BRENT SPENCE
BRIDGE CORRIDOR

Moving the Economy,
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BRENT SPENCE BRIDGE PROJECT

TRAFFIC OPERATIONS REPORT

AUGUST 2022

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

KENTUCKY TRANSPORTATION CABINET

HNTB

Appendices available *upon request*

EXECUTIVE SUMMARY

The Brent Spence Bridge Corridor consists of 7.8 total miles of I-71 and I-75 located within portions of Ohio and Kentucky. The traffic analysis presented in the report builds upon previous work completed by the Brent Spence Bridge Corridor project (2013-2022), Brent Spence Strategic Corridor Study (2017), and the ODOT Connected Autonomous Vehicle study (2020-2021). This latest analysis develops refined alternative traffic forecasts and operational analysis using TransModeler for two value engineering concepts (Concept I-M and Concept I-W) with a comparison to Alternative I from the Environmental Assessment (EA) in 2012.

This traffic study includes the review of available traffic counts, OKI travel demand modeling, Existing (2019) TransModeler validation, development of refined alternative traffic forecasts, and TransModeler scenario analysis of 2050 build concepts. ODOT, KYTC, and HNTB have closely coordinated on the traffic analysis methodologies and results. The outcomes from that coordination are reflected in this report.

TransModeler was used to refine Concept I-W and I-M designs to optimize the traffic performance in the corridor. The models include freeway mainline, ramps, ramp terminals, and adjacent intersections. The future modeling assumptions remove external capacity constraints from the corridor and conserve the existing traffic temporal distributions. These inputs maximize traffic demand on the concept design elements, which provides valuable insight into areas of concern for each concept. Design enhancements were made for each Concept based on the traffic analysis.

The TransModeler analysis shows Concept I-W has acceptable traffic operations. There are segments of the I-71/I-75 corridor that have periods of poor traffic operations, but all segments fully recover within the model period. This is not the case with Concept I-M, which experiences severe queuing on I-71/I-75 NB in the AM period. The traffic delays for Concept I-M in the AM period exclude it from further consideration as a value engineering concept.

The 2050 Concept I-W model indicates corridor travel time improvements compared to 2019 Existing of 7.3 minutes for NB I-71/I-75 in the AM period and 7.1 minutes for SB I-71/I-75 in the PM period. This improved travel time occurs along with increased vehicle throughput on I-71/I-75 of 54% for NB I-71/I-75 in AM period and 59% for SB I-71/I-75 in the PM period.

PROJECT BACKGROUND

The Brent Spence Bridge Corridor consists of 7.8 total miles of I-71 and I-75 located within portions of Ohio and Kentucky. This Corridor is located within the Greater Cincinnati/Northern Kentucky region and is a major route for local and regional mobility. Locally, it connects to I-74, I-275 and US 50. The Brent Spence Bridge provides an interstate connection over the Ohio River and carries both I-71 and I-75 traffic. This Corridor is also one of the busiest trucking routes in the US, connecting Michigan to Florida via I-75.

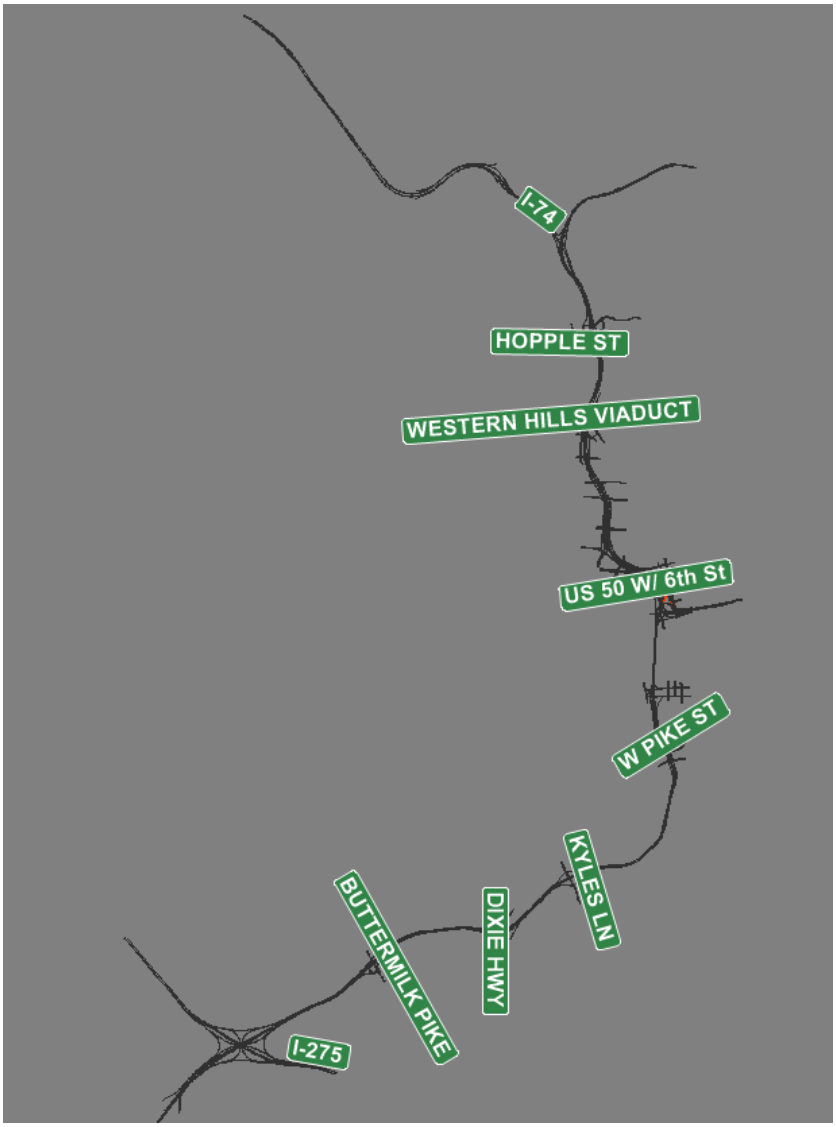
Since 2013, there have been multiple traffic evaluation completed as part of the Brent Spence Bridge Corridor Study (BSBC) from 2013-2022 and the Brent Spence Strategic Corridor Study (Strategic Corridor) in 2017. A summary of these traffic evaluations is listed below:

- 2013-2015 (BSBC): Traffic Forecasting, Travel Demand Modeling, and Traffic operations analysis using HCS and VISSIM. The study focussed on the traffic impacts of tolling the BSB.
- 2017 (Strategic Corridor): Traffic count collection, Travel Demand Modeling, and Traffic Operations analysis with TransModeler. The study included the development and evaluation of the Brent Spence Bridge bypass concepts, including the Cincinnati Eastern Bypass.

- 2019-2020 (BSBC): TransModeler analysis of value engineering concepts; Concept I-W and Concept I-M were part of this study. The planning level evaluation was based on forecasted 2040 toll free traffic volumes developed for Alternative I in 2015. A detailed alternative analysis using the OKI travel demand model was not completed for this study.

The current traffic study includes a review of available traffic counts, OKI travel demand modeling, Existing (2019) TransModeler validation, development of refined alternative traffic forecasts, and TransModeler scenario analysis of 2050 build concepts. The TransModeler project limits are shown in Figure 1. The primary focus of the traffic analysis is freeway operational analysis of the value engineering concepts.

Figure 1: TransModeler Project Limits



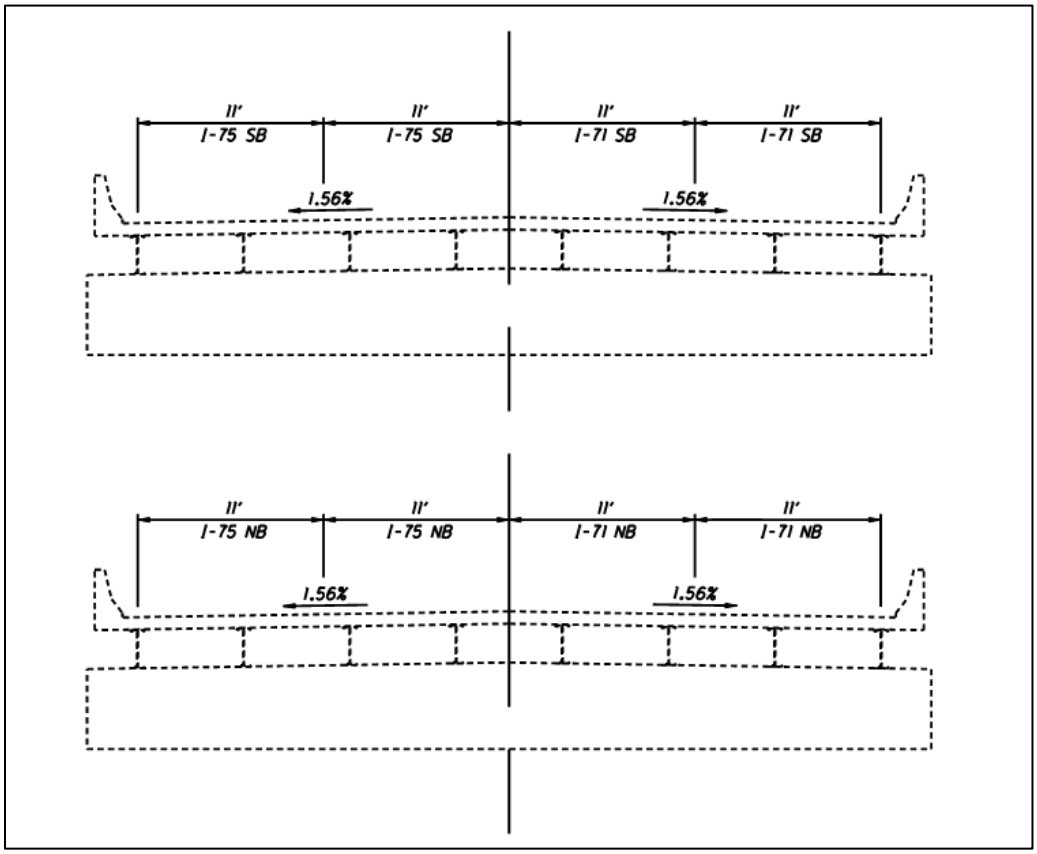
TRANSMODELER MODEL SCENARIOS

2019 EXISTING

Existing conditions for the I-71/I-75 corridor were evaluated between the I-275 Interchange in Kentucky to north of the I-75/I-74 Interchange in Ohio. The existing model was defined as a 2019 midweek condition, which is the timeframe of the Brent Spence Bridge traffic counts and the validation targets for speed and travel time. Other count targets in the corridor were combined and range in years from 2015 to 2021. Ramp terminal intersections along with some adjacent relevant intersections were included in the modelling limits. The AM and PM periods were modeled and defined as 6-10 AM and 2-7 PM. These periods encompass the duration of typical peak period conditions. Given the range of traffic count inputs the modeling target calibration is the median traffic condition for April, May, September, and October 2019. A 10th – 90th calibration data range is also reported to provide context and allow for deviation in calibration convergence if reasonably within the broader range of observed traffic operational conditions.

The existing cross section of the Brent Spence Bridge is shown in Figure 2.

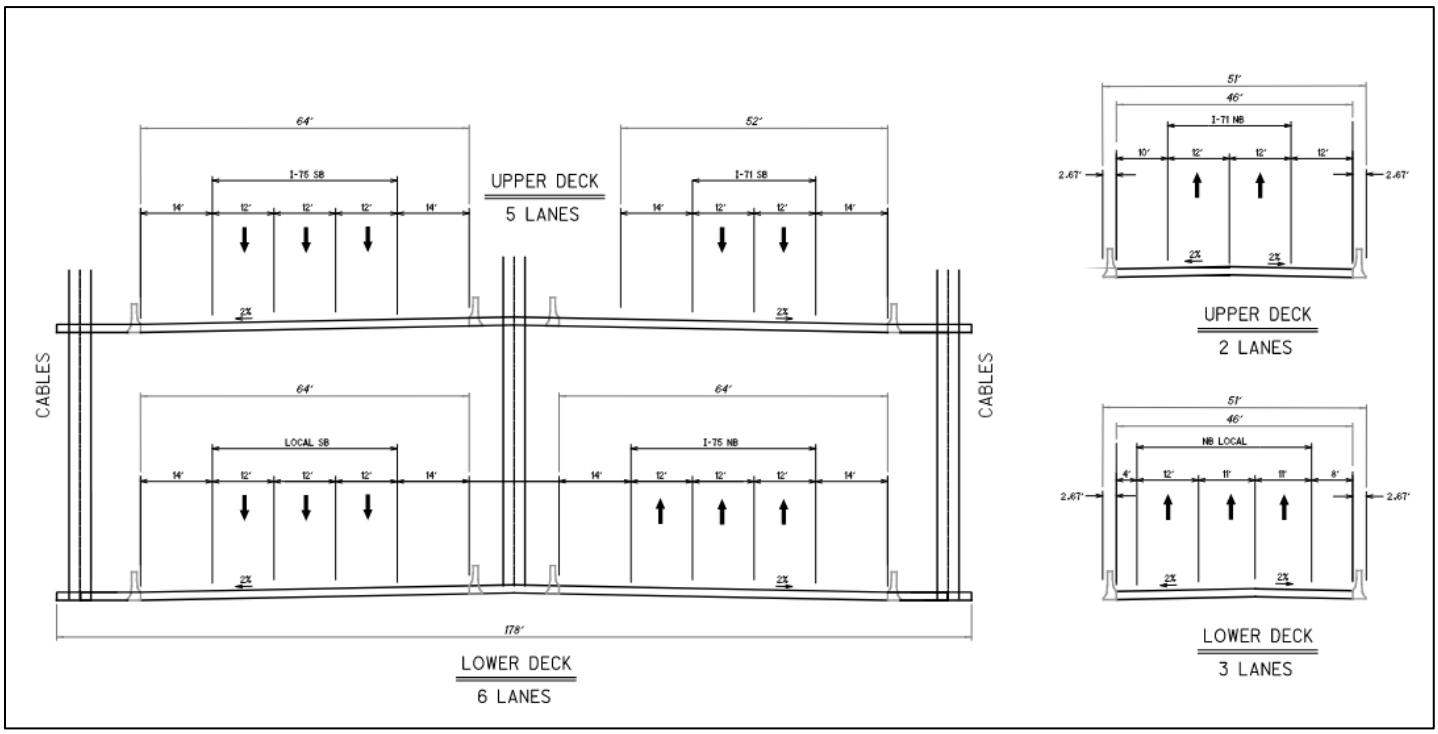
Figure 2: Existing Brent Spence Bridge Cross Section



2050 ALTERNATIVE I

Alternative I was identified as the preferred alternative during the 2012 EA. This alternative was analyzed with TransModeler to provide a base comparison for the two value engineering concepts (Concept I-W and Concept I-M). All build scenarios were evaluated using year 2050 planning level volumes developed as part of this updated analysis. All the build model scenarios maintain the existing model network structure and time periods. The full plan set of Alternative I and the two value engineering concepts are provided in Appendix B. The proposed companion bridge and existing Brent Spence Bridge cross sections for Alternative I are shown in Figure 3.

Figure 3: Alternative I Brent Spence Bridge Cross Section



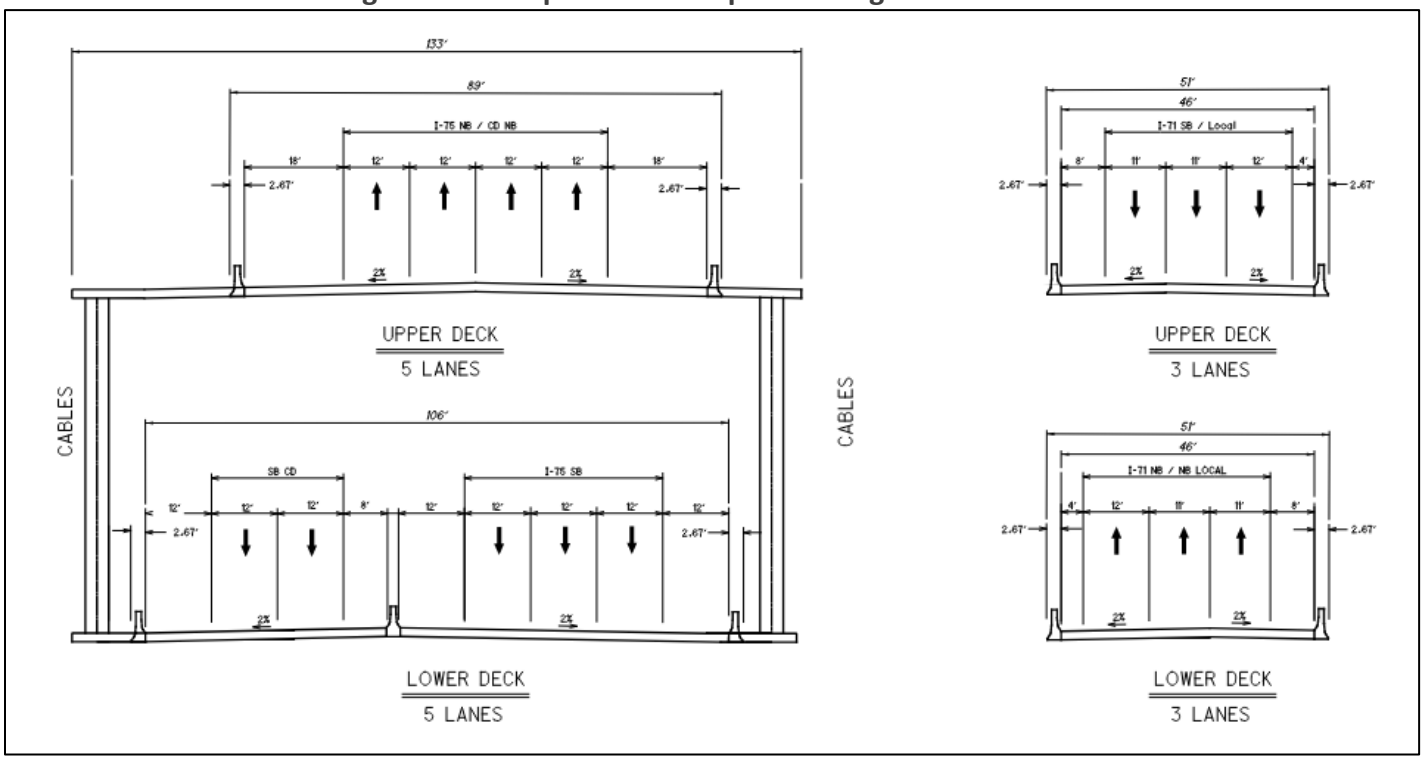
2050 CONCEPT I-M

Concept I-M is based on Alternative I with the following key modifications:

- Companion bridge carries only I-75 traffic (local, CD, interstate).
- Existing Brent Spence Bridge carries only I-71 traffic (local, CD, interstate).
- The value engineering advantage is the reuse of existing structures built as part of the Fort Washington Way project in the mid-2000s.

The proposed companion bridge and existing Brent Spence Bridge cross sections for Concept I-M are shown in Figure 4.

Figure 4: Concept I-M Brent Spence Bridge Cross Section



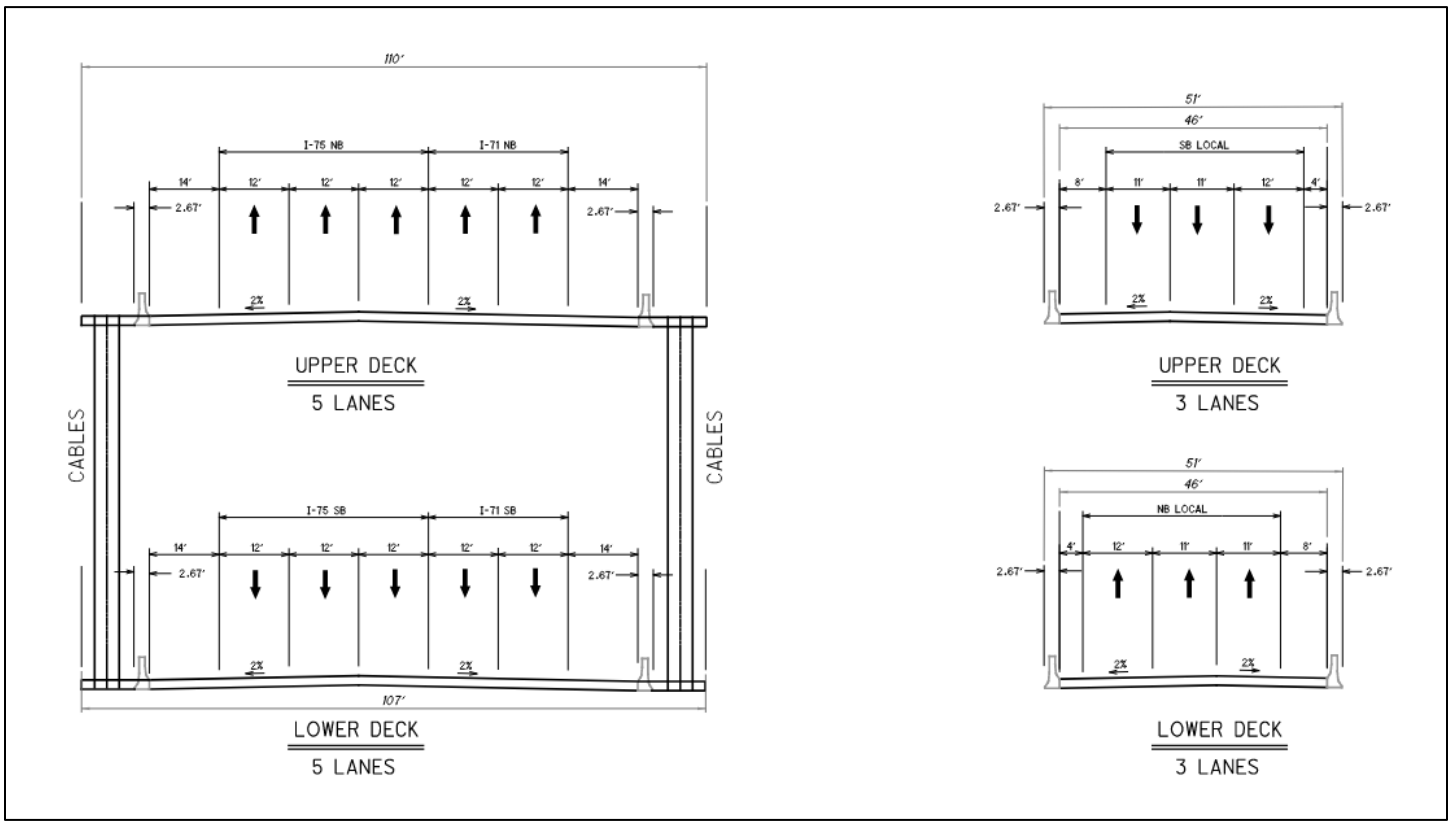
2050 CONCEPT I-W

Concept I-W is based on Alternative I with the following key modifications:

- Companion bridge carries only interstate mainline traffic.
- Existing Brent Spence Bridge carries only local and CD traffic.
- The value engineering advantage is the reduced footprint of the companion bridge and western construction limits of the project, both north and south of the river.

The proposed companion bridge and existing Brent Spence Bridge cross sections for Concept I-W are shown in Figure 5.

Figure 5: Concept I-W Brent Spence Bridge Cross Section



METHODOLOGY

The TransModeler models were developed following guidelines from the *ODOT Analysis and Traffic Simulation Manual: Traffic Simulation with TransModeler* and with consideration for the KYTC TransModeler guidance. The model development procedures are outlined below.

1) Existing Model Network Development:
    a. The corridor model developed by Caliper in 2020, for the Connected Autonomous Vehicle (CAV) analysis, was used as the starting model. The CAV specific attributes are not included in the operations analysis.
    b. Link grades were reviewed and updated in the model as needed.
    c. Some zones and centroid connectors were modified to correlate directly with the extracted O-D matrices from the OKI travel demand model.
    d. Some network adjustments were made to both simplify the network for areas not critical to the analysis (city street intersection beyond the project area) and to add network to capture the impacts of the build alternatives, such as adding the Clay Wade Baily Bridge and adjacent intersections in Covington.
2) Volume Development
    a. Traffic counts from 2017 – 2021 are reviewed for the project corridor and count target volumes are selected.
    b. The selected traffic volumes are used for TransModeler validation and inputs for the O-D matrix estimation.
    c. Model periods were defined as 6:00-10:00 AM and 2:00-7:00 PM to capture the full extent of peak period travel delays. Each model will also include a 30-minute warmup.
    d. Existing O-D matrices were developed for three vehicles classes in 15-minute bins.
        i. Autos
        ii. Single Unit Trucks
        iii. Articulated Trucks
    e. Planning level peak period O-D matrices were developed using a forecast pivot method that combines the existing O-D matrices and subarea matrices from the OKI travel demand model.
    f. Project specific vehicle fleet information was developed for the project using traffic counts and recommendations from ODOT and KYTC manuals.
3) Existing Model Calibration
    a. Volume convergence checks for the peak period volumes
        i. 85% of peak period volumes are within 15% of the counts.
        ii. Model/count regression line is close to 1 (not less than 0.95 and not greater than 1.05).
        iii. Model/Count regression line intercept is close to 0, an absolute value less than 10.

b. Bottleneck review
    i. Observed speed heat maps from INRIX data were compared to delay trends from the models.
c. Speed Review
    i. Freeway link speeds within 10 mph of INRIX data for more than 85% of network links measured at 15-minute intervals.
d. Travel Time Review for I-71/I-75 freeway segments
    i. INRIX point-to-point travel times in 15-minute bins was used for validation
    ii. For segments less than 7 minutes, the travel times should be within 1 minute of field data for more than 85% of the segments.
    iii. For segments greater than 7 minutes, the travel times should be within 15% of the field data for more than 85% of the travel time segments.
e. Existing model reviews were completed by ODOT, KYTC, and Caliper.

4) Scenario Modeling
    a. MOE's for freeway segments include:
        i. Travel Speeds
        ii. Travel Times
        iii. Freeway Level of Service
        iv. Visual Network audit, including vehicle queue identification

VOLUME DEVELOPMENT

TRAFFIC COUNTS

Traffic counts from ODOT, KYTC, OKI, and project counts from the 2017 BSB Strategic Corridor (BSBSC) project were reviewed for the study limits shown in Figure 1. The traffic counts between 2015 and 2021 were considered for this project. The analysis year is 2019 to coincide with a pre-COVID pandemic condition. The data was reviewed at each count station and a count target was selected using available data. The project corridor has 206 directional link traffic count locations and 32 intersection counts. The link and turn movement counts were used for estimating TransModeler O-D matrices and for model validation. The methodology for the count selection is detailed below.

Step 1: Identify traffic count date that best represents a 2019 condition

- In most cases a 2018 or 2019 traffic count was used when available
- The 2017 BSB Strategic Corridor project counts are used when ODOT, KYTC, and OKI data is unavailable

Step 2: Check for multiple days of count data

- Yes: Go to step 3
- No: Single day is count target

Step 3: Check for outlier counts

- Yes: Remove outlier counts
    - Use remaining count if only one day remains
    - Go to step 4 if there are still multiple days
- No: Go to Step 4

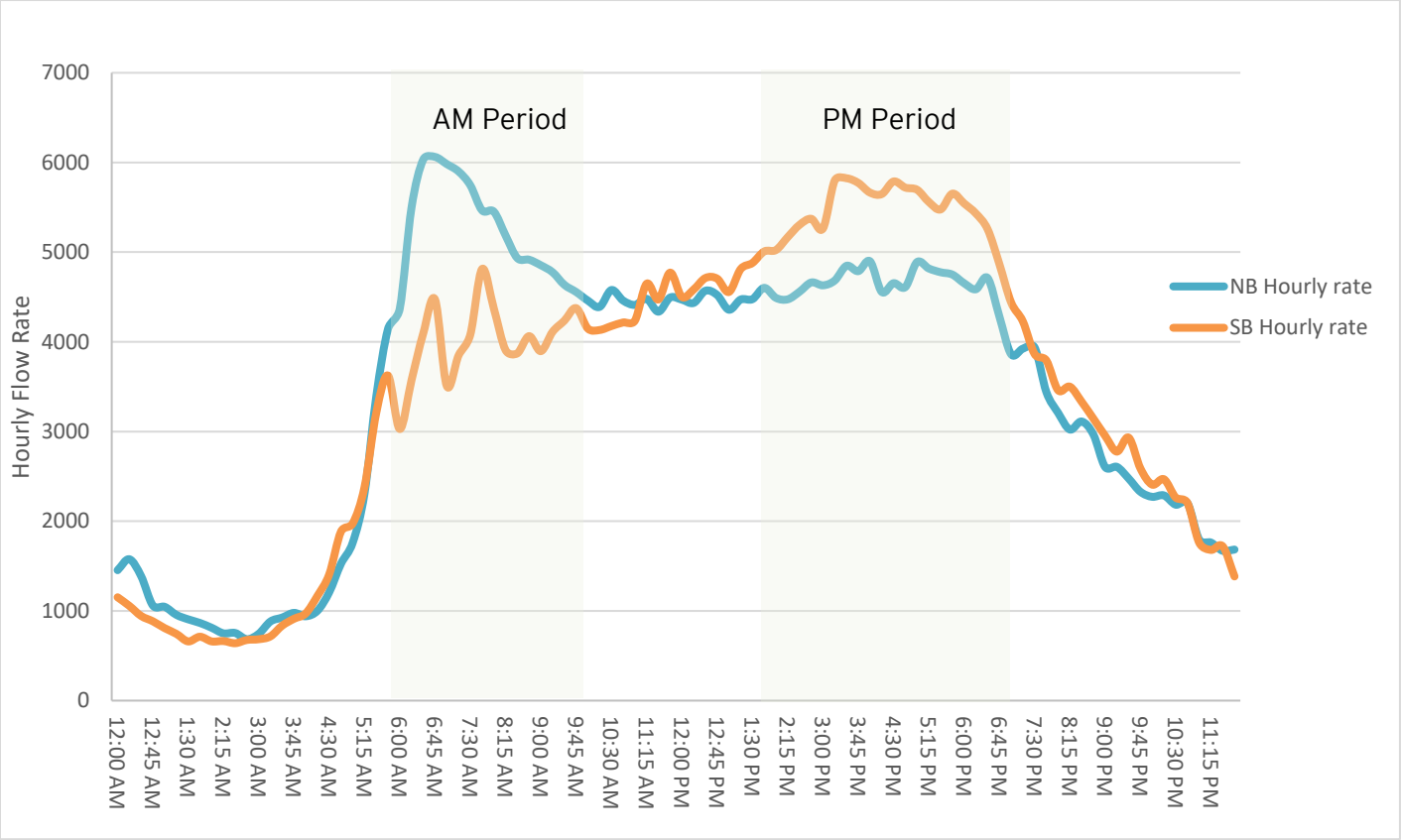
Step 4: Remove counts outside Tuesday, Wednesday, Thursday

Step 5: Use remaining count or average multiple count days

Summary tables and figures of the traffic counts identified for the project are summarized in Appendix A. The TransModeler validation to existing traffic counts is summarized in the existing calibration section. Given the range of count years and sources, outlier counts are expected, and were flagged during the TransModeler volume development process. The classification counts and the 15-minute temporal distributions were used for calibrating the TransModeler O-D matrices.

The traffic count that is most critical to the project is the Brent Spence Bridge count. The count target for the Brent Spence Bridge is based on continuous count data provided by OKI from June 2019 to October 2019. After reviewing the data, the median count value from selected midweek days in October 2019 was chosen as the target. An hourly flow rate graph of the selected Brent Spence traffic count is shown in Figure 6. For more information on the Brent Spence Bridge traffic counts see the technical memorandum titled: *Brent Spence Bridge Project: Traffic Counts, Modeling, and Forecast* Review, which compares Brent Spence Bridge traffic counts taken between 2013 and 2019.

Figure 6: Brent Spence Bridge Traffic Count: Midweek October 2019



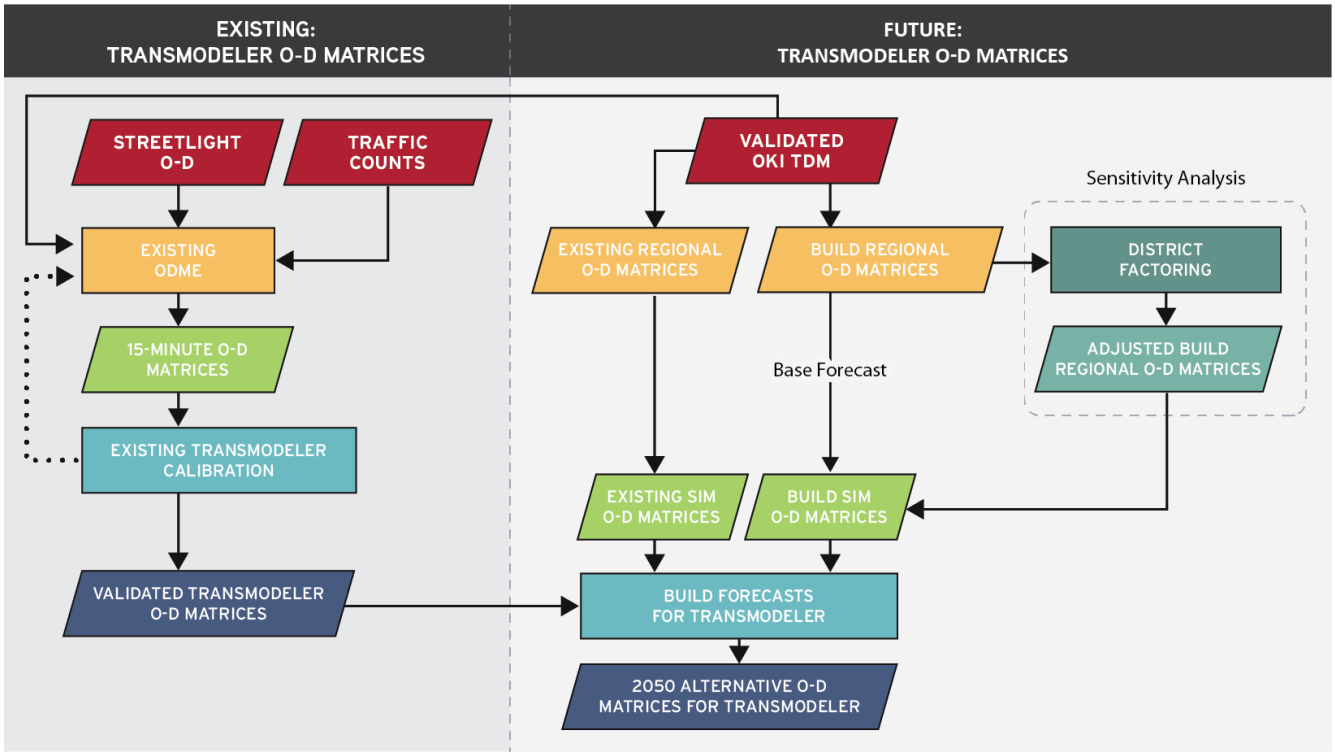
ORIGIN-DESTINATION FORECASTING OVERVIEW

The BSB traffic forecasting methodology, as defined by ODOT's forecasting manual[1], is a refined alternative level forecast. This process involves existing origin-destination matrix estimation (ODME) and O-D matrix pivoting to forecast travel demand for each O-D pair. The methodology proposed for the BSB project is outlined in Figure 7. The forecasts use OKI travel demand model (Ohio 3C CT-RAMP Activity Based Model), Streetlight O-D, and project compiled traffic counts. The traffic forecasting process results in the following datasets:

- Existing O-D Matrices for TransModeler (AM and PM peak Periods)
- Future O-D Matrices for TransModeler (AM and PM peak Periods)
    - 2050 Base
    - 2050 with District Factoring

The methodology uses tools found within ODOT's Simulation Demand Estimator (SDE) process and includes some modifications to meet specific needs for the project.

Figure 7: Traffic Forecasting Workflow



[1] https://www.transportation.ohio.gov/wps/portal/gov/odot/working/publications/traffic-forecasting-manual-training

2019 EXISTING

The Existing TransModeler model represents a year 2019 condition. The Brent Spence Bridge traffic counts are from 2019, while all project counts vary in years from 2015-2021. Given the variation in traffic count years and seasons, a blending of the traffic count data was needed. This blending or also known as balancing, was accomplished in the process of developing Origin-Destination (O-D) matrices for corridor through a process known as Origin Destination Matrix Estimation (ODME). The ODME process detailed in this section has multiple steps that start with estimating period matrices that match counts and target pattern O-D matrices. The process ends with dividing the period matrices into 15-minute matrices by vehicle classification. The link and turning movement volumes that can be extrapolated from the initial period ODME are considered a balanced volume set for the existing model calibration. The convergence of the model volumes to both this balanced volume set and the raw traffic counts are summarized in the existing model calibration section.

The existing TransModeler O-D matrices are developed using an ODME approach, implemented by HNTB with the R scripting language, that applies an entropy maximization technique through iterative matrix factoring. The goal of the ODME is to derive 15-minute O-D matrices by vehicle classifications that best fit the count data (link and turning movements), and the anticipated trip pattern distributions at the interchanges and freeway ramp-to-ramp movements. The TransModeler network structure allows for a practical application of all-or-nothing traffic assignment, as there is one clear shortest path between every O-D pair. This condition is optimal for the proposed ODME process, which assigns a skim matrix for each traffic count location. A skim matrix defines the O-D trips that traverse a particular point in the network. The assigned skim matrices are the basis of the ODME factoring algorithm which iteratively factors the pattern matrices by O-D pairs using the skims and the traffic count targets. An O-D pattern fitting procedure follows each round of count factoring to preserve the underlying trip distributions. The final estimated matrices are derived using the method of successive averages which combines the results of each factoring iteration. An override factor is applied to the Brent Spence Bridge traffic counts to guarantee convergence to those counts.

A key input for the ODME is a pattern O-D matrix. The project team reviewed Streetlight and extracted O-D matrices from the OKI model. Both data sets are suitable as pattern O-D matrices, however, it was agreed that the OKI model is a better choice in this situation as the growth rates are developed using the OKI travel demand model. The Streetlight O-D was used for validating the OKI data and for the initial 15-minute matrix distributions within the ODME process. The ODME steps are listed below.

Step 1: Estimate Period O-D Matrices

Total vehicle O-D matrices are estimated for 6-10 AM and 2–7 PM. The ODME uses directional link and turning movement traffic counts as targets. O-D period pattern matrices are extracted from the OKI travel demand model. Streetlight for the AM and PM periods is also reviewed and serves as a secondary source of O-D data. The Streetlight query details for these matrices include:

- Hours: 6-10 AM; 2-7 PM (separate queries)
- Year: 2019 (12-months)

The resultant of this first step is AM and PM period matrices for total trips. These matrices represent a best fit of the available link and turn count data while also maintaining pattern and overall trip distribution targets.

Step 2: Develop Temporal Distribution of Trip tables

15-minute trips tables are developed from the total peak trip tables. This procedure develops proportioning tables that best match the static assignment of each of the target link counts. The initial proportions are identified by O-D pairs using Streetlight data and then factored to best match available count data temporal distributions. This is a simplified algorithm that does not account for the time it takes for each trip to travel from the origin to each of the link targets. This limitation is accounted for in step 4 with the iterative TransModeler assignment and trip table refinements.

Step 3: Develop Classification Trips Tables

The 15-minute O-D matrices are divided into three classifications: autos, single unit trucks, and articulated trucks. The matrices are proportioned by O-D cell into the three classifications. The proportioning procedures uses an iterative factoring algorithm that seeks the best fit to the count classification data. The initial estimate of the proportional matrices is based on the classification O-D matrices from the OKI model.

Step 4: Feedback Loop with TransModeler Assignment and Table Adjustments

TransModeler is simulated with the initial matrices from Step 3. The convergence on count targets and operation metrics are evaluated. The proportioning tables from Step 3 were revisited and the temporal distributions of trips were iteratively refined to meet validation targets. The final matrices developed through the existing TransModeler validation are inputs for the 2050 forecasts.

2050 BUILD CONCEPTS

The future TransModeler O-D matrices were derived using a matrix pivot method from ODOT's Simulation Demand Estimator (SDE) tool with three input data sets:

- Validated 2019 existing TransModeler O-D matrices
- Existing 2018 subarea matrices from the full OKI TDM model run
- Future 2050 subarea matrices from the full OKI TDM model run

The pivot method captures the differences between the existing and future OKI subarea matrices and applies those differences to the validated existing TransModeler O-D matrices. The temporal distribution within each period match the existing TransModeler O-D's. The pivot method was applied separately to each vehicle classification and allows for different growth patterns between the autos and truck matrices to be considered.

The steps to obtain the existing and future subarea matrices using a modified application of ODOT's SDE process is listed below.

Step 1: Validated OKI TDM for Project Area

The OKI model is validated for a buffer area surrounding the project corridor to account for alternative routes. This sub-area is validated by ODOT and the details of the model validation are presented in Appendix E.

Step 2: District Factoring Build Regional Model

ODOT identified limitations with the OKI Regional Model destination choice algorithm. This model limitation omits the potential for new trips that may choose to cross the Ohio River screenline with I-71/I-75 corridor improvements. The solution for fixing the destination choice algorithm could not be achieved during this study, so an alternative approach was taken that adjusts the regional model trip matrices by factoring the trips at a district level based on model observations from previous Brent Spence Bridge demand modeling done in 2015. Because of the uncertainty with the outcome of this approach, the volumes produced from the "District Factoring" are available as a sensitivity analysis for the value engineering concepts (I-W and I-M). The 2050 base forecasts that were developed for Alt I, Concept I-W, and Concept I-M do not include this step.

Step 3: Subarea Extraction

Subarea matrices are extracted from the validated OKI Travel Demand model to match the limits of the TransModeler network. Matrices are extracted for the Existing Model, each Build model, and a second set of Build models that use *District Factoring* methodology.

Step 4: Factor Period Matrices

The peak periods as defined by the OKI model are 6-9 AM and 3-7 PM. The TransModeler periods are 6-10 AM and 2-7 PM. The matrices from the OKI model are factored to estimate the additional hour in each of the TransModeler periods. The factor used is based on Brent Spence Bridge traffic counts taken in 2019 and is calculated to be 1.31 for AM period and 1.24 for PM period. The formulas for these factors are listed below:

- AM Factor = (6-10 AM BSB Count) / (6-9 AM BSB Count)
- PM Factor = (2-7 PM BSB Count) / (3-7 PM BSB Count)

These factored matrices are used as the inputs for the future TransModeler O-D matrix forecasts.

Step 5: TransModeler Matrix Forecast Pivot

The scenario O-D matrices for TransModeler are developed using a forecast pivot method. The inputs are the existing validated TransModeler matrices (period level), the Existing OKI subarea matrices, and the Build scenario OKI subarea matrices (base and district factored forecasted separately). The forecasting steps applied for each peak period scenario are outlined below.

1) O-D pair forecast targets are developed using NCHRP 765 methods
2) Origin and Destination marginal forecast targets are developed using NCHRP 765 methods
3) The O-D forecast targets (1) are Fratar factored to match the marginal targets (2)

These steps are completed for the peak period auto matrices and combined truck matrices for each build scenario. The reference NCHRP 765 equations for developing forecast targets for both (1) and (2) are as follows:

Forecast Variables

R = Count/(Existing Model Assignment)

D = Count – Existing Model Assignment

MR = (Future Model Assignment)/(Existing Model Assignment)

Forecast Target Methods

Ratio = R x (Future Model Assignment)

Difference = D + (Future Model Assignment)

MRatio = Ratio {if MR < 1}

MRatio = ((MR-1)*Difference + Ratio)/MR {if MR >=1}

Raf = (MRatio + Difference)/2

Forecast target selection:

Forecast Target = Ratio {If MR < 1 & R <=1}

Forecast Target = Difference {If MR < 1 & R >=2}

Forecast Target = Raf {If MR < 1 & 1 > R < 2}

Forecast Target = MRatio {If MR > 1 & R <=0.5}

Forecast Target = Difference {If MR > 1 & R >= 2}

Forecast Target = Raf {If MR > 1 & 0.5 > R < 2}

Step 6: Temporal Distribution

Step 5 captures the peak period traffic growth from the existing to future year OKI travel demand model and applies it to the Existing TransModeler O-D matrices. The traffic growth from the OKI model is measured at the period level. In this step, the existing 15-minute temporal distribution and truck splits (single-unit versus articulated trucks) are applied to the period matrices resulting in 15-minute future year O-D matrices by vehicle classification. Peak spreading is possible by year 2050, but these influences are not captured in the TransModeler analysis. The resultant O-D matrices from the forecast pivot procedure are the input matrices for the TransModeler scenario analysis.

Brent Spence Bridge Forecasts

A comparison of the period demand for the build concepts compared to the existing are summarized in Table 1. The demand is measured by TransModeler as the trips in the 5:30-10:00 AM and 1:30 – 7:00 PM O-D matrices that have a path on the Brent Spence Bridge. The 2050 demand is measured using the base forecasting procedures. There are slight differences in the BSB demand between concepts as is expected when using unique OKI model outputs for each forecasting scenario. However, these forecast differences are minor and are not the controlling factors for operational differences summarized in this report.

Table 1: Brent Spence Bridge Peak Period Traffic Demand

Scenario	Northbound BSB		Southbound BSB	
	AM Period	PM Period	AM Period	PM Period
2019 Existing	25,105	26,883	17,392	30,931
2050 Concept I	39,600	28,300	17,100	50,400
2050 Concept I-W	38,400	26,300	16,600	49,200
2050 Concept I-M	38,600	26,600	15,200	47,000

EXISTING MODEL CALIBRATION

MODEL CHARACTERISTICS

Software: TransModeler 6.1

Model Durations:

- AM Period 6:00 – 10:00 AM with 30-minute warmup
- PM Period: 2:00 – 7:00 PM with 30-minute warmup

Car Following Model: Modified General Motors

Traffic Demand Inputs: O-D Matrices in 15-minute bins by auto, SU trucks, and articulated trucks

Link Grades: Per ODOT standards, freeway links with grades of 2% or greater are included, other freeway links are set to 0%. Arterial roads with 3% or greater are included in the model with all other links set to 0%.

Calibration Considerations

- Temporal Distribution of Traffic Demand
- Vehicle Fleet Distributions
- Normal Acceleration
- Car Following Model
- Local Headway Buffers

TRAFFIC VOLUME

The traffic volume validation goal is to have 85% of the link traffic count targets within 15% of the modeled period volumes. And the trendline of the count versus model scatter plots are to have slope between 0.95 and 1.05 with a slope intercept between -10 and +10. These validation targets are tested on both the raw traffic counts and the balanced traffic counts generated from the ODME. Table 2 summarizes the result of the volume validation. Scatter plots comparing the counts and model assignments are shown in Figure 8 to Figure 11. Except for the Y-intercept target, the model volumes achieve validation goals when compared to the balanced count set.

Table 2: Traffic Volume Validation

Period	% of Counts within 15% of Model		Trend Line Slope		Trend Line Y-Intercept	
	Raw Counts	Balanced Counts	Raw Counts	Balanced Counts	Raw Counts	Balanced Counts
AM Period	70%	90%	1.016	1.025	-37	-64
PM Period	75%	91%	1.047	1.020	-167	-71

Figure 8: AM Period Model Versus Raw Traffic Counts

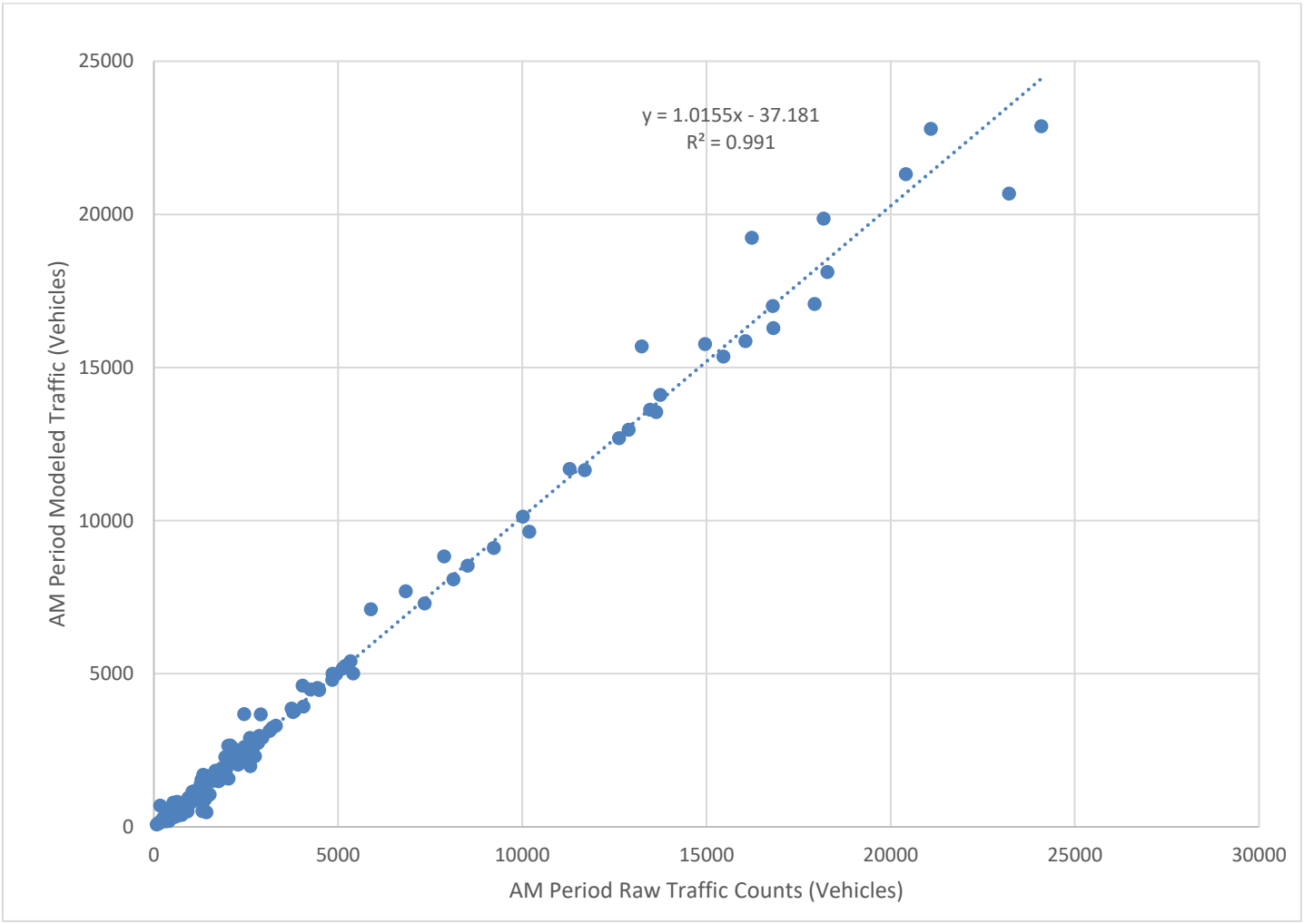


Figure 9: AM Period Model Versus Balanced Traffic Counts

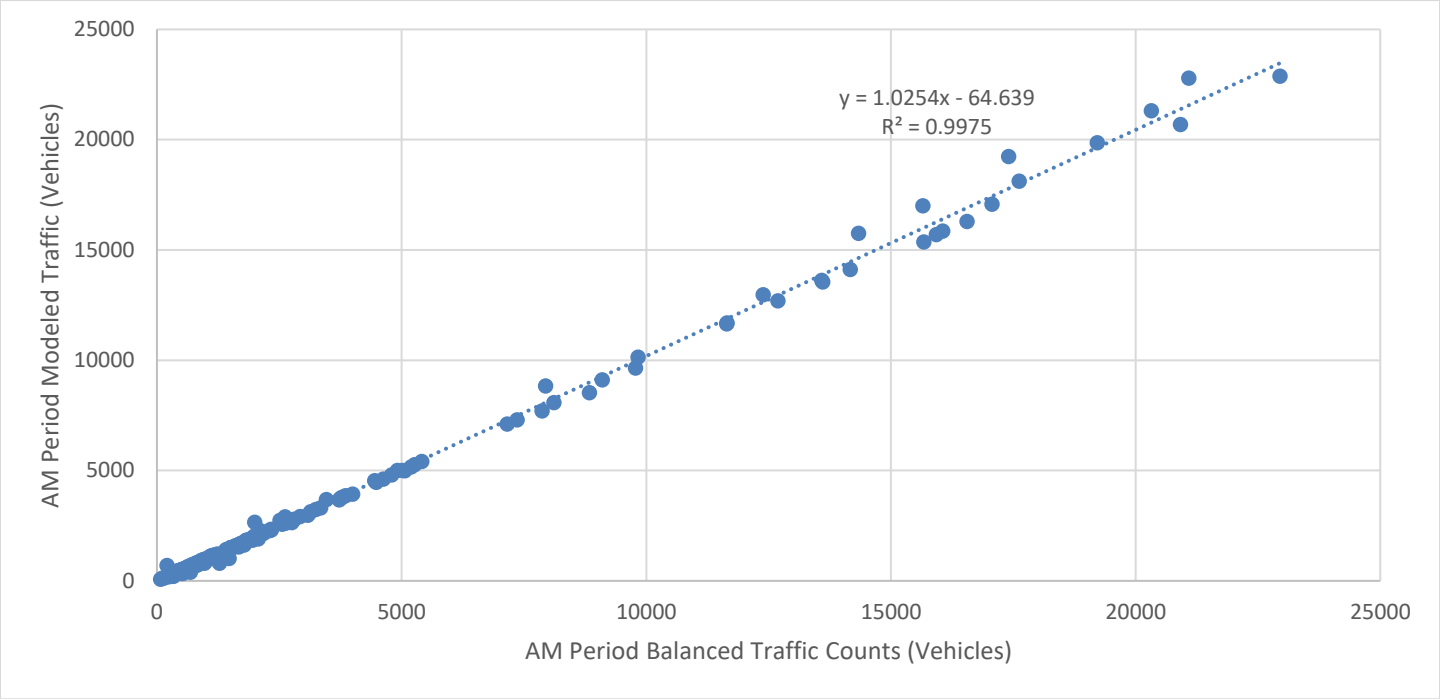


Figure 10: PM Period Model Versus Raw Traffic Counts

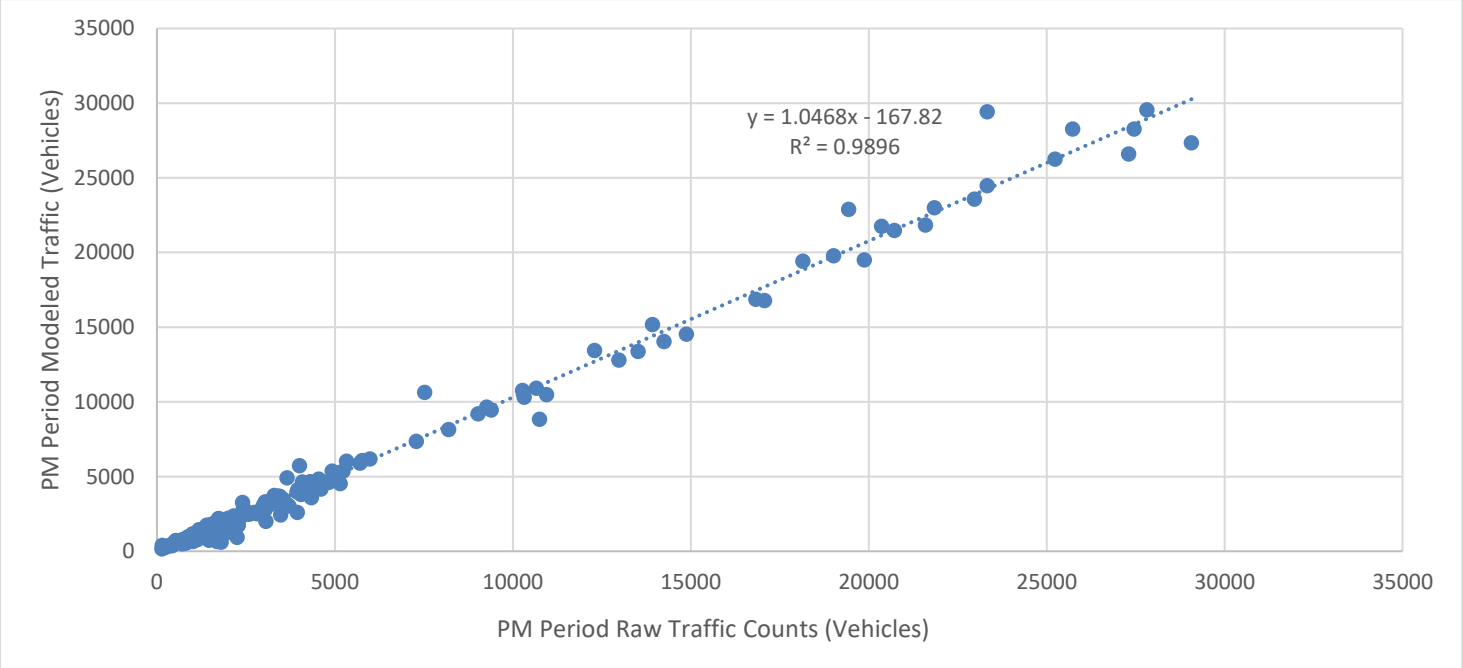
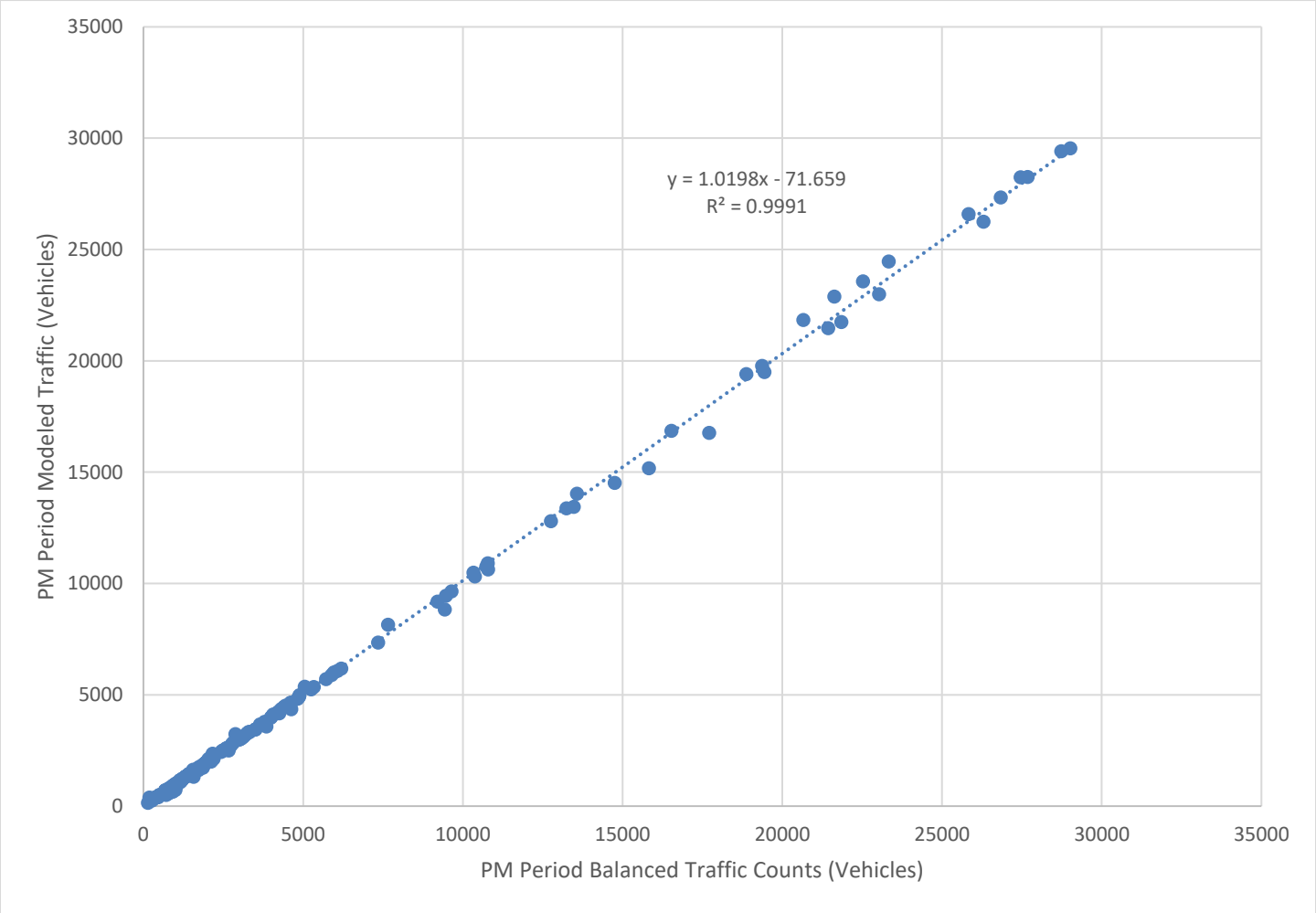


Figure 11: PM Period Model Versus Balanced Traffic Counts



The convergence of the BSB counts to the model are shown in Figure 12 to Figure 15. These graphs show the 10th – 90th percentile midweek traffic counts from April, May, September, and October 2019. In most cases the model is close but not exceeding the 90th percentile threshold. The one exception to this is the NB AM period where the field data shows a decreasing throughput on the bridge from 7-10 AM where the model maintains a consistent throughput on the bridge until about 8:30 before decreasing traffic. During calibration, the traffic demand for NB BSB was increased for the AM period in order to meet speed and travel time validation targets.

Figure 12: NB AM Period - BSB Count Versus Model

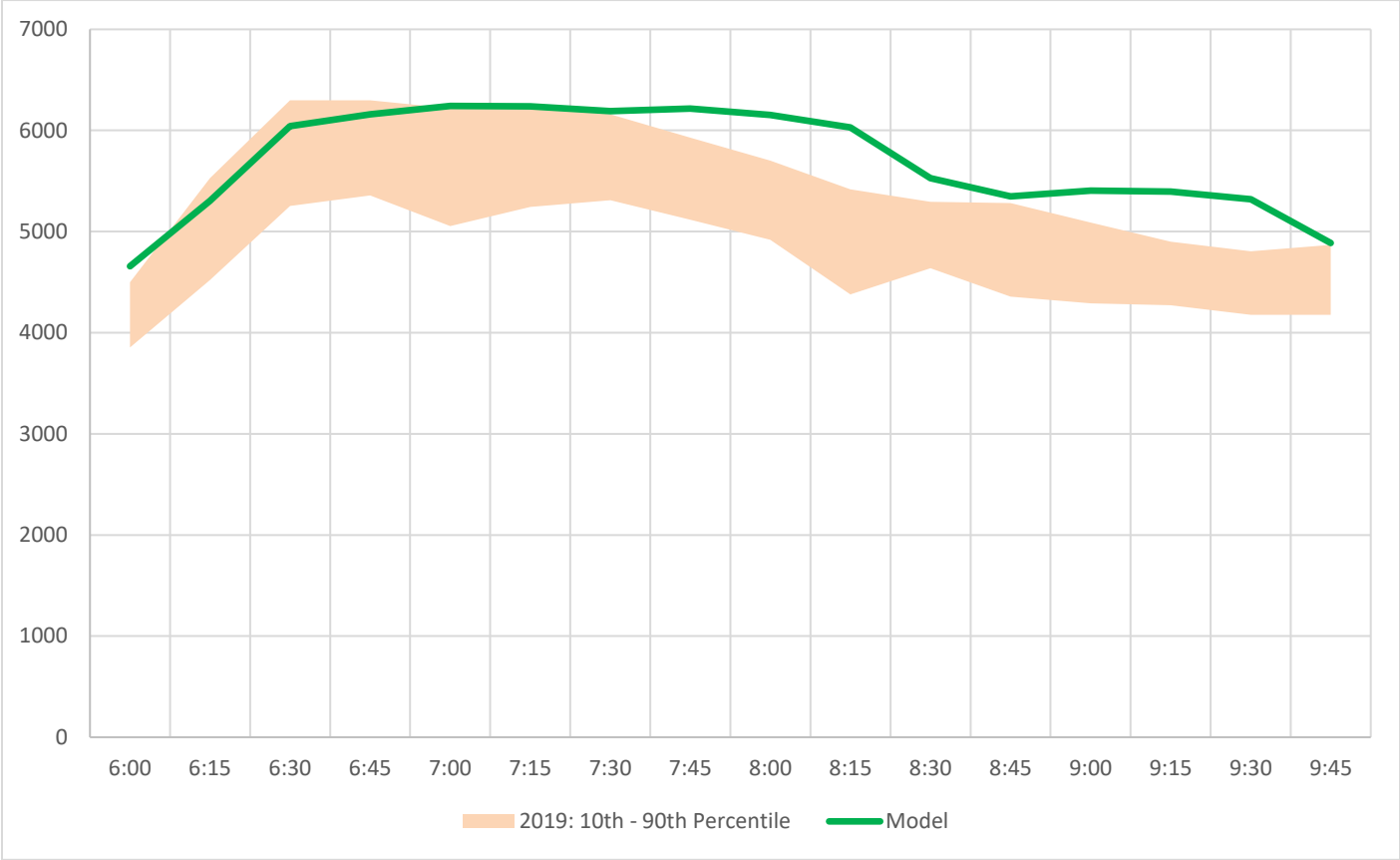


Figure 13: SB AM Period - BSB Count Versus Model

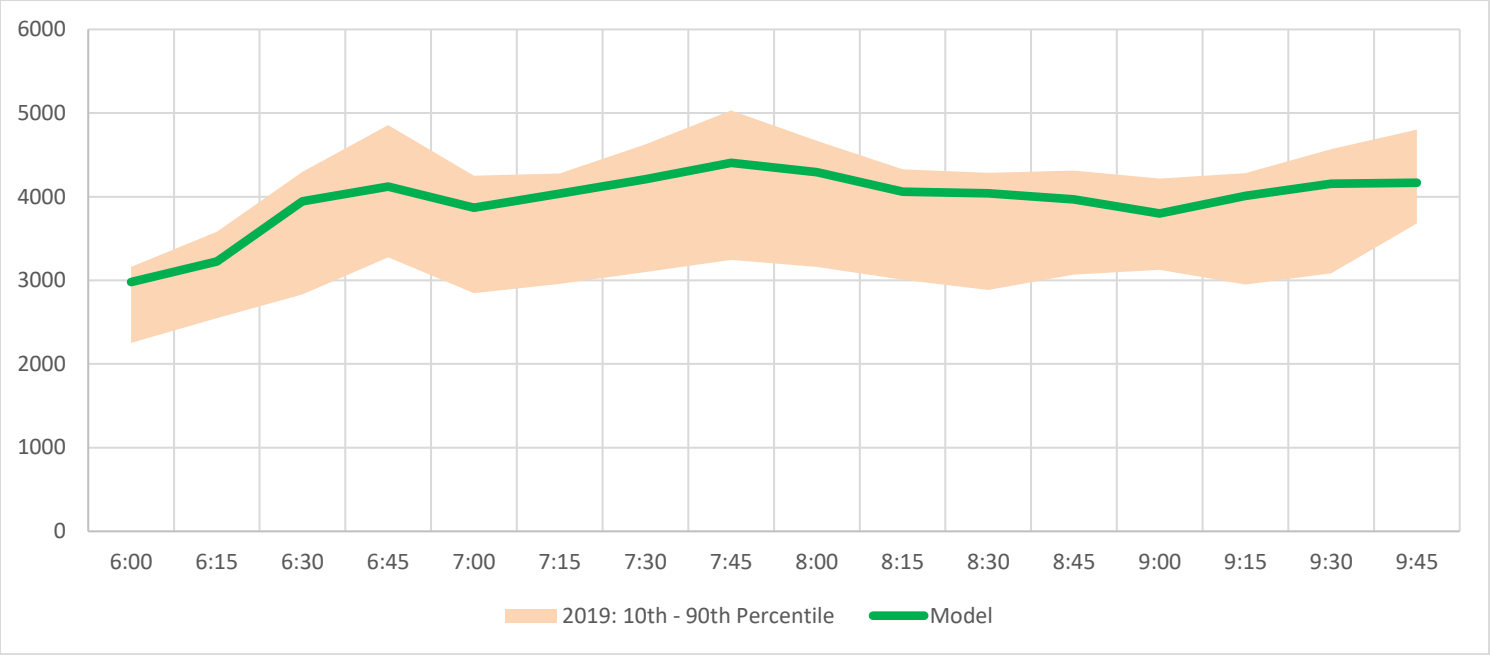


Figure 14: NB PM Period – BSB Count Versus Model

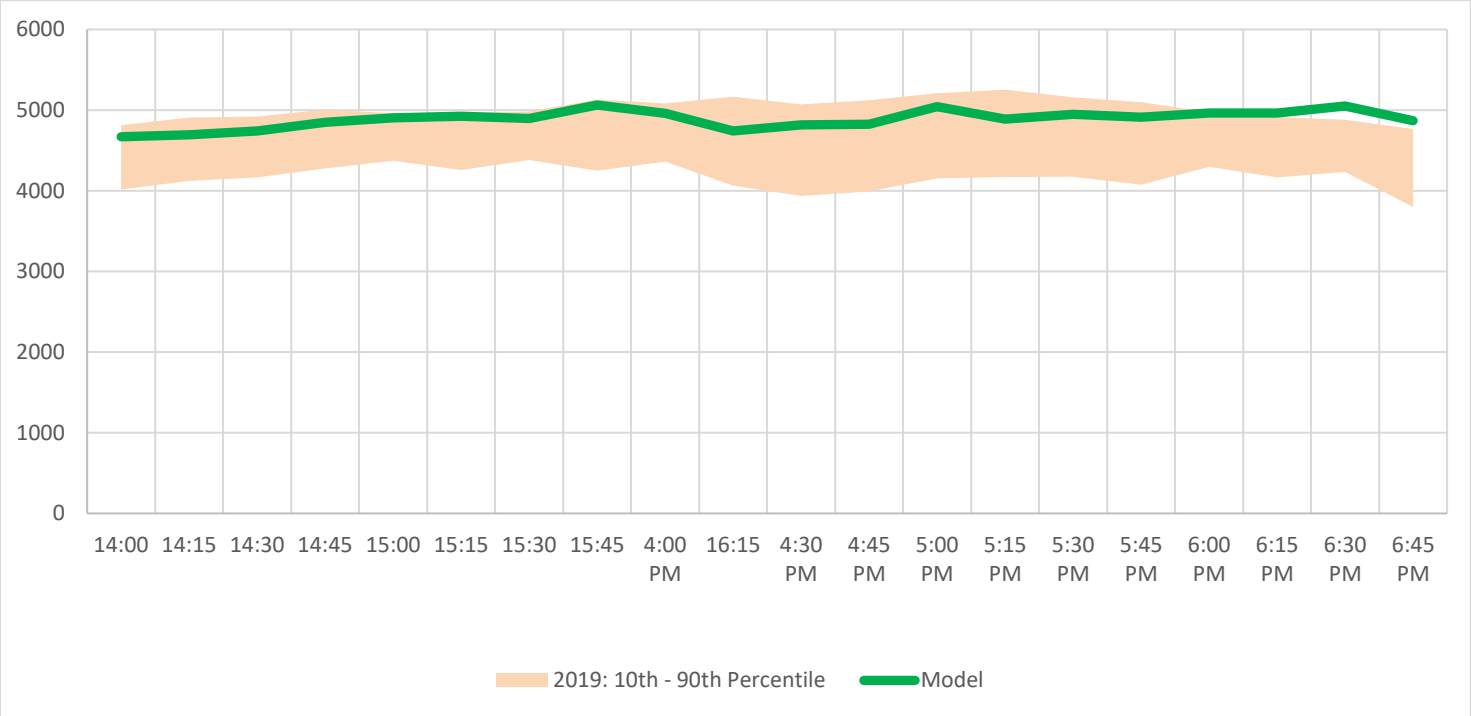
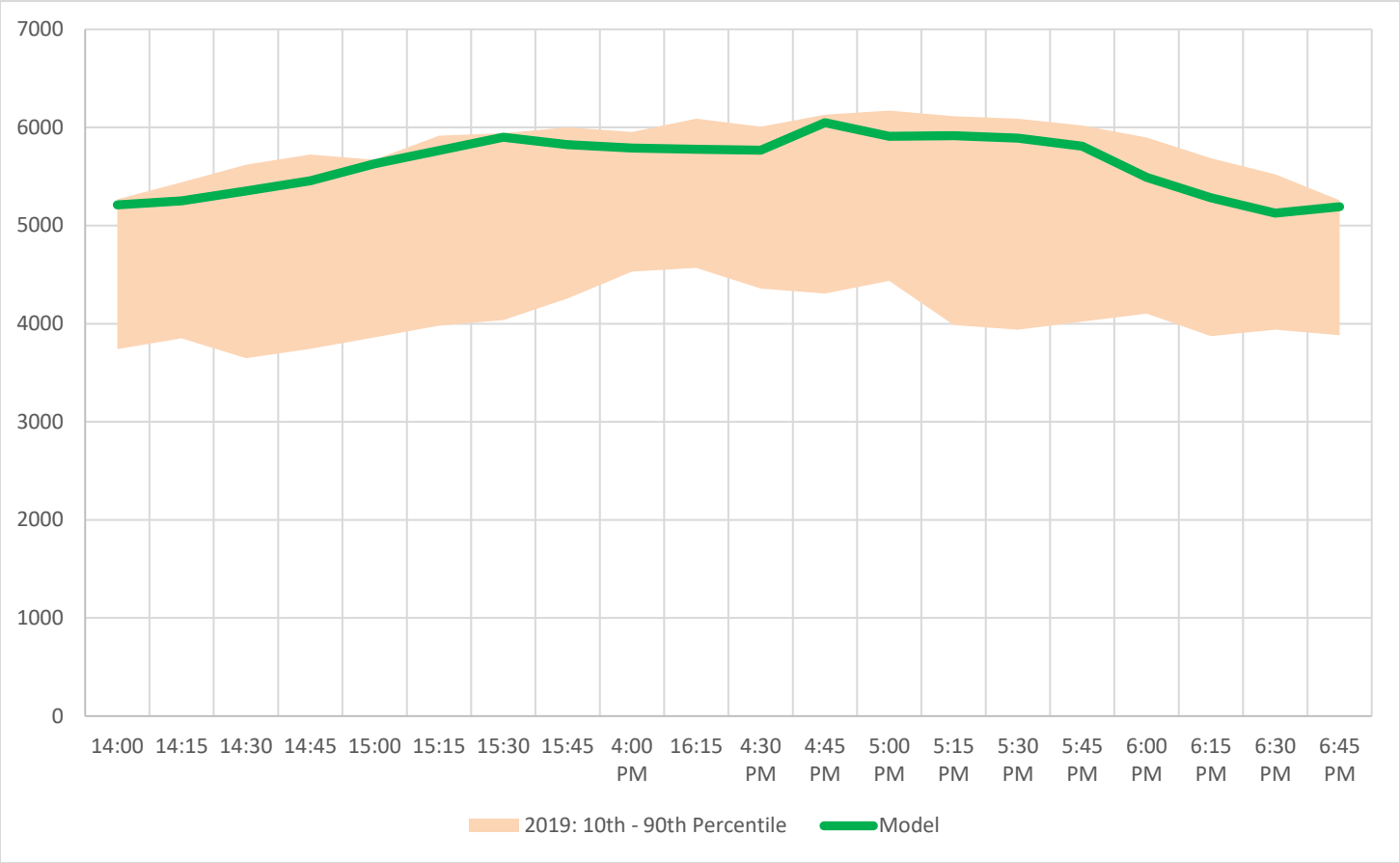


Figure 15: SB PM Period – BSB Count Versus Model



TransModeler temporal distribution tool is not needed for this model as demand inputs are in 15-minute O-D matrices. However, as a reference for validation, the total distribution of trips in the corridor by 15-minute bins are summarized in Figure 16 and Figure 17.

Figure 16: AM Peak Average Volume Profile

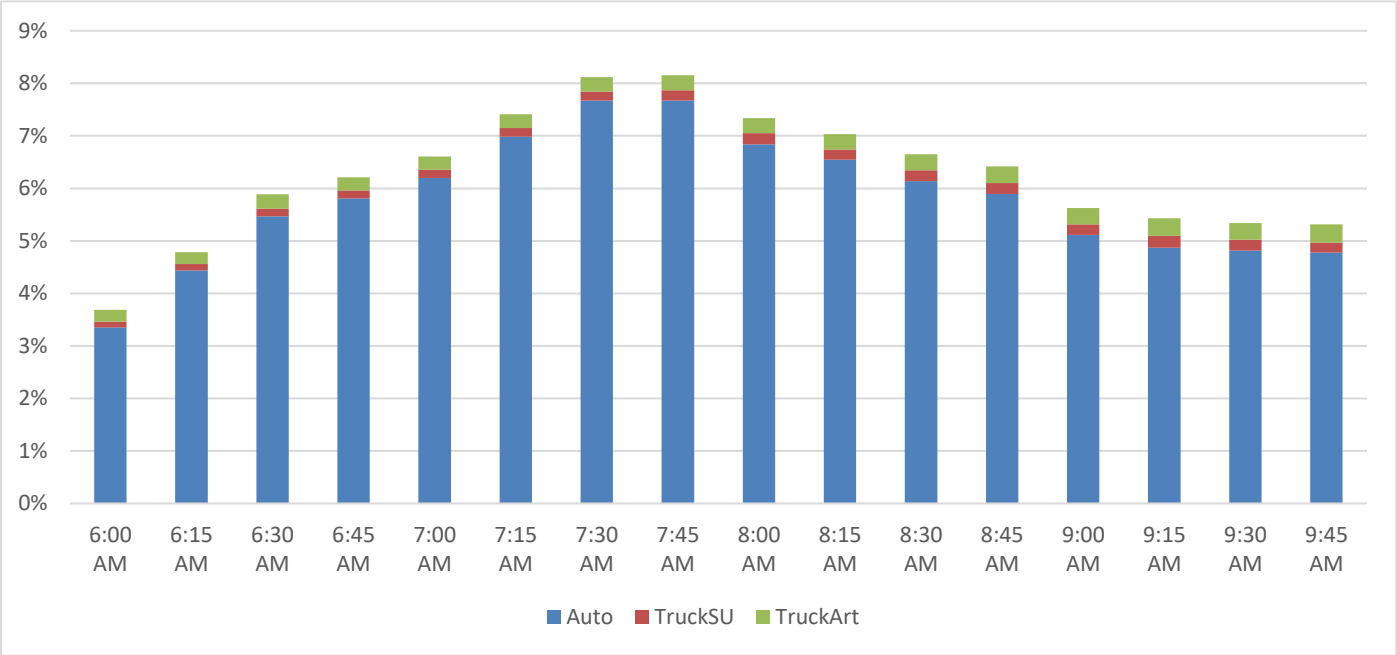
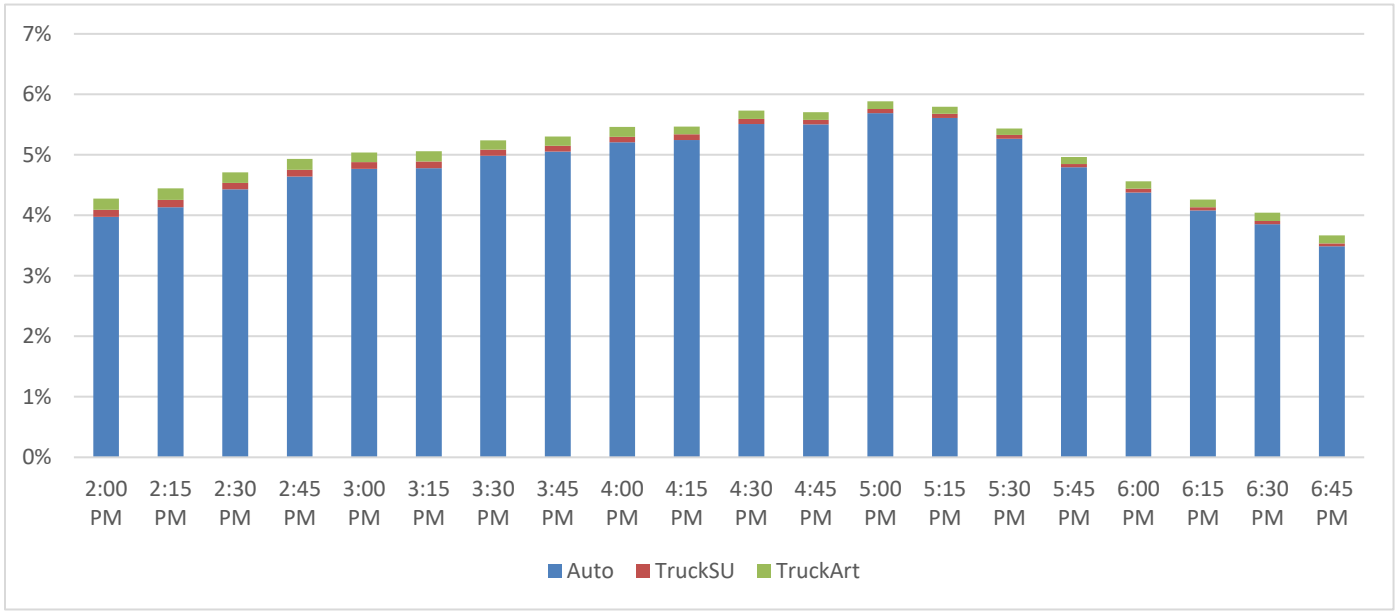


Figure 17: PM Peak Average Volume Profile



TRAVEL SPEEDS

Travel speeds on the I-71/I-75 corridor were obtained from INRIX for year 2019. The midweek (Tuesday, Wednesday, Thursday) travel speeds and travel times were analyzed for four months (April, May, September, October). Traffic summaries were obtained for the 10th percentile, median, and 90th percentile. The target for calibration was the median speed and travel time; however, given the variation in count data, consideration was given for the 10th percentile and 90th percentile range. If the modeled speeds were outside the validation target based on the median, a secondary check was added to evaluated goodness of fit to other observed weekday conditions. The validation target was to have 85% of speed location by 15-minute bins within 10 mph. The models performance against this goal and the secondary check for 10th -90th percentile range is provided in Table 3. As shown in the table, the speed targets are met for the AM period, but are slightly under the target for PM period.

Table 3: Speed Validation Results

	AM Period		PM Period	
Facility	Within 10 mph of Median	Or Between 10 % - 90%	Within 10 mph of Median	Or Between 10 % - 90%
I-75 SB	100%	100%	77%	92%
I-75 NB	90%	94%	80%	87%

Speed comparison tables are provided for each direction of I-71/I-75 for the two peak periods. Table 4 shows the NB I-71/I-75 for the AM period. The model is representing the general delay patterns of the corridor with traffic delays starting upstream of the Brent Spence Bridge with queues extending towards the I-275 Interchange.

The SB I-71/I-75 corridor in the AM period is shown in Table 5. The model captures the observed condition of mostly free-flow speeds. The only reduction in speed occurs between 12th Street and Kyles Lane, which has a steep grade of 5%.

The NB I-71/I-75 corridor in the PM period is shown in Table 6. The model has slight speed reductions between Kyles Lane and the BSB. These speeds trends are most consistent with the 90th percentile travel speeds. The median speeds indicate more speed reductions upstream of the BSB. Overall, the INRIX data indicates the travel delays are much lower in the PM period compared to the AM period. Given the AM period is the controlling peak direction for the NB, the convergence of speeds towards the 90th percentile instead of the median will not impact build concept design recommendations.

Travel speeds for SB I-71/I-75 in the PM period are shown in Table 7. The model captures the queueing from the Brent Spence Bridge with traffic delays reaching past Hopple Street. The model's speed profiles north of the BSB are between the median and 10th percentile speeds. The one area the model is not matching speeds is between the BSB and 12th Street. The INRIX data indicates reduced speeds on the steep incline between 12th Street and Kyles Lane, which the model matches. However, the model does not capture the delays that propagate between the incline and the BSB.

Table 4: NB I-71/I-75: Speed Comparison for AM Period

Data	Segment	NB I-71/I-75															
		6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30	9:45
Model	Hopple Exit to I-74 Merge	58	58	57	57	57	56	57	57	57	57	57	57	58	58	57	58
	WHV Exit to Hopple Exit	58	58	57	57	57	57	57	57	57	57	57	57	58	58	58	58
	Ezzard Charles Entrance to WHV Exit	55	55	54	54	53	53	53	53	53	54	54	54	54	54	54	54
	I-71 CD Merge to Ezzard Charles Entrance	58	57	57	56	57	56	56	56	56	56	56	57	57	56	57	57
	I-71 Exit to I-71 CD Merge	55	54	54	54	54	54	54	53	54	54	54	54	54	54	53	54
	5th Street Entrance to I-71 Exit (BSB)	50	48	44	44	44	43	42	41	43	44	46	48	47	45	46	48
	12th Street Exit to 5th Street Entrance	52	50	38	22	20	19	20	20	20	20	21	21	22	24	26	46
	Kyles Exit to 12th Street Exit	50	44	36	33	20	18	18	19	20	19	19	19	21	27	40	51
	Dixie Exit to Kyles Exit	54	51	22	16	14	11	11	11	13	13	14	15	19	36	54	54
	Buttermilk Exit to Dixie Exit	53	50	46	28	28	26	15	12	14	22	33	42	47	53	53	53
	I-275 to Buttermilk Exit	56	53	53	55	56	56	56	55	53	56	56	56	56	56	56	56
INRIX ((10th Percentile)	Hopple Exit to I-74 Merge	57	58	57	57	56	56	54	54	55	55	54	55	55	54	55	55
	WHV Exit to Hopple Exit	58	58	58	57	57	57	55	56	56	56	56	55	56	56	57	57
	Ezzard Charles Entrance to WHV Exit	56	57	56	56	56	56	56	55	56	56	55	55	56	55	56	56
	I-71 CD Merge to Ezzard Charles Entrance	56	55	55	54	55	55	53	55	54	54	54	54	54	54	55	55
	I-71 Exit to I-71 CD Merge	52	51	51	50	50	50	49	49	49	47	48	48	48	48	49	49
	5th Street Entrance to I-71 Exit (BSB)	48	44	41	40	39	37	36	37	36	36	35	36	37	38	38	38
	12th Street Exit to 5th Street Entrance	52	39	31	29	25	22	20	21	21	20	20	21	24	25	25	27
	Kyles Exit to 12th Street Exit	53	36	27	23	21	18	17	18	17	18	17	18	21	21	20	24
	Dixie Exit to Kyles Exit	56	35	19	16	13	12	12	12	12	12	13	14	17	21	18	26
	Buttermilk Exit to Dixie Exit	59	37	20	15	11	11	10	10	11	11	12	13	16	21	19	31
	I-275 to Buttermilk Exit	60	41	23	17	14	11	9	10	11	12	13	16	22	35	36	29
INRIX (Median)	Hopple Exit to I-74 Merge	59	59	59	59	58	58	58	58	57	57	57	57	57	57	57	57
	WHV Exit to Hopple Exit	60	61	60	60	60	60	59	60	59	59	59	58	59	59	59	59
	Ezzard Charles Entrance to WHV Exit	59	60	59	59	59	59	58	59	58	58	58	57	58	58	58	58
	I-71 CD Merge to Ezzard Charles Entrance	58	58	58	58	57	57	57	57	57	56	56	56	57	57	57	57
	I-71 Exit to I-71 CD Merge	55	54	54	53	53	52	52	52	51	51	51	51	51	51	52	51
	5th Street Entrance to I-71 Exit (BSB)	51	48	44	43	43	41	40	39	39	39	39	40	41	41	42	42
	12th Street Exit to 5th Street Entrance	55	48	38	33	30	25	24	24	24	24	24	26	29	31	32	32
	Kyles Exit to 12th Street Exit	58	47	33	28	25	22	21	21	21	21	21	23	28	31	34	38
	Dixie Exit to Kyles Exit	58	44	28	20	17	15	15	15	15	16	17	20	26	44	48	51
	Buttermilk Exit to Dixie Exit	62	49	29	19	16	13	13	14	14	15	18	22	38	55	58	59
	I-275 to Buttermilk Exit	63	57	33	25	22	15	13	14	19	29	33	45	58	60	60	61
INRIX (90th Percentile)	Hopple Exit to I-74 Merge	61	61	61	61	60	59	59	60	59	58	59	58	58	58	59	59
	WHV Exit to Hopple Exit	62	62	62	62	62	61	61	61	61	60	60	60	61	60	60	60
	Ezzard Charles Entrance to WHV Exit	61	61	61	61	61	60	61	60	60	60	59	59	59	59	60	60
	I-71 CD Merge to Ezzard Charles Entrance	60	60	61	60	60	59	59	59	59	59	58	58	58	58	59	58
	I-71 Exit to I-71 CD Merge	57	56	56	55	55	55	54	54	53	53	53	53	53	54	55	54
	5th Street Entrance to I-71 Exit (BSB)	55	51	48	47	47	44	42	42	42	42	42	42	44	46	49	49
	12th Street Exit to 5th Street Entrance	58	52	46	44	40	31	30	27	28	27	27	30	36	50	54	54
	Kyles Exit to 12th Street Exit	59	52	42	34	31	30	27	24	26	25	25	30	41	57	57	57
	Dixie Exit to Kyles Exit	60	55	34	26	21	19	19	18	18	21	24	32	56	58	58	59
	Buttermilk Exit to Dixie Exit	63	60	43	32	25	18	17	18	23	30	35	49	61	62	61	61
	I-275 to Buttermilk Exit	64	62	57	57	48	25	20	31	54	57	59	61	63	63	63	63

Table 5: SB I-71/I-75: Speed Comparison for AM Period

Data	Segment	SB I-71/I-75															
		6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30	9:45
Model	I-75 Merge to Hopple Street Entrance	57	56	54	55	56	56	55	55	55	55	55	55	55	56	56	56
	Hopple Street Entrance to WHV Entrance	57	56	55	55	55	55	54	53	53	53	54	54	55	55	55	55
	WHV Entrance to Ezzard Charles Exit	57	57	56	56	56	55	54	54	54	54	54	55	56	56	56	56
	Ezzard Charles Exit to 7th Street Exit	55	55	54	54	54	53	52	52	52	52	53	54	54	53	54	54
	7th Street Exit to I-71 Entrance	54	53	52	52	53	53	53	52	52	52	53	53	53	51	51	51
	I-71 Entrance to 4th Street Exit (BSB)	55	54	54	54	54	54	54	54	53	54	53	53	54	53	52	52
	4th Street Exit to 12th Entrance	57	57	57	56	57	57	57	56	56	56	56	57	57	56	56	56
	12th Street Entrance to Kyles Entrance	50	51	50	50	51	51	51	50	50	50	49	49	49	48	47	47
	Kyles Entrance to Dixie Entrance	59	58	57	58	58	58	58	57	57	58	58	58	58	58	57	57
	Dixie Entrance to Buttermilk Pike Entrance	58	58	57	57	57	58	57	57	57	57	57	57	57	57	56	57
	Buttermilk Pike to I-275 Interchange	59	58	57	57	57	57	57	57	57	58	57	58	58	58	56	57
INRIX ((10th Percentile)	I-75 Merge to Hopple Street Entrance	55	55	54	53	53	54	52	53	50	47	46	48	49	49	49	54
	Hopple Street Entrance to WHV Entrance	58	57	57	57	56	54	53	53	49	45	47	54	54	54	53	53
	WHV Entrance to Ezzard Charles Exit	56	56	55	55	55	54	52	51	48	45	45	52	53	52	51	53
	Ezzard Charles Exit to 7th Street Exit	53	52	47	50	54	51	48	47	46	47	45	49	51	47	46	47
	7th Street Exit to I-71 Entrance	53	48	33	44	51	50	43	46	49	48	45	47	45	37	35	40
	I-71 Entrance to 4th Street Exit (BSB)	52	50	47	48	51	51	49	50	50	50	48	49	48	46	45	45
	4th Street Exit to 12th Entrance	56	55	54	55	56	55	56	56	56	56	55	54	54	53	54	54
	12th Street Entrance to Kyles Entrance	49	47	48	50	50	50	49	50	51	50	49	49	48	46	47	47
	Kyles Entrance to Dixie Entrance	58	57	57	57	57	58	57	59	58	58	57	57	57	57	56	56
	Dixie Entrance to Buttermilk Pike Entrance	60	59	59	61	60	61	61	62	61	61	60	60	59	58	59	59
	Buttermilk Pike to I-275 Interchange	59	59	58	60	60	59	61	61	61	60	60	59	59	58	59	58
INRIX (Median)	I-75 Merge to Hopple Street Entrance	58	58	57	57	57	56	56	56	54	53	52	54	55	55	55	56
	Hopple Street Entrance to WHV Entrance	60	59	60	59	58	58	57	57	56	55	56	57	57	57	58	58
	WHV Entrance to Ezzard Charles Exit	59	58	58	58	57	57	55	54	54	54	54	56	56	56	56	56
	Ezzard Charles Exit to 7th Street Exit	56	56	55	56	56	55	54	53	52	53	53	54	54	53	53	54
	7th Street Exit to I-71 Entrance	55	52	47	53	53	53	52	52	52	51	51	52	52	49	47	51
	I-71 Entrance to 4th Street Exit (BSB)	55	53	51	53	54	54	53	54	54	53	52	52	52	50	50	51
	4th Street Exit to 12th Entrance	57	57	57	58	58	58	58	59	58	57	57	57	57	56	56	56
	12th Street Entrance to Kyles Entrance	51	51	51	52	53	53	53	54	53	52	52	51	51	50	50	51
	Kyles Entrance to Dixie Entrance	60	59	59	60	60	60	60	61	61	60	59	59	59	59	59	59
	Dixie Entrance to Buttermilk Pike Entrance	62	61	62	62	63	63	63	64	63	62	62	62	62	62	62	61
	Buttermilk Pike to I-275 Interchange	62	62	61	62	63	62	62	63	63	62	62	62	62	61	61	61
INRIX (90th Percentile)	I-75 Merge to Hopple Street Entrance	59	59	59	59	58	59	58	57	57	56	55	56	57	56	57	57
	Hopple Street Entrance to WHV Entrance	61	61	61	61	60	60	59	59	58	58	58	59	59	59	59	59
	WHV Entrance to Ezzard Charles Exit	60	60	61	60	59	59	57	57	57	57	57	58	58	58	58	58
	Ezzard Charles Exit to 7th Street Exit	58	58	58	58	58	57	56	56	56	56	56	57	56	56	56	56
	7th Street Exit to I-71 Entrance	57	55	53	56	56	55	55	55	55	54	54	55	54	53	52	54
	I-71 Entrance to 4th Street Exit (BSB)	57	56	54	56	56	57	56	56	57	55	55	55	54	53	53	54
	4th Street Exit to 12th Entrance	59	58	58	59	60	60	60	60	61	59	59	58	58	57	57	57
	12th Street Entrance to Kyles Entrance	53	52	53	55	55	56	56	56	57	55	53	54	53	52	52	52
	Kyles Entrance to Dixie Entrance	61	61	61	62	62	63	62	63	63	61	61	61	61	60	60	60
	Dixie Entrance to Buttermilk Pike Entrance	63	63	63	64	64	64	64	65	65	64	64	63	63	63	62	63
	Buttermilk Pike to I-275 Interchange	64	63	63	64	65	65	64	65	65	64	64	63	63	64	62	63

Table 6: NB I-71/I-75: Speed Comparison for PM Period

Data	Segment	NB I-71/I-75																			
		14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	18:45
Model	Hopple Exit to I-74 Merge	58	57	57	58	57	57	57	57	57	57	57	57	57	58	58	58	58	58	58	58
	WHV Exit to Hopple Exit	57	57	57	57	57	57	57	56	56	56	56	54	47	46	46	49	53	54	55	57
	Ezzard Charles Entrance to WHV Exit	54	53	53	53	52	52	52	51	50	51	51	51	51	49	49	48	50	52	54	55
	I-71 CD Merge to Ezzard Charles Entrance	56	56	56	56	55	55	55	55	54	54	54	53	53	54	50	51	51	53	55	57
	I-71 Exit to I-71 CD Merge	54	54	54	54	54	54	54	54	54	54	54	54	55	55	53	51	50	51	54	54
	4th Street Entrance to I-71 Exit (BSB)	49	48	48	48	49	48	48	47	47	49	49	50	50	50	50	50	48	48	49	49
	12th Street Exit to 4th Street Entrance	52	52	52	52	52	52	52	52	52	52	53	52	52	52	52	52	52	52	52	52
	Kyles Exit to 12th Street Exit	50	50	50	50	50	50	50	50	50	51	50	50	49	50	49	50	50	50	50	50
	Dixie Exit to Kyles Exit	53	54	54	54	54	54	54	54	55	55	54	54	54	54	54	54	54	54	54	54
	Buttermilk Exit to Dixie Exit	52	52	52	52	52	53	52	52	53	53	53	52	52	52	52	52	52	53	52	53
	I-275 to Buttermilk Exit	55	54	54	55	55	55	55	55	56	55	55	55	55	54	54	54	54	55	55	56
INRIX 10th Percentile	Hopple Exit to I-74 Merge	56	56	56	55	55	55	52	44	42	41	39	39	40	39	41	47	56	56	55	57
	WHV Exit to Hopple Exit	58	58	57	57	57	56	53	39	33	32	29	28	29	31	33	46	58	58	59	59
	Ezzard Charles Entrance to WHV Exit	57	57	56	56	55	55	54	50	44	34	31	31	30	31	33	52	56	56	57	57
	I-71 CD Merge to Ezzard Charles Entrance	55	55	54	54	53	53	53	52	49	34	43	30	33	25	39	52	53	54	54	55
	I-71 Exit to I-71 CD Merge	48	49	48	47	46	47	46	46	45	43	46	42	42	35	41	45	46	46	47	48
	4th Street Entrance to I-71 Exit (BSB)	37	37	37	35	34	35	34	36	36	36	36	35	35	34	35	34	35	34	37	37
	12th Street Exit to 4th Street Entrance	26	25	24	24	24	25	24	27	29	29	29	26	23	24	25	21	26	24	23	24
	Kyles Exit to 12th Street Exit	22	24	23	23	25	25	23	24	26	26	29	30	22	19	21	20	23	23	21	24
	Dixie Exit to Kyles Exit	23	28	25	26	26	26	25	25	21	29	34	26	26	19	17	20	19	23	23	33
	Buttermilk Exit to Dixie Exit	24	27	25	25	25	25	25	26	22	27	32	27	24	16	17	17	19	21	25	43
	I-275 to Buttermilk Exit	42	28	26	23	25	27	38	35	46	46	45	38	22	17	16	17	20	18	33	56
INRIX Median	Hopple Exit to I-74 Merge	57	58	57	57	57	57	57	55	54	47	46	46	47	45	48	55	58	59	59	59
	WHV Exit to Hopple Exit	59	60	59	59	59	59	58	58	55	44	44	40	41	40	45	58	60	61	61	61
	Ezzard Charles Entrance to WHV Exit	58	59	58	58	57	57	57	57	55	50	53	47	47	42	51	58	58	59	59	60
	I-71 CD Merge to Ezzard Charles Entrance	57	57	56	56	56	55	55	55	54	53	55	52	52	45	55	57	57	57	58	58
	I-71 Exit to I-71 CD Merge	51	51	50	50	49	49	49	49	50	49	50	49	48	48	50	50	51	51	52	53
	4th Street Entrance to I-71 Exit (BSB)	43	41	40	39	39	39	38	39	40	42	44	40	40	40	40	40	41	42	44	47
	12th Street Exit to 4th Street Entrance	44	36	30	30	29	30	29	32	36	42	49	38	35	33	36	36	40	39	47	53
	Kyles Exit to 12th Street Exit	49	44	36	32	31	31	34	33	44	53	56	52	48	40	37	38	41	50	56	58
	Dixie Exit to Kyles Exit	56	52	42	37	36	39	44	42	53	57	57	56	55	45	51	46	41	52	58	59
	Buttermilk Exit to Dixie Exit	60	58	53	35	37	40	56	53	60	60	60	59	59	50	57	56	56	59	61	62
	I-275 to Buttermilk Exit	61	59	60	47	50	54	60	60	61	61	60	61	61	58	59	59	61	62	62	63
INRIX 90th Percentile	Hopple Exit to I-74 Merge	59	59	59	59	58	59	58	58	58	54	53	52	52	52	56	59	60	60	61	60
	WHV Exit to Hopple Exit	61	61	60	61	60	60	60	60	58	56	55	52	53	50	58	61	62	62	62	63
	Ezzard Charles Entrance to WHV Exit	60	60	59	59	59	59	58	59	57	56	57	56	56	57	59	60	60	61	61	61
	I-71 CD Merge to Ezzard Charles Entrance	58	59	58	58	58	57	57	58	57	57	57	56	57	57	58	59	59	60	60	60
	I-71 Exit to I-71 CD Merge	55	54	53	53	53	52	52	53	53	53	54	52	53	52	54	54	54	54	55	56
	4th Street Entrance to I-71 Exit (BSB)	49	47	46	45	46	45	44	47	48	50	49	48	46	45	48	47	49	49	50	53
	12th Street Exit to 4th Street Entrance	55	53	51	51	50	49	47	51	54	55	55	54	53	51	53	53	55	55	56	57
	Kyles Exit to 12th Street Exit	59	58	58	56	56	55	55	55	59	59	59	57	58	56	57	57	58	59	60	61
	Dixie Exit to Kyles Exit	59	58	58	56	57	56	58	58	59	60	59	58	59	58	58	59	59	60	61	61
	Buttermilk Exit to Dixie Exit	62	61	60	60	60	60	61	61	62	62	62	62	62	62	61	62	62	63	64	64
	I-275 to Buttermilk Exit	64	63	62	62	61	62	63	63	63	63	63	63	63	63	62	63	64	64	65	65

Table 7: SB I-71/I-75: Speed Comparison for PM Period

Data	Segment	SB I-71/I-75																			
		14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	18:45
Model	I-75 Merge to Hopple Street Entrance	56	56	56	56	56	56	56	56	56	47	35	27	24	31	42	52	55	55	56	57
	Hopple Street Entrance to WHV Entrance	55	54	55	52	48	51	51	47	31	16	13	10	9	14	21	40	48	45	46	51
	WHV Entrance to Ezzard Charles Exit	56	55	51	33	26	32	29	21	12	9	8	7	9	10	12	19	24	21	23	32
	Ezzard Charles Exit to 7th Street Exit	49	42	26	14	14	16	14	11	8	8	8	8	9	10	13	11	11	12	13	17
	7th Street Exit to I-71 Entrance	32	26	19	17	18	16	16	15	14	14	14	13	14	14	17	16	15	16	17	20
	I-71 Entrance to 4th Street Exit (BSB)	50	50	50	50	49	50	50	50	51	51	51	50	51	50	50	50	51	51	50	49
	4th Street Exit to 12th Entrance	55	55	55	55	55	55	54	55	55	55	55	54	54	54	54	54	55	55	55	55
	12th Street Entrance to Kyles Entrance	45	45	45	45	45	45	45	45	46	46	45	45	44	44	44	45	46	47	46	46
	Kyles Entrance to Dixie Entrance	56	57	56	56	56	56	56	56	56	56	55	55	55	55	55	55	56	56	56	56
	Dixie Entrance to Buttermilk Pike Entrance	56	56	55	55	55	55	55	55	55	55	55	55	54	55	55	55	55	56	56	56
	Buttermilk Pike to I-275 Interchange	56	55	55	53	54	53	53	54	53	54	52	51	50	47	48	53	54	55	55	56
INRIX 10th Percentile	I-75 Merge to Hopple Street Entrance	54	55	54	53	54	52	48	49	46	44	31	37	30	27	30	29	28	34	35	51
	Hopple Street Entrance to WHV Entrance	54	53	46	41	47	35	23	28	16	12	9	10	9	8	8	8	8	9	11	28
	WHV Entrance to Ezzard Charles Exit	34	29	18	14	22	14	12	10	9	7	7	7	6	6	6	6	6	8	8	14
	Ezzard Charles Exit to 7th Street Exit	16	13	13	12	12	10	9	8	7	7	6	6	6	5	5	5	6	7	8	11
	7th Street Exit to I-71 Entrance	21	18	16	17	16	15	12	12	11	10	10	9	9	8	9	10	10	11	12	15
	I-71 Entrance to 4th Street Exit (BSB)	41	39	33	36	33	29	27	24	24	22	23	23	22	20	23	24	25	27	28	32
	4th Street Exit to 12th Entrance	51	42	36	31	27	24	21	20	20	19	20	20	18	18	20	21	21	23	23	29
	12th Street Entrance to Kyles Entrance	44	40	40	38	38	36	35	35	35	35	35	34	33	34	35	34	34	33	33	35
	Kyles Entrance to Dixie Entrance	55	56	56	56	56	56	54	55	55	54	52	48	50	49	55	54	54	54	54	54
	Dixie Entrance to Buttermilk Pike Entrance	58	58	59	59	59	59	59	57	57	55	55	56	56	58	55	57	57	57	58	58
	Buttermilk Pike to I-275 Interchange	57	58	58	58	58	58	58	57	57	57	53	54	49	54	55	56	56	56	55	57
INRIX Median	I-75 Merge to Hopple Street Entrance	57	57	56	56	56	56	56	56	55	55	55	54	54	52	53	52	55	56	57	57
	Hopple Street Entrance to WHV Entrance	58	58	57	56	57	56	55	55	55	52	50	44	38	26	27	30	46	55	58	58
	WHV Entrance to Ezzard Charles Exit	56	54	50	50	47	38	38	34	32	25	18	12	10	9	9	10	15	31	53	56
	Ezzard Charles Exit to 7th Street Exit	51	39	25	22	21	15	14	12	11	9	8	8	7	7	7	8	9	12	26	47
	7th Street Exit to I-71 Entrance	39	27	22	22	20	19	18	16	14	13	12	12	12	11	11	13	15	17	22	38
	I-71 Entrance to 4th Street Exit (BSB)	46	44	43	43	42	40	39	34	31	29	29	29	28	26	28	31	35	38	42	46
	4th Street Exit to 12th Entrance	55	54	54	54	53	50	40	29	26	25	25	25	24	22	26	27	34	40	52	55
	12th Street Entrance to Kyles Entrance	49	48	48	48	47	44	41	39	39	38	38	38	38	38	38	38	38	40	46	49
	Kyles Entrance to Dixie Entrance	59	58	58	58	58	58	58	58	57	57	57	57	57	57	57	57	57	57	57	59
	Dixie Entrance to Buttermilk Pike Entrance	61	61	61	61	61	61	61	61	61	61	60	60	61	61	60	60	60	60	61	62
	Buttermilk Pike to I-275 Interchange	61	60	60	60	60	60	60	60	60	60	59	59	59	60	59	60	60	60	60	61
INRIX 90th Percentile	I-75 Merge to Hopple Street Entrance	58	58	58	58	58	58	58	58	58	57	57	57	57	57	56	57	58	59	59	59
	Hopple Street Entrance to WHV Entrance	59	59	59	59	59	59	59	59	59	59	57	57	57	56	56	57	59	60	61	61
	WHV Entrance to Ezzard Charles Exit	58	58	58	58	57	55	54	52	53	52	46	44	48	40	39	49	55	56	58	59
	Ezzard Charles Exit to 7th Street Exit	55	55	54	53	50	37	34	24	35	28	15	15	17	13	13	18	39	52	55	57
	7th Street Exit to I-71 Entrance	50	51	45	42	37	24	21	20	21	18	16	15	15	13	14	17	25	40	50	53
	I-71 Entrance to 4th Street Exit (BSB)	51	50	49	48	46	44	43	42	41	37	38	37	37	35	36	37	42	46	49	52
	4th Street Exit to 12th Entrance	57	56	56	56	55	54	53	52	51	42	44	39	38	39	44	51	53	55	56	57
	12th Street Entrance to Kyles Entrance	51	51	51	51	50	50	49	49	48	43	43	41	41	42	42	46	48	49	51	51
	Kyles Entrance to Dixie Entrance	60	60	59	60	60	60	59	59	60	59	59	59	59	59	58	59	58	60	60	60
	Dixie Entrance to Buttermilk Pike Entrance	63	63	62	62	63	63	62	63	63	62	62	62	62	63	62	62	62	62	63	63
	Buttermilk Pike to I-275 Interchange	62	62	62	62	62	62	62	62	62	62	62	61	61	62	62	62	62	62	62	63

TRAVEL TIMES

Travel time validation is for I-71/I-75 between I-275 Interchange in Kentucky to the I-74 Interchange in Ohio. The travel time target was determined using INRIX data for midweek days in April, May, September, and October of 2019. The median travel time in 15-minute bins was set as the target travel time. The 10th percentile and 90th percentile was also used to gauge the reasonableness of the modelled travel time and to serve as a secondary validation target. The results of the travel time validation are reported in Table 8. The travel time calibration goal was for the model to be within 15% of the median travel time target for 85% of the 15-minute bins. This was achieved for both directions in the AM period. The PM period does not meet this goal but does meet the secondary objective of having 85% of the travel time targets between the 10th and 90th percentile travel time.

Table 8: Travel Time Validation

	AM Period		PM Period	
Facility	Within 15% of Median Travel Time	Or Between 10 % - 90%	Within 15% of Median Travel Time	Or Between 10 % - 90%
I-75 SB	100%	100%	70%	95%
I-75 NB	100%	100%	45%	85%

Table 9: AM Period Travel Time – NB I-71/I-75 (I-275 to I-74)

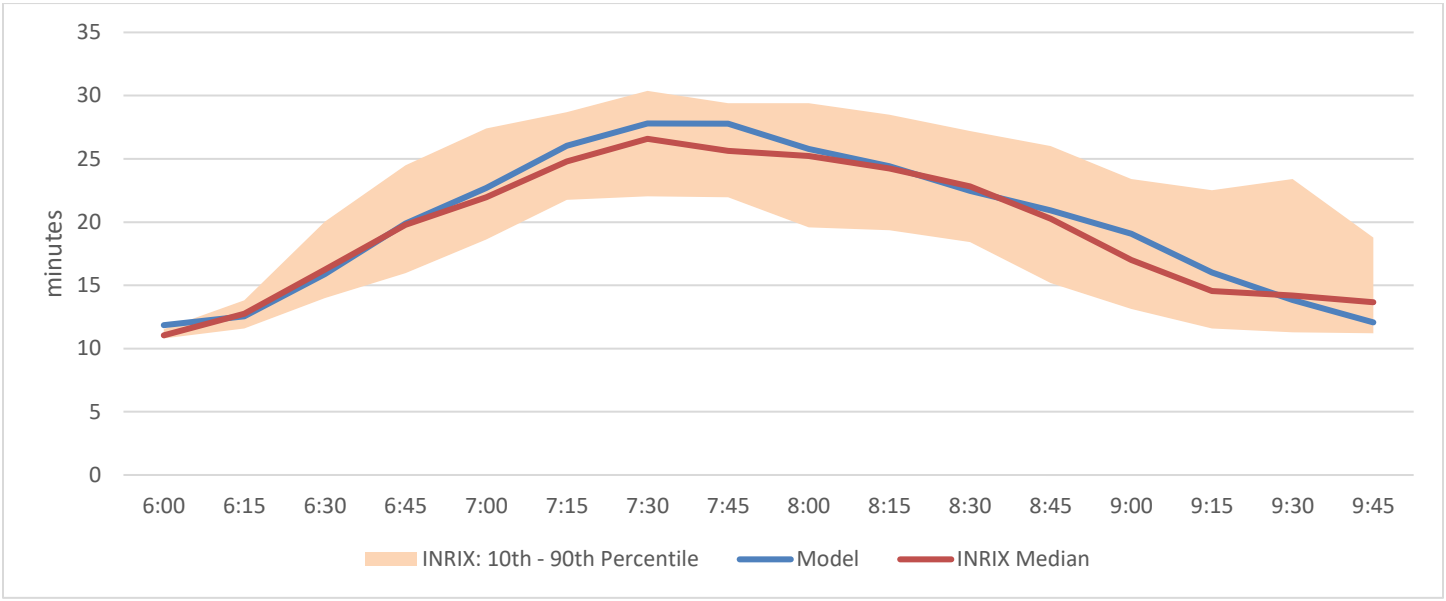


Table 10: AM Travel Time – SB I-71/I-75 (I-74 to I-275)

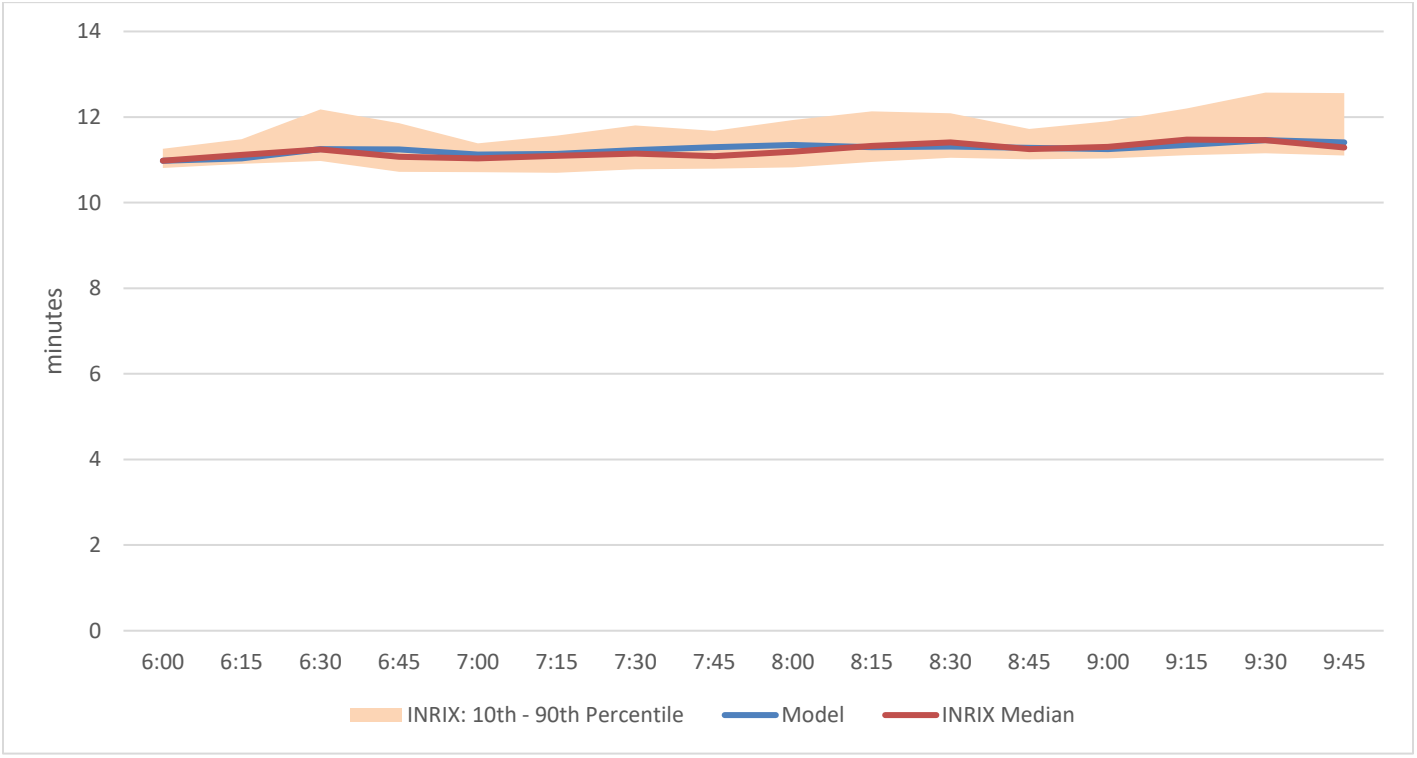


Table 11: PM Travel Time – NB I-71/I-75 (I-275 to I-74)

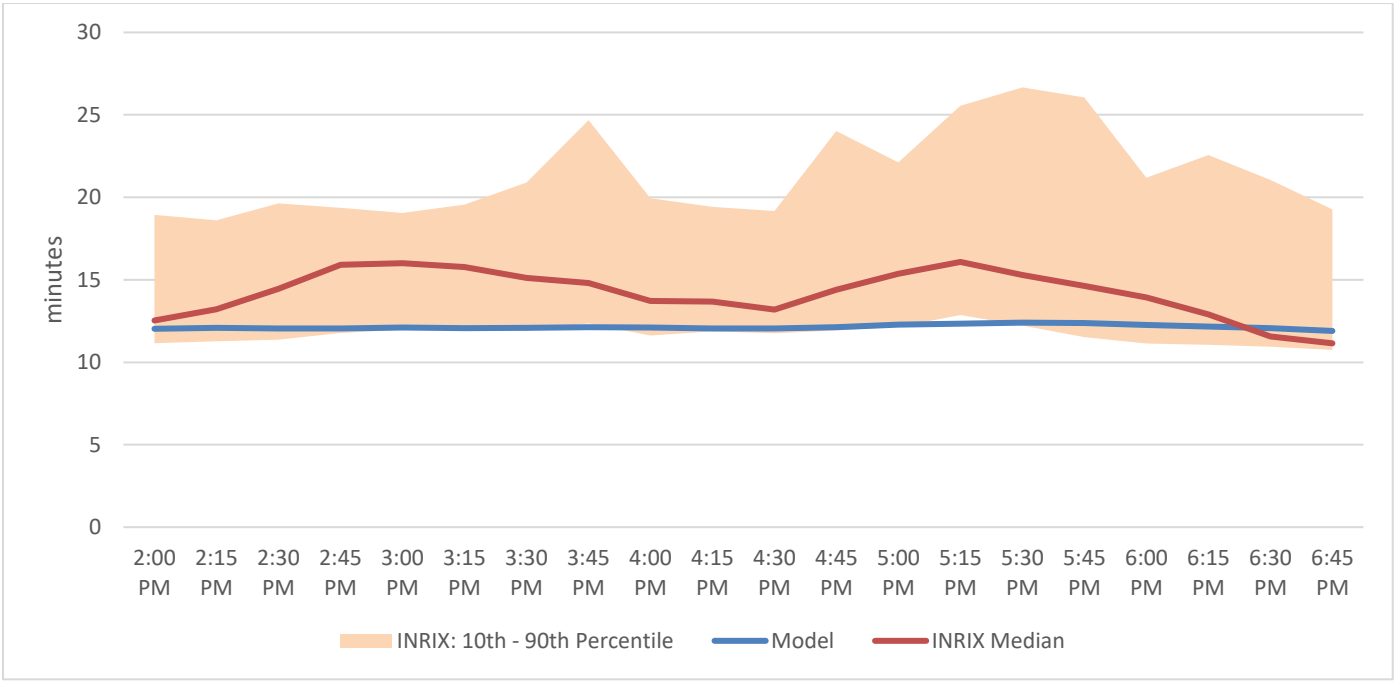
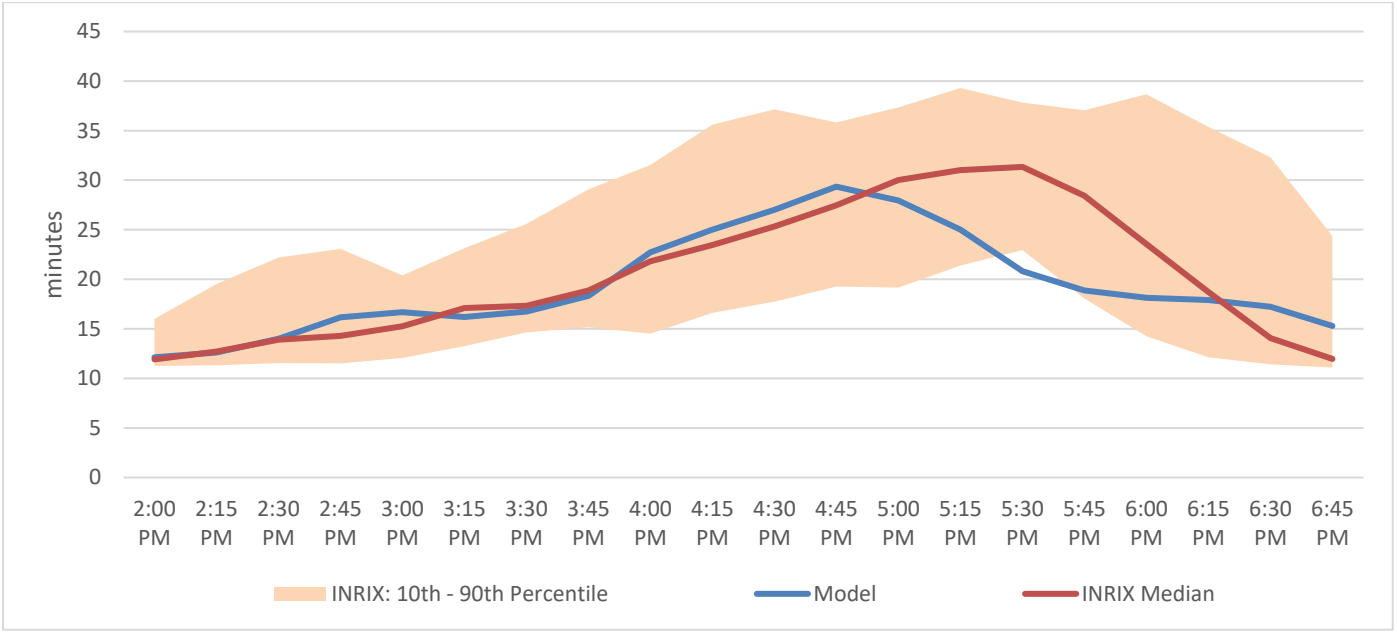


Table 12: PM Travel Time – SB I-71/I-75 (I-74 to I-275)



DEVIATIONS FROM DEFAULT VALUES

The calibration workflow prioritizes traffic demand adjustments to meet calibration targets. These include changes to the trip temporal distributions and refinements to the vehicle fleet inputs. Once the options for traffic adjustments were exhausted, the calibration was refined by modifying the normal acceleration, car following model, and headway buffers. The adjustments to these variables are discussed in the following sections. All existing model parameter adjustments are carried forward to the future year models.

VEHICLE FLEET

The O-D matrices are divided into three classifications: Autos, SU Trucks, and Articulated Trucks. The characteristics of SU Trucks and Articulated Trucks are based on default TransModeler definition. The Autos are more specifically defined based on vehicle fleet distributions. ODOT and KYTC have different default recommendations. These recommendations as well as the fleet used in the BSB model are detailed in Table 13. The BSB model fleet distribution uses project counts to determine the motorcycle, pickups/vans/SUV, and bus percentages. The remaining automobile distribution is divided between high, middle, and low performance vehicles. These characteristics are not part of the traffic count data, so the ODOT and KYTC relative proportions were averaged to allocate the remaining auto distributions. A comparison of the auto vehicle fleet information is summarized in Table 13.

Table 13: Auto Vehicle Fleet

Auto Vehicles Class	BSB Model	ODOT Default	KYTC Default
Motorcycles	0.3%	0.0%	0.0%
High Performance	14.6%	20.0%	5.5%
Middle Performance	39.6%	40.0%	21.9%
Low Performance	30.0%	30.0%	16.8%
Pickups/Vans/SUVs	14.9%	10.0%	55.3%
Buses	0.7%	0.0%	0.5%

NORMAL ACCELERATION

The KYTC TransModeler manual recommends modifications to the normal acceleration Beta parameter. The change in distribution for the Beta parameter results in slower accelerations for a portion of the modeled traffic. The TransModeler defaults and the parameters in the BSB model are shown in Table 14.

Table 14: Normal Acceleration

TransModeler Default		BSB Model (KYTC Recommendation)	
Percentage of Vehicles	Beta	Percentage of Vehicles	Beta
20	1.10	10	1.10
60	1.00	30	1.00
20	0.95	20	0.90
		20	0.88
		20	0.75

CAR FOLLOWING MODEL

The car following model is the Modified GM. The model coefficients are default except for the Alpha+ coefficient. The default is 1.81 and the calibrated model uses 2.31. This value is within the acceptable range outlined in the KYTC TransModeler manual, which states to calibrate the car following model by using Alpha values between 1.81 and 2.81. Increasing the alpha coefficient from 1.81 to 2.31 decreases roadway capacity. A range of values were tested during calibration, 2.31 was chosen based on the volume throughput for SB I-71/I-75 at the BSB. The NB direction warranted further reduction in the capacity, which is accounted for with the use of a local headway buffer parameter.

HEADWAY BUFFER

The headway buffer is identified in the OATS manual as a parameter to consider for adjustment during model calibration. This parameter can be applied locally or globally in the network. The headway buffer specifies the additional time that a driver prefers between themselves and another vehicle. Increasing the buffer time decreases the roadway capacity. During the calibration workflow, the headway buffer was tested after modification to the normal acceleration and car following model. The headway buffer was applied only to NB I-71/I-75 between Buttermilk Parkway and the Ohio side of the Brent Spence Bridge. The application of the parameters improves the convergence of the model for speeds, travel time, and volume throughput on the Brent Spence Bridge. Without the parameter applied, the model shows similar, but less severe travel delay patterns compared to field conditions. NB I-71/I-75 in Kentucky does have unique roadway characteristics with steep grades and panoramic views that would impact vehicle headways. A comparison of the default and proposed local headway buffer are summarized in Table 15.

Table 15: Headway Buffers

Percentage of Drivers	On Freeways (Sec)	
	Default	Local Application
10	0.00	0.03
10	0.02	0.06
10	0.03	0.09
10	0.04	0.12
10	0.05	0.15
10	0.06	0.18
10	0.07	0.21
10	0.07	0.24
10	0.09	0.27
10	0.10	0.30

SCENARIO ANALYSIS SUMMARIES

The 2019 Existing model was calibrated to field conditions as discussed in the last section. The models and volume temporal distributions were carried forward for the build concept models. There were three build scenarios modeled: Alternative I, and the two value engineering scenarios (Concept I-W and Concept I-M). Alternative I was modeled for comparison purposes as this configuration is the preferred alternative from 2012 EA. Alternative I was modeled with only the 2050 base traffic forecast as described in the volume development section. The value engineering concepts have two volume sets, the base volume and a secondary volume set for sensitivity testing that uses the district factoring approach. The district factoring volumes increase the traffic using the Brent Spence Bridge which is meant to approximate potential impacts of new travel patterns based on I-71/I-75 improvements. Both volume sets are available in the TransModeler files, and the operational results summarized in the appendices. However, for simplicity this section of the document will compare operational results using only the 2050 base forecasts that do not include the district factoring.

The build models make some modification from on the ground truths to ensure that the forecasted traffic is reaching the Brent Spence Bridge project limits. These modeling overrides include:

- Internal I-275 Interchange traffic is removed from the model's O-D matrices. Future I-275 improvements are anticipated to alleviate congestion at the interchange and will not be a bottleneck for the I-71/I-75 project. Because I-275 operations are not reported, the traffic is removed for simplicity.
- Extra roadway lanes are added to I-71/I-75 between the I-275 Interchange and the southern project limits. This allows the full forecasted traffic to reach the Brent Spence Bridge for NB I-71/I-75 in the AM peak and exit the project limits for SB I-71/I-75 in the PM peak. The modeling assumption is that future projects will remove this external traffic bottleneck. These additional lanes do overlap with the southern portion of BSB corridor. Without these additional lanes, the models for all build concepts will show significant traffic delays for NB I-71/I-75 south of the project corridor and significant queueing for SB I-71/I-75 within the project corridor from the southern capacity constraint.

The following sections include modeling observations and high-level summary results for the year 2050 Alternative I, Concept I-M, and Concept I-W. Detailed traffic volume and traffic operations details are provided in Appendix C and Appendix D; the content of the appendices is listed below.

Appendix C: TransModeler Traffic Demand and Assigned Volume

- Line Diagram References:
    - These pdf's contain line diagrams of each scenario with ID's that are used for summarizing the traffic demand and operations data from TransModeler
    - These ID references are used in the *Scenarios Analysis Summaries* section of the report to identify segments in the operation summaries.
- Traffic Volume and Demand Spreadsheets:
    - These spreadsheets contain the TransModeler traffic volumes and traffic demand for each model scenario.
    - Traffic volume is the number of vehicles served on a link. The traffic volumes are summarized in 15 minute bins.

- Traffic demand is measured by TransModeler using the period O-D matrices, which are 5:30-10 AM and 1:30–7:00 PM.
    - The traffic demand is higher than the served traffic volume because it represents an additional 30-minute model duration.

Appendix D: TransModeler Traffic Operations

- Traffic Operations Spreadsheets
    - These spreadsheets contain the TransModeler operational outputs for each model scenario, including:
        - Level of Service (LOS)
        - Travel Speeds
        - Travel Times
        - Link Density
    - LOS is not a direct output from TransModeler but is approximated using density outputs and the LOS scale for basic freeways. This calculation is meant for a quick comparison between design concepts as is not meant to directly correlate to Highway Capacity Manual results.
    - The LOS scale used in the spreadsheet is:
        - LOS A - < 11 veh/mi/ln
        - LOS B – 11 to 18 veh/mi/ln
        - LOS C – 18 to 26 veh/mi/ln
        - LOS D – 26 to 35 veh/mi/ln
        - LOS E – 35 to 45 veh/mi/ln
        - LOS F - > 45 veh/mi/ln
- Intersection Operations
    - These are output files from TransModeler for intersections for reference
    - Intersections were a secondary focus of the operations analysis.
    - Geometric modifications were only made for the NB 5th Street exit in Ohio to prevent freeway queuing and in coordination with KYTC to minimize right-of-way acquisition for the I-71/I-75 frontage road system.

A high-level operations summary of the I-71 and I-75 mainlines for the 2019 Existing, and 2050 scenarios is provided in Table 16. The Existing condition has reduced travel time for I-71 and I-75 in the peak travel direction (Northbound in AM peak and Southbound in PM peak). The reduced travel times for the peak directions are also present for the 2050 build scenarios, but are not as severe for Concept I-W and Alternative I. Concept I-M has significant travel delays for NB I-71/I-75 in the AM period; therefore, it is recommended that Concept I-M is excluded from further consideration as a value engineering concept to Alternative I.

Table 16: Average Modeled Travel Time During Peak Periods

Scenarios	I-75 NB: I-275 to I-75/74		I-75 SB: I-75/74 to I-275		I-71 NB: I-275 to Vine Street		I-71 SB: Vine Street to I-275	
	AM	PM	AM	PM	AM	PM	AM	PM
2019 Existing	20.9	13.0	11.8	20.1	17.2	9.2	9.0	9.6
2050 Concept I	13.5	12.6	11.5	13.5	10.2	8.6	8.5	9.3
2050 Concept I-W	13.6	12.6	12.2	13.0	9.8	8.7	8.5	9.3
2050 Concept I-M	27.5	12.7	11.9	13.0	25.4	8.7	8.4	9.6

2019 EXISTING

As shown in the Existing calibration section, NB I-71/I-75 is the peak direction in the AM period and SB I-71/I-75 is the peak direction in the PM period. These two peak period directions will be the focus of the results discussion for the build concepts. The existing model has maximum corridor travel delays of 16 minutes for NB I-71/75 in the AM peak and 17 minutes SB I-71/75 in the PM peak. Level of Service (LOS) F occurs for multiple hours for the roadway segments approaching the Brent Spence Bridge in the peak travel direction.

2050 ALTERNATIVE I

Alternative I is the preferred alternative from the 2012 EA. For modeling consistency between Alternative I and the two value engineering concepts, minor geometric adjustments were made on the Kentucky frontage road system between 12th Street and 4th Street; at the 5th Street intersection with Central Avenue in Ohio; and at the I-71 merge in Ohio. Otherwise, the concept was modeled as shown by the plan view in Appendix B. The design adjustments included in the TransModeler analysis are labeled on the plan view.

The TransModeler analysis was completed using the 2050 Base forecasts as outlined in the forecasting methodology section. Overall, Alternative I has acceptable traffic operations. The two areas of mainline freeway delays occur in the peak direction of travel: NB I-71/I-75 in the AM peak and SB I-71/I-75 in the PM peak. The travel delays are comparable to travel delays also identified for the value engineering concepts. Complete operational and traffic volume summaries are contained in Appendix C and D. A summary of the areas of traffic delays for the I-71/I-75 mainlines are discussed below.

NB I-71 Merge with Local I-71 Traffic

The freeway merge section in Ohio between NB I-71 mainline and the ramp from the NB I-71 local bridge results in traffic delays on the Brent Spence Bridge as detailed in Table 17.These delays last about 1-hour and are then resolved for the remainder of the AM period analysis.

Table 17: NB I-71 AM Period Travel Speeds (mph)

Link Name	ID	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30	9:45
I-71N North of I-75/I-71 Split	M-28	45	45	45	45	46	47	47	47	48	48	47	47	47	47	46	47
I-71 NB after Jillians Ramp	M-29	48	49	49	48	49	49	52	53	52	52	52	51	50	51	50	51
NB Brent Spence Bridge	M-30	57	57	56	34	20	19	48	57	58	58	58	58	58	58	57	57
1-71N North of Companion Bridge	M-31	51	49	30	13	11	11	23	54	55	54	55	54	54	54	53	54
I-71 N	M-32	56	56	56	56	56	56	56	56	57	57	57	57	57	57	57	57

SB I-71/I-75 from 9th Street to Kyles Lane

The SB I-71/I-75 mainline has a 5% incline between 12th Street and Kyles Lane (SB is uphill and NB is downhill). The steep incline combined with heavy traffic volumes results in reduced travel speeds on a portion of the SB I-71/I-75 mainline between 12th Street and Kyles Lane.

Table 18: SB I-71/I-75 PM Period Travel Speeds (mph)

Link Name	ID	2:00 PM	2:15 PM	2:30 PM	2:45 PM	3:00 PM	3:15 PM	3:30 PM	3:45 PM	4:00 PM	4:15 PM	4:30 PM	4:45 PM	5:00 PM	5:15 PM	5:30 PM	5:45 PM	6:00 PM	6:15 PM	6:30 PM	6:45 PM
Companion Bridge	M-20	57	57	57	57	58	58	58	58	57	58	58	59	59	58	58	58	58	58	57	58
Mainline South of Companion Bridge Merge	M-21	50	50	50	52	51	52	51	52	52	53	51	53	53	53	51	52	53	52	51	53
Mainline South of Companion CD	M-22	53	53	52	53	53	53	53	53	52	53	53	52	53	53	54	53	53	54	53	54
Mainline South of Bullock Ramp/12th	M-23	43	44	43	43	42	44	43	41	38	42	43	43	43	45	44	46	44	47	45	46
Mainline at Kyles	M-24	52	52	51	51	52	52	52	52	51	52	52	51	52	52	53	53	53	52	52	52
Mainline at Dixie Hwy	M-25	56	56	55	55	56	55	55	55	55	55	55	55	55	55	55	56	56	56	56	56
Mainline South of Kyles CD	M-26	55	55	54	54	55	55	55	55	54	54	54	55	54	55	55	55	55	55	55	55
Mainline South of Dixie Hwy	M-27	54	55	53	52	54	54	52	53	53	53	53	53	53	54	54	54	54	55	55	54

2050 CONCEPT I-M

Concept I-M was refined during the design modification phase of the project to address some operational concerns. The design changes include:

1) The addition of an eastbound through lane at the 5th Street intersection with Central Avenue in Ohio.
2) Right sizing of the Kentucky frontage road system to have acceptable operations and minimize right-of-way acquisition.
3) A new ramp between the NB Frontage Road north of 9th Street and I-71, which provides interstate access consistent with the existing conditions and the other build scenarios.

With these changes Concept I-M has acceptable operations for the off-peak directions, but still experiences major operational concerns for NB I-71 in the AM period and minor operational concerns for SB I-71/I-75 in the PM period. The major operational issues for NB I-71 in the AM period make Concept I-M an unacceptable value engineering concept. Further details on these operational findings are discussed below and a full summary of traffic demand, travel time, speed, and level of service are summarized in Appendix C and Appendix D.

NB I-71 in AM Period

Mainline NB I-71 in Concept I-M uses two travel lanes as it enters the existing Brent Spence Bridge span. Local and CD connections also merge or use an add lane on the existing bridge for a total of three lanes NB on the existing bridge. However, this add lane from 4th Street in Kentucky is dropped to the 2nd Street exit in Ohio, leaving only two travel lanes to connect to EB Fort Washington Way to NB I-75 and EB US 50. The two travel lanes are not adequate to accommodate the I-71 traffic demand in the AM peak period. Due to the capacity constraint, traffic queuing develops from the Brent Spence Bridge and extends south past I-275, impacting both I-71 and I-75 mainline traffic. The extent of the traffic queues are shown in Table 19, Figure 18, and Figure 19. These model results use the 2050 base forecasts.

Table 19: NB I-71 AM Period Travel Speeds (mph) – Concept I-M

Link Name	ID	6:00 AM	6:15 AM	6:30 AM	6:45 AM	7:00 AM	7:15 AM	7:30 AM	7:45 AM	8:00 AM	8:15 AM	8:30 AM	8:45 AM	9:00 AM	9:15 AM	9:30 AM	9:45 AM
Mainline South of Dixie Hwy	M-01	51	45	44	17	11	12	11	11	16	17	19	20	15	19	24	24
Mainline btw Dixie and Kyles	M-02	54	52	42	11	10	11	10	11	13	14	16	16	13	17	20	19
Mainline North of Kyles CD	M-03	50	49	22	11	11	12	10	13	15	16	18	17	13	19	22	21
Mainline North of Kyles ramp	M-04	50	43	16	12	14	13	12	15	16	17	17	16	14	18	19	18
Mainline North of 12th CD exit	M-05	47	30	20	18	21	19	17	26	25	31	35	23	23	32	39	39
1-71N North of I-75/I-71 Split	M-27	51	20	16	14	14	13	14	15	14	16	15	15	16	21	45	52
I-71N North of 5th Ramp	M-28	32	21	21	17	16	15	16	16	17	21	19	17	20	26	33	45
I-71N South of 4th Ramp	M-29	30	26	26	23	21	20	22	22	24	31	27	26	27	35	39	43
NB Brent Spence Bridge	M-30	23	23	25	25	24	24	26	27	29	30	26	27	29	35	34	49
1-71N North Companion Bridge	M-31	40	41	43	45	45	42	44	46	46	44	43	43	43	42	44	49
1-71N East of 2nd Ramp	M-32	53	52	53	54	53	53	54	56	54	54	55	54	54	54	53	53
I-71 N	M-33	54	54	54	54	54	53	54	54	54	54	54	54	54	54	54	54

Figure 18: I-75 NB Traffic Queues (part 1) – Concept I-M

Figure 19: I-71/I-75 Traffic Queues (part 2) – Concept I-M

2050 CONCEPT I-W

Overall, Concept I-W has acceptable traffic operations. The off-peak directions continue to operate acceptably as they do in the other concepts. The AM period has a travel delay for NB I-71 similar to Alternative I and in the PM period SB I-71/I-75 has travel delays similar to other build scenarios. During the design refinement stage of the project many of the operational concerns for Concept I-W were addressed. The design changes include:

1) Modification of the lane alignment for the NB I-75 CD road from the existing Brent Spence Bridge through the US-50 exit.
2) The addition of an eastbound through lane at the 5th Street intersection with Central Avenue in Ohio.
3) Right-sizing of the Kentucky frontage road system to have acceptable operations and minimize right-of-way acquisition
4) Extension of the merge area between NB I-71 and the NB I-71/I-75 CD prior to entering Fort Washington Way.
    a. A longer merge area is desired, but design constraints limit the merge taper length to 950'.

Using the final Concept I-W design, the traffic operations are level of service E or better on the freeway mainlines for all periods with the exception of two locations: (1) NB I-71 merge with I-71/I-75 CD in the AM

peak and (2) SB I-71/I-75 between 12th Street and Kyles Lane in the PM peak. These locations have travel delays that start within the modeled period and are resolved prior to the end of the period when using the 2050 base forecasts. The 2050 forecasts with district factoring (sensitivity test) intensifies the travel delay for these two movements and reveals one more area of concern, the NB I-71/I-75 CD road, which results in some traffic delays from the Ohio River to 12th Street on the CD road. The design modifications listed above are recommended based on the model results using both model volume sets. Further refinements to address these remaining issues are outside the design refinements targeted for this analysis. The two areas with travel delays using the 2050 base volume set are described in more detail below. The full documentation of travel time, volume, and speed metrics for Concept I-W are summarized in Appendix C and Appendix D.

NB I-71 Merge with I-71/I-75 CD

NB I-71 mainline uses the companion bridge and has a merge with a ramp from the NB I-71/I-75 CD road from the existing BSB. The merging of these two roads causes traffic delays and queues onto the companion bridge impacting I-71/I-75 mainline traffic. The delays at the ramp merge last for 75 minutes while the delays on the companion bridge last for 30 minutes. During the design refinements, the merge taper length was extended from 400' to 950'. This change improved the operations and limited the extent of traffic delays. A longer merge area is desirable but is not feasible with the concept's current configuration. Some of the design constraints for these two ramps include:

- The end of the current taper is constrained by an existing retaining wall and utilities
- The beginning of the merge is restricted on the west and south by railroad clearance requirements
- The horizontal curve is restricted on the south by limited clearance between NB I-71 and NB I-75 CD

Figure 20: Traffic Queuing at I-71 Merge

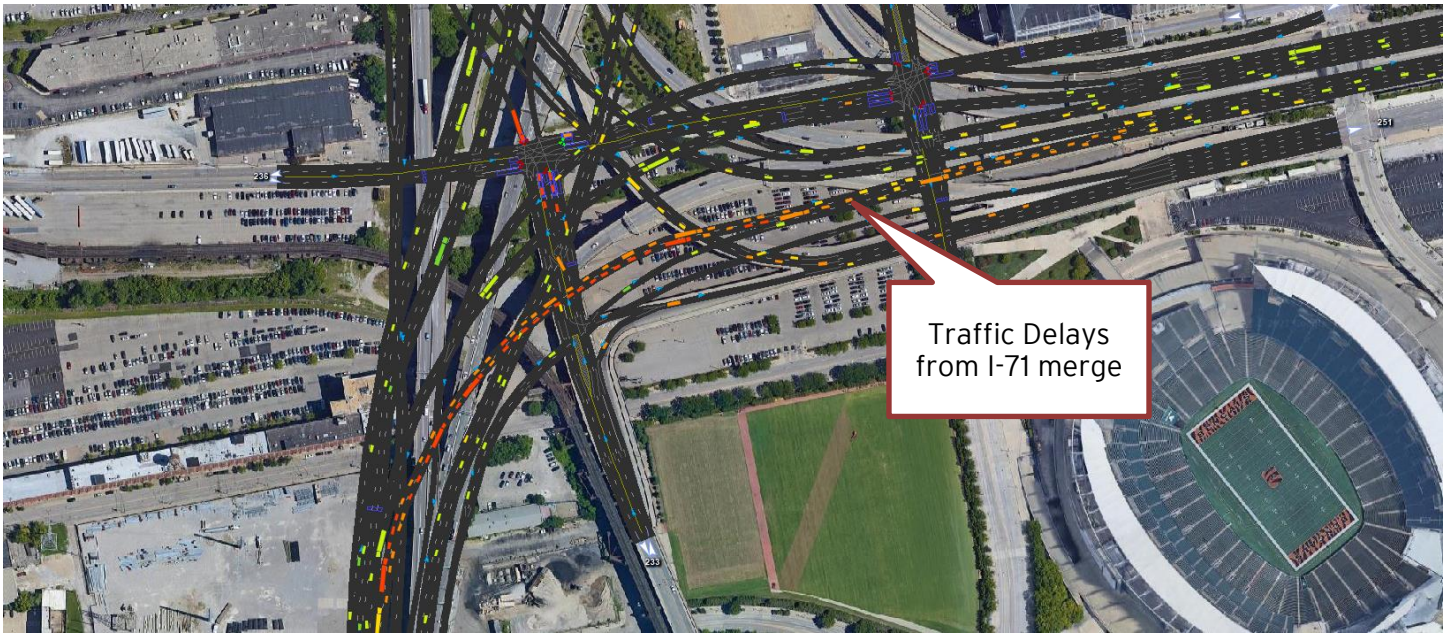


Table 20: AM I-71 NB Travel Speeds (mph) – Concept I-W

Link Name	ID	6:00 AM	6:15 AM	6:30 AM	6:45 AM	7:00 AM	7:15 AM	7:30 AM	7:45 AM	8:00 AM	8:15 AM	8:30 AM	8:45 AM	9:00 AM	9:15 AM	9:30 AM	9:45 AM
Mainline North of 12th CD exit	M-05	52	51	51	51	51	51	54	54	54	54	54	54	54	54	54	54
Companion Bridge	M-06	57	57	57	54	29	22	57	58	58	58	58	58	58	58	58	58
1-71 NB off Companion Bridge	M-25	56	56	45	20	12	12	29	57	57	58	57	57	57	58	57	58
I-71 NB after BSB merge	M-26	45	41	28	21	20	20	29	49	50	49	48	48	49	50	50	52
I-71 NB	M-27	56	56	55	55	55	54	55	56	57	57	57	56	57	57	57	57
I-71 WB	M-28	58	58	58	57	58	56	57	57	57	58	58	58	59	59	58	58
I-71 SB btw BSB and Companion ramps	M-29	59	59	58	58	58	58	59	59	59	57	58	58	58	58	58	58
I-71 SB before Companion Bridge	M-30	54	55	55	55	55	55	56	55	55	54	54	53	54	54	53	53

SB I-71/I-75 12th Street to Kyles Lane

SB I-71/I-75 has a +5% grade between 12th Street and Kyles Lane. The steep grade along with high PM period traffic volumes result in travel delays on the roadway section between 12h Street and Kyles Lane in Kentucky. All three concepts experience similar travel delays in this section. Figure 21 and Table 21 show the extent of the speed reductions. The traffic delays are contained between Kyles Lane and 12th Street and do not impact the companion bridge.

Figure 21: Traffic Delays for SB I-71/I-75 in PM Period

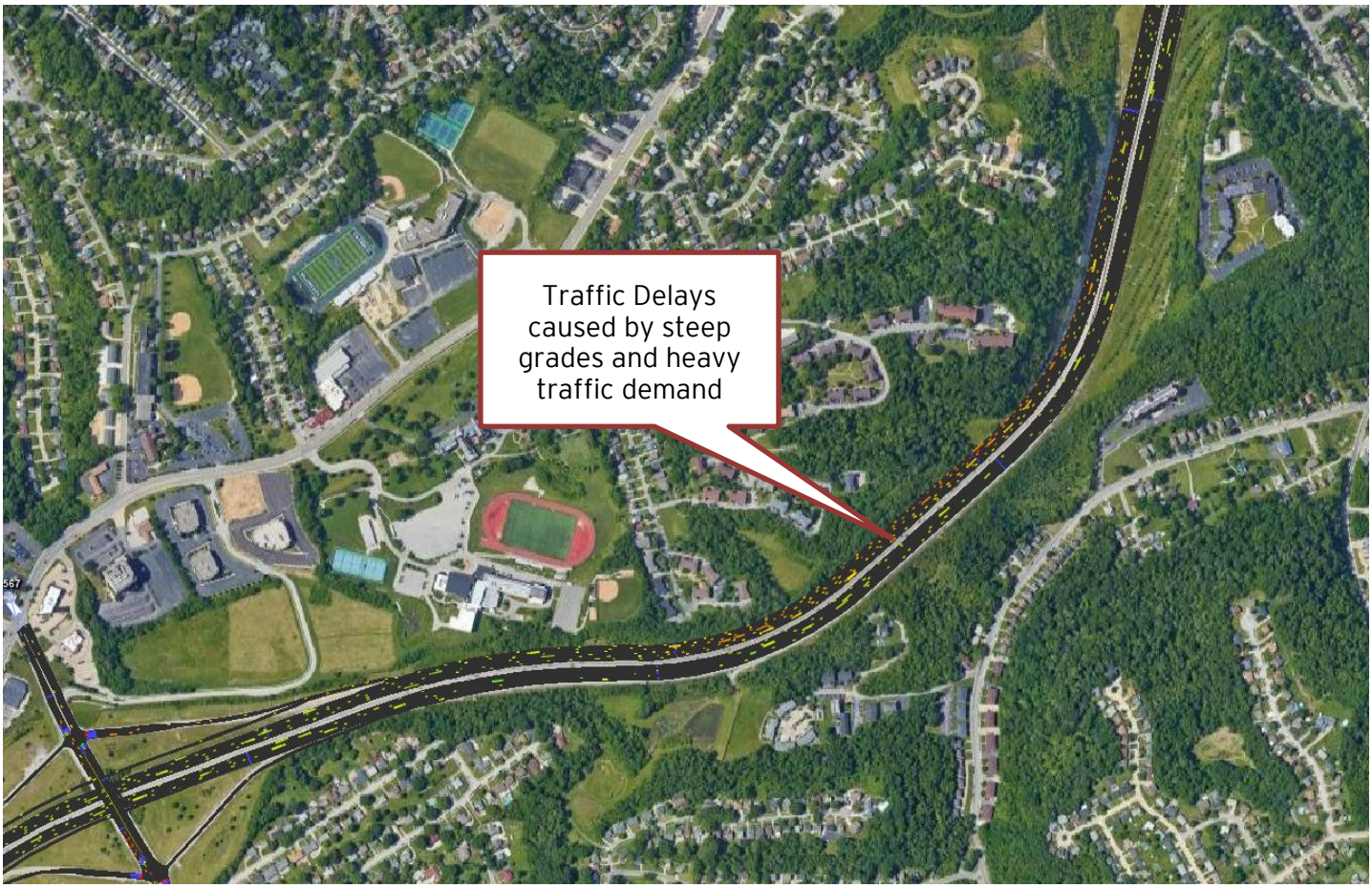


Table 21: PM I-71/I-75 SB Travel Speeds (mph) – Concept I-W

Link Name	ID	2:00 PM	2:15 PM	2:30 PM	2:45 PM	3:00 PM	3:15 PM	3:30 PM	3:45 PM	4:00 PM	4:15 PM	4:30 PM	4:45 PM	5:00 PM	5:15 PM	5:30 PM	5:45 PM	6:00 PM	6:15 PM	6:30 PM	6:45 PM
Companion Bridge	M-19	54	55	55	55	55	55	55	55	56	56	56	56	57	57	56	56	56	56	56	56
Mainline North of Bullock Ramp	M-20	55	55	55	55	55	55	54	54	54	54	54	54	55	55	55	55	55	56	56	56
Mainline South of Bullock Ramp	M-21	42	44	43	41	43	42	39	37	38	41	40	39	42	44	41	41	45	44	45	45
Mainline btw Dixie and Kyles	M-22	55	55	54	54	55	55	54	54	54	54	54	55	55	55	55	55	55	55	55	55
Mainline at Dixie Hwy	M-23	54	54	54	53	53	52	53	51	52	52	52	53	53	52	52	54	54	53	53	53
Mainline South of Dixie Hwy	M-24	54	54	54	52	53	52	53	52	53	52	52	53	53	54	53	54	54	54	54	54

CONCLUSION

Traffic operations analysis using TransModeler and refined alternative traffic forecasts developed from the OKI travel demand model were completed for the Brent Spence Bridge Corridor. The Existing TransModeler files were validated to 2019 AM and PM peak periods. The forecast O-D matrices represent a 2050 condition. The existing modeling indicates operational deficiencies, especially for NB I-71/I-75 in the AM peak period and SB I-71/I-75 in the PM peak period. Two value engineering concepts were evaluated and compared to Alternative I (preferred alternative from 2012 EA). The operations analysis indicates Concept I-W has acceptable traffic operations while Concept I-M experiences excessive traffic queues for NB I-71/I-75 in the AM peak period. Based on this analysis, it is recommended that Concept I-W is carried forward as a value engineering concept to Alternative I and Concept I-M should be excluded from further consideration. Additional operational analysis is recommended to refine the concept during final design.

Appendix A: Traffic Count Documentation

Brent Spence Bridge Corridor - Intersection Counts				
Count ID	Intersection	State	Source	Year
BSBSC Int 1	I-71/I-75 SB & Buttermilk Pike	KY	BSBC	2017
BSBSC Int 2	I-71/I-75 NB & Buttermilk Pike	KY	BSBC	2017
BSBSC Int 3	I-71/I-75 SB & Dixie Highway	KY	BSBC	2017
BSBSC Int 4	I-71/I-75 NB & Dixie Highway	KY	BSBC	2017
BSBSC Int 5	I-71/I-75 SB & Kyles Lane	KY	BSBC	2017
BSBSC Int 6	I-71/I-75 NB & Kyles Lane	KY	BSBC	2017
BSBSC Int 7	I-71/I-75 NB & 12th Street	KY	BSBC	2017
BSBSC Int 8	I-71/I-75 SB & Bullock Street	KY	BSBC	2017
BSBSC Int 9	I-71/I-75 NB & Pike Street	KY	BSBC	2017
BSBSC Int 10	I-71/I-75 SB & Pike Street	KY	BSBC	2017
BSBSC Int 11	4th Street & Crescent Avenue	KY	BSBC	2017
BSBSC Int 12	5th Street & Crescent Avenue	KY	BSBC	2017
124231	Clay Wade Bailey & 2nd Street	OH	TMMS	2018
137131	Central Avenue & 8th Street	OH	TMMS	2018
146031	Linn Street & 8th Street	OH	TMMS	2021
145531	Linn Street & Gest Street	OH	TMMS	2021
145431	US 50 Ramp & Gest Street	OH	TMMS	2021
145631	Freeman Avenue & Gest Street	OH	TMMS	2021
145731	Western Avenue & Gest Street	OH	TMMS	2021
145931	Winchell Avenue & EB Ezzard Charles	OH	TMMS	2021
150931	Winchell Avenue & WB Ezzard Charles	OH	TMMS	2021
146231	Western Avenue & EB Ezzard Charles	OH	TMMS	2021
151031	Western Avenue & WB Ezzard Charles	OH	TMMS	2021
147631	Winchell Avenue & Liberty Street	OH	TMMS	2021
147531	Western Avenue & Liberty Street	OH	TMMS	2021
147231	Winchell Avenue & Findlay Street	OH	TMMS	2021
147331	Western Avenue & Findlay Street	OH	TMMS	2021
146931	Winchell Avenue & Bank Street	OH	TMMS	2021
146831	Spring Grove Avenue & Bank Street	OH	TMMS	2021
146531	Winchell Avenue & Harrison Avenue	OH	TMMS	2021
146431	Spring Grove Avenue & Harrison Avenue	OH	TMMS	2021
146331	Western Hills Viaduct & Central Parkway	OH	TMMS	2021

Directional Link Traffic Counts in TransModeler Study Limit					
ID	Location Description	State	Source	Count Year	Count Type
KEN0255NB	NB I-71/I-75 at Brent Spence Bridge	OH/KY	OKI	2019	15 min volume
KEN0255SB	SB I-71/I-75 at Brent Spence Bridge	OH/KY	OKI	2019	15 min volume
18731	Ramp from US-50 EB to 2nd	OH	TMMS	2018	15 min class
30931	NB Winchell Ave to Findlay St	OH	TMMS	2018	15 min class
40231	Ramp I-75 SB to Hopple St	OH	TMMS	2018	15 min class
53199	Winchell Dr, ramp from Gest to Winchell Ave	OH	TMMS	2018	15 min class
59431	I-74 WB ramp to Montana Ave	OH	TMMS	2018	15 min class
79131	Ramp, I-75 SB to I-74 WB	OH	TMMS	2018	15 min class
79431	I-75 NB ramp to Hopple St	OH	TMMS	2018	15 min class
79531	I-75 SB to Western Hills Viaduct WB	OH	TMMS	2018	15 min class
79631	EB Western Hills Viaduct to I-75 SB	OH	TMMS	2018	15 min class
79731	I-75 SB exit to Findlay St.	OH	TMMS	2018	15 min class
79831	EB Western Hills Viaduct to I-75 NB	OH	TMMS	2018	15 min class
81431	Ramp, I-74 EB to I-75 NB	OH	TMMS	2018	15 min class
81731	I-75 NB entrance from Freeman	OH	TMMS	2018	15 min class
81831	I-75 NB entrance from Ezzard Charles	OH	TMMS	2018	15 min class
81931	Ramp, I-75 NB from Hopple St	OH	TMMS	2018	15 min class
84631	Ramp, Linn St to EB 6th St	OH	TMMS	2018	15 min class
85631	Ramp, I-75 SB from WB Hopple St	OH	TMMS	2018	15 min class
89631	Ramp, I-75 NB to WHV WB	OH	TMMS	2018	15 min class
89931	I-75 SB Exit at Ezzard Charles	OH	TMMS	2018	15 min class
90031	I-75 SB Exit at Freeman	OH	TMMS	2018	15 min class
90131	Western Entrance ramp to I-75 SB	OH	TMMS	2018	15 min class
90231	Ramp from Winchell Avenue to I-75 NB	OH	TMMS	2018	15 min class
90831	Ramp, I-74 EB to Beekman	OH	TMMS	2018	15 min class
90931	Ramp, Beekman to I-74 EB	OH	TMMS	2018	15 min class
103631	Ramp, I-71 NB to 2nd St W	OH	TMMS	2018	15 min class
104331	Ramp, I-71 SB to I-75 NB	OH	TMMS	2018	15 min class
104531	Ramp, 3rd WB to I-7I SB	OH	TMMS	2018	15 min class
104831	Ramp, I-75 NB to 5th St	OH	TMMS	2018	15 min class
104931	Ramp, I-75 NB to US 50 WB	OH	TMMS	2018	15 min class
105231	Ramp, 9th to I-75 SB	OH	TMMS	2018	15 min class
105431	Ramp, US 50 EB to I-75 SB	OH	TMMS	2018	15 min class
108231	Ramp, I-75 SB to 5th St (Ohio)	OH	TMMS	2018	15 min class
117131	Ramp, 4th to I-75 NB	OH	TMMS	2018	15 min class
134031	Ramp, I-74 WB ON to S	OH	TMMS	2018	15 min class
134131	Ramp, I-74 WB ON to S	OH	TMMS	2018	15 min class
138231	Ramp, Hopple St to I-75 NB	OH	TMMS	2018	15 min class
138331	Ramp, Winchell Ave (north of Bank St) to I-75 NB	OH	TMMS	2018	15 min class
139631	Ramp, I-71/Central Ave to Winchell/Ezzard	OH	TMMS	2018	15 min class
139731	Winchell Ave, 350' northwest of 9th	OH	TMMS	2018	15 min class
147931*	Winchell Ave, btw Bank & Harrison	OH	TMMS	2021	15 min class
148831	Winchell Ave, btw Findlay & Bank	OH	TMMS	2021	15 min class
149131	Western Ave, btw Liberty St & Ezzard Charles	OH	TMMS	2021	15 min class
149231	Winchell Ave, btw Liberty St & Ezzard Charles	OH	TMMS	2021	15 min class
149331	WB Ezzard Charles, btw Western & Winchell	OH	TMMS	2021	15 min class

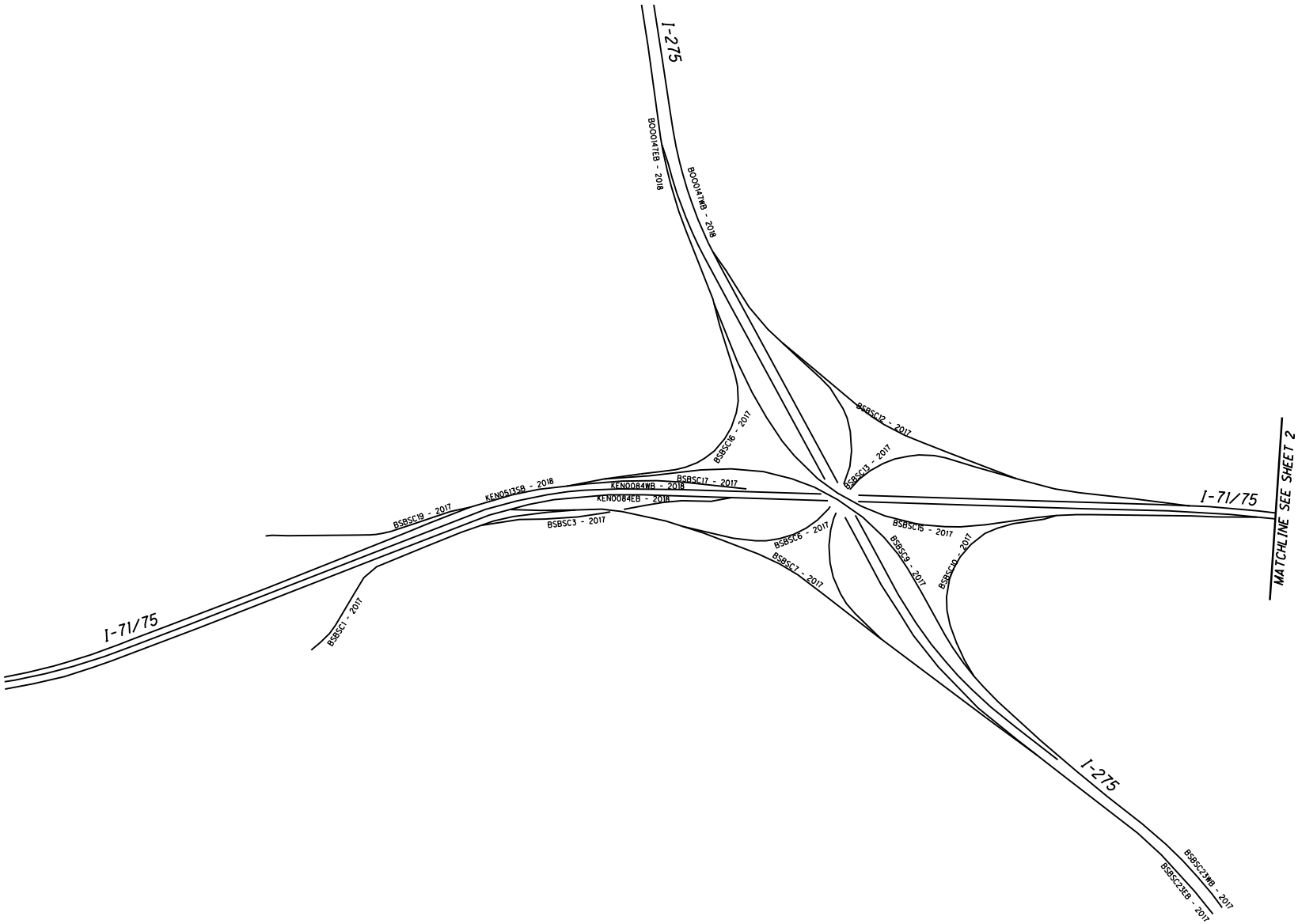
Directional Link Traffic Counts in TransModeler Study Limit					
ID	Location Description	State	Source	Count Year	Count Type
149431	EB Ezzard Charles, btw Western & Winchell	OH	TMMS	2021	15 min class
149631	Western Ave north of Gest	OH	TMMS	2021	15 min volume
151331	Ramp from 7th St to Gest St	OH	TMMS	2021	15 min class
151431	Ramp from Gest St to 7th St	OH	TMMS	2021	15 min class
103199EB	EB Findlay St, btw Dalton & I-75	OH	TMMS	2018	15 min class
103199WB	WB Findlay St, btw Dalton & I-75	OH	TMMS	2018	15 min class
104631NB	I-71/I-75 NB to I-71 NB	OH	TMMS	2018	15 min class
105131NB	Ramp, 6th St to I-75 NB	OH	TMMS	2018	15 min volume
105331SB	I-75 SB, btw 7th & 9th	OH	TMMS	2018	15 min class
105631SB	Ramp, US 50 EB to I-71 NB	OH	TMMS	2018	15 min class
105731SB	Ramp, I-71 SB to US 50 WB	OH	TMMS	2018	15 min class
105831NB*	I-75 NB, south of 5th St	OH	TMMS	2018	15 min class
108131SB	Ramp, I-75 SB to 2nd St	OH	TMMS	2018	15 min class
117031SB*	Ramp, I-71 SB to I-75 SB	OH	TMMS	2018	15 min class
123931EB	US 50 EB, 250' west of Freeman	OH	TMMS	2021	15 min class
12531WB	WB 9th to Central Ave	OH	TMMS	2018	15 min class
12931NB	NB Central Ave btw Pete Rose Way & 3rd	OH	TMMS	2018	15 min class
12931SB	SB Central Ave btw Pete Rose Way & 3rd	OH	TMMS	2018	15 min class
13031NB	NB Central Ave btw McFarland & 4th	OH	TMMS	2018	15 min class
13031SB	SB Central Ave btw McFarland & 4th	OH	TMMS	2018	15 min class
13231NB	NB Central Ave at Ezzard Charles	OH	TMMS	2018	15 min class
137131NB	I-75 NB, 250' north of Findlay St	OH	TMMS	2018	15 min class
137131SB	I-75 SB, 250' north of Findlay St	OH	TMMS	2018	15 min class
13731NB	NB Central Pkwy btw Addison St & Marshall Ave	OH	TMMS	2018	15 min class
13731SB	SB Central Pkwy btw Addison St & Marshall Ave	OH	TMMS	2018	15 min class
137631NB	NB Central Pkwy, 200' north of Brighton Pl	OH	TMMS	2021	15 min class
137631SB	SB Central Pkwy, 200' north of Brighton Pl	OH	TMMS	2021	15 min class
138131NB	Ramp, I-75 NB to I-74 WB	OH	TMMS	2018	15 min class
143531EB	EB Harrison Ave, btw I-75 & Winchell Ave	OH	TMMS	2021	15 min class
143531WB	WB Harrison Ave, btw I-75 & Winchell Ave	OH	TMMS	2021	15 min class
147731EB*	EB WHV at Spring Grove Ave	OH	TMMS	2021	15 min class
147731WB*	WB WHV at Spring Grove Ave	OH	TMMS	2021	15 min class
147831SB*	SB Spring Grove Ave, btw Harrison Ave & Bank St	OH	TMMS	2021	15 min volume
148031EB	EB Harrison Ave, btw Winchell Ave & Patterson St	OH	TMMS	2021	15 min class
148031WB	WB Harrison Ave, btw Winchell Ave & Patterson St	OH	TMMS	2021	15 min class
148531EB	EB Bank St, btw Dalton & Winchell	OH	TMMS	2021	15 min class
148531WB	WB Bank St, btw Dalton & Winchell	OH	TMMS	2021	15 min class
148631EB	EB Bank St, btw Winchell & Colerain	OH	TMMS	2021	15 min volume
148631WB	WB Bank St, btw Winchell & Colerain	OH	TMMS	2021	15 min volume
148931EB	EB Findlay St, btw Western & I-75	OH	TMMS	2021	15 min class
148931WB	WB Findlay St, btw Western & I-75	OH	TMMS	2021	15 min class
149031EB	EB Liberty St, btw Western & Winchell	OH	TMMS	2021	15 min class
149031WB	WB Liberty St, btw Western & Winchell	OH	TMMS	2021	15 min class
149531EB	EB Gest St btw Dalton & Western	OH	TMMS	2021	15 min class
149531WB	WB Gest St btw Dalton & Western	OH	TMMS	2021	15 min class
149831EB	EB Gest St, btw Freeman & Linn	OH	TMMS	2021	15 min class

Directional Link Traffic Counts in TransModeler Study Limit					
ID	Location Description	State	Source	Count Year	Count Type
149831WB	WB Gest St, btw Freeman & Linn	OH	TMMS	2021	15 min class
150031NB	NB Linn Ave, btw Gest St & 8th St	OH	TMMS	2021	15 min volume
150031SB	SB Linn Ave, btw Gest St & 8th St	OH	TMMS	2021	15 min volume
150131EB	EB 8th St east of Linn St	OH	TMMS	2021	15 min class
150131WB	WB 8th St east of Linn St	OH	TMMS	2021	15 min class
150231NB	NB Mound St, btw Richmond St & 9th St	OH	TMMS	2021	15 min class
150231SB	SB Mound St, btw Richmond St & 9th St	OH	TMMS	2021	15 min class
1503198EB	EB MLK, btw MLK & Dixmyth	OH	TMMS	2018	15 min class
1503198WB	WB MLK, btw MLK & Dixmyth	OH	TMMS	2018	15 min class
150331WB	WB 9th St, btw Winchell & Central	OH	TMMS	2021	15 min class
150431EB	EB Gest St, btw 6th St & 8th St	OH	TMMS	2021	15 min class
151531SB	I-75 SB South of 8th St	OH	TMMS	2021	15 min class
15931EB*	EB 3rd btw Clay Wade Bailey & Central Ave	OH	TMMS	2018	15 min class
15931WB*	WB 3rd btw Clay Wade Bailey & Central Ave	OH	TMMS	2018	15 min class
27131EB	EB Ramp conn US 50 EB to 5th	OH	TMMS	2018	15 min class
27231WB	WB 6th Ramp to US 50 WB, west of Central Ave	OH	TMMS	2018	15 min class
27531WB	WB 6th to Central Ave	OH	TMMS	2018	15 min class
3131EB	EB Freeman Ave btw 8th & Gest	OH	TMMS	2018	15 min class
3131WB	WB Freeman Ave btw 8th & Gest	OH	TMMS	2018	15 min class
38731SB	SB Central Pkwy, 100 ft N of College Dr	OH	TMMS	2015	15 min volume
39231NB	Ramp I-75 NB to I-74 WB	OH	TMMS	2018	15 min class
40131EB	WB Hopple St, enter at I-75 SB ramp	OH	TMMS	2018	15 min class
40131WB	WB Hopple St, enter at I-75 SB ramp	OH	TMMS	2018	15 min class
5253198NB	NB McMillan St, btw McMicken Ave & Clemmer Ave	OH	TMMS	2018	15 min class
5253198SB	SB McMillan St, btw McMicken Ave & Clemmer Ave	OH	TMMS	2018	15 min class
5313198NB*	NB Dalton Ave, btw Findlay & York St	OH	TMMS	2021	15 min class
5313198SB*	SB Dalton Ave, btw Findlay & York St	OH	TMMS	2021	15 min class
5393198SB	SB Western Ave, btw Liberty St & Findlay St	OH	TMMS	2021	15 min class
59331EB	I-74 EB ramp from Montana Ave	OH	TMMS	2018	15 min class
79231SB	Ramp, I-74 EB to I-75 SB	OH	TMMS	2018	15 min class
79331NB	I-75 NB ramp from Hopple St	OH	TMMS	2018	15 min class
81531EB	I-75 SB Exit to Seventh St	OH	TMMS	2018	15 min class
81631NB	Ramp, 6th St to I-75 NB	OH	TMMS	2018	15 min class
91031WB	Ramp, I-74 WB to Beekman	OH	TMMS	2018	15 min class
93199EB	EB W 3rd St, btw Gest & Clay Wade Bailey	OH	TMMS	2018	15 min class
93199WB	WB W 3rd St, btw Gest & Clay Wade Bailey	OH	TMMS	2018	15 min class
9631NB	NB Central Ave btw 5th & 6th	OH	TMMS	2018	15 min class
9631SB	SB Central Ave btw 5th & 6th	OH	TMMS	2018	15 min class
9731NB	NB Central Ave btw 6th & 7th	OH	TMMS	2018	15 min class
9731SB	SB Central Ave btw 6th & 7th	OH	TMMS	2018	15 min class
9831EB	EB 7th Ave to Plum St	OH	TMMS	2018	15 min class
HAM0547NB	NB I-75 E of Spring Grove Ave	OH	OKI	2018	15 min volume
HAM0547SB	SB I-75 E of Spring Grove Ave	OH	OKI	2018	15 min volume
HAM0903EB	EB US 50 E of Gest St	OH	OKI	2018	15 min volume
HAM0903WB	WB US 50 E of Gest St	OH	OKI	2018	15 min volume
HAM1754EB	NB I-75 S of Clifton Ave	OH	OKI	2018	15 min volume

Directional Link Traffic Counts in TransModeler Study Limit					
ID	Location Description	State	Source	Count Year	Count Type
HAM1754WB	SB I-75 S of Clifton Ave	OH	OKI	2018	15 min volume
HAM1804NB	I-75 NB, south of Monmouth Ave	OH	OKI	2018	15 min volume
HAM1804SB	SB I-75 N of Hopple St	OH	OKI	2018	15 min volume
HAM2664EB	EB I-74 E of North Bend Rd	OH	OKI	2018	15 min volume
HAM2664WB	WB I-74 E of North Bend Rd	OH	OKI	2018	15 min volume
059001NB*	NB Clay Wade Bailey Bridge	KY	KYTC	2019	15 min class
059001SB*	SB Clay Wade Bailey Bridge	KY	KYTC	2019	15 min class
059801NB*	I-275 NB East of Madison Pike Exit	KY	KYTC	2019	60 min class
059801SB*	I-275 SB East of Madison Pike Exit	KY	KYTC	2019	60 min class
059C19EB	EB Dixie Hwy btw Saint Johns Rd and Fortside Dr	KY	KYTC	2021	15 min volume
059C19WB	WB Dixie Hwy btw Saint Johns Rd and Fortside Dr	KY	KYTC	2021	15 min volume
059C46	I-75 NB ramp from Buttermilk Pike	KY	KYTC	2020	15 min volume
059C47	Ramp from I-75 NB to Buttermilk Pike	KY	KYTC	2020	15 min volume
059C48	Ramp from Buttermilk Pike to I-75 NB	KY	KYTC	2020	15 min volume
059C49	Ramp from I-75 SB to Buttermilk Pike	KY	KYTC	2020	15 min volume
059C50	Ramp from Buttermilk Pike to I-75 SB	KY	KYTC	2020	15 min volume
059C71EB	EB MLK Blvd btw Main St and Lee St	KY	KYTC	2021	15 min class
059C71WB	WB MLK Blvd btw Main St and Lee St	KY	KYTC	2021	15 min class
059C76NB	NB Philadelphia St btw 3rd St and 4th St	KY	KYTC	2019	15 min volume
059C76SB	SB Philadelphia St btw 3rd St and 4th St	KY	KYTC	2019	15 min volume
059C78	4th St east of Crescent Ave	KY	KYTC	2021	15 min volume
059D22EB	EB Kyles Lane at I-75	KY	KYTC	2021	15 min volume
059D22WB	WB Kyles Lane at I-75	KY	KYTC	2021	15 min volume
059D72EB	EB Kyles Lane btw I-75 and Kennedy Rd	KY	KYTC	2021	15 min volume
059D72WB	WB Kyles Lane btw I-75 and Kennedy Rd	KY	KYTC	2021	15 min volume
059D75	5th St btw Crescent Ave and I-75	KY	KYTC	2020	15 min volume
059D76	4th St btw I-75 and Philadephia St	KY	KYTC	2019	15 min volume
059D77	EB 5th Street west of Philadelphia	KY	KYTC	2016	60 min volume
059H34	Ramp from I-75 NB to 12th/MLK Blvd	KY	KYTC	2019	15 min volume
059M56	Ramp from 4th Street to SB I-71/I-75	KY	KYTC	2019	15 min volume
059N01	Ramp from I-75 NB to Kyles Lane	KY	KYTC	2019	15 min volume
059N02	Ramp from Kyles Lane to I-75 NB	KY	KYTC	2019	15 min volume
059N03	Ramp from I-75 SB to Kyles Lane	KY	KYTC	2019	15 min volume
059N04	Ramp from Kyles Lane to I-75 SB	KY	KYTC	2019	15 min volume
059N05	Ramp from NB I-71/I-75 to Dixie Hwy	KY	KYTC	2020	15 min volume
059N06	Ramp from Dixie Hwy to I-75 NB	KY	KYTC	2020	15 min volume
059N07	Ramp from I-75 SB to Dixie Hwy	KY	KYTC	2020	15 min volume
059N08	Ramp from Dixie Hwy to I-75 SB	KY	KYTC	2020	15 min volume
BOO0147EB	EB I-275 E of Mineola Pk	KY	OKI	2018	15 min volume
BOO0147WB	WB I-275 E of Mineola Pk	KY	OKI	2018	15 min volume
BSBSC1	Donaldson Road to I-75 NB and I-275	KY	BSBSC	2017	15 min volume
BSBSC10	I-275 WB to I-75 NB	KY	BSBSC	2017	15 min volume
BSBSC12*	I-75 S to I-275 WB	KY	BSBSC	2017	15 min volume
BSBSC13	I-75 SB to I-275 EB	KY	BSBSC	2017	15 min volume
BSBSC15	I-275 EB to I-75 NB	KY	BSBSC	2017	15 min volume
BSBSC16	I-275 EB to I-75 SB	KY	BSBSC	2017	15 min volume

Directional Link Traffic Counts in TransModeler Study Limit					
ID	Location Description	State	Source	Count Year	Count Type
BSBSC17	I-75 SB to C-D	KY	BSBSC	2017	15 min volume
BSBSC19	I-75 CD SB to Donaldson Road WB	KY	BSBSC	2017	15 min volume
BSBSC23EB	I-275 East of I-71/I-75	KY	BSBSC	2017	15 min volume
BSBSC23WB	I-275 WB East of I-71/I-75	KY	BSBSC	2017	15 min volume
BSBSC3	Donaldson Road to I-275	KY	BSBSC	2017	15 min volume
BSBSC41	12th Street to I-75 NB	KY	BSBSC	2017	15 min volume
BSBSC44	Ramp, I-75 NB to 5th St	KY	BSBSC	2017	15 min volume
BSBSC6	I-75 NB and Donaldson Road to I-275 WB	KY	BSBSC	2017	15 min volume
BSBSC7	I-75 NB and Donaldson Road to I-275 EB	KY	BSBSC	2017	15 min volume
BSBSC9	I-275 WB to I-75	KY	BSBSC	2017	15 min volume
KEN0057EB	NB I-71/I-75 South of Dixie Hwy	KY	OKI	2018	15 min volume
KEN0057WB	SB I-71/I-75 South of Dixie Hwy	KY	OKI	2018	15 min volume
KEN0075EB	I-71/I-75 SB south of Buttermilk Pike	KY	OKI	2018	15 min volume
KEN0075WB	I-71/I-75 NB south of Buttermilk Pike	KY	OKI	2018	15 min volume
KEN0084EB	NB I-75 South of I-275	KY	OKI	2018	15 min volume
KEN0084WB	SB I-75 South of I-275	KY	OKI	2018	15 min volume
KEN0337	Ramp from 4th Street to NB I-71/I-75	KY	OKI	2019	15 min volume
KEN0338	Ramp from SB I-71/I-75 to 5th Street	KY	OKI	2019	15 min volume
KEN0471EB	I-71 NB, btw Kyles Lane & 12th St	KY	OKI	2018	15 min volume
KEN0471WB	I-71 SB, btw Kyles Lane & 12th St	KY	OKI	2018	15 min volume
KEN0513SB	SB I-71/I-75 CD W of SR 236	KY	OKI	2018	15 min volume

* Indicates a count that was flagged as an outlier during the TransModeler volume development



LEGEND

XX - XX = COUNT ID - COUNT YEAR

● *INTERSECTION COUNTS*

N

0 200 400 800

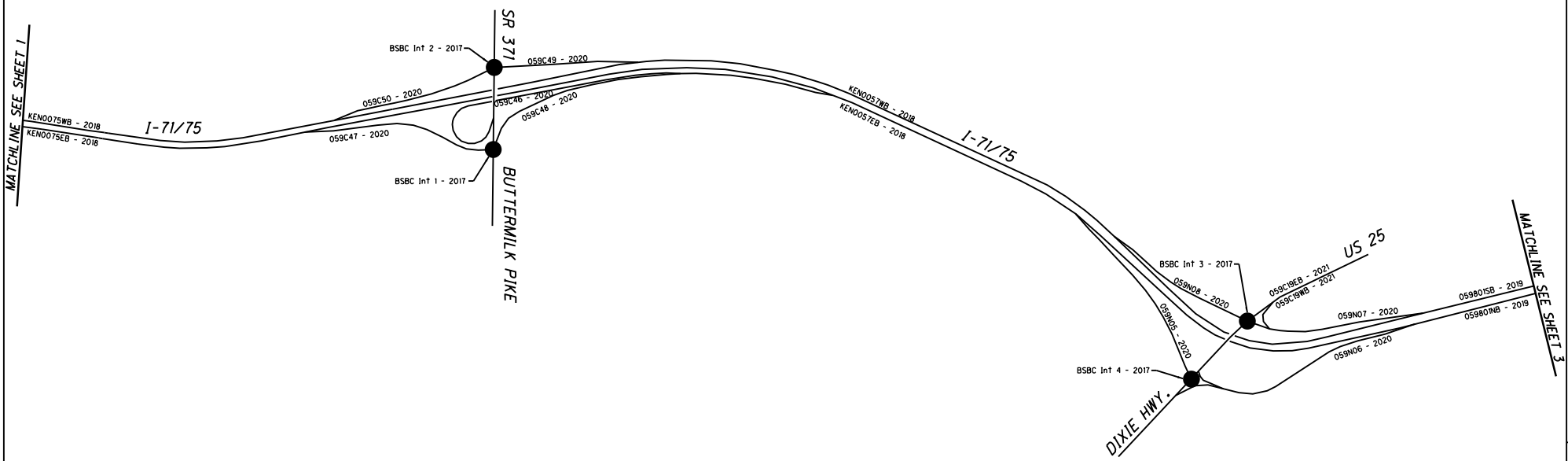
ANALYST

DATE 11/21/2021

BRENT SPENCE BRIDGE PROJECT
TRAFFIC COUNT PLATES

ODOT PROJECT HAM-71/75-0.00-0.22
KYTC PROJECT ITEM NO. 6-17

1/6



LEGEND

XX - XX = COUNT ID - COUNT YEAR

● *INTERSECTION COUNTS*

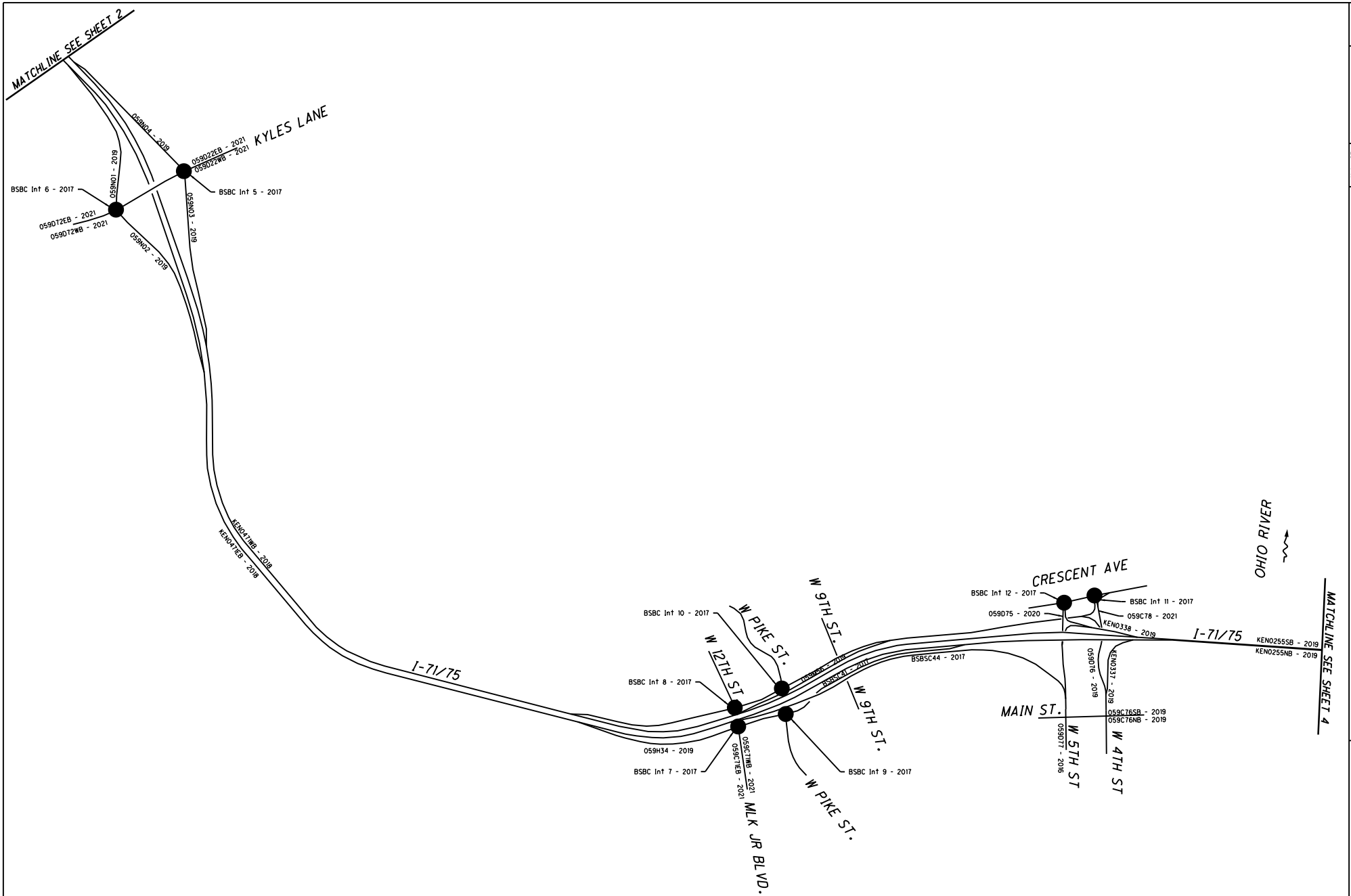
0 200 400 800

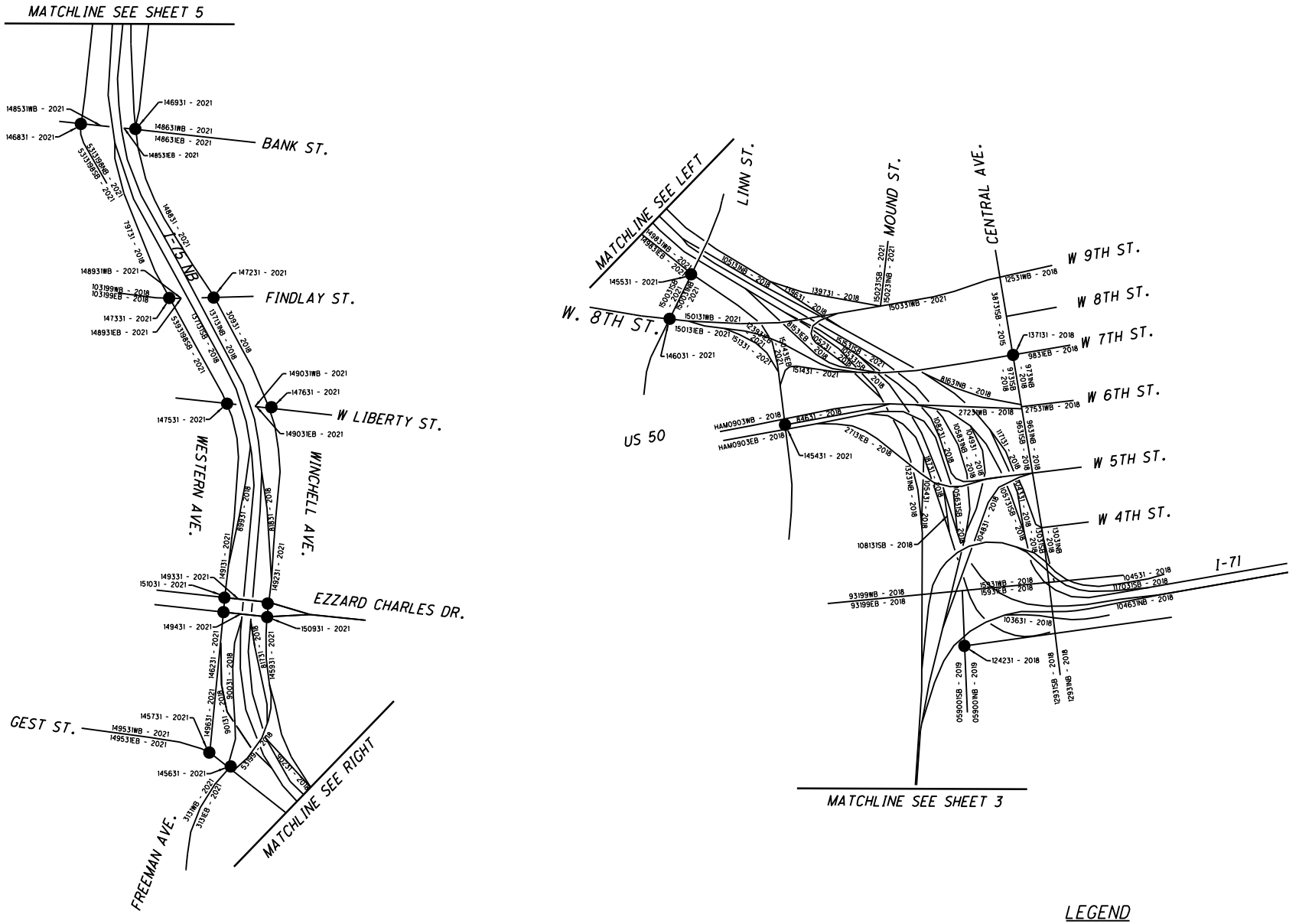
ANALYST

DATE 11/2/2021

BRENT SPENCE BRIDGE PROJECT
TRAFFIC COUNT PLATES

ODOT PROJECT HAM-71/75-0.00-0.22
KYTC PROJECT ITEM NO. 6-17


MATCHLINE SEE SHEET 2
KYLES LANE
059N04 - 2019
059N01 - 2019
059N03 - 2019
059N02 - 2019
059D22EB - 2021
059D22WB - 2021
BSBC Int 5 - 2017
BSBC Int 6 - 2017
059D72EB - 2021
059D72WB - 2021
KEN0417WB - 2018
KEN0417EB - 2018
I-71/75
059H34 - 2019
BSBC Int 7 - 2017
059C71WB - 2021
059C71EB - 2021
MLK JR BLVD.
BSBC Int 8 - 2017
W 12TH ST
BSBC Int 10 - 2017
W PIKE ST.
W 9TH ST.
W 9TH ST.
BSBC Int 9 - 2017
W PIKE ST.
BSBSC44 - 2017
CRESCENT AVE
BSBC Int 12 - 2017
059D75 - 2020
BSBC Int 11 - 2017
059C78 - 2021
KEN0338 - 2019
I-71/75
KEN0255SB - 2019
KEN0255NB - 2019
OHIO RIVER
MATCHLINE SEE SHEET 4
MAIN ST.
059D76 - 2019
KEN0337 - 2019
059C76SB - 2019
059C76NB - 2019
W 5TH ST
059D77 - 2016
W 4TH ST
LEGEND
XX - XX = COUNT ID - COUNT YEAR
INTERSECTION COUNTS
N
0
200
400
800
ANALYST
DATE
11/12/2021
BRENT SPENCE BRIDGE PROJECT
TRAFFIC COUNT PLATES
ODOT PROJECT HAM-71/75-0.00-0.22
KYTC PROJECT ITEM NO. 6-17
3
6



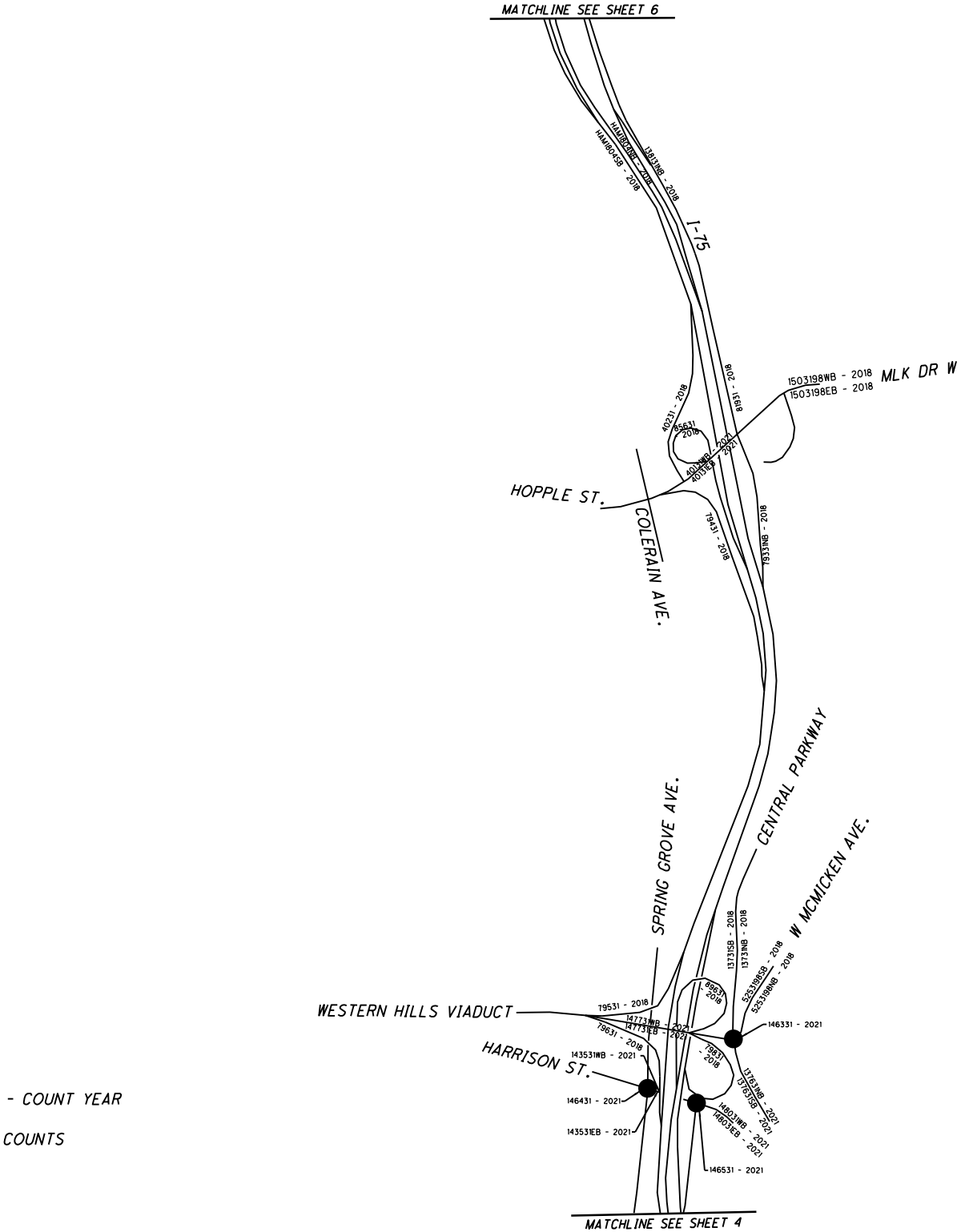
ANALYST

DATE 11/12/2021

BRENT SPENCE BRIDGE PROJECT
TRAFFIC PLATES

ODOT PROJECT HAM-71/75-0.00-0.22
KYTC PROJECT ITEM NO. 6-17

4
6



LEGEND

XX - XX = COUNT ID - COUNT YEAR

● INTERSECTION COUNTS

N

0 200 400 800

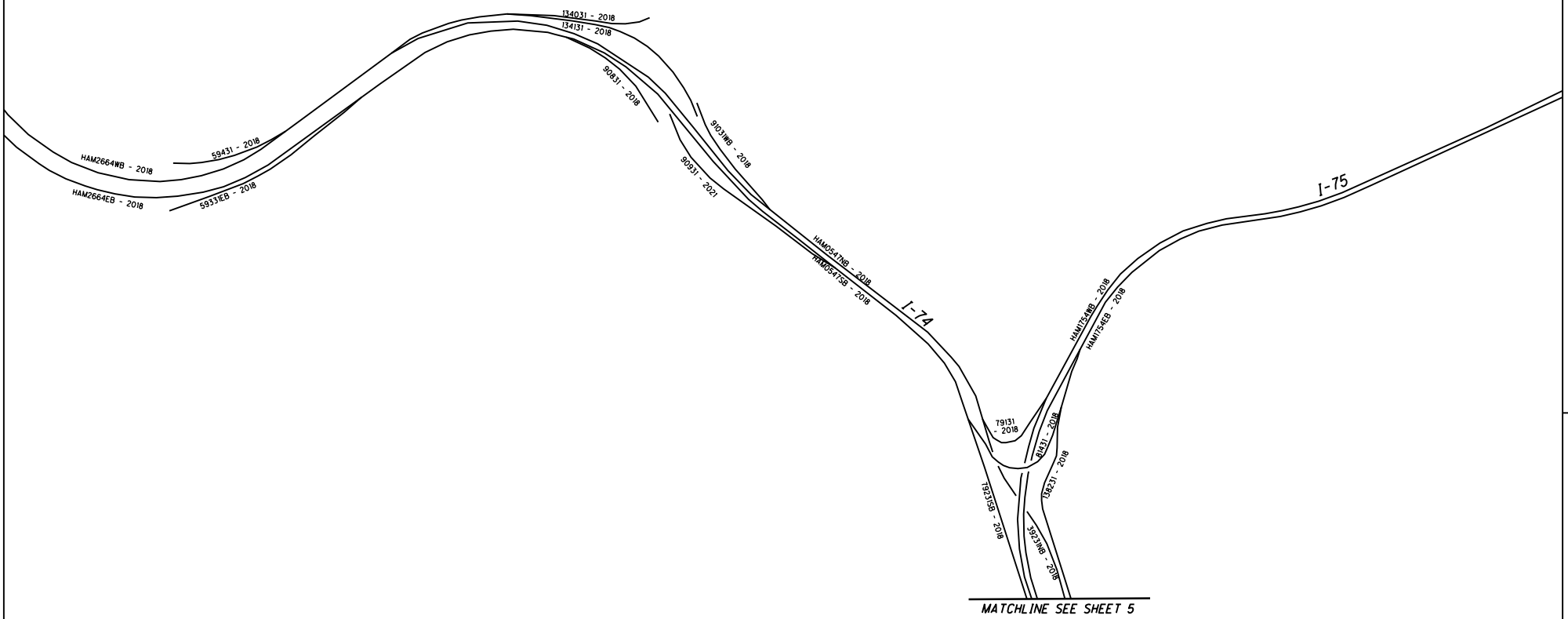
ANALYST

DATE 11/2/2021

BRENT SPENCE BRIDGE PROJECT
TRAFFIC COUNT PLATES

ODOT PROJECT HAM-71/75-0.00-0.22
KYTC PROJECT ITEM NO. 6-17

5
6



LEGEND

XX - XX = COUNT ID - COUNT YEAR

● *INTERSECTION COUNTS*

N

0 200 400 800

ANALYST

DATE 11/21/2021

BRENT SPENCE BRIDGE PROJECT
TRAFFIC COUNT PLATES

ODOT PROJECT HAM-71/75-0.00-0.22
KYTC PROJECT ITEM NO. 6-17

6
6

Appendix B: Design Layouts

Alternative I

Concept I-M

Concept I-W

(See Project files)

Appendices available *upon request*

Appendix C: TransModeler Traffic Demand and Assigned Volume

2019 Existing

2050 Concept I

2050 Concept I-M

2050 Concept I-W

(See Project Files)

Appendices available *upon request*

Appendix D: TransModeler Traffic Operations

2019 Existing

2050 Concept I

2050 Concept I-M

2050 Concept I-W

(See Project Files)

Appendices available *upon request*

Appendix E: OKI Model Validation Report

(See Project Files)

Appendices available *upon request*