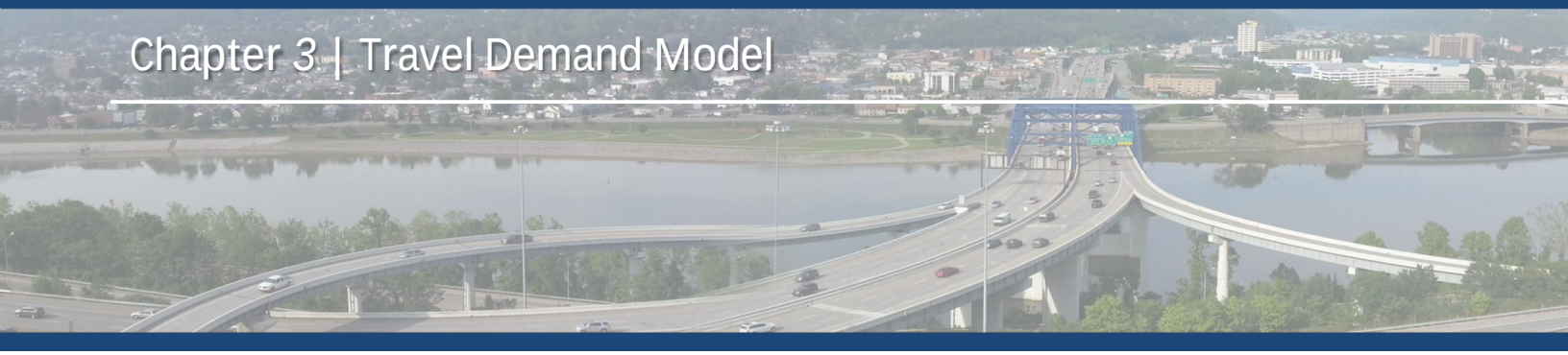
Chapter 3 | Travel Demand Model



Introduction

The *RIC Metropolitan Transportation Plan* extends far into the future, requiring a methodology that predicts future transportation needs. A travel demand model (TDM) allows the MTP to forecast future traffic conditions based on socioeconomic data and other transportation attributes. The future condition analysis plays a crucial role in project selection and project prioritization.

As in past long-range plan updates, RIC used a regional travel demand model to support the analysis and highlight important linkages between land uses and transportation. This chapter provides an overview of the travel demand model and the key demographic data that was used to estimate future highway congestion and travel.

Regional Travel Demand Model

The project team used the regional travel demand model to assist in the identification and evaluation of future traffic conditions. The travel demand model is advantageous for this type of analysis because it:

- Estimates diversions related to transportation investments including new roadway construction and capacity-enhancing projects (e.g. widening projects)
- Estimates the impact of congestion on regional trip-making behavior and route choices
- Provides relationships between demographics (e.g. household, employment) and travel

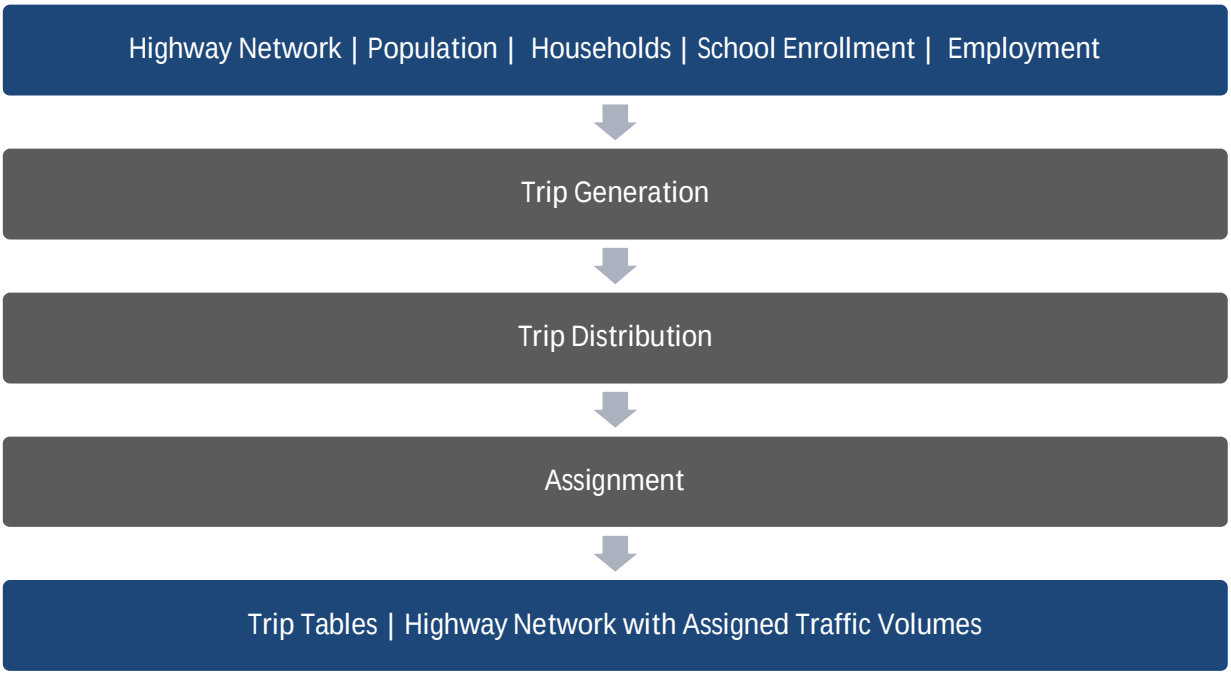
The project team used the regional travel demand model to estimate future roadway deficiencies for the end year of the MTP, 2050. The regional travel demand model was also used to evaluate the individual impacts of proposed capacity-increasing projects, which provided an important performance measure for the project prioritization process. The travel demand modeling process offers “planning-level” assessment. Although the model analyzes individual links of the highway network, it does not explicitly account for every intersection or specific details of intersection traffic signal timing.

The RIC regional travel demand model was originally developed in the early 1990s to support regional planning efforts. The model encompasses both Kanawha and Putnam counties and includes the primary roadways within each county.

The highway network database contains attributes for each individual highway segment including information on the roadway functional classification—the grouping of streets according to the land use served, number of lanes, and speed limits. The "trips" are generated across 411 traffic analysis zones (TAZs) and are loaded onto the roadway network using generalized links that represent the local roadway system.

The model incorporates trip generation, trip distribution, and traffic assignment. Given the small portion of daily travel carried by the mass transit system in the Charleston region, no separate mode choice for transit model is included. Instead, person trips are factored to vehicle trips using auto occupancy information and a transit/walk/bike factor derived from distance.

The model can categorize results according to functional classification. For the purposes of the MTP, the model analyzes Expressways and Freeways, Arterials, Collectors, and Local streets. The model output includes the volume information for trucks and automobiles along with vehicle miles traveled (VMT) and vehicle hours traveled (VHT) by link and by time period.



Model Update and Validation

The regional travel demand model was revalidated and updated to consider socioeconomic and network data consistent with a 2019 base year and 2050 horizon year. The process of updating the model includes revisiting the socioeconomic data, refining the parameters of the model, and reviewing the network attributes.

Travel demand model validation refers to the process of testing a model's ability to replicate base year conditions. For this update, 2019 represented the model's base year. The project team evaluated individual components of the travel demand model process against available data sources including:

- WVDOT traffic counts
- Average work travel times from the American Community Survey (ACS)
- U.S. Census Longitudinal Employer-Household Dynamics (LEHD) workflow data

The model validation effort consisted of an iterative procedure to adjust model parameters to produce reasonable base year (2019) traffic volume assumptions as compared to available traffic count data.

The project team evaluated the performance of the model at each of the count locations. The most common variables used are count deviation and root means square error (RMSE). The RMSE measures the overall absolute difference between traffic volume and count data. To address count deviation, the Federal Highway Administration (FHWA) provides recommendations for model validation in its 1990 report title *Calibration and Adjustment of System Planning Models*. Generally, the model volumes should be within 5.0% of the traffic counts. Table 3-1 summarizes the validation statistics for the 2019 base year. The results indicate the travel demand model sufficiently replicates 2019 daily traffic volumes and is suitable for areawide system and air quality planning purposes.

Table 3-1: Travel Demand Model Validation & Difference for Daily Travel by Facility Type

FACILITY TYPE	TARGET (+/-)	MODEL
Freeway	5%	-4.4%
Principal Arterial	10%	-1.7%
Minor Arterial	20%	18.2
Collector	25%	-3.6
Total	5%	1.8%

CATEGORY	MODEL	FHWA TARGET (+/-)
RMSE	31.4%	< 35%
R^2	0.924	> 0.88

Travel Demand Model Input Data

The primary role of the travel demand model within the MTP planning process is to assist with the evaluation of the transportation system and understand the impacts of transportation investments for the 2050 planning horizon. Demographic and traffic growth forecasts are essential to model future transportation improvement scenarios. The demographics reflect the changes in land use in terms of population, households, and employment. The model's highway network also incorporates transportation projects or investments. The model results must be interpreted and applied to evaluate the impact on key performance measures.

Demographic Forecasts

The demographic forecast identifies the future development patterns that will generate traffic throughout the region. RIC staff provided forecast data by zone for the travel demand model, which was then reviewed and incorporated into the model. By 2050, the estimates indicate the region will experience a net reduction in population, but a net increase in employment.

Table 3-2: Population Projections (2019 and 2050)

COUNTY	2019 POPULATION	2050 POPULATION	PERCENT CHANGE
Kanawha	188,704	173,114	-9.01%
Putnam	59,364	67,034	11.44%

Table 3-3: Employment Projections (2019 and 2050)

COUNTY	2019 EMPLOYMENT	2050 EMPLOYMENT	PERCENT CHANGE
Kanawha	131,785	159,303	17.27%
Putnam	24,003	33,639	28.65%

The project team relied on stakeholder and staff input, economic development insights, and professional judgement to help refine these projections. The population and employment projections attempt to reflect local growth while considering new potential areas and growing employment centers. The distribution of demographic information helped further refine the TAZ-level inputs—unit of geography most commonly utilized in transportation planning models—within the regional travel demand model. These regional growth and employment projections provide estimates not absolutist predictions. Figures 3-1 and 3-2 identify the change between 2019 and 2050 by TAZ for population and employment (respectively) in Putnam and Kanawha counties.

Figure 3-1: Projected Population Change by TAZ

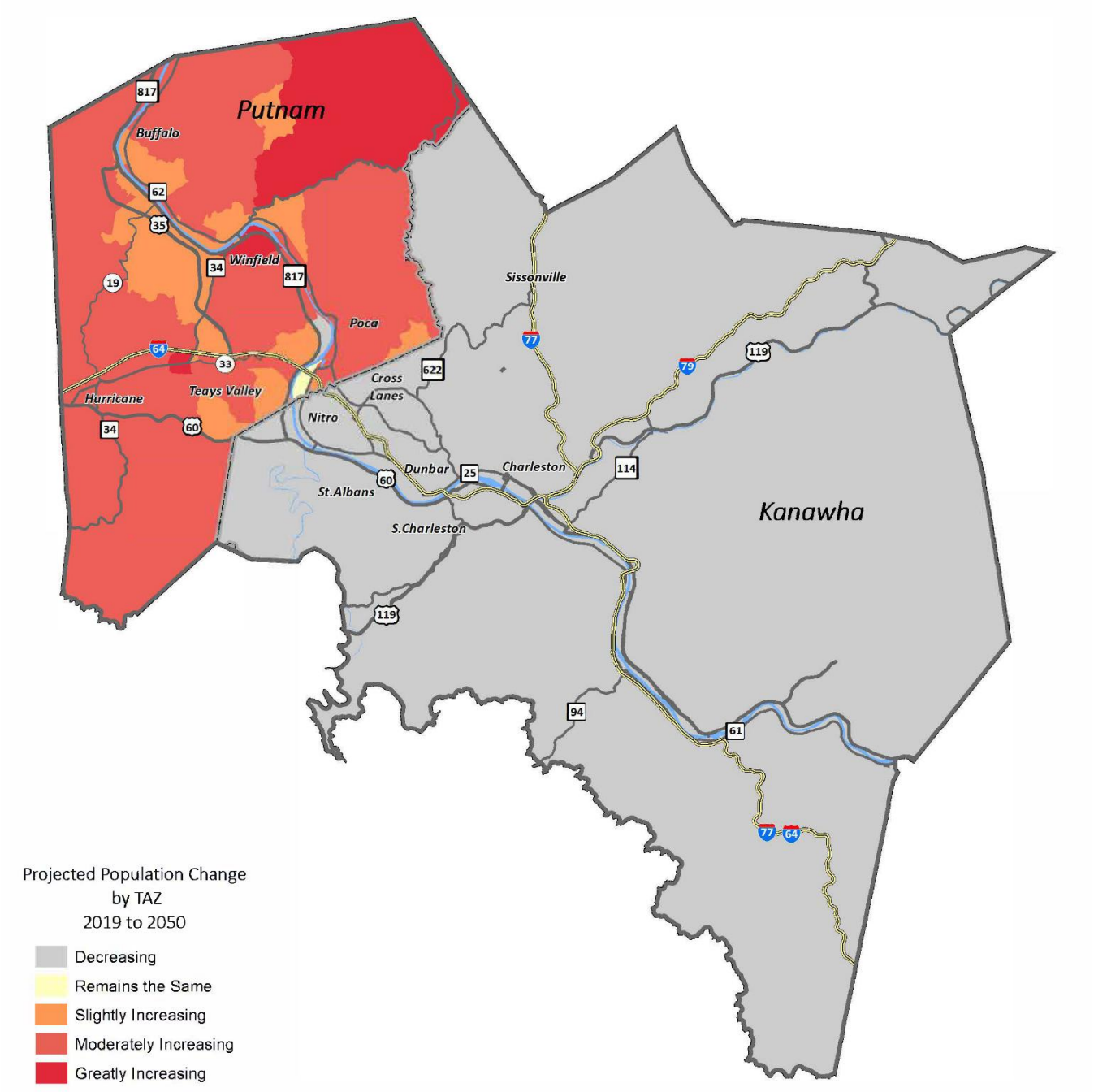
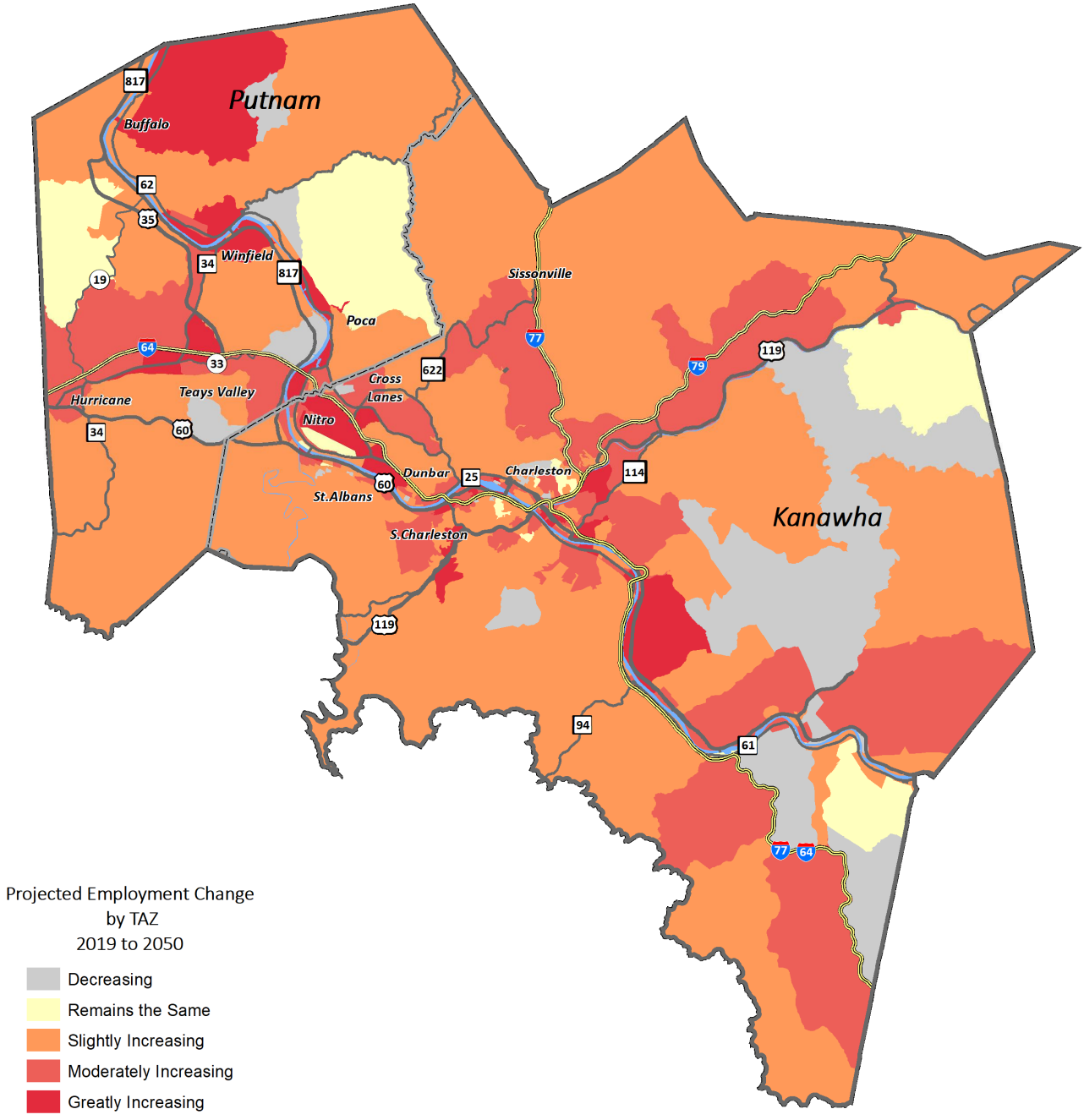


Figure 3-2: Projected Employment Change by TAZ



Highway Networks

The regional travel demand model assigns vehicle trips to the highway network for each scenario. The base year model was prepared to support the model validation effort described earlier in this section. Future year highway networks are required to support the assessment of the 2050 horizon year and to develop interim year networks as required for transportation air quality conformity analysis.

The E+C Network

To evaluate the future transportation needs, the project team identified the future network of roads, which included projects that are already committed for construction. As a result, the modeling analysis assumes completion of these projects and focuses on identifying additional transportation needs. This network is called the “existing plus committed” or E+C network.

2050 Project Scenario Networks

The RIC travel demand model was used to evaluate the impact of identified MTP projects on the highway network. The scenario networks account for projects by changing existing roadway link attributes or by adding new roadway projects to the network. The project team initiated several iterations of networks including all projects identified through the planning process. The network served as an integral part of developing project-level performance measures within the prioritization process.

The project team developed a highway network with only the fiscally constrained projects. The results support the development of the overall plan performance measures.