Monmouth County Travel Demand Model

Model Development Manual

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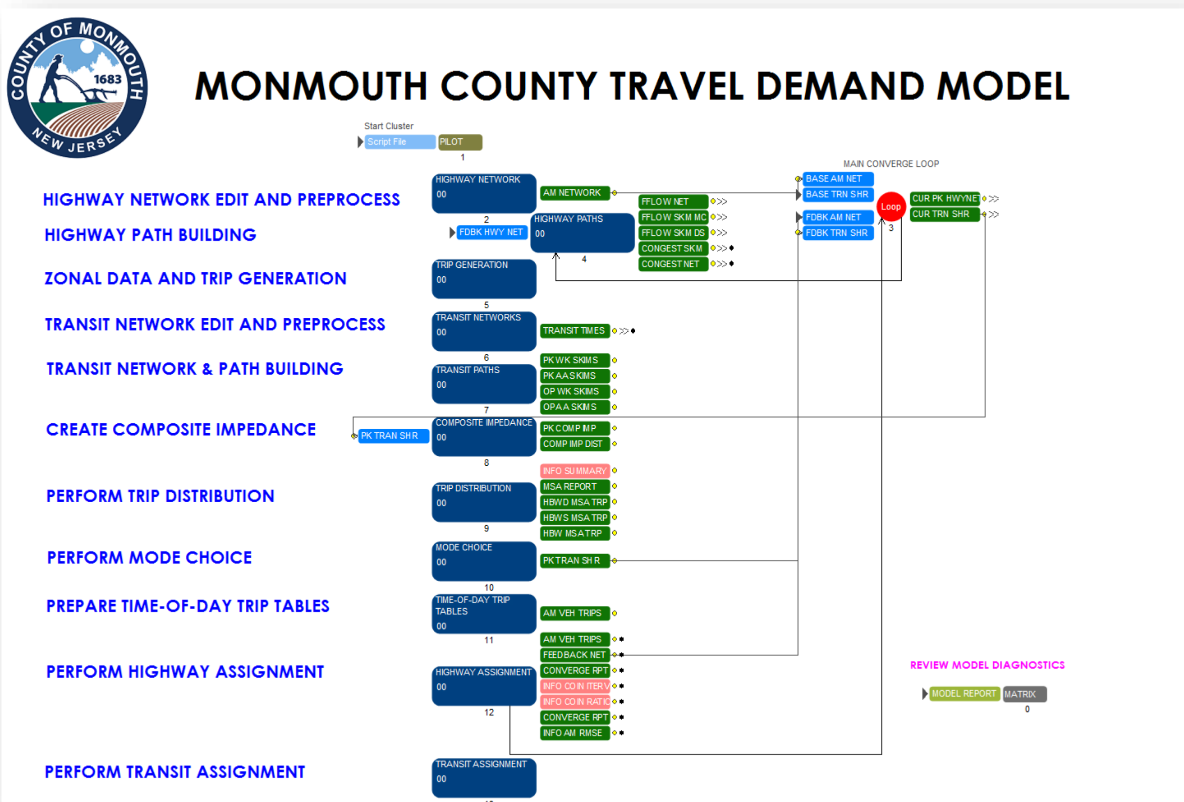
1.0 INTRODUCTION

The new Monmouth County Travel Demand Model (MCTDM) was developed using Citilabs' Cube Voyager Software Package, and was structured to be consistent with the MPO's Model, the NJTPA's North Jersey Regional Transportation Model – Enhanced (NJRTM-E).

The MCTDM consists of a main model and a series of support applications. The support applications range from input preparation to output processing. Figure 1.1 shows a diagram of the main model of the MCTDM as it is displayed in Cube Voyager. Chapters 2 to 9 discuss the development of the main model, while Chapter 10 will discuss the support applications. The users are also strongly advised to review the MCTDM Users Guide for additional information on the support applications.

Figure 1.1 Monmouth County Travel Demand Model Main Application



The model was calibrated and validated to the 2015 traffic conditions. This manual presents the details of the model structures, model features, and assumptions that were implemented in the new MCTDM, as well as the results of the model calibration including summaries from various model components ranging from trip generation to highway and transit assignments. The organization of this document is described in the following section.

1.1 ORGANIZATION OF THE REPORT

The remainder of this report is organized in the following chapters:

- *Chapter 2 – Traffic Analysis Zones and Socioeconomic Data.* This chapter describes the Traffic Analysis Zones (TAZs) of the MCTDM, and the socioeconomic data used in the model.
- *Chapter 3 – Data Collection and Sources.* This chapter discusses various data sources used in developing the forecasts.
- *Chapter 4 – Highway Network Development.* This chapter presents the development of MCTDM highway network and the descriptions of its variables.
- *Chapter 5 – Highway Path Building.* This chapter discusses the path building process for the highway network.
- *Chapter 6 – Transit Network Development.* This chapter describes the development of transit network using Public Transport Module.
- *Chapter 7 – Transit Path-Building.* This chapter explains the methodology used to create paths for various transit modes.
- *Chapter 8 – Composite Impedance Estimation.* This chapter discusses the application of composite impedance as well as the variables that influence the impedance.
- *Chapter 9 – Model Calibration.* This chapter presents the calibration and validation summaries of the model components.
- *Chapter 10 – Additional Features.* This chapter discussed additional features such as Seasonal Model, Support Applications, and Future Scenarios.

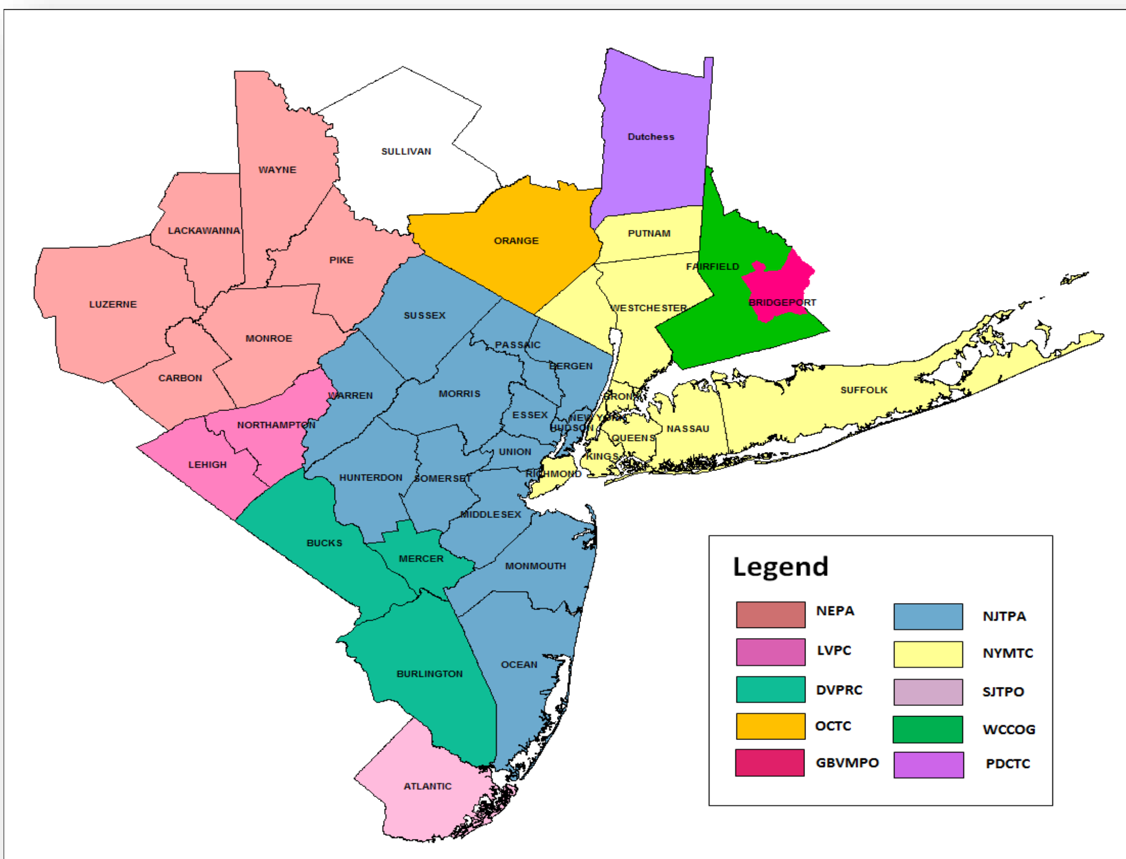
2.0 TRAFFIC ANALYSIS ZONES AND SOCIOECONOMIC DATA

2.1 INTRODUCTION

The Monmouth County Travel Demand Model's geographical coverage is identical with that of the North Jersey Regional Transportation Model – Enhanced (NJRTM-E). It is comprised of forty counties in New Jersey, New York, and Pennsylvania, representing six Metropolitan Planning Organizations (MPOs) as shown in Figure 2.1, including:

- North Jersey Transportation Planning Agency (NJTPA)
- South Jersey Transportation Planning Organization (SJTPO - partial)
- New York Metropolitan Transportation Council (NYMTC)
- Delaware Valley Regional Planning Commission (DVRPC - partial)
- Northeastern Pennsylvania Alliance (NEPA - partial)
- Lehigh Valley Planning Commission (LVPC)
- Orange County Transportation Council (OCTC)
- Poughkeepsie – Dutchess County Transportation Council (PDCTC)
- Western Connecticut Council of Government (WCCOG – partial)
- Greater Bridgeport / Valley MPO (GBVMPO – partial)

Figure 2.1 The MCTDM Geographical Coverage



2.2 TRAFFIC ANALYSIS ZONES

The MCTDM TAZ system was developed based on the updated NJRTM-E TAZ system along with additional refinement in Monmouth and Ocean Counties. The TAZ boundary was developed using the block, block-group, and census-tract boundaries of the 2010 Census. The TAZs in Ocean County are identical with the Ocean County Transportation Model that was completed in 2015, while the TAZ refinement for Monmouth County was developed with guidance from County Staff. The refined TAZ System consists of 3248 zones, including 3 external zones and 362 reserved zones for future use. 228 of those zones are in Monmouth County. Figure 2.2 shows an overlay of NJRTM-E TAZ Systems in Monmouth and Ocean Counties. Table 2.1 shows the list of TAZs by County for the entire model area.

The reserved zones were prepared for future use. For example, a corridor study that requires additional TAZ refinement. The reserved zones can be used in this study without changing the TAZ numbering system. Modifying or changing the TAZ numbers would lead to erroneous model execution and results.

The three external zones were added as part of the NJRTM-E Refinement Project that was completed in 2015. The original NJRTM-E did not use any external zones, instead it provided enough buffer areas of additional counties surrounding the thirteen NJTPA's counties from which external traffic was to be generated. While the buffer area surrounding the NJTPA region is providing a reasonable external trip process for most of the modeled area, the estimated traffic on the southern section of the New Jersey Turnpike (NJTPK) were much lower than the observed traffic. An external zone representing the southern terminus of the NJTPK was added during the NJRTM-E Refinement Project to address this issue. Two additional external zones were also added at the western terminus of I-80 and I-78. It should be noted that the since the model has a larger buffer to the west and north of the NJTPA region, there is less traffic from these two external loading points reaching the NJTPA region than the traffic from the southern terminus of the NJTPK.

Figure 2.2 TAZ System in Monmouth County Region

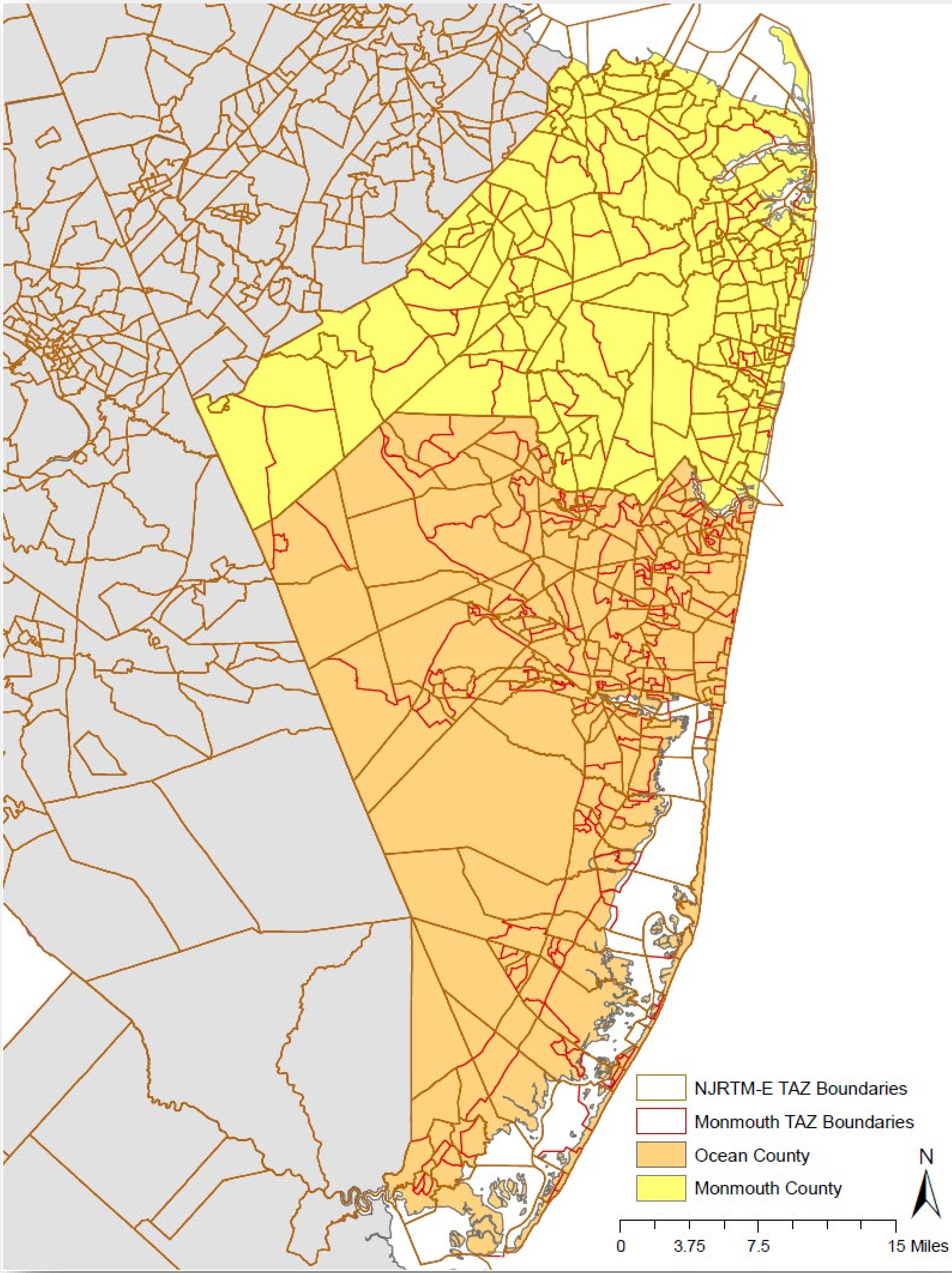


Table 2.1 The MCTDM TAZ System

Region	County	NJRTME				Monmouth			
		Existing Zones		Reserved Zones		Existing Zones		Reserved Zones	
		Zone Numbers	No. of Zones	Zone Numbers	No. of Zones	Zone Numbers	No. of Zones	Zone Numbers	No. of Zones
New Jersey	Atlantic	1 - 25	**25**		0	1 - 25	**25**		0
	Bergen	26 - 213	**188**	214 - 225	12	26 - 213	**188**	214 - 225	12
	Burlington	226 - 366	**141**	368 - 369	2	226 - 366	**141**	368 - 369	2
	Essex	370 - 598	**229**	599 - 610	12	370 - 598	**229**	599 - 610	12
	Hudson	611 - 796	**186**	797 - 831	35	611 - 796	**186**	797 - 831	35
	Hunterdon	832 - 863	**32**	864 - 872	9	832 - 863	**32**	864 - 872	9
	Mercer	874 - 997	**124**	998 - 1007	10	874 - 997	**124**	998 - 1007	10
	Middlesex	1008 - 1216	**209**	1217 - 1226	10	1008 - 1216	**209**	1217 - 1226	10
	Monmouth	1227 - 1379	**153**	1380 - 1389	10	1227 - 1379	**153**	1380 - 1389	10
						2951 - 3025	**75**	2901 - 2950	50
	Morris	1390 - 1490	**101**	1491 - 1500	10	1390 - 1490	**101**	1491 - 1500	10
	Ocean	1501 - 1636	**136**	1637 - 1646	10	1501 - 1636	**136**	1637 - 1646	10
						3031 - 3248	**218**	3026 - 3030	5
	Passaic	1647 - 1747	**101**	1748 - 1757	10	1647 - 1747	**101**	1748 - 1757	10
	Somerset	1758 - 1838	**81**	1839 - 1847	9	1758 - 1838	**81**	1839 - 1847	9
	Sussex	1848 - 1891	**44**	1892 - 1901	10	1848 - 1891	**44**	1892 - 1901	10
	Union	1902 - 2016	**115**	2017 - 2034	18	1902 - 2016	**115**	2017 - 2034	18
	Warren	2035 - 2061	**27**	2062 - 2070	9	2035 - 2061	**27**	2062 - 2070	9
New York	Bronx	2072 - 2077	**6**	-	0	2072 - 2077	**6**	-	0
	Dutches	2078 - 2079	**2**	-	0	2078 - 2079	**2**	-	0
	Kings	2080 - 2097	**18**	-	0	2080 - 2097	**18**	-	0
	Nassau	2098 - 2099	**2**	-	0	2098 - 2099	**2**	-	0
	New York (Manhattan)	2100 - 2389	**290**	-	0	2100 - 2389	**290**	-	0
	Orange	2390 - 2417	**28**	-	0	2390 - 2417	**28**	-	0
	Putnam	2418 - 2418	**1**	-	0	2418 - 2418	**1**	-	0
	Queens	2419 - 2429	**11**	-	0	2419 - 2429	**11**	-	0
	Richmond	2430 - 2480	**51**	2481 - 2489	9	2430 - 2480	**51**	2481 - 2489	9
	Rockland	2490 - 2554	**65**	-	0	2490 - 2554	**65**	-	0
	Suffolk	2555 - 2555	**1**	-	0	2555 - 2555	**1**	-	0
	Sullivan	2556 - 2556	**1**	-	0	2556 - 2556	**1**	-	0
	Westchester	2557 - 2583	**27**	-	0	2557 - 2583	**27**	-	0
Pennsylvania	Bucks	2584 - 2654	**71**	-	0	2584 - 2654	**71**	-	0
	Carbon	2655 - 2655	**1**	-	0	2655 - 2655	**1**	-	0
	Lackawanna	2656 - 2696	**41**	-	0	2656 - 2696	**41**	-	0
	Lehigh	2697 - 2723	**27**	-	0	2697 - 2723	**27**	-	0
	Luzerne	2724 - 2799	**76**	-	0	2724 - 2799	**76**	-	0
	Monroe	2800 - 2819	**20**	-	0	2800 - 2819	**20**	-	0
	Northampton	2820 - 2857	**38**	-	0	2820 - 2857	**38**	-	0
	Pike	2858 - 2870	**13**	-	0	2858 - 2870	**13**	-	0
	Wayne	2871 - 2898	**28**	-	0	2871 - 2898	**28**	-	0
Connecticut	Bridgeport	2899 - 2899	**1**	-	0	2899 - 2899	**1**	-	0
	Fairfield Co. Other	2900 - 2900	**1**	-	0	2900 - 2900	**1**	-	0
Total Internal Zones			**2,712**		**185**		**3,005**		**240**
External Zones	NJ Turnpike Southern Terminus	367	**1**			367	**1**		
	I-80 Western Terminus	2071	**1**			2071	**1**		
	I-78 Western Terminus	873	**1**			873	**1**		
Total Monmouth County Model					**2,900**				**3,248**

2.3 SOCIOECONOMIC DATA

The socioeconomic data (SED) for the MCTDM was provided by NJTPA and it is consistent with SED that is utilized for the 2015 NJRTM-E Revalidation Project and expected to be used for NJTPA's 2045 Regional Transportation Plan. As part of this three model-year scenarios have been prepared; 2015 (calibration year), 2025 and 2040. Table 2.2 shows the population (POP), household (HH), and employment (EMP) summary by county for the full model's extent. Table 2.3 shows the summary by municipalities (MCD) for the Monmouth County Region and Table 2.4 presents the compounded annual growth rate (CAGR) between 2015-2025 and 2025-2040. The Monmouth County population and households are estimated to grow at an annual rate of 0.12% and 0.52%, respectively, between 2015 and 2025, while employment grows at a rate of 0.31% annually. Between 2025 and 2040, population and households are estimated to grow at a rate of 0.24% and 0.28% per year, respectively, while employment is estimated to grow at a rate of 0.33% per year.

Table 2.2 Socioeconomic Data Summary by County

STATE	COUNTY	POP			HH			EMP		
		2015	2025	2040	2015	2025	2040	2015	2025	2040
New Jersey	Atlantic	269,939	286,821	312,144	102,250	108,644	118,236	164,953	167,260	170,721
	Bergen	928,736	951,196	1,011,159	339,860	356,064	375,917	444,410	469,825	495,158
	Burlington	450,912	471,735	494,722	168,000	177,175	186,644	218,492	228,427	239,422
	Essex	790,286	818,044	885,615	289,757	306,636	335,761	372,712	392,071	417,641
	Hudson	664,766	696,939	784,871	259,460	277,029	317,032	292,804	320,252	347,051
	Hunterdon	127,964	128,443	133,892	48,489	51,016	52,722	55,827	57,304	60,638
	Mercer	367,662	377,426	390,730	134,065	138,555	144,036	267,528	276,216	286,083
	Middlesex	829,266	862,805	942,881	284,658	302,001	333,200	397,998	418,521	447,748
	Monmouth	**631,442**	**639,231**	**662,606**	**238,584**	**251,386**	**262,238**	**265,560**	**273,814**	**287,830**
	Morris	500,519	515,015	527,355	186,604	197,862	203,040	303,983	316,741	326,097
	Ocean	**585,735**	**629,601**	**727,411**	**225,056**	**243,084**	**282,784**	**169,467**	**183,536**	**201,414**
	Passaic	505,892	528,416	584,980	170,877	181,445	201,022	189,774	200,796	213,823
	Somerset	331,195	339,637	359,896	118,200	126,293	134,632	192,717	203,308	216,146
	Sussex	149,798	151,373	156,225	56,688	59,351	61,624	43,621	45,340	47,252
	Union	549,162	572,196	633,168	189,424	199,433	220,062	245,932	257,616	273,198
	Warren	109,881	112,152	117,200	42,989	45,655	48,541	36,043	37,630	39,270
New York	Bronx	1,369,017	1,438,559	1,532,536	494,510	519,622	553,571	386,605	402,695	424,011
	Dutchess	281,430	291,719	314,973	112,123	119,799	129,718	118,868	126,343	137,069
	Kings	2,567,223	2,670,642	2,804,914	953,490	991,903	1,041,777	865,022	895,593	939,005
	Nassau	1,331,352	1,356,323	1,503,550	450,947	468,171	511,890	578,075	596,938	630,461
	New York	1,543,334	1,594,211	1,624,236	776,333	801,935	817,044	2,385,359	2,463,108	2,576,985
	Orange	373,355	404,327	476,678	132,785	147,608	174,450	145,299	155,842	172,119
	Putnam	97,432	98,824	105,090	36,187	38,231	40,290	28,529	29,090	29,393
	Queens	2,261,478	2,325,428	2,384,645	801,323	823,972	844,957	727,389	741,692	760,688
	Richmond	470,523	485,599	493,266	168,976	174,385	177,146	138,588	142,688	148,033
	Rockland	315,895	328,990	370,167	103,962	108,891	121,928	118,415	127,409	139,808
	Suffolk	1,471,420	1,509,850	1,626,165	508,497	541,575	588,165	637,685	673,361	721,640
	Westchester	942,765	967,338	1,074,537	356,763	372,890	411,415	439,406	457,380	481,197
Pennsylvania	Bucks	634,887	673,289	727,145	240,202	257,429	279,557	296,107	313,849	335,697
	Carbon	62,839	64,062	64,174	25,140	25,629	25,674	18,063	18,076	18,095
	Lackawanna	212,771	210,447	210,086	85,927	85,028	84,863	97,399	96,540	95,268
	Lehigh	367,603	406,436	469,975	143,340	161,139	185,574	234,009	262,324	302,771
	Luzerne	301,158	296,045	295,655	122,422	120,009	119,819	143,073	140,251	136,112
	Monroe	201,799	245,644	318,350	71,603	86,985	112,471	71,616	87,839	117,848
	Northampton	313,625	347,641	403,979	121,003	135,626	156,703	139,093	155,149	176,761
	Pike	80,304	106,075	153,938	30,024	39,659	57,554	12,100	15,864	23,303
	Wayne	57,110	60,697	60,485	21,801	23,113	23,038	18,272	18,728	19,433
Others		1,011,107	1,073,715	1,129,735	362,456	401,582	403,562	450,478	770,058	871,699
TOTAL		**24,061,581**	**25,036,891**	**26,869,133**	**8,974,772**	**9,466,808**	**10,138,657**	**11,711,272**	**12,539,475**	**13,326,887**

Table 2.3 Socioeconomic Data Summary by MCD

Monmouth County	2015			2025			2040		
MCD	POP	HH	EMP	POP	HH	EMP	POP	HH	EMP
Aberdeen township	18,210	7,004	3,808	18,394	7,311	3,907	18,930	7,564	4,173
Allenhurst borough	500	221	205	513	248	221	513	248	221
Allentown borough	1,827	717	669	1,854	764	687	1,935	803	733
Asbury Park city	16,127	6,850	4,023	16,687	7,821	4,430	20,008	9,504	4,985
Atlantic Highlands borough	4,384	1,905	1,402	4,428	1,990	1,431	4,561	2,060	1,508
Avon-by-the-Sea borough	1,901	918	341	1,924	967	357	1,992	1,008	400
Belmar borough	5,792	2,745	1,308	5,862	2,889	1,357	6,071	3,009	1,484
Bradley Beach borough	4,342	2,147	761	4,382	2,234	786	4,495	2,301	851
Brielle borough	4,773	1,839	1,444	4,812	1,905	1,466	4,924	1,958	1,523
Colts Neck township	10,185	3,338	2,917	10,437	3,664	3,053	11,011	3,916	3,356
Deal borough	754	339	559	775	382	577	794	399	598
Eatontown borough	12,717	5,418	16,474	12,968	5,955	18,152	13,866	6,335	19,824
Englishtown borough	1,846	633	870	1,879	683	891	1,979	727	944
Fair Haven borough	6,120	2,007	968	6,162	2,067	984	6,285	2,116	1,030
Farmingdale borough	1,329	557	1,918	1,347	592	1,938	1,403	622	1,984
Freehold borough	12,045	4,081	3,584	12,207	4,322	3,673	12,688	4,526	3,907
Freehold township	36,234	12,811	27,997	36,567	13,323	28,246	37,595	13,761	28,887
Hazlet township	20,329	7,273	6,478	20,500	7,542	6,569	21,008	7,764	6,817
Highlands borough	5,004	2,672	986	5,040	2,751	1,006	5,144	2,813	1,060
Holmdel township	16,769	5,690	11,322	17,032	6,054	12,546	17,484	6,250	13,716
Howell township	51,055	17,582	14,340	51,588	18,380	14,624	53,204	19,055	15,390
Interlaken borough	825	368	39	825	368	39	825	368	39
Keansburg borough	10,102	3,876	1,903	10,172	3,995	1,936	10,369	4,087	2,023
Keyport borough	7,239	3,124	2,758	7,298	3,238	2,797	7,470	3,328	2,897
Lake Como borough	1,758	800	268	1,782	847	285	1,852	887	327
Little Silver borough	5,949	2,186	2,358	5,995	2,260	2,384	6,125	2,319	2,452
Loch Arbour village	201	84	38	211	103	53	211	103	53
Long Branch city	30,714	11,972	10,490	31,068	12,562	10,708	32,116	13,053	11,265
Manalapan township	38,986	13,510	10,065	39,342	14,040	10,246	40,390	14,472	10,717
Manasquan borough	5,896	2,418	1,548	5,970	2,552	1,596	6,189	2,663	1,717
Marlboro township	40,224	13,243	10,420	40,563	13,726	10,580	41,564	14,120	11,009
Matawan borough	8,808	3,421	4,074	8,885	3,552	4,124	9,113	3,660	4,253
Middletown township	66,559	24,409	21,336	67,167	25,392	21,678	68,942	26,192	22,575
Millstone township	10,639	3,363	1,771	10,909	3,743	1,928	11,687	4,060	2,293
Monmouth Beach borough	3,282	1,522	483	3,307	1,573	497	3,381	1,615	535
Neptune City borough	4,868	2,173	1,513	4,904	2,244	1,535	5,007	2,300	1,593
Neptune township	27,925	11,410	14,291	28,199	11,884	14,474	29,016	12,277	14,954
Ocean township	27,282	10,809	10,256	27,513	11,211	10,394	28,210	11,547	10,776
Oceanport borough	5,831	2,269	3,988	6,104	2,766	5,093	6,841	3,137	6,090
Red Bank borough	12,202	5,021	13,362	12,335	5,255	13,479	12,732	5,447	13,774
Roosevelt borough	893	320	79	912	350	90	969	376	119
Rumson borough	7,121	2,388	1,813	7,183	2,480	1,844	7,362	2,552	1,921
Sea Bright borough	1,473	807	496	1,490	844	509	1,541	874	541
Sea Girt borough	1,827	838	1,172	1,852	888	1,193	1,925	930	1,245
Shrewsbury borough	3,807	1,285	6,396	4,021	1,639	6,437	4,033	1,648	6,438
Shrewsbury township	1,140	594	844	1,157	630	860	1,208	660	898
Spring Lake borough	2,992	1,276	889	3,030	1,347	915	3,115	1,398	979
Spring Lake Heights borough	4,712	2,359	1,227	4,747	2,434	1,247	4,847	2,493	1,305
Tinton Falls borough	18,514	8,730	10,852	18,726	9,130	11,004	19,259	9,411	11,340
Union Beach borough	6,244	2,183	848	6,287	2,249	865	6,411	2,301	913
Upper Freehold township	6,938	2,414	2,203	7,322	3,026	2,473	8,373	3,548	3,102
Wall township	26,154	10,238	19,233	26,413	10,678	19,427	27,209	11,051	19,941
West Long Branch borough	8,096	2,428	6,168	8,179	2,535	6,221	8,425	2,622	6,354
County Total	631,442	238,584	265,560	639,231	251,386	273,814	662,606	262,238	287,830

Table 2.4 SED Growth Rate by MCD

Monmouth County	2015-2025			2025-2040		
MCD	POP	HH	EMP	POP	HH	EMP
Aberdeen township	0.10%	0.43%	0.26%	0.19%	0.23%	0.44%
Allenhurst borough	0.26%	1.18%	0.76%	0.00%	0.00%	0.00%
Allentown borough	0.15%	0.63%	0.26%	0.28%	0.34%	0.43%
Asbury Park city	0.34%	1.33%	0.97%	1.22%	1.31%	0.79%
Atlantic Highlands borough	0.10%	0.44%	0.20%	0.20%	0.23%	0.35%
Avon-by-the-Sea borough	0.12%	0.52%	0.48%	0.23%	0.27%	0.75%
Belmar borough	0.12%	0.51%	0.37%	0.23%	0.27%	0.60%
Bradley Beach borough	0.09%	0.40%	0.32%	0.17%	0.20%	0.53%
Brielle borough	0.08%	0.36%	0.15%	0.15%	0.18%	0.25%
Colts Neck township	0.24%	0.94%	0.46%	0.36%	0.44%	0.63%
Deal borough	0.28%	1.19%	0.32%	0.16%	0.30%	0.24%
Eatontown borough	0.20%	0.95%	0.97%	0.45%	0.41%	0.59%
Englishtown borough	0.18%	0.78%	0.24%	0.34%	0.41%	0.39%
Fair Haven borough	0.07%	0.30%	0.16%	0.13%	0.16%	0.31%
Farmingdale borough	0.14%	0.61%	0.10%	0.27%	0.32%	0.16%
Freehold borough	0.13%	0.58%	0.25%	0.26%	0.31%	0.41%
Freehold township	0.09%	0.39%	0.09%	0.19%	0.22%	0.15%
Hazlet township	0.08%	0.36%	0.14%	0.16%	0.19%	0.25%
Highlands borough	0.07%	0.29%	0.20%	0.14%	0.15%	0.35%
Holmdel township	0.16%	0.62%	1.03%	0.17%	0.21%	0.60%
Howell township	0.10%	0.44%	0.20%	0.21%	0.24%	0.34%
Interlaken borough	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Keansburg borough	0.07%	0.30%	0.17%	0.13%	0.15%	0.29%
Keyport borough	0.08%	0.36%	0.14%	0.16%	0.18%	0.24%
Lake Como borough	0.13%	0.58%	0.60%	0.26%	0.31%	0.92%
Little Silver borough	0.08%	0.34%	0.11%	0.14%	0.17%	0.19%
Loch Arbour village	0.47%	2.12%	3.41%	0.00%	0.00%	0.00%
Long Branch city	0.11%	0.48%	0.21%	0.22%	0.26%	0.34%
Manalapan township	0.09%	0.39%	0.18%	0.18%	0.20%	0.30%
Manasquan borough	0.13%	0.54%	0.30%	0.24%	0.28%	0.49%
Marlboro township	0.08%	0.36%	0.15%	0.16%	0.19%	0.27%
Matawan borough	0.09%	0.38%	0.12%	0.17%	0.20%	0.21%
Middletown township	0.09%	0.40%	0.16%	0.17%	0.21%	0.27%
Millstone township	0.25%	1.08%	0.86%	0.46%	0.54%	1.16%
Monmouth Beach borough	0.08%	0.33%	0.28%	0.15%	0.17%	0.50%
Neptune City borough	0.07%	0.32%	0.14%	0.14%	0.16%	0.25%
Neptune township	0.10%	0.41%	0.13%	0.19%	0.22%	0.22%
Ocean township	0.08%	0.37%	0.13%	0.17%	0.20%	0.24%
Oceanport borough	0.46%	2.00%	2.47%	0.76%	0.84%	1.20%
Red Bank borough	0.11%	0.46%	0.09%	0.21%	0.24%	0.14%
Roosevelt borough	0.21%	0.90%	1.36%	0.40%	0.48%	1.88%
Rumson borough	0.09%	0.38%	0.17%	0.16%	0.19%	0.28%
Sea Bright borough	0.12%	0.45%	0.25%	0.23%	0.23%	0.41%
Sea Girt borough	0.13%	0.58%	0.18%	0.26%	0.31%	0.28%
Shrewsbury borough	0.55%	2.47%	0.06%	0.02%	0.04%	0.00%
Shrewsbury township	0.14%	0.59%	0.19%	0.29%	0.31%	0.28%
Spring Lake borough	0.13%	0.54%	0.28%	0.18%	0.25%	0.46%
Spring Lake Heights borough	0.07%	0.31%	0.17%	0.14%	0.16%	0.30%
Tinton Falls borough	0.11%	0.45%	0.14%	0.19%	0.20%	0.20%
Union Beach borough	0.07%	0.30%	0.20%	0.13%	0.15%	0.36%
Upper Freehold township	0.54%	2.29%	1.17%	0.90%	1.07%	1.52%
Wall township	0.10%	0.42%	0.10%	0.20%	0.23%	0.17%
West Long Branch borough	0.10%	0.43%	0.09%	0.20%	0.23%	0.14%
County Total	0.12%	0.52%	0.31%	0.24%	0.28%	0.33%

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3.0 DATA COLLECTION AND SOURCES

Data to support model calibration and validation efforts for various model components were gathered from numerous sources, including:

- 2010-2011 NJTPA and NYMTC Regional Household Travel Survey (RHTS).
- 2010 census data and American Community Survey (ACS) data.
- Longitudinal Employer-Household Dynamics (LEHD) data.
- Monmouth and Ocean County Automatic Traffic Recorders (ATRs) counts.
- NJDOT traffic counts Weigh-in-Motion (WIM) Data, and 48-hour continuous data.
- New Jersey Turnpike Authority (NJTA) traffic counts along the Garden State Parkway.
- INRIX speed data.
- The 2015 NJ Transit Ridership data.
- Ferry ridership data.

3.1 2010-2011 NJTPA-NYMTC RHTS DATA

The 2010-2011 RHTS was conducted from September 2010 through November 2011 in a coordinated effort between NJTPA and NYMTC. In total, 18,965 households completed the survey's travel diaries, 7,574 of which were households in the NJTPA region. The survey study area comprises 28-counties constituting the Tri-State metropolitan area that includes:

- New York: Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, and Westchester.
- New Jersey: Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren.
- Connecticut: Fairfield and New Haven.

The survey datasets are comprised of 18,965 household records, 39,789 person records, and 143,925 trip records. Of these records, only 679 households were from the Monmouth County Region. The sample represents approximately 0.3% of the total households in the region as shown in Table 3.1. The percentage of the sample size for Monmouth County is consistent with the sample size for the NJTPA region, the NJTPA's 13 counties, as shown in Table 3.2. Figure 3.1 shows the sample size and location for Monmouth County. The household sample size by municipality is provided in Table 3.3.

Table 3.1 RHTS Sample Size for Monmouth County

Type	Number of Samples	SED (2015)	% Sample
Household	679	238,584	0.3%

Table 3.2 RHTS Sample Size for NJTPA Counties

Type	Number of Samples	SED (2015)	% Sample
Household	7,574	2,450,644	0.3%

Figure 3.1 RHTS Sample Size by Location in Monmouth County

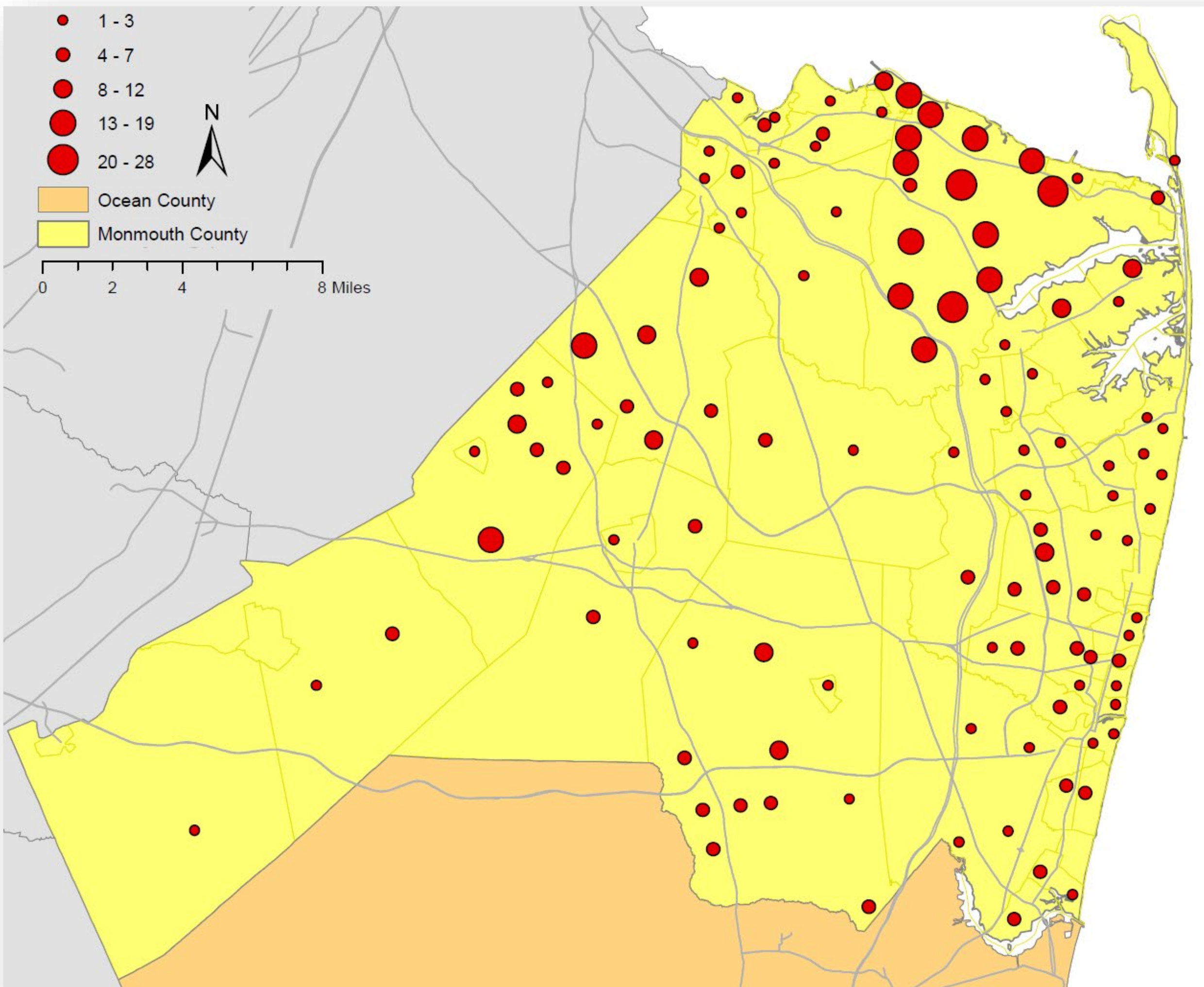


Table 3.3 RHTS Sample Size by Municipality

Monmouth MCD	Number of Samples	Monmouth MCD	Number of Samples
Aberdeen township	11	Long Branch city	8
Allenhurst borough	-	Manalapan township	47
Allentown borough	-	Manasquan borough	5
Asbury Park city	3	Marlboro township	58
Atlantic Highlands borough	2	Matawan borough	5
Avon-by-the-Sea borough	2	Middletown township	250
Belmar borough	2	Millstone township	5
Bradley Beach borough	1	Monmouth Beach borough	-
Brielle borough	7	Neptune City borough	2
Colts Neck township	8	Neptune township	27
Deal borough	-	Ocean township	35
Eatontown borough	6	Oceanport borough	-
Englishtown borough	2	Red Bank borough	1
Fair Haven borough	12	Roosevelt borough	-
Farmingdale borough	1	Rumson borough	11
Freehold borough	2	Sea Bright borough	-
Freehold township	10	Sea Girt borough	-
Hazlet township	13	Shrewsbury borough	2
Highlands borough	6	Shrewsbury township	1
Holmdel township	3	Spring Lake borough	6
Howell township	60	Spring Lake Heights borough	7
Interlaken borough	-	Tinton Falls borough	7
Keansburg borough	26	Union Beach borough	1
Keyport borough	10	Upper Freehold township	1
Lake Como borough	-	Wall township	7
Little Silver borough	-	West Long Branch borough	6
Loch Arbour village	-		
		Total	679

3.2 LONGITUDINAL EMPLOYER-HOUSEHOLD DYNAMICS DATA

The Longitudinal Employer-Household Dynamics (LEHD) data is published by the Center for Economic Studies at the US Census Bureau. The LEHD data provides information such as household and employer locations that can be used as a complimentary data source for calibrating trip distribution of the Home-Based Trip Purpose (HBW). The latest LEHD data available was collected in 2014. Additional discussion on the LEHD data will be provided in the Trip Distribution Calibration Section (Section 9.3).

3.3 TRAFFIC COUNT DATA

The traffic count data was obtained from various sources, including:

- Traffic count data provided by Monmouth County
- Traffic count data that was collected in the past three years from Ocean County
- Garden State Parkway and the New Jersey Turnpike traffic count data obtained from the New Jersey Turnpike Authority (NJTPA)
- Traffic count data downloaded from the NJDOT's website.

As part of this project, Stantec gathered traffic count data between 2013 and 2017. All the counts that were collected on the years other than 2015 were converted into 2015 counts, the model calibration year, using assumed growth rate derived from various permanent station locations within Monmouth County. Table 3.4 shows the assumed annual growth factor of 0.6% used for this purpose.

Table 3.4 Average Annual Growth Rates

COUNTY	SITE NAME	FACILITY TYPE/LOCATION	2015 TRAFFIC VOLUME	ANNUAL GROWTH RATE
Monmouth	6-1-002	Rural Principal Arterial - Other (Rt. 33 - Wall TWP)	39,722	1.7%
	6-1-010	Rural Principal Arterial - Other (Rt. 33 - Manalapan TWP)	27,649	-2.1%
	6-1-011	Urban Principal Arterial - Other (Rt. 18 - Marlboro TWP)	51,210	0.3%
	6-1-014	Urban Collector (Old Mill Road - Sring Lake Height Boro)	2,986	4.4%
	6-1-015	Rural Principal Arterial - Interstate (I-195 - Upper Freehold)	53,991	3.0%
	6-1-016	Urban Principal Arterial - Other Freeways (Rt. 138 - Wall TWP)	23,366	1.4%
	6-1-017	Urban Principal Arterial - Other (NJ 34 - Wall TWP)	31,098	1.4%
	6-1-018	Rural Minor Arterial (NJ 34 - Wall TWP)	34,978	-1.6%
	6-1-020	Urban Principal Arterial Other (NJ 36 - Sea Bright Boro)	11,485	-4.5%
	6-1-022	Urban Principal Arterial - Other (Freehold TWP)	53,267	-0.2%
	6-1-024	Rural Principal Other (NJ 18 - Colts Neck Twp)	40,274	1.1%
Average Growth Rate Per Year				**0.6%**

Considering that the County Model is calibrated to the average annual weekday traffic (AWDT), the count data that were based on the average annual daily traffic (AADT) shall be converted into AWDT. Stantec developed the AWDT factors using the same permanent count data used for estimating the annual growth rates above. Table 3.5 shows the AADT to AWDT conversion factor.

Table 3.5 AADT TO AWDT CONVERSION FACTOR

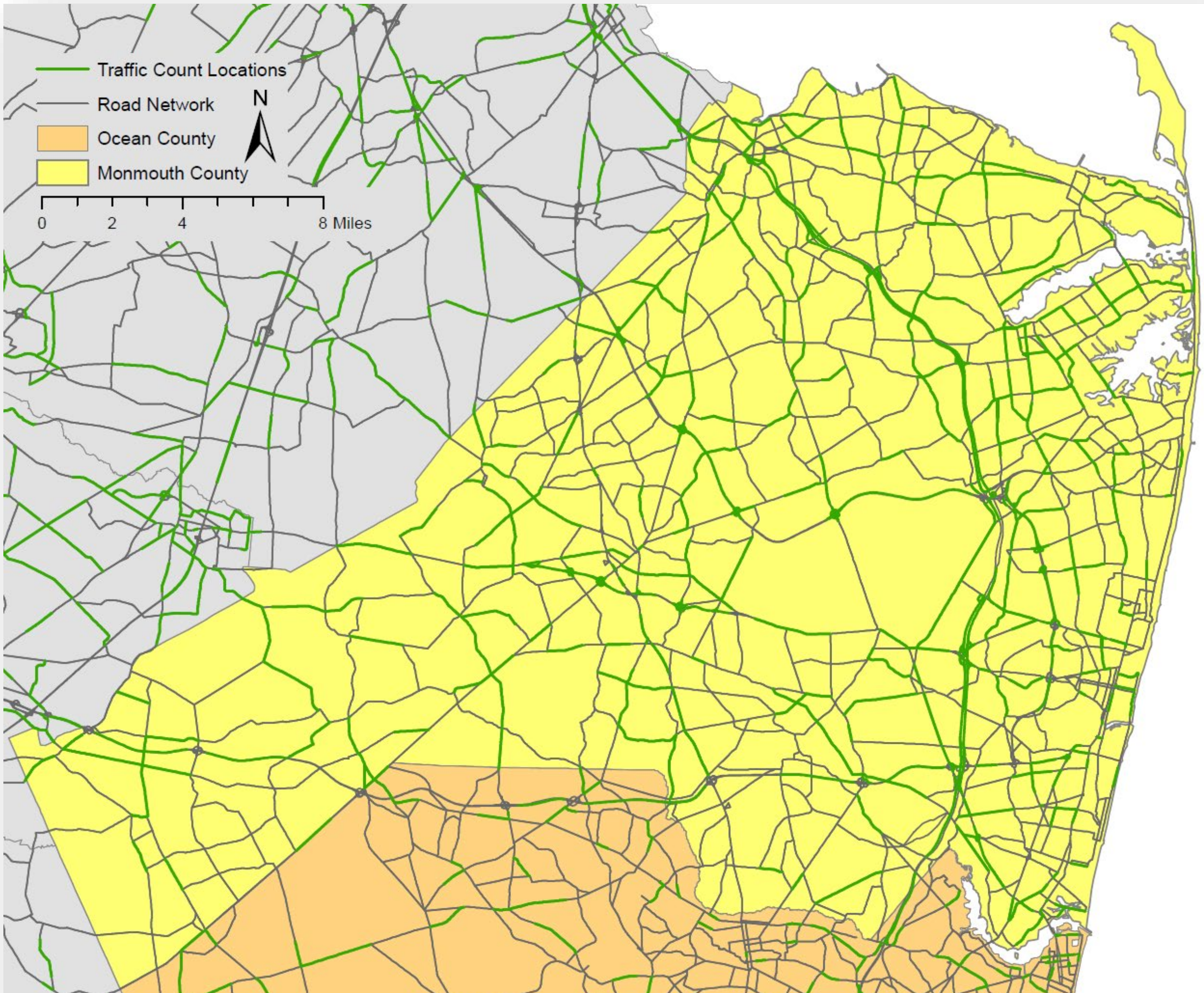
COUNTY	SITE NAME	FACILITY TYPE/LOCATION	AWDT	AADT	FACTOR
Monmouth	6-1-002	Rural Principal Arterial - Other (Rt. 33 - Wall TWP)	39,722	38,736	1.03
	6-1-010	Rural Principal Arterial - Other (Rt. 33 - Manalapan TWP)	27,649	26,445	1.05
	6-1-011	Urban Principal Arterial - Other (Rt. 18 - Marlboro TWP)	51,210	48,556	1.05
	6-1-014	Urban Collector (Old Mill Road - Sring Lake Height Boro)	2,986	2,935	1.02
	6-1-015	Rural Principal Arterial - Interstate (I-195 - Upper Freehold)	53,991	53,469	1.01
	6-1-016	Urban Principal Arterial - Other Freeways (Rt. 138 - Wall TWP)	23,366	23,224	1.01
	6-1-017	Urban Principal Arterial - Other (NJ 34 - Wall TWP)	31,098	28,540	1.09
	6-1-018	Rural Minor Arterial (NJ 34 - Wall TWP)	34,978	34,193	1.02
	6-1-020	Urban Principal Arterial Other (NJ 36 - Sea Bright Boro)	11,485	11,312	1.02
	6-1-022	Urban Principal Arterial - Other (Freehold TWP)	53,267	52,004	1.02
	6-1-024	Rural Principal Other (NJ 18 - Colts Neck Twp)	40,274	37,667	1.07
AADT TO AWDT CONVERSION FACTOR					1.04

For the purpose of the screenline calibration, additional traffic counts were collected at fourteen locations specified by Monmouth County, mostly at the locations along the screenlines, as shown in Table 3.6. All traffic count locations used in the model calibration are shown in Figure 3.2. Roadway links where traffic counts are available are printed in green in this Figure. Traffic counts from the adjacent counties, such as Burlington, Middlesex, and Ocean, in the vicinity of Monmouth County are also available and will be used for the calibration.

Table 3.6 Additional Traffic Count Locations

Location Number	Street Name	Description
1	NJ-35	Between Navesink River Rd and Cooper Rd
2	Broadway	Between Norwood Ave and 3rd Ave
3	Sea Girt Ave (E of Old Mill Rd)	Between Old Mill Rd and NJ-71
4	Five Points Rd	Between CR-537 and NJ-18
5	CR-12A	W of Browns Dock Rd
6	CR 15 Grassmere Ave	Between Westra St and Main St
7	Ely Harmony Rd	Between Siloam Rd and Nomoco Rd
8	Wilson Ave	Between Texas Rd and NJ-79
9	Kings Hwy E	Between Chapel Hill Rd and Locust Point Rd
10	Wickapecko Dr	Between Roseld Ave and NJ-66
11	Bangs Ave	Between Ridge Ave and NJ-71
12	N Bath Ave (SE of High St)	Between Norwood Ave and 3rd Ave
13	Westwood Ave (S of N Bath Ave)	Between N Bath Ave and Cedar Ave
14	Ely Harmony Rd	Between CR-537 and Siloam Rd

Figure 3.2 All Traffic Count Locations in Monmouth County



3.4 SPEED DATA

Speed data along various roadways within the Monmouth County region will be used as part of the highway assignment calibration. The data can be used for comparison with the model estimated speed. Depending on this comparison, the adjustments to the assumed speed and roadway capacity can be performed to bring the estimated speed closer to the observed speed. The observed speed data that will be used in the model calibration was obtained from INRIX data and provided by NJTPA. The observed speed data at various locations are shown in Table 3.7.

Table 3.7 Observed Speed Data from INRIX

Road Name	Location	Direction	Observed Average Speed (INRIX Data)			
			AM	MD	PM	NT
Garden State Parkway	Between US 9 and Burnt Tavern Rd	Northbound	68	68	68	66
		Southbound	69	68	66	67
US 9	Between RT 18 and Central Avenue	Northbound	40	35	33	42
		Southbound	40	35	33	41
I-195	Between NJ TPK and GSP	Westbound	67	67	66	66
		Eastbound	67	67	68	66
CR 33	Between NJ TPK and RT 18	Westbound	46	47	45	48
		Eastbound	47	47	45	48
RT 18	Between US 9 and CR 33	Northbound	66	63	65	63
		Southbound	64	64	65	63
CR 35	Between US 9 and County Line Rd.	Northbound	32	30	28	34
		Southbound	33	30	28	34
RT 79	Between RT 34 and RT 33	Northbound	32	33	31	35
		Southbound	34	34	31	37
RT 34	Between RT 79 and RT 35	Northbound	43	42	40	45
		Southbound	42	42	39	44
RT 537	Between I-195 and GSP	Westbound	38	36	33	40
		Eastbound	38	37	35	40

3.5 TRANSIT RIDERSHIP DATA

Transit trips in Monmouth County only account for 2.8% of overall trips generated in the county, as revealed by the Household Survey Data. Those trips are mostly served by NJ Transit buses and commuter trains, but also included travel modes such as ferries and private buses. NJ TRANSIT provided the 2015 bus and rail daily ridership data, while Monmouth County provided the ferry data. Unfortunately, ridership on the 800 series buses is not available. Table 3.8 lists the observed daily ridership data by transit mode.

Table 3.8 Observed Daily Ridership by Transit Mode

Line No.	Bus Ridership	Route
63	85	Lakewood- Jersey City - Weehauken
64	762	Lakewood – Jersey City - Weehawken
67	496	Toms River – Newark – Jersey City
130	763	Lakewood – New York Express (Outbound)
131	555	Sayreville – New York
132	329	Lakewood - Gordon's Corner – New York
133	617	Old Bridge – Aberdeen – New York
135	359	Freehold – Matawan – New York
136	157	Lakewood - Freehold Mall - New York Express
137	1,017	Toms River - New York
139	6,127	Lakewood – New York
317	437	Asbury Park – Fort Dix – Philadelphia
319	345	Atlantic City – New York
Total	**12,049**	

Train Station	Rail Ridership
Aberdeen-Matawan	2,460
Hazlet	874
Middletown	1,331
Red Bank	1,155
Little Silver	740
Long Branch	1,105
Elberon	117
Allenhurst	125
Asbury Park	548
Bradley Beach	225
Belmar	256
Spring Lake	152
Manasquan	175
Total	**9,263**

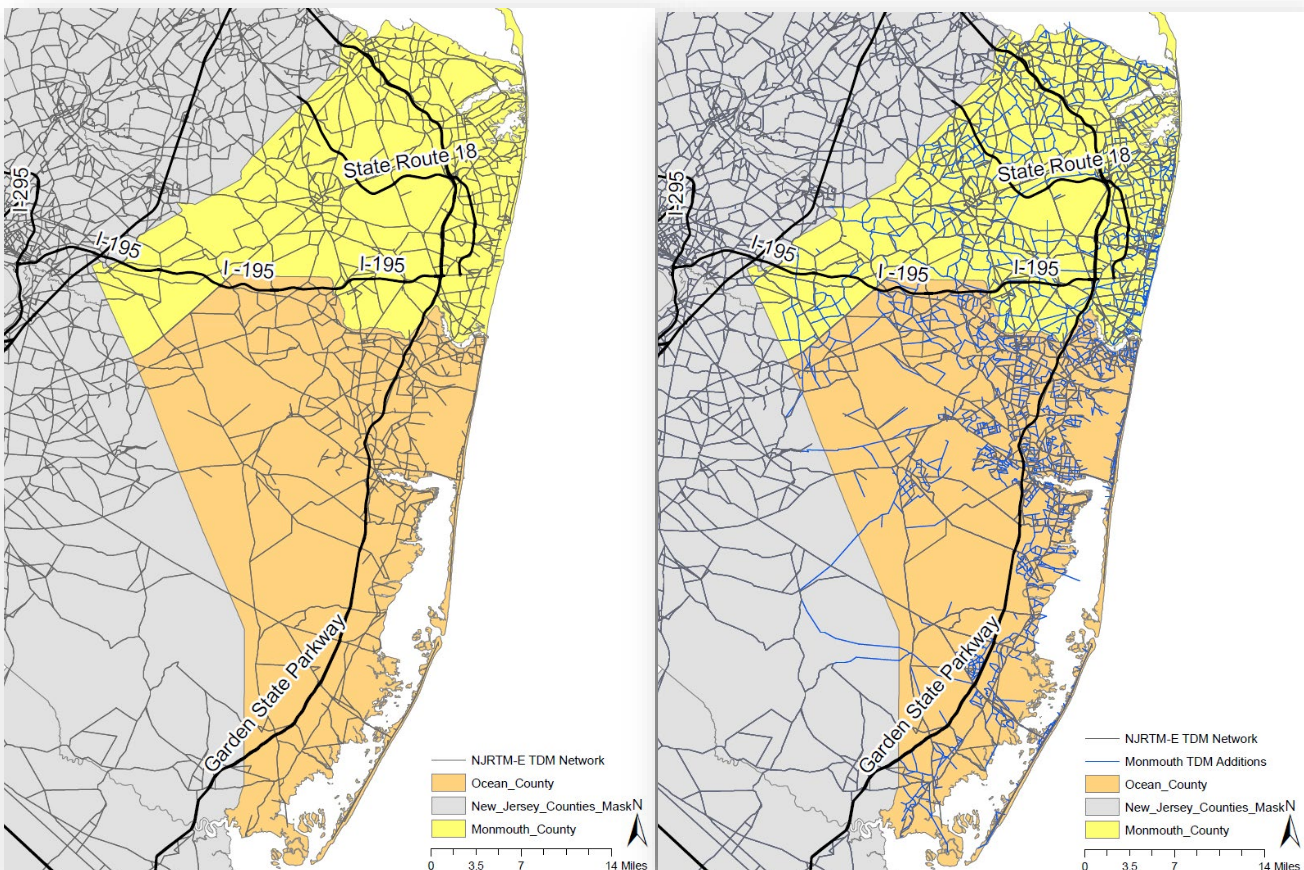
Terminal	Ferry Ridership
Belford	1,916
Atlantic Highlands	1,863
Highlands	1,417
Total	**5,195**

4.0 HIGHWAY NETWORK DEVELOPMENT

4.1 INTRODUCTION

The MCTDM highway network was developed based on the NJRTM-E highway network with additional roadway refinement within Monmouth and Ocean counties. Many local roadways were added to the highway network to provide more detail representation of the roadways in these two counties. Figure 4.1 shows the highway network refinements made within Monmouth and Ocean Counties compared to the NJRTM-E highway network.

Figure 4.1 MCTDM Highway Network Refinements



This section provides a detailed description of the highway network development task for the MCTDM project. The MCTDM highway network includes most of the major arterials and collector roads in the county to help represent travel in the region. The highway network includes variables such as travel time and toll costs that will be used as the basis for estimating composite impedance variables, which in turn will be used by the trip distribution model. The composite impedance variable will be discussed further in Chapter 8.

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. The highway network also includes zone centroids which serve as terminal points for trips in the modeling process. These zones centroids also represent proxy locations for the socioeconomic data (population and employment) contained within the TAZs that generate trips in the MCTDM. The centroids are attached to the highway network via hypothetical links called centroid connectors.

Each highway link contains 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 A.

4.2 PHYSICAL/OPERATIONAL VARIABLES

These variables describe the physical and operational attributes of the highway network which help determine the capacity and speed of the links. The techniques used to estimate speed and capacity are based on the 2000 Highway Capacity Manual (HCM) procedures, published by the Transportation Research Board (TRB), and 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 including:

- Facility type
- Area Type
- Link Type
- Number of Lanes by Time Period
- Traffic Control Devices Variables
- Toll Variables

Facility type and area type variables are used for defining speed and capacity for the links. Additional discussion on the link speed and capacity is presented in Section 4.2.8.

4.2.1 Facility Type

The MCTDM recognizes twelve different facility types that are stored in the "FT" variable. The twelve facility categories are as follows:

- Freeways (FT=1) – limited access roadway facilities, including toll facilities, with grade-separated interchanges and no traffic signals on the main lanes. Example: Garden State Parkway, I-195.
- Expressway (FT=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. Example: US-9 in Freehold Township.
- Principal Arterial Divided (FT=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. Example: NJ-33 in Freehold Township.
- Principal Arterial Undivided (FT=4) – same as principal arterial divided except that there are no raised center medians and, generally, no bays for left turns. Example: NJ-36 in Monmouth Beach.
- Major Arterial Divided (FT=5) – arterials with moderate speed limits (e.g. 30-45 mph), raised center median with turning bays at intersections, some parking restrictions, mainly serving through traffic although some local property access is permitted. No coded examples in Monmouth County.
- Major Arterial Undivided (FT=6) – same as major arterials divided except that there are no raised center medians and, generally, no bays for left turns. Example: CR-520 in Lincroft.
- Minor Arterial (FT=7) – arterials with moderately low speed (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. Example: CR3 – Tennent Road in Manalapan.
- Collectors/Locals (FT=8) – roadways with moderately low speed limit (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. Example: CR4 – Crine Road in Colts Neck.
- High-Speed Ramps (FT=9) – ramps that generally connect freeway-to-freeway facilities, or also known as direct connector, have some relatively high speed limits, e.g. 50-60 mph.
- Medium-Speed Ramps (FT=10) – ramps that have moderately high turning radius and typically with speed limit approximately 40 mph.
- Low-Speed Ramps (FT=11) – ramps with low turning radius and low speed limit, e.g. 25 mph, includes jughandles.

- Centroid Connectors (FT=12) – "dummy" roadway link with unlimited capacity that serve solely to connect TAZs to roadway network. These are only used by the model and do not reflect real world facilities.

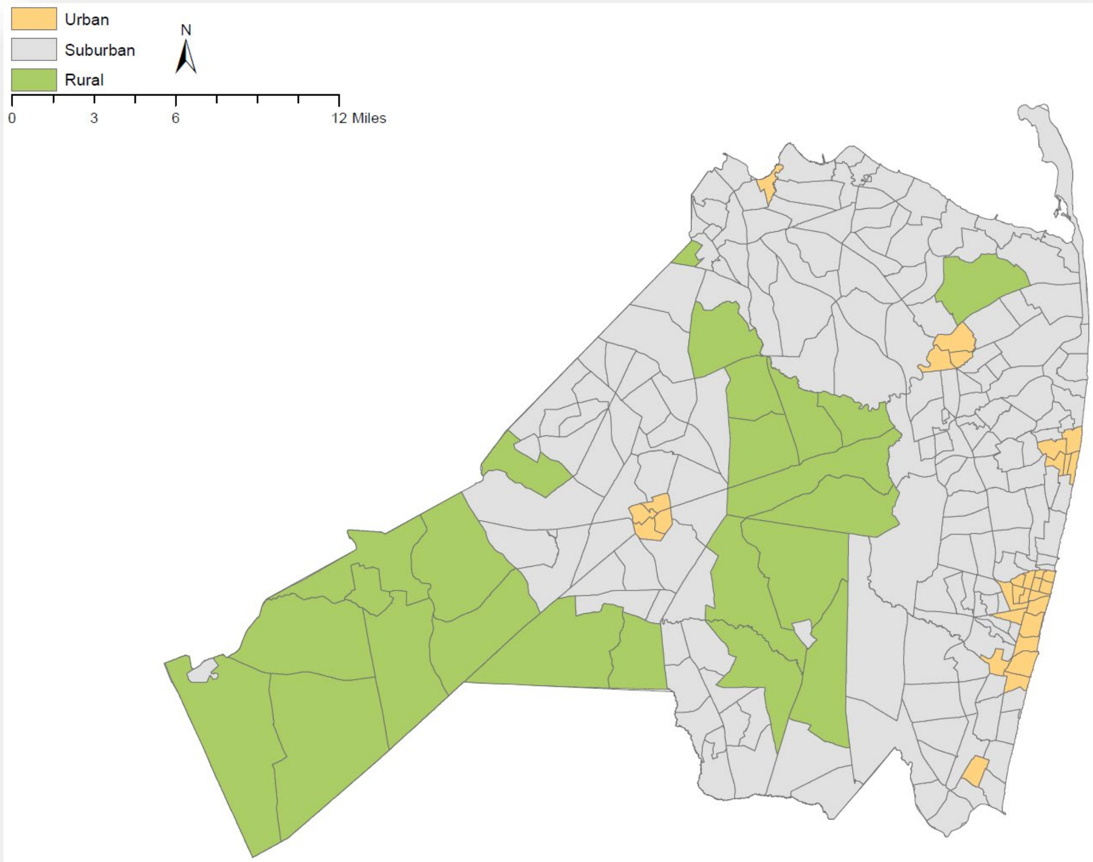
4.2.2 Area Type

Four separate area types were identified for the purpose of estimating highway capacity and speeds. These types are stored in the "AT" variable. The four area types are as follows:

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

The area type designation in Monmouth County is shown in Figure 4.2.

Figure 4.2 Area Type Designation in Monmouth County



4.2.3 Link Type

This variable is used in the model as a permission code when assigning vehicles to access highway links based on a vehicle's mode type (e.g., excluding trucks on auto only roads) and toll facility type (e.g., differentiating single and high occupancy vehicles for tolls). This variable is used in highway path building and highway assignment procedures. There are sixteen (16) link types defined in the MCTDM 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).
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 link.
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 must pay. HOV mode is free.

Note that the MCTDM 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. For example, 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)*.

4.2.4 Number of Lanes

The model 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. Currently, there is no reversible lane in Monmouth County. 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.

4.2.5 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 MCTDM provides 13 TCD categories, defined as follows:

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

As mentioned previously, the techniques to estimate speed and capacity utilize this variable as part of the 2000 HCM procedures. In addition to 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

The detailed data for the TCD and its complimentary variables can be updated in the future as more comprehensive databases become available. Note that due to the implementation of a separate intersection model for Monmouth and Ocean Counties (see Section 4.2.6), and to prevent the double-counting of TCD modeling, the TCD variable for Monmouth County and Ocean County has been defined as TCD=12 (no controls). The impact of the TCD in these two counties are controlled by the junction model.

4.2.6 Intersection Model

To improve the modeling of intersections, Citilabs, the developer of the Cube Software, introduced a module called Intersection Model. This module allows analysts to provide more detailed information for intersections in the model, such as type of intersection, traffic signal phasing, etc. The Intersection Model will convert all the intersections characteristics into turning penalties during the highway skim and highway assignment process. The turning penalty represents additional intersection delays caused by traffic control devices installed in an intersection. These delays will be added to link travel time during a highway path building and highway assignment process in selecting a shortest route between an origin point and a destination point.

While this module provides the ability to input detailed intersection information, since the MCTDM is still a macroscopic model, it is not a replacement for a microsimulation model for more detail corridor analysis. The Intersection Model recognizes several types of intersections, including:

- Signal-controlled intersections
- Two-way stop
- All-way stop
- Roundabout
- Priority junction (Yield)

Due to the limited availability of intersection data, Stantec developed default assumptions for each intersection type. These assumptions are included in Appendix B. The intersection data can always be updated in the future when the data is available. The Intersection Model is not used in the NJRTM-E, however, it is included in the Ocean County Transportation Model.

4.2.7 Toll Variables

The MCTDM requires several toll variables for different toll applications. The toll variables are listed below:

- TOLL – the toll cost values in dollars.
- MCTOLL – a variable indicating whether the toll is two-way (driver encounters it in both directions) or is charged only one-way on the facility (e.g., most bridges and tunnels to NYC are one-way tolls). This variable is used by the 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 possible values.
    - TOLLAPC=0: This is the default value. The toll is applied to all modes (SOV, HOV, and truck).
    - TOLLAPC=1: The toll is applied to all modes, except HOV.

- TOLLAPC=2: The 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. A detailed discussion about the toll look-up table will be given following this list.
    - TOLLCLASS=0: This is the default value. This is applied to all links without any toll values.
    - TOLLCLASS between 1 and 98: The toll cost will be obtained from a look-up table.
    - TOLLCLASS=99: The toll value is coded directly on the link.
- 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 periods. 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.

MCTOLL variable is used to identify facilities with one-way tolling schemes and is used by both the mode choice and highway assignment processes. For mode choice, trips are processed in a production-attraction format and the choice of mode is based on cost and time considerations of each mode encountered on the trip from the production TAZ to the attraction TAZ. For estimating the highway trip cost, the model needs to assume that the toll is encountered at some time during the day (whether it's the initial or the return trip. Therefore, this variable is used to split the round-trip cost of the one-way toll using 50% of the total one-directional toll for each direction of the facility However, for the purposes of traffic assignment, the full cost of the toll is posted in the direction that the toll is assessed. This allows for the potential of vehicles diverting their trip (free vs. toll) if such options are present. An example of this directional tolling schemes employed in Monmouth County and its vicinity is present on the Garden State Parkway. In this situation, travelers are able to move in one direction either toll free or paying fewer tolls than they would be on the opposition direction trip. Certain travelers can use the Garden State Parkway in the reduced toll direction, and return via other toll-free roadways.

The possible values for MCTOLL are as follows:

- MCTOLL=0: no toll on the link (the default value).
- MCTOLL=1 for links with the same toll value in both directions
- MCTOLL=+0.5 and -0.5 for links with a 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 4.3 shows an example of one-way toll collection location on Garden State Parkway at Asbury Park Toll Plaza, while Figure 4.4 shows an example of two-way toll location at Toms River Toll Plaza in Ocean County. These figures indicate what values should be input to TOLL and MCTOLL variables when representing either one-way or two-way toll collection plans.

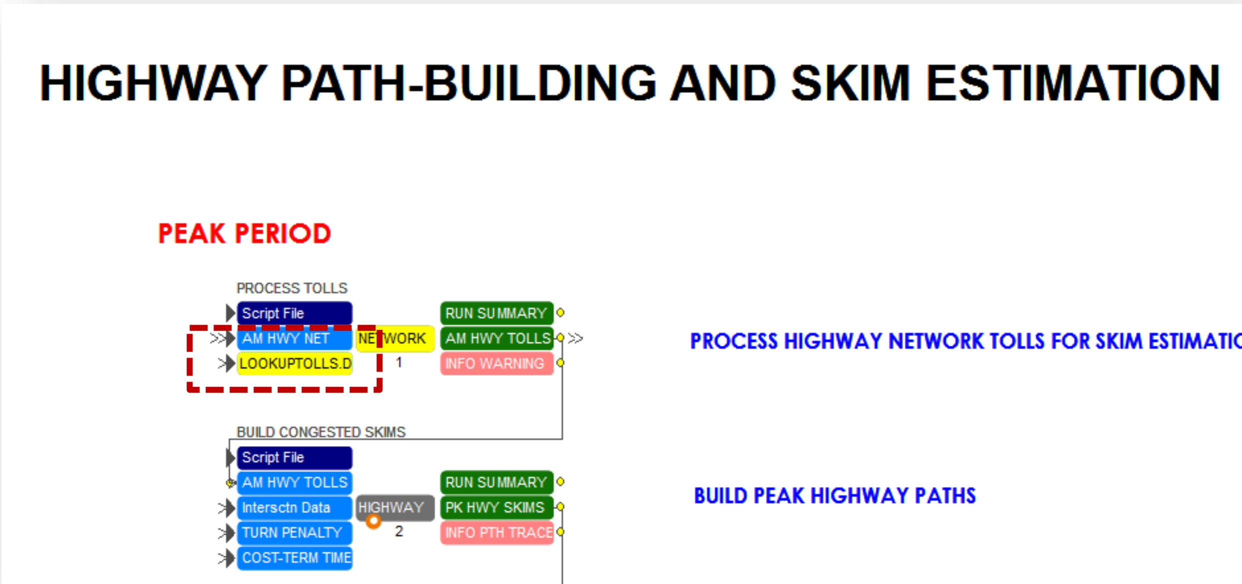
Figure 4.3 MCTOLL for One-Way Toll Collection

Figure 4.4 MCTOLL for Two-Way Toll Collection

In contrast to the one-way toll collection plan at Asbury Park Plaza, the MCTOLL variable is coded differently to represent the two-way toll collection situation at Toms River, New Jersey. As shown in Figure 4.3, the MCTOLL variable is coded as "1" in each 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 identify the tolling locations for display purposes in CUBE and GIS by showing only those links where MCTOLL is greater than zero. This will display the actual toll in the direction that it is assessed.

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 a 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 4.5. Note that most, or if not all, of the toll rates in this model are posted directly on the links.

Figure 4.5 Toll Class Look-Up Table



The MCTDM model reserves 98 keys (TOLLCLASS=1-98) to be used for different toll rates. Currently, only 12 keys have been populated, although not used. The remaining keys are reserved for future use. Note that TOLLCLASS code 99 is used to indicate that the lookup table is not applied and that the toll posted on the link is the actual value.

4.2.8 Speed and Capacity Estimation

Speeds and capacity variables for the MCTDM were developed by using relationships between facility type and area type. The values adopted for this effort were obtained from several sources, including the speeds provided by the 2000 HCM procedures, and were adjusted using professional judgment during the course of the model development. The recommended "ideal" uncongested speeds (off-peak speed), which are used as input to the highway path building process, are presented in Table 4.1. 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 to first iteration of the highway path building process were assumed to be approximately 20% lower than the uncongested speed.

Table 4.1 Uncongested Speed by Facility Type and Area Type

Facility Type	Area Type			
	CBD	Urban	Suburban	Rural
Freeways	60	60	70	70
Expressways	50	52	53	55
Principal Arterials Divided	42	50	51	52
Principal Arterials Undivided	40	40	45	48
Major Arterials Divided	35	39	44	45
Major Arterials Undivided	32	36	40	41
Minor Arterials	25	29	32	33
Collectors/Locals	20	25	26	26
High-speed Ramps	50	52	53	55
Medium-speed Ramps	30	30	30	30
Low-speed Ramps	25	25	25	25
Centroid Connectors	10	10	10	10

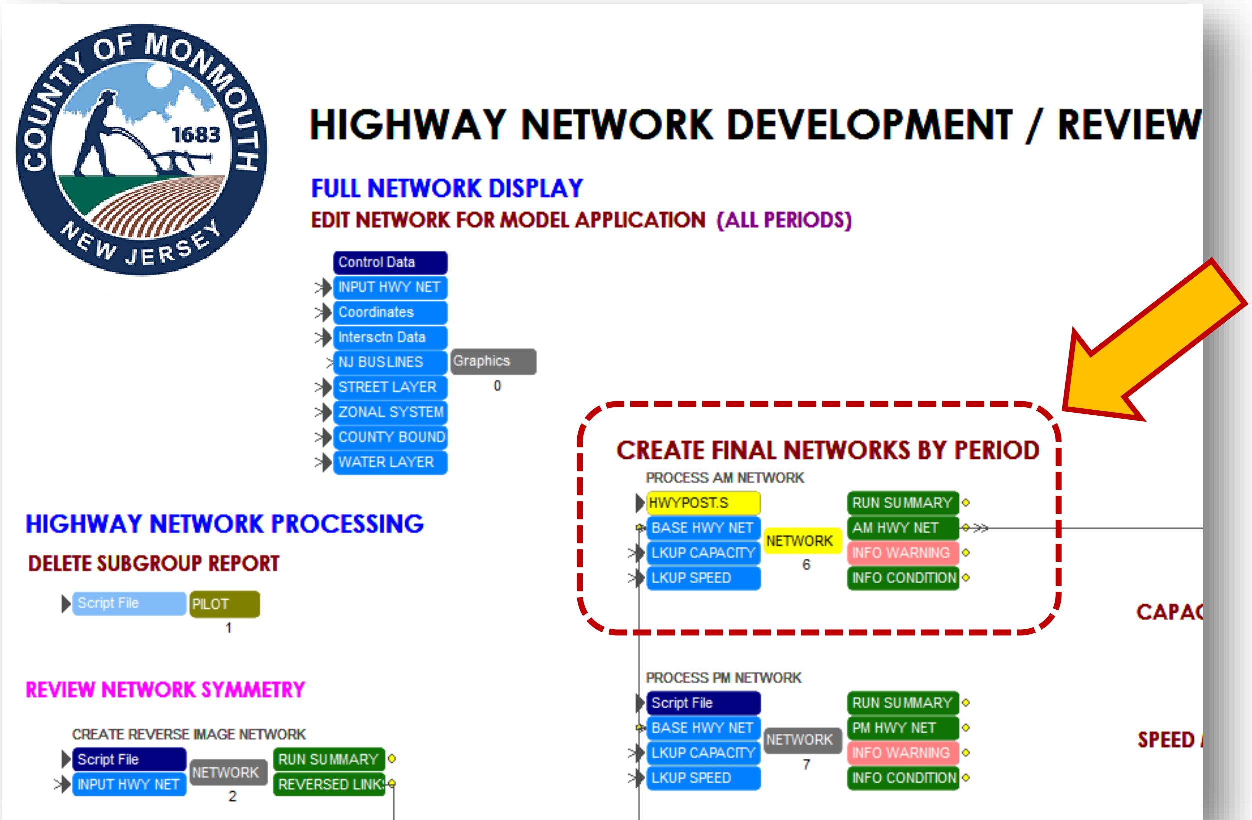
The "ideal" capacities were also assumed to be a function of facility type and area type. These initial hourly capacities per lane are listed in Table 4.2. The initial capacity values for each link were adjusted to account for geometric constraints or other impedances along the link, such as parking availability, traffic control devices, green time/cycle ratio, signal cycle length, etc.

Table 4.2 Initial Hourly Capacity per Lane

Facility Type	Area Type			
	CBD	Urban	Suburban	Rural
Freeways	1600	1650	1700	1750
Expressways	1500	1525	1575	1625
Principal Arterials Divided	1450	1525	1550	1600
Principal Arterials Undivided	1400	1425	1500	1550
Major Arterials Divided	1350	1375	1475	1500
Major Arterials Undivided	1000	1025	1100	1150
Minor Arterials	800	825	900	950
Collectors/Locals	700	725	750	775
High-speed Ramps	1750	1750	1750	1750
Medium-speed Ramps	900	900	900	900
Low-speed Ramps	700	700	700	700
Centroid Connectors	9000	9000	9000	9000

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 4.6.

Figure 4.6 Highway Network Development Module



4.3 IDENTIFICATION AND PERFORMANCE VARIABLES

The identification variables contain information for identification and labeling purposes only, and are used as part of the network display. The variables include roadway name, Standard Route Identification (SRI), Milepost, county where the links are located, conformity-based project ID number, and the TAZ where the links reside.

The performance variables contain information related to traffic counts. These variables are used primarily for reference purposes when comparing traffic forecasts to base year conditions. Provisions were made to permit two traffic count data sets, an average daily count data set and a summer count data set wherever available, each with a separate reference year. The summer count data set will be used for the seasonal model development.

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5.0 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 that 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 of 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 is performed only during the first iteration of the model, while the peak period skims are accumulated during each iteration of the model. Table 5.1 lists the skim variables for each time period.

The access and egress terminal times are defined at the area type of zone while 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 are stored in the ZONECOSTTIME.DBF file.

Table 5.1 Highway Path-Building Impedance Variables

Time Period	Table No	Impedance Variables
Peak	1	congested time - SOV
	2	congested tolls (dollars) - SOV
	3	congested distance (miles) - SOV
	4	congested tolls (cents) - SOV
	5	congested time - HOV
	6	congested tolls (dollars) - HOV
	7	congested distance (miles) - 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 toll (dollar) - SOV
	3	uncongested distance - SOV
	4	uncongested toll (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

5.3 MODE SPECIFIC PATH BUILDING

In the path-building process, the model 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-E.
- 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 new mode choice model, developed using a customized C program, will be utilized in this model. This mode choice model will also be implemented in the NJRTM-E to replace the older, FORTRAN-Based Mode Choice program. Table 5.2 lists the skim variables by time period for Mode Choice Model.

Table 5.2 Skim File Structure for Mode Choice

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

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6.0 TRANSIT NETWORK DEVELOPMENT

6.1 INTRODUCTION

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. The transit path-building and assignment is performed using the Public Transport (PT) routine. This routine is the same as the new transit module that was recently adopted by the NJRTM-E, and is currently used in its model recalibration.

6.2 TRANSIT NETWORK COMPONENTS

6.2.1 Transit Network Modes

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-way 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 MCTDM transit network are listed in Table 6.1. As shown in the table, the first 10 modes represent the actual transit services provided in the region. 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 MCTDM. 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 15 is used to provide a common catchment link between the Park and Ride (PNR) lot and the station and serves a single reference link to summarize all drive access trips using the station. The definition of catchment link is discussed in Section 6.2.4. Walk access to transit service is provided via Mode 14 links and includes a catchment link at major transit station. A schematic representation of this coding process is provided in Figure 6.1.

Table 6.1 Transit Network Modes

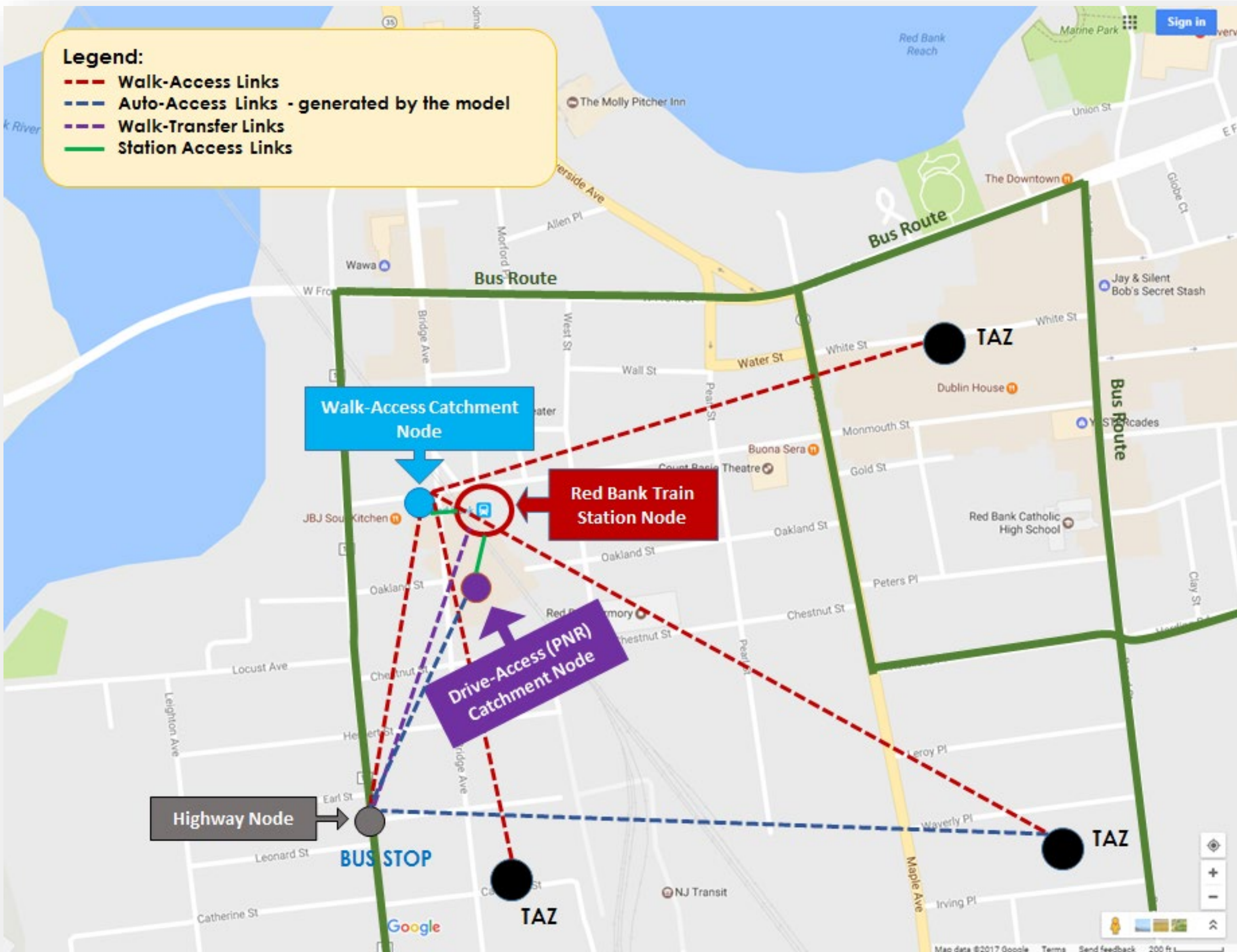
Mode Number	Mode Designation	Type of Service
1	Transit	Commuter Rail
2	Transit	PATH
3	Transit	NYC Subway
4	Transit	Newark Subway
5	Transit	Bus-Local
6	Transit	Bus-PABT
7	Transit	Bus PNR Bus
8	Transit	Ferry
9	Transit	Light-Rail Transit (LRT)
10	Transit	Long-Haul Ferry
11	Non-Transit	Auto Access to Zone to Gathering Node (PNR Lot)
12	Non-Transit	Walk Transfer
13	Non-Transit	Not-used
14	Non-Transit	Walk Access - Zone to Station
15	Non-Transit	Auto Gathering Access - Gathering Node (PNR Lot) to Station

Note:

Ferry = Ferry lines between Northern New Jersey and Manhattan, such as between Hoboken and Manhattan.

Long-Haul Ferry = Ferry lines between Monmouth County and Manhattan.

Figure 6.1 Sample Access Coding



6.2.2 Transit Network Elements

The transit network consists of several elements that are maintained as separate files which are used as input to the Public Transit (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.

6.2.3 Transit Route Coding

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 MCTDM. 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.

6.2.4 Transit Access Coding

The transit access coding in the MCTDM was designed as a two-tier process. One tier represents auto access to the transit network. Each zone is assumed to have auto-access to a predefined set of Park and Ride (PNR) lots. These access links are built using the existing highway links. In addition, each PNR lots has a defined set of zones dedicated to accessing it by using the PNR Catchment Zones module. The module can be revised as necessary. The auto access mode was coded as mode 11 as discussed previously and listed in Table 6.1.

The auto-access links only connect zones to the node representing the PNR lots. A separate connector called a "catchment" link connects the PNR lot to the rail station or express bus stop. These links were coded as mode 15 and each station has the specific catchment link included in the PNR coding statement.

The second tier of transit access coding represents walk access. The model automatically generates transit access links from each zone to available transit stops. The number of access links to each transit mode is controlled by the Public Transit path-building process. The automated walk access links are created using the underlying highway network and using an assumed speed of three (3) mph walk speed. The model assumes a maximum walking distance of 1 mile through the network grid 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 percentage of each zone within walk distance be calculated. This task was performed as part of the Transit Walk Access Coverage Application discussed in sections 4.6 and 5.1 of the User Guide. The procedure estimated the area percentage of each zone that is within ½ mile from transit service.

6.2.5 Transit Use Codes

Stantec has developed a new coding process to represent "special use" transit facilities 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 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 for the a.m. peak period and the off-peak period.

- TCODExx, where xx is the period designation AM or OP: This code describes the type of special use transit facility. See Table 6.2 for a list of the codes.
- TSCALExx: This code is a time multiplier that enables the analyst to scale the transit time against the free flow or congested time highway time.
- TADDxx: This code is a time surcharge, either positive or negative, for transit vehicles on the link.

The index variable TCODE is described in Table 6.2. The transit assignment is only performed for peak (a.m. peak) and off-peak periods because the assigned transit trips are still in a Production-Attraction (P-A) format, where the direction of travel has not been defined.

Table 6.2 TCODE Variable Description

TCODE	Description	Comments
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 still reference 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 as follows:

- 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 that 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.

6.2.6 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 results 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 the link distance factored by speed adjustment constant (see formula below):

*Transit Time = Highway Time + distance * 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. Tables 6.3 and 6.4 list the factors for peak and off-peak periods, respectively.

Table 6.3 Speed Adjustments Factors for Peak Period

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

Table 6.4 Speed Adjustments Factors for Off-Peak Period

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

6.2.7 Transit Fare

The fare estimation procedure from the NJRTM-E was adopted for use by the MCTDM 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 6.5 lists the fare systems used in the MCTDM.

Table 6.5 Fare Types

Mode	Fare Type
Commuter Rail	Zonal Fare
Local Bus	Distance-based fare system
Light Rail Transit	Fixed fare system
NYC Subway	Fixed fare system
Newark Subway	Zonal Fare
Ferry	Zonal Fare
Express Bus	Distance-based fare system
PATH	Fixed fare system
PNR Lots	Station specific fares

7.0 TRANSIT PATH-BUILDING

7.1 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. The path-building procedures also estimate transit fares for each mode as part of a separate fare estimation program called "NJFARE2". These impedance values are accumulated in matrix files based on the mode choice transit options in the model. 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.

7.2 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 MCTDM adopted the hierarchical system developed for the NJRTM-E and 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.

7.3 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 MCTDM 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 7.1.

Table 7.1 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	655

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 created only in the first model iteration. The peak period transit skim files were created 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 7.2 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 7.2 Path Building Mode Weights

Path (Favored Mode)	Rail	Long Ferry	PATH	NYC Sub	NWK Sub	Local Bus	Expr Bus	PNR Bus	Ferry	LRT	Non-Transit
Peak Walk-to-Rail	1.0	1.2	1.5	2.0	1.0	2.5	6.0	6.0	1.2	1.2	2.0
Peak Walk-to PATH	4.0	4.0	1.0	2.0	1.0	1.5	4.0	4.0	4.0	4.0	1.5
Peak Walk-to-Bus	4.0	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	1.5
Peak Walk-to-Ferry	4.0	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.5
Peak Walk-to-LRT	4.0	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	1.5
Peak Walk-to-Long Dist. Ferry	1.2	1.0	4.0	1.5	1.0	2.0	4.0	4.0	1.2	1.2	2.0
Peak Drive-to-Rail	1.0	1.0	1.0	2.0	1.0	3.0	6.0	6.0	1.2	1.2	2.0
Peak Drive-to-PATH	4.0	4.0	1.0	2.0	1.0	2.0	4.0	4.0	4.0	4.0	1.5
Peak Drive-to-Bus	4.0	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	1.5
Peak Drive-to Ferry	4.0	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.5
Peak Drive-to-LRT	4.0	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	1.5
Peak Drive-to Long Dist. Ferry	1.2	1.0	4.0	1.5	1.0	2.0	4.0	4.0	1.2	1.2	2.0
Off-peak Walk-to-Rail	1.0	1.2	1.5	2.0	1.0	2.5	6.0	6.0	1.2	1.2	2.0
Off-peak Walk-to PATH	4.0	4.0	1.0	2.0	1.0	1.5	4.0	4.0	4.0	4.0	1.5
Off-peak Walk-to-Bus	4.0	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	1.5
Off-peak Walk-to-Ferry	4.0	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.5
Off-peak Walk-to-LRT	4.0	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	1.5
Off-peak Walk-to-Long Dist. Ferry	1.2	1.0	4.0	1.5	1.0	2.0	4.0	4.0	1.2	1.2	2.0
Off-peak Drive-to-Rail	1.0	1.0	1.0	2.0	1.0	3.0	6.0	6.0	1.2	1.2	2.0
Off-peak Drive-to-PATH	4.0	4.0	1.0	2.0	1.0	2.0	4.0	4.0	4.0	4.0	1.5
Off-peak Drive-to-Bus	4.0	4.0	4.0	1.5	1.0	1.0	1.2	1.2	2.0	4.0	1.5
Off-peak Drive-to Ferry	4.0	4.0	4.0	1.5	1.0	2.0	4.0	4.0	1.0	1.2	1.5
Off-peak Drive-to-LRT	4.0	4.0	1.2	1.5	1.0	2.0	4.0	4.0	1.5	1.0	1.5
Off-peak Drive-to Long Dist. Ferry	1.2	1.0	4.0	1.5	1.0	2.0	4.0	4.0	1.2	1.2	2.0

Skim matrices were prepared based on the mode choice requirements. Twelve skim files were created consistent with the path building processes performed, as mentioned at the beginning of section 7.3. Extensive information was stored in each skim file for use in the mode choice process. Table 7.3 shows the list of tables stored in a typical skim file.

Table 7.3 Skim File Table Format

Tables No	Description	Tables No	Description
1	In-Vehicle Time - IVTT	20	PNR Bus last station
2	Total wait time	21	Ferry first station
3	Walk time	22	Ferry last station
4	Rail time	23	Initial wait time
5	PATH time	24	Drive distance
6	NYC Subway & Staten Island Rapid Transit time	25	PNR location
7	Newark City Subway time	26	Total transit distance
8	Total Bus time (modes 5,6,7)	27	Local bus time
9	Ferry time & Port Authority Bus Lines time	28	PABT Bus first station
10	LRT time	29	PABT Bus last station
11	Drive time	30	PATH first station
12	Walk-access time	31	PATH last station
13	Number of transfer	32	Newark Subway first station
14	Local Bus distance	33	Newark Subway last station
15	PABT Bus distance	34	LRT first station
16	LRT distance	35	LRT last station
17	Commuter Rail first station	36	Long-Haul Ferry time
18	Commuter Rail last station	37	Long-Haul Ferry first station
19	PNR Bus first station	38	Long-Haul Ferry last station

7.4 TRANSIT FARE ESTIMATION

Within the path-building step, transit fares are calculated for each access model/line-haul mode combination. The fare estimation process is generated via a complex fare system used by NJ Transit as described extensively in the "Transit Network Development" section of this document. It is implemented with a customized C+ program which is invoked directly by CUBE. It provides several systems to assess fares along with surcharges for specific situations. 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.

8.0 COMPOSITE IMPEDANCE ESTIMATION

8.1 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 including using 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, discussed further in Chapter 9.4, includes not only cost and time elements, but also the mode bias constants which account for non-measurable traveler preferences, such as safety and comfort. Initially Stantec investigated the use of the logsum term from NJ Transit Mode Choice Model. 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 the NJRTM-E.

An alternative impedance term was adopted for the NJRTM-E 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:

$$IC = 1.0 / (1.0/IH + MST/IT)$$

Where:

IC = Composite impedance for zonal pair i-j
IH = Highway impedance for zonal pair i-j for the "representative" auto mode
MST = County-wide transit mode share
IT = 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 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 MCTDM, 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 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 county-wide transit share as opposed to the specific transit mode share of a given origin-destination zonal pair. The MCTDM used the mode shares for each I-J zonal pair to more properly reflect within the composite term the degree of competitiveness provided by the transit service for individual zonal pairs.

8.2 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 transit modes as well as the cost and time components that are included for mode choice. While the single occupancy vehicle (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. Stantec defined the best transit mode being used 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:

IH =TimeSOV + TollsSOV /100.0 * 60.0/14.4

Transit Mode

IT =TimeTIVT + TimeTOVT*2.5 + CostTRAN /100.0 * 60.0/14.4

where:

IH	= Highway impedance for zonal pair i-j for the auto mode
IT	= Transit impedance
TimeSOV	= Time for the SOV mode in minutes
TollsSOV	= Toll costs for the SOV mode in cents
TimeTIVT	= In-vehicle time (in-vehicle and drive access) for best transit mode in minutes
TimeTOVT	= Out-of-vehicle time (walk and wait) for best transit mode in minutes
CostTRAN	= 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.

8.3 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, Stantec utlized specific i-j zonal pair transit mode shares, rather than the county-wide 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 a weighing mechanism (the MST variable). 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 percentage 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 county-wide 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. Stantec elected to use separate weights with the specific transit share for each zonal pair. This necessitated creating 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 (Transit Shares Seeding Process) 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.

9.0 MODEL CALIBRATION

9.1 INTRODUCTION

Model calibration was performed for each model component from Trip Generation to Highway Assignment. Since the MCTDM was derived from the NJRTM-E with special focus on the Monmouth County Region. Stantec updated any model parameters for which data was available, and retained the original NJRTM-E parameters and formulas if it was not. The adjusted parameters are discussed in the following sections. Additional adjustment factors specific to Monmouth County were added as necessary.

As previously mentioned Chapter 3.1, the 2010-2011 NJTPA-NYMTC RHTS data was used to calibrate the trip generation model, trip distribution model, and mode choice components, supplemented by other sources such as LEHD data as necessary.

The MCTDM consists of four time-of-day periods, although most of the calibration summaries are presented in daily estimates. The four time-of-day periods are:

- Morning Peak Period between 6 AM and 9 AM
- Midday Period between 9 AM and 3 PM
- Afternoon Peak Period between 3 PM and 6 PM
- Night Period between 6 PM and 6 AM

9.2 TRIP GENERATION

The MCTDM trip generation component was developed using standard technique commonly found within the four-step urban travel demand models. These techniques include a cross classification process for trip productions and linear regression equations for trip attractions, and mostly obtained from the NJRTM-E Model. The trip generation parameters were updated if new data were available. The updated parameters include the household distribution by lifecycle, household distribution by size, work attraction by income, household distribution by income, and income group category. Table 9.1 shows the income group definition used in this model.

Table 9.1 Income Group Definition

Income Group	New Income Range (2015$)		
1	-	-	15,000
2	15,000	-	50,000
3	50,000	-	100,000
4	100,000	-	200,000
5	>200000		

During the trip generation calibration process, additional adjustment factors specific for the Monmouth County Model were introduced in order to replicate the trip production and attraction obtained from the 2010-2011 RTHS data. The adjustment factors were applied to the final trip productions and attractions prior to being distributed in the Trip Distribution Module.

Consistent with the NJRTM-E, there are six trip purposes in the MCTDM:

- Home-Based Work Direct (HBWD)
- Home-Based Work Strategic (HBWS)
- Home-Based Shop (HBS)
- Home-Based Other (HBO)
- Non-home Based Work (NHBW)
- Non-Home Based Other (NHBO)

The comparison of total trip production and attraction by purpose is shown in Table 9.2. The trips are only for those that are produced in the Monmouth County Region or attracted to the region. The trip production and attraction summaries by income group for each purpose are shown in Tables 9.3 to 9.8. The calibration indicated that the model estimated trip productions and attractions replicated the observed data well.

Table 9.2 Trip Production and Attraction Comparison by Purpose

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
HBWD	308,465	308,463	0.0%	251,741	251,773	0.0%
HBWS	105,093	105,091	0.0%	84,314	84,339	0.0%
HBS	256,579	256,577	0.0%	272,689	272,702	0.0%
HBO	987,455	987,559	0.0%	1,010,099	1,010,670	0.1%
NHBW	123,983	123,985	0.0%	123,983	123,985	0.0%
NHBO	613,583	613,679	0.0%	613,583	613,679	0.0%
TOTAL	**2,395,158**	**2,395,354**	**0.0%**	**2,356,409**	**2,357,148**	**0.0%**

Table 9.3 Trip Production and Attraction Comparison by Income - HBWD

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
INCOME 1	2,940	2,940	0.0%	2,924	2,925	0.0%
INCOME 2	37,886	37,887	0.0%	59,222	59,235	0.0%
INCOME 3	106,608	106,607	0.0%	91,068	91,084	0.0%
INCOME 4	108,842	108,839	0.0%	73,132	73,134	0.0%
INCOME 5	52,189	52,190	0.0%	25,395	25,396	0.0%
TOTAL	**308,465**	**308,463**	**0.0%**	**251,741**	**251,774**	**0.0%**

Table 9.4 Trip Production and Attraction Comparison by Income - HBWS

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
INCOME 1	249	249	0.0%	1,490	1,515	1.7%
INCOME 2	10,573	10,572	0.0%	16,049	16,050	0.0%
INCOME 3	37,054	37,053	0.0%	28,680	28,681	0.0%
INCOME 4	36,736	36,737	0.0%	25,311	25,311	0.0%
INCOME 5	20,481	20,480	0.0%	12,784	12,783	0.0%
TOTAL	**105,093**	**105,091**	**0.0%**	**84,314**	**84,340**	**0.0%**

Table 9.5 Trip Production and Attraction Comparison by Income - HBS

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
INCOME 1	18,689	18,688	0.0%	20,100	20,124	0.1%
INCOME 2	40,022	40,022	0.0%	42,717	42,716	0.0%
INCOME 3	60,583	60,581	0.0%	65,483	65,498	0.0%
INCOME 4	110,288	110,288	0.0%	112,699	112,671	0.0%
INCOME 5	26,997	26,997	0.0%	31,690	31,694	0.0%
TOTAL	**256,579**	**256,576**	**0.0%**	**272,689**	**272,703**	**0.0%**

Table 9.6 Trip Production and Attraction Comparison by Income - HBO

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
INCOME 1	46,228	46,234	0.0%	46,566	46,628	0.1%
INCOME 2	110,999	111,012	0.0%	116,441	116,402	0.0%
INCOME 3	315,914	315,930	0.0%	322,412	322,873	0.1%
INCOME 4	326,581	326,620	0.0%	314,205	314,241	0.0%
INCOME 5	187,733	187,763	0.0%	210,475	210,526	0.0%
TOTAL	**987,455**	**987,559**	**0.0%**	**1,010,099**	**1,010,670**	**0.1%**

Table 9.7 Trip Production and Attraction Comparison by Income - NHBW

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
INCOME 1	5,535	5,535	0.0%	5,535	5,535	0.0%
INCOME 2	18,150	18,152	0.0%	18,150	18,152	0.0%
INCOME 3	33,010	33,011	0.0%	33,010	33,011	0.0%
INCOME 4	41,894	41,890	0.0%	41,894	41,890	0.0%
INCOME 5	25,394	25,396	0.0%	25,394	25,396	0.0%
TOTAL	**123,983**	**123,984**	**0.0%**	**123,983**	**123,985**	**0.0%**

Table 9.8 Trip Production and Attraction Comparison by Income - NHBO

PURPOSE	TRIP PRODUCTION			TRIP ATTRACTION		
	OBS	EST	DIFF %	OBS	EST	DIFF %
INCOME 1	28,414	28,473	0.2%	28,414	28,473	0.2%
INCOME 2	89,387	89,446	0.1%	89,387	89,446	0.1%
INCOME 3	199,025	199,075	0.0%	199,025	199,075	0.0%
INCOME 4	229,659	229,629	0.0%	229,659	229,629	0.0%
INCOME 5	67,098	67,056	-0.1%	67,098	67,056	-0.1%
TOTAL	**613,583**	**613,679**	**0.0%**	**613,583**	**613,679**	**0.0%**

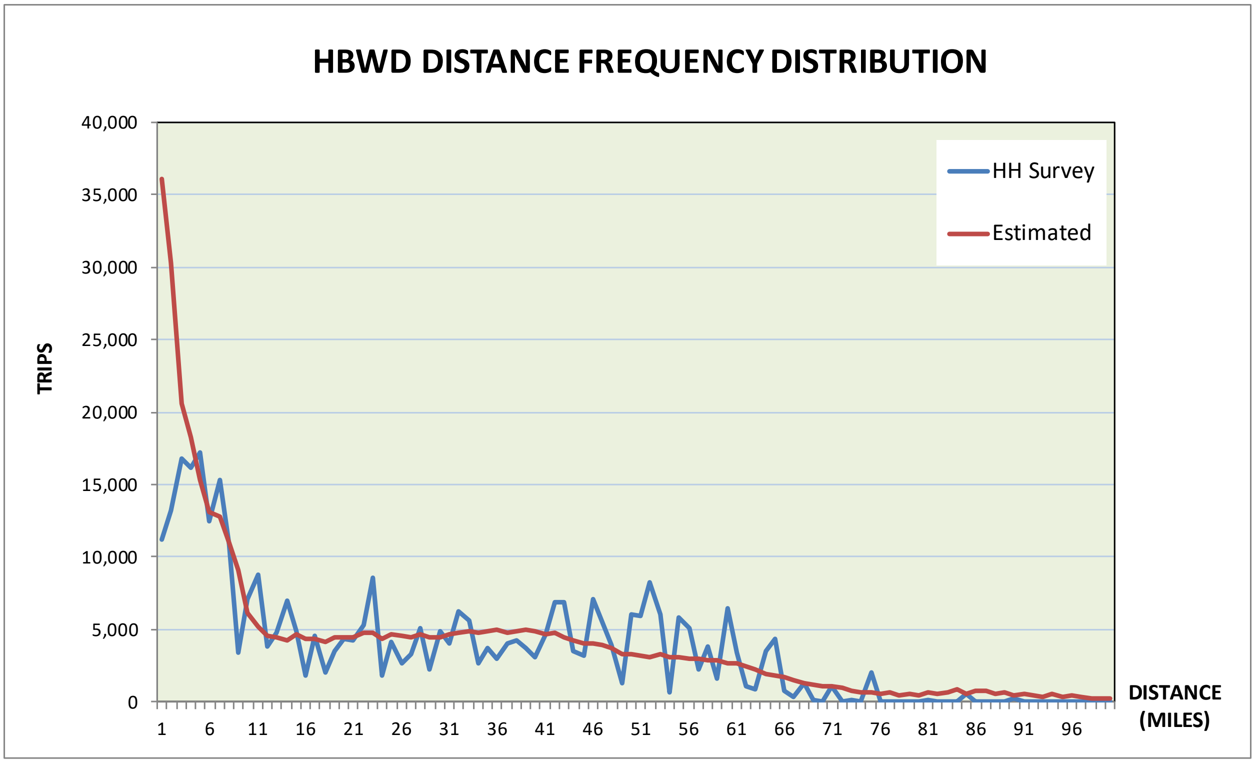
9.3 TRIP DISTRIBUTION

The trip distribution calibration focused on developing the inter- and intra-TAZ travel flows. The estimated travel flows were compared to the observed flows that were developed from the various sources, such as the Household Survey data and the LEHD data.

The MCTDM utilizes standard Gravity Model procedures to perform the trip distribution process. The objective of the trip distribution is to develop model estimates that properly replicate the observed average trip length and also maintain the observed trip pattern for each trip purpose. The trip distribution calibration process follows the same approach as the calibration of the NJRTM-E.

The trip patterns were calibrated by comparing the model estimated frequency distribution of travel time and distance for each trip purpose for trips generated or attracted to Monmouth County to the observed data. The travel time and trip distance frequency distributions were used to help model the distribution of trips both produced and attracted to Monmouth County. The frequency distributions of trip distance and travel time by trip purpose are shown in Figures 9.1 to 9.6, while the average impedances (travel time and distance) by trip purpose are shown in Table 9.9. The results of these comparison indicated that the estimated trip patterns replicated the observed data reasonably well.

Figure 9.1 HBWD Frequency Distribution



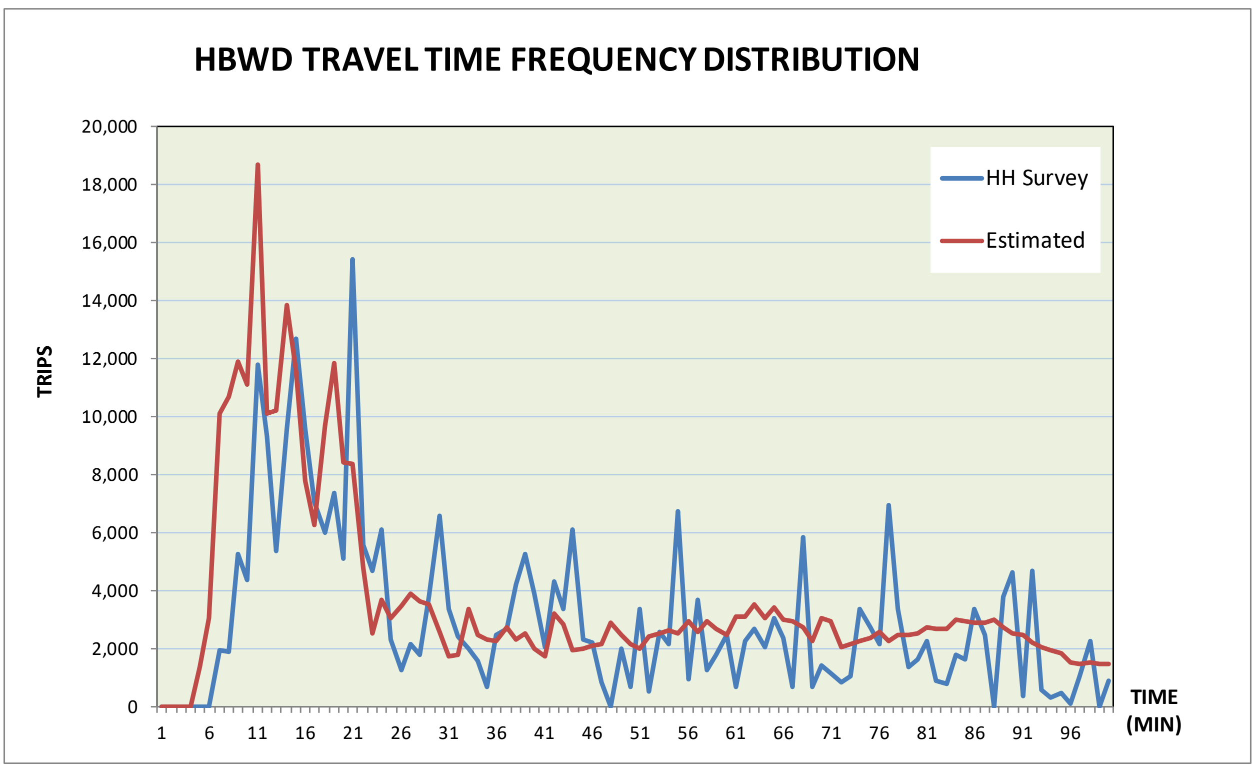
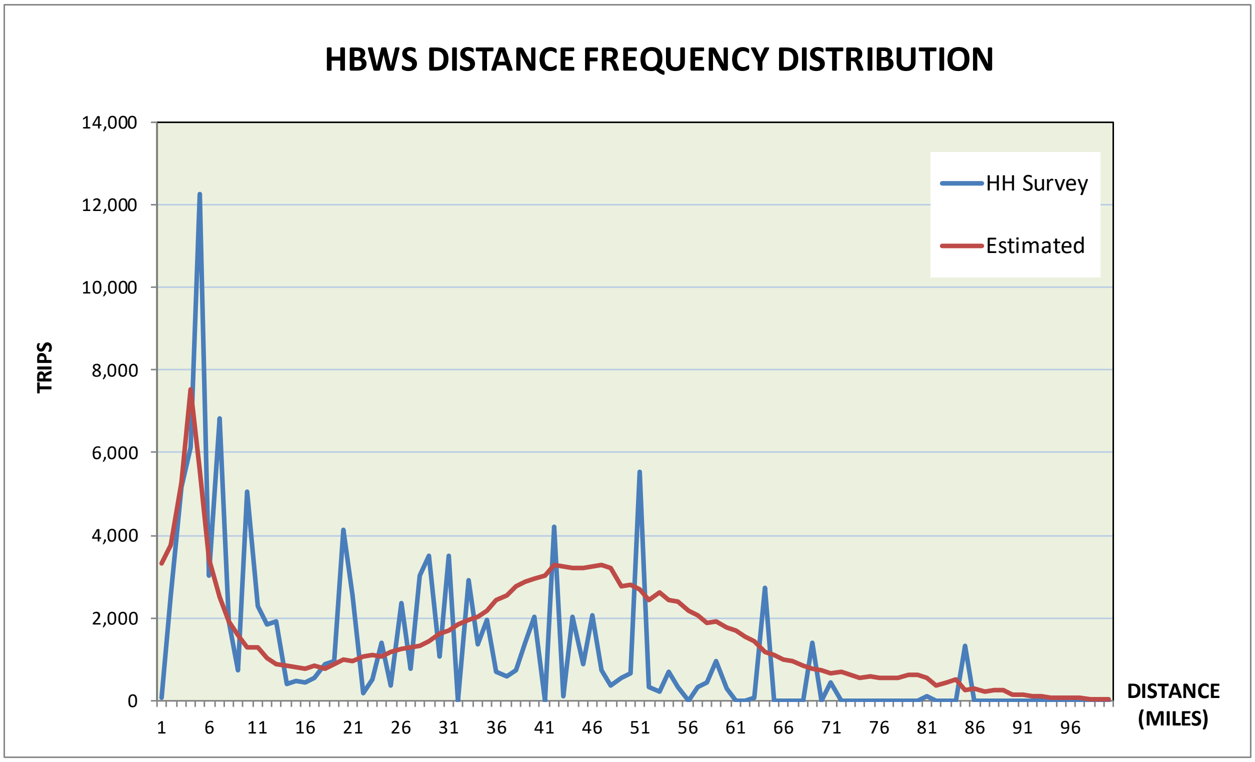


Figure 9.2 HBWS Frequency Distribution



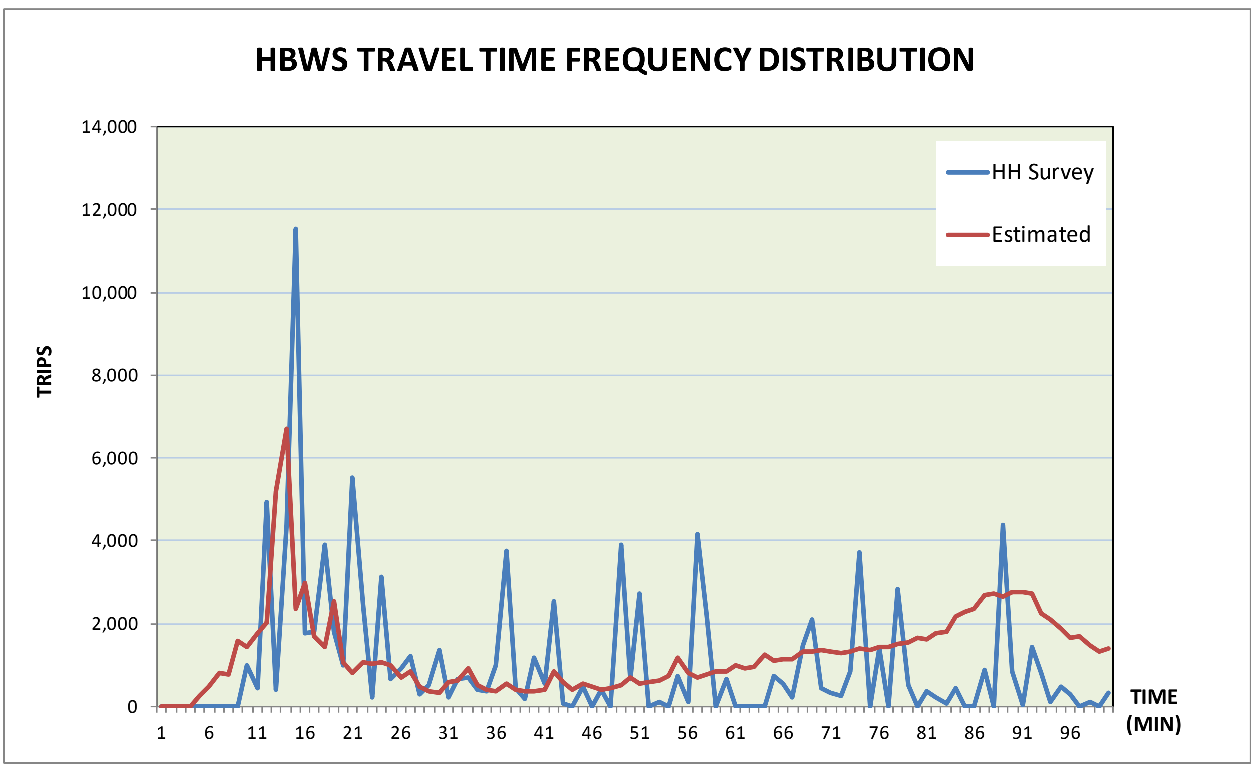
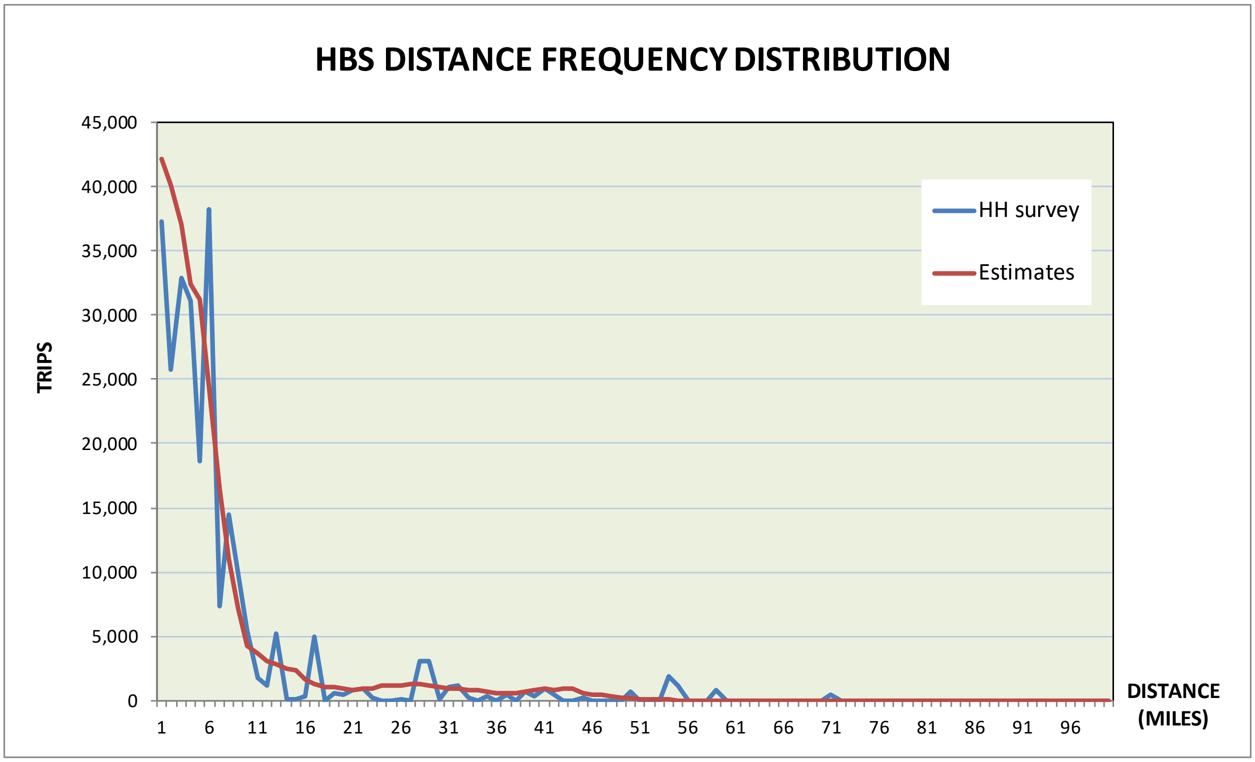


Figure 9.3 HBS Frequency Distribution



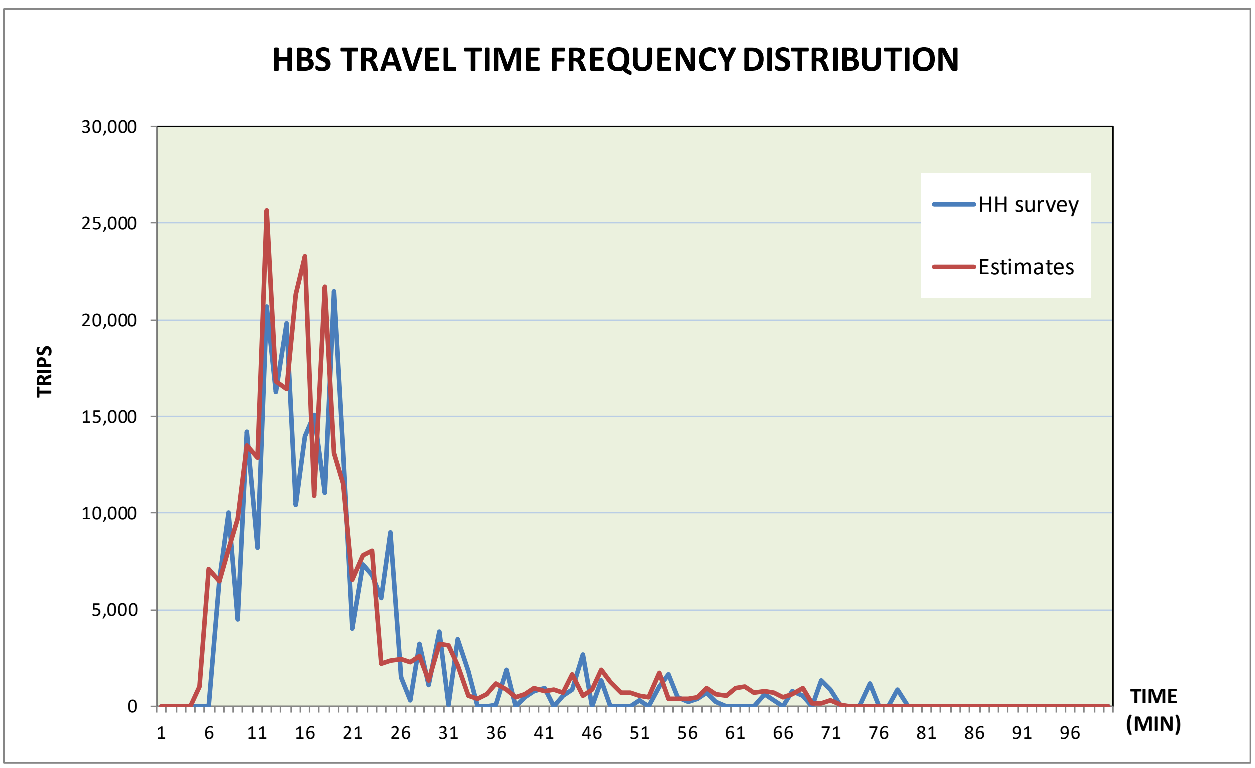
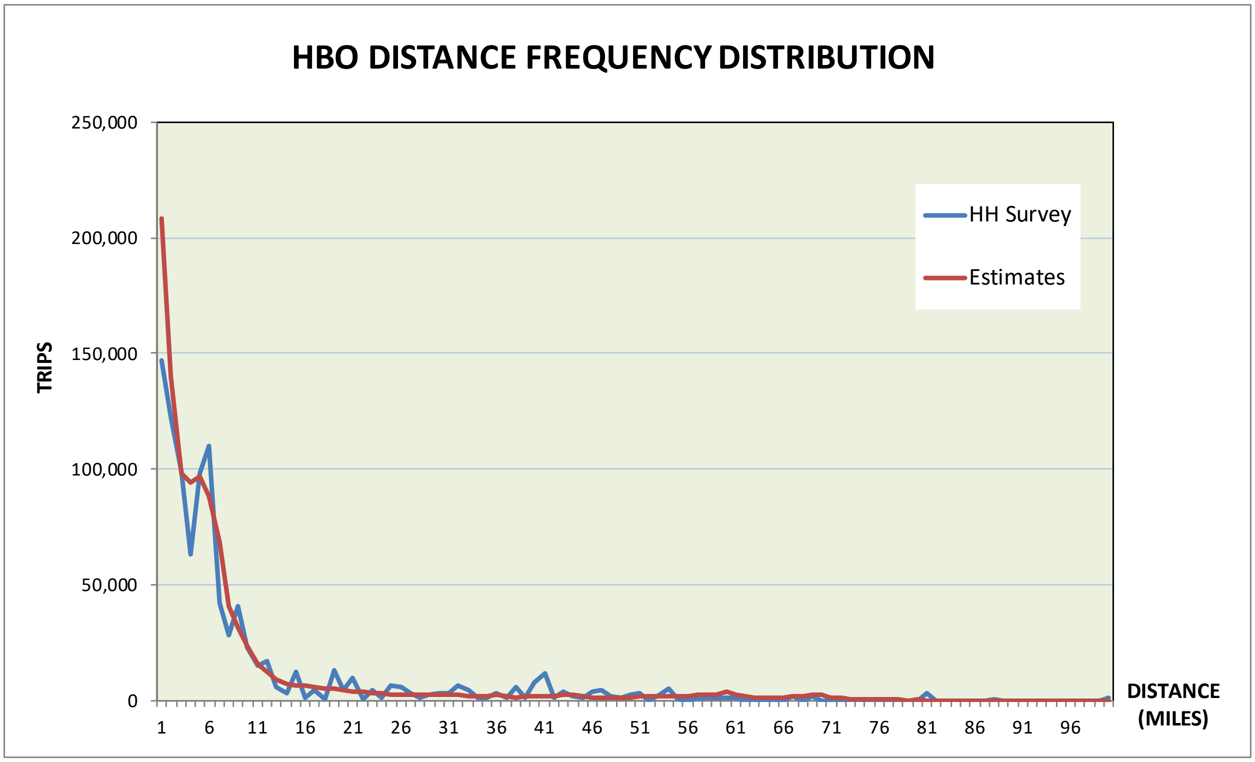


Figure 9.4 HBO Frequency Distribution



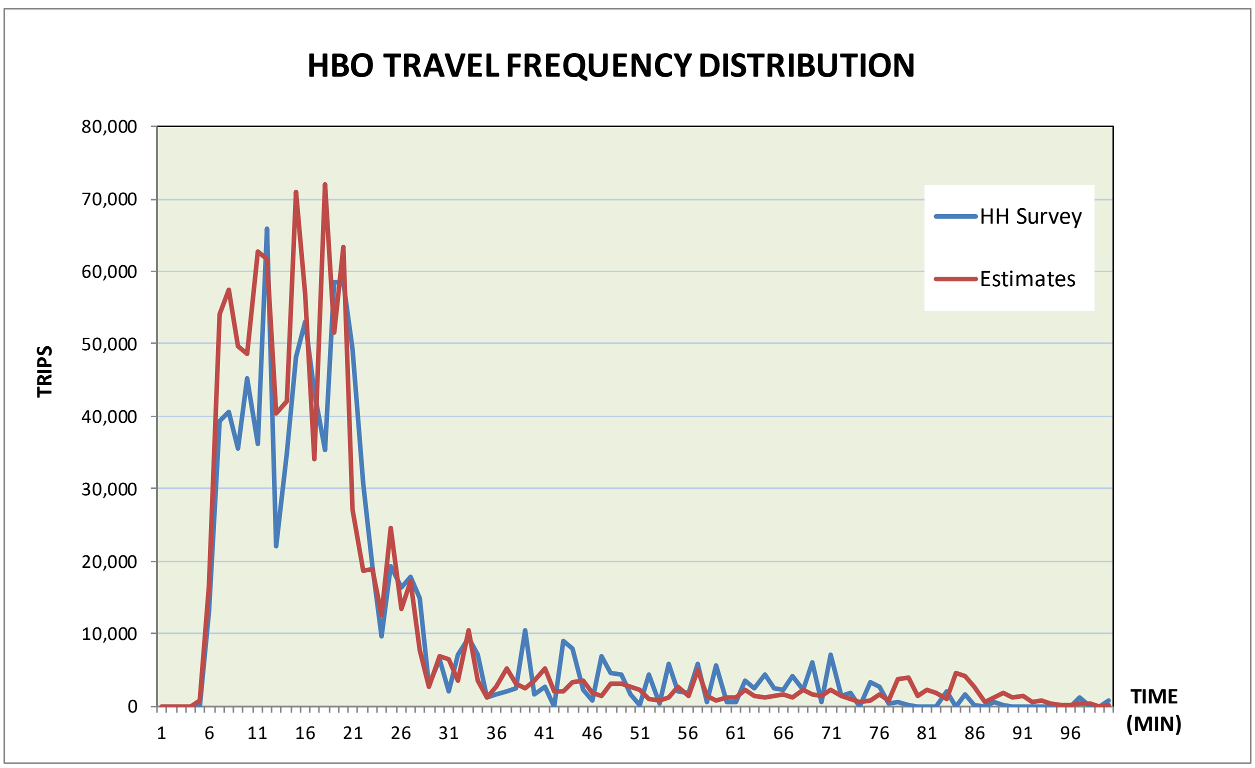
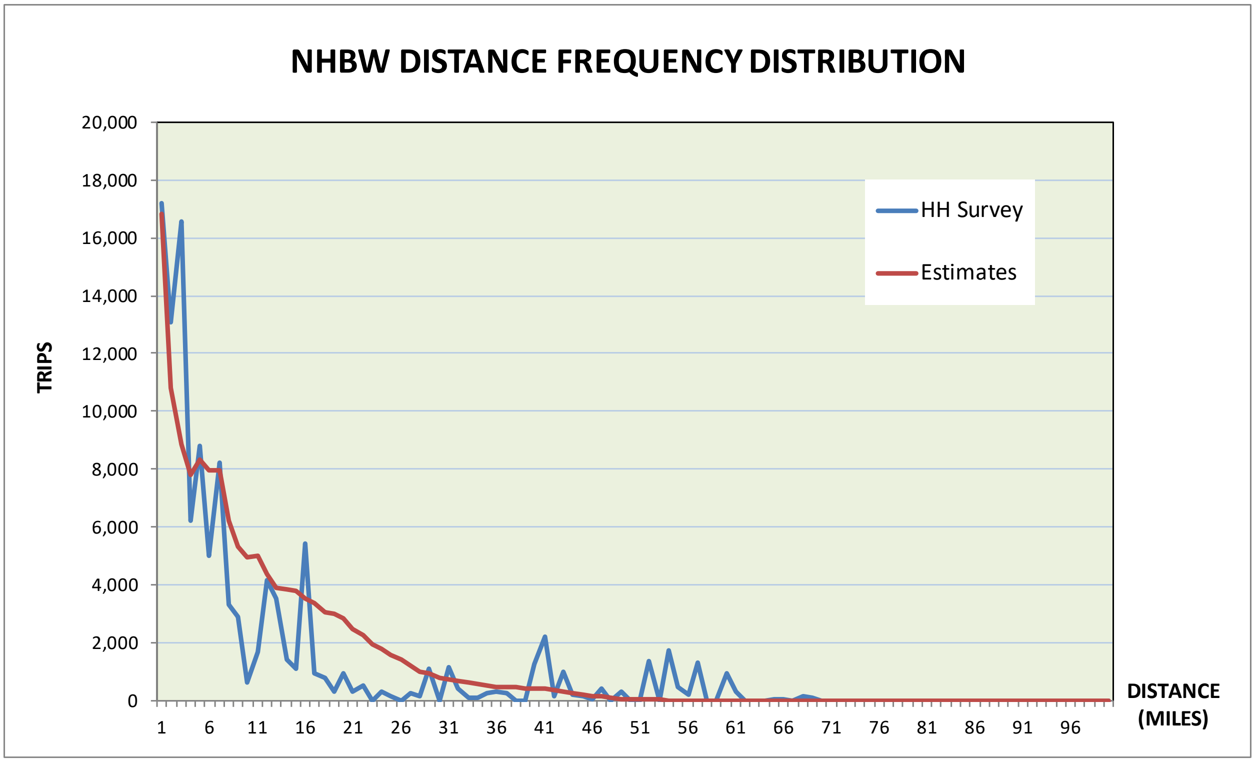


Figure 9.5 NHBW Frequency Distribution



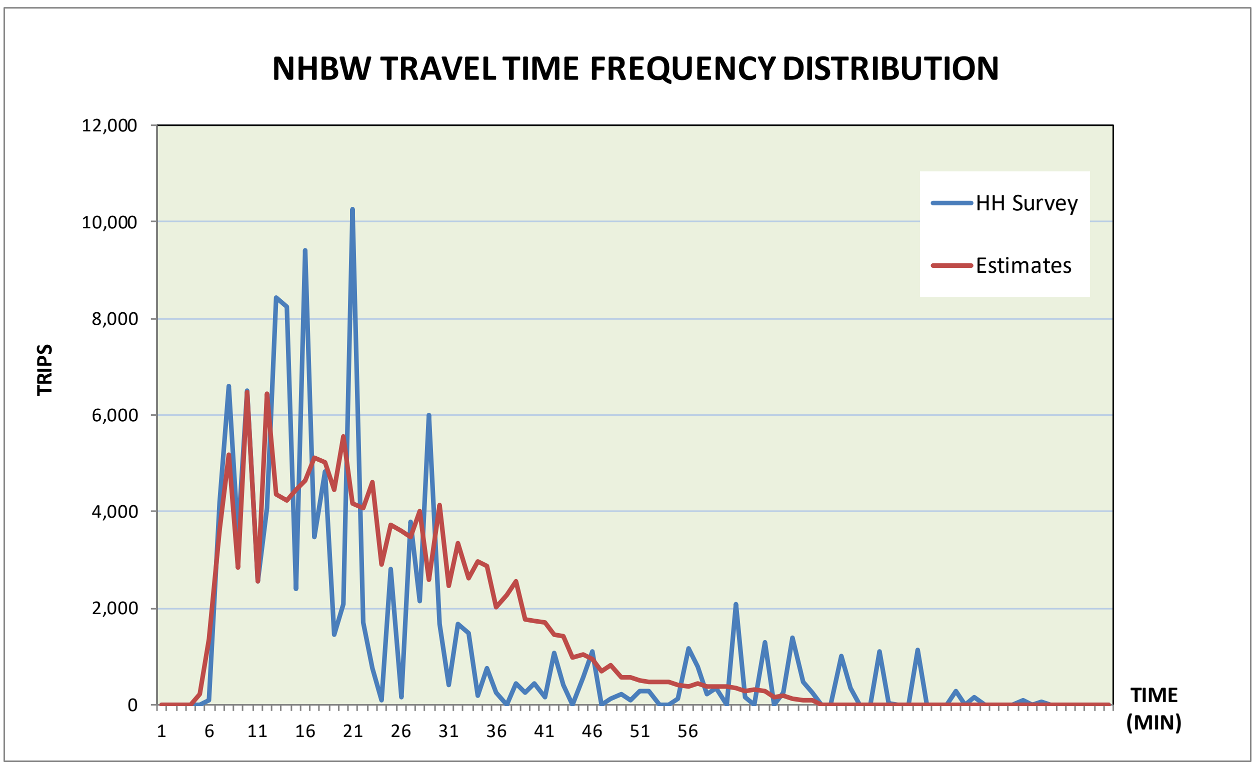
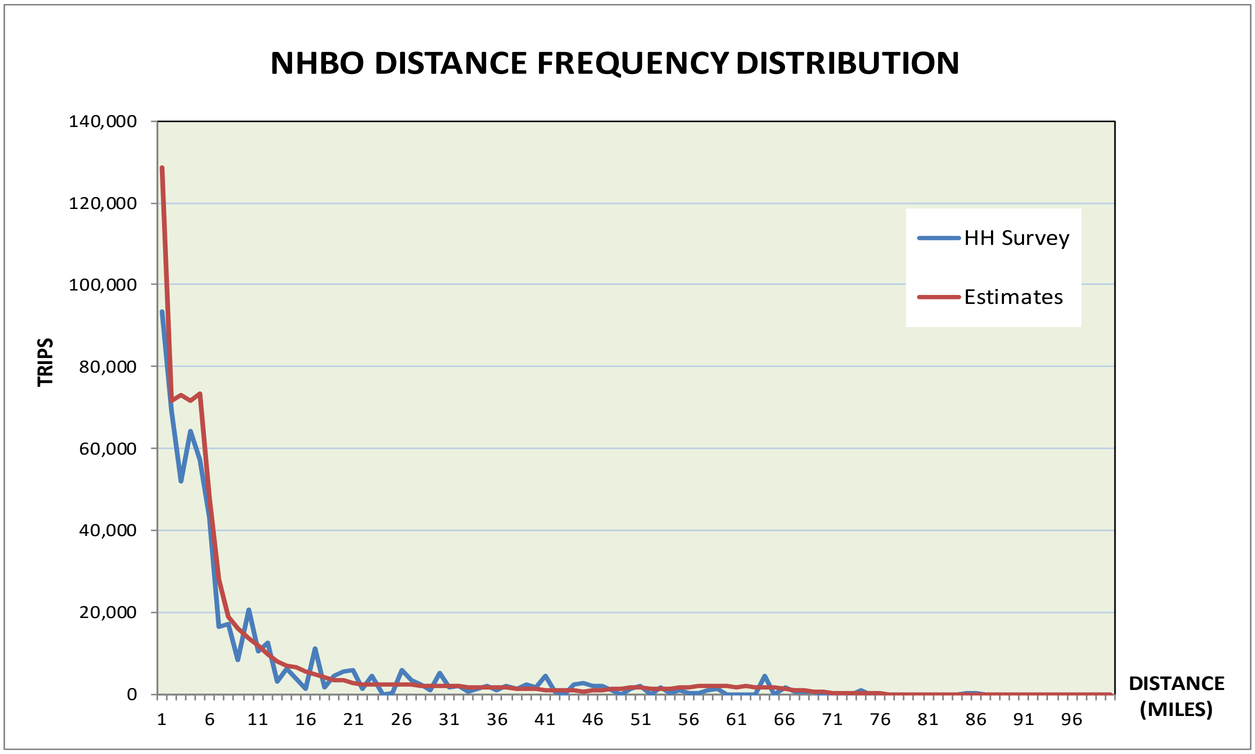


Figure 9.6 NHBO Frequency Distribution



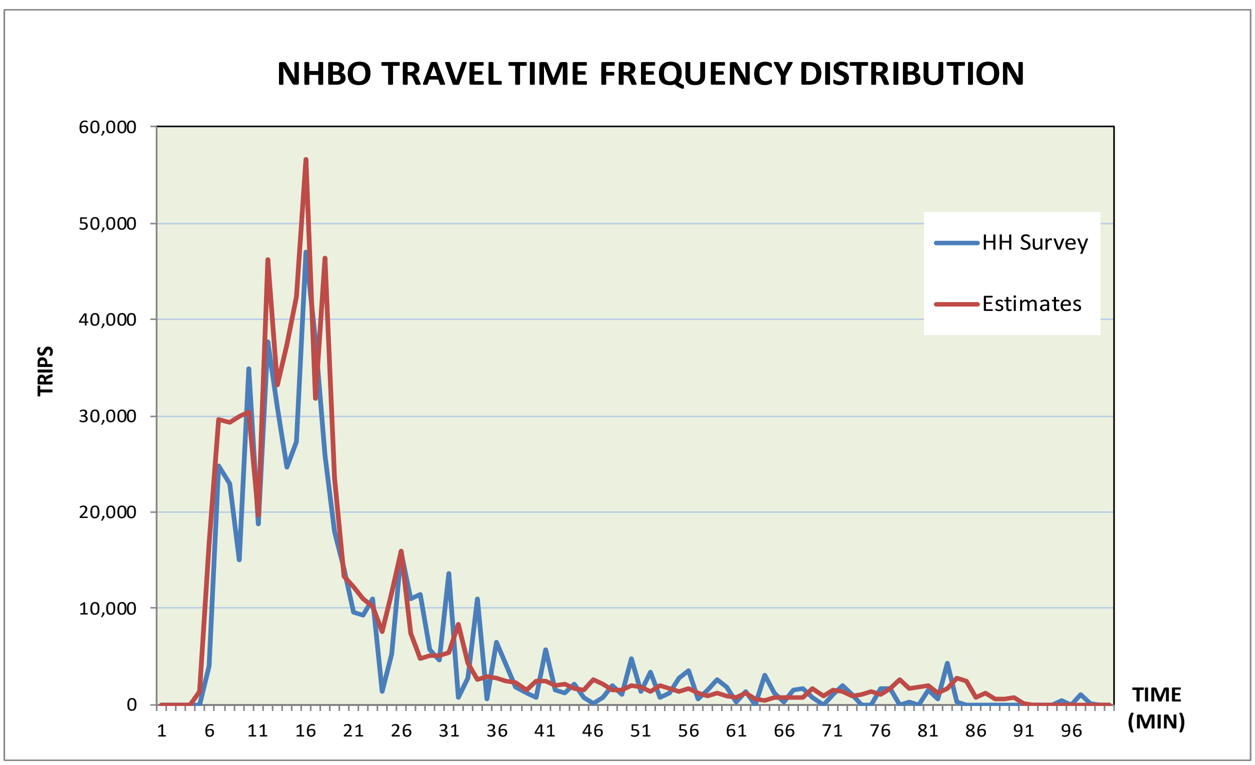


Table 9.9 Trip Average Travel Time and Distance

TRIP PURPOSE	AVERAGE DISTANCE (MILES)			AVERAGE TRAVEL TIME (MINUTES)			AVERAGE SPEED (MPH)		
	OBSERVED	ESTIMATED	%DIFF	OBSERVED	ESTIMATED	%DIFF	OBSERVED	ESTIMATED	%DIFF
HBW	**30.1**	**28.5**	**-5.3%**	**55.8**	**53.8**	**-3.5%**	**32.3**	**31.7**	**-1.9%**
HBS	7.4	7.2	-1.7%	19.7	19.1	-3.2%	22.4	22.7	1.6%
HBO	9.8	9.2	-6.3%	22.5	21.2	-5.9%	26.2	26.1	-0.4%
NHBW	11.5	11.1	-3.5%	23.8	24.3	1.9%	28.8	27.3	-5.3%
NHNW	9.6	9.2	-4.3%	22.0	21.1	-4.0%	26.2	26.2	-0.3%

Trip patterns can also be measured by district-to-district trip flows. District-to-district trip flows would help to gauge how close the estimated trip distribution replicated the observed data. In the MCTDM, a district is defined as a group of municipalities. Monmouth County is divided into 17 districts as shown in Table 9.10 and Figure 9.7. Outside Monmouth County, the region is divided into six external districts as shown in Table 9.11 and Figure 9.8. Prior to comparing the district-to-district trip flows, the percent shares of trip productions and trip attractions by trip purpose were compared first to measure the distribution of trip production and attraction across the district. Figures 9.9 to 9.13 show the percent distribution by district for each trip purpose. The estimated distribution by district replicated the observed data reasonably well.

Table 9.10 Monmouth County Internal District Definition

DISTRICT	MUNICIPALITY
1	Millstone Township
1	Upper Freehold Township
1	Allentown Borough
1	Roosevelt Borough
2	Freehold Township
2	Freehold Borough
3	Manalapan Township
3	Englishtown Borough
4	Marlboro Township
4	Holmdel Township
5	Keyport Borough
5	Aberdeen Township
5	Matawan Borough
6	Manasquan Borough
6	Brielle Borough
6	Lake Como Borough
6	Spring Lake Borough
6	Spring Lake Heights Borough
6	Sea Girt Borough
6	Belmar Borough
7	Highlands Borough
7	Atlantic Highlands Borough
7	Sea Bright Borough
8	Wall Township

DISTRICT	MUNICIPALITY
9	Deal Borough
9	Allenhurst Borough
9	Interlaken Borough
9	Loch Arbour Village
9	Ocean Township
10	Union Beach Borough
10	Hazlet Township
10	Keansburg Borough
11	Howell Township
11	Farmingdale Borough
12	Rumson Borough
12	Fair Haven Borough
12	Red Bank Borough
12	Shrewsbury Borough
12	Little Silver Borough
13	Tinton Falls Borough
13	Shrewsbury Township
13	Colts Neck Township
14	Eatontown Borough
14	Oceanport Borough
14	West Long Branch Borough
15	Asbury Park City
15	Neptune Township
15	Neptune City Borough
15	Bradley Beach Borough
15	Avon-by-the-Sea Borough
16	Middletown Township
17	Long Branch City
17	Monmouth Beach Borough

Figure 9.7 Monmouth County Internal District

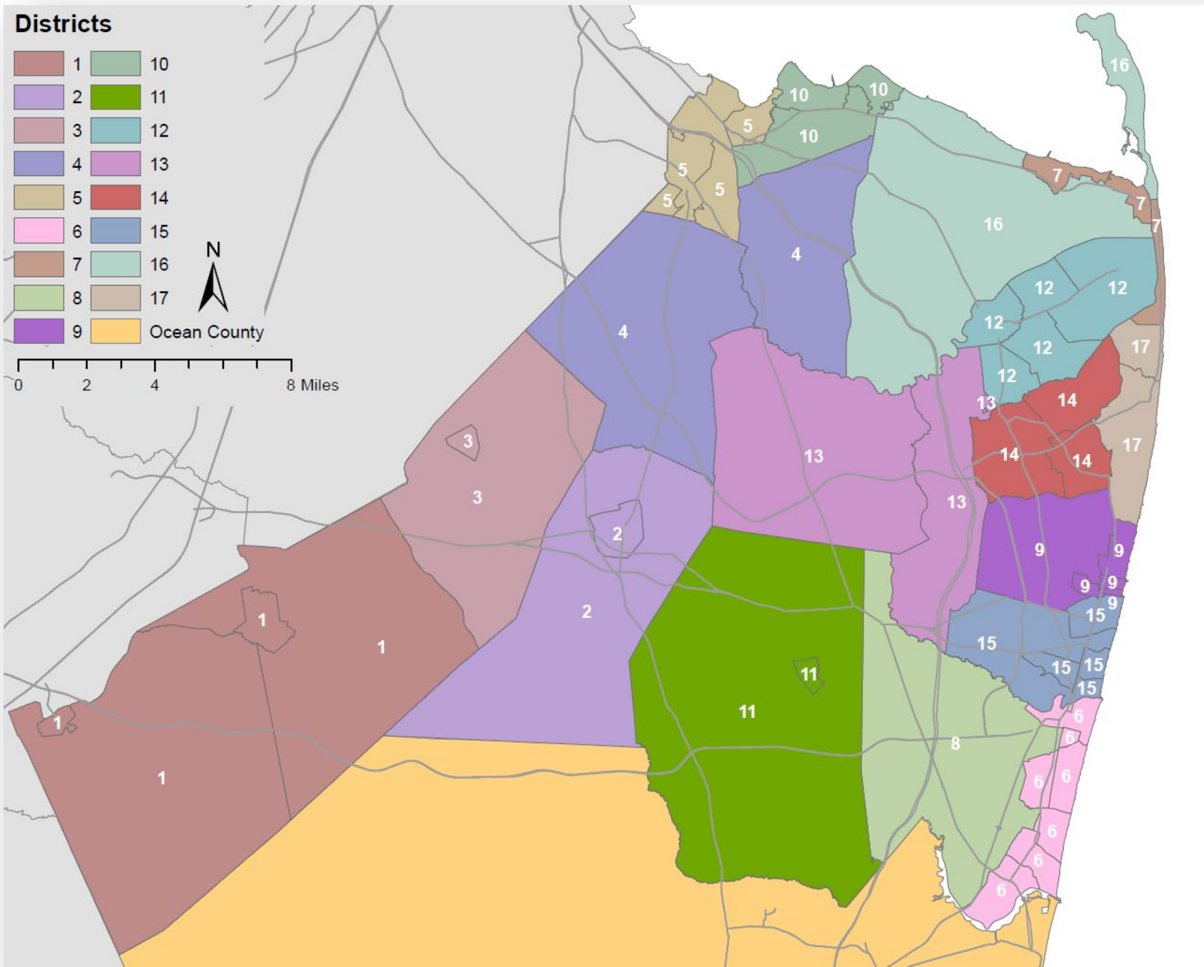


Table 9.11 Monmouth County External District Definition

EXTERNAL DISTRICT	DEFINITION
1	New York Five Boroughs and Long Island
2	Northern and Central NJ (excluding the ones below) and NY
3	Mercer/Burlington and PA
4	Ocean/Atlantic and South Jersey
5	Essex/Hudson
6	Middlesex

Figure 9.8 External District Definition

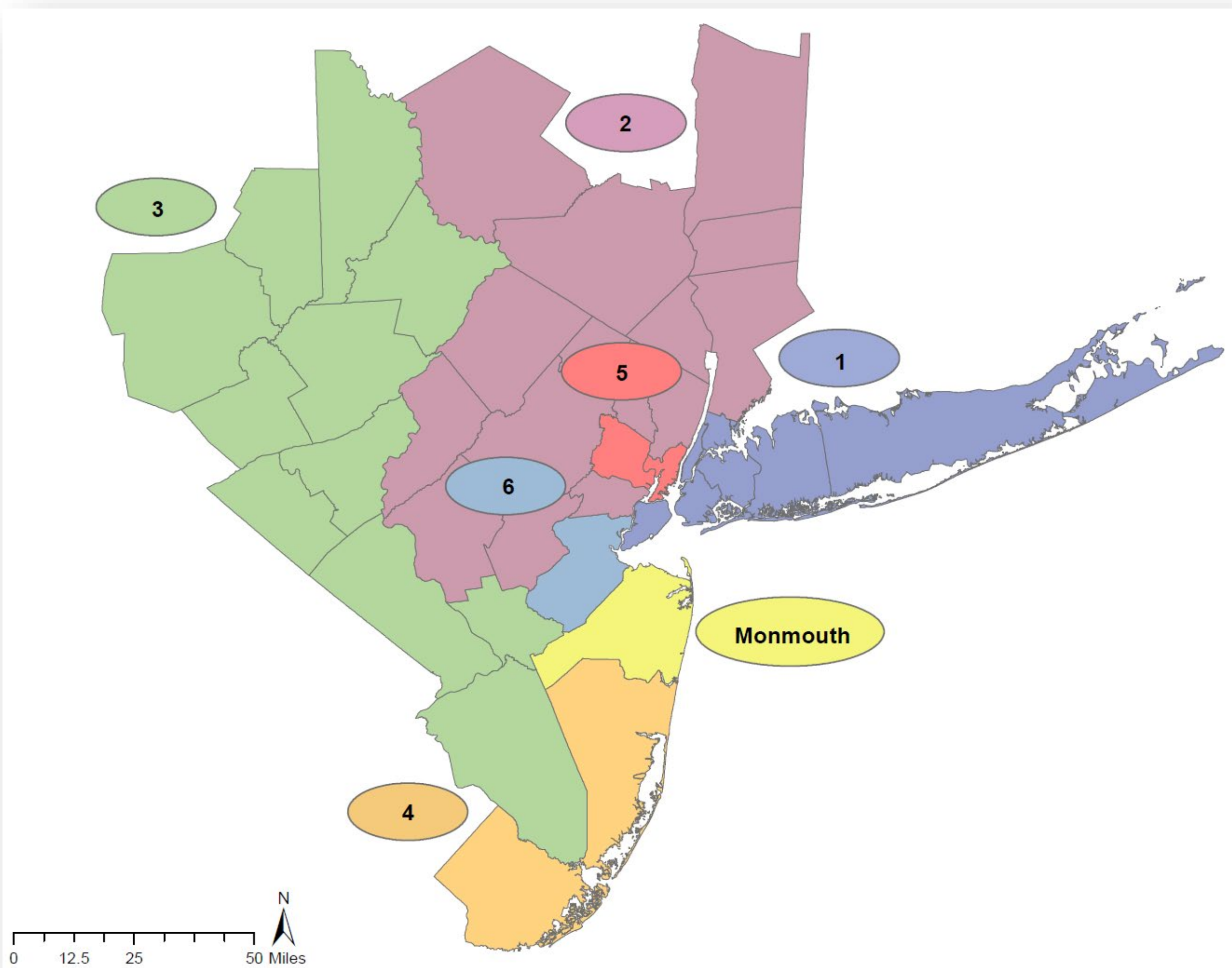
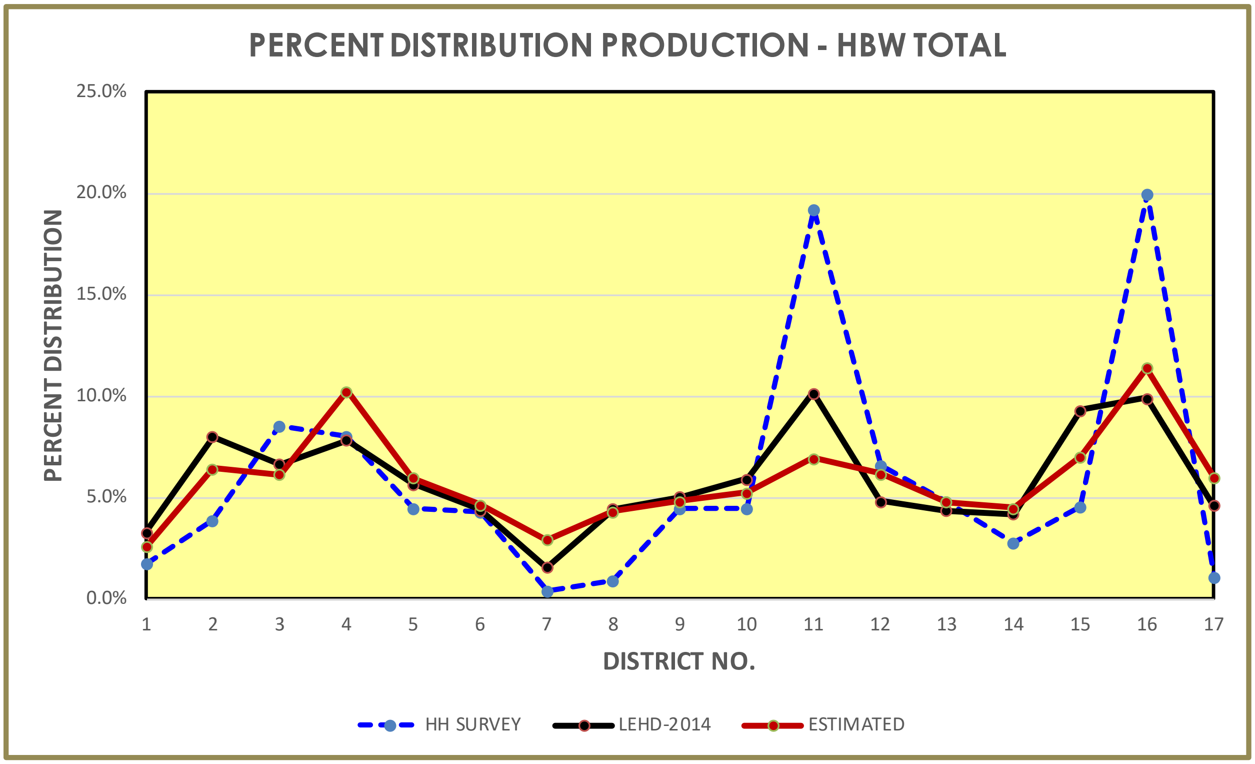


Figure 9.9 HBW Distribution by District



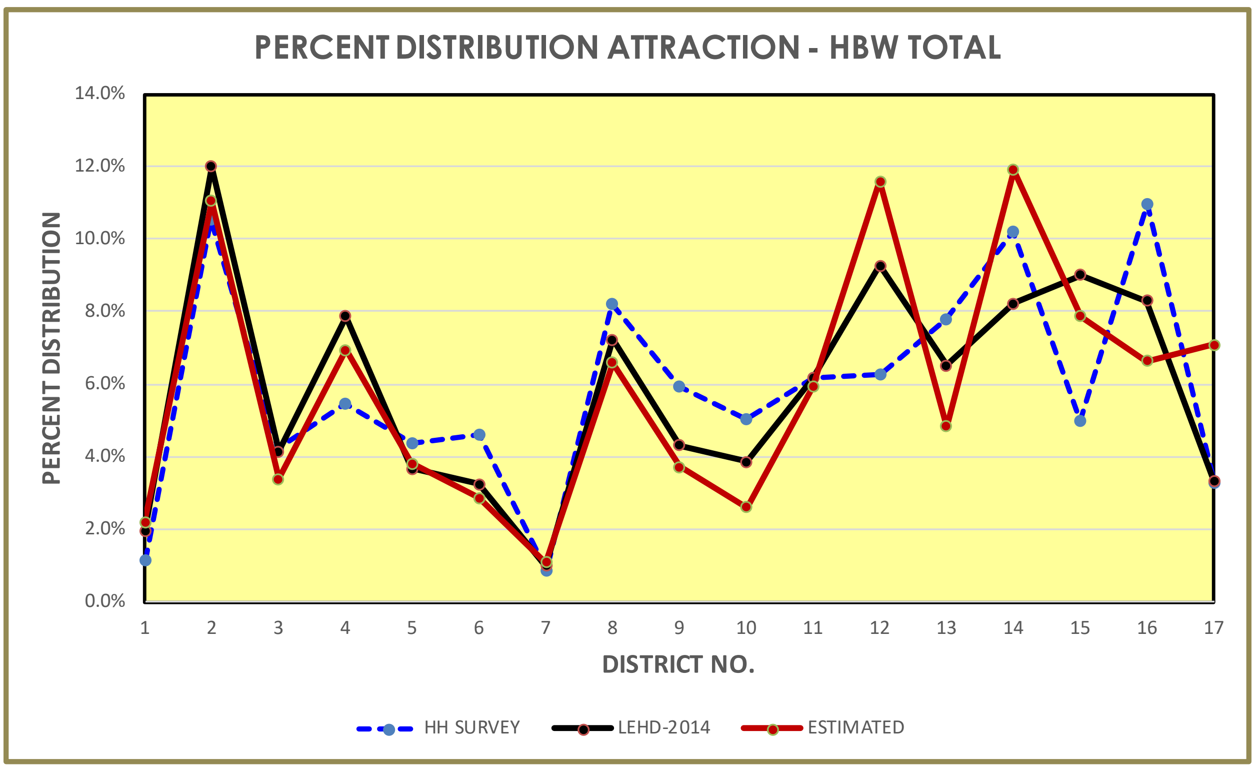
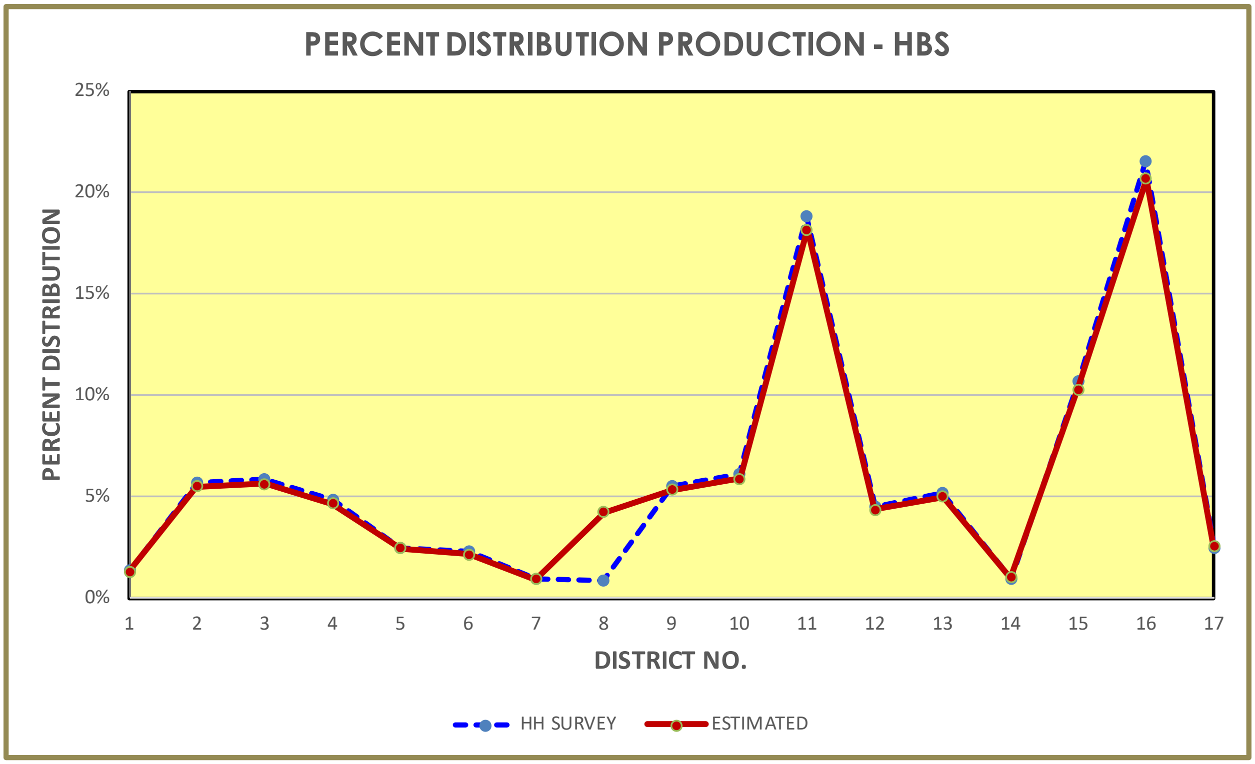


Figure 9.10 HBS Distribution by District



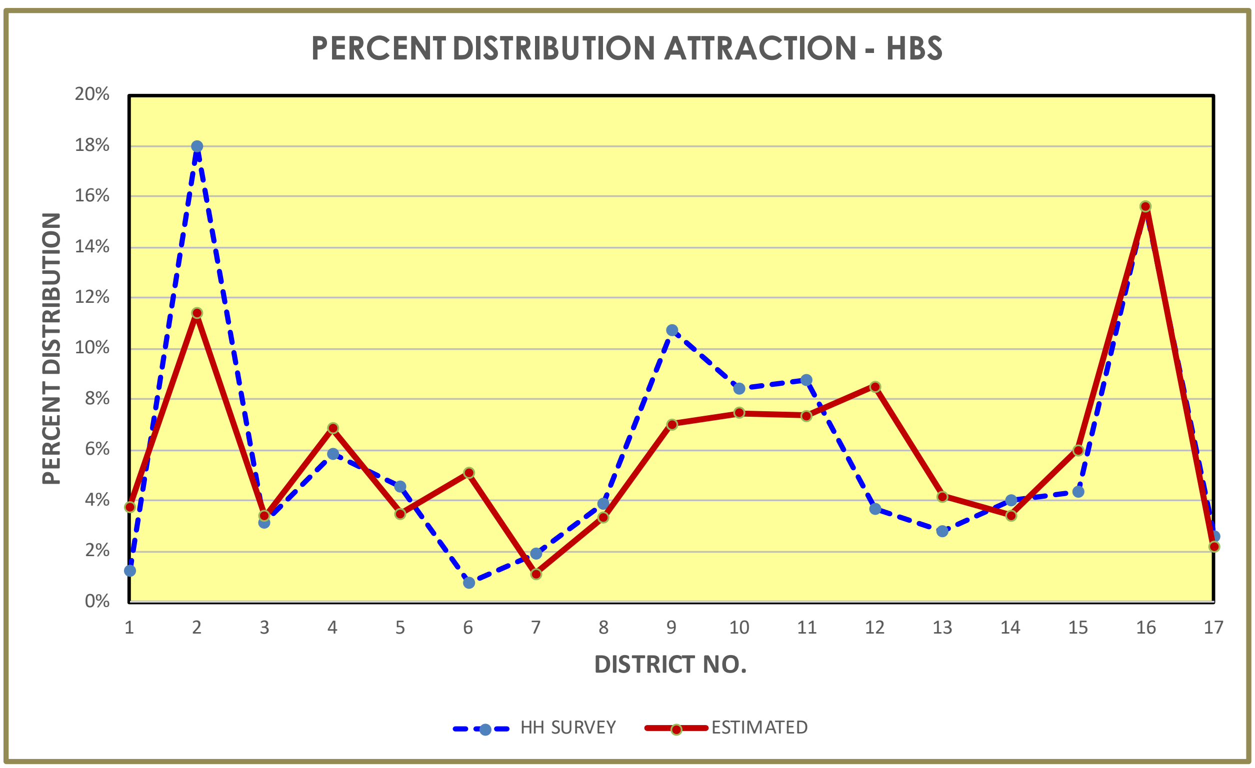
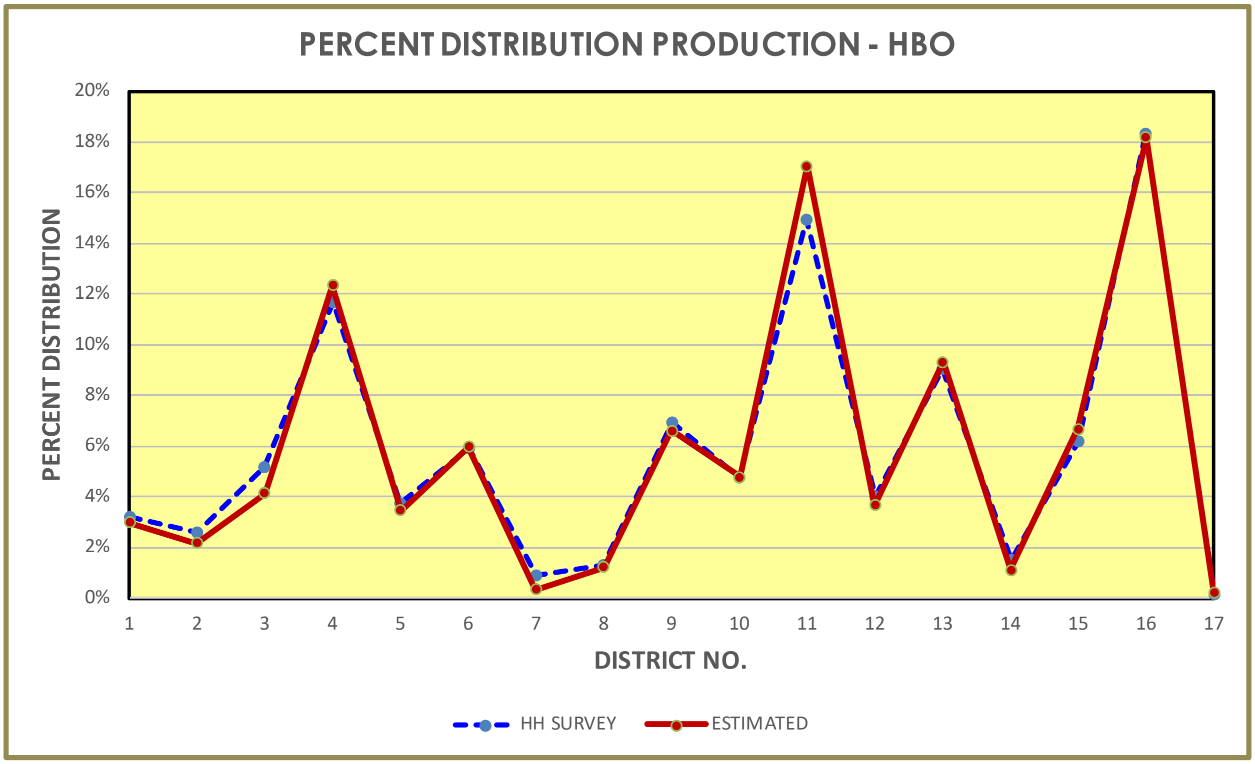


Figure 9.11 HBO Distribution by District



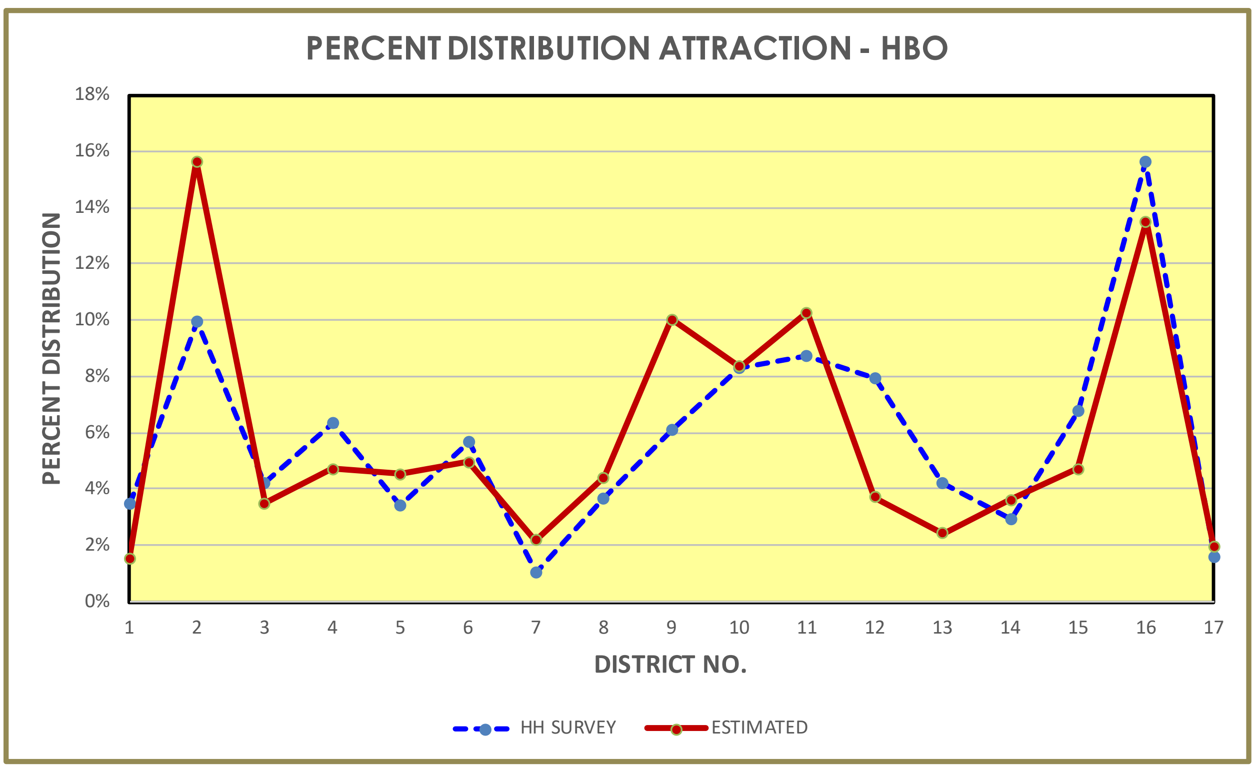
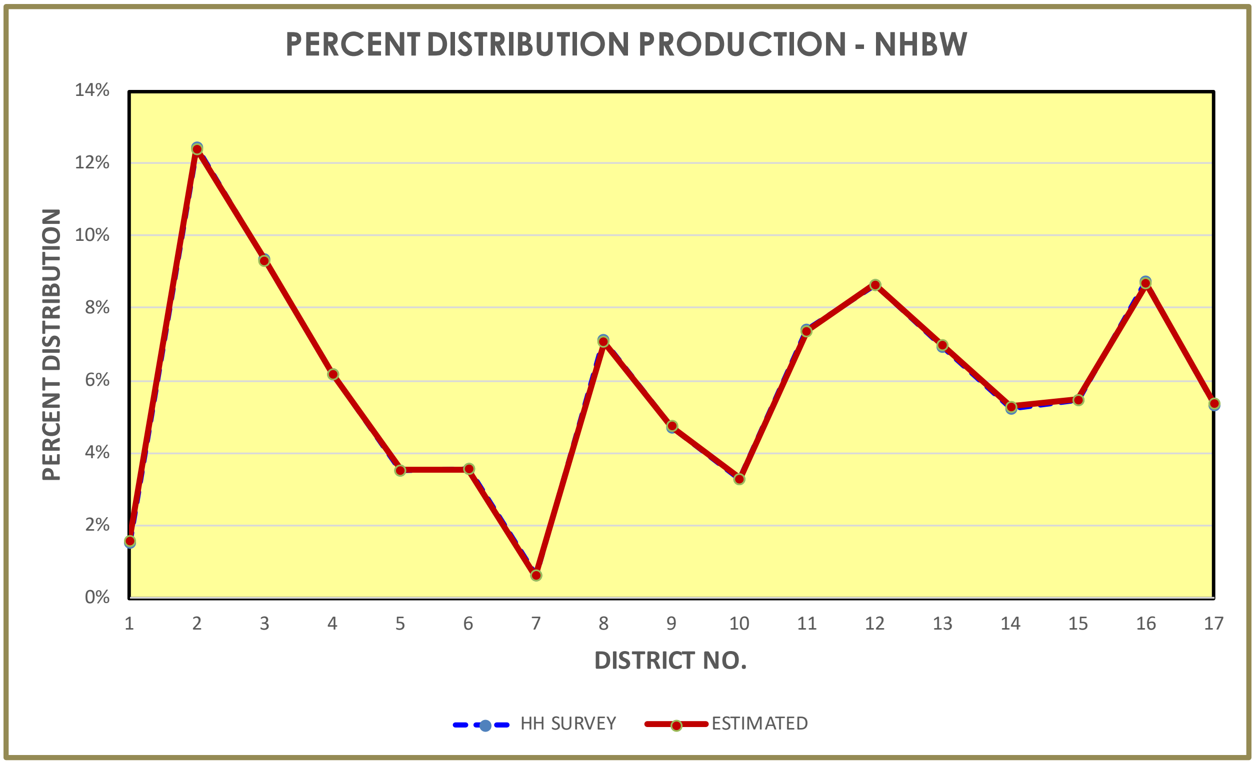


Figure 9.12 NHBW Distribution by District



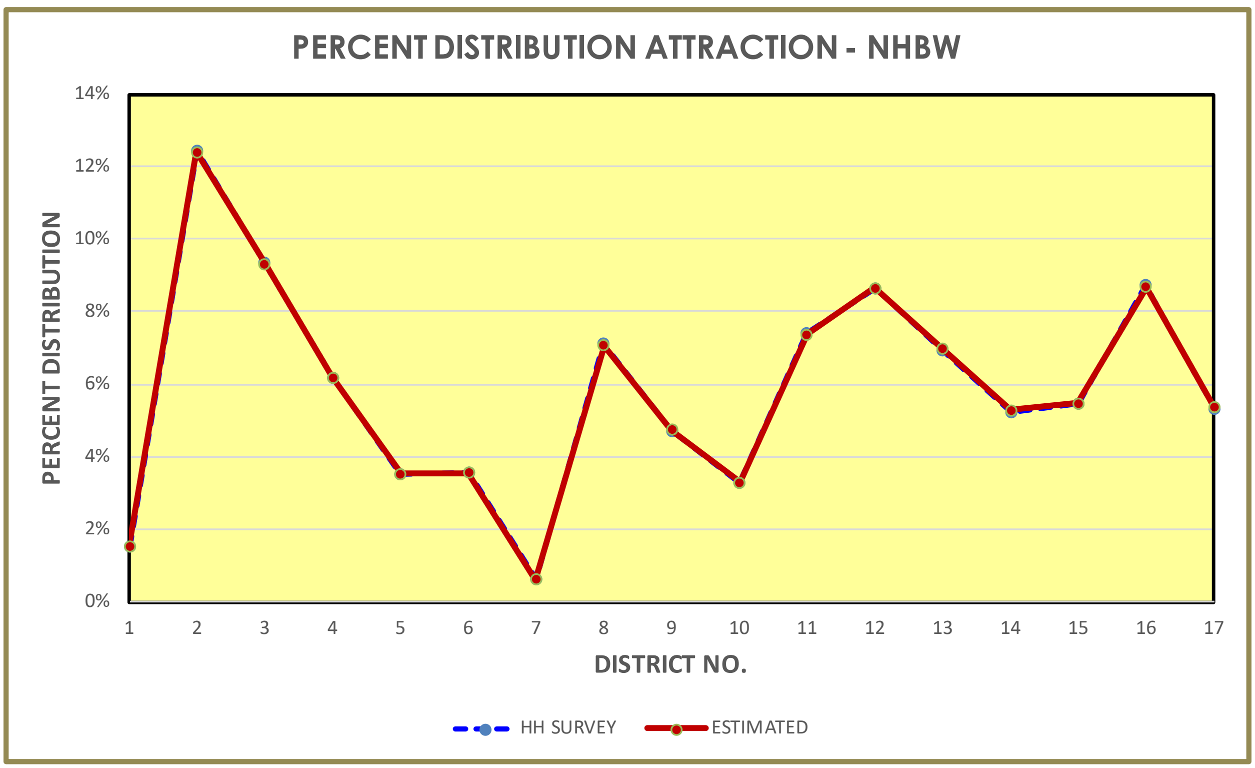
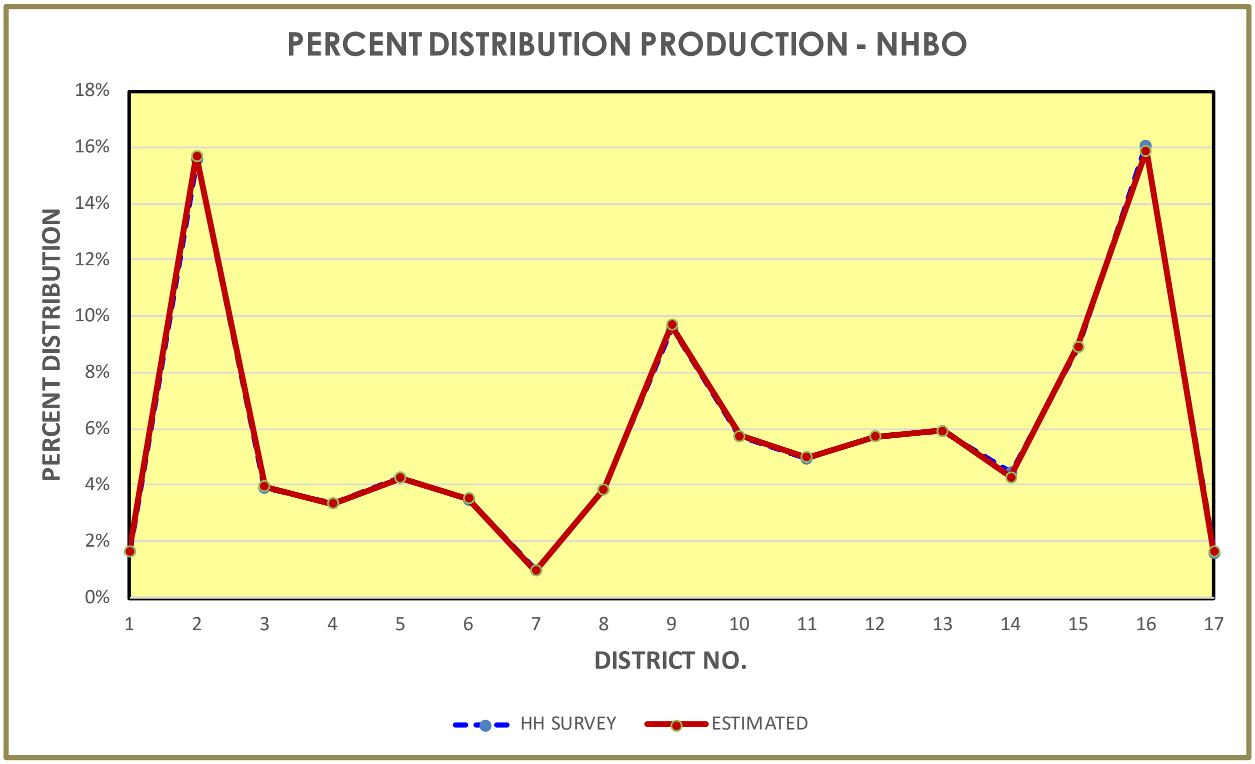
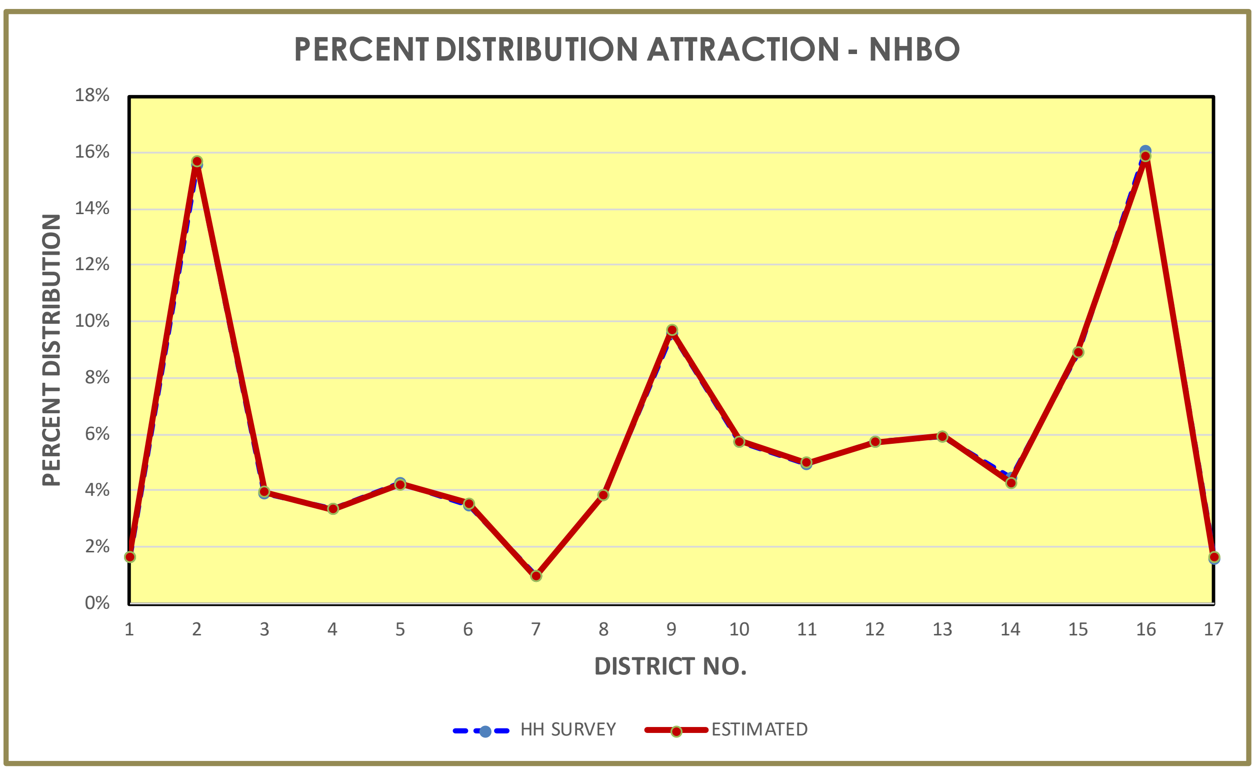


Figure 9.13 NHBO Distribution by District





The district-to-district trip flows for HBW are shown in Table 9.12. Considering that the household survey data at county level is very limited, LEHD data was used as the observed targets for the HBW purpose. The percentage of district-to-district trip flows were used in the calibration process, instead of using the trip values.

For other trip purposes, more aggregated district definitions are used due to limited observed data. The non-HBW district definition is shown in Table 9.13 and Figure 9.14. Tables 9.14 to 9.17 show district-to-district trip flow comparisons for non-HBW trip purposes. As expected, there are more variations between observed and estimated values at this level of comparison, although they are still within reasonable tolerance considering the limited observed data available.

Table 9.12 Trip Flows Distribution by District - HBW

DISTRICT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	11.0%	5.7%	1.8%	1.7%	0.4%	0.3%	0.1%	1.1%	0.3%	0.3%	1.1%	1.0%	0.9%	0.9%	0.9%	0.9%	0.2%	0.0%	15.0%	23.5%	7.3%	6.8%	18.9%	100.0%
	18.6%	2.3%	0.6%	0.4%	0.2%	0.2%	0.1%	0.4%	0.2%	0.2%	0.6%	0.6%	0.4%	0.8%	0.5%	0.4%	0.4%	2.8%	15.6%	22.4%	10.0%	6.7%	15.7%	100.0%
2	0.6%	19.3%	3.4%	3.8%	1.0%	0.4%	0.1%	1.7%	0.9%	0.7%	2.9%	2.2%	2.3%	2.1%	2.0%	2.0%	0.5%	0.0%	14.9%	9.1%	7.4%	6.3%	16.3%	100.0%
	0.3%	37.3%	1.9%	1.0%	0.3%	0.2%	0.1%	0.6%	0.3%	0.2%	4.7%	0.7%	1.1%	1.2%	0.8%	0.4%	0.6%	4.3%	13.8%	3.7%	9.7%	7.5%	9.3%	100.0%
3	0.6%	8.9%	9.3%	6.7%	1.2%	0.4%	0.1%	1.1%	0.9%	0.8%	1.7%	1.5%	1.6%	1.4%	1.2%	1.9%	0.4%	0.0%	15.8%	9.7%	5.5%	6.5%	22.8%	100.0%
	0.5%	15.0%	14.7%	2.0%	0.3%	0.1%	0.1%	0.4%	0.2%	0.2%	1.7%	0.6%	0.5%	0.8%	0.4%	0.4%	0.4%	4.1%	16.0%	9.9%	6.1%	9.7%	15.9%	100.0%
4	0.3%	4.7%	2.6%	11.8%	2.3%	0.3%	0.2%	1.1%	0.8%	2.0%	1.0%	2.7%	1.9%	1.9%	1.5%	4.5%	0.7%	0.0%	19.9%	4.9%	4.1%	9.3%	21.5%	100.0%
	0.1%	6.6%	3.4%	19.7%	2.0%	0.1%	0.1%	0.5%	0.2%	1.2%	1.1%	2.3%	1.6%	1.8%	0.4%	2.3%	0.4%	4.8%	18.1%	3.4%	3.7%	10.3%	16.0%	100.0%
5	0.2%	2.9%	1.0%	4.9%	10.1%	0.1%	0.4%	1.2%	0.7%	4.4%	0.8%	3.3%	1.8%	2.3%	1.5%	3.5%	0.7%	0.0%	18.6%	3.9%	3.8%	8.4%	25.2%	100.0%
	0.1%	0.8%	0.3%	7.9%	16.5%	0.1%	0.2%	0.4%	0.3%	3.8%	0.4%	2.3%	1.0%	1.2%	0.5%	2.7%	0.6%	9.6%	17.7%	2.2%	4.0%	10.2%	17.2%	100.0%
6	0.3%	3.5%	0.7%	1.6%	0.6%	16.5%	0.3%	8.7%	1.8%	0.6%	2.0%	3.0%	2.6%	2.8%	6.8%	2.2%	1.0%	0.0%	12.3%	5.3%	13.8%	5.9%	7.9%	100.0%
	0.1%	0.7%	0.2%	0.3%	0.2%	14.9%	0.1%	15.0%	1.4%	0.1%	1.0%	0.8%	0.7%	2.1%	7.2%	0.3%	1.5%	4.1%	9.7%	3.3%	22.4%	5.8%	8.2%	100.0%
7	0.2%	2.5%	0.5%	2.6%	1.4%	0.5%	11.9%	1.6%	1.6%	2.6%	0.9%	10.5%	2.7%	4.1%	2.5%	9.3%	2.1%	0.0%	16.0%	3.8%	3.7%	8.2%	10.9%	100.0%
	0.1%	0.4%	0.1%	1.0%	0.6%	0.2%	9.6%	0.3%	0.7%	0.8%	0.2%	9.9%	0.7%	8.1%	0.7%	4.7%	13.5%	10.2%	14.2%	1.8%	3.8%	9.6%	8.8%	100.0%
8	0.2%	3.2%	0.6%	1.5%	0.5%	8.5%	0.2%	13.8%	2.2%	0.6%	2.1%	3.2%	2.7%	3.4%	10.6%	2.1%	1.1%	0.0%	11.9%	4.8%	13.7%	5.7%	7.5%	100.0%
	0.1%	0.9%	0.2%	0.4%	0.2%	4.4%	0.1%	28.8%	1.2%	0.1%	1.9%	0.8%	1.1%	2.1%	5.9%	0.3%	0.9%	5.0%	10.4%	3.2%	18.4%	5.5%	8.2%	100.0%
9	0.1%	3.7%	0.7%	2.1%	0.9%	1.4%	0.4%	3.3%	14.1%	0.8%	1.3%	5.9%	5.2%	8.8%	9.5%	3.1%	4.5%	0.0%	11.6%	4.0%	5.7%	5.7%	7.3%	100.0%
	0.1%	0.6%	0.1%	0.4%	0.2%	0.6%	0.1%	1.7%	19.5%	0.1%	0.5%	3.1%	2.8%	18.4%	10.0%	0.6%	4.7%	5.9%	10.8%	2.2%	4.7%	6.0%	6.5%	100.0%
10	0.1%	3.1%	0.7%	5.6%	3.8%	0.2%	0.7%	1.4%	1.0%	13.2%	0.8%	4.0%	2.0%	2.2%	1.8%	6.2%	0.8%	0.0%	17.4%	4.2%	3.6%	9.0%	17.9%	100.0%
	0.1%	0.6%	0.2%	5.9%	4.2%	0.1%	0.7%	0.4%	0.3%	12.4%	0.3%	5.7%	0.8%	2.1%	0.6%	6.6%	1.0%	12.3%	16.5%	1.9%	4.2%	9.5%	13.6%	100.0%
11	0.4%	8.9%	1.6%	2.4%	0.7%	1.3%	0.2%	4.1%	1.6%	0.6%	10.2%	2.4%	2.7%	2.8%	3.1%	1.8%	0.9%	0.0%	12.6%	7.4%	15.7%	5.5%	13.1%	100.0%
	0.2%	7.2%	0.4%	0.5%	0.2%	0.4%	0.1%	1.6%	0.3%	0.1%	20.4%	0.6%	0.8%	0.9%	1.1%	0.3%	0.5%	3.1%	11.9%	3.7%	30.5%	6.4%	8.9%	100.0%
12	0.2%	2.3%	0.4%	2.5%	1.4%	0.4%	1.3%	1.8%	2.0%	1.2%	0.9%	24.2%	4.8%	4.9%	3.3%	6.4%	2.6%	0.0%	14.7%	3.7%	3.9%	7.7%	9.5%	100.0%
	0.1%	0.3%	0.1%	0.6%	0.3%	0.1%	0.5%	0.3%	0.9%	0.3%	0.2%	39.5%	2.4%	11.2%	0.6%	3.1%	4.1%	5.3%	11.8%	2.0%	2.8%	7.1%	6.5%	100.0%
13	0.2%	4.2%	0.9%	3.5%	1.3%	0.7%	0.5%	2.5%	2.9%	1.1%	1.8%	9.0%	10.9%	5.8%	4.8%	4.9%	2.1%	0.0%	14.5%	4.9%	6.6%	7.3%	9.7%	100.0%
	0.1%	2.0%	0.3%	2.0%	0.4%	0.3%	0.1%	2.2%	1.7%	0.2%	1.6%	5.9%	18.8%	10.7%	3.1%	1.7%	1.9%	6.8%	14.2%	2.6%	5.2%	8.7%	9.4%	100.0%
14	0.1%	3.4%	0.6%	2.0%	0.9%	0.6%	0.8%	2.6%	4.6%	1.0%	1.1%	9.7%	5.7%	15.5%	4.4%	3.5%	7.6%	0.0%	12.3%	4.0%	5.5%	6.1%	8.0%	100.0%
	0.1%	0.5%	0.1%	0.5%	0.2%	0.3%	0.3%	0.6%	3.3%	0.2%	0.3%	6.5%	2.6%	35.3%	2.3%	1.0%	11.0%	5.4%	11.1%	2.0%	3.9%	6.5%	6.1%	100.0%
15	0.2%	3.9%	0.8%	1.7%	0.6%	1.8%	0.2%	4.9%	4.1%	0.7%	1.7%	4.3%	5.6%	5.5%	21.6%	2.0%	2.2%	0.0%	11.2%	4.7%	9.8%	5.5%	7.1%	100.0%
	0.1%	0.8%	0.2%	0.5%	0.3%	2.3%	0.1%	4.8%	5.0%	0.2%	0.8%	1.9%	2.3%	5.9%	30.1%	0.5%	3.7%	5.3%	10.6%	2.5%	7.8%	6.0%	8.2%	100.0%
16	0.1%	2.6%	0.7%	4.0%	1.9%	0.4%	2.0%	1.8%	1.3%	3.4%	1.0%	10.3%	3.6%	3.3%	2.7%	16.9%	1.2%	0.0%	14.8%	3.8%	3.8%	8.0%	12.3%	100.0%
	0.1%	0.4%	0.1%	1.9%	0.9%	0.1%	1.2%	0.3%	0.4%	1.7%	0.2%	17.3%	2.1%	4.7%	0.5%	20.8%	2.0%	6.6%	15.0%	2.0%	3.4%	8.7%	9.4%	100.0%
17	0.1%	2.7%	0.4%	1.6%	0.7%	0.8%	0.6%	2.3%	3.7%	1.0%	1.1%	7.6%	3.7%	9.9%	5.2%	2.4%	16.3%	0.0%	14.2%	4.3%	5.9%	7.1%	8.5%	100.0%
	0.1%	0.5%	0.2%	0.4%	0.2%	0.4%	0.6%	0.6%	2.5%	0.2%	0.3%	4.7%	1.4%	18.8%	2.5%	0.8%	28.0%	6.6%	11.0%	2.1%	4.4%	6.6%	7.1%	100.0%
18	1.1%	9.1%	5.5%	13.0%	5.4%	2.4%	2.1%	4.3%	4.8%	4.8%	4.5%	10.1%	5.1%	7.9%	5.0%	11.6%	3.3%							100.0%
	1.1%	9.7%	3.0%	9.3%	6.7%	1.6%	1.3%	4.5%	3.1%	5.0%	3.8%	11.9%	5.3%	11.6%	6.4%	8.4%	7.3%							100.0%
19	1.3%	12.5%	5.1%	8.6%	4.5%	1.7%	0.6%	6.3%	3.6%	5.0%	5.9%	8.3%	6.2%	10.4%	5.8%	12.4%	1.8%							100.0%
	2.1%	10.3%	3.5%	8.5%	5.3%	2.1%	1.4%	5.2%	3.0%	3.7%	4.7%	12.4%	5.8%	11.1%	6.3%	7.9%	6.9%							100.0%
20	11.2%	16.8%	6.7%	7.2%	2.3%	1.6%	0.4%	6.0%	2.9%	2.6%	8.8%	6.4%	6.5%	7.8%	4.5%	7.0%	1.3%							100.0%
	7.0%	15.0%	3.2%	5.9%	2.8%	3.2%	0.7%	7.7%	3.6%	1.9%	7.9%	8.6%	5.0%	8.9%	8.8%	4.9%	4.9%							100.0%
21	2.5%	12.8%	3.0%	4.5%	1.5%	5.7%	0.4%	13.9%	4.7%	1.3%	11.8%	6.1%	6.4%	7.4%	11.5%	3.9%	2.5%							100.0%
	3.1%	12.6%	2.8%	4.5%	2.4%	5.6%	0.7%	11.9%	3.7%	1.4%	11.8%	7.1%	4.8%	9.1%	9.3%	3.6%	5.7%							100.0%
22	1.3%	12.1%	4.0%	8.7%	5.4%	1.5%	0.6%	5.7%	2.5%	4.8%	6.1%	9.0%	7.1%	13.0%	5.4%	10.0%	2.7%							100.0%
	1.3%	10.1%	3.2%	7.5%	4.9%	2.1%	1.4%	5.4%	3.3%	3.4%	4.3%	12.0%	6.2%	13.2%	6.8%	7.1%	7.8%							100.0%
23	1.8%	14.4%	8.1%	15.0%	8.2%	0.9%	0.5%	3.9%	2.2%	6.4%	4.7%	7.2%	5.8%	6.8%	4.4%	8.7%	1.1%							100.0%
	1.9%	12.0%	6.9%	9.6%	8.2%	2.0%	1.2%	4.8%	2.8%	3.3%	4.6%	9.6%	4.9%	9.9%	6.2%	5.8%	6.3%							100.0%
TOTAL																								
ATTRACTION																								

NOTE:

1234%	Observed Data from LEHD data
1234%	Model Estimated

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Table 9.13 The Non-HBW District Definition

Non-HBW District	HBW District	Description
1	1	Please see Table 9.10 for HBW District Definition
	2	
	3	
2	4	
	5	
	10	
3	7	
	13	
	16	
4	11	
	8	
5	6	
	9	
	15	
6	12	
	14	
	17	
7	22	Essex - Hudson
	23	Middlesex
8	20	Mercer - Burlington - PA
9	18	NYC - Long Island - Staten Island
	19	Northern NJ and NY
10	21	Ocean - Atlantic

Figure 9.14 Non-HBW District Map

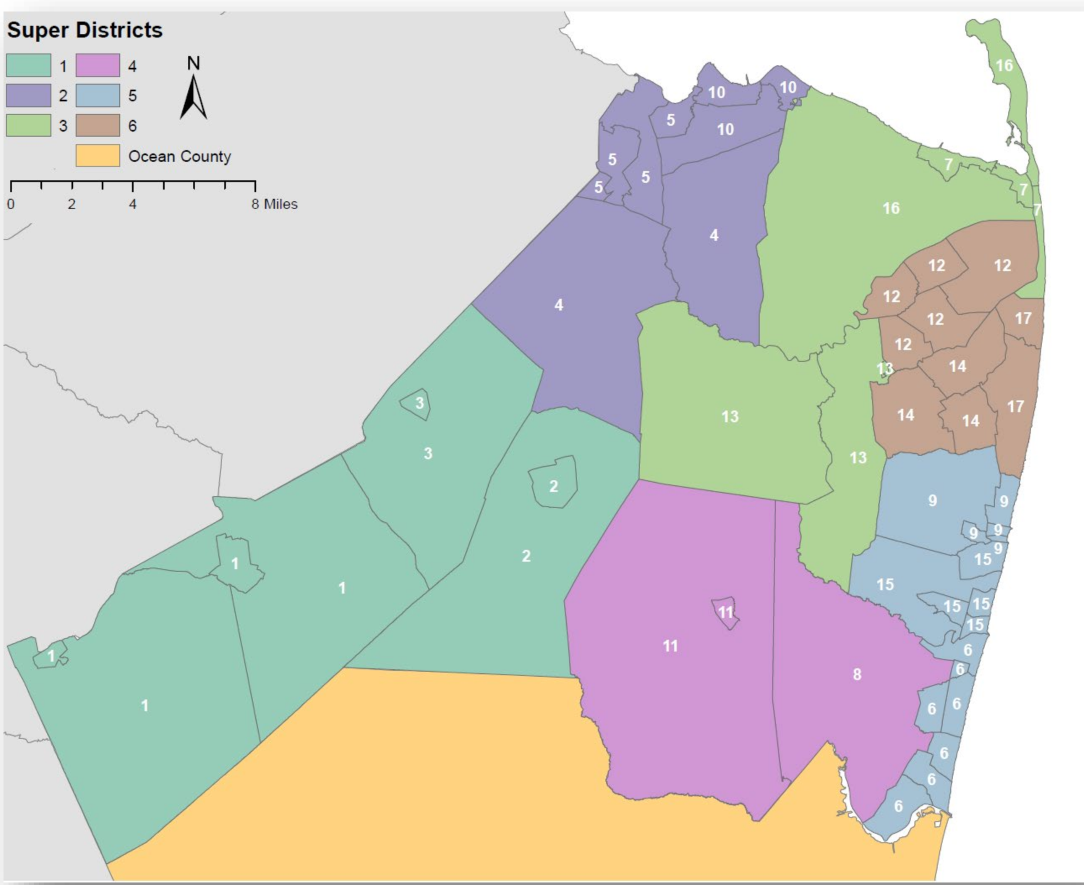


Table 9.14 Trip Flows Distribution by District - HBS

DISTRICT		1	2	3	4	5	6	7	8	9	10	Total
1	Obs	65.2%	17.8%	0.0%	0.3%	0.0%	0.0%	3.9%	9.2%	0.0%	3.6%	**100.0%**
	Est	73.0%	8.3%	2.7%	2.6%	0.6%	0.9%	5.8%	1.9%	1.5%	2.7%	**100.0%**
2	Obs	7.8%	88.0%	2.8%	0.0%	0.0%	0.0%	0.6%	0.0%	0.7%	0.0%	**100.0%**
	Est	4.8%	67.4%	16.4%	0.2%	0.3%	2.3%	6.4%	0.1%	1.7%	0.3%	**100.0%**
3	Obs	0.4%	19.7%	61.1%	0.3%	12.8%	5.3%	0.0%	0.0%	0.4%	0.0%	**100.0%**
	Est	0.8%	15.3%	57.1%	0.7%	4.1%	18.9%	1.6%	0.1%	1.0%	0.5%	**100.0%**
4	Obs	36.4%	0.0%	0.0%	45.2%	9.7%	0.0%	0.5%	0.0%	0.0%	8.2%	**100.0%**
	Est	19.9%	1.3%	3.1%	35.5%	12.4%	1.4%	1.6%	0.9%	0.7%	23.2%	**100.0%**
5	Obs	0.0%	0.0%	8.6%	15.1%	59.5%	14.3%	2.0%	0.0%	0.0%	0.6%	**100.0%**
	Est	0.6%	0.4%	4.6%	6.5%	71.9%	11.7%	0.6%	0.1%	0.8%	2.6%	**100.0%**
6	Obs	0.0%	0.0%	19.8%	0.0%	3.1%	77.2%	0.0%	0.0%	0.0%	0.0%	**100.0%**
	Est	0.2%	0.9%	14.8%	0.1%	6.2%	76.1%	0.8%	0.0%	0.6%	0.3%	**100.0%**
7	Obs	86.9%	8.3%	4.9%	0.0%	0.0%	0.0%					**100.0%**
	Est	24.7%	51.6%	12.2%	1.8%	3.4%	6.3%					**100.0%**
8	Obs	NA	NA	NA	NA	NA	NA					**0.0%**
	Est	77.1%	4.4%	1.7%	10.4%	5.4%	1.0%					**100.0%**
9	Obs	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%					**100.0%**
	Est	25.2%	37.6%	23.4%	3.9%	2.9%	6.9%					**100.0%**
10	Obs	35.4%	0.0%	17.5%	33.0%	0.0%	14.0%					**100.0%**
	Est	23.8%	5.9%	8.8%	25.9%	28.4%	7.2%					**100.0%**
Total	**Obs**	**21.3%**	**18.0%**	**19.4%**	**12.1%**	**15.1%**	**9.8%**	**1.0%**	**1.1%**	**0.2%**	**2.0%**	**100.0%**
	Est	**16.8%**	**16.2%**	**19.0%**	**9.7%**	**16.4%**	**12.8%**	**2.2%**	**0.4%**	**0.9%**	**5.4%**	**100.0%**

Table 9.15 Trip Flows Distribution by District - HBO

DISTRICT		1	2	3	4	5	6	7	8	9	10	Total
1	Obs	73.0%	12.2%	0.9%	1.3%	1.0%	0.3%	3.7%	2.2%	4.7%	0.6%	**100.0%**
	Est	71.8%	1.6%	0.3%	2.7%	0.9%	0.1%	3.4%	15.1%	1.0%	3.1%	**100.0%**
2	Obs	13.0%	66.5%	3.6%	1.2%	0.0%	4.8%	7.9%	0.1%	2.1%	0.8%	**100.0%**
	Est	18.3%	53.2%	9.5%	0.8%	1.2%	1.7%	6.9%	6.5%	1.5%	0.3%	**100.0%**
3	Obs	0.6%	7.8%	64.7%	4.6%	3.0%	14.8%	1.0%	0.0%	1.4%	2.1%	**100.0%**
	Est	4.2%	12.1%	49.2%	2.1%	10.6%	12.9%	1.4%	6.1%	0.8%	0.6%	**100.0%**
4	Obs	25.5%	0.3%	2.8%	49.7%	6.7%	1.4%	0.0%	0.0%	1.2%	12.4%	**100.0%**
	Est	21.5%	0.1%	0.6%	47.9%	2.8%	0.2%	0.3%	10.0%	0.2%	16.4%	**100.0%**
5	Obs	3.7%	0.0%	1.3%	8.0%	78.4%	5.4%	0.5%	0.0%	1.6%	1.1%	**100.0%**
	Est	0.4%	0.1%	1.5%	11.5%	69.8%	8.3%	0.1%	5.0%	0.1%	3.1%	**100.0%**
6	Obs	0.0%	1.2%	5.1%	0.0%	4.3%	87.4%	2.0%	0.0%	0.0%	0.0%	**100.0%**
	Est	0.4%	1.7%	18.0%	0.3%	15.5%	60.9%	0.4%	2.4%	0.2%	0.2%	**100.0%**
7	Obs	14.5%	22.0%	12.2%	0.0%	21.9%	29.4%					**100.0%**
	Est	47.3%	38.8%	4.4%	4.0%	3.2%	2.4%					**100.0%**
8	Obs	39.0%	0.0%	0.0%	7.8%	53.2%	0.0%					**100.0%**
	Est	78.4%	0.9%	1.4%	14.0%	3.4%	1.9%					**100.0%**
9	Obs	7.2%	54.3%	4.2%	0.0%	13.3%	21.0%					**100.0%**
	Est	33.5%	35.7%	10.8%	6.6%	5.3%	8.2%					**100.0%**
10	Obs	32.0%	3.7%	18.9%	27.3%	14.3%	3.9%					**100.0%**
	Est	24.0%	0.5%	1.0%	52.6%	20.5%	1.3%					**100.0%**
Total	**Obs**	**16.4%**	**16.8%**	**19.5%**	**11.6%**	**17.2%**	**11.6%**	**2.2%**	**0.2%**	**1.7%**	**2.7%**	**100.0%**
	Est	**18.0%**	**15.3%**	**15.8%**	**12.7%**	**17.1%**	**8.1%**	**2.0%**	**6.7%**	**0.6%**	**3.7%**	**100.0%**

Table 9.16 Trip Flows Distribution by District - NHBW

DISTRICT		1	2	3	4	5	6	7	8	9	10	Total
1	Obs	77.8%	5.9%	1.0%	8.3%	0.0%	0.8%	1.7%	0.6%	0.6%	3.2%	**100.0%**
	Est	52.1%	6.1%	4.1%	8.0%	2.7%	2.8%	12.0%	2.7%	2.0%	7.4%	**100.0%**
2	Obs	10.6%	63.3%	17.3%	0.0%	0.0%	2.7%	1.6%	0.0%	3.8%	0.7%	**100.0%**
	Est	9.9%	36.3%	14.6%	2.6%	2.4%	7.9%	18.7%	0.1%	6.1%	1.5%	**100.0%**
3	Obs	1.5%	13.8%	45.4%	1.5%	7.7%	23.4%	2.3%	0.3%	0.7%	3.5%	**100.0%**
	Est	6.1%	12.3%	36.1%	4.5%	7.1%	21.2%	6.8%	0.1%	2.4%	3.4%	**100.0%**
4	Obs	13.3%	0.0%	1.7%	42.5%	22.0%	2.1%	2.0%	0.0%	1.4%	15.0%	**100.0%**
	Est	13.7%	2.7%	5.7%	32.4%	13.7%	5.1%	2.9%	0.9%	0.5%	22.4%	**100.0%**
5	Obs	0.0%	0.0%	9.2%	23.3%	42.0%	17.9%	0.4%	0.0%	0.6%	6.6%	**100.0%**
	Est	4.7%	2.7%	9.1%	14.1%	41.0%	14.7%	2.0%	0.2%	0.5%	11.0%	**100.0%**
6	Obs	0.9%	1.8%	19.9%	1.6%	12.7%	51.0%	0.2%	0.0%	0.6%	11.1%	**100.0%**
	Est	3.6%	5.7%	18.1%	3.5%	10.4%	52.1%	3.2%	0.0%	1.2%	2.4%	**100.0%**
7	Obs	28.8%	14.9%	27.3%	21.7%	4.1%	3.3%					**100.0%**
	Est	37.4%	32.2%	14.0%	5.6%	3.4%	7.5%					**100.0%**
8	Obs	76.7%	0.0%	23.3%	0.0%	0.0%	0.0%					**100.0%**
	Est	74.1%	2.3%	1.9%	17.6%	3.2%	0.8%					**100.0%**
9	Obs	11.4%	42.8%	10.5%	17.1%	7.4%	10.8%					**100.0%**
	Est	25.5%	39.6%	18.7%	3.8%	2.6%	9.8%					**100.0%**
10	Obs	11.4%	1.4%	8.5%	32.9%	13.6%	32.2%					**100.0%**
	Est	21.6%	2.8%	7.5%	41.7%	19.7%	6.7%					**100.0%**
Total	**Obs**	**21.3%**	**11.9%**	**14.9%**	**13.3%**	**12.5%**	**17.6%**	**1.2%**	**0.2%**	**1.0%**	**6.1%**	**100.0%**
	Est	**19.7%**	**11.0%**	**13.7%**	**12.2%**	**11.6%**	**16.3%**	**6.5%**	**0.7%**	**1.7%**	**6.6%**	**100.0%**

Table 9.17 Trip Flows Distribution by District - NHBO

DISTRICT		1	2	3	4	5	6	7	8	9	10	Total
1	Obs	67.1%	3.9%	7.0%	5.0%	3.1%	0.2%	5.0%	2.8%	1.8%	4.0%	**100.0%**
	Est	72.3%	2.5%	2.0%	6.0%	1.1%	0.4%	7.4%	2.4%	3.0%	3.0%	**100.0%**
2	Obs	6.1%	64.0%	14.2%	0.3%	0.6%	2.0%	8.1%	0.0%	3.0%	1.5%	**100.0%**
	Est	3.6%	53.2%	18.8%	0.4%	0.7%	1.8%	15.2%	0.4%	5.1%	0.6%	**100.0%**
3	Obs	6.4%	8.3%	65.3%	1.5%	7.7%	9.3%	0.5%	0.0%	0.3%	0.6%	**100.0%**
	Est	1.8%	11.3%	58.4%	1.5%	6.5%	11.8%	3.4%	0.6%	3.8%	0.9%	**100.0%**
4	Obs	11.9%	0.4%	3.8%	35.4%	17.5%	5.3%	0.4%	0.0%	4.6%	20.7%	**100.0%**
	Est	14.4%	0.7%	4.0%	38.9%	17.8%	1.1%	2.7%	1.1%	2.6%	16.6%	**100.0%**
5	Obs	3.0%	0.4%	8.0%	7.1%	68.3%	6.5%	0.7%	0.0%	1.1%	5.0%	**100.0%**
	Est	1.0%	0.5%	7.0%	7.1%	68.5%	7.3%	1.5%	0.5%	2.0%	4.6%	**100.0%**
6	Obs	0.4%	2.3%	18.2%	4.0%	12.0%	58.4%	1.2%	0.0%	1.5%	1.9%	**100.0%**
	Est	0.8%	2.1%	23.5%	0.8%	14.0%	53.3%	1.8%	0.5%	2.6%	0.6%	**100.0%**
7	Obs	40.3%	41.8%	4.8%	1.4%	6.2%	5.5%					**100.0%**
	Est	31.2%	40.1%	14.1%	4.4%	6.1%	4.0%					**100.0%**
8	Obs	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%					**100.0%**
	Est	48.7%	7.8%	13.4%	9.6%	13.3%	7.2%					**100.0%**
9	Obs	23.2%	24.0%	4.0%	24.1%	14.0%	10.7%					**100.0%**
	Est	21.5%	21.0%	27.8%	7.1%	13.1%	9.5%					**100.0%**
10	Obs	19.6%	4.7%	3.4%	42.0%	25.1%	5.2%					**100.0%**
	Est	17.5%	2.6%	6.6%	42.4%	28.4%	2.5%					**100.0%**
Total	**Obs**	**19.4%**	**12.2%**	**21.0%**	**8.1%**	**20.1%**	**10.8%**	**2.4%**	**0.5%**	**1.5%**	**4.0%**	**100.0%**
	Est	**18.8%**	**11.8%**	**20.2%**	**7.9%**	**19.6%**	**10.3%**	**4.6%**	**0.9%**	**2.8%**	**3.1%**	**100.0%**

9.4 MODE CHOICE

The mode choice model for the MCTDM is adopted from the NJRTM-E and the NJ Transit's North Jersey Travel Demand Forecasting Model (NJTDFM). The model was developed using a C-Based programming language and invoked by the NJRTM-E within Cube Environment. This C-Based mode choice model replaces the older mode choice model developed using FORTRAN programming language. The mode choice is a typical step within a traditional 4-step travel forecasting model. In this step, trips in each TAZ-to-TAZ cell of the person trip table are divided among 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 TAZ pair and the characteristics of the traveler, the production TAZ, and the attraction TAZ. The mathematical function used in the mode choice model to perform this split is known as a nested logit model. Figure 9.15 shows the nesting structure of this model.

The logit model is structured so that for each Production and Attraction TAZ pair, the percentage (or share) of trips choosing a given mode *a* from a choice of *m* modes is equal to the exponential of utility associated with mode *a* divided by the sum of the exponential of utility for all *m* modes. The equation is:

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

where,

Pa is the probability of a traveler choosing mode a;
Ua is the utility (or attractiveness) of mode a; and
ΣUi is the sum of the utilities for all m modes.

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

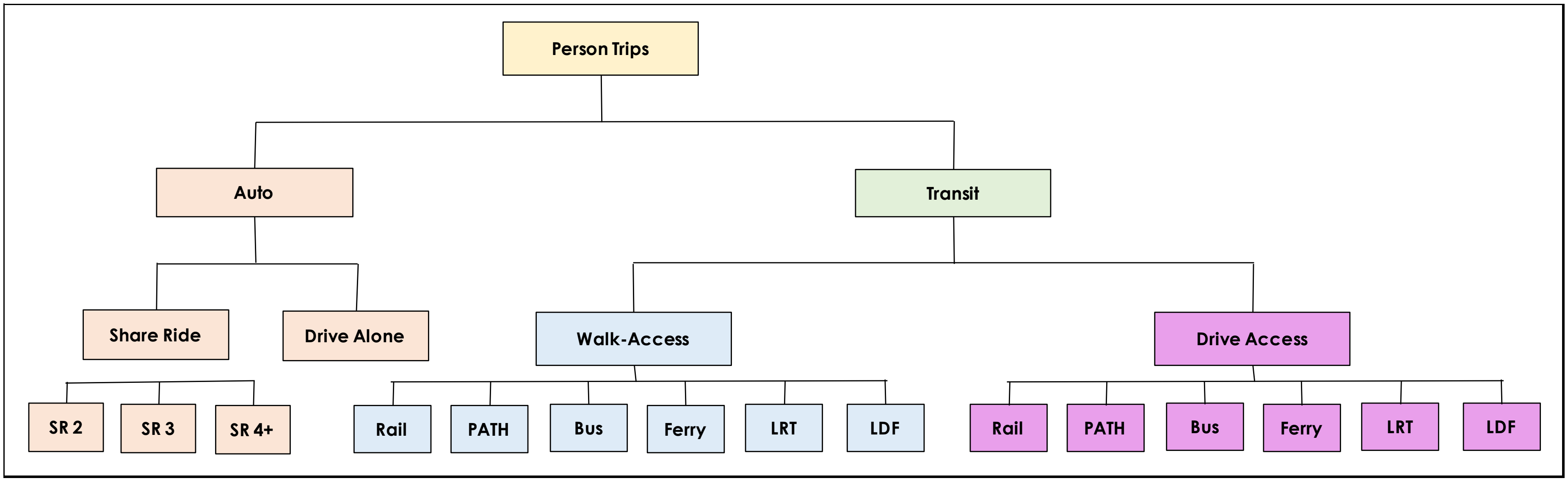
$$U_a = c_1 \times Distance_a + c_2 \times Fare_a + c_3 \times InVehicleTime_a + \ldots + C_a$$

where,

U_a is the utility (or attractiveness) of mode a;

$Distance_a$, $Fare_a$, and In-Vehicle $Time_a$ - are level of service variables of mode *a* for this trip
c_1,c_2,.. are coefficients estimated for each of the terms based on survey results
c_a is the constant for mode a – obtained through calibration

Figure 9.15 Nesting Structure for Mode Choice Model



Note:
LRT = Light Rail Transit
LDF = Long Distance Ferry

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The models are structured as a series of choices, or also known as 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 exponential of 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:

Ub is the utility for nest b
Cnest is a coefficient called the nesting coefficient, or theta; and
Cb is a nest level constant for nest b– obtained through calibration.

The calibration was performed by adjusting these mode choice coefficients and comparing model estimated person trips by travel mode to the observed targets obtained from the Household Survey Data. The model consists of four major auto modes:

- Single Occupancy Vehicles (SOV)
- High Occupancy Vehicle with 2 occupants (HOV2)
- High Occupancy Vehicles with 3 occupants (HOV3)
- High Occupancy Vehicles with 4 or more occupants (HOV4+)

And two transit sub-modes:

- Walk to transit
- Drive to transit

Each transit sub-modes consists of commuter rail, bus, PATH, subway, light rail, and Ferry. The percent mode share comparison for each trip purpose is shown in Table 9.18 to Table 9.23. The model estimated percent mode shares replicated the observed data reasonably well.

Table 9.18 Mode Choice Comparison - HBWD

MODE	HBWD (Person Trips)	
	2010 RHTS	Estimated
	Pct	Pct
SOV	77.4%	80.2%
HOV2	7.2%	6.6%
HOV3	0.3%	0.4%
HOV4	0.0%	0.3%
Walk-Transit	2.4%	3.6%
Drive-Transit	12.8%	8.9%
TOTAL	**100.0%**	**100.0%**

Table 9.19 Mode Choice Comparison - HBWS

MODE	HBWS (Person Trips)	
	2010 RHTS	Estimated
	Pct	Pct
SOV	85.4%	80.3%
HOV2	11.2%	13.6%
HOV3	1.2%	3.7%
HOV4	2.2%	2.3%
Walk-Transit	0.0%	0.1%
Drive-Transit	0.0%	0.0%
TOTAL	100.0%	100.0%

Table 9.20 Mode Choice Comparison - HBS

MODE	HBS (Person Trips)	
	2010 RHTS	Estimated
	Pct	Pct
SOV	57.5%	57.8%
HOV2	24.2%	27.7%
HOV3	14.6%	10.2%
HOV4	2.1%	3.7%
Walk-Transit	1.6%	0.5%
Drive-Transit	0.0%	0.1%
TOTAL	100.0%	100.0%

Table 9.21 Mode Choice Comparison - HBO

MODE	HBO (Person Trips)	
	2010 RHTS	Estimated
	Pct	Pct
SOV	45.4%	46.9%
HOV2	28.0%	29.3%
HOV3	16.6%	15.9%
HOV4	8.5%	7.7%
Walk-Transit	0.8%	0.1%
Drive-Transit	0.7%	0.1%
TOTAL	100.0%	100.0%

Table 9.22 Mode Choice Comparison - NHBW

MODE	NHBW (Person Trips)	
	2010 RHTS	Estimated
	Pct	Pct
SOV	80.6%	80.5%
HOV2	18.0%	18.5%
HOV3	0.5%	0.8%
HOV4	0.8%	0.2%
Walk-Transit	0.0%	0.0%
Drive-Transit	0.0%	0.0%
TOTAL	100.0%	100.0%

Table 9.23 Mode Choice Comparison - NHBO

MODE	NHBO (Person Trips)	
	2010 RHTS	Estimated
	Pct	Pct
SOV	44.7%	43.7%
HOV2	35.7%	37.3%
HOV3	15.2%	15.5%
HOV4	4.1%	3.4%
Walk-Transit	0.1%	0.1%
Drive-Transit	0.1%	0.1%
TOTAL	100.0%	100.0%

9.5 HIGHWAY ASSIGNMENT

The highway assignment model was performed for four different time periods, AM Peak, PM Peak, Midday, and Night, as discussed in Section 9.1. In order to prepare these four-period highway assignments, the daily trip tables by purpose were stratified into four time-of-day trip tables using the factors developed from the Household Survey Data. The time-of-day factors are shown in Table 9.24. The factors for the home-based trip purposes were differentiated by the direction of travel (Production/Home to Attraction and Attraction to Production/Home), while the non-home based trip purposes assume the same factor for both directions.

Table 9.24 Time-of-Day Factors

Production to Attraction

Period	HBW	HBS	HBO
AM	0.3542	0.0430	0.1493
MD	0.1056	0.2142	0.1853
PM	0.0205	0.0718	0.0936
NT	0.0407	0.0563	0.0851
TOTAL	**0.5210**	**0.3853**	**0.5133**

Attraction to Production

Period	HBW	HBS	HBO
AM	0.0068	0.0161	0.0403
MD	0.0714	0.2341	0.1328
PM	0.2633	0.1895	0.1413
NT	0.1376	0.1750	0.1722
TOTAL	**0.4790**	**0.6147**	**0.4867**

Non-Home Based Purposes

Period	NHBW	NHBO
AM	0.0751	0.0825
MD	0.6199	0.4876
PM	0.2219	0.2560
NT	0.0831	0.1739
TOTAL	**1.0000**	**1.0000**

The highway assignment calibration focused on the standard comparison of volumes and VMT by various classifications, such as facility type and area type. The assignment calibration also focused on the screenline volumes and the distribution of the traffic among the roadways that construed the screenlines.

Tables 9.25 and 9.26 show the volume comparison between observed count data and estimated volumes by facility type and area type, respectively. At the county-level, the estimated volume is approximately within one percent of the observed data. At more disaggregated level, the combination of AT and FT, the differences are more pronounced as shown in Tables 9.27.

The percent of Root Mean Square Error (RMSE) is commonly used to determine how closely estimated volumes replicate observed count data. The lower the RMSE values, the better the model estimated volumes replicate the count data. Table 9.28 shows the model estimated RMSE by volume group compared to the FHWA standard.

Table 9.25 Comparison by Facility Type

FACILITY TYPE	VOLUME		
	OBSERVED	ESTIMATED	EST/OBS
Limited-Access Facility	3,656,436	3,497,673	0.96
Expressway	198,964	186,218	0.94
Principal Arterial Divided	510,588	454,914	0.89
Principal Arterial Undivided	466,781	483,220	1.04
Minor Arterial Divided	294,106	260,664	0.89
Minor Arterial Undivided	1,014,673	1,035,818	1.02
Minor Arterials	1,835,628	1,967,082	1.07
Collector/Local	63,316	101,551	1.60
TOTAL	**8,040,492**	**7,987,140**	**0.99**

Table 9.26 Comparison by Area Type

AREA TYPE	VOLUME		
	OBSERVED	ESTIMATED	EST/OBS
Urban	505,432	538,131	1.06
Suburban	6,789,820	6,645,734	0.98
Rural	745,240	803,275	1.08
TOTAL	**8,040,492**	**7,987,140**	**0.99**

Table 9.27 Volume Comparison by Facility Type and Area Type

OBSERVED VOLUME

FACILITY TYPE	AREA TYPE			
	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	--	3,449,090	207,346	3,656,436
Expressway	--	180,656	18,308	198,964
Principal Arterial Divided	17,289	419,197	74,102	510,588
Principal Arterial Undivided	135,106	257,456	74,219	466,781
Minor Arterial Divided	--	294,106	--	294,106
Minor Arterial Undivided	63,733	700,502	250,438	1,014,673
Minor Arterials	282,231	1,458,086	95,311	1,835,628
Collector/Local	7,073	30,727	25,516	63,316
TOTAL	**505,432**	**6,789,820**	**745,240**	**8,040,492**

ESTIMATED VOLUME

FACILITY TYPE	AREA TYPE			
	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	--	3,293,379	204,294	3,497,673
Expressway	--	170,641	15,577	186,218
Principal Arterial Divided	14,314	375,460	65,140	454,914
Principal Arterial Undivided	133,282	244,381	105,557	483,220
Minor Arterial Divided	--	260,664	--	260,664
Minor Arterial Undivided	59,932	728,251	247,635	1,035,818
Minor Arterials	324,388	1,518,397	124,297	1,967,082
Collector/Local	6,215	54,561	40,775	101,551
TOTAL	**538,131**	**6,645,734**	**803,275**	**7,987,140**

ESTIMATED VOLUME/OBSERVED VOLUME

FACILITY TYPE	AREA TYPE			
	Urban	Suburban	Rural	TOTAL
Limited-Access Facility	--	0.95	0.99	0.96
Expressway	--	0.94	0.85	0.94
Principal Arterial Divided	0.83	0.90	0.88	0.89
Principal Arterial Undivided	0.99	0.95	1.42	1.04
Minor Arterial Divided	--	0.89	--	0.89
Minor Arterial Undivided	0.94	1.04	0.99	1.02
Minor Arterials	1.15	1.04	1.30	1.07
Collector/Local	0.88	1.78	1.60	1.60
TOTAL	**1.06**	**0.98**	**1.08**	**0.99**

Table 9.28 RMSE Comparison by Volume Group

VOLUME GROUP	MODEL ESTIMATED RMSE	FHWA STANDARD
> 80,000	12.0	16.0
70,000-80,000	16.6	16.0
60,000-70,000	11.7	18.0
50,000-60,000	21.9	20.0
40,000-50,000	--	21.0
30,000-40,000	13.7	23.0
20,000-30,000	37.7	25.0
10,000-20,000	41.1	27.0
0-10,0000	55.9	40-60
TOTAL	**41.0**	**35-40**

The next comparison is traffic volume by screenline. Figure 9.16 shows the screenline locations for this study, while Table 9.29 shows the total traffic by screenline.

Figure 9.16 Screenline Definition

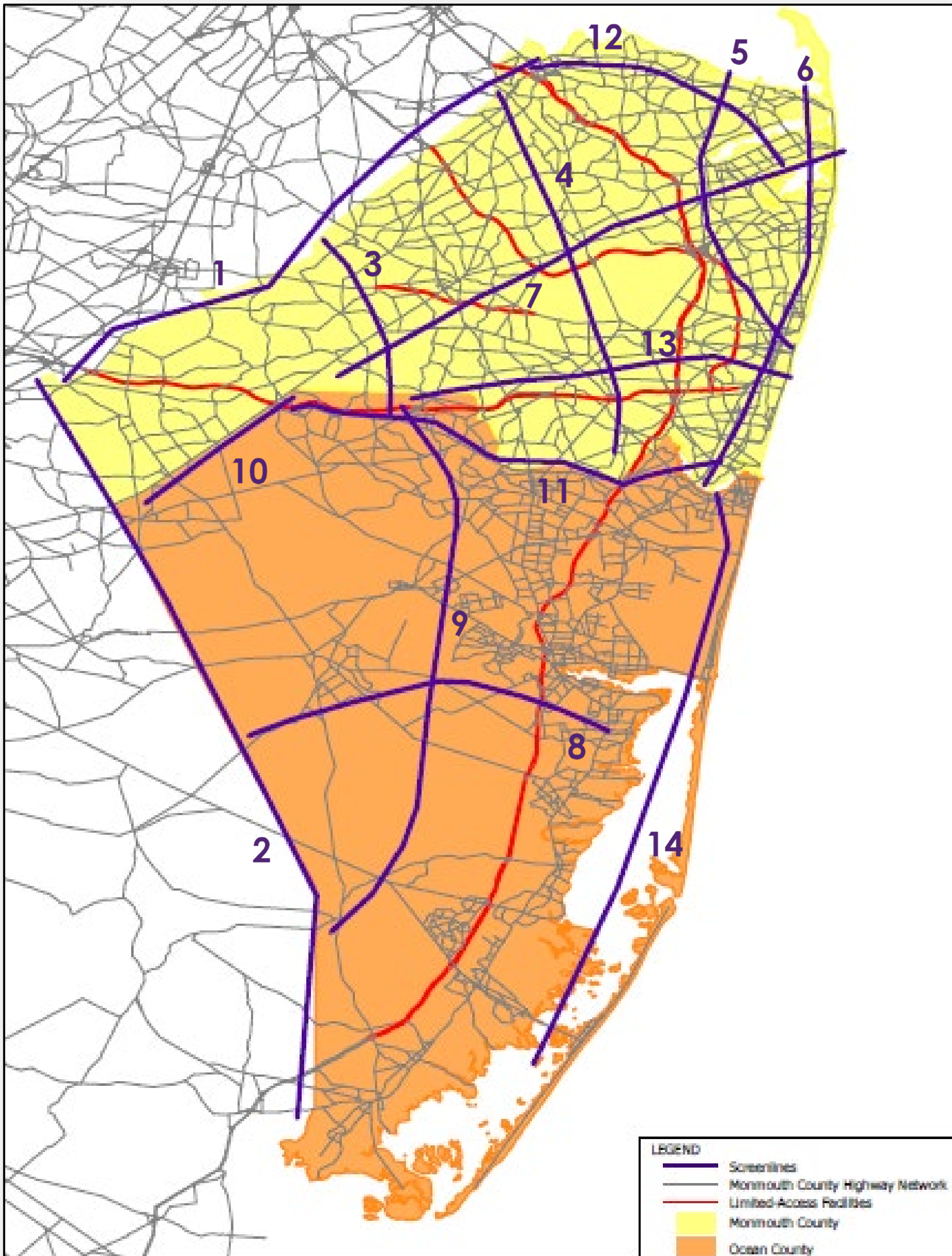


Table 9.29 Total Screenline Traffic Comparison

Screenline No	Observed Counts	Estimated Volumes	Ratio
Screenline 1	532,390	571,200	1.07
Screenline 2	97,268	152,063	1.56
Screenline 3	125,926	157,211	1.25
Screenline 4	217,001	215,488	0.99
Screenline 5	321,046	352,843	1.10
Screenline 6	263,048	230,648	0.88
Screenline 7	536,700	537,322	1.00
Screenline 8	110,436	115,419	1.05
Screenline 9	196,025	207,562	1.06
Screenline 10	72,313	99,071	1.37
Screenline 11	322,895	269,572	0.83
Screenline 12	181,817	172,117	0.95
Screenline 13	347,466	294,092	0.85
Screenline 14	96,340	74,136	0.77
Total	**3,420,671**	**3,448,745**	**1.01**

The distribution of screenline traffic among the roadways is shown in Table 9.30. At this level, the difference between observed and estimated traffic is more pronounced as expected.

Table 9.30 Individual Roadway Comparison by Screenline

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 1	CR-526/Robinsville Allentown Rd	9,004	1.7%	31,651	5.5%	3.52
	I-195	63,637	12.0%	41,337	7.2%	0.65
	Old York Rd	6,551	1.2%	8,615	1.5%	1.32
	CR-571/Etra Perineville Rd	3,919	0.7%	7,835	1.4%	2.00
	NJ-33	34,181	6.4%	41,815	7.3%	1.22
	CR-522 (N of Spotswood Englishtown Rd)	6,945	1.3%	9,890	1.7%	1.42
	CR-527/Old Bridge Englishtown Rd	10,173	1.9%	10,471	1.8%	1.03
	CR-520/Texas Rd	13,716	2.6%	11,766	2.1%	0.86
	NJ-18	39,948	7.5%	49,996	8.8%	1.25
	US-9	77,040	14.5%	84,642	14.8%	1.10
	Ticetown Rd	1,451	0.3%	10,053	1.8%	6.93
	CR-516/Old Bridge Matawan Rd	4,298	0.8%	10,289	1.8%	2.39
	CR-689/Amboy Rd	5,066	1.0%	7,884	1.4%	1.56
	NJ-34	25,466	4.8%	39,526	6.9%	1.55
	CR-6A/Ravine Dr	5,104	1.0%	4,777	0.8%	0.94
	Garden State Parkway	180,990	34.0%	172,742	30.2%	0.95
	NJ-35	38,182	7.2%	22,920	4.0%	0.60
	Amboy Rd	6,719	1.3%	4,991	0.9%	0.74
	TOTAL	**532,390**	**100.0%**	**571,200**	**100.0%**	**1.07**
Screenline 2	CR-524	6,387	6.6%	10,999	7.2%	1.72
	CR-28/Old York Rd	3,399	3.5%	8,567	5.6%	2.52
	CR-537/Monmouth Rd	6,347	6.5%	15,296	10.1%	2.41
	CR-528/Jacobstown New Egypt Rd	4,504	4.6%	4,413	2.9%	0.98
	CR-616/Cookstown New Egypt Rd	5,782	5.9%	5,505	3.6%	0.95
	Bunting Bridge Rd	1,556	1.6%	277	0.2%	0.18
	NJ-70	11,083	11.4%	11,327	7.4%	1.02
	NJ-72	8,891	9.1%	15,298	10.1%	1.72
	Garden State Parkway	39,733	40.8%	73,809	48.5%	1.86
	US-9	9,586	9.9%	6,572	4.3%	0.69
	TOTAL	**97,268**	**100.0%**	**152,063**	**100.0%**	**1.56**
Screenline 3	CR-527A/Iron Ore Rd	3,816	3.0%	5,780	3.7%	1.51
	Woodward Rd	9,572	7.6%	5,781	3.7%	0.60
	NJ-33	27,727	22.0%	45,909	29.2%	1.66
	CR-527/Sweetmans Ln	11,634	9.2%	7,263	4.6%	0.62
	Oakland Mills Rd	1,146	0.9%	4,546	2.9%	3.97
	Monmouth Rd	20,269	16.1%	22,744	14.5%	1.12
	Ely Harmony Rd	2,280	1.8%	5,468	3.5%	2.40
	I-195	49,482	39.3%	59,721	38.0%	1.21
	TOTAL	**125,926**	**100.0%**	**157,211**	**100.0%**	**1.25**
Screenline 4	CR-516/New Brunswick Ave	9,452	4.2%	10,430	5.0%	1.10
	Wilson Ave	4,490	2.0%	6,884	3.3%	1.53
	NJ-79	10,004	4.5%	7,842	3.8%	0.78
	Lloyd Rd	15,755	7.0%	12,167	5.8%	0.77
	CR-520/Newman Springs Rd	12,605	5.6%	10,399	5.0%	0.83
	Crine Rd	5,834	2.6%	5,812	2.8%	1.00
	CR-537	15,273	6.8%	14,493	6.9%	0.95
	NJ-18	47,666	21.2%	48,278	23.1%	1.01
	Asbury Rd	8,094	3.6%	9,196	4.4%	1.14
	Belmar Blvd	3,579	1.6%	4,497	2.2%	1.26
	CR-524	7,739	3.4%	5,949	2.9%	0.77
	I-195	65,719	29.2%	60,634	29.1%	0.92
	CR-549/Herbertsville Rd	15,077	6.7%	7,419	3.6%	0.49
	Lakewood Allenwood Rd	3,453	1.5%	4,620	2.2%	1.34
	TOTAL	**224,740**	**100.0%**	**208,619**	**100.0%**	**0.93**

Table 9.29 – Continued

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 5	NJ-36	23,861	7.4%	23,048	6.6%	0.97
	CR-516/Leonardville Rd	11,918	3.7%	10,982	3.1%	0.92
	Kings Hwy E	4,430	1.4%	11,719	3.4%	2.65
	Cooper Rd	987	0.3%	100	0.0%	0.10
	NJ-35	42,398	13.2%	34,072	9.8%	0.80
	W Front St	16,330	5.1%	29,231	8.4%	1.79
	CR-520/Newman Springs Rd	18,584	5.8%	25,668	7.4%	1.38
	CR-13A/Sycamore Ave	19,090	5.9%	16,413	4.7%	0.86
	Tinton Ave	18,075	5.6%	16,932	4.8%	0.94
	NJ-36	34,899	10.9%	40,877	11.7%	1.17
	CR-547/Wyckoff Rd	16,390	5.1%	16,503	4.7%	1.01
	Indistrial Way W	12,203	3.8%	10,033	2.9%	0.82
	W Park Ave	17067	5.3%	23,882	6.8%	1.40
	Deal Rd	11,583	3.6%	13,564	3.9%	1.17
	NJ-35	30,216	9.4%	28,806	8.2%	0.95
	Wickapecko Dr	5,574	1.7%	9,050	2.6%	1.62
	Asbury Ave	11,115	3.5%	7,780	2.2%	0.70
	Bangs Ave	2,684	0.8%	6,284	1.8%	2.34
	NJ-71/Main St	18,640	5.8%	20,141	5.8%	1.08
	Lake Terrace	5,002	1.6%	4,120	1.2%	0.82
	TOTAL	**321,046**	**100.0%**	**349,205**	**100.0%**	**1.09**
Screenline 6	NJ-36/Memorial Pkwy	13,708	5.2%	19,893	8.6%	1.45
	Ridge Rd	5,526	2.1%	4,170	1.8%	0.75
	CR-520/Rumson Rd	12,494	4.7%	10,625	4.6%	0.85
	NJ-36 (Joline Ave)	23,082	8.8%	9,933	4.3%	0.43
	Broadway	11,381	4.3%	9,530	4.1%	0.84
	N Bath Ave (SE of High St)	9,915	3.8%	4,372	1.9%	0.44
	Westwood Ave (S of N Bath Ave)	6,563	2.5%	6,331	2.7%	0.96
	Cedar Ave (E of Westwood Ave)	11,905	4.5%	8,816	3.8%	0.74
	NJ-71/Norwood Ave (N of Roseld Ave)	14,799	5.6%	12,196	5.3%	0.82
	Grassmere Ave	2,604	1.0%	4,403	1.9%	1.69
	Asbury Ave	7,319	2.8%	6,951	3.0%	0.95
	Bangs Ave	2,684	1.0%	6,284	2.7%	2.34
	NJ-33	17,289	6.6%	14,314	6.2%	0.83
	NJ-35	16,823	6.4%	10,179	4.4%	0.61
	NJ-35/River Rd	27,442	10.4%	16,900	7.3%	0.62
	16th Ave	7,537	2.9%	7,627	3.3%	1.01
	CR-30/18th Ave	5,287	2.0%	9,293	4.0%	1.76
	CR-524/Allaire Rd	8,465	3.2%	9,673	4.2%	1.14
	Warren Ave (E of Old Mill Rd)	6,708	2.6%	6,112	2.6%	0.91
	Sea Girt Ave (E of Old Mill Rd)	9,217	3.5%	11,296	4.9%	1.23
	Atlantic Ave	9,842	3.7%	6,796	2.9%	0.69
	Old Bridge Rd	4,457	1.7%	7,850	3.4%	1.76
	NJ-35	22,000	8.4%	19,306	8.4%	0.88
	Riverview Dr	6,001	2.3%	7,800	3.4%	1.30
	TOTAL	**263,048**	**100.0%**	**230,648**	**100.0%**	**0.88**

Table 9.29 – Continued

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 7	Ely Harmony Rd	532	0.1%	3,571	0.7%	6.71
	CR-527/Siloam Rd	10,960	2.0%	9,257	1.7%	0.84
	CR-524 (E of Gravel Hill Rd)	13,996	2.6%	13,857	2.6%	0.99
	Stillwells Corner Rd	10,016	1.9%	9,844	1.8%	0.98
	US-9	54,084	10.1%	56,379	10.5%	1.04
	NJ-33	30,472	5.7%	31,010	5.8%	1.02
	NJ-33 (Park Ave)	10,610	2.0%	13,379	2.5%	1.26
	CR-55/Kozloski Rd	23,074	4.3%	24,364	4.5%	1.06
	NJ-18 (S of Exit 22A)	47,666	8.9%	48,278	9.0%	1.01
	Five Points Rd	12,007	2.2%	9,193	1.7%	0.77
	CR-537	15,273	2.8%	14,493	2.7%	0.95
	Heyers Mill Rd (S of Flock Rd)	2,011	0.4%	3,625	0.7%	1.80
	NJ-34	16,639	3.1%	27,128	5.0%	1.63
	Swimming River Rd	10,318	1.9%	8,867	1.7%	0.86
	Garden State Parkway	170,600	31.8%	171,156	31.9%	1.00
	Hance Ave	9,436	1.8%	8,329	1.6%	0.88
	CR-13 /Shrewsbury Ave	31,867	5.9%	16,218	3.0%	0.51
	NJ-35/Broad St	22,033	4.1%	19,873	3.7%	0.90
	Branch Ave	11,680	2.2%	13,441	2.5%	1.15
	Prospect Ave	11,249	2.1%	9,061	1.7%	0.81
	Seven Bridges Rd	10,413	1.9%	12,076	2.2%	1.16
	NJ-36/Ocean Ave	11,764	2.2%	13,923	2.6%	1.18
	TOTAL	**536,700**	**100.0%**	**537,322**	**100.0%**	**1.00**
Screenline 8	CR-530 (N of Dover Rd)	20,064	18.2%	11,453	9.9%	0.57
	Garden State Parkway	81,785	74.1%	95,756	83.0%	1.17
	Pinewald Rd (S of Birch St)	8,587	7.8%	8,209	7.1%	0.96
	TOTAL	**110,436**	**100.0%**	**115,419**	**100.0%**	**1.05**
Screenline 9	I-195	49,482	25.2%	59,721	28.8%	1.21
	Jackson Mills Rd	9,172	4.7%	10,139	4.9%	1.11
	Bennetts Mills Rd	12,761	6.5%	6,257	3.0%	0.49
	E Veterans Hwy	10,365	5.3%	8,339	4.0%	0.80
	CR-527/Whitesville Rd	9,155	4.7%	11,404	5.5%	1.25
	CR-547/S Hope Chapel Rd	13,205	6.7%	12,145	5.9%	0.92
	CR-571/ Ridgeway Rd	12,244	6.2%	16,362	7.9%	1.34
	NJ-70	14,727	7.5%	10,653	5.1%	0.72
	NJ-37	30,130	15.4%	20,811	10.0%	0.69
	CR-530	20,064	10.2%	11,453	5.5%	0.57
	Dover Rd	1,168	0.6%	7,143	3.4%	6.12
	Lacey Rd	6,741	3.4%	4,579	2.2%	0.68
	CR-532/Warren Grove Rd (S of Jones Rd)	2,089	1.1%	6,924	3.3%	3.31
	CR-539/ Main St	4,722	2.4%	21,632	10.4%	4.58
	TOTAL	**196,025**	**100.0%**	**207,562**	**100.0%**	**1.06**
Screenline 10	Highbridge Rd	2,898	4.0%	2,368	2.4%	0.82
	CR-539/Pinehurst Rd	13,051	18.0%	12,997	13.1%	1.00
	CR-640/Hawkin Rd	2,847	3.9%	2,952	3.0%	1.04
	I-195	39,990	55.3%	56,570	57.1%	1.41
	Cassville Rd	13,527	18.7%	24,184	24.4%	1.79
	TOTAL	**72,313**	**100.0%**	**99,071**	**100.0%**	**1.37**

Table 9.29 – Continued

ScreenLine	Location	Observed Counts	Distribution	Estimated Volumes	Distribution	Ratio
Screenline 11	CR-571/Casville Rd	13,527	4.2%	24,184	9.0%	1.79
	CR-527/Cedar Swamp Rd	18,919	5.9%	10,995	4.1%	0.58
	Jackson Mills Rd	9,172	2.8%	10,139	3.8%	1.11
	Bennetts Mills Rd	16,398	5.1%	8,346	3.1%	0.51
	S New Prospect Rd	8,388	2.6%	5,189	1.9%	0.62
	US-9	26,755	8.3%	24,590	9.1%	0.92
	CR-547/Squankum Rd	11,847	3.7%	12,236	4.5%	1.03
	Lanes Mill Rd	25,258	7.8%	10,151	3.8%	0.40
	Garden State Parkway	113,792	35.2%	115,537	42.9%	1.02
	Lanes Mill Rd	18,253	5.7%	7,539	2.8%	0.41
	NJ-70	33,088	10.2%	15,280	5.7%	0.46
	Old Bridge Rd	5,498	1.7%	6,081	2.3%	1.11
	NJ-35	22,000	6.8%	19,306	7.2%	0.88
	TOTAL	**322,895**	**100.0%**	**269,572**	**100.0%**	**0.83**
Screenline 12	NJ-35	38,182	21.0%	22,920	13.3%	0.60
	Maple St	15,763	8.7%	10,170	5.9%	0.65
	Broad St	5,262	2.9%	21,604	12.6%	4.11
	Green Grove Ave	4,500	2.5%	6,385	3.7%	1.42
	NJ-36	36,014	19.8%	27,705	16.1%	0.77
	Union Ave	8,346	4.6%	7,473	4.3%	0.90
	CR-7	10,840	6.0%	9,314	5.4%	0.86
	Leonardville Rd	12,116	6.7%	10,222	5.9%	0.84
	E Rd	6,792	3.7%	11,150	6.5%	1.64
	Kings Hwy E/Monmouth Ave	4,430	2.4%	11,719	6.8%	2.65
	CR-12A/Navesink River Rd	7,611	4.2%	10,395	6.0%	1.37
	CR-10/River Rd	13,528	7.4%	3,623	2.1%	0.27
	CR-34/Ridge Rd	5,937	3.3%	6,379	3.7%	1.07
	CR-520/Rumson Rd	12,496	6.9%	13,058	7.6%	1.04
	TOTAL	**181,817**	**100.0%**	**172,117**	**100.0%**	**0.95**
Screenline 13	Harmony Rd	2,336	0.7%	4,914	1.7%	2.10
	Fort Plains Rd	6,066	1.7%	7,533	2.6%	1.24
	US-9	42,918	12.4%	30,824	10.5%	0.72
	CR-524A/Squankum Yellowbrook Rd	7,739	2.2%	5,949	2.0%	0.77
	CR-524/Main St	10,851	3.1%	15,232	5.2%	1.40
	NJ-34	29,681	8.5%	29,277	10.0%	0.99
	NJ-18/Belmar Blvd	6,403	1.8%	6,310	2.1%	0.99
	Garden State Parkway	154,742	44.5%	125,305	42.6%	0.81
	Gully Rd	4,028	1.2%	10,570	3.6%	2.62
	NJ-18	41,836	12.0%	22,850	7.8%	0.55
	NJ-35	31,000	8.9%	20,075	6.8%	0.65
	NJ-71/Main St	6,079	1.7%	8,494	2.9%	1.40
	Ocean Ave N	3,787	1.1%	6,758	2.3%	1.78
	TOTAL	**347,466**	**100.0%**	**294,092**	**100.0%**	**0.85**
Screenline 14	NJ-88/Ocean Rd	23,830	24.7%	14,806	20.0%	0.62
	NJ-13/Bridge Ave	15,297	15.9%	10,474	14.1%	0.68
	CR-528/Herbert St	7,143	7.4%	8,881	12.0%	1.24
	NJ-37	23,635	24.5%	25,564	34.5%	1.08
	NJ-72	26,435	27.4%	14,412	19.4%	0.55
	TOTAL	**96,340**	**100.0%**	**74,136**	**100.0%**	**0.77**

The final comparison for the highway assignment calibration is speed by time-of-day for various major highways within Monmouth County as shown in Table 9.31. The estimated speeds are generally within reasonable tolerance except for CR 35 and Route 79, in which the model estimated a higher speed than indicated by the observed data.

Table 9.31 Speed Comparison for Major Roadways

Road Name	Location	Direction	AM Period Speed (mph)			MD Period Speed (mph)		
			OBS	EST	PCT DIFF	OBS	EST	PCT DIFF
Garden State Parkway	Between US 9 and Burnt Tavern Rd	Northbound	68	50	-27%	68	68	0%
		Southbound	69	63	-8%	68	68	0%
US 9	Between RT 18 and Central Avenue	Northbound	40	44	12%	35	45	26%
		Southbound	40	44	10%	35	45	28%
I-195	Between NJ TPK and GSP	Westbound	67	64	-5%	67	65	-3%
		Eastbound	67	59	-12%	67	65	-2%
CR 33	Between NJ TPK and RT 18	Westbound	46	48	4%	47	48	3%
		Eastbound	47	49	3%	47	49	4%
RT 18	Between US 9 and CR 33	Northbound	66	65	-2%	63	64	1%
		Southbound	64	58	-10%	64	64	-1%
CR 35	Between US 9 and County Line Rd.	Northbound	32	20	-38%	30	30	1%
		Southbound	33	27	-17%	30	33	9%
RT 79	Between RT 34 and RT 33	Northbound	32	31	-3%	33	31	-5%
		Southbound	34	31	-11%	34	31	-8%
RT 34	Between RT 79 and RT 35	Northbound	43	47	10%	42	47	13%
		Southbound	42	47	12%	42	47	14%
RT 537	Between I-195 and GSP	Westbound	38	38	1%	36	38	8%
		Eastbound	38	39	0%	37	39	5%

Road Name	Location	Direction	PM Period Speed (mph)			NT Period Speed (mph)		
			OBS	EST	PCT DIFF	OBS	EST	PCT DIFF
Garden State Parkway	Between US 9 and Burnt Tavern Rd	Northbound	68	62	-9%	66	69	4%
		Southbound	66	57	-14%	67	68	3%
US 9	Between RT 18 and Central Avenue	Northbound	33	44	33%	42	45	8%
		Southbound	33	44	34%	41	45	11%
I-195	Between NJ TPK and GSP	Westbound	66	53	-21%	66	65	0%
		Eastbound	68	63	-7%	66	66	-1%
CR 33	Between NJ TPK and RT 18	Westbound	45	47	5%	48	48	0%
		Eastbound	45	49	8%	48	49	1%
RT 18	Between US 9 and CR 33	Northbound	65	56	-13%	63	66	3%
		Southbound	65	63	-4%	63	66	3%
CR 35	Between US 9 and County Line Rd.	Northbound	28	25	-12%	34	19	-45%
		Southbound	28	19	-33%	34	14	-58%
RT 79	Between RT 34 and RT 33	Northbound	31	31	2%	35	31	-11%
		Southbound	31	31	1%	37	31	-14%
RT 34	Between RT 79 and RT 35	Northbound	40	47	15%	45	48	6%
		Southbound	39	47	18%	44	48	8%
RT 537	Between I-195 and GSP	Westbound	33	37	11%	40	39	-1%
		Eastbound	35	37	5%	40	40	-1%

9.6 TRANSIT ASSIGNMENT CALIBRATION

Monmouth County has various transit lines that serve the county, including buses, trains, and ferries. Table 9.31 shows the transit ridership comparison by modes and lines.

Table 9.32 Transit Ridership Comparison

Line Name	Bus Ridership	
	Observed	Estimated
64	325	231
67	166	430
133	556	47
135	154	106
139	3383	4711
Total	**4,584**	**5,525**

Station Name	Rail Ridership	
	Observed	Estimated
Aberdeen-Matawan	2,460	1,560
Hazlet	874	1,179
Middletown	1,331	1,083
Red Bank	1,155	798
Little Silver	740	915
Long Branch	1,105	1,432
Elberon	117	176
Allenhurst	125	67
Asbury Park	548	430
Bradley Beach	225	395
Belmar	256	333
Spring Lake	152	271
Manasquan	175	260
Total	**9,263**	**8,899**

Station Name	Ferry Ridership	
	Observed	Estimated
Belford	1916	2937
Atlantic Highlands	1863	1309
Highlands	1417	1366
Total	**5,196**	**5,612**

9.7 MODEL OUTPUTS

Each model component of the MCTDM produces a number of output files. Some of them are temporary and can be ignored, while others are either inputs of the following components or output files for review and summary. The major output files of each component are listed in Appendix C for reference.

In addition to the above output files, other important outputs are the period-specific output highway networks generated by the highway network assignment process. There are four time periods defined in the MCTDM as discussed in Chapter 9.1, including AM Peak, Midday, PM Peak, and Night. The highway assignment process generates a highway network file, also known as loaded highway network, for each time period. The loaded highway network includes additional link variables, or output link variables, as listed in Appendix D.

10.0 ADDITIONAL FEATURES

10.1 SEASONAL MODEL

The seasonal model was developed to capture additional traffic demand for people traveling to the New Jersey shores during the summer months. The increase of summer traffic can be attributed to two categories:

- The increase of local activities.
- The in-flux of long-distance trips from nearby regions, such as New York City, Philadelphia, Trenton, and South Jersey.

The increase of local-activities is assumed to be proportional with the vacation housing available in the area. Table 10.1 provides the percentage of seasonal housing by municipality. The data was obtained from the 2015 Housing Units Summary from the Census website. The percentage of vacation housing units were then converted from MCD-Level to TAZ-Level using an MCD-Zones equivalency table developed for this model.

The additional traffic from the local trips is calculated using the following formula:

> Additional Local Trips for *i-j* cell = Average Daily Trips * the average of percent vacation housing units at location *i* and *j*

Only a portion of these trips are assumed to occur. Therefore, an adjustment factor is applied to these local trips. Currently, the factor is set to 0.50. The factor was determined with a trial and error approach to get the estimated trips replicating the very limited observed data.

The second component of the seasonal model is the in-flux on long distance trips. For the purpose of this model, Stantec assumed that there are five origin points for these trips:

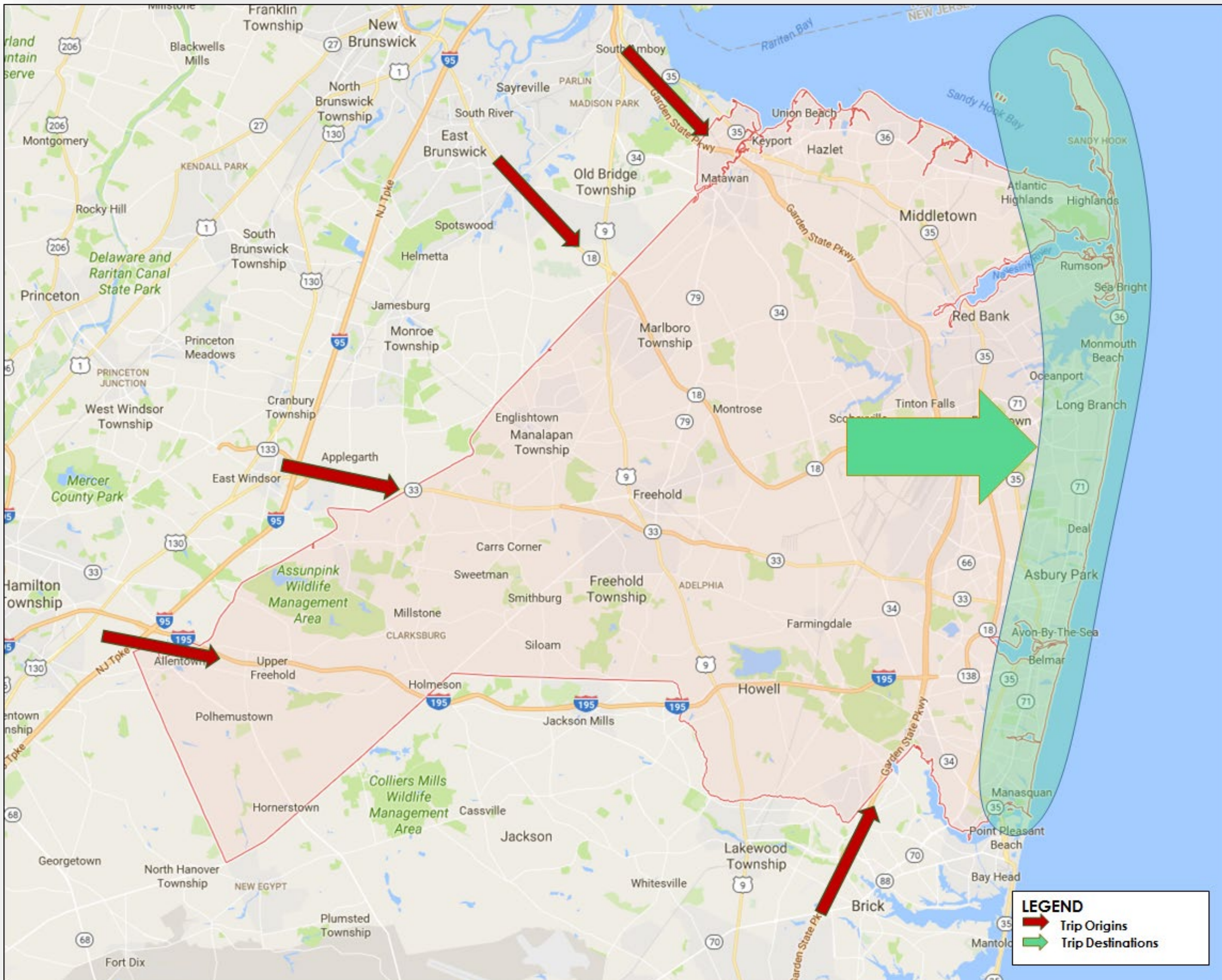
- Garden State Parkway (GSP) for the Northern market such as NYC and North Jersey.
- Route 18 for the Northwestern market, such as North Jersey.
- I-195 and Route 33 for the Western market, such as Trenton and Central Jersey.
- GSP for the Southern market, such as South Jersey.

Figure 10.1 shows the proximity of these locations.

Table 10.1 Vacation Housing Percentage by MCD in Monmouth

MCD	Vacation House Percentage	MCD	Vacation House Percentage
Aberdeen township	0.0%	Long Branch city	9.0%
Allenhurst borough	0.0%	Manalapan township	0.0%
Allentown borough	0.0%	Manasquan borough	21.2%
Asbury Park city	3.3%	Marlboro township	0.0%
Atlantic Highlands borough	0.0%	Matawan borough	0.0%
Avon-by-the-Sea borough	0.0%	Middletown township	0.8%
Belmar borough	21.4%	Millstone township	0.0%
Bradley Beach borough	0.0%	Monmouth Beach borough	20.7%
Brielle borough	0.0%	Neptune township	8.1%
Colts Neck township	0.0%	Neptune City borough	0.0%
Deal borough	58.5%	Ocean township	4.0%
Eatontown borough	0.0%	Oceanport borough	0.0%
Englishtown borough	0.0%	Red Bank borough	0.0%
Fair Haven borough	0.0%	Roosevelt borough	0.0%
Farmingdale borough	0.0%	Rumson borough	0.0%
Freehold borough	0.0%	Sea Bright borough	26.6%
Freehold township	0.0%	Sea Girt borough	0.0%
Hazlet township	0.0%	Shrewsbury borough	0.0%
Highlands borough	8.1%	Shrewsbury township	0.0%
Holmdel township	0.0%	Spring Lake borough	0.0%
Howell township	0.0%	Spring Lake Heights borough	23.8%
Interlaken borough	0.0%	Tinton Falls borough	0.0%
Keansburg borough	0.0%	Union Beach borough	0.0%
Keyport borough	0.0%	Upper Freehold township	0.0%
Lake Como borough	0.0%	Wall township	3.9%
Little Silver borough	0.0%	West Long Branch borough	0.0%
Loch Arbour village	0.0%		

Figure 10.1 Seasonal Traffic Flow Pattern - Inbound



The five seasonal TAZs are as follows:

- TAZ 1111 - represents the origin point of the Northern market such as NYC/North Jersey.
- TAZ 3013 – represents the origin point of the Northwestern market, such as North Jersey.
- TAZs 954 and 1335 – represents the origin point of the Western market, such as Central NJ and Trenton.
- TAZ 3161 – represents the origin point of the Southern market, such as South Jersey.

As the first step of the long-haul seasonal traffic estimation, Stantec gathered traffic count information from NJDOT's permanent stations and Garden State Parkway that can be used as proxy for these locations. There were very limited traffic counts that can be used for this purpose, since the counts should have both average daily counts, as well as counts for summer months by direction. Table 10.2 shows the comparison between high summer traffic volumes and AADT for the selected locations. Since there is no permanent count available on I-195, Stantec utilized the NJDOT's seasonal factor to convert the AADT into Summer Counts.

Table 10.2 High Summer Month and AADT Traffic Comparison

Location	In-Bound			Out-Bound			Average Additional Summer Traffic
	High Summer Volume	AADT	Additional Summer Traffic	High Summer Volume	AADT	Additional Summer Traffic	
GSP at Exit 120	114,793	88,987	25,806	109,704	85,042	24,662	25,234
RT 18 east of Route 9	16,072	12,503	3,569	16,072	12,503	3,569	3,569
RT 33 east of NJ Turnpike	8,299	7,040	1,259	8,300	7,041	1,259	1,259
I-195 east of NJ Turnpike	33,185	29,966	3,219	34,577	31,223	3,354	3,287
GSP north of Route 88	72,160	55,938	16,222	68,985	53,477	15,508	15,865

The average additional summer traffic from Table 10.2 was used as the base for the long-haul trip production, and is summarized in Table 10.3. Additional adjustment factors were added to account for the discrepancy between the seasonal TAZ locations (shown in Figure 10-2) and the locations of the count, such that the estimated additional summer traffic replicate the observed data. The adjustment factors are listed in Table 10.4.

Table 10.3 Long-Haul In-Bound Trip Origin

Location	Average Additional Summer Traffic
North (GSP)	25,234
Northwest (RT 18)	3,569
West (RT 33)	1,259
West (I-195)	3,287
South (GSP)	15,865

Table 10.4 Adjustment Factors In-Bound Trip Origin

Location	Production Adjustment Factors
North (GSP)	1
Northwest (RT 18)	1
West (RT 33)	1
West (I-195)	1
South (GSP)	1

The attraction of the long-haul in-bound summer traffic was also estimated based on vacation housing units. The distribution of the trips from the four production zones to all potential attraction zones, zones with vacation housing, was performed using a simple gravity model with trips balanced to production.

The out-bound trips, which represent the return trips on Sunday, were calculated using similar approach as the in-bound trips. However, the production and attraction were reversed and the trips are balanced to attraction.

The daily seasonal trips were distributed into four time-of-day, AM, PM, Midday, and Night using the time of day factors developed from the GSP hourly summer traffic counts at five toll plazas are shown in Table 10.5

Table 10.5 Time-Of-Day Factors for Seasonal Trips

Toll Location	AM	MD	PM	NT	TOTAL
New Gretna NB (Inbound)	2,289	15,217	6,306	12,825	36,637
Barnegat SB (Outbound)	5,901	22,033	11,914	13,003	52,851
Toms River NB (Inbound)	4,439	25,705	12,106	23,903	66,153
Toms River SB (Outbound)	8,194	27,407	13,614	16,688	65,903
Asbury Park NB (Outbound)	6,485	40,782	22,027	41,064	110,358
Raritan Toll Plaze SB (Inbound)	15,013	64,703	38,820	47,545	166,081
Inbound Total	21,741	105,625	57,232	84,273	268,871
Outbound Total	20,580	90,222	47,555	70,755	229,112
Inbound Time-Of-Day Factors	8.1%	39.3%	21.3%	31.3%	
Outbound Time-of-Day Factors	9.0%	39.4%	20.8%	30.9%	

Table 10.6-10.9 tables show traffic comparison between traffic counts and the estimated volumes at selected locations for inbound and outbound by facility type and area type respectively. In general, the estimated volumes are reasonably close. A sample of daily seasonal traffic pattern is shown in Figure 10.2.

Table 10.6 Inbound Seasonal Traffic Comparison by Facility Type

FACILITY TYPE	VOLUME		
	OBSERVED	ESTIMATED	EST/OBS
Limited-Access Facility	767,136	897,690	1.17
Expressway	41,692	41,501	1.00
Principal Arterial Divided	29,932	26,625	0.89
Principal Arterial Undivided	69,278	46,413	0.67
Minor Arterial Divided	10,553	14,911	1.41
Minor Arterial Undivided	66,126	66,381	1.00
Minor Arterials	116,569	108,210	0.93
Collector/Local	3,362	5,220	1.55
TOTAL	**1,104,648**	**1,206,951**	**1.09**

Table 10.7 Inbound Seasonal Traffic Comparison by Area Type

AREA TYPE	VOLUME		
	OBSERVED	ESTIMATED	EST/OBS
Urban	76,129	63,007	0.83
Suburban	881,137	871,870	0.99
Rural	147,382	272,074	1.85
TOTAL	**1,104,648**	**1,206,951**	**1.09**

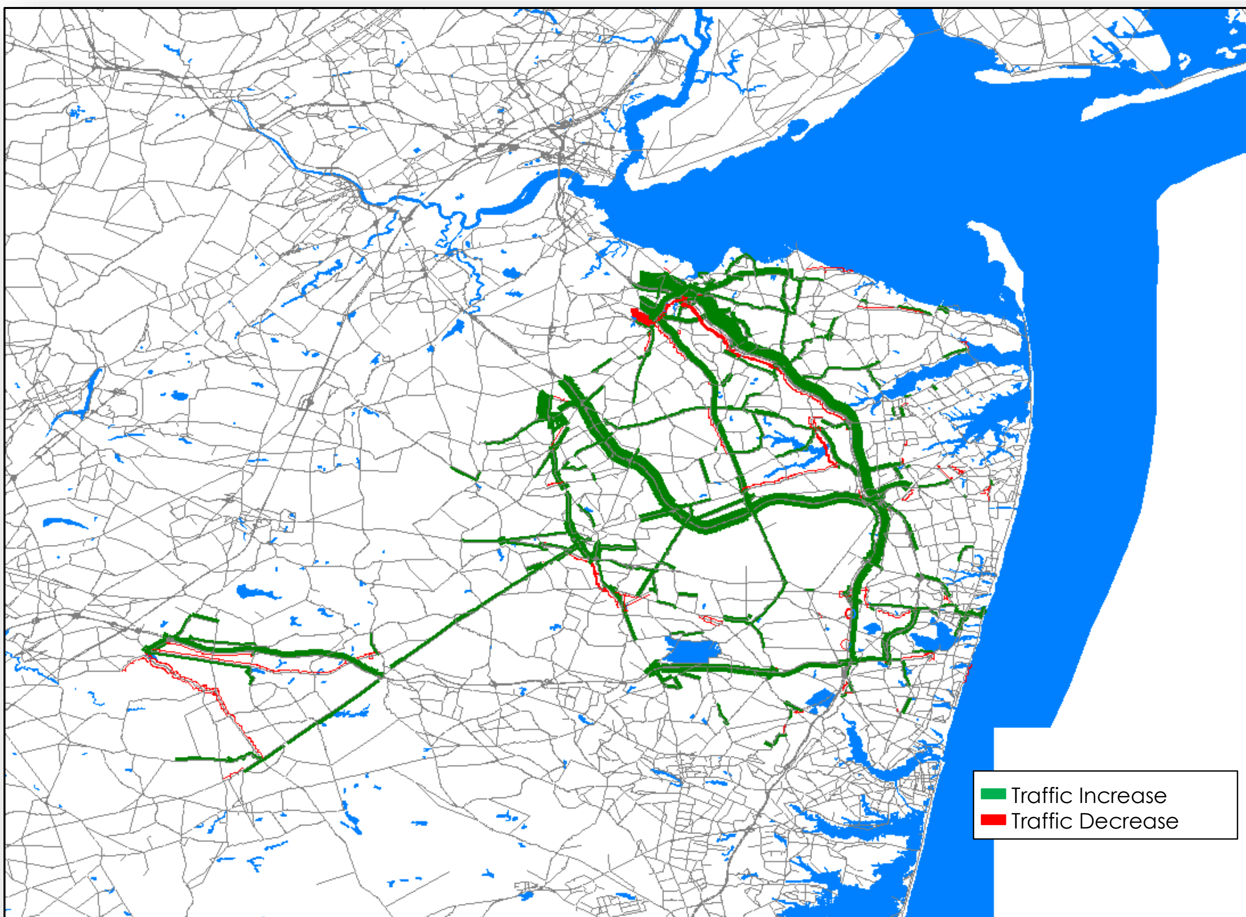
Table 10.8 Inbound Seasonal Traffic Comparison by Facility Type

FACILITY TYPE	VOLUME		
	OBSERVED	ESTIMATED	EST/OBS
Limited-Access Facility	766,895	902,118	1.18
Expressway	38,632	46,686	1.21
Principal Arterial Divided	29,934	27,473	0.92
Principal Arterial Undivided	66,330	50,328	0.76
Minor Arterial Divided	10,553	15,049	1.43
Minor Arterial Undivided	57,240	65,564	1.15
Minor Arterials	116,498	111,315	0.96
Collector/Local	3,363	3,680	1.09
TOTAL	**1,089,445**	**1,222,213**	**1.12**

Table 10.9 Inbound Seasonal Traffic Comparison by Area Type

AREA TYPE	VOLUME		
	OBSERVED	ESTIMATED	EST/OBS
Urban	76,130	67,799	0.89
Suburban	861,779	885,848	1.03
Rural	151,536	268,566	1.77
TOTAL	**1,089,445**	**1,222,213**	**1.12**

Figure 10.2 Daily Seasonal In-Bound Traffic Pattern for 2015 Model Year



For future year analysis, Stantec assumes that the long-haul traffic grows at a rate of 2% per year. This assumption considered that Hurricane Sandy hit the Jersey Shore in 2012 and impacted travel to Jersey Shore during that year. To minimize the impact of hurricane Sandy on the calculation, the growth rate was calculated using post Sandy traffic count data along the GSP at five mainline locations. Table 10.10 shows the historical growth rates at these locations:

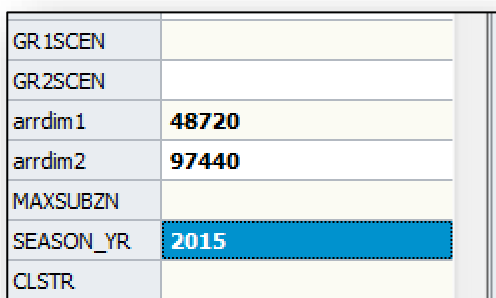
Table 10.10 Historical Growth Rate along GSP

Toll Location	Dir	Average Highest Summer Month Daily Traffic		% CAGR(1)
		2013	2015	2013-2015
New Gretna	NB	26,840	25,820	-1.9%
	SB	27,700	26,650	-1.9%
Barnegat	NB	43,840	43,720	-0.1%
	SB	41,160	41,060	-0.1%
Toms River	NB	56,020	59,250	2.8%
	SB	52,780	56,190	3.2%
Asbury Park	NB	96,190	99,150	1.5%
	SB	98,120	101,140	1.5%
Raritan	NB	154,220	164,530	3.3%
	SB	132,840	141,710	3.3%
TOTAL	**NB**	**377,110**	**392,470**	**2.0%**
	SB	**352,600**	**366,750**	**2.0%**
	Two-way	**729,710**	**759,220**	**2.0%**

Note: (1) ACGR = Annual Compounded Growth Rate

To account for the growth, the analyst has to input the analysis year for the seasonal model. The year has to be input into SEASON_YR key variable as shown in Figure 10.4.

Figure 10.3 SEASON_YR Key Variable Input Window



10.2 OTHER SUPPORT APPLICATIONS

In addition to the Seasonal Model described in Chapter 10.1, the MCTDM includes a series of support applications that will help to prepare input data and summarize the model outputs. The list of the support applications is shown in Table 10.11.

Table 10.11 Support Applications

Support Application	Description
Transit Walk Access Coverage	Estimates the percentage of each zone within transit walk-access - this application is needed to adjust the accessibility to transit in case there are route changes, or addition/removal certain transit routes, in the future.
NYMTC Trip Processing	Generates mode shares for the NYMTC-controlled region by using the person trips data by mode from the NYMTC BPM model.
Subarea Processing	Helps extract network and trip tables for a customized subarea.
Fixed Distribution Analysis	Supports scenarios where it may be necessary to retain a common or fixed distribution of person trips.
Summary Preparation Process	Summarizes the travel characteristics like average travel time and distance between counties, municipatlities, etc. by time of day.
Daily Network Statistics	Prepares a loaded network with daily statistics, including transit link volumes.
SED Conversion from NJRTM-E	Facilitate the SED (Socioeconomic Data) conversion from NJRTM-E TAZs to Monmouth
Growth Factor	Calculates the annual growth between model years or scenarios for all roadways in the network.
Critical Locations	Identifies roadway corridors with congestion problems.
PT Accessibility Display Tool	Prepares a series of shape files for transit accessibility-related display.
Seasonal Model	Estimates the seasonal increase or decrease in traffic, especially trips to and from the Jersey shore during the summer months.
Dynamic Traffic Assignment with Cube Avenue	Prepares the model output for dynamic traffic assignment (using Cube Avenue). It should be noted that Cube Avenue license is sold separately by Citilabs, and currently is not in our contract.

10.2.1 Transit Walk-Access Coverage

Access Processing support application is developed to estimate the percentage of each TAZ within transit walk-access coverage. This data is required for the mode choice model component and should be estimated when significant changes to the transit network are implemented. As an example, the walk coverage should be re-estimated if a scenario extends (or truncates) a transit route, or if new stations and boarding points are added. In preparation for this estimation, the background highway layer is merged with additional data from the transit input card files. The user then needs to execute the transit accessibility process in the CUBE environment. Finally, access coverage data is processed and zonal coverage is updated. Note that the execution of this particular application is performed manually by the model user. Detail discussion about this support application is provided in the Users' Guide Manual.

10.2.2 NYMTC Trip Processing

This application is utilized to generate the mode shares for the NYMTC-controlled region from the NYMTC's Best Practice Model (BPM) person trips by mode tables. A file in DBF format of county-level person trips by mode from NYMTC BPM model is initially converted to Voyager matrix format and mode shares are then calculated for each mode. Unreasonable auto shares are checked and resolved in a subsequent routine. Finally, county-level mode shares are expanded to zonal level and mode shares in the NJT controlled area are set to be zeros. To maintain consistency between the NJRTM-E and the County Model, the NYMTC mode shares update is usually performed at the NJRTM-E level and the results are shared with the County Model. This application is rarely used by the County Model. Additional information is provided in the Users' Guide Manual.

10.2.3 Subarea Processing

A customized subarea extraction process is also provided as a standard output support application in the MCTDM. A model user can extract a subarea network and trip tables within a customized subregion within the MCTDM geographical area. This application is particularly useful if an analyst needs to perform a more detailed corridor analysis using a microscopic or mesoscopic model. The extracted subarea networks and trip tables are used as an input to these models. This application is discussed further in the Users' Guide Manual.

10.2.4 Fixed Distribution Analysis

The fixed distribution analysis application was developed for scenarios where it would be necessary to retain a common or "Fixed" distribution of person trips. A few examples of those scenarios including traffic impact study for temporary roadway closures, build and no-build impact analysis for small projects, etc. The advantage of this approach is to avoid performing a lengthy model run.

To provide the maximum amount of flexibility, the user is permitted to control the specific model components that will be executed for each scenario. This will enable the user to perform only those elements of the model that are deemed necessary for the type and level of analysis desired, thereby minimizing execution time. As an example, if a user was investigating a scenario that featured a widening of a minor roadway that did not provide transit service, the user might wish to avoid executing the transit model components and the mode choice component. In contrast, if a major new transit facility was being developed, the user may wish to see the full impact of this project and therefore would execute both the highway and transit components of the model. This application is discussed further in the Users' Guide Manual.

10.2.5 Summary Preparation Process

This application was originally developed for the NJRTM-E and was retained in the MCTDM. The application summarizes the aggregated travel characteristics, such as average travel time and distance between counties by time of day (peak and off-peak), average time and distance from an MCD to others, and from others to an MCD. This application is discussed further in the Users' Guide Manual.

10.2.6 Daily Network Statistics

This application generates a daily loaded network and its pertinent statistics, such as total daily volumes, traffic volumes by time period, etc. Transit link volumes are merged to the loaded network as well so that the transit travel pattern can be viewed visually in CUBE environment. Summary statistics including vehicle-miles of travel (VMT) and vehicle-hours of travel (VHT) are produced in the last routine. This application is discussed further in the Users' Guide Manual.

10.2.7 SED Conversion from NJRTM-E

The MCTDM was developed based on the NJRTM-E's model structure. However, the MCTDM has more refined TAZ system than the NJRTM-E's system. This application was developed to facilitate the SED conversion from the NJRTM-E's system to the MCTDM's system. In the future, if Monmouth County decides to adopt the new and updated NJRTM-E's socioeconomic data, this application can be used to convert the NJRTM-E's socioeconomic data into the MCTDM's data. This application is discussed further in the Users' Guide Manual.

10.2.8 Growth Factors

This application was developed to calculate the roadways' growth rates between the two model years or scenarios, for example the growth rates between 2015 and 2025, can be calculated using the 2015 and 2025 model year's outputs. This application is discussed further in the Users' Guide Manual.

10.2.9 Critical Locations

This application can be used to identify any roadway corridors that experience some congestion problems. The congested corridors were defined as those that have V/C ratio of 0.9 or higher. The congestion criteria can be adjusted as necessary by the users. Additional discussions are provided in the Users' Guide Manual.

10.2.10 Public Transit (PT) Accessibility Display Tool

PT Accessibility Display application is a tool to display various TAZs that have transit-accessibility to selected TAZs. For example, this application can be used to display all TAZs that can reach Freehold via transit. This application is discussed in detail in the Users' Guide Manual.

10.3 FUTURE YEAR SCENARIOS

Two future year scenarios are prepared as part of this project, including 2025 and 2040. The future year highway networks were developed by implementing a series of future projects to the base year network. The future projects include transportation projects within Monmouth County as well as projects in the immediate surrounding counties that may impact traffic in Monmouth County. The surrounding counties include Mercer, Burlington, Ocean, and Middlesex. The list of future projects were obtained from the FY 2015 NJTPA's Conformity Project list and shown in Table 10.12. All future projects obtained from the NJTPA's Conformity Project list for these counties will be completed by 2025. There is no project that will be completed beyond 2025, Therefore, the 2025 highway network is identical with the 2040 highway network.

Table 10.12 Future Project List

COUNTY	DBNUM	COMPLETION YEAR	ROUTE	PROJECT NAME	MILE POST	DESCRIPTION
Monmouth	96040	2016	34	Route 34, Colts Neck, Intersection Improvements (CR 537)	12.90 - 13.60	In support of the Access Management Plan for Rt. 34 in Colts Neck, this project will provide for operational/safety improvements to the intersection of State Rt. 34 and County Rt. 537. This will include considerations for bicycle and pedestrian activities. Please note: This is a "revisit". Previous efforts to provide operational improvements at this intersection resulted in a scheme that had prohibitive environmental impacts and very high costs.
Monmouth	97071	2016	Route 9, Craig Road/East Freehold Road		116.18-116.31	On the Route 9 and Craig Road intersection, it is proposed to add an additional lane in each direction. The majority of the widening will be in the existing grass median. A concrete barrier will be installed for safety. A reverse-loop jug handle for Route 9 northbound is proposed on the northern side of the Getty gas station. A deceleration lane for the jug handle will begin in advance of the traffic signal. Right and left turns will be permitted from the jug handle onto Pond Road. Route 9 northbound traffic destined for Pond Road southbound will continue to use the existing ramp which will be restricted to right turns. The Access Design unit has granted a waiver for cars and smaller trucks only, with ingress to the Getty gas station from the deceleration lane on Route 9 northbound. All vehicles will exit from the rear of the gas station onto Pond Road. A traffic signal is proposed at the intersection of Craig/East Freehold Road and Pond Road. The signal will be coordinated with the Route 9 traffic signal. Left turns will be prohibited from Craig Road eastbound to Pond Road northbound.
Monmouth	HP01002	2018		Halls Mill Road	N/A	Improvements to Halls Mill Road from Rt. 33 Bypass to CR 524 will include realignment and widening to four travel lanes as well as other improvements.
Monmouth	N09670	2018	33	Route 33, Operational and Pedestrian Improvements, Neptune	40.42 - 41.82	A total of 491 crashes were recorded on this section of NJ SR-33 during the four-year period from 2003 to 2006. Of those, 180 (37%) involved personal injury and 311 (63%) involved only property damage. There were no crash-related fatalities recorded during this period. Eleven crashes (2%) involved pedestrians or bicycles. Several intersections warrant attention, as does the segment as a whole. The busy four lane undivided roadway within a constrained right-of-way limits the uniform application of left turn lanes. Improvements are suggested at the Oxford Way, Wakefield Road, Jersey Shore Medical Center main entrance and Neptune Blvd. intersections, as well as a segment-wide improvement to pedestrian facilities including restriped, crosshatched crosswalks and pedestrian countdown heads. *A further corridor wide traffic study of NJ SR-33 to determine whether lane reconfiguration might aid safety and provide turn lane capacity is also suggested.*
Monmouth	GSP1405	2019	GSP, Interchange 109 Improvements			This project will provide for a New semi-direct NB entrance Ramp from Newman Springs Road and replacement of all four GSP bridges over Newman Springs Road to facilitate improvements to the roadway and interchange ramps.
Monmouth	HP01001	2019	71	Route 71, Wyckoff Road, CR 547	15.62 - 15.84	This project will provide intersection improvements at Rt. 71 and Wycoff Road. Improvements will include widening of Rt. 71 and the provision of a traffic signal. The outside lanes will be made bicycle compatible. Sidewalks will be reconstructed. The following special Federal appropriation was allocated to this project. FY 2001/Section 378/45A $149,670

Table 10.12 - Continued

COUNTY	DBNUM	COMPLETION YEAR	ROUTE	PROJECT NAME	MILE POST	DESCRIPTION
Monmouth	GSP109	2019	GSP Interchange 109			The purpose of this project is to improve the safety and operations of Interchange 109 in Middletown Township, Monmouth County. Proposed improvements will eliminate vehicular traffic queues extending onto the Garden State Parkway northbound mainline local roadway from the northbound exit ramp at Interchange 109; and improve traffic flow of traffic destined to/from the Garden State Parkway by mitigating peak hour traffic congestion along Newman Springs Road within the vicinity of the interchange. **Additional Info from NJTA website:** Interchange 109 is the connection between the Garden State Parkway and Newman Springs Road (CR 520). During peak travel periods, congestion causes traffic exiting onto northbound Newman Springs Road to back up from the exit ramp onto the northbound Parkway. The planned improvements include reconfiguring several intersections on Newman Springs Road; eliminating the existing eastbound jug handle at Half Mile Road; constructing an eastbound entrance loop ramp and bridge over Newman Springs Road to the northbound Parkway; adding lanes to Newman Springs Road; and replacing four functionally obsolete Parkway bridges over Newman Springs Road to accommodate the new lanes.
Monmouth	NS0403	2022		County Route 537 Corridor, Section A, NJ Rt. 33 Business and Gravel Hill Road	48.93 - 51.56	CR 537 serves regional travel between Burlington, Ocean and Monmouth Counties. This roadway also serves as a link between rapidly developing areas of Mercer and Ocean Counties to recreational and commercial activities within Monmouth County. As a result, traffic volumes along this corridor have significantly increased, resulting in high congestion along this section of CR 537. As a result of the Local Concept Development phase the county is proposing improvements for the nearly 2.1 mile long segment of the Monmouth County Route 537 (CR 537) corridor. Improvements will include but are not limited to: providing missing sidewalk segments, enhancing public transportation services, providing 15' outside lanes, ITS improvements, access management strategies, eliminating the substandard thorough lane drop transition, addition of east bound lane onto Iron Bridge Road, addition of both left turn lane and right turn lanes on the north bound side at Redwood Lane, widening at Stillwells Corner Road and Wemrock Road Intersection, widening at Wal-Mart drive, and widening at Trotters Way.
Ocean	94071A	2018	72	Route 72, East Road	21.73 - 22.54	The improvements include intersection reconfiguration to improve geometry and installation of a median barrier to replace the existing grass median. The conversion to a median barrier will allow for the addition of a Rt. 72 westbound auxiliary lane and an eastbound outside shoulder. By maintaining the existing curb line, this improvement will have minimal Right of Way impacts.
Ocean	11385	2020	72	Route 72, Manahawkin Bay Bridges, Contract 1A & 1B	25.38 - 26.14 28.24 - 28.74	Contract 1A will include Rt. 72 and Marsha Drive Intersection Improvements, reconstruction and widening of Rt. 72 and Marsha Drive, and reconstruction of a traffic signal. The project also includes the installation of new storm drainage systems, a detention basin, ITS improvements, highway lighting and utility relocations. Contract 1B will include operational and safety improvements in Ship Bottom Borough, on Long Beach Island. Approx. 3000' feet of Rt. 72 (locally known as 8th and 9th Streets) and three cross roads (Barnegat Avenue, Central Avenue and Long Beach Boulevard) will be widened. Two-way traffic will be restored along Barnegat Avenue, Central Avenue and Long Beach Boulevard. Five traffic signals will be reconstructed. A new traffic signal will be installed at the intersection of 8th Street and Long Beach Boulevard. In order to reduce frequent flooding along Rt.72 and the intersections, a new storm drainage system and a pump station along with a sand filter will be installed. The project also includes the installation of bicycle and pedestrian accommodations, ITS improvements, highway lighting and utility relocations.

Table 10.12 - Continued

COUNTY	DBNUM	COMPLETION YEAR	ROUTE	PROJECT NAME	MILE POST	DESCRIPTION
Ocean	00357A TO C	2020	Manahawkin Bay Bridges			These structurally deficient structures are 2,400 feet long, carry four lanes of traffic and are in overall poor condition due to the condition of the superstructure. Fatigue cracks were observed in the steel floor beam webs at numerous locations during the 1995 inspection and painting operation for this bridge. Necessary retrofit was accomplished by drilling holes at the tip of the cracks in 1995. The 1999 inspection revealed propagation of cracks in the floor beam webs and bracket connection angles beyond the holes drilled in 1995 and also development of additional fatigue cracks. Heavy pitting and section loss in stringers, floor beams and thru-girders was noted at random locations. Construction of a new parallel bridge over Manahawkin Bay to the south of the existing structure. Rehabilitation of the three Trestle bridges (over Hilliards Thorofare, West Thorofare, and East Thorofare) to provide the structural/safety improvements and to extend service life 20+ years. Bridge replacement eliminated. Construction of Marsha Drive intersection improvements. This project is anticipated to be bicycle/pedestrian compatible. This is a multi-year funded project under the provisions of Section 13 of P.L. 1995, c. 108. Total funding needed for construction is anticipated to be $189,000,000.
Ocean	09322	2021	88	Route 88, Bridge over Beaver Dam Creek	7.60	This is a full bridge replacement project. Superstructure rating=4, deck rating=5, SR=44.90.
Ocean	NS0414	2016	Garden State Parkway Interchange 91			Garden State Parkway Interchange 91 Improvements and Burnt Tavern Road RoadThe current configuration of Exit 91 allows only northbound entrance and southbound exit to and from the Parkway. This limited access causes motorists to those areas east and west of the interchange to have to find alternative routes to access the Garden State Parkway thus increasing travel miles. In the southeast quadrant of the interchange, the County will construct an exit ramp from northbound Garden State Parkway (GSP) to Burrsville Road and an entrance ramp to northbound GSP from Burrsville Road with a signalized intersection. This will require widening of northbound GSP to accommodate the access ramp and widening of Burrsville Road for vehicles turning left into the entrance ramp. The existing access road between Burnt Tavern Road and Burrsville Road will be eliminated. In the southwest quadrant of the interchange, the applicant proposes the construction of a new entrance ramp to southbound GSP from Lanes Mill Road West with a signalized intersection. The existing southbound GSP service road shall be extended to the Dorado Park & Ride and a new connector road shall be constructed from Herborn Avenue to Lanes Mill Road West, intersecting with the new southbound GSP ramps.
Middlesex	98541	2016		South Amboy Intermodal Center		This is an intermodal project linking several major regional routes and modes of transportation into one central point of transfer. Improvements in the vicinity of the South Amboy waterfront may include rail and bus transit plazas, arterial and site access road improvements, bridge reconfiguration, bulkheading and breakwater development, ferry terminal, and pedestrian access to rail and bus facilities.
Middlesex	FS09644	2017	Bridge over Route 1			The project includes widening of the Rt. 18 NB structure by one lane to create an accel/decel lane for the ramps to and from Rt. 1. This widening will then allow the existing lane to be used as a third thru lane on Rt. 18 NB which will eliminate a merge conflict between Rt. 18 NB traffic and NJ Turnpike traffic eliminating backups on Rt. 18 NB and the NJ Turnpike. The project will also modify Ramp D from Rt. 18 NB to Rt. 1 SB and replacement of the entire Rt. 18 NB/SB super structure utilizing precast superstructure units.
Middlesex	GSP1003	2018	GSP Interchange 125 Improvements			This project will provide for the reconfiguation of the existing ramps and construction of new ramps to provide full access between the Parkway and Chevalier Avenue. Interchange 125 is presently configured with a southbound entrance and northern exit ramp. This project will provide a northbound entrance and southbound exit ramp. The southbound exit ramp will be tolled to be consistent with one-way tolls at the Raritan Toll Plaza. The improvements are necessary to complete what is currently a partial interchange and to provide access to a waterfront development being constructed by Sayreville Seaport Associates.

Table 10.12 - Continued

COUNTY	DBNUM	COMPLETION YEAR	ROUTE	PROJECT NAME	MILE POST	DESCRIPTION
Middlesex	GSP1403	2018	GSP Widening, Interchange 35 to Interchange 48			This project will provide for the widening of the Garden State Parkway between Interchanges 35 and 48 from 2 lanes to 3 lanes in each direction. Project will also include improvements to Interchanges 36, 37 and 38
Middlesex	00321	2019		Schalk's Crossing Road Bridge, CR 683	0.70	Funding is being provided for the replacement of the bridge deck that will maintain the existing steel superstructure and provide bicycle/pedestrian accessibility. A shared bicycle/pedestrian sidewalk lane will be provided through cantilever addition on the through girders along both the east and west sides of Schalk's Crossing Road. Repairs will be made to the substructure. Prior to any bridge rehabilitation, the railroad catenary system will be modified. Roadway improvements would include milling and resurfacing the existing roadway approaches for tie-ins to bridge.
Middlesex	9227	2019	34	Route 34, Amboy Road/Morristown Road (5)	24.60 - 24.80	This project will address proposed intersection improvements. Two closely aligned roads intersect Rt. 34 at acute angles, which creates traffic movement and sight distance problems. Morristown Road, in particular, has heavy left turning movements from Rt. 34 southbound with no traffic control.
Middlesex	9169Q	2019	287	Route 287, Interchange 10 Ramp Improvements	10.27-10.6	This project will provide operational improvements to the on and off-ramps to/from Easton Avenue by lengthening the acceleration lanes along I-287 NB.
Middlesex	9169R	2019	287	Route 287, River Road (CR 622), Interchange Improvements	9.8 - 10.2	This project is to make operational improvements to the on-ramp from River Road to reduce the number of vehicles in queue entering the interstate and weaving conditions.
Middlesex	08417	2020	1	Route 1, Forrestal Road to Aaron Road	13.30 - 22.50	A project to address the deficiencies along the portion of Route 1 in South Brunswick between MP 13.30 and 22.50. This stretch of the roadway currently accommodates only two travel lanes in each direction. Sections of Route 1 both north and south carry three lanes of travel. The 3 Intersections of Ridge Road, New Road, and Deans Lane/Henderson Road will be advanced into Concept Development under this agreement.
Middlesex	99316	2020		Oak Tree Road Bridge, CR 604	RR 24.81	The bridge is structurally deficient and functionally obsolete. It needs to be widened due to increased traffic volume and to meet wider approach roadway width. The bridge acts as a major link between South Plainfield and Woodbridge Townships.
Middlesex	079A	2022	9	Route 9/35, Main Street Interchange	129.82	Rt. 9/35 over Main Street Interchange is a breakout from the Rt 9/35 over Main St. Bridge. The lack of an acceleration lane from Rt. 9 Northbound to Rt. 9/35 Northbound ramp has created a safety condition for vehicles attempting to merge. Furthermore, the tight radius and heavy truck traffic from this ramp have contributed to the congestion and the queue on Rt. 9 Northbound which extends for about a mile causing more safety concerns. Rt. 9/35 Southbound to Rt. 9 Southbound ramp is a also a safety problem at this interchange, as this ramp is also substandard and is contributing to the extensive queue which extends from Rt. 9/35 to the Edison Bridge. Both ramps will be investigated separately and may graduate as two individual projects.
Mercer	DVRHNC36	2020		I-95 at Scudders Falls Bridge - Widening		One lane in each direction
Mercer	DVRHNC67	2020		New Jersey Turnpike - Widening		One lane in each direction
Mercer	DB08004	2021	I-95/Scudder Falls Improvement Project			Widening of I-95 from PA 332 to the River Bridge. Replacement and Widening of the River Bridge. Reconfiguation of the NJ 29 & I-95 Interchange and repaving of I-95 to CR 579 Bear Tavern Road.

Table 10.12 - Continued

COUNTY	DBNUM	COMPLETION YEAR	ROUTE	PROJECT NAME	MILE POST	DESCRIPTION
Burlington	DVD9912	2020		South Pemberton Road, CR 530		This project will provide for the reconstruction of CR 530 from Route 206 to CR 644 to improve safety, reduce accidents, facilitate left-turn movements with a continuous center left-turn lane, and add shoulders. The intersection of Magnolia Road and CR 530 will be relocated. (Phase I) This project is funded under the provisions of Section 13 of P.L. 1995, c.108. This is a multi-year funded Federal-aid construction project. Total Federal-aid needed for construction is anticipated to be $23.688 million. The following special Federal appropriations were allocated to this project. TEA-21/Q92 $6,150,596 (balance available $3,846,530). SAFETEA-LU FY 2006 High Priority $8,000,000 (available 20% per year). This project relocates the existing Magnolia Rd. (CR 644) & Hampton St. (CR 530) intersection to the east, installs a new fully actuated traffic signal and constructs a new Magnolia Rd. ramp to intersect with Hanover St. (CR 616). This project also includes upgrades to the existing traffic signal at the intersection of Hampton St. (CR 530) & Hanover St. (CR 616). Phase 2 breakout project is DB# D9912A.
Burlington	D9912A	2025		South Pemberton Road, CR 530, Phase 2		This project will reconstruct and provide lane and shoulder widening approximately 2.7 miles of CR 530 (S. Pemberton Rd.) from Hanover St. (CR 616) in Pemberton Borough to US Route 206 in Southampton Township. The widening of the roadway is not an additional through lane, but will include a 5 lane cross-section that contains a fourteen foot continuous turn lane, new six foot shoulders, and four- twelve foot travel lanes. There are many driveways/access points along the corridor, and the continuous turn lane is to provide a safe area to get out of the main flow of traffic and reduce collisions during turns off of the roadway. Over the last ten years there have been twelve fatalities on this stretch of roadway. Crash data over the last five years (2006-2010) documents 348 crashes in this segment, including 94 injury crashes. The roadway segment is a heavily traveled corridor due to the fact that it is a continuation of State Highway Route 38. Route 38 ends at Route 206 (The South Pemberton Road westernmost limit) and becomes CR 530/South Pemberton Road, which carries a traffic volume of over 25,000 AADT. This project provides for the acquisition of easements and/or full takings of over 90 parcels and provides for the environmental clean-up and demolishing of all structures. This project will also include tree clearing to accommodate roadway and shoulder width. This project is a breakout of South Pemberton Road, CR 530, Phase 1 (DB# D9912).

The future socioeconomic data was provided by NJTPA as shown previously in Table 2.2 and Table 2.3. The base year and future years Vehicle Miles Traveled (VMT) comparison by facility type and their compounded annual growth rates (CAGR) are presented in Table 10.13. The VMT in Monmouth County increases approximately 0.3% per year between 2015 and 2025, and 0.4% per year between 2025 and 2040.

Table 10.13 Base Year and Future Years VMT Comparison by Facility Type

FACILITY TYPE	VMT				
	2015	2025	CAGR 2015-2025	2040	CAGR 2025-2040
Limited-Access Facility	6,320,267	6,500,038	0.3%	7,055,549	0.5%
Expressway	323,372	323,975	0.0%	349,751	0.5%
Principal Arterial Divided	1,590,850	1,634,793	0.3%	1,737,411	0.4%
Principal Arterial Undivided	1,087,483	1,109,471	0.2%	1,180,405	0.4%
Minor Arterial Divided	711,491	733,966	0.3%	777,423	0.4%
Minor Arterial Undivided	2,609,485	2,729,127	0.4%	2,916,061	0.4%
Minor Arterials	3,932,937	4,069,168	0.3%	4,291,393	0.4%
Collector/Local	997,327	1,041,486	0.4%	1,120,883	0.5%
TOTAL	**17,573,212**	**18,142,024**	**0.3%**	**19,428,876**	**0.5%**

APPENDIX A – HIGHWAY NETWORK VARIABLES

PHYSICAL / OPERATIONAL VARIABLES

VARIABLE NAME	DESCRIPTION	UNIT	DEFINITION
A	A Node of a highway link	Integer	
B	B Node of a highway link	Integer	
DISTANCE	Distance of a highway link	Miles	
CAPACITY	Hourly lane capacity	VPH	Define by a look up table, a function of area type and facility type, unless overriden by user via FIXCAP
FT	Facility type	Integer from 1 to 12	FT is divided into 12 categories:
			1. Freeway (limited access)
			2. Expressway (grade separated at major facilities, signals at minor facilities)
			3. Principal arterial divided
			4. Principal arterial undivided
			5. Major arterial divided
			6. Major arterial undivided
			7. Minor arterial
			8. Collector/local
			9. High speed ramp (direct freeway-freeway 55 mph)
			10. Medium speed ramp (40 mph)
			11. Low speed ramp/jughandle (25 mph)
			12. Centroid connector
AT	Area type	Integer from 1- to 4	AT is divided into 5 categories
			1. CBD
			2. Urban
			3. Suburban
			4. Rural
LANESAM	Number of lanes - AM Peak	Integer	Number of lanes in the AM Peak period.
LANESPM	Number of lanes - PM Peak	Integer	Number of lanes in the PM Peak period.
LANESOP	Number of lanes - Off Peak	Integer	Number of lanes in the Off Peak period.
LINKTYPE	Link permission code to utilize the link based on auto mode and toll	Integer from 1 to 16	Linktype is divided into 16 categories:
			1. Free - all
			2. Free - auto only
			3. Free - truck only
			4. Urban toll - all
			5. Urban toll - auto only
			6. Urban toll - truck only
			7. Rural toll - all
			8. Rural toll - auto only
			9. Rural toll - truck only
			10. Urban free - HOV only
			11. Urban toll - HOV only
			12. Urban toll - SOV, free HOV
			13. Urban toll, free HOV
			14. ETC only - all
			15. ETC only - auto only
			16. ETC only SOV and truck toll, free HOV
TERTYPE	Terrain Type. Default terrain type is defined based on counties and facility type:	Integer from 1 to 3	Tertype is divided into 3 categories:
	- Rolling Terrain: Sussex, Warren Morris, Passaic, Hunterdon, Somerset, Rockland, Orange, Lackawanna, Wayne, Sullivan, and Luzerne		1. Level
	- Mountainous: none		2. Rolling
	- Level: all other counties and highways		3. Mountainous

VARIABLE NAME	DESCRIPTION	UNIT	DEFINITION
NLTLANE	Number of left turn lanes		Default=0
NRTLANE	Number of right turn lanes		Default=0
LWIDTH	Lane width	Feet	Default=12 feet
LSHOULD	Standard shoulder available	Flag	0 = Shoulder substandard or missing 1 = Standard shoulder (default)
TCD	Traffic Control Devices	Integer from 1 to 12, 99	TCD is divided into 13 categories: 1. Two-way stop 2. All-way stop 3. Yield 4. Ramp-meter 5. Signal-uncoordinated-actuated 6. Signal-uncoordinated-fixed 7. Signal-coordinated-restricted progression 8. Signal-coordinated-favorable progression 9. Signal-coordinated-maximum progression 10. Freeway diverge point 11. Freeway merge point 12. Uncontrolled - Shape Point 99. Unknown
NSIG	Number of signal in the link	Integer	User-specified, program will assume=1 if the value is not provided and TCD=5-9
SIGCYC	Signal cycle	Secs	User-specified, program default if the the value is provided
SIGCOR	Signal coordination	Integer from 0 to 3	SIGCOR is divided into 3 categories: 0. Uncoordinated Signal (Default) 1. Coord-unfavorable 2. Coord-favorable 3. Coord-max
GC	Green time/cycle ratio		Share of green time/cycle
ALCOEF	Alpha coefficient for Volume Delay Function in assignment		Calculated by program
BTCOEF	Beta coefficient for Volume Delay Function in assignment		Calculated by program
JFACT	Delay factor in HCM approximation of TCD-related delay		Calculated by program
JAFACT	Delay factor for Akcelik Formula		Calculated by program
ACCPT	Number of access point		Program will provide default based on area type and facility type.
FIXCAP	Fix capacity	Flag	0 = not fixed (default) 1 = fixed capacity to specific value, retains settings of TCD, GC
FIXTIME	Fix Time	Flag	0 = not fixed (default) 1 = fixed
TOLL	Toll values - actual placement	Dollars	For toll diversion highway assignment
MCTOLL	Scaled toll values to balance by direction	Flag	0 = no toll (default) 1 = non-directional toll -0.5 and 0.5 = directional toll
TOLLAPC	Toll applied to vehicle types	Flag	0 = default 1 = set HOV toll to 0 2 = set truck toll to 0
TOLLCLASS	Toll class for lookup system	Integer from 0-99	0= no toll (default) 1-98 = obtained from lookup table 99 = toll value coded on link directly
TOLLFACAM	Base toll factor for AM Period		default =1
TOLLFACPM	Base toll factor for PM Period		default =1
TOLLFACMD	Base toll factor for Mid-Day Period		default =1
TOLLFACNT	Base toll factor for Night Period		default =1
FIXTOLL	Fix Toll	Flag	0 = not fixed 1 = fixed toll (default)

VARIABLE NAME	DESCRIPTION	UNIT	DEFINITION
PARK	Parking permission code	Flag 0 or 1	PARK is divided into 2 categories: 1. Permitted parking - default values for FT=7 and AT=1,2; FT=8 and AT=1,2,3 0. Not permitted - default for others
QUEFLG	Flag for queueing function	Flag	1 = additional queueing function is permitted in the volume delay function 0 = no additional queueing function is used
ZDELAY	Initial delay due to TCD		Calculated by program
ADDDELAY	Additional delay applied to the link	Mins	Optional field - NJ Transit (not used)
SPEED	Link speed		Calculated by program, but user can override
T0	Free-flow travel time	Mins	Calculated by program, but user can override via FIXTIME parameter
TCODEAM	Transit travel time flag for AM Peak	Flag	0 = standard roadway (default) 1 = XBL 2= bus queue jump 9= exclusive bus link (BRT) Other codes available
TCODEOP	Transit travel time flag for Off Peak	Flag	0 = standard roadway (default) 1 = XBL 2= bus queue jump 9= exclusive bus link (BRT) Other codes available
TADDAM	Added time penalty to transit - AM	Mins	Link specific adjustment transit time - AM
TADDOP	Added time penalty to transit - OP	Mins	link specific adjustment transit time - OP
TSCALEAM	Transit time scaling factor - AM		Systematic adjustment factor - AM
TSCALEOP	Transit time scaling factor - OP		Systematic adjustment factor - OP
NONWALK	Index of non-walkable link	Flag 0 or 1	0-Walkable and pedestrian friendly 1-Non-walkable

IDENTIFICATION VARIABLES

VARIABLE NAME	DESCRIPTION	UNIT	DEFINITION
NAME	Road name	String	Example: "New Jersey Turnpike"
SRI	Standard Route Identifier	String	Example: "00000095" for New Jersey Turnpike
BEGIN_MP	Mile post of the beginning of the link	Miles	
END_MP	Mile post of the end of the link	Miles	
RT_LTR	Route lettering	String	Example: "I-95" for New Jersey Turnpike
COUNTY	County FIPS code	Integer	
PROJN	Conformity based project ID # obtained from NJTPA	Integer	
REFZONE	Zone where the link resides	Integer	

PERFORMANCE/USE VARIABLES

VARIABLE NAME	DESCRIPTION	UNIT	DEFINITION
SOURCE	The source of the counts	Integer	1=NJTA 2=Monmouth County 3=NJDOT 4=Ocean County Highway Network 2014 (only Amercom) 5=Ocean County
COUNTS_TOT	Total counts	Integer	Final counts
COUNTS_AUT	Total auto counts	Integer	Final auto counts
COUNTS_TRK	Total truck counts	Integer	Final truck counts
COUNTS_MTK	Total medium counts if available	Integer	Final medium truck counts
COUNTS_HTK	Total heavy counts if available	Integer	Final heavy truck counts
SUMR_COUNT	Summer counts if available	Integer	
COUNT_YEAR	The year of total counts	Integer	
AWDT	AWDT counts indicator	Integer	If AWDT=1, the above counts represent AWDT counts. Otherwise, they represent AADT.

APPENDIX B – INTERSECTION MODEL ASSUMPTIONS

INTERSECTION TYPE:

There are five intersection types defined in the Intersection Model:

1. All-Way Stop
2. Two-Way Stop
3. Priority Intersection (Two-way Yield) Geometric
4. Fixed Signals Geometric
5. Gap Acceptance Roundabout

ALL-WAY STOP:

Default assumptions for the all-way stop parameters are as follows:

Attributes	Values	Description
Approach Nodes		Location-based
First Arm		Location-based
Lane Geometry	As observed	Use Aerial Photographs/Maps or other information such as NJ Straight Line Diagram
Minimum Capacity	100	Default Cube/Voyager value=1.0; Use 100 vehs/hr. (Professional judgment)
Randomness	1	Default for unsignalized intersection; completely random, no coordination with other TCD
Number of Lanes	As observed	Use Aerial Photographs/Maps or other information such as NJ Straight Line Diagram. Number of Lanes will overwrite Lane Geometry data, please careful when use this. Check User's Guide.
Estimated Delay	0	Use the following assumptions (professional judgment): - Rural = 0.0 - Suburban = 0.1 - Urban = 0.2 - CBD = 0.3 All in secs./veh
Initial Queue	0	Assume No Initial Queue
Ban Turn	As observed	If information is not clear, always allow turn
Volumes	Ignore	

TWO-WAY STOP:

Attributes	Values	Description
Approach Nodes		Location-based
First Arm		Location-based
Lane Geometry	As observed	Use Aerial Photographs/Maps or other information such as NJ Straight Line Diagram
Storage Space	As observed	If not sure, use 0 (see discussion in the User's Guide)
Average Lane Width	12 ft.	
Grade	0	Assume grade = 0% for all intersections
Turn Channelized	As observed	If not sure, No channelization
Minimum Capacity	100	Default Cube/Voyager value=1.0; Use 100 vehs/hr. (Professional judgment)
Randomness	1	Default for unsignalized intersection; completely random, no coordination with other TCD
Pedestrian Flow	0	No pedestrian crossing
Pedestrian Speed	4.0 ft/sec	Appproximately 3 MPH
Flare Storage	0	Assume no-flare storage at minor approach for this project
Estimated Delay		Use the following assumptions (professional judgment): - Rural = 0.0 - Suburban = 0.1 - Urban = 0.2 - CBD = 0.3 All in secs./veh
Initial Queue	0	Assumed no initial queue
Ban Turn	As observed	If information is not clear, always allow turn
Critical Gap		Use the following default values for Critical Gap (seconds): Left turn from major: Two-lane Major = 4.1 Four-lane Major = 4.1 Right turn from minor: Two-lane Major = 6.2 Four-lane Major = 6.9 Through traffic on minor: Two-lane Major = 6.5 Four-lane Major = 6.5 Left turn from minor: Two-lane Major = 7.1 Four-lane Major = 7.5
Follow Up Time		Use the following default values for Critical Gap (seconds): Left turn from major: 2.2 secs. Right turn from minor: 3.3 secs. Through traffic on minor: 4.0 secs. Left turn from minor: 3.5 secs.
Volumes	Ignore	

PRIORITY INTERSECTION:

Attributes	Values	Description
Approach Nodes		Location-based
First Arm		Location-based
Major Road Width	As observed	the average of major road approach width, see the attached User's Guide for formula (p. 316-317). Assume lane width is 12 ft/lane.
Central Reservation Width	As observed	Use Aerial Photographs/Maps. If there is central reservation width, assume **10 ft.** (professional judgment)
Single Lane Only	As observed	Use Aerial Photographs/Maps or other information such as NJ Straight Line Diagram
Minimum Capacity	100	Default Cube/Voyager value=1.0; Use 100 vehs/hr. (Professional judgment)
Randomness	1	Default for unsignalized intersection
Pedestrian Flow	0	No pedestrian crossing
Crossing Length		
Crossing to Exit		
Crissing to Entry		
Estimated Delay		Use the following assumptions (professional judgment): - Rural = 0.0 - Suburban = 0.1 - Urban = 0.2 - CBD = 0.3 All in secs./veh
Initial Queue	0	Assumed no initial queue
Ban Turn	As observed	
		Width for each available movements of the minor road (see the User's Guide for further explanation). Assume lane width=12 ft/lane
Width		
Visibility		
Volumes	Ignore	

FIXED SIGNAL:

Attributes	Values	Description
Approach Nodes		Location-based
First Arm		Location-based
Phases		
Lane Geometry	As observed	Use Aerial Photographs/Maps or other information such as NJ Straight Line Diagram
Central Business District	No	No CBD in Monmouth County
Average Lane Width	12ft.	Assume standard lane width = 12 ft.
Grade	0	Assume grade = 0% for all intersections
Minimum Capacity	100	Default Cube/Voyager value=1.0; Use 100 vehs/hr. (Professional judgment)
Randomness	0.55	Default for signalized intersection
Parking Maneuvers	0	Assume 10 cars/hour in Urban area and 0 cars/hour in suburban/rural.
Bus Blockage	0	Assume no Bus Blockage for this project
Unit Extension	5 secs	Assume Unit extension = 5 secs (highest actuated in table 16-13 HCM, lower than pretimed)
Conflicting Bike	0	Assume No Conflicting Bike for this project
Estimated Delay		Use the following assumptions (professional judgment): - Rural = 0.0 - Suburban = 0.1 - Urban = 0.2 - CBD = 0.3 All in secs./veh
Pedestrian Flow	0	Assume No pedestrian crossing
Estimated Delay	0	Default value, although this may be a poor estimate for urban areas
Initial Queue	0	Assumed no initial queue
Ban Turn	As observed	If information is not clear, always allow turn
Volumes	Ignore	

ROUNDABOUT:

Attributes	Values	Description
Approach Nodes		Location-based
First Arm		Location-based
Critical Gap	4.3	Use the following default values for Critical Gap (seconds): 4.1-4.6 secs
Follow-up Time	2.8	Use the following default values for Critical Gap (seconds): 2.6 - 3.1 secs.
Minimum Capacity	100	Default Cube/Voyager value=1.0; Use 100 vehs/hr. (Professional judgment)
Randomness	1	Default for unsignalized intersection
Estimated Delay		Use the following assumptions (professional judgment): - Rural = 0.0 - Suburban = 0.1 - Urban = 0.2 - CBD = 0.3 All in secs./veh
Initial Queue	0	Assumed no initial queue
Volumes	Ignore	

APPENDIX C – OUTPUT FILE REFERENCE

File Name	Description
access.crd	Access stations prepared for transit station activity summary
access_bus.tb	Access support links for Bus mode
access_commuter_rail.tb	Access support links for Commuter Rail mode
access_ferry.tb	Access support links for Ferry mode
access_lrt.tb	Access support links for LRT mode
access_nwk_subway.tb	Access support links for Newark Subway mode
access_ny_subway.tb	Access support links for New York Subway mode
access_path.tb	Access support links for PATH mode
allmode-walk.dbf	Walk access zonal coverage. Generated by support application "Access Processing"
allmodes.tb	Transit lines of all modes combined. Generated by model.
bus.far	Fare for Bus mode
hwamtp.crd	Turn penalties
hwybu.net	Input base network
linearthur.tb	Arthur bus line file
linebus.tb	Bus line file (other than Arthur)
lineferry.tb	Ferry line file
linelrt.tb	LRT line file
linenysubway.tb	New York State Subway line file
linerail.tb	Rail line file
linesum2.crd	Stops of all transit lines prepared for transit ridership summary
linkbusother.tb	Additional transit links used by Bus
linkbusprxbl.tb	Additional XBL transit links and PNR Lots.
linkferry.tb	Additional links specific to Ferry
linklrt.tb	Additional links specific to LRT
linknysubway.tb	Additional links specific to New York Subway
linkrail.tb	Additional links specific to Rail
linksum.crd	Used for transit ridership summary at special facilities
lookupcap.dbf	Capacity lookup table (by FT/AT)
lookupffspeed.dbf	Free-flow speed lookup table (by FT/AT)
lookuptolls.dbf	Default toll lookup table (by TOLLCLASS link variable)
nodebusprxbll.tb	Additional nodes for PNR lots and XBL transit links
nodeferryll.tb	Additional nodes specific to Ferry
nodenysubwayll.tb	Additional nodes specific to New York Subway
noderailll.tb	Additional nodes specific to Rail
op_ferry.far	Fares for Ferry in the off-peak period
op_lrt.far	Fares for LRT in the off-peak period
op_ncs.far	Fares for Subway in the off-peak period
op_path.far	Fares for PATH in the off-peak period
op_rail.far	Fares for Rail in the off-peak period
parameters_bus.crd	Parameters specific to Bus mode during path skimming
parameters_common.crd	Common parameters used for transit path skimming

File Name	Description
parameters_common2.crd	Common parameters used for transit assignment
parameters_ferry.crd	Parameters specific to Ferry mode during path skimming
parameters_lhferry.crd	Parameters specific to Longhaul Ferry mode during path skimming
parameters_lrt.crd	Parameters specific to LRT mode during path skimming
parameters_path.crd	Parameters specific to PATH mode during path skimming
parameters_rail.crd	Parameters specific to Rail mode during path skimming
period_access_ctl1.crd	Parameters used for peak walk access path skimming
period_access_ctl2.crd	Parameters used for peak auto access path skimming
period_access_ctl3.crd	Parameters used for off-peak walk access path skimming
period_access_ctl4.crd	Parameters used for off-peak auto access path skimming
pk_ferry.far	Fares for Ferry in the peak period
pk_lrt.far	Fares for LRT in the peak period
pk_ncs.far	Fares for Subway in the peak period
pk_path.far	Fares for PATH in the peak period
pk_rail.far	Fares for Rail in the peak period
pno_rail.tb	Park-and-Ride in the off-peak period for Rail
pnp_rail.tb	Park-and-Ride in the peak period for Rail
pnr.far	Fares for Park-and-Ride
pnr_bus.tb	Park-and-Ride for Bus
pnr_fry.tb	Park-and-Ride for Ferry
pnr_lrt.tb	Park-and-Ride for LRT
pnr_nwksub.tb	Park-and-Ride for Newark Subway
pnr_path.tb	Park-and-Ride for PATH
rider.crd	Input prepared for bus ridership summary
select.crd	Input prepared for ridership summary of selected locations and routes
special.far	Special Bus fares
stopbuffer2.dbf	Stop buffer file. Generated by support application "Access Processing"
stopbuffer2.prj	Stop buffer file. Generated by support application "Access Processing"
stopbuffer2.sbn	Stop buffer file. Generated by support application "Access Processing"
stopbuffer2.sbx	Stop buffer file. Generated by support application "Access Processing"
stopbuffer2.shp	Stop buffer file. Generated by support application "Access Processing"
stopbuffer2.shp.xml	Stop buffer file. Generated by support application "Access Processing"
stopbuffer2.shx	Stop buffer file. Generated by support application "Access Processing"
total.crd	Input for transit ridership summary
trace_controls.crd	Parameters specified for transit path tracing
transpdadjop.dbf	Speed adjustment factors by FT/AT for transit in the off-peak period
transpdadjpk.dbf	Speed adjustment factors by FT/AT for transit in the peak period
trn_link.tb	All additional transit links and access links combined together. Generated by model
trn_link1.tb	Temporary transit link file. Generated by model
trn_node.tb	All addition transit nodes and access nodes combined together. Generated by model.
usage.far	Fares of usage (NJTPK surcharge)
xbus.far	Fares for Express Bus

APPENDIX D – OUTPUT LINK VARIABLES

VARIABLE NAME	DESCRIPTION	UNIT	DEFINITION
V_1	The total assigned link volume	Vehicles	Generated by highway assignment process
TIME_1	Actual link travel time	Minutes	Generated by highway assignment process
VC_1	Volume/capacity ratio		Generated by highway assignment process
CSPD_1	Congested travel speed	mph	Generated by highway assignment process
VDT_1	Vehicle-distance travelled		Generated by highway assignment process
VHT_1	Vehicle-hours of travel		Generated by highway assignment process
V1_1	Loaded volume (SOV free pass)	Vehicles	Generated by highway assignment process
V2_1	Loaded volume (SOV toll by cash)	Vehicles	Generated by highway assignment process
V3_1	Loaded volume (SOV toll by ETC)	Vehicles	Generated by highway assignment process
V4_1	Loaded volume (HOV free pass)	Vehicles	Generated by highway assignment process
V5_1	Loaded volume (HOV toll by cash)	Vehicles	Generated by highway assignment process
V6_1	Loaded volume (HOV toll by ETC)	Vehicles	Generated by highway assignment process
V7_1	Loaded volume (truck free pass)	Vehicles	Generated by highway assignment process
V8_1	Loaded volume (truck toll by cash)	Vehicles	Generated by highway assignment process
V9_1	Loaded volume (truck toll by ETC)	Vehicles	Generated by highway assignment process
VT_1	Two-way loaded volume	Vehicles	Generated by highway assignment process
V1T_1	Two-way volume (SOV free pass)	Vehicles	Generated by highway assignment process
V2T_1	Two-way volume (SOV toll by cash)	Vehicles	Generated by highway assignment process
V3T_1	Two-way volume (SOV toll by ETC)	Vehicles	Generated by highway assignment process
V4T_1	Two-way volume (HOV free pass)	Vehicles	Generated by highway assignment process
V5T_1	Two-way volume (HOV toll by cash)	Vehicles	Generated by highway assignment process
V6T_1	Two-way volume (HOV toll by ETC)	Vehicles	Generated by highway assignment process
V7T_1	Two-way volume (truck free pass)	Vehicles	Generated by highway assignment process
V8T_1	Two-way volume (truck toll by cash)	Vehicles	Generated by highway assignment process
V9T_1	Two-way volume (truck toll by ETC)	Vehicles	Generated by highway assignment process