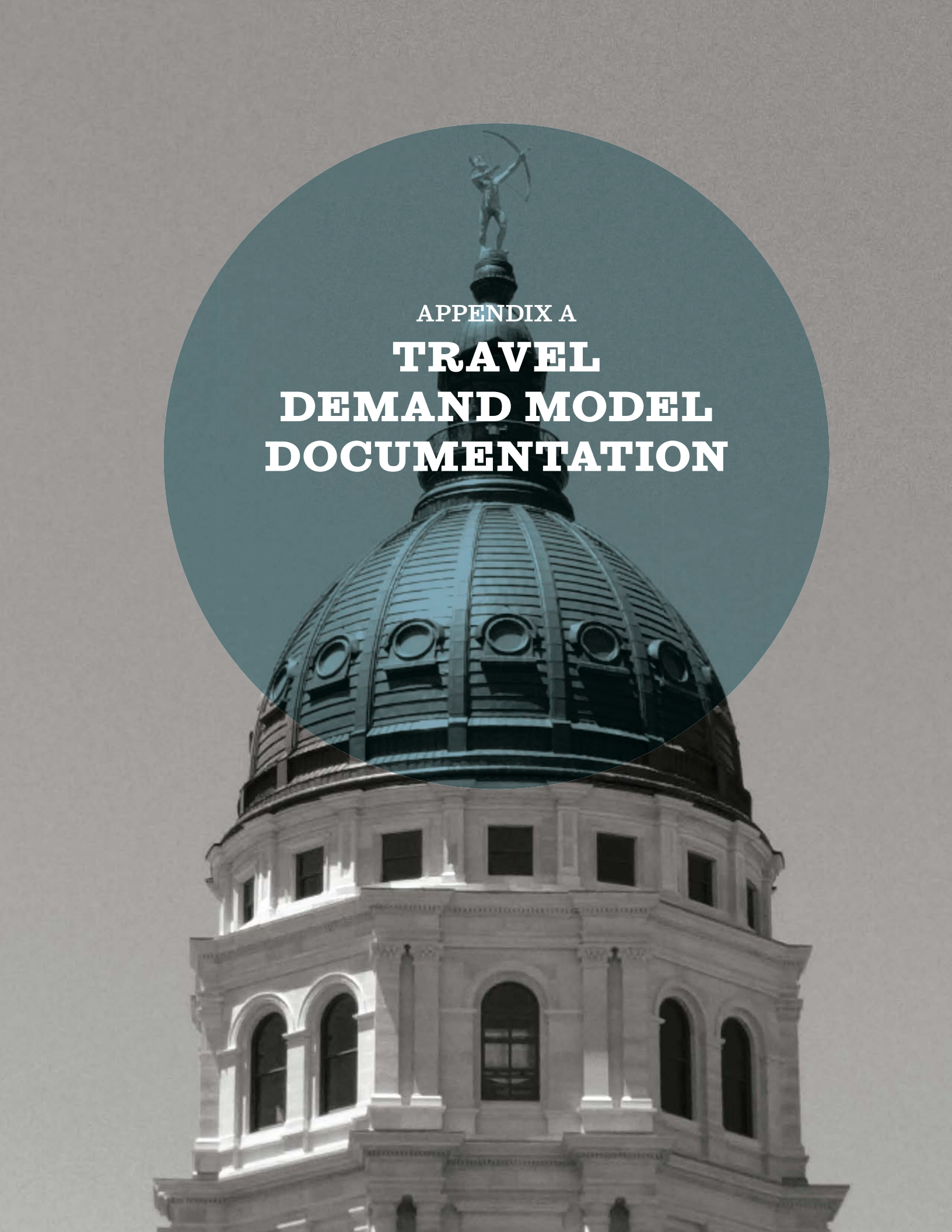


APPENDIX A

TRAVEL DEMAND MODEL DOCUMENTATION

Model Update, 2015 base year calibration and validation.

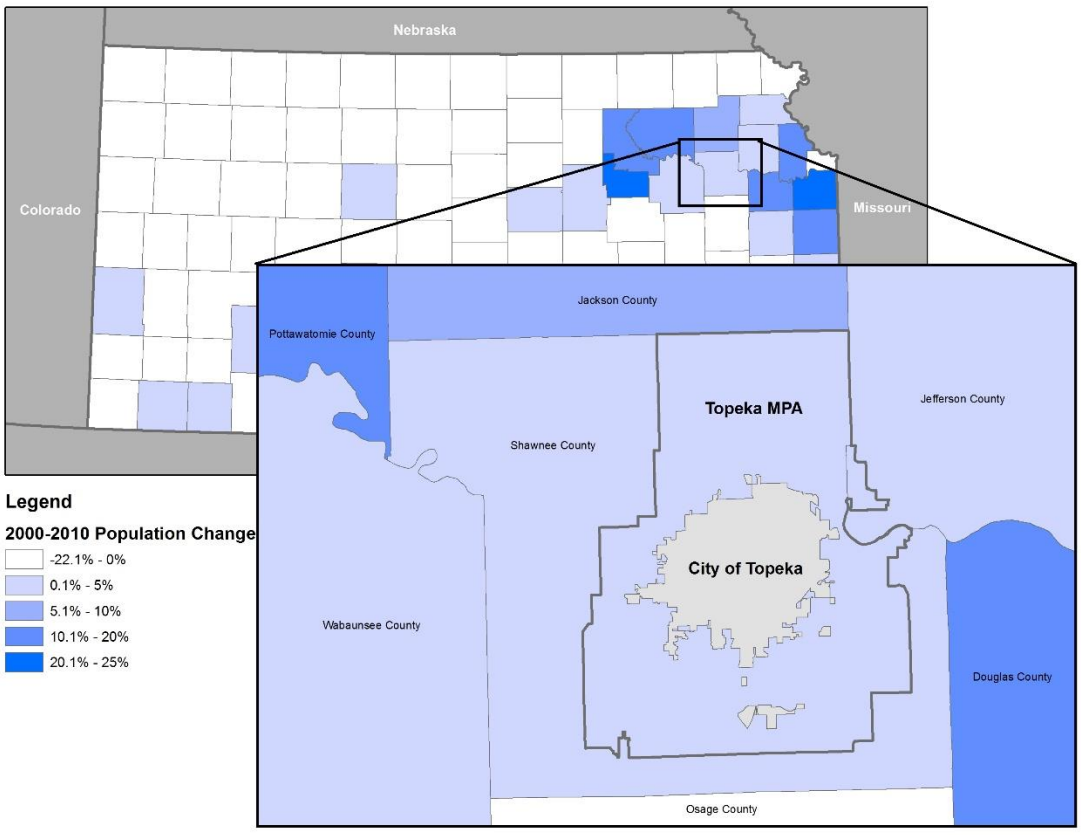
1. Introduction

As part of the Long Range Transportation Plan (LRTP)/Travel Demand Model Update project initiated by Metropolitan Topeka Planning Organization (MTPO), WSP was tasked with updating the existing Topeka Travel Demand Model and to make it available as a tool for the development of the LRTP.

The MTPO Travel Demand Model is a traditional trip based model with trip generation, trip distribution and assignment steps. The model does not include a mode-choice component. It is implemented in TransCAD 7.0 (build 12295 64-bit) transportation planning software.

The modeling approach to the update was developed in consultation with the MTPO and the Kansas Department of Transportation (KDOT). The project involved updating the existing model from a 2010 base year to 2015 base year, developing a 2040 "Existing plus Committed" future base year and evaluating five LRTP scenarios as part of the LRTP. The project also included transitioning the model from a TransCAD 6.0 software platform to the latest version (TransCAD 7.0), while incorporating a graphical user interface (GUI) which wasn't available in the earlier model.

The model covers the entire Metropolitan Topeka Planning Organization (MPTO) planning area (below); the area covered is 285 square miles with a population of 170,869 and employment of 111,574 for the 2015 base year. The area is forecasted to grow to a population of 197,942 in 2040 with a total employment of 129,330.



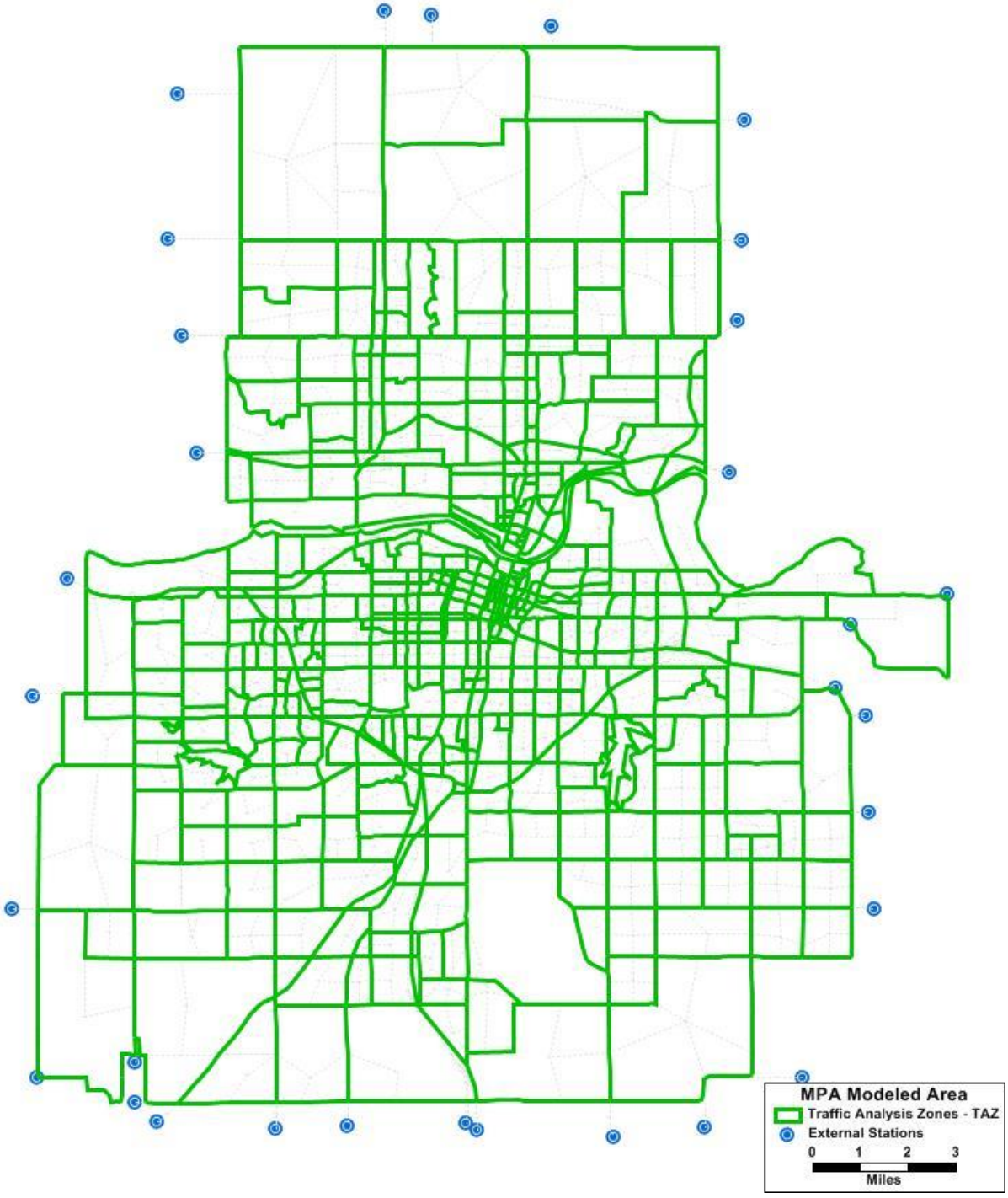


Figure 1: MPA Zone Structure

The model contains 515 traffic analysis zones (TAZs) with 31 external stations (Figure 1). The highway/streets network is classified by six (6) area types and eight (8) functional classifications (Figure 2).

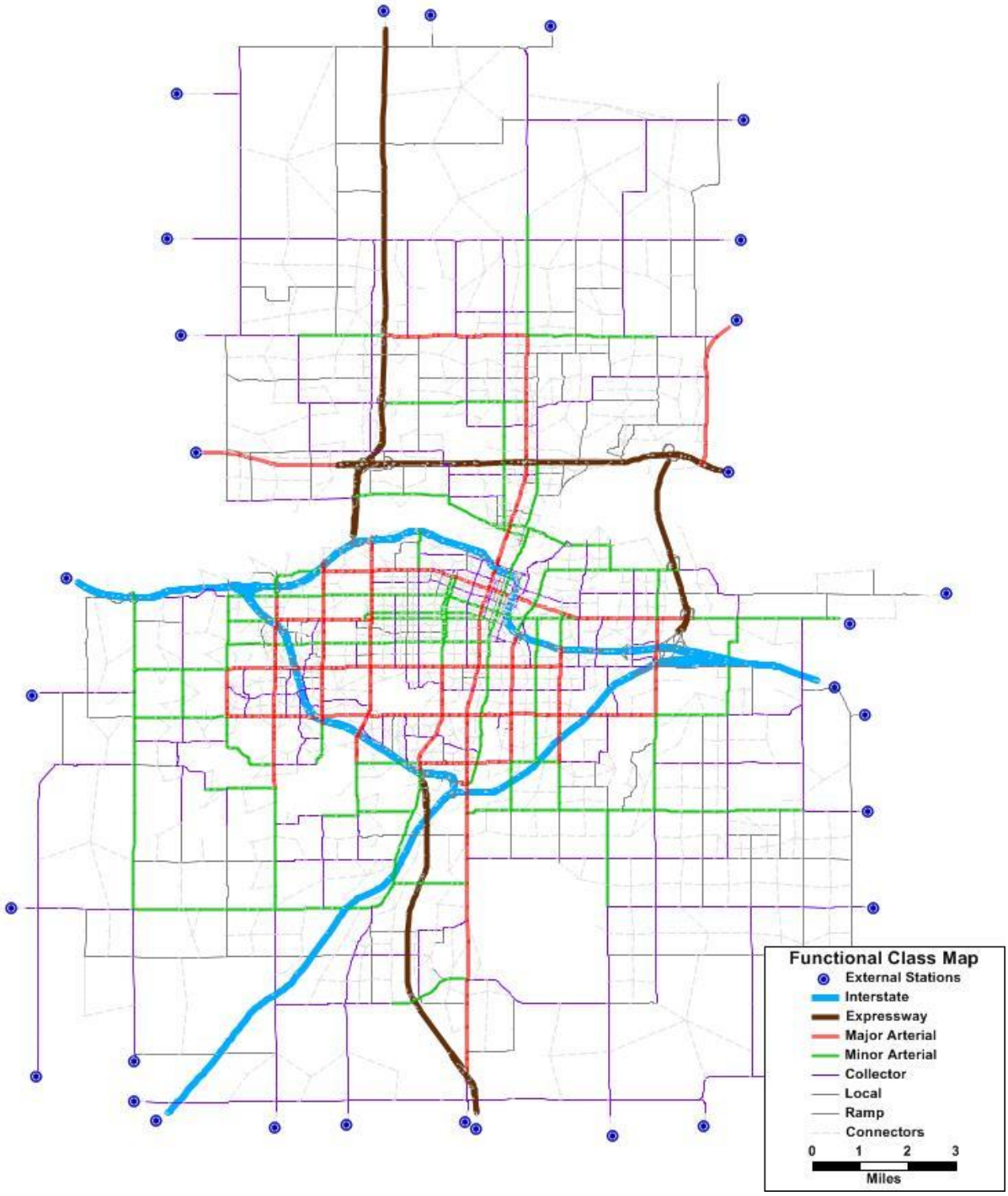


Figure 2: MPA Functional Classification

2. Data Collection and Analysis

As part of this task traffic count data for base year validation and socio-economic data for base and future years was obtained and assembled into formats compatible with the model.

Traffic Counts

Traffic count data for 2013 and 2015 was received from KDOT, Shawnee County and the City of Topeka, these daily counts were reviewed for consistency and then coded as attributes to the model network, care was taken to ensure that one-way and two-way counts were processed and assigned to the correct directional links. Data was received for a total of 1,042 locations (698 - 2013 counts, 334 - 2015 counts), these counts were reviewed and pared down to 594 count locations within the model limits while eliminating duplicate counts for the same location from different years and retaining the latest (Figure 3). The count locations were also reviewed to ensure a good representation by area types and functional (Table 1) class and as well as ensuring a good geographical distribution.

Table 1: Traffic Count Inventory by Functional Class

Functional Class	Traffic Counts	Percentage of Traffic Counts
Interstates	76	13%
Expressways	54	9%
Major Arterials	84	14%
Minor Arterials	89	15%
Collectors	130	22%
Local Streets	11	2%
Ramps	150	25%

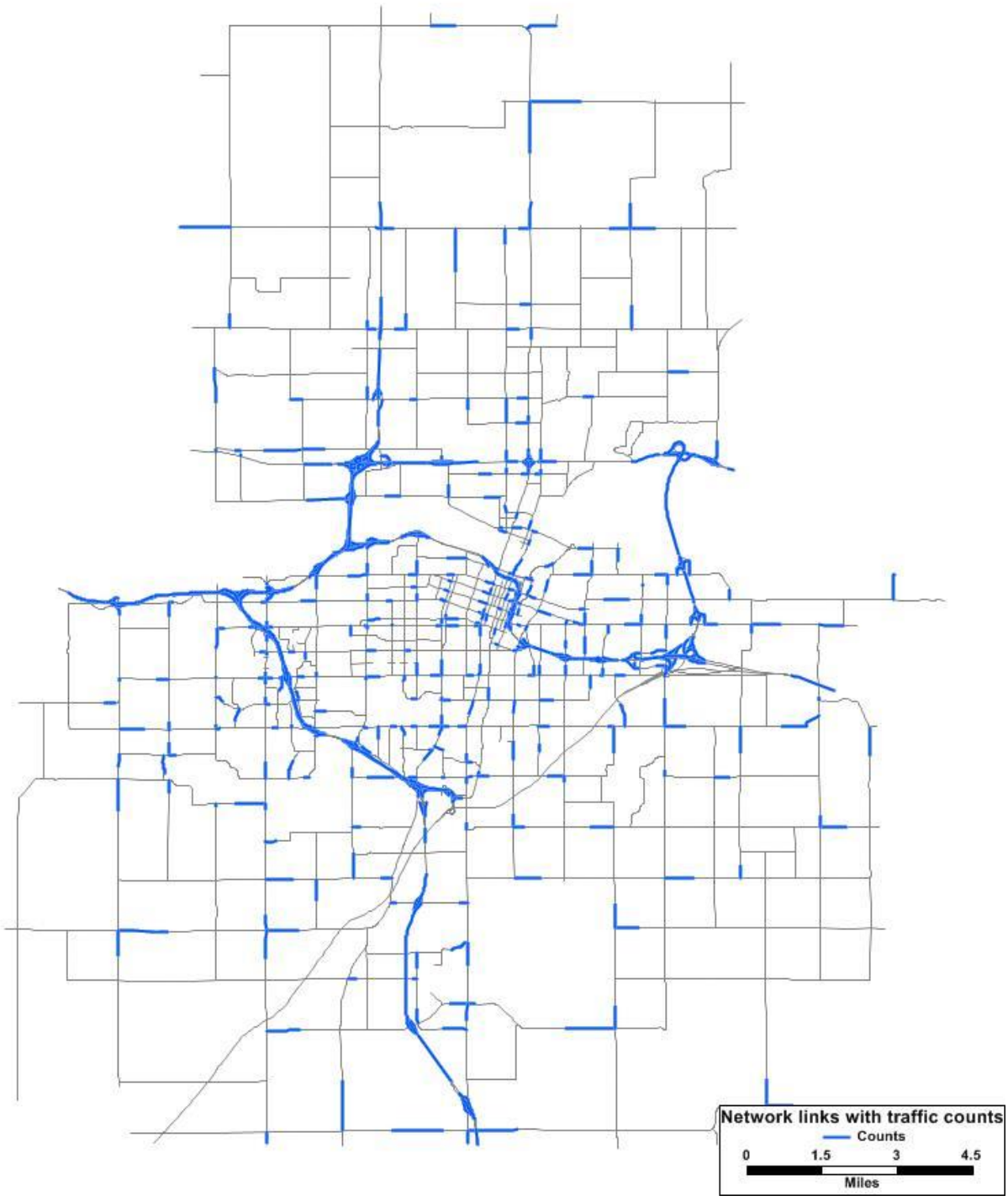


Figure 3: Location of Daily Counts

Socio-economic Data

Socio-economic (SE) data for 2015 base year and 2040 future was received from MTPO for the whole of Shawnee County by traffic analysis zones. The data was reviewed for consistency, while ensuring there were no unreasonable outliers. The data for both years was then compiled into a master SE database. The following are the required SE inputs at the TAZ level by analysis year –

- Population - HH_POP
- Households - HH
- Retail Employment - RETAIL
- Non-retail Employment - NON_RETAIL
- Total Employment - TOT_EMPLOY
- Median Household Income (in thousands of dollars) – INCOME in year 2010 dollars

3. Model Update, Calibration and Validation

There were three key aspects to the model update

- Transition the model to TransCAD 7.0
- Develop a Graphical User Interface (GUI)
- Calibrate and validate the model

Transitioning the model to TransCAD 7.0 and the development of the GUI were an integrated process. This involved reconfiguring the existing scripts to be compatible with the latest version as well as developing separate resource model files (*.rsc) for each of the model steps instead of one long script. This facilitates easy navigation through the code, making it modular and enabling a better interface with the GUI.

The following improvements were added to the model structure –

- Input and output files are separated and stored in respective folders, this ensures that the input files are not overwritten through the model run process.
- As part of the updated model run process, copies of input files are made and stored in the output folder and computations handled within those files. For example, highway network fields such as capacity, alpha, beta, free-flow speeds, peak speed, free-flow time and peak time are not input fields but computed fields, the input network file is processed and these variables are computed in output network file.
- Socio-economic (SE) data is no longer handled as a set of highway|Endpoint layer attributes, but is included as a stand-alone separate data file - Master_SE_Data.bin. This enables more flexibility in managing the file and ensures model transparency. The master data file stores SE data for base and all horizon years and any specific land use scenarios that need to be modeled. This format enables easy data manipulation and maintenance in MS Excel and easy import into TransCAD.
- The model GUI also features an option to archive input and output folders if the same scenario is re-run (Figure 4).

- A simple travel time feedback loop was also incorporated into the model routine to improve overall performance of the model.
- The assignment process was re-written to be compatible with TransCAD 7.0.
- The region's external to external (EE) trip table was also updated to reflect the new 2015 base year. Latest counts at external stations from the County and KDOT were used to update the growth factors and also the EE trip tables.

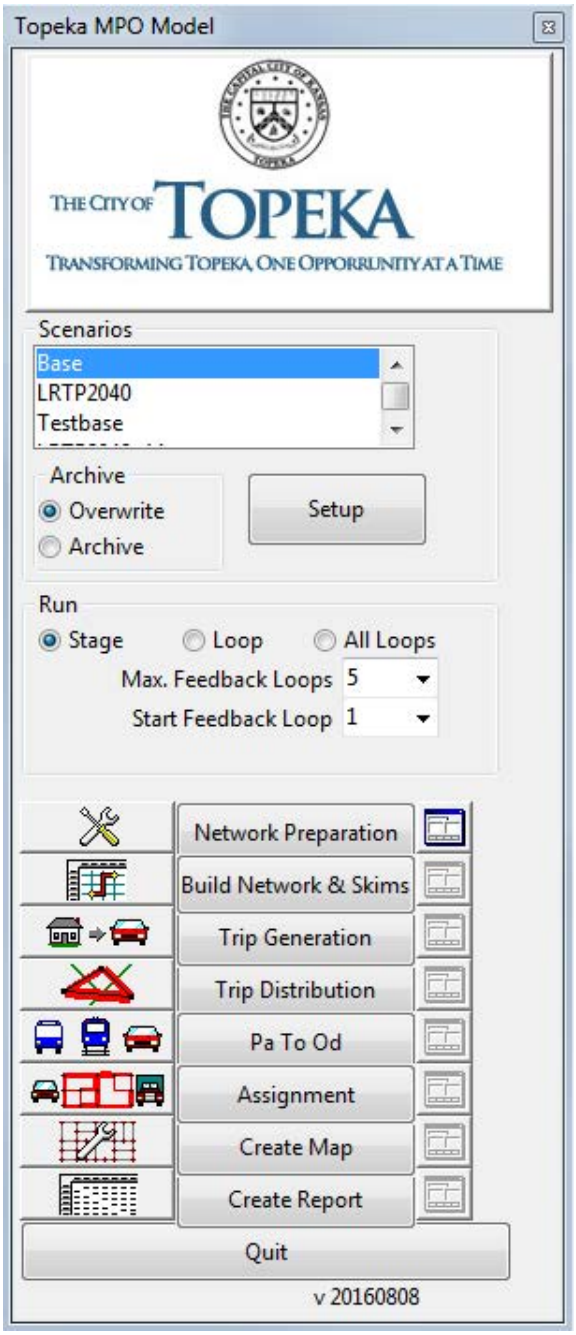


Figure 4: Topeka MPO Model User Interface

Calibration and validation

Initial model validation included running the base year model with the new 2015 base year SE data and comparing it to the latest traffic counts. Figure 5 shows this comparison with the observed volumes on the horizontal axis and the estimated volumes on the vertical axis. The initial results also showed that the model was over-forecasting on the river crossings (Topeka river screenline), specifically US-75, K-4, NW Topeka Blvd and Kansas Ave. This indicated an issue with spatial distribution of trips, the trip distribution procedures were reviewed and the friction factor parameters were adjusted for a

reasonable representation of trip length frequency distributions by trip types – HBW, HBNW and NHB (Figures 6-8).

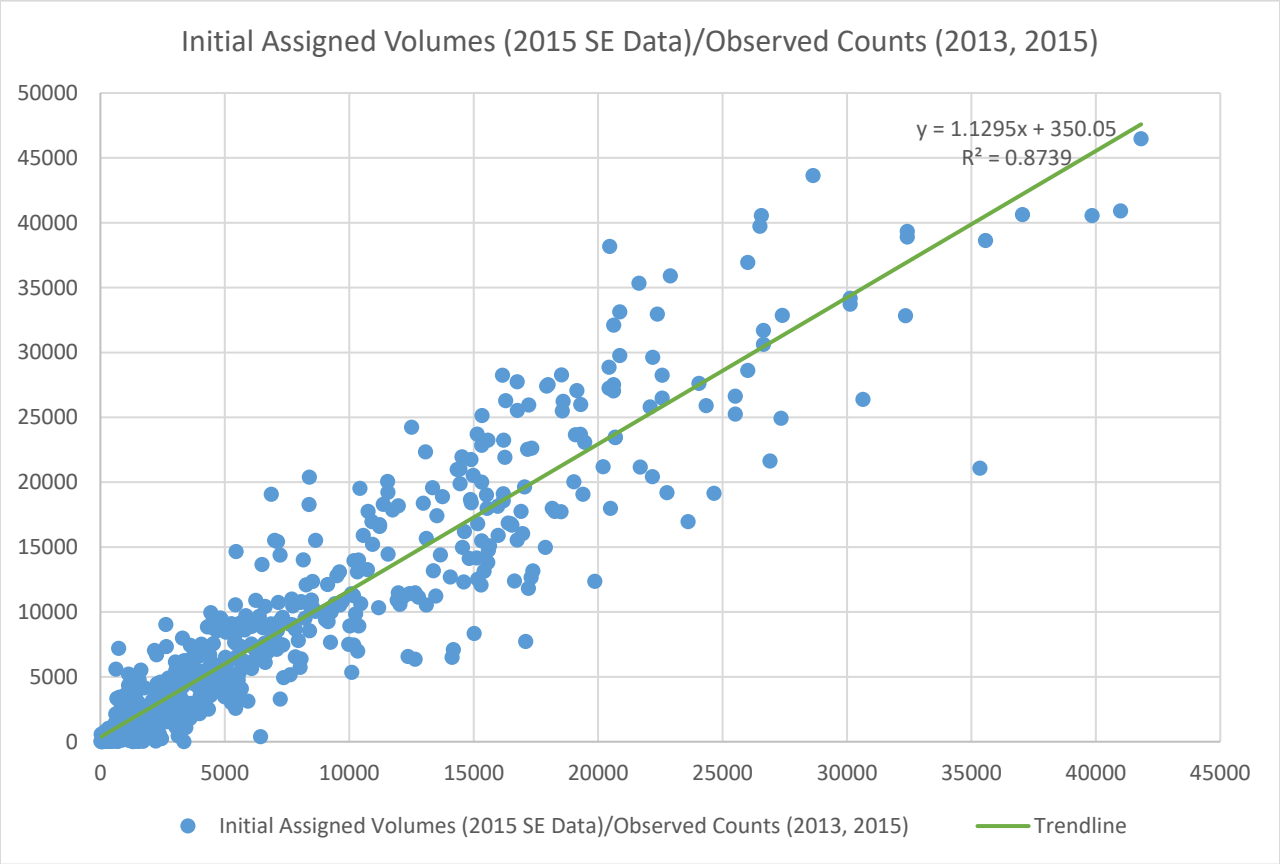


Figure 5: Initial Comparison of Observed and Estimated Link Volumes

Comparison of initial model outputs also enabled us to identify issues with count data and help review and refine them.

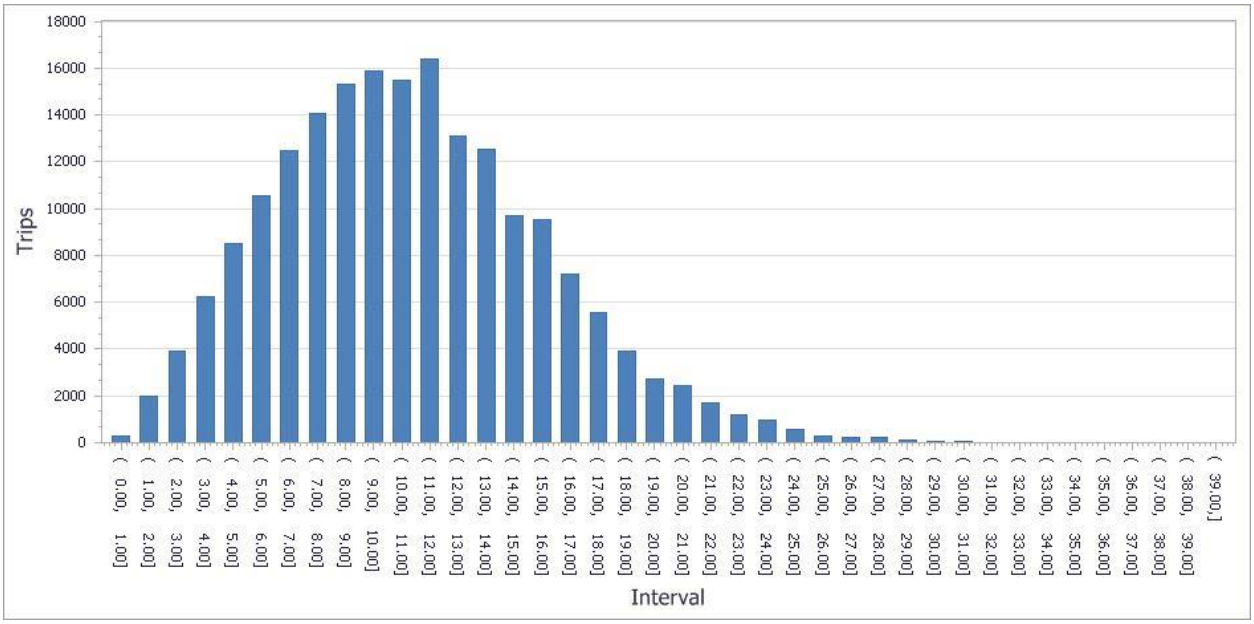


Figure 6 - HBW Trip length frequency distribution

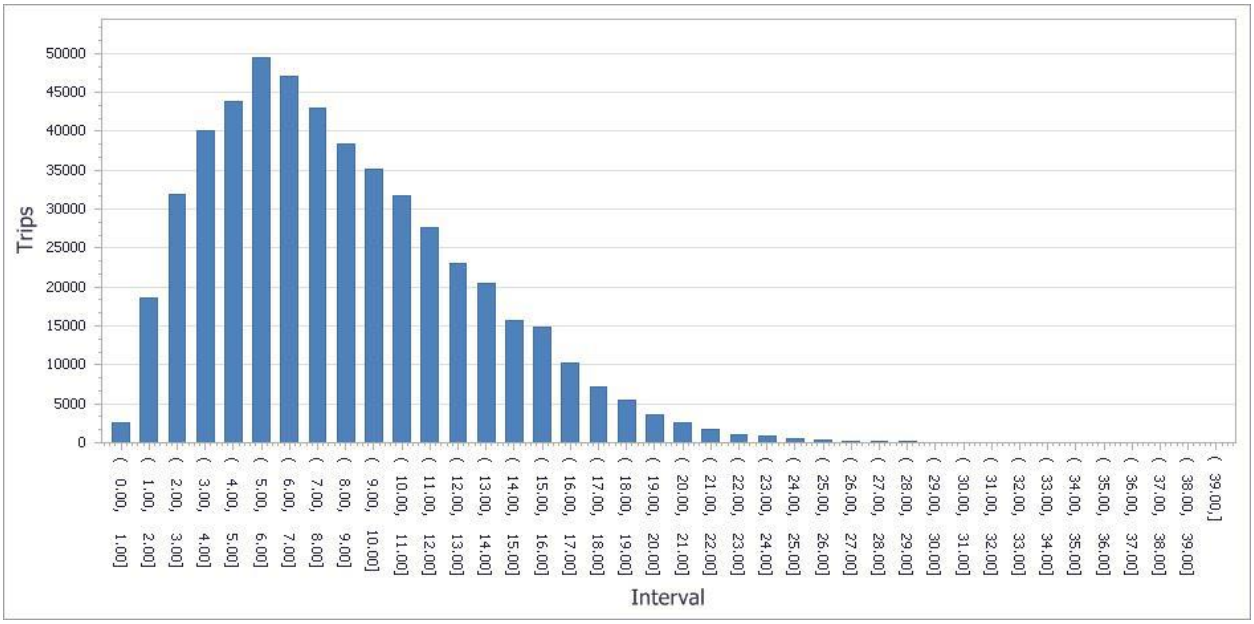


Figure 7 - HBNW Trip length frequency distribution

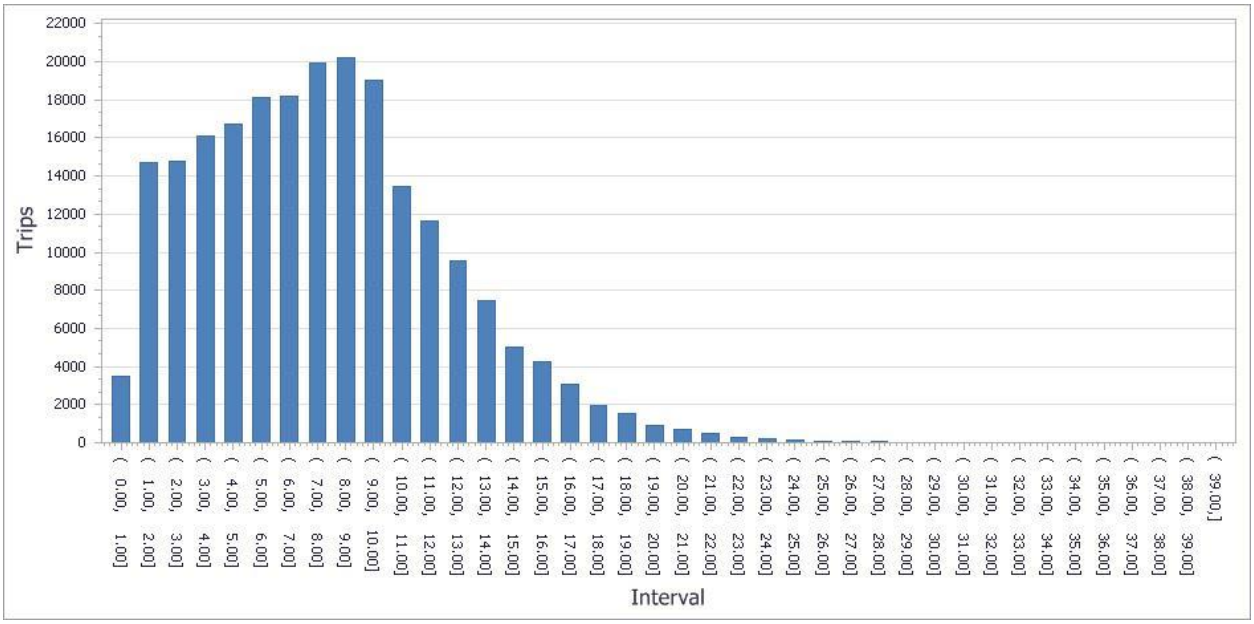


Figure 8 - NHB Trip length frequency distribution

Assignment Validation

The model was re-run with the new calibrated friction factors and validated to the traffic counts, this comparison ensures that the model reasonably represents the observed traffic patterns. Figure 9 shows a very good fit of the assignment volumes with the observed traffic counts, with counts on the horizontal axis and estimated volumes on the vertical axis. The traffic patterns were also validated by comparing the model vehicle miles travelled (VMT) and vehicle hours travelled (VHT) to count based (observed) VMT and VHT. These were also reviewed by facility type and regionally (Table 2) for reasonableness.

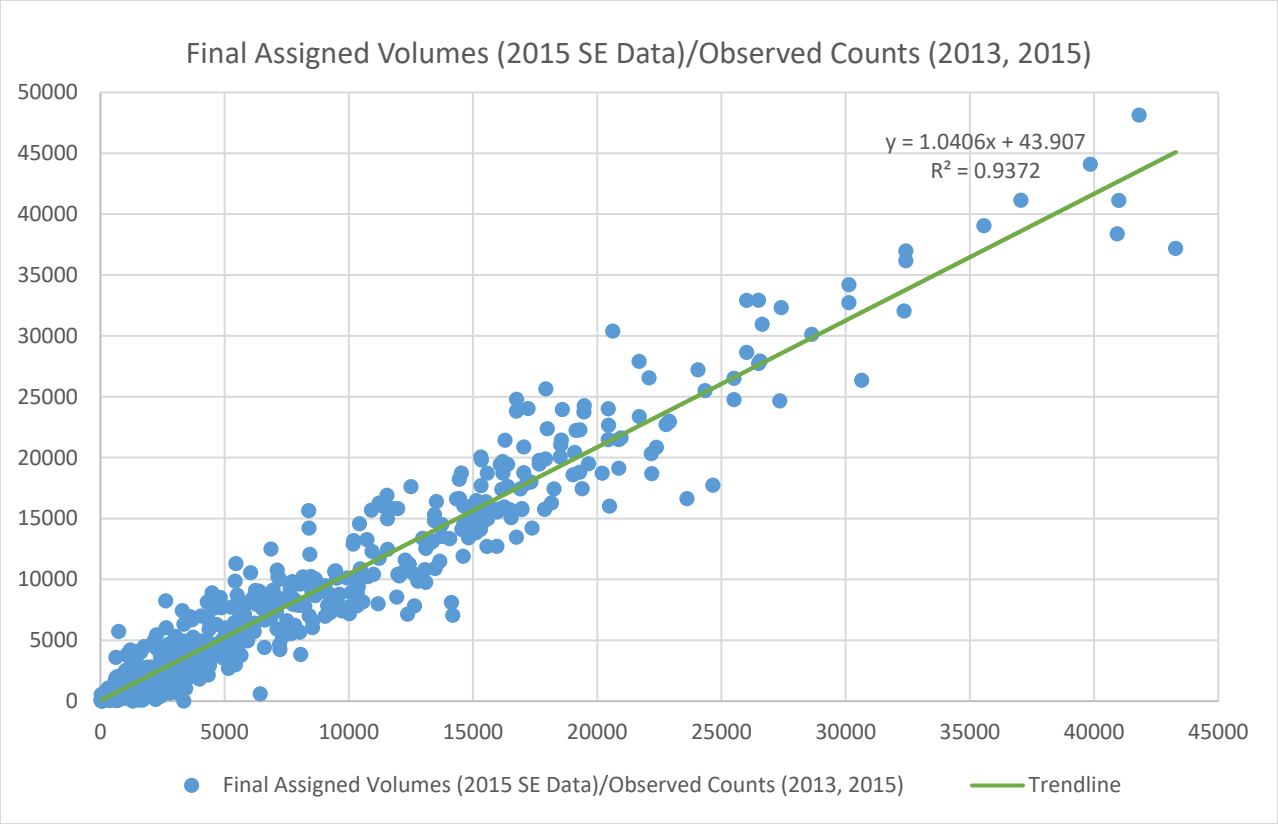


Figure 9: Final Comparison of Observed and Estimated Link Volumes

Table 2: Regional VMT and VHT Comparisons, Validated Topeka MPO Model

Facility Type	# Counts	Counts (Obs) VMT	Assignment (Est) VMT	Counts (Obs) VHT	Assignment (Est) VHT	% Difference in VMT	% Difference in VHT	Target
Interstates	76	610,416	611,358	10,072	10,100	0.2%	0.3%	+/- 10%
Expressways	54	264,787	255,265	4,311	4,150	-3.6%	-3.7%	+/- 10%
Major Arterials	84	174,633	190,759	4,887	5,384	9.2%	10.2%	+/- 10%
Minor Arterials	89	104,389	119,548	2,797	3,217	14.5%	15.0%	+/- 15%
Collectors	130	64,302	66,787	1,716	1,775	3.9%	3.4%	+/- 25%
Local Streets	11	1,082	1,671	24	37	54.4%	49.6%	n/a
Ramps	150	115,543	106,779	5,723	5,484	-7.6%	-4.2%	+/- 10%
Total	594	1,335,152	1,352,167	29,530	30,147	1.27%	2.09%	+/- 10%

Note: Targets are for general guidance and not a rule or regulation.

Travel Forecasts

The updated and validated 2015 base year model was used to develop a 2040 Existing + Committed (E+C) model to establish a baseline for developing and comparing future year alternative scenarios as part of the MTP development process. For models and model results, see Chapter 4 of the Plan.