



NJRTM-E Model Development Manual Version 4

2023 Revalidation

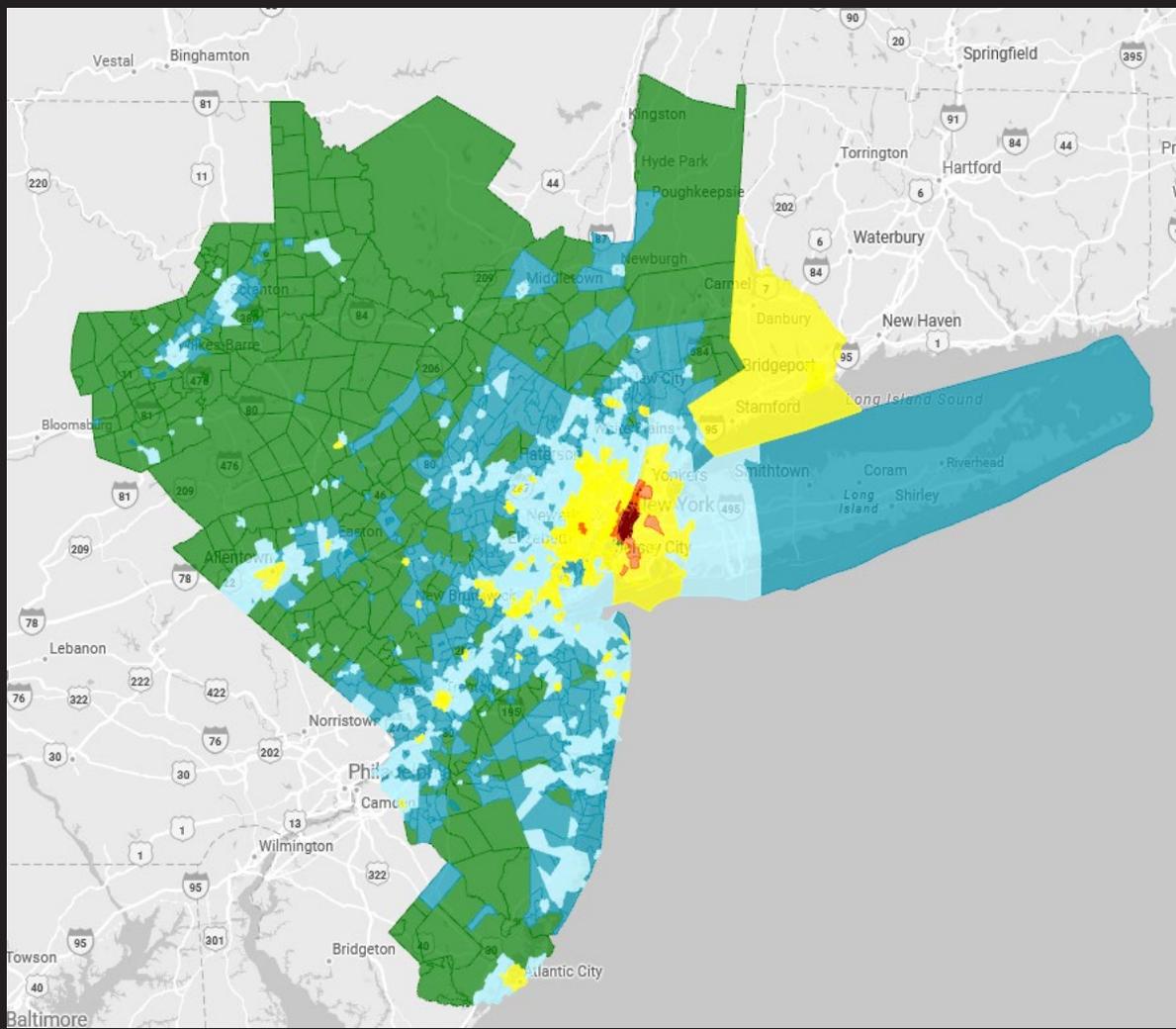
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1. INTRODUCTION

This document is a resource for understanding the development and performance of the North Jersey Transportation Planning Authority's (NJTPA) travel demand model also known as the North Jersey Regional Transportation Model-Enhanced (NJRTM-E). The NJRTM-E was initially developed in 2008 (with predecessor models going back to the 1980's) to provide a common modeling process suitable for the planning needs for all regional transportation agencies including its sponsors, the NJTPA, NJ TRANSIT (NJT), and the New Jersey Department of Transportation (NJDOT). It has since been revalidated in 2011, refined in 2015 and revalidated again in 2018 and 2023. All data and model results in this edition of the document are based on the most recent validation project (2023) and refer to initial model development and the latest validation results.

The NJRTM-E has several prominent features including an enlarged modeled region encompassing the NJTPA as well as eastern Pennsylvania and metropolitan area of New York City. The NJRTM-E also features the inclusion of the customized NJT mode choice model as the basis for estimation of auto and transit mode shares. It is envisioned that this model will become the principal travel demand forecasting process for planning analysis in Northern New Jersey.

This document includes a complete description of the model development and the latest calibration of each model component. In addition, the document includes a summary of selected sensitivity tests used to validate the model. A Users Guide, developed as a separate document, is provided to describe the use of the model and its many features. The Users Guide also includes a series of appendices which contain additional technical information related to the operation of the model and supporting features.

The development report includes separate sections on each major model component. These sections are as follows:

- Zonal System and Socioeconomic Data
- Highway Network
- Transit Network
- Highway Path Building
- Transit Path Building
- Composite Impedance
- Trip Generation
- Trip Distribution
- Mode Choice
- Time of Day Trip Estimation
- Highway Assignment
- Model Convergence
- Transit Assignment

Additional documentation for specific NJ model elements, such as mode choice, is also referenced in relevant sections of this report.

1.1 PROJECT OVERVIEW

As mentioned above, the initial goal of developing the NJRTM-E was to create a unified travel demand model suitable for the needs of multiple agencies performing regional and project-specific planning studies in Northern New Jersey. To accomplish this goal, the needs of each of the sponsoring agencies (NJTPA, NJ Transit and NJDOT) were identified and a series of recommendations were generated for discussion with the technical committee overseeing the

project. The resulting work plan was structured as a hybrid approach where some model components, such as NJ Transit's mode choice model, were adopted without modification, while other components, such as trip generation were replaced with new versions. Involvement of all sponsoring agencies was maintained in subsequent validations and refinements to ensure that agency needs continued to be addressed. For the original NJRTM-E development, key model revisions by component included the following:

- Zonal System and Socioeconomic Data – The zonal system was expanded to cover a region of 40 counties covering all of northern New Jersey, eastern Pennsylvania, southern New York and the western area of Connecticut. Unified socioeconomic data estimates were also prepared based on the latest available forecasts.
- Highway Network – The highway network was expanded and geo-referenced within the northern New Jersey region. A significant amount of new variables were incorporated into the network to permit enhanced estimation of capacity and speeds, as well as advanced toll modeling techniques.
- Transit Network – The transit network from the NJ Transit Model was incorporated into the final model and a series of refinements were implemented to support the modeling of transit specific facilities such as express bus lanes.
- Highway Path Building – Highway path-building and impedance estimation were updated to account for the NJ Transit mode choice model and the toll diversion modeling.
- Transit Path Building – Transit path-building and impedance estimation were adopted from the NJ Transit regional model and revisions to support the estimation of transit specific facilities were implemented.
- Composite Impedance – Due to the complex structure of the NJ Transit mode choice model geographic segmentation, an alternative method of estimating composite impedance was developed. The new procedure is based on the parallel conductance formula and is sensitive to all time and cost elements of the highway and transit networks.
- Trip Generation – The trip generation procedures were redesigned to incorporate several new features. These new features include the introduction of several new trip purposes and the estimation of non-motorized travel, along with other modifications required to support the distribution of trips by income category.
- Trip Distribution – The trip distribution process was restructured to allocate trips by income for each trip purpose using the income groups established for the mode choice model. The distribution process was also modified to utilize the new composite impedance term developed as part of this project.
- Mode Choice – The existing mode choice model was replaced by the more robust NJ Transit mode choice model. This model also performed mode choice for each purpose in both the peak and off-peak periods.
- Time of Day Trip Estimation - This component received minor modifications as a result of redefining the peak period durations and the introduction of new trip purposes.

- Highway Assignment – The highway assignment process was restructured to provide enhanced capabilities to model additional delay related to queuing as well as to incorporate enhanced modeling of toll diversion by payment type.
- Model Convergence – The new model was structured to replace the previous naïve iteration convergence process with specific procedures to determine model convergence within acceptable closure criteria.
- Transit Assignment – The transit assignment procedures were adopted to be consistent with the NJ Transit Regional Transit Model.

In addition to the structural changes to the model, another key aspect of the development project was the need to increase the model's usability by analysts at each of the agencies. Therefore, the model interface was structured as a "flowchart" so the users could easily identify the location and contents of input files as well as review and summarize output data. The initial development effort also included "support" applications that created specific input data for the model as well as summarized output data and files for post-processors such as PPSUITE and SUMMIT.

1.2 MODEL IMPLEMENTATION HISTORY

Because of the funding constraints and other software development issues, the implementation of the NJRTM-E was implemented in several phases starting in 2004. The first phase was focused on resolving any technical issues related to conversion of the models from TRANPLAN to CUBE Voyager. This element of the project was conducted during 2004 and 2005. The second phase of the model development was initiated in 2005 and included an independent peer review of the proposed work program developed for the new model. The results from the peer review process were reviewed by the stakeholder agencies and specific recommendations were incorporated into the final model. The "Summary Report of the Peer Review Panel for the North Jersey Transportation Planning Authority Travel Model Improvement Effort" was completed in January of 2006.

The final phase of model development was completed in the Winter of 2008. A Users Guide was prepared and training for agency staff and subregion planning staff was provided in the Spring of 2008. The training included several introductory sessions for senior agency staff and consultants and was followed by a three-day training course for agency staff and interested subregion staff.

Subsequent to initial development the model has been updated and refined:

2010-11 Revalidation: The NJRTM-E was revalidated in 2011 with a 2008 base year. Some improvements to output reporting were also added during this project

2014-2015 Refinement: The NJRTM-E was refined in 2015 with three major changes.

- The transit path building routine was converted from using CUBE's legacy TRNBUILD program to CUBE's updated PT program.
- Transit boarding and volume output were improved to take advantage of PT and provide the user with GIS based output.
- Improvements were made to the external-to-external and external-to internal trip generation and distribution by adding an application to provide the ability to increase trips coming into the modeling region using three major external locations: the NJ Turnpike, I-80, and I-78.

The updated model also supports the Cube Cluster feature. Cube cluster allows certain model components to be processed using multiple processors concurrently, hence, reducing the model's runtime. It should be noted that the results may vary slightly depending on the number of processors used during the execution of the NJRTM-E.

2017-2018 Revalidation: The NJRTM-E was revalidated with a 2015 base year. The new household survey data, the 2010/2011 Regional Household Travel Survey by NYMTC and NJTPA were used for the first time in this validation / calibration efforts. As part of this validation process, mode choice programs were converted from FORTRAN to C.

2022-2023 Validation: The NJRTM-E was revalidated to the 2019 traffic conditions. The 2010 / 2011 Regional Household Travel Survey data was again used to build the observed conditions. The 2019 traffic conditions reflected the pre-pandemic situation. In this validation project, the NJRTM-E was also converted from Cube version 6 to Cube 2023.

2. ZONAL SYSTEM AND SOCIOECONOMIC DATA

2.1 INTRODUCTION

One of the critical limitations of the previous regional model was the area encompassed in the model and its location with respect to the major regional trip generators. Most regional models are centered about the dense urban core that is the major trip attractor in the region. In contrast, the previous regional model' eastern boundary terminated at the Hudson River just to the west of New York City. Similarly, other nearby generators adjacent to the region (Atlantic City, Trenton, and Easton, PA) were not included in the previous model. This limitation caused significant problems with forecasting trips that interacted with these adjacent generators, particularly those trips destined to the heavily congested New York City area that is a critical market for transit trips.

As part of the NJRTM-E, the modeled area includes the 13 NJTPA counties as well as the several layers of counties surrounding the NJTPA region that will serve as a buffer area for estimating travel into and out of the detailed core area. These adjacent counties include areas from southern New Jersey, eastern Pennsylvania, southern New York and Connecticut.

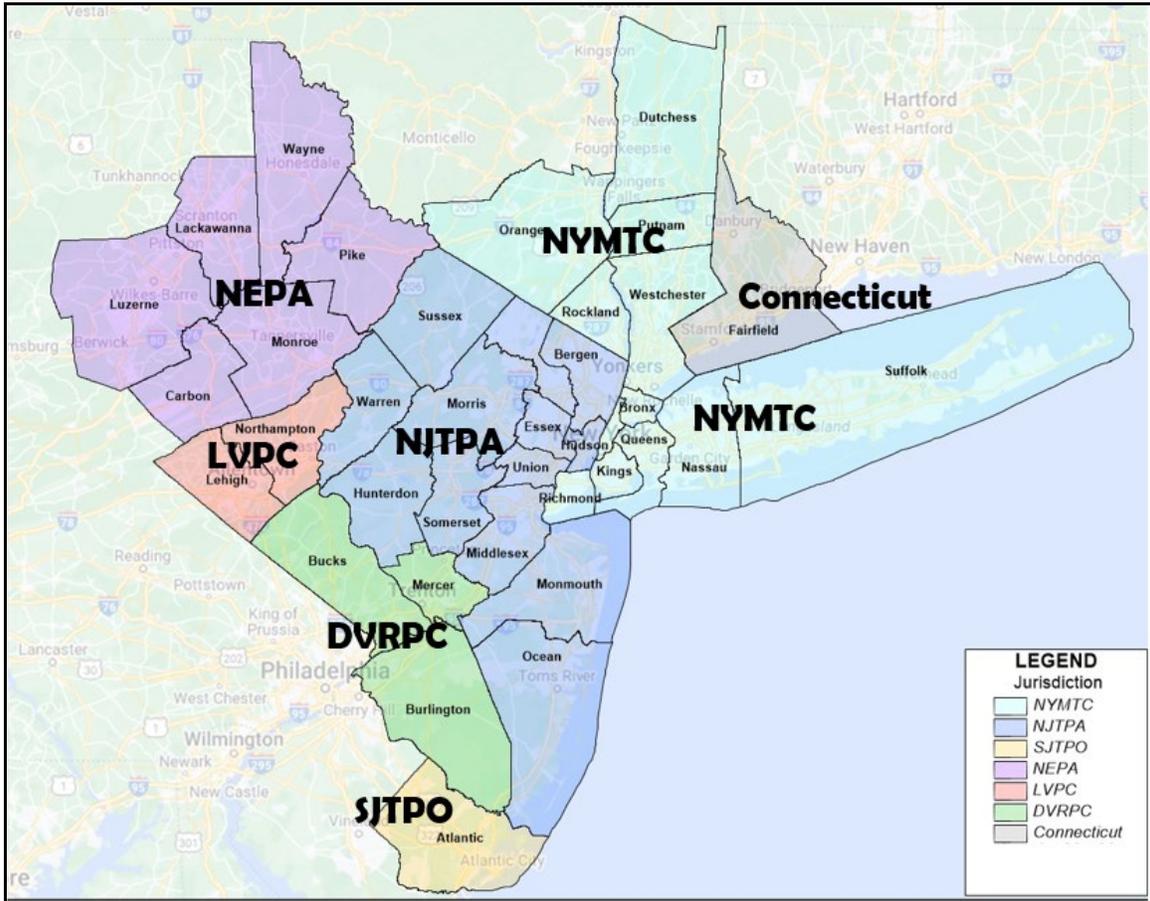
The objectives of including these surrounding counties are twofold. First, it is anticipated that this model will be used to forecast transit facilities that extend beyond the 13-county region, such as the Lackawanna Cutoff rail line or reactivation of the West Trenton rail line. Extending the NJRTM-E modeled area permits the model to estimate several key markets for transit usage outside the North Jersey Region such as Trenton and New York City. Second, since the existing 13 county region is rapidly developing, many of the NJTPA counties at the edge of the region have significant interaction with developing areas in Pennsylvania and southern New Jersey. The expanded study area enables the modeling process to be sensitive to both development and network improvements outside of the NJTPA region.

The model extends the coverage area from the 13 NJTPA counties to a total of 40 counties, encompassing areas from six Metropolitan Planning Organizations (MPOs) or planning areas in New Jersey, New York and Pennsylvania and Connecticut. Those regional planning organizations are:

- North Jersey Transportation Planning Agency (NJTPA)
- South Jersey Transportation Planning Organization (SJTPO)
- New York Metropolitan Transportation Council (NYMTC)
- Delaware Valley Regional Planning Commission (DVRPC)
- Northeastern Pennsylvania Alliance (NEPA)
- Lehigh Valley Planning Commission (LVPC)

The geographical coverage of the model is depicted in Figure 1. It should be noted that the resulting boundary for the enlarged model area is extensive and there are numerous roadways entering the region. Using traditional modeling techniques, each of these roadways would be represented as an external zone. However, it was recognized early on that obtaining traffic counts and future year estimates for each of these roadways would be a difficult and time-consuming process. Therefore, a decision was made to ignore the trips entering at the far edge of regional model since few, if any of these trips would enter into the NJTPA 13-county region. Specific exceptions to this process were made for long-haul truck trips assumed to access the region at specific interstate roadways along the extended boundary. Other issues associated with this particular modeling technique are discussed in subsequent sections of this document.

Figure 1 – NJRTM-E Modeled Area & Regional Planning Agencies



2.2 MODEL ZONAL SYSTEM

The NJRTM-E zonal system was developed to support the forecasting of regional traffic flows. The zonal system is now 2020-census based. Within the NJTPA region, zones are mostly based on census tracts, however, some are block group based and a few include block level data. All zones nest within NJTPA municipalities. Outside the NJTPA region, zones will tend to be geographically larger (e.g. municipality based) although Manhattan has a finer zone structure than other surrounding areas. The largest geographic entity in this model is at the county level. The NJRTM-E consists of 3028 zones, including 180 reserved zones, as shown in Table 1.

It is anticipated that the socioeconomic data will need to be updated as new regional estimates are developed. It was anticipated that updates to the zonal data for regions outside of NJTPA would be provided on a periodic basis by the adjacent MPOs. In order to facilitate this process and ease the transferability of socioeconomic data from other MPO's to the NJRTM-E zonal system, the NJRTM-E generally honored the zonal system of other MPO's models, especially the large MPO's such as NYMTC and DVRPC. In some situations, an aggregation process was required to combine several zones from other models into a larger zone in the NJRTM-E system. **APPENDIX A – ZONAL EQUIVALENCY** lists the zonal equivalency between NJRTM-E and NYMTC models, as well as NJRTM-E and DVRPC models.

Table 1 – NJRTM-E Zonal System

Region	County	Zone Type (Majority of TAZs)	NJRTM-E TAZs		RESERVED TAZs	
			Zone Numbers	No. of Zones	Zone Numbers	No. of Zones
New Jersey	Atlantic	MCD	1 - 25	25		0
	Bergen	Census Tract+Block Group	26 - 236	211	237 - 246	10
	Burlington	MCD+Census Tract	247 - 387	141	388 - 389	2
	Essex	Census Tract+Block Group	391 - 620	230	623 - 632	10
	Hudson	Census Tract+Block Group	633 - 829	197	830 - 863	34
	Hunterdon	Census Tract+Block Group	864 - 899	36	900 - 909	10
	Mercer	Census Tract+Block Group	910 - 1033	124	1034 - 1042	9
	Middlesex	Census Tract+Block Group	1043 - 1262	220	1263 - 1272	10
	Monmouth	Census Tract+Block Group	1273 - 1437	165	1438 - 1447	10
	Morris	Census Tract	1448 - 1559	112	1560 - 1569	10
	Ocean	Census Tract+Block Group	1570 - 1725	156	1726 - 1735	10
	Passaic	Census Tract	1736 - 1856	121	1857 - 1866	10
	Somerset	Census Tract+Block Group	1867 - 1952	86	1953 - 1962	10
	Sussex	Census Tract+Block Group	1963 - 2007	45	2008 - 2017	10
	Union	Census Tract+Block Group	2018 - 2143	126	2145 - 2160	16
Warren	Census Tract+Block Group	2161 - 2187	27	2188 - 2197	10	
New York	Bronx	District	2198 - 2203	6	-	0
	Dutches	District	2204 - 2205	2	-	0
	Kings	District	2206 - 2223	18	-	0
	Nassau	District	2224 - 2225	2	-	0
	New York (Manhattan)	Census Tract	2226 - 2515	290	-	0
	Orange	District	2516 - 2543	28	-	0
	Putnam	District	2544 - 2544	1	-	0
	Queens	District	2545 - 2555	11	-	0
	Richmond	District	2556 - 2606	51	2607 - 2615	9
	Rockland	Census Tract	2616 - 2680	65	-	0
	Suffolk	County	2681 - 2681	1	-	0
	Sullivan	District	2682 - 2682	1	-	0
Westchester	District	2683 - 2709	27	-	0	
Pennsylvania	Bucks	Multiple Block Groups	2710 - 2780	71	-	0
	Carbon	County	2781 - 2781	1	-	0
	Lackawanna	MCD	2782 - 2822	41	-	0
	Lehigh	MCD	2823 - 2849	27	-	0
	Luzerne	MCD	2850 - 2925	76	-	0
	Monroe	MCD	2926 - 2945	20	-	0
	Northampton	MCD	2946 - 2983	38	-	0
	Pike	MCD	2984 - 2996	13	-	0
Wayne	MCD	2997 - 3024	28	-	0	
Connecticut	Bridgeport	MCD	3025 - 3025	1	-	0
	Fairfield Co. Other	District	3026 - 3026	1	-	0
Special Generators / Externals	EWR (Essex County)		621	1		
	Port Newark (Essex County)		622	1		
	Port Elizabeth (Union County)		2144	1		
	NJTPK Southern Terminus		390	1		
	I-78 Western Terminus (PA)		3027	1		
	I-80 Western Terminus (PA)		3028	1		
Total				2848		180
				Total Zones		3028

2.3 AREA TYPE

As part of the model development, each of the zones was categorized into a series of area types based on density of existing development and other characteristics. The categorization was accomplished by assigning each of the zones with one of six available area types. The definitions of the six area types are listed in Table 2. This series of area types was used to estimate non-motorized trips as part of the trip generation procedure. The model also maintained a four-category definition of area type: CBD, Urban, Suburban and Rural. This condensed area type system was used to control the estimation of network capacities and speeds. In this definition, the “Manhattan CBD” and “CBD/Urban High Density” in Table 2 were combined into CBD category. And “Suburban High” and “Suburban” were combined into Suburban category.

Table 2 – Six-Category “Trip Generation” Area Type System

Area Type	Area Type Description	Characteristics
1	Manhattan CBD	Designated for typical Manhattan area
2	CBD / Urban High Density	Very high employment density or very high population density
3	Urban	High residential densities, small lots for single family dwelling units, many apartments, mostly through streets. Employment interspersed throughout the residential areas
4	Suburban High	Medium to high residential densities, mixed developments
5	Suburban	Low to medium residential densities, medium to large lots for single family dwelling units, homogenous land uses, restricted traffic flows (some cul-de-sacs) on residential areas.
6	Rural	Very low residential densities and much undeveloped or agricultural land, relatively few roads.

The initial determination of area type was performed in an automated fashion using relationships developed from population and employment densities using a floating zone technique that evaluated the density characteristics of a given zone as function of all zones within a certain radius of the current zone. The area type designations assigned to each zone were then reviewed and adjusted by NJTPA staff as necessary. The adjustments were made by NJTPA based on knowledge of local conditions. Figure 2 shows the area type designation for the NJRTM-E Region, while Figure 3 displays the area type within the NJTPA region.

As part of this analysis, layers of reserved land uses were obtained, such as parks, water bodies and wetlands, as well as military bases along with an inventory of developable land from NJTPA for use in the density calculations. Refinements to the calculated area types were discussed with NJTPA staff and implemented as necessary to provide reasonable designation in situations where area types varied significantly between adjacent zones.

Figure 2 – Area Type Designation for the NJRTM-E Region

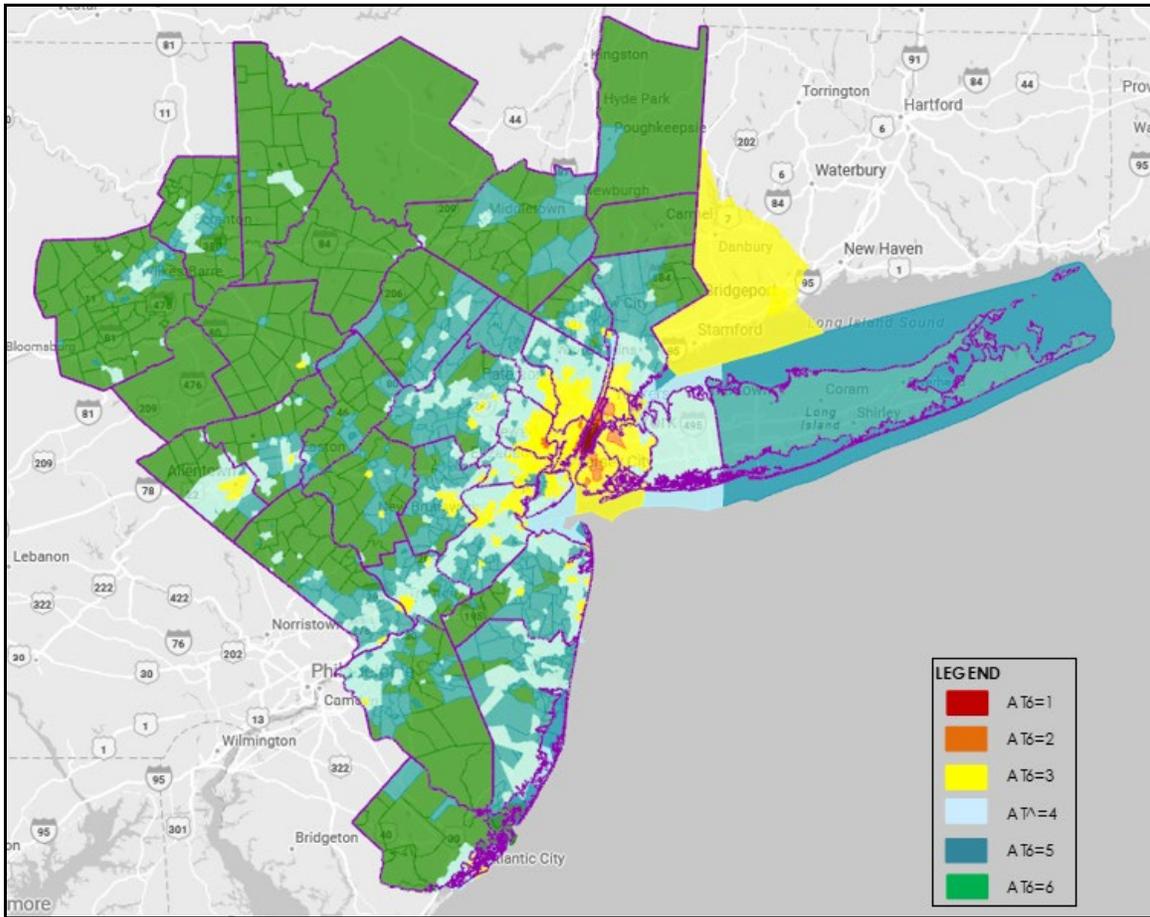
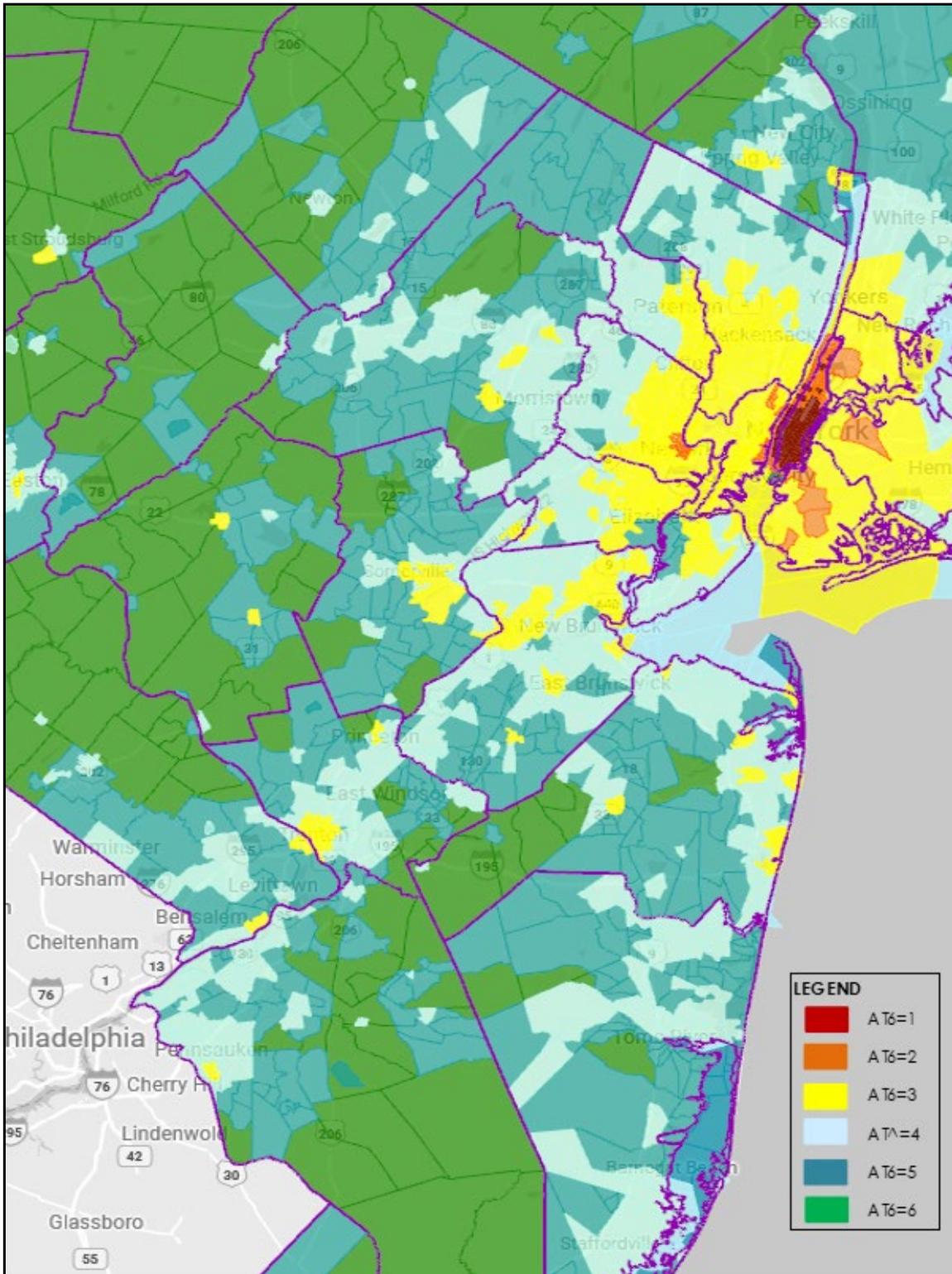


Figure 3 – Area Type Designation for the NJTPA Region



2.4 SOCIOECONOMIC DATA

The socioeconomic data was gathered, developed, and processed from the latest MPO-approved socioeconomic data, as well as census data and other sources. The methodology used to develop the socioeconomic inputs is discussed in the following sections for each MPO. These sections will also describe the data inputs, sources by region and methods used to develop the NJRTM-E Traffic Analysis Zone (TAZ) level socioeconomic data forecasts.

For purposes of simplifying aggregation and ease of transferring data, the zones were established with geographic definitions consistent with census topography. Within the NJTPA region, zones are mostly based on census tracts, however, some are block group based and a few include block level data. All zones nest within NJTPA municipalities.

Table 3 has a brief description of the socioeconomic data variables. They include population, households and employment which is split into ten sectors corresponding to the North American Industry Classification System (NAICS). The employment sectors are aggregated into three categories: Basic, Service and Retail. Basic employment equals the sum of agriculture/ mining (AGMINE), construction (CONST), manufacturing (MFG) transportation (TRANS), and wholesale (WHLSE). Retail covers Retail Trade (RET). The service category includes FIRE through Military (Finance/Insurance/Real Estate (FIRE), Service (SER), government (GOV), and Information (INFO).

Table 3 – Socioeconomic Variables

Socioeconomic Variables		
Code	Data Description	Employment NAICS Codes
POP	Number of persons living within TAZ	
HH	Number of households contained in TAZ	
AGMINE	Agriculture, Forestry, Fishing Employment, and Mining	11,21
CONST	Construction Employment	22-23
MFG	Manufacturing Employment	31-33
TRANS	Transportation, Communications, Electric, Gas, And Sanitary Services Employment	48-49
WHLSE	Wholesale Trade Employment	42
RET	Retail Trade Employment	44-45
FIRE	Finance, Insurance and Real Estate Employment	52-53
SER	Services Employment	54-56,61-62,71-72,81
GOV	Government - Public Administration Employment	92
MIL	Military Employment	51
BASIC	AGMINE + CONST + MFG + TRANS + WHLSE Employment	11,21-23,31-33,42,48-49
RETAIL	RET Employment	44-45
SERVICE	FIRE + SER + GOV + MIL Employment	51-56,61-62,71-72,81,92
TOTAL	Total Employment = BASIC + RETAIL + SERVICE	
INCOME	Average Household Income within TAZ	

Aside from the socioeconomic variables listed in Table 3, the model also includes other TAZ-level data such as the percentage of households by lifecycle, and parking costs. These variables are described in subsequent sections of this report.

2.5 SOCIOECONOMIC DATA BY SUBREGION

The year 2019 was selected as the base year for the 2022-23 model validation effort. However, due to flat growth between 2019 and 2020 socioeconomic data in the region, the decennial Census 2020 data was used as the input SED to represent 2019 conditions. The socioeconomic data included population, household, and employment data. The population and household data were developed based on Census 2020 by NJTPA staff and provided to Stantec in the new zonal system. The employment data for the NJTPA Region was provided by NJTPA and was based on the forecasts used for the 2021 Long Range Transportation Plan (LRTP). The employment data for all regions is consistent with data used in the current FY21 Conformity project, except for DVRPC. The data for DVRPC was not available in time to include in the Conformity study but was incorporated into this validation effort. The 2019 socioeconomic data were summarized by county as shown in Table 4.

Since each of the various MPOs and planning agencies maintain individual socioeconomic data files with its own TAZ system, it was necessary to convert each surrounding MPO socioeconomic data to the NJRTM-E socioeconomic data format and TAZ system. Table 5 shows the typical socioeconomic data format provided by the surrounding MPOs while **APPENDIX A – ZONAL EQUIVALENCY** listed the zonal equivalency between NJRTM-E TAZ system and the NYMTC and DVRPC TAZ systems. The TAZ system for other MPOs in the NJRTM-E is usually at county-level or MCD-Level, and the socioeconomic data received from those MPOs are easily aggregated to these levels.

Table 4 – The 2019 NJRTM-E Socioeconomic Data Summary

Region	County	2019 Socioeconomic Data		
		Population	Household	Total Employment
New Jersey	Atlantic	274,534	106,716	157,276
	Bergen	955,732	350,664	429,205
	Burlington	461,860	174,560	241,043
	Essex	863,728	312,913	377,590
	Hudson	724,854	289,408	299,252
	Hunterdon	128,947	48,978	50,793
	Mercer	387,340	139,361	230,526
	Middlesex	863,162	300,547	400,291
	Monmouth	643,615	244,630	265,717
	Morris	509,285	188,496	295,279
	Ocean	637,229	238,812	177,340
	Passaic	524,118	177,075	182,371
	Somerset	345,361	125,598	188,754
	Sussex	144,221	55,915	42,059
	Union	575,345	200,372	239,876
	Warren	109,632	43,327	34,341
	Total	8,148,963	2,997,372	3,611,713
New York	Bronx	1,472,654	522,450	394,406
	Dutchess	295,911	111,927	117,891
	Kings	2,736,074	1,009,804	894,383
	Nassau	1,395,774	455,482	573,980
	New York (Manhattan)	1,694,251	817,782	2,650,527
	Orange	401,310	135,746	148,561
	Putnam	97,668	35,329	26,927
	Queens	2,405,464	847,210	749,661
	Richmond	495,747	173,202	134,126
	Rockland	338,329	102,948	121,606
	Suffolk	1,525,920	516,872	633,405
	Westchester	1,004,457	367,296	439,344
		Total	13,863,559	5,096,048
Pennsylvania	Bucks	646,538	245,587	308,716
	Carbon	64,749	26,850	24,172
	Lackawanna	215,896	88,745	96,992
	Lehigh	374,557	142,970	260,151
	Luzerne	325,594	134,551	141,674
	Monroe	168,327	62,284	80,946
	Northampton	312,951	121,015	156,767
	Pike	58,535	23,635	19,842
	Wayne	51,155	20,794	23,710
		Total	2,218,302	866,431
All Regions		24,230,824	8,959,851	11,609,501

Table 5 – Typical Socioeconomic Data Format from Surrounding MPOs

Region / MPO	County	Socioeconomic Dataset
NJTPA	Bergen	Total Population, Total Households, Total Employment, Average Household Income, Basic, Retail, and Service Employments, Ten Employment Categories as shown in Table 3.
	Essex	
	Hudson	
	Hunterdon	
	Middlesex	
	Monmouth	
	Morris	
	Ocean	
	Passaic	
	Somerset	
	Sussex	
	Union	
	Warren	
SJTPO	Atlantic	Household Population, Group Quarters Population, Total Population, Households, Total Employment, and Average Household Income.
DVRPC	Burlington	Population, Household, Total Employment
	Mercer	
	Bucks	
NYMTC	Bronx	Household Population, Number of Households, Household Income, Total Employment, Retail Employment, and Office Employment
	Dutchess	
	Kings	
	Nassau	
	New York (Manhattan)	
	Orange	
	Putnam	
	Queens	
	Richmond	
	Rockland	
	Suffolk	
	Westchester	
LVPC	Lehigh	Population, Household, and Total Employment at MCD-level
	Northampton	
NEPA	Carbon	Population, Household, and Total Employment typically at County-Level
	Lackawanna	
	Luzerne	
	Monroe	
	Pike	
Wayne		

3. HIGHWAY NETWORK DEVELOPMENT

3.1 INTRODUCTION

This section provides a detailed description of the highway network development task for the NJRTM-E project. The highway network process is used to abstract the actual roadway network as a representative network for subsequent processing. The highway network is used as the basis for estimating various impedance variables such as travel times and costs used by the trip distribution and mode choice models. The highway network is also used as input to the highway assignment process.

The highway network is developed as a series of links and nodes, with the links representing roadway segments and the nodes representing their point of intersection. Nodes are also used as shaping points to align highway network links to the corresponding street configuration. The highway network also includes zone centroids which serve as the terminal points for trips in the modeling process. These zone centroids also represent a proxy location for the socioeconomic data (population and employment) contained within the traffic analysis zones that generate trips in the NJRTM-E. The centroids are attached to the highway network via hypothetical links called centroid connectors.

Each highway link contains various data that define the operational and physical characteristics of the given facility along with fields used to provide identification data, such as roadway names. In general these parameters are categorized into three groups:

- Physical/operational variables
- Identification variables
- Performance variables

The complete list of these variables is given in **Appendix F of the NJRTM-E User's Guide**.

3.2 PHYSICAL/OPERATIONAL VARIABLES

These variables describe the physical and operational attributes of highway network and define the type of highway links in the network, for example, links for freeways, arterial, etc., which in turn will affect the capacity and speed of the links. The techniques used to estimate speed and capacity were implemented in order to provide sensitivity to a wider range of potential improvement types, such as signalization and intersection improvements, with the objective of providing more realistic estimates of capacity suitable for operational analysis. Several key variables will be discussed in the following sections include:

- Facility Type
- Area Type
- Link Type
- Number of Lanes by time period
- Traffic Control Devices (TCD) variables
- Toll variables

During the course of setting capacity and speeds for the links, the model will review the coded values and will generate a series of information statements, warnings, and fatal messages, based on the logic of these variables. Note also that there are other variables that influence the

calculation of speed and capacity, such as shoulder conditions and parking conditions, but these variables have limited coding options which require less description.

3.2.1 Facility Type

The NJRTM-E recognizes twelve different facility types that are stored in the “FT” variable. The twelve facility categories are as follows:

1. Freeways (Facility Type 1) – limited access roadway facilities, including toll facilities, with no at-grade intersections, and no traffic signals on the main lanes.
2. Expressways (Facility Type 2) – partially limited access roadway facilities with generally high speed limits, grade separated interchanges with other major facilities, and at-grade intersections with minor facilities.
3. Principal Arterial Divided (Facility Type 3) – arterials with moderately high speed limits (e.g., 35-50 mph), raised center medians with turning bays at intersections, parking restrictions, mainly serving through traffic rather than local property access.
4. Principal Arterial Undivided (Facility Type 4) – same as principal arterial divided except that there are no raised center medians and, generally, no bays for left turns.
5. Major Arterials Divided (Facility Type 5) – arterials with moderate speed limits (e.g., 30-45 mph), raised center medians with turning bays at intersections, some parking restrictions, mainly serving through traffic although some local property access is permitted.
6. Major Arterials Undivided (Facility Type 6) – same as major arterials divided except that there are no raised center medians and, generally, no bays for left turns.
7. Minor Arterials (Facility Type 7) – arterials with moderately low speed limits (e.g., 25-35 mph) and few parking restrictions that serve some through traffic, some distribution of traffic from principal and major facilities to local streets and local property access.
8. Collectors/Locals (Facility Type 8) – roadways with moderately low speed limits (e.g., 25-35 mph) and few parking restrictions that serve mainly to collect and distribute traffic from principal, major, and minor facilities to local streets and local property access.
9. High-Speed Ramps (Facility Type 9) – ramps that generally connect freeway to freeway facilities, or also known as direct connectors, have some relatively high speed limits, e.g., 50-60 mph.
10. Medium-Speed Ramps (Facility Type 10) – ramps that have moderately high turning radius and typically with speed limit approximately 40 mph.
11. Low-Speed Ramps (Facility Type 11) – ramps with low turning radius and low speed limit, e.g., 25 mph, includes jughandles.
12. Centroid Connectors (Facility Type 12) – “dummy” roadway links with unlimited capacity that serve solely to connect transportation analysis zones to the roadway network.

3.2.2 Area Type

Six separate area types were identified for the NJRTM-E region for the purposes of estimating non-motorized travel during Phase2 of the project. These six area types were compressed into 4 categories for the purposes of estimating highway capacity and speeds. These area types, stored in the “AT” variable, are listed below:

1. CBD (Area Type 1) – this area type is designated particularly to Manhattan Region, where population and employment densities are typically very high, such as downtown Newark and Jersey City.
2. Urban (Area Type 2) – characterized by high residential densities, small lots for single family dwelling units, many apartments, mostly through streets, Employment interspersed throughout the residential areas.
3. Suburban (Area Type 3) – characterized by low to medium residential densities, medium to large lots for single family dwelling units, homogenous land uses, restricted traffic flow restrictions such as cul-de-sacs, dead ends, traffic circles, and frequent stop signs.
4. Rural (Area Type 4) – characterized by very low residential densities and much undeveloped or agricultural land, relatively few roads.

3.2.3 Link Type

This variable is created to serve as a permission code to utilize the highway link based on vehicle type mode and toll facility type. This variable is used in highway path building and highway assignment procedures to exclude links that are not illegible for paths being developed for certain trip markets, such as “SOV-Cash”. There are sixteen (16) link types defined in the NJRTM-E and they are listed below:

1. Free All (Link Type 1) – non-tolled links designated for all modes.
2. Free Auto Only (Link Type 2) – non-tolled links designated for auto mode only.
3. Free Truck Only (Link Type 3) – non-tolled links designated for truck mode only.
4. Urban Toll All (Link Type 4) – Urban tolled links designated for all trip modes (auto and trucks). Urban links are defined as links with Area Type 3 or higher (Area Types 1 to 3). The toll links are assumed to accommodate all types of toll payments, such as cash or electronic toll collection (ETC or EZ-Pass).
5. Urban Toll Auto Only (Link Type 5) – Urban tolled links designated for auto mode only.
6. Urban Toll Truck Only (Link Type 6) – Urban tolled links designated for truck mode only.
7. Rural Toll All (Link Type 7) – Rural tolled links designated for all trip modes (auto and trucks). Rural links are defined as links with area type 4. (the four-category version of the area types)
8. Rural Toll Auto Only (Link Type 8) – Rural tolled links designated for auto mode only.

9. Rural Toll Truck Only (Link Type 9) – Rural tolled links designated for truck mode only.
10. Urban Free HOV Only (Link Type 10) – Urban free links for all HOV modes. This is a typical HOV link.
11. Urban Toll HOV Only (Link Type 11) – Urban tolled HOV Only. This link type is prepared for a scenario where the HOV links are now tolled.
12. Urban Toll SOV, Free HOV (Link Type 12) – Urban tolled links for SOV mode only, HOV mode is free. This is a typical use for HOT Lane scenarios.
13. Urban Toll Non-HOV vehicles (Link Type 13) – Urban toll links, all vehicles except HOVs
14. ETC Only All (Link Type 14) – Toll links dedicated for ETC patrons only (patrons with EZ-pass) for all modes. This link type is typical for congestion pricing or HOT lane scenarios where all payments are done electronically.
15. ETC Only Auto Only (Link Type 15) – Toll links dedicated for ETC patrons and Auto mode only. Truck trips are not eligible to use this type of links.
16. ETC Only SOV and Truck Toll, HOV Free (Link Type 16) – Toll links dedicated for all ETC patrons; however, only SOV and truck trips have to pay. HOV mode is free.

Note that the NJRTM-E creates a total of nine different path sets based on mode (SOV,HOV, Truck) and toll usage (Free, Cash Payment, ETC Payment). It is important to note that the Link Type variable does not assess the toll cost. It is only used to determine if a path set can use the link in question. The following example is presented to describe the use of this variable in the path sets. The path-building and highway assignment process for an SOV cash “path” without EZ-Pass should exclude all links with link types:

- 3, 6, 9 because these links are limited to trucks only
- 10, 11 because these links are limited to HOVs only
- 14, 15, and 16 because these links are limited to vehicles with transponders (ETC).

3.2.4 Number of Lanes

The NJRTM-E provides three number of lane variables by time of day:

- LanesAM – number of lanes for AM Peak period
- LanesPM – number of lanes for PM Peak period
- LanesOP – number of lanes for Midday and Night periods

The purpose of having different variables for each time period is to accommodate the situations where the configuration of the roadway varies by time of day, such as a period-specific HOV lane or a roadway with a reversible lane. Typically, an HOV lane is usually applied to the peak direction reducing one lane from the available general-purpose lanes. During the off-peak period, this lane is usually converted back into a general-purpose lane. Having separate lane variables for each time period within a master network for each model year reduces the model complexity by providing a consistent network suitable for several different time-of-day analyses.

3.2.5 Traffic Control Devices

The traffic control device (TCD) parameters were added to the model to improve the representation of capacity, speed and intersection delay. The NJRTM-E provides 13 TCD categories, defined as follows:

1. Two-way stop (TCD 1)
2. All-way stop (TCD 2)
3. Yield (TCD 3)
4. Ramp-meter (TCD 4)
5. Signalized-uncoordinated-actuated (TCD 5)
6. Signalized-uncoordinated-fixed (TCD 6)
7. Signalized-coordinated-restricted progression (TCD 7)
8. Signalized-coordinated-favorable progression (TCD 8)
9. Signalized-coordinated-maximum progression (TCD 9)
10. Freeway diverge point (TCD 10)
11. Freeway merge point (TCD 11)
12. No controls (TCD 12)
13. Unknown (TCD 99)

Note that while the model includes a TCD for ramp metering, procedures to implement this function are not in the current model. Similarly delay estimation for the freeway merge point TCD is not included in the current model. In addition to the TCD variable, the model also includes additional signal-related variables that adjust time and capacity. These variables include:

- NSIG – number of signals in the link
- SIGCYC – Signal cycle in seconds
- SIGCOR – Signal coordination type
 - 0 = uncoordinated signal (default)
 - 1 = coordinated-unfavorable
 - 2 = coordinated-favorable
 - 3 = coordinated-maximum progression
- GC – green time per cycle ratio

Originally, the number signals and type signals (signalized or non-signalized) were compared to the signal data from the New Jersey Congestion Management System (CMS) database version 3.1 (November 3, 2003). The comparison, however, was only performed for the North Jersey Region (NJTPA Region). It should be noted that the comparison is only limited to whether or not an intersection is signalized. All other complimentary variables were defined based on default values assumed by the model. The detailed data for the TCD and its complimentary variables can be updated in the future as more comprehensive databases become available. The TCD data was then regularly reviewed and updated as part of the NJTPA's regional conformity projects.

3.2.6 Toll Variables

The NJRTM-E requires several toll variables for different toll applications. The toll variables are listed below:

- TOLL – the toll cost values in dollars.
- MCTOLL – the scaled toll values to balance by direction especially for one-way toll, prepared for mode choice process. MCTOLL will be explained further following this list.

- TOLLAPC – a flag to identify the type of toll links, for example, HOV free toll links, truck-free toll links, etc. The TOLLAPC has three values, with default value of 0. The default value indicates that toll is applicable to all modes (SOV, HOV, and truck). TOLLAPC of 1 indicates that toll is applied to all modes, except HOV. TOLLAPC of 2 indicates that toll is applied to all modes, except trucks.
- TOLLCLASS – toll class for lookup system. This variable provides flexibility to use toll values either directly from values coded in the link or values defined in a look-up table. The default value of TOLLCLASS is zero which is applied to all links without any toll values. TOLLCLASS between 1 and 98 indicates that the toll cost will be obtained from a look-up table. TOLLCLASS of 99 indicates that toll value is coded directly on the link. A detailed discussion about the toll look-up table will be given following this list.
- TOLLFACAM, TOLLFACPM, TOLLFACMD, TOLLFACNT – base toll factor for each time period (AM, PM, MD, and NT). This variable provides flexibility to have variable tolls for different time period. The default values of these variables are one (1), i.e., tolls are the same for all time periods and they are the same as the values coded in the toll links.
- FIXTOLL – this variable provides whether or not the toll cost is fixed through all assignment iterations or can be adjusted for each assignment iteration such as for congestion pricing scenarios. The FIXTOLL variable has two values, a value 0 for variable tolls and a value of 1 for fixed toll rates. The default is fixed tolls.
- CASH, ETC, PBM – the toll rates for the cash, Electronic Toll Collection (ETC), and Pay-By-Mail (PBM) payment types, respectively.

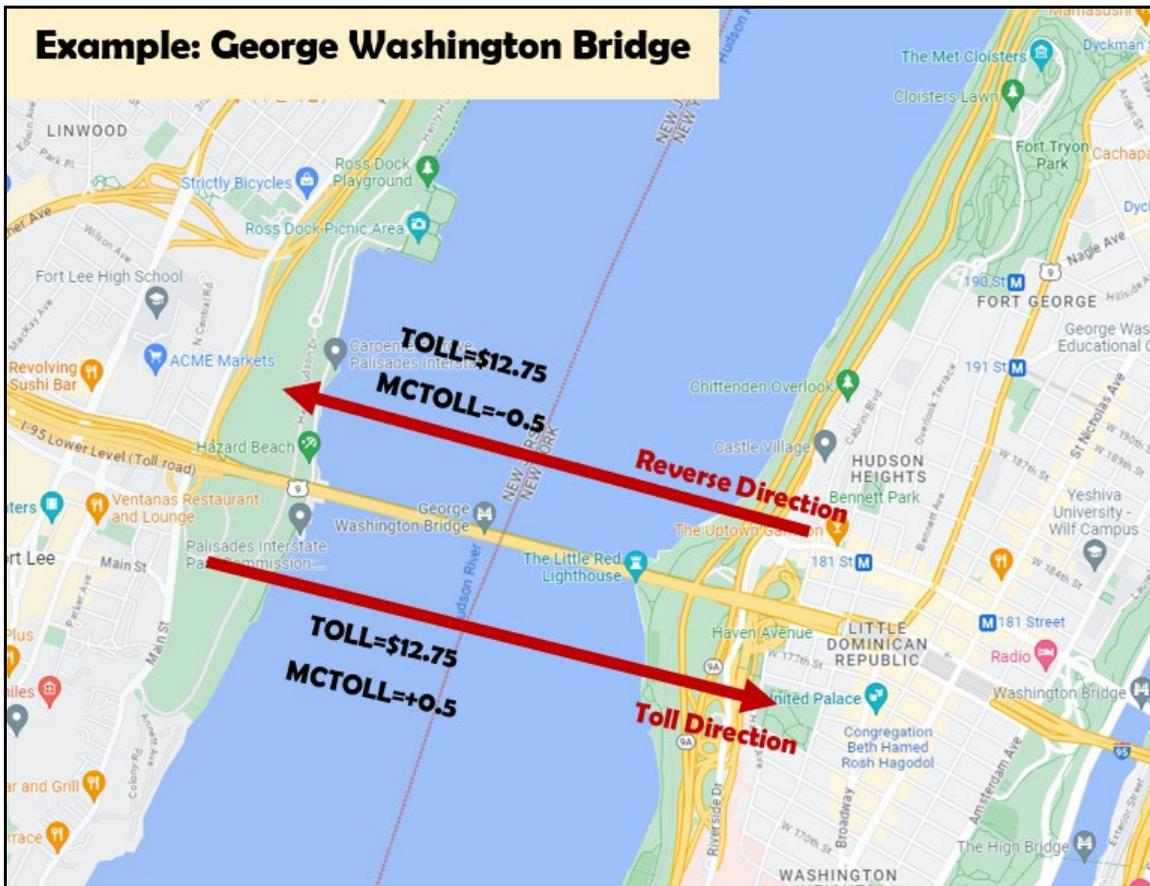
MCTOLL variable is used to control cost allocation in mode choice and traffic diversion in highway assignment with facilities employing one-way tolling schemes. For mode choice, trips are provided in a production-attraction format, so the cost of each direction of an assumed round trip should be 50% of a one-directional toll and must be presented on both directions of facility since round trips originating on either side of the toll plaza will encounter the toll at some time of the day. However, for the purposes of traffic assignment, the full cost of the toll is posted in the direction that the toll is assessed, so that the diversion process can seek differing paths (free vs. toll) if such options are present. An example of this is directional tolling schemes employed at the Holland Tunnel and the Verrazano-Narrows Bridge. In this situation, certain travelers can enter New York eastbound in the morning via the Verrazano-Narrows bridge (paying a lower toll than the eastbound Holland Tunnel) and return back to New Jersey via the non-tolled westbound Holland Tunnel.

The default value for MCTOLL is zero (0) which indicates that the toll does not exist in the link. For links with toll values, there are two sets of MCTOLL values:

- MCTOLL=1 for links with toll in both directions
- MCTOLL=+0.5 and -0.5 for links with one-way toll. The positive value (+0.5) is posted on link in the direction where the one-way toll is assessed, while the negative value (-0.5) is posted on the reverse, non-toll direction.

Figure 4 and **Figure 5** display the application of MCTOLL variable under differing conditions. These figures indicate what values should be input to TOLL and MCTOLL variables when representing either one-way or two-way toll collection plans.

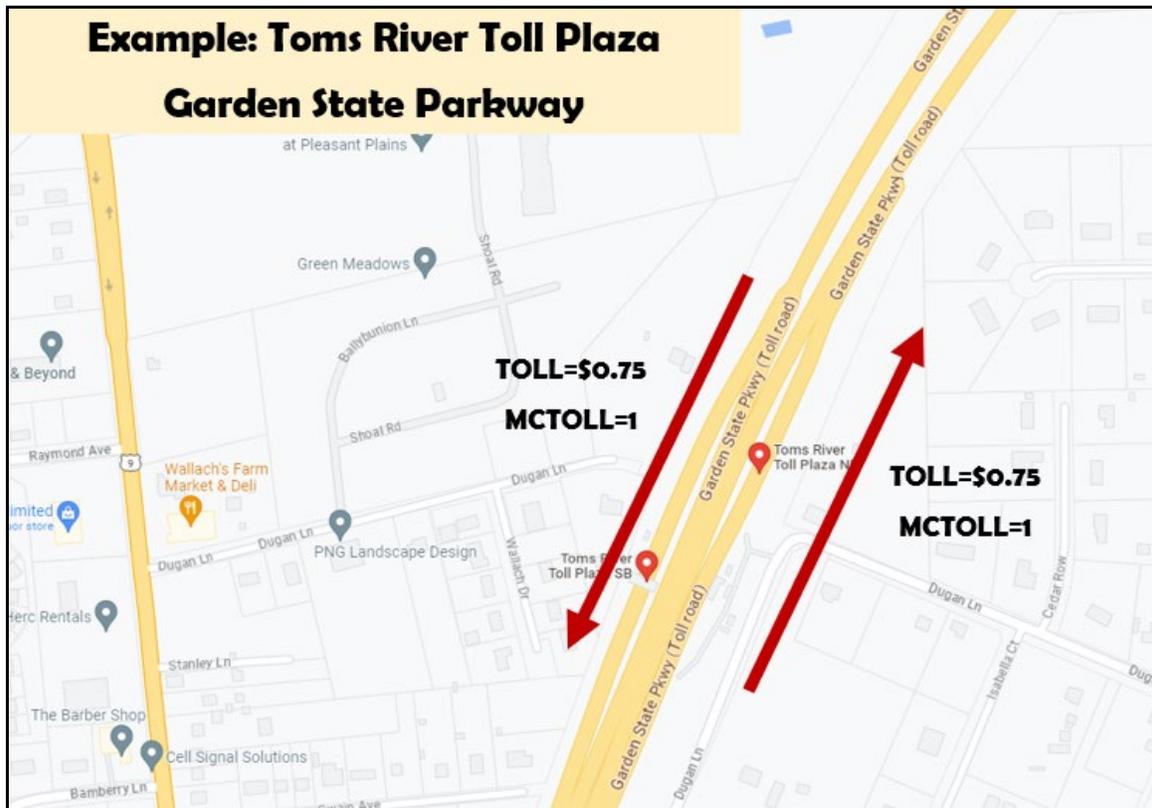
Figure 4 – MCTOLL for One-Way Toll Collection



For one-way toll collection plan, the toll values for mode choice are the absolute values of the TOLL multiplied by MCTOLL. In the example above, both directions will have toll values of \$6.38. In the assignment process, the assigned toll values will be the TOLL multiplied by a “factor”. The “factor” is defined as one (1) if MCTOLL is greater than zero and defined as zero (0) if MCTOLL is less or equal to zero. In the example above, the TOLL value for the toll direction (from New Jersey to New York) is \$12.75, while the TOLL value for the reverse direction is \$0.00.

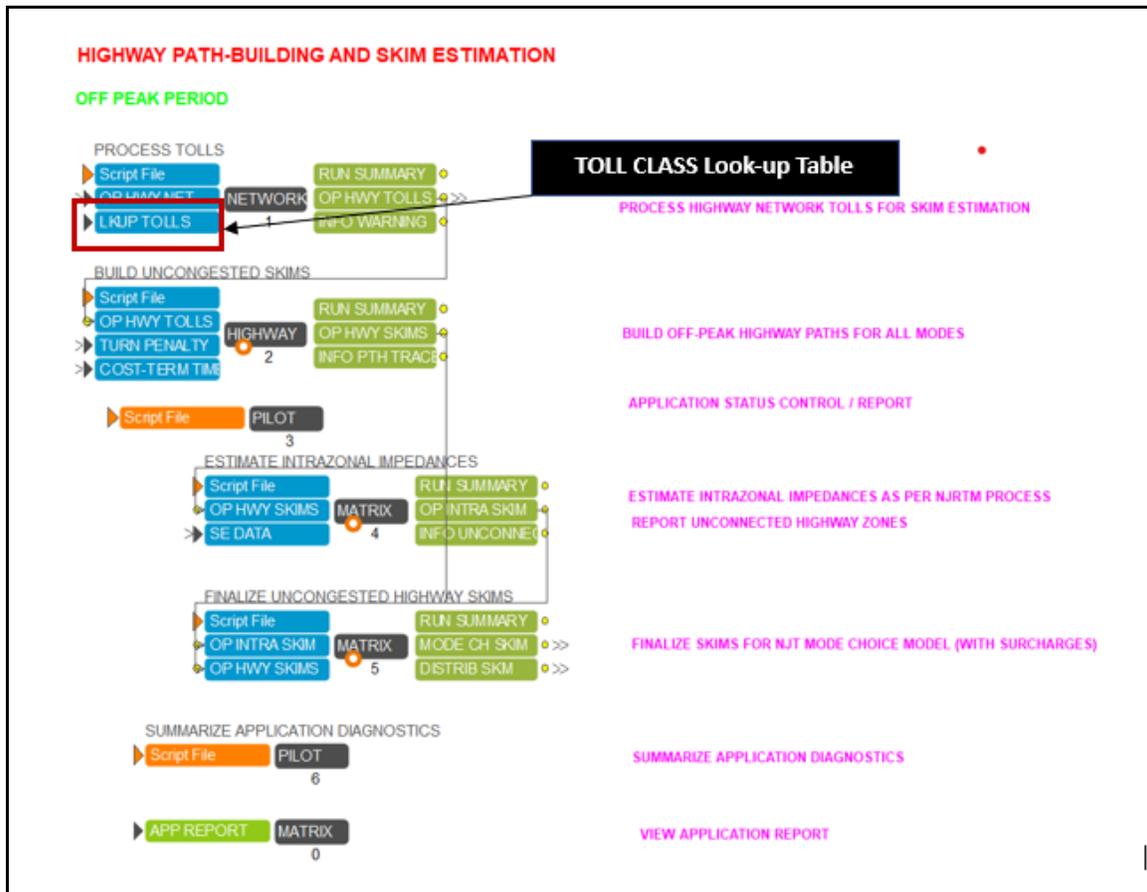
In contrast to the one-way toll collection plan at the George Washington Bridge, the MCTOLL variable is coded differently to represent the two-way toll collection situation for the Garden State Parkway toll plaza at Toms River, New Jersey. As shown in Figure 5, the MCTOLL variable is coded as 1.0 in direction which enables the toll to be properly assessed for both mode choice and the highway assignment procedures. Note that an equal toll cost (in this case \$0.75) is applied to each direction of the link, just as was the case with the one-directional toll scheme. It should also be noted that the MCTOLL variable can be used to control the display of true tolling locations in CUBE. When displaying toll costs for links, the posting process can be controlled by limiting the

Figure 5 – MCTOLL for Two-Way Toll Collection



TOLLCLASS, as explained previously, is a variable to allow the use of toll rates either directly coded on the link or toll rates defined from the look-up table. The look-up table that contains the toll rate is stored in "LOOKUPTOLLS.DBF" file in the "Highway Path-Building and Skim Estimation" module, as shown in Figure 6.

Figure 6 – Toll Class Look-Up Table



The NJRTM-E model reserves 98 keys (TOLLCLASS=1-98) to be used for different toll rates. Currently, all toll rates coded in the highway network are actual toll rates. Figure 7 shows the sample of the toll class look-up table. Note that TOLLCLASS code 99 is used to indicate that the look-up table is not applied and that the toll posted on the link is the actual value.

Figure 7 – Current Toll Class Table

LOOKUPKEY	RESULT
1	0.25
2	0.5
3	0.75
4	1
5	1.25
6	1.5
7	1.75
8	2
9	2.25
10	2.5
11	2.75
12	3

3.2.7 Additional Network Variables

Other pertinent highway network variables including FIXCAP, FIXTIME and LWCAPACITY.

FIXTIME is a variable to control whether travel time on a roadway link is calculated by a Volume Delay Function based on the Volume-Capacity Ratio (V/C ratio) or whether travel time is assumed to be based on free flow. FIXTIME can be defined as ‘0’ or ‘1’.

- FIXTIME=0: the congested travel time is calculated using the appropriate corresponding volume-delay function.
- FIXTIME=1: the travel time on the corresponding link will always be kept constant at free-flow time (T0). This is usually applied to links outside New Jersey Region where the highway network links are under-represented. Therefore, most of links can be overloaded during the highway assignments due to lack of roadway capacity to accept the travel demand. It is also applied to the park and lot links (small triangles).

FIXCAP is a variable that determines whether a roadway link’s capacity will be adjusted using the dynamic capacity approach to model peak spreading during the peak or off-peak periods. This approach allows an adjustment to the capacity when the V/C ratio reaches 0.9 or higher. While the NJRTM-E stores estimated hourly capacities, each period’s capacity is usually lower than the number of hours in the period. For example, the AM Peak period is defined as a three-hour period, while the AM Peak capacity factor is defined as 2.632 times the hourly capacity, or slightly lower than 3 hours. For a link that has a V/C ratio equal to or greater than 0.9, the period capacity will be dynamically and proportionally adjusted from 2.632 * capacity to 3.000 * capacity when the V/C ratio equals 1.00 or greater. FIXCAP can be defined as ‘0’ or ‘1’.

- FIXCAP=0: the dynamic capacity approach is used for the link. All links will normally use a value of 0.
- FIXCAP=1: the capacity for a link is not adjusted to use the dynamic capacity approach

The LWCAPACITY variable stores the adjusted capacity resulting from the dynamic capacity approach calculation.

3.2.8 Speed and Capacity Estimation

Speeds and capacity variables for the NJRTM-E were developed by using relationships between facility type and area type. The recommended “ideal” uncongested speeds (off-peak speed), which are used as input to the highway path building process, are presented in Table 6. Note that these speeds represent theoretical upper limits or “ideal” values prior to considering other factors such as number of lanes, grade, shoulder conditions, and traffic control devices that reduce these initial values. Initial estimates of congested speeds (peak speeds), which are used as input for the first iteration of the highway path building process, were assumed to be approximately 20% lower than the uncongested speed.

Table 6 – Uncongested Speed by Facility Type and Area Type

Facility Type	Area Type					
	Manhattan CBD	CBD	Urban	Suburban High	Suburban	Rural
Freeway	38	57	67	69	69	71
Expressway	35	43	50	62	62	70
Principal Arterial Divided	22	37	44	47	55	57
Principal Arterial undivided	25	28	37	47	53	55
Major Arterial Divided	22	26	33	43	50	50
Major Arterial Undivided	18	24	33	41	47	47
Minor Arterial	17	22	31	36	45	45
Collector / Local	16	16	24	35	35	35
High Speed Ramp	45	50	55	55	55	55
Medium-Speed Ramp	20	28	35	35	40	40
Low-Speed Ramp	15	25	25	25	25	25
Centroid Connector	10	10	10	10	10	10

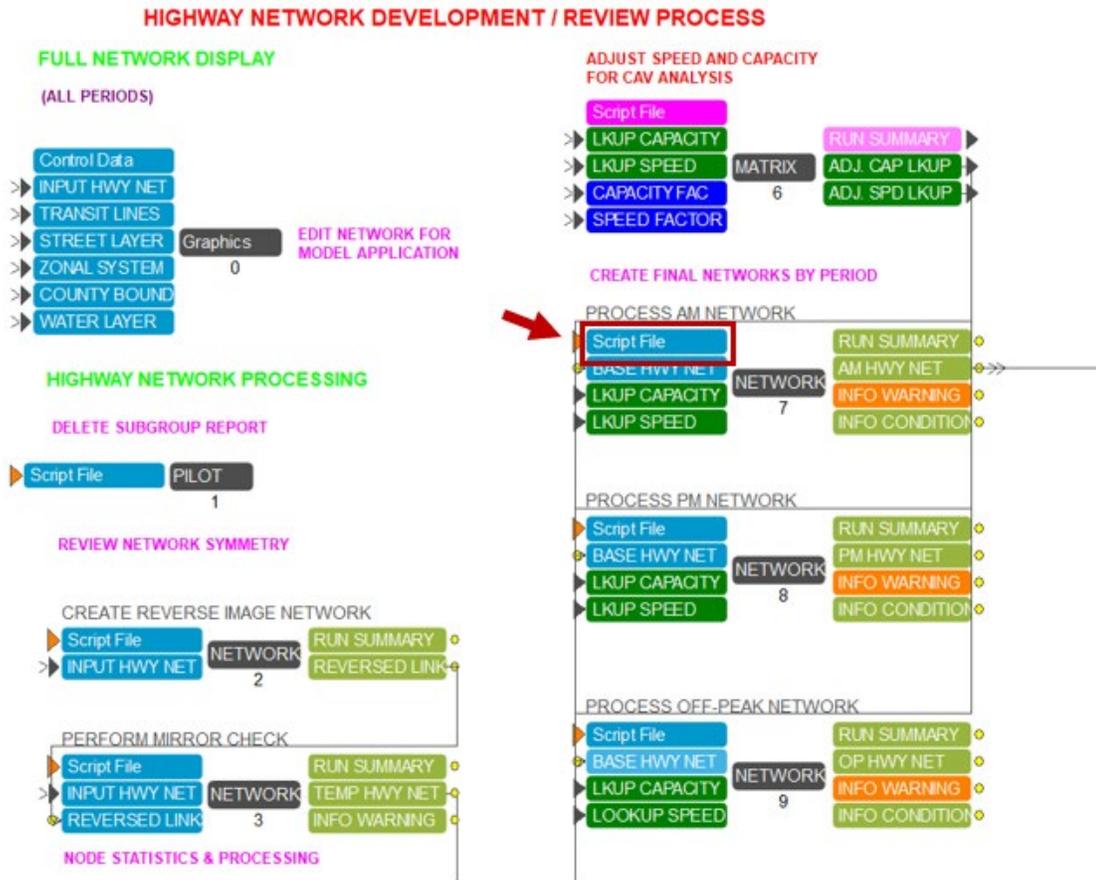
The “ideal” capacities were also assumed to be a function of facility type and area type. These initial hourly capacities per lane are listed in Table 7. The initial capacity values for each link were adjusted to take into account for geometric constraints or other impedances along the link, such as parking availability, traffic control devices, green time/cycle ratio, signal cycle length, etc.

Table 7 – Initial Hourly Capacity per Lane by Facility Type and Area Type

Facility Type	Area Type					
	Manhattan CBD	CBD	Urban	Suburban High	Suburban	Rural
Freeway	2,000	2,150	2,150	2,200	2,300	2,300
Expressway	1,800	1,850	1,950	1,950	2,100	2,100
Principal Arterial Divided	1,650	1,750	1,800	1,900	2,000	2,000
Principal Arterial undivided	1,600	1,675	1,750	1,850	2,000	2,000
Major Arterial Divided	1,550	1,650	1,700	1,750	1,900	1,900
Major Arterial Undivided	1,500	1,625	1,675	1,700	1,850	1,850
Minor Arterial	1,450	1,600	1,650	1,675	1,800	1,800
Collector / Local	1,100	1,250	1,300	1,350	1,350	1,350
High Speed Ramp	1,760	1,760	1,760	1,760	1,760	1,760
Medium-Speed Ramp	1,500	1,500	1,500	1,500	1,500	1,500
Low-Speed Ramp	1,200	1,200	1,200	1,200	1,200	1,200
Centroid Connector	9,000	9,000	9,000	9,000	9,000	9,000

The adjustments to speed and capacity are implemented during creation of period-specific networks and the procedures can be viewed in the control files in the “Highway Network Development Module” as shown in Figure 8.

Figure 8 – Highway Network Development Module



3.3 IDENTIFICATION AND PERFORMANCE VARIABLES

The identification variables, as their name implies, contain information for identification purposes only and are used as part of the network display. The variables include roadway name, SRI, Milepost, NHS (National Highway System), county where the links are located, conformity-based project ID number, and the zone where the links reside.

The NHS variable was added as part of the 2018 NJRTM-E Revalidation Project. The NHS codes are as follows:

- 0 – Not on NHS
- 1 – Interstate
- 2 – Not Used
- 3 – Non-Interstate STRAHNET (Strategic Highway Network)

- 4 – STRAHNET Connector
- 5 – Not Used
- 6 – Not Used
- 7 – Other NHS
- 8 – Approved Intermodal
- 9 – Segment is dual designated as both an Approved Intermodal Connector and STRAHNET
- 10 – Principal arterial added to the NHS under MAP-21

The performance variables contain mainly the performance information such as traffic counts and the year those traffic counts were gathered. These variables are used primarily for reference purposes when comparing traffic forecasts to base year conditions. Note that provisions were made to permit three traffic count data sets, each with a separate reference year. It was envisioned that peak period counts, seasonal counts, or data sets with conflicting estimates could be stored in these fields as part of a future effort.

3.4 HIGHWAY NETWORK DEVELOPMENT

The NJRTM-E highway network was originally obtained from the New Jersey Transit Highway Network which includes the NJTPA Region, NYMTC region, and a portion of DVRPC region (Mercer County, NJ and Bucks County, PA). This highway network was later expanded to include more counties in Pennsylvania and South Jersey to form the current NJRTM-E highway network. Several highway network sources from adjacent MPO’s, such as DVRPC and SJTPO were used as references in the initial expansion effort.

The current NJRTM-E consists of 3028 zones and follows the 2020 Census boundaries. The NJRTM-E node numbering system, including the reserved transit nodes, is listed in **Appendix G of the “User’s Guide” manual**. The node numbering system reserved the first 4299 nodes for use as zones. With the current 3028 NJRTM-E zones, the reserved zones and remaining 1271 unallocated zones are available for future use.

After the completion of node numbering system, the expansion of networks into Atlantic Counties, Lehigh Valley Counties, and Northeast Pennsylvania Counties was performed. The relevant segments included in the highway network and their attributes were identified from the state maps, street layers, or other on-line electronic maps. As part of this effort, the network within NJTPA region and Mercer County were refined. Those refinements include:

- Bifurcation of freeways in New Jersey Counties
- Detailed interchange coding of all limited-access facilities within New Jersey Counties
- Inclusion of all 500-series routes in New Jersey Counties
- Inclusion of the majority of 600-series routes in New Jersey Counties
- Conflation of highway network to street layer to permit true-shape display
- Zonal connector refinements to reflect proper connection from zones to highway network.
- Identified traffic signal locations within the NJTPA Region using CMS data.
- The placement of toll codes and toll costs on the appropriate network links, including the all toll bridges along the Delaware and Hudson Rivers.
- Additional layers of background features such as jurisdictional boundaries (TAZ, MCD, County); local street layer, and water layer.
- Enhancement of the facility type grouping from 9 to 12, which includes the introduction of different ramps type as discussed in the previous section.

- Introduction of coding procedures to permit modeling of various types of toll facilities, such as ETC-only toll links, HOT-Lanes, and one-way toll plans.

As a final step, the network was inspected to ensure that all recently-constructed facilities were properly coded in the network. Extensive checks for each of the key link variables were performed along with extensive network connectivity analysis to ensure that the network was configured correctly.

3.5 REVISED TOLL ESTIMATION PROCESS

The toll estimation system was also enhanced in the new model. Included in this effort is the updated toll costs for the New Jersey Turnpike, Garden State Parkway, and the addition of all bridge crossing tolls, such as bridges along the Hudson and Delaware Rivers, as well as toll bridges in the other New York counties. The toll rates were collected from several different agencies or readily available toll schedules including:

- Delaware River Joint Toll Bridge Commission (DRJTBC)
- Metropolitan Transportation Authority (MTA) Bridges and Tunnels in New York City
- Garden State Parkway
- New Jersey Turnpike Authority
- Burlington County Bridge Commission
- New York State Thruway Authority

In most cases, toll schedules were obtained directly from the respective agency's website and additional phone conversations with the agency staff when necessary.

Updates to the Garden State Parkway, toll bridges and tunnels, were relatively straightforward. Since these facilities use ramp-barrier system, tolls were directly represented by the costs posted on specific links. Each toll location was checked and modified as appropriate to reflect as closely as possible the year 2019 toll conditions. The coding process for the New Jersey Turnpike is based on an entrance/exit system in which toll charges accumulate as travel accumulates. Within the original NJRTM, the New Jersey Turnpike toll was based on a series of per mile charges that varied for each section of the Turnpike. However, since the Turnpike does not have a uniform toll rate for the entire system, the NJRTM-E provides an approximation of actual cost for each interchange to interchange movement. To develop an accurate but simple system to represent tolls, it was decided to represent each toll cost as a series of link specific charges between each interchange. This is consistent with the approach used in the original NJRTM. **APPENDIX B – TOLL RATE SCHEDULE** shows the toll cost posted between interchanges in the New Jersey Turnpike as well as the scheduled toll rates from NJ Turnpike Authority.

4. TRANSIT NETWORK DEVELOPMENT

4.1 INTRODUCTION

The NJRTM-E adopted existing transit networks from the NJ Transit Regional Transit Model. The primary purpose of the transit network was to develop estimates of the time and cost variables for peak and off-peak periods as required for the mode choice model. The transit network was also used as the basis to load trips within the transit assignment process. In the NJRTM-E, transit path-building and assignment are performed using CUBE’s Public Transit (PT) routine.

It should be noted that the NJ Transit Regional Transit Model covered a larger region than the original NJRTM. The adoption of this larger region facilitated estimation of transit demand for major transit hubs in the system, such as New York City, and permitted the estimation of transit services into adjacent regions in Pennsylvania and southern New Jersey. Note that during the course of the original model development, the client team elected not to extend the detailed representation of all transit services into the regions east of the Hudson River, but rather retain the existing coding of high capacity routes in Manhattan embedded in the NJT Model. This topic is discussed in further detail in Chapter 10 which describes the mode choice model development.

4.2 TRANSIT NETWORK COMPONENTS

4.2.1 Transit Network Modes

The transit network was developed based on the original network provided by New Jersey Transit. The network included those services that were present in the year 2019. As a result, the fares, headways, and travel times were all based on the conditions that existed in 2019. The network included all transit services provided in the North Jersey Region as well as some services in New York City (either operated by New Jersey Transit or the Port Authority of New York/New Jersey, MTA NYC Subway), Trenton, and long-haul transit lines that served the northwestern portion of New Jersey and Eastern Pennsylvania.

Similar to the highway network with the various types of facilities, the transit network was represented as a series of different “services”. These services are abstracted as a series of “modes”, reflecting the specific operating characteristics, such as use of shared right-of-ways in the case of bus services or the use of exclusive guide ways for the various rail services. Stratifying the network by mode is necessary since each type of transit service has different performance characteristics. For example, the performance characteristics of the commuter rail lines are significantly different than the local bus lines. The transit network was constructed by incorporating all of these “modes” representing the different type of transit services along with the necessary access and transfer connections. In the transit networks, modes represent actual transit routes, as well as walk/auto access connectors and “sidewalk” systems used to transfer in the CBD. It is common practice to refer to modes as being either “transit” or “non-transit” modes.

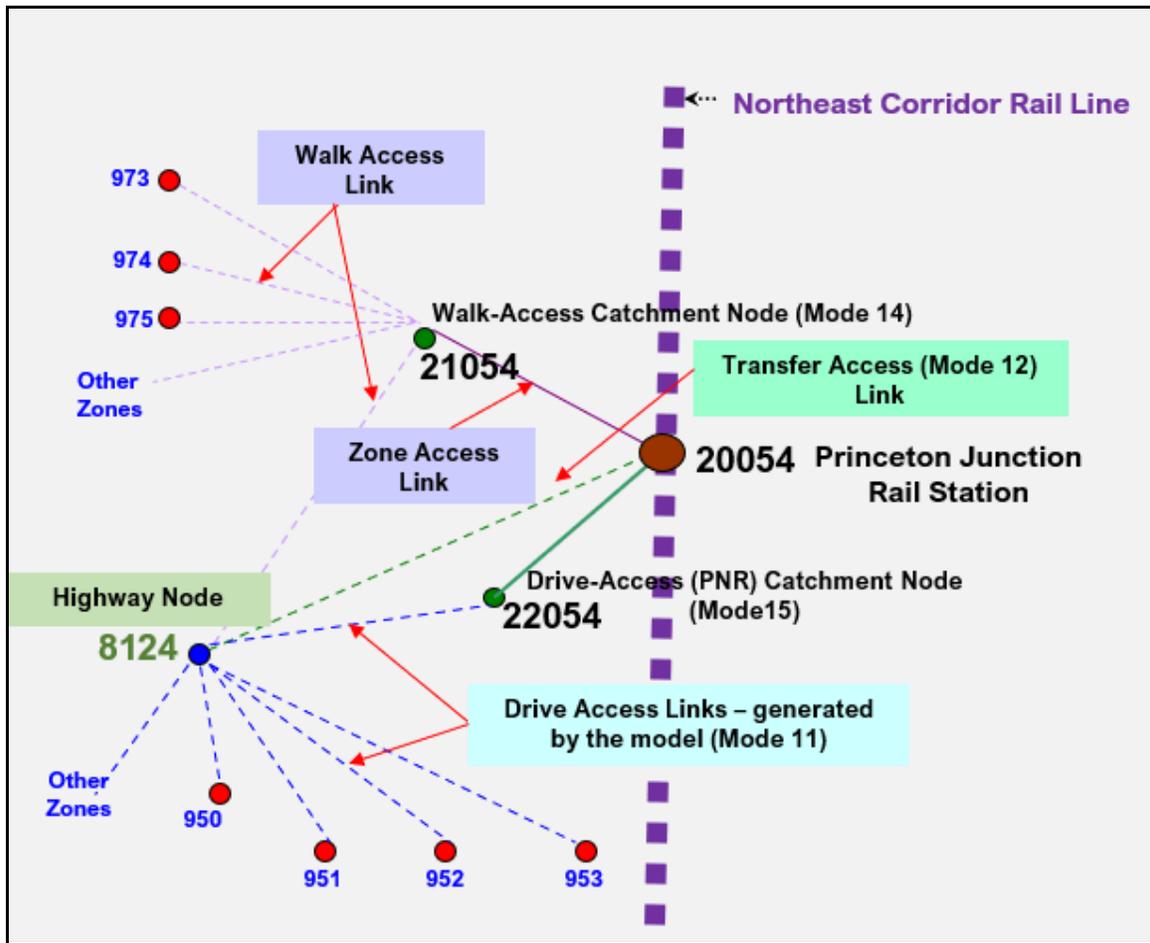
The various modes used in the NJRTM-E transit network are listed in Table 8. As shown in the table, the first 10 modes represent the actual transit services provided in the region. Note that Long distance ferry (mode 10) represents ferry lines from Monmouth County to Manhattan, while Ferry (mode 8) represents the remaining ferry lines. Modes 11-15 are the non-transit modes which provide access and transfer linkages for the network. There are two different auto-access related modes (modes 11 and 15) used in the NJRTM-E. Mode 11 includes the links connecting zones to gathering nodes at the major transit boarding points, such as PNR lots for express bus and rail lines. Mode 12 represents walk transfer links between different transit services (e.g.,

between a transfer between a bus and a train). Mode 15 is used to provide a common “catchment” link between the PNR lot and the station and serves as a single reference link to summarize all drive access trips using the station. Walk access to transit service is provided via Mode 14 links and includes a catchment link at major transit stations. A schematic representation of this coding process is provided in Figure 9.

Table 8 – NJRTM-E Transit Network Modes

Mode Number	Mode Designation	Type of Service
1	Transit	COMMUTER RAIL
2	Transit	PATH
3	Transit	NYC SUBWAY
4	Transit	NEWARK CITY SUBWAY
5	Transit	LOCAL BUS
6	Transit	EXPRESS BUS1
7	Transit	EXPRESS BUS2
8	Transit	FERRY
9	Transit	LIGHT RAIL
10	Transit	LONG DISTANCE FERRY
11	Non-Transit	PNR CONNECTORS
12	Non-Transit	TRANSFER CONNECTORS
14	Non-Transit	WALK ACCESS CONNECTOR
15	Non-Transit	PNR LOT TO STATION CONNECTOR
16	Non-Transit	PNR CONNECTORS TO BUS
17	Non-Transit	PNR CONNECTORS TO PATH
18	Non-Transit	PNR CONNECTORS TO LR
19	Non-Transit	PNR CONNECTORS TO RAIL
20	Non-Transit	PNR CONNECTORS TO FERRY
21	Non-Transit	PNR CONNECTORS TO NWKSUB

Figure 9 – Sample Access Coding from Princeton Junction Station



4.2.2 Transit Network Elements

The transit network consists of several elements that are maintained as separate files which are used as input to the PT routine. The description of the coding structure and requirements for these elements is provided within the CUBE/VOYAGER documentation. The transit system includes:

- Transit routes for each transit mode.
- Non-transit access or transfer links for both walk and drive access.
- Transit nodes for the non-highway transit facilities such as stations for commuter rail lines, ferry terminals, and the subway system.
- Transit links for all non-highway transit lines as well as special connection links for the Hudson River XBL service, and PNR links.
- Park and Ride catchment zones for each station that define the zones that can utilize certain park and ride lots.

4.2.3 Transit Route Coding

In accordance with the NJ Transit Regional Transit Model requirements, the NJRTM-E transit network coding was structured as a non-integrated procedure. As a non-integrated procedure, the transit network is created during the model execution process as part of the transit path-building and assignment procedures. The transit network uses the underlying highway network as the basis for the transit routes. The transit network was coded to be consistent with the format required by the PT module. Although many line variables are available within PT to abstract transit routes, only certain variables were used in the NJ Transit Regional Transit Model. The variables utilized are listed as follows:

- Name – Route Name
- Mode – Transit Mode
- Oneway – Flag to indicated one-way or two-way routes
- Headway[1] – peak period headways in minutes
- Headway[2] – off peak period in minutes
- N - List of nodes identifying the orientation of a transit route through the network.

The detailed descriptions of these parameters can be found in the CUBE/VOYAGER documentation under the PT routine.

4.2.4 Transit Access Coding

The transit access coding in the NJRTM-E was designed as a two-tier process. One tier represented auto access to the transit network. Each zone was assumed to be eligible for auto-access, with connections to a predefined set of Park and Ride (PNR) lots. These access links were built using the existing highway links. In addition, PNR lots were also assumed to be accessible from certain zones. These zones were defined in the PNR Catchment Zones module and could be revised as necessary. The auto access mode was coded as mode 11 as discussed previously and listed in Table 8.

The auto-access links only connect zones to the node representing the PNR lots. To advance the travel from the PNR lots to the stations or express bus stops, a “catchment” link was utilized as a means of summarizing all trips accessing the station. These links were coded as mode 15.

The second tier represented walk access. Each zone has transit access automatically generated to available transit stops and the number of access links to each transit mode is controlled by the PT path-building process. The automated walk access links were created using the underlying highway network and an assumed speed of three (3) mph walk speed. A maximum distance of 1 mile through the network grid was assumed for all modes except commuter rail (at 1.25 miles) and the Newark Subway (at 0.75 miles). In addition, certain zones in the immediate proximity of major transit stations had user-defined walk access links.

The mode choice model also requires that the percentage of each zone within walk distance be calculated. This task was performed as part of the Transit Walk Access Coverage Application discussed in section 5.15 of the User Guide. The procedure estimated the area percentage of each zone that is within ½ mile from transit service.

4.2.5 Transit Use Codes

As part of the highway network refinement effort, a new coding process was developed to represent “special use” transit facilities so as to minimize the coding of additional “parallel” transit only links. This new approach facilitates the coding of highway-based “special use” transit facilities such as exclusive bus lanes adjacent to general-purpose highway lanes (XBL) and preferential treatment such as queue jumps at traffic signals. This coding system also permits the coding of exclusive bus facilities such as those associated with a BRT-type system to be incorporated directly into the highway network, yet it restricts the use of these links to the designated transit lines.

This coding system was implemented within the existing transit speed calculation process. The coding system contains three variables, each provided for the a.m. peak period and the off-peak period. The first variable (TCODExx, where xx is the period designation) is an index describing the type of special use transit facility. The second variable (TSCALExx) provides a time multiplier that enables the analyst to scale the transit time against the free flow or congested time highway time. The third variable (TADDxx) provides a time surcharge, either positive or negative, for transit vehicles on the link. The index variable TCODE is described in Table 9.

Table 9 – TCODE Variable Description

TCODE	Description	Example / Notes
0	Standard Roadway	Local street - use standard time factoring
1	Exclusive Bus Lane	XBL
2	Queue Jump Lane	US 22
3	Reserved	
4	Reserved	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	Exclusive Bus ROW	BRT System - use hard coded time

The primary benefit of this coding approach is that the bus routes that utilized these special facilities can still reference to the existing highway network without resorting to coding transit-only links that would need to be maintained in separate files. With this coding process, an exclusive bus-only roadway can be incorporated into the highway network with TCODE=9. This system can also be used to incorporate other transit only links, such as rail lines, in the network, since all TCODES greater than 8 are not available for highway path-building and assignment.

Some examples of how this coding system can be applied are provided for the users review. For the XBL system, the user would code the relevant highway links with a TCODE value of 1.0. All links with this code utilize free flow travel time, which could then be scaled by the user (say 1.05) with the TSCALE variable, based on actual observed speeds. If the current XBL system encounters a ten-minute delay at the approach of the Lincoln Tunnel, that link would have a value of 10.0 in the TADD variable. Note that this process is independent of the level of congestion on the adjacent general use lanes. Hypothetically, if an alternative XBL system added a new lane and

mitigated the delay at the Lincoln Tunnel approach, then TSCALE could be set to 1.0 and TADD set to 0.0.

In the case of a queue jump (TCODE=2) or some other shoulder treatment, the bus runtime would be scaled using congested travel time. The analyst has the option with the TSCALE variable to adjust the runtime to reflect conditions in the field. The TADD variable could then have an additional surcharge (positive or negative) to address any minor differences. Note in this case that the bus travel time in the future year would be affected by the general increase in level of congestion although the analyst could still refine this further if necessary.

In the case of an HOV lane that is available for express bus service, it would not be necessary to utilize the new coding procedure. Buses utilizing this lane, as well as all buses in the general use lanes would have travel times automatically adjusted in response to the congestion levels as part of the normal transit travel time estimation process.

4.2.6 Transit Network/Highway Network Integration

The NJRTM-E was designed so that the bus service in the transit network is referenced to the highway network in order to estimate travel time. This process ensures that the highway and transit times are estimated on a consistent basis. With this process, increases in highway congestion will result in increased bus travel time. The linkage between the travel time on the networks was performed with a distance-based approach, i.e., the highway travel time was amplified by a distance factored by speed adjustment constant, following formula below:

$$\text{Transit Time} = \text{Highway Time} + \text{distance} * \text{speed factor}$$

Where:

- Transit Time = defined transit time for each highway link
- Highway Time = estimated highway time in each network link
- Distance = link distance
- Speed Factor = Speed factor based on facility type and area type.

The speed adjustment factors are varied between peak and off-peak periods. Table 10 and Table 11 list the factors for peak and off-peak periods, respectively.

Table 10 – Speed Adjustment Factors for Peak Period

FT	AT1	AT2	AT3	AT4	AT5	AT6
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	1.00	0.85	0.70	0.60	0.00	0.00
4	1.20	1.20	1.00	0.60	0.00	0.00
5	1.70	2.50	2.20	0.70	0.00	0.00
6	1.70	2.80	2.50	0.70	0.00	0.00
7	1.90	2.80	2.50	1.25	0.00	0.00
8	2.00	2.80	2.50	2.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00

Table 11 – Speed Adjustment Factors for Off-Peak Period

FT	AT1	AT2	AT3	AT4	AT5	AT6
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.50	0.35	0.25	0.10	0.00	0.00
4	1.00	0.35	0.35	0.25	0.00	0.00
5	1.50	0.50	0.30	0.25	0.00	0.00
6	1.50	1.50	0.30	0.50	0.00	0.00
7	1.50	1.50	1.00	1.45	0.00	0.00
8	2.20	2.00	1.50	2.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00

The distance-based approach was used primarily to minimize the impact of highway time changes during the calibration process. Because the highway network congested time oscillated frequently and sometimes quite significantly for some links during the calibration process, this caused a significant change of transit time as well. To provide more stable transit time for the calibration effort, the distance-based approach was used. It is recommended that the more common approach of scaling travel time be considered as a future enhancement.

4.3 TRANSIT FARE

The fare estimation procedure from the NJ Transit Regional Transit Model was adopted for use by the NJRTM-E to calculate the fares for each of the transit modes. The following fare systems exist among the different transit modes in use:

- A distance-based fare system based on the distance traveled between boarding and alighting location
- A zonal fare system based on the boarding and the alighting station
- A flat fare system where a boarding fare is collected for all passengers on a given route or mode
- Costs for specific Park and Ride (PNR) lots

Table 12 lists the fare systems used in the NJRTM-E.

Table 12 – NJRTM-E Fare Types

Mode	Fare Type
Commuter Rail	Zonal fare
Local Bus	Distance bases fare system
LRT*	Fixed fare system
NYC Subway	Fixed fare system
Newark Subway	Zonal fare
Ferry	Zonal fare
Express Buses	Distance bases fare system
PATH*	Fixed fare system
PNR Lots	Station specific fares

*At present, the PATH and LRT modes have a fixed fare system, but the fare files have been coded with a zone based fare system for flexibility in case of future fare policy changes.

The file name specification used to store the fare files is as follows:

PP_MMMM.far

Where:

- PP is the time of day (PK for peak and OP for off-peak)*
- MMMM is the mode name (rail, bus, ferry, bus etc.)
- *The 'PP' part of the filename does not exist for the Bus modes.

Note that the model provides period-specific fares for modes except the bus modes. The transit path-building routines require the following files:

- Bus.far (Bus)
- Xbus.far (Express Bus)
- OP_Rail.far (Off Peak Commuter Rail)
- PK_Rail.far (Peak Commuter Rail)
- OP_Ferry.far (Off Peak Ferry)
- PK_Ferry.far (Peak Ferry)
- OP_Ncs.far (Off Peak Newark City Subway)
- PK_Ncs.far (Peak Newark City Subway)
- OP_Path.far (Peak PATH)
- Pk_Path.far (Off Peak PATH)
- OP_LRT.far (Off Peak LRT)
- PK_LRT.far (Peak LRT)

In addition to the above transit mode fare files, the following fare files are also defined:

- PNR.far (PNR lot fare file)
- Special.far (Fare adjustments to distance-based fare system at specific locations)
- Usage.far (Flat fares and fare adjustments for various inter/inter-modal transfer combinations)

4.3.1 Distance Based Fare System

The file format for the distance-based fare system file is shown in Table 13 and a sample distance-based fare file is shown in Figure 10. Note that both the bus modes, local and express, utilize the distance-based fare system.

Table 13 – File Structure for ‘Distance Based Fare’ Files

Field Number	Variable
1	Fare in cents
2	Distance range in hundredths of miles separated by a hyphen "-"

Figure 10 – Sample ‘Distance Based’ Fare File

```

Bus.FAR (C:\NJRTME2019\modeldata\19... X
1 ;---- Local Bus Distance Fares ----
2 160 1-399
3 220 400-799
4 255 800-1199
5 280 1200-1599
6 300 1600-1999
7 345 2000-2399
8 380 2400-2799
9 410 2800-3199
10 450 3200-3599
11 480 3600-3999
12 510 4000-4399
13 550 4400-4799
14 595 4800-5199
15 630 5200-5599
16 660 5600
    
```

Regular and Express Bus Fares

Both peak period and off-peak period buses use the identical distance-based fare system. The Year 2019 fares (in dollars) for the regular buses are shown in Table 14.

Table 14 – Bus Fares by Mode and Distance Range

Distance Range	Bus Fare (\$)	
	Local	Express
1-3.99	\$1.60	\$2.95
4.00-7.99	\$2.20	\$4.05
8.00-11.99	\$2.55	\$4.45
12.00-15.99	\$2.80	\$5.45
16.00-19.99	\$3.00	\$6.45
20.00-23.99	\$3.45	\$6.85
24.00-27.99	\$3.80	\$7.30
28.00-31.99	\$4.10	\$7.80
32.00-35.99	\$4.50	\$8.35
36.00-39.99	\$4.80	\$9.00
40.00-43.99	\$5.10	\$9.70
44.00-47.99	\$5.50	\$10.30
48.00-51.99	\$5.95	\$10.95
52.00-55.99	\$6.30	\$11.50
56.00-69.99	\$6.60	\$12.30
70.00-89.99	\$6.60	\$12.85
90.00 and above	\$6.60	\$13.55

4.3.2 Zone-Based Fare System

The zone-based fare method uses a field associated with the boarding station and alighting station as an index to a fare matrix look up table that contains the appropriate station-to-station fare. The fare file for a Zone based fare system should be set up with the following information:

Name: This record type is identified with the keyword “NAME” appearing in columns 1-4. The remainder of this line contains a descriptive comment that identifies the file and serves as a heading for any printed reports.

Comment: Comments are identified with an exclamation point (!) in Column 1 and are used to provide descriptions in the file that are not read or processed by the fare matrix building program

Pivot Location: This record type is identified with the keyword “PIVOT” in columns 1-5, followed by a pivot fare zone identification number columns 9-10. The Pivot fare zone is used for trips that involve travel on more than one line. The commuter railroads in the North New Jersey area generally allow a monthly pass user to travel on any line or branch within the zone range stated on the pass. As a practical manner, this means that for travel between stations on different branches, the traveler needs to buy a pass from the higher fare zone for the boarding station or alighting station to the transfer station.

Fare Zone Definition: This record type is identified with the keyword “ZNST” in columns 1-4. Each defined fare zone appears as a separate record. The fare zone identification appears in columns 9-10 followed by a descriptive label in columns 12-25

Station Fare Zone Identification: This record type is identified with the keyword “STAT” in columns 1-4 followed by the Transit Station Node number in columns 6-10. Each station must appear at least once as a separate record in the appropriate zone fare definition file. If a station serves multiple lines, then it can appear multiple times with a separate record for each branch that it serves. Hoboken is one station that must appear multiple times in the file. The station name appears in columns 14-40. The line appears in columns 43-45 and the branch appears in column 47. The fare zone for this station appears in columns 49-51. The lines and branches are used to determine whether the station-to-station fare is calculated as a direct trip or as a trip to or from the pivot zone. If both the line and branch for the boarding station and the alighting station are the same or if the line is the same and either branch is left blank, the fare is based on the direct fare between the two fare zones. If the lines or branches are not the same, then the fare is the maximum of the boarding station to the pivot zone and the alighting station to the pivot zone.

Fare Heading: This record type is identified with the keyword “FHDG” in columns 1-4. Columns 11-15 contains the “to” fare zone number for the first column, Columns 16-20 contains the “to” fare zone number for the second column and so on for each fare zone identified with the ZNST records.

Fare: This record type is identified with the keyword “FARE” in columns 1-4. Columns 6-10 define the “from” fare zone for this record. A separate Fare Record is defined for each fare zone identified with the ZNST records. Column 11-15 defines the fare (in cents) for travel from the fare zone identified in Columns 11-15 to the fare zone identified for the first column in the FHDG record. Columns 16-20 define the fare for the second column and so on. It should be noted that the user need only code the upper right half of the fare zone matrix. The network building programs assume that the lower left half of the fare zone matrix is a mirror image of the upper right half of the matrix.

A sample ‘zone based’ fare file is shown in Figure 11.

Figure 11 – Sample ‘Zone Based’ Fare File

```

pk_ncs.FAR (C:\NJRTME2019\modeldata... X
1  NAME:NJDTFM PK NCS FARE-STATION EQUIVALENCE AND FARE TABLES
2  ! PIVOT RECORD INDICATES THAT TRIPS THAT CANNOT MATCH LINES
3  ! AND BRANCHES MUST TRAVEL TO/FROM THAT FARE ZONE. THE HIGHEST
4  ! FARE TO/FROM THE PIVOT IS THE ASSIGNED FARE.
5  PIVOT 1
6  ! FZONE NAME STATIONS (NOT CURRENTLY USED EXCEPT AS COMMENTS)
7  ZNST: 1 Non-Downtown Nwk Stations
8  ZNST: 2 Downtown Nwk Stations
9  ! STAT RECORDS INDICATE THE FARE ZONE ASSIGNMENT
10 ! A BLANK LINE OR BRANCH MEANS THAT ANY LINE OR BRANCH QUALIFIES.
11 ! NODE NAME FOR INFORMATION LIN B FZ PNR$ (B=BRANCH, FZ= FAREZONE)
12 STAT:20601 - Franklin Avenue NCS 1 1
13 STAT:20602 - Heller Parkway NCS 1 1
14 STAT:20603 - Davenport Avenue NCS 1 1
15 STAT:20604 - Bloomfield Avenue NCS 1 1
16 STAT:20605 - Park Avenue NCS 1 1
17 STAT:20606 - Orange Street NCS 1 1
18 STAT:20607 - Norfolk Street NCS 1 1
19 ! Intra-Downtown Travel Half Price per T. Marchwinski Meeting 7/14/04
20 ! By Jeff Roux
21 STAT:20608 - Warren Street NCS 1 2
22 STAT:20609 - Washington Street NCS 1 2
23 STAT:20610 - Broad Street NCS 1 2
24 STAT:20649 - Newark Broad Street NCS 1 2
25 !
26 !
27 FHDG: 1 2
28 FARE: 1 150. 150.
29 FARE: 2 . 80.
30

```

The commuter rail, ferry and Newark city subway modes use a zone-based fare system. Each of these systems is described below.

Commuter Rail Fares

Each individual commuter rail station is assigned to a fare zone. The commuter rail fare zones are shown in Table 15 below.

Table 15 – NJRTM-E Commuter Rail Fare Zones

Zone No.	Zone Name
1	New York NEC/NJC
2	New York M&E
3	New York Main/Bergen/Pas
4	Hoboken NEC
5	Newark/Hoboken Other
6	Secaucus
21	Elizabeth
22	Linden
31	Cranford
32	Rahway
41	Avenel
42	MET PK/WDBRG
51	Metuchen
52	Perth Amboy
61	Edison / Amboy
62	New Brunswick
71	South Brunswick / Matawan
72	Hazlet
81	Middletown
91	Red Bank
101	Princeton / Little Silver
111	Long Branch
121	Hamilton / ASB
131	Trenton / Belmar
141	Point Pleasant
151	Bay Head
161	Salisbury Mills
171	Campbell Hall
181	Middletown
191	Otisville
201	Port Jervis - Cornwall Heights (SEPTA)
202	Edington-Bristol (SEPTA)
203	Levittown (SEPTA)
204	Trenton (SEPTA)

The stations, the commuter rail lines are associated with, and their corresponding zone numbers are shown in Table 16 below.

Table 16 – NJRTM-E Station Fare Zone Numbers

Station	Line	Zone	Station	Line	Zone	Station	Line	Zone	Station	Line	Zone
NY Penn Station	NEC	1	Rahway	NEC	32	Morris Plain	ME	91	Lynhurst	BER	22
NY Penn Station	RAR	1	Linden	NEC	31	Morristown	ME	81	Kingsland	BER	22
NY Penn Station	ME	2	Elizabeth	NEC	21	Convent Station	ME	72	Glen Rock (Bergen)	BER	52
NY Penn Station	BER	3	N. Elizabeth	NEC	21	Madison	ME	71	Radbun	BER	42
NY Penn Station	PAS	3	High Bridge	RAR	121	Chatham	ME	62	Broadway	BER	42
Secaucus	NEC	7	Annandale	RAR	111	Gladstone	ME	111	Plauderville	BER	41
Secaucus	BER	6	Lebanon	RAR	111	Peapack	ME	111	Garfield	BER	32
Secaucus	PAS	6	White House	RAR	101	Fair Hills	ME	101	Rutherford	BER	31
Newark Penn Station	NEC	5	North Branch	RAR	91	Bernardsville	ME	91	Harmon Cove	PAS	21
Newark Penn Station	RAR	5	Raritan	RAR	81	Basking Ridge	ME	91	Spring Valley	PAS	72
Hoboken Terminal	NEC	4	Somerville	RAR	81	Lyons	ME	81	Nanuet	PAS	71
Hoboken Terminal	BTN	5	Bridgewater	RAR	71	Millington	ME	81	Pearl River	PAS	71
Hoboken Terminal (Morr)	ME	5	Bound Brook	RAR	62	Stirling	ME	81	Montvale	PAS	62
Hoboken Terminal (Glad)	ME	5	Dunnellen	RAR	52	Gillette	ME	72	Park Ridge	PAS	62
Hoboken Terminal	MAI	5	Painfield	RAR	51	Berkeley Heights	ME	71	Woodcliff Lake	PAS	62
Hoboken Terminal	BER	5	Netherwood	RAR	42	Murray Hills	ME	62	Hillsdale	PAS	61
Hoboken Terminal	PAS	5	Fanwood	RAR	41	New Providence	ME	61	Westwood	PAS	61
MNR Grand Central	MNR	3	Westfield	RAR	32	Summit	ME	61	Emerson	PAS	52
Bayhead Station	NEC	141	Garwood	RAR	32	Short Hills	ME	51	Oradell	PAS	51
Pt. Pleasant Beach	NEC	141	Cranford	RAR	31	Millburn	ME	51	River Edge	PAS	42
Manasquan	NEC	141	Roselle Park	RAR	22	Maplewood	ME	42	N. Hackensack	PAS	42
Spring Lake	NEC	131	Hackettstown	BNT	131	South Orange	ME	41	Anderson St.	PAS	41
Belmar	NEC	131	Mount Olive	BNT	131	Mountain Station	ME	41	Essex St.	PAS	41
Bradley Beach	NEC	121	Netcong	BNT	121	Highland Avenue	ME	41	Teterboro	PAS	32
Asbury Park	NEC	121	Lake Hopatcong	BNT	121	Orange	ME	32	Woodbridge	PAS	31
Alenhurst	NEC	121	Howard Blvd.	BNT	111	Brick Church	ME	32	Cornwall Heights	SR7	201
Elberon	NEC	111	Hover	BNT	101	East Orange	ME	32	Eddington	SR7	202
Long Branch	NEC	111	Denville	BNT	91	Newark Broad Street	ME	22	Croydon	SR7	202
Little Silver	NEC	101	Mountain Lakes	BNT	81	Port Jervis	BER	201	Bristol	SR7	202
Red Bank	NEC	91	Boonton	BNT	81	Otisville	BER	191	Levittown	SR7	203
Middletown	NEC	81	Towaco	BNT	71	Middletown	BER	181	Trenton (SEPTA)	SR7	204
Hazlet	NEC	72	Lincoln Park	BNT	62	Campbell Hall	BER	171	MNR Beacon	MNR	91
Matawan	NEC	71	Mountain View (Wayne)	BNT	61	Salisbury Mills	BER	161	MNR Peakskill	MNR	72
South Amboy	NEC	61	Little Falls	BNT	52	Hariman	BER	121	MNR Ossining	MNR	61
Perth Amboy	NEC	52	Great Notch	BNT	51	Tuxedo	BER	91	MNR Tarrytown	MNR	61
Woodbridge	NEC	42	Montclair State Uni.	BNT	42	Sloatsburg	BER	91	Wattsessing Avenue	ME	32
Avenel	NEC	41	Montclair Heights	BNT	42	Suffern	BER	81	Mount Tabor	ME	91
Trenton	NEC	131	Mountain Ave	BNT	42	Mahwah	BER	81	Clifton	BER	41
Hamilton	NEC	101	Upper Montclair	BNT	41	Route 17	BER	72	Passaic	BER	32
Princeton	NEC	101	Watchung Ave	BNT	41	Ramsey	BER	72	Delwanna	BER	31
Princeton Junction (shuttle)	NEC	101	Walnut Street	BNT	41	Allendale	BER	71	Glen Rock (Main)	BER	52
Princeton Junction	NEC	101	Benson Street	BNT	32	Walkwick	BER	62	Hawthorne	BER	51
Jersey Avenue	NEC	62	Rowe Street	BNT	31	Ho-ho-Kus	BER	62	Paterson	BER	42
New Brunswick	NEC	62	Arlington	BNT	22	Ridgewood	BER	61	Glen Ridge	ME	32
Edison	NEC	61	Metropark	NEC	42	Bay Street	ME	41	Bloomfield	ME	32
Metucheh	NEC	51									

The NJRTM-E adopted the two commuter rail fare systems for the peak and off-peak periods. Table 17 below summarizes the Year 2019 peak period rail fare matrix, while Table 18 below summarizes the off-peak period rail fare matrix.

Table 17 – Year 2019 NJ Transit Peak Period Commuter Rail Fares

ZONE	1	2	3	4	5	6	7	8	21	22	31	32	41	42	51	52	53	61	62	63	71	72	81	91	101	111	121	131	141	151	161	171	181	191	201	202	203	204	
1	1.88	1.88	1.88	2.90	3.48	2.90	2.90	2.90	4.83	5.75	5.75	6.20	6.83	7.10	7.70	8.10	8.10	8.73	9.03	9.03	9.65	10.00	10.20	10.35	10.35	10.63	10.63	11.00	11.00	11.00	8.00	8.28	8.53	9.00	13.45	13.45	13.10	11.00	
2		1.88	1.88	2.90	3.48	2.90	2.90	2.90	3.33	3.48	3.90	4.23	4.83	5.20	5.75	6.20	6.20	6.83	7.10	7.10	7.70	8.10	9.03	10.00	10.20	10.35	10.35	10.35	11.00	11.00	8.00	8.28	8.53	9.00	11.60	12.80	12.45	10.35	
3			1.88	2.90	3.48	2.90	2.90	2.90	3.33	3.48	3.90	4.23	4.83	5.20	5.75	6.20	6.20	6.28	6.28	6.28	7.70	7.73	7.73	10.00	10.20	10.35	10.35	10.35	11.00	11.00	8.00	8.28	8.53	9.00	11.60	12.80	12.45	10.35	
4				1.88	1.88	1.88	1.88	1.88	1.88	2.23	2.90	3.33	4.20	4.20	4.83	5.20	5.20	5.75	6.20	6.20	6.83	7.48	7.48	7.48	7.48	7.70	8.10	8.10	8.10	8.10	6.60	6.88	7.13	7.60	10.55	10.55	10.20	8.10	
5					1.88	1.88	1.88	1.88	1.88	1.88	2.23	2.90	3.33	4.20	4.20	4.83	5.20	5.20	5.75	6.20	6.20	6.83	7.10	7.28	7.48	7.48	7.70	7.70	8.10	8.10	8.10	6.60	6.88	7.13	7.60	7.93	10.55	10.20	8.10
6						1.88	1.88	1.88	4.83	2.78	1.38	2.95	3.38	3.63	4.25	4.70	4.70	5.15	5.55	5.55	6.25	6.65	7.50	10.00	10.20	10.35	10.35	10.35	10.35	10.35	6.60	6.88	7.13	7.60	11.25	12.80	12.45	10.35	
7							1.88	1.88	4.83	5.75	5.75	6.20	6.83	7.10	7.70	8.10	8.10	8.73	9.03	9.03	9.65	10.00	10.20	10.35	10.35	10.63	10.63	11.00	11.00	11.00	6.60	6.88	7.13	7.60	13.45	13.45	13.10	11.00	
8								1.88	3.33	3.48	3.90	4.23	4.83	5.20	5.75	6.20	6.20	6.83	7.10	7.10	7.70	8.10	9.03	10.00	10.20	10.35	10.35	10.35	11.00	11.00	6.60	6.88	7.13	7.60	13.45	13.45	13.10	11.00	
21									1.38	1.38	1.38	1.38	1.88	2.23	2.90	3.33	3.33	4.20	4.20	4.20	4.83	5.20	6.13	6.20	6.20	6.20	6.83	6.83	7.10	7.10	5.48	5.93	6.20	6.45	6.60	9.28	8.93	6.83	
22										1.38	1.38	1.38	1.38	1.88	2.23	2.90	2.90	3.33	3.90	3.90	4.23	4.83	5.75	6.13	6.20	6.20	6.20	6.83	6.83	6.83	5.48	5.93	6.20	6.45	6.60	9.28	8.93	6.83	
31											1.38	1.38	1.38	1.38	1.88	2.23	2.23	2.90	3.33	3.33	3.90	4.20	5.20	6.13	6.20	6.20	6.20	6.83	6.83	6.83	5.30	5.80	6.10	6.35	6.55	9.28	8.93	6.83	
32												1.38	1.38	1.38	1.38	1.88	1.88	2.38	2.90	2.90	3.33	3.90	4.83	5.75	6.13	6.20	6.20	6.20	6.83	6.83	5.13	5.75	6.00	6.33	6.40	8.65	8.30	6.20	
41													1.38	1.38	1.38	1.38	1.88	2.23	2.23	2.90	3.33	4.20	5.20	6.13	6.20	6.20	6.20	6.20	6.20	4.95	5.48	5.78	6.15	6.28	8.65	8.30	6.20		
42														1.38	1.38	1.38	1.38	1.88	2.23	2.23	2.90	3.90	4.83	5.75	6.13	6.20	6.20	6.20	6.20	4.73	5.30	5.63	6.08	6.15	8.65	8.30	6.20		
51															1.38	1.38	1.38	1.38	1.38	1.38	1.88	2.23	3.33	4.20	5.20	6.13	6.20	6.20	6.20	4.58	5.18	5.40	5.93	6.10	8.65	8.30	6.20		
52																1.38	1.38	1.38	1.38	1.38	1.38	1.88	2.90	3.90	4.83	5.75	6.13	6.20	6.20	4.38	4.95	5.28	5.75	6.00	8.65	8.30	6.20		
53																	1.38	1.38	1.38	1.38	1.38	1.88	2.90	3.90	4.83	5.75	6.13	6.20	6.20	4.38	4.95	5.28	5.75	6.00	8.58	8.23	6.13		
61																		1.38	1.38	1.38	1.38	1.38	1.88	2.90	3.90	4.83	5.75	6.13	6.20	6.20	4.13	4.78	5.13	5.60	5.80	8.65	8.30	6.20	
62																			1.38	1.38	1.38	1.38	1.88	2.90	3.90	4.83	5.75	6.13	6.20	6.20	3.90	4.55	4.95	5.48	5.73	8.58	8.23	6.13	
63																				1.38	1.38	1.38	1.38	1.88	2.90	3.90	4.83	5.75	6.13	6.20	3.70	4.38	4.70	5.25	5.33	8.58	8.23	6.13	
71																					1.38	1.38	1.38	2.23	3.33	4.20	5.20	6.13	6.20	3.70	4.38	4.70	5.25	5.33	8.58	8.23	6.13		
72																						1.38	1.38	1.88	2.90	3.90	4.83	5.75	6.13	6.13	3.45	4.18	4.55	5.10	5.23	8.20	7.85	5.75	
81																							1.38	2.23	3.33	4.20	5.20	6.13	6.13	3.15	3.90	3.90	4.13	4.23	7.65	7.30	5.20		
91																								1.38	2.23	3.33	4.20	5.20	5.20	2.70	3.45	3.60	3.90	4.03	6.65	6.30	4.20		
101																								1.38	2.23	3.33	4.20	4.20	2.35	3.00	3.35	3.75	4.03	5.78	5.43	3.33			
111																									1.38	1.38	2.23	3.33	3.33	1.98	2.55	3.10	3.60	4.03	4.68	4.33	2.23		
121																										1.38	1.38	2.23	2.23	1.60	2.08	2.83	3.43	4.03	3.83	3.48	1.38		
131																												1.38	1.38	9.58	9.85	10.10	10.58	10.90	3.83	3.48	1.38		
141																													1.38	1.38	9.58	9.85	10.10	10.58	10.90	9.28	8.93	6.83	
151																													1.38	9.58	9.85	10.10	10.58	10.90	9.28	8.93	6.83		
161																															1.45	1.45	2.08	2.83	3.25	13.95	13.60	11.50	
171																																1.45	1.60	2.33	2.98	14.05	13.70	11.60	
181																																	1.45	1.80	2.55	14.35	14.00	11.90	
191																																		1.45	1.85	14.93	14.58	12.48	
201																																			2.10	2.10	2.45	2.45	
202																																					2.10	2.10	2.45
203																																						2.10	2.10
204																																							2.10

Table 18 – Year 2019 NJ Transit Off-Peak Period Commuter Rail Fares

ZONE	1	2	3	4	5	6	7	8	21	22	31	32	41	42	51	52	53	61	62	63	71	72	81	91	101	111	121	131	141	151	161	171	181	191	201	202	203	204	
1	2.75	2.75	2.75	4.00	5.00	4.00	4.00	4.00	7.00	8.50	8.50	8.75	9.25	10.00	11.00	11.50	11.50	12.25	13.00	13.00	13.75	14.00	14.25	14.75	14.75	15.00	15.00	15.50	15.50	14.00	15.25	16.00	17.25	19.00	19.00	18.50	15.50		
2		2.75	2.75	4.00	5.00	4.00	4.00	4.00	4.75	5.00	5.25	6.25	7.00	7.25	8.50	8.75	8.75	9.25	10.00	10.00	11.00	11.50	13.00	14.00	14.25	14.75	14.75	14.75	15.50	15.50	14.00	15.25	16.00	17.25	19.00	18.25	17.75	14.75	
3			2.75	4.00	5.00	4.00	4.00	4.00	4.75	5.00	5.25	6.25	7.00	7.25	8.50	8.75	8.75	9.25	10.00	10.00	11.00	11.50	12.50	13.75	14.25	14.75	14.75	15.50	15.50	14.00	15.25	16.00	17.25	19.00	18.25	17.75	14.75		
4			2.75	2.75	2.75	2.75	2.75	2.75	3.25	4.00	4.75	5.25	6.00	7.00	7.50	7.50	8.50	9.00	9.00	9.75	10.75	10.75	10.75	10.75	11.00	11.50	11.50	11.50	11.25	12.50	13.25	14.50	15.00	15.00	14.50	11.50			
5					2.75	2.75	2.75	2.75	2.75	3.25	4.00	4.75	5.25	6.00	7.00	7.50	7.50	8.50	9.00	9.00	9.75	10.00	10.25	10.75	10.75	11.00	11.00	11.50	11.50	11.25	12.50	13.25	14.50	16.25	15.00	14.50	11.50		
6						2.75	2.75	2.75	7.00	4.00	2.25	4.25	4.75	5.25	6.00	6.75	6.75	7.25	8.00	8.00	9.00	9.50	10.75	14.00	14.25	14.75	14.75	14.75	14.75	14.75	11.25	12.50	13.25	14.50	16.25	18.25	17.75	14.75	
7							2.75	7.00	8.50	8.50	8.75	9.25	10.00	11.00	11.50	11.50	12.25	13.00	13.00	13.75	14.00	14.25	14.75	14.75	15.00	15.00	15.50	15.50	15.50	11.25	12.50	13.25	14.50	19.00	19.00	18.50	15.50		
8								2.75	4.75	5.00	5.25	6.25	7.00	7.25	8.50	8.75	8.75	9.25	10.00	10.00	11.00	11.50	13.00	14.00	14.25	14.75	14.75	14.75	15.50	15.50	11.25	12.50	13.25	14.50	19.00	19.00	18.50	15.50	
21									2.25	2.25	2.25	2.25	2.75	3.25	4.00	4.75	4.75	5.25	6.00	6.00	7.00	7.50	8.50	9.00	9.00	9.00	9.75	9.75	10.00	10.00	10.50	12.00	13.00	14.00	15.75	13.25	12.75	9.75	
22										2.25	2.25	2.25	2.25	2.75	3.25	4.00	4.00	4.75	5.25	5.25	6.25	7.00	8.50	8.50	9.00	9.00	9.00	9.75	9.75	9.75	10.50	12.00	13.00	14.00	15.75	13.25	12.75	9.75	
31											2.25	2.25	2.25	2.75	3.25	3.25	4.00	4.75	4.75	5.25	6.00	7.50	8.50	9.00	9.00	9.00	9.00	9.75	9.75	10.25	11.75	12.75	13.75	15.50	13.25	12.75	9.75		
32												2.25	2.25	2.25	2.25	2.75	2.75	2.75	4.00	4.00	4.75	5.25	7.00	8.50	8.50	9.00	9.00	9.00	9.75	9.75	9.75	10.25	11.25	12.00	13.50	15.25	12.50	12.00	9.00
41													2.25	2.25	2.25	2.25	2.25	2.75	3.25	3.25	4.00	4.75	6.00	7.50	8.50	9.00	9.00	9.00	9.00	9.00	9.00	10.50	11.50	13.00	14.50	12.50	12.00	9.00	
42														2.25	2.25	2.25	2.25	2.25	2.75	2.75	3.25	4.00	5.25	7.00	8.50	8.50	9.00	9.00	9.00	9.00	9.00	8.50	10.25	11.25	12.50	14.25	12.50	12.00	9.00
51															2.25	2.25	2.25	2.25	2.25	2.25	2.75	3.25	4.75	6.00	7.50	8.50	9.00	9.00	9.00	9.00	8.00	9.75	10.50	12.00	13.75	12.50	12.00	9.00	
52																2.25	2.25	2.25	2.25	2.25	2.25	2.75	4.00	5.25	7.00	8.50	8.50	9.00	9.00	9.00	7.75	9.00	10.00	11.50	13.25	12.50	12.00	9.00	
53																	2.25	2.25	2.25	2.25	2.25	2.75	4.00	5.25	7.00	8.50	8.50	9.00	9.00	9.00	7.75	9.00	10.00	11.50	13.25	12.50	12.00	9.00	
61																		2.25	2.25	2.25	2.25	2.25	3.25	4.75	6.00	7.50	8.50	9.00	9.00	9.00	7.25	8.50	9.75	11.00	13.00	12.50	12.00	9.00	
62										2.25	2.25	2.25	2.25	2.75	4.00	5.25	7.00	8.50	8.50	9.00	9.00	9.00	6.50	8.00	9.00	9.00	9.00	6.50	8.00	9.00	10.50	12.50	12.00	11.50	8.50				
63																			2.25	2.25	2.25	2.75	4.00	5.25	7.00	8.50	8.50	9.00	9.00	6.50	8.00	9.00	10.50	12.50	12.00	11.50	8.50		
71																				2.25	2.25	2.25	3.25	4.75	6.00	7.50	8.50	9.00	9.00	6.25	7.50	8.25	10.00	11.75	12.00	11.50	8.50		
72																					2.25	2.25	2.75	4.00	5.25	7.00	8.50	8.50	8.50	5.75	7.00	8.00	9.25	11.50	12.00	11.50	8.50		
81																						2.25	2.25	3.25	4.75	6.00	7.50	8.50	8.50	5.25	6.50	7.25	8.50	10.50	11.00	10.50	7.50		
91																							2.25	2.25	3.25	4.75	6.00	7.50	7.50	4.50	5.75	6.50	7.75	10.00	9.50	9.00	6.00		
101																								2.25	2.25	3.25	4.75	6.00	6.00	3.75	5.00	6.00	7.25	10.00	8.25	7.75	4.75		
111																									2.25	2.25	3.25	4.75	4.75	3.00	4.25	5.50	6.75	10.00	6.75	6.25	3.25		
121																										2.25	2.25	3.25	3.25	2.25	3.75	5.25	6.50	10.75	5.75	5.25	2.25		
131																											2.25	2.25	2.25	15.50	16.75	17.50	18.75	3.50	5.75	5.25	2.25		
141																											2.25	2.25	15.50	16.75	17.50	18.75	12.75	12.75	12.25	9.25			
151																											2.25	15.50	16.75	17.50	18.75	12.75	12.75	12.25	9.25				
161																													2.25	1.75	3.75	5.25	6.75	19.00	18.50	15.50			
171																														2.25	2.00	3.75	5.50	20.25	19.75	16.75			
181																															2.25	2.50	4.75	21.00	20.50	17.50			
191																																2.25	3.00	22.25	21.75	18.75			
201																																		3.00	3.00	3.50	3.50		
202																																				3.00	3.00	3.50	
203																																					3.00	3.00	
204																																						3.00	3.00

Ferry Fares

The fare policy for the ferry and long-distance ferry modes is similar to the commuter rail mode in that it is a zone-based fare system and there is a peak and an off-peak fare calculation in place. The zone classification for the ferry mode is shown in Table 19. The station-to-zone mapping for the ferry system is shown in Table 20.

Table 19 – Zone Classification for Ferry Mode

Zone No.	Zone Name
1	Midtown Manhattan
2	Lower Manhattan
3	Staten Island
4	Port Imperial
5	Hoboken
6	Highland / Atlantic Highlands
7	South Amboy
8	Colgate
9	West Haverstraw / Ossining
10	Harborside
11	Port Liberte
12	Belford
13	Newport
14	Liberty Harbor
15	North Hoboken
16	Lincoln Harbor

Table 20 – Station-to-Zone Mapping for Ferry Zone

Ferry Station	Zone No.	Ferry Station	Zone No.
East 34th Street	1	South Amboy	7
West 38th Street	1	Colgate	8
Fulton Ferry Terminal	2	Ossining	9
Pier 11	2	West Haverstraw	9
South Ferry	2	Harborside	10
World Financial Center	2	Port Liberte	11
St. George Street (SI)	3	Belford	12
Port Imperial	4	Newport	13
Hoboken	5	Liberty Harbor	14
Atlantic Highlands	6	North Hoboken	15
Highlands	6	Lincoln Harbor	16

The peak-period ferry fare matrix and the off-peak period ferry fare matrix are shown in Table 21 and Table 22 respectively. Note that all values are expressed in dollars.

Table 21 – Year 2019 NJ TRANSIT Peak Period Ferry Fares

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	99.99	99.99	99.99	5.28	6.00	14.83	14.83	5.25	99.99	5.25	99.99	14.83	5.73	5.25	6.00	5.28
2		4.88	0.00	5.29	4.56	14.83	14.83	4.56	99.99	4.56	6.75	14.83	99.99	4.56	4.56	99.99
3			99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4				99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5					99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6						99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7							99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8								99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9									2.50	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10										99.99	99.99	99.99	99.99	99.99	99.99	99.99
11											99.99	99.99	99.99	99.99	99.99	99.99
12												99.99	99.99	99.99	99.99	99.99
13													99.99	99.99	99.99	99.99
14														99.99	99.99	99.99
15															99.99	99.99
16																99.99

Table 22 – Year 2019 NJ TRANSIT Off-Peak Period Ferry Fares

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	99.99	99.99	99.99	5.28	6.00	14.83	14.83	5.25	99.99	5.25	99.99	14.83	5.73	5.25	6.00	5.28
2		4.88	0.00	5.29	4.56	14.83	14.83	4.56	99.99	4.56	6.75	14.83	99.99	4.56	4.56	99.99
3			99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4				99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5					99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6						99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7							99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8								99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9									2.50	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10										99.99	99.99	99.99	99.99	99.99	99.99	99.99
11											99.99	99.99	99.99	99.99	99.99	99.99
12												99.99	99.99	99.99	99.99	99.99
13													99.99	99.99	99.99	99.99
14														99.99	99.99	99.99
15															99.99	99.99
16																99.99

Newark City Subway Fares

The Newark City Subway fare system has three zone classifications. At present, a constant fare rate is maintained for all zone-to-zone travel except for the intra-downtown travel for which half

price of the regular fare is charged. The zone classification for the Newark City Subway system is shown in Table 23 and the station-to-zone mapping is shown in Table 24.

Table 23 – Zone Classification for Newark City Subway Mode

Zone No.	Zone Name
1	Non-Downtown Newark Stations
2	Downtown Newark Stations
3	Borad Street Extension

Table 24 – Station-to-Zone Mapping for Newark City Subway Mode

NCS Station	Zone No.	NCS Station	Zone No.
Bloomfield Avenue	1	Newark Penn Grove Outbound	2
Branch Brook Park	1	Warren Street	2
Davenport Avenue	1	Washington Street	2
Grove Street	1	Atlantic Street	3
Norfolk Street	1	Broad Street Station	3
Orange Street	1	Newark Penn Broad Inbound	3
Park Avenue	1	Newark Penn Broad Outbound	3
Silver Lake	1	NJPAC	3
Broad Street Downtown	2	Stadium	3
Newark Penn Grove Inbound	2	Washington Park	3

The year 2019 peak and off-peak fare matrix for the Newark Subway is shown in Table 25.

Table 25 – Year 2019 Fare Matrix for Newark City Subway Mode

Peak NCS Fare			Off-Peak NCS Fare		
Zone	1	2	Zone	1	2
1	1.50	1.50	1	1.60	1.60
2		0.80	2		0.80

4.3.3 Station Specific Fare System

The file format for the station-specific fare system used for the PNR charges and special bus stations is listed in Table 26. Figure 12 shows a ‘Station Specific’ Fare file. The PNR parking cost is calculated by dividing the monthly PNR cost for that station by 40.

Table 26 – File Structure for ‘Station Specific Fare’ Files

Field Number	Variable
1	Fare in cents
2	Transit node number

Figure 12 – Sample ‘Station Specific’ Fare File

```

PNR.FAR (C:\NJRTME2019\modeldata\19... x
4 ; RAIL PARK RIDES
5 00 22000 ;--- Bayhead
6 00 22001 ;--- Point Pleasant
7 00 22002 ;--- Manasquan
8 00 22003 ;--- Spring Lake
9 00 22004 ;--- Belmar
10 00 22005 ;--- Bradley Beach
11 00 22006 ;--- Asbury Park
12 00 22007 ;--- Allenhurst
13 00 22008 ;--- Elberon
14 250 22009 ;--- Long Branch
15 250 22010 ;--- Long Branch
16 180 22011 ;--- Little Silver
17 180 22012 ;--- Red Bank
18 210 22013 ;--- Middletown
19 140 22014 ;--- Hazlet
20 300 22015 ;--- Matawan
21 220 22016 ;--- South Amboy
22 00 22017 ;--- Perth Amboy
23 190 22018 ;--- Woodbridge
24 00 22019 ;--- Avenel
25 ; Published monthly ($135 at Trenton)
26 810 22050 ;--- Trenton
27 550 22051 ;--- Hamilton
28 00 22052 ;--- Princeton
29 00 22053 ;--- Princeton Junction Dinky
    
```

4.3.4 Special Bus Station Premiums

The transit stations and the corresponding add-on fares are listed in Table 27. These added costs to the distance-based fares are included to estimate the total costs from the regional PNR lots.

Table 27 – Premium Bus Stations and Add-On Fares

Premium Fares (in cents)	Node Number
-25	9863
550	8926
25	5005

4.3.5 Fixed Fare System

The LRT, New York City Subway and PATH systems use a fixed fare system. The PATH and LRT fare systems have been coded as “zone-based” fare systems to accommodate future changes in the fare calculation methodology. All the fares are in Year 2019 dollars.

Light Rail Transit

The peak period fare in the model for LRT travel is \$ 1.75 while for the off-peak period it is \$2.25. The peak and the off-peak period fare is the cost of a one-way trip.

New York City Subway

All trips are charged the equivalent of the monthly pass fare divided by 40 (\$2.00) upon entering the system.

PATH Line

The model uses a fare of \$2.10 during the peak period, while in the off-peak period the fare is \$2.75. The peak and the off-peak period fare is the cost of one-way trip.

4.3.6 Transfer Costs

Inter/Intra modal transfer costs, in addition to the flat fares for modes including New York City Subway and PABT Local Bus are input to the model through the “Usage.far” file. The file format for ‘Usage.far’ is listed in Table 28 and Table 29 lists fares in the usage.far file.

Table 28 – File Structure for ‘Usage Fare’ Files

Field Number	Variable
1	Fare adjustments in cents
2	Mode/Transfer Combination (MTC) number

Table 29 – Transfer Fare Costs

Fare Adjustment in cents	MTC Number	Mode / Transfer Combination
120	1	PATH Fare
200	2	Subway Fare
110	3	NCS Fare
240	4	Mode 7 Fare
50	5	Ferry Fare
70	6	PABT Local Bus
-102	7	LRT to Port Imperial Ferry Adjustment
122	8	SEPTA Station Add-on
-58	9	Rail to LRT Discount
-50	10	Rail to NCS Discount
-100	11	Bus to Port Imperial Ferry Adjustment
-200	12	RVL - JCL/NEC Transfer Adjustment Fare (PK)
-275	13	RVL - JCL/NEC Transfer Adjustment Fare (OP)
528	14	Pt Imperial Fare to 38th Street (Arthur's PK)
487	15	Pt Imperial Fare to 38th Street (Arthur's OP)
600	16	Other Waterfront to 38th Street (Arthur's PK)
487	17	Pt Imperial Fare to 38th Street (Arthur's OP)

The PATH, Ferry and NCS fares listed in the “Usage.far” file are ignored by the model. MTC Numbers 7 and 9 through 11 are used for the various inter-modal transfer combinations, while MTC numbers 12 through 17 are used for special cases of intra-modal transfers (commuter rail-to-commuter rail and ferry-to-ferry). A sample “Usage.far” is shown in Figure 13.

Figure 13 – Sample “Usage.far” File

```

USAGE.FAR (C:\NJRTME2019\modeldata... x
1  ; PATH, NCS and LRT Fare Not Done Here, Use Fare Matrix
2  120 1 ;---- PATH Fare ----
3  200 2 ;---- Subway Fare ----
4  110 3 ;---- NCS Fare ----
5  240 4 ;---- Mode 7 Fare ----
6  50 5 ;---- Ferry Fare ----
7  70 6 ;---- PABT Local Bus ----
8  -102 7 ;---- LRT to Port Imperial Ferry Adjustment
9  122 8 ;---- SEPTA Station Add-on
10 -058 9 ;---- Rail to LRT Discount
11 -050 10 ;---- Rail to NCS Discount
12 -100 11 ;---- Bus to Port Imperial Ferry Adjustment
13 ; J. Roux here. Transfers between RVL and JCL/NEC do not pay the max
14 ; of NYPS fare but rather Nwk Penn Station fare. #12 and #13 below represent
15 ; the difference between fares to NYPS (pivot) and actual.
16 ; This ensures the proper fare is charged for suburban RVL to suburban
17 ; JCL/NEC and vica-versa.
18 -200 12 ;---- RVL - JCL/NEC Transfer Adjustment Fare (Peak)
19 -275 13 ;---- RVL - JCL/NEC Transfer Adjustment Fare (Off-Peak)
20 528 14 ;---- Pt Imperial Fare to 38th Street (Arthur's Peak)
21 487 15 ;---- Pt Imperial Fare to 38th Street (Arthur's OP)
22 600 16 ;---- Other Waterfront to 38th Street (Arthur's Peak)
23 487 17 ;---- Pt Imperial Fare to 38th Street (Arthur's OP)
24

```

5. HIGHWAY PATH-BUILDING

5.1 INTRODUCTION

The highway path-building procedure is used to accumulate impedances for use by the trip generation, trip distribution, and the mode choice model components. The impedances include auto travel time, terminal time, and tolls for each origin-destination zonal pair. These impedance values are stored as a series of matrix files, often referred to as “skim” files. The content of each skim table is structured for use by one or more of the model components referenced above.

5.2 HIGHWAY PATH BUILDING PROCESS

The highway path-building process was developed to provide necessary travel time estimates for several model components. The trip generation component uses uncongested travel time as an accessibility variable for the allocation of attractions by income level. Highway travel times are used as part of the composite impedance terms that provides a measure of spatial separation for the trip distribution process. Lastly, the highway skims for time, distance, and toll costs are used as impedances for the mode choice model. The selection of the minimum path for each zonal pair was based solely on the highway travel time, since time is the primary component influencing travel determination. The path-building routine accumulates all the remaining impedance variables as the minimum path for each zonal pair was processed.

The path-building process is performed for peak and off-peak periods. The off-peak path building process was performed only during the first iteration of the model, while the peak period skims are accumulated during each iteration of the model. Table 30 lists the skim variables for each time-period.

Table 30 – Highway Path-Building Impedance Variables

Time Period	Table No.	Impedance Variables
Peak	1	Congested time - SOV
	2	Congested tolls (dollars) - SOV
	3	Congested distance - SOV
	4	Congested tolls (cents) - SOV
	5	Congested time - HOV
	6	Congested tolls (dollars) - HOV
	7	Congested distance - HOV
	8	Congested tolls (cents) - HOV
	9	Terminal time (total access and egress time for i-j pairs)
	10	SOV time + terminal time
	11	HOV time + terminal time
Off-Peak	1	Uncongested time - SOV
	2	Uncongested tolls (dollars) - SOV
	3	Uncongested distance - SOV
	4	Uncongested tolls (cents) - SOV
	5	Uncongested time - HOV
	6	Uncongested tolls (dollars) - HOV
	7	Uncongested distance - HOV
	8	Uncongested tolls (cents) - HOV
	9	Terminal time (total access and egress time for i-j pairs)
	10	SOV time + terminal time
	11	HOV time + terminal time
	12	Uncongested time - Truck
	13	Uncongested tolls (dollars) - Truck
	14	Uncongested distance - Truck
15	Truck time + terminal time	

The access and egress terminal times are defined at the area type of zone and the total terminal time for a given origin-destination zonal pair is the summation of egress time at the origin and the access time at the destination zone. The terminal times for each zone range between 1 and 7 minutes and are stored in the ZONECOSTTIME.DBF file.

5.3 MODE SPECIFIC PATH BUILDING

In the path-building process, the NJRTM-E estimates paths for three different vehicle types or “modes”: those being SOV, HOV, and Truck. The inclusion or exclusion of highway links for each mode-specific path is controlled by the “LINKTYPE” variable as described previously in the highway network development section of this document. This variable serves as a “permission”

code to utilize the individual highway links based on travel mode and, during the highway assignment process, both mode and toll condition.

5.4 INTRAZONAL TIME ESTIMATION

The intrazonal time was estimated in the final step of the highway path-building process. This time was necessary for the trip distribution process. Intrazonal time was calculated based on the zonal size as follows:

- For zones in the detailed study area, the intrazonal time was calculated using half of the sum of time from two (2) closest “nonzero” zones, and then multiplied it by 0.60. The 0.60 value was obtained to replicate the intrazonal times in the original NJRTM.
- For zones in the more aggregated outlying regions (usually reflected by the zonal size of district level or higher), the intrazonal time was calculated using the time from the nearest zone multiplied by 0.6.

5.5 SKIM FILES FOR MODE CHOICE

As a final step in the highway path-building process, the skim files were formatted to be consistent with requirements for the NJ Transit mode choice model. The mode choice model was developed using a customized C-Based program that required matrix data to be provided in MINUTP format. To accommodate this requirement, the Voyager routines stored the output in this format as opposed to the standard matrix format. Table 31 lists the variables by time period.

Table 31 – Skim File Structure for Mode Choice

Time Period / Mode	Table No.	Impedance Variables
Peak / SOV	1	time (minutes)
	2	distance (1/100 of miles)
	3	time (1/100 of minutes)
	4	cost (cents)
Peak / HOV	1	time (minutes)
	2	distance (1/100 of miles)
	3	time (1/100 of minutes)
	4	cost (cents)
Off-Peak / All modes	1	time (minutes)
	2	distance (1/100 of miles)
	3	time (1/100 of minutes)
	4	cost (cents)

6. TRANSIT PATH-BUILDING

6.1 INTRODUCTION

The transit path-building procedure is used to accumulate impedances for the transit modes that are available within the mode choice model. The impedances include transit in-vehicle time and various out-of-vehicle time measures such as walk time and wait time. These impedance values are accumulated in matrix files based on definition of the mode choice model variables. It should be noted that transit paths are established by time-period for each “access submode/line-haul mode combination” and that paths are developed based on minimum travel times weighted by time component.

6.2 MODE HIERARCHY

Since travel through the transit networks often requires transfers between various transit modes, such as transfer from a NJ Transit commuter rail line to the PATH system, it is necessary to establish a hierarchy between the modes to define which mode is the “primary mode” and which modes act as secondary transfer modes. The NJRTM-E model adopted the hierarchical system developed for the NJ Transit Mode Choice Model, which is based solely on the use of particular modes at any point during the travel path. The hierarchical system is defined as follows:

- A path is defined as the commuter rail mode if it contains time on the commuter rail lines.
- A path is defined as the “LRT mode” if includes time on the LRT lines, but not time on commuter rail lines
- A path is defined as the “PATH mode” if it includes time on PATH, but not the commuter rail mode or the LRT mode.
- A path is defined as the “bus mode” if it includes bus time or Newark Subway time but no other transit modes other than ferry time
- A path is defined as the “long haul ferry mode” if it includes only long-haul ferry time.
- A path is defined as the “ferry mode” if it includes only local ferry time.

6.3 PATH-BUILDING PARAMETERS

The path-building process was done separately for each walk-access and drive-access transit path mode options. A total of 12 transit path building processes were performed for each time period, consistent with the NJ Transit Mode Choice Model requirements. These access/line-haul mode combinations include:

- Walk-access and auto-access for bus
- Walk-access and auto-access for rail
- Walk-access and auto-access for PATH
- Walk-access and auto-access for LRT
- Walk-access and auto-access for ferry
- Walk-access and auto-access for long-haul ferry

In the transit path-building procedures, various time components were introduced and each time component was normally weighted to reflect how onerous that time component is to the user. For example, time spent waiting for a transit vehicle is perceived as more onerous or burdensome than the time spent in-vehicle traveling towards destination. The NJRTM-E defined the values of

out-of-vehicle time factors, which include wait and transfer times, in the range of 1.5 to 2.0. The list of path-building parameters is shown in Table 32.

Table 32 – Path Building Parameters

Parameters	Values
Number of zone access links to:	
Rail, NYC Subway, Bus, Ferry, and Long Haul Ferry	8
PATH	4
Newark Subway, LRT	3
Maximum walk distance (miles) to:	
Commuter Rail and Long Haul Ferry	1.25
Newark Subway	0.75
All other modes	1.00
Assigned walk speed (mph)	3.0
Transfer Penalty (minutes) for:	
First Transfer	5.3
Second Transfer	6.9
Third Transfer	7.6
Fourth Transfer	8.2
Fifth Transfer and up	8.6
Initial wait factor for:	
Commuter Rail and Long Haul Ferry	2.0
All other modes	1.5
Transfer wait factor for:	
Commuter Rail and Long Haul Ferry	2.0
All other modes	1.5
Maximum impedance	650

In the path-building process, two sets of skim files by time-of-day were prepared: the peak and off-peak transit skims. The off-peak transit skim files were performed only in the first model iteration. The peak period transit skim files were performed during each model iteration in order to reflect changes in congested highway travel time and the resultant impact on highway-based transit run times.

As mentioned at the beginning of this section, the skim files were prepared for each “preferred” line-haul mode for each access mode. To obtain the desired paths for the preferred access/line-haul mode combinations, the times of individual modes are weighted to influence the creation of paths. To discourage the use of particular modes, weights in excess of 1.0 were applied. It should be noted that paths being created for a particular mode, even when weighted favorably may not result in the use of the required line-haul mode. If this condition exists for a given line-haul mode on a particular origin-destination zonal pair, that mode is rejected during the fare estimation process and the mode will not be an eligible option in the subsequent mode choice processing. Table 33 lists the in-vehicle time weights applied to each mode as part of path-building for a particular access/line-haul mode combination. Note that the weights by mode are identical by time period.

Table 33 – Path-Building Mode Weights

Path (Favored Mode)	COMM. RAIL	PATH	NYC SUBWAY	NEWARK CITY SUBWAY	LOCAL BUS	EXPRESS BUS	PNR BUS	FERRY	LIGHT RAIL	LONG DIST. FERRY	PNR CONN.	TRANSFER CONN.	WALK ACCESS CONN	PNR LOT TO STA. CONN	PNR CONN. TO BUIS
Peak Walk-to-Rail	1.0	1.2	1.5	1.0	2.5	6.0	6.0	1.2	1.2	1.2	1.8	2.0	2.0	2.0	1.8
Peak Walk-to-PATH	4.0	1.0	2.0	1.0	1.5	4.0	4.0	4.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Peak Walk-to-Bus	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Peak Walk-to-Ferry	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	4.0	1.3	1.5	1.5	1.5	1.3
Peak Walk-to-LRT	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	4.0	1.3	1.5	1.5	1.5	1.3
Peak Walk-to-Long Dist. Ferry	1.2	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.0	1.8	2.0	2.0	2.0	1.8
Peak Drive-to-Rail	1.0	1.0	1.5	1.0	3.0	6.0	6.0	1.2	1.2	1.2	1.8	2.0	2.0	2.0	1.8
Peak Drive-to-PATH	4.0	1.0	2.0	1.0	2.0	4.0	4.0	4.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Peak Drive-to-Bus	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Peak Drive-to-Ferry	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	4.0	1.3	1.5	1.5	1.5	1.3
Peak Drive-to-LRT	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	4.0	1.3	1.5	1.5	1.5	1.3
Peak Drive-to-Long Dist Ferry	1.2	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.0	1.8	2.0	2.0	2.0	1.8
Off-peak Walk-to-Rail	1.0	1.2	1.5	1.0	2.5	6.0	6.0	1.2	1.2	1.2	1.8	2.0	2.0	2.0	1.8
Off-peak Walk-to-PATH	4.0	1.0	2.0	1.0	1.5	4.0	4.0	4.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Walk-to-Bus	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Walk-to-Ferry	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Walk-to-LRT	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Walk-to-Long Dist. Ferry	1.2	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.0	1.8	2.0	2.0	2.0	1.8
Off-peak Drive-to-Rail	1.0	1.0	1.5	1.0	3.0	6.0	6.0	1.2	1.2	1.2	1.8	2.0	2.0	2.0	1.8
Off-peak Drive-to-PATH	4.0	1.0	2.0	1.0	2.0	4.0	4.0	4.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Drive-to-Bus	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Drive to Ferry	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Drive to LRT	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	4.0	1.3	1.5	1.5	1.5	1.3
Off-peak Drive to Long Dist. Ferry	1.2	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.0	1.8	2.0	2.0	2.0	1.8

Skim matrices were prepared based on the mode choice requirements. Twelve skim files were prepared consistent with the path building processes performed, as mentioned above. Extensive information was stored in each skim file for use in the mode choice process. Table 34 shows the list of tables stored in a typical skim file.

Table 34 – Skim File Table Format

Table No	Description	Table No	Description
1	In-vehicle time (IVTT) - Rail	27	Total Bus Time - PATH
2	In-vehicle time (IVTT) - PATH	28	PATH Time - Rail
3	In-vehicle time (IVTT) - Bus	29	Distance - Rail
4	In-vehicle time (IVTT) - Ferry	30	Distance - PATH
5	In-vehicle time (IVTT) - Light Rail	31	Distance - Bus
6	Total wait time - Rail	32	Distance - Ferry
7	Total wait time - PATH	33	Distance - Light Rail
8	Total wait time - Bus	34	Rail Time - Rail
9	Total wait time - Ferry	35	Subway Time - Rail
10	Total wait time - Light Rail	36	Subway Time - PATH
11	Walk time - Rail	37	Subway Time - Bus
12	Walk time - PATH	38	Subway Time - Ferry
13	Walk time - Bus	39	Subway Time - Light Rail
14	Walk time - Ferry	40	Bus Time - Light Rail
15	Walk time - Light Rail	41	Light Rail Time - Light Rail
16	Fare - Rail	42	In-vehicle time (IVTT) - Long Distance Ferry
17	Fare - PATH	43	Wait Time - Long Distance Ferry
18	Fare - Bus	44	Walk Time - Long Distance Ferry
19	Fare - Ferry	45	Fare - Long Distance Ferry
20	Fare - Light Rail	46	Number of Transfers - Long Distance Ferry
21	Number of Transfer - Rail	47	Bus Time - Long Distance Ferry
22	Number of Transfer - PATH	48	PATH Time - Long Distance Ferry
23	Number of Transfer - Bus	49	Distance - Long Distance Ferry
24	Number of Transfer - Ferry	50	Long Distance Ferry Time - Long Distance Ferry
25	Number of Transfer - Light Rail	51	Subway Time - Long Distance Ferry
26	Total Bus Time - Rail	52	Long Distance Ferry Time - Rail

6.4 TRANSIT FARE ESTIMATION

Within the path-building step, transit fares are calculated for each access model/line-haul mode combination. The fares calculated in the NJRTM-E reflect the 2019-dollar values. In 2018, the transit fare module was converted from the Customized C+ program (NJFARE2 program) to a cube module. The transit fare estimation module is shown in Figure 14.

Figure 14 – The New Transit Fare Module



In summary, those fare systems are described as follows:

- Distance-based fare system for bus modes
- Zone-based fare system for commuter rail, ferry, and Newark City subway modes
- Station-specific fare system for special bus station premiums
- Fixed fare system for LRT, NYC subway, and PATH

The transit fare for each origin-destination zonal pair is a function of the path selection. It is important to note, however, that the fare values do not influence the path selection process. Rather, it is based purely on the weighted travel times, as discussed earlier.

7. COMPOSITE IMPEDANCE ESTIMATION

7.1 COMPOSITE IMPEDANCE TERM DEVELOPMENT

The objective of utilizing a composite impedance term in the trip distribution process is to enable the routine to be sensitive to not only the highway travel time, but rather a more complete representation of the travel choices and costs between various origin-destination zonal pairs. Several methods have been investigated in the past and generally there is a strong preference to use the logsum term of the mode choice model since it is properly structured to represent the impedances offered by all modes and weighted to reflect the actual usage of these modes. The logsum term includes not only cost and time elements, but also the mode bias constants which account for nonmeasurable traveler preferences, such as safety and comfort. Initially, the use of the logsum term from NJ Transit Mode Choice Model was reviewed and investigated. However, this particular model has mode bias terms that vary by geographic market segment. This variation causes significant discontinuous impedance values when trips are being allocated across competing destinations. This level of variation was assumed to provide significant problems with the use of this term during the trip distribution and was therefore removed from consideration as the impedance term for this project.

An alternative impedance term was adopted for this project using a structure known as the “parallel conductance” formula. This particular formulation is flexible enough to incorporate most of the impedance terms in the traditional mode choice logsum term and can be structured to be sensitive to the actual mode choice of the zonal pair or subregions. The formula is structured as follows:

$$I_c = 1.0 / (1.0/I_H + MS_T/I_T)$$

Where:

I_c = Composite impedance for zonal pair i-j

I_H = Highway impedance for zonal pair i-j for the “representative” auto mode

MS_T = Regional transit mode share

I_T = Transit impedance for zonal pair i-j for the “representative” transit mode

Note that the highway and transit impedance terms would represent all elements of travel times and costs, by structuring the impedance for each mode as a generalized cost. With this approach, the composite impedance term would reflect all of the costs (fare, tolls, auto operating costs & parking) and the various time components (in-vehicle, waiting/walking) that are incorporated in the logsum term. For the NJTPA integrated model, the generalized costs would be based on the values of time for each trip purpose obtained from the New Jersey Transit Mode Choice Model, which was based on the stated preference survey conducted by RSG in the early 1990s.

The modal share term provides a mechanism that effectively “weighs” the impact of the transit impedance into the composite term. Note that if transit mode share is zero, then the term defaults back to the highway-based impedance. If transit share is nonzero, the composite term is reduced in value in order to represent the aspect of having multiple services available between a given origin and destination. The transit modal share term in many applications is derived from a general “regional” transit share as opposed to the specific transit mode share of a given origin-destination zonal pair. The NJRTM-E used the mode shares for each I-J zonal pair rather than a regional share value in order to more properly reflect within the composite term the degree of competitiveness provided by the transit service for individual zonal pairs.

7.2 COMPOSITE IMPEDANCE VARIABLES

As part of developing the composite impedance estimates, it was necessary to adopt both the “representative” mode for the various auto modes and transit modes as well as the cost and time components that are included for mode choice. While the SOV auto mode would be the likely mode representing all auto modes due to its dominance and uniform characteristics, the selection of the representative transit mode was more complex. There are multiple line-haul modes available coupled with both walk access and drive access submodes. The “best” transit mode being used was defined as the “reference” mode, as being the transit mode with the minimum travel time, appropriately weighted for in-vehicle and out-of-vehicle elements as well as transfer surcharges. The time and cost variables for each representative mode are as follows:

Auto Mode:

$$I_H = \text{Time}_{\text{SOV}} + \text{Tolls}_{\text{SOV}} / 100.0 * 60.0 / 14.4$$

Transit Mode

$$I_T = \text{Time}_{\text{TIVT}} + \text{Time}_{\text{TOVT}} * 2.5 + \text{Cost}_{\text{TRAN}} / 100.0 * 60.0 / 14.4$$

where:

I_H = Highway impedance for zonal pair i-j for the auto mode

I_T = Transit impedance

Time_{SOV} = Time for the SOV mode in minutes

$\text{Tolls}_{\text{SOV}}$ = Toll costs for the SOV mode in cents

$\text{Time}_{\text{TIVT}}$ = In-vehicle time (in-vehicle and drive access) for best transit mode in minutes

$\text{Time}_{\text{TOVT}}$ = Out-of-vehicle time (walk and wait) for best transit mode in minutes

$\text{Cost}_{\text{TRAN}}$ = Transit fare and PNR cost for best transit mode in cents

Note that the highway costs did not include parking costs since uniform data was not available for the entire study area as part of this project. Also, auto operating costs were not included since it was believed that these estimates should be determined based on speed rather than just distance and adequate information on fuel costs by speed were not available for this analysis. As such the SOV time variable serves as a proxy for the influence of both auto time and the cost of fuel on the distribution of trips. In contrast, the transit cost variable reflects both transit fares and parking costs at stations since this data is readily-available and is estimated with specificity as part of the transit networks.

7.3 COMPOSITE IMPEDANCE APPLICATION ISSUES

There are several implementation issues that need to be addressed when implementing the proposed composite impedance structure. The first issue is related to the inability of the impedance term to reflect the appropriate weight that should be applied to each mode that is represented in the composite term. When using the logsum term, the weighted effect of each mode’s contribution to the overall “utility” is directly incorporated into the composite impedance value. Therefore, the introduction of a new mode or any reduction in service is properly reflected as part of the change in the overall impedance. In contrast, the parallel conductance formula includes only one representative mode for auto and transit. Potential inconsistencies can occur if changes in the mode representing the “best” path have offsetting characteristics. For example, consider a situation where the introduction of a new transit service that provides a better travel

time, but at higher cost. In such cases, the new service, as the “best” transit mode, may have a marginally lower travel time, but a higher fare, that leads to a higher transit impedance term. The higher transit impedance term, if not properly controlled, would lead to a higher composite impedance value, causing trip distribution to allocate fewer trips between a given zonal pair in response to the introduction of an “additional” mode with better service. For several reasons, this is counter-intuitive. Most relevant is the fact that the previous transit mode deemed “best” prior to the new mode might still exist, so the overall service should not have a higher impedance value than the value prior to the new mode. To address this possible issue, specific i-j zonal pair transit mode shares were utilized, rather than the regional transit modal shares as a means of offsetting this concern. Note, however, this condition would only be possible in situations where the travel time gains for the new mode are minimal and differential fare for the new mode is significant.

The second implementation issue is the need to establish transit shares by zonal pair for use in the calculation as weighing mechanism. As mentioned above, the logsum value reflects the appropriate weighting of all modes as a function of their “utility”. If the logsum approach is used, by simply executing the mode choice model prior to trip distribution, the “logsum” composite impedance term and share percentages for each mode are established simultaneously prior to trip distribution. Distribution is then performed and the percentages shares are applied to resulting person trips to create the final trips by mode for each zonal pair.

In contrast, the parallel conductive technique requires the transit share in order to form the composite impedance value. Prior applications of this technique simply specified a “regional” transit share to be used to weigh the transit contribution for the combined term, but this approach limits the sensitivity since each zonal pair would have the same transit weighting, even though transit level of service may vary significantly between certain origin-destination zonal pairs. The model elected to use a separate weighing approach with the specific transit share for each zonal pair. This necessitated the creation of transit shares prior to the execution of the mode choice model.

In order to prepare transit shares for the initial model iteration, a support application was developed that establishes shares based on a previous model run. These initial shares are applied only during the first model iteration, with all subsequent iterations using shares developed from the previous iteration of the current execution.

8. TRIP GENERATION

8.1 INTRODUCTION

This section describes the development of new trip generation process for the NJRTM-E. The new trip generation procedure incorporated several significant enhancements into the regional modeling process. These enhancements include several new trip purposes and the estimation of non-motorized trips. The development of the generation model is based on the statistical analysis of data available for the 39-county region with NJTPA as the core, along with other data sets obtained for special generators such as the Newark Airport. The Regional Household Travel Survey (RHTS) conducted in 2010 and 2011 constitutes the primary data source. 2019 LEHD (Longitudinal Employer-Household Dynamics data) and 2015-2019 PUMS (Public Use Microdata Sample) form the supplemental/secondary sources for the estimation and calibration.

The NJRTM-E included the several new trip purposes that were created by subdividing existing purposes as well as the estimation of trips for particular generators that were modeled with limited accuracy in the previous model. As an example, the previous home-based work purpose has been partitioned into two purposes, home-based work “direct” and home-based work “strategic”. In 2017, the method for determining HBWS was reviewed to determine whether it should be changed. The detail review and analysis of the HBWS trip purpose are presented in **APPENDIX L – HOME-BASED WORK STRATEGIC (HBWS)**. The final recommendation was to retain the original definition of the dwell-time. Several new trip purposes, such university trips and airport trips, were incorporated into the new model in order to more accurately predict trip activity from these unique generators. While trips from these sites were previously abstracted as part of the home-based other trip purpose, their unique characteristics could not be fully modeled as part of this generic purpose. The following list summarizes the trip purposes included in the NJRTM-E, along with brief description of each purpose:

- Home-based Work Direct (HBWD) – includes work trips that travel directly between home and work, without any intermediate stops.
- Home-based Work Strategic (HBWS) – includes “strategic” work trips that have intermediate stops of limited duration, usually to serve another passenger, which may influence mode choice.
- Home-based Shop (HBSH) – defined as trips with one trip end at home and the other at a retail location.
- Home-based Other (HBO) - defined as trips with one trip end at home and the other at a non-retail location other than a college/university or airport.
- Home-based University (HBU) - defined as trips with one trip end at home and the other at a college or university.
- Work-based Other (NHBW) – defined as a non-home-based trip with one trip end at work
- Non-Home Non-Work (NHBO) – defined as a non-home based trip with neither trip end at work
- Airport - defined as trips with one trip at Newark Airport.
- Truck Trip Purposes (Heavy, Medium, and Commercial)

The NJRTM-E also structured the estimation of trips by income. The income group definition from the previous validation (2017) was adopted in this validation. Additional discussions on the income group is provided in **APPENDIX M – INCOME GROUP ADJUSTMENTS**. The five income groups are as follows:

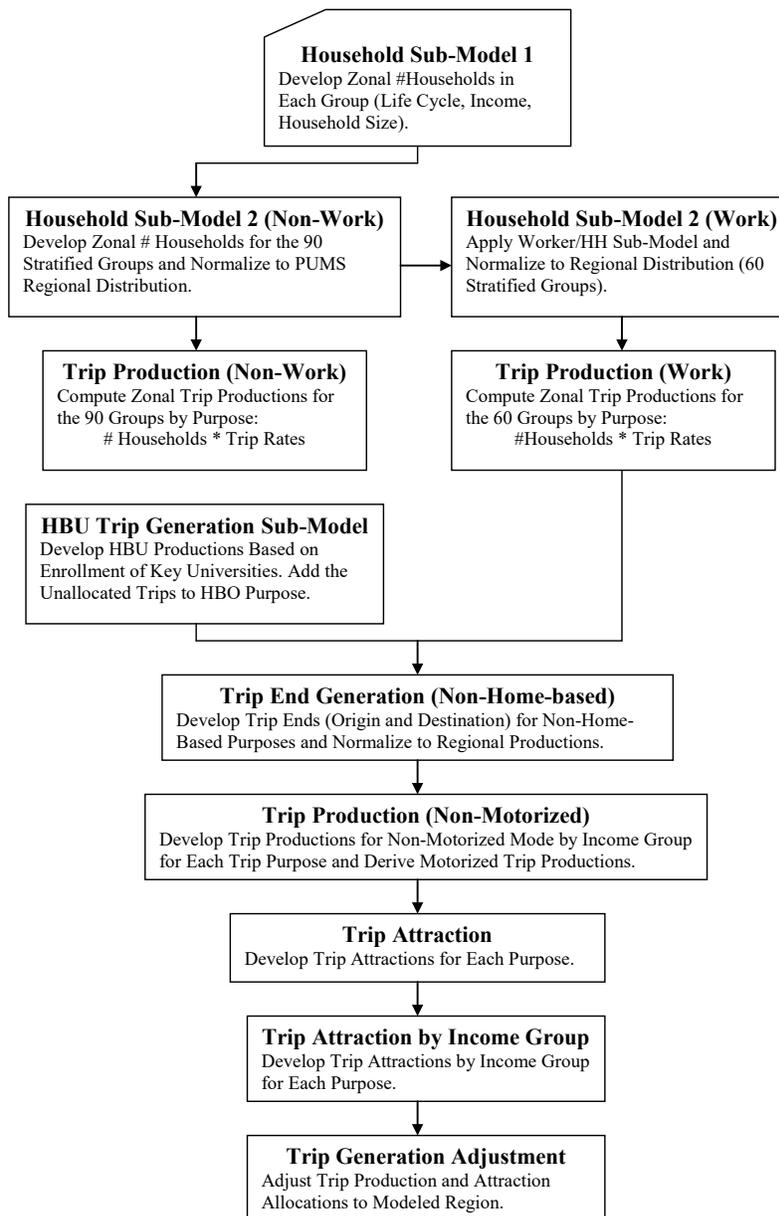
- Group 1 – equal or less than \$15,000
- Group 2 – between \$15,000 and \$50,000

- Group 3 – between \$50,000 and \$100,000
- Group 4 – between \$100,000 and \$200,000
- Group 5 – higher than \$200,000

8.2 STRUCTURE OVERVIEW

The NJRTM-E trip generation component was developed using standard techniques commonly found within four-step urban travel demand models. These techniques include a cross-classification process for trip productions and linear equations for trip attractions. The flowchart in Figure 15 depicts the general process of this trip generation model:

Figure 15 – Trip Generation Structure Overview



The trip generation component includes several procedures used to prepare the necessary zonal variables and apply the trip estimation techniques, each of which is briefly defined below:

- **Household Sub-models.** In this step, households are stratified into 90 groups (6 by household size * 5 by income group * 3 by life cycle) and then 60 groups (4 by number of workers * 5 by income group * 3 by life cycle).
- **Trip Production Estimation.** This step applies the trip production rates derived from household survey to each household group. The resulting trip productions are then aggregated to 15 groups (5 by income group and 3 by life cycle).
- **HBU Trip Generation Sub-model.** This routine applies a customized technique to estimate home-based trip generation at colleges and universities. Special procedures are applied to estimate this purpose due to the limitations in the enrollment database used to control the estimation of trips for the HBU trip purpose.
- **NHB Trip End Estimation.** Trip ends are estimated for non-home-based trip purposes and normalized to the regional total derived from cross-classification process.
- **Non-motorized Sub-model.** Total person trips are partitioned into Non-motorized trips and motorized trip productions by trip purpose.
- **Trip Attraction Estimation.** Motorized trip attractions are estimated for home-based purposes and stratified by income group.
- **Regional Adjustment.** The resulting productions and attractions are adjusted at the county level for the modeled region. These adjustments are applied primarily to counties in the buffer region near the edge of the modeled area to account for trips destined to areas outside of the modeled area.

The development of these procedures is described in further detail in the following sections.

8.3 HOUSEHOLD SUBMODELS

8.3.1 Introduction

The purpose of the household submodels is to stratify households in each zone by associated socioeconomic attributes. These allocations are controlled by the aggregate average zonal values and seed distributions of households observed in PUMS data from the Census and CTPP data.

The procedure of this model contains the following four main steps:

1. Create 1-dimensional distribution of households by household size or workers
2. Create 1-dimensional distribution of households by income
3. Create 3-dimensional distribution of households by household size, income and life cycle
4. Create 3-dimensional distribution of households by number of workers, income and life cycle

The process utilized in each of these steps is provided in detail in the following sections.

8.3.2 One-dimensional Distribution of Households by Size

This step stratifies households by household size (1,2,3,4,5,6+ persons per household) at zonal level so to provide initial estimates of trips at the zonal level as well as a regional control totals for the joint distribution of households by household size, income and life cycle. A set of percentage allocations that relate a zone's average household size to the probable distribution of households by size was developed from census data. These percentage allocations were developed by computing the percentages of households by size for each census tract and then averaging the percentages by grouped average household size, as shown in Table 35.

Table 35 – Household Distribution by Size Lookup Table

PPHH	HH1	HH2	HH3	HH4	HH5	HH6
10	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11	93.8%	5.7%	0.3%	0.2%	0.0%	0.0%
12	87.6%	10.7%	0.8%	0.6%	0.3%	0.0%
13	70.6%	27.5%	1.8%	0.2%	0.0%	0.0%
14	69.7%	21.7%	6.8%	1.7%	0.0%	0.2%
15	56.0%	38.9%	4.0%	0.7%	0.2%	0.2%
16	56.8%	33.4%	5.3%	2.9%	0.9%	0.8%
17	52.2%	32.3%	10.0%	3.7%	1.0%	0.8%
18	49.2%	34.0%	9.0%	4.8%	1.7%	1.3%
19	42.6%	37.3%	10.4%	6.8%	2.2%	0.7%
20	40.3%	36.0%	12.9%	6.9%	2.5%	1.4%
21	39.2%	33.1%	13.4%	9.4%	3.2%	1.8%
22	35.3%	32.8%	15.3%	11.3%	3.6%	1.7%
23	31.8%	34.1%	15.8%	11.9%	4.5%	2.0%
24	29.7%	32.3%	17.0%	13.3%	5.1%	2.5%
25	26.6%	32.5%	17.9%	14.4%	5.9%	2.8%
26	23.6%	32.1%	18.6%	16.2%	6.4%	3.1%
27	21.5%	31.0%	19.4%	17.1%	7.4%	3.7%
28	19.9%	29.6%	19.4%	19.1%	7.9%	4.2%
29	16.9%	29.6%	19.9%	20.4%	8.7%	4.5%
30	15.0%	27.9%	20.6%	22.7%	8.7%	5.2%
31	14.8%	26.8%	20.0%	21.8%	9.0%	7.5%
32	14.7%	25.8%	19.4%	21.0%	9.3%	9.9%
33	14.5%	24.7%	18.7%	20.2%	9.6%	12.3%
34	14.3%	23.7%	18.1%	19.4%	9.9%	14.6%
35	14.2%	22.7%	17.4%	18.5%	10.3%	17.0%
36	14.0%	21.6%	16.8%	17.7%	10.6%	19.3%
37	14.0%	19.5%	17.0%	16.6%	12.2%	20.7%
38	14.0%	17.5%	17.3%	15.5%	13.7%	22.1%
39	11.3%	18.2%	15.8%	16.2%	11.1%	27.4%
40	10.5%	16.8%	15.4%	15.3%	11.0%	31.0%
41	11.0%	15.7%	14.3%	14.6%	10.7%	33.7%
42	9.0%	15.1%	14.0%	14.1%	10.8%	37.0%
43	8.5%	14.4%	13.9%	13.7%	10.7%	38.8%
44	8.0%	13.5%	13.6%	13.5%	10.4%	41.0%
45	7.6%	12.7%	13.0%	13.1%	9.8%	43.8%

Note that the first column (PPHH) is an index field, which is the persons per household, multiplied by 10.0 to create integer values for the lookup table. The final range of average household sizes was expanded from the sample data to cover a range of 1.0 to 4.5.

The initial distributions were smoothed statistically using log-linear regression analysis to produce a set of percentages that vary logically across the full expected range of zonal average values. In addition, the percentage allocations were normalized at each average household size value such

that the sum of all six percentages equals 100 percent and the resulting computed “output” average household size equals the “input” average household size. The look-up procedure was then employed to provide an initial distribution of households by size in each zone and to establish initial estimated totals by household size for the joint distribution process.

8.3.3 One-dimensional Distribution of Households by Income

This process stratifies households by household income at zonal level so as to provide an initial allocation of households by income group in each zone and initial regional totals for use in the joint distribution process of households by household size, income and life cycle. The same approach as described for household distribution by size was applied for the household distribution by income. Table 36 provides a listing of the allocation percentages for each ratio increment.

Note that the first column labeled “INCRATIO” is the index pointer for the lookup function. Since incomes may increase in magnitude over time, the index pointer controlling the lookup procedure was developed as the zonal average income divided by the regional average income. To establish the percentage allocation by income for the ratio index, census income categories were re-grouped into five defined income categories, and a corresponding look-up table that gives a household distribution by income group for each income ratio (in increments of 0.1 from 0.0 to 5.8) was developed from the 2020 Census data and 2015-2019 ACS data. The index was then calculated as 1.0+ the ratio increment.

8.3.4 Joint Distribution of Households by Size, Income and Life Cycle

In this step, an iterative proportional fitting (IPF) algorithm was used to estimate the joint distribution of households by size, income and life cycle in each zone. As part of this process, the resulting zonal estimates are normalized for each dimension to ensure that the aggregate summary of each segment matches the regional control totals. The IPF algorithm requires a “seed” distribution representing the regional control totals for the joint distribution categories as well as initial summary totals estimated by the submodels and the zone-specific one-dimensional marginal distributions by size, income and life cycle that were created in the previous steps.

The number of households by household size, income group and life cycle used for the seed distribution was summarized from PUMS as shown in Table 37. A seed distribution was then derived as in Table 38.

Table 36 – Household Distribution by Income Group Lookup Table

INCRATIO	INC1	INC2	INC3	INC4	INC5
10	100.0%	0.0%	0.0%	0.0%	0.0%
11	76.0%	17.9%	6.1%	0.0%	0.0%
12	48.1%	35.8%	12.3%	3.1%	0.7%
13	34.7%	43.8%	15.3%	5.5%	0.6%
14	25.1%	45.5%	21.3%	7.0%	1.1%
15	18.9%	45.3%	24.7%	9.9%	1.3%
16	15.7%	40.4%	28.4%	13.3%	2.1%
17	12.1%	37.6%	30.8%	16.7%	2.8%
18	9.6%	32.9%	33.3%	20.6%	3.7%
19	8.9%	28.6%	34.9%	23.0%	4.5%
20	7.1%	25.5%	34.3%	26.9%	6.1%
21	6.4%	22.9%	33.3%	29.3%	8.1%
22	5.3%	21.0%	31.8%	32.3%	9.5%
23	5.0%	18.9%	30.3%	35.2%	10.6%
24	4.7%	17.2%	27.5%	37.0%	13.6%
25	4.4%	16.0%	25.5%	38.8%	15.4%
26	4.1%	14.8%	24.4%	38.5%	18.3%
27	3.9%	13.7%	23.2%	38.2%	20.9%
28	3.7%	12.4%	22.0%	38.1%	23.7%
29	3.5%	11.8%	21.0%	37.1%	26.6%
30	3.4%	11.2%	19.9%	36.1%	29.4%
31	3.3%	10.7%	18.8%	34.8%	32.4%
32	3.3%	10.3%	17.8%	33.5%	35.1%
33	3.1%	9.8%	16.8%	32.0%	38.3%
34	3.0%	9.4%	15.7%	30.5%	41.3%
35	2.9%	9.1%	14.8%	29.0%	44.2%
36	3.0%	8.7%	13.8%	27.3%	47.2%
37	2.8%	8.4%	12.9%	27.0%	48.8%
38	2.7%	8.1%	11.9%	26.7%	50.6%
39	2.7%	7.8%	11.0%	26.4%	52.1%
40	2.7%	7.5%	10.1%	26.0%	53.7%
41	2.6%	7.3%	9.2%	25.6%	55.4%
42	2.5%	7.0%	8.3%	25.2%	57.0%
43	2.5%	6.8%	7.4%	24.8%	58.5%
44	2.4%	6.6%	6.6%	24.4%	60.0%
45	2.4%	6.3%	5.7%	23.9%	61.7%
46	2.3%	6.1%	4.9%	23.5%	63.2%
47	2.3%	6.0%	4.0%	23.0%	64.6%
48	2.3%	5.8%	3.3%	22.5%	66.2%
49	2.2%	5.6%	2.5%	22.1%	67.6%
50	2.1%	5.4%	1.7%	21.6%	69.1%
51	2.2%	5.3%	1.0%	21.1%	70.5%
52	2.1%	5.1%	0.2%	20.7%	71.9%
53	2.0%	5.0%	0.0%	20.2%	72.8%
54	2.0%	4.9%	0.0%	19.7%	73.4%
55	1.9%	4.7%	0.0%	19.3%	74.1%
56	1.9%	4.6%	0.0%	18.8%	74.7%
57	1.9%	4.5%	0.0%	18.4%	75.2%
58	1.9%	4.4%	0.0%	17.9%	75.8%
59	1.8%	4.2%	0.0%	17.5%	76.5%
60	1.8%	4.1%	0.0%	17.1%	77.0%
61	1.7%	4.0%	0.0%	16.6%	77.7%
62	1.7%	3.9%	0.0%	16.2%	78.2%
63	1.7%	3.8%	0.0%	15.8%	78.7%
64	1.6%	3.8%	0.0%	15.4%	79.2%
65	1.6%	3.7%	0.0%	15.0%	79.7%
66	1.6%	3.6%	0.0%	14.6%	80.2%
67	1.5%	3.5%	0.0%	14.2%	80.8%
68	1.6%	3.4%	0.0%	13.8%	81.3%

Table 37 – Household Distribution by Household Size/Income /Life Cycle

2015-2019 PUMS Household Distribution by Household Size/Income Group (Retiree Group)

HH Size	Income Group					Total
	1	2	3	4	5	
1	74,045	134,023	48,775	12,191	5,782	274,816
2	16,390	89,277	107,602	76,913	32,613	322,795
3	1,645	14,164	25,627	28,885	12,448	82,769
4	764	6,056	10,660	16,565	8,899	42,944
5	465	2,441	6,512	12,077	7,528	29,023
6+	220	2,022	4,874	9,899	7,673	24,688
Total	93,529	247,983	204,050	156,530	74,943	777,035

2019 PUMS Household Distribution by Household Size/Income Group (With Children No Retiree)

HH Size	Income Group					Total
	1	2	3	4	5	
1	0	0	0	0	0	0
2	9,734	19,971	13,306	5,273	1,523	49,807
3	13,774	44,992	56,876	72,659	40,421	228,722
4	9,709	44,114	63,728	103,422	72,102	293,075
5	3,974	23,533	31,143	39,965	27,349	125,964
6+	1,646	12,758	17,179	21,705	12,097	65,385
Total	38,837	145,368	182,232	243,024	153,492	762,953

2019 PUMS Household Distribution by Household Size/Income Group (No Children No Retiree)

HH Size	Income Group					Total
	1	2	3	4	5	
1	61,699	120,805	127,236	56,697	16,045	382,482
2	15,039	62,601	118,608	148,916	75,357	420,521
3	2,401	15,586	35,749	52,934	28,739	135,409
4	738	4,062	14,074	26,882	16,401	62,157
5	145	757	2,422	6,011	4,604	13,939
6+	160	361	582	1,208	1,699	4,010
Total	80,182	204,172	298,671	292,648	142,845	1,018,518

With zonal-level one-dimensional household distribution by life cycle provided by NJTPA, household distribution by size and income derived above and this seed distribution, a joint distribution of households by size, income and life cycle was developed through iterative fitting. As the iterative fitting was performed at zonal level, the resulting regional total of each household group will deviate from the control values, thereby requiring the resulting zonal-level joint distribution to be normalized against the control totals by group.

Table 38 – Household Distribution by Life Cycle/Income /Household Size

Income Group - Household Size	Household with Retires		Household with Children		Household with No Child or Retiree	
	Index	Percentage	Index	Percentage	Index	Percentage
Income Group 1 - HH Group 1	1	2.894%	31	0.000%	61	2.412%
Income Group 1 - HH Group 2	2	0.641%	32	0.380%	62	0.588%
Income Group 1 - HH Group 3	3	0.064%	33	0.538%	63	0.094%
Income Group 1 - HH Group 4	4	0.030%	34	0.379%	64	0.029%
Income Group 1 - HH Group 5	5	0.018%	35	0.155%	65	0.006%
Income Group 1 - HH Group 6	6	0.009%	36	0.064%	66	0.006%
Income Group 2 - HH Group 1	7	5.238%	37	0.000%	67	4.722%
Income Group 2 - HH Group 2	8	3.489%	38	0.781%	68	2.447%
Income Group 2 - HH Group 3	9	0.554%	39	1.759%	69	0.609%
Income Group 2 - HH Group 4	10	0.237%	40	1.724%	70	0.159%
Income Group 2 - HH Group 5	11	0.095%	41	0.920%	71	0.030%
Income Group 2 - HH Group 6	12	0.079%	42	0.499%	72	0.014%
Income Group 3 - HH Group 1	13	1.906%	43	0.000%	73	4.973%
Income Group 3 - HH Group 2	14	4.206%	44	0.520%	74	4.636%
Income Group 3 - HH Group 3	15	1.002%	45	2.223%	75	1.397%
Income Group 3 - HH Group 4	16	0.417%	46	2.491%	76	0.550%
Income Group 3 - HH Group 5	17	0.255%	47	1.217%	77	0.095%
Income Group 3 - HH Group 6	18	0.191%	48	0.671%	78	0.023%
Income Group 4 - HH Group 1	19	0.476%	49	0.000%	79	2.216%
Income Group 4 - HH Group 2	20	3.006%	50	0.206%	80	5.820%
Income Group 4 - HH Group 3	21	1.129%	51	2.840%	81	2.069%
Income Group 4 - HH Group 4	22	0.647%	52	4.042%	82	1.051%
Income Group 4 - HH Group 5	23	0.472%	53	1.562%	83	0.235%
Income Group 4 - HH Group 6	24	0.387%	54	0.848%	84	0.047%
Income Group 4 - HH Group 1	25	0.226%	55	0.000%	85	0.627%
Income Group 5 - HH Group 2	26	1.275%	56	0.060%	86	2.945%
Income Group 5 - HH Group 3	27	0.487%	57	1.580%	87	1.123%
Income Group 5 - HH Group 4	28	0.348%	58	2.818%	88	0.641%
Income Group 5 - HH Group 5	29	0.294%	59	1.069%	89	0.180%
Income Group 5 - HH Group 6	30	0.300%	60	0.473%	90	0.066%
Income Group 1 - HH Group 6		30.3706%		29.820%		39.809%

8.3.5 Joint Distribution of Households by Number of Workers, Income and Life Cycle

For the work-based trip purposes, the production cross-classification process utilizes the number of workers as a predictive variable. In order to estimate households by number of workers, a submodel was used to disaggregate households into several worker categories. These estimates are derived using the zonal joint distribution of households by household size, income group and life cycle previously calculated. Note that the resulting joint distribution of workers per household was also normalized against regional control totals derived from PUMS.

A discrete choice worker per household submodel was developed to obtain the joint distribution of households by number of workers, income and life cycle. The worker per household submodel was estimated based on the RHTS data, which has nearly 11000 samples. The primary modeling technique was a multinomial logit structure with the alternative “households with 3+ workers” as the reference alternative (with a zero utility). Thus all variables and corresponding coefficients can be interpreted as relative contributions to having less than 3 workers in the households. The multinomial logit model for workers per household model is defined in the following formula:

$$P_i = \frac{\exp(V_i)}{\sum_{j=0}^3 \exp(V_j)}, \text{ for } i = 0,1,2,3$$

Where:

$i, j = 0,1,2,3$ Choice alternatives (number of workers in the household)

P_i Probability of alternative i

V_i Utility function for alternative i

The utility function of the worker per household sub-model has the following general form:

$$V_i = \alpha_i X + \sum_{k=1}^3 \beta_i^k Y^k + \sum_{l=1}^4 \gamma_i^l Z^l$$

Where:

$k = 1,2,3$ Life cycle group

$l = 1,2,3,4$ Income group from 1 to 4 with income group 5 serving as the reference group

α_i Alternative-specific coefficients for household size

X Household size as a continuous variable

β_i^k Alternative-specific constants for life cycle category k

Y^k Binary variable for life cycle category k

γ_i^l Alternative-specific constant for income group l

Z^l Binary variable for Income group l

With the binary variables being 1 or 0, the associated coefficients function as alternative-specific constants. As both the lifecycle variable and the income group variable were treated as binary

values and there can only be one constant in the utility function, income group 5 was chosen as the base “reference” group so that solutions for the remaining constants could be estimated by ALOGIT.

The estimated coefficients and t-statistics are listed below in Table 39. Note that the 3+ Worker Household is the reference alternative.

Table 39 – Workers per Household Sub-Model Coefficients and Constants

Workers/ HH	HH Size	Retiree	With Children	No Children	Inc_Grp1	Inc_Grp2	Inc_Grp3	Inc_Grp4
0	-1.8440	6.9730	4.9960	-1.3290	5.2710	2.3800	0.2993	-1.4130
	-12.7	-13.4	-15.6	-13.6	-6.3	0.0	-6.3	0.0
1	-0.8222	3.9110	4.6730	0.4245	3.2280	1.7960	0.6452	-0.5227
	-7.7	-8.6	-9.9	-11.5	-5.8	-0.6	-5.8	-0.6
2	-0.6018	2.6190	4.3400	1.4190	1.1880	0.6782	0.4720	-0.2749
	-5.9	-3.3	-5.9	-9.1	-5.1	-0.5	-5.1	-0.5

Note:

"Rho-Squared" w.r.t. Zero = .4048

"Rho-Squared" w.r.t. Constants = .3870

The T-statistics generated by ALOGIT log-likelihood maximization technique indicated that the household size variable and most of the group specific constants were significant above the 95% confidence level. The Rho-squared values indicate that the model shows a significant improvement over the assumption of equal market shares model, but only a limited improvement against a model which include only the constant terms.

The estimated coefficient of the household size variable becomes less negative for the higher workers per household groups. This indicates that, other aspects being equal, the number of workers is likely to increase as household size increases. The negative signs are consistent with the positive correlation between household size and number of workers per household in that, as household size increases, it's less likely that the household has either zero workers or workers in other categories less than 3 workers.

The decreasing magnitude of constants for Retiree group and With Children group with the increase of number of workers per household indicates that number of workers per household is negatively correlated to these life cycle groups. Given a household with retiree(s), other things equal, the household tends to have fewer workers than other households. Similarly, for a household with children and no retiree(s), the household may be forced to have fewer workers as one of the parents (or the only parent) may have to stay home with their children. In contrast, for households with no children or retirees, more workers are expected, which is consistent with the increasing pattern of the coefficient for No Children group.

In terms of the contribution of life cycle to the various worker alternatives, the retiree group has the largest estimated coefficient for 0 worker/HH alternative, reflecting the fact that “elderly” households tend to have no workers. The with children group has the largest estimated constants other worker alternatives, which reflects the likelihood of 1 or 2 worker households versus the 3+ worker category since these households need to balance working and staying home with children. The constants for the no children group are lower than the other life cycle groups for the lower worker alternatives and therefore have greater share 2 or 3+ worker households.

The constants for the income group constant logically decline for each worker group as income increases. This is logical as more income tends to be produced by household with more workers, therefore the lower work categories become less likely alternatives as income increases. With the application of the estimated worker per household model, households were stratified by number of workers, income and life cycle at the zonal level. To establish control totals for the joint distribution process, the number of households by number of workers, income and life cycle were summarized and cross-tabulated from PUMS as listed in Table 40.

Table 40 – Household Distribution by Number of Workers/Income /Life Cycle

**2015-2019 PUMS Household Distribution by Number of Workers/Income Group
(Retire Group)**

Workers	Income Group					Total
	1	2	3	4	5	
0	88,131	188,783	93,613	33,797	13,504	417,828
1	5,026	50,624	76,167	56,672	22,163	210,652
2	338	7,456	27,657	44,352	22,874	102,677
3+	34	1,120	6,613	21,709	16,402	45,878
Total	93,529	247,983	204,050	156,530	74,943	777,035

**2015-2019 PUMS Household Distribution by Number of Workers/Income Group
(With Children No Retiree)**

Workers	Income Group					Total
	1	2	3	4	5	
0	16,334	3,782	744	132	259	48,785
1	18,952	85,891	64,276	48,967	29,422	342,625
2	3,289	48,249	90,732	146,001	97,239	332,158
3+	262	7,446	26,480	47,924	26,572	108,684
Total	38,837	145,368	182,232	243,024	153,492	762,953

**2015-2019 PUMS Household Distribution by Number of Workers/Income Group
(No Children No Retiree)**

Workers	Income Group					Total
	1	2	3	4	5	
0	45,403	14,365	2,446	495	824	63,533
1	31,543	142,014	156,723	76,326	26,449	433,055
2	2,992	40,792	107,753	147,767	74,218	373,522
3+	244	7,001	31,749	68,060	41,354	148,408
Total	80,182	204,172	298,671	292,648	142,845	1,018,518

The 5 year 2015-2019 PUMS data were then compared with the original 2015 PUMS data for reasonableness check as shown in Table 41. The percent distribution of both PUMS data was also compared. The comparisons indicate that the overall distributions are similar and reasonable.

Table 41 – Household Distribution by Number of Workers/Income group

2015 PUMS Household Distribution by Number of Workers/Income Group

Workers	Income Group					Total
	1	2	3	4	5	
0	187,592	259,826	102,182	31,118	13,100	593,818
1	46,254	312,469	345,023	206,619	79,688	990,053
2	2,945	80,544	213,596	312,874	137,010	746,969
3+	158	9,877	45,805	88,312	42,515	186,667
Total	236,949	662,716	706,606	638,923	272,313	2,517,507

2015-2019 PUMS Household Distribution by Number of Workers/Income Group

Workers	Income Group					Total
	1	2	3	4	5	
0	149,868	206,930	96,803	34,424	14,587	502,612
1	55,521	278,529	297,166	181,965	78,034	891,215
2	6,619	96,497	226,142	338,120	194,331	861,709
3+	540	15,567	64,842	137,693	84,328	302,970
Total	212,548	597,523	684,953	692,202	371,280	2,558,506

2015 PUMS Percent Household Distribution

Workers	Income Group					Total
	1	2	3	4	5	
0	7.5%	10.3%	4.1%	1.2%	0.5%	23.6%
1	1.8%	12.4%	13.7%	8.2%	3.2%	39.3%
2	0.1%	3.2%	8.5%	12.4%	5.4%	29.7%
3+	0.0%	0.4%	1.8%	3.5%	1.7%	7.4%
Total	9.4%	26.3%	28.1%	25.4%	10.8%	100.0%

2015-2019 PUMS Percent Household Distribution

Workers	Income Group					Total
	1	2	3	4	5	
0	5.9%	8.1%	3.8%	1.3%	0.6%	19.6%
1	2.2%	10.9%	11.6%	7.1%	3.0%	34.8%
2	0.3%	3.8%	8.8%	13.2%	7.6%	33.7%
3+	0.0%	0.6%	2.5%	5.4%	3.3%	11.8%
Total	8.3%	23.4%	26.8%	27.1%	14.5%	100.0%

Using this information, a regional joint distribution of households by number of workers, income and life cycle was created. This joint distribution derived from PUMS is listed in Table 42. As the discrete choice worker per household model was performed at zonal level, the resulting regional total of each household group will deviate from the control values, requiring the normalization of the zonal-level joint distribution against the control totals by group obtained from the PUMS data.

Table 42 – Household Distribution by Number of Workers/Income /Life Cycle

Income Group - Household Size	Household with Retires		Household with Children		Household with No Child or Retiree	
	Index	Percentage	Index	Percentage	Index	Percentage
Income Group 1 - 0 Workers	1	5.274%	21	1.246%	41	1.860%
Income Group 1 - 1 Worker	2	0.173%	22	1.099%	42	1.499%
Income Group 1 - 2 Workers	3	0.020%	23	0.234%	43	0.162%
Income Group 1 - 3+ Workers	4	0.003%	24	0.027%	44	0.025%
Income Group 2 - 0 Workers	5	6.294%	25	0.767%	45	1.054%
Income Group 2 - 1 Worker	6	0.965%	26	2.734%	46	4.398%
Income Group 2 - 2 Workers	7	0.109%	27	1.192%	47	0.905%
Income Group 2 - 3+ Workers	8	0.014%	28	0.185%	48	0.135%
Income Group 3 - 0 Workers	9	3.997%	29	0.676%	49	0.939%
Income Group 3 - 1 Worker	10	2.481%	30	4.485%	50	7.768%
Income Group 3 - 2 Workers	11	0.647%	31	5.210%	51	4.644%
Income Group 3 - 3+ Workers	12	0.163%	32	1.168%	52	0.833%
Income Group 4 - 0 Workers	13	1.136%	33	0.230%	53	0.328%
Income Group 4 - 1 Worker	14	1.381%	34	2.822%	54	3.004%
Income Group 4 - 2 Workers	15	1.025%	35	5.949%	55	6.226%
Income Group 4 - 3+ Workers	16	0.415%	36	1.892%	56	2.217%
Income Group 5 - 0 Workers	17	0.483%	37	0.080%	57	0.101%
Income Group 5 - 1 Worker	18	0.451%	38	1.482%	58	1.038%
Income Group 5 - 2 Workers	19	0.291%	39	2.170%	59	2.179%
Income Group 5 - 3+ Workers	20	0.210%	40	0.583%	60	0.924%
Income Group 1 - HH Group 6		25.532%		34.231%		40.237%

8.4 TRIP PRODUCTION ESTIMATION

8.4.1 Introduction

The household survey data was used as the basis of estimating trip generation rates for all purposes except the Newark Airport Trips and truck trips. The trip production rates from the revised and re-weighted household survey formed the base rates and were reviewed for reasonableness and adjusted as necessary. For the home-based work purpose, other comparisons to trip rates from the Census/PUMS were performed as well. The production rates are cross-tabulated for each of the household group, both by household size, income group and life cycle for the nonwork-related purposes, while the work-related purposes were stratified by number of workers, income group, and life cycle. The resulting trip generation rates, together with the households by category generated by household submodels, were used to generate zonal-level trip productions for each household group by trip purpose.

8.4.2 Trip Production Rate by Trip Purpose by Household Group

The trip generation rates used in this model calibration are the same rates used in the previous model validation as both projects utilized the same household survey to develop the trip generation model. Table 43 shows the trip generation rates by work trip purpose as well as HBW trip rates by region for comparison purposes.

The NJRTM-E trip generation process stratifies the generic HBW trip purpose into two separate purposes, “direct” and “strategic”. The HBWS trip rate is approximately 24% of the total HBW purpose trips. From a limited literature review, it appears reasonable. Austin Texas has HBWS trip rates that are 31% of the HBW Purpose. For models recently developed for Memphis and Los Angeles, the HBWS trip rate was approximately 30 percent and 23 percent respectively. It should be noted that other studies from unreferenced regions have percentages as low as 5%. It is likely that differing survey techniques and variation in the definitions used to establish “strategic” trips in each region would explain most of this variation.

For the nonwork purposes, the aggregate trip generation rates for each life cycle category are listed in Table 44. As expected the home-based other trip purpose generates most of the nonwork trips and clearly increases for households that do not have retirees, with highest rates for households with children. Similarly, households with retirees have the lowest number of home-based university trips. For home-based shopping trips, the retiree households have a higher rate, but this is most likely attributed to their ability to conduct separate, dedicated trips, rather than chaining trips (including shopping trips) together as households with working individuals and family obligations must do.

Table 43 – Home-Based Work Trip Rate Comparison

Household Category	Trip Purpose			Total
	HBWD	HBWS	NHBW	
Retired	0.59	0.16	0.25	1.00
Children	2.21	1.10	1.38	4.69
No Children	1.70	0.46	1.28	3.44
Weighted	1.53	0.56	1.02	
HBW Combined	2.09			
Total Work-Related	3.11			

Total HBW Trip Rates by Region

Region	Rate	Year
Baltimore	1.74	1993
Los Angeles	1.78	
Portland	1.79	
Houston	1.79	
Wilmington	1.82	
Phoenix	1.86	
Dallas	1.94	
San Antonio	1.95	
San Francisco	2.03	
Reading	2.04	
NJTPA	2.06	1986
NJTPA	2.06	1998
Seattle	2.27	
DVRPC	2.42	2001

Table 44 – Nonwork-Based Trip Rates

Household Category	Trip Purpose			
	HBS	HBO	HBU	NHBO
Retired	1.15	3.22	0.05	2.10
Children	1.01	7.94	0.20	3.38
No Children	0.70	1.95	0.16	0.93
Weighted	0.91	4.00	0.14	1.95

Table 45 and Table 46 list the final trip production rates by household group for the work purposes and non-work purposes respectively.

Table 45 – Production Rates - Work Related Trips by Household Group

Income Group - Household Size	Household with Refires			Household with Children			Household with No Child or Retiree		
	HBWD	HBWS	NHBW	HBWD	HBWS	NHBW	HBWD	HBWS	NHBW
Income Group 1 - 0 Workers	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Income Group 1 - 1 Worker	1.055	0.048	1.891	0.733	0.116	0.607	0.535	0.048	1.817
Income Group 1 - 2 Workers	1.739	0.220	0.471	1.904	0.823	2.748	2.688	0.026	5.889
Income Group 1 - 3+ Workers	2.301	0.273	0.550	4.127	0.449	2.748	5.369	0.561	8.087
Income Group 2 - 0 Workers	0.040	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Income Group 2 - 1 Worker	1.099	0.229	0.141	1.315	0.767	0.433	1.186	0.274	0.263
Income Group 2 - 2 Workers	3.313	0.385	0.162	2.015	0.894	0.617	2.272	0.334	0.314
Income Group 2 - 3+ Workers	3.154	0.816	0.177	3.826	0.515	1.082	3.669	0.477	0.596
Income Group 3 - 0 Workers	0.013	0.005	0.015	0.000	0.000	0.000	0.000	0.000	0.000
Income Group 3 - 1 Worker	1.358	0.263	0.407	0.994	1.031	0.853	1.218	0.361	0.894
Income Group 3 - 2 Workers	2.530	0.496	0.358	2.160	0.811	0.542	2.617	0.629	1.094
Income Group 3 - 3+ Workers	3.966	1.327	0.799	3.331	0.769	0.456	4.415	0.699	0.532
Income Group 4 - 0 Workers	0.061	0.033	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Income Group 4 - 1 Worker	1.255	0.307	0.146	1.724	0.388	0.540	1.227	0.423	0.191
Income Group 4 - 2 Workers	2.332	1.148	0.418	2.083	1.349	0.412	2.348	0.738	0.299
Income Group 4 - 3+ Workers	3.503	0.797	0.273	3.392	1.207	0.557	4.073	0.791	0.289
Income Group 5 - 0 Workers	0.284	0.000	0.058	0.000	0.000	0.000	0.000	0.000	0.000
Income Group 5 - 1 Worker	1.164	0.174	0.514	1.254	0.315	2.217	0.705	0.500	1.592
Income Group 5 - 2 Workers	2.157	0.743	0.681	2.173	1.383	1.602	2.443	0.813	0.739
Income Group 5 - 3+ Workers	5.573	1.499	3.251	2.867	1.838	2.402	3.674	1.216	1.426

Table 46 – Production Rates - Non-Work Trip Purposes by Household Group

Income Group - Household Size	Household with Refires				Household with Children				Household with No Child or Retiree			
	HBS	HBO	HBV	NHBO	HBS	HBO	HBV	NHBO	HBS	HBO	HBV	NHBO
Income Group 1 - HH Group 1	0.685	1.781	0.010	1.306	0.000	0.000	0.000	0.000	0.475	1.361	0.230	0.873
Income Group 1 - HH Group 2	1.005	2.430	0.010	0.623	1.274	3.732	0.040	6.429	0.202	0.700	0.820	0.209
Income Group 1 - HH Group 3	1.608	4.135	0.160	1.029	0.395	4.255	0.020	0.287	0.555	2.035	0.490	0.375
Income Group 1 - HH Group 4	1.358	5.217	0.040	1.624	0.392	9.328	0.080	2.242	0.575	2.035	0.710	0.417
Income Group 1 - HH Group 5	1.634	9.442	0.330	0.583	1.634	6.846	0.210	1.584	0.535	2.406	1.520	0.250
Income Group 1 - HH Group 6	4.562	10.815	0.330	4.786	2.181	30.467	0.370	21.623	0.535	2.406	1.520	0.375
Income Group 2 - HH Group 1	1.150	1.886	0.010	2.243	0.000	0.000	0.000	0.000	0.689	1.273	0.050	1.073
Income Group 2 - HH Group 2	1.366	3.182	0.010	3.042	0.924	2.729	0.040	5.272	1.352	2.262	0.140	2.195
Income Group 2 - HH Group 3	1.506	3.822	0.140	2.055	0.381	4.661	0.170	1.382	0.398	2.554	0.260	1.266
Income Group 2 - HH Group 4	1.169	5.045	0.040	3.124	0.722	5.618	0.160	1.527	1.295	2.700	0.420	0.802
Income Group 2 - HH Group 5	1.554	6.285	0.230	2.752	0.879	5.407	0.330	1.896	0.584	2.129	1.020	3.748
Income Group 2 - HH Group 6	0.702	7.916	0.230	1.657	1.454	11.369	0.330	12.629	0.584	4.541	1.020	0.745
Income Group 3 - HH Group 1	0.767	2.208	0.010	1.605	0.000	0.000	0.000	0.000	0.599	1.474	0.030	0.722
Income Group 3 - HH Group 2	1.183	3.875	0.020	2.341	0.781	2.978	0.030	0.731	0.708	2.565	0.110	0.868
Income Group 3 - HH Group 3	1.053	3.263	0.140	1.084	0.702	4.129	0.140	0.956	1.173	5.023	0.110	2.100
Income Group 3 - HH Group 4	1.591	6.614	0.040	2.553	0.745	6.582	0.110	2.152	1.881	1.211	0.410	1.586
Income Group 3 - HH Group 5	1.588	8.153	0.320	1.448	0.919	7.270	0.320	2.067	1.966	10.704	1.280	0.384
Income Group 3 - HH Group 6	1.589	12.154	0.290	4.743	1.310	14.069	0.360	7.680	0.550	4.979	1.280	0.576
Income Group 4 - HH Group 1	1.190	3.008	0.000	2.300	0.000	0.000	0.000	0.000	0.381	1.454	0.020	0.655
Income Group 4 - HH Group 2	1.619	3.362	0.000	3.120	5.025	3.429	0.030	6.649	0.754	2.567	0.030	1.303
Income Group 4 - HH Group 3	1.584	4.467	0.090	2.277	0.815	4.037	0.030	1.953	0.964	2.508	0.310	1.421
Income Group 4 - HH Group 4	1.294	8.274	0.030	3.025	0.965	8.500	0.210	2.960	0.781	4.116	0.960	0.701
Income Group 4 - HH Group 5	2.272	9.020	0.440	5.552	0.866	9.971	0.170	4.207	1.481	8.916	1.840	1.886
Income Group 4 - HH Group 6	1.431	8.560	0.390	3.295	0.692	8.130	0.260	1.346	0.690	5.699	1.840	1.014
Income Group 4 - HH Group 1	0.646	1.118	0.000	2.599	0.000	0.000	0.000	0.000	0.958	0.710	0.000	0.950
Income Group 5 - HH Group 2	1.534	2.360	0.000	3.180	0.500	1.666	0.010	0.269	0.584	1.170	0.010	0.709
Income Group 5 - HH Group 3	1.525	2.631	0.030	2.146	0.632	2.833	0.020	2.547	1.624	1.025	0.120	0.616
Income Group 5 - HH Group 4	1.325	4.142	0.030	3.692	0.309	3.217	0.040	1.683	0.291	0.251	0.690	0.164
Income Group 5 - HH Group 5	2.346	3.012	0.470	3.440	0.932	7.629	0.070	5.093	0.450	2.189	1.370	0.683
Income Group 5 - HH Group 6	3.415	6.462	0.470	3.867	0.448	4.592	0.180	6.579	0.630	2.712	1.370	1.053

8.4.3 Trip Production Calibration and Adjustment

As income group and area type are two important dimensions throughout the modeling process, a decision was made to calibrate the initial trip production estimates to match targets stratified by these two variables by trip purpose. These adjustments effectively factored base trip rates produced by the generic production rate table for all regions. Note that area is not a variable used on the production cross-classification procedures so these factors were introduced to scale trip productions by area type. The adjustment factors are listed in Table 47.

Table 47 – Production Adjustment Factors by Area Type & Trip Purpose

Area Type	HBWD	HBWS	HBS	HBO	HBU	NHBW	NHBO
CBD/Urban High	1.20	0.95	1.40	1.10	1.60	0.75	1.12
Urban	0.90	0.86	0.74	0.83	0.95	0.83	0.85
Suburban High	1.10	1.03	1.17	1.08	1.00	1.07	1.00
Suburban	1.07	1.20	1.13	1.17	1.50	1.17	1.13
Rural	0.85	1.08	0.98	1.00	0.90	1.04	1.08

Within the core calibration region that is defined as the NJTPA counties and Mercer County, adjustment factors by income group and county were also implemented. These factors are listed as part of **APPENDIX C – COUNTY PRODUCTION ADJUSTMENT FACTORS BY INCOME**.

Table 48 provides a comparison of the estimated and observed trip productions at the county level. Note that that the aggregate county estimates are within two percent of the observed total for all counties, with most counties within one percent of the target values. For the estimates by individual trip purposes nearly all other estimates are within one percent. The Trip production comparison by county and by income group is provided in **APPENDIX D – TRIP PRODUCTIONS BY COUNTY & INCOME GROUP**.

Table 48 – Trip Productions by County

Trip Production from Model by County

County	HBWD	HBWS	HBS	HBO	HBU	NHBW	NHBO	TOTAL
Bergen	510,703	228,667	416,276	1,510,957	44,985	152,851	776,555	3,640,994
Essex	373,923	115,754	207,057	912,851	19,065	131,336	489,278	2,249,264
Hudson	368,010	71,260	126,802	445,315	27,764	73,422	220,356	1,332,929
Hunterdon	55,886	15,710	36,945	142,867	2,431	9,408	59,985	323,232
Mercer	185,506	74,449	129,552	425,739	8,028	63,472	274,407	1,161,154
Middlesex	471,598	157,495	286,786	1,100,796	27,694	125,404	490,386	2,660,159
Monmouth	310,224	104,149	250,609	963,896	11,911	120,847	575,868	2,337,504
Morris	271,101	86,853	153,250	690,320	6,960	108,988	406,770	1,724,243
Ocean	280,613	107,580	254,879	833,173	22,897	75,018	501,811	2,075,972
Passaic	243,843	81,242	197,162	658,915	18,889	58,389	414,812	1,673,251
Somerset	185,935	71,408	111,260	399,245	13,375	60,640	204,596	1,046,458
Sussex	74,380	40,804	39,842	180,901	2,942	23,972	71,906	434,747
Union	298,571	134,964	151,954	764,249	10,263	74,264	351,349	1,785,614
Warren	49,567	16,673	47,931	151,492	2,404	7,085	53,793	328,945
TOTAL	3,679,860	1,307,009	2,410,303	9,180,718	219,608	1,085,096	4,891,871	22,774,465

Trip Production from Household Survey by County

County	HBWD	HBWS	HBS	HBO	HBU	NHBW	NHBO	TOTAL
Bergen	510,705	228,668	416,276	1,511,981	45,341	152,851	776,764	3,642,585
Essex	373,924	115,754	207,057	912,713	19,015	131,337	489,276	2,249,075
Hudson	368,010	71,260	126,801	445,787	27,754	73,422	220,635	1,333,670
Hunterdon	55,886	15,710	36,945	142,875	2,398	9,408	59,970	323,193
Mercer	185,506	74,449	129,552	425,691	7,948	63,472	274,359	1,160,977
Middlesex	471,597	157,496	286,787	1,100,825	27,735	125,404	490,275	2,660,119
Monmouth	310,223	104,149	250,609	964,041	11,832	120,847	575,904	2,337,606
Morris	271,101	86,853	153,249	690,044	6,828	108,988	406,932	1,723,995
Ocean	280,613	107,581	254,880	833,169	22,390	75,018	501,799	2,075,450
Passaic	243,843	81,242	197,162	658,802	18,734	58,389	414,970	1,673,143
Somerset	185,935	71,408	111,260	399,129	13,371	60,640	204,593	1,046,336
Sussex	74,380	40,804	39,842	180,884	2,792	23,972	71,904	434,579
Union	298,570	134,964	151,953	764,067	10,195	74,264	351,209	1,785,223
Warren	49,567	16,673	47,931	151,470	2,314	7,085	53,857	328,896
TOTAL	3,679,861	1,307,010	2,410,305	9,181,478	218,648	1,085,096	4,892,449	22,774,848

Percent Ratio of Trip Production by County (Model vs. Household Survey)

County	HBWD	HBWS	HBS	HBO	HBU	NHBW	NHBO	TOTAL
Bergen	100.0%	100.0%	100.0%	99.9%	99.2%	100.0%	100.0%	100.0%
Essex	100.0%	100.0%	100.0%	100.0%	100.3%	100.0%	100.0%	100.0%
Hudson	100.0%	100.0%	100.0%	99.9%	100.0%	100.0%	99.9%	99.9%
Hunterdon	100.0%	100.0%	100.0%	100.0%	101.3%	100.0%	100.0%	100.0%
Mercer	100.0%	100.0%	100.0%	100.0%	101.0%	100.0%	100.0%	100.0%
Middlesex	100.0%	100.0%	100.0%	100.0%	99.9%	100.0%	100.0%	100.0%
Monmouth	100.0%	100.0%	100.0%	100.0%	100.7%	100.0%	100.0%	100.0%
Morris	100.0%	100.0%	100.0%	100.0%	101.9%	100.0%	100.0%	100.0%
Ocean	100.0%	100.0%	100.0%	100.0%	102.3%	100.0%	100.0%	100.0%
Passaic	100.0%	100.0%	100.0%	100.0%	100.8%	100.0%	100.0%	100.0%
Somerset	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Sussex	100.0%	100.0%	100.0%	100.0%	105.4%	100.0%	100.0%	100.0%
Union	100.0%	100.0%	100.0%	100.0%	100.7%	100.0%	100.0%	100.0%
Warren	100.0%	100.0%	100.0%	100.0%	103.9%	100.0%	99.9%	100.0%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.4%	100.0%	100.0%	100.0%

The trip productions for New York Counties were also calibrated to match the targets stratified by income group. The original trip production adjustment factors for Manhattan and Other New York Counties were adopted for the 2023 Revalidation as shown in Table 49 and Table 50, respectively.

Table 49 – Production Adjustment Factors by Income Group for Manhattan

INCGRP	HBWD	HBWS	HBS	HBO	NHBW	NHBO
1	0.27	0.17	0.20	1.05	1.96	1.25
2	0.32	0.71	0.43	1.13	1.07	1.07
3	0.46	0.62	0.74	0.79	0.84	0.78
4	0.52	0.69	1.35	1.35	1.21	0.76
5	0.92	1.62	1.65	1.65	1.56	1.27

Table 50 – Production Adjustment Factors by Income - Other NY Counties

INCGRP	HBWD	HBWS	HBS	HBO	NHBW	NHBO
1	0.49	0.30	0.80	1.05	0.44	1.00
2	0.62	0.72	0.88	0.92	1.05	0.92
3	0.61	0.61	0.73	0.83	0.84	0.93
4	1.00	1.12	1.18	1.24	1.00	1.16
5	1.14	1.02	1.54	0.95	0.81	0.81

8.5 HOME-BASED UNIVERSITY MODEL

8.5.1 Methodology Overview

The approach adopted for home-based-university (HBU) purpose utilized trip generation rates from the household survey and enrollment information for major universities located in the detailed New Jersey region and New York City region. The definition of this purpose includes any home-based trip made by individuals aged 18 or older that lists school as the other trip end. Due to the limited nature of observed trip generation data for the HBU purpose, this approach focused on using the university enrollment data, including statistics about students residing off-campus to control the overall estimation process. Note that while the enrollment data base includes many of the universities, it is not an exhaustive listing of all post-secondary schools. However, the process is flexible so that if and when other data is obtained for any additional universities, the new sites can be easily integrated into the process.

The process is basically a balanced approach that utilizes data from both the household survey and the university enrollment. The household survey provided trip rates and trip length distribution data for which to calibrate the trip distribution. The university enrollment data quantifying off-campus students were used as control totals for the purpose as well as the location of the trip attractions for this purpose.

The flow chart in Figure 16 depicts the process. Note that during the initial steps of the process, the HBU trip ends are estimated with the cross-classification process for the entire region and that these trip ends represent all post-secondary school trips, even to schools such as technical schools, that are not currently included in the university database. Therefore, the number of HBU trips produced will exceed the number of trip attractions in the university database. In the final stages of the process described below, any remaining unallocated HBU trip productions are merged back into the home-based other purpose.

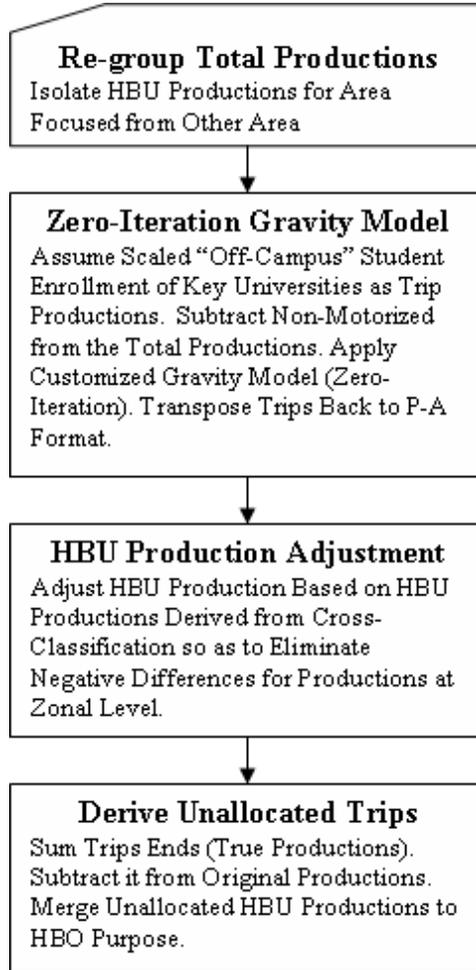
Since the process uses the university enrollment data base as the controlling estimate of total HBU trips, it is necessary to temporarily invert the typical “production-attraction” designations so that trips are “produced” at the university end and “attracted” to households. Trip ends at the household level estimated from cross-classification for the modeled region were designated as attractions. Estimates of trip ends associated with off-campus residents at each university were treated as productions. A zero-iteration gravity model technique was used to allocate trip ends to the proportionate trip lengths observed from the survey data, but the model does not attempt to balance the unused “attractions” at the home end.

After converting the trip end orientation back to the traditional home-based production-attraction format, the procedure quantifies any differences between the zonal level HBU trip productions from the cross-classification process and the HBU trip productions allocated by the zero iteration gravity model. Note The HBU productions from cross-classifications were expected to be greater than the HBU productions allocated by the gravity model since cross-classification estimates would, in-theory, include all home-based post secondary school trips. However, it was necessary to implement an adjustment step to eliminate the negative differences in individual zones where the gravity model allocated more trip ends than were estimated by the cross-classification process. In all the other zones where unallocated trip ends occurred, these trip ends were removed from the HBU trip purpose and added to the home-based-other trip purpose.

Note that this process is dynamic, so that as additional enrollment information is provided about any remaining universities or post-secondary education institutions, the amount of unallocated trip ends would automatically be reduced. Since enrollment information for the remote areas of

Pennsylvania and Connecticut were not included in the database, HBU trip ends from these regions were converted directly to home-based other trips.

Figure 16 – HBU Sub-Model Process



8.5.2 University Enrollment

The enrollment data of universities in New Jersey region were provided by NJTPA and verified against the enrollment summary on the website of “New Jersey Commission on Higher Education”. The enrollment data for universities in New York City were obtained from the website of “New York State Education Department (Office of Higher Education)”. Information on the number of off-campus students was obtained from each institution either by phone calls or website search. Table 51 and Table 52 list the detailed enrollment by college by state, together with a calculated university student related “productions” by assuming “off-campus” full-time students go to universities 4 out of 5 days a week and part-time students go to universities 2 out of 5 days a week. It should be noted that these trip ends relate the initial arrival and final departure of students each day and that these trip ends could be trips that are home-based as well as trips that are non-home based. Note also that these trip ends do not account for other non-home-based trips that students make during the course of the day. As an example, a student

may leave the campus for lunch or some other activity and return to campus the same day before finally leaving campus for the day.

Table 51 – University Enrollment for New Jersey Institutions

Institutions	County	Area Type	Zone	Enrollment	Full Time	Part Time	On Campus
Stockton University	Atlantic	4	13	9,934	8,895	1,039	2,951
Atlantic Cape Community College	Atlantic	4	14	5,048	2,198	2,850	-
Felician College	Bergen	2	100	2,262	1,750	512	563
Ramapo College of New Jersey	Bergen	3	137	6,142	5,044	1,098	2,792
Bergen Community College	Bergen	2	173	12,968	6,817	6,151	-
Fairleigh Dickinson University (FDU)-Metro	Bergen	2	211	8,206	2,650	5,556	806
New Jersey Institute of Technology	Essex	1	497	11,518	8,479	3,039	2,025
UMDNJ (Newark Campus)	Essex	2	500	2,504	1,908	596	-
Essex County College	Essex	2	567	7,434	3,610	3,824	-
Rutgers University (Newark Campus)	Essex	1	573	11,101	8,033	3,068	1,394
Bloomfield College	Essex	2	405	1,628	1,529	99	188
Montclair State University	Essex	3	475	21,007	16,404	4,603	2,821
Seton Hall University	Essex	3	604	10,219	7,591	2,628	2,199
Caldwell College	Essex	3	412	2,206	1,713	493	325
Hudson County Community College	Hudson	2	701	8,202	4,507	3,695	-
Saint Peter's College	Hudson	2	708	3,233	2,418	815	790
New Jersey City University	Hudson	2	728	7,949	5,372	2,577	3,577
Stevens Institute of Technology	Hudson	2	672	7,283	6,102	1,181	2,032
Thomas Edison State College	Mercer	2	926	10,227	97	10,130	-
Rider University	Mercer	3	962	4,674	3,735	939	1,699
The College of New Jersey	Mercer	3	943	7,821	7,181	640	4,122
Princeton University	Mercer	3	1022	8,419	8,325	94	7,999
Mercer County Community College	Mercer	4	1009	7,480	2,576	4,904	-
Rutgers University (New Brunswick Campus)	Middlesex	3	1178	50,173	42,823	7,350	20,174
UMDNJ (Piscataway Campus)/Rutgers Bio	Middlesex	2	1179	6,800	5,786	1,014	-
Middlesex County College	Middlesex	3	1085	11,142	5,139	6,003	-
Monmouth University	Monmouth	3	1437	5,953	4,912	1,041	1,646
Brookdale Community College	Monmouth	4	1295	11,489	5,303	6,186	-
College of Saint Elizabeth	Morris	3	1468	1,287	763	524	241
Fairleigh Dickinson University (FDU)-Florham	Morris	3	1485	3,366	3,069	297	1,188
Drew University	Morris	3	1488	2,319	1,982	337	1,140
County College of Morris	Morris	3	1536	7,488	3,436	4,052	-
Georgian Court College	Ocean	2	1640	2,411	1,562	849	218
Ocean County College	Ocean	3	1713	8,171	4,250	3,921	-
Passaic County Community College	Passaic	2	1805	6,497	2,446	4,051	-
William Paterson University of New Jersey	Passaic	3	1839	10,105	7,510	2,595	2,391
Raritan Valley Community College	Somerset	3	1883	7,793	2,992	4,801	-
Sussex County Community College	Sussex	3	1987	2,318	1,276	1,042	-
Kean University	Union	2	2136	14,309	10,866	3,443	1,331
Union County College	Union	3	2024	9,181	4,226	4,955	-
Centenary College	Warren	3	2168	1,681	1,082	599	840
Warren County Community College	Warren	4	2165	3,243	547	2,696	-

Table 52 – University Enrollment for New York Institutions

Institutions	County	Area Type	Zone	Enrollment	Full Time	Part Time	On Campus
Barnard College	New York	1	2292	2,677	2,630	47	2,409
Bernard Baruch College	New York	1	2410	18,679	12,778	5,901	-
Borough-Manhattan Community College	New York	1	2457	25,500	17,772	7,728	-
CUNY City College	New York	1	2275	15,816	11,038	4,778	768
Columbia University	New York	1	2292	33,087	27,227	5,860	10,050
Fashion Institute of Technology	New York	1	2437	8,726	7,505	1,221	1,051
Graduate School and University Center CUNY	New York	1	2444	6,846	4,144	2,702	-
CUNY Hunter College	New York	1	2373	23,193	14,680	8,513	681
CUNY John Jay College of Criminal Justice	New York	1	2391	15,880	11,630	4,250	-
Marymount Manhattan College	New York	1	2371	1,892	1,660	232	660
New School University	New York	1	2504	10,377	9,249	1,128	1,250
New York University	New York	1	2507	46,812	40,037	6,775	12,872
Pace University	New York	1	2474	8,989	6,900	2,089	1,319
School of Visual Arts	New York	1	2448	4,561	4,392	169	1,231
Teachers College	New York	1	2292	4,526	2,438	2,088	678
Touro College	New York	1	2442	4,885	2,507	2,378	43
Yeshiva University	New York	1	2242	4,685	3,978	707	736
CUNY College of Staten Island	Staten Island	2	2589	12,782	9,333	3,449	-
Wagner College	Staten Island	2	2583	2,154	1,832	322	1,724
St John's University-Staten Island	Staten Island	2	2583	2,427	1,015	1,412	411
Bronx Community College	Bronx	1	2200	10,040	6,191	3,849	-
Fordham University-Rose Hill	Bronx	2	2198	7,984	7,277	707	3,993
Fordham University-Lincoln Center	New York	1	2389	8,571	6,025	2,546	954
CUNY Herbert Lehman College	Bronx	2	2198	15,143	8,264	6,879	-
Hostos Community College	Bronx	2	2201	7,120	3,758	3,362	-
Manhattan College	Bronx	2	2198	4,232	3,926	306	2,182
Monroe College	Bronx	1	2200	3,924	2,366	1,558	129
ASA Institute of Bus/Comp Technology	Kings	1	2207	3,970	3,594	376	-
CUNY Brooklyn College	Kings	1	2220	17,811	11,733	6,078	-
Kingsborough Community College	Kings	2	2219	15,443	7,672	7,771	-
Long Island University-Brooklyn Campus	Kings	1	2207	5,897	4,363	1,534	462
Medgar Evers College	Kings	1	2221	5,798	4,118	1,680	-
CUNY NYC College of Technology	Kings	1	2207	17,036	10,572	6,464	-
Polytechnic University / NYU Tandon School	Kings	1	2207	6,073	5,329	744	867
Pratt Institute	Kings	1	2207	4,455	4,255	200	1,393
St Francis College	Kings	1	2207	2,672	2,434	238	-
Laguardia Community College	Queens	2	2545	18,555	9,972	8,583	-
CUNY Queens College	Queens	2	2549	19,923	12,926	6,997	-
Queensborough Community College	Queens	3	2550	14,035	8,411	5,624	-
St John's University -Queens	Queens	2	2549	18,834	12,940	5,894	2,740
CUNY York College	Queens	2	2551	8,337	5,277	3,060	-

The original approach to estimate HBU trips was also used in the 2023 revalidation project. Additionally, county adjustment factors were applied as shown in **APPENDIX C – COUNTY PRODUCTION ADJUSTMENT FACTORS BY INCOME**. For revalidation purposes, the estimated HBU by County were compared with observed data from the 2010 Household Survey, adjusted to 2019 conditions, and the results are shown in the Table 53.

Table 53 – HBU Trips Comparison

County	Trips		
	Observed	Estimated	%Difference
Bergen	45,341	45,684	0.8%
Essex	19,015	18,881	-0.7%
Hudson	27,754	27,254	-1.8%
Hunterdon	2,398	2,364	-1.4%
Mercer	7,948	7,794	-1.9%
Middlesex	27,735	27,526	-0.8%
Monmouth	11,832	12,185	3.0%
Morris	6,828	7,017	2.8%
Ocean	22,390	22,711	1.4%
Passaic	18,734	18,602	-0.7%
Somerset	13,371	14,096	5.4%
Sussex	2,792	3,071	10.0%
Union	10,195	10,749	5.4%
Warren	2,314	2,465	6.5%
TOTAL	218,648	220,397	0.8%

8.6 NON-HOME-BASED TRIP ENDS ESTIMATION

The NJRTM-E provides a more detailed treatment of non-home based trips than was provided by the NJRTM. The aggregate non-home-based (NHB) trips from the NJRTM was partitioned into two purposes, non-home-based work (NHBW) and non-home-based other (NHBO). The NHBW purpose contains non-home-based trips that have at least one trip end at work while the NHBO purpose includes all other non-home-based trips. The productions of non-home-based purposes from the cross-classification process represent the trips that are “produced” by households within the region. These productions are based on the characteristics of the households although the trips are not linked to the home zone. The technique employed for estimating the non-home based trip purposes, is to use the cross-classification procedure to estimate total regional non-home-based trips and to use standard attraction equations to allocate the trips ends to individual zones. Note that the region totals by income group from cross-classification will serve as control totals that govern the overall amount of non-home-based trip ends.

The linear regression estimation method was used for non-home-based trip ends, similar to trip attractions for home-based purposes. For convenience, the methodology and results are all stated together with the trip attraction model in the following section of this report. The regression equations with the estimated coefficients for each purpose were applied then at the zonal level, providing an initial estimate of total trip ends that occur in each zone. As the estimated trip ends here represent both “origins and destinations” of the non-home-based trips, the zonal estimates are divided in half to provide both trip origins and destinations.

As all non-home-based trips occur in zones other than the home zone, the income of trip maker for the individual trips is not known. Since the NJT mode choice model that was adopted for the NJRTM-E requires trips by income group, it was necessary to create a process to estimate the income of the non-home-based trips. The method adopted assumed that the distribution of NHBW trip ends by income group was related to the home-based work trips that were attracted to the zone. To estimate these percentages, trips by income for both of the HBW purposes (both Direct and Strategic) attracted to each zone were summed together to create percentage shares. Similarly, the distribution of NHBO trip ends by income group was assumed to be the same as the distribution by income group for home-based non-work purposes (HBSH and HBO) attracted to each zone. As part of this process, it was necessary to ensure that the zonal level estimates by income group matched the regional control totals. After the stratification by income group at the zonal level, the trip ends were then summed and normalized against control totals by income group from cross-classification process.

It should be noted that the trip ends estimated here are total trips including both non-motorized and motorized modes, since these trip ends were initially estimated from the household survey in the same method as the home-based trips. It was therefore necessary to partition these trips into motorized and non-motorized share, since only the motorized trips are retained in the remaining model components.

The total trip ends here were adjusted by region (NJTPA+MERCER, NEW YORK, OTHER REGION) to match the total origins and destinations from household survey by region. Since the household survey only includes NJTPA+MERCER and 12 New York counties, the adjustment factors for the OTHER REGION were derived based on the production control total from cross-classification process. As the non-motorized share model is applied prior to the attraction model, the final trip ends are not partitioned by income in this step. Rather, there is a temporary “placeholder” income stratification to maintain a common modeling structure during the estimation of the motorized trip ends. As part of the trip attraction model component, the motorized trip ends are stratified by income group using the process stated above. As part of this process, the total NHB trip ends in NJTPA+MERCER region were adjusted to match the stratified

targets by income group from household survey, in order to maintain both the total trip ends as well as the motorized trip ends in this region predicted by the non-motorized model.

Table 54 lists the regional NHB adjustment factors by trip purpose and by region. These adjustments were relatively minor with all factors altering the initial model estimates by less than 10 percent.

Table 54 – Regional NHB Adjustment Factors by Purpose

Region	Adjustment Factors	
	NHBW	NHBO
NJTPA+Mercer	0.99	1.09
New York Counties (Less Sullivan)	0.98	0.94
Other Region	1.08	1.09

8.7 NON-MOTORIZED MODEL

8.7.1 Introduction

The purpose of the non-motorized model is to separate productions of non-motorized mode from those of motorized mode. For the NJRTM-E the modeling of non-motorized trips was focused primarily on estimating the probability of non-motorized trips as a function of land use and network characteristics that could be investigated as part of potential policy initiatives. Therefore, the non-motorized trips were estimated directly as part of the trip generation process and were not advanced through the remaining model components.

The estimation dataset for each trip purpose consists of observed trips for households in NJTPA region and Mercer County, defined with a choice (motorized or non-motorized) field and a weight field, and zonal level variables that are used to describe the likelihood of selecting a non-motorized mode. For home-based purposes, the household residence zones were chosen as the basis for the zonal level variables. For non-home-based purposes, the origin zones were instead chosen as the basis.

The estimation dataset included a series of density-related variables such as area type, population/employment density and intersection/network density, a variable describing the portion of the total roadway network that is defined as “pedestrian restrictive”, as well as a variable describing the availability of autos to the traveler. The home-based purpose models included the use of the auto availability term, since home-based trips can reference the variables associated with the home zone during model application. In contrast, the models for non-home-based purposes did not include the auto availability term since the non-home-based trips cannot be linked to the characteristics of the trip makers during the application of the model.

8.7.2 Methodology

The model developed for this process predicts the percentage share of trips that will utilize non-motorized modes. The binary logit model was utilized as the model structure for the share estimation. In the transformed structure listed below, the motorized mode is assumed as a “reference” or base mode, in which case the utility for the motorized mode is set equal to zero. As

a result, the coefficients and constant terms in the models apply only to the non-motorized mode. The structure of the model is as follows:

$$P_{nm} = \frac{1.0}{1.0 + e^{-U_{nm}}}$$

Where:

P_{nm} = percentage share for non-motorized mode

U_{nm} = utility of the non-motorized mode.

The utility function in the model estimation is as follows:

$$U_{nm} = \beta_1 * (PopDen) + \beta_2 * (EmpDen) + \beta_3 * (IntDen) + \beta_4 * (NetConn) + \beta_5 * (Net Restrict) + \beta_6 * (AutoPP) + ATConst$$

Where:

- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ = estimated coefficients
- PopDen* = population density (Population / "Developable" Area)
- EmpDen* = employment density (Employment / "Developable" Area)
- IntDen* = intersection density (Number of intersections / "Developable" Area)
- NetConn* = street network connectivity (Number intersections / distance of polylines)
- Net Restrict* = network restrictiveness (share of roadway network in each zone that is defined as "pedestrian restrictive")
- AutoPP* = number of autos available per person
- ATConst* = area-type specific constant

The utility functions from the 2018 Model Validation were adopted in this validation. The coefficients by purpose for the non-motorized trips are listed in Table 55. The non-motorized trip comparison by trip purpose is shown in Table 56. At the system level, the estimated non-motorized trips replicated the observed data very well, and the difference is within one percent of the observed data. As expected, there is more variations at the purpose-level. The non-motorized trip comparison by county is presented in Table 57. The estimated non-motorized trips replicated the observed data reasonably well at county-level.

Table 55 – The 2018 NJRTM-E Revalidation Utility Coefficients for the Non-Motorized Trips

Logistic Regression Results in R - HBWD

Variable	Coefficient	Std. Error	z value	Pr (> z)
POP_DEN	7.39E-06	1.75E-06	4.227	2.36E-05
EMP_DEN	4.94E-06	1.16E-06	4.265	2.00E-05
ST_CONN	7.12E-02	1.39E-02	5.126	2.95E-07
AUTOPP	-2.44E+00	1.88E-01	-13.001	<2e-16
AT1	NA	NA	NA	NA
AT7	-2.85E+00	1.43E-01	-19.888	<2e-16
AT4	-2.79E+00	1.55E-01	-17.961	<2e-16
AT8	-3.85E+00	1.81E-01	-21.222	<2e-16

Logistic Regression Results in R - HBWS

Variable	Coefficient	Std. Error	z value	Pr (> z)
POP_DEN	4.40E-05	2.29E-06	19.208	<2e-16
EMP_DEN	2.63E-05	2.25E-06	11.66	<2e-16
AUTOPP	-1.85E+00	2.78E-01	-6.649	2.94E-11
AT1	NA	NA	NA	NA
AT7	-2.901	0.169	-17.169	<2e-16
AT4	-3.66E+00	2.10E-01	-17.484	<2e-16
AT8	-4.59E+00	2.99E-01	-15.375	<2e-16

Logistic Regression Results in R - HBSH

Variable	Coefficient	Std. Error	z value	Pr (> z)
POP_DEN	2.22E-05	1.23E-06	18.12	<2e-16
ST_CONN	1.47E-01	9.13E-03	16.07	<2e-16
RESRATIO	1.13E+00	1.13E-01	9.98	<2e-16
AUTOPP	-3.26E+00	1.10E-01	-29.69	<2e-16
AT1	NA	NA	NA	NA
AT7	-1.69E+00	9.68E-02	-17.49	<2e-16
AT4	-2.09E+00	1.02E-01	-20.47	<2e-16
AT8	-1.75E+00	1.02E-01	-17.15	<2e-16

Logistic Regression Results in R - HBO

Variable	Coefficient	Std. Error	z value	Pr (> z)
POP_DEN	2.51E-05	6.22E-07	40.264	<2e-16
EMP_DEN	5.45E-06	5.63E-07	9.685	<2e-16
AUTOPP	-1.68E+00	5.03E-02	-33.348	<2e-16
RESRATIO	-1.72E+00	5.51E-02	-31.285	<2e-16
AT1	NA	NA	NA	NA
AT7	-9.89E-01	3.40E-02	-29.069	<2e-16
AT4	-1.28E+00	3.76E-02	-34.02	<2e-16
AT8	-1.62E+00	4.15E-02	-39.016	<2e-16

Logistic Regression Results in R - NHBW

Variable	Coefficient	Std. Error	z value	Pr (> z)
EMP_DEN	1.33E-05	7.78E-07	17.13	<2e-16
ST_CONN	2.93E-01	1.56E-02	18.82	<2e-16
AUTOPP	-2.34E+00	1.80E-01	-12.98	<2e-16
AT1	NA	NA	NA	NA
AT7	-4.048	0.1492	-27.13	<2e-16
AT4	-2.83E+00	1.65E-01	-17.15	<2e-16
AT8	-3.17E+00	1.78E-01	-17.83	<2e-16

Logistic Regression Results in R - NHNW

Variable	Coefficient	Std. Error	z value	Pr (> z)
POP_DEN	3.52E-05	1.05E-06	33.57	<2e-16
RESRATIO	-1.60E+00	9.91E-02	-16.12	<2e-16
AUTOPP	-1.89E+00	8.11E-02	-23.25	<2e-16
AT1	NA	NA	NA	NA
AT7	-1.704	0.05252	-32.45	<2e-16
AT4	-1.72E+00	5.91E-02	-29.03	<2e-16
AT8	-2.80E+00	7.71E-02	-36.36	<2e-16

Note: Signif. codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '.' 0.1 ' ' 1

Table 56 – Non-Motorized Trips by Purpose Comparison for NJRTM-E Counties + Mercer

Trip Purpose	Observed	Estimated	% Difference
HBWD	95,931	96,592	0.7%
HBWS	43,140	43,394	0.6%
HBS	234,303	230,802	-1.5%
HBO	1,246,388	1,257,443	0.9%
WBO	97,223	95,207	-2.1%
NHBO	379,744	372,631	-1.9%
Total	2,096,729	2,096,070	0.0%

Table 57 – Non-Motorized Trips by County Comparison for NJRTM-E Counties + Mercer

Trip Purpose	Observed	Estimated	% Difference
Bergen	250,201	244,720	-2.2%
Essex	404,987	415,070	2.5%
Hudson	511,138	506,456	-0.9%
Hunterdon	18,292	18,252	-0.2%
Mercer	90,078	87,320	-3.1%
Middlesex	117,594	112,708	-4.2%
Monmouth	59,497	58,115	-2.3%
Morris	83,266	82,986	-0.3%
Ocean	126,528	128,868	1.8%
Passaic	199,000	205,125	3.1%
Somerset	41,364	41,838	1.1%
Sussex	12,041	12,040	0.0%
Union	173,049	172,867	-0.1%
Warren	9,695	9,705	0.1%
Total	2,096,729	2,096,070	0.0%

8.8 TRIP ATTRACTION ESTIMATION

8.8.1 Introduction

The trip attraction models were updated to account for the new trip distribution process that allocates trips by income group. These models were estimated as linear functions via standard regression techniques. The model includes separate equations for each trip purpose, including the non-home-based purposes. For the home-based purposes, attraction equations were estimated for motorized trip ends, since the non-motorized trips were estimated separately after trip production calculations. For the non-home-based trips, trip ends at the zonal level are controlled by the attraction estimation process. It was therefore necessary to estimate total trip attractions and then apply a separate process to calculate the motorized trips for these purposes.

The estimation dataset for each purpose consists of district level observed attractions, summarized from RHTS survey (motorized trips only for home-based purposes, and total trip ends, i.e. total at origin ends and destination ends for non-home-based purposes), and district level characteristics including household-related demographics, employment-related statistics and land use density related features. The 158 districts in NJTPA region adopted from previous analysis and the zones in Mercer County were aggregated into 54 districts based on the related socioeconomic characteristics and the county boundaries. Manhattan as an additional district was included initially for testing purposes, but the magnitude of activity in this district provided an inordinate influence on the model estimation and it was therefore excluded from the final estimation analysis. Since a significant part of trips attracted to Sussex, Warren, Hunterdon and Mercer could have origins outside of the surveyed region, such as Pennsylvania, districts in these counties were excluded from the regression analysis as well.

The attraction rates were adopted from the 2018 revalidation project. These attractions rates generated trip attraction estimates reasonably well compared to the observed target derived from the 2010 Household Survey Data, as shown in the calibration / validation summaries later in this chapter.

8.8.2 Methodology

The model developed for this process predicts trips attracted to each district based on district level characteristics. Linear regression model was utilized for model selection and estimation. Different combinations of district level characteristics were tested in the selection phase including total households, total employment, employment by type, area type, employment density, household size, household density, etc. The coefficients, t-statistics, R-squared values as well as the F-statistics were estimated for each model specification. These values were provided directly by linear regression analysis performed within Excel.

The appropriate dataset of independent variables varies by trip purpose. For work-related purposes, employment-related data are expected to play an important role in the estimation and household-related demographics are irrelevant. For non-work-related purposes, it was anticipated that both household-related data and employment-related data could be used as predictive variables. Density-related terms, which incorporate developable area, such as employment density, household density and area type, could influence the magnitude of trips: therefore, these terms were included in the estimation data set.

Employment data was provided in several categories: 1-category (total employment), 2-category (Retail and Non-Retail), 3-category (Basic, Retail and Service) and 10-category (Agriculture & Mining, Construction, Manufacturing, Transportation, Wholesale, Retail, F.I.R.E, Service, Government and Military/Info). The “Military/Info” group was excluded from analysis as it’s too scarce to have an influence.

As part of the regression analysis, the initial review was focused on the reasonableness of the model, in terms of the logic and magnitude of the estimated coefficients. Variables that would tend to encourage trip attractions should have positive signs in general. In contrast, variables that would tend to inhibit trip attractions should have negative signs. Another check is that the t-statistics shall be statistically significant at the 90 percent confidence level ($|t\text{-statistics}| > 1.64$).

In order to interpret the model’s ability to explain the observed data, the R-Squared term is used. The value of R-Square ranges from 0.0 (model does not “fit” the data”) to 1.0 (model fits the data perfectly). In addition, F-statistics from the linear regression analysis were assessed to compare the model to the “constant-only” model structure. The larger the F-statistics value, the more likely the model is both correct in its structure and efficient in predictive capacity. F-statistics indicate the goodness of fit of the model and simultaneously account for the normal predictive “benefit” from using additional independent variables. As such, it provides a “compromise” statistic that can be used to balance the model’s goodness of fit and model parsimony in terms of the number of independent variables required to achieve that level of replication. The combination use of R-Square and F-statistics provide general guidance on model selection. Finally, the constant term is expected to be small in terms of its absolute value and should contribute less to the overall R-square term in a “good” model.

Table 58 summarizes the final trip attraction models for each purpose. In these models, the constant terms have been set to zero prior to the final calibration adjustments.

Table 58 – Coefficients for Attraction Models by Trip Purpose

CODE	HBWD	HBWS	HBS	HBO	NHBW	NHBO	VAR
1							POP
2			0.2848	1.13280		1.4623	HH
3	1.1618	0.4167					Total EMP
4				-0.04467	0.9329		EMPBASIC
5					2.0937		EMPRETAIL
6					1.1482		EMPSERVICE
7			1.8239				RETAIL
8							NON_RETAIL
9							AGRICULTURE&MINING
10						42.3760	CONSTRUCTION
11							MANUFACTURING
12							TRANSPORTATION
13						-19.2090	WHOLESALE
14				2.72877		4.9286	RETAIL
15				-6.77490			F.I.R.E
16				3.13670		1.9825	SERVICE
17				-9.82502			GOVERNMENT
18							MILITARY/OTHER
19							AREA TYPE
20			-0.0096				VICINITY DENSITY
21							HHSIZE
22							HH WITH RETIREE
23							HH WITH CHILDREN
24							HH WITH NO CHILDREN
25							HH Density
26							% HH RETIRED
27							% RETAIL
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	CONSTANT

8.8.3 Comparison/Validation

The model estimated trip attractions by trip purpose and by county is shown in Table 59. The estimated trip attractions replicated the observed data very well. Most of the differences between the model estimated and the observed data were below one percent.

Table 59 – Attractions by County by Income Group

HBWD - ATTRACTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff
Bergen	5,725	5,725	0.0%	89,355	89,353	0.0%	154,109	154,106	0.0%	154,047	154,045	0.0%	56,912	56,913	0.0%	460,148	460,142	0.0%
Essex	15,127	15,126	0.0%	82,034	82,032	0.0%	127,176	127,173	0.0%	134,368	134,367	0.0%	35,540	35,541	0.0%	394,245	394,238	0.0%
Hudson	13,438	13,438	0.0%	63,982	63,980	0.0%	97,079	97,077	0.0%	108,197	108,196	0.0%	23,889	23,890	0.0%	306,584	306,581	0.0%
Hunterdon	807	807	0.0%	8,967	8,967	0.0%	6,490	6,490	0.0%	29,077	29,077	0.0%	9,494	9,494	0.0%	54,834	54,834	0.0%
Mercer	878	878	0.0%	32,289	32,288	0.0%	59,929	59,928	0.0%	82,883	82,882	0.0%	13,010	13,010	0.0%	188,989	188,987	0.0%
Middlesex	8,139	8,139	0.0%	80,853	80,851	0.0%	140,656	140,653	0.0%	137,500	137,499	0.0%	22,537	22,537	0.0%	389,685	389,679	0.0%
Monmouth	2,950	2,950	0.0%	61,880	61,879	0.0%	93,985	93,984	0.0%	75,459	75,458	0.0%	25,826	25,826	0.0%	260,100	260,096	0.0%
Morris	279	279	0.0%	59,599	59,597	0.0%	100,161	100,159	0.0%	105,493	105,492	0.0%	38,507	38,507	0.0%	304,038	304,034	0.0%
Ocean	4,410	4,410	0.0%	56,867	56,866	0.0%	76,851	76,850	0.0%	67,129	67,128	0.0%	5,212	5,212	0.0%	210,470	210,466	0.0%
Passaic	14,121	14,121	0.0%	44,537	44,536	0.0%	88,156	88,155	0.0%	55,466	55,466	0.0%	5,803	5,803	0.0%	208,083	208,080	0.0%
Somerset	209	209	0.0%	17,464	17,463	0.0%	64,388	64,386	0.0%	97,378	97,377	0.0%	19,902	19,902	0.0%	199,341	199,338	0.0%
Sussex	1,020	1,020	0.0%	9,324	9,323	0.0%	16,114	16,114	0.0%	18,163	18,163	0.0%	1,689	1,689	0.0%	46,309	46,309	0.0%
Union	1,204	1,204	0.0%	44,290	44,289	0.0%	80,689	80,687	0.0%	84,695	84,694	0.0%	18,270	18,270	0.0%	229,147	229,144	0.0%
Warren	511	511	0.0%	7,685	7,685	0.0%	7,909	7,909	0.0%	8,969	8,969	0.0%	506	506	0.0%	25,581	25,580	0.0%
TOTAL	68,817	68,816	0.0%	659,125	659,109	0.0%	1,113,692	1,113,670	0.0%	1,158,824	1,158,813	0.0%	277,098	277,099	0.0%	3,277,556	3,277,507	0.0%

HBWS - ATTRACTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff
Bergen	501	499	-0.3%	34,682	34,682	0.0%	44,457	44,457	0.0%	87,253	87,251	0.0%	23,808	23,808	0.0%	190,701	190,697	0.0%
Essex	2,286	2,280	-0.3%	25,336	25,335	0.0%	47,863	47,862	0.0%	44,777	44,777	0.0%	10,075	10,073	0.0%	130,337	130,327	0.0%
Hudson	724	722	-0.3%	11,629	11,629	0.0%	33,294	33,294	0.0%	32,025	32,024	0.0%	14,002	14,002	0.0%	91,674	91,671	0.0%
Hunterdon	150	150	-0.3%	9,349	9,349	0.0%	2,521	2,521	0.0%	5,596	5,596	0.0%	8,151	8,151	0.0%	25,767	25,766	0.0%
Mercer	65	65	-0.2%	2,375	2,375	0.0%	25,351	25,351	0.0%	43,572	43,571	0.0%	15,066	15,066	0.0%	86,429	86,428	0.0%
Middlesex	1,184	1,180	-0.3%	25,953	25,952	0.0%	56,445	56,443	0.0%	45,212	45,212	0.0%	10,540	10,540	0.0%	139,333	139,328	0.0%
Monmouth	1,552	1,547	-0.3%	16,975	16,975	0.0%	28,352	28,351	0.0%	24,807	24,807	0.0%	12,701	12,702	0.0%	84,387	84,382	0.0%
Morris	873	870	-0.3%	11,735	11,735	0.0%	28,681	28,680	0.0%	46,738	46,737	0.0%	19,171	19,171	0.0%	107,198	107,193	0.0%
Ocean	1,477	1,472	-0.3%	16,087	16,087	0.0%	33,054	33,053	0.0%	21,350	21,350	0.0%	1,569	1,569	0.0%	73,536	73,531	0.0%
Passaic	1,788	1,760	-1.6%	10,180	10,179	0.0%	32,548	32,547	0.0%	36,583	36,582	0.0%	3,777	3,777	0.0%	84,875	84,846	0.0%
Somerset	558	556	-0.3%	13,693	13,693	0.0%	18,847	18,846	0.0%	37,334	37,333	0.0%	16,370	16,370	0.0%	86,802	86,799	0.0%
Sussex	494	493	-0.3%	1,580	1,580	0.0%	4,948	4,948	0.0%	4,849	4,849	0.0%	682	682	0.0%	12,552	12,550	0.0%
Union	447	446	-0.3%	16,247	16,247	0.0%	54,086	54,085	0.0%	29,948	29,948	0.0%	11,709	11,709	0.0%	112,438	112,435	0.0%
Warren	236	235	-0.3%	597	597	0.0%	1,667	1,667	0.0%	3,552	3,552	0.0%	834	834	0.0%	6,886	6,885	0.0%
TOTAL	12,335	12,275	-0.5%	196,416	196,414	0.0%	412,113	412,105	0.0%	463,597	463,591	0.0%	148,453	148,453	0.0%	1,232,915	1,232,838	0.0%

HBS - ATTRACTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff
Bergen	16,783	17,261	2.9%	120,132	120,102	0.0%	125,583	125,158	-0.3%	128,403	128,414	0.0%	36,696	36,945	0.7%	427,596	427,881	0.1%
Essex	10,157	10,110	-0.5%	56,177	56,136	-0.1%	41,401	41,410	0.0%	35,728	35,780	0.1%	18,162	18,238	0.4%	161,625	161,674	0.0%
Hudson	10,682	10,571	-1.0%	42,237	41,894	-0.8%	29,812	29,676	-0.5%	21,536	21,744	1.0%	3,125	3,282	5.0%	107,392	107,167	-0.2%
Hunterdon	517	512	-1.1%	4,879	4,894	0.3%	9,466	9,476	0.1%	13,456	13,450	-0.1%	2,718	2,712	-0.2%	31,037	31,043	0.0%
Mercer	4,185	4,183	0.0%	36,456	36,452	0.0%	47,988	47,983	0.0%	39,243	39,249	0.0%	12,164	12,169	0.0%	140,036	140,035	0.0%
Middlesex	10,684	10,723	0.4%	61,899	61,959	0.1%	96,514	96,545	0.0%	75,983	75,898	-0.1%	6,501	6,462	-0.6%	251,581	251,587	0.0%
Monmouth	19,713	19,698	-0.1%	42,174	42,136	-0.1%	64,274	64,236	-0.1%	110,456	110,528	0.1%	31,135	31,202	0.2%	267,752	267,799	0.0%
Morris	3,915	3,902	-0.3%	44,492	44,440	-0.1%	53,400	53,394	0.0%	54,355	54,414	0.1%	23,909	23,955	0.2%	180,071	180,105	0.0%
Ocean	15,629	15,606	-0.1%	75,756	75,723	0.0%	69,500	69,489	0.0%	73,292	73,329	0.1%	11,094	11,112	0.2%	245,270	245,259	0.0%
Passaic	17,801	17,736	-0.4%	72,518	72,362	-0.2%	69,874	69,814	-0.1%	48,433	48,571	0.3%	3,162	3,204	1.3%	211,788	211,687	0.0%
Somerset	14,149	14,131	-0.1%	22,482	22,451	-0.1%	39,804	39,804	0.0%	46,496	46,521	0.1%	18,991	19,027	0.2%	141,922	141,933	0.0%
Sussex	2,159	1,838	-14.8%	8,315	8,312	0.0%	13,106	13,103	0.0%	11,164	11,170	0.0%	1,010	1,011	0.2%	35,954	35,434	-0.9%
Union	3,264	3,280	0.5%	41,798	41,843	0.1%	49,410	49,371	-0.1%	27,229	27,214	-0.1%	8,890	8,886	0.0%	130,591	130,594	0.0%
Warren	923	1,016	10.1%	13,082	13,094	0.1%	8,860	8,892	0.4%	15,420	15,290	-0.8%	1,329	1,339	0.7%	39,614	39,630	0.0%
TOTAL	130,560	130,565	0.0%	642,398	641,797	-0.1%	718,990	718,352	-0.1%	701,195	701,571	0.1%	178,884	179,543	0.4%	2,372,028	2,371,828	0.0%

Table 59 - Continued

HBO - ATTRACTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff
Bergen	30,316	32,948	8.7%	254,010	258,375	1.7%	489,053	485,692	-0.7%	597,235	593,692	-0.6%	152,653	152,032	-0.4%	1,523,267	1,522,739	0.0%
Essex	62,307	62,198	-0.2%	209,973	209,370	-0.3%	276,286	276,138	-0.1%	246,936	247,412	0.2%	115,048	115,322	0.2%	910,550	910,439	0.0%
Hudson	54,924	53,935	-1.8%	107,071	106,139	-0.9%	137,508	136,140	-1.0%	82,850	84,943	2.5%	36,456	37,679	3.4%	418,809	418,835	0.0%
Hunterdon	2,294	2,297	0.1%	19,989	19,985	0.0%	29,857	29,868	0.0%	66,521	66,610	0.1%	14,936	14,877	-0.4%	133,594	133,637	0.0%
Mercer	10,815	10,834	0.2%	75,394	75,371	0.0%	122,025	122,008	0.0%	163,147	163,241	0.1%	46,665	46,713	0.1%	418,049	418,167	0.0%
Middlesex	30,447	30,652	0.7%	171,124	171,175	0.0%	366,622	366,821	0.1%	441,119	440,593	-0.1%	46,872	47,046	0.4%	1,056,183	1,056,287	0.0%
Monmouth	45,967	45,901	-0.1%	115,337	115,098	-0.2%	319,875	319,722	0.0%	310,182	310,331	0.0%	208,645	209,478	0.4%	1,000,005	1,000,530	0.1%
Morris	8,783	8,569	-2.4%	112,583	112,240	-0.3%	199,701	199,600	-0.1%	270,115	270,674	0.2%	137,495	137,840	0.3%	728,677	728,922	0.0%
Ocean	41,359	41,268	-0.2%	248,335	247,886	-0.2%	304,093	303,989	0.0%	167,160	167,301	0.1%	13,303	13,324	0.2%	774,250	773,769	-0.1%
Passaic	43,748	43,665	-0.2%	166,958	166,345	-0.4%	176,117	175,824	-0.2%	194,494	195,042	0.3%	37,300	37,574	0.7%	618,616	618,450	0.0%
Somerset	21,223	21,174	-0.2%	71,874	71,690	-0.3%	115,378	115,308	-0.1%	147,330	147,485	0.1%	60,198	60,432	0.4%	416,004	416,088	0.0%
Sussex	4,616	4,606	-0.2%	21,883	21,840	-0.2%	62,500	62,470	0.0%	55,854	55,918	0.1%	7,815	7,840	0.3%	152,668	152,674	0.0%
Union	18,507	18,761	1.4%	125,630	125,690	0.0%	213,512	213,319	-0.1%	309,155	308,846	-0.1%	59,635	59,864	0.4%	726,438	726,480	0.0%
Warren	1,838	2,222	20.9%	22,981	23,393	1.8%	45,020	44,764	-0.6%	43,286	42,830	-1.1%	3,014	2,995	-0.6%	116,138	116,204	0.1%
TOTAL	377,143	379,028	0.5%	1,723,142	1,724,598	0.1%	2,857,546	2,851,662	-0.2%	3,095,383	3,094,917	0.0%	940,036	943,017	0.3%	8,993,250	8,993,222	0.0%

NHBW - ATTRACTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff
Bergen	3,468	3,467	0.0%	14,238	14,238	0.0%	62,149	62,146	0.0%	51,097	51,095	0.0%	19,436	19,436	0.0%	150,388	150,382	0.0%
Essex	3,828	3,827	0.0%	17,879	17,879	0.0%	45,464	45,462	0.0%	40,815	40,814	0.0%	13,821	13,820	0.0%	121,808	121,803	0.0%
Hudson	2,997	2,996	0.0%	6,323	6,323	0.0%	35,806	35,804	0.0%	16,540	16,539	0.0%	2,961	2,961	0.0%	64,626	64,623	0.0%
Hunterdon	343	343	0.0%	1,678	1,678	0.0%	2,456	2,455	0.0%	2,583	2,583	0.0%	1,179	1,179	0.0%	8,239	8,239	0.0%
Mercer	1,559	1,559	0.0%	13,935	13,935	0.0%	28,319	28,317	0.0%	14,510	14,509	0.0%	3,437	3,437	0.0%	61,759	61,757	0.0%
Middlesex	1,837	1,837	0.0%	18,372	18,372	0.0%	52,062	52,060	0.0%	44,023	44,021	0.0%	9,345	9,345	0.0%	125,639	125,635	0.0%
Monmouth	5,279	5,277	0.0%	17,569	17,569	0.0%	33,456	33,455	0.0%	38,991	38,989	0.0%	24,864	24,863	0.0%	120,158	120,153	0.0%
Morris	1,997	1,996	0.0%	12,850	12,850	0.0%	33,489	33,487	0.0%	43,407	43,405	0.0%	13,309	13,309	0.0%	105,051	105,047	0.0%
Ocean	651	651	0.0%	17,031	17,031	0.0%	33,629	33,627	0.0%	25,938	25,937	0.0%	4,467	4,466	0.0%	81,715	81,713	0.0%
Passaic	2,173	2,173	0.0%	4,859	4,859	0.0%	31,521	31,520	0.0%	12,689	12,688	0.0%	3,900	3,900	0.0%	55,142	55,140	0.0%
Somerset	1,276	1,276	0.0%	3,431	3,431	0.0%	20,070	20,069	0.0%	30,356	30,355	0.0%	9,452	9,452	0.0%	64,585	64,583	0.0%
Sussex	1,496	1,496	0.0%	3,334	3,334	0.0%	10,636	10,636	0.0%	4,998	4,998	0.0%	1,933	1,933	0.0%	22,398	22,396	0.0%
Union	1,622	1,621	0.0%	7,525	7,525	0.0%	27,260	27,259	0.0%	35,776	35,774	0.0%	7,321	7,321	0.0%	79,504	79,501	0.0%
Warren	232	232	0.0%	730	730	0.0%	1,660	1,660	0.0%	5,519	5,519	0.0%	44	44	0.0%	8,185	8,185	0.0%
TOTAL	28,758	28,750	0.0%	139,753	139,754	0.0%	417,976	417,958	0.0%	367,241	367,228	0.0%	115,469	115,465	0.0%	1,069,197	1,069,155	0.0%

NHBO - ATTRACTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff	Observed	Estimated	%Diff
Bergen	15,623	16,838	7.8%	163,473	165,667	1.3%	250,819	249,323	-0.6%	307,447	305,546	-0.6%	59,034	58,769	-0.4%	796,396	796,143	0.0%
Essex	27,203	27,197	0.0%	115,319	115,215	-0.1%	155,848	155,824	0.0%	96,458	96,537	0.1%	36,932	36,945	0.0%	431,761	431,720	0.0%
Hudson	28,045	27,617	-1.5%	78,601	78,057	-0.7%	65,572	65,028	-0.8%	41,112	42,009	2.2%	14,152	14,613	3.3%	227,482	227,324	-0.1%
Hunterdon	2,532	2,536	0.2%	5,612	5,620	0.2%	11,470	11,479	0.1%	30,350	30,345	0.0%	3,398	3,384	-0.4%	53,362	53,365	0.0%
Mercer	13,454	13,488	0.2%	62,696	62,753	0.1%	111,533	111,570	0.0%	72,311	72,278	0.0%	22,769	22,724	-0.2%	282,763	282,814	0.0%
Middlesex	12,287	12,382	0.8%	90,467	90,655	0.2%	189,035	189,219	0.1%	182,396	181,971	-0.2%	26,092	26,090	0.0%	500,278	500,317	0.0%
Monmouth	27,760	27,776	0.1%	84,481	84,491	0.0%	188,643	188,646	0.0%	220,628	220,494	-0.1%	64,589	64,647	0.1%	586,101	586,054	0.0%
Morris	12,240	12,076	-1.3%	109,999	109,907	-0.1%	86,800	86,798	0.0%	146,125	146,241	0.1%	53,846	53,827	0.0%	409,010	408,850	0.0%
Ocean	29,492	29,487	0.0%	213,174	213,204	0.0%	136,948	136,962	0.0%	91,548	91,525	0.0%	12,749	12,738	-0.1%	483,911	483,915	0.0%
Passaic	32,789	32,742	-0.1%	159,366	159,122	-0.2%	118,292	118,164	-0.1%	104,765	104,952	0.2%	13,686	13,756	0.5%	428,898	428,755	0.0%
Somerset	20,537	20,535	0.0%	29,285	29,269	-0.1%	55,163	55,158	0.0%	82,271	82,259	0.0%	27,049	27,073	0.1%	214,305	214,295	0.0%
Sussex	8,417	8,416	0.0%	12,437	12,438	0.0%	24,803	24,802	0.0%	22,771	22,771	0.0%	2,400	2,401	0.0%	70,829	70,828	0.0%
Union	9,807	9,968	1.6%	94,881	95,150	0.3%	128,486	128,450	0.0%	103,159	102,898	-0.3%	27,494	27,487	0.0%	363,826	363,953	0.0%
Warren	672	807	20.0%	9,515	9,669	1.6%	12,588	12,526	-0.5%	25,067	24,774	-1.2%	3,861	3,832	-0.7%	51,703	51,609	-0.2%
TOTAL	240,859	241,885	0.4%	1,229,304	1,231,218	0.2%	1,536,001	1,533,950	-0.1%	1,526,409	1,524,600	-0.1%	368,052	368,288	0.1%	4,900,624	4,899,941	0.0%

8.9 TRUCK TRIPS GENERATION

8.9.1 Trip Generation

The methodology of truck trip estimation was adopted from the procedures developed for the NJDOT Statewide Truck Model back in the early 1990s. This earlier process estimated truck trips by either of two types, Medium and Heavy. Medium trucks were categorized as 2-axle, 6-tire vehicles and heavy trucks as any 3+ axle vehicles. Trucks are allowed to use the entire NJTPA highway network except those roadways with truck restrictions and prohibitions (e.g., the Garden State Parkway). The commercial vehicle trips, defined as 2-axle four tire vehicles, were estimated based on the procedures adopted from NYMTC's Best Practices Model.

Internally, trip generation is performed at the zonal level using employment, households and truck terminals as the independent variables. Employment by type was used primarily for internal trip generation. Special generators, in the form of truck terminals, warehouses and pipeline terminals are utilized for conditions where the typical employment relationships would poorly estimate the truck trips. In addition, the truck terminals serve as attractors for a portion of the long-haul truck trips entering the study area from the adjacent region. For trips generated outside the region, a series of external zones were developed that represent entry points into the region. These entry points of "external zones" include major highways at the study area border as well as intermodal terminals located inside the region such as Port Elizabeth/ Newark and the various intermodal rail terminals.

8.9.2 External Trip Generation

Since the NJRTM-E employs a large buffered area around the NJTPA region, most locally-oriented truck trips would be encompassed within the modeled region. However, it was recognized that there would still be some extremely long-distance truck trips that would most likely approach the modeled region along the major interstate roadways. Therefore, a decision was made to reference these external gateways into the modeled region solely for the use of modeling long-haul truck movements. Dummy links with a restriction for truck usage only were created and connected from the external truck zones to the nearby highway links. Note that the intermodal truck facilities are also included as "external gateways" in the model. The source data used in the model was obtained from the original NJ Statewide Model. The data was updated as part of the 2018 Revalidation Process using the observed truck data provided by Port Authority of New York and New Jersey and NJTPA. The updated data is listed in Table 60.

Truck trips generated from the external regions were obtained from the original NJRTM-E and was updated as part of the 2023 Revalidation Project. Total external trip travel was partitioned into four categories: EI (highway based external to internal), EIMC (intermodal facility external to internal), EIE (external-internal-external) and EE (external to external). The resulting external trips are listed for medium and heavy truck respectively in Table 61.

Note that there are several externally-related truck trip categories. Through trucks are designated as EE movements and includes movements from intermodal facilities and the external "gateway" zones, A second category (EIE) refers to truck trips that are essentially external-external movements, but are routed through an intermediate truck terminal where loads are combined or transferred among vehicles, before the truck trip continues out of the region to a final destination. For external – internal trips, there are two categories. The EIMC represents truck trips that are going between an internal zone and intermodal facility such as Port Newark or an intermodal rail

facility. The remaining EI category represents trips to and from internal zones and the external “gateway” zones.

Table 60 – External Truck Stations

External Station	Location	E-E Percentage	EIE Percentage	E-I Percentage
5	US 206 @ Wescoatville	0.00%	0.00%	100.00%
23	GSP / US 9 @ Somers Point	0.00%	0.00%	100.00%
138	Mill Pond Rd.	0.00%	0.00%	100.00%
219	NJ 94	0.00%	0.00%	100.00%
252	US 130	0.00%	0.00%	100.00%
262	I-295	0.00%	0.00%	100.00%
390	NJTPK	22.26%	5.59%	72.15%
590	Oak Island	0.00%	0.00%	100.00%
621	Newark Airport	3.88%	0.00%	96.12%
622	Port Newark	15.10%	0.00%	84.90%
636	Port Jersey	6.72%	0.00%	93.28%
749	Croxtton	0.00%	0.00%	100.00%
769	S. Kearny	0.00%	0.00%	100.00%
786	N. Ber. L - Ferry	18.89%	0.00%	81.11%
1997	CR 517	0.00%	0.00%	100.00%
1999	CR 515	0.00%	0.00%	100.00%
2056	E-Rail	0.00%	0.00%	100.00%
2144	Port Elizabeth	17.09%	0.00%	82.91%
2207	Brooklyn	9.85%	0.00%	90.15%
2225	LIE N	40.01%	9.98%	50.01%
2224	South Parkway	0.00%	0.00%	100.00%
2525	NY 17	0.94%	0.00%	99.06%
2517	CR 521	0.00%	0.00%	100.00%
2536	I-87	31.44%	7.86%	60.70%
2548	La Guardia	0.00%	0.00%	100.00%
2554	JFK	16.35%	0.00%	83.65%
2556	Howland Hook	9.10%	0.00%	90.90%
2656	CR 511	0.00%	0.00%	100.00%
2698	I-684	22.56%	5.63%	71.81%
2691	NY 100	0.00%	0.00%	100.00%
2692	Taconic CMB	0.00%	0.00%	100.00%
2693	US 9	0.94%	0.00%	99.06%
2700	I-95 Connecticut	24.00%	6.00%	70.00%
2768	Morrisville	19.82%	0.00%	80.18%
2710	PA Turnpike NE	17.97%	4.49%	77.54%
2717	CR 726	0.00%	0.00%	100.00%
2752	PA Turnpike NE	22.89%	5.71%	71.40%
2776	I-95 PA	24.97%	6.24%	68.79%
2775	US 1	9.99%	0.00%	90.01%
2848	PA 309/PA 412	0.00%	0.00%	100.00%
2828	US 22	5.00%	0.00%	95.00%
2829	I-78	25.80%	6.45%	67.75%
2856	I-80	17.51%	4.37%	78.15%
2958	Columbia	0.91%	0.00%	99.09%
2949	PA 611	0.00%	0.00%	100.00%
2986	CR 560	0.00%	0.00%	100.00%
2996	US 206	0.92%	0.00%	99.08%

Table 61 – External Truck Traffic by Type

External Station	Location	Medium Truck				Heavy Truck			
		EI	EIMC	EIE	EE	EI	EIMC	EIE	EE
5	US 206 @ Wescoatville	595	1,364	-	-	-	-	-	-
23	GSP / US 9 @ Somers Point	464	1,797	-	-	-	-	-	-
138	Mill Pond Rd.	977	418	-	-	-	-	-	-
219	NJ 94	505	216	-	-	-	-	-	-
252	US 130	1,005	2,303	-	-	-	-	-	-
262	I-295	375	13,758	-	-	-	-	-	-
390	NJTJK	1,866	5,562	-	-	-	575	-	2,291
590	Oak Island	-	-	-	63	-	-	-	-
621	Newark Airport	-	-	331	487	-	-	9	24
622	Port Newark	-	-	2,061	5,024	-	-	122	1,138
636	Port Jersey	-	-	-	3,636	-	-	-	262
749	Croxtton	-	-	-	879	-	-	-	-
769	S. Kearny	-	-	-	1,355	-	-	-	-
786	N. Ber. L - Ferry	-	-	-	614	-	-	-	143
1997	CR 517	88	37	-	-	-	-	-	-
1999	CR 515	142	61	-	-	-	-	-	-
2056	E-Rail	-	-	-	330	-	-	-	-
2144	Port Elizabeth	-	-	2,061	14,866	-	-	122	3,366
2207	Brooklyn	-	-	-	119	-	-	-	13
2225	LIE N	1,649	2,031	-	-	125	609	506	2,438
2224	South Parkway	-	-	-	-	-	-	-	-
2525	NY 17	-	-	796	1,845	-	-	3	22
2517	CR 521	267	267	-	-	-	-	-	-
2536	I-87	632	6,108	-	-	-	873	-	3,491
2548	La Guardia	-	-	29	63	-	-	-	-
2554	JFK	-	-	300	897	-	-	141	93
2556	Howland Hook	-	-	-	3,898	-	-	-	390
2656	CR 511	163	69	-	-	-	-	-	-
2698	I-684	2,656	3,818	-	-	117	391	472	1,562
2691	NY 100	-	-	-	-	-	-	-	-
2692	Taconic CMB	-	-	-	-	-	-	-	-
2693	US 9	279	562	-	-	-	-	1	7
2700	I-95 Connecticut	2,376	11,484	-	-	-	1,188	-	4,751
2768	Morrisville	-	-	-	267	-	-	-	66
2710	PA Turnpike NE	724	2,313	-	-	6	170	21	683
2717	CR 726	146	-	-	-	-	-	-	-
2752	PA Turnpike NE	1,629	4,357	-	-	24	455	95	1,824
2776	I-95 PA	2,100	5,775	-	-	21	693	87	2,772
2775	US 1	1,601	4,419	-	-	-	-	66	602
2848	PA 309/PA 412	1,115	1,115	-	-	-	-	-	-
2828	US 22	2,012	11,611	-	-	-	-	-	717
2829	I-78	1,691	10,927	-	-	-	1,201	-	4,806
2856	I-80	1,340	8,703	-	-	-	562	-	2,251
2958	Columbia	184	359	-	-	-	-	1	4
2949	PA 611	75	75	-	-	-	-	-	-
2986	CR 560	221	221	-	-	-	-	-	-
2996	US 206	161	162	-	-	-	-	1	2

8.9.3 Internal Trip Generation

Employment by type (retail, industrial, public, office and other) and the number of households were used to estimate truck trip ends. Trip generation rates by truck type, as listed in Table 62, were obtained from the NJDOT Statewide Model.

Table 62 – I/I Truck Trip Generation Rates

Variable	Medium Trucks	Heavy Trucks
Household	0.0240	0.0202
Retail Employment	0.1264	0.0590
Industrial Employment	0.0523	0.0800
Public Employment	0.0032	0.0384
Office Employment	0.0202	0.0051
Other Employment	0.0553	0.1207

When the NJRTM-E was initially created in 2008, the project team performed comparisons to other regional models and found our rates to be similar. A similar comparison was performed for commercial trip rates with the NYMTC travel demand model. As new data becomes available, the project team will determine the best timing to revisit these comparisons.

8.9.4 Special Truck Generators

Special generators include truck terminals, warehouse, and pipeline terminals. Truck terminals will serve as attractors for a portion of the long-haul trucks entering the study region. The special generator inventory was updated using the information provided by NJTPA as part of this project, as shown Table 63.

Table 63 – Special Truck Generators

Special Generator Category	Number of Facilities
Truck terminals	589
Warehouses	733
Pipelines	10
Total	1,332

Trip generation rates from the NJ Statewide Model were adopted for the NJRTM-E. These rates are listed in Table 64.

Table 64 – Trip Generation Rate for Special Generators

Type	Rates	Medium Trucks	Heavy Trucks
Truck terminals	55	0.45	0.55
Warehouses	275	0.36	0.64
Pipelines	220	0.20	0.80
Other Generators	1	1.00	1.00

8.9.5 Truck Trip Production – Attraction Balancing

The balancing process from the NJ Statewide Model was adopted. Essentially, the attractions were scaled to ensure that at least one attraction is available for each truck trip production. From model simulation purposes, all externally-related trips were assumed to be “produced” at the external zone and “attracted” at the internal zones. Since several of the externally-related trip purposes used similar attraction variables, the attraction balancing is performed with a hierarchical process to insure that the attractions were properly accounted within the scaling calculations.

First, EIE attractions estimated at the truck terminals were scaled to match the external station EIE productions. The difference between the initial, calculated truck terminal attractions and the scaled truck terminal attractions were then utilized for the EI intermodal truck trip purposes. The intermodal EI trip attractions were estimated as a “weighted” value of the facility-based attractions (truck terminals and warehouses) and industrial employment attractions.

After the calculation of the final weighted attraction term for the EI intermodal trip purpose, the attractions were scaled to equal the total EI intermodal productions by truck type. The unused EI intermodal attractions from this calculation were then combined as appropriate with the internal trip attractions generated from the standard equations and the pipeline special generators. Note that since industrial employment is also used to generate attractions in the standard equations, the portion of industrial employment attractions used to satisfy EI intermodal trips was subtracted from the total industrial employment attractions. This was done in order to prevent any double-counting of trip attractions.

Finally, the highway-based EI trip attractions are estimated based on accessibility percentages. The accessibility function is as follows:

$$EITRKP_i = \alpha \sum_j \frac{EITRK_j}{TIME_{ij}^\beta}$$

Where

$EITRKP_i$ -----Percentage of truck trip ends at internal zone i that are EI

α, β -----Coefficient

$EITRK_j$ -----Volume of external-internal truck trips at external station j

$TIME_{ij}$ -----Travel time from internal zone i to external zone j

These attractions are then scaled to match the total EI highway-based trip productions by trip type. The final EI attractions are then subtracted from the internal trip attractions.

After the subtraction process is completed, the remaining attractions are designated as “internal trip ends” and the internal productions for each zone are set equal to these internal attractions in each zone. This infers that for every truck entering a site on a daily basis, that truck or another leaves the site. As a result, the internal productions and attractions by truck type are automatically balanced.

9. TRIP DISTRIBUTION

9.1 INTRODUCTION

This chapter focuses on calibration and application aspects of the trip distribution model. The calibration process is developed using various data sources available for the 39-county region with NJTPA as the core region. The primary data source is the Regional Household Travel Survey (RHTS) conducted in 2010 and 2011. Additional data sources include the 2015-2019 LEHD data and 2019 traffic counts.

9.2 METHODOLOGY

Trip distribution links trip productions in the model region with trip attractions to create matrices of inter and intra-zonal travel flows. The results of trip distribution will be input to mode choice, and later assigned to highway and/or public transportation systems to determine the travel demand constrained by the supply capacities of the underlying facilities.

9.2.1 Gravity Distribution Model

The basic “Gravity Model” procedure was adopted to perform the trip distribution process. The gravity model theory states that the number of trips between two zones is directly proportional to the number of productions and attractions in those zones, and inversely proportional to the spatial separation between the zones. The formula is as follows.

$$Trip_{i \rightarrow j} = \frac{P_i \times A_j \times f(\text{Im } p_{i \rightarrow j}) \times k_{i \rightarrow j}}{\sum_{r=1}^{\text{zones}} A_r \times f(\text{Im } p_{i \rightarrow r}) \times k_{i \rightarrow r}}$$

Where

P_i The number of trips produced from zone i

A_j The number of trips attracted to zone j

$\text{Im } p_{i \rightarrow j}$ The travel impedance from zone i to zone j

$f(\text{Im } p_{i \rightarrow j})$ The friction factor, which is a function of travel impedance

$k_{i \rightarrow j}$ The specific zone-to-zone adjustment factor

The matrix of inter-zonal and intra-zonal travel impedances reflects the spatial separation between zones. Friction factors and k-factors are determined during the calibration process and their values will be used in the application process. The trip distribution model will be performed for each income group and each purpose, except HBU. The income stratification is retained in the distribution process so that trips by income group can be applied to the mode choice model.

9.2.2 Calibration Overview

The purpose of trip distribution calibration is to develop friction-factors and k-factors that properly replicate the observed average trip length and also maintain the observed trip flow pattern. Prior to the calibration process, skim tables containing composite impedances for all zonal pairs need to be prepared. Congested skims were used for home-based-work trips since these trips normally occur during the peak period. Uncongested skims were used for non-home-based-work trips as they are more evenly distributed during the course of the day and tend to occur during off-peak period.

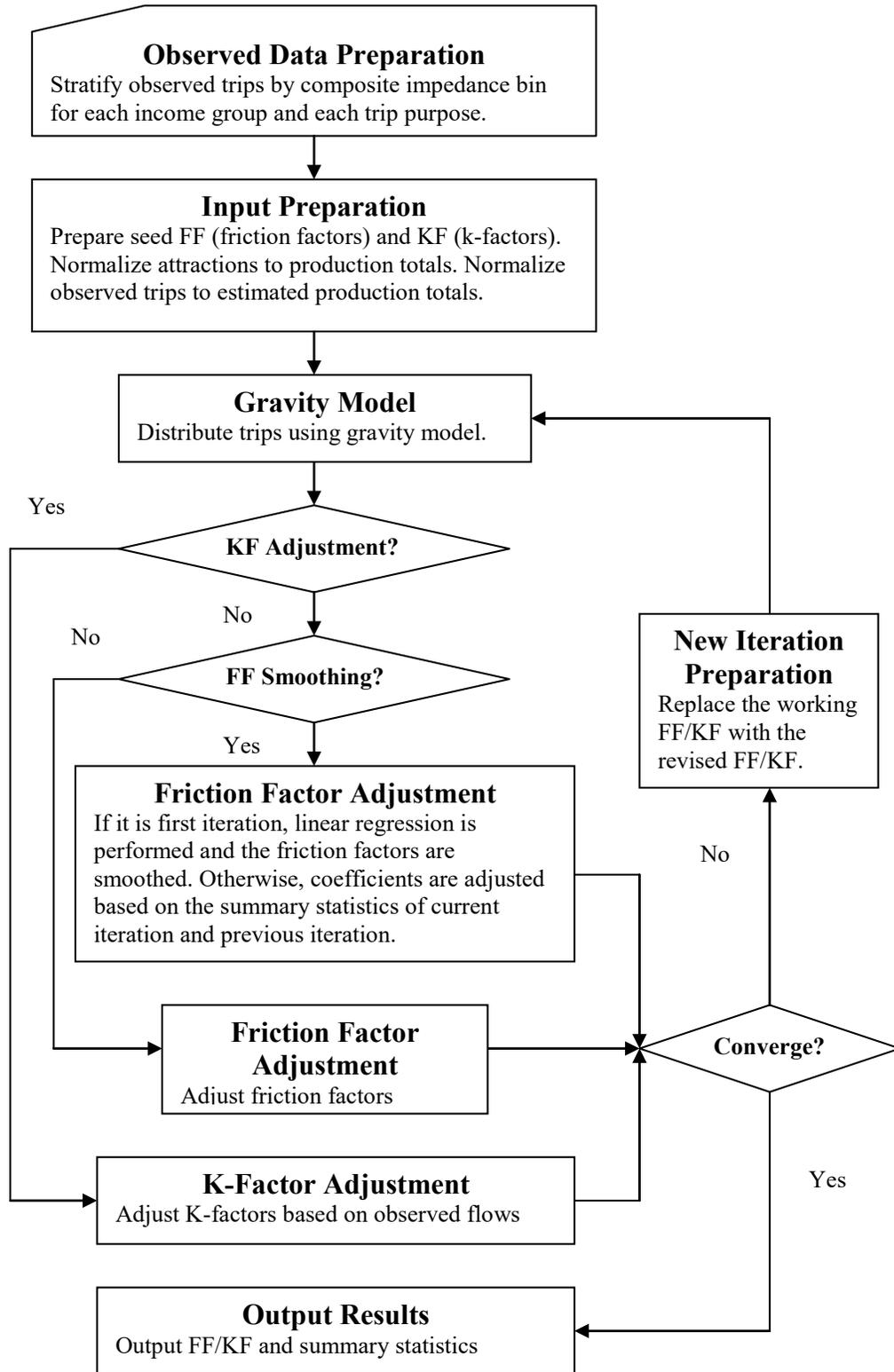
Uncongested skims were obtained from the uncongested network using free-flow time. A factor of 1.1 was applied to free-flow time to account for minor delay to the free-flow traffic condition. For the initial model iteration, congested skims were obtained from the congested networks with congested speed assumed to be 1.2 of the free-flow speed. In the successive feedback iterations, the congested speed was obtained directly from the loaded am peak period highway network of the previous iteration.

The congested skims used in the calibration phase are results of several feedback iterations. Model convergence is influential to the estimation of the congested travel time values. In the case where the congested travel times from a given model iteration underestimate the true congestion level in the network, the trips will be distributed further, hence increasing congestion for the next iteration run. In contrast, if the congested time is overestimated, then the trips will be distributed with shorter average trips lengths in the next iteration run reducing congestion level. As part of the overall model calibration effort, it was necessary to recalibrate distribution in a sequential process as the entire model progressed towards convergence.

The general calibration process is depicted in Figure 17. Observed trip flows by trip purpose and income group are organized to be stratified by composite impedance interval and normalized against estimated total trips for the calibration region which includes NJTPA, Mercer and Manhattan. The gravity model requires input data that include composite impedance skim tables, zonal trip ends (productions and attractions), friction factors, and k-factors. Pattern seed for friction factors and k-factors were also generated for the initial calibration phase. Trip production totals, assumed to be more accurate than attraction totals, were used to normalize attractions. Following the input data preparation, the gravity model was then executed using a 15-iteration closure criterion.

Separate trip distribution models will be developed for each purpose and income group combination. In order to simplify the process, friction factors by trip purpose using all income groups combined were developed as the initial model. These friction factors were used as the seed for friction factor calibration for each corresponding purpose-income group combination. This approach will ensure that the friction-factors across income group for each purpose can retain similar common base and deviate from that accordingly. It can also accelerate the calibration process as the friction-factors for combined income groups, should provide a reasonable baseline to estimate factors for each income group, given there should be a certain similarity to distribution of trips by purpose regardless of income level.

Figure 17 – Trip Distribution Calibration Process



The friction factors from the calibration process, when plotted against time (or composite impedance), tend to form a discontinuous pattern due to variation in the observed data by impedance interval. The friction factor smoothing phase was intended to smooth this irregular shape in order to provide a logical continuous function with declining factors as impedance is increased. This function normally takes the form of a specific mathematical function, such as gamma function. The impact of smoothing process was a deviation of friction factors from the previously well-calibrated results. Further adjustments, including K-factor adjustments, were required to ensure the model convergence as well as to eliminate potential distortion caused by the smoothing process. The calibration process was terminated after either the convergence or maximum iteration was reached. The friction factors and K-factors from this final calibration will be used in the application.

9.2.3 Calibration Method

The trips produced by the gravity model were then aggregated by composite impedance bin. The normalized observed trips in each bin may be different from the estimated trips hence a revised friction factor is needed to compensate for the difference. The revised friction-factor for that specific bin was calculated as follows:

$$FF_{revised} = FF_{current} * \frac{Observed\ Trips}{Estimated\ Trips}$$

Where

$FF_{current}$ - represents the friction factor of the current iteration

$FF_{revised}$ - represents the revised friction factor which will be used in the next iteration

If the estimated trips are lower than the observed trips in the current iteration, the adjustment would have the corresponding friction-factor increased. The gravity model formula shows that if the friction factor for certain zonal pairs increase, the resulting trips between the zonal pairs will increase as well.

If the estimated trips are higher than the observed trips in the current iteration, the adjustment would decrease the corresponding friction-factor in such that the estimated trips in the next iteration would also decrease. The friction-factor adjustment is an iterative process. After several iterations, the friction factors are anticipated to converge and the estimated trips for every composite impedance interval are close to replicating the observed trips. The Root Mean Square of Errors (RMSE) and the difference between observed and estimated trip length are used as two indicators for converge. The RMSE is calculated as follows:

$$RMSE = \frac{\sqrt{\frac{\sum_{i=1}^n (EstTrips_i - ObsTrips_i)^2}{n-1}}}{\frac{\sum_{i=1}^n ObsTrips_i}{n}}$$

In the friction-factor smoothing process, the gamma function is utilized to define the relationship between composite impedance and friction-factors. The following formula defines the gamma function:

$$FF(IMP) = \alpha(IMP)^\beta e^{\gamma(IMP)}$$

The exponential format can be converted into a linear format by multiplying each side with natural logarithm:

$$Ln(FF(IMP)) = Ln(\alpha) + \beta Ln(IMP) + \gamma(IMP)$$

A log-linear regression is then utilized to estimate the three parameters of the gamma function. The parameter estimation of the gamma function would only occur at the first iteration of the friction-factor smoothing phase. For the latter iterations, the values of the coefficients are adjusted empirically based on the comparison of observed average trip length, average trip length of the current iteration and the average trip length from the last iteration.

In the K-factor adjustment phase, trips produced by the gravity model are aggregated to county-level. K-factors are adjusted to make estimated trips match observed trips at county level. Normally, the use of K-factors is required to capture certain characteristics that influence travel that are not, or cannot be, directly modeled. Examples would include such items as tax policies that inhibit or support travel to certain regions or travel time reliability that may influence the likelihood of travel. Other geographic features such as travel across large water bodies or reserved/restricted areas where intermediate stops are not possible, can act as barriers to travel. Topographical features such mountain ranges also can inhibit travel. Lastly, given that transit networks and impedances were not fully abstracted in areas east of the Hudson River, the composite impedance terms for those areas reflect only the auto-related costs and times. This limitation introduces an inconsistency into the distribution process and may further justify the use of K-factors for some situations. A discussion regarding the limited transit network representation east of the Hudson River is provided in the Chapter 10 Introduction section of the mode choice model development.

It is preferable to have as few K-factor adjustments as possible. K-factors are adjusted based on the ratio of observed trips and estimated trips:

$$KF_{revised} = KF_{current} * \frac{Observed\ Trips}{Estimated\ Trips}$$

The 40 counties in the model form 1600 county pairs. It is unrealistic and undesirable to adjust all of them. The strategy here is to apply as few K-factors for Intra-NJTPA trips as possible and to apply common K-factors for other trips based on geographical proximity and jurisdiction.

A final assessment of the trip distribution process between the NJTPA region and the outlying areas focused on evaluating the pattern of trips entering and exiting the region by major roadways or transit facilities, a cordon line around the combined NJTPA and Mercer Counties was established to isolate trips between selected regions. The cordon line has the following “intercept” components:

- the land boundary between NJTPA and NY Other West,
- the Hudson River between NJTPA and New York,
- the land boundary between NJTPA + Mercer and NJ Other, and
- the Delaware River between PA and New Jersey.

Trip volumes for all facilities that cross these intercept boundaries were summarized and compared against count data that was gathered by various agencies, such as the Port Authority of New York / New Jersey and NJ Transit. These comparisons were used to identify any potential differences between the modeled trip distribution and known travel volumes.

9.3 OBSERVED DATA PREPARATION

Observed data were obtained from several sources, such as:

- 2010 / 2011 RHTS Household Survey
- 2019 NJ Transit Ridership Data
- 2019 Traffic Counts Collected from Various Sources
- 2020 Census Data
- 2015-2019 Census American Community Survey and PUMS data

As part of the calibration process, the observed trip frequencies for each trip purpose were grouped by impedance intervals. These trip frequencies were developed using the model’s highway skims and observed trip tables. Note that the plot of observed trip frequency by impedance interval forms an irregular, discrete, non-smooth pattern due to the limited sampling process of the survey. Additional steps were taken to smooth the frequency pattern.

9.4 CALIBRATION PROCESS

The calibration process consists of three stages:

- Stage 1: Derive Common Friction-factors for Each Trip Purpose
- Stage 2: Derive Un-smoothed Friction-factors and K-factors for Each Income Group of Each Trip Purpose
- Stage 3: Derive Smoothed Friction-factors and Adjusted K-factors for Each Income Group of Each Trip Purpose

Each income group of each purpose has its own friction-factor lookup table and needs to be developed individually. The first stage is to develop a common friction-factor lookup table for each purpose with all income groups combined as described in the previous section. The common characteristics of travel behavior for trips from the same trip purpose were maintained with this

approach. In this stage, K-factors were assumed to be the same for all income groups of the same trip purpose.

The common friction-factor lookup table for each trip purpose derived in the first stage would then be used as the seed friction-factors for each income group in the second stage. The friction factors for each income group would deviate from the common factors indicating behavior differences among different income groups. An iterative approach of friction-factor and K-factor calibration was adopted. County level K-factors were derived first for the trips between NJTPA + Mercer and Manhattan. And K-factors for other region-pairs were derived later based on the comparison of observed trips and estimated trips.

The un-smoothed friction-factors derived in the second stage were smoothed using linear regression method in the first iteration of the third stage. Gamma function was used in the regression analysis. It was anticipated that the smoothing process would affect the calibration results of the second stage. A similar iterative approach of friction factor and K-factor calibration process was also applied. Note that the smoothing process via regression analysis would only be performed at the first iteration of this stage. In the following iterations, the coefficients of the gamma function will be adjusted empirically based on the average trip lengths from the current iteration, and from the observed data. After all friction-factors and K-factors were derived, friction factors for home-based work purposes and other purposes were grouped separately as the input for the application of the trip distribution.

9.5 APPLICATION

The calibrated friction-factors and K-factors were applied to the gravity model of the trip distribution component. It generally takes several iterations of full model run in order to achieve reasonable or appropriate congestion level in the loaded highway network. **APPENDIX E – FRICTION-FACTORS FOR HBWD AND HBWS PURPOSES** contains the HBWD and HBWS friction factors while **APPENDIX F – FRICTION-FACTORS FOR HBSH AND HBO PURPOSES** contains HBSH and HBO friction factors. **APPENDIX G – FRICTION-FACTORS FOR NHBW AND NHBO PURPOSES** includes the friction-factors for NHBW and NHBO by income group.

K-factors are provided at county level for each trip purpose with composite impedance ranges from 1 to 300, which covers almost all possible impedances within the model region. The final K-factors are listed in APPENDIX H – K-FACTORS FOR ALL TRIP PURPOSES. K-factors within NJTPA and Mercer County Region are in most cases set to a value of 1.0, indicating no adjustment was implemented. This indicates that the basic distribution process was able to allocate trips in a manner that replicates observed travel patterns with no additional adjustments. In contrast, K factors were required for many patterns between New Jersey and New York. The need for these adjustments is most likely related to the institutional issues, such as tax policies and other features, such as the level of network abstraction in the model for outlying areas,

9.6 CALIBRATION RESULTS

The outputs of trip distribution from the full-model run were summarized for various measures and the results were compared to targets derived from observed data, such as RHTS Household Survey Data, etc.

Average trip length is an important measure of trip spread or distribution. The average trip length was summarized with respect to distance and travel time from both model estimates and household survey data. The average trip length for trips from and to NJTPA and Mercer counties, the regions used in trip distribution calibration, were summarized in Table 65. The average trip lengths of the estimated trips are very close to those from household survey data, indicating that the model has a reasonable spread of trips across the region. Comparison against time and distance variables listed in Table 65 indicates that model provides a reasonable replication with respect to both variables.

Table 65 – Average Trip Length Comparisons by Purpose

Trip Purpose	Average Distance (Miles)			Average Travel Time (Minutes)			Average Speed (MPH)		
	OBSERVED	ESTIMATED	%DIFF	OBSERVED	ESTIMATED	%DIFF	OBSERVED	ESTIMATED	%DIFF
HBWD	16.5	16.5	-0.2%	39.1	39.6	1.2%	25.4	25.0	-1.5%
HBWS	16.7	17.0	1.5%	37.8	39.2	3.7%	26.6	26.0	-2.1%
HBS	5.2	5.5	3.9%	17.8	17.8	0.5%	17.7	18.3	3.5%
HBO	6.2	6.3	0.3%	18.9	18.8	-0.2%	19.9	20.0	0.5%
NHBW	9.8	9.9	1.8%	24.1	24.8	2.9%	24.3	24.1	-1.1%
NHNW	5.7	5.7	-0.6%	18.0	18.4	2.2%	19.1	18.6	-2.8%

Beyond the aggregate measures of travel time and distance discussed above, comparisons were also performed for the distribution of trips by impedance units. Figure 18 to Figure 23 depict the travel time and distance frequency distribution of each trip purpose.

Figure 18 – Frequency Distribution for HBWD Purpose

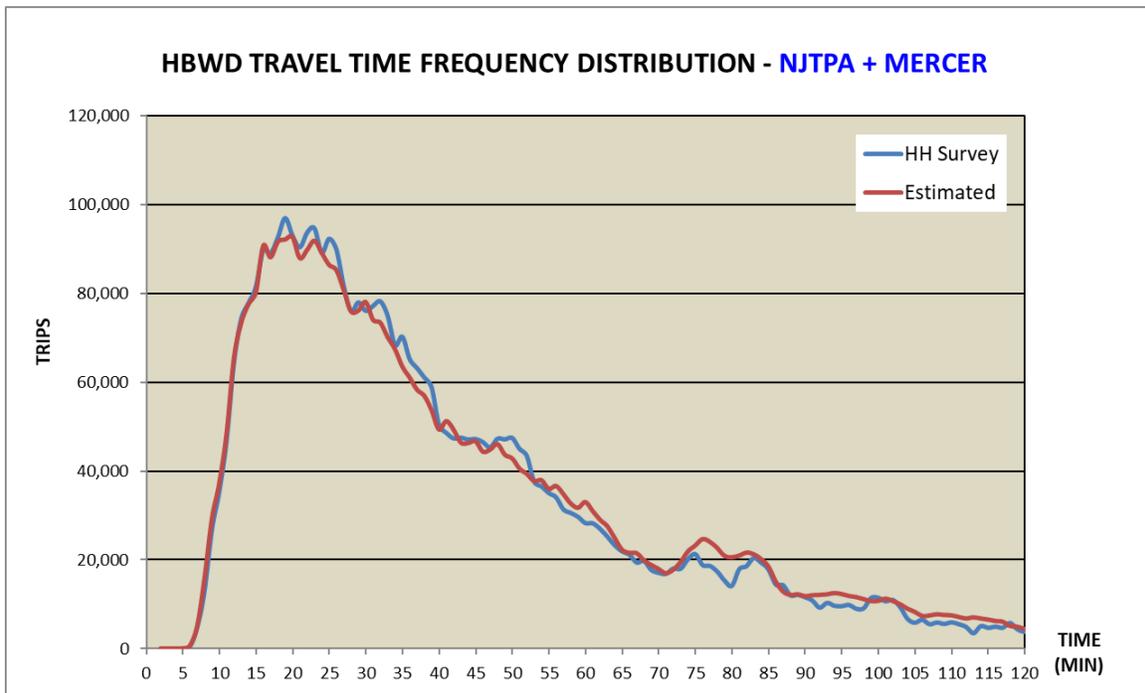
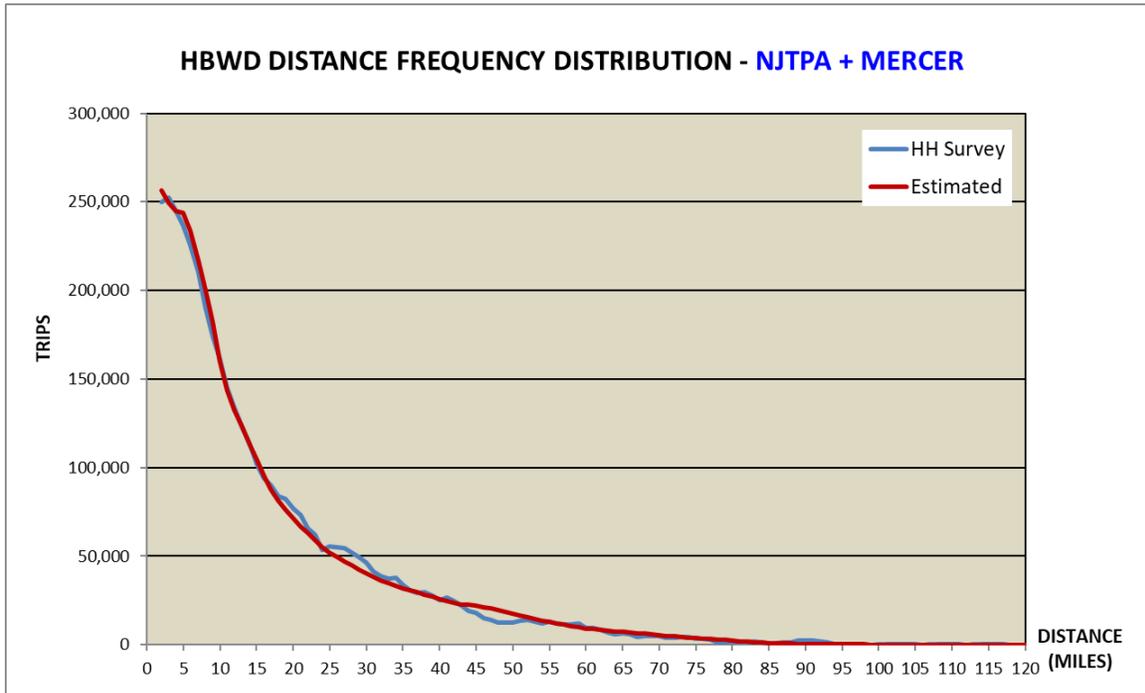


Figure 19 – Frequency Distribution for HBWS Purpose

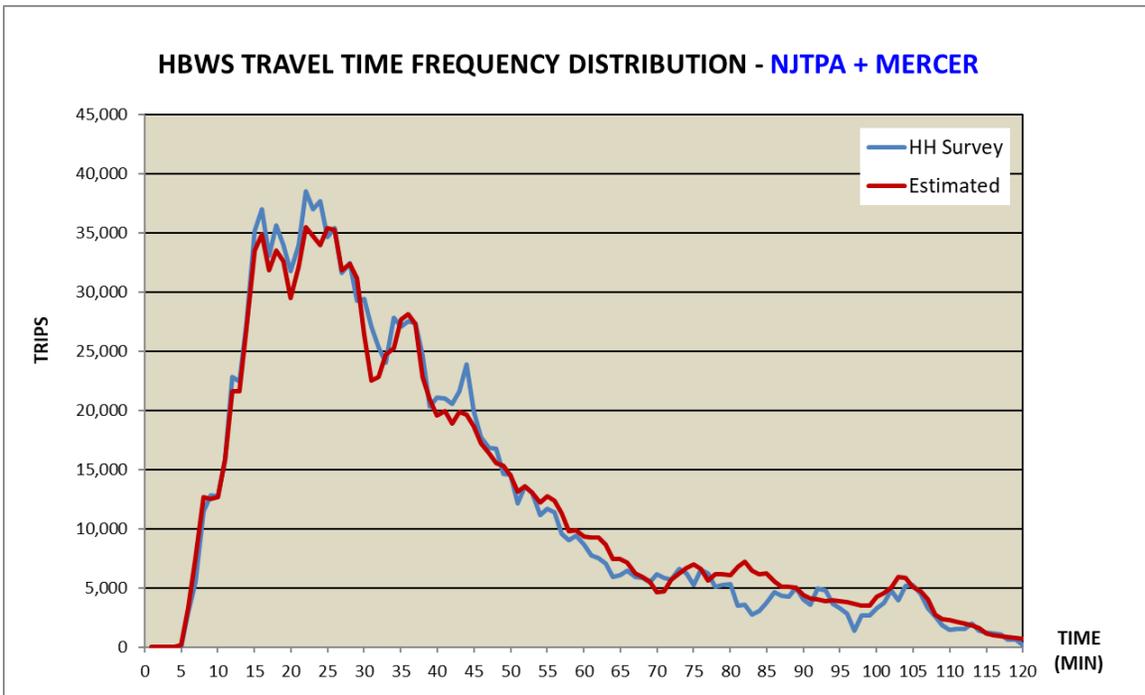
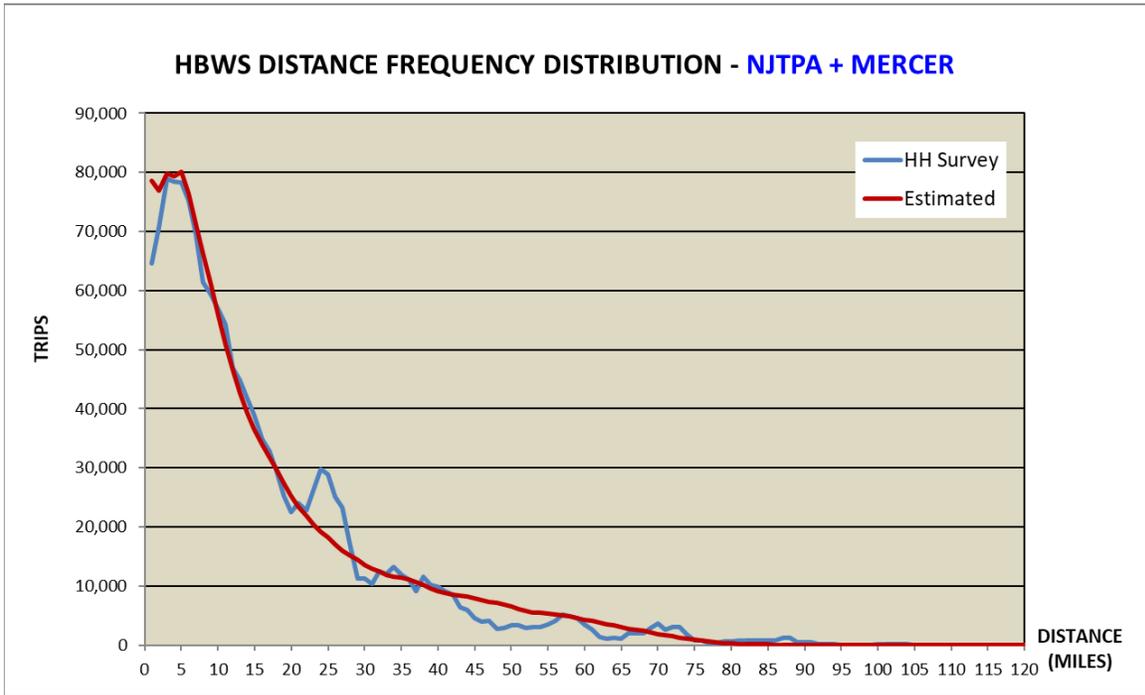


Figure 20 – Frequency Distribution for HBS Purpose

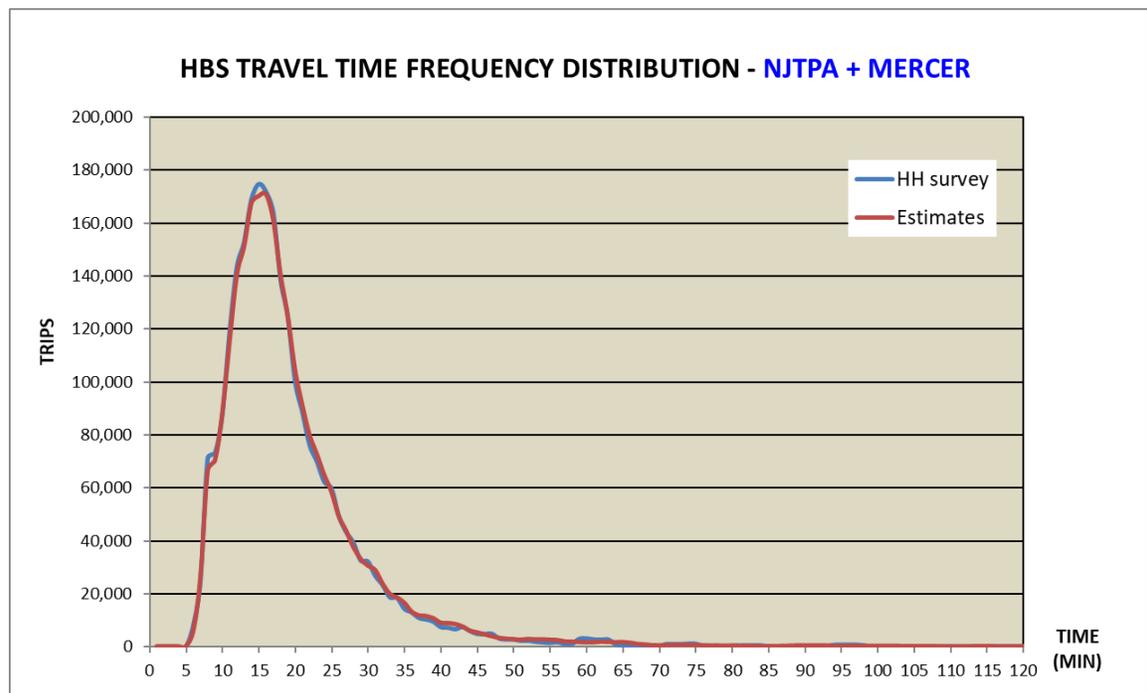
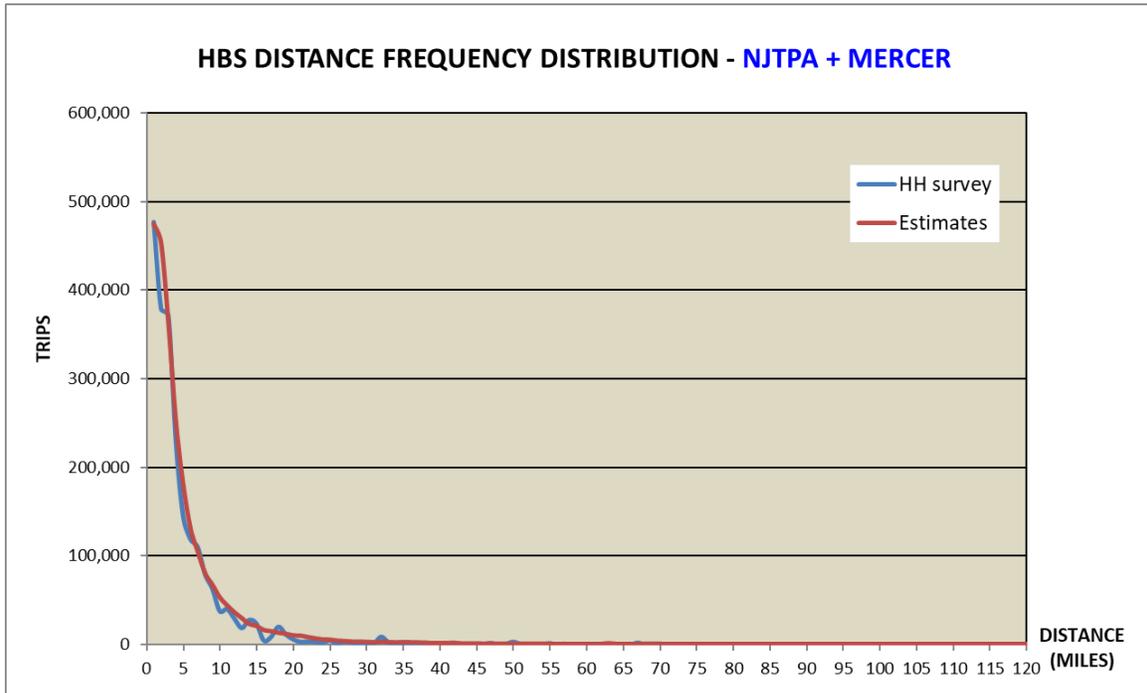


Figure 21 – Frequency Distribution for HBO Purpose

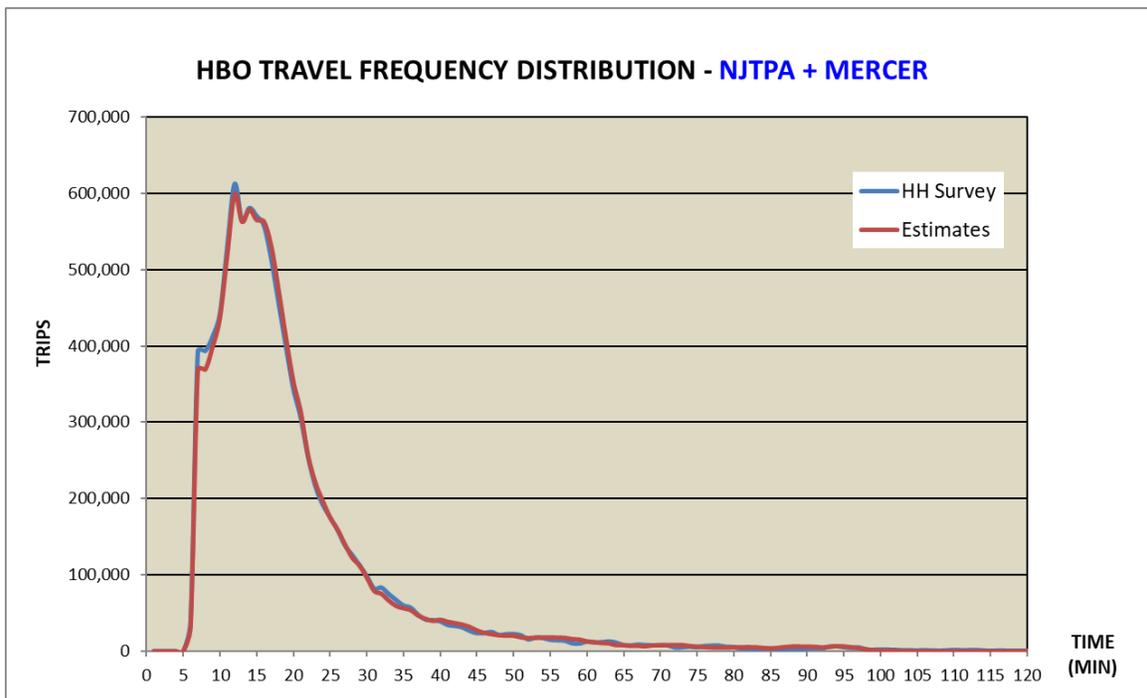
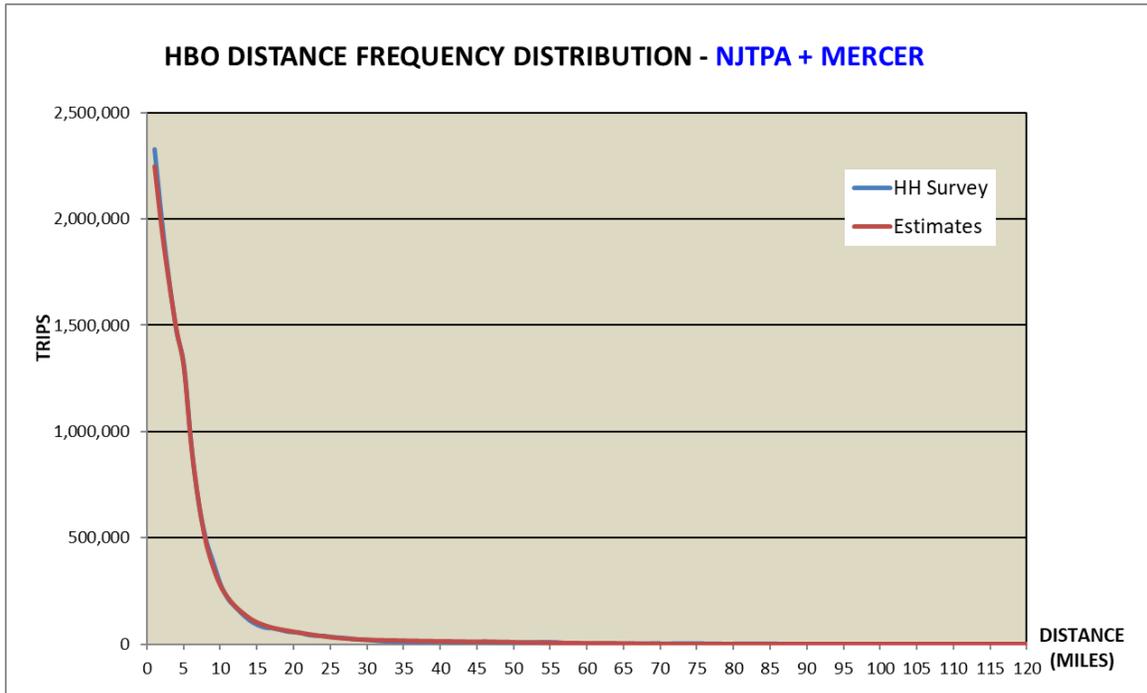


Figure 22 – Frequency Distribution for NHBW Purpose

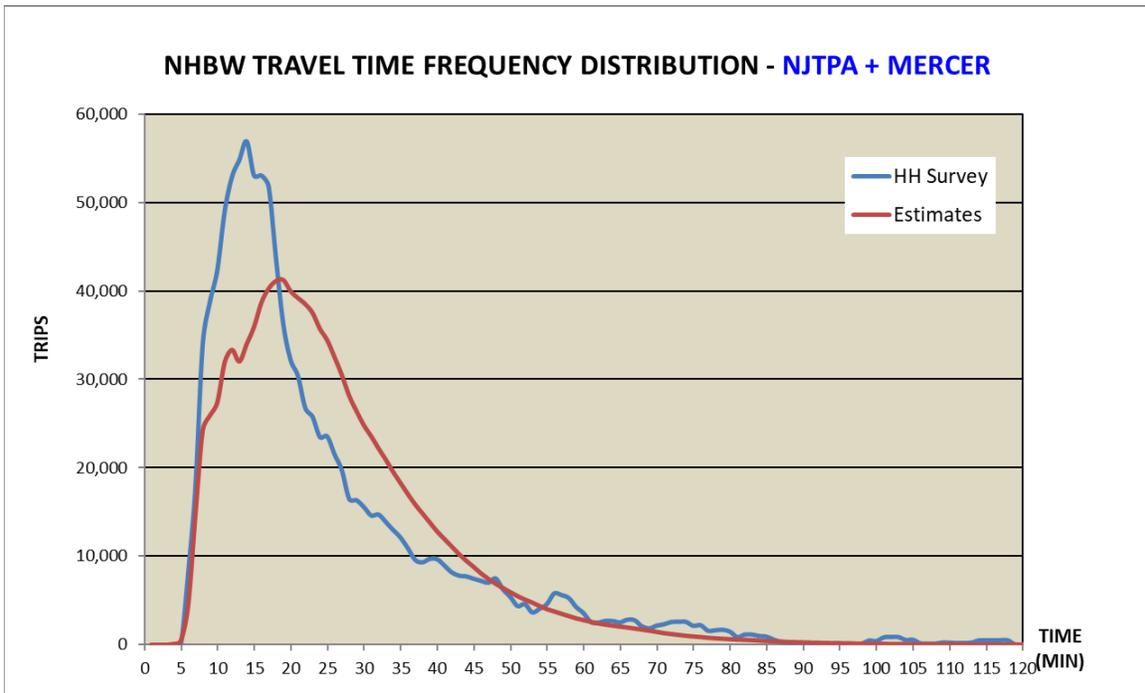
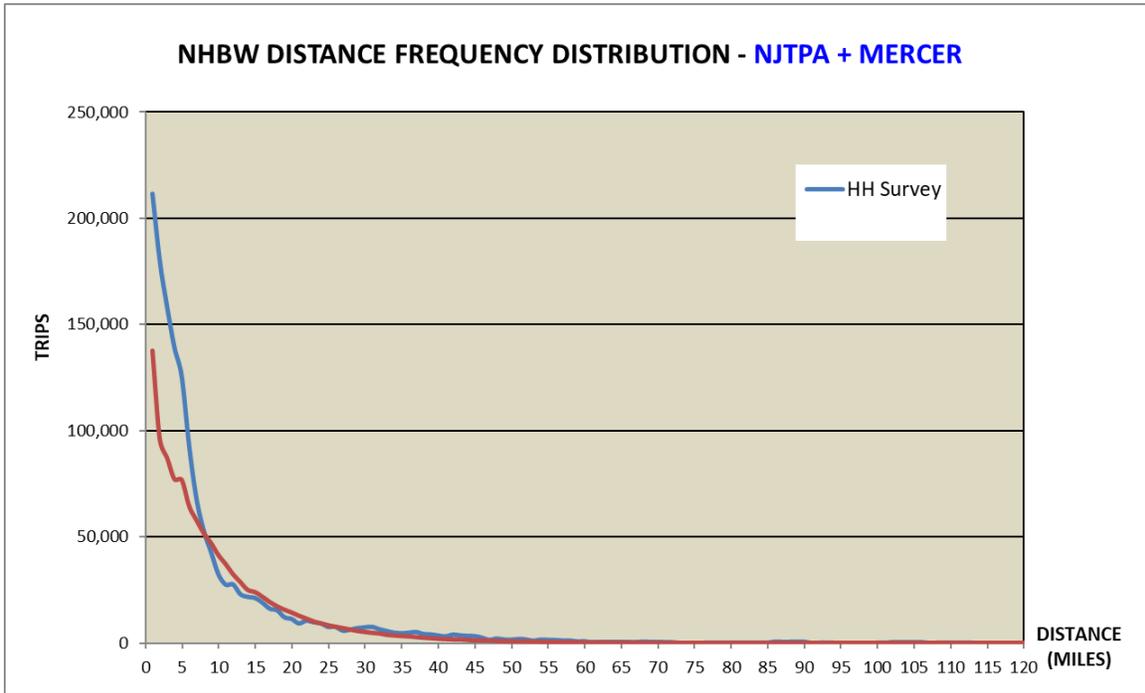
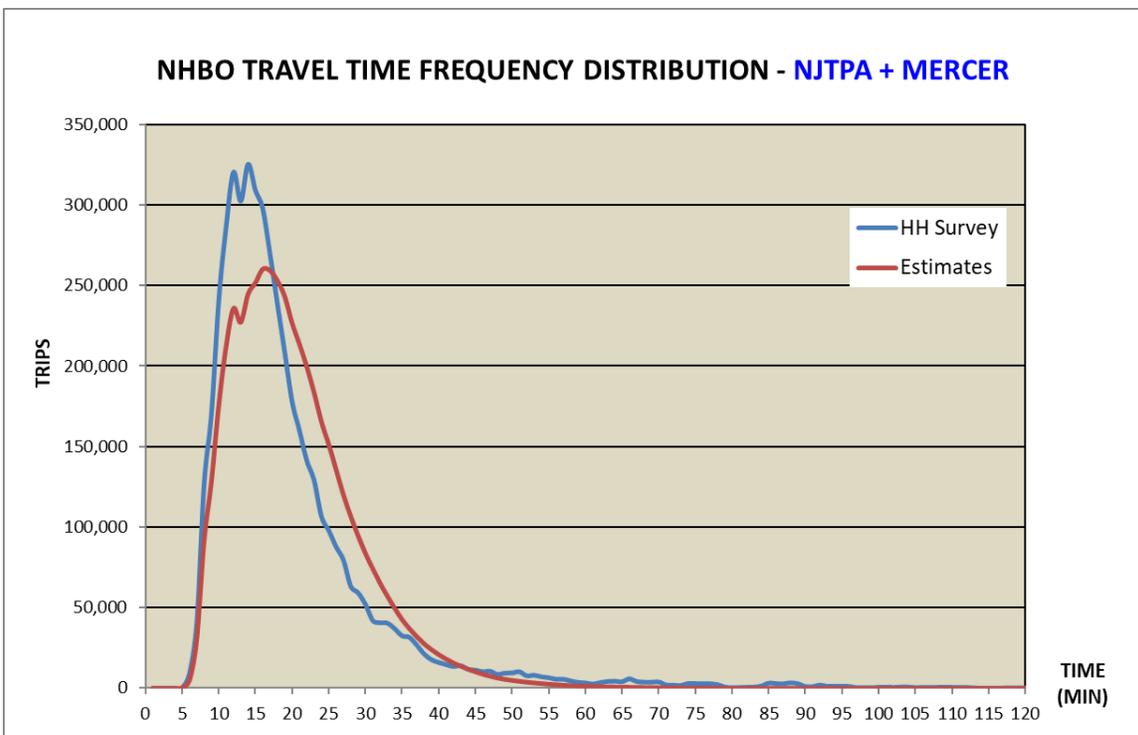
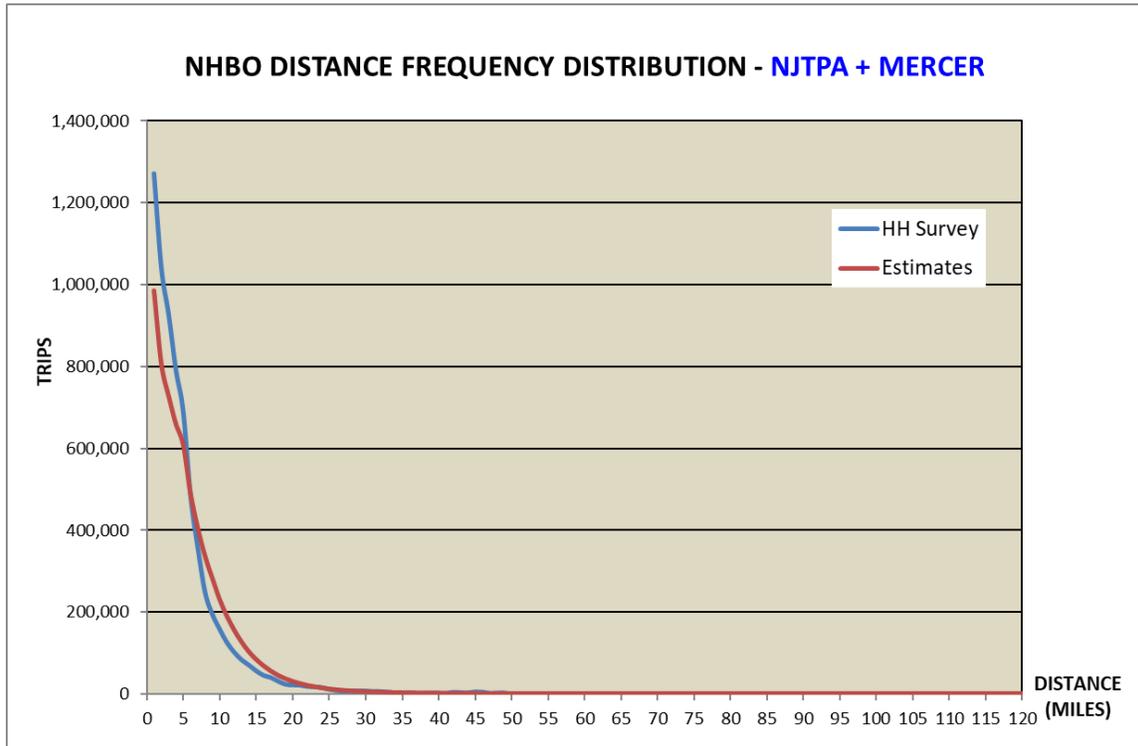


Figure 23 – Frequency Distribution for NHBO Purpose



The county-to-county person trips from both the household survey and NJRTM-E model were summarized, compared, and listed in **APPENDIX I – COUNTY LEVEL TRIP INTERCHANGE COMPARISONS**. These counties are the primary focus of the NJRTM-E model but have trip interactions with NJTPA core area. The trips originated from or destined to these areas are aggregated together by region and checked against available data.

9.7 PRE-MODE CHOICE TIME-OF-DAY PARTITION

Prior to mode choice step, the trips in the NJT controlled region have to be partitioned into peak and off-peak trips. Table 66 shows the time-of-day partition percentages for the peak and off-peak period by trip purpose. These percentages were developed based on the 2010-2011 NYMTC/NJTPA Regional Household Travel Survey Data. The partitioned trips were used as inputs to the NJRTM-E’s mode choice model which was adopted from the NJT model.

Table 66 – Time-of-Day Partition Percentages

Period	Purpose						
	HBWD	HBWS	HBUS	HBS	HBO	NHBW	NHBO
HBWD	0.72	0.73	0.53	0.48	0.57	0.39	0.43
NHBO	0.28	0.27	0.47	0.52	0.43	0.61	0.57

9.8 TRUCK TRIP DISTRIBUTION CALIBRATION

9.8.1 External to External Trip Distribution

External to external trips were developed by utilizing the survey data. It was structured to have two layers of EE travel patterns, a method adopted from the New Jersey Statewide Truck Model. These patterns form the basis of simulating external truck trips across the region. The first layer, referred to as primary EE patterns, included EE movements obtained from all survey-related information. The second layer, referred to as secondary EE patterns, provides movements that were based on professional judgment. The primary patterns would govern the secondary patterns in the case where movements occurred in both patterns.

9.8.2 EI, EIE, EIMC, II Trip Distribution

A standard gravity model was utilized for truck’s Internal-Internal (II), External-Internal (EI), External-Internal-External (EIE) trip distribution analyses. This method was also adopted from the New Jersey Statewide Truck Model. The gravity model distributes trips proportionally to the magnitude of productions and attractions at the origin and destination zones, and inversely to the distance or “spatial separation” between these zones. Off-peak highway skims were used to represent the spatial separation between zones. Commercial vehicle trips were distributed using the same travel times as medium trucks.

9.8.3 Trip Distribution Validation

The truck trip distribution model was validated to the recent traffic counts available for the trans-Delaware river and trans-Hudson river trips, as well as to the Origin-Destination (O-D) truck trips from / to various important truck generators, such as Ports and Airports. shows the truck distribution comparison between various ports / Airports and Counties in the study regions.

Table 67 – Truck Trips Distribution From / To Ports and Airports

From Facility

COUNTY	From EWR		From HH		From JFK		From NYMT		From PEPN		From PJ		From SWF	
	Obs.	Est.												
Bergen	2.3%	0.0%	0.4%	0.0%	3.0%	0.0%	1.7%	1.6%	2.1%	6.8%	4.7%	28.1%	6.2%	14.3%
Essex	12.8%	10.2%	17.8%	14.4%	9.3%	3.4%	0.0%	0.1%	24.6%	7.4%	14.3%	5.2%	3.5%	0.0%
Hudson	10.4%	11.0%	5.7%	6.3%	2.6%	5.7%	41.4%	37.4%	11.0%	7.5%	24.2%	18.0%	2.3%	0.0%
Hunterdon	1.9%	1.3%	0.2%	0.6%	0.9%	0.0%	1.7%	0.0%	5.8%	1.0%	1.2%	0.1%	0.2%	0.0%
Mercer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.4%	0.0%	0.0%
Middlesex	9.5%	10.6%	29.4%	32.2%	1.9%	2.2%	11.8%	6.4%	19.7%	21.0%	18.1%	23.7%	6.6%	0.5%
Monmouth	0.6%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.6%	0.1%	4.9%	1.5%	0.0%	0.0%	0.4%
Morris	0.4%	0.0%	0.0%	0.0%	0.4%	0.5%	0.8%	0.9%	0.4%	7.6%	1.2%	0.0%	0.2%	0.3%
Ocean	0.0%	3.1%	0.4%	0.0%	0.0%	0.0%	0.0%	1.5%	0.1%	3.0%	0.3%	0.0%	0.0%	0.0%
Passaic	0.1%	4.4%	0.0%	0.0%	0.1%	0.8%	1.3%	1.7%	0.3%	4.8%	1.2%	0.0%	0.2%	0.2%
Somerset	1.2%	3.7%	2.8%	0.0%	0.2%	0.1%	1.3%	2.1%	0.6%	3.8%	1.7%	0.0%	0.2%	0.0%
Sussex	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.2%	1.7%
Union	23.7%	18.6%	30.7%	35.4%	5.9%	7.5%	2.5%	0.1%	11.8%	5.2%	12.2%	7.4%	0.5%	0.0%
Warren	1.0%	1.1%	0.2%	0.0%	0.3%	1.5%	0.0%	0.0%	1.4%	1.9%	0.1%	0.0%	0.1%	0.0%
NJTPA+MERCER	64.1%	64.0%	87.6%	88.9%	24.6%	21.8%	62.4%	52.5%	77.9%	76.2%	80.6%	82.9%	20.1%	17.2%
OTHER	35.9%	36.0%	12.4%	11.1%	75.4%	78.2%	37.6%	47.5%	22.1%	23.8%	19.4%	17.1%	79.9%	82.8%
TOTAL	100.0%													

COUNTY	To EWR		To HH		To JFK		To NYMT		To PEPN		To PJ		To SWF	
	Obs.	Est.												
Bergen	1.9%	0.0%	0.9%	0.0%	3.9%	0.0%	0.9%	1.6%	2.0%	6.8%	7.7%	28.2%	0.4%	14.3%
Essex	13.5%	10.2%	14.8%	14.4%	8.4%	3.4%	2.3%	0.1%	20.9%	7.4%	12.4%	5.2%	4.5%	0.0%
Hudson	5.3%	11.0%	3.3%	6.3%	5.0%	5.7%	29.8%	37.4%	14.8%	7.5%	30.1%	18.0%	3.4%	0.0%
Hunterdon	1.1%	1.3%	0.7%	0.6%	0.4%	0.0%	1.8%	0.0%	5.0%	1.0%	1.3%	0.1%	0.0%	0.0%
Mercer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.4%	0.0%	0.0%
Middlesex	9.1%	10.6%	40.0%	32.2%	1.7%	2.2%	15.1%	6.4%	22.2%	21.1%	13.5%	23.7%	5.1%	0.5%
Monmouth	0.2%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.6%	0.2%	4.9%	1.4%	0.0%	0.0%	0.4%
Morris	0.8%	0.0%	0.9%	0.0%	0.3%	0.5%	0.0%	0.9%	0.6%	7.6%	2.7%	0.0%	0.5%	0.3%
Ocean	0.0%	3.1%	0.4%	0.0%	0.0%	0.0%	0.0%	1.5%	0.5%	3.0%	0.1%	0.0%	0.0%	0.0%
Passaic	0.1%	4.4%	0.0%	0.0%	0.1%	0.8%	0.0%	1.7%	0.4%	4.8%	1.1%	0.0%	0.0%	0.2%
Somerset	1.0%	3.7%	3.9%	0.0%	0.2%	0.1%	0.0%	2.1%	0.5%	3.8%	0.8%	0.0%	0.0%	0.0%
Sussex	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	0.1%	0.0%	0.2%	1.7%
Union	27.8%	18.6%	22.2%	35.4%	3.0%	7.5%	1.8%	0.1%	12.3%	5.2%	6.2%	7.4%	0.4%	0.0%
Warren	0.6%	1.1%	0.2%	0.0%	0.6%	1.5%	0.5%	0.0%	0.4%	1.9%	0.2%	0.0%	0.0%	0.0%
NJTPA+MERCER	61.4%	63.9%	87.4%	88.9%	23.6%	21.9%	52.3%	52.5%	79.8%	76.3%	77.6%	83.0%	14.5%	17.2%
OTHER	38.6%	36.1%	12.6%	11.1%	76.4%	78.1%	47.7%	47.5%	20.2%	23.7%	22.4%	17.0%	85.5%	82.8%
TOTAL	100.0%													

Note

- EWR: Newark Liberty Airport
- HH: Howland Hook
- JFK: JFK Airport
- NYMT: Marine Terminal
- PEPN: Port Elizabeth/Port Newark
- PJ: Port Jersey
- SWF: Stewart Airport

9.9 AIRPORT TRIP GENERATION AND DISTRIBUTION

9.9.1 General Information

The base year (2000) air passenger trips were developed using trip tables derived from survey data provided by NJ Transit. However, NJT did not provide any estimation method to project future air passenger trips. In an effort to include a capability to estimate future air trips, a regression model was developed for airport trips using socioeconomic data and the 2000 air-passenger trips as the basis of the model estimation and calibration. There are four types of air passenger trips introduced in the model for each time period, peak and off-peak:

- AIR1 : Business Trip from Residence
- AIR2 : Business Trip from Non-Residence
- AIR3 : Non-Business Trip from Residence
- AIR4 : Non-Business Trip from Non-Residence

9.9.2 Model Estimation Using Linear Regression Method

The passenger trip table was constructed with an assumption that only trips destined to the airport were included, the reverse-direction trips (trips originated from the airport) were not. In other words, the air-passenger model only estimated the zonal trip production but not the zonal trip attraction. Other techniques are employed to represent the directional distribution of trips to and from the airport. In the NJRTM-E, the air-passenger trip tables include trips originating from all the NJRTM-E zones (3028 zones) and destined to the Newark airport zone (zone 599). As such, the model can be described as a very simple combined generation – distribution model, or a direct demand model, with a single destination.

The air passenger trip model for each purpose was estimated using a linear regression method. The base year air passenger trips (2000) were used as the observed data or the dependent variable. The independent variables were selected among the zonal socioeconomic data that include:

- POP : zonal population
- EMP : zonal total population
- INCOME : zonal median income
- DIST_NEWARK: distance from each zone to Newark airport
- DIST_NEAR : distance from each zone to nearest airport (JFK, LaGuardia, Lehigh Valley, or Philadelphia) except Newark Airport

The linear regression models were developed on a daily basis using MCD or district level data, even though the final model will be applied at the zonal level. The main reason of using the MCD level data, instead of zonal level data, is because the zonal level observed data were limited in many areas. It should be noted that the observed air-passenger data was available only for selected regions. These selected regions were New Jersey and Manhattan, NY which have significant air passenger trips to Newark Airport. In the New Jersey region, the observed data was prepared at MCD level, while for Manhattan, the observed data was prepared at district level. Manhattan was divided into three districts: Upper Manhattan, Mid-Manhattan, and Lower Manhattan. The air passenger trips from Bucks County, PA and other counties in NY were also

available. However, they were not used because the data was a very limited sample for that region.

9.9.3 Model Estimation

The SPSS software was used to perform the linear regression. The zero trip observations were excluded from the analysis using the SPSS data selection option. The best models were selected using the “Step-Wise” method. This method was executed by including all five independent variables and the following regression models (with R-squared terms listed) were selected for each air-passenger type:

i) AIR1 (Business, Resident) Passenger Trip Model

$$\text{AIR1_Trip} = -2.119 + 0.000488*\text{POP} + 0.0005478*\text{EMP} + 0.00043*\text{INCOME} - 0.533*\text{DIST_NEWARK} + 0.303*\text{DIST_NEAR} \quad (\text{R}^2=0.769)$$

ii) AIR2 (Business, Non-Resident) Passenger Trip Model

$$\text{AIR2_Trip} = 7.318 + 0.0002798*\text{POP} + 0.001458*\text{EMP} - 0.521*\text{DIST_NEWARK} + 0.519*\text{DIST_NEAR} \quad (\text{R}^2=0.752)$$

iii) AIR3 (Non-Business, Resident) Passenger Trip Model

$$\text{AIR3_Trip} = 12.267 + 0.0009773*\text{POP} + 0.0004697*\text{EMP} + 0.0003516*\text{INCOME} - 0.705*\text{DIST_NEWARK} + 0.263*\text{DIST_NEAR} \quad (\text{R}^2=0.841)$$

iv) AIR4 (Non-Business, Non-Resident) Passenger Trip Model

$$\text{AIR4_Trip} = -25.881 + 0.0003883*\text{POP} + 0.001874*\text{EMP} + 0.0000648*\text{INCOME} - 0.429*\text{DIST_NEWARK} + 0.349*\text{DIST_NEAR} \quad (\text{R}^2=0.843)$$

The independent variable, “DIST_NEWARK”, has negative impact on the air-passenger trips. The longer distance for a zone to Newark Airport results in less passenger trips produced by the zone being destined to Newark airport. The other independent variables have a positive relationship to the air passenger trips production.

9.9.4 Calibration of Constants

The regression models were developed using MCD level or district level data points and will be used to estimate zonal-level air-passenger trip productions in the final model application. As such, there is an inconsistency pertaining to geographical sizes used during model estimation and the model application. The constants were recalibrated and adjusted for various model regions to reduce the inconsistency. Table 68 shows regression constants for the four air passenger types and for various regions.

Table 68 – Constants of Regression for Airport Trips

State & County		Calibrated Constant Value			
		AIR1	AIR2	AIR3	AIR4
New Jersey		-28.8343	-5.4775	-14.7265	-7.8730
New York	Bronx	-139.4302	-184.3404	-205.4723	-116.0245
	Kings	-107.6452	-155.6539	-162.2311	-153.7849
	New York	-45.8975	-3.9224	-27.5394	-1.9437
	Queens	-216.0321	-202.0500	-267.9113	-215.8475
	Richmond	-27.6106	-20.5270	-14.6100	-16.9003
	Westchester	-88.8921	-82.6934	-71.6079	-119.8549
	Other Counties	-31.2129	-2.7077	-10.0467	-8.3078
Pennsylvania		-38.1420	-2.9272	-32.6916	-7.7643

There were a few cases where negative trips were generated for zones far from Newark Airport. The high distance values and negative coefficient of “DIST_NEWARK” variable contributed to this problem. In the final model application, any cells with negative values were set equal to zero correct this problem.

9.9.5 Trip Scale Factors

The model also introduced trip scale factors to adjust the air-passenger trip tables when necessary. For example, if in the future Newark Airport is expanded and the air-trips are projected to increase by ten percent, a factor of 1.1 can be applied to the estimated air-trips to reflect the change. This factor provides flexibility and quick adjustments to model any future changes to airport facilities without recalibrating the model.

9.9.6 Time-of-Day Factors

The estimated daily air-passenger trips were then stratified into peak and off-peak trips using time-of-day factors shown in Table 69. The factors were developed for different regions using the 2000 observed air-trips provided by NJ TRANSIT. The same factors are applied to the four different air-passenger types.

Table 69 – Time of Day Distribution of Airport Trips

State	County	Peak	Off-Peak
New Jersey	Bergen	36.71%	63.29%
	Essex	41.87%	58.13%
	Hudson	38.38%	61.62%
	Hunterdon	37.40%	62.60%
	Mercer	39.40%	60.60%
	Middlesex	37.67%	62.33%
	Monmouth	39.09%	60.91%
	Morris	38.02%	61.98%
	Ocean	43.47%	56.53%
	Passaic	40.05%	59.95%
	Somerset	41.97%	58.03%
	Sussex	46.49%	53.51%
	Union	43.49%	56.51%
Warren	36.04%	63.96%	
New Jersey Total		39.56%	60.44%
New York	Bronx	26.71%	73.29%
	Kings	34.87%	65.13%
	New York	29.46%	70.54%
	Orange	31.87%	68.13%
	Queens	32.35%	67.65%
	Richmond	40.71%	59.29%
	Rockland	28.48%	71.52%
	Westchester	53.16%	46.84%
New York Total		33.50%	66.50%
Pennsylvania		32.33%	67.67%
Default for Other Counties		37.76%	62.24%

9.10 EXTERNAL TRIP DISTRIBUTION

9.10.1 Introduction

Although the NJTPA region is surrounded by a large buffered area of additional counties from which external traffic is generated, the magnitude and trip length of external traffic on the southern section of the New Jersey Turnpike (NJTPK) tended to be much lower than the observed traffic counts and the patterns were inconsistent with the patterns from entry-exit transaction data. The differences were predominantly related to auto trips as described in the latest NJRTM-E Revalidation Report (2011). While the buffer area surrounding the NJTPA region is providing a reasonable external trip process for most of the modeled area, the magnitude of external traffic on the Turnpike and relatively long-distance characteristics of these trips due to the Turnpike’s function as a gateway for travel into the Northeast Corridor required a more detailed approach for modeling external auto travel.

As part of the 2015 NJRTM-E Refinement project, the external auto trips on the southern section of the NJ Turnpike were adjusted with the objective of improving the estimated volume and travel patterns. The adjustments were implemented as a separate external traffic estimation module that is embedded into the NJRTM-E model framework. The external traffic distribution is performed using a gravity model distributing trips from the NJ Turnpikes southern terminus modeled at the Camden – Burlington County Line to the remaining internal zones within the NJRTM-E. The

revised external modeling process was calibrated using the New Jersey Turnpike entry-exit transaction data provided by the New Jersey Turnpike Authority.

The module was designed to be flexible and easily adaptable to other NJRTM-E external gateways serving significant long-distance travel, such as western terminus of I-80 and I-78. It should be noted that since the model has a larger buffer to the west and north of the NJTPA region these external loading points, as well as those on the northern side of the region are significantly more distant from the NJTPA region and the portion of traffic from those zones that reaches the NJTPA counties may be much lower than the percentage of traffic on the southern end of the NJ Turnpike. The same module was also utilized in the 2022 Validation Project using the updated data from the 2019 traffic counts.

9.10.2 Process Overview

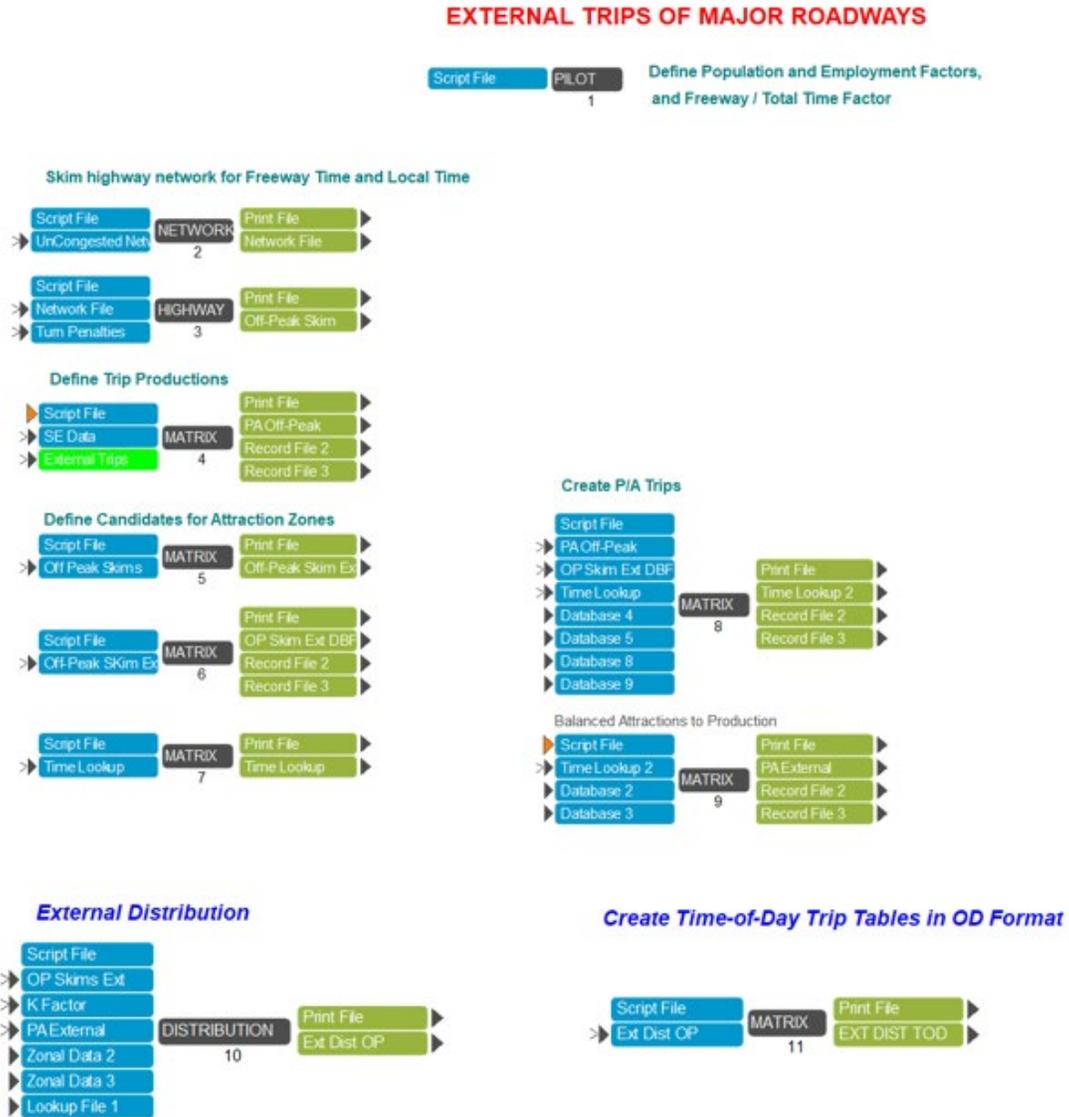
The refined external forecasting process has four basic elements. The first element is a referencing process to tie the external trips to the external gateway point. The second element is the estimation of internal EI trip attractions within the NJRTM-E region. The third element is a gravity model process to distribute the EI vehicle trips and the final element converts the trips to O-D flows for each of the assignment periods and merges the trips into the final vehicle trip tables.

The external application was added in the Trip Distribution module of the NJRTM-E as shown in Figure 24 and. As part of the external model application, the analyst has to provide the traffic volumes at the three external locations, including New Jersey Turnpike, I-78, and I-80, for each model year. The volumes are stored in the "External.DBF" file in the network related input folder, as mentioned above.

Figure 24 – External Trip Model in the Trip Distribution Model



Figure 25 – External Trip Model Application



9.10.3 External-Internal Trip Generation

The daily observed auto vehicle trips from/to the southern terminus of the NJTPK is used as the production control total for the NJ Turnpike southern external with zone 390 as its surrogate zone. The trips will then be distributed to other zones (attraction zones).

The attraction zones were defined by using a two-tier process. The first tier is to locate the candidate attraction zones. A zone is defined as a candidate attraction zone if the time spent

traversing limited-access facilities (such as New Jersey Turnpike) to this zone is at least half of the total trip time from the external production zone. This condition was adopted to reflect the general orientation of traffic entering the modeled region via the NJ Turnpike. As an example, it is assumed that traffic from the NJ Turnpike external gateway would be more likely to seek destination zones in core areas along the limited access facilities interconnected to the Turnpike as opposed to seek destinations in the far northwestern section of New Jersey. For those destinations, it would be more likely that travelers from south of the region would have used other limited access roadways in Pennsylvania to reach that general area. This assumption is logically supported by the magnitude of entry-exit patterns from the NJ Turnpike at its interchanges with other interstate roadways, although the final zonal destinations are not known. This assumption can be further refined in the next revalidation effort with additional route-specific survey data, such as cell phone-based O-D data.

In the second step, the trip attractions for all selected zones are estimated. Attractions are calculated as a function of ‘zonal activity’, which is defined as population + 0.50 * total employment, and travel time from the southern external to each attraction zone. Zones with greater activity will attract proportionally more trips.

9.10.4 Gravity Model

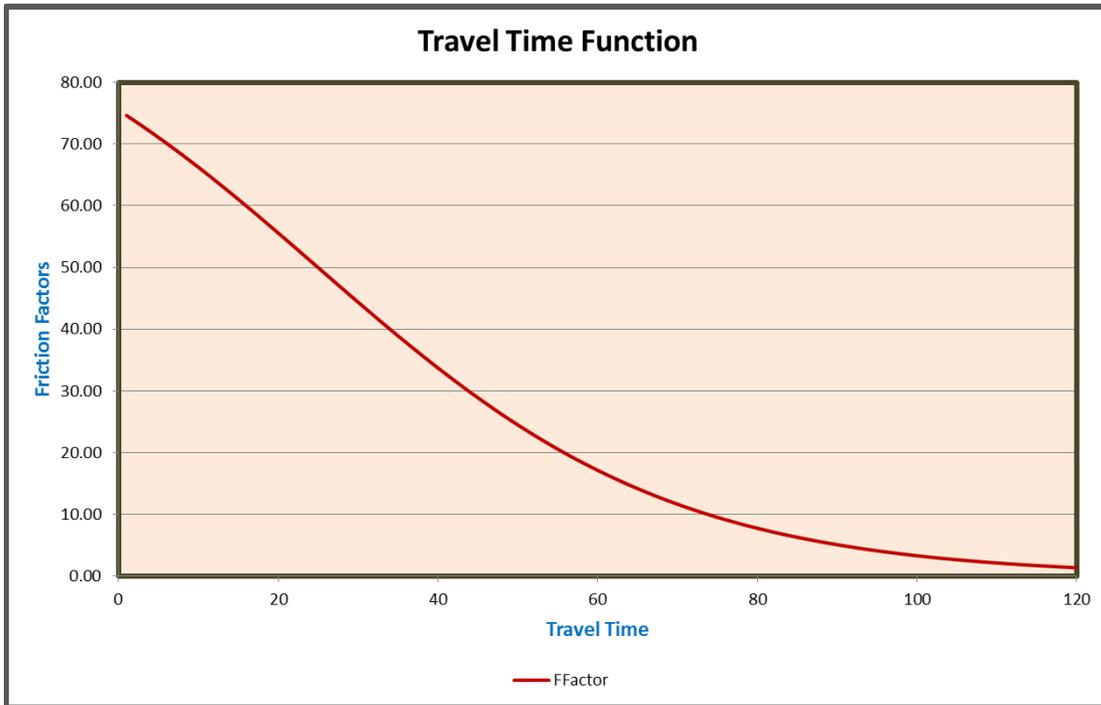
The external trip distribution is performed using a typical Gravity Model, defined as follows:

$$T_{ij} = \frac{A_j F_{ij} K_{ij}}{\sum_{\text{all zones } k} A_k F_{ik} K_{ik}} x P_i$$

- Where: T_{ij} = Trip produced at zone i and attracted to zone j
- P_i = Total trip production at zone i
- A_j = Total attraction at zone j
- F_{ij} = Friction Factor between zones i and j
- K_{ij} = K-Factor, socioeconomic adjustment factor for interchange ij

To facilitate the transferability of this model to other major external gateways within the NJRTM-E region such as I-80 and I-78, K-factors were not utilized. The friction factors were adjusted as part of the calibration process. Figure 26 shows the friction factors as a function of travel time.

Figure 26 – Friction Factor



9.10.5 Time-Of-Day Trip Table

The daily production/attraction (P/A) external auto trip table stratified into four time-of-day (TOD) trip tables thus being converted to a final origin-destination (O-D) trip table. The time of day allocations were developed using the non-home-based (NHB) TOD factors with some directional scaling assumptions for the two peak periods. It was assumed that there would be a pronounced directional flow northbound (inbound) in the am peak period and a smaller directional imbalance in the pm peak period. These factors were defined as follows:

- AM Peak = 0.121 * Daily Trip (Inbound 65% / outbound 35%)
- PM Peak = 0.223 * Daily Trip (inbound 45% / outbound 55%)
- MD = 0.462 * Daily trip (inbound 50% / outbound 50%)
- NT = 0.194 * Daily Trip (inbound 50% / outbound 50%)

The TOD external trip tables were combined with the NHB trips prior to the highway assignment process.

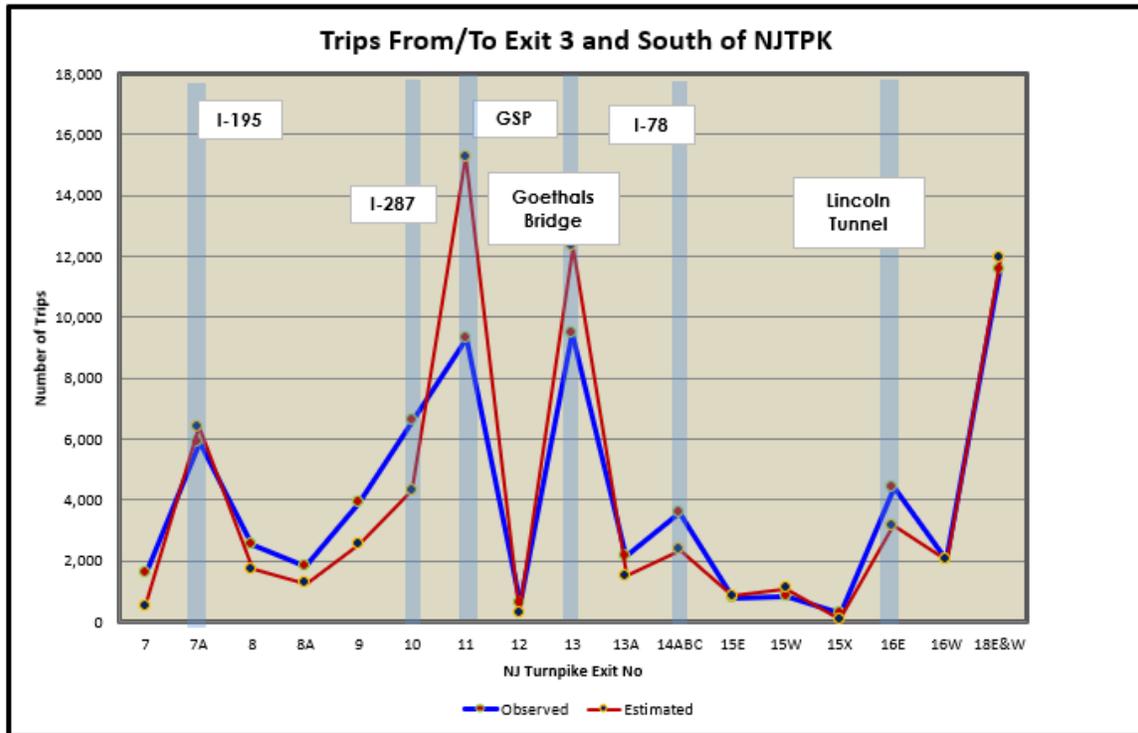
9.10.6 Highway Assignment Results

Upon the completion of the highway assignment the estimated trips by entry-exit combination from the NJ Turnpike southern external to other northern interchanges are compared to the observed data. Table 70 shows the comparison of the observed data and estimated trips. The comparison is displayed graphically in Figure 27.

Table 70 – Observed and Estimated O-D Trip Comparison

Interchange	From South		To South		Total		Distance
	Observed	Estimated	Observed	Estimated	Observed	Estimated	
7	838	328	740	190	1,578	518	27.0
7A	3,167	3,145	2,740	3,266	5,907	6,411	56.0
8	1,245	944	1,271	765	2,516	1,709	44.3
8A	965	680	836	566	1,801	1,246	49.4
9	2,018	1,022	1,899	1,512	3,917	2,535	59.9
10	3,309	2,380	3,322	1,919	6,631	4,299	65.4
11	4,879	7,612	4,435	7,640	9,314	15,252	74.4
12	286	144	291	140	577	284	66.6
13	4,862	5,706	4,594	6,609	9,456	12,315	71.6
13A	1,221	677	912	830	2,133	1,507	72.7
14ABC	1,899	1,310	1,664	1,038	3,563	2,348	78.6
15E	378	466	376	376	754	842	80.0
15W	437	480	379	610	816	1,090	81.0
15X	135	51	147	21	282	71	81.8
16E	2,832	2,003	1,592	1,147	4,424	3,150	85.0
16W	816	962	1,199	1,068	2,015	2,030	86.6
18E&W	2,646	125	2,883	0	11,572	11,973	96.3
TOTAL	31,933	28,035	29,280	27,698	67,256	67,581	

Figure 27 – Observed and Estimated O-D Trip From/To Interchange 3 and South



9.10.7 Other External Gateways

The New Jersey Turnpike external model was also applied to other major externals within the NJRTM-E's geographical coverage, such as I-78 and I-80 on the western edge of the model. The analyst needs to provide the external trips for these externals, including the southern external of the New Jersey Turnpike, for each model year. The estimated external trips can be developed from base year traffic counts in the vicinity of these external zones, and assumed growth factors to project the corresponding future year traffic at these locations. The traffic has to be input manually by the analyst to external.DBF file in the network related input folder, for example, "modeldata\19VAN" folder.

Currently, there is no-observed data available for I-78 and I-80 externals. Therefore, the model was not calibrated for these two locations.

10. MODE CHOICE

10.1 INTRODUCTION

The mode choice model process for the NJRTM-E was created specifically to address several objectives identified by the client team. The objectives can be generally described as the desire to retain the existing NJT mode choice model process, both in terms of its structure and the software routines used to perform the mode choice model. For the existing model structure, the NJT mode choice model provides a robust and well-specified nested logit model that has been designed specifically to address the complex and competitive transit choice environment that exists in Northern New Jersey. With respect to the software, the existing process uses a C-Based program to perform mode choice and the transit skims are generated with the PT Routine.

It should be noted that the NJT Mode Choice Model transit networks provide extensive detail regarding the lines and services within New Jersey and a segment of the high capacity transit services offered by MTA in Manhattan. During the development effort for the mode choice process, it was recognized that it would be desirable to retain this model structure for the entire expanded region. However, there were some concerns related to the ability of the older versions of TRNBUILD to handle a more extensive transit network that would result from coding all of the transit services in detail for the region east of the Hudson River. At this point the client team was unwilling to investigate converting the transit path-building process to the new Voyager Public Transport (PT) routine, given concerns that it might require an in-depth recalibration of the existing mode choice model. Furthermore it was acknowledged that maintaining the coding for the additional transit services east of the Hudson River would also place additional burdens on the client staff tasked with this requirement.

As a result of these concerns, a decision was made to partition the region into two “choice-based” sub-regions. This decision introduced a level of complexity into the model process, but enabled the final model to utilize the existing NJT mode choice model without significant modification. The two choice regions include the “NJT-Controlled” region and “the other-controlled” region. The NJT-Controlled Region is primarily west of the Hudson River including counties in the NJTPA, SJTPO, DVRPC, LVPC, NEPA regions and Orange and Rockland Counties in New York State. The locations of these regions can be seen in Figure 1. All trips “produced” in this region utilize the NJT mode choice model process. The other-controlled region is mainly located in the east of Hudson River. This region includes:

- Bronx, Queens, Kings, Richmond boroughs,
- Long Island (Nassau and Suffolk), Westchester, Putnam, and Dutchess Counties, NY and
- Fairfield County, CT.

Trips originating from this region are controlled by another process that utilizes mode shares obtained from the NYMTC Best-Practices Model (BPM). The remaining area is Manhattan and trips originating from Manhattan with destinations west of the Hudson River use the NJT mode choice model to estimate mode shares, while trips from Manhattan to areas east of the Hudson rely on shares derived from the NYMTC BPM.

10.2 NJTPA REGION

10.2.1 Methodology Overview

The mode choice model for the NJRTM-E is adopted from the NJ TRANSIT North Jersey Travel Demand Forecasting Model (NJTDFM) referred to in this report as the NJT Model. The mode choice is a typical step within a traditional 4-step travel forecasting model. In this step, trips in each zone-to-zone cell of the person trip table are divided among the different available travel modes. The selection of travel mode is a function of the characteristics of each mode that is available for that particular origin-destination zonal pair and the characteristics of the traveler, the production zone, and the attraction zone.

The mathematical function used in the NJT Model to perform this split is known as a nested logit model. The logit model is structured so that, for each zone interchange, the percentage (or share) of trips choosing a given mode “a” from a choice of “m” modes is equal to the exponentiated utility associated with mode “a” divided by the sum of the exponentiated utility for all “m” modes. The equation is:

$$P_a = \frac{e^{U_a}}{\sum_{i=1}^m e^{U_i}}$$

where,

- P_a is the probability of a traveler choosing mode a;
- U_a is the utility (or attractiveness) of mode a; and
- $\sum U_i$ is the sum of the utilities for all m modes.

The utility equation, U_a , is mode-specific and can be represented in the following general form:

$$U_a = c_1 \times Distance_a + c_2 \times Fare_a + c_3 \times InVehicleTime_a + \dots + C_a$$

where,

- U_a is the utility (or attractiveness) of mode a;
- $Distance_a$
- $Fare_a$
- $In\text{-}Vehicle\ Time_a$
- \dots_a are level of service variables of mode a for this trip
- c_1, c_2, \dots are coefficients estimated for each of the terms based on survey results
- c_a is the constant for mode a – obtained through calibration

The models are structured as a series of choices, or “nests”, such as “transit vs. auto” or “walk access vs. drive access to transit”. The nested logit structure implies that the share of trips choosing a particular mode b is dependent upon the logarithm of the sum (“logsum”) of the exponentiated modal utilities of those sub-modes nesting below mode b. This is computed as:

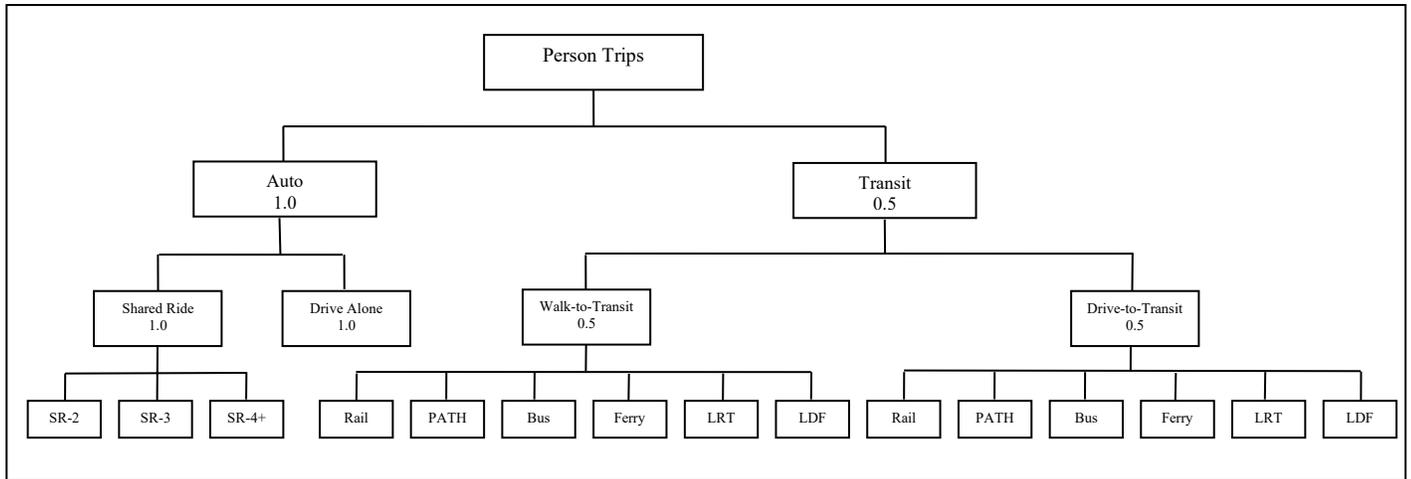
$$U_b = c_{nest} \times \ln\left(\sum_{i=1}^n e^{U_i}\right) + C_b$$

where:

- U_b it the utility for nest b
- C_{nest} is a coefficient called the nesting coefficient, or theta; and
- C_b is a nest level constant for nest b– obtained through calibration.

The nesting structure for the model is presented as Figure 28 below. The nesting coefficients (thetas) were estimated from research completed by Resource Systems Group (RSG) and were set at 0.5 for the transit, walk-access, and drive-access nests.

Figure 28 – Nesting Structure for Mode Choice Model

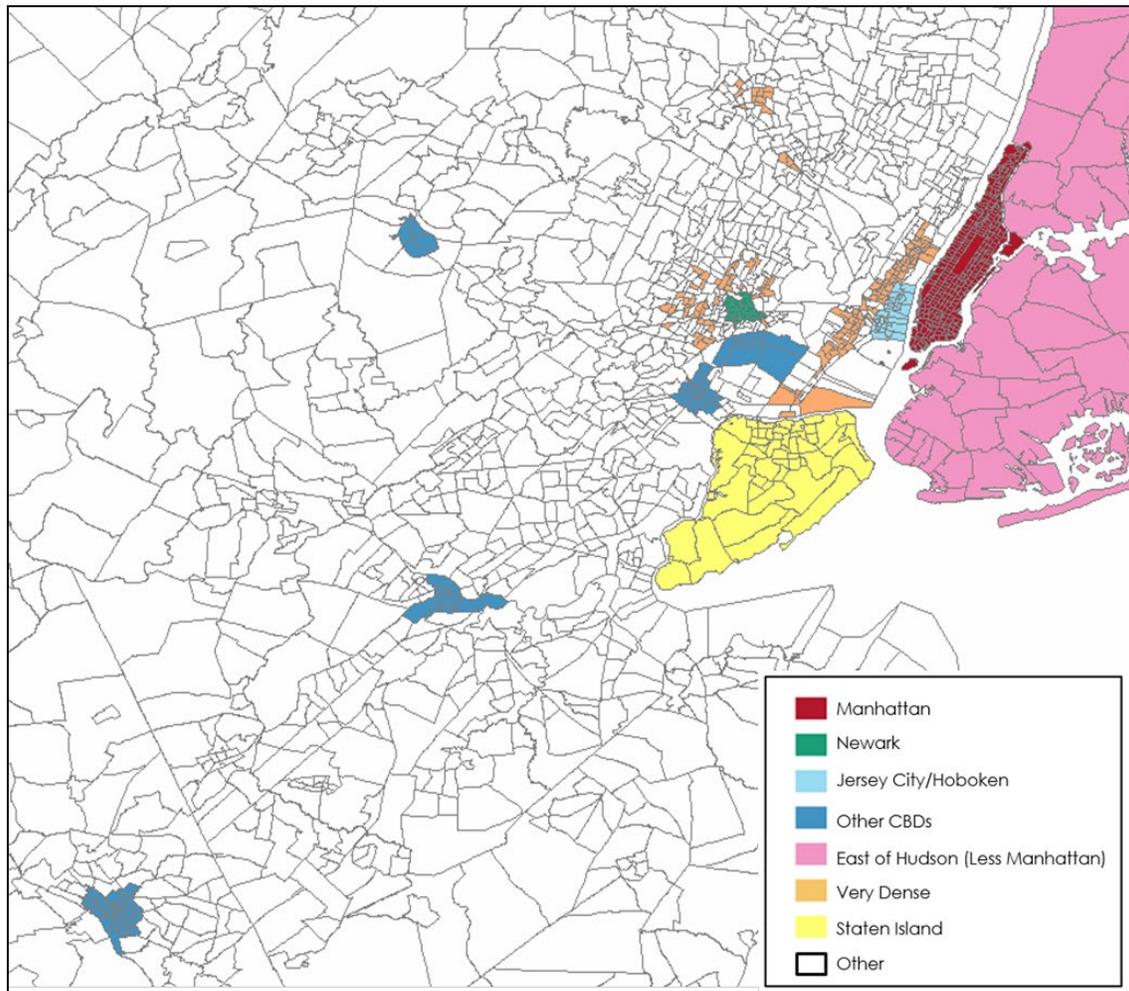


To allow the model to closely replicate observed ridership patterns, the region is subdivided into 11 different market segments. Each market segment has its own set of mode-specific constants. The market segments are described in Table 71 below and are pictured in Figure 29.

Table 71 – Market Segment Definitions

Market Segment	Market Segment Definition
1	West of Hudson (Less Staten Island) to Manhattan
2	(Less Staten Island) to Newark
3	(Less Staten Island) to Jersey City/Hoboken
4	(Less Staten Island) to Other CBD's
5	West of Hudson (Less Staten Island) to Other East of Hudson (Other than Manhattan)
6	Non-dense P's to Non-dense A's
7	Manhattan to West of Hudson
8	From Staten Island/From West of Hudson to Staten Island
9	Dense P's to Non-dense A's
10	Non-dense P's to Dense A's
11	Dense P's to Dense A's

Figure 29 – Market Segment Definition



These market segments are designed to represent:

- Key destination areas in the region that are unique and exhibit higher levels of transit ridership. These include:
 1. Manhattan,
 2. Newark Super CBD,
 3. Jersey City/Hoboken Core,
 4. Other CBDs (Morristown, New Brunswick, Elizabeth, and Trenton). These were defined by NJ TRANSIT based on employment and a presence of all-day, two-way rail service.

- Travel to or from Staten Island exhibits different behavior from travel elsewhere in the region
- Reverse commute travel from Manhattan to suburban locations attracts a higher transit share than travel from suburban origins to suburban destinations.
- Travel produced in or attracted to densely populated areas (25,000 or more persons per square mile) are more likely to use transit than persons in less densely populated areas.

10.2.2 Home-Based Work (HBW) Mode Choice Model

Coefficients for the HBW mode choice model were originally estimated for the previous version of NJTDFM (for base year 1990) using ALOGIT and the HBW trans-Hudson survey trip data. This earlier version of the NJTDFM used the results of the model estimation directly. The earlier NJTDFM was calibrated using different modal weights for path-building and the mode choice models. Experience has shown that inconsistent weights between the path-builder and mode choice models will typically cause spurious Transportation System User Benefits estimates.

As part of the 2023 Revalidation Process, the mode choice coefficients were adjusted to be consistent with the most recent NJTDFM Model. Table 72 shows the adjusted HBW mode choice coefficients.

Table 72 – Final HBW Mode Choice Model Coefficients

Parameters	Coefficient
Auto IVTT (minutes)	-0.04000
Walk (minutes)	-0.06444
Wait (minutes)	-0.06444
XFERS (minutes)	-0.04310
Drive Access Time - PK (minutes)	-0.06444
Drive Access Time - OP (minutes)	-0.05640
Terminal Time (minutes)	-0.10490
Penalty Time (minutes)	-0.40000

In addition, the original mode choice estimation included transportation costs (fares, tolls, parking and automobile operation costs) in Year 1990 cents. In order to maintain consistency with the

original model estimation, it was necessary to represent future transportation costs within the updated NJTDFM mode choice models. Current year 2019 costs are coded (in cents) into the highway and transit networks. Within the mode choice model, the coded fares are deflated from Year 2019 (coded) to Year 1990 cents. This is done by using the annual New York-Northern New Jersey-Long Island Consumer Price Index (CPI) data from the U.S. Department of Labor for 2019 (278.164) and 1990 (138.5). Thus, the coded Year 2019 transportation costs are multiplied by 0.4979 to deflate to Year 1990 costs. The final Home-Based Work income constants are summarized below in Table 73.

Table 73 – HBW Income Constants

Income Group	Auto	Transit - Rail / Long Ferry	Transit - Others
1	0	-1.1240	0.0000
2	0	0.0000	-0.8076
3	0	-0.4734	-1.2400
4	0	-0.5383	-1.5430
5	0	-0.5534	-2.0670

10.2.3 Non-Work (HBS,HBO,NHB) Mode Choice Models

The non-work mode choice models are similar in structure to the HBW model. The non-work mode choice models have the same nesting structure and market segments. Table 74 summarizes the updated non-work mode choice coefficients and Table 75 summarizes the non-work income group constants.

Table 74 – Estimated Non-Work Mode Choice Coefficients

Parameters	Coefficient
Auto IVTT (minutes)	-0.04000
Walk (minutes)	-0.05230
Wait (minutes)	-0.05230
XFERS (minutes)	-0.03490
Drive Access Time (minutes)	-0.04580
Terminal Time (minutes)	-0.01970
Penalty Time (minutes)	-0.40000

Table 75 – Non-Work Purpose Income Constants

Income Group	Auto	Transit - Rail / Long Ferry	Transit - Others
1	0	0.0000	0.0000
2	0	-0.4617	-0.8225
3	0	-1.5250	-1.2090
4	0	-1.4090	-1.7070
5	0	-1.4940	-1.8650

10.2.4 Aggregate Model Calibration Process

Mode-specific constants were defined so that the aggregate mode shares for each market segment matched observed shares. This was done by iteratively running the mode choice model, comparing observed and modeled results, and adjusting constants accordingly. The set of constants for each market segment and purpose are shown at level of application and the top nest level are listed in **APPENDIX J – CONSTANTS-EXPRESSED AT NEST LEVEL OF APPLICATION** and **APPENDIX K – MODEL CONSTANTS-EXPRESSED AT TOP NEST LEVEL**, respectively. The results of the calibration are discussed in Section 10.4.

10.3 NON-NJTPA REGION

10.3.1 Methodology Overview

For regions outside of NJTPA as described in the introduction above, the mode choice was estimated using share information from the NYMTC “Best Practice” Model. As a secondary control, the model assumptions regarding mode share (and overall traffic into the region) were governed by flows across the NJTPA cordon lines, many of which are “portals” across the Hudson and Delaware Rivers. These “assumed mode shares” are held constant in the basic model structure, but could be altered or refined periodically, based on new assumptions and/or refined NYMTC trip tables that would be available in the future. For particular studies, alternative assumptions could be adopted, if required. The mode shares are then applied to the estimated person trips from distribution for those regions not controlled by the NJRTM-E mode choice model.

10.3.2 NYMTC Base Year Trip Table Processing

Several processing steps were required to obtain the necessary share information for the NYMTC region. Initially, the trips from NYMTC BPM model trip tables (year 2000) were compressed into county-county matrices. Next, NYMTC staff provided output trip files by mode and traditional “4-step” trip purpose designations. Since this data was not available in a production-attraction format, it was necessary to establish mode shares using the origin-destination trips by mode. It was assumed that this was adequate for predicting mode choice in the NYMTC region.

The mode choice regions are shown in Figure 1, as discussed previously in Section 10.1. For all trips with origins west of the Hudson River (whether New Jersey, New York (Orange/ Rockland/

Sullivan), or Pennsylvania), trips by mode were calculated from the NJT mode choice model that was embedded in the NJRTM-E as the primary mode choice routine. Also, all movements from Manhattan westward into New Jersey, Pennsylvania or the three New York counties listed above were estimated by the NJT mode choice process.

For all other trips originating in Manhattan with destinations to locations east of the Hudson River, mode share and the resulting vehicle trips are calculated using percentage shares from the NYMTC model. These mode shares are applied to the person trips generated by the NJRTM-E for the regions east of the Hudson River. The general processing of this data is as follows:

- Use the total person trips generated by the integrated model trip distribution. Zero out all regions to be estimated via the NJT Mode Choice Model, as described above. This process is part of the standard distribution procedure and has internal auditing to ensure its proper application.
- Calculate the transit percentage shares from the NYMTC mode shares and factor the base trip table from the above step to remove transit-related person trips. This process provides controls and limited summaries to ensure proper application.
- Convert remaining person trips into vehicle trips using the percentage shares for the auto-based trip purposes. Note that the process summarizes both the person trips and vehicle trips by mode. The final model uses a 3+ auto occupancy mode for autos while the NJT model provides an additional 4+ auto occupancy mode. Since few vehicle trips exist in the 4+ category and most of these trips would not enter the NJTPA region a decision was made not to further stratify the 3+ autos into two separate modes.

It should be noted that the mode shares created from the NYMTC BPM were obtained as vehicle trips for the auto modes and therefore were converted back to person trips to establish “person-trip” based shares. As part of the process, certain thresholds were established since the version of the BPM mode available at the time of this model development had some illogical share conditions for particular county-county movements. The support application developed for the NJRTM-E overrides any illogical mode shares and these thresholds can be adjusted if deemed necessary at some point in the future.

10.4 RESULTS OF NJT MODE CHOICE MODEL

As discussed previously, the NJT mode choice model performs the choice process separately for market segments defined by geographic locations and density. The 11 segments of regional movements were pre-defined by the NJT model and are listed in Table 71.

According to the definition, the area to the west of Hudson River was partitioned into six main parts: Newark, Jersey City/Hoboken, Other CBD's, Staten Island, Dense and Non-Dense area. And the area to the east of Hudson River was partitioned into two parts: Manhattan and other east of Hudson River.

The results from the NJRTM-E model were summarized by purpose as shown in Table 76. A more disaggregated summary by market segment and travel mode was also prepared and compared against AECOM mode choice model targets, the NJT model and the household survey. Auto occupancies were also calculated and checked. In the following tables, market segments 1,5 and 7 formed the trans-Hudson region, and market segments 4,6,9,10 and11 formed the intra-west of Hudson region with the exception of trips to Newark and Jersey City/Hoboken CBDs. Each of these eleven market segments is summarized within the multi-page Table 77. The first set of tables compares the mode choice results for all 11 regions.

Table 76 – Comparison of Mode Choice Results by Trip Purpose

Mode	HBWD (Person Trips)		Mode	HBWS (Person Trips)	
	2010 RHTS (Pct)	Estimated (Pct)		2010 RHTS (Pct)	Estimated (Pct)
SOV	75.8%	75.5%	SOV	86.1%	85.0%
HOV2	5.7%	5.6%	HOV2	8.3%	8.4%
HOV3	0.8%	0.7%	HOV3	2.1%	2.1%
HOV4	0.6%	0.5%	HOV4	0.6%	0.4%
Walk-Transit	10.7%	9.3%	Walk-Transit	2.5%	2.7%
Drive-Transit	6.5%	8.3%	Drive-Transit	0.4%	1.5%
TOTAL	100.0%	100.0%	TOTAL	100.0%	100.0%
Average Car Occupancy	1.05	1.05	Average Car Occupancy	1.07	1.07

Mode	HBS (Person Trips)		Mode	HBO (Person Trips)	
	2010 RHTS (Pct)	Estimated (Pct)		2010 RHTS (Pct)	Estimated (Pct)
SOV	59.2%	57.6%	SOV	40.6%	39.9%
HOV2	25.8%	24.4%	HOV2	32.0%	31.7%
HOV3	6.9%	8.5%	HOV3	14.7%	14.9%
HOV4	3.6%	4.1%	HOV4	9.0%	9.2%
Walk-Transit	4.3%	4.8%	Walk-Transit	3.1%	3.1%
Drive-Transit	0.2%	0.6%	Drive-Transit	0.6%	1.1%
TOTAL	100.0%	100.0%	TOTAL	100.0%	100.0%
Average Car Occupancy	1.27	1.29	Average Car Occupancy	1.51	1.52

Mode	NHBW (Person Trips)		Mode	NHBO (Person Trips)	
	2010 RHTS (Pct)	Estimated (Pct)		2010 RHTS (Pct)	Estimated (Pct)
SOV	81.8%	83.3%	SOV	45.6%	44.5%
HOV2	11.8%	10.6%	HOV2	32.4%	31.8%
HOV3	2.1%	1.9%	HOV3	12.8%	13.9%
HOV4	1.5%	1.4%	HOV4	7.2%	8.1%
Walk-Transit	2.1%	1.8%	Walk-Transit	1.6%	1.4%
Drive-Transit	0.7%	1.0%	Drive-Transit	0.3%	0.4%
TOTAL	100.0%	100.0%	TOTAL	100.0%	100.0%
Average Car Occupancy	1.10	1.09	Average Car Occupancy	1.45	1.47

Mode	All Purposes (Person Trips)	
	2010 RHTS (Pct)	Estimated (Pct)
SOV	54.0%	53.5%
HOV2	24.8%	24.2%
HOV3	9.9%	10.2%
HOV4	5.8%	6.1%
Walk-Transit	4.1%	3.9%
Drive-Transit	1.4%	2.1%
TOTAL	100.0%	100.0%
Average Car Occupancy	1.41	1.42
Total Transit	5.5%	6.0%

Table 77 – Comparison of Mode Choice Results by Market Segment

Market Segment 1

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model
SOV	10.5%	10.5%	19.2%	61.6%	61.6%	69.9%	18.4%	18.4%	7.1%	16.5%	16.5%	7.8%	52.1%	52.1%	47.3%	28.0%	28.0%	24.4%
HOV2	1.5%	1.5%	2.3%	5.7%	5.7%	4.3%	6.8%	6.8%	2.7%	12.7%	12.7%	5.8%	7.7%	7.7%	7.0%	3.1%	3.1%	2.6%
HOV3	0.4%	0.4%	0.6%	1.6%	1.6%	1.0%	--	0.0%	0.0%	1.8%	1.8%	0.8%	--	0.0%	0.0%	14.1%	14.1%	11.6%
HOV4	0.2%	0.2%	0.3%	0.4%	0.4%	0.2%	0.3%	0.3%	0.0%	0.6%	0.6%	0.3%	--	0.0%	0.0%	--	0.0%	0.0%
AUTO	12.6%	12.6%	22.3%	69.3%	69.3%	75.4%	25.5%	25.5%	9.8%	31.6%	31.6%	14.7%	59.9%	59.9%	54.4%	45.2%	45.2%	38.6%
CRW	9.1%	6.6%	3.3%	4.5%	2.8%	1.9%	26.9%	4.1%	9.7%	2.9%	4.1%	2.8%	3.3%	1.8%	1.9%	1.3%	3.9%	2.2%
CRR	26.8%	20.9%	17.2%	10.0%	2.8%	4.4%	1.6%	1.5%	16.2%	9.2%	16.6%	20.6%	--	7.3%	14.8%	4.7%	13.0%	17.6%
SUBW	10.6%	22.1%	16.1%	4.0%	11.8%	5.0%	31.7%	37.6%	32.1%	15.3%	17.0%	10.7%	19.3%	17.5%	9.9%	20.4%	15.8%	6.6%
SUBR	4.7%	7.4%	7.8%	0.4%	4.6%	4.9%	6.6%	1.7%	5.9%	2.3%	2.4%	1.1%	15.1%	4.6%	7.3%	8.5%	5.4%	10.8%
BUSW	18.9%	7.4%	5.6%	8.8%	1.5%	1.4%	7.4%	17.0%	14.5%	18.0%	11.8%	22.6%	0.2%	0.9%	1.7%	4.8%	3.1%	2.4%
BUSR	14.5%	6.6%	9.3%	3.1%	1.6%	1.3%	0.4%	0.5%	3.6%	18.4%	10.3%	22.9%	1.3%	0.1%	0.4%	15.0%	1.2%	2.8%
FRYW	1.5%	2.6%	2.9%	--	1.0%	0.3%	--	6.8%	2.6%	1.1%	4.0%	0.4%	0.9%	2.9%	3.4%	--	3.8%	2.8%
FRYR	1.3%	11.3%	13.2%	--	4.0%	5.1%	--	4.8%	5.4%	1.2%	1.9%	3.2%	--	4.2%	5.6%	--	8.4%	16.1%
LRTW	--	1.3%	1.2%	--	0.1%	0.0%	--	0.6%	0.0%	--	0.4%	0.8%	--	0.6%	0.3%	--	0.1%	0.0%
LRTR	--	1.1%	1.1%	--	0.4%	0.4%	--	0.1%	0.1%	--	0.0%	0.0%	--	0.3%	0.3%	--	0.2%	0.1%
TRANSIT	87.4%	87.4%	77.7%	30.7%	30.7%	24.6%	74.5%	74.5%	90.2%	68.4%	68.4%	85.3%	40.1%	40.1%	45.6%	54.8%	54.8%	61.4%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Market Segment 2

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model	Survey	AECOM	Model
SOV	54.2%	54.2%	56.1%	81.3%	81.3%	81.2%	--	0.0%	9.4%	29.4%	29.4%	31.7%	85.8%	85.8%	85.8%	24.0%	24.0%	27.6%
HOV2	16.2%	16.2%	16.5%	16.7%	16.7%	16.8%	--	0.0%	8.8%	25.5%	25.5%	27.5%	11.1%	11.1%	11.0%	28.8%	28.8%	32.7%
HOV3	--	0.0%	0.0%	--	0.0%	0.1%	--	0.0%	8.4%	3.2%	3.2%	3.7%	--	0.0%	0.1%	15.5%	15.5%	17.5%
HOV4	0.4%	0.4%	0.4%	--	0.0%	0.0%	--	0.0%	8.2%	1.9%	1.9%	2.3%	1.3%	1.3%	1.3%	4.6%	4.6%	5.3%
AUTO	70.8%	70.8%	73.0%	97.9%	97.9%	98.1%	0.0%	0.0%	34.8%	60.0%	60.0%	65.3%	98.2%	98.2%	98.2%	73.0%	73.0%	83.2%
CRW	2.6%	4.2%	3.3%	--	0.3%	0.1%	--	1.4%	1.2%	1.0%	2.0%	1.4%	--	0.2%	0.2%	0.7%	2.9%	1.4%
CRR	10.9%	10.4%	13.4%	--	0.0%	0.0%	--	0.0%	0.6%	0.1%	0.1%	0.3%	--	0.0%	0.1%	--	0.0%	0.0%
SUBW	8.4%	1.2%	0.4%	0.2%	0.1%	0.0%	--	1.2%	0.0%	0.3%	0.9%	0.4%	1.8%	0.0%	0.0%	--	0.1%	0.0%
SUBR	--	0.3%	0.0%	--	0.0%	0.0%	--	0.0%	0.4%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	7.3%	12.8%	9.6%	1.9%	1.7%	1.8%	100.0%	97.4%	62.7%	37.8%	36.9%	32.5%	--	1.6%	1.5%	26.3%	24.0%	15.4%
BUSR	--	0.2%	0.2%	--	0.0%	0.0%	--	0.0%	0.3%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYW	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	--	0.2%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.8%	0.1%	0.1%	--	0.0%	0.0%	--	0.0%
LRTR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	29.2%	29.2%	27.0%	2.1%	2.1%	1.9%	100.0%	100.0%	65.2%	40.0%	40.0%	34.7%	1.8%	1.8%	1.8%	27.0%	27.0%	16.8%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 77 -Cont.

Market Segment 3

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	31.9%	31.9%	31.2%	78.5%	78.5%	82.4%	54.2%	54.2%	57.8%	27.4%	27.4%	29.3%	75.1%	75.1%	76.5%	30.7%	30.7%	33.8%
HOV2	3.0%	3.0%	2.7%	6.4%	6.4%	6.9%	15.2%	15.2%	16.1%	24.0%	24.0%	25.7%	5.0%	5.0%	5.1%	30.1%	30.1%	32.9%
HOV3	--	0.0%	0.0%	--	0.0%	0.0%	8.1%	8.1%	8.6%	11.5%	11.5%	12.3%	--	0.0%	0.0%	9.6%	9.6%	10.5%
HOV4	--	0.0%	0.0%	3.9%	3.9%	4.2%	--	0.0%	0.0%	13.5%	13.5%	14.4%	1.6%	1.6%	1.6%	14.5%	14.5%	15.8%
AUTO	34.8%	34.8%	33.9%	88.7%	88.7%	93.6%	77.5%	77.5%	82.5%	76.3%	76.3%	81.7%	81.6%	81.6%	83.1%	84.9%	84.9%	93.0%
CRW	13.1%	2.3%	1.8%	--	0.9%	0.7%	1.1%	0.2%	0.1%	1.2%	0.7%	1.4%	11.3%	1.2%	1.4%	1.1%	0.5%	0.2%
CRR	15.9%	12.6%	21.4%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.6%	1.8%	--	0.5%	1.3%	--	0.0%	0.0%
SUBW	15.0%	12.3%	11.4%	7.6%	2.2%	0.8%	6.9%	7.0%	3.5%	4.0%	8.1%	4.4%	3.1%	4.9%	3.0%	3.0%	4.1%	0.9%
SUBR	4.6%	1.4%	4.2%	--	0.0%	0.0%	--	0.0%	0.1%	0.9%	0.3%	1.3%	0.9%	0.2%	1.2%	--	0.0%	0.0%
BUSW	5.3%	11.3%	11.8%	1.5%	3.6%	3.4%	7.3%	9.5%	11.1%	10.0%	7.0%	7.5%	1.2%	3.7%	4.7%	7.4%	4.2%	3.4%
BUSR	0.3%	1.3%	4.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.3%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYW	--	0.0%	0.1%	--	0.0%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYR	--	0.2%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	8.6%	16.2%	8.7%	2.2%	4.6%	1.4%	7.1%	5.7%	2.7%	7.3%	6.6%	1.7%	1.9%	7.6%	5.2%	3.6%	6.4%	2.4%
LRTR	2.2%	7.6%	2.7%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.3%	0.1%	--	0.2%	0.1%	--	0.0%	0.0%
TRANSIT	65.2%	65.2%	66.1%	11.3%	11.3%	6.4%	22.5%	22.5%	17.5%	23.7%	23.7%	18.3%	18.4%	18.4%	16.9%	15.1%	15.1%	7.0%
TOTAL	100.0%																	

Market Segment 4

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	86.9%	86.9%	85.9%	72.1%	72.1%	70.9%	67.0%	67.0%	59.8%	37.8%	37.8%	38.2%	78.2%	78.2%	78.5%	32.7%	32.7%	33.4%
HOV2	3.0%	3.0%	3.0%	8.7%	8.7%	8.6%	10.3%	10.3%	9.6%	31.6%	31.6%	32.0%	16.1%	16.1%	16.1%	40.9%	40.9%	41.3%
HOV3	0.7%	0.7%	0.6%	14.3%	14.3%	14.1%	8.0%	8.0%	7.2%	15.9%	15.9%	16.0%	0.9%	0.9%	0.9%	10.0%	10.0%	10.3%
HOV4	0.1%	0.1%	0.1%	--	0.0%	0.0%	6.6%	6.6%	5.9%	4.1%	4.1%	4.2%	2.3%	2.3%	2.2%	12.7%	12.7%	12.8%
AUTO	90.7%	90.7%	89.6%	95.1%	95.1%	93.6%	91.9%	91.9%	82.5%	89.4%	89.4%	90.4%	97.5%	97.5%	97.8%	96.3%	96.3%	97.8%
CRW	2.8%	1.7%	0.9%	--	1.0%	0.3%	--	0.3%	0.1%	4.7%	1.1%	0.3%	0.8%	0.0%	0.0%	--	0.2%	0.1%
CRR	1.5%	0.2%	0.2%	--	0.0%	0.1%	--	0.9%	1.3%	1.6%	1.4%	1.1%	--	0.0%	0.0%	--	0.0%	0.0%
SUBW	0.5%	0.1%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.4%	0.1%	0.0%	1.2%	0.0%	0.0%	--	0.0%	0.0%
SUBR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	4.2%	5.7%	4.9%	4.9%	3.8%	5.9%	5.5%	5.2%	4.0%	3.6%	7.5%	6.6%	0.6%	2.5%	2.2%	3.7%	3.5%	2.2%
BUSR	0.4%	0.2%	0.3%	--	0.0%	0.0%	2.6%	1.5%	10.7%	0.3%	0.4%	1.2%	--	0.0%	0.0%	--	0.0%	0.0%
FRYW	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	--	0.1%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTR	--	1.4%	4.1%	--	0.0%	0.1%	--	0.3%	1.3%	--	0.1%	0.2%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	9.3%	9.3%	10.4%	4.9%	4.9%	6.4%	8.1%	8.1%	17.5%	10.6%	10.6%	9.6%	2.5%	2.5%	2.2%	3.7%	3.7%	2.2%
TOTAL	100.0%																	

Table 77 -Cont.

Market Segment 5

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	69.5%	69.5%	96.1%	82.9%	82.9%	94.7%	42.3%	42.3%	70.8%	22.5%	22.5%	24.9%	76.9%	76.9%	85.0%	53.2%	53.2%	56.3%
HOV2	4.2%	4.2%	3.0%	4.7%	4.7%	3.1%	18.9%	18.9%	29.2%	20.7%	20.7%	22.8%	13.7%	13.7%	14.9%	27.1%	27.1%	27.8%
HOV3	0.8%	0.8%	0.5%	2.0%	2.0%	1.0%	--	0.0%	0.0%	23.8%	23.8%	26.3%	--	0.0%	0.0%	3.9%	3.9%	3.9%
HOV4	0.9%	0.9%	0.4%	2.8%	2.8%	1.2%	--	0.0%	0.0%	23.5%	23.5%	26.0%	--	0.0%	0.0%	11.8%	11.8%	12.0%
AUTO	75.5%	75.5%	100.0%	92.4%	92.4%	100.0%	61.2%	61.2%	100.0%	90.4%	90.4%	100.0%	90.6%	90.6%	100.0%	96.0%	96.0%	100.0%
CRW	3.8%	1.6%	0.0%	--	1.2%	0.0%	26.1%	5.5%	0.0%	0.2%	0.6%	0.0%	--	0.3%	0.0%	--	0.2%	0.0%
CRR	4.8%	3.4%	0.0%	--	0.1%	0.0%	--	0.0%	0.0%	4.8%	4.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
SUBW	1.4%	6.4%	0.0%	0.6%	4.3%	0.0%	0.5%	6.7%	0.0%	2.2%	2.7%	0.0%	--	7.0%	0.0%	4.0%	3.3%	0.0%
SUBR	1.8%	5.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.6%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	5.5%	2.5%	0.0%	6.9%	2.0%	0.0%	12.1%	24.5%	0.0%	2.3%	1.1%	0.0%	9.4%	1.8%	0.0%	--	0.5%	0.0%
BUSR	7.3%	1.2%	0.0%	0.1%	0.0%	0.0%	--	0.0%	0.0%	0.1%	0.3%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYW	--	0.1%	0.0%	--	0.0%	0.0%	--	0.5%	0.0%	--	0.1%	0.0%	--	0.2%	0.0%	--	0.1%	0.0%
FRYR	--	3.8%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.1%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	--	0.0%	0.0%	--	0.0%	0.0%	--	1.4%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTR	--	0.5%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	24.5%	24.5%	0.0%	7.6%	7.6%	0.0%	38.8%	38.8%	0.0%	9.6%	9.6%	0.0%	9.4%	9.4%	0.0%	4.0%	4.0%	0.0%
TOTAL	100.0%																	

Market Segment 6

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	89.2%	89.2%	89.8%	88.9%	88.9%	89.0%	59.5%	59.5%	59.6%	41.3%	41.3%	41.4%	85.5%	85.5%	85.5%	45.2%	45.2%	45.3%
HOV2	6.2%	6.2%	6.0%	8.8%	8.8%	8.6%	25.1%	25.1%	25.0%	32.6%	32.6%	32.6%	10.4%	10.4%	10.4%	32.0%	32.0%	32.1%
HOV3	0.8%	0.8%	0.8%	1.5%	1.5%	1.5%	8.7%	8.7%	8.7%	15.2%	15.2%	15.3%	2.0%	2.0%	2.0%	14.1%	14.1%	14.2%
HOV4	0.6%	0.6%	0.6%	0.3%	0.3%	0.3%	4.5%	4.5%	4.5%	9.5%	9.5%	9.5%	1.4%	1.4%	1.4%	7.6%	7.6%	7.7%
AUTO	96.8%	96.8%	97.2%	99.5%	99.5%	99.5%	97.8%	97.8%	97.8%	98.6%	98.6%	98.7%	99.3%	99.3%	99.2%	98.9%	98.9%	99.3%
CRW	0.2%	0.3%	0.2%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
CRR	0.3%	0.2%	0.3%	--	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
SUBW	0.0%	0.1%	0.0%	--	0.0%	0.0%	0.2%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SUBR	0.0%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	2.4%	2.2%	1.7%	0.5%	0.4%	0.5%	1.9%	2.1%	2.1%	1.0%	1.1%	0.9%	0.4%	0.5%	0.4%	0.9%	0.9%	0.5%
BUSR	0.1%	0.2%	0.6%	--	0.0%	0.0%	--	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%	0.1%	0.1%
FRYW	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.0%	0.0%	0.0%	--	0.0%	0.0%	0.1%	0.0%	0.0%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.0%	0.0%	0.0%
LRTW	0.1%	0.1%	0.0%	--	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LRTR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	3.2%	3.2%	2.8%	0.5%	0.5%	0.5%	2.2%	2.2%	2.2%	1.4%	1.4%	1.3%	0.7%	0.7%	0.8%	1.1%	1.1%	0.7%
TOTAL	100.0%																	

Table 77 -Cont.

Market Segment 7

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	32.5%	34.8%	58.2%	28.7%	53.3%	59.6%	60.3%	60.3%	57.1%	47.6%	63.1%	67.1%	24.9%	36.5%	40.0%	36.1%	44.6%	47.8%
HOV2	0.1%	0.2%	0.3%	13.2%	24.6%	26.9%	--	0.0%	0.0%	14.4%	19.1%	16.5%	11.5%	16.9%	21.5%	8.4%	10.4%	11.6%
HOV3	--	0.0%	0.0%	--	0.0%	0.0%	31.7%	31.7%	30.4%	2.3%	3.1%	0.0%	--	0.0%	0.0%	5.9%	7.4%	8.6%
HOV4	6.3%	6.7%	11.1%	--	0.0%	0.0%	--	0.0%	0.0%	9.3%	12.3%	16.4%	10.1%	14.8%	15.4%	10.1%	12.5%	14.3%
AUTO	38.9%	41.7%	69.7%	41.9%	77.9%	86.5%	92.0%	92.0%	87.5%	73.7%	97.6%	100.0%	46.6%	68.2%	77.0%	60.6%	74.9%	82.3%
CRW	7.7%	2.7%	1.4%	2.0%	1.4%	0.4%	--	0.0%	0.0%	--	0.0%	0.0%	13.4%	0.8%	0.8%	--	1.3%	0.0%
CRR	6.5%	0.0%	0.0%	46.2%	0.0%	0.0%	--	0.0%	0.0%	22.3%	0.0%	0.0%	7.8%	0.0%	0.0%	0.7%	0.0%	0.0%
SUBW	8.6%	25.7%	6.5%	9.2%	10.0%	4.4%	8.0%	0.2%	0.0%	1.2%	1.3%	0.0%	5.0%	26.2%	13.5%	12.3%	15.4%	7.7%
SUBR	0.3%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.4%	0.0%	0.0%	1.6%	0.0%	0.0%	4.4%	0.0%	0.0%
BUSW	20.6%	26.9%	20.8%	0.8%	10.6%	8.1%	--	7.8%	12.4%	0.6%	0.9%	0.0%	1.9%	3.5%	8.4%	5.7%	7.3%	9.6%
BUSR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.7%	0.0%	0.0%	19.6%	0.0%	0.0%	12.7%	0.0%	0.0%
FRYW	17.4%	2.8%	1.6%	--	0.1%	0.5%	--	0.0%	0.0%	--	0.1%	0.0%	1.4%	0.5%	0.2%	2.3%	0.5%	0.3%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	1.2%	0.0%	0.0%	2.7%	0.0%	0.0%	1.4%	0.0%	0.0%
LRTW	--	0.2%	0.0%	--	0.1%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.7%	0.0%	--	0.6%	0.0%
LRTR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	61.1%	58.3%	30.3%	58.1%	22.1%	13.5%	8.0%	8.0%	12.5%	26.3%	2.4%	0.0%	53.4%	31.8%	23.0%	39.4%	25.1%	17.7%
TOTAL	100.0%																	

Market Segment 8

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	63.1%	63.1%	55.5%	66.9%	66.9%	62.7%	51.1%	51.1%	50.1%	39.4%	39.4%	40.2%	90.7%	90.7%	90.9%	39.7%	39.7%	40.6%
HOV2	4.5%	4.5%	3.8%	27.5%	27.5%	29.6%	25.6%	25.6%	25.2%	31.2%	31.2%	32.0%	4.5%	4.5%	4.5%	29.6%	29.6%	30.3%
HOV3	1.5%	1.5%	1.2%	1.1%	1.1%	1.3%	2.0%	2.0%	2.0%	11.8%	11.8%	12.1%	0.5%	0.5%	0.5%	14.3%	14.3%	14.6%
HOV4	0.4%	0.4%	0.4%	1.2%	1.2%	1.4%	12.2%	12.2%	12.1%	9.8%	9.8%	10.0%	--	0.0%	0.0%	10.3%	10.3%	10.5%
AUTO	69.5%	69.5%	60.8%	96.7%	96.7%	95.1%	91.0%	91.0%	89.4%	92.2%	92.2%	94.2%	95.7%	95.7%	95.9%	93.8%	93.8%	96.2%
CRW	--	0.2%	0.2%	--	0.0%	0.0%	--	0.0%	0.0%	0.0%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
CRR	--	0.0%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%	0.1%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
SUBW	4.7%	0.8%	0.3%	--	0.1%	0.0%	0.5%	0.0%	0.0%	0.4%	0.1%	0.0%	--	0.0%	0.0%	0.2%	0.0%	0.0%
SUBR	0.4%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	12.6%	1.7%	18.7%	1.4%	0.1%	1.5%	5.2%	0.6%	1.4%	3.8%	0.5%	0.6%	2.4%	0.1%	0.1%	4.8%	0.1%	0.1%
BUSR	4.9%	0.0%	0.1%	0.7%	0.0%	0.0%	0.2%	0.0%	0.0%	0.4%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYW	5.4%	20.0%	5.5%	1.0%	2.3%	3.3%	3.1%	8.2%	8.8%	2.9%	6.5%	5.1%	2.0%	4.2%	4.0%	0.6%	5.6%	3.8%
FRYR	2.4%	6.7%	4.8%	0.1%	0.7%	0.1%	--	0.2%	0.4%	0.3%	0.7%	0.0%	--	0.0%	0.0%	0.6%	0.5%	0.0%
LRTW	--	0.1%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTR	0.0%	1.0%	9.4%	--	0.2%	0.0%	--	0.0%	0.0%	--	0.1%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	30.5%	30.5%	39.2%	3.3%	3.3%	4.9%	9.0%	9.0%	10.6%	7.8%	7.8%	5.8%	4.3%	4.3%	4.1%	6.2%	6.2%	3.8%
TOTAL	100.0%																	

Table 77 -Cont.

Market Segment 9

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	66.4%	66.4%	70.5%	64.7%	64.7%	62.7%	37.9%	37.9%	39.6%	33.4%	33.4%	34.2%	68.4%	68.4%	69.3%	31.1%	31.1%	32.8%
HOV2	9.7%	9.7%	9.9%	16.8%	16.8%	15.3%	26.7%	26.7%	27.5%	33.5%	33.5%	33.9%	12.3%	12.3%	12.3%	16.0%	16.0%	17.5%
HOV3	0.5%	0.5%	0.6%	3.7%	3.7%	3.6%	17.3%	17.3%	16.9%	3.4%	3.4%	4.0%	1.7%	1.7%	2.1%	19.3%	19.3%	18.9%
HOV4	1.4%	1.4%	1.4%	--	0.0%	0.0%	--	0.0%	0.1%	19.9%	19.9%	19.5%	1.2%	1.2%	1.2%	27.9%	27.9%	27.4%
AUTO	77.9%	77.9%	82.4%	85.2%	85.2%	81.7%	81.9%	81.9%	84.0%	90.1%	90.1%	91.5%	83.5%	83.5%	84.9%	94.3%	94.3%	96.6%
CRW	1.9%	0.4%	0.5%	3.0%	0.5%	0.2%	0.6%	0.0%	0.0%	--	0.2%	0.1%	--	0.1%	0.1%	--	0.0%	0.0%
CRR	0.5%	0.9%	1.2%	--	0.0%	0.0%	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%	--	0.0%	0.0%	0.6%	0.0%	0.0%
SUBW	0.7%	1.8%	0.5%	3.2%	1.1%	0.3%	0.4%	0.5%	0.1%	0.3%	0.6%	0.2%	--	0.5%	0.1%	--	0.1%	0.0%
SUBR	--	0.2%	0.1%	--	0.0%	0.0%	--	0.1%	0.0%	--	0.2%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	13.6%	14.8%	11.9%	8.5%	12.7%	17.6%	16.4%	15.7%	15.1%	8.8%	8.3%	7.8%	16.5%	15.5%	14.8%	5.1%	4.9%	3.1%
BUSR	3.6%	2.4%	2.1%	--	0.0%	0.0%	0.1%	0.1%	0.1%	0.4%	0.3%	0.1%	--	0.0%	0.0%	--	0.5%	0.2%
FRYW	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	1.8%	0.9%	0.4%	--	0.5%	0.2%	0.4%	1.6%	0.4%	0.2%	0.2%	0.0%	--	0.4%	0.2%	--	0.1%	0.0%
LRTR	--	0.6%	0.8%	--	0.0%	0.0%	--	0.0%	0.1%	--	0.0%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	22.1%	22.1%	17.6%	14.8%	14.8%	18.3%	18.1%	18.1%	16.0%	9.9%	9.9%	8.5%	16.5%	16.5%	15.1%	5.7%	5.7%	3.4%
TOTAL	100.0%																	

Market Segment 10

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	77.5%	77.5%	79.1%	88.8%	88.8%	88.5%	62.5%	62.5%	63.3%	33.0%	33.0%	33.9%	69.3%	69.3%	70.5%	58.8%	58.8%	59.7%
HOV2	7.7%	7.7%	8.0%	5.7%	5.7%	5.9%	22.5%	22.5%	24.0%	25.2%	25.2%	26.0%	16.9%	16.9%	17.0%	24.0%	24.0%	24.6%
HOV3	--	0.0%	0.3%	5.5%	5.5%	5.6%	--	0.0%	0.1%	33.2%	33.2%	32.9%	--	0.0%	0.4%	13.0%	13.0%	12.8%
HOV4	0.1%	0.1%	0.2%	--	0.0%	0.0%	2.3%	2.3%	2.2%	1.5%	1.5%	1.8%	2.2%	2.2%	2.2%	0.8%	0.8%	0.9%
AUTO	85.3%	85.3%	87.5%	100.0%	100.0%	99.9%	87.3%	87.3%	89.6%	92.9%	92.9%	94.5%	88.4%	88.4%	90.1%	96.6%	96.6%	98.1%
CRW	--	0.3%	0.1%	--	0.0%	0.0%	--	0.2%	0.1%	0.5%	0.2%	0.1%	--	0.2%	0.1%	--	0.1%	0.0%
CRR	6.1%	2.0%	1.4%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
SUBW	--	0.9%	0.2%	--	0.0%	0.0%	9.3%	1.0%	0.2%	--	0.9%	0.3%	2.1%	1.1%	0.2%	0.1%	0.3%	0.0%
SUBR	--	0.7%	0.3%	--	0.0%	0.0%	--	0.0%	0.0%	0.2%	0.1%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%
BUSW	8.6%	6.9%	5.5%	--	0.0%	0.1%	3.4%	10.0%	9.5%	6.1%	5.6%	4.9%	8.2%	10.0%	9.4%	1.3%	3.1%	1.8%
BUSR	--	2.9%	4.7%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.1%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%
FRYW	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	--	0.5%	0.1%	--	0.0%	0.0%	--	1.6%	0.5%	0.3%	0.2%	0.0%	1.2%	0.2%	0.1%	2.0%	0.0%	0.0%
LRTR	--	0.4%	0.3%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
TRANSIT	14.7%	14.7%	12.5%	0.0%	0.0%	0.1%	12.7%	12.7%	10.4%	7.1%	7.1%	5.5%	11.6%	11.6%	9.9%	3.4%	3.4%	1.9%
TOTAL	100.0%																	

Table 77 -Cont.

Market Segment 11

Mode	HBWD			HBWS			HBS			HBO			NHBW			NHNW		
	Survey	AECOM	Model															
SOV	47.6%	47.6%	50.4%	78.5%	78.5%	77.4%	51.3%	51.3%	51.3%	36.1%	36.1%	38.6%	60.2%	60.2%	60.4%	56.4%	56.4%	58.8%
HOV2	8.5%	8.5%	9.0%	11.5%	11.5%	11.1%	38.4%	38.4%	38.4%	27.5%	27.5%	29.4%	4.3%	4.3%	4.3%	31.0%	31.0%	32.4%
HOV3	8.7%	8.7%	9.2%	--	0.0%	0.0%	1.5%	1.5%	1.5%	8.6%	8.6%	9.2%	20.2%	20.2%	20.3%	0.8%	0.8%	0.8%
HOV4	4.6%	4.6%	4.9%	--	0.0%	0.0%	--	0.0%	0.0%	7.5%	7.5%	8.0%	--	0.0%	0.0%	1.4%	1.4%	1.5%
AUTO	69.5%	69.5%	73.6%	90.0%	90.0%	88.5%	91.3%	91.3%	91.1%	79.7%	79.7%	85.3%	84.7%	84.7%	85.0%	89.6%	89.6%	93.5%
CRW	7.4%	0.2%	0.1%	--	0.0%	0.0%	--	0.0%	0.0%	0.2%	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
CRR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
SUBW	2.2%	2.1%	0.7%	--	0.2%	0.0%	--	0.2%	0.0%	0.2%	1.0%	0.2%	--	1.5%	0.4%	0.4%	0.8%	0.1%
SUBR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	0.5%	0.0%	0.0%
BUSW	20.3%	26.1%	24.8%	10.0%	9.4%	11.4%	8.7%	7.6%	8.5%	19.8%	17.6%	14.3%	15.3%	13.0%	14.3%	8.6%	8.9%	6.1%
BUSR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.2%	0.1%
FRYW	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
FRYR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%
LRTW	0.6%	2.1%	0.8%	--	0.3%	0.0%	--	0.9%	0.4%	0.1%	1.7%	0.3%	--	0.7%	0.3%	1.0%	0.2%	0.0%
LRTR	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.0%	0.0%	--	0.2%	0.1%
TRANSIT	30.5%	30.5%	26.4%	10.0%	10.0%	11.5%	8.7%	8.7%	8.9%	20.3%	20.3%	14.7%	15.3%	15.3%	15.0%	10.4%	10.4%	6.5%
TOTAL	100.0%																	

11. TIME OF DAY TRIP ALLOCATION

11.1 INTRODUCTION

The trip generation process was developed on a 24-hour basis. Similarly the trip distribution process used one condition, either peak or off-peak, to control the distribution of trips. Prior to mode choice, the daily trips were partitioned into peak and off-peak periods consistent with the requirements of the NJT mode choice model adopted by the NJRTM-E. The transit trips predicted by the model were retained in these two designations for purposes of assignment, but the peak and off-peak auto trips were merged together to create the specific peak and off-peak period trip tables. The final highway trip assignment was performed by time-of-day for four periods covering the a.m. and p.m. peaks, the midday period, and the other off-peak periods. Highway assignment is performed by time-of-day to account for congestion effects and the subsequent diversion of trips caused by that congestion. Transit assignment was performed by time-of-day or period-specific to account for differences in the amount of transit services available for different time of day.

The daily trip tables generated following the mode split process were in production/attraction (P/A) format, except for the non-home based trip purposes. These non-home-based daily trip tables were estimated in an origin/destination (O/D) format. The daily P/A trip tables were converted to period-specific O/D trip tables using time-of-day and direction split factors. The daily O/D trip tables were converted into period-specific O/D trip tables using only time-of-day factors.

In the highway assignment process, peak periods could comprise of timeframes of multiple hours instead of a one-hour timeframe. Since link capacity is normally defined as hourly capacity, peak period capacity factors were developed to convert hourly capacities to multiple hour capacities.

11.2 METHODOLOGY

11.2.1 Data Sources and Preparation

Data from the 2010 / 2011 RHTS (Regional Household Travel Survey) were used as the primary source of data for the development of time-of-day and direction split factors. The survey data were expanded to represent total trip making in the survey area. The weighted trip data were then summarized into a table stratified by purpose, time-of-day, and direction of the trip. The reported starting time of the trip was used to determine time-of-day of the trip. The time-of-day was stratified into 48 one-half hour time periods starting on the hour or half-hour and ending at 29 or 59 minutes after the hour.

The direction of the trip could be determined whether a trip originated from home to a non-home location (i.e., a production zone to attraction zone trip) or a trip originated from a non-home location to the home of the trip maker (i.e., an attraction zone to production zone trip). For non-home-based trips, the direction of trips was derived from actual origins and destinations to form an observed O/D trip table.

The motorized trips generated by the NJTPA counties and Mercer County households were divided into three major trip purposes: home-based work, home-based non-work, and non-home-based. In addition, home-based work trips were stratified further into home-based work direct and

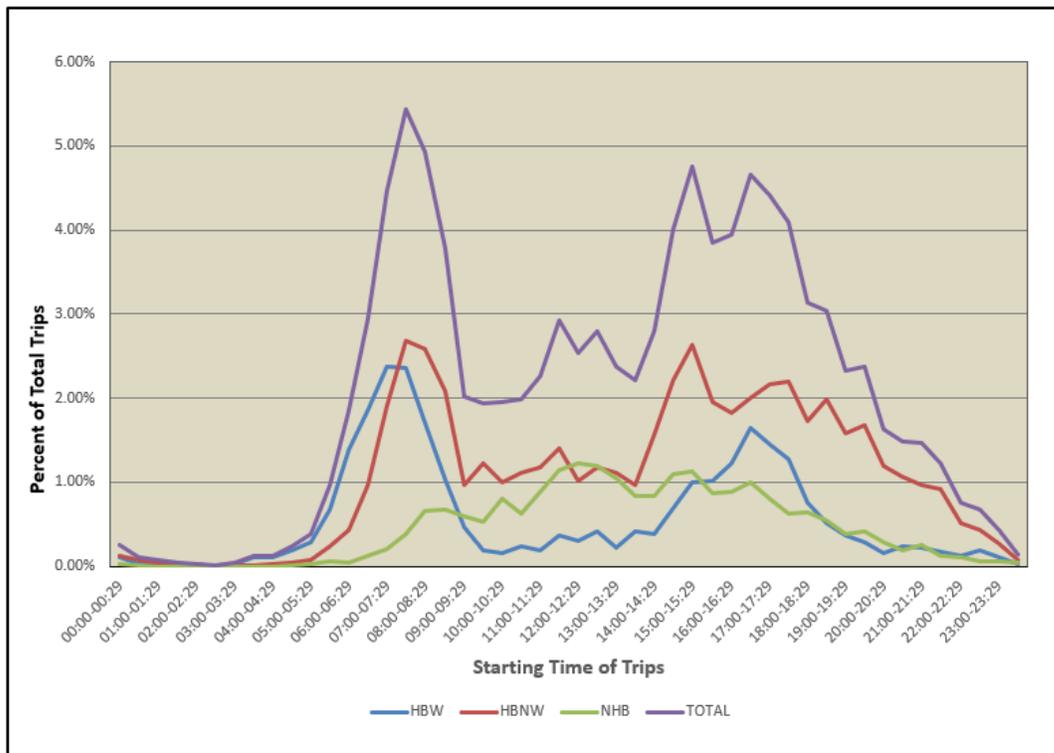
home-based work strategic. Home-based non-work trips were stratified into home-based shop and home-based other. Finally, the total trips were summarized.

11.2.2 Analysis of Trips by Time-of-Day

Table 78 summarizes the percentages of trips, in half-hour intervals, for a period of a day based on the survey records. The percentages were provided for all the three purposes, i.e., home-based work, home-based non-work, and non-home based, so that the total percentages of these three purposes equaled 100%. This data was then used to establish the duration of the two peak periods and to identify the maximum demand in any single hour of each period for the purposes of scaling the network capacities to reflect peaking characteristics.

The data listed in Table 78 were plotted to depict daily travel trends as shown in Figure 30. The daily travel pattern shows that the AM peak period is prominently visible and the largest component of the AM peak period is the home-based work trips. There are also a substantial number of home-based non-work trips that take place during the morning peak period.

Figure 30 – Time-of-Day Travel Pattern



The peak activity of the p.m. peak period is also clearly depicted, although the duration or spread of these trips is evident as well. The afternoon peak is longer than the morning peak period since a substantial amount of home-based non-work and non-home-based travel also occurs during the afternoon peak period. The pattern also shows a minor spike of trip activities at midday. A major component of this midday peak is non-home-based travel. These activities are typically related to midday errands and lunch trips with one trip end at the place of work. Generally, the traditional

PM peak period can be seen from about 3:00 to 6:00 p.m. The afternoon peak period has a large percentage of home-based work trips as well. Table 78 shows the peak periods (in green) and peak hours of each period (in yellow for peak periods and blue for Midday and Night periods).

Table 78 – Household Survey Trip Distribution by Time-of-Day

STARTING TIME	HBW	HBNW	NHB	TOTAL
00:00-00:29	0.10%	0.13%	0.02%	0.26%
00:30-00:59	0.02%	0.07%	0.01%	0.10%
01:00-01:29	0.03%	0.04%	0.00%	0.07%
01:30-01:59	0.03%	0.02%	0.00%	0.05%
02:00-02:29	0.00%	0.02%	0.01%	0.02%
02:30-02:59	0.01%	0.00%	0.00%	0.01%
03:00-03:29	0.03%	0.01%	0.00%	0.04%
03:30-03:59	0.10%	0.01%	0.00%	0.12%
04:00-04:29	0.10%	0.03%	0.00%	0.12%
04:30-04:59	0.19%	0.04%	0.01%	0.24%
05:00-05:29	0.29%	0.07%	0.02%	0.39%
05:30-05:59	0.67%	0.23%	0.06%	0.96%
06:00-06:29	1.38%	0.43%	0.04%	1.86%
06:30-06:59	1.85%	0.97%	0.12%	2.94%
07:00-07:29	2.37%	1.90%	0.20%	4.47%
07:30-07:59	2.36%	2.69%	0.38%	5.43%
08:00-08:29	1.71%	2.58%	0.65%	4.94%
08:30-08:59	1.03%	2.08%	0.68%	3.79%
09:00-09:29	0.46%	0.96%	0.59%	2.02%
09:30-09:59	0.19%	1.22%	0.53%	1.94%
10:00-10:29	0.15%	0.99%	0.81%	1.95%
10:30-10:59	0.24%	1.11%	0.63%	1.98%
11:00-11:29	0.19%	1.17%	0.89%	2.26%
11:30-11:59	0.36%	1.41%	1.15%	2.92%
12:00-12:29	0.30%	1.01%	1.23%	2.54%
12:30-12:59	0.42%	1.18%	1.20%	2.80%
13:00-13:29	0.22%	1.11%	1.04%	2.37%
13:30-13:59	0.42%	0.96%	0.84%	2.22%
14:00-14:29	0.38%	1.57%	0.84%	2.79%
14:30-14:59	0.69%	2.22%	1.10%	4.01%
15:00-15:29	1.00%	2.64%	1.12%	4.76%
15:30-15:59	1.02%	1.96%	0.87%	3.85%
16:00-16:29	1.23%	1.83%	0.89%	3.95%
16:30-16:59	1.64%	2.01%	1.00%	4.66%
17:00-17:29	1.45%	2.17%	0.81%	4.42%
17:30-17:59	1.27%	2.19%	0.62%	4.09%
18:00-18:29	0.75%	1.73%	0.64%	3.13%
18:30-18:59	0.51%	1.99%	0.55%	3.04%
19:00-19:29	0.36%	1.58%	0.39%	2.33%
19:30-19:59	0.28%	1.68%	0.41%	2.37%
20:00-20:29	0.15%	1.20%	0.29%	1.63%
20:30-20:59	0.23%	1.07%	0.19%	1.49%
21:00-21:29	0.22%	0.97%	0.26%	1.46%
21:30-21:59	0.17%	0.92%	0.13%	1.22%
22:00-22:29	0.13%	0.51%	0.11%	0.75%
22:30-22:59	0.18%	0.43%	0.06%	0.67%
23:00-23:29	0.11%	0.27%	0.06%	0.43%
23:30-23:59	0.02%	0.07%	0.05%	0.14%
Total	27.02%	51.45%	21.53%	100.00%

11.2.3 Determination of Peak Periods

The highway assignment process utilizes four time-of-day periods, i.e., the morning peak period, the midday period, the afternoon peak period, and the night period. The length of each period was defined based on travel trends shown in Table 78 and Figure 30 as follows:

- Morning peak period is from 6:00 to 9:00 a.m.
- Midday period is from 9:00 a.m. to 3:00 p.m.
- Afternoon period is from 3:00 p.m. to 6:00 p.m.
- Night period is from 6:00 p.m. to 6:00 a.m.

11.2.4 Time-of-Day and Direction Split Factors

Time-of-day and direction factors were determined using the survey data and the definition of peak and off-peak periods. The data were simply summarized into the four time-periods by direction of travel and trip purpose. Table 79 shows the time-of-day and direction factors for each trip purpose. Each factor represents the proportion of trips in that market segment to the total daily trips. For example, 38.9 percent of daily HBW trips are made in the direction of home to work during the morning peak period. In contrast, only 0.7 percent of the daily HBW trips are made in the direction of work to home during the same morning peak period. These percentages imply that 98.3 percent of the home-based work trips made during morning peak period are from home to work while only 1.7 percent of the trips are from work to home. A similar directionality split for home-based work trips can also be seen in the afternoon peak period except that the major direction is from work to home. In the off-peak period, the directionality split is more balanced. The summation of direction and time-of-day factors for each purpose should equal to 1.0.

On an average day, 55.1 percent of the work trips are from home to work and 44.9 percent of the work trips are from work to home. This does not mean that some workers do not return home from work each day. Instead, it shows the effect of trip chaining on daily travel patterns. These percentages show that more travelers stop at intermediate points on their journey home from work each day than on their journey from home to work. The effect of trip chaining is more evident if the daily split of home-based non-work trips is also reviewed. The home-based non-work have more trips (56.3 percent) made from non-home location to home than the reversed direction (43.7 percent).

The household survey data were available to estimate time-of-day/direction split factors for home-based and non-home-based trips. However, primary data were not available for other trips that must be included in the travel modeling process which includes truck trips and airport trips. The allocation of truck trips for the heavy and medium vehicle types by time of day was retained from the NJRTM while the commercial truck trips were allocated from data obtained from the NYMTC BPM Model, as shown in Table 80. The airport trips allocated to the auto mode were converted to vehicle trips using assumed auto occupancy rates and then allocated into the time-of-day periods based on data obtained from the survey and discussions with AECOM. The allocation by time of day for airport trips is provided in Table 81.

Table 79 – Time-of-Day Distribution by Purpose

P-> A (From Home to Other)

Period	HBWD	HBWS	HBW	HBS	HBO
AM	0.353	0.496	0.389	0.067	0.210
MD	0.066	0.096	0.074	0.202	0.113
PM	0.020	0.030	0.022	0.073	0.099
NT	0.062	0.074	0.065	0.094	0.086
Total	0.501	0.696	0.550	0.436	0.508

A->P (From Other to Home)

Period	HBWD	HBWS	HBW	HBS	HBO
AM	0.004	0.016	0.007	0.011	0.030
MD	0.079	0.064	0.075	0.222	0.141
PM	0.296	0.153	0.259	0.165	0.155
NT	0.120	0.071	0.109	0.166	0.166
Total	0.499	0.304	0.450	0.564	0.492

Non-Home-Based

Period	NHBW	NHBO	NHB
AM	0.062	0.121	0.097
MD	0.562	0.463	0.504
PM	0.282	0.223	0.247
NT	0.094	0.193	0.152
Total	1.000	1.000	1.000

Table 80 – Truck Trip Time-of-Day Distribution

Period	Truck Type		
	Medium	Heavy	Commercial
AM	20.0%	17.0%	6.2%
Midday	24.0%	17.0%	28.2%
PM	34.0%	42.0%	56.2%
Night	22.0%	24.0%	9.4%
Total	100.0%	100.0%	100.0%

Table 81 – Airport Trip Time of Day Distribution

Period	Airport Trips		
	P->A	A->P	Total
AM	9.4%	3.5%	12.9%
Midday	11.5%	12.1%	23.7%
PM	15.0%	13.8%	28.8%
Night	14.1%	20.6%	34.7%
Total	50.0%	50.0%	100.0%

11.3 ESTIMATION OF CAPACITY FACTORS FOR ASSIGNMENT

The capacity factors were needed to convert hourly link capacity to period-specific link capacity during the highway assignment process. These factors were developed from the 2010-2011 RHTS. The capacity factor provides the ratio of peak-hour traffic in a specific period to the total traffic in that period. Table 82 lists the capacity factor by time-of-day periods.

Table 82 – Time Period Split and Capacity Factors

Period	Length (Hours)	Duration	Peak Hour	Total%	Peak Hour%	Capacity Factor
AM	3	6AM - 9 AM	7:30 AM - 8:30 AM	23.43%	10.38%	0.4430
MD	6	9AM - 3 PM	11:30 AM - 12:30 AM	29.79%	5.46%	0.1833
PM	3	3 PM - 6 PM	4:30 PM - 5:30 PM	25.73%	9.08%	0.3529
NT	12	6 PM - 6 AM	7:00 PM - 8:00 PM	21.05%	4.70%	0.2233
Total	24		0.696	100.00%		

11.4 APPLICATION METHODOLOGY

The time-of-day and directional split factors developed in the previous section will be applied to the vehicle trip tables generated by the mode choice model. The factors are applied prior to the highway assignment process so that the highway assignment can be performed on a time-of-day basis. These factors should be used for future assignments as well unless new factors are developed using up-to-date observed data.

Each period-specific highway assignment should use the appropriate capacity factors to scale the link capacity into period capacity. The capacity factors shown in Table 82 were used as an initial point for this process. The capacity factor adjustments are used to reflect the spreading of the “peak hour” within the peak period due to capacity restraints and can be modified as needed based on future analysis.

12. HIGHWAY ASSIGNMENT

12.1 INTRODUCTION

The purpose of this section is to summarize the development of the volume-delay functions (VDF) adopted for the NJRTM-E Model. The discussion includes a description of the VDF general structure as well as the characteristics that should be incorporated into the final functions. This section also discusses the proposed VDF calibration by facility type and area type, and anticipated adjustments that may be required. Lastly, it provides an overview of the highway assignment calibration strategy and the role of the preliminary assignment calibration.

12.1.1 Development of Volume Delay Functions (VDF)

During the initial development of the NJRTM-E, a review was performed on the readily-available literature and general modeling practice as a means of summarizing the trends regarding highway assignment and volume-delay functions. The following list of objectives was developed as a result of this review:

- Variation in Volume-Delay Functions – Many of the assignment procedures developed for large regional models contain separate volume-delay functions by facility type. Previous practice was to permit a single volume delay function, such as the BPR, but to vary the starting speeds and per lane capacity values by facility type and area type. The use of a single function in older models probably reflects several conditions including the limits of older packages and/or built-in defaults included in the major modeling packages. The flexibility available in the current generation of modeling software removes these types of limitations. It is recommended that the volume-delay functions be structured as facility-type specific, so that variation observed traffic characteristics can be modeled more accurately.
- Capacity Definition – In many previous models there was some level of uncertainty as to what level of service was being represented with the “stated” per-lane capacities. The original BPR model assumed capacity was the value that provided level-of-service “C” or the “practical capacity” of a roadway. This approach was consistent with general planning policy, in that links with volumes in excess of level of service “C” would be identified as potential needs for future capacity increases. However, the level-of-service “C” definition is not precise and, for certain facilities such as freeways, the speeds and delays exhibit very little variation at this level of service. For these reasons, the capacity was defined as the theoretical maximum capacity associated with level-of-service “E”.
- The volume-delay functions should specifically estimate delay as separate from time since the delay is normally associated with queuing that occurs at a single location controlling by the link capacity. The volume delay function should be an additive term, reflecting the queuing point, rather than a scaling factor that increases time in proportion to the link’s overall travel time.
- The representation of trucks in the volume-delay functions should be incorporated to reflect the disproportionate impacts of trucks on link capacity. This is relatively straightforward with the CUBE Voyager software. Note that the model must still report the

trucks as a separate mode without the scaling adjustments used to modify the volume/capacity ratio calculations.

- The procedure should establish a minimum speed for each facility type. This “floor” will help insure that equilibrium does not encounter any “delay spikes” associated with links operating at exceptionally high volume/capacity ratios.
- The adopted volume-delay function should be computationally-efficient and should not result in excessive execution times.

Limits of Standard BPR Equation

The BPR formula has several limitations that will restrict its ability to meet the objectives listed previously. The formula is structured as a multiplicative function which essentially scales the initial time for the entire link, rather than just adding a surcharge representing a single queuing location. Since the network links in the NJRTM-E model are basically short segments with only one controlling location that limits capacity, the use of a scaling function is not recommended. Table 83 provides a simple example of the problem with volume-delay functions, such as the BPR, that apply a multiplicative factor:

Table 83 – BPR Function Example

Miles	FF Speed	FF Time (Minutes)	V/C Ratio	BPR Time	Delta Time	Implied Speed
1.00	60.00	1.00	1.00	1.15	0.15	52.2
2.00	60.00	2.00	1.00	2.30	0.30	52.2

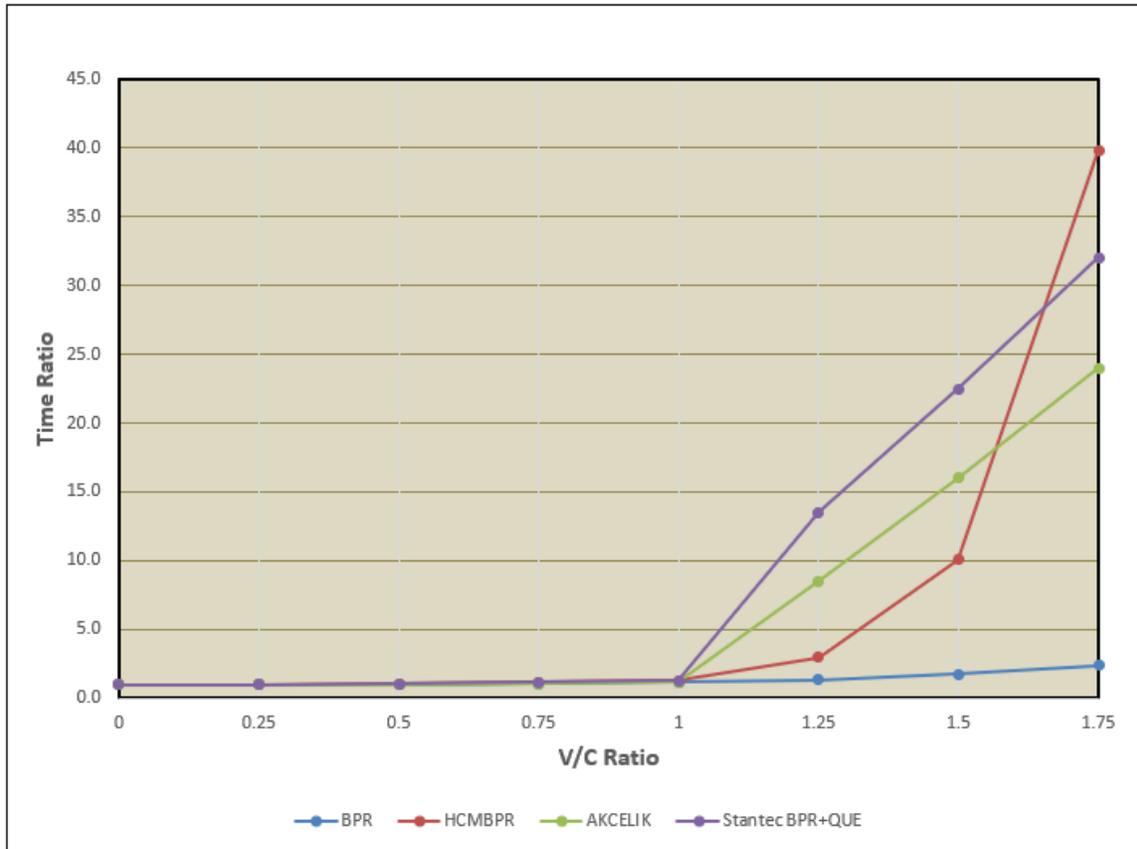
These two links in the example have the same congestion (queuing) problems at one location: however, since the BPR equation uses a scaling function rather than a surcharge calculation, the longer segment suffers twice as long a delta time as compared to the shorter segment (0.30 compared to 0.15)

The second limitation is related to the estimation of congested travel times. The basic BPR function ($T_F = T_0 * (1.0 + 0.15 * V/C^4)$) generally underestimates travel time for links with volumes greater than their capacity. Some more recent literature and the latest Highway Capacity Manual have suggested the use of higher exponential terms to increase the congested travel time estimates. However at these points, the revised travel times increase significantly and become increasingly asymptotic. This may cause the equilibrium function to have significant problems adjusting between iterations and achieving the proper closure.

Figure 31 displays the standard BPR function along with three volume-delay functions that were considered. Note that the Y-axis is the time ratio, defined as the revised time divided by the freeflow time. The graphs are listed for the freeway category and it should be noted that all of the curves provide similar estimates of revised time for volume/capacity ratios less than 1.0. The asymptotic nature of the HCM BPR function is evident. Both the Akcelik and “BPR & Queuing” Model result in much higher revised travel times immediately after the volume capacity ratio exceeds 1.0. It is anticipated that these increased travel times would have the effect of restraining the model from assigning many links with traffic volumes that would result in illogically high

volume/capacity ratios. This approach should provide for assignment results that are more “operational” in nature, as opposed to results from a typical planning model.

Figure 31 – Volume Delay Function Comparison



Recommended Volume-Delay Function

The highway assignment module provides three different volume-delay functions (VDF) to choose. Those three VDFs are:

- Standard BPR formula
- A hybrid of the 2000 HCM (BPR) volume-delay functions and a simplified queuing formula from the Transportation and Traffic Engineering Handbook. This formula is defined as follows:

- $T_F = T_0 * (1.0 + a * (V/C)^b) + (120/2) * (1 - (C/M))$

Note that this option is structured so that the “a” and “b” coefficients can vary by facility type, as is current practice in more recent models.

- the “Akcelik / Davidson Formula” which appears to have been implemented successfully in several research papers. This formula is structured as follows:

$$S_F = S_O + 0.25 * [T*(V/C-1) + \{(V/C-1)^2 + 8.0*J*(V/C) / (C*T)\}^{0.5}]$$

Where:

S_F, S_O = Final and initial speeds, stated as “hours/mile”
 T = Queuing Period (assumed 1 hour)
 J = Calibration Parameter which varies by Facility Type

Note that time (in minutes) is then calculated as follows:

$$\text{Time} = (\text{Distance} / S_F) * 60.0$$

From the above three VDFs, the hybrid formula had the best fit compared to the observed data in the original model calibration / validation. Therefore, it was selected as the default VDF for this model. As part of the 2018 Revalidation project, the VDF was again reviewed and compared to the INRIX speed data. The hybrid VDF replicated the observed data well. This VDF is retained as the default VDF of this model.

Calibration Data Set

The calibration data set was developed for use in the highway assignment calibration tasks. The data contained the following items:

- Traffic Count Data as provided from the NJDOT Counts Database, the New Jersey Turnpike Authority (NJTA), the Delaware River Joint Toll Bridge Commission, and traffic counts from NJTPA subregions.
- INRIX speed data provided by NJTPA.

Assignment Calibration

The assignment calibration focused both on the standard comparisons of volumes and VMT by various classifications and statistical measures of fit such as Root Mean Squared Errors (RMSE) by volume group. The assignment calibration also focused on replicating delay at major trans-Hudson Crossing points, such as the Lincoln Tunnel, that heavily influence mode choice. The assignment calibration provided summaries of the following comparisons:

- Volumes and VMT by Facility Type, Area Type and sub-regions
- RMSE by Volume Group
- Comparison of Modeled Speeds / Observed Speeds

12.2 CALIBRATION RESULTS

The outputs of highway assignments were validated and compared to the observed data. The validation efforts were focused mainly on the NJTPA counties and Mercer County. The validation

results were summarized in various tables to depict different aspects and levels of comparison. Table 84 shows the comparison of VMT and volume by facility type and area type between NJRTM-E model and observed traffic count data. The estimated VMT and volume are within 5% of the observed data at a regional level. In a more disaggregate level, the variations between estimated and observed data are more pronounced. For example, comparison by area type or by facility type is generally within ten percent range with the exception of a few facility types, such as minor arterial undivided and ramps. In general, the NJRTM-E's estimated VMT and volume replicate the observed data reasonably well. Table 85 shows the comparison of percent differences of traffic volumes by facility type and area type to the FHWA standard or standards used by other DOTs. The comparison shows that the calibration results are generally well below the standards.

The VMT and volume comparison by facility type and area type between the estimated and observed heavy trucks is shown in. The results indicated that the difference between the estimated and observed heavy trucks is approximately one percent at regional level. The difference is more pronounced at a disaggregate-level, such as by facility type and area type. The limited-access facility has the best fit compared to other facilities, and this facility has the highest number of observed data. The heavy truck counts were available only on 85 locations, while the total traffic counts were available on 6368 locations.

Table 87 compares the regional RMSE by volume group from the NJRTM-E to FHWA standard. The NJRTM-E estimates met the FHWA standard for each volume grouping. At a regional level, an RMSE of 37% is within the range of the FHWA standard.

Table 84 – VMT and Volume by FT/AT (NJTPA+Mercer)

Observed Volume vs. Estimated Volume by FT/AT

OBSERVED VOLUME

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	473,264	6,872,793	10,069,938	1,589,479	19,005,474
Expressway	--	2,343,741	2,655,009	73,497	5,072,247
Principal Arterial Divided	34,134	1,348,008	4,996,109	287,099	6,665,350
Principal Arterial Undivided	203,178	950,277	3,616,564	494,199	5,264,218
Major Arterial Divided	--	32,240	235,442	--	267,682
Major Arterial Undivided	66,823	2,335,888	7,088,764	1,039,626	10,531,101
Minor Arterials	134,655	3,861,272	7,557,706	608,097	12,161,730
Collector/Local	70,986	147,620	195,664	93,436	507,706
TOTAL	983,040	17,891,839	36,415,196	4,185,433	59,475,508

ESTIMATED VOLUME

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	465,283	6,787,056	10,125,534	1,635,290	19,013,163
Expressway	--	2,341,608	2,561,088	70,208	4,972,904
Principal Arterial Divided	34,204	1,376,308	4,832,922	293,400	6,536,834
Principal Arterial Undivided	207,728	926,249	3,542,152	470,324	5,146,453
Major Arterial Divided	--	31,761	246,148	--	277,909
Major Arterial Undivided	63,034	2,291,311	6,848,243	1,048,945	10,251,533
Minor Arterials	134,302	3,876,845	7,370,535	581,034	11,962,716
Collector/Local	70,217	154,340	184,767	101,919	511,243
TOTAL	974,768	17,785,478	35,711,389	4,201,120	58,672,755

ESTIMATED VOLUME/OBSERVED VOLUME

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	0.98	0.99	1.01	1.03	1.00
Expressway	--	1.00	0.96	0.96	0.98
Principal Arterial Divided	1.00	1.02	0.97	1.02	0.98
Principal Arterial Undivided	1.02	0.97	0.98	0.95	0.98
Major Arterial Divided	--	0.99	1.05	--	1.04
Major Arterial Undivided	0.94	0.98	0.97	1.01	0.97
Minor Arterials	1.00	1.00	0.98	0.96	0.98
Collector/Local	0.99	1.05	0.94	1.09	1.01
TOTAL	0.99	0.99	0.98	1.00	0.99

Table 84- Continued

Observed VMT vs. Estimated VMT by FT/AT

OBSERVED VMT

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	263,725	4,336,970	10,845,827	2,434,212	17,880,734
Expressway	--	1,093,445	1,278,437	76,630	2,448,512
Principal Arterial Divided	15,080	573,408	3,744,349	354,391	4,687,228
Principal Arterial Undivided	66,520	373,737	2,851,192	516,562	3,808,011
Major Arterial Divided	--	11,528	136,161	--	147,689
Major Arterial Undivided	9,279	802,768	5,072,234	1,217,218	7,101,499
Minor Arterials	33,149	1,207,116	5,630,687	769,871	7,640,823
Collector/Local	8,205	34,252	119,065	50,401	211,923
TOTAL	395,958	8,433,224	29,677,952	5,419,285	43,926,419

ESTIMATED VMT

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	260,400	4,250,941	10,882,855	2,454,312	17,848,508
Expressway	--	1,055,189	1,263,125	71,258	2,389,572
Principal Arterial Divided	15,590	581,008	3,547,160	367,082	4,510,840
Principal Arterial Undivided	67,869	355,429	2,719,855	492,505	3,635,658
Major Arterial Divided	--	7,797	139,910	--	147,707
Major Arterial Undivided	8,695	765,943	4,665,329	1,216,178	6,656,145
Minor Arterials	30,307	1,157,916	5,050,762	642,355	6,881,340
Collector/Local	8,205	36,962	106,983	54,530	206,680
TOTAL	391,066	8,211,185	28,375,979	5,298,220	42,276,450

ESTIMATED VOLUME/OBSERVED VMT

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	0.99	0.98	1.00	1.01	1.00
Expressway	--	0.97	0.99	0.93	0.98
Principal Arterial Divided	1.03	1.01	0.95	1.04	0.96
Principal Arterial Undivided	1.02	0.95	0.95	0.95	0.95
Major Arterial Divided	--	0.68	1.03	--	1.00
Major Arterial Undivided	0.94	0.95	0.92	1.00	0.94
Minor Arterials	0.91	0.96	0.90	0.83	0.90
Collector/Local	1.00	1.08	0.90	1.08	0.98
TOTAL	0.99	0.97	0.96	0.98	0.96

Table 85 – Percent Differences Compared to FHWA and Other Standards

Facility Type	Estimated %Difference	FHWA Standard
Limited-Access Facility	0.0%	+/- 7%
Expressway	2.0%	+/- 10%
Principal Arterial Divided	1.9%	+/- 10%
Principal Arterial Undivided	2.2%	+/- 10%
Major Arterial Divided	-3.8%	+/- 15%
Major Arterial Undivided	2.7%	+/- 15%
Minor Arterials	1.6%	+/- 15%
Collector/Local	-0.7%	+/- 20%
TOTAL	1.3%	N/A

Area Type	Estimated %Difference	Ohio DOT	Florida DOT
CBD	0.8%	+/- 10%	+/- 15%
Urban	0.6%	+/- 10%	+/- 15%
Suburban	1.9%	+/- 10%	+/- 15%
Rural	-0.4%	+/- 10%	+/- 15%
TOTAL	1.3%	N/A	N/A

TOTAL COUNTS

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	6	110	188	36	340
Expressway	--	61	92	8	161
Principal Arterial Divided	4	50	225	16	295
Principal Arterial Undivided	10	88	375	83	556
Major Arterial Divided	--	4	20	--	24
Major Arterial Undivided	7	351	1,180	283	1,821
Minor Arterials	22	779	1,780	303	2,884
Collector/Local	13	46	69	50	178
TOTAL	62	1,489	3,929	779	6,259

Table 86 – Heavy Truck Volume by FT/AT (NJTPA+Mercer)

OBSERVED VOLUME

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	34,500	363,013	226,852	64,664	689,029
Expressway	--	2,857	8,323	338	11,518
Principal Arterial Divided	--	--	864	--	864
Principal Arterial Undivided	--	--	243	112	355
Major Arterial Divided	--	--	--	--	--
Major Arterial Undivided	--	--	--	--	--
Minor Arterials	--	--	--	--	--
Collector/Local	--	--	--	--	--
TOTAL	34,500	365,870	236,282	65,114	701,766

ESTIMATED VOLUME

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	44,634	313,237	262,631	89,834	710,336
Expressway	--	2,532	10,393	64	12,989
Principal Arterial Divided	--	--	2,531	--	2,531
Principal Arterial Undivided	--	--	176	92	268
Major Arterial Divided	--	--	--	--	--
Major Arterial Undivided	--	--	--	--	--
Minor Arterials	--	--	--	--	--
Collector/Local	--	--	--	--	--
TOTAL	44,634	315,769	275,731	89,990	726,124

ESTIMATED VOLUME/OBSERVED VOLUME

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	1.29	0.86	1.16	1.39	1.03
Expressway	--	0.89	1.25	0.19	1.13
Principal Arterial Divided	--	--	2.93	--	2.93
Principal Arterial Undivided	--	--	0.72	0.82	0.75
Major Arterial Divided	--	--	--	--	--
Major Arterial Undivided	--	--	--	--	--
Minor Arterials	--	--	--	--	--
Collector/Local	--	--	--	--	--
TOTAL	1.29	0.86	1.17	1.38	1.03

TOTAL COUNTS

Facility Type	Area Type				
	CBD	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	7	37	23	9	76
Expressway	--	3	2	1	6
Principal Arterial Divided	--	--	1	--	1
Principal Arterial Undivided	--	--	1	1	2
Major Arterial Divided	--	--	--	--	--
Major Arterial Undivided	--	--	--	--	--
Minor Arterials	--	--	--	--	--
Collector/Local	--	--	--	--	--
TOTAL	7	40	27	11	85

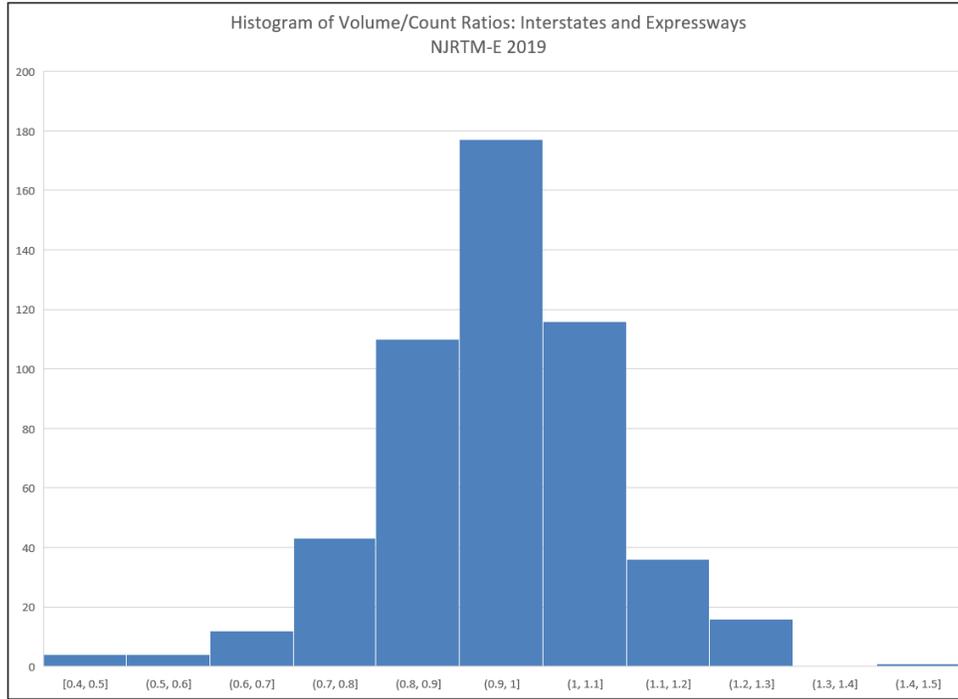
Table 87 – RMSE Summary by Volume Group

Volume Group	Model'S RMSE	FHWA RMSE	No. Of Counts
>100,000	12.3	15.0	28
90,000-100,000	10.6	15.0	12
80,000-90,000	8.3	16.0	16
70,000-80,000	11.4	16.0	38
60,000-70,000	12.0	18.0	46
50,000-60,000	13.2	20.0	78
40,000-50,000	12.5	21.0	95
30,000-40,000	13.8	23.0	118
20,000-30,000	21.9	25.0	181
10,000-20,000	22.8	27.0	638
0-10,000	52.7	40-60	5,009
TOTAL	32.9	35-40	6,259

Figure 32 shows the measure of spread of the ratios between estimated and observed traffic volumes by facility type. The ratio of one indicates that the estimated traffic volumes replicate the observed traffic counts perfectly. The higher facilities, which usually have higher volumes, have a narrower spread, while the lower facilities have a wider spread. This indicates that the lower facilities, which most likely have lower volumes, have more variation between the observed traffic counts and the estimated traffic volumes.

Figure 32 – The Measure of Spread Between Estimated and Observed Volumes

Interstates and Expressways



Principal Arterials

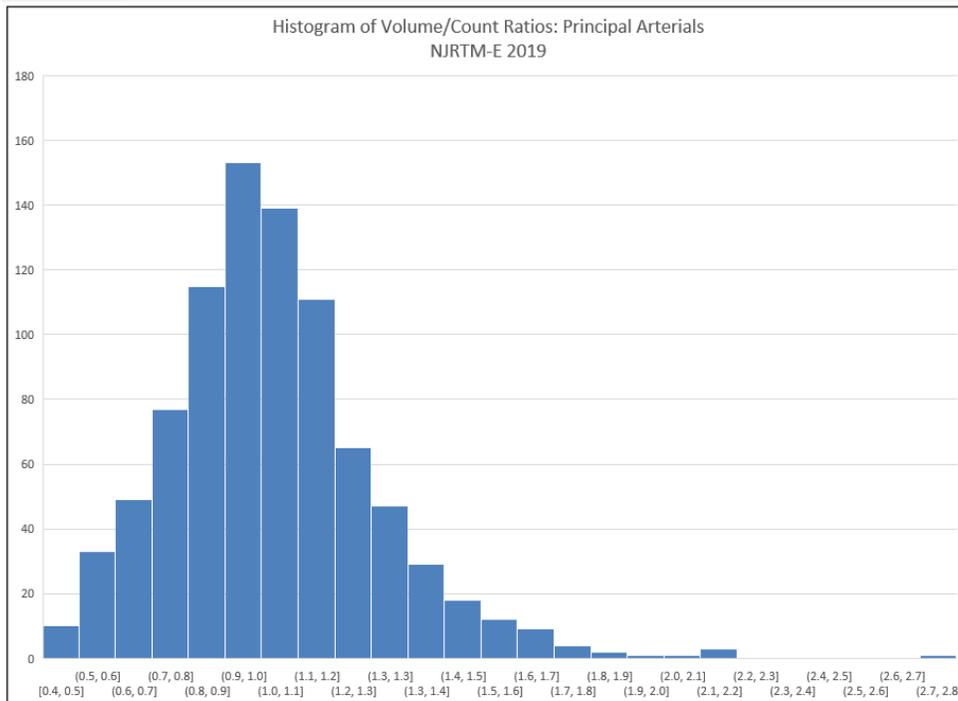
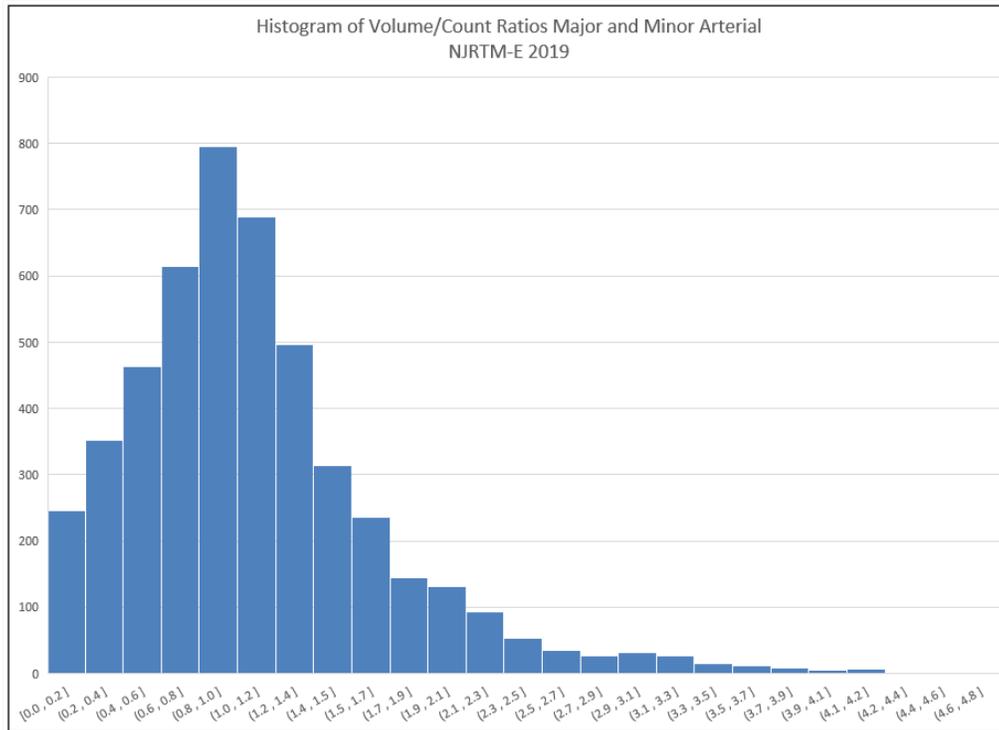


Figure 32 – Cont.

Major and Minor Arterials



Collectors and Local Roads

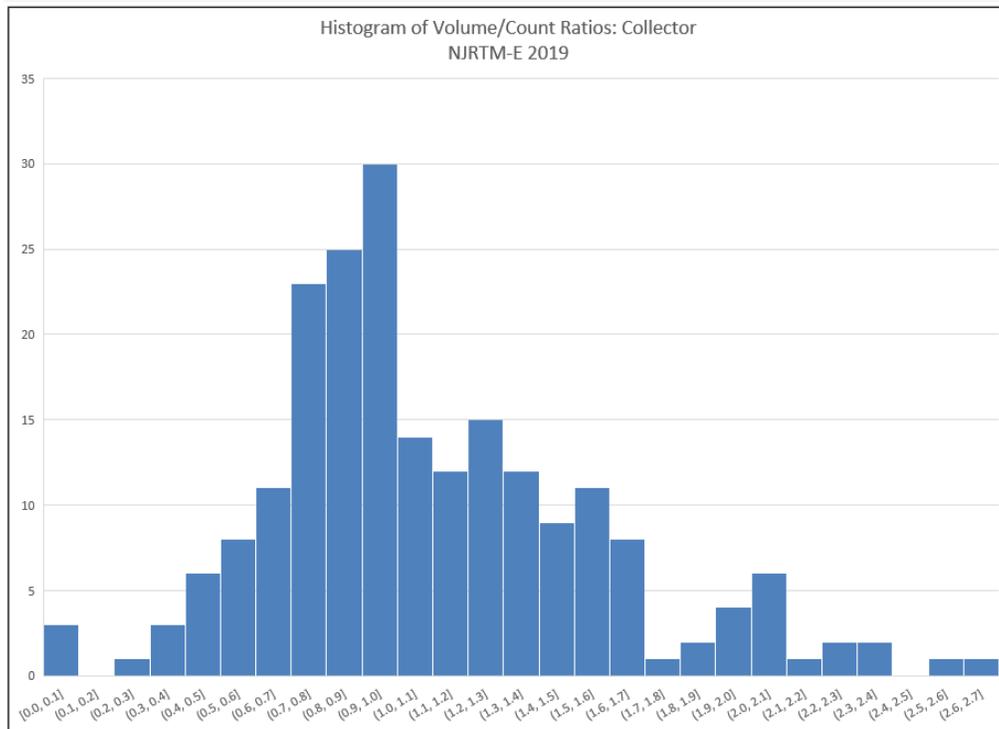


Figure 33 depicts the locations of the various screenlines used for model validation and Figure 35 shows the FHWA standards in a graphical form for various total screenline volumes. Table 88 summarizes model performance in respect to estimated and observed volumes at screenline crossings. The ratios of model volumes and observed counts are mostly within tolerance of the FHWA Standards. The detail screenline summary is shown in Table 94.

The model estimated speed was also compared to the observed speed from INRIX data. Table 89 shows the average speed comparison by facility type and area type for each time period. The average speeds by facility type and area type for the night time period are generally within reasonable tolerance indicating that free-flow speed assumption is reasonable. The average speeds for other periods are also within reasonable tolerance indicating that the volume-delay-functions used in the model are reasonable as well. Table 90 shows the number of highway network links with observed speed data. A total of more than 9,500 links in the network have observed speed data.

Table 91 summarizes the heavy trucks and total traffic by freeway segment for New Jersey Turnpike and Garden State Parkway. In the system level, the heavy truck percentages estimated for the NJTPK and GSP are close to the observed percentages. This summary is repeated for the traffic along the Delaware River crossings as shown in Table 92. The system level comparison is again reasonable.

Figure 33 – Screenline Map



Figure 34 – Screenlines 2, 17 and 18 Locations

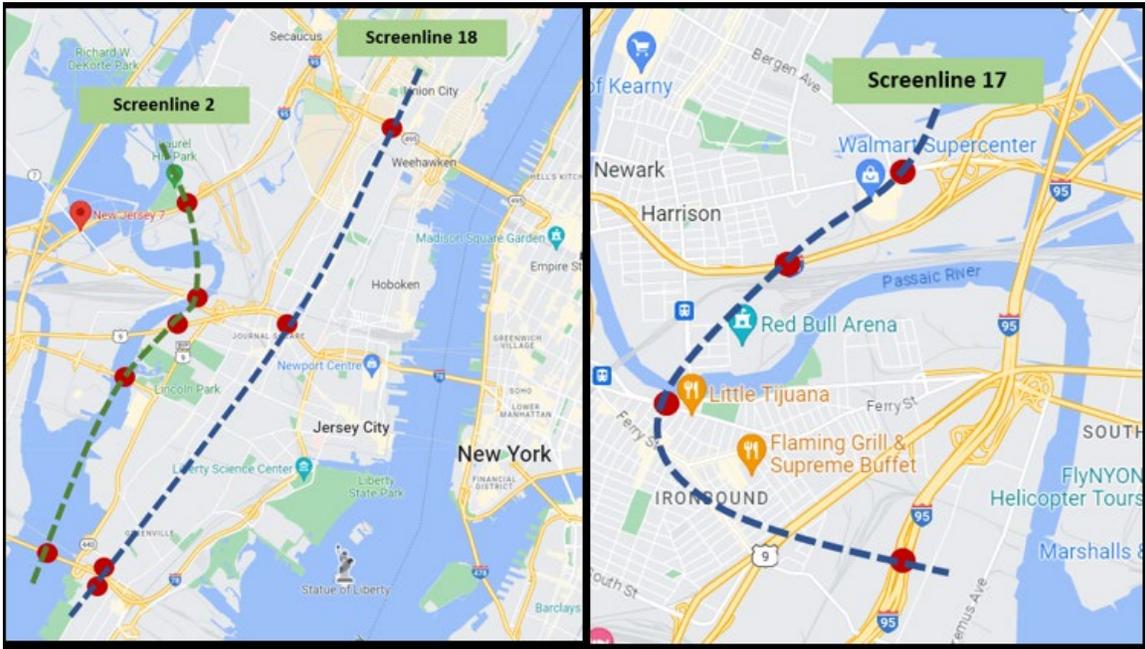
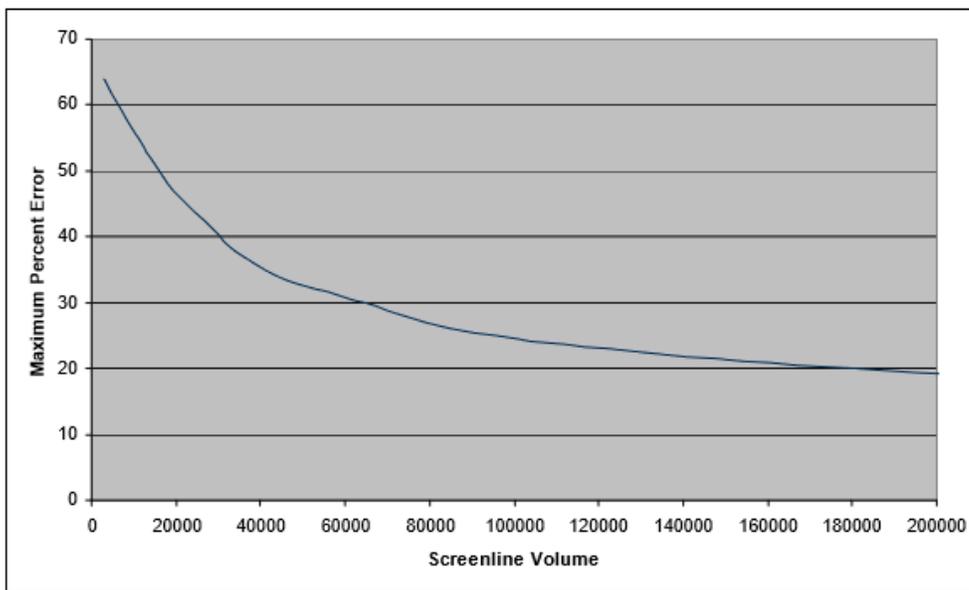


Figure 35 – Desirable Deviation in Total Screenline Volume Guidelines



Source: Calibration and Adjustment of System Planning Models, FHWA, December 1990.

Table 88 – Screenline Summary

Screenline No	Observed Counts	Estimated Volumes	Percent Difference	FHWA Standard
Screenline 1	863,731	814,491	-5.70%	+ / - 19%
Screenline 2	420,505	407,267	-3.15%	+ / - 19%
Screenline 3	577,128	592,551	2.67%	+ / - 19%
Screenline 4	846,164	836,011	-1.20%	+ / - 19%
Screenline 5	358,997	344,036	-4.17%	+ / - 19%
Screenline 6	500,299	523,173	4.57%	+ / - 19%
Screenline 7	570,648	635,504	11.37%	+ / - 19%
Screenline 8	459,965	423,199	-7.99%	+ / - 19%
Screenline 9	205,868	219,045	6.40%	+ / - 19%
Screenline 10	288,818	286,789	-0.70%	+ / - 19%
Screenline 11	191,020	184,905	-3.20%	+ / - 19%
Screenline 12	196,850	196,502	-0.18%	+ / - 19%
Screenline 13	348,707	306,222	-12.18%	+ / - 19%
Screenline 14	359,683	370,635	3.04%	+ / - 19%
Screenline 15	653,332	660,597	1.11%	+ / - 19%
Screenline 16	243,110	234,572	-3.51%	+ / - 19%
Screenline 17	365,427	353,812	-3.18%	+ / - 19%
Screenline 18	303,895	302,451	-0.48%	+ / - 19%
Screenline 19	358,091	336,765	-5.96%	+ / - 19%
Total	8,112,238	8,028,528	-1.03%	

Table 89 – Average Speed Comparison by Facility Type and Area Type

AM Peak Period

Facility Type	Area Type											
	CBD			Urban			Suburban			Rural		
	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio
Freeway	26.5	27.4	1.03	44.4	46.5	1.05	59.8	61.6	1.03	62.5	63.9	1.02
Expressway				37.8	35.6	0.94	45.3	44.1	0.97	60.9	59.4	0.98
Principal Arterial Divided	13.3	8.0	0.60	33.1	30.8	0.93	39.2	37.8	0.96	40.4	41.6	1.03
Principal Arterial Undivided	18.9	18.8	1.00	21.6	22.9	1.06	34.0	32.3	0.95	41.6	42.0	1.01
Major Arterial Divided							27.5	27.3	0.99			
Major Arterial Undivided	13.9	13.3	0.95	20.0	18.3	0.91	30.1	26.6	0.89	38.6	37.9	0.98
Minor Arterial	12.5	11.5	0.92	17.8	17.1	0.96	28.4	25.4	0.90	33.9	33.0	0.98
Collector / Local	11.7	10.3	0.88	12.7	12.1	0.95	17.7	18.5	1.05			
High-Speed Ramp				52.4	47.3	0.90	37.5	46.2	1.23			
Medium-Speed Ramp				20.4	25.0	1.23	28.6	30.6	1.07	35.2	33.5	0.95

PM Peak Period

Facility Type	Area Type											
	CBD			Urban			Suburban			Rural		
	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio
Freeway	23.4	24.7	1.05	40.6	45.2	1.11	57.9	61.7	1.06	64.0	63.9	1.00
Expressway				33.5	34.9	1.04	41.0	42.6	1.04	61.0	59.4	0.97
Principal Arterial Divided	10.0	9.3	0.93	27.6	28.8	1.04	35.7	37.0	1.04	38.2	41.1	1.08
Principal Arterial Undivided	13.5	17.0	1.25	19.1	21.7	1.14	30.4	31.6	1.04	40.4	41.6	1.03
Major Arterial Divided							26.1	27.6	1.06			
Major Arterial Undivided	12.3	12.5	1.02	17.8	16.9	0.95	28.2	25.4	0.90	38.5	37.4	0.97
Minor Arterial	11.1	10.5	0.95	16.1	16.1	1.00	26.8	24.3	0.91	33.9	33.2	0.98
Collector / Local	11.3	6.9	0.61	11.7	12.0	1.03	15.4	15.8	1.03			
High-Speed Ramp				47.6	47.6	1.00	37.2	54.6	1.47			
Medium-Speed Ramp				18.6	22.6	1.22	28.1	30.5	1.09	30.7	34.6	1.13

Table 89 - Continued

MD Period

Facility Type	Area Type											
	CBD			Urban			Suburban			Rural		
	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio
Freeway	29.3	33.7	1.15	52.7	59.3	1.12	64.2	63.8	0.99	65.0	65.1	1.00
Expressway				40.0	41.0	1.03	46.3	47.9	1.03	59.4	59.5	1.00
Principal Arterial Divided	12.7	10.6	0.83	33.4	33.4	1.00	38.6	40.7	1.05	40.4	43.1	1.07
Principal Arterial Undivided	18.3	20.0	1.09	21.5	24.2	1.12	32.8	34.0	1.04	41.3	43.1	1.04
Major Arterial Divided							27.0	29.7	1.10			
Major Arterial Undivided	13.8	15.1	1.10	19.7	20.6	1.05	29.8	30.3	1.02	38.3	39.6	1.04
Minor Arterial	12.1	14.1	1.17	17.7	19.0	1.08	28.3	28.6	1.01	33.5	34.3	1.02
Collector / Local	12.5	13.0	1.04	12.7	14.3	1.13	17.6	19.8	1.12			
High-Speed Ramp				51.6	49.7	0.96	38.6	54.9	1.42			
Medium-Speed Ramp				20.8	25.5	1.22	29.0	33.1	1.14	32.7	35.0	1.07

NT Period

Facility Type	Area Type											
	CBD			Urban			Suburban			Rural		
	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio	Obs.	Est.	Ratio
Freeway	35.4	34.3	0.97	54.0	59.7	1.11	64.0	64.2	1.00	64.2	65.6	1.02
Expressway				42.1	42.5	1.01	48.3	49.0	1.01	58.7	59.5	1.01
Principal Arterial Divided	18.9	19.1	1.01	35.6	34.6	0.97	41.1	40.8	0.99	43.5	43.1	0.99
Principal Arterial Undivided	21.0	20.4	0.97	23.8	24.5	1.03	35.4	34.6	0.98	42.3	43.3	1.02
Major Arterial Divided							29.2	29.8	1.02			
Major Arterial Undivided	15.1	15.3	1.02	21.4	21.6	1.01	31.6	31.3	0.99	39.8	40.2	1.01
Minor Arterial	13.6	14.5	1.06	19.3	19.5	1.01	30.0	28.9	0.96	35.2	34.3	0.97
Collector / Local	14.3	14.2	0.99	13.9	14.5	1.05	20.7	20.5	0.99			
High-Speed Ramp				50.9	49.9	0.98	39.0	55.0	1.41			
Medium-Speed Ramp				23.0	26.0	1.13	31.7	33.8	1.07	35.9	35.0	0.97

Table 90 – Number of Highway Network Links with Speed Data

Facility Type	Area Type				Total
	CBD	Urban	Suburban	Rural	
Freeway	15	685	747	114	1,561
Expressway		384	322	20	726
Principal Arterial Divided	4	190	564	21	779
Principal Arterial Undivided	40	279	784	224	1,327
Major Arterial Divided			35		35
Major Arterial Undivided	51	963	1,347	317	2,678
Minor Arterial	49	934	1,213	59	2,255
Collector / Local	4	12	4		20
High-Speed Ramp		6	1		7
Medium-Speed Ramp		37	65	8	110
ToTal	163	3,490	5,082	763	9,498

Table 91 – New Jersey Toll Road Volume by Vehicle Type

New Jersey Turnpike

Interchanges	2019 Count Total			Model Estimates Total			Pct Difference	
	Truck	Total	%Heavy	Truck	Total	%Heavy	Truck	Total
4 - 5	11,021	81,901	13.5%	15,295	85,124	8.7%	39%	3.9%
5 - JCT	11,654	88,173	13.2%	18,579	103,398	7.6%	59%	17.3%
JCT - 6	8,505	55,703	15.3%	10,941	34,090	8.3%	29%	-38.8%
BRIDGE	9,492	60,452	15.7%	13,189	27,749	17.1%	39%	-54.1%
JCT - 7	18,544	133,720	13.9%	27,584	131,859	9.4%	49%	-1.4%
7 - 7A	20,929	146,674	14.3%	28,239	145,295	8.6%	35%	-0.9%
7A - 8	23,348	161,440	14.5%	27,415	167,238	12.9%	17%	3.6%
8 - 8A	23,035	166,647	13.8%	27,046	181,254	12.4%	17%	8.8%
8A - 9	26,002	185,856	14.0%	30,213	197,659	13.3%	16%	6.4%
9 - 10	26,944	204,334	13.2%	31,506	224,519	13.5%	17%	9.9%
10 - 11	27,425	203,062	13.5%	31,261	218,642	14.8%	14%	7.7%
11 - 12	32,117	221,140	14.5%	34,169	245,320	13.8%	6%	10.9%
12 - 13	36,409	256,776	14.2%	36,365	262,441	14.1%	0%	2.2%
13 - 13A	39,962	274,616	14.6%	31,911	272,004	13.0%	-20%	-1.0%
13A - 14	33,279	228,115	14.6%	28,335	211,086	15.2%	-15%	-7.5%
14 - 14A	8,098	88,836	9.1%	4,001	104,726	5.6%	-51%	17.9%
14A - 14B	3,665	70,915	5.2%	1,240	79,015	1.9%	-66%	11.4%
14B - 14C	3,301	67,548	4.9%	978	73,761	1.4%	-70%	9.2%
14 - M	36,734	251,354	14.6%	29,344	200,005	16.0%	-20%	-20.4%
15E - JE	16,650	124,634	13.4%	8,993	100,862	13.2%	-46%	-19.1%
JE - 15X	17,561	134,359	13.1%	9,918	129,519	11.3%	-44%	-3.6%
15X - 16E	16,309	130,727	12.5%	9,720	122,605	11.6%	-40%	-6.2%
16E - 17	8,270	55,940	14.8%	4,336	53,892	19.2%	-48%	-3.7%
JW - 15W	22,874	136,309	16.8%	25,314	128,434	16.7%	11%	-5.8%
15W - 16W	19,526	127,218	15.3%	24,077	123,617	16.0%	23%	-2.8%
16W - 18W	14,086	87,502	16.1%	21,468	98,820	15.8%	52%	12.9%
Total	515,740	3,743,951	13.8%	531,435	3,722,935	12.8%	3%	-0.6%
Total in NJTPA Area	412,247	3,015,888	13.7%	390,193	3,028,182	13.3%	-5%	0.4%

Table 91 – Cont.

Garden State Parkway

Toll Plaza	2019 Count			Model			Pct Diff
	NB	SB	TOTAL	NB	SB	TOTAL	Total
Raritan River	138,638	111,040	249,678	135,399	112,572	247,971	-0.7%
Asbury	78,040	79,600	157,640	82,393	77,741	160,134	1.6%
Toms River	48,276	52,079	100,355	48,542	51,073	99,616	-0.7%
Barnegat	36,137	33,935	70,072	33,871	31,911	65,782	-6.1%
New Gretna	18,256	20,295	38,551	19,338	20,091	39,428	2.3%
TOTAL	319,347	296,949	616,296	319,543	293,387	612,930	-0.5%

Table 92 – Delaware River Crossing Summary

Name	Direction	Total Volume - Toll Bridges				Percent Distribution		
		Observed	Estimated	Difference	%Diff	Observed	Estimated	%Diff
Trenton-Morrisville Toll Bridge (US-1)	WB	25,101	26,705	1,604	6.4%	14.0%	14.5%	0.5%
	EB	29,264	28,693	(571)	-2.0%			
Scudder Falls (I-95)	WB	30,826	28,181	(2,645)	-8.6%	15.9%	16.1%	0.2%
	EB	30,826	33,341	2,515	8.2%			
New Hope-Lambertville Bridge	WB	5,262	6,949	1,687	32.1%	3.0%	3.3%	0.3%
	EB	6,301	5,548	(753)	-11.9%			
Interstate 78 Toll Bridge	WB	32,212	33,485	1,273	4.0%	17.2%	18.2%	1.0%
	EB	34,523	35,958	1,435	4.2%			
Easton-Phillipsburg Toll Bridge (US 22)	WB	14,731	15,520	789	5.4%	8.1%	8.4%	0.2%
	EB	16,814	16,439	(375)	-2.2%			
Portland-Columbia Toll Bridge	WB	4,884	4,465	(419)	-8.6%	2.5%	2.4%	-0.1%
	EB	4,884	4,756	(128)	-2.6%			
Delaware Water Gap Toll Bridge (I-80)	WB	26,320	25,895	(425)	-1.6%	13.8%	13.9%	0.1%
	EB	27,129	27,044	(85)	-0.3%			
Milford-Montague Toll Bridge (US 206)	WB	3,441	2,858	(583)	-16.9%	1.7%	1.6%	-0.1%
	EB	3,070	3,297	227	7.4%			
Toll Bridge Total		295,588	299,133	3,545	1.2%	76.2%	78.4%	2.2%

Name	Direction	Total Volume - Non-Tolled Bridges				Percent Distribution		
		Observed	Estimated	Difference	%Diff	Observed	Estimated	%Diff
Lower Trenton	WB	7,756	7,662	(94)	-1.2%	4.0%	3.5%	-0.5%
	EB	7,756	5,837	(1,919)	-24.7%			
Calhoun Street	WB	8,243	7,861	(382)	-4.6%	4.3%	3.8%	-0.4%
	EB	8,243	6,720	(1,523)	-18.5%			
Washington Crossing (Rt 532)	WB	3,687	2,938	(749)	-20.3%	1.9%	1.7%	-0.2%
	EB	3,687	3,595	(92)	-2.5%			
New Hope-Lambertville	WB	6,299	6,779	480	7.6%	3.2%	3.4%	0.2%
	EB	6,299	6,295	(4)	-0.1%			
Center Bridge-Stockton	WB	2,488	2,743	255	10.2%	1.3%	1.4%	0.1%
	EB	2,488	2,436	(52)	-2.1%			
Frenchtown-Uhterstown	WB	2,685	3,414	729	27.1%	1.4%	1.7%	0.3%
	EB	2,685	3,056	371	13.8%			
Milford-Upper Black Eddy	WB	1,868	1,692	(176)	-9.4%	1.0%	1.0%	0.1%
	EB	1,868	2,271	403	21.6%			
Riegelsville	WB	1,609	2,102	493	30.7%	0.8%	1.0%	0.2%
	EB	1,609	1,682	73	4.5%			
Northampton	WB	8,970	7,633	(1,337)	-14.9%	4.6%	3.6%	-1.0%
	EB	8,970	6,206	(2,764)	-30.8%			
Belvidere-Riverton	WB	2,536	917	(1,619)	-63.8%	1.3%	0.4%	-1.0%
	EB	2,536	433	(2,103)	-82.9%			
Non-Toll Bridges		92,282	82,274	(10,008)	-10.8%	23.8%	21.6%	-0.8%
Grand Total		387,870	381,407	(6,463)	-1.7%	15.5%	14.2%	-1.3%

The estimated Trans-Hudson vehicular traffic was compared to the observed data in Table 93. At the system level, the comparison indicates that the model replicated the observed data

reasonably well on both directions. While the traffic comparison of northern bridges, between Verrazano and Newburgh-Beacon bridges are generally within reasonable range, the southern bridges between Goethals and Outerbridge Crossings, are generally overestimated slightly, although they are still within reasonable tolerance. Figure 36 shows a schematic diagram of the volume differences between estimated and observed volumes for Trans-Hudson Bridges and Tunnels.

Table 93 – Trans-Hudson Vehicular Traffic Summary

Location	Direction	Observed Counts			Model			Pct. Difference	
		Auto	Truck	Total	Auto	Truck	Total	Auto	Total
Newburgh-Beacon Bridge	EB	29,466	4,831	34,297	28,405	4,423	32,828	-3.6%	-4.3%
	WB	30,687	5,031	35,718	31,092	4,491	35,583	1.3%	-0.4%
Bear Mountain Bridge	EB	10,093	245	10,338	9,841	120	9,962	-2.5%	-3.6%
	WB	10,093	245	10,338	10,355	176	10,531	2.6%	1.9%
Tappan Zee Bridge	EB	67,421	9,557	76,978	69,433	4,641	74,075	3.0%	-3.8%
	WB	61,232	8,680	69,912	65,963	5,631	71,594	7.7%	2.4%
George Washington Bridge	EB	129,171	13,487	142,658	122,137	17,204	139,341	-5.4%	-2.3%
	WB	125,044	17,016	142,060	123,551	19,419	142,970	-1.2%	0.6%
Lincoln Tunnel	EB	44,936	3,496	48,432	42,678	4,895	47,573	-5.0%	-1.8%
	WB	50,282	2,844	53,126	50,541	3,116	53,658	0.5%	1.0%
Holland Tunnel	EB	41,267	-	41,267	39,367	-	39,367	-4.6%	-4.6%
	WB	44,401	-	44,401	42,376	-	42,376	-4.6%	-4.6%
Verrazano-Narrows Bridge	EB	100,872	7,547	108,419	95,474	8,306	103,780	-5.4%	-4.3%
	WB	93,490	5,394	98,884	91,274	6,686	97,960	-2.4%	-0.9%
Total	EB	423,226	39,163	462,389	407,335	39,590	446,925	-3.8%	-3.3%
	WB	415,229	39,210	454,439	415,151	39,520	454,671	0.0%	0.1%
Goethals Bridge	EB	40,004	5,184	45,188	41,138	6,448	47,586	2.8%	5.3%
	WB	37,400	2,981	40,381	37,925	3,945	41,871	1.4%	3.7%
Outerbridge Crossing	EB	38,606	2,706	41,312	40,075	3,855	43,930	3.8%	6.3%
	WB	39,018	2,294	41,312	39,260	4,407	43,668	0.6%	5.7%
Bayonne Bridge	SB	8,870	321	9,191	8,836	762	9,597	-0.4%	4.4%
	NB	8,375	816	9,191	7,573	1,089	8,662	-9.6%	-5.8%
Total	EB/NB	87,480	8,211	95,691	90,049	11,065	101,114	2.9%	5.7%
	WB/SB	84,793	6,091	90,884	84,759	9,442	94,200	0.0%	3.6%
Total All Bridges	EB/NB	510,706	47,374	558,080	497,384	50,654	548,038	-2.6%	-1.8%
	WB/SB	500,022	45,301	545,323	499,909	48,962	548,871	0.0%	0.7%

Figure 36 – Volume Differences Between Observed and Estimated Data for Trans-Hudson Bridges and Tunnels



NOTE:

0,000 Difference (estimated volume - traffoc count) in vehicles
 0.0% Percent Difference

Table 94 – Detail Screenline Summary

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 1	CR_613 Passaic Ave	22,775	2.6%	17,828	2.2%	0.78
	NJ-23	18,522	2.1%	17,267	2.1%	0.93
	US-46	137,824	16.0%	142,139	17.5%	1.03
	NJ-19	37,724	4.4%	34,135	4.2%	0.90
	Main St	10,810	1.3%	6,935	0.9%	0.64
	SR-20/McLean Blvd	50,338	5.8%	62,800	7.7%	1.25
	River Dr	30,737	3.6%	26,223	3.2%	0.85
	GSP	108,772	12.6%	102,525	12.6%	0.94
	NJ-17	92,426	10.7%	94,939	11.7%	1.03
	S River St	16,566	1.9%	6,294	0.8%	0.38
	Teaneck Rd	6,897	0.8%	9,630	1.2%	1.40
	NJ Turnpike	225,504	26.1%	185,392	22.8%	0.82
	Rte 93/Grand Ave	31,004	3.6%	31,310	3.8%	1.01
	US 46/Bergen Blvd	19,061	2.2%	17,050	2.1%	0.89
	Palisade Ave	28,341	3.3%	34,163	4.2%	1.21
	River Rd	26,430	3.1%	25,860	3.2%	0.98
	TOTAL	863,731	100.0%	814,491	100.0%	0.94
Screenline 2	I-95	134,359	32.0%	129,519	31.8%	0.96
	CR-508 (Newark-Jersey City Turnpike)	48,818	11.6%	38,449	9.4%	0.79
	US-1/9 (Pulaski Skyway)	77,960	18.5%	62,806	15.4%	0.81
	US-1/9 (Truck)	70,532	16.8%	71,766	17.6%	1.02
	I-78 (NJ Turnpike Ext)	88,836	21.1%	104,726	25.7%	1.18
	TOTAL	420,505	100.0%	407,267	100.0%	0.97
Screenline 3	NJ-3	113,693	19.7%	142,500	24.0%	1.25
	Rte 510/S Orange Ave	16,610	2.9%	9,350	1.6%	0.56
	Chancellor Ave	8,192	1.4%	17,261	2.9%	2.11
	US 22	78,430	13.6%	76,404	12.9%	0.97
	NJ-27/Newark Ave	15,019	2.6%	17,800	3.0%	1.19
	US-9	70,568	12.2%	73,141	12.3%	1.04
	I-95	274,616	47.6%	256,095	43.2%	0.93
	TOTAL	577,128	100.0%	592,551	100.0%	1.03
Screenline 4	Rte 10/W Mt Pleasant Ave	31,293	3.7%	39,088	4.7%	1.25
	Old Short Hills Rd	12,446	1.5%	16,161	1.9%	1.30
	Millburn Ave	15,142	1.8%	19,100	2.3%	1.26
	I-78 Express (W of Vauxhall Rd)	168,680	19.9%	166,020	19.9%	0.98
	Morris Ave	26,204	3.1%	26,680	3.2%	1.02
	Garden State Pkwy	204,444	24.2%	186,786	22.3%	0.91
	Rte 509/Salem Rd	6,439	0.8%	5,575	0.7%	0.87
	E 1st Ave	10,291	1.2%	11,644	1.4%	1.13
	Rte 27/E St Georges Ave	23,862	2.8%	22,365	2.7%	0.94
	E Elizabeth Ave	13,299	1.6%	12,956	1.5%	0.97
	US-9	77,288	9.1%	80,982	9.7%	1.05
	NJ Turnpike	256,776	30.3%	248,654	29.7%	0.97
	TOTAL	846,164	100.0%	836,011	100.0%	0.99
Screenline 5	NJ-27 (N of Cortelyous Ln)	23,157	6.5%	13,299	3.9%	0.57
	US-1 (N of Finnigans Ln)	74,294	20.7%	69,288	20.1%	0.93
	US 130 (N of Davidson Mill Rd)	39,928	11.1%	28,341	8.2%	0.71
	NJ Turnpike	185,856	51.8%	197,659	57.5%	1.06
	CR-535/Cranbury South River Rd (N of Docks)	19,222	5.4%	17,954	5.2%	0.93
	Spotswood Englishtown Rd	6,832	1.9%	6,244	1.8%	0.91
	CR-527/Old Bridge-Englishtown Rd	9,708	2.7%	11,251	3.3%	1.16
	TOTAL	358,997	100.0%	344,036	100.0%	0.96
Screenline 6	I-80 (W of Exit 38)	159,612	31.9%	150,520	28.8%	0.94
	US-46	7,490	1.5%	6,344	1.2%	0.85
	Cooper Rd	3,044	0.6%	1,554	0.3%	0.51
	Mendham Rd (E of Whitehead Rd)	9,928	2.0%	11,105	2.1%	1.12
	US-202 (Mt Kemble Ave)	8,686	1.7%	8,911	1.7%	1.03
	I-287 (W of Sand Spring Rd)	103,344	20.7%	124,780	23.9%	1.21
	Blue Mill Rd	7,898	1.6%	6,929	1.3%	0.88
	Springfield Ave (E of Snyder Ave)	14,215	2.8%	12,047	2.3%	0.85
	Mountain Ave (E of Snyder Ave)	15,746	3.1%	21,864	4.2%	1.39
	I-78 (Exit 43)	102,882	20.6%	116,708	22.3%	1.13
	US-22 (S of Park Ave)	67,454	13.5%	62,411	11.9%	0.93
	TOTAL	500,299	100.0%	523,173	100.0%	1.05

Table 94 - Continued

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 7	I-78 (W of Exit 43)	102,882	18.0%	116,708	18.4%	1.13
	Valley Rd	7,238	1.3%	12,575	2.0%	1.74
	US-22	54,067	9.5%	50,533	8.0%	0.93
	CR-531/Park Ave	13,225	2.3%	18,290	2.9%	1.38
	West End Ave	11,912	2.1%	12,317	1.9%	1.03
	N Washington Ave	20,351	3.6%	22,365	3.5%	1.10
	I-287 (Delaware & River Canal)	123,317	21.6%	149,907	23.6%	1.22
	Landing Ln	29,176	5.1%	33,874	5.3%	1.16
	George St (N of Livingston Ave)	6,406	1.1%	6,489	1.0%	1.01
	New St	16,218	2.8%	14,786	2.3%	0.91
	NJ Turnpike	185,856	32.6%	197,659	31.1%	1.06
	TOTAL	570,648	100.0%	635,504	100.0%	1.11
Screenline 8	I-80 (W of CR 637/Reynolds Ave)	208,797	45.4%	213,639	50.5%	1.02
	US-202	18,351	4.0%	21,459	5.1%	1.17
	NJ-23	67,275	14.6%	59,174	14.0%	0.88
	Riverdale Rd	8,044	1.7%	6,717	1.6%	0.84
	Hamburg Turnpike	18,179	4.0%	11,568	2.7%	0.64
	Ringwood Ave	14,188	3.1%	9,876	2.3%	0.70
	US-202	15,285	3.3%	15,182	3.6%	0.99
	Colonial Rd	8,459	1.8%	386	0.1%	0.05
	NJ-208	49,422	10.7%	51,373	12.1%	1.04
	Franklin Ave	14,705	3.2%	14,106	3.3%	0.96
	Pulis Ave	7,932	1.7%	5,792	1.4%	0.73
	Darlington Ave	4,258	0.9%	1,859	0.4%	0.44
	N Central Ave	6,978	1.5%	2,855	0.7%	0.41
	E Franklin Turnpike	18,092	3.9%	9,213	2.2%	0.51
	TOTAL	459,965	100.0%	423,199	100.0%	0.92
Screenline 9	NJ 27/ Middlesex Ave (N of Green St)	13,078	6.4%	11,960	5.5%	0.91
	Green St	14,784	7.2%	12,688	5.8%	0.86
	US 1	67,146	32.6%	65,200	29.8%	0.97
	Woodbridge Center Dr	8,060	3.9%	15,622	7.1%	1.94
	CR 514/Main St	14,972	7.3%	13,937	6.4%	0.93
	CR 611/State St	5,204	2.5%	12,041	5.5%	2.31
	Outerbridge Crossing	82,624	40.1%	87,598	40.0%	1.06
	TOTAL	205,868	100.0%	219,045	100.0%	1.06
Screenline 10	CR 521/River Rd	6,511	2.3%	6,155	2.1%	0.95
	NJ 23/CR 443	2,646	0.9%	2,329	0.8%	0.88
	CR 519/Mountain Rd	1,324	0.5%	2,655	0.9%	2.01
	CR 651/Unionville Rd	322	0.1%	505	0.2%	1.57
	CR 284	1,459	0.5%	6,809	2.4%	4.67
	McAfee Glenwood Rd	2,477	0.9%	3,348	1.2%	1.35
	CR 515	252	0.1%	892	0.3%	3.54
	CR 511/Lakeside Rd	3,251	1.1%	1,662	0.6%	0.51
	I-287 (NJ-NJ State Border)	159,202	55.1%	143,792	50.1%	0.90
	E Saddle River Rd	6,622	2.3%	10,833	3.8%	1.64
	Garden State Pkwy	52,366	18.1%	47,618	16.6%	0.91
	Palisades Interstate Pkwy	40,866	14.1%	40,145	14.0%	0.98
	US-9 W	11,520	4.0%	20,047	7.0%	1.74
TOTAL	288,818	100.0%	286,789	100.0%	0.99	
Screenline 11	I-78	66,735	34.9%	69,442	37.6%	1.04
	Northampton St Bridge	17,940	9.4%	13,839	7.5%	0.77
	US 22 (Easton-Phillipsburg Toll Bridge)	31,545	16.5%	31,959	17.3%	1.01
	Riverton - Belvidere Bridge	5,072	2.7%	1,351	0.7%	0.27
	CR 94 (Portland-Columbia Toll Bridge)	9,768	5.1%	9,221	5.0%	0.94
	I-80 (Delaware Water Gap Toll Bridge)	53,449	28.0%	52,939	28.6%	0.99
	US 206 (Milford-Montague Toll Bridge)	6,511	3.4%	6,155	3.3%	0.95
	TOTAL	191,020	100.0%	184,905	100.0%	0.97
Screenline 12	CR 627 (Riegelsville Bridge)	3,218	1.6%	3,784	1.9%	1.18
	Upper Black Eddy-Milford Bridge	3,736	1.9%	3,963	2.0%	1.06
	Uhlerstown-Frenchtown Bridge	5,370	2.7%	6,470	3.3%	1.20
	Centre Bridge-Stockton Bridge	4,976	2.5%	5,178	2.6%	1.04
	US 202 (New Hope-Lambertville Toll Bridge)	11,563	5.9%	12,497	6.4%	1.08
	New Hope-Lambertville Bridge	12,598	6.4%	13,075	6.7%	1.04
	Washington Crossing Bridge	7,374	3.7%	6,533	3.3%	0.89
	I-95 (Scudder Falls Bridge)	61,652	31.3%	61,522	31.3%	1.00
	Calhoun Street Bridge	16,486	8.4%	14,581	7.4%	0.88
	Lower Trenton Bridge	15,512	7.9%	13,500	6.9%	0.87
	US-1 (Trenton-Morrisville Toll Bridge)	54,365	27.6%	55,398	28.2%	1.02
TOTAL	196,850	100.0%	196,502	100.0%	1.00	

Table 94 - Continued

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 13	CR-522/Freehold Rd-Tennent Ave	9,172	2.6%	8,306	2.7%	0.91
	CR-3/Tennent Rd	12,167	3.5%	12,548	4.1%	1.03
	US-18 (Under Wyncrest Rd Overpass)	47,539	13.6%	43,084	14.1%	0.91
	NJ-79 (S of Newton St)	16,963	4.9%	11,759	3.8%	0.69
	NJ-34 (N of Conover Rd)	14,846	4.3%	11,394	3.7%	0.77
	CR-50/Swimming River Rd	10,054	2.9%	5,730	1.9%	0.57
	GSP (S of Newman Springs Rd/CR 520)	161,106	46.2%	134,357	43.9%	0.83
	NJ-13/Shrewsbury Ave	17,290	5.0%	17,908	5.8%	1.04
	NJ-35/Broad St	21,170	6.1%	24,908	8.1%	1.18
	Branch Ave	10,829	3.1%	8,397	2.7%	0.78
	Seven Bridges Rd (N of Silverside Ave)	9,756	2.8%	10,304	3.4%	1.06
	NJ-36 (Ocean Ave N of Beach Rd)	17,815	5.1%	17,526	5.7%	0.98
	TOTAL	348,707	100.0%	306,222	100.0%	0.88
Screenline 14	GSP (Alfred E. Driscoll Bridge)	249,678	69.4%	253,356	68.4%	1.01
	US-9 (Ellis S Vieser Memorial Bridge)	85,536	23.8%	97,117	26.2%	1.14
	NJ-35	24,469	6.8%	20,162	5.4%	0.82
TOTAL	359,683	100.0%	370,635	100.0%	1.03	
Screenline 15	Goethal's Bridge (I-278)	85,569	13.1%	89,456	13.5%	1.05
	Bayonne Bridge	18,382	2.8%	18,259	2.8%	0.99
	I-78 (Holland Tunnel)	85,668	13.1%	81,742	12.4%	0.95
	Lincoln Tunnel (NJ/NY-495)	102,578	15.7%	101,230	15.3%	0.99
	I-95 (NJ Turnpike)	278,511	42.6%	282,310	42.7%	1.01
	Outerbrigde Crossing	82,624	12.6%	87,598	13.3%	1.06
TOTAL	653,332	100.0%	660,597	100.0%	1.01	
Screenline 16	Tappan Zee Bridge (I-287)	146,782	60.4%	145,669	62.1%	0.99
	US-202(Bear Mountain Bridge)	20,627	8.5%	20,493	8.7%	0.99
	I-84 (Newburgh-Beacon Bridge)	75,701	31.1%	68,411	29.2%	0.90
TOTAL	243,110	100.0%	234,572	100.0%	0.96	
Screenline 17	Newark Jersey City Tpk	16,458	4.5%	20,344	5.8%	1.24
	I-280	83,175	22.8%	81,895	23.1%	0.98
	Market Street	14,440	4.0%	15,132	4.3%	1.05
	I-95	251,354	68.8%	236,441	66.8%	0.94
TOTAL	365,427	100.0%	353,812	100.0%	0.97	
Screenline 18	I-78 (NJ Turnpike Ext)	88,836	29.2%	104,726	34.6%	1.18
	NJ-440	24,542	8.1%	27,427	9.1%	1.12
	US-1/US-9 (Pulaski Skyway)	77,960	25.7%	62,806	20.8%	0.81
	NJ-495 (Lincoln Tunnel)	112,557	37.0%	107,491	35.5%	0.95
TOTAL	303,895	100.0%	302,451	100.0%	1.00	
Screenline 19	I-295 (N of W Burlington St)	79,067	22.1%	71,449	21.2%	0.90
	US-206	19,594	5.5%	8,434	2.5%	0.43
	US-130	23,853	6.7%	14,412	4.3%	0.60
	Ward Ave	3,986	1.1%	2,843	0.8%	0.71
	NJ Turnpike	146,674	41.0%	145,295	43.1%	0.99
	Crosswicks Chesterfield Rd	4,222	1.2%	6,690	2.0%	1.58
	Jacobstown Rd	3,962	1.1%	3,395	1.0%	0.86
	Cookstown New Egypt Rd	4,542	1.3%	7,884	2.3%	1.74
	NJ-70	16,011	4.5%	13,782	4.1%	0.86
	NJ-72	8,829	2.5%	5,041	1.5%	0.57
	GSP	38,551	10.8%	40,988	12.2%	1.06
	US-9	8,800	2.5%	16,551	4.9%	1.88
TOTAL	358,091	100.0%	336,765	100.0%	0.94	

13. MODEL CONVERGENCE

13.1 INTRODUCTION

This section describes the convergence functions for the feedback process that has been implemented in NJRTM-E in line with the 4-step demand modeling process. In this sequential process, the convergence functions control the model iterations as the iterative process approaches an optimal solution. The convergence process monitors statistics from trip distribution and highway assignment in order to determine when both the travel patterns and highway volumes have achieved consistency between model iterations. When the variation of both of these model components is within the limits of the adopted tolerances, the model converge process will be satisfied and feedback process will be terminated. Note that future year applications of the model may require more feedback iterations than the calibration year as overall demand and congestion levels may increase causing the model to process additional iterations to meet the convergence criteria.

13.2 TRIP DISTRIBUTION CONVERGENCE

The convergence of the trip distribution process ensures that the allocation of travel patterns for the home-based work purpose fully reflects the impact of congestion generated as part of the highway assignment. The convergence functions are based on the trips and the travel impedance represented with the multimodal composite impedance term discussed in Chapter 7. The convergence criteria are focused on only HBW trip purposes because these two purposes (direct and strategic) are the only ones distributed based on peak period travel conditions which are subject to the feedback conditions. The convergence function measures the variation between successive iterations with a standard statistical test known as the coincidence ratio.

Coincidence Ratio

The coincidence ratio is commonly used as a measure to determine the degree of replication between two distributions that are assumed to be similar, such as an observed and estimated trip table. In the case of a model convergence process, the coincidence ratio is measuring the similarity between successive iterations of the trip table. If the ratio's value is 0.0, the two distributions are completely disjointed while a value of 1.0 indicates identical distributions. As the trip tables become increasingly similar following the progressing of model iterations, the coincidence ratio approaches a value of 1.0. The equation is defined as follows:

$$coincidence \quad ratio = \frac{\sum_{t=1}^T \min \left\{ \frac{f^m(t)}{F^m}, \frac{f^0(t)}{F^0} \right\}}{\sum_{t=1}^T \max \left\{ \frac{f^m(t)}{F^m}, \frac{f^0(t)}{F^0} \right\}}$$

Where:

- $f^m(t)$ = frequency of trips for time interval t in iteration n
- $f^0(t)$ = frequency of trips for time interval t in iteration n-1
- F^m = total O-D trips in iteration n

F^0 = total O-D trips in iteration n-1
 T = number of time interval

13.3 HIGHWAY ASSIGNMENT CONVERGENCE

The convergence of the highway assignment process indicates that the amount of traffic and hence congestion on the individual network links is nearly identical between iterations. This convergence is a critical feature of the model, as the congestion is fed back to the prior model components that rebuild highway and transit paths/skims, which in turn influences both trip distribution and mode choice. Once the highway assignment convergence is achieved and the resulting trip distribution and mode choice estimates are nearly identical between successful iterations, the overall model convergence is complete. The method used to determine the degree of convergence between two networks is a statistical measure known as the route mean square error (RMSE). When the differences are expressed on a percentage basis, the term is referred to as the percent RMSE. This term is also commonly employed to test the degree of similarity between traffic estimated by model and observed traffic counts.

Percent RMSE (Root Mean Square Error)

The percent RMSE is commonly used to determine how closely estimated volumes replicate observed count data. In the iterative model process, the percent RMSE will be used as the convergence criterion for the highway assignment, essentially measuring the difference in the link volumes between successive model assignments. The percent RMSE will be measured using the assigned traffic on the links between the current iteration (iteration “n”) and the previous iteration (n-1). As the assigned traffic volumes on the links in the current iteration approach the values from the previous iteration, the percent RMSE term approaches zero. The formula for the RMSE term is as follows:

$$\%RMSE = \frac{\sqrt{\frac{\sum_i (f_i^n - f_i^{n-1})^2}{k-1}}}{\frac{\sum_i f_i^{n-1}}{k}} \times 100$$

Where:

f_i^n = estimated link volume at link i for iteration n
 k = number of total links

13.4 COMPARISON OF FEEDBACK METHODS

A critical element in the model convergence process is the method used to establish the trip table for each subsequent model iteration. It is necessary to “blend” the trips estimated in the current model iteration with the trips with the prior iteration in order to allow both distribution estimates to influence the subsequent mode choice and assignment processes. This blending also helps minimize the model’s tendency to oscillate back and forth between iterations. Two types of MSA

methods were tested for model feedback: 1/k MSA and 1/2 MSA. The formula for the MSA Method is as follows:

$$Trips_{adjusted} = (1 - \alpha) \times Trips_{previous} + \alpha \times Trips_{current}$$

Where:

$Trips_{adjusted}$ = Adjusted trips (after trip distribution and before mode choice)

α = Weight factor, 1/(Number of Iterations) for 1/k MSA and 1/2 for 1/2 MSA

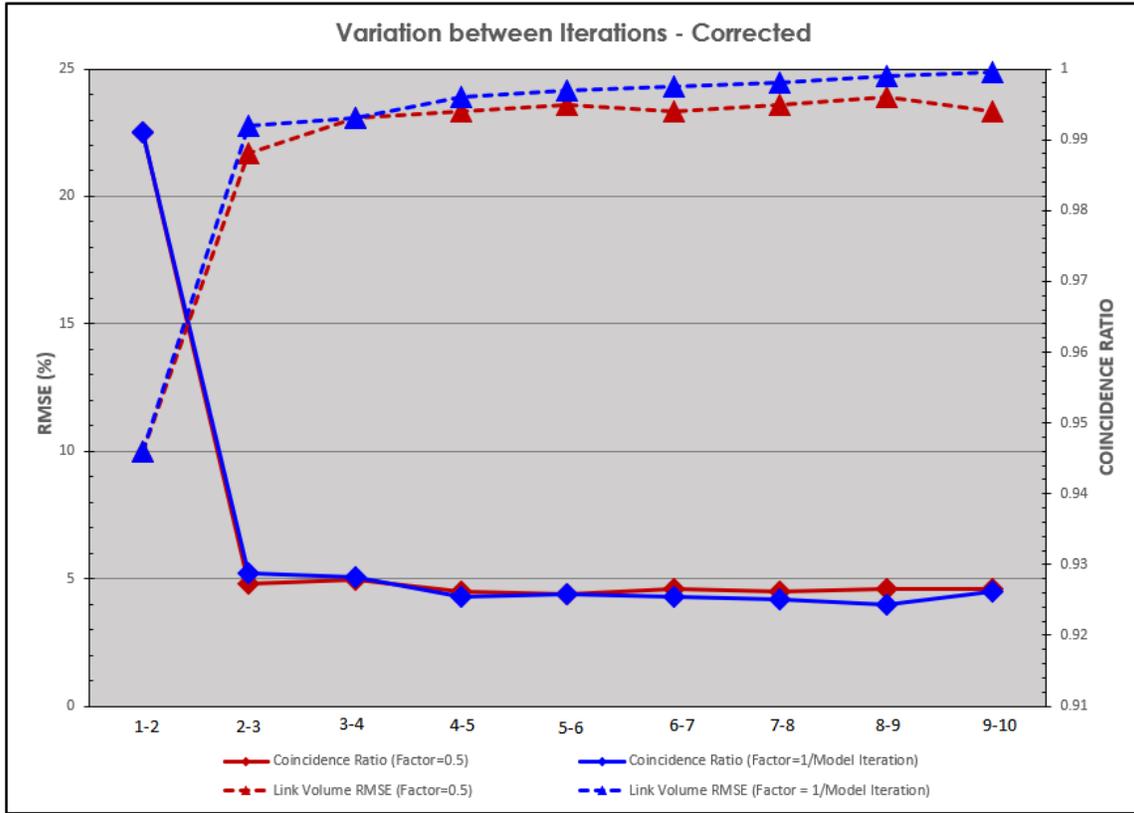
$Trips_{previous}$ = Trips from previous iteration

$Trips_{current}$ = Trips from gravity trip distribution model

As both equations show, the trips from the previous iteration and trips from the current trip distribution are weighted to form the adjusted trips which are used for the subsequent mode choice and assignment procedures. Note that only home-based-work trips use peak skims and are therefore subject to the MSA process. As such the two Home-Based work purposes are adjusted every iteration after the first iteration.

For 1/K MSA Method, α is 1/(current iteration index). For instance, it is 1/3 when it is at the 3rd iteration. For 1/2 MSA Method, α is always 0.5. As the number of iterations increases, 1/K MSA Method puts less weight on the current iteration while the 1/2 MSA Method always uses 1/2 as the weight for the current iteration. To determine which method provided a superior process for the NJRTM-E model, a 10-iteration trial was performed for each method. The results of these trials are shown in Figure 37. Although the 1/2 MSA Method generates a better RMSE value of less than 5% by the third model iteration, the 1/k Method provides a superior coincidence ratio value which is more stable in subsequent iterations. Note also that either technique appears to generate RMSE values of less than 5% after the fourth model iteration. On this basis the 1/k Method was adopted for the NJRTM-E convergence process.

Figure 37 – RMSE & Coincidence Ratio Summary by MSA Method



13.5 FEEDBACK WITHIN CUBE ENVIRONMENT

For reference purposes, this section summarizes the processing of files within the iterative model structure. This includes filenames and copy procedures performed during each model iteration, as well as the CUBE naming process that stores output files by iteration.

Iteration-Dependent Files

Two files exist that need to be stored for analysis governing model convergence. The first file (HBWPTRP.TRP) will be copied into a file (HBWPTRP.TRP-PREVIOUS) so that it will be available for both model convergence testing and the iteration weighing of trips via the MSA process. It should be noted that this file is created during the first iteration in a separate portion of the peak period distribution. For all iterations after the first iteration, the HBWPTRP.TRP file is generated directly within the MSA process.

During the testing of model convergence, this file is compared to the existing “previous” version and then copied into the previous version in preparation for the next convergence test. This copy step immediately follows convergence testing (within the HWYASSC2.S PILOT step).

The second file (HWYFBNET.NET) is generated following the AM peak highway assignment. For the first iteration, the model copies this file into a separate file (HWYFBNET-PREVOUS.NET) so

that it is available for the second iteration when the convergence processing is initially performed. For all subsequent iterations, the current feedback network is copied following the convergence analysis in the HWYASSC2.S PILOT step.

Highway Path Building

During the first iteration of the highway peak period skims, congested travel time is set at $1.20 * T_0$. For all iterations afterwards congested time is obtained directly from T_0 updated following the am peak period loading of each iteration.

Transit Network and Speed Processing

Note that the transit network speed processing script is now iteration dependent, so that the first iteration copies the T_0 field into TR. All exclusive transit lane options (TCODE controlled) will use the original freeflow time in the TR field, while other links will have T_0 updated following the am peak period loading of each iteration.

Trip Distribution

Note that the MSA step provides the composite file HBWPTRP.TRP for the convergence testing as well as the MSA “weighted files” for each HBW trip purpose. These weighted files are copied into the standard HBWxPTRP.TRP files as part of the TRIPDISTMSA5.S PILOT script within the MSA component. This copy step is performed for each iteration after the first iteration. Note that the MSA process is only initiated during the second iteration, so the TRIPDISTMSA5.S script does not test for iteration.

Mode Choice

Following the peak period mode share calculations, it was necessary to establish the transit shares for each zonal pair for the next iteration of trip distribution. Since the composite impedance calculation uses zonal transit shares, prior to mode choice, it is necessary to establish the shares for the first model iteration via a seed process. The seed process generates shares for both the peak and off-peak periods in a “support application” called TRANSIT SHARES SEED PROCESSING. This process uses inputs from a previous “baseline” condition as a means of providing shares for the first iteration transit shares.

Note that these shares also use the NYMTC baseline mode shares for estimating transit shares in the NYMTC region. However, since the coded transit network within the NYMTC-controlled mode choice region is minimal, these shares are not currently used in the composite impedance calculations. If/When the transit network is extended into the NYMTC-controlled region, the shares can be applied to estimate/influence the composite impedance term.

The peak period seed file is called REGION_PKSHR.TAB. Since the off-peak period is not carried through the feedback loop, this file (REGION_OPShR.TAB) is calculated as part of the seed process. Both of these files are stored in the {SEDID} data directory since the transit shares are a combination of both network and socioeconomic conditions. These files should be able to approximate transit shares well enough for the initial model iteration.

The FB_PKSHR.TAB file is used to store the transit shares for each subsequent model iteration. Within the model loop control, this file is denoted as the CURRPKSHR.MAT and is used as input into the peak period composite impedance calculation

Highway Assignment

Note that the conditional testing of model convergence controls the copying of the current combined HBW trips and AM feedback network into the “previous” versions. Therefore if a model converges before the maximum number of iterations, the previous versions will be retained rather than being overwritten by the copy step.

Cube Naming Convention / Output Files by Iteration

Selected files are copied into iteration-specific versions and are stored with an extended filename (xxxx_lter0y.ext) where “y” is the model iteration of the file. These files are identified on the application flowchart.

14. TRANSIT ASSIGNMENT

14.1 INTRODUCTION

The transit assignment process is used to distribute transit passengers to transit lines in both peak and off-peak period. The different trip tables from the mode choice model are combined into four trip tables (combination of two time-periods and two access sub-modes). For each time period, the assignment process was performed separately for each walk-access and drive-access transit modes resulting in 12 assignment processes were performed for each time period:

- Walk-access and auto-access for bus
- Walk-access and auto-access for rail
- Walk-access and auto-access for PATH
- Walk-access and auto-access for LRT
- Walk-access and auto-access for ferry
- Walk-access and auto-access for long-haul ferry

The parameters used for controlling the assignment process are identical to those used in the transit path-building process. The only difference is that in the path-building process, skims are set as the outputs, while in the assignment process, transit trips are added as inputs, and transit volumes by link by line are added as output.

Two executable programs coded in C-Based program are used to generate the ridership summary. These custom programs were developed for the NJT Model and are structured to summarize ridership by the major transit system components. These components include the major line-haul transit routes by mode and summaries of transit activity and the major transit stations served by NJ Transit. The first series of tables summarize the ridership and station activity of the individual commuter rail lines. These tables are followed by several other tables that summarize the ridership for the PATH system and the ferry lines serving New York City. Tables summarizing the ridership for the Newark City Subway line, as well as the station activity for the major rail and bus stations serving New York City are also provided. Lastly, a summary of bus ridership by line is provided,

14.2 RESULTS

Table 95 shows the NJ TRANSIT commuter rail ridership by line group. The total rail ridership estimate is approximately one percent higher than the observed data. However, there is more variation in each individual line. Table 96 – Table 101 summarize the NJT commuter rail ridership for each line. The variation on each individual station is more pronounced than the variation of the aggregate values as shown in these tables,

Table 95 – Average Weekday Boarding by Rail Line

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Main/Bergen/Port Jervis Line	15,688	16,160	472	3.0%
North Jersey Coastline/Northeast Corridor Line	62,404	63,395	991	1.6%
Pascack Valley Line	4,446	4,711	265	6.0%
Boonton Line	9,630	10,475	845	8.8%
Morris/Essex Line	28,777	29,376	599	2.1%
Raritan Valley Line	11,825	11,522	(303)	-2.6%
Newark City Subway	19,176	19,953	777	4.1%
Hudson-Bergen Light Rail	46,728	48,424	1,696	3.6%
TOTAL	198,674	204,015	5,341	2.7%

Table 96 – Weekday Station Utilization - Main/Bergen/Port Line Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Suffern	657	61	(596)	-90.7%
Mahwah	156	33	(123)	-79.0%
Route 17	871	101	(770)	-88.4%
Ramsey (Main)	533	932	399	74.9%
Allendale	389	303	(86)	-22.2%
Waldwick	499	305	(194)	-38.8%
Ho-Ho-Kus	519	349	(170)	-32.7%
RidgeWood	1,732	1,222	(510)	-29.4%
Glen Rock (Main)	1,223	721	(502)	-41.0%
Glen Rock (Bergen)				
SUBTOTAL	6,579	4,028	(2,551)	-38.8%
Hawthorne	535	2	(533)	-99.7%
Paterson	617	66	(551)	-89.3%
Clifton	926	490	(436)	-47.1%
Passaic	646	732	86	13.3%
Delawanna	715	536	(179)	-25.0%
Lyndhurst	999	556	(443)	-44.4%
Kingsland	587	484	(103)	-17.6%
SUBTOTAL	5,025	2,865	(2,160)	-43.0%
Radburn	1,608	1,217	(391)	-24.3%
Broadway	323	493	170	52.5%
Plauderville	630	450	(180)	-28.5%
Garfield	166	369	203	122.4%
Rutherford	1,357	1,313	(44)	-3.3%
SUBTOTAL	4,084	3,842	(242)	-5.9%
TOTAL	15,688	10,734	(4,954)	-31.6%

Table 97 – Weekday Station Utilization - Pascack Valley Line Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Montvale	170	316	146	86.0%
Park Ridge	182	336	154	84.8%
Woodcliff Lake	118	121	3	2.7%
Hillsdale	429	479	50	11.6%
Westwood	459	652	193	42.0%
Emerson	214	298	84	39.1%
Oradell	422	403	(19)	-4.4%
River Edge	592	378	(214)	-36.1%
SUBTOTAL	2,586	2,983	397	15.4%
New Bridge Landing	570	489	(81)	-14.3%
Anderson St.	463	514	51	11.0%
Essex St.	361	349	(12)	-3.4%
Teterboro/Williams Ave	165	161	(4)	-2.6%
Woodridge	301	216	(85)	-28.3%
SUBTOTAL	1,860	1,728	(132)	-7.1%
TOTAL	4,446	4,711	265	6.0%

Table 98 – Weekday Station Utilization - Boonton Line Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Hackettstown	87	98	11	12.9%
Mount Olive	17	13	(4)	-21.5%
Netcong (Both Lines)	79	147	68	86.1%
Lake Hopatcong (Both Lines)	46	155	109	236.4%
SUBTOTAL	335	413	78	23.4%
Mountain Lakes	19	5	(14)	-75.3%
Boonton	47	180	133	282.8%
Towaco	102	190	88	86.0%
Lincoln Park	97	118	21	21.8%
Mountain View	132	240	108	81.5%
SUBTOTAL	397	732	335	84.4%
Little Falls	178	361	183	103.1%
Montclair State University	593	495	(98)	-16.5%
Montclair Heights	326	241	(85)	-25.9%
Mountain Ave	146	308	162	110.7%
Upper Montclair	582	346	(236)	-40.6%
Watchung Ave	820	952	132	16.1%
Walnut St	1,180	1,279	99	8.4%
SUBTOTAL	3,825	3,982	157	4.1%
Montclair-Bay St	1,453	1,575	122	8.4%
Glen Ridge	1,412	1,302	(110)	-7.8%
Bloomfield	1,640	1,661	21	1.3%
Watsessing Ave	568	810	242	42.6%
SUBTOTAL	5,073	5,348	275	5.4%
TOTAL	9,630	10,475	845	8.8%

Table 99 – Weekday Station Utilization - Morris/Essex Line Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Morris Plains	628	891	263	41.9%
Morristown	1,719	2,180	461	26.8%
Convent Station	976	425	(551)	-56.5%
Madison	1,530	1,702	172	11.2%
Chatham	1,528	1,532	4	0.3%
SUBTOTAL	6,381	6,729	348	5.5%
Gladstone	97	121	24	24.5%
Peapack	37	69	32	87.1%
Far Hills	88	287	199	225.6%
Bernardsville	119	207	88	73.6%
Basking Ridge	97	139	42	43.1%
Lyons	375	427	52	13.8%
Millington	136	321	185	136.2%
Stirling	101	116	15	14.6%
Gillette	137	196	59	42.8%
Berkeley Heights	473	676	203	42.9%
Murray Hill	551	445	(106)	-19.3%
New Providence	514	436	(78)	-15.3%
SUBTOTAL	2,725	3,437	712	26.1%
Summit	3,736	4,135	399	10.7%
Short Hills	1,646	1,373	(273)	-16.6%
Millburn	1,802	2,576	774	42.9%
Maplewood	3,418	3,315	(103)	-3.0%
South Orange	4,150	4,597	447	10.8%
Mountain Station	332	400	68	20.4%
Highland Avenue	272	735	463	170.1%
Orange	1,450	341	(1,109)	-76.5%
Brick Church	2,363	705	(1,658)	-70.2%
East Orange	502	1,033	531	105.7%
SUBTOTAL	19,671	19,210	(461)	-2.3%
TOTAL	28,777	29,376	599	2.1%

Table 100 – Weekday Station Utilization - Raritan Valley Line Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
High Bridge	46	116	70	151.7%
Annandale	63	118	55	86.9%
Lebanon	20	85	65	323.5%
White House	83	178	95	114.6%
North Branch	43	69	26	61.5%
Raritan	551	320	(231)	-41.9%
Somerville	683	642	(41)	-6.0%
Bridgewater	310	299	(11)	-3.4%
SUBTOTAL	1,799	1,827	28	1.6%
Bound Brook	544	518	(27)	-4.9%
Dunellen	835	954	119	14.2%
Plainfield	697	286	(411)	-58.9%
Netherwood	444	528	84	18.9%
Fanwood	1,030	977	(53)	-5.2%
Westfield	2,567	2,679	112	4.3%
Garwood	122	157	35	28.3%
Cranford	1,432	995	(437)	-30.5%
Roselle Park	922	886	(36)	-3.9%
Union	1,433	1,717	284	19.8%
SUBTOTAL	10,026	9,695	(331)	-3.3%
TOTAL	11,825	11,522	(303)	-2.6%

Table 101 – Weekday Station Utilization - NJ Coastline/Northeast Corridor Line

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Bay Head	175	155	(20)	-11.2%
Pt Pleasant Beach	233	255	22	9.4%
Manasquan	166	302	136	81.7%
Spring Lake	144	207	63	43.6%
Belmar	221	261	40	18.1%
Bradley Beach	191	255	64	33.4%
Asbury Park	479	430	(49)	-10.3%
Allenhurst	134	192	58	43.1%
Elberon	118	227	109	92.0%
SUBTOTAL	1,861	2,283	422	22.7%
Long Branch	1,032	959	(73)	-7.1%
Little Silver	697	536	(161)	-23.1%
Red Bank	981	909	(72)	-7.3%
Middletown	1,200	1,353	153	12.8%
Hazlet	832	1,297	465	55.9%
Matawan	2,272	2,188	(84)	-3.7%
South Amboy	1,119	1,673	554	49.5%
Perth Amboy	723	722	(1)	-0.1%
Woodbridge	1,668	1,956	288	17.3%
Avenel	271	298	27	10.1%
SUBTOTAL	10,795	11,893	1,098	10.2%
Trenton	3,673	7,775	4,102	111.7%
Hamilton	5,206	2,660	(2,546)	-48.9%
Princeton Junction	6,737	7,083	346	5.1%
Jersey Ave	1,416	934	(482)	-34.0%
New Brunswick	4,457	3,454	(1,003)	-22.5%
Edison	2,773	3,776	1,003	36.2%
Metuchen	3,528	3,656	128	3.6%
Metropark	7,347	5,386	(1,961)	-26.7%
SUBTOTAL	35,137	34,725	(412)	-1.2%
Rahway	3,175	3,732	557	17.5%
Linden	2,374	3,117	743	31.3%
Elizabeth	3,500	3,604	104	3.0%
North Elizabeth	871	1,024	153	17.6%
Newark International Airport	4,691	3,016	(1,675)	-35.7%
SUBTOTAL	14,611	14,494	(117)	-0.8%
TOTAL	62,404	63,395	991	1.6%

Table 102 provides a summary of the ridership for the PATH service for stations both in New Jersey and Manhattan. Overall ridership at these stations is approximately 4% lower than the observed values. Within Manhattan, the ridership for the 33rd Street Branch is approximately 4% higher than the observed value. The estimated ridership on 33rd and 23rd street station are reasonably close to the observed data, while there is more variation on the rest of the stations. Ridership for the New Jersey stations and the World Trade Station overall is approximately 10% below the observed value, however there is more variation on each individual station.

Table 102 – Weekday Station Utilization - PATH System

Station Name	Observed	Estimated	Diff	% Diff
	2019			
33rd St	34,966	35,015	49	0.1%
23rd St	9,682	9,104	(578)	-6.0%
14th St	9,121	12,509	3,388	37.1%
9th St	5,067	6,275	1,208	23.8%
Christopher St	5,199	3,059	(2,140)	-41.2%
SUBTOTAL	64,035	65,962	1,927	3.0%
WTC	64,048	60,677	(3,371)	-5.3%
Hoboken	29,915	28,726	(1,189)	-4.0%
Pavonia/Newport	19,351	21,919	2,568	13.3%
Exchange Place	18,262	15,727	(2,535)	-13.9%
Grove St	22,191	19,778	(2,413)	-10.9%
Journal Square	27,250	28,458	1,208	4.4%
Harrison	9,143	11,799	2,656	29.1%
Newark (Path)	30,186	34,876	4,690	15.5%
SUBTOTAL	220,346	221,961	1,615	0.7%
TOTAL	284,381	287,922	3,541	1.2%

The ridership for the Newark Subway Line Stations is listed in Table 103. The total estimated ridership is approximately 10% lower than the observed values. As expected, the variation is more pronounced at each station.

Table 103 – Weekday Station Utilization - Newark City Subway Line Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
Grove Street	809	1,075	266	32.9%
Silver Lake	530	790	260	49.1%
Branch Brook Park / Heller Parkwa	2,174	1,929	(245)	-11.3%
Davenport Ave	545	26	(519)	-95.2%
Bloomfield Ave	1,281	1,093	(188)	-14.7%
Park Ave	1,403	1,306	(97)	-6.9%
Orange St	1,027	863	(164)	-16.0%
Norfolk St	827	960	133	16.0%
Warren St	1,012	1,002	(10)	-1.0%
Washington St	1,041	1,666	625	60.0%
Millitary Park	1,582	635	(947)	-59.9%
NJ PAC/Center St	59	42	(17)	-28.7%
Atlantic St	11	12	1	13.4%
Washington Park	232	747	515	221.9%
Broad Street	418	133	(285)	-68.1%
Newak Penn Station - Broad Inbo	6,225	7,674	1,449	23.3%
TOTAL	19,176	19,953	777	4.1%

Ridership for the Hudson Bergen LRT Stations is listed in Table 104. At system-level, the estimated ridership replicated the observed ridership. However, there is more variation at individual station.

Table 104 – Weekday Station Utilization - Hudson-Bergen LRT Stations

Station Name	Observed	Estimated	Diff	% Diff
	2019			
West Side Avenue	1,985	1,995	10	0.5%
MLK Drive	1,555	1,651	96	6.2%
Garfield Avenue	897	205	(692)	-77.2%
SUBTOTAL	4,437	3,851	(586)	-13.2%
22nd Street	2,031	2,905	874	43.1%
34th St., Bayonne	1,718	1,499	(219)	-12.7%
45th St., Bayonne	1,190	1,502	312	26.2%
Danforth Avenue	1,000	624	(376)	-37.6%
Richard St., JC	884	30	(854)	-96.6%
SUBTOTAL	6,823	6,560	(263)	-3.9%
Liberty State Park	3,249	13,267	10,018	308.4%
Jersey Av	1,361	617	(744)	-54.7%
Marin Blvd	1,115	166	(949)	-85.1%
Essex Street	1,542	1,574	32	2.0%
Exchange Place	6,140	2,251	(3,889)	-63.3%
Harborside	2,070	3,581	1,511	73.0%
Harsimus Cove	1,407	1,012	(395)	-28.1%
Newport Mall (Pavonia/Newport)	6,793	5,982	(811)	-11.9%
SUBTOTAL	23,677	28,450	4,773	20.2%
2nd Street	1,378	1,483	105	7.6%
9th Street	2,970	2,562	(408)	-13.7%
Lincoln Harbor	1,025	415	(610)	-59.5%
Port Imperial	1,390	1,370	(20)	-1.5%
Bergenline Ave	3,518	2,546	(972)	-27.6%
Tonnelle Ave	1,510	1,189	(321)	-21.3%
SUBTOTAL	11,791	9,564	(2,227)	-18.9%
TOTAL	46,728	48,424	1,696	3.6%

Table 105 and Table 106 summarize the PABT bus ridership, aggregated and by line for the various service types in the region. Note that while there is some variation in the difference by line group, and in some instances, the differences can be quite significant such as PABT short distance, and PABT GWB, the overall PABT ridership is within 4 percent of the observed ridership.

Table 105 – PABT Bus Ridership

Bus Line	2019 Observed	NJRTME Revalidation	
		Estimated	Pct Diff
BERGEN PABT ROUTES	30,777	28,011	-9.0%
ROUTE 9 PABT	8,514	8,853	4.0%
PABT SHORT DISTANCE	33,663	25,542	-24.1%
PARK & RIDE	3,423	2,263	-33.9%
MIDDLESEX/UNION PABT	8,220	13,252	61.2%
PASSAIC PABT	13,023	18,103	39.0%
GW BRIDGE	5,388	5,420	0.6%
PABT Total	103,008	101,444	-1.5%

Table 106 – PABT Bus Ridership

Bus Line	2019 Observed	NJRTME Revalidation		Bus Line	2019 Observed	NJRTME Revalidation	
		Estimated	Pct Diff			Estimated	Pct Diff
BERGEN PABT ROUTES				PARK & RIDE			
160	1,245	765	-38.6%	320	2,815	1,618	-42.5%
161/162	3,603	6,238	73.1%	321	608	645	6.0%
163/164	6,119	3,693	-39.6%	Subtotal	3,423	2,263	-33.9%
165	5,865	6,118	4.3%	MIDDLESEX/UNION PABT			
166	7,915	5,837	-26.3%	112	1,059	1,626	53.6%
167	3,407	3,082	-9.5%	113	2,157	4,066	88.5%
155	286	121	-57.7%	114	3,045	4,501	47.8%
157	156	67	-56.8%	115	662	1,534	131.8%
168	1,508	1,809	19.9%	116	1,297	1,525	17.6%
144/148	673	282	-58.1%	Subtotal	8,220	13,252	61.2%
Subtotal	30,777	28,011	-9.0%	PASSAIC PABT			
ROUTE 9 PABT				190	5,436	6,765	24.4%
131	497	69	-86.0%	191	680	1,104	62.4%
133	503	620	23.2%	192	2,944	4,500	52.9%
135	271	176	-34.9%	193	966	1,014	4.9%
137	846	471	-44.4%	194	989	1,854	87.5%
138	282	154	-45.4%	195	493	579	17.5%
139	6,115	7,363	20.4%	196	403	235	-41.7%
Subtotal	8,514	8,853	4.0%	197	1,112	2,051	84.4%
PABT SHORT DISTANCE				Subtotal	13,023	18,103	39.0%
107	1,944	1,829	-5.9%	GW BRIDGE			
108	665	1,820	173.6%	171	726	1,346	85%
111	995	64	-93.5%	175	885	1,207	36%
121	73	27	-63.6%	178	919	664	-28%
123	2,336	834	-64.3%	181	342	263	-23%
126	8,005	5,567	-30.5%	182	743	805	8%
127	1,005	741	-26.3%	186	1,403	799	-43%
128	3,763	991	-73.7%	188	370	337	-9%
129	1,434	636	-55.6%	Subtotal	5,388	5,420	0.6%
154	1,286	946	-26.4%				
156	3,290	4,779	45.3%				
158	3,760	2,062	-45.2%				
159	5,107	5,246	2.7%				
Subtotal	33,663	25,542	-24.1%				

APPENDIX A – ZONAL EQUIVALENCY

1. NJRTME – NYMTC BPM EQUIVALENCY

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Bronx	2198	1139,1142-1189,1327-1330,1339	54
	2199	1233-1234,1256-1275,1296-1326,1331-1338,1340-1341	63
	2200	1036,1038,1040-1042,1044-1045,1047-1060,1063-1078,1080-1138,1140-1141	98
	2201	1005-1035,1037,1039,1043,1046,1061-1062,1079,1343	39
	2202	1190-1232,1240,1245-1249,1276-1282,1286-1294,1342	66
	2203	1235-1239,1240-1244,1250-1255,1283-1285,1295	19
Dutchess	2204	3223-3230,3240-3247,3249	17
	2205	3201-3222,3231-3239,3248,3250-3279	62
Kings	2206	1344-1368,1371-1372,1374-1391,1426-1428,1431,1434-1507,1512-1515,1525-1528,1947-1951	136
	2207	1369-1370,1373,1392-1394,1396-1403,1408-1425,1429-1430,1432-1433,2103	37
	2208	1395,1404-1407,1552-1566,1569-1570,1573-1585,1589	36
	2209	1586-1588,1590,1597-1621,1771-1783,1785-1806,1815-1820,1887,1889,2102	73
	2210	1694-1702,1720	10
	2211	1686-1688,1690-1693	7
	2212	1677-1685,1689	10
	2213	1674-1676	3
	2214	1703-1709,1712-1714,1717-1719	13
	2215	1710-1711,1715-1716,1721-1726,1755-1759	15
	2216	1727-1734,1740-1754,1828	24
	2217	1735,1821-1834,1846-1847	15
	2218	1736-1739,1760-1770,1811-1814,1829,1839-1840,1908-1915,1920,1934-1939,2100-2101	39
	2219	1835-1838,1841-1845,1873-1875,1890-1907,1916-1919,1921-1933,1940-1942,2021-2032	62
	2220	1784,1807-1810,1851-1856,1858-1872,1876-1886,1888,1976-1989,1995-1997,2034-2041	63
2221	1567-1568,1571-1572,1591-1596,1622-1638,1648-1670,1672,1848-1850,1857,1968-1975	63	
2222	1508-1511,1516-1519,1532-1551,1639-1647,1671,1673,1943-1946,1952-1967,2006-2012	65	
2223	1520-1524,1529-1531,1545-1546,1990-1994,1998-2005,2014-2020,2033,2042-2099	89	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Nassau	2224	2263-2420	158
	2225	2213-2262,2421-2491	121
Manhattan	2226	303	1
	2227	299	1
	2228	335	1
	2229	302	1
	2230	301	1
	2231	329	1
	2232	300	1
	2233	328	1
	2234	325	1
	2235	324	1
	2236	315	1
	2237	323	1
	2238	320	1
	2239	321	1
	2240	322	1
	2241	317	1
	2242	316	1
	2243	318	1
	2244	304	1
	2245	319	1
	2246	326	1
	2247	314	1
	2248	313	1
	2249	327	1
	2250	312	1
	2251	310	1
	2252	309	1
	2253	307	1
	2254	308	1
	2255	311	1
	2256	275	1
	2257	305	1
2258	306	1	
2259	272	1	
2260	248	1	
2261	274	1	
2262	273	1	
2263	270	1	
2264	247	1	
2265	271	1	
2266	246	1	
2267	245	1	
2268	241	1	
2269	269	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Manhattan	2270	261	1
	2271	297	1
	2272	260	1
	2273	267	1
	2274	268	1
	2275	240	1
	2276	244	1
	2277	243	1
	2278	242	1
	2279	265	1
	2280	239	1
	2281	264	1
	2282	262	1
	2283	263	1
	2284	259	1
	2285	296	1
	2286	293	1
	2287	238	1
	2288	235	1
	2289	257	1
	2290	266	1
	2291	197	1
	2292	237	1
	2293	234	1
	2294	233	1
	2295	232	1
	2296	258	1
	2297	252	1
	2298	251	1
	2299	256	1
	2300	254	1
	2301	250	1
	2302	255	1
	2303	253	1
	2304	249	1
2305	295	1	
2306	286	1	
2307	287	1	
2308	294	1	
2309	285	1	
2310	283	1	
2311	292	1	
2312	289	1	
2313	288	1	
2314	291	1	
2315	290	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Manhattan	2316	236	1
	2317	194	1
	2318	193	1
	2319	332	1
	2320	196	1
	2321	195	1
	2322	190	1
	2323	284	1
	2324	282	1
	2325	281	1
	2326	280	1
	2327	279	1
	2328	276	1
	2329	192	1
	2330	191	1
	2331	185	1
	2332	184	1
	2333	179	1
	2334	178	1
	2335	173	1
	2336	188-189	2
	2337	186-187	2
	2338	182-183	2
	2339	180-181	2
	2340	176-177	2
	2341	174-175	2
	2342	171-172	2
	2343	198	1
	2344	231	1
	2345	229	1
	2346	278	1
	2347	220	1
	2348	230	1
	2349	228	1
	2350	226	1
	2351	224	1
2352	222	1	
2353	227	1	
2354	277	1	
2355	225	1	
2356	217	1	
2357	223	1	
2358	216	1	
2359	221	1	
2360	218	1	
2361	219	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Manhattan	2362	298	1
	2363	168	1
	2364	215	1
	2365	214	1
	2366	213	1
	2367	212	1
	2368	209	1
	2369	208	1
	2370	211	1
	2371	210	1
	2372	206	1
	2373	205	1
	2374	207	1
	2375	199-200	2
	2376	201	1
	2377	333	1
	2378	334	1
	2379	202	1
	2380	204	1
	2381	203	1
	2382	162	1
	2383	159-160	2
	2384	143	1
	2385	142	1
	2386	140	1
	2387	138-139	2
	2388	166	1
	2389	167	1
	2390	165	1
	2391	164	1
	2392	169-170	2
	2393	93	1
	2394	94,96	2
	2395	92,95	2
	2396	136-137	2
	2397	135141	2
	2398	130-131,133-134	4
	2399	129132	2
	2400	157-158	2
	2401	156	1
2402	161	1	
2403	154-155	2	
2404	153	1	
2405	151	1	
2406	146	1	
2407	150	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Manhattan	2408	149	1
	2409	331	1
	2410	148	1
	2411	144	1
	2412	145	1
	2413	147	1
	2414	118-119	2
	2415	120-121	2
	2416	122-123	2
	2417	126-127	2
	2418	90-91	2
	2419	87,89	2
	2420	124-125	2
	2421	85	1
	2422	152	1
	2423	110-111	2
	2424	112	1
	2425	114-115	2
	2426	82	1
	2427	84	1
	2428	32,78-80,83	5
	2429	86	1
	2430	23	1
	2431	24	1
	2432	3	1
	2433	81	1
	2434	77	1
	2435	75	1
	2436	74	1
	2437	128	1
	2438	76	1
	2439	73	1
	2440	72	1
	2441	107113	2
	2442	103	1
	2443	330	1
	2444	105-106	2
	2445	101-102	2
	2446	98-99	2
	2447	104	1
	2448	100	1
	2449	97	1
2450	88	1	
2451	116-117	2	
2452	108	1	
2453	42	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Manhattan	2454	40	1
	2455	31	1
	2456	28-29	2
	2457	13	1
	2458	2	1
	2459	1	1
	2460	5	1
	2461	41	1
	2462	38	1
	2463	39	1
	2464	30	1
	2465	19-20	2
	2466	11-12	2
	2467	10	1
	2468	8	1
	2469	4	1
	2470	6-7	2
	2471	9	1
	2472	14	1
	2473	17-18	2
	2474	15-16	2
	2475	44	1
	2476	43	1
	2477	45	1
	2478	46	1
	2479	47	1
	2480	48	1
	2481	49	1
	2482	50	1
	2483	55	1
	2484	56	1
	2485	59	1
	2486	57	1
	2487	58	1
	2488	51	1
	2489	61	1
2490	62	1	
2491	54	1	
2492	53	1	
2493	52	1	
2494	60	1	
2495	64	1	
2496	71	1	
2497	70	1	
2498	63	1	
2499	68	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Manhattan	2500	66	1
	2501	67	1
	2502	65	1
	2503	69	1
	2504	37	1
	2505	36	1
	2506	26	1
	2507	35	1
	2508	33	1
	2509	27	1
	2510	34	1
	2511	25	1
	2512	21	1
	2513	22	1
	2514	109	1
2515	163	1	
Orange	2516	3134-3136	3
	2517	3156-3157	2
	2518	3155	1
	2519	3158	1
	2520	3159	1
	2521	3161	1
	2522	3160	1
	2523	3128-3133	6
	2524	3149-3154	6
	2525	3147-3148	2
	2526	3143-3146	4
	2527	3165	1
	2528	3162-3164	3
	2529	3189-3190	2
	2530	3191	1
	2531	3188	1
	2532	3192	1
	2533	3186-3187	2
	2534	3173-3176	4
	2535	3166-3169,3199	5
	2536	3137-3142,3200	7
	2537	3121-3127	7
	2538	3170-3172	3
	2539	3178-3180	3
2540	3177,3181	2	
2541	3182-3185	8	
2542	3194	1	
2543	3193	1	
Putnam	2544	3102-3120	19

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Queens	2545	336-360,362-368,372-409,421,992-994	74
	2546	415,419,420,422,482,485,486,494-523,529-554,564-581,995-996	83
	2547	361,369-371,410-414,416-418,423-481,483,484,487-491,561-563,582-591	91
	2548	1004	1
	2549	492,493,592-646,651-665,682-691,785-797,999-1000	97
	2550	647-650,692,780-784,798-817	30
	2551	666-681,818-964,998,1001	165
	2552	524-528,555-560,693-755,758-779,997	97
	2553	756-757,977-991	17
	2554	1002-1003	2
	2555	965-976	12
Richmond	2556	2212	1
	2557	2150	1
	2558	2128	1
	2559	2132	1
	2560	2129	1
	2561	2130	1
	2562	2131	1
	2563	2133	1
	2564	2134	1
	2565	2135	1
	2566	2127	1
	2567	2126	1
	2568	2125	1
	2569	2120	1
	2570	2121	1
	2571	2117	1
	2572	2118	1
	2573	2119	1
	2574	2123	1
	2575	2122	1
	2576	2137	1
	2577	2107-2111	5
	2578	2104-2106,2145	4
	2579	2138	1
	2580	2136	1
	2581	2139	1
	2582	2124	1
	2583	2112-2115,2141-2142	6
	2584	2144,2146	2
	2585	2143,2147-2149,2159,2162-2163,2165	8
2586	2151	1	
2587	2152	1	
2588	2209	1	
2589	2153	1	
2590	2166,2168	2	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Richmond	2591	2167	1
	2592	2169	1
	2593	2171	1
	2594	2154	1
	2595	2155	1
	2596	2156	1
	2597	2157	1
	2598	2160-2161,2170,2179-2184	9
	2599	2164,2172-2178	8
	2600	2187-2191,2211	6
	2601	2185-2186,2192-2201	12
	2602	2202-2204,2208	4
	2603	2205-2207	3
	2604	2210	1
	2605	2116,2158	2
	Rockland	2606	2140
2616		3080	1
2617		3085	1
2618		3081	1
2619		3083	1
2620		3082	1
2621		3084	1
2622		3087	1
2623		3086	1
2624		3067	1
2625		3066	1
2626		3100	1
2627		3101	1
2628		3068	1
2629		3070	1
2630		3069	1
2631		3071	1
2632		3077	1
2633		3079	1
2634		3078	1
2635		3073	1
2636		3072	1
2637		3076	1
2638		3075	1
2639		3074	1
2640		3088	1
2641		3089	1
2642		3090	1
2643		3091	1
2644		3092	1
2645	3098	1	

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Rockland	2646	3093	1
	2647	3095	1
	2648	3096	1
	2649	3097	1
	2650	3094	1
	2651	3055	1
	2652	3054	1
	2653	3099	1
	2654	3057	1
	2655	3058	1
	2656	3059	1
	2657	3060	1
	2658	3061	1
	2659	3065	1
	2660	3064	1
	2661	3062	1
	2662	3048	1
	2663	3053	1
	2664	3056	1
	2665	3052	1
	2666	3050	1
	2667	3051	1
	2668	3063	1
	2669	3049	1
	2670	3045	1
	2671	3047	1
	2672	3046	1
	2673	3043	1
	2674	3044	1
	2675	3041	1
	2676	3042	1
	2677	3040	1
2678	3037	1	
2679	3038	1	
2680	3039	1	
Suffolk	2681	2492-2813	322

County	NJRTME Zone	BPM	
		TAZ_ID	Number of Zones
Westchester	2683	2985-2986,3010,3012,3013	5
	2684	2984,3007-3009,3011,3014-3019	11
	2685	2994,3000,3001,3003-3006	7
	2686	2993,2997-2999,3002	5
	2687	2995	1
	2688	2987,2996,3028	3
	2689	2989	1
	2690	2939-2940,2988,2990	4
	2691	2991-2992	2
	2692	2983,3029,3035	3
	2693	2794-2982	9
	2694	2966,2968-2973,3030,3034	9
	2695	2967,3026-3027	3
	2696	2895-2904,2959-2965,3025,3032-3033	20
	2697	2881-2890,3020-3022	13
	2698	2875-2880,3036	7
	2699	2868-2874	7
	2700	2859-2860,2864	3
	2701	2857-2858	2
	2702	2852-2856	5
	2703	2837-2841,2843-2851,3031	15
	2704	2842	1
	2705	2814-2816	3
	2706	2817-2836	20
2707	2861-2867,3023-3024	8	
2708	2891-2894	4	
2709	2905-2938,2941-2958	52	

2. NJRTM-E – DVRPC EQUIVALENCY

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Burlington	247	20067, 20069, 20070	3
	248	20071	1
	249	20066, 20068	2
	250	20077	1
	251	20036, 20037, 20038, 20039	4
	252	20033	1
	253	20031, 20032	2
	254	20035	1
	255	20034	1
	256	20229	1
	257	20230	1
	258	20226, 20228	2
	259	20225	1
	260	20224	1
	261	20227	1
	262	20223	1
	263	20252, 20255	2
	264	20256, 20257, 20258, 20259, 20260	5
	265	20254	1
	266	20249	1
	267	20247, 20248	2
	268	20250	1
	269	20251, 20253	2
	270	20261, 20262, 20266, 20270, 20272	5
	271	20264, 20267	2
	272	20271, 20275	2
	273	20265	1
	274	20263, 20269	2
	275	20268, 20274, 20276, 20279, 20280	5
	276	20281, 20282, 20283	3
	277	20273, 20277, 20278	3
	278	20218, 20219	2
	279	20214, 20217	2
	280	20221, 20222	2
	281	20216	1
	282	20220	1
283	20215	1	
284	20207, 20212	2	
285	20210	1	
286	20213	1	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Burlington	287	20205, 20208, 20209	3
	288	20206, 20211	2
	289	20203, 20204	2
	290	20201, 20202	2
	291	20245, 20246	2
	292	20231, 20232, 20234	3
	293	20233	1
	294	20236, 20242, 20244	3
	295	20235	1
	296	20237	1
	297	20238-20241, 20243	5
	298	20411, 20412	2
	299	20413, 20415	2
	300	20414, 20416	2
	301	20406-20410	5
	302	20438, 20441, 20442	3
	303	20436, 20437, 20439, 20440	4
	304	20078	1
	305	20079, 20083	2
	306	20086	1
	307	20087	1
	308	20080	1
	309	20081, 20084	2
	310	20089, 20090	2
	311	20091	1
	312	20085	1
	313	20088	1
	314	20082	1
	315	20051	1
	316	20052, 20053	2
	317	20001, 20002	2
	318	20041, 20042	2
	319	20040	1
320	20075, 20076	2	
321	20072, 20074	2	
322	20073	1	
323	20049	1	
324	20048, 20050	2	
325	20043	1	
326	20044	1	
327	20045	1	
328	20046, 20047	2	
329	20017, 20020	2	
330	20013, 20014, 20016	3	
331	20015, 20018, 20019	3	
332	20024, 20027, 20029, 20030	4	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Burlington	333	20028	1
	334	20021	1
	335	20023, 20025	2
	336	20026	1
	337	20022	1
	338	20063, 20064	2
	339	20062, 20065	2
	340	20055-20061	7
	341	20003, 20004, 20005	3
	342	20006	1
	343	20010, 20011, 20012	3
	344	20007, 20008, 20009	3
	345	20054	1
	346	20822-20831	10
	347	20608, 20611	2
	348	20609, 20610, 20612-20614	5
	349	20607	1
	350	20651, 20653, 20655	3
	351	20650, 20652, 20654	3
	352	20649	1
	353	20624, 20625, 20626, 20627	4
	354	20623	1
	355	20622	1
	356	20615, 20616, 20619	3
	357	20618, 20620	2
	358	20617	1
	359	20621	1
	360	20657	1
	361	20656	1
	362	20640	1
	363	20647	1
	364	20642, 20644, 20648	3
	365	20628, 20634, 20635	3
	366	20637	1
	367	20629-20633, 20636	6
	368	20638, 20639	2
	369	20641, 20646	2
370	20643	1	
371	20645	1	
372	20424, 20426, 20428, 20430, 20431, 20433, 20435	7	
373	20432, 20434	2	
374	20423, 20429	2	
375	20425, 20427	2	
376	20808-20815	8	
377	20816-20821	6	
378	20832-20842	11	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Burlington	379	20601, 20602, 20603, 20604, 20605	5
	380	20606	1
	381	20401, 20404, 20405	3
	382	20402, 20403	2
	383	20421, 20422	2
	384	20420	1
	385	20417, 20418	2
	386	20419	1
	387	20801-20807	7
Mercer	874	18001	1
	875	18002	1
	876	18003	1
	877	18004, 18007	2
	878	18008	1
	879	18006, 18010	2
	880	18015	1
	881	18013	1
	882	18011	1
	883	18009	1
	884	18012	1
	885	18022	1
	886	18019	1
	887	18016	1
	888	18023	1
	889	18014, 18018, 18021, 18024	4
	890	18017, 18020, 18025	3
	891	18034, 18035	2
	892	18030	1
	893	18029	1
	894	18027	1
	895	18026	1
	896	18028	1
	897	18032	1
	898	18038, 18040	2
	899	18031, 18036	2
	900	18037	1
	901	18033	1
	902	18039	1
	903	18041	1
	904	18801	1
905	18806	1	
906	18810	1	
907	18812, 18815	2	
908	18808	1	
909	18802, 18803, 18807	3	
910	18804, 18805	2	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Mercer	947	18809, 18811, 18814, 18816	4
	948	18813, 18818	2
	949	18817	1
	950	19001, 19005, 19006, 19009	4
	951	19002, 19003, 19007, 19008	4
	952	19004, 19010	2
	953	19011, 19013, 19015, 19017, 19018	5
	954	19012, 19016, 19019, 19020, 19022, 19023	6
	955	19014	1
	956	19024	1
	957	19021	1
	958	18832, 18834	2
	959	18827, 18830, 18831, 18833	4
	960	18824, 18828, 18829	3
	961	18821, 18823, 18825	3
	962	18826	1
	963	18822	1
	964	18819, 18820	2
	965	18240, 18242	2
	966	18241	1
	967	18236, 18238	2
	968	18239	1
	969	18230, 18233	2
	970	18231	1
	971	18237	1
	972	18235	1
	973	18232	1
	974	18229, 18234	2
	975	18228	1
	976	18225	1
	977	18221, 18222	2
	978	18212, 18216	2
	979	18203, 18206, 18210	3
	980	18214, 18219	2
981	18220	1	
982	18215, 18218	2	
983	18223, 18227	2	
984	18226	1	
985	18224	1	
986	18213	1	
987	18207, 18211	2	
988	18204, 18208	2	
989	18201, 18202, 18205, 18209, 18217	5	
990	18418, 18419	2	
991	18420, 18422, 18423, 18426	4	
992	18421	1	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Mercer	993	18424, 18428, 18431	3
	994	18425, 18427, 18429, 18430	4
	995	18401, 18402	2
	996	18406, 18407	2
	997	18411, 18412	2
	998	18409, 18413	2
	999	18403, 18404	2
	1000	18405	1
	1001	18410	1
	1002	18414	1
	1003	18415	1
	1004	18408	1
	1005	18416	1
	1006	18417	1
	1007	18623, 18628, 18630	3
	1008	18621, 18624	2
	1009	18620	1
	1010	18622	1
	1011	18625	1
	1012	18627	1
	1013	18633	1
	1014	18634, 18636	2
	1015	18626, 18631	2
	1016	18629, 18632, 18635	3
	1017	18601	1
	1018	18602	1
	1019	18604	1
	1020	18610	1
	1021	18607	1
	1022	18605	1
	1023	18606	1
	1024	18603	1
	1025	18613, 18616	2
1026	18608	1	
1027	18609	1	
1028	18611	1	
1029	18612	1	
1030	18615	1	
1031	18618, 18619	2	
1032	18614	1	
1033	18617	1	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Bucks	2710	14005-14013	9
	2711	14032	1
	2712	14018, 14020-14023, 14025-14030	11
	2713	14014, 14015, 14016, 14017	4
	2714	14031	1
	2715	14211-14216	6
	2716	14203, 14204	2
	2717	14210	1
	2718	14201, 14202	2
	2719	14205-14209	5
	2720	14001-14004	4
	2721	14409-14413	5
	2722	14425, 14426, 14427	3
	2723	14428, 14429, 14434	3
	2724	14432, 14433, 14435-14440	8
	2725	14431	1
	2726	14414-14424	11
	2727	14430	1
	2728	14408	1
	2729	14401-14407	7
	2730	14217-14222	6
	2731	14811-14816	6
	2732	14621-14624, 14627, 14628	6
	2733	14601, 14602	2
	2734	14625, 14626	2
	2735	14629-14638	10
	2736	14603-14610, 14612, 14615, 14620	11
	2737	14611, 14613, 14614, 14616, 14617, 14618	6
	2738	14801-14810	10
	2739	15005, 15007	2
	2740	15006	1
	2741	15004	1
	2742	15003	1
	2743	15002	1
	2744	15001	1
	2745	15414, 15415, 15417	3
	2746	15412, 15413	2
	2747	15416	1
	2748	15418, 15419	2
	2749	15244-15249	6
	2750	15229-15243	15
2751	15201	1	
2752	15223-15228	6	
2753	15202-15222	21	
2755	15401-15404, 15406-15411	10	
2754	15405	1	

County	NJRTME Zone	DVRPC Model	
		TAZ_ID	Number of Zones
Bucks	2756	16035, 16036, 16038, 16039	4
	2757	16037	1
	2758	16023-16029, 16031, 16032, 16034	10
	2759	16030, 16033	2
	2760	16047, 16048	2
	2761	16040, 16041, 16042, 16043	4
	2762	16022	1
	2763	16001, 16002, 16006, 16007, 16017	5
	2764	16003, 16004, 16005, 16008, 16009-16016, 16018-16021	16
	2765	16044, 16045, 16046	3
	2766	16216-16228	13
	2767	16215	1
	2768	15804-15808, 15810-15812, 15814-15816, 15818, 15819-15827	21
	2769	15802	1
	2770	15803	1
	2771	15828	1
	2772	15801	1
	2773	15809, 15813, 15817	3
	2774	15630-15637	8
	2775	15603, 15606, 15608-15629	24
2776	15601, 15602, 15604, 15605, 15607	5	
2777	16201, 16202, 16203	3	
2778	16204, 16207, 16208, 16211-16214	7	
2779	16205, 16206, 16209, 16210	4	
2780	14619	1	

APPENDIX B – TOLL RATE SCHEDULE

Cash Only Toll Rate Schedule – Class 1 Passenger Cars (2 Axles) from New Jersey Turnpike Authority

	4	5	6	7	7A	8	8A	9	10	11	12	13	13A	14	14A	14B	14C	15E	15W	15X	16E	16W	18E	18W
4		0.90	2.90	1.45	1.65	2.45	3.00	3.60	4.00	4.35	5.15	6.50	6.50	7.55	9.55	9.70	10.25	8.80	9.05	9.55	9.70	9.70	11.25	11.25
5	0.90		2.15	0.90	1.35	1.65	2.45	2.90	3.00	3.60	4.60	5.45	5.45	7.25	9.05	9.10	9.55	7.55	8.05	8.65	9.10	9.10	10.65	10.65
6	2.90	2.15		1.65	2.15	2.90	3.60	4.00	4.35	4.60	5.45	6.65	6.65	8.05	9.70	10.25	10.65	9.05	9.10	9.95	10.25	10.25	11.80	11.80
7	1.45	0.90	1.65		0.90	1.45	1.65	2.15	2.45	2.90	4.00	4.75	4.75	6.50	8.05	8.80	9.05	7.25	7.40	8.35	8.80	8.80	9.70	9.70
7A	1.65	1.35	2.15	0.90		0.90	1.45	1.65	2.15	2.45	3.60	4.60	4.60	6.10	7.55	8.05	8.80	6.65	7.25	7.55	8.05	8.05	9.55	9.55
8	2.45	1.65	2.90	1.45	0.90		0.90	1.35	1.45	1.65	2.90	4.00	4.00	5.15	7.25	7.40	7.55	6.10	6.50	7.05	7.40	7.40	9.05	9.05
8A	3.00	2.45	3.60	1.65	1.45	0.90		0.90	1.35	1.45	2.45	3.60	3.60	4.75	6.65	7.25	7.40	5.45	6.10	6.75	7.25	7.25	8.80	8.80
9	3.60	2.90	4.00	2.15	1.65	1.35	0.90		0.90	0.90	1.65	2.90	2.90	4.35	6.10	6.50	6.65	4.75	5.15	5.95	6.50	6.50	7.55	7.55
10	4.00	3.00	4.35	2.45	2.15	1.45	1.35	0.90		0.90	1.45	2.45	2.45	4.00	5.45	6.10	6.50	4.60	4.75	5.65	6.10	6.10	7.40	7.40
11	4.35	3.60	4.60	2.90	2.45	1.65	1.45	0.90	0.90		0.90	1.65	1.65	3.00	4.75	5.15	5.45	4.00	4.35	4.80	5.15	5.15	6.65	6.65
12	5.15	4.60	5.45	4.00	3.60	2.90	2.45	1.65	1.45	0.90		1.20	1.20	2.45	4.35	4.60	4.75	3.00	3.60	4.15	4.60	4.60	6.10	6.10
13	6.50	5.45	6.65	4.75	4.60	4.00	3.60	2.90	2.45	1.65	1.20		0.90	1.45	3.00	3.60	4.00	2.15	2.45	3.20	3.60	3.60	4.75	4.75
13A	6.50	5.45	6.65	4.75	4.60	4.00	3.60	2.90	2.45	1.65	1.20	0.90		0.90	3.00	3.00	4.00	2.15	2.45	3.20	3.60	3.60	4.75	4.75
14	7.55	7.25	8.05	6.50	6.10	5.15	4.75	4.35	4.00	3.00	2.45	1.45	0.90		1.65	2.15	2.45	0.90	1.35	1.75	2.15	2.15	3.60	3.60
14A	9.55	9.05	9.70	8.05	7.55	7.25	6.65	6.10	5.45	4.75	4.35	3.00	3.00	1.65		0.90	1.35	2.45	2.90	3.50	4.00	4.00	5.15	5.15
14B	9.70	9.10	10.25	8.80	8.05	7.40	7.25	6.50	6.10	5.15	4.60	3.60	3.00	2.15	0.90		0.90	2.90	3.00	4.00	4.35	4.35	5.45	5.45
14C	10.25	9.55	10.65	9.05	8.80	7.55	7.40	6.65	6.50	5.45	4.75	4.00	4.00	2.45	1.35	0.90		3.00	3.60	4.15	4.60	4.60	6.10	6.10
15E	8.80	7.55	9.05	7.25	6.65	6.10	5.45	4.75	4.60	4.00	3.00	2.15	2.15	0.90	2.45	2.90	3.00		0.90	1.05	1.45	1.45	2.90	2.90
15W	9.05	8.05	9.10	7.40	7.25	6.50	6.10	5.15	4.75	4.35	3.60	2.45	2.45	1.35	2.90	3.00	3.60	0.90		1.20	1.35	1.35	2.45	2.45
15X	9.55	8.65	9.95	8.35	7.55	7.05	6.75	5.95	5.65	4.80	4.15	3.20	3.20	1.75	3.50	4.00	4.15	1.05	1.20		0.35			0.80
16E	9.70	9.10	10.25	8.80	8.05	7.40	7.25	6.50	6.10	5.15	4.60	3.60	3.60	2.15	4.00	4.35	4.60	1.45	1.35	0.35				
16W	9.70	9.10	10.25	8.80	8.05	7.40	7.25	6.50	6.10	5.15	4.60	3.60	3.60	2.15	4.00	4.35	4.60	1.45	1.35					1.45
18E	11.25	10.65	11.80	9.70	9.55	9.05	8.80	7.55	7.40	6.65	6.10	4.75	4.75	3.60	5.15	5.45	6.10	2.90	2.45	0.80				
18W	11.25	10.65	11.80	9.70	9.55	9.05	8.80	7.55	7.40	6.65	6.10	4.75	4.75	3.60	5.15	5.45	6.10	2.90	2.45			1.45		

Cash Only Toll Rate Schedule – Class 1 Passenger Cars (2 Axles) assumed in the NJRTM-E

	4	5	6	7	7A	8	8A	9	10	11	12	13	13A	14	14A	14B	14C	15E	15W	15X	16E	16W	18E	18W
4	0.00	0.53	1.6	1.43	1.96	2.49	3.02	3.73	4.26	4.79	5.50	6.30	6.83	7.48	8.98	9.88	10.58	8.03	8.73	9.58	9.93	9.93	11.00	11.38
5	0.53	0.00	1.07	0.90	1.43	1.96	2.49	3.20	3.73	4.26	4.97	5.77	6.30	6.95	8.45	9.35	10.05	7.50	8.20	9.05	9.40	9.40	10.47	10.85
6	1.60	1.07	0.00	1.97	2.50	3.03	3.56	4.27	4.80	5.33	6.04	6.84	7.37	8.02	9.52	10.42	11.12	8.57	9.27	10.12	10.47	10.47	11.54	11.92
7	1.43	0.90	1.97	0.00	0.53	1.06	1.59	2.30	2.83	3.36	4.07	4.87	5.40	6.05	7.55	8.45	9.15	6.60	7.30	8.15	8.50	8.50	9.57	9.95
7A	1.96	1.43	2.50	0.53	0.00	0.53	1.06	1.77	2.30	2.83	3.54	4.34	4.87	5.52	7.02	7.92	8.62	6.07	6.77	7.62	7.97	7.97	9.04	9.42
8	2.49	1.96	3.03	1.06	0.53	0.00	0.53	1.24	1.77	2.30	3.01	3.81	4.34	4.99	6.49	7.39	8.09	5.54	6.24	7.09	7.44	7.44	8.51	8.89
8A	3.02	2.49	3.56	1.59	1.06	0.53	0.00	0.71	1.24	1.77	2.48	3.28	3.81	4.46	5.96	6.86	7.56	5.01	5.71	6.56	6.91	6.91	7.98	8.36
9	3.73	3.20	4.27	2.30	1.77	1.24	0.71	0.00	0.53	1.06	1.77	2.57	3.10	3.75	5.25	6.15	6.85	4.30	5.00	5.85	6.20	6.20	7.27	7.65
10	4.26	3.73	4.80	2.83	2.30	1.77	1.24	0.53	0.00	0.53	1.24	2.04	2.57	3.22	4.72	5.62	6.32	3.77	4.47	5.32	5.67	5.67	6.74	7.12
11	4.79	4.26	5.33	3.36	2.83	2.30	1.77	1.06	0.53	0.00	0.71	1.51	2.04	2.69	4.19	5.09	5.79	3.24	3.94	4.79	5.14	5.14	6.21	6.59
12	5.50	4.97	6.04	4.07	3.54	3.01	2.48	1.77	1.24	0.71	0.00	0.80	1.33	1.98	3.48	4.38	5.08	2.53	3.23	4.08	4.43	4.43	5.50	5.88
13	6.30	5.77	6.84	4.87	4.34	3.81	3.28	2.57	2.04	1.51	0.80	0.00	0.53	1.18	2.68	3.58	4.28	1.73	2.43	3.28	3.63	3.63	4.70	5.08
13A	6.83	6.30	7.37	5.40	4.87	4.34	3.81	3.10	2.57	2.04	1.33	0.53	0.00	0.65	2.15	3.05	3.75	1.20	1.90	2.75	3.10	3.10	4.17	4.55
14	7.48	6.95	8.02	6.05	5.52	4.99	4.46	3.75	3.22	2.69	1.98	1.18	0.65	0.00	1.50	2.40	3.10	0.55	1.25	2.10	2.45	2.45	3.52	3.90
14A	8.98	8.45	9.52	7.55	7.02	6.49	5.96	5.25	4.72	4.19	3.48	2.68	2.15	1.50	0.00	0.90	1.60	2.05	2.75	3.60	3.95	3.95	5.02	5.40
14B	9.88	9.35	10.42	8.45	7.92	7.39	6.86	6.15	5.62	5.09	4.38	3.58	3.05	2.40	0.90	0.00	0.70	2.95	3.65	4.50	4.85	4.85	5.92	6.30
14C	10.58	10.05	11.12	9.15	8.62	8.09	7.56	6.85	6.32	5.79	5.08	4.28	3.75	3.10	1.60	0.70	0.00	3.65	4.35	5.20	5.55	5.55	6.62	7.00
15E	8.03	7.50	8.57	6.60	6.07	5.54	5.01	4.30	3.77	3.24	2.53	1.73	1.20	0.55	2.05	2.95	3.65	0.00	0.70	1.55	1.90	1.90	2.97	3.35
15W	8.73	8.20	9.27	7.30	6.77	6.24	5.71	5.00	4.47	3.94	3.23	2.43	1.90	1.25	2.75	3.65	4.35	0.70	0.00	0.85	1.20	1.20	2.27	2.65
15X	9.58	9.05	10.12	8.15	7.62	7.09	6.56	5.85	5.32	4.79	4.08	3.28	2.75	2.10	3.60	4.50	5.20	1.55	0.85	0.00	0.35		1.42	
16E	9.93	9.40	10.47	8.50	7.97	7.44	6.91	6.20	5.67	5.14	4.43	3.63	3.10	2.45	3.95	4.85	5.55	1.90	1.20	0.35	0.00		1.07	
16W	9.93	9.40	10.47	8.50	7.97	7.44	6.91	6.20	5.67	5.14	4.43	3.63	3.10	2.45	3.95	4.85	5.55	1.90	1.20			0.00		1.45
18E	11.00	10.47	11.54	9.57	9.04	8.51	7.98	7.27	6.74	6.21	5.50	4.70	4.17	3.52	5.02	5.92	6.62	2.97	2.27	1.42	1.07		0.00	
18W	11.38	10.85	11.92	9.95	9.42	8.89	8.36	7.65	7.12	6.59	5.88	5.08	4.55	3.90	5.40	6.30	7.00	3.35	2.65			1.45		0.00

APPENDIX C – COUNTY PRODUCTION ADJUSTMENT FACTORS BY INCOME

Purpose	County	INC1	INC2	INC3	INC4	INC5	Purpose	County	INC1	INC2	INC3	INC4	INC5
HBWD	Bergen	0.7337	1.7259	0.9344	0.8103	0.9931	HBU	Bergen	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Essex	0.9385	1.3141	0.8584	0.8781	0.6802	HBU	Essex	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Hudson	2.7722	1.9978	0.9061	0.8246	0.5946	HBU	Hudson	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Hunterdon	0.5269	0.9062	0.6645	0.6836	0.9258	HBU	Hunterdon	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Mercer	0.3000	1.1709	0.8049	1.0139	0.6136	HBU	Mercer	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Middlesex	0.6672	1.4208	1.0433	1.0229	0.4018	HBU	Middlesex	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Monmouth	0.5751	1.1296	0.8315	0.6329	0.7794	HBU	Monmouth	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Morris	0.3000	2.1633	0.9420	0.7172	0.5639	HBU	Morris	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Ocean	0.5769	1.5721	0.6364	0.6094	0.3573	HBU	Ocean	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Passaic	2.0054	1.5755	0.9172	0.7713	0.8544	HBU	Passaic	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Somerset	0.3024	1.3045	0.9500	0.9427	0.5502	HBU	Somerset	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Sussex	0.5043	1.2289	0.8866	0.7629	0.4922	HBU	Sussex	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Union	0.3005	1.9065	0.8845	1.1125	0.5183	HBU	Union	1.0000	1.0000	1.0000	1.0000	1.0000
HBWD	Warren	0.8509	1.2777	0.8125	0.6545	0.3167	HBU	Warren	1.0000	1.0000	1.0000	1.0000	1.0000
HBWS	Bergen	0.9882	3.9371	0.9020	1.1488	0.7528	NHBW	Bergen	3.7501	0.4861	0.8131	0.3649	0.5551
HBWS	Essex	0.9981	1.3682	0.6817	0.9508	0.7076	NHBW	Essex	3.7256	2.5245	1.4789	1.1540	0.7392
HBWS	Hudson	1.5901	1.1802	0.6767	0.7468	0.8118	NHBW	Hudson	2.9871	0.6039	3.1047	1.6567	0.8529
HBWS	Hunterdon	0.8684	2.1022	0.5170	0.3655	0.3004	NHBW	Hunterdon	0.3000	0.7785	0.6233	0.3000	0.6806
HBWS	Mercer	0.8939	1.0721	1.0086	0.9839	0.7965	NHBW	Mercer	0.3000	3.7601	0.8510	0.5573	0.3000
HBWS	Middlesex	0.8645	1.9177	1.0371	0.8178	0.5790	NHBW	Middlesex	3.7476	1.6352	0.9979	0.6752	0.4220
HBWS	Monmouth	0.3520	0.9230	0.8403	0.5593	0.6806	NHBW	Monmouth	3.7725	2.7563	0.8167	0.8897	1.4902
HBWS	Morris	0.9945	0.9074	0.7170	0.7386	0.5722	NHBW	Morris	0.3255	0.6145	1.3681	0.9252	0.6704
HBWS	Ocean	2.0548	1.2116	0.6813	0.7452	0.3406	NHBW	Ocean	0.8054	1.1495	2.1972	1.3705	0.8198
HBWS	Passaic	2.2494	1.3748	0.9158	0.8784	0.6470	NHBW	Passaic	3.7696	0.3000	1.2520	0.3808	0.4107
HBWS	Somerset	0.9288	1.7115	0.8503	0.7385	0.9324	NHBW	Somerset	0.3660	0.4786	1.6190	0.9652	0.5157
HBWS	Sussex	1.7902	1.5214	1.8425	0.6050	0.7770	NHBW	Sussex	3.7868	3.7636	3.1306	1.3300	3.5858
HBWS	Union	1.9907	1.5219	1.6048	1.3505	0.8559	NHBW	Union	0.3000	0.6418	1.1047	1.6038	0.5680
HBWS	Warren	2.0373	0.9684	0.6826	0.5578	0.3007	NHBW	Warren	0.3000	0.3700	0.3000	0.7768	0.3000
HBS	Bergen	0.6010	2.0211	1.7866	1.2434	0.6576	NHBO	Bergen	0.7339	1.1371	0.9248	0.9375	0.5608
HBS	Essex	0.6792	1.2223	1.2003	0.9563	0.5453	NHBO	Essex	0.6108	0.7624	0.7507	0.6887	0.7101
HBS	Hudson	1.5202	1.5322	1.1676	0.7557	0.3057	NHBO	Hudson	1.0975	1.0316	0.4350	0.5881	1.9490
HBS	Hunterdon	0.3174	0.7646	1.1083	0.8365	0.3585	NHBO	Hunterdon	0.8529	0.7102	0.9211	1.0637	1.4255
HBS	Mercer	0.5615	0.9834	1.4392	0.9435	0.6203	NHBO	Mercer	0.5025	0.5536	0.9991	1.0683	1.3882
HBS	Middlesex	0.6535	1.0981	1.3171	0.8308	0.3067	NHBO	Middlesex	0.3353	0.7193	0.8636	0.8590	1.7016
HBS	Monmouth	1.7208	0.7766	1.0020	1.2718	0.6093	NHBO	Monmouth	0.8730	0.5712	1.0218	0.7263	0.8256
HBS	Morris	0.5512	1.1203	0.8606	0.6704	0.5539	NHBO	Morris	0.6638	1.6815	0.7307	0.7149	0.8129
HBS	Ocean	0.9365	1.1336	0.9373	1.0932	0.5766	NHBO	Ocean	0.6941	1.1824	0.7774	0.4834	3.6092
HBS	Passaic	2.4704	1.5560	1.5032	0.9849	0.3033	NHBO	Passaic	0.8155	1.4241	0.7717	0.8726	1.1471
HBS	Somerset	3.0603	0.5022	1.0756	0.8579	0.6501	NHBO	Somerset	1.8093	1.3282	0.8151	0.8449	1.1028
HBS	Sussex	0.3000	0.5270	1.0612	0.7529	0.3000	NHBO	Sussex	0.5208	0.6046	0.9038	0.7033	1.3629
HBS	Union	0.4786	1.1164	1.2873	0.6467	0.5110	NHBO	Union	0.3703	1.0005	0.9830	0.7793	0.7948
HBS	Warren	0.3781	1.3735	1.0183	1.3546	0.4357	NHBO	Warren	0.4773	1.2291	1.5140	1.0425	3.8351
HBO	Bergen	0.6806	1.4215	1.5453	1.3149	0.9035							
HBO	Essex	1.0468	1.1074	1.2429	1.1129	1.1534							
HBO	Hudson	1.7912	1.0648	0.8869	0.5380	0.7262							
HBO	Hunterdon	0.6759	0.7085	0.8575	0.9390	0.3526							
HBO	Mercer	0.3807	0.7060	0.8928	0.9737	0.8956							
HBO	Middlesex	0.4448	0.9082	1.0957	0.9906	0.6991							
HBO	Monmouth	1.2261	0.8056	1.2661	0.8293	1.3689							
HBO	Morris	0.3417	1.1898	0.9974	0.8850	0.9944							
HBO	Ocean	0.7329	1.2478	1.0799	0.5379	0.4572							
HBO	Passaic	1.0293	1.6406	1.1114	1.0482	0.7594							
HBO	Somerset	1.1884	1.1459	0.8131	0.7093	0.7860							
HBO	Sussex	0.4718	0.7166	1.2466	0.6507	0.4823							
HBO	Union	0.4412	1.1147	1.3077	1.2608	0.9404							
HBO	Warren	0.3015	0.8824	1.0932	0.9091	0.5189							

APPENDIX D – TRIP PRODUCTIONS BY COUNTY & INCOME GROUP

HBWD - PRODUCTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.
Bergen	4,716	4,716	0.0%	72,664	72,664	0.0%	156,267	156,266	0.0%	182,534	182,533	0.0%	94,524	94,524	0.0%	510,705	510,703	0.0%
Essex	14,094	14,094	0.0%	84,029	84,029	0.0%	121,605	121,604	0.0%	115,527	115,526	0.0%	38,669	38,669	0.0%	373,924	373,923	0.0%
Hudson	23,063	23,063	0.0%	91,614	91,614	0.0%	118,405	118,405	0.0%	106,705	106,705	0.0%	28,223	28,223	0.0%	368,010	368,010	0.0%
Hunterdon	349	349	0.0%	4,253	4,253	0.0%	14,332	14,332	0.0%	24,231	24,230	0.0%	12,723	12,723	0.0%	55,886	55,886	0.0%
Mercer	585	585	0.0%	30,085	30,085	0.0%	60,239	60,239	0.0%	78,877	78,877	0.0%	15,721	15,721	0.0%	185,506	185,506	0.0%
Middlesex	5,425	5,425	0.0%	69,628	69,629	0.0%	178,528	178,527	0.0%	196,075	196,076	0.0%	21,940	21,940	0.0%	471,597	471,598	0.0%
Monmouth	2,958	2,958	0.0%	38,115	38,115	0.0%	107,295	107,295	0.0%	109,356	109,356	0.0%	52,500	52,500	0.0%	310,223	310,224	0.0%
Morris	482	482	0.0%	45,177	45,177	0.0%	85,585	85,585	0.0%	102,206	102,206	0.0%	37,651	37,651	0.0%	271,101	271,101	0.0%
Ocean	5,037	5,037	0.0%	81,894	81,894	0.0%	99,403	99,403	0.0%	84,669	84,669	0.0%	9,611	9,611	0.0%	280,613	280,613	0.0%
Passaic	15,360	15,360	0.0%	55,052	55,052	0.0%	85,668	85,668	0.0%	69,069	69,069	0.0%	18,694	18,694	0.0%	243,843	243,843	0.0%
Somerset	210	210	0.0%	19,654	19,654	0.0%	57,467	57,467	0.0%	83,559	83,559	0.0%	25,045	25,045	0.0%	185,935	185,935	0.0%
Sussex	635	635	0.0%	10,575	10,575	0.0%	29,008	29,008	0.0%	29,308	29,308	0.0%	4,854	4,854	0.0%	74,380	74,380	0.0%
Union	1,249	1,249	0.0%	64,218	64,218	0.0%	90,267	90,267	0.0%	120,685	120,685	0.0%	22,151	22,151	0.0%	298,570	298,571	0.0%
Warren	1,052	1,052	0.0%	9,984	9,984	0.0%	20,777	20,777	0.0%	16,279	16,279	0.0%	1,474	1,475	0.0%	49,567	49,567	0.0%
TOTAL	75,216	75,216	0.0%	676,942	676,942	0.0%	1,224,846	1,224,843	0.0%	1,319,078	1,319,079	0.0%	383,780	383,780	0.0%	3,679,861	3,679,860	0.0%

HBWS - PRODUCTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.
Bergen	876	876	0.0%	51,345	51,345	0.0%	50,160	50,159	0.0%	95,584	95,584	0.0%	30,703	30,703	0.0%	228,668	228,667	0.0%
Essex	1,953	1,953	0.0%	24,817	24,817	0.0%	29,367	29,368	0.0%	43,140	43,140	0.0%	16,476	16,476	0.0%	115,754	115,754	0.0%
Hudson	1,477	1,477	0.0%	13,237	13,237	0.0%	22,591	22,591	0.0%	24,689	24,689	0.0%	9,266	9,266	0.0%	71,260	71,260	0.0%
Hunterdon	89	89	0.0%	3,567	3,567	0.0%	4,427	4,427	0.0%	5,742	5,742	0.0%	1,885	1,885	0.0%	15,710	15,710	0.0%
Mercer	653	653	0.0%	8,940	8,940	0.0%	26,308	26,308	0.0%	29,240	29,240	0.0%	9,308	9,308	0.0%	74,449	74,449	0.0%
Middlesex	978	978	0.0%	28,844	28,844	0.0%	58,288	58,288	0.0%	56,249	56,249	0.0%	13,136	13,136	0.0%	157,496	157,495	0.0%
Monmouth	249	249	0.0%	9,783	9,783	0.0%	36,994	36,994	0.0%	36,675	36,675	0.0%	20,448	20,448	0.0%	104,149	104,149	0.0%
Morris	424	424	0.0%	6,054	6,054	0.0%	22,583	22,583	0.0%	40,461	40,461	0.0%	17,332	17,332	0.0%	86,853	86,853	0.0%
Ocean	2,779	2,779	0.0%	21,894	21,894	0.0%	38,945	38,945	0.0%	39,891	39,891	0.0%	4,073	4,073	0.0%	107,581	107,580	0.0%
Passaic	2,508	2,508	0.0%	14,913	14,913	0.0%	28,624	28,624	0.0%	29,111	29,111	0.0%	6,086	6,086	0.0%	81,242	81,242	0.0%
Somerset	298	298	0.0%	8,209	8,209	0.0%	17,858	17,858	0.0%	25,576	25,576	0.0%	19,468	19,468	0.0%	71,408	71,408	0.0%
Sussex	338	338	0.0%	4,507	4,507	0.0%	22,730	22,730	0.0%	9,550	9,550	0.0%	3,680	3,680	0.0%	40,804	40,804	0.0%
Union	1,758	1,758	0.0%	15,352	15,352	0.0%	51,748	51,748	0.0%	51,370	51,370	0.0%	14,736	14,736	0.0%	134,964	134,964	0.0%
Warren	392	392	0.0%	2,700	2,700	0.0%	6,897	6,897	0.0%	6,047	6,047	0.0%	637	637	0.0%	16,673	16,673	0.0%
TOTAL	14,772	14,772	0.0%	214,162	214,161	0.0%	417,519	417,519	0.0%	493,323	493,322	0.0%	167,235	167,235	0.0%	1,307,010	1,307,009	0.0%

HBS - PRODUCTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.												
Bergen	7,181	7,181	0.0%	117,754	117,754	0.0%	125,951	125,950	0.0%	127,273	127,273	0.0%	38,117	38,117	0.0%	416,276	416,276	0.0%
Essex	10,404	10,404	0.0%	72,190	72,190	0.0%	58,329	58,329	0.0%	48,928	48,928	0.0%	17,207	17,207	0.0%	207,057	207,057	0.0%
Hudson	11,134	11,133	0.0%	49,553	49,553	0.0%	37,129	37,129	0.0%	24,552	24,552	0.0%	4,434	4,434	0.0%	126,801	126,802	0.0%
Hunterdon	517	517	0.0%	6,214	6,214	0.0%	11,737	11,737	0.0%	15,174	15,174	0.0%	3,302	3,302	0.0%	36,945	36,945	0.0%
Mercer	4,183	4,183	0.0%	31,920	31,920	0.0%	47,931	47,931	0.0%	35,348	35,348	0.0%	10,171	10,171	0.0%	129,552	129,552	0.0%
Middlesex	9,881	9,881	0.0%	78,523	78,522	0.0%	107,868	107,868	0.0%	79,399	79,399	0.0%	11,117	11,117	0.0%	286,786	286,786	0.0%
Monmouth	18,243	18,243	0.0%	39,111	39,111	0.0%	59,148	59,148	0.0%	107,754	107,754	0.0%	26,353	26,353	0.0%	250,609	250,609	0.0%
Morris	3,912	3,912	0.0%	39,287	39,287	0.0%	38,217	38,217	0.0%	47,987	47,987	0.0%	23,847	23,847	0.0%	153,249	153,250	0.0%
Ocean	17,079	17,079	0.0%	80,948	80,948	0.0%	67,650	67,651	0.0%	78,817	78,817	0.0%	10,384	10,384	0.0%	254,880	254,879	0.0%
Passaic	26,029	26,029	0.0%	64,980	64,980	0.0%	60,882	60,882	0.0%	41,138	41,138	0.0%	4,134	4,134	0.0%	197,162	197,162	0.0%
Somerset	14,684	14,684	0.0%	11,791	11,791	0.0%	30,604	30,604	0.0%	36,184	36,184	0.0%	17,997	17,996	0.0%	111,260	111,260	0.0%
Sussex	509	509	0.0%	6,848	6,848	0.0%	16,456	16,456	0.0%	14,223	14,223	0.0%	1,806	1,806	0.0%	39,842	39,842	0.0%
Union	4,525	4,525	0.0%	46,597	46,597	0.0%	55,511	55,511	0.0%	31,734	31,734	0.0%	13,587	13,587	0.0%	151,953	151,954	0.0%
Warren	922	922	0.0%	16,088	16,088	0.0%	12,556	12,556	0.0%	17,035	17,035	0.0%	1,329	1,329	0.0%	47,931	47,931	0.0%
TOTAL	129,202	129,202	0.0%	661,804	661,803	0.0%	729,969	729,968	0.0%	705,546	705,546	0.0%	183,784	183,784	0.0%	2,410,305	2,410,303	0.0%

HBO - PRODUCTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.
Bergen	29,518	29,493	-0.1%	230,322	230,130	-0.1%	466,945	466,583	-0.1%	620,810	620,429	-0.1%	164,385	164,323	0.0%	1,511,981	1,510,957	-0.1%
Essex	71,748	71,759	0.0%	207,287	207,316	0.0%	264,560	264,597	0.0%	262,470	262,510	0.0%	106,647	106,668	0.0%	912,713	912,851	0.0%
Hudson	62,647	62,583	-0.1%	122,826	122,706	-0.1%	142,341	142,198	-0.1%	88,506	88,406	-0.1%	29,467	29,422	-0.2%	445,787	445,315	-0.1%
Hunterdon	3,650	3,650	0.0%	14,627	14,627	0.0%	37,061	37,060	0.0%	77,165	77,160	0.0%	10,372	10,371	0.0%	142,875	142,867	0.0%
Mercer	11,776	11,778	0.0%	69,972	69,981	0.0%	130,966	130,982	0.0%	168,406	168,423	0.0%	44,572	44,576	0.0%	425,691	425,739	0.0%
Middlesex	25,334	25,331	0.0%	185,349	185,329	0.0%	381,276	381,255	0.0%	433,621	433,629	0.0%	75,246	75,252	0.0%	1,100,825	1,100,796	0.0%
Monmouth	45,088	45,082	0.0%	108,274	108,258	0.0%	308,697	308,643	0.0%	318,742	318,693	0.0%	183,240	183,220	0.0%	964,041	963,896	0.0%
Morris	7,919	7,922	0.0%	104,459	104,499	0.0%	174,550	174,618	0.0%	275,163	275,272	0.0%	127,953	128,009	0.0%	690,044	690,320	0.0%
Ocean	46,414	46,413	0.0%	256,300	256,298	0.0%	331,168	331,169	0.0%	173,217	173,221	0.0%	26,071	26,072	0.0%	833,169	833,173	0.0%
Passaic	41,390	41,398	0.0%	198,181	198,217	0.0%	187,567	187,599	0.0%	199,429	199,462	0.0%	32,235	32,240	0.0%	658,802	658,915	0.0%
Somerset	20,133	20,138	0.0%	72,310	72,324	0.0%	97,236	97,257	0.0%	140,504	140,546	0.0%	68,944	68,980	0.1%	399,129	399,245	0.0%
Sussex	4,383	4,383	0.0%	25,801	25,803	0.0%	82,205	82,212	0.0%	58,596	58,602	0.0%	9,899	9,901	0.0%	180,884	180,901	0.0%
Union	17,123	17,125	0.0%	142,487	142,510	0.0%	247,893	247,947	0.0%	284,832	284,912	0.0%	71,732	71,755	0.0%	764,067	764,249	0.0%
Warren	2,717	2,717	0.0%	29,351	29,355	0.0%	58,036	58,045	0.0%	55,816	55,824	0.0%	5,550	5,551	0.0%	151,470	151,492	0.0%
TOTAL	389,840	389,772	0.0%	1,767,545	1,767,353	0.0%	2,910,500	2,910,165	0.0%	3,157,279	3,157,089	0.0%	956,314	956,339	0.0%	9,181,478	9,180,718	0.0%

NHBW - PRODUCTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.
Bergen	1,932	1,932	0.0%	13,429	13,429	0.0%	65,219	65,220	0.0%	54,545	54,545	0.0%	17,726	17,726	0.0%	152,851	152,851	0.0%
Essex	3,367	3,367	0.0%	19,563	19,563	0.0%	47,202	47,202	0.0%	46,003	46,003	0.0%	15,201	15,201	0.0%	131,337	131,336	0.0%
Hudson	2,969	2,969	0.0%	8,703	8,703	0.0%	38,226	38,226	0.0%	17,702	17,702	0.0%	5,822	5,822	0.0%	73,422	73,422	0.0%
Hunterdon	182	182	0.0%	1,621	1,621	0.0%	2,758	2,758	0.0%	3,990	3,990	0.0%	857	857	0.0%	9,408	9,408	0.0%
Mercer	1,338	1,338	0.0%	19,578	19,578	0.0%	23,521	23,521	0.0%	14,059	14,059	0.0%	4,976	4,976	0.0%	63,472	63,472	0.0%
Middlesex	1,835	1,835	0.0%	19,535	19,535	0.0%	50,294	50,294	0.0%	45,761	45,761	0.0%	7,979	7,979	0.0%	125,404	125,404	0.0%
Monmouth	5,270	5,270	0.0%	18,268	18,268	0.0%	30,567	30,567	0.0%	42,604	42,604	0.0%	24,138	24,139	0.0%	120,847	120,847	0.0%
Morris	868	868	0.0%	10,987	10,987	0.0%	31,913	31,913	0.0%	43,587	43,587	0.0%	21,633	21,633	0.0%	108,988	108,988	0.0%
Ocean	650	650	0.0%	15,591	15,591	0.0%	35,282	35,282	0.0%	19,635	19,635	0.0%	3,860	3,860	0.0%	75,018	75,018	0.0%
Passaic	3,740	3,740	0.0%	9,723	9,723	0.0%	25,428	25,428	0.0%	16,482	16,481	0.0%	3,017	3,017	0.0%	58,389	58,389	0.0%
Somerset	610	610	0.0%	2,083	2,083	0.0%	22,080	22,080	0.0%	27,118	27,118	0.0%	8,749	8,749	0.0%	60,640	60,640	0.0%
Sussex	1,494	1,494	0.0%	3,373	3,373	0.0%	11,090	11,090	0.0%	6,180	6,180	0.0%	1,835	1,835	0.0%	23,972	23,972	0.0%
Union	1,449	1,449	0.0%	6,562	6,562	0.0%	27,484	27,483	0.0%	31,869	31,869	0.0%	6,900	6,900	0.0%	74,264	74,264	0.0%
Warren	283	283	0.0%	453	453	0.0%	1,016	1,016	0.0%	5,079	5,079	0.0%	254	254	0.0%	7,085	7,085	0.0%
TOTAL	25,986	25,986	0.0%	149,470	149,470	0.0%	412,080	412,079	0.0%	374,614	374,613	0.0%	122,947	122,947	0.0%	1,085,096	1,085,096	0.0%

NHBO - PRODUCTION

County	Income 1			Income 2			Income 3			Income 4			Income 5			Total		
	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.	Observed	Estimated	%Diff.
Bergen	15,665	16,887	7.8%	159,262	161,404	1.3%	246,296	244,823	-0.6%	298,321	296,472	-0.6%	57,220	56,968	-0.4%	776,764	776,555	0.0%
Essex	26,820	26,820	0.0%	118,835	118,732	-0.1%	162,771	162,746	0.0%	139,855	139,968	0.1%	40,994	41,013	0.0%	489,276	489,278	0.0%
Hudson	27,476	27,063	-1.5%	82,161	81,594	-0.7%	60,916	60,411	-0.8%	39,519	40,379	2.2%	10,565	10,909	3.3%	220,635	220,356	-0.1%
Hunterdon	2,478	2,483	0.2%	13,646	13,667	0.2%	10,579	10,587	0.1%	29,580	29,575	0.0%	3,688	3,673	-0.4%	59,970	59,985	0.0%
Mercer	13,201	13,237	0.3%	56,710	56,764	0.1%	107,317	107,352	0.0%	75,474	75,440	0.0%	21,653	21,614	-0.2%	274,359	274,407	0.0%
Middlesex	10,073	10,153	0.8%	103,580	103,798	0.2%	190,776	190,960	0.1%	158,150	157,779	-0.2%	27,696	27,696	0.0%	490,275	490,386	0.0%
Monmouth	26,836	26,856	0.1%	85,492	85,504	0.0%	188,459	188,460	0.0%	212,701	212,568	-0.1%	62,417	62,480	0.1%	575,904	575,868	0.0%
Morris	12,503	12,338	-1.3%	112,711	112,620	-0.1%	87,827	87,824	0.0%	141,535	141,645	0.1%	52,355	52,343	0.0%	406,932	406,770	0.0%
Ocean	32,396	32,397	0.0%	211,417	211,451	0.0%	146,276	146,289	0.0%	98,502	98,475	0.0%	13,208	13,198	-0.1%	501,799	501,811	0.0%
Passaic	32,083	32,063	-0.1%	155,519	155,285	-0.2%	122,692	122,558	-0.1%	91,483	91,643	0.2%	13,193	13,262	0.5%	414,970	414,812	0.0%
Somerset	21,070	21,073	0.0%	24,947	24,934	-0.1%	48,896	48,892	0.0%	79,274	79,263	0.0%	30,404	30,434	0.1%	204,593	204,594	0.0%
Sussex	8,412	8,413	0.0%	13,815	13,816	0.0%	23,866	23,865	0.0%	23,688	23,687	0.0%	2,124	2,125	0.0%	71,904	71,906	0.0%
Union	9,899	10,064	1.7%	90,658	90,917	0.3%	126,639	126,603	0.0%	95,512	95,268	-0.3%	28,501	28,496	0.0%	351,209	351,349	0.0%
Warren	724	869	20.1%	10,481	10,651	1.6%	15,416	15,340	-0.5%	23,877	23,597	-1.2%	3,359	3,335	-0.7%	53,857	53,793	-0.1%
TOTAL	239,636	240,717	0.5%	1,239,235	1,241,137	0.2%	1,538,726	1,536,710	-0.1%	1,507,475	1,505,760	-0.1%	367,378	367,548	0.0%	4,892,449	4,891,871	0.0%

APPENDIX E – FRICTION-FACTORS FOR HBWD AND HBWS PURPOSES

CI	HBWD					HBWS				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
1	29637	29637	427607	217786	217786	3261	1492	815	0	696
2	607831	607831	2047466	935715	935715	118830	15955	11189	64	17724
3	2514316	2514316	5016166	4010353	4010353	666029	183823	48800	2184	103685
4	5399863	5399863	8835229	6749818	6749818	1734572	464159	133080	21463	332122
5	12146512	12146512	14646433	9764162	9764162	2968237	931427	280570	106367	764824
6	14513261	14513261	18084424	14716840	14716840	3894372	1616275	125667	341877	1429460
7	14824883	14824883	20127223	18296693	18296693	4253655	2537031	201223	815006	2313252
8	13501501	13501501	20857837	72012961	72012961	5687782	3700467	296776	1561232	3368874
9	11264453	11264453	20560230	84883841	84883841	4903305	5103152	411063	2530625	4526623
10	8770285	8770285	19528072	94895576	94895576	7797538	6733079	541847	3595528	5707910
11	6456934	6456934	17979558	101503291	101503291	24889489	285712	686185	110207480	20510789
12	4539220	4539220	18478827	107030640	107030640	17562968	353129	840689	128889931	23547090
13	3069682	3069682	19060243	109585651	109585651	11843652	425760	1001755	139999053	26086559
14	2008453	2008453	17824297	107558241	107558241	7684244	502597	1165765	142788195	28036067
15	1277224	1277224	18363502	105119228	105119228	4822374	582595	1329238	413825820	29353391
16	792331	792331	18882231	173064634	173064634	2939897	664700	1488953	381331110	30040537
17	480935	480935	19345861	161142823	161142823	1747198	747884	1642032	337098761	30134606
18	286344	286344	17553914	146691650	146691650	1015211	831157	1785994	287239836	29697913
19	167579	167579	17805752	132728791	132728791	578142	913593	1918781	236860326	28808573
20	96571	96571	17971142	118750738	118750738	323350	994337	2038766	442525613	128577291
21	54881	54881	18048353	28776440	28776440	177925	1072616	2144741	345045858	121406328
22	30797	30797	15786558	25060084	25060084	96469	1147745	2235893	262638009	113312300
23	17085	17085	15706942	22718474	22718474	51605	1219125	2311775	195573830	104645323
24	9378	9378	15562117	20569143	20569143	27268	1286251	2372268	142740610	95710744
25	5098	5098	15358150	18622929	18622929	14246	1348705	2417535	102277441	86764653
26	2747	2747	12944322	15683727	15683727	1228	1406151	2447987	72050286	78013365
27	1468	1468	12684627	14150879	14150879	629	1458339	2464233	49965707	69615781
28	779	779	12390831	12802801	12802801	319	1505090	2467047	34149548	61687627
29	410	410	12068143	11622794	11622794	161	1546298	2457327	23025994	54306786
30	214	214	9767925	9479521	9479521	80	1581919	2436061	15331020	47519080
31	112	112	9462895	7019862	7019862	40	1611968	2404298	10087938	41344060
32	58	58	914552	1812613	1812613	20	1636512	2363118	6565046	35780483
33	30	30	881839	1546323	1546323	10	1655660	2313613	4228363	30811268
34	15	15	848489	1324961	1324961	5	1669562	2256863	2696961	26407835
35	8	8	814764	1141358	1141358	2	1678402	2193920	1704475	22533786
36	4	4	780897	989249	989249	1	1682391	2125800	1067934	19147936
37	2	2	747097	863231	863231	1	1681761	2053465	663655	16206738
38	1	1	713549	758703	758703	0	1676764	1977821	409236	13666161
39	0	0	680411	671788	671788	0	1667664	1899708	250504	11483098
40	0	0	647821	599247	599247	0	1654734	1819901	152274	9616368
41	0	0	615897	459300	459300	0	1638254	1739107	13136	1720156
42	0	0	584737	425354	425354	0	1618505	1657961	7882	1431562
43	0	0	554423	395385	395385	0	1595770	1577031	4701	1187936
44	0	0	525020	368687	368687	0	1570327	1496819	2788	983048
45	0	0	496580	344692	344692	0	1542451	1417764	1644	811351
46	0	0	469142	322941	322941	0	1512407	1340241	965	667953
47	0	0	442733	303070	303070	0	1480454	1264572	563	548572
48	0	0	417371	284789	284789	0	1446843	1191023	327	449486
49	0	0	393066	267865	267865	0	1411811	1119811	189	367480
50	0	0	369818	252114	252114	0	825352	1051110	109	299797
51	0	0	347622	237391	237391	0	803029	985051	42	162720
52	1	1	326466	223579	223579	0	780242	921730	24	132218
53	1	1	306334	210584	210584	0	757104	861207	14	107231
54	1	1	287206	198331	198331	0	733721	803517	8	86808
55	1	1	269058	186759	186759	0	710193	748667	4	70151
56	1	1	251863	175816	175816	0	686611	696642	2	56595
57	1	1	235592	165461	165461	0	663058	647409	1	45584
58	1	1	220215	155657	155657	0	213204	600917	1	36657
59	1	1	205699	146374	146374	0	20545	557103	0	29434
60	1	1	192012	137584	137584	0	1978	515892	0	23600

NJR TM-E MODEL DEVELOPMENT REPORT Version 4

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	289492608	1049187781	5802355365	37654523	225303544	408259003	353443858	47000438
7	403428991	349510521	540597663	176882557	123015959	7539518	66372601	101686250	167053327	83343619
8	195584274	468451901	407926652	401189188	356382116	16020236	104255822	200047428	235383610	93828595
9	256821447	389565431	361217487	151759792	218250976	7859732	130531666	138687340	116547577	115353748
10	118242543	304767060	354141997	173410416	119126645	3137013	17825869	61686055	68617569	27878812
11	103222513	296339507	174100957	254477810	86085660	8920839	43344214	40162071	42319905	13826515
12	183065675	116455246	147430614	208632326	130746761	5255140	24050663	51092337	53700353	17194869
13	140910486	206628967	146485650	131312242	262399385	1155355	25990626	40404225	36008661	13513131
14	111877791	58438376	89634458	77614871	96706147	5141306	13770459	18686331	24957378	7805898
15	79589061	108397350	86110088	88013916	73805105	1118697	13432614	17580650	19259255	8822041
16	108746540	54988501	40845032	62206397	81317110	2131258	9054413	11726399	9009912	4796610
17	33120510	34560823	32986578	63330631	55701059	1146387	3578378	11779629	12238731	11675253
18	2087015	24851606	28094341	32536627	24797334	780029	3231418	8776324	6446794	3511620
19	11845460	11112697	23876835	28599471	13397845	326105	3181591	5334733	2690873	737517
20	17103438	10273289	17547129	17820445	8169139	630353	4551437	1777909	3765002	1551380
21	4024447	14671247	19675912	12184905	15668172	190734	1503241	3399781	3609342	642048
22	12796223	14812278	9417324	6908043	10038156	135511	1400974	2353670	1618643	622823
23	3108522	15049706	11351274	4844801	10306387	21057	1842102	1997508	1640501	632695
24	1627585	4249581	6502306	6959060	1278474	368107	560238	1514262	969250	43212
25	1506921	8227536	3507425	1798621	5769932	115616	973663	1567578	457849	143373
26	3218514	2972183	2916138	3267878	850993	43073	975411	855756	2010018	194968
27	2067179	4360674	2852192	7238120	281894	43814	793913	459967	116703	9480
28	204897	2866488	2989078	3559516	2365270	131811	1002399	514740	485501	78589
29	0	271780	695404	1750447	3459452	165190	52530	701391	401971	97945
30	0	1472263	1519599	2831166	1390780	487	231284	35629	59445	33938
31	1443120	2397174	862735	2871155	115227	3262	183785	404188	253807	100802
32	268711	534077	1111213	548084	188308	81204	38682	657919	200872	26442
33	0	823898	281100	392491	0	0	42215	472818	86149	19899
34	0	890230	1113097	1186019	227835	165	128519	268086	110131	33774
35	0	470747	1573154	774120	39530	142	30877	131626	9134	12627
36	0	9466	192267	205364	0	41636	186520	233984	142675	10707
37	0	146045	366699	78964	0	7870	33784	64848	50403	1084
38	0	202806	7905	1126156	32281	5241	5351	30014	94070	36006
39	0	840109	690562	94878	26728	7264	15781	121068	71514	8639
40	0	191658	129761	192757	0	143	112941	147504	51122	24901
41	0	109685	309098	69446	0	6875	6768	28868	190083	6646
42	0	89703	357140	25818	0	1356	2014	49650	18407	21
43	0	235285	155020	20106	449231	586	9101	119242	20558	2295
44	485849	9683	33710	36563	0	437	2962	52379	15707	929
45	0	114675	92351	2129	12694	88	67965	1372	3768	7785
46	0	20396	131843	15715	0	799	895	49436	6102	11738
47	0	25303	44479	8582	0	1516	24463	38186	885	766
48	178855	30276	54127	1996	30741	5	10916	9846	5189	5291
49	0	0	54169	201	9434	0	18646	12427	7096	6789
50	3551	16846	0	20468	0	131	1768	3445	32131	293
51	0	11326	6005	1045	11440	279	55	1182	5584	239
52	0	1813	14872	141551	16092	9	7605	1910	2051	84
53	0	0	1322	10450	0	16075	9992	24387	2687	3283
54	0	152284	5908	4024	0	4	664	2545	52684	0
55	2676	2273	9499	0	0	30952	230	153	18290	1352
56	4943	0	7756	2781	0	0	168	7254	971	96
57	0	0	0	16842	0	0	13048	3554	3576	1899
58	0	7139	0	9692	16916	93	205	1091	292	4
59	0	0	255	57869	0	0	44963	94	1132	13758
60	0	0	0	0	0	65	539	2140	31	268

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
61	0	0	0	8041	0	0	12072	9719	199	732
62	0	3409	29212	13643	11500	0	819	294	398	0
63	0	0	1600	20014	0	0	43	8179	4252	160
64	0	26988	0	1307	0	172	108	373	5105	113
65	7860	0	0	13598	0	782	279	11	4438	4
66	0	152	250	400	0	0	875	70	60	8
67	0	0	2084	360	0	98	0	81	1201	765
68	0	0	1206	0	0	0	4	442	73	160
69	0	0	0	0	0	1527	5425	16470	2701	0
70	0	87	19	0	0	123	418	6612	23	270
71	0	0	0	11062	0	0	2369	4041	55	0
72	0	2967	0	0	0	840	0	0	78	0
73	0	0	0	0	0	209	1192	1824	7	182
74	0	0	0	0	0	0	500	93	4893	1030
75	0	1706	0	0	0	0	38	349	6	45
76	0	0	0	0	0	0	281	107	406	13
77	0	521	0	1814	0	0	2	1005	0	0
78	0	0	0	0	0	261	223	0	174	0
79	0	0	0	0	0	0	16	4	1743	150
80	0	0	0	0	0	6	0	5092	161	0
81	0	0	0	186	0	95	47	1	3	0
82	0	360	0	0	0	0	5450	25	173	0
83	0	0	176	0	0	0	134	31	630	0
84	0	0	0	0	0	0	4	0	329	0
85	0	0	0	0	0	5	83	53	15	11
86	0	0	0	0	0	0	0	8	26	0
87	0	0	0	0	0	0	21	0	113	0
88	0	0	0	0	0	0	0	5458	8	229
89	0	0	0	0	0	0	4	1	109	39
90	0	0	0	0	0	26	0	15	0	0
91	0	0	0	0	0	1134	1	0	0	144
92	0	0	0	461	0	0	1	0	4106	2097
93	0	569	0	0	0	0	0	141	7464	0
94	0	0	0	29	0	0	4	16	115	25
95	0	0	0	0	0	0	8	1817	203	309
96	0	0	0	0	0	0	15	47	0	0
97	0	8	0	0	0	0	0	211	91	0
98	0	0	0	0	0	0	2356	0	28	2
99	0	194	0	0	0	0	0	1	16	61
100	0	1584	0	0	0	233	0	0	3287	30
101	0	0	0	0	0	0	0	0	0	0
102	0	0	0	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	397	0	0	0	0	0
106	0	0	0	0	0	0	0	0	0	0
107	0	0	0	0	0	0	0	0	0	0
108	0	0	0	0	0	0	0	0	0	0
109	0	0	0	0	0	0	0	0	0	0
110	0	0	0	201	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0	0	0
112	0	0	0	0	0	0	0	0	0	0
113	0	0	1123	0	0	0	0	0	0	0
114	0	0	0	0	0	0	0	0	0	0
115	0	0	216	0	0	0	0	0	0	0
116	0	0	0	0	0	0	0	0	0	0
117	0	0	0	0	0	0	0	0	0	0
118	0	0	455	0	0	0	0	0	0	0
119	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
121	0	0	0	0	0	0	0	0	0	0
122	0	0	0	0	0	0	0	0	0	0
123	0	0	0	0	0	0	0	0	0	0
124	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0
126	0	0	0	0	0	0	0	0	0	0
127	0	0	0	0	0	0	0	0	0	0
128	0	0	0	0	0	0	0	0	0	0
129	0	0	0	117	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0
131	0	0	0	0	0	0	0	0	0	0
132	0	0	0	0	0	0	0	0	0	0
133	0	0	0	0	0	0	0	0	0	0
134	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0
136	0	0	0	0	0	0	0	0	0	0
137	0	0	0	0	0	0	0	0	0	0
138	0	0	0	0	0	0	0	0	0	0
139	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0
141	0	0	0	0	0	0	0	0	0	0
142	0	0	0	92	0	0	0	0	0	0
143	0	0	0	0	0	0	0	0	0	0
144	0	0	0	0	0	0	0	0	0	0
145	0	44	0	0	0	0	0	0	0	0
146	0	0	0	0	0	0	0	0	0	0
147	0	0	0	0	0	0	0	0	0	0
148	0	0	0	0	0	0	0	0	0	0
149	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0
151	0	0	0	0	0	0	0	0	0	0
152	0	0	0	0	0	0	0	0	0	0
153	0	0	0	0	0	0	0	0	0	0
154	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0
156	0	0	0	0	0	0	0	0	0	0
157	0	0	0	0	0	0	0	0	0	0
158	0	0	0	0	0	0	0	0	0	0
159	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0
161	0	0	0	0	0	0	0	0	0	0
162	0	0	0	0	0	0	0	0	0	0
163	0	0	0	0	0	0	0	0	0	0
164	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0
166	0	0	0	0	0	0	0	0	0	0
167	0	0	0	0	0	0	0	0	0	0
168	0	0	0	0	0	0	0	0	0	0
169	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0
171	0	0	0	0	0	0	0	0	0	0
172	0	0	0	0	0	0	0	0	0	0
173	0	0	0	0	0	0	0	0	0	0
174	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0
176	0	0	0	0	0	0	0	0	0	0
177	0	0	0	0	0	0	0	0	0	0
178	0	0	0	0	0	0	0	0	0	0
179	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
241	0	0	0	0	0	0	0	0	0	0
242	0	0	0	0	0	0	0	0	0	0
243	0	0	0	0	0	0	0	0	0	0
244	0	0	0	0	0	0	0	0	0	0
245	0	0	0	0	0	0	0	0	0	0
246	0	0	0	0	0	0	0	0	0	0
247	0	0	0	0	0	0	0	0	0	0
248	0	0	0	0	0	0	0	0	0	0
249	0	0	0	0	0	0	0	0	0	0
250	0	0	0	0	0	0	0	0	0	0
251	0	0	0	0	0	0	0	0	0	0
252	0	0	0	0	0	0	0	0	0	0
253	0	0	0	0	0	0	0	0	0	0
254	0	0	0	0	0	0	0	0	0	0
255	0	0	0	0	0	0	0	0	0	0
256	0	0	0	0	0	0	0	0	0	0
257	0	0	0	0	0	0	0	0	0	0
258	0	0	0	0	0	0	0	0	0	0
259	0	0	0	0	0	0	0	0	0	0
260	0	0	0	0	0	0	0	0	0	0
261	0	0	0	0	0	0	0	0	0	0
262	0	0	0	0	0	0	0	0	0	0
263	0	0	0	0	0	0	0	0	0	0
264	0	0	0	0	0	0	0	0	0	0
265	0	0	0	0	0	0	0	0	0	0
266	0	0	0	0	0	0	0	0	0	0
267	0	0	0	0	0	0	0	0	0	0
268	0	0	0	0	0	0	0	0	0	0
269	0	0	0	0	0	0	0	0	0	0
270	0	0	0	0	0	0	0	0	0	0
271	0	0	0	0	0	0	0	0	0	0
272	0	0	0	0	0	0	0	0	0	0
273	0	0	0	0	0	0	0	0	0	0
274	0	0	0	0	0	0	0	0	0	0
275	0	0	0	0	0	0	0	0	0	0
276	0	0	0	0	0	0	0	0	0	0
277	0	0	0	0	0	0	0	0	0	0
278	0	0	0	0	0	0	0	0	0	0
279	0	0	0	0	0	0	0	0	0	0
280	0	0	0	0	0	0	0	0	0	0
281	0	0	0	0	0	0	0	0	0	0
282	0	0	0	0	0	0	0	0	0	0
283	0	0	0	0	0	0	0	0	0	0
284	0	0	0	0	0	0	0	0	0	0
285	0	0	0	0	0	0	0	0	0	0
286	0	0	0	0	0	0	0	0	0	0
287	0	0	0	0	0	0	0	0	0	0
288	0	0	0	0	0	0	0	0	0	0
289	0	0	0	0	0	0	0	0	0	0
290	0	0	0	0	0	0	0	0	0	0
291	0	0	0	0	0	0	0	0	0	0
292	0	0	0	0	0	0	0	0	0	0
293	0	0	0	0	0	0	0	0	0	0
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295	0	0	0	0	0	0	0	0	0	0
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297	0	0	0	0	0	0	0	0	0	0
298	0	0	0	0	0	0	0	0	0	0
299	0	0	0	0	0	0	0	0	0	0
300	0	0	0	0	0	0	0	0	0	0

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
181	0	0	0	0	0	0	0	0	0	0
182	0	0	0	0	0	0	0	0	0	0
183	0	0	0	0	0	0	0	0	0	0
184	0	0	0	0	0	0	0	0	0	0
185	0	0	0	0	0	0	0	0	0	0
186	0	0	0	0	0	0	0	0	0	0
187	0	0	0	0	0	0	0	0	0	0
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189	0	0	0	0	0	0	0	0	0	0
190	0	0	0	0	0	0	0	0	0	0
191	0	0	0	0	0	0	0	0	0	0
192	0	0	0	0	0	0	0	0	0	0
193	0	0	0	0	0	0	0	0	0	0
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197	0	0	0	0	0	0	0	0	0	0
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199	0	0	0	0	0	0	0	0	0	0
200	0	0	0	0	0	0	0	0	0	0
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202	0	0	0	0	0	0	0	0	0	0
203	0	0	0	0	0	0	0	0	0	0
204	0	0	0	0	0	0	0	0	0	0
205	0	0	0	0	0	0	0	0	0	0
206	0	0	0	0	0	0	0	0	0	0
207	0	0	0	0	0	0	0	0	0	0
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209	0	0	0	0	0	0	0	0	0	0
210	0	0	0	0	0	0	0	0	0	0
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213	0	0	0	0	0	0	0	0	0	0
214	0	0	0	0	0	0	0	0	0	0
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217	0	0	0	0	0	0	0	0	0	0
218	0	0	0	0	0	0	0	0	0	0
219	0	0	0	0	0	0	0	0	0	0
220	0	0	0	0	0	0	0	0	0	0
221	0	0	0	0	0	0	0	0	0	0
222	0	0	0	0	0	0	0	0	0	0
223	0	0	0	0	0	0	0	0	0	0
224	0	0	0	0	0	0	0	0	0	0
225	0	0	0	0	0	0	0	0	0	0
226	0	0	0	0	0	0	0	0	0	0
227	0	0	0	0	0	0	0	0	0	0
228	0	0	0	0	0	0	0	0	0	0
229	0	0	0	0	0	0	0	0	0	0
230	0	0	0	0	0	0	0	0	0	0
231	0	0	0	0	0	0	0	0	0	0
232	0	0	0	0	0	0	0	0	0	0
233	0	0	0	0	0	0	0	0	0	0
234	0	0	0	0	0	0	0	0	0	0
235	0	0	0	0	0	0	0	0	0	0
236	0	0	0	0	0	0	0	0	0	0
237	0	0	0	0	0	0	0	0	0	0
238	0	0	0	0	0	0	0	0	0	0
239	0	0	0	0	0	0	0	0	0	0
240	0	0	0	0	0	0	0	0	0	0

APPENDIX F – FRICTION-FACTORS FOR HBSH AND HBO PURPOSES

CI	NHBW					NHBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
1	15882629	8637694	8637694	8637694	8637694	4348293	415386015	415386015	4348293	4348293
2	6827243	3584828	3584828	3584828	5377242	14135351	126871650	126871650	14135351	14135351
3	4059982	2067787	2067787	2067787	3101680	25455874	59899065	59899065	25455874	25455874
4	2757485	1364824	1364824	1364824	2047236	35995679	33799827	33799827	35995679	35995679
5	2014301	969886	969886	969886	1454830	44582883	21030091	21030091	44582883	44582883
6	770384	722191	722191	722191	1083286	50779423	13918970	13918970	50779423	50779423
7	608307	555371	555371	555371	888593	54587013	9613790	9613790	54587013	54587013
8	491633	437281	437281	437281	743378	56247872	6850759	6850759	56247872	56247872
9	404460	350562	350562	350562	631012	56115280	4999619	4999619	56115280	56115280
10	337440	285064	285064	285064	541622	54573255	3717942	3717942	54573255	54573255
11	284736	234485	234485	234485	492419	51989709	2807217	2807217	51989709	51989709
12	242524	194721	194721	194721	428386	48691756	2146375	2146375	48691756	48691756
13	208200	162994	162994	162994	374886	44955208	1658506	1658506	44955208	44955208
14	179935	137367	137367	137367	329680	41002750	1293095	1293095	41002750	41002750
15	156407	116448	116448	116448	291120	37007110	1016030	1016030	37007110	37007110
16	136640	99219	99219	99219	257971	33096778	803733	803733	33096778	33096778
17	119900	84919	84919	84919	229282	29362736	639573	639573	29362736	29362736
18	105623	72969	72969	72969	204314	25865253	511619	511619	25865253	25865253
19	93371	62923	62923	62923	182476	22640225	411184	411184	22640225	22640225
20	82799	54432	54432	54432	163296	19704773	331856	331856	19704773	19704773
21	73632	47222	47222	47222	146389	17062012	268849	268849	17062012	17062012
22	65647	41074	41074	41074	131436	14704997	218555	218555	14704997	14704997
23	58665	35811	35811	35811	118175	12619888	178226	178226	12619888	12619888
24	52538	31290	31290	31290	106385	10788448	145756	145756	10788448	10788448
25	47143	27394	27394	27394	98617	9189949	119516	119516	9189949	9189949
26	424	24027	24027	24027	88899	7802603	98237	98237	7802603	7802603
27	382	21110	21110	21110	80216	6604591	80928	80928	6604591	6604591
28	344	18576	18576	18576	72445	5574789	66808	66808	5574789	5574789
29	311	16370	16370	16370	65479	4693242	55258	55258	4693242	4693242
30	281	14446	14446	14446	60671	3941455	45787	45787	3941455	3941455
31	254	12764	12764	12764	54884	3302547	38003	38003	3302547	3302547
32	231	11291	11291	11291	51939	2761297	31592	31592	2761297	2761297
33	209	10000	10000	10000	49998	2304125	26302	26302	2304125	2304125
34	190	8865	8865	8865	45212	1919022	21928	21928	1919022	1919022
35	173	7867	7867	7867	40909	1595446	18305	18305	1595446	1595446
36	157	6988	6988	6988	37037	1324208	15300	15300	1324208	1324208
37	143	6213	6213	6213	33548	1097342	12803	12803	1097342	1097342
38	131	5528	5528	5528	30403	907980	10726	10726	907980	907980
39	119	4923	4923	4923	27566	750227	8995	8995	750227	750227
40	109	4387	4387	4387	25005	619046	7550	7550	619046	619046
41	100	3912	3912	3912	22690	510147	6344	6344	510147	510147
42	91	3491	3491	3491	20598	419892	5335	5335	419892	419892
43	83	3118	3118	3118	18706	345203	4491	4491	345203	345203
44	76	2786	2786	2786	16714	283484	3783	3783	283484	283484
45	70	2491	2491	2491	14944	232553	3189	3189	232553	232553
46	64	2228	2228	2228	13368	190579	2691	2691	190579	190579
47	59	1994	1994	1994	11965	156029	2272	2272	156029	156029
48	54	1786	1786	1786	10715	127625	1920	1920	127625	127625
49	49	1600	1600	1600	9600	104298	1623	1623	104298	104298
50	45	1434	1434	1434	8606	85162	1373	1373	85162	85162
51	42	1286	1286	1286	7718	69480	1162	1162	69480	69480
52	38	1154	1154	1154	6924	56640	984	984	56640	56640
53	35	1036	1036	1036	6215	46139	834	834	46139	46139
54	32	930	930	930	5581	37557	707	707	37557	37557
55	30	836	836	836	5013	30550	600	600	30550	30550
56	28	751	751	751	4505	24833	509	509	24833	24833
57	25	675	675	675	4050	20173	432	432	20173	20173
58	23	607	607	607	3642	16377	367	367	16377	16377
59	22	546	546	546	3276	13287	312	312	13287	13287
60	20	491	491	491	2948	10774	266	266	10774	10774

NJRTM-E MODEL DEVELOPMENT REPORT Version 4

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
61	106	141	141	141	127	3	1509	348	64	58
62	79	105	105	250	95	1	51	51	99	51
63	59	79	79	79	71	1	177	677	404	108
64	44	252	58	58	53	1	41	41	41	41
65	33	43	43	43	39	1	434	37	154	37
66	24	32	32	32	29	1	709	486	26	33
67	18	1303	24	24	22	1	410	30	27	85
68	13	18	18	18	16	1	27	27	53	27
69	13	13	195	13	12	1	1774	539	804	30
70	10	10	10	10	9	7	21	339	21	21
71	7	7	7	7	7	1	169	2153	75	19
72	5	5	5	5	5	1	17	17	17	17
73	4	4	4	4	4	1	15	15	15	15
74	3	3	3	3	3	1	14	14	686	14
75	2	2	2	2	2	1	12	12	3	33
76	2	2	2	2	1	1	334	11	11	11
77	1	1	1	1	1	1	10	574	10	10
78	1	1	1	1	1	1	9	9	9	9
79	1	1	1	1	1	5	226	8	8	8
80	0	1	0	0	0	1	3666	2630	7	7
81	0	0	0	0	0	1	6	6	35	75
82	0	0	1	0	0	1	573	229	29	6
83	0	0	0	0	0	1	5	5	27	5
84	0	0	0	0	0	1	5	6159	5	5
85	0	0	0	0	0	1	4	4	4	4
86	1	1	1	1	1	1	238	4	4	21
87	1	1	1	1	1	1	3	3	3	3
88	1	1	1	1	1	1	3	134	5	3
89	1	1	1	3	1	1	3	3	3	3
90	1	1	1	1	1	1	2	2	2	2
91	1	1	1	4	1	1	2	2	2	2
92	1	2	1	1	1	1	2	2	2	2
93	1	1	1	1	1	1	2	919	2	2
94	1	1	1	1	1	1	2	2	2	3
95	1	1	1	1	1	1	1	1	1	1
96	1	1	1	1	1	1	1	1	1	1
97	1	1	1	1	1	1	1	1	1	1
98	1	1	1	1	1	1	6118	1080	1	6
99	1	1	1	1	1	1	1	1	1	1
100	1	1	1	1	1	1	1	1	5	1
101	1	1	1	1	1	1	1	1477	1	1
102	1	1	1	1	1	1	1	1	1	1
103	1	1	1	1	1	1	1	1	1	1
104	1	1	1	1	1	3	1	1	1	1
105	1	1	1	1	1	1	0	0	1	0
106	1	1	1	1	1	1	0	0	1	0
107	1	1	1	1	1	1	0	0	1	0
108	1	1	1	1	1	1	0	0	1	0
109	1	1	1	1	1	1	0	0	1	0
110	1	1	1	1	1	1	0	0	1	0
111	1	1	1	1	1	1	0	0	1	0
112	1	1	1	1	1	1	0	0	1	0
113	1	1	1	1	1	1	0	0	1	0
114	1	1	1	1	1	1	0	0	1	0
115	1	1	1	1	1	1	0	0	1	0
116	1	1	1	1	1	1	0	0	1	0
117	1	1	1	1	1	1	0	0	1	0
118	1	1	1	1	1	1	0	0	1	0
119	1	1	1	1	1	1	0	0	1	0
120	1	1	1	1	1	1	0	0	2	0

CI	HBS					HBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
121	1	1	1	1	1	1	0	0	1	0
122	1	1	1	1	1	1	0	0	1	0
123	1	1	1	1	1	1	0	0	1	0
124	1	1	1	1	1	1	0	0	1	0
125	1	1	1	1	1	1	0	0	1	0
126	1	1	1	1	1	1	0	0	1	0
127	1	1	1	1	1	1	0	0	1	0
128	1	1	1	1	1	1	0	0	1	0
129	1	1	1	1	1	1	0	0	1	0
130	1	1	1	1	1	1	0	0	1	0
131	1	1	1	1	1	1	0	0	1	0
132	1	1	1	1	1	1	0	0	1	0
133	1	1	1	1	1	1	0	0	1	0
134	1	1	1	1	1	1	0	0	1	0
135	1	1	1	1	1	1	0	0	1	0
136	1	1	1	1	1	1	0	0	3	0
137	1	1	1	1	1	1	0	0	1	0
138	1	1	1	1	1	1	0	0	1	0
139	1	1	1	1	1	1	0	0	1	0
140	1	1	1	1	1	1	0	0	1	0
141	1	1	1	1	1	1	0	0	1	0
142	1	1	1	1	1	1	0	0	1	0
143	1	1	1	1	1	1	0	0	1	0
144	1	1	1	1	1	1	0	0	1	0
145	1	1	1	1	1	1	0	0	1	0
146	1	1	1	1	1	1	0	0	1	0
147	1	1	1	1	1	1	0	0	1	0
148	1	1	1	1	1	1	0	0	1	0
149	1	1	1	1	1	1	0	0	1	0
150	1	1	1	1	1	1	0	0	1	0
151	1	1	1	1	1	1	0	0	1	0
152	1	1	1	1	1	1	0	0	1	0
153	1	1	1	1	1	1	0	0	1	0
154	1	1	1	1	1	1	0	0	21	0
155	1	1	1	1	1	1	0	0	1	0
156	1	1	1	1	1	1	0	0	1	0
157	1	1	1	1	1	1	0	0	1	0
158	1	1	1	1	1	1	0	0	1	0
159	1	1	1	1	1	1	0	0	1	0
160	1	1	1	1	1	1	0	0	1	0
161	1	1	1	1	1	1	0	0	1	0
162	1	1	1	1	1	1	0	0	1	0
163	1	1	1	1	1	1	0	0	1	0
164	1	1	1	1	1	1	0	0	1	0
165	1	1	1	1	1	1	0	0	1	0
166	1	1	1	1	1	1	0	0	1	0
167	1	1	1	1	1	1	0	0	1	0
168	1	1	1	1	1	1	0	0	1	0
169	1	1	1	1	1	1	0	0	1	0
170	1	1	1	1	1	1	0	0	1	0
171	1	1	1	1	1	1	0	0	1	0
172	1	1	1	1	1	1	0	0	1	0
173	1	1	1	1	1	1	0	0	1	0
174	1	1	1	1	1	1	0	0	1	0
175	1	1	1	1	1	1	0	0	1	0
176	1	1	1	1	1	1	0	0	1	0
177	1	1	1	1	1	1	0	0	1	0
178	1	1	1	1	1	1	0	0	1	0
179	1	1	1	1	1	1	0	0	1	0
180	1	1	1	1	1	1	0	0	1	0

APPENDIX G – FRICTION-FACTORS FOR NHBW AND NHBO PURPOSES

CI	NHBW					NHBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
1	15882629	8637694	8637694	8637694	8637694	4348293	415386015	415386015	4348293	4348293
2	6827243	3584828	3584828	3584828	5377242	14135351	126871650	126871650	14135351	14135351
3	4059982	2067787	2067787	2067787	3101680	25455874	59899065	59899065	25455874	25455874
4	2757485	1364824	1364824	1364824	2047236	35995679	33799827	33799827	35995679	35995679
5	2014301	969886	969886	969886	1454830	44582883	21030091	21030091	44582883	44582883
6	770384	722191	722191	722191	1083286	50779423	13918970	13918970	50779423	50779423
7	608307	555371	555371	555371	888593	54587013	9613790	9613790	54587013	54587013
8	491633	437281	437281	437281	743378	56247872	6850759	6850759	56247872	56247872
9	404460	350562	350562	350562	631012	56115280	4999619	4999619	56115280	56115280
10	337440	285064	285064	285064	541622	54573255	3717942	3717942	54573255	54573255
11	284736	234485	234485	234485	492419	51989709	2807217	2807217	51989709	51989709
12	242524	194721	194721	194721	428386	48691756	2146375	2146375	48691756	48691756
13	208200	162994	162994	162994	374886	44955208	1658506	1658506	44955208	44955208
14	179935	137367	137367	137367	329680	41002750	1293095	1293095	41002750	41002750
15	156407	116448	116448	116448	291120	37007110	1016030	1016030	37007110	37007110
16	136640	99219	99219	99219	257971	33096778	803733	803733	33096778	33096778
17	119900	84919	84919	84919	229282	29362736	639573	639573	29362736	29362736
18	105623	72969	72969	72969	204314	25865253	511619	511619	25865253	25865253
19	93371	62923	62923	62923	182476	22640225	411184	411184	22640225	22640225
20	82799	54432	54432	54432	163296	19704773	331856	331856	19704773	19704773
21	73632	47222	47222	47222	146389	17062012	268849	268849	17062012	17062012
22	65647	41074	41074	41074	131436	14704997	218555	218555	14704997	14704997
23	58665	35811	35811	35811	118175	12619888	178226	178226	12619888	12619888
24	52538	31290	31290	31290	106385	10788448	145756	145756	10788448	10788448
25	47143	27394	27394	27394	98617	9189949	119516	119516	9189949	9189949
26	424	24027	24027	24027	88899	7802603	98237	98237	7802603	7802603
27	382	21110	21110	21110	80216	6604591	80928	80928	6604591	6604591
28	344	18576	18576	18576	72445	5574789	66808	66808	5574789	5574789
29	311	16370	16370	16370	65479	4693242	55258	55258	4693242	4693242
30	281	14446	14446	14446	60671	3941455	45787	45787	3941455	3941455
31	254	12764	12764	12764	54884	3302547	38003	38003	3302547	3302547
32	231	11291	11291	11291	51939	2761297	31592	31592	2761297	2761297
33	209	10000	10000	10000	49998	2304125	26302	26302	2304125	2304125
34	190	8865	8865	8865	45212	1919022	21928	21928	1919022	1919022
35	173	7867	7867	7867	40909	1595446	18305	18305	1595446	1595446
36	157	6988	6988	6988	37037	1324208	15300	15300	1324208	1324208
37	143	6213	6213	6213	33548	1097342	12803	12803	1097342	1097342
38	131	5528	5528	5528	30403	907980	10726	10726	907980	907980
39	119	4923	4923	4923	27566	750227	8995	8995	750227	750227
40	109	4387	4387	4387	25005	619046	7550	7550	619046	619046
41	100	3912	3912	3912	22690	510147	6344	6344	510147	510147
42	91	3491	3491	3491	20598	419892	5335	5335	419892	419892
43	83	3118	3118	3118	18706	345203	4491	4491	345203	345203
44	76	2786	2786	2786	16714	283484	3783	3783	283484	283484
45	70	2491	2491	2491	14944	232553	3189	3189	232553	232553
46	64	2228	2228	2228	13368	190579	2691	2691	190579	190579
47	59	1994	1994	1994	11965	156029	2272	2272	156029	156029
48	54	1786	1786	1786	10715	127625	1920	1920	127625	127625
49	49	1600	1600	1600	9600	104298	1623	1623	104298	104298
50	45	1434	1434	1434	8606	85162	1373	1373	85162	85162
51	42	1286	1286	1286	7718	69480	1162	1162	69480	69480
52	38	1154	1154	1154	6924	56640	984	984	56640	56640
53	35	1036	1036	1036	6215	46139	834	834	46139	46139
54	32	930	930	930	5581	37557	707	707	37557	37557
55	30	836	836	836	5013	30550	600	600	30550	30550
56	28	751	751	751	4505	24833	509	509	24833	24833
57	25	675	675	675	4050	20173	432	432	20173	20173
58	23	607	607	607	3642	16377	367	367	16377	16377
59	22	546	546	546	3276	13287	312	312	13287	13287
60	20	491	491	491	2948	10774	266	266	10774	10774

CI	NHBW					NHBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
61	18	442	442	442	2654	8731	226	226	8731	8731
62	17	398	398	398	2390	7072	192	192	7072	7072
63	16	359	359	359	2152	5725	164	164	5725	5725
64	14	323	323	323	1939	4632	139	139	4632	4632
65	13	291	291	291	1748	3746	119	119	3746	3746
66	12	263	263	263	1575	3028	101	101	3028	3028
67	11	237	237	237	1421	2446	86	86	2446	2446
68	10	214	214	214	1281	1975	74	74	1975	1975
69	10	193	193	193	1156	1594	63	63	1594	1594
70	9	174	174	174	1043	1286	54	54	1286	1286
71	8	157	157	157	941	1037	46	46	1037	1037
72	8	142	142	142	850	836	39	39	836	836
73	7	128	128	128	768	674	33	33	674	674
74	7	116	116	116	693	543	29	29	543	543
75	6	104	104	104	626	437	24	24	437	437
76	6	94	94	94	566	352	21	21	352	352
77	5	85	85	85	511	283	18	18	283	283
78	5	77	77	77	462	228	15	15	228	228
79	4	70	70	70	418	183	13	13	183	183
80	4	63	63	63	378	147	11	11	147	147
81	4	57	57	57	342	118	10	10	118	118
82	4	52	52	52	309	95	8	8	95	95
83	3	47	47	47	280	76	7	7	76	76
84	3	42	42	42	253	61	6	6	61	61
85	3	38	38	38	229	49	5	5	49	49
86	3	35	35	35	207	39	4	4	39	39
87	2	31	31	31	188	32	4	4	32	32
88	2	28	28	28	170	25	3	3	25	25
89	2	26	26	26	154	20	3	3	20	20
90	2	23	23	23	139	16	2	2	16	16
91	2	21	21	21	126	13	2	2	13	13
92	2	19	19	19	114	10	2	2	10	10
93	2	17	17	17	104	8	2	2	8	8
94	1	16	16	16	94	7	1	1	7	7
95	1	14	14	14	85	5	1	1	5	5
96	1	13	13	13	77	4	1	1	4	4
97	1	12	12	12	70	3	1	1	3	3
98	1	11	11	11	63	3	1	1	3	3
99	1	10	10	10	57	2	1	1	2	2
100	1	9	9	9	52	2	1	1	2	2
101	1	8	8	8	47	1	0	0	1	1
102	1	7	7	7	43	1	0	0	1	1
103	1	6	6	6	39	1	0	0	1	1
104	1	6	6	6	35	1	0	0	1	1
105	1	5	5	5	32	1	0	0	1	1
106	1	5	5	5	29	0	0	0	0	0
107	1	4	4	4	26	0	0	0	0	0
108	1	4	4	4	24	0	0	0	0	0
109	0	4	4	4	22	0	0	0	0	0
110	0	3	3	3	20	0	0	0	0	0
111	0	3	3	3	18	0	0	0	0	0
112	0	3	3	3	16	0	0	0	0	0
113	0	2	2	2	15	0	0	0	0	0
114	0	2	2	2	13	0	0	0	0	0
115	0	2	2	2	12	0	0	0	0	0
116	0	2	2	2	11	0	0	0	0	0
117	0	2	2	2	10	0	0	0	0	0
118	0	2	2	2	9	0	0	0	0	0
119	0	1	1	1	8	0	0	0	0	0
120	0	1	1	1	8	0	0	0	0	0

CI	NHBW					NHBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
121	0	1	1	1	7	0	0	0	0	0
122	0	1	1	1	6	0	0	0	0	0
123	0	1	1	1	6	0	0	0	0	0
124	0	1	1	1	5	0	0	0	0	0
125	0	1	1	1	5	0	0	0	0	0
126	0	1	1	1	4	0	0	0	0	0
127	0	1	1	1	4	0	0	0	0	0
128	0	1	1	1	4	0	0	0	0	0
129	0	1	1	1	3	0	0	0	0	0
130	0	0	0	0	3	0	0	0	0	0
131	0	0	0	0	0	0	0	0	0	0
132	0	0	0	0	0	0	0	0	0	0
133	0	0	0	0	0	0	0	0	0	0
134	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0
136	0	0	0	0	0	0	0	0	0	0
137	0	0	0	0	0	0	0	0	0	0
138	0	0	0	0	0	0	0	0	0	0
139	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0
141	0	0	0	0	0	0	0	0	0	0
142	0	0	0	0	0	0	0	0	0	0
143	0	0	0	0	0	0	0	0	0	0
144	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0
146	0	0	0	0	0	0	0	0	0	0
147	0	0	0	0	0	1	0	0	1	1
148	0	0	0	0	0	1	0	0	1	1
149	0	0	0	0	0	1	0	0	1	1
150	0	0	0	0	0	1	0	0	1	1
151	0	0	0	0	0	1	0	0	1	1
152	0	0	0	0	0	1	0	0	1	1
153	0	0	0	0	0	1	0	0	1	1
154	0	0	0	0	0	1	0	0	1	1
155	0	0	0	0	0	1	0	0	1	1
156	0	0	0	0	0	1	0	0	1	1
157	0	0	0	0	0	1	0	0	1	1
158	0	0	0	0	0	1	0	0	1	1
159	0	0	0	0	0	1	0	0	1	1
160	0	0	0	0	0	1	0	0	1	1
161	0	0	0	0	0	1	0	0	1	1
162	0	0	0	0	0	1	0	0	1	1
163	0	0	0	0	0	1	1	1	1	1
164	0	0	0	0	0	1	1	1	1	1
165	0	0	0	0	0	1	1	1	1	1
166	0	0	0	0	0	1	1	1	1	1
167	0	0	0	0	0	1	1	1	1	1
168	0	0	0	0	0	1	1	1	1	1
169	0	0	0	0	0	1	1	1	1	1
170	0	0	0	0	0	1	1	1	1	1
171	0	0	0	0	0	1	1	1	1	1
172	0	0	0	0	0	1	1	1	1	1
173	0	0	0	0	0	1	1	1	1	1
174	0	0	0	0	0	1	1	1	1	1
175	0	0	0	0	0	1	1	1	1	1
176	0	0	0	0	0	1	1	1	1	1
177	0	0	0	0	0	1	1	1	1	1
178	0	0	0	0	0	1	1	1	1	1
179	0	0	0	0	0	1	1	1	1	1
180	0	0	0	0	0	1	1	1	1	1

CI	NHBW					NHBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
181	0	0	0	0	0	1	1	1	1	1
182	0	0	0	0	0	1	1	1	1	1
183	0	0	0	0	0	1	1	1	1	1
184	0	0	0	0	0	1	1	1	1	1
185	0	0	0	0	0	1	1	1	1	1
186	0	0	0	0	0	1	1	1	1	1
187	0	0	0	0	0	1	1	1	1	1
188	0	0	0	0	0	1	1	1	1	1
189	0	0	0	0	0	1	1	1	1	1
190	0	0	0	0	0	1	1	1	1	1
191	0	0	0	0	0	1	1	1	1	1
192	0	0	0	0	0	1	1	1	1	1
193	0	0	0	0	0	1	1	1	1	1
194	0	0	0	0	0	1	1	1	1	1
195	0	0	0	0	0	1	1	1	1	1
196	0	0	0	0	0	1	1	1	1	1
197	0	0	0	0	0	1	1	1	1	1
198	0	0	0	0	0	1	1	1	1	1
199	0	0	0	0	0	1	1	1	1	1
200	0	0	0	0	0	1	1	1	1	1
201	0	0	0	0	0	1	1	1	1	1
202	0	0	0	0	0	1	1	1	1	1
203	0	0	0	0	0	1	1	1	1	1
204	0	0	0	0	0	1	1	1	1	1
205	0	0	0	0	0	1	1	1	1	1
206	0	0	0	0	0	1	1	1	1	1
207	0	0	0	0	0	1	1	1	1	1
208	0	0	0	0	0	1	1	1	1	1
209	0	0	0	0	0	1	1	1	1	1
210	0	0	0	0	0	1	1	1	1	1
211	0	0	0	0	0	1	1	1	1	1
212	0	0	0	0	0	1	1	1	1	1
213	0	0	0	0	0	1	1	1	1	1
214	0	0	0	0	0	1	1	1	1	1
215	0	0	0	0	0	1	1	1	1	1
216	0	0	0	0	0	1	1	1	1	1
217	0	0	0	0	0	1	1	1	1	1
218	0	0	0	0	0	1	1	1	1	1
219	0	0	0	0	0	1	1	1	1	1
220	0	0	0	0	0	1	1	1	1	1
221	0	0	0	0	0	1	1	1	1	1
222	0	0	0	0	0	1	1	1	1	1
223	0	0	0	0	0	1	1	1	1	1
224	0	0	0	0	0	1	1	1	1	1
225	0	0	0	0	0	1	1	1	1	1
226	0	0	0	0	0	1	1	1	1	1
227	0	0	0	0	0	1	1	1	1	1
228	0	0	0	0	0	1	1	1	1	1
229	0	1	1	1	1	1	1	1	1	1
230	0	1	1	1	1	1	1	1	1	1
231	0	1	1	1	1	1	1	1	1	1
232	0	1	1	1	1	1	1	1	1	1
233	0	1	1	1	1	1	1	1	1	1
234	0	1	1	1	1	1	1	1	1	1
235	0	1	1	1	1	1	1	1	1	1
236	0	1	1	1	1	1	1	1	1	1
237	0	1	1	1	1	1	1	1	1	1
238	0	1	1	1	1	1	1	1	1	1
239	0	1	1	1	1	1	1	1	1	1
240	0	1	1	1	1	1	1	1	1	1

CI	NHBW					NHBO				
	INC1	INC2	INC3	INC4	INC5	INC1	INC2	INC3	INC4	INC5
241	0	1	1	1	1	1	1	1	1	1
242	0	1	1	1	1	1	1	1	1	1
243	0	1	1	1	1	1	1	1	1	1
244	0	1	1	1	1	1	1	1	1	1
245	0	1	1	1	1	1	1	1	1	1
246	0	1	1	1	1	1	1	1	1	1
247	0	1	1	1	1	1	1	1	1	1
248	0	1	1	1	1	1	1	1	1	1
249	0	1	1	1	1	1	1	1	1	1
250	0	1	1	1	1	1	1	1	1	1
251	0	1	1	1	1	1	1	1	1	1
252	0	1	1	1	1	1	1	1	1	1
253	0	1	1	1	1	1	1	1	1	1
254	0	1	1	1	1	1	1	1	1	1
255	0	1	1	1	1	1	1	1	1	1
256	0	1	1	1	1	1	1	1	1	1
257	0	1	1	1	1	1	1	1	1	1
258	0	1	1	1	1	1	1	1	1	1
259	0	1	1	1	1	1	1	1	1	1
260	0	1	1	1	1	1	1	1	1	1
261	0	1	1	1	1	1	1	1	1	1
262	0	1	1	1	1	1	1	1	1	1
263	0	1	1	1	1	1	1	1	1	1
264	0	1	1	1	1	1	1	1	1	1
265	0	1	1	1	1	1	1	1	1	1
266	0	1	1	1	1	1	1	1	1	1
267	0	1	1	1	1	1	1	1	1	1
268	0	1	1	1	1	1	1	1	1	1
269	0	1	1	1	1	1	1	1	1	1
270	0	1	1	1	1	1	1	1	1	1
271	0	1	1	1	1	1	1	1	1	1
272	0	1	1	1	1	1	1	1	1	1
273	0	1	1	1	1	1	1	1	1	1
274	0	1	1	1	1	1	1	1	1	1
275	0	1	1	1	1	1	1	1	1	1
276	0	1	1	1	1	1	1	1	1	1
277	0	1	1	1	1	1	1	1	1	1
278	0	1	1	1	1	1	1	1	1	1
279	0	1	1	1	1	1	1	1	1	1
280	0	1	1	1	1	1	1	1	1	1
281	0	1	1	1	1	1	1	1	1	1
282	0	1	1	1	1	1	1	1	1	1
283	0	1	1	1	1	1	1	1	1	1
284	0	1	1	1	1	1	1	1	1	1
285	0	1	1	1	1	1	1	1	1	1
286	0	1	1	1	1	1	1	1	1	1
287	0	1	1	1	1	1	1	1	1	1
288	0	1	1	1	1	1	1	1	1	1
289	0	1	1	1	1	1	1	1	1	1
290	0	1	1	1	1	1	1	1	1	1
291	0	1	1	1	1	1	1	1	1	1
292	0	1	1	1	1	1	1	1	1	1
293	0	1	1	1	1	1	1	1	1	1
294	0	1	1	1	1	1	1	1	1	1
295	0	1	1	1	1	1	1	1	1	1
296	0	1	1	1	1	1	1	1	1	1
297	0	1	1	1	1	1	1	1	1	1
298	0	1	1	1	1	1	1	1	1	1
299	0	1	1	1	1	1	1	1	1	1
300	0	1	1	1	1	1	1	1	1	1

APPENDIX H – K-FACTORS FOR ALL TRIP PURPOSES

K-Factors for HBWD Trip Purpose

County	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	Bronx	Kings	Manhattan	Queens	Richmond
Bergen	1.13	1.61	0.53	30.41	30.41	30.41	15.36	3.97	30.41	0.67	20.37	30.41	7.59	1.68	0.82	0.13	0.23	0.06	0.71
Essex	1.55	0.82	0.67	30.41	10.04	2.81	0.71	2.95	15.51	0.88	9.91	0.15	0.76	1.50	0.49	0.05	0.50	0.11	0.66
Hudson	2.42	0.58	0.49	0.15	7.19	22.35	3.47	30.11	0.15	2.48	8.48	17.79	1.28	1.51	0.68	0.22	0.64	1.05	0.07
Hunterdon	1.92	2.36	7.07	0.32	24.18	12.06	4.00	4.53	30.41	1.86	14.24	0.15	6.68	19.20	0.05	0.05	0.20	0.34	0.06
Mercer	0.15	0.15	0.47	0.21	2.83	0.65	0.30	6.30	1.32	0.15	0.73	0.15	0.17	0.37	0.05	0.05	0.11	0.05	0.06
Middlesex	1.81	1.40	0.71	29.65	7.85	1.03	0.62	4.82	16.09	2.66	8.23	0.38	0.70	0.39	2.39	0.13	0.21	0.05	0.12
Monmouth	5.06	4.35	3.47	30.41	5.25	1.78	0.87	19.92	1.14	1.31	8.43	0.38	2.37	1.54	0.05	0.07	0.38	0.56	0.18
Morris	1.63	1.00	0.40	11.25	30.41	2.22	0.15	0.78	0.15	1.28	1.07	15.90	1.99	29.66	0.84	0.05	0.28	0.05	0.45
Ocean	16.88	7.50	6.60	13.08	26.91	3.73	3.33	30.41	0.97	1.79	7.68	0.15	0.15	1.48	2.80	0.05	0.17	0.05	1.29
Passaic	0.93	0.50	0.84	30.41	0.15	1.28	0.15	2.75	0.15	1.55	7.97	24.18	1.93	1.53	0.12	0.16	0.12	0.07	0.06
Somerset	7.98	4.18	4.14	15.81	18.93	2.33	1.85	14.07	0.50	1.61	6.03	8.27	1.33	1.46	1.23	0.10	0.20	1.04	1.02
Sussex	6.48	2.11	3.19	0.15	30.41	11.89	0.15	4.44	0.38	2.84	6.67	5.63	0.75	29.63	1.02	0.05	0.05	0.05	0.06
Union	1.73	0.37	2.51	12.00	30.41	1.35	0.15	1.57	0.15	1.26	0.95	0.38	1.11	1.51	0.47	0.07	0.52	0.05	0.10
Warren	0.85	0.16	0.21	2.12	2.33	0.18	1.32	0.72	0.15	0.97	0.56	2.25	0.40	6.70	0.06	0.05	0.06	0.05	0.05
Bronx	38.57	38.57	38.57	1.93	1.93	1.93	1.93	1.93	1.93	0.48	1.45	1.93	1.93	1.93	16.00	16.00	16.00	16.00	0.20
Kings	38.57	38.57	38.57	1.93	1.93	38.57	38.57	38.57	1.93	0.48	1.38	1.93	0.19	1.88	16.00	16.00	16.00	16.00	16.00
Manhattan	8.62	20.64	8.04	1.93	1.93	38.57	1.93	38.57	1.93	6.69	3.78	1.93	19.09	2.38	0.90	0.08	0.26	0.14	16.00
Queens	38.57	38.57	38.57	1.93	1.93	38.57	38.57	1.93	1.93	38.57	14.05	1.93	38.57	2.89	16.00	16.00	16.00	16.00	16.00
Richmond	26.93	3.60	1.20	0.27	0.27	0.49	20.37	0.27	53.33	53.33	52.92	0.27	0.61	1.89	2.33	1.39	11.04	10.16	1.36

K-Factors for HBWS Trip Purpose

COUNTY	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	Bronx	Kings	Manhattan	Queens	Richmond
Bergen	2.70	1.60	1.88	34.83	0.44	3.20	0.17	1.39	0.17	1.29	0.55	19.28	2.30	33.98	0.56	0.27	0.02	0.02	0.07
Essex	0.38	2.18	0.45	0.17	34.83	0.78	0.35	2.77	0.17	0.30	4.07	0.17	1.60	0.47	0.02	0.04	0.04	0.07	0.03
Hudson	1.97	0.89	0.71	0.17	0.44	0.91	1.18	7.33	0.17	1.11	5.56	0.44	2.19	1.75	0.45	0.08	0.08	0.18	0.03
Hunterdon	0.17	0.21	0.31	4.06	3.17	0.87	0.17	0.85	13.69	0.17	5.91	0.17	1.36	2.10	0.02	0.02	0.02	0.02	0.03
Mercer	0.17	0.17	0.17	0.17	4.20	0.42	0.17	1.24	0.89	0.17	0.48	0.44	0.17	0.43	0.02	0.02	0.04	0.02	0.03
Middlesex	0.31	0.31	0.17	0.17	24.26	1.83	0.24	2.18	0.77	0.17	0.58	0.17	0.68	33.93	0.50	0.02	0.10	0.08	0.04
Monmouth	3.26	1.79	3.50	0.17	5.28	0.87	1.27	2.51	0.66	1.31	5.89	0.17	0.52	1.71	0.22	0.13	0.06	0.02	0.03
Morris	1.11	1.78	0.17	4.72	34.83	0.17	0.17	0.57	0.17	5.28	2.24	5.83	0.98	0.20	3.76	2.65	0.04	0.02	0.03
Ocean	0.17	4.39	0.17	0.17	34.83	2.26	0.64	0.17	0.96	1.55	4.70	1.74	2.80	1.77	0.02	1.30	0.60	0.02	0.60
Passaic	1.95	2.96	3.15	0.17	0.44	0.17	9.06	1.25	0.17	2.00	1.45	10.35	0.61	0.44	0.04	0.29	0.03	0.02	0.03
Somerset	1.54	3.53	1.56	5.91	17.34	1.21	3.50	0.66	0.50	1.81	2.68	4.24	1.64	0.94	0.06	0.66	0.28	0.02	0.27
Sussex	7.72	4.72	24.91	0.17	34.83	0.17	0.17	1.32	1.74	11.41	6.20	1.17	3.99	27.41	3.76	3.76	0.02	0.02	0.03
Union	0.17	0.35	2.51	0.17	0.17	3.08	0.17	1.32	0.17	3.15	1.40	0.17	1.99	0.48	0.69	0.30	0.10	0.02	0.07
Warren	0.17	1.71	0.24	8.59	0.17	0.25	0.17	2.00	0.43	11.19	5.02	1.72	3.73	0.82	0.04	0.03	3.61	0.02	0.02
Bronx	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	14.48	0.08	0.16	0.34	0.08
Kings	0.72	1.66	2.75	0.72	0.72	1.08	28.33	0.72	75.88	0.72	32.23	0.72	39.17	2.79	0.08	1.12	0.12	0.85	0.08
Manhattan	0.72	2.75	2.89	0.72	7.23	10.77	0.72	7.80	0.72	0.72	0.78	0.72	0.72	7.06	0.46	0.08	0.08	0.08	0.08
Queens	0.72	1.45	2.46	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	1.78	0.71	0.27	0.12	15.04	0.08
Richmond	1.00	1.00	1.00	1.00	1.00	1.40	2.50	93.72	1.00	1.00	1.97	1.00	0.88	7.06	0.08	0.14	0.10	1.01	0.14

K-Factors for HBS Trip Purpose

COUNTY	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	Bronx	Kings	Manhattan	Queens	Richmond
Bergen	1.68	1.20	0.20	1.00	1.00	0.10	1.00	0.10	1.00	2.49	1.49	1.00	4.20	1.08	0.18	0.18	0.23	0.18	0.24
Essex	0.49	1.33	0.26	1.00	1.00	1.18	1.00	2.87	1.00	2.44	1.27	1.00	0.17	0.98	0.18	0.18	0.70	0.18	0.24
Hudson	3.88	4.45	4.01	1.00	1.00	20.00	1.00	0.10	1.00	20.00	7.28	1.00	20.00	1.50	0.18	0.18	1.23	1.09	0.24
Hunterdon	1.00	20.00	1.00	0.85	0.11	20.00	1.00	0.11	1.00	1.00	0.79	0.10	20.00	0.86	1.75	1.75	1.75	1.75	2.42
Mercer	1.00	1.00	1.00	1.08	0.61	0.20	0.10	1.00	0.10	1.00	0.40	1.00	20.00	1.50	1.75	35.00	1.75	1.75	0.24
Middlesex	0.10	16.90	0.10	20.00	10.42	0.89	3.65	0.99	0.10	1.00	0.56	1.00	0.18	0.98	0.44	0.18	35.00	0.18	0.34
Monmouth	1.00	0.25	0.25	1.00	8.91	0.14	0.74	1.00	0.63	1.00	0.66	1.00	2.61	1.04	1.75	0.18	1.75	1.75	0.24
Morris	5.99	0.36	0.10	3.41	1.00	20.00	1.00	0.65	1.00	0.23	1.08	0.18	2.54	0.41	0.18	0.18	3.41	0.18	0.24
Ocean	1.00	1.00	1.00	1.00	20.00	0.25	1.02	1.00	1.06	1.00	1.03	1.00	1.00	1.00	1.75	1.75	1.75	1.75	2.42
Passaic	0.44	0.92	0.46	1.00	1.00	0.25	1.00	3.12	1.00	0.73	0.75	0.10	6.19	1.14	0.18	0.18	0.18	0.18	0.24
Somerset	0.85	0.75	5.42	0.80	10.52	0.36	1.01	1.50	1.03	0.72	0.85	0.51	2.72	0.86	1.22	0.84	9.30	1.22	1.15
Sussex	0.25	0.25	1.00	1.00	1.00	1.00	1.00	5.34	1.00	16.20	5.88	0.34	1.00	2.09	1.75	1.75	1.75	1.75	2.42
Union	20.00	1.45	0.42	20.00	1.00	2.93	0.10	1.07	1.00	20.00	7.76	1.00	2.14	1.03	0.18	0.18	2.96	0.18	0.21
Warren	1.50	0.28	0.98	7.97	1.00	1.05	0.98	4.46	1.00	1.50	0.99	1.46	1.03	0.78	1.71	1.71	1.78	1.71	1.71
Bronx	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.00	1.00	1.00	1.00	1.00
Kings	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.00	20.00	20.00	20.00	20.00
Manhattan	5.46	0.44	4.60	1.75	1.75	1.75	1.75	1.75	1.75	0.44	1.32	1.75	1.75	1.75	0.23	0.10	2.19	0.24	0.10
Queens	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.00	20.00	1.00	20.00	1.00
Richmond	2.42	0.60	0.24	2.42	2.42	67.74	0.60	2.42	2.42	2.42	2.42	2.42	0.21	1.71	1.00	0.10	20.00	20.00	20.00

K-Factors for HBO Trip Purpose

COUNTY	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	Bronx	Kings	Manhattan	Queens	Richmond
Bergen	0.81	1.34	0.26	0.10	20.00	0.50	20.00	0.18	0.10	0.30	0.48	0.10	1.92	0.15	0.46	1.30	0.44	1.35	1.77
Essex	1.74	0.66	0.40	20.00	20.00	0.52	6.15	0.36	0.10	0.94	0.59	0.10	0.75	0.79	3.20	1.21	5.36	35.00	0.24
Hudson	4.97	0.83	0.65	0.10	20.00	0.85	13.90	1.66	20.00	4.77	14.82	0.10	0.69	0.12	1.38	1.50	0.42	33.95	0.24
Hunterdon	0.10	20.00	20.00	0.90	3.50	4.29	18.50	2.59	20.00	0.10	8.98	0.10	20.00	0.95	0.18	0.18	35.00	0.18	0.24
Mercer	0.10	5.64	11.40	0.99	0.95	2.64	2.24	0.10	13.10	0.10	5.97	0.25	3.03	0.18	0.44	0.18	35.00	35.00	0.24
Middlesex	14.20	1.90	1.56	4.40	0.63	0.80	0.52	1.07	0.53	1.45	1.38	20.00	0.66	6.74	0.18	25.38	9.14	35.00	0.34
Monmouth	13.60	3.08	10.60	0.10	0.10	1.42	0.79	5.32	0.39	16.40	7.13	20.00	2.30	19.53	0.18	0.18	19.43	0.18	16.02
Morris	2.61	3.51	2.79	0.10	2.54	1.43	5.77	0.92	7.00	0.70	3.64	0.61	9.58	0.35	0.18	35.00	1.63	35.00	0.24
Ocean	0.10	20.00	20.00	0.10	4.80	20.00	11.90	2.17	0.68	0.10	1.28	0.10	20.00	0.62	0.18	35.00	0.18	0.18	48.39
Passaic	0.86	1.36	1.04	5.99	0.10	0.10	0.10	0.22	0.10	0.81	1.38	1.31	0.69	0.12	0.18	0.18	9.03	13.09	0.24
Somerset	1.59	10.90	9.60	2.21	2.22	8.49	6.13	1.60	0.40	0.34	1.09	0.50	9.69	0.42	0.18	15.04	11.56	4.71	20.42
Sussex	20.00	20.00	20.00	0.10	0.10	0.10	14.70	12.50	0.10	20.00	6.78	0.60	3.42	0.25	0.18	0.18	27.30	0.18	48.39
Union	0.91	1.09	12.10	0.10	0.10	0.20	0.12	0.21	5.97	0.43	2.70	0.10	0.79	0.12	0.18	0.18	6.14	35.00	0.21
Warren	19.50	19.50	0.42	10.71	0.10	19.48	0.10	19.48	0.25	19.49	10.76	11.30	0.12	1.28	0.18	0.18	6.77	1.09	0.18
Bronx	0.18	0.18	0.18	0.18	0.18	28.53	14.18	0.18	0.18	8.17	2.82	0.18	0.18	0.18	0.15	1.95	0.22	0.10	4.29
Kings	0.18	1.19	0.33	0.18	0.18	0.33	0.40	0.18	0.18	0.18	0.18	0.18	0.18	0.18	3.05	0.13	0.23	0.26	0.10
Manhattan	0.32	1.66	0.23	0.18	35.00	0.18	0.18	0.61	0.44	0.18	0.29	0.18	1.10	34.11	0.32	1.00	0.15	0.55	0.46
Queens	0.23	1.58	0.18	0.18	0.18	13.06	0.18	0.18	0.18	0.18	0.18	0.18	0.35	0.18	0.10	0.18	0.16	0.18	0.88
Richmond	2.30	1.60	1.23	0.24	0.24	0.44	1.65	0.24	7.43	0.24	3.25	0.24	0.21	0.18	11.60	0.34	1.39	20.00	0.24

K-Factors for NHBW Trip Purpose

COUNTY	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	Bronx	Kings	Manhattan	Queens	Richmond
Bergen	1.12	1.32	2.20	0.10	0.10	2.88	2.04	0.47	0.10	0.85	0.35	1.63	1.33	19.51	0.18	1.84	0.32	0.18	0.24
Essex	0.63	0.59	0.89	0.10	6.31	1.61	0.10	1.15	0.10	1.46	0.56	11.40	0.72	19.49	0.18	0.49	5.06	0.18	0.24
Hudson	0.42	0.29	0.95	0.10	20.00	0.77	1.40	0.11	20.00	0.51	12.31	0.10	0.25	0.10	5.93	0.18	2.94	0.72	0.24
Hunterdon	0.10	0.10	8.56	1.64	0.10	0.10	0.10	0.63	0.10	5.75	2.39	0.10	1.00	0.92	0.18	0.18	0.18	0.18	0.24
Mercer	0.10	0.10	0.10	0.18	1.52	0.39	0.14	0.10	1.55	0.10	0.76	0.10	0.10	0.10	0.18	0.18	35.00	0.18	0.24
Middlesex	0.15	0.10	0.61	1.14	2.96	0.93	0.28	0.31	4.76	3.04	3.34	0.10	0.92	0.12	0.18	4.31	7.84	0.18	0.34
Monmouth	0.16	0.10	0.10	0.10	0.32	0.15	0.87	0.51	0.77	0.10	0.38	0.10	0.14	0.10	0.18	0.18	0.18	0.18	0.24
Morris	2.15	1.01	0.10	2.16	0.10	1.91	10.50	0.64	3.16	2.04	2.15	0.31	0.48	6.61	35.00	0.18	9.57	0.18	0.24
Ocean	2.06	0.10	0.10	0.10	4.30	6.92	1.09	0.10	0.72	0.10	0.36	0.10	0.10	0.10	0.18	0.18	13.46	0.18	0.24
Passaic	0.85	1.96	0.12	6.01	0.10	1.19	0.10	1.62	0.10	0.80	0.50	0.10	0.19	0.10	0.18	3.75	0.49	7.23	0.24
Somerset	1.19	0.73	0.11	2.34	2.09	3.42	0.62	0.67	4.53	0.51	2.18	0.35	0.15	1.90	0.44	1.36	5.92	2.51	0.24
Sussex	0.10	5.81	0.10	0.10	0.10	0.10	0.10	1.65	0.10	0.10	4.79	0.90	0.10	0.10	0.18	0.18	0.18	0.18	0.24
Union	0.20	0.39	0.20	1.70	4.61	0.69	0.51	0.58	9.80	0.25	4.69	0.10	0.99	0.12	0.18	0.25	4.46	0.18	0.21
Warren	0.10	19.48	0.10	2.06	0.22	0.12	0.11	1.65	0.36	0.10	0.23	0.10	0.12	0.98	0.18	0.18	0.29	0.18	0.18
Bronx	0.54	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	12.21	9.17	19.60	20.00	7.04
Kings	0.98	0.18	0.18	0.18	0.18	28.18	0.18	10.64	0.18	0.18	0.25	0.18	0.18	0.18	1.23	16.80	20.00	14.80	1.66
Manhattan	0.88	10.78	1.17	0.18	35.00	13.14	34.13	21.54	0.18	0.18	0.34	26.08	17.92	0.64	20.00	10.28	15.10	9.08	2.46
Queens	0.18	35.00	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	16.30	8.29	18.70	11.73	2.99
Richmond	0.24	1.65	0.39	0.24	0.24	0.34	0.36	0.24	0.24	0.24	0.24	0.24	0.21	0.18	0.10	0.57	0.27	0.28	0.55

K-Factors for NHBO Trip Purpose

COUNTY	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	Bronx	Kings	Manhattan	Queens	Richmond
Bergen	1.04	0.27	0.63	0.10	0.25	0.19	13.30	0.67	1.00	0.28	2.67	0.10	0.25	0.25	1.47	0.18	0.18	0.18	0.24
Essex	0.23	0.71	0.22	3.12	20.00	0.39	1.03	0.61	1.00	0.45	1.18	13.00	1.18	0.13	0.86	1.10	0.46	0.18	0.24
Hudson	0.25	0.39	0.93	0.10	0.25	0.87	0.10	0.65	1.00	0.49	5.07	0.10	0.46	0.99	0.18	3.60	0.21	0.18	0.65
Hunterdon	0.10	20.00	0.10	0.86	0.35	0.15	0.10	0.16	1.00	0.10	0.48	0.10	0.10	0.22	0.44	0.44	0.18	1.75	0.24
Mercer	0.25	0.10	0.25	0.14	1.13	0.23	0.38	0.10	0.99	20.00	7.07	1.00	16.10	0.52	1.75	0.44	0.18	1.75	0.24
Middlesex	2.36	0.18	0.38	0.10	1.65	0.81	0.34	1.67	11.10	0.10	4.91	20.00	0.14	0.10	35.00	1.26	4.94	0.18	0.34
Monmouth	0.10	1.45	0.10	0.10	1.37	0.50	0.65	0.10	0.66	20.00	8.09	0.10	1.17	0.13	0.44	35.00	26.25	0.18	2.47
Morris	0.69	0.76	0.10	0.24	0.25	0.10	20.00	0.68	1.00	0.57	0.69	0.69	0.30	1.12	0.18	0.18	0.18	0.18	0.24
Ocean	1.00	1.00	1.00	0.25	6.67	1.71	0.56	1.00	0.57	1.00	0.60	1.00	0.10	0.98	1.75	1.75	1.75	1.75	0.24
Passaic	0.24	0.71	0.51	20.00	1.00	0.10	0.10	0.74	1.00	0.84	0.73	1.53	0.10	0.10	0.18	0.18	0.18	0.18	0.24
Somerset	0.80	0.83	0.61	6.80	3.90	0.79	1.38	0.73	0.64	0.73	0.58	5.78	0.18	0.48	0.84	0.84	1.29	0.84	0.24
Sussex	14.80	0.10	0.10	20.00	1.00	20.00	0.10	0.45	1.00	0.10	0.48	0.54	0.10	0.26	0.44	1.75	0.44	1.75	2.42
Union	0.10	0.21	0.38	14.60	0.10	0.25	0.10	0.27	0.25	0.25	0.68	0.10	0.87	0.12	0.18	0.35	0.18	35.00	0.21
Warren	0.10	0.10	0.25	0.52	0.10	19.48	0.10	0.52	0.98	0.10	0.49	0.44	0.12	1.48	1.71	1.71	0.18	2.63	0.43
Bronx	0.28	0.18	0.18	0.44	1.75	35.00	0.44	0.18	1.75	0.18	0.90	35.00	0.18	1.71	19.30	7.89	0.75	5.20	18.40
Kings	0.47	0.18	2.14	0.44	0.44	21.00	35.00	0.18	1.75	0.18	0.84	1.75	0.18	1.71	0.67	20.00	0.65	6.27	0.15
Manhattan	0.18	1.38	0.39	0.18	1.75	3.29	35.00	8.66	1.75	0.63	5.19	1.75	0.18	1.71	3.66	4.77	0.19	1.34	0.52
Queens	0.18	0.18	0.18	1.75	1.75	0.18	35.00	0.18	1.75	0.18	0.90	1.75	0.18	1.71	0.36	11.20	0.39	18.70	1.06
Richmond	0.24	0.24	0.63	0.24	0.24	0.51	0.90	0.24	48.39	0.24	20.42	2.42	0.23	1.71	0.10	0.62	0.20	1.05	0.43

APPENDIX I – COUNTY LEVEL TRIP INTERCHANGE COMPARISONS

All Person Trips County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	2,841,186	76,492	76,763	8,945	1,286	15,141	8,123	24,994	1,298	145,871	9,128	1,025	19,328	1,279	3,230,856	34,880	14,312	140,253	4,357	1,251	195,052	3,425,909
	2,777,624	109,327	105,248	232	468	7,612	5,490	23,788	17	177,030	3,738	456	22,219	96	3,233,345	10,192	878	135,123	478	1,253	147,923	3,381,268
Essex	73,738	1,566,418	58,878	13,133	4,601	14,706	3,157	142,683	229	120,679	14,858	3,669	137,976	933	2,155,656	2,913	1,584	103,494	3,511	2,247	113,748	2,269,404
	97,474	1,399,616	77,676	3,166	1,760	20,749	3,538	147,943	68	159,390	19,780	2,826	168,321	316	2,102,622	1,179	276	115,376	1,362	2,651	120,844	2,223,466
Hudson	105,309	54,007	814,290	0	2,464	16,869	2,322	14,776	3,936	19,509	10,238	129	15,657	0	1,059,506	6,788	11,572	197,785	9,208	1,335	226,689	1,286,195
	132,198	66,971	746,955	1	613	7,446	1,488	22,462	536	48,865	10,901	2	16,144	0	1,054,583	2,028	885	236,958	3,886	1,989	245,745	1,300,328
Hunterdon	80	9,603	2,293	225,872	5,879	9,074	380	5,356	1,125	212	34,021	0	7,482	6,414	307,792	0	0	3,481	257	0	3,738	311,530
	273	10,397	4,197	195,338	8,815	16,626	1,177	13,753	384	355	47,139	13	9,534	8,430	316,430	6	6	727	2	46	788	317,217
Mercer	0	278	3,064	3,792	968,352	52,171	10,388	2,612	11,969	3,166	13,242	0	2,432	0	1,071,465	0	2,138	16,811	254	0	19,203	1,090,668
	77	1,642	3,306	6,550	947,180	70,213	14,059	4,309	21,839	59	17,428	1	5,018	12	1,091,692	34	1,517	11,280	10	1,225	14,066	1,105,758
Middlesex	19,357	30,517	12,138	3,032	90,175	1,998,081	76,584	15,505	13,364	7,878	149,871	1,335	70,819	1,100	2,489,758	7,616	16,860	74,684	3,302	7,144	109,605	2,599,363
	13,879	53,068	16,169	12,042	86,717	1,935,133	92,164	22,705	18,106	6,301	173,111	532	97,851	593	2,528,371	515	4,017	82,990	357	12,309	100,187	2,628,558
Monmouth	6,398	21,391	17,087	305	12,617	75,727	2,109,068	7,037	91,380	2,021	16,487	1,074	19,389	1,064	2,381,046	38	5,267	42,889	1,878	10,517	60,590	2,441,636
	5,488	23,978	19,972	809	14,296	89,731	1,919,101	9,426	122,658	2,827	31,175	17	20,040	100	2,259,618	37	1,985	46,031	163	10,221	58,437	2,318,055
Morris	32,986	95,071	2,998	5,564	629	5,706	2,506	1,348,509	254	79,137	39,928	23,691	46,235	11,029	1,694,244	7,193	2,114	18,373	769	566	29,015	1,723,259
	46,502	126,264	5,155	8,152	252	8,610	2,867	1,212,474	30	92,610	49,376	35,806	65,293	16,690	1,670,081	1,900	2,688	27,484	283	698	33,053	1,703,135
Ocean	2,010	9,712	9,248	51	20,591	25,934	184,481	1,743	1,701,223	205	3,190	0	4,028	0	1,962,417	539	2,117	9,842	0	4,494	16,992	1,979,409
	650	7,290	3,742	193	20,839	20,179	261,727	1,011	1,660,894	79	5,969	0	3,800	0	1,986,372	1	101	723	2	5,547	6,374	1,992,746
Passaic	193,981	104,866	24,046	993	0	645	1,398	83,118	0	1,133,876	5,114	3,770	4,262	0	1,556,069	944	4,038	21,032	2,153	0	28,166	1,584,235
	223,225	133,697	39,351	714	1	549	54	96,438	0	1,056,246	7,991	4,823	6,501	8	1,569,598	460	119	46,114	569	30	47,292	1,616,890
Somerset	4,139	23,445	9,009	23,145	31,372	76,964	4,795	38,139	782	2,152	748,699	560	41,571	552	1,005,324	0	569	13,101	2,277	4,349	20,296	1,025,620
	4,379	41,213	16,428	25,118	36,608	105,425	5,216	60,648	801	2,123	646,119	591	56,708	1,150	1,002,525	7	138	18,747	322	9,791	29,005	1,031,531
Sussex	15,414	10,002	5,476	487	1,536	1,098	248	64,133	0	13,733	3,241	282,391	2,220	3,883	403,861	552	349	2,127	0	242	3,270	407,131
	12,595	9,837	6,661	213	2	527	12	92,010	0	16,711	5,044	263,951	1,047	4,455	413,065	65	3	484	3	1	555	413,620
Union	7,361	120,698	84,686	3,193	1,862	101,442	860	47,374	1,377	12,568	66,737	0	1,259,638	1,133	1,708,929	2,211	9,166	51,501	3,687	7,375	73,940	1,782,869
	10,441	140,253	121,352	4,095	539	127,200	1,315	49,434	1,947	11,700	60,623	6	1,165,173	5	1,694,082	132	2,388	71,025	632	5,155	79,331	1,773,414
Warren	3,260	2,116	0	15,364	228	1,175	285	29,315	0	2,393	6,405	8,584	1,250	212,294	282,669	0	0	1,785	0	0	1,785	284,453
	1,348	2,724	323	29,908	28	2,827	99	39,455	0	3,273	10,206	13,501	884	207,549	312,126	6	1	568	2	12	587	312,713
NJTPA+Mercer	3,305,220	2,124,618	1,119,975	303,876	1,141,593	2,394,733	2,404,595	1,825,294	1,826,938	1,543,399	1,121,159	326,228	1,632,285	239,681	21,309,593	63,673	70,086	697,158	31,652	39,519	902,088	22,211,681
	3,326,154	2,126,276	1,166,535	286,532	1,118,118	2,412,827	2,308,307	1,795,853	1,827,279	1,577,569	1,088,600	322,525	1,638,533	239,404	21,234,509	16,561	15,001	793,629	8,072	50,927	884,189	22,118,699
Bronx	8,877	113	1,037	0	0	3,360	229	0	0	6,821	0	142	217	0	20,795							20,795
	13,754	1,309	3,503	0	0	4,047	15	89	0	8,789	6	0	37	0	31,549							31,549
Kings	9,610	14,594	20,144	542	0	8,120	6,348	3,412	1,115	0	0	0	12,614	119	76,619							76,619
	636	1,259	3,569	0	0	951	131	48	3	53	12	0	2,299	0	8,962							8,962
Manhattan	32,956	13,041	21,761	3,780	4,329	7,181	5,637	4,486	349	1,566	248	137	4,331	1,115	100,920							100,920
	25,485	9,115	20,795	0	0	167	22	2,701	0	2,280	8	14	1,429	5	62,020							62,020
Queens	6,363	14,125	3,975	0	0	9,002	6,355	1,135	0	846	0	0	2,174	0	43,975							43,975
	1,046	1,731	921	0	0	11,367	3	17	0	209	0	0	325	0	15,618							15,618
Richmond	1,957	7,945	9,026	0	0	14,689	6,835	4,350	3,342	933	1,701	0	5,358	0	56,137							56,137
	2,935	10,625	13,738	43	76	24,065	7,268	5,868	4,151	988	1,333	0	8,715	1	79,805							79,805
New York City	59,763	49,818	55,943	4,322	4,329	42,353	25,404	13,383	4,806	10,166	1,950	279	24,694	1,234	298,446							298,446
	43,856	24,038	42,526	43	77	40,596	7,439	8,723	4,154	12,319	1,359	15	12,805	6	197,955							197,955
TOTAL	3,364,983	2,174,436	1,175,918	308,198	1,145,923	2,437,086	2,429,999	1,838,677	1,831,744	1,553,565	1,123,109	326,507	1,656,980	240,915	21,608,038	63,673	70,086	697,158	31,652	39,519	902,088	22,510,127
ATTRACTION	3,370,010	2,150,314	1,209,060	286,575	1,118,194	2,453,422	2,315,745	1,804,576	1,831,433	1,589,888	1,089,959	322,539	1,651,338	239,410	21,432,465	16,561	15,001	793,629	8,072	50,927	884,189	22,316,654

TEXT	Observed
TEXT	Estimated

Home-Based-Work Direct County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+ Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	264,932	26,896	23,363	4,472	960	9,312	1,078	9,407	137	27,511	8,558	376	7,087	572	384,661	12,550	4,933	85,088	1,417	664	104,651	489,312
	235,530	34,201	25,936	160	0	6,140	389	12,283	17	23,100	3,096	156	11,642	0	352,649	3,442	80	98,651	68	957	103,198	455,848
Essex	20,249	187,784	19,181	5,425	290	4,029	273	35,007	229	19,327	2,129	319	18,530	0	312,772	1,982	684	55,671	703	2,024	61,063	373,836
	26,510	163,081	28,557	688	5	6,740	146	29,876	64	17,851	7,202	0	15,709	0	296,430	220	26	74,868	9	2,053	77,176	373,606
Hudson	36,814	19,520	146,281	0	95	12,784	537	9,791	0	7,156	2,908	129	5,581	0	241,596	3,595	6,784	111,068	5,843	324	127,614	369,210
	27,393	14,474	111,038	0	0	5,453	72	15,569	0	7,586	1,520	2	3,180	0	186,286	269	218	180,968	286	202	181,943	368,229
Hunterdon	80	1,013	1,729	23,150	3,174	6,106	167	2,290	326	130	11,518	0	1,797	739	52,217	0	0	1,980	111	0	2,091	54,309
	257	2,329	3,351	6,025	3,729	8,553	148	7,068	143	249	19,175	0	3,302	1,246	55,572	0	0	449	0	18	467	56,040
Mercer	0	0	2,617	255	139,004	16,477	2,163	2,269	1,605	0	4,241	0	553	0	169,182	0	0	10,089	0	0	10,089	179,270
	42	870	2,501	1,011	131,341	21,867	2,994	3,655	2,991	32	8,823	0	762	0	171,888	0	36	7,384	0	805	8,225	180,114
Middlesex	10,601	17,056	8,486	571	18,909	247,812	13,546	7,301	8,131	5,825	42,150	0	25,619	0	406,005	5,805	10,868	44,527	340	2,596	64,137	470,142
	4,612	30,777	12,439	8,966	14,724	228,076	18,924	11,921	12,174	4,522	39,230	0	30,701	0	417,067	451	1,370	46,153	55	7,288	55,316	472,383
Monmouth	3,295	13,575	8,690	305	3,035	21,848	176,035	5,121	18,605	534	6,972	0	8,800	0	266,813	0	2,905	37,141	1,878	1,753	43,678	310,490
	2,632	18,768	12,496	802	2,456	23,561	157,772	5,735	18,445	414	17,397	0	10,884	0	271,363	0	421	33,909	135	5,186	39,651	311,014
Morris	10,680	27,597	2,293	3,608	190	2,901	0	140,505	0	17,091	12,126	5,947	12,535	3,758	239,232	2,172	376	16,371	0	566	19,485	258,717
	14,910	39,119	3,176	5,745	50	2,055	1	116,045	0	20,551	12,500	10,341	14,782	3,148	242,422	419	10	21,967	3	596	22,995	265,418
Ocean	1,873	3,407	3,157	51	4,612	7,061	60,198	1,194	181,452	103	1,572	0	0	0	264,681	539	194	7,560	0	1,259	9,552	274,233
	648	4,941	3,615	193	6,223	7,259	75,999	993	165,467	62	3,701	0	107	0	269,209	0	2	346	0	2,783	3,131	272,340
Passaic	43,100	19,226	9,282	347	0	304	0	25,548	0	109,416	2,946	370	1,990	0	212,528	760	2,704	11,434	714	0	15,611	228,139
	44,263	15,681	13,463	280	0	238	0	23,378	0	112,599	5,100	1,247	2,806	0	219,056	82	17	10,515	12	14	10,641	229,696
Somerset	1,615	9,283	7,113	6,095	13,184	24,431	1,028	10,257	0	890	81,447	0	12,801	0	168,144	0	569	8,764	2,277	4,349	15,960	184,104
	1,863	22,609	12,976	3,198	11,664	32,938	792	16,700	0	1,014	48,363	0	16,403	0	168,520	1	63	8,152	317	9,352	17,884	186,404
Sussex	6,342	3,631	1,766	0	1,467	943	0	16,376	0	3,569	2,063	34,109	331	925	71,522	276	0	1,330	0	0	1,606	73,128
	5,569	2,526	1,721	2	1	459	0	19,650	0	2,822	3,204	29,695	121	816	66,587	44	0	157	0	0	200	66,787
Union	5,893	31,091	28,992	610	1,586	24,711	153	14,956	0	2,601	12,591	0	132,473	1,133	256,790	1,154	4,849	31,252	0	1,660	38,915	295,704
	5,689	24,653	43,083	1,411	320	30,064	176	14,429	0	3,348	10,446	0	114,615	0	248,235	86	349	48,356	18	1,836	50,645	298,880
Warren	674	470	0	4,447	228	252	285	8,886	0	1,210	3,891	1,897	793	17,742	40,775	0	0	1,222	0	0	1,222	41,997
	1,009	539	310	9,599	27	134	98	9,530	0	1,398	2,686	2,270	404	20,218	48,223	1	0	142	0	11	154	48,377
NJTPA+Mercer	406,150	360,548	262,949	49,337	186,734	378,969	255,463	288,906	210,485	195,362	195,111	43,147	228,890	24,868	3,086,918	28,832	34,865	423,497	13,283	15,197	515,674	3,602,592
	370,925	374,568	274,663	38,079	170,540	373,538	257,511	286,832	199,302	195,548	177,443	43,711	225,419	25,428	3,013,508	5,014	2,594	532,015	902	31,104	571,628	3,585,136
Bronx	2,959	113	1,037	0	0	0	0	0	0	0	0	0	217	0	4,326							4,326
	11,383	1,196	3,246	0	0	0	0	8	0	13	0	0	5	0	15,851							15,851
Kings	9,125	9,080	10,709	542	0	516	2,592	3,122	0	0	0	0	0	119	35,805							35,805
	465	442	2,436	0	0	171	27	21	0	0	0	0	0	0	3,563							3,563
Manhattan	10,277	1,838	8,664	3,780	1,456	4,818	633	429	221	463	0	0	354	0	32,932							32,932
	16,462	4,269	12,998	0	0	62	0	752	0	1,196	0	0	440	0	36,181							36,181
Queens	4,023	9,435	2,643	0	0	1,147	3,887	1,135	0	846	0	0	1,762	0	24,878							24,878
	630	111	619	0	0	19	3	0	0	90	0	0	56	0	1,527							1,527
Richmond	988	2,541	5,050	0	0	579	410	0	2,274	933	1,613	0	2,421	0	16,808							16,808
	1,172	1,373	2,472	0	0	353	1,841	1	74	833	894	0	407	0	9,421							9,421
New York City	27,372	23,006	28,103	4,322	1,456	7,060	7,521	4,686	2,495	2,242	1,613	0	4,754	119	114,749							114,749
	30,112	7,391	21,772	0	0	606	1,870	781	74	2,132	894	0	909	0	66,543							66,543
TOTAL	433,521	383,554	291,052	53,659	188,189	386,029	262,984	293,593	212,980	197,604	196,724	43,147	233,644	24,987	3,201,667	28,832	34,865	423,497	13,283	15,197	515,674	3,717,341
ATTRACTION	401,038	381,959	296,435	38,079	170,540	374,144	259,382	287,613	199,377	197,680	178,337	43,711	226,328	25,428	3,080,051	5,014	2,594	532,015	902	31,104	571,628	3,651,678

TEXT	Observed
TEXT	Estimated

Home-Based-Work Strategic County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	128,486	9,370	13,800	4,472	0	3,265	0	5,694	0	16,936	0	376	4,984	572	187,956	10,075	5,443	8,797	0	363	24,679	212,635
	134,869	9,654	20,003	70	0	199	0	3,787	0	15,469	8	188	2,143	44	186,434	598	407	13,252	12	106	14,374	200,808
Essex	4,171	52,392	6,973	92	578	1,711	273	19,635	0	3,983	8,604	0	9,447	0	107,857	453	321	7,548	244	0	8,566	116,424
	2,505	62,554	4,470	0	8	327	76	16,582	0	2,052	7,257	0	10,111	0	105,944	1	87	8,140	6	127	8,361	114,306
Hudson	8,458	3,760	25,982	0	0	486	198	2,914	0	1,348	1,884	0	3,302	0	48,331	1,284	515	14,349	294	0	16,441	64,773
	5,143	3,943	20,483	0	0	16	1	1,922	0	940	646	0	2,127	0	35,220	34	202	35,484	42	112	35,874	71,094
Hunterdon	0	144	50	7,773	721	1,098	0	720	326	0	3,022	0	920	167	14,943	0	0	119	0	0	119	15,062
	14	97	85	8,026	521	522	1	1,907	37	17	2,726	2	833	706	15,495	0	2	103	0	23	128	15,623
Mercer	0	0	287	0	51,961	7,561	808	343	1,866	0	1,334	0	265	0	64,426	0	0	1,824	0	0	1,824	66,250
	32	223	277	1,129	52,305	7,341	1,691	633	1,346	23	1,671	0	343	9	67,023	0	57	3,389	0	402	3,848	70,872
Middlesex	1,532	3,469	1,006	0	14,541	94,159	2,663	3,728	1,097	0	9,712	0	12,874	607	145,388	869	0	12,563	181	2,143	15,756	161,144
	259	2,395	714	7	10,334	90,422	3,625	3,825	155	92	7,484	0	14,208	221	133,741	12	321	21,228	27	2,193	23,780	157,522
Monmouth	2,141	4,464	4,452	0	2,599	8,417	66,983	647	4,324	443	6,778	0	2,363	0	103,610	38	255	1,468	0	967	2,728	106,338
	1,172	2,985	4,915	0	1,417	5,868	62,013	817	3,570	283	9,591	0	1,967	1	94,599	0	1,553	7,181	4	896	9,634	104,233
Morris	2,549	8,781	86	1,114	190	0	0	43,707	0	14,146	6,745	1,548	3,108	0	81,975	2,849	1,440	504	0	0	4,793	86,768
	3,331	11,784	292	734	44	42	0	30,069	0	20,047	5,085	2,745	3,059	68	77,299	417	2,586	2,851	1	66	5,922	83,221
Ocean	0	2,054	0	0	10,511	5,478	12,212	0	69,626	103	1,427	0	2,136	0	103,546	0	744	2,093	0	1,474	4,310	107,856
	1	1,769	37	0	5,972	2,836	13,319	2	68,942	17	2,165	0	2,245	0	97,304	0	92	352	0	2,441	2,884	100,188
Passaic	15,540	12,797	7,308	0	0	0	1,398	6,247	0	26,662	476	407	911	0	71,744	184	986	2,237	0	0	3,407	75,151
	16,998	13,977	8,175	0	0	1	50	6,173	0	27,391	407	430	368	0	73,970	3	63	2,076	0	5	2,148	76,118
Somerset	2,102	5,865	1,251	7,539	2,722	5,178	580	2,866	0	850	34,779	0	3,941	0	67,673	0	0	1,112	0	0	1,112	68,785
	1,906	6,908	2,372	10,361	2,740	7,325	232	5,659	0	805	25,057	1	4,497	5	67,868	0	73	2,811	1	306	3,190	71,058
Sussex	3,783	4,243	3,369	0	70	0	0	7,043	0	7,354	661	8,526	1,828	1,659	38,536	276	349	44	0	0	669	39,204
	3,279	2,778	4,156	3	0	1	0	8,022	0	6,754	1,018	6,926	663	2,113	35,712	8	0	33	0	0	41	35,753
Union	82	12,363	15,086	0	0	16,701	54	9,938	0	7,568	7,061	0	51,300	0	120,153	1,057	4,104	5,779	0	2,624	13,564	133,718
	239	6,361	14,505	3	0	15,267	201	7,793	0	4,843	3,731	0	64,577	1	117,521	30	2,015	13,983	2	1,355	17,385	134,906
Warren	0	242	0	3,353	0	0	0	2,754	0	546	1,906	782	457	3,977	14,017	0	0	235	0	0	235	14,253
	13	384	13	3,196	0	11	0	4,707	0	1,332	3,903	485	476	1,480	16,000	0	0	411	0	0	411	16,410
NJTPA+Mercer	168,843	119,945	79,651	24,344	83,893	144,054	85,168	106,236	77,239	79,938	84,389	11,639	97,836	6,982	1,170,157	17,087	14,155	58,672	718	7,571	98,204	1,268,361
	169,761	125,812	80,497	23,530	73,342	130,179	81,209	91,897	74,051	80,062	70,749	10,778	107,618	4,647	1,124,131	1,105	7,457	111,294	95	8,031	127,981	1,252,112
Bronx	746	0	0	0	0	0	0	0	0	0	0	0	0	0	746							746
	284	25	72	0	0	0	0	5	0	43	0	0	4	0	434							434
Kings	0	703	1,379	0	0	246	2,592	0	1,115	0	0	0	11,891	0	17,925							17,925
	52	57	614	0	0	6	34	2	3	8	0	0	2,120	0	2,897							2,897
Manhattan	0	1,307	2,003	0	2,055	1,175	0	633	0	0	0	0	0	0	7,173							7,173
	995	340	4,162	0	0	23	0	427	0	72	0	0	17	0	6,036							6,036
Queens	0	492	996	0	0	0	0	0	0	0	0	0	0	0	1,488							1,488
	39	8	85	0	0	0	0	0	0	4	0	0	2	0	139							139
Richmond	274	0	860	0	0	0	410	4,350	0	0	89	0	0	0	5,983							5,983
	149	1,023	3,975	0	0	1,289	544	5,508	1	52	178	0	1,691	1	14,411							14,411
New York City	1,020	2,502	5,238	0	2,055	1,421	3,002	4,984	1,115	0	89	0	11,891	0	33,315							33,315
	1,520	1,454	8,908	0	0	1,318	577	5,943	4	180	178	0	3,833	1	23,916							23,916
TOTAL	169,864	122,447	84,889	24,344	85,947	145,475	88,170	111,220	78,354	79,938	84,478	11,639	109,726	6,982	1,203,472	17,087	14,155	58,672	718	7,571	98,204	1,301,676
ATTRACTION	171,281	127,266	89,405	23,530	73,342	131,497	81,786	97,840	74,055	80,242	70,927	10,778	111,451	4,648	1,148,047	1,105	7,457	111,294	95	8,031	127,981	1,276,028

Observed
Estimated

Home-Based-Shop County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+ Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	359,821	865	1,815	0	0	0	571	0	0	32,629	0	153	95	0	395,950	1,703	2,089	5,421	0	0	9,213	405,163
	359,409	1,960	2,169	0	0	0	0	50	0	37,515	4	3	538	0	401,649	2,153	12	3,023	62	0	5,250	406,899
Essex	6,396	141,302	6,403	0	0	260	0	13,511	0	26,495	0	0	6,414	0	200,781	0	0	4,057	0	0	4,057	204,838
	6,086	135,516	5,951	2	0	1,582	6	19,788	0	30,516	35	14	4,820	1	204,317	81	15	2,191	2	1	2,291	206,608
Hudson	10,143	1,683	95,195	0	0	1,692	0	0	0	2,456	791	0	2,101	0	114,061	0	0	12,383	531	0	12,914	126,975
	10,294	2,800	97,033	0	0	299	0	0	0	6,649	1	0	4,568	0	121,644	34	27	4,621	119	1	4,802	126,446
Hunterdon	0	89	0	28,018	221	413	0	156	0	0	4,104	0	581	1,969	35,552	0	0	0	0	0	0	35,552
	1	249	1	26,725	60	2,776	3	155	1	1	2,801	4	949	2,110	35,834	6	4	59	1	1	71	35,905
Mercer	0	0	0	177	116,629	3,212	0	0	0	0	954	0	265	0	121,237	0	2,138	830	0	0	2,968	124,205
	2	4	2	1,016	114,770	4,648	694	6	121	1	2,353	1	2,636	3	126,258	34	1,423	220	10	0	1,688	127,945
Middlesex	0	525	0	163	15,933	221,948	14,318	254	0	618	16,664	0	2,338	0	272,760	0	0	8,232	0	0	8,232	280,993
	1	7,328	8	593	13,361	218,364	19,567	592	2	23	19,083	0	3,222	1	282,145	16	9	4,121	4	34	4,184	286,330
Monmouth	0	0	0	0	2,795	4,116	249,590	0	4,721	0	0	0	230	0	261,452	0	0	0	0	240	240	261,693
	2	3	2	1	3,957	3,339	234,152	10	7,288	1	33	0	1,289	0	250,078	36	7	126	25	5	198	250,276
Morris	2,158	2,016	0	138	190	746	0	137,390	0	5,305	4,293	1,508	2,701	999	157,445	0	0	119	0	0	119	157,564
	7,892	2,319	15	381	0	1,959	2	122,010	0	3,996	5,136	2,844	4,329	1,651	152,535	9	2	360	2	0	374	152,909
Ocean	0	0	0	0	792	0	14,431	144	231,441	0	0	0	245	0	247,052	0	0	0	0	0	0	247,052
	0	0	0	0	673	7	14,984	0	231,805	0	2	0	1	0	247,472	1	7	6	1	0	16	247,487
Passaic	29,656	5,118	1,789	0	0	0	0	14,175	0	141,451	0	0	324	0	192,514	0	0	0	259	0	259	192,773
	30,513	7,513	2,043	1	0	4	0	20,308	0	131,968	7	184	1,823	2	194,365	254	3	352	4	0	614	194,979
Somerset	0	0	372	0	1,157	2,447	0	1,107	0	0	106,657	0	1,658	0	113,397	0	0	220	0	0	220	113,617
	11	17	476	105	2,216	2,338	31	1,383	0	2	101,765	5	2,187	3	110,538	5	2	590	5	0	602	111,140
Sussex	0	0	91	0	0	0	0	7,230	0	1,191	0	28,571	0	797	37,880	0	0	0	0	0	0	37,880
	1	1	1	0	0	0	0	8,189	0	1,691	1	28,158	1	743	38,788	12	3	60	3	0	78	38,866
Union	284	6,214	297	176	0	14,074	0	4,228	0	987	12,271	0	117,397	0	155,927	0	0	1,015	0	0	1,015	156,942
	2,678	6,683	194	148	0	17,400	3	3,955	0	1,744	11,705	1	106,942	0	151,453	2	3	238	1	4	247	151,700
Warren	0	0	0	1,409	0	0	0	4,204	0	0	0	1,067	0	35,035	41,715	0	0	0	0	0	0	41,715
	0	0	0	2,201	0	2	0	4,986	0	1	8	1,992	1	33,253	42,444	4	1	9	1	0	16	42,460
NJTPA+Mercer	408,459	157,812	105,962	30,079	137,718	248,909	278,910	182,399	236,162	211,131	145,734	31,299	134,348	38,800	2,347,722	1,703	4,227	32,279	790	240	39,239	2,386,961
	416,891	164,395	107,895	31,172	135,037	252,717	269,443	181,433	239,217	214,109	142,935	33,205	133,306	37,767	2,359,521	2,648	1,519	15,976	242	46	20,431	2,379,952
Bronx	167	0	0	0	0	0	0	0	0	0	0	0	0	0	167							167
	64	0	4	0	0	0	0	0	0	2	0	0	0	0	71							71
Kings	0	0	940	0	0	0	0	0	0	0	0	0	0	0	940							940
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							0
Manhattan	2,226	0	194	0	0	0	0	0	0	0	0	0	0	0	2,420							2,420
	187	0	6	0	0	0	0	0	0	0	0	0	0	0	193							193
Queens	368	0	0	0	0	0	1,445	0	0	0	0	0	0	0	1,813							1,813
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							0
Richmond	0	0	0	0	0	1,531	0	0	0	0	0	0	0	0	1,531							1,531
	2	1	4	0	0	5,828	2	0	0	0	8	0	13	0	5,858							5,858
New York City	2,761	0	1,134	0	0	1,531	1,445	0	0	0	0	0	0	0	6,872	6,872						
	253	1	15	0	0	5,828	2	0	0	2	8	0	13	0	6,122	6,122						
TOTAL	411,221	157,812	107,096	30,079	137,718	250,439	280,355	182,399	236,162	211,131	145,734	31,299	134,348	38,800	2,354,594	1,703	4,227	32,279	790	240	39,239	2,393,833
ATTRACTION	417,144	164,395	107,909	31,172	135,037	258,545	269,445	181,433	239,217	214,111	142,943	33,205	133,319	37,767	2,365,642	2,648	1,519	15,976	242	46	20,431	2,386,073

Observed
Estimated

Home-Based-Other County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+ Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	1,299,923	25,529	17,511	0	326	1,435	6,042	1,930	337	33,903	285	0	5,367	0	1,392,588	5,979	1,176	31,559	2,750	224	41,688	1,434,276
	1,268,845	48,353	29,299	3	468	480	5,028	2,816	0	59,826	483	9	6,281	3	1,421,894	2,511	278	14,044	310	170	17,314	1,439,208
Essex	23,660	769,607	9,584	7,494	3,285	1,895	2,313	33,006	0	32,355	1,362	0	41,608	209	926,378	365	124	27,146	2,564	0	30,200	956,578
	39,296	647,199	17,785	2,349	1,627	4,104	3,093	39,744	4	59,567	2,010	7	67,099	45	883,929	842	116	25,012	1,343	65	27,378	911,307
Hudson	36,655	17,670	325,445	0	508	499	1,336	1,650	1,931	4,939	2,450	0	1,843	0	394,926	217	2,096	39,223	2,336	126	43,997	438,923
	69,634	28,213	294,427	1	495	810	1,324	4,427	440	25,817	5,701	0	4,043	0	435,332	461	293	4,527	3,301	216	8,798	444,130
Hunterdon	0	854	386	112,467	1,020	1,183	213	1,373	472	0	10,538	0	4,094	1,559	134,160	0	0	1,382	146	0	1,528	135,688
	1	2,406	689	103,869	3,019	4,375	1,024	3,242	201	2	15,611	4	4,206	2,889	141,536	0	0	116	0	1	118	141,654
Mercer	0	278	160	3,158	370,981	14,591	4,637	0	6,618	0	4,526	0	329	0	405,277	0	0	1,839	254	0	2,092	407,370
	0	541	525	3,066	358,107	23,899	5,503	12	15,183	0	6,664	0	541	1	414,042	0	0	186	0	3	189	414,231
Middlesex	5,556	8,599	1,435	2,065	25,893	918,580	32,045	2,252	720	368	51,695	862	15,998	494	1,066,563	0	4,216	5,975	2,780	97	13,067	1,079,630
	7,938	10,998	2,182	2,299	31,200	887,957	34,885	3,422	1,376	731	72,434	518	29,204	372	1,085,514	8	2,168	10,577	271	300	13,324	1,098,839
Monmouth	923	3,068	2,650	0	838	20,454	926,061	1,112	30,697	581	2,113	1,074	6,311	1,064	996,945	0	1,132	3,507	0	4,502	9,141	1,006,087
	1,678	1,966	2,556	6	2,503	36,811	836,323	2,790	55,572	1,935	3,470	17	4,361	100	950,088	1	3	4,752	0	3,322	8,078	958,165
Morris	5,129	16,866	584	63	58	661	342	623,067	167	15,860	10,915	8,612	20,715	1,482	704,522	0	298	309	769	0	1,375	705,898
	6,189	33,621	1,542	511	158	1,738	994	555,084	22	14,259	19,680	12,716	34,710	6,096	687,320	10	89	1,240	277	4	1,618	688,939
Ocean	0	4,039	5,871	0	900	9,627	59,970	303	715,340	0	191	0	1,647	0	797,887	0	1,180	0	0	1,760	2,940	800,826
	0	580	90	0	2,386	6,588	109,248	16	681,837	0	102	0	1,447	0	802,294	0	0	0	0	321	321	802,615
Passaic	64,148	31,988	2,916	282	0	0	0	10,709	0	504,228	1,643	2,429	776	0	619,120	0	0	7,274	334	0	7,608	626,728
	84,957	52,770	10,515	340	1	60	4	17,151	0	444,109	2,410	2,481	1,293	6	616,097	97	5	32,670	414	5	33,191	649,288
Somerset	273	6,467	273	4,925	6,848	26,630	1,640	14,892	0	0	312,671	0	13,195	134	387,949	0	0	2,864	0	0	2,864	390,813
	476	9,230	581	6,627	10,249	37,647	2,245	25,705	4	7	276,721	2	22,030	45	391,569	1	0	7,181	0	9	7,191	398,760
Sussex	4,760	899	250	0	0	0	248	24,725	0	1,618	0	131,951	62	207	164,719	0	0	754	0	121	874	165,593
	2,760	3,595	783	1	0	3	12	43,498	0	5,268	6	122,418	260	468	179,074	0	0	235	0	1	236	179,310
Union	715	50,256	34,050	0	0	24,568	230	11,119	602	329	15,496	0	622,637	0	760,002	0	0	11,021	1,844	335	13,199	773,201
	1,183	74,602	58,775	51	16	36,847	244	13,713	1,416	691	11,006	3	556,561	4	755,114	12	13	7,664	578	172	8,439	763,553
Warren	2,586	680	0	5,251	0	654	0	9,112	0	637	608	4,326	0	106,225	130,078	0	0	328	0	0	328	130,406
	326	1,121	0	13,916	1	2,215	0	14,499	0	542	3,573	8,111	3	103,503	147,810	0	0	7	0	0	7	147,816
NJTPA+Mercer	1,444,329	936,800	401,114	135,705	410,658	1,020,776	1,035,078	735,249	756,884	594,817	414,494	149,253	734,582	111,374	8,881,114	6,561	10,220	133,180	13,776	7,165	170,902	9,052,015
	1,483,285	915,195	419,750	133,040	410,230	1,043,534	999,928	726,118	756,054	612,754	419,872	146,286	732,038	113,530	8,911,612	3,944	2,965	108,210	6,494	4,589	126,202	9,037,814
Bronx	2,858	0	0	0	0	2,418	229	0	0	6,821	0	0	0	0	12,326							12,326
	769	80	160	0	0	4,037	15	74	0	8,697	6	0	27	0	13,866							13,866
Kings	0	4,811	3,887	0	0	823	189	0	0	0	0	0	723	0	10,434							10,434
	107	760	425	0	0	453	68	19	0	45	12	0	178	0	2,067							2,067
Manhattan	8,713	1,635	1,017	0	407	0	0	481	0	0	0	0	383	1,115	13,750							13,750
	902	618	269	0	0	11	0	172	0	75	2	0	107	5	2,160							2,160
Queens	1,972	1,154	336	0	0	7,855	0	0	0	0	0	0	413	0	11,730							11,730
	367	1,344	215	0	0	11,348	0	16	0	115	0	0	267	0	13,671							13,671
Richmond	695	3,979	1,452	0	0	6,477	3,167	0	681	0	0	0	262	0	16,713							16,713
	1,542	6,124	4,149	42	76	7,980	3,816	338	3,884	88	197	0	3,612	0	31,848							31,848
New York City	14,238	11,580	6,692	0	407	17,573	3,584	481	681	6,821	0	0	1,781	1,115	64,953							64,953
	3,687	8,927	5,218	42	76	23,828	3,899	619	3,884	9,020	216	0	4,191	5	63,612							63,612
TOTAL	1,458,567	948,379	407,806	135,705	411,065	1,038,349	1,038,662	735,730	757,565	601,638	414,494	149,253	736,363	112,490	8,946,066	6,561	10,220	133,180	13,776	7,165	170,902	9,116,968
ATTRACTION	1,486,972	924,122	424,968	133,082	410,305	1,067,362	1,003,827	726,737	759,938	621,773	420,088	146,286	736,229	113,535	8,975,224	3,944	2,965	108,210	6,494	4,589	126,202	9,101,426

Observed
Estimated

Non-Home-Based Work County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	108,349	7,797	7,779	0	0	1,077	167	1,056	86	8,066	0	119	1,356	134	135,987	77	672	848	85	0	1,682	137,669
	99,720	9,646	10,698	0	0	782	35	1,347	0	9,977	2	101	1,460	48	133,815	130	101	488	22	18	760	134,574
Essex	5,678	65,342	7,781	0	329	4,286	0	11,224	0	9,783	0	2,301	9,940	723	117,386	0	268	4,729	0	0	4,997	122,383
	7,150	57,051	8,035	1	85	5,405	13	18,518	0	13,260	80	2,253	13,290	270	125,412	15	29	3,639	2	269	3,954	129,366
Hudson	4,037	3,117	43,776	0	1,861	727	251	111	1,387	1,129	1,586	0	1,050	0	59,032	1,692	41	12,041	205	0	13,979	73,011
	6,884	5,183	43,033	0	118	604	92	128	96	2,168	2,512	0	933	0	61,752	1,217	35	7,301	136	403	9,091	70,843
Hunterdon	0	0	128	6,266	0	110	0	202	0	82	2,860	0	90	269	10,009	0	0	0	0	0	0	10,009
	0	5	71	4,702	25	26	0	398	0	81	3,322	1	154	323	9,109	0	0	0	0	1	1	9,110
Mercer	0	0	0	51	49,240	2,914	235	0	1,257	0	668	0	0	0	54,365	0	0	2,230	0	0	2,230	56,595
	0	4	0	98	46,420	4,003	338	2	1,303	0	1,012	0	8	1,303	53,189	0	0	102	0	14	116	53,304
Middlesex	105	231	725	233	5,877	95,002	1,484	526	2,291	1,066	7,171	319	7,810	0	122,842	0	1,674	1,209	0	0	2,884	125,725
	43	406	436	157	6,443	86,787	1,735	433	1,843	913	11,240	0	12,025	0	122,461	0	148	434	0	914	1,497	123,958
Monmouth	39	38	0	0	221	2,284	117,044	158	9,481	0	0	0	179	0	129,444	0	0	0	0	0	0	129,444
	4	49	2	0	313	1,748	106,023	75	10,872	0	25	0	228	0	119,339	0	0	0	0	191	191	119,530
Morris	5,562	10,974	36	375	0	1,346	1,090	72,271	87	7,243	1,853	697	2,605	1,447	105,583	2,172	0	1,071	0	0	3,242	108,825
	7,593	15,782	45	516	0	2,566	1,288	60,144	8	8,500	2,395	989	3,115	2,081	105,021	1,044	0	1,054	0	31	2,130	107,151
Ocean	137	0	0	0	1,113	3,202	7,029	0	64,292	0	0	0	0	0	75,773	0	0	190	0	0	190	75,963
	1	0	0	0	1,092	2,750	8,442	0	60,072	0	0	0	0	0	72,357	0	0	1	0	2	2	72,359
Passaic	9,603	13,575	163	82	0	342	0	6,642	0	25,521	49	0	132	0	56,110	0	349	86	846	0	1,281	57,391
	12,269	16,701	189	39	0	239	0	8,391	0	17,673	64	11	126	0	55,702	13	30	80	138	6	268	55,969
Somerset	0	312	0	1,183	1,334	6,305	58	1,974	782	412	47,309	79	886	418	61,051	0	0	0	0	0	0	61,051
	20	461	17	1,918	1,919	9,763	115	4,100	797	279	37,699	165	1,437	1,088	59,778	0	0	1	0	104	105	59,882
Sussex	0	1,230	0	0	0	0	0	3,114	0	0	517	17,683	0	0	22,544	0	0	0	0	0	0	22,544
	2	932	0	0	0	0	0	3,921	0	13	813	17,182	1	11	22,875	0	0	0	0	0	0	22,875
Union	260	5,735	1,913	302	277	5,255	341	2,259	775	174	2,900	0	48,874	0	69,063	0	105	1,719	0	0	1,824	70,887
	309	8,817	523	92	203	7,843	445	3,569	530	216	4,660	2	44,955	0	72,164	2	8	719	0	533	1,262	73,426
Warren	0	723	0	480	0	0	0	948	0	0	0	0	0	4,649	6,801	0	0	0	0	0	0	6,801
	0	679	0	445	0	2	0	1,565	0	0	14	26	1	3,808	6,540	0	0	0	0	0	0	6,540
NJTPA+Mercer	133,769	109,073	62,301	8,971	60,252	122,851	127,698	100,486	80,439	53,478	64,913	21,197	72,921	7,640	1,025,990	3,941	3,108	24,123	1,136	0	32,308	1,058,297
	133,995	115,717	63,049	7,969	56,618	122,516	118,525	102,590	75,520	53,079	63,839	20,732	77,734	7,630	1,019,511	2,422	352	13,817	299	2,486	19,377	1,038,889
Bronx	429	0	0	0	0	0	0	0	0	0	0	0	0	0	429							429
	292	5	5	0	0	0	0	1	0	8	0	0	0	0	312							312
Kings	185	0	0	0	0	2,632	0	290	0	0	0	0	0	0	3,107							3,107
	10	0	1	0	0	266	0	7	0	0	0	0	1	0	285							285
Manhattan	3,855	3,546	1,461	0	413	613	542	1,815	0	0	0	137	2,150	0	14,531							14,531
	980	2,971	588	0	0	67	18	941	0	9	0	14	864	0	6,453							6,453
Queens	0	3,044	0	0	0	0	0	0	0	0	0	0	0	0	3,044							3,044
	6	268	2	0	0	0	0	0	0	0	0	0	0	0	276							276
Richmond	0	1,425	212	0	0	0	117	0	0	0	0	0	181	0	1,935							1,935
	28	1,663	233	0	0	613	92	17	1	7	26	0	401	0	3,082							3,082
New York City	4,470	8,015	1,672	0	413	3,245	659	2,105	0	0	0	137	2,330	0	23,046							23,046
	1,317	4,907	830	0	0	946	110	966	1	25	26	14	1,266	0	10,408							10,408
TOTAL	138,239	117,089	63,973	8,971	60,664	126,095	128,357	102,591	80,439	53,478	64,913	21,334	75,252	7,640	1,049,036	3,941	3,108	24,123	1,136	0	32,308	1,081,344
ATTRACTION	135,311	120,624	63,879	7,969	56,619	123,462	118,636	103,555	75,521	53,104	63,865	20,746	78,999	7,630	1,029,919	2,422	352	13,817	299	2,486	19,377	1,049,297

Observed
Estimated

Non-Home-Based Other County-to-County Comparison

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL	
Bergen	679,675	6,034	12,494	0	0	53	264	6,907	737	26,827	285	0	439	0	733,714	4,496	0	8,539	105	0	13,140	746,854	
	679,251	5,513	17,142	0	0	10	38	3,505	0	31,144	146	0	154	0	736,903	1,359	0	5,665	2	2	7,028	743,931	
Essex	13,585	349,991	8,955	122	119	2,525	298	30,300	0	28,736	2,764	1,050	52,038	0	490,482	113	186	4,342	0	223	4,864	495,346	
	15,928	334,215	12,878	125	35	2,590	203	23,435	0	36,144	3,195	551	57,291	0	486,589	19	3	1,526	0	136	1,684	488,273	
Hudson	9,201	8,258	177,612	0	0	681	0	310	618	2,481	618	0	1,780	0	201,558	0	2,137	8,722	0	885	11,744	213,302	
	12,850	12,357	180,942	0	0	265	0	416	0	5,705	521	0	1,293	0	214,348	13	110	4,057	3	1,055	5,238	219,586	
Hunterdon	0	7,504	0	48,198	742	163	0	615	0	0	1,979	0	0	1,711	60,912	0	0	0	0	0	0	60,912	
	0	5,310	1	45,991	1,462	374	1	983	2	5	3,504	2	91	1,156	58,883	0	0	0	0	1	1	2	58,886
Mercer	0	0	0	152	240,536	7,417	2,545	0	624	3,166	1,519	0	1,020	0	256,978	0	0	0	0	0	0	0	256,978
	0	0	0	229	244,236	8,456	2,839	0	896	2	1,906	0	728	0	259,291	0	0	0	0	0	0	0	259,292
Middlesex	1,563	637	486	0	9,023	420,581	12,528	1,443	1,125	0	22,479	155	6,181	0	476,200	942	102	2,178	0	2,308	5,529	481,729	
	1,027	1,164	391	20	10,656	423,526	13,428	2,512	2,555	20	23,638	14	8,492	0	487,442	28	0	477	0	1,580	2,085	489,527	
Monmouth	0	247	1,296	0	3,128	18,607	573,356	0	23,553	463	625	0	1,506	0	622,780	0	976	773	0	3,054	4,803	627,583	
	0	206	0	0	3,649	18,406	522,817	0	26,911	194	658	0	1,311	0	574,152	0	1	64	0	620	685	574,837	
Morris	6,907	28,837	0	266	0	52	1,074	331,568	0	19,491	3,997	5,379	4,570	3,344	405,488	0	0	0	0	0	0	0	405,488
	6,588	23,640	85	265	0	249	581	329,121	0	25,258	4,581	6,171	5,298	3,647	405,484	0	0	11	0	1	13	405,497	
Ocean	0	213	219	0	2,664	566	30,642	102	439,073	0	0	0	0	0	473,478	0	0	0	0	0	0	0	473,478
	0	0	0	0	4,492	739	39,735	0	452,770	0	0	0	0	0	497,736	0	0	19	1	0	20	497,756	
Passaic	31,933	22,162	2,589	282	0	0	0	19,797	0	326,598	0	565	128	0	404,054	0	0	0	0	0	0	0	404,054
	34,225	27,055	4,966	54	0	7	0	21,037	0	322,507	2	470	85	0	410,408	11	0	420	0	0	430	410,838	
Somerset	149	1,519	0	3,403	6,126	11,973	1,488	7,044	0	0	165,836	482	9,091	0	207,111	0	0	140	0	0	140	207,250	
	103	1,988	7	2,909	7,820	15,414	1,801	7,101	0	16	156,515	417	10,153	9	204,254	0	0	12	0	20	33	204,286	
Sussex	530	0	0	487	0	155	0	5,644	0	0	0	61,550	0	295	68,660	0	0	0	0	121	121	68,781	
	983	5	0	207	0	63	0	8,730	0	164	2	59,571	1	303	70,030	0	0	0	0	0	0	70,030	
Union	127	15,040	4,348	2,106	0	16,133	83	4,875	0	910	16,418	0	286,956	0	346,994	0	108	715	1,844	2,756	5,422	352,416	
	342	19,136	4,272	2,390	0	19,780	247	5,974	0	858	19,074	0	277,522	0	349,596	0	0	65	32	1,255	1,353	350,949	
Warren	0	0	0	424	0	269	0	3,411	0	0	0	513	0	44,666	49,283	0	0	0	0	0	0	49,283	
	0	0	0	552	0	465	0	4,168	0	0	21	616	0	45,286	51,110	0	0	0	0	0	0	51,110	
NJTPA+Mercer	743,669	440,441	207,999	55,439	262,339	479,175	622,278	412,016	465,729	408,672	216,518	69,692	363,708	50,016	4,797,692	5,550	3,510	25,407	1,948	9,346	45,762	4,843,454	
	751,297	430,589	220,681	52,742	272,351	490,343	581,690	406,983	483,134	422,017	213,763	67,813	362,419	50,402	4,806,226	1,430	115	12,317	39	4,671	18,571	4,824,797	
Bronx	1,718	0	0	0	0	942	0	0	0	0	0	142	0	0	2,802							2,802	
	962	2	16	0	0	10	0	0	0	25	0	0	0	0	1,016							1,016	
Kings	300	0	3,228	0	0	3,904	976	0	0	0	0	0	0	0	8,408							8,408	
	2	0	92	0	0	53	2	0	0	0	0	0	0	0	150							150	
Manhattan	7,885	4,715	8,423	0	0	575	4,463	1,127	128	1,103	248	0	1,445	0	30,112							30,112	
	5,958	916	2,771	0	0	4	4	409	0	928	6	0	2	0	10,997							10,997	
Queens	0	0	0	0	0	0	1,023	0	0	0	0	0	0	0	1,023							1,023	
	4	0	1	0	0	0	0	0	0	0	0	0	0	0	5							5	
Richmond	0	0	1,452	0	0	6,103	2,730	0	387	0	0	0	2,494	0	13,167							13,167	
	41	441	2,904	0	0	8,001	974	5	191	7	30	0	2,591	0	15,186							15,186	
New York City	9,903	4,715	13,103	0	0	11,524	9,192	1,127	515	1,103	248	142	3,938	0	55,512							55,512	
	6,967	1,359	5,784	0	0	8,069	980	414	191	961	37	0	2,593	0	27,354							27,354	
TOTAL	753,572	445,156	221,102	55,439	262,339	490,699	631,470	413,144	466,244	409,776	216,767	69,834	367,647	50,016	4,853,204	5,550	3,510	25,407	1,948	9,346	45,762	4,898,966	
ATTRACTION	758,264	431,948	226,465	52,743	272,351	498,412	582,670	407,397	483,326	422,977	213,800	67,813	365,011	50,402	4,833,580	1,430	115	12,317	39	4,671	18,571	4,852,151	

TEXT Observed
 TEXT Estimated

All HBW County-to-County Comparison with Adjusted Observed Data for NJTPA, Mercer, and NYC

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	393,418	36,266	37,163	8,945	960	12,576	1,078	15,101	137	44,447	8,558	752	12,071	1,144	572,617	22,625	10,376	93,885	1,417	1,027	129,330	701,947
	370,399	43,855	45,939	229	0	6,339	389	16,070	17	38,569	3,104	344	13,785	44	539,083	4,040	487	111,902	81	1,063	117,572	656,655
Essex	24,420	240,176	26,155	5,517	868	5,740	545	54,642	229	23,310	10,733	319	27,976	0	420,630	2,435	1,005	63,219	947	2,024	69,630	490,260
	29,014	225,635	33,027	688	13	7,068	223	46,458	64	19,903	14,460	0	25,821	0	402,375	222	113	83,007	15	2,180	85,537	487,912
Hudson	45,272	23,280	172,262	0	95	13,270	735	12,704	0	8,505	4,792	129	8,883	0	289,927	4,879	7,299	125,416	6,137	324	144,056	433,983
	32,536	18,417	131,521	0	0	5,469	72	17,491	0	8,526	2,166	2	5,307	0	221,507	303	420	216,453	328	314	217,817	439,323
Hunterdon	80	1,157	1,779	30,923	3,895	7,204	167	3,010	653	130	14,540	0	2,717	906	67,160	0	0	2,099	111	0	2,210	69,370
	271	2,427	3,436	14,051	4,249	9,076	149	8,975	180	266	21,900	2	4,134	1,952	71,067	0	2	552	0	41	596	71,663
Mercer	0	0	2,904	255	190,966	24,038	2,971	2,612	3,471	0	5,575	0	818	0	233,608	0	0	11,912	0	0	11,912	245,521
	74	1,093	2,779	2,141	183,646	29,208	4,685	4,288	4,336	54	5,494	0	1,105	9	238,912	0	94	10,773	0	1,207	12,074	250,986
Middlesex	12,133	20,525	9,492	571	33,449	341,970	16,209	11,029	9,228	5,825	51,862	0	38,493	607	551,393	6,674	10,868	57,090	521	4,739	79,893	631,286
	4,871	33,172	13,153	8,973	25,058	318,499	22,549	15,746	12,330	4,614	46,715	0	44,909	221	550,808	463	1,691	67,380	82	9,480	79,096	629,905
Monmouth	5,436	18,039	13,141	305	5,634	30,265	243,018	5,767	22,929	977	13,750	0	11,163	0	370,423	38	3,160	38,609	1,878	2,720	46,405	416,829
	3,804	21,753	17,411	803	3,873	29,428	219,786	6,552	22,015	697	26,988	0	12,851	1	365,962	0	1,974	41,090	138	6,083	49,285	415,247
Morris	13,229	36,378	2,379	4,723	381	2,901	0	184,211	0	31,237	18,870	7,496	15,643	3,758	321,207	5,021	1,816	16,875	0	566	24,278	345,485
	18,240	50,903	3,468	6,479	95	2,097	1	146,114	0	40,597	17,584	13,085	17,841	3,216	319,721	836	2,596	24,818	4	663	28,918	348,639
Ocean	1,873	5,461	3,157	51	15,123	12,539	72,410	1,194	251,078	205	2,999	0	2,136	0	368,227	539	937	9,652	0	2,734	13,863	382,090
	649	6,710	3,652	193	12,195	10,095	89,318	995	234,410	79	5,866	0	2,353	0	366,514	0	94	697	0	5,224	6,015	372,529
Passaic	58,640	32,023	16,589	347	0	304	1,398	31,795	0	136,077	3,422	776	2,901	0	284,272	944	3,689	13,671	714	0	19,018	303,291
	61,261	29,658	21,638	280	0	239	50	29,551	0	139,990	5,507	1,678	3,174	0	293,026	85	80	12,592	12	19	12,788	305,814
Somerset	3,717	15,148	8,364	13,634	15,906	29,609	1,609	13,122	0	1,739	116,226	0	16,742	0	235,817	0	569	9,876	2,277	4,349	17,072	252,889
	3,769	29,517	15,348	13,558	14,404	40,263	1,024	22,359	0	1,819	73,420	1	20,901	5	236,388	1	136	10,963	317	9,658	21,075	257,462
Sussex	10,124	7,874	5,135	0	1,536	943	0	23,419	0	10,924	2,724	42,636	2,158	2,585	110,058	552	349	1,374	0	0	2,274	112,332
	8,848	5,303	5,877	5	2	460	0	27,672	0	9,575	4,222	36,621	784	2,929	102,299	52	0	189	0	0	241	102,540
Union	5,975	43,454	44,078	610	1,586	41,412	206	24,894	0	10,169	19,652	0	183,774	1,133	376,943	2,211	8,953	37,031	0	4,284	52,479	429,422
	5,929	31,014	57,588	1,414	320	45,331	376	22,222	0	8,191	14,177	0	179,192	1	365,756	116	2,364	62,339	20	3,191	68,030	433,785
Warren	674	712	0	7,800	228	252	285	11,640	0	1,756	5,797	2,679	1,250	21,719	54,792	0	0	1,457	0	0	1,457	56,250
	1,022	923	323	12,795	27	145	98	14,237	0	2,730	6,589	2,755	880	21,698	64,222	1	0	552	0	11	565	64,787
NJTPA+Mercer	574,993	480,492	342,600	73,680	270,626	523,023	340,631	395,143	287,724	275,301	279,500	54,786	326,725	31,850	4,257,075	45,919	49,020	482,169	14,002	22,768	613,878	4,870,953
	540,686	500,380	355,160	61,609	243,882	503,717	338,720	378,729	273,353	275,610	248,192	54,489	333,037	30,075	4,137,639	6,118	10,051	643,308	997	39,134	699,608	4,837,248
Bronx	3,705	113	1,037	0	0	0	0	0	0	0	0	0	217	0	5,072							5,072
	11,667	1,221	3,318	0	0	0	0	13	0	56	0	0	10	0	16,285							16,285
Kings	9,125	9,783	12,088	542	0	761	5,184	3,122	1,115	0	0	0	11,891	119	53,729							53,729
	517	499	3,050	0	0	178	61	22	3	9	0	0	2,120	0	6,460							6,460
Manhattan	10,277	3,145	10,667	3,780	3,510	5,993	633	1,062	221	463	0	0	354	0	40,106							40,106
	17,457	4,609	17,161	0	0	85	0	1,179	0	1,268	0	0	457	0	42,216							42,216
Queens	4,023	9,927	3,639	0	0	1,147	3,887	1,135	0	846	0	0	1,762	0	26,366							26,366
	669	119	704	0	0	19	3	1	0	94	0	0	58	0	1,666							1,666
Richmond	1,262	2,541	5,910	0	0	579	820	4,350	2,274	933	1,701	0	2,421	0	22,791							22,791
	1,321	2,396	6,447	0	0	1,642	2,385	5,509	75	886	1,072	0	2,098	1	23,831							23,831
New York City	28,392	25,508	33,341	4,322	3,510	8,481	10,523	9,670	3,610	2,242	1,701	0	16,645	119	148,064							148,064
	31,632	8,844	30,679	0	0	1,924	2,448	6,724	78	2,312	1,073	0	4,742	1	90,459							90,459
TOTAL	603,385	506,001	375,941	78,002	274,137	531,504	351,155	404,812	291,333	277,542	281,201	54,786	343,371	31,969	4,405,139	45,919	49,020	482,169	14,002	22,768	613,878	5,019,017
ATTRACTION	572,318	509,225	385,840	61,610	243,882	505,641	341,168	385,453	273,431	277,922	249,264	54,489	337,779	30,076	4,228,098	6,118	10,051	643,308	997	39,134	699,608	4,927,706

TEXT Observed
 TEXT Estimated

All Non-HBW County-to-County Comparison with Adjusted Observed Data for NJTPA, Mercer, and NYC

REGION	Bergen	Essex	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	Ocean	Passaic	Somerset	Sussex	Union	Warren	NJTPA+Mercer	Bronx	Kings	Manhattan	Queens	Richmond	New York City	TOTAL
Bergen	2,447,768	40,225	39,600	0	326	2,565	7,045	9,893	1,160	101,424	569	273	7,257	134	2,658,239	12,255	3,936	46,368	2,940	224	65,722	2,723,962
	2,407,225	65,472	59,309	3	468	1,272	5,102	7,717	0	138,461	635	112	8,434	52	2,694,261	6,153	391	23,220	397	190	30,351	2,724,613
Essex	49,318	1,326,242	32,723	7,616	3,733	8,966	2,611	88,041	0	97,369	4,125	3,350	109,999	933	1,735,026	478	579	40,275	2,564	223	44,118	1,779,145
	68,460	1,173,980	44,649	2,478	1,747	13,681	3,315	101,485	4	139,486	5,320	2,826	142,500	315	1,700,247	957	163	32,369	1,347	471	35,307	1,735,554
Hudson	60,037	30,727	642,028	0	2,369	3,599	1,587	2,071	3,936	11,004	5,446	0	6,774	0	769,578	1,909	4,273	72,369	3,072	1,011	82,633	852,212
	99,662	48,553	615,434	1	613	1,977	1,416	4,971	536	40,340	8,735	1	10,837	0	833,076	1,725	466	20,505	3,558	1,675	27,928	861,004
Hunterdon	0	8,446	514	194,949	1,984	1,870	213	2,346	472	82	19,481	0	4,765	5,508	240,632	0	0	1,382	146	0	1,528	242,160
	3	7,970	762	181,287	4,566	7,550	1,028	4,777	204	89	25,239	11	5,399	6,478	245,362	6	4	175	2	5	192	245,554
Mercer	0	278	160	3,537	777,386	28,133	7,417	0	8,498	3,166	7,667	0	1,614	0	837,857	0	2,138	4,899	254	0	7,290	845,148
	3	549	527	4,409	763,534	41,005	9,374	21	17,503	4	11,934	1	3,913	3	852,780	34	1,423	507	10	18	1,992	854,772
Middlesex	7,224	9,992	2,646	2,461	56,726	1,656,111	60,375	4,476	4,136	2,053	98,009	1,335	32,327	494	1,938,365	942	5,992	17,594	2,780	2,404	29,712	1,968,077
	9,008	19,896	3,016	3,069	61,659	1,616,634	69,615	6,959	5,776	1,687	126,396	532	52,943	373	1,977,562	52	2,326	15,610	275	2,828	21,091	1,998,653
Monmouth	962	3,353	3,946	0	6,983	45,462	1,866,051	1,270	68,452	1,044	2,737	1,074	8,226	1,064	2,010,623	0	2,108	4,280	0	7,797	14,185	2,024,807
	1,684	2,225	2,561	6	10,423	60,303	1,699,315	2,875	100,643	2,130	4,187	17	7,189	100	1,893,657	36	11	4,941	25	4,138	9,152	1,902,808
Morris	19,757	58,693	619	842	248	2,805	2,506	1,164,297	254	47,900	21,058	16,195	30,591	7,272	1,373,038	2,172	298	1,499	769	0	4,737	1,377,775
	28,262	75,362	1,686	1,673	158	6,513	2,866	1,066,359	30	52,013	31,792	22,721	47,452	13,475	1,350,360	1,064	91	2,666	279	36	4,136	1,354,496
Ocean	137	4,251	6,090	0	5,468	13,395	112,071	549	1,450,145	0	191	0	1,892	0	1,594,190	0	1,180	190	0	1,760	3,130	1,597,319
	1	580	90	0	8,643	10,084	172,409	16	1,426,484	0	104	0	1,447	0	1,619,859	1	7	25	2	323	359	1,620,218
Passaic	135,341	72,844	7,457	645	0	342	0	51,323	0	997,798	1,692	2,993	1,361	0	1,271,797	0	349	7,360	1,439	0	9,148	1,280,945
	161,964	104,039	17,713	433	1	310	4	66,887	0	916,256	2,484	3,146	3,326	7	1,276,572	375	39	33,522	557	11	34,503	1,311,076
Somerset	421	8,297	644	9,511	15,465	47,355	3,186	25,017	782	412	632,473	560	24,829	552	769,507	0	0	3,224	0	0	3,224	772,731
	610	11,696	1,080	11,560	22,204	65,162	4,192	38,289	801	304	572,699	590	35,807	1,145	766,138	5	3	7,784	5	133	7,931	774,068
Sussex	5,290	2,128	341	487	0	155	248	40,714	0	2,809	517	239,755	62	1,298	293,803	0	0	754	0	242	995	294,798
	3,747	4,534	784	209	0	67	12	64,338	0	7,136	822	227,329	264	1,525	310,766	13	3	295	3	1	314	311,080
Union	1,386	77,244	40,607	2,584	277	60,030	654	22,480	1,377	2,399	47,085	0	1,075,864	0	1,331,986	0	213	14,470	3,687	3,091	21,460	1,353,447
	4,512	109,238	63,763	2,681	219	81,870	939	27,212	1,946	3,509	46,446	6	985,981	5	1,328,327	16	24	8,686	612	1,964	11,302	1,339,628
Warren	2,586	1,404	0	7,564	0	923	0	17,674	0	637	608	5,905	0	190,576	227,876	0	0	328	0	0	328	228,204
	326	1,801	0	17,113	1	2,682	0	25,218	0	544	3,616	10,746	4	185,851	247,903	4	1	16	2	0	23	247,926
NJTPA+Mercer	2,730,227	1,644,125	777,375	230,195	870,967	1,871,711	2,063,963	1,430,151	1,539,214	1,268,098	841,659	271,442	1,305,560	207,830	17,052,518	17,755	21,065	214,989	17,650	16,751	288,210	17,340,728
	2,785,467	1,625,896	811,375	224,923	874,236	1,909,110	1,969,587	1,417,124	1,553,926	1,301,959	840,408	268,036	1,305,496	209,329	17,096,870	10,443	4,950	150,320	7,074	11,793	184,581	17,281,451
Bronx	5,172	0	0	0	0	3,360	229	0	0	6,821	0	142	0	0	15,724							15,724
	2,087	88	185	0	0	4,047	15	76	0	8,733	6	0	27	0	15,264							15,264
Kings	485	4,811	8,056	0	0	7,359	1,164	290	0	0	0	0	723	0	22,889							22,889
	119	760	519	0	0	773	70	26	0	45	12	0	179	0	2,503							2,503
Manhattan	22,679	9,896	11,094	0	819	1,188	5,005	3,424	128	1,103	248	137	3,977	1,115	60,814							60,814
	8,027	4,506	3,634	0	0	82	22	1,522	0	1,013	8	14	972	5	19,804							19,804
Queens	2,340	4,198	336	0	0	7,855	2,468	0	0	0	0	0	413	0	17,610							17,610
	377	1,612	218	0	0	11,348	0	16	0	115	0	0	267	0	13,952							13,952
Richmond	695	5,404	3,116	0	0	14,111	6,015	0	1,068	0	0	0	2,937	0	33,345							33,345
	1,614	8,228	7,291	43	76	22,422	4,884	360	4,076	102	261	0	6,617	0	55,974							55,974
New York City	31,372	24,310	22,602	0	819	33,872	14,881	3,714	1,197	7,924	248	279	8,049	1,115	150,382							150,382
	12,224	15,194	11,846	43	76	38,671	4,991	1,999	4,076	10,007	287	15	8,062	5	107,496							107,496
TOTAL	2,761,599	1,668,435	799,977	230,195	871,786	1,905,582	2,078,844	1,433,865	1,540,411	1,276,022	841,907	271,720	1,313,609	208,946	17,202,900	17,755	21,065	214,989	17,650	16,751	288,210	17,491,110
ATTRACTION	2,797,691	1,641,089	823,221	224,966	874,312	1,947,781	1,974,578	1,419,123	1,558,002	1,311,965	840,695	268,051	1,313,559	209,334	17,204,367	10,443	4,950	150,320	7,074	11,793	184,581	17,388,947

Observed
Estimated

APPENDIX J – CONSTANTS-EXPRESSED AT NEST LEVEL OF APPLICATION

1. From Everywhere (except Staten Island) to Manhattan

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	2.88739	3.13620	1.67808	2.94974	7.68656	7.90375	6.09863	7.64087	4.13200	5.32317	4.61332	5.66382
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.77007	-2.13753	-3.18114	-3.80638	-3.02093	-2.34052	-1.76945	-2.70615	-0.66500	-1.27021	-0.62376	-1.35171
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	4.93698	2.62688	6.99367	3.47112	3.63726	-3.48318	1.31981	-4.09306	-8.88108	-7.72020	-10.68170	-8.68310
WK-BUS	3.74709	4.61803	2.06145	2.14523	3.05455	-6.88441	-1.88482	-5.71107	-2.77714	-6.75685	-6.62568	-10.37791
WK-FERRY	19.77449	18.71363	14.01282	14.46680	17.53849	35.02491	6.79732	16.88561	14.77946	10.21908	24.26004	20.39109
WK-LRT	1.87577	1.24868	3.08727	1.17869	1.43497	0.28678	-1.25953	-5.74971	3.93037	-3.48301	2.22230	-6.76961
WK-LNGFRY	2.47766	7.72426	-2.39123	6.75149	21.97721	11.09655	11.13792	5.14019	16.74193	-4.33817	14.18417	-3.45046
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	7.70010	4.27825	12.91752	7.43464	4.06343	0.09682	3.12804	-1.48280	-5.91509	-5.00892	-7.22518	-5.67265
DR-BUS	4.81209	6.98456	7.59376	8.24983	1.72405	-1.34676	0.09649	-1.97205	-0.44643	-2.64994	-5.35432	-7.11017
DR-FERRY	-1.39688	-2.32355	4.88588	1.87702	7.95218	-6.27478	-5.07524	-11.28444	-1.24640	-9.80246	-4.66022	-12.35452
DR-LRT	1.02118	-1.12285	6.28812	1.81246	2.42864	-0.61812	-3.42707	-6.08547	-7.46654	-6.67559	-9.34991	-8.55374
DR-LNGFRY	-2.32057	2.38885	1.76705	4.06447	19.03387	-2.25052	5.08735	5.54506	9.55068	-2.74284	0.20667	-3.82787
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.37971	-1.96169	-1.65095	-2.19972	-0.77006	0.67520	0.15710	0.24832	-0.21166	-0.59403	-0.17893	-0.56029
SR3	-3.32052	-3.28301	-1.83786	-1.75565	-1.00478	-1.12350	-1.10085	-1.36310	-1.87126	-1.13673	-1.82655	-1.09177
SR4	-3.16549	-4.23776	-4.02127	-5.04436	-3.44992	0.86337	-1.82418	-0.86665	-1.24882	-1.15573	-1.19973	-1.10513

2. From Everywhere (except Staten Island and Manhattan) to Newark Super CBD

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.71069	3.15071	1.38791	2.66670	1.93766	4.66217	6.28843	7.95276	2.85482	3.11634	2.62884	3.23819
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.98740	-5.40607	-0.59116	-4.40803	-5.74224	-9.29161	-3.33865	-7.58437	-3.30713	-3.40553	-4.36319	-4.58205
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	5.75313	-2.09521	8.98289	1.73079	0.00002	1.59907	19.99231	7.01744	-4.94043	-7.02595	-4.96246	-8.21177
WK-BUS	0.86376	-4.57249	6.64892	2.29899	2.85540	-2.37806	-2.04816	-12.64417	1.40385	-2.08067	0.32445	-4.49277
WK-FERRY	1.08254	-4.20676	3.84147	1.31451	0.00002	-2.39445	4.91737	-11.17568	-4.94043	-7.02595	-4.96246	-8.21177
WK-LRT	4.00536	-2.66011	7.40681	1.62416	0.00002	-2.39445	4.91737	-11.17568	-4.94043	-7.02595	-4.96246	-8.21177
WK-LNGFRY	1.08254	-4.20676	3.84147	1.31451	0.00002	-2.39445	4.91737	-11.17568	-4.94043	-7.02595	-4.96246	-8.21177
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	-0.95348	-1.38286	0.28100	-0.45841	0.00002	-7.25829	-5.90384	-6.20922	-6.88582	-5.39881	-6.88242	-5.19547
DR-BUS	-3.91635	-5.95971	7.54793	7.52613	0.00002	6.48784	-6.63902	-5.65288	6.66197	1.59670	7.64854	1.72358
DR-FERRY	-6.43354	-8.55073	-0.02603	1.64188	0.00002	-7.25829	-2.37182	-3.04488	-6.88582	-2.11736	-6.88242	-1.30138
DR-LRT	-6.43354	-8.55073	-0.02603	1.64188	0.00002	-7.25829	-1.00522	-1.70874	-6.88582	-2.11736	-6.88242	-1.30138
DR-LNGFRY	-6.43354	-8.55073	-0.02603	1.64188	0.00002	-7.25829	-2.37182	-3.04488	-6.88582	-2.11736	-6.88242	-1.30138
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.41027	-1.39214	-1.82980	-1.82151	0.52540	0.51828	1.10330	1.11755	-0.73583	-2.08132	-2.34693	-1.84764
SR3	-3.52741	-3.51764	-4.24233	-4.23576	-0.94603	-0.95100	0.31771	0.32371	-1.38603	-1.80354	-5.92239	-4.48568
SR4	-4.11067	-4.09523	-4.21135	-4.20962	-0.95647	-0.96376	0.30578	0.30944	-0.31971	-1.75355	-5.70904	-5.29139

3. From Everywhere (except Staten Island and Manhattan) to Jersey City/Hoboken Core

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.01341	0.67833	18.82039	1.46953	1.93521	2.30021	3.19683	4.76391	1.18088	1.89291	1.34779	1.92708
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.44570	-0.30186	-31.90695	-0.59009	-1.25138	-4.71716	-0.58357	-3.45600	0.17055	-1.99493	0.17527	-2.06015
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	10.92915	6.56908	27.57442	10.40317	-1.91988	3.98275	-1.08294	-5.51923	-6.77245	-1.43046	-10.63498	-4.90614
WK-BUS	6.30732	3.83173	20.00898	8.28773	-1.12958	-7.61204	-8.82244	-16.84401	0.46681	-7.11878	-4.54847	-12.31643
WK-FERRY	9.74906	8.55816	27.46520	19.06484	10.27758	0.00002	-1.66979	-1.11609	8.39323	-3.60585	12.66034	-6.53737
WK-LRT	17.03273	15.08311	26.64728	18.10677	8.97651	10.75604	1.08684	-2.26580	7.79658	2.13239	6.46244	0.36059
WK-LNGFRY	10.99522	12.55816	25.16678	19.06484	0.00002	0.00002	-9.38668	-12.71930	-6.77245	-3.60585	-10.63498	-6.53737
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	6.87400	2.80232	8.30582	4.00074	1.40118	0.00002	-4.08638	-4.91363	-0.97427	-3.87471	-4.80309	-7.68548
DR-BUS	6.67197	9.46848	6.49258	9.78572	1.99540	0.00002	-3.32605	0.79795	-0.97427	-3.87471	-4.80309	-7.68548
DR-FERRY	11.40230	7.24961	11.94887	7.53650	4.98796	0.00002	-7.03528	-4.18086	8.00865	-3.87471	0.73218	-7.68548
DR-LRT	6.70285	0.94492	9.57014	1.62345	1.99540	5.69208	-4.19947	-7.40621	-1.39636	-6.29176	-4.69821	-10.03871
DR-LNGFRY	3.92257	7.24961	4.40290	7.53650	1.99540	0.00002	-3.32605	-4.18086	-0.97427	-3.87471	-4.80309	-7.68548
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.95100	-2.10062	-1.98000	-2.14823	-0.22957	-0.23020	0.29694	0.32578	-2.53255	-2.07469	-0.15360	-0.10554
SR3	-4.11189	-3.30562	-4.16127	-3.36622	-1.83523	-1.78529	-0.54553	-0.52964	-3.99945	-2.27817	-1.21214	-0.30562
SR4	-3.52115	-3.60134	-3.57432	-3.67282	-1.84795	-1.84321	-0.56436	-0.55082	-4.30957	-3.32491	-1.22394	-1.34978

4. From Everywhere (except Staten Island and Manhattan) to Other CBD's

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	0.89832	3.71640	0.91363	3.98675	2.75061	4.35706	5.55252	6.67703	2.62440	3.21694	2.06114	3.11786
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-2.11538	-5.27398	-2.21537	-5.80272	-8.88594	-12.15159	-4.13359	-5.12210	-3.89473	-4.30223	-3.67145	-4.19427
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	4.89510	6.19619	5.26654	6.58711	0.00002	-3.07960	7.27208	5.35022	0.00002	-0.28245	0.00002	-2.43178
WK-BUS	3.56495	-5.76507	3.58913	-6.76539	3.29760	-1.20087	-0.41272	-7.58173	7.37440	3.48914	4.89178	0.32391
WK-FERRY	3.33397	-4.71302	3.34089	-5.20656	0.00002	-3.07960	0.25998	-8.65652	0.00002	-0.28245	0.00002	-2.43178
WK-LRT	6.77390	5.63347	6.80995	5.99203	0.00002	25.19345	9.27404	8.63915	0.00002	-0.28245	0.00002	-2.43178
WK-LNGFRY	3.33397	-4.71302	3.34089	-5.20656	0.00002	-3.07960	0.25998	-8.65652	0.00002	-0.28245	0.00002	-2.43178
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	5.53059	6.67111	5.63413	6.31275	0.00002	0.00002	1.25809	-1.74043	5.66697	-1.80384	3.86483	-2.88322
DR-BUS	4.29543	-1.32117	4.43221	-1.15731	14.66614	14.71051	-1.86688	-2.45753	7.19439	5.23559	4.91407	2.81812
DR-FERRY	2.20095	0.91328	2.13196	0.73952	0.00002	0.00002	-1.46140	-0.88633	5.66697	-1.80384	3.86483	-2.88322
DR-LRT	2.20095	0.91328	2.13196	0.73952	0.00002	0.00002	-1.46140	-0.88633	5.66697	-1.80384	3.86483	-2.88322
DR-LNGFRY	2.20095	0.91328	2.13196	0.73952	0.00002	0.00002	-1.46140	-0.88633	5.66697	-1.80384	3.86483	-2.88322
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-2.01043	-2.14359	-1.99849	-2.13267	-0.10578	-0.11235	0.43417	0.47756	-2.22498	-1.68268	-0.18220	0.61325
SR3	-3.93894	-4.08791	-3.92349	-4.06956	-1.69554	-1.69838	-0.42891	-0.41447	-3.83170	-2.15699	-1.37663	0.14408
SR4	-4.17498	-4.37856	-4.15725	-4.35956	-1.69780	-1.70313	-0.36718	-0.34407	-4.12332	-3.27091	-1.37996	-0.96775

5. From Everywhere (except Staten Island and Manhattan) to East of Hudson (except Manhattan)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.68578	2.30139	13.19832	7.26471	11.05317	8.60415	7.37397	9.84321	0.87159	4.71683	2.56019	5.60432
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.44076	-1.28929	-12.85722	-4.58293	-3.42307	-0.16125	-2.60804	-5.86397	3.24612	-1.75072	4.20275	-1.43188
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	6.08655	5.09751	29.11610	18.47775	0.00002	0.00002	19.21801	3.19964	7.86298	-10.48139	3.51820	-15.81145
WK-BUS	5.85920	5.73463	-2.28631	3.65188	-13.94409	-8.56129	-0.46725	-11.55523	-0.88473	-11.25265	-2.65950	-15.95041
WK-FERRY	8.24602	15.10933	32.56365	19.41718	70.27708	0.00002	8.03818	-7.85646	9.45103	-4.96163	4.32780	-10.33214
WK-LRT	3.01564	1.66005	25.52314	15.47488	0.00002	15.33272	14.64409	7.20683	0.00002	-10.36624	0.00002	-15.26368
WK-LNGFRY	4.69948	5.40055	13.99274	7.90390	0.00002	0.00002	8.03818	-7.85646	0.00002	-11.05993	0.00002	-13.72316
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	9.00379	4.06493	14.94336	5.44413	1.04945	-16.23485	6.63619	-1.06147	-9.54265	-3.53696	-10.83733	-7.85637
DR-BUS	8.23898	7.50290	1.32888	4.85183	-8.42320	-8.40996	0.12517	-3.69202	3.37147	-13.82157	-0.14581	-17.72755
DR-FERRY	2.10205	-0.06291	2.41906	-1.74650	-5.96765	-16.23485	-9.58017	-11.86614	-5.01941	-13.82157	-11.21208	-17.72755
DR-LRT	1.63975	1.39811	10.89182	-0.23098	-10.30654	-16.23485	-9.58017	-0.99197	-9.54265	-13.82157	-10.83733	-17.72755
DR-LNGFRY	6.47057	1.39811	-5.02276	-0.23098	-10.30654	-16.23485	-9.58017	-11.86614	-9.54265	-13.82157	-10.83733	-17.72755
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.51401	-0.85542	-1.39676	-0.77634	-0.56069	0.83643	-0.11031	0.43470	-2.27281	-1.36151	-0.14141	-0.46735
SR3	-2.59193	-2.83761	-2.43968	-2.73298	-3.26352	-2.00975	-1.32856	-0.71794	-2.68065	-2.51182	-0.53785	-1.60617
SR4	-2.88264	-2.96664	-2.71251	-2.84973	-1.49329	-2.05077	-1.26386	0.18747	-1.88723	-2.76057	0.26256	-1.84951

6. From Non-Dense to Non-Dense (except non-dense zones in Newark, Jersey City, Hoboken and Other CBDs)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	0.65238	2.32105	0.69859	2.44993	1.65042	2.45124	3.52568	4.41154	1.76097	2.97427	1.07074	2.66697
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-1.26492	-3.74351	-1.40849	-3.98572	-3.96311	-3.60337	-1.99245	-3.74098	-2.80428	-3.41185	-2.79504	-3.29883
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	6.88132	-0.55397	6.76928	-1.20745	0.00002	0.00002	1.12203	-7.49716	7.62053	-1.63872	4.34109	-2.70550
WK-BUS	4.85264	-2.25781	4.86079	-2.47563	4.19893	2.92027	2.33088	-5.42723	9.83000	2.47942	6.84062	0.04741
WK-FERRY	11.64666	15.61728	7.49747	-2.71488	0.00002	0.00002	0.57154	-6.75961	9.61784	-1.63872	4.34109	-2.70550
WK-LRT	2.53150	-9.50047	2.51900	-9.82260	3.35762	0.82928	-4.08748	-8.13701	2.92345	-1.63872	1.79757	-2.70550
WK-LNGFRY	4.49980	-2.58324	4.51489	-2.71488	0.00002	0.00002	0.57154	-6.75961	7.62053	-1.63872	4.34109	-2.70550
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	3.63865	3.14284	3.56032	2.99714	-2.91413	-6.63473	-6.01531	-7.91519	3.71793	-3.18090	1.20880	-4.30360
DR-BUS	4.18503	-0.92553	4.20975	-0.99066	3.05867	-2.17281	-2.62815	-7.53738	8.91076	2.32587	6.34093	-0.09786
DR-FERRY	5.59314	16.28931	5.93909	0.17681	-2.91413	-6.63473	-0.78724	-6.17509	10.45843	14.18861	7.93528	-4.30360
DR-LRT	-8.22437	-12.89047	-8.99166	-13.64568	-2.91413	-6.63473	-9.84517	-15.29295	5.17031	-8.64454	1.43190	-9.48440
DR-LNGFRY	2.17957	0.08684	2.26926	0.17681	-2.91413	-6.63473	-6.01531	-6.17509	3.71793	-3.18090	1.20880	-4.30360
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-2.28616	-2.25196	-2.26862	-2.23574	-0.14020	-0.14397	0.13648	-0.57967	-1.51639	-1.62680	-0.21594	0.59861
SR3	-4.26098	-4.23661	-4.23619	-4.21359	-1.74246	-1.74630	-0.73178	-1.85337	-2.69757	-2.11899	-1.39456	0.10890
SR4	-4.55391	-4.51889	-4.52517	-4.49220	-1.74474	-1.75025	-0.73279	-2.14614	-2.70434	-3.29074	-1.40000	-1.06131

7. From Manhattan to Everywhere (except Manhattan)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.42972	11.16072	1.18287	8.77464	3.10792	8.10516	4.85322	14.91016	4.18056	4.83296	1.69898	3.69957
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	15.44454	38.46076	17.67517	12.15516	4.25867	0.00002	20.47042	26.62980	8.73774	7.13765	7.88082	5.51833
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	15.47814	-18.16336	12.41953	-12.48398	2.54110	3.29708	6.77565	-16.99285	-6.87274	0.27190	-3.50094	-2.10024
WK-BUS	12.24711	-25.70220	9.79223	-18.90155	6.25671	-18.32013	5.49876	-23.03723	8.00056	6.06975	12.56898	5.36477
WK-FERRY	12.66419	-29.26073	9.52090	-18.00868	5.29048	0.00002	0.00002	-18.52964	-2.38724	1.69734	1.90984	-1.36416
WK-LRT	9.11588	-25.43005	7.17092	-18.13084	0.00002	17.73586	0.00002	-22.44527	-0.27212	0.50919	6.18118	0.68339
WK-LNGFRY	12.93355	-15.87104	11.82565	-9.67230	0.00002	0.00002	0.00002	-18.52964	0.00002	0.00002	0.00002	0.00002
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DR-BUS	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DR-FERRY	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DR-LRT	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DR-LNGFRY	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-3.16021	-1.92807	-3.13471	-1.89965	-6.28932	-6.07941	-1.25690	-1.23711	-0.02331	-0.36345	-0.00436	-0.37166
SR3	-3.39298	-3.97909	-3.36317	-3.93341	-6.28932	-6.07941	-3.32057	-3.58646	-0.09406	0.50510	-0.07708	0.50302
SR4	-4.62880	-3.19077	-4.59363	-3.14668	-6.28932	-6.07941	-5.16329	-5.83515	-2.75544	-3.91608	-2.76340	-3.67842

8. To or From Staten Island

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	3.36222	6.56573	4.12691	7.84652	-1.06134	10.54168	2.17582	2.12761	2.68717	1.57575	0.54452	-0.92869
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-2.52908	-5.00802	-0.66526	-4.10340	2.72577	-21.57199	9.20503	2.87068	-3.92448	-2.45877	-2.05221	0.37191
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.07861	-17.84559	-1.79879	-15.07494	0.00002	-19.56734	14.97464	6.15827	0.00002	0.00002	0.00002	0.00002
WK-BUS	-10.48335	-28.00272	-13.03939	-23.01667	0.00002	-19.01403	-1.06618	-2.59338	9.20220	11.68896	7.89724	11.90057
WK-FERRY	-4.82689	-10.40435	-7.43799	-15.13788	7.28694	-20.79691	5.35656	4.53404	0.96497	2.37787	-0.60759	2.67524
WK-LRT	4.51977	-12.90617	0.33036	-12.54400	0.00002	-20.15375	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
WK-LNGFRY	-10.65306	-11.68309	-14.71328	-17.36230	0.00002	-21.15373	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	12.27944	-2.97779	15.50441	-2.00076	0.00002	0.00002	-14.48987	-4.39051	0.00002	0.00002	0.00002	0.00002
DR-BUS	22.60441	-0.04933	25.06461	-0.86153	0.00002	0.00002	0.80174	-2.62331	0.00002	0.00002	0.00002	0.00002
DR-FERRY	-3.59986	-5.51688	-9.86922	-12.20116	11.37662	12.29915	-13.79882	-1.52270	10.13465	10.68225	11.35834	11.58238
DR-LRT	-7.33766	-22.02511	-15.40428	-31.46359	0.00002	0.00002	-21.91695	-12.52049	0.00002	0.00002	0.00002	0.00002
DR-LNGFRY	0.30622	-5.97225	-6.69604	-12.82056	0.00002	0.00002	-12.48987	-6.39051	0.00002	0.00002	0.00002	0.00002
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-2.50712	-2.71023	-2.44301	-2.65524	2.11993	1.44323	0.00654	-0.21030	-0.74250	-0.61894	-0.72697	-0.60454
SR3	-4.16994	-4.22724	-4.08434	-4.15388	0.19556	-0.41551	-1.73655	-1.21014	-1.47543	-2.14516	-1.45661	-2.12660
SR4	-4.54136	-5.46289	-4.44598	-5.37623	0.42620	-3.08996	-1.25060	-2.27531	-1.07371	-7.81864	-1.04997	-8.01327

9. From Dense to Non-Dense (except non-dense zones in Newark, Jersey City, Hoboken, Other CBD's or East of Hudson)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.22858	4.29107	1.73779	5.10931	2.01004	2.47058	4.74497	7.39603	4.86474	2.59969	2.95753	1.06831
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-1.03928	-3.13625	-1.52731	-4.48038	-4.35261	-5.22718	-7.95232	-5.46376	-4.11532	-2.57411	-4.78636	-3.28304
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	7.37173	-5.26229	4.57920	-9.45869	0.00002	0.00002	1.52666	-13.25307	-1.25724	0.00002	-2.35399	0.00002
WK-BUS	7.46552	-6.72237	5.48900	-9.80839	3.79015	3.44695	-0.53601	-13.93391	4.49432	7.50628	2.24973	5.01406
WK-FERRY	7.12638	-6.50678	8.33572	-9.54246	0.00002	0.00002	-1.24371	-10.44151	0.00002	0.00002	0.00002	0.00002
WK-LRT	1.67429	-11.68061	-0.35709	-14.77475	1.11404	2.98961	-6.25170	-18.58411	-0.46942	3.48481	-1.16728	1.71594
WK-LNGFRY	5.33841	-6.50678	7.14590	-9.54246	0.00002	0.00002	-1.24371	-9.44151	0.00002	0.00002	0.00002	0.00002
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	7.14431	-3.72486	5.00748	-5.33941	0.00002	9.34003	10.21935	-7.19307	0.00002	5.65346	0.00002	5.04573
DR-BUS	9.47156	-1.30478	8.31210	-1.98688	0.00002	11.33167	12.82937	-6.37715	15.33871	14.40558	12.05163	11.64865
DR-FERRY	2.29962	34.11398	1.92016	-3.00661	0.00002	0.00002	2.86724	-7.43683	10.85176	0.00002	6.21209	0.00002
DR-LRT	-4.55228	-18.56903	-7.17933	-19.46596	0.00002	0.00002	0.00002	-15.68302	-3.53722	0.00002	0.98172	0.00002
DR-LNGFRY	10.61174	-2.07816	10.16076	-3.00661	0.00002	0.00002	0.00002	-9.43684	0.00002	0.00002	0.00002	0.00002
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-0.80507	-0.74207	-0.78960	-0.72964	-0.10377	-0.12234	0.46037	0.46399	-1.59361	-1.64760	-0.18755	-0.29848
SR3	-2.47232	-2.61916	-2.45156	-2.60394	-1.71785	-1.71868	-0.40357	-0.39384	-2.70742	-2.10552	-1.35883	-0.75484
SR4	-2.61177	-2.97054	-2.58808	-2.95163	-1.72078	-1.72167	-0.40396	-0.40237	-2.71151	-3.27461	-1.36369	-1.92046

10. From Non-Dense to Dense (except non-dense zones in Newark, Jersey City, Hoboken, Other CBD's or East of Hudson)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.43969	1.75382	1.32094	1.67269	1.05527	1.81339	3.99562	4.97740	2.68949	4.16236	1.53474	3.00226
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-1.35013	-2.41322	-1.35713	-2.33967	-3.17862	-0.40968	-2.53043	-4.16347	-1.37188	-2.31540	-1.21030	-2.01955
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	4.43464	2.46711	5.56831	3.25685	0.00002	0.00002	-0.64037	-4.99056	2.83345	-5.68179	0.57020	-7.71033
WK-BUS	4.60584	3.15935	5.55684	4.01614	4.96547	5.57639	1.18270	-4.93789	7.58024	-0.80358	2.91824	-4.12637
WK-FERRY	13.88655	11.87644	11.18923	12.50204	0.00002	0.00002	58.82324	-6.21550	2.83345	0.48388	0.57020	-2.76524
WK-LRT	0.37027	13.76613	1.34053	15.55815	12.44250	16.56178	-0.95465	-7.33435	3.04085	-4.01356	-0.60714	-6.74509
WK-LNGFRY	18.98271	11.87644	13.03617	12.50204	0.00002	0.00002	-0.42102	-6.21550	2.83345	0.48388	0.57020	-2.76524
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	1.48567	4.54860	2.11227	4.95364	0.00002	-7.48608	3.03585	-4.12972	-4.71675	-11.64632	-9.16226	-14.25473
DR-BUS	5.06678	5.07962	5.91308	5.62216	12.46699	0.17520	1.75225	-2.18727	8.38583	0.62036	5.29683	-2.15906
DR-FERRY	26.96956	21.93431	23.35260	20.97671	0.00002	24.98859	-7.60713	-9.64469	18.42003	1.87111	8.53170	1.06527
DR-LRT	-6.02503	-7.36570	-6.39589	-6.64721	5.30251	-5.06299	-7.60713	-8.46671	-4.71675	-11.64632	-9.16226	-14.25473
DR-LNGFRY	3.45324	4.12411	3.31673	4.85642	0.00002	-7.48608	-7.60713	-9.64469	-4.71675	-11.64632	-9.16226	-14.25473
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.70113	-1.76192	-1.69328	-1.75665	-0.06266	-0.07343	0.50239	0.51388	-1.54631	-1.75706	-0.09980	0.02394
SR3	-3.77865	-3.76919	-3.76917	-3.76037	-1.61674	-1.62191	-0.32798	-0.31880	-2.68751	-2.12520	-1.23794	-0.34204
SR4	-4.09578	-4.09240	-4.08713	-4.08349	-1.62130	-1.62740	-0.33566	-0.33084	-2.69221	-3.25616	-1.24230	-1.47155

11. From Dense to Dense (except non-dense zones in Newark, Jersey City, Hoboken, Other CBD's or East of Hudson)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	4.01445	4.56407	4.39411	5.01617	2.23805	2.92499	3.55058	2.95765	11.43715	5.03184	1.80794	1.16143
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-5.20467	-4.18892	-5.32686	-4.92470	-5.11271	-1.65320	-4.16073	0.66393	-19.43308	-6.84171	-5.22713	-5.61102
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	-3.83434	-4.34160	-4.53279	-5.66557	1.02438	-1.46242	7.35850	6.31010	0.00002	-2.61769	0.00002	-0.75867
WK-BUS	-0.66723	-3.89428	-0.67543	-4.07520	-0.09694	-1.40073	3.54556	2.34535	6.49653	1.92739	2.59846	0.30451
WK-FERRY	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
WK-LRT	-1.82019	16.00871	-1.87270	17.85731	15.67791	20.09305	7.15066	9.39063	15.12103	-0.70112	3.51505	-1.25699
WK-LNGFRY	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	-2.20979	-4.66639	-4.73822	-6.14217	0.00002	1.62685	5.98375	-5.87801	0.00002	0.00002	0.00002	0.00002
DR-BUS	24.97442	12.27075	23.84533	12.46800	0.00002	2.11812	10.53678	-4.99370	19.96972	20.12862	18.70355	14.71454
DR-FERRY	12.63030	10.64512	11.93719	12.31315	0.00002	0.00002	0.00002	-10.46237	10.08597	0.00002	11.12264	0.00002
DR-LRT	-6.14361	-13.63337	-8.73735	-15.20286	0.00002	-3.48948	-2.73030	-9.45345	-7.49058	9.74330	-4.47548	6.47146
DR-LNGFRY	22.61570	0.00002	17.78737	0.00002	0.00002	0.00002	0.00002	-10.46237	0.00002	0.00002	0.00002	0.00002
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-0.85649	-0.87757	-0.84883	-0.87176	-0.10881	-0.11280	0.46716	0.47938	-1.51702	-1.62399	-0.19739	-0.67952
SR3	-2.56979	-2.09786	-2.56234	-2.08762	-1.70999	-1.70883	-0.39002	-0.39105	-2.72966	-2.09503	-1.38797	-1.14998
SR4	-3.02396	-3.00981	-3.00834	-3.01683	-1.71183	-1.71287	-0.39329	-0.39498	-2.73226	-3.28147	-1.39311	-2.33791

APPENDIX K – MODEL CONSTANTS-EXPRESSED AT TOP NEST LEVEL

1. From Everywhere (except Staten Island) to Manhattan

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	2.88739	3.13620	1.67808	2.94974	7.68656	7.90375	6.09863	7.64087	4.13200	5.32317	4.61332	5.66382
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.38504	-1.06877	-1.59057	-1.90319	-1.51047	-1.17026	-0.88473	-1.35308	-0.33250	-0.63511	-0.31188	-0.67586
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.23425	0.65672	1.74842	0.86778	0.90932	-0.87080	0.32995	-1.02327	-2.22027	-1.93005	-2.67043	-2.17078
WK-BUS	0.93677	1.15451	0.51536	0.53631	0.76364	-1.72110	-0.47121	-1.42777	-0.69429	-1.68921	-1.65642	-2.59448
WK-FERRY	4.94362	4.67841	3.50321	3.61670	4.38462	8.75623	1.69933	4.22140	3.69487	2.55477	6.06501	5.09777
WK-LRT	0.46894	0.31217	0.77182	0.29467	0.35874	0.07170	-0.31488	-1.43743	0.98259	-0.87075	0.55558	-1.69240
WK-LNGFRY	0.61942	1.93107	-0.59781	1.68787	5.49430	2.77414	2.78448	1.28505	4.18548	-1.08454	3.54604	-0.86262
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	1.92503	1.06956	3.22938	1.85866	1.01586	0.02421	0.78201	-0.37070	-1.47877	-1.25223	-1.80630	-1.41816
DR-BUS	1.20302	1.74614	1.89844	2.06246	0.43101	-0.33669	0.02412	-0.49301	-0.11161	-0.66249	-1.33858	-1.77754
DR-FERRY	-0.34922	-0.58089	1.22147	0.46926	1.98805	-1.56870	-1.26881	-2.82111	-0.31160	-2.45062	-1.16506	-3.08863
DR-LRT	0.25530	-0.28071	1.57203	0.45312	0.60716	-0.15453	-0.85677	-1.52137	-1.86664	-1.66890	-2.33748	-2.13844
DR-LNGFRY	-0.58014	0.59721	0.44176	1.01612	4.75847	-0.56263	1.27184	1.38627	2.38767	-0.68571	0.05167	-0.95697
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.37971	-1.96169	-1.65095	-2.19972	-0.77006	0.67520	0.15710	0.24832	-0.21166	-0.59403	-0.17893	-0.56029
SR3	-3.32052	-3.28301	-1.83786	-1.75565	-1.00478	-1.12350	-1.10085	-1.36310	-1.87126	-1.13673	-1.82655	-1.09177
SR4	-3.16549	-4.23776	-4.02127	-5.04436	-3.44992	0.86337	-1.82418	-0.86665	-1.24882	-1.15573	-1.19973	-1.10513

2. From Everywhere (except Staten Island and Manhattan) to Newark Super CBD

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.71069	3.15071	1.38791	2.66670	1.93766	4.66217	6.28843	7.95276	2.85482	3.11634	2.62884	3.23819
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.49370	-2.70304	-0.29558	-2.20402	-2.87112	-4.64581	-1.66933	-3.79219	-1.65357	-1.70277	-2.18160	-2.29103
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.43828	-0.52380	2.24572	0.43270	0.00001	0.39977	4.99808	1.75436	-1.23511	-1.75649	-1.24062	-2.05294
WK-BUS	0.21594	-1.14312	1.66223	0.57475	0.71385	-0.59452	-0.51204	-3.16104	0.35096	-0.52017	0.08111	-1.12319
WK-FERRY	0.27064	-1.05169	0.96037	0.32863	0.00001	-0.59861	1.22934	-2.79392	-1.23511	-1.75649	-1.24062	-2.05294
WK-LRT	1.00134	-0.66503	1.85170	0.40604	0.00001	-0.59861	1.22934	-2.79392	-1.23511	-1.75649	-1.24062	-2.05294
WK-LNGFRY	0.27064	-1.05169	0.96037	0.32863	0.00001	-0.59861	1.22934	-2.79392	-1.23511	-1.75649	-1.24062	-2.05294
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	-0.23837	-0.34572	0.07025	-0.11460	0.00001	-1.81457	-1.47596	-1.55231	-1.72146	-1.34970	-1.72061	-1.29887
DR-BUS	-0.97909	-1.48993	1.88698	1.88153	0.00001	1.62196	-1.65976	-1.41322	1.66549	0.39918	1.91214	0.43090
DR-FERRY	-1.60839	-2.13768	-0.00651	0.41047	0.00001	-1.81457	-0.59296	-0.76122	-1.72146	-0.52934	-1.72061	-0.32535
DR-LRT	-1.60839	-2.13768	-0.00651	0.41047	0.00001	-1.81457	-0.25131	-0.42719	-1.72146	-0.52934	-1.72061	-0.32535
DR-LNGFRY	-1.60839	-2.13768	-0.00651	0.41047	0.00001	-1.81457	-0.59296	-0.76122	-1.72146	-0.52934	-1.72061	-0.32535
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.41027	-1.39214	-1.82980	-1.82151	0.52540	0.51828	1.10330	1.11755	-0.73583	-2.08132	-2.34693	-1.84764
SR3	-3.52741	-3.51764	-4.24233	-4.23576	-0.94603	-0.95100	0.31771	0.32371	-1.38603	-1.80354	-5.92239	-4.48568
SR4	-4.11067	-4.09523	-4.21135	-4.20962	-0.95647	-0.96376	0.30578	0.30944	-0.31971	-1.75355	-5.70904	-5.29139

3. From Everywhere (except Staten Island and Manhattan) to Jersey City/Hoboken Core

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.01341	0.67833	18.82039	1.46953	1.93521	2.30021	3.19683	4.76391	1.18088	1.89291	1.34779	1.92708
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.22285	-0.15093	-15.95348	-0.29505	-0.62569	-2.35858	-0.29179	-1.72800	0.08528	-0.99747	0.08764	-1.03008
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	2.73229	1.64227	6.89361	2.60079	-0.47997	0.99569	-0.27074	-1.37981	-1.69311	-0.35762	-2.65875	-1.22654
WK-BUS	1.57683	0.95793	5.00225	2.07193	-0.28240	-1.90301	-2.20561	-4.21100	0.11670	-1.77970	-1.13712	-3.07911
WK-FERRY	2.43727	2.13954	6.86630	4.76621	2.56940	0.00001	-0.41745	-0.27902	2.09831	-0.90146	3.16509	-1.63434
WK-LRT	4.25818	3.77078	6.66182	4.52669	2.24413	2.68901	0.27171	-0.56645	1.94915	0.53310	1.61561	0.09015
WK-LNGFRY	2.74881	3.13954	6.29170	4.76621	0.00001	0.00001	-2.34667	-3.17983	-1.69311	-0.90146	-2.65875	-1.63434
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	1.71850	0.70058	2.07646	1.00019	0.35030	0.00001	-1.02160	-1.22841	-0.24357	-0.96868	-1.20077	-1.92137
DR-BUS	1.66799	2.36712	1.62315	2.44643	0.49885	0.00001	-0.83151	0.19949	-0.24357	-0.96868	-1.20077	-1.92137
DR-FERRY	2.85058	1.81240	2.98722	1.88413	1.24699	0.00001	-1.75882	-1.04522	2.00216	-0.96868	0.18305	-1.92137
DR-LRT	1.67571	0.23623	2.39254	0.40586	0.49885	1.42302	-1.04987	-1.85155	-0.34909	-1.57294	-1.17455	-2.50968
DR-LNGFRY	0.98064	1.81240	1.10073	1.88413	0.49885	0.00001	-0.83151	-1.04522	-0.24357	-0.96868	-1.20077	-1.92137
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.95100	-2.10062	-1.98000	-2.14823	-0.22957	-0.23020	0.29694	0.32578	-2.53255	-2.07469	-0.15360	-0.10554
SR3	-4.11189	-3.30562	-4.16127	-3.36622	-1.83523	-1.78529	-0.54553	-0.52964	-3.99945	-2.27817	-1.21214	-0.30562
SR4	-3.52115	-3.60134	-3.57432	-3.67282	-1.84795	-1.84321	-0.56436	-0.55082	-4.30957	-3.32491	-1.22394	-1.34978

4. From Everywhere (except Staten Island and Manhattan) to Other CBD's

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	0.89832	3.71640	0.91363	3.98675	2.75061	4.35706	5.55252	6.67703	2.62440	3.21694	2.06114	3.11786
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-1.05769	-2.63699	-1.10769	-2.90136	-4.44297	-6.07580	-2.06680	-2.56105	-1.94737	-2.15112	-1.83573	-2.09714
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.22378	1.54905	1.31664	1.64678	0.00001	-0.76990	1.81802	1.33756	0.00001	-0.07061	0.00001	-0.60795
WK-BUS	0.89124	-1.44127	0.89728	-1.69135	0.82440	-0.30022	-0.10318	-1.89543	1.84360	0.87229	1.22295	0.08098
WK-FERRY	0.83349	-1.17826	0.83522	-1.30164	0.00001	-0.76990	0.06500	-2.16413	0.00001	-0.07061	0.00001	-0.60795
WK-LRT	1.69348	1.40837	1.70249	1.49801	0.00001	6.29836	2.31851	2.15979	0.00001	-0.07061	0.00001	-0.60795
WK-LNGFRY	0.83349	-1.17826	0.83522	-1.30164	0.00001	-0.76990	0.06500	-2.16413	0.00001	-0.07061	0.00001	-0.60795
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	1.38265	1.66778	1.40853	1.57819	0.00001	0.00001	0.31452	-0.43511	1.41674	-0.45096	0.96621	-0.72081
DR-BUS	1.07386	-0.33029	1.10805	-0.28933	3.66654	3.67763	-0.46672	-0.61438	1.79860	1.30890	1.22852	0.70453
DR-FERRY	0.55024	0.22832	0.53299	0.18488	0.00001	0.00001	-0.36535	-0.22158	1.41674	-0.45096	0.96621	-0.72081
DR-LRT	0.55024	0.22832	0.53299	0.18488	0.00001	0.00001	-0.36535	-0.22158	1.41674	-0.45096	0.96621	-0.72081
DR-LNGFRY	0.55024	0.22832	0.53299	0.18488	0.00001	0.00001	-0.36535	-0.22158	1.41674	-0.45096	0.96621	-0.72081
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-2.01043	-2.14359	-1.99849	-2.13267	-0.10578	-0.11235	0.43417	0.47756	-2.22498	-1.68268	-0.18220	0.61325
SR3	-3.93894	-4.08791	-3.92349	-4.06956	-1.69554	-1.69838	-0.42891	-0.41447	-3.83170	-2.15699	-1.37663	0.14408
SR4	-4.17498	-4.37856	-4.15725	-4.35956	-1.69780	-1.70313	-0.36718	-0.34407	-4.12332	-3.27091	-1.37996	-0.96775

5. From Everywhere (except Staten Island and Manhattan) to East of Hudson (except Manhattan)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.68578	2.30139	13.19832	7.26471	11.05317	8.60415	7.37397	9.84321	0.87159	4.71683	2.56019	5.60432
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.22038	-0.64465	-6.42861	-2.29147	-1.71154	-0.08063	-1.30402	-2.93199	1.62306	-0.87536	2.10138	-0.71594
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.52164	1.27438	7.27903	4.61944	0.00001	0.00001	4.80450	0.79991	1.96575	-2.62035	0.87955	-3.95286
WK-BUS	1.46480	1.43366	-0.57158	0.91297	-3.48602	-2.14032	-0.11681	-2.88881	-0.22118	-2.81316	-0.66488	-3.98760
WK-FERRY	2.06151	3.77733	8.14091	4.85430	17.56927	0.00001	2.00955	-1.96412	2.36276	-1.24041	1.08195	-2.58304
WK-LRT	0.75391	0.41501	6.38079	3.86872	0.00001	3.83318	3.66102	1.80171	0.00001	-2.59156	0.00001	-3.81592
WK-LNGFRY	1.17487	1.35014	3.49819	1.97598	0.00001	0.00001	2.00955	-1.96412	0.00001	-2.76498	0.00001	-3.43079
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	2.25095	1.01623	3.73584	1.36103	0.26236	-4.05871	1.65905	-0.26537	-2.38566	-0.88424	-2.70933	-1.96409
DR-BUS	2.05975	1.87573	0.33222	1.21296	-2.10580	-2.10249	0.03129	-0.92301	0.84287	-3.45539	-0.03645	-4.43189
DR-FERRY	0.52551	-0.01573	0.60477	-0.43663	-1.49191	-4.05871	-2.39504	-2.96654	-1.25485	-3.45539	-2.80302	-4.43189
DR-LRT	0.40994	0.34953	2.72296	-0.05775	-2.57664	-4.05871	-2.39504	-0.24799	-2.38566	-3.45539	-2.70933	-4.43189
DR-LNGFRY	1.61764	0.34953	-1.25569	-0.05775	-2.57664	-4.05871	-2.39504	-2.96654	-2.38566	-3.45539	-2.70933	-4.43189
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.51401	-0.85542	-1.39676	-0.77634	-0.56069	0.83643	-0.11031	0.43470	-2.27281	-1.36151	-0.14141	-0.46735
SR3	-2.59193	-2.83761	-2.43968	-2.73298	-3.26352	-2.00975	-1.32856	-0.71794	-2.68065	-2.51182	-0.53785	-1.60617
SR4	-2.88264	-2.96664	-2.71251	-2.84973	-1.49329	-2.05077	-1.26386	0.18747	-1.88723	-2.76057	0.26256	-1.84951

6. From Non-Dense to Non-Dense (except non-dense zones in Newark, Jersey City, Hoboken and Other CBDs)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	0.65238	2.32105	0.69859	2.44993	1.65042	2.45124	3.52568	4.41154	1.76097	2.97427	1.07074	2.66697
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.63246	-1.87176	-0.70425	-1.99286	-1.98156	-1.80169	-0.99623	-1.87049	-1.40214	-1.70593	-1.39752	-1.64942
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.72033	-0.13849	1.69232	-0.30186	0.00001	0.00001	0.28051	-1.87429	1.90513	-0.40968	1.08527	-0.67638
WK-BUS	1.21316	-0.56445	1.21520	-0.61891	1.04973	0.73007	0.58272	-1.35681	2.45750	0.61986	1.71016	0.01185
WK-FERRY	2.91167	3.90432	1.87437	-0.67872	0.00001	0.00001	0.14289	-1.68990	2.40446	-0.40968	1.08527	-0.67638
WK-LRT	0.63288	-2.37512	0.62975	-2.45565	0.83941	0.20732	-1.02187	-2.03425	0.73086	-0.40968	0.44939	-0.67638
WK-LNGFRY	1.12495	-0.64581	1.12872	-0.67872	0.00001	0.00001	0.14289	-1.68990	1.90513	-0.40968	1.08527	-0.67638
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	0.90966	0.78571	0.89008	0.74929	-0.72853	-1.65868	-1.50383	-1.97880	0.92948	-0.79523	0.30220	-1.07590
DR-BUS	1.04626	-0.23138	1.05244	-0.24767	0.76467	-0.54320	-0.65704	-1.88435	2.22769	0.58147	1.58523	-0.02447
DR-FERRY	1.39829	4.07233	1.48477	0.04420	-0.72853	-1.65868	-0.19681	-1.54377	2.61461	3.54715	1.98382	-1.07590
DR-LRT	-2.05609	-3.22262	-2.24792	-3.41142	-0.72853	-1.65868	-2.46129	-3.82324	1.29258	-2.16114	0.35798	-2.37110
DR-LNGFRY	0.54489	0.02171	0.56732	0.04420	-0.72853	-1.65868	-1.50383	-1.54377	0.92948	-0.79523	0.30220	-1.07590
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-2.28616	-2.25196	-2.26862	-2.23574	-0.14020	-0.14397	0.13648	-0.57967	-1.51639	-1.62680	-0.21594	0.59861
SR3	-4.26098	-4.23661	-4.23619	-4.21359	-1.74246	-1.74630	-0.73178	-1.85337	-2.69757	-2.11899	-1.39456	0.10890
SR4	-4.55391	-4.51889	-4.52517	-4.49220	-1.74474	-1.75025	-0.73279	-2.14614	-2.70434	-3.29074	-1.40000	-1.06131

7. From Manhattan to Everywhere (except Manhattan)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.42972	11.16072	1.18287	8.77464	3.10792	8.10516	4.85322	14.91016	4.18056	4.83296	1.69898	3.69957
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	7.72227	19.23038	8.83759	6.07758	2.12934	0.00001	10.23521	13.31490	4.36887	3.56883	3.94041	2.75917
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	3.86954	-4.54084	3.10488	-3.12100	0.63528	0.82427	1.69391	-4.24821	-1.71819	0.06798	-0.87524	-0.52506
WK-BUS	3.06178	-6.42555	2.44806	-4.72539	1.56418	-4.58003	1.37469	-5.75931	2.00014	1.51744	3.14225	1.34119
WK-FERRY	3.16605	-7.31518	2.38023	-4.50217	1.32262	0.00001	0.00001	-4.63241	-0.59681	0.42434	0.47746	-0.34104
WK-LRT	2.27897	-6.35751	1.79273	-4.53271	0.00001	4.43397	0.00001	-5.61132	-0.06803	0.12730	1.54530	0.17085
WK-LNGFRY	3.23339	-3.96776	2.95641	-2.41808	0.00001	0.00001	0.00001	-4.63241	0.00001	0.00001	0.00001	0.00001
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DR-BUS	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DR-FERRY	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DR-LRT	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DR-LNGFRY	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-3.16021	-1.92807	-3.13471	-1.89965	-6.28932	-6.07941	-1.25690	-1.23711	-0.02331	-0.36345	-0.00436	-0.37166
SR3	-3.39298	-3.97909	-3.36317	-3.93341	-6.28932	-6.07941	-3.32057	-3.58646	-0.09406	0.50510	-0.07708	0.50302
SR4	-4.62880	-3.19077	-4.59363	-3.14668	-6.28932	-6.07941	-5.16329	-5.83515	-2.75544	-3.91608	-2.76340	-3.67842

8. To or From Staten Island

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	3.36222	6.56573	4.12691	7.84652	-1.06134	10.54168	2.17582	2.12761	2.68717	1.57575	0.54452	-0.92869
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-1.26454	-2.50401	-0.33263	-2.05170	1.36289	-10.78600	4.60252	1.43534	-1.96224	-1.22939	-1.02611	0.18596
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	0.26965	-4.46140	-0.44970	-3.76874	0.00001	-4.89184	3.74366	1.53957	0.00001	0.00001	0.00001	0.00001
WK-BUS	-2.62084	-7.00068	-3.25985	-5.75417	0.00001	-4.75351	-0.26655	-0.64835	2.30055	2.92224	1.97431	2.97514
WK-FERRY	-1.20672	-2.60109	-1.85950	-3.78447	1.82174	-5.19923	1.33914	1.13351	0.24124	0.59447	-0.15190	0.66881
WK-LRT	1.12994	-3.22654	0.08259	-3.13600	0.00001	-5.03844	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
WK-LNGFRY	-2.66327	-2.92077	-3.67832	-4.34058	0.00001	-5.28843	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	3.06986	-0.74445	3.87610	-0.50019	0.00001	0.00001	-3.62247	-1.09763	0.00001	0.00001	0.00001	0.00001
DR-BUS	5.65110	-0.01233	6.26615	-0.21538	0.00001	0.00001	0.20044	-0.65583	0.00001	0.00001	0.00001	0.00001
DR-FERRY	-0.89997	-1.37922	-2.46731	-3.05029	2.84416	3.07479	-3.44971	-0.38068	2.53366	2.67056	2.83959	2.89560
DR-LRT	-1.83442	-5.50628	-3.85107	-7.86590	0.00001	0.00001	-5.47924	-3.13012	0.00001	0.00001	0.00001	0.00001
DR-LNGFRY	0.07656	-1.49306	-1.67401	-3.20514	0.00001	0.00001	-3.12247	-1.59763	0.00001	0.00001	0.00001	0.00001
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-2.50712	-2.71023	-2.44301	-2.65524	2.11993	1.44323	0.00654	-0.21030	-0.74250	-0.61894	-0.72697	-0.60454
SR3	-4.16994	-4.22724	-4.08434	-4.15388	0.19556	-0.41551	-1.73655	-1.21014	-1.47543	-2.14516	-1.45661	-2.12660
SR4	-4.54136	-5.46289	-4.44598	-5.37623	0.42620	-3.08996	-1.25060	-2.27531	-1.07371	-7.81864	-1.04997	-8.01327

9. From Dense to Non-Dense (except non-dense zones in Newark, Jersey City, Hoboken, Other CBD's or East of Hudson)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.22858	4.29107	1.73779	5.10931	2.01004	2.47058	4.74497	7.39603	4.86474	2.59969	2.95753	1.06831
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.51964	-1.56813	-0.76366	-2.24019	-2.17631	-2.61359	-3.97616	-2.73188	-2.05766	-1.28706	-2.39318	-1.64152
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.84293	-1.31557	1.14480	-2.36467	0.00001	0.00001	0.38167	-3.31327	-0.31431	0.00001	-0.58850	0.00001
WK-BUS	1.86638	-1.68059	1.37225	-2.45210	0.94754	0.86174	-0.13400	-3.48348	1.12358	1.87657	0.56243	1.25352
WK-FERRY	1.78160	-1.62670	2.08393	-2.38562	0.00001	0.00001	-0.31093	-2.61038	0.00001	0.00001	0.00001	0.00001
WK-LRT	0.41857	-2.92015	-0.08927	-3.69369	0.27851	0.74740	-1.56293	-4.64603	-0.11736	0.87120	-0.29182	0.42899
WK-LNGFRY	1.33460	-1.62670	1.78648	-2.38562	0.00001	0.00001	-0.31093	-2.36038	0.00001	0.00001	0.00001	0.00001
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	1.78608	-0.93122	1.25187	-1.33485	0.00001	2.33501	2.55484	-1.79827	0.00001	1.41337	0.00001	1.26143
DR-BUS	2.36789	-0.32620	2.07803	-0.49672	0.00001	2.83292	3.20734	-1.59429	3.83468	3.60140	3.01291	2.91216
DR-FERRY	0.57491	8.52850	0.48004	-0.75165	0.00001	0.00001	0.71681	-1.85921	2.71294	0.00001	1.55302	0.00001
DR-LRT	-1.13807	-4.64226	-1.79483	-4.86649	0.00001	0.00001	0.00001	-3.92076	-0.88431	0.00001	0.24543	0.00001
DR-LNGFRY	2.65294	-0.51954	2.54019	-0.75165	0.00001	0.00001	0.00001	-2.35921	0.00001	0.00001	0.00001	0.00001
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-0.80507	-0.74207	-0.78960	-0.72964	-0.10377	-0.12234	0.46037	0.46399	-1.59361	-1.64760	-0.18755	-0.29848
SR3	-2.47232	-2.61916	-2.45156	-2.60394	-1.71785	-1.71868	-0.40357	-0.39384	-2.70742	-2.10552	-1.35883	-0.75484
SR4	-2.61177	-2.97054	-2.58808	-2.95163	-1.72078	-1.72167	-0.40396	-0.40237	-2.71151	-3.27461	-1.36369	-1.92046

10. From Non-Dense to Dense (except non-dense zones in Newark, Jersey City, Hoboken, Other CBD's or East of Hudson)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	1.43969	1.75382	1.32094	1.67269	1.05527	1.81339	3.99562	4.97740	2.68949	4.16236	1.53474	3.00226
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-0.67507	-1.20661	-0.67857	-1.16984	-1.58931	-0.20484	-1.26522	-2.08174	-0.68594	-1.15770	-0.60515	-1.00978
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	1.10866	0.61678	1.39208	0.81421	0.00001	0.00001	-0.16009	-1.24764	0.70836	-1.42045	0.14255	-1.92758
WK-BUS	1.15146	0.78984	1.38921	1.00404	1.24137	1.39410	0.29568	-1.23447	1.89506	-0.20090	0.72956	-1.03159
WK-FERRY	3.47164	2.96911	2.79731	3.12551	0.00001	0.00001	14.70581	-1.55388	0.70836	0.12097	0.14255	-0.69131
WK-LRT	0.09257	3.44153	0.33513	3.88954	3.11063	4.14045	-0.23866	-1.83359	0.76021	-1.00339	-0.15179	-1.68627
WK-LNGFRY	4.74568	2.96911	3.25904	3.12551	0.00001	0.00001	-0.10526	-1.55388	0.70836	0.12097	0.14255	-0.69131
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	0.37142	1.13715	0.52807	1.23841	0.00001	-1.87152	0.75896	-1.03243	-1.17919	-2.91158	-2.29057	-3.56368
DR-BUS	1.26670	1.26991	1.47827	1.40554	3.11675	0.04380	0.43806	-0.54682	2.09646	0.15509	1.32421	-0.53977
DR-FERRY	6.74239	5.48358	5.83815	5.24418	0.00001	6.24715	-1.90178	-2.41117	4.60501	0.46778	2.13293	0.26632
DR-LRT	-1.50626	-1.84143	-1.59897	-1.66180	1.32563	-1.26575	-1.90178	-2.11668	-1.17919	-2.91158	-2.29057	-3.56368
DR-LNGFRY	0.86331	1.03103	0.82918	1.21411	0.00001	-1.87152	-1.90178	-2.41117	-1.17919	-2.91158	-2.29057	-3.56368
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-1.70113	-1.76192	-1.69328	-1.75665	-0.06266	-0.07343	0.50239	0.51388	-1.54631	-1.75706	-0.09980	0.02394
SR3	-3.77865	-3.76919	-3.76917	-3.76037	-1.61674	-1.62191	-0.32798	-0.31880	-2.68751	-2.12520	-1.23794	-0.34204
SR4	-4.09578	-4.09240	-4.08713	-4.08349	-1.62130	-1.62740	-0.33566	-0.33084	-2.69221	-3.25616	-1.24230	-1.47155

11. From Dense to Dense (except non-dense zones in Newark, Jersey City, Hoboken, Other CBD's or East of Hudson)

Mode	Peak HBWD	Off-Peak HBWD	Peak HBWS	Off-Peak HBWS	Peak HBS	Off-Peak HBS	Peak HBO	Off-Peak HBO	Peak NHBW	Off-Peak NHBW	Peak NHBO	Off-Peak NHBO
DRIVE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TRANSIT	4.01445	4.56407	4.39411	5.01617	2.23805	2.92499	3.55058	2.95765	11.43715	5.03184	1.80794	1.16143
WK-TRN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-TRN	-2.60234	-2.09446	-2.66343	-2.46235	-2.55636	-0.82660	-2.08037	0.33197	-9.71654	-3.42086	-2.61357	-2.80551
WK-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
WK-PATH	-0.95859	-1.08540	-1.13320	-1.41639	0.25610	-0.36561	1.83963	1.57753	0.00001	-0.65442	0.00001	-0.18967
WK-BUS	-0.16681	-0.97357	-0.16886	-1.01880	-0.02424	-0.35018	0.88639	0.58634	1.62413	0.48185	0.64962	0.07613
WK-FERRY	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
WK-LRT	-0.45505	4.00218	-0.46818	4.46433	3.91948	5.02326	1.78767	2.34766	3.78026	-0.17528	0.87876	-0.31425
WK-LNGFRY	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DR-RAIL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
DR-PATH	-0.55245	-1.16660	-1.18456	-1.53554	0.00001	0.40671	1.49594	-1.46950	0.00001	0.00001	0.00001	0.00001
DR-BUS	6.24361	3.06769	5.96133	3.11700	0.00001	0.52953	2.63420	-1.24843	4.99243	5.03216	4.67589	3.67864
DR-FERRY	3.15758	2.66128	2.98430	3.07829	0.00001	0.00001	0.00001	-2.61559	2.52149	0.00001	2.78066	0.00001
DR-LRT	-1.53590	-3.40834	-2.18434	-3.80072	0.00001	-0.87237	-0.68258	-2.36336	-1.87265	2.43583	-1.11887	1.61787
DR-LNGFRY	5.65393	0.00001	4.44684	0.00001	0.00001	0.00001	0.00001	-2.61559	0.00001	0.00001	0.00001	0.00001
DRVALN	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR2	-0.85649	-0.87757	-0.84883	-0.87176	-0.10881	-0.11280	0.46716	0.47938	-1.51702	-1.62399	-0.19739	-0.67952
SR3	-2.56979	-2.09786	-2.56234	-2.08762	-1.70999	-1.70883	-0.39002	-0.39105	-2.72966	-2.09503	-1.38797	-1.14998
SR4	-3.02396	-3.00981	-3.00834	-3.01683	-1.71183	-1.71287	-0.39329	-0.39498	-2.73226	-3.28147	-1.39311	-2.33791

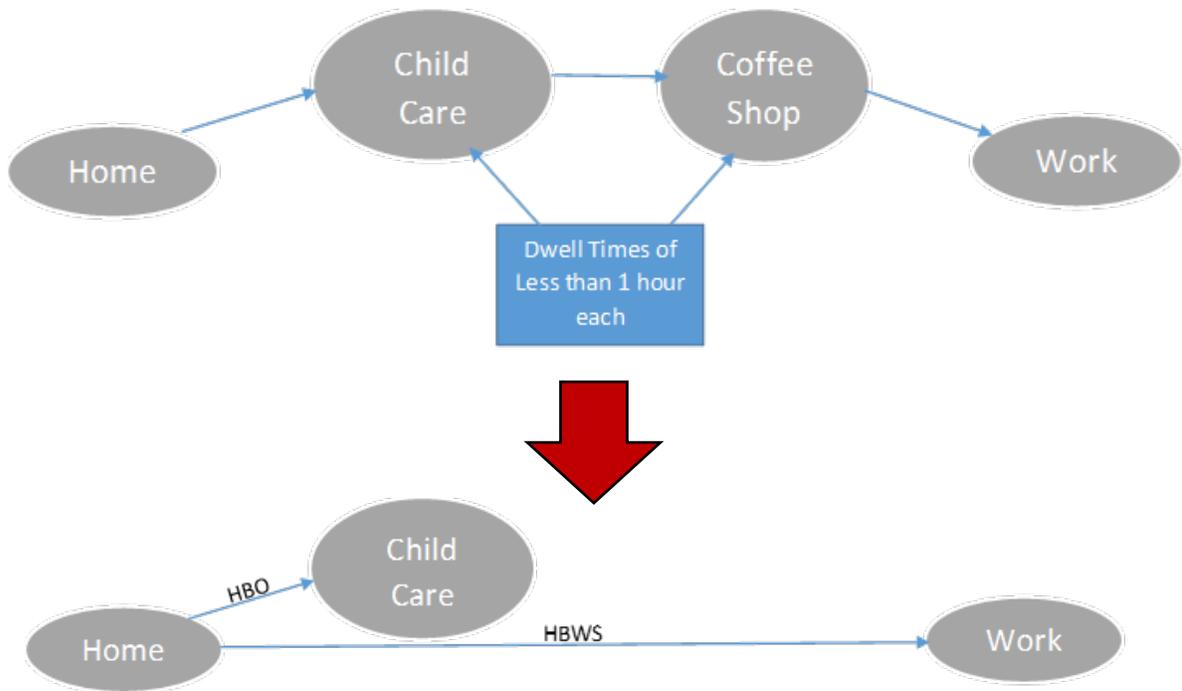
APPENDIX L – HOME-BASED WORK STRATEGIC (HBWS)

INTRODUCTION

This memo describes the process of developing the Home-Based Work Strategic (HBWS) data from the 2010-2011 NYMTC/NJTPA Household Survey Data. The HBWS is defined as a trip from home to work (or vice versa) with intermediate stops in between (chain trips). In the current definition, HBWS trips only consider any intermediate stops with activity duration (dwell-time) less than an hour at each stop. The HBWS chained trip is converted into a single Home-to-Work Strategic trip, while keeping the first leg of the chained trip and assigning it into another Home-Based trip purpose. The first leg of the trip was included as a proxy for the added Vehicle Miles Travelled (VMT) that normally occurs during trip chaining.

NJTPA expressed concerns about whether the manner in which HBWS trips were calculated for the NJRTM-E might cause the exclusion of too many lost (or misapplied) trips in the model; therefore, Stantec analyzed the characteristics of these trips as calculated and applied by the model. Figure 38 shows the schematic diagram of the HBWS Trip.

Figure 38 – A Sample of HBWS Trip



As part of this analysis, Stantec in coordination with NJTPA, revisited the dwell-time for the HBWS purpose. Setting too short a dwell time cutoff might result in too many trips where the home-to-work connection, including the income connection used in trip generation, is lost while using too long a dwell time cutoff might exclude important intermediate trips in the analysis. Review from various travel demand models indicated that the dwell-time used by those models varied significantly. For example, the CAMPO Austin’s model used a 5-minute cut-off instead of 60 minutes. Therefore, NJTPA and Stantec deemed that it would be useful to assess the impacts of the maximum dwell-time on the development of the HBWS trips.

Three dwell-time categories were tested in this review: 60 minutes, 30 minutes, and 15 minutes. The impact of the duration criteria on the HBWS generation was evaluated. This will eventually be used to decide if the current criteria need to be adjusted in this NJRTM-E Revalidation Project. Additionally, Stantec also developed the frequency distribution and average trip length of the first leg, and the frequency distribution of the activity duration. The impact of the first leg of the HBWS trip chain on the VMT was also reviewed.

THE PROCESS TO CREATE THE HBWS TRIPS

The HBWS trips were created from the 2010-2011 HH Survey Data as follow:

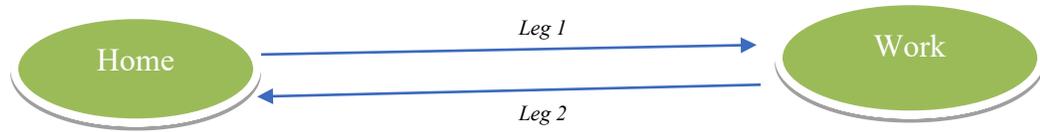
1. Stantec used the LINKED TRIP database and developed a Python program to summarize the HBWS trips.
2. Each tour by each person (on the same day) was analyzed. If a tour did not include any “between work and non-work” trips based on using the OD primary trip purpose field (ODTPURP2N), it was excluded from HBWS consideration. Additionally, if the tour was less than three legs, it was also excluded. Figure 39 shows a sample of the tours that were excluded from the HBWS consideration.

Figure 39 – Samples of Excluded Tours Data from HBWS Consideration

- a. Does not include “Between Work and Non-Work” OD primary purpose

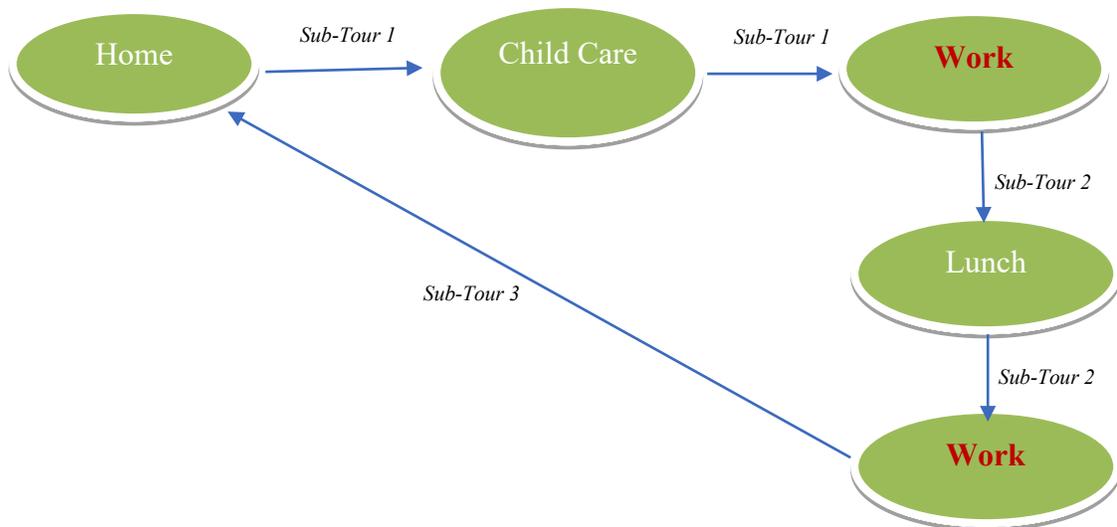


b. Less than three legs



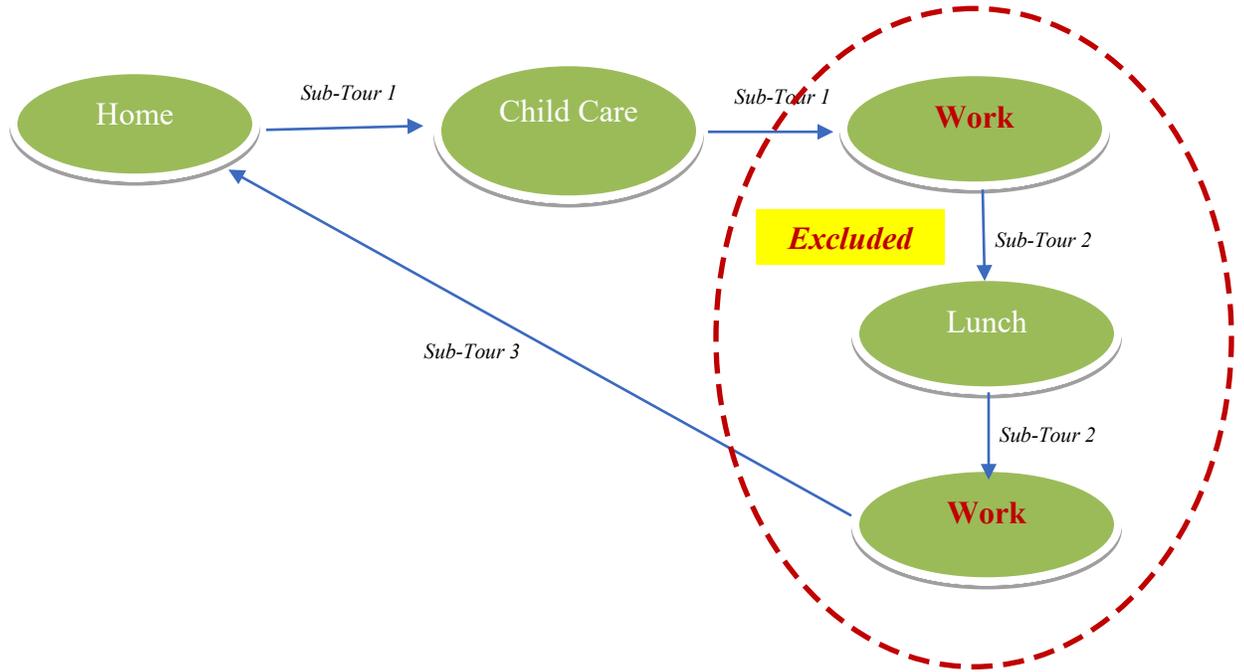
3. Each tour was partitioned into several sub-tours. The sub-tour number for each tour starts at 1, and every time a leg has a work-related “origin trip purpose” (OTPURP=1, 9, 10, 14) the sub-tour number was increased. Figure 40 shows a sample of tour disaggregation process.

Figure 40 – A Sample of Tour Partition to Sub-Tour



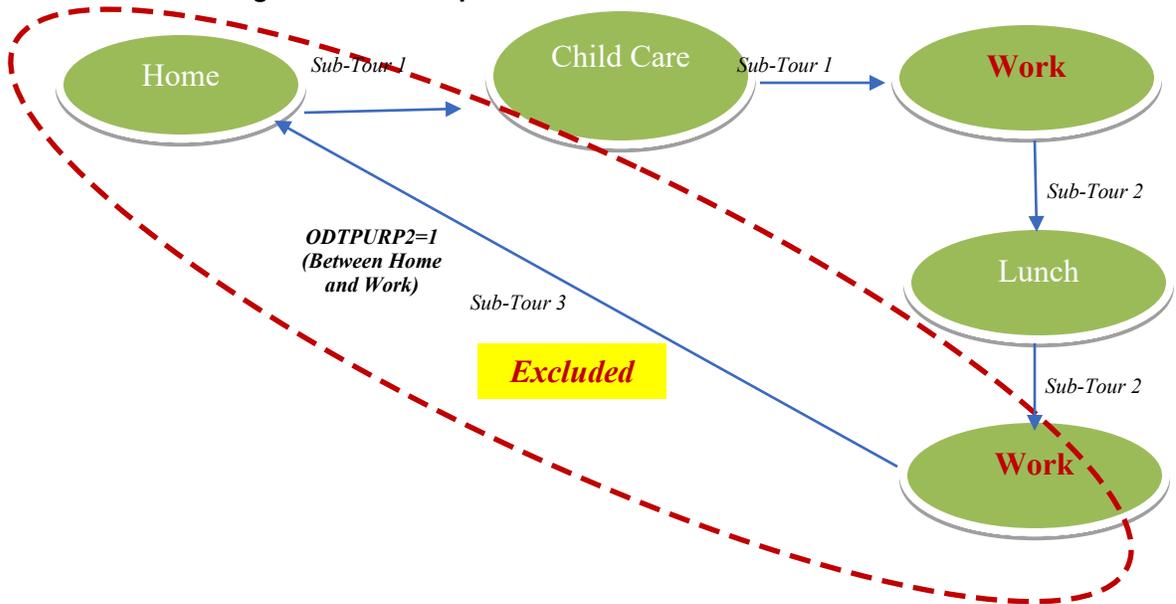
4. Any legs of the sub-tours that do not have origin (ORIG_HOME) = home or destination (DEST_HOME) = home were excluded from consideration. As shown in Figure 41.

Figure 41 – A Sample of Sub-Tour Without Origin or Destination Home.



- Any sub-tours with ODTPURP2=1 (between Home and Work or HBWD) were also excluded as shown in Figure 42.

Figure 42 – A Sample of Sub-Tour with ODTPURP2=1.



6. To check the impacts of using different dwell times as a cutoff for inclusion as an HBWS trip, the number of trips was calculated using maximum dwell-times of 60, 30, and 15 minutes at the intermediate stops. The summary of HBWD and HBWS trips for each dwell-time limit is presented in Table 107. The comparison was performed for all records (trips), as well as for trips with at-least one end in NJTPA counties. Note that the number of trips were calculated using WHT_FAC3 (Level 3 Weights – a final weight that combines the Level-2 Weights and the correction for under-reporting non-GPS sample trips). The results indicated that the HBW trips purpose is dominated by HBW-Direct trips which comprise approximately 80% of the total HBW trips. The HBWS trips are approximately between 17% and 23% of total HBW trips, and between 19% and 24% of HBW trips that start or end in NJTPA counties.

Table 107 – HBWD and HBWS Comparison from 2010 HH Survey Data.

Max Dwell-Time	Trip Purpose	All-Trips			At-Least One End in NJTPA Counties		
		Number of Records	Trips	Percent Trips	Number of Records	Trips	Percent Trips
60 Minutes	HBWD	28,926	11,718,152	77.3%	12,936	3,934,978	75.7%
	HBWS	5,346	3,433,014	22.7%	2,526	1,263,441	24.3%
	Total HBW	34,272	15,151,166	100.0%	15,462	5,198,418	100.0%
30 Minutes	HBWD	28,926	11,718,152	79.9%	12,936	3,934,978	78.2%
	HBWS	4,371	2,939,135	20.1%	2,094	1,095,293	21.8%
	Total HBW	33,297	14,657,287	100.0%	15,030	5,030,270	100.0%
15 Minutes	HBWD	28,926	11,718,152	82.8%	12,936	3,934,978	81.3%
	HBWS	3,531	2,431,372	17.2%	1,691	905,989	18.7%
	Total HBW	32,457	14,149,524	100.0%	14,627	4,840,964	100.0%

Stantec also reviewed the time-of-day pattern of the HBWS for trips that start or end in NJTPA Counties as shown in Table 108. This analysis was performed to ascertain whether time-of-day splits required any major adjustments. The comparison indicates that the majority of work trips happened during the normal office hours, i.e., leaving for work in the AM and coming home in the PM. The split between Home-to-Work trips and Work-to-Home trips is similar across the maximum dwell-time categories.

Table 108 – HBWS Pattern By Time-of-Day.

Max Dwell-Time Limit (Minutes)	Time-of-Day	Direction of Trips	Trips	Pct. Trips
60 Minutes	AM	Home-to-Work	543,941	93.1%
		Work-to-Home	40,060	6.9%
		Total	584,001	100.0%
	PM	Home-to-Work	19,741	2.9%
		Work-to-Home	659,699	97.1%
		Total	679,440	100.0%
Total			1,263,441	
30 Minutes	AM	Home-to-Work	519,989	94.3%
		Work-to-Home	31,498	5.7%
		Total	551,487	100.0%
	PM	Home-to-Work	16,886	3.1%
		Work-to-Home	526,920	96.9%
		Total	543,806	100.0%
Total			1,095,293	
15 Minutes	AM	Home-to-Work	490,774	94.9%
		Work-to-Home	26,352	5.1%
		Total	517,126	100.0%
	PM	Home-to-Work	14,464	3.7%
		Work-to-Home	374,399	96.3%
		Total	388,863	100.0%
Total			905,989	

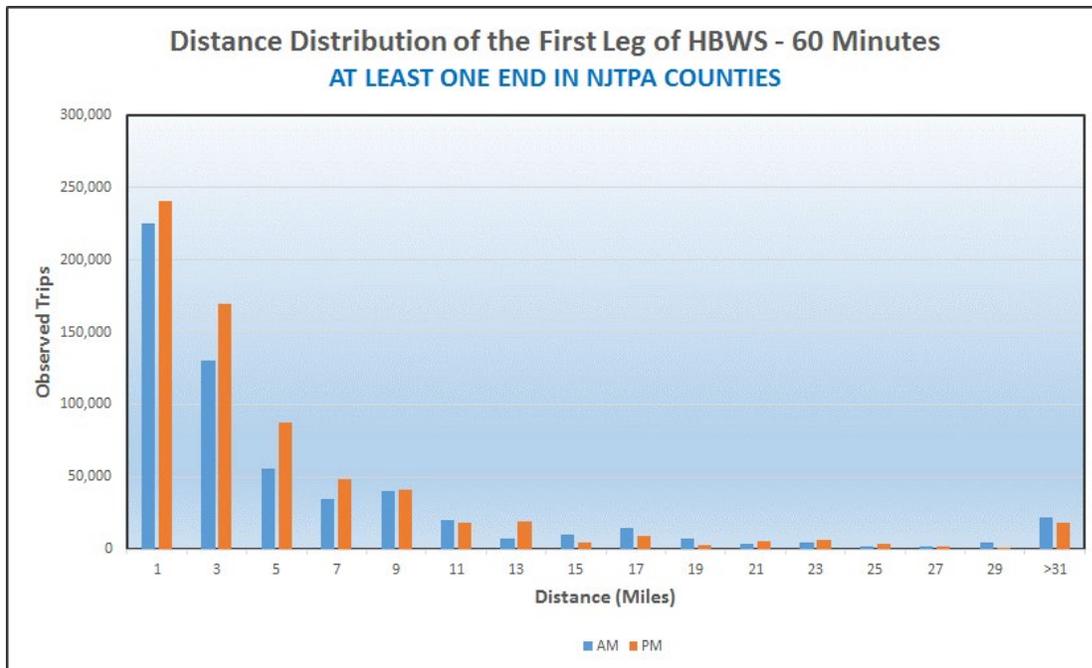
DISTANCE DISTRIBUTION FOR THE FIRST LEG OF HBWS TRIPS

The frequency distribution of the first leg’s average distance were calculated to help determine the trip characteristics of the first trip leg and the added VMT from including the first trip chaining leg as compared to the actual VMT by the survey participant. The average distance of the HBWS first leg trip by time-of-day (AM or PM) is shown in Table 109. The average distance is higher for the trips that start or end in the 13 NJTPA Counties than the overall average. This is reasonable since the overall average is skewed by significantly shorter trips that occur in Manhattan. The average distance for AM and PM periods is similar for both sample sets. The average distance among the three dwell-time categories is also comparable. The distance distribution of the first leg for the 60-minute dwell-time is shown in Figure 43.

Table 109 – Average Distance of the First Leg of HBWS Trips

MaxDwell-Time (Minutes)	Description	Average Distance for all trips (Miles)	Average Distance for Only if O or D within the 13 NJTPA Counties
60 Minutes	AM (Home-to-Work)	4.41	5.83
	PM (Work-to-Home)	4.26	5.75
	Total	4.35	5.86
30 Minutes	AM (Home-to-Work)	4.44	5.85
	PM (Work-to-Home)	4.09	5.42
	Total	4.28	5.69
15 Minutes	AM (Home-to-Work)	4.26	5.40
	PM (Work-to-Home)	3.75	5.08
	Total	4.06	5.31

Figure 43 – Distance Distribution of the HBWS’ First Leg for 60-Minutes Activity Duration.



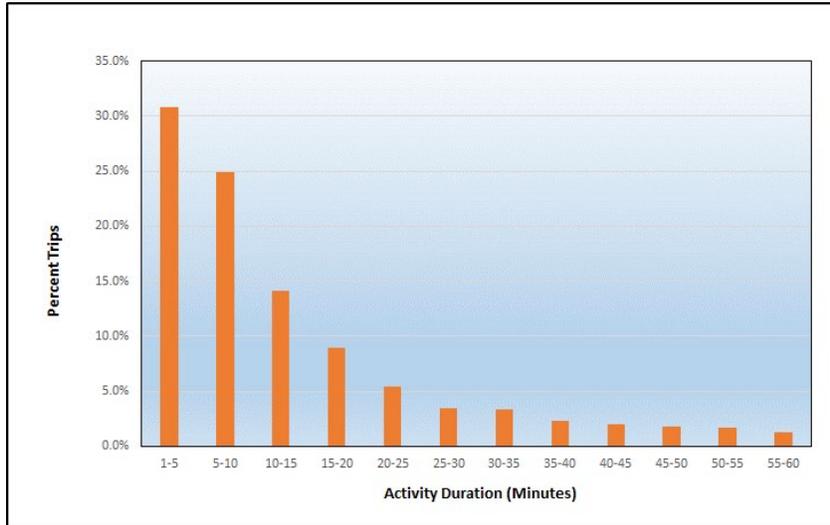
FREQUENCY DISTRIBUTION OF DWELL-TIME FOR HBWS

The frequency distribution of dwell-time at intermediate stops for HBWS trip purpose was also evaluated. Table 110 and Figure 44 show the dwell-time percent frequency distribution with a 60-minute cut off. Using 60-minute dwell-time as the base, the frequency distribution table shows that the 15-minute dwell-time category only captured approximately 70% of HBWS trips, while the 30-minute dwell-time category captured approximately 88% of the trips.

Table 110 – Dwell-Time Percent Distribution.

Dwell-Time Range	Percent Trips	Cummulative Percent
1-5	30.8%	69.8%
5-10	24.9%	
10-15	14.1%	
15-20	9.0%	87.7%
20-25	5.4%	
25-30	3.5%	
30-35	3.3%	100.0%
35-40	2.3%	
40-45	2.0%	
45-50	1.8%	
50-55	1.6%	
55-60	1.3%	

Figure 44 – Dwell-Time Percent Trip Distribution for all Intermediate Legs.



CONCLUSION

Based on the observations above, it was concluded that the HBWS trip patterns among the three dwell-time categories are quite similar. While most first leg trips occurred during the first 30

minutes, NJTPA and Stantec decided to retain the original dwell-time criteria of 60 minutes for this project. Additionally, Stantec in coordination of NJTPA, also reviewed the impact of adding the first of the HBWS trips on the VMT estimates. Table 111 shows the comparison of the HBWS tour distance (real distance) with the modeled distance (direct distance + first leg).

Table 111 – Average HBWS Distance Comparison – Real vs. Modeled

	Average Distance (Miles)
HBWS Tour Distance to Work	20.04
HBWS Direct Distance to Work	16.14
First Leg Distance	5.86
Total	22.00
% Difference	9.8%

Considering that the HBWS trips are approximately 5.6% of the total trips, the impact of the modeled distance on the regional VMT is approximately 0.5% higher than the real VMT, as shown in Table 112. This impact is reasonably small and on the higher side, which is acceptable for the Conformity Analysis.

Table 112 – The Impact of Modeled HBWS Distance on Regional VMT

% HBWS Trips (of Total trips)	5.6%
% difference attributable to the HBWS distance variation	9.8%
% VMT Change at Regional Level	0.5%

While the current treatment of HBWS trips by the NJRTM-E is inexact, both NJTPA and Stantec concluded that the benefits of keeping the HBWS definition unchanged was the best alternative. Using a HBWS provides a better accounting of all trips where the primary purpose is the work destination while keeping the first leg of the trip helps the model retain the VMT lost from excluding intermediate trips from the model.

APPENDIX M – INCOME GROUP ADJUSTMENTS

In the last NJRTM-E validation (2017), the income group definition was adjusted to the 2015 dollars (calibration year). This income by group definition is listed below:

- Group 1 – equal or less than \$15,000
- Group 2 – between \$15,000 and \$50,000
- Group 3 – between \$50,000 and \$100,000
- Group 4 – between \$100,000 and \$200,000
- Group 5 – higher than \$200,000

In order to be consistent with the new calibration year, 2019, this definition needs to be adjusted to the 2019 dollars. The adjustments were made using the all urban consumers CPI (CPI-U) data as shown in Table 113. The 2019 CPI is approximately 8 percent higher than the 2015 CPI value. The table shows the adjusted income group range to the 2019 dollars.

Table 113 – CPI Changes between 2015 and 2019

Year	Annual Average All Urban Consumers (CPI-U)
2015	237.017
2019	255.657
% CPI Change	7.86%

Since the new parameters will be based on the latest available Census-based income groups, the five income groups in the table above were reconciled with these groups. Table 114 shows the comparisons of the grouping reconciliation for the 2015 dollar-based and the 2019 dollar-based.

Table 114 – The Adjusted Income Group Range to 2019 Dollars Value

Income Group	2015 \$	2019 \$ (CPI Adjusted)
1	\$0 - \$14,999	\$0 - \$16,179
2	\$15,000 - \$49,999	\$16,180 - \$53,932
3	\$50,000 - \$99,999	\$53,933 - \$107,864
4	\$100,000 - \$199,999	\$107,865 - \$215,729
5	>= \$200,000	>= \$215,730

The comparisons indicate that the 2015 income group definition is more aligned with the Census-Based definition as shown in Table 115. Therefore, it was decided to keep the 2015 income group definition. The 2019 income data provided in the socioeconomic data, in 2019 dollars, was converted into 2015 dollars in the trip generation scripts wherever income group distribution is invoked in the household submodels.

Table 115 – The Income Group Range Comparison

Census-Based Income Group	Income Range (Census-Based)	2015 Income Group (Model-Based)	2019 Income Group (Model-Based)
1	\$0 - \$10,000	\$0 - \$14,999	\$0 - \$16,179
2	\$10,000 - \$14,999		
3	\$15,000 - \$24,999	\$15,000 - \$49,999	\$16,180 - \$53,932
4	\$25,000 - \$34,999		
5	\$35,000 - \$49,999		
6	\$50,000 - \$74,999	\$50,000 - \$99,999	\$53,933 - \$107,864
7	\$75,000 - \$99,999		
8	\$100,000 - \$149,999	\$100,000 - \$199,999	\$107,865 - \$215,729
9	\$150,000 - \$199,999		
10	>= \$200,000	>= \$200,000	>= \$215,730