Florida Department of TRANSPORTATION

Florida Department of Transportation

Northwest Florida Regional Planning Model

2020 Model Validation Report

FDOT Office
District Three Systems Planning

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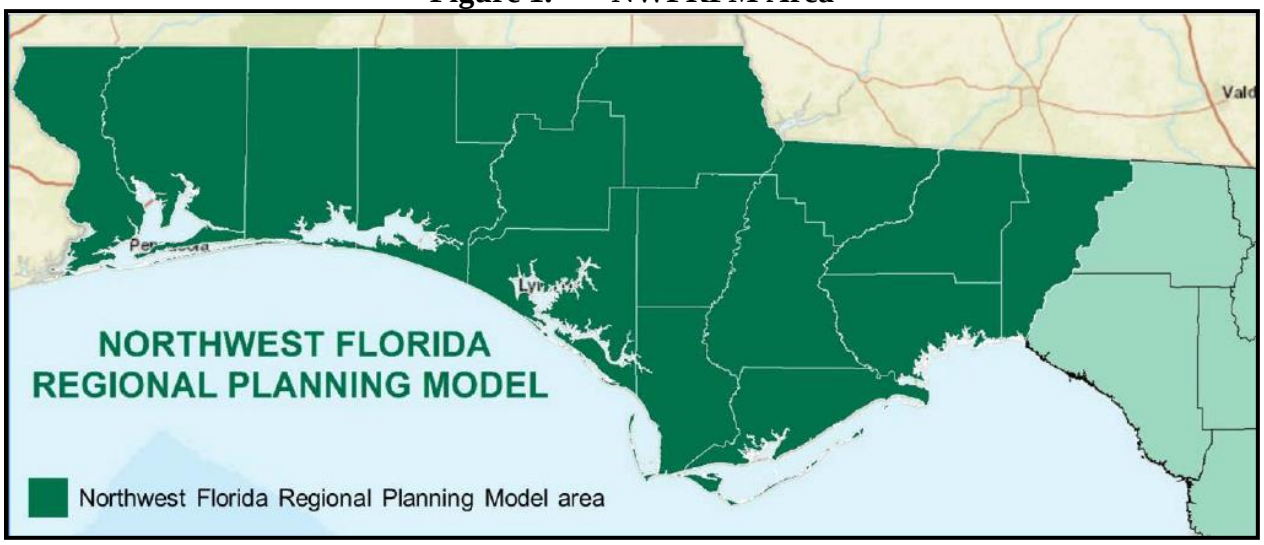
1. Introduction

The Northwest Florida Regional Planning Model (NWFRPM) Validation Report documents the Base Year 2020 model validation of the NWFRPM version 4.0. The validation was performed by re-evaluating and updating the previous version of the NWFRPM (version 3.1.4) based on the Florida Standard Urban Transportation Model Structure (FSUTMS) using PTV VISUM software.

1.1. Model Background

The NWFRPM is a "traditional" FSUTMS four-step, trip-based model that has been in different stages of development since its inception. Originally, this model was designed to support Florida Department of Transportation (FDOT or Department) projects in District 3 in areas that were otherwise not included in existing Metropolitan Planning Organization (MPO) travel demand models. The model was then expanded to include the MPO urbanized areas, replacing these individual models. Model coverage was further expanded and now includes all of FDOT District 3, as depicted in **Figure 1**.

Figure 1. NWFRPM Area



The NWFRPM model area includes a 16-county region with four urbanized areas and multiple adjacent rural counties. The model area includes the region governed by the Emerald Coast Regional Council (ECRC) and the Apalachee Regional Planning Council (ARPC). The urbanized areas and their respective MPOs include the Florida-Alabama Transportation Planning Organization (TPO) (FATPO) which encompasses Escambia and Santa Rosa Counties as well as a portion of Baldwin County in Alabama; the Okaloosa-Walton TPO (OWTPO); Bay County TPO; and the Capital Region Transportation Planning Agency (CRTPA), which includes the Tallahassee urbanized area as well as Gadsden, Leon, Wakulla, and Jefferson counties.

In addition to the Regional Councils and their planning areas, the other counties within FDOT District 3 are included in the NWFRPM as they are the subject of transportation planning efforts by the Department, counties, local governments, and organizations such as Opportunity Florida (a coalition of public-private stakeholders). Each of these entities and organizations are working towards

transportation improvements in the Florida Panhandle. The additional counties include Calhoun, Franklin, Gulf, Holmes, Jackson, Liberty, and Washington.

1.2. Model Validation

This model validation effort updated the model base year from 2015 to 2020. There are two key differences that need to be highlighted for this update. First, the model software has changed from CUBE Voyager to PTV VISUM. Second, the pandemic that occurred in the spring of 2020 had a significant impact on travel patterns and employment rates. Therefore, the validation uses pre-pandemic 2019 traffic count and employment data. All other aspects of the model procedures are consistent with the 2015 adopted model.

Additionally, the model's Traffic Analysis Zones (TAZ) were updated as part of the 2020 validation. The model has a total of 4240 TAZs. External TAZs are represented by zones 4100-4126 and 4208-4240.

This model update and validation effort utilized existing, readily available data. Other than traffic counts routinely collected by FDOT, no other transportation surveys were implemented. The primary data sources utilized were the U.S. Census Bureau's American Community Survey, Dun & Bradstreet employment data, Florida Department of Business and Professional Regulation, Florida Department of Education, and university enrollment reports.

1.3. Report Organization

This report documents the 2020 model validation following the traditional four-step model process, as detailed in the following chapters.

- **Chapter 2: Trip Generation** – Converts socio-economic data into person trip ends based on production and attraction rates for the study area; total person trip productions and attractions are balanced for each TAZ for each trip purpose.
- **Chapter 3: Highway Network** – A series of links and nodes that represent the roadway system.
- **Chapter 4: Trip Distribution** – Establishes the trip origins and destinations between all TAZs based on the application of a gravity model with friction factors.
- **Chapter 5: Transit Model** – A line file that represents the transit network.
- **Chapter 6: Mode Choice** – Presents the mode share by households, single occupancy vehicle, high occupancy vehicle, and transit by trip purpose.
- **Chapter 7: Trip Assignment** – Determines the highway and transit routes used.
- **Chapter 8: Reporting** – Generates statistics for the highway and transit assignments, provides a summary of the validation statistics, including a comparison with each urbanized area and rural county statistics, as well as recommendations for future model improvements.

Each chapter has a description of the model step as it was implemented in VISUM, including any issues or challenges faced during development, parameter values and their descriptions, and the model results in tabular format. Additionally, a filterable Excel file of all of the Variables in the VISUM model is included as a separate file in the Model Document folder, titled NWFRPM_V4_ATTRIBUTE_list.xlsx.

2. Trip Generation

Trip generation is the process that determines the number of trip ends that originate (productions) and terminate (attractions) within each TAZ. Trip productions generally reflect the home end of a trip while trip attractions typically consist of the work, shop, recreational, or school end of the trip.

This chapter describes validation of the trip generation model, including an overview of the model structure and a summary of model results. (Documentation on the socio-economic data used in the trip generation model is available in the *NWFRPM 2020 and 2050 Socio-Economic Data Documentation* report.) Trip generation model performance was assessed based on a review of trip productions by purpose and aggregate trip rates as well as similar statistics from the validated 2015 NWFRPM.

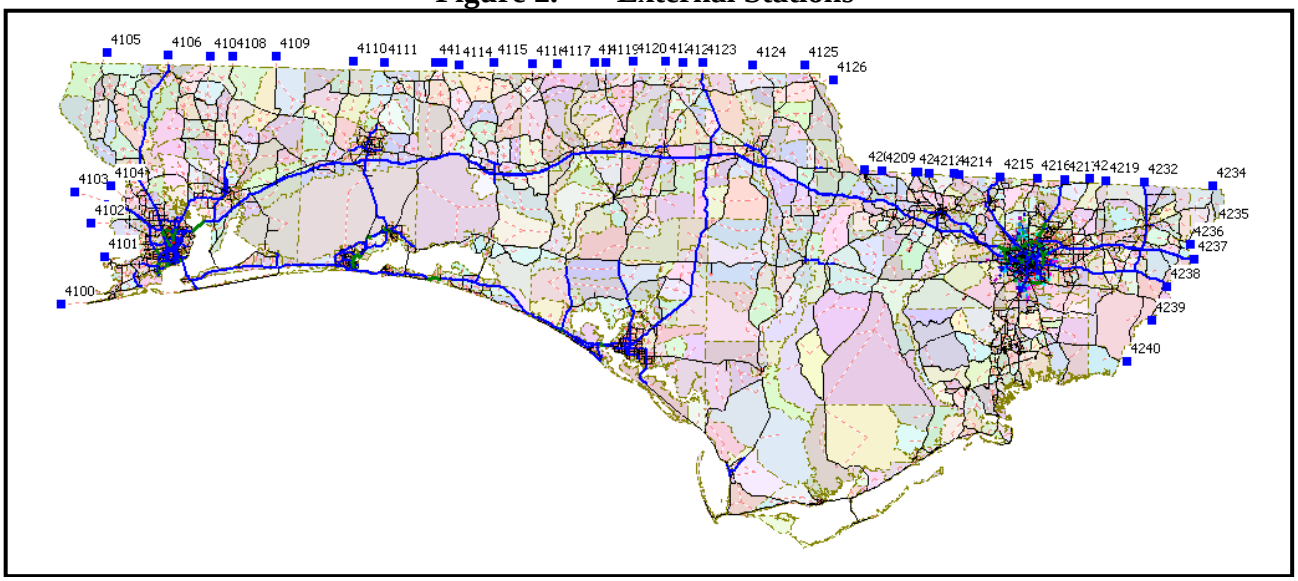
The trip generation process was completely scripted in the model chain. Data inputs are formatted using the same variable names as traditional FSUTMS ASCII text files to make it easier for first time VISUM users. However, the input data is in a single VISUM List format instead of two ASCII text files.

2.1. External Trips

External trips are vehicle trips having at least one trip end (origin or destination) outside of the model area boundary. External trips consist of two components: External-to-External (EE), or "through" trips, and Internal-to-External (IE) trips. EE trips have both trip ends outside of the model area while IE trips have one trip end within the model area and the other trip end outside of the model area.

The NWFRPM includes 47 external stations. **Figure 2** depicts the location of all external zones in relation to the roadway network. External TAZs are represented by zones 4100-4126 and 4208-4240.

Figure 2. External Stations



2.1.1. External Model Structure

The NWFRPM VISUM Trip Generation module includes internal trip generation and also estimates EE trips. The Trip Generation module is used to build an EE trip matrix through the use of an input file EE_TRIPS. The EETRIPS Matrix contains a series of origin and destination zones with their respective estimate of through trips. IE trips are generated based on input of the ZONES List.

2.1.2. External Model Trip Development and Validation

The first step in developing the external trip data was to estimate total external trips at each external zone, based on available 2019 traffic counts obtained from the 2019 Florida Transportation Information (FTI) Access Database. Next, total external trips were split into EE and IE components based on the proportion of EE and IE trips in the 2015 validated model. The EE trips were placed in the EE_TRIPS Table file and the IE trips were entered in the ZONES file.

2.1.3. Assessment of Data Sources and External Model Results

Origin-Destination (O-D) survey data is typically utilized to develop external trip data. However, since survey data was unavailable for this model validation, the methodology described in **Section 2.1.2** was used to develop this dataset. See the NWFRPM_V4_ATTRIBUTE_list.xlsx Excel file in the Model Document folder for the dataset details.

A review of the count stations close to the model boundaries indicate a reasonable match of external travel movements. It should be noted that there were not counts at every external station; for those stations the best available count was utilized. In some cases, the count was far away from the external station and thus the evaluation was based on overall traffic patterns in the area. A more in-depth discussion of volume to count ratios can be found in **Chapter 7** of this report.

2.2. Model Parameters

Several files are required in the trip generation module. They include trip production rates, trip attraction rates, and special generators (SPECGEN Table). This section describes the methodology used to develop these model parameters.

2.2.1. Trip Generation Rates

Trip generation rates consist of two components for each trip purpose: production and attraction rates. The 2020 NWFRPM was based on the previous model's use of the TBRPM lifestyle approach, which characterizes households as retired, working with children, and working without children. Home-based trip productions are applied to these categories, and trip rates are further stratified by auto ownership levels (0, 1, 2, and 3+). The total number of home-based trips produced for a given zone is determined by applying the appropriate trip production rate. Trip production rates are in the GENRATES_LIFESYTLE Table file. A further breakdown of the stratification of household classifications and their corresponding trip production rates are shown in **Table 1**.

Trip attraction rates were the same as those developed for the validated 2015 NWFRPM. Trip attraction rates coincide with each of the model's MPO areas. They are in the following Table files: ESARATES (FATPO), OKWAARATES (OWTPO), BAARATES (Bay County TPO), TAARATES (CRTPA), and RUARATES (Rural Areas). The trip attraction rates for each of these areas and hotel-motels are shown in **Tables 2 – 7**, respectively.

A subarea numbering scheme was continued from the 2015 NWFRPM, which aligns with the MPO jurisdictions, while using counties as the fundamental geography for groupings. This model also includes a new variable named "DISTRICT", which makes MPO reporting easier. **Figure 3** displays the subareas.

Figure 3. NWFRPM Sub-areas

Table 1. Trip Production Rates

CATEGORY	PURPOSE	AUTOS	HHTYPE	PRATE	PURNAME	HHNAME
101	1	0	1	0.07	HBW	Retired
111	1	1	1	0.39	HBW	Retired
121	1	2	1	0.56	HBW	Retired
131	1	3	1	0.89	HBW	Retired
102	1	0	2	1.33	HBW	WNC
112	1	1	2	1.66	HBW	WNC
122	1	2	2	2.76	HBW	WNC
132	1	3	2	3.35	HBW	WNC
103	1	0	3	0.64	HBW	WWC
113	1	1	3	2.25	HBW	WWC
123	1	2	3	2.69	HBW	WWC
133	1	3	3	2.85	HBW	WWC
201	2	0	1	0.29	HBSH	Retired
211	2	1	1	0.88	HBSH	Retired
221	2	2	1	1.23	HBSH	Retired
231	2	3	1	1.36	HBSH	Retired
202	2	0	2	0.09	HBSH	WNC
212	2	1	2	0.36	HBSH	WNC
222	2	2	2	0.67	HBSH	WNC
232	2	3	2	0.85	HBSH	WNC
203	2	0	3	0.11	HBSH	WWC
213	2	1	3	0.51	HBSH	WWC
223	2	2	3	0.86	HBSH	WWC
233	2	3	3	0.99	HBSH	WWC
301	3	0	1	1.39	HBSR	Retired
311	3	1	1	2.19	HBSR	Retired
321	3	2	1	3.39	HBSR	Retired
331	3	3	1	3.67	HBSR	Retired
302	3	0	2	0.44	HBSR	WNC
312	3	1	2	1.09	HBSR	WNC
322	3	2	2	1.83	HBSR	WNC
332	3	3	2	2.35	HBSR	WNC
303	3	0	3	0.78	HBSR	WWC
313	3	1	3	1.71	HBSR	WWC
323	3	2	3	2.89	HBSR	WWC
333	3	3	3	3.15	HBSR	WWC
401	4	0	1	0.61	HBO	Retired
411	4	1	1	1.85	HBO	Retired
421	4	2	1	2.15	HBO	Retired
431	4	3	1	2.36	HBO	Retired
402	4	0	2	0.47	HBO	WNC
412	4	1	2	0.73	HBO	WNC
422	4	2	2	1.47	HBO	WNC
432	4	3	2	1.71	HBO	WNC
403	4	0	3	2.9	HBO	WWC
413	4	1	3	4.94	HBO	WWC
423	4	2	3	6.47	HBO	WWC
433	4	3	3	7.19	HBO	WWC

Notes: AUTOS= auto per household; HHTYPE= type of household; HBW= home-based work trip; HBSH= home-based shopping trip ; HBSR= home-based social recreational trip; HBO= home-based other trip; Retired= Retired Households; WNC= Working Households with no Children; WWC= Working Households with Children

Table 2. FATPO Trip Attraction Rates

PURPOSE	ARAT_IEMP	ARAT_CEMP	ARAT_SEMP	ARAT_TEMP	ARAT_TOTDU	ARAT_SENR
1	1.44	1.64	0.88	0.00	0.00	0.00
2	0.00	2.06	0.00	0.00	0.00	0.00
3	0.00	1.40	0.84	0.00	0.59	0.00
4	0.00	1.32	1.08	0.00	0.36	1.35
5	0.00	2.72	1.06	0.00	0.44	0.00
6	0.37	0.40	0.36	0.00	0.34	0.00

Table 3. OWTPO Trip Attraction Rates

PURPOSE	ARAT_IEMP	ARAT_CEMP	ARAT_SEMP	ARAT_TEMP	ARAT_TOTDU	ARAT_SENR
1	2.11	1.53	1.74	0.00	0.00	0.00
2	0.00	2.02	0.06	0.00	0.00	0.00
3	0.00	1.56	1.40	0.00	0.62	0.00
4	0.00	1.98	1.33	0.00	0.44	1.65
5	0.00	2.35	1.04	0.00	0.25	0.00
6	0.56	0.44	0.40	0.00	0.30	0.00

Table 4. Bay County TPO Trip Attraction Rates

PURPOSE	ARAT_IEMP	ARAT_CEMP	ARAT_SEMP	ARAT_TEMP	ARAT_TOTDU	ARAT_SENR
1	2.67	2.03	1.30	0.00	0.00	0.00
2	0.00	1.84	0.03	0.00	0.00	0.00
3	0.00	1.66	1.16	0.00	0.66	0.00
4	0.00	1.84	1.19	0.00	0.40	1.96
5	0.00	2.63	0.97	0.00	0.50	0.00
6	0.62	0.47	0.33	0.00	0.34	0.00

Table 5. CRTPA Trip Attraction Rates

PURPOSE	ARATEIND	ARATECOM	ARATESVC	ARATETOT	ARATEDUS	ARATESCH
1	1.67	1.40	1.25	0.00	0.00	0.00
2	0.00	2.05	0.00	0.00	0.00	0.00
3	0.00	1.16	1.04	0.00	0.43	0.00
4	0.00	1.90	1.22	0.00	0.09	1.26
5	0.00	3.52	1.12	0.00	0.13	0.00
6	0.50	0.44	0.39	0.00	0.27	0.00

Table 6. Rural County Trip Attraction Rates

PURPOSE	ARAT_IEMP	ARAT_CEMP	ARAT_SEMP	ARAT_TEMP	ARAT_TOTDU	ARAT_SENR
1	1.27	1.80	1.64	0.00	0.00	0.00
2	0.00	1.70	0.14	0.00	0.00	0.00
3	0.00	1.47	1.46	0.00	0.52	0.00
4	0.00	1.41	1.54	0.00	0.27	1.72
5	0.00	2.28	1.18	0.00	0.24	0.00
6	0.31	0.36	0.38	0.00	0.25	0.00

Table 7. Hotel and Motel Population Trip Attraction Rates

PURPOSE	HMPRATE
1	0.49
2	0.34
3	2.72
4	0.13
5	0.00
6	0.03
7	0.00

2.2.2. Special Generators

Special generators are used for activity centers that have a rate of activity significantly different from standard trip generation rates utilized in the trip generation model. Examples of these activity centers in the NWFRPM include recreational areas, beaches, colleges/universities, military bases, and airports. Applications of special generator zones deviate from trip generation procedures used in other TAZs and may create complications during future year model applications. Therefore, initial model runs were conducted without special generator adjustments. After running the model from trip generation through trip assignment, it was noticed that the military bases, with the exception of Naval Air Station (NAS) Pensacola and NAS Mainside, were attracting a considerably lower number of trips than the 2020 traffic counts indicated. The recreational areas, shopping centers, and colleges were all attracting considerably fewer trips than traffic counts indicated.

To account for these discrepancies, special generator adjustments were then made for the areas mentioned above using the 2020 NWFRPM Special Generators (SPECGEN Table). The number of trip productions and/or attractions to these special generators was either increased or decreased based on the circumstances and professional judgement. The model was run again from trip generation through trip assignment and resulted in volume to count ratios that were within acceptable ranges. **Table 8** provides a summary of special generator trips used in the validated 2020 NWFRPM.

Table 8. Special Generator Trips

ZONE	DESCRIPTION	P/A	OPERATION	NUMBER OF P/A	HBW %	HBSH %	HBSR %	HBO %	NHB %
108	Misc Navy Facilities	A	-	1000	0.00	0.00	0.00	50.00	50.00
174	Pensacola Airport	A	+	10000	0.00	0.00	0.00	100.00	0.00
209	Naval Air Station Pensacola	A	-	15000	40.00	0.00	30.00	0.00	30.00
220	Saufley Field	A	+	6000	0.00	0.00	0.00	100.00	0.00
234	Johnson Beach	A	+	1000	0.00	0.00	50.00	50.00	0.00
254	UWF Group Quarters	P	+	22000	0.00	20.00	20.00	60.00	0.00
268	Fort Pickens	A	+	6000	0.00	80.00	0.00	20.00	0.00
487	Santa Rosa Island	A	+	4500	0.00	80.00	0.00	20.00	0.00
557	PJC Milton	A	+	12000	0.00	0.00	86.00	14.00	0.00
661	Santa Rosa Mall	A	+	5000	0.00	40.00	0.00	0.00	60.00
669	Hurlburt Field	A	+	8000	0.00	0.00	0.00	100.00	0.00
696	Eglin AFB	A	+	1200	20.00	5.00	20.00	35.00	20.00
698	Eglin AFB	P	+	4000	30.00	20.00	20.00	20.00	10.00
698	Eglin AFB	A	+	20000	50.00	0.00	0.00	0.00	50.00
699	Eglin AFB	P	+	18000	40.00	20.00	20.00	20.00	0.00
705	Ft. Walton Beach Park	A	+	15000	0.00	0.00	0.00	0.00	100.00
713	Eglin AFB	P	+	5000	30.00	20.00	20.00	20.00	10.00
713	Eglin AFB	A	+	5000	50.00	0.00	0.00	25.00	25.00
761	Destin-Ft.Walton Beach Airport	A	+	35000	0.00	0.00	0.00	20.00	80.00
768	Henderson Beach Park	A	+	5000	0.00	0.00	0.00	0.00	100.00
844	Okaloosa Regional Airport	A	+	15000	0.00	0.00	0.00	0.00	100.00
971	Grayton Beach Park - Seaside	A	+	10000	0.00	0.00	0.00	0.00	100.00
1186	Panama City Airpor	A	+	15000	0.00	0.00	0.00	0.00	100.00
1305	Tyndall AFB	P	+	25000	70.00	0.00	0.00	0.00	30.00
1310	St. Andrews State Park	A	+	10000	0.00	0.00	0.00	0.00	100.00
1628	St. Joesph Peninsula	P	+	1500	30.00	30.00	0.00	30.00	10.00
1671	St. George Island	P	+	4000	30.00	30.00	0.00	30.00	10.00
1692	Alligator Point	P	+	500	30.00	30.00	0.00	30.00	10.00
2127	FAMU	A	+	12000	0.00	0.00	0.00	40.00	60.00
2128	FAMU	P	+	5000	0.00	0.00	0.00	100.00	0.00
2201	Governor's Square Mall	A	+	12000	0.00	40.00	0.00	0.00	60.00
2226	FAMU	P	+	3000	0.00	0.00	10.00	40.00	50.00
2240	FSU	P	+	5000	0.00	0.00	0.00	80.00	20.00
2243	FSU	P	+	3000	0.00	0.00	0.00	80.00	20.00
2244	FSU	P	+	1000	0.00	0.00	20.00	60.00	20.00
2245	FSU	A	+	16000	0.00	0.00	0.00	40.00	60.00
2246	FSU	P	+	3500	0.00	0.00	0.00	80.00	20.00
2247	FSU	P	+	1000	0.00	0.00	20.00	60.00	20.00
2248	FSU	P	+	3800	0.00	0.00	0.00	80.00	20.00
2250	FSU	A	+	12000	0.00	0.00	0.00	40.00	60.00
2375	TCC	A	+	20000	0.00	0.00	0.00	40.00	60.00
2376	TCC Student Housing	P	+	3500	0.00	0.00	10.00	90.00	0.00
2754	Tallahassee Airport	A	+	15000	0.00	0.00	0.00	80.00	20.00

Notes: P= Productions; A= Attractions; + = additional; - = subtracted; HBW= home-based work trip; HBSH= home-based shopping trip; HBSR= home-based social recreational trip; HBO= home-based other trip; NHB= Non-home-based trip

2.3. Model Results

Validation of the 2020 NWFRPM was evaluated based on comparisons of aggregate trip rates and trips by purpose against the 2015 NWFRPM. Aggregate trip rates included the total number of study area trips per person, dwelling unit, and employee. Comparisons of trips by purpose included the number of productions, percent of productions, and unbalanced attractions for each purpose. Evaluations of balanced versus unbalanced trip attractions were also used in assessing model performance.

2.3.1. Aggregate Trip Rates

Table 9 summarizes the aggregate trip rates. The number of persons per household and total number of trips per dwelling unit (household) for the 2020 NWFRPM was higher than the 2015 NWFRPM. Trips per person and trips per employee, however, decreased when compared with the 2015 NWFRPM, as shown in **Table 9**.

Table 9. Aggregate Trip Rate Comparison

Unit of Measure	2020 NWFRPM	2015 NWFRPM
Person per Household	2.58	2.74
Internal Trips per Household	9.53	10.48
Internal Trips per Person	3.70	3.82
Internal Trips per Employee	7.29	8.77

2.3.2. Percent of Trips by Purpose

The percent of trips by purpose did not differ significantly from the validated 2015 NWFRPM used in the comparison. Home-based work, home-based shop, home-based other, and truck-taxi represented about the same proportion of trips. Home-based social/recreation reduced by 1 percent compared with the 2015 NWFRPM. Non-home-based trips were increased by 2 percent. The percentage of internal-external trips was the same as the 2015 NWFRPM. **Table 10** shows a summary of trips by purpose.

Table 10. Summary of Trips by Purpose: Percent by Productions

Trip Purpose	2020 NWFRPM	2015 NWFRPM
Home-Based Work	18%	18%
Home-Based Shop	7%	7%
Home-Based Social-Recreational	22%	24%
Home-Based Other	22%	22%
Non-Home-Based	20%	18%
Truck-Taxi	8%	8%
Internal-External	3%	2%
Total	100%	100%

3. Highway Network

The highway network represents the transportation system in the travel demand model study area. It includes a series of "links", each containing a set of attributes relevant to simulating highway conditions, that are interconnected by "nodes." It also includes "connectors," which represent where the TAZs access the highway network. The result of the highway network module is free-flow travel time skims between TAZ pairs, which are developed based on the network characteristics.

The NWFRPM network links include variables outlined in the FSUTMS highway network coding standards, which include area type and facility type, as well as VFACTORS, and SPDCAP (both in Tables). The VFACTORS file is used for the calculation of capacities in the BPR (Bureau of Public Roads) equation utilized during trip assignment and the SPDCAP table is the lookup table for the initial speeds and capacities. Highway paths are built based on these network attributes, as well as turning movement prohibitors. Turning movement prohibitors identify the movements that can be made between links at nodes. In addition to these standard variables the network includes location and district attributes to identify the sub-areas detailed in **Figure 3**. Traffic count information was also added for validation purposes.

3.1. Network Development

The highway network is comprised of three files in VISUM: LINKS, NODES and CONNECTORS. The highway network was prepared for the base year 2020 condition for the 16 counties in the NWFRPM study area. The 2015 validated network was used as the basis for the 2020 network. It was updated to reflect improvements made to the network between 2015 and 2020. These improvements were identified from the various MPO Transportation Improvement Programs (TIPs) and the FDOT 5-Year Work Program. Verification of network characteristics was completed through use of maps, aerial photography, network plots, and field data inventory.

3.2. Network Parameters

Each link in the network has a series of attributes that describe the roadway characteristics. The entire list of attributes is included in the NWFRPM_V4_ATTRIBUTE_list.xlsx Excel file in the Model's Document folder.

The speed-capacity lookup table (FDOT.SPEEDCAP Table) values were developed as a function of the standard two-digit FSUTMS area types and facility types, which are consistent with the FDOT Generalized Service Volume Tables. Area types are used to define land uses adjacent to each roadway, and facility types are used to classify roadways by function and design characteristics. Speed and capacity values were prepared for every combination of area type groups, facility type groups, and number of lanes (1 lane to 9 lanes). The highway link's uncongested travel speed and capacity are input into the highway network through the speed-capacity lookup table, which is used to calculate travel times. Area type and facility type coding found in the original MPO networks were compared for consistency against the NWFRPM 2020 network prior to the start of the validation process. Additional review and refinement of the highway network's speeds and capacities were adjusted to better replicate traffic flow during the validation process.

The Travel demand model output volumes represent Peak Season Weekday Average Daily Traffic (PSWADT) and are stored in the "VolVehPRT(AP)" LINKS variable. However, the NWFRPM also reports volumes in Annual Average Daily Traffic (AADT), as AADT volumes are required when estimating design hour traffic and performing operational analysis. Model Output Conversion Factors (MOCF) are used to convert PSWAT to AADT. Each Seasonal Factor Category code (IMPT_SFACT) is assigned a MOCF. The applicable MOCF, as defined in the 2019 FDOT FTI Access Database, and was added to all network links. The MOCF is then used to used to automatically convert PSWADT to AADT. The NWFRPM also compares the resulting AADT volumes to the input counts.

Toll data is included in the LINKS portion of the Network in the NWFRPM and is used to represent toll plazas in the highway network. The LINKS file contains data identifying the locations, capacities, service times, prices, and methods of toll collection at each toll plaza and is used to calculate toll delays. In the NWFRPM toll links are used to represent the Bob Sikes Bridge, Mid-Bay Bridge, Garcon Point Bridge, Orchard Pond Parkway and Mid-Bay Bridge Connector. These entries were updated as part of the 2020 validation.

3.3. Traffic Count Data

The validation of a travel demand model relies on the existence of extensive base year traffic count data. Volume-to-count ratios generated by the model are used to measure the ability of a travel demand model's highway assignment to simulate known traffic conditions. Traffic counts are needed for a variety of different roadway categories distributed throughout the model area in order to validate highway assignment performance by facility type, area type, and lane configuration. The base year model is validated to traffic count data obtained from the 2019 FDOT FTI Access Database, which is reported as AADT.

The highway network has 18,839 nodes, 13,950 connectors, 3,540 zones and 41,596 links of which 3,076 have traffic counts.

3.4. Highway Paths and Skims

The NWFRPM highway path module uses the standard VISUM "Calculate PrT skim matrix" procedure to build time and distance skim matrices. These paths are defined as the shortest time path through the highway network for each zonal pair. Intrazonal and terminal times are also added to the intrazonal skims. Intrazonal times represent the travel time assumed for trips that begin and end in the same TAZ. These times are calculated as one-half the travel time from one zone to the nearest adjacent zone. Terminal times represent the time at either end of a trip to travel from an origin to the network or from the network to a final destination. This accounts for the time necessary to walk to or from the vehicle used for any given trip and to park. The terminal times from the 2015 NWFRPM were used for the 2020 validation, as the validation results were within an acceptable range.

Skims are updated with terminal times, which are a function of area type and intrazonal times. Turn prohibitors and penalties, stored in the "TURNS" portion of the Network in VISUM, are also added at this stage. Turning prohibitors identify the movements that cannot be made between links at nodes and penalties apply additional to specific turning movements. The result of the highway network module is free-flow travel time skims between zone pairs.

4. Trip Distribution

Trip distribution is a critical component of the regional model as it creates the trip tables that are later assigned to the highway network. It is a challenge to validate since the only data sources for its development were parameters and statistics from other geographies in and out of the State of Florida.

4.1. Model Development

As standard per FSUTMS procedures, a gravity model is used to estimate the number of trip ends produced at each TAZ, per trip purpose, that is being attracted by all or parts of the other TAZs in the model. It is also necessary to have some measure of the spatial separation of the TAZs or travel impedances, which is usually measured in time units, distance, or costs.

The trip generation step of the model created zonal records for all trip productions and attractions. The network step produced the travel path skim matrices based on travel time and cost, as well as distances, including terminal times, intra-zonal times, time penalties and turning movement prohibitors. In addition to these inputs, a travel function must be incorporated to replicate drivers' behavior for the different trip purposes, which is known as the friction factor.

Friction factors are derived from travel characteristics surveys, and they generally follow well studied curves' shapes, i.e., empirical values taken from surveys can be represented by mathematical functions that replicate the trip length distribution and the average trip lengths by purpose. The trip length distribution curve shows a few motorized trips for short distances, followed by higher number of trips for medium trip durations and then decreasing number of trips as time and/or distance increases. These curves can be different for different trip purposes, as it is the case for home-based work trips which usually have a longer commute time than a trip to the grocery store.

Lacking any kind of travel survey for the whole region under study, one proven way to develop these friction factors is the "gamma function", which is recommended by the Transportation Research Board publication NCHRP Report 365 – Travel Estimation Techniques for Urban Planning (National Academy Press, Washington D.C., 1998). As a reference, this is the same function that was used in the development of the Florida Statewide Model. The gamma function is represented by the following equation.

$$F_{ij} = a \times t_{ij}^{b} \times e^{c \times t_{ij}}$$

Where:
F_{ij} = friction factor between origin TAZ "i" and destination TAZ "j"
a = a constant scaling factor coefficient that does not affect the shape of the distribution
b and c = model coefficients, usually a negative value, calibrated for the different trip purposes.
t_{ij} = time or most appropriately, generalized cost of travel between "i" and "j"
t = same as above
e = the base of the natural logarithms

The gamma function is used to generate a lookup table that is then used by the gravity model.

4.2. Model Parameters

The validated 2015 Model friction factors were used which are included in the FFTable file. There is a maximum time limit of 300 minutes for trip distribution. The maximum number of iterations was set to MAXITERS=50 for the gravity model as well as a maximum root mean square error (RMSE) of MAXRMSE=10

4.3. Model Results

For the validation effort, one basic result is expected from the trip distribution step. Trip length averages should be reasonable when compared amongst trip purposes within the region and across other urban areas outside the region. **Table 11** shows that the 2020 NWFRPM average trip lengths (presented in minutes) are reasonable and similar to the 2015 NWFRPM.

Table 11. Trip Distribution Statistics: Average Trip Length in Minutes

Trip Purpose	2020 NWFRPM	2015 NWFRPM
Home-Based Work	19.31	19.38
Home-Based Shop	17.99	18.09
Home-Based Social-Recreation	18.25	17.84
Home-Based Other	20.24	20.11
Non-Home-Based	17.14	17.23
Truck-Taxi	18.90	18.89
Internal-External	63.98	63.84

5. Transit Model

The transit service for the Tallahassee area is included in the NWFRPM. It is provided by StarMetro and is a fixed-route bus network. The VISUM Public Transport (PuT) program is used to represent the transit network in the NWFRPM. Transit path building involves the generation of zone-to-zone transit paths, transit skims, and transit fares. These files are built for peak and off-peak periods.

5.1. Transit Network

An updated 2020 transit network was not created for this validation, rather the 2015 base year transit network was utilized. Updated 2020 data was not provided by StarMetro. The transit network comprises several files, which include Stop Points, Stop Areas, Stops, and Lines.

In the NWFRPM, modal definitions follow FSUTMS transit modeling standards. All StarMetro routes are local bus routes and therefore coded as LB. The fare attached to the link is mapped to the operator in the Fare Systems List. All StarMetro service uses a flat-fare system and FSU routes are free. Fares are shown in the Ticket Types List. The 2015 fare structure was used in the 2020 validation.

The transit network in the NWFRPM has been established to accommodate walk and auto access modes for local bus service. Like other FSUTMS models, the NWFRPM uses the “PK” designation for “peak” transit trips and “OP” for “off-peak” transit trips. There is not a true time of day description. Rather, the “peak” period refers to home-based work trips while the “off-peak” refers to all other internal person trip purposes from trip distribution. The mode definitions are referred to by the variable TSysCode in VISUM.

5.2. Transit Paths

In VISUM, the Transit skims or paths are initially based on the highway network then updated after Mode Choice using the PuT assignment procedure. Transit skims are produced for both Peak and Off-Peak. The procedure is used to obtain travel times and costs for transit service based on access mode. The procedure first identifies the minimum paths between all pairs of zones by all available transit modes. After travel time skims are constructed, the transit cost for each preferred path is calculated based on boarding and transfer fares. Multiple paths are built for the PK and OP periods. The nested logit model requires three sets of transit paths for each PK and OP period. The path parameters are defined in the individual path factor files.

Transit skims are the travel cost components obtained from the transit paths. These are required by the mode choice model in calculating the share of the different paths.

6. Mode Choice

The NWFRPM mode choice model uses a nested logit formulation. A nested logit model is a behavioral model that estimates the probability of a decision maker's choice of taking an alternative from a set of alternatives.

6.1. Mode Choice Structure

A nested logit mode choice model works by computing the utility for each of the bottom level choices. The utility represents the total economic "cost" in terms of travel time, fare, or other cost and other impediments/inducements to travel associated with each mode. It is typically constructed as a linear function of the different components of time and cost. The choices at the top level are auto and transit. The auto nest is divided into drive-alone and shared-ride trips. Shared-ride trips are further divided into 2 passenger and 3+ passenger trips. The transit nest is divided into the access markets, which include walk access and auto access. The access trips are further divided into bus and premium modes.

The total person trips are divided into 0-auto, 1-auto, or 2-auto households for the home-based work and non-home-based work purposes. No market segmentation is done for the non-home-based work purpose. The mode choice module is run separately for these markets.

6.2. Mode Choice Results

Because the transit in the model was not updated as part of the 2020 validation, the statistics presented in **Table 12** are reported for information only. The VISUM PuT procedure produced different results than the prior CUBE PT procedure The 2020 model produced 23,473 transit trips, compared to 17,540 trips in 2015.

Table 12. 2020 NWFRPM Mode Share

Mode	Home-Based Work			Home-Based Other			Non-Home-Based		
	0 Car HH	1 Car HH	2+ Car HH	0 Car HH	1 Car HH	2+ Car HH	0 Car HH	1 Car HH	2+ Car HH
Drive Alone	0%	38%	`37%	0%	79%	87%	48%	0%	0%
Carpool 2	55%	36%	36%	61%	16%	10%	30%	0%	0%
Carpool 3+	39%	26%	27%	28%	5%	3%	22%	0%	0%
Walk-Bus	6%	0%	0%	11%	1%	0%	0%	0%	0%

7. Trip Assignment

During trip assignment the highway and transit routes utilized are assigned to the model network. The NWFRPM utilizes equilibrium assignment, which uses a modified BPR (Bureau of Public Roads) volume delay function and variables from the SPDCAP Table file for trip assignment. BPR curves are a type of volume-delay function used to describe the speed-flow relationships in a travel demand model network based on the available link capacity. The formula indicates that as volume increases or flow increases relative to capacity, the speed decreases and travel time increases. The VFACTORS Table includes the parameters used in the BPR function. The initial SPDCAP file was the same asthat used the validated 2015 model. These parameters were included in the network's links in the Highway Network step.

7.1. Model Development

The generalized cost used for path and assignment calculations is travel time plus the cost of tolls. There are five toll facilities in the overall network (see **Section 3.2**).

There is capability to apply different toll rates and toll payment schemes (conventional tolls or open road tolling, including electronic toll collection systems) for future toll projects in the region. Turning movement prohibitors and a few remaining penalties from existing travel demand models are also included in the path building process during trip assignment.

7.2. Highway Assignment

The highway assignment portion loads auto trips onto the highway network. The NWFRPM uses the standard FSUTMS assignment model, which produces the daily loaded network using an equilibrium assignment algorithm. The highway assignment is a multi-class equilibrium assignment. The BPR equation is used as the volume-delay function using the VFACTORS Table file. The VFACTORS Table file contains UROAD factors, CONFAC values, and BPR coefficients for each facility type. To further refine this step, the SPDCAP file is used to reference the lanes, capacity, and speed for each area type and facility type.

7.3. Highway Assignment Model Results

The VISUM model does not currently implement an overall evaluation of how each facility type and area type are performing based on volume-to-count vehicle miles traveled (VMT), but rather it is reports for each MPO area. This is a change from past models, however model wide statistics aren't relevant to model performance since the MPO model area based statistics are more relevant because they indicate more localized performance measures.

FDOT assignment validation standards described in *FSUTMS-Cube Framework Phase II: Model Calibration and Validation Standards* include a preferred accuracy level of +/- 15% error for each category for facility type, area type, and number of lanes; however, +/- 25% is acceptable. The validation standards also include a preferred accuracy level of +/- 2% error for areawide; however, +/- 5% is acceptable. See **Chapter 8** on Reporting for the details for each MPO area.

8. Reporting

The final step in the model flow, as designed for the NWFRPM, is the Reporting process, which is an evaluation of the assignment process by area type, facility type, and by sub area within the region.

8.1. Final Model Validation Results

Tables 13 – **16** summarize the facility type and area type validation statistics for the urbanized areas within the NWFRPM. These tables provide volume to count VMT for the existing facility types and area types. The results are mixed, as there are cases where some urbanized areas perform better than other urbanized areas.

Table 13. Florida Alabama TPO Sub-Area Assignment Statistics

Facility Type	Volume / Count VMT	Area Type	Volume / Count VMT
Freeways and Expressways	0.97	CBD	1.00
Divided Arterials	1.11	Fringe	0.91
Undivided Arterials	1.06	Residential	1.02
Collectors	0.70	OBD	0.93
One-Way Facilities	0.97	Rural	1.09
Toll Facilities	0.75	Total	1.01
Total	1.01		

Table 14. Bay County TPO Sub-Area Assignment Statistics

Facility Type	Volume / Count VMT	Area Type	Volume / Count VMT
Divided Arterials	1.09	CBD	0.99
Undivided Arterials	0.97	Fringe	1.86
Collectors	0.72	Residential	0.87
Total	1.00	OBD	1.04
		Rural	0.67
		Total	0.90

Table 15. Okaloosa-Walton TPO Sub-Area Assignment Statistics

Facility Type	Volume / Count VMT	Area Type	Volume / Count VMT
Freeways and Expressways	0.90	CBD	0.88
Divided Arterials	0.95	Fringe	1.04
Undivided Arterials	0.90	Residential	0.92
Collectors	0.81	OBD	1.00
Toll Facilities	0.51	Rural	0.83
Total	0.91	Total	0.91

Table 16. Capital Region TPA Sub-Area Assignment Statistics

Facility Type	Volume / Count VMT	Area Type	Volume / Count VMT
Freeways and Expressways	1.08	CBD	1.39
Divided Arterials	1.34	Fringe	1.71
Undivided Arterials	1.15	Residential	1.14
Collectors	0.84	OBD	1.27
One-Way Facilities	1.11	Rural	1.08
Total	1.17	Total	1.17

8.2. Summary and Conclusions

The 2020 NWFRPM, as it was validated, is a suitable tool for planning applications at the regional and urbanized area level. As detailed in the previous section, the validation statistics by sub-area support the use of the regional model for sub-area planning applications.

However, it is recommended that other means of forecasting be utilized in coordination with the NWFRPM, as the overall model performance is underestimating trips. In this 2020 validation the lifestyle Trip Generation is producing less productions and attractions than previous cross classification trip generation. Therefore it is recommended to utilize not just NWFRPM future volumes in traffic forecasts, but to alsolook at percentage shifts in traffic.

The validation statistics for the FATPO, OWTPO and Bay County TPO did quite well. The CRTPA was over assigned in general with only Collectors being low. However, in general, Collector facility types and Rural areas had low volume to count ratios, while Divided Arterial facility types and Fringe areas had high volume to count ratios. Model volumes should be reviewed carefully on these facilities and/or area types.

A corridor or subarea validation is highly recommended when using the NWFRPM for more micro-analysis. As detailed in the *NWFRPM 2020 and 2050 Socio-Economic Data Documentation* report, the 2020 socio-economic data was primarily based on American Community Survey Block Group data due to the trip generation utilizing the trip characteristics of populations living in single family (e.g. standalone residential homes) and multi-family (e.g. apartment complex) structures, which is no longer reported in the Decennial Census. This data was allocated from the Census Block Group to the NWFRPM TAZs based on land area, rather than land use patterns. Therefore, while the data was assigned to the general area of development, sub-area validation is needed to support micro-analysis. Another important consideration is the lack of available local traffic counts for the base year.

To more accurately model future development in rural areas and areas surrounding existing cities and communities, further updates to the TAZ and highway network may be needed.. This is recommended to develop TAZ geography consistency across the model and to improve the overall usefulness of the model as a planning tool.

Another consideration is that a regional travel characteristics study was not available for this model validation; however, it should be considered as part of future validation efforts to improve the

calibration of trip generation parameters and friction factors, as well as provide a better understanding of O-D patterns for short and long trips within and through the region. It is recommended that the use of sources such as Replica or Streetlight data be used in future validations.

Two socioeconomic data sets are a challenge in this region. First, employment data are difficult to assess due to the presence of military bases throughout the region from Pensacola to Panama City and are likely not accurate due to understandable national security issues. Second, the occupancy rate of dwelling units is difficult to accurately evaluate in resort/beach communities, which in turn creates a seasonal population that is usually mis-represented. These two data issues likely need additional considerations in future model validation efforts.