



MEMORANDUM

Date: September 14, 2010

To: Lisa Ives

CC: William Crowell

From: William Woodford, Nikhil Puri

Re: Validation of Preliminary Year 2047 DEIS Forecasts

This memorandum discusses preliminary Year 2047 forecast results being prepared for the Tappan Zee Bridge/I-287 Corridor Project Draft Environment Impact Statement (DEIS) and tests their reasonableness by:

- Comparing DEIS outcomes to previous Year 2035 forecasts developed for the Transit Mode Selection Report (TMSR) and explaining the reasons for significant variation based on changes in input assumptions such as population and employment. Key findings include:
 - DEIS AM peak period, peak direction (eastbound) traffic volumes on the Tappan Zee Bridge in 2047 are similar in magnitude to the 2035 forecasts from the TMSR.
 - DEIS commuter rail volumes for 2047 are 20 to 30 percent less than the TMSR forecasts for 2035.
 - Some parts of the BRT forecasts are lower in the DEIS than the TMSR, while other elements are similar to the TMSR 2035 forecasts.
- Comparing forecasted traffic to existing traffic volumes and confirming that the growth in vehicular volumes is consistent with input growth assumptions contained in the socioeconomic forecasts. Key findings include:
 - AM peak period, peak direction traffic volumes on the Tappan Zee Bridge grow by only 14 percent between 2005 and 2047. This is less than half of the underlying growth in population, employment and trans-Hudson trip making.

The difference between the DEIS and TMSR commuter rail and BRT forecasts are, for the most part, a product of significant changes to the underlying socioeconomic assumptions related to the location of forecast year population and employment. Given these inputs, changes in forecasted transit volumes are reasonable and explainable.

However, Tappan Zee Bridge volumes are similar for the 2047 DEIS and the 2035 TMSR, while forecasted traffic volumes growth rates are lower than suggested by the

underlying socioeconomic forecasts. This means that the differences in population and employment forecasts are not the entire explanation.

In areas where the model does not fully explain observed Tappan Zee Bridge volumes, adjustments may be required post-model so that published forecast findings reflect reasonable projections of future travel demand in the corridor.

Forecasting Methodology

Forecasts for both the DEIS and TMSR phases of the project were developed using a modified version of the regional travel demand modeling procedures maintained by the New York Metropolitan Transportation Council (NYMTC). The Best Practices Model (BPM) is a journey-based disaggregate travel forecasting model designed to represent usage of both the highway and transit systems. This model was adapted for both the DEIS and TMSR phases of this project to represent specific highway and transit demand patterns in the Tappan Zee Bridge/I-287 Corridor.

Although the general modeling approach is similar, the actual DEIS and TMSR forecasting models differ. Here is a summary of the similarities and differences:

- Both models were calibrated to match 2005 Tappan Zee Bridge/I-287 Corridor travel conditions.
- The TMSR calibration was based on socioeconomic forecasts, while the DEIS calibration was based on 2005 Census data, which differ by as much as 13 percent from the TMSR socioeconomic forecasts.
- The TMSR travel demand forecasts were based on the 2004 version of the NYMTC BPM. The forecast year for the TMSR analysis was 2035.
- The DEIS forecasts were based on the 2009 version of the NYMTC BPM. The forecast year for the DEIS is 2047.

Differences in the underlying model, the socioeconomic data, and the steps taken to calibrate the BPM to match corridor conditions can result in significant variation in forecast results.

Key Forecast Results

The modified BPM was used to forecast base and future year travel demand for the full project “Build” Alternatives consisting of Commuter Rail Transit in Rockland County crossing the Tappan Zee Bridge. The DEIS alternative modeled has a Full-Corridor Busway, and the TMSR option consisted of buses in HOT lanes in Rockland County and exclusive bus lanes in Westchester County . The alternatives were known as “Option 4D” in the TMSR and “Alternative B” in the DEIS.

Key differences between the DEIS and TMSR model results are as follows:

1. AM peak period traffic volumes on the Tappan Zee Bridge for the TMSR and DEIS phases of the project are presented in Table 1. This table shows that AM peak period, peak direction (eastbound) DEIS traffic volumes for 2047 are expected to equal 25,688 vehicles, which is approximately 4 percent less than the 26,663 vehicles forecasted for the TMSR for 2035. The growth in eastbound volumes from 2005 to 2047 is 14 percent in the DEIS compared to the 24 percent growth from 2005 to 2035 in the TMSR report. Westbound growth rates in the DEIS are higher than the rates from the TMSR (35 percent vs. 24 percent).
2. Daily highway volumes on the Tappan Zee Bridge for the TMSR and DEIS phases of the project are presented in Table 2. The daily eastbound DEIS forecasts for 2047 are approximately 2 percent higher than the forecasted volumes prepared for the TMSR for 2035 (84,366 daily in the DEIS as compared to 83,013 in the TMSR). The growth in eastbound traffic from 2005 to 2047 is 32 percent in the DEIS compared to 31 percent growth from 2005 to 2035 from the TMSR report. Westbound growth rates in the DEIS are also similar to those from the TMSR, 31 percent and 32 percent, respectively.
3. Daily commuter rail ridership for the Port Jervis line and the Cross-Hudson line are presented in Table 3. As shown in this table, commuter rail ridership from the DEIS for 2047 is 20 to 30 percent less than equivalent forecasts for 2035 from the TMSR report.
4. BRT ridership in the corridor is presented in Table 4. Overall volumes for BRT service are similar between the DEIS for 2047 and the TMSR for 2035. However, the DEIS results show 37 percent fewer Cross-Hudson BRT trips and 10 percent more intra-Westchester/CT BRT trips.

Table 1: Tappan Zee Bridge AM Peak Period Traffic Volume Growth Relative to 2005 TMSR (2035) and DEIS (2047)

Direction	TMSR				DEIS			
	2005	2035 No Build	Difference 2005-2035	% Growth	2005	2047 No Build	Difference 2005-2047	% Growth
Eastbound	21,469	26,663	5,194	24%	22,511	25,688	3,177	14%
Westbound	12,887	15,991	3,104	24%	11,302	15,234	3,932	35%
Total	34,356	42,654	8,298	24%	33,813	40,902	7,089	21%

Table 2: Tappan Zee Bridge Average Weekday Traffic Growth Relative to 2005 TMSR (2035) and DEIS (2047)

Direction	TMSR				DEIS			
	2005	2035 No Build	Difference 2005-2035	% Growth	2005	2047 No Build	Difference 2005-2047	% Growth
Eastbound	63,605	83,013	19,408	31%	63,949	84,366	20,416	32%
Westbound	66,358	87,924	21,566	32%	63,313	83,203	19,890	31%
Total	129,963	170,937	40,974	32%	127,262	167,569	40,307	32%

Table 3: Daily Ridership on Port Jervis Line and Cross-Hudson CRT
TMSR (2035) and DEIS (2047)

CRT Lines	TMSR 2035	DEIS 2047	Difference (TMSR-DEIS)	% Difference
Port Jervis Line	31,600	21,800	-9,700	-31%
Cross-Hudson CRT ^[1]	29,200	22,600	-6,600	-23%

[1] Cross-Hudson CRT represents the Option 4D of the TMSR and DEIS Alternative B: Corridor Busway.

Table 4: Daily BRT Ridership by Market
TMSR (2035) and DEIS (2047)

Tappan Zee Bridge BRT	TMSR (2035) Alternative 4D: Full-Corridor BRT (3A)	DEIS (2047) Alternative B: Corridor Busway	Difference (TMSR-DEIS)	% Difference
Intra-Rockland/ Orange-Rockland	11,200	11,500	+300	+3%
Cross-Hudson Circumferential ^[1]	9,400	5,900	-3,500	-37%
Intra-Westchester/ Westchester-CT	28,300	31,100	+2,800	+10%
Total BRT	48,900	48,500	-400	-<1%

[1] Orange/Rockland ↔ Westchester

The findings of the preliminary DEIS forecasting effort are sufficiently different from prior analyses to warrant a thorough review of forecasting assumptions to understand why these outcomes have occurred and, as necessary, develop post-model adjustments so that the resulting forecasts represent the expected levels of future traffic and transit ridership in the corridor.

Overview of Forecast Assessment

The analysis of the forecasting results shows that the change in the TMSR and DEIS forecasts is related, in part, to significant shifts in the base and future year population and employment assumptions. These growth assumptions reflect regionally adopted forecasts developed by NYMTC.

The particular factor that affects these forecasts relates to the balance between worker residence location and employment location. This balance varies considerably between the Year 2035 TMSR and the Year 2047 DEIS forecasts. This change has led to substantial differences in future year commuting flows for each series, which explains nearly all of the differences in transit ridership between the TMSR and DEIS forecast sets. It also means that many of the DEIS outcomes are not a function of the Tappan Zee Bridge project model calibration and are likely to change materially only if NYMTC substantially revises its socioeconomic projections.

The other major finding of this analysis is that the model calibration underestimates overall Tappan Zee Bridge travel by 8 percent and underestimates certain key markets (i.e., Orange/Bergen/Passaic work trips to Westchester County) using the Tappan Zee

Bridge by 25 to 50 percent. Since the model is not structured to allow fine tuning of these factors, raw model outputs should be adjusted to properly represent observed conditions. The markets in question are where the higher growth rates are located so this adjustment should result in output growth rates that better align with the underlying socioeconomic assumptions.

Effect of Differences in Forecasted Population and Employment

As described in the overview, a key factor in the changes in travel demand is related to differences in the underlying demographic forecasts for the New York metropolitan area, and in the Tappan Zee Bridge/I-287 Corridor in particular. The TMSR and DEIS forecasts are summarized in Tables 5, 6, and 7. Key differences between the two forecasts are as follows:

1. Year 2047 labor force for Rockland and Orange Counties that are used in the DEIS forecasts are 26 and 9 percent lower, respectively, than the 2035 forecasts that were the basis of the TMSR forecasts. These differences reduce the number of work trips originating in Orange and Rockland Counties, including many who travel eastward in the morning across the Tappan Zee Bridge.
2. Projected 2047 employment in Rockland County used in the DEIS is 26 percent higher than in the 2035 forecast used in the TMSR, resulting in fewer residents needing to leave Rockland County to seek employment and drawing new persons to travel westward across the Tappan Zee Bridge from their homes in Westchester County.
3. Employment in Westchester is 12 percent higher in the DEIS forecast as compared to the TMSR, but only 2 percent higher in Manhattan. This change theoretically increases the demand for cross-Hudson travel from Orange and Rockland Counties to Westchester, but since there is a sharp decline in Rockland and Orange Labor Force in the DEIS forecasts as compared to the TMSR, this effect is mitigated. The decline in Rockland and Orange Labor Force and the fact that Manhattan DEIS employment is only slightly higher than the TMSR means that travel between Orange/Rockland and Manhattan is likely to be smaller in the DEIS than in the TMSR.

Table 5: TMSR and DEIS Base and Forecast Year Population

County	TMSR			DEIS			Difference	
	2005	2035	Growth	2005	2047	Growth	2005	Future
Rockland	289,726	364,182	26%	286,779	339,922	19%	-1%	-7%
Orange	359,535	535,195	49%	358,649	511,676	43%	0%	-4%
Westchester	940,803	995,916	6%	919,626	1,062,598	16%	-2%	7%
Manhattan	1,521,804	1,661,344	9%	1,544,199	1,962,928	27%	1%	18%

Table 6: TMSR and DEIS Base and Forecast Year Labor Force

County	TMSR			DEIS			Difference	
	2005	2035	Growth	2005	2047	Growth	2005	Future
Rockland	168,670	224,103	33%	145,999	165,295	13%	-13%	-26%
Orange	180,653	287,997	59%	170,796	261,168	53%	-5%	-9%
Westchester	449,023	532,607	19%	465,294	510,875	10%	4%	-4%
Manhattan	727,646	816,508	12%	830,700	928,391	12%	14%	14%

Table 7: TMSR and DEIS Base and Forecast Year Employment

County	TMSR			DEIS			Difference	
	2005	2035	Growth	2005	2047	Growth	2005	Future
Rockland	108,635	139,426	28%	122,404	176,036	44%	13%	26%
Orange	136,723	197,317	44%	133,423	182,614	37%	-2%	-7%
Westchester	406,497	510,770	26%	407,542	573,119	41%	0%	12%
Manhattan	2,081,871	2,693,638	29%	2,044,134	2,753,295	35%	-2%	2%

The change in the balance of labor force to employment can lead to substantial changes in the flows of work-related travel, as illustrated in Table 8 and fully documented in Appendix A and B.

Table 8: TMSR and DEIS Base and Forecast Year Work Flows

Market	TMSR			DEIS			Difference	
	2005	2035	Growth	2005	2047	Growth	2005	2047
Rockland-Manhattan	17,349	26,837	55%	17,366	18,507	7%	0%	-31%
Orange-Manhattan	9,031	22,565	150%	10,836	18,490	71%	20%	-18%
<i>Commuter Rail Market</i>	26,380	49,402	87%	28,202	36,997	31%	7%	-25%
Intra-Rockland	60,172	76,169	27%	82,731	100,851	22%	37%	32%
Intra-Orange	97,701	137,632	41%	102,823	132,753	29%	5%	-4%
Intra-Westchester	229,021	268,791	17%	251,834	290,340	15%	10%	8%
<i>Subtotal Intra-County</i>	386,894	482,592	25%	437,388	523,944	20%	13%	9%
Rockland-Westchester	12,069	14,636	21%	14,250	16,754	18%	18%	14%
Orange-Westchester	4,885	9,466	94%	5,593	13,732	146%	14%	45%
<i>Subtotal Tappan Zee Bridge Eastbound</i>	16,954	24,102	42%	19,843	30,486	54%	17%	26%
Westchester-Rockland	2,311	2,719	18%	4,485	5,396	20%	94%	98%
Westchester-Orange	246	131	-47%	1,669	1,260	-25%	578%	862%
<i>Subtotal Tappan Zee Bridge Westbound</i>	2,557	2,850	11%	6,154	6,656	8%	141%	134%

One of the most important effects is that total work-related travel volumes from Rockland and Orange Counties to Manhattan are 25 percent lower in the DEIS than the TMSR. This decline is consistent with lower labor force forecasts in Orange and Rockland Counties, coupled with substantial employment growth in Rockland County and more modest growth in Manhattan employment.

The fact that total work-related travel volumes from Rockland and Orange Counties to Manhattan decline by 25 percent fully explains the 23 percent reduction in cross-Hudson and Port Jervis Line commuter rail ridership, which is largely oriented around service from Rockland and Orange Counties to Manhattan market.

The next key observation is that intra-County travel in the corridor is only 9 percent higher in the 2047 DEIS than in the 2035 TMSR. This outcome reflects a complex balancing of lower labor force growth in all three counties versus higher projected employment in Rockland and Westchester Counties and lower employment growth in Orange County.

This intra-county comparison affects the market for BRT services related to intra-Orange/Rockland and intra-Westchester/CT travel. A comparison of intra-Westchester BRT ridership shows that it tracks the change in intra-Westchester travel reasonably well (3 percent vs. 8 percent growth). Intra-Rockland BRT usage requires a more complex analysis since the 2005 labor force and employment figures for Rockland that were used in the model calibration are quite different (see Tables 6 and 7). In simple terms, however, intra-Rockland travel grows at a lower rate in the DEIS, but it starts at a higher base. After calibrating to existing transit trips, the net result is approximately the same level of demand for intra-Rockland BRT travel to that projected in the TMSR phase of the project.

The last key market is for cross-Hudson travel. In the eastbound direction, work-related travel is up by 26 percent when comparing the DEIS in 2047 to the TMSR in 2035. Furthermore, the DEIS shows a higher level of growth in these markets than was assumed for the TMSR.

This is one element of the forecast results that does not align with the traffic and ridership results. Eastbound AM peak DEIS traffic volumes on the Tappan Zee Bridge are expected to grow by 14 percent between 2005 and 2047, while the underlying growth in cross-Hudson trip making (Orange/Rockland to Westchester) is expected to grow by 54 percent. Likewise, cross-Hudson BRT usage is 37 percent lower in the DEIS than in the TMSR, while a comparison of the total travel demand shows an increase of 26 percent.

Refined Assessment of Cross-Hudson Travel Market vs. Tappan Zee Bridge Traffic

To gain a better understanding of the difference between forecasted growth in corridor travel as compared to traffic volumes, a more refined analysis was conducted. This involved examining the major markets with an additional factor to account for the fact that not all trips in each market currently use the Tappan Zee Bridge to cross the Hudson River. This analysis is presented in Table 9.

Table 9: Refined Estimate of DEIS Growth in Eastbound Tappan Zee Bridge-Oriented Work Trip Markets

Market	2005 Total Trips	2047 Total Trips	Percent using Tappan Zee Bridge	2005 Trips using Tappan Zee Bridge	2047 Trips using Tappan Zee Bridge	Growth
Orange-Westchester	5,593	13,732	32%	1,790	4,394	146%
Rockland-Westchester	14,250	16,754	91%	12,968	15,246	18%
Bergen/Passaic-Westchester	4242	5349	83%	3,521	4,440	26%
Total EB crossing (P to A)	24,085	35,835	<i>N/A</i>	18,278	24,080	32%

The refined analysis of work trips shows that the demand for eastbound work-related travel grows by 32 percent, which is still higher than the projected 14 growth in AM peak period peak-direction travel on the Tappan Zee Bridge. Some of this might be explained by a greater amount of peak spreading, which is reflected in the fact that total daily bridge crossings grow by 32 percent between 2005 and 2047. Nevertheless, since a large proportion of work trips is likely to travel in the peak period, additional analysis is required to understand the degree to which the assignment results can be relied on to represent future traffic.

Additional Validation of Tappan Zee Bridge Corridor Travel

Given the fact that assigned volumes on the Tappan Zee Bridge appear to grow more slowly than the underlying growth in traffic, three additional validation tests were conducted to determine whether the model understands the specific locations of travel crossing the Hudson River and related volumes on the Tappan Zee Bridge in the validation year.

These additional validation tests are described in the sub-sections that follow and include:

- Test 1. Overall Performance of the Model in Representing Bridge Flows
- Test 2. Performance of the Model in Representing Utilization of Trans-Hudson Bridge Crossings by Individual County-to-County Markets
- Test 3. Representation of Sub-County Markets

Test 1. Overall Performance of the Model in Representing Bridge Flows

This test shows that on a daily two-way basis the model underestimates two-way traffic flows by 6 percent in the AM peak and 8 percent over the entire day (Table 10). AM peak and daily east-west directionality is well-represented by the model. Although this level of model fidelity is well within the standard performance specifications for regional forecasting models like the BPM, raw model output results should be adjusted so that they are related to actual base year volumes rather than modeled quantities. In other words, the raw model outputs need to be adjusted post-model so that they better align with actual counts and travel patterns.

Table 10: Comparison of 2005 Toll Plaza/Count Data vs. DEIS Modeled Traffic Volumes by Time of Day

Time Period	Tappan Zee Bridge EB			Tappan Zee Bridge WB			Tappan Zee Bridge Two Directions		
	Year 2005 Average	Model Run	Difference with Year 2005	Year 2005 Average ^[1]	Model Run	Difference with Year 2005	Year 2005 Average	Model Run	Difference with Year 2010
AM	23,749	22,511	-5%	12,207	11,302	-7%	35,955	33,813	-6%
Midday	20,132	19,963	-1%	23,365	20,711	-11%	43,497	40,674	-6%
PM	15,103	13,204	-13%	21,782	21,329	-2%	36,885	34,533	-6%
Night	11,476	8,271	-28%	10,450	9,972	-5%	21,926	18,243	-17%
Total	70,460	63,949	-9%	67,804	63,314	-7%	138,263	127,263	-8%

[1] Westbound volumes based are on August 2010 NYS Thruway counts, adjusted for to represent 2005 volumes and seasonal variation (August vs. annual average).

Test 2. Performance of the Model in Representing Utilization of Trans-Hudson Bridge Crossings by Individual County-to-County Markets

This test demonstrates that although the model generates an accurate estimate of total daily travel, it underestimates usage of the Tappan Zee Bridge by travelers from Orange, Bergen, and Passaic Counties to Westchester County (Table 11). This means that the model tends to underestimate Tappan Zee Bridge usage by two of the higher-growth markets crossing the Hudson, while overestimating traffic between Rockland and Westchester. Raw model output results should be rebalanced so that the proportion of each market utilizing the Tappan Zee Bridge better conforms to survey findings.

Table 11: Survey (2003) vs. Model (2005) Distribution of Trans-Hudson Travel by Bridge Crossing

County-County Market	Newburgh Beacon		Bear Mountain		Tappan Zee		George Washington	
	Survey	Model	Survey	Model	Survey	Model	Survey	Model
Orange to Westchester	27%	17%	42%	60%	32%	24%	0%	0%
Rockland to Westchester	0%	0%	5%	5%	91%	95%	4%	0%
Bergen/Passaic to Westchester	0%	0%	4%	2%	83%	42%	13%	56%

Test 3. Representation of Sub-County Markets

This test is designed to understand why the Orange County-Westchester Market is overestimated by the model on the Bear Mountain Bridge and underestimated on the Tappan Zee Bridge (Table 11). This test examines sub-county markets (Figure 1) to determine the degree to which the model properly represents travel in the various portions of each county that have convenient access to the Bear Mountain and Tappan Zee Bridges.

As this comparison shows (Table 12), the modeled estimates of work travel match total Orange County to Westchester County flows quite well, but overestimates the degree to which this travel is oriented towards the northern half of Westchester County—the

section that is most conveniently accessed by the Bear Mountain Bridge. Raw forecasts of Orange County to Westchester County travel should be rebalanced to reflect observed sub-county distributions. This adjustment should be performed in conjunction with the adjustments to county-to-county usage of the Tappan Zee Bridge described earlier since the two factors will interact.

Figure 1: Orange County and Westchester County Subdistricts

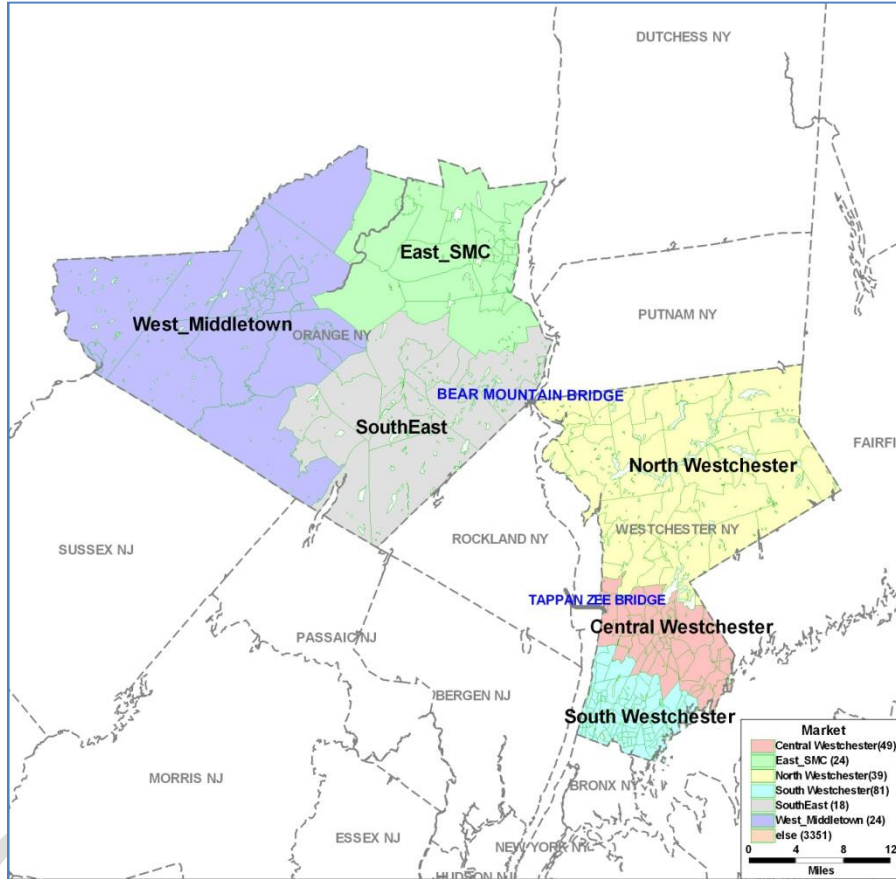


Table 12: Census Journey to Work (2003) vs. Model (2005) Distribution of Sub-County Travel for Work Trips between Orange County and Westchester County

Census Journey to Work

Orange County	Central Westchester	North Westchester	South Westchester	Total Westchester
East SMC Orange County	1,000	1,024	426	2,450
Southeast Orange County	895	502	351	1,748
West Middletown Orange County	547	302	254	1,103
Total Orange County	2,442	1,828	1,031	5,301

DEIS Calibrated (2005) Highway AM Person Trip Table

Orange County	Central Westchester	North Westchester	South Westchester	Total Westchester
East SMC Orange County	398	930	131	1,458
Southeast Orange County	611	1,728	259	2,599
West Middletown Orange County	279	273	112	664
Total Orange County	1,289	2,931	502	4,721

Recommendations

This assessment suggests that the model results are generally explained by a combination of the nature of NYMTC forecasts of population, labor force, and employment and by certain aspects of the present model that do not fully represent fine grained travel conditions in the corridor. In particular:

- Changes to forecasts of commuter rail transit and intra-county BRT ridership appear to be fully explained by labor force/employment balance contained in the latest NYMTC socioeconomic forecasts.
- The model appears to systematically underestimate certain Trans-Hudson markets that affect both Tappan Zee Bridge vehicular traffic and cross-Hudson BRT volumes.
- Model recalibration to address these issues is not possible without access to the underlying programs and would be a time-consuming and costly process.
- A pragmatic solution to this situation would be to acknowledge these short-falls and develop a post-model adjustment process for both reporting and for conducting the traffic simulation. This adjustment should account for the fact that the model under-estimates certain Tappan Zee Bridge markets, while also understanding the capacity limits of the Tappan Zee Bridge and the rest of the I-287 highway corridor.

Appendix A.

TMSR County-to-County 2005 and 2035 Work Journeys

2005 TMSR One-Way Work Trips

Home County	Employment Location					
	Rockland	Orange	Westchester	Manhattan	Rest of Region	Total
Rockland	60,172	2,966	12,069	17,349	28,264	120,820
Orange	9,913	97,701	4,885	9,031	29,516	151,046
Westchester	2,311	246	229,021	76,852	40,296	348,726
Manhattan	763	64	7,805	599,640	69,008	677,280
Rest of Region	8,139	4,500	56,022	1,448,034	4,997,108	6,513,803
Total	81,298	105,477	309,802	2,150,906	5,164,192	7,811,675

2035 TMSR One-Way Work Trips

Home County	Employment Location					
	Rockland	Orange	Westchester	Manhattan	Rest of Region	Total
Rockland	76,169	2,189	14,636	26,837	31,717	151,548
Orange	9,039	137,632	9,466	22,565	54,589	233,291
Westchester	2,719	131	268,791	87,636	42,495	401,772
Manhattan	900	42	7,555	664,171	73,767	746,435
Rest of Region	11,743	3,845	67,434	1,828,283	6,240,393	8,151,698
Total	100,570	143,839	367,882	2,629,492	6,442,961	9,684,744

2005-2035 TMSR Growth in One-Way Work Trips

Home County	Employment Location					
	Rockland	Orange	Westchester	Manhattan	Rest of Region	Total
Rockland	27%	-26%	21%	55%	12%	25%
Orange	-9%	41%	94%	150%	85%	54%
Westchester	18%	-47%	17%	14%	5%	15%
Manhattan	18%	-34%	-3%	11%	7%	10%
Rest of Region	44%	-15%	20%	26%	25%	25%
Total	24%	36%	19%	22%	25%	24%

Appendix B.

DEIS County-to-County 2005 and 2047 Work Journeys

2005 DEIS One-Way Work Trips

Home County	Employment Location					
	Rockland	Orange	Westchester	Manhattan	Rest of Region	Total
Rockland	82,731	3,664	14,250	17,366	25,830	143,841
Orange	7,314	102,823	5,593	10,836	24,566	151,132
Westchester	4,485	1,669	251,834	56,999	53,046	368,033
Manhattan	79	33	4,538	622,966	73,091	700,707
Rest of Region	8,305	5,020	76,982	1,169,061	5,298,551	6,557,919
Total	102,914	113,209	353,197	1,877,228	5,475,084	7,921,632

2047 DEIS One-Way Work Trips

Home County	Employment Location					
	Rockland	Orange	Westchester	Manhattan	Rest of Region	Total
Rockland	100,851	2,479	16,754	18,507	25,160	163,751
Orange	16,628	132,753	13,732	18,490	47,225	228,828
Westchester	5,396	1,260	290,340	59,823	45,709	402,528
Manhattan	119	22	5,347	693,261	83,716	782,465
Rest of Region	11,719	4,535	125,906	1,504,937	6,804,988	8,452,085
Total	134,713	141,049	452,079	2,295,018	7,006,798	10,029,657

2005 to 2047 DEIS Growth in One-Way Work Trips

Home County	Employment Location					
	Rockland	Orange	Westchester	Manhattan	Rest of Region	Total
Rockland	22%	-32%	18%	7%	-3%	14%
Orange	127%	29%	146%	71%	92%	51%
Westchester	20%	-25%	15%	5%	-14%	9%
Manhattan	51%	-33%	18%	11%	15%	12%
Rest of Region	41%	-10%	64%	29%	28%	29%
Total	31%	25%	28%	22%	28%	27%