TREASURE COAST REGIONAL PLANNING MODEL
2000 MODEL UPDATE

TECHNICAL REPORT 3

MODEL APPLICATION GUIDELINES

Contract Number: C-8770
FM Number: 233054-1-12-01

Submitted To:
Florida Department of Transportation - District IV

Submitted by:
The Corradino Group

June 2006

Table of Contents

LIST OF FIGURES iii
LIST OF TABLES iv

1. INTRODUCTION 1-1
   1.1 Model Enhancements 1-2
   1.2 Multi-Modal and Highway-Only Analysis 1-3

2. MODEL DESCRIPTION 2-1
   2.1 Flow Charts 2-1
   2.2 Input Files 2-3
      2.2.1 EETRIPS.DBF 2-3
      2.2.2 xxGRATESB.SYN – (xx-> IR-Indian River, SL-St. Lucie, MA-Martin) 2-3
      2.2.3 GAMMA_PARAM.DBF 2-3
      2.2.4 HELABELS.SYN 2-5
      2.2.5 HERATES.SYN 2-5
      2.2.6 HESCREEN.SYN 2-5
      2.2.7 {Input Highway Network}.NET 2-5
      2.2.8 PROFILE.MAS 2-5
      2.2.9 SCHOOL.YYA 2-5
      2.2.10 SPDCAP.ASC 2-5
      2.2.11 STATDATA.YYA 2-6
      2.2.12 STP60.SYN 2-6
      2.2.13 TCARDS.PRN 2-6
      2.2.14 BASEFARES.FAR 2-6
      2.2.15 TNETAMx.FAC and TNETMDx.FAC 2-6
      2.2.16 SYSTEM.PTS 2-7
      2.2.17 TROUTE.IN 2-7
      2.2.18 VFACTORS.YYA 2-7
      2.2.19 ZDATA1B.YYA 2-7
      2.2.20 ZDATA2.YYA 2-7
      2.2.21 ZDATA3B.YYA 2-7
      2.2.22 ZDATA4B.YYA 2-7

3. MODEL GUIDELINES 3-1
   3.1 External 3-2
   3.2 Generation 3-3
   3.3 Network (Highway) 3-5
   3.4 Highway Path 3-6
   3.5 Distribution 3-7
   3.6 Transit Network 3-10
   3.7 Mode Choice 3-12
      3.7.1 Highway-Only Model 3-13
   3.8 Highway Assignment 3-13
   3.9 Transit Assignment 3-14
   3.10 Highway Evaluation 3-15

4. FREE-FLOW SPEED ESTIMATION PROCESS 4-1
4.1 Free-Flow Speed Estimation Process- User Guidelines 4-1
4.2 The Traditional FSUTMS Method 4-2
4.3 Free-Flow Speed Estimation 4-3
4.3.1 Method and Data 4-3

5. MODEL APPLICATION AND ADJUSTMENTS 5-1
5.1 External Travel Data 5-1
5.2 Zonal Demographic Data 5-1
5.3 Alternative Network Development 5-2
5.3.1 Highway Network 5-2
5.3.2 Transit Network 5-3
5.4 Transit Fares 5-4

6. SUMMARY AND CONCLUSION 6-1

7. LIST OF REFERENCES 7-1

Appendix A PROFILE.MAS
Appendix B FULL MODEL SCRIPTS
Appendix C FULL USER PROGRAMS
Appendix D FORMAT AND LISTING OF USER INPUT FILES
Appendix E DEFINITION OF FSUTMS TWO-DIGIT CODING
Appendix F CUBE VOYAGER SCRIPTS OF FREE-FLOW SPEED ESTIMATION PROCESS

3332/WP/Report/TC2000-TR3/TC2000-tr3.doc

List of Figures

Figure 1-1 Treasure Coast Regional Planning Model (Version: III) 1-4

Figure 2-1 Full Model Macro Flow Chart 2-2
Figure 2-2 Multinomial Logit Mode Choice Structure of Full Model 2-8

Figure 3-1 Main TCRPM CUBE/Voyager Application 3-1
Figure 3-2 External-External CUBE/Voyager Application 3-2
Figure 3-3 Trip Generation CUBE/Voyager Application 3-3
Figure 3-4 Highway Network CUBE/Voyager Application 3-6
Figure 3-5 Highway Path CUBE/Voyager Application 3-7
Figure 3-6 Trip Distribution CUBE/Voyager Application 3-8
Figure 3-7 Transit Network CUBE/Voyager Application 3-11
Figure 3-8 Mode Choice CUBE/Voyager Application 3-12
Figure 3-9 Highway and Transit Assignment CUBE/Voyager Application 3-14

Figure 4-1 Posted Speed Limits of Network Links 4-11
Figure 4-2 SEGID Designation of Network Links 4-12

Figure A-1 TCRPM Base Scenario Keys A-3

Figure D-1 Listing of HELABELS.SYN File D-1
Figure D-2 Listing of HERATES.SYN File D-3
Figure D-3 Listing of HESCREEN.SYN File D-5
Figure D-4 Listing of BASEFARES File D-6
Figure D-5 Listing of TNETAMx.FAC File D-7
Figure D-6 Listing of TNETMDx.FAC File D-8
Figure D-7 Sample Listing of TROUTE File D-9
Figure D-8 Listing of VFACTORS File D-10

List of Tables

Table 2-1 User-Specified Input Files and Their Usage 2-4
Table 2-2 Custom Written Program Description 2-15

Table 4-1 Link and Node Attributes for Free Flow Speed Estimation Process 4-1
Table 4-2 Special Segment Data (SPEC_SEGDATA) 4-2
Table 4-3 Free-Flow Speed Estimation Equations 4-4
Table 4-4 Free-Flow Speed Default Parameters (DEFAULT_SEGMENT.CSV) 4-5
Table 4-5 Free Flow Speed Signalized Segment Data – SEGMENT.DBF File 4-9
Table 4-6 Free Flow Speed Adjustment Factors – SPDADJ.DBF File 4-13

Table A-1 TCRPM Catalog Keys A-1

Table D-1 Format for EETRIPS File D-12
Table D-2 Format for xxGRATESB.SYN File D-13
Table D-3 Attributes for Network (Input and Loaded) File D-16
Table D-4 Format for SCHOOL File D-18
Table D-5 Format for Transit Speed-Delay Curves File (SDLAYUPD) D-19
Table D-6 Format for Speed-Capacity Table (SPDCAP) D-20
Table D-7 Format for STATDATA File D-21
Table D-8 Format for STP60.SYN File D-22
Table D-9 Format for TCARDS File D-26
Table D-10 Format for Lifestyle Production Data (ZDATA1B) D-27
Table D-11 Format for Attraction Data (ZDATA2) D-28
Table D-12 Format for Special Generator Data (ZDATA3B) D-29
Table D-13 Format for External-Internal Data (ZDATA4B) D-30

1. INTRODUCTION

This report is one of three Technical Reports developed for the 2000 update of the Treasure Coast Regional Planning Model (TCRPM). It provides instruction on the application of the model. The model chain and all required inputs are described in detail.

This application guide assumes that the users have working knowledge of Florida Standard Urban Transportation Modeling Structure (FSUTMS) and CUBE. This report contains seven chapters and five appendices.

- Chapter 1, **INTRODUCTION**, contains an overview of this technical report and model enhancements.

- Chapter 2, **MODEL DESCRIPTION**, contains a description of the Treasure Coast models. All user written programs and input files are discussed in this chapter. It provides the flow charts of the model chain. The PROFILE.MAS and the script files referenced in Chapters 2 and 3 are described in the appendices.

- Chapter 3, **MODEL GUIDELINES**, provides guidelines for each of the main modules. It explains how the TCRPM is different from standard FSUTMS. The scripts, input and output files for each module are described.

- Chapter 4, **FREE FLOW SPEED ESTIMATION PROCESS**, discusses the method and implementation of this new process.

- Chapter 5, **MODEL APPLICATION AND ADJUSTMENTS**, discusses the issues related to important changes in the model input files.

- Chapter 6, **SUMMARY AND CONCLUSION**, provides highlights of the model application guideline report.

- Chapter 7, **LIST OF REFERENCES**, provides a list of references on Southeast Florida, other Florida and other national resources referenced in technical reports of TCRPM.

- The **PROFILE.MAS** file, which controls model operation and provides many input parameters, is presented in Appendix A (PROFILE.MAS). Some of the key model dataand other model parameters are entered in this file. Comments are provided for each of the parameters to explain its use.

- Appendices B (**FULL MODEL SCRIPTS**) and C (**HIGHWAY-ONLY MODEL SCRIPTS**) present all the CUBE/Voyager scripts for the "full" and "highway-only" models.

- The formats and contents of the input files are documented in Appendix D (**FORMAT AND LISTING OF USER INPUT FILES**). Users should find this information very useful for model application because it presents the format for all fixed format files.

- Appendix E (**DEFINITION OF FSUTMS TWO-DIGIT CODING**) provides the definition of the FSUTMS two-digit area and facility type classifications used in TCRPM.

1.1 Model Enhancements

The 2000 TCRPM generally follows the Florida Standard Urban Transportation Modeling Structure (FSUTMS) and its application in CUBE Voyager software. However, it includes enhancements to the FSUTMS process. Some of these enhancements were directly adapted from the (1) Southeast Regional Planning Model (SERPM) or (2) 2000 Palm Beach/Broward models. Others are entirely new. This report focuses on these enhancements. The following is a list of the key enhancements and features of TCRPM.

- TCRPM includes new process to estimate the free-flow speeds based on posted speed limits and signalization data. Chapter 4 of this report presents the method and process for the free flow speed estimation process. This is an enhancement of the 2000 model.

- It implements a logit model to separate the non-motorized trips from the motorized trips. The motorized trips are then used in the analysis of highways and transit. Thus, the number of highway and transit trips is sensitive to "walkability" characteristics of the TAZs. This enhancement is also new in the 2000 model that was originally implemented in version 5 of the SERPM model.

- TCRPM has two model streams: a full model with transit options and a highway-only model with policy-sensitive auto occupancy.

- TCRPM implements an enhanced FSUTMS trip generation model, which is often referred as life-style based trip generation model. The model used in the 2000 Palm Beach/Broward models was further modified mainly to implement new Census data (STP60 file) and separate trip generation rates for the three counties. This modified version (LSTGENM2) of the trip generation program implements (1) revised trip attraction rates based on area types and employment categories and (2) revised trip production rates that were initially calibrated using 1999 Southeast Florida Travel Characteristics Survey. The NHB purpose is separated into NHBW and NHBO purposes.

- The revised model includes airport trips as a separate trip purpose. The trip production rates of visitors were initially derived from the 1999 Southeast Florida Visitor Survey.

- It implements three truck purposes (4-tired, Single Unit and Combination), treating trucks as a separate mode from generation through assignment.

- It includes HOV and toll models similar to those implemented in SERPM.

- TCRPM treats internal-external trips as internal trips and improves the modeling of these trips by eliminating the internal-external purpose.

- It includes school trips as a separate trip purpose and a refined methodology for school trip distribution.

- The final weighted trip tables of all internal trip purposes use a combination of trip tables that were distributed with free flow and congested skims. The weights of combination depend on trip purposes and were derived from the 1999 Southeast Florida Travel Characteristics Survey.

- FSUTMS' two-digit area and facility type classifications have been implemented using the Model Task Force definition.

- The TCRPM speed/capacity table specifies capacities that are consistent with the 1998 FDOT Level Of Service (LOS) Manual and the Highway Capacity Manual. The speed/capacity table also specifies the speeds for the centroid links (FT2=51-53).

- The model uses facility type specific volume-delay functions in traffic assignment.

- It also uses facility type specific UROAD factors to convert LOS-E to LOS-C capacity.

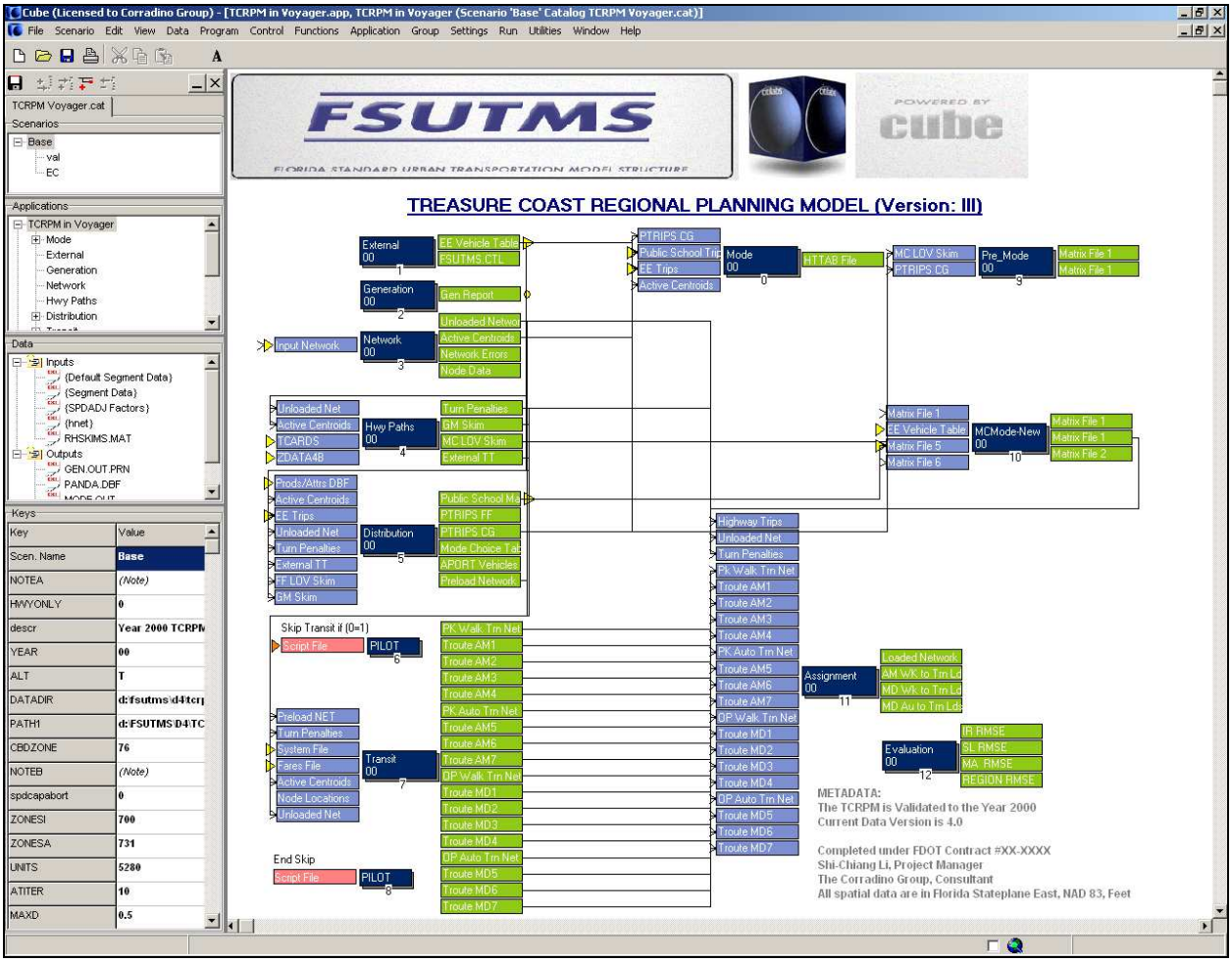
1.2 Multi-Modal and Highway-Only Analysis

TCRPM has the ability to operate in a full multi-model analysis mode or in a highway-only mode with policy-sensitive auto occupancy. The multi-model run with transit is referred to in this report as a "full" model run. On the other hand, the highway-only model with separate levels of auto-occupancy is referred to as a "highway-only" model run. Both use versions of the multinomial logit model, but the highway-only model allocates trips only to levels of auto occupancy but not to transit trip tables. The highway-only model does not require transit network inputs.

The model was initially validated for the highway-only analysis process. The highway-only model validation process followed with a few adjustments so that highway-only results closely replicate the "full" model results. The "full" model with the transit was then further calibrated. When operating in the highway-only mode, the model does not use transit networks.

The 2000 update of TCRPM requires **CUBE/Voyager (CV)** software. TCRPM is contained in a CV catalog file that includes a series of applications, which further contains several modules. A screenshot of TCRPM's catalog and main application is shown in **Figure 1-1**.

Figure 1-1
Treasure Coast Regional Planning Model (Version: III)
2000 Treasure Coast Regional Planning Model



Both "full" and "highway-only" simulation runs can be applied from the CUBE scenario manager with appropriate values for the scenario "KEYS". TCRPM catalog keys are shown in Appendix-A. TCRPM uses CUBE's scenario manager for managing input and output files. User can execute any number of scenarios in succession. Each scenario of the model uses its own set of "scenario specific" input files, while using common set of scripts and applications.

The scripts for the full model are shown in Appendix B.

The typical application of TCRPM is to execute the model from CUBE Voyager interface. Both full and highway-only models could be run from the same directory just switching the "Highway-Only" on or off using value 1 or 0 respectively.

2. MODEL DESCRIPTION

TCRPM is executed from the standard CV run menu. There are two versions of the model, the full model, which includes transit, and the highway-only model, which does not include transit. Both use versions of the multinomial logit model, but the highway-only model allocates trips only to levels of auto occupancy but not to transit trip tables. The highway-only model does not require transit network inputs.

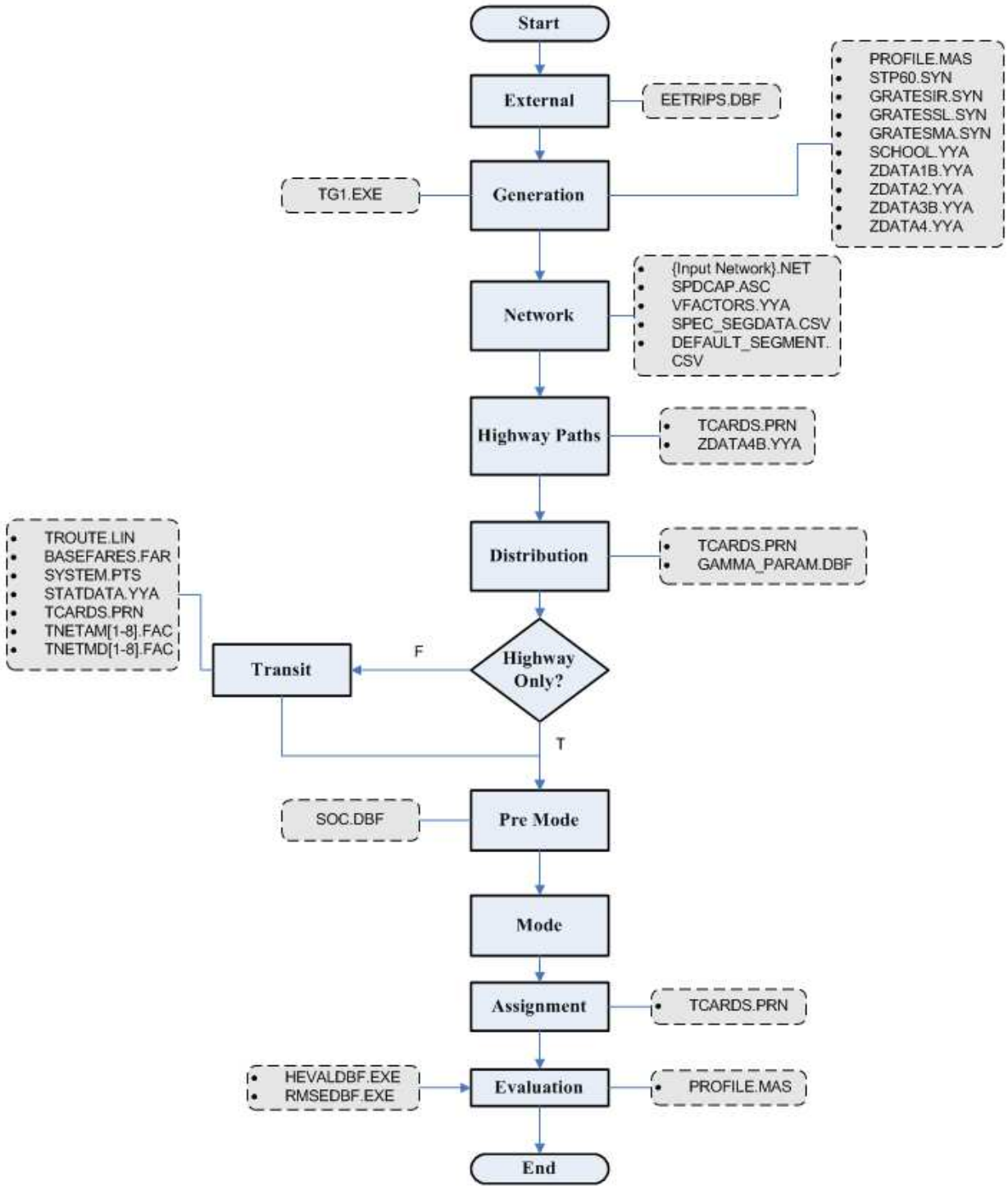
The TCRPM's PROFILE.MAS file, which now only controls operations for the trip generation and model evaluation called from the model script files is presented in Appendix A. **The other CUBE/Voyager scripts do not use PROFILE.MAS and most of the parameters used by them are stored as "KEYS" in the TCRPM Cube/Voyager catalog**. The trip generation and model evaluation programs are external FORTRAN programs and need to use PROFILE.MAS since they do not have access to the CUBE Keys. This file contains some input data parameters and some of the modeling parameters. Comments are provided for each of the parameters to explain their use.

2.1 Flow Charts

The macro flow charts of the full model is shown in **Figure 2-1**. There are 10 component modules. These components, briefly described below, are processed in a serial fashion to complete the area travel demand model run.

1. **External** creates the external-external trip matrix
2. **Generation** calculates the zonal trip productions and attractions
3. **Network** builds the highway network
4. **Hwy Paths** finds the minimum impedance interzonal highway travel paths
5. **Distribution** creates the zone-to-zone person trip tables
6. **Transit** builds the transit network
7. **Pre-Mode** separates the non-motorized trips
8. **Mode Choice** converts the person trips to transit mode of travel and highway vehicle trips
9. **Assignment** assigns the vehicle/transit trips to the highway/transit network respectively
10. **Evaluation** summarizes the highway evaluation simulation results

Figure 2-1
Full Model Macro Flow Chart
2000 Treasure Coast Regional Planning Model



The macro flow chart (**Figure 2-1**) identifies all the user-supplied input files that are used by each of the modules. Subsequent sections will describe the input/output files as well as the special programs.

2.2 Input Files

All user-specified files required for a model run are listed in **Table 2-1**. Following the FSUTMS naming conventions, the TCRPM user-supplied files generally use the CV compatible extensions such as *.NET for network files, *.MAT for matrix files, etc. and the files used by the standard programs like TG1 (Trip Generation) and HEVALDBF (Highway Evaluation) are designated by FILENAME.YYA where the filename extension YYA denotes the year and alternative. For 2000 base year model, YY=00 and A=T result the user supplied file extension of 00T. The parameter data files, which consist of PROFILE.MAS and FILENAME.SYN are also described in this section. Program-generated model output files are identified by standard CV filename extensions.

Table 2-1 identifies the primary use of these inputs, by module, for full and highway-only models. The contents and usage of each of these files are also summarized. The formats of all structured input files are shown in Appendix **Tables D-1** through **D-13**. Users will find these tables extremely helpful. Others input files which do not follow the rigid formats are presented in **Figures D-1** through **D-8**. Users should find this information very useful for model application. The following subsections provide further description of each of the input files.

2.2.1 EETRIPS.DBF

This file is used to build the through vehicle trip table by specifying trips between all external stations. **Table D-1** presents the format of this file. This program is used by CV's Matrix program to create the External-External (EE) trip matrix.

2.2.2 *xx*GRATESB.SYN – (xx -> IR- Indian River, SL- St. Lucie, MA - Martin)

This file specifies (1) trip production rates, (2) trip attraction rates and (3) household stratification curves. The trip production rates are different for all three counties developed using the household survey responses from the corresponding counties. The trip attraction rates are broadly similar for all three counties with some differences for individual counties. The household stratification curves are same for all three counties. The modified lifestyle based trip generation program (LSTGENM2.EXE) uses this file. **Table D-2** presents the format of this file. The formats of this file are context sensitive and determined by the first character of the record.

2.2.3 GAMMA_PARAM.DBF

This file specifies parameters for the gamma function to calculate the friction factors for the gravity model for all purposes. TCRPM uses 11 trip purposes. This file is used by the program to create a friction factor matrix by calculating friction factor value for individual origin-destination (OD) cells by using the zone pair impedance with the gamma function.

Table 2-1
User-Specified Input Files and Their Usage
2000 Treasure Coast Regional Planning Model

Input File	Content or Usage
BASEFARES.FAR	Fares for Transit Modes
EETRIPS.DBF	External-External Trips File
xxGRATESB.SYN	County Specific Trip Production and Attraction File
GAMMA_PARAM.DBF	Gamma Function Parameters
{Input Highway Network}.NET	Input Highway Network
HELABELS.SYN	A Standard FSUTMS File
HERATES.SYN	A Standard FSUTMS File
HESCREEN.SYN	A Standard FSUTMS File
PROFILE.MAS	It contains substituion parameters used by many custom programs
SCHOOL.YYA	Enrolment and TAZ allocation of school trips
SPDCAP.ASC	Speed and Capacity File (Speeds are only used for Centroid Connectors
STATDATA.YYA	PnR and KnR lots station data
STP60.SYN	2000 Census Special Tabulation Data
TCARDS.yya	Turn Penalty file
TNETAMx.FAC and TNETMDx.FAC	Peak and Off-Peak transit factors file
SYSTEM.PTS	List of modes that the system can use
TROUTE.LIN	Transit Network
VFACTORS.YYA	Used for facility specific UROAD facotrs and volume-delay relation by equilibrium assignment
ZDATA1B.yya	Zonal Data 1 file (Populationa dn Household)
ZDATA2.yya	Zonal Data 2 file (Employment)
ZDATA3B.yya	Zonal Data 3 file (Special Generator)
ZDATA4B.yya	Zonal Data 4 file (EI Trips)

2.2.4 HELABELS.SYN

With the implementation of 2-digit facility and area type codes, this file allows users to group the highway evaluation (HEVAL) summary by grouping the 2-digit codes. **Figure D-1** presents the 2000 HELABELS.SYN file. It specifies label names for numbered facility and area types for use in the HEVAL summary. This file is structured in ASCII format and defines the labels, which are to be assigned to each facility type and area type. Following the two digit codes of FT and AT, this file specifies the numbered grouping for analysis and validation modes of the HEVAL routine. The labels that go with these groupings are entered in last two columns. The first of the last two columns is used for ANALYSIS and the last one is used for VALIDATION. The PROFILE.MAS file sets the modes of analysis by specifying YES to the ANALYSIS and VALIDATION parameters.

2.2.5 HERATES.SYN

Figure D-2 presents a listing of this file. It contains the highway evaluation rates used for the ANALYSIS mode calculation of HEVAL routine. This includes accident rates, injury rates, fatality rates, fuel use, construction costs, and emissions of CO, HC and NOx.

2.2.6 HESCREEN.SYN

The HEVAL routine optionally permits the user to label the screenlines and cutlines. This feature is toggled on by the presence of the HESCREEN.SYN file. A listing of the 2000 HESCREEN.SYN file is shown in **Figure D-3**.

2.2.7 {Input Highway Network}.NET

This file is a CV highway network file. This file contains both nodes and links. The attributes for this file have been shown in **Table D-3**.

2.2.8 PROFILE.MAS

This file stores all user defined model parameters for input into all FSUTMS script files. **Appendix A** shows the listing of the PROFILE.MAS file that was used in 2000 validation. All parameters listed in the PROFILE.MAS are preceded by the ampersand sign ("&") and the label for the variable. The variable or value itself then follows on the next line. Descriptions of each of the parameters follow the variable labels. These descriptions explain the meaning of each variable.

2.2.9 SCHOOL.YYA

The life-style based trip generation program (TG1.EXE) uses the school file to develop the school trip tables. It contains the enrollment and TAZ allocations that are used to calculate the school trip productions and attractions. **Table D-4** presents the format of the SCHOOL.YYA file.

2.2.10 SPDCAP.ASC

This look-up speed-capacity table specifies the speeds for only centroid links (FT=51-53), The process described in Chapter 4 must be used to estimate the initial speeds that is based on the posted speed limit as well as the signalized data for the signal controlled facilities. The capacities for all links are read from this speed-capacity table. The speeds and capacities are keyed to the area type, facility type, and number of lanes attributes of the highway network file. The SPDCAP.YYA is a fixed format file. **Table D-11** presents the format for the speed-capacity table.

2.2.11 STATDATA.YYA

The station data file describes permanent park-and-ride and kiss-and-ride locations for rail and express bus stations. **Table D-7** presents the format for the STATDATA file. The mode choice program also uses this file.

2.2.12 STP60.SYN

The modified life-style based trip generation program (TG1.EXE) uses this file as one of its inputs. Special Tabulation Product (STP) #60 from the 2000 Census is a table created for the Florida Department of Transportation. The tabulation at the TAZ level was done for 26 MPO regions in Florida. The universe for the table is all households in the study area. The spreadsheet file (stp60-mt1.xls) was converted to an ASCII file with each field of 10 characters in width. All fields are right justified. The converted ASCII file is named as STP60.SYN. The format for the STP60.SYN file is presented in **Table D-8**. The tabulation consists of a cross-classification of four characteristics of households (presence or absence of children, workers, persons and autos) for each traffic analysis zone.

The STP60.SYN file consists of one record for each TAZ in the MPO region, plus a total record for the entire area. Each record begins with an MPO region code of 4 characters (column position 7-10), followed FIPS state and county codes (column position 11-20) and then TAZ code (column position 21-30). The rest of the record is made up of 176 fields that are also ten characters wide, one for each data item in the table. The total record is the first record and is identified by a zero in the TAZ code field. For the number of workers in household variable, a worker is defined as a person 16 years old and over who was employed and at work during the census reference week. The presence of children is identified as a household member of less than 18 years of age.

2.2.13 TCARDS.PRN

TCRPM uses turning penalties and prohibitors that are entered in the TCARDS file. **Table D-9** presents the formats for the TCARDS file.

2.2.14 BASEFARES.FAR

These files contain the fare parameters used to calculate transit fares. **Figure D-4** presents the fare parameters in 2000-model validation for peak and off-peak periods, respectively. Both boarding and transfer fares are entered in these files. This file also lists fares for modes such as Tri_Rail that are currently not present in the model area. These fares are listed to provide user a frame work for future testing. Company descriptions of these files are for fare purposes only. For example, buses may use two fare structures, one for local bus, and one for express bus. Each fare structure is applied to a company for access and transfer fare calculations. Company 2 is used for Tri-Rail feeder buses. The Tri-Rail (company 5) fares depend on number of fare zones traveled and are automatically computed using the STATFARE program. The STATFARE program gets travel zone information from the STATDATA file and fares from PROFILE.MAS file.

2.2.15 TNETAMx.FAC and TNETMDx.FAC

These files identify transit parameters used to build the AM (peak period) and MD (off-peak period) transit networks. **Figures D-5** and **D-6** present listings of TPARMAM (peak-period file) and TPARMMD (off-peak period file), respectively. The transit operating characteristics are listed in this file with specified mode in parenthesis.

2.2.16 SYSTEM.PTS

This file describes the different types of modes that the system can use. Not all of the modes described in the file are used for the 2000 base model.

2.2.17 TROUTE.LIN

Figure D-7 presents sample listings of the transit network file. The transit lines depict routes through a sequence of nodes contained in transit networks. This file is a standard CV Public Transportation (PT) route file.

2.2.18 VFACTORS.YYA

This file allows the user (1) to implement facility specific volume-delay relationship (ALPHA and BETA of BPR volume-delay function; (2) to specify the volume to capacity ratio (UROAD Factor) at which traffic diversion should occur; and (3) to specify factors (CONFAC) of hourly to all-day capacities. A complete listing of the parameters of the VFACTORS file that was used in 2000 model validation run is presented in **Figure D-8**.

2.2.19 ZDATA1B.YYA

This file contains mainly the production demographic data that is an input to the life-style based trip generation program. The latest life-style based trip generation program (TG1) uses this file. **Table D-10** presents the format for this file.

2.2.20 ZDATA2.YYA

This file is the standard trip attraction data file for the trip generation program. It also contains parking costs for the mode choice model. **Table D-11** presents the format of this ZDATA2 file.

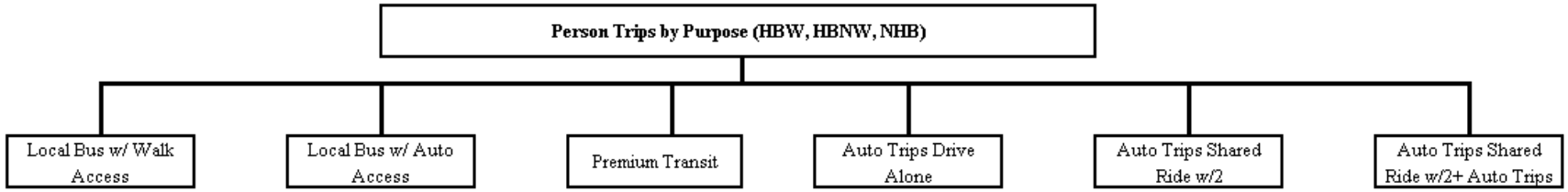
2.2.21 ZDATA3B.YYA

The information on special generators is contained in this file. **Table D-12** presents the format of this file. The airport enplanement data is also entered in this file.

2.2.22 ZDATA4B.YYA

This file provides information on external to internal trips for the revised Life Style Trip Generation Model (TG1). It specifies both productions and attractions for each of the external stations. Table **D-13** presents the format for the ZDATA4B file. The model treats the external stations as internal zones. The file also requires data for extra-regional travel time as well as the percent of work and non-work trips by zero, one and two-or-more auto households. The percentage data are written to the A1DECK file, which is an input to the mode-choice routine.

Figure 2-2
Multinomial Logit Mode Choice Structure of Full Model
2000 Treasure Coast Regional Planning Model

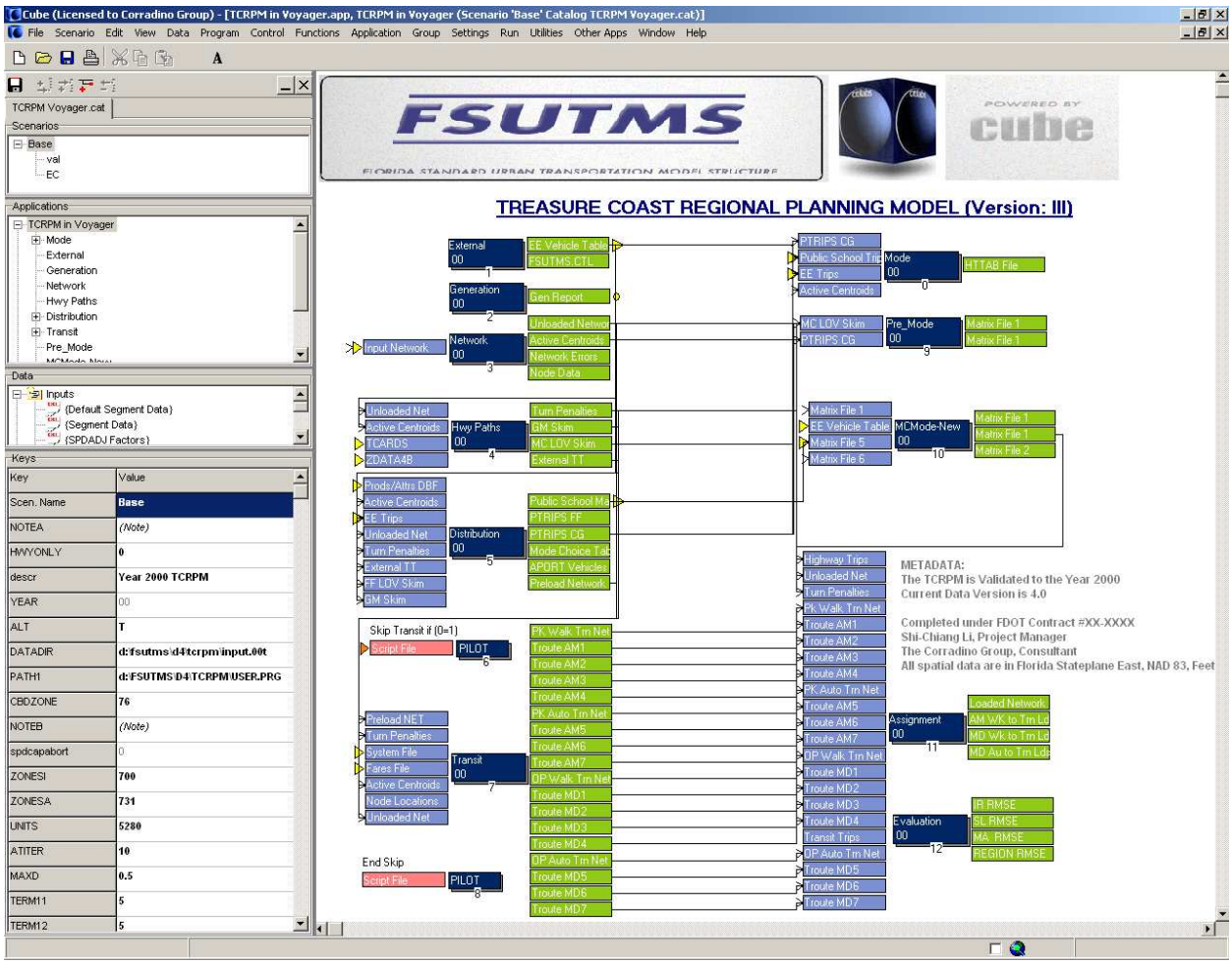


3. MODEL GUIDELINES

This section provides the user with guidelines for preparing and running TCRPM as it was updated and validated to 2000 conditions. While TCRPM follows the Florida Standard Urban Transportation Model Structure (FSUTMS), it includes new and refined modeling procedures. A typical model run will need a minimum of 200 MB of empty hard disk space in a single partition. The user should not begin a model run without at least this much space. Further guidelines for full and highway-only model runs are provided in earlier chapters.

It should be mentioned that formats of all fixed format input files are presented in the 13 tables in **Appendix D**. All other input files are listed in the 8 figures of Appendix D. Chapter 2 provides descriptions of each of the user input files. The rest of this section presents the model guidelines for each of the main modules. TCRPM main CV application is shown in **Figure 3-1**.

Figure 3-1
Main TCRPM CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



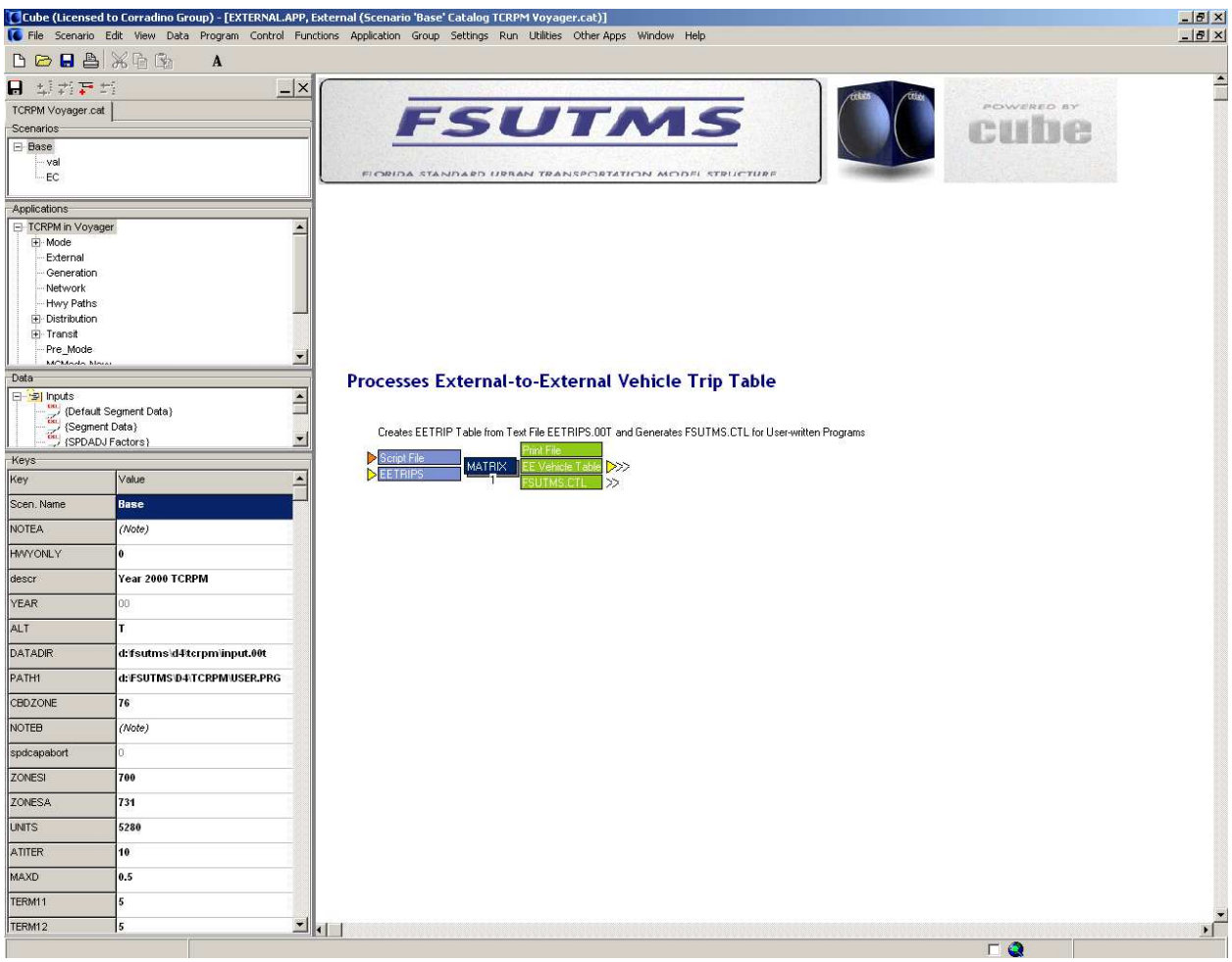
3.1 External

TCRPM uses the modified external model process. Thus, the External step deals only with the through vehicle trip table. The External step builds the external-external vehicle trip table matrix (EETAB) from the EETRIPS file. EETRIPS is a user-developed database file in standard dBase format, and its contents are developed outside of the modeling process. **Table D-1** presents the format of this file. Later in the modeling process (MODE), EETAB is subdivided into truck, auto drive-alone, and auto shared-ride trips.

External-internal highway trips are generated in the Trip Generation module and distributed in the Trip Distribution module as internal trips. These trips are included in the purpose-specific trip tables with the internal trips.

The scripts for the External module appear in **Appendix B**. TCRPM External-External CV application is shown in **Figure 3-2**.

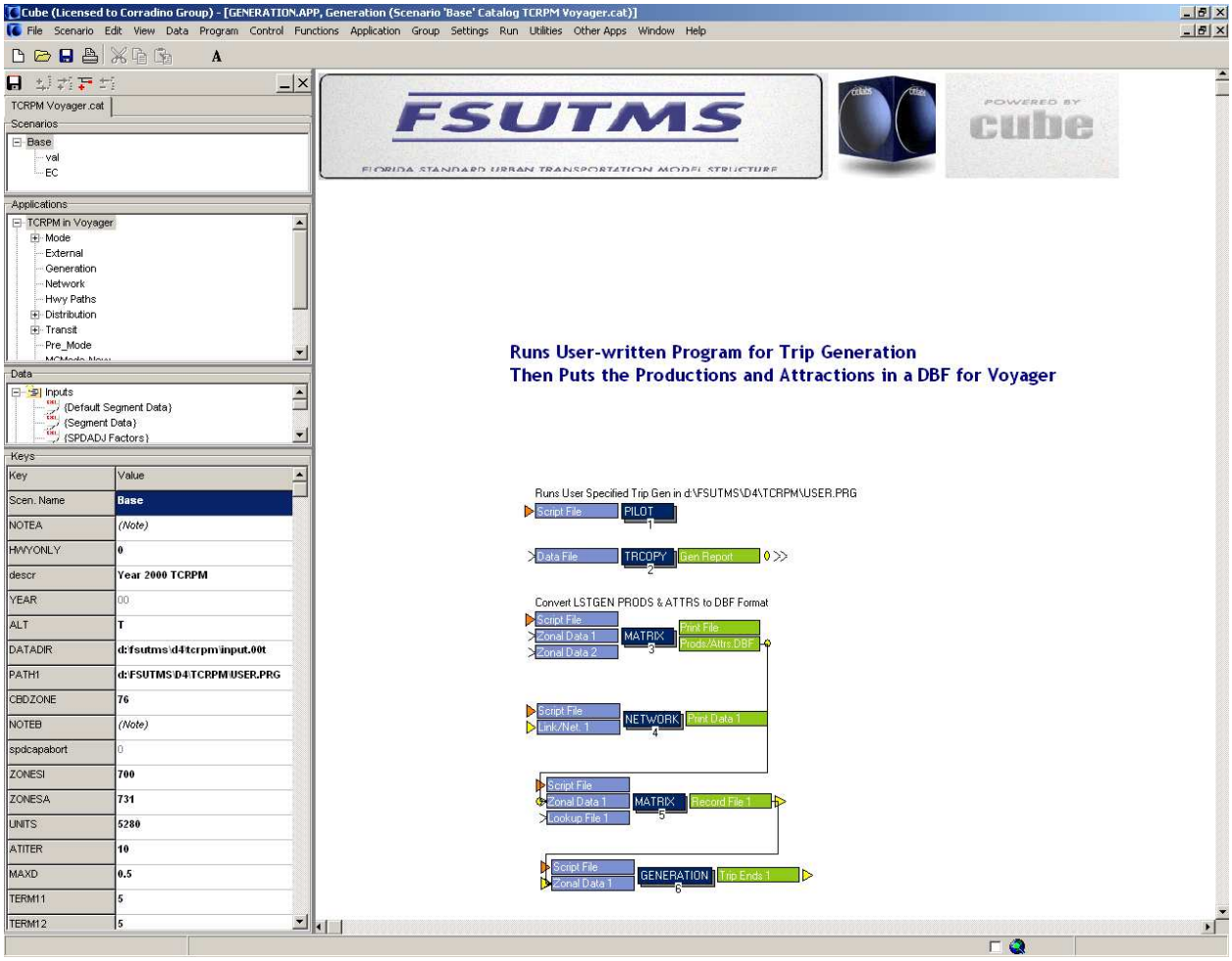
Figure 3-2
External-External CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



3.2 Generation

TCRPM uses the Life Style Trip Generation Model modified for Treasure Coast conditions and named TG1. The detailed descriptions of original life style trip generation program can be found in the following report: "***Enhanced FSUTMS Trip Generation Model***; Final Report, August 1997; Prepared by Carr Smith Corradino for the Florida Department of Transportation, District 4". A report on Trip Attraction Study has detailed description of the modified program. This section provides a short description of the modified program in terms of trip purposes and input and output files. TCRPM Trip Generation CV application is shown in **Figure 3-3**.

Figure 3-3
Trip Generation CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



The trip generation model is applied through the LSTGENM2 computer program. This model develops productions and attractions for all trip purposes, including internal-external trips. Trip purposes are:

1. Home-based-work - HBW
2. Home-based-shopping - HBSHP
3. Home-based-social/recreational - HBSR
4. Home-based-school (non-public) - HBSCH

5. Home-based-other - HBO
6. Non-home-based Work – NHBW
7. Non-home-based Other – NHBO
8. Airport
9. 4-tired Truck
10. Single Unit Truck
11. Combination Truck

The Trip Generation module (see **Figure 2-1**) requires the following user-supplied input files and **PROFILE.MAS**:

1. **GRATESB.SYN** – This file contains the production and attraction rates for all trip purposes. It also contains the household stratification curves. [Format in **Table D-2**]

2. **SCHOOL** – This file provides the elementary, middle, and high school TAZ for public school students living in each home TAZ (production zone), and the enrollment of elementary, middle, and high school students in the TAZ (attraction zone). [Format in **Table D-4**]

3. **STP60.SYN** – This is the 2000 Census Special Tabulation Product file obtained by FDOT from the Census Bureau that contains the detailed household composition structure for each TAZ. [Format in **Table D-8**]

4. **ZDATA1B** – This is the household production data file for the modified Life-Style trip production model. [Format in **Table D-10**]

5. **ZDATA2** – The standard FSUTMS attraction data file. [Format in **Table D-11**]

6. **ZDATA3B** – The revised FSUTMS special generator data file. The revision is made to accommodate the new trip purposes. [Format in **Table D-12**]

7. **ZDATA4B** – The revised internal-external data file. It contains data on total trip productions, attractions, trip purpose split, and extra-regional travel time estimates for the IE model (a calibrated value). [Format in **Table D-13**]

The GEN module produces four output files:

1. **ATTRS** – Trip attractions for the eleven trip purposes.
2. **PRODS** – Trip productions for the eleven trip purposes.
3. **PBSCH** - Non-private school trip table.

The PRODS and ATTRS files each contain one record for each of the internal zones and external stations. Later, in the Trip Distribution module, K-factors prevent IE trips from being distributed between pairs of external stations. The EXTERNAL module explained earlier provides external-external trips.

3.3 Network (Highway)

The Highway Network module (see **Figure 2-1**) produces the highway network by using information from a few mandatory attributes. The mandatory attributes are:

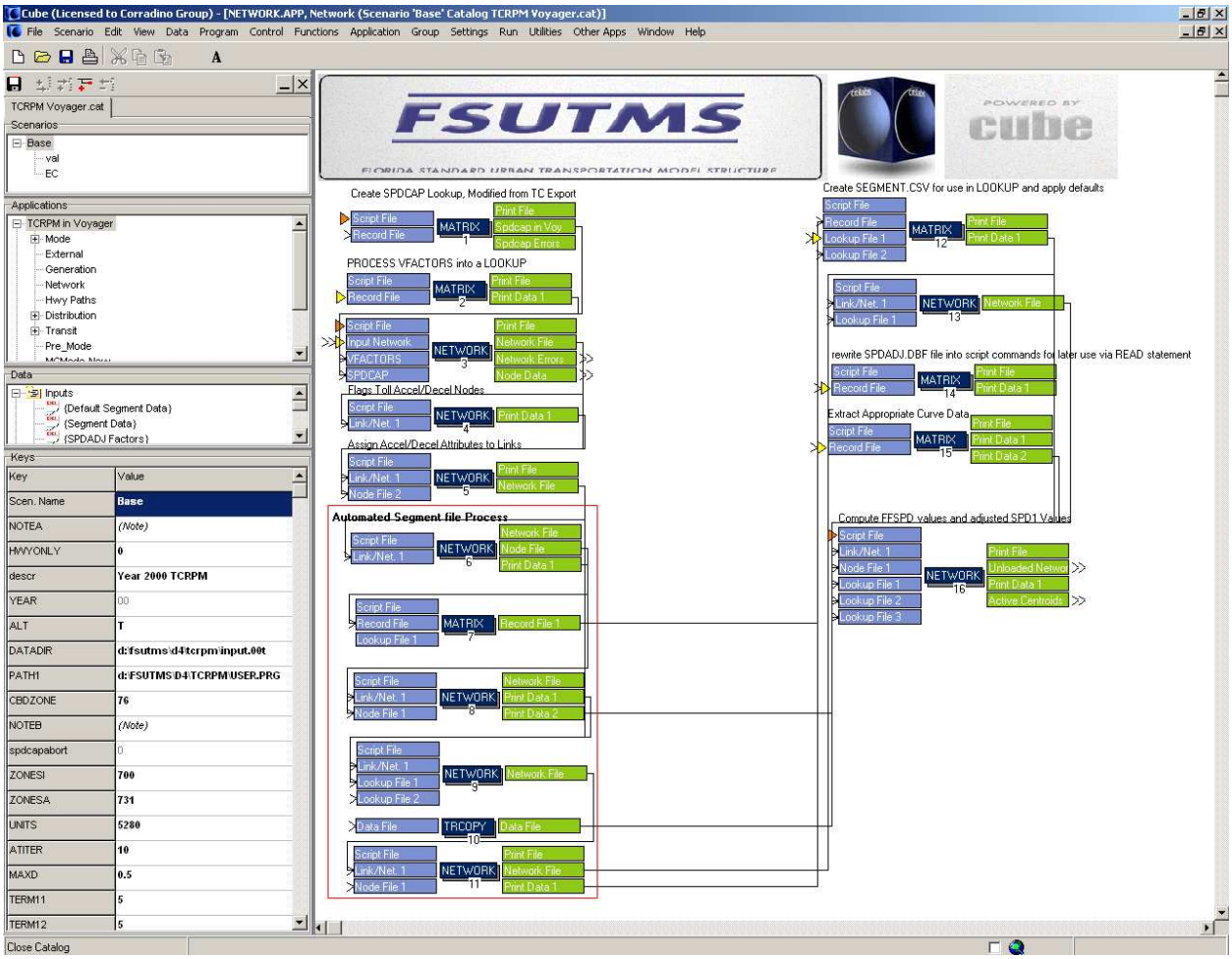
1. Facility_Type – Two digit facility type
2. Area_Type - Two digit area type
3. Lanes – Number of directional lanes
4. PostSpd – posted speed on the link

Along with the highway network, it also produces additional attributes that are used in later steps. These attributes are:

Capacity
Free-Flow Speed
Toll Acceleration
Toll Deceleration
UROAD Factor
BPR Curve Coefficients

The speed and capacity file was a product of model calibration and began with the table developed from the 1999 validated Model. The speed values for any non-centroid links are entered as "zero" in the SPDCAP table. The free-flow speed is calculated from the posted speed and other link-node characteristics. Area types and facility types conform to the standard 2-digit definitions approved in 1997 by the Model Task Force (MTF). **Appendix E** displays the definition of the MTF's 2-digit coding. TCRPM Highway Network CV application is shown in **Figure 3-4**.

Figure 3-4
Highway Network CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



The Highway Network Scripts appear in **Appendix B**. All input files conform to the FSUTMS two-digit formats.

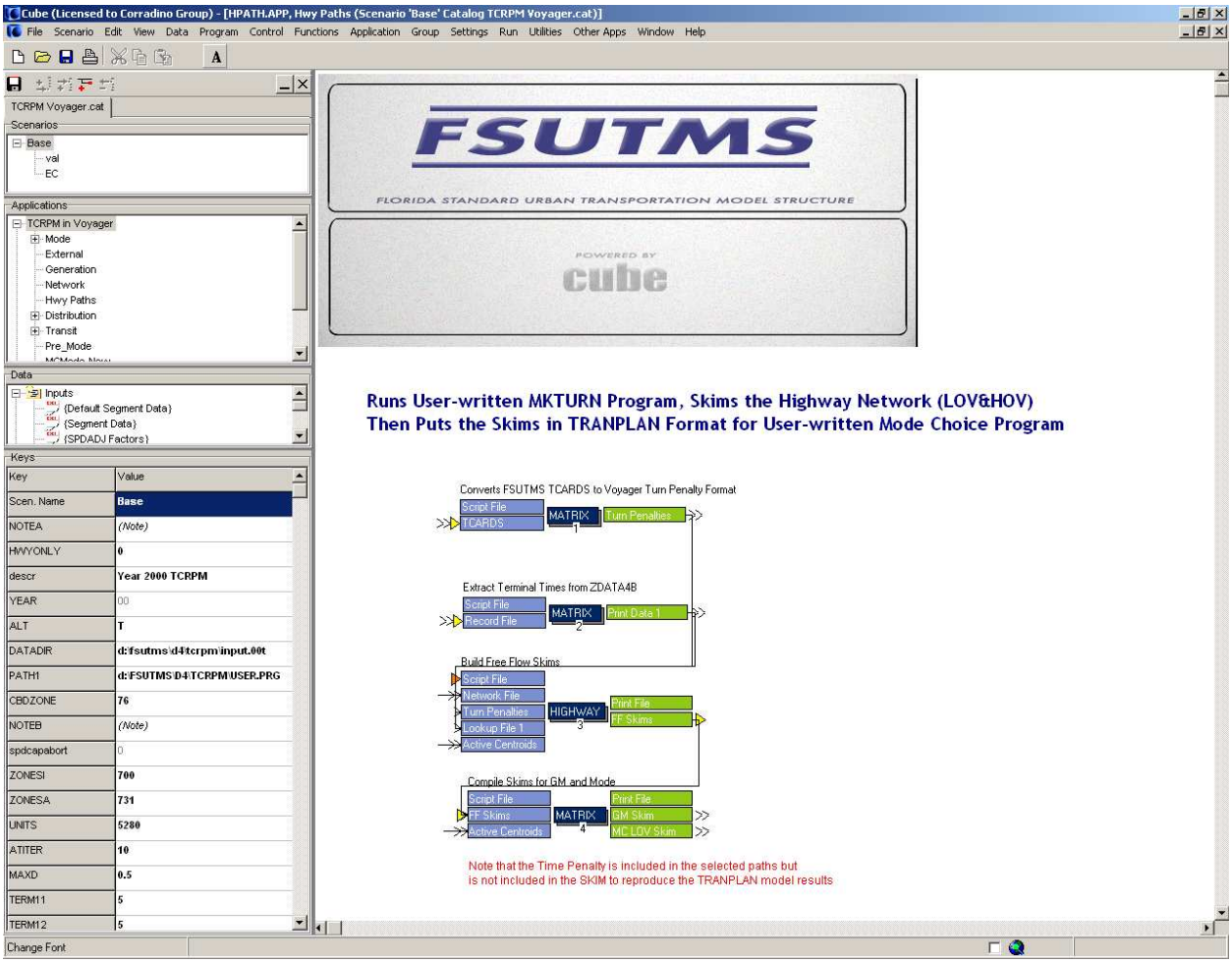
3.4 Highway Path

TCRPM highway path module Highway Path (see **Figure 2-1**) uses CUBE's path building process. All the paths are built for the toll links using the converted toll cost to time using CTOLL. user-supplied input files are:

- **TCARDS** – Turn penalties and prohibitors. [Format for TCARDS in **Table D-9**]
- **ZDATA4b** – For external station terminal times. [Format in **Table D-13**]

The skim matrices produced by this step are free-flow and contain intrazonal and terminal times. The FHSKIMS matrix contains network skims without the HOV links by deleting the HOV links as the network is skimmed. The HFSKIMS matrix contains skims for the entire network including HOV links if they are on the minimum path. The skim tables for the FHSKIMS and HFSKIMS are (1) cost; (2) distance; (3) time; and, (4) impedance. The DISTRIB and MODE modules use these matrices.

Figure 3-5
Highway Path CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



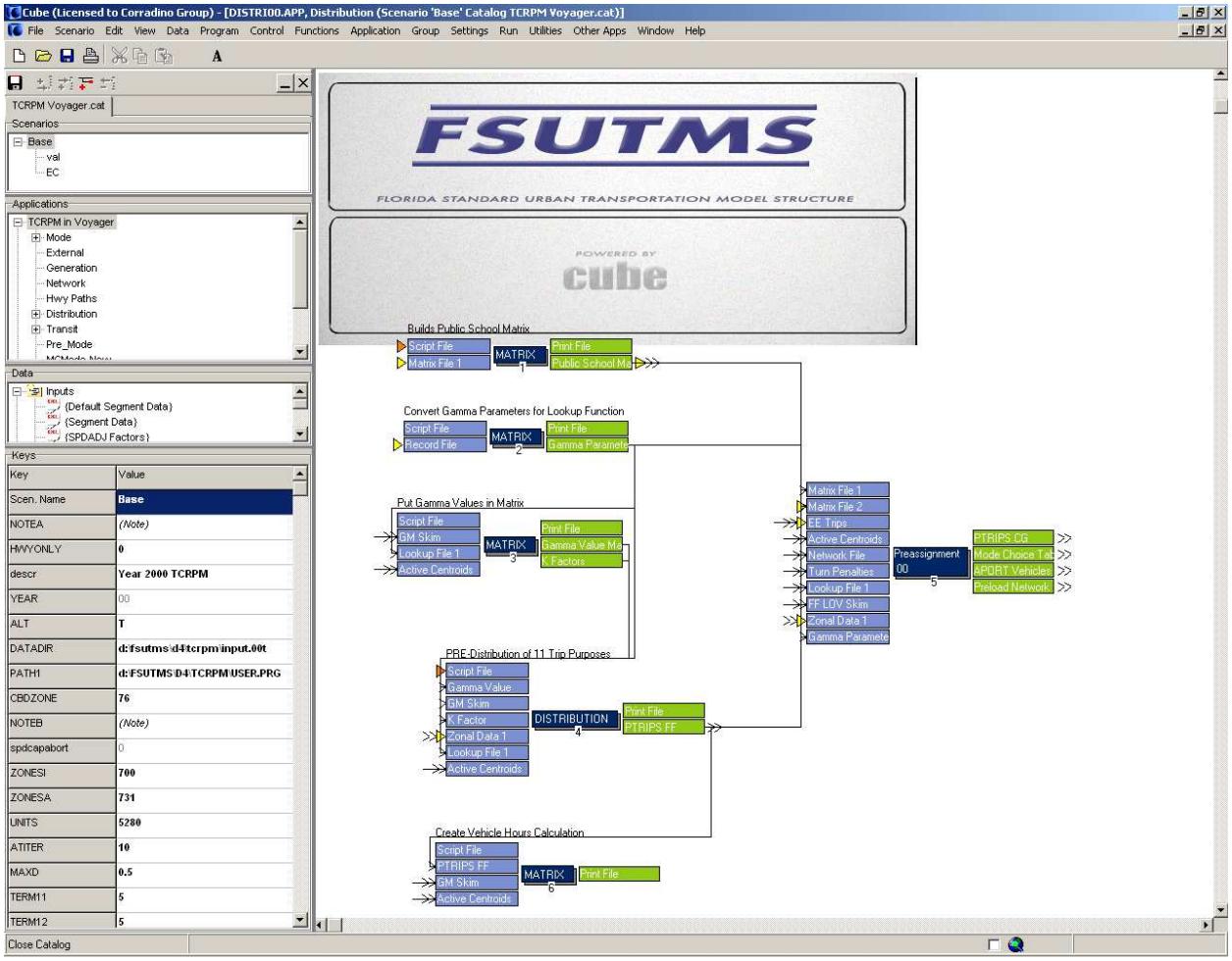
The Highway Path scripts appear in **Appendix B**. TCRPM Highway Path CV application is shown in **Figure 3-5**.

3.5 Distribution

The Trip Distribution module (see **Figures 2-1** and **2-2**) develops trip tables, by trip purpose, based on the outputs of the Trip Generation module (PRODS and ATTRS), and highway network skims from the Highway Path module. The standard CV "Distribution" program is used to distribute the productions and attractions.

CV offers two methods to perform trip distribution, one is using the pre-defined Gravity function, and the other is by explicitly defining the gravity model. TCRPM uses the latter method. However, other criteria like convergence and maximum iterations are used similarly in both methods. Trip distribution is performed twice, first time using free flow time and the "final" Trip Distribution in TCRPM is performed using constrained highway skims in distribution, which requires "pre-assignment" step to be applied in order to develop the constrained skims. The IE/EI trips are also in the internal trip tables, which requires the addition of extra-regional travel times at external stations in the time skim matrices as terminal times from ZDATA4B.

Figure 3-6
Trip Distribution CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



The distribution with the free-flow skims uses the free-flow skim matrix (FHSKIMS) generated from the Highway Path module. Intra-zonal impedances and terminal times are added to this skim matrix. A free-flow distribution follows with all productions and attractions (PRODS and ATTRS). The trip table in the pre-assignment step of the trip distribution module uses the vehicle trip table created using trip purpose specific auto occupancy rates.

After the pre-assignment step, the loaded network is then used to develop the congested skim matrices RHSKIMS (without HOV) and HRSKIMS (with HOV). The final person trip table matrix is developed by combining trip tables, developed using free-flow and congested skims, and using pre-defined weights. The weights are shown in Appendix-A under catalog keys.

The main steps in the Trip Distribution module are:

A. Develop the public school trip table (PSCHOOL) from the PBSCH file (output of Trip Generation module).

B. Develop congested skims. The process uses a free-flow distribution and an assignment. The steps are:
   - Build Intrazonal Impedances and Terminal time to FHSKIMS (free-flow skims of HPATH module
   - Make a G/M (Gravity Model) distribution using free-flow skim
   - Develop vehicle trip table using trip purpose specific auto occupancies
   - Run Equilibrium trip assignment (Pre-Assignment)
   - Develop the congested skims

C. Skim the pre-assigned loaded network to develop the congested-flow skim matrix RHSKIMS.

D. Distribute trips (PRODS and ATTRS) using congested-flow skim
   - Build Intrazonal Impedances and Terminal time to HVSKIMS
   - Distribute (G/M distribution) all trips

E. Develop the weighted trip tables by purpose. This final weighted trip table is named as PTRIPS11, which is then used in the MODE module.

The mix of free-flow and constrained trip tables by purpose are defined as TCRPM model catalog "KEYS". The weighting constants are:

- &WRHBW Constrained Trip Table weight for final dist-HBW Trips
- &WFHBW Free-flow Trip Table weight for final dist-HBW Trips
- &WRHBSHP Constrained Trip Table weight for final dist-HBSHP Trips
- &WFHBSHP Free-flow Trip Table weight for final dist-HBSHP Trips
- &WRHBSR Constrained Trip Table weight for final dist-HBSR Trips
- &WFHBSR Free-flow Trip Table weight for final dist-HBSR Trips
- &WRHBSCH Constrained Trip Table weight for final dist-HBSCH Trips
- &WFHBSCH Free-flow Trip Table weight for final dist-HBSCH Trips
- &WRHBO Constrained Trip Table weight for final dist-HBO Trips
- &WFHBO Free-flow Trip Table weight for final dist-HBO Trips
- &WRNHBW Constrained Trip Table weight for final dist-NHBW Trips
- &WFNHBW Free-flow Trip Table weight for final dist-NHBW Trips
- &WRNHBO Constrained Trip Table weight for final dist-NHBO Trips
- &WFNHBO Free-flow Trip Table weight for final dist-NHBO Trips
- &WRARPRT Constrained Trip Table weight for final dist-AIRPORT Trips
- &WFARPRT Free-flow Trip Table weight for final dist-AIRPORT Trips
- &WRTRK Constrained Trip Table weight for final dist-Truck Trips
- &WFTRK Free-flow Trip Table weight for final dist-Truck Trips

For each trip purpose, the sum of the "WR" (constrained weight) and "WF" (free-flow weight) should be 1.00 (e.g., &WRHBW + &WFHBW = 1.00).

The primary product of Trip Distribution is the eleven-purpose total person trip table PTRIPS11. This table is an input to the MODE and Highway Assignment modules.

The Trip Distribution scripts appear in **Appendix B**

3.6 Transit Network

The Transit Network module (see **Figure 2-1**) builds the AM and MD transit networks both in the P-to-A (production-to-attraction) direction. Due to limited transit service in the Treasure Coast region, same transit network is used for peak and off-peak period. This module also (see **Figure 2-1**) builds seven transit path files, skim matrix files and fare matrix files for each time period (AM and MD) for use in the mode choice and assignment models.

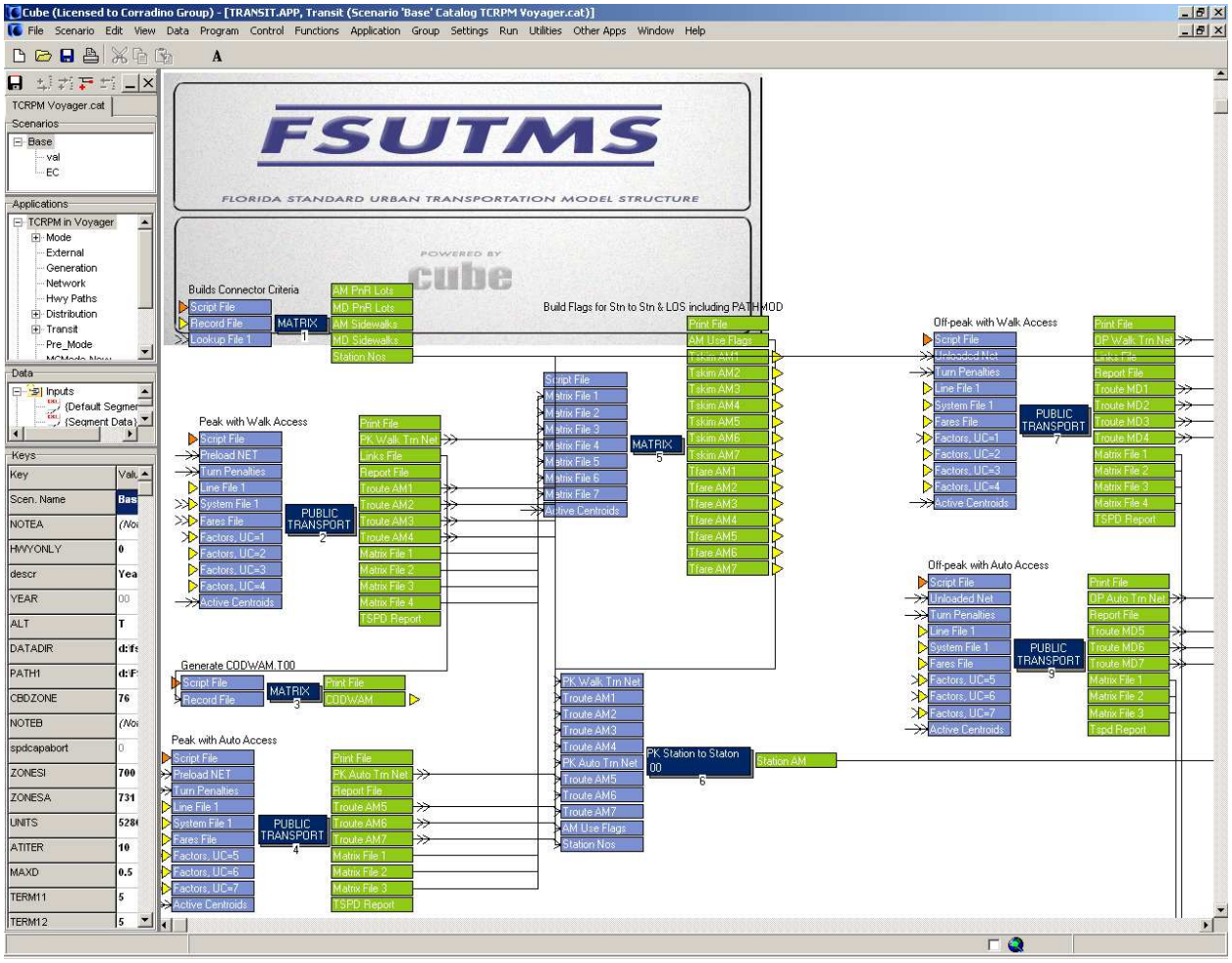
The Transit Network module builds the transit network from routes specified in TROUTEAM and TROUTEMD, which are given the same file.
User-supplied input files for TNET are:

- **TROUTE.LIN** – Transit route file [Format in **Table D-7**]
- **SYSTEM.PTS** – Transit system information file
- **BASEFARES.FAR** – Base fares for transit modes [Listing in **Figure D-4**]
- **TNETAM{1-8}.FAC** – AM transit network factors file [Sample listing in **Figure D-5**]
- **TNETMD{1-8}.FAC** – MD transit network factors file [Sample listing in **Figure D-6**]
- **TCARDS.PRN** – The turn penality file
- **STATDATA** –Tri-Rail fare zone information from this file and fares from BASEFARES.FAR file to develop Tri-Rail station-to-station fares. Since there is no Tri-Rail service in Treasure Coast region, this file has been kept as a placeholder and can be used for testing future Tri-Rail alternatives [Format in **Table D-7**]

The output files are named TROUTEAM1, TROUTEAM2 … TROUTEAM7, TROUTEMD1, TROUTEMD2 … TROUTEMD7, TFAREAM1, TFAREAM2 … TFAREAM7, TFAREMD1, TFAREMD2 … TFAREMD7, TSKIMAM1, TSKIMAM2 … TSKIMAM7, TSKIMMD1, TSKIMMD2 … TSKIMMD7. The files numbered 1 – 7 represent mode and path combinations defined in the multinomial logit model:

1. WALK ACCESS – Local bus and Tri-Rail Feeder
2. WALK ACCESS – Express Bus
3. WALK ACCESS – Metrorail and Mover (not used)
4. WALK ACCESS – Tri-Rail
5. AUTO ACCESS – Express Bus
6. AUTO ACCESS – Metrorail and Mover (not used)
7. AUTO ACCESS – Tri-Rail

Figure 3-7
Transit Network CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



Each of the skim matrix files contains 12 tables:

1. Mode 1 (Centroid walk) time,
2. Mode 2 (Auto connector) time,
3. Mode 3 (Walk network) time,
4. Mode 4 (Local bus) and Mode 12 (Tri-Rail feeders) time,
5. Mode 5 time (not used),
6. Mode 6 (Express Bus) time,
7. Mode 7 time (not used),
8. Mode 8 (Tri-Rail) time,
9. Transfers,
10. First wait time,
11. Second wait time, and
12. Total time.
13. Fare

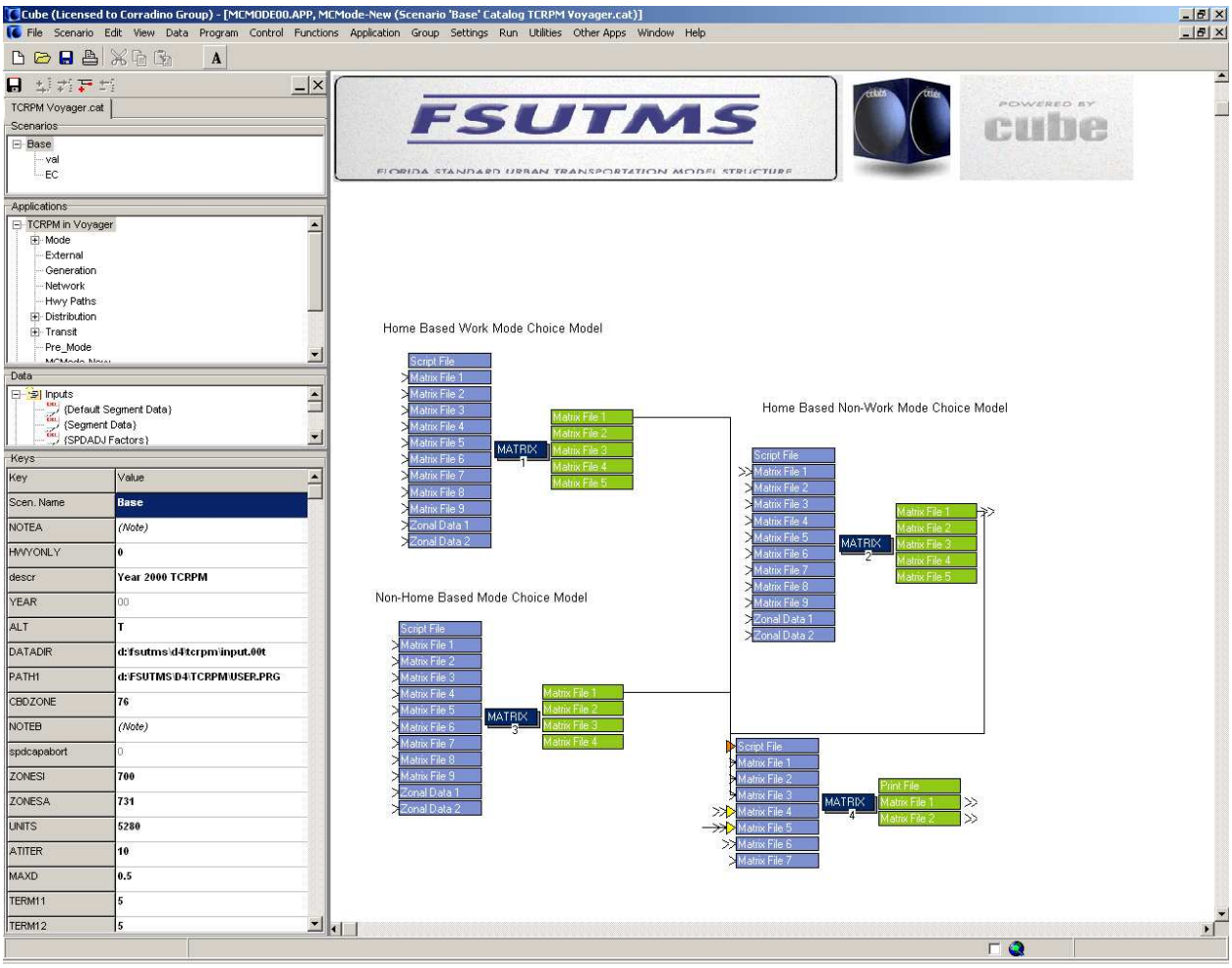
3.7 Mode Choice

Before applying the Mode Choice model, a pre-mode choice model is applied, separating motorized from non-motorized trips by purpose. This model was estimated from the Treasure Coast household travel survey. For home based work (HBW), home based shop (HBShop), home based social-recreational (HBSR), home based other (HBO), non-home based work (NHBW), and non-home based other (NHBO) a binary logit choice model was estimated where the choices were (modes as defined in the household travel survey data set):

- Motorized (including driver or passenger of car or truck, public bus, service van, car pool or van pool, and motorcycle); and
- Non-motorized (including walk and bicycle).

The mode choice model is based on the Polk County mode choice model. It is a multinomial logit model with three auto modes (1, 2, and 3+ occupants) and three transit modes (local-walk, express-walk, and express-auto access). Even though there are no express routes in the Treasure Coast model, all three transit modes have been retained so that in the future, express routes could be modeled if needed.

Figure 3-8
Mode Choice CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



TCRPM's mode choice program uses a multinomial logit model to allocate internal and IE/EI person trips between transit path and mode combinations, and levels of auto occupancy. The full model multinomial logit structure is presented in **Figure 2-3.** External autos are split between drive-alone, two occupants, and three-or-more occupants.

The main steps of the full model MODE script (see **Appendix B**) are:

1. Combine 11 trips purposes of HH trips (PTRIPS11 file from DISTRIB module) in three main purposes (HBW, HBNW and NHB). The output file PTRIPS3X contains three main trip purposes (HBW, HBNW and NHB).

2. The pre-mode choice separates motorized and non-motorized trips.

3. Apply full mode choice program. The output trip tables are HBWORK, HBNWORK and NHB.

4. The final revised trip tables are MC_HBW.MAT, MC_HBNW.MAT and MC_NHB.TEM. There are 6 tables in each of the trip table file. Those tables are:

    I. Drive Alone
    II. Shared Ride with 2 Occupants
    III. Shared Ride with 3-or-more Occupants
    IV. Walk Access
        1. Walk Access Local Bus
        2. Walk Access Premium Transit
    V. Auto Access
        1. Auto (Park-n-Ride) Access Premium Transit

5. Develop all day highway OD trip tables. The highway trip tables in O-D format containing auto trips by occupancy (DA, SR2 and SR3+) and truck trips are written to HWYTTAB. The truck trip table of HWYTTAM includes 4-tired, single unit and combination trucks.

6. Create trip tables for peak and off-peak transit trip assignment (TRANSITTTAB).

The Mode Choice scripts appear in **Appendix B**.

3.7.1 Highway-Only Model

The highway-only TCRPM model does not develop any transit skims or paths. The mode choice model is however executed and the transit skims from a previous assignment are used in the mode choice model. A TCRPM CV catalog key called HWYONLY controls the switch between a full model run and highway-only run. The allowable values for this key are 0 and 1. Value of 1 would make the model do a highway-only run, while 0 would result in a full model run including transit elements.

3.8 Highway Assignment

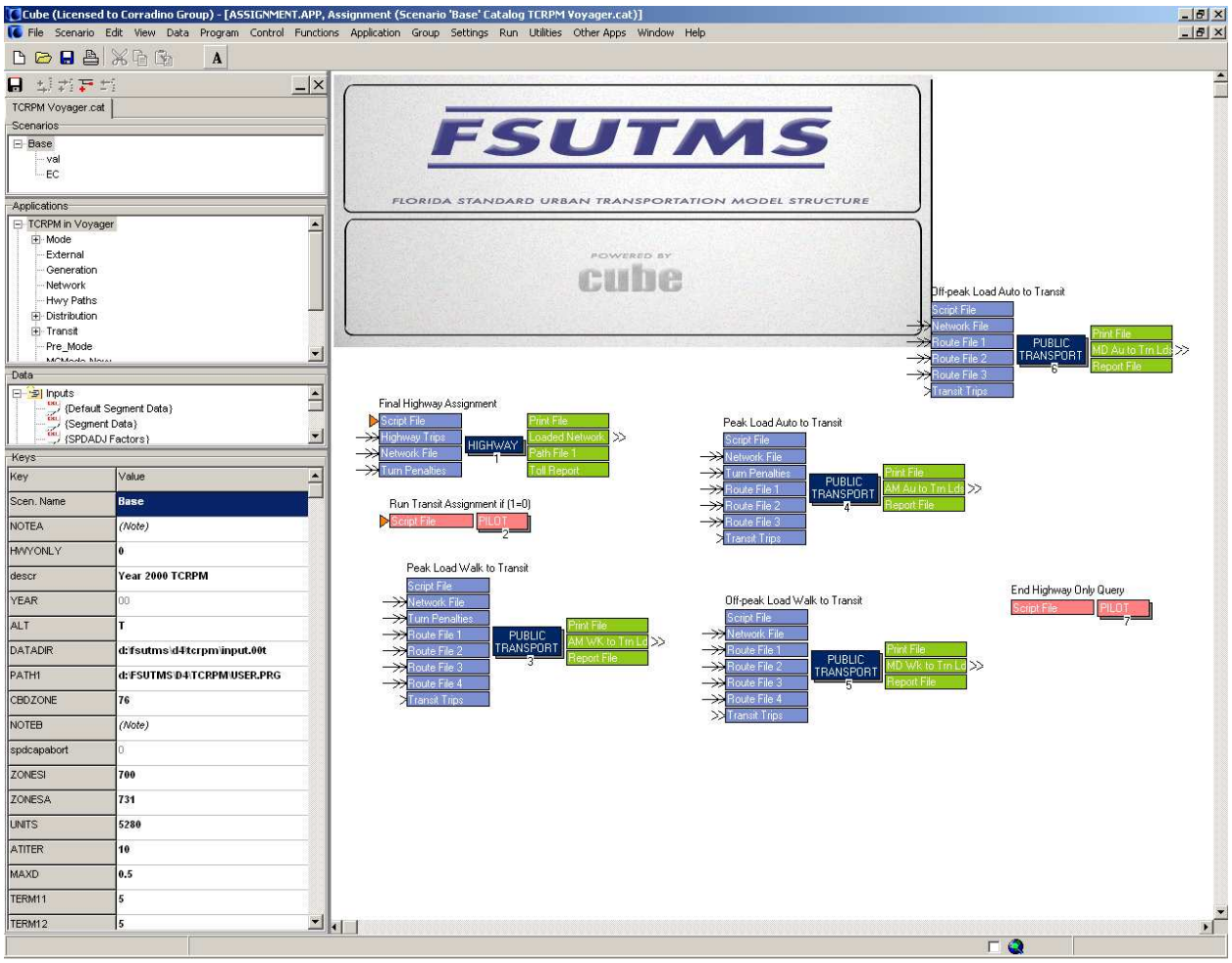
The highway assignment model loads vehicle trips onto the highway network. The model loads truck, HOV, and drive-alone trips. The iterative-equilibrium assignment method is used for capacity restraint.

The loaded network file is called LOADED.NET. The assignment model uses revised volume/delay curves developed during calibration and facility type-specific UROAD factors to convert the input level-of-service "E" capacities from possible to practical capacities.

The only user-supplied input files required is **TCARDS.** This file contains turn penalties and prohibitors. [Format in **Table D-9**]

The loaded highway network file (LOADED.NET) is then used in the Highway Evaluation module to generate highway evaluation/analysis report. The Highway Assignment script appears in **Appendix B**.

Figure 3-9
Highway and Transit Assignment CUBE/Voyager Application
2000 Treasure Coast Regional Planning Model



3.9 Transit Assignment

The Transit Assignment module loads the AM and midday transit networks, which are same for Treasure Coast. The Transit Network module produces the transit networks and the MODE module produces the transit trip tables.

All transit loadings are performed on a P/A basis. That is, trips are loaded in the home to non-home direction, not in the true travel direction because of the path-building conventions that provide auto access to transit at the home end. Thus, balancing the transit loadings by direction should be done manually if these loadings in the true travel direction are desired.

Both AM and midday assignments are produced. The AM assignment is composed of home-based-work transit trips, and the midday assignment is composed of all other trip purposes. The assumption here is that this split by purpose provides a reasonable estimate of the number of transit trips and the travel patterns for each of these time periods.

The assignment processes for both time periods load the appropriate transit trip tables onto the "legs" of the corresponding transit paths. The path files used in each of the assignment steps are shown in the following table:

Assignment Steps	AM Path	Midday Path
Walk access to local bus and Tri-Rail feeder buses	TROUTEAM1	TROUTEMD1
Walk access to express buses*	TROUTEAM2	TROUTEMD2
Walk access to Premium*	TROUTEAM3	TROUTEMD3
Auto access to Express Buses	TROUTEAM5	TROUTEMD5
Auto access to Metrorail and Mover*	TROUTEAM6	TROUTEMD6
Auto access to Tri-Rail*	TROUTEAM7	TROUTEMD7

* These modes serve as placeholders for any future testing.

The assignment steps uses transit network files (TROUTEAM and TROUTEMD) generated from Transit Network module. The transit trip table TRANSITTTAB from MODE module are also used in these assignment steps.

The Transit Assignment scripts appear in **Appendix B**.

3.10 Highway Evaluation

The standard FSUTMS highway evaluation program (HEVAL) produces evaluation reports for all vehicles (drive-alone autos, shared-ride autos and trucks).

User-supplied input files are (see **Figures 2-1 and 2-2**):

- **HELABELS.SYN** – The HEVAL file defining area type and facility type labels. [Listing in **Figure D-1**]
- **HERATES.SYN** – The HEVAL file defining accident rates, accident costs, fuel consumption rates, and air pollutant emission rates. [Listing in **Figure D-2**]
- **HESCREEN.SYN** – This is an optional file, which describes the screenlines and cutlines. [Listing in **Figure D-3**]
- **PROFILE.MAS** – Standard file. [Listing in **Appendix A**]

The highway evaluation report is written to HEVAL.OUT. The EVALUATION scripts appear in **Appendix B**.

4. FREE FLOW SPEED ESTIMATION PROCESS

This section describes the process for estimation of free-flow speed. Speeds, capacities and volume/delay functions play an important role in nearly all facets of the travel demand model. They impact the estimate of mobile source emissions as well. The chapter provides a very brief review of current practice in southeast Florida, some alternatives that have been examined by others, and the approach used for the 2000 TCRPM.

4.1 Free Flow Speed Estimation Process – User Guidelines

The free flow speed estimation is part of the model stream for TCRPM and is a fully automated procedure. There are model keys that are used for estimating free-flow speeds. This is part of the "Network" application. The model user may have to deal with this for two purposes:

- If the model user wants to add additional SEGID, then all the links expected to be part of the same segment must have same number in the "SEGID" field on the link layer. These SEGIDs must be unique and not be in use already. The listing of SEGIDs is shown in **Table 4-5**. All the new signalized nodes should have a value "1" in the SIGNAL attribute on the node layer. User must specify this value for all new signals.
- If the model user wants to update signal data or test a new signal at a particular intersection that is already part of a segment. All the new signalized nodes should have a value "1" in the SIGNAL attribute on the node layer. User must specify this value for all new signals. For updating link records, if g/C ratio is available for all incoming links then it must be specified on the link layer. The list of all free flow speed estimation process attributes is as shown in **Table 4-1**.

Table 4-1
Link and Node Attributes for Free-Flow Speed Estimation Process
2000 Treasure Coast Regional Planning Model

Link Attributes	
GC_RATIO*	if signalized and data is available, g/C ratio for the upstream node
Node Attributes	
SIGNAL	Should either have a value of 1 or 0. (1 for signalized and 0 for non-signalized)
CYC_LEN*	if signalized and data is available, cycle length in seconds

* In absence of local, default data would be used from DEFAULT_SEGMENT.CSV shown in **Table 4-4**

During the process of model calibration, certain SEGIDs were allocated special signal related data. This data is maintained in a separate file called "SPEC_SEGDATA.CSV". **The Model user must not modify this file and any signal related data must be entered in the node and link layer as explained above.** The data in the file is as shown below in **Table 4-2**. The free flow speed estimation process is completely explained in section 4-2.

Table 4-2
Special Segment Data (SPEC_SEGDATA)
2000 Treasure Coast Regional Planning Model

SEGID	Cycle Length	g/C Ratio	DF (Degree of Freedom)
14	90	0.85	0.85
16	90	0.85	0.85
34	90	0.75	0.75
36	100	0.80	0.85
38	100	0.80	0.85
105	90	0.70	0.85
106	90	0.70	0.85
107	90	0.70	0.85
108	90	0.70	0.85
109	100	0.85	0.85
136	90	0.70	0.85
137	90	0.70	0.85
139	120	0.85	0.85
140	80	0.60	0.85
204	70	0.65	0.80
213	70	0.65	0.80

4.2 The Traditional FSUTMS Method

Since the late 1970's most Florida models have used speed/capacity lookup tables to estimate free-flow speeds and capacities. The BPR formulation has been used to estimate congested travel speeds.

The Florida Department of Transportation has conducted extensive research on estimating speeds and capacities for planning purposes, and the literature has recognized this effort. The "default" speed/capacity table, as recommended by the Model Task Force, is based on this research, as documented in the *Level of Service Manual*. The speed/capacity table is constructed so that speeds and capacities are determined from the area type, facility type, and number of lanes of a roadway. Area type and facility type each are specified as two-byte codes for each roadway link. Often, adjustments are made to the table to improve model calibration, as indicated by root mean square error and screenline analyses.

The traditional BPR curve is used in most areas to estimate congested roadway travel speeds. The BPR expression is:

$$s = s_f/[1+a(v/c)^b]$$

where

- s = capacity restrained speed
- s_f = free-flow speed
- v = volume
- c = practical capacity
- a = coefficient (traditionally, 0.15)
- b = exponent (traditionally, 4)

FSUTMS specifies a set of factors in the VFACTORS file to convert LOS E capacity to practical capacity. A VFACTOR can be assigned to each facility type. The VFACTORS file also allows the BPR equation to use different coefficients (a) and exponents (b). In the southeast Florida models, modified BPR curves have been used, with different coefficients and exponents for each facility type.

4.3 Free-Flow Speed Estimation

While the speeds in the FSUTMS default lookup table provide a good estimate of free-flow speeds, some modelers have been somewhat dissatisfied with the results of their use. A common example would be when a roadway is greatly over- or under-assigned, and an examination of the free-flow speed suggests that it was clearly too high or too low. This occurrence is particularly true in the case of parallel streets, one of which is greatly over-assigned and the other under-assigned. Often it is found that inappropriate speeds have been used, and the relationship between the speeds of the parallel facilities is incorrect.

The literature contains several recent reports on free-flow speed estimation. These include the Travel Model Improvement Program's (TMIP), *Travel Model Speed Estimation and Post Processing Methods for Air Quality Analysis* (October, 1997), NCHRP Report 387, *Planning Techniques to Estimate Speeds and Service Volumes for Planning Applications* (1997), and NCHRP Report 394, *Improving Transportation Data for Mobile Source Emissions* (1997). These reports note problems with existing speed estimate methods and alternatives are suggested, but no clear-cut consensus is presented. One of the TMIP recommendations (Number 2, Section 1.4 on page 8) says:

> "Consider enhancing their methods for estimating link free-flow speed and capacity. Recent research found that the accuracy of the standard BPR curve could be improved by 50% by using actual free-flow speeds and capacities rather than estimated values based on area type and facility type."

Some of the studies suggest collecting data to determine the relationship between posted speeds and actual free-flow speeds. While this might produce the best local estimates of speeds, data collection is costly and time-consuming, and is not funded for the TCRPM model update.

The TMIP report describes two methods for estimating free-flow speeds, one based on the Highway Capacity Manual (HCM), and the other based on NCHRP 3-55(2). The HCM method requires geometric and signal spacing data, which may not be available. The NCHRP method, which is the procedure recommended in NCHRP Report 387, relies on posted speeds for urban and rural uninterrupted flow, and posted speed, signal spacing and timing data for urban interrupted flow.

4.3.1 Method and Data

The consultant's preliminary recommendation for TCRPM update is the NCHRP 3-55(2) method with modification for non-rural collectors with speeds 35 mi/hr or less. The recommendation is based on the NCHRP Report 387 recommendation, the simplicity of implementation, and the tie to posted speeds. A summary of the method appears below.

Uninterrupted flow, posted speed greater than 50 mph:
Mean speed= 0.88(Posted speed) + 14
Uninterrupted flow, posted speed less than or equal to 50 mph:
Mean speed= 0.79(Posted speed) + 12

The speed for the non-rural collectors with speeds 35 mi/hr or less has been revised based on HCM 2000 recommendation of a travel time delay of 1 to 10 seconds for a 0.25 mile of roadway to account for the effect of stop signs and turning movements. Without this change, some low-speed collector roads are assigned higher speeds than parallel arterials, resulting in illogical traffic assignments. The original procedure did not consider stop sign delays for low facility type roads, so it was decided that a new free flow estimation curve must be developed for non-rural collectors with posted speed 35 mi/hr or less that would consider this delay. Since the HCM recommended delay has a wide range, it was decided that a near median value, 4 seconds, should be used as the delay and added to the original free flow travel time, which is estimated using the NCHRP 387 recommended equation (FFS= 0.79* Posted Speed + 12) for roadways that have posted speed of 50 mi/hr or less.

The revised FFS estimation curve was derived by performing linear regression between the posted speed and the free flow speed estimated by applying a four second delay to the free flow speed estimated using "FFS= 0.79* Posted Speed + 12" at different posted speeds, 20, 25, 30, 35 mi/hr.

The revised equation for non-rural collectors, with posted speed 35 mi/hr or less and no SEGID specified, is:

$$\text{Free Flow Speed} = 0.59*\text{Posted Speed} + 13.12$$

Table 4-3 shows the free flow speed estimated using the original curve along with the free flow speed estimated using the revised curve.

Table 4-3
Free-Flow Speed Estimation Equations
2000 Treasure Coast Regional Planning Model

	Free-Flow Speed	
	Old Equation	**Revised Equation**
Posted Speed	*0.79*(Posted Speed) + 12*	*0.59*(Posted Speed) + 13.12*
25	31.75	27.84
30	35.70	30.78
35	39.65	33.72

Signalized intersections:

$S_f = L/[L/S_{mb} + N(D/3600)]$

where

S_f = Free-flow speed for an urban interrupted facility.
L = Length of the facility
S_{mb} = Mid-block free-flow speed=0.79(Posted speed) + 12
D = Average delay per signal (seconds)

and,

$D = DF * 0.5 * C(1 - g/C)^2$

where,

DF = (1-P)/(1-g/C) where: P= proportion of vehicles arriving on green
g = the effective green time (seconds)
C = Cycle length (seconds)

When P is unknown, use:

DF = 0.9 for uncoordinated actuated signals

= 1.0 for uncoordinated fixed time signals
= 1.2 for coordinated signals with unfavorable progression
= 0.9 for coordinated signals with favorable progression
= 0.6 for coordinated signals with highly favorable progression

The consultant applied the above procedure in the Treasure Coast model and performed some tests to observe the effect of the free flow speed estimation process on various facilities.

Default values for the Treasure Coast Model are shown below:

Table 4-4
Free-Flow Speed Default Parameters (DEFAULT_SEGMENT.CSV)
2000 Treasure Coast Regional Planning Model

Facility Type	Cycle Length	G/C	DF
1	90	1.00	1.00
2	90	0.55	0.70
3	90	0.45	0.85
4	60	0.40	1.00
5	60	0.40	1.00
6	90	0.55	0.70
7	90	0.45	1.00
8	90	1.00	1.00
9	90	1.00	1.00

Data requirements for TCRPM are:

- Posted speed for all links
- Location of signalized intersections
- Distance between signals for signal controlled areas
- An assessment of progression to estimate DF.

Additional data on signal timing would enhance the accuracy. The desirable additional data are:

- g/C
- cycle length for individual signalized intersections

It is assumed that actual data on the proportion of vehicles arriving on green, P, will not be available. Thus, the modeler would be expected to provide the following:

- A FSUTMS network map with traffic signals marked on the map.
- Indications on the map showing groups of signals that are tied together for progression, and the degree of progression for each group (DF, as noted earlier).
- The approximate peak period and midday cycle length.
- The approximate G/C for each approach.

The consultant will add a segment code to the link records CUBE Viper format. Data required for the signal data calculation will be stored in a segment file. This method will allow multiple links to be described by a single segment. Additionally, the consultant will develop a comparison between the speeds resulting from the method described above and the speed/capacity tables used in the last update. Variables that would appear in the segment file are:

- SEGID - Segment number
- NSIG - Number of signals in the signalized segment
- SLEN - Length of the signalized segment
- DF - Signalized delay function
- CYCLE - Cycle length
- GC - Fraction green g/C.

One of the problems in the methodology is that it is possible that cross-streets that approach a common node or intersection would be assigned different cycle-lengths, when they really must have the same cycle length. Similarly, the total g/C for the intersection might not sum to 1.0. Thus, a change in the method was made to rationalize the values for all links approaching a common node. All other links on signal segments are governed by the segment parameters.

The segment file should be a database file as described above. If a value appears for the segment value in the link record, the free-flow speed would be calculated using the interrupted flow equations. If available, the cycle length value would be specified on the corresponding node record. If one or more signalized nodes on a segment contain cycle length value, the highest cycle length value specified would be used as the cycle length for that segment. Otherwise, default values would be used. If a g/C value is available, it should be specified on the link records for all movements for that particular intersection. The user must ensure that g/C values specified for all movements add up to 100%. In absence of detailed g/C data, a procedure has been put in place that uses default facility type specific g/C values as specified in **Table 4-4**. The default values for incoming links into a signalized node are further modified. This is done to consider effect of intersection of different or same facility types and also to ensure that g/C values for two movements adds up to 100%. This procedure assumes that a signalized intersection has at least two movements (e.g., a through street and a cross-street). For a signalized node with two or more incoming links, the default g/C value for all links is temporarily assigned. Then, using the maximum and minimum g/C value from among the temporary values, relative proportions to each other are calculated. These proportions are then reassigned as g/C values to the corresponding links (An example is shown below). No more than two links with the highest default values are assigned the maximum proportion value. The rest of links are assigned minimum proportion values. This is done to remain consistent with the assumption of two movements, and that the maximum signal leg cannot have more than two links while the rest of the links would overlap in the second signal leg.

Example:
For a signalized intersection of one-digit facility types: 2 and 4. There are two links with one-digit facility type value 2 and two links with one-digit facility type value 4. Their default g/C values are 0.55 and 0.4 respectively.

Max = 0.55 and Min = 0.4
Then, the proportion of the maximum, Max', is calculated as
Max'= 0.55/(0.55 + 0.4) = 0.58
And similarly Min' is calculated as
Min' = 0.4/(0.55+0.40) = 0.42

The Max' value is assigned to two links with one-digit facility types value 2 and Min' is assigned to links with one-digit facility types value 4. The total g/C for the intersection is 1.0.
The segment file is a database file.

Implementation

The consultant has developed a computer program for implementing the method for estimating free-flow speeds from posted speeds and signal information. This method is a CUBE Voyager application that works as follows:

- The highway network is stored as a Viper line database.
- The modeler would add two numeric fields to the link records: (1) Posted Speed, and (2) Segid
- The modeler would add two numeric fields to the node records: (1) Signal, and (2) Cycle Length
- The modeler would populate the posted speed (Posted Speed) field from available data. A value would be required for every link.
- The modeler would populate the signal field in the node records with a value of 1, and where available, Cycle Length data as well.
- A segment id (Segid) would be placed on every link controlled by signals. Links with the same Segid would use the same segment data.
- FFSpeed would be added by the computer program will be filled in with the free-flow speed.
- The program would create a segment file called SEGMENT.DBF to hold the signal data. This is a temporary file that requires no user input. Fields would be:
  - SEGID - Segment number (matches link record)
  - NUMSIG - Number of signals in the signalized segment
  - Length - Length of the signalized segment (miles)
  - FT1 – One digit FSUTMS facility type
  - DF - Signalized delay function (see values described earlier)
  - CYCLE - Cycle length (seconds)
  - GC – Default Fraction green g/C (decimal fraction < 1.0).

- The model application script would develop the free-flow speed values from the posted speed and traffic signal segment data.

Thus, the procedure described here would comprise a complete procedure for calculating the free-flow speeds, as well as facilities for maintaining highway networks. Source code for the program is attached.

Table 4-5 presents a segment data file that was developed and then validated for the 2000 TCRPM. Two critical link specific data items that must be entered on the network are the posted speed (POSTSPD) and the signalized segment ID (SEGID). These data were initially entered in the TransCAD database file. They were then ported to the Cube-Voyager network with the change in modeling platform. **Figures 4-1** and **4-2** show the posted speed and SEGID data for the 2000 network. Users should enter and/or modify these data directly in the Cube-Voyager's input network (UNLOADED.NET).

The FSUTMS SPDCAP table is used to read the speeds for the centroid connectors (FT2=51-52) only. Link capacity values and any adjustments (capacity modifier) to those values are read from the standard SPDCAP table. Modelers often need to adjust the speed further to properly validate the model. Adjustments to the free-flow speeds should be made before they are used in the model. The multiplicative factors for speed adjustment are entered in a separate database file (SPDADJ.DBF). This file has five fields:

1. Lower range of the 2-digit area type codes
2. Higher range of the 2-digit area type codes
3. Lower range of the 2-digit facility type codes
4. Higher range of the 2-digit facility type codes, and
5. Multiplicative speed adjustment factor.

Table 4-6 presents the free flow speed adjustment factors that were used in the 2000 TCRPM validation. Most of the factors are very small (+/- 10 percent). Users usually do not need to alter these values when testing future alternatives.

Table 4-5

Free Flow Speed Signalized Segment Data – SEGMENT.DBF File

2000 Treasure Coast Regional Planning Model

SEGID	LENGTH	NUMSIG	FT1	CYCLE	GC	DF
1	8.41	4.5	2	90	0.55	0.7
2	6.32	5	4	60	0.4	1
3	4.46	2	2	90	0.55	0.7
4	1.89	2	2	90	0.55	0.7
5	1.82	6.5	2	90	0.55	0.7
6	3.78	4.5	3	90	0.45	0.85
7	3.71	2.5	2	90	0.55	0.7
8	2.21	3.5	2	90	0.55	0.7
9	2.16	1.5	3	90	0.45	0.85
10	3.75	2.5	4	60	0.4	1
11	4.02	2.5	3	90	0.45	0.85
12	5.4	1.5	4	60	0.4	1
13	2.13	3.5	4	60	0.4	1
14	3.02	3.5	3	90	0.85	0.85
16	6.06	6.5	2	90	0.85	0.85
17	3.81	4	3	90	0.45	0.85
18	4.78	4	3	90	0.45	0.85
19	7.84	5.5	3	90	0.45	0.85
20	1.18	2	3	90	0.45	0.85
21	2.07	6	3	90	0.45	0.85
22	1.18	1	3	90	0.45	0.85
24	4.02	2	4	60	0.4	1
25	5.66	6.5	3	90	0.45	0.85
26	2.78	5	3	90	0.45	0.85
27	2.54	2	4	60	0.4	1
28	2.69	2	4	60	0.4	1
29	2.95	1	4	60	0.4	1
30	3.73	5.5	4	60	0.4	1
31	4.24	3.5	2	90	0.55	0.7
32	3.91	2	4	60	0.4	1
33	6.95	7.5	2	90	0.55	0.7
34	2.19	2	2	90	0.75	0.75
36	1.68	3	6	100	0.8	0.85
37	1.31	3.5	2	90	0.55	0.7
38	1.57	2	2	100	0.8	0.85
39	0.86	2	4	60	0.4	1
40	4.2	6.5	2	90	0.55	0.7
41	4.11	5	3	90	0.45	0.85
42	4.03	5.5	4	60	0.4	1
44	4.9	4.5	3	90	0.45	0.85
45	8.04	5	2	90	0.55	0.7
46	3.24	2	2	90	0.55	0.7
47	4.23	4.5	3	110	0.45	0.85
48	0.96	4	2	90	0.55	0.7
49	0.37	1	2	90	0.55	0.7
50	4.74	3	4	60	0.4	1

SEGID	LENGTH	NUMSIG	FT1	CYCLE	GC	DF
101	4.66	1	3	90	0.45	0.9
102	5.09	3	2	90	0.55	0.7
103	8.08	4	3	120	0.45	0.9
104	1.74	0.5	3	110	0.45	0.9
105	1.9	2	2	110	0.7	0.9
106	0.72	4.5	2	90	0.7	0.9
107	0.59	4	2	90	0.7	0.9
108	0.49	2	2	90	0.7	0.9
109	1.96	4.5	2	100	0.85	0.9
110	2.16	2	2	100	0.55	0.7
111	2.32	2	2	120	0.55	0.7
112	1.43	3	2	120	0.55	0.7
114	4.29	7	2	120	0.55	0.7
115	5.92	1	3	120	0.45	0.9
117	2.56	2	3	50	0.45	0.9
118	2.39	1	3	50	0.45	0.9
121	1.76	4	3	90	0.45	0.9
122	1.46	4.5	2	90	0.55	0.7
123	2.77	2	3	120	0.45	0.9
124	4.92	1.5	3	90	0.45	0.9
126	5.13	6	4	120	0.4	1
127	2.82	2	4	60	0.4	1
128	2.28	4.5	4	60	0.4	1
129	2.68	2	4	120	0.4	1
130	2.28	2	4	120	0.4	1
131	3.09	1	4	60	0.4	1
132	2.76	5	2	90	0.55	0.7
133	3.11	1.5	3	50	0.45	0.9
134	4.6	1.5	3	110	0.45	0.9
135	1.71	4	3	90	0.45	0.9
136	2.46	5.5	3	120	0.7	0.9
137	0.89	5	3	90	0.7	0.9
138	2.31	6	2	90	0.55	0.7
139	2.8	5	2	120	0.85	0.9
140	0.76	3.5	2	80	0.6	0.9
141	1.7	3.5	3	120	0.45	0.9
142	0.99	5	4	60	0.4	1
143	0.5	0.5	4	60	0.4	1
144	2.43	2	3	120	0.45	0.9
145	1.69	3	4	100	0.4	1
146	3.4	6.5	3	90	0.45	0.9
147	2.2	4.5	3	120	0.45	0.9
148	1.31	1	4	60	0.4	1
150	2.03	2	4	60	0.4	1
152	2.35	4.5	3	90	0.45	0.9
153	0.66	1.5	4	60	0.4	1

Table 4-5 (cont'd)

Free Flow Speed Signalized Segment Data – SEGMENT.DBF File

2000 Treasure Coast Regional Planning Model

SEGID	LENGTH	NUMSIG	FT1	CYCLE	GC	DF
154	1.9	1.5	4	60	0.4	1
155	4.45	7	4	60	0.4	1
156	2.93	1	2	90	0.55	0.7
157	1.25	1	4	60	0.4	1
158	1.23	2	4	60	0.4	1
159	0.64	1.5	4	60	0.4	1
160	0.25	0.5	4	60	0.4	1
161	1.03	1.5	4	60	0.4	1
162	0.63	1.5	4	60	0.4	1
163	0.42	5	2	90	0.55	0.7
164	0.76	1	4	60	0.4	1
165	0.21	1	4	60	0.4	1
166	0.3	0.5	4	60	0.4	1
167	0.11	0.5	4	60	0.4	1
168	0.1	0.5	4	60	0.4	1
169	0.34	0.5	4	60	0.4	1
170	2.53	2.5	3	90	0.45	0.85
171	1.48	2.5	3	90	0.45	0.85
172	0.91	1	4	60	0.4	1
173	0.89	1	3	50	0.45	0.85
174	1.48	1	4	120	0.4	1
175	1.12	1	4	120	0.4	1
176	2.37	0.5	4	120	0.4	1
177	1.03	0.5	4	60	0.4	1
178	2.19	2	4	60	0.4	1
179	5.36	2.5	4	60	0.4	1
180	2.97	2	4	60	0.4	1
181	1.11	1.5	4	120	0.4	1
182	1.55	1.5	4	60	0.4	1
183	0.93	2.5	4	60	0.4	1
184	1.72	3	4	60	0.4	1
185	0.92	1.5	4	60	0.4	1
186	0.89	1	4	60	0.4	1
187	2.27	2	3	90	0.45	0.85
190	1.54	3.5	2	90	0.55	0.7
191	0.56	1.5	4	60	0.4	1
192	0.53	2.5	4	60	0.4	1
193	0.57	2	4	60	0.4	1
194	0.21	1	4	60	0.4	1
196	3.83	3.5	4	60	0.4	1
198	2.14	1.5	3	120	0.45	0.85

SEGID	LENGTH	NUMSIG	FT1	CYCLE	GC	DF
199	1.03	1	3	120	0.45	0.9
201	0.63	1	2	90	0.55	0.7
202	0.73	3	2	90	0.55	0.7
204	1.68	5.5	3	70	0.65	0.8
205	0.45	2	2	90	0.55	0.7
206	1.27	3.5	2	90	0.55	0.7
207	2.02	3	2	90	0.55	0.7
208	3.21	3.5	2	90	0.55	0.7
209	2.68	1	2	90	0.55	0.7
210	4.89	4	3	90	0.45	0.9
211	0.54	1	4	60	0.4	1
212	0.68	1	3	90	0.45	0.9
213	2.58	5	3	70	0.65	0.8
214	1.57	3.5	3	90	0.45	0.9
215	3.92	3.5	3	90	0.45	0.9
216	1.86	3	3	90	0.45	0.9
217	2.33	2.5	3	90	0.45	0.9
218	1.28	3	2	90	0.55	0.7
220	1.61	2	2	90	0.55	0.7
221	1.42	3.5	2	90	0.55	0.7
222	0.86	1	3	90	0.45	0.9
223	3.03	3	3	90	0.45	0.9
224	1.62	3	3	90	0.45	0.9
226	2.44	4.5	4	60	0.4	1
227	0.63	2.5	2	90	0.55	0.7
228	1.15	2	4	60	0.4	1
229	2.05	3	3	90	0.45	0.9
230	2.65	7	2	90	0.55	0.7
231	1.05	3	2	90	0.55	0.7
232	0.87	2	3	90	0.45	0.9
233	1.39	2.5	6	90	0.55	0.7
235	3.11	3.5	3	90	0.45	0.9
236	3.55	2	3	90	0.45	0.9
237	2.66	2.5	2	90	0.55	0.7
238	1.46	1.5	4	60	0.4	1
239	1.61	2	3	90	0.45	0.9
240	2.77	1.5	3	90	0.45	0.9
241	1.97	3.5	3	90	0.45	0.9
242	2.26	1	3	90	0.45	0.9
243	1.13	1	4	60	0.4	1
244	1.47	2	2	90	0.55	0.7
245	0.81	2	3	90	0.45	0.9

Figure 4-1
Posted Speed Limits of Network Links
2000 Treasure Coast Regional Planning Model

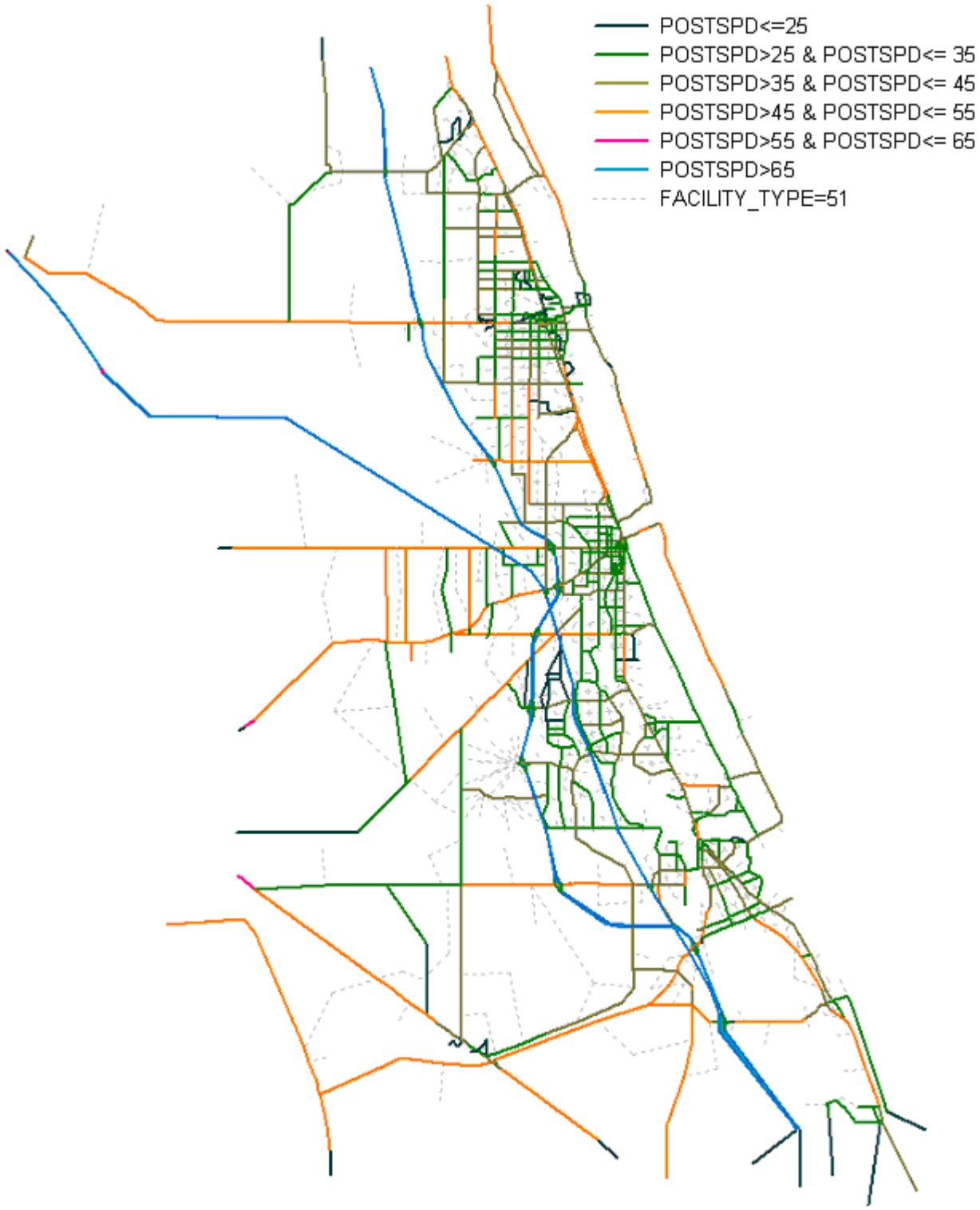


Figure 4-2
SEGID Designation of Network Links
2000 Treasure Coast Regional Planning Model

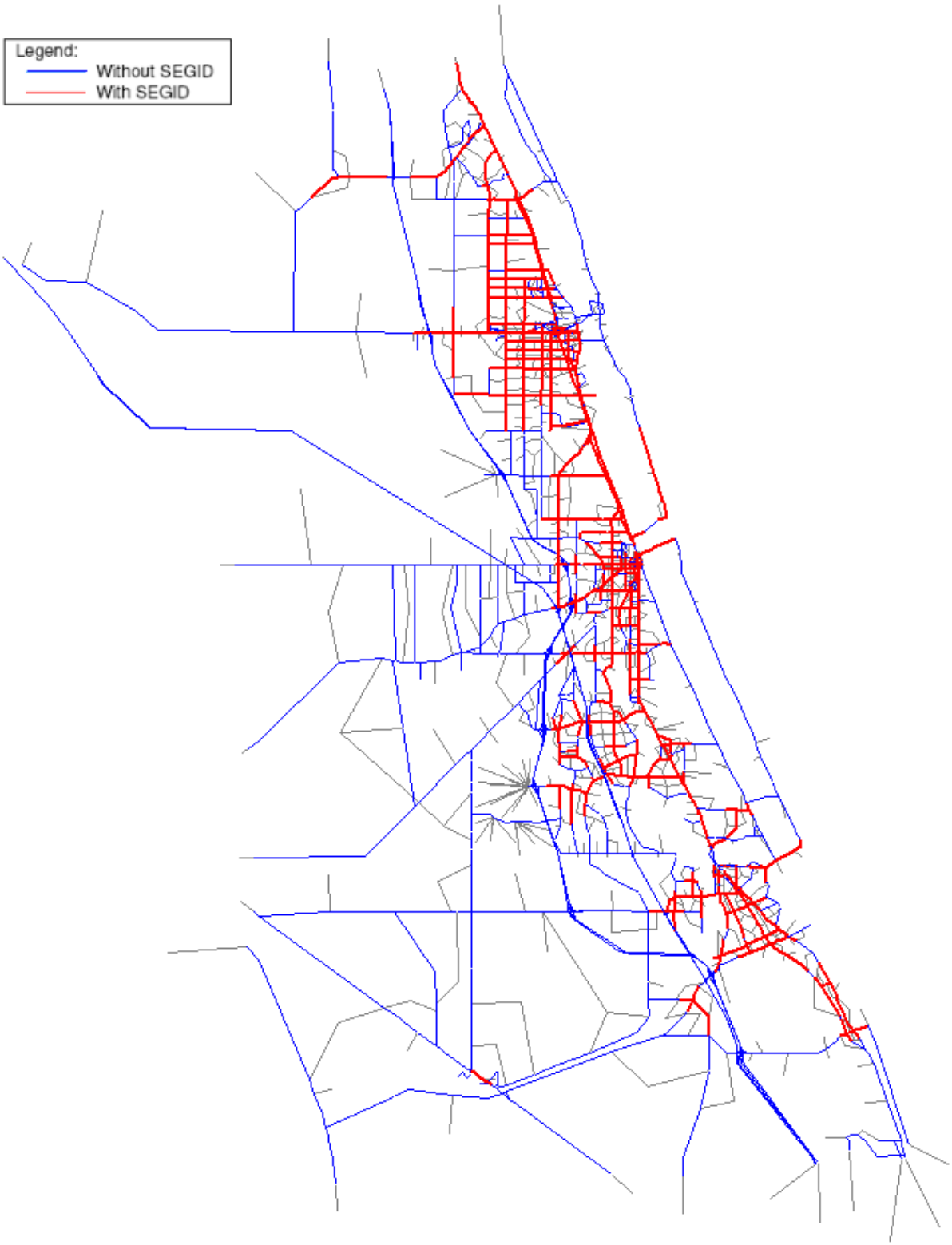


Table 4-6

Free Flow Speed Adjustment Factors – SPDADJ.DBF File

2000 Treasure Coast Regional Planning Model

Area Type Range		Facility Type Range		FACTOR
Low	High	Low	High	
AT1	AT2	FT1	FT2	
11	14	21	26	1.00
11	14	31	38	1.00
11	14	41	48	1.00
11	14	61	68	1.00
21	21	21	26	1.00
21	21	31	38	1.00
21	21	41	48	1.00
21	21	61	68	1.00
31	35	11	17	0.90
31	35	21	26	1.00
31	35	31	38	1.00
31	35	41	48	1.00
31	35	61	68	1.00
31	35	71	79	0.70
31	35	97	98	1.00
31	35	81	85	1.00
41	45	11	17	1.00
41	45	21	26	1.00
41	45	31	38	1.00
41	45	41	48	1.00
41	45	61	68	1.00
41	45	71	79	0.70
41	45	97	98	1.00
51	52	11	17	1.00
51	52	21	26	1.00
51	52	31	38	1.00
51	52	41	48	1.00
51	52	71	79	0.70
51	52	97	98	1.00
51	52	91	95	1.00

5. MODEL APPLICATION AND ADJUSTMENTS

Chapter 2 identifies the inputs and special programs for TCRPM. This chapter provides guidelines for several inputs and parameters that users may need to modify as part of the model application.

Users should always compare the model results either to the base year results or to other alternatives to evaluate the reasonableness of network and parameter changes. The log and output files should also be carefully examined for error messages, warnings and notes. These messages and notes are extremely useful in the debugging process should the user make an error in the content or specification of input data.

For each alternative to be analyzed, users need to be sure to create/rename the input file extension to reflect the "year" and "alternative" designation. The changes required to model data and parameters as well as a few checks to those data and parameters are described in the following sections.

5.1 External Travel Data

ZDATA4B and EETRIPS are the external data files. For future year applications, these two external files should be updated. In TCRPM, volumes from the adjacent models (SERPM and Brevard County) should be examined so that assumptions are consistent. Historical growth and expected future growth should also be examined. Through vehicle trips are entered in the EETRIPS file. Major attractions or activity centers near, but outside the model area may require changes to be made in the EETRIP and ZDATA4B files.

The ZDATA4B file contains internal-external productions and attractions in terms of person trips. Both ZDATA4B and EETRIPS files work together to define the external station highway traffic. The percent distribution of trips for each external station in the ZDATA4B file should be reviewed for future year model applications. The external travel times in ZDATA4B also should be reviewed and adjusted if external travel conditions have changed.

If the model is being used to determine development impacts, then external data should be checked if the site to be analyzed is near the study boundary or it is expected that external trips for the proposed site were not fully accounted for during the normal development of these files.

For any future application, the external-external trips (EETRIPS) and internal-external trips (ZDATA4B) should be factored to the anticipated traffic growth at the external stations. Adjacent models, as well as a traffic trend analysis of external station traffic, should be used to develop the traffic growth factors.

5.2 Zonal Demographic Data

All the demographic data files (ZDATA1B, ZDATA2, SCHOOL, ZDATA3B) should be updated/reviewed in all future year model applications. The zonal data files should be checked and then modified if changes are made in the zone system. The zonal data files may also need to be changed even if there is no change in the zonal system. The contents of these files should be edited to reflect proposed land use changes.

The ZDATA3B file should be reviewed for the need to add new special generators if the normal generation process fails to generate the expected level of traffic for the proposed development. Following is the set of "guidelines" that should be followed in deciding whether to add special generators:

1. If the TAZ's activity would not be reflected by the ordinary employment or school enrollment of the TAZ, like a park or marina, then add all of the special generators trips.

2. If the TAZ contains a mall or shopping center and if the special generator attractions are greater than the standard generator attractions, then add the difference. Otherwise add zero.
3. If the TAZ contains a large college or university, and
    a. If the school enrollment in the SCHOOL file is zero, then add the entire special generator.
    b. If the school enrollment in the SCHOOL file is greater than zero, then add the difference if positive.
    c. Otherwise add zero.

5.3 Alternative Network Development

In most model applications, the users will need to modify the cost-feasible networks to represent various alternative scenarios. It is always helpful to generate plots of the network where changes need to be carried out. Then the modifications necessary for the alternative should be sketched on the plots. **Any changes required to the network must be made to the input Cube-Voyager network.** For any new or improved facilities, users should check the reasonableness of the posted speeds and other signal related data (see Chapter 4).

The user should be aware that changes in the highway network might require changes in the transit network, as all node sequences in the route cards must be present in the highway network. If, for example, a link in the highway network is divided into two links, then the new node must be added to the route description for every route using that link, or "Transit Network" will fail. Thus, the user should keep a record of highway network changes so that similar changes can be made in the route descriptions. In general, CUBE will automatically update the PT transit network files if they are open and displayed when the highway network is edited.

5.3.1 Highway Network

The highway network consists of general use links, toll links and restricted use facilities, which are limited to High Occupancy Vehicles (HOV). TCRPM incorporates a flexible method for handling HOV lanes not by restricting the modes allowed to use the HOV lanes, but by restricting the modes that can enter the HOV accessing ramps.

Almost all alternatives will require changes to be made to the highway network. Both written and graphical descriptions of the alternative network will be used to make changes to the highway networks. Cube/VIPER should be used to make changes to the highway network

There will be occasional need to change the TCARDS file. Changes may be required if tolls or turns are changed as part of the alternative or to reflect changes in the network or zonal system. Direct changes in the TCARDS records will be necessary to:

1. add or remove turning penalties
2. add or remove turning prohibitors
3. implement a penalty for HOV ingress and egress links.

When making any highway network edits the user should carefully review the following attributes for all affected links:

1. Two-digit facility-type code (FACILITY_TYPE)
2. Two-digit area-type code (AREA_TYPE)
3. Number of lanes per direction (LANES)

4. Screenline and Cutline code (SCREENLINE)
5. Geographical Location (GL) (LOCATION)
6. Posted Speed (POSTSPD)
7. SEGID

And the affected nodes,

1. Signal (SIGNAL)
2. Cycle Length (CYC_LEN)

The first three parameters of the link records are used to derive the capacity values from a lookup table (SPDCAP**). It should be mentioned the initial speeds of any non-centroid links are computed from the posted speed and signalized data. Chapter 4 describes this estimation process. Appendix E** should be consulted for the description of the two-digit facility and area types. The LOCATION code is used in summarizing the evaluation statistics and in air quality analysis. Highway network changes can be categorized as follows:

1. Addition and deletion of nodes
2. Moving dummy zones to proposed new zone locations
3. Addition and deletion of links
4. Modification of existing network attributes.

5.3.2 Transit Network

Changes in the transit network and parameter files should be made as appropriate when testing transit alternatives. Transit alternatives usually involve the addition, deletion and modification of transit lines. The following steps could be followed to code the transit network alternatives.

1. Make highway and transit plots for the part of the network where the changes need to be made.

2. Mark the changes on both of these plots. Then Cube/VIPER should be used to trace the highway nodes, which constitute the transit route modification. Users should also identify the stop node locations.

3. Edit the transit route files (TROUTEAM.LIN/TROUTEMD.LIN) for the changes identified in Step 2. **The underlying highway network file should be open when making changes to the transit network in VIPER.** For any transit links, which do not run on highway links, code those links as FACLITY_TYPE (59).

4. It should be noted that the transit network uses the highway network data to extract link geometry and operating characteristics. This may require several back and forth changes in both the highway and transit networks. If the transit network is open and displayed in CUBE when editing the highway network, CUBE will automatically update the PT route node list.

Usually several back-and-forth debugging steps are needed for all transit-related changes. Transit "route" file will need to be modified for most transit alternatives. It should be noted that changes in the transit route file may be needed as a result of changes made to the highway network. This will be needed only if the transit lines run on the modified portions of the highway network.

Having successfully completed transit network coding, the user should modify the STATDATA file (see **Appendix D** for the formats of this files). TCRPM builds the transit access connectors automatically.

The STATDATA file contains transit station data information for the fixed-guideway systems and the major Park-N-Ride (PNR) and Kiss-N-Ride (KNR) locations, which are not used for the Treasure Coast region. Alternatives that modify this data should be reflected in the STATDATA file. The user should also check STATDATA for any changes to this file. **Appendix D** contains the formats for the STATDATA file.

Route characteristics should be properly coded for each new or modified new transit line. The most important characteristic is headway. Headways represent the time between runs. Users may test different headways during peak and off-peak periods. A related term of the headways is the HEADWAY, which can also be used to code multiple headways within peak and off-peak periods.

5.4 Transit Fares

Transit Fare is one of the variables that the user may modify depending on the alternative. The fare data are input to the model from BASEFARES.FAR.

The boarding and transfer fare data presented in BASEFARES.FAR file. For any alternative involving Tri-Rail zonal fares, users should modify the fare information in the BASEFARES.FAR and STATDATA files (Presently placeholders).

6. SUMMARY AND CONCLUSION

TCRPM model application guidelines report has documented the differences between the TCRPM and standard FSUTMS and the changes needed to apply the model for various alternatives. It assumes that users have knowledge of CUBE/Voyager for a variety of alternatives. The report has identified the key data and their format in Appendix D. Chapter 2 describes all the user input files. Users should consult **Tables 2-1** and **2-2** for a complete list of the input files and TCRPM specific routines.

TCRPM model includes many new features, which do not exist in standard FSUTMS. It implements the multinomial logit mode choice model using standard transit mode (local bus) and access. TCRPM highway-only model adds the flexibility to analyze the highway alternative without going through the time-consuming transit processes.

Chapter 3 describes each module of TCRPM and its inputs and outputs. Chapter 4 documents the free-flow speed estimation process and provides detail information for implementation of this process in Cube-Voyager application.

Chapter 5 provides general information for the modeling changes needed for a wide range of transportation alternatives. Regardless of the alternative to be tested, the user should review all input and output files and reports for reasonableness. It is expected that the user will find this report a useful guide to understand the 2000 Treasure Coast Regional Planning Model and to apply the model for any applications.

7. LIST OF REFERENCES

Recent MPO Model References:

1. **Data Compilation and Review, Technical Report 1, Broward County Planning Model – 1999 Model Update**, Broward County Department of Planning and Environmental Protection, FDOT, Prepared by Carr Smith Corradino, November 2001.

2. **Model Calibration and Validation, Technical Report 2, Broward County Planning Model – 1999 Model Update**, Broward County Department of Planning and Environmental Protection, FDOT, Prepared by Carr Smith Corradino, November 2001.

3. **Model Application Guidelines, Technical Report 3, Broward County Planning Model – 1999 Model Update**, Broward County Department of Planning and Environmental Protection, FDOT, Prepared by Carr Smith Corradino, November 2001.

Recent SERPM (Versions IV and V) Related References:

4. **Revised Transit Model and Validation, Technical Report, Southeast Regional Planning Model V (SERPM-V) – 1999 and 2025 Models**, FDOT – District 4, Prepared by The Corradino Group and AECOM Consult. Inc., April 2005.

5. **Data Development and Model Update, Technical Report 1 (Draft), SERPM-V – 1999 and 2025 Models**, FDOT- District 4, Prepared by The Corradino Group, December 2002.

6. **Model Calibration and Validation, Technical Report 2 (Draft), SERPM-V – 1999 and 2025 Models**, FDOT- District 4, Prepared by The Corradino Group, December 2002.

7. **Model Application Guidelines, Technical Report 3 (Draft), SERPM-V – 1999 and 2025 Models**, FDOT- District 4, Prepared by The Corradino Group, December 2002.

8. **SERPM-IV Model Forecast Enhancements, Technical Report**, Southeast Florida Travel Characteristics Study Phase IV, FDOT, Prepared by Carr Smith Corradino, October 2001.

9. **Tri-Rail Long Range Plan Modeling Using SERPM-IV, Technical Memorandum,** Prepared for Parsons Brinkerhoff, Prepared By The Corradino Group, October 2001.

10. **SERPM-IV 1996 Model Validation,, Technical Report**, FDOT, Prepared by Reynolds, Smith and Hills, Inc and The Corradino Group, June 1999.

11. **SERPM-IV Users Manual: PC-X32 Version**, FDOT, Prepared by The Corradino Group, September 1997.

12. **Southeast Regional Planning Model IV (SERPM-IV), Model Validation Report,** FDOT, Prepared by The Corradino Group, August 1996.

Other Florida References:

13. **Trip Attraction Equation Refinements, Draft Final Report**, FDOT, Prepared by Carr Smith Corradino, December 2001.

14. **Development of Trip Rates and Friction Factors for Southeast Florida Demand Forecast Models**, Technical Report, Southeast Florida Travel Characteristics Study Phase IV, Florida Department of Transportation, Prepared by Carr Smith Corradino, October 2001.

15. **Southeast Florida Regional Travel Characteristics Study - Travel 2000,** Executive Summary and Final Technical Reports, Prepared for Florida Department of Transportation and Palm Beach, Broward and Miami-Dade MPOs, Prepared by Carr Smith Corradino, October 2000.

16. **Lifestyle Trip Generation Model: Revised Special Generator and Schools Model**, Technical Memorandum, Florida Department of Transportation, District 4, submitted by: Carr Smith Corradino, September 1999.

17. **Highway Network (HNET) Procedural Enhancement Study, Executive Summary, Technical Report and User's Manual**, System Planning Office, FDOT, Prepared by PBS&J, March 1998.

18. **An Addendum to the Enhanced FSUTMS Trip Generation Model**, FDOT, Prepared by Carr Smith Corradino, September 1997.

19. **Enhanced FSUTMS Trip Generation Model – Final Report**, FDOT, District 4, Prepared by Carr Smith Corradino, August 1997.

20. **MDTA On-Board Survey Analysis**, MDTA, Prepared by Center for Urban Transportation Research- University of South Florida, May 1994.

21. **Tri-Rail On-Board Survey Analysis**, Tri-County Commuter Rail Authority, Prepared by Center for Urban Transportation Research - University of South Florida, October 1991.

Other National References:

22. **NCHRP 365 – Travel Estimation Techniques for Urban Planning**, Transportation Research Board, National Research Council, 1998.

23. **Model Validation and Reasonableness Checking Manual**, Travel Model Improvement Program, Federal Highway Administration, February 1997.

24. **Quick Response Freight Manual**, Travel Model Improvement Program, USDOT, September 1996.

25. **Calibration and Adjustment of System Planning Models**, Federal Highway Administration, USDOT, December 1990.

26. **NCHRP 255 – Highway Traffic Data for Urbanized Area Project Planning and Design**, Transportation Research Board, National Research Council, December 1982.

27. **NCHRP 187 – Quick Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide**, Transportation Research Board, National Research Council, 1978.

28. **Traffic Assignment - methods, application and products**, U.S. Department of Transportation (USDOT), August 1973.