TREASURE COAST REGIONAL PLANNING MODEL
2000 MODEL UPDATE

TECHNICAL REPORT 2

MODEL CALIBRATION AND VALIDATION

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COMMONLY USED ABBREVIATIONS (Alphabetic Listing)

AADT	Annual Average Daily Traffic
AT	Area Type
AUTOCON	Transit Auto Connector Program
BPR	Bureau of Public Roads
CBD	Central Business District
CL	County Line
COMB	Combination Trucks
CV	Cube-Voyager
DA	Drive Alone
DF	Dampening Factor
DU	Disutility/Dwelling Unit
EB	Express Bus
EE	External-External
EI	External-Internal
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FLL	Ft. Lauderdale Hollywood International Airport
FSUTMS	Florida Standard Urban Transportation Model Structure
FT	Facility Type
GIS	Geographic Information System
HB-Other (HBO)	Home Based Other
HB-School (HBSCH)	Home Based School
HB-Shop (HBSHP)	Home Based Shopping
HB-SocRec (HBSCR)	Home Based Social Recreation
HB-Work (HBW)	Home Based Work
HCM	Highway Capacity Manual
HEVAL	Highway Evaluation Routine
HH	Household
H/M	Hotel/Motel
HOV	High Occupancy Vehicle
IE	Internal-External
IVT	In-Vehicle Time
KNR	Kiss-n-Ride
LB	Local Bus
LOS	Level of Service

MPO	Metropolitan Planning Organization
MPMP	Multi-Path Multi-Period
MR	Metro-Rail
MTF	Model Task Force
MV	Metro-Mover
NCHRP	National Cooperative Highway Research Program
NHB	Non Home Based
NHBW	Non Home Based Work
NHBO	Non Home Based Other
NLOGITFL	Full Nested Logit Model
NLOGITHO	Highway-Only Nested Logit Model
NPTS	National Person Transportation Survey
PB	Palm Beach
PCWALK	Percent Walk
PNR	Park-n-Ride
PTMS	Portable Traffic Monitoring Sites
QRFM	Quick Response Freight Manual
OBD	Outer Business District
OD	Origin-Destination
RMSE	Root Mean Square Error
SEFTCS	Southeast Florida Travel Characteristics Survey
SERPM	Southeast Regional Planning Model
SIC	Standard Industrial Classification
SIDECON	Transit Sidewalk Connector Program
SOV	Single Occupancy Vehicle
SPDCAP	Speed-Capacity
SR	Shared Ride
STATDATA	Transit Station Data
STATFARE	Transit Station-to-Station Fare Program
Std. Dev.	Standard Deviation
STP	Special Tabulation Product
SU	Single Unit Trucks
T	Truck Percent
TAZ	Traffic Analysis Zone
TG1	Modified Life-Style Based Trip Generation Routine (Version 2)
T/L	Trip Length
TMIP	Travel Model Improvement Program
TR	Tri-Rail
TTMS	Telemetered Traffic Monitoring Sites

USDOT	United States Department of Transportation
V/C	Volume over Count ratio
VHT	Vehicle Hours of Travel
VHT-V/C	VHT Volume over Count ratio
VIPER	Visual Planning Environment
VMT	Vehicle Miles of Travel
VMT-V/C	VMT Volume over Count ratio
VPD	Vehicle Per Day
WALKCON	Transit Walk Connector Program
YR	Year

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L:\Projects\3038a\RPTS-BO\BO2000-tr2\BO2000-TR2.doc

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1. INTRODUCTION

TCRPM follows the standard 4-step process (trip generation, trip distribution, mode split and assignment) to estimate travel demand. *Trip Generation* determines the total number of trips produced and attracted each day for each trip purpose. *Trip Distribution* finds the number of person trips that go between all pair of zones. The *Mode Split* step finds the number of trips using each available mode between a production/attraction zone pair. The *Trip Assignment* step is used to determine which route highway and transit trips will follow.

The model includes both transit and highway modes. The model with transit modes in this report is referred as the "full" model. **Figure 1-1** presents the macro flow chart of the full model. The full model structure has 10 component. These components, briefly described below, are processed in a serial fashion to complete the travel demand simulation.

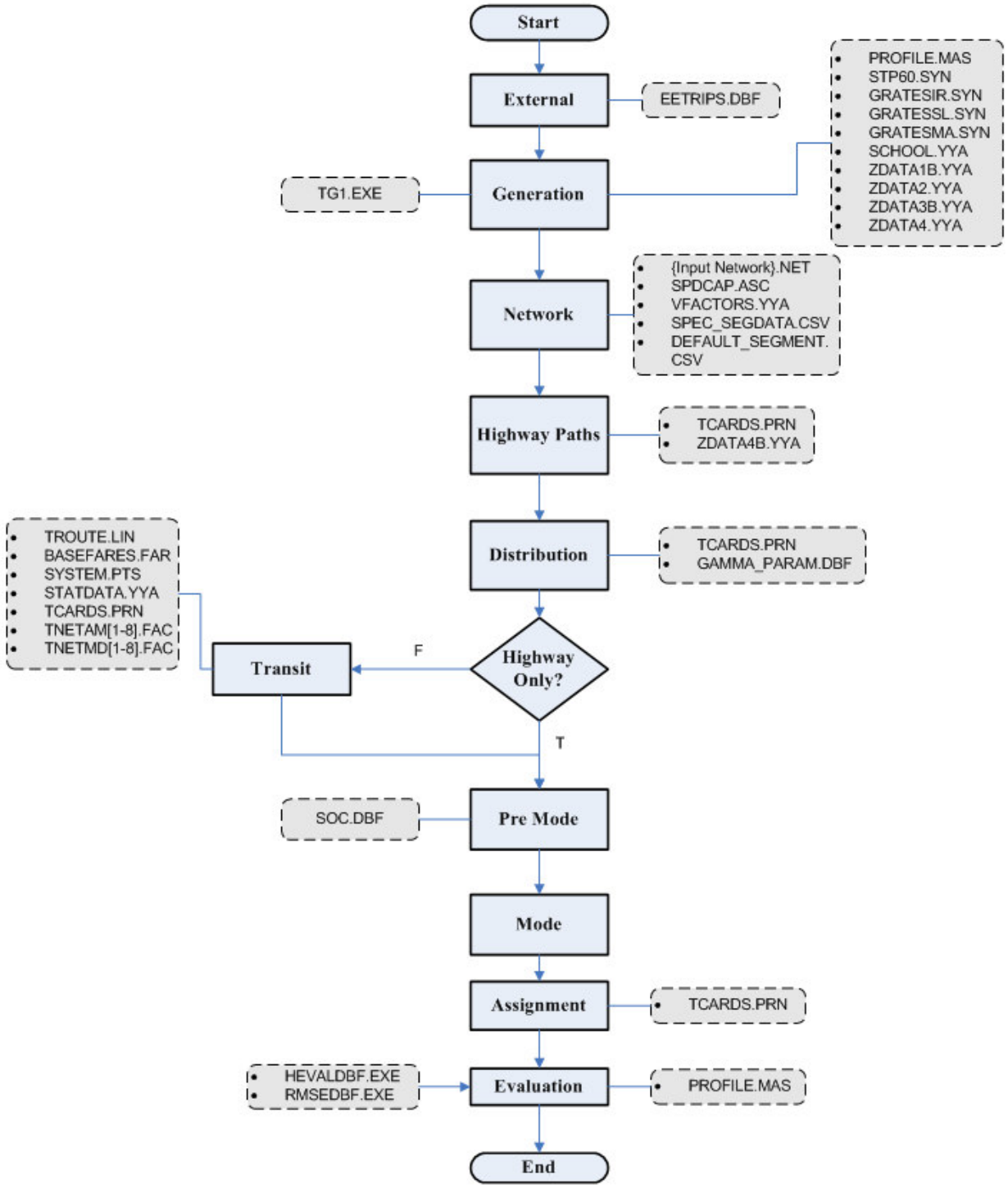
1. **External** creates the external-external trip matrix
2. **Generation** calculates the zonal trip productions and attractions
3. **Network** builds the highway network
4. **Hwy Paths** finds the minimum impedance interzonal highway travel paths
5. **Distribution** creates the zone-to-zone person 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

This macro flow chart identifies all the user-supplied input files that are used by each of the modules. It also shows all TCRPM specific programs used in these modules. Chapter 2 of Technical Report 3 (Model Application Guidelines) has detail description of the input files and the customized programs.

The roots of TCRPM transit models are in the Polk County model.

TCRPM quantifies the amount of travel expected to take place on the transportation system. The model results are used to estimate the impacts of constructing new or improved highway and transit facilities or implementing transportation services or demand management activities. The model was calibrated based on information collected in the 1999 Southeast Florida Travel Characteristics Surveys (SEFTCS). The model simulates average weekday travel.

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



TCRPM Update Study project consists of updating the year 1996 model to 2000. It consists of five main tasks.

Task 1: Data Compilation and Development
Task 2: Data Review and Update
Task 3: Model Update and Calibration
Task 4: Model Validation
Task 5: Develop Model Application Guidelines

This report is the second of three technical reports and presents the model validation efforts and results. The model is run with Cube Voyager version 4.01. In this report, the term calibration and validation are used interchangeably. In fact calibration and validation are separate tasks, although many transportation planners/modelers try to do both at the same time. Calibration applies to each step in the modeling process, while validation applies to the model as a whole. In calibration, each model step has one or more parameters that can be adjusted to assure that the step is replicating known travel behavior. Very often calibration is performed by statistical methods. Validation primarily involves comparing a base-year forecast to known traffic levels (counts and ridership). A poor quality validation would indicate the need for additional calibration.

1.1 MODEL ENHANCEMENT SUMMARY

TCRPM generally follows the Florida Standard Urban Transportation Modeling Structure (FSUTMS). However, it includes enhancements to the FSUTMS process. Some of these enhancements were directly adapted from (1) the Southeast Regional Planning Model (SERPM) or (2) the 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 new 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 TCRPM/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 REPORT ORGANIZATION

This validation report is divided into fourteen (14) chapters and three (3) appendices.

- Chapter 1, **INTRODUCTION**, describes the model enhancements and report organization.

- Chapter 2, **HIGHWAY NETWORK**, describes two-digit codes, speed, and capacity.

- Chapter 3, **EXTERNAL TRIP MODEL**, contains a description of the external model and its validation.

- Chapter 4, **TRIP GENERATION MODEL**, summarizes the changes in the trip generation model, the rates used in the model and the results.

- Chapter 5, **HIGHWAY PATH AND SKIMS**, describes the paths and skims used in model validation.

- Chapter 6, **TRIP DISTRIBUTION MODEL**, provides the description of the enhanced trip distribution model, which distributes trips once with free-flow skims and once with congested skims and then combines them in the proportion of travel that occur in each time period. It then summarizes and compares the key results.

- Chapter 7, **TRANSIT NETWORK, PATH, SKIM AND FARE**, describes the transit network, path, skim and fare. Numerous tables and figures are used to summarize the model results.

- Chapter 8, **MODE CHOICE MODEL**, describes the mode choice model. It uses a nested logit structure for mode choice analysis. Numerous tables and figures are used to summarize the model results.

- Chapter 9, **HIGHWAY ASSIGNMENT MODEL**, describes parameters and results of the assignment process and compares the results against established criterion.

- Chapter 10, **SUMMARY AND CONCLUSION**, provides the highlights of the 2000 model validation process.

- Chapter 11, **LIST OF REFERENCES**, provides a list of references on Southeast Florida, other Florida and other national resources referenced in technical reports of Broward Model.

2. HIGHWAY NETWORK

The TCRPM highway network is a Cube Voyager format network and can be viewed using VIPER. The highway network consists of general use links, toll links and restricted use facilities, which are limited to Highway Occupancy Vehicles (HOV).

Chapter 4 of Technical Report 3 (Model Application Guidelines) describes the free-flow speed estimation process. The process was implemented in a Cube-Voyager (CV) application. **This process is fully automated and users should follow instructions as specified in Chapter 4 of Technical Report 3.**

2.1 TWO-DIGIT CODES

The TCRPM highway network uses the two-digit facility and area type classification as adopted by the Model Task Force. FSUTMS includes a set of standard area type and facility type definitions used to describe key roadway characteristics. Area types are used to define the land use adjacent to each roadway link. Facility types classify each roadway link according to its function and/or design characteristics. The two-digit facility type classification is shown in **Table 2-1**, while the two-digit area type classification is shown in **Table 2-2**. Area types and facility types conform to the standard 2-digit definitions approved by the Model Task Force (MTF). Few new area types (AT 35 and 45) were coded for the Treasure Coast network.

Tables 2-1 and **2-2** also show the number of links for the 2-digit facility and area types. For the 2000 TCRPM network, there are 4,024 links. High Occupancy Vehicle (HOV) lanes are represented as special links. HOV lane information includes number of lanes and type of access control.

2.2 MODEL VALIDATION

The TCRPM highway network was reviewed and edited for the following link characteristics:

- Area Type (AT)
- Facility Type (FT)
- Number of Lanes
- Centroid Connections and Locations
- Posted Speeds
- Added Network Detail
- Link Prohibitors
- Toll Facilities

Details of the development of the highway network were described in Chapter 5 of Technical Report 1 (Data Compilation and Review).

Table 2-1

FDOT Adopted Two-Digit Facility Type

2000 Treasure Coast Regional Planning Model

One Digit Code	Two Digit Code Range	Description	No. of Links
FT1	11-17	Freeways and Expressways	108
FT2	21-25	Divided Arterials	615
FT3	31-38	Undivided Arterials	1,192
FT4	41-48	Collector	924
FT5	51	Centroid Connector	946
FT6	61-67	One Way Facilities	27
FT7	71+, 97-98	Ramps	146
FT8	81-82	HOV	-
FT9	91-95	Toll Facilities	66
		Total	**4,024**

Table 2-2

FDOT Adopted Two-Digit Area Type

2000 Treasure Coast Regional Planning Model

One Digit Code	Two Digit Code Range	Description	No. of Links
AT1	11-14	CBD	115
AT2	21-22	Fringe	116
AT3	31-35	Residential	2,264
AT4	41-45	Outlying CBD	663
AT5	51-52	Rural	866
		Total	**4,024**

As part of model validation, consistency of the TAZ structure and that of highway network was checked by overlaying the two layers in Cube VIPER software. The TIGER street network was used to check the centroid connectors. Based on this review, a number of changes were made to the centroid connectors. Several facility and area type reviews were made using network plots.

Traffic Counts

Model validation is based primarily on traffic counts. The counts (Average Annual Daily Traffic – AADT) were reviewed for reasonableness and edits were done where necessary. The count data are used by the HEVAL routine in the validation mode to compare the model generated traffic volumes to the traffic counts. Care was taken to ensure that count data were available for model validation. **Table 2-3** presents a summary of the links by main facility and area type combinations with traffic counts. Overall, 26 percent of links have traffic counts. Traffic counts do not exist for any of the ramps. For other facility types, the percentage of links having traffic counts varies from 37.96% (Freeway) to 65.15% (Toll Facilities). For other area types, percentage of links having traffic counts varies from 23.4% (CBD) to 41.0 (Fringe).

In order to assess the extent of traffic counts, a summary of traffic counts is made in terms of mileages of the roadways. **Table 2-4** presents this summary by main facility and area type combinations. There are 1,298 directional miles of road in the 2000 Treasure Coast network. Of those, 498 directional miles of roads have traffic counts, which accounts about 38.4% of the total miles. For facility types ignoring ramps, the percentages of directional miles with traffic counts varies from 30.0% (One way & Frontage roads) to 44-46% (Divided and Undivided Arterial, HOV and Toll roads). For area types ignoring rural area, the percentages of link-miles having traffic counts varies from 22.61% (Rural) to 31.39% (Out-CBD).

Speeds and Capacities

Unlike standard FSUTMS models, TCRPM uses a look-up table by facility type, area type and number of lanes in a "limited" fashion. Speeds for all non-centroid links are based on posted speed limit and signal data. Chapter 4 of Technical Report 3 (Model Application Guidelines) has a detail description and implementation of free-flow speeds. FSUTMS defines link speeds and capacities in the SPDCAP file based on each combination of area type, facility type and number of lanes. The two-digit coding allows enough flexibility to incorporate variations in model input speeds and capacities. In TCRPM, capacities of all network links (centroid and non-centroid) are based on the capacities defined in the look-up SPDCAP table. On the other hand, the SPDCAP table is only used to determine the speed of the non-centroid links (FT2=51-52).

The speed and capacity file (SPDCAP) was a product of model calibration and began with the table developed from the Southeast Florida Regional Planning Model, Version 4 (SERPM-IV) and then later modified in 1996 and 1999 model updates. The speed and capacity table that was validated in the 2000 TCRPM/Palm Beach/Broward models was the starting point for the 2000 model validation. The speeds for all non-centroid links (FT2=10-49,60-99) are entered as zero in the SPDCAP table, since their values are computed based on mathematical formulae shown in Chapter 4 of Technical Report 3.

Table 2-3

Link Count Summary by Facility and Area Type Combinations

2000 Treasure Coast Regional Planning Model

1. Number of Links

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			32		76	108
2. Divided Arterial (21-26)	60	29	250	268	8	615
3. Undivided Arterial (31-38)	13	30	626	163	360	1,192
4. Collector (41-48)	3	25	689	95	112	924
6. One-Way & Frontage (61-68)	13		6	8		27
7. Ramps (71-79, 97-98)			61	21	64	146
8. HOV (81-85)						0
9. Toll Facility (91-95)			5		61	66
TOTAL	89	84	1,669	555	681	3,078

2. Percentage of Links with Counts

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			46.88		34.21	**37.96**
2. Divided Arterial (21-26)	20.00	34.48	21.20	36.94	25.00	**28.62**
3. Undivided Arterial (31-38)	15.38	33.33	25.72	30.06	18.33	**24.16**
4. Collector (41-48)	33.33	12.00	25.11	27.37	15.18	**23.81**
6. One-Way & Frontage (61-68)	53.85		50.00	37.50		**48.15**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					70.49	**65.15**
TOTAL	**24.72**	**27.38**	**24.27**	**31.89**	**22.61**	**25.37**

3. Number of Links With Traffic Counts

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			15		26	41
2. Divided Arterial (21-26)	12	10	53	99	2	176
3. Undivided Arterial (31-38)	2	10	161	49	66	288
4. Collector (41-48)	1	3	173	26	17	220
6. One-Way & Frontage (61-68)	7		3	3		13
7. Ramps (71-79, 97-98)			0	0	0	0
8. HOV (81-85)						
9. Toll Facility (91-95)			0		43	43
TOTAL	22	23	405	177	154	781

Table 2-4

Link-Miles Count Summary by Facility and Area Type Combinations

2000 Treasure Coast Regional Planning Model

1. Total Link Miles (*)

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			33.43		111.82	145.25
2. Divided Arterial (21-26)	6.94	3.46	70.57	60.05	8.01	149.03
3. Undivided Arterial (31-38)	1.24	4.34	203.69	38.43	290.45	538.15
4. Collector (41-48)	0.45	2.35	232.25	26.17	111.39	372.61
6. One-Way & Frontage (61-68)	1.49		0.85	1.05	14.92	18.31
7. Ramps (71-79, 97-98)			15.42	3.55		18.97
8. HOV (81-85)						0.00
9. Toll Facility (91-95)			1.64		112.73	114.37
TOTAL	10.12	10.15	557.85	129.25	649.32	1,356.69

2. Total Link Miles With Traffic Counts

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			15.27		53.92	69.18
2. Divided Arterial (21-26)	1.90	1.88	19.54	29.83	3.08	56.23
3. Undivided Arterial (31-38)	0.16	1.92	71.67	12.76	78.96	165.47
4. Collector (41-48)	0.28	0.42	76.27	7.80	30.49	115.26
6. One-Way & Frontage (61-68)	0.54		0.41	0.28	0.00	1.23
7. Ramps (71-79, 97-98)						0.00
8. HOV (81-85)						0.00
9. Toll Facility (91-95)					96.27	96.27
TOTAL	2.88	4.22	183.16	50.67	262.71	503.63

2. Percentage of Link Miles with Counts

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			45.66		48.22	47.63
2. Divided Arterial (21-26)	27.38	54.34	27.69	49.68	38.45	37.73
3. Undivided Arterial (31-38)	12.90	44.24	35.19	33.20	27.18	30.75
4. Collector (41-48)	62.22	17.87	32.84	29.81	27.37	30.93
6. One-Way & Frontage (61-68)	36.24		48.24	26.19	0.00	6.69
7. Ramps (71-79, 97-98)			0.00	0.00		0.00
8. HOV (81-85)						
9. Toll Facility (91-95)			0.00		85.39	84.17
TOTAL	28.46	41.58	32.83	39.20	40.46	37.12

(*) Freeways and other directionally coded represent bidirectional miles, otherwise centerline miles.

The speeds and capacities might need to be adjusted during the validation process. Required adjustments to the capacities can be made in the SPDCAP table, whereas the adjustments to the speeds can be made through the SPDADJ.DBF file.

The "adjustment" records of the SPDCAP tables were used to adjust the capacities. Appendix C of Technical Report 1 (Data Compilation and Review) presents a sample listing of the SPDCAP table.

The CV application uses the SPDADJ.DBF file to derive the initial free-flow speeds of all non-centroid links. Very minor adjustments were required to adjust the speeds. **Table 4-6 of TR3** (Model Application Guidelines) presents these adjustment factors. The factors are defined for a range of 2-digit area and have only been used for ramps and facility type 11/area type 3 combinations. Besides these two facilities, these values are 1.00, which means that no adjustments were made to the mathematical formulae derived free-flow speed values.

To check the hierarchy of the speeds and capacities, data from the HEVAL summary were used. A summary of the speed statistics by the main facility and area type was made to check the reasonableness of the speeds. The original speeds were also checked to the model generated congested speeds. **Tables 2-5** and **2-6** present these summaries.

For the 2000 model, an overall decrease in 1.81 mph is shown between the original and congested speeds. The percent change in speeds among the facility type in 2000 validation run ranges –38.5% (toll facility which includes toll plaza delay) to –0.5% (freeway). **Table 2-5** shows logical hierarchies of speeds. By facility type, higher volume facilities are more congested, and rural areas are less congested. The overall speed for undivided arterial comes out higher than the overall speed for divided arterials. The reason for this is presence of many more undivided arterials than divided arterials in rural areas. The rural areas generally have higher speeds than urban areas. This increases the average for undivided arterials over divided arterial even though divided arterials have higher speeds in all areas including rural areas. None of these results are contrary to the observed travel characteristics in the region.

A summary of the systemwide capacities (in vehicle-per-lane-per-hour) was made from the HEVAL report in "ANALYSIS" mode. This summary was made for each combination of the main facility and area type combinations. **Table 2-6** represents the summary capacities reported in vehicles per hour per lane. The speeds and capacities in **Tables 2-5** and **2-6** conform the hierarchies among the facility and area types and the reported values are very "reasonable".

Table 2-5

HEVAL Speed Statistics by Facility and Area Type Combinations – "Full" Model Run

2000 Treasure Coast Regional Planning Model

1. Original Speeds in MPH

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			66.99		75.31	**73.20**
2. Divided Arterial (21-26)	34.70	35.01	42.95	44.05	59.89	**43.34**
3. Undivided Arterial (31-38)	35.43	32.70	42.48	41.44	54.24	**47.61**
4. Collector (41-48)	33.54	32.83	36.09	35.18	42.27	**37.64**
6. One-Way & Frontage (61-68)	39.56		41.13	38.16	29.45	**39.34**
7. Ramps (71-79, 97-98)			28.79	32.18		**29.40**
8. HOV (81-85)						
9. Toll Facility (91-95)			48.24		74.80	**74.23**
TOTAL	**35.14**	**33.50**	**39.66**	**40.86**	**53.67**	**44.67**

2. Congested Speeds in MPH

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			66.54		74.52	**72.50**
2. Divided Arterial (21-26)	34.35	33.40	41.23	40.82	58.79	**41.12**
3. Undivided Arterial (31-38)	30.43	29.36	40.84	38.29	53.91	**46.25**
4. Collector (41-48)	32.73	31.51	34.99	33.76	42.11	**36.73**
6. One-Way & Frontage (61-68)	39.56		41.13	38.16	26.67	**39.34**
7. Ramps (71-79, 97-98)			28.31	26.62		**27.39**
8. HOV (81-85)						
9. Toll Facility (91-95)			48.24		52.98	**52.91**
TOTAL	**34.11**	**31.17**	**38.32**	**38.09**	**51.50**	**42.86**

3. Change (Congested-Original) in Speeds in MPH

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			-0.45	0.00		**-0.70**
2. Divided Arterial (21-26)	-0.35	-1.61	-1.72	-3.23	-1.10	**-2.22**
3. Undivided Arterial (31-38)	-5.00		-1.64	-3.15		**-1.36**
4. Collector (41-48)	-0.81	-1.32	-1.10	-1.42		**-0.91**
6. One-Way & Frontage (61-68)			0.00	0.00		**0.00**
7. Ramps (71-79, 97-98)	0.00		-0.48	-5.56		**-2.01**
8. HOV (81-85)						
9. Toll Facility (91-95)			0.00			**-21.32**
TOTAL	**-1.03**	**-2.33**	**-1.34**	**-2.77**	**-2.17**	**-1.81**

4. Percent Change [(Congested-Original)/Original] in Speeds

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			-0.67%	#DIV/0!		**-0.96%**
2. Divided Arterial (21-26)	-1.01%	-4.60%	-4.00%	-7.33%	-1.84%	**-5.12%**
3. Undivided Arterial (31-38)	-14.11%		-3.86%	-7.60%		**-2.86%**
4. Collector (41-48)	-2.42%	-4.02%	-3.05%	-4.04%		**-2.42%**
6. One-Way & Frontage (61-68)			0.00%	0.00%		**0.00%**
7. Ramps (71-79, 97-98)	#DIV/0!		-1.67%	-17.28%		**-6.84%**
8. HOV (81-85)						
9. Toll Facility (91-95)			0.00%			**-28.72%**
TOTAL	**-2.93%**	**-6.96%**	**-3.38%**	**-6.78%**	**-4.04%**	**-4.05%**

Table 2-6

Validated Capacity (LOS E) of Two-Digit Facility and Area Type Cells

2000 Treasure Coast Regional Planning Model

1. Systemwide Number of Lane Miles

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			119.96		506.68	**626.64**
2. Divided Arterial (21-26)	25.80	14.66	316.76	258.92	31.96	**648.10**
3. Undivided Arterial (31-38)	3.74	10.17	481.93	73.46	650.14	**1,219.44**
4. Collector (41-48)	0.90	5.00	613.38	57.72	270.30	**947.30**
6. One-Way & Frontage (61-68)	6.53		3.89	5.18		**15.60**
7. Ramps (71-79, 97-98)			12.28	0.68	11.24	**24.20**
8. HOV (81-85)						
9. Toll Facility (91-95)			3.36	1.36	547.25	**551.97**
TOTAL	**36.97**	**29.83**	**1,551.56**	**395.96**	**2,017.57**	**4,033.25**

2. Systemwide Hourly Capacity-Miles

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			234457		998721	**1,233,178**
2. Divided Arterial (21-26)	41768	11245	293457	224267	45523	**616,260**
3. Undivided Arterial (31-38)	2864	7250	377540	59870	686787	**1,134,311**
4. Collector (41-48)	549	4255	391281	38182	195798	**630,064**
6. One-Way & Frontage (61-68)	11460		3836	4662		**19,957**
7. Ramps (71-79, 97-98)			16967	968	13449	**31,383**
8. HOV (81-85)						
9. Toll Facility (91-95)			5544	2414	899334	**907,292**
TOTAL	**56,641**	**22,750**	**1,323,082**	**330,362**	**2,839,611**	**4,572,446**

3. Estimated Systemwide Capacity in Vehicle-Per-Lane-Per-Hour

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1,954		1,971	**1,968**
2. Divided Arterial (21-26)	1,619	767	926	866	1,424	**951**
3. Undivided Arterial (31-38)	766		783	815	1,056	**930**
4. Collector (41-48)	610	851	638	661	724	**665**
6. One-Way & Frontage (61-68)			986	900		**1,279**
7. Ramps (71-79, 97-98)			1,382	1,423	1,197	**1,297**
8. HOV (81-85)						
9. Toll Facility (91-95)			1,650	1,775	1,643	**1,644**
TOTAL	**1,532**	**763**	**853**	**834**	**1,407**	**1,134**

3. EXTERNAL TRIP MODEL

This chapter presents the validation of external trips. The highway external trips are divided into external-internal (IE and EI) person trip ends and through (EE) vehicle trip ends, and the external-internal trip ends are further divided by type of trip end (trip productions and trip attractions) and by trip purpose (the same 11 trip purposes used for the internal trip ends). Finally, the external-internal trip productions and attractions by trip purpose are distributed and assigned with the internal-internal trip ends.

Modeling EE trips is the first step in FSUTMS. The external trip module requires an EE trip table that contains EE vehicle trip between external stations.

External stations are intersections between the network and the study area boundary. These stations serve as ports of entry and exit from/to the study area. Each station was coded with a TAZ number (701 to 731). Many of these stations are "dummy" and not used to simulate any external traffic. External stations are shown in **Figure 3-1**.

3.1 MODEL ENHANCEMENTS

The enhancements to both IE and EE processes that were adopted in the previous model update study (1996) were also continued in the 2000 model update study. The modified process eliminates IE/EI as a separate trip purpose. The IE/EI trips in the modified process were modeled as part of the internal trip purpose. The modified IE/EI process works as follows:

- Total productions and attractions and their percentages by internal trip purposes are entered in the ZDATA4B file. The initial estimates of total productions and attractions should be made from the traffic counts and an estimate of through trips.

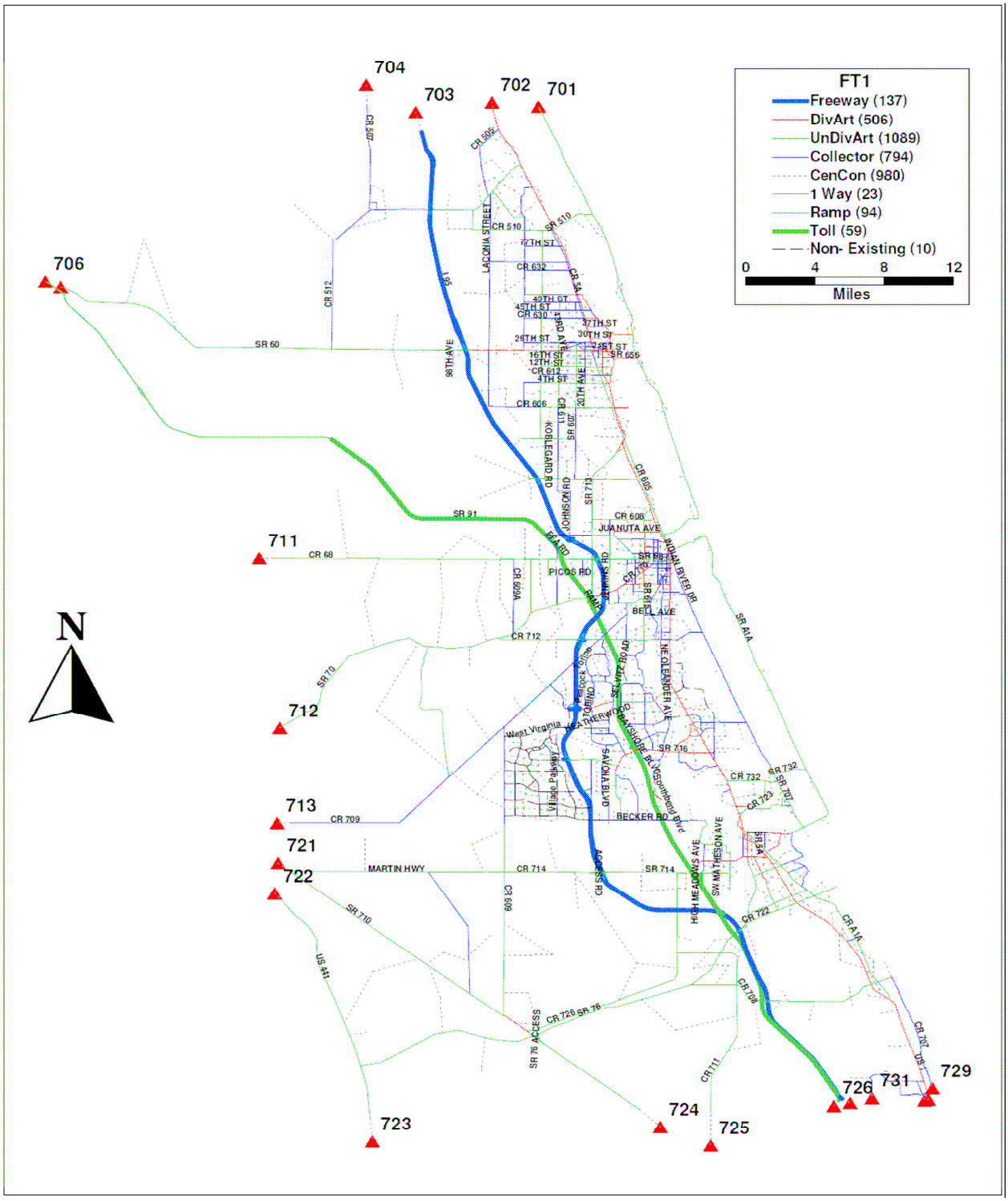
- The productions and attractions for each trip purpose are then obtained by multiplying the percentages for each purpose by total trips.

- K factors from all external zones to all external zones are set at zero for all trip purposes. This prevents IE trips from becoming EE.

Figure 3-1

External Station Locations

2000 Treasure Coast Regional Planning Model



3.2 MODEL VALIDATION

Validation of the EETRIPS file was based on extrapolation and professional judgment. The EETRIP file validation would generally rely upon recently collected roadside or cordon line surveys to determine the proportion of the vehicle traffic that passes through the study area. The EETRIP file was developed by comparing the 1999, 2000, 2001 and 2002 traffic counts. The FDOT, MPO and Consultant staff reviewed the resultant through trip table to affirm the reasonableness of the data for model validation. The final EETRIPS file is summarized in **Table 3-1**.

Initial external station productions and attractions for IE person trips were developed from traffic counts. After the completion of a simulation run, the assigned volume at the external links may not sum to the counts. The validation of the external model adjusted the both IE person trips and EE vehicle trips to match the assigned volumes with the traffic counts.

The distribution process determines the number of IE trips (they will be present in the internal trip tables). Some adjustments to productions and attractions were made so that the model produces the desired volumes at the external stations. The travel times on the external connectors represent the average time from the station to a typical destination outside the study area. The trips produced at an external station are assumed to be equal to the attractions (a very standard assumption), which is equal to half the daily volume on that link.

3.3 RESULTS AND COMPARISONS

The IE trip ends (entered in ZDATA4B file) were developed by subtracting the EE trip ends from the count. The IE trip ends were then divided by 2 to obtain the directional values and multiplied by an auto occupancy rate to obtain person trips. The external station traffic count and the splits of IE and EE trips are summarized in **Table 3-2**.

The external trips consist of both IE passenger trips and EE vehicle trips. The percentages of 11 trip purposes of the IE trips are primarily based on the numbers generated from the trip generation model. Adjustments were made at some of the external stations. The actual IE trip ends at each external zone are determined by the trip distribution. The trip ends thus had to be adjusted so that post distribution trip ends matched traffic counts. The validated ZDATA4B file is shown in **Appendix B**. Several runs were made to validate the external station volumes. The IE productions, attractions and extra-regional time for each external station were modified through the validation runs to replicate each of the external station volumes to traffic counts. The results of this validation are presented in **Table 3-3**. With the exception of a few low volume roads (within 1%), all external station volumes match the traffic counts.

Table 3-1

Through (External-External) Vehicle Trip Table

2000 Treasure Coast Regional Planning Model

FROM STATION	TO STATION 701	702	703	704	705	706	711	712	713	721	722	723	724	725	726	727	728	729	730	731	Total Origin	Total Destination	Total Through Veh
701					400										236	192					828	829	1,657
702					100			1							183	448					732	732	1,464
703								1				2			2,624	7,000					9,627	9,638	19,265
704																					0	0	0
705	400	100													46	398					944	944	1,888
706								1							4,466	2,065					6,532	6,531	13,063
711																					0	0	0
712	1	1													929						931	932	1,863
713																					0	0	0
721											1	75	89		770	1,254					2,189	2,188	4,377
722										1		1,021	12								1,034	1,035	2,069
723			2							75	1,021		232								1,330	1,330	2,660
724										89	13	232				1,137					1,471	1,470	2,941
725																					0	0	0
726	236	183	2,636		46	4,466		929		769											9,265	9,254	18,519
727	192	448	7,000		398	2,065				1,254			1,137				140				12,634	12,634	25,268
728																140					140	140	280
729																					0	0	0
730																					0	0	0
731																					0	0	0
Total Destination	829	732	9,638	0	944	6,531	0	932	0	2,188	1,035	1,330	1,470	0	9,254	12,634	140	0	0		47,657	47,657	95,314

Station (TC2000)	Road Name	Station (TC2000)	Road Name
701	SR-A1A (North)	721	Warfield Highway / SR-710 (North)
702	US-1 (North)	722	US-441 / Conner's Highway (North)
703	I-95 (North)	723	US-441 / SR 15 (South)
704	SR-60	724	Warfield Highway / SR-710 (South)
705	Florida's Turnpike (North)	725	Florida's Turnpike (South)
712	SR-70 / Okeechobee Road	726	I-95 (South)
		727	US-1 (South)

Table 3-2

External Station Traffic Counts and IE and EE Splits

2000 Treasure Coast Regional Planning Model

External Station	Highway Name	County	Vehicle Trips					
			Year 2000	External-External Trips		Internal-External Trips		Truck Percentage
			AADT	Total	Percent	Total	Percent	
701	SR-A1A (North)	Indian River	5,723	1,657	28.95%	4,066	71.05%	4.0%
702	US-1 (North)	Indian River	21,136	1,464	6.93%	19,672	93.07%	5.0%
703	I-95 (North)	Indian River	33,128	19,265	58.15%	13,863	41.85%	19.0%
704	CR-507	Indian River	1,641	0	0.00%	1,641	100.00%	7.0%
705	SR-60	Indian River	4,216	1,888	44.78%	2,328	55.22%	32.0%
706	Florida's Turnpike (North)	Indian River	20,872	13,063	62.59%	7,809	37.41%	12.0%
711	Florida Cracker Trail / CR-68	St. Lucie	2,158	0	0.00%	2,158	100.00%	20.0%
712	SR-70 / Okeechobee Road	St. Lucie	8,000	1,863	23.29%	6,137	76.71%	15.0%
713	*Glades Cutoff Road / CR-709*	*St. Lucie*	*800*	0	0.00%	800	100.00%	5.0%
721	Warfield Highway / SR-710 (North)	Martin	7,200	4,377	60.79%	2,823	39.21%	18.0%
722	US-441 / Conner's Highway (North)	Martin	2,561	2,069	80.79%	492	19.21%	20.0%
723	US-441 / SR-15 (South)	Martin	3,381	2,660	78.67%	721	21.33%	18.0%
724	Warfield Highway / SR-710 (South)	Martin	4,382	2,941	67.12%	1,441	32.88%	20.0%
725	SR-711	Martin	3,000	0	0.00%	3,000	100.00%	5.0%
726	Florida's Turnpike (South)	Martin	20,600	18,519	89.90%	2,081	10.10%	10.0%
727	I-95 (South)	Martin	64,500	25,268	39.18%	39,232	60.82%	10.0%
728	US-1 (South)	Martin	25,000	280	1.12%	24,720	98.88%	4.0%
729	SR-A1A / CR-707 (South)	Martin	5,600	0	0.00%	5,600	100.00%	3.0%
730	Old Dixie Highway to Palm Beach County	Martin	6,300	0	0.00%	6,300	100.00%	3.0%
731	Island way to Palm Beach County	Martin	5,000	0	0.00%	5,000	100.00%	3.0%
	ALL STATION:		245,198	95,314	38.87%	149,884	61.13%	

Table 3-3

External Station Count and Volume Comparison

2000 Treasure Coast Regional Planning Model

External Station	Highway Name	County	Year 2000		
			Count	Assigned Volume	Volume/ Count
701	SR-A1A (North)	Indian River	5,723	6,023	1.05
702	US-1 (North)	Indian River	21,136	21,049	1.00
703	I-95 (North)	Indian River	33,128	35,020	1.06
704	CR-507	Indian River	1,641	1,746	1.06
705	SR-60	Indian River	4,216	4,504	1.07
706	Florida's Turnpike (North)	Indian River	20,872	20,399	0.98
711	Florida Cracker Trail / CR-68	St. Lucie	2,158	2,224	1.03
712	SR-70 / Okeechobee Road	St. Lucie	8,000	8,384	1.05
713	*Glades Cutoff Road / CR-709*	*St. Lucie*	*800*	1,245	1.56
721	Warfield Highway / SR-710 (North)	Martin	7,200	7,359	1.02
722	US-441 / Conner's Highway (North)	Martin	2,561	2,599	1.01
723	US-441 / SR-15 (South)	Martin	3,381	3,424	1.01
724	Warfield Highway / SR-710 (South)	Martin	4,382	4,459	1.02
725	SR-711	Martin	3,000	3,138	1.05
726	Florida's Turnpike (South)	Martin	20,600	20,725	1.01
727	I-95 (South)	Martin	64,500	65,312	1.01
728	US-1 (South)	Martin	25,000	26,317	1.05
729	SR-A1A / CR-707 (South)	Martin	5,600	5,893	1.05
730	Old Dixie Highway to Palm Beach County	Martin	6,300	6,529	1.04
731	Island way to Palm Beach County	Martin	5,000	5,142	1.03
	ALL STATION:		**245,198**		

4. TRIP GENERATION MODEL

Trip generation determines the number of person trips that originate or are produced in each zone and the number of trips that are destined or are attracted to that zone. The standard FSUTMS GEN model was replaced with the Lifestyle Trip Generation Model for all Southeast Florida models validated since 1996. The lifestyle trip generation process uses a cross-classification model for trip productions. Two separate structures were used for the work and non-work trips. The process also used revised trip attraction rates that vary by employment categories and area types. Land uses that exhibit extraordinary trip productions or trip attraction characteristics are represented by special generators. The lifestyle trip generation model includes a modified process to handle special generator trips in the trip generation model. Trips that have one end in the study area and the other end out of the study area are known as internal-external trips are modeled as internal-internal trips in the lifestyle trip generation process.

This chapter highlights several key changes and processes of the Modified Life-Style Trip Generation Model LSTGENM2 (TG1). It then summarizes the validated rates and results.

4.1 MODEL DESCRIPTION

This section provides a brief description of the modified trip generation program itself by explaining the functions of each subroutine. It then provides a discussion of several key issues related to the lifestyle trip generation program.

Cross-classification and regression-type models are used in TCRPM's trip generation model. Cross-classification analysis is used to group households with common socioeconomic characteristics (with or without households, household size, number of vehicles and number of workers) together to create relatively homogenous groups. The trip generation model set consists of a model to estimate productions (trip ends at a person's home) and attractions (trip ends at the non-home end of a trip).

The modified life-style trip production models are cross-classification models that estimate trips per household based on the following classifying variables:

- vehicles in households with and without children
- workers in households with and without children (for HBW and NHBW purposes)
- persons in households with and without children (for non-work purpose only)
- hotel/motel type (optionally can be used for three hotel-motel types)

The revised trip attraction models use employment by type, school enrollment, households and area type as independent variables.

Similar to the previous lifestyle trip generation programs (LSTGEN/LSTGENX), the modified lifestyle trip generation program (complied version called TG1) consists of a main routine and 15 subroutines. There are also other functions and subroutines that are utilized in several subroutines. A brief description of these routines follows here. The source code (written in FORTRAN) is presented in **Appendix C**.

- **LSTGEN (main routine):** This main program calls twelve subroutines to perform specific tasks. Those subroutines in order of call are STP60, READCTL, READAT, READSPGN, READRATE, MAKESEED, REPORT1, CALCPA, ADJPA, SCHOOL, REPORT2, and A1DECK. The final productions and attractions for eleven trip purposes are written to PRODS.ALTYR and ATTRS.ALTYR files. It also produces two other output files: (1) A1DECK – A zonal data file required by the mode choice model and (2) PBSCH – Public (Non-private) school trip table.

- **STP60 (subroutine)**: Reads STP60.SYN file to calculate percentages of households according to the trip generation classification scheme. The STP60.SYN file is the 2000 Census Special Tabulation Product file obtained by FDOT from the Census Bureau that contains detailed household data for each TAZ. **Table D-14** of **Technical Report 3** shows the format and description of the each data items of the STP60.SYN file. This file has 179 variables with a width of 10 columns for each.

- **READCTL (subroutine)**: Reads FSUTMS.CTL and PROFILE.MAS to obtain year, scenario (example, 00B) and TAZ information. It then defines the following file names: ZDATA1B, ZDATA2, ZDATA3B, ZDATA4B, SCHOOL, LINKS, PRODS and ATTRS.

- **READAT (subroutine)**: Reads area types from LINKS file and data from ZDATA1B and ZDATA2 files.

- **READSPGN (subroutine)**: Reads special generator and airport data from the ZDATA3B file.

- **READRATE (subroutine)**: Reads production rates, attraction rates and disaggregation curves specified in the GRATESB.SYN file.

- **MAKESEED (subroutine)**: Makes the seed matrix for the referenced zone and writes the STP60.TEM file.

- ***PREFRAT* (subroutine)**: Used as a pre-processor to subroutine FRAT. It is called from subroutine MAKESEED.

- ***FRAT* (subroutine)**: Performs a "frataring" technique to generate each production cell socioeconomic (SE) data. It is called from subroutine PREFRAT.

- **CALCPA (subroutine)**: Calculates the productions and attractions.

- ***SESPGEN* (subroutine)**: Adjusts the SE data, if requested, for the special generators. It is called from subroutine CALCPA.

- ***PASPGEN* (subroutine)**: Adjusts the productions and attractions, if requested, for the special generators. It is called from subroutine CALCPA.

- **ADJPA (subroutine)**: Reads the temporary production and attraction files and then balances the attractions to the productions. Total productions and attractions at the external station are held constant. Beside, school, NHBW and NHBO purposes, attractions are balanced to productions. For the school purpose, balancing of trip productions to the control trip attractions, based on school enrollment and attraction rate will always be done. For the NHBW and NHBO purposes, both ends of the trips are adjusted to the control values. Separate allocation rates are used for the origin/production and destination/attraction ends of the trips. The NHBW and NHBP control total values are calculated from the trip production matrix rates, which are based on the household travel survey.

- **REPORT1 (subroutine)**: Writes out the header and input assumptions to TRIPGEN.OUT file.

- **SCHOOL (subroutine)**: Calculates the school trips. The public school OD trip information is written to PBSCH.TEM file.

- **A1DECK (subroutine- Not used for TCRPM)**: Generates the A1DECK information for use in the mode-choice model and writes the A1DECK.AYY file. The A1DECK is an intermediate file. The contents of this file are listed below.
    1. Zone (column 1-6)
    2. Terminal time (column 7-11)
    3. Long-term (9-hour) parking cost (column 12-16)
    4. Short-term (3-hour) parking cost (column 17-21)
    5. Percent of zero auto – HBW trips (column 25-28)
    6. Percent of 1 auto – HBW trips (column 29-32)
    7. Percent of 2-or-more autos – HBW trips (column 33-36)
    8. Percent of zero auto – Other trips (column 40-43)
    9. Percent of 1 auto – Other trips (column 44-47)
    10. Percent of 2-or-more autos – Other trips (column 48-51)
    11. CBD (=1) and Exurban (=2) flag (column 52-55).

- **REPORT2 (subroutine)**: Calculates and then writes out the summaries of productions and attractions to the TRIPGEN.OUT file.

These routines are compiled to generate the LSTGENM2.EXE executable file.

4.2 MODEL ENHANCEMENTS

The Standard FSUTMS model was completely replaced with the Enhanced FSUTMS Trip Generation Model (Corradino, August 1997). The enhanced life-style model (LSTGEN/LSTGENX) was further modified including more trip purposes and an update to the standard trip attraction model. The attractions rates were based on "disaggregate" analysis for work purposes (HBW and NHBW). An aggregate analysis was used for non-work trip purposes. Rates were developed based on area type used in highway network. The *Trip Attraction Equation Refinement Study* [Reference 13] report has a detailed description of the development of the trip attraction rates. The following documents describe the earlier lifestyle trip generation programs (LSTGEN/LSTGENX).

- Final Report - Enhanced FSUTMS Trip Generation Model [Reference 19]
- A working Paper – An Addendum to the Enhanced FSUTMS Trip Generation Model [Reference 18]
- Technical Memorandum – Lifestyle Trip Generation Model: Revised Special Generator and Schools Model, [Reference 16]

The standard FSUTMS GEN model developed early in the 1980s produces trips for the following internal purposes:

- Home-Based Work (HBW)
- Home-Based Shopping (HBSHP)
- Home-Based Social-Recreation (HBSR)
- Home-based Other (HBO)
- Non-Home-Based (NHB)
- Truck-Taxi
- Internal-External (IE)

For the four home-based purposes, the standard production model used a cross-classification structure defined by single/multi-family dwelling units, vehicles and persons. The 1996 version of the lifestyle model used in the 1996 validation of the TCRPM, Palm Beach and Broward models (LSTGEN/LSTGENX) implemented seven trip purposes [References 16, 18 and 19]. It uses separate cross-classification structures for the work and non-work purposes. The lifestyle model uses persons, vehicles, workers and presence (or absence) of children to explain the household trip production rate, by purpose.

The LSTGEN/LSTGENX model uses seven purposes. Three trucks, a separate airport and two NHB purposes increased the number of trip purposes from seven to eleven. LSTGENM (or LSTGENM2) produces daily trips for the following eleven purposes:

1. Home-Based Work (HBW) person trips
2. Home-Based Shopping (HBShop/HBSHP) person trips
3. Home-Based Social-Recreation (HBSocRec/HBSCR) person trips
4. Home-based School (HBSchool/HBSCH) person trips [It includes only private schools and colleges and universities]
5. Home-based Other (HBO) person trips
6. Non-Home-Based Work (NHBW) person trips
7. Non-Home-Based Other (NHBO) person trips
8. Airport (AIRPORT) person trips
9. Truck – 4-Tired Commercial vehicle trips
10. Truck – Single Unit Commercial vehicle trips
11. Truck – Combinations Commercial vehicle trips

References 13 and 14 describe the calibration of production and attraction rates using the 1999 Southeast Florida Travel Characteristics Surveys. The major changes by purpose in LSTGENM (or LSTGENM2), compared to the earlier life-style routines (LSTGEN/LSTGENX), are noted as follows.

- HBW:
  - Revised attraction rates for industrial, commercial and service employment
  - Three types of hotels/motels (H/M) for productions and default for all types
- HBShop, HBSocRec, HBO:
  - Revised Attraction Rates and rates differ by area type
  - Three types of hotels/motels (H/M) for productions and default for all types
  - Add H/M to attraction equation
- HBSchool:
  - No change
- NHB Work:
  - Split from NHB – one end is the work location
  - Control total from life-style production rates which uses the HBW cross-classification structure (children, worker and vehicle)
  - Three types of hotels/motels (H/M) for productions and default for all type
  - Production and attraction allocation rates are different and use separate rates for industrial, commercial and service employment. These rates also vary by area type. Attraction allocation also uses households and H/M.
  - Always produced at work end
- NHB Other:
  - Split from NHB

- Control total from life-style production rates which uses the non-work cross-classification structure (children, person and vehicle)
- Three types of hotels/motels (H/M) for productions and default for all types
- Production (origin) and attraction (destination) allocation rates are different and use separate rates for industrial, commercial, service employment. These rates also vary by area type. Attraction allocation also uses households and H/M.
- Productions are set equal to attractions.

- Airport:
  - A new purpose for major international airports (FLL) only
  - Productions are at the airport, based on enplanements
  - Attracted to business (total employment) and residences (HH and H/M)
- Trucks:
  - Three truck purposes (4-tire, single unit, combination)
  - Split the old purpose into 3 types
  - New truck model production and attraction model formats use a format similar to the previous truck model. Productions equal attractions.

With the new special Census 2000 tabulation (STP60), a few minor changes were made to the LSTGENM, primarily to implement the new Census data. This second modified version of the LSTGENM is named as LSTGENM2, which is used for the 2000 model update. The rest of this subsection discusses the key enhancements to the lifestyle trip generation program.

Production and Attraction Model Structures

Cross-classification and regression-type models are used in the lifestyle trip generation model. Cross-classification analysis is used to group households with common socioeconomic characteristics (with or without households, household size, number of vehicles and number of workers) together to create relatively homogenous groups. The modified lifestyle trip production models are cross-classification models that estimate trips per household based on the following classifying variables:

- Vehicles in households with and without children
- Workers in households with and without children (for HBW and NHBW purposes)
- Persons in households with and without children (for non-work purpose only)
- Hotel-motel type (optionally three hotel-motel types can be used)

Figure 4-1 presents the trip production model structures of the 2000 based lifestyle model of Southeast Florida. It differentiates the work and non-work structures. The simple rate based equations were used for the airport and the three truck purposes.

Figure 4-1

Trip Production Model Structure

2000 Treasure Coast Regional Planning Model

Cross-Classified Structure of Work Purposes

1. Home-Based Work (HBWork)
6. Non-Home-Based Work (NHBWork) Production/Attraction Controls

		Rates per Household		
		WORKER		
CHILDREN	VEHICLE	0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		x	x
	1 vehicle		x	x
	2 vehicles		x	x
	3+ vehicles		x	x
With Children	0 vehicle		x	x
	1 vehicle		x	x
	2 vehicles		x	x
	3+ vehicles		x	x

Hotel/Motel(H/M) Type(*)	Rate/Unit
Business	x
Leisure/Recreational	x
Mix	x
All Types	x

(*) Model uses either "Individual H/M Type rates" or "all H/M type rate"

Cross-Classified Structure of Non-Work Purposes:

2. Home-Based Shopping (HBShop)
3. Home-Based Social Recreation (HBSocRec)
4. Home-Based School (HBSchool) - No H/M Rates
5. Home-Based Other (HBOther)
7. Non-Home-Based Other (NHBOther) Origin/Destination Controls

		Rates per Household			
		PERSON			
CHILDREN	VEHICLE	1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	x	x	x	x
	1 vehicle	x	x	x	x
	2 vehicles	x	x	x	x
	3+ vehicles	x	x	x	x
With Children	0 vehicle		x	x	x
	1 vehicle		x	x	x
	2 vehicles		x	x	x
	3+ vehicles		x	x	x

Hotel/Motel(H/M) Type(*)	Rate/Unit
Business	x
Leisure/Recreational	x
Mix	x
All Types	x

(*) Model uses either "Individual H/M Type rates" or "all H/M type rate"

(8) Airport Trip Purpose (for major airport only)

Trips per Enplanement = X

(9-11) Three Truck (4-tired, SU & COMB) Purposes:

Truck production rates are same as their attraction rates.
Truck Attraction Structure is shown in Figure 4-2.

The revised trip attraction models use employment by type, school enrollment, households and area type as independent variables. The attractions rates were based on "disaggregate" analysis for work purposes (HBW and NHBW). An aggregate analysis was used for non-work trip purposes. Rates were developed based on the area type used in highway network. The *Trip Attraction Equation Refinement Study* report [Reference 13] has a detailed description of the development of the trip attraction rates. **Figure 4-2** presents the modified trip attraction model structure.

School Trips

For the lifestyle trip generation program, the HBSCH trip purpose was introduced as trip purpose four. School trips were divided in two broad categories—public and private. Public schools are further divided into elementary, middle, and high school. Because most public school students are assigned to a school from designated school boundaries within a school district, the trip table is fairly well established. However, in this study area, this is not true for St. Lucie County. The students in St. Lucie County are not restricted within a school district. The public school trips in St. Lucie are distributed like private school trips using the gravity model.

The model takes this structure into account by using separate processes for public and private schools. Trip tables are directly built for the public school students using actual school board student enrollment information for each school and related school boundary. Private school and college students are distributed using the normal gravity model.

The initial set of HBSCH productions is calculated using the trip rates and socioeconomic data. Then the productions of the home zones are prorated in proportion to the attractions. These prorated values become the school productions for this school. This is done for the private as well as the public school trips.

For private schools, the total productions are proportioned to the total attractions (enrollment x trips/enrollment). THE GRATESB.SYN file contains the system level attraction rates. The school specific rates as well as production and attraction data needed to calculate HBSCH productions and attractions are contained in file SCHOOL.YYA. The format for the school file is shown in **Table D-9** of **Technical Report 3**.

To accommodate the change in the school trip rate method, three variables, representing grade school, middle school and high school trip generation rates were added to the "school" file. If the school rates (fields 9-12) are blank, but the TAZ has a school, the model uses the trip attraction rate indicated in the GRATESB.SYN file. Thus, the modeler has control over the trip attraction rate for each type of school, for each TAZ.

Truck Model

Truck traffic has different travel characteristics than passenger vehicles. TEA-21 and subsequent legislation has placed a greater emphasis on truck traffic. Truck traffic is important for pavement design and capacity analysis. Truck trips also have different characteristics than auto trips such as travel pattern and vehicle operating characteristics. The modified lifestyle trip generation routine implements three truck purposes (4-tired, Single Unit and Combinations), treating trucks as separate mode from generation through assignment.

The structure of the truck model follows the one suggested in FHWA's Quick Response Freight Manual (QRFM). The truck model uses the same highway network and socio-economic data as the auto model. The truck QRFM rates were not directly applicable to the FSUTMS truck model since it uses employment categories that are not directly comparable. A mapping of the FSUTMS and QRFM employment categories by the Standard Industrial Classification (SIC) codes overcame this problem. The process developed truck rates for TCRPM. These rates were further adjusted as part of model validation.

Figure 4-2

Trip Attraction Model Structure

2000 Treasure Coast Regional Planning Model

Trip Purpose		Area Type	Attraction Variables: Industrial Employment (SIC:1-39)	Commercial Employment (SIC:50-59)	Service Employment (SIC:40-49,60-99)	Total Employment	Households	Occupied H/M Units	School and College Enrollment
1. HB-Work		ALL	X	X	X				
2. HB-Shop		CBD		X	X				
		Fringe		X	X				
		Residential		X	X				
		OBD		X	X				
		Rural		X	X				
3. HB-SocRec		CBD		X	X		X	X	
		Fringe		X	X		X	X	
		Residential		X	X		X	X	
		OBD		X	X		X	X	
		Rural		X	X		X	X	
4. HB-School		ALL							X
5. HB-Other		CBD		X	X		X	X	
		Fringe		X	X		X	X	
		Residential		X	X		X	X	
		OBD		X	X		X	X	
		Rural		X	X		X	X	
6. NHB-Work (*)	a. Production Allocation	ALL	X	X	X				
	b. Attraction Allocation	CBD	X	X	X		X	X	
		Fringe	X	X	X		X	X	
		Residential	X	X	X		X	X	
		OBD	X	X	X		X	X	
		Rural	X	X	X		X	X	
7. NHB-Other (*)	a. Origin Allocation	CBD	X	X	X		X	X	
		Fringe	X	X	X		X	X	
		Residential	X	X	X		X	X	
		OBD	X	X	X		X	X	
		Rural	X	X	X		X	X	
	b. Destination Allocation	CBD	X	X	X		X	X	
		Fringe	X	X	X		X	X	
		Residential	X	X	X		X	X	
		OBD	X	X	X		X	X	
		Rural	X	X	X		X	X	
8. Airport		ALL				X	X	X	
Truck	9. Four-tired	ALL	X	X	X		X	X	
	10. Single Unit	ALL	X	X	X		X	X	
	11. Combinations	ALL	X	X	X		X	X	

(*) For allocation of trips computed based on trip production control total.

The friction factors for the three truck purposes were developed using the negative exponential functions suggested in the QRFM. The assignment of the truck trips uses the all-or-nothing assignment technique. The assumption here is that most truck trips will use a pre-determined shortest time path and will not divert because of congestion. The truck trips are then preloaded to make a combined equilibrium assignment of cars and trucks.

Internal-External (IE) Trips

Most non-Southeast Florida FSUTMS models take a traditional approach to IE trips treating them separately and independently from internal trips. While this approach works well in isolated areas, it has problems in urban areas, which are part of a larger urban area. The problem is usually seen as an overestimation of traffic near a study area boundary. The reason for the overestimation is the surcharge of IE trips across the study area boundary.

This revised model includes a modified IE process that eliminates IE as a separate trip purpose. These trips are now handled as part of the internal trip purposes. The process works as follows:

- Total person trip productions and total person trip attractions at each external TAZ are entered in the ZDATA4B.YYA file. These are obtained from external station counts by adjusting the values so that the trip ends after distribution at each external TAZ match the counts.

- The file also contains the percentages of productions and attractions by internal purpose.

- The IE person trip P's and person trip A's by purpose at each external station are estimated by multiplying the two sets of data noted above.

- K factors from all external zones to all external zones are set at zero for all purposes. This prevents IE trips from becoming EE trips.

- Distribute the IE trip ends as part of the internal trip distribution process.

The distribution process will determine the IE and EI trips (they will be present in the internal trip tables). Because the gravity model ensures the distribution of all productions, but not all attractions, the production ends of the IE trips will be fairly accurate while the attraction ends could be significantly different from the counts. Some adjustment of the total IE trips (productions and attractions) and/or travel time at external station connectors will be needed so that the desired volumes at the external stations are obtained.

NHBW and NHBO Trips

A nationwide review [see Reference 13] of Non Home Based (NHB) trip modeling techniques showed a growing trend of using two separate NHB purposes – Non Home Based Work (NHBW) and Non Home Based Other (NHBO). In this update, these two NHB purposes were modeled. Calibration of trip rates of these two purposes used the 1999 Southeast Florida Travel Characteristics Surveys (SEFTCS). Results showed different trip generation and distribution characteristics for the NHBW and NHBO purposes. These surveys were also used data for model trip distribution parameters. Both production and attractions of NHBW and NHBO are new in the 1999 and 2000 models.

The control totals for the NHBW and NHBO trips are obtained using cross-classification trip production rates. Like other home-based trip purposes, NHBW and NHBO trips are generated for each travel zone. However, these values cannot be used for NHBW (or NHBO) productions and attractions because, by definition, NHBW (or NHBO) trips are not related to zonal household characteristics. The zonal level trips were summed to derive the control total values for the study area. The control total value is then allocated to zones in proportion to the modified NHBW and NHBO regression equation trip ends. Thus, the NHBW and NHBO regression equations are used to allocate the control total value. This process produces more accurate control totals for the NHB trips based on the travel survey data. Therefore, it is a worthy enhancement to the NHB trip process.

Stratification Curves

Stratification curves are needed to distribute the aggregate zonal level data to the discrete classes used in the trip production matrices. Data from a 1990 Census special tabulation (STP#283) were used to develop stratification models. Models were developed for the following categories:

- Zonal household vehicles of without-children households,
- Zonal household vehicles of with-children households,
- Zonal household workers of without-children households,
- Zonal household workers of with-children households,
- Zonal household persons of without-children households, and
- Zonal household persons of with-children households.

Polynomial regression analysis was performed for each data set. The deviation of the average of the class of the variable from its grand mean was used as the independent variable. The dependent variables are the frequencies of each class of the variable. The general form of this equation is

$$Y_i = \beta_o + \beta_1 x_i + \beta_2 x_i^2 + \ldots\ldots + \beta_j x_i^j + \ldots + \beta_n x_i^n$$

$$(\text{where, } x_i = X_i - \overline{X})$$

The specification of the independent variable as a deviation reduces the multicollinearity problem, as well as computational problems arising from higher order polynomials. **Table 4-1** summarizes the stratification models. These models were developed during the 1996 model update by analyzing the 1990 Census Special Tabulation Data (STP 283).

Table 4-1

Households Stratification Models

2000 Treasure Coast Regional Planning Model

A. Zonal Household Vehicles of "Without-Children-Households"

X = Average Number of "without-children-household" vehicles - 1.48163

Fraction of households with zero vehicle (C0PH0V):

C0PH0V = 0.072776 -0.174903 * X +0.202600 *X^2 -0.078867 *X^3

Fraction of households with one vehicle (C0PH1V):

C0PH1V = 0.482594 -0.425940 * X -0.242545 *X^2 +0.201796 *X^3

Fraction of households with two vehicles (C0PH2V):

C0PH2V = 0.333415 +0.422258 * X -0.191951 *X^3

Fraction of households with three-or-more vehicles (C0PH3+V):

C0PH3+V = 0.091395 +0.221173 * X +0.153701 *X^2

B. Zonal Household Vehicles of "With-Children-Households"

X = Average Number of "with-children-household" vehicles - 1.87622

Fraction of households with zero vehicle (C1PH0V):

C1PH0V = 0.018540 -0.057316 * X +0.110140 *X^2 -0.072534 *X^3

Fraction of households with one vehicle (C1PH1V):

C1PH1V = 0.269781 -0.532833 * X +0.195506 *X^3

Fraction of households with two vehicles (C1PH2V):

C1PH2V = 0.573846 +0.300282 * X -0.385719 *X^2 -0.201778 *X^3

Fraction of households with three-or-more vehicles (C1PH3+V):

C1PH3+V = 0.150200 +0.343300 * X +0.198200 *X^2

C. Zonal Household Workers of "Without-Children-Households"

X = Average Number of "without-children-household" workers - 1.06366

Fraction of households with zero worker (C0PH0W):

C0PH0W = 0.296204 -0.462422 * X +0.171256 *X^2

Fraction of households with one worker (C0PH1W):

C0PH1W = 0.407592 -0.303007 *X^2 +0.094322 *X^3

Fraction of households with two workers (C0PH2W):

C0PH2W = 0.261694 +0.374844 * X -0.104689 *X^3

Fraction of households with three-or-more workers (C0PH3+W):

C0PH3+W = 0.047641 +0.072716 * X +0.059803 *X^2 +0.050610 *X^3

D. Zonal Household Workers of "With-Children-Households"

X = Average Number of "with-children-household" workers - 1.63649

Fraction of households with zero worker (C1PH0W):

C1PH0W = 0.037779 -0.105925 * X +0.165710 *X^2 -0.078987 *X^3

Fraction of households with one worker (C1PH1W):

C1PH1W = 0.385018 -0.520355 * X +0.195933 *X^3

Fraction of households with two workers (C1PH2W):

C1PH2W = 0.470920 +0.438651 * X -0.200182 *X^2 -0.181715 *X^3

Fraction of households with three-or-more workers (C1PH3+W):

C1PH3+W = 0.090592 +0.245527 * X +0.172362 *X^2

E. Zonal Household Persons of "Without-Children-Households"

X = Average Number of "without-children-household" persons - 1.84769

Fraction of households with one person (C0PH1P):

C0PH1P = 0.341007 -0.540536 * X +0.199598 *X^2

Fraction of households with two persons (C0PH2P):

C0PH2P = 0.529833 +0.198791 * X -0.442505 *X^2 -0.111906 *X^3

Fraction of households with three persons (C0PH3P):

C0PH3P = 0.109413 +0.222457 * X -0.041524 *X^3

Fraction of households with four-or-more persons (C0PH4+P):

C0PH4+P = 0.033020 +0.111846 * X +0.103744 *X^2

F. Zonal Household Persons of "With-Children-Households"

X = Average Number of "with-children-household" persons - 3.69562

Fraction of households with one person (C1PH1P):

C1PH1P = 0.000000

Fraction of households with two persons (C1PH2P):

C1PH2P = 0.060251 -0.093107 * X +0.025287 *X^2 -0.144799 *X^3

Fraction of households with three persons (C1PH3P):

C1PH3P = 0.361326 -0.600386 * X +0.283011 *X^3

Fraction of households with four-or-more persons (C1PH4+P):

C1PH4+P = 0.564017 +0.650724 * X +0.145491 *X^2

Special Generator Process

Activity within some zones is significantly different from the regional averages. The differences in predicted trips would be large enough to change planning decisions on specific roadway or transit facilities. These facilities may include some airports, recreation and amusement areas, regional shopping centers, military and government complexes, hospitals, and colleges and universities. These facilities' are often treated as special generators.

The lifestyle trip generation process includes a modified process to handle special generator trips in the trip generation model. One of the criticisms of the trip generation process used in Florida concerns the special generator process. Traditionally, trip generation models adjust the calculated number of trip attractions such for each trip purpose the sum of the adjusted attraction equals the sum of productions. Even if this adjustment were not made in the trip generation step, the adjustment would be made effectively in the gravity model. This is because the gravity model distributes as many trips as there are trip productions.

The problem occurs when there is an attraction special generator. The attractions for a zone set by the special generator model are adjusted up or down so that the attractions used by the model are different from those specified for the special generator. Sometimes these differences are large. If, for example, the sum of attractions is 120% of the sum of productions, then the attractions at every zone including the special generators will be only 83.3% of the input values. Conversely, if the sum of attractions if only 80% of the sum of productions, the model will use a value that is 125% of the input values. If the model is being applied to assess the impacts of a proposed development, the traffic forecast at the entrance to the development might be quite different from what is expected.

To overcome the above problem, a modified special generator process was implemented in the LSTGENM or LSTGENM2 routines. This modified process holds the special generators attractions constant, and then applies the adjustments only to the non-special generator zones so that the sum of adjusted attractions will be equal to the sum of productions. Thus, if a TAZ has "regular" attractions from the trip rate equations, and an addition of special generator trips, the regular trips will be subject to adjustment, while the additional trips will not be subject to adjustment.

While the adjustment method is the same for home-based and non-home based trips, the application is slightly different. For home-based trips productions never are adjusted. For non-home based trips, productions and attractions are the same by definition. Thus, both productions and attractions are adjusted. A benefit of this adjustment process is that special generators can be applied with a much higher degree of accuracy than under the conventional approach.

The adjustment procedure for each purpose adjusts the trips as follows:

- Productions are calculated for each TAZ, and totaled for the study area.
- Attractions are calculated for each TAZ, and totaled for the study area. However, during the process, separate totals are kept for regular attractions and special generator attractions.
- The sum of special generator attractions is subtracted from the sum the sum of productions. Let this difference be X. The adjustment factor for regular attractions for each TAZ is X divided by the sum of regular trip attractions. The LSTGENM2 reports this factor as "Balance Factor".
- The regular attractions are multiplied by the adjustment factor.
- The adjusted regular attractions are added to the unadjusted special generator attractions for each TAZ. The sum for each TAZ is passed to the trip distribution model.

The result is that the sums of productions and attractions are equal, and the special generator portions of a TAZ's trip attraction are not adjusted. The changes that were made to the lifestyle generation model's special generator procedure do not require changes to any input variable. However, the trip attraction balancing procedure has been modified. This adjustment methodology should give logical results unless the special generator trips are a very large fraction of the total number of trips or the sum of productions and attractions are grossly out of balance.

4.3 MODEL VALIDATION

The ZDATA1B input data provides TAZ level household characteristic data. The trip generation routine then estimates the households within each cell of the cross-classification matrices. The LSTGENM2 routine reports the number of households in each of the cross-classification cells. The HBW and NHBW productions use the work classification structure, which uses the stratification variables presence/absence of children, number of HH workers and number of HH autos. The other purposes (HBShop, HBSocRec, HBSchool-non-public, HBOther and NHBO) productions use the non-work structure, which uses the stratification variables presence/absence of children, household size and number of HH autos. The other production and attraction models use a regression model. The production and attraction rates, as well as the stratification curves, are entered in the GRATESB.SYN file.

Both production and attraction rates were developed from the 1999 South Florida Travel Characteristics survey. The trip generation (both productions and attractions) calibration processes are based mainly on statistical analyses. A report titled "*Development of Trip Rates and Friction Factors for Southeast Florida Demand Forecast Models*," [Reference 14] describes trip production calibration process. *Trip Attraction Equation Refinement Study* [Reference 13] report describes the trip attraction calibration process. In model validation, the calibrated rates were adjusted to produce reasonable results.

The validation of the trip generation model started with the county specific calibrated trip rates. In consultation with FDOT District IV, the rates were modified so that model produces reasonable results both in the trip generation module and in the context of overall model stream. In the context of the overall model chain, the rates were modified so that model generated volumes reasonably replicate the observed counts The validated production and attraction trip rates are presented in **Tables 4-2.1, 4-2.2, 4-2.3** and **4-3**.

The MPO's TAZ data includes only the total number of hotels and motels, not the number by type of hotel/motel. Thus, one hotel/motel rate by purpose was used in the 2000 model validation, although rates by type were developed. The attraction rates shown in **Table 4-3** depend on area type, employment type, school enrollments, and occupied dwelling and hotel/motel units.

The Treasure Coast area was reviewed for special generators. The decision to include any of the special generation was made during the validation process. The special generators file was not used during the early stages of model validation. There was only one special generator included in TCRPM. This special generator was added to include social recreation trips across the Jensen Beach causeway. As part of the validation process, traffic volumes around special generator sites were reviewed. The special generators trips in ZDATA3B file were then adjusted. **Appendix B** lists the ZDATA3B file that is validated for the 2000 TCRPM.

Table 4-2-1

Indian River Validated Trip Production Matrices

2000 Treasure Coast Regional Planning Model

(1) Home-Based Work (HBWork)

CHILDREN	VEHICLE	WORKER		
		0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		1.366	2.752
	1 vehicle		1.411	2.797
	2 vehicles		1.383	2.770
	3+ vehicles		1.935	3.322
With Children	0 vehicle		0.994	2.381
	1 vehicle		1.039	2.426
	2 vehicles		1.013	2.399
	3+ vehicles		1.564	2.950
All Hotel & Motel Types:		0.396		

(2) Home-Based Shopping (HBShop)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.315	1.159	2.285	2.707
	1 vehicle	0.711	1.555	2.681	3.103
	2 vehicles	0.241	1.085	2.210	2.633
	3+ vehicles	0.625	1.469	2.595	3.018
With Children	0 vehicle		0.260	0.981	1.404
	1 vehicle		0.338	1.377	1.800
	2 vehicles		0.564	0.906	1.330
	3+ vehicles		0.166	1.292	1.714
All Hotel & Motel Types:		0.600			

(3) Home-Based Social-Recreation (HBSocRec)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	1.072	1.512	1.824	1.943
	1 vehicle	0.599	1.040	1.351	1.470
	2 vehicles	0.595	1.036	1.347	1.466
	3+ vehicles	0.304	0.745	1.055	1.175
With Children	0 vehicle		1.368	1.678	1.798
	1 vehicle		0.895	1.205	1.325
	2 vehicles		0.891	1.202	1.321
	3+ vehicles		0.599	0.911	1.030
All Hotel & Motel Types:		4.915			

(4) Home-Based School (HBSchool)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.035	0.047	0.067	0.223
	1 vehicle	0.054	0.066	0.322	0.408
	2 vehicles	0.071	0.028	0.003	0.472
	3+ vehicles	0.096	0.054	0.028	0.498
With Children	0 vehicle		0.561	0.535	1.006
	1 vehicle		0.746	0.720	1.190
	2 vehicles		0.810	0.785	1.255
	3+ vehicles		0.836	0.810	1.280

(5) Home-Based Other (HBOther)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.315	1.185	3.549	5.096
	1 vehicle	1.323	2.193	4.556	6.103
	2 vehicles	1.483	2.354	4.717	6.263
	3+ vehicles	0.035	0.905	3.268	4.816
With Children	0 vehicle		0.619	2.981	4.529
	1 vehicle		1.625	3.989	5.536
	2 vehicles		1.786	4.149	5.697
	3+ vehicles		0.338	2.701	4.248
All Hotel & Motel Types:		0.391			

(6) Non-Home-Based-Work (NHBWork) Origin/Destination Controls

CHILDREN	VEHICLE	WORKER		
		0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		1.011	2.317
	1 vehicle		0.969	2.275
	2 vehicles		1.358	2.663
	3+ vehicles		1.103	2.409
With Children	0 vehicle		0.858	2.163
	1 vehicle		0.815	2.122
	2 vehicles		1.205	2.510
	3+ vehicles		0.950	2.255
All Hotel & Motel Types:		0.237		

(7) Non-Home-Based-Other (NHBOther) Origin/Destination Controls

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	1.086	2.153	2.862	4.415
	1 vehicle	1.636	2.703	3.412	4.965
	2 vehicles	0.677	1.745	2.454	4.007
	3+ vehicles	0.636	1.703	2.412	3.965
With Children	0 vehicle		2.057	2.765	4.318
	1 vehicle		2.606	3.315	4.868
	2 vehicles		1.648	2.357	3.910
	3+ vehicles		1.606	2.315	3.868
All Hotel & Motel Types:		1.600			

(8) Airport Trip Purpose

Trips per Enplanement = 3.25

(9-11) Three Truck (4-tired, SU & COMB) Purposes:

Truck production rates are same as their attraction rates.
Truck Attraction Rates are shown in Table 4-3.

Table 4-2-2

St. Lucie Validated Trip Production Matrices

2000 Treasure Coast Regional Planning Model

(1) Home-Based Work (HBWork)

CHILDREN	VEHICLE	WORKER		
		0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		1.489	3.146
	1 vehicle		1.398	3.056
	2 vehicles		1.645	3.303
	3+ vehicles		2.222	3.879
With Children	0 vehicle		1.074	2.731
	1 vehicle		0.984	2.640
	2 vehicles		1.231	2.887
	3+ vehicles		1.808	3.464
All Hotel & Motel Types:		0.396		

(2) Home-Based Shopping (HBShop)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.906	1.591	1.647	2.128
	1 vehicle	0.757	1.442	1.498	1.980
	2 vehicles	0.476	1.161	1.217	1.699
	3+ vehicles	0.260	0.946	1.002	1.483
With Children	0 vehicle		1.300	1.354	1.836
	1 vehicle		1.151	1.206	1.687
	2 vehicles		0.870	0.925	1.406
	3+ vehicles		0.655	0.710	1.192
All Hotel & Motel Types:		0.600			

(3) Home-Based Social-Recreation (HBSocRec)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.589	0.878	1.172	1.321
	1 vehicle	0.299	0.588	0.882	1.031
	2 vehicles	0.307	0.597	0.891	1.040
	3+ vehicles	0.150	0.440	0.734	0.882
With Children	0 vehicle		0.942	1.236	1.385
	1 vehicle		0.652	0.946	1.095
	2 vehicles	0.661	0.955	1.103	
	3+ vehicles		0.503	0.797	0.946
All Hotel & Motel Types:		4.915			

(4) Home-Based School (HBSchool)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.075	0.063	0.191	0.859
	1 vehicle	0.015	0.004	0.132	0.800
	2 vehicles	0.046	0.035	0.162	0.831
	3+ vehicles	0.046	0.035	0.048	0.716
With Children	0 vehicle		0.630	0.757	1.426
	1 vehicle		0.571	0.698	1.366
	2 vehicles		0.601	0.729	1.397
	3+ vehicles		0.487	0.614	1.283

(5) Home-Based Other (HBOther)

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	1.214	2.250	1.561	3.429
	1 vehicle	1.364	2.399	1.711	3.579
	2 vehicles	0.852	1.888	1.198	3.067
	3+ vehicles	0.851	1.887	1.197	3.066
With Children	0 vehicle		4.002	3.313	5.181
	1 vehicle		4.152	3.463	5.331
	2 vehicles		3.640	2.950	4.819
	3+ vehicles		3.639	2.949	4.818
All Hotel & Motel Types:		0.391			

(6) Non-Home-Based-Work (NHBWork) Origin/Destination Controls

CHILDREN	VEHICLE	WORKER		
		0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		1.548	3.276
	1 vehicle		1.497	3.225
	2 vehicles		1.903	3.631
	3+ vehicles		1.588	3.317
With Children	0 vehicle		1.459	3.187
	1 vehicle		1.408	3.136
	2 vehicles		1.814	3.542
	3+ vehicles		1.499	3.228
All Hotel & Motel Types:		0.237		

(7) Non-Home-Based-Other (NHBOther) Origin/Destination Controls

CHILDREN	VEHICLE	PERSON			
		1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.595	1.977	2.035	2.802
	1 vehicle	1.402	2.784	2.842	3.608
	2 vehicles	0.321	1.703	1.762	2.528
	3+ vehicles	0.076	1.458	1.516	2.283
With Children	0 vehicle		2.584	2.643	3.408
	1 vehicle		3.390	3.449	4.215
	2 vehicles		2.310	2.369	3.135
	3+ vehicles		2.064	2.123	2.889
All Hotel & Motel Types:		1.600			

(8) Airport Trip Purpose

Trips per Enplanement = 3.25

(9-11) Three Truck (4-tired, SU & COMB) Purposes:

Truck production rates are same as their attraction rates.
Truck Attraction Rates are shown in Table 4-3.

Table 4-2-3

Martin Validated Trip Production Matrices

2000 Treasure Coast Regional Planning Model

(1) Home-Based Work (HBWork)

CHILDREN	VEHICLE	WORKER: 0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		1.059	1.813
	1 vehicle		0.956	1.710
	2 vehicles		1.024	1.777
	3+ vehicles		1.482	2.235
With Children	0 vehicle		0.802	1.556
	1 vehicle		0.700	1.454
	2 vehicles		0.768	1.521
	3+ vehicles		1.225	1.978
All Hotel & Motel Types:		0.396		

(2) Home-Based Shopping (HBShop)

CHILDREN	VEHICLE	PERSON: 1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.157	0.925	1.483	1.783
	1 vehicle	0.649	1.573	2.357	2.479
	2 vehicles	0.152	1.076	1.859	1.982
	3+ vehicles	0.470	1.394	2.178	2.301
With Children	0 vehicle		0.960	1.742	1.866
	1 vehicle		0.719	1.503	1.626
	2 vehicles		0.222	1.005	1.129
	3+ vehicles		0.541	1.323	1.447
All Hotel & Motel Types:		0.600			

(3) Home-Based Social-Recreation (HBSocRec)

CHILDREN	VEHICLE	PERSON: 1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.106	0.502	0.699	1.538
	1 vehicle	0.434	0.830	1.028	1.866
	2 vehicles	0.150	0.546	0.744	1.582
	3+ vehicles	0.030	0.367	0.564	1.402
With Children	0 vehicle		0.624	0.821	1.660
	1 vehicle		0.952	1.150	1.989
	2 vehicles		0.668	0.866	1.704
	3+ vehicles		0.488	0.686	1.525
All Hotel & Motel Types:		4.915			

(4) Home-Based School (HBSchool)

CHILDREN	VEHICLE	PERSON: 1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.000	0.023	0.047	0.592
	1 vehicle	0.008	0.031	0.055	0.600
	2 vehicles	0.034	0.057	0.080	0.626
	3+ vehicles	0.248	0.239	0.288	0.888
With Children	0 vehicle		0.755	0.779	1.325
	1 vehicle		0.763	0.787	1.332
	2 vehicles		0.789	0.813	1.359
	3+ vehicles		0.515	0.539	1.085

(5) Home-Based Other (HBOther)

CHILDREN	VEHICLE	PERSON: 1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	0.960	1.789	2.882	5.270
	1 vehicle	1.414	2.243	3.336	5.723
	2 vehicles	1.109	1.939	3.032	5.420
	3+ vehicles	1.178	2.006	3.100	5.487
With Children	0 vehicle		1.853	2.946	5.333
	1 vehicle		2.306	3.400	5.787
	2 vehicles		2.003	3.096	5.483
	3+ vehicles		2.070	3.163	5.551
All Hotel & Motel Types:		0.391			

(6) Non-Home-Based-Work (NHBWork) Origin/Destination Controls

CHILDREN	VEHICLE	WORKER: 0 Worker	1 Worker	2+ Workers
Without Children	0 vehicle		0.723	1.551
	1 vehicle		1.041	1.871
	2 vehicles		1.176	2.004
	3+ vehicles		1.280	2.108
With Children	0 vehicle		0.805	1.634
	1 vehicle		1.124	1.953
	2 vehicles		1.258	2.087
	3+ vehicles		1.362	2.191
All Hotel & Motel Types:		0.237		

(7) Non-Home-Based-Other (NHBOther) Origin/Destination Controls

CHILDREN	VEHICLE	PERSON: 1 person	2 persons	3 persons	4+ persons
Without Children	0 vehicle	2.257	3.291	4.628	5.603
	1 vehicle	2.321	3.356	4.691	5.666
	2 vehicles	1.233	3.356	4.691	5.666
	3+ vehicles	2.509	3.543	4.878	5.854
With Children	0 vehicle		3.358	4.694	5.669
	1 vehicle		3.422	4.758	5.734
	2 vehicles		2.335	3.670	4.646
	3+ vehicles		3.609	4.946	5.921
All Hotel & Motel Types:		1.600			

(8) Airport Trip Purpose

Trips per Enplanement = 3.25

(9-11) Three Truck (4-tired, SU & COMB) Purposes:

Truck production rates are same as their attraction rates.
Truck Attraction Rates are shown in Table 4-3.

Table 4-3

Validated Trip Attraction Rates (All Counties)

2000 Treasure Coast Regional Planning Model

		Socio-Economic Data Categories						
	Area	Employment				School	Occupied	Occupied
Purpose	Type	Industial	Commercial	Service	Total	Enrollment	Dwelling Units	H/M Units
1. HBWork	CBD	1.950	1.950	1.950				
	Fringe	1.365	1.338	1.345				
	Residential	1.844	1.806	1.816				
	OBD	1.911	1.890	1.900				
	Rural	1.911	1.838	1.908				
2. HBShop	CBD		1.749	0.059				
	Fringe		2.282	0.085				
	Residential		2.780	0.328				
	OBD		1.702	0.273				
	Rural		2.392	0.294				
3. HBSocRec	CBD		1.544	0.462			0.936	0.936
	Fringe		1.762	0.854			0.556	0.556
	Residential		0.604	0.851			0.351	0.351
	OBD		0.352	0.505			0.352	0.352
	Rural		0.532	0.715			0.352	0.352
4. HBSchool	ALL					1.850		
5. HBOther	CBD		4.181	1.120			1.705	1.705
	Fringe		1.260	3.177			0.289	0.289
	Residential		1.883	2.738			0.417	0.417
	OBD		1.230	1.438			0.535	0.535
	Rural		1.618	2.207			0.423	0.423
6a. NHBWork Origin/Production Allocation	CBD	0.999	1.922	1.709				
	Fringe	0.408	0.785	0.698				
	Residential	0.529	1.019	0.905				
	OBD	0.554	1.066	0.948				
	Rural	0.499	0.961	0.854				
6b. NHBWork Destination/Attraction Allocation	CBD	0.278	2.323	1.068			0.652	0.652
	Fringe	0.123	2.558	1.048			0.040	0.040
	Residential	0.183	1.177	0.777			0.126	0.126
	OBD	0.150	1.024	0.555			0.205	0.205
	Rural	0.160	1.133	0.709			0.135	0.135
7a. NHBOther Origin/Production Allocation	CBD	0.181	2.928	1.303			0.533	0.533
	Fringe	0.142	3.010	1.216			0.442	0.442
	Residential	0.213	2.170	1.541			0.279	0.279
	OBD	0.161	1.500	1.019			0.299	0.299
	Rural	0.192	1.995	1.389			0.294	0.294
7b. NHBOther Destination/Attraction Allocation	CBD	0.312	3.144	1.109			0.829	0.829
	Fringe	0.103	3.522	1.368			0.544	0.544
	Residential	0.166	2.680	1.201			0.290	0.290
	OBD	0.077	1.942	0.793			0.343	0.343
	Rural	0.138	2.488	1.096			0.311	0.311
8. Airport	CBD				0.075		0.050	0.825
	Fringe				0.056		0.035	0.673
	Residential				0.046		0.030	0.551
	OBD				0.056		0.035	0.673
	Rural				0.039		0.024	0.469
9. Truck - 4-tired Commercial Vehicle	ALL	0.104	0.081	0.044			0.017	
10. Truck - Single-Unit	CBD	0.092	0.077	0.028			0.023	
	Fringe	0.084	0.071	0.026			0.021	
	Residential	0.098	0.082	0.030			0.024	
	OBD	0.064	0.054	0.020			0.016	
	Rural	0.144	0.121	0.045			0.036	
11. Truck - Combinations	CBD	0.032	0.015	0.005			0.005	
	Fringe	0.027	0.012	0.004			0.004	
	Residential	0.051	0.023	0.008			0.007	
	OBD	0.020	0.009	0.003			0.003	
	Rural	0.137	0.062	0.021			0.020	

4.4 RESULTS AND COMPARISONS

The number of unadjusted and adjusted productions and attractions in the 2000 validated model are presented in **Table 4-4**. In the 2000 model, almost 2.1 million person trips are generated, out of which 1.3 million trips (62.0 percent) are home–based. The overall trips per household and employee are 11.49 and 13.11, respectively.

The trip production and attraction rates for the 2000 lifestyle model were based on current and reliable data from the 1999 Southeast Florida Regional Travel Characteristics Survey. An improved trip attraction model was implemented in the 2000 Treasure Coast model. The model has more trip purposes than any of the predecessor models. Also, trip rates for hotel and motel populations were derived from the 1999 Visitor survey. Three separate categories of hotel/motel rate can be applied.

The lifestyle model also has improved approaches to school trips, truck model, airport trips, IE trips, two NHB trips, household stratification models and special generator process. It should be noted that most of the other urban models in Florida use a seven-purpose trip generation model that combines truck and taxi trips. TCRPM results generally compare favorably with modeling results from other areas in Florida and other states.

Table 4-4

Trip Generation Summary

2000 Treasure Coast Regional Planning Model

Purpose	Productions	Productions Percent	Attractions (Adjusted)	Special Generations
(1)	(2)	(3)	(4)	(5)
1. HB Work	241,095	11.56%	241,374	
2. HB Shopping	228,534	10.96%	228,529	
3. HB SocRec	195,183	9.36%	195,272	4,999
4a. HB School -Non Public	150,190	7.20%	150,194	
5. HB Other	496,673	23.81%	497,171	
6. Non Home Based Work	229,578	11.01%	229,782	
7. Non Home Based Other	505,681	24.24%	505,947	
8. Airport	-	0.00%	-	
9. Truck (4-tired)	14,797	0.71%	14,696	
10. Truck (Single Unit)	16,213	0.78%	15,574	
11. Truck (Combination)	7,773	0.37%	7,250	
Total:	**2,085,717**	100.00%	**2,085,789**	4,999

Statistics	Result
Total HB Trips (Production)	1,311,675
Total HB Trips (Attraction)	1,312,540
Total Trips (Production)	2,085,717
Total Trips (Attraction)	2,085,789
Person Trips per Household	**11.49**
Person Trips per Employee	**13.11**

5. HIGHWAY PATHS AND SKIMS

Minimum impedance travel paths are calculated using time over the highway and HOV system. In building paths, a turning penalty file is used. Paths are not built through prohibited movements. Initial paths are built using the link free-flow speeds. Terminal times and intrazonal times are also added.

This chapter describes the enhancements and then presents the key modeling data that were used in model validation.

5.1 MODEL ENHANCEMENTS

TCRPM highway path module uses standard Cube Voyager procedures to build time and distance skim matrices for Single Occupancy Vehicle (SOV) and High Occupancy Vehicle (HOV) paths (which are simple placeholders currently). The SOV paths are defined as the shortest time path through the portion of the highway network available to single occupant vehicles. SOV paths do not include HOV facilities. HOV paths are defined as the shortest time path through the portion of the network available to passenger cars with two or more persons in the vehicle. Such paths consider both HOV and SOV facilities. Truck traffic was assigned to the SOV network in free-flow fashion.

5.2 MODEL VALIDATION

To check the network for coding errors and to ensure reasonable paths were built through the network, the Cube-Base/VIPER (Visual Planning Environment) program was used to check the path building. This program was used to display the path between several selected pairs of centroid in various locations in the network. The routines trace the shortest path using the network impedance of time or distance with the summation of link impedances computed. Numerous paths were drawn on the computer screen to make sure that paths drawn were “reasonable”.

In TCRPM, three variables are considered as significant in determining the minimum paths between any given pair of zones. These variables are as follows:

1. In-Vehicle Travel (IVT) time: IVT time is the primary variable, which is determined as a function of distance and input speed.

2. Prohibited and penalized movement: The TCARDS file contains a listing of all link penalties and prohibitors in the highway network. It also annotates the types of prohibitors and penalties.

Prohibitors are generally coded to identify those turning movements in the highway network that are not permitted. Another use of prohibitors is in the double-line coding of freeway facilities, toll plazas, and interchanges where they are used to route vehicles to the proper entrance and exit ramps, and to prevent U-turn or illogical movements from occurring. TCRPM includes 8 such penalties.

Time penalties are added to a highway network for several reasons. They can represent movements that are unusually difficult, such as left turns where no signal protection exists. The 2000 model includes few of these link specific penalties. These have been generally added to add extra penalty for trips going on across the Causeways.

3. Toll Impedance: The toll parameters are specified on the highway network links. The purpose of the toll links file is to account for the costs and delays (i.e., stopping at a toll plaza to pay the toll) associated

with using toll facilities in the computation of travel impedance. These costs and delays impact a potential user's decision of whether or not to travel on the toll facility.

The toll links must contain the following data:

- Toll class
- Toll Type
- Number of lanes
- Number of plaza lanes
- Toll amount
- Average service time
- Deceleration and acceleration code

In the 2000 model, toll plazas using the "ticket" system were modeled by both type 1 and type 2. Toll type 1 is used on entry and exit ramps to represent time lost through acceleration/deceleration and queuing at the tollbooths. However, no toll (money) is assessed at the type 1 locations; only service time, acceleration/deceleration, and queuing. Tolls are not assessed because the length of the toll road trip, and thus the dollar amount, is not known by the model at either the entry or exit booth. Type 2 is used on the mainline to assess the toll amounts, but in reality no such "booths" exist. So, between every entry and exit nodes, an imaginary tollbooth location was used to assess the toll. The toll amount is equal to the toll rate per mile, times the distance between the entry and exit nodes. No extra travel time, including acceleration/deceleration, service time and queuing, is added at these imaginary locations. On the other hand, the "coin" system type 1 will always be used, whether the tollbooths are on mainline or ramps. For these locations, there is always a time delay associated with the booths (acceleration/deceleration, service time, and queuing), and assessment of a toll.

Toll costs are converted to travel time and factored by a parameter called a CTOLL. In TCRPM, the value of CTOLL is 0.06. Service times and monetary costs for the toll facility are converted to travel time, and this value is added to the regular travel time for toll links, based upon their speeds.

Using these variables, a single composite measure of impedance is obtained for use in the determination of the minimum path between all pair of zones. The calculations of impedance are based upon the combination of time and distance (on non-toll links) or time and toll (on toll links) are as follows:

For non-toll links,

$$IMPED = CTIME * TIME$$

For toll links,

$$IMPED = \{CTIME * (SERVT + TIME)\} + CTOLL * TOLL$$

Where,

CTIME = time coefficient,
TIME = travel time on the link, and
SERVT = service time on the toll booth

Highway path development is one of the critical components of the model stream. For all pairs of zones, minimum paths are determined based upon the least impedance criteria. They include IVT time, prohibited and penalized movements, and toll cost and service time.

6. TRIP DISTRIBUTION MODEL

Except for through vehicles, TCRPM uses the Cube Voyager distribution program to distribute trips between the production and attraction zones for all trips and purposes. In addition to this distribution, the Trip Distribution module of TCRPM performs additional functions including:

- Computation of intrazonal and terminal times,
- Preloading of the highway network, and
- Development of congested travel time skims for input to the later steps of the model.

The results of these functions, in turn, become inputs for transit network development and mode choice estimation. TCRPM implements two different steps to distribute trips produced in one TAZ with trip attractions in another. In both of these steps, trips are distributed using a standard gravity model. The first step distribution uses uncongested travel time as a measure of spatial separation. The second step distribution occurs after a "pre" assignment of trips and considers the impact of congestion.

6.1 MODEL ENHANCEMENTS

Enhancements were made to the TCRPM distribution model by improving the key inputs to the model. Some of these enhancements are tied to the lifestyle trip generation process. These enhancements include the following:

- Introduction of multiple school and truck purposes
- Elimination of Internal-External (IE) trips as a separate purpose
- Addition of distribution using congested time
- Use of purpose specific weights to mix the free-flow and congested trip tables.

Attention has been given to refining production and attraction data as well as trip purpose data, and to improving the measure of spatial separation to be sensitive to the impacts of future congestion. The following subsections describe the enhancements incorporated into the trip distribution process.

School and Truck Purposes

Coincident with enhancements to the trip generation model, the trip distribution model incorporates expanded trip purposes. Those include two NHB purposes, four school purposes, an airport purpose and three truck purposes. The gravity model handles eleven purposes.

The airport trip purpose was added to the model in the 1999 model update. The three truck purposes follow the process recommended in the Quick Response Freight Manual [Reference 24]. The school trip purpose handled by the gravity model includes only private schools, and colleges and universities. Three public school (elementary, middle and high) trip matrices are directly written through the trip generation program. The program uses information from the SCHOOL file to estimate these matrices. As public school children are allocated to the schools in their district, the model directly writes out the trip matrices. The benefit of this approach is that it allows for a more accurate match of productions with attractions. The private school trips go through the normal distribution process. The friction factors for school trips were developed based on the origin-destination (O-D) survey results of 1999 SEFTCS [Reference 15].

The truck model uses three truck purposes (4-tired, single-unit and combination) as suggested in the recent USDOT publication "Quick Response Freight Manual" (QRFM) [Reference 24]. It replaces the

earlier "light" and "heavy" truck purposes modeled in the 1996 model, which were adapted from the 1990 SERPM-IV model. The QRFM model is a recent publication and gained popularity in the modeling communities to improve the truck model component. To simulate the truck distribution for three of its purposes, the friction factors recommended by the QRFM were used. These friction factors use negative exponential functions. Those functions are:

Four-tire Commercial Vehicles: $F_{ij} = EXP(-0.13 * t_{ij})$

Single Unit Trucks (6+ tires): $F_{ij} = EXP(-0.09 * t_{ij})$

Combination Trucks: $F_{ij} = EXP(-0.07 * t_{ij})$

where, F_{ij} and t_{ij} are friction factors and travel time between zones "i" and "j". EXP is the exponential function.

Table 6-1 presents the friction factors for truck trips, which are based on the above equations.

Internal External Trips

Internal External (IE) trips are no longer treated as a separate trip purpose. They are instead included in the internal trip productions and attractions. Thus, the external TAZs (701-731) have productions and attractions associated with them. The trip distribution model determines the number of IE trips. Trips are prevented from becoming EE by applying K factors of "0" to all trips with external TAZs as the origin and destination.

The change in IE, school and truck trips are part of the changes introduced by the lifestyle trip generation model. The trip distribution model was changed accordingly. One of those changes is to rewrite the terminal time computation program. Since external zones are modeled as internal zones, the extra-regional travel time of each of the external zones are entered in ZDATA4B file (see **Appendix B**).

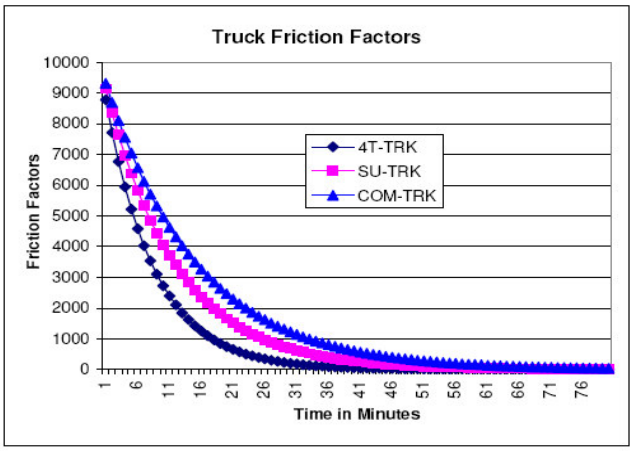
Table 6-1

Truck Trip Friction Factors

2000 Treasure Coast Regional Planning Model

Time in minutes	Four-Tire Commercial Vehicles	Single Unit Trucks (6+ Tires)	Combinations
1	8,781	9,139	9,324
2	7,711	8,353	8,694
3	6,771	7,634	8,106
4	5,945	6,977	7,558
5	5,220	6,376	7,047
6	4,584	5,827	6,570
7	4,025	5,326	6,126
8	3,535	4,868	5,712
9	3,104	4,449	5,326
10	2,725	4,066	4,966
11	2,393	3,716	4,630
12	2,101	3,396	4,317
13	1,845	3,104	4,025
14	1,620	2,837	3,753
15	1,423	2,592	3,499
16	1,249	2,369	3,263
17	1,097	2,165	3,042
18	963	1,979	2,837
19	846	1,809	2,645
20	743	1,653	2,466
21	652	1,511	2,299
22	573	1,381	2,144
23	503	1,262	1,999
24	442	1,153	1,864
25	388	1,054	1,738
26	340	963	1,620
27	299	880	1,511
28	263	805	1,409
29	231	735	1,313
30	202	672	1,225
31	178	614	1,142
32	156	561	1,065
33	137	513	993
34	120	469	926
35	106	429	863
36	93	392	805
37	81	358	750
38	72	327	699
39	63	299	652
40	55	273	608
41	48	250	567
42	43	228	529
43	37	209	493
44	33	191	460
45	29	174	429
46	25	159	400
47	22	146	373
48	19	133	347
49	17	122	324
50	15	111	302

Time in minutes	Four-Tire Commercial Vehicles	Single Unit Trucks (6+ Tires)	Combinations
51	13	102	282
52	12	93	263
53	10	85	245
54	9	78	228
55	8	71	213
56	7	65	198
57	6	59	185
58	5	54	172
59	5	49	161
60	4	45	150
61	4	41	140
62	3	38	130
63	3	34	122
64	2	32	113
65	2	29	106
66	2	26	99
67	2	24	92
68	1	22	86
69	1	20	80
70	1	18	74
71	1	17	69
72	1	15	65
73	1	14	60
74	1	13	56
75	1	12	52
76	1	11	49
77	0	10	46
78	0	9	43
79	0	8	40
80	0	7	37



Note: In QRFM, the following exponential functions are recommended for truck friction factors:

Four-tire commercial vehicles: $F_{ij} = e^{(-0.13 * t_{ij})}$

Single unit trucks (6+ tires): $F_{ij} = e^{(-0.09 * t_{ij})}$

Combinations: $F_{ij} = e^{(-0.07 * t_{ij})}$

Treating external-to-internal and internal-to-external trips as internal trips is one of the key enhancements to TCRPM. Benefits realized from this enhancement include the following:

- Permits trips generated inside of study area to be attracted to locations outside.
- Routine external-internal trip productions can now compete with internal-internal trips for attractions.
- Routine internal-external trip attractions can now satisfy some internal trip productions.
- Trip length distributions from external stations will vary based upon the types of trips made at those points.
- The total number of trips generated by a household is no longer influenced by its location in the study area.

Distribution Using Congested Time

Congestion on the roadway network has an impact on trip distribution and should be accounted for in the model. This is particularly true if future congestion levels are significantly different than those experienced in 2000. Using the standard approach of distributing trips based strictly on free-flow highway travel time, there would be minimal impact on overall distribution by the addition of capacity to existing facilities.

Many models now use congested time or a combination of uncongested and congested time to distribute the trips. In 2000 TCRPM, the final distribution uses the congested time from a pre-assignment step. The distribution model steps now are:

- Distribute trip using uncongested (or free-flow) times
- Run a highway-only mode choice analysis using default values for transit shares
- Run highway assignment
- Get congested times
- Redistribute trips using congested time
- Combine the trips using purpose-specific weights from the output trip tables using uncongested and congested times.

The TCRPM trip distribution model differs from the conventional FSUTMS distribution models in that it considers the both free-flow and congested time and then takes a weighted measure of trips rather than simply the free-flow highway travel time between origin and destination zones. The reason for this approach is to properly account for influence of present and future congestion during different time periods.

This modified process takes into account that the level of traffic varies by hour and trip purpose. As urban roadways get very congested during peak hours, some of the trips shift to other less congested hours. This in turn causes the network to be more congested during a significant portion of time. This is true of all major urban areas and is rapidly becoming so even in smaller urban areas. A distribution based on only uncongested time would understate the level of congestion on the process of trip distribution. On the other hand, use of congested time would overstate the level of congestion. The use of both times in the distribution process is a more appropriate simulation of the trip distribution phenomenon. The composite trip interchanges follow the following equation:

$$\{ CWGT_i \times \text{Congested Trip Table} \} + \{ (1 - CWGT_i) \times \text{Free Flow Trip Table} \}$$

where, $CWGT_i$ represents fraction of trips occurring during congested hours for purpose i.

As can be seen from this equation, each purpose uses a different weighting factor. The CWGT will be closer to 1 as a larger fraction of trips occurs during congested time periods. The weighting factors were based on the trip starting time of the household travel logs of the 1999 Southeast Florida Travel Characteristics Survey [SEFTCS, Reference 15]. Chapter 6 of Technical Report 1 (TR1 - Data Compilation and Review) summarizes the weights to combine the trips using the free-flow and congested times. These weights are entered in PROFILE.MAS file (see **Appendix A**).

6.2 MODEL CALIBRATION AND VALIDATION

Although the gravity model formulation includes both friction factors (representing travel impedance between zones) and K-factors (often referred as socioeconomic adjustment factor), calibration of the gravity model centers on the adjustment of the friction factor component of the equation. For TCRPM, K-factors were not considered due to the reasonable aggregate performance of the gravity model with friction factors alone.

The trip distribution model was calibrated using the Household Travel Characteristic Study, 1999. The person trip file used in this calibration used calibrated trip rates from the 1999 household characteristics survey. The calibrated Gamma Function parameters for friction factors are shown in **Table 6-2**.

The 2000 validation of the model started with the calibrated gamma function parameters. The trip distribution validation procedure is an iterative process, where a set of travel time factors is developed for each trip purpose. The model computed trip length statistics were then compared to the observed/target trip lengths. Based on the results shown in **Section 6.3**, no further adjustment was made to the friction factors.

Table 6-2
Calibrated Gamma Function Parameters
2000 Treasure Coast Regional Planning Model

PURPOSE	a_p	b_p	c_p
1. HB Work	4544694	-0.33	0.20
2. HB Shopping	1587980	1.10	0.16
3. HB SocRec	111421638	1.28	0.14
4a. HB School -Non Public	55574	0.43	0.35
5. HB Other	111421638	1.28	0.12
6. Non Home Based Work	111421638	1.28	0.08
7. Non Home Based Other	111421638	1.28	0.10
8. Airport	1	0.00	0.00
9. Truck (4-tired)	1	0.00	0.13
10. Truck (Single Unit)	1	0.00	0.09
11. Truck (Combination)	1	0.00	0.07

However, the validation process often used in other models could be followed if the further validation was warranted. The process of this validation uses an iterative adjustment to the friction factors through use a "Gamma" function (a function most commonly used for synthesized friction factors). The gamma function is defined in the following form:

$$\mathbf{F(I)_p = a_p * (I **- b_p) * EXP(-c_p * I)}$$

Where,

a_p, b_p, and c_p	=	calibration coefficients for trip purpose "p",
$F(I)_p$	=	friction factor for impedance value "I" and trip purpose "p",
I	=	impedance value, and
EXP	=	exponential function (the base of natural logarithm).

The gamma function usually does a very good job for trip distribution. Further validation of the calibrated friction factors could be done using the "Gamma" function through a non-linear curve fitting technique. This will give the starting point for any adjustment to the calibration coefficient.

The parameter "a" (known as scale factor) can be varied without changing the distribution and is usually not subject to change in model validation. The coefficients b and c, known as shape factors, are usually varied iteratively to match against the target trip lengths and trip length distribution.

6.3 RESULTS AND COMPARISONS

Beside interzonal (zone to zone) travel time, the gravity model requires two additional measures of time – intrazonal travel time and out-of-vehicle travel (terminal time). Intrazonal travel time is the time needed for a trip between two sites within the same zone. This time is usually smaller than the interzonal time. FSUTMS estimates intrazonal time based on the Nearest Neighbor Theory. The theory states that intrazonal travel time is proportional to the amount of time it takes to get to the nearest adjacent zone or zones. The half of the nearest zone IVT time is taken as measure of intrazonal time. In TCRPM, 2 adjacent zones are used to compute the intrazonal travel time during the trip distributions.

Intrazonal trips are trips that do not leave the origin zone. They are not loaded onto network and are effectively subtracted from total trips before assignment. They play a significant role in estimating the local VMT for air pollution analysis. Calibration of intrazonal trips is not easy unless a good sample size of shorter trips exist in the observed database. These trips, in general, are under reported in most household surveys.

Terminal times are the average times required to either get in a vehicle and go from the driveway to the street at the origin (production) end of the trip, or the average time required to park the vehicle and reach the final destination point at the destination (attraction) end of the trips. In FSUTMS, terminal times vary according to the area type of a zone. The values applied for terminal times in the TCRPM are shown in the following table.

Area Type	Terminal Time (minute)
11. Urbanized Area (over 500,000) Primary City CBD	*5*
12. Urbanized Area (under 500,000) Primary City CBD	*5*
13. Other Urbanized Area CBD & Small City Downtown	*5*
21. All CBD Fringe Areas	3
31. Residential Area of Urbanized Areas	*1*
32. Undeveloped Portions of Urbanized Areas	*1*
33. Transitioning Areas (Urban Areas over 5,000 Population)	*1*
34. Beach Residential	*1*
41. High Density Outlying Business District (OBD)	2
42. Other Outlying Business District	2
43. Beach OBD	2
51. Developed Rural Areas/Small Cities under 5,000 Population	*1*
52. Undeveloped Rural Areas	*1*

Terminal times are added to the in-vehicle travel time for both ends of a trip, resulting in total travel time between pair of zones. The resulting travel times are ready for input into the gravity model.

The TCRPM distribution model is a two-step process. In the initial step, all trips are distributed based on free-flow travel time. These trips are then assigned to the network to develop the congested skims which are used in the congested skims distribution. The congested skim distribution uses the same gravity model distribution process.

The weighted trip tables from these two distributions use purpose specific weights. The weight will be closer to 1 as more trips of a given purpose indicate more congestion of traffic and will be closer to zero otherwise. The trip tables of the two distributions are then combined by the purpose specific weighting factors. The weighting factors (other than airport and truck purposes) were based on the trip starting time from the household travel logs of the 1999 Southeast Florida Travel Characteristics Survey (SEFTCS) [Reference 15]. These weighting factors are entered in the PROFILE.MAS file. The following values were used in the 2000 model validation:

Purpose	Constrained TT Weight	Free-Flow TT Weight
Home-Based Work	61.07%	38.93%
Home-Based Shopping	36.66%	63.34%
Home-Based Social Recreation	34.98%	65.02%
Home-Based School (private schools, and colleges & universities)	79.59%	20.41%
Home-Based Other	47.45%	52.55%
Non-Home-Based Work	48.27%	51.73%
Non-Home-Based Other	38.77%	61.23%
Airport	50%	50%
Trucks (4-tired, SU and COMB)	40%	60%

Values shown for airport and truck purposes are based on professional judgment and are believed to be reasonable weights to combine the free-flow and congested airport and truck tables.

Trip length statistics (average and standard deviation) as well as intrazonal trip percentages are summarized for final trip distribution. **Table 6-3** presents the summary statistics. The model generated average trip length was compared to the target trip length. The target trip lengths are developed from comparative analysis of the trip lengths of 1999 Southeast Florida Household trip log data.

The following are notable findings (see **Table 6-3**):

- The modeled trip length closely matches the target trip length.

- By purpose, the difference in trip length between the model and target varies from –1.12 (HBW) to 0.65 (non-public school) minutes for final trip distribution

- Among the first seven trip purposes, HBW trips are longer, with trip length of 16.14 minutes. Truck trips, in general, showed longer trip lengths of 13.23 –31.75 minutes (with free-flow skims).

- The overall intrazonal trip percentages are 3.29% (person trips) and 3.57% (vehicle trips). By purpose, the intrazonal percentages vary from 0.52% (work trips) to 10.09% (school trips). In addition to the sizes of TAZs, intrazonal percentages depend on other factors, including mixed/balanced land uses (homogeneous/heterogeneous nature of the TAZ with respect to dwelling units and employment), extent of local roads, and extent of non-motorized travel. The probability of the shorter trips becoming intrazonal goes up if there is a better balance of households (trip productions) and employment (attractions). Also, large percentages of non-motorized trips are intrazonal trips. No national target values for these percentages are available since urban development patterns and transportation infrastructure are unique to each urban area. However, the values shown in **Table 6-3** are very "reasonable". For example, the home-based work purpose has the lowest intrazonal percentages of trips - less than 1 percent. The truck traffic intrazonal percentage is lower (0.65%) compared to other vehicle trips (3.68%).

Based on the close match between the model trip lengths and target trip lengths as well as reasonable intrazonal trip percentages, calibrated friction factors were not adjusted further in the model validation phase.

Within the framework of the gravity model trip distribution, TCRPM includes sophisticated enhancements by incorporating purpose specific weights to combine the free-flow and congested trip tables. The trip length statistics are in close agreement with the target trip lengths.

Table 6-3

Trip Length (T/L, in minutes) and Intrazonal Percentages

2000 Treasure Coast Regional Planning Model

	Weighted Average Initial Free-Flow/Final Congested Distribution		
Purpose	**Target Trip Length (minute)**	**Average Model T/L (minute)**	**Standard in T/L (minute)**
(1)	**(2)**	**(3)**	**(3-2)**
1. Home Based Work	**17.26**	16.14	-1.12
2. Home Based Shopping	**12.05**	12.58	0.53
3. Home Based SocRec	**12.00**	12.37	0.37
4a. HB School - Non Public		13.86	0.65
4b. HB School - Public			
4. Home Based School	**13.21**		
5. Home Based Other	**12.53**	12.54	0.01
6. Non Home Based Work	**12.62**	11.95	-0.67
7. Non Home Based Other	**11.30**	11.35	0.05
8. Airport			
9. Trucks - Four-Tired		13.99	
10. Trucks - Single Unit		21.52	
11. Trucks - Combination		31.75	
Purposes 1-7:	**13.23**	13.07	-0.16

7. TRANSIT NETWORK, PATH, SKIM AND FARE

The transit network is coded over the roadway links for those modes and lines that share the right-of-way with automobiles. Transit networks also require walk and auto access connectors that are not found in the highway network. Minimum impedance travel paths are calculated using time and cost over the transit system. The transit modes that could be included are local bus and express bus. Transit paths, skims and fare matrices were derived from the transit networks using a set of path-building parameters. This chapter describes transit networks, paths and fares used in model validation.

7.1 TRANSIT NETWORK

The transit network component generally consists of highway network links on which buses operate. The transit network differs from the highway network when the exclusive transit links (for example, transit links not included in the highway network) are present. Transit networks also require walk access and park-n-ride access links that are not found in the highway networks.

Both MPO staff and the Consultant reviewed and developed the 2000 networks for local buses, since this the only mode present currently.

Transit Speed Curves

The transit model assumes the time for a transit vehicle to traverse a highway link is a linear (usually, segmented/piecewise linear) function of the highway travel time. This relationship is defined by the speed curve update cards (SDLAYUPD.YYA file – see **Appendix B**), which determines the transit speed function based on highway attributes. It should noted that this file utilizes two-digit transit mode format. While speeds for modes that have exclusive right-of-way are "hard-wired" into transit links as attributes, modes that share right-of-way with vehicular traffic are estimated based on relationship to highway speed, which may vary with congestion.

The transit model assumes the time for a transit vehicle to traverse a highway link is a linear function of the highway travel time. The Transit Network module develops the transit network and computes the transit speed from highway speeds depending on mode, facility and area types. **Table 7-1** shows the speed conversion parameters.

Table 7-1

Highway to Transit Speed Conversion

2000 Treasure Coast Regional Planning Model

PART I – Curve Number for Each Mode, Area Type, and Facility Type

Mode 1								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	1	1	1	1	1	1	1	1
20-29	1	1	1	1	1	1	1	1
30-39	1	1	1	1	1	1	1	1
40-49	1	1	1	1	1	1	1	1
50-59	1	1	1	1	1	1	1	1

Mode 2								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	2	2	2	2	2	2	2	2
20-29	2	2	2	2	2	2	2	2
30-39	2	2	2	2	2	2	2	2
40-49	2	2	2	2	2	2	2	2
50-59	2	2	2	2	2	2	2	2

Mode 3								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	80-89	90-99
10-19	1	1	1	1	1	1	1	1
20-29	1	1	1	1	1	1	1	1
30-39	1	1	1	1	1	1	1	1
40-49	1	1	1	1	1	1	1	1
50-59	1	1	1	1	1	1	1	1

Mode 4								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	3	6	6	13	4	6	3	3
20-29	4	6	6	6	5	6	4	4
30-39	4	8	8	8	6	8	4	4
40-49	4	10	10	10	7	10	4	4
50-59	5	12	12	12	15	12	5	5

Mode 5								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	3	6	6	13	4	6	3	3
20-29	4	6	6	6	5	6	4	4
30-39	4	8	8	8	6	8	4	4
40-49	4	10	10	10	7	10	4	4
50-59	5	12	12	12	15	12	5	5

Mode 6								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	3	6	6	13	4	6	3	3
20-29	4	7	7	8	5	7	4	4
30-39	4	9	9	9	6	9	4	4
40-49	4	9	9	9	7	9	4	4
50-59	5	11	11	11	15	11	5	5

Mode 7								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	3	3	4	4	4	4	3	3
20-29	3	3	5	5	5	5	3	3
30-39	3	3	6	6	6	6	3	3
40-49	3	3	7	7	7	7	3	3
50-59	3	3	8	8	15	8	3	3

Mode 8								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	3	3	4	4	4	4	3	3
20-29	3	3	5	5	5	5	3	3
30-39	3	3	6	6	6	6	3	3
40-49	3	3	7	7	7	7	3	3
50-59	3	3	8	8	15	8	3	3

Mode 12								
Area	Facility Type							
Type	10-19	20-29	30-39	40-49	50-59	60-69	70-89	90-99
10-19	3	6	6	13	4	6	3	3
20-29	4	6	6	6	5	6	4	4
30-39	4	8	8	8	6	8	4	4
40-49	4	10	10	10	7	10	4	4
50-59	5	12	12	12	15	12	5	5

Table 7-1 (cont'd)

Highway to Transit Speed Conversion

2000 Treasure Coast Regional Planning Model

PART II – Highway to Transit Curves (speeds in mph)

Low Highway Speed (X1), Low Transit Speed (Y1)
High Highway Speed (X2), High Transit Speed (Y2)

1	
30.0	2.5
70.0	2.5

2	
30.0	30.0
70.0	70.0

3	
26.0	26.0
43.0	35.0

4	
26.0	26.0
50.0	45.0

5	
42.0	42.0
55.0	50.0

6	
18.0	***11.0***
32.0	*20.0*

7	
22.0	13.0
35.0	22.0

8	
18.0	***12.0***
37.0	***24.0***

9	
18.0	14.0
36.0	***28.0***

10	
18.0	11.0
36.0	***22.0***

11	
24.0	16.0
48.0	29.0

12	
24.0	***15.0***
48.0	***24.0***

13	
10.0	6.0
26.0	***14.0***

14	
7.0	7.0
40.0	20.0

15	
30.0	30.0
70.0	70.0

LEGEND:

Mode
1 = Walk (Centroid Connector)
2 = Auto Connector
3 = Sidewalk
4 = Local Bus (Palm Beach & Broward)
5 = Local Bus (Miami-Dade)
6 = Express Bus
7 = Metro-Rail
8 = Tri-Rail
12 = Local Bus (Tri-Rail Feeder)

Facility Type
10-19 = Freeway
20-29 = Divided Arterial
30-39 = Undivided Arterial
40-49 = Collector
50-59 = Local (Centroid Connector)
60-69 = One Way
70-79 = Ramps
80-89 = HOV
90-99 = Toll Links

Area Type
10-19 = CBD
20-29 = Fringe
30-39 = Residential
40-49 = OBD
50-59 = Rural

Transit Network Summary

One transit network was developed for TCRPM. The AM and Midday networks are same. Each route is coded as a 2-way route if the bus route follows exactly the same route in the inbound and outbound directions. All bus routes were coded to accurately reflect the actual street routes followed by the buses to the maximum extent possible, using available highway network lines. Special links (Facility Type 59) links were coded for those roadways that are required for maintaining the continuity of transit routes, but are not in the highway network. The AM and Midday 2000 base year transit networks reflect the 2000 transit services of Indian River County, St. Lucie County and Martin County.

7.2 TRANSIT PATH

The transit path are developed in the Transit module. Transit path first identifies the minimum paths between all pair of zones by all available transit modes. After paths are created and travel time skims are constructed, the transit cost for each preferred path is calculated based on boarding and transfer fares. Multiple paths are built both for AM peak and midday periods. The multinomial logit model (adapted from Polk County) requires seven sets of transit paths for each peak and midday period. These are:

- Local Bus with Walk Access;
- Express Bus with Walk Access; (Placeholder)
- Metro-Rail with Walk Access; (Placeholder)
- Tri-Rail with Walk Access; (Placeholder)
- Express Bus with Auto Access; (Placeholder)
- Metro-Rail with Auto Access; and, (Placeholder)
- Tri-Rail with Auto Access. (Placeholder)

Paths are developed using parameters intended to isolate a mode, or a submode, such as walk or auto access. People tend to perceive the time they spend walking to transit, waiting to broad, and waiting for transfers, as greater than it actually is. The model multiplies these times by a weighting factor to better reflect how people perceive them in choosing transit paths. Also, because travelers usually do not like to make transfers, a penalty time is added for each transfer. Transit path selection criteria for each mode depends then on the following parameters: time weighting coefficients, minimum and maximum wait times, transfer penalty, and mode deletion.

7.3 TRANSIT SKIM AND FARE

The Transit module also develops the transit skim files. Skim files for each of the seven paths were also developed. Each of the skim matrix files contains 12 tables. Those tables are:

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

The skim and fare matrices are used by the mode choice program.

After minimum transit travel time paths have been identified, total fares for each transit path are also calculated. Total transit fares are a function of boarding and transfer costs. Transit fare information was assembled from individual MPO transit planners for use in the 2000 model update. **Tables 7-3 & 7-4** summarize the 2000 transit path building and fare parameters respectively.

Table 7-3

Transit Path Building Parameters

2000 Treasure Coast Regional Planning Model

```
/*      WALK    TO      LOCAL   BUS     */
/*For   Route   Enumeration*/
MAXFERS=4
EXTRA =                 1
EXTRA =                 1
SPREAI =                1
SPREADFUNC=1
SPREAI =                0
REWAI =                 3
REWAI =                 10
LOOKBACK=0.0

/*For   Route   Enumeration and         Evaluation*/
RUNFACTOR[1]=2.25
RUNFACTOR[101]=2.25
RUNFACTOR[2]=9.99
RUNFACTOR[3]=2.25
RUNFACTOR[4]=1.00
RUNFACTOR[5]=1.00
RUNFACTOR[6]=9.99
RUNFACTOR[7]=9.99
RUNFACTOR[8]=9.99
RUNFACTOR[9]=9.99
RUNFACTOR[10]=9.99
RUNFACTOR[11]=9.99
RUNFACTOR[12]=1.00

WAITF NODES=1000-99999

XFERC FROM=4,   TO=4
XFERC FROM=4,   TO=5
XFERC FROM=4,   TO=6
XFERC FROM=4,   TO=7
XFERC FROM=4,   TO=8
XFERC FROM=4,   TO=12
XFERC FROM=5,   TO=4
XFERC FROM=5,   TO=5
XFERC FROM=5,   TO=6
XFERC FROM=5,   TO=7
XFERC FROM=5,   TO=8
XFERC FROM=5,   TO=12
XFERC FROM=8,   TO=12
XFERC FROM=12,  TO=4
XFERC FROM=12,  TO=5
XFERC FROM=12,  TO=6
XFERC FROM=12,  TO=7
XFERC FROM=12,  TO=8
XFERC FROM=12,  TO=12
```

```
BRDPEN[1]=0
BRDPEN[2]=999
BRDPEN[3]=0
BRDPEN[4]=0
BRDPEN[5]=0
BRDPEN[6]=999
BRDPEN[7]=999
BRDPEN[8]=999
BRDPEN[9]=0
BRDPEN[10]=0
BRDPEN[11]=0
BRDPEN[12]=0

/*For   Route   Evaluation*/
ALPHA         =       1
LAMBDAW       =       0
LAMBDAA       =       0
CHOICECUT=0.05
IWAITCURV NODES=1000-99999
XWAITCURV N=1000-99999
WAITFACTOR=2.5,N=1000-99999
FARESYSTE MODE=4
FARESYSTE MODE=12
FARESYSTE MODE=6
FARESYSTE MODE=8

VALUEOFTIME=255*15.00
```

Table 7-4

Transit Fare Matrix

2000 Treasure Coast Regional Planning Model

```
FARESYSTEM NUMBER=1 LONGNAME="MODE04" NAME="M04" STRUCTURE=FLAT SAME=CUMULATIVE,
IBOARDFARE=1.00,FAREFROMFS=0.50,1.00,0.50,0.50,0.00
FARESYSTEM NUMBER=2 LONGNAME="MODE12" NAME="M12" STRUCTURE=FREE
FARESYSTEM NUMBER=3 LONGNAME="MODE06" NAME="M06" STRUCTURE=FLAT SAME=CUMULATIVE,
IBOARDFARE=1.00,FAREFROMFS=0.50,1.00,0.50,0.50,0.00
FARESYSTEM NUMBER=4 LONGNAME="MODE04F" NAME="M04F" STRUCTURE=FLAT SAME=CUMULATIVE,
IBOARDFARE=0.50,FAREFROMFS=0.50,0.50,0.50,0.50,0.00
FARESYSTEM NUMBER=5 LONGNAME="MODE08" NAME="M08" STRUCTURE=FLAT SAME=CUMULATIVE,
IBOARDFARE=2.00,FAREFROMFS=0.00,0.00,0.00,0.00,0.00
;FARESYSTEM NUMBER=6 LONGNAME="TRIRAIL ZONE", NAME="TRIZONE", STRUCTURE=COUNT, FARE2
;FARETABLE=1-1.67,2-2.50,3-3.33, 4-3.75, 5-4.17, 6-4.58, 7-5.00

/*
COMPANY = 1, MODE =  4, LINES = 1-89,101-255
COMPANY = 2, MODE = 12, LINES = 1-255
COMPANY = 3, MODE =  6, LINES = 1-255
COMPANY = 4, MODE =  4, LINES = 92-97
COMPANY = 5, MODE =  8, LINES = 200
BOARDING FARES = (1,100)
                 (2,00)
                 (3,100)
                 (4,50)
                 (5,00)
TRANSFER FARES = (1-1,50 ) (1-2,00 ) (1-3,50 ) (1-4,50 ) (1-5,-00)
                 (2-1,100) (2-2,00 ) (2-3,100) (2-4,50 ) (2-5,-00)
                 (3-1,50 ) (3-2,00 ) (3-3,50 ) (3-4,50 ) (3-5,-00)
                 (4-1,50 ) (4-2,00 ) (4-3,50 ) (4-4,50 ) (4-5,-00)
                 (5-1,00 ) (5-2,00 ) (5-3,00 ) (5-4,00 ) (5-5,00 )

Tri-Rail:
6677   942   5.0     0  9999  9999   3.0   2.0  1  TR: I95 IN PALM BEACH   3
2172    17   5.0   100     0     0   3.0   2.0  1  TR: DEERFIELD BEACH     3
2180   172   5.0   275     0     0   3.0   2.0  1  TR: POMPANO BEACH       3
3106   389   5.0   750     0     0   3.0   2.0  1  TR: CYPRESS CREEK       4
4178   282   5.0   750     0     0   3.0   2.0  1  TR: FT LAUDERDALE       4
4960   649   5.0    50     0     0   3.0   2.0  1  TR: AIRPORT/GRIFFIN RD  5
5088   692   5.0   750     0     0   3.0   2.0  1  TR: SHERIDAN STOP       5
5330   726   5.0   182     0     0   3.0   2.0  1  TR: HOLLYWOOD           5
6678   943   5.0     0  9999  9999   3.0   2.0  1  TR: I95 IN MIAMI-DADE   6

&ZFARE1       Tri Rail Fare in Cents for 1 Zones Traveled
167
&ZFARE2       Tri Rail Fare in Cents for 2 Zones Traveled
250
&ZFARE3       Tri Rail Fare in Cents for 3 Zones Traveled
333
&ZFARE4       Tri Rail Fare in Cents for 4 Zones Traveled
375
&ZFARE5       Tri Rail Fare in Cents for 5 Zones Traveled
417
&ZFARE6       Tri Rail Fare in Cents for 6 Zones Traveled
458
&ZFARE7       Tri Rail Fare in Cents for 7 Zones Traveled
500

*/
```

8. MODE CHOICE MODEL

The mode choice model determines the amount of travel that will take place on each available mode of transportation. Separate models are used for the three main trip purposes (HBW, HBNW and NHB). This is because people have a different propensity for using transit for different types of trips. For example, people are more willing to use transit for work trips than for other trips. In addition, separate models are used to estimate mode choice by automobile as a surrogate measure of income.

Model structure

Pre-mode choice model

Following trip distribution, 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 non-motorized mode is the base alternative and has a utility of 0. The results of the binary logit estimation are presented in Table 2 with the t-statistics in brackets. The variables shown in Table 2 are used only for the motorized mode. The variables "No car in Household" and "Fewer Cars Than Workers in Household" are coded as 0/1 dummy variables.

The HBSchool trips are not handled in the pre-mode choice model, as discussed below.

Table 8-1

Pre-Mode Choice Model Estimation Results

2000 Treasure Coast Regional Planning Model

PURPOSE	HBW	HBShop	HBSR	HBO	NHBW	NHBO
Constant	4.87 (9.9)	4.15 (10.1)	1.40 (11.8)	2.00 (19.3)	3.88 (12.8)	3.27 (20.5)
Trip Distance	0.238 (2.3)	0.290 (2.6)	0.260 (5.7)	0.494 (9.4)	0.701 (2.4)	0.166 (3.5)
Total Employment within 1 mile of Attraction Zone	-9.8e-5 (-1.6)				-1.1e-4 (-2.1)	-3.9e-5 (-1.5)
No car in Household		-4.91 (-6.0)	-3.00 (-3.7)	-1.95 (-3.5)		
Fewer Cars Than Workers in Household	-2.12 (-3.5)	-1.33 (-2.4)	-0.626 (-2.1)	-0.917 (-3.5)		
Commercial Employment within 1 mile of Attraction Zone		-3.1e-4 (-1.5)	-1.2e-4 (-1.3)	-3.3e-4 (-5.0)		
Observations	1507	1451	1146	3120	1419	3015
Final log likelihood (L)	-58.9	-91.2	-424.6	-664.6	-87.4	-384.5
D.O.F.	4	5	5	5	3	3
Rho^2 (0)	0.944	0.909	0.465	0.693	0.911	0.816
Rho^2 (c)	0.158	0.228	0.101	0.139	0.094	0.025

Mode Choice Model

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. However, the two express modes are set with a constant of -999 in the model so that no trips would be allocated to these modes.

The model parameters are summarized in Table 8-2.

Table 8-2
Mode Choice Model Parameters
2000 Treasure Coast Regional Planning Model

Parameter	HBW	HBNW	NHB
In-vehicle time (min)	-0.020	-0.015	-0.015
First wait time < 7 minutes (min)	-0.045	-0.035	-0.045
First wait time > 7 minutes (min)	-0.023	-0.035	-0.045
Walk time (min)	-0.045	-0.035	-0.045
Auto access time (min)	-0.020	-0.015	-0.018
Transfer time	-0.045	-0.035	-0.045
Parking cost (cents)	-0.0032	-0.0048	-0.0048
Auto cost (cents)	-0.0025	-0.0048	-0.0048
Transit fare (cents)	-0.0032	-0.0048	-0.0048

The HBSchool model is a simple cross-classification into mode by location of origin. Both motorized and non-motorized trips are modeled together. The cross-classification table was based on the results from the household travel survey and is shown in Table 8-3. It should be noted that the "public bus" mode shares are so high that if they represented public transportation trips the total would exceed the entire observed ridership on the transit system. So it is assumed that these trips do not represent public transportation, and they are not included in the transit trip tables developed for assignment to the transit network.

Table 8-3
HBSchool Mode Choice Table
2000 Treasure Coast Regional Planning Model

County	Auto Driver	Shared Ride 2	Shared Ride 3+	Public Bus	School Bus	Walk/Bike
Indian River	0.2180	0.3083	0.1955	0.0000	0.2481	0.0301
Martin	0.1720	0.2376	0.1807	0.0127	0.2611	0.0382
St. Lucie	0.2582	0.1909	0.3250	0.0392	0.2386	0.0458

Model calibration and validation

Pre-mode choice model

The pre-mode choice model was validated by comparing the modeled shares of non-motorized to the observed shares from the household travel survey. It should be noted that the shares are based on a low number of observations from the survey, but the shares appear to be reasonable, and no better data exist. Table 8-4 shows the comparison of the final calibrated non-motorized mode shares to the observed shares and the new constants for all trip purposes.

Table 8-4
Pre-Mode Choice Calibration
2000 Treasure Coast Regional Planning Model

	Non-Motorized Mode Share		
Purpose	**Model**	**Survey**	**Calibrated Constant**
HBW	0.81%	0.80%	3.880
HBSH	1.58%	1.59%	3.950
HBSR	14.55%	14.64%	0.987
HBO	4.04%	4.03%	2.305
NHBW	6.69%	6.76%	1.907
NHBO	1.27%	1.27%	3.920

Mode choice

A set of mode choice validation targets was developed from the ridership data and the household travel survey. The targets for the transit mode were obtained from the ridership data (see Table 4-1). As discussed above, it was assumed that linked and unlinked transit trips were the same for this sparse transit network. It was also assumed, in the absence of transit on-board survey data, that 50 percent of transit trips were home based work, 40 percent were home based non-work, and 10 percent were non-home based. This is similar to the shares of transit trips by purpose in other areas. The transit trips were validated by a geographic market segmentation of Martin/St. Lucie Counties and Indian River County and (for home based trips) by auto ownership level. Table 8-5 shows the trips by county segmentation.

Table 8-5
Transit Trips by County Segmentation
2000 Treasure Coast Regional Planning Model

	HBW	**HBNW**	**NHB**	**Total**
Indian River	266	213	53	532
Martin/St. Lucie	97	78	19	194
Total	363	291	72	726

The calibration targets for transit trips for each auto ownership level were obtained by adjusting the implied transit shares from the validation targets to get new shares by auto ownership level. The adjustments were based on the different mode shares by auto ownership level used in the Southeast Regional Planning Model (SERPM). The adjustment process is shown in Table 8-6. These adjusted shares were

Table 8-6
Transit Shares by Auto Ownership Level
2000 Treasure Coast Regional Planning Model

	Base (adjusted from Table 6 ridership)	SERPM	Adjusted
HBW			
0 car	0.15%	59.2%	1.84%
1 car	0.15%	8.0%	0.25%
2+ car	0.15%	0.9%	0.03%
HBNW			
0 car	0.03%	10.6%	0.26%
1 car	0.03%	2.3%	0.06%
2+ car	0.03%	0.5%	0.01%

For the three auto submodes (vehicle occupancy levels), the shares by each trip purpose were obtained from the household travel survey. It should be noted that there was only a small number of zero-car households, and so the shares for zero and one-car households were computed together.

Table 8-7 shows the final validation targets by mode, trip purpose, and vehicle availability level, as well as the final calibrated mode shares and constants.

Table 8-7
Mode Choice Model Calibration Results
2000 Treasure Coast Regional Planning Model

Zero car households

HBW	Target Share	Model share	Revised Constant
Drive Alone	81.75%	81.44%	0
Shared Ride 2	14.10%	14.39%	-1.17
Shared Ride 3+	2.32%	2.30%	-2.77
Walk to Local Transit	1.84%	1.87%	3.95
Total		100.00%	

HBNW	Target Share	Model share	Revised Constant
Drive Alone	40.37%	40.47%	0
Shared Ride 2	37.62%	37.40%	0.375
Shared Ride 3+	21.75%	21.87%	0.005
Walk to Local Transit	0.26%	0.25%	2.32
Total	100.00%	100.00%	

Table 8-7

Mode Choice Model Calibration Results (continued)

2000 Treasure Coast Regional Planning Model

One car households

HBW	Target Share	Model share	Revised Constant
Drive Alone	83.07%	83.09%	0
Shared Ride 2	14.32%	14.23%	-1.21
Shared Ride 3++	2.35%	2.43%	-2.76
Walk to Local Transit	0.25%	0.25%	1.44
Total		100.00%	

HBNW	Target Share	Model share	Revised Constant
Drive Alone	40.46%	40.69%	0
Shared Ride 2	37.70%	37.67%	0.377
Shared Ride 3++	21.79%	21.59%	-0.014
Walk to Local Transit	0.06%	0.06%	0.75
Total	100.00%	100.00%	

Two+ car households

HBW	Target Share	Model share	Revised Constant
Drive Alone	90.60%	90.75%	0
Shared Ride 2	7.01%	6.91%	-2.02
Shared Ride 3++	2.36%	2.31%	-2.95
Walk to Local Transit	0.03%	0.03%	-0.45
Total	100.00%	100.00%	

HBNW	Target Share	Model share	Revised Constant
	Share	Share	Const
Drive Alone	43.04%	42.99%	0
Shared Ride 2	35.15%	35.22%	0.255
Shared Ride 3++	21.80%	21.78%	-0.06
Walk to Local Transit	0.01%	0.01%	-0.72
Total	100.00%	100.00%	

9. HIGHWAY ASSIGNMENT MODEL

The last step of the four-step modeling process is assignment. Highway assignments are normally performed on a daily basis with trips factored to a peak hour for volume-to-capacity calculations. This was accomplished through an equilibrium assignment process.

Evaluation of the highway assignment model is based on comparisons between traffic counts and model assigned volumes. Simulated traffic volumes are compared to traffic counts in several different ways to determine whether the coded highway network accurately represents the highway systems, and to determine whether the various assumptions used in the model chain are reasonable. The highway evaluation program (HEVAL) is the primary tool used in comparing simulated volumes with the traffic counts.

The 1996 and 2000 updates of TCRPMs include two separate model streams: (1) the "full" model stream, which includes a transit option, and (2) the "highway-only" model stream.

9.1 MODEL ENHANCEMENTS

The highway assignment model uses an equilibrium assignment algorithm. In equilibrium, all travelers are assigned to their optimum path; no traveler can have a shorter path available. Each assignment of trips from all zones is considered one assignment iteration. Typically, multiple iterations are required before networks can reach full equilibrium. After each assignment iteration, link speeds are readjusted and the next assignment is performed.

The 1996 and 2000 Treasure Coast models include several model enhancements – application of multiple BPR curves, variable UROAD factors, CONFAC factors, and the "highway-only" process.

The following subsections describe the parameters (BPR Curves, UROAD, CONFAC) of the VFACTORS file - a new addition to the FSUTMS since the V5.3 release. The 2000 model must be run with the FSUTMS V5.5 release.

Multiple BPR Curves

An iterative equilibrium technique is used in TCRPM. It is also a standard practice in most of the FSUTMS highway models in Florida. In this type of assignment, all of the trips are loaded, the paths are revised, the trips are again loaded, and the procedure is repeated until equilibrium is reached. This technique uses the BPR formulation, in which link travel time is recomputed using the following relationship:

$$T_c = T_f * \{1 + \alpha (v/c)^{\beta}\}$$

Where,

T_c = congested link travel time
T_f = link free-flow travel time
v = assigned volume
c = link capacity
α,β = BPR parameters

Since speed is distance divided travel time, the BPR formulation in terms of speeds is expressed as follows:

$$S_c = S_f \ / \{1 + \alpha (v/c)^{\beta}\}$$

Where,

S_c = estimated congested speed

S_f = link free-flow speed

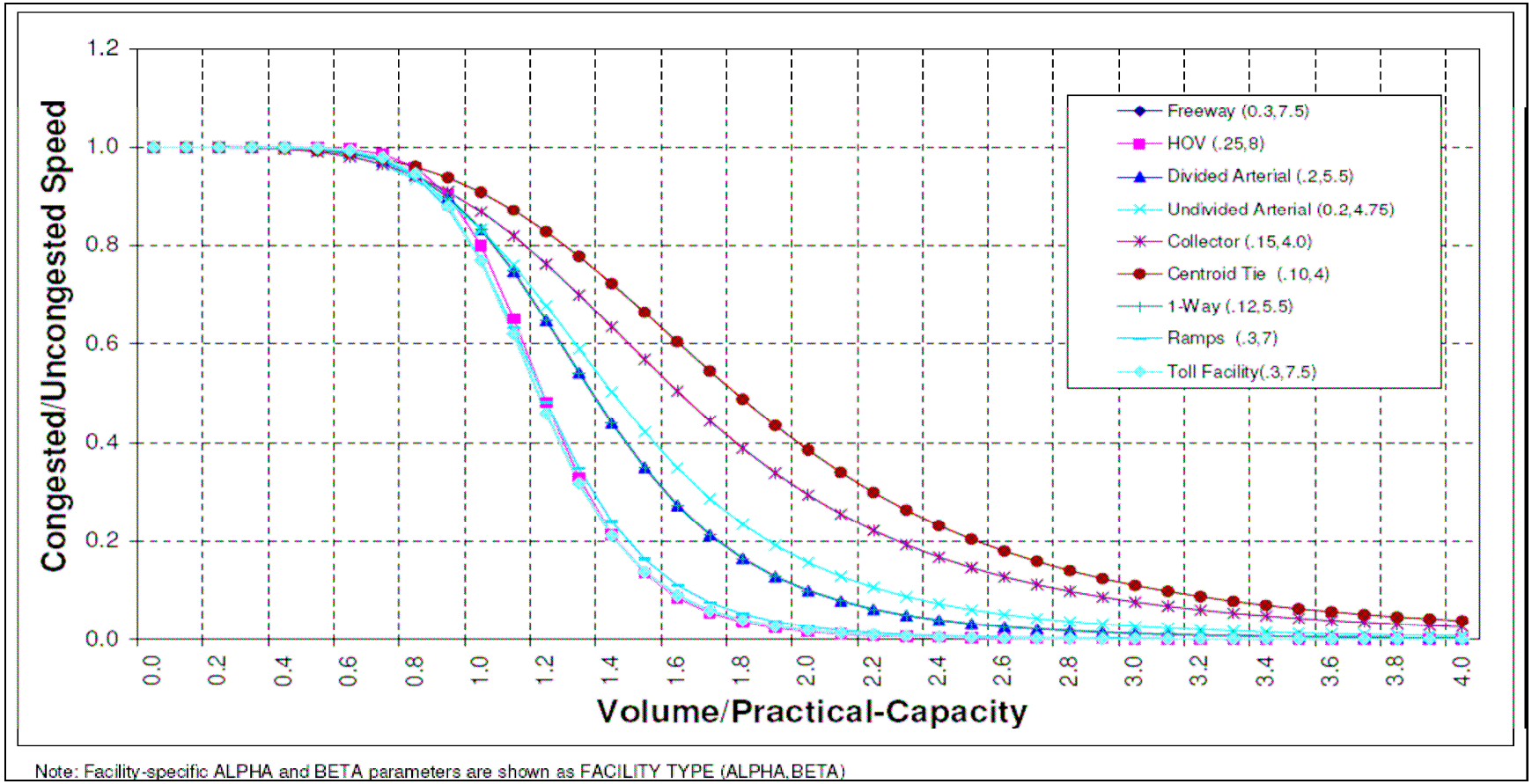
One of the enhancements in TCRPM highway assignment process is the incorporation of multiple BPR curves based on the facility type of the roadways. Using different BPR curves for different types of facilities recognizes that each facility type has its own unique characteristics for responding to congestion. For example, freeways can generally handle a higher level of congestion than surface streets before speeds begin to deteriorate. However, with more congestion, speeds deteriorate to stop-and-go conditions much more quickly on freeways than they do on surface streets. It should be noted that the BPR curve is not sensitive to the impacts of signal spacing, timing and coordination. However, the free-flow speed calculation process implemented in TCRPM (see **Chapter 4** of **TR3** – Model Application Guidelines) considers the signal cycle length and coordination. The BPR curve does not accurately estimate speeds for volume/capacity ratios greater than 1.0.

The BPR curves determine both the level of congestion (the volume/capacity ratio at which speeds begin to deteriorate) and the rate at which they deteriorate as congestion increases. Similar to 1996, the 2000 update study used multiple BPR curves. The curves are specified in the VFACTORS file (see **Appendix B**). The adjustment to the BPR curves was done by changing the α and the β values. In addition, speeds and capacities were also adjusted. The facility specific BPR curves, used in the 2000 validated model, are shown in **Figure 9-1**. A relatively steeper curve was used for freeways and HOV facilities. The curves for arterials were comparatively less steep.

Variable UROAD Factors

The volume-delay relationship assumes practical capacity. A UROAD factor of 0.75 commonly has been used since FSUTMS was first developed. The UROAD factors, entered in the VFACTORS file, convert the possible (LOS E) capacity to the practical/design capacity (LOS C) – a condition at which trips generally begin diverting to less congested facilities. The Volume-Delay relationship and UROAD factors work together. The capacities from the look-up speed-capacity table are converted to the practical capacity for use in the volume-delay relationship.

Figure 9-1
Volume-Delay Curves
2000 Treasure Coast Regional Planning Model



Note: Facility-specific ALPHA and BETA parameters are shown as FACILITY TYPE (ALPHA,BETA)

The LOS C capacity is largely subjective and is determined by different methods, depending upon the facility type and traffic control. Thus, there no longer exists a simple method of relating LOS C to LOS E capacity that works across the full range of facilities or traffic controls. For example, LOS C on freeway is determined by traffic density, while LOS on two-lane roads is determined by percent time delay.

The validated VFACTORS file is shown in **Appendix B**.

CONFAC Factors

For the 24-hour model, CONFAC is the ratio between the peak hour traffic and the daily traffic. The FSUTMS programs use the CONFAC parameter to convert hourly capacity to a daily value so that a 24-hour assignment can be made. Historically, the method for obtaining daily capacity restrained traffic assignments has been to divide the hourly capacity by CONFAC (say, 0.10) to reflect the daily highway capacity.

The VFACTORS file specifies the value of CONFAC, which is the fraction of the 24-hour trip table that occurs in the peak hour for the purpose of calculating volume/capacity (capacities almost always are stated as hourly volumes). Empirical evidence shows that as overall congestion grows, the value of CONFAC decreases. The theoretical lower limit for CONFAC is 0.042 (1/24), that is, conditions are equally congested during every hour of the day. The upper limit is 1.00, which would occur when all traffic moves during a single hour (admittedly unlikely). Quick response values for CONFAC for areas with a population of more than one million are about 0.095. Generally, FDOT District Four models use a value between 0.080 and 0.10.

The 2000 model used smaller values of CONFAC for the limited access facilities (freeways, expressways, HOV facility, and toll facilities) compared to those used for other facilities, recognizing the fact that limited access facilities in general are more congested compared to other facilities.

9.2 MODEL VALIDATION

The HEVAL routine is used by most FSUTMS models to perform systems evaluation activities and to assist in the model validation process. HEVAL operates in one of two modes (validation and analysis). The validation mode allows the user to print a variety of reports designed to assist in the validation task. The validation mode does not require any input data other than the loaded highway network file. The analysis mode requires a series of input parameters to calculate the number of accidents, emissions, fuel consumption, and construction costs in addition to the loaded link record file.

Validation of a traffic assignment involves an examination of several statistics, most of which are related to actual ground counts taken on various links throughout the network. The traffic counts for TCRPM were identified through a variety of sources. One key to successful highway model validation is the availability of accurate traffic counts, in sufficient quantity. Efforts were made to insure that sufficient counts were included in the model for all available 1-digit area type and facility combinations. The percentages of the links with traffic counts by the facility and area types are shown in **Table 2-3** of **Chapter 2**. This table shows that overall 30 percent of the links have traffic counts. In terms of link mileages, about 38 percent of links mileages have traffic counts (see **Table 2-4**). The statistics of percent links and percent link mileages with traffic counts (**Tables 2-3** and **2-4**) will be very useful to evaluate the validation results presented in this chapter. For example, there will be less confidence in the evaluation results (say volume-over-count ratio) in locations where fewer links have traffic counts. These counts provide the basis for highway assignment evaluation, and are input into the model as link attributes.

The highway assignment model was validated by adjusting several model parameters. The most notable ones are the parameters of the VFACTORS file and the speeds and capacities. The validated speeds and capacities are presented in **Tables 2-5 to 2-9**. Numerous changes were made to the speed values through speed modifier file (SPDADJ.DBF file) and to the capacity by the capacity modifier record of SPDCAP table. Numerous manual adjustments were made to the speed values through the use of posted speed and signalization data during the earlier stages of model validation. **Chapter 4** of **Technical Report 3** (Model Application Guidelines) documents these changes. Hierarchy of speeds and capacities among the facility and area types were always checked when a change in speed and capacity was made.

9.3 RESULTS AND COMPARISON

The HEVAL and RMSE routines generated statistics provide the basis on which the ability of the model to simulate observed conditions is judged and include VMT-V/C ratios, VHT-V/C ratios, volume-over-count (V/C) ratios, volume to count comparisons for screenlines and cutlines, and percent root mean square error.

These statistics for the full model with the transit option as well as the highway-only model, summarized from HEVAL and RMSE outputs, are presented in numerous tables in this chapter for the highway assignment model. **Chapter 8** of this report provides a detailed discussion on the transit model and validation results. The subsections present the highway validation results largely in tabular form.

Systemwide Statistics

The ratios of VMT and VHT, as calculated from assigned volumes versus those calculated from ground counts, were available. Further aggregations of these statistics were compared by area type, facility type, and for the total of all links. A ratio of 1.0 indicates exact agreement between the assigned volumes and the traffic counts. The systemwide values (see **Table 9-1**) of total VMT-V/C, VHT-V/C and V/C ratios range 0.99-1.00 in all measures. ***Table 3*** *of the* ***FDOT Model Update Task C Report*** suggests that the systemwide V/C ratios should be within ±5 percent. These overall ratios indicate that both full and highway-only models perform extremely well relative to these performance measures.

Beside volume-over-count ratios, the systemwide results from the 2000 full and highway-only validation runs are also summarized in **Table 9-1** on the following items:

- Number of Links
- System Miles
- Lane Miles
- Directional Miles
- Average Link Volume
- VMT
- VMT per household
- VMT per Capita
- VHT
- VHT per household
- VHT per Capita
- Input (Free-Flow) Speed
- Model Congested Speed
- Change and Percent Change in Speed
- Root Mean Square Error (RMSE) percentage

Table 9-1

Systemwide Model Validation Statistics

2000 Treasure Coast Regional Planning Model

	Year 2000 Validation Results
Total Households	181,449
Total Population	434,000
Total Number of Non-Centroid Links	3,078
Total Non-Centroid System Miles	1,357
Total Non-Centroid Lane Miles	3,253
Average Non-Centroid Total Volume	10,302
Total Non-Centroid VMT(NC-VMT)	12,847,935
NC-VMT per Household	70.81
NC-VMT per Capita	29.60
Total Non-Centroid VHT(NC-VHT)	274,723
NC-VHT per Household	1.51
NC-VHT per Capita	0.63
Total NC ORIGINAL Speed (mph)	44.67
Total NC CONGESTED Speed (mph)	42.79
Total Change in Speed (mph)	-1.88
Tot. Percent Change in Speed	-4.21%
Total VMT-Volume/Count (VMT-V/C)	1.01
Total VHT-Volume/Count (VHT-V/C)	1.01
Total Volume/Count (V/C)	1.00

Count Range	Acceptable Range	RMSE Statistics
<5,000	45 - 55	55.20
5,000 - 10,000	35 - 45	31.85
10,000 - 20,000	27 - 35	20.87
20,000 - 30,000	24 - 27	15.88
30,000 - 40,000	22 - 24	2.05
40,000 - 50,000	20 - 22	
50,000 - 60,000	18 - 20	
60,000 - 70,000	17 - 18	
70,000 - 80,000	16 - 17	
80,000 - 90,000	15 - 16	
90,000 - 100,000	14 - 15	
100,000 - 400,000	<14	
ALL	**32 - 39**	**30.80**

Symbol Used:

NC = Non-Centroid, VMT = Vehicle-Miles-of -Travel, VHT = Vehicle-Hours-of-Travel, V/C = Volume-over-Count, and RMSE = Root-Mean-Square-Error

Table 9-1-1

Individual Counties RMSE Statistics

2000 Treasure Coast Regional Planning Model

		RMSE Statistics (%)		
Count Range	**Acceptable Range**	**Indian River**	**St. Lucie**	**Martin**
<5,000	45 - 55	49.69	60.98	58.07
5,000 - 10,000	35 - 45	35.62	25.00	34.18
10,000 - 20,000	27 - 35	17.38	23.13	22.95
20,000 - 30,000	24 - 27	0.00	13.03	17.71
30,000 - 40,000	22 - 24	0.00	0.00	2.05
40,000 - 50,000	20 - 22	0.00	0.00	0.00
50,000 - 60,000	18 - 20	0.00	0.00	0.00
60,000 - 70,000	17 - 18	0.00	0.00	0.00
70,000 - 80,000	16 - 17	0.00	0.00	0.00
80,000 - 90,000	15 - 16	0.00	0.00	0.00
90,000 - 100,000	14 - 15	0.00	0.00	0.00
100,000 - 400,000	<14	0.00	0.00	0.00
ALL	**32 - 39**	**30.20**	**31.42**	**30.26**

Results of full and highway-only models are very similar and are equal in many instances.

Percent Root Mean Square Error Statistics

The percent Root Mean Square Error (RMSE) for total areawide assignment is another aggregate measure to see how well the model chain has replicated ground counts. RMSE is the standard measure of error in system planning models.

The smaller the percent RMSE in the model, the higher the level of confidence in the model's ability to replicate existing traffic. The RMSE value (see **Table 9-1**) for the validated models is 30.80. These statistics are better than the suggested range of 32-39 percent.

Percent RMSE provides a comparison of estimated traffic volumes to observed counts by volume groups of different ranges for all links for which traffic counts are available. The RMSE results for all volume groups greater than 5,000 VPD are either better or within the suggested ranges. In case of the low volume group (<5,000 VPD), the RMSE statistics are slightly higher than the upper limits of suggested range. In case of low volume groups, these slight discrepancies are "tolerable", since errors introduced in such cases generally do not alter the design consideration. The RMSE statistics by the volume groups indicate that the simulated network contains the correct number and type of facilities and the relative speeds and capacities among facilities have resulted in an accurate assignment of traffic. Thus, by both systemwide V/C and RMSE measures, the validated models did an excellent job of replicating traffic counts.

Screenline, Cutline and Corridor Statistics

Screenlines, cutlines and corridors are cross-sections of roadways that travel in the same direction, and carry traffic considered significant within the study area. Screenlines and cutlines of TCRPM are based on those selected for the 1996 model. The locations of the screenlines and cutlines for the 2000 TCRPM are depicted in **Figure 9-2**.

In addition to aggregate summaries by area type and facility type, screenline summaries are produced by the HEVAL. **Table 9-2** summarizes the validation results of the screenlines and cutlines and several selected corridors in terms of assigned volume-to-ground-count (V/C) ratios. Results are summarized from both full and highway-only model runs.

Most of the screenline volume-over-count ratios lie within the FDOT-suggested guidelines of ±10 percent. The FDOT also suggested that the screenlines with volumes over 50,000 vehicle per day (VPD), estimated traffic volumes at screenlines should be within 10% of observed volumes for screenlines. Estimated traffic volumes for screenlines less than 50,000 VPD should be within 20% of observed traffic volumes. The screenlines that exceeded the suggested limit were investigated to see if any systematic pattern existed. The individual link volume/count ratios were examined through VIPER to see any systematic pattern. No such patters were found.

Figure 9-2
Screenline and Cutline Locations
2000 Treasure Coast Regional Planning Model

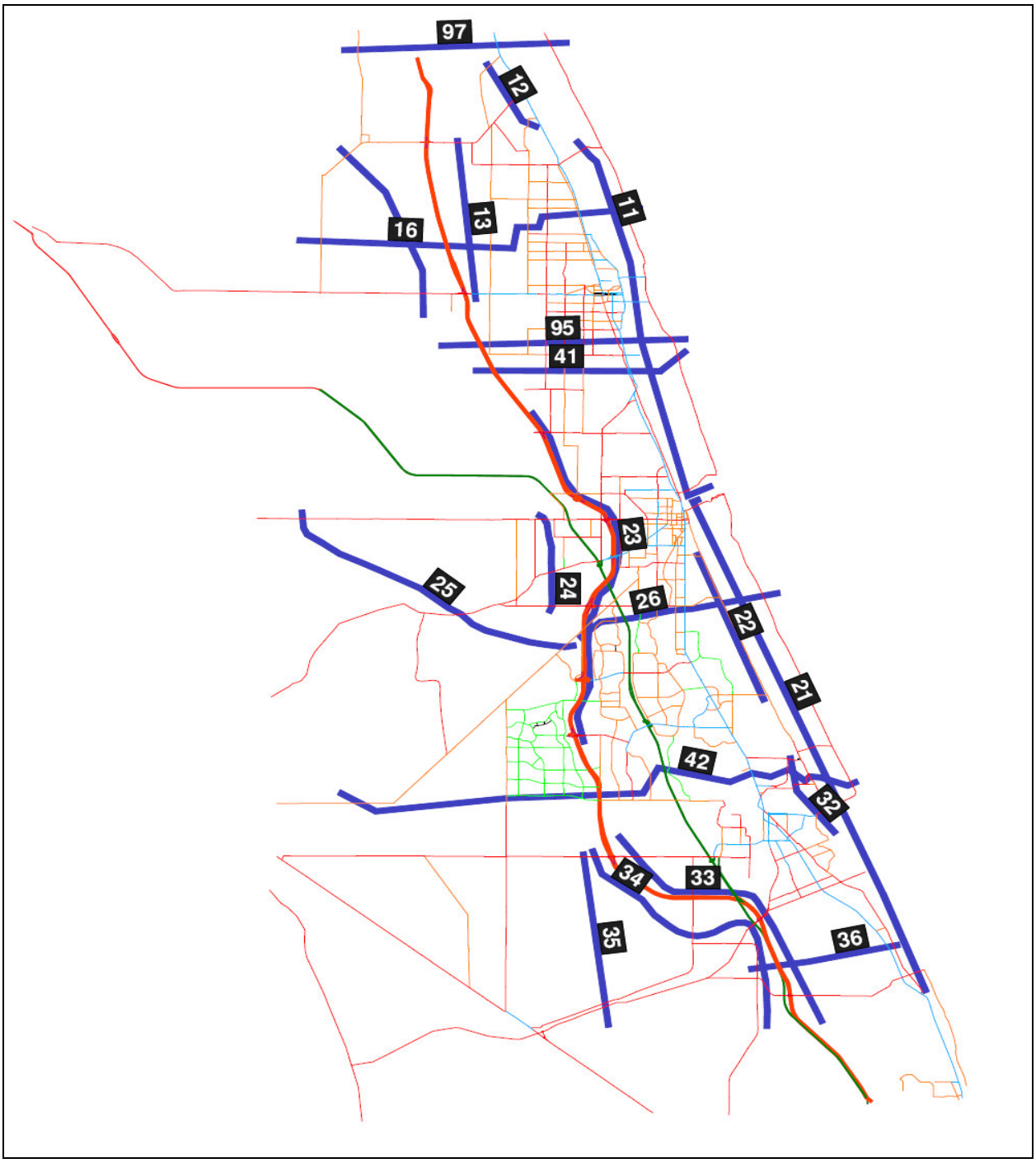


Table 9-2

Screenline, Cutline and Corridor Volume-over-Count Summary

2000 Treasure Coast Regional Planning Model

SL, CL & & Corridor Number	Screenline(SL), Cutline(CL) & Corridor Name	Total Count	TCRPM Total Volume	TCRPM Volume/ Count (V/C)
11	EW East of US1 in Indian River County	55,142	58,749	1.07
12	NW of US1 in Indian River County	23,394	22,242	0.95
13	East of I95 in Indian River County	34,274	35,836	1.05
14	West of I95 in Indian River County	36,866	37,873	1.03
16	EW Across Region in Indian River County	158,343	150,478	0.95
21	East of US1 in St.Lucie County	48,636	48,131	0.99
22	West of US1 in St.Lucie County	36,264	39,338	1.08
23	East of I95 in St.Lucie County	34,764	32,467	0.93
25	EW flow from the Okeechobee County line to I95	4,712	5,015	1.06
26	NS South of Midway Road	124,971	137,754	1.10
32	EW East of US1 in Martin County	47,742	48,239	1.01
33	EW East of Florida's Turnpike	43,977	44,820	1.02
34	EW West of FLorida's Turnpike	33,448	29,036	0.87
35	EW Western Boundry of Martin County	12,086	11,718	0.97
36	NS Southern boundary of Martin County	201,752	218,838	1.08
41	Indian River- St. Lucie Boundary	146,613	150,080	1.02
42	St. Lucie - Martin County Boundary	234,783	229,692	0.98
97	Northern Boundary of Indian River	7,362	7,844	1.07
	ALL Screnlines (No. 11 to 97)	**1,285,129**	**1,308,150**	**1.02**

Volume-over-Count Statistics

Several indicators are available for determining the overall performance of the highway assignment model. The volume-over-count (V/C) statistics are one of the key statistics. The ratios of VMT and VHT, as calculated from assigned volume versus those calculated from ground counts were evaluated for those links where ground counts were available. The simple ratios of assigned volume over count also were recorded. Further aggregations of these statistics were compared by area type, facility type, their combinations and for the total of all links. A ratio of 1.0 indicates exact agreement between the assignment and the traffic count.

The FDOT Model Update Task C Report recommends a ±15 percent accuracy for assigned VMT (or VHT) to count VMT (or VHT). It is assumed that each combination of area/facility/number of lanes and link group contains a statistically valid number of links. For link groups having less than 100,000 total VMT (or less than 20,000 VHT), only a ±25 percent accuracy level is desired. Although not specified in the Task C report, assigned V/C ratios by their facility and area type were also analyzed. The analysis was based on a ±10 percent accuracy level, as was recommended for screenlines and cutlines.

The summaries of the VMT based volume/count, VHT based volume/count and simple unweighted volume/count statistics by major facility and area type are summarized in **Tables 9-3-1** and **9-3-2** show Volume/Count statistics for the whole treasure coast region as well as individual counties.

Table 9-3-1

Region-Wide Volume-over-Count Ratio by Facility and Area Types

2000 Treasure Coast Regional Planning Model

Facility Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios	Area Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios
1. Freeway (11-17)	1.04	1.05	1.04	1.04	1. CBD (11-14)	0.96	0.96	0.87	0.93
2. Divided Arterial (21-25)	1.05	1.03	1.02	1.03	2. Fringe (21)	0.94	0.95	1.01	0.97
3. Undivided Arterial (31-38)	0.95	0.95	0.93	0.94	3. Residential (31-35)	1.01	0.98	0.98	0.99
4. Collector (41-48)	0.93	0.93	0.98	0.95	4. OBD (41-45)	1.00	1.01	1.01	1.01
6. One-Way & Frontage (61-68)	1.07	1.05	0.97	1.03	5. Rural (51-52)	1.02	1.03	1.04	1.03
7. Ramps (71-79, 97-98)									
8. HOV (81-85)	1.04	1.05	1.10	1.06					
9. Toll Facility (91-95)	1.01	1.01	1.00	1.01	**TOTAL:**	**1.01**	**1.01**	**1.00**	**1.01**

Table 9-3-2

County-Specific Volume-over-Count Ratio by Facility and Area Types

2000 Treasure Coast Regional Planning Model

Indian River

Facility Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios	Area Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios
1. Freeway (11-17)	1.00	1.00	1.01	1.00	1. CBD (11-14)	0.92	0.91	0.83	0.89
2. Divided Arterial (21-25)	1.03	1.03	1.03	1.03	2. Fringe (21)	0.90	0.87	0.95	0.91
3. Undivided Arterial (31-38)	0.92	0.92	0.85	0.90	3. Residential (31-35)	0.89	0.88	0.89	0.89
4. Collector (41-48)	0.85	0.85	0.93	0.88	4. OBD (41-45)	1.00	1.00	1.02	1.01
6. One-Way & Frontage (61-68)	1.09	1.09	0.99	1.06	5. Rural (51-52)	0.97	0.97	1.00	0.98
7. Ramps (71-79, 97-98)									
8. HOV (81-85)									
9. Toll Facility (91-95)					**TOTAL:**	**0.96**	**0.95**	**0.96**	**0.96**

St. Lucie

Facility Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios	Area Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios
1. Freeway (11-17)	1.08	1.09	1.06	1.08	1. CBD (11-14)	0.60	0.62	0.61	0.61
2. Divided Arterial (21-25)	0.93	0.92	0.94	0.93	2. Fringe (21)	0.83	0.84	0.89	0.85
3. Undivided Arterial (31-38)	1.04	1.05	1.06	1.05	3. Residential (31-35)	1.08	1.04	1.04	1.05
4. Collector (41-48)	1.00	0.98	1.04	1.01	4. OBD (41-45)	0.97	0.97	0.92	0.95
6. One-Way & Frontage (61-68)					5. Rural (51-52)	1.01	1.03	1.04	1.03
7. Ramps (71-79, 97-98)									
8. HOV (81-85)									
9. Toll Facility (91-95)	1.05	1.06	1.15	1.09	**TOTAL:**	**1.04**	**1.03**	**1.02**	**1.03**

Martin

Facility Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios	Area Type	VMT Vol./Count	VHT Vol./Count	Volume/ Count	Ave. of 3 Vol/ Count Ratios
1. Freeway (11-17)	1.03	1.04	1.04	1.04	1. CBD (11-14)	1.17	1.20	1.04	1.14
2. Divided Arterial (21-25)	1.13	1.10	1.07	1.10	2. Fringe (21)	1.07	1.09	1.14	1.10
3. Undivided Arterial (31-38)	0.95	0.95	0.93	0.94	3. Residential (31-35)	0.99	0.97	0.96	0.97
4. Collector (41-48)	0.94	0.96	0.92	0.94	4. OBD (41-45)	1.01	1.01	1.01	1.01
6. One-Way & Frontage (61-68)	0.82	0.82	0.82	0.82	5. Rural (51-52)	1.05	1.05	1.06	1.05
7. Ramps (71-79, 97-98)									
8. HOV (81-85)									
9. Toll Facility (91-95)	1.03	1.03	1.04	1.03	**TOTAL:**	**1.03**	**1.03**	**1.01**	**1.02**

The summaries of three V/C ratios and their averages for each of the combination of the main facility and area types for Treasure Coast region and individual counties are shown in **Tables 9-4-1** to **9-4-4**, respectively. The row (facility) and column (area) marginal of these two tables are shown in Table **9-3**. The facility and area type combination statistics in **Tables 9-4** and **9-5** were used to adjust the model parameters (for example, speeds and capacities).

Volume/Count ratios by area type and facility type provide measures of trip generation as well as trip distribution characteristics of the model chain. Results of these comparisons suggest that the highway assignment reflects well the observed vehicular traffic patterns. The systemwide V/C statistics by major facility and area group in most cases (see **Table 9-3**) has satisfied the FDOT-suggested guidelines.

Table 9-4-1

Region Wide Volume-over-Count Ratios by Facility and Area Type Combinations

2000 Treasure Coast Regional Planning Model

1. VMT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.20		1.00	**1.04**
2. Divided Arterial (21-26)	0.92	0.97	1.06	1.02	1.57	**1.05**
3. Undivided Arterial (31-38)	0.51	0.91	0.93	0.95	0.98	**0.95**
4. Collector (41-48)	1.19	0.64	0.90	0.88	1.11	**0.93**
6. One-Way & Frontage (61-68)	1.09		1.13	0.97		**1.07**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.04	**1.04**
TOTAL	**0.96**	**0.94**	**1.01**	**1.00**	**1.02**	**1.01**

2. VHT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.19		1.00	**1.05**
2. Divided Arterial (21-26)	0.94	0.95	1.03	1.02	1.57	**1.03**
3. Undivided Arterial (31-38)	0.56	0.97	0.93	0.98	0.98	**0.95**
4. Collector (41-48)	1.16	0.68	0.90	0.91	1.11	**0.93**
6. One-Way & Frontage (61-68)	1.06		1.13	0.96		**1.05**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.05	**1.05**
TOTAL	**0.96**	**0.95**	**0.98**	**1.01**	**1.03**	**1.01**

3. Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.11			**1.04**
2. Divided Arterial (21-26)	0.88	1.04	1.01	1.03	1.01	**1.02**
3. Undivided Arterial (31-38)	0.51	0.94	0.92	0.94	1.47	**0.93**
4. Collector (41-48)	1.19	0.84	0.99	0.88	0.98	**0.98**
6. One-Way & Frontage (61-68)	0.91		1.10	0.96	1.27	**0.97**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.10	**1.10**
TOTAL	**0.87**	**1.01**	**0.98**	**1.01**	**1.04**	**1.00**

4. Averages of 3 Volume/Count Ratios

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.17		0.67	**1.04**
2. Divided Arterial (21-26)	0.91	0.99	1.03	1.02	1.38	**1.03**
3. Undivided Arterial (31-38)	0.53	0.94	0.93	0.96	1.14	**0.94**
4. Collector (41-48)	1.18	0.72	0.93	0.89	1.07	**0.95**
6. One-Way & Frontage (61-68)	1.02		1.12	0.96		**1.03**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.06	**1.06**
TOTAL	**0.93**	**0.97**	**0.99**	**1.01**	**1.03**	**1.01**

Table 9-4-2

Indian River Volume-over-Count Ratios by Facility and Area Type Combinations

2000 Treasure Coast Regional Planning Model

1. VMT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)					1.00	**1.00**
2. Divided Arterial (21-26)	0.73	1.02	0.99	1.05		**1.03**
3. Undivided Arterial (31-38)		0.31	0.89	0.83	0.96	**0.92**
4. Collector (41-48)	1.19		0.84	0.75	0.91	**0.85**
6. One-Way & Frontage (61-68)	1.09		1.13	1.06		**1.09**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)						
TOTAL	**0.92**	**0.90**	**0.89**	**1.00**	**0.97**	**0.96**

2. VHT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)					1.00	**1.00**
2. Divided Arterial (21-26)	0.74	1.01	0.97	1.05		**1.03**
3. Undivided Arterial (31-38)		0.31	0.87	0.84	0.95	**0.90**
4. Collector (41-48)	1.16		0.85	0.78	0.92	**0.86**
6. One-Way & Frontage (61-68)	1.06		1.13	1.06		**1.08**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)						
TOTAL	**0.91**	**0.87**	**0.88**	**1.00**	**0.97**	**0.95**

3. Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)					1.01	**1.01**
2. Divided Arterial (21-26)	0.70	1.08	1.00	1.05		**1.03**
3. Undivided Arterial (31-38)		0.40	0.82	0.92	0.96	**0.85**
4. Collector (41-48)	1.19		0.94	0.78	1.13	**0.93**
6. One-Way & Frontage (61-68)	0.91		1.10	1.06		**0.99**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)						
TOTAL	**0.83**	**0.95**	**0.89**	**1.02**	**1.00**	**0.96**

4. Averages of 3 Volume/Count Ratios

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)					1.00	**1.00**
2. Divided Arterial (21-26)	0.72	1.04	0.99	1.05		**1.03**
3. Undivided Arterial (31-38)		0.34	0.86	0.86	0.96	**0.89**
4. Collector (41-48)	1.18		0.88	0.77	0.99	**0.88**
6. One-Way & Frontage (61-68)	1.02		1.12	1.06		**1.05**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)						
TOTAL	**0.89**	**0.91**	**0.89**	**1.01**	**0.98**	**0.96**

Table 9-4-3

St. Lucie Volume-over-Count Ratios by Facility and Area Type Combinations

2000 Treasure Coast Regional Planning Model

1. VMT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.21		0.95	**1.08**
2. Divided Arterial (21-26)	0.61	0.79	0.91	1.06		**0.93**
3. Undivided Arterial (31-38)	0.51	1.75	1.09		0.90	**1.04**
4. Collector (41-48)		0.64	0.95	0.67	1.43	**1.00**
6. One-Way & Frontage (61-68)						
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.05	**1.05**
TOTAL	**0.60**	**0.83**	**1.08**	**0.97**	**1.01**	**1.04**

2. VHT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.21		0.95	**1.09**
2. Divided Arterial (21-26)	0.62	0.80	0.91	1.06		**0.92**
3. Undivided Arterial (31-38)	0.56	1.62	1.09		0.88	**1.05**
4. Collector (41-48)		0.68	0.95	0.67	1.45	**0.98**
6. One-Way & Frontage (61-68)						
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.06	**1.06**
TOTAL	**0.62**	**0.84**	**1.04**	**0.97**	**1.03**	**1.03**

3. Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.12		0.98	**1.06**
2. Divided Arterial (21-26)	0.64	0.76	0.95	1.08		**0.94**
3. Undivided Arterial (31-38)	0.51	1.59	1.12		0.91	**1.06**
4. Collector (41-48)		0.84	1.07	0.67	1.40	**1.04**
6. One-Way & Frontage (61-68)						
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.15	**1.15**
TOTAL	**0.61**	**0.89**	**10.40**	**0.92**	**1.04**	**1.02**

4. Averages of 3 Volume/Count Ratios

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.18		0.96	**1.08**
2. Divided Arterial (21-26)	0.62	0.78	0.92	1.07		**0.93**
3. Undivided Arterial (31-38)	0.53	1.65	1.10		0.90	**1.05**
4. Collector (41-48)		0.72	0.99	0.67	1.43	**1.01**
6. One-Way & Frontage (61-68)						
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.09	**1.09**
TOTAL	**0.61**	**0.85**	**4.17**	**0.95**	**1.03**	**1.03**

Table 9-4-4

Martin Volume-over-Count Ratios by Facility and Area Type Combinations

2000 Treasure Coast Regional Planning Model

1. VMT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.08		1.03	**1.03**
2. Divided Arterial (21-26)	1.17	1.02	1.32	0.99	1.57	**1.13**
3. Undivided Arterial (31-38)		1.11	0.80	1.04	1.04	**0.95**
4. Collector (41-48)			0.89	1.16		**0.94**
6. One-Way & Frontage (61-68)				0.82		**0.82**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.03	**1.03**
TOTAL	**1.17**	**1.07**	**0.99**	**1.01**	**1.05**	**1.03**

2. VHT-Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.08		1.03	**1.04**
2. Divided Arterial (21-26)	1.20	1.02	1.33	0.99	1.57	**1.10**
3. Undivided Arterial (31-38)		1.12	0.81	1.09	1.03	**0.95**
4. Collector (41-48)			0.90	1.12		**0.96**
6. One-Way & Frontage (61-68)				0.82		**0.82**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.03	**1.03**
TOTAL	**1.20**	**1.09**	**0.97**	**1.01**	**1.05**	**1.03**

3. Volume/Count Ratio

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.08		1.03	**1.04**
2. Divided Arterial (21-26)	1.04	1.15	1.37	1.01	1.47	**1.07**
3. Undivided Arterial (31-38)		1.13	0.81	0.98	1.04	**0.93**
4. Collector (41-48)			0.79	1.09		**0.92**
6. One-Way & Frontage (61-68)				0.82		**0.82**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.04	**1.04**
TOTAL	**1.04**	**1.14**	**0.96**	**1.01**	**1.06**	**1.01**

4. Averages of 3 Volume/Count Ratios

Facility Type	Area Type: CBD (11-14)	Fringe (21)	Residential (31-35)	OBD (41-45)	Rural (51-52)	TOTAL
1. Freeway (11-17)			1.08		1.03	**1.04**
2. Divided Arterial (21-26)	1.14	1.06	1.34	1.00	1.54	**1.10**
3. Undivided Arterial (31-38)		1.12	0.81	1.04	1.04	**0.94**
4. Collector (41-48)			0.86	1.12		**0.94**
6. One-Way & Frontage (61-68)				0.82		**0.82**
7. Ramps (71-79, 97-98)						
8. HOV (81-85)						
9. Toll Facility (91-95)					1.03	**1.03**
TOTAL	**1.14**	**1.10**	**0.97**	**1.01**	**1.05**	**1.02**

All of the statistics from the 2000 Treasure Coast Regional Planning Model presented in numerous tables in this chapter certify that the 2000 Treasure Coast model produced quality results and the model is validated well with respect to FDOT and national standards.

10. SUMMARY AND CONCLUSION

The TCRPM model provides the MPO, the Department and others with a dependable tool for forecasting travel demands in the Treasure Coast Area. This model is capable of estimating the number of vehicles on a future road or passengers on a new local bus service. This information is used in the MPO planning process to aid decision makers in their selection of transportation plan alternatives, polices and programs.

The 2000 TCRPM is not simply an update to its predecessor models. It includes a number of major enhancements, as listed in the Introduction chapter. Notably, the enhancements include:

- implements a new process to estimate the free-flow speeds based on posted speed limits and signalization data,
- uses lifestyle variables that eliminate the anomaly of generating working trips from retirement communities,
- uses special tabulation data (STP60) and other socioeconomic data that are based on Census 2000,
- includes two non-home-based purposes to enhance the modeling capabilities of those trips,
- implements the newly developed trip attraction rates that not only depends on employment classes and other production variables but also uses area types,
- used the recent Southeast Florida travel surveys to calibrate the trip generation and distribution parameters and also used these surveys to develop the transit validation targets,
- uses purpose-specific combination of trip tables distributed with the free flow and congested skims,
- implements a three purpose truck model to simulate the truck traffic to meet the TEA-21 emphasis of freight movement planning,
- explicitly models public school trips that are based on school zone boundaries,
- uses two-digit network Facility Type/Area Type codes, and

A wide range of adjustments was made to the modeling system to produce good calibration. Some of the adjustments are global in nature, some are local in nature, and some are combinations of both. The validation statistics demonstrates that 2000 TCRPM does an excellent job of replicating existing travel conditions.

This report summarized the model validation efforts for 2000 TCRPM and compared the results against the validation criteria established for FSUTMS and elsewhere in nation. In most cases, the performance of the model meets or exceeds the established criteria. All key model statistics and data were summarized and compared through numerous tables and figures. It was shown that both highway and transit models do a good job of replicating ground counts and transit use. The evaluation measures indicate a high degree of correlation between observed and estimated traffic volumes as forecasted by the model.

TCRPM is a reliable tool for system level transportation planning analyses. As with all models, however, the model results should be adjusted before using them in planning and design. In addition, the model results could be used to provide detailed information, such as traffic volumes and bus patronage to state, district and local engineers and planners for use in their design of facilities.

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