CHAPTER 2 - TRAVEL DEMAND MODEL DEVELOPMENT

2.1 EXISTING TRAVEL DEMAND MODEL

In order to accurately project future year traffic volumes within this regional study area, it was first necessary to construct a calibrated travel demand model of the existing street network and existing land uses. This model was calibrated to closely replicate existing weekday PM peak hour traffic conditions and to serve as the base model for comparison of all future land use and transportation network improvement scenarios.

To collect the necessary existing street network information for the development of the existing travel demand model, a field review was conducted on all city and state roadways within the study area. Data collected in the field included street names, posted speed limits, intersection controls, intersection geometry, and number of lanes on each roadway or highway facility within the study boundary. Additionally, special consideration was taken during the field review to identify geometric, traffic control, or environmental constraints that were impacting traffic operations. These types of constraints are important as they have a direct and significant effect on a roadway segment's operational characteristics, and therefore the overall traffic carrying capacity of the street. **Exhibit 2.1.1** through **Exhibit 2.1.7** detail the existing lane configurations on the major highways and arterial streets within the study boundary, including I-70 from 110th Street east to 78th Street and I-435 from Riverview Road north to Leavenworth Road.

A roadway network for the existing travel demand model was developed using a system of links and nodes to represent existing streets and intersection, respectively, and was based on aerial photography and roadway centerline data. The link system was coded with the existing street attributes gathered during reviews, such as speed limit, number of lanes, approximate directional capacity, and functional classification. Similarly, the model nodes were also coded with the field collected attributes. These link and node attributes are used by the travel demand model software to calculate travel times and delays, and ultimately to project traffic volumes per model link and movement.

In addition to the field review, GBA conducted weekday PM peak hour and Saturday peak hour traffic counts at critical locations within the study area to supplement traffic count information supplied by the UG and KDOT. This count data, in conjunction with the count information supplied by the UG and KDOT, was used in the calibration of the existing demand models. **Exhibit 2.2.1** through **Exhibit 2.2.5** show the existing weekday PM peak hour and the Saturday peak hour design traffic volumes at major intersection within the study area. **Exhibit 2.2.6** shows the existing weekday Average Daily Traffic (ADT) volumes recorded on major roadways within the study area.

The existing land uses, in the form of current parcel information, was obtained by GBA from the Wyandotte County Appraiser's Office in a GIS dataset format. The existing land use information was categorized into 13 specific land use classifications for analysis: Single Family, Multi-Family, Apartment, Hotel, Office, Medical Office, Shopping Center, Free Standing Discount Store, High Turnover Restaurant, Low Turnover Restaurant, Gas Station, Industrial, and Warehouse. These 13 individual land use classifications were selected based on their unique trip generation properties and the significant numbers of properties within each of these land use classes within the study area. To develop a graphical representation of the gathered information based on the surrounding City's land use data, these land uses were aggregated into the following categories to create a consistent land use map for this study: Undeveloped, Recreational (parks), Public (government offices, churches, schools, libraries, hospitals, and museums), Entertainment (stadiums, race tracks, casinos), Commercial (retail and professional services), Office Park (office complex), Low Density Residential (3 dwelling units per acre), Medium Density Residential (6 dwelling units per acre), and High Density Residential (8 or more dwelling units per acre). See **Exhibit 2.3.1** for a map of existing land uses.

Unique land uses that currently exist within the study area that did not fall within in the broad parameters of the 13 individual land use classifications were tabulated as Special Generators. Traffic projections from these special generators were determined on an individual basis and added to the travel demand model for distribution to the street network. Some examples of Special Generators that were identified include hospitals, schools, public / recreational areas, and other unique land uses.

2.2 TRAFFIC ANALYSIS ZONES AND MODEL CALIBRATION

Throughout the study area, Traffic Analysis Zones (TAZs) were created as an integral part of the travel demand model development process. The TAZ's provide a traffic origin / destination framework for the assignment and distribution of traffic generated by the regional land uses. The TAZ boundaries generally follow major city streets within the study area or other topographical / physical features that limit or control traffic distribution to the street network. **Figure 2.2.1** depicts the zone boundaries as defined for this regional model.

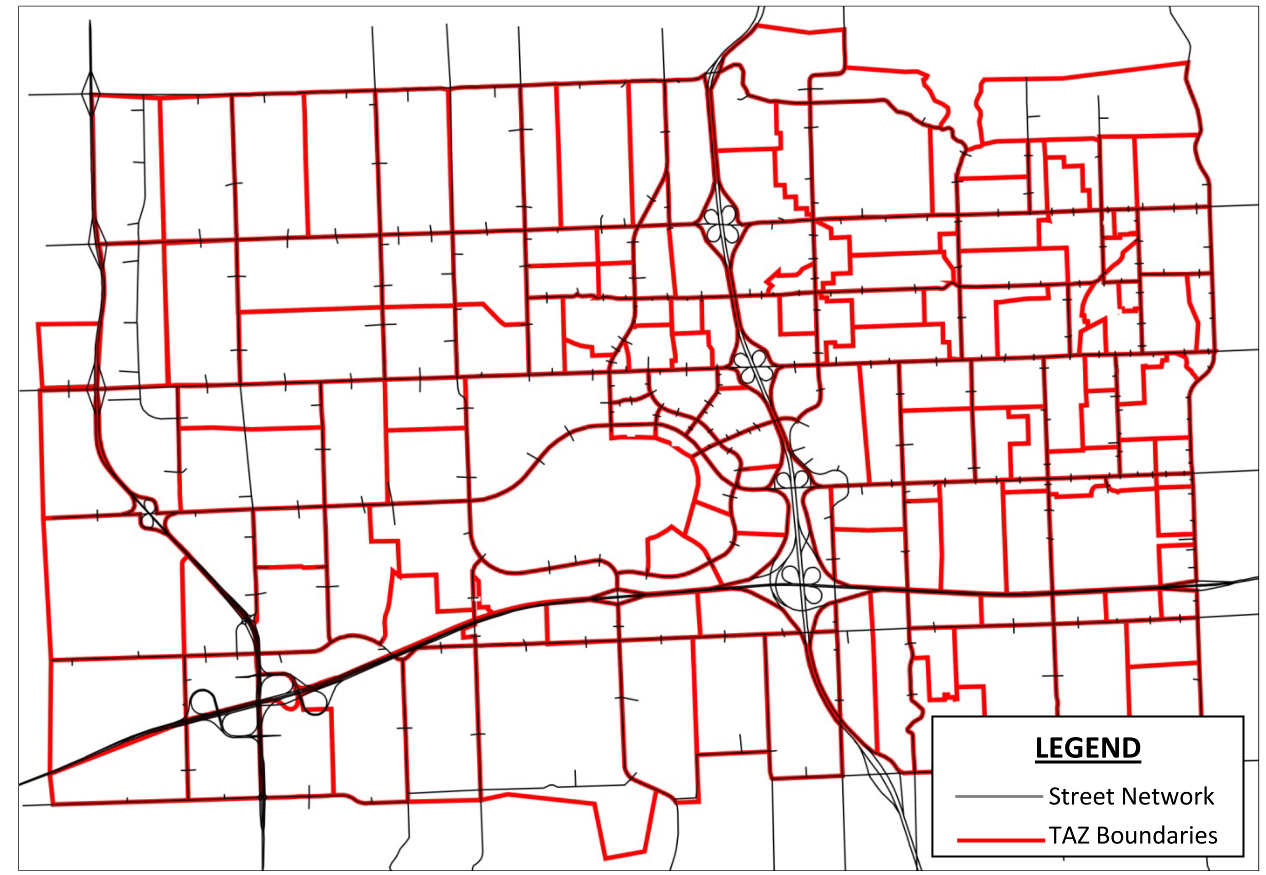

Figure 2.2.1 - Traffic Analysis Zones

The land use information was mapped to the TAZ's by utilizing the county GIS dataset and the established traffic analysis zone locations. Projections of both entering and exiting traffic volumes by zone were then calculated for each of the 13 different land use categories described above, and assigned to the model street network via the traffic analysis zones. Three trip types were defined and used in this analysis: home-based work (HBW), home-based other (HBO), and non home-based (NHB).

Following the initial model creation, the next step was to calibrate the existing weekday PM peak hour model against the existing weekday PM peak hour traffic count volumes. This was done by adjusting the model parameters to allow the model's mathematical algorithms to reproduce local driver behavior and existing traffic volumes. The results of the early model runs were compared against the recorded design traffic volumes within the study area to determine the accuracy of the model.

Based on the comparisons and resulting determined accuracy, a series of iterative model adjustments and model runs were then completed. This process was repeated until an acceptable level of correlation between existing traffic counts and the existing travel demand model was attained. This comparison produces an important statistic called a

Coefficient of Correlation or R^2 value and graphically displays how well the regression line of assignment data represents the actual recorded traffic volume data. A minimum acceptable R^2 has been established by the Federal Highway Administration for travel demand models at 0.88 (FHWA - *Calibrating and Adjustment of System Planning Models, December 1990*), with a value of 1.00 being perfect correlation. **Figure 2.2.2** graphically shows the Coefficient of Correlation comparison of the existing weekday PM peak period traffic counts to the existing weekday PM peak hour travel demand model traffic projections. The existing travel demand model has been calibrated to an R^2 value of 0.97, with 370 points of comparison being made.

Using the calibrated weekday PM model as a base condition for the roadway network and land use, a Saturday model was also developed to replicate typical Saturday traffic volumes under existing conditions. The Saturday peak period existing model had a calculated R^2 of 0.90 with 294 comparison points.

See Exhibit 2.2.1 through Exhibit 2.2.5 for existing weekday PM peak hour and the Saturday peak hour design traffic volumes. Exhibit 2.2.6 shows the existing weekday Average Daily Traffic (ADT) volumes.

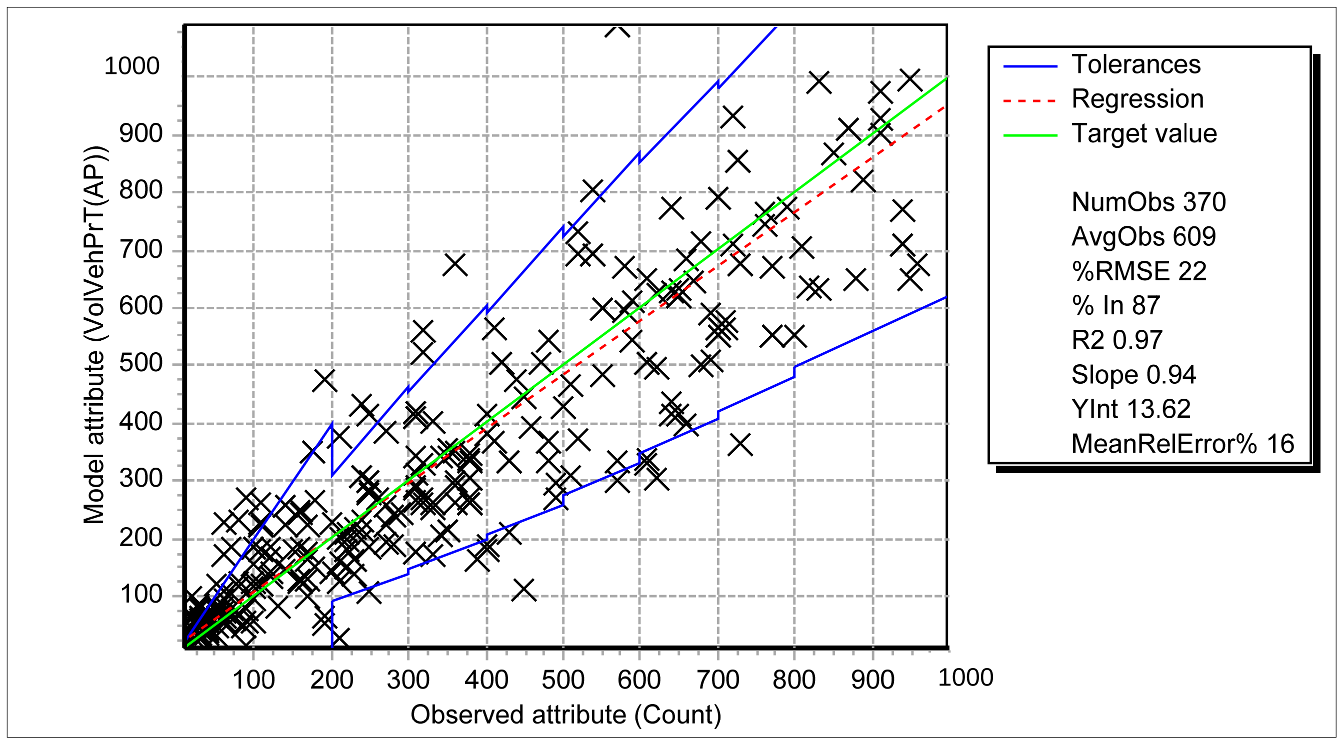

Figure 2.2.2 - Existing Weekday PM Peak Hour Coefficient of Correlation

2.3 EXISTING TRAVEL DEMAND MODEL RESULTS

The completed calibration models were developed to provide both existing weekday PM and Saturday peak period traffic projections. **Figure 2.3.1** and **Figure 2.3.2** are graphical representations of the calibrated model traffic volumes for the existing weekday PM peak hour and the existing Saturday peak hour of the study area.

As shown on Figures 2.3.1 and Figure 2.3.2, the highest traffic flows are correctly modeled to occur on the interstate system, with lower volumes being observed on the city's arterial and collector street networks. In general, the weekday PM peak traffic period has larger system wide traffic volumes, particularly on the highway system, while the Saturday peak traffic period exhibits greater traffic flows on the city arterials and streets, primarily within the Village West / Legends commercial and entertainment area. See Exhibit 2.3.1 for a map of existing land uses.

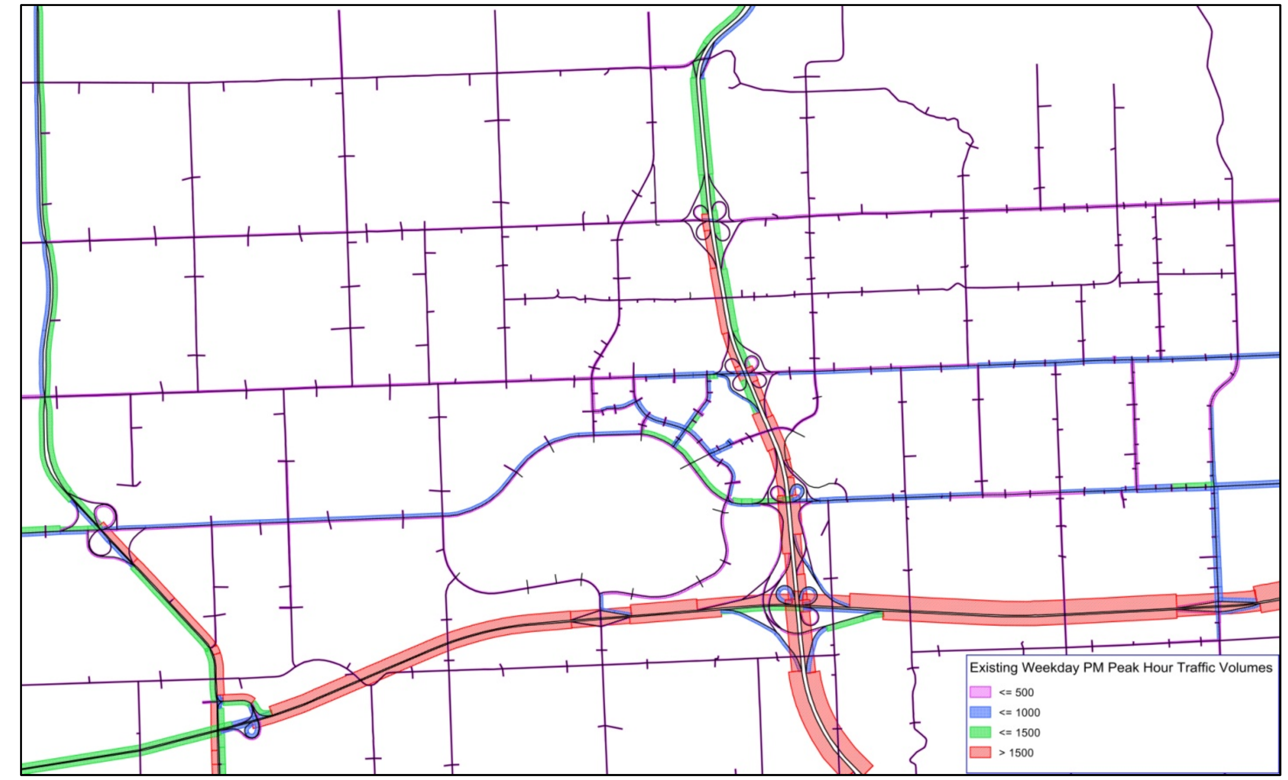

Figure 2.3.1 - Existing Weekday PM Peak Hour Traffic

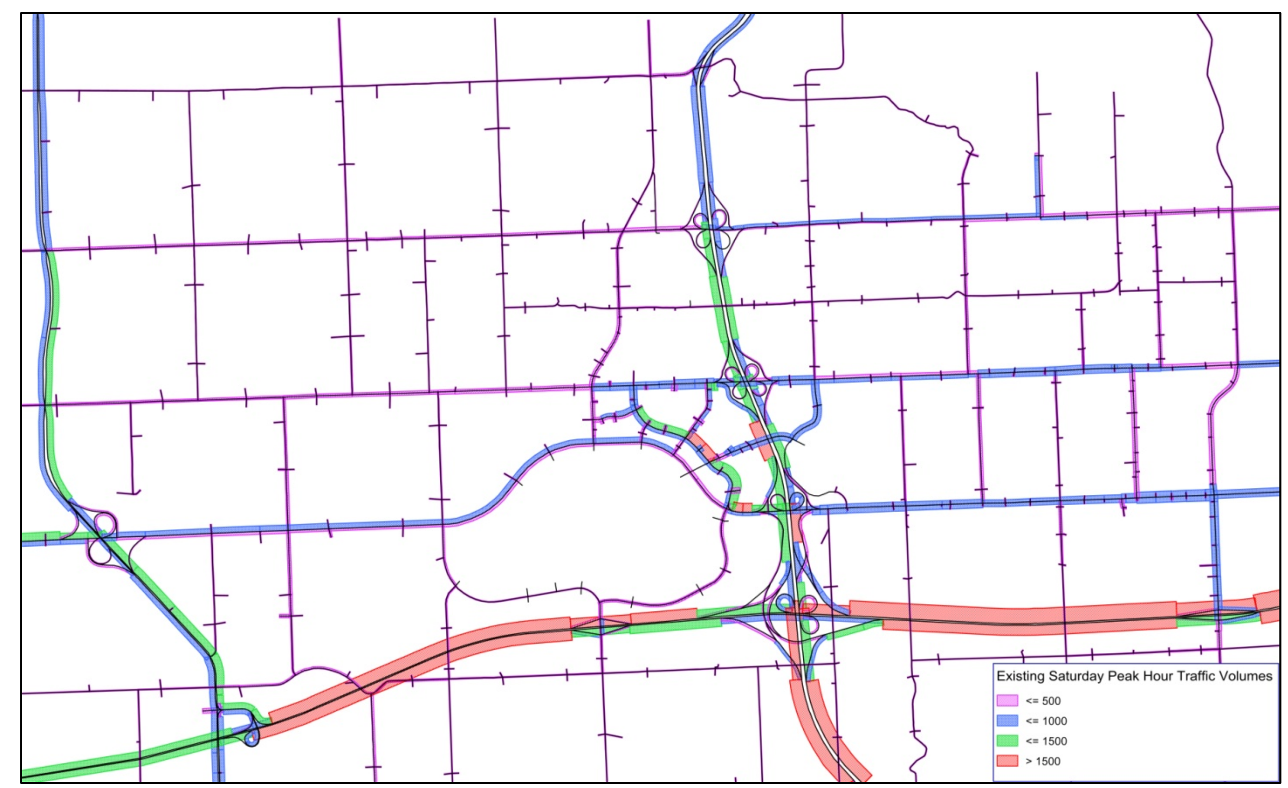

Figure 2.3.2 - Existing Saturday Peak Hour Traffic Volumes

2.4 DESIGN YEAR 2040 TRAVEL DEMAND MODEL

Future land use projections for the study area were next determined with input from the UG, the City of Edwardsville, and the City of Bonner Springs engineering and planning staffs, as well as from the KDOT planning staff. Additionally, some of the major land owners in the study area, such as the Kansas Speedway, were interviewed to determine future possibilities of other major development projects. Each of these stakeholders was asked to detail future land use assumptions that should be used in the development of future land use projections for this project. Additionally, each stakeholder was also asked to identify expected growth patterns within their planning areas. **Exhibit 2.4.1** graphically displays the information received and the overall full-build out projections of future land uses within the study area. See below for a description of future land uses included in Exhibit 2.4.1:

- Traditional Neighborhood Development (TND) – includes a range of housing types, a network of well-connected streets and blocks, public spaces, and amenities such as stores, schools, and places of worship within walking distance from residences
- Recreational – includes parks
- Public –government offices, churches, schools, libraries, hospitals, and museums
- Entertainment – stadiums, race tracks, and casinos
- Commercial –retail sales and professional services and offices
- Office Park – large office complexes
- Mixed –mix of commercial, office, and residential
- Low Density Residential – 3 dwelling units per acre
- Medium Density Residential – 6 dwelling units per acre
- High Density Residential – 8 or more dwelling units per acre

Please note that each of the stakeholders worked with GBA to make reasonable projections of future land uses. It was determined that the Village West Regional Travel Demand Model should not be overly optimistic with regard to future land uses, but should be as true a representation as possible of what may occur based upon best planning and engineering judgment.

The supplied future land use information was sorted into ten general land use categories for analysis: Single Family, Multi-Family, Apartment, Hotel, Office, Commercial, Fast Food Restaurant, Sit-Down Restaurant, Warehouse, and Special Generators. These ten future land use categories were selected to be included in the future models based upon their significant density of projected development within the region, their compliance with each city's future zoning master plans, and the proven accuracy of traffic predictions using ITE trip generation protocols for each of these classifications.

Traffic generation for each of the ten land use categories was projected for both Design Year 2040 and Full Build-out land use scenarios. See **Exhibit 2.4.2** for a summary of the development projections by number of dwelling units, rooms, or square footage within the study area. As shown on Exhibit 2.4.2, Design Year 2040 land use data was developed as a percentage of the Full Build-out land use projections. Based upon our discussions with the Cities, it is expected that future development will continue to be centered about the existing Village West / Legends commercial and entertainment area hub, and the regions surrounding the I-70 / K-7 interchange in Bonner Springs. It was projected that the proposed developments nearest to these hubs would be 100% complete by Design Year 2040, while lower percentages of development would occur as the distance between these sites and the hubs increased. **Exhibit 2.4.3** is a summary of the Existing, Design Year 2040, and Full Build-out land use projections, tabulated by both Cities and for the entire model.

In addition, the existing street network was enhanced by the modeling of the traffic control and geometric street and / or highway improvements planned to be implemented by the various cities and the State of Kansas by 2040. Below is a list of planned major roadway and traffic control improvements that was developed with the assistance of KDOT and UG planning staff:

- Widening of State Avenue to three lanes in each direction between K-7 and 94th Street
- Widening of Parallel Parkway to three lanes in each direction between K-7 and 98th Street
- Improving 118th Street to a major arterial type roadway between State Avenue and Donahoo Road
- Widening Donahoo Road to a major arterial type road between K-7 and I-435
- Improving Leavenworth Road to a major arterial type roadway between K-7 and I-435
- Major reconstruction of the system interchange of I-70 and K-7 per the KDOT ultimate design concept and widening of I-70 to 3 lanes in each direction through the study area
- Construction of diamond type interchanges on K-7 at Parallel Parkway, Leavenworth Road, and Donahoo Road per K-7 Corridor Management Plan
- Construction of K-7 frontage road system per K-7 Corridor Management Plan
- Relocation of intersection of 98th Street and State Avenue per Schlitterbahn development plan
- Realignment of 98th Street along Schlitterbahn development between State Avenue and Parallel Parkway
- Addition of traffic signals at primary intersections throughout the study area

The background traffic volumes on both I-70 and on I-435 are expected to increase significantly due to general metro-wide development. The growth rate used for the background traffic of the future model scenario was developed based on projections from the K-7 / I-70 interchange study project, located less than four miles to the west of this interchange, as well as reviews of past growth trends in this region of the City. The growth rate for the study area was determined to be 3 percent per year. These background traffic volume growth rates were reviewed and approved by KDOT Planning staff.

Using the land use provided by the stakeholders and future street network improvements expected to be completed by year 2040, the Design Year 2040 PM peak hour and the Design Year 2040 Saturday peak hour travel demand models were developed.

2.5 DESIGN YEAR 2040 TRAVEL DEMAND MODEL RESULTS

See **Figure 2.5.1, Figure 2.5.2** and **Figure 2.5.3** for graphical representations of the projected 2040 traffic volumes for the weekday PM peak hour, for the Saturday peak hour, and for the weekday PM peak hour with State Avenue interchange improvements within the study area. The State Avenue improvements are discussed in detail in Chapter 4 and include improvements at the I-435 interchange and the Village West Parkway intersection. **Exhibit 2.5.1** through **Exhibit 2.5.5** show the projected traffic volumes for the 2040 weekday PM peak hour and the 2040 weekday PM peak hour with State Avenue improvement. Expected 2040 ADT volumes are shown on **Exhibit 2.5.6.**

As part of the future scenarios, the Bus Rapid Transit (BRT) system expect to serve the Village West / Legends commercial and entertainment region was considered in the development of traffic volumes. Based on information from the Kansas City Area Transit Authority (KCATA), the BRT would have minimal impacts on the projected traffic volumes. At full ridership, the BRT would be expected to carry 3,500 people per day. It is anticipated many of the riders would be employees of the Village West / Legends commercial and entertainment district and would not be visitors to the area. As such, no modifications to the trip generation or volume projections were made to the future traffic demand models due to the BRT system.

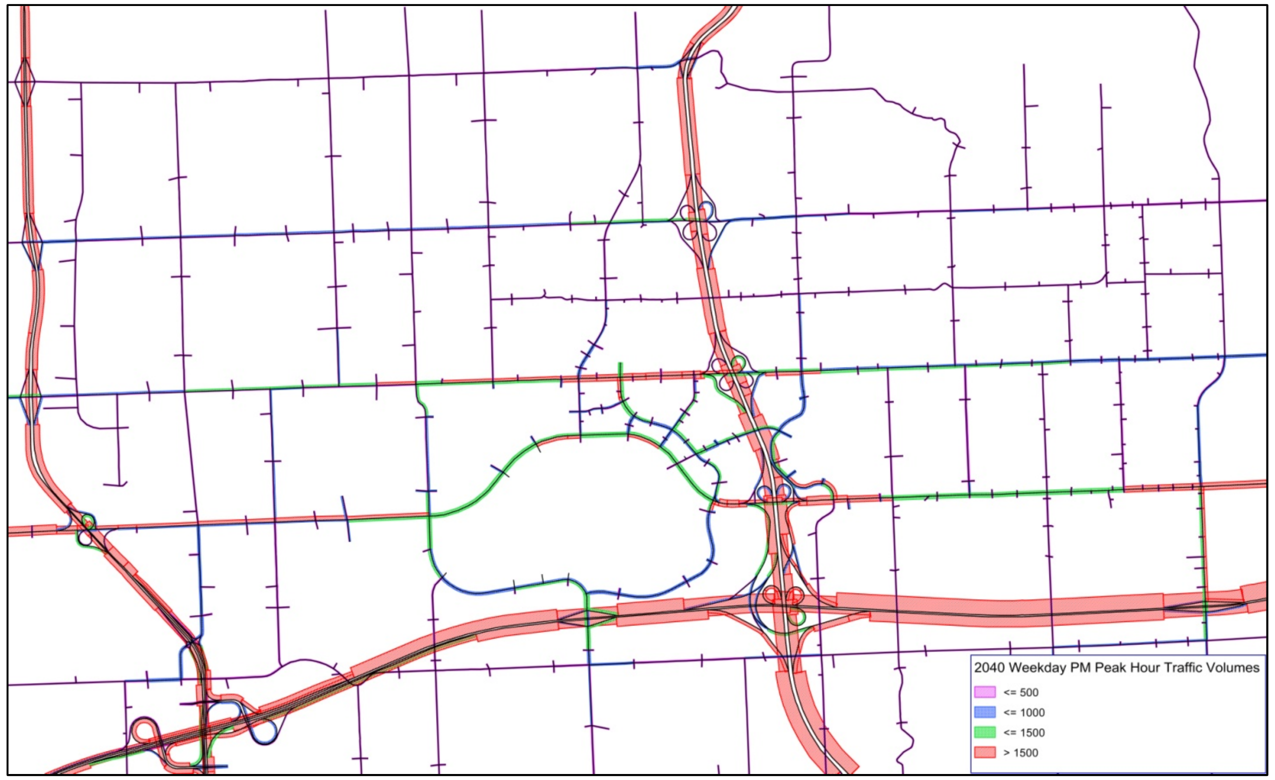

Figure 2.5.1 - Design Year 2040 Weekday PM Peak Hour Traffic Volumes

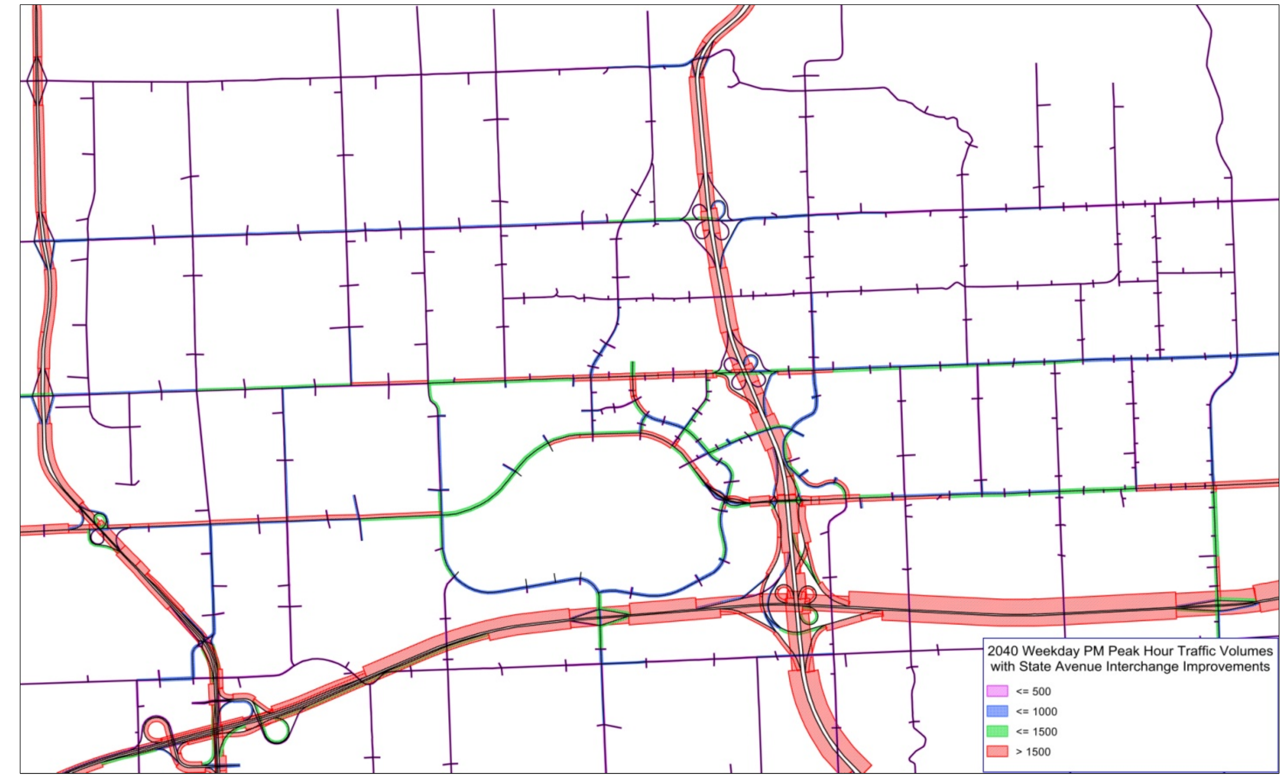

Figure 2.5.3 - Design Year 2040 PM Peak Hour Traffic Volumes with State Avenue Interchange Improvements

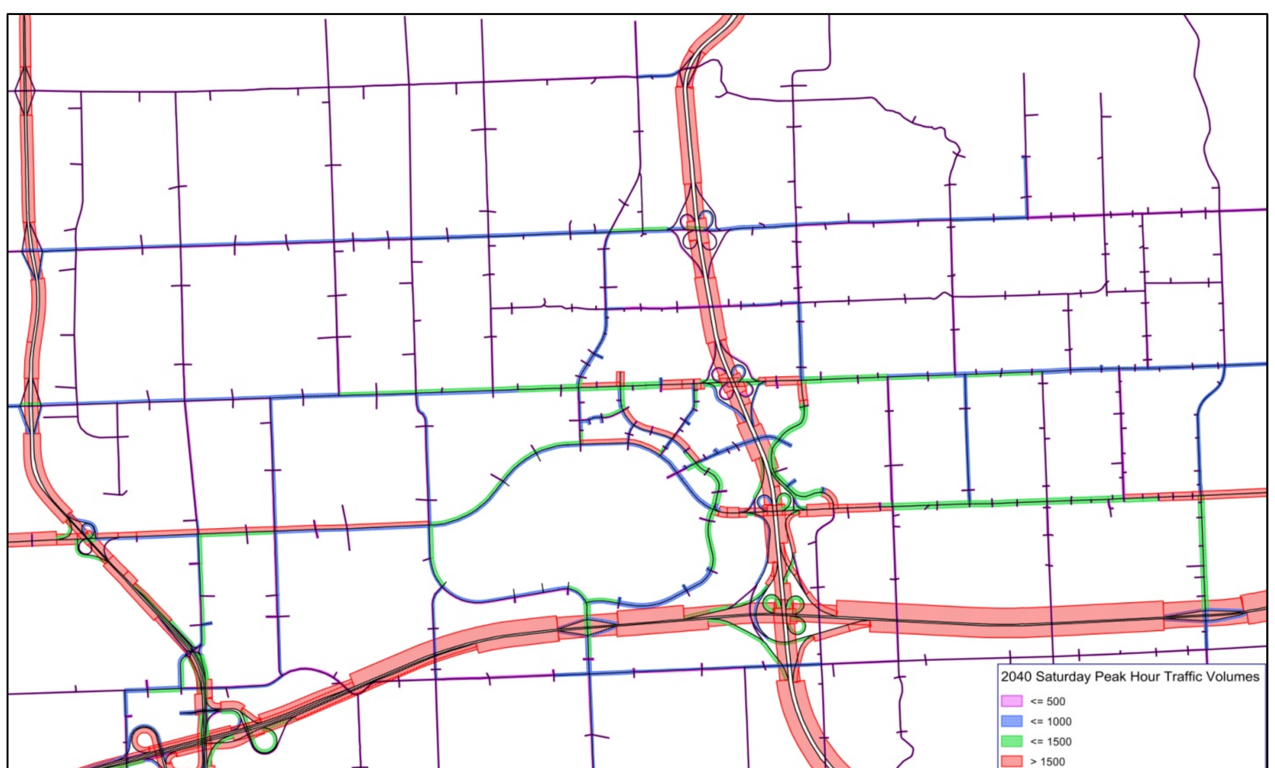

Figure 2.5.2 - Design Year 2040 Saturday Peak Hour Traffic Volumes

2.6 FULL BUILD-OUT TRAVEL DEMAND MODEL RESULTS

It is expected the Full Build-out traffic scenario would not occur until at least the Year 2070, unless development activity and economic opportunities significantly improve beyond even the most aggressive levels experienced in the recent past.

The Full Build-out travel demand model was developed using the final Full Build-out land use data and the future street network improvements provided by the stakeholders. The future street network improvements include all roadway improvements planned by the local and state agencies, as well as the major roadway enhancements determined to be necessary as part of the detailed Design Year 2040 analyses, including interchange improvements on State Avenue and on Parallel Parkway.

See **Figure 2.6.1** and **Figure 2.6.2** for a graphical representation of the projected Full Build-out traffic volumes for the PM peak period and the Saturday peak period within the study area.

As can be seen in these figures, the overall traffic patterns of the Full Build-out traffic scenario are similar to the Design Year 2040 scenario in that the majority of the traffic flows are on the interstates that cross through the study area. In general, the Full Build-out volumes were 25% to 30% higher than the Design Year 2040 projections. Significant improvements to the interstate system, including additional through lanes, would be expected to be required to successfully and safely handle these long term traffic projections.

It should be noted that the Full Build-out travel demand model was primarily developed to provide a method for verifying the long term viability of any major roadway or interstate enhancements that were determined as part of the detailed Design Year 2040 analyses. Discussion of the long term viability of any developed improvement scenario, due to Full Build-out traffic projections, is addressed in the following chapters, along with the Design Year 2040 roadway improvement recommendations.

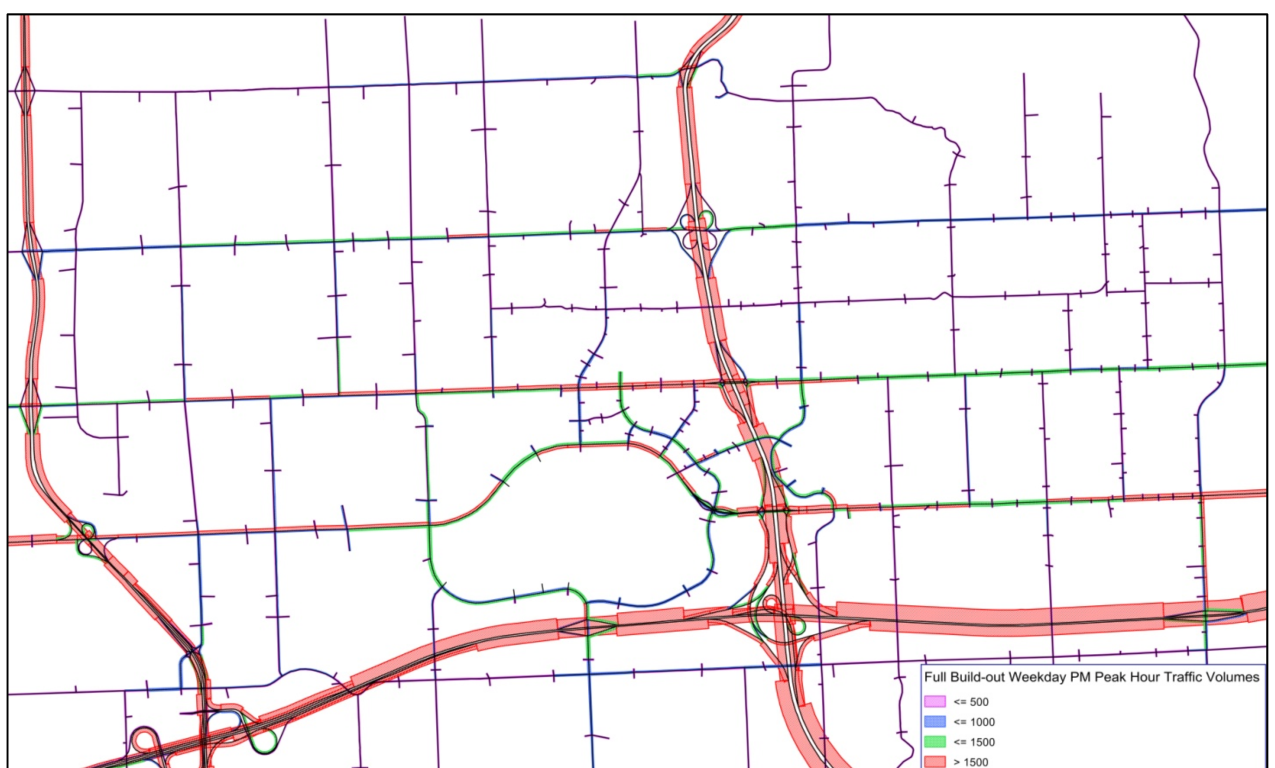

Figure 2.6.1 - Full Build-out Weekday PM Peak Hour Traffic Volumes

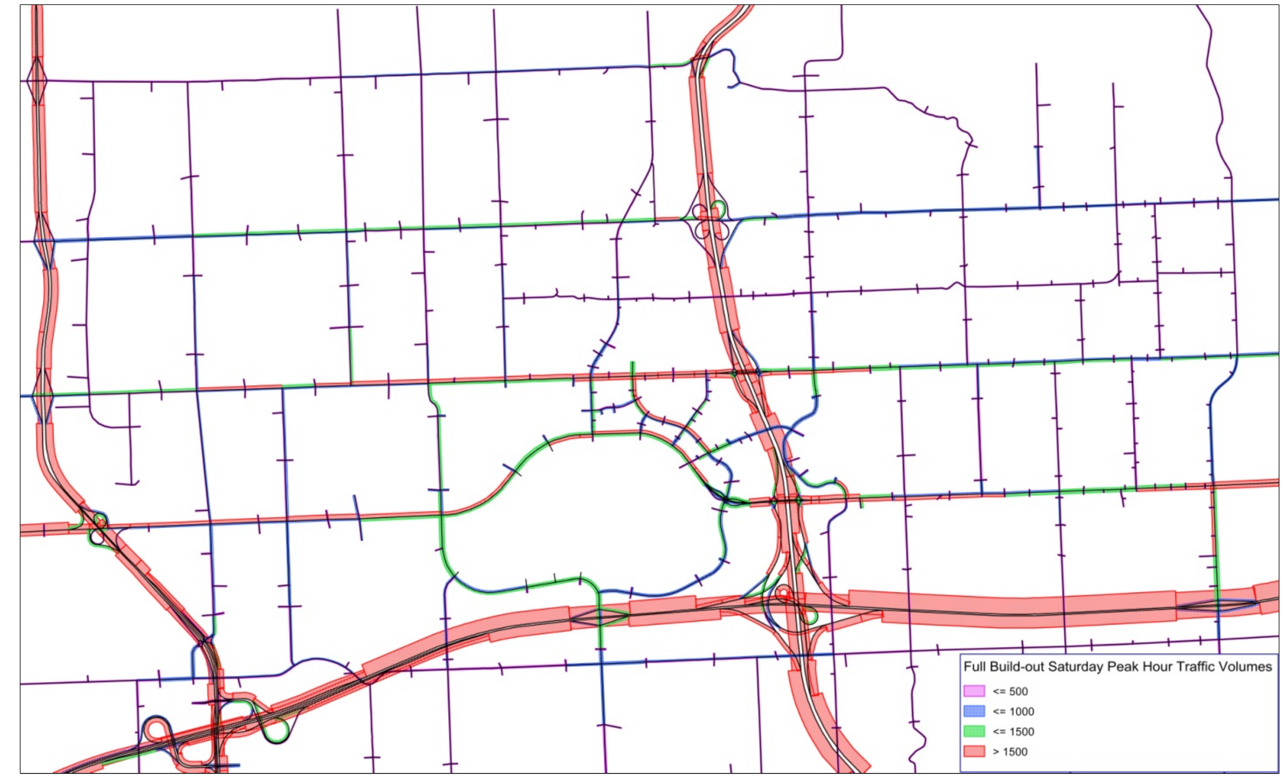

Figure 2.6.2 - Full Build-out Saturday Peak Hour Traffic Volumes