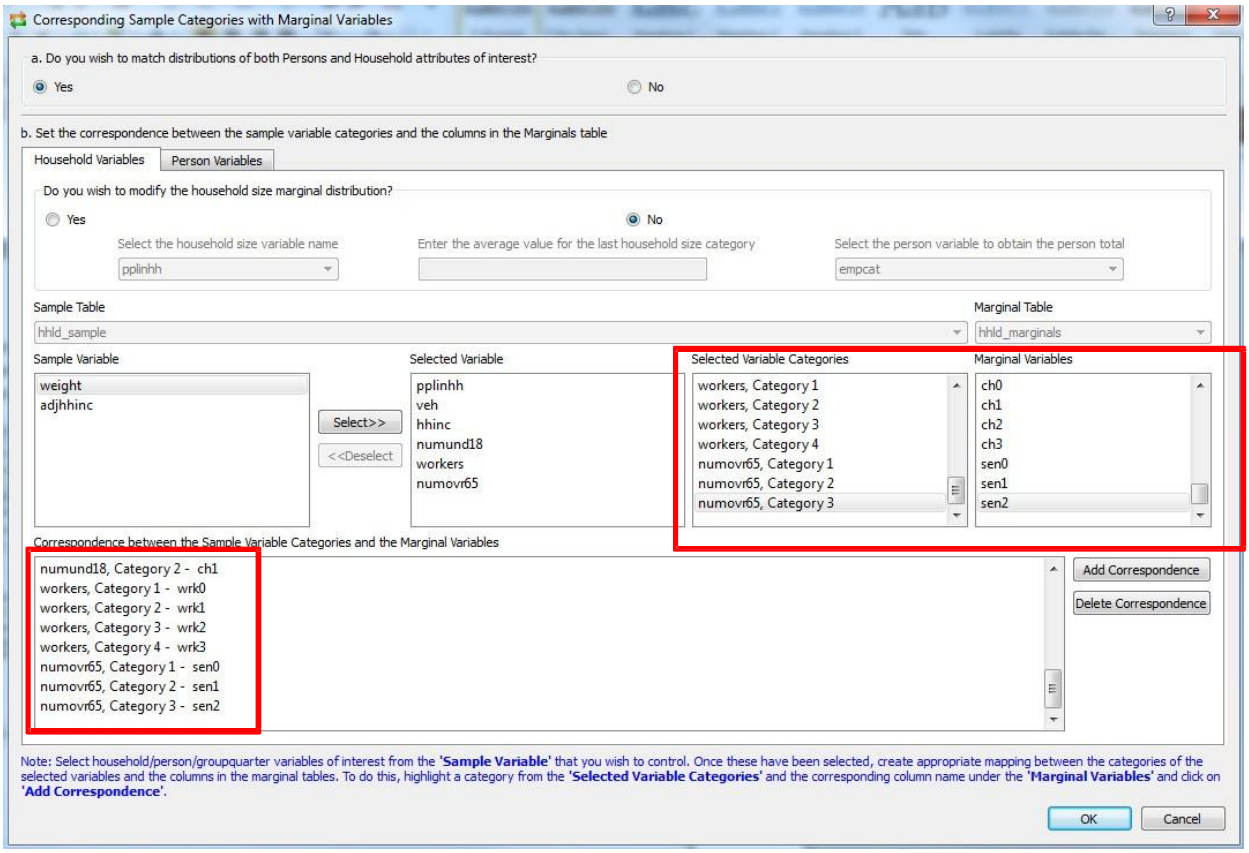
Once the import is complete, the correspondence map between the variables in the Control File and the variables in the Sample File must be established. Select the correspondence tool on the toolbar to begin the process.



There are six Household sample variables that should be selected for this analysis: People in Households (pplinhh), vehicles per household (vec), household income (hhinc), children in household (numund18), workers in household (workers), and seniors in household (numovr65).

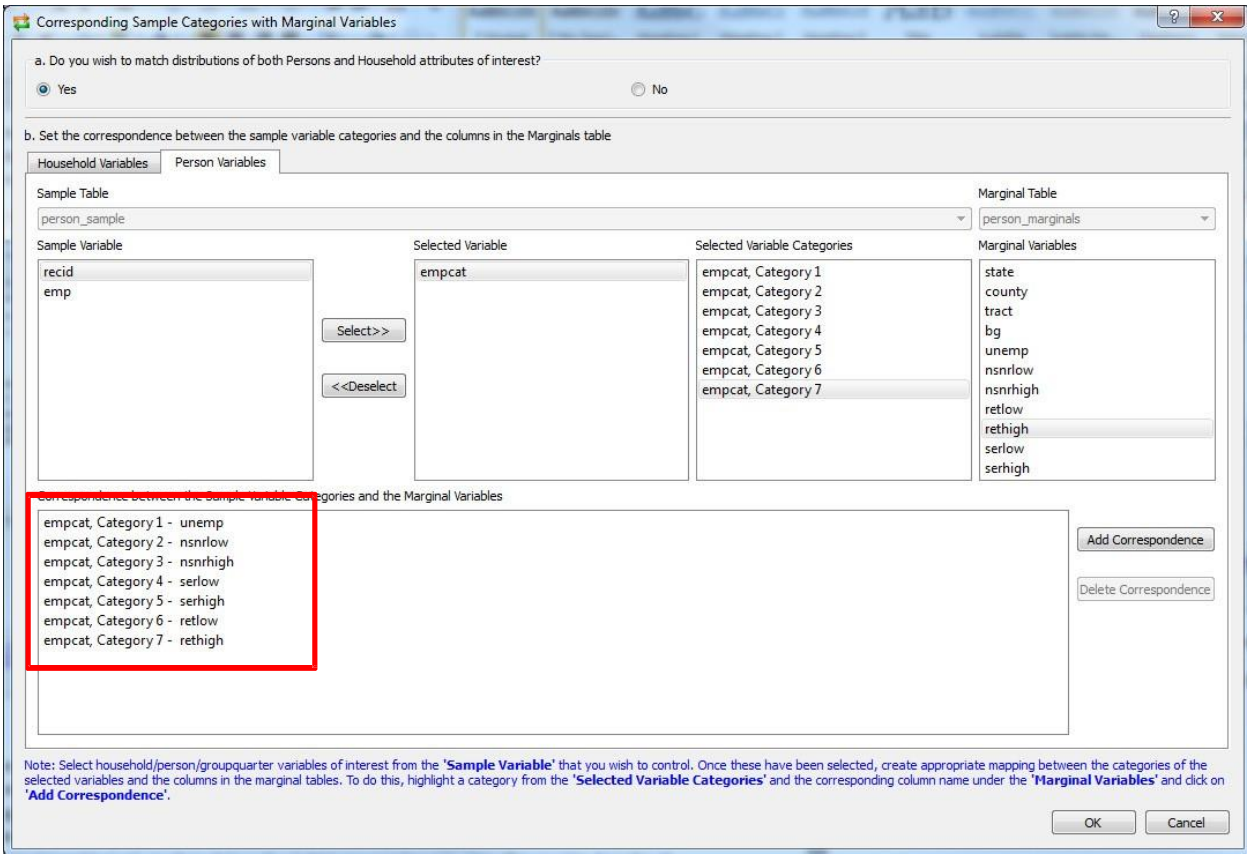


For each Household sample variable, there are a specific number of categories associated with it. Each Household sample variable category must be mapped to the corresponding control total variable category from PUMS. This is accomplished by clicking on the Household sample variable category in the 'Selected Variable Categories' column and its corresponding PUMS control total variable category in the 'Marginal Variables' column, then clicking the 'Add Correspondence' button. This must be done for all variable categories. **IMPORTANT:** For TRMv6, **Vehicles, Children, Workers and Seniors…**Category 1 corresponds to zero **ie…**zero vehicles, children, workers, seniors in the household. This results in the Household Sample variable category being one less than the PUMS control total variable category. Household Income categories correspond to Low, MedLow, MedHigh, High.

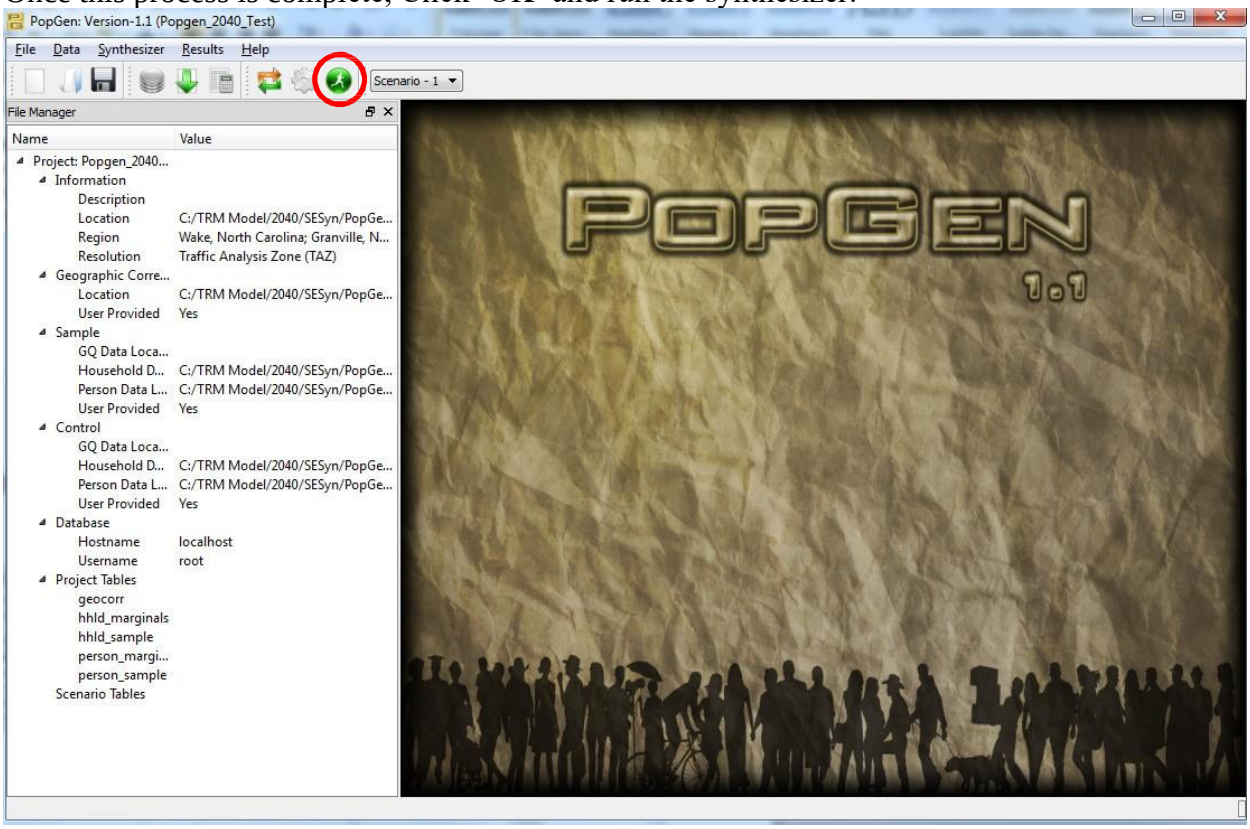


The same process must be completed for Person Variable 'Employment Category'.

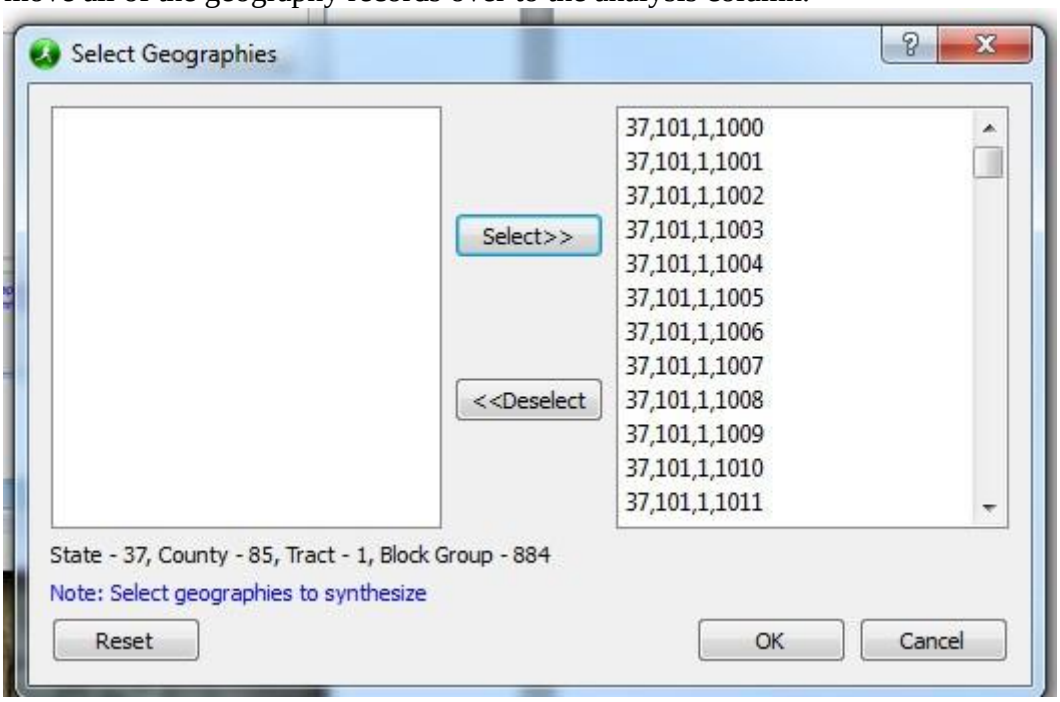
IMPORTANT: Employment Categories 4 and 5 correspond to Service Low and High. Categories 6 and 7 correspond to Retail Low and Retail High. See below:



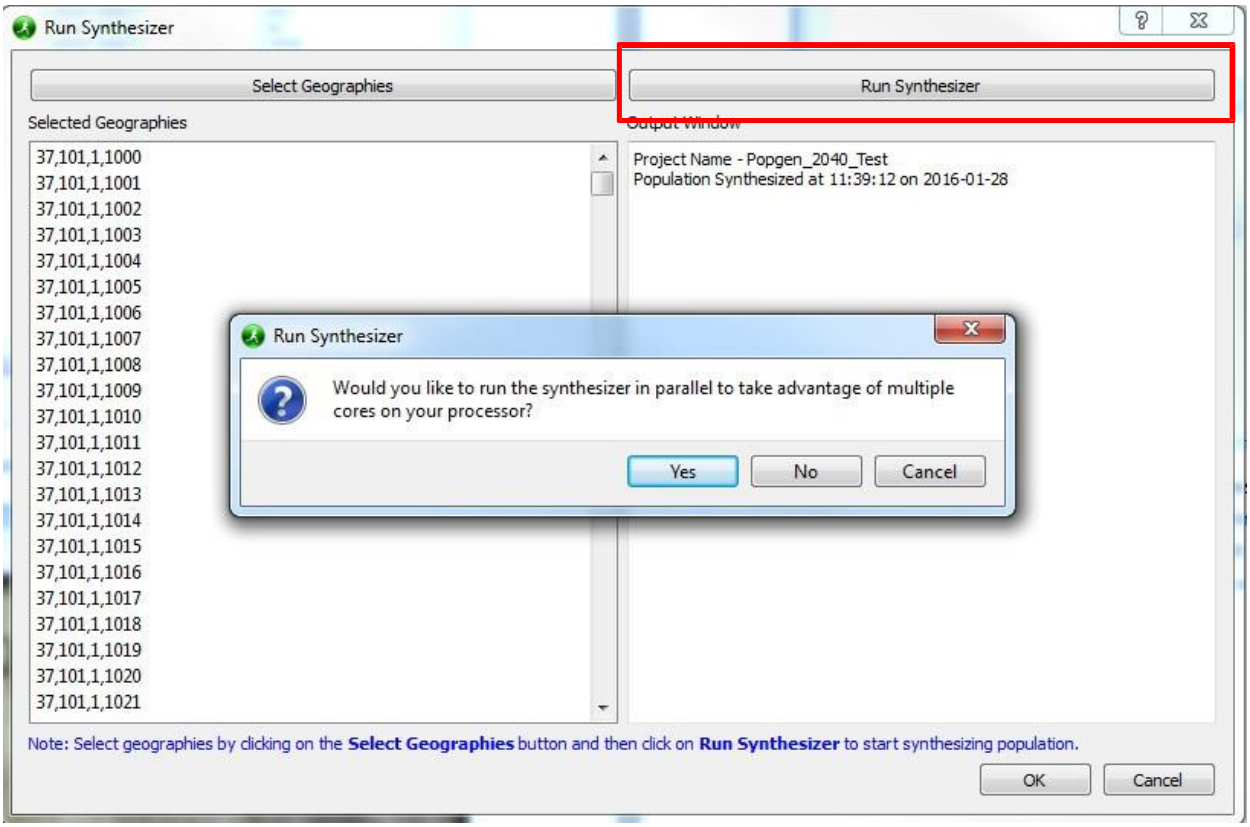
Once this process is complete, Click 'OK' and run the synthesizer:



Next, click 'Select Geographies' to load all of the geographies to be synthesized. Select them all by clicking the first geography record, then holding down 'Shift' on the keyboard while scrolling down to the last record and selecting the last geography record. Click 'Select' to move all of the geography records over to the analysis column.

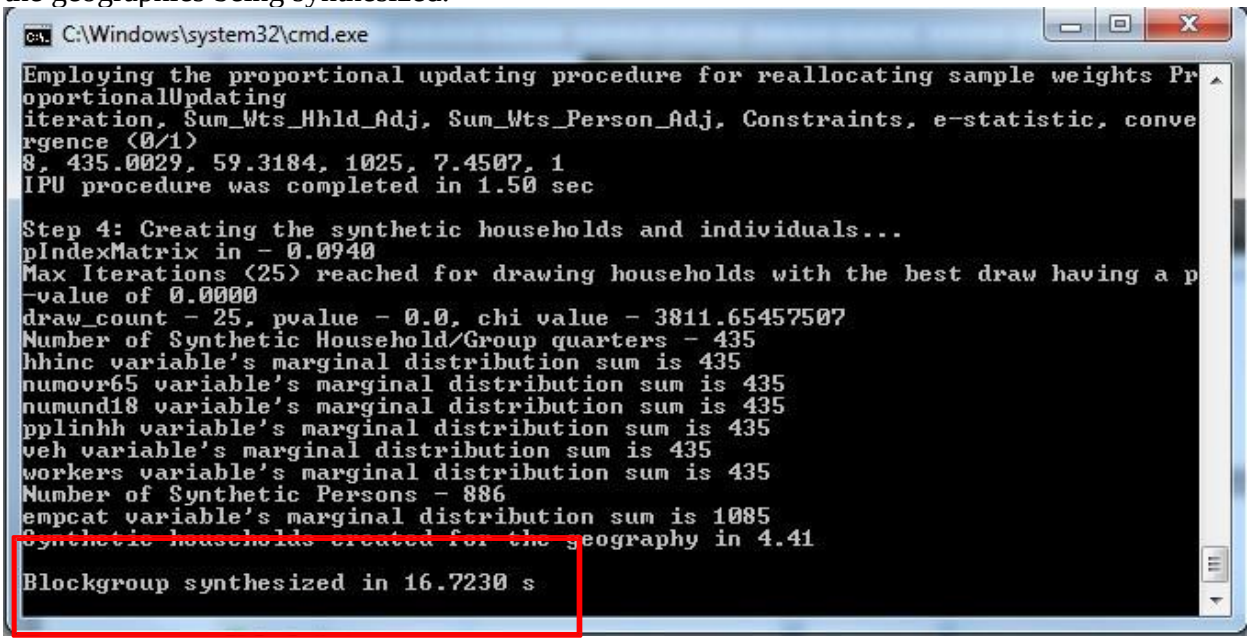


The next screen confirms the selected geographies to be synthesized. Click 'Run Synthesizer' to begin the model run. After a few seconds, a prompt asking to run the synthesizer using multiple computer processor cores (if applicable) on your system will be shown. Click 'Yes' to run the synthesizer using multiple cores (reduces run time) or 'No' to run on a single core as below.

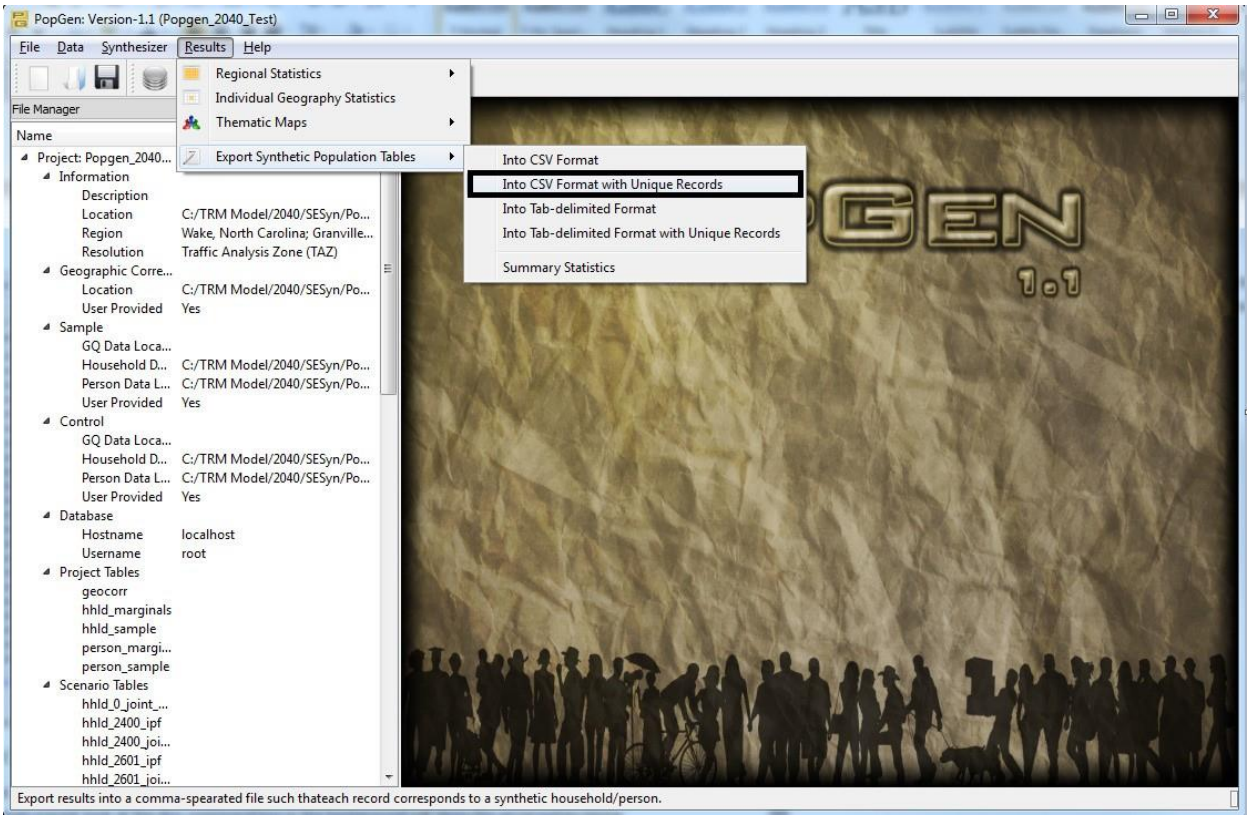


Once 'Yes' or 'No' is selected, the model will begin to run.

Note: the PopGen interface will appear to be frozen with no indicator the model is actually running, however a quick look at the DOS command window in the background will show the geographies being synthesized.



Once the PopGen run is complete, click 'OK' to exit the Run Synthesizer dialog. In the PopGen GUI, choose **Results→Export Synthetic Population Tables→Into CSV Format with Unique Records.**



Next, browse to the preferred output location to export the "housing_synthetic_data.csv" and "person_synthetic_data.csv" files and export the appropriate household and person variables.

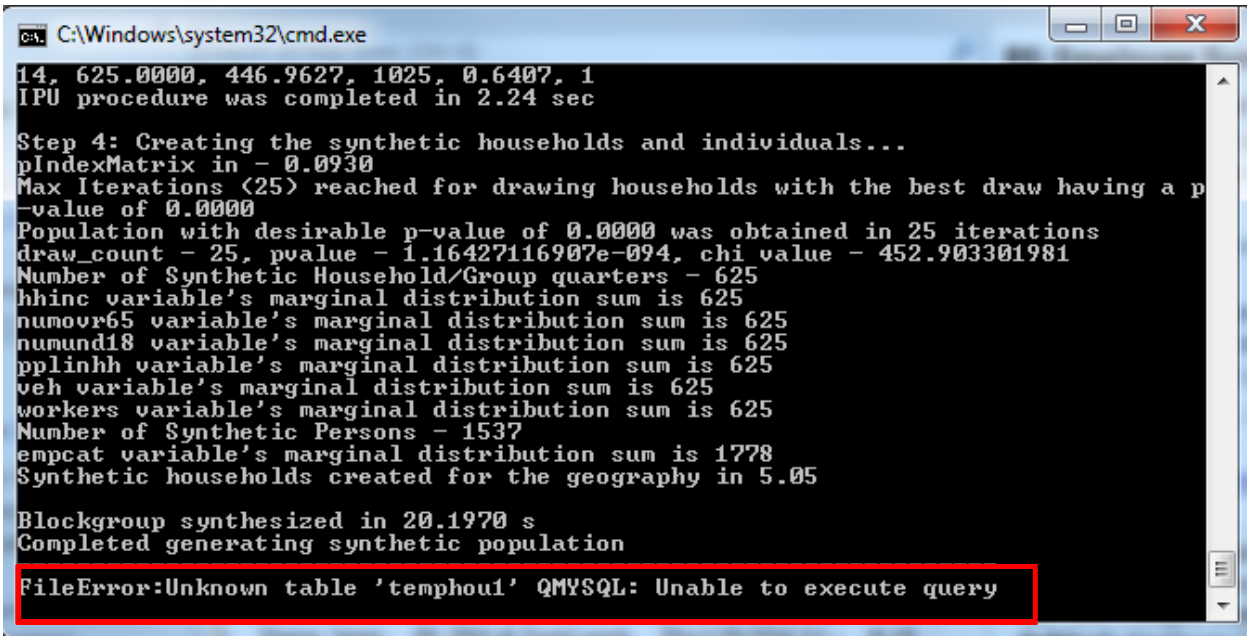
Household variables to export:

- hhinc
- numovr65
- numund18
- pplinhh
- veh
- workers

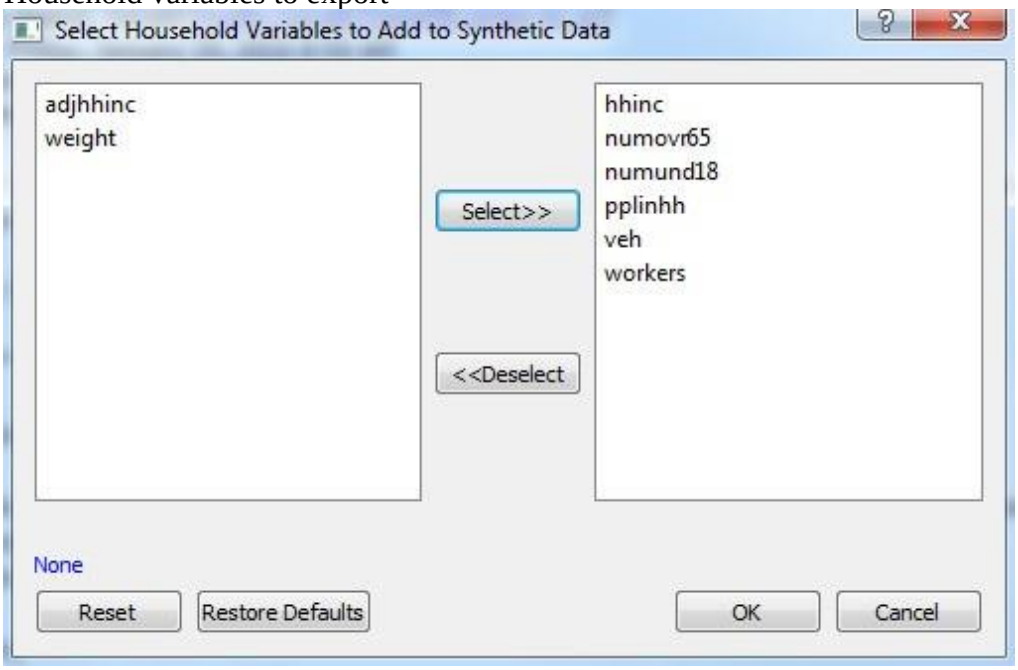
Person variables to export:

- empcat

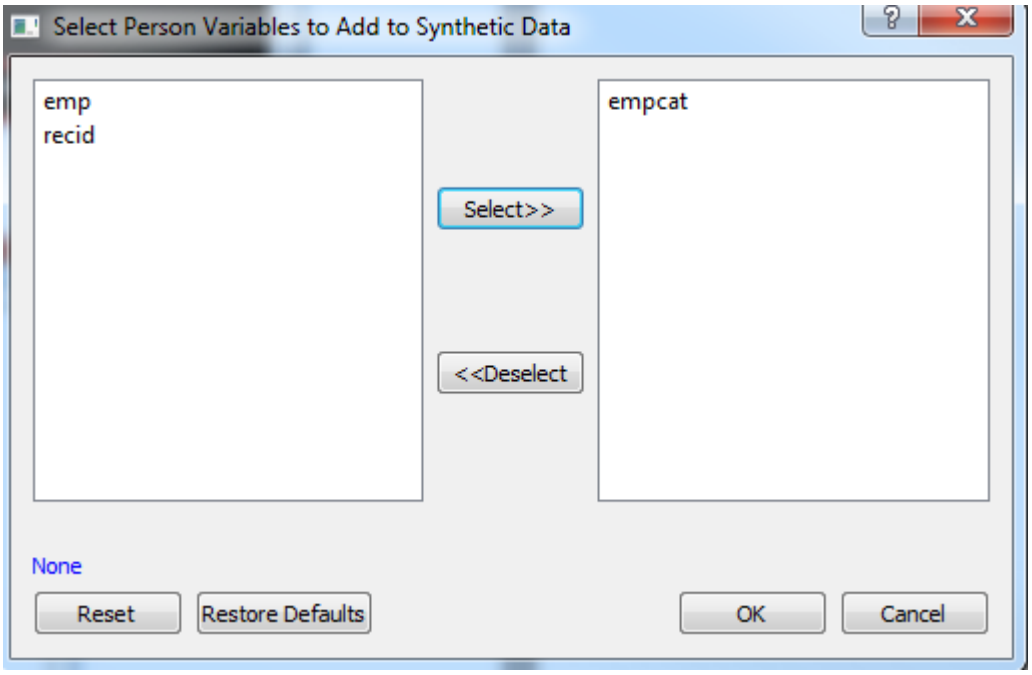
IMPORTANT: During both the household and person synthetic data exports the GUI will appear to be frozen and the DOS command window will show a "FileError" message (see below). The message can be ignored and the export process will still complete normally.



Household variables to export



Person variables to export



The PopGen model run is now complete.

4.3.3 Convert PopGen Outputs

The final step to create a synthesized population consists of converting the Household_Synthetic_data.csv and "Person_Synthetic_data.csv" files created during the PopGen run into a format compatible with TRMv6 using the 'Convert PopGen Outputs' script.

To access the script in TRMv6 in TransCad, choose **Tools→Add Ins→Trmv6.** Once the TRMv6 GUI is open, select **Toolbox→Create Synthesized Population→Convert PopGen Outputs**. During the run you will be prompted to select the Model Year PopGen directory, the "Housing_Synthetic_data.csv" and "Person_Synthetic_data.csv" files created from the PopGen model run and for an interim fiel directory to stor interim files created during script processing.

Once this step is complete, a binary file named "Popgen.bin" will be generated and stored in the PopGen working directory. This completes the process of developing a synthesized population for TRMv6.

4.4 Transit Timed-Transfer Wait-Time Table Files

To reduce transfer times between certain transit routes, transit agencies may coordinate the operation schedules for those routes. Timed-transfer wait-time tables (TimedTransferWaitTime_AM_ModelYear.bin and TimedTransferWaitTime_OP_ModelYear.bin) may be used to specify cases of such coordination. The tables each have seven data fields: FROM_LINE, TO_LINE, BOARD_STOP, WAIT_TIME, FROM_NAME, TO_NAME, and BOARD_NODE. The user has to manually code the last four fields, and the model will automatically fill the first three fields, based on the information in the four user-coded fields.

For each record in the table:

1) The FROM_NAME field should be filled with the name of the route travelers transfer from, and the TO_NAME field should be filled with the name of the route travelers transfer to. The names of the routes should exactly match those in the transit route system file (transit.rts), and are case sensitive.
2) Timed-transfer wait times should be in minutes and be entered in the WAIT_TIME field.
3) The user has to identify the stop location where travelers board the next transit route, and, in the BOARD_NODE field, specify the ID of the node that lies under the stop in the model network (as opposed to the ID of the stop).
4) Based on the above inputs, the model finds route IDs that correspond to the route names in the FROM_NAME and TO_NAME fields, and uses those IDs to fill the FROM_LINE and TO_LINE fields, respectively. The model also finds the stop ID on the TO_LINE route that is located at the node specified in the BOARD_NODE field. It then overwrites the transfer time calculated by TransCAD with the value specified in the WAIT_TIME field for that specific route pair at that specific boarding location.

4.5 Mode Choice FORTRAN Program Control Files

Of the two sets of FORTRAN program control files in the TRMv6 (for trip generation and for mode choice), only the mode-choice set may require modification, depending on the specification of modes in the working scenario relative to the base-year 2013 model. One control file is used for each combination of trip purpose and time of day. Therefore, modifications should be evaluated carefully with respect to trip purposes and times of day.

Likely modifications may include:

1) If HOV lanes are available, you need to change the value of the parameter HWY2P from F to T (F means no/false and T means yes/true). Also, make sure that a value for the parameter FSKA2P has been specified in the control file (for example, FSKA2P ='..\..\Interim\AMHOV.BIN'). The value of FSKA2P is the name and file path of a highway skim matrix for high occupancy vehicles, in TransCAD's binary file format (see Section 3.3 for more information about HOV skim files). The TRMv6 currently can only handle situations where HOV lanes require a minimum vehicle occupancy of two persons, as opposed to a minimum of three persons, so leave HWY3P = F.

2) Even if there are HOV lanes in the working scenario, leave HOV = F. This parameter controls whether traveling in HOV lanes is treated as a separate choice in the model. The TRMv6 does not treat it as a separate choice.

3) If express buses are available as a mode, set the value of the parameter EXPBUS equal to T; otherwise, set it equal to F. When EXPBUS = T, you must also specify a value for the

parameter FSKEXP (for example, FSKEXP ='..\..\Interim\AMP.BIN'), consisting of an express-bus skim matrix (see Section 3.3 for more information about express-bus skim files).

In addition, you must specify an express-bus Alternative Specific Constant (ASC), corresponding to the variable KExp(n) in express-bus utility functions. KExp(n) values corresponding to five household strata are stored in the parameters KEXP(1) through KEXP(5) in the control file for general-population trip purposes; in the control file for USM trip purposes, there are only KEXP(1) and KEXP(2), corresponding to on- and off-campus students, respectively. KExp(n) values vary by combination of trip purpose and time of day. Importantly, for each combination of trip purpose and time of day in the TRMv6, while KExp(n) values are the same across the five household strata (n=1-5) or between the two student types (n=1-2), you still need to specify the values separately.

The values of these constants, as well as other ASCs in the mode-choice utility functions, have been calibrated by the TRMSB, using data from the 2006 Greater Triangle Household Travel Survey (2006HTS) and the 2006 Triangle Region Transit On-Board Survey (2006TOB). These values vary by trip purpose and time of day, and the 2013 values may be found on the data CD-ROM.

4) If rail is available as a mode, set the value of the parameter RAIL equal to T; otherwise, set it equal to F. When RAIL = T, you must also specify a value for the parameter FSKRAL (for example, FSKRAL ='..\..\Interim\AMR.BIN'), consisting of a rail skim matrix (see Section 3.3 for more information). Unlike in the case of express bus travel, you do not need to specify constants for the rail utility functions, as they take default values of zero in the TRM.

   You need to specify and store rail-mode ASCs in the parameters KRAL(1) through KRAL(5) for general-population trip purposes and in only KRAL(1)-KRAL(2) for USM trip purposes. Rail ASCs vary by combination of trip purpose and time of day. You also need to specify a walk-to-rail ASC, KRalW, and a coefficient for rail in-vehicle-time weight, CRIVTW. KRalW is the same across all five household strata within each combination of general-population trip purpose and time of day and the same between the two student types within each combination of USM trip purpose and time of day. Listing separate values for KRalW(1) through KRalW(n) is not necessary; one KRalW value is sufficient. The same is true for CRIVTW, which does not vary by trip purpose or time of day in the TRMv6.

   Table 4-2 shows rail-related parameters.

Table 4-4 Future-Year Mode Choice *.ctl Files: Rail-Related Parameters

	HBW (Peak & Off-Peak)	HBShop, HBK12, HBO, U_HBO (Peak & Off-Peak)	NHNW, WBNH UBNH, (Peak & Off-Peak) NHNU (Daily)	HBU (Peak & Off-Peak)
KRal: Rail Constant				
KRal(1) – KRal(5)	0.15	0.06	0.12	NA
KRal(1) – KRal(2)	NA	0.06	0.12	0.15

	HBW (Peak & Off-Peak)	HBShop, HBK12, HBO, U_HBO (Peak & Off-Peak)	NHNW, WBNH UBNH, (Peak & Off-Peak) NHNU (Daily)	HBU (Peak & Off-Peak)
KRalW: Rail Walk-Access Constant				
KRalW	0.75	0.75	0.75	0.75
CRIVTW: Coefficient for rail in-vehicle-time weight (discount)				
CRIVTW	0.85	0.85	0.85	0.85

4.6 Creating Post-2013 External Transit Trip Matrix

4.6.1 Assumptions

The approach described below was designed using the following assumptions:

1) External transit trips are produced only from those external stations that had observed transit trips in the 2006 TOB survey. No external station outside of this set will ever produce any such trips, and all stations within the set are guaranteed to continue to produce such trips. This is not a realistic assumption, but it is useful, at least until new information suggests otherwise.
2) From 2013 onward, the percent of motorized cross-boundary travel at an external station that is allocated to external transit trips remains unchanged from what was observed in the 2006 HTS and the 2006 TOB survey.
3) The 2013 peak-period and off-peak-period percentages of external transit trips (based on the results of the 2006 TOB survey) are held constant for all TRMv6 model years.
4) Trip attraction ends are taken to be the same as what were observed in the TOB survey, unless and until additional observed data suggest otherwise. I.e., no internal TAZ attracts any external transit trips, except for those where such trip ends were observed in the survey.
5) The access modes remain unchanged.

4.6.2 Step-by-Step Approach

Below are step-by-step instructions on how TRMv6 2013 and 2040 external transit trip tables are developed. This may be regarded as a "shortcut" approach.

Step 1 - Derive Automobile Cross-Boundary ADT

This approach assumes a relationship between transit E-I trips and automobile cross-boundary ADT. After automobile trips passing through external stations are calculated, a portion of them are converted to transit E-I trips.

The annual average weekday traffic count for each external station is the variable ADT in scenario\input\SEData\SE_ModelYear.bin. ADT is the sum of commercial-vehicle traffic and personal-automobile traffic:

$$ADT|_{ModelYear} = \text{Auto } ADT|_{ModelYear} + \text{CV } ADT|_{ModelYear}$$

That is, automobile ADT (Auto ADT) at each applicable external station may be calculated as:

$$\begin{aligned}\text{Auto } ADT|_{ModelYear} &= ADT|_{ModelYear} - \text{CV } ADT|_{ModelYear} \\ &= ADT|_{ModelYear} * (1 - PctCV|_{ModelYear}/100)\end{aligned}$$

where

$ADT|_{ModelYear}$ = weekday average daily traffic; and
$PctCV|_{ModelYear}$ = percent of total ADT that is commercial vehicle traffic, which may be kept equal to the base-year value or changed by the user.

Then, because

$$\text{Auto } ADT|_{ModelYear} = \text{Auto EE } ADT|_{ModelYear} + \text{Auto cross-boundary } ADT|_{ModelYear}$$

and

$$\text{Auto EE } ADT|_{ModelYear} = \text{Auto } ADT|_{ModelYear} * (PctAutoEE|_{ModelYear}/100)$$

where

Auto EE $ADT|_{ModelYear}$ = weekday average daily automobile E-E traffic, and
$PctAutoEE|_{ModelYear}$ = percent of Auto ADT that is through (E-E) trips, which may be kept equal to the base-year value or changed by the user,

The automobile cross-boundary ADT (Auto cross-boundary ADT) at each applicable external station may be calculated as:

$$\text{Auto cross-boundary } ADT|_{ModelYear} = \text{Auto } ADT|_{ModelYear} * (1 - PctAutoEE|_{ModelYear}/100)$$

Table 4-3 shows 2013 automobile cross-boundary ADT values at those external stations for which external transit trips are to be calculated, as derived by the method just described.

Table 4-5 TRMv6 2013 Automobile Cross-Boundary ADT

External Station TRMv6 TAZ ID	**External Station Roadway Name**	**2013 Weekday Average Daily Traffic Count** ADT	**2013 % Commercial Vehicles** PctCV	**2013 % Auto Through (E-E)** PctAutoEE	**2013 Auto ADT** = ADT * (1 - PctCV/100)	**2013 Auto Cross-Boundary ADT** = Auto ADT * (1 - PctAutoEE/100)
2861	NC-57/Semora Rd. (Person Co.)	5,870	16.00	2.64	4,931	4,801
2876	I-85 N (Granville Co.)	32,000	13.10	26.23	27,808	20,513
2881	US-1 N/Capital Blvd. (Franklin Co.)	12,000	11.82	9.45	10,582	9,582

2897	US-64 E (Nash Co.)	21,000	15.90	13.67	17,661	15,246
2916	US-70 Bypass E (Johnston Co.)	11,830	17.46	31.40	9,764	6,699
2923	I-40 E (Johnston Co.)	18,000	14.60	30.72	15,372	10,650
2933	NC-42 S (Chatham Co.)	2,000	7.97	0.00	1,841	1,841
2935	US-1 S/Jefferson Davis Hwy. (Chatham Co.)	20,000	11.96	24.94	17,608	13,216
2937	Pittsboro Goldston Rd./SR 1010 (Chatham Co.)	1,700	3.93	0.00	1,633	1,633
2944	NC-87 W (Orange Co.)	2,900	8.01	27.48	2,668	1,935
2946	Saxapahaw Bethlehem Ch. Rd./SR 2146 (Orange Co.)	2,600	4.02	0.00	2,495	2,495
2951	I-40/I-85 W (Orange Co.)	88,000	14.80	32.78	74,976	50,401
2952	US-70/N. 7th St. (Orange Co.)	7,800	7.29	36.00	7,231	4,628

Step 2 - Calculate Model-Year Factor for Automobile Cross-Boundary ADT

In accordance with aforementioned assumptions, for any model year (2013 or future), peak (or off-peak) external transit-trip productions at each applicable external station may be calculated as

$$\text{Ext. Transit-PK (or -OP)}|_{2040}$$
$$= \text{Auto cross-boundary ADT}|_{2040} * \%\ \text{transit}|_{2013} * \%\ \text{Peak (or Off-Peak)}|_{2013}$$

This allows the derivation of external-station-specific ratios between model-year (2040) and base-year (2013) external transit trips, as shown in Table 4-4 and in accordance with the following equation:

$$\text{Ext. Transit-PK (or -OP)}|_{2040} \div \text{Ext. Transit-PK (or -OP)}|_{2013}$$
$$= \text{Auto cross-boundary ADT}|_{2040} \div \text{Auto cross-boundary ADT}|_{2013}$$
$$= \text{Factor}|_{2040}$$

Table 4-6 TRMv6 – 2040 Auto Cross-Boundary (XB) ADT Ratio Factor

External Station TRMv6 TAZ ID	**External Station Roadway Name**	**2013 Auto Cross-Boundary ADT** = Auto $XB\|_{2013}$	**2040 Auto Cross-Boundary ADT** = Auto $XB\|_{2040}$	**Factor_ Auto_XB$\|_{2040_2013}$** = Auto $XB\|_{2040}$ ÷ Auto $XB\|_{2013}$
2861	NC-57/Semora Rd. (Person Co.)	4,801	6,109	1.27
2876	I-85 N (Granville Co.)	20,513	21,643	1.06
2881	US-1 N/Capital Blvd. (Franklin Co.)	9,582	16,731	1.75
2897	US-64 E (Nash Co.)	15,246	25,802	1.69
2916	US-70 Bypass E (Johnston Co.)	6,699	8,469	1.26
2923	I-40 E (Johnston Co.)	10,650	12,743	1.20
2933	NC-42 S (Chatham Co.)	1,841	1,547	0.84
2935	US-1 S/Jefferson Davis Hwy. (Chatham Co.)	13,216	27,445	2.08
2937	Pittsboro Goldston Rd./SR 1010 (Chatham Co.)	1,633	1,448	0.89
2944	NC-87 W (Orange Co.)	1,935	2,406	1.24
2946	Saxapahaw Bethlehem Ch. Rd./SR 2146 (Orange Co.)	2,495	4,341	1.74
2951	I-40/I-85 W (Orange Co.)	50,401	76,593	1.52
2952	US-70/N. 7th St. (Orange Co.)	4,628	5,430	1.17

Step 3 - Estimate Future-Model-Year Peak and Off-Peak External Transit Trips

Since the ratio between future-model-year 2040 and base-year 2013 external transit trip productions is equal to the ratio between automobile cross-boundary (XB) ADTs in the same two years, future-year external transit trips equal 2013 external transit trips multiplied by the ratio between automobile cross-boundary ADTs in the same two years:

$$\text{Ext. Transit-PK (or -OP)}|_{2040} = \text{Ext. Transit-PK (or -OP)}|_{2013} * \text{Factor}|_{2040}$$

Tables 4-5 and 4-6 show external transit-trip productions for the peak and off-peak periods, respectively, for 2013 and 2040.

Table 4-7 TRMv6 – 2013 and 2040 Peak-Period External Transit Trip Tables

External Transit Trip Table TRMv6	**Production External Station** TRMv6	**Attraction Internal TAZ** TRMv6	**2013 Peak External Transit Trips**	**Factor_Auto_XB**$|_{2040\_2013}$ = Auto XB$|_{2040}$/Auto XB$|_{2013}$	**2040 Peak External Transit Trips**
Local-Park&Ride ("Trip 2" in input file)	2861	316	50.09	1.27	63.73
	2933	1491	6.35	0.84	5.34
	2944	316	3.41	1.24	4.24
	2951	316	7.25	1.52	11.01
	2951	1491	12.33	1.52	18.74
	2952	313	190.54	1.17	223.56
	2952	316	3.26	1.17	3.82
Local-Kiss&Ride ("Trip 3" in input file)	2897	1433	4.86	1.69	8.22
	2923	1433	4.09	1.20	4.89
Express-Park&Ride; Auto-Intercept ("Trip 5" in input file)	2876	315	3.81	1.06	4.02
	2897	1301	5.15	1.69	8.72
	2933	1301	16.39	0.84	13.78
	2935	1301	5.01	2.08	10.41
	2935	1294	26.41	2.08	54.84
	2935	1300	22.33	2.08	46.36
	2946	1298	5.21	1.74	9.06
	2946	1292	20.51	1.74	35.69
	2946	1305	6.50	1.74	11.30
	2951	1501	17.15	1.52	26.06
	2951	1293	3.97	1.52	6.04
	2951	1294	4.96	1.52	7.53
	2951	1300	12.25	1.52	18.62
	2951	1300	12.25	1.52	18.62
	2951	1300	5.47	1.52	8.31
	2951	1300	13.54	1.52	20.58

External Transit Trip Table TRMv6	**Production External Station** TRMv6	**Attraction Internal TAZ** TRMv6	**2013 Peak External Transit Trips**	**Factor_Auto_XB**$\|_{2040\_2013}$ = Auto XB$\|_{2040}$/Auto XB$\|_{2013}$	**2040 Peak External Transit Trips**
	2951	1300	14.93	1.52	22.70
	2951	1300	10.67	1.52	16.21
	2951	1300	6.80	1.52	10.33
	2951	1296	5.11	1.52	7.76
	2951	1296	6.34	1.52	9.64
	2951	1291	7.66	1.52	11.64
	2951	1292	4.06	1.52	6.18
	2951	1292	13.54	1.52	20.58
	2951	1311	12.25	1.52	18.62
	2952	1523	1.21	1.17	1.42
	2952	1298	14.64	1.17	17.17
	2952	1292	7.97	1.17	9.35
	2952	1311	15.61	1.17	18.32
Express-Kiss&Ride ("Trip 6" in input file)	2881	1112	0.42	1.75	0.73
	2916	1137	1.67	1.26	2.11
	2923	2404	4.31	1.20	5.15
	2952	1523	1.67	1.17	1.96

Table 4-8 TRMv6 – 2013 and 2040 Off-Peak-Period External Transit Trip Tables

External Transit Trip Table TRMv6	**Production External Station** TRMv6	**Attraction Internal TAZ** TRMv6	**2013 Off-Peak External Transit Trips**	**Factor_Auto_XB**$\|_{2040\_2013}$ = Auto XB$\|_{2040}$/Auto XB$\|_{2013}$	**2040 Off-Peak External Transit Trips**
Local-Park&Ride ("Trip 2" in input file)	2876	313	2.35	1.06	2.48
	2897	1491	9.23	1.69	15.62
	2916	1491	14.03	1.26	17.74
	2935	315	2.19	2.08	4.55
	2951	1491	8.24	1.52	12.53
	2951	1301	7.79	1.52	11.83
	2951	1310	11.38	1.52	17.30
	2951	1296	21.30	1.52	32.38
	2951	1293	6.14	1.52	9.32
	2952	315	9.72	1.17	11.40
	2952	1300	8.86	1.17	10.40
	2952	1300	5.01	1.17	5.88
	2952	1303	2.20	1.17	2.58
Local-Kiss&Ride ("Trip 3" in input file)	2923	2369	2.02	1.20	2.42
	2933	1280	10.51	0.84	8.83
	2951	1485	9.74	1.52	14.80
	2951	1483	7.20	1.52	10.93

External Transit Trip Table TRMv6	**Production External Station** TRMv6	**Attraction Internal TAZ** TRMv6	**2013 Off-Peak External Transit Trips**	**Factor_Auto_XB**$\|_{2040\_2013}$ = Auto XB$\|_{2040}$/Auto XB$\|_{2013}$	**2040 Off-Peak External Transit Trips**
	2951	1596	6.45	1.52	9.81
Express-Park&Ride; Auto-Intercept ("Trip 5" in input file)	2935	1293	6.03	2.08	12.53
	2937	1300	56.24	0.89	49.85
	2951	1300	3.20	1.52	4.87
	2951	1300	5.22	1.52	7.94
	2951	1292	5.24	1.52	7.97
	2951	1292	3.06	1.52	4.65
	2951	1291	7.08	1.52	10.76
Express-Kiss&Ride ("Trip 6" in input file)	2923	2369	0.85	1.20	1.02

Step 4 - Create Future-Year External Transit Trip Tables in TransCAD

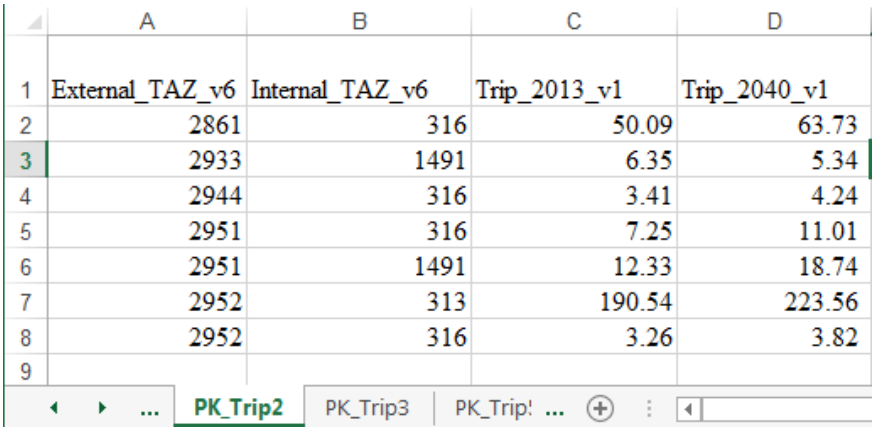
The last step is to create future-year external-transit-trip TransCAD-format matrix files (to be used in the TRMv6), using the data estimated in the previous step.

You need to create two TransCAD matrix files, for the peak and off-peak periods:

TRMv6 Model\scenario\input\transit\Transit_External_PK.mtx and Transit_External_OP.mtx

1) Create an Excel file with the following tabs:
   PK_Trip2, PK_Trip3, PK_Trip5, PK_Trip6
   OP_Trip2, OP_Trip3, OP_Trip5, and OP_Trip6

2) Put the information from Tables 4-5 and 4-6 in the appropriate Excel-workbook tabs; e.g., copy the contents of the "Local-Park&Ride ("Trip 2" in input file)" section of Table 4-5 (which is specific to peak-period trips) to the Excel tab "PK_Trip2," as shown below (with different column headings). In addition to 2013 and 2040, you may have a column for 2010 trips, which may go either in the same Excel file or in a separate file; there is no need to have three years' values in one file, but putting them all in one place may save you the trouble of keeping multiple Excel workbooks.

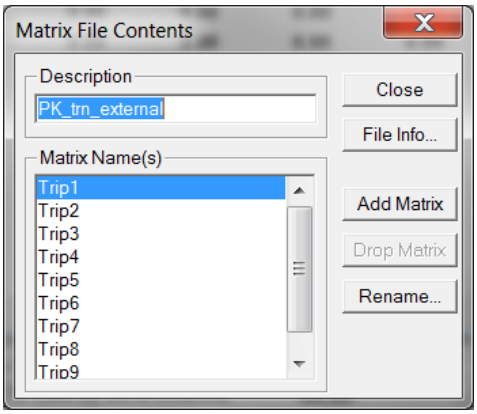


	A	B	C	D
1	External_TAZ_v6	Internal_TAZ_v6	Trip_2013_v1	Trip_2040_v1
2	2861	316	50.09	63.73
3	2933	1491	6.35	5.34
4	2944	316	3.41	4.24
5	2951	316	7.25	11.01
6	2951	1491	12.33	18.74
7	2952	313	190.54	223.56
8	2952	316	3.26	3.82
9				

PK_Trip2 | PK_Trip3 | PK_Trip! ...

3) You can copy the 2040 matrix files, Transit_External_PK.mtx and Transit_External_OP.mtx, to a different location (e.g., in the corresponding model-year scenario folder).

4) The TransCAD matrix files Transit_External_PK.mtx and Transit_External_OP.mtx have the following structure:



5) Set **all cell values of all matrices,** in both the peak-period and off-peak-period matrix files, to **zero.**

6) To create a 2040 external transit trip table, open the Excel file, showing the tab labeled "PK_Trip2," and use the 2040 values from it to update the "Trip2" matrix in Transit_External_PK.mtx.

7) Repeat the same operation to use information from the "PK_Trip3," "PK_Trip5," and "PK_Trip6," Excel tabs to update the "Trip3," "Trip5," and "Trip6" matrices within Transit_Exernal_PK.mtx, respectively.

8) Repeat the same process to update Transit_Exernal_OP.mtx with data from the Excel tabs whose names start with "OP."

4.7 Parking Capacity and Parking Cost Input

4.7.1 Parking Capacity File \Input\Programs\ParkCap.bin

In TRMv6, parking space constraints are applied to auto vehicle (as opposed to person) trips in the 8-hour peak period (AM and PM, combined) that are destined to each specific parking analysis sub-area (PASA), by PASA and trip purpose.

4.7.1.1 Parking Space Capacity Definition

The TRMv6 models the parking behavior of auto-trip-makers by the PASA to which their trips are destined (attraction end), the parking facility use type (commuter workers, commuter university students, or visitors), and trip purpose.

For simplicity, the model assumes that there are mutually exclusive markets (parking spaces) for the three parking facility use types. The model does not apply the number of related parking spaces directly. Rather, it translates the number of parking spaces to the auto vehicle trips that can be accommodated. The parking-space capacity of a PASA for a given parking facility use type is defined as the maximum auto vehicle trips that the related parking spaces within the PASA can accommodate. [Note that enhanced parking constraint models, which would be implemented in a future TRM, would automatically calculate the capacities on the fly, and a user would only need to prepare parking spaces by parking facility type, which would be more intuitive and convenient for the user (especially for policy testing), and would be a means of error-proofing.]

The TRMv6 parking capacity constraint model does not apply to HBK12 trips, which means that TRMv6 assumes all auto vehicle trips to K12 schools can be accommodated by the schools' parking spaces in the base year and will still be so accommodated in modeled future years. This implies that auto vehicle trips to K12 schools will not be affected by any parking-space-related policies.

4.7.1.2 Parking Capacity File ParkCap.bin Preparation

Table 4-7 provides the step-by-step approach to calculate parking capacity by trip purpose for a given PASA, for base year 2013 and for future-year models (with assumptions).

Table 4-9 Parking Capacity Calculation by TRMv6 Trip Purpose

Approach	Information
Step 1: Collect parking space inventory	Usually, the parking-space-inventory geographic files of a PASA list all parking facilities with numbers of spaces, as well as other information. <u>Sources - 2013:</u> - Stakeholders provided (incl. local parking studies) - TRM team collected/created date based on information from the PASA-specific official webpages (incl. local parking studies)
Step 2: Estimate numbers of parking spaces by parking facility use type: commuter workers, commuter university students, and visitors	In order to estimate parking capacities for each trip purpose, we need to know the number of parking spaces designated for each of the three parking facility use types. When such information is not readily available from the parking space inventory, we: - estimate each of the three aforementioned types' percent share of all parking facilities within the PASA - Aggregate parking spaces by parking facility use type to the TAZ level and then to the PASA level <u>Sources:</u> - Parking space inventory data - Official parking information websites - Local parking studies - Local planners

Approach	Information
Step 3: Calculate parking capacities by parking facility use type	<u>Parking capacity definition:</u> Maximum auto vehicle trip attractions that can be accommodated by parking spaces of a given parking facility use type during the 8-hour peak time period, using the number of parking spaces designated as that use type and the observed average parking duration. <u>Calculation:</u> Maximum number of vehicle parkings that each parking space|Use Type can accommodate = 8 hours ÷ average parking duration (hours)|PASA-Use Type Each car parking involves 2 auto vehicle trips Total parking capacity|Use Type = Maximum number of auto vehicle trips that can be accommodated by a given parking space|Use Type * Parking Spaces|Use Type = [8 hours ÷ average parking duration (hours)|PASA-Use Type] * 2 * Parking Spaces|Use Type E.g., if there are 100 parking spaces designated for visitors in a PASA and the observed average parking duration is 2 hours, then during the 8-hour peak period, Each parking space|visitor can accommodate 4 cars = [8 hours ÷ 2 hours] Each car parked involves 2 visitor auto vehicle trips Total parking capacity|visitor of the PASA = [8 hours ÷ 2 hours] * 2 auto trips * 100 parking spaces = 800 auto trips that can be parked <u>Source – Weighted average parking duration:</u> 2006HTS-2013 and 2001 NCSU student travel survey, by PASA, parking facility use type, and trip purpose.
Step 4A: Allocate parking capacities to trip purpose within each parking facility use type, using **observed** percent shares of auto trip attractions by trip purpose within each parking facility use type	The current TRMv6 models mode choice with parking capacity constraints by trip purpose. This step allocates parking capacities of each parking facility use type to the trip purposes within the use type, using observed percent shares of auto trip attractions by trip purposes. Parking facility use type coverage of trip purposes: - Commuter workers: HBW - Commuter university students: HBU - Visitor: HBShop, HBO, NHNW, WBNH For the visitor use type in a PASA, Parking capacity|visitor-HBShop = Parking capacity|visitor-all four purposes * Percent share of auto trip attractions|HBShop E.g., if the total visitor parking capacity of the PASA is 800 auto vehicle trips and the percent share of HBShop auto vehicle trip attractions among all visitor auto vehicle trip attractions is 40%, then the PASA HBShop parking capacity = 800 * 40% = 320 auto vehicle trips <u>Sources – Percent share of auto trip attractions by trip purpose within each parking facility use type:</u>

Approach	Information
	2006HTS-2013 and 2001 NCSU Student Travel Survey
Step 4B: Allocate parking capacities to trip purposes within each parking facility use type, using **modeled** percent shares of auto trip attractions by trip purpose within each parking facility use type	Calculating **modeled percent shares of auto trip attractions by purpose** directly is more consistent with other components of the TRM stream (especially recommended for future year models): - PASA summary of auto vehicle trip attractions by purpose E.g., \Interim\PASAPurpose_PK.bin/dcb Where Purpose = HBShop (Shp), HBO (Oth), NHNW, or WBNH In these files, the auto trip attractions are converted to total auto vehicle trips from mode-choice outputs of auto person trips by occupancy category (1, 2, or 3+) using the approach below: 1) Convert mode-choice-outputted auto person trips to auto vehicle trips = Auto – 1 person (Trip13) + (Auto – 2 person (Trip14) ÷ 2) + (Auto – 3+ person (Trip15) ÷ Average Auto Vehicle Occupancy|Trip Purpose) 2) Total auto vehicle trips|Use Type = ∑ auto vehicle trips|Trip Purpose within the use type 3) Calculate mode choice output % distribution of auto vehicle trip attractions|Trip Purpose within each use type = Auto vehicle trips|Trip Purpose of the use type ÷ Total auto vehicle trips|Use Type (above) 4) Allocate parking capacity|use type to parking capacity|trip purpose within a use type using above percent distribution <u>Sources:</u> - Average auto vehicle occupancy for auto 3+-person share drive|Trip Purpose: 2006HTS-2013 and 2001 NCSU Student Travel Survey - Modeled percent share of auto trip attractions by trip purpose within each parking facility use type: TRMv6-2013 mode choice output (e.g., \Interim\Shp_PK.bin): motorized trips by mode (including auto-1 person, auto-2 person and auto-3+ person).
Step 5: Calculate future-year parking capacities	A PASA's future-year parking capacities by trip purpose are calculated with the following assumptions (based on some common knowledge of zoning ordinances and/or construction requirements): 1) The base year 2013 parking capacity by trip purpose per related employee (or Off-Campus Student Enrollment) will remain the same for future years 2) The HBW parking capacities are related to total employees within a PASA 3) The HBShop parking capacities are related to retail employees, alone, within a PASA 4) The HBO, NHNW, and WBNH parking capacities are related to retail and service employees (combined) 5) The HBU parking capacities are related to university off-campus student enrollment The above assumptions are conceptually consistent with the trip attraction models. The relationships between parking capacities by trip purpose and the related employees are established by using the ratio of parking capacities by trip purpose and the employees associated with them.

Approach	Information
	Calculation of future year parking capacities Future year parking capacity|trip purpose = Future Year number of related emloyees * Base Year Ratio of parking capacity|trip purpose to related employees E.g., if the PASA's HBShop capacity for the base year is 320 auto vehicle trips, its number of employees (jobs) in retail establishments is 40, and future-year retail employees is forecasted as 200: - The base-year ratio of HBShop capacity to retail employees = 320 auto vehicle trips ÷ 40 retail employees = 8 auto vehicle trips per retail employee - The future year HBShop capacity = 8 auto vehicle trips per retail employee * 200 retail employees = 1,600 auto vehicle trip
Step 6: Create \Input\Programs\ParkCap.bin file	Figure 4-3 shows the TRMv6-2013 ParkCap.bin file Notes: 1) TRMv6 does not model university commuter students to CBD PASAs, thus the capacities for HBU trips are set to 20,000 for all CBD PASAs. 2) The TRMv6 parking constraint model currently does not apply to RDU airport, thus the capacities for all trip purposes are set to 20,000 for that PASA.

Table 4-10 TRM v.6-2013 ParkCap.bin File

PASA Name [NOT part of the file]	PASA	CapHBW	CapHBSH	CapHBO	CapHBU	CapNHNW	CapWBNH
UNC Campus	1	35300	2900	13100	16300	4200	2800
Duke Campus	2	42600	3800	18000	10000	10000	3500
NCCU Campus	3	22200	3400	3800	18800	17000	7400
NCSU Campus	4	3800	100	800	4500	700	400
Chapel Hill CBD	5	5100	4400	2200	20000	7600	2700
Durham CBD	6	13100	2000	4300	20000	3400	3600
Raleigh CBD	7	69600	9600	23300	20000	29900	9100
Carrboro CBD	8	6000	10600	11100	20000	18000	6900
Hillsborough CBD	9	3900	1300	6600	20000	5800	2300
RDU Airport	10	20000	20000	20000	20000	20000	20000
Source: TRMv6-2013 Official \Input\Programs\ParkCap.bin							

4.7.2 Parking Cost in \Input\SE_Year.bin File

In TRMv6, parking cost constraints are applied to auto person (as opposed to vehicle) trips in the 8-hour peak period (AM and PM, combined) that are destined to each specific PASA, by trip purpose.

4.7.2.1 Parking Cost Definition

In TRMv6, the parking cost of a trip is defined as a dollar value per auto person trip by PASA and parking facility use type, and it is a weighted average for the PASA. In the mode choice

model, the parking cost is part of the general cost. The same parking cost is applied to auto trip attractions of different trip purposes within the same parking facility use type in a given PASA.

The TRMv6 parking cost constraint model does not apply to HBK12 trips, which means that TRMv6 assumes that all auto vehicle trips to K12 schools are free in the base year and will still be free in modeled future years. This implies that auto vehicle trips' parking behavior will not be affected by any parking-cost-related policies.

4.7.2.2 Parking Cost Preparation: in \Input\SEData\SE_Year.bin File

Table 4-8 provides the step-by-step approach to calculate parking costs by parking facility use type for a given PASA, for base year 2013 and for future-year models.

Table 4-11 Parking Cost Calculation by TRMv6 Trip Purpose

Approach	Information
Step 1: Collect parking fare information	Source – Base Year 2013: Base-year parking fare information was collected from parking space inventory files, local parking-related official websites, and online information about commercially-run parking facilities, then processed by the TRM team. Parking fare information often is provided by parking facility or type of facility, in the following typical categories: - Commuter worker HBW trips: monthly rate (or annual rate) - University commuter student HBU trips: monthly rate (or annual rate) - Visitor trips (HBShop, HBO, NHNW, and WBNH): hourly rate
Step 2A: Parking cost for commuter worker HBW trips	Commuter worker HBW trip parking costs are typically calculated as below: Using annual rate (e.g., university annual pass rate) 1) Annual total work hours are 2,080 per commuter worker 2) All commuter workers work the full 2,080 hours, which is 260 workdays (= 2,080 hours ÷ 8 hours/workday) 3) All commuters drive to work and park 260 workdays per year 4) The cost of an HBW auto vehicle parking pass per day (NOT the trip yet!) = Annual parking rate ÷ 260 workdays 5) The parking cost of an HBW auto vehicle trip (drive alone) = Cost of an HBW auto vehicle parking pass per day ÷ Peak-period average HBW auto vehicle trips per vehicle per day 6) The parking cost of an HBW auto vehicle trip (drive-2 person) = Parking cost of an HBW auto vehicle trip (drive alone) ÷ 2 persons 7) The parking cost of an HBW auto vehicle trip (drive-3+ person) = Parking cost of an HBW auto vehicle trip (drive alone) ÷ average auto occupancy for 3+ persons Using monthly rate 1) Annual total work hours are 2,080 per commuter worker 2) All commuter workers work the full 2,080 hours, which is about 22 work days per month (= 2,080 hours ÷ 8 hours/workday ÷ 12 months) 3) All commuters drive to work and park 22 workdays per month 4) The cost of an HBW auto vehicle parking pass per day (NOT the trip yet!) = Monthly parking rate ÷ 22 workdays The rest of the steps are the same as steps 5-7 when using an annual rate

Approach	Information
	Source – average peak-period HBW auto vehicle trips (8 hours of AM and PM peaks) and average auto vehicle occupancy for auto-3+ person visitor trips: 2006HTS-2013 by PASA
Step 2B: Parking cost for university commuter student HBU trips	The calculation of parking costs for university commuter students is similar to that for the commuter workers in Step 2A. Using annual rate (e.g., university annual pass rate) 1) The annual-pass effective days are assumed to be 233 Source: NCSU 2010 school-in-session days (two semesters plus two summer sessions) 2) All commuter students drive and park on campus all 233 days 3) The cost of an HBU auto vehicle parking pass per day (NOT the trip yet!) = Annual parking rate ÷ 233 school days 4) The parking cost of a HBU auto vehicle trip (drive alone) = Cost of an HBU auto vehicle parking pass per day ÷ Peak-period average HBU auto vehicle trips per vehicle per day 5) The parking cost of an HBU auto vehicle trip (drive-2 person) = Parking cost of a HBU auto vehicle trip (drive alone) ÷ 2 persons 6) The parking cost of an HBU auto vehicle trip (drive-3+ person) = Parking cost of a HBU auto vehicle trip (drive alone) ÷ average auto occupancy for 3+ persons <u>Source – average peak-period HBU auto vehicle trips (8 hours of AM and PM peaks) and average auto vehicle occupancy for auto-3+ person visitor trips:</u> 2006HTS-2013 and 2001 NCSU Student Travel Survey, by PASA and trip purpose.
Step 2C: Parking cost for visitor trips (HBShop, HBO, NHNW and WBNH)	Visitor parking costs are calculated from a) hourly rates, b) average visitor-trip parking durations, and c) average auto vehicle occupancies for auto-3+ person trips. Visitor-parking hourly rates usually are charged by whole hours; the average visitor-trip parking durations thus are rounded up to the whole hour (parking-cost charging hours), then used to calculate parking costs. 1) The parking cost of a visitor auto vehicle trip (drive alone) = Hourly rate * Parking-Cost Charging Hours = Hourly rate * Average parking duration for a visitor trip, rounded up to the whole hour 2) The parking cost of a visitor auto vehicle trip (drive-2 person) = Parking cost of a visitor auto vehicle trip (drive alone) ÷ 2 persons 3) The parking cost of a visitor auto vehicle trip (drive-3+ person) = Parking cost of a visitor auto vehicle trip (drive alone) ÷ average auto occupancy for 3+ persons <u>Sources:</u> - Hourly rate: parking space inventory and/or parking-facility official website, by PASA and/or facility - Average visitor-trip parking duration and average auto vehicle occupancy for visitor auto-3+ person trips: 2006HTS-2013.
Step 5: Create \Input\Programs\ParkCap.bin file	Parking cost per auto vehicle trip per traveler, by parking facility use type, as inputs, are stored in the \Input\SEData\SE_Year.bin file Table 4-12 displays the TRMv6-2013 parking cost in the SE_2013.bin file [example]

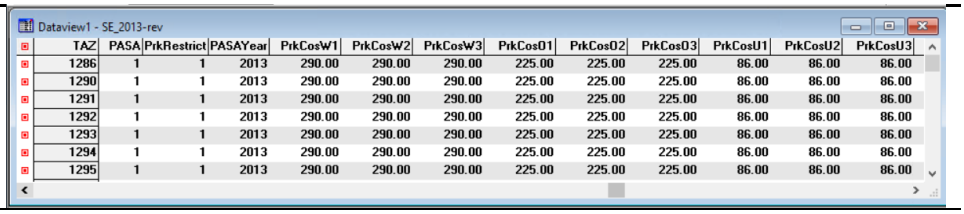
Approach	Information
	

Table 4-12 TRMv6-2013 Parking Cost in SE_2013.bin File

TAZ [Sample]	PASA	PrkCosW1	PrkCosW2	PrkCosW3	PrkCosO1	PrkCosO2	PrkCosO3	PrkCosU1	PrkCosU2	PrkCosU3
1286	1	290	290	290	225	225	225	86	86	86
86	2	207	207	207	200	200	200	54	54	54
1485	3	117	117	117	200	200	200	61	61	61
300	4	172	172	172	200	200	200	55	55	55
1271	5	488	488	488	149	149	149	0	0	0
286	6	322	322	322	99	99	99	0	0	0
1418	7	365	365	365	157	157	157	0	0	0
1116	8	0	0	0	0	0	0	0	0	0
1188	9	0	0	0	0	0	0	0	0	0
2369	10	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0

Source: TRMv6-2013 \Input\SEData\SE_2013.bin

Notes:

1) PrkCosW1, PrkCosO1, PrkCosU1: Auto-1 person parking cost per auto traveler for HBW trips, Visitor trips (HBShop, HBO, NHNW and WBNH), and HBU trips, respectively, in cents
2) PrkCosW2, PrkCosO2, PrkCosU2: Auto-2 person parking cost per auto traveler for HBW trips, Visitor trips (HBShop, HBO, NHNW and WBNH), and HBU trips, respectively, in cents
3) PrkCosW3, PrkCosO3, PrkCosU3: Auto-3+ person parking cost per auto traveler for HBW trips, Visitor trips (HBShop, HBO, NHNW and WBNH), and HBU trips, respectively, in cents

PrkCos*2 and PrkCos*3 are set equal to PrkCos*1 to feed into the mode choice FORTRAN program, where division by vehicle occupancy is performed.

Chapter 5. DATA DICTIONARY FOR INPUTS, OUTPUTS, PARAMETERS, AND PROGRAM-REQUIRED FILES

This chapter lists inputs, outputs, parameters, and program-required files for each model step.

5.1 Create Walk Access Files

5.1.1 Input: Universe Highway Geographic File

(\Input\Master Geograpy**Highway.dbd**)

1) Line Layer:

Field Name	Description	Notes
ID	Link ID	
Length	Link length (in miles)	
Dir	Traffic flow direction relative to topological direction of the link	0 = two-way 1 = one-way along topological direction of the link -1 = one-way against topological direction of the link
TransCAD_ID	Created to preserve link ID	
RoadName	Road name	
COUNTY	Name of county where link exists	Must use full name of county: Chatham, Durham, Franklin, Granville, Harnett, Johnston, Nash, Orange, Person or Wake
FCLASS	Federal Functional Class (FFC) in NC numbering convention	11 = Urban interstate 12 = Urban freeway/expressway 13 = Urban principal arterial 14 = Urban minor arterial 15 = Urban collector 16 = Urban local 21 = Rural interstate 22 = Rural principal arterial 23 = Rural minor arterial 24 = Rural major collector 25 = Rural minor collector 26 = Rural local 99 = Not classified such as centroid connector
NEWFCLASS	Revised functional class NCDOT	1 = Interstate 2 = Other Freeways and Expressways 3 = Other Principal Arterials 4 = Minor Arterials 5 = Major Collectors 6 = Minor Collectors 7 = Local 99 = Not classified such as centroid connector
FCGroup	Aggregation of FFC with some adjustments, used for VDF parameter lookup	1 = Freeway 2 = Major Arterial 3 = Minor Arterial 4 = Collector 5 = Local

Field Name	Description	Notes
		999 = Centroid Connector
ProjID	Future project ID	
ProjName	Project Name	Superstreet will be taken into account in TRM only if ProjName contains "Superstr"
DIRECTION	Traffic flow direction relative to topological direction of the link	Value in field Dir should be identical to this one
LANESAB/BA	Number of lanes: AB/BA direction	
PostSpd	Posted speed limit (mph)	20 = Posted speed ≤ 20 25 = Posted speed 25 35 = Posted speed 30 or 35 40 = ONLY for Special = 26 45 = Posted speed 40 or 45 or Special = 24 or 25 50 = ONLY for Special = 22 or 23 55 = Posted speed 50 or 55 or Special = 21 60 = Posted speed 60 65 = Posted speed 65 70 = Posted speed 70 99 = Speed irrelevant
Med_Lt	Median/left-turn-treatment indicator	1 = No median or continuous left-turn lane; 2 = With median/turn bays or continuous left-turn lane; 99 = Median or left-turn treatment irrelevant
Special	Special classification	1 = Interstate/freeway 2 = Suburban freeway 3 = Urban freeway 4 = Rural highway 5 = Suburban freeway/expressway 6 = Collector/distributor 21 = Freeway-to-freeway ramp 22 = Freeway-to-freeway loop ramp with weave 23 = Freeway-to-freeway loop ramp 24 = Freeway-to-arterial ramp/loop 25 = Arterial-to-freeway ramp/loop 26 = Arterial-to-arterial ramp/loop 31 = Centroid connector 41 = HOV link 42 = HOT link 43 = Toll link 54 = Parking-lot link 55 = Transit-only 99 = All other highway link types
Mode	Link mode	1 = Walk-access link 3 = CBD walk link 4 = Walk link in parking lot 5 = Transit-only link 99 = Highway link/centroid connector NOTE: Non-motorized modes must match modes in file Mode.DBF
FacilityType	Link facility type	1 = Freeway 2 = Freeway ramp 3 = Freeway weaving section 4 = On-ramp 5 = Off-ramp 6 = Freeway HOV 7 = Multilane highway 8 = 2-lane highway

Field Name	Description	Notes
		9 = Major arterial 10 = Minor arterial 11 = Arterial ramp 12 = Collector and local 13 = Centroid connector 14 = Park & Ride link 15 = Transit-only
Lane_Width	Lane width (feet)	
Lateral_ClearanceAB/BA	Lateral clearance in feet	Default value is 6 feet
PARKING	On street parking allowed?	0 = No 1 = Yes Default = 0
Remain_Highway	Used to flag highway links that will remain as highways even when their area types are changed. One example is NC 54 to the south of Chapel Hill, since it has ramps, but is not a freeway.	
AreaType	Link area type	1=CBD, 2 = urban, 3=suburban, 4=rural, Auto filled by model
Shoulder_Width	Shoulder width (feet)	
TruckProhibited	Controls if link is available to trucks for CV skim	null = all trucks allowed 1 = truck prohibited – not in SUT or MUT skims 2 = MUT prohibited – not in MUT skims
COUNT_ID(AB)/(BA)	Count station ID: AB/BA direction	These four fields are not maintained. A separate traffic count file, TrafficCount_Observed_2013.bin, holds the most accurate information.
COUNT_DirRatio	Directional ratio when a two-way count needs to be split directionally	
COUNT_ID	Count station ID	
AB/BALINKTIME AB/BANONTRANSITTIME	Space holders for storing transit travel time or walk time for links with a Mode value of 1, 3, 4, or 5 in the transit background geographic file	
Toll_VvvTt	Toll charges ($) E.g., Toll_SOVAM, Toll_MUTMD For 20 combinations of vehicle type Vvv (4) and time period of the day Tt (5): Four vehicle types: Vvv ∈ [SOV, HOV, SUT, MUT] SOV = Single-Occupant Vehicle HOV= High-Occupancy Vehicle SUT = Single-Unit Truck MUT = Multi-Unit Truck Five time periods: Tt ∈ [AM, PM, OP, MD, NT] AM/PM = AM/PM Peak OP = Off-Peak MD = Midday NT = Night	These fields are added to this file and their values are populated automatically by the program in step "Prepare Geo Files". Only those links with Special = 42 or 43 have non-null values, and the value is calculated as toll rate ($/mile) * link length (miles).

2) Node Layer:

Field Name	Description	Notes
ID	Node ID	
Longitude	Node longitude	
Latitude	Node latitude	
TransCAD_ID	Created to preserve link ID	
PARKINGNODE	Park-and-ride lot indicator	= 1 if the node is designated as a parking lot for park-and-ride trips
CBD Walk	Used in walk access link creation	Not used any more
6digitTAZ	Census TAZ identifier	Unique ID used by planners, but not used in the model
TAZ	TAZ ID if node is centroid of a TAZ	Positive integer value ≤2389 (maximum external station ID)
County	County where node exists	Not used in the model
External	Node is external station	null = not external station 1 = is external station
PnR Category1	Project PnR lot included	Project name
PnR Category2	Project PnR lot included	Project name

5.1.2 Input: Universe Transit System Files

(\Input\Master Geography\Transit.rts, Transit_AM.rts, & Transit_OP.rts)

1) Route Layer:

Field Name	Description	Notes
Route_ID	Each route name, as shown in the transit-route-system file, is used to index the stop-to-stop matrix, so that the matrix may be displayed with only the stops that belong to (a) chosen route(s).	One or two matrix indices may be chosen to display the matrix contents, one for the From box and one for the To box. This also applies to all other types of indices described in this table. For information on matrix indices, refer to the Matrix chapter of the TransCAD User's Guide. TransCAD may assign a new Route ID when the same transit route system is modified or recreated
Route_Name	Route name	Route names are given by the user and won't be changed by TransCAD when a transit-route system is created or modified. Coding convention: Operator + Space + Number/Code + Space + OB/IB/EB/WB/NB/SB + Colon(:) + Description.
Operator	The name of each company (combined with mode) is used to index the stop-to-stop matrix, so that the matrix may be displayed with only the stops that belong to (a) chosen company(s)/mode(s).	1 = GoTriangle/Orange County (OPT) 2 = GoRaleigh 3 = Chapel Hill Transit 4 = GoDurham 5 = NCSU Wolfline 6 = DUKE/NCCU 8 = GoCary If an operator is missing in the "Transit Operator and Company Dictionary.dbf" file, the index will be named as the word "Operator" plus the operator's ID used in the transit-route-system file.

Field Name	Description	Notes
Company	Combination of transit agency and transit mode, corresponding to MODE_ID field in Mode.DBF file	11 = GoTriangle - Local/Orange County (OPT) 12 = GoRaleigh - Local/GoCary 13 = Chapel Hill Transit - Local 14 = GoDurham - Local 15 = Duke/NCSU Local 16 = Express 17 = GoTriangle - Shuttle 18 = GoTriangle - Rail
Mode	Transit mode	5 = Local bus route 7 = Express bus route or rail route
AMPK_Hdwy	AM-peak-period route headway in minutes	
OP_Hdwy	Off-peak route headway in minutes	
XferPen	To-this-route transfer penalty in minutes	Applies only when transfer is made to the subject route
RFacLocal	IVTT weight for local buses	Automated; no manual input needed
RFacPrem	IVTT weight for express buses	Automated; no manual input needed
RFacRail	IVTT weight for rail	Automated; no manual input needed
FareFac	Fare weight	Input by user. Currently no special value, but a value of 1 is applied universally.
Fare	Average fare by route and company, considering free riders, discount-fare riders, and various pass riders	GoTriangle - Local = $0.62 (Local)/$0.73 (Express) GoRaleigh = $0.41 (Local)/$1.34 (Express)/$0.00 (R-Line) Chapel Hill Transit = $0.00/$2.89 (PX) GoCary = $0.53 GoDurham = $0.40/$0.00 (Bull City Connector) NCSU Wolfline = $0.00 Duke = $0.00 OPT = $0.00 All values are for 2013
Line_No	Unique and fixed transit-line number used by the TRM	
PK_InitWT	Weight of initial wait time for peak period	
OP_InitWT	Weight of initial weight time for off-peak	

2) Stop Layer:

Field Name	Description	Notes
ID	Stop ID, unique system-wide	These fields are determined by TransCAD and none are editable by the user
Longitude	Stop longitude	
Latitude	Stop latitude	
Route_ID	ID of route the stop is on	
Pass_Count	Number of the pass of route on highway link where the stop is located (e.g. first or second)	
Milepost	Milepost on route where the stop is located	
STOP_ID	Same value as ID	
NodeID	ID of highway node nearest to the stop	Determined and filled by the program automatically. A search range of 0.01 miles is used.

5.1.3 Input: Transit Operator and Company Dictionary File

(\Input\Transit\Transit Operator and Company Dictionary.dbf)

Filed Name	Description	Notes
OperatorID	Transit operator codes used in TRM v.6 transit route system	1 = GoTriangle (former TTA) 2 = GoRaleigh (former CAT) 3 = Chapel Hill Transit (CHT) 4 = GoDurham (former DATA) 5 = NCSU Wolfline 6 = Duke or NCCU 7 = Orange County (OPT) 8 = GoCary (former C-Tran)
OperatorNM	Transit operator name	TTA = GoTriangle CAT = GoRaleigh CHT = Chapel Hill Transit DATA = GoDurham NCSU = NCSU Wolfline Duke/NCCU = Duke or NCCU Orange County (OPT) Cary = GoCary (former C-Tran)
Company	The code id of each company (combined with mode) is used to index the stop-to-stop matrix, so that the matrix may be displayed with only the stops that belong to (a) chosen company(s)/mode(s).	If a company is missing in the "Transit Operator and Company Dictionary.dbf" file, the index will be named as the string "Comp/Mode" plus the company's ID used in the transit-route-system file. 11 = GoTriangle local bus routes 12 = GoRaleigh or GoCary local bus route 13 = CHT local bus routes 14 = GoDurham local bus routes 15 = Duke/NCSU/NCCU local bus roues 16 = All express routes 17 = GoTriangle shuttle routes 18 = All rail routes (future years only)
Company	The name of each company	TTA Local Routes = GoTriangle local bus routes CAT/Cary Local Roues = GoRaleigh or GoCary local bus route CHT local bus routes DATA Local Routes = GoDurham local bus routes Duke/NCSU/NCCU local bus roues All express routes TTA Shuttle = GoTriangle shuttle routes All rail routes (future years only)

5.1.4 Input: SE Distribution Weights for Transit Table

(\Input\Transit\SE Distribution Weights for Transit.dbf)

Field Name	Description	Notes
BUFFER	Buffer rings surrounding transit stops	10 buffer rings within a radius of 0.5 miles. Buffer 1 is the most inner buffer and buffer 10 is the most outer one.
WEIGHT	Weight associated with each buffer ring	The closer a buffer is to the stop, the higher its weight is.

5.1.5 Input/Output: Demographic/Socioeconomic Data

(\Input\SEData\SE_2013.bin)

Field Name	Description	Notes
TAZ	TAZ ID	
County	Name of county the TAZ belongs to	County
ATYPE	Area Type	Filled automatically when running model
HH	General population households (including college/university students living off-campus, excluding those living on campus)	
HH_POP	Population in general-population households (HH, above), including college/university students living off-campus, excluding those living on campus	
MEANINC	TAZ mean household income (2013 USDs)	
Stud_GQ	College and university students living in group quarters	
Other_NonInst_GQ	Other non-institutional group-quarters population	
StudGQ_Univ	University students living in group quarters for four major universities: Univ $\in$ [Duke, NCCU, NCSU, UNC] Based on student group-quarters population from Census	
BuildingS_Univ	Building floor area for service at four major university campuses (Unit: 1000 square feet) Univ $\in$ [Duke, NCCU, NCSU, UNC]	
Industry	Employees in TRMv6 Establishment Type "Industry"	
Office	Employees in TRMv6 Establishment Type "Office"	
Service_RateLow	Employees in TRMv6 Establishment Type "Service, low individual customer attraction rate per employee"	
Service_RateHigh	Employees in TRMv6 Establishment Type "Service, high individual customer attraction rate per employee"	
Retail	Employees in TRMv6 Establishment Type "Retail"	
IndOff_EarnLow	Employees in TRMv6 Establishment Type "Industry" and/or "Office" with a Low earning level (<$50K in 2013 USDs)	
IndOff_EarnHigh	Employees in TRMv6 Establishment Type "Industry" and/or "Office" with a High earning level (≥$50K in 2013 USDs)	
Service_EarnLow	Employees in TRMv6 Establishment Type "Service_RateLow/High" with a Low earning level (<$50K in 2013 USDs)	

Field Name	Description	Notes
Service_EarnHigh	Employees in TRMv6 Establishment Type "Service_RateLow/High" with a High earning level (≥$50K in 2013 USDs)	
Retail_EarnLow	Employees in TRMv6 Establishment Type "Retail" with a Low earning level (<$50K in 2013 USDs)	
Retail_EarnHigh	Employees in TRMv6 Establishment Type "Retail" with a High earning level (≥$50K in 2013 USDs)	
ADT	ADT on external-station links	
PctCV	% of ADT that is classified as CV	
PctAUTOEE	% of automobile traffic that is through traffic	
PctCVEE	% of CV traffic that is through traffic	
ZONEAREA	Area of TAZ in square miles	
SHORTWALKAM (or OP)	Percent of TAZ that is within AM peak (or off-peak (OP)) transit short-walk distance (0-0.25 miles from stop)	Filled automatically in step "Create Walk Access"
LONGWALKAM (or OP)	Percent of TAZ that is within AM peak (or off-peak (OP)) transit long-walk distance (0.25-0.5 miles from stop)	
DISTGROUP	Old TRM v.6 District ID	Please use the replacing field 'district' as DISTGROUP is no longer used and will be removed from SE_ModelYear.bin later
EXTERNAL	External Station Indicator	= 1 if TAZ is an external station. Otherwise, 0.
District	District ID (TRMv6)	For district trip distribution analysis Replacing the field "DISTGROUP"
AVEBLOCK_P	Average block size, based on perimeter	
AVEBLOCK_A	Average block size, based on area	
RoadwayLen	Roadway length (does not include freeways)	
NMPathLen	Non-motorized path length (including sidewalks and greenways)	
Enrollment	Enrolled students of elementary, middle, and high schools in the TAZ	
PASA	ID for Parking Analysis Sub-Area (TRMv6)	1 = UNC campus 2 = Duke campus 3 = NCSU campus 4 = NCCU campus 5 = Chapel Hill CBD 6 = Durham CBD 7 = Raleigh CBD 8 = Carrboro CBD 9 = Hillsborough CBD 10 = RDU airport
PrkRestrict	Used to calculate automobile terminal time.	0: Terminal time determined based on area type 1: Origin Terminal Time = 2, Destination Terminal Time = 4 2: Origin Terminal Time = 2, Destination Terminal Time = 3
PASAYear	Indicator of PASA boundary year	Same for all TRMv6 model years
PrkCosW1/W2/W3	Parking cost per work-purpose automobile trip	PrkCosW1 = parking cost per automobile trip per traveler – drive alone PrkCosW2 = parking cost per automobile trip per traveler – 2-person carpool

Field Name	Description	Notes
		PrkCosW2 = PrkCosW1 ÷ 2 except for at Duke, where a special cost is used PrkCosW3 = parking cost per automobile trip per traveler – 3+-person carpool PrkCosW3 = PrkCosW1 ÷ 3 except for at Duke, where PrkCosW3 = $0.00
PrkCosO1/O2/O3	Parking cost per other-purpose automobile trip	PrkCosO1 = parking cost per automobile trip per traveler – drive alone PrkCosO2 = parking cost per automobile trip per traveler – 2-person carpool PrkCosO2 = PrkCosO1 ÷ 2 PrkCosO3 = parking cost per automobile trip per traveler – 3+-person carpool PrkCosO3 = PrkCosO1 ÷ 3 "Other" trip purposes include: HBShop, HBO, NHNW, WBNH, U_HBO, and NHNU
PrkCosU1/U2/U3	Parking cost per automobile trip by an off-campus university student commuting to campus	PrkCosU1 = parking cost per automobile trip per traveler – drive alone PrkCosU2 = parking cost per automobile trip per traveler – 2-person carpool PrkCosU2 = PrkCosU1 ÷ 2 PrkCosU3 = parking cost per automobile trip per traveler – 3+-person carpool PrkCosU3 = PrkCosU1 ÷ 3 except for at Duke, where PrkCosU3 = $0.00 University trips subject to these costs include: HBU, UBNH
Campus	Indicates TAZ is on one of four major university campuses: Duke, NCCU, NCSU, or UNC	1 = A four-major-university-campuses TAZ, if Campus_Univ = 1 (any of the four major universities)
Campus_Univ	Indicates TAZ is a univ. campus TAZ: Univ ∈ [Duke, NCCU, NCSU, UNC]	1 = University campus TAZ
In_ShortWalk_Univ	Whether a TAZ touches the 0.25-mile buffer of campus related bus system Univ ∈ [Duke, NCCU, NCSU, UNC]	0 = No 1 = Yes
Housing_Univ	Percent of household population that should be counted as on-campus students in TAZ Univ ∈ [Duke, NCCU, NCSU, UNC]	Please refer to "Explanation of new Fields in the TRMv6 SE Table 11242014.docx" for more details
Univ_Off	University students living off-campus Univ ∈ [Duke, NCCU, NCSU, UNC]	Filled automatically by university student model

5.1.6 Output: Walk Access Links

(\Interim\Walk_access_links.dbd)

Same as 5.1.1 "Universe Highway Geographic File (Highway.dbd)".

5.2 Prepare Geo Files

5.2.1 Input/Output: Master Line Geography

(Input\Master Geography\Highway.dbd)

5.2.2 Input/Output: Transit Route System

(Input\Master Geography\Transit.rts)

1. **Transit Background (**\Input\Transit\Transit_Line.dbd)
2. **AM Transit Route System** (Input\transit\Transit_AM.rts)
3. **OP Transit Route System** (Input\transit\Transit_OP.rts)

5.2.3 Parameter: Toll Rate

(Input\Master Geography\Transit.rts)

5.3 Create Network

- \Input\Parameters\TurnPenalties.bin
- \Input\Parameters\FacilityType.bin
- \Input\Parameters\Lane_Width_Factors.bin
- \Input\Parameters\Lateral_Clearance_Factors.bin

5.3.1 Input: TAZ Geographic File

(TRMv6_TAZ.dbd)

Field Name	Description	Notes
ID	TAZ ID	Value ≤ 2,857 (maximum internal TAZ ID)
Area	TAZ area in square miles	
District_TRMv6_v1	District ID for TAZ aggregation	For district-to-district flow analysis
PASA_TRMv6	Parking Analysis Sub-Area	For parking-constraint-model use
DCHC_ID	DCHC TAZ ID	
COUNTY	County where TAZ is located	
TRACT	2010 census tract ID	
BLOCKGROUP	2010 census block group ID	
MPO_ID	MPO ID	0 = not in MPO 1 = CAMPO 2 = DCHC MPO

Field Name	Description	Notes
MUNI	Municipality name	

5.3.2 Input: Speed Capacity Lookup Table

(\Input\Parameters\Default_For_Speed_Capacity.bin)

Field Name	Description	Notes
FacilityType	Facility type	Factor on which lookup of capacity and free-flow speed is based
AreaType	Area type for roadway facility	1 = CBD; 2 = Urban; 3 = Suburban; 4 = Rural
R_AccessDen	Roadway access density	
R_SignalSpacing	Roadway signal spacing	
R_CycleLength	Roadway signal cycle length (duration)	
R_GCRatio	Roadway signal green/cycle ratio	
R_ArrivalType	Roadway arrival type	
R_SignalDelay	Roadway signal delay	
R_FixedSpd	Roadway fixed speed (mph)	
R_PHF	Roadway peak hour factor	
R_ParkRate	Roadway on street parking maneuver rate (frequency of on-street parking maneuvers).	Unit is "number or on-street parking maneuvers per hour" suggested to use default
R_SpdCalib	Multiplicative factor used to adjust the calculated free flow speed	
R_CapCalib	Multiplicative factor used to adjust the calculated capacity	
R_BusCategory	Roadway bus category	
R_Alpha	Parameter Alpha for Conical VDF	
R_Rho	Parameter Rho for Conical VDF	

5.3.3 Input: Capacity Factor Lookup Table

(\Input\Parameters\CapacityFactor.bin)

Field Name	Description	Notes
FACTYPE	Facility type	Factors on which lookup of capacity factors is based: **Facility Type:** 1 = Freeway 2 = Freeway ramp 3 = Freeway weaving section 4 = On-ramp 5 = Off-ramp 6 = Freeway HOV 7 = Multilane highway 8 = 2-lane highway 9 = Major arterial 10 = Minor arterial 11 = Arterial ramp 12 = Collector and local 13 = Centroid connector
AREATYPE	Area type for roadway facility	

Field Name	Description	Notes
		14 = Park & Ride link 15 = Transit-only **AreaType:** 1 = CBD 2 = Urban 3 = Suburban 4 = Rural
R_PKHRFCTt	Factor multiplied by hourly capacity to get time-of-day capacity For three periods of the day: Tt ∈ [AM, PM, OFF] AM = AM Peak PM = PM Peak OFF = Off Peak	Values returned by lookup: AM = 3.50 PM = 3.50 OFF = 7.14

5.3.4 Terminal Time Matrix Files

(\Input\Parameters\Auto_TerminalTime.mtx)

Matrix Core Name	Description	Notes
TerminalTime	TAZ-to-TAZ terminal times for automobiles and for commercial vehicles (in minutes)	Function of area types of both origin and destination TAZs, generated automatically when running SE Check and Post-Processing Tool

5.3.5 Volume Delay Function Parameter Lookup Table

(\Input\Parameters\VDFConical.bin)

Field Name	Description	Notes
FacilityType	TRMv6 facility type	Factor on which lookup of Alpha value and facility type is based: 1 = Freeway 2 = Freeway ramp 3 = Freeway weaving section 4 = On-ramp 5 = Off-ramp 6 = Freeway HOV 7 = Multilane highway 8 = 2-lane highway 9 = Major arterial 10 = Minor arterial 11 = Arterial ramp 12 = Collector and local 13 = Centroid connector 14 = Park & Ride link 15 = Transit-only
R_Alpha	Alpha parameter value for Conical VDF function	Value returned by lookup
R_Type	Functional-class-group description	Value returned by lookup

5.3.6 Turn Penalty File

(\Input\Parameters\TurnPenalties.bin)

Field Name	Description	Notes
FROM_ID	ID of link from which vehicle turns	
TO_ID	ID of link to which vehicle turns	
PENALTY	Time penalty, in minutes	0.15-3.00 minutes, unless null
Remark		All = empty

5.3.7 Bus Speed Equation Lookup Table

(Input\Transit\BusSpeed_Equations.bin)

Field Name	Description	Notes
bus speed category	Bus speed category	1 = Urban Freeway; 2 = Urban Arterial; 3 = Urban Local/One-Way; 4 = Suburban Freeway; 5 = Suburban Arterial; 6 = Suburban Local/One-Way; 7 = Rural Freeway; 8 = Rural Arterial; 9 = Rural Local/One-Way
X1-AM	Lower highway speed boundary for AM peak	Inputs to equation: Y = a + bX where Y = Calculated bus speed a = intercept b = slope X = Input highway speed Units: mph
X2-AM	Higher highway speed boundary for AM peak	
b1-AM	Used in equation as "b" value if input highway speed X < X1-AM; "a" is set to 0	
b2-AM	Used in equation as "b" value if input highway speed X is between X1-AM and X2-AM	
a-AM	Used in equation as "a" value if input highway speed X is between X1-AM and X2-AM	
X1-OP	Lower highway speed boundary for off-peak period	
X2-OP	Higher highway speed boundary for off-peak period	
b1-OP	Used in equation as "b" value if input highway speed X < X1-OP; "a" is set to 0	
b2-OP	Used in equation as "b" value if input highway speed X is between X1-OP and X2-OP	
a-OP	Used in equation as "a" value if input highway speed X is between X1-OP and X2-OP	
Y2-AM	Maximum bus speed to use, if input highway speed X > X2-AM	
Y2-OP	Maximum bus speed to use, if input highway speed X > X2-OP	

5.3.8 Transit - Mode Table

(\Input\Transit\Modes.DBF)

Field Name	Description	Notes
MODE_NAME	Name describing available mode	Takes one of the following values: WALK, CBDWALK, WALK FUNNEL, Company 1-6, Company 1 EXP, DRIVE, TTA Shuttle, TTA Rail
MODE_ID	Corresponding mode ID as coded in the transit route system	1= WALK 3 = CBDWALK 4 = WALK FUNNEL 11 = Company 1 12 = Company 2 13 = Company 3 14 = Company 4 15 = Company 5 16 = Company 1 EXP 17 = TTA Shuttle 18 = TTA Rail 19 = Company 6 99 = DRIVE
TYPE	Type of mode	W = Walk T = Transit H = Highway
MODE_ACC_D	Drive access	0 = Not used 1 = Used
MODE_EGR_D	Drive egress	
MODE_ACC_W	Walk access	
MODE_EGR_W	Walk egress	
MODE_WL	Walk to local bus	
MODE_WP	Walk to express bus	
MODE_WR	Walk to rail	
MODE_DL	Drive to local bus	
MODE_DP	Drive to express bus	
MODE_DR	Drive to rail	

5.3.9 Mode Transfer Table

(\Input\Transit\ModeXfer_2035.DBF)

Field Name	Description	Notes
FROM	From MODE_ID (i.e., transit company in TRMv6)	See Mode Table (Modes.DBF) for definition of MODE_ID
TO	To MODE_ID (i.e., transit company in TRMv6)	
STOP	ID of stop of To mode where only transfers can only take place	Always keep this field blank
COST	Represents transfer-time penalty between modes (companies)	Not used, because route-to-route transfer penalties are used in TRMv6, which overwrite these mode-to-mode values
FARE	Average fare for transfer between modes (companies) in USDs	Values vary by company; 0 = Free 0.15-1.10: transfer fare 999.00: transfers prohibited between From mode and To mode

5.3.10 Timed Transfer Wait Time Tables

(\Input\Transit\TimedTransferWaitTime_AM_ModelYear.bin & TimedTransferWaitTime_OP_ModelYear.bin)

Field Name	Description	Notes
FROM_LINE	From-route ID	These fields are filled by the model automatically
TO_LINE	To-route ID	
BOARD_STOP	ID of stop where transfer boarding takes place	
WAIT_TIME	Wait time for transfer (in minutes)	These fields are user-coded. FROM_NAME and TO_NAME should exactly match those in the transit route system file and are case-sensitive.
FROM_NAME	From-route name	
TO_NAME	To-route name	
BOARD_NODE	Highway-node ID for stop where transfer boarding takes place	

5.3.11 Commercial Vehicle Trip Generation Model Parameters

(\Input\CommVeh\CV Trip Generation Model Coefficients.dbf)

Field Name	Description	Notes
VARIABLE	Socioeconomic datum for CV-trip production TAZ	IND_EMP = employment in establishments of type "Industry" RET_EMP = employment in establishments of type "Retail" OFF_EMP = employment in establishments of type "Office" SER_EMP = employment in establishments of type "Service" HH = households
LCV_GOODS	Coefficient for CV trip generation model for light-duty commercial vehicles (LCVs) delivering goods	
LCV_SRVCS	Coefficient for CV trip generation model for LCVs delivering services	
LCV_OTHER	Coefficient for CV trip generation model for LCVs traveling for other purposes	
SUT_GOODS	Coefficient for CV trip generation model for Single-Unit Trucks (SUTs) delivering goods	
SUT_SRVCS	Coefficient for CV trip generation model for SUTs delivering services	
MUT_GOODS	Coefficient for CV trip generation model for Multi-Unit Trucks (MUTs) delivering goods	

5.3.12 Commercial Vehicle Trip Generation Calibration Factors

(\Input\CommVeh\CV Trip Generation Calibration Factors.dbf)

Field Name	Description	Notes
MODEL	CV trip generation model type	LCV_Goods LCV_Services LCV_Other SUT_Goods SUT_Services MUT_Goods
FACTOR	CV trip generation model calibration factor	Range: 0.852-1.370

5.3.13 General Population Destination Choice Model Parameters

(\Input\Parameters\DChoice.xlsx)

Tab	Description	Notes
PK_Factor	Peak-time factor, by general-population trip purpose	Range: 0.434-0.821
Purpose	General-population destination choice model parameters by trip purpose and HH strata: Trip purposes: HBWHi: High-earning-employee Home-Based Work (HBW) HBWLo: Low-earning-employee HBW HBShp: Home-Based Shopping HBSch: Home-Based K12 School HBO: Home-Based Other WBNH: Work-Based Non-Home NHNW: Non-Home Non-Work HH strata: Strata1: Cars = 0, Income = any Strata2: Cars > 0, Income = [$0, $25K) Strata3: Workers > Cars > 0, Income = [$25K, $75K) Strata4: Cars ≥ Workers > 0, Income = [$25K, $75K) Strata5: Cars > 0, Income = [$75k, ∞) Strata1OP-Strata5OP: Coeffecients to be applied in off-peak periods	Explanatory Variables: LogSum: Mode choice LogSum Hwy_Dist: Highway distance Hwy_Dist_SQR: Square root of highway distance Hwy_Dist_SQ: Square of highway distance Hwy_Dist_CU: Cube of highway distance Emp_Acc: Overall employment accessibility Retail_Acc: Retail-employment accessibility Cross_Co: Cross-county dummy variable Size Variables: Industry: Employment in "Industry" Office: Employment in "Office" Service_RateHigh: Employment in "Service-RateHigh" Service_RateLow: Employment in "Service-RateLow" Retail: Employment in "Retail" HH: Households HH_Pop: HH population Stud_GQ: Students living in group quarters Other_NonInst_GQ: Others living in non-institutional group quarters ENROLLMENT: K12 school enrollment Model Settings: Max_Iter: Maximum iterations Stop_Criteria: Convergence %RMSE

5.3.14 Commercial Vehicle Destination Choice Model Parameters

(\Input\CommVeh\CV Destination Choice Model Coefficients.dbf)

Field Name	Description	Notes
VARIABLE	Explanatory variable used in CV destination choice model	Destination Ends = 1 for all Square Root of Travel Time Inter-Durham-Orange: Dummy variable Inter-Wake-Durham: Dummy variable Inter-Wake-Johnston: Dummy variable Inter-Wake-Orange: Dummy variable Inter-Other-Counties: Dummy variable Suburban-Rural: Dummy variable Suburban-Suburban: Dummy variable Urban-Rural: Dummy variable Urban-Suburban: Dummy variable Urban-Urban: Dummy variable Distance_AM = AM peak distance Distance_MD = Mid-day distance Distance_PM = PM peak distance Distance_NT = Night time distance
LCV_GOODS	Coefficient for CV destination choice model for light-duty commercial vehicles (LCVs) delivering goods	
LCV_SRVCS	Coefficient for CV destination choice model for LCVs delivering services	
LCV_OTHER	Coefficient for CV destination choice model for LCVs traveling for other purposes	
SUT_GOODS	Coefficient for CV destination choice model for Single-Unit Trucks (SUTs) delivering goods	
SUT_SRVCS	Coefficient for CV destination choice model for SUTs delivering services	
MUT_GOODS	Coefficient for CV destination choice model for Multi-Unit Trucks (MUTs) delivering goods	

5.3.15 Commercial Vehicle Destination Choice Model Execution Control File

(\Input\CommVeh\CV destination choice execution control file.txt)

Field Name	Description	Notes
Maximum iterations = 50	CV destination choice model convergence criterion: maximum iterations	User can set this value. The higher the number, the longer the model run time.
Maximum %RMSE = 0.05	CV destination choice model convergence criterion: maximum % Root Mean Square Error	User can set this value. The smaller the %RMSE, the closer the results between last two iterations, and the longer the model run time.

5.3.16 USM Off-Campus Students by University Lookup Table

(\Input\Univ\Stud_Off Total [Model Year].dbf)

Field Name	Description	Notes
STUD_TYPE	University student type	
TYPE_ID	University student type ID	2 = Off-campus undergraduate 3 = Off-campus graduate
[University]	Numbers of off-campus students attending each of four major universities: UNC, Duke, NCSU, and NCCU	Field names are "NCSU", "UNC", "DUKE", and "NCCU"

5.3.17 University Student Model – Trip Generation Rate

(\Input\Univ\University Student Trip Rate.DBF)

Field Name	Description	Notes
STUD_TYPE	University student type	On-campus Off-campus undergraduate Off-campus graduate
TYPE_ID	University student type ID	1 = On-campus 2 = Off-campus undergraduate 3 = Off-campus graduate
[USM Trip Purpose]	USM trip generation rate by student type and trip purpose: HBU: Home-Based University HBO: Home-Based Other UBNH: University-Based Non-Home NHNU: Non-Home Non-University	Field names are "HBU", "HBO", "UBNH", and "NHNU"

5.3.18 University Student Trip Peak Factor Lookup Table

(\Input\Univ\University Trip PK Factor.dbf)

Field Name	Description	Notes
STRATA	University student type	On-campus Off-campus
[USM Trip Purpose]	Proportion of USM student trips that are during peak periods, by trip purpose: HBU, HBO, UBNH, and NHNU	Ranges: On-Campus: 0.00 [NHNU]-0.4702 [HBU] Off-Campus: 0.00 [NHNU]-0.5844 [HBU]

5.3.19 USM Off-Campus Student Reduction Factor Lookup Table

(\Input\Parameters\OffStudent_Reduction_Factors.dbf)

Field Name	Description	Notes
TAZ	TRMv6 Internal TAZ ID	Range: 1-2,857
District	TRMv6 District ID	Range: 1-43
HB_Factors	Factor for HBW, HBShop, HBSch, and HBO	Auto filled by model
NHB_Factors	Factor for WBNH and NHNW	Auto filled by model

5.3.20 Air Passenger Trip Rate File

(\Input\Parameters\AirPassenger_Rate.dbf)

Field Name	Description	Notes
COUNTY	County ID	1 = Wake 2 = Durham 3 = Orange 4 = Other
NAME	County Name	Wake, Durham, Orange, or Other
HB_HHN	Home-based airport person-trip rate by household income group N $\in$ [1, 2, 3, 4]: 1 = Low income [$0, $25K) 2 = Medium-low income [$25k, $50K) 3 = Medium-high income [$50k, $75k) 4 = High income [$75k, ∞)	HH1 = 0.0014 HH2 = 0.0054 HH3 = 0.0066 HH4 = 0.0095
WB_EMP	Employee work-based airport person-trip rate	
PR_HH	Private-residence-based airport person-trip rate	
NHNW_EMP	Employee non-home-non-work-based airport person trip rate	

5.3.1 RDU Airport Daily Enplaned Passenger

(\Model Setup file\TRM_v6_Mod.bin)

The RDU daily enplaned passenger information currently is hard coded in the TRM_v6_Mod.bin file, it is **not** recommended for a user to modify this file.

Instead, during a model scenario setup, a user needs to check this information and make sure the correct value is used, by clicking the 'Contents' then 'Trip Generation", typing in the correct values (no comma) in the box after the button 'Scaler' at the bottom (the notes in the Help box indicates the correct values to be used for each specific model year).

Model Year	Daily Enplaned Passenger
2013 Base Year	12800
2025	18000
2035	22500
2045	27000

5.3.2 Non-Motorized Trip Split Model Specification File

(\Input\Programs\Non-Motorized Trip Split Models.dbf)

Field Name	Description	Notes
VARIABLES	Explanatory variable name (including the constant)	- RunTheModel? - Debug? - Constant - Non-motorized time minus motorized time (no cost) - Non-motorized time minus motorized time (with cost) - Composite motorized time (no cost) - Non-motorized distance - Squared non-motorized distance - Non-motorized path density (production zone) - Non-motorized path density (attraction zone) - Land use mix (production zone) - Land use mix (attraction zone) - Urban dummy (production zone) - Urban dummy (production & attraction zones) - Retail employment density (attraction zone) / 1000 - HH Strata 1 dummy - HH Strata 2 dummy - HH Strata 3 dummy - HH Strata 4 dummy - HH Strata 5 dummy
Purp_Tt	Coefficients of explanatory variables used in non-motorized model, by trip-purpose/time-of-day combination; null if variable is not used E.g., WRK_PK, NHNW_OP For 12 combinations of general-population trip purpose (6) and period of the day (2) Six trip purposes: Purp $\in$ [WRK, SHP, SCH, OTH, NHNW, WBNH] Two periods of the day: Tt $\in$ [PK, OP]	

5.3.3 Non-Motorized Trip Split Model Constant Factor File

(\Input\Programs\Non-Motorized Trip Split Model Constant Factors.dbf)

Field Name	Description	Notes
STRATA	HH Strata	HH Strata 1 HH Strata 2 HH Strata 3 HH Strata 4 HH Strata 5

Field Name	Description	Notes
Purp_Tt	Factors (multipliers), by HH strata, for constant used in non-motorized trip split model E.g., WRK_PK, WBNH_OP For Six trip purposes: Purp ∈ [WRK, SHP, SCH, OTH, NHNW, WBNH] Two time periods: Tt ∈ [PK, OP]	

5.3.4 Transit Share of Motorized Person Trips

(\Input\Parameters\Transit Share in Motorized Modes.dbf)

Field Name	Description	Notes
PURPORSE	Trip purpose	HBW, HBSh, HBSc, HBO, WBNH, NHNW
STRATAn_Tt	HH strata n transit share by trip purpose in time period Tt E.g., STRATA1_PK, STRATA5_OP For Five household strata: n ∈ [1, 2, 3, 4, 5] Two time periods: Tt ∈ [PK, OP]	

5.3.5 Walk Share of Non-Motorized Person Trips

(\Input\Parameters\Walk Share in non-Motorized Modes.dbf)

Field Name	Description	Notes
PURPOSE	Trip purpose	HBW, HBShop, HBK12, HBO, WBNH, NHNW
WALKSHARE	Walk share by trip purpose	

5.3.6 Directional Time-of-Day Factors

(\Input\Parameters\HourlyFactor.bin)

Field Name	Description	Notes
HOUR	24 intervals, one for each hour of the day, numbered 0-23	Values in all other fields are zero for all hourly intervals, except for 6 (06:00-07:30, AM peak shoulder 1), 7 (07:30-08:30, AM peak hour), 8 (08:30-10:00, AM peak shoulder 2), 12 (10:00-15:30, midday), 15 (15:30-17:00, PM peak shoulder 1, 16 (17:00-18:00, PM peak hour), 17

Field Name	Description	Notes
		(18:00-19:30, PM peak shoulder 2), and 23 (19:30-06:00, nighttime).
Act_Time	Clock times for start and end of time period in military time	Hour = 6: 600-730 Hour = 7: 730-830 Hour = 8: 830-1000 Hour = 12: 1000-153 Hour = 15: 1530-170 Hour = 16: 1700-180 Hour = 17: 1800-193 Hour = 23: Night All others: null
Hours	Time-period/sub-time-period length	Hour = 6: 1.50 Hour = 7: 1.00 Hour = 8: 1.50 Hour = 12: 5.50 Hour = 15: 1.50 Hour = 16: 1.00 Hour = 17: 1.50 Hour = 23: 10.50 All others: null
DEP_Purp	Percent of daily trips departing from home, by hour E.g., DEP_HBW, DEP_U_NHNU For ten trip purposes: Purp $\in$ [HBW, SHP, SCH, OTH, WBNH, NHNW, U_HBU, U_HBO, U_UBNH, U_NHNU]	Sum up to 50% of regional daily total for the trip purpose (except for NHNW and U_NHNU, where the sum is 100%)
RET_Purp	Percent of daily trips returning home, by hour E.g., RET_HBW, RET_U_NHNU For ten trip purposes (same as above)	Sum up to 50% of regional daily total for the trip purpose (except for NHNW and U_NHNU, where the sum is 100%)
CV_LCVPurp	CV – light-duty commercial vehicle percent by hour E.g., CV_LCVGOODS For three purposes: Purp $\in$ [GOODS, SERVC, OTHER]	Sum up to 100% of regional daily total for combination of vehicle type and trip purpose
CV_SUTPurp	CV – single-unit truck percent by hour E.g., CV_SUTSERVC For two purposes: Purp $\in$ [GOODS, SERVC]	Sum up to 100% of regional daily total for combination of vehicle type and trip purpose
CV_MUTGOODS	CV – multi-unit truck percent by hour	Sum up to 100% of regional daily total for combination of vehicle type trip purpose (only one trip purpose for vehicle type MUT)
CV_Vvv_I2E	Each-hour percent of daily CV internal-TAZ-to-external-station trips For three vehicle types: Vvv $\in$ [LCV, SUT, MUT]	Sum up to 100% of regional daily total for the vehicle type

Field Name	Description	Notes
CV_Vvv_E2I	Each-hour percent of daily CV external-station-to-internal-TAZ trips For three vehicle types: Vvv ∈ [LCV, SUT, MUT]	Sum up to 100% of regional daily total for the vehicle type
CV_Vvv_E2E	Each-hour percent of daily CV external-station-to-external-station trips For three vehicle types: Vvv ∈ [LCV, SUT, MUT]	Sum up to 100% of regional daily total for the vehicle type
Auto_IE	Each-hour percent of daily automobile IE trips departing from internal TAZs to external stations	Sum up to 100% of regional daily total
Auto_EI	Each-hour percent of daily automobile IE trips returning to internal TAZs from external stations	Sum up to 100% of regional daily total
AUTOEEPER	Each-hour percent of daily automobile EE (through) trips	Sum up to a regional total of 100%

5.3.7 Transit Transfer Movement Tables

(\Input\Transit\TimedTransferWaitTime_AM_2013.bin and TimedTransferWaitTime_OP_2013.bin)

Field Name	Description	Notes
FROM_LINE	ID of route transferred from	
TO_LINE	ID of route transferred to	
BOARD_STOP	ID of boarding stop of route transfer to	
WAIT_TIME	Dwell time at timed transfer stop	6.00 minutes = 2013 dwell time
FROM_NAME	Name of route in route system which is matched in script to route system to look up FROM_LINE values	Copy string from route system attributes – case sensitive
TO_NAME	Name of route in route system which is matched in script to route system to look up TO_LINE values	Copy string from route system attributes – case sensitive
BOARD_NODE	ID of node in line layer associated with route system where transfer takes place	

5.3.8 Transit Operator and Company Dictionary File

(\Input\Transit\Transit Operator and Company Dictionary.dbf)

Field Name	Description	Notes
OPERATORID	Operator ID, as used in transit route system file	1 = GoTriangle 2 = GoRaleigh 3 = Chapel Hill Transit 4 = GoDurham 5 = NCSU Wolfline 6 = Duke/NCCU 7 = Orange County (OPT) 8 = GoCary
OPERATORNM	Operator name	

Field Name	Description	Notes
COMPANYID	Company ID, as used in transit route system file	11 = GoTriangle Local Routes 12 = GoRaleigh/GoCary Local Routes 13 = Chapel Hill Transit Local Routes 14 = GoDurham Local Routes 15 = Duke/NCSU/NCCU Local Routes 16 = All Express Routes 17 = GoTriangle Shuttle 18 = All Rail Routes
COMPANYNM	Company name	

5.3.9 Observed Vehicle Trip Matrix File

(\EvalModule\Observed_PersonTrips_PA_2013.mtx)

Matrix Core Name	Description	Notes
Tt_Purp	2013 observed TAZ-to-TAZ person-trip interchanges E.g., PK_HBW, OP_WBNH For Two periods of the day: Tt ∈ [PK, OP] Six trip purposes: Purp ∈ [Hbw, Shp, Sch, Oth, WBNH, NHNW]	Source: 2006HTS Expanded to 2013 HHs

5.3.10 Observed Highway Traffic Count Data

(\EvalModule\TrafficCount_Observed_2013.bin)

Field Name	Description	Notes
ID	Highway Link ID	Must match that in highway network geographic file
Old_ID	Data process use	Data process use, user to ignore
Daily Counts	Count values used for evaluation report	
Screenline	TRM v.6 screenline ID	
Cutline	TRM v.6 cutline ID	
COUNT_ID	Count station ID	
Split	Split factor for dividing counts for example on freeways	1 = no split 2 = divide count by 2
Route	Name of facility where count is located	
Location	Description of count location	
County	County name where count is located	
ATRG		Data process use
AxleFact		Data process use
Count05	Year 2005 counts	
AADT05	Year 2005 annual average daily traffic count	
ADT05	Year 2005 average daily traffic count	
2009_Fact_AADT	Year 2009 factored AADT	
2009_AADT	Year 2009 annual average daily traffic count	

Field Name	Description	Notes
2009_Fact_April_AWDT	Year 2009 April factored average weekday daily traffic count	
2009_April_AWDT	Year 2009 April average weekday daily traffic count	
2010_Fact_AADT	Year 2010 factored annual average daily traffic count	
2010_AADT	Year 2010 annual average daily traffic count	
2010_Fact_April_AWDT	Year 2010 April factored average weekday daily traffic count	
2010_April_AWDT	Year 2010 April average weekday daily traffic count	
2013_April_AWDT	Year 2013 April average weekday daily traffic count	
Source	Count program	"NCDOT Coverage" = annual count program NCDOT "Special count" = special count request location
2009SourceDOT	2009 daily traffic count source (NCDOT)	CB = count based GF = growth factored
2010SourceDOT	2010 daily traffic count source (NCDOT)	CB = count based GF = growth factored
Comments	Data prepare notes	
Temp		

5.3.11 Observed Transit Ridership Data

(\EvalModule\Transit_Ridership_Observed_2013.dbf)

Field Name	Description	Notes
COMPANY	Transit agency name	TTA, CAT, CHT, DATA, NCSU, DUKE, CTRAN
RIDERSHIP	Daily transit ridership	

5.3.12 Peak-Period Parking Capacity by PASA and Trip Purpose

(\Input\Programs\Parkcap.bin)

Field Name	Description	Notes
PASA	ID for parking analysis sub-area	1 = UNC campus 2 = Duke campus 3 = NCSU campus 4 = NCCU campus 5 = Chapel Hill CBD 6 = Durham CBD 7 = Raleigh CBD 8 = Carrboro CBD 9 = Hillsboro CBD 10 = RDU airport
CapPurp	Peak-period parking capacity E.g., CapHBW, CapHBU	

Field Name	Description	Notes
	For six trip purposes: Purp ∈ [HBW, HBSH, HBO, HBU, NHNW, WBNH]	

5.3.13 External-Internal Transit Trip Tables by Time of Day

(\Input\Transit\Transit_External_PK.mtx and Transit_External_OP.mtx)

Matrix Core Name	Description	Notes
Trip1	Walk-access local bus trips	
Trip2	Park-and-ride local bus trips	
Trip3	Kiss-and-ride local bus trips	
Trip4	Walk-access express bus trips	
Trip5	Park-and-ride express bus trips	
Trip6	Kiss-and-ride express bus trips	
Trip7	Walk-access rail trips	
Trip8	Park-and-ride rail trips	
Trip9	Kiss-and-ride rail trips	

5.3.14 Trip Generation FORTRAN Program Control File

(\Input\Programs\trmgen.ctl)

```
TRM Trip Generation Program
Created 2010
Model Year = 05
&xinfiles
   soced_file =  '..\..\Interim\dem_tg.bin',      ! Socioeconomic data file for Trip Generation (generated automatically by TransCAD script)
   trnwlk_file = '..\..\Interim\amwp.bin',        ! Walk to transit skim file (generated automatically by TransCAD script)
   trndrv_file = '..\..\Interim\amdr.bin',        ! Drive to transit skim file (generated automatically by TransCAD script)
   hwytme_file = '..\..\Interim\amlov.bin',       ! SOV highway skim file (generated automatically by TransCAD script)
    adjzne_file =  'sch_adj.prn',                 ! School bus percentage and adjacent zones for HBSchool trips

&xoutfiles freport = '..\..\Interim\tg.rep',     ! Trip generation program report
   strata_file =  '..\..\Interim\hhstrata.txt',  ! Households by strata
   accessib_file = '..\..\Interim\racc_str.dat', ! Accessibility measure for non-motorized model
   accstr_file =  '..\..\Interim\accstr.txt',    ! Accessibility measure for attraction share model
   fwrkend = '..\..\Interim\wrkend.txt',         ! Home-based work trip productions and attractions
   fshpend = '..\..\Interim\shpend.txt',         ! Home-based shop trip productions and attractions
   fothend = '..\..\Interim\othend.txt',         ! Home-based other trip productions and attractions
   fschend = '..\..\Interim\schend.txt',         ! Home-based school trip productions and attractions
   fwbnhend = '..\..\Interim\wbnhend.txt',       ! Work-based non home trip productions and attractions
   fnhnwend = '..\..\Interim\nhnwend.txt',       ! Non-home non-work trip productions and attractions
   fvehown = '..\..\Interim\tghh.txt',           ! Households stratification (by income, size, children, auto, worker)
   fnonmot = '..\..\Interim\nonmot.txt' /        ! Non-motorized trip productions and attractions; not used in TRMv6 v5

&param zones = 2956                              ! Total number of zones (internal and external)
   trnfac=0.01,                                  ! transit skim conversion factor
   hwytmefac=1.0,                                ! Highway time conversion factor
   hwydstfac=1.0,                                ! Highway distance conversion factor
   fexp=-2.0                                     ! Power unit for accessibility measure
   schbuspct=0.7992,0.5419,0.4297,0.3057,0.2321  ! Percentage of students taking school buses by HH strata (for HBSchool purpose)
   calibrate=0                                   ! Set to 0 for application & set to 1 for calibration (does not include on-campus students)
```

5.3.15 Mode Choice FORTRAN Program Control Files

(\Input\Programs\mchbw_pk.ctl, mchbw_op.ctl, mcshp_pk.ctl, mcshp_op.ctl, mcsch_pk.ctl, mcsch_op.ctl, mcoth_pk.ctl, mcoth_op.ctl, mcwbnh_pk.ctl, mcwbnh_op.ctl mcnhnw_pk.ctl, mcnhnw_op.ctl, mcu_hbu_pk.ctl, mcu_hbu_op.ctl, mcu_hbo_pk.ctl, mcu_hbo_op.ctl, mcu_ubnh_pk.ctl, mcu_ubnh_op.ctl, and mcu_nhnu_daily.ctl)

The contents of the file **mchbw_pk.ctl** are shown below for the purpose of illustration. The values shown here might not reflect the latest calibration. Refer to the 2013 model provided in the data CD-ROM for the most accurate values.

```
&Files
  FSKA0P='..\..\Interim\AMLOV.BIN'              ! Input: Auto-drive alone skim matrix
  FSKA2P='..\..\Interim\AMHOV.BIN'              ! Input: Auto-HOV skim matrix
  FSKLCL='..\..\Interim\AML.BIN'                ! Input: Transit-local bus skim matrix
  FSKEXP='..\..\Interim\AMP.BIN'                ! Input: Transit-express bus skim matrix
  FSKRAL='..\..\Interim\AMR.BIN'                ! Input: Transit-rail skim matrix
  FPERIN='..\..\Interim\WRKPK_PER_M.BIN'        ! Input: Motorized person trip matrix
  FZWALK='..\..\Interim\MCWALK.BIN'             ! Input: Percent walk file
  FPCOST='..\..\Interim\PARKCOST.BIN'           ! Input: Parking cost file
  FMDOUT='..\..\Interim\HBW_PK.BIN'             ! Output: Motorized person trip by mode matrix
  FHOVPR='..\..\Interim\HBW_PK2P.BIN'           ! Output: HOV trip matrix
  FAINDR='..\..\Interim\HBW_PK_DRV.ASC'         ! Output: Auto intercept Drive access trip matrix
  FAINTR='..\..\Interim\HBW_PK_TRN.ASC'         ! Output: Auto intercept Transit trip matrix
  FRPORT='..\..\Output\MC_HBW_PK.RPT'           ! Output: Report file
  FUSERB='..\..\Interim\UBHBW_PK.BIN'           ! Output: Summit file
  FLGSUM='..\..\Interim\LSHBW_PK.BIN'           ! Output: LOGSUM file
  FPASAT='..\..\Interim\PASAHBW_PK.BIN'         ! Output: Summary of auto-vehicle trips by PASA

/
&PARAMS
  NZONES=2956   ! Number of internal zones AND external stations
  NCATS=5       ! Number of market segments [HH Strata]
  parkuse=1     ! TRM v.6 new: Parking cost use 1=HBW, 2=HBShop, 3=HBO(U_HBO), 4=U_HBU (U_UBNH), 5=NHNW (U_NHNU), 6=WBNH
[0=HBK12]
  shadincr=500.0  ! shadow price increment for parking capacity constraint calculations
  NIter=5       ! Calibration only: Maximum iteration
```

```
/
&OPTIONS
  DRYRUN=F       ! Execute dryrun and terminate
  DEBUG=F        ! Selected zone debug option
  HWY2P=T        ! TRMv.5=T for all; If unavailable skip/PB:2-person auto skims available
  HWY3P=F        ! 3/+-person auto skims available
  CALIB=F        ! Automated calibraiton option: T=Calibrate ASCs; F=Regular run without a calibration
  USERBEN=F      ! Output Summit user benefit
  HOV=F          ! TRM v.5=F for all: Do NOT use [PB old: Consider HOV lane usage]
  EXPBUS=T       ! Express bus skims available
  RAIL=T         ! Urban rail skims available [T: Use;If not available, skip]
  WORK=F         ! TRM v.5=F for all: Do NOT use [PB old]
  NMOT=F         ! Non-motorized option
  LCLKR=F        ! TRM v.5=F for all: Do NOT use [PB old:Allow Kiss&Ride to local bus (at walk access locations)]
  AUTINT=T       ! Allow auto-intercept option
  LCLDRV=T       ! Allow drive access to local bus
  UNIV=F         ! True: bypass the drive-alone prohibition for HH 1
  CCode=T F F F T T T  ! Specify ASCs to be calibrated [Effective only CALIB=T]


/
&SELECTS
  I(1)=1,-2956
  J(1)=1,-2956
  TDAY='PEAK'
  TPURP='HBW'
  ALTNAME='TRM v.6 - Year 2013 [ASC: v.4d_1, MZI, Sat, 2016-01-16] KRAL, KRALW, CRIVTW 2040 vals. added JH 2016-02-24'
  MDLYEAR=2013       ! Auto vehicle trip summary by PASA


/
&PARMS
  CIVT=-0.025
  CWAIT1=-0.050
  CWAIT2=-0.050
  CTWALK=-0.0625
  CDRIVE=-0.050
  COCOST=-0.00439,-0.00545,-0.00188,-0.00175,-0.00086
  CPCOST=-0.00439,-0.00545,-0.00188,-0.00175,-0.00086
  CXFERS=-0.2
```

```
CCBD=0.0
CLSPRM=0.5
CLSSUB=0.5
ACPM=10.0
OCC3P=3.5
INTDA=0.8
INT2P=0.1
INT3P=0.1
HOVMIN=0.1
ADJFCT=0.5

 KTRN(1)=  11.73010
 KTRN(2)=  -1.06231
 KTRN(3)=   0.46726
 KTRN(4)=  -2.24170
 KTRN(5)=  -2.75561

 KSR(1)=   0.00000
 KSR(2)=  -0.54626
 KSR(3)=  -0.15751
 KSR(4)=  -1.31237
 KSR(5)=  -1.46637

 KATR(1)= -14.92000
 KATR(2)=  -2.36312
 KATR(3)=  -2.12353
 KATR(4)=  -1.84238
 KATR(5)=  -2.28612

 K3P(1)=  -1.28428
 K3P(2)=  -0.06492
 K3P(3)=  -0.35606
 K3P(4)=  -0.38428
 K3P(5)=  -0.32211

 KDRV(1)= -15.00000
 KDRV(2)=  -3.47948
 KDRV(3)=  -4.27956
 KDRV(4)=  -3.15519
 KDRV(5)=  -2.50572
```

```
   KPNR(1)=  -0.83194
   KPNR(2)=   1.42921
   KPNR(3)=   0.67187
   KPNR(4)=   2.26897
   KPNR(5)=   1.50387

   KEXP(1)=  0.80161
   KEXP(2)=  0.80161
   KEXP(3)=  0.80161
   KEXP(4)=  0.80161
   KEXP(5)=  0.80161

   KRAL(1)= 0.15
   KRAL(2)= 0.15
   KRAL(3)= 0.15
   KRAL(4)= 0.15
   KRAL(5)= 0.15
   KRALW=   0.75
   CRIVTW=  0.85
/
```

5.4 Preparing Synthesized Population

5.4.1 Input File: Households by size table

(\SESYN\INPUT\SEData\HHsize_by_taz.bin)

Field Name	Description	Notes	Format
ID	TRMv6 Internal TAZ ID	Range: 1-2,857	I4
HHs1	Household size 1	Number of one person households in TAZ	I4
HHs2	Household size 2	Number of two person households in TAZ	I4
HHs3	Household size 3	Number of three person households in TAZ	I4
HHs4	Household size 4	Number of four person households in TAZ	I4
HHs5	Household size 5	Number of five person households in TAZ	I4
HHs6	Household size 6+	Number of six plus person households in TAZ	I4

5.4.2 Input File: Households by income table

(\SESYN\INPUT\SEData\HHInc_by_taz.bin)
Note: All income is stated in 2006 $

Field Name	Description	Notes	Format
ID	TRMv6 Internal TAZ ID	Range: 1-2,857	I4
HH_Inc1	Low income ($0, $25K)	Number of low income HHs in TAZ	I4
HH_Inc2	Medium-low income ($25k, $50K)	Number of medium low income HHs in TAZ	I4
HH_Inc3	Medium-high income ($50k, $75k)	Number of medium high income HHs in TAZ	I4
HH_Inc4	High income ($75k, ∞)	Number of high income HHs in TAZ	I4

5.5 Output Files

5.5.1 Highway Line Geographic File

(\Input\Highway\Highway_Line.dbd)

1) Line Layer:

Field Name	Description	Notes
All Fields from Line Layer of Universe Highway Geographic File	See Universe Highway Geographic File (Highway.dbd)	
FACTYPEAB(BA)	Facility type – AB/BA direction	Filled automatically in step "Create Network"
AB(BA)_BUS_SPEED_CAT	Bus speed category – AB/BA direction	
AB(BA)HRCAPACITY	Hourly lane capacity – AB/BA direction	
AB(BA)AMCAPACITY1	AM pre-peak-hour 1.5-hour link capacity – AB/BA direction	
AB(BA)AMCAPACITY2	AM peak-hour link capacity – AB/BA direction	
AB(BA)AMCAPACITY3	AM post-peak-hour 1.5-hour link capacity – AB/BA direction	
AB(BA)PMCAPACITY1	PM pre-peak-hour 1.5-hour link capacity – AB/BA direction	
AB(BA)PMCAPACITY2	PM peak-hour link capacity – AB/BA direction	
AB(BA)PMCAPACITY3	PM post-peak-hour 1.5-hour link capacity – AB/BA direction	
AB(BA)OPCAPACITY	Off-peak link capacity – AB/BA direction	
AB(BA)FFSPEED	Free-flow speed – AB/BA direction	
AB(BA)FFTIME	Free-flow travel time – AB/BA direction	
AB(BA)ALPHA	Alpha value for Conical VDF – AB/BA direction	
AB(BA)CONGSPD	Congested speed – AB/BA direction	Initially filled with free-flow speed/time in step "Create Network". Later updated with congested speed/time in step "Highway Assignment", after AM assignment is finished.
AB(BA)CONGTIME	Congested travel time – AB/BA direction	

2) Node Layer:

- Same as Node Layer of Universe Highway Geographic File (Highway.dbd)

5.5.2 Transit Background Line File

(\Input\Transit\Transit_Line.dbd)

1) Line Layer:

Field Name	Description	Notes
All Fields from Line Layer of Universe Highway Geographic File	See Universe Highway Geographic File (Highway.dbd)	
AB(BA)LINKTIME	Non-transit-on-highway link travel time – AB/BA direction (Not used by model, but still has to stay in the file. Will clean later.)	For walk-access links, CBD walk links, and parking-lot walk links (mode = 1, 3, & 4, respectively), value = walk time in minutes = (Length in miles/3 mph)*60 minutes in an hour; for transit-only links (mode = 5), value = driving time = (Length/PostSpd)*60. AB(BA)LINKTIME is exactly the same as AB(BA)NONTRANSITTIME
AB(BA)NONTRANSITTIME	Non-transit-on-highway link travel time – AB/BA direction	
AB(BA)AMFFTIME	Transit travel time on highway link during peak period – AB/BA direction	Calculated for highway links and CBD links only (mode = 99 or 3): = (Length/AB(BA)_AM(OP)_BUS _SPEED) * 60 (in minutes)
AB(BA)OPFFTIME	Transit travel time on highway link during off-peak period – AB/BA direction	
AB(BA)AMLINKTIME	Transit-related travel time during peak period – AB/BA direction	For highway links (mode = 99), copies transit travel time in AB(BA)AM(OP)FFTIME; for all other links (mode = 1, 3, 4,and 5), copies value in AB(BA)NONTRANSITTIME
AB(BA)OPLINKTIME	Transit-related travel time during off-peak period – AB/BA direction	
AB(BA)WALKTIME	Walk time – AB/BA direction	No value for freeway/expressway-related facilities or centroid connectors
AB(BA)AMDRIVETIME	Automobile drive time during peak period – AB/BA direction	Same as AB(BA)CONGTIME in Highway Line Geographic File
AB(BA)OPDRIVETIME	Automobile drive time during off-peak period – AB/BA direction	Same as AB(BA)FFTIME in Highway Line Geographic File
AB(BA)_BASE_SPEED	Free-flow base speed for transit – AB/BA direction	Same as AB(BA)FFSPEED in Highway Line Geographic File
AB(BA)_CONG_SPEED	Congested base speed for transit – AB/BA direction	Same as AB(BA)CONGSPD in Highway Line Geographic File
AB(BA)_BUS_SPEED_CATEGORY	Transit speed category – AB/BA direction	Used to get bus equation parameters from Bus Speed Equation Lookup Table for calculating transit travel speeds
AB(BA)_AM_BUS_SPEED	Transit speed during peak period – AB/BA direction	Calculated for highway links and CBD links only (mode = 99 or 3), based on AB(BA)_CONG_SPEED and bus equation parameters; used for calculation of AB(BA)AMFFTIME
AB(BA)_OP_BUS_SPEED	Transit speed during off-peak period – AB/BA direction	Calculated for highway links and CBD links only (mode = 99 or 3), based on AB(BA)_BASE_SPEED and bus equation parameters; used for calculation of AB(BA)OPFFTIME

2) Node Layer:

Field Name	Description	Notes
All Fields from Node Layer of Universe Highway Geographic File	See Universe Highway Geographic File (Highway.dbd)	
KissingNodes	Indicates if node is kiss-and-ride location	1 if node is kiss-and-ride location; otherwise, null

5.5.3 Walk Access Times

(\Interim\WalkTime.bin)

Field Name	Description	Notes
TAZ	TAZ ID	
WalkPct1	Percent of TAZ within walk range (0 – 0.05 miles) of stop(s)	
WalkPct2	Percent of TAZ within walk range (0 – 0.1 miles) of stop(s)	
WalkPct3	Percent of TAZ within walk range (0 – 0.15 miles) of stop(s)	
WalkPct4	Percent of TAZ within walk range (0 – 0.2 miles) of stop(s)	
WalkPct5	Percent of TAZ within walk range (0 – 0.25 miles) of stop(s)	
WalkPct6	Percent of TAZ within walk range (0 – 0.3 miles) of stop(s)	
WalkPct7	Percent of TAZ within walk range (0 – 0.35 miles) of stop(s)	
WalkPct8	Percent of TAZ within walk range (0 – 0.4 miles) of stop(s)	
WalkPct9	Percent of TAZ within walk range (0 – 0.45 miles) of stop(s)	
WalkPct10	Percent of TAZ within walk range (0 – 0.5 miles) of stop(s)	
ShortPct	Percent of TAZ within short-walk range (0-0.25 miles) of stop(s)	
LongPct	Percent of TAZ within long-walk range (0.25-0.5 miles) of stop(s)	
ShortTime	Average walk time for portion of TAZ in short-walk range	
LongTime	Average walk time for portion of TAZ in long-walk range	
WalkTime	Average walk time of TAZ in walk range	WalkTime = ShortTime * ShortPct + LongTime * LongPct

5.5.4 Highway Skim Matrix Files

(AMLOV.mtx, AMHOV.mtx, OPLOV.mtx, OPHOV.mtx, AMLOV2.mtx, AMHOV2.mtx, OPLOV2.mtx, and OPHOV2.mtx)

1) \Output\AMLOV.mtx, AMHOV.mtx, OPLOV.mtx, and OPHOV.mtx

Matrix Core Name	Description	Notes
Time	Travel time in minutes, including toll-converted time, based on value of time	
Distance	Travel distance in miles	

2) \Output\AMLOV2.mtx, AMHOV2.mtx, OPLOV2.mtx, and OPHOV2.mtx

Matrix Core Name	Description	Notes
Time	Travel time in minutes, no tolls included	
Distance	Travel distance in miles	
Toll_VehTt (Skim)	Toll by vehicle occupancy and time of day E.g., Toll_HOVAM(Skim) Two vehicle types: Veh ∈ [SOV, HOV] Two periods of the day: Tt ∈ [AM, OP]	

5.5.5 Premium Transit Skim Matrix Files

(\Interim\AMDRIVE.mtx, AMWALK.mtx, and OPWALK.mtx)

Matrix Core Name	Description
Fare	Transit fare in USDs * 100
Initial Wait Time	Initial wait time in minutes * 100
Transfer Wait Time	Transfer wait time in minutes * 100
Number of Transfers	Average number of transfers
Prem IVT	In-vehicle travel time on express buses and rail transit (in minutes * 100)
WalkTime (Walk)	Walk time on walk-access links and highway links (in minutes * 100)
DriveTime (Drive)	Drive time on highway links and centroid connectors (in minutes * 100)
WalkTime (CBDWalk)	Walk time on CBD highway links (in minutes * 100)
Local IVT	In-vehicle travel time on local buses (in minutes * 100)

5.5.6 Transit Skim Matrix Files by Transit Mode, Access Mode, and Time of Day

(\Output\AMKLSKIM1.mtx, AMKPSKIM1.mtx, AMKRSKIM1.mtx, AMDLSKIM1.mtx, AMDPSKIM1.mtx, AMDRSKIM1.mtx, AMWLSKIM1.mtx, AMWPSKIM1.mtx, AMWRSKIM1.mtx, OPKLSKIM1.mtx, OPKPSKIM1.mtx, OPKRSKIM1.mtx, OPDLSKIM1.mtx, OPDPSKIM1.mtx, OPDRSKIM1.mtx, OPWLSKIM1.mtx, OPWPSKIM1.mtx, and OPWRSKIM1.mtx)

Note: Because these matrix files are large and take up a lot of disk space, only AMDRSKIM1.mtx and AMWRSKIM1.mtx are kept for debugging purpose, if any bugs exist, and all other matrix files are deleted in the middle of the model run.

Matrix Core Name	Description
Fare	Transit fare in USDs * 100
Initial Wait Time	Initial wait time in minutes * 100
Transfer Wait Time	Transfer wait time in minutes * 100
Number of Transfers	Average number of transfers
WalkTime (Walk)	Walk time on walk-access links (in minutes * 100)
WalkTime (Drive)	Walk time on highway links (in minutes * 100)
WalkTime (CBDWalk)	Walk time on CBD highway links (in minutes * 100)
WalkTime (Walk Funnel)	Walk time on walk funnels (in minutes * 100)
DriveTime (Drive)	Drive time on highway links and centroid connectors (in minutes * 100)
LinkTime (Local)	IVTT on local buses (in minutes * 100)
LinkTime (Express)	IVTT on express buses (in minutes * 100)
LinkTime (Shuttle)	IVTT on shuttle buses (in minutes * 100)
LinkTime (Rail)	IVTT on rail transit (in minutes * 100)

5.5.7 Transit Skim Matrix Files by Transit Mode and Time of Day for All Access Modes

(\Interim\AML.mtx, AMP.mtx, AMR.mtx, OPL.mtx, OPP.mtx, and OPR.mtx)

Matrix Core Name	Description	Notes
Wait1_W	Initial wait time – Walk access	
Wait2_W	Transfer wait time – Walk access	
Xfer_W	Number of transfers – Walk access	
Walk_W	Walk time – Walk access	
CBDWalk_W	CBD walk time – Walk access	
Tmp1	Divider	User ignore
Shutl_W	IVTT on shuttle buses – Walk access	
Local_W	IVTT on local buses – Walk access	
Exp_W	IVTT on express buses – Walk access	
Rail_W	IVTT on rail transit – Walk access	
Fare_W	Transit fare – Walk access	
Wait1_D	Initial wait time – Park-and-ride	
Wait2_D	Transfer wait time – Park-and-ride	
Xfer_D	Number of transfers – Park-and-ride	
Walk_D	Walk time – Park-and-ride	
CBDWalk_D	CBD walk time – Park-and-ride	
Shutl_D	IVTT on shuttle buses – Park-and-ride	
Tmp2	Divider	User ignore
Drive_D	Drive time – Park-and-ride	
Tmp3	Divider	User ignore
Local_D	IVTT on local buses – Park-and-ride	
Exp_D	IVTT on express buses – Park-and-ride	
Rail_D	IVTT on rail transit – Park-and-ride	
Fare_D	Transit fare – Park-and-ride	
Wait1_K	Initial wait time – Kiss-and-ride	
Wait2_K	Transfer wait time – Kiss-and-ride	
Xfer_K	Number of transfers – Kiss-and-ride	
Walk_K	Walk time – Kiss-and-ride	
CBDWalk_K	CBD walk time – Kiss-and-ride	
Shutl_K	IVTT on shuttle buses – Kiss-and-ride	
Tmp4	Divider	User ignore

Matrix Core Name	Description	Notes
Drive_K	Drive time – Kiss-and-ride	
Tmp5	Divider	User ignore
Local_K	IVTT on local buses – Kiss-and-ride	
Exp_K	IVTT on express buses – Kiss-and-ride	
Rail_K	IVTT on rail transit – Kiss-and-ride	
Fare_K	Transit fare – Kiss-and-ride	
AM(OP)L: LocalCT AM(OP)P: ExpCT	LocalCT: Local bus composit travel time ExpCT: Express bus composit travel time	
AM(OP)P: TransitCT	Transit composit travel time	
AM(OP)P: MCT	Motorized trip composite travel time	

5.5.8 Air Passenger Trips

(\Interim\AirP.bin)

Field Name	Description	Notes
TAZID	TAZ ID	
CountyID	County ID	1 = Wake 2 = Durham 3 = Orange 4 = Other
HH1	Air passenger trips from low-income households	
HH2	Air passenger trips from medium-low-income households	
HH3	Air passenger trips from medium-high-income households	
HH4	Air passenger trips from high-income households	
HHs	Total households in TAZ	
EMP	Total employees in TAZ (i.e., regular + special)	
HBA	Home-based airport trips	Not balanced to airport-passenger-trip control total
WBA	Work-based airport trips	Not balanced to airport-passenger-trip control total
PRA	Private-residence-based (not home-based) airport trips	Not balanced to airport-passenger-trip control total
OTHA	Other-place-based airport trips	Not balanced to airport-passenger-trip control total
HBO	Home-based other trips	= HBA, after balanced to airport-passenger-trip control total
WBNH	Work-based non-home trips	= WBA, after balanced to airport-passenger-trip control total
NHNW	Non-home-non-work-based airport trips	= PRA + OTHA, after both balanced to airport-passenger-trip control total

5.5.9 All-Mode, Motorized, and Non-Motorized Person-Trip PA Matrix Files

(Motorized: \Interim\
M_WrkPK_Per.mtx, M_ShpPK_Per.mtx, M_SchPK_Per.mtx, M_OthPK_Per.mtx,

M_WBNHPK_Per.mtx, M_NHNWPK_Per.mtx;
M_WrkOP_Per.mtx, M_ShpOP_Per.mtx, M_SchOP_Per.mtx, M_OthOP_Per.mtx,
M_WBNHOP_Per.mtx, M_NHNWOP_Per.mtx;
Univ_Motorized_HBU.mtx, Univ_Motorized_HBO.mtx, Univ_Motorized_NHNU.mtx,
and Univ_Motorized_UBNH.mtx

Nonmotorized: \Interim\
NM_WrkPK_Per.mtx, NM_ShpPK_Per.mtx, NM_SchPK_Per.mtx,
NM_OthPK_Per.mtx, NM_WBNHPK_Per.mtx, and NM_NHNWPK_Per.mtx;
NM_WrkOP_Per.mtx, NM_ShpOP_Per.mtx, NM_SchOP_Per.mtx,
NM_OthOP_Per.mtx, NM_WBNHOP_Per.mtx, and NM_NHNWOP_Per.mtx;
Univ_NonMotorized_HBU.mtx, Univ_NonMotorized_HBO.mtx,
Univ_NonMotorized_NHNU.mtx, and Univ_NonMotorized_UBNH.mtx)

i. \Interim\Univ_Motorized_HBU.mtx, Univ_Motorized_HBO.mtx,
Univ_Motorized_NHNU.mtx, and Univ_Motorized_UBNH.mtx

Matrix Core Name	Description	Notes
St_Tt	Motorized trips for four combinations of student type (2) and time of day (2) E.g., On_PK, Off_OP Two student types: St $\in$ [On, Off] On = Students living on-campus Off = Students living off-campus Two periods of the day: Tt $\in$ [PK, OP] PK = Peak periods (AM and PM peak periods combined) OP = Off-Peak	In P-A format For Purp = NHNU: On_PK and Off_PK = 0 NHNU trips modeled only for entire day

ii. \Interim\Univ_NonMotorized_HBU.mtx, Univ_NonMotorized_HBO.mtx,
Univ_NonMotorized_NHNU.mtx, and Univ_NonMotorized_UBNH.mtx

Matrix Core Name	Description	Notes
St_Tt	Non-motorized trips for four combinations of student type (2) and time of day (2) (same as motorized, above) E.g., On_PK, Off_OP	In P-A format For Purp = NHNU: On_PK and Off_PK = 0 NHNU trips modeled only for entire day

iii. \Interim\[All other trip matrix files]

Matrix Core Name	Description
TripH	Trip interchanges for household strata H, in PA format E.g., Trip1, Trip5 Five HH strata: H ∈ [1, 2, 3, 4, 5]

5.5.10 Final Trip OD Matrix Files for Highway Assignment

(\Output\TOTAM_OD.mtx, TOTPM_OD.mtx, TOTMD_OD.mtx, and TOTNT_OD.mtx)

1) \Output\TOTAM_OD.mtx and TOTPM_OD.mtx,

Matrix Core Name	Description
SOV1/HOV1	SOV (or HOV) vehicle-trip interchange table for pre-peak-hour shoulder AM Peak: 6:00-7:30 AM; PM Peak: 3:30-5:00 PM
SUT1/MUT1	Single-unit-truck (or multi-unit-truck) vehicle-trip interchange table for pre-peak-hour shoulder (same as above)
SOV2/HOV2	SOV (or HOV) vehicle-trip interchange table for peak hour AM Peak: 7:30-8:30 AM; PM Peak: 5:00-6:00 PM
SUT2/MUT2	SUT (or MUT) vehicle-trip interchange table for peak hour (same as above)
SOV3/HOV3	SOV (or HOV) vehicle-trip interchange table for post-peak-hour shoulder AM Peak: 8:30-10:00 AM; PM Peak: 6:00-7:30 PM
SUT3/MUT3	SUT (or MUT) vehicle-trip interchange table for post-peak-hour shoulder (same as above)

2) \Output\TOTMD_OD.mtx and TODNT_OD.mtx

Matrix Core Name	Description
SOV/HOV	SOV (or HOV) vehicle-trip interchange table
SUT/MUT	SUT (or MUT) vehicle-trip interchange table

5.5.11 Final Trip PA Matrix Files for Transit Assignment

(\Output\PK_TRN.mtx and OP_TRN.mtx)

Matrix Core Name	Description
Trip1	Walk to Local Bus trip interchange table
Trip2	Park-and-Ride to Local Bus trip interchange table
Trip3	Kiss-and-Ride to Local Bus trip interchange table
Trip4	Walk to Express Bus trip interchange table
Trip5	Park-and-Ride to Express Bus trip interchange table
Trip6	Kiss-and-Ride to Express Bus trip interchange table
Trip7	Walk to Rail trip interchange table
Trip8	Park-and-Ride to Rail trip interchange table
Trip9	Kiss-and-Ride to Rail trip interchange table

5.5.12 Highway Assignment Result Files – Sub-periods (pre-peak-hour shoulder, peak hour, and post-peak-hour shoulder)

(Output\AMP1.bin, AMP2.bin, AMP3.bin, PMP1.bin, PMP2.bin, and PMP3.bin)

Field Name	Description	Notes
ID1	Highway link ID	
AB(BA)_Flow_PCE	All-vehicle volume in PCE: AB/BA direction	
Tot_Flow_PCE	All-vehicle volume in PCE: Total = AB + BA	
AB(BA)_Time	Travel time: AB/BA direction	
MAX_Time	Maximum travel time: AB or BA direction	
AB(BA)_voc	Volume-to-capacity ratio: AB/BA direction	
MAX_voc	Maximum volume-to-capacity ratio: AB or BA	
AB(BA)_V_Dist_T	Vehicle miles traveled: AB/BA direction	
Tot_V_Dist_T	Vehicle miles traveled: Total = AB + BA	
AB(BA)_vht	Vehicle minutes traveled: AB/BA direction	
TOT_vht	Vehicle hours traveled: Total = AB + BA	
AB(BA)_speed	Travel speed: AB/BA direction	
AB(BA)_VDF	Volume Delay Function value: AB/BA direction	
MAX_VDF	Maximum Volume Delay Function value: AB or BA direction	
AB(BA)_Flow_SOV1/2/3	SOV volume: AB/BA direction	Numbers in field title: 1: pre-peak-hour shoulder 2: peak hour 3: post-peak-hour shoulder
AB(BA)_Flow_HOV1/2/3	HOV volume: AB/BA direction	
AB(BA)_Flow_TRK1/2/3	Truck volume: AB/BA direction	
AB(BA)_Flow	All-vehicle volume: AB/BA direction	
Tot_Flow	All-vehicle volume: Total = AB + BA	

5.5.13 Highway Assignment Result Files – Period Total

(\Output\AMAssn1.bin and PMAssn1.bin)

Field Name	Description	Notes
ID1	Highway link ID	
AB(BA)_Flow_PCE	All-vehicle volume in PCE: AB/BA direction	Sum of fields with same titles as in AMP1.bin, AMP2.bin, and AMP3.bin for AM peak and in PMP1.bin, PMP2.bin, and PMP3.bin for PM peak
Tot_Flow_PCE	All-vehicle volume in PCE: Total = AB + BA	
AB(BA)_Time	Travel time: AB/BA direction	Sub-period volume-weighted average travel time and speed
AB(BA)_Speed	Travel speed: AB/BA direction	
AB(BA)_Flow_SOV	SOV volume: AB/BA direction	Sum of the fields with the same titles* as in AMP1.bin, AMP2.bin, and AMP3.bin for AM peak and in PMP1.bin, PMP2.bin, and PMP3.bin for PM peak *Field titles in sub-period files have an additional digit to indicate the sub-period (i.e., 1, 2, or 3)
AB(BA)_Flow_HOV	HOV volume: AB/BA direction	
AB(BA)_Flow_TRK	Truck volume: AB/BA direction	

Field Name	Description	Notes
AB(BA)_Flow	All-vehicle volume: AB/BA direction	Sum of fields with same titles as in AMP1.bin, AMP2.bin, and AMP3.bin for AM peak and in PMP1.bin, PMP2.bin, and PMP3.bin for PM peak
Tot_Flow	All-vehicle volume: Total = AB + BA	
AB(BA)_Flow_PCE1	All-vehicle volume in PCE: AB/BA direction during pre-peak-hour shoulder	= AB(BA)_Flow_PCE in AMP1.bin or PMP1.bin
AB(BA)_Flow_PCE2	All-vehicle volume in PCE: AB/BA direction during peak-hour	= AB(BA)_Flow_PCE in AMP2.bin or PMP2.bin
AB(BA)_Flow_PCE3	All-vehicle volume in PCE: AB/BA direction during post-peak-hour shoulder	= AB(BA)_Flow_PCE in AMP3.bin or PMP3.bin

5.5.14 Highway Assignment Turning Movement Files

(\Output\TMV_AM1.bin, TMV_AM2.bin, TMV_AM3.bin, TMV_PM1.bin, TMV_PM2.bin, TMV_PM3.bin, Intersection Turning Movements_MD.bin, and Intersection Turning Movements_NT.bin)

Field Name	Description	Notes
FROMLINK	"From" link for the turn	
TOLINK	"To" link for the turn	
NODE	Intersection node ID	
VOLUME	Total vehicle turning volume	For "Intersection Turning Movements_MD/NT.bin" files, there is no sub-period N VOLUME = VOLUME_SOV + VOLUME_HOV + VOLUME_SUT
VOLUME_VehN	Turning volume by vehicle type for sub-period N within AM or PM peak period: E.g., Volume_SOV1, Volume_SUT1 Three vehicle types: Veh ∈ [SOV, HOV, SUT] Three sub-periods: N ∈ [1, 2, 3] AM Peak period: 1 = pre-peak-hour shoulder: 6:00-7:30 AM 2 = peak hour: 7:30 – 8:30 AM 3 = post-peak-hour shoulder: 8:30-10:00 AM PM Peak period: 1 = pre-peak-hour shoulder: 3:30-5:00 PM 2 = peak hour: 5:00-6:00 PM 3 = post-peak-hour shoulder: 6:00-7:30 PM	

5.5.15 Transit Assignment Result Files – Transit Flows by Route

(Output*_**flw**.bin)

Field Name	Description	Notes
ROUTE	Transit route ID	
FROM_STOP	From-stop ID	

Field Name	Description	Notes
TO_STOP	To-stop ID	
FROM_MP	Milepost of From stop	
TO_MP	Milepost of To stop	
TransitFlow	Transit flow (riders onboard) from From stop to To stop	
BaseIVTT	In-vehicle travel time (in minutes)	
Cost	General cost (in USDs)	
VOC	Volume-to-capacity ratio	Always null for TRMv6, because TRMv6 does not use capacity-constrained assignment methods

5.5.16 Transit Assignment Result Files – Aggregated Transit Flows on Highway Links

(Output*_**agg**.bin)

Field Name	Description	Notes
ID1	Link ID	Matches ID in Transit Line geographic file
AB(BA)_TransitFlow	All-route transit flow on link: AB/BA direction	
AB(BA)_NonTransit	All-route non-transit flow on link: AB/BA direction	
AB(BA)_TotalFlow	All-route transit and non-transit flow on link: AB/BA direction	AB_TotalFlow = AB_TransitFlow + AB_NonTransit
AB(BA)_Access_Walk_Flow	All-route walk-access flow on link: AB/BA direction	
AB(BA)_Xfer_Walk_Flow	All-route transfer-walk flow on link: AB/BA direction	
AB(BA)_Egress_Walk_Flow	All-route walk-egress flow on link: AB/BA direction	
AB(BA)_Walk_Flow	All-route all-walk flow on link: AB/BA direction	AB_Walk_Flow = AB_Access_Walk_Flow + AB_Xfer_Walk_Flow + AB_Egress_Walk_Flow
AB(BA)_Drive_Flow	All-route drive-access flow on link: AB/BA direction	

5.5.17 Transit Assignment Result Files – Boarding/Alighting by Stop

(Output*_**ono**.bin)

Field Name	Description	Notes
STOP	Stop ID	
ROUTE	Transit route ID	
On	Total number of riders boarding	
Off	Total number of riders alighting	

Field Name	Description	Notes
DriveAccessOn	Number of drive-access riders boarding	Field available only in park-and-ride and kiss-and-ride boarding/alighting tables
WalkAccessOn	Number of walk-access riders boarding	On = WalkAccessOn (or DriveAccessOn) + DirectTransferOn + WalkTransferOn
DirectTransferOn	Number of transfer riders boarding: transferred from another route at same location	
WalkTransferOn	Number of transfer riders boarding: transferred from another route with some walking	
DirectTransferOff	Number of transfer riders alighting: transfer to another route at the same location	Off = DirectTransferOff + WalkTransferOff + EgressOff
WalkTransferOff	Number of transfer riders alighting: transfer to another route with some walking	
EgressOff	Number of riders alighting to egress the transit system	

5.5.18 Transit Assignment Result Files – Transfers among Routes and Stops

(Output*_**mov**.bin)

Field Name	Description
FROM LINE	From-route ID
TO LINE	To-route ID
ALIGHT STOP	Alighting stop ID
BOARD STOP	Boarding stop ID
VOLUME	Transfer volume

5.5.19 Transit Assignment Result Files – Walk Flows

(Output*_**wfl**.bin)

Field Name	Description	Notes
ID1	Highway Link ID	Matches ID in Transit Line geographic file
AB(BA)_WalkFlow	All transit-related walk (and drive) flow: AB/BA direction	Park-and-ride and kiss-and-ride tables contain transit-related drive flow, but walk-access tables do not In drive-access tables: AB(BA)_Flow = AB(BA)_Walk_Flow + AB(BA)_Drive_Flow In walk-access tables: AB(BA)_Flow = AB(BA)_Access_Walk_Flow + AB(BA)_Xfer_Walk_Flow + AB(BA)_Egress_Walk_Flow
TOT_WalkFlow	All transit-related walk (and drive) flow total: AB + BA	
AB(BA)_Access_Walk_Flow	Walk-access walk flow: AB/BA direction	
TOT_Access_Walk_Flow	Walk-access walk flow total: AB + BA	

Field Name	Description	Notes
AB(BA)_Xfer_Walk_Flow	Transfer walk flow: AB/BA direction	
TOT_Xfer_Walk_Flow	Transfer walk flow total: AB + BA	
AB(BA)_Egress_Walk_Flow	Egress walk flow: AB/BA direction	
TOT_Egress_Walk_Flow	Egress walk flow total: AB + BA	
AB(BA)_Walk_Flow	Transit-related walk flow: AB/BA direction	Park-and-ride and kiss-and-ride tables contain these fields, but walk-access tables do not AB(BA)_Walk_Flow = AB(BA)_Access_Walk_Flow + AB(BA)_Xfer_Walk_Flow + AB(BA)_Egress_Walk_Flow
TOT_Walk_Flow	Transit-related walk flow total: AB + BA	
AB(BA)_Drive_Flow	Transit-related drive flow: AB/BA direction	Only park-and-ride and kiss-and-ride tables contain these fields
TOT_Drive_Flow	Transit-related drive flow total: AB + BA	

5.5.20 Transit Assignment Result Files – Stop-to-Stop PA Flows

(Output*_**s2s**.mtx)

Matrix Core Name	Description	Notes
WalkAccess (or DriveAccess)	Stop-to-stop transit flow matrix in PA format	Matrix core is named by TransCAD, automatically. If the matrix is of a transit mode by walk access, the core is named "WalkAccess". If it is of park-and-ride or kiss-and-ride access, the core is named "DriveAccess".

5.5.21Drive Access Origin-TAZ-to-Parking-Lot Drive Time Matrix Files

(\Output\origin_parking_AMDL.mtx, origin_parking_AMDP.mtx, origin_parking_AMDR.mtx, origin_parking_AMKL.mtx, origin_parking_AMKP.mtx, origin_parking_AMKR.mtx, origin_parking_OPDL.mtx, origin_parking_OPDP.mtx, origin_parking_OPDR.mtx, origin_parking_OPKL.mtx, origin_parking_OPKP.mtx, and origin_parking_OPKR.mtx)

Matrix Core Name	Description	Notes
Drive Time	Origin-TAZ-to-parking-lot drive time in minutes	Rows are TAZ IDs and columns are parking-lot node IDs

5.5.22 Drive Access TAZ-to-TAZ Parking Lot Choice Matrix Files

(\Output\Parking_AMDL.mtx, parking_AMDP.mtx, parking_AMDR.mtx, parking_AMKL.mtx, parking_AMKP.mtx, parking_AMKR.mtx, parking_OPDL.mtx, parking_OPDP.mtx, parking_OPDR.mtx, parking_OPKL.mtx, parking_OPKP.mtx, and parking_OPKR.mtx)

Matrix Core Name	Description
Parking Nodes	Chosen parking-lot node ID for each TAZ pair

5.5.23 Trip Mode Split Produced by Mode Choice FORTRAN Program

(\Interim\HBW_PK.bin, SHP_PK.bin, SCH_PK.bin, OTH_PK.bin, WBNH_PK.bin, NHNW_PK.bin, U_HBU_PK.bin, U_HBO_PK.bin, U_UBNH_PK.bin, HBW_OP.bin, SHP_OP.bin, SCH_OP.bin, OTH_OP.bin, WBNH_OP.bin, NHNW_OP.bin, U_HBU_OP.bin, U_HBO_OP.bin, U_UBNH_OP.bin, and U_NHNU_Daily.bin)

Field Name	Description	Notes
IZ	Origin TAZ ID	
JZ	Destination TAZ ID	
Trip1	Walk-access local bus trips	
Trip2	Park-and-ride local bus trips	
Trip3	Kiss-and-ride local bus trips	
Trip4	Walk-access express bus trips	
Trip5	Park-and-ride express bus trips	
Trip6	Kiss-and-ride express bus trips	
Trip7	Walk-access rail trips	
Trip8	Park-and-ride rail trips	
Trip9	Kiss-and-ride rail trips	
Trip10	Non-motorized trips - Walking	Not used in TRM (i.e., all = 0)
Trip11	Non-motorized trips - Biking	Not used in TRM (i.e., all = 0)
Trip12	Drive-alone highway trips	
Trip13	2-person carpool trips	
Trip14	3+-person carpool trips	
Trip15	Auto-intercept trips	

5.5.24 Mode Choice Parking-Related Shadow Price File

(\Input\Programs\ShadPrice.bin)

Field Name	Description	Notes
ZONE	TAZ ID	
ShadPurp	Peak-period parking capacity constraint's resultant shadow price E.g., ShadHBW, ShadWBNH For six trip purposes: Purp $\in$ [HBW, HBSH, HBO, HBU, NHNW, WBNH]	Excludes: HBK12, U_HBO, U_UBNH, and U_NHNU

5.5.25 Mode-Choice-Resultant Automobile Trip Production and Attraction Summary Files by PASA and Trip Purpose

(\Interim\PASAHBW_PK.bin, PASASHP_PK.bin, PASASCH_PK.bin, PASAOTH_PK.bin, PASAHBU_PK.bin, PASANHNW_PK.bin, PASAWBNH_PK.bin, PASAHBW_OP.bin,

PASASHP_OP.bin, PASASCH_OP.bin, PASAOTH_OP.bin, PASAHBU_OP.bin, PASANHNW_OP.bin, PASAWBNH_OP.bin)

Field Name	Description	Notes
PASA	ID for parking analysis sub-area	1 = UNC campus 2 = Duke campus 3 = NCSU campus 4 = NCCU campus 5 = Chapel Hill CBD 6 = Durham CBD 7 = Raleigh CBD 8 = Carrboro CBD 9 = Hillsboro CBD 10 = RDU airport
P	Automobile trip productions summarized by PASA	
A	Automobile trip attractions summarized by PASA	

Chapter 6. INSTALLING POPGEN

This section describes how to install the PopGen software and the supplementary software needed to run PopGen. The supplementary software needs to be installed before running PopGen. This will be necessary in order to run the population synthesis procedure which is executed outside of TransCad.

To download PopGen 1.1 software and related packages, go to this URL: PopGen software download click here

To access installation instructions with screenshots, go to this URL: PopGen installation instructions click here