APPENDIX 7

US 25 CORRIDOR ANALYSIS REPORT

(TRAFFIC ANALYSIS)

US 25 Corridor Study

From KY 14/16 to North of the City of Walton
Boone and Kenton Counties, KY
Item No. 6-105.00

November 2023

US 25 Corridor Analysis Report

(Draft)

US-25 Study
Item Numbers 6-105

Boone County, Kentucky

Prepared For:
Kentucky Transportation Cabinet
421 Buttermilk Pike, Fort Mitchell, KY 41017

April 3, 2023

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1.0 Introduction

1.1 Project Location and Background

This project began as a combined Operational Analysis Report for item numbers 6-80 and 6-105 I-75 interchange at Walton, and the US 25 Corridor. After project scoping KYTC made the decision to include ultimately the I-71/75 interchange in the design. For simplicity of what will be a necessary System Interchange Modification Report, the project Team made the decision to separate the components of 6-105 US 25 Planning into it's own planning level traffic analysis. Included herein is the relevant traffic related to 6-105 only.

The project is located in Boone County, Kentucky, near the border of Kenton County, along the I-75 and US-25 corridor between the KY 14/16 interchange to the south and KY-338 to the north. The focus of the study will be on the US-25 between KY 14 and KY 16. The purpose of this study is to evaluate the vehicular and truck impacts along US 25 of four potential alternative parallel corridors.

The project study area is broken into three (3) study segments:

- Segment 1: US 25 Mary Grubbs Highway to Old Beaver Road (Yellow)
- Segment 2: Old Beaver Road to Old Nicholson Road (Blue)
- Segment 3: Old Nicholson Road to KY 16 (Green)

The study area is shown in Figure 1.1.

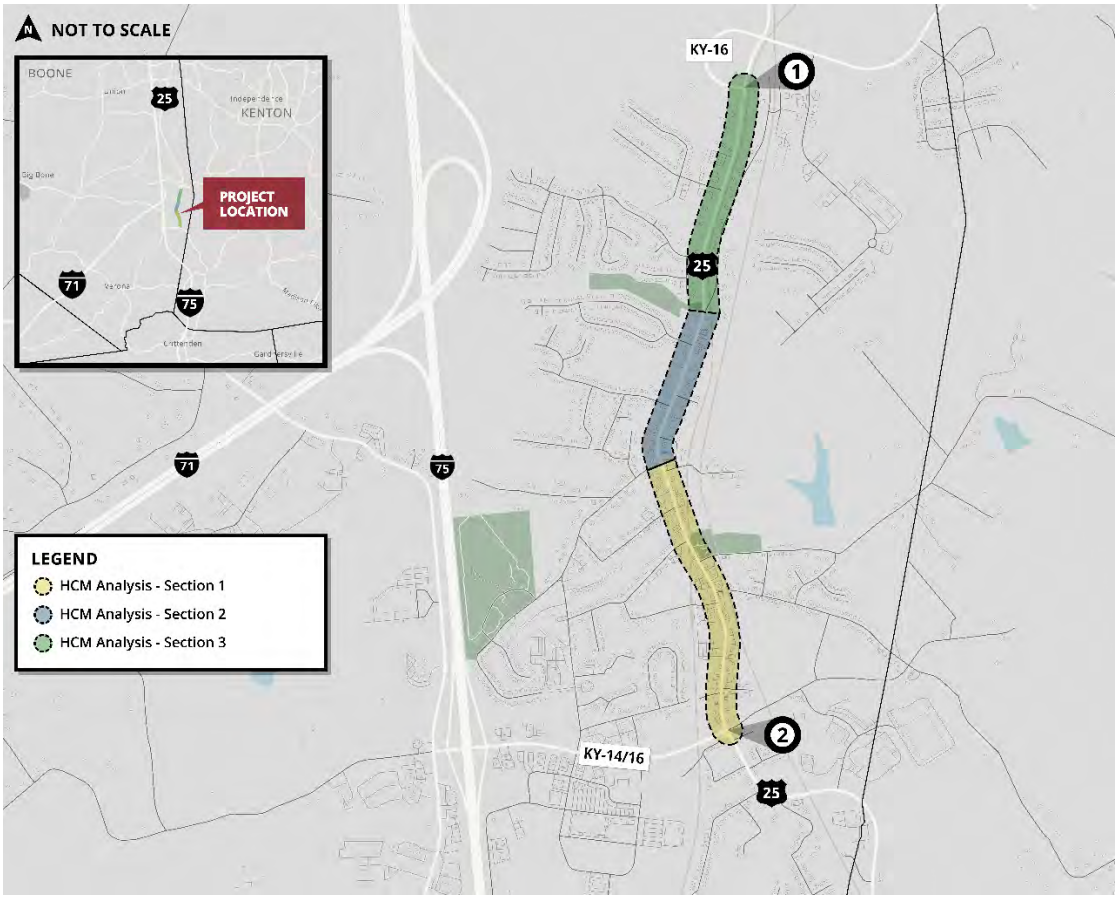

Figure 1.1: Study Area Map by Analysis Type

2.0 Existing Conditions

2.1 Data Collection

Traffic count data was gathered from the Kentucky Transportation Cabinet (KYTC) Traffic Counts database where available and included Annual Average Daily Traffic (AADT), truck percentages, K factors, and D factors.

Traffic counts were collected using cameras between 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM in January and February 2022. All counts were summarized in 15-minute increments. All counts were classified as cars or heavy vehicles (trucks). Counts were conducted at the following locations as shown in **Figure 2.1**:

- Intersection – KY 14/16 at US-25
- Intersection – KY 16 at US-25

Access to Streetlight Insight data, including origin-destinations and travel speeds, was provided by the Ohio-Kentucky-Indiana Regional Council of Governments (OKI). To supplement the collected data, Streetlight Insight data were expanded to a 'typical day' using the collected count data above. Typical day counts for the daily, peak hours, and shoulder periods were reported for following locations:

- US-25 sink and source volumes for each of the three identified segments between KY 14/16 and KY 16

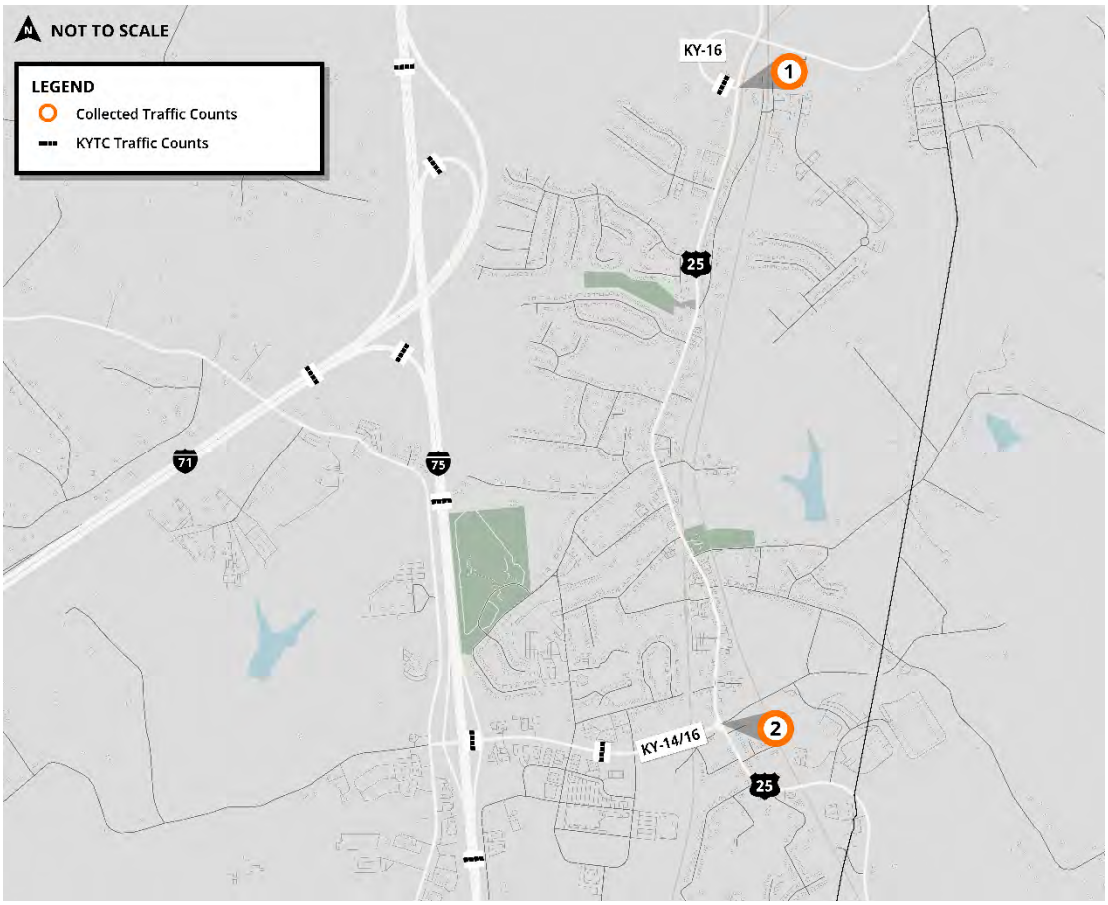

Figure 2.1: Traffic Count Locations and Sources

2.2 Existing Year (2022) Volume Development

Existing year traffic volumes were developed using the year 2022 collected traffic counts and year 2019 Streetlight data. The Streetlight data was used to supplement any gaps in the data collection as the 2022 collected traffic counts only cover two hours during the AM period and two hours during the PM period. Streetlight data was pulled for the months of January and February. The Streetlight data was further parsed to only include Tuesdays through Thursdays to be consistent with the collected traffic counts time period. The Traffic Analysis Methodology is provided in Appendix A and the collected traffic data are provided in **Appendix B**. Once the count data was processed, it was converted to a 'typical day' by applying seasonal adjustment factors by functional classification from Table D2 of the *Kentucky Traffic Forecasting Report – 2008*.

The AM and PM peak hours were determined by observing the aggregate volume across field observed counts to find the heaviest one-hour traffic flow. The results show morning and afternoon peak hours occurred between 7:30 to 8:30 AM, and 4:00 to 5:00 PM, respectively.

Next, the temporal distribution through the day was determined using the Streetlight data. The average Streetlight indexed volumes were collected for every 15-minute increment and the percent distribution of each 15-minute indexed volume was calculated and is plotted in **Figure 2.2** below for the entire study area. To develop peak to daily ratios (K factor), a temporal distribution was developed for the surface streets and the interstates separately. Through this analysis, a K factor of 8.0 percent was defined for the interstates and a K factor of 9.0 percent was defined for the surface streets by observing the percent of volume occurring during the PM peak hour (4:00 to 5:00 PM), which exhibits higher overall volumes. The design traffic factors for the study area are provided in **Table 2.1** below and include the K factors derived from Streetlight and both directional factors (D factors) and truck factors (T%) derived from the field observed count data.

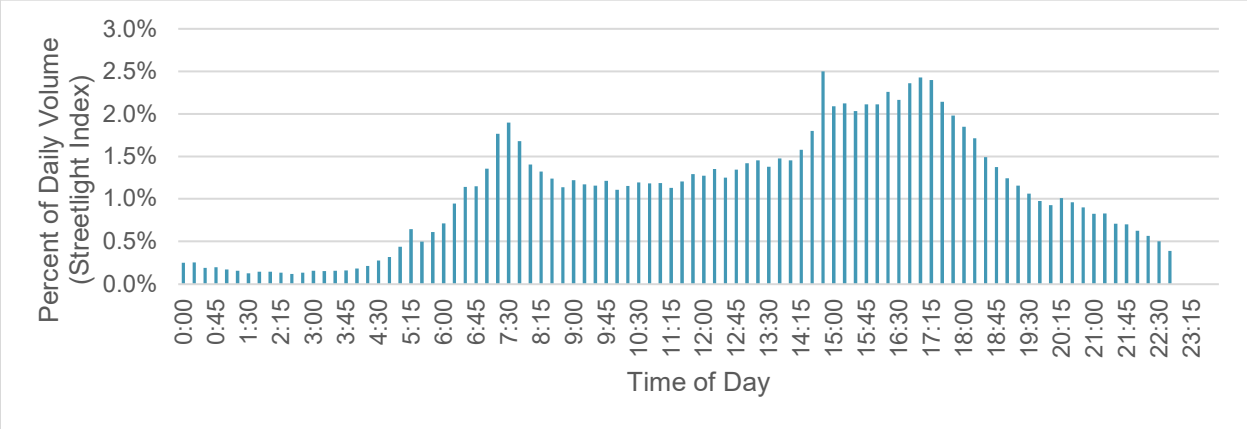

Figure 2.2: Streetlight Derived Temporal Distribution

Table 2.1: Design Traffic Factors

Roadway	Segment	K factor	D factor	T%
US-25	South of KY 14/16	9%	51%-60%	3%-4%
	North of KY 14/16			
	South of High School CT			
	North of High School CT			
	North of University Dr			
	North of KY 16			

With the AM and PM peak hour volumes processed from the field observed count data, an origin-destination matrix estimation (ODME) procedure was employed to balance the volumes and impute any missing data. A model network was constructed in PTV Visum 2020 for the Volume Development area shown within the study area. In this existing condition network, this is a closed system with no route choice available. That is, each origin-destination pair in the network is served by a single path. PTV's TFLOWFUZZY method was applied to fit seed origin-destination car and truck matrices to car and truck count volumes at all locations where counts were collected. In this process, the seed origin-destination matrices are very important to the result and so Streetlight origin-destination data for cars and trucks (separately) was pulled for January and February 2019 and processed to match the zones in the PTV Visum network for the AM peak hour and for the PM peak hour. The TFLOWFUZZY process was then run to fit the seed origin-destination matrix to the collected and processed count data and re-assigned to the network. This adjusts the origin-destination matrix to fit the data and any paths which do not include a count (e.g., the north and south legs of School Road and Beatrice Avenue) are adjusted to maintain the overall distribution found in the Streetlight data. The turning movement volumes were then extracted from the network to provide imputed count data. To accept the processed volumes and the origin-destination matrices, all turning movement counts were found to be within 10 percent and 35 vehicles of the collected count.

The results of the process comparing the count versus processed volumes for the AM and PM peak hours for both cars and trucks can be found in **Figure 2.3**, **Figure 2.4**, **Figure 2.5**, and **Figure 2.6**, respectively. The slope of the line is provided to show that the count to volume ratio is nearly 1.0.

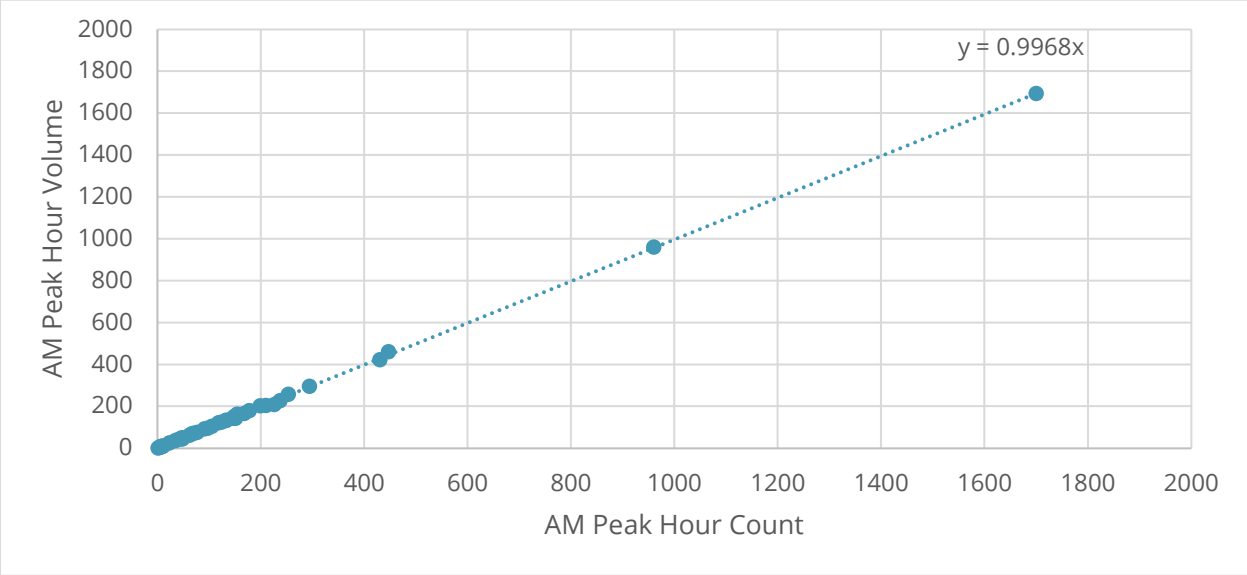

Figure 2.3: AM Peak Hour Count versus Processed Volume – Cars

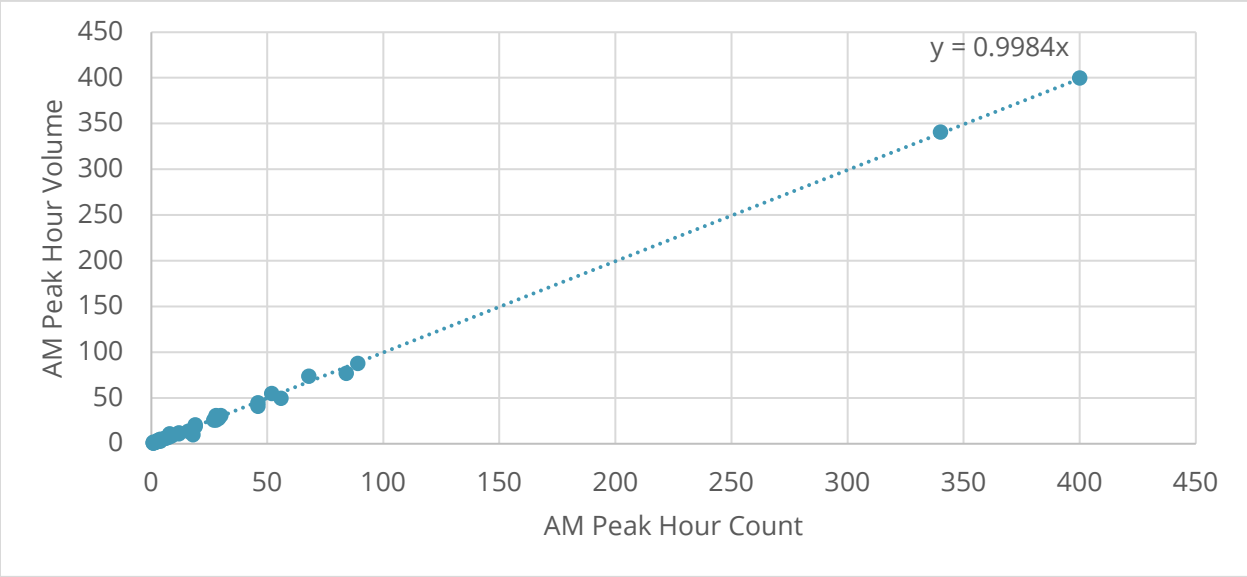

Figure 2.4: AM Peak Hour Count versus Processed Volume – Trucks

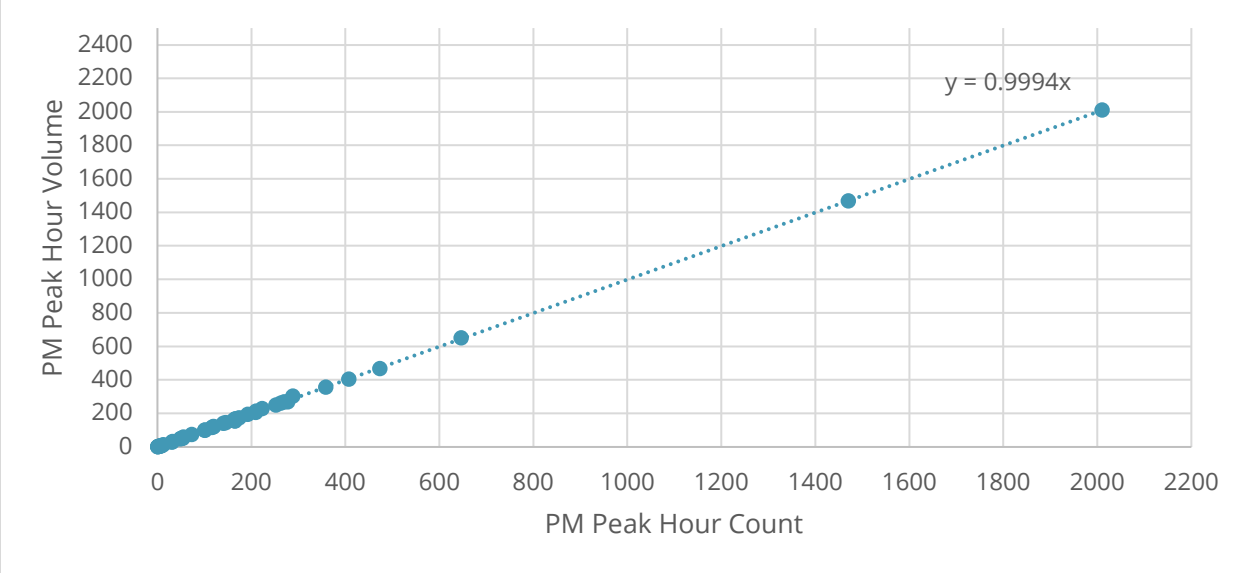

Figure 2.5: PM Peak Hour Count versus Processed Volume - Cars

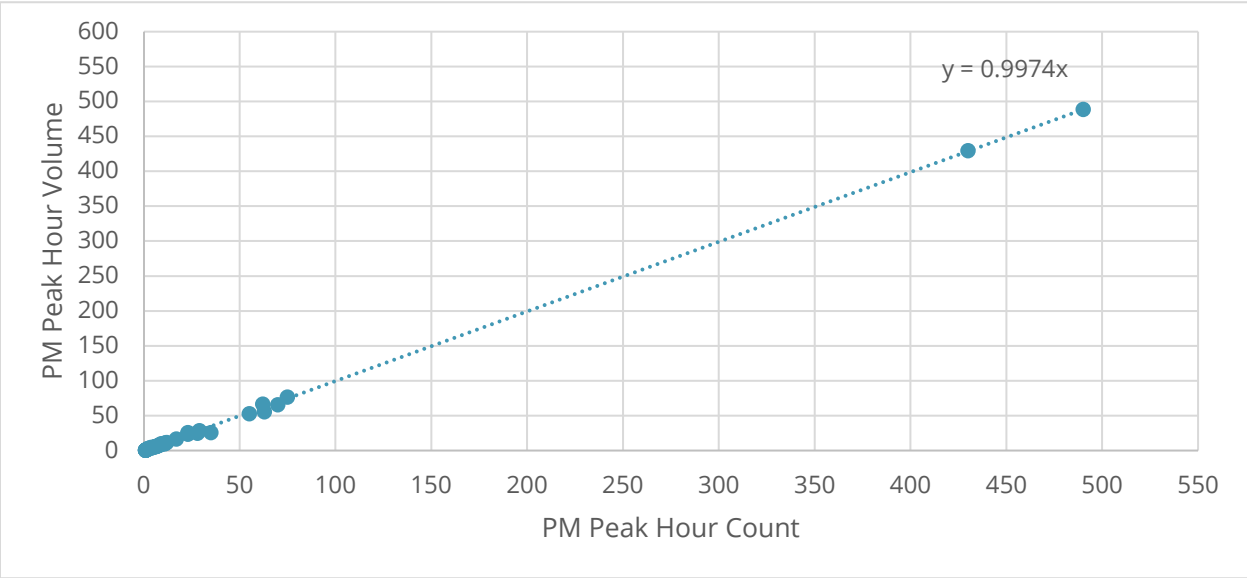

Figure 2.6: PM Peak Hour Count versus Processed Volume - Trucks

Observation of the 2022 field collected count data indicates that the PM peak hour volumes are consistently higher than the AM peak hour. Therefore, AADTs were estimated by dividing the processed PM peak hour traffic by the K factors derived from the Streetlight data. **Table 2.2** summarizes the estimated AADTs along US 25, compared to the KYTC Traffic Counts. This comparison is provided as a quality check to ensure there is no erroneous count data, however the KYTC Traffic Counts are not available at all locations and are provided for various years between 2015 and 2020. The only location where the AADT differs substantially is on KY 14/16 east of the I-75 southbound ramp terminal. However, this KYTC count location is suspect as the AADT is substantially lower than the field observed counts would suggest. Existing Year (2022) AADTs are provided in **Figure 2.7**.

Table 2.2: Comparison of Processed 2022 AADT and KYTC Traffic Counts

Locations	Study Traffic			KYTC Traffic Counts			AADT Difference
	Processed PM DHV	K Factor*	AADT	Station ID	Year	AADT	
US-25 south of KY 14/16	676	9%	7,500				
US-25 north of KY 14/16 to Old Beaver Road	800	9%	8,900	008R04	2015	6,964	1,936
US-25 north of Old Beaver Road to Old Nicholson Road	891	9%	9,900				
US-25 north of Old Nicholson Road to KY 16	905	9%	10,000	008257	2019	11,185	-1,185
US-25 north of KY 16	704	9%	7,800				

*K Factor derived from Streetlight Data

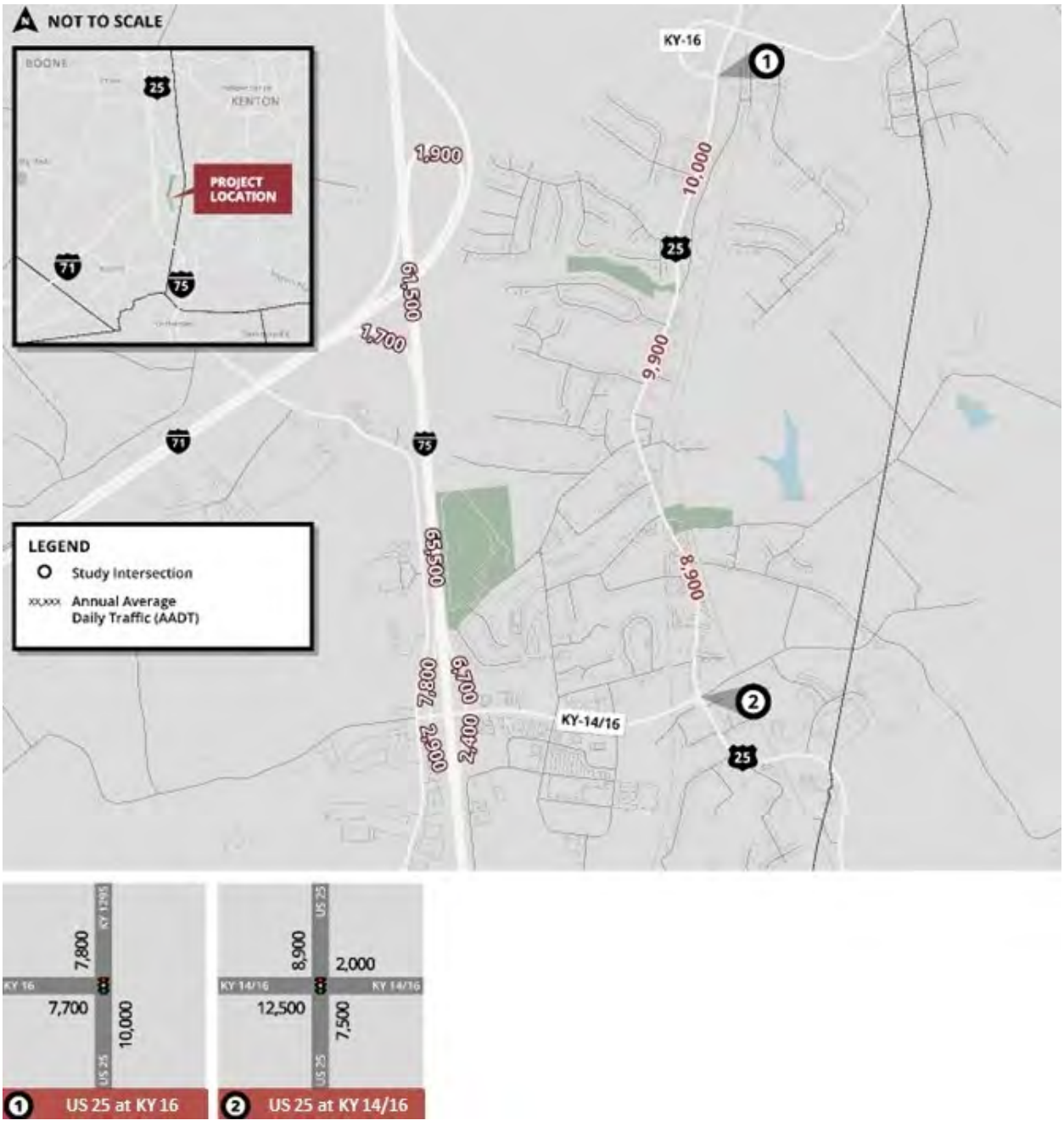

Figure 2.7: Existing Year (2022) AADT

The Existing Year (2022) AADTs were input into a VISUM model, then smoothed and balanced to develop the directional peak hour volumes for the Existing Year (2022) US 25 study segment corridor analysis. The peak hour directional volumes for the three segments along US 25 are provided in **Table 2.3**. **Table 2.4** provides the truck percentages for the three segments along US 25.

Table 2.3: Balanced Directional Peak Hour Volumes for Existing Year (2022)

Segment	Location	Directional Peak Hour Volume	
		AM Peak Volume (veh/hr)	PM Peak Volume (veh/hr)
South of Segment 1	South of KY 14/16/ Mary Grubbs Hwy	265	399
Segment 1	US 25 Mary Grubbs Hwy to Old Beaver Road	297	435
Segment 2	Old Beaver Road to Old Nicholson Road	317	488
Segment 3	Old Nicholson Road to KY 16	326	523
North of Segment 3	North of KY 16	315	437

Table 2.4: Existing Year (2022) Truck Percentages

Segment	Location	Truck Percentages	
		AM Peak Hour	PM Peak Hour
South of Segment 1	South of KY 14/16/ Mary Grubbs Hwy	3%-4%	3%-4%
Segment 1	US 25 Mary Grubbs Hwy to Old Beaver Road	3%-4%	3%-4%
Segment 2	Old Beaver Road to Old Nicholson Road	3%-4%	3%-4%
Segment 3	Old Nicholson Road to KY 16	3%-4%	3%-4%
North of Segment 3	North of KY 16	3%-4%	3%-4%

2.3 Existing Year (2022) Arterial Operational Analysis

Arterial level operational analysis was conducted using HCS along the three segments of US 25. The segments along US 25 are as follows:

- US-25 Mary Grubbs Highway to Old Beaver Road (Segment 1)
- Old Beaver Road to Old Nicholson Road (Segment 2)
- Old Nicholson Road to KY 16 (Segment 3)

Table 2.5 provides the corridor analysis results from HCS for the existing three segments along US 25. The HCS analysis reports can be found in Appendix D.

Table 2.5: Existing Year (2022) US 25 Corridor Analysis Results from HCS

Segment	Location	AM Peak Hour			PM Peak Hour		
		Volume (veh/hr)	Density (veh/mi/ln)	LOS	Volume (veh/hr)	Density (veh/mi/ln)	LOS
South of Segment 1	South of KY 14/16/ Mary Grubbs Hwy	265	3.1	B	399	5.8	C
Segment 1	US 25 Mary Grubbs Hwy to Old Beaver Road	297	3.7	B	435	6.6	C
Segment 2	Old Beaver Road to Old Nicholson Road	317	4.2	B	488	8.0	C
Segment 3	Old Nicholson Road to KY 16	326	3.7	B	523	7.6	C
North of Segment 3	North of KY 16	315	4.1	B	437	6.6	C

From the HCS analysis results, it is evident that the corridor is performing better than the Level of Service (LOS) target D during both AM and PM peak hour of the existing year (2022).

3.0 Future Travel Demand

3.1 Design Year (2050) Volume Development

The design year 2050 AADTs were forecasted using the provided OKI Travel Demand Model (2020 base year) to compute annual growth rates to apply to the Existing Year 2022 balanced AADTs. Difference and ratio methodologies found in *National Cooperative Highway Research Program (NCHRP) Report 765* were used to develop the design year 2050 AADT forecasts. These methods assume that the change in AADT between the model's horizon year and base year is correct. Therefore, this difference is applied to the balanced AADT. To allow for a direct comparison, an interpolated model AADT is calculated for the year 2022 as a new base year. The difference method takes the difference between the horizon and base years in the model and applies that difference to the balanced 2022 AADT. The ratio method calculates the ratio of horizon to base year and applies that ratio to the balanced 2022 AADT. An average of the difference and ratio method was taken for a majority of the segments to establish NCHRP 2050 AADTs (where the ratio of OKI Year 2022 interpolated AADT to Existing AADT is between 0.5 and 2). One segment had a ratio greater than 2, therefore the 2050 AADTs from the difference method was used. A comparison of the interpolated 2022 AADTs based upon the OKI Travel Demand Model base year (2020) and horizon year (2050) AADTs and associated NCHRP 765 forecast adjustments can be found in **Table 3.1**.

Growth rates between existing year (2022) and design year (2050) were reviewed to ensure positive growth and reasonableness. The study area average annual growth rate was calculated as 2.1%. As a comparison point, the 2020 U.S. Census data was reviewed and the population of Boone County increased 17,175, representing an average annual growth of 1.4% between 2010 and 2020. The design year 2050 AADTs are shown in **Table 3.2**.

To develop future year Directional Design Hour Volumes (DDHV), the design year 2050 AADTs were multiplied by Existing Year K and D factors for the AM and PM peak hours. Truck DDHVs were also calculated using the existing truck percentage on each directional link. Forecasted AM and PM DDHVs were used in the Visum model as target values for developing the design year 2050 balanced traffic, following the least squares algorithm. These 2050 DDHVs are shown in **Table 3.3**. The results of the least squared regression and its comparison to the initial forecasted AM and PM peak hour DDHVs can be found in **Table 3.4** and **Table 3.5**, respectively. These comparisons indicate a good fit with no significant outliers indicating that the balanced design year 2050 DDHVs are in line with the target design year 2050 DDHVs.

To provide an additional check that the forecast volume balancing process does not materially change the design year (2050) AADTs, the AADT is back casted using peak hour traffic and the K factor. Due to the PM peak hour having the highest demand, design year (2050) PM peak hour DDHVs were divided by the associated K factor to yield a balanced design year (2050) AADT, shown in **Table 3.6**. Future volume development data can be found in Appendix C. Based on the results of this check, the balancing process applied to the DDHVs does not materially change the AADTs in the study area. It should be noted that the balanced design year (2050) AADTs are for reference purposes only. Resultant design year (2050) AADTs can be found in **Figure 3.1**.

Table 3.1: OKI Model Forecasts and NCHRP 765 Adjustments

Location	NCHRP 765 Adjustment Process									
	Existing Year (2022) AADT	OKI model 2020 AADT	OKI model interpolated 2022 AADT	OKI model 2050 AADT	OKI to Existing AADT Difference (2022)	2050 Smoothed Difference AADT	OKI to Existing AADT Ratio (2022)	2050 Smoothed Ratio AADT	NCHRP 2050 AADT	NCHRP AGR
US-25 south of KY 14/16	7,500	4,920	5,345	11,287	2,155	13,442	1.4	15,838	15,000	3.6%
US-25 north of KY 14/16 to Old Beaver Road (Segment 1)	8,900	5,096	5,282	7,874	3,618	11,493	1.7	13,269	12,000	1.2%
US-25 north of Old Beaver Road to Old Nicholson Road [1] (Segment 2)	9,900	NA	NA	NA	NA	NA	NA	NA	NA	NA
US-25 north of Old Nicholson Road to KY 16 (Segment 3)	10,000	7,417	7,750	12,422	2,250	14,672	1.3	16,028	15,000	1.8%
US-25 north of KY 16	7,800	5,668	5,890	8,984	1,910	10,895	1.3	11,899	11,000	1.5%

1. Segment is not included in the OKI model, and AADT is estimated from the reasonable adjacent segments

Table 3.2: Design Year (2050) AADT Forecasts

Location	Existing Year (2022) AADT	Forecasting Method	Recommended AGR	Design Year (2050) AADT
US-25 south of KY 14/16	7,500	OKI Forecast Model	3.6%	15,000
US-25 north of KY 14/16 to Old Beaver Road (Segment 1)	8,900	OKI Forecast Model	1.2%	12,000
US-25 north of Old Beaver Road to Old Nicholson Road [1] (Segment 2)	9,900	Adjacent Link	1.8%	15,000
US-25 north of Old Nicholson Road to KY 16 (Segment 3)	10,000	OKI Forecast Model	1.8%	15,000
US-25 north of KY 16	7,800	OKI Forecast Model	1.5%	11,000

Table 3.3: Design Year (2050) DDHVs

Location	Design Year (2050) AADT	AM Peak Hour					PM Peak Hour				
		K	D	Peak Direction	NB/EB DDHV	SB/WB DDHV	K	D	Peak Direction	NB/EB DDHV	SB/WB DDHV
US-25 south of KY 14/16	15,000	6%	57%	NB/EB	530	400	9%	59%	SB/WB	550	800
US-25 north of KY 14/16 to Old Beaver Road (Segment 1)	12,000	6%	52%	SB/WB	340	380	9%	51%	NB/EB	550	530
US-25 north of Old Beaver Road to Old Nicholson Road [1] (Segment 2)	15,000	6%	50%	NB/EB	450	450	9%	52%	SB/WB	650	700
US-25 north of Old Nicholson Road to KY 16 (Segment 3)	15,000	6%	51%	NB/EB	460	440	9%	54%	SB/WB	620	740
US-25 north of KY 16	11,000	6%	67%	NB/EB	440	210	9%	60%	SB/WB	400	600

Table 3.4: Balanced Design Year (2050) AM DDHV Forecast Consistency Check

Location	AM Peak Hour Forecast		AM Peak Hour Balanced Forecast		NB/EB Comparison		SB/WB Comparison	
	NB/EB DDHV	SB/WB DDHV	NB/EB DDHV	SB/WB DDHV	Difference	Percent Difference	Difference	Percent Difference
US-25 south of KY 14/16	530	400	520	390	-10	-1.9%	-10	-2.5%
US-25 north of KY 14/16 to Old Beaver Road (Segment 1)	340	380	360	400	20	5.9%	20	5.3%
US-25 north of Old Beaver Road to Old Nicholson Road [1] (Segment 2)	450	450	430	420	-20	-4.4%	-30	-6.7%
US-25 north of Old Nicholson Road to KY 16 (Segment 3)	460	440	470	450	10	2.2%	10	2.3%
US-25 north of KY 16	440	210	450	220	10	2.3%	10	4.8%

Table 3.5: Balanced Design Year (2050) PM DDHV Forecast Consistency Check

Location	PM Peak Hour Forecast		PM Peak Hour Balanced Forecast		NB/EB Comparison		SB/WB Comparison	
	NB/EB DDHV	SB/WB DDHV	NB/EB DDHV	SB/WB DDHV	Difference	Percent Difference	Difference	Percent Difference
US-25 south of KY 14/16	550	800	540	770	-10	-1.8%	-30	-3.8%
US-25 north of KY 14/16 to Old Beaver Road (Segment 1)	550	530	600	560	50	9.1%	30	5.7%
US-25 north of Old Beaver Road to Old Nicholson Road [1] (Segment 2)	650	700	640	660	-10	-1.5%	-40	-5.7%
US-25 north of Old Nicholson Road to KY 16 (Segment 3)	620	740	640	760	20	3.2%	20	2.7%
US-25 north of KY 16	400	600	410	620	10	2.5%	20	3.3%

Table 3.6: AADT Design Year (2050) Forecast Consistency Check

Location	K	Design Year (2050) Forecast			Design Year (2050) Balanced Forecast			Design Year (2050) AADT Comparison	
		NB/EB DDHV	SB/WB DDHV	AADT	NB/EB DDHV	SB/WB DDHV	AADT	Difference	Percent Difference
US-25 south of KY 14/16	9.0%	550	800	15,000	540	770	15,000	0	0.0%
US-25 north of KY 14/16 to Old Beaver Road (Segment 1)	9.0%	550	530	12,000	600	560	13,000	1,000	8.3%
US-25 north of Old Beaver Road to Old Nicholson Road [1] (Segment 2)	9.0%	650	700	15,000	640	660	14,000	-1,000	-6.7%
US-25 north of Old Nicholson Road to KY 16 (Segment 3)	9.1%	620	740	15,000	640	760	15,000	0	0.0%
US-25 north of KY 16	9.0%	400	600	11,000	410	620	11,000	0	0.0%

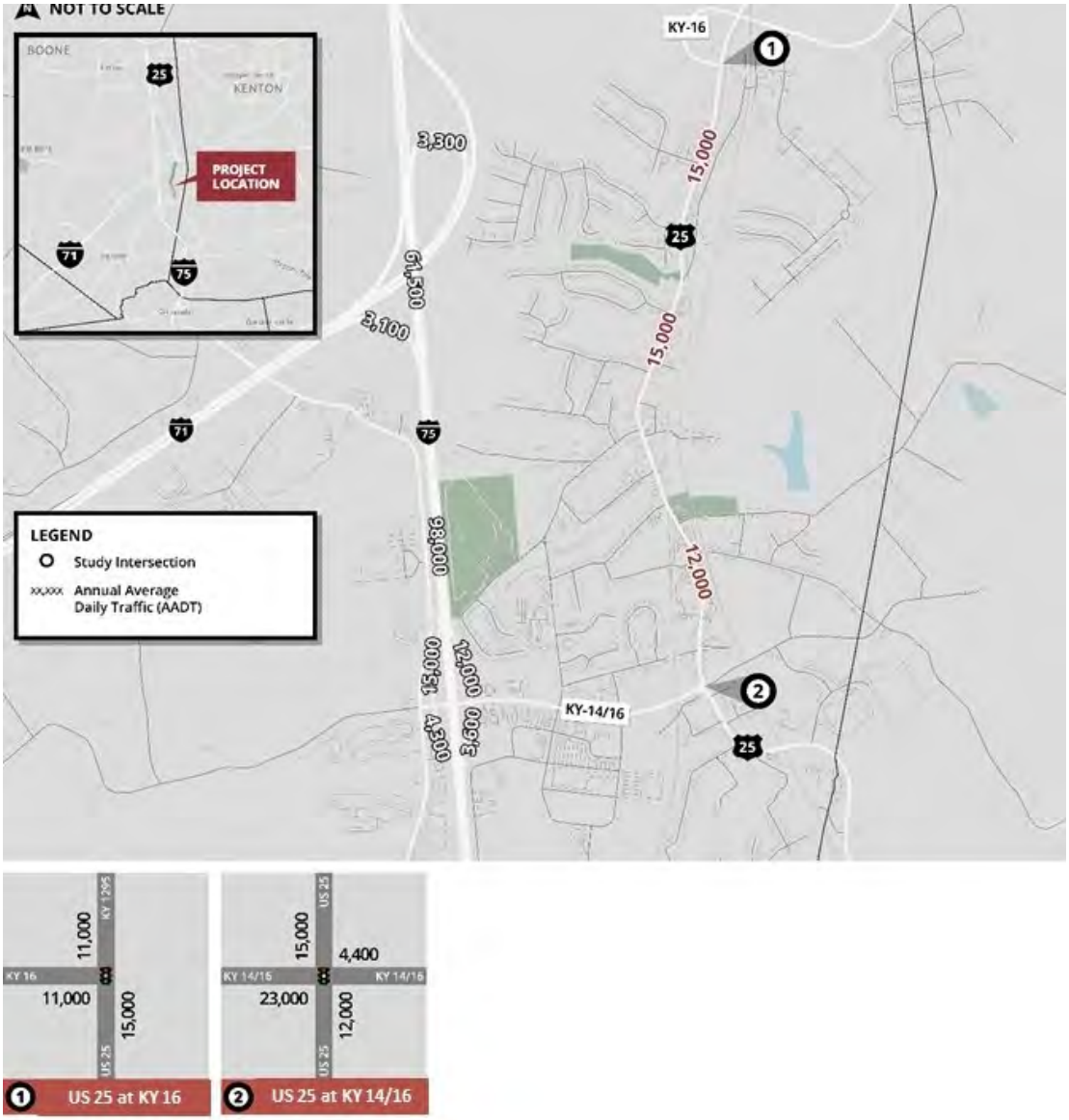

Figure 3.1: Design Year (2050) AADTs

The calculated Design Year (2050) AADTs were input into a VISUM model, then smoothed and balanced to develop the directional peak hour volumes for the No-Build (2050) study segments corridor analysis. The peak hour directional volumes for the No-Build (2050) Alternative at those three segments along US 25 are provided in **Table 3.7**.

Table 3.7: Balanced Directional Peak Hour Volumes for the No-Build (2050) Alternative

Segment	Location	Directional Peak Hour Volume	
		AM Peak Volume (veh/hr)	PM Peak Volume (veh/hr)
S. of Segment 1	S. of Mary Grubbs	520	770
Segment 1	US 25 Mary Grubbs Hwy to Old Beaver Road	423	634
Segment 2	Old Beaver Road to Old Nicholson Road	456	704
Segment 3	Old Nicholson Road to KY 16	503	777
N. of Segment 3	N. of KY 16	450	620

4.0 Alternatives Considered

4.1 No-Build Alternative

The No-Build Alternative maintains the existing year (2022) lane configuration and traffic control at all study intersections and maintains the existing lanes and alignment along US 25 within the study area.

4.2 Build Alternatives

Four alternate bypass corridors parallel to US 25 (shown in pink) were considered for analysis as Build Alternatives, as shown in **Figure 4.1** and described below, as follows:

- Alternative 1(Yellow), runs from north of Chambers Road to Stephenson Mill Road, west of US 25 and I-75
- Alternative 2 (Blue), runs from Chambers Road at I-75 to Stephenson Mill Road, just west of US 25 and I-75
- Alternative 3 (Red), runs from north of Chambers Road to Richard Knock Highway, just east of US 25
- Alternative 4 (Green), runs from Old Lexington Pike north of KY 16 to Richard Knock Highway, just east of US 25

Segment analysis will be conducted along US-25 to compare the effects of each Build Alternative versus the No-Build Alternative in 2050. The segments to be analyzed are:

S. of Segment 1	S. of Mary Grubbs
Segment 1	US 25 Mary Grubbs Hwy to Old Beaver Road
Segment 2	Old Beaver Road to Old Nicholson Road
Segment 3	Old Nicholson Road to KY 16
N. of Segment 3	N. of KY 16

The design year 2050 AADTs for both passenger vehicles and trucks were forecasted separately using the provided OKI regional Cube model year (2050) for each of the four bypass alternatives and along US 25. Utilizing this provided data, comparisons in the network along US 25 were made against the 2050 No-Build Scenario for each of the four bypass alternatives. The results of these comparisons can be found in Section 5 of this report.

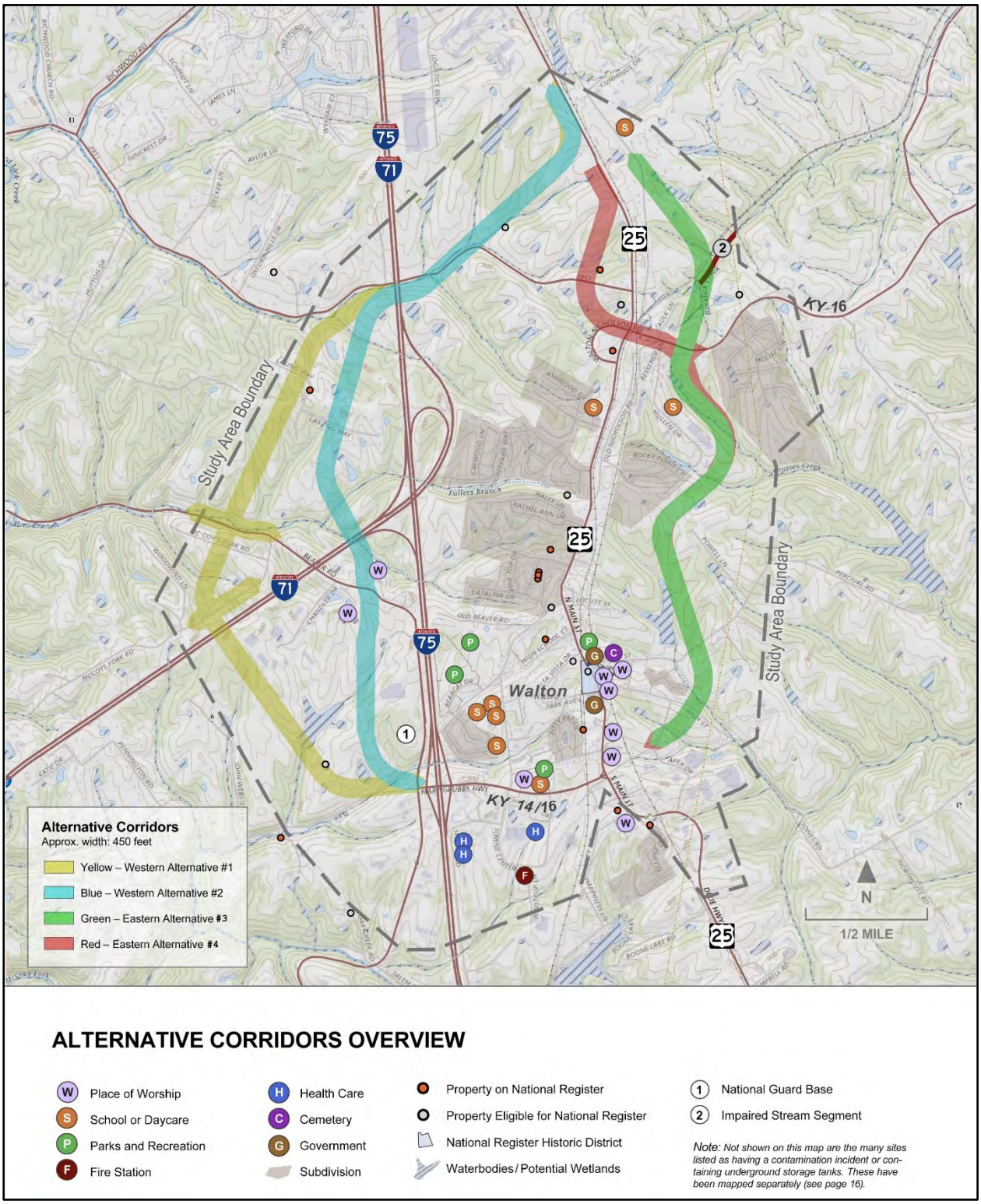

Figure 4.1: Four Alternative Corridors Map

5.0 Alternative Analysis

An analysis of the design year (2050) future traffic operations was conducted to compare the No-Build and Build Alternatives. The following section will present both the No-Build and Build Alternative results, provide a direct comparison of the alternatives, and highlight any operational benefits of the Build Alternatives.

5.1 Design Year (2050) No-Build Alternative Arterial Operational Analysis

Arterial level operational analysis was conducted using HCS along the three segments of the US 25.

Table 5.1 provides the corridor analysis results from HCS for the three existing segments along US 25 for No-Build Alternative. The HCS analysis reports can be found in Appendix D

Table 5.1: No-Build Alternative (2050) US 25 Corridor Analysis Results from HCS

Segment	Location	AM Peak Hour			PM Peak Hour		
		Volume (veh/hr)	Density (veh/mi/ln)	LOS	Volume (veh/hr)	Density (veh/mi/ln)	LOS
South of Segment 1	South of KY 14/16/ Mary Grubbs Hwy	520	8.6	C	770	15.0	D
Segment 1	US 25 Mary Grubbs Hwy to Old Beaver Road	423	6.3	C	634	11.4	D
Segment 2	Old Beaver Road to Old Nicholson Road	456	7.2	C	704	13.4	D
Segment 3	Old Nicholson Road to KY 16	503	7.1	C	777	13.3	D
North of Segment 3	North of KY 16	450	6.0	C	620	9.7	C

The HCS analysis results indicate that, for the No-Build Alternative, the corridor is performing better than the LOS target D during the AM peak hour and performing at LOS target D during the PM peak hour in 2050.

5.2 Design Year (2050) Build Alternatives Arterial Operational Analysis

The design year (2050) Build Alternatives includes the four alternative corridors parallel to US 25.

Four bypass alternatives were run through the OKI regional Cube model year (2050), and the resulted networks were compared to the No-Build 2050 to summarize the impacts of bypass on US 25 traffic on each alternative. **Table 5.2** provides the volume differences for each bypass corridor from the existing US 25 corridor. **Table 5.3** provides the bypass corridor's truck volume comparison.

From the volume comparisons it is evident that the percentage of volume change on US 25 corridor is minimal and less than 1000 vehicles., all resulting in LOS A. None of the US 25 segments are experiencing truck volume reduction under any of the build alternatives. The volume reduction on the three US 25 segments were minimal or non-existent under all Build Alternative corridors. However, HCS analysis was conducted for these four bypass corridors for the Build conditions to estimate average speed, ultimately calculating an estimated travel time for each of the Build Alternative corridors to compare against the US 25 corridor. The Build Alternative corridors do not provide a travel time savings, as shown in Table 5.3.

Table 5.2: Bypass Corridors Volume Comparison

Sections	OKI Model Volumes (2050)					US 25 Percent Change				US 25 Volume Change			
	No-Build	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4
Bypass (between KY 14/16 Hwy and US 25)	NA	100	650	950	1000								
US 25_between Mary Grubbs Hwy and Old Beaver Rd (Segment 1)	8450	8350	8050	7800	7800	-1%	-5%	-8%	-8%	-100	-400	-650	-650
US 25_between Old Beaver Rd and Nicholson Rd (Segment 2)	13450	13250	12900	12650	12650	-1%	-4%	-6%	-6%	-200	-550	-800	-800
US 25_between Nicholson Rd and KY 16 (Segment 3)	13450	13250	12900	12650	12650	-1%	-4%	-6%	-6%	-200	-550	-800	-800

[1.] There is only one segment coded in the OKI cube network between Old Beaver and US 25. So same traffic volumes are copied for segment 2 and 3.

[2.] No-build traffic volumes are extracted from files received on 11/15/2022

Alternative. The HCS analysis reports can be found in Appendix D

Table 5.3: Build Alternative (2050) Corridor Analysis Travel Time Comparison Results from HCS

Segment	Location	AADT (veh/day)	LOS	K	D	DHV	Avg. Speed (mi/hr)	Estimated Distance (miles)	Travel Time (Min)	PM Peak US 25 Travel Time (Min)
Bypass (between KY 14/16 Hwy and US 25)	Alternative 1	100	A	6%	55.4%	4	47.1	4.56	5.82	3.87
	Alternative 2	650	A	6%	55.4%	22	47.1	3.60	4.59	
	Alternative 3	950	A	6%	55.4%	32	47.1	3.50	4.46	
	Alternative 4	1000	A	6%	55.4%	31	47.1	3.60	4.59	

Table 5.4: Bypass Corridors Truck Volume Comparison

Sections	OKI Model Truck Volumes (2050)									OKI Model Truck % (2050)				
	No-Build	Alt 1		Alt 2		Alt 3		Alt 4		No-Build	Alt 1	Alt 2	Alt 3	Alt 4
	Vol	Vol	% Change	Vol	% Change	Vol	% Change	Vol	% Change	% Trucks	% Trucks	% Trucks	% Trucks	% Trucks
Bypass (between KY 14/16 Hwy and US 25)	NA	50		50		100		100		NA	50%	8%	11%	10%
US 25_between Mary Grubbs Hwy and Old Beaver Rd (Segment 1)	1150	1100	-4.35%	1100	-4.35%	1100	-4.35%	1100	-4.35%	14%	13%	14%	14%	14%
US 25_between Old Beaver Rd and Nicholson Rd (Segment 2)	1550	1550	0.00%	1500	-3.23%	1500	-3.23%	1500	-3.23%	12%	12%	12%	12%	12%
US 25_between Nicholson Rd and KY 16 (Segment 3)	1550	1550	0.00%	1500	-3.23%	1500	-3.23%	1500	-3.23%	12%	12%	12%	12%	12%

6.0 Conclusion and Recommendation

The purpose of this study is to evaluate the vehicular and truck impacts of four potential alternative parallel corridors on US 25. The followings are the key findings and conclusions of this study:

- Three segments of US 25 studied are expected to operate at LOS C or D in the peak hours under the No-Build Alternative (2050).
- Four parallel alternative corridors were analyzed to determine if they would reduce demand on the three US 25 segments, regarding the overall volumes and truck volumes.
  - Analysis indicates that the effect of building any of the four alternative corridors would have a minimal or non-existent effect on US 25 LOS.
  - Overall bypass corridor volumes reduced the most for Alternative 3 and Alternative 4, on segments 2 and 3, with a reduction of 800 vehicles daily or 6%.
  - Truck volumes reduced for a maximum of 50 trucks per day on each segment, for Alternatives 2,3 and 4, resulting in a reduction of -4.35% to -3.23% of overall trucks.
  - Alternative 1 also showed a 50 trucks per day reduction, but only for Segment 1, resulting in a -4.35% overall truck reduction.
  - No travel time saving was measured on any of the Build Alternative corridors, as compared to US 25.

Appendices

Appendix A

Methodology Statement

Traffic Analysis Methodology *(Draft)*

I-75/KY-14 Interchange and US 25 Study
Item Numbers 6-80 & 6-105

Boone County, Kentucky

Prepared For:
Kentucky Transportation Cabinet
421 Buttermilk Pike, Fort Mitchell, KY 41017

April, 2022

Table of Contents

1.0 Introduction

The purpose of this methodology statement is to outline Lochner's proposed approach to aid the Kentucky Transportation Cabinet (KYTC) in analyzing traffic patterns and developing design concepts in support of the I-75/KY-14 interchange and US 25 Study.

1.1 Project Location

The project is in Boone County, near the border of Kenton County, along the I-75 and US-25 corridor between the KY-14/16 interchange to the south and KY-338 to the north. The focus of the study will be on the I-75 at KY-14/16 interchange and on US-25 between KY-14 and KY-16. To account for the possibility of the need for an Interchange Modification Report, the study will also consider the merge and diverge areas at the I-71/I-75 interchange (0.5 miles north of the KY-14/16 interchange) and the I-75 at Violet Road interchange (4.7 miles south of the KY-14/16 interchange). The study area and analysis locations are shown in **Figure 1.1**.

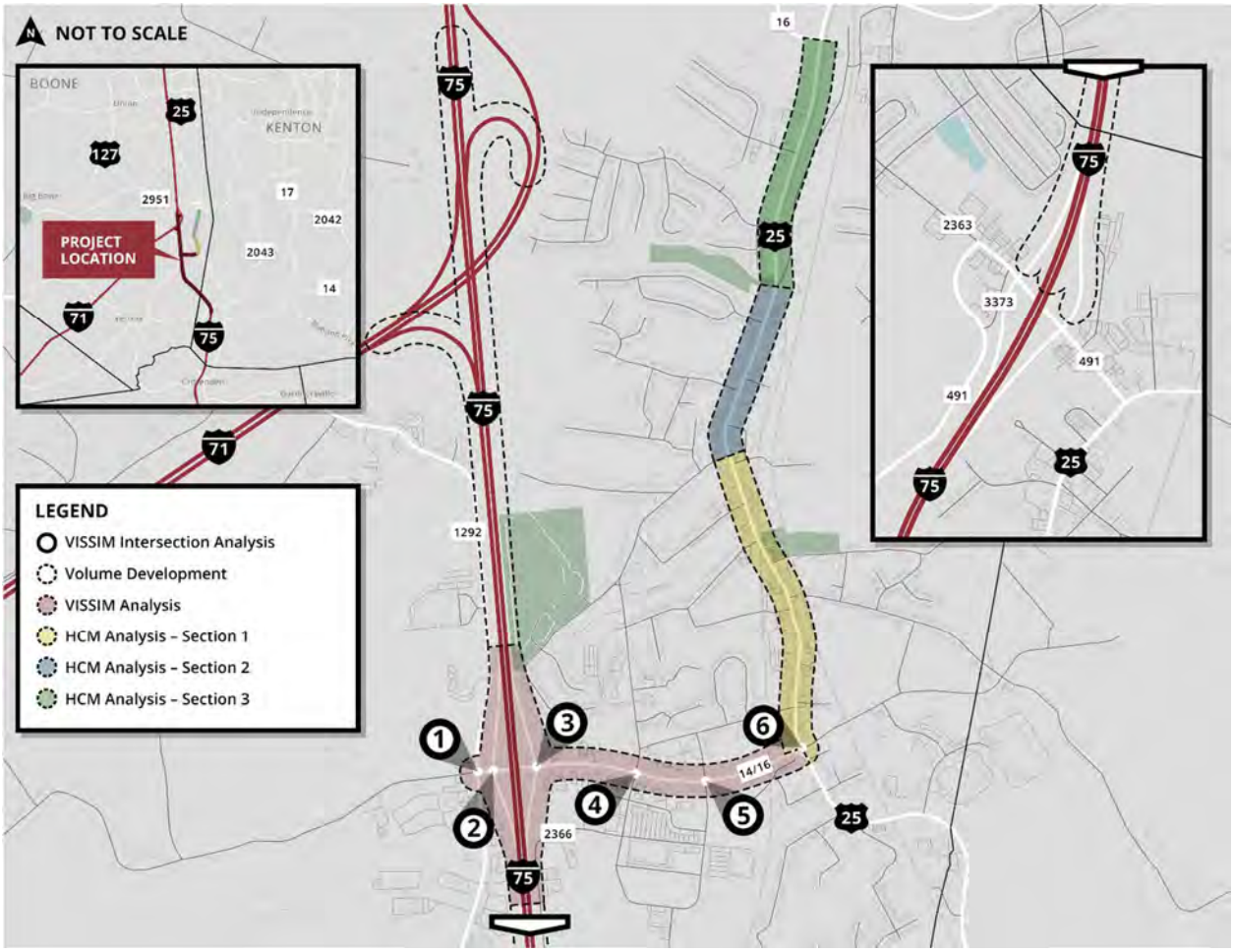

Figure 1.1: Study Area and Analysis Map

1.2 Study Area

The study area includes the I-75/KY-14 interchange in southern Boone County as well as the following intersections:

1. KY-14/16 at KY-1292 (Beaver Road)
2. KY-14/16 at I-75 Southbound Ramp Terminal
3. KY-14/16 at I-75 Northbound Ramp Terminal
4. KY-14/16 at School Road
5. KY-14/16 at Beatrice Avenue
6. KY-14/16 at US 25

Segment analysis will be conducted along US 25 in the following sections:

1. US 25 to Old Beaver Road
2. Old Beaver Road to Old Nicholson Road
3. Old Nicholson Road to KY-16

1.3 Project Schedule

The following dates are anticipated based on the Milestone Project Schedule:

- First Project Team Meeting - Existing Conditions 3/31/22
- Second Project Team Meeting – Development and Presentation of Improvement Concepts 6/15/22
- Third Project Team Meeting – Feedback, Prioritization and/or Recommendations 9/15/22

2.0 Study Approach

2.1 Analysis Years

The following years will be used for both the Vissim and HCM analyses:

- Existing Year (2022)
- Opening Year (2030)
- Design Year (2045)

2.2 Alternatives

The following alternatives will be analyzed during the course of this analysis:

Existing – Represents the existing conditions as of project notice to proceed

No Build – Represents the existing conditions plus any committed improvements within the study area between the existing year (2022) and design year (2045)

Two Build Alternatives

1. Move KY-1292 and provide new access from KY-14/16 south of Stephenson Mill Road to Stephenson Mill Road to the west of the Flying J Travel Center.
2. Reconfiguration of KY-14/16 interchange to a single-point urban interchange (SPUI).

The No Build and Build Alternatives will be analyzed with up to three (3) bypass alternative volume sets.

2.3 Data Collection

2.3.1 Existing and Historic Traffic Data

Traffic count data was gathered from the KYTC Traffic Counts database where available and included AADT, truck percentages, K factors, and D factors.

Traffic counts were collected using cameras between 7:00 AM and 9:00 AM in January and February 2022. All counts are summarized in 15-minute bins. All counts were classified as cars or heavy vehicles (trucks). Counts were conducted at the following locations:

- Intersection – KY-1292 at KY-14/16
- Intersection – Southbound I-75 ramp terminal at KY-14/16
- Intersection – Northbound I-75 ramp terminal at KY-14/16
- Intersection – KY-14/16 at US-25
- Intersection – KY-16 at US-25
- Mainline – I-75, south of KY-14/16 interchange

Data collection location and sources are indicated in **Figure 2.1**.

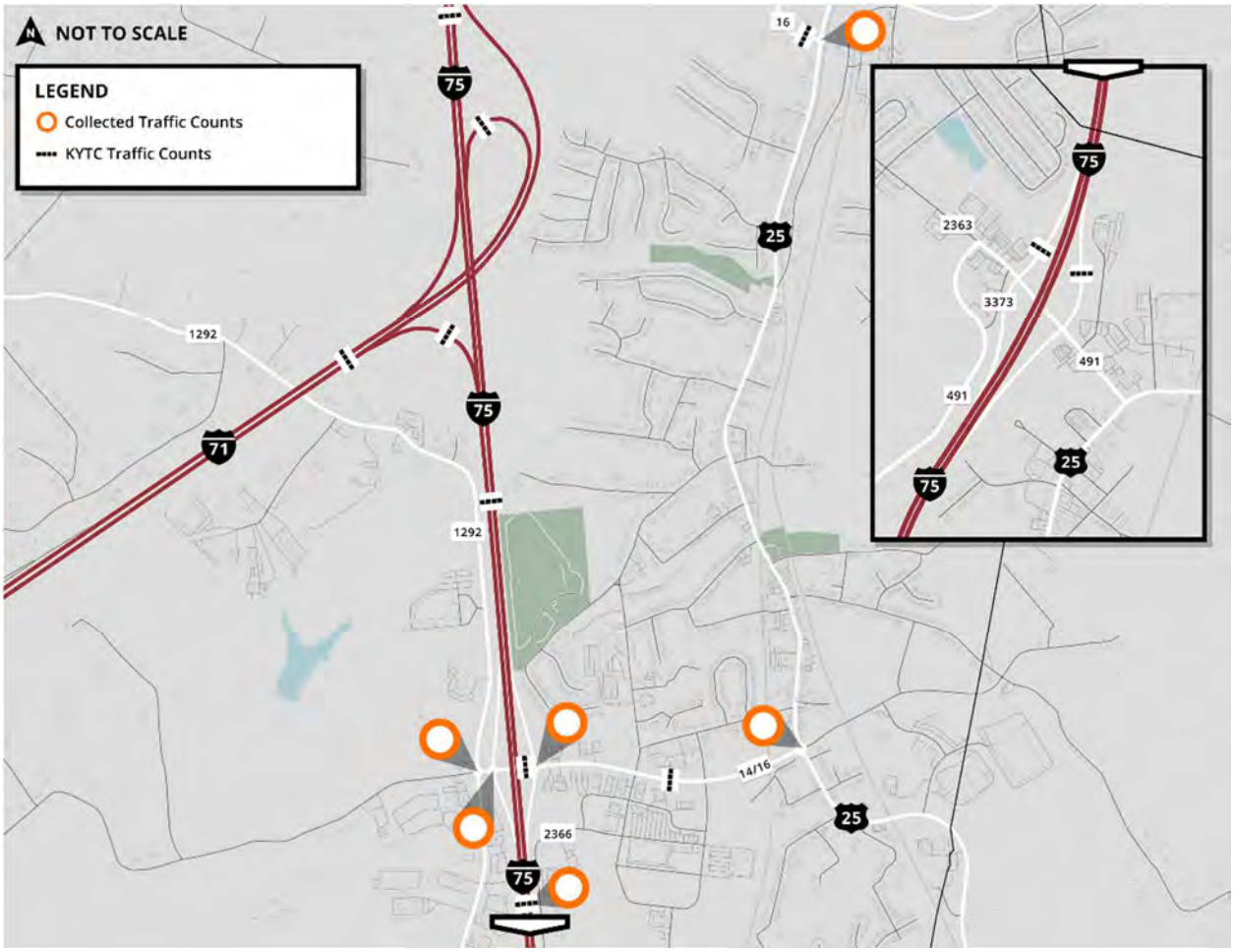

Figure 2.1: Traffic Count Locations and Sources

Access to Streetlight Insight including origin-destinations and travel speeds data will be provided by OKI. To supplement the collected data, data from Streetlight Insight will be expanded to a 'typical day' using the collected count data above. The percent movements will be applied to the counted data at the following locations to derive typical day counts for the daily, peak hours, shoulder periods:

- Intersection movements at KY 14/16 and School Road
- Intersection movements at KY 14/16 and Beatrice Avenue
- I-75 at I-71 interchange
- I-75 at Violet Road interchange
- US-25 sink and source volumes for each of the three identified segments between KY 14/16 and KY 16

2.4 Existing Volume Development

Volume development will be based on the counts collected during January and February 2022 and supplemented using Streetlight data collected during January and February 2019. Streetlight data for 2022 is not available, so 2019 Streetlight will be used to better represent current and pre-COVID 19 conditions. The process for developing existing year (2022) volumes will follow the following process:

1. We will calculate the AM and PM peak hours within the two hours during the AM and two hours during the PM where we have field observed count data. This will be done by observing the aggregate volume across field observed counts to find the highest aggregate volume.
2. Prepare the two missing intersection counts to minimize volume imbalance by matching the percent movements from Streetlight to the field observed counts on KY 14/16.
3. Create productions and attractions at each zone in VISUM for the AM and PM Peak Hours.
    a. If we have a count here, we use that directly.
    b. If we don't have a count, we will estimate using Streetlight data. We will calculate the sample size for each location where we have a count against the Streetlight index volume and then use that to expand the places where we don't have a count.
    c. For each zone we will compute a truck percentage.
4. We will create two initial seed origin-destination matrices by extracting the AM and PM peak hour origin-destination matrices from Streetlight for all vehicles and for trucks and applying an iterative proportional fitting method to match the productions and attractions of each external zone in the study area.
5. Using PTV VISUM's TFLOWFUZZY method, we will create a car and a truck origin-destination matrix which together will match the field observed total count data with a tolerance of 10 percent or 35 vehicles per movement.
6. We will re-calculate the AM and PM peak hour truck percentages and compare to the field observed truck percentages to ensure we match these field observed conditions.
7. Using the Streetlight data, we will construct a study area temporal distribution of volumes on I-75 and on the surface streets. These will be used to derive a shoulder hour on each side of the peak hours for analysis in the micro-simulation analysis. This will also be used to estimate peak-to-daily ratios which can be used to estimate AADTs for each link. These AADTs will be compared to the AADTs found in the KYTC Traffic Count Database with the understanding that the KYTC Traffic Count Database will not have counts available beyond 2019.

2.5 Travel Demand Forecasting

Travel demand modeling will be performed in conjunction with the OKI Regional Council of Governments who maintains the regions travel demand model. The model is an activity-based model (ABM) that uses the Coordinated Travel – Regional Activity Based Modeling Platform (CT-RAMP). The model will be validated to subarea conditions for this study by OKI using traffic counts and Streetlight origin-destination data collected as part of this study. OKI will provide the consultant with daily loaded networks and trip tables to be used for forecasting. Additional adjustments to the daily volumes, converted to AADT, will be performed using methods described in the National Cooperative Highway Research Program (NCHRP) Report 765 titled *Analytical Travel Forecasting Approaches for Project-Level Planning and Design*. The future year AADTs will be converted to directional design hour volumes using K and D factors developed from the existing data collection efforts. Any modifications to this will be documented. OKI will provide loaded highway networks and trip tables for each analysis year. Project team will produce directional design hour volumes for the study area.

2.6 Traffic Operational Analysis

Operational analysis will be conducted in two parts. A PTV VISSIM micro-simulation model will be developed for the KY-14/16 interchange at I-75. This will include I-75 from the merge and diverge areas at I-71 to the north and Violet Road to the south. KY-14/16 will be modeled from west of KY-1292 to east of US-25. The calibration and alternatives analysis for this micro-simulation is provided below. This study will not analyze I-75 or the interchanges to the north (I-71) and south (Violet Road). These additional locations will be used only to calibrate the model and to be prepared for a potential interchange modification report (IMR).

Analysis of US-25 between KY-14/16 and KY-16 will be focused on capacity analysis of the roadway and the impacts of potential bypasses. This analysis will rely on Highway Capacity Manual (HCM) version 7 methodologies. MOEs for this analysis will include level of service and volume to capacity ratios. Operational analysis on US-25 will be reported between:

- US 25 to Old Beaver Road
- Old Beaver Road to Old Nicholson Road
- Old Nicholson Road to KY-16

2.7 Microsimulation Calibration Methodology

PTV VISSIM 2020 (service pack 14) will be used to conduct this analysis. The VISSIM microsimulation model will be calibrated with travel times from provided Streetlight Insight Data and with field collected volume data for the same dates and times. A three-hour AM and a three-hour PM peak period will be conducted using 15-minute flow rates. Since this is a closed system, origin to destination static assignment will be used. The extended period of microsimulation analysis will demonstrate the build-up and duration of traffic congestion. The following calibration metrics and targets were selected from the *KYTC Microsimulation Guidelines* dated November 2021.

Table 2.1: KYTC Microsimulation Targets

Calibration Metric	Calibration Measure	Calibration Target
Volume	Individual link flows: Within 15%, for 700 veh/h < Flow < 2,700 veh/h Within 100 veh/h, for Flow <700 veh/h Within 400 veh/h, for Flow >2,700 veh/h	>85% of cases
	Sum of all link flows	Within 5% of sum of all link counts
	GEH Statistic <3 for interstate GEH Statistic <5 for local roadway facilities	>85% of cases
Speed	Within 10% (or 10mph, if higher)	>85% of cases
Queue	Queues in observed conditions (Qualitative)	Observation of similar conditions within model

Modifications to the model will be made in accordance with guidance in the *KYTC Microsimulation Guidelines* and *FHWA's Traffic Analysis Toolbox Volume III*. These modifications will be documented in the calibration memo. The model will start with the nine key microsimulation parameters provided in the *KYTC Microsimulation Guidelines* and the seed .inpx file provided by KYTC.

Once the model has been calibrated using a single model run, the number of required simulation runs will be calculated using the equation provided in the KYTC Microsimulation Guidelines provided below. Calibration will be verified for the average of these runs using random seeds.

$$N = (2 * t_{0.025,N-1} * s/R)^2$$

Where:

- N=number of required simulation runs
- $t_{0.025,N-1}$ = student's statistic for two-sided error of 2.5% (5% total) with N-1 degrees of freedom
- s = standard deviation about the sample mean for travel time
- R = confidence interval for the true mean

2.8 Micro-simulation Selection of Measures of Effectiveness (MOE)

A target LOS 'D' shall be established for the I-75/KY-14 interchange study area. Roadway geometric and traffic control improvements will be recommended to achieve a future LOS of D or better for each roadway element in the study area. Model volumes for the AM and PM peak hours will be compared to the demand volume for the respective peak hour. Vehicle speeds will be analyzed in one-hour groups (one hour before the peak hour, the peak hour, one hour after the peak hour). For queue lengths, the maximum of the entire simulation period will be analyzed.

The MOEs for the interstate include:

- Demand versus simulated traffic volume,
- Estimated density (and associated level of service from the HCM, 7th edition), and
- Vehicle speed profiles.

The MOEs for arterial roadway segments include:

- Demand versus simulated traffic volume and
- Vehicle speed profiles.

The MOEs for the study intersections include:

- Demand versus simulated traffic volume,
- Maximum vehicle queue lengths and available storage by movement,
- Movement and overall intersection control delay, and
- Movement and overall intersection LOS.

Appendix B

Traffic Data Collection

US25 and Mary Grubbs AM

Cars

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings
7:00	0	4	7	30	0	0	0	10	2	0	0	47	14	1	0	0	18	6	11	0
7:15	0	3	7	54	0	0	0	9	1	0	0	57	13	0	0	0	40	7	18	0
7:30	0	4	10	67	0	0	0	13	0	0	0	67	18	0	0	0	43	8	34	0
7:45	0	4	15	48	0	0	0	9	1	0	0	42	18	0	0	0	42	18	41	0
8:00	0	1	10	59	0	0	0	10	3	0	0	47	17	1	0	0	28	12	31	0
8:15	0	2	12	59	0	0	0	8	3	0	0	27	18	2	0	0	45	12	32	0
8:30	0	3	12	46	0	0	0	11	0	0	0	45	19	0	0	0	43	14	22	0
8:45	0	2	5	17	0	0	0	4	0	0	0	12	9	0	0	0	16	7	12	0

Heavy Vehicles

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk
7:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	2	3	0
7:15	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	2	4	0
7:30	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	5	4	1	0
7:45	0	0	0	4	0	0	0	1	0	0	0	1	0	0	0	0	5	1	4	0
8:00	0	0	0	2	0	0	0	0	0	0	0	2	1	0	0	0	3	0	4	0
8:15	0	0	1	1	0	0	1	2	0	0	0	5	2	0	0	0	3	2	3	0
8:30	0	1	1	2	0	0	0	5	0	0	0	2	2	0	0	0	1	3	4	0
8:45	0	0	0	2	0	0	0	1	0	0	0	0	0	1	0	0	1	2	0	0

TOTAL

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings
7:00	0	4	7	30	0	0	0	10	2	0	0	48	14	1	0	0	20	8	14	0
7:15	0	3	7	56	0	0	0	9	1	0	0	61	13	0	0	0	40	9	22	0
7:30	0	4	10	68	0	0	0	13	0	0	0	68	19	0	0	0	48	12	35	0
7:45	0	4	15	52	0	0	0	10	1	0	0	43	18	0	0	0	47	19	45	0
8:00	0	1	10	61	0	0	0	10	3	0	0	49	18	1	0	0	31	12	35	0
8:15	0	2	13	60	0	0	1	10	3	0	0	32	20	2	0	0	48	14	35	0
8:30	0	4	13	48	0	0	0	16	0	0	0	47	21	0	0	0	44	17	26	0
8:45	0	2	5	19	0	0	0	5	0	0	0	12	9	1	0	0	17	9	12	0

Cars

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings
16:00	0	2	28	55	0	0	0	20	4	0	0	43	30	0	0	0	76	16	71	0
16:15	0	3	31	55	0	0	0	20	3	0	0	36	25	1	0	0	75	8	66	0
16:30	0	0	41	76	0	0	5	20	17	0	0	48	31	0	0	0	64	13	61	0
16:45	0	3	23	74	0	0	0	16	8	0	0	42	19	0	0	0	70	12	72	0
17:00	0	3	33	86	0	0	1	12	6	0	0	47	25	1	0	0	62	10	68	0
17:15	0	1	42	67	0	0	0	6	7	0	0	34	16	1	0	0	75	15	85	0
17:30	0	1	25	62	0	0	0	21	1	0	0	40	18	1	0	0	71	11	62	0
17:45	0	6	21	60	0	0	0	13	3	0	0	37	19	0	1	0	50	10	57	0

Heavy Vehicles

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk
16:00	0	0	2	3	0	0	0	2	0	0	0	2	3	0	0	0	2	1	3	0
16:15	0	0	1	2	0	0	0	1	0	0	0	1	0	1	0	0	4	0	2	0
16:30	0	0	1	3	0	0	0	1	0	0	0	2	0	0	0	0	1	0	1	0
16:45	0	0	0	1	0	0	0	3	1	0	0	1	0	0	0	0	0	0	3	0
17:00	0	0	2	5	0	0	0	2	0	0	0	0	0	0	0	0	3	2	0	0
17:15	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
17:30	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	2	0	0	0
17:45	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0

TOTAL

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings
16:00	0	2	30	58	0	0	0	22	4	0	0	45	33	0	0	0	78	17	74	0
16:15	0	3	32	57	0	0	0	21	3	0	0	37	25	2	0	0	79	8	68	0
16:30	0	0	42	79	0	0	5	21	17	0	0	50	31	0	0	0	65	13	62	0
16:45	0	3	23	75	0	0	0	19	9	0	0	43	19	0	0	0	70	12	75	0
17:00	0	3	35	91	0	0	1	14	6	0	0	47	25	1	0	0	65	12	68	0
17:15	0	1	42	68	0	0	0	7	7	0	0	34	16	1	0	0	75	15	86	0
17:30	0	1	25	63	0	0	0	22	1	0	0	41	19	1	0	0	73	11	62	0
17:45	0	6	22	61	0	0	0	13	3	0	0	38	19	1	1	0	51	10	58	0

Cars

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings
7:00	0	0	17	17	0	0	0	0	0	0	0	29	39	0	0	0	30	0	42	0
7:15	0	0	20	21	0	0	0	0	0	0	0	44	32	0	0	0	28	0	55	0
7:30	0	0	20	18	0	0	0	0	0	0	0	39	47	0	0	0	42	0	50	0
7:45	0	0	13	16	0	0	0	0	0	0	0	33	39	0	0	0	39	0	69	0
8:00	0	0	21	13	0	0	0	0	0	0	0	20	45	0	0	0	31	0	48	0
8:15	0	0	26	16	0	0	0	0	0	0	0	36	41	0	0	0	24	0	48	0
8:30	0	0	24	13	0	0	0	0	0	0	0	37	31	0	0	0	32	0	34	0
8:45	0	0	29	7	0	0	0	0	0	0	0	31	25	0	0	0	24	0	30	0

Heavy Vehicles

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk
7:00	0	0	2	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0
7:15	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0
7:30	0	0	4	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0
7:45	0	0	8	0	0	0	0	0	0	0	0	2	2	0	0	0	1	0	1	0
8:00	0	0	2	0	0	0	0	0	0	0	0	1	3	0	0	0	2	0	1	0
8:15	0	0	4	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	2	0
8:30	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	0
8:45	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	1	0

TOTAL

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings
7:00	0	0	19	17	0	0	0	0	0	0	0	32	41	0	0	0	30	0	42	0
7:15	0	0	22	22	0	0	0	0	0	0	0	44	32	0	0	0	29	0	59	0
7:30	0	0	24	18	0	0	0	0	0	0	0	41	50	0	0	0	42	0	50	0
7:45	0	0	21	16	0	0	0	0	0	0	0	35	41	0	0	0	40	0	70	0
8:00	0	0	23	13	0	0	0	0	0	0	0	21	48	0	0	0	33	0	49	0
8:15	0	0	30	16	0	0	0	0	0	0	0	37	45	0	0	0	24	0	50	0
8:30	0	0	26	13	0	0	0	0	0	0	0	38	31	0	0	0	33	0	36	0
8:45	0	0	31	7	0	0	0	0	0	0	0	31	28	0	0	0	25	0	31	0

Cars

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings	U Turns	Left Turns	Straight Through	Right Turns	Ped Crossings
16:00	0	0	76	39	0	0	0	0	0	0	0	51	44	0	0	0	29	0	53	0
16:15	0	0	62	32	0	0	0	0	0	0	0	46	38	0	0	0	21	0	59	0
16:30	0	0	79	34	0	0	0	0	0	0	0	70	52	0	0	0	27	0	39	0
16:45	0	0	61	39	0	0	0	0	0	0	0	63	37	0	0	0	28	0	65	0
17:00	0	0	73	43	0	0	0	0	0	0	0	53	32	0	0	0	33	0	65	0
17:15	0	0	72	37	0	0	0	0	0	0	0	48	30	0	0	0	27	0	48	0
17:30	0	0	57	42	0	0	0	0	0	0	0	75	39	0	0	0	24	0	52	0
17:45	0	0	53	33	0	0	0	0	0	0	0	54	22	0	0	0	22	0	59	0

Heavy Vehicles

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk	U Turns	Left Turns	Straight Through	Right Turns	Bicycles in Crosswalk
16:00	0	0	2	1	0	0	0	0	0	0	0	2	4	0	0	0	0	0	3	0
16:15	0	0	3	2	0	0	0	0	0	0	0	2	4	0	0	0	0	0	3	0
16:30	0	0	1	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0
16:45	0	0	4	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0
17:00	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
17:15	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
17:30	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
17:45	0	0	2	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	1	0

TOTAL

	Southbound					Westbound					Northbound					Eastbound				
Time	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings
16:00	0	0	78	40	0	0	0	0	0	0	0	53	48	0	0	0	29	0	56	0
16:15	0	0	65	34	0	0	0	0	0	0	0	48	42	0	0	0	21	0	62	0
16:30	0	0	80	36	0	0	0	0	0	0	0	71	53	0	0	0	27	0	41	0
16:45	0	0	65	39	0	0	0	0	0	0	0	64	39	0	0	0	29	0	65	0
17:00	0	0	75	43	0	0	0	0	0	0	0	53	33	0	0	0	33	0	66	0
17:15	0	0	74	37	0	0	0	0	0	0	0	48	31	0	0	0	27	0	48	0
17:30	0	0	59	42	0	0	0	0	0	0	0	75	40	0	0	0	24	0	52	0
17:45	0	0	55	33	0	0	0	0	0	0	0	55	24	0	0	0	23	0	60	0

Appendix C

Volume Development

Volume Development Documentation

No Build Volumes
Design Year 2050

I-75/KY-14 Interchange and US 25 Study
Item Numbers 6-80 & 6-105

Boone County, Kentucky

Prepared For:
Kentucky Transportation Cabinet
421 Buttermilk Pike, Fort Mitchell, KY 41017

November, 2022

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1.0 Volume Development

1.1 Volume Development Process

The design year 2050 AADTs were forecasted using the provided OKI Travel Demand Model to compute annual growth rates to apply to the Existing Year 2022 balanced AADTs. Difference and ratio methodologies found in National Cooperative Highway Research Program (NCHRP) Report 765 were used to develop the design year 2050 AADT forecasts. These methods assume that the change in AADT between the model's horizon year and base year is correct and so this difference is applied to the balanced AADT. To allow for a direct comparison an interpolated model AADT is calculated for the year 2022 as a new base year. The difference method takes the difference between the horizon and base years in the model and applies that difference to the balanced 2022 AADT. The ratio method calculates the ratio of horizon to base year and applies that ratio to the balanced 2022 AADT. An average of the difference and ratio method was taken for majority of the segments to establish NCHRP 2050 AADTs (where Ratio is between 0.5 and 2), and for one segment with ratio greater than 2, the 2050 AADTs from the difference method was used. A comparison of the interpolated 2022 AADTs based upon the OKI Travel Demand Model base year (2020) and horizon year (2050) AADTs and associated NCHRP 765 forecast adjustments can be found in **Table 1.1**.

Growth rates between existing year (2022) and design year (2050) were reviewed ensure positive growth and reasonableness. The study area average annual growth rate was calculated as 2.1%. As a comparison point the 2020 U.S. Census data was reviewed and the population of Boone County increased 17,175, representing an average annual growth of 1.4% between 2010 and 2020. AADTs on Stephenson Mills Road to the west of KY 1292 and on Mary Grubbs highway to the east of US 25, were not estimated in the NCHRP forecast method, as those segments were not included in the OKI Model network. The OKI model network has only one intersection of TAZ connectors for both the School Road and Beatrice Avenue intersections, and thus the AADTs on School Road and Beatrice Avenue were forecasted by applying the NCHRP growth rates between OKI model existing and future year from a single intersection links to the 2022 AADTs. The design 2050 AADTs for all links in the in the study area are shown in **Table 1.2**.

To develop future year Directional Design Hour Volumes (DDHV), the design year 2050 AADTs were multiplied by Existing Year K and D factors for the AM and PM peak hours. Truck DDHVs were also calculated using the existing truck percentage on each directional link. Forecasted AM and PM DDHVs were used in the Visum model as target values for developing the design year 2050 balanced traffic, following the least squares algorithm. These 2050 DDHVs are shown in **Table 1.3**. The results of the least squared regression and its comparison to the initial forecasted DDHVs can be found in **Table 1.4 and Table 1.5.** These comparisons indicate a good fit with no significant outliers indicating that the balanced design year 2050 DDHVs are in line with the target design year 2050 DDHVs.

To provide an additional check that the forecast volume balancing process does not materially change the forecast AADT, the PM peak hour DDHVs were divided by the associated K factor to yield a balanced design year 2050 AADT, shown in **Table 1.6**. The balancing process does not materially change the AADTs in the study area.

Table 1.1: OKI Model Forecasts with NCHRP Adjustments

Location	NCHRP 765 Adjustment Process									
	Existing 2022 AADT	OKI model 2020 AADT	OKI model interpolated 2022 AADT	OKI model 2050 AADT	Delta	2050 Delta AADT	Ratio	2050 Ratio AADT	NCHRP 2050 AADT	NCHRP AGR
I-75 North of KY 14/16	65,500	68,979	71,410	105,444	-5,910	99,534	0.9	96,717	98,000	1.8%
I-75 South of KY 14/16	55,000	61,049	62,818	87,574	-7,818	79,756	0.9	76,675	78,000	1.5%
Northern I-75 ramps from KY 14/16	14,500	10,687	11,486	22,676	3,014	25,689	1.3	28,625	27,000	3.1%
Southern I-75 ramps from KY 14/16	5,300	2,685	2,815	4,632	2,485	7,118	1.9	8,723	7,900	1.8%
KY 14/16 west of 1292 [1]	1,400	NA	NA	NA	NA	NA	NA	NA	NA	NA
KY 14/16 east of 1292	9,900	6,998	7,493	14,419	2,407	16,826	1.3	19,050	18,000	2.9%
KY 14/16 east of I-75 SB Ramp Terminal	14,000	10,227	10,888	20,134	3,112	23,246	1.3	25,889	25,000	2.8%
KY 14/16 east of I-75 NB Ramp Terminal	18,000	13,776	14,609	26,269	3,391	29,661	1.2	32,367	31,000	2.6%
KY 14/16 east of School Road [1]	10,500	NA	NA	NA	NA	NA	NA	NA	NA	NA
KY 14/16 east of Beatrice Avenue	12,500	8,007	8,599	16,894	3,901	20,795	1.5	24,558	23,000	3.0%
Mary Grubbs Hwy east of US 25 [1]	2,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
KY 1292 south of KY 14/16	5,700	5,646	6,069	11,994	-369	11,625	0.9	11,265	11,000	3.3%
KY 1292 north of KY 14/16	3,600	1,546	1,651	3,109	1,949	5,058	2.2	6,780	5,900	2.3%
School Road north of KY 14/16	5,300	4,506	4,641	6,524	659	7,184	1.1	7,452	7,300	1.3%
School Rd south of KY 14/16	9,100	6,205	6,381	8,833	2,719	11,552	1.4	12,598	12,000	1.1%
Beatrice Ave north of KY 14/16 [1]	600	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beatrice Ave south of KY 14/16 [1]	3,400	NA	NA	NA	NA	NA	NA	NA	NA	NA
US 25 south of KY 14/16	7,500	4,920	5,345	11,287	2,155	13,442	1.4	15,838	15,000	3.6%
US 25 north of KY 14/16 to Old Beaver Road	8,900	5,096	5,282	7,874	3,618	11,493	1.7	13,269	12,000	1.2%
US 25 north of Old Beaver Road to Old Nicholson Road [1]	9,900	NA	NA	NA	NA	NA	NA	NA	NA	NA
US 25 north of Old Nicholson Road to KY-16	10,000	7,417	7,750	12,422	2,250	14,672	1.3	16,028	15,000	1.8%
US 25 north of KY16	7,800	5,668	5,890	8,984	1,910	10,895	1.3	11,899	11,000	1.5%

KY 16 east of US 25	7,700	6,234	6,427	9,132	1,273	10,405	1.2	10,940	11,000	1.5%

1. Segment is not included in the OKI model, and AADT is estimated from the reasonable adjacent segments

Table 1.2: Design Year 2050 Forecasts

Location	Existing Year 2022 AADT	Forecasting Method	Recommended AGR	Design Year 2050 AADT
I-75 North of KY 14/16	65,500	OKI Forecast Model	1.8%	98,000
I-75 South of KY 14/16	55,000	OKI Forecast Model	1.5%	78,000
Northern I-75 ramps from KY 14/16	14,500	OKI Forecast Model	3.1%	27,000
Southern I-75 ramps from KY 14/16	5,300	OKI Forecast Model	1.8%	7,900
KY 14/16 west of 1292	1,400	Model Zone 2098	5.1%	3,400
KY 14/16 east of 1292	9,900	OKI Forecast Model	2.9%	18,000
KY 14/16 east of I-75 SB Ramp Terminal	14,000	OKI Forecast Model	2.8%	25,000
KY 14/16 east of I-75 NB Ramp Terminal	18,000	OKI Forecast Model	2.6%	31,000
KY 14/16 east of School Road	10,500	Adjacent Link	3.0%	19,000
KY 14/16 east of Beatrice Avenue	12,500	OKI Forecast Model	3.0%	23,000
Mary Grubbs Hwy east of US 25	2,000	Model Zone 2048	4.3%	4,400
KY 1292 south of KY 14/16	5,700	OKI Forecast Model	3.3%	11,000
KY 1292 north of KY 14/16	3,600	OKI Forecast Model	2.3%	5,900
School Road north of KY 14/16	5,300	OKI Forecast Model	1.3%	7,300
School Rd south of KY 14/16	9,100	OKI Forecast Model	1.1%	12,000
Beatrice Ave north of KY 14/16	600	Adjacent Link	1.5%	850
Beatrice Ave south of KY 14/16	3,400	Adjacent Link	1.4%	4,700
US 25 south of KY 14/16	7,500	OKI Forecast Model	3.6%	15,000
US 25 north of KY 14/16 to Old Beaver Road	8,900	OKI Forecast Model	1.2%	12,000
US 25 north of Old Beaver Road to Old Nicholson Road	9,900	Adjacent Link	1.8%	15,000
US 25 north of Old Nicholson Road to KY-16	10,000	OKI Forecast Model	1.8%	15,000
US 25 north of KY16	7,800	OKI Forecast Model	1.5%	11,000

KY 16 east of US 25	7,700	OKI Forecast Model	1.5%	11,000

Table 1.3: Design Year 2050 DDHVs

Location	Design Year 2050 AADT	AM Peak Hour					PM Peak Hour				
		K	D	Peak Direction	NB/EB DDHV	SB/WB DDHV	K	D	Peak Direction	NB/EB DDHV	SB/WB DDHV
I-75 North of KY 14/16	98,000	6%	60%	NB/EB	3,700	2,500	8%	56%	SB/WB	3,400	4,400
I-75 South of KY 14/16	78,000	6%	62%	NB/EB	3,000	1,800	8%	57%	SB/WB	2,700	3,500
Northern I-75 ramps from KY 14/16	27,000	8%	56%	NB/EB	1,100	890	9%	54%	SB/WB	1,100	1,300
Southern I-75 ramps from KY 14/16	7,900	6%	64%	NB/EB	320	180	9%	55%	SB/WB	320	390
KY 14/16 west of 1292	3,400	8%	51%	NB/EB	140	130	9%	50%	SB/WB	150	150
KY 14/16 east of 1292	18,000	8%	50%	SB/WB	710	720	9%	50%	SB/WB	810	820
KY 14/16 east of I-75 SB Ramp Terminal	25,000	7%	68%	NB/EB	1,200	570	9%	67%	NB/EB	1,500	740
KY 14/16 east of I-75 NB Ramp Terminal	31,000	8%	52%	SB/WB	1,100	1,200	9%	52%	NB/EB	1,500	1,400
KY 14/16 east of School Road	19,000	8%	54%	SB/WB	680	790	9%	53%	NB/EB	920	810
KY 14/16 east of Beatrice Avenue	23,000	7%	55%	SB/WB	690	830	9%	54%	NB/EB	1,100	940
Mary Grubbs Hwy east of US 25	4,400	7%	56%	NB/EB	160	130	9%	66%	SB/WB	130	260
KY 1292 south of KY 14/16	11,000	8%	52%	NB/EB	450	420	9%	56%	SB/WB	440	550
KY 1292 north of KY 14/16	5,900	9%	55%	NB/EB	280	230	9%	58%	SB/WB	220	310
School Road north of KY 14/16	7,300	11%	60%	SB/WB	310	470	9%	63%	SB/WB	240	420
School Rd south of KY 14/16	12,000	4%	66%	SB/WB	180	350	9%	57%	SB/WB	460	610
Beatrice Ave north of KY 14/16	850	11%	50%	SB/WB	48	48	9%	69%	NB/EB	51	23
Beatrice Ave south of KY 14/16	4,700	3%	60%	SB/WB	51	76	9%	57%	NB/EB	240	180
US 25 south of KY 14/16	15,000	6%	57%	NB/EB	530	400	9%	59%	SB/WB	550	800
US 25 north of KY 14/16 to Old Beaver Road	12,000	6%	52%	SB/WB	340	380	9%	51%	NB/EB	550	530
US 25 north of Old Beaver Road to Old Nicholson Road	15,000	6%	50%	NB/EB	450	450	9%	52%	SB/WB	650	700
US 25 north of Old Nicholson Road to KY-16	15,000	6%	51%	NB/EB	460	440	9%	54%	SB/WB	620	740
US 25 north of KY16	11,000	6%	67%	NB/EB	440	210	9%	60%	SB/WB	400	600
KY 16 east of US 25	11,000	7%	64%	SB/WB	280	490	9%	55%	NB/EB	540	450

Table 1.4: Balanced Design Year 2050 AM DDHVs Forecast Consistency Check

Location	AM Peak Hour Forecast		AM Peak Hour Balanced		NB/EB Comparison		SB/WB Comparison	
	NB/EB DDHV	SB/WB DDHV	NB/EB DDHV	SB/WB DDHV	Difference	Percent Difference	Difference	Percent Difference
I-75 North of KY 14/16	3,700	2,500	3,700	2,500	0	0.0%	0	0.0%
I-75 South of KY 14/16	3,000	1,800	3,000	1,800	0	0.0%	0	0.0%
Northern I-75 ramps from KY 14/16	1,100	890	1,100	890	0	0.0%	0	0.0%
Southern I-75 ramps from KY 14/16	320	180	370	220	50	15.6%	40	22.2%
KY 14/16 west of 1292	140	130	97	96	-43	-30.7%	-34	-26.2%
KY 14/16 east of 1292	710	720	720	730	10	1.4%	10	1.4%
KY 14/16 east of I-75 SB Ramp Terminal	1,200	570	1,200	550	0	0.0%	-20	-3.5%
KY 14/16 east of I-75 NB Ramp Terminal	1,100	1,200	1,100	1,200	0	0.0%	0	0.0%
KY 14/16 east of School Road	680	790	670	770	-10	-1.5%	-20	-2.5%
KY 14/16 east of Beatrice Avenue	690	830	680	830	-10	-1.4%	0	0.0%
Mary Grubbs Hwy east of US 25	160	130	120	99	-40	-25.0%	-31	-23.8%
KY 1292 south of KY 14/16	450	420	460	430	10	2.2%	10	2.4%
KY 1292 north of KY 14/16	280	230	250	210	-30	-10.7%	-20	-8.7%
School Road north of KY 14/16	310	470	320	490	10	3.2%	20	4.3%
School Rd south of KY 14/16	180	350	200	370	20	11.1%	20	5.7%
Beatrice Ave north of KY 14/16	48	48	57	48	9	18.8%	0	0.0%
Beatrice Ave south of KY 14/16	51	76	54	84	3	5.9%	8	10.5%
US 25 south of KY 14/16	530	400	520	390	-10	-1.9%	-10	-2.5%
US 25 north of KY 14/16 to Old Beaver Road	340	380	360	400	20	5.9%	20	5.3%
US 25 north of Old Beaver Road to Old Nicholson Road	450	450	430	420	-20	-4.4%	-30	-6.7%
US 25 north of Old Nicholson Road to KY-16	460	440	470	450	10	2.2%	10	2.3%
US 25 north of KY16	440	210	450	220	10	2.3%	10	4.8%
KY 16 east of US 25	280	490	270	480	-10	-3.6%	-10	-2.0%

Table 1.5: Balanced Design Year 2050 PM DDHVs Forecast Consistency Check

Location	PM Peak Hour Forecast		PM Peak Hour Balanced		NB/EB Comparison		SB/WB Comparison	
	NB/EB DDHV	SB/WB DDHV	NB/EB DDHV	SB/WB DDHV	Difference	Percent Difference	Difference	Percent Difference
I-75 North of KY 14/16	3,400	4,400	3,400	4,400	0	0.0%	0	0.0%
I-75 South of KY 14/16	2,700	3,500	2,700	3,500	0	0.0%	0	0.0%
Northern I-75 ramps from KY 14/16	1,100	1,300	1,100	1,300	0	0.0%	0	0.0%
Southern I-75 ramps from KY 14/16	320	390	390	470	70	21.9%	80	20.5%
KY 14/16 west of 1292	150	150	120	120	-30	-20.0%	-30	-20.0%
KY 14/16 east of 1292	810	820	810	850	0	0.0%	30	3.7%
KY 14/16 east of I-75 SB Ramp Terminal	1,500	740	1,500	730	0	0.0%	-10	-1.4%
KY 14/16 east of I-75 NB Ramp Terminal	1,500	1,400	1,500	1,400	0	0.0%	0	0.0%
KY 14/16 east of School Road	920	810	920	810	0	0.0%	0	0.0%
KY 14/16 east of Beatrice Avenue	1,100	940	1,100	940	0	0.0%	0	0.0%
Mary Grubbs Hwy east of US 25	130	260	100	210	-30	-23.1%	-50	-19.2%
KY 1292 south of KY 14/16	440	550	450	560	10	2.3%	10	1.8%
KY 1292 north of KY 14/16	220	310	210	280	-10	-4.5%	-30	-9.7%
School Road north of KY 14/16	240	420	270	440	30	12.5%	20	4.8%
School Rd south of KY 14/16	460	610	500	640	40	8.7%	30	4.9%
Beatrice Ave north of KY 14/16	51	23	58	29	7	13.7%	6	26.1%
Beatrice Ave south of KY 14/16	240	180	260	180	20	8.3%	0	0.0%
US 25 south of KY 14/16	550	800	540	770	-10	-1.8%	-30	-3.8%
US 25 north of KY 14/16 to Old Beaver Road	550	530	600	560	50	9.1%	30	5.7%
US 25 north of Old Beaver Road to Old Nicholson Road	650	700	640	660	-10	-1.5%	-40	-5.7%
US 25 north of Old Nicholson Road to KY-16	620	740	640	760	20	3.2%	20	2.7%
US 25 north of KY16	400	600	410	620	10	2.5%	20	3.3%
KY 16 east of US 25	540	450	530	450	-10	-1.9%	0	0.0%

Table 1.6: AADT Forecast Consistency Check

Location	K Factor	Design Year 2050 Forecast			Balanced Design Year 2050 Forecast			AADT Comparison	
		NB/EB DDHV	SB/WB DDHV	AADT	NB/EB DDHV	SB/WB DDHV	AADT	Difference	Percent Difference
I-75 North of KY 14/16	8.0%	3,400	4,400	98,000	3,400	4,400	98,000	0	0.0%
I-75 South of KY 14/16	8.0%	2,700	3,500	78,000	2,700	3,500	78,000	0	0.0%
Northern I-75 ramps from KY 14/16	9.0%	1,100	1,300	27,000	1,100	1,300	27,000	0	0.0%
Southern I-75 ramps from KY 14/16	9.0%	320	390	7,900	390	470	9,600	1,700	21.5%
KY 14/16 west of 1292	8.9%	150	150	3,400	120	120	2,700	-700	-20.6%
KY 14/16 east of 1292	9.0%	810	820	18,000	810	850	18,000	0	0.0%
KY 14/16 east of I-75 SB Ramp Terminal	9.1%	1,500	740	25,000	1,500	730	25,000	0	0.0%
KY 14/16 east of I-75 NB Ramp Terminal	9.1%	1,500	1,400	32,000	1,500	1,400	32,000	0	0.0%
KY 14/16 east of School Road	9.1%	920	810	19,000	920	810	19,000	0	0.0%
KY 14/16 east of Beatrice Avenue	8.9%	1,100	940	23,000	1,100	940	23,000	0	0.0%
Mary Grubbs Hwy east of US 25	8.8%	130	260	4,400	100	210	3,500	-900	-20.5%
KY 1292 south of KY 14/16	9.0%	440	550	11,000	450	560	11,000	0	0.0%
KY 1292 north of KY 14/16	9.0%	220	310	5,900	210	280	5,400	-500	-8.5%
School Road north of KY 14/16	9.1%	240	420	7,300	270	440	7,800	500	6.8%
School Rd south of KY 14/16	9.0%	460	610	12,000	500	640	13,000	1,000	8.3%
Beatrice Ave north of KY 14/16	8.7%	51	23	850	58	29	1,000	150	17.6%
Beatrice Ave south of KY 14/16	8.9%	240	180	4,700	260	180	5,000	300	6.4%
US 25 south of KY 14/16	9.0%	550	800	15,000	540	770	15,000	0	0.0%
US 25 north of KY 14/16 to Old Beaver Road	9.0%	550	530	12,000	600	560	13,000	1,000	8.3%
US 25 north of Old Beaver Road to Old Nicholson Road	9.0%	650	700	15,000	640	660	14,000	-1,000	-6.7%
US 25 north of Old Nicholson Road to KY-16	9.1%	620	740	15,000	640	760	15,000	0	0.0%
US 25 north of KY16	9.0%	400	600	11,000	410	620	11,000	0	0.0%
KY 16 east of US 25	9.0%	540	450	11,000	530	450	11,000	0	0.0%

Appendix D

HCS Analysis Reports

Appendix D

HCS Analysis Reports

US 25

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2022
Jurisdiction	KYTC	Time Analyzed	AM Peak Hour
Project Description	US-25 Segment 1 (Mary Grubbs Highway to Old Beaver Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	4000
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	66.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	297	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.17

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.59560	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.40993	PF Power Coefficient (p)	0.68859
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	3.7
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	4000	-	-	36.5

Vehicle Results

Average Speed, mi/h	36.5	Percent Followers, %	45.7
Segment Travel Time, minutes	1.25	Follower Density (FD), followers/mi/ln	3.7
Vehicle LOS	B		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	53	0.05	3.7	B

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2022
Jurisdiction	KYTC	Time Analyzed	PM Peak Hour
Project Description	US-25 Segment 1 (Mary Grubbs Highway to Old Beaver Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	4000
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	66.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	435	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.26

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.59560	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.40993	PF Power Coefficient (p)	0.68859
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	6.6
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	4000	-	-	36.2

Vehicle Results

Average Speed, mi/h	36.2	Percent Followers, %	54.8
Segment Travel Time, minutes	1.26	Follower Density (FD), followers/mi/ln	6.6
Vehicle LOS	C		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	77	0.09	6.6	C

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2022
Jurisdiction	KYTC	Time Analyzed	AM Peak Hour
Project Description	US-25 Segment 2 (Old Beaver Road to Old Nicholson Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	2320
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	61.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	317	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.19

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.57425	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.45247	PF Power Coefficient (p)	0.68056
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	4.2
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	2320	-	-	36.4

Vehicle Results

Average Speed, mi/h	36.4	Percent Followers, %	48.6
Segment Travel Time, minutes	0.72	Follower Density (FD), followers/mi/ln	4.2
Vehicle LOS	B		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	33	0.03	4.2	B

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2022
Jurisdiction	KYTC	Time Analyzed	PM Peak Hour
Project Description	US-25 Segment 2 (Old Beaver Road to Old Nicholson Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	2320
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	61.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	488	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.29

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.57425	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.45247	PF Power Coefficient (p)	0.68056
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	8.0
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	2320	-	-	36.1

Vehicle Results

Average Speed, mi/h	36.1	Percent Followers, %	59.0
Segment Travel Time, minutes	0.73	Follower Density (FD), followers/mi/ln	8.0
Vehicle LOS	C		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	50	0.06	8.0	C

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2022
Jurisdiction	KYTC	Time Analyzed	AM Peak Hour
Project Description	US-25 Segment 3 (Old Nicholson Road to KY-16)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	3200
Lane Width, ft	11	Shoulder Width, ft	0
Speed Limit, mi/h	45	Access Point Density, pts/mi	13.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	326	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.19

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	43.2
Speed Slope Coefficient (m)	2.87611	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.42345	PF Power Coefficient (p)	0.70765
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	3.7
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	3200	-	-	41.6

Vehicle Results

Average Speed, mi/h	41.6	Percent Followers, %	47.4
Segment Travel Time, minutes	0.87	Follower Density (FD), followers/mi/ln	3.7
Vehicle LOS	B		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	46	0.04	3.7	B

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2022
Jurisdiction	KYTC	Time Analyzed	PM Peak Hour
Project Description	US-25 Segment 3 (Old Nicholson Road to KY-16)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	3200
Lane Width, ft	11	Shoulder Width, ft	0
Speed Limit, mi/h	45	Access Point Density, pts/mi	13.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	523	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.31

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	43.2
Speed Slope Coefficient (m)	2.87611	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.42345	PF Power Coefficient (p)	0.70765
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	7.6
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	3200	-	-	41.1

Vehicle Results

Average Speed, mi/h	41.1	Percent Followers, %	59.4
Segment Travel Time, minutes	0.88	Follower Density (FD), followers/mi/ln	7.6
Vehicle LOS	C		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	75	0.08	7.6	C

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Analyzed	AM Peak Hour
Project Description	US-25 Segment 1 (Mary Grubbs Highway to Old Beaver Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	4000
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	66.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	423	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.25

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.59560	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.40993	PF Power Coefficient (p)	0.68859
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	6.3
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	4000	-	-	36.2

Vehicle Results

Average Speed, mi/h	36.2	Percent Followers, %	54.2
Segment Travel Time, minutes	1.26	Follower Density (FD), followers/mi/ln	6.3
Vehicle LOS	C		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	75	0.09	6.3	C

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Analyzed	PM Peak Hour
Project Description	US-25 Segment 1 (Mary Grubbs Highway to Old Beaver Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	4000
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	66.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	634	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.37

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.59560	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.40993	PF Power Coefficient (p)	0.68859
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	11.4
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	4000	-	-	35.8

Vehicle Results

Average Speed, mi/h	35.8	Percent Followers, %	64.3
Segment Travel Time, minutes	1.27	Follower Density (FD), followers/mi/ln	11.4
Vehicle LOS	D		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	113	0.17	11.4	D

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Analyzed	AM Peak Hour
Project Description	US-25 Segment 2 (Old Beaver Road to Old Nicholson Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	2320
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	61.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	456	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.27

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.57425	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.45247	PF Power Coefficient (p)	0.68056
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	7.2
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	2320	-	-	36.1

Vehicle Results

Average Speed, mi/h	36.1	Percent Followers, %	57.3
Segment Travel Time, minutes	0.73	Follower Density (FD), followers/mi/ln	7.2
Vehicle LOS	C		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	47	0.06	7.2	C

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Analyzed	PM Peak Hour
Project Description	US-25 Segment 2 (Old Beaver Road to Old Nicholson Road)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	2320
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	61.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	704	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.41

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	37.8
Speed Slope Coefficient (m)	2.57425	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.45247	PF Power Coefficient (p)	0.68056
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	13.4
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	2320	-	-	35.7

Vehicle Results

Average Speed, mi/h	35.7	Percent Followers, %	68.2
Segment Travel Time, minutes	0.74	Follower Density (FD), followers/mi/ln	13.4
Vehicle LOS	D		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	73	0.11	13.4	D

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Analyzed	AM Peak Hour
Project Description	US-25 Segment 3 (Old Nicholson Road to KY-16)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	3200
Lane Width, ft	11	Shoulder Width, ft	0
Speed Limit, mi/h	45	Access Point Density, pts/mi	13.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	503	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.30

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	43.2
Speed Slope Coefficient (m)	2.87611	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.42345	PF Power Coefficient (p)	0.70765
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	7.1
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	3200	-	-	41.2

Vehicle Results

Average Speed, mi/h	41.2	Percent Followers, %	58.3
Segment Travel Time, minutes	0.88	Follower Density (FD), followers/mi/ln	7.1
Vehicle LOS	C		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	72	0.08	7.1	C

HCS Two-Lane Highway Report

Project Information

Analyst	Caleb Van Nostrand	Date	3/1/2022
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Analyzed	PM Peak Hour
Project Description	US-25 Segment 3 (Old Nicholson Road to KY-16)	Units	U.S. Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	3200
Lane Width, ft	11	Shoulder Width, ft	0
Speed Limit, mi/h	45	Access Point Density, pts/mi	13.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	777	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.46

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	43.2
Speed Slope Coefficient (m)	2.87611	Speed Power Coefficient (p)	0.41674
PF Slope Coefficient (m)	-1.42345	PF Power Coefficient (p)	0.70765
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	13.3
%Improvement to Percent Followers	0.0	%Improvement to Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	3200	-	-	40.7

Vehicle Results

Average Speed, mi/h	40.7	Percent Followers, %	69.6
Segment Travel Time, minutes	0.89	Follower Density (FD), followers/mi/ln	13.3
Vehicle LOS	D		

Facility Results

T	VMT veh-mi/p	VHD veh-h/p	Follower Density, followers/ mi/ln	LOS
1	111	0.15	13.3	D

Appendix D

HCS Analysis Reports

Bypass Alternatives

HCS7 Two-Lane Highway Report

Project Information

Analyst	HW Lochner (JS)	Date	4/4/23
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Period Analyzed	Peak Hour
Project Description	Bypass Alternative 1	Unit	United States Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	24077
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	3.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	4	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.00

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	47.1
Speed Slope Coefficient	3.18561	Speed Power Coefficient	0.41674
PF Slope Coefficient	-1.45561	PF Power Coefficient	0.64615
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	0.0
%Improved % Followers	0.0	% Improved Avg Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	24077	-	-	47.1

Vehicle Results

Average Speed, mi/h	47.1	Percent Followers, %	4.2
Segment Travel Time, minutes	5.82	Followers Density, followers/mi/ln	0.0
Vehicle LOS	A		

HCS7 Two-Lane Highway Report

Project Information

Analyst	HW Lochner (JS)	Date	4/4/23
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Period Analyzed	Peak Hour
Project Description	Bypass Alternative 2	Unit	United States Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	19008
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	3.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	23	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.01

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	47.1
Speed Slope Coefficient	3.18561	Speed Power Coefficient	0.41674
PF Slope Coefficient	-1.45561	PF Power Coefficient	0.64615
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	0.1
%Improved % Followers	0.0	% Improved Avg Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	19008	-	-	47.1

Vehicle Results

Average Speed, mi/h	47.1	Percent Followers, %	12.1
Segment Travel Time, minutes	4.59	Followers Density, followers/mi/ln	0.1
Vehicle LOS	A		

HCS7 Two-Lane Highway Report

Project Information

Analyst	HW Lochner (JS)	Date	4/4/23
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Period Analyzed	Peak Hour
Project Description	Bypass Alternative 3	Unit	United States Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	18480
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	3.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	34	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.02

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	47.1
Speed Slope Coefficient	3.18561	Speed Power Coefficient	0.41674
PF Slope Coefficient	-1.45561	PF Power Coefficient	0.64615
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	0.1
%Improved % Followers	0.0	% Improved Avg Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	18480	-	-	47.1

Vehicle Results

Average Speed, mi/h	47.1	Percent Followers, %	15.1
Segment Travel Time, minutes	4.46	Followers Density, followers/mi/ln	0.1
Vehicle LOS	A		

HCS7 Two-Lane Highway Report

Project Information

Analyst	HW Lochner (JS)	Date	4/4/23
Agency	KYTC	Analysis Year	2050
Jurisdiction	KYTC	Time Period Analyzed	Peak Hour
Project Description	Bypass Alternative 4	Unit	United States Customary

Segment 1

Vehicle Inputs

Segment Type	Passing Constrained	Length, ft	19008
Lane Width, ft	11	Shoulder Width, ft	2
Speed Limit, mi/h	45	Access Point Density, pts/mi	3.0

Demand and Capacity

Directional Demand Flow Rate, veh/h	36	Opposing Demand Flow Rate, veh/h	-
Peak Hour Factor	0.94	Total Trucks, %	3.00
Segment Capacity, veh/h	1700	Demand/Capacity (D/C)	0.02

Intermediate Results

Segment Vertical Class	1	Free-Flow Speed, mi/h	47.1
Speed Slope Coefficient	3.18561	Speed Power Coefficient	0.41674
PF Slope Coefficient	-1.45561	PF Power Coefficient	0.64615
In Passing Lane Effective Length?	No	Total Segment Density, veh/mi/ln	0.1
%Improved % Followers	0.0	% Improved Avg Speed	0.0

Subsegment Data

#	Segment Type	Length, ft	Radius, ft	Superelevation, %	Average Speed, mi/h
1	Tangent	19008	-	-	47.1

Vehicle Results

Average Speed, mi/h	47.1	Percent Followers, %	15.7
Segment Travel Time, minutes	4.59	Followers Density, followers/mi/ln	0.1
Vehicle LOS	A		