2010 Base Year Update and Validation of the NYMTC New York Best Practice Model (NYBPM)

FINAL REPORT

Prepared for the

New York Metropolitan Transportation Council

By the
Systems Analysis Group, Parsons Brinckerhoff

October 29, 2014

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The purpose of this report is to document the work done in the past two years to prepare the New York Best Practice Model (NYBPM), which refers to the set of data bases and regional travel demand models used by the New York Metropolitan Transportation Council, the New York Metropolitan Planning Organization (MPO) for the forecasting and estimation of mobile source emissions as part of the region's pending Conformity Analysis of the Transportation Improvements Plan (TIP) and Long Range Plan.

The development of the NYBPM 2010 Update occurred in three distinct phases of the model evolution for the 2010 Update which are also serve as the basis of organization for the this General Final Report.

- Stage 1A: Trans-Hudson Travel Demand Forecasting Model (TH-TDFM 2005 model for Lincoln Tunnel Helix forecasting)
- Stage 1B: TH-TDFM 2010 Update: Stage 1B – update with BPM-2G platform and TransCAD implementation of all transit components, and focus on Trans-Hudson transit forecasting
- Stage 2: NYBPM 2010 Update Final – update of all regional data, networks, development of additional procedures for NYMTC, calibration and validation of the final 2010 Update model.

The first task of this 2010 Update and Validation consisted of updating the more specific Trans-Hudson Travel Demand Forecasting Model (TH-TDFM) to 2010 for the Port Authority of New York and New Jersey (PANYNJ). That final report was submitted at the end of 2013[1]. During the NYBPM 2010 Update, several decisions were made to modify elements of the model that were not applied to the TH-TDFM 2010 update, in particular a major Transportation Analysis Zone (TAZ) refinement, a conflated highway network with additional attributes and totally overhauled Truck & Commercial Van and External Auto Travel models.

This report is organized according to the basic elements of the work that has been done to update and prepare the NYBPM and post-processing system for use in conformity analysis:

- Sections 2 and 3: An overview of the TH-TDFM Helix (Stage 1A) and 2010 Update (Stage 1B) models
- Section 4: Stage 2 updates of the data bases that support the NYBPM, from the Base Year 2005 to a new Base Year 2010 set, including updated Socioeconomic/Demographic (SED) data, 2000 and 2010 Census data, revised zonal geography, as well as highway and transit counts.
- Section 5: Revision and updates to both the NYBPM highway and transit networks, including corrections and updates that incorporate improvements and changes implemented

[1] TH-TDFM 2010 Update – Final Deliverables, PB/AECOM/Caliper, December 18, 2013

in the regional transportation system since the 2005 base year. This also includes updating the highway and transit costs to 2010 dollars. A substantial improvement has been made to the highway network through the conflation of its geography to "ground truth".

- Section 6: Modification of several NYBPM application procedures, including new Truck and Commercial Vans and External Auto travel models , the ability to calibrate the core models by a flexible district system, the ability to run MDSC for selected purposes, and the ability to run PAP and highway assignment by purpose.
- Section 7: Re-Calibration of the NYBPM to a Base Year 2010, based on the revised set of input data and new calibration targets.

1.2 OVERVIEW OF THE NYTMC BEST PRACTICE MODEL

A brief overview of the NYMTC Best Practice Models (NYBPM) is useful in understanding the NYBPM 2010 Update and Validation effort documented in this report. A complete description of the NYBPM can be found in the *General Final Report: New York Best Practice Model*[2].

Regional Model Area

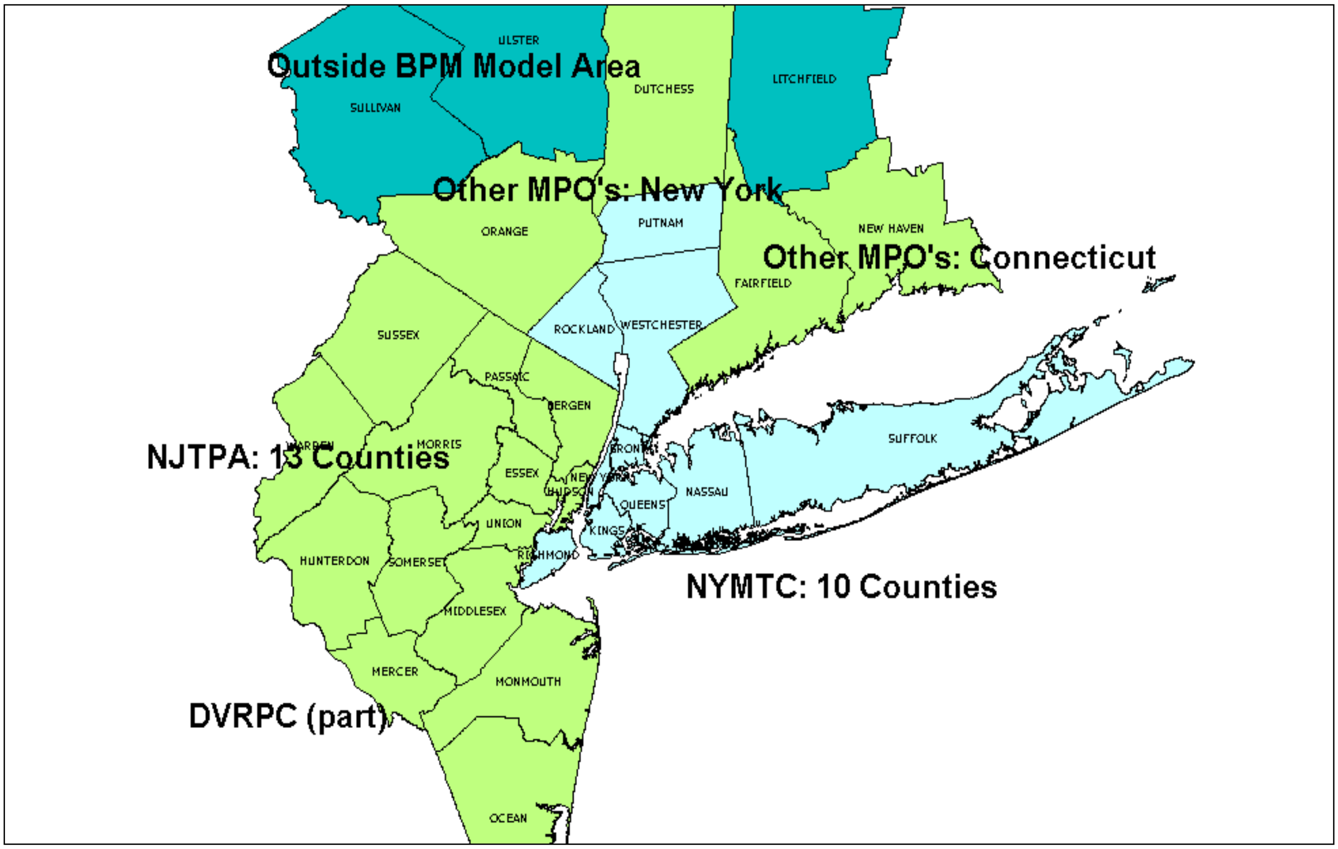
In order to adequately model travel in the New York region, the NYBPM networks, zones and the Regional Travel – Household Interview Survey (RT-HIS) survey data are representative of the full 28 county region. The focus of the planning application and calibration of the model to date, however, has been on the ten counties that comprise the NYTMC planning jurisdiction and air quality attainment area.

While Conformity Analysis done by NYMTC with the NYBPM model is focused on twelve (12) New York counties, the NYBPM model area consists of the entire 28 county metropolitan region, including portions of New York, New Jersey, and Connecticut. It is comprised of more than 4,600 transportation analysis zones and includes most types of road facilities, from minor arterials and above, and all forms of public transportation. In addition to 10 New York counties in the NYMTC planning regions, the NYBPM model area includes the 13 counties in northern New Jersey that are part of the North Jersey Planning Authority (NJTPA), Mercer County (part of the Delaware Valley Regional Planning Commission or DVRPC), Dutchess and Orange Counties in the Hudson Valley, and Fairfield and New Haven Counties in Connecticut. The inclusion of Sussex, Warren, and Hunterdon Counties in New Jersey established the Delaware River as the western boundary of the study area. This boundary dramatically reduces the number of external stations on the western border and encompasses virtually all of the transit and railroad services that cross the Hudson River.

The map included in **Figure 1-1** below shows the NYBPM model study area.

[2] *General Final Report: New York Best Practice Model.* Draft Final – January 30, 2005. Prepared by Parsons Brinckerhoff / PB Consult for NYMTC.

Figure 1-1: New York Metropolitan Region: NYMTC and NYBPM Model Area



<u>NYMTC (MPO) Counties</u>
1-New York (Manhattan)
2-Queens
3-Bronx
4-Kings (Brooklyn)
5-Richmond (Staten Island)
6-Nassau
7-Suffolk
8-Westchester
9-Rockland
10-Putnam

<u>Other New York</u>
11-Orange
12-Dutchess

<u>Connecticut Counties</u>
13-Fairfield
27-New Haven

<u>NJTPA (MPO) Counties</u>
14-Bergen
15-Passaic
16-Hudson
17-Essex
18-Union
19-Morris
20-Somerset
21-Middlesex
22-Monmouth
23-Ocean
24-Hunterdon
25-Warren
26-Sussex

<u>Other NJ Counties</u> (part of DVRPC)
28-Mercer

Model Structure

The NYBPM was designed and developed based on contemporary best practices in travel demand modeling and extensive field research over the last few years. The guiding principle in developing this model set was to incorporate the best modeling structures and components available that could be practically implemented within the project time and budget framework.

As such, the NYBPM is representative of the emerging set of activity / tour-based models of regional travel demand models which are characterized by the following key features:

- Comprehensive coverage of *all modes and vehicle types* in detailed highway and transit simulations.
- Use of *tour* (or paired journeys) as the basic unit of modeling, instead of *trip* that is used in conventional demand models of the previous generation.
- Use of *micro-simulation* approach to generate forecasts that are discrete choices for individuals, as opposed to probabilities that represent market segment shares in conventional models.
- Using the contemporary conceptual framework *of daily activity agenda* of individuals with accounting for intra-household interactions between members and constraints on peoples' travel in terms of both time and space.
- The NYBPM is a complex model that is designed to predict the detailed travel patterns of the region's diverse population for all modes of travel, by introducing some important innovative extensions beyond conventional travel demand models.

The overall structure of the models and procedures that comprise the NYBPM is shown in the highly simplified schematic found in **Figure 1-2**. While in many respects, the data flow of the NYMTC model can be seen to be similar to that of conventional "4-Step" travel forecasting models – travel production, distribution, mode choice and assignment – the following main features of the NYBPM are distinctive, and represent best practice in travel demand modeling.

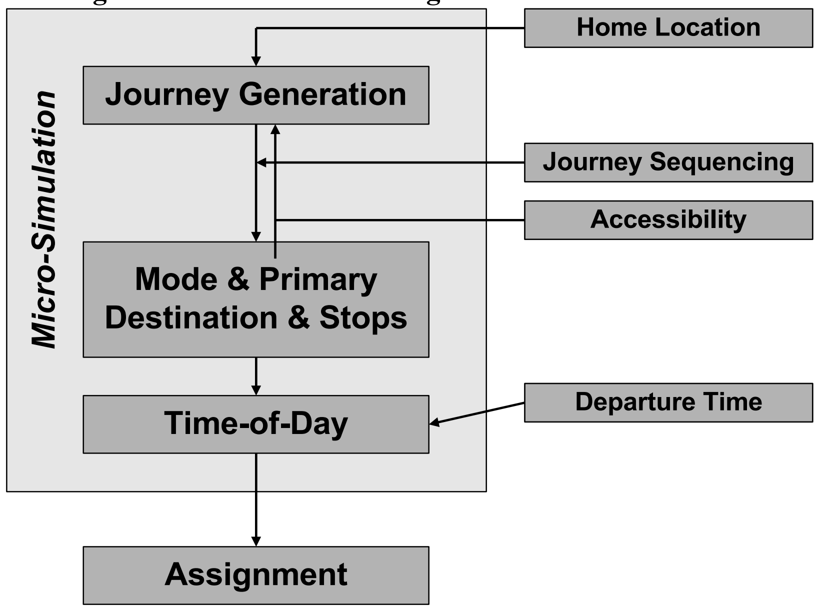
Journey-Based Models

Among its innovations is the new model's use of the concept of "journeys" rather than the more traditional "trips." The journey, defined as travel between principal locations, identifies anchor points in an individual's travel pattern, such as home, work or school.

In the conventional model, for example, a trip would be classified and analyzed as a home-to-work travel, only if its origin was home and its destination the workplace, and there were not intermediate stops made between the two points. If the individual were to make a stops at a day care center, gym or other for some other activity, the conventional model interprets the two isolated trips, and do not take into account that the general travel pattern is a commute to work. The use of the journey construct allows for the purpose and time of each segment to be linked, providing additional insight and accuracy for the modeling and predicting traveler decisions and analyzing their needs.

Thus use of the journey helps planners form a more realistic analysis that is based on the various decisions made by travelers between these locations, such as mode, purpose, destination, frequency and location of intermediate stops, as well as time of day periods. The nine million households of the study area generate 25 million paired journeys per day for the base year 1996.

Figure 1-2: General Modeling Structure of the NYBPM



Micro-simulation Approach

Where traditional models operate at the zone level, with matrix tables of aggregate flows, the NYBPM uses the micro-simulation method to simulate the travel pattern of each person and each individual journey in the region. The micro-simulation method provides many advantages, and a finer level of detail which, when combined with the NYBPM's use of the journey, increases the accuracy and usefulness of the travel demand forecasts.

Applications Software

The NYBPM was developed using a combination of customized programs and TransCAD GISDK software. The models are run using a menu-driven system with partial user interaction, currently entirely supported by TransCAD's GISDK.

The Highway and Road Network

The NYBPM highway network contains more than 60,000 links, including most minor arterial roadways and above-roadway facilities. The database includes information on number of lanes, functional class, speed, parking restriction, truck usage. As inputs to the NYBPM core models, the networks are used to estimate travel times and distances between all parts of the regions (by Traffic Analysis Zones (TAZ's), and then for assignment of models forecast travel demand flows (trip tables) to produce link level volumes flows by vehicle class (Single Occupancy Vehicles (SOV), High Occupancy Vehicles (HOV2, HOV3+), Taxi, Medium and Heavy Trucks, and Commercial Vans), as well as speeds reflecting volumes and capacities.

The Transit Network

The transit network in the NYBPM 2010 Update is a very complex network and has been updated based on information provided by the Metropolitan Transit Authority (MTA), New Jersey Transit (NJ Transit), and other transit operators in the region. The network has 43 NY city subway route families, 40 commuter rail route families, 2300 bus routes and 29 ferry route families as well as the sidewalk network developed and introduced as part of the 2005-2G implementation. In addition, the transit network components also include station to station transfer databases, walk/drive links for rail and other transit connectivity, route coding and fare coding.

1.3 Model Estimation, Calibration and Validation

The development of the NYBPM travel forecasting model was based on the statistical analysis of data specifically collected or otherwise related to the 28 County New York metropolitan region, and to resident travel within the region. While the form and structure of the NYBPM models are essentially generic, it is through the process of model estimation and calibration that the NYBPM has become a "local" model of travel within the tri-state region.

The estimation data sets for the original model development – Base Year 1996 – were constructed from various data sources in a format specific to each model and to the requirements of the ALOGIT software. The RT-HIS conducted in 1997 and 1998 constituted the primary data source for the model estimation. The RT-HIS was also the primary basis for the calibration of the original NYBPM, supplemented by 1990 Census Data, such as the Public Use Micro-Sample (PUMS) data, and the Census Transportation Planning Package (CTPP) data. Highway volume assignments were calibrated based on the 1996 Screenline Count Data base. For the NYBPM 2010 Update, the more recent NYMTC 2010 Regional Household Travel Survey (RHTS) was used for the calibration of the model components.

1.4 Summary

This report describes the work that has been done to properly update the New York Best Practice Model for a new Base Year 2010 (from the previous Base Year 2005), and to validate the updated NYBPM regional travel demand model for use in further applications for SIP / TIP and Plan air quality Conformity Analysis.

The development of the NYBPM 2010 update model involves a replication of most of the data and model update tasks done in the prior 2002 and 2005 Updates. This update of the NYBPM however involved several major features and objectives that were both new and substantial.

The important new elements in the development of the 2010 NYBPM included:

- the adoption of the TransCAD 6.0 GUI and 2G platform developed by Caliper for the prior 2005 NYBPM,
- incorporate the features implemented by Parsons Brinckerhoff for the PANYNJ's Trans-Hudson Travel Demand Forecasting Model (TH-TDFM), done on top of the TransCAD 5.0/CENTRAL 2005 NYBPM,
- incorporate NJTPA modeling data and networks for improved NJ representation,
- integration of major updates and improvements of several components of the NYBPM identified as needed by NYMTC and its Steering Committee in the course of the NYBPM 2010 Update project, and developed in parallel by Parsons Brinckerhoff

These initiatives and new features included the following. The key databases that support the NYBPM were updated to a new Base Year 2010 from the previous Base Year 2005, including updated base year Socioeconomic /Demographic (SED) data, 2000 and 2010 Census data, and highway and transit counts needed for re-calibration and validation. Substantial revisions and updates have been made to both the NYBPM highway and transit networks, including corrections and updates that incorporate improvements and changes implemented in the regional transportation system since the 2005 base year and the transition to a highway network conflated to "ground truth" geography. Additionally, the Transportation Analysis Zone (TAZ) system has been overhauled and moved to a 2010 Census geographic base, with most zones corresponding directly to Census tracts in New York and Connecticut.

In addition, several NYBPM computer application procedures have been improved or added to the set of procedures that comprise the NYBPM modeling system. These include new and improved External Auto travel and Truck and Commercial Vans models, the ability to calibrate the core models by a flexible district system, the ability to run the core model for selected purposes, and the ability to run PAP and highway assignment by journey purpose. In conjunction with these improvements, two distinct truck classes, each with its own tolls, roadway restrictions, PCE, VOT, and VOC are now utilized in the multi-class assignment method in the NYBPM.

Based on the revised full set of input data and new calibration target data developed as part of the NYBPM 2010 Update, and using the improved application procedures implemented in this update, the NYBPM was re-calibrated to match both observed highway and transit travel in the region's 28 county model area, and to provide for reliable future year forecasts.

2 STAGE 1A: INCORPORATION OF THE TH-TDFM 2005 BASE YEAR MODEL

This section provides a general description of the Trans-Hudson - Travel Demand Forecasting Model (TH-TDFM) as implemented for use in the Lincoln Tunnel Helix Replacement project[1], representing **Stage 1A** of the NYBPM 2010 Update process. It specifically describes the features added or modified to the NYBPM Update 2005 version of the 28 county NYMTC regional model that has served as the base platform for Stage 1A**,** including those required as a result of incorporating New Jersey data inputs and networks from the NJRTM-E model maintained by the NJTPA.

Section 3 then presents the **Stage 1B** second wave of improvements and features added to the TH-TDFM as part of its 2010 Update, delivered prior to the current NYBPM 2010 Update with additional model improvements, calibration and validation done as **Stage 2.**

2.1 DESCRIPTION OF THE BASE YEAR 2005 TH-TDFM MODELING APPLICATION SYSTEM – STAGE 1A

The objectives and approach to each of these main components of Stage 1A were developed in LH-Task 1[2], and are documented in:

- Technical Memorandum: Platform Selection and Technical Approach

This Technical Memorandum describes the fully functioning TH-TDFM model application system that includes the data, methods and model features planned and specified in LH-Task 1, as well as special components further developed in LH-Tasks 2-5 and described in separate prior LH Technical Memoranda for each:

- LH-Task 2: Zone System and Socio-Economic Data
- LH-Task 3: Highway Network Development
- LH-Task 4: Transit Network Development
- LH-Task 5: Special Generators

The work in LH-Task 6 required the linking and implementation into an operation system of the model components outlined in the LH-Task 1 Technical Memorandum, as enhancements or extensions to the NYBPM that serves as the base model platform. This work, consisting of reprogramming, scripting, testing, and de-bugging of the overall model application system, was completed in early July 2010, at which point the calibration and validation of Stage 1A could be started.

The discussion in this section of the report is intended to explain how the implemented Stage 1A model applications system worked, and specifically how it differs from the standard NYBPM used by NYMTC for regional analysis, planning and air quality conformity analysis. The general and technical user documentation for the NYBPM that was supported by NYMTC as of Fall 2010 consisted of:

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[1] Taken from Section 2 of "Technical Memorandum Task 6: Model Application System and Calibration", prepared for the Port Authority of New York and New Jersey, October 22, 2010.

[2] LH-Task 1 refers to the Lincoln Tunnel Helix Replacement Study TH-TDFM model tasks (except when in the title of a report, where the report prefix would be LH), or Stage 1A, in order to avoid confusion with Stage 2, labeled simply as Tasks 1 to 18.

- Transportation Models and Data Initiative: NYMTC Best Practice Model (NYBPM) – General Final Report: January 2005, PB
- 2005 Update and Re-Calibration of the NYMTC New York Best Practice Model (NYBPM) – Final Report June 2009, PB
- New York Best Practice Model (NYBPM)- For Regional Travel Demand Forecasting - NYBPM User Documentation: BPM 2005 Update, June 2009, PB
- Best Practice Model Regional Transit Network - Transit Network Data Coding: February 9, 2007, AECOM Consult

The descriptions of the model procedures provided in this section are meant to help the general reader understand the modeling system – its inputs, outputs, and processing flow as applied in the application of the model for scenario forecasts.

While not a detailed model User Guide, the general explanation of each model component and step in this section includes references to the model files, procedures, scripts, and software changes that were developed and implemented specifically in Stage 1A, that differ in any respect from the NYBPM 2005 Update and its set of technical and user documentation maintained by NYMTC.

The technical details of model components are documented in LH - Appendix E: TH-TDFM Model – Data Input Files, Scripts and Procedures: Modifications to the NYBPM.

The overall structure and flow of data inputs, processing steps and model outputs of Stage1.1 is shown in **Figure 2-1**. This flow chart distinguishes between elements of the TH-TDFM that are:

- NYBPM 2005 components – unchanged as part of the Stage 1ANJRTM-E model components – extracted and adapted for use in Stage1.1
- NYBPM components - which required modification, primarily due to the differences in the zone system
- TH-TDFM - unique component developed for Stage 1A

The description of the Stage 1A modeling application system in this section of the report is organized by the model components shown in **Figure 2-1**. The **LETTER CODE** for each is keyed in the discussion and also to the organization of listing of data files, scripts and other technical documentation found in LH-Appendix E.

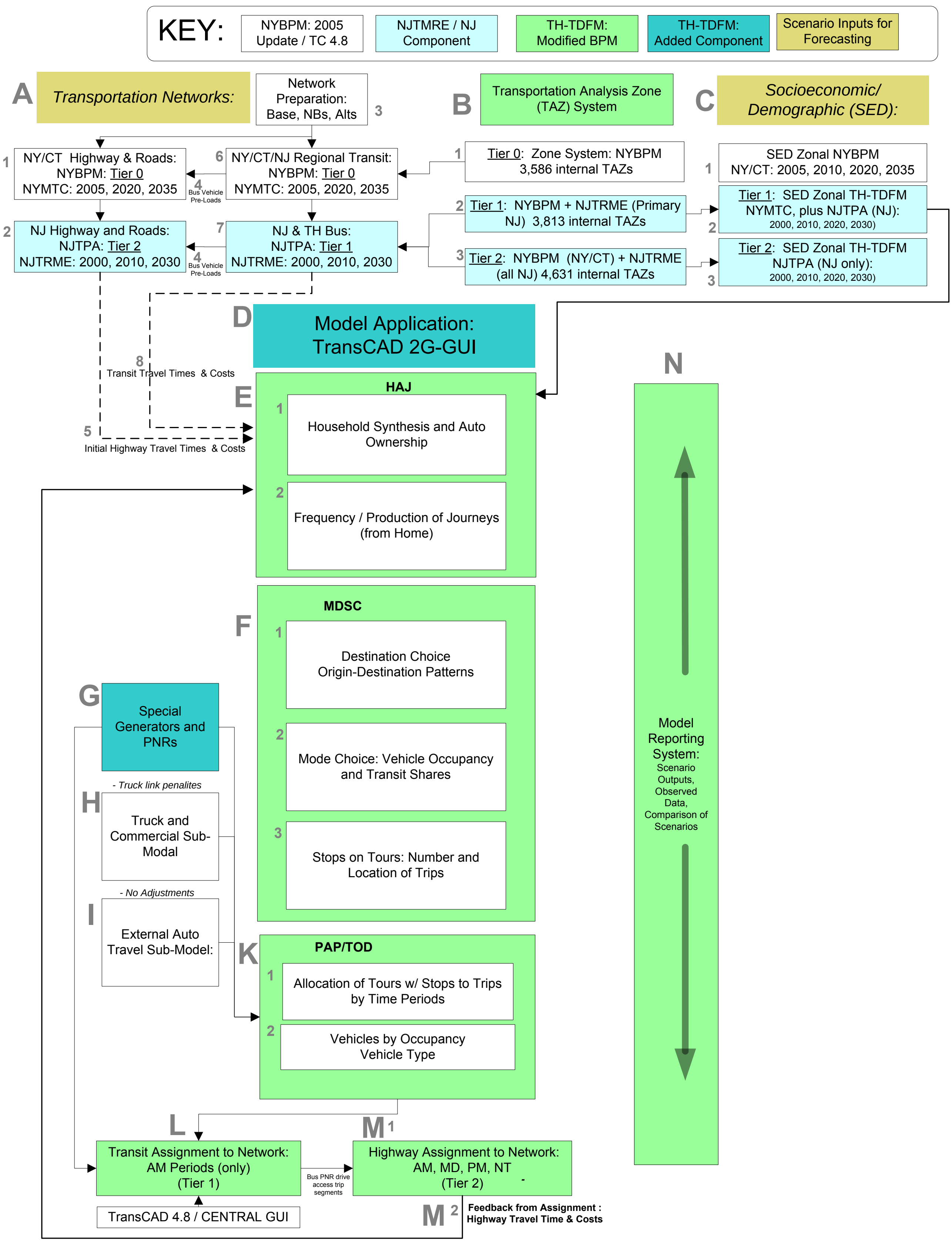

Figure 2-1: General Structure of the original TH-TDFM – Stage 1A

These include, in the general sequence of their application for a model forecast run of Stage1.1:

A. Transportation Networks: Highway and Transit
B. Transportation Analysis Zone (TAZ) Zone System
C. Socio-Economic & Demographic (SED) Data
D. Model Application Shell – TransCAD Graphical User Interface (GUI)
E. Core Choice Models – Household Synthesis, Auto Ownership, and Journey production (HAJ)
F. Core Choice Models – Mode, Destination and Stops (frequency and location) (MDSC)
G. Special Generators
H. Truck and Commercial Vehicle Traffic
I. External (to region) Auto Travel
J. Time of Day for Pricing – Option
K. Pre-Assignment Processor and Time of Day (PAP/TOD)
L. Transit Assignment / Loading of the Network
M. Highway Assignment / Loading of the Network and Feedback System
N. Model Reporting System

2.2 [A: 1-5] Transportation Networks – Regional Roads and Highway (Highway Network)

The highway network for NYBPM was developed based on the GIS database and procedures, and the limited access highways are represented in "dualized form", employing uni-directional links for both mainlines and interchange ramps. However, this GIS-based highway coding was limited to the counties in New York in NYMTC's development of the NYBPM. For the New Jersey counties, the NYBPM highway network still used an abstract "stick-network" taken from previous NJT and NJTPA models resulting in a simplified coding of the limited access highways. As part of Stage 1A development, the highways in New Jersey have been refined and updated, by adopting the highway network coding from the NJRTM-E (2010). This generally includes representation of the limited access highways, including their interchanges, at sufficient level of detail with the use of uni-directional link coding for the mainline and interchange ramps.

The main features of the TH-TDFM highway were designed and have been developed to:

- Retain NYBPM highway network database and assignment methods for East of the Hudson River (EHR), applied [A:1 (Tier 0 level of coding)].
- Adopt the entire NJRTM-E highway network [A2: (Tier 2 level coding)] for all NJ counties (WHR-NJ), adding detail, more current link attributes, as well a uni-directional

coding and ramp detail for Freeways and Expressways, like NYBPM has East of the Hudson River

- Join the transformed NJ highway network with the NY/CT NYBPM highway network at the Interstate/Trans-Hudson Cordon, with reconfigured coding of the 6 PANYNJ Interstate crossings.
- Revised TAZ centroid connectors that link the TH-TDFM zones to the adopted NJ highways (Tier 2)
- Retention of all NJRTM-E highway link attributes, integrated into an extended Highway Dataview with both NJRTM-E (WHR-NJ) and NYBPM (WHR-NY, EHR).
- Maintenance of NJRTM-E link identifiers, to facilitate future updates.
- Retention of NJRTM-E Facility Type, Capacities, and Free Flow Speed for comparison with NYBPM PLT-AreaType based lookups used for the current TH-TDFM assignment, and for possible future optional application of a modified highway assignment procedures in the WHR-NJ portion of the network.

With respect to Stage 1A application and use, the NYBPM procedures have been modified for:

- Preparation for a scenario highway networks (NETPREP) [A:3]
- Bus vehicle Pre-Loads (from the Transit network) [A:4], and
- Skimming of the Tier 2 NJ network and an aggregation procedure to generate Tier 1 level OD tables of highway travel times and costs, that serve as input to the Core choice models [A:5] .

2.3 [A: 6-7; L) TRANSPORTATION NETWORKS – REGIONAL TRANSIT SYSTEM (TRANSIT NETWORK)

The Stage 1A transit network encompasses the public transit systems and services operating in the New York metropolitan region, covering the 28 counties (12 in New York, 14 in New Jersey, and 2 in Connecticut) that comprise the metropolitan region. Although it is structured as an integrated transit system in the model, the Stage 1A transit network is an amalgam of diverse transit modes and services provided by a number of different transit providers that are mostly public, but also include private carriers. The various transit modes and services that are represented and simulated in the transit model network are as follows:

- Ferry
- Long Island Rail Road (LIRR)
- Metro-North Rail Road (MNR)
- New Jersey Transit Commuter Rail
- New York City Transit Subway
- PATH
- Newark City Subway and Hudson-Bergen Light Rail Transit (LRT)
- Express or Commuter Buses, and Local Bus operated by public and private carriers in NY, NJ, and CT

All of these, except LIRR and Metro-North Commuter rail operate and serve the Trans-Hudson travel market between New York and northern New Jersey in the metropolitan region.

The model adopted the current transit network coding and current methods (NYBPM 2005, TransCAD 4.8 with CENTRAL user interface), and all of the NYBPM transit service coding except Trans-Hudson bus service from West of the Hudson River, which had been taken from the NJRTM-E (CUBE Voyager platform) to provide a more accurate and up to date representation of the Trans-Hudson bus system (e.g., their routes, capacity, headways, etc.) than found in the regional NYBPM at that time.

The main features of the Stage 1A transit network system were designed and have been developed to:

- Retain all NYBPM transit network features and assignment procedures for all but Trans-Hudson and NJ bus service; including:
    1. EHR, WHR-NY – All transit modes.
    2. WHR-NJ - All transit modes, except Bus
- Replace Trans-Hudson and NJ Bus service coding with NJRTM-E with coding on top of the NJRTM-E highway links added to NYBPM All Links Layer for WHR-NJ
- Adapt walk and drive access connectors in O-NJ to NYBPM zone system (Tier 0) and methods
- Use NJRTM-E walk and drive access connectors in P-NJ (Tier 1)

The NYBPM transit network and processing procedures were modified for:

- Preparation for a scenario transit networks [A:3]
- Skimming of transit travel times and costs (Tier 1) [A:8]

2.4 [B] TRANSPORTATION ANALYSIS ZONE (TAZ) SYSTEM

The objective that guided the design and implementation of the Stage 1A zone system, and corresponding transportation networks, was to use the finest appropriate level of detail available from existing models and socio-economic data, subject to limitations of the model application structure and processing efficiencies, to obtain as accurate a representation of travel across the Hudson River as possible.

The 3,586 (Tier 0) NYBPM zones used in the entire 28 county modeled region were expanded to the following "tiered" zone systems, as a result of adding two layers of additional detail:

- <u>Tier 1</u> – For all Core model processing and Transit network procedures, adopting 220 smaller NJRTM-E zones in P-NJ to the 409 P-NJ zones in the NYBPM, along with 7 new Special Generator zones, to yield a total of 3,813 Tier 1 zones in modeled region.
- <u>Tier 2</u> - for Highway Assignment (only), adopting all 1,658 NJRTM-E zones in NJ (except several special generators and a few zones actually larger than the corresponding NYBPM zones), resulting in a total of 4,631 Tier 2 zones, used in the highway assignment step.

2.5 [C]Socio-Economic & Demographic (SED) Data

Since the Stage 1A model was built on a hybrid Zone system that uses both the NYBPM and the NJRTM-E models, it followed that the socio-economic and demographic (SED) data used to populate the TH-TDFM zones that serve as the SED inputs for both the base year calibration, and for future year TH-TDFM forecasting, have also been constructed from these two sources. New York and Connecticut retain the zonal data input components from the NYBPM, while the SED data for the fourteen counties in northern New Jersey have been adapted from the NJRTM-E. While only SED data in Primary New Jersey (P-NJ) Tier 1 zones have been used for travel generation and the core model steps, the more disaggregate NJTPA SED data for Other New Jersey (O-NJ) Tier 2 zones are maintained in the SED model inputs database, and are aggregated to obtain the SED for the Tier 1 NJ zones.

The main features of the SED database and how it functions in the framework of the two-tiered modeling system include:

- For the primary NJ zones, only the SED data at the more detailed NJRTM-E zone level from the Primary New Jersey (P-NJ) zones (where Tier 1 are the same as Tier 2) are used for travel generation and other core model steps.
- For the Other New Jersey (O-NJ) zones (where there are both Tier 1 and Tier 2 levels), the Tier 2 level SED data is maintained in the model's inputs database, and are used in application in two ways: 1) aggregated to obtain the Tier 1 SED for core model and transit processing, and 2) used to allocate Tier 1 output highway trip tables to Tier 2 for the highway assignment step.
- Procedures to translate NJRTM-E SED data measure to the 15 standard SED data items used as inputs to the Stage1.1 model.

2.6 [D] Model Application Shell – TransCAD Graphical User Interface (GUI)

The most current version of the NYBPM platform developed by NYMTC, *Version 1.2: TransCAD 5.0 H /GISDK GUI – "Highway Model"* was adapted to serve as the overall model application shell of the Stage 1A model[1]. This version of the NYBPM was operated using the new Graphical User Interface (GUI) developed by Caliper for NYMTC, which replaced the interface originally developed for the NYBPM using the proprietary CENTRAL software. This new GUI was implemented in GISDK, TransCAD's native scripting language. It generally replicated the model application options that were available under the CENTRAL GUI..

This revised NYBPM GUI was adapted in this task as the main platform for Stage 1.1, including modifications to accommodate the enhanced Stage 1A features that were added to the NYBPM. It has since been adopted by NYMTC for its NYBPM 2G platform.

[1] Technical Users Documentation – *BPM Flow Chart GUI Highway and Final Model Candidate Deliverable*, 3/26/2010; Jim Lam, Caliper Corporation.

2.7 [E, F] Choice Models – Household Synthesis, Auto Ownership, and Journey production (HAJ) and, Mode, Destination and Stops (frequency and location) (MDSC)

All improved features of the NYBPM that were developed as part of the 2005 Update were retained for the Stage 1A as part of the base model, namely:

- Revised External (Auto) method - base year and forecast
- Enhanced the Mode Destination and Stop Choice Model,
- Revised Pre-Assignment Processor (PAP) and Time-of-Day (TOD)
- Updated the Highway Assignment and Skimming Procedures
- Blending of Skims/Tour-Level Skims
- Revised Transit Network Skimming Procedures
- Updated Truck and Van Trip Table Estimation and Forecasting Procedures

No fundamental changes to the core models of the NYBPM (principally HAJ and MDSC) were required for Stage 1A development. However, in order to accommodate an expanded zone system, to allow for additional smaller zones in New Jersey, a fairly substantial number of changes to the software coding of these core models were required, for the NYBPM to function properly with any number of internal zones other that the 3,586 for which it was developed. The adoption of the expanded zone system for the entire model chain was deemed essential to the development of a more accurate, robust and sustainable multi-modal Stage 1A modeling capability.

The incorporation of the expanded zone system required revisions and adjustments to many of the core NYBPM-based procedures:

- HAJ (Household Synthesis, Auto Owner ship, and Journey Generation) [E] – various programs, scripts, control files, and database had to be reviewed, modified, tested, debugged, and finalized.
- MDSC (Mode, Destination, and Stop Choice) [F] - various programs, scripts, control files, and database had to be reviewed, modified, tested, debugged, and finalized.

2.8 [G] Special Traffic Generators and Park and Ride Facilities

The data and methods used in Stage 1A for the implemented enhancements related to Special Generators and Park and Ride Facilities as part of LH-Task 5 are described in detail in *Technical Memorandum - Task 5: Special Generators*

Special Traffic Generators: The prior NYBPM based model (GTM) developed for use in the Goethals Bridge Modernization study, incorporated port activity into the NYBPM system by applying the Port Authority Comprehensive Port Improvement Plan (CPIP) forecasts of truck volumes and distributions, and incorporated Newark Liberty International Airport (EWR) passenger access trips using airport demand estimates and forecasts and passenger distributions from the Air Passenger Survey. These special generator assumptions were reviewed and updated for the base year and forecast year special generator volumes in light of newer data sources and analyses. The EWR air passenger trip estimates were updated using air passenger access mode choice models developed for the NJRTM-E and for Port Authority Aviation Demand analyses. Special generator baselines and forecasts were coordinated with PA staff.

The Stage 1A model includes Port Newark, Port Elizabeth and Howland Hook, the three special generators previously developed for the GTM. It also includes Newark Liberty International Airport which was also developed for the GTM. The PA has expanded the port data to include Port Jersey and MOTBY. In addition, estimates were made for two cargo areas (north and south) at Newark Airport and for two bus Park and Ride (PNR) facilities in the primary Lincoln Tunnel area.

The eight special generator locations are:

- Port Newark (PN)
- Port Elizabeth (PE)
- Howland Hook (HH)
- Port Jersey (PJ)
- Bayonne Military Ocean Terminal (MOTBY)
- Newark Cargo Area (North) (NN)
- Newark Cargo Area (South) (SN)
- Newark Liberty International Airport (EWR)

Five additional special generator zones that may be fully implemented in a future version of the model were also defined: Newburgh-Stewart International Airport (SWF), a consolidated cargo area at John F Kennedy International Airport (JFK), and two Brooklyn ports: South Brooklyn, from approximately 29th Street – 65th Street and Red Hook, from approximately Atlantic Avenue – Sackett St. The intent in defining these zones at this stage in the development of the model was to put a placeholder in the zone system and procedures that are zonal-based so that these facilities can be treated as special generators in a future deployment of the model without restructuring of model procedures

Park and Ride Facilities – Auto Traffic: Stage 1A includes explicit traffic modeling of the auto trips to and from the major Park and Ride facilities in the corridor – the North Bergen and the Vince Lombardi Park and Ride facilities. While transit components of the current NYBPM include these facilities and the bus service provided at them, the drive access portion of these modeled trips was not accounted for in the highway assignment step. For Stage 1A, in the model's highway assignment step, the loading on the highway network of the vehicle trips associated with drive-to-transit was implemented for these two major traffic generators in the corridor.

- Vince Lombardi (VL) and North Bergen (NB), both located in the vicinity of the primary Lincoln Tunnel approach corridor in NJ

The main features of the Special Generator and Park and Ride enhancements incorporated in Stage 1A, and the steps needed to implement them can be summarized:

- Modification to the Pre-Assignment Processor (PAP) step of the NYBPM to include the OD trip flows by vehicle type produced by special generator forecasting models [K]
- Further modification of PAP to add the drive-access link flows from the zone-to- station transit flows taken from the transit assignment step to the vehicle trip tables loaded in the highway assignment, for these two PNRs in the vicinity of the Primary Lincoln Tunnel (P-LT) corridor [K].

The PNR special generators were ultimately replaced in Stage 1B, as described in **section 3.3**.

2.9 [H] Truck and Commercial Vehicle Traffic

Ancillary special models are used in the NYBPM to generate origin-to-destination truck and light commercial vehicle trip tables that are included in the multi-class highway assignment, along with the auto (SOV and HOV) vehicle trips that are there simulated in the core passenger models [2.7: E, F], and the Special Generator / PNR vehicle trips from the modules discussed above [2.8: G]

These models are essentially unchanged from the application in the NYBPM, except for the adjustment of certain assignment parameters in the context of the calibration process, and:

- Procedures needed to allocate the Tier 1 truck and CMV tables to the Tier 2 level for highway assignment, and
- Modifications made to PAP to "zero out" the truck/CMV model trips for intermodal Special Generator zones for which truck and commercial van vehicle trip flows are estimated by those procedures. 2.10 (I) External (to Region) Auto Travel

The truck and CMV model was completely overhauled and replaced in Stage 2, as described in S**ection 6.1**.

2.10 [I] External Auto Travel Sub-Model

Like the truck and CMV trips, auto travel external to the 28 county modeled region in the NYBPM was estimated with an ancillary model and added to within-region auto vehicle trip flows generated by the Core models, prior to the multi-class highway assignment step. These include External to External or through trips (EE), External to Internal or trips from outside to the region (EI), and Internal to External or trips from inside to outside the region (IE).

The external auto model was completely overhauled and replaced in Stage 2, as described in **section 6.2**. In particular, a relation to growth and work trips with one trip end outside the NYBPM area was created.

2.11 [K] Pre-Assignment Processor and Time of Day (PAP/TOD)

This Stage 1A module performed the same pre-assignment functions as in the NYBPM, to:

- Aggregate micro-simulation travel forecasts for resident regular person travel from the Core Choice models in list-based (disaggregate individual records) format, to conventional OD matrices or trip tables that are assignable in the TransCAD highway and transit network loading steps.
- Apply diurnal travel distributions ("TOD maps") , that have been derived from the Regional Travel - Household Interview Survey, to allocate the forecast "daily" trips modeled in the Core Choice models to one half-hour segments, and then aggregated to the four time periods assigned – AM Peak (6-10 am), Midday (10 am – 4 pm), PM Peak (4 – 8 pm), and Night (other).

The main features of the modified PAP/TOD Stage 1A module are:

- Revision of the trip table aggregation process to incorporate Special Generator [G], modeled flows, by vehicle class (e.g. SOV, HOV2, HOV3+, Taxi) and by Time Period.

- A similar incorporation of the drive-access flows from the Transit assignment for selected Park and Ride Facilities [G], adding their auto vehicle trips to the vehicle and time period trip tables for subsequent assignment to the highway network.
- Special procedures to disaggregate the Tier 1 vehicle highway mode trip tables to the more detailed Tier 2 level (in NJ), using the more detailed Tier 2 SED data [K]. This method was subsequently abandoned in Stage 1B with the use of a single unified SED database.

2.12 [L] TRANSIT ASSIGNMENT / LOADING OF THE NETWORK

As described previously, Stage 1A adopted the transit network coding and current methods (NYBPM 2005, TransCAD 4.8 with CENTRAL user interface), and all of the NYBPM transit service coding except Trans-Hudson and NJ bus service from West of the Hudson River, which were taken from the NJRTM-E (CUBE platform) in order to provide a more accurate and up to date representation of the Trans-Hudson bus system (e.g., their routes, capacity, headways, etc.) than found in the regional NYBPM at that time.

The main features of the transit assignment step, similar as the NYBPM 2005 Update were:

- Loads the four (4) transit trip tables generated from the core Mode Choice model and pre-processed by PAP/TOD:
    1. Drive to Commuter Rail
    2. Walk to Commuter Rail
    3. Drive to Transit (all other)
    4. Walk to Transit (all other)
- Ridership levels and patterns for major transit modes, other than Commuter Rail, such as Subway/PATH, Bus, Ferry are forecasted as a result of the assignment step, in which the Transit (Other) trip tables are loaded on the network based on the relative utility of the OD path characteristics (time and costs) of each sub-modes.
- While the transit network includes both AM Peak and Midday coded transit services, the transit assignment is done only for the 6-10 AM Peak period.
- Transit assignment, like transit network building and skimming, were performed in TransCAD 4.8, using the CENTRAL user interface of the 2005 version of the NYBPM, while all other TH-TDFM modules, including the Highway assignment were done using TransCAD 5.0 and the GISDK-based GUI described in **Section 2.6** [D].

Modifications of the assignment and other network procedures for transit were implemented in Stage 1A to allow transit forecast to be done fully consistent with the Core model's Tier 1 zone system, adopted for a more focused Trans-Hudson modeling, expanded from the Tier 0 zone system used by the NYBPM.

2.13 [M1] HIGHWAY ASSIGNMENT / LOADING OF THE NETWORK

The adoption of the NJRTM-E highway network and corresponding zone systems in Stage 1A, for both the Tier 1 (detail in Primary NJ only) and for the Tier 2 (detail in all of NJ), lead to many modifications to the NYBPM application procedures, including highway assignment.

The main features of the Stage 1A highway assignment step that were common to the NYBPM, including for the NJ portion of the network that has been "imported" from the NJRTM-E and functions at the more detailed Tier 2 level were:

- Loading the highway network with the six (6) highway mode vehicle trip tables generated from the core Mode Choice model and pre-processed by PAP/TOD:
    1. Single Occupant Vehicle (SOV)
    2. High Occupant Vehicle – 2 person (HOV2)
    3. High Occupant Vehicle – 2 person (HOV3+)
    4. Taxi
    5. Truck (6 tires+)
    6. Other Commercial Vehicles CMV / Vans)
- Loading four sets of Time Period vehicle trip tables that comprise a 24 hour weekday:
    1. AM Peak Period: 6-10 am
    2. Midday: 10 am – 4 pm
    3. PM Peak Period : 4 pm – 8 pm
    4. Night/Other: other hours
- Methods of establishing link traffic carrying capacities and free flow speeds applied in network preparation procedures (NETPREP).
- The same Vehicle Delay Functions (VDFs) and other assignment parameters that determine simulated "congested" speeds and path-building, with minimization of generalized cost and loading are used.
- Multiple iterations (internal) of the assignment are performed, with a relative gap convergence criteria of 0.005 set as the default, requiring about 50-100 iterations.
- Applying the general user equilibrium Multi-Class highway assignment in TranCAD 5.0, generating "loaded" highway network link files that contain forecast link volumes, broken-down by vehicle class, and estimated speeds.
- These files support "skimming" of link travel times, tolls, and distance measures for network paths between all origin-destination zone interchanges, providing full OD matrices with the level of service and transportation cost inputs to the Core Choice models.

2.14 [M2] FEEDBACK OF HIGHWAY TRAVEL TIMES / GLOBAL ITERATIONS

When applied to generate a Scenario forecast, consisting of 1) future year SED inputs and/or 2) an alternative set of transportation networks, the Sage 1.1 model was applied with several global (whole model chain) iterations, in which the simulated travel times from the prior iteration are used as inputs for the Core Choice models in the next iterations, in order to approximate an equilibrium of transportation supply and demand, meaning that there is a consistency between the simulated levels of service (congestion) associated with the final output volumes and the level of service (congestion) that were the basis (inputs) for the mode, destination and route choices modeled.

The same forecast methods as the NYBPM 2005 Update were used, as implemented in the TransCAD 5.0 GUI, the Planning Scenario – 4 Global Iterations with unaveraged Final. This includes four (4) global iterations of the entire model, with an averaging of trip tables and link volumes in the intermediate iterations to promote convergence. The model is started with level of service inputs generated by the NYBPM "Pre-Skim / Trip Table inflation process. The final iteration, that generates the Scenario forecast, is done without any averaging of demand or link volumes, so that a fully consistent set of model measures, from each stage of the model, is available to report all the important impacts of the Scenario on travel – trip production, origin-destination patterns, mode and route choice, as well as system performance measures such as travel times and costs.

2.15 [N] MODEL REPORTING SYSTEM

For a thorough validation and calibration of the Stage 1A model, a full set of new automated reporting procedures and templates were developed that focus on the Trans-Hudson travel markets and facilities. The model reporting system is a set of linked procedures that extract data from the detailed TransCAD model outputs, -- zone level trip tables and link level loaded post-assignment highway and transit network data files – aggregate and summarize the model output data for key travel measures, reporting them in templates, mostly in Excel format.

Important features of the Stage 1A reporting system include:

- Modifications of NYBPM standardized reports, to specifically focus on the geography of the Trans-Hudson travel market and transportation system
- A system is comprised of GISDK scripts, SPSS syntax files, and macro-based Excel files.
- Reporting templates that have been designed and implemented to allow for direct comparison of the output of a model Scenario run, with either 1) corresponding observed travel measures (e.g. survey data, counts, etc.) or 2) with a Base or other model scenario run.

The model reporting system is the primary way in which the TH-TDFM is a useful, accessible and transparent analysis tool for the PANYNJ modelers who use and maintain the model.

3 STAGE 1B: INCORPORATION OF THE TH-TDFM 2010 UPDATE MODEL

The TH-TDFM 2010 Update, or **Stage 1B** of the NYBPM 2010 Update, included many other new features that became part of the final Stage 2 NYBPM 2010 Update model. This section presents an overview of these additional features, whereas the calibration and validation results may be consulted in the final report submitted to PANYNJ in December 2013[1]. **Figure 3-1** presents the same model structure as in **Figure 2-1** for Stage 1A, highlighting the new features and transit calibration and forecasting focus of the TH-TDFM 2010 update effort done by the PANYNJ, Parsons Brinckerhoff and AECOM.

3.1 [O] TAZ SYSTEM AND BASE NETWORKS

The starting point for Stage 1B were the networks and procedures developed in the NYBPM 2005 update, also known as BPM 2G once the updated GUI was implemented, along with the more detailed network of the Stage 1A. This model merge implied also that some of the features developed for Stage 1A would have to be added to the 2005 NYBPM, in particular the Special Generators feature. The TAZ system used for Stage 1B (which has since then been superseded by a Tier 1.2 system in NY and CT in Stage 2) is a hybrid of the Tier 0 system of the BPM 2005 and the Stage 1A Tier 2 system, resulting in a Tier 1.1 TAZ system with several aggregations in NJ and some additional splits in Manhattan.

3.2 [P] REVISED TRANSIT PROCEDURES

Among the transit improvements, three of the larger development items on the Trans-Hudson networks include:

- Development of improved bus travel time estimates for West of Hudson bus services
- Calibration adjustments made to Trans-Hudson bus link travel times to calibrate the “other-transit” trips from the West of Hudson market to Manhattan.
- Development of improved procedures to represent drive-access to transit in Stage 1B.

3.2.1 DEVELOPMENT OF IMPROVED BUS TRAVEL TIME ESTIMATES

Bus travel time procedures were modified from NYBPM 2005 Update for Stage 1B. With the NYBPM emphasis being largely focused on the East of Hudson region, the NYBPM employed simplified procedures to estimate West of Hudson bus travel times. Bus travel times were analyzed at the regional level, with an emphasis on routes providing service to Manhattan, to calibrate improved bus travel time relationships for Stage 1B. The process relied on using equations of motion (with acceleration & deceleration rates, maximum operating speeds, and stop spacing to estimate stop-to-stop travel times).

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[1] TH-TDFM 2010 Update – Final Deliverables, PB/Aecom/Caliper, December 18, 2013

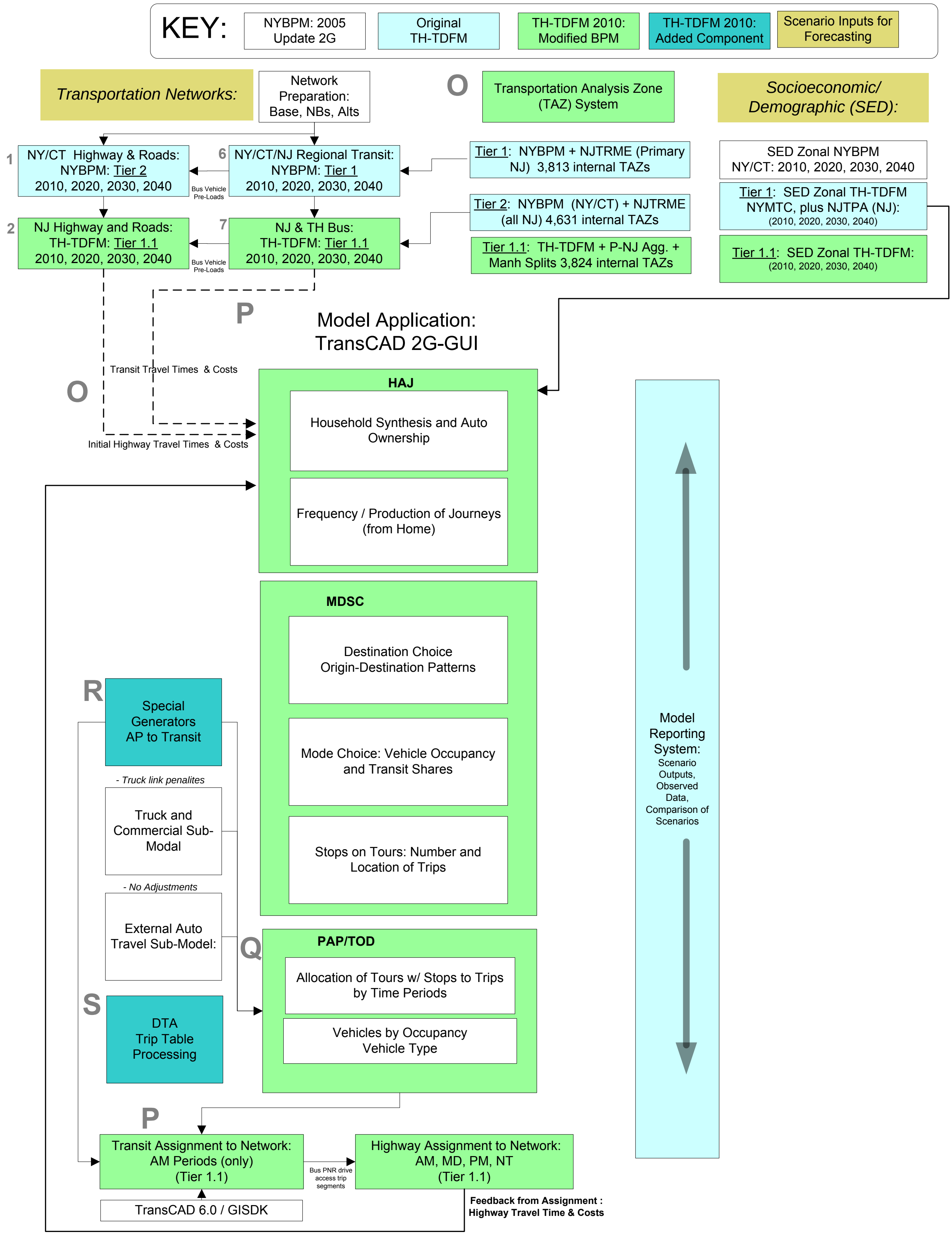

Figure 3-1: General Structure of the TH-TDFM 2010 Update– Stage 1B

3.2.2 CALIBRATION OF TRANS-HUDSON DELAYS

The above section discusses the procedures to develop bus travel time relationships that closely match the schedule. One of the challenges of the Stage 1B calibration is the fact that the mode choice model uses two modal choices for Trans-Hudson travel (commuter rail and other transit). As such, the other-transit path-building bears the heavy burden of replicating observed modal shares between PATH, bus, and ferry. These modes are particularly competitive with one-another from the urban portions of Northern NJ. During calibration, the Trans-Hudson delay parameter was used to replicate observed transit sub-mode volumes for the "other-transit" category of trips.

3.2.3 ENHANCEMENTS TO WEST OF HUDSON DRIVE ACCESS TO TRANSIT

The NYBPM 2005 Update used a two-part strategy for representing Drive-Access trips. For areas East of the Hudson, FORTRAN routines were calibrated that developed centroid-to-station connection links to provide accessibility to fixed guideway transit. For the West of Hudson markets, the NYBPM directly used drive-access links from the NJ Transit North Jersey Transit Demand Forecasting Model (NJTDFM). When the FORTRAN process was converted to native TransCAD procedures for NYBPM 2G, it was applied to entire modeling region (East and West of the Hudson River). The West of the Hudson region has a very different propensity for drive-access compared to the East of the Hudson River region. As such, the converted GISDK routines were fine-tuned in the following fashion:

1. The restriction that required the production end TAZ to be the same as the PNR lot was eliminated. This restriction unduly constrained commuters to using lots in their home county.
2. The maximum drive access time parameter in the path-builder was expanded from 30 minutes to 180 minutes. At 30 minutes, the parameter was set so that several long drives to transit (observed in the on-board survey data) were not allowed to occur. In order to prevent building a "cliff" in the path-builder, the 180 minute maximum was set to consider virtually all possible drive access opportunities. Sub-optimum opportunities would be culled using the path weight on drive access time.
3. Additional discipline in the park-and-ride logic was implemented, to force commuter rail paths to drive to commuter rail stations and other-transit paths to drive to non-commuter rail stations. This prevented the path-builder from allowing drive access to the "other" transit mode (ex. commuter rail parking at PATH stations and vice versa).

3.3 [Q] HIGHWAY ASSIGNMENT OF DRIVE ACCESS/EGRESS TRIPS TO SELECTED PNR FACILITIES

Park-and-Ride processing was revised and upgraded for Stage 1B. Highway trips necessary for providing "Drive to Transit" and "Drive to Commuter Rail" transit travel had not previously been addressed and were not specifically processed in previous versions of the model. Thus, a "drive" component of transit travel in the model was missing, and these highway trips were not included in the highway assignment task. Stage 1B was upgraded to have these trips embedded in the modeling process, as a task automatically performed in the end of the model's Pre-Assignment Procedure (PAP). As a result, "Drive to Transit" and "Drive to Commuter Rail" origin-destination trips are added into the highway trip tables before running the "Highway Assignment" task.

Three major issues had to be resolved in order to develop and implement this additional feature:

- Flows between TAZ trip ends and transit parking Facility: Extract transit "Drive" trips to parking facilities and derive Origin-Destination (OD) demand based on the TAZ system;
- Time Of Day (Transit TOD ⇔ Highway TOD): Transform AM and MD transit demand into four time-of-day-period (AM, MD, PM, NT) highway demand;
- Mode Split: The transit demand has only one "Drive" mode to either Transit or Rail, while highway modes include "SOV" and "HOV" options.

Drive Access Trip Extraction

The implemented revisions to the Park-and-Ride procedure follow the steps below:

- Transit "Drive" trips are extracted by parking facility separately for AM and MD day period. Origin-Centroid-to-Parking demand tables are created in this step for AM and MD day period;
- Each Parking Facility is associated with the nearest Centroid. Associated "parking" centroids are used in place of Parking Facilities in the demand table derived in the first step. This way, Origin-to-Destination transit "Drive" demand matrices based on network centroids are constructed for AM and MD periods.

Time of Day (TOD) Allocation

Lacking sufficient data to reliably estimate the relationships, this issue was resolved with the following two assumptions:

- PM matrix is estimated as a transposed AM matrix;
- NT matrix is estimated as a transposed MD matrix;

Modal Split – SOV and HOV

In reality, the transit "Drive" mode consists of "Park-and-Ride" (PNR) and "Kiss-and-Ride" (KNR) alternatives, which correspond to highway "SOV" and "HOV" modes. In terms of vehicle trips, "SOV" trips have to be one-way trips from the origin (home) to the destination (parking), while "HOV" (KNR) trips assume a vehicle trip back from parking to home. The following two assumptions are made in the Stage 1B "Park and Ride" procedure:

- SOV (PNR) mode trips were estimated as 80% of all trips and
- HOV (KNR) mode trips were estimated as 20% of all transit "Drive" trips.
- According to this assumption, three additional final processing operations were applied to each TOD transit "Drive" demand matrix:
  - 20% of all trips in transit "Drive" demand in each TOD period were separated from total amount into initial HOV trips. The remaining portion of the demand comprised SOV mode trips;
  - The initial HOV portion of the demand was duplicated;
  - The duplicated portion was transposed and added to the initial SOV demand, so that the trip to drop off a passenger is included in the final HOV demand and the return trip home for the driver is included in the final SOV demand used in the highway assignment.

Selection of PNR for Highway Assignment

The upgrade of "Park and Ride" procedure is performed automatically during the PAP model task as an addition to the main GISDK script. The procedure includes a filter that allows the user to limit the number of considered parking facilities. This may be a convenient control if a parking facility creates unreasonable traffic flows around its associated centroid. The filter is based on a parking facility capacity. Currently the filter is set to allow processing of parking facilities with a capacity of 500 or greater. If the user changes the filter value, the GISDK script has to be recompiled for the change to take effect.

3.4 [R] Special Generators – Air passenger transit assignment

3.4.1 Purpose of Transit Special Generators for Air Passengers

The special generator functions in Stage 1A allowed for the addition of airport passengers to the trip tables for auto modes, but additional procedures were required to account for airport passengers using transit modes. Past research (Harvey (1987)[2], Furuichi & Koppelman (1994)[3], and Hess and Polak (2005)[4]) indicates that air passengers have a much higher value of time than other travelers.

In order to account for this difference in the air passenger behavior, this update was performed to add airport transit passengers as a separate mode in the assignment procedure. By assigning air passengers separately from other transit passengers, the model is able to account for the higher value of time in the air passengers' route and mode choices.

This effort included adding a core to the transit trip tables, modifying the model codes to allow for the processing of transit modes in the special generator procedures, and generating inputs for testing the modified code. Once the trip tables were updated, the next stage of work included modifying the transit network settings and the transit assignment codes to assign the airport transit mode if the user specifies that it should be included. There are as of yet no data files available using this methodology, as samples using transformed auto passengers trip tables were used to test the code.

3.4.2 PAP Methodology

There were three phases involved in this effort. The first was developing the test inputs and modifying the existing Stage 1A input matrices to account for the additional transit mode. The second phase was the modification of the trip table procedures to allow for the processing of airport transit special generator trips and the additional transit mode. The final phase was testing the code and testing the format of the input files to ensure that the inputs produced in this and other projects were in a format that could be read and processed by the code.

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[2] Harvey, Greig. 1987. Airport Choice in a Multiple Airport Region, Transportation Research 21A (6): 439-339.

[3] Furuichi, Masahiko and Koppelman, Frank S. 1994. An Analysis of Air Traveler's Departure Airport and Destination Choice Behavior. *Transportation Research* 28A (3); 187-195.

[4] Hess, S. and Polak, J.W. 2005. Accounting for Random Taste Heterogeneity in Airport Choice Modelling. Paper presented at the 84th Annual Meeting of the Transportation Research Board, Washington D.C., January 9-13, 2005.

3.5 [S] Extraction of Vehicular Trip Tables for DTA Processing

3.5.1 Purpose of Matrix Extraction for DTA Processing

The purpose of this task was limited to creating a standalone Stage 1B procedure to produce trip tables of trips for dynamic traffic assignment. The Pre-assignment processor (PAP) tracks trips by 30 minute intervals during the day; however, these trips are aggregated into 4 broad time periods for static highway assignment. These trips are tracked by their arrival time before being aggregated into the four time periods for the existing static assignment model, while DTA procedures require time slices by departure time, necessitating an extra conversion step. This task ultimately provided a set of procedures to create trip tables for 15 or 30 minute time intervals (that may be specified by the user) during the entire day.

3.5.2 Existing Time Of Day Choice and Other Pre-Assignment Processes

The time of day choice model in the NYBPM model system is combined with the other pre-assignment data processing procedures. The purpose of this modeling stage is to prepare the time-of-day period specific trip tables for highway and transit assignments implemented in TransCAD. This model system component is applied after the core set of choice models that includes choice of destination, mode, stop frequency, and stop location for each journey.

At this point, journeys are broken into trips and trip tables are prepared for highway and transit assignments by time-of-day periods. Also, various additional traffic components not covered by the core travel model system and modeled by ancillary models (external trips, trucks, commercial vehicles) are added at this stage in order to create a full set of highway vehicle class tables.

The procedure includes the following four steps:

1. Transformation of bi-directional paired journeys to elemental origin-destination trips based on the destination, stop frequency, and stop location choices.
2. Choice of trip modes based on the entire-journey mode choice and trip location in the journey trip chain.
3. Choice of time-of-day period to each trip based on the journey purpose, direction (outbound, inbound), mode, and geographical segment.
4. Aggregation of individual records with trip modes into trip tables by highway vehicle classes and transit passenger modes for assignment.

The outbound trip arrival time for each journey is randomly selected from the cumulative arrival time distribution corresponding to the journey purpose, mode, and destination. The inbound trip arrival time is based on the previously chosen outbound trip arrival time and the activity duration. The activity duration is randomly selected from the cumulative activity duration distribution corresponding to the journey purpose, mode, destination, and outbound arrival time.

3.5.3 General Approach to Creating Trip Tables for Dynamic Traffic Assignment (DTA)

The approach for creating the DTA trip tables requires intervention at Steps 3 and 4 of the PAP/TOD program. Choice of time of day is modeled for each journey by directional legs (outbound and inbound) with a half-hour resolution (centered 30-min intervals) during the full 24-hour period. This is formally expressed in 48 possible time choices t = 1,2,...,48 associated with the arrival time for each trip. Subsequently, detailed time of day choices are aggregated by four broad time of day periods.

Two Python programs were developed that enable the data to be set up and used in the PAP modification to create 15 minute slices by mode. The first python program converts the existing time of data (TOD) maps from 48 slices of 30 minute duration to 96 slices of 15 minute duration by interpolating the average probability for each TOD map.

It should be noted that although this process has been successful, the use of the resulting matrices is limited to a region wide DTA application, and it is not currently possible to use the built-in macroscopic DTA tool to extract a subarea matrix from the regional trip tables that are produced. An aggregation of the regional trip tables is always possible, but would limit the path choices during the assignment process.

This feature has been used in a simplified way for the Grand Central Parkway (GCP) Corridor study, as an input to a mesoscopic scale subarea network developed to analyze vehicle behavior on the GCP and the local network in the vicinity of LaGuardia Airport (LGA).

4 STAGE 2: UPDATES AND IMPROVEMENTS - NYMTC NYBPM 2010 UPDATE

Building on the adopted TH-TDFM features in Stage 1, Stage 2 of the development of the NYBPM 2010 Update focused on the standard data and network updates to a Base Year 2010, model improvements identified in the project RFP, confirmed and specified in Task 1 of the project, as well as the integration of major updates and improvements of several components of the NYBPM identified as needed by NYMTC and its Steering Committee in the course of the NYBPM 2010 Update project, and developed in parallel by Parsons Brinckerhoff.

In much the same way as Stage 1A and 1B data and features developments were presented in the previous two sections, **Figure 4-1** presents the structure of the Stage 2 model, and provides a framework for the discussion and description of the data and network component updates, and additional improvements implemented in Stage 2.

In this **Section 4**, the updates of socio-economic and demographic (SED), traffic and transit count data are documented, keyed to Items 4.1, 4.2 and 4.3 in Figure 4-1. Highway and transit network updates and improvements are described in **Section 5,** and new features added in **Section 6**.

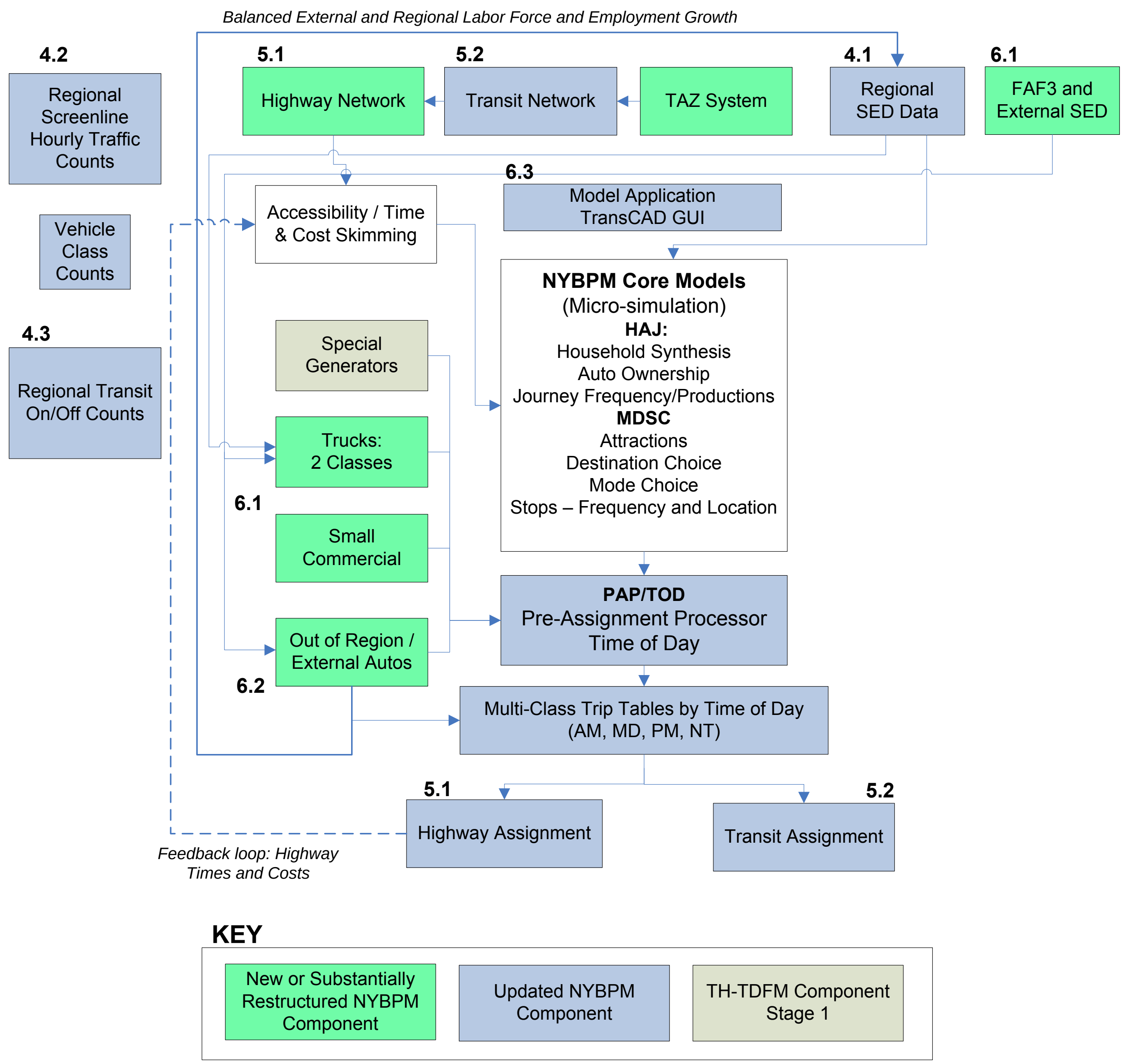

Figure 4-1: General Structure of the NYBPM 2010 Update – Stage 2

4.1 Socio-Economic Demographic (SED) Data and Transportation Analysis Zone (TAZ) Update

The NYBPM uses a fairly limited subset of population and employment-related zonal data items required as inputs to both base year and future year model applications. The 15 specific zonal SED items are listed in **Table 4-1**. The SED for the NYBPM 2010 Update, or Stage 2, were developed in a series of three steps: (1) migration from TAZ Tier 0 (3586 zones) to TAZ Tier 1.1 system (3824 zones), (2) revision of employment data region-wide, and (3) migration to the new, 2010 Census tract-based TAZ Tier 1.2 (4629 zones) system.

Table 4-1 Summary of Socioeconomic and Demographic Data (SED) Inputs for NYBPM

SED Item #	Description	Name	Units
1	Population in Households	HHPop	persons
2	Population in Group Quarters	GQPop	persons
3	Institutional	GQPopIns	persons
4	Street people	GQPopStr	persons
5	Other Group Quarters (Colleges & Universities, Military, etc.)	GQPopOth	persons
6	Number of Households	HHnum	households
7	Household Size (# of Persons):	HHSize	persons/household
8	Employed Labor Force - Workers (by residence)	ELF	persons
9	Mean Household Income	HHincx	2010 Dollars
10	Employment (at workplace) - Total	EmpTot	persons
11	Employment (at workplace) – Retail	EmpRet	persons
12	Employment (at workplace) – Office	EmpOff	persons
13	Earnings per worker (at workplace)	EarnWork	2010 Dollars
14	University enrollment (at institution)	UnvEnrol	persons
15	School enrollment: K-12 Total (at school)	K12ETot	persons

4.1.1 Initial Development of Base and Future Year SED: Tier 0 to Tier 1.1

The original NYBPM was developed using Base Year 1996 data, and the existing 2005 NYBPM was calibrated using Base Year 2005 SED zonal data. The update of the NYBPM for Base Year 2010 required the development of current estimates of the each of the data items listed in **Table 4-1** at the transportation analysis zone (TAZ) level. Additionally, for Stage 2, the NYBPM was to be migrated from the original "Tier 0" zone system (3586 zones) to the more disaggregate Tier 1 zone system (3813 zones) adopted for the 2005 TH-TDFM, and consequently to the newer Tier 1.1 zone system (3824 zones) which included zonal aggregations in outer NJ and zonal splits in Manhattan.

NYMTC's adopted SED data was provided at the Tier 0 TAZ level for Base Year 2010 and all forecast years. The data was converted to the Tier 1.1 TAZ level using proportions from the TH-TDFM SED data and new zonal area. Since these data are direct inputs to the NYBPM, and directly influence the production and attraction of travel to and from the TAZs that comprise the NYBPM, it was important to review and develop confidence in their accuracy before adopting them for the re-calibration of the NYBPM travel models for the new Base Year 2010.

4.1.2 Revision of Employment Data

In the Tier 1.1 TAZ SED data, it was found that total employment figures in New York City differed substantially from ACS 2006-2010 numbers (from -21% to +11% deviation) while all other NYBPM counties' total employment numbers matched the ACS figures fairly closely (within ±5%). Employment is one of the most important components of the SED input to the NYBPM, particularly in terms of the core Mode Destination and Stops Choice (MDSC) model, and it is important that employment data be consistently defined throughout the modeled region. For this reason, it was decided that Base Year 2010 employment data would be scaled region-wide to match ACS 2006-2010 county-level targets for total employment. The distribution of this total employment figure to zones within each county was retained from the original data, and the existing growth rates for each zone were applied to calculate future year forecasts.

4.1.3 Development of Tier 1.2 TAZ System and Final SED Migration

In the course of Stage 2, it was decided that the NYBPM TAZ system should be revised in such a way as to have a one-to-one relationship with 2010 Census tracts in New York and Connecticut. Zonal splits in Manhattan, below the tract level, made in the Tier 1.1 TAZ system were to be retained. This resulted in the creation of the Tier 1.2 TAZ system, comprised of 4,629 internal zones. The zonal geography and identification / numbering scheme were both reviewed by and discussed with NYMTC staff and the Steering Committee to finalize a robust zonal system with the capacity for additional internal, external, and special generator zones to be introduced in the future.

This substantial increase in the number of zones represents the first time the number of zones in the NYBPM has exceeded 4000, which was previously a hard-coded maximum. In order to exceed this limit, a number of model procedures and programs were updated, tested, and re-compiled.

Additionally, the new Tier 1.2 zone system required new centroid connectors to be built to load trips onto the highway network. Building an entirely new set of sound network loading points would require extensive additional analysis and thorough review, which the Stage 2 schedule did not allow. Additionally, retaining the same network loading points allowed Stage 2 results to maintain comparability with the calibrated Stage 1B output. For these reasons, it was decided that all existing loading points to the network would be retained and new connectors would be built to join centroids to these existing loading points. The new connectors were built through an automated TransCAD function, with different maximum connector lengths set for each county, to build connectors logically in-line with zone size and highway network density.

The SED data from the Tier 1.1 TAZ system, including the revised employment data described in the previous section, was migrated to the Tier 1.2 TAZ system through a series of conversion tables. Because the Tier 1.1 zones were based on 2000 Census tracts and Tier 1.2 zones were built from 2010 Census tracts, three steps of correspondence were established:

(1) Tier 1.1 TAZs to 2000 Census tracts

(2) Standard 2000 tracts to 2010 tracts (published by the US Census Bureau)

(3) 2010 Census tracts to Tier 1.2 TAZs

In the end, this produced an area-based correspondence between Tier 1.1 zones and Tier 1.2 zones. Several additional correspondence factors were calculated for specific variables, such as household population, number of households, and group quarter population, where data is available directly from standard Census files. These factors ensure that the values for these basic SED variables directly match the Census values for each corresponding tract.

4.2 HIGHWAY TRAFFIC COUNTS

The NYBPM screenline volume database was developed as the principal source of observed traffic volume data for use in Base Year 1996, 2002, and 2005 calibration and validation of the NYBPM. It consisted of about 2,200 highway network link records, with estimated volume data by direction, by hour, for each link in the database. The screenline database covers the ten New York counties that comprise the NYMTC area, and all interstate crossings between New York and New Jersey. This section provides documentation for the development of the NYBPM screenline database update from the 2005 base year to the current 2010 base year.

As part of screenline count update effort, NYMTC identified and compiled a set of traffic volume databases and documents from the various regional and sub-regional agencies, including New York State Department of Transportation (NYSDOT) Screenline Count files (previously known as TF3), NYSDOT Continuous and Short counts, New York City Department of Transportation (NYCDOT) vehicle class counts and bridge traffic counts, and MTA bridge traffic counts. Using methods applied in the development of prior NYBPM screenline count databases (1996, 2002, and 2005), the appropriateness of each traffic volume database or document, as well as the validity of the individual records were reviewed and incorporated into the Stage 2 screenline database[1]. The NYBPM screenline database consists of 2,257 highway network links. For locations where traffic counts are not available, the traffic volumes are estimated using the TRAffic Volume Estimation Program (TRAVEP).

The screenline database updating process involved the following steps:

- Review the available traffic volume sources.
- Extract the applicable traffic volumes from available sources.
- Compile the traffic volumes into a single database.
- Select the most representative traffic volumes from multiple matching records.
- Index the traffic count volumes to year 2010 by applying growth factors.
- Run "TRAVEP " - a program that applies adjustment factors, distributes daily traffic counts into 24-hourly volumes, and estimates traffic volumes for screenline links with no available traffic count volumes.

Three Levels of Screenlines: The 2,257 BPM highway network links that comprise the screenline database were selected to according to a three-level hierarchy of cutlines reflecting their significance for regional model calibration and analysis; (See **Table 4-2**).

- Priority 1: County Borders - screenlines have the highest significance capturing county-to-county travel flows (347 links)

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[1] Where applicable, an individual count record was examined for consistency with historical data on the same and/or adjacent roadway sections. Other information such as date/duration of survey period and relevant changes in traffic configuration were also considered.

- Priority 2: Intra-County Quadrants / Major – subdividing each county in quadrants (932 links)
- Priority 3: Sub-Quadrant /Minor– further subdividing screenlines (e.g., within county screenlines reflecting local travel patterns) have the lowest significance, in terms of regional analysis (978 links).

Table 4-2 Screenline Links by Functional Class Group and Priority Level

Functional Class Group	Priority - Screenline Level: Number of Links			Total
	1: County	2: Major	3: Minor	
1 FC 1, 11, 12, 20	99	181	193	473
2 FC 2, 6, 14, 16	191	631	681	1503
3 FC 7-9, 17, 19	57	120	104	281
All Links	347	932	978	2257
Functional Class Group	Priority – Percent of All Screenline Links			Total
	1: County	2: Major	3: Minor	
1 FC 1, 11, 12, 20	4.4%	8.0%	8.6%	21.0%
2 FC 2, 6, 14, 16	8.5%	28.0%	30.2%	66.6%
3 FC 7-9, 17, 19	2.5%	5.3%	4.6%	12.5%
All Links	15.4%	41.3%	43.3%	100.0%

A set of procedures were developed and performed to search for appropriate traffic volumes from each data source and convert into a format consistent with the 2005 pre-adjusted (i.e. containing non-estimated traffic volumes only) screenline database. All screenline link records updated in 2010 were then extracted from the individual data source files, and appended to the secondary data source (i.e. the 2005 pre-adjusted database). Finally, TRAVEP was run to estimate counts for all locations with no count data available.

4.3 Transit Counts

Transit counts were collected and updated in Task 5 for Stage 2 validation and calibration. The counts for the year 2010 assembled and processed include:

- Hub-bound CBD cordon counts by general transit mode – Typical Weekday and AM Peak period
- AM Peak Period Ridership By Station/Cordon Location: Summary Level - Commuter Rail, Ferries, and Trans-Hudson Bus
- Average Annual Weekday Ridership – Hourly – Bus Boardings (NYC Transit)
- Average Annual Weekday Ridership – Hourly – Subway Entries (NYC Transit)
- October Weekday 2010 Subway Station to Station Flows – Hourly

4.3.1 Hub-bound CBD Cordon Transit Counts

These typical weekday and 6-10 AM Peak period transit counts were taken from the Hub-Bound Travel 2010 Report, made available by NYTMC. Specifically, the total number of persons entering the Manhattan Central Business District (CBD), on a typical Fall weekday, were obtained from that report's "Table 14: Where, When and How People Entered the Hub on a Fall Day in 2010." Given that there were service changes earlier in 2010, some of the travel patterns might reflect a transition from travel patterns riders had become accustomed to with previous service.

The 2010 estimates, along with the 2005 estimates used in the previous NYBPM validation, are shown in **Table 4-3,** by the three sectors: 60th Street (from the North), East River Sector (from the East), and New Jersey Sector (from the West). The table shows about a 6 percent increase in weekday travel to the CBD from the prior 2005 NYBPM Base Year, with substantial growth in Trans-Hudson continuing from New Jersey (14%), and also across the Brooklyn cordon (11%).

Table 4-4 extracts the estimated inbound transit flows to the CBD during the morning peak period. Transit ridership entering the CBD during the 6-10 AM hours accounts for about 49% of total weekday ridership, and varies by sector from a high for the NJ cordon (55%) to a low for the 60^{th} Street cordon (41%). While the NYBPM models OD demand for four time periods over the 24 hour weekday (AM, Midday, PM, and Night/Other), it is the only the AM Peak Period for which NYBPM transit assignments are made and can be directly compared to transit counts.

Table 4-3- Hub-bound CBD Cordon Counts by General Transit Mode – Typical Weekday - Total

PART A: TOTAL WEEKDAY - 2010 - INBOUND

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	38,282	24,851	11,762		36,613	193,768	268,663
Rapid Rail	769,426	727,547	452,804		1,180,351	115,934	2,065,711
Subway and Bus	**807,708**	**752,398**	**464,566**		**1,216,964**	**309,702**	**2,334,374**
Ferry & Tram		155	35	36,251	36,441	18,954	55,395
Subway+Bus+Ferry	**807,708**	**752,553**	**464,601**	**36,251**	**1,253,405**	**328,656**	**2,389,769**
Commuter Rail	**102,710**		**114,566**		**114,566**	**82,890**	**300,166**
Total Transit	**910,418**	**752,553**	**579,167**	**36,251**	**1,367,971**	**411,546**	**2,689,935**

PART B: TOTAL WEEKDAY - 2005 - INBOUND

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	52,014	30,668	16,101		46,769	181,272	280,055
Rapid Rail	752,625	645,045	438,585		1,083,630	89,336	1,925,591
Subway and Bus	**804,639**	**675,713**	**454,686**		**1,130,399**	**270,608**	**2,205,646**
Ferry & Tram		171	2,206	32,697	35,074	19,319	54,393
Subway+Bus+Ferry	**804,639**	**675,884**	**456,892**	**32,697**	**1,165,473**	**289,927**	**2,260,039**
Commuter Rail	**97,562**		**114,229**		**114,229**	**72,364**	**284,155**
Total Transit	**902,201**	**675,884**	**571,121**	**32,697**	**1,279,702**	**362,291**	**2,544,194**

PART C: TOTAL WEEKDAY - Growth in Transit Trips

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	(13,732)	(5,817)	(4,339)		(10,156)	12,496	(11,392)
Rapid Rail	16,801	82,502	14,219		96,721	26,598	140,120
Subway and Bus	**3,069**	**76,685**	**9,880**		**86,565**	**39,094**	**128,728**
Ferry & Tram		-16	(2,171)	3,554	1,367	(365)	1,002
Subway+Bus+Ferry	**3,069**	**76,669**	**7,709**	**3,554**	**87,932**	**38,729**	**129,730**
Commuter Rail	**5,148**	**-**	**337**		**337**	**10,526**	**16,011**
Total Transit	**8,217**	**76,669**	**8,046**	**3,554**	**88,269**	**49,255**	**145,741**

PART D: TOTAL WEEKDAY - Percent Growth in Transit

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	-26.4%	-19.0%	-26.9%		-21.7%	6.9%	-4.1%
Rapid Rail	2.2%	12.8%	3.2%		8.9%	29.8%	7.3%
Subway and Bus	**0.4%**	**11.3%**	**2.2%**		**7.7%**	**14.4%**	**5.8%**
Ferry & Tram		-9.4%	-98.4%	10.9%	3.9%	-1.9%	1.8%
Subway+Bus+Ferry	**0.4%**	**11.3%**	**1.7%**	**10.9%**	**7.5%**	**13.4%**	**5.7%**
Commuter Rail	**5.3%**		**0.3%**		**0.3%**	**14.5%**	**5.6%**
Total Transit	**0.9%**	**11.3%**	**1.4%**	**10.9%**	**6.9%**	**13.6%**	**5.7%**

Table 4-4: Hub-bound CBD Cordon Counts by General Transit Mode – Typical Weekday – 6-10 AM Peak Period

PART A: 2010 - INBOUND - 6-10 AM Peak Period

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	14,957	20,004	9,909		29,913	105,410	150,280
Rapid Rail	288,680	362,577	223,969		586,546	62,113	937,339
Subway and Bus	**303,637**	**382,581**	**233,878**		**616,459**	**167,523**	**1,087,619**
Ferry & Tram		28	23	16,738	16,789	12,739	29,528
Subway+Bus+Ferry	**303,637**	**382,609**	**233,901**	**16,738**	**633,248**	**180,262**	**1,117,147**
Commuter Rail	**70,172**		**81,872**		**81,872**	**47,513**	**199,557**
Total Transit	**373,809**	**382,609**	**315,773**	**16,738**	**715,120**	**227,775**	**1,316,704**

PART B: TOTAL WEEKDAY - 2010 - INBOUND

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	38,282	24,851	11,762		36,613	193,768	268,663
Rapid Rail	769,426	727,547	452,804		1,180,351	115,934	2,065,711
Subway and Bus	**807,708**	**752,398**	**464,566**		**1,216,964**	**309,702**	**2,334,374**
Ferry & Tram		155	35	36,251	36,441	18,954	55,395
Subway+Bus+Ferry	**807,708**	**752,553**	**464,601**	**36,251**	**1,253,405**	**328,656**	**2,389,769**
Commuter Rail	**102,710**		**114,566**		**114,566**	**82,890**	**300,166**
Total Transit	**910,418**	**752,553**	**579,167**	**36,251**	**1,367,971**	**411,546**	**2,689,935**

PART C: TOTAL WEEKDAY - A Peak Share of Total Weekday

	60TH ST SECTOR	BROOKLYN SECTOR	QUEENS SECTOR	STATEN ISLAND SECTOR	COMBINED: EAST RIVER	N. J. SECTOR	ALL SECTORS
Bus	39%	80%	84%		82%	54%	56%
Rapid Rail	38%	50%	49%		50%	54%	45%
Subway and Bus	**38%**	**51%**	**50%**		**51%**	**54%**	**47%**
Ferry & Tram		18%	66%	46%	46%	67%	53%
Subway+Bus+Ferry	**38%**	**51%**	**50%**	**46%**	**51%**	**55%**	**47%**
Commuter Rail	**68%**		**71%**		**71%**	**57%**	**66%**
Total Transit	**41%**	**51%**	**55%**	**46%**	**52%**	**55%**	**49%**

4.3.2 COMMUTER RAIL, FERRIES, AND TRANS-HUDSON BUS COUNTS

The transit counts available for comparing Commuter Rail, Ferries, and Trans-Hudson Bus ridership with the model assigned Stage 2 transit volumes are presented in detail in the "*Tasks 5, 10, 11 and 12: Transit Network Update*" Technical Memorandum, dated July 28, 2014. Two separate sets of counts are shown in Table 14 of the report, and both have been used in Stage 2 development.

A. Survey Related Counts: These include counts collected from 2005-2008, and are the basis of the Transit OD survey expansion used to validate the networks as described in Section 5.2: Transit Services and Network . These are the most relevant for the transit network assignments testing done in that work, where the network and assignment procedures should mimic the survey based counts (survey trips in and boarding/alighting outs from the transit assignment).

B: Best Available 2010 Counts: These include more recent count updates where available, including most Trans-Hudson transit services. Thus, for comparison of the transit volumes from the application of the full NYBPM model when done in Task 15, these are the set of transit observed volumes that will be used for model validation.

4.3.3 NEW YORK CITY TRANSIT – BUS AND SUBWAY COUNTS – HOURLY WEEKDAY RIDERSHIP

Average weekday bus boardings by route for NYC Transit buses, and by station entry for Subway trips, both hourly for the full 24 hour day, have been provided to NYMTC by NYC Transit. These detailed databases are separately transmitted, but summarized by Borough and time of day period in **Table 4-5** and **Table 4-6** below. These data are developed from MetroCard turnstile transactions, which include transfers. Total average weekday NYCT bus ridership in 2010 was 2.2 million, while weekday subway ridership was 5.2 million.

Table 4-5: 2010 Transit Counts by Borough and Time Period – NYCT Bus Boardings (MetroCard Swipes)

Borough	AM	MD	PM	NT	TOTAL
Manhattan	127,103	185,568	148,872	53,245	**514,788**
Queens	106,586	116,203	99,062	48,368	**370,218**
Bronx	149,341	190,803	137,940	59,789	**537,874**
Brooklyn	180,052	228,729	181,103	78,722	**668,605**
Staten Island	26,902	30,648	24,456	11,690	**93,696**
Express Buses	18,314	4,712	14,857	4,375	**42,259**
	608,299	**756,663**	**606,290**	**256,188**	**2,227,440**

Table 4-6: 2010 Transit Counts by Borough and Time Period – NYCT Subway Station Entries (MetroCard Swipes)

Borough	AM	MD	PM	NT	TOTAL
Manhattan	532,173	795,554	1,092,196	436,324	**2,856,247**
Queens	304,989	212,331	150,507	87,666	**755,493**
Bronx	171,869	137,801	88,181	58,374	**456,225**
Brooklyn	420,795	322,059	230,356	120,828	**1,094,038**
	1,429,825	**1,467,744**	**1,561,240**	**703,193**	**5,162,002**

4.3.4 October Weekday 2010 Subway Station to Station Flows – Hourly

NYC Transit also provided NYMTC with estimated station-to-station subway flow (trip table) data derived from 2012 MetroCard station entry data, and with established methods and algorithms, imputed station exits. Using station-level factors comparing 2012 and 2010 station entries, it is possible to develop a 2010 station-to-station subway flow (trip table). This also provides the basis for the estimation of hourly subway station exits. **Table 4-7** below summarizes these by Borough for the 6-10 AM Peak Period for which the NYBPM assigns transit trips.

Table 4-7: 2010 Transit Counts by Borough and Time Period – NYCT Subway Station Exits

Borough	AM
Manhattan	1,137,072
Queens	134,366
Bronx	90,596
Brooklyn	236,903
	1,598,937

4.3.5 Correspondence Files – NYBPM 2010 Transit-to-NYCT Count Data

An important product of the work done in Task 5 is the development of a current set of correspondence files relating NYCT subway stations, represented as "PTZs" in the NYBPM transit network, to NYCT count and MetroCard databases. These were included in the Tasks 5, 10, 11, 12 deliverables.

5 NYBPM NETWORK UPDATES

5.1 STAGE 2: HIGHWAY AND TRANSIT NETWORK UPDATES AND IMPROVEMENTS

In this **Section 5**, the highway (5.1) and transit network (5.2) updates and improvements implemented in Stage 2 are described, with the discussion of each element keyed to the **Figure 4-1**.

5.1.1 CONFLATED HIGHWAY NETWORK

The creation and attribution of a ground-truth conflated highway network was a major Stage 2 component. Alignment to ground truth allows the highway network to better represent distances travelled and more accurately measure VMT. It also facilitates comparison with external data sources and improves alignment with other "ground truth" geographic files. The process of establishing the conflated Stage 2 highway network is broken down into three steps below: initial creation, manual conflation, and attribution.

5.1.1.1 Initial Conflated Highway Network Creation

Caliper created a 2010 conflated highway network for New York and Connecticut using the NYBPM 2005 base network as a starting point. Links added or changed between 2005 and 2010 were added to this network or modified using the Stage 1B highway network for reference. Aerial imagery was used to align highway links to ground-truth geometry. Attributes and link ID's were transferred from Stage 1B as was feasible.

For the New Jersey portion of the highway network, the Stage 1B network was used directly, as the New Jersey portion of the highway network had been based on NJTRM-E GIS files which were already conflated. This portion of the network was merged with the conflated New York and Connecticut portions, to create the initial version of the NYBPM 2010 conflated highway network.

5.1.1.2 Manual Conflation

Following the initial creation of a conflated network by Caliper, Parsons Brinckerhoff completed substantial manual conflation and quality assurance / quality control of the highway network. Additional conflation was performed in terms of ground-truth geometry and link alignment as well as ensuring all roadways with the functional class of minor arterial and above are included in the network (except in Manhattan). Basic directionality coding in the network was also addressed, with a new scheme introduced to standardize directional coding. Under this new scheme, the topological direction of all two-way links is set to either east-bound or north-bound, and the topological direction of all one-way links is the same as the direction of flow.

5.1.1.3 Highway Network Attribution

After the extensive work that went into the geographic conflation and basic attribution of the highway network, it was essential that the network be as fully and correctly attributed as feasible in the Stage 2 timeframe. Attributes were checked systematically, with higher priority given to functional class and number of lanes, which have the greatest impact on traffic assignment. These basic attributes were checked against the Stage 1B network, as well as external data sources. Secondary attributes, such as the presence of a median or access control, were brought over from the Stage 1B network where a correspondence had been established in the initial step of creating the conflated highway network. The conflated network went through several rounds of testing in NYBPM NetPrep and highway assignment procedures. The final validation test showed that the same trip tables assigned to the Stage 1B network and the new conflated network produce similar results at major regional crossings, and at the county screenline level.

A substantial additional improvement has been made in terms of NYBPM highway network attribution. As part of a parallel effort, a direct link-to-link correspondence has been established between the conflated NYBPM highway network and both the New York State Roadway Inventory System (NYS RIS) and NAVTEQ databases. Correspondence has also been defined between NYS RIS and NAVTEQ data field codes and standard NYBPM highway network field codes. This correspondence allows a number of attributes (such as the presence of a median, access control, or the presence of parking) that have previously been missing for most highway links to be easily and systematically populated. It also provides additional references for checking other attributes, such as functional class and the number of lanes. Additionally, posted speed has been incorporated as a new attribute of the NYBPM highway network. This can be used in calculating free-flow speed and possibly in spot-checking model performance in uncongested scenarios.

5.1.2 Historic Representation of Tolls in the NYBPM Highway Network

The NYBPM was originally developed for Base Year 1996, using survey data and other inputs developed for that point in time, including tariffs or the toll facilities in the region. The behavioral relationship estimated for the travel choice models between travelers' perception of the relative disutility of travel time and monetary cost reflects conditions at that point in time. In other words, the value of time implied by the NYBPM choice models were appropriately expressed in 1996 dollars.

Before the 2002 Update, tolls were coded in the NYBPM highway network data based on the cash auto toll value, or the cash heavy truck estimated average toll coded on links where tolls are charged, with tariff values being those in place in 1996/97. This basic representation of tolls ignored various forms of discounts available to different travel segments, but was a reasonable way to incorporate the toll component of travel into the NYBPM choice models as part of their statistical estimation, and for the calibration of the assignment procedures.

With the introduction of EZ-Pass, and various time-of-day toll policies in the region, starting with the Port Authority of NY/NJ's March 2001 toll change, this method represents even more of a simplification of reality than it did when originally implemented in the NYBPM. As part of the NYBPM 2002 Update, consideration was given to the modifications to the NYBPM data structures and enhancements to the choice models that would be needed to better address the new tolling polices, and also to account for generally higher average toll costs (at least in nominal dollars). It was determined that a meaningful improvement in how the NYBPM could model tolls will require time and resources beyond the available timeline for the 2002 Update.

For the 2005 Update, it was decided that the 1996/97 dollar tolls be converted to 2005 dollars. The auto tolls on Port Authority and MTA facilities were calculated based on weighted Cash (30%) and EZ-Pass (70%) tolls, where a general average percentage EZ-Pass (70%) users on bridges/tunnels was obtained from the MTA 2006 OD surveys. For PA bridges and tunnels, tolls were further averaged (1/3rd for peak and 2/3rd for off-peak) across time-of-day to compute an average toll. Average truck tolls were computed by Urbitran based on truck size distribution (number of axles) on different facilities. This change required implementing a procedure within the NYBPM MDSC model to "re-index" (e.g. by CPI) the estimated value of time related coefficients on cost components in the choice model utility expressions.

For the NYBPM 2010 Update, as in prior versions of the NYBPM, tolls are implemented as link attributes, coded in the highway networks database. As explained in section 2, tolls in Stages 1A and 1B represent average period costs per vehicle for SOV (and include HOV2) or for HOV3+. With the additional truck category, tolls are also coded in separate fields for medium (typically 2 or 3 axle) trucks and for heavy (4+ axle) trucks in the highway network. The next section summarizes the main changes to the tolling methodology for Stage 2.

5.1.3 BPM 2010 Updated Tolls

In addition to the toll categorization by vehicle and by time period introduced in Stage 1A, there are three main areas that were updated for Stage 2:

- Blended tolls across screenlines
- Additional truck category
- Simplified truck tolls

Table 5-1 shows 2010 tolls by time period and vehicle categories, for the different mode and time period combinations at the major crossings.

5.1.3.1 Blended Tolls Across Screenlines

Upon implementing the updated tolls per category, the methodology of blending tolls based on axle and E-Z Pass ratios at different facilities seemed to induce contrary effects. For example, Lincoln Tunnel (LT) truck traffic has noticeably less large trucks than the other PANYNJ bridges (no heavy trucks allowed in Holland Tunnel), which means that the blended truck rate across all axle categories is lower than at GWB or any of the Staten Island Bridges (SIB). In the future, this difference in blended rate may go up to over $25, almost half of the other bridges' toll values. In effect, this creates a much more desirable path through LT than at any of the other bridges, in particular GWB which is the closest competition. After assignment, the reverse of the existing situation would be observed, meaning a majority of trucks would be using LT and maybe only half as many at GWB. In order to correct this situation, the same toll is charged across a screen line, where prices are equivalent.

In the NYBPM network, there are only two such screen lines where similarly tolled facilities are in direct competition: the 6 PANYNJ crossings (with a subset of SIB for auto tolls) and the three MTA Bronx-Queens (BQ) crossings. Verrazano-Narrows has its own tolling scheme, and both MTA tunnels are sufficiently distant from the tolled BQ bridges, as well as being in direct competition with four other free bridges, that they don't need to be grouped with the BQ MTA bridges tolling scheme.

The high trucking tolls exacerbates the differences in the truck mix, and this could really only be solved by expanding the truck classes to match the tolling schemes. However, this is an impractical solution, as both the data for 6 different axle classes is lacking in the Freight Analysis Framework (FAF) used to model trucks and this would further complicate an already very complex modeling structure. It is common practice though to have at least two classes of trucks for models of this magnitude, usually single-unit and tractor-trailer. These two categories could then be assigned to the 2-3 axle and 4+ toll classes and would lead to better toll management, for example banning all trucks at the center tube of the Lincoln Tunnel and allowing light trucks only at Holland tunnel to reflect the existing truck mix at these two facilities.

Table 5-1 : 2010 Toll Values at Crossings and Barriers

	SOV/HOV2				HOV3				Medium Truck				Heavy Truck			
	AM	MD	PM	NT	AM	MD	PM	NT	AM	MD	PM	NT	AM	MD	PM	NT
Holland	$ 7.64	$ 6.53	$ 7.66	$ 6.53	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 16.59	$ 15.28	$ 16.84	$ 13.81	No Heavy Trucks Allowed			
Lincoln	$ 7.64	$ 6.47	$ 7.56	$ 6.47	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 17.06	$ 15.66	$ 17.78	$ 14.51	$ 36.41	$ 33.36	$ 36.27	$ 26.89
G.W. Bridge (Overall)	$ 7.67	$ 6.51	$ 7.68	$ 6.51	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 17.66	$ 15.98	$ 17.27	$ 13.92	$ 38.89	$ 35.50	$ 39.16	$ 29.81
Bayonne	$ 6.46	$ 5.96	$ 6.36	$ 5.86	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 19.55	$ 17.13	$ 19.68	$ 15.96	$ 39.42	$ 35.76	$ 39.49	$ 30.00
Goethals	$ 6.69	$ 6.12	$ 6.66	$ 6.02	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 19.03	$ 17.10	$ 17.47	$ 14.25	$ 39.13	$ 35.69	$ 39.40	$ 29.72
Outerbridge	$ 6.27	$ 6.07	$ 6.61	$ 5.93	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 17.91	$ 16.31	$ 16.99	$ 13.44	$ 37.77	$ 34.04	$ 39.04	$ 30.04
Hudson River Crossings	$ 7.65	$ 6.50	$ 7.66	$ 6.50	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 17.78	$ 16.23	$ 17.52	$ 14.21	$ 38.74	$ 35.32	$ 39.16	$ 29.65
Staten Island Bridges	$ 6.45	$ 6.08	$ 6.59	$ 5.96	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 17.78	$ 16.23	$ 17.52	$ 14.21	$ 38.74	$ 35.32	$ 39.16	$ 29.65
Brooklyn-Battery	$5.06	$ 5.06	$ 5.06	$ 5.06	$ 5.06	$ 5.06	$ 5.06	$ 5.06	$9.71	$ 9.71	$ 9.71	$ 9.71	$19.59	$ 19.59	$ 19.59	$ 19.59
Bronx-Whitestone	$ 5.28	$ 5.28	$ 5.28	$ 5.28	$ 5.28	$ 5.28	$ 5.28	$ 5.28	$ 10.34	$ 10.34	$ 10.34	$ 10.34	$ 23.77	$ 23.77	$ 23.77	$ 23.77
Cross Bay	$ 2.12	$ 2.12	$ 2.12	$ 2.12	$ 2.12	$ 2.12	$ 2.12	$ 2.12	$ 4.88	$ 4.88	$ 4.88	$ 4.88	$ 11.84	$ 11.84	$ 11.84	$ 11.84
Henry Hudson	$ 2.48	$ 2.48	$ 2.48	$ 2.48	$ 2.48	$ 2.48	$ 2.48	$ 2.48	No Trucks Allowed				No Trucks Allowed			
Marine Pkwy	$ 2.03	$ 2.03	$ 2.03	$ 2.03	$ 2.03	$ 2.03	$ 2.03	$ 2.03	$ 4.99	$ 4.99	$ 4.99	$ 4.99	$ 11.98	$ 11.98	$ 11.98	$ 11.98
Queens Midtown	$ 5.09	$ 5.09	$ 5.09	$ 5.09	$ 5.09	$ 5.09	$ 5.09	$ 5.09	$ 9.43	$ 9.43	$ 9.43	$ 9.43	$ 20.53	$ 20.53	$ 20.53	$ 20.53
RFK (Bronx)	$ 5.38	$ 5.38	$ 5.38	$ 5.38	$ 5.38	$ 5.38	$ 5.38	$ 5.38	$ 10.26	$ 10.26	$ 10.26	$ 10.26	$ 24.38	$ 24.38	$ 24.38	$ 24.38
RFK (Manhattan)	$ 5.15	$ 5.15	$ 5.15	$ 5.15	$ 5.15	$ 5.15	$ 5.15	$ 5.15	$ 9.76	$ 9.76	$ 9.76	$ 9.76	$ 22.85	$ 22.85	$ 22.85	$ 22.85
Throgs Neck	$ 5.18	$ 5.18	$ 5.18	$ 5.18	$ 5.18	$ 5.18	$ 5.18	$ 5.18	$ 10.32	$ 10.32	$ 10.32	$ 10.32	$ 24.58	$ 24.58	$ 24.58	$ 24.58
Verrazano	$ 10.21	$ 10.21	$ 10.21	$ 10.21	$ 10.21	$ 10.21	$ 10.21	$ 10.21	$ 20.60	$ 20.60	$ 20.60	$ 20.60	$ 48.28	$ 48.28	$ 48.28	$ 48.28
Bronx-Queens Crossings	$5.24	$ 5.24	$ 5.24	$ 5.24	$ 5.24	$ 5.24	$ 5.24	$ 5.24	$10.22	$ 10.22	$ 10.22	$ 10.22	$24.30	$ 24.30	$ 24.30	$ 24.30
Tappan Zee	$ 4.33	$ 4.33	$ 4.33	$ 4.33	$ 1.86	$ 1.86	$ 1.86	$ 1.86	$ 16.39	$ 9.45	$ 9.45	$ 9.45	$ 32.46	$ 19.50	$ 19.50	$ 19.50
Bear Mountain	$ 0.89	$ 0.96	$ 0.93	$ 0.91	$ 0.89	$ 0.96	$ 0.93	$ 0.91	$ 3.08	$ 3.08	$ 3.08	$ 3.08	$ 7.52	$ 7.52	$ 7.52	$ 7.52
Newburgh Beacon	$ 0.87	$ 0.95	$ 0.92	$ 0.91	$ 0.87	$ 0.95	$ 0.92	$ 0.91	$ 2.80	$ 2.80	$ 2.80	$ 2.80	$ 7.54	$ 7.54	$ 7.54	$ 7.54
NYTA Barriers																
New Rochelle	$ 1.69	$ 1.69	$ 1.69	$ 1.69	$ 1.69	$ 1.69	$ 1.69	$ 1.69	$ 3.57	$ 3.57	$ 3.57	$ 3.57	$ 7.36	$ 7.36	$ 7.36	$ 7.36
Harriman	$ 1.16	$ 1.16	$ 1.16	$ 1.16	$ 1.16	$ 1.16	$ 1.16	$ 1.16	$ 2.13	$ 2.13	$ 2.13	$ 2.13	$ 3.97	$ 3.97	$ 3.97	$ 3.97
Yonkers	$ 1.21	$ 1.21	$ 1.21	$ 1.21	$ 1.21	$ 1.21	$ 1.21	$ 1.21	$ 1.97	$ 1.97	$ 1.97	$ 1.97	$ 3.82	$ 3.82	$ 3.82	$ 3.82
Spring Valley	Only Trucks Tolled				Only Trucks Tolled				$ 3.24	$ 3.24	$ 5.61	$ 3.24	$ 8.09	$ 8.09	$ 12.99	$ 8.09

5.1.3.2 Additional Truck Category

Given the detail available at toll booths, graciously shared by the four NY based tolling agencies (MTA, PANYNJ, NYTA and NYSBA), precise axle counts were available for the average representative period of the year, in this case October 2010, which enabled the trucking classes to be split between 2, 3 axle medium truck and 4+ axle heavy trucks. The tolls for the GSP (southern section only, where trucks are allowed) and NJ Turnpike were calculated based on 2011 annual report axle shares, in order to split values into the two truck categories.

5.1.3.3 Simplified Truck Tolls

There were several links that had either auto or truck tolls in the previous networks, these were consolidated when all categories are applicable. This was the case for the NY Thruway and especially for NJ Turnpike, where several small tolled links, particularly in interchanges, were cleaned up. As a result, and because of the split in the two truck classes, these had to be re-calculated entirely. The tolls on NJ Turnpike are based on the maximum distance toll within the NYBPM area (exit 7 to exit 18) and proportioned in between the exits. The truck tolled links are aligned to be the same as the auto tolled links, which was not the case in the previous version.

5.1.4 Updated Vehicle Operating Cost and Value of Time

The vehicle operating cost (VOC) and value of time (VOT) was scaled by CPI from 2005 to convert into 2010 dollar equivalent. The VOT for autos were calculated by time period based on VOT by purpose and distribution of highway journeys by purpose over the day. The revised VOC and VOT values (which include an update and a split of the previous Truck category into Medium and Heavy Truck) for Stage 2 are shown in **Table 5-2**.

Table 5-2: 2010 Vehicle Operating Costs and Value of Time by Vehicle Class

Vehicle Type	Operating Cost (¢/mile)	VOT (AM) (¢/min)	VOT (MD) (¢/min)	VOT (PM) (¢/min)	VOT (NT) (¢/min)
Auto (SOV)	22	31.44	35.11	30.56	29.44
Medium Truck	38	100	100	100	100
Heavy Truck	60	150	150	150	150
Commercial Vans	21.33	82.5	82.5	82.5	82.5

5.1.5 Bus Vehicles on the Highway Network - Update

Stage 2 offers three options for implementing bus preloads on the highway network. The first option is based on using a highway-to-transit correspondence table originally employed in earlier versions of the NYBPM. This table is manually pre-processed and must be edited to reflect any changes in the highway and transit networks. The second option was introduced in the NYBPM during development of the NYBPM-2G version. It includes a tagging procedure that automatically creates a correspondence between the highway and transit networks. The third option is a supplementary procedure to either the first or the second option. It does not cover the entire NYBPM network, but uses a pre-prepared lookup table for the most critical locations in the region. Bus preload data from this look-up table overwrites whatever bus preload information was created from either the first or the second method. This third option guaranties a precise number of buses loaded in selected locations of the highway network where greater precision is required. The Lincoln Tunnel with its heavy bus flow is one example of such a selected location that requires extra controls on the bus preload volume.

Each option of implementing bus preload in NYBPM has its advantages and disadvantages. The automatic procedure is convenient, quick, easy to implement, and covers the entire region. However, it requires an almost perfect match and strong correlation between the highway and transit network layouts. In dense or shifted network areas, this procedure is likely to create incorrect correspondence relationships, which result in bus loads on highway links that should not have buses and/or leave some highway links that are supposed to have a bus preload without buses.

The second bus preload option, which uses a fixed highway/transit correspondence table, has the potential to achieve "absolute" accuracy. However, the process to develop such a correspondence table is very labor intensive and time consuming. Ultimately, while it may be the best choice for models covering small areas, it is almost unfeasible to build such a table for the whole NYBPM region.

The solution developed for Stage 2 aims to use the strengths of both approaches and minimize their weaknesses. This approach has the primary goal of having a functionally accurate bus preload in the model. Particularly, the aim is to represent the usage of capacity in the NYBPM highway network as realistically as possible. For this purpose, it was decided to implement the bus preload in the model using a fixed highway/transit correspondence table, which allows users to keep control and stabilize results of the bus preload, given that base highway and transit networks stay unchanged. For possible network alternatives and future scenarios, this correspondence table must be edited accordingly. However, such edits are limited to only changes projected in the highway and/or transit network(s) and should be done along with preparation of the PROJ/CHNG GIS layers.

The development of such a fixed highway/transit correspondence table is implemented in two steps. The first step is to manually build the highway/transit correspondences for those highway and transit links that have the heaviest bus loads during an average business day. In the second step, this table is expanded to cover most of the modeled region. For this expansion, the automatic tagging procedure is to be used for all remaining links that have not been covered in the first step.

For Stage 2, the manually built highway/transit correspondence table has been developed for all links with at least 100 buses per day.

5.1.6 Final Stage 2 Highway Network

These updates were incorporated into the base network, along with other minor corrections, throughout the recalibration process. The final updated base network is the 2010 Base, Stage 2, Version 7 network, to be released with the final NYBPM 2010 Update installation.

All projects (PROJ/CHGS files) to build alternative networks for use with the new Stage 2 version will need to be coded "on-top" of this new base highway network referencing the new link IDs. These projects can have numbers starting from 001. Project 000 will be reserved for corrections to the base network.

5.2 TRANSIT SERVICES AND NETWORK UPDATE

All transit service represented in the NYBPM transit network and route database has been updated to reflect 2010 conditions. These updates were accomplished in conjunction with transit network calibration (performed with the assistance of AECOM) and with the highway network update. Edits to the rail and bus service attributes were made by AECOM as well as by the Port Authority of New York and New Jersey, as a part of Stage 1B. All of these revisions and updates have been incorporated into the Stage 2 transit network. Bus pre-loads for highway network assignment have been updated with the correspondence between the updated all links layer of the transit network and the updated and conflated highway network highway network.

5.2.1 TRANSIT SERVICES UPDATE

The update of the Stage 2 transit element has been done within the transit modeling system implemented in TransCAD 6.0-based BPM-2G, developed since the prior NYBPM 2005 Update. All base and future year scenario transit system components are stored in a specific location within the model. The Transit Master folder is used as an internal transit repository and is stored at the following location:

“<NYBPM-MODEL>\2_Alts\Master\0_Input\2_TNet\”

This folder contains all transit system components required by the model: Transit Routes, Route Stops, Stations, Park-N-Ride facilities and the Underlying Link Layer that can be thought of as a Street Layer with walk access/egress links, transfer links, and specialized Transit facilities, such as railroad or subway paths, etc. Each transit component in this repository is assigned a scenario year(s) in which it operates. Thus, the NYBPM transit repository has the following scenario years available in the model: 2005, 2010, 2011, 2012, 2014, 2020, 2030, 2035, and 2040. It also has data sets of transit fares by mode and by fare zone where applicable for each of the scenario years available in the model and listed above.

To build a new scenario, the user selects a scenario year and a fare year, and the model automatically builds the scenario year transit system based on the data from the transit repository (Transit Master). Thus, in the new scenario folder, the model creates the scenario-specific transit system, which is referred to in all model runs of the given scenario.

5.2.2 TRANSIT NETWORK CALIBRATION

Validation and calibration of the transit network for Stage 2 has been carried out in two phases. Stage 1, performed as the West of Hudson River (WOH) calibration, was completed in Stage 1B for the PANYNJ, and its results were carried over as the starting point for the transit network and calibration in Stage 2. For this project, Stage 2 focused on the East of Hudson (EOH) calibration in order to complete a similar level of transit network validation and calibration for the NYBPM 2010. This used the same process, featuring a transit OD survey-based assignment calibration methodology, as described in the following sections, while also allowing for the migration to the new and expanded Tier 1.2 TAZ system used in Stage 2.

5.2.2.1 Survey-Based Assignment and Calibration Process

Through this exercise, AECOM evaluated the transit network performance in replicating observed transit counts, by feeding the transit assignment the best-available database of on-board surveys described above. Approximately 30 iterations of these assignment tests were run and a number of transit procedure and network improvements were identified and implemented to enhance the performance of the transit networks. These include:

- *Expanding the available network of walk links* – This was identified by cross tabulating the number of transit trips by class (walk-commuter rail, drive-commuter rail, walk-transit and drive-transit) where the surveys showed trips, but the path-builder did not construct a path. Through this approach, instances were found where the new TAZ system connected centroids to links that prohibited walking. Our review showed that many of these non-activated walk access links were in fact arterials (with sidewalks). Because of this finding, AECOM expanded the number of links available for walking East of the Hudson River, which significantly enhanced the performance of the path-builder in identifying walk-access transit paths. For these newly identified walk links, the walking speed was coded as 3.0 mph (consistent with the methodology for the regional walk links).
- *Adjusting the PNR settings* – PNR settings were adjusted to better mimic commuter rail PNR choices at individual stations using on-board surveys to adjust parameters.
- *Shadow pricing* – For two non-terminal commuter rail stations (i.e. Metro-North / 125th Street and LIRR / Jamaica), shadow pricing was added to transfer links between commuter rail and the subway at both terminals. From a time and cost perspective, it would be advantageous for a significant number of customers to transfer at both of these stations. However, both the MNR and LIRR on-board surveys show that very few customers actually make both transfers. As such, additional time penalties were added to the commuter rail and subway transfers, to mimic the observed amount of commuter rail to subway transfers at both locations.

5.2.2.2 East of Hudson River (EOH) Transit Network Calibration Details

This section documents the improvements and enhancements that were made to the NYBPM transit networks to support Stage 2 in the calibration of the transit network for the East of Hudson (EOH) region. This represents an extension of the West of Hudson transit network validation work that the PANYNJ performed in their development of Stage 1B. The work focused on several areas, including:

- Correcting coding mistakes identified through the QA/QC process, identified by stakeholders.
- Updating all of the costs in the NYBPM transit networks to 2010 dollars (refer to section **5.2.3**).
- Migration of the regional transit survey database from Stage 1B Tier 1.1 TAZ system (3824 TAZs) to the expanded Stage 2 Tier 1.2 TAZ system (4629 TAZ's).
- A series of iterative assignment tests of the regional transit survey database to the 2010 base year networks. Through this exercise, the transit network performance was evaluated in replicating observed transit counts, when the transit assignment is fed a best-available database of on-board surveys.

Correcting Coding Mistakes Identified Through the QA/QC Process

For the purpose of developing the East of Hudson transit validation work to support the NYBPM 2010 Update implementation and calibration, AECOM started this work using the finalized Stage 1B transit networks that were completed in November 2013. PANYNJ staff performed several enhancements to the NYBPM transit networks during the summer and fall of 2013. As they transmitted these transit networks to the Parsons Brinckerhoff Team, they identified several clean-ups to the underlying transit networks. The following edits were performed:

- Extended the N train to Stillwell-Coney Island
- Removed V/M service to 2nd Av, updating the G train with service to Church Av
- Updated travel times, headways, and capacities for the northbound G
- Recoded the headways for the G train as 6.5 minutes in the peak-period, 10 minutes during midday
- Made minor changes to travel times.

Bus service changes to the network included the following:

- M60 Local was updated to reflect anticipated capacity changes due to the use of articulated buses on the route; more specifically, vehicle capacity on the M60 Local was increased to 85 persons per vehicle and headways changed from every eight minutes to every ten minutes, during the AM peak.
- The headway was changed for only one direction (LaGuardia to Broadway)
- The capacity was updated to reflect the use of articulated buses.

Following the completion of the edits identified by PANYNJ, a complete inspection was performed of the coded NYCT subway routes with data from the MTA Regional Transit Forecasting Model (MTA Headquarters current forecasting model, or MTA RTFM). AECOM tied all of the service plans back to the MTA RTFM. While this review did not identify any major issues, it did result in mostly minor modifications to:

- Headways by route (generally the NYBPM was very good with only a few routes with 1-2 trains per hour variances)
- Stop-to-Stop travel times: This represents the bulk of the changes. There were several very minor adjustments (on the order of 0.5 minutes) that were made.
- Capacities: Review and adjustment of NJ Commuter Rail capacities

Suggested Future Improvements

While good incremental progress has been made in this task with respect to Stage 2 transit networks, there are recommended next steps for future development and improvement of the NYBPM transit procedures beyond the scope of the current work. These include:

- Updating the transit survey database with the most current survey data as new datasets continue to roll in between the start of 2014 and the beginning of 2015.
- A major effort to review details of the NYCT bus networks. As AECOM has identified previously, the NYCT transit networks come from the NYCT transit assignment

MetroCard model. That model uses Stochastic User Equilibrium assignment method, which does not combine headways. As a result, NYCT uses an approach where coded headways do not represent actual service frequency, but are pre-calculated to post a proper combined waiting time. The pathfinder algorithm used in NYBPM, however, does combine headways. As a result, the wait times on the bus system are likely generally too low in the NYBPM.

- Known issues have been resolved with respect to the NYCT subway services (hundreds of individual routes), but not the bus system (because it involves several hundred routes, with extensive individual route variation). This exercise will require significant resources to resolve, but it is one where the investment is probably worthwhile if the current set of TransCAD procedures will continue to be used for at least the next 5 years.

5.2.3 Transit Fares

The 2002 NYBPM transit fares were coded in Year 1996 dollars, corresponding the former base year of the NYMTC BPM (and model estimation). For forecast year fares, the identical fares have been applied – meaning that the existing process assumes fares will rise with inflation. For the NYBPM 2005 Update, at which point the MTA and other regional agencies had implemented fare increases that exceeded the rate of inflation, fares were updated to represent Year 2005 fare policies, with average fare values represented in 2005 dollars. Like tolls and other costs update for the 2005 NYBPM, these fares were transformed within the processing of the NYBPM so that they are modeled consistently with the original mode choice model parameters estimated with 1996 dollars.

For Stage 2, these fares have been updated to 2010 values in Year 2010 dollars. Additionally, current fares at the time of the model update (i.e. Spring 2014) have been identified and indexed to 2010, to stand as future year forecast fares in the case that fares are assumed to rise with inflation. Stage 2 also included the creation of a transit fare update tool, which allows users to input fares in nominal dollars and update the necessary files through a utility accessed through the model GUI.

6 NEW OR IMPROVED NYBPM PROCEDURES

The set of improvements to NYBPM application procedures done as part of Stage 2 are described in this section. Two major ancillary models have been re-developed: the truck and commercial van model and the external autos model. The new Truck and Commercial Van Model (6.1), and the new External Auto Model with Out of Region SED balancing (6.2) are described with the discussion of each element keyed to **Figure 4-1**. In addition, several important new or restructured and modified enhanced NYBPM features incorporated the NYBPM 2010 Update model are also described (6.3). These include:

- Trip table results by purpose in addition to the results by mode
- Ability to run the MDSC by individual purpose or combinations of purposes
- Ability to calibrate the model at a finer level (flexible districts)
- Development of scenario/file management system for transit coding
- Incorporating the ITS project coding and highway scenario/file management system into GUI for the NYBPM
- Review of FTA forecasting guidelines to improve consistency and compatibility of the NYBPM with FTA New Starts program
- Enhancing Highway Project TIP Coding

6.1 TRUCK AND COMMERCIAL VAN MODEL

The NYBPM Truck Flow Estimating Model (TFEM) was originally developed in 1996 and updated periodically. TFEM simulates both freight-carrying trucks and non-freight commercial vehicles, the latter being called vans in this model. The core of this model is an advanced version of an origin-destination matrix estimation (ODME) method. The resulting trip table is not used further, but rather the rows totals and the column totals are used as trip production and trip attraction volumes. A gravity model, which was calibrated to truck survey data, is used to distribute these flows, and additional k-factors where necessary to better match observed truck flows. Because of the known shortcomings of this implementation, it was recommended to make use of the 2010 model update to overhaul the truck and commercial van model.

The principal improvements over the prior NYBPM commercial vehicle models include:

- the introduction of two truck vehicle types – Multiple Unit (MUT, also described as Heavy Trucks) and Single Unit (SUT or Medium Trucks)
- a commodity flow based approach to forecasting truck demand using FHWA's Freight Analysis Framework (FAF)
- modeling of truck demand segmented by long distance and short distance trips.

The "*Task 14: Update Truck and Other Small Commercial Vehicles Model*" technical memorandum, dated August 21, 2014, describes in extensive detail the work that was done to create the updated truck model. This section highlights some of its main features and procedures.

6.1.1 COMMERCIAL MODEL EVOLUTION

This revised truck modeling framework is also seen as an important step on a long-term roadmap for NYBPM truck modeling. **Figure 6-1** shows an example how this truck model evolution could unfold.

The initial model, developed in 1996, collected truck count data and provided analyses of truck O-D surveys. The methodology proposed for this phase adds an explicit representation of external traffic at true origins and destinations, rather than locking in external trips at external stations. This phase also helps developing significant datasets, most importantly providing an employment inventory with categories geared towards truck modeling. In the future, this may lead to a tour-based truck model. Most experts in academia and practice agree that a tour-based model design represents actual travel behavior of trucks much more realistically than trip-based approaches.

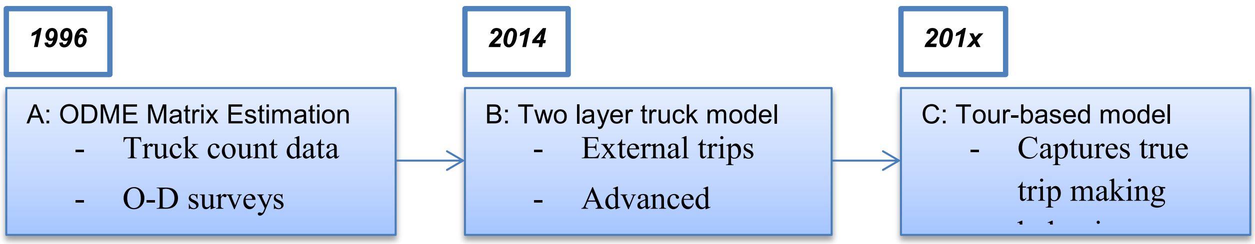

Figure 6-1: Evolutionary Path of BPM Truck Modeling

Currently, only three operational tour-based truck models in North America were implemented for Calgary (Alberta), Portland (OR) and the State of Ohio. In San Diego (CA) and Chicago (IL), tour-based models are under development and expected to become operational within the next year. The proposed model for this phase of the NYBPM update would prepare NYMTC to move towards a tour-based model in the future if desired.

6.1.2 Multi-Layer Modeling

Freight flows are global in scope. They reach from local trips of consumer goods distribution, which commonly are no longer than a few miles, to international flows that may span half the globe. To account for these different geographies, a multi-layer approach was implemented, as visualized in **Figure 6-2**. A global layer accounts for freight flows with at least one trip end outside the NYBPM study area, while the NYBPM layer captures freight flows within the NYBPM study area.

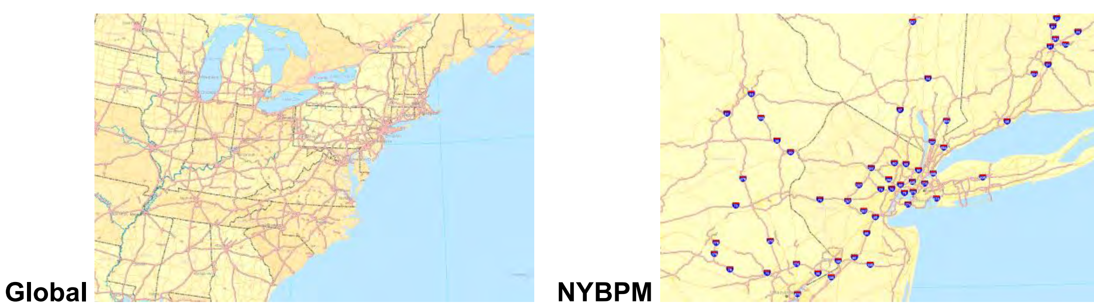

Figure 6-2: Multi-layer approach for truck modeling in NYBPM

The Global or National network layer is used as a support for the commodity based truck model, essentially for long distance (>50miles) trips, based on FAF3 data and forecasts. The NYBPM layer is used to account for local truck traffic within the NYBPM study area. FAF3 data is not reliable to model short-distance trips. Since the FAF3 data were derived from the commodity flow survey (CFS), which inherently underestimates short-distance freight flows, FAF is only suitable for long-distance truck flows. The most common approach of modeling short-distance truck flows is documented in the

Quick Response Freight Manual (QRFM), published by FHWA[1]. This procedure has a couple of known short-comings, among others that it is based on survey data for Phoenix (AZ) from 1992. Parsons Brinckerhoff has developed several enhancements to the QRFM that help overcoming many of its shortcomings, as presented in section 6.1.4.

A further enhancement to the model was to distinguish truck types by single-unit and multi-unit trucks. Truck types have a very different distribution for short- and long-distance trips. According to FAF payload factors[2], single-unit trucks dominate trips of less than 50 miles with 79% and multi-unit trucks dominate trips greater than 500 miles with 93%. In truck modeling, distinguishing truck types is relevant for several reasons, including varying values of time, differences in tolls and different impacts on congestion due to truck length and the ability to accelerate.

6.1.3 Long-Distance Truck Flows

The FAF zone system used to evaluate long-distance truck trips is very coarse, leading to a double-tiered disaggregation methodology that was used for this update.

From Geography	To Geography	Employment
FAF zones	Counties	12 categories (BLS and USDA)
Counties	BPM TAZ	20 categories (LEHD)

Table 6-1: Use of employment to disaggregate from FAF zones to TAZ

First, the FAF3 data are disaggregated from FAF zones to counties using employment by twelve industries. Within the NYBPM model area, twenty employment types, that were derived from LEHD census block data, are used to further disaggregate to zones (**Table 6-1**). Average payload factors were used to convert commodity flows in tons into truck trips. Finally, empty trucks that were not included in the commodity flow data are added to the trip table. The design of the model is presented in **Figure 6-3**.

Truck trip tables for each truck type are the output of this module. These trip tables are then fed into the TransCAD multi-class assignment.

After implementing the long-distance truck flows, some calibration is necessary to match truck counts at external stations. This calibration is implemented by scaling up or down selected FAF flows to better match observed data. This scaling is necessary as the FAF data are based on the Commodity Flow Survey with a limited number of survey records. It turned out, however, that even when using larger scaling factors (ranging from 0.3 to 2.5), traffic counts were not matched well. The team was unwilling to introduce larger scaling factors and further investigated why model results for most part were substantially lower than count volumes, particularly in the north-south direction.

Comparisons with the New Jersey statewide freight model revealed that this truck model was missing a large number of short-distance flows at external stations. The modeling concept assumed that the boundary of the model area is rural enough that no significant number of short-distance truck trips would occur at the boundary of the BPM study area. This study area, however, is quite urban even at its boundary, particularly to the south in New Jersey and to the Northeast in Connecticut.

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[1] Quick Response Freight Manual, http://www.ops.fhwa.dot.gov/freight/publications/qrfm2/
[2] Compare FAF website, http://faf.ornl.gov/fafweb/Data/Freight_Traffic_Analysis/chap3.htm

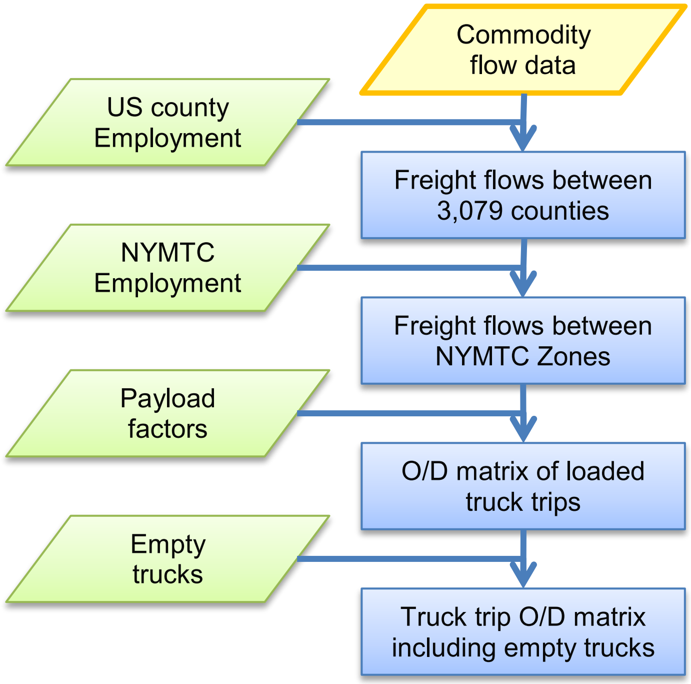


Figure 6-3: Model Design of the Regional Truck Model

The procedure is visualized in **Figure 6-4**. Based on observed truck volumes, short-distance trucks are added at external stations to ensure the entire truck market is represented properly.

A gravity model is used to distribute short-distance trucks at external stations, and the average trip length is based on the New Jersey statewide truck model with 21.1 miles for trucks entering on highways and 18.4 miles for trucks entering on other facility types.

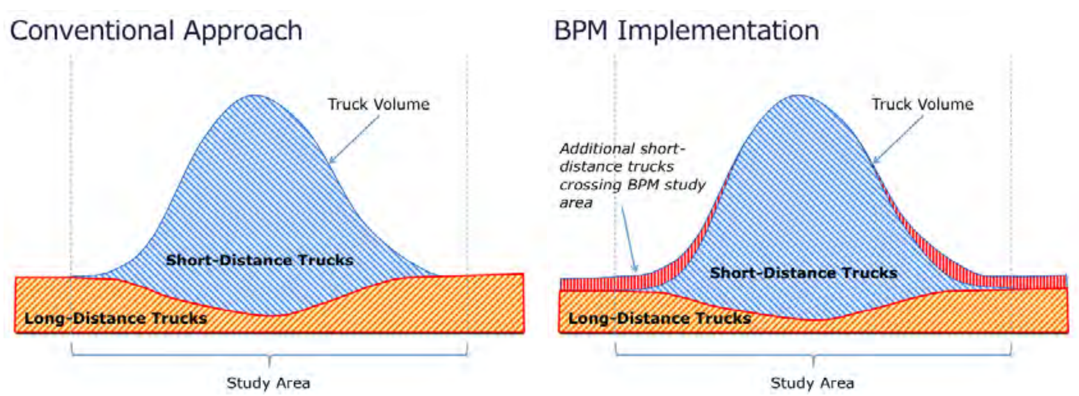


Figure 6-4: Local Trucks Added at External Stations

After implementing these additional short-distance trucks, the model validates as shown in **Table 6-2**. The overall percent deviation is very small, within +1%, and the percent root mean square error (%RMSE), which describes the average deviation at each external station, is also very reasonable at 14%.

Table 6-2: Validation of the Truck Model at External Stations

Summary Total Trucks	Total	FC 1, 11, 12	FC 2, 6, 14, 16	FC Other
		(Interstate, Freeway,	(Arterials)	(Collectors and local

	Expressway)		roads)
Number of Ext Stat	94	22	51	21
Model Volume	171,050	116,255	50,598	4,196
Count Volume	169,777	116,893	48,830	4,054
Absolute difference	1,273	-638	1,768	142
Ratio	1.01	0.99	1.04	1.04
Percent Deviation	1%	-1%	4%	4%
RMSE	253	242	222	46
%RMSE	14%	10%	49%	3%

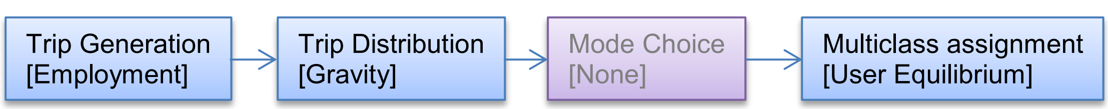
6.1.4 Short Distance Trucks

A local truck model was built to simulate short-distance truck trips. While the exact threshold value between short- and long-distance trucks is somewhat arbitrary, previous experience suggests that 50 miles is a good point to distinguish long-distance (or FAF-based) from short-distance truck trips. **Table 6-3** shows how short- and long-distance truck flows are merged. For trips that have both trip ends within the NYBPM study area and are shorter than 50 miles, the short-distance truck model is be applied. For all other trips, the long-distance (or FAF-based) truck model provides truck flows.

Table 6-3: Definition of short- and long-distance truck flows

Flow direction	Short-distance (≤ 50 miles)	Long-distance (> 50 miles)
Internal-Internal	Use short-distance truck model	Use long-distance (or FAF-based) truck model and short-distance truck flows crossing external stations
Internal-External	Use long-distance (or FAF-based) truck model and short-distance truck flows crossing external stations	
External-Internal		
External-External		

The short-distance truck model is designed as a three-step model based on the Quick Response Freight Manual (QRFM)[3] model, as published by FHWA. This model generates truck trips based on trip production and attraction rates and distributes trips using a generalized cost-based gravity model (**Figure 6-5**). Mode choice (another common step in person travel demand modeling) is irrelevant as almost all short-distance freight flows are carried by trucks.



[3] Beagan, D., Fischer, M., Kuppam, A. (2007) Quick Response Freight Manual II. FHWA: Washington, D.C.

Figure 6-5: Short-distance truck model concept

In order to tie these short-distance truck trip generation rates to zonal data, various zonal attributes were used to predict truck trip generation in a series of multiple regressions. ODME trip production was used as dependent variable. As independent variables, employment by industry, basic population data, various measures of density, and 2011 data from the American Transportation Research Institute (ATRI) were tested. Employment data were derived from the 2010 LEHD, which provides employment by 20 NAICS industry codes at the Census tract level.

Employment density was calculated from this data, and standard NYBPM SED input data was used for basic attributes and population density. Additionally, lane-mile density was calculated using the NYBPM highway network. Together, these variables are able to improve traffic flow representation across the widely varying urban, suburban, and rural areas of the NYBPM region, when compared to the relatively simple and aggregate QRFM rates. In this context, employment density can act as a proxy for the office employment that may be coded as manufacturing or another industry, as discussed above. Employment density was considered as a predictor, either as total employment density, or broken in two separate components: office employment density and non-office employment density. These more specific types of employment density allow the model to more accurately represent the effect of density in relation to truck trip generation by employment in specific industries.

Additionally, all twenty categories of employment have been segmented by area, in terms of Manhattan vs. non-Manhattan zones. This causes the model structure to assume an inherently different relationship between employment and truck trip generation in Manhattan. This is reasonable given the unique density, traffic, parking cost and restrictions, space constraints, and difficulty of access on the island of Manhattan, which cannot be fully captured through available SED-based variables.

A tabulation based on 2011 ATRI data was provided to the Parsons Brinckerhoff team by PANYNJ[4]. The data comes from GPS records of truck movements, taken from seven day periods in May and October of 2011. In analysis zones where trucks stopped for 10 minutes or more, the number of trucks stopped there and the average duration of the stop were recorded over each seven day period. This data covers the entire 28-county NYBPM region. It is expected that this data is more representative of larger trucks, and so it has only been tested in the regression for heavy trucks in the new BPM truck model. Three variables were derived, based on the average of the May and October data, and tested in the regression: average number of stops, average duration of stops, and the product of average number and duration of stops.

A step-wise multiple regression has identified the variables that best explain truck trip generation. The revised trip generation function helps generate truck flows that better match observed volumes at count locations, and which are tied to zonal attributes that are forecast into future years

A gravity model was used to distribute the trips generated by the estimated factors from the multiple regression. The gravity model uses a generalized cost impedance based on the standard NYBPM impedance calculation shown below.

$$Impedance = ttime + toll\text{-}cost/VOT + distance \times VOC/VOT + Truck\ Penalty \times distance$$

[4] PANYNJ Monthly Economic Indicators, December 2012: Transportation Focus: Activity Patterns of Trucks Visiting the NY/NJ Metro Region. Available at: http://www.panynj.gov/about/gtr/pdf/2013/monthly_economic_indicators_2012-12.pdf.

Where, *ttime* is the congested travel time (in minutes), *toll-cost* is the per-vehicle toll cost (in cents), *VOT* is the value-of-time (cents/minute), *VOC* is vehicle operating cost per unit distance (cents/mile) and *Truck Penalty* is the calibrated penalty values (minutes/mile) assigned based on the "TRUCK" highway network field and designed to encourage the use of designated truck routes. For all facilities with one-way tolls, the toll was split and applied to both directions to more accurately represent the cost of a trip at the distribution stage. The average trip length was calibrated to 8.0 for single-unit trucks and 10.1 for multi-unit trucks. Lacking data for the New York region, these values were copied from the Chicago implementation of a similar model.

Validating the local truck model against truck count data revealed that the model had difficulties matching truck volumes at bridge crossings. Based on major waterways, five regions were defined as shown in **Figure 6-6**. Adjustment coefficients were calibrated to better match volumes traveling between these five regions. These five regions are listed as follows:

Figure 6-6: Water-Delineated Regions of BPM Study Area

1 – Manhattan Island
2 – Long Island
3 – Mainland east of the Hudson River
4 – Mainland west of the Hudson River
5 – Staten Island

The adjustment coefficients were calibrated based on daily O-D pair volumes and then applied to each period matrix to obtain distributed O-D pairs at the TAZ level.

Table 6-4: Truck Counts and Flows at Major Crossings, Produced by the New Truck Model

Upper Hudson Crossings		**Counts**		**Flows**		**Deviation**		**% Deviation**	
		EB	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
Newburgh Beacon Bridge	Medium	1,229	1,345	2,056	1,895	827	550	67%	41%
	Heavy	3,939	4,024	1,970	2,102	-1,969	-1,922	-50%	-48%
Bear Mountain Bridge	Medium	176	77	111	54	-65	-23	-37%	-30%
	Heavy	80	146	542	429	462	283	578%	194%
Tappan Zee Bridge	Medium	530	753	2,472	1,334	1,942	582	366%	77%
	Heavy	3,528	4,734	3,265	2,801	-263	-1,933	-7%	-41%
Total Upper Hudson	**Medium**	**1,935**	**2,175**	**4,639**	**3,283**	**2,704**	**1,108**	**140%**	**51%**
	Heavy	**7,578**	**8,904**	**5,777**	**5,331**	**-1,801**	**-3,572**	**-24%**	**-40%**
	Total	**9,513**	**11,078**	**10,416**	**8,615**	**903**	**-2,464**	**9%**	**-22%**

Hudson River Crossings		**Counts**		**Flows**		**Deviation**		**% Deviation**	
		EB	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
George Washington Bridge	Medium	4,554	7,284	5,891	6,976	1,337	-308	29%	-4%
	Heavy	8,554	9,223	7,029	9,000	-1,525	-223	-18%	-2%
Lincoln Tunnel	Medium	3,197	3,407	2,404	1,777	-793	-1,630	-25%	-48%
	Heavy	609	1,128	2,049	1,986	1,440	858	236%	76%
Holland Tunnel	Medium	1,055	1,694	2,335	2,117	1,280	423	121%	25%
Goethals Bridge	Medium	1,852	2,431	1,632	1,477	-220	-954	-12%	-39%
	Heavy	3,037	2,434	2,110	1,677	-927	-757	-31%	-31%
Outerbridge Crossing	Medium	1,276	1,655	1,502	1,110	226	-545	18%	-33%
	Heavy	1,834	989	1,531	1,173	-303	184	-17%	19%
Bayonne Bridge	Medium	579	558	2,007	341	1,428	-217	247%	-39%
	Heavy	452	662	1,827	365	1,375	-297	304%	-45%
Total Hudson River	**Medium**	**12,513**	**17,029**	**15,771**	**13,799**	**3,258**	**-3,230**	**26%**	**-19%**
	Heavy	**14,486**	**14,436**	**14,545**	**14,201**	**59**	**-235**	**0%**	**-2%**
	Total	**26,999**	**31,465**	**30,316**	**28,000**	**3,317**	**-3,465**	**12%**	**-11%**

Table 6-4 presents truck flows by crossings at a more detailed level, showing that the comparison between the old and new models becomes closer. It should be noted that these results do not account for any network calibrations nor integration of validated and calibrated core models. In this comparison, total flows with the new model still show improvements over the TFEM across the different, area specific crossing screenlines, as shown in **Table 6-5**. A calculation of overall RMSE% error for the new model yields 61% for both Medium and Heavy truck categories, but when calculated as total truck volumes, this value is 40%, compared to 51% using TFEM total truck volumes. Given that the emphasis for an SED based model is its forecasting capability (discussed in the next section), and not necessarily how it represents all the detailed flows in base year, these results before detailed calibration of the overall model components are encouraging.

Table 6-4: Truck Counts and Flows at Major Crossings, Produced by the New Truck Model (cont.)

East River Crossings		Counts		Flows		Deviation		% Deviation	
		EB	WB	EB	WB	EB	WB	EB	WB
Triboro Bridge (Mn/Qn)	Medium	1,355	1,396	587	76	-768	-1,320	-57%	-95%
	Heavy	70	138	45	23	-25	-115	-36%	-83%
Queensboro Bridge	Medium	4,220	2,706	4,047	2,882	-173	176	-4%	7%
	Heavy	107	386	2,516	1,283	2,409	897	2251%	232%
Queens Midtown Tunnel	Medium	3,095	4,021	1,400	349	-1,695	-3,672	-55%	-91%
	Heavy	76	116	11	15	-65	-101	-85%	-87%
Williamsburg Bridge	Medium	598	227	573	3,101	-25	2,874	-4%	1266%
	Heavy	45	26	127	204	82	178	183%	685%
Manhattan Bridge	Medium	3,972	2,279	5,109	6,414	1,137	4,135	29%	181%
	Heavy	244	165	623	934	379	769	155%	466%
Brooklyn-Battery Tunnel	Medium	1,600	1,545	508	872	-1,092	-673	-68%	-44%
	Heavy	16	48	8	440	-8	392	-49%	817%
Verrazano Bridge	Medium	5,967	4,544	4,082	2,312	-1,885	-2,232	-32%	-49%
	Heavy	3,628	2,701	2,938	1,042	-690	-1,659	-19%	-61%
Total East River	**Medium**	**20,807**	**16,718**	**16,306**	**16,007**	**-4,501**	**-711**	**-22%**	**-4%**
	Heavy	**4,186**	**3,580**	**6,268**	**3,942**	**2,082**	**362**	**50%**	**10%**
	Total	**24,993**	**20,298**	**22,574**	**19,949**	**-2,419**	**-349**	**-10%**	**-2%**

Bronx/Queens Crossings		Counts		Flows		Deviation		% Deviation	
		NB	SB	NB	SB	NB	SB	NB	SB
Triboro Bridge (Mn/Bx)	Medium	685	319	3,177	3,142	2,492	2,823	364%	885%
	Heavy	63	18	2,915	1,569	2,852	1,551	4527%	8615%
Bronx Whitestone Bridge	Medium	2,697	3,009	1,649	1,810	-1,048	-1,199	-39%	-40%
	Heavy	1,749	1,753	1,474	1,926	-275	173	-16%	10%
Throgneck Bridge	Medium	3,732	3,740	4,881	2,928	1,149	-812	31%	-22%
	Heavy	3,753	3,538	2,910	2,671	-843	-867	-22%	-25%
Total Bronx/Queens	**Medium**	**7,114**	**7,068**	**9,707**	**7,880**	**2,593**	**812**	**36%**	**11%**
	Heavy	**5,565**	**5,309**	**7,299**	**6,166**	**1,734**	**857**	**31%**	**16%**
	Total	**12,679**	**12,377**	**17,006**	**14,046**	**4,327**	**1,669**	**34%**	**13%**

Table 6-5: Major Crossings Summary for New Truck Model and Previous TFEM

Summary: New Truck Model		Counts		Flows		Deviation		% Deviation	
		EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB
Upper Hudson Crossings	Medium	1,935	2,175	4,639	3,283	2,704	1,108	140%	51%
	Heavy	7,578	8,904	5,777	5,331	-1,801	-3,572	-24%	-40%
	Total	**9,513**	**11,078**	**10,416**	**8,615**	**903**	**-2,464**	**9%**	**-22%**
Hudson River Crossings	Medium	12,513	17,029	15,771	13,799	3,258	-3,230	26%	-19%
	Heavy	14,486	14,436	14,545	14,201	59	-235	0%	-2%
	Total	**26,999**	**31,465**	**30,316**	**28,000**	**3,317**	**-3,465**	**12%**	**-11%**
East River Crossings	Medium	20,807	16,718	16,306	16,007	-4,501	-711	-22%	-4%
	Heavy	4,186	3,580	6,268	3,942	2,082	362	50%	10%
	Total	**24,993**	**20,298**	**22,574**	**19,949**	**-2,419**	**-349**	**-10%**	**-2%**
Bronx/Queens Crossings	Medium	7,114	7,068	9,707	7,880	2,593	812	36%	11%
	Heavy	5,565	5,309	7,299	6,166	1,734	857	31%	16%
	Total	**12,679**	**12,377**	**17,006**	**14,046**	**4,327**	**1,669**	**34%**	**13%**

Summary: Previous TFEM		Counts		Flows		Deviation		% Deviation	
		EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB
Upper Hudson Crossings	Trucks	9,482	11,078	13,853	13,815	4,371	2,736	46%	25%
Hudson River Crossings	Trucks	27,016	31,512	32,569	37,430	5,553	5,918	21%	19%
East River Crossings	Trucks	24,993	20,298	29,329	26,872	4,336	6,574	17%	32%
Bronx/Queens Crossings	Trucks	12,679	12,377	20,087	17,040	7,408	4,663	58%	38%

6.1.5 Truck Forecasting Methodology

The main reason for upgrading the Truck model is to be able to tie it to different available forecasts, instead of using predetermined growth factors. For the long distance model, FAF3 has commodity flow forecasts for the year 2040, from which intermediate years can be interpolated between the 2010 and 2040 resulting truck trip tables.

For the short distance truck trips, the Socio Economic and Network related data parameters need to be updated. The standard SED data already exists by five-year increments to 2040 for the core model, and the disaggregate LEHD employment categories have been forecasted in line with the standard SED employment forecasts. As for the network, the parameter data would need to be culled from the future scenario builds to be analyzed. There is no mechanism to update the GPS data used for heavy trucks, which would remain constant.

Finally, for the short-distance truck trips at the external cordon, the methodology would be to increase these observed trips in 2010 be the proportion increase in households plus employment for the two adjacent Counties to the external station. This SED data is already available from the External Model data files for the Counties outside of the NYBPM until 2040 in 5 year increments.

6.1.6 Improvements to Commercial Van Modeling

A special case of commercial vehicles are non-freight service trips that need to be modeled separately. Non-freight trips are not generated based on commodity flows, but rather are service trips that serve households and businesses. Typical examples of such service vehicles include plumbers, gardeners, pool cleaners, electricians, garbage collection, police fleets, rental cars, and other commercial vehicles that do not carry any significant amount of freight. The share of such vehicles varies across the country, but is commonly estimated to range between 6 to 8 percent of all vehicles in urban areas[5].

Commercial vehicles show travel patterns that are different from personal autos, and therefore, deserve separate treatment in urban models. They often chain trips to tours, tend to concentrate in industrial and commercial areas, are more likely to avoid the worst traffic peaks, have a larger impact on pavement and emissions due to larger vehicles sizes, and these trips tend to have a higher value of time that affects their willingness to pay for travel time savings. Many urban models ignore this category entirely. Often, Non Home-Based Other (NHBO) trips are scaled up to fill in non-freight commercial vehicles, an unsatisfying way to represent this substantial part of urban traffic.

The NYBPM is remarkable as it has accounted for non-freight commercial vehicles early on. Taxis are treated as a separate vehicle category all together, and other non-freight commercial vehicles are represented in a category called "Van". While the BPM is ahead of many urban models in the U.S., the NYBPM results for Vans are not satisfying yet. For reasons that are not well understood yet, the model barely generates Vans traveling between the northern and the southern part of Manhattan, with 60th Street almost forming a barrier that is rarely crossed by Vans in the model. This unlikely model result appears to be rooted in methodological issues of the current model implementation.

An alternative approach is used for this model update to overcome shortcomings of the current implementation. A methodology that is consistent with modeling short-distance freight-carrying trucks has been implemented to account for non-freight commercial vehicles. This methodology consists of six steps that are outlined below.

a. The afore-mentioned Quick Response Freight Manual[6] (QRFM) provides trip generation rates for 4-tire non-freight commercial vehicles. These rates were derived from the 1992 Phoenix truck survey, which in their raw form provide unrealistic van trips. These rates were used for the initial estimate of a van trip table. Subsequently, these rates were adjusted to New York-specific van travel behavior.
b. The QRFM provides parameters for trip distribution, though those are not transferable from Phoenix to New York due to a different zone system and different activity patterns. Instead, the average trip length frequency distribution of non-freight commercial vehicles derived from a survey has been used to calibrate the NYBPM van model. Existing truck surveys were reviewed for non-freight commercial vehicle information, but no such data was found to be available for the New York region. This being the case, a survey conducted for the NC Triangle region (Raleigh) has been used as a placeholder until more local data become available. A gravity model was used to model a van trip table.
c. The trip table generated with QRFM data is unlikely to match observed van counts well (these counts will need to be generated using survey data and observed minus simulated auto count differences, as very few "pure" van counts are available). Therefore, origin-

[5] ARC (2008) The Travel Forecasting Model Set For the Atlanta Region. 2008 Documentation. November 2008. Internet resource: http://www.atlantaregional.com/File%20Library/Transportation/Travel%20Demand%20Model/tp_modeldocumentation_111008.pdf, accessed 23 August 2010. Page 166.

[6] Beagan, D., Fischer, M., Kuppam, A. (2007) Quick Response Freight Manual II. FHWA: Washington, D.C.

destination matrix estimation (ODME) has been used to estimate a reasonable van trip table. ODME adjusts the QRFM trip table to match count data as well as possible. This step is done only for analytical reasons. In production mode, ODME is of little use as it is difficult to grow this trip table for future years and because this trip table is entirely insensitive to scenario analyses. However, ODME is helpful in understanding existing vehicle patterns.

d. Trip productions and trip attractions are calculated using the column and row totals of the ODME trip table. These trip productions and attractions are disconnected from actual activity in each zone (i.e. population and employment), they purely represent an artificial trip table that generates trips that match traffic counts. However, relating these trip production and attractions to socio-economic data and other zonal attributes helps re-estimating trip generation and attraction rates.

e. A stepwise multiple regression has been implemented, where ODME trip productions is the dependent variable and independent variables are employment by type, households by income, density, area type and other zonal attributes. As a *stepwise* multiple regression is used, irrelevant variables were dropped automatically and parameters for statistically relevant zonal attributes have been calculated. In essence, this step re-estimates QRFM trip production and attraction rates and embellishes these rates with additional zonal attributes.

f. The revised trip generation and attraction rates are used in the NYBPM van model. Given that local count data and socio-economic data are used in parameter estimation, it is logical that these van flows match count data better than the current implementation.

The methodology used for modeling vans closely resembles the design of the short-distance truck model proposed in section **6.1.4**. This ensures consistency throughout commercial vehicle modeling and benefits from economies of scale if a similar method is applied twice. The combination of ODME with multiple regression helps in overcoming many shortcomings of the current van model implementation.

The results of the improved commercial van model are summarized in **Table 6-6**. These demonstrate the substantial improvement made over the original van model, with the use of updated local count data and SED data. Logically, future year forecasts of commercial van traffic will also be more reasonable, given the basis of the model in local SED forecasts.

Table 6-6: Summary of Commercial Van Model Performance: Original vs. New

	AM		PM	
	Original Model	New Model	Original Model	New Model
Model Flow	824,568	543,172	296,242	243,328
Count Volume	396,003	396,003	256,944	256,944
Absolute Difference	428,565	147,169	39,299	-13,616
Percent Difference	108%	37%	15%	-5%

RMSE	741	330	253	157
% RMSE	29%	13%	19%	11%

6.1.7 Concluding Remarks on the Improved Truck and Commercial Van Models

The revised approach to model truck flows for NYBPM are now based on all local freight data that are available to the team, including but not limited to employment data, O-D surveys, studies of distribution centers and intermodal facilities, and truck count data. As truck flows are global in scope, additional data sources such as FAF, port statistics, rail waybill data and air cargo statistics are used to the extent available.

Most importantly, this approach leads NYMTC on a path to more sophisticated freight modeling, which helps match observed truck travel behavior well and increases policy sensitivities substantially.

This phase has also helped to identify data and analysis gaps for future freight modeling. For example, it has been found that a comprehensive truck survey or GPS-based truck data collection effort could contribute substantially to future freight modeling efforts in the NYBPM region. Further, the collection of additional truck traffic count data, throughout both urban and rural areas and particularly in New Jersey, stands to substantially improve truck modeling capabilities. Further refinement would also be obtained in the long-distance truck model with the application of County specific scaling factors, as FAF disaggregation based on SED alone does not readily allow to calibrate to screenlines internal to the large FAF zones. The identification and differentiation of private vs fleet operators would also greatly enhance the overall truck and commercial van volumes at individual bridges, as both have very different VOT, the former usually with lower VOT and more convoluted paths.

6.2 External Autos Travel Model

In the original NYBPM, the actual method of accounting for external trips, both External/Internal-Internal/External (EI/IE) and through trips (E-E), has been based on traffic counts taken along the external cordon in the original model (1996). Growth factors were projected into the future for these counts, and the trips were distributed into the NYBPM area based on a gravity function. Given the small percentage of these trips in comparison to the internal trips, this method was kept through the previous updates (2002 and 2005), with slight improvements in the most recent update to account for trips made into the CBD area, as they were higher than the results of the Port Authority surveys had shown. This method is thus totally separated from the core activity based methods, the auto trips calculated from this ancillary model (once separated by time period and mode) being simply added to those from the internal core models.

For Stage 2, an effort was made to integrate the external model into the NYBPM core process, taking into account jobs held by Out-of-Region (OR) workers and workers commuting outside the NYBPM region. This analysis is based on the Census Transportation Planning Products (CTPP) home to work survey and uses 2006-2010 ACS data as the seed matrix for County to County auto and total trips using a Fratar model for the extended region. The other non-work purpose EI/IE trips, and E-E trips are handled by a second program, NELDT (National Evaluation of Long Distance Trips) which is based on the 2002 National Household Travel Survey (NHTS). The more recent 2009 NHTS could not be used due to its lack of information on long distance trips.

6.2.1 Methodology

The overall methodological framework is illustrated in Error! Reference source not found. and explained in detail in the "*Task Order K: Improved BPM 2010 Forecasting with Out-of-Region Analysis Incorporated*" technical memorandum dated August 7, 2014. Essentially, the external trips are extracted from available survey data (CTPP and NHTS) and forecasts of these trips are based on population and employment prediction statistics obtained from NYMTC and from the following surrounding Municipal Planning Organizations (MPO) or State Departments of Transportation (DOT):

i. MassDOT
ii. ConnDOT
iii. NYSDOT
iv. NJTPA
v. SJTPO
vi. DVRPC

The data came in various formats and for different horizons, but through interpolation as well as extrapolation to 2040, datasets were created for 5 year intervals starting in 2010. Using CTPP home to work data as seed (2006-10), a Fratar method was employed to distribute future employment and population growth. External-internal and internal-external (EI and IE), as well as External-External (E-E) trips were retained and the reverse direction added and stored as HBW 24 hour trips. The external "Halo" region is presented in **Figure 6-8**.

The next step consisted of evaluating non Work E-I, I-E and E-E auto trips, using a methodology that Parsons Brinckerhoff applied previously to the Chicago and San Diego regional models; NELDT (National Evaluation of Long-Distance Trips). All E-E trips qualify as long-distance trips (>50 mi., save at the edges of the area) whereas EI/IE non-work short distance trips are omitted using this method. In order to be able to assign from external County TAZ to internal NYBPM TAZ, County to County ODs were disaggregated as County to TAZ ODs, using the appropriate SED data; population for non-work trip purpose and employment for work or business trip purpose.

Short distance non Work trips at the edge of the network (absent from both initial methods) were added as a third component of external demand. The NJTRM-E travel demand model was used to determine the proportion of short non-Work trips crossing the outer NYBPM contained within that model's network. The proportion of short (<50mi) non-Work trips, long (>50mi) non-Work trips and all Home to Work trips was calculated for two different facility types (freeway and other) along the external cordon and was applied to the counts at the whole periphery of the NYBPM area in order to differentiate and calibrate the base year factors in both the Fratar and NELDT components of the model. Given the similarity of urban and rural mixes on each side of the Delaware River cordon, it is possible to apply the New Jersey data to the rest of the external cordon in New York and Connecticut. The calibration then used state-to-state adjustment factors to further refine the fit along the border by State sections.

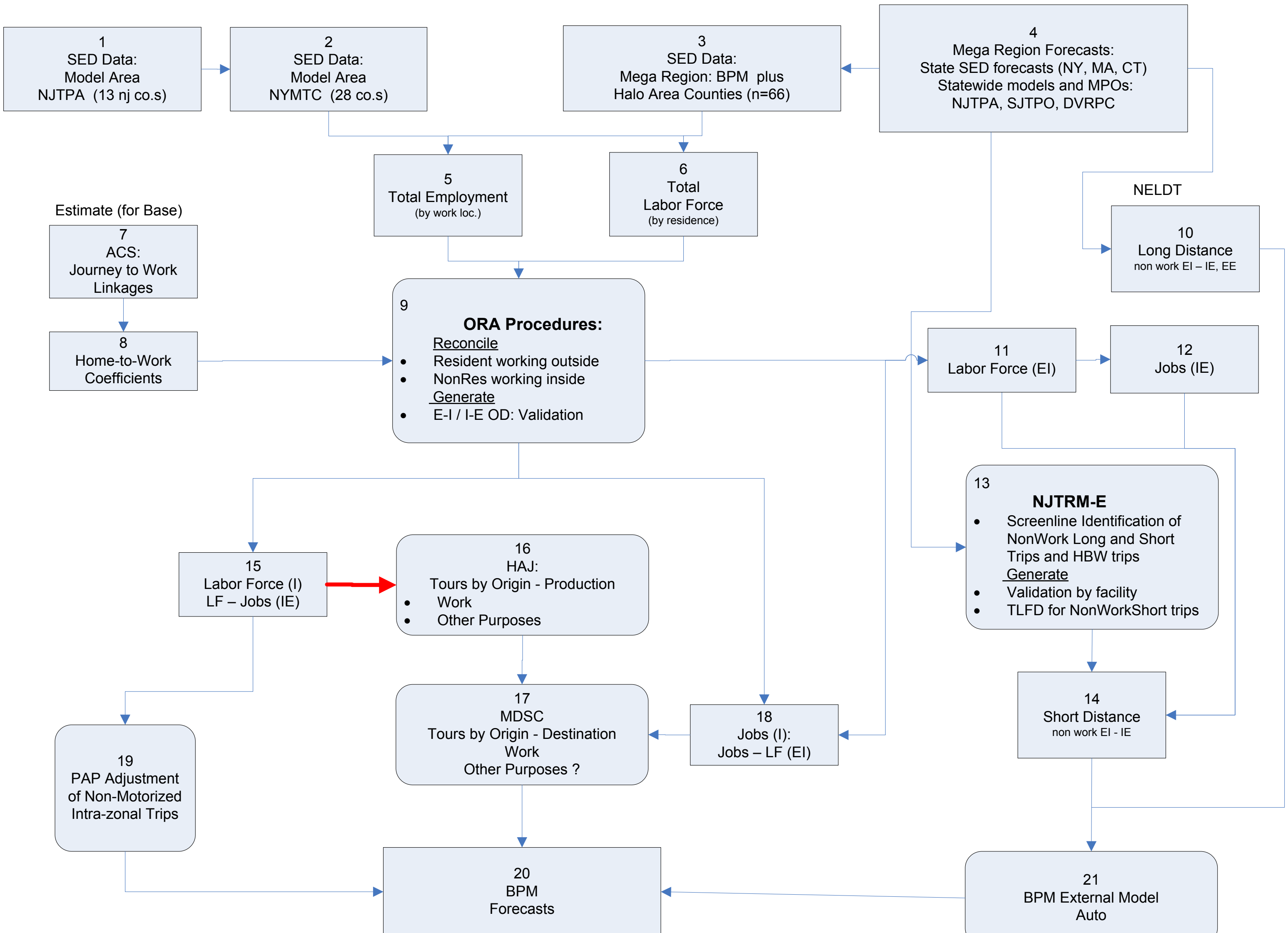


Figure 6-7: Out-of-Region Analysis Model Framework

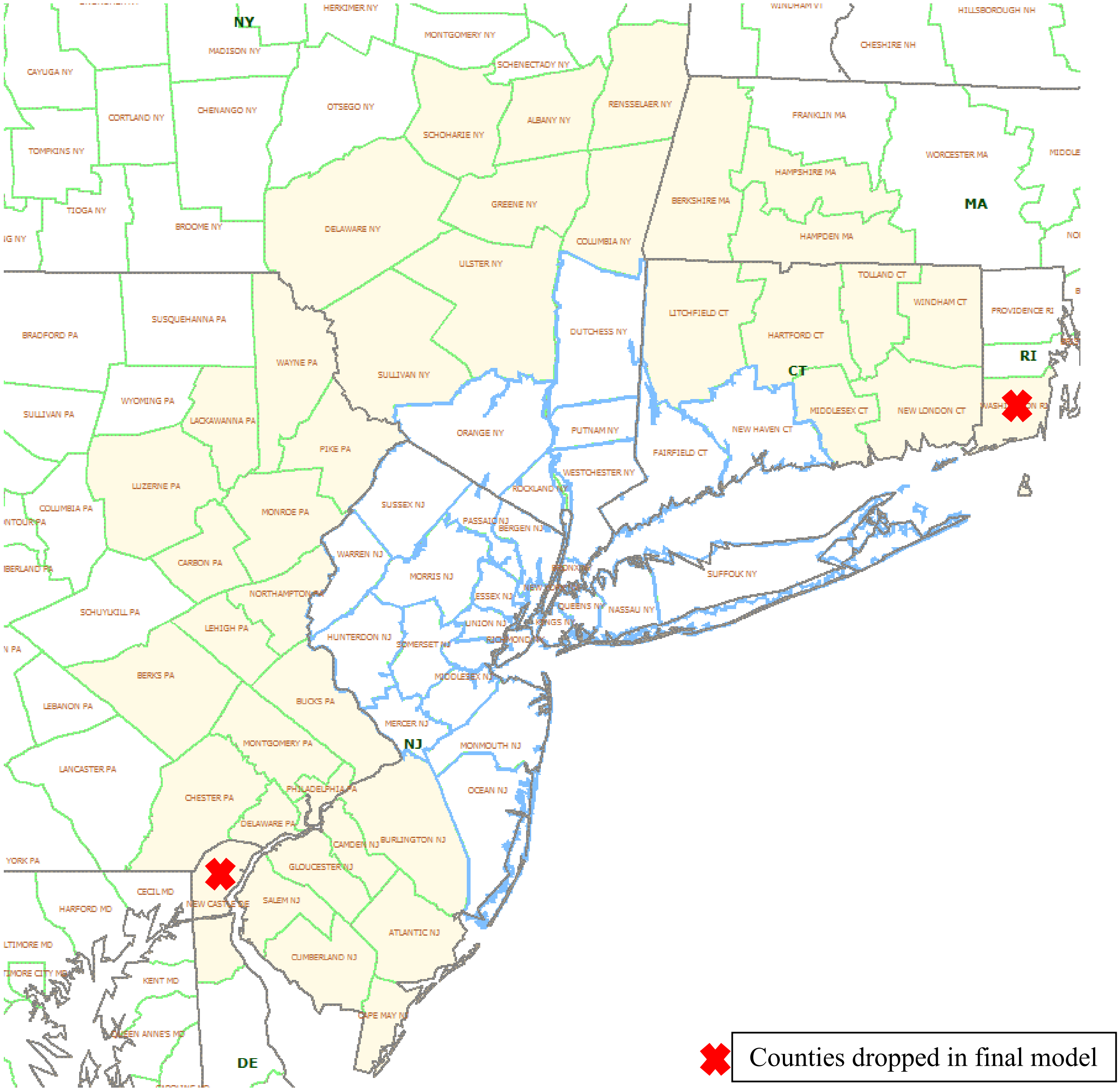


Figure 6-8: Halo County Map

For the short distance non-work portion of trips, the trip length frequency distribution for trips of 50 miles or less (by Freeway or Other facility type) was extracted from the NJTRM-E along the screenline, for trips on the model (east) side only. This distribution was then applied within a singly constrained gravity model, using the proportion of productions/attractions at the external stations obtained for the Home to Work Fratar model. It is assumed that short distance non-Work trips will have a direct relation with population and activity (discretionary and maintenance trips) and can by tied to the Home-to-Work component of the model, whereas the long-distance non-Work component is inherently independent from short distance non-work trips. This means all three components of external trips are directly or indirectly tied to socio-economic factors with the assumption that the proportion of short distance/Home-to-Work trips will remain relatively constant over time.

The demand obtained was then assigned using the National + NYBPM network, along with a current version of the internal auto and truck demand. NYBPM subarea traversal trip tables by purpose were extracted from the National Network Model to create TAZ Tier 1.2 NYBPM trip tables. These daily external matrices were then split into 4 periods and 3 modes (SOV, HOV2, HOV3+) using the existing mode factors of the current external model to be combined with the core model trip tables produced for the same classes in the existing PAP procedure.

One final step consisted of adjusting employment totals by TAZ by subtracting jobs identified as being held by out-of-region labor force, using results from step 1) above. Labor force cannot be readjusted in the same way in the present form of the model (see the red arrow between boxes 15 and 16 in **Figure 6-7**, since removing a worker would also remove its other non-work related activities. In order to prevent the worker traveling outside the region from competing for internal region jobs, a job is added in the same TAZ as its place of residence before the MDSC stage. The most probable effect is to create an intra-zonal non-motorized work trip, and thus removing the worker from competing for other jobs with those within the core model. This slightly increases the proportion of non-motorized trips, which can subsequently be reduced at the PAP stage (box 19 in **Figure 6-7**).

In summary, these are the steps in the External model:

- CTPP total trips and employment adjusted to Labor Force for the base year, to be kept for subsequent Labor Force and Employment adjustment for the core model.
- Population and employment adjusted to CTPP auto trips for the base year, future year matrices to use percent increases for both vectors.
- Fratar distribution of auto trips to future horizon year, thus obtain EI/IE and EE work trips.
- NELDT model used to forecast EI/IE and E-E long distance non-work trips, based on population increases.
- Using ratios and TLFD obtained from NJTRM-E, calculate short-distance non-Work trips at the cordon using a singly constrained gravity model
- Assign and extract 24 hour subarea matrices by purpose
- 24 hour matrices split into 4 time periods by sub-auto modes.
- CTPP total trip matrix augmented by same increases as in step 2, jobs subtracted within NYBPM area for EI work trips, added for IE work trips.
- Intra-zonal non-motorized trips re-adjusted post MDSC for all IE work trips.

6.2.2 External Model Comparison to Traffic Counts

Table 6-7 presents the comparison of daily counts at the main external stations, by category. The State Target values correspond to the observed 24 hour count values at external stations within each state, i.e., NY external stations in Dutchess County bordering CT are counted as being part of the NY State total.

Table 6-7: Comparison of 24 hour Counts at External Sections

State Targets		Observed	Simulated	% Dif
CT	43%	600371	581321	-3.2%
NJ	39%	548729	576184	5.0%
NY	18%	247262	236771	-4.2%
Total		1396362	1394276	-0.1%
Purpose Targets				
Long Distance	14%	194872	191982	-1.5%
Short Distance	46%	642658	646253	0.6%
Home Based Work	40%	558833	556041	-0.5%
		1396362	1394276	-0.1%

6.2.3 Adjustment of Core Home/Work Trips

One of the main reasons for the out of area analysis is the re-balancing of the workers and jobs inside the NYBPM area to account for either jobs held out of the area by NYBPM residents (IE), or vice-versa, jobs within the NYBPM area by residents of the Halo counties (EI). As noted above, the EI adjustment is fairly straightforward; jobs are removed by TAZ according to the results of the FRATAR balancing for total Home-to-Work trips. For the IE adjustment, removing a worker would also remove other non-work tours, so the solution that was adopted was to add a job in the same TAZ, thus "neutralizing" this worker from competing for jobs in other TAZs, and most probably creating a non-motorized intra-zonal work-trip. The auto trips that would have been generated by either the EI or the IE home-to-work trips are already taken into account in the External assignment of the CTPP home-to-work auto trips. **Table 6-8** presents the number of jobs removed or added by County for 2010.

Table 6-8: Core Model Job Adjustments by County

		Original BPM SED			Adjusted SED, with External Work Trip Balancing			Number Difference			Percent Difference		
COUNTY		**EMPTOT**	**EMPRET**	**EMPOFF**	**EMPTOT**	**EMPRET**	**EMPOFF**	**EMPTOT**	**EMPRET**	**EMPOFF**	**EMPTOT**	**EMPRET**	**EMPOFF**
Manhattan	1	2,326,753	169,188	1,042,086	2,306,076	167,820	1,032,597	(20,677)	(1,368)	(9,489)	-0.9%	-0.8%	-0.9%
Queens	2	678,039	69,398	103,102	675,489	69,258	102,849	(2,550)	(140)	(253)	-0.4%	-0.2%	-0.2%
Bronx	3	359,626	31,196	42,234	358,084	31,145	42,155	(1,542)	(51)	(79)	-0.4%	-0.2%	-0.2%
Kings	4	764,014	69,533	122,780	760,964	69,421	122,456	(3,050)	(112)	(324)	-0.4%	-0.2%	-0.3%
Richmond	5	121,945	13,966	24,249	121,057	13,903	24,125	(888)	(63)	(124)	-0.7%	-0.5%	-0.5%
Nassau	6	563,930	66,939	129,566	563,150	66,901	129,429	(780)	(38)	(137)	-0.1%	-0.1%	-0.1%
Suffolk	7	613,769	81,415	119,900	612,633	81,344	119,756	(1,136)	(71)	(144)	-0.2%	-0.1%	-0.1%
Westchester	8	432,422	42,073	99,337	428,957	41,824	98,621	(3,465)	(249)	(716)	-0.8%	-0.6%	-0.7%
Rockland	9	113,129	13,317	22,114	112,190	13,234	21,956	(939)	(83)	(158)	-0.8%	-0.6%	-0.7%
Putnam	10	27,869	3,183	5,102	27,467	3,145	5,036	(402)	(38)	(66)	-1.4%	-1.2%	-1.3%
Orange	11	140,685	18,924	21,655	124,396	16,381	18,874	(16,289)	(2,543)	(2,781)	-11.6%	-13.4%	-12.8%
Dutchess	12	119,279	13,573	19,571	108,030	12,169	17,554	(11,249)	(1,404)	(2,017)	-9.4%	-10.3%	-10.3%
Fairfield	13	455,326	47,546	135,583	439,157	45,885	130,538	(16,169)	(1,661)	(5,045)	-3.6%	-3.5%	-3.7%
Bergen	14	430,115	54,023	102,747	427,012	53,679	102,056	(3,103)	(344)	(691)	-0.7%	-0.6%	-0.7%
Passaic	15	180,106	23,981	30,566	178,514	23,779	30,310	(1,592)	(202)	(256)	-0.9%	-0.8%	-0.8%
Hudson	16	272,962	26,211	81,589	270,100	25,997	80,756	(2,862)	(214)	(833)	-1.0%	-0.8%	-1.0%
Essex	17	374,389	30,113	87,061	368,477	29,720	85,726	(5,912)	(393)	(1,335)	-1.6%	-1.3%	-1.5%
Union	18	239,885	26,259	44,727	236,441	25,920	44,106	(3,444)	(339)	(621)	-1.4%	-1.3%	-1.4%
Morris	19	284,670	28,713	81,455	276,422	27,887	79,007	(8,248)	(826)	(2,448)	-2.9%	-2.9%	-3.0%
Somerset	20	169,681	19,630	50,666	161,709	18,657	48,244	(7,972)	(973)	(2,422)	-4.7%	-5.0%	-4.8%
Middlesex	21	370,013	43,736	80,368	359,286	42,471	77,975	(10,727)	(1,265)	(2,393)	-2.9%	-2.9%	-3.0%
Monmouth	22	263,013	34,103	64,408	260,105	33,739	63,696	(2,908)	(364)	(712)	-1.1%	-1.1%	-1.1%
Ocean	23	163,220	27,183	27,013	163,574	27,192	27,052	354	9	39	0.2%	0.0%	0.1%
Hunterdon	24	53,851	6,714	12,781	47,902	5,848	11,184	(5,949)	(866)	(1,597)	-11.0%	-12.9%	-12.5%
Warren	25	37,723	5,665	4,693	29,658	4,055	3,451	(8,065)	(1,610)	(1,242)	-21.4%	-28.4%	-26.5%
Sussex	26	44,068	5,708	8,674	41,087	5,359	7,860	(2,981)	(349)	(814)	-6.8%	-6.1%	-9.4%
New Haven	27	382,410	42,891	59,969	350,824	39,041	54,008	(31,586)	(3,850)	(5,961)	-8.3%	-9.0%	-9.9%
Mercer	28	221,030	16,252	48,974	175,073	12,023	36,053	(45,957)	(4,229)	(12,921)	-20.8%	-26.0%	-26.4%
Region Total		10,203,922	1,031,433	2,672,970	9,983,834	1,007,797	2,617,430	(220,088)	(23,636)	(55,540)	-2.2%	-2.3%	-2.1%

6.3 Restructure/Modify Specified NYBPM Procedures

The objective of restructuring and modifying specified NYBPM features is the incorporation of a number of enhancements in various NYBPM procedures. These model improvements are features that were originally identified in the project RFP, and were confirmed in Task 1: Specify BPM 2010 Update Approach and Elements as both desirable and practical improvements to be implemented as part of Stage 2. These new features add additional policy sensitivities, testing capabilities, and/or improve the ability of the model to replicate base year conditions as part of the re-calibration. As these procedures are described in detail in the "Task 13: Restructure/Modify Specified NYBPM Procedures" technical memorandum, dated September 26, 2014, this section essentially describes their functionality.

6.3.1 Trip Table Results by Purpose in Addition to the Results by Mode

A flag has been added as a parameter input to the NYBPM that allows a user to choose to produce and assign trip tables by purpose. This flag is called "_PAP By Purpose Flag", and by default it is set to false when the model is run. If the flag is set to true, PAP will produce trip tables segmented by purpose.

For highway trip tables, the trip table matrices by purpose have 8 sets of passenger mode cores corresponding to the standard NYBPM journey purposes. In addition to these cores, the trip tables also contain cores for Medium Trucks, Heavy Trucks, and Other Commercial vehicles. Finally, for passenger trips for which the purpose is not known (i.e. external and special generator trips), a set of "Other" passenger mode cores is also present in the highway trip tables. This creates a total of 39 trip tables for each time of day period:

- 8 purposes x 4 passenger modes (SOV, HOV2, HOV3+, and Taxi)
- 3 commercial vehicle modes (Medium Truck, Heavy Truck and Commercial Vans)
- 4 passenger modes for transit/commuter rail drive access/egress, external, and special generator trips.

For transit trip tables, each mode is similarly segmented by purpose. In addition to the standard transit trips, airport transit trips are reported in a separate trip table. This creates a total of 33 trip tables for each time of day period:

- 8 purposes x 4 passenger modes (WT, DT, WCR, and DCR)
- 1 airport transit mode

When this option is selected, the highway trip tables may be assigned by purpose as they are output from PAP. Transit trips can only be assigned in their standard format, by mode.

6.3.2 Ability to Run the MDSC by Individual Purpose or Combinations of Purposes

An input parameter has been added to the NYBPM to allow a user to choose to run MDSC for a selected subset of purposes. The parameter is called "Run MDC by Purpose" and it has the form of an array of eight elements. The parameter can be found in list of Scenario Parameters and accessed in the Scenario Toolbox. By default, all of these elements are set to 1, indicating that MDSC should be run for all purposes. By changing selected elements to 0, a user can omit purposes from being run in the MDC step.

Almost any combination of purposes or individual purposes can be run in MDSC, with one exception. If any of the work trip purposes (Work—Low Income [1], Work—Middle Income [2], or Work—High Income [3]) are not being run, the at-work purpose [8] will not be run.

6.3.3 Ability to Calibrate the Model at a Finer Level (District Level)

6.3.3.1 Current Calibration System

The NYBPM Mode, Destination, and Stops Choice model (MDSC) is usually calibrated at the "BPM District" (0-30, counties with Manhattan broken down into four parts) level. The exception to this is the O/D-based motorized and non-motorized mode-specific constants, which already run on flexible user-defined indices based on the "fixed" 0-30 counties with Manhattan splits. However, trip productions, county-to-county factors, destination choice factors, mode choice constants, and trip length factors all use a standard district system to set calibration factors and report results. These "BPM Districts" are defined in a number of model input files, which index TAZs to the standard 31 districts (or 28 counties). These indices define which factors are applied to which groups of zones, and how the model results are reported.

6.3.3.2 Purpose and Design of New Flexible System Implemented as Part of the NYBPM 2010 Update

A flexible zone system has been implemented to allow calibration of the model and reporting at a finer and fully flexible level of detail. MDSC can now be calibrated at and produce reports at any district level defined by the user using a flexible a listing of TAZ to user named district(s). The model utility functions are now able to read and apply constants for any defined district system, for the specific set of constants applied at any stage in the model.

New calibration indices can be defined by the user in a new model input file (FLEX_DISTRICT_TAZ_CORRESP), which allows for up to 19 different district systems to be defined at once. This file allows TAZs to be grouped by any arbitrary number of districts, including by default the standard 31 districts ("BPMDist0").

References have been updated in the model source code to refer to this new index file for district definition. The column number is used to specify which of the district definitions to use for the model run. District and Subregion indices can also be set for MDSC's postsum reporting step, through the DISTRICT_LABELS_FILE and SUBREGION_LABELS_FILE in the PostSum.ini file. Labels can also be set for reports built according to the flexible district and subregion systems in these files.

6.3.3.3 Tests Performed and Results

The functionality of the flexible district system has been tested at all stages of MDSC. This includes the initialization of the model control files, the model run for each purpose, and post-processing and reporting, as shown in **Table 6-9**. Testing has confirmed the functionality of the new input files and parameters that allow for the definition of additional flexible district systems.

Table 6-9: Functionality of Flexible Calibration and Reporting Tested

Functionality	Model Step	Flexible District Referenced in File
Mode choice constants	MDSC	M_INDICES_[purpose 1-8].csv
County-to-county calibration factors		CC [purpose 1-8]
Destination choice calibration factors		
Trip Length factors		DISTFACT [purpose 1-8].prn
PostSum reporting		countyIndices.csv subregionIndices.csv tazDistrictsCorresp.csv

6.3.4 Development of Scenario/File Management System for Transit Coding

A transit scenario manager network building tool was developed under a separate contract (Task Order P-2M / C000753) in conjunction with delivery of the TransCAD 6.0 / GUIT-T NYBPM 2G platform. As a part of Stage 2, the tool has been further refined for clarity and efficiency. Additionally, a large number of future year projects have been reviewed and updated.

6.3.5 Incorporating the ITS Project Coding and Highway Scenario/File Management System into GUI for the NYBPM

A current system similar to TIP highway projects coding has been implemented to organize ITS and signal projects. There are 2 major components:

a. ITS/Signal Projects: 15 additional ITS/Signal related attributes are found in each of the project coding
b. ITS/Signal Scenario Manager: similar to highway scenario manger, this manager controls which ITS/Signal projects to be incorporated to a scenario network

ITS project coding, however, is only required to provide additional details attached to scenario networks for air quality analysis as a part of post processing.

A utility has been added to the GUI menu to facilitate the network update process to incorporate ITS/Signal projects into a scenario network.

The highway network builder for scenarios has been incorporated as part of the GUI menu since the creation of the BPM 2G. For Stage 2, this tool has been reviewed and updated so that it works with the new base network and other revised and updated processes in the model.

6.3.6 Review of FTA Forecasting Guidelines to Improve Consistency and Compatibility of the NYBPM with FTA New Starts Program

The most important change affecting the consideration of the use of the NYBPM regional model for New Starts planning is the use of “Project Trips” rather than User Benefits as the primary metric of mobility improvements and cost effectiveness associated with the project, as well as the opportunity to consider expected changes in highway VMT. A new tool is also available for these calculations and the applicant has the option to use the FTA sponsored simplified forecasting procedure called Simplified Trips on Projects (STOPS), either as an alternative to a locally developed travel forecasting model, or to supplement it. This is possible since the applicant is no longer required to apply the relatively prescriptive methods previously used for the estimation of project User Benefits derived from a comparison of the modeling of base and build alternatives, with the results quantified by the SUMMIT program, using logsum measures provided by a discrete logit-based mode choice model. Instead, the key measures are estimated daily linked trips on the project, with trips by transit dependent and non-transit dependent travelers, distinguished and separately evaluated.

Stage 2 is an improved and reasonable modeling platform for both regional and corridor level planning for a robust multi-modal analysis of transportation policies, infrastructure investments, or service scenarios where both transit and highway simulation is required. It also certainly the best existing tool for accounting for transit within the analysis needed for emissions forecasts required for TIP/SIP Conformity Determination. While less fully and finely calibrated to observed transit use patterns than models that have been the primary platform for FTA directed planning, such as the MTA’s Regional Transit Forecasting Model (RTFM) or the New Jersey Transit Forecasting Model (NJTFM), unlike these models, the NYBPM can provide a full and consistent set of forecasted measures for both highway and transit system performance and impacts.

6.3.7 Enhancing Highway Project TIP Coding

The highway project coding system has been reviewed and updated for Stage 2. All existing TIP projects have been re-coded on the new conflated network produced in Task 6. Because of widespread changes in link geometry, as well as new Link ID numbers and updated attributes throughout the modeled region, each project was re-built and tested for functionality with a new base network.

Additionally, all highway network corrections are now coded in a single project, named PROJ000, to keep network corrections distinct from TIP projects. In the future, all corrections to the base network can be implemented in PROJ000 to keep track of what changes have been made in a single location.

This PROJ000 should be considered as the only project to recreate an updated base network when corrections to the existing base network are necessary. It will not serve as one of the TIP projects in the project scenario manager.

Whenever there are additional corrections added to PROJ000, a new base network should be rebuilt so that future project coding and scenario network will be able to make use of the latest physical network and attributes.

A copy of the base network at the time of 2010 Update is to be saved in a separate folder (e.g. C:\BPM_Stage1\1_Prep\1_HNet\0_Base\Original Base Network).

7 RE-CALIBRATION AND VALIDATION OF NYBPM 2010

7.1 OVERVIEW OF CALIBRATION AND VALIDATION METHODS FOR NYBPM UPDATES

This section of the final report describes the data developed that served as the calibration targets for Stage 2, the technical calibration approach, and results of the base year calibration and validation.

As part of the Stage 2 development, a re-calibration of the NYBPM to a Base Year 2010 was done based on the revised set of input data, new calibration targets, and improved application procedures discussed in the preceding sections of this report. The calibration and validation methods developed and used were similar to those of prior NYBPM model updates.

The 2002 update simplified the original 1996 calibration structure of the NYBPM by substantially reducing the number of applied "constants". The 2005 update utilized the1996 RT-HIS, expanded to 2005 values, along with 2006 American Community Survey (ACS) Journey to Work data, 2005 highway traffic counts, 2005 transit counts, and MTA's RTFM trip tables and Metrocard data for borough-to-borough transit ridership. For the NYBPM 2010 Update, the more recent RHTS 2010 survey data were used, along with recent Origin-Destination surveys, updated and expanded highway and transit counts, and more recent ACS five year data.

7.2 RE-CALIBRATION PROCESS AND PRINCIPLES

As in previous updates of the NYBPM, the current re-calibration process was guided by the following principles:

- Focus on Highway Validation, the most critical for the accurate generation of travel forecasting inputs to air quality analysis.
- Aim for a calibration that is generally on the "low side" of observed or estimated counts, accounting for the missing components of travel not modeled in the NYBPM (e.g. visitors, airport access, police and other fleet vehicle activities).
- Obtain more a uniform regional pattern of volume-count measures with a focus on inter-county screenlines and major crossings (bridges and tunnels) in the region.
- Auto Calibration for Mode Choice model

The two important and highly related concepts of validation and calibration of the model are first described.

Validation: The effectiveness of the NYBPM for planning applications will depend a great deal on how realistically it reflects travel market characteristics and traveler choice behaviors, and the extent to which the model accurately represents the transportation network and service options in the NYMTC region with a sufficient level of resolution. Validation of the model's performance will be assessed in two important respects. First, it will be evaluated in terms of how closely the base year model outputs correspond to the best available data describing auto, truck and transit travel within the general transportation corridors related to regional travel demand, and more directly to the observed travel characteristics of users of the vehicular crossings and transit links that comprise the Inter-County regional cordons. Secondly, it can be assessed in terms of the reasonableness of its travel forecasts with respect to changes in inputs, such as improvement in network connections, capacities, service levels and travel costs, like those that might constitute a planning scenario for testing with the model. This second important aspect of validation is evaluated in the application of the calibrated model in a 2040 Future Year forecast scenario (pending)

Calibration: Best available "target" data of a range of different travel measures have been used for the Calibration of the NYBPM, which is the process by which factors in each of the principal modeling steps – travel generation, origin-destination, mode and route choice – are adjusted when applied in the Base Year to best approximate observed data on current travel. For the core models, which are logit choice models applied with microsimulation in the NYBPM, these adjustments are implemented as modifications of the constant terms in the utility calculations used to determine the probability of selection of each travel choice from a set of available choices. The modeling of a series of travel choices is implemented in the model sequentially -- for each household and each traveler – starting with: the number of autos in the household, then the frequency (or production) of journeys made by purpose, then the location of non-home destinations (yielding an origin-destination distribution of journeys), then mode choice and finally the frequency and location of stops made on each journey.

In the NYBPM, the utility expressions used in these logit models are linear combinations of travel time and cost measures, with each term differentially weighted by coefficients that were statistically estimated with the 1998 Regional Travel – Household Interview Survey. As distinguished from the constants (or error terms) adjusted in Calibration, these coefficients of travel time, costs or other policy variables, provide the behavioral sensitivity of the model to changes in transportation capacities, level of service, and costs. As a result, "over-calibration" (very large constants that dominate the utility values calculated) that can be done in order to achieve exact or very close replications of observed data (such as typical day traffic counts), is generally not advisable, since the result is usually a model that produces forecasts with too little sensitivity to changes in transportation connections, services and polices to be evaluated as part of the planning process. Related to the second aspect of validation process discussed above, "sensitivity tests" to assess the reasonableness of the model's response to changes in inputs can be done.

The NYBPM 2010 Update has been calibrated in series of steps to maintain as much as possible an internal consistency of the model with respect to the trip generation, distribution, mode choice and network assignment – highway and transit, and to avoid excessively large constants in the utilities used for these model components.

7.3 Stage 1 – TH-TDFM Calibration Data and Methods

The NYBPM 2010 Update or Stage 2 calibration was done as part at each of the three distinct stages of its development, reflecting the objectives and focus of each stage, the state of the model application platform, and the data and other resources available. This section briefly identifies the key data, in addition to those available from the NYMTC regional calibration of the NYBPM 2005, that were used to develop the TH-TDFM or Stage 1 of the NYBPM 2010 Update commissioned by the PANYNJ.

Figure 7-1 shows the data and focus of the calibration methods developed and used in Stage 1 work, with Keys shown that index to the discussion of each in the text.

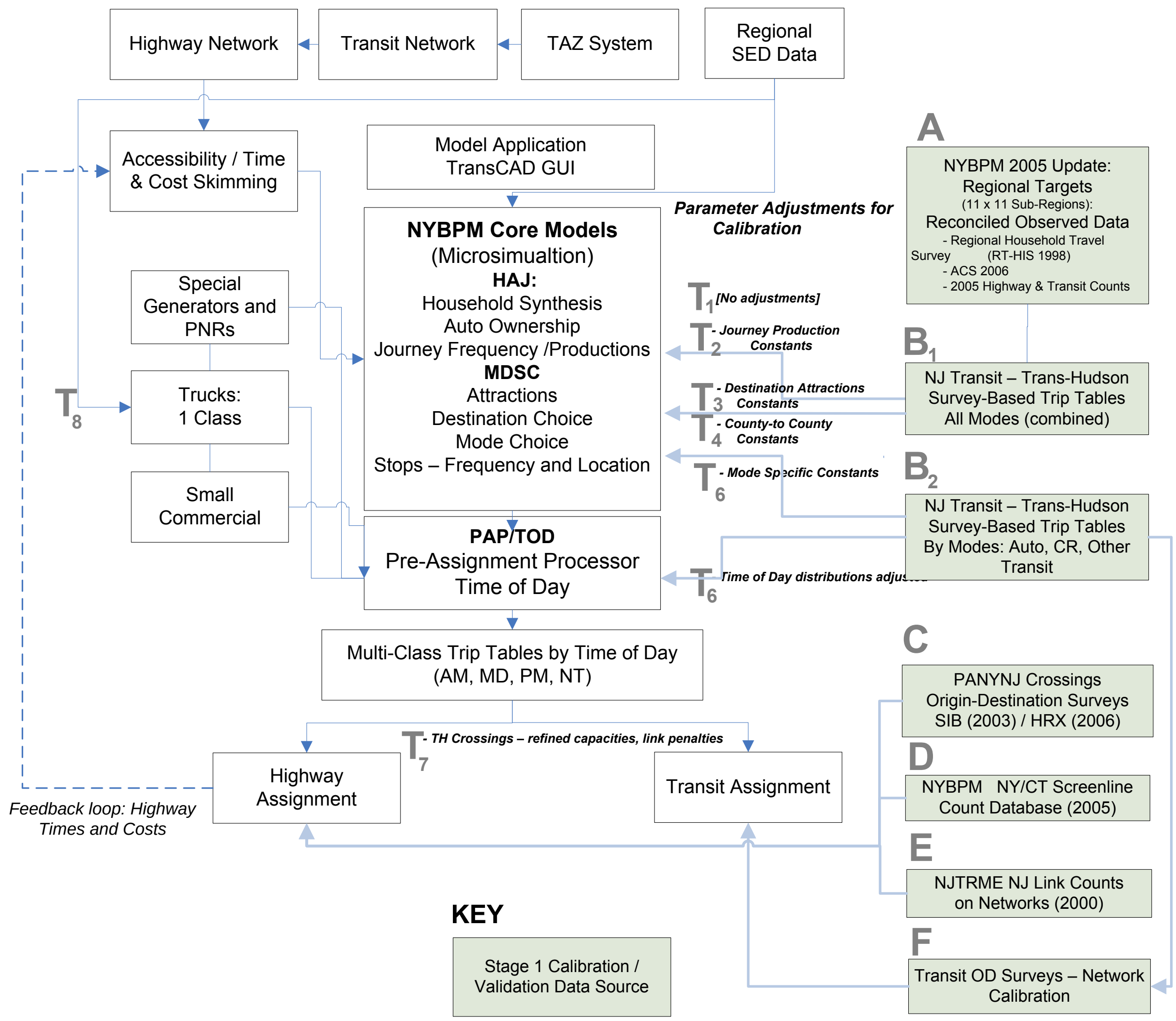


Figure 7-1: Stage 1 (TH-TDFM) Calibration Data and Focus

Six basic data sets developed in the TH-TDFM Stage 1 were developed and applied in the calibration process.

A. NYMTC: Comprehensive Regional Model Calibration Target Data – NYBPM 2005 Update

The 2005 based comprehensive set of reconciled travel data, consisting of a re-weighting of the 1998 RT-HIS 11,0000 household travel survey data, with 2005 ACS, and adjustment to current highway screenline counts, MetroCard NY transit flows, and calibrated MTA RTFM model transit flows for non-NYC travel.

B. NJ Transit: Calibrated Model and Survey Based Trip Tables (2005)

Focusing on Trans-Hudson transportation facilities and travel markets, the most recent set of OD trip tables were obtained from the NJ Transit model for the purposes of establishing OD and mode choice calibration targets for the Trans-Hudson travel simulated in the TH-TDFM. These model data consist of two distinct set of travel data:

- Person Trips (all modes) Tables by general purpose. The Trans-Hudson flows in these trip tables have been developed by NJ Transit and its consultant AECOM, from the most recent set of Auto and Transit OD surveys done by both the PANYNJ and NJ Transit. In the NJ Transit Model, these base year survey-based person trip tables are factored by projected changes in SED forecasts for future year forecasts. In contrast, the TH-TDFM, like the NYBPM, estimates these all-mode person trip flows using the travel generation and distribution models. They have been used in the Trans-Hudson focused calibration of Destination Choice (Home to Primary Destination journeys)
- Mode Trip Tables – These are the result of the application of the NJ Transit Mode Choice modeled, well calibrated to each of the modal surveys. These have been used in the Trans-Hudson focused calibration of the Mode choice model of the TH-TDFM

C. PANYNJ: HRX (2006) and SIB (2003) Auto Origin-Destination (OD) Survey Data

The most recent weekday Auto surveys conducted at the 6 PANYNJ crossings were available and used to compare the Origin-Destination (OD) and Time of Day (TOD) pattern of the modeled Auto Trans-Hudson travel. The results of the highway assignment, with Select (or Critical) Link Analysis include for the PANYNJ crossings, allowed for an assessment of the underlying OD, TOD and the route/crossing choices being modeled in the TH-TDFM in the calibration test runs.

Other key Trans-Hudson travel data obtained from the PANYNJ and used for the TH-TDFM calibration included:

- PA Crossing Volumes by Vehicle Type (2005 – 2008) Eastbound
- Westbound Counts – by Vehicle Type
- EB and WB by Vehicle Occupancy
- PATH System-Wide Passenger Survey (2009)

See *Appendix B: Data for Calibration and Validation* for table summaries of these data.

D. NYMTC: Regional Highway Vehicle Counts (2005) – Screenlines: NY, CT and TH Crossings

The NYBPM screenline volume database has been used and updated as the principal source of observed traffic volume data for the calibration of the NYBPM, 1996, 2002, and 2005. It consists of about 2,200 highway network link records, with actual or estimated volume data by direction, by hour, for each link in the database. This screenline database, however, only covers the ten New York counties that comprise the NYMTC area, and all interstate crossings between New York and New Jersey.

E. NJTPA: Regional Highway Vehicle Counts (2000) – NJRTM-E Links: NJ

For traffic counts in New Jersey, the Base Year 2000 count data used for the calibration of the NJRTM-E were obtained and linked to the TH-TDFM highway network, so that comparisons of these count data (1,419) with model volumes can be made by County by Functional Class Group. NJTPA: Regional Highway Vehicle Counts (2000) – NJRTM-E Links: NJ

F. Transit Survey Based Trip Tables for Network and Assignment Calibration

The validation and calibration of the transit network for the NYBPM 2010 Update was carried out in two phases. Stage 1, as indicated above, performed as the West of Hudson River (WOH) calibration, was completed in the TH-TDFM 2010 Update project (Stage 1B) for the PANYNJ, and its results were carried over as the starting point for the transit network and calibration in the NYBPM 2010 Update (Stage 2).

A 6-10 AM Peak period set of NYBPM synthetic trip tables were extracted from the TH set of Origin-Destination surveys describe above (Source B). These were used in Stage 1B to test and adjust the transit network coding, path-building and assignment procedures focused on Trans-Hudson and West of the Hudson River (WHR) transit service, aiming for the network and loading of the survey demand to reasonably replicate observed transit counts.

7.4 Stage 2 – Final NYBPM 2010 Update Calibration Data and Methods

The calibration settings developed in Stage 1, focused on Trans-Hudson travel market and transportation system, were taken as the starting point for the calibration of the NYBPM 2010 in Stage 2. While there are changes to inputs, including base year employment estimates in Manhattan that affect the model and required some adjustment to these bi-state travel market settings, these settings were largely kept and modified only as needed aiming to maintain in Stage 2 a generally equivalent level of calibration for Trans-Hudson travel where possible.

As discussed in prior sections of this report, the re-calibration of the NYBPM used:

- Tabulations from the 2010 Regional Household Travel Survey (RHTS) for aggregate calibration targets and validation of core model productions, attractions, origin and destination flows, and mode shares
- A new set of various traffic counts / Screenline counts updated 2010, with expanded vehicle class and truck counts

- Transit counts – Hub-bound 2010 data were compiled for comparison with the transit model results, along with terminal and major station level on's/off's and NYC bus and subway on's and off's,
- Journey-to-Work flow data at the county level from the ACS 2006-2010

Figure 7-2 shows the data and focus of the calibration methods used in Stage 2 of the NYBPM 2-2010 Update for the NYMTC regional model, with Keys shown that provide an index to the discussion of each in the text.

In addition to the six major sources of calibration and validation data used in Stage 1, focused on Trans-Hudson travel, additional regional data sources were developed and applied in Stage 2 calibration of the NYBPM 2010 Update model:

G. Stage 1 Trans-Hudson Calibration Data – Items A-F in **Figure 7-1**

H. Regional Household Travel Survey – NYMTC 2010

The 2010 Update takes advantage of the recent 2010 Regional Household Travel Survey (RHTS) to establish new calibration targets for the core models of the NYBPM. The core model calibration target data for NYBPM is largely taken from aggregate summaries and tabulations of the RHTS, using the 2010 expansion weights and GPS correction factors developed the NYMTC survey project, and as documented in that project's Final Report.

The tour production, destination choice origin-destination, and mode share targets derived from the RTHS were initially used as explained below to obtain initial calibration constants for the core models (HAJ and MDSC). By assigning the RHTS survey data with NYBPM highway and transit network and procedures, it was possible to assess how well the "observed" RHTS travel patterns replicated traffic and transit counts, and to what extent there are sampling or other biases in these targets. As a result of this analysis further adjustments of these core model parameters were made as the RHTS targets were "relaxed" and model demand loaded on to the highway and transit networks were further calibrated to counts.

I. American Community Survey (ACS) 2006-2010

The journey-to-work information is taken from the 5-year 2006-2010 ACS tabulations, available through the Census Transportation Planning Products (CTPP) package as home-to-work flows. Specifically, table A302103 (Means of transportation to work) has been used to create tabulations for comparison with the NYBPM 2010.

It is important to note that a multi-level balancing and weighting procedure was applied, that in addition to adjusting the sample for key household and individual characteristics, also included controlling for journey to usual work place patterns taken from American Community Survey (ACS) 2010 One Year PUMS data. These data are also used to validate the model mode and general OD pattern for work travel (see Appendix B).

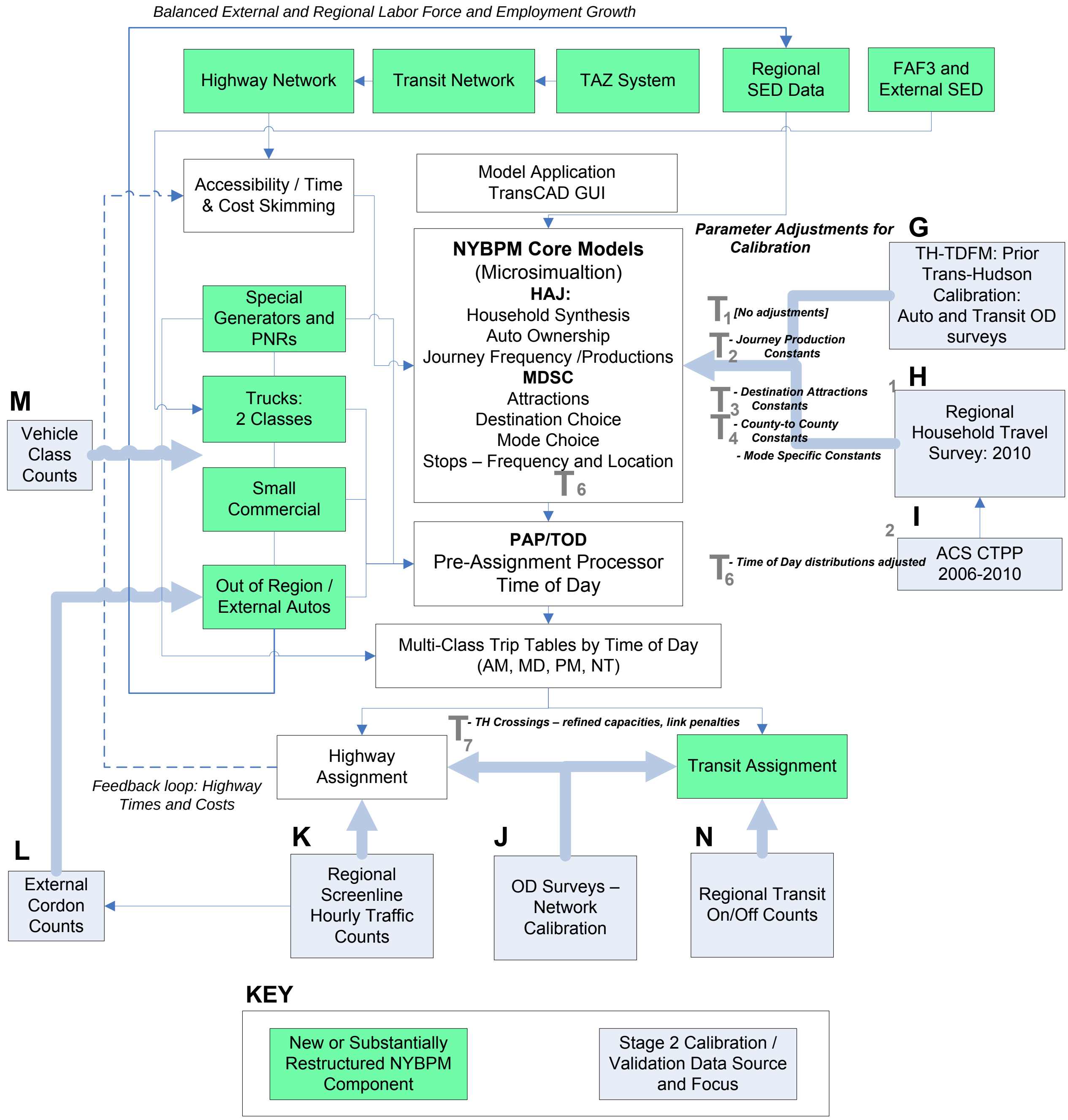


Figure 7-2: Stage 2 NYBPM 2010 Update Calibration Data and Focus

J. Updated Synthetic Transit OD Surveys for Network and Assignment Calibration

The Stage 1 results of the validation and calibration of the transit network focused on WOH were carried over as the starting point for the transit network and calibration in the NYBPM 2010 Update. Stage 2 focused on the East of Hudson (EOH) calibration, performed as a part of Task Order J, in order to complete a similar level of transit network validation and calibration for the NYBPM 2010. This used the same process, featuring a transit OD survey-based assignment calibration methodology, as described in the following sections, while also allowing for the migration to the new and expanded Tier 1.2 TAZ system used in the NYBPM 2010 Update model.

An updated set of transit OD Surveys was used for a transit network and assignment calibration focused in Stage 2 East of the Hudson River (EHR).

This regional transit survey database consists of the following elements:

- 2002 PANYNJ Interstate Bus Survey
- 2005 NJT On-Board Rail Survey
- 2007 PATH On-Board Rail Survey
- 2007 NJ Hudson-Bergen LRT Survey
- 1998 PANYNJ Ferry Survey (scaled to 2005 using counts by ferry service)
- Late 1990's NJT Local Bus Surveys (scaled to 2005 using NJT counts)
- 2007 Metro-North On-Board OD Survey
- 2006 LIRR On-Board OD Survey
- 2008 MTA RTFM Estimates of East of Hudson Subway/Bus Trips

K. Regional Screeneline Traffic Count Database – 2010 Update

Three Levels of Screenlines: Hourly directional traffic counts representing all vehicles were developed with actual or estimated volume for 2,257 BPM highway network links that comprise the screenline database were selected to according to a three-level hierarchy of cutlines reflecting their significance for regional model calibration and analysis

- Priority 1: County Borders - screenlines have the highest significance capturing county-to-county travel flows (347 links)
- Priority 2: Intra-County Quadrants / Major – subdividing each county in quadrants (932 links)
- Priority 3: Sub-Quadrant /Minor– further subdividing screenlines (e.g., within county screenlines reflecting local travel patterns) have the lowest significance, in terms of regional analysis (978 links).

L. External Cordon Traffic Count Database – 2010 Update

This is an extract of the traffic counts from the Screenline database for the 111 links that represent the external crossing stations.

M. Vehicle Classification Count Database – 2010 Update

Approximately 300 truck counts were available in the screenline database throughout the New York counties of the NYBPM model area, some of which distinguish either by number of axles or by single-unit and multi-unit trucks. These were supplemented in CT and NJ with Weigh-in-Motion data at approximately 80 locations.

N. Regional Transit Counts Database – 2010 Update

For use in validating and calibrating the NYBPM 2010 Update model, transit counts were collected and updated in Task 5. The counts for the year 2010 assembled and processed as part of the NYBPM 2010 Update project include:

- Hub-bound CBD cordon counts by general transit mode – Typical Weekday and AM Peak period
- AM Peak Period Ridership By Station/Cordon Location: Summary Level - Commuter Rail, Ferries, and Trans-Hudson Bus
- Average Annual Weekday Ridership – Hourly – Bus Boardings (NYC Transit)
- Average Annual Weekday Ridership – Hourly – Subway Entries (NYC Transit)
- October Weekday 2010 Subway Station to Station Flows – Hourly

7.5 BASE YEAR TRAVEL DEMAND MODEL CALIBRATION AND VALIDATION

In each stage of development of the NYBPM 2010 Update, the calibration process focused on making adjustments to model inputs, networks and parameters, specifically utility constants) in order to achieve a reasonable replication of observed or otherwise estimated base year travel – total (all modes) O-D trip flows, mode shares, transit ridership and roadway volumes.

In Stage 1, focused on Trans-Hudson travel, an aggregation scheme of 12 sub-regions was used as shown in **Table 7-1** below for the reporting and calibration of the TH-TDFM, and a 12 x12 sub-region-to-sub-region Origin-Destination framework for which additional calibration constants adjustments were made, “on top” of the values calibrated based on the general 11 x 11 scheme used for the NYBPM 2010 Update.

Table 7-1: Sub-Regional Analysis Framework for Calibration of Trans-Hudson Travel – Stage 1

West of Hudson River: WHR

1. P-NJ– Primary Trans-Hudson New Jersey
2. O-NJ - Other New Jersey
3. W-NY– New York (Rockland, Orange)

East of Hudson River: EHR

4. Uptown Manhattan
5. CBD: Midtown
6. CBD: Lower and Valley
7. Bronx
8. Brooklyn & Queens
9. Staten Island
10. Long Island (Nassau, Suffolk)
11. Other NY (Westchester, Putnam, Dutchess)
12. Connecticut (New Haven, Fairfield)

For the full regional level calibration done in Stage 2 the sub-regional scheme modified and expanded as shown in the table below:

Table 7-2: Sub-Regional Analysis Framework for Calibration of Trans-Hudson Travel - Stage 2

1. Manhattan – Downtown
2. Manhattan – Valley
3. Manhattan - Midtown
4. Manhattan - Uptown
5. Bronx
6. Queens
7. Brooklyn
8. Staten Island
9. Nassau
10. Suffolk
11. Westchester
12. Other EHR-NY
13. Connecticut
14. Primary NJ
15. Other NJ
16. Other WHR (NY)

These are the OD basis used to compare model outputs with validation data sources as documented in **Appendix B.**

In each of the three stages of the NYBPM 2010 Update calibration, the calibration process was essentially sequential in which preliminary model outputs for each of the core models are compared to the calibration targets estimates, with adjustments to the utility constants of the logit probability model corresponding to each stage are adjusted to improve the match:

- Tour-production / attractions (HAJ)
- Destination Choice (OD)
- Mode Choice
- Stop Choice
- Time of Day

In addition to the data sources applied, **Figure 7-2** shows the specific *model parameter adjustments*, at each stage in the model, and the source of the observed travel data targets used. The model parameter files that implement these changes are located in the model folder (0_BPM) \ 0_SETUP \ 2_LUT\. The final set of model parameter adjustments (utility constants) are documented in **Appendix A**.

The specific sub-folder location and file name for each set are also noted in the discussion below:

T.1 Model Parameter Adjustments – HAJ: Household Synthesis and Auto Ownership

No adjustments to the NYBPM set.

T.2 Model Parameter Adjustments – HAJ: Journey Production

These are scaling factors, applied by county of residence and by travel purpose, to the production of travel in the Journey Frequency model that is part of HAJ. These adjust the magnitude of daily travel produced, with county-level adjustments made where warranted.

A comprehensive adjustment of these production factors was done in Stage 2, initially adjusting county level productions by travel purpose to target values derived from the RTHS 2010. The factors in NJ were held were held constant, however, with the values calibrated in Stage 1 held constant aiming to maintain the Stage 1 calibration of Trans-Hudson travel. Further adjustments of the production factors were done with as the subsequent iterative analysis of highway and transit assignment volumes were compared to counts.

\ 0_SETUP \ 2_LUT\1_HAJ \ HAJ_JFAC4.txt .

T.3 Model Parameter Adjustments – MDSC: Destination Attractions

These are scaling factors, applied by county of destination and by travel purpose, to the attraction of trips (primary destination of journeys) production of travel in the Mode, Destination, and Stops (MDSC). These adjust the magnitude of daily journeys made to a county.

\ 0_SETUP \ 2_LUT\2_MDSC \ ATT_CORR_1,2,3 .. 8.txt

T.4 Model Parameter Adjustments – MDSC: Origin to Destination (County to County)

These are county-to-county constants, added to the utilities used in the Destination Choice model (within MDSC) that adjust the magnitude of modeled daily travel between county pairs. Sometimes referred to as K factors, these shape the OD distribution of travel, or the "person trip" tables (by purpose). This step in the calibration of the NYBPM calibration was done using developed semi-automated approach, in which model Trans-Hudson person trip flows were compared to the NJ Transit survey-based estimates.

In Stage 2, the calibration of county to county coefficients was initially done against mode share targets at the 16 district level defined as in Table 7 2 developed from the updated RHTS 2010. All interchanges between NJ and NY/CT, and within NJ held were held constant however, with the values calibrated in Stage 1 held constant. Further adjustments of selected county to county interchanges were done with as the subsequent iterative analysis of highway and transit assignment volumes were compared to counts.

\ 0_SETUP \ 2_LUT\2_MDSC \ CC1(2,3 .. 8)_X.csv

T.5 Model Parameter Adjustments – <u>MDSC: Mode Choice – Trans-Hudson (12 x 12 subregions)</u>

These are constants, added to the utilities used in the Mode model (within MDSC) that can be used to adjust the modeled daily journey mode shares for any of the 12 special TH-TDFM sub-regional OD pairs described in Table 7 1. This step in the Stage 1 was done using the auto calibration iterative procedures of the NYBPM.

In Stage 2, auto calibration of the mode specific constants was initially done against the update RHTS 2010 mode share targets at the 16 district level defined as in Table 7 2, but with all interchanges between NJ and NY/CT, and within NJ held constant as calibrated in Stage 1. Further adjustments of selected county to county interchanges were done with as the subsequent iterative analysis of highway and transit assignment volumes were compared to counts.

\ 0_SETUP \ 2_LUT\2_MDSC \ M-INDICES_1,2,3 ..8.csv – Definition of OD geography

\ 0_SETUP \ 2_LUT\2_MDSC \ M-TARGETS_1,2,3 ..8.csv – Target Shares for Auto Calibration

\ 0_SETUP \ 2_LUT\2_MDSC \ M-MSCS_1,2,3 ..8.csv – Mode Specific Constants

T.6 Model Parameter Adjustments – PAP/TOD: Time of Day Distributions

In the TOD component of the NYBPM and TH-TDFM, survey-based diurnal distributions, or "time maps," are applied to allocate the daily modeled OD flows by mode to the 4 time of day periods assigned to the highway and transit networks. Based on the OD crossing volumes counts by time period and by crossing, new time maps for specific Trans-Hudson travel sub-markets were estimated and added to the TOD model.

\ 0_SETUP \ 2_LUT\3_PAP \ TOD_FACTORS4.ASC – Time Maps, Diurnal Distributions

T.7 Model Parameter Adjustments – Highway ASSIGN: Capacities and Free Flow Speeds – PA Crossings

In Stage 2, additional targeted specific speed (free flow) adjustments were made at regional crossings in the East River, Bronx-Manhattan, and the Mid-Hudson sectors to improve balancing of traffic volumes by individual crossings in these corridors.

7.6 LOG OF CALIBRATION TESTS AND MODEL RUNS

A detailed log that generally documents and chronicles the series of 102 model runs and adjustments that were made as part of the calibration process in Stage 2 of the NYBPM 2010 Update calibration is found in **Appendix D.** These document incremental adjustments in model parameters tested and adopted leading to the final base year calibration of the model. Similar logs were maintained for the 36 tests and calibration runs done as part of Stage 1A, and the 35 additional model runs were conducted as part of Stage 1B.

7.7 CALIBRATION AND VALIDATION RESULTS

The validation results for the updated and re-calibrated NYBPM 2010 are reported in this section of the report with respect to three general categories of evaluation:

- NYBPM Core Choice Models
- Highway Assignment Results
- Transit – flows across Hub-Bound Sectors

7.7.1 CORE CHOICE MODELS

A full set of validation reports can be found in **Appendix B**. The validation reports are included for the following data-

1. *ACS2010* – American Community Survey 2006-2010 5-year data
2. *RHTS2010*- NYMTC Regional Travel - Household Interview Surveyed 2010 - with Household Expansion (per ACS and GPS Correction)
3. *TRANSITOD* – Composite Survey and Other Transit OD – AM period
4. *NYBPM2005* – BPM Update 2005 – Calibration G15C(4) – prior Update
5. *NYBPM2010* – BPM Update 2010 – Final Calibration (October 2014)

The reports are prepared to allow for the comparison of the various core model component base year outputs at journey and trip level, whichever is applicable. The employed labor force and total employment between 2005 and 2010 base years are also compared. **Table 7-3** lists and components and segmentation scheme of the summary reports all found in **Appendix B**.

Table 7-3: Listing of the Calibration/Validation Reports

Section	Component		Geography	Table	Units / Measures	Validation Data Compared
D1	SED		16 Districts		ELF EMPTOT Diff	NYBPM2005, **NYBPM2010**
D2	HAJ / MDSC		31 Districts | 16 Districts	by BPM Purpose (8)	P's A's Diff	RHTS2010, NYBPM2005, **NYBPM2010**
D3	DEST	a	16 x 16 | 7 x 7	by BPM Purpose (8)	Out-bound Journeys - O x D	RHTS2010, NYBPM2005, **NYBPM2010**
		b	16 x 16 | 7 x 7	by BPM Work (All)	Out-bound Journeys - O x D	ACS2010, RHTS2010, NYBPM2005, **NYBPM2010**
		c	16 x 16 | 7 x 7	By Mode	Trips (all)	
				Auto		RHTS2010, NYBPM2005, **NYBPM2010**
				Transit		TRANSITOD (AM period only)
D4	MODE	a	16 x 16 | 7 x 7	by BPM Mode Group (4) by Purpose (8)	Out-bound Journeys - O x D	RHTS2010, NYBPM2005, **NYBPM2010**
				All Modes Auto Commuter Rail Transit Non-Motorized		
		b		by BPM Mode Group (4) - Work only	Out-bound Journeys - O x D	ACS2010, RHTS2010, NYBPM2005, **NYBPM2010**
D5	MODE: Trips		16 x 16 | 7 x 7	by TOD (4 Periods), Weekday	Trips (all) - Vehicle	RHTS2010, NYBPM2005, **NYBPM2010**
				Auto Commuter Rail Transit		
D6	Link Volumes		Major Crossings	by TOD (4 Periods), Weekday	Volumes - all vehicles	RHTS2010, NYBPM2005, **NYBPM2010**
				Auto	Compared to Counts	
D7	Transit: Trips		Hub-Bound	Weekday Total	Transit trips entering CBD	TRANSITOD, RHTS2010, NYBPM2005, **NYBPM2010**
				Commuter Rail Transit	Compared to Counts	

7.7.2 Highway Assignment Validation

The calibration results presented in this section summarize the NYBPM validation results for the highway assignments for the NYBPM 2010 Update and Re-Calibration. These are presented with respect to the acceptability and validation criteria that were developed for the Air Quality Inter-Agency Consultation Group (AQICG) developed for the original NYBPM Base Year 1996, in conjunction with the Project Advisory Committee (PAC), primarily based on criteria from published FHWA guidelines.

The evaluations of the NYBPM assignments with respect to traffic counts are based on comparison of model volume flows with respect to the updated set of regional Year 2010 screenline counts that are described in **Section 4.2**.

The results in the following tables in this section are summarized at several different levels of aggregation, including:

- *All network links* - 60,000 with centroid connector links excluded. Note that while there is complete representation of principal roadways in the NYBPM network (Major Arterials and above), the some minor arterials are not represented, and only a small portion of collectors, and local streets are included.
- *Screenline Data* – the three tier system of cutlines in the NY 12-county area, for which a database of actual and synthesized, hourly by direction, but without vehicle classification counts – 2,257 links in the NYBPM highway network in the updated 2010 screenline database.
- *Inter-County Screenlines* – the first tier of Screenline database counts on all roads crossing county boundaries.
- *Major River Crossings* – for each bridge and tunnel connecting New York and New Jersey (Interstate crossings), as well all Manhattan crossings and upper Hudson River bridges in the modeled region.

In the following set of tables, measures of the model volume / count deviation are shown using standard FHWA criteria. The measures of validations are shown for road classifications listed above, and by Volume Group and Functional Class group.

For the use of NYBPM model in Conformity Analysis, model base year volumes are compared to the best available traffic counts (Screenline count database), and goodness-of-fit statistics are reviewed, focusing at the County by Functional Class group level, and looking at average and RMSE volume-to-count deviations. As shown in Figure **Figure 7-4**, the difference in modeled daily two-way flows and counts for weekday county screenlines is within ±5% for New York City Boroughs, Nassau and Westchester. To put this in perspective, the results of the assigning the RHTS survey (with the same base year model truck, CMV and externals included) directly are also shown in **Figure 7-3** for comparison. It can be seen that there are substantial biases in the RHTS used for approximate targets for the core models, that the final calibration to counts process overcame to arrive at much better fit these inter-county screenline volumes. **Table 7-4** and **Table 7-5** provided tabulations of the inter-county screenline measures, including by time period.

As shown in **Table 7-6**, The flow to count deviation is within FHWA Desirable Deviation Range and is least for the higher volume groups, and higher functional class groups (**Table 7-7).** This is the primary focus for assessing the acceptability of the model for mobile source emissions analysis, where the essential NYBPM inputs to the AQ analysis are similarly aggregated link VMT, along with average speeds that are subsequently developed with the post-processing procedures.

The volumes for the major regional crossings are also considered, especially for the bridges and tunnels that connect Manhattan Island to the other NYC boroughs and New Jersey, given the huge influence Manhattan has on regional travel patterns. **Table 7-8** compares the model assigned weekday two-way traffic to counts by major crossing groups. Total model volumes at all major crossings are within 2% of counts. Model traffic assignment results for the individual crossings that comprise the East River cordon that is within 1% of counts overall, are shown in Figure **7-5**, substantially improved over the 2005 Update results. Table 7-9 provides a breakdown of the East River crossings by toll and non-tolled facilities, showing that the free bridges are somewhat over assigned (_6%). Results for individual crossing in other crossing groups that represent regional cordons are shown in **Figure 7-6** Mid-Hudson, **Figure 7-7** Hudson River (PANYNJ), and **Figure 7-8** Staten Island Bridges. The results for 2010 are generally improved or similar to 2005, particularly for the "core" area Manhattan crossings that comprise about 85% of the total traffic counted on all regional crossing tunnels, within 2% of counts overall, and most major crossings less than 5% deviation from counts. In both base years, however, there exists an overall over assignment in the southern SIB corridor, and an under-assignment for the northern Mid- Hudson bridge, of about 15% overall. Both of these cases could be addressed in the framework of ongoing regional model improvement with further work and resources, but neither is considered problematic at this point for the requirements of the more aggregate-based regional mobile source emissions modeling that applied for NYTMC's Conformity Analysis.

In corridor transportation studies employing the NYBPM, the regionally calibrated NYBPM is used as the foundation for the travel forecasting done to support planning of transportation for the corridor. For these studies, substantial additional sub-area data and modeling resources are budgeted to implement refinements "on top" of the regional model, to improve details of the representation of the highway and transit systems, and of travel patterns within the study corridor, in order to achieve a level of calibration and validation needed for these specific studies. To substantially improve facility-level calibration properly, a thorough investigation of each potential source of distortion in the model needs to be done systematically as the more generalized regional model validation is done within the corridor they serve, focused on subarea zonal SED input data, the transit and highway networks, travel generation, OD distribution, mode choice, including external travel, and finally highway assignment.

Additional and more detailed highway validation results are also found in **Appendix B.**

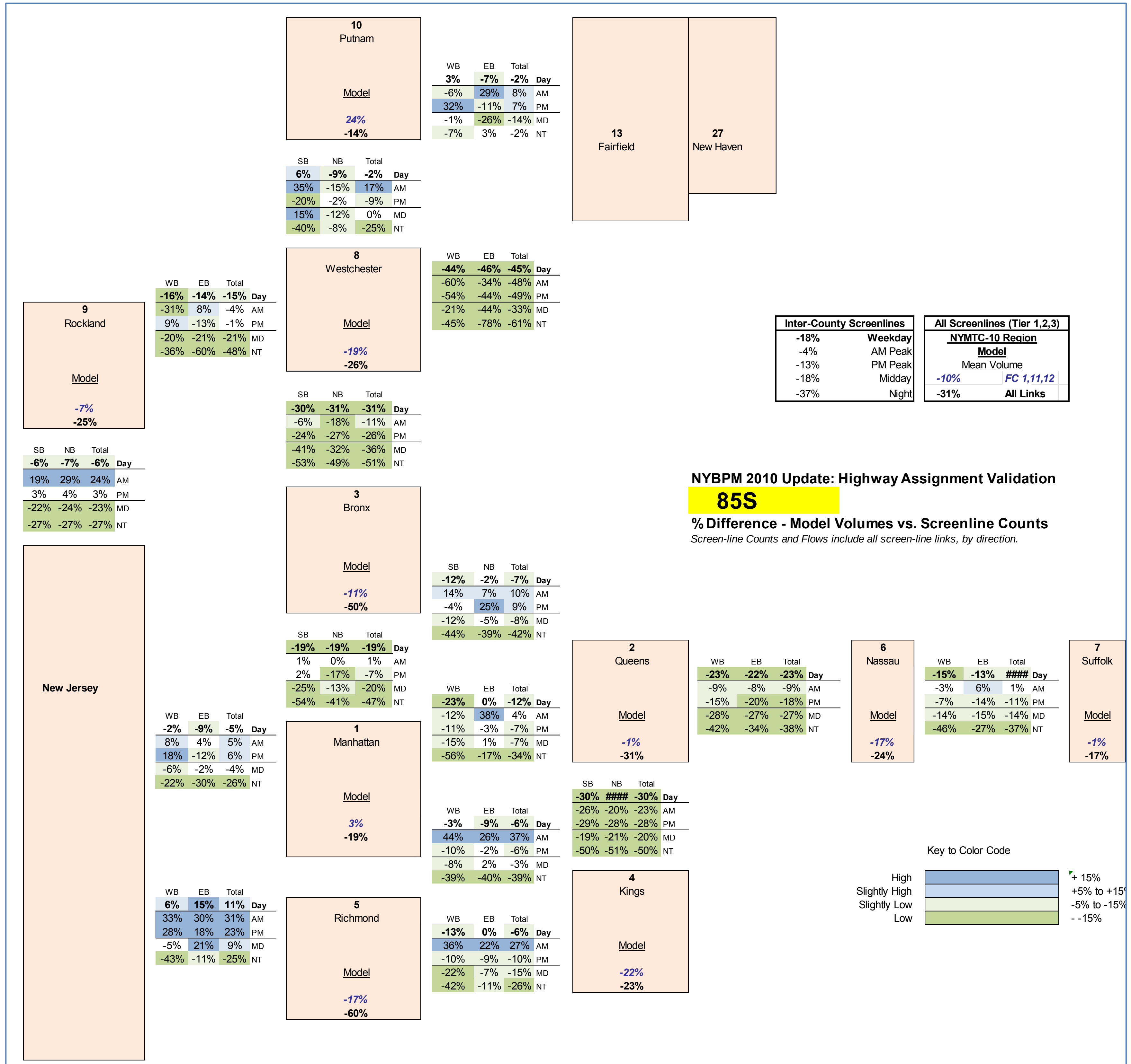


Figure 7-3: Inter-County Screenlines – Traffic Volumes: RHTS Assigned Compared to Counts

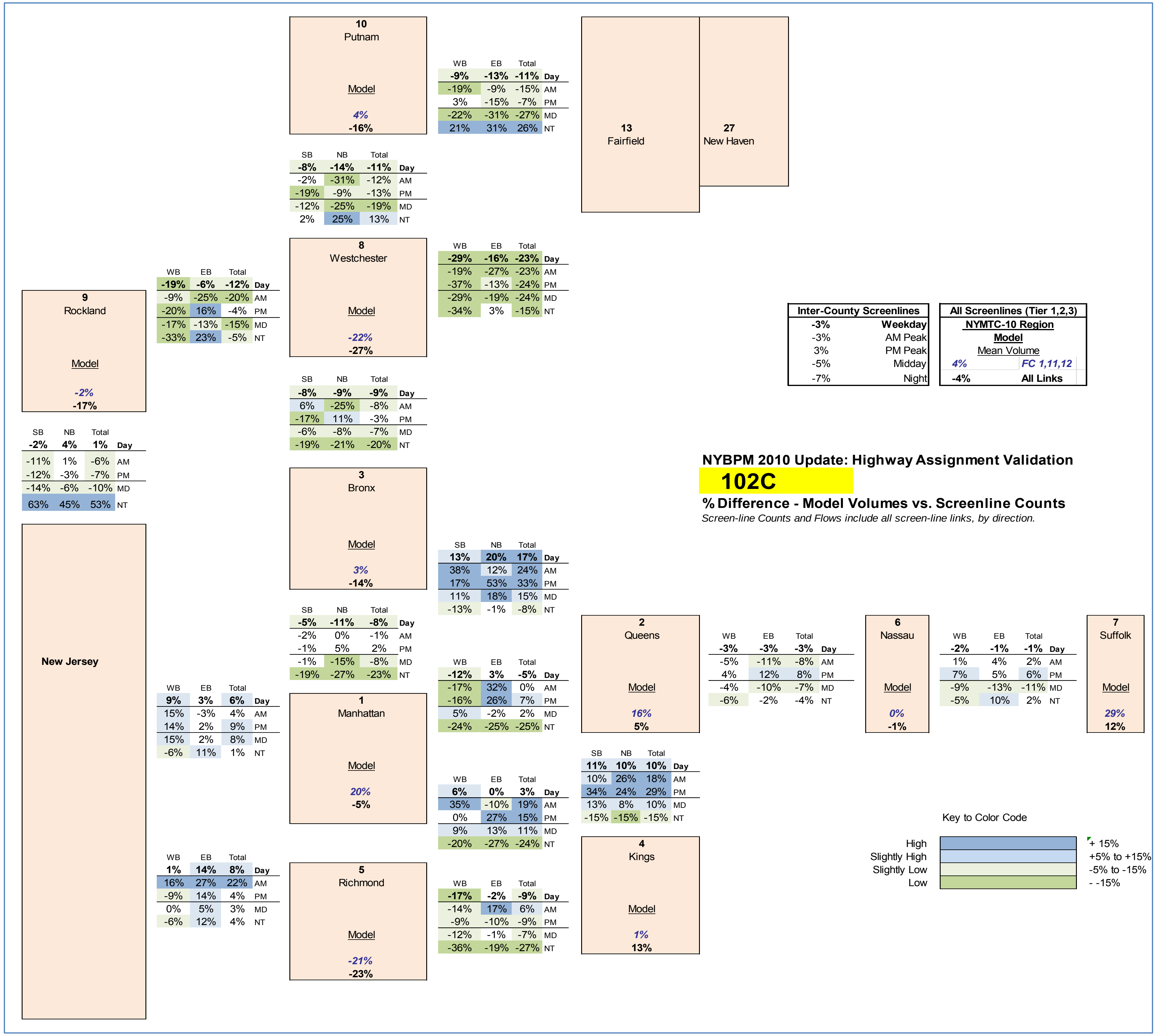


Figure 7-4: Inter-County Screenlines – Traffic Volumes: Model Compared to Counts

Table 7-4 County to County Flows: Inter-County Screenlines – Base / Model Calibration – 2010 Update

Inter-County Screen-line	Weekday				By Time Period: % Diff			
	Counts	Assigned	Difference	% Diff	AM	PM	MD	NT
Manhattan-Queens	333,635	318,396	-15,239	-5%	0%	7%	2%	-25%
Manhattan-Kings	363,871	375,602	11,731	3%	19%	15%	11%	-24%
Manhattan-Bronx	644,047	592,680	-51,367	-8%	-1%	2%	-8%	-23%
Manhattan - New Jersey	505,176	534,946	29,770	6%	4%	9%	8%	1%
Queens-Bronx	306,614	357,775	51,161	17%	24%	33%	15%	-8%
Queens-Nassau	1,132,740	1,098,885	-33,855	-3%	-8%	8%	-7%	-4%
Bronx-Westchester	757,377	690,724	-66,653	-9%	-8%	-3%	-7%	-20%
Kings-Queens	690,074	761,947	71,872	10%	18%	29%	10%	-15%
SI-Kings	204,809	186,922	-17,887	-9%	6%	-9%	-7%	-27%
SI-NJ	169,523	182,502	12,979	8%	22%	4%	3%	4%
Nassau-Suffolk	718,332	708,509	-9,823	-1%	2%	6%	-11%	2%
Westchester-Fairfield	213,454	165,270	-48,184	-23%	-23%	-24%	-24%	-15%
Westchester-Putnam	215,996	191,894	-24,102	-11%	-12%	-13%	-19%	13%
Rockland-Westchester	129,376	113,850	-15,526	-12%	-20%	-4%	-15%	-5%
Rockland-Orange	222,732	156,224	-66,508	-30%	-38%	-37%	-35%	9%
Rockland-NJ	317,545	321,202	3,657	1%	-6%	-7%	-10%	53%
Putnam-Fairfield	102,294	90,975	-11,319	-11%	-15%	-7%	-27%	26%
Putnam-Dutchess	149,348	113,109	-36,239	-24%	-26%	-22%	-27%	-21%
Orange-Westchester	18,318	27,748	9,430	51%	65%	29%	70%	28%
Orange-Dutchess	75,858	85,903	10,045	13%	-7%	32%	15%	24%
Orange-NJ	74,108	65,795	-8,313	-11%	-17%	-22%	-22%	30%
Orange-Other NY	145,188	145,688	500	0%	-35%	-14%	5%	72%
Dutchess-CT	27,207	12,777	-14,430	-53%	-69%	-61%	-58%	10%
Dutchess	91,507	72,107	-19,400	-21%	-52%	-33%	-13%	41%
Total	7,609,129	7,371,429	-237,700	-3%	-3%	2%	-5%	-7%

Table 7-5 County Summary: Inter-County Screenlines – Base / Model Calibration – 2010 Update

Screen-lines for Counties: Total To and From	Weekday				By Time Period: % Diff			
	Counts	Assigned	Difference	% Diff	AM	PM	MD	NT
1 Manhattan	1,846,729	1,821,624	-25,105	-1%	4%	7%	2%	-17%
2 Queens	2,463,063	2,537,003	73,940	3%	4%	17%	1%	-11%
3 Bronx	1,708,038	1,641,180	-66,858	-4%	1%	5%	-3%	-19%
4 Kings	1,258,754	1,324,471	65,717	5%	16%	18%	8%	-20%
5 Staten Island	374,332	369,425	-4,907	-1%	13%	-4%	-2%	-13%
6 Nassau	1,851,072	1,807,394	-43,678	-2%	-4%	7%	-9%	-2%
7 Suffolk	1,147,782	1,065,672	-82,110	-7%	-6%	-4%	-15%	1%
8 Westchester	1,257,179	1,102,396	-154,783	-12%	-15%	-9%	-13%	-13%
9 Rockland	569,187	525,285	-43,902	-8%	-13%	-11%	-17%	27%
10 Putnam	455,360	451,232	-4,127	-1%	-14%	-5%	-3%	35%
11 Orange	404,952	300,478	-104,474	-26%	-39%	-35%	-29%	21%
12 Dutchess	542,751	520,214	-22,537	-4%	-12%	-6%	-12%	27%

Table 7-6 Volume Group - 2010 Update Base / Model Calibration – All Screenline Links (only)

Volume Group	Scrn. Network Link	Daily Count	Daily BPM Flow	Difference	FHWA Desirable Deviation Range	BPM Deviation % Diff	% RMSE BPM from Est.
More than 80,000	54	91,642	86,644	-4,999		-5%	26%
70,000-79,999	64	74,659	71,708	-2,951	21%	-4%	34%
50,000-69,999	137	59,843	58,706	-1,136		-2%	39%
25,000-49,999	378	34,227	30,405	-3,822	22%	-11%	56%
10,000-24,999	784	15,930	14,186	-1,743	25%	-11%	69%
5,000-9,999	486	7,459	8,249	790	29%	11%	122%
2,500-4,999	216	3,698	5,295	1,597	36%	43%	226%
1,000-2,499	64	1,876	4,484	2,608	47%	139%	291%
Less than 1,000	29	577	5,870	5,293	60%	917%	1788%
Total / Average	2,212	21,660	20,586	-1,075		-5%	65%

Table 7-7 Functional Class – 2010 Base / Model Calibration – Screenlines (only) for the NYMTC 12 Region

Functional Class Group	Scrn. Network Link	Daily Count	Daily BPM Flow	Difference	FHWA Desirable Deviation Range	BPM Deviation % Diff	% RMSE BPM from Est.
1. FC 1,11,12	445	49,831	51,124	1,293	7%	3%	37%
2. FC 2,6,14,16	1455	16,096	14,429	-1,667	15%	-10%	86%
3. FC 7,8,9,17,19	256	6,991	4,724	-2,267	25%	-32%	98%
Total / Average	2,156	21,977	20,841	-1,136		-5%	65%

Table 7-8 BPM Major Crossing Cordon Summary - Modeled Volumes and Typical Weekday Counts – 2010 Update

Major Crossing Cordon Summary	% of total	Counts	Model Volumes	Deviation	%Diff
East River Crossings (inc. VNB) - NYC & MTA	33%	902,315	880,921	-21,394	-2.4%
Bronx- Manhattan Crossings	23%	619,212	585,258	-33,954	-5.5%
Hudson River Crossings - PANYNJ	19%	505,176	534,946	29,770	5.9%
Bronx- Queens Crossings - MTA	11%	306,614	357,775	51,161	16.7%
Mid-Hudson Bridges	8%	223,552	227,501	3,949	1.8%
Staten Island Bridges - PANYNJ	6%	169,523	182,502	12,979	7.7%
All Crossings	**100%**	**2,726,392**	**2,768,902**	**42,510**	**1.6%**

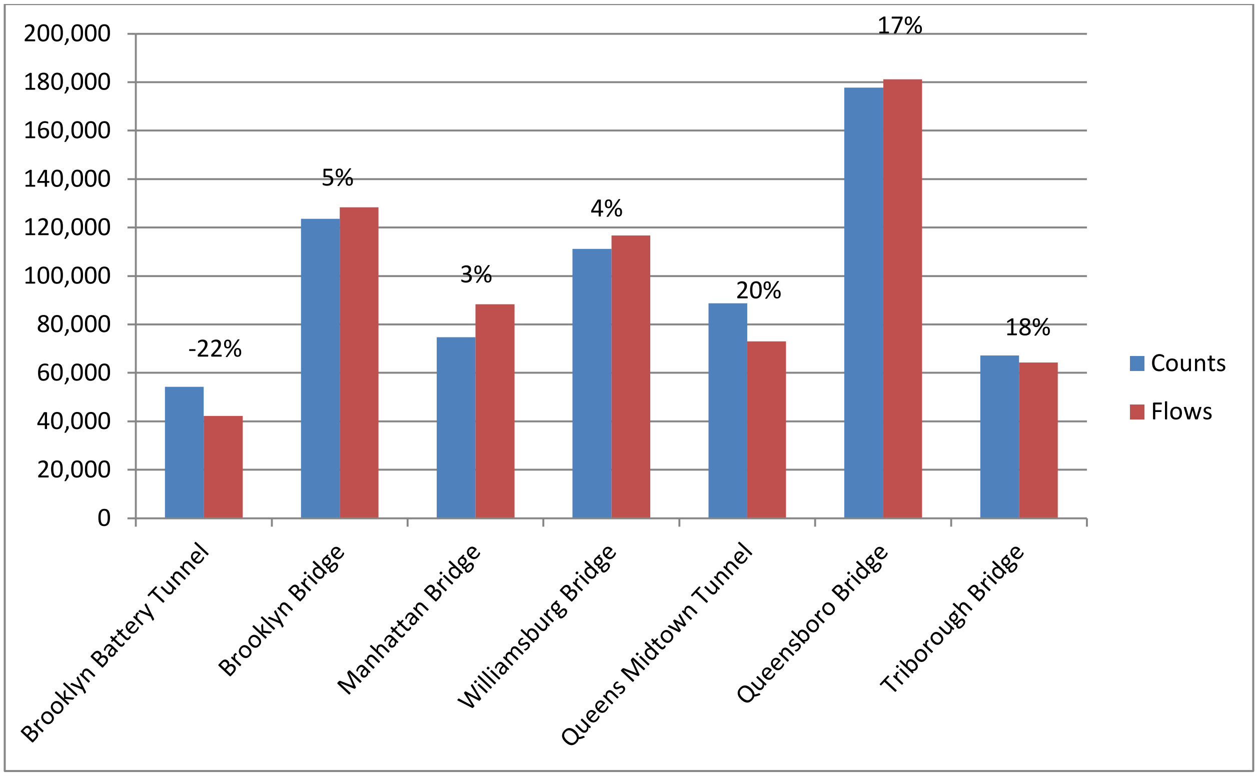


Figure 7-5 East River Crossings - Daily Model Volumes vs. Counts - 2010 Update

Table 7-9 East River Sector - Summary of Tolled and Free Crossings: 2010 Volume Deviations from Count

Free or Tolled Crossings	Weekday	By Time Periods			
		AM	Midday	PM	Night
All Crossings	-2%	9%	3%	6%	-25%
Tolled facilities*	-12%	2%	-7%	-12%	-33%
Free Bridges	6%	15%	13%	24%	-20%

* Includes Verrazano Bridge

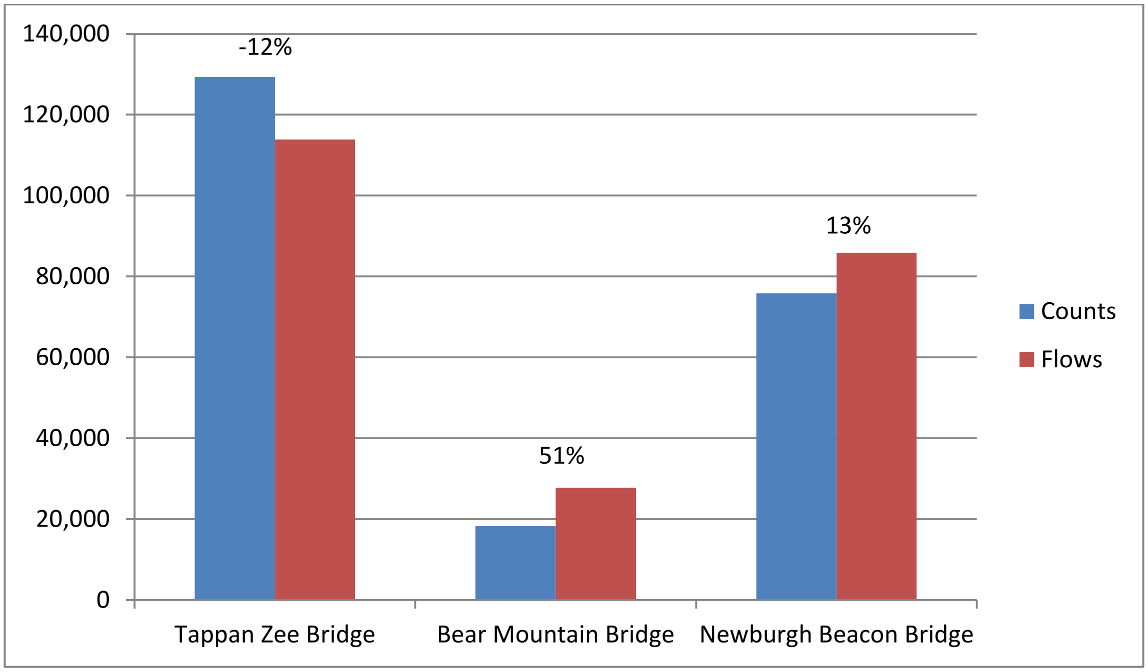


Figure 7-6 Mid-Hudson River Crossings - Daily Model Volumes vs. Counts - 2010 Update

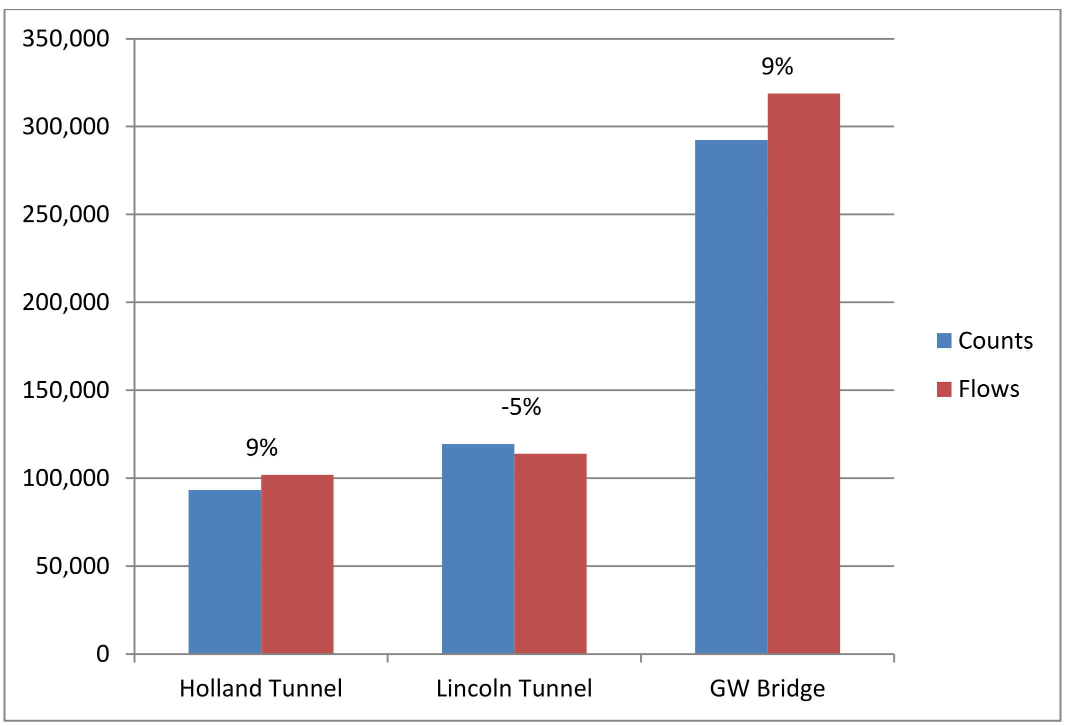


Figure 7-7 Hudson Crossings - Daily Model Volumes vs. Counts- 2010 Update

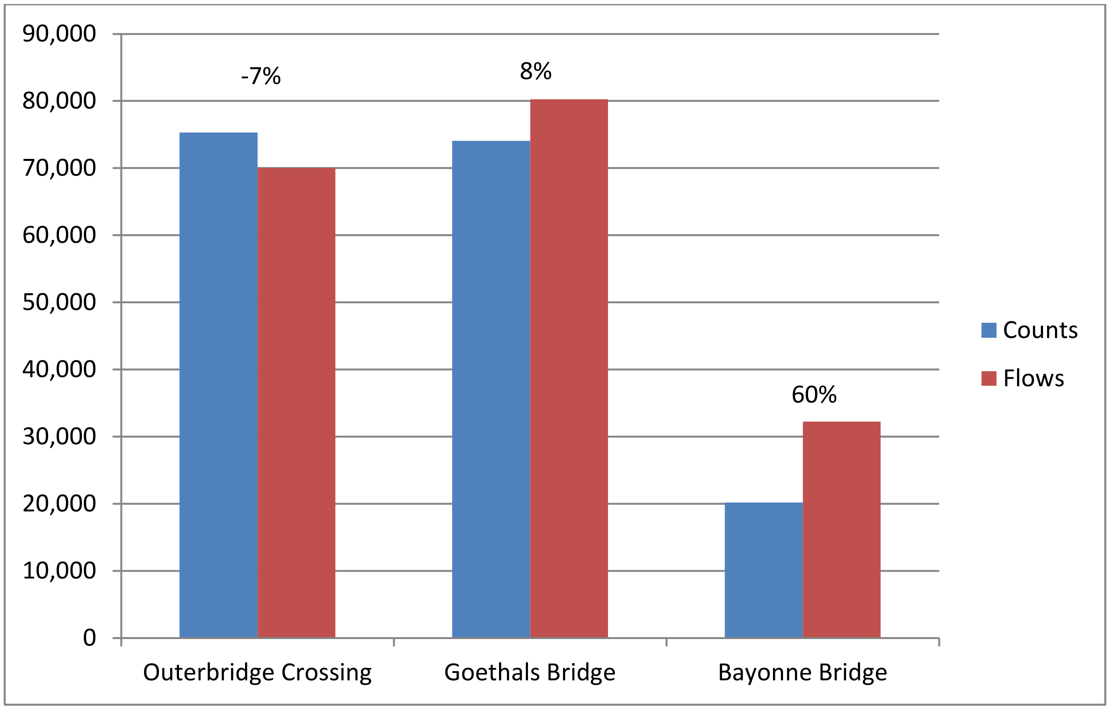


Figure 7-8 Staten Island Crossings - Daily Model Volumes vs. Counts - 2010 Update

7.7.3 Transit Validation

While the NYBPM model transit demand for all four periods of the weekday, the assignment procedures for transit, however, are for the AM 4 hour peak period only. It is possible to compare the NYBPM daily demand estimates with respect to weekday total Hub-Bound transit counts, as shown in **Figure 7-9** and **Table 7-11**. The NYBPM transit volumes in these exhibits are CBD cordon crossings estimates that are approximated from county-to-county modeled transit trip tables for all four time periods combined. It is important to note that due to the hierarchical structure of modes in the NYBPM, commuter rail trips that transfer to subway or bus to enter the CBD are accounted for in the model number as Commuter Rail, while they are included in Other Transit in the counts. As a benchmark, the results of assigning the composite set of transit OD surveys discussed in Section 7.4 as used for transit network and assignment calibration, are shown in **Table 7-10.**

The results of assigning the 6-10 AM model transit trip tables and comparing the results to counts are found in the remaining exhibits in this section. Both the results of the assigning the RHTS transit survey records, and the assignment of the NYBPM 2010 Update model (102C) are reported. The survey-based and the model assignment results for On and Offs for major commuter rail, and transit terminals are shown in **Table 7-12** and **Table 7-13**, respectively.

A summary of assigned subway boardings and alightings by NYC borough compared to NYCT subway counts are reported in **Table 7-14** and **Table 7-15** for both the composite OD transit surveys and the NYBPM 2010 Update model, respectively. The results of the transit assignment for both the survey and the model are broken down by subway Branch in **Table 7-16** and **Table 7-17** as well. A comparison of the NYBPM 2010 Update bus assignment results with NYCT 6-10 am bus count boardings is found in **Table 7-18**.

In general, the additional effort made as part of the NYBPM 2010 Update and parallel model improvement tasks has resulted in an improved representation of transit in the regional model. Further calibration of the NYBPM for AM peak period transit assignment would involve review and possible adjustment to the time-of-day factors that allocate daily transit trips to the morning peak period assigned, as well as additional detailed checking of the route system coding, assignment parameters, and capacity factors.

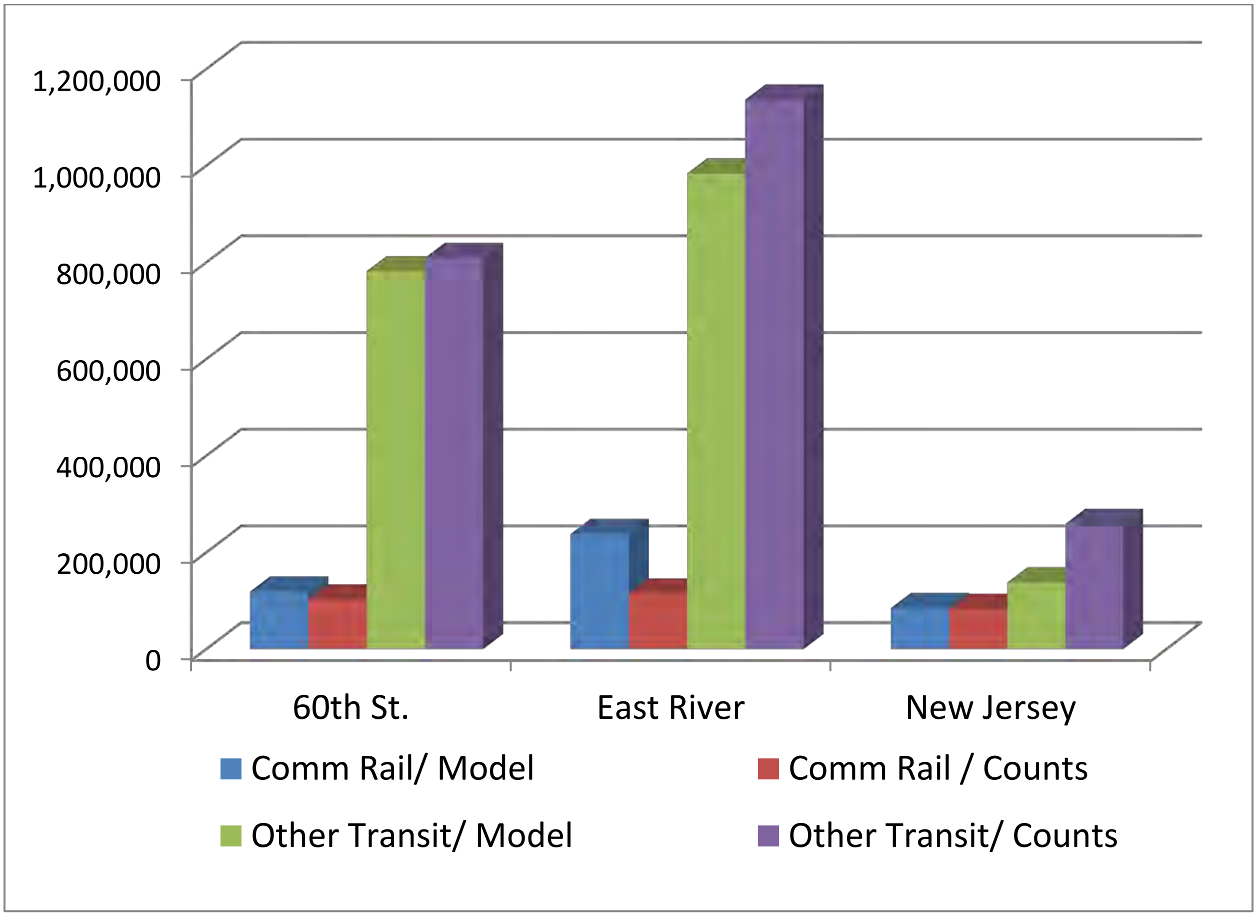


Figure 7-9: NYBPM 2010 Transit Validation – Three Sectors Hub-Bound Sectors - 2010 Update

Table 7-10 RHTS 2010 Transit Assignment – to Hub-Bound Counts

Scenario: RHTS2010 - Run 85S

Hub-Bound 2010 - Weekday Inbound

Note: NYBPM CBD cordon crossing are estimated from county-to-county transit trip tables and commuter rail trips that transfer to subway or bus to enter the CBD are accounted for in the NYBPM number as Commuter Rail, while included in Other Transit in the counts

Total - All Transit

Sector		NYBPM Trips	Counts 2010	Difference	% Diff
60th St.	1	895,092	910,418	-15,326	-2%
East River	2	1,343,490	1,367,971	-24,481	-2%
New Jersey	3	336,490	411,546	-75,056	-18%
		2,575,071	**2,689,935**	**-114,864**	**-4%**

Commuter Rail (only) *

Sector		NYBPM Trips	Counts 2010	Difference	% Diff
60th St.	1	139,212	102,710	36,502	36%
East River	2	196,900	114,566	82,334	72%
New Jersey	3	107,795	82,890	24,905	30%
		443,907	**300,166**	**143,741**	**48%**

Other Transit: Bus, Subway, Ferries, LRT, etc.

Sector		NYBPM Trips	Counts 2010	Difference	% Diff
60th St.	1	755,880	808,817	-52,937	-7%
East River	2	1,146,590	1,136,166	10,424	1%
New Jersey	3	228,695	258,895	-30,200	-12%
		2,131,164	**2,203,878**	**-72,714**	**-3%**

**NOTE: BPM Commuter Rail includes trips that used CR but enter the Hub by Subway or PATH.*

Table 7-11: NYBPM 2010 Update Transit Validation – to Hub-Bound Counts

Scenario: NYBPM2010 - Run 102C

Hub-Bound 2010 - Weekday Inbound

Note: NYBPM CBD cordon crossing are estimated from county-to-county transit trip tables and commuter rail trips that transfer to subway or bus to enter the CBD are accounted for in the NYBPM number as Commuter Rail, while included in Other Transit in the counts

Total - All Transit

Sector		NYBPM Trips	Counts 2010	Difference	% Diff
60th St.	1	900,241	910,418	-10,177	-1%
East River	2	1,221,425	1,367,971	-146,546	-11%
New Jersey	3	222,295	411,546	-189,251	-46%
		2,343,961	**2,689,935**	**-345,974**	**-13%**

Commuter Rail (only) *

Sector		NYBPM Trips	Counts 2010	Difference	% Diff
60th St.	1	118,710	102,710	16,000	16%
East River	2	237,851	114,566	123,285	108%
New Jersey	3	84,620	82,890	1,730	2%
		441,181	**300,166**	**141,015**	**47%**

Other Transit: Bus, Subway, Ferries, LRT, etc.

Sector		NYBPM Trips	Counts 2010	Difference	% Diff
60th St.	1	781,531	808,817	-27,286	-3%
East River	2	983,574	1,136,166	-152,592	-13%
New Jersey	3	137,675	258,895	-121,220	-47%
		1,902,780	**2,203,878**	**-301,098**	**-14%**

**NOTE: BPM Commuter Rail includes trips that used CR but enter the Hub by Subway or PATH.*

Table 7-12: Major Rail and Terminals Summary – Transit Assignment Report (Congested) – RHTS

9_1B - Transit Assignment Report - Congested Summary		**85S - RHTS**
AM Peak Period Ridership By Station/Cordon Location	compared to:	**Survey Based Counts ***

Node Station	Counts		Model		# Difference (Model - Counts)		% Difference (Diff / Counts)	
	Survey Based Counts *		BPM Assignment 85S - RHTS					
	Ons	Offs	Ons	Offs	Ons	Offs	Ons	Offs
NJT Commuter Rail								
TOTAL Port Jervis/Main/Bergen County	9,770	279	9,358	5,588	(412)	5,309	-4%	1903%
TOTAL Pascack	3,018	85	6,980	713	3,962	628	131%	738%
NEWARK BROAD ST	402	796	1,889	5,837	1,487	5,041	370%	633%
TOTAL Morris & Essex	18,474	1,753	16,717	6,367	(1,757)	4,614	-10%	263%
TOTAL Raritan	6,945	163	17,439	2,171	10,494	2,008	151%	1232%
TOTAL NJC/NEC	42,442	3,251	33,373	4,754	(9,069)	1,503	-21%	46%
NJT Terminal Stations								
Secaucus (MAIN)	396	2,490	0	3,328	(396)	838	-100%	34%
Secaucus (NEC/NJC/M&E)	3,207	396	10,037	673	6,830	277	213%	70%
Secaucus (BRG/PAS)	0	629	0	6,549	0	5,920		941%
Secaucus Subtotal	3,603	3,515	10,037	10,550	6,434	7,035	179%	200%
Newark Penn Station (NJT)	4,199	15,322	7,280	31,877	3,081	16,555	73%	108%
Hoboken (NJT)	0	16,579	5,726	10,110	5,726	(6,469)		-39%
New York Penn Station (NJT)	**0**	**50,966**	**1,881**	**41,827**	**1,881**	**(9,139)**		**-18%**
Total Terminal Stations	7,802	**86,382**	24,923	**94,364**	17,121	**7,982**	219%	**9%**
NJT Rail without Terminal Stations	**84,161**	**5,631**	**86,563**	**19,897**	**2,402**	**14,266**	**3%**	**253%**
NJT Rail with Terminal Stations	**91,963**	**92,013**	**111,487**	**114,261**	**19,524**	**22,248**	**21%**	**24%**
PATH								
33rd St Line								
33rd St	2,534	10,746	2,631	9,386	97	(1,360)	4%	-13%
23rd St	297	3,547	256	5,187	(41)	1,640	-14%	46%
14th St	446	3,071	0	2,203	(446)	(868)	-100%	-28%
9th St	246	1,498	1,978	1,935	1,732	437	704%	29%
Christopher St	309	1,374	1,774	1,423	1,465	49	474%	4%
33rd St Line Subtotal	**3,832**	**20,236**	**6,639**	**20,133**	**2,807**	**(103)**	**73%**	**-1%**
WTC	**7,726**	**41,404**	**14,674**	**42,864**	**6,948**	**1,460**	**90%**	**4%**
New Jersey								
Hoboken	23,434	1,035	18,118	1,603	(5,316)	568	-23%	55%
Pavonia/Newport	3,391	2,061	10,407	3,692	7,016	1,631	207%	79%
Exchange Place	1,863	6,462	5,666	22,039	3,803	15,577	204%	241%
Grove St	6,036	1,448	6,038	1,541	2	93	0%	6%
Journal Square	12,648	2,446	7,643	6,192	(5,005)	3,746	-40%	153%
Harrison	3,895	496	1,651	0	(2,244)	(496)	-58%	-100%
NEWARK PENN STATION	18,785	3,194	32,147	4,920	13,362	1,726	71%	54%

9_1B - Transit Assignment Report - Congested Summary
AM Peak Period Ridership By Station/Cordon Location

compared to:

85S - RHTS

Survey Based Counts *

Node	Station	Counts		Model		# Difference (Model - Counts)		% Difference (Diff / Counts)	
		Survey Based Counts *		BPM Assignment 85S - RHTS					
		Ons	Offs	Ons	Offs	Ons	Offs	Ons	Offs
	Subtotal	**70,052**	**17,142**	**81,670**	**39,987**	**11,618**	**22,845**	**17%**	**133%**
	TOTAL PATH	**81,610**	**78,782**	**102,984**	**102,984**	**21,374**	**24,202**	**26%**	**31%**
Bus	**PABT Regional Commuter**	**6,550**	**62,470**	**13,677**	**96,328**	**7,127**	**33,858**	**109%**	**54%**
	PABT Jitney	1,668	4,236	NA	NA				
	Midtown Curbside	0	6,365	0	0	0	-6,365		**-100%**
	Downtown Curbside	0	4,565	0	0	0	-4,565		**-100%**
	GWBBS	1,165	1,590	0	0	-1,165	-1,590	**-100%**	**-100%**
	TOTAL Trans-Hudson Bus	**9,383**	**79,226**	**13,677**	**96,328**	**4,294**	**17,102**	**46%**	**22%**
Ferry	Midtown	0	4,025	0	0	0	-4,025		**-100%**
	Downtown	0	7,305	0	0	0	-7,305		**-100%**
	Total TH Ferry	**0**	**11,330**	**0**	**0**	**0**	**-11,330**		**-100%**
	Trans-Hudson Transit Total	**20,941**	**203,162**	**36,871**	**201,153**	**15,930**	**(2,009)**	**76%**	**-1%**
LIRR									
CITY TERMINAL ZONE									
3000	New York-Penn Station	5,965	**85,526**	**2,424**	**87,196**	**(3,541)**	**1,670**	**-59%**	**2%**
3807	New York-GCT	0	0	0	0	0	0		
3002	Hunterspoint Ave	0	3,409	0	4,053	0	644		19%
3001	Long Island City	0	79	0	0	0	(79)		-100%
3091	Flatbush Ave	4,143	10,593	0	8,155	(4,143)	(2,438)	-100%	-23%
	Atlantic Ave - New Service	0	0	0	0	0	0		
	Lower Manhattan	0	0	0	0	0	0		
	Subtotal	10,108	99,607	2,424	99,404	(7,684)	(203)	-76%	0%
LIRR Total W/O Terminal Zone		**111,979**	**19,262**	**112,815**	**6,910**	**836**	**(12,352)**	**1%**	**-64%**
LIRR Total With Terminal Zone		**126,406**	**123,899**	**124,607**	**124,607**	**(1,799)**	**708**	**-1%**	**1%**
MNCR									
MANHATTAN									
3500	125th St	142	2,514	7	2,163	(135)	(351)	-95%	-14%
3201	125th St	0	0	0	0				
3200	NYC-Grand Central	**0**	**70,632**	**1,322**	**85,820**	**1,322**	**15,188**		**22%**
	Total	142	73,146	1,329	87,983	1,187	14,837	836%	20%
Total MNCRR W/O Manhattan		**81,251**	**8,268**	**110,548**	**23,782**	**29,297**	**15,514**	**36%**	**188%**
Total MNCRR With Manhattan		**81,393**	**81,414**	**111,878**	**111,765**	**30,485**	**30,351**	**37%**	**37%**

* Best 2010 Counts where Survey-based Counts are not available.

Table 7-13: Major Rail and Terminals Summary – Transit Assignment Report (Congested) – NYBPM 2010 Update

9_1B - Transit Assignment Report - Congested Summary
AM Peak Period Ridership By Station/Cordon Location

compared to: **102C** **Survey Based Counts***

Node Station	Counts: Survey Based Counts * Ons	Offs	Model: BPM Run 102C Ons	Offs	# Difference (Model - Counts) Ons	Offs	% Difference (Diff / Counts) Ons	Offs
NJT Commuter Rail								
TOTAL Port Jervis/Main/Bergen County	9,770	279	12,469	5,508	2,699	5,229	28%	1874%
TOTAL Pascack	3,018	85	6,370	3,103	3,352	3,018	111%	3551%
NEWARK BROAD ST	402	796	2,374	4,824	1,972	4,028	490%	506%
TOTAL Morris & Essex	18,474	1,753	12,824	6,888	(5,650)	5,135	-31%	293%
TOTAL Raritan	6,945	163	7,859	1,688	914	1,525	13%	936%
TOTAL NJC/NEC	42,442	3,251	37,736	7,362	(4,706)	4,111	-11%	126%
NJT Terminal Stations								
Secaucus (MAIN)	396	2,490	704	2,971	308	481	78%	19%
Secaucus (NEC/NJC/M&E)	3,207	396	5,738	1,142	2,531	746	79%	188%
Secaucus (BRG/PAS)	0	629	498	3,067	498	2,438		388%
Secaucus Subtotal	3,603	3,515	6,940	7,180	3,337	3,665	93%	104%
Newark Penn Station (NJT)	4,199	15,322	8,161	23,334	3,962	8,012	94%	52%
Hoboken (NJT)	0	16,579	1,630	10,729	1,630	(5,850)		-35%
New York Penn Station (NJT)	**0**	**50,966**	**1,143**	**35,922**	**1,143**	**(15,044)**		**-30%**
Total Terminal Stations	7,802	**86,382**	17,875	**77,165**	10,073	**(9,217)**	129%	**-11%**
NJT Rail without Terminal Stations	**84,161**	**5,631**	**83,455**	**25,697**	**(706)**	**20,066**	**-1%**	**356%**
NJT Rail with Terminal Stations	**91,963**	**92,013**	**101,329**	**102,862**	**9,366**	**10,849**	**10%**	**12%**
PATH								
33rd St Line								
33rd St	2,534	10,746	633	8,358	(1,901)	(2,388)	-75%	-22%
23rd St	297	3,547	501	3,609	204	62	69%	2%
14th St	446	3,071	261	1,772	(185)	(1,299)	-42%	-42%
9th St	246	1,498	1,305	2,540	1,059	1,042	431%	70%
Christopher St	309	1,374	957	2,382	648	1,008	210%	73%
33rd St Line Subtotal	**3,832**	**20,236**	**3,657**	**18,662**	**(175)**	**(1,574)**	**-5%**	**-8%**
WTC	**7,726**	**41,404**	**3,762**	**50,854**	**(3,964)**	**9,450**	**-51%**	**23%**
New Jersey								
Hoboken	23,434	1,035	10,615	432	(12,819)	(603)	-55%	-58%
Pavonia/Newport	3,391	2,061	19,036	361	15,645	(1,700)	461%	-82%
Exchange Place	1,863	6,462	3,043	1,924	1,180	(4,538)	63%	-70%
Grove St	6,036	1,448	3,162	949	(2,874)	(499)	-48%	-34%
Journal Square	12,648	2,446	2,336	3,580	(10,312)	1,134	-82%	46%
Harrison	3,895	496	4,263	284	368	(212)	9%	-43%

9_1B - Transit Assignment Report - Congested Summary
AM Peak Period Ridership By Station/Cordon Location

compared to:

102C
Survey Based Counts*

		Counts		Model		# Difference (Model - Counts)		% Difference (Diff / Counts)	
Node	Station	Survey Based Counts *		BPM Run 102C					
		Ons	Offs	Ons	Offs	Ons	Offs	Ons	Offs
	NEWARK PENN STATION	18,785	3,194	29,657	2,487	10,872	(707)	58%	-22%
	Subtotal	**70,052**	**17,142**	**72,113**	**10,017**	**2,061**	**(7,125)**	**3%**	**-42%**
	TOTAL PATH	**81,610**	**78,782**	**79,532**	**79,532**	**(2,078)**	**750**	**-3%**	**1%**
Bus	**PABT Regional Commuter**	**6,550**	**62,470**	**4,638**	**62,788**	**-1,912**	**318**	**-29%**	**1%**
	PABT Jitney	1,668	4,236	NA	NA				
	Midtown Curbside	0	6,365	0	4,326	0	-2,039		**-32%**
	Downtown Curbside	0	4,565	0	8,455	0	3,890		**85%**
	GWBBS	1,165	1,590	612	1,528	-553	-62	**-47%**	**-4%**
	TOTAL Trans-Hudson Bus	**9,383**	**79,226**	**5,250**	**77,097**	**-4,133**	**-2,129**	**-44%**	**-3%**
Ferry	Midtown	0	4,025	153	1,597	153	-2,428		**-60%**
	Downtown	0	7,305	128	200	128	-7,105		**-97%**
	Total TH Ferry	**0**	**11,330**	**281**	**1,797**	**281**	**-9,533**		**-84%**
	Trans-Hudson Transit Total	**20,941**	**203,162**	**14,094**	**184,331**	**-6,847**	**(18,831)**	**-33%**	**-9%**
LIRR									
CITY TERMINAL ZONE									
3000	New York-Penn Station	5,965	**85,526**	**1,970**	**95,685**	**(3,995)**	**10,159**	**-67%**	**12%**
3807	New York-GCT	0	0	0	0	0	0		
3002	Hunterspoint Ave	0	3,409	0	4,157	0	748		22%
3001	Long Island City	0	79	0	0	0	(79)		-100%
3091	Flatbush Ave	4,143	10,593	2,790	9,729	(1,353)	(864)	-33%	-8%
	Atlantic Ave - New Service	0	0	0	0	0	0		
	Lower Manhattan	0	0	0	0	0	0		
	Subtotal	10,108	99,607	4,760	109,572	(5,348)	9,965	-53%	10%
LIRR Total W/O Terminal Zone		**111,979**	**19,262**	**134,049**	**11,723**	**22,070**	**(7,539)**	**20%**	**-39%**
LIRR Total With Terminal Zone		**126,406**	**123,899**	**148,506**	**148,506**	**22,100**	**24,607**	**17%**	**20%**
MNCR									
MANHATTAN									
3500	125th St	142	2,514	1,558	11,113	1,416	8,599	997%	342%
3201	125th St	0	0	0	0				
3200	NYC-Grand Central	**0**	**70,632**	**1,465**	**54,544**	**1,465**	**(16,088)**		**-23%**
	Total	142	73,146	3,023	65,657	2,881	(7,489)	2029%	-10%
Total MNCRR W/O Manhattan		**81,251**	**8,268**	**99,578**	**36,760**	**18,327**	**28,492**	**23%**	**345%**
Total MNCRR With Manhattan		**81,393**	**81,414**	**102,602**	**102,417**	**21,209**	**21,003**	**26%**	**26%**

* Best 2010 Counts where Survey-based Counts are not available.

Table 7-14: Composite Transit OD Survey Assignment - Subway Boardings by Borough

SUBWAY STATIONS - ENTRIES AND EXITS (6 AM - 10 AM)

OD SURVEY-BASED Transit Assignment (TASN) versus MetroCard by BOROUGH

		IN				OUT			
	BOROUGH	Observed	Survey-based TASN	Diff.	% Diff.	Observed	Survey-based TASN	Diff.	% Diff.
1	Manhattan	532,173	927,349	395,176	74%	1,137,072	1,424,086	287,014	25%
2	Queens	304,989	499,610	194,621	64%	134,366	262,604	128,238	95%
3	Bronx	169,155	267,692	98,537	58%	90,596	127,702	37,106	41%
4	Brooklyn	423,509	745,266	321,757	76%	236,903	474,659	237,756	100%
Total		**1,429,825**	**2,439,917**	**1,010,092**	**71%**	**1,598,937**	**2,289,051**	**690,114**	**43%**

Table 7-15: NYBPM 2010 Update Model - Subway Boardings by Borough

SUBWAY STATIONS - ENTRIES AND EXITS (6 AM - 10 AM)

NYBPM 2010 Update: Model Transit Assignment versus MetroCard by BOROUGH

		IN				OUT			
	BOROUGH	Observed	Model	Diff.	% Diff.	Observed	Model	Diff.	% Diff.
1	Manhattan	532,173	697,333	165,160	31%	1,137,072	1,029,423	-107,649	-9%
2	Queens	304,989	314,141	9,152	3%	134,366	176,314	41,948	31%
3	Bronx	169,155	159,456	-9,699	-6%	90,596	93,249	2,653	3%
4	Brooklyn	423,509	363,649	-59,860	-14%	236,903	203,268	-33,635	-14%
Total		**1,429,825**	**1,534,580**	**104,755**	**7%**	**1,598,937**	**1,502,254**	**-96,683**	**-6%**

Table 7-16: Composite Transit OD Survey Assignment - Subway Boardings by Branch

SUBWAY STATIONS - ENTRIES AND EXISTS (6 AM - 10 AM)

OD SURVEY-BASED Transit Assignment (TASN) versus MetroCard by BRANCH

		IN				OUT			
ID	Branch Name	Observed	Survey-based TASN	Diff.	% Diff.	Observed	Survey-based TASN	Diff.	% Diff.
1	Broadway/7 Av (CBD)	49,132	50,529	1,397	3%	88,158	103,389	15,231	17%
2	Broadway/7 Av (Non-CBD)	34,483	35,809	1,326	4%	51,871	46,757	-5,114	-10%
3	Upper Broadway	42,984	62,233	19,249	45%	30,159	22,058	-8,101	-27%
4	Lenox Av	15,922	10,574	-5,348	-34%	12,722	8,067	-4,655	-37%
5	Lexington Av (CBD)	25,137	11,337	-13,800	-55%	75,830	62,728	-13,102	-17%

SUBWAY STATIONS - ENTRIES AND EXISTS (6 AM - 10 AM)

OD SURVEY-BASED Transit Assignment (TASN) versus MetroCard by BRANCH

		IN				OUT			
ID	Branch Name	Observed	Survey-based TASN	Diff.	% Diff.	Observed	Survey-based TASN	Diff.	% Diff.
6	Lexington Av (Non-CBD)	59,333	92,706	33,373	56%	78,238	89,626	11,388	15%
7	Jerome Av	32,579	27,496	-5,083	-16%	19,833	13,089	-6,744	-34%
8	White Plains Rd	44,963	83,722	38,759	86%	25,243	49,364	24,121	96%
9	Dyre Av	8,974	10,790	1,816	20%	3,618	4,174	556	15%
10	Pelham	39,200	60,003	20,803	53%	17,270	27,100	9,830	57%
11	Broadway-60 St	10,252	6,073	-4,179	-41%	54,481	40,343	-14,138	-26%
12	Nassau St	585	129	-456	-78%	5,024	9513	4,489	89%
13	14 St	5,003	5,069	66	1%	8,822	10,186	1,364	15%
14	6 Av	11,795	22,273	10,478	89%	59,728	67,238	7,510	13%
15	8 Av	34,911	26,816	-8,095	-23%	55,416	59,164	3,748	7%
16	53 St	1,617	33,158	31,541	1951%	24,488	50,290	25,802	105%
17	63 St	5,912	4,580	-1,332	-23%	16,546	28,563	12,017	73%
18	8 Av/Central Pk W	30,872	68,882	38,010	123%	29,704	49,964	20,260	68%
19	Washington Heights	20,493	17,136	-3,357	-16%	5,766	5,016	-750	-13%
20	Concourse	27,834	49,164	21,330	77%	10,486	9,873	-613	-6%
21	Manhattan CBD Transfer	172,392	470,050	297,658	173%	510,046	747,980	237,934	47%
22	Upper Manhattan/Bronx X-fer	14,759	40,139	25,380	172%	20,021	40,478	20,457	102%
23	New Lots	32,338	49,588	17,250	53%	9,349	21,852	12,503	134%
24	Nostrand Av	16,508	18,689	2,181	13%	5,665	2,474	-3,191	-56%
25	Eastern Pkwy	11,861	21,268	9,407	79%	11,673	19,215	7,542	65%
26	4 Av	35,090	72,083	36,993	105%	16,313	53,737	37,424	229%
27	Sea Beach	19,645	18,814	-831	-4%	6,982	5,894	-1,088	-16%
28	West End	24,098	25,669	1,571	7%	7,647	7,834	187	2%
29	Brighton	52,133	79,112	26,979	52%	21,293	26,483	5,190	24%
30	Franklin Av	923	92	-831	-90%	366	312	-54	-15%
31	Culver	37,839	67,077	29,238	77%	19,889	44,817	24,928	125%
32	Rockaway	7,402	21,279	13,877	187%	2,993	10,725	7,732	258%
33	Lefferts Blvd	6,545	5,981	-564	-9%	1,045	823	-222	-21%
34	Fulton St	41,157	58,279	17,122	42%	16,776	21,463	4,687	28%
35	Crosstown	16,704	32,936	16,232	97%	10,551	16,133	5,582	53%

SUBWAY STATIONS - ENTRIES AND EXISTS (6 AM - 10 AM)

OD SURVEY-BASED Transit Assignment (TASN) versus MetroCard by BRANCH

		IN				OUT			
ID	**Branch Name**	**Observed**	**Survey-based TASN**	**Diff.**	**% Diff.**	**Observed**	**Survey-based TASN**	**Diff.**	**% Diff.**
36	Queens Blvd	101,042	184,789	83,747	83%	41,334	101,328	59,994	145%
37	Jamaica	34,113	36,713	2,600	8%	15,398	18,188	2,790	18%
38	Myrtle Av	9,869	0	-9,869	-1	1,949	0	-1,949	-1
39	Canarsie	37,602	40,867	3,265	9%	17,505	16,208	-1,297	-7%
40	Flushing (Queens)	92,025	118,118	26,093	28%	42,282	53,022	10,740	25%
41	Astoria	27,701	28,487	786	3%	7,716	6,387	-1,329	-17%
42	Downtown Brooklyn Transfer	26,924	131,256	104,332	388%	61,049	149,419	88,370	145%
43	Other Brooklyn Transfer	36,154	112,002	75,848	210%	16,372	77,946	61,574	376%
44	Queens Transfer	28,842	121,777	92,935	322%	26,376	83,002	56,626	215%
45	No Corresponding PTZ	44,181	6,373	-37,808	-86%	34,944	6,830	-28,114	-80%
Total		**1,429,825**	**2,439,917**	**1,010,092**	**71%**	**1,598,937**	**2,289,051**	**690,114**	**43%**

Table 7-17: NYBPM 2010 Update Model - Subway Boardings by Branch

SUBWAY STATIONS - ENTRIES AND EXISTS (6 AM - 10 AM)

NYBPM 2010 Update: Model Transit Assignment versus MetroCard by BRANCH

		IN				OUT			
ID	Branch Name	Observed	Model	Diff.	% Diff.	Observed	Model	Diff.	% Diff.
1	Broadway/7 Av (CBD)	49,132	45,287	-3,845	-8%	88,158	89,092	934	1%
2	Broadway/7 Av (Non-CBD)	34,483	44,504	10,021	29%	51,871	38,819	-13,052	-25%
3	Upper Broadway	42,984	28,560	-14,424	-34%	30,159	30,456	297	1%
4	Lenox Av	15,922	9,474	-6,448	-40%	12,722	12,029	-693	-5%
5	Lexington Av (CBD)	25,137	15,487	-9,650	-38%	75,830	39,759	-36,071	-48%
6	Lexington Av (Non-CBD)	59,333	33,140	-26,193	-44%	78,238	52,409	-25,829	-33%
7	Jerome Av	32,579	37,450	4,871	15%	19,833	16,313	-3,520	-18%
8	White Plains Rd	44,963	36,547	-8,416	-19%	25,243	28,457	3,214	13%
9	Dyre Av	8,974	24,026	15,052	168%	3,618	7,505	3,887	107%
10	Pelham	39,200	26,884	-12,316	-31%	17,270	20,231	2,961	17%
11	Broadway-60 St	10,252	709	-9,543	-93%	54,481	15,021	-39,460	-72%
12	Nassau St	585	2,068	1,483	253%	5,024	6271.58535	1,248	25%
13	14 St	5,003	11,416	6,413	128%	8,822	10,318	1,496	17%
14	6 Av	11,795	14,929	3,134	27%	59,728	24,936	-34,792	-58%
15	8 Av	34,911	13,236	-21,675	-62%	55,416	60,378	4,962	9%
16	53 St	1,617	5,298	3,681	228%	24,488	12,732	-11,756	-48%
17	63 St	5,912	19,207	13,295	225%	16,546	14,440	-2,106	-13%
18	8 Av/Central Pk W	30,872	21,270	-9,602	-31%	29,704	26,316	-3,388	-11%
19	Washington Heights	20,493	28,003	7,510	37%	5,766	8,344	2,578	45%
20	Concourse	27,834	82,680	54,846	197%	10,486	12,182	1,696	16%
21	Manhattan CBD Transfer	172,392	322,065	149,673	87%	510,046	575,921	65,875	13%
22	Upper Manhattan/Bronx X-fer	14,759	23,761	9,002	61%	20,021	20,537	516	3%
23	New Lots	32,338	34,550	2,212	7%	9,349	20,744	11,395	122%
24	Nostrand Av	16,508	9,149	-7,359	-45%	5,665	10,951	5,286	93%
25	Eastern Pkwy	11,861	9,630	-2,231	-19%	11,673	4,004	-7,669	-66%
26	4 Av	35,090	23,169	-11,921	-34%	16,313	3,297	-13,016	-80%
27	Sea Beach	19,645	23,122	3,477	18%	6,982	19,466	12,484	179%
28	West End	24,098	23,181	-917	-4%	7,647	7,851	204	3%
29	Brighton	52,133	27,433	-24,700	-47%	21,293	10,980	-10,313	-48%

SUBWAY STATIONS - ENTRIES AND EXISTS (6 AM - 10 AM)

NYBPM 2010 Update: Model Transit Assignment versus MetroCard by BRANCH

		IN				OUT			
ID	**Branch Name**	**Observed**	**Model**	**Diff.**	**% Diff.**	**Observed**	**Model**	**Diff.**	**% Diff.**
30	Franklin Av	923	25,424	24,501	2655%	366	18974.3072	18,608	5084%
31	Culver	37,839	33,732	-4,107	-11%	19,889	0	-19,889	-100%
32	Rockaway	7,402	18,819	11,417	154%	2,993	28,850	25,857	864%
33	Lefferts Blvd	6,545	10,645	4,100	63%	1,045	7,389	6,344	607%
34	Fulton St	41,157	16,948	-24,209	-59%	16,776	1,657	-15,119	-90%
35	Crosstown	16,704	79,467	62,763	376%	10,551	19,849	9,298	88%
36	Queens Blvd	101,042	72,184	-28,858	-29%	41,334	46,504	5,170	13%
37	Jamaica	34,113	7,985	-26,128	-77%	15,398	12,971	-2,427	-16%
38	Myrtle Av	9,869	19,087	9,218	0.934013	1,949	0	-1,949	-1
39	Canarsie	37,602	53,449	15,847	42%	17,505	19,870	2,365	14%
40	Flushing (Queens)	92,025	58,528	-33,497	-36%	42,282	32,332	-9,950	-24%
41	Astoria	27,701	11,540	-16,161	-58%	7,716	3,834	-3,882	-50%
42	Downtown Brooklyn Transfer	26,924	54,876	27,952	104%	61,049	45,013	-16,036	-26%
43	Other Brooklyn Transfer	36,154	42,577	6,423	18%	16,372	34,011	17,639	108%
44	Queens Transfer	28,842	33,082	4,240	15%	26,376	31,240	4,864	18%
45	No Corresponding PTZ	44,181		-44,181	-100%	34,944		-34,944	-100%
Total		**1,429,825**	**1,534,580**	**104,755**	**7%**	**1,598,937**	**1,502,254**	**-96,683**	**-6%**

Table 7-18: NYBPM 2010 - NYCT Bus Boardings – AM Period - 2010 Update

Borough	**Observed**	**Model**	**Diff.**	**% Diff.**
Manhattan	127,103	219,712	92,609	73%
Queens	106,586	258,638	152,052	143%
Bronx	149,341	182,712	33,371	22%
Brooklyn	180,052	252,871	72,819	40%
Staten Island	26,902	19,683	-7,219	-27%
Express Buses	18,314	14,576	-3,738	-20%
	608,298	**948,192**	**339,894**	56%

APPENDIX A: BPM 2010 CALIBRATION PARAMETERS

Household – Auto Ownership – Journey Productions (HAJ) Model

Adjustments to Productions

During the application of the HAJ modeling step, the program reads the HAJ_JFC4.txt file from the 0_SetUp\2_LUT\1_HAJ directory. This file provides constants used to adjust productions by purpose at the district level. In this file, the reference value is 1. Values above 1 increase productions, while those below 1 decrease productions. In the file, reproduced below as **Table A-1**, shows the final journey production attraction factors by purpose and NYBPM district.

Table A-1: Journey Production Adjustment Factors

BPMDist	District Name	Purp1	Purp2	Purp3	Purp4	Purp5	Purp6	Purp7	Purp8
0	Lower Manhattan	20.00	20.00	1.04	0.63	0.75	0.51	0.66	1.11
1	Valley Manhattan	9.09	0.71	19.35	0.46	0.70	0.79	2.37	0.91
2	Midtown Manhattan	0.65	1.09	1.32	1.74	0.85	1.74	3.35	0.66
3	Upper Manhattan	0.61	0.84	8.30	0.65	0.90	0.90	2.11	0.77
4	Queens	0.65	1.21	1.79	0.98	1.12	1.06	1.78	0.88
5	Bronx	1.17	1.28	0.55	1.14	0.94	1.08	1.35	0.92
6	Kings	0.88	1.18	2.47	1.16	1.26	0.93	1.79	1.10
7	Richmond	0.18	0.87	1.02	0.84	1.02	1.02	1.60	0.71
8	Nassau	0.42	0.96	1.06	0.91	1.22	0.92	1.93	0.70
9	Suffolk	0.43	1.19	1.02	0.89	1.53	1.12	2.34	0.65
10	Westchester	1.20	1.05	1.00	1.20	1.20	1.15	1.25	1.40
11	Rockland	0.48	0.92	1.58	0.88	3.11	0.80	2.41	0.64
12	Putnam	0.76	1.22	0.99	1.18	0.42	1.48	2.00	0.49
13	Orange	0.95	1.05	0.89	0.91	1.46	0.75	1.76	0.59
14	Dutchess	1.00	1.17	0.80	0.90	1.00	1.20	1.00	1.40
15	Fairfield	1.68	1.07	1.09	0.74	1.12	1.06	1.98	0.57
16	Bergen	0.69	1.12	1.08	1.06	1.44	1.14	2.05	0.80
17	Passaic	1.19	0.99	0.92	0.54	1.10	1.01	2.12	0.71
18	Hudson	3.91	1.18	1.55	1.01	0.55	0.76	1.54	0.93
19	Essex	0.94	1.08	1.03	0.89	0.60	0.94	1.90	0.83
20	Union	0.38	1.29	0.91	1.00	0.75	0.83	2.04	0.82
21	Morris	0.00	0.99	0.85	0.87	0.48	0.79	1.81	0.76
22	Somerset	0.03	1.00	0.90	0.86	1.15	0.64	1.52	0.63
23	Middlesex	0.43	1.15	0.90	1.05	1.08	0.88	1.64	0.75
24	Monmouth	0.80	0.91	0.91	0.87	0.77	0.86	2.04	0.77
25	Ocean	0.80	0.97	0.82	0.72	2.47	0.74	1.71	0.60
26	Hunterdon	0.20	0.79	0.76	0.78	0.31	0.79	1.40	0.62
27	Warren	0.52	0.83	0.24	0.91	0.69	1.24	0.97	0.54
28	Sussex	0.22	1.24	0.64	0.66	0.85	0.77	1.22	0.76
29	New Haven	0.47	1.01	0.83	0.84	1.17	0.85	1.41	0.88
30	Mercer	0.35	0.86	0.80	0.83	0.67	0.77	1.58	0.74

Mode-Destination Choice Model (MDSC)
For the Mode-Destination Choice model and its calibrated adjustment factors, there are four general types of adjustments which are applied on top of the basic mode and destination choice models developed the statistical estimation (ALOGIT).

First, the attractions may be adjusted upwards or downwards by use of a simple scaling factor that can be applied for selected zones. As part of the calibration of the Destination Choice model, distance scaling factors were used to improve to overall match of the model trip length distribution with the RT-HIS survey data estimates. Additionally, county to county k-factors were applied for the current NYBPM calibration. Finally, mode specific constants were applied to specific corridors to try to capture the observed modal shares by purpose. Of the three types of adjustment factors, the modal share factors will require the most explanation.

Adjustments to Attractions
NYBPM attractions may be adjusted upwards or downwards by use of a simple scaling factor that can be applied for selected zones, by tour purpose. While the adjustment can be made at the individual zonal level, in the current NYBPM calibration all adjustments were applied at the district level.

The following **Table A-2** represents the adjustments made by district for each travel purpose for the current NYBPM Base Year 2010 calibration.

Table A-2: Correction Factors for Attractions - District Level

BPMDist	District Name	Purp1	Purp2	Purp3	Purp4	Purp5	Purp6	Purp7	Purp8
0	Lower Manhattan	0.74	0.74	1.05	1.71	7.59	1.02	0.82	1.45
1	Valley Manhattan	0.81	0.81	0.97	0.81	1.30	0.87	0.88	1.39
2	Midtown Manhattan	0.72	0.72	1.25	1.12	1.82	0.68	0.87	1.41
3	Upper Manhattan	0.87	0.87	0.74	1.82	1.33	1.05	0.85	0.97
4	Queens	1.11	1.11	1.05	1.02	1.35	1.04	0.93	0.62
5	Bronx	1.16	1.16	0.80	0.79	0.99	1.11	0.86	0.59
6	Kings	1.04	1.04	0.82	0.78	1.72	1.10	1.29	0.93
7	Richmond	1.09	1.09	0.93	0.49	0.74	0.89	0.84	0.72
8	Nassau	1.03	1.03	1.06	0.93	1.41	1.65	1.33	0.79
9	Suffolk	1.22	1.22	1.00	1.13	1.27	0.96	1.07	0.89
10	Westchester	0.94	0.94	1.07	1.30	0.50	1.02	1.02	0.90
11	Rockland	1.11	1.11	0.95	0.79	2.54	0.88	0.89	1.12
12	Putnam	0.87	0.87	1.95	1.03	0.15	0.92	0.86	0.49
13	Orange	1.02	1.02	0.69	0.65	1.17	0.89	1.18	1.09
14	Dutchess	1.02	1.02	1.35	0.68	0.63	1.00	0.96	0.70
15	Fairfield	1.03	1.03	1.12	0.84	1.08	0.98	0.97	0.61
16	Bergen	1.05	1.05	1.11	1.05	1.72	1.14	0.98	0.93
17	Passaic	1.28	1.28	0.58	0.68	2.52	1.21	1.45	0.80
18	Hudson	1.11	1.11	1.16	0.72	0.63	0.56	0.74	0.64
19	Essex	1.05	1.05	0.82	1.26	0.69	0.92	1.04	0.92

BPMDist	District Name	Purp1	Purp2	Purp3	Purp4	Purp5	Purp6	Purp7	Purp8
20	Union	1.09	1.09	0.84	1.40	1.34	0.68	0.89	0.93
21	Morris	1.04	1.04	1.37	1.31	0.95	1.17	1.72	1.15
22	Somerset	1.15	1.15	1.64	1.23	1.44	1.52	1.00	1.15
23	Middlesex	1.14	1.14	0.76	1.52	1.96	0.80	0.95	0.85
24	Monmouth	0.96	0.96	1.01	1.25	0.84	1.15	1.18	1.10
25	Ocean	1.16	1.16	1.36	1.10	3.54	0.77	1.10	0.95
26	Hunterdon	0.76	0.76	2.33	1.23	0.27	1.03	1.38	0.89
27	Warren	0.79	0.79	0.62	1.28	0.44	0.90	0.56	1.32
28	Sussex	1.02	1.02	0.91	1.03	1.06	0.66	1.49	2.22
29	New Haven	1.21	1.21	0.80	1.19	0.83	0.91	0.93	1.52
30	Mercer	1.01	1.01	1.15	1.08	0.50	1.28	0.83	1.32

Distance Adjustments

Distance scaling factors can be applied as part of the NYBPM Destination Choice model in order to more closely match observed tour length distributions. Without any distance scaling, model trip lengths were generally longer than found in the RT-HIS data used for calibration. For the 2010 Update, as was done for the 2005 calibration, distance factors were taken from 2002 calibration and were applied by county (1-28) of tour origin. Each purpose has a different set of distance factors that are a component of the utility expression for any Origin-Destination zonal interchange. These factors consist of a linear component and a non-linear component. The linear component tends to shorten all tour distances, but has the greatest impact for tours under 5 miles. The base value is 0, and all values developed in calibration are slightly less than 0 (it would be possible to increase tour distances as well). The largest linear distance adjustments are applied to purposes 3 (high income work), 4 (school) and 6 (maintenance).

The second component is a non-linear component that shortens the “tail” of the trip length distributions and generally has the greatest impact on tours longer than 20 miles. For this component, a value of 1 is the reference value. Values larger than 1 tend to shorten the tail end of the distribution. In general, the non-linear component in the NYBPM calibration varies more by county than does the linear component, which often has the same value for all counties. The purpose with the highest non-linear adjustment factors is purpose 1 (low income work). **Table A-3** summarizes the values of the distance adjustment factors for all purposes.

Table A-3: Summary of Distance Factor Adjustments for All Purposes

	Purpose 1		Purpose 2		Purpose 3		Purpose 4		Purpose 5		Purpose 6		Purpose 7		Purpose 8	
BPMCo	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**	**Dist_Lin**	**Dist_Nlin**
1	0	1	-0.01	1	-0.01	1	-0.04	1.4	-0.015	1.75	-0.04	1.1	-0.02	1.1	-0.02	1.1
2	-0.01	1.25	-0.01	1	-0.01	1	-0.04	1.4	-0.015	1.5	-0.05	1.1	-0.02	1.1	-0.02	1.1
3	-0.02	1.5	-0.03	1.1	-0.04	1.1	-0.04	1.4	-0.015	1.75	-0.04	1.1	-0.02	1.1	-0.02	1.1
4	-0.01	1.25	-0.01	1	-0.01	1	-0.04	1.4	-0.015	1.5	-0.04	1.1	-0.02	1.1	-0.02	1.1
5	-0.02	2	-0.04	1.25	-0.06	1.25	-0.04	1.4	-0.015	1.75	-0.06	1.5	-0.05	1.4	-0.02	1.1
6	-0.02	2	-0.04	1.2	-0.06	1.2	-0.04	1.4	-0.01	1.25	-0.05	1.1	-0.03	1.1	-0.02	1.1
7	-0.02	2	-0.045	1.25	-0.065	1.25	-0.04	1.4	-0.015	1.5	-0.05	1.2	-0.03	1.2	-0.02	1.1
8	-0.035	2	-0.055	1.25	-0.07	1.25	-0.04	1.4	-0.015	1.75	-0.06	1.5	-0.05	1.5	-0.02	1.1
9	-0.04	2	-0.055	1.25	-0.075	1.25	-0.04	1.4	-0.015	1.75	-0.07	1.5	-0.06	1.5	-0.02	1.3
10	-0.04	2	-0.055	1.25	-0.075	1.25	-0.04	1.4	-0.015	1.75	-0.07	1.5	-0.06	1.5	-0.02	1.3
11	-0.025	2	-0.055	1.1	-0.06	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.3	-0.04	1.3	-0.02	1.1
12	-0.025	2	-0.055	1.1	-0.06	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.3	-0.04	1.3	-0.02	1.1
13	-0.04	2	-0.055	1.25	-0.075	1.25	-0.04	1.4	-0.015	1.75	-0.07	1.5	-0.06	1.5	-0.02	1.3
14	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
15	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
16	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
17	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
18	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
19	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
20	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
21	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
22	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
23	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
24	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
25	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
26	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1
27	-0.04	2	-0.055	1.25	-0.055	1.25	-0.04	1.4	-0.015	1.75	-0.07	1.5	-0.06	1.5	-0.02	1.3
28	-0.025	1.75	-0.05	1.1	-0.055	1.1	-0.04	1.4	-0.015	1.75	-0.06	1.2	-0.04	1.2	-0.02	1.1

County-to-County Adjustments

For the origin-destination county-to-county constants that are part of the utility expressions in the Destination Choice model, zero is the reference value. Positive numbers increase the utility of a targeted origin-destination interchange, and the probability of selection of a destination in that district, while negative values add disutility to the destination choice. With or without the county-to-county constants, in the NYBPM Destination Choice model, origin productions are constrained for all purposes and remain unchanged. For Work, School and University tours (Purposes 1-3, 4 and 5) destinations attractions are also fully constrained to attractions, while for Maintenance, Discretionary, and At-Work tours (Purposes 5, 6 and 8) a "relaxed" constraint is applied. Consequently, the origin-destination distribution pattern resulting from the NYBPM Destination choice model will reflect a matrix balancing that affects the interchanges for which no county-to-county constant is applied.

The destination choice calibration constants in the NYBPM are specified for district-to-district pairs. The calibration was carried out manually by running multiple iterations of MDSC model.

A full set of the tables of district-to-district constants as developed for the current 2010 NYBPM calibration are found in **Tables A-4-1 – A-4-8.**

Table A-4-1: County-To-County Factors - Purpose 1: Work / Low Income

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	2.6	-2.1	-2.1	1.8	-1.0	-0.3	-1.7	-0.3	-4.1	-4.1	3.1	-2.7	1.5	-1.3	1.5	-2.8	-2.9	-3.3	-2.6	-3.5	-3.0	-3.8	-4.2	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-2.8	-3.8
1	Valley Mn	-1.8	1.9	-2.4	6.3	-4.4	3.3	-5.7	-0.8	-5.5	-4.1	1.6	-2.8	3.0	-2.8	2.3	-3.5	-3.7	-3.3	-2.5	-3.4	-2.7	-3.8	-3.8	-3.5	-3.8	-3.8	-3.8	-3.8	-3.8	-3.5	-3.8
2	Midtown Mn	-2.2	-1.6	-2.0	12.2	-6.6	-1.4	-3.8	-0.8	-6.6	-4.1	1.6	-3.5	3.0	-2.0	3.0	-2.8	-4.6	-4.2	-3.0	-3.9	-3.6	-4.7	-4.7	-4.4	-4.7	-4.7	-4.7	-4.7	-4.7	-2.8	-4.7
3	Upper Mn	-3.4	0.2	-1.1	7.4	-0.2	-5.0	-3.4	-0.9	-9.8	-5.8	-3.5	-5.5	-3.5	-5.5	-2.8	-2.8	-8.4	-8.5	-6.2	-7.7	-6.6	-7.3	-6.5	-6.3	-6.5	-6.5	-6.5	-6.5	-6.5	-2.8	-6.5
4	Queens	-2.4	-0.7	-3.4	6.6	0.1	1.0	0.7	-1.7	-4.9	-7.6	-1.9	-2.2	-4.7	-5.2	-4.7	-0.9	-4.0	-3.4	-0.9	-2.7	-1.3	-2.5	-2.5	-2.3	-2.7	-2.5	-2.5	-2.5	-2.5	-3.3	-2.7
5	Bronx	-3.0	-0.1	-4.2	6.9	-6.4	3.4	-4.9	-0.1	-7.2	-7.2	-1.5	-4.6	-0.8	-4.5	-0.8	-3.3	-7.5	-7.2	-5.6	-6.6	-6.2	-6.6	-6.0	-5.6	-6.0	-6.0	-6.0	-6.0	-5.9	-2.6	-6.0
6	Kings	-6.0	0.5	-3.5	7.7	0.2	2.1	2.4	1.9	-7.5	-7.6	-4.9	-3.7	-4.7	-5.2	-5.4	-3.3	-2.9	-2.5	-1.5	-2.4	-1.9	-3.0	-3.0	-2.9	-3.2	-3.0	-3.0	-3.0	-3.0	-3.3	-3.2
7	Richmond	-2.4	2.5	3.2	1.4	-1.7	0.4	-2.3	2.9	-2.4	-1.3	-3.1	-3.6	-3.1	-3.6	-3.1	-2.1	-2.2	-1.7	-3.9	-2.8	-3.2	-1.1	-1.8	-2.4	-2.0	-1.1	-1.1	-1.1	-1.1	-2.1	-1.3
8	Nassau	-4.6	-4.6	-2.1	0.0	-3.6	5.6	-2.3	-1.6	-3.4	-4.2	8.7	3.0	8.1	2.8	8.1	0.0	-2.8	-2.2	-2.4	-1.0	-1.5	0.4	0.4	-0.3	0.4	0.4	0.4	0.4	0.4	0.0	0.4
9	Suffolk	-3.2	-3.2	-1.7	-0.3	-3.3	-1.6	-1.6	-1.6	-4.2	-2.5	8.1	3.7	8.1	2.8	8.1	0.0	-2.0	-1.4	-2.4	-1.0	-1.5	0.4	0.4	-0.3	0.4	0.4	0.4	0.4	0.4	0.0	0.4
10	Westchester	9.1	4.2	2.9	-1.4	-8.2	-4.1	-7.6	-2.8	-5.7	-5.7	2.8	0.7	10.7	-5.5	2.6	-3.1	-7.9	-9.4	-6.6	-8.0	-6.7	-8.5	-8.6	-8.0	-8.6	-8.6	-8.6	-8.6	-8.5	-1.7	-8.6
11	Rockland	6.9	6.9	4.8	-2.4	-3.5	-3.9	-2.9	-6.0	-1.5	-1.2	-4.7	-3.4	-5.4	-2.8	-5.4	-2.4	-6.0	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-6.3	-5.5
12	Putnam	4.2	4.2	2.9	-1.4	-4.8	-2.8	-2.8	-2.8	-4.1	-4.1	1.2	-5.1	5.9	-5.7	1.2	-2.8	-7.1	-7.7	-5.8	-7.2	-6.7	-8.6	-8.6	-8.0	-8.6	-8.6	-8.6	-8.6	-8.6	-2.8	-8.6
13	Orange	6.9	12.4	5.5	-0.3	-4.4	-4.5	-7.9	-5.3	-4.8	-5.5	-6.9	-4.2	-6.3	-3.4	-6.8	-3.4	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-5.5	-3.9	-5.5
14	Dutchess	11.4	4.2	2.9	-1.4	-7.3	-2.8	-2.8	-2.8	-4.1	-4.8	3.3	-3.7	1.9	-5.1	2.7	-3.5	-7.1	-7.7	-5.8	-7.2	-6.7	-8.6	-8.6	-8.0	-8.6	-8.6	-8.6	-8.6	-8.6	-2.8	-8.6
15	Fairfield	0.6	1.3	3.4	0.0	-3.7	-1.4	-1.4	-1.4	-5.1	-5.1	-3.7	-3.3	-3.1	-3.3	-3.1	5.2	-4.3	-3.6	-3.2	-3.5	-3.4	-3.8	-3.9	-3.7	-3.9	-3.9	-3.9	-3.9	-3.8	-6.1	-3.9
16	Bergen	-2.3	-2.3	-2.7	0.6	-2.7	-1.0	-7.9	-3.3	-3.2	-3.1	-1.0	0.0	-0.9	0.0	-0.9	-4.4	1.3	2.2	2.3	2.2	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	-4.6	2.2
17	Passaic	-2.5	-2.5	-1.9	1.3	-2.9	-0.7	-7.9	-2.9	-3.2	-3.2	-1.9	0.0	-1.4	0.0	-1.4	-5.3	2.3	1.9	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	-4.9	2.2
18	Hudson	-1.7	-1.3	-1.2	1.8	-0.3	0.9	-6.0	-4.8	-2.0	-2.0	0.4	0.0	0.1	0.0	0.1	-4.1	2.2	2.1	2.3	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	-4.1	2.1
19	Essex	-2.3	-1.9	-1.5	0.9	-3.1	0.0	-8.1	-3.3	-2.2	-2.2	-0.7	0.0	-1.0	0.0	-1.0	-4.8	2.2	2.2	2.3	1.8	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	-4.7	2.2
20	Union	-2.2	-1.8	-1.5	1.8	-1.2	0.4	-7.9	-4.4	-3.3	-2.1	-0.3	0.0	-0.6	0.0	-0.6	-4.5	2.2	2.2	2.3	2.2	1.3	2.1	2.1	2.2	2.1	2.1	2.1	2.1	2.1	-4.5	2.1
21	Morris	-2.7	-2.2	-1.4	1.7	-4.4	-0.7	-10.6	-1.7	-2.4	-2.4	-1.6	0.0	-2.0	0.0	-2.0	-5.1	2.3	2.3	2.3	2.3	2.3	1.6	2.3	2.3	2.3	2.3	2.3	2.3	2.3	-5.1	2.3
22	Somerset	-2.6	-2.7	-1.9	1.7	-4.4	-0.8	-10.8	-0.8	-3.1	-2.4	-2.0	0.0	-2.0	0.0	-2.0	-5.2	2.3	2.3	2.3	2.3	2.3	2.3	1.6	2.3	2.3	2.3	2.3	2.3	2.3	-5.2	2.3
23	Middlesex	-2.5	-2.6	-1.9	1.7	-3.7	-0.4	-10.1	-1.5	-3.0	-2.3	-1.3	0.0	-1.6	0.0	-1.6	-5.0	2.3	2.3	2.3	2.3	2.3	2.2	2.2	1.6	2.2	2.2	2.2	2.2	2.2	-5.0	2.2
24	Monmouth	-2.7	-2.7	-1.9	1.7	-4.7	-0.8	-11.1	-1.1	-3.1	-2.4	-2.0	0.0	-2.0	0.0	-2.0	-5.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.5	2.3	2.3	2.3	2.3	-5.2	2.3
25	Ocean	-2.7	-2.7	-1.9	1.7	-4.4	-0.8	-10.8	-0.5	-3.1	-2.4	-2.0	0.0	-2.0	0.0	-2.0	-5.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.4	2.3	2.3	2.3	-5.2	2.3
26	Hunterdon	-2.7	-2.7	-1.9	1.7	-4.4	-0.8	-9.4	-0.5	-3.1	-2.4	-2.0	0.0	-2.0	0.0	-2.0	-5.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.7	2.3	2.3	-5.2	2.3
27	Warren	-2.7	-2.7	-1.9	1.7	-4.4	-0.8	-9.4	-1.1	-3.1	-2.4	-2.0	0.0	-2.0	0.0	-2.0	-5.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.8	2.3	-5.2	2.3
28	Sussex	-2.7	-2.7	-1.9	1.7	-4.4	-0.7	-9.4	-0.5	-2.4	-2.4	-2.3	0.0	-2.0	0.0	-2.0	-5.5	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.7	-5.1	2.3
29	New Haven	1.3	1.3	-0.1	0.0	-2.8	-1.4	-1.4	-1.4	-4.8	-4.8	-3.7	-4.1	-1.7	-3.9	-3.1	1.4	-3.5	-3.6	-3.2	-3.5	-3.4	-3.8	-3.9	-3.7	-3.9	-3.9	-3.9	-3.9	-3.8	4.3	-3.9
30	Mercer	-2.7	-2.7	-1.9	1.7	-4.7	-0.8	-9.7	-0.8	-2.4	-2.4	-2.0	0.0	-2.0	0.0	-2.0	-5.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	-5.2	1.6

Table A-4-2: County-To-County Factors - Purpose 2: Work / Middle Income

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	4.7	2.4	0.7	0.3	-3.5	-2.5	-1.4	-4.4	1.7	1.7	3.8	1.0	0.4	0.3	-0.3	7.1	5.1	4.7	5.3	4.5	4.9	4.2	3.8	4.2	4.2	4.2	4.2	4.2	4.2	0.3	4.2
1	Valley Mn	1.1	4.0	1.1	1.5	1.5	-4.1	-5.1	-1.5	3.5	1.7	-1.0	-0.5	-0.3	7.1	-0.3	1.8	4.3	4.7	5.0	4.6	5.3	4.2	4.2	4.5	4.2	4.2	4.2	4.2	4.2	2.6	4.2
2	Midtown Mn	1.1	1.9	1.7	1.0	-7.9	-4.6	-5.2	-4.4	3.6	1.7	-1.0	-1.2	0.4	-0.4	-0.3	0.3	3.4	3.8	4.7	4.1	4.4	3.3	3.3	3.6	3.3	3.3	3.3	3.3	3.3	0.3	3.3
3	Upper Mn	1.2	1.3	1.5	1.4	3.0	0.1	-5.4	3.7	1.7	1.8	-2.0	4.7	-0.4	1.2	-0.4	5.0	1.7	1.6	3.9	2.4	3.5	2.8	3.6	3.8	3.6	3.6	3.6	3.6	3.6	-0.7	3.6
4	Queens	-3.1	5.7	-0.5	1.7	2.9	9.1	1.2	1.6	1.1	1.5	-1.7	-0.2	-3.3	-0.5	-3.3	1.0	0.4	1.0	3.5	1.7	3.0	1.9	1.9	2.1	1.7	1.9	1.9	1.9	1.9	-4.4	1.7
5	Bronx	-2.3	-1.9	-1.8	1.0	-1.9	2.5	-1.8	-0.6	-1.7	1.6	-2.2	-1.2	-2.5	0.2	-2.5	0.0	-1.2	-0.9	0.7	-0.3	0.0	-0.3	0.2	0.6	0.2	0.2	0.2	0.2	0.3	-3.7	0.2
6	Kings	-3.1	-3.5	-2.3	1.5	0.1	9.0	2.0	5.7	0.3	0.4	-1.3	1.9	-2.2	-1.2	-2.9	-2.1	1.6	2.0	3.0	2.1	2.6	1.5	1.5	1.6	1.3	1.5	1.5	1.5	1.5	-4.4	1.3
7	Richmond	-2.0	0.4	-1.3	-1.0	-1.4	1.9	-0.8	2.9	1.1	2.3	-3.2	-1.1	-1.2	-1.1	-2.6	-2.5	0.5	0.6	0.4	-1.4	-0.4	-1.4	0.5	-2.1	0.2	3.2	-1.4	-0.7	0.0	-0.4	-1.6
8	Nassau	-1.7	-2.7	1.2	2.5	-0.2	0.9	1.5	2.0	-1.8	2.2	-10.6	5.2	-7.3	4.3	-8.0	-0.2	2.9	3.5	3.3	4.8	4.2	6.1	6.1	5.5	6.1	6.1	6.1	6.1	6.1	-1.8	6.1
9	Suffolk	-5.1	-5.8	-5.8	0.3	-3.2	-1.7	-0.9	4.7	-1.5	0.0	-14.0	5.2	-7.3	4.3	-7.3	-1.8	3.7	4.3	3.3	4.8	4.2	6.1	6.1	5.5	6.1	6.1	6.1	6.1	6.1	-1.8	6.1
10	Westchester	-2.1	0.1	-0.6	1.9	-0.5	2.4	1.7	1.6	-0.9	0.0	0.9	2.3	2.5	2.7	-1.7	2.3	-0.1	-1.6	1.2	-0.2	1.1	-0.7	-0.8	-0.2	-0.8	-0.8	-0.8	-0.8	-0.7	0.8	-0.8
11	Rockland	0.5	-3.9	5.0	-8.4	4.7	2.4	1.7	-1.7	4.1	7.6	-1.9	2.0	-6.5	-0.5	-6.5	-1.9	0.9	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-7.5	1.4
12	Putnam	-0.7	1.5	0.2	-2.3	5.9	2.8	1.4	2.3	1.6	2.9	0.5	1.6	0.0	2.2	-0.6	-0.8	0.7	0.1	2.0	0.6	1.1	-0.8	-0.8	-0.2	-0.8	-0.8	-0.8	-0.8	-0.8	-0.2	-0.8
13	Orange	1.4	-4.2	0.2	-4.2	0.4	3.9	3.3	1.3	-0.6	0.1	-2.9	3.1	-7.4	-0.6	1.5	-5.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-5.2	1.4
14	Dutchess	-1.0	-0.7	0.5	-7.2	3.4	4.6	1.4	1.6	1.6	7.7	2.6	1.9	1.5	2.0	-0.5	1.4	0.7	0.1	2.0	0.6	1.1	-0.8	-0.8	-0.2	-0.8	-0.8	-0.8	-0.8	-0.8	-0.2	-0.8
15	Fairfield	-1.9	-4.9	-2.0	2.5	0.9	4.7	2.6	3.0	1.9	0.3	-6.8	2.8	-4.0	-0.9	-4.0	-0.1	4.9	5.5	6.0	5.6	5.8	5.4	5.3	5.5	5.3	5.3	5.3	5.3	5.4	2.7	5.3
16	Bergen	-2.4	-2.4	-2.8	-0.8	-1.3	1.7	-1.7	1.0	-1.0	-0.9	-7.4	-6.6	-7.4	-6.6	-7.4	-7.1	0.4	1.0	1.1	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-6.8	1.0
17	Passaic	-2.6	-2.6	-2.0	-0.1	-1.5	2.1	-1.7	2.4	-1.0	-1.0	-8.2	-6.6	-8.0	-6.6	-8.0	-8.0	1.3	0.6	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-7.1	1.0
18	Hudson	-1.8	-1.5	-1.4	0.3	0.9	2.2	0.2	-0.4	0.3	0.3	-6.2	-6.6	-6.5	-6.6	-6.5	-6.9	1.5	0.9	0.6	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	-6.4	0.9
19	Essex	-2.4	-2.0	-1.6	-0.7	-1.8	1.3	-1.8	1.9	0.0	0.0	-7.3	-6.6	-7.6	-6.6	-7.6	-7.5	1.1	1.0	1.1	0.6	1.1	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-6.9	1.0
20	Union	-2.3	-1.9	-1.6	0.2	0.0	1.6	-1.7	1.7	-1.1	0.1	-6.9	-6.6	-7.2	-6.6	-7.2	-7.2	1.0	1.0	1.1	1.0	0.7	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	-6.7	0.9
21	Morris	-2.8	-2.3	-1.5	0.1	-3.1	0.6	-4.4	2.6	-0.2	-0.2	-8.2	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.6	1.1	0.4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	-7.4	1.1
22	Somerset	-2.7	-2.8	-2.0	0.1	-3.1	0.5	-4.5	4.9	-0.9	-0.2	-8.6	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.1	1.1	1.1	0.4	1.1	1.1	1.1	1.1	1.1	1.1	-7.4	1.1
23	Middlesex	-2.6	-2.7	-2.0	0.1	-2.4	0.8	-3.8	2.9	-0.8	-0.1	-7.8	-6.6	-8.2	-6.6	-8.2	-7.7	1.1	1.1	1.1	1.1	1.1	1.0	1.0	0.6	1.0	1.0	1.0	1.0	1.0	-7.2	1.0
24	Monmouth	-2.8	-2.8	-2.0	0.1	-3.4	0.5	-4.8	3.3	-0.9	-0.2	-8.6	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.5	1.1	1.1	1.1	1.1	-7.4	1.1
25	Ocean	-2.8	-2.8	-2.0	0.1	-3.1	0.5	-4.5	4.7	-0.9	-0.2	-8.6	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.7	1.1	1.1	1.1	-7.4	1.1
26	Hunterdon	-2.8	-2.8	-2.0	0.1	-3.1	0.5	-3.1	4.8	-0.9	-0.2	-8.6	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.1	1.1	1.1	1.7	1.1	1.1	1.1	0.2	1.1	1.1	-7.4	1.1
27	Warren	-2.8	-2.8	-2.0	0.1	-3.1	0.5	-3.1	4.1	-0.9	-0.2	-8.6	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.1	1.1	1.4	1.1	1.1	1.1	1.1	1.1	0.2	1.1	-7.4	1.1
28	Sussex	-2.8	-2.8	-2.0	0.1	-3.1	0.6	-3.1	4.8	-0.2	-0.2	-8.9	-6.6	-8.6	-6.6	-8.6	-8.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.3	-7.4	1.1
29	New Haven	-2.1	-2.1	-4.0	4.0	1.8	0.6	4.9	3.0	-0.2	0.5	-10.8	0.5	-3.3	-1.4	-4.0	0.3	6.2	6.0	6.5	6.1	6.3	5.9	5.8	6.0	5.8	5.8	5.8	5.8	5.9	1.2	5.8
30	Mercer	-2.8	-2.8	-2.0	0.1	-3.4	0.5	-3.4	4.5	-0.2	-0.2	-8.6	-6.6	-8.6	-6.6	-8.6	-7.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.7	1.1	1.1	1.1	1.1	1.1	-7.4	0.6

Table A-4-3: County-To-County Factors - Purpose 3: Work / High Income

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1.1	0.0	-0.5	-2.6	1.7	6.9	-0.6	0.8	0.3	1.0	-2.8	2.8	-2.8	2.8	-2.8	-0.2	4.2	3.8	4.5	3.6	4.1	3.3	2.9	3.3	3.3	3.3	3.3	3.3	3.3	-0.2	3.3
1	Valley Mn	0.8	3.1	1.4	-0.2	-3.5	1.9	0.7	0.2	2.9	0.3	-3.5	1.3	-2.8	1.3	-3.5	1.8	3.4	3.8	4.1	3.7	4.4	3.3	3.3	3.6	3.3	3.3	3.3	3.3	3.3	-0.2	3.3
2	Midtown Mn	-0.4	-0.4	2.3	-2.3	-2.5	4.5	-0.2	0.2	-0.1	0.3	-3.5	1.3	-2.8	1.4	-2.8	2.9	2.5	2.9	3.8	3.2	3.5	2.4	2.4	2.8	2.4	2.4	2.4	2.4	2.4	-0.2	2.4
3	Upper Mn	0.4	0.8	1.5	-1.1	-0.4	4.1	-1.1	0.8	-0.4	1.2	1.6	6.9	2.8	5.0	2.8	-2.5	2.2	2.0	4.4	2.9	4.0	3.2	4.0	4.3	4.0	4.0	4.0	4.0	4.0	-2.5	4.0
4	Queens	-1.2	-0.3	1.4	0.4	1.7	1.4	-0.9	-2.0	0.7	0.4	2.7	-0.1	-0.4	-1.0	-1.1	-1.2	-1.5	-0.9	1.6	-0.2	1.2	0.1	0.1	0.2	-0.1	0.1	0.1	0.1	0.1	-3.1	-0.1
5	Bronx	0.0	-1.2	-1.0	0.2	-1.8	-1.2	-6.5	-1.0	-2.9	-2.2	1.7	0.2	-0.1	-0.4	-0.8	-3.1	-5.0	-4.7	-3.1	-4.1	-3.7	-4.1	-3.5	-3.1	-3.5	-3.5	-3.5	-3.5	-3.4	-2.5	-3.5
6	Kings	-0.4	-1.3	0.7	0.9	-1.1	1.3	1.2	-0.4	-1.9	-1.3	1.7	0.5	-1.1	-1.7	-1.8	-3.1	1.3	1.7	2.7	1.8	2.3	1.2	1.2	1.3	1.0	1.2	1.2	1.2	1.2	-3.1	1.0
7	Richmond	7.1	4.4	3.2	-0.3	-2.0	-1.7	-6.2	-0.3	0.4	-0.6	-1.1	-1.1	-0.4	-1.1	-0.4	-2.5	-0.7	-0.2	-1.6	-0.6	-0.9	0.4	0.4	-0.2	0.2	0.4	0.4	0.4	0.4	-2.5	0.2
8	Nassau	0.0	-1.1	2.7	-1.0	-1.1	0.3	-1.6	-0.3	-1.1	0.6	1.4	9.0	-0.6	8.1	-0.6	5.6	3.9	4.5	4.2	5.7	5.2	7.0	7.0	6.4	7.0	7.0	7.0	7.0	7.0	0.6	7.0
9	Suffolk	-3.0	-6.0	-1.7	-8.5	-2.6	-2.2	-7.7	0.4	1.2	0.0	5.4	9.0	-0.6	8.7	-0.6	0.6	4.7	5.3	4.2	5.7	5.2	7.0	7.0	6.4	7.0	7.0	7.0	7.0	7.0	0.6	7.0
10	Westchester	-0.3	-1.4	0.5	-2.7	-1.1	0.2	-2.2	0.1	-2.8	-2.8	-1.1	1.2	2.9	1.3	3.8	0.8	-1.7	-2.2	0.6	-0.8	0.5	-1.3	-1.4	-0.8	-1.4	-1.4	-1.4	-1.4	-1.3	0.5	-1.4
11	Rockland	-2.7	-2.8	-3.6	-4.9	-1.1	-2.3	-7.1	-3.9	5.2	1.0	-1.4	-1.7	-7.6	-0.3	-7.0	2.9	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	2.4	-1.2
12	Putnam	-3.1	-4.5	-2.7	-6.6	3.1	-3.5	-1.0	0.8	-0.5	-0.5	-0.5	-0.9	5.5	-1.2	-0.7	-1.2	0.1	-0.5	1.4	0.0	0.5	-1.4	-1.4	-0.8	-1.4	-1.4	-1.4	-1.4	-1.4	-1.2	-1.4
13	Orange	-7.3	-6.4	-4.7	-9.5	-3.8	-4.9	-9.9	-3.2	0.5	-2.7	-5.3	1.4	-8.5	-3.4	-1.2	-0.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-0.5	-1.2
14	Dutchess	-3.7	-6.1	-6.0	-5.3	-3.2	-1.3	-4.9	0.8	-1.2	-1.2	0.0	-0.9	5.2	-2.4	1.0	-0.5	0.1	-0.5	1.4	0.0	0.5	-1.4	-1.4	-0.8	-1.4	-1.4	-1.4	-1.4	-1.4	-1.2	-1.4
15	Fairfield	-4.7	-3.7	-1.6	-15.3	-4.4	-7.1	-8.5	-2.8	-4.4	-3.7	0.0	5.9	2.3	4.5	2.3	-0.3	2.5	3.2	3.6	3.3	3.4	3.0	2.9	3.1	2.9	2.9	2.9	2.9	3.0	-0.1	2.9
16	Bergen	-1.7	-1.7	-2.1	-6.5	0.1	0.6	-2.8	-1.2	1.6	1.7	1.4	0.9	1.4	0.9	1.4	4.1	0.1	0.5	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4.0	0.5
17	Passaic	-1.9	-1.9	-1.3	-5.8	-0.2	1.0	-2.8	-0.7	1.6	1.6	0.6	0.9	0.9	0.9	0.9	3.2	0.6	-0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	3.7	0.5
18	Hudson	-1.1	-0.8	-0.7	-5.4	2.3	1.1	-0.9	-1.7	2.8	2.8	2.6	0.9	2.3	0.9	2.3	4.3	0.5	0.4	-0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.4	0.4
19	Essex	-1.7	-1.3	-0.9	-6.4	-0.5	0.2	-2.9	-0.2	2.6	2.6	1.6	0.9	1.2	0.9	1.2	3.7	0.6	0.5	0.6	-0.1	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	3.9	0.5
20	Union	-1.6	-1.2	-0.9	-5.4	1.4	0.5	-2.8	-1.2	1.5	2.7	2.0	0.9	1.6	0.9	1.6	4.0	0.5	0.5	0.6	0.5	-0.1	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	4.1	0.4
21	Morris	-2.1	-1.6	-0.8	-5.5	-1.8	-0.5	-5.5	0.4	2.4	2.4	0.6	0.9	0.2	0.9	0.2	3.4	0.6	0.6	0.6	0.6	0.6	0.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	3.5	0.6
22	Somerset	-2.0	-2.1	-1.3	-5.5	-1.8	-0.6	-5.6	1.3	1.7	2.4	0.2	0.9	0.2	0.9	0.2	3.3	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6	3.4	0.6
23	Middlesex	-1.9	-2.0	-1.3	-5.5	-1.1	-0.3	-4.9	0.7	1.8	2.5	1.0	0.9	0.7	0.9	0.7	3.5	0.6	0.6	0.6	0.6	0.6	0.5	0.5	-0.3	0.5	0.5	0.5	0.5	0.5	3.6	0.5
24	Monmouth	-2.1	-2.1	-1.3	-5.5	-2.1	-0.6	-5.9	1.0	1.7	2.4	0.2	0.9	0.2	0.9	0.2	3.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.2	0.6	0.6	0.6	0.6	3.4	0.6
25	Ocean	-2.1	-2.1	-1.3	-5.5	-1.8	-0.6	-5.6	1.7	1.7	2.4	0.2	0.9	0.2	0.9	0.2	3.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.6	0.6	0.6	3.4	0.6
26	Hunterdon	-2.1	-2.1	-1.3	-5.5	-1.8	-0.6	-4.2	1.7	1.7	2.4	0.2	0.9	0.2	0.9	0.2	3.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.6	3.4	0.6
27	Warren	-2.1	-2.1	-1.3	-5.5	-1.8	-0.6	-4.2	1.0	1.7	2.4	0.2	0.9	0.2	0.9	0.2	3.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-0.8	0.6	3.4	0.6
28	Sussex	-2.1	-2.1	-1.3	-5.5	-1.8	-0.5	-4.2	1.7	2.4	2.4	-0.1	0.9	0.2	0.9	0.2	3.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.1	3.5	0.6
29	New Haven	-4.7	-4.7	-4.7	-14.1	-2.8	-6.5	-8.5	-2.8	-3.5	-3.5	1.6	5.9	3.0	4.7	3.0	2.7	3.4	3.3	3.7	3.4	3.5	3.1	3.0	3.2	3.0	3.0	3.0	3.0	3.1	0.1	3.0
30	Mercer	-2.1	-2.1	-1.3	-5.5	-2.1	-0.6	-4.5	1.4	2.4	2.4	0.2	0.9	0.2	0.9	0.2	3.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	3.4	0.2

Table A-4-4: County-To-County Factors - Purpose 4: School

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1.0	-0.3	-1.2	-0.1	-7.1	-4.5	-8.8	-3.1	-2.1	-0.7	6.3	3.6	0.0	4.3	0.0	-2.1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-1.4	-0.9
1	Valley Mn	2.7	1.0	-6.5	1.8	-7.8	-4.5	-10.2	-3.1	-2.1	-0.7	-0.7	3.6	0.0	3.6	0.0	-1.4	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-1.4	-0.9
2	Midtown Mn	-1.2	-1.1	1.9	2.3	-7.8	-1.9	-8.8	-3.1	-2.1	-0.7	-0.7	3.6	0.0	3.6	0.0	-2.1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-1.4	-0.9
3	Upper Mn	-0.7	-3.5	-1.3	2.3	-8.6	-5.5	-10.2	-3.6	-3.8	-2.5	-4.5	-4.0	-0.9	-3.3	-0.9	-2.1	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-1.4	-2.6
4	Queens	-0.4	-2.2	-1.4	-0.4	0.1	0.9	-4.8	3.2	-2.3	-4.9	-0.9	-1.7	-0.2	-1.7	-0.9	-1.4	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-1.4	5.0
5	Bronx	1.8	-2.6	0.7	2.8	-3.1	0.3	-6.0	3.3	-5.7	-5.1	-0.8	-1.7	0.5	-1.7	-0.2	-5.1	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-4.4	-3.0
6	Kings	1.6	-1.4	0.2	1.7	-0.5	1.8	0.2	-1.0	-2.7	-2.7	-0.9	-1.7	-0.2	-1.7	-0.9	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	0.0
7	Richmond	4.8	-0.7	-0.7	5.2	-1.7	-0.7	-4.2	-0.1	-1.4	-0.1	-0.9	-1.7	-0.2	-1.7	-0.2	-2.1	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-1.4	-2.3
8	Nassau	-1.4	-1.4	-1.4	1.6	-2.1	0.1	-4.1	-3.4	0.7	-1.0	-1.4	-0.7	-0.7	-0.7	-0.7	-1.4	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	-1.4	4.0
9	Suffolk	-1.4	-0.7	-0.7	7.1	-3.3	0.8	-4.1	-2.7	-6.9	0.4	-1.4	-0.7	-0.7	-0.7	-0.7	-1.4	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	-1.4	4.0
10	Westchester	0.5	-1.8	-1.8	0.8	-5.5	-6.4	-7.2	-3.5	-7.1	-5.7	0.6	-1.5	0.7	-1.6	-1.3	-9.3	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-6.4	-2.5
11	Rockland	-1.8	-1.8	-1.8	-0.2	-3.2	-3.9	-3.9	-3.2	-2.1	-0.7	1.0	0.1	-0.3	-8.2	-1.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-4.4	-5.0
12	Putnam	-1.1	-1.1	-1.1	1.4	-4.8	-5.9	-5.8	-2.8	-5.7	-5.7	1.8	-0.9	0.5	-1.6	-1.3	-7.8	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-6.4	-2.5
13	Orange	-1.8	-1.8	-1.1	0.5	-3.2	-2.5	-3.2	-2.5	-0.7	-0.7	4.8	-0.1	-0.3	-0.1	-1.9	-4.4	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-4.4	-5.0
14	Dutchess	-1.1	-1.1	-1.1	1.4	-5.5	-5.3	-5.8	-2.8	-5.7	-5.7	-0.6	-0.9	-1.3	-1.6	0.3	0.3	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-5.7	-2.5
15	Fairfield	-1.4	-1.4	-1.4	-1.4	-1.4	-2.1	-1.4	-0.7	-1.4	-0.7	-1.5	-1.4	-1.5	-1.4	-0.8	0.1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-1.5	5.0
16	Bergen	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
17	Passaic	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
18	Hudson	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
19	Essex	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
20	Union	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
21	Morris	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
22	Somerset	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
23	Middlesex	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
24	Monmouth	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
25	Ocean	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
26	Hunterdon	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
27	Warren	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
28	Sussex	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
29	New Haven	-1.4	-1.4	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.8	-0.7	-0.8	-0.7	-0.1	-1.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-0.4	5.0
30	Mercer	1.3	1.3	1.3	0.0	0.0	1.4	-5.0	1.9	-5.0	-5.0	1.6	0.6	1.6	0.6	1.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0

Table A-4-5: County-To-County Factors - Purpose 5: University

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	6.5	6.5	7.2	-4.8	-4.9	-4.9	-0.7	-4.2	-2.8	-1.4	-2.8	-0.2	-1.4	-0.2	-2.1	-2.8	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-2.8	-5.2
1	Valley Mn	15.9	10.3	7.2	-2.5	-1.3	-4.9	-4.9	-4.2	-2.8	-1.4	-2.8	-0.2	-2.1	-0.2	-2.1	-2.8	-5.2	-5.2	-5.5	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-2.8	-5.2
2	Midtown Mn	15.1	13.5	8.8	-6.1	-4.9	-4.9	-4.9	-4.2	-2.8	-1.4	-2.8	-0.2	-2.1	-0.2	-1.4	-2.8	-5.2	-5.2	-5.4	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-2.8	-5.2
3	Upper Mn	17.4	13.3	13.1	-2.3	-1.1	-0.5	3.3	-0.4	-0.1	-1.1	-2.8	-1.5	-2.1	-1.5	-2.1	-2.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-2.8	-5.8
4	Queens	6.6	4.5	5.0	-0.7	0.5	-4.0	2.0	-0.3	0.3	-1.5	-4.1	-1.5	-3.5	-1.5	-3.5	-4.8	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-4.8	-2.0
5	Bronx	9.6	7.2	5.8	-0.4	2.4	-0.1	2.8	0.4	-0.8	-0.8	-4.7	3.4	-3.5	-1.5	-3.5	-7.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-7.8	-5.8
6	Kings	11.5	5.8	4.3	-1.6	0.2	-1.0	1.9	-1.0	-2.8	-1.5	-8.1	-4.5	-7.5	-4.5	-7.5	-7.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-7.8	-5.8
7	Richmond	8.7	6.0	0.6	3.5	3.6	-0.3	1.8	0.3	-0.8	-0.1	-3.5	-1.5	-2.8	-1.5	-3.5	-2.1	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-2.8	-5.8
8	Nassau	-0.1	-0.9	0.1	0.3	-0.2	-1.6	1.0	-0.9	1.0	0.8	-7.8	-5.5	-7.1	-5.5	-7.8	-7.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-7.8	-5.8
9	Suffolk	-0.1	-0.1	-0.1	1.8	-0.4	-0.9	-1.9	-0.2	2.2	0.7	-7.8	-5.5	-7.1	-5.5	-7.1	-7.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-7.8	-5.8
10	Westchester	3.9	7.5	10.6	0.2	-1.5	-0.8	-0.8	-0.1	-2.1	-1.4	-2.3	1.7	-1.5	-5.2	-1.5	-5.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-5.3	-1.6
11	Rockland	2.7	4.3	2.7	-4.5	-1.2	-1.3	-0.5	-0.5	-1.5	-1.5	-3.8	-1.3	-1.8	-4.4	-1.8	-3.7	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-2.9	-1.6
12	Putnam	3.9	3.9	3.9	0.3	-0.1	0.6	-0.1	-0.1	-1.4	-1.4	0.8	-4.6	-2.3	-4.6	1.7	-5.3	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-3.9	-1.6
13	Orange	2.7	3.4	2.7	1.4	-0.5	-0.5	-0.5	-0.5	-1.5	-1.5	-1.8	1.9	-1.8	-4.1	-11.2	-3.7	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-2.9	-1.6
14	Dutchess	3.9	3.9	3.9	1.0	-0.1	-0.1	-0.1	-0.1	-1.4	-1.4	-0.8	-4.6	-1.5	-5.9	-1.1	-0.4	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-3.9	-1.6
15	Fairfield	-0.7	-1.4	-0.7	-2.1	-2.1	-2.8	-1.4	-1.4	-0.7	0.0	-2.8	-0.8	-2.8	-0.8	-2.1	-0.3	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	1.8	-0.8
16	Bergen	2.9	2.9	2.9	-2.3	0.5	0.5	0.4	0.4	-0.8	-0.8	-0.5	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
17	Passaic	2.9	2.9	2.9	-2.3	0.5	0.5	0.4	0.4	-0.8	-0.8	-0.5	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
18	Hudson	2.9	2.8	2.8	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
19	Essex	2.9	2.8	2.8	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
20	Union	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
21	Morris	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
22	Somerset	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
23	Middlesex	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
24	Monmouth	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
25	Ocean	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
26	Hunterdon	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
27	Warren	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
28	Sussex	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1
29	New Haven	-0.7	-0.7	-0.7	-1.4	-1.4	-2.1	-1.4	-1.4	0.0	0.0	-1.4	-0.7	-1.4	-0.7	-1.4	2.5	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.6	-0.7
30	Mercer	2.9	2.9	2.9	-2.4	0.4	0.4	0.4	0.4	-0.8	-0.8	-0.6	0.1	-0.6	0.1	-0.6	-0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7	0.1

Table A-4-6: County-To-County Factors - Purpose 6: Maintenance

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	-2.7	1.0	0.1	-0.2	3.5	5.4	4.0	-0.7	-0.2	-0.2	-1.0	-6.1	-0.3	-5.2	-0.3	2.6	0.2	0.0	1.3	0.8	1.0	-0.2	0.4	0.6	0.8	0.8	0.8	0.8	0.8	3.3	0.8
1	Valley Mn	-0.4	0.9	-1.3	-2.4	0.0	-1.5	-0.7	-0.7	2.6	-0.9	-0.4	-6.8	-1.0	-5.2	-0.3	1.9	0.2	0.0	1.1	1.0	1.3	-0.2	0.8	0.9	0.8	0.8	0.8	0.8	0.8	2.6	0.8
2	Midtown Mn	-1.8	0.0	0.8	0.1	-0.1	-0.7	1.2	-0.7	-0.9	-0.2	-0.4	-3.3	-0.3	-1.0	-0.3	2.4	-0.1	-0.3	1.3	0.8	1.0	-0.7	0.2	0.5	0.2	0.2	0.2	0.2	0.2	2.6	0.2
3	Upper Mn	-2.9	-0.7	-1.6	0.2	0.8	-0.3	-0.5	-0.9	1.1	3.4	3.2	-5.5	2.6	-5.3	2.6	-1.5	0.3	0.5	1.9	1.3	2.1	1.5	2.5	2.4	2.5	2.5	2.5	2.5	2.5	-1.4	2.5
4	Queens	0.0	0.7	-0.1	-0.5	0.6	0.7	0.0	2.3	1.5	2.6	2.3	5.9	0.0	7.3	0.0	-2.1	0.6	1.3	2.1	0.6	1.7	0.9	0.9	1.0	0.7	0.9	0.9	0.9	0.9	-2.1	0.7
5	Bronx	0.2	0.6	0.3	1.1	1.6	-0.1	0.9	-0.7	-1.4	0.3	1.4	2.1	0.5	0.2	0.5	-2.1	-4.3	-2.8	-5.2	-3.2	-3.9	-1.4	-1.4	-2.2	-1.4	-1.4	-1.4	-1.4	-1.4	-2.1	-1.4
6	Kings	1.0	0.9	0.7	1.2	1.1	2.2	0.4	0.8	0.2	1.0	0.0	5.0	0.0	5.0	0.0	-2.1	1.4	1.1	2.0	1.4	1.6	0.8	0.8	0.8	0.6	0.8	0.8	0.8	0.8	-1.4	0.6
7	Richmond	4.0	5.0	4.8	6.1	7.2	2.3	-0.8	0.2	0.9	0.9	0.7	6.6	0.7	6.6	0.7	-1.4	1.8	2.7	-0.1	2.0	1.3	4.0	4.0	2.9	3.8	4.0	4.0	4.0	4.0	-1.4	3.8
8	Nassau	0.6	1.1	1.7	0.3	0.8	-0.2	-1.2	-0.7	0.0	1.7	-2.8	6.5	-2.8	5.6	-2.8	-2.1	2.6	3.0	2.6	3.6	3.2	4.5	4.5	4.1	4.5	4.5	4.5	4.5	4.5	-1.4	4.5
9	Suffolk	1.0	1.7	3.3	1.2	0.6	0.5	2.6	0.0	0.0	-0.2	-1.9	7.7	-2.1	7.0	-2.1	-2.1	2.6	3.0	2.6	3.6	3.2	4.5	4.5	4.1	4.5	4.5	4.5	4.5	4.5	-1.4	4.5
10	Westchester	2.0	2.6	2.1	-1.5	0.0	-0.9	3.8	0.5	0.5	1.1	-0.7	1.5	0.6	0.7	1.6	0.8	-0.8	-0.4	0.2	1.1	0.8	2.0	2.0	1.6	2.0	2.0	2.0	2.0	2.0	2.8	2.0
11	Rockland	7.3	6.6	4.6	4.9	6.5	0.0	6.9	8.6	0.7	0.0	-7.0	-0.8	-10.1	3.7	-10.1	0.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.7	0.9
12	Putnam	2.6	3.9	3.9	-0.3	3.0	-0.5	4.5	-0.2	1.1	1.1	1.8	6.4	-0.9	0.7	0.1	1.6	1.0	1.4	0.2	1.1	0.8	2.0	2.0	1.6	2.0	2.0	2.0	2.0	2.0	3.5	2.0
13	Orange	7.3	6.1	6.0	7.7	6.9	0.4	6.9	8.6	-0.3	-0.3	-10.7	1.5	-10.7	-0.9	-5.2	-0.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	-0.9	0.9
14	Dutchess	2.6	3.2	3.9	-1.0	3.0	0.2	4.5	-0.2	1.1	1.1	2.8	1.6	2.9	-3.0	-0.6	3.1	1.0	1.4	0.2	1.1	0.8	2.0	2.0	1.6	2.0	2.0	2.0	2.0	2.0	2.8	2.0
15	Fairfield	7.5	9.8	9.8	5.3	-1.4	-2.1	-1.4	-1.4	1.4	2.1	-4.6	3.4	-2.2	3.2	-2.2	-1.1	3.9	4.3	4.0	4.9	4.6	5.8	5.8	5.4	5.8	5.8	5.8	5.8	5.8	0.6	5.8
16	Bergen	-1.4	-1.4	-1.3	-1.7	0.6	-2.6	0.9	-1.0	1.0	1.0	-2.5	0.4	-2.2	0.4	-2.2	2.7	-0.3	-0.2	0.0	-0.2	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	2.8	-0.3
17	Passaic	-0.3	-0.3	0.1	-0.4	2.5	-2.7	1.9	0.4	2.5	2.5	-1.4	0.4	-0.7	0.4	-0.7	2.6	-0.1	-0.3	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	3.1	-0.2
18	Hudson	-3.2	-2.8	-3.3	-2.6	-0.4	-2.1	-0.9	-3.4	-0.7	-0.7	-4.8	0.4	-4.8	0.4	-4.8	2.2	-0.3	-0.4	0.0	-0.3	-0.2	-0.6	-3.0	-2.8	-0.6	-0.6	-0.6	-0.6	-0.6	2.3	-3.0
19	Essex	-1.0	-0.6	-0.4	-2.1	0.8	-2.3	1.7	0.0	2.4	2.4	-1.7	0.4	-1.7	0.4	-1.7	2.8	-0.2	-0.2	-0.1	-0.1	-0.1	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	2.9	-0.3
20	Union	-1.8	-1.3	-1.3	-1.7	1.9	-2.2	1.0	-1.1	1.3	1.3	-2.8	0.4	-2.8	0.4	-2.8	2.6	-0.2	-0.3	0.0	-0.2	-0.1	-0.4	-0.4	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	2.7	-0.4
21	Morris	0.9	1.4	2.2	0.1	4.5	-2.6	3.1	2.0	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
22	Somerset	0.9	0.9	1.7	0.1	4.5	-2.6	3.1	2.0	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
23	Middlesex	0.0	0.0	0.6	-0.4	3.4	-2.5	2.0	0.6	4.0	4.0	-0.2	0.4	-0.2	0.4	-0.2	3.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	3.2	-0.1
24	Monmouth	0.9	0.9	1.7	0.1	4.2	-2.6	2.8	1.7	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
25	Ocean	1.8	1.8	2.7	1.1	4.5	-2.6	3.1	2.0	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
26	Hunterdon	1.8	1.8	2.7	1.1	4.5	-2.6	3.1	2.0	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
27	Warren	1.8	1.8	2.7	1.1	4.5	-2.6	3.1	2.0	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
28	Sussex	1.8	1.8	2.7	1.1	4.5	-2.6	3.1	2.0	5.2	5.2	0.7	0.4	1.1	0.4	1.1	2.9	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0
29	New Haven	7.5	7.5	7.5	3.0	-1.4	-2.1	-1.4	-1.4	1.4	1.4	-1.5	3.6	-1.5	2.7	-1.5	1.6	4.9	5.4	4.1	5.0	4.7	5.9	5.9	5.5	5.9	5.9	5.9	5.9	5.9	-0.5	5.9
30	Mercer	1.8	1.8	2.7	1.1	4.2	-2.6	2.8	1.7	5.2	5.2	1.1	0.4	1.1	0.4	1.1	3.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0

Table A-4-7: County-To-County Factors - Purpose 7: Discretionary

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	-6.9	0.2	3.5	2.7	-0.9	5.5	4.8	-0.2	7.3	0.9	2.5	-6.5	2.5	-5.5	2.5	-1.4	-0.7	-0.9	0.4	-0.1	0.1	-1.1	-0.5	-0.3	-0.1	-0.1	-0.1	-0.1	-0.1	-0.7	-0.1
1	Valley Mn	-2.1	0.6	-1.1	-2.2	0.5	2.3	0.0	-0.9	1.6	0.2	2.3	-7.2	1.8	2.5	2.5	-1.4	-0.7	-0.9	0.5	0.1	0.4	-1.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-1.4	-0.1
2	Midtown Mn	-1.4	-0.7	0.9	-2.1	-1.1	0.3	-0.1	-0.9	0.2	0.2	2.3	-3.6	2.5	-2.7	2.5	-0.9	-1.0	-1.2	0.6	-0.1	0.1	-1.6	-0.7	-0.4	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
3	Upper Mn	-0.4	-0.1	-0.6	0.3	1.4	2.0	0.5	2.0	-2.1	-2.1	2.2	-6.9	8.2	-6.6	7.2	-1.5	-2.6	-2.4	-1.0	-1.6	-0.8	-1.4	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4	-1.4	-0.4
4	Queens	-0.4	1.0	0.6	0.1	0.2	-1.4	0.9	-0.7	1.7	0.1	-1.1	5.4	-1.1	4.5	-1.1	-1.4	-0.9	-0.2	0.6	-0.9	0.2	-0.6	-0.6	-0.5	-0.8	-0.6	-0.6	-0.6	-0.6	-2.5	-0.8
5	Bronx	2.6	1.2	0.5	0.5	-1.0	-0.3	-0.2	1.6	-1.4	-0.7	-0.6	3.2	-0.6	-0.3	-0.6	-2.5	-2.9	-1.4	-3.8	-1.8	-2.5	0.0	0.0	-0.8	0.0	0.0	0.0	0.0	0.0	-2.5	0.0
6	Kings	-0.7	0.8	-0.3	-0.6	0.2	1.2	0.4	0.9	0.2	3.1	-1.1	4.5	-1.1	4.5	-1.1	-2.5	0.1	-0.2	0.6	0.0	0.2	-0.6	-0.6	-0.5	-0.8	-0.6	-0.6	-0.6	-0.6	-1.8	-0.8
7	Richmond	3.1	3.5	1.3	3.8	-0.7	-0.7	0.2	0.5	0.0	0.0	-0.4	6.1	-0.4	6.1	-0.4	-1.8	1.0	1.9	-0.9	1.3	0.5	3.2	3.2	2.1	3.0	3.2	3.2	3.2	3.2	-1.8	3.0
8	Nassau	3.7	3.4	3.9	1.5	0.3	-2.7	-1.6	-0.4	0.0	1.6	-0.5	1.1	-0.5	0.2	-0.5	-2.1	-2.3	-1.9	-2.4	-1.3	-1.7	-0.4	-0.4	-0.8	-0.4	-0.4	-0.4	-0.4	-0.4	-2.1	-0.4
9	Suffolk	1.4	4.2	5.4	4.6	-1.1	2.0	-0.8	-0.4	0.2	-0.2	1.8	2.4	0.2	0.2	0.2	-2.1	-2.3	-1.9	-2.4	-1.3	-1.7	-0.4	-0.4	-0.8	-0.4	-0.4	-0.4	-0.4	-0.4	-1.4	-0.4
10	Westchester	3.3	3.9	4.0	2.1	1.6	-1.1	4.3	-0.1	6.0	1.9	-0.9	-1.5	-2.3	-1.4	1.6	0.6	-5.7	-5.3	-4.7	-3.8	-4.1	-2.9	-2.9	-3.3	-2.9	-2.9	-2.9	-2.9	-2.9	0.7	-2.9
11	Rockland	7.1	7.8	5.8	3.7	7.5	3.9	7.2	4.7	1.6	1.6	-7.6	-1.5	-9.7	1.7	-9.7	-0.5	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1
12	Putnam	2.5	3.9	3.2	1.3	-0.1	-0.1	-0.1	-0.1	1.9	1.2	1.1	3.1	-0.7	0.4	0.4	0.5	-3.9	-3.4	-4.7	-3.8	-4.1	-2.9	-2.9	-3.3	-2.9	-2.9	-2.9	-2.9	-2.9	1.4	-2.9
13	Orange	6.4	6.4	5.8	4.5	7.2	0.8	10.4	4.0	1.3	1.3	-9.6	-0.4	-10.3	-1.4	-9.0	-1.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.9	-0.1
14	Dutchess	9.9	3.2	8.9	2.9	0.6	-0.8	-0.1	-0.1	1.2	1.2	1.4	-0.5	2.0	-0.3	-0.8	1.5	-3.9	-3.4	-4.7	-3.8	-4.1	-2.9	-2.9	-3.3	-2.9	-2.9	-2.9	-2.9	-2.9	0.7	-2.9
15	Fairfield	4.1	5.5	6.4	-1.4	2.3	3.8	2.9	2.9	1.4	1.4	1.8	4.7	1.9	4.5	3.3	-0.9	6.3	6.7	6.4	7.3	7.0	8.2	8.2	7.8	8.2	8.2	8.2	8.2	8.2	0.3	8.2
16	Bergen	-0.2	-0.2	-0.1	-0.5	-1.5	-1.9	0.3	-3.1	0.8	0.8	-0.7	1.1	-0.3	1.1	-0.3	0.1	-0.3	-0.2	0.0	-0.2	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	0.1	-0.3
17	Passaic	0.9	0.9	1.3	0.8	0.4	-2.0	1.3	-1.7	2.3	2.3	0.4	1.1	1.2	1.1	1.2	0.0	-0.1	-0.3	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.4	-0.2
18	Hudson	-2.0	-1.5	-2.0	-1.4	-2.4	-1.3	-1.5	-5.4	-0.9	-0.9	-2.9	1.1	-2.9	1.1	-2.9	-0.4	-0.3	-0.4	0.0	-0.3	-0.2	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6
19	Essex	0.2	0.7	0.9	-0.8	-1.2	-1.5	1.1	-2.1	2.2	2.2	0.2	1.1	0.2	1.1	0.2	0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	0.2	-0.3
20	Union	-0.6	-0.1	-0.1	-0.4	-0.1	-1.4	0.4	-3.1	1.1	1.1	-0.9	1.1	-0.9	1.1	-0.9	0.0	-0.2	-0.3	0.0	-0.2	-0.1	-0.4	-0.4	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	0.0	-0.4
21	Morris	2.1	2.6	3.4	1.4	2.5	-1.8	2.5	-0.1	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
22	Somerset	2.1	2.1	2.9	1.4	2.5	-1.8	2.5	-0.1	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
23	Middlesex	1.2	1.2	1.8	0.9	1.4	-1.7	1.4	-1.5	3.7	3.7	1.7	1.1	1.7	1.1	1.7	0.5	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.5	-0.1
24	Monmouth	2.1	2.1	2.9	1.4	2.2	-1.8	2.2	-0.4	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
25	Ocean	3.0	3.0	3.9	2.4	2.5	-1.8	2.5	-0.1	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
26	Hunterdon	3.0	3.0	3.9	2.4	2.5	-1.8	2.5	-0.1	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
27	Warren	3.0	3.0	3.9	2.4	2.5	-1.8	2.5	-0.1	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
28	Sussex	3.0	3.0	3.9	2.4	2.5	-1.8	2.5	-0.1	5.0	5.0	2.5	1.1	2.9	1.1	2.9	0.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
29	New Haven	4.1	4.1	4.8	-0.7	2.9	2.3	3.6	2.9	2.1	1.4	3.3	4.8	3.3	3.9	3.3	1.4	7.2	7.7	6.4	7.3	7.0	8.2	8.2	7.8	8.2	8.2	8.2	8.2	8.2	-0.6	8.2
30	Mercer	3.0	3.0	3.9	2.4	2.2	-1.8	2.2	-0.4	5.0	5.0	2.9	1.1	2.9	1.1	2.9	0.7	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0

Table A-4-8: County-To-County Factors - Purpose 8: At-Work

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	2.0	2.7	0.5	1.4	-2.8	0.8	-1.3	-2.5	1.3	1.3	-0.5	-0.2	0.2	-0.2	0.2	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0
1	Valley Mn	-1.2	2.7	-0.1	1.3	-1.1	0.1	-2.1	-2.5	1.3	5.2	-0.5	-0.2	0.2	-0.2	0.2	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0
2	Midtown Mn	0.6	0.6	2.9	1.1	-0.6	-2.5	-2.9	-2.5	1.3	1.3	0.4	-0.2	0.2	-0.2	0.2	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0
3	Upper Mn	-3.5	-3.7	-4.8	-0.1	-5.2	-3.2	-3.9	-3.9	-1.4	-1.4	-1.4	-2.8	-0.7	-2.1	-0.7	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0
4	Queens	-6.8	-5.4	-6.8	-6.5	-1.3	1.3	-2.5	0.1	-4.8	-4.8	-3.8	-1.4	-2.7	-0.7	-2.0	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	0.0
5	Bronx	-4.6	-4.6	-4.6	-4.4	-1.1	-1.2	-1.1	-1.1	-2.4	-4.8	-3.2	-1.4	-0.6	-1.4	-0.6	-1.4	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	-1.4	0.8
6	Kings	-12.3	-4.3	-4.2	-3.1	-3.5	-1.1	0.8	-1.1	-2.5	-4.8	-2.7	-0.7	-2.0	-0.7	-2.0	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0
7	Richmond	-3.8	-3.8	-3.8	-3.1	-1.1	-1.1	-1.1	-0.6	-4.8	-4.1	-2.7	-1.4	-2.0	-1.4	-2.0	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	0.0
8	Nassau	-4.0	-2.0	-4.0	-2.4	-2.6	-3.2	-1.2	-3.2	-1.0	-0.3	-1.4	-1.4	-1.4	-0.7	-0.7	0.4	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.4	2.1
9	Suffolk	-4.0	-4.0	-4.0	-2.4	0.0	-3.2	-1.5	-2.5	-0.1	-0.4	-1.4	-1.4	-0.7	-0.7	-0.7	0.4	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.4	2.1
10	Westchester	-5.8	-5.8	-6.2	-2.2	-3.9	-2.7	-2.6	-2.6	-1.4	-1.4	-1.1	-2.4	-1.3	-3.4	-1.3	-1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.0	0.0
11	Rockland	-4.3	-5.0	-5.0	-1.4	-2.6	-2.6	-2.6	-2.6	-1.4	-0.7	-1.2	-2.8	-1.3	-2.4	-1.3	-2.1	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.5	-1.6
12	Putnam	-5.1	-5.1	-5.8	-2.2	-2.6	-2.6	-2.6	-1.9	-1.4	-0.7	-1.3	-3.4	-1.5	-3.4	-1.3	-3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.0	0.0
13	Orange	-5.0	-5.0	-5.0	-1.4	-2.6	-2.6	-2.6	-2.6	-1.4	-1.4	-1.3	-2.4	-1.3	-3.8	-1.3	-2.1	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-2.1	-1.6
14	Dutchess	-5.1	-5.8	-5.8	-2.2	-2.6	-2.6	-2.6	-1.9	-1.4	-0.7	-1.3	-3.4	-1.3	-3.4	-1.5	-3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.0	0.0
15	Fairfield	-2.9	0.0	-2.9	-1.4	-1.4	-1.4	-1.4	-0.7	-1.4	-1.4	-1.7	-1.4	-2.4	-1.4	-2.4	-1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	0.0
16	Bergen	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
17	Passaic	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
18	Hudson	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
19	Essex	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
20	Union	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
21	Morris	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
22	Somerset	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
23	Middlesex	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
24	Monmouth	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
25	Ocean	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
26	Hunterdon	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
27	Warren	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
28	Sussex	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0
29	New Haven	-2.9	-2.9	-2.9	-1.4	-1.4	-1.4	-1.4	-0.7	-1.4	-1.4	-2.4	-0.7	-2.4	-0.7	-1.7	-3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
30	Mercer	-1.6	-1.6	-1.6	-0.7	0.0	-1.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0

Mode Share Adjustments

For the 2010 NYBPM Re-calibration, the "observed" or "target" mode shares were developed primarily from the 2010 RHTS survey data, with the appropriate GPS correction factors and ACS 2010-based weights applied in the tabulations of mode shares by tour-purpose. The motorized mode targets were computed for aggregate origin destination pairs based on meaningful travel corridors such as from Long Island to Manhattan. The indices developed to define the origin and destination pair varies by purpose and are shown in **Tables A-5-1 to A-5-8**. The motorized mode choice adjustment factors are shown in **Tables A-6-1 to A-6-8.**

The non-motorized targets were also revised based on the 2010 RHTS and were defined in an entirely different fashion than the motorized targets. Since the non-motorized mode choice occurs before the destination choice, only origins are known for these trips. The adjustments for the non-motorized model are based on origins only rather than based on both origin and destination. The indices for origin aggregation and estimated adjustment factors are shown in **Tables A-7 and A-8.**

These motorized and non-motorized targets were used in the auto calibration procedure of MDSC model to compute mode specific adjustment constants. It should be noted that the auto-calibration is done only during the calibration process and the targets are not used thereafter in regular forecasting model runs. The final mode share adjustment factors from the calibration runs will be used in all NYBPM runs, base year and future, for all scenarios to be analyzed.

Table A-5-1: Origin-Destination Based Indices for Mode Specific Constants - Purpose 1: Work / Low Income

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	1	2	2	2	2	2	2	2	39	2	39	2	2	32	39	32	39	32	39	39	39	39	39	39	39	39	2	39
1	Valley Mn	1	1	1	1	2	2	2	2	2	2	2	39	2	39	2	2	32	39	32	39	32	39	39	39	39	39	39	39	39	2	39
2	Midtown Mn	1	1	1	1	2	2	2	2	2	2	2	39	2	39	2	2	31	39	31	39	31	39	39	39	39	39	39	39	39	2	39
3	Upper Mn	1	1	1	1	2	2	2	2	2	2	2	38	2	38	2	2	30	38	30	38	30	38	38	38	38	38	38	38	38	2	38
4	Queens	3	3	3	3	7	7	7	11	11	11	11	41	11	41	11	11	34	41	34	41	34	41	41	41	41	41	41	41	41	11	41
5	Bronx	3	3	3	3	7	7	7	11	11	11	11	40	11	40	11	11	33	40	33	40	33	40	40	40	40	40	40	40	40	11	40
6	Kings	3	3	3	3	7	7	7	11	11	11	11	41	11	41	11	11	34	41	34	41	34	41	41	41	41	41	41	41	41	11	41
7	Richmond	5	5	5	5	11	11	11	8	11	11	11	42	11	42	11	11	35	42	35	42	35	42	42	42	42	42	42	42	42	11	42
8	Nassau	4	4	4	4	11	11	11	11	9	9	11	43	11	43	11	11	36	43	36	43	36	43	43	43	43	43	43	43	43	11	43
9	Suffolk	4	4	4	4	11	11	11	11	9	9	11	43	11	43	11	11	36	43	36	43	36	43	43	43	43	43	43	43	43	11	43
10	Westchester	6	6	6	6	11	11	11	11	11	11	10	44	10	44	10	10	37	44	37	44	37	44	44	44	44	44	44	44	44	10	44
11	Rockland	20	20	19	18	26	25	26	27	28	28	29	10	29	10	29	29	46	48	46	48	46	48	48	48	48	48	48	48	48	29	48
12	Putnam	6	6	6	6	11	11	11	11	11	11	10	44	10	44	10	10	37	44	37	44	37	44	44	44	44	44	44	44	44	10	44
13	Orange	20	20	19	18	26	25	26	27	28	28	29	10	29	10	29	29	46	48	46	48	46	48	48	48	48	48	48	48	48	29	48
14	Dutchess	6	6	6	6	11	11	11	11	11	11	10	44	10	44	10	10	37	44	37	44	37	44	44	44	44	44	44	44	44	10	44
15	Fairfield	6	6	6	6	11	11	11	11	11	11	10	44	10	44	10	10	37	44	37	44	37	44	44	44	44	44	44	44	44	10	44
16	Bergen	14	14	13	12	22	21	22	23	24	24	29	11	29	11	29	29	8	8	8	8	8	8	8	8	8	8	8	8	8	29	8
17	Passaic	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
18	Hudson	14	14	13	12	22	21	22	23	24	24	29	11	29	11	29	29	8	8	8	8	8	8	8	8	8	8	8	8	8	29	8
19	Essex	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
20	Union	14	14	13	12	22	21	22	23	24	24	29	11	29	11	29	29	8	8	8	8	8	8	8	8	8	8	8	8	8	29	8
21	Morris	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
22	Somerset	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
23	Middlesex	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
24	Monmouth	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
25	Ocean	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
26	Hunterdon	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
27	Warren	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
28	Sussex	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47
29	New Haven	6	6	6	6	11	11	11	11	11	11	10	44	10	44	10	10	37	44	37	44	37	44	44	44	44	44	44	44	44	10	44
30	Mercer	17	17	16	15	26	25	26	27	28	28	29	11	29	11	29	29	45	47	45	47	45	47	47	47	47	47	47	47	47	29	47

Table A-5-2: Origin-Destination Based Indices for Mode Specific Constants - Purpose 2: Work / Middle Income

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	3	26	26	26	22	30	30	34	67	34	67	34	34	60	67	60	67	60	67	67	67	67	67	67	67	67	34	67
1	Valley Mn	1	77	1	3	26	26	26	22	30	30	34	67	34	67	34	34	60	67	60	67	60	67	67	67	67	67	67	67	67	34	67
2	Midtown Mn	1	1	78	3	26	26	26	22	30	30	34	67	34	67	34	34	59	67	59	67	59	67	67	67	67	67	67	67	67	34	67
3	Upper Mn	2	2	2	79	26	26	26	22	30	30	34	66	34	66	34	34	58	66	58	66	58	66	66	66	66	66	66	66	66	34	66
4	Queens	6	7	8	14	80	27	27	23	31	31	35	69	35	69	35	35	62	69	62	69	62	69	69	69	69	69	69	69	69	35	69
5	Bronx	4	4	5	14	27	81	27	23	31	31	35	68	35	68	35	35	61	68	61	68	61	68	68	68	68	68	68	68	68	35	68
6	Kings	9	10	11	14	27	27	82	23	31	31	35	69	35	69	35	35	62	69	62	69	62	69	69	69	69	69	69	69	69	35	69
7	Richmond	12	12	13	14	28	28	28	24	31	31	35	70	35	70	35	35	63	70	63	70	63	70	70	70	70	70	70	70	70	35	70
8	Nassau	16	16	17	15	29	29	29	25	32	32	35	71	35	71	35	35	64	71	64	71	64	71	71	71	71	71	71	71	71	35	71
9	Suffolk	16	16	17	15	29	29	29	25	32	32	35	71	35	71	35	35	64	71	64	71	64	71	71	71	71	71	71	71	71	35	71
10	Westchester	18	18	19	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
11	Rockland	47	47	46	45	54	53	54	55	56	56	57	36	57	36	57	57	74	76	74	76	74	76	76	76	76	76	76	76	76	57	76
12	Putnam	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
13	Orange	47	47	46	45	54	53	54	55	56	56	57	36	30	36	57	57	74	76	74	76	74	76	76	76	76	76	76	76	76	57	76
14	Dutchess	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
15	Fairfield	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
16	Bergen	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
17	Passaic	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
18	Hudson	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
19	Essex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
20	Union	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
21	Morris	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
22	Somerset	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
23	Middlesex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
24	Monmouth	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
25	Ocean	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
26	Hunterdon	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
27	Warren	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
28	Sussex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
29	New Haven	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
30	Mercer	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75

Table A-5-3: Origin-Destination Based Indices for Mode Specific Constants - Purpose 3: Work / High Income

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	1	2	2	2	2	2	2	2	40	2	40	2	2	33	40	33	40	33	40	40	40	40	40	40	40	40	2	40
1	Valley Mn	1	1	1	1	2	2	2	2	2	2	2	40	2	40	2	2	33	40	33	40	33	40	40	40	40	40	40	40	40	2	40
2	Midtown Mn	1	1	1	1	2	2	2	2	2	2	2	40	2	40	2	2	32	40	32	40	32	40	40	40	40	40	40	40	40	2	40
3	Upper Mn	1	1	1	1	2	2	2	2	2	2	2	39	2	39	2	2	31	39	31	39	31	39	39	39	39	39	39	39	39	2	39
4	Queens	3	3	3	3	7	7	7	11	11	11	11	42	11	42	11	11	35	42	35	42	35	42	42	42	42	42	42	42	42	11	42
5	Bronx	3	3	3	3	7	7	7	11	11	11	11	41	11	41	11	11	34	41	34	41	34	41	41	41	41	41	41	41	41	11	41
6	Kings	3	3	3	3	7	7	7	11	11	11	11	42	11	42	11	11	35	42	35	42	35	42	42	42	42	42	42	42	42	11	42
7	Richmond	5	5	5	5	11	11	11	8	11	11	11	43	11	43	11	11	36	43	36	43	36	43	43	43	43	43	43	43	43	11	43
8	Nassau	4	4	4	4	11	11	11	11	9	9	11	44	11	44	11	11	37	44	37	44	37	44	44	44	44	44	44	44	44	11	44
9	Suffolk	4	4	4	4	11	11	11	11	9	9	11	44	11	44	11	11	37	44	37	44	37	44	44	44	44	44	44	44	44	11	44
10	Westchester	6	6	6	6	11	11	11	11	11	11	10	45	10	45	10	10	38	45	38	45	38	45	45	45	45	45	45	45	45	10	45
11	Rockland	20	20	19	18	27	26	27	28	29	29	30	10	30	10	30	30	47	49	47	49	47	49	49	49	49	49	49	49	49	30	49
12	Putnam	6	6	6	6	11	11	11	11	11	11	10	45	10	45	10	10	38	45	38	45	38	45	45	45	45	45	45	45	45	10	45
13	Orange	20	20	19	18	27	26	27	28	29	29	30	10	30	10	30	30	47	49	47	49	47	49	49	49	49	49	49	49	49	30	49
14	Dutchess	6	6	6	6	11	11	11	11	11	11	10	45	10	45	10	10	38	45	38	45	38	45	45	45	45	45	45	45	45	10	45
15	Fairfield	6	6	6	6	11	11	11	11	11	11	10	45	10	45	10	10	38	45	38	45	38	45	45	45	45	45	45	45	45	10	45
16	Bergen	14	14	13	12	22	21	22	23	24	24	25	11	25	11	25	25	8	8	8	8	8	8	8	8	8	8	8	8	8	25	8
17	Passaic	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
18	Hudson	14	14	13	12	22	21	22	23	24	24	25	11	25	11	25	25	8	8	8	8	8	8	8	8	8	8	8	8	8	25	8
19	Essex	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
20	Union	14	14	13	12	22	21	22	23	24	24	25	11	25	11	25	25	8	8	8	8	8	8	8	8	8	8	8	8	8	25	8
21	Morris	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
22	Somerset	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
23	Middlesex	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
24	Monmouth	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
25	Ocean	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
26	Hunterdon	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
27	Warren	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
28	Sussex	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48
29	New Haven	6	6	6	6	11	11	11	11	11	11	10	45	10	45	10	10	38	45	38	45	38	45	45	45	45	45	45	45	45	10	45
30	Mercer	17	17	16	15	27	26	27	28	29	29	30	11	30	11	30	30	46	48	46	48	46	48	48	48	48	48	48	48	48	30	48

Table A-5-4: Origin-Destination Based Indices for Mode Specific Constants - Purpose 4: School

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
1	Valley Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	Midtown Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	Upper Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	Queens	4	4	4	4	6	9	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
5	Bronx	4	4	4	4	9	6	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
6	Kings	4	4	4	4	9	9	6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
7	Richmond	4	4	4	4	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
8	Nassau	5	5	5	5	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
9	Suffolk	5	5	5	5	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
10	Westchester	5	5	5	5	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
11	Rockland	5	5	5	5	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
12	Putnam	5	5	5	5	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
13	Orange	5	5	5	5	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
14	Dutchess	5	5	5	5	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
15	Fairfield	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
16	Bergen	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10
17	Passaic	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10
18	Hudson	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10
19	Essex	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10
20	Union	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10
21	Morris	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10
22	Somerset	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10
23	Middlesex	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10
24	Monmouth	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10
25	Ocean	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10
26	Hunterdon	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10
27	Warren	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10
28	Sussex	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7	10	10
29	New Haven	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7	10
30	Mercer	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	7

Table A-5-5: Origin-Destination Based Indices for Mode Specific Constants - Purpose 5: University

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	Valley Mn	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Midtown Mn	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	Upper Mn	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4	Queens	3	3	3	3	7	7	7	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
5	Bronx	3	3	3	3	7	7	7	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
6	Kings	3	3	3	3	7	7	7	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
7	Richmond	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
8	Nassau	4	4	4	4	11	11	11	11	9	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
9	Suffolk	4	4	4	4	11	11	11	11	9	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
10	Westchester	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
11	Rockland	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
12	Putnam	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
13	Orange	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
14	Dutchess	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
15	Fairfield	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
16	Bergen	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
17	Passaic	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
18	Hudson	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
19	Essex	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
20	Union	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
21	Morris	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
22	Somerset	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
23	Middlesex	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
24	Monmouth	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
25	Ocean	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
26	Hunterdon	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
27	Warren	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
28	Sussex	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8
29	New Haven	6	6	6	6	11	11	11	11	11	11	10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	10	11
30	Mercer	5	5	5	5	11	11	11	8	11	11	11	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8	8	8	8	11	8

Table A-5-6: Origin-Destination Based Indices for Mode Specific Constants - Purpose 6: Maintenance

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	3	26	26	26	22	30	30	34	67	34	67	34	34	60	67	60	67	60	67	67	67	67	67	67	67	67	34	67
1	Valley Mn	1	77	1	3	26	26	26	22	30	30	34	67	34	67	34	34	60	67	60	67	60	67	67	67	67	67	67	67	67	34	67
2	Midtown Mn	1	1	78	3	26	26	26	22	30	30	34	67	34	67	34	34	59	67	59	67	59	67	67	67	67	67	67	67	67	34	67
3	Upper Mn	2	2	2	79	26	26	26	22	30	30	34	66	34	66	34	34	58	66	58	66	58	66	66	66	66	66	66	66	66	34	66
4	Queens	6	7	8	14	80	27	27	23	31	31	35	69	35	69	35	35	62	69	62	69	62	69	69	69	69	69	69	69	69	35	69
5	Bronx	4	4	5	14	27	81	27	23	31	31	35	68	35	68	35	35	61	68	61	68	61	68	68	68	68	68	68	68	68	35	68
6	Kings	9	10	11	14	27	27	82	23	31	31	35	69	35	69	35	35	62	69	62	69	62	69	69	69	69	69	69	69	69	35	69
7	Richmond	12	12	13	14	28	28	28	24	31	31	35	70	35	70	35	35	63	70	63	70	63	70	70	70	70	70	70	70	70	35	70
8	Nassau	16	16	17	15	29	29	29	25	32	32	35	71	35	71	35	35	64	71	64	71	64	71	71	71	71	71	71	71	71	35	71
9	Suffolk	16	16	17	15	29	29	29	25	32	32	35	71	35	71	35	35	64	71	64	71	64	71	71	71	71	71	71	71	71	35	71
10	Westchester	18	18	19	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
11	Rockland	47	47	46	45	54	53	54	55	56	56	57	36	57	36	57	57	74	76	74	76	74	76	76	76	76	76	76	76	76	57	76
12	Putnam	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
13	Orange	47	47	46	45	54	53	54	55	56	56	57	36	30	36	57	57	74	76	74	76	74	76	76	76	76	76	76	76	76	57	76
14	Dutchess	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
15	Fairfield	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
16	Bergen	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
17	Passaic	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
18	Hudson	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
19	Essex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
20	Union	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
21	Morris	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
22	Somerset	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
23	Middlesex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
24	Monmouth	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
25	Ocean	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
26	Hunterdon	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
27	Warren	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
28	Sussex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
29	New Haven	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
30	Mercer	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75

Table A-5-7: Origin-Destination Based Indices for Mode Specific Constants - Purpose 7: Discretionary

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	3	26	26	26	22	30	30	34	67	34	67	34	34	60	67	60	67	60	67	67	67	67	67	67	67	67	34	67
1	Valley Mn	1	77	1	3	26	26	26	22	30	30	34	67	34	67	34	34	60	67	60	67	60	67	67	67	67	67	67	67	67	34	67
2	Midtown Mn	1	1	78	3	26	26	26	22	30	30	34	67	34	67	34	34	59	67	59	67	59	67	67	67	67	67	67	67	67	34	67
3	Upper Mn	2	2	2	79	26	26	26	22	30	30	34	66	34	66	34	34	58	66	58	66	58	66	66	66	66	66	66	66	66	34	66
4	Queens	6	7	8	14	80	27	27	23	31	31	35	69	35	69	35	35	62	69	62	69	62	69	69	69	69	69	69	69	69	35	69
5	Bronx	4	4	5	14	27	81	27	23	31	31	35	68	35	68	35	35	61	68	61	68	61	68	68	68	68	68	68	68	68	35	68
6	Kings	9	10	11	14	27	27	82	23	31	31	35	69	35	69	35	35	62	69	62	69	62	69	69	69	69	69	69	69	69	35	69
7	Richmond	12	12	13	14	28	28	28	24	31	31	35	70	35	70	35	35	63	70	63	70	63	70	70	70	70	70	70	70	70	35	70
8	Nassau	16	16	17	15	29	29	29	25	32	32	35	71	35	71	35	35	64	71	64	71	64	71	71	71	71	71	71	71	71	35	71
9	Suffolk	16	16	17	15	29	29	29	25	32	32	35	71	35	71	35	35	64	71	64	71	64	71	71	71	71	71	71	71	71	35	71
10	Westchester	18	18	19	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
11	Rockland	47	47	46	45	54	53	54	55	56	56	57	36	57	36	57	57	74	76	74	76	74	76	76	76	76	76	76	76	76	57	76
12	Putnam	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
13	Orange	47	47	46	45	54	53	54	55	56	56	57	36	30	36	57	57	74	76	74	76	74	76	76	76	76	76	76	76	76	57	76
14	Dutchess	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
15	Fairfield	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
16	Bergen	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
17	Passaic	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
18	Hudson	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
19	Essex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
20	Union	41	41	40	39	49	48	49	50	51	51	52	37	52	37	52	52	38	38	38	38	38	38	38	38	38	38	38	38	38	52	38
21	Morris	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
22	Somerset	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
23	Middlesex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
24	Monmouth	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
25	Ocean	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
26	Hunterdon	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
27	Warren	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
28	Sussex	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75
29	New Haven	20	20	21	15	29	29	29	25	33	33	36	72	36	72	36	36	65	72	65	72	65	72	72	72	72	72	72	72	72	36	72
30	Mercer	44	44	43	42	54	53	54	55	56	56	57	37	57	37	57	57	73	75	73	75	73	75	75	75	75	75	75	75	75	57	75

Table A-5-8: Origin-Destination Based Indices for Mode Specific Constants - Purpose 8: At-Work

	O / D	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	Lower Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
1	Valley Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	Midtown Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	Upper Mn	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	Queens	2	2	2	2	6	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
5	Bronx	2	2	2	2	9	6	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
6	Kings	2	2	2	2	9	9	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
7	Richmond	2	2	2	2	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
8	Nassau	5	5	5	10	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	Suffolk	5	5	5	10	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
10	Westchester	5	5	5	10	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
11	Rockland	5	5	5	10	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
12	Putnam	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
13	Orange	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
14	Dutchess	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
15	Fairfield	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
16	Bergen	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8
17	Passaic	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
18	Hudson	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8
19	Essex	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8
20	Union	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8
21	Morris	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8
22	Somerset	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
23	Middlesex	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
24	Monmouth	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
25	Ocean	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
26	Hunterdon	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
27	Warren	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
28	Sussex	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8
29	New Haven	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8
30	Mercer	5	5	5	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7

Table A-6-1: Mode Specific Constants - Purpose 1: Work / Low Income

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManhattan	10.03	-2.32	-0.15	-99.00	-1.29	-4.25	-99.00	-99.00	5.33	0.00	-99.00
2	FromManhattan	9.70	-10.81	-10.10	-10.71	0.48	-99.00	-3.33	-99.00	-99.00	0.00	-99.00
3	QBBtoManh	-1.21	-1.46	-0.54	-31.42	-0.08	-2.67	-2.30	-3.06	-99.00	0.00	-99.00
4	LItoManh	3.79	4.43	6.99	7.01	10.74	6.23	11.26	6.20	-99.00	0.00	-99.00
5	SItoManh	-1.03	-0.44	3.58	3.11	9.96	-0.68	66.11	1.62	-99.00	0.00	-99.00
6	UpperNY/CTtoManh	-39.00	-39.02	-35.18	-35.06	-24.73	-31.05	-99.00	-99.00	-99.00	0.00	-99.00
7	WithinQBB	-2.75	-2.24	-1.73	-3.59	-0.14	-0.49	-99.00	-99.00	0.20	0.00	-99.00
8	WithinNJ/SI	-11.65	-15.89	-14.86	-14.87	28.82	-13.91	27.22	-16.85	-9.81	0.00	-99.00
9	WithinLI	-3.55	-1.73	-0.98	-0.50	3.13	0.81	4.76	-1.81	4.59	0.00	-99.00
10	WithinUpperNY/CT	-3.71	-1.51	-0.53	-0.66	6.05	0.89	3.55	-1.38	3.96	0.00	-99.00
11	AllOthers	-3.88	-3.14	-1.91	-2.90	5.49	2.92	-0.23	-4.35	6.02	0.00	-99.00
12	PNJtoUptown	1.60	-1.57	0.01	0.94	1.18	-0.91	1.03	-1.49	-99.00	0.00	-99.00
13	PNJtoMidtown	-2.21	-2.52	-0.13	0.42	2.09	-0.73	0.29	-2.92	-99.00	0.00	-99.00
14	PNJtoDwntwnValley	-2.45	-2.58	-0.51	0.24	1.85	-0.26	0.78	-2.91	-99.00	0.00	-99.00
15	ONJtoUptown	6.33	1.16	2.70	3.71	-1.45	1.24	-2.84	0.28	-99.00	0.00	-99.00
16	ONJtoMidtown	-0.98	-0.08	2.48	3.09	0.19	2.95	-1.32	1.00	-99.00	0.00	-99.00
17	ONJtoDwntwnValley	-1.00	0.12	2.61	3.35	-0.71	2.79	-0.02	1.57	-99.00	0.00	-99.00
18	WHR-NYtoUptown	18.63	17.67	18.77	21.56	18.14	18.80	-99.00	22.32	-99.00	0.00	-99.00
19	WHR-NYtoMidtown	1.53	2.29	4.65	5.53	2.01	5.42	-3.57	0.24	-99.00	0.00	-99.00
20	WHR-NYtoDwntwnValley	2.51	3.08	6.26	5.77	3.52	5.32	-0.14	2.31	-99.00	0.00	-99.00
21	PNJtoBronx	-0.06	-2.00	-1.00	-0.61	4.36	0.73	2.55	0.58	-99.00	0.00	-99.00
22	PNJtoQn/Bklyn	-0.84	-1.35	0.22	0.31	3.52	2.69	1.82	-0.20	-99.00	0.00	-99.00
23	PNJtoSI	2.89	0.04	0.40	0.71	10.44	-99.00	7.76	4.64	-99.00	0.00	-99.00
24	PNJtoLI	3.66	0.21	1.29	1.67	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
25	ONJ/WHR-NYtoBronx	3.29	-0.98	0.39	0.64	-1.85	0.73	-2.58	-0.24	-99.00	0.00	-99.00
26	ONJ/WHR-NYtoQn/Bklyn	-0.13	1.24	3.13	3.62	3.56	5.77	2.59	3.18	-99.00	0.00	-99.00
27	ONJ/WHR-NYtoSI	4.36	-0.67	-0.76	0.05	1.48	0.47	-99.00	1.53	-99.00	0.00	-99.00
28	ONJ/WHR-NYtoLI	1.01	2.16	4.04	4.54	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
29	PNJ/ONJ/WHR-NYtoOthNY/CT	6.21	5.55	5.97	7.77	10.11	10.84	10.93	10.88	-99.00	0.00	-99.00
30	UptowntoPNJ	12.46	-2.65	-1.52	-0.47	-0.66	-99.00	-1.88	-99.00	-99.00	0.00	-99.00
31	MidtowntoPNJ	18.85	2.16	4.68	5.06	7.59	-99.00	5.96	-99.00	-99.00	0.00	-99.00
32	DwntwnValleytoPNJ	13.61	-3.25	-0.72	0.48	2.24	-99.00	0.14	-99.00	-99.00	0.00	-99.00
33	BronxtoPNJ	3.98	0.31	0.35	1.36	-1.72	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
34	Qn/BklyntoPNJ	1.65	-1.82	0.16	0.90	-1.51	-2.55	-3.45	-99.00	-99.00	0.00	-99.00
35	SItoPNJ	1.50	-0.63	0.31	1.32	3.86	4.37	-99.00	-99.00	-99.00	0.00	-99.00
36	LItoPNJ	13.60	12.57	16.01	17.55	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
37	OthNY/CTtoPNJ	1.79	1.25	2.97	3.29	-0.52	-99.00	-99.00	-99.00	-99.00	0.00	-99.00

38	UptowntoONJ	10.93	-5.03	-4.30	-3.11	-3.16	-99.00	-3.23	-99.00	-99.00	0.00	-99.00
39	Mid/DwnValltoONJ	13.98	-0.95	1.49	2.16	1.06	-99.00	-2.15	-99.00	-99.00	0.00	-99.00
40	BronxtoONJ	6.00	3.44	4.20	5.36	2.11	-99.00	2.60	-99.00	-99.00	0.00	-99.00
41	Qn/BklyntoONJ	1.23	-0.77	0.62	1.32	-4.17	-99.00	-4.21	-99.00	-99.00	0.00	-99.00
42	SItoONJ	2.34	0.10	1.39	1.99	5.06	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
43	LItoONJ	29.66	34.21	34.83	34.83	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
44	OthNY/CTtoONJ	0.20	0.54	1.85	2.66	-2.60	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
45	ONJtoPNJ	1.59	-3.71	-3.20	-3.27	-5.20	-3.84	-4.29	-2.80	-3.20	0.00	-99.00
46	WHR-NYtoPNJ	0.59	-1.21	0.01	-0.14	-2.55	-0.03	-1.89	0.54	0.39	0.00	-99.00
47	ONJtoONJ	1.03	-3.32	-2.58	-2.81	-6.06	-4.81	-4.99	-4.84	-2.79	0.00	-99.00
48	WHR-NYtoONJ	0.64	-1.30	-0.02	-0.21	-99.00	5.20	-99.00	2.10	0.00	0.00	-99.00

Table A-6-2: Mode Specific Constants - Purpose 2: Work / Middle Income

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManh CBD	-0.73	-3.06	-99.00	-99.00	0.09	-99.00	24.95	-99.00	-0.82	0.00	-99.00
2	UpperManh/CBD	-0.59	-0.18	1.44	-99.00	0.19	-2.77	-1.17	-0.45	-0.11	0.00	-99.00
3	CBD/UpperManh	-99.00	-99.00	-99.00	-99.00	-0.33	-99.00	-99.00	13.04	1.29	0.00	-99.00
4	Bronx/Lo&Valley Manh	0.29	0.65	-99.00	0.95	0.14	-0.75	-1.57	-99.00	-4.49	0.00	-99.00
5	Bronx/Mid Manh	-1.15	0.68	-99.00	-99.00	0.29	0.54	-2.55	-1.62	-99.00	0.00	-99.00
6	Qns/Lo Manh	-99.00	-99.00	-99.00	-99.00	0.32	0.63	-99.00	0.27	-99.00	0.00	-99.00
7	Qns/Valley Manh	-1.50	2.28	2.07	4.01	-0.31	-0.25	-1.55	-0.77	-99.00	0.00	-99.00
8	Qns/Mid Manh	-2.65	0.91	2.64	-99.00	0.69	-0.98	-4.30	-0.57	-99.00	0.00	-99.00
9	Bkln/Lo Manh	-99.00	-99.00	-2.13	-99.00	0.34	-3.33	-99.00	-99.00	-0.65	0.00	-99.00
10	Bkln/Valley Manh	-0.35	0.10	-0.59	-99.00	0.22	-1.09	-99.00	-99.00	-99.00	0.00	-99.00
11	Bkln/Mid Manh	-4.36	-2.06	-99.00	-99.00	0.26	-5.96	24.95	-99.00	-99.00	0.00	-99.00
12	SI/Lo&Valley Manh	-1.08	0.47	-99.00	-99.00	0.47	-1.28	-99.00	-99.00	-99.00	0.00	-99.00
13	SI/Mid Manh	-3.43	-99.00	-99.00	1.15	0.68	-3.23	-99.00	-99.00	-99.00	0.00	-99.00
14	Othey NYC/Up Manh	-0.17	0.45	2.72	-99.00	-0.06	-1.53	-0.06	-99.00	-1.51	0.00	-99.00
15	LI&NYS-Sbrb&CT/Up Manh	0.77	-4.70	-1.72	-99.00	-2.34	-3.81	-0.56	-2.73	8.44	0.00	-99.00
16	LI/Lo&Valley Manh	-0.63	-2.08	-99.00	-99.00	1.05	0.09	1.73	-1.55	-99.00	0.00	-99.00
17	LI/Mid Manh	-2.74	-0.16	-99.00	-99.00	1.81	0.62	1.53	-1.78	-99.00	0.00	-99.00
18	Westchester/Lo&Valley Manh	1.03	-1.97	-99.00	-99.00	-1.65	-99.00	0.92	1.14	-99.00	0.00	-99.00
19	Westchester/Mid Manh	-0.81	2.68	-99.00	-99.00	-4.01	-99.00	0.51	-0.66	-99.00	0.00	-99.00
20	NYS-Sbrb&CT/Lo&Valley Manh	-6.41	-99.00	-99.00	-99.00	-99.00	-99.00	5.09	-5.23	-99.00	0.00	-99.00
21	NYS-Sbrb&CT/Upper Manh	-4.10	0.95	1.34	-99.00	-99.00	-99.00	3.79	-1.64	-99.00	0.00	-99.00
22	Manh/SI	1.35	-99.00	-99.00	-99.00	0.70	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
23	BxQnsBkln/SI	-1.64	-99.00	-99.00	-99.00	-1.42	2.18	-99.00	11.54	-99.00	0.00	-99.00
24	Within SI	-0.53	0.79	0.85	1.51	-0.20	-99.00	24.95	-99.00	0.73	0.00	-99.00
25	LI&NYS-EOH&CT/SI	0.62	-99.00	-99.00	-99.00	-99.00	-99.00	-0.30	-99.00	-99.00	0.00	-99.00
26	Manh/Bx&Qns&Bkln	-0.33	0.92	-0.60	-99.00	-0.75	-99.00	-3.78	3.33	2.28	0.00	-99.00
27	Inter Bx&Qns&Bkln	-0.87	0.58	-0.85	2.03	0.17	0.46	1.18	-99.00	-99.00	0.00	-99.00
28	SI/Bx&Qns&Bkln	-0.53	1.32	0.72	-0.45	-0.44	0.32	-99.00	-99.00	-99.00	0.00	-99.00
29	LI&NYS-EOH&CT/Bx&Qns&Bkln	-0.51	0.85	-0.09	1.69	0.53	0.51	0.83	0.14	3.20	0.00	-99.00
30	Manh/LI	1.25	1.84	-99.00	-99.00	-99.00	-99.00	-1.00	-99.00	-99.00	0.00	-99.00
31	Other NYC/LI	0.09	1.04	0.76	-99.00	-2.38	-99.00	-2.22	0.13	-99.00	0.00	-99.00
32	WithinLI	0.06	-0.30	0.67	-0.32	-2.16	-99.00	-2.23	-2.50	3.39	0.00	-99.00
33	NYS-EOH&CT/LI	0.42	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
34	Manh/NYS-EOH&CT	0.66	0.90	-2.05	-99.00	-99.00	3.52	-2.97	1.99	1.27	0.00	-99.00

35	Other NYC&LI/NYS-EOH&CT	-2.01	0.67	0.82	2.53	-2.81	-0.49	-2.51	0.84	6.84	0.00	-99.00
36	Within UpperNYS& CT - No HRX	-0.22	0.32	0.70	0.51	2.04	0.50	2.43	0.02	3.39	0.00	-99.00
37	NJ/NYS-WHO	0.52	-0.17	-0.45	-1.21	-2.02	-1.64	-3.82	-0.78	-5.94	0.00	-99.00
38	PNJ/NJ	0.27	-0.31	-0.51	-0.25	-1.43	-0.96	0.65	-0.26	-5.07	0.00	-99.00
39	PNJtoUptown	0.86	-0.65	0.13	0.86	0.38	-0.53	-1.11	-1.78	-99.00	0.00	-99.00
40	PNJtoMidtown	-1.72	-0.54	0.36	1.30	1.03	-0.13	-0.92	-1.71	-99.00	0.00	-99.00
41	PNJtoDwntwnValley	-1.02	-0.02	0.86	1.80	0.40	-0.10	-0.26	-1.21	-99.00	0.00	-99.00
42	ONJtoUptown	0.92	0.56	1.47	2.46	-0.81	1.29	-2.04	-0.20	-99.00	0.00	-99.00
43	ONJtoMidtown	-2.86	-0.50	0.47	1.55	0.52	2.69	-0.94	0.14	-99.00	0.00	-99.00
44	ONJtoDwntwnValley	-1.26	0.56	1.50	2.69	-0.57	2.40	-0.12	0.62	-99.00	0.00	-99.00
45	WHR-NYtoUptown	1.38	0.19	0.93	1.88	-2.84	0.53	-99.00	-3.10	-99.00	0.00	-99.00
46	WHR-NYtoMidtown	-0.52	1.04	2.03	3.12	-1.70	2.05	-5.68	-2.24	-99.00	0.00	-99.00
47	WHR-NYtoDwntwnValley	0.10	1.48	2.55	3.65	-1.47	1.55	-4.34	-1.14	-99.00	0.00	-99.00
48	PNJtoBronx	-0.61	-0.76	-0.79	-0.05	4.22	1.39	1.54	0.08	-99.00	0.00	-99.00
49	PNJtoQn/Bklyn	-1.86	-0.88	-0.74	0.10	4.32	1.94	1.36	-0.83	-99.00	0.00	-99.00
50	PNJtoSI	0.14	-1.14	-1.53	-1.20	3.04	-99.00	-99.00	-0.14	-99.00	0.00	-99.00
51	PNJtoLI	0.05	0.41	0.80	1.76	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
52	PNJtoOthNY/CT	-1.69	-2.74	-2.89	-2.18	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
53	ONJ/WHR-NYtoBronx	-0.16	0.27	0.64	1.50	1.38	2.91	-0.08	0.39	-99.00	0.00	-99.00
54	ONJ/WHR-NYtoQn/Bklyn	-0.91	0.52	0.93	1.79	2.26	3.91	0.43	0.13	-99.00	0.00	-99.00
55	ONJ/WHR-NYtoSI	0.24	-0.74	-1.00	-0.56	-1.42	0.46	-99.00	-0.48	-99.00	0.00	-99.00
56	ONJ/WHR-NYtoLI	-0.84	1.06	2.03	2.83	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
57	ONJ/WHR-NYtoOthNY/CT	0.45	0.55	0.85	1.78	-0.30	3.08	-5.77	-3.27	-99.00	0.00	-99.00
58	UptowntoPNJ	0.56	-1.25	-1.39	0.34	0.07	-99.00	-1.73	-99.00	-99.00	0.00	-99.00
59	MidtowntoPNJ	-1.62	-2.34	-2.39	-1.08	1.86	-99.00	-1.11	-99.00	-99.00	0.00	-99.00
60	DwntwnValleytoPNJ	-1.56	-4.85	-2.61	-0.95	0.95	-99.00	-1.88	-99.00	-99.00	0.00	-99.00
61	BronxtoPNJ	0.55	-0.24	-0.63	0.15	-2.72	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
62	Qn/BklyntoPNJ	-0.24	-0.31	0.60	1.73	-0.91	-2.19	-2.32	-99.00	-99.00	0.00	-99.00
63	SItoPNJ	-0.01	-2.74	-2.91	-1.96	0.67	0.43	-99.00	-99.00	-99.00	0.00	-99.00
64	LItoPNJ	-0.93	-1.72	-0.11	2.39	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
65	OthNY/CTtoPNJ	-0.26	0.68	1.02	1.93	-3.10	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
66	UptowntoONJ	1.00	-0.92	-1.09	0.83	-0.27	-99.00	-1.48	-99.00	-99.00	0.00	-99.00
67	Mid/DwnValltoONJ	1.10	-0.15	-0.53	1.51	0.16	-99.00	-2.35	-99.00	-99.00	0.00	-99.00
68	BronxtoONJ	0.23	0.46	0.27	1.21	-3.77	-99.00	-5.63	-99.00	-99.00	0.00	-99.00
69	Qn/BklyntoONJ	-0.81	0.57	0.88	1.93	-3.69	-99.00	-4.03	-99.00	-99.00	0.00	-99.00
70	SItoONJ	0.46	-2.63	-3.14	-2.60	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00

71	LItoONJ	-2.20	1.34	1.49	2.64	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
72	OthNYS/CTtoONJ	-0.50	0.95	0.90	1.94	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
73	ONJtoPNJ	0.19	-0.29	-0.51	-0.29	-0.20	0.31	-0.06	0.10	-4.90	0.00	-99.00
74	WOHtoPNJ	0.27	-0.20	-0.34	-0.15	-2.38	-0.89	-3.51	-0.21	-4.58	0.00	-99.00
75	ONJtoONJ	0.20	-0.30	-0.50	-0.28	-2.40	-1.51	-1.52	-2.09	-4.58	0.00	-99.00
76	WOHtoONJ	0.24	-0.33	-0.53	-0.31	-99.00	-0.24	-99.00	-3.19	-4.38	0.00	-99.00
77	inValeyManh	-1.80	-99.00	-0.41	-99.00	0.80	-1.45	-99.00	-99.00	1.55	0.00	-99.00
78	inMidManh	-99.00	-99.00	-0.86	-99.00	0.59	-99.00	-99.00	-99.00	-0.93	0.00	-99.00
79	inUpperManh	0.46	-0.56	0.33	-99.00	0.39	-99.00	-99.00	-99.00	-2.27	0.00	-99.00
80	inQueens	-0.69	0.70	1.34	1.63	0.44	-0.92	0.88	-99.00	-99.00	0.00	-99.00
81	inBronx	-2.49	0.57	1.84	0.53	0.43	-0.71	-99.00	-99.00	3.55	0.00	-99.00
82	inKings	-1.79	0.83	0.74	1.90	0.44	-1.22	24.95	-99.00	-0.22	0.00	-99.00

Table A-6-3: Mode Specific Constants - Purpose 3: Work / High Income

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManhattan	-0.88	-1.00	0.60	-1.00	-0.07	-3.98	-99.00	-99.00	0.83	0.00	-99.00
2	FromManhattan	-0.42	1.13	0.62	-99.00	0.20	-0.25	1.84	3.14	0.22	0.00	-99.00
3	QBBtoManh	-0.20	-0.05	0.49	-99.00	1.05	-1.40	0.20	1.03	-0.35	0.00	-99.00
4	LItoManh	-1.22	0.73	0.31	-0.74	-1.01	-3.26	0.21	1.00	3.25	0.00	-99.00
5	SItoManh	-29.87	-28.46	-28.40	-27.32	-26.04	-28.74	-99.00	-99.00	-26.21	0.00	-99.00
6	UpperNY/CTtoMan	-1.07	-0.93	-1.15	-1.72	-0.91	-1.77	0.72	0.16	5.24	0.00	-99.00
7	WithinQBB	-0.20	0.08	0.38	-0.77	1.16	-1.71	-99.00	-99.00	0.09	0.00	-99.00
8	WithinNJ/SI	0.27	-0.32	-0.01	-1.04	1.02	-2.38	4.62	-1.08	-1.85	0.00	-99.00
9	WithinLI	0.03	0.37	0.07	0.63	-0.74	-28.82	-99.00	-1.53	0.26	0.00	-99.00
10	WithinUpperNY/CT	0.21	-0.28	0.14	0.53	-0.45	-99.00	1.19	0.06	-0.31	0.00	-99.00
11	AllOthers	0.31	-0.39	0.62	0.09	-0.18	-2.30	0.43	-0.14	-0.66	0.00	-99.00
12	PNJtoUptown	0.21	-0.71	-0.39	0.32	2.46	-0.93	-0.65	-1.98	-99.00	0.00	-99.00
13	PNJtoMidtown	-2.28	-0.98	-0.10	0.30	2.22	-1.48	-1.28	-2.59	-99.00	0.00	-99.00
14	PNJtoDwntnValley	-2.42	-1.00	-0.30	0.21	2.03	-0.95	-0.96	-2.48	-99.00	0.00	-99.00
15	ONJtoUptown	0.84	0.93	1.75	2.48	2.02	2.11	0.87	-0.10	-99.00	0.00	-99.00
16	ONJtoMidtown	-2.24	0.37	0.94	1.74	2.04	2.52	0.88	0.25	-99.00	0.00	-99.00
17	ONJtoDwntnValley	-1.74	0.49	1.12	1.94	1.23	2.46	1.68	0.66	-99.00	0.00	-99.00
18	WHR-NYtoUptown	1.26	0.65	1.15	1.89	-1.43	0.41	-99.00	-2.32	-99.00	0.00	-99.00
19	WHR-NYtoMidtown	-0.36	1.46	2.25	2.91	-0.85	1.78	-4.53	-1.23	-99.00	0.00	-99.00
20	WHR-NYtoDwntwnValley	0.28	1.90	2.64	3.33	-0.48	1.29	-2.78	-0.22	-99.00	0.00	-99.00
21	PNJtoBronx	-0.63	-0.51	-0.80	-0.43	5.41	1.17	2.05	0.38	-99.00	0.00	-99.00
22	PNJtoQn/Bklyn	-2.65	-1.32	-1.62	-1.01	5.85	0.37	0.98	-1.59	-99.00	0.00	-99.00
23	PNJtoSI	0.82	-0.74	-0.91	-0.48	5.92	-99.00	-99.00	0.84	-99.00	0.00	-99.00
24	PNJtoLI	-0.03	1.69	1.68	2.16	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
25	PNJtoOthNY/CT	-1.97	-2.04	-2.23	-1.07	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
26	ONJ/WHR-NYtoBronx	-0.03	1.00	1.07	1.71	2.55	2.57	2.97	2.19	-99.00	0.00	-99.00
27	ONJ/WHR-NYtoQn/Bklyn	-1.16	1.38	1.39	1.97	4.05	3.73	3.24	1.23	-99.00	0.00	-99.00
28	ONJ/WHR-NYtoSI	0.46	-0.81	-1.54	-1.33	0.89	1.16	-99.00	-0.08	-99.00	0.00	-99.00
29	ONJ/WHR-NYtoLI	-0.35	2.15	2.75	3.30	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
30	ONJ/WHR-NYtoOthNY/CT	-0.04	0.63	0.71	1.51	-0.71	0.38	-2.24	0.01	-99.00	0.00	-99.00
31	UptowntoPNJ	0.34	-0.83	-0.16	0.90	0.88	-99.00	-0.68	-99.00	-99.00	0.00	-99.00
32	MidtowntoPNJ	-1.06	-1.59	0.56	0.68	3.73	-99.00	0.53	-99.00	-99.00	0.00	-99.00
33	DwntnValleytoPNJ	-1.80	-4.57	-1.26	-0.17	1.67	-99.00	-1.03	-99.00	-99.00	0.00	-99.00
34	BronxtoPNJ	1.41	1.56	2.04	2.62	0.39	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
35	Qn/BklyntoPNJ	-0.94	-0.09	1.31	1.82	0.46	-1.78	-0.55	-99.00	-99.00	0.00	-99.00
36	SItoPNJ	-0.10	-1.57	-1.70	-0.81	2.70	0.96	-99.00	-99.00	-99.00	0.00	-99.00
37	LItoPNJ	-1.37	-1.11	0.40	2.38	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00

38	OthNY/CTtoPNJ	-0.27	1.05	1.22	1.70	-2.27	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
39	UptowntoONJ	0.88	-0.39	0.43	1.72	0.18	-99.00	-0.70	-99.00	-99.00	0.00	-99.00
40	Mid/DwnValltoONJ	0.93	0.21	0.77	2.59	1.07	-99.00	-1.45	-99.00	-99.00	0.00	-99.00
41	BronxtoONJ	1.52	2.67	3.11	3.18	1.43	-99.00	0.66	-99.00	-99.00	0.00	-99.00
42	Qn/BklyntoONJ	-1.51	0.81	1.82	2.25	-3.17	-99.00	-2.67	-99.00	-99.00	0.00	-99.00
43	SItoONJ	0.41	-1.54	-2.06	-1.86	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
44	LItoONJ	-2.43	2.10	2.07	2.83	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
45	OthNY/CTtoONJ	-0.42	1.19	0.92	1.70	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
46	ONJtoPNJ	-0.02	-0.04	-0.40	-0.59	2.34	0.69	2.22	0.54	-6.86	0.00	-99.00
47	WHR-NYtoPNJ	0.24	-0.01	-0.31	-0.57	-1.81	-1.77	-2.73	-0.52	-6.93	0.00	-99.00
48	ONJtoONJ	0.13	0.00	-0.34	-0.50	0.06	-1.05	0.35	-1.45	-6.69	0.00	-99.00
49	WHR-NYtoONJ	0.22	-0.11	-0.54	-0.74	-99.00	-1.29	-99.00	-3.74	-7.27	0.00	-99.00

Table A-6-4: Mode Specific Constants - Purpose 4: School

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManhattan	4.09	1.68	1.98	2.43	-0.78	0.25	-99.00	-99.00	0.72	0.00	-0.32
2	ManhToNYC	2.70	1.17	0.79	1.84	-0.98	-99.00	-99.00	-99.00	-99.00	0.00	0.03
3	ManhToOthers	1.60	0.16	-0.37	0.85	-4.20	-99.00	-99.00	-99.00	-99.00	0.00	0.49
4	NYCtoManh	-0.16	0.66	0.45	0.30	-0.06	1.50	2.38	-1.37	-99.00	0.00	-0.78
5	OtherstoManh	1.63	1.13	1.46	1.99	-3.70	-0.29	1.51	0.37	-99.00	0.00	0.37
6	IntraQ\B\B	1.32	0.29	0.56	0.16	-0.89	-0.83	-80.29	-99.00	-99.00	0.00	0.10
7	IntraOth	-0.59	-0.38	-0.47	0.91	-2.98	-99.00	-99.00	-99.00	-99.00	0.00	0.62
8	IntraOth	-0.78	-1.17	-1.01	-0.05	0.03	-99.00	-99.00	-99.00	-99.00	0.00	0.99
9	Q\B\BtoQ\B\B	1.19	-0.25	-0.42	0.44	0.05	-99.00	-99.00	-99.00	-99.00	0.00	-0.43
10	AllOthers	0.61	0.34	0.50	0.63	-2.99	-3.49	-1.44	-2.09	-99.00	0.00	-0.07

Table A-6-5: Mode Specific Constants - Purpose 5: University

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManhattan	5.79	10.80	10.75	11.65	-1.80	3.91	-99.00	-99.00	-3.94	0.00	-99.00
2	FromManhattan	6.28	-3.44	-4.20	-2.66	-3.27	14.38	-1.46	24.93	-99.00	0.00	-99.00
3	QBBtoManh	2.36	1.50	0.63	1.28	1.07	-2.54	-0.35	-3.95	-99.00	0.00	-99.00
4	LItoManh	-1.12	1.49	0.43	1.45	-99.00	-99.00	-11.71	1.61	-99.00	0.00	-99.00
5	NJ/SItoManh	-0.28	3.55	1.61	3.36	-2.17	-4.07	4.20	-0.35	-99.00	0.00	-99.00
6	UpperNY/CTtoManh	0.48	3.81	2.81	3.28	-0.90	-0.10	-3.53	-0.87	-99.00	0.00	-99.00
7	WithinQBB	-0.65	3.64	3.28	3.73	-0.07	9.20	-99.00	-99.00	-8.11	0.00	-99.00
8	WithinNJ/SI	2.80	2.35	1.54	3.25	-7.82	0.22	-7.43	2.42	-16.25	0.00	-99.00
9	WithinLI	0.65	-0.06	-0.78	0.93	-6.17	6.11	-4.41	-1.44	-99.00	0.00	-99.00
10	WithinUpperNY/CT	0.60	0.10	-0.87	0.99	-2.35	8.69	-99.00	-99.00	-99.00	0.00	-99.00
11	AllOthers	5.40	-4.57	-5.42	-3.22	-14.17	-4.85	-99.00	-99.00	-99.00	0.00	-99.00

Table A-6-6: Mode Specific Constants - Purpose 6: Maintenance

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManh CBD	-2.21	1.69	2.08	-99.00	-0.54	-1.38	-99.00	-99.00	-0.80	0.00	-99.00
2	UpperManh/CBD	0.19	-0.26	-1.18	-99.00	-0.10	-0.64	-99.00	-99.00	0.99	0.00	-99.00
3	CBD/UpperManh	-99.00	-2.19	-99.00	-99.00	-0.25	-99.00	-99.00	-99.00	1.30	0.00	-99.00
4	Bronx/Lo&Valley Manh	0.89	-1.01	-99.00	-99.00	0.10	1.46	-99.00	-99.00	-0.44	0.00	-99.00
5	Bronx/Mid Manh	-99.00	1.09	2.82	-99.00	0.24	1.50	-99.00	-99.00	-1.28	0.00	-99.00
6	Qns/Lo Manh	0.73	-99.00	3.25	-99.00	-2.61	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
7	Qns/Valley Manh	-99.00	3.66	-99.00	-99.00	1.24	-99.00	-5.32	-99.00	1.52	0.00	-99.00
8	Qns/Mid Manh	-99.00	-99.00	-99.00	-99.00	1.82	-99.00	-4.16	-99.00	-99.00	0.00	-99.00
9	Bkln/Lo Manh	-99.00	-99.00	-99.00	-99.00	-1.09	-99.00	25.99	-99.00	-99.00	0.00	-99.00
10	Bkln/Valley Manh	-2.07	-2.38	2.75	-0.80	-0.65	-0.53	25.99	-99.00	-99.00	0.00	-99.00
11	Bkln/Mid Manh	-99.00	2.21	-99.00	-99.00	-1.11	-99.00	-99.00	-99.00	-1.61	0.00	-99.00
12	SI/Lo&Valley Manh	-99.00	-99.00	1.51	2.94	-0.39	-1.57	-99.00	-99.00	-99.00	0.00	-99.00
13	SI/Mid Manh	-99.00	0.95	-99.00	-99.00	0.05	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
14	Othey NYC/Up Manh	-0.85	0.86	1.94	2.73	-0.52	-0.67	-99.00	-1.17	0.76	0.00	-99.00
15	LI&NYS-Sbrb&CT/Up Manh	-0.08	1.86	1.23	-99.00	-3.13	-99.00	-1.20	-99.00	2.59	0.00	-99.00
16	LI/Lo&Valley Manh	0.32	2.15	-99.00	-99.00	-99.00	-99.00	-3.30	0.57	-99.00	0.00	-99.00
17	LI/Mid Manh	0.01	-99.00	-99.00	-99.00	-99.00	-99.00	-0.34	1.09	-99.00	0.00	-99.00
18	Westchester/Lo& Valley Manh	-3.50	1.64	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
19	Westchester/Mid Manh	-1.00	-99.00	-99.00	-99.00	-99.00	-0.17	-99.00	-1.10	2.93	0.00	-99.00
20	NYS-Sbrb&CT/Lo&Valley Manh	-99.00	1.09	-99.00	-99.00	-99.00	-99.00	-99.00	0.38	-99.00	0.00	-99.00
21	NYS-Sbrb&CT/Upper Manh	-99.00	0.61	-99.00	-99.00	-99.00	-99.00	-99.00	0.50	-99.00	0.00	-99.00
22	Manh/SI	1.89	2.28	2.47	2.80	1.81	2.08	-99.00	-99.00	-99.00	0.00	-99.00
23	BxQnsBkln/SI	-4.22	-0.53	1.97	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
24	Within SI	-0.82	0.48	0.95	1.61	-1.11	-99.00	-99.00	-99.00	0.38	0.00	-99.00
25	LI&NYS-EOH&CT/SI	1.52	2.45	3.44	3.81	3.27	2.08	1.87	5.38	-99.00	0.00	-99.00
26	Manh/Bx&Qns&Bkln	-99.00	0.85	0.58	1.51	-0.42	0.40	-99.00	-99.00	-99.00	0.00	-99.00
27	Inter Bx&Qns&Bkln	-1.38	-0.56	0.79	1.91	0.08	-99.00	-99.00	-99.00	1.69	0.00	-99.00
28	SI/Bx&Qns&Bkln	-3.60	-2.46	0.16	2.58	-3.02	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
29	LI&NYS-EOH&CT/Bx&Qns	-1.34	0.34	1.28	1.13	-2.75	-99.00	0.28	1.82	3.04	0.00	-99.00

	&Bkln											
30	Manh/LI	0.69	0.02	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
31	Other NYC/LI	-0.06	0.83	0.33	0.88	-1.61	-99.00	-3.83	-99.00	0.78	0.00	-99.00
32	WithinLI	-0.72	0.30	1.39	1.38	-1.92	-99.00	-1.25	-99.00	-1.40	0.00	-99.00
33	NYS-EOH&CT/LI	0.76	1.47	2.34	2.98	-0.16	1.04	-2.11	3.93	-99.00	0.00	-99.00
34	Manh/NYS-EOH&CT	0.75	-1.77	-0.32	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
35	Other NYC&LI/NYS-EOH&CT	-0.62	0.67	1.88	0.31	-1.29	1.05	-2.49	-99.00	-99.00	0.00	-99.00
36	Within UpperNYS& CT - No HRX	-0.91	0.06	1.32	1.80	-1.54	1.15	-2.49	4.12	-0.40	0.00	-99.00
37	NJ/NYS-WHO	-0.31	0.31	0.91	1.53	-2.15	-0.91	-3.94	3.52	-99.00	0.00	-99.00
38	PNJ/NJ	-0.55	0.14	0.99	1.76	-2.18	-0.50	-2.04	-99.00	-1.56	0.00	-99.00
39	PNJtoUptown	0.13	0.91	1.20	2.27	-0.23	0.94	-3.28	0.71	-99.00	0.00	-99.00
40	PNJtoMidtown	0.15	0.92	1.25	2.19	0.29	1.34	-3.30	0.43	-99.00	0.00	-99.00
41	PNJtoDwntnValley	-0.12	0.86	1.32	2.27	0.29	1.73	-2.74	0.34	-99.00	0.00	-99.00
42	ONJtoUptown	1.23	2.09	2.50	3.57	-1.19	2.36	-4.33	1.37	-99.00	0.00	-99.00
43	ONJtoMidtown	0.98	1.87	2.43	3.38	-1.24	2.30	-4.16	1.07	-99.00	0.00	-99.00
44	ONJtoDwntnValley	0.86	1.76	2.32	3.28	-1.38	2.64	-3.41	1.49	-99.00	0.00	-99.00
45	WHR-NYtoUptown	0.15	0.95	1.42	2.32	-2.84	1.49	-99.00	1.16	-99.00	0.00	-99.00
46	WHR-NYtoMidtown	1.07	2.18	2.46	3.77	-2.89	2.29	-4.71	2.39	-99.00	0.00	-99.00
47	WHR-NYtoDwntnValley	0.77	1.98	2.35	3.33	-3.12	1.33	-4.00	2.52	-99.00	0.00	-99.00
48	PNJtoBronx	-0.38	-0.20	0.83	1.81	0.73	2.89	1.54	5.85	-99.00	0.00	-99.00
49	PNJtoQn/Bklyn	-0.57	-0.62	0.70	1.29	0.60	2.20	-1.40	4.09	-99.00	0.00	-99.00
50	PNJtoSI	-0.23	0.59	0.95	1.93	-1.41	-99.00	-0.23	-99.00	-99.00	0.00	-99.00
51	PNJtoLI	-0.37	-0.40	1.02	1.53	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
52	PNJtoOthNY/CT	-0.39	-0.11	1.09	1.73	-2.71	-0.23	-99.00	-99.00	-99.00	0.00	-99.00
53	ONJ/WHR-NYtoBronx	0.10	0.19	1.83	2.39	-0.55	2.77	-0.38	6.02	-99.00	0.00	-99.00
54	ONJ/WHR-NYtoQn/Bklyn	-0.51	-0.55	0.63	1.43	-1.91	2.59	-1.92	3.74	-99.00	0.00	-99.00
55	ONJ/WHR-NYtoSI	-0.55	0.28	0.87	1.45	-2.11	-99.00	-2.39	2.67	-99.00	0.00	-99.00
56	ONJ/WHR-NYtoLI	-0.67	-0.45	0.75	1.68	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
57	ONJ/WHR-NYtoOthNY/CT	-0.27	-0.04	0.96	2.14	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
58	UptowntoPNJ	-0.06	0.06	0.23	-4.39	0.86	-99.00	-2.96	-99.00	-99.00	0.00	-99.00
59	MidtowntoPNJ	-2.83	-2.32	-1.87	-2.46	1.25	-99.00	-2.05	-99.00	-99.00	0.00	-99.00
60	DwntwnValleytoPNJ	-1.68	-1.44	-1.08	-99.00	0.94	-99.00	-4.06	-99.00	-99.00	0.00	-99.00
61	BronxtoPNJ	3.53	3.66	3.80	4.24	1.00	-99.00	0.00	-99.00	-99.00	0.00	-99.00
62	Qn/BklyntoPNJ	0.77	0.99	1.29	1.99	-3.23	-99.00	-99.00	-99.00	-99.00	0.00	-99.00

63	SItoPNJ	0.09	0.75	1.26	1.77	-2.68	-99.00	-2.53	-99.00	-99.00	0.00	-99.00
64	LItoPNJ	-0.92	0.08	0.96	1.68	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
65	OthNY/CTtoPNJ	-0.33	0.47	1.18	1.88	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
66	UptowntoONJ	0.53	0.94	1.00	-2.66	0.08	-99.00	-0.94	-99.00	-99.00	0.00	-99.00
67	Mid/DnValltoONJ	-0.02	0.41	1.14	-1.55	0.60	-99.00	-3.65	-99.00	-99.00	0.00	-99.00
68	BronxtoONJ	1.62	1.77	1.77	2.70	-3.12	-99.00	-1.04	-99.00	-99.00	0.00	-99.00
69	Qn/BklyntoONJ	0.44	0.69	1.15	1.86	-4.49	-99.00	-3.89	-99.00	-99.00	0.00	-99.00
70	SItoONJ	-0.58	0.50	0.88	1.29	-99.00	-99.00	-1.70	-99.00	-99.00	0.00	-99.00
71	LItoONJ	-0.68	0.09	0.89	1.49	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
72	OthNYS/CTtoONJ	-0.44	0.38	1.09	1.86	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
73	ONJtoPNJ	-0.55	0.14	0.99	1.76	-2.18	-0.50	-2.04	-99.00	-1.56	0.00	-99.00
74	WOHtoPNJ	-0.31	0.31	0.91	1.53	-2.15	-0.91	-3.94	3.52	-99.00	0.00	-99.00
75	ONJtoONJ	-0.55	0.14	0.99	1.76	-2.18	-0.50	-2.04	-99.00	-1.56	0.00	-99.00
76	WOHtoONJ	-0.31	0.31	0.91	1.53	-2.15	-0.91	-3.94	3.52	-99.00	0.00	-99.00
77	inValeyManh	-1.31	1.04	-99.00	-99.00	0.08	-99.00	-99.00	-99.00	-1.07	0.00	-99.00
78	inMidManh	-99.00	-99.00	-99.00	-99.00	0.33	-99.00	-99.00	-99.00	-1.07	0.00	-99.00
79	inUpperManh	-1.67	-0.22	2.07	1.86	-0.21	-2.33	-99.00	-99.00	0.47	0.00	-99.00
80	inQueens	-0.55	0.25	1.32	1.23	-0.76	-99.00	-2.07	2.95	0.56	0.00	-99.00
81	inBronx	-1.18	0.12	0.71	0.72	-0.83	-0.16	0.97	-99.00	2.14	0.00	-99.00
82	inKings	-0.54	0.11	1.06	0.69	-0.41	1.36	-99.00	-99.00	0.13	0.00	-99.00

Table A-6-7: Mode Specific Constants - Purpose 7: Discretionary

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManh CBD	-99.00	0.49	-99.00	-99.00	0.49	-99.00	-99.00	-99.00	-1.91	0.00	-99.00
2	UpperManh/CBD	0.93	2.29	2.71	2.54	-0.47	1.18	-99.00	-99.00	-0.71	0.00	-99.00
3	CBD/UpperManh	-0.92	-0.21	1.70	-99.00	0.39	-99.00	-99.00	-99.00	-1.66	0.00	-99.00
4	Bronx/Lo&Valley Manh	-0.82	-99.00	-99.00	-99.00	0.04	1.92	-99.00	-99.00	-99.00	0.00	-99.00
5	Bronx/Mid Manh	-99.00	1.19	-99.00	-99.00	0.09	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
6	Qns/Lo Manh	1.97	2.41	2.38	2.17	-0.55	1.94	-99.00	-99.00	-99.00	0.00	-99.00
7	Qns/Valley Manh	1.00	-99.00	3.71	-99.00	-1.07	0.45	-1.06	-99.00	-99.00	0.00	-99.00
8	Qns/Mid Manh	-99.00	-99.00	-99.00	-99.00	-0.89	3.53	-2.36	-99.00	-99.00	0.00	-99.00
9	Bkln/Lo Manh	2.46	2.80	2.85	1.99	-0.76	1.98	-99.00	-99.00	-99.00	0.00	-99.00
10	Bkln/Valley Manh	0.99	2.44	-99.00	-99.00	-0.23	-99.00	-99.00	-99.00	0.35	0.00	-99.00
11	Bkln/Mid Manh	2.49	2.67	2.81	2.00	-0.93	1.62	-99.00	-99.00	-99.00	0.00	-99.00
12	SI/Lo&Valley Manh	-99.00	0.69	-99.00	-99.00	-2.61	2.84	-99.00	-99.00	-99.00	0.00	-99.00
13	SI/Mid Manh	1.79	3.11	2.81	3.10	-1.98	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
14	Othey NYC /Up Manh	0.68	2.05	0.87	-99.00	-0.17	1.09	-99.00	-99.00	-0.91	0.00	-99.00
15	LI&NYS-Sbrb&CT/Up Manh	-1.53	-2.71	1.92	2.26	-4.09	-99.00	-2.09	-99.00	-1.98	0.00	-99.00
16	LI/Lo&Valley Manh	0.48	-99.00	-99.00	-99.00	-1.46	-99.00	0.56	-0.41	0.57	0.00	-99.00
17	LI/Mid Manh	-1.14	-2.42	0.68	-99.00	-99.00	0.67	-0.87	1.34	-0.02	0.00	-99.00
18	Westchester/Lo& Valley Manh	0.79	-99.00	2.02	-99.00	-99.00	-99.00	-0.08	2.22	-99.00	0.00	-99.00
19	Westchester/Mid Manh	-1.19	1.93	-99.00	2.73	-99.00	-99.00	-2.24	0.68	-99.00	0.00	-99.00
20	NYS-Sbrb&CT /Lo&Valley Manh	-0.02	-99.00	3.06	-99.00	-99.00	-99.00	-3.24	-99.00	-99.00	0.00	-99.00
21	NYS-Sbrb&CT/Upper Manh	1.92	2.04	2.13	1.59	-99.00	-99.00	-4.03	0.32	-99.00	0.00	-99.00
22	Manh/SI	0.43	-0.30	-0.86	-0.68	0.74	0.79	-99.00	-99.00	2.97	0.00	-99.00
23	BxQnsBkln/SI	0.45	1.09	0.79	1.25	-4.16	-0.35	-99.00	-99.00	-99.00	0.00	-99.00
24	Within SI	-0.53	0.41	0.36	0.84	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
25	LI&NYS-EOH&CT/SI	1.43	1.05	1.24	1.53	2.47	3.85	-99.00	-99.00	4.20	0.00	-99.00
26	Manh/Bx&Qns&Bkln	-1.89	0.73	-1.59	0.55	0.59	1.08	-99.00	-99.00	-99.00	0.00	-99.00
27	Inter Bx&Qns&Bkln	-1.15	0.60	1.03	0.80	-1.49	0.82	-99.00	-99.00	-99.00	0.00	-99.00
28	SI/Bx&Qns&Bkln	-99.00	0.68	0.33	-99.00	-99.00	0.49	-99.00	-99.00	-99.00	0.00	-99.00
29	LI&NYS-EOH&CT/Bx&Qns &Bkln	-0.04	0.38	-1.16	1.06	-99.00	1.25	-1.71	-99.00	-99.00	0.00	-99.00

30	Manh/LI	-0.75	-0.99	-1.08	-1.70	1.07	0.92	-99.00	-99.00	3.80	0.00	-99.00
31	Other NYC/LI	-0.03	0.57	-0.33	1.41	-3.53	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
32	WithinLI	-0.44	0.28	0.23	0.88	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
33	NYS-EOH&CT/LI	-1.75	-1.63	1.29	0.49	-99.00	-99.00	-99.00	1.26	-99.00	0.00	-99.00
34	Manh/NYS-EOH&CT	-3.03	-0.69	-2.07	-99.00	-99.00	4.80	-3.98	2.69	-99.00	0.00	-99.00
35	Other NYC&LI/NYS-EOH&CT	-0.08	0.60	0.58	1.16	0.01	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
36	Within UpperNYS& CT - No HRX	-0.47	0.45	0.21	0.81	-2.29	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
37	NJ/NYS-WHO	-0.53	0.57	0.47	0.95	-4.58	-0.64	-99.00	-99.00	-99.00	0.00	-99.00
38	PNJ/NJ	-0.48	0.61	0.68	1.26	-3.81	-1.40	-99.00	-99.00	-6.25	0.00	-99.00
39	PNJtoUptown	-0.19	1.47	1.15	2.10	-0.76	2.66	0.25	3.01	-99.00	0.00	-99.00
40	PNJtoMidtown	-0.29	1.57	1.33	1.98	-0.59	2.74	-0.21	2.40	-99.00	0.00	-99.00
41	PNJtoDwntnValley	-0.33	1.58	1.42	2.39	-0.54	3.08	0.41	2.68	-99.00	0.00	-99.00
42	ONJtoUptown	-0.13	1.51	1.40	2.18	-2.51	3.47	-2.03	2.25	-99.00	0.00	-99.00
43	ONJtoMidtown	-0.07	1.62	1.47	2.22	-2.50	3.20	-2.04	1.61	-99.00	0.00	-99.00
44	ONJtoDwntwnValley	-0.48	1.27	1.15	2.01	-2.91	3.39	-1.35	1.99	-99.00	0.00	-99.00
45	WHR-NYtoUptown	-0.34	1.17	0.83	1.92	-2.44	3.29	-99.00	2.04	-99.00	0.00	-99.00
46	WHR-NYtoMidtown	0.48	2.05	1.80	2.78	-3.00	3.57	-1.07	2.60	-99.00	0.00	-99.00
47	WHR-NYtoDwntnValley	0.36	2.15	1.87	2.55	-3.45	3.21	-2.05	2.83	-99.00	0.00	-99.00
48	PNJtoBronx	-0.03	0.25	0.17	0.86	0.71	2.44	0.11	1.96	-99.00	0.00	-99.00
49	PNJtoQn/Bklyn	-0.04	0.16	0.25	0.77	0.61	1.59	-2.06	0.19	-99.00	0.00	-99.00
50	PNJtoSI	1.12	2.05	1.46	1.75	1.04	-99.00	2.08	-99.00	-99.00	0.00	-99.00
51	PNJtoLI	0.20	0.27	0.27	0.86	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
52	PNJtoOthNY/CT	0.09	0.44	0.58	1.17	-1.69	0.16	-99.00	-99.00	-99.00	0.00	-99.00
53	ONJ/WHR-NYtoBronx	0.27	0.42	0.46	1.28	-0.78	2.43	-2.39	2.17	-99.00	0.00	-99.00
54	ONJ/WHR-NYtoQn/Bklyn	0.20	0.19	0.10	0.77	-1.05	2.74	-2.44	0.02	-99.00	0.00	-99.00
55	ONJ/WHR-NYtoSI	-0.13	0.86	0.30	0.61	0.16	-99.00	-1.34	-0.44	-99.00	0.00	-99.00
56	ONJ/WHR-NYtoLI	0.02	0.15	0.09	0.90	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
57	ONJ/WHR-NYtoOthNY/CT	0.01	0.24	0.11	0.91	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
58	UptowntoPNJ	2.05	2.75	1.88	-1.04	2.81	-99.00	-2.11	-99.00	-99.00	0.00	-99.00
59	MidtowntoPNJ	-1.13	-0.73	-0.88	-2.08	2.28	-99.00	-3.97	-99.00	-99.00	0.00	-99.00
60	DwntnValleytoPNJ	-0.80	-0.47	-1.02	-99.00	1.16	-99.00	-5.06	-99.00	-99.00	0.00	-99.00
61	BronxtoPNJ	3.23	3.08	1.89	2.76	-2.17	-99.00	-2.08	-99.00	-99.00	0.00	-99.00
62	Qn/BklyntoPNJ	1.77	2.00	1.03	1.45	-2.92	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
63	SItoPNJ	0.61	1.47	0.75	1.03	-2.08	-99.00	-0.62	-99.00	-99.00	0.00	-99.00

64	LItoPNJ	0.06	0.92	0.57	1.45	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
65	OthNY/CTtoPNJ	2.00	2.94	2.71	3.42	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
66	UptowntoONJ	3.07	3.04	1.77	-1.04	2.32	-99.00	-1.31	-99.00	-99.00	0.00	-99.00
67	Mid/DnValltoONJ	1.18	1.81	1.38	-0.76	1.62	-99.00	-4.50	-99.00	-99.00	0.00	-99.00
68	BronxtoONJ	2.33	2.08	1.10	1.21	-3.12	-99.00	-5.20	-99.00	-99.00	0.00	-99.00
69	Qn/BklyntoONJ	1.25	1.38	0.61	1.17	-4.18	-99.00	-3.90	-99.00	-99.00	0.00	-99.00
70	SItoONJ	-0.12	0.97	0.23	0.48	-99.00	-99.00	-2.06	-99.00	-99.00	0.00	-99.00
71	LItoONJ	0.28	0.86	0.30	0.88	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
72	OthNYS/CTtoONJ	-0.15	0.92	0.53	1.25	-99.00	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
73	ONJtoPNJ	-0.48	0.61	0.68	1.26	-3.81	-1.40	-99.00	-99.00	-6.25	0.00	-99.00
74	WOHtoPNJ	-0.53	0.57	0.47	0.95	-4.58	-0.64	-99.00	-99.00	-99.00	0.00	-99.00
75	ONJtoONJ	-0.48	0.61	0.68	1.26	-3.81	-1.40	-99.00	-99.00	-6.25	0.00	-99.00
76	WOHtoONJ	-0.53	0.57	0.47	0.95	-4.58	-0.64	-99.00	-99.00	-99.00	0.00	-99.00
77	inValeyManh	-99.00	1.55	-99.00	-99.00	0.32	-99.00	-99.00	-99.00	-0.79	0.00	-99.00
78	inMidManh	-99.00	-99.00	-99.00	-99.00	0.52	-99.00	-99.00	-99.00	-99.00	0.00	-99.00
79	inUpperManh	0.14	1.61	3.05	2.49	-0.40	-99.00	-99.00	-99.00	-0.95	0.00	-99.00
80	inQueens	-0.09	0.76	0.30	0.89	-0.66	-99.00	-99.00	-99.00	-99.00	0.00	-75.61
81	inBronx	-1.76	-0.13	0.12	0.70	0.37	0.51	1.91	-99.00	0.34	0.00	-99.00
82	inKings	-0.20	0.25	-1.28	0.47	-1.67	-99.00	-99.00	-99.00	-2.48	0.00	-99.00

Table A-6-8: Mode Specific Constants - Purpose 8: At-Work

Index	District Name	SOV	HOV 2	HOV 3	HOV4+	WT	DT	WC	WC	Taxi	NM	SB
1	InManhattan	20.24	-10.65	-11.63	-99.00	-4.39	-99.00	-99.00	-99.00	-11.67	0.00	-99.00
2	x2	5.63	-6.10	-6.66	-99.00	2.57	-99.00	-99.00	-99.00	-13.07	0.00	-99.00
3	x3	22.18	-11.73	-11.77	-99.00	0.99	-99.00	-99.00	-99.00	-17.83	0.00	-99.00
5	x4	5.62	-6.06	-5.89	-99.00	1.75	-99.00	-99.00	-99.00	-9.32	0.00	-99.00
6	x5	-2.12	-4.80	-4.65	-99.00	3.47	-99.00	-99.00	-99.00	-12.47	0.00	-99.00
7	x6	3.87	-4.34	-4.20	-99.00	-5.09	-99.00	-99.00	-99.00	-14.87	0.00	-99.00
8	x7	5.04	-5.39	-5.87	-99.00	-4.36	-99.00	-99.00	-99.00	-14.72	0.00	-99.00
9	x8	2.84	-4.03	-3.69	-99.00	2.62	-99.00	-99.00	-99.00	-11.88	0.00	-99.00
10	x9	3.00	-8.64	-8.76	-99.00	-99.00	-99.00	-99.00	-99.00	-9.70	0.00	-99.00

Table A-7: Non-Motorized Mode Mode Specific Constant Indices

BPMDist	District Name	Index
0	Lower Man	1
1	Valley Man	1
2	Midtown Man	1
3	Upper Man	2
4	Queens	3
5	Bronx	3
6	Kings	3
7	Richmond	4
8	Nassau	4
9	Suffolk	4
10	Westchester	4
11	Rockland	4
12	Putnam	5
13	Orange	5
14	Dutchess	5
15	Fairfield	4
16	Bergen	6
17	Passaic	6
18	Hudson	7
19	Essex	7
20	Union	7
21	Morris	6
22	Somerset	6
23	Middlesex	6
24	Monmouth	6
25	Ocean	6
26	Hunterdon	6
27	Warren	6
28	Sussex	6
29	New Haven	4
30	Mercer	6

Table A-8: Non-Motorized Mode Choice Adjustment Factors

BPMDist	District Name	Purp1	Purp2	Purp3	Purp4	Purp5	Purp6	Purp7	Purp8
0	Lower Manh	1.38	0.06	0.44	-2.52	0.68	-0.54	0.06	-0.26
1	Valley Manh	1.33	-0.07	0.04	-2.55	0.86	-0.46	-0.96	-1.09
2	Midtown Manh	0.71	-0.40	-0.78	-5.96	0.07	-0.20	-0.77	0.41
3	Upper Manhattan	2.56	0.26	0.42	-10.64	-0.09	-0.42	-0.55	-0.58
4	Queens	1.79	-0.05	-0.29	-17.92	-0.40	0.32	0.49	-0.31
5	Bronx	2.34	1.21	0.31	-16.79	0.51	0.08	-0.38	-0.67
6	Kings	3.06	0.77	0.87	9.11	0.85	-0.05	-0.06	0.16

APPENDIX B: CALIBRATION AND VALIDATION DISTRICT SUMMARIES

APPENDIX C: DETAILED HAJ AND MDSC REPORTS

APPENDIX D: CALIBRATION MODEL RUN LOG