BRENT SPENCE BRIDGE CORRIDOR

Moving the Economy,
Creating Jobs

BRENT SPENCE BRIDGE PROJECT

ANALYSIS OF DESIGN CONCEPTS

MAY 2020

STATE OF OHIO DEPARTMENT OF TRANSPORATION

KENTUCKY TRANSPORTATION CABINET

HNTB

1. EXECUTIVE SUMMARY

1.1 PROJECT HISTORY

In March 2012, an Environmental Assessment was prepared for the Brent Spence Bridge (BSB) project to analyze impacts to the natural and human environment for two feasible alternatives for improving the I-71/I-75 Corridor in Kentucky and Ohio. In August 2012, the Federal Highway Administration (FHWA) issued a Finding of No Significant Impact (FONSI) identifying the selected alternative for the BSB project. This selected alternative is referred to as Alternative I.

Two primary studies were conducted since 2013 to evaluate potential tolling solutions and to consider potential eastern bypass solutions. Each of these studies collected traffic counts and used travel demand models to forecast traffic volumes on the Brent Spence Bridge (BSB).

In 2019, the Kentucky Transportation Cabinet (KYTC) and the Ohio Department of Transportation (ODOT) determined that a review of the traffic data and forecasts from the previous studies should be conducted prior to moving forward with the Brent Spence Bridge (BSB) project. The goal of this new study was to provide concurrence between KYTC and ODOT on the traffic baseline and forecasts, and to develop and analyze additional concepts that meet the corridor goals and provide potential construction cost savings.

1.2 STUDY ACTIONS

Since the Fall of 2019, several traffic and design activities have progressed to establish an updated baseline for traffic counts and forecasts, perform traffic modeling, and evaluate practical design concepts for the BSB Corridor that could reduce construction costs. These efforts include:

Traffic Counts, Modeling and Forecast Review - December 2019

A review of the existing traffic counts, modeling and forecasts was conducted utilizing the data from the BSB studies conducted since 2013. For this *Traffic Counts, Modeling and Forecast Review* (Appendix 6.5), the 2040 regional travel demand model from the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) was utilized to project future traffic volumes. The BSB traffic projections include proposed improvements to the bridge and I-71/I-75 corridor in Kentucky and Ohio based on the current selected Alternative I and assumed no tolling.

Based on these efforts, KYTC and ODOT established the following criteria for the BSB project:

- The baseline traffic volume 160,000 vehicles per day (VPD) will be used for any additional near-term studies.
- The 2040 Toll Free estimated traffic volume of 227,900 VPD will be used in any near-term design and traffic studies.
- OKI is developing an updated regional travel demand model for year 2050 with current travel and census data. This model will be incorporated into the traffic forecasts for the BSB project when complete, and the forecasts will be extended to 2050.

Performance-Based Design Workshop - December 2019

In recent years, both KYTC and ODOT adopted a performance-based practical design philosophy that allows for engineering judgement to be used in the application of standards to develop a "right-sized," fundable project. The purpose of this effort was to apply this performance-based practical design philosophy to identify new concepts for the BSB corridor to reduce the overall cost of the project. This included a review of the design goals that led to the identification of Alternative I as the selected overall design for the corridor in 2012.

During the workshop, three concepts were developed for further analysis to determine the feasibility of the physical construction as well as the ability to handle traffic flows:

- Concept M - This design keeps many of the same traffic movements and local connections on the existing BSB as they are today, including both directions of I-71. The new bridge carries only I-75 and connections to and from the local street system along the west side of downtown.
- Concept W – This design has a similar mainline and ramp layout through the corridor as Alternative I. However, all interstate traffic for I-71 and I-75 is carried on the new bridge, and all local connectivity is accommodated via the existing BSB.
- Concept S – This design of the bridges and mainline approaches are similar to Concept W. However, the local roadway networks in Ohio and Kentucky are designed as a "super street."

TransModeler Calibration and Results - May 2020

TransModeler was utilized to evaluate travel time, speeds, and capacity along the mainline, ramps, and local streets for all three concepts developed at the Workshop. The analyses are presented in the *TransModeler Calibration and Results* report (Appendix 6.6).

During initial analysis of Concept S, the Ohio super street design was found to not be feasible as envisioned, due to physical design constraints. With additional analysis, it was also determined that the Kentucky super street design could not accommodate the high volume of circulating traffic without significant widening for additional lanes and traffic control. Therefore, Concept S was removed from further study.

The horizontal and vertical design of the remaining concepts were refined, and the alignments were integrated into the traffic models. The refined designs were compared to Alternative I to determine cost savings.

1.3 RECOMMENDATIONS

Based on the design and operational characteristics, Concept S is recommended to be removed from further study due to fatal flaws in the design and traffic operations. Concept M and Concept W are viable concepts that would provide significant cost savings on the project. It is recommended that both concepts be carried forward for more detailed analysis.

2. PURPOSE OF STUDY

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. The bridge also facilitates local travel by providing access to downtown Cincinnati, Hamilton County, Ohio and Covington, Kenton County, Kentucky. This corridor is also one of the busiest trucking routes in the US, connecting Michigan to Florida via I-75.

The Brent Spence Bridge (BSB) opened in 1963 and was originally designed to carry 80,000 vehicles per day (VPD). The March 2012 Brent Spence Bridge Project - Environmental Assessment listed traffic counts on the bridge at 160,000 VPD with projections of 233,000 VPD in 2035 with no tolling.

Two primary studies were conducted since 2013. The *Brent Spence Bridge Corridor Study (BSBC Study)* in 2013-2015 included the continued development of the Brent Spence project incorporating the potential for financing using tolling. The *Brent Spence Strategic Corridor Study (Strategic Corridor Study)* in 2017 included the development and evaluation of Brent Spence Bridge bypass concepts, including the proposed Cincinnati Eastern Bypass (CEB). Both the *BSBC Study* and the *Strategic Corridor Study* obtained traffic counts and used the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) travel demand model to forecast traffic in 2040. Since May 2019, OKI has set up continuous traffic counters on the BSB and other nearby bridges over the Ohio River.

The purpose of this study is to conduct a review of the traffic data and forecasts from the previous studies to establish an updated baseline for traffic forecasts and evaluate practical design concepts for the BSB corridor that could reduce costs. Microsimulation was selected as the traffic analysis tool for project scoping due to the complexity of the I-71/I-75 system interchange. The model developed for the *Strategic Corridor Study* was updated and calibrated appropriately for this project scoping. It was recognized that a more comprehensive calibrated model will be required for analysis to support the project NEPA document and Interstate Access Request (IAR).

3. STUDY PROCESS

3.1 TRAFFIC COUNTS, MODELING, AND FORECAST REVIEW

Traffic counts were taken on the Brent Spence Bridge at various times and by various methods by project stakeholders since 2013. These include counts used for the 2015 ODOT certified traffic; counts in 2017 used for the KYTC *Strategic Corridor Study*; and counts in 2019 from OKI continuous count stations on the Brent Spence Bridge and other nearby bridges over the Ohio River. The studies and counts have shown comparable results for existing traffic volumes.

A review of the traffic modeling and forecasts was also conducted utilizing the data from these earlier BSB studies. The 2040 regional travel model from OKI was utilized to project future traffic volumes. The BSB traffic projections include proposed improvements to the bridge and I-71/I-75 corridor in Kentucky and Ohio based on the current selected Alternative I and assumed no tolling.

Based on these efforts, KYTC and ODOT established the following criteria for the BSB project:

- The baseline traffic volume 160,000 VPD will be used for any additional near-term studies.
- The 2040 Toll Free estimated traffic volume of 227,900 VPD will be used in any near-term design and traffic studies.
- OKI is developing an updated regional travel demand model for year 2050 with current travel and census data. This model will be incorporated into the traffic forecasts for the BSB project when complete, and the forecasts will be extended to 2050.

3.2 PERFORMANCE-BASED DESIGN WORKSHOP

In December 2019, a performance-based design workshop was held with members of ODOT, KYTC, FHWA and HNTB in attendance. The goal of the workshop was to identify concepts that could reduce the construction cost of selected Alternative I for the BSB corridor. The workshop was spurred by KYTC's and ODOT's adoption of a performance-based design methodology that would allow for the consideration of new ideas and initiatives that were not available in previous iterations.

A key point of discussion at the workshop was the design goals for the current selected Alternative I. It was decided that the potential to produce significant cost savings, rather than strict adherence to the previous design goals, should be the driving factor for developing new concepts. At the meeting, it was decided that:

- A 55 MPH (posted speed limit) design speed would be acceptable for interstate 71 and 75 (Alternative I had a 60 MPH design speed).
- Ramps with approved design exceptions from the Fort Washington Way Project would not be required to be modified to meet current standards as part of the BSB project.
- System-to-system connections of I-71, I-75 and US 50 could be from the left lane.
- System-to-system connections should not be made on the collector-distributer roadways, if possible.
- Collector-Distributor roadways could have lower speeds than 55 mph if the system-to-system connections were removed, but they must provide sufficient capacity so as not to queue onto the interstate.
- Vertical clearance was to meet state standards (15.5' for ODOT and 16.5' for KYTC).
- Cost/benefit analysis would be used to determine if it was feasible to design outside the project footprint evaluated in the 2012 Environmental Assessment.

The performance-based design workshop identified three new concepts for the BSB project for further traffic operational and design study. These concepts and the results of the additional study are discussed in the following sections.

4. CONCEPTS CONSIDERED

The three concepts identified in the performance-based design workshop were labeled as Concept M, Concept W, and Concept S and were evaluated using TransModeler to determine any fatal flaws with traffic operations or geometric layout. Construction cost estimates were also prepared to compare the new concepts with selected Alternative I.

Traffic volumes were redistributed for each of the concepts and assigned to the appropriate mainline, ramp and local street section. This allowed for a high-level review of capacity and anticipated number of lanes for each concept. TransModeler software was used to evaluate travel time, speeds, and capacity along the mainline, ramps, and local streets. The analysis followed an iterative process of geometric modifications and redistribution of traffic movements to further refine each concept.

Horizontal and vertical geometry were designed to meet the requirements as determined in the workshop. Vertical clearances were checked using ConceptStation, which estimates structure depth based on pier spacing. ConceptStation utilizes FHWA design criteria to add superelevation in the design to be more accurate on vertical clearance checks. ConceptStation also allowed for quick calculations of retaining wall quantities. The analysis of the additional concepts is summarized in the following sections.

4.1 CONCEPT M

In Concept M, all I-71 traffic will be on the existing Brent Spence Bridge (as it is today), and all I-75 traffic will be on the new bridge. Local traffic connectivity will be distributed to both bridges, with many connections to the existing bridge remaining. I-71 traffic on the Ohio side will utilize the existing structures in both directions. Both I-71 approach bridges north of the BSB will be widened to 3 lanes to support the projected volume of traffic. Bridges that connect I-71 and US 50 in both directions over 3rd Street will remain in place.

Traffic movements and bridge cross sections for Concept M are shown in Appendix 6.1 and described below:

- I-71 SB local traffic will only be able to exit in Kentucky at 5th Street and will navigate the local network to reach locations farther south.
- I-75 SB local traffic will only be able to exit at 9th Street in Kentucky and will navigate the local network to reach locations farther north.
- Local I-75 SB traffic entering in Cincinnati will connect to I-75 SB without navigating the local street network.
- The I-75 NB exits to 5th Street and Winchell/Ezzard Charles in Ohio will use the new bridge with mainline I-75 NB traffic.
- Local Kentucky residents traveling to 5th Street and Winchell/Ezzard Charles in Ohio will need to enter I-75 NB just north of 9th Street.
- The 4th Street entrance ramp in Kentucky will take vehicles to I—71 NB, 2nd Street and US 50 EB and WB.
- The I-75 SB collector-distributor (C-D) system will still have exits in Ohio to 7th Street, 5th Street and 2nd Street.
- A new connection will be added from the I-75 SB C-D system to exit at 3rd Street across from the Clay Wade Bailey Bridge, similar to Alternative I.
- An entrance ramp in Ohio across from the Clay Wade Bailey bridge will provide access to the I-75 NB C-D system that can continue along Winchell or enter onto I-75 NB south of Ezzard Charles.

Concept M utilized 55 MPH design speeds for all interstate movements. The C-D systems were designed at a minimum of 45 MPH, with ramp design speeds variable based on ramp design standards. Concept M does not impact areas outside of the current footprint evaluated in the 2012 Environmental Assessment.

Concept M performed acceptably and has shown to be feasible for advancement and refinement in further studies. The main issue of concern occurs in the AM peak at the diverge of I-71/I-75 northbound. In the current design as modeled, there are 5 lanes approaching the major diverge, with the two right lanes traveling to the existing BSB and the three left-most lanes traveling to the new bridge. The traffic performs at the LOS E/LOS F threshold, and becomes so dense that a "rolling queue" is formed.

To improve this rolling queue, consideration was given to the addition of a third lane on the approach to the existing BSB, with the approaching middle lane at the diverge operating as an option lane. However, with the original concept as designed and modeled, the plan was for the existing bridge to have only 3 lanes, to allow for adequate shoulders (instead of the 4 lanes that exist today.) An additional third lane from the diverge could be achieved, but one of the 3 lanes would have to be dropped prior to meeting the 4th Street entrance ramp on the bridge.

Upon review of the design plans, it was determined that this additional lane could physically be built and a merge designed after the 5th Street off-ramp and before meeting the existing bridge. A quick check of the model with this option lane revealed no congestion downstream. There was still a slowdown at the diverge, but a notable improvement from the design without the option lane. For this reason, the design of Concept M shown in Appendix 6.1, and the costs included in Appendix 6.4, include this additional lane. However, the overall model runs and associated graphics do not reflect this change. Consideration of number of lanes and lane assignments on the existing bridge should be analyzed in further studies, as part of the process to determine the preferred alternative for the BSB Corridor.

The construction cost for Concept M was developed as a cost reduction from Alternative I. Retaining walls, new structures and structure removal quantities were compared between Concept M and Alternative I. All other quantities were viewed to be the same or have a minimal impact to the overall cost. In Kentucky, Concept M is ~$24M less through the elimination of a long bridge structure. In Ohio, Concept M is ~$175M less by eliminating retaining walls and utilizing existing bridges, which reduces the amount of new bridge to be constructed and the removal of the old bridges. For the new river crossing, Concept M is ~$185M less by reducing the lane width of the structure from 172' to 133'. The total savings for Concept M relative to Alternative I was found to be ~$384M. (See Appendix 6.4 and Page 9)

4.2 CONCEPT W

The Concept W design will change the location of the mainline and C-D system on the existing Brent Spence Bridge and the new river crossing. In Concept W, all the local traffic (C-D system) will be on the existing bridge and all interstate traffic will be on the new bridge.

Traffic movements and bridge cross sections for Concept W are shown in Appendix 6.2 and described below:

- SB local traffic will be on the upper deck of the existing bridge and NB local traffic will be on the lower deck of the existing bridge. This is due to the short distance available for the NB 4th Street entrance ramp in Kentucky.
- The SB local exit to 5th Street in Kentucky will be a left hand exit due to horizontal and vertical constraints that will push the exit profile above an 8 percent downgrade.
- All SB local traffic will have access to the 5th Street exit, the 9th Street exit and the 12th Street entrance onto the interstate in Kentucky.

- The NB local route will provide connections to NB I-71/EB US 50, NB I-75, WB US 50, 2nd Street, 5th Street and Winchell/Ezzard Charles in Ohio.
- A new connection will be added from the I-75 SB C-D system to 3rd Street across from the Clay Wade Bailey Bridge, similar to Alternative I.
- An entrance ramp in Ohio across from the Clay Wade Bailey bridge will provide access to the I-75 NB C-D system that can continue along Winchell or enter onto I-75 NB south of Ezzard Charles.
- An additional 12 feet of width will be added across the new river bridge to accommodate future maintenance.

Concept W design speeds for all movements are within 5 MPH of the selected Alternative I design speeds. Concept W does not impact areas outside of footprint evaluated in the 2012 Environmental Assessment.

Concept W performs the best out of the three alternatives analyzed. The southbound I-75 exit to the Kentucky local network is on the LOS D/LOS E threshold. This diverge could be reconfigured as the concept is further refined to improve traffic operations. Otherwise, Concept W performs at LOS D or better within the project area.

The construction cost for Concept W was developed as a cost reduction from Alternative I. New retaining walls, new structure costs and the new river crossing were compared. In bridges other than the new river crossing, Concept W was ~$26M less than Alternative I due to the width reduction at each end of the new bridge. Concept W required new walls for an additional cost of ~$11M. The new river crossing width was reduced from 172' to 119' which had a cost reduction of ~$246M. The total savings for Concept W relative to Alternative I was found to be ~$261M. (See Appendix 6.4 and Page 9)

4.3 CONCEPT S AND CONCEPT WS

Concept S includes the construction of an at-grade superstreet in both Kentucky and Ohio. The superstreet will eliminate structures crossing the mainline at 6th Street and 7th Street in Ohio and will eliminate two braided ramps in Kentucky. System-to-system connections between I-71, I-75 and US 50 will be direct and not part of the superstreet movements. However, due to the proximately of each exit/entrance on the Ohio side and the associated high volume of weaving traffic, the resulting unsafe operation was deemed a fatal flaw for this concept. (See Appendix 6.3)

While the Ohio side of the superstreet failed the basic traffic operational analysis, the super street in Kentucky appeared to function effectively and was incorporated into a new Concept WS - a hybrid design of Concept W in Ohio and Concept S in Kentucky. In Kentucky, all local SB traffic not traveling to the interstate will exit at 5th Street at a new signalized intersection. The local SB traffic will then merge with traffic from Bullock, similar to other concepts. (See Appendix 6.3)

Initial analysis concluded that Concept WS was not a viable option. The superstreets in this concept move trips through a series of signalized intersections, that would otherwise be on an access-controlled freeway ramp system. The traffic signals could not accommodate the traffic moving through the superstreets and the traffic on intersecting east-west local roads. This inability to accommodate the traffic movements, and the associated unsafe conditions due to queuing, proved to be a fatal flaw for Concept WS.

5. RECOMMENDATIONS

Concept S and Concept WS are recommended to be removed from further study due to fatal flaws in traffic operations.

Concept M and Concept W are both considered viable options for the BSB corridor:

- Concept W separates local and interstate traffic. The total savings for Concept W relative to Alternative I was found to be approximately $261M.
- Concept M uses the new bridge for all I-75 traffic and keeps I-71 traffic on the existing BSB by maintaining existing connections in Ohio. The total savings for Concept M relative to Alternative I was found to be approximately $384M, or $123M less expensive than Concept W.

It is recommended that Concept M and Concept W be carried for further study. Consideration of other items should be a part of additional efforts to refine or eliminate concepts; such as safety, constructability, future maintenance, event traffic control, incident management, tolling logistics, and local connectivity.

Cost Comparison: Alternative I with Concept M and Concept W									
		Construction Costs (2017 Dollars)							
Contract #	Segment Description	Alternative I		Concept M		Alternative I		Concept W	
KY-7	I-75 Reconstruction from South Termini of 12th Street Interchange to New Bridge over Ohio River	Retaining Walls	$30,214,143	Retaining Walls	$55,096,387	Retaining Walls	$0	Retaining Walls	$11,448,699
		New Structures	$162,557,947	New Structures	$114,210,940	New Structures	$100,407,239	New Structures	$89,510,807
	Kentucky Totals		$192,772,090		$169,307,327		$100,407,239		$100,959,506
OH-7 (PID 89068)	I-75 Reconstruction from New Bridge over Ohio River to North of Linn Street	Retaining Walls	$23,209,947	Retaining Walls	$13,978,846	Retaining Walls	$0	Retaining Walls	$0
		New Structures	$271,680,043	New Structures	$117,390,822	New Structures	$189,161,276	New Structures	$173,691,021
		Remove Structures	$17,672,641	Remove Structures	$6,061,563	Remove Structures	$0	Remove Structures	$0
	Ohio Totals		$312,562,632		$137,431,231		$189,161,276		$173,691,021
	New River Crossing	New Bridge	$555,225,840	New Bridge	$369,649,988	New Bridge	$555,225,840	New Bridge	$308,998,818
	New River Crossing Totals		$555,225,840		$369,649,988		$555,225,840		$308,998,818
	Combined Totals		$1,060,560,561		$676,388,546		$844,794,355		$583,649,344
	Total Amount Saved with Concept M	$384,172,015							
	Total Amount Saved with Concept W					$261,145,011			

APPENDIX 6.1
CONCEPT M LAYOUT - KENTUCKY

APPENDIX 6.1
CONCEPT M LAYOUT - OHIO


APPENDIX 6.2
CONCEPT W LAYOUT
DATE: 4/6/2020

APPENDIX 6.3
CONCEPT S LAYOUT

DATE: 4/6/2020

APPENDIX 6.3
CONCEPT WS - LAYOUT

DATE: 4/6/2020

Appendix 6.4

Cost Comparison: Alternative I with Concept M and Concept W

		Construction Costs (2017 Dollars)							
Construction Contract #	Segment Description	Alternative I		Concept M		Alternative I		Concept W	
KY-7	I-75 Reconstruction from the South Termini of the 12th Street Interchange to the New Bridge over the Ohio River	Retaining Walls	$30,214,143	Retaining Walls	$55,096,387	Retaining Walls	$0	Retaining Walls	$11,448,699
		New Structures	$162,557,947	New Structures	$114,210,940	New Structures	$100,407,239	New Structures	$89,510,807
	Kentucky Totals		$192,772,090		$169,307,327		$100,407,239		$100,959,506
OH-7 (PID 89068)	I-75 Reconstruction from the New Bridge over the Ohio River to North of Linn Street	Retaining Walls	$23,209,947	Retaining Walls	$13,978,846	Retaining Walls	$0	Retaining Walls	$0
		New Structures	$271,680,043	New Structures	$117,390,822	New Structures	$189,161,276	New Structures	$173,691,021
		Remove Structures	$17,672,641	Remove Structures	$6,061,563	Remove Structures	$0	Remove Structures	$0
	Ohio Totals		$312,562,632		$137,431,231		$189,161,276		$173,691,021
	New River Crossing	New Bridge	$555,225,840	New Bridge	$369,649,988	New Bridge	$555,225,840	New Bridge	$308,998,818
	New River Crossing Totals		$555,225,840		$369,649,988		$555,225,840		$308,998,818
	Combine Totals		$1,060,560,561		$676,388,546		$844,794,355		$583,649,344
	Total Amount Saved on Concept M	$384,172,015							
	Total Amount Saved on Concept W					$261,145,011			

Appendix 6.4

Altnerative I Detailed Construction Costs

Group	Item	Unit Price Determined From:	2012 Unit Price	2017 Unit Price	Unit	KY-7 Quantity	KY-7 Total	OH-7 Quantity	OH-7 Total
Roadway	Fill - Embankment (Includes wasting excess excav	Procedure for Construction Budget Estimating	$6.00		CY				
Retaining Walls	Retaining Wall (Ohio)	PCBE - Poured In Place (median cost)	$140.00	$150.08	SF			142,897	$21,445,734.34
Retaining Walls	Retaining Wall (Kentucky)	Per discussion at FHWA Workshop	$200.00	$214.40	SF	118,825	$25,475,786.09		
Retaining Walls	Retaining Wall RWJS	Per discussion at FHWA Workshop			LS		$4,738,356.85		$1,645,740.00
Retaining Walls	Subtotal						$30,214,142.94		$23,091,474.34
Structures	Structure Removal - Non-Complex	Procedure for Construction Budget Estimating	$14.00	$15.01	SF				$0.00
Structures	Structure Removal - Standard	Procedure for Construction Budget Estimating	$18.00	$19.30	SF			396,141	$7,643,848.55
Structures	Structure Removal - Complex to Very Complex	Procedure for Construction Budget Estimating	$35.00	$37.52	SF			267,295	$10,028,792.70
Structures	Tier 1 Structure up to 25' Height	Enigneer's Estimate - Complex Structure	$150.00	$160.80	SF	315,174	$50,679,394.52	65,593	$10,547,232.72
Structures	Tier 2 Structure --> 25' - 50' Height	Enigneer's Estimate - Complex Structure	$175.00	$187.60	SF	372,133	$69,811,345.40	631,959	$118,554,140.66
Structures	Tier 3 Structure > 50' Height	Enigneer's Estimate - Complex Structure	$225.00	$241.20	SF	174,410	$42,067,206.68	591,129	$142,578,669.89
Structures	Subtotal						$162,557,946.59		$289,352,684.51
		Total Construction Costs w/o Incidental Costs					**$192,772,089.53**		**$312,444,158.85**

Concept M Detailed Construction Costs

Group	Item	Unit Price Determined From:	2012 Unit Price	2017 Unit Price	Unit	KY-7 Quantity	KY-7 Total	OH-7 Quantity	OH-7 Total
Retaining Walls	Retaining Wall (Ohio)	PCBE - Poured In Place (median cost)	$140.00	$150.08	SF			81,388	$12,214,633.15
Retaining Walls	Retaining Wall (Kentucky)	Per discussion at FHWA Workshop	$200.00	$214.40	SF	234,882	$50,358,029.78		
Retaining Walls	Retaining Wall RWJS	Per discussion at FHWA Workshop			LS		$4,738,356.85		$1,764,212.93
Retaining Walls	Subtotal						$55,096,386.63		$13,978,846.08
Structures	Structure Removal - Non-Complex	Procedure for Construction Budget Estimating	$14.00	$15.01	SF				$0.00
Structures	Structure Removal - Standard	Procedure for Construction Budget Estimating	$18.00	$19.30	SF			199,202	$3,843,753.20
Structures	Structure Removal - Complex to Very Complex	Procedure for Construction Budget Estimating	$35.00	$37.52	SF			59,111	$2,217,810.13
Structures	Tier 1 Structure up to 25' Height	Enigneer's Estimate - Complex Structure	$150.00	$160.80	SF	365,437	$58,761,585.24	151,728	$24,397,571.28
Structures	Tier 2 Structure --> 25' - 50' Height	Enigneer's Estimate - Complex Structure	$175.00	$187.60	SF	125,605	$23,563,136.11	126,454	$23,722,468.58
Structures	Tier 3 Structure > 50' Height	Enigneer's Estimate - Complex Structure	$225.00	$241.20	SF	132,200	$31,886,219.07	287,196	$69,270,781.96
Structures	Subtotal						$114,210,940.42		$123,452,385.15
		Total Construction Costs w/o Incidental Costs					**$169,307,327.05**		**$137,431,231.23**

Appendix 6.4

BSB Concept W Cost Estimate Quantities				
Concept W vs. Alternative I				
Cost Comparison - Original Design vs Concept W				
Bridge Deck (sq ft)	Alternative I	Concept W	Difference	Comments
Location				
Upper Deck - new bridge KY	176,592	174,797	(1,795)	
Lower Deck - new bridge KY	193,336	152,425	(40,911)	
Upper Deck - old bridge KY	126,713	143,274	16,561	
Lower Deck - old bridge KY	-	-	-	Same foot print in both OD and Concept W
9th Street	3,538	-	(3,538)	Reduction based on no gore for split of NB 71/75 traffic
KY Slip Ramp to I-71	26,030	-	(26,030)	Retaining Walls added
KY 5th Street	9,019	6,645	(2,373)	Reduction based on intersection location now off bridge
Total Kentucky	535,226	477,142	(58,085)	
Upper Deck - new bridge OH	273,487	251,846	(21,641)	
Lower Deck - new bridge OH	366,605	257,904	(108,701)	
Upper Deck - old bridge OH	154,219	221,628	67,409	
Lower Deck - old bridge OH	214,023	194,492	(19,531)	
Total Ohio	1,008,334	925,869	(82,464)	
Total (sqft)	1,543,560	1,403,011	(140,549)	
				SQFT
Cost Per Unit -2012			$ 175	per SQFT
Cost Per Unit -2017			187.60	per SQFT
Additional Cost/Savings			-26,366,688	
Retaining walls (sqft)				
KY - NB 71/75	0	45,327	45327	SQFT
KY - SB 5th Exit	0	8,072	8072	
Total Walls		53399	53399	
Cost Per Unit -2012			$ 200	per SQFT
Cost Per Unit -2017			$ 214	per SQFT
Additional Cost/Savings			$11,448,699	
Total			($14,917,989)	

Appendix 6.4

Alternative	Main Bridge					Approaches					Total Bridge Length (Main + back + approaches)	Total Cost
	Length	Width	Area	Unit $	Cost	Length	Width	Area	Unit $	Cost		
Original Preferred	2000'	172'	344,000	$1,448	$498,052,180	400'	172'	68,800	$831	$57,173,660	2400'	$555,225,840
Concept M	1740'	133'	231,420	$1,312	$303,560,661	660'	133'	87,780	$753	$66,089,327	2400'	$369,649,988
Concept W	1740'	119'	207,060	$1,226	$253,753,249	660'	119'	78,540	$703	$55,245,569	2400'	$308,998,818

Notes/Assumptions:

Annual Inflation Rate of 1.40% was used (from PB Cost Savings Report).

Total river crossing bridge length is combines main span, backspan, approaches for a total of 1,200 feet. The total was doubled to 2,400 feet to account for both decks on proposed bridge.

Total cost for Main bridge and approaches were taken from PB Cost Savings Report dated 3/15/2015 and inflated to 2017 dollars.

Cost includes 20% contingency.

Cost estimate inflated to year 2017.

Appendix 6.5

BRENT SPENCE BRIDGE CORRIDOR

Moving the Economy,
Creating Jobs

BRENT SPENCE BRIDGE PROJECT

TRAFFIC COUNTS, MODELING, AND FORECAST REVIEW

DECEMBER 2019

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

KENTUCKY TRANSPORTATION CABINET

HNTB

TABLE OF FIGURES

1. INTRODUCTION

This memorandum presents a review of traffic counts, travel demand models, and forecasts completed since 2013 for the Brent Spence Bridge (BSB). Two primary studies were conducted since 2013: the Brent Spence Bridge Corridor study (BSBC Study) in 2013-2015, and the Eastern Bypass (EB) study in 2017. Both studies obtained traffic counts and used the OKI travel demand model to forecast traffic. Since the EB study in 2017, OKI has been developing an updated travel demand model (TDM) and established continuous traffic counters on the BSB.

The BSB traffic counts include:

- 2013 OKI Video Count – 1 month
- 2014 KTYC ATR Count – 6 days
- 2017 KYTC Video Counts – 1 week
- 2019 OKI ATR counts – 5 months

The OKI TDM assumptions and results are summarized for the 2 projects. Differences in the model networks and results are discussed. The models reviewed for each study include:

- BSBC Study – 2010 Existing, 2040 No Build, 2040 Build Toll Free, 2040 Build Tolled
- EB Study – 2015 Existing, 2040 No Build, 2040 Build Toll Free

OKI is currently developing an updated 2050 TDM. HNTB developed zonal growth factors to convert the 2040 model into a pseudo 2050 model. The traffic assignments from the 2050 model are compared to the previously completed 2040 models. The forecast implications of the 2050 model are discussed.

2. BRENT SPENCE TRAFFIC COUNTS

Traffic counts were taken on the Brent Spence Bridge at various times and by various methods by project stakeholders since 2013. The 2013 and 2014 counts were used for the ODOT certified traffic approved in 2015. The 2017 counts were used for the KYTC Eastern Bypass study. Since May 2019, OKI has set up continuous traffic counters on the Brent Spence Bridge and other nearby bridges over the Ohio River.

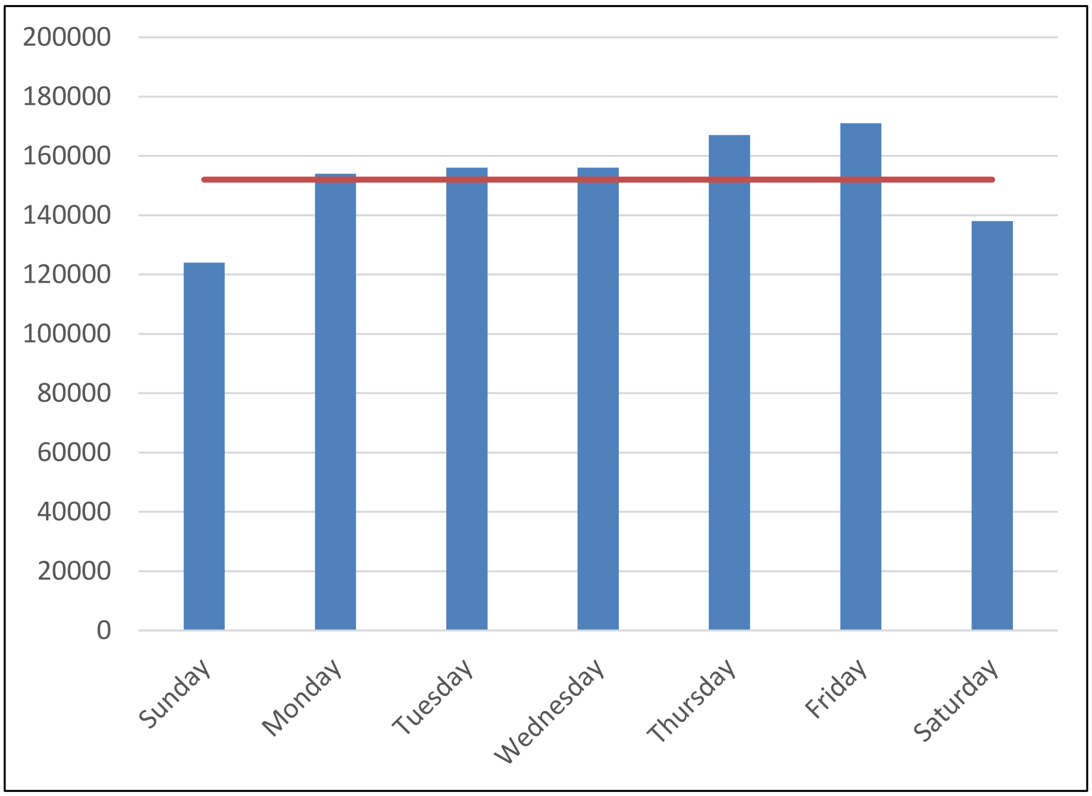
Each of the traffic counts collected since 2013 are summarized below. Additionally, the counting technology is identified for each traffic count. An overview of the count collection technology is provided in section 2.5.

2.1 2013 OKI VIDEO COUNTS

OKI arranged for video counts to be taken on the Brent Spence Bridge for one month in April/May 2013. Count data was collected from April 19 to May 19, 2013. The daily volumes are shown in the figure below:

Figure 2-1: 2013 OKI Video Count Daily Averages

Day of Week	ADT
Sunday	124,000
Monday	154,000
Tuesday	156,000
Wednesday	156,000
Thursday	167,000
Friday	171,000
Saturday	138,000
Average	**152,000**



Volumes on weekdays ranged from 149,200 to 177,800 and volumes on weekend days ranged from 113,000 to 142,900.

2.2 2014 KYTC ATR COUNTS

KYTC compiled counts from their ATR site 059014. The ATR site used permanent sensors in the pavement to collect the counts. The ATR location is milepost 191.3 on I-71/75 just south of the Brent Spence Bridge.

Figure 2-2: 2014 KYTC Video Count Locations

Date	Day of Week	ADT
8/7/2014	Thursday	192,800
8/8/2014	Friday	190,300
8/9/2014	Saturday	159,300
8/10/2014	Sunday	141,300
8/11/2014	Monday	173,300
8/12/2014	Tuesday	183,600
8/13/2014	Wednesday	153,800

2.3 2017 KYTC VIDEO COUNTS

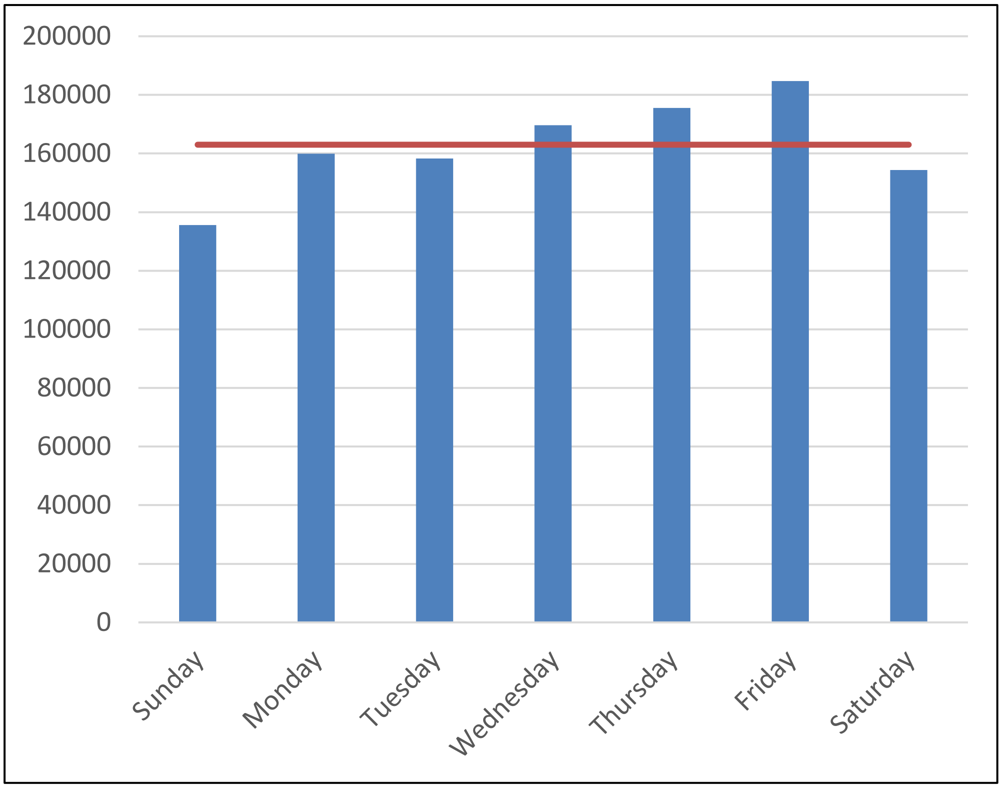
KYTC arranged for video counts to be taken at the south end of the Brent Spence Bridge. Mainline counts were taken from a camera located in the median just south of W. 5th street. The NB on-ramp from W. 4th Street and the SB off-ramp to W. 5th Street were also counted to capture all Brent Spence Bridge traffic. The count locations are shown in the figure below:

Figure 2-3: 2017 KYTC Video Count Locations

Count data was collected from March 6 to March 12, 2017. And the daily volumes are shown in the figure below:

Figure 2-4: 2017 KYTC Video Count Daily Volumes

Day of Week	ADT
Sunday	135,600
Monday	159,900
Tuesday	158,300
Wednesday	169,700
Thursday	175,500
Friday	184,700
Saturday	154,400
Average	**163,000**



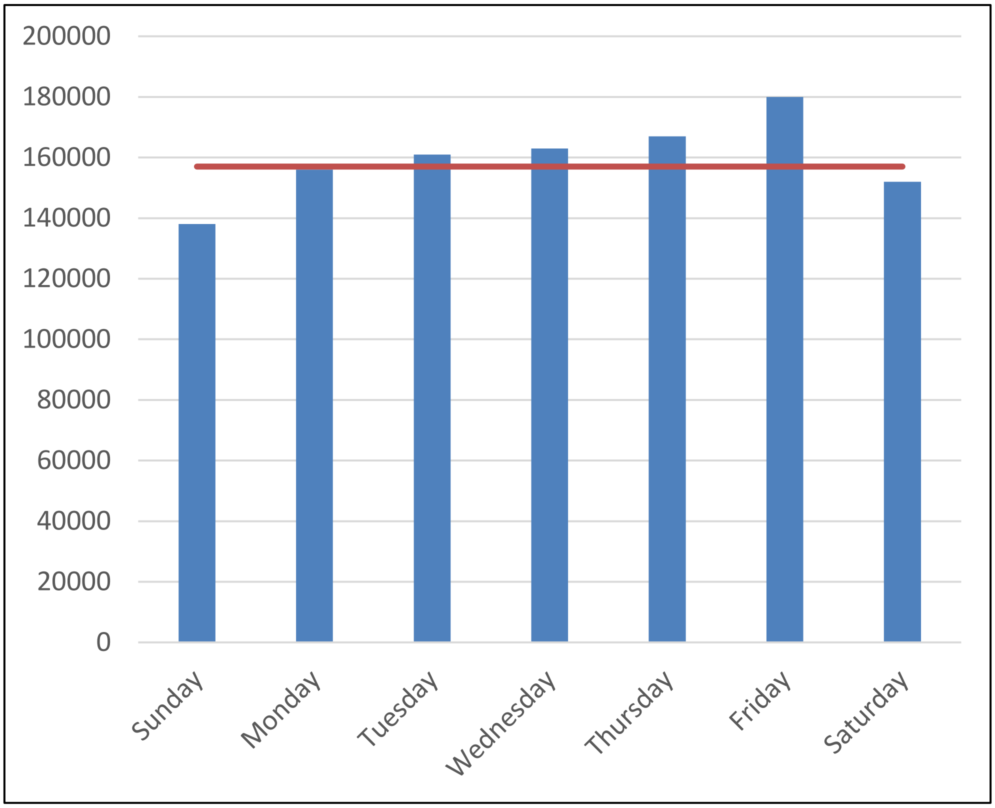
Volumes on weekdays ranged from 158,300 to 184,700 and volumes on weekends ranged from 135,600 to 154,400.

2.4 2019 OKI ATR COUNTS

OKI attached Image Sensing radar devices to overhead signing structures and are aimed downward toward the travel lanes of the Brent Spence Bridge. The overhead vantage point reduces the number of counting errors due to traffic blocking side-fire radar from sensing traffic in inside lanes. Traffic Data is being collected continuously since May 25, 2019. The data summarized here is from May 25 ,2019 to October 31, 2019.

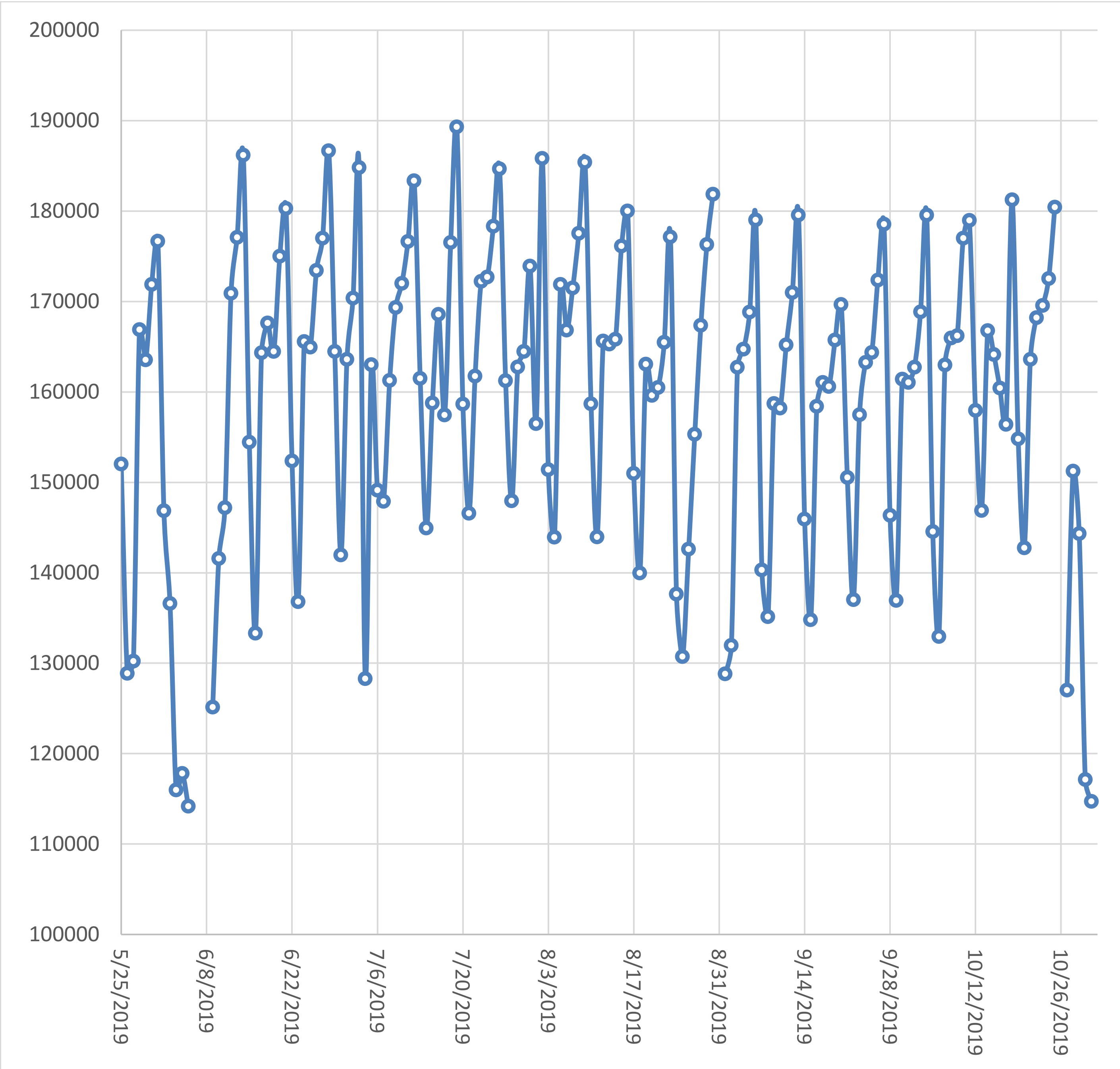
Figure 2-5: 2019 OKI Microwave Radar Count Daily Volumes

Day of Week	ADT
Sunday	138,000
Monday	156,000
Tuesday	161,000
Wednesday	163,000
Thursday	167,000
Friday	180,000
Saturday	152,000
Average	**159,000**



Volumes on weekdays ranged from 114,700 to 189,300 and volumes on weekends ranged from 125,300 to 164,500. The day-to-day variation in traffic counts on the Brent Spence Bridge is summarized in Figure 2-6, which shows the daily traffic volumes from May 25 to October 31, 2019.

Figure 2-6: Brent Spence Daily Traffic: May to October 2019



2.5 TRAFFIC COUNTING TECHNOLOGIES

The methods used to collect traffic data use different technologies to detect vehicles on the roadway and collect volume data. The technologies used for each of the counts are discussed below along with the advantages and disadvantages of each method.

Inductive Loop Detectors –Inductive Loop Detectors consists of: a wire loop (containing one or more turns of wire) embedded in the pavement, a lead-in wire running from the in-pavement loop to the detector unit, and the inductive loop detector unit. The detector unit is an electronic circuit on a card or device that processes the inducted voltages in the loop into count data. It can detect vehicle presence and passage. Advanced processing can be used to derive vehicle class characteristics.

Microwave Radar Sensors - Microwave Radar Sensors transmit electromagnetic energy from an antenna towards vehicle travelling on the roadway. When a vehicle passes through the antenna beam, a portion of the transmitted energy is reflected towards the antenna. The energy then enters a receiver where the detection is made and traffic flow data such as volume, speed, and vehicle length are calculated.

Video Detection Sensors – Video Detector Sensors consist of one or more cameras, a microprocessor-based computer for digitizing and analyzing the imagery, and software for interpreting the images and converting them into traffic flow data A video detection system can provide detection of vehicle across several lanes. The specific technology used in the 2013 and 2017 counts digitized the imagery onsite and then the imagery was sent to a central location for final processing.

Figure 2-7: Summary of Traffic Count Technology

Technology	Strengths	Weaknesses
Inductive Loop	• Flexible Design • Mature Technology • Large Experience Base • Provides basic traffic parameters • Insensitive to weather • Common standard for obtaining occupancy measurements • Advance signal processing can provide axel classification data	• Wire loops subject to stresses of traffic • Multiple loops are required to monitor a location • Detection accuracy may decrease when a large variety of classes is required • Does not detect axels in commonly used configuration.
Microwave Radar Sensors	• Typically insensitive to weather • Direct Measurement of speed • Multiple lane operation • Detects stopped and slow-moving vehicles • Lane assignments can be accommodated for on location.	• Detector can miss occasional vehicle traveling side-by-side • Calibration and sensor placement are crucial to proper operation • Does not detect axles.
Video Detection sensors	• Monitors multiple lanes and multiple detection zones per lane • Easy to add and modify detection zones • Vast array of data available • Generally, cost effective when multiple zones are capture by a single camera or specialized data is required.	• Installation and Maintenance including periodic lens cleaning • Performance affected by weather, vehicle shadows, vehicle projection into adjacent lanes, occlusion day-to-night transition, vehicle/road contrast, and dirty lenses • Night time operation requires illumination • Does not detect axles. • Some models susceptible to camera motion due to strong winds or vibration

2.6 BRENT SPENCE HOURLY TRAFFIC

The Brent Spence Bridge peaks for the northbound direction in the AM and southbound direction in the PM. The hourly midweek traffic volumes derived from the 2019 OKI counts are shown in Figure 2-8. The Friday profile, Figure 2-9, has similar peaks as the midweek but higher traffic volumes are sustained through the middle of the day.

Figure 2-8: Brent Spence Bridge - 2019 Midweek – Hourly Traffic Flow

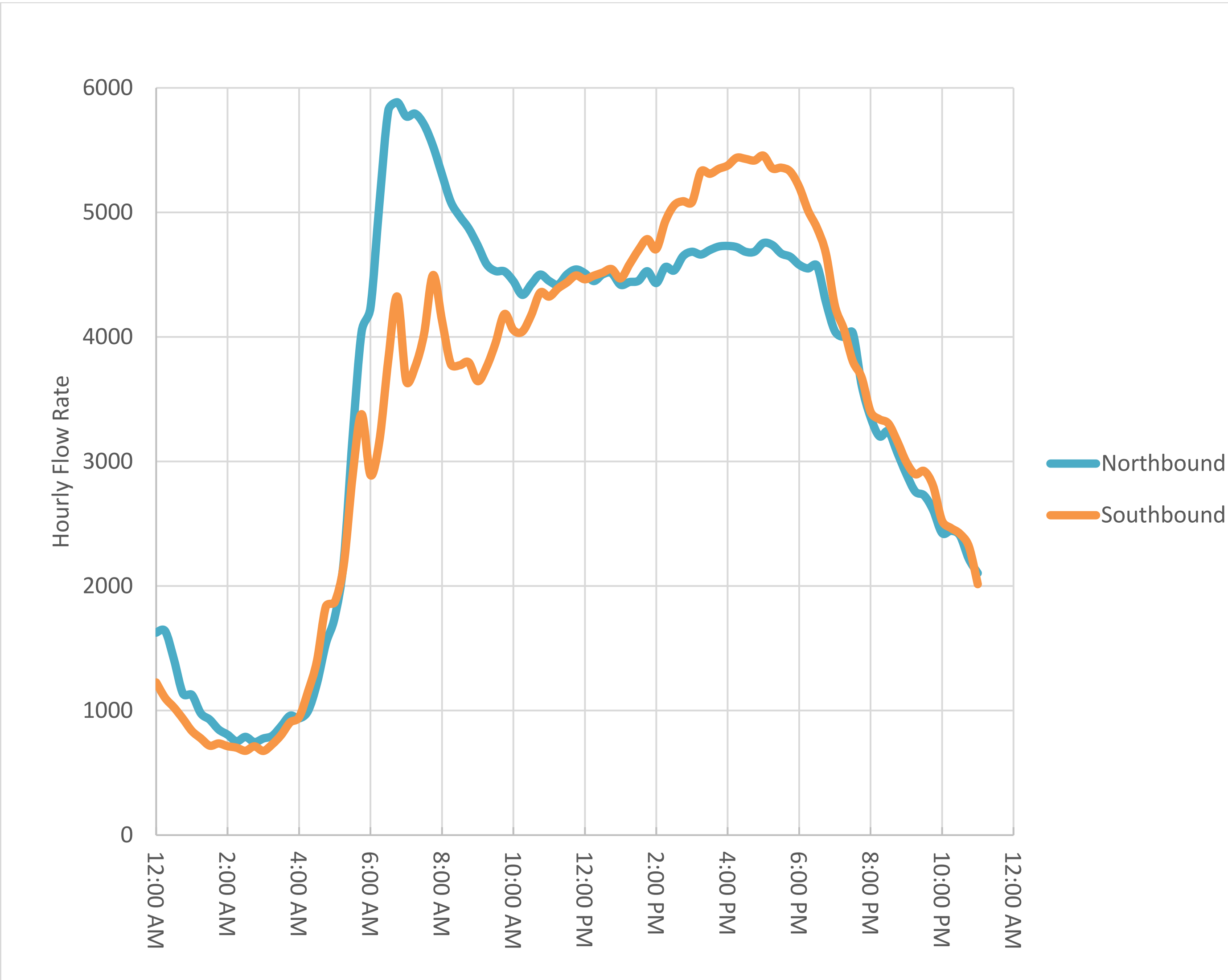
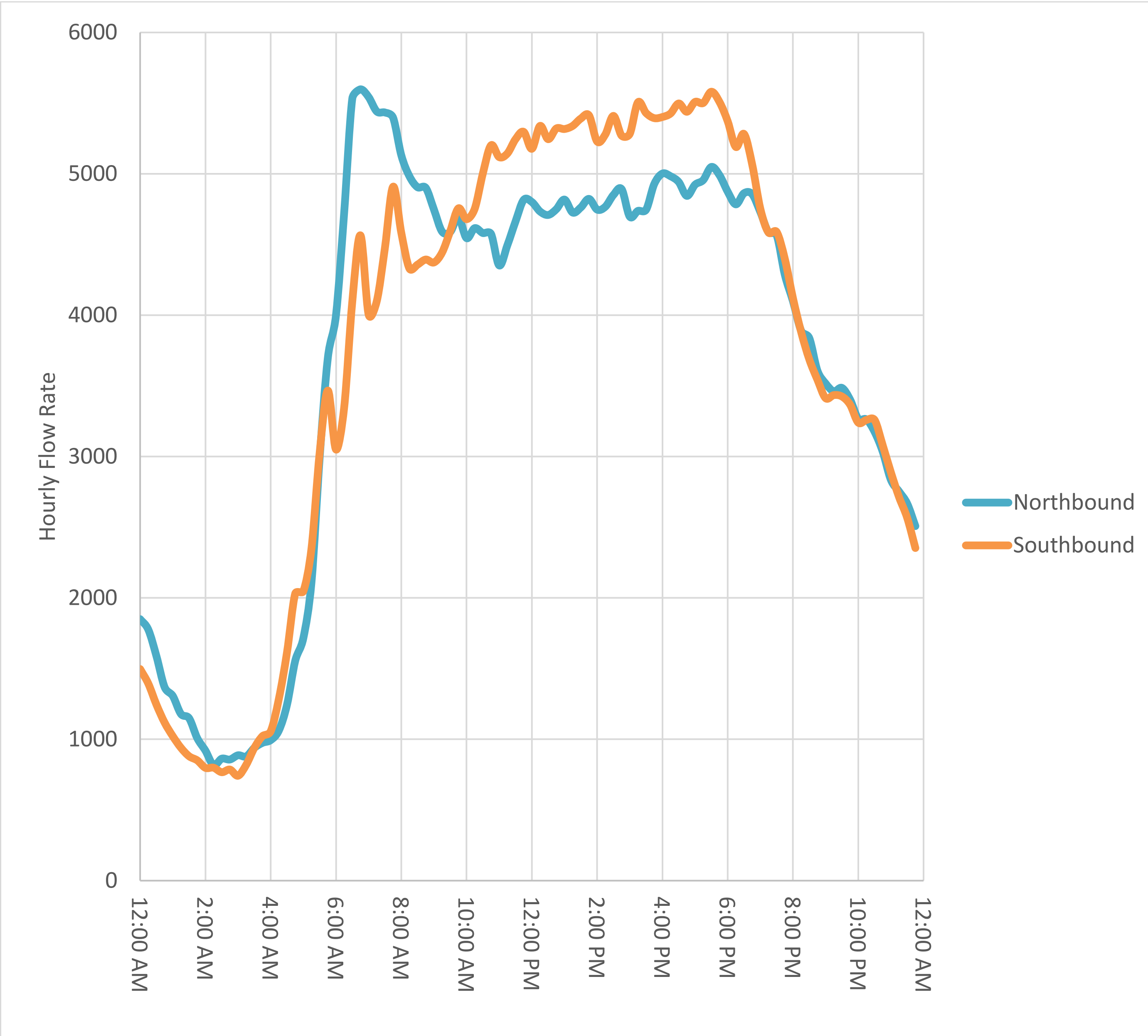


Figure 2-9: Brent Spence Bridge – 2019 Friday – Hourly Traffic Flow



3. TRAVEL DEMAND MODEL COMPARISION

Travel Demand Model forecasts were completed for the Brent Spence Bridge as part of the Brent Spence Bridge Corridor study in 2015 and the Eastern Bypass study in 2017. The OKI TDM traffic assignments and model assumptions are compared for these studies.

3.1 TRAFFIC ASSIGNMENT

The OKI travel demand model was used to forecast traffic volumes for both the Brent Spence Bridge Corridor Study and the Eastern Bypass Study. The traffic assignment from these two studies are summarized in the table below. The Build model for the BSB Corridor Study represents Alternative I. The Eastern Bypass Study Build model includes capacity improvements on the Brent Spence Bridge and I-75 in Ohio. Details of the Build model networks are covered in section 3.2.

Figure 3-1: Daily Traffic Assignment

OKI Model Scenario	BSB Corridor Study	Eastern Bypass Study
2010 Existing	141,900	-
2017 Existing	-	159,300
2040 No Build	173,700	174,400
2040 Build Toll Free	228,000	174,200
2040 Build Tolled ($2)	165,500	-

3.2 MODEL ASSUMPTIONS

The OKI TDM network is compared for the two Brent Spence Bridge studies. The comparison of the Build models from the two studies reveals similar network assumptions on I-75 from the BSB north into Ohio. The significant difference between these models, as it relates to the BSB, is the capacity assumption on I-71/75 in Kentucky. The BSBC study assumes I-71/75 capacity expansion in Kentucky, as shown in Alternative I, while the EB study assumes existing capacity on I-71/75. This difference is the primary contributor in the traffic assignment differences between the two studies (228,000 verse 174,200).

The OKI TDM lanes and traffic assignments for the BSB and I-71/75 in Kentucky are shown in the following figures.

Figure 3-2: OKI TDM Lanes on Brent Spence Bridge

Build (BSB Corridor Study) *No Build (Eastern Bypass Study)* *Build (Eastern Bypass Study)*

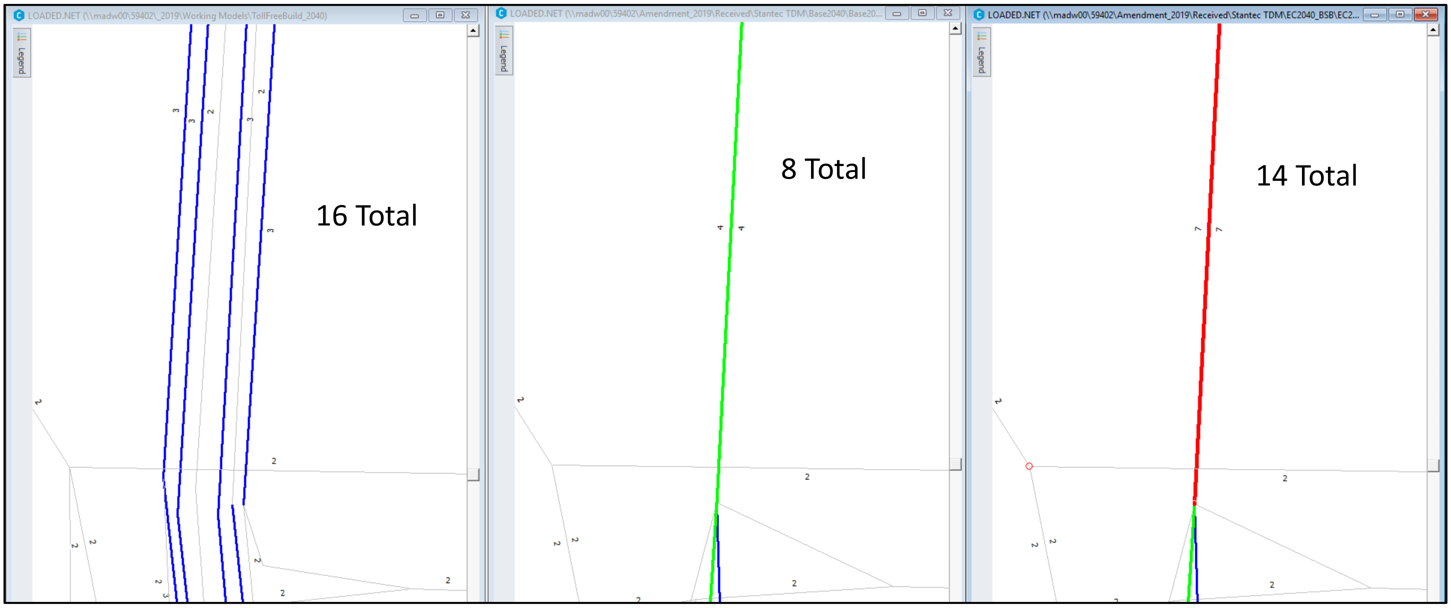


Figure 3-3: OKI TDM Lanes on I-71/75 in Kentucky

Build (BSB Corridor Study) *No Build (Eastern Bypass Study)* *Build (Eastern Bypass Study)*

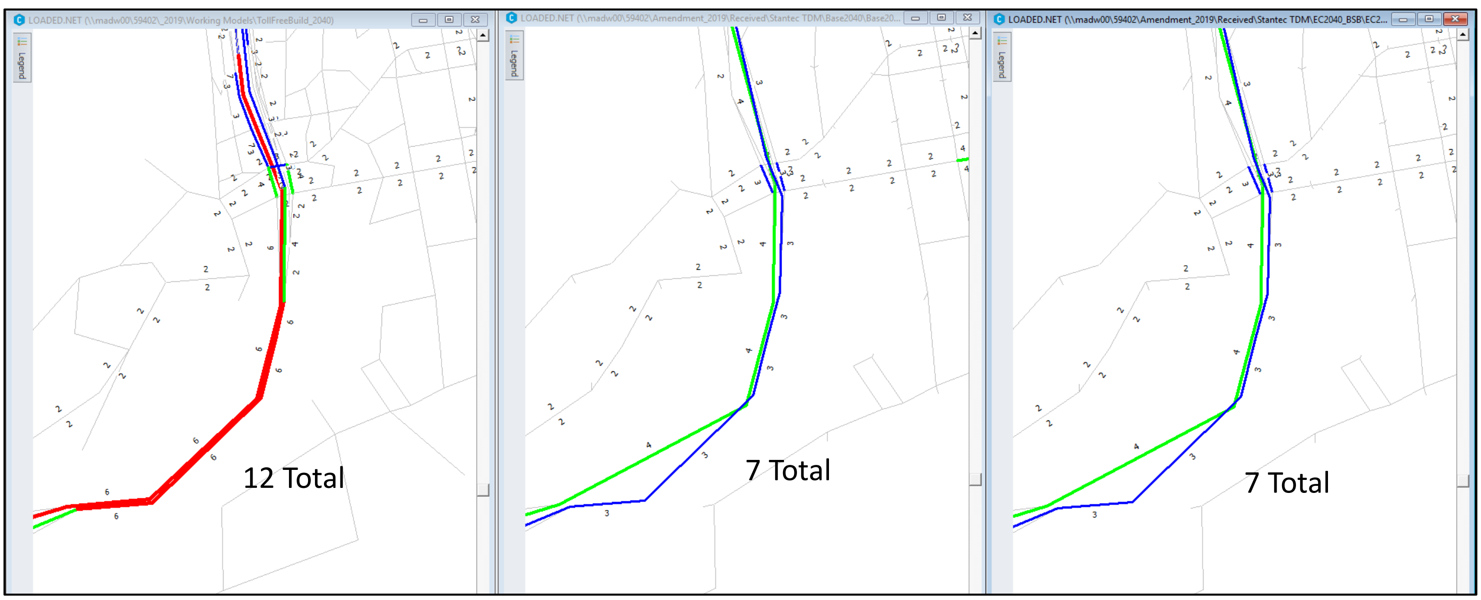


Figure 3-4: OKI TDM Traffic Assignment on Brent Spence Bridge

Build (BSB Corridor Study) *No Build (Eastern Bypass Study)* *Build (Eastern Bypass Study)*

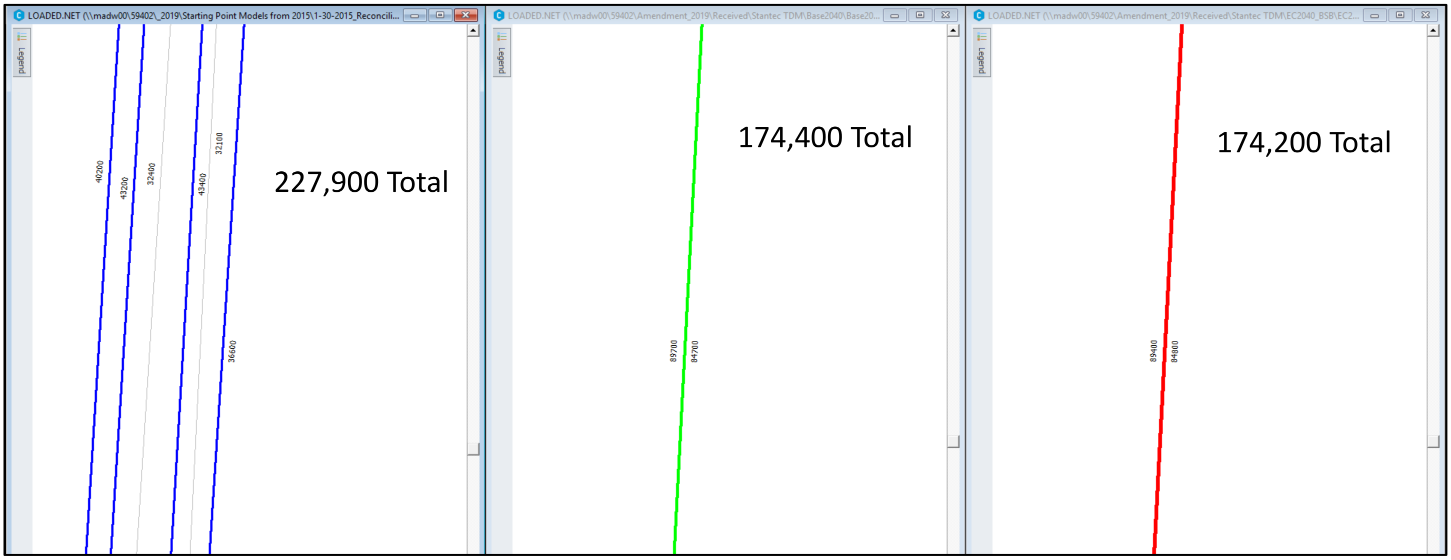
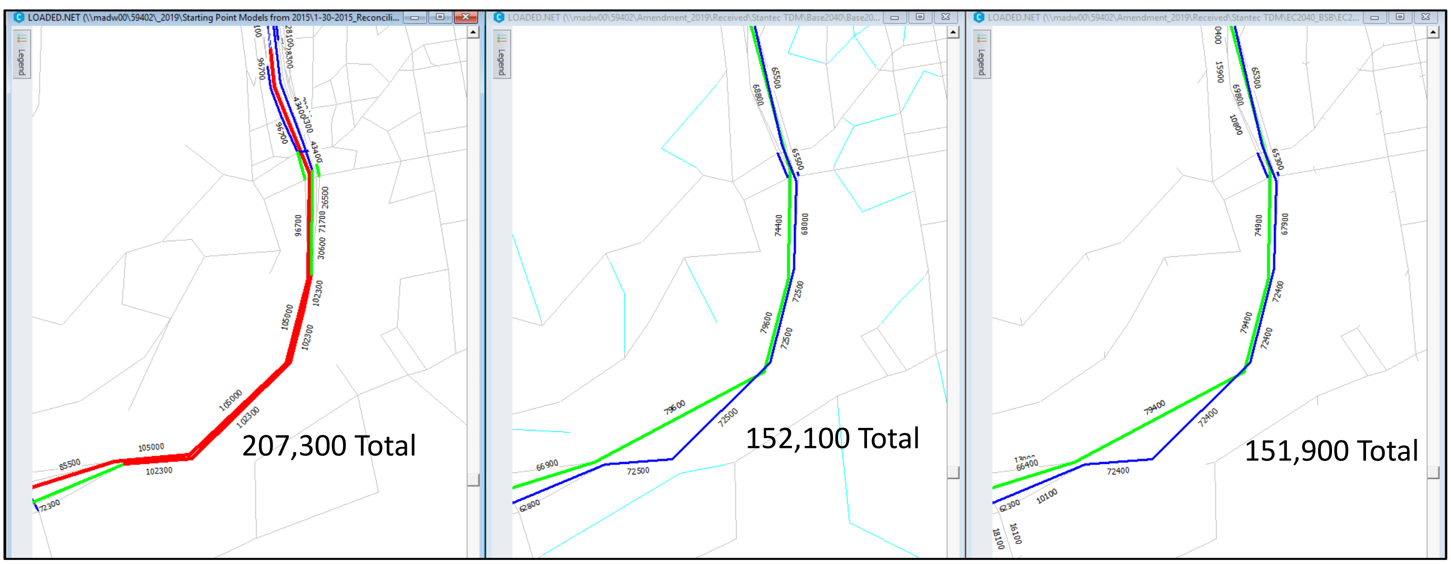


Figure 3-5: OKI TDM Traffic Assignment on I-71/75 in Kentucky

Build (BSB Corridor Study) *No Build (Eastern Bypass Study)* *Build (Eastern Bypass Study)*



4. PSEUDO 2050 TRAVEL DEMAND MODEL

The Brent Spence Bridge Corridor study and Eastern Bypass study models have a horizon year of 2040. At the time of this memorandum, OKI is developing an updated model for horizon year 2050. The purpose of this modeling exercise is to evaluate the anticipated impacts of the updated 2050 socio-economic data.

4.1 2050 TDM METHODOLGY

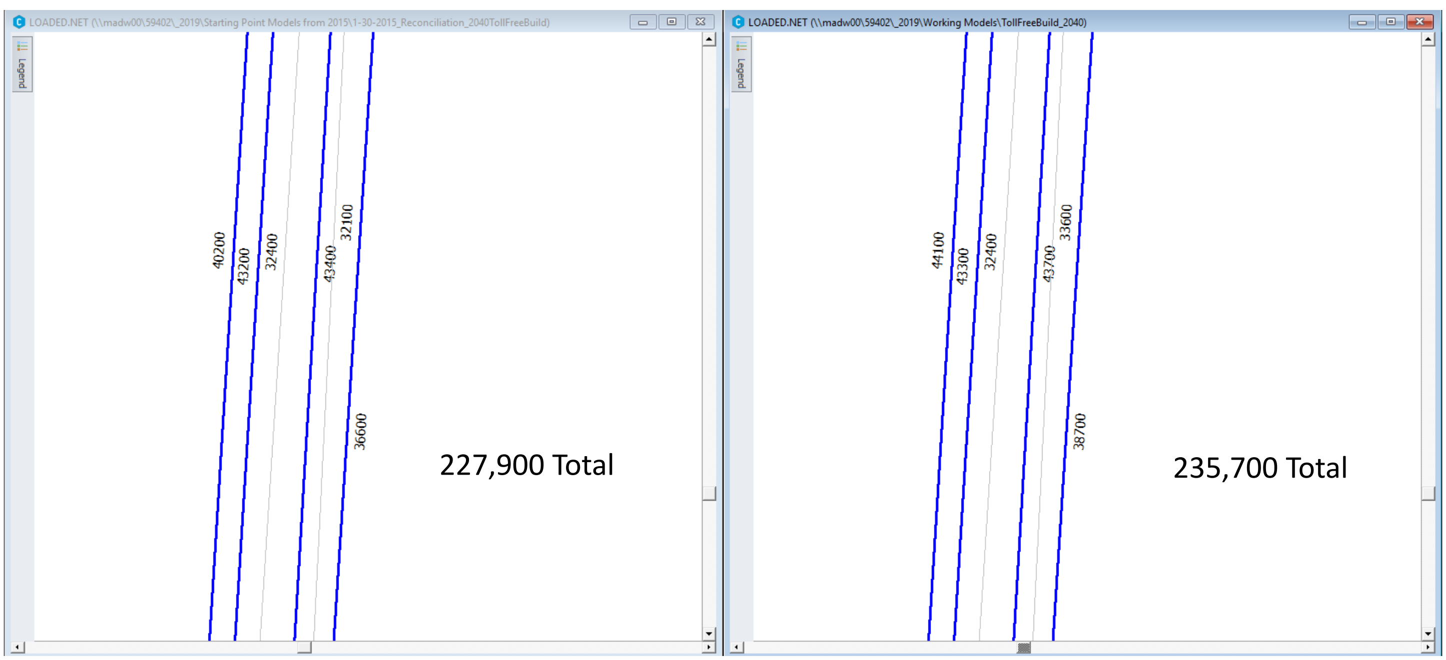
The pseudo 2050 TDM model is developed using the 2040 Build model from the BSBC study. 2040 to 2050 growth factor are developed by comparing the 2040 and 2050 socio-economic data. The derived zonal growth factors are applied to the 2040 trip tables. On average, the region-wide trip tables showed approximately 6 percent more trips in the 2050 tables compared to the 2040 tables. The derived 2050 trip tables where then assigned to the BSBC study No Build and Build models.

4.2 2050 MODEL RESULTS

The BSB Build traffic assignments increased by 3.4% from 2040 to 2050. The traffic assignment of BSB are shown in the figure below.

Figure 4-1: Brent Spence Traffic Assignment 2040 & 2050

2040 Build (BSB Corridor Study) *2050 "pseudo" Build*



5. TRAFFIC FORECASTS

ODOT certified 2040 AM, PM, and Daily forecasts during the BSBC study. The project team reviewed the forecasting methodology used in the BSBC study and estimated a 2050 forecast using the updated 2015 and 2050 travel demand models.

5.1 2050 DAILY FORECASTS (ESTIMATE)

The 2040 forecasts from the BSBC study were derived using 2010 AADT (traffic counts), 2010 TDM, and 2040 TDM. The 2050 forecasts are estimated using a 2019 AADT, 2015 TDM, and 2050 TDM. The existing data for both 2040 and 2050 forecasts are listed below.

- 2010 AADT: 154,300
- 2010 Assignment: 141,800
- 2015 Assignment: 142,700
- 2019 AADT (estimate from OKI counts): 159,000

The 2010 AADT increases at an annual rate of 0.1% from 2010 to 2019. The traffic assignment increases by 0.6% from 2010 to 2015, or 0.1% annually.

The future traffic assignments and growth rates are:

- 2040 Build Toll Free Assignment: 227,900
  - 2.02% annual growth rate from 2010 assignment
- 2050 Build Toll Free Assignment: 235,700
  - 1.86% annual growth rate from 2015 assignment

Although the 2050 traffic assignment increases from 2040, the growth rate from the base year is lower for 2050 due to the higher base year assignment in 2015 and the longer duration over which the growth is spread.

If the 1.86% growth rate is applied to the 2019 AADT, the 2050 forecast for the BSB is estimated as 250,700. This is only 3 percent higher than the 2040 forecasts of 242,700.

Because of the similarity between the 2040 forecast previously derived and the 2050 forecast estimate, the project team decided to use the 2040 certified forecasts for the current traffic analysis.

5.2 2040 PEAK HOUR FORECAST

The AM and PM peak design hour forecasts developed as part of the Brent Spence Bridge Study and certified by ODOT are compared against various traffic counts and the method forecasts (reflective of typical weekday peak) developed during the BSB study. This summary is in Table 5-1.

Table 5-1: Brent Spence Bridge - Peak Hour Counts and Forecasts

Count/Forecast	AM - Northbound	PM - Southbound
2013 Count (T-Th April/May OKI)	6,000	5,800
2014 Count (T-Th August KYTC)	5,500	6,300
2017 Count (T-Th Jan/March KYTC)	5,900	6,100
2019 Count (T-Th June-Oct OKI)	5,800	5,500
2010 Balanced Peak Hour	5,200	5,100
2040 No Build Method Forecast	6,200	6,200
2040 No Build Design Hour Forecast	7,800	7,800
2040 Toll Free Method Forecast	8,600	8,700
2040 Toll Free Design Hour Forecast	10,600	10,900

6. SUMMARY

Traffic counts, travel demand modeling, and forecasts completed during and since the Brent Spence Bridge Corridor and Eastern Bypass studies were reviewed.

6.1 TRAFFIC COUNTS

Brent Spence Bridge traffic counts were collected in 2013, 2014, 2017, and 2019. The daily counts vary from about 130,000 to 180,000 with the lowest volumes observed on Sunday and highest on Friday. The counts were collected using video, radar, and inductive loops. Each method has its advantages and disadvantages, but the counts appear to be consistent between the count sources.

6.2 2040 BUILD TRAVEL DEMAND MODEL COMPARISON

The OKI Travel Demand Model was used for the Brent Spend Bridge and Eastern Bypass studies. The Build models (assuming additional capacity on Brent Spence Bridge) from the two studies were compared. The models were consistent on the Brent Spence Bridge and I-75 in Ohio. The Brent Spence Bridge study model included capacity expansion on I-71/75 south of the Brent Spence Bridge while the Eastern Bypass model represents existing conditions. This difference in "Build" assumptions creates the large differences in traffic assignments on the Brent Spence Bridge.

6.3 2050 MODEL REVIEW

The socio-economic data anticipated for the 2050 OKI model was compared to the 2040 data. Zonal growth factors were created to grow the 2040 model, used in the BSBC study, to a pseudo 2050 model. The 2050 model assignments were compared to the 2040 model. The BSB assignments for the Build Toll Free scenario increased by 3.4%.

6.4 FORECAST REVIEW

ODOT Certified 2040 AM, PM, and Daily forecasts were established during the BSBC study. The 2019 AADT (estimate), 2015 model assignments, and 2050 model assignments were used to approximate a 2050 daily forecast. The forecast revealed only a 3.29% increase from the 2040 forecast. Due to the minimum differences between forecasts, the project team decided to use the 2040 certified traffic for the current traffic analysis.

6.5 FUTURE ACTIONS

The project team should work with OKI to incorporate the newest version of the OKI travel demand model into future forecasting efforts.

The project team should compile the continuous traffic count data currently being collected on the BSB facility and along the parallel facilities across the Ohio River in the downtown Cincinnati area. This continuous count data should be analyzed to develop BSB-specific traffic count factors to be used during future traffic forecasting efforts. Currently both ODOT and KYTC have statewide traffic count factors based on their respective state's traffic data, resulting in the BSB facility having different traffic count factors being applied on either side of the state line.

BRENT SPENCE BRIDGE CORRIDOR

Moving the Economy,
Creating Jobs

BRENT SPENCE BRIDGE PROJECT

TRANSMODELER CALIBRATION AND RESULTS

MAY 2020

STATE OF OHIO DEPARTMENT OF TRANSPORATION

KENTUCKY TRANSPORTATION CABINET

HNTB

1. PROJECT BACKGROUND AND PURPOSE

1.1 BACKGROUND

In March 2012, an Environmental Assessment was prepared for the Brent Spence Bridge (BSB) project to analyze impacts to the natural and human environment for two feasible alternatives for improving the I-71/I-75 Corridor in Kentucky and Ohio. In August 2012, the Federal Highway Administration (FHWA) issued a Finding of No Significant Impact (FONSI) identifying the selected alternative for the BSB project. This selected alternative is referred to as Alternative I.

Two primary studies were conducted since 2013. The *Brent Spence Bridge Corridor Study (BSBC Study)* in 2013-2015 evaluated the impacts of tolls on the Brent Spence Bridge and completed traffic tasks including data collection, forecasting, travel demand modeling, and traffic operational analysis using HCS and VISSIM. In addition to the toll evaluation, alternative designs were evaluated including Concept W (also known as Whiz Bang).

The *Brent Spence Strategic Corridor Study (Strategic Corridor Study)* in 2017 included the development and evaluation of Brent Spence Bridge bypass concepts and corridor operations using TransModeler. The project's operational analysis evaluated the impacts of an Eastern Bypass on the operations of the Brent Spence Bridge and completed data collection for use in the model calibration. The traffic projections used model assignments from the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) travel demand model.

Both the *BSBC Study* and the *Strategic Corridor Study* obtained traffic counts and used the OKI travel demand model to forecast traffic in 2040. Since May 2019, OKI has set up continuous traffic counters on the BSB and other nearby bridges over the Ohio River.

In December 2019, a review of the traffic modeling and forecasts was finalized with data from these earlier BSB studies, titled *Traffic Counts, Modeling, and Forecast Review*. In this study, the 2040 regional travel model from OKI was utilized to project future traffic volumes. The BSB traffic projections include proposed improvements to the bridge and I-71/I-75 corridor in Kentucky and Ohio based on the current selected Alternative I and assumed no tolling.

Based on these efforts, KYTC and ODOT established the following criteria for the BSB project:

- The baseline traffic volume 160,000 VPD will be used for any additional near-term studies.
- The 2040 Toll Free estimated traffic volume of 227,900 VPD will be used in any near-term design and traffic studies.
- OKI is developing an updated regional travel demand model for year 2050 with current travel and census data. This model will be incorporated into the traffic forecasts for the BSB project when complete, and the forecasts will be extended to 2050.

Also in December 2019, a performance-based design workshop was held with members of ODOT, KYTC, FHWA and HNTB in attendance. The goal of the workshop was to identify concepts that could reduce the construction cost of selected Alternative I for the BSB corridor. The performance-based design workshop identified three new concepts for the BSB project for further traffic operational and design study. These concepts and the results of the additional study are discussed in the following sections.

1.2 PURPOSE

The purpose of this report is to continue the evaluation of the corridor concepts identified in the BSB performance-based design workshop. Microsimulation using TransModeler was selected as the traffic analysis tool for this project due to the complexity of the I-71/I-75 system interchange. Transmodeler calibration was updated for this project, using the 2017 *Strategic Corridor Study* models as a base, with some additions to the model network and traffic count targets. The Build alternatives are analyzed using 2040 traffic volumes developed for Alt I and Concept W during the *BSBC study*.

This report describes the model calibration methodology, validation results, and operational results for the concepts, developed in coordination with the geometric design efforts. The traffic analysis completed for this project is preliminary and is used to identify the feasibility of each concept. Further analysis will be completed as part of future projects with updated base traffic data for model calibration and forecasts for the scenario analysis. It was recognized that a more comprehensive calibrated model will be required for analysis to support the project NEPA document and Interstate Access Request (IAR).

2. MODEL SCENARIOS

2017 Existing

Existing conditions for the I-71/I-75 corridor between the I-275 interchange in Kentucky and Western Hills Viaduct in Ohio.

2040 Concept W

Build configuration for the Brent Spence Bridge with local access traffic on the existing bridge, and interstate through traffic on the new bridge.

2040 Concept M

Build configuration for the Brent Spence Bridge with I-71 traffic on the existing bridge, and I-75 traffic on new bridge. Some local access traffic is present on both bridges, with many existing connections maintained on the existing bridge.

2040 Concept WS

Build configuration for the Brent Spence Bridge following Concept W in Ohio with a superstreet configuration on the local CD road in Kentucky.

3. METHODOLOGY

The TransModeler models are developed following guidelines from the DRAFT *ODOT Analysis and Traffic Simulation Manual: Traffic Simulation with TransModeler.* The model development has the following steps:

1) Existing Model Network Development:
    a. The corridor model developed in 2017 for the *Strategic Corridor Study* is used as the starting model.
    b. Small network adjustments were made to capture the needs of the scenario modeling.
2) Volume Development
    a. Traffic volumes used for the 2017 *Strategic Corridor Study* were reviewed and used as the target volume set for calibration.
    b. 2017 *Strategic Corridor Study* volumes were supplemented with counts collected by ODOT Traffic Monitoring Management System (TMMS).
    c. Model periods are established as 6:00-10:00 AM and 2:00-7:00 PM.
    d. Existing origin-destination (OD) matrices were synthesized using TransModeler ODME tools and set the previous model OD as a seed matrix and 2017 traffic counts as target volumes.
    e. Build Scenario OD's were developed using peak design hour forecasts from the 2015 *BSBC Study*.
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. Speed and Bottleneck review
        i. Observed speed heat maps from INRIX data are compared to delay trends from the models
    c. Point-to-point travel times for I-71/I-75 are compared between field observed (INRIX) and model results
4) Scenario Modeling
    a. MOE's for Freeway segments include:
        i. Travel Speeds
        ii. Freeway Level of Service
        iii. Visual Network audit, including vehicle queue identification

4. VOLUME DEVELOPMENT

4.1 2017 EXISTING

Existing models represent a year 2017 condition. The project team started from previously developed models and traffic counts taken during the *Strategic Corridor Study* in 2017. This study existing model defined the AM period as 6:00-10:00 AM and PM period as 2:00-6 :00PM.

Updates to the existing model volume were made using TransModeler's built-in ODME tool to refine the model origin-destination matrices to account for a few updates, including:

- Model network adjusted at the following locations:
  - Added origin node 28 at 4th Street entrance ramp to I-75 northbound
  - Added origin node 36 at 6th Street entrance ramp to I-75 northbound
  - Separated origin node 105 at I-71 westbound into two separate nodes
  - Separated destination node 158 at I-71 westbound into two separate nodes
  - Separated node 189 at Priority Road into separate origin and destination nodes
- Extended PM period to 2-7 PM to capture entire PM peak period traffic
- Removed traffic count targets based on network balancing review

4.2 2040 BUILD

During the 2015 *BSBC Study*, certified design hour traffic volumes were developed for Concept W. Using these forecasts, origin-destination (OD) matrices were synthesized for the AM and PM design hours. Peak hour origin-destination matrices were synthesized using a simple seed matrix that eliminates illogical paths. The OD matrices were estimated to match the peak design hour forecasts assuming one logical path between each origin and destination, which is consistent with the linear study corridor. The synthesized OD matrices for Concept W were used for the other build scenarios.

The peak hour build OD matrices were expanded to period matrices using factors of 2.6 (AM) and 3.1 (PM). These factors were derived from Brent Spence Bridge counts. The 15-minute loading of the period matrices follow existing profiles.

5. EXISTING MODEL CALIBRATION

Microsimulation was selected as the traffic analysis tool for project scoping due to the complexity of the I-71/I-75 system interchange and local service ramps along the I-75 corridor. The model developed for the *Strategic Corridor Study* was updated with available traffic counts from various sources and dates. The model was calibrated appropriately for project scoping, but a more comprehensive calibrated model will be required for analysis to support the project NEPA document and Interstate Access Request (IAR). The procedures for data collection and calibration are outlined in the *FHWA Analysis Tools Volume III*.

5.1 TRAFFIC VOLUME

The validated 2017 model volumes were compared against traffic counts along the I-71/I-75 freeway mainline and ramps between Buttermilk Pike on the south and Western Hills Viaduct on the north. Validation criteria was not compared for areas south of the Buttermilk Pike, as it is outside the study limits. A plot of the AM and PM model volumes against traffic counts are shown in **Figure 1** (AM) and **Figure 2** (PM).

The existing models meet DRAFT ODOT modeling guidance for volume validation by having 90% of AM peak and 96% of PM peak traffic counts within 15% of model volumes. Additionally, the regression line in the model/count plot is 1.019 (AM) and 1.004 (PM). This outcome is within the acceptable range of 0.95 to 1.05. The Y-intercept is -118 (AM) and -43 (PM) which is just outside the desirable range of +- 10.

Table 1 and **Table 2** show convergence of the model volumes to traffic counts for I-71/I-75 southbound and northbound. The modeled volumes were within 15% of the counts, more than 85% of the time.

Volume profiles were created based on traffic counts and adjusted to replicate speeds and bottlenecks. The volume profiles for the AM and PM peak periods are summarized in **Figure 3** and **Figure 4**. These profiles are used globally for the project area and applied consistently for Existing and Future Build scenarios.

The vehicle mix was determined by aggregating traffic counts throughout the study area. Rather than creating a separate ODME matrix for cars, single unit trucks, and trailer trucks, the vehicle mix was applied consistently to all OD pairs. The fleet has 3% single unit trucks and 5% trailer trucks, 20% pick-up truck or SUV, and the remaining 72% are passenger vehicles ranging from high performance to low performance.

Figure 1: Comparison of AM Period Model Assignments Versus Counts

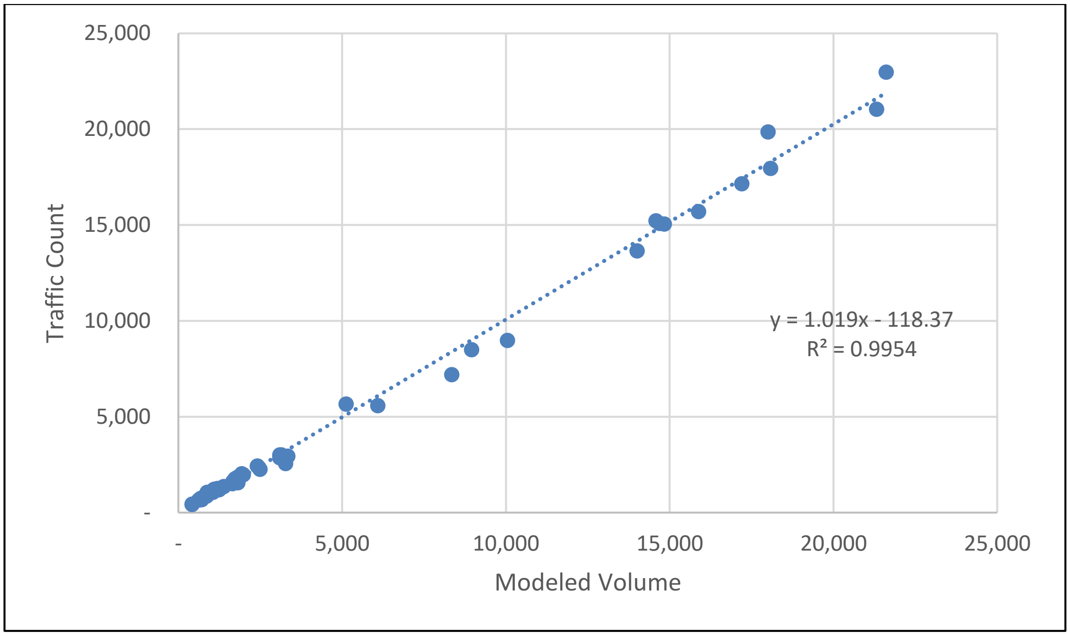


Figure 2: Comparison of PM Period Model Assignments Versus Counts

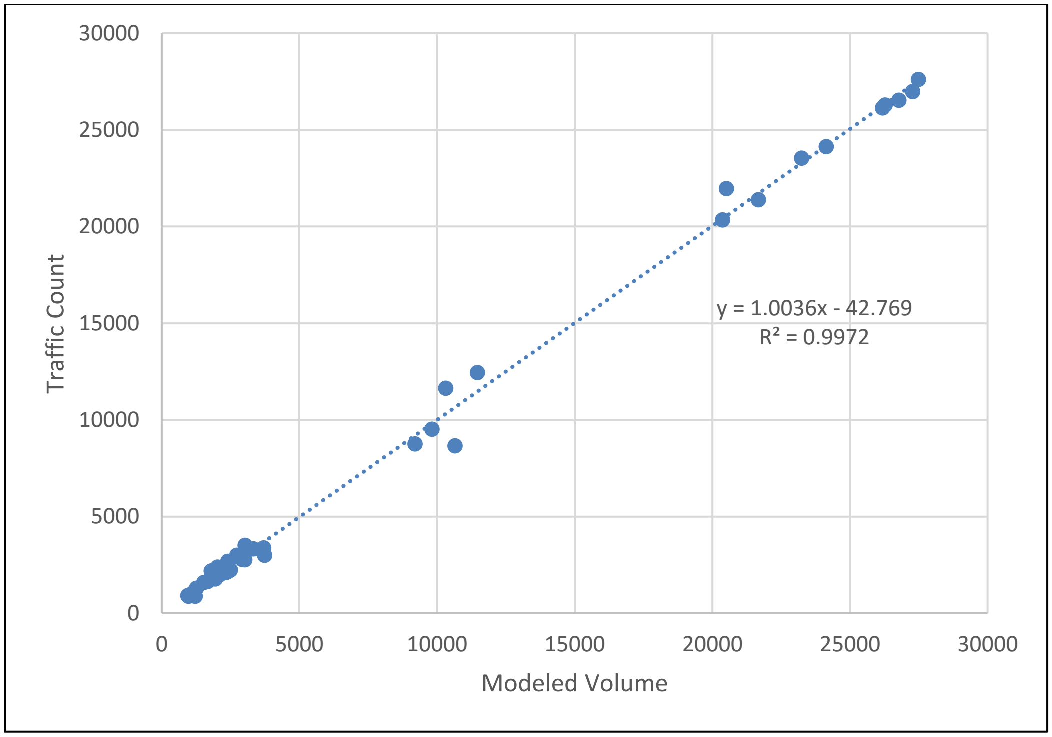


Table 1: SB I-71/I-75 Volume Validation

Location	AM Peak			PM Peak		
	Count	Modeled Volume	Percent Difference	Count	Modeled Volume	Percent Difference
SB Mainline north of Western Hills Viaduct	21,319	21,044	1.3%	24,143	24,880	3.1%
SB Exit Ramp to Western Hills Viaduct	1,026	1,067	4.0%	3,020	2,880	4.6%
SB Entrance Ramp from Western Hills Viaduct	3,100	3,013	2.8%	2,403	2,613	8.7%
SB Mainline between Western Hills Viaduct and Findlay	21,620	22,972	6.3%	23,245	24,595	5.8%
SB Exit Ramp to Western near Findlay	1,814	1,836	1.2%	2,128	2,098	1.4%
SB Exit Ramp to Western near Ezzard Charles	1,242	1,200	3.4%	973	882	9.4%
SB Mainline between Ezzard Charles and Freeman	-	19,947	-	-	21,616	-
SB Exit Ramp to Freeman	1,666	1,616	3.0%	1,956	1,826	6.6%
SB Entrance Ramp from Western near Gest	761	794	4.3%	1,533	1,667	8.7%
SB Exit Ramp to 7th	3,147	3,011	4.3%	954	876	8.2%
SB Split to I-71 EB, 5th and 2nd	8,958	8,498	5.1%	9,817	10,155	3.4%
SB Exit Ramp to 5th	1,985	1,983	0.1%	2,499	2,233	10.6%
SB Mainline between 7th and 9th	-	16,114	-	-	20,589	-
SB Entrance Ramp from 9th	425	431	1.4%	1,799	3,331	85.2%
SB Entrance Ramp from EB US 50/6th St Expy	1,707	1,605	6.0%	2,330	2,524	8.3%
SB Entrance Ramp from SB I-71/WB US 50	6,094	5,580	8.4%	11,467	11,410	0.5%
SB Mainline on Brent Spence Bridge	14,583	15,228	4.4%	26,285	27,699	5.4%
SB Exit Ramp to 5th in KY	1,824	1,555	14.7%	2,931	3,090	5.4%
SB Exit Ramp to Pike and 12th	1,129	1,231	9.0%	2,408	2,538	5.4%
SB Mainline at 5th in KY	-	13,678	-	-	24,628	-
SB Entrance Ramp from 4th	1,391	1,357	2.4%	3,744	4,071	8.7%
SB Entrance Ramp from 12th	1,211	1,258	3.9%	2,402	2,583	7.5%
SB Mainline south of 12th	14,839	15,052	1.4%	27,276	28,707	5.2%
SB Exit Ramp to Kyles Ln	1,652	1,514	8.4%	2,910	2,931	0.7%
SB Entrance Ramp from Kyles Ln	1,092	1,201	10.0%	1,979	2,269	14.7%
SB Mainline south of Kyles Ln	-	14,729	-	-	28,016	-
SB Exit Ramp to Dixie Hwy	715	682	4.6%	2,365	2,330	1.5%
SB Entrance Ramp from Dixie Hwy	881	1,062	20.5%	2,028	2,264	11.6%
SB Mainline south of Dixie Hwy	14,692	15,080	2.6%	26,183	27,709	5.8%

Table 2: NB I-71/I-75 Volume Validation

Location	AM Peak			PM Peak		
	Count	Modeled Volume	Percent Difference	Count	Modeled Volume	Percent Difference
NB Mainline north of Western Hills Viaduct	18,091	17,958	0.7%	27,489	27,855	1.3%
NB Entrance Ramp from Western Hills Viaduct	2,419	2,425	0.2%	2,144	2,052	4.3%
NB Entrance Ramp from Winchell near Bank	1,059	1,063	0.4%	2,368	2,241	5.4%
NB Entrance Ramp at Western Hills Viaduct	2,419	2,425	0.2%	2,144	2,052	4.3%
NB Exit Ramp to Western Hills Viaduct	1,269	1,218	4.0%	3,331	3,576	7.4%
NB Mainline between Ezzard Charles and Western Hills	15,890	15,703	1.2%	26,777	27,164	1.4%
NB Entrance Ramp from Winchell at Ezzard Charles	423	441	4.3%	1,215	1,161	4.4%
NB Mainline north of Ezzard Charles	-	15,284	-	-	26,033	-
NB Entrance ramp from Gest/Freeman	1,750	1,772	1.3%	2,363	2,287	3.2%
NB Entrance Ramp from Winchell/9th	633	665	5.1%	2,728	2,713	0.5%
NB Entrance Ramp from Freeman	1,750	1,772	1.3%	2,363	2,287	3.2%
NB CD (I-71 SB/US 50 WB, 4th and 6th) ramp to Winchell	-	1,461	-	-	3,012	-
NB Entrance Ramp from CD (I-71 SB/US 50 WB, 4th and 6th Street)	5,127	5,657	10.3%	10,318	11,333	9.8%
NB Mainline between 6th and 7th	8,347	7,197	13.8%	10,654	9,708	8.9%
NB Exit Ramp to WB US 50/6th St Expy	1,941	2,024	4.3%	3,028	3,236	6.9%
NB Exit Ramp to 5th in Ohio	1,683	1,641	2.5%	1,109	1,146	3.3%
NB Exit Ramp to NB I-71/EB US 50	10,052	8,983	10.6%	9,208	8,895	3.4%
NB Mainline on Brent Spence Bridge	18,012	19,866	10.3%	20,509	23,016	12.2%
NB Entrance from 5th St in KY	3,350	2,949	12.0%	3,710	3,761	1.4%
NB Exit Ramp to 12th St	3,274	2,563	21.7%	1,667	1,797	7.8%
NB Mainline south of 5th Street	-	16,952	-	-	19,299	-
NB Exit Ramp to 5th St in KY	1,733	1,754	1.2%	2,005	2,134	6.4%
NB Entrance Ramp from 12th St	924	962	4.1%	2,157	2,413	11.9%
NB Mainline South of 12th St	17,208	17,157	0.3%	21,674	22,126	2.1%
NB Entrance Ramp from Kyles Ln	3,098	2,855	7.8%	2,220	2,315	4.3%
NB Exit Ramp from Kyles Ln	690	739	7.1%	2,171	2,342	7.9%
NB Mainline South of Kyles Ln	-	15,053	-	-	22,177	-
NB Entrance Ramp from Dixie Hwy	2,500	2,261	9.6%	2,293	2,481	8.2%
NB Exit Ramp to Dixie Hwy	863	852	1.3%	1,269	1,395	9.9%
NB Mainline South of Dixie Hwy	14,014	13,658	2.5%	20,376	21,117	3.6%

Figure 3: AM Peak Volume Profile

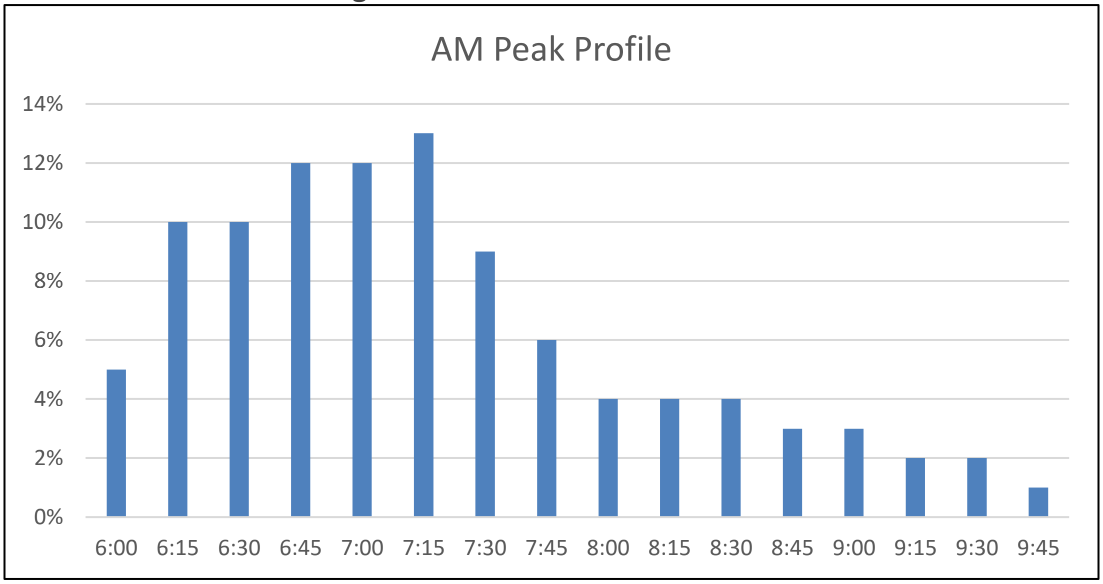
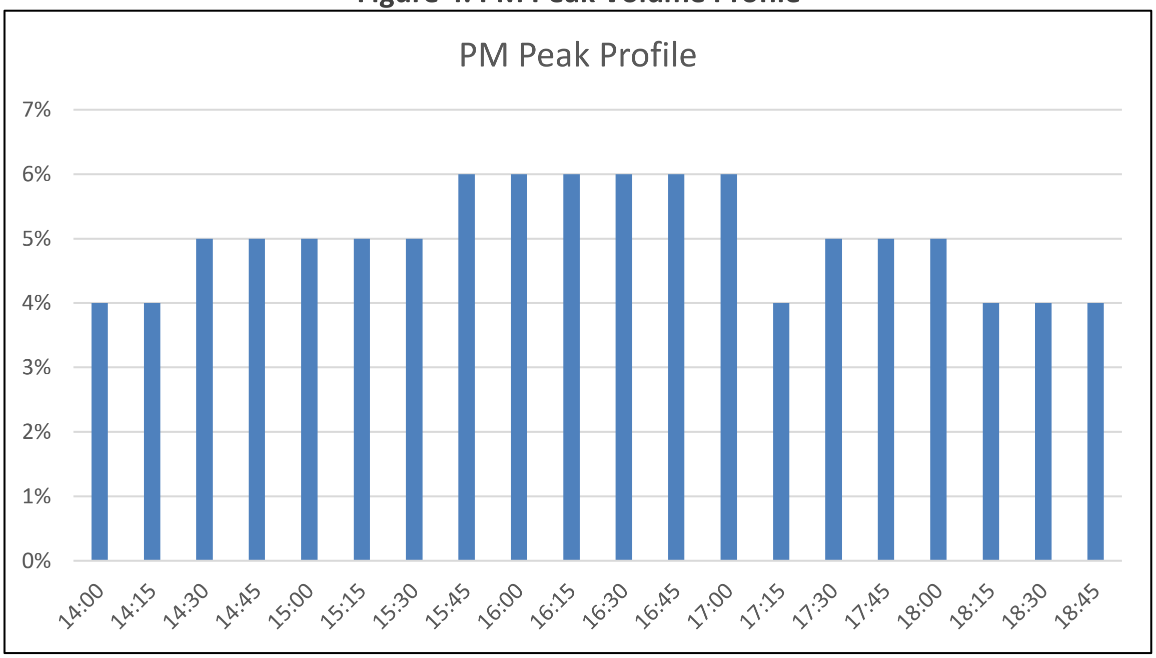


Figure 4: PM Peak Volume Profile



5.2 TRAVEL SPEEDS

Travel speeds on the I-71/I-75 corridor are obtained from NPMRDS (supplied by INRIX). The observed 2017 median weekday speeds are compared to the model speeds. Figure 5- Figure 8 compares the speeds by period and direction. The models match the off-peak direction speeds for AM southbound and PM northbound. However, the travel delays for the peak directions do not match field conditions. The field observed travel speeds indicate queuing and delays leading to the Brent Spence Bridge, which are not replicated by the model. Additional model calibration is needed once the project advances to the next stage of analysis.

5.3 TRAVEL TIMES

Point-to-point travel time for I-71/I-75 between Dixie Hwy and the Western Hills Viaduct are summarized in Table 3. The model travel times are averaged over the peak period. The travel time range shows the high and low peak period travel time over 3 model runs. The modeled and observed travel times are compared as part of the model validation. As indicated for the travel speed comparison, the model travel time in the peak direction does not match field conditions while the off-peak travel time is a good representation of field conditions.

Table 3: Travel Time Validation

	NMPRDS Travel Time	Modeled Travel Time
I-75 Northbound – AM Peak	10.8 minutes	6.9-8.4 minutes
I-75 Southbound – AM Peak	7.6 minutes	6.7-8.3 minutes
I-75 Northbound – PM Peak	8.2 minutes	7.1-8.5 minutes
I-75 Southbound – PM Peak	14.0 minutes	6.8-8.9 minutes

Figure 5: AM Peak I-71/I-75 Northbound Speed Data Heat Map

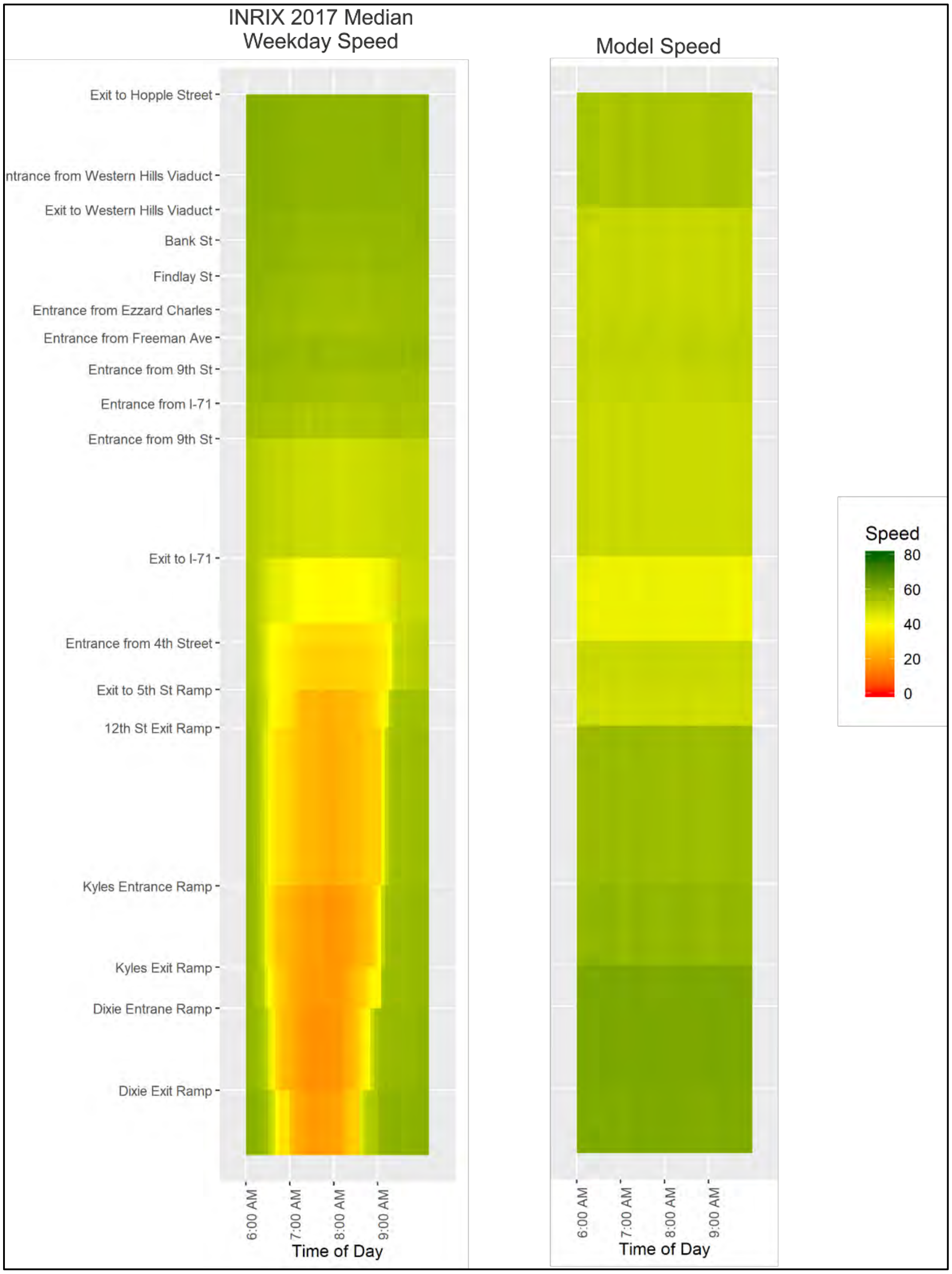


Figure 6: AM Peak I-71/I-75 Southbound Speed Data Heat Map

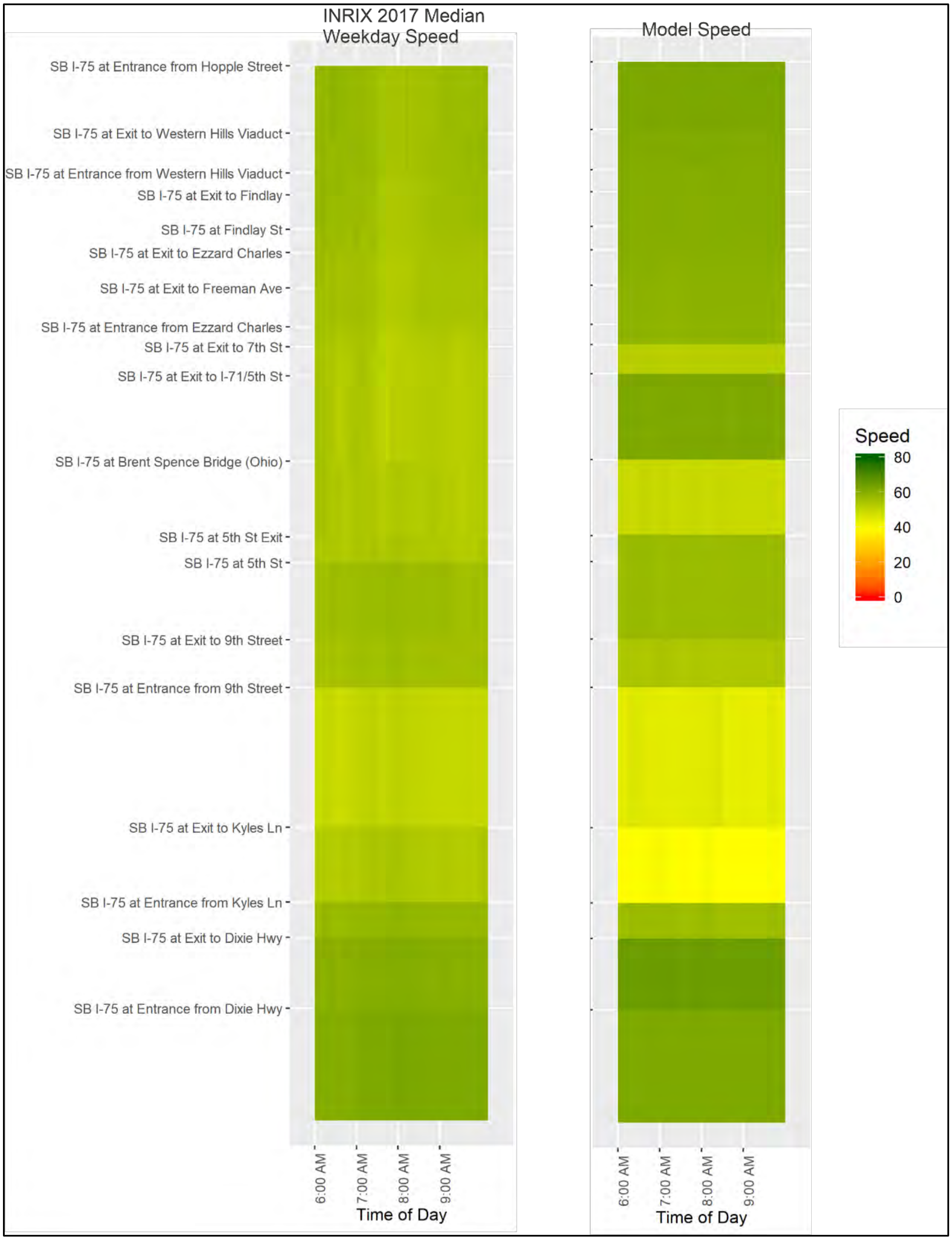


Figure 7: PM Peak I-71/I-75 Northbound Speed Data Heat Map

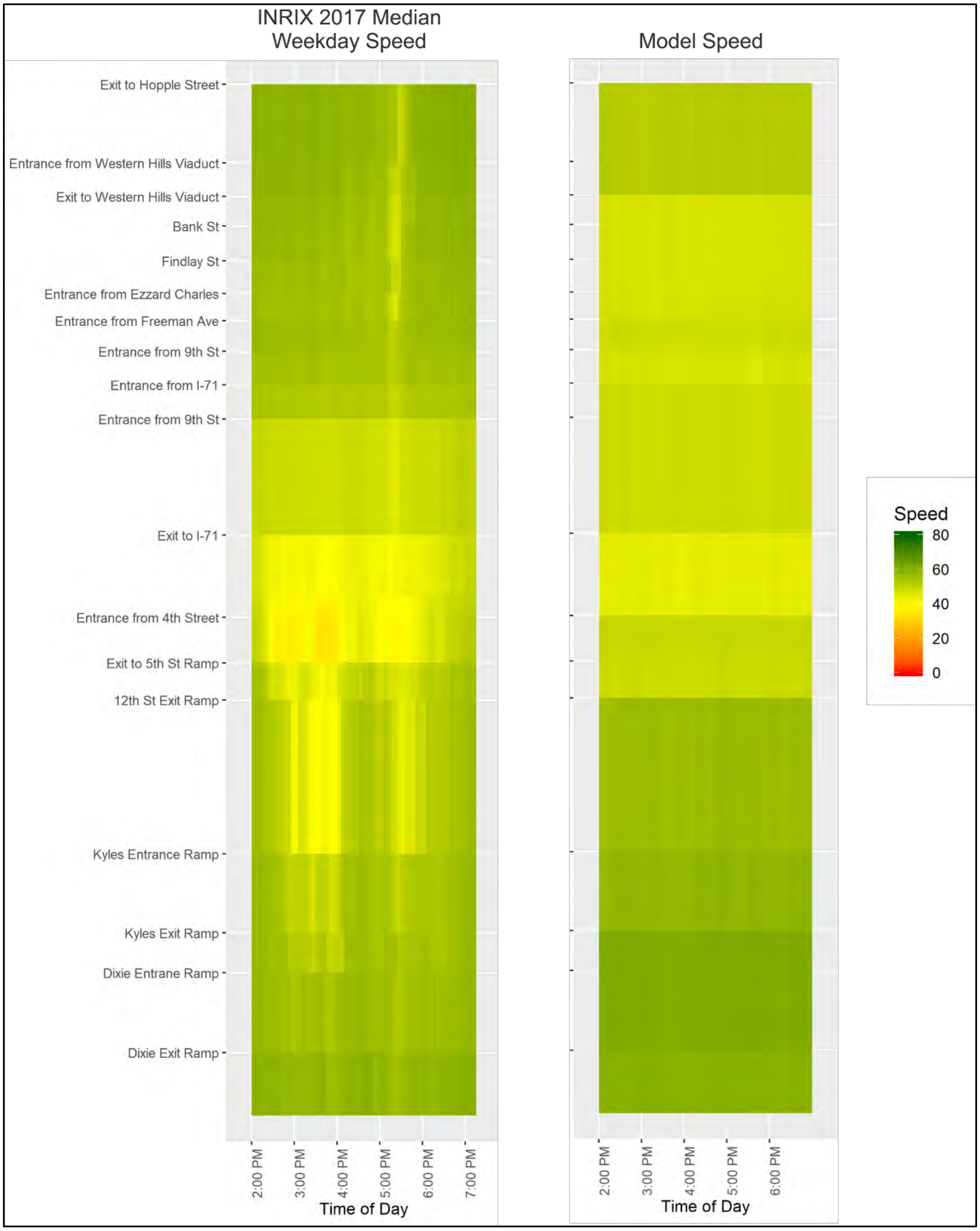
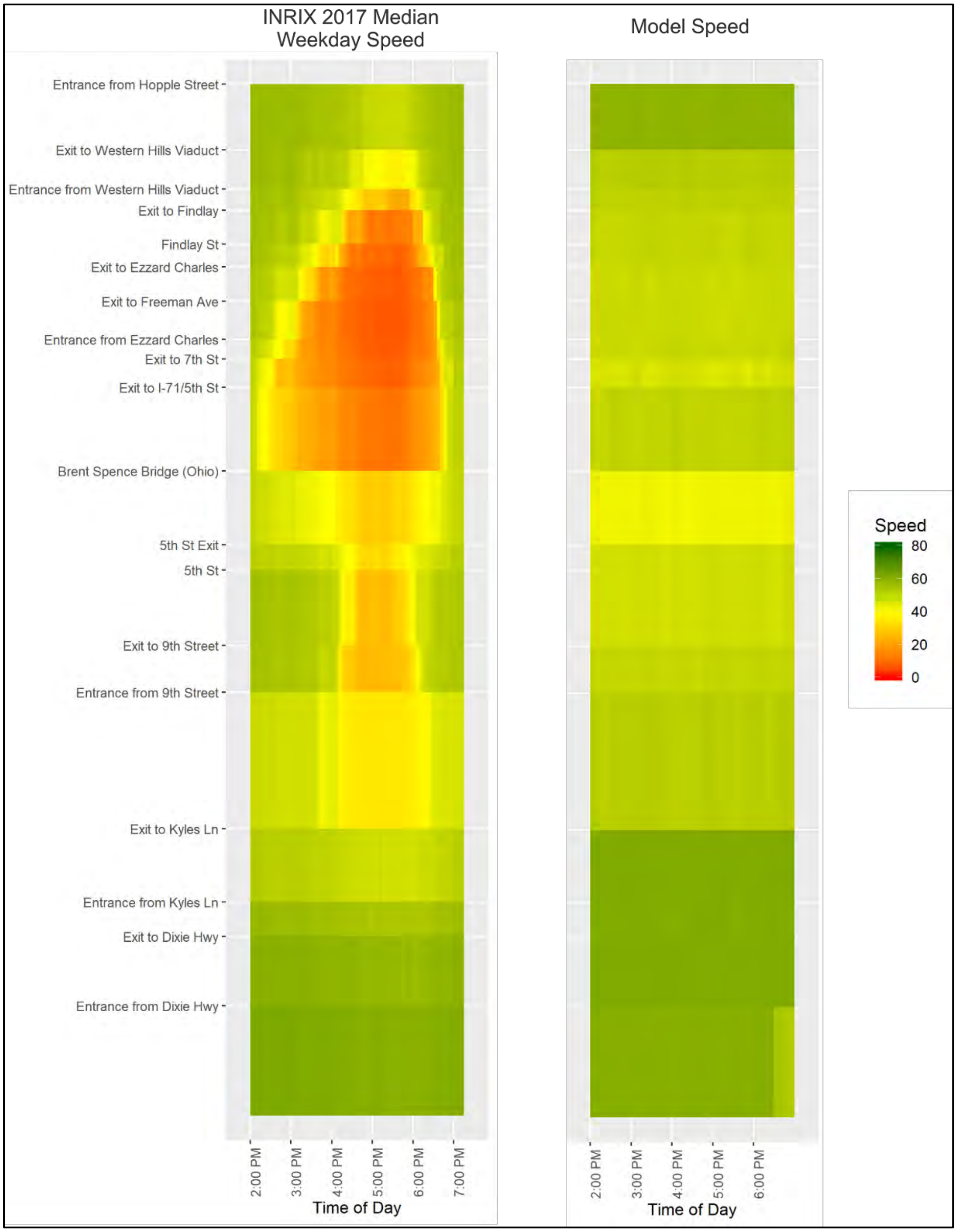


Figure 8: PM Peak I-71/I-75 Southbound Speed Data Heat Map



5.4 DEVIATIONS FROM DEFAULT VALUES

Lane connectivity bias is adjusted to replicate driver behavior when merging at an entrance ramp or at a lane drop. The default connectivity bias is 1.00. When the connectivity bias is reduced, it lowers lane utilization behaviors. The connectivity bias was reduced to 0.8 at the end of a merge lane or lane drop to change merging behavior, so drivers will merge as soon as possible rather than driving to the end of the lane taper.

Two additional road classes are added to the model to capture the differences between freeways near the urban core and freeways through transitioning/suburban areas. Urban Freeway 55 mph road class is developed to adjust for the reduced speeds observed near the Cincinnati urban core. A class for the Brent Spence Bridge is created to adjust for reduced capacity on the bridge due to the narrow lanes and minimal shoulder. The road classes are summarized in **Table 4.**

Table 4: Model Road Classes

Attribute	Default Freeway	Freeway (70 mph)	Urban Freeway (55 mph)
Saturation Flow Rate	2,400 veh/hr/ln	2,400 veh/hr/ln	1,900 veh/hr/ln
Speed Limit	65 mph	65 mph	55 mph
Free-flow Speed	70 mph	70 mph	60 mph
Desired Speed Distribution	Freeway (Default)	Freeway	Urban Freeway

The freeway desired speed distributions were adjusted to match off-peak speeds from NPMRDS, which approximate the free flow condition. The desired speed distribution describes how much faster or slower than the speed limit vehicles in the model drive and is expressed in percentage of drivers. The default freeway desired speed distribution in **Figure 9** was adjusted to include more vehicles driving below the posted speed limit and slightly more variation in speeds as shown in **Figure 10**. A new category was created for the urban freeways with a 55 mph speed limit to have even more variation in speeds and a trend towards driving above the speed limit as shown in **Figure 11**.

Figure 9:Default Freeway Speed Distribution

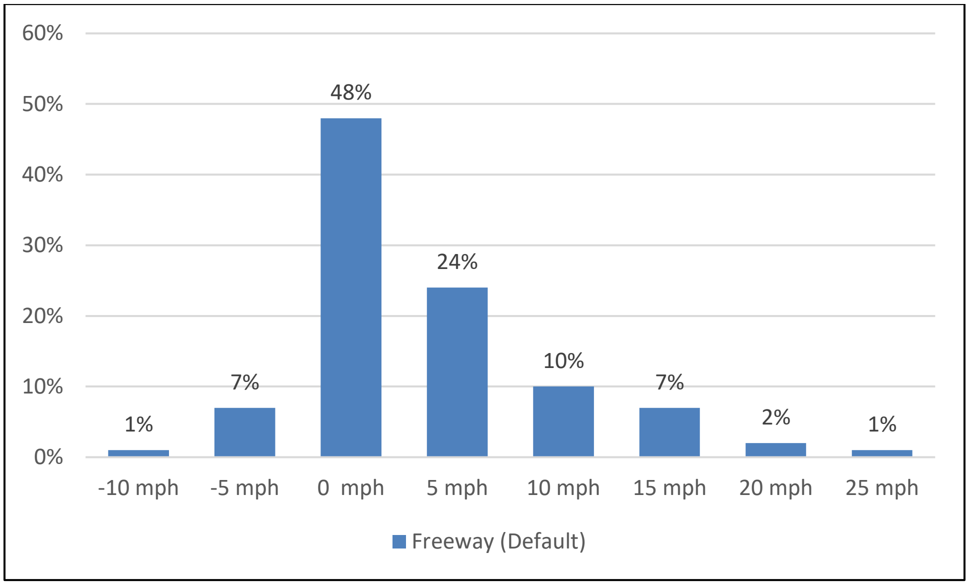


Figure 10: Adjusted Freeway (70 mph) Speed Distribution

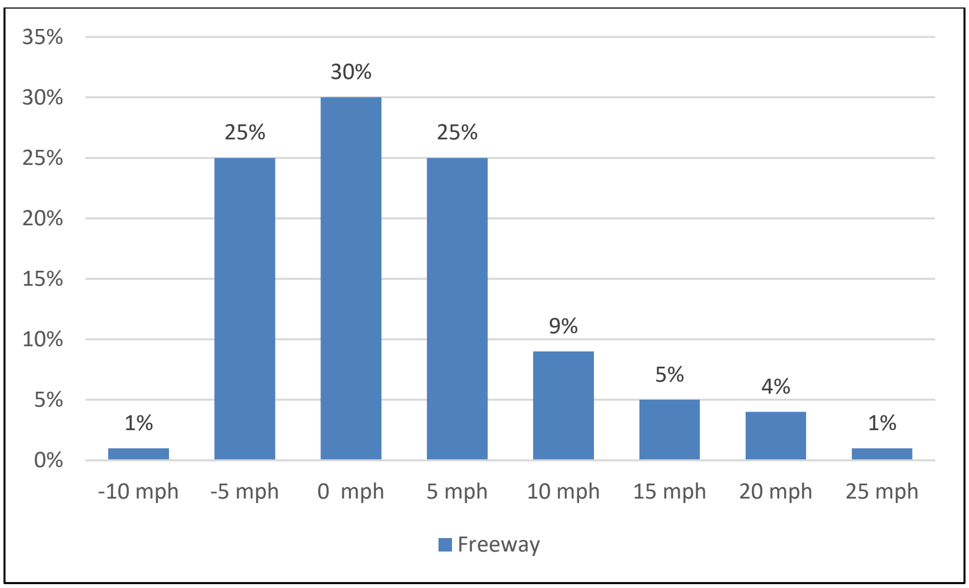
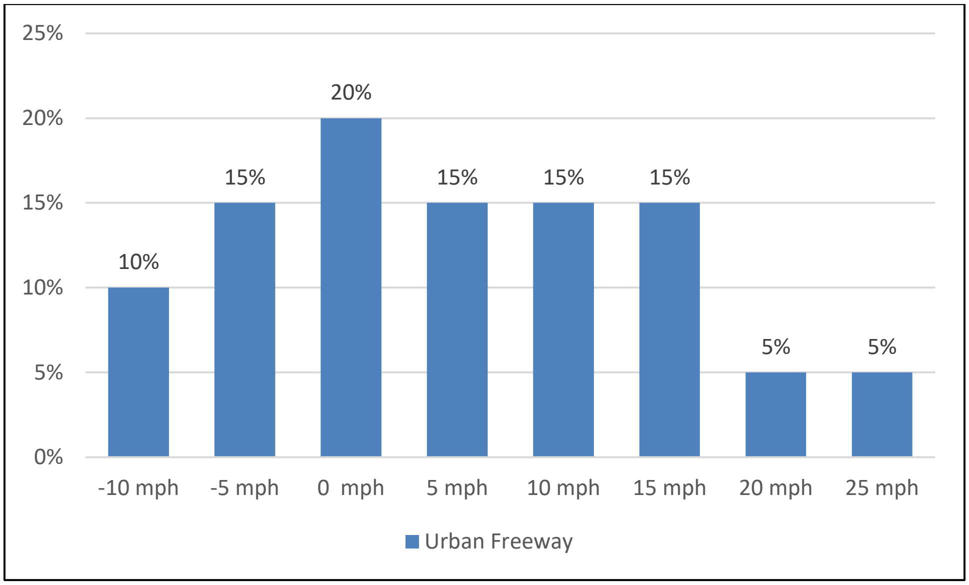


Figure 11: Urban Freeway (55 mph) Distribution



Critical headways for freeway merging was adjusted to increase the percentage of drivers that prefer a larger headway while merging. There are entrance ramps near the Ohio and Kentucky sides of the bridge that disrupt traffic flow. The default and adjusted critical headway parameters are shown in **Table 5.**

Table 5: Critical Headway

Critical Heady for Freeway Merging (seconds)	Default Percentage of Drivers	Adjusted Percentage of Drivers
0.2 sec	20%	10%
0.4 sec	50%	20%
0.6 sec	20%	50%
0.8 sec	10%	20%

Though the model does not fully depict slowdowns and recoveries during the peak periods, further adjustments were not made to the parameters. The adjusted critical headway and speed distribution inputs improved the calibration by decreasing modeled speeds (which is more comparable to observed speeds). Although the best available traffic counts and speed data were used for the calibration there are limitations on how this data should be used. The TransModeler default parameters are based on peer reviewed research and will not be adjusted beyond the limitations of the input data.

6. SCENARIO ANALYSIS SUMMARIES

The concepts developed at the performance-based design workshop in December 2019 were analyzed using the microsimulation model. The purpose of the analysis was to determine if these concepts for the I-71/I-75 system interchange and Ohio River crossing are viable and should be carried forward to the NEPA phase for further refinement. The concepts include improvements to the I-75 corridor to eliminate upstream and downstream bottlenecks that would restrict traffic flow through the project area. The purpose of this study is not to define improvements to the I-75 corridor, but to ensure the I-71/I-75 system interchange and bridge over the Ohio River can accommodate future traffic.

The level of service (LOS) and mainline freeway speeds during the peak hour are reported. The AM peak analysis covers 6:00 AM to 10:00 AM, and results are reported for the peak hour which occurs from 7:00 AM to 8:00 AM. The PM peak analysis covers 3:00 PM to 7:00 PM, and results are reported for the peak hour which occurs from 4:00 PM to 5:00 PM.

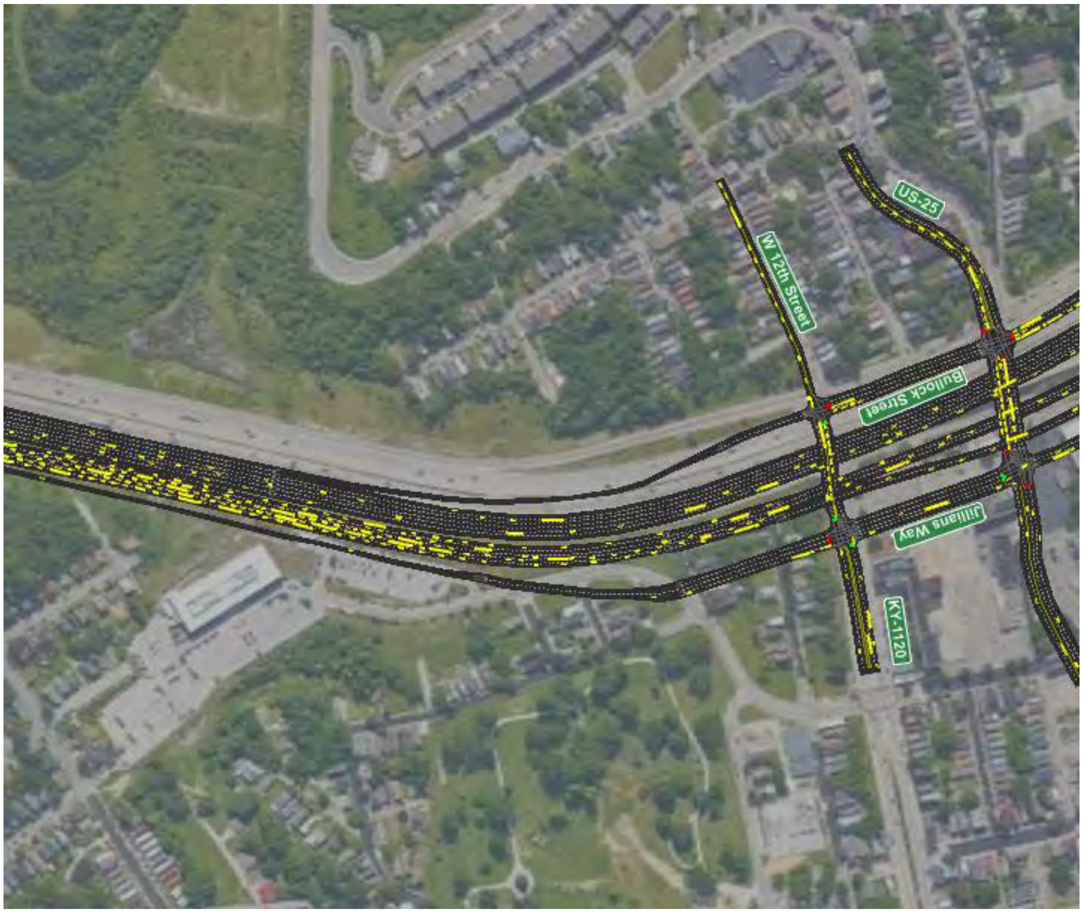
6.1 2040 CONCEPT W

Concept W has the best operations of the three concepts analyzed. Most of the freeway segments operate at a level of service of D or better with mainline speeds of 50 mph or greater. Line diagram summaries for Concept W are presented in the appendix and include details on the freeway level of service and peak hour traffic forecasts. The one segment with a level of service on the LOS D/LOS E threshold is the southbound exit to I-75 local (near Ezzard Charles). This diverge could be reconfigured as the concept is further refined to improve traffic operations.

6.2 2040 CONCEPT M

Concept M performed acceptably and can be improved as the concept is further developed. The major diverge at I-71/I-75 northbound performs at the LOS E/LOS F threshold and traffic forms a "rolling queue" as shown in **Figure 12**. The forecasted traffic to I-71 and I-75 at this diverge are nearly equal. In the current design, there are 5 lanes approaching the major diverge. I- 75 northbound is 3 lanes wide and there is a 2-lane ramp to I-71 northbound. A lane could be added on the ramp to I-71 northbound and the approaching middle lane could become an option lane. The desired 3-lane cross section on the existing bridge can be used if one of the 3 lanes on the ramp to I-71 northbound is dropped prior to the 4th Street entrance ramp.

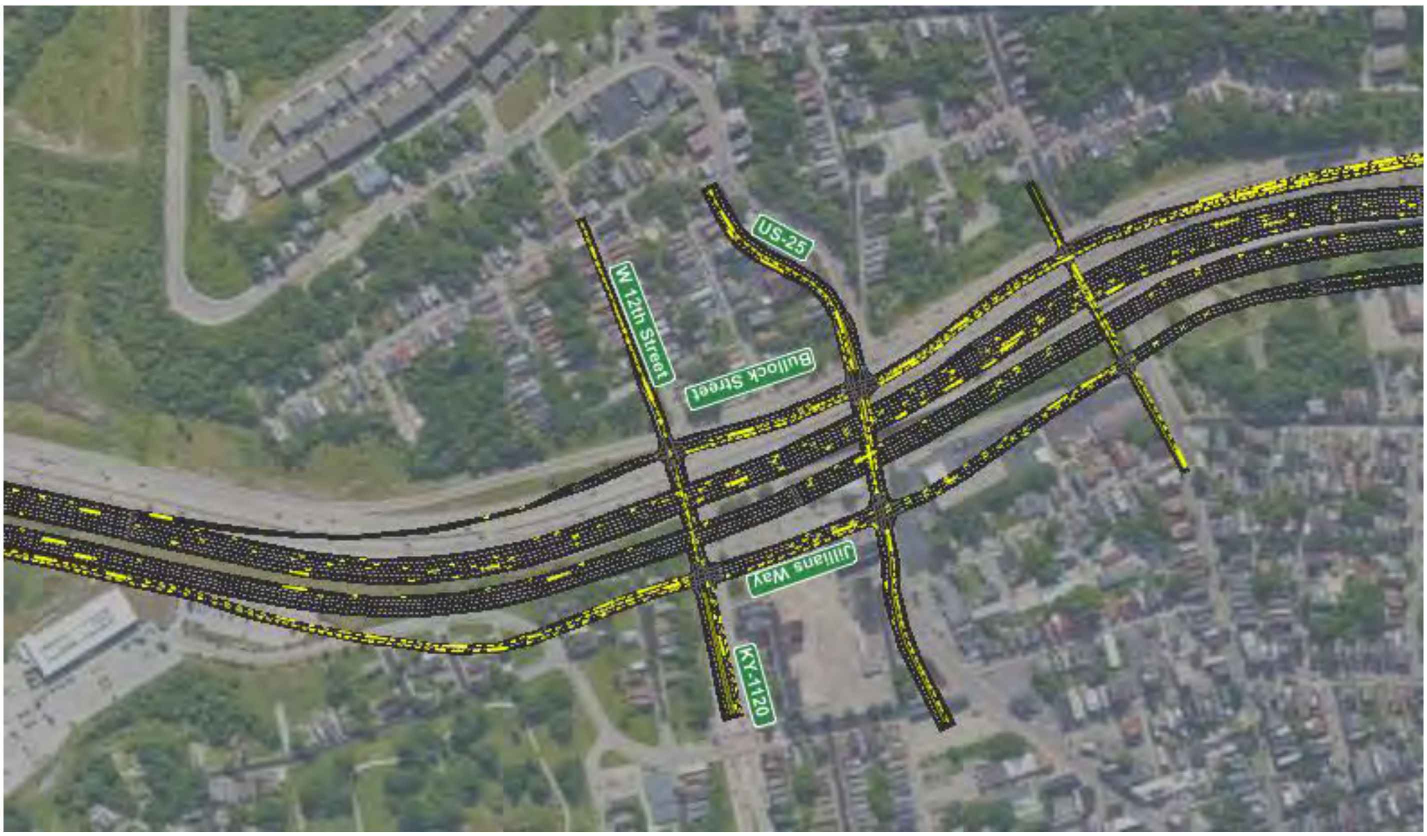
Figure 12: Concept M in Kentucky During AM Peak



6.3 2040 CONCEPT WS

Initial analysis concluded that Concept WS is not a viable option. Concept WS is identical to Concept W in Ohio but has "superstreets" in Kentucky that connects the local roadways. The superstreets in this concept move trips that would otherwise be on an access-controlled freeway ramp system through a series of signalized intersections. The traffic signals could not accommodate the traffic moving through the superstreets and the traffic on intersecting east-west local roads. The traffic delays observed for Concept WS are highlighted in Figure 13.

Figure 13: Concept WS Superstreets in Kentucky During AM Peak



7. RECOMMENDATIONS

Traffic analysis of Concept W and Concept M show reasonable operation and are both recommended for further study in the BSB Project. The corresponding geometric design and cost estimate analysis for each concept is shown in the *Analysis of Design Concepts* report, also completed in April 2020. Concept WS is not recommended for further study. Refinement of the model calibration and traffic analyses should be made concurrent with any updated geometric design and constructability efforts.

Data collection is the most critical action for the next phase of model calibration. Updated counts, origin-destination data from a source such as Streetlight, and a comprehensive speed/travel time data analysis using NPMRDS (INRIX) are recommended. All this data can be used to satisfy updated modeling guidelines from FHWA Analysis Toolbox Volume III. Specifically, this data can be used for cluster analysis, which group data into similar type days based on demand, speed, queuing patterns, and weather conditions. The models can then be calibrated to various conditions instead of the traditional model that tries to replicate an average condition. With more robust data, the headway parameters can be further adjusted to improve calibration. Further refinements to the model geometry, including elevation throughout the corridor, are also recommended.

2040 Concept M Freeway Capacity Analysis Summary

I-75 Northbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
NB Mainline (at I-275)	F-101	Mainline	37.4	36.2 - 38.8	58	E	22.6	22.1 - 23.3	62	C
NB Entrance Ramp from I-275	R-01	Merge	26.8	25.8 - 27.2	--	C	19.9	18 - 21.4	--	B/C
NB Mainline	F-102	Mainline	25.7	24.9 - 26.4	61	C/D	18.7	18.5 - 19.2	62	C
NB Exit Ramp to Buttermilk Pk.	R-02	Diverge	28.0	26.4 - 30	--	C/D	21.5	20.8 - 22.4	--	C
NB Mainline (at Buttermilk Pk.)	F-103	Mainline	26.8	26.3 - 27.2	62	D	21.2	20.8 - 21.5	62	C
NB Entrance Ramp from Buttermilk Pk.	R-03	Merge	28.1	27.2 - 29.4	--	C/D	21.9	20.8 - 22.5	--	C
NB Mainline south of Dixie Hwy	F-104	Mainline	23.3	22.5 - 23.9	61	C	18.4	18 - 19.4	62	C
NB Exit Ramp to Dixie Hwy	R-04	Diverge	25.7	25.5 - 26.1	--	C	20.3	19.4 - 21.7	--	C
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (3 lanes)	F-105	Mainline	26.6	25.9 - 27.1	62	C/D	20.8	20.3 - 21.4	63	C
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (4 lanes)	F-106	Mainline	26.7	26.2 - 27.1	62	D	20.8	20.3 - 21.5	62	C
NB Entrance Ramp from Dixie Hwy	R-05	Merge[1]	25.3	24.4 - 25.9	--	C	20.9	19.5 - 21.9	--	C
NB Entrance Ramp from Kyle	R-06	Merge[1]	23.5	22.7 - 24.2	--	C	19.2	18.6 - 19.7	--	B
NB Mainline	F-107	Mainline	26.4	22.9 - 32.8	56	C/D	19.1	18.9 - 19.3	63	C
NB Exit Ramp to MLK Jr Blvd/US 25/Pike St/9th St	R-07	Diverge	38.5	28.9 - 49.6	--	D/F	21.7	21.1 - 22.6	--	C
NB Mainline	F-108	Mainline	55.0	42.8 - 68.6	30	E/F	28.4	28 - 28.8	46	D
NB Exit Ramp to Local Lanes/I-71 EB	R-08	Diverge[1]	44.5	43.4 - 45.7	--	E/F	32.1	30.7 - 33.8	--	D
NB Mainline	F-109	Mainline	25.7	24.5 - 26.6	50	C/D	21.2	20.6 - 21.6	51	C
NB Entrance Ramp from MLK Jr Blvd/US 25/Pike St/9th St	R-09	Merge[1]	23.4	22.2 - 24.7	--	C	19.6	19 - 20.1	--	B/C
NB Mainline on New Bridge over Ohio River	F-110	Mainline	23.2	22.3 - 24.1	49	C	19.6	18.8 - 19.8	50	C
NB Exit Ramp to 5th St/6th St	R-10	Diverge[1]	25.1	22 - 30.4	--	C/D	25.7	21.6 - 32	--	C/D
NB Mainline at 9th St Viaduct	F-111	Mainline	25.1	24.1 - 27.1	49	C/D	21.5	20.9 - 22.4	49	C
NB Entrance Ramp from Northbound Local Lanes	R-11	Merge[1]	19.5	17.3 - 20.5	--	B/C	18.5	18 - 18.9	--	B
NB Mainline at Ezzard Charles Dr	F-112	Mainline	18.5	16.9 - 19.3	50	B/C	18.9	17.8 - 20.7	51	C
NB Entrance Ramp from Freeman Ave	R-12	Merge[1]	18.3	17 - 19.5	--	B	18.8	18 - 20.6	--	B/C
NB Mainline	F-113	Mainline	21.7	20.3 - 23.4	50	C	22.4	21 - 23.5	50	C
NB Exit Ramp to Western Hills Viaduct	R-13	Diverge[1]	26.3	23.8 - 28.2	--	C/D	27.0	25.6 - 27.7	--	C
NB Mainline north of Western Hills Viaduct	F-114	Mainline	19.8	19.3 - 20.6	52	C	19.6	18.5 - 20.1	51	C

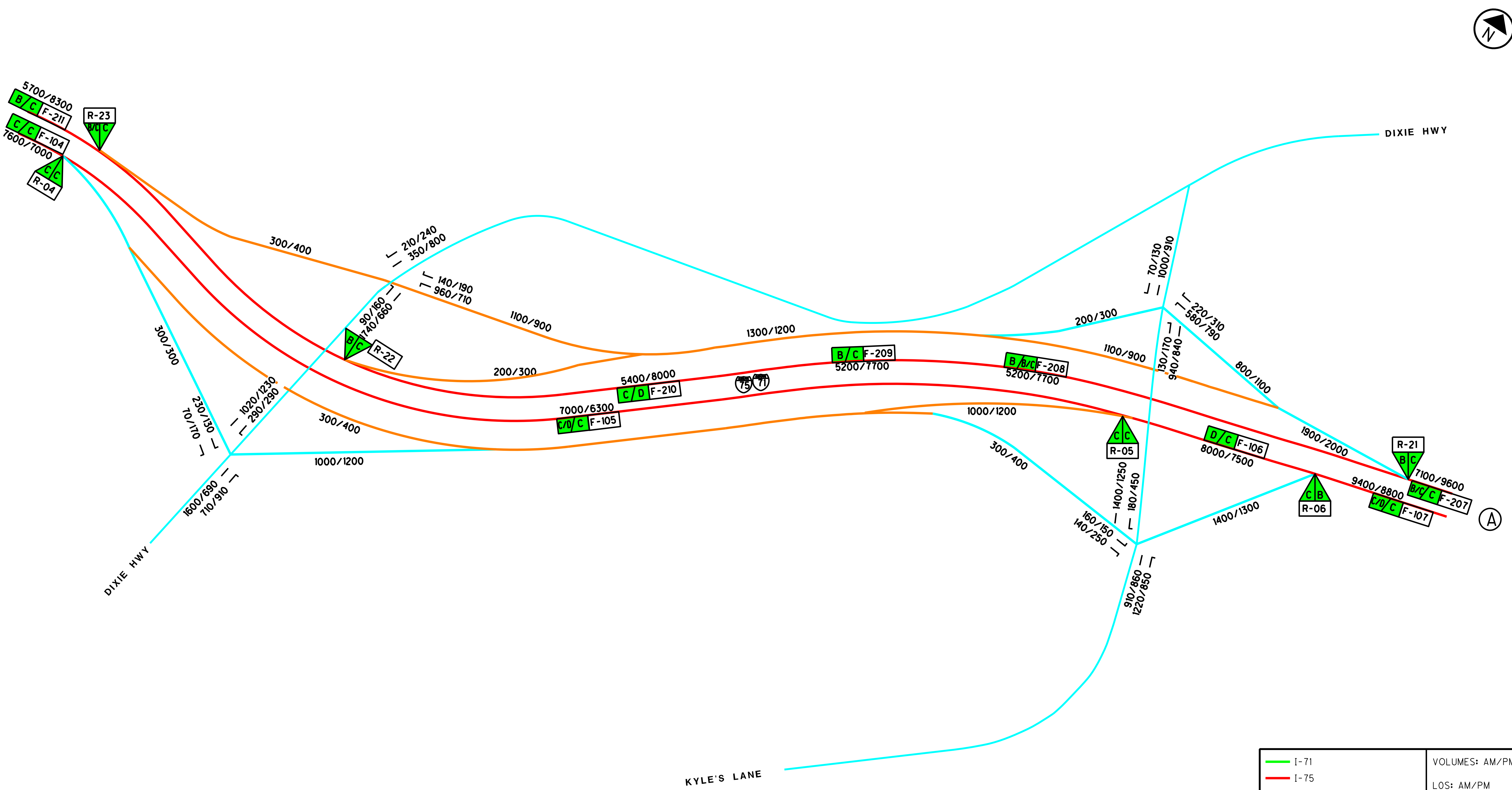
2040 Concept M Freeway Capacity Analysis Summary

I-75 Southbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
SB Mainline north of Western Hills Viaduct	F-201	Mainline	27.6	26.8 - 28.4	50	D	21.0	20.4 - 21.3	52	C
SB Entrance Ramp from Western Hills Viaduct	R-14	Merge[1]	26.2	26 - 26.4	--	C	19.7	18.8 - 21.7	--	B/C
SB Mainline south of Western Hills Viaduct	F-202	Mainline	25.9	24.9 - 27.5	49	C/D	19.8	19.1 - 20.7	50	C
SB Exit Ramp to Western Avenue	R-15	Diverge	26.6	24.8 - 27.5	--	C	21.8	21.1 - 23.3	--	C
SB Exit Ramp to I-75 Local	R-16	Diverge[1]	30.9	27.4 - 33.8	--	C/D	25.9	21.7 - 28.2	--	C/D
SB Mainline	F-203	Mainline	33.5	32 - 38.2	45	D/E	31.5	30.8 - 32.6	45	D
SB Exit to I-71 EB	R-17	Diverge	42.2	39.1 - 47.3	--	E/F	42.9	41.5 - 44	--	E
SB Mainline on New Bridge over Ohio River	F-204	Mainline	20.5	20 - 21.4	50	C	20.6	20.1 - 21.4	50	C
SB Entrance Ramp from I-75 Local Lanes	R-18	Merge[1]	18.3	17.4 - 19.5	--	B	19.9	18.7 - 21.1	--	B/C
SB Entrance Ramp from I-71 Southbound	R-19	Merge[1]	19.5	19.2 - 19.9	--	B	21.4	21.1 - 21.9	--	C
SB Mainline	F-205	Mainline	19.5	19.2 - 19.9	52	C	21.4	21.1 - 21.9	52	C
SB Entrance Ramp from Bullock St	R-20	Merge[1]	15.4	14.9 - 16.2	--	B	18.2	17.9 - 18.9	--	B
SB Mainline	F-207	Mainline	18.5	17.1 - 19.5	63	B/C	21.7	19.8 - 22.8	62	C
SB Exit Ramp to Kyles/Dixie C-D Road	R-21	Diverge	17.6	17 - 18.5	--	B	22.0	19.6 - 24.9	--	C
SB Mainline (6 Lanes)	F-208	Mainline	13.3	12.4 - 14.3	64	B	17.3	16.5 - 18	63	B/C
SB Mainline (5 Lanes)	F-209	Mainline	16.2	15.3 - 16.7	61	B	21.3	20.6 - 22.8	59	C
SB Mainline (4 Lanes)	F-210	Mainline	20.4	19.6 - 20.8	61	C	26.5	26 - 27	59	D
SB Entrance Ramp from Kyles/Dixie C-D Road	R-22	Merge[1]	17.0	15.6 - 18.1	--	B	22.6	21.3 - 24.4	--	C
SB Entrance Ramp from Dixie Hwy	R-23	Merge	18.3	15.9 - 21	--	B/C	24.0	23.3 - 25.3	--	C
SB Mainline	F-211	Mainline	17.0	16.6 - 17.3	62	B	22.2	22.1 - 22.5	61	C
SB Exit Ramp to Buttermilk Pk.	R-24	Diverge	18.9	17.6 - 20.1	--	B/C	24.3	23.4 - 25.1	--	C
SB Mainline	F-212	Mainline	19.0	17.2 - 20.2	62	B/C	25.8	24.9 - 27.1	61	C/D
SB Entrance Ramp from Buttermilk Pk.	R-25	Merge	18.9	16.9 - 21	--	B/C	24.5	23.7 - 25.3	--	C
SB Mainline north of Buttermilk Pk.	F-213	Mainline	18.1	17.5 - 18.8	61	B/C	23.9	23.5 - 24.5	59	C
SB Exit Ramp to I-275	R-26	Diverge	18.5	16.5 - 20.4	--	B/C	26.4	25.5 - 27	--	C
SB Mainline at I-275	F-214	Mainline	21.9	21.3 - 22.5	62	C	28.2	27.8 - 28.6	61	D

2040 Concept M Freeway Capacity Analysis Summary

I-71 Local Northbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
I-71 Local Northbound (mainline)	L-101	Mainline	59.9	59 - 60.7	33	F	47.2	45.6 - 50.2	36	F
After Exit to W 5th Street (mainline)	L-102	Mainline	39.1	38.5 - 39.7	40	E	33.2	32.1 - 34.2	40	D
Ramp from 4th Street	LR-01	Merge[1]	38.9	36.6 - 41.6	--	E	29.1	27.2 - 30.4	--	D
I-71 over Ohio River	L-103	Mainline	37.0	36.6 - 37.3	43	E	28.8	27.4 - 30.1	45	D
Exit to 6th Street	LR-02	Diverge[1]	57.4	55.1 - 60.2	--	F	45.0	40.5 - 47.1	--	E/F
I-71 Northbound	L-104	Mainline	40.5	38.9 - 42.3	36	E	31.5	30.3 - 32.4	38	D
I-71 Northbound Ramp Merge	LR-03	Merge[1]	31.5	30.1 - 32.6	--	D	27.2	26.2 - 28.5	--	C/D

I-71 Local Southbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
I-71 SB Major Diverge	LR-04	Diverge[1]	29.9	27.7 - 31.6	--	C/D	27.4	25.2 - 29.5	--	C/D
Ramp from 3rd St	LR-05	Merge[1]	27.0	25.6 - 27.8	--	C	25.8	24 - 27.3	--	C
I-71 Southbound Ramp	L-203	Mainline	30.5	29.4 - 31	42	D	25.0	23.9 - 26.2	43	C/D
SB I-71 local over Ohio River	L-201	Mainline	26.8	26 - 27.6	46	D	27.2	26.3 - 28.5	45	D
Ramp to 5th Street	LR-06	Diverge[1]	26.8	26 - 27.6	--	C	27.2	26.3 - 28.5	--	C/D
I-71 on to merge with I-75	L-202	Mainline	35.7	35 - 37.4	37	E	38.3	36.8 - 39.3	37	E



I-71	VOLUMES: AM/PM
I-75	LOS: AM/PM
COLLECTOR-DISTRIBUTOR	LOS A-D
US 50	LOS E
LOCAL ROADS AND RAMPS	LOS F

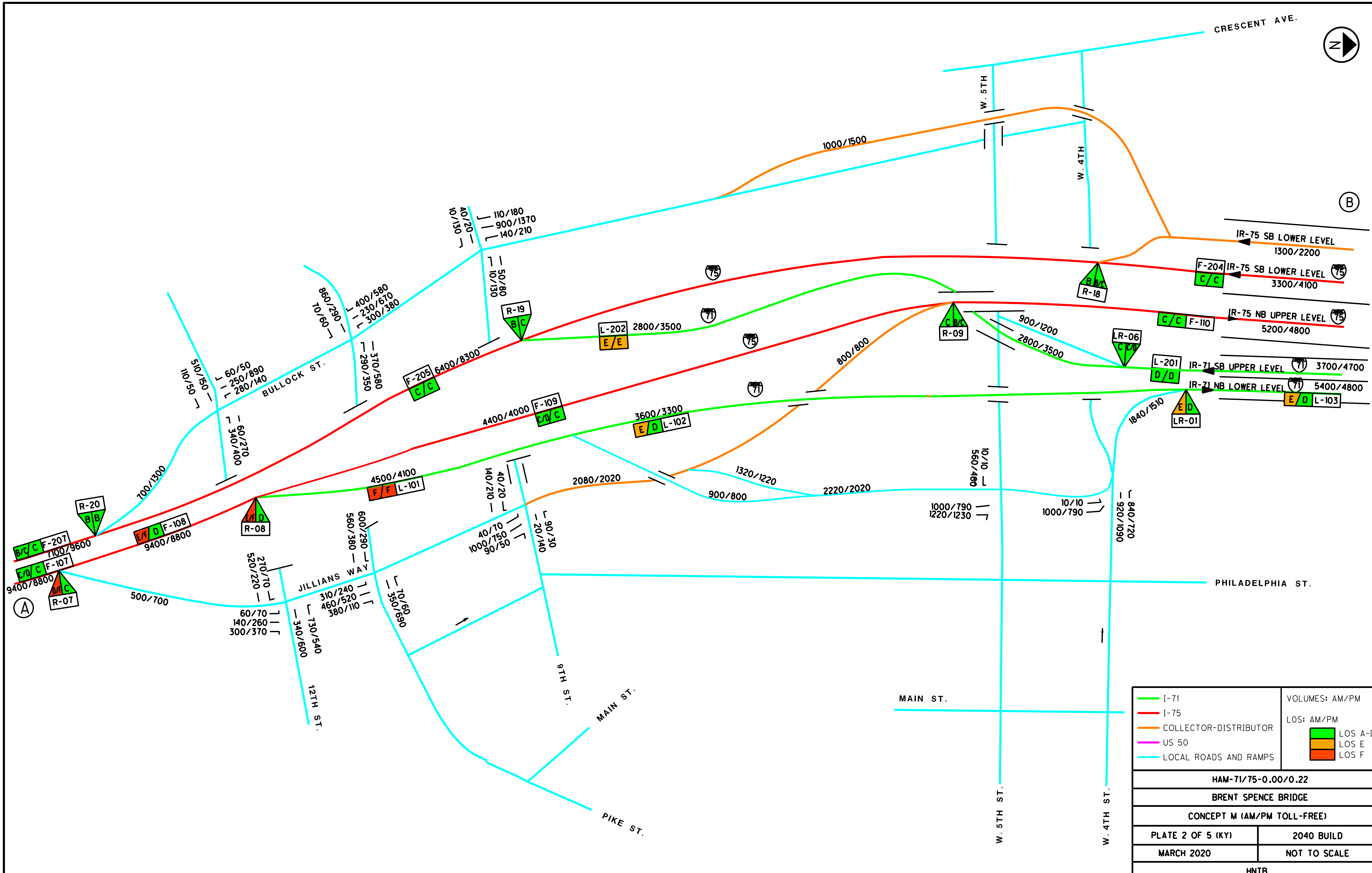
HAM-71/75-0.00/0.22

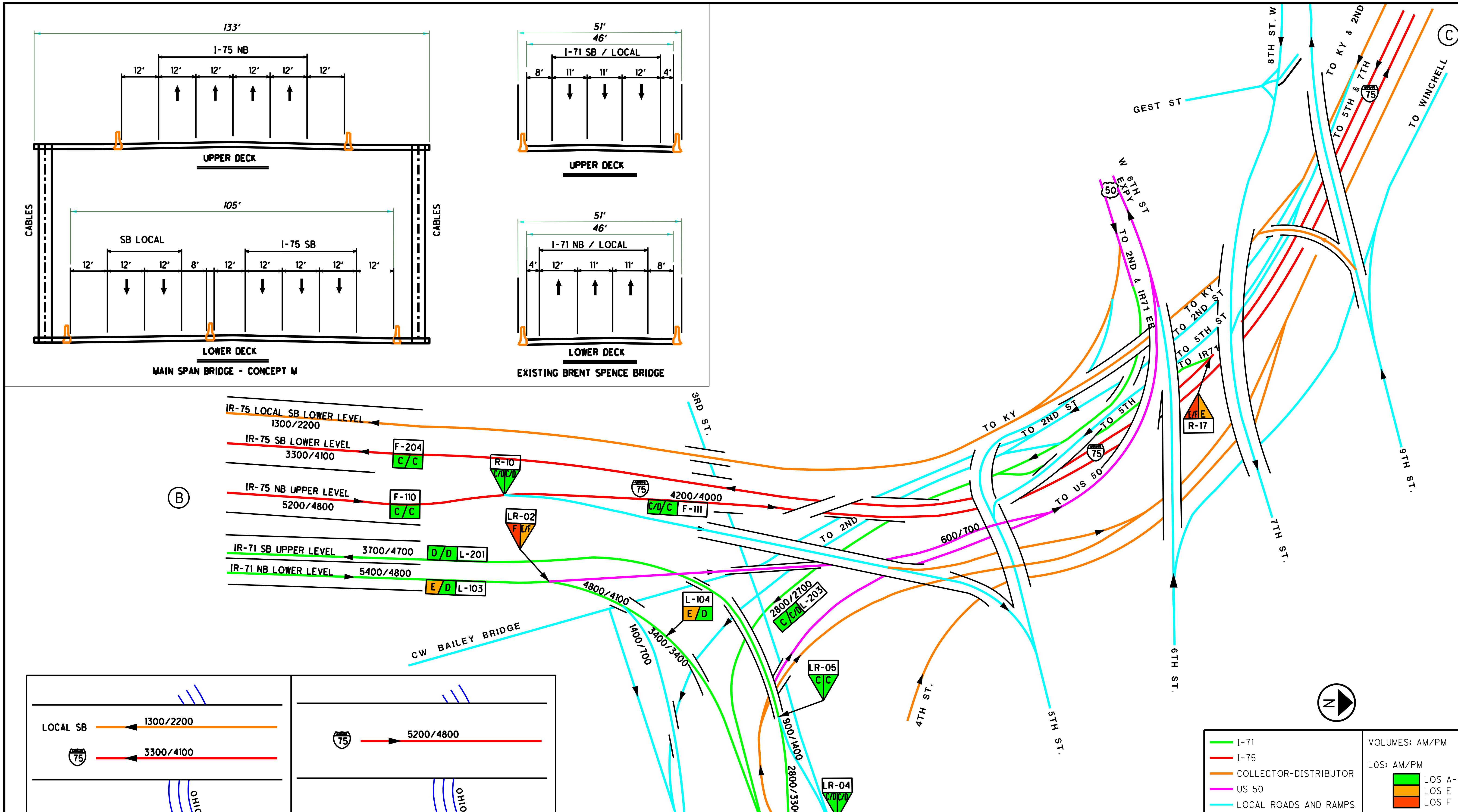
BRENT SPENCE BRIDGE

CONCEPT M (AM/PM TOLL-FREE)

PLATE 1 OF 5 (KY)	2040 BUILD
MARCH 2020	NOT TO SCALE

HNTB


CRESCENT AVE.
W. 5TH
W. 4TH
1000/1500
IR-75 SB LOWER LEVEL
1300/2200
F-204
C/C
IR-75 SB LOWER LEVEL
3300/4100
R-18
IR-75 NB UPPER LEVEL
5200/4800
F-110
LR-06
IR-71 SB UPPER LEVEL
3700/4700
L-201
D/D
IR-71 NB LOWER LEVEL
5400/4800
L-103
LR-01
1840/1510
R-09
900/1200
2800/3500
800/800
L-202
E/E
2800/3500
R-19
110/180
900/1370
140/210
40/20
10/130
50/80
10/130
400/580
230/670
300/380
860/290
70/60
370/580
290/350
F-205
6400/8300
BULLOCK ST.
60/50
250/890
280/140
510/150
110/50
60/270
340/400
700/1300
R-20
F-207
7100/9600
F-107
9400/8800
R-07
F-108
9400/8800
R-08
F-109
4400/4000
L-102
3600/3300
4500/4100
L-101
2080/2020
1320/1220
900/800
2220/2020
10/10
560/480
1000/790
1220/1230
10/10
1000/790
840/720
920/1090
140/210
40/20
40/70
1000/750
90/50
90/30
20/140
600/290
560/380
JILLIANS WAY
310/240
460/520
380/110
70/60
350/690
270/70
520/220
60/70
140/260
300/370
730/540
340/600
500/700
PHILADELPHIA ST.
12TH ST.
9TH ST.
MAIN ST.
PIKE ST.
MAIN ST.
W. 5TH ST.
W. 4TH ST.
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT M (AM/PM TOLL-FREE)
PLATE 2 OF 5 (KY)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB



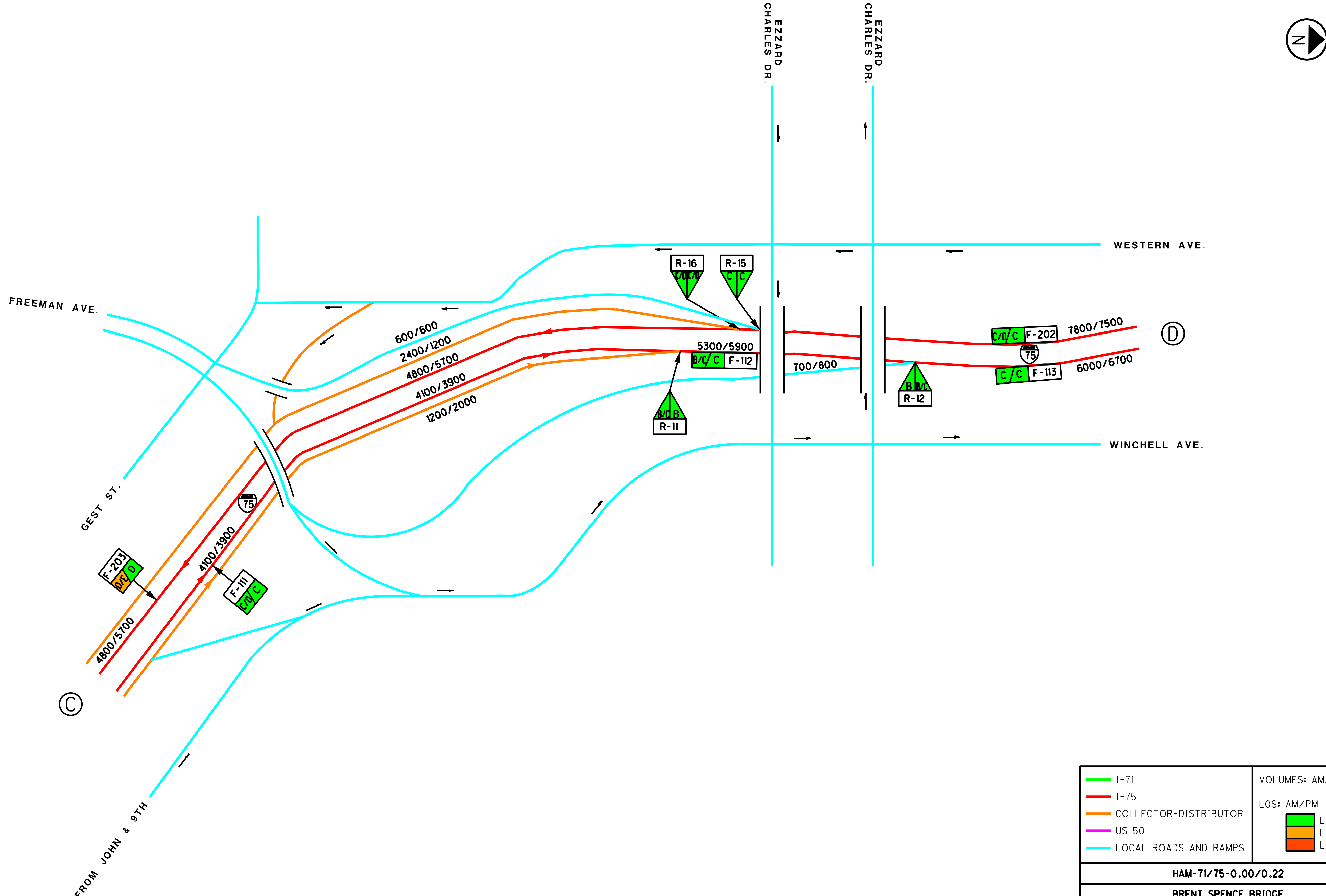
HAM-71/75-0.00/0.22

BRENT SPENCE BRIDGE

CONCEPT M (AM/PM TOLL-FREE)

PLATE 3 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE

HNTB



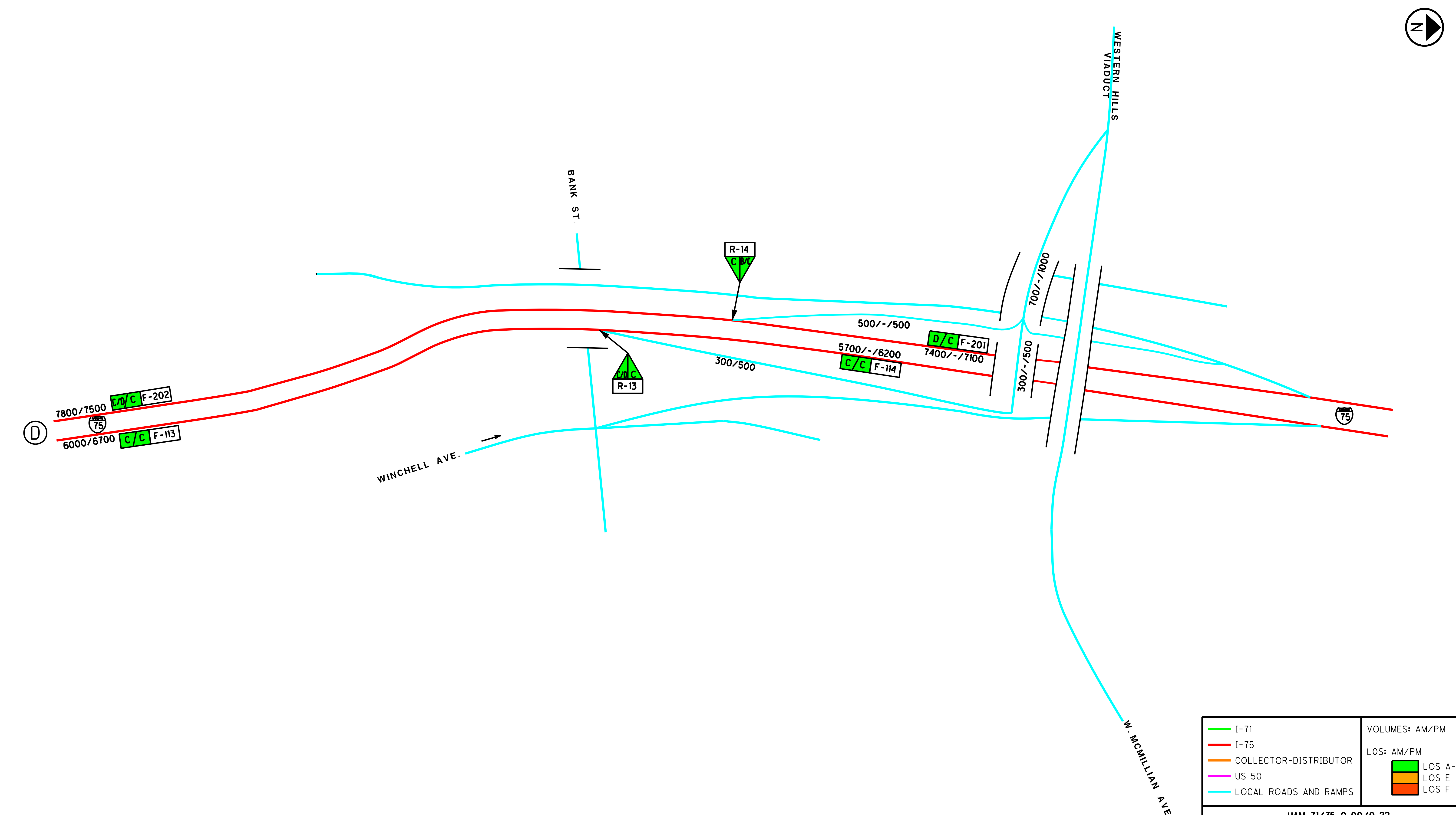
HAM-71/75-0.00/0.22

BRENT SPENCE BRIDGE

CONCEPT M (AM/PM TOLL-FREE)

PLATE 4 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE

HNTB



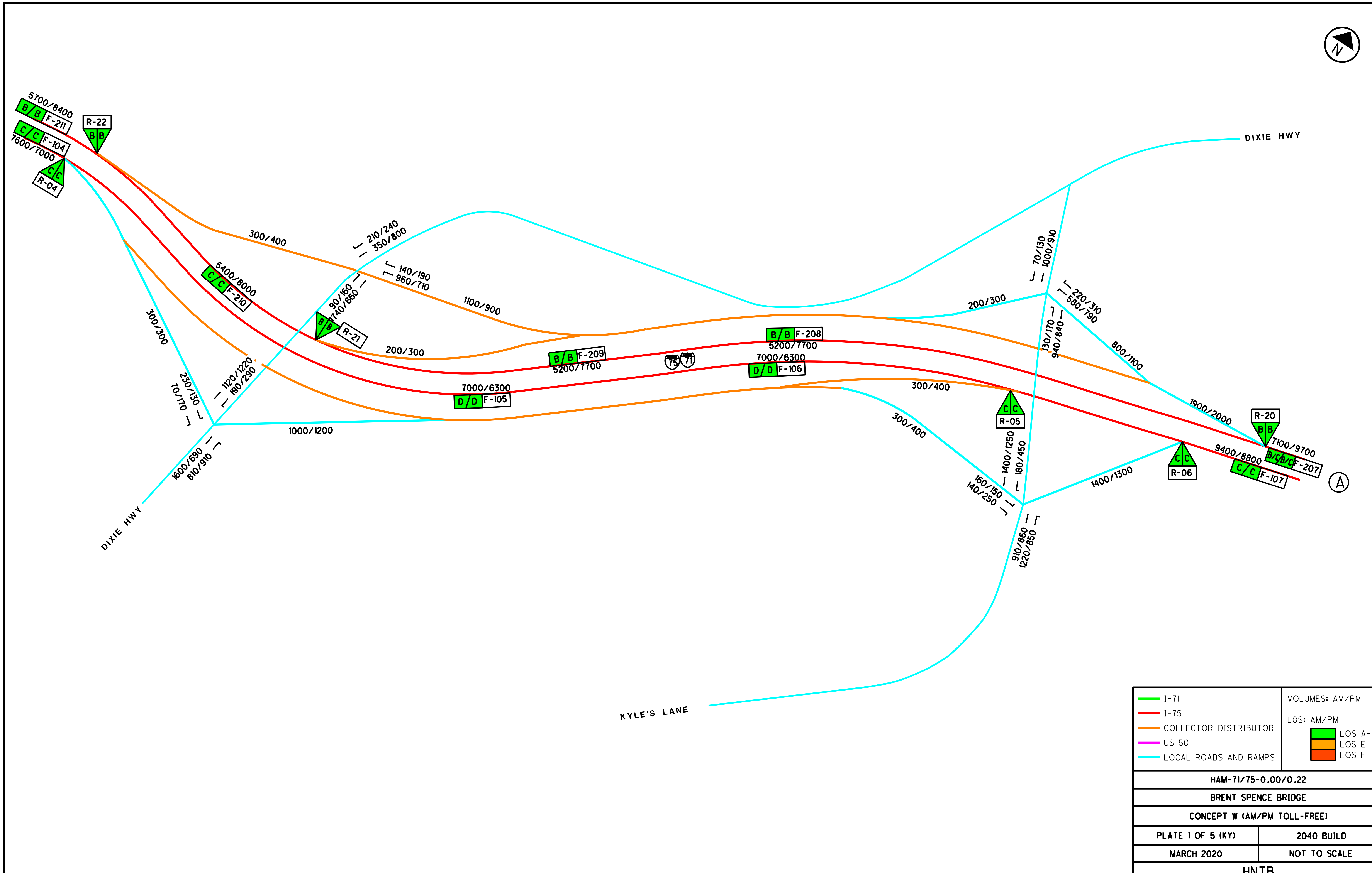
HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT M (AM/PM TOLL-FREE)	
PLATE 5 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	

2040 Concept W Freeway Capacity Analysis Summary

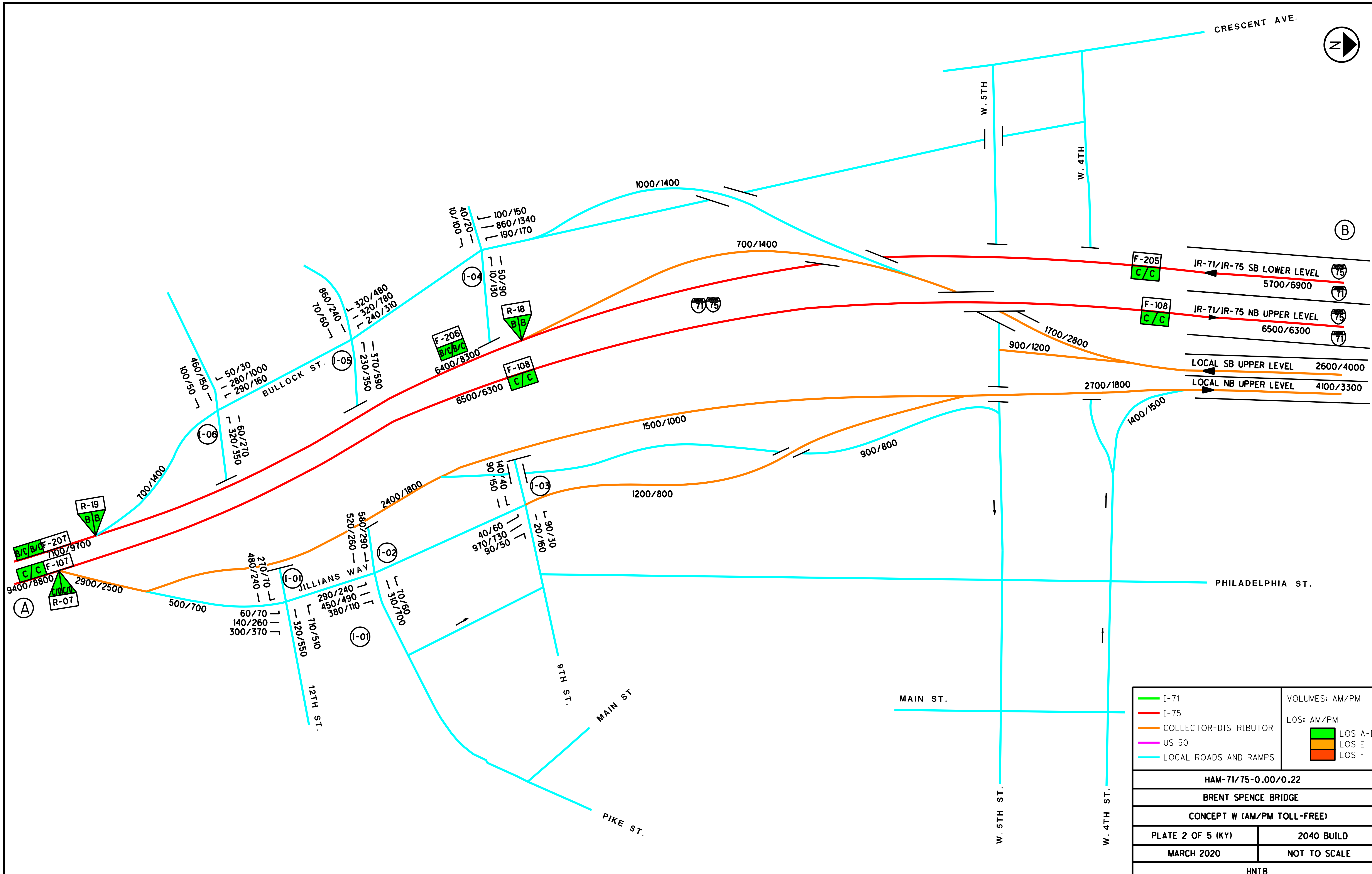
I-75 Northbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
NB Mainline (at I-275)	F-101	Mainline	37.3	36.3 - 38.4	59	E	21.9	21.5 - 22.5	64	E
NB Entrance Ramp from I-275	R-01	Merge	27.1	25.9 - 28.4	--	C/D	25.3	23.8 - 26.5	--	C/D
NB Mainline	F-102	Mainline	25.4	24.6 - 26.1	62	C/D	23.7	22.9 - 24.4	62	C/D
NB Exit Ramp to Buttermilk Pk.	R-02	Diverge	27.2	25.7 - 28.1	--	C/D	26.6	24.9 - 28.3	--	C/D
NB Mainline (at Buttermilk Pk.)	F-103	Mainline	26.1	25.6 - 26.7	63	C/D	26.9	26.2 - 27.3	63	C/D
NB Entrance Ramp from Buttermilk Pk.	R-03	Merge	25.1	24.6 - 25.7	--	C	24.6	22.9 - 26.6	--	C
NB Mainline south of Dixie Hwy	F-104	Mainline	23.0	22.5 - 23.7	63	C	31.4	30.3 - 31.9	59	C
NB Exit Ramp to Dixie Hwy	R-04	Diverge	23.8	22.4 - 26.1	--	C	32.2	30.5 - 33.4	--	C
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (3 lanes)	F-105	Mainline	26.7	26.4 - 27.1	63	D	26.7	25.2 - 27.8	63	D
NB Mainline (at US 25/Dixie Hwy/Kyles Lane) (4 lanes)	F-106	Mainline	26.4	26 - 27.1	63	D	19.5	19.1 - 20.1	65	D
NB Entrance Ramp from Dixie Hwy	R-05	Merge[1]	25.8	24.7 - 26.8	--	C	19.6	17.4 - 21.3	--	C
NB Entrance Ramp from Kyle	R-06	Merge[1]	24.3	23.2 - 24.9	--	C	18.5	17.9 - 19.9	--	C
NB Mainline	F-107	Mainline	23.4	22.6 - 24.4	62	C	18.5	18.3 - 18.9	64	C
NB Exit Ramp to MLK Jr Blvd/US 25/Pike St/9th St/Brent Spence Bridge	R-07	Diverge	28.6	27.8 - 29.2	--	C/D	21.8	20.4 - 22.3	--	C/D
NB Mainline on New Bridge over Ohio River	F-108	Mainline	23.6	22.8 - 24.5	51	C	19.6	17.9 - 21.6	52	C
NB Exit Ramp to NB I-71/EB US 50	R-08	Diverge[1]	26.9	25.1 - 28.1	--	C/D	23.0	22 - 23.9	--	C/D
EB I-71	F-109a	Diverge[2]	29.8	26.8 - 33	--	C/D	26.8	25.5 - 27.4	--	C/D
EB Entrance Ramp from I-71 SB	R-08a	Diverge[3]	27.8	27 - 28.6	--	C/D	23.4	22.8 - 23.9	--	C/D
NB I-71 Diverge	R-08b	Diverge[4]	20.2	19.6 - 21.1	--	B/C	20.1	19.1 - 21	--	B/C
NB Mainline	F-109	Mainline	23.5	22.4 - 24	50	C	18.8	18.2 - 19.1	51	C
NB Entrance Ramp from 3rd Street	R-09	Merge	27.4	26.3 - 29	--	C/D	25.3	22.8 - 27.8	--	C/D
NB Mainline	F-110	Mainline	26.3	25.9 - 27.3	51	C/D	23.1	22.4 - 23.5	52	C/D
NB Entrance Ramp from CD (I-71 SB/ US 50 WB/ 4th and 6th)	R-10	Merge[1]	18.2	16 - 20.5	--	B/C	17.6	16.6 - 19	--	B/C
NB Mainline	F-111	Mainline	18.2	17.5 - 19.5	53	B/C	18.3	17.4 - 19.1	53	B/C
NB Entrance Ramp from Freeman Ave	R-11	Merge	17.8	16.4 - 18.9	--	B	17.4	16 - 19.1	--	B
NB Mainline	F-112	Mainline	20.8	20.3 - 21.5	53	C	20.1	19.4 - 20.8	52	C
NB Exit Ramp to Western Hills Viaduct	R-12	Diverge	26.2	23.4 - 28.5	--	C/D	24.7	22.4 - 26	--	C/D
NB Mainline north of Western Hills Viaduct	F-113	Mainline	19.8	19.4 - 20.1	53	C	18.5	17.8 - 19.4	54	C

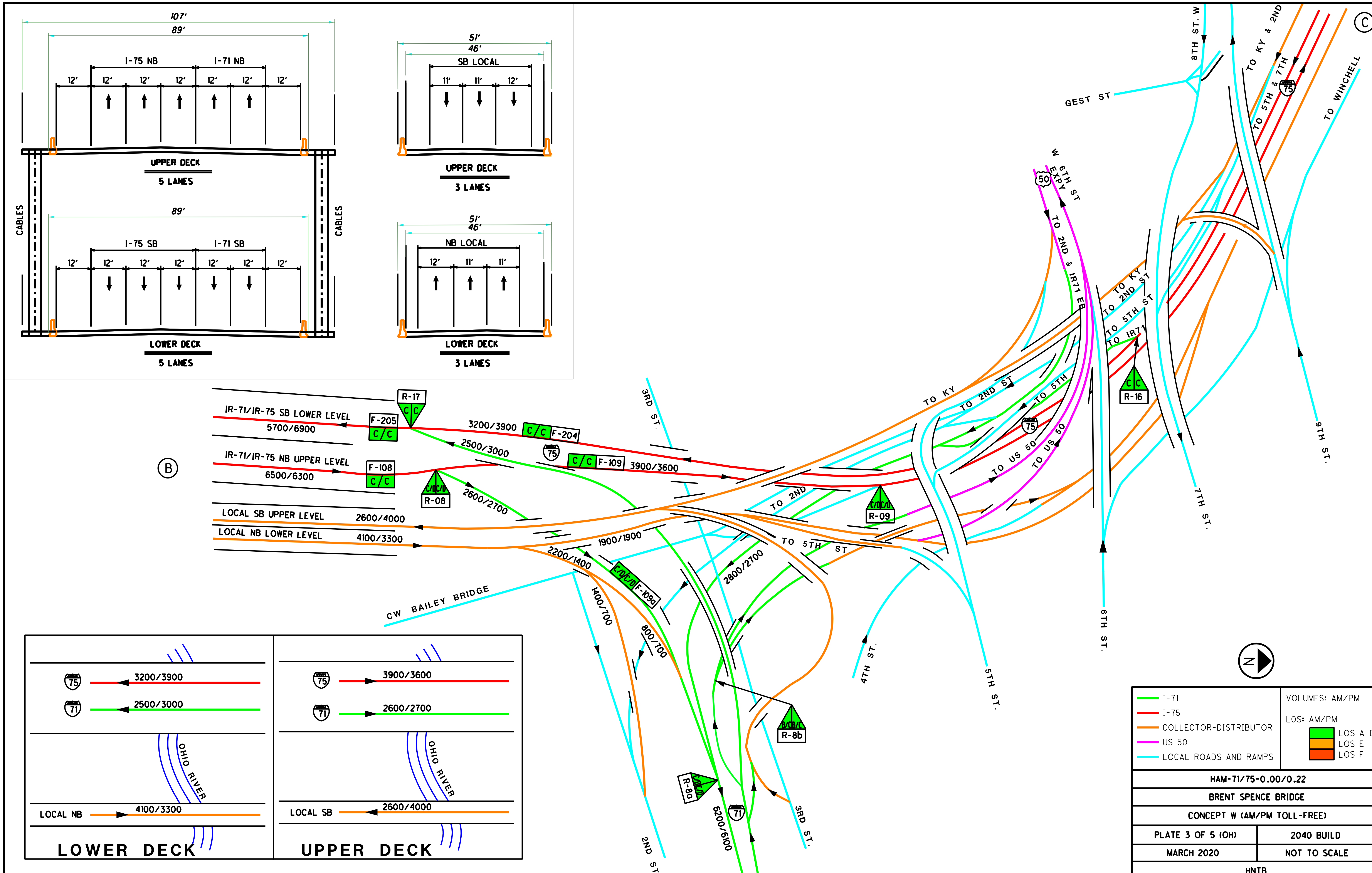
2040 Concept W Freeway Capacity Analysis Summary

I-75 Southbound	ID	HCS Type	AM Peak				PM Peak			
			Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS	Average Density (pc/mi/ln)	Density Range (pc/mi/ln)	Average Speed (mph)	LOS
SB Mainline north of Western Hills Viaduct	F-201	Mainline	26.3	25.9 - 27	52	C/D	20.2	19.4 - 20.7	54	C/D
SB Entrance Ramp from Western Hills Viaduct	R-13	Merge[1]	23.5	22.5 - 24	--	C	18.3	17.5 - 18.7	--	C
SB Mainline south of Western Hills Viaduct	F-202	Mainline	23.6	23 - 24	52	C	18.8	17.9 - 19.3	53	C
SB Exit Ramp to Western Avenue	R-14	Diverge	22.7	21.5 - 24	--	C	17.8	17.1 - 18.6	--	C
SB Exit Ramp to I-75 Local	R-15	Diverge[1]	33.5	30.2 - 35.5	--	D/E	27.1	24.8 - 29.3	--	D/E
SB Mainline	F-203	Mainline	29.8	28.9 - 30.9	50	D	29.4	28 - 30.1	50	D
SB Exit to I-71 EB	R-16	Diverge[1]	25.3	23.9 - 26.6	--	C	24.4	23.2 - 25.6	--	C
SB Mainline	F-204	Mainline	19.5	18.3 - 20	52	C	20.3	19.4 - 21	51	C
SB Entrance Ramp from I-71 WB	R-17	Merge[1]	21.9	21.3 - 22.7	--	C	23.6	21.5 - 26.9	--	C
SB Mainline on New Bridge over Ohio River	F-205	Mainline	21.3	20.8 - 21.7	50	C	21.7	21.2 - 22	50	C
SB Entrance Ramp from Southbound I-75 Local	R-18	Merge[1]	16.5	15.9 - 17.2	--	B	18.3	17.7 - 19.3	--	B
SB Mainline	F-206	Mainline	18.6	17.9 - 19	55	B/C	20.6	20.2 - 20.9	54	B/C
SB Entrance Ramp from Bullock St	R-19	Merge[1]	14.5	14 - 14.8	--	B	18.7	18.2 - 19.3	--	B
SB Mainline	F-207	Mainline	17.9	17.6 - 18.4	64	B/C	21.2	20.5 - 21.7	63	B/C
SB Exit Ramp to Kyles/Dixie C-D Road	R-20	Diverge	16.4	15.9 - 17.1	--	B	21.1	20 - 21.7	--	B
SB Mainline (6 Lanes)	F-208	Mainline	13.2	12.8 - 13.8	65	B	16.8	16.3 - 17.1	63	B
SB Mainline (5 Lanes)	F-209	Mainline	15.5	14.5 - 16.4	63	B	21.7	21.4 - 22.1	59	B
SB Mainline (4 Lanes)	F-210	Mainline	19.4	19.1 - 19.7	62	C	26.6	26.2 - 27.2	60	C
SB Entrance Ramp from Kyles/Dixie C-D Road	R-21	Merge[1]	16.7	15.3 - 17.8	--	B	21.5	19.8 - 22.6	--	B
SB Entrance Ramp from Dixie Hwy	R-22	Merge	16.7	15.5 - 18.6	--	B	22.2	20.6 - 23.9	--	B
SB Mainline	F-211	Mainline	15.9	15.7 - 16	64	B	21.7	21.4 - 22	63	B
SB Exit Ramp to Buttermilk Pk.	R-23	Diverge	18.0	17 - 18.9	--	B	23.9	23.3 - 24.3	--	B
SB Mainline at Buttermilk Pk.	F-212	Mainline	18.2	16.9 - 18.7	64	B/C	25.3	24.5 - 26	63	B/C
Entrance from Buttermilk Pk.	R-24	Merge	18.2	16.4 - 19.2	--	B	24.0	23.1 - 26.1	--	B
SB Mainline	F-213	Mainline	17.2	17 - 17.5	62	B	24.6	23.8 - 25.4	57	B
SB Exit Ramp to I-275	R-24	Diverge	18.4	17.5 - 19.1	--	B	27.1	26.5 - 28.1	--	B
SB Mainline	F-214	Mainline	20.9	19.8 - 21.7	64	C	28.0	27.7 - 28.2	63	C

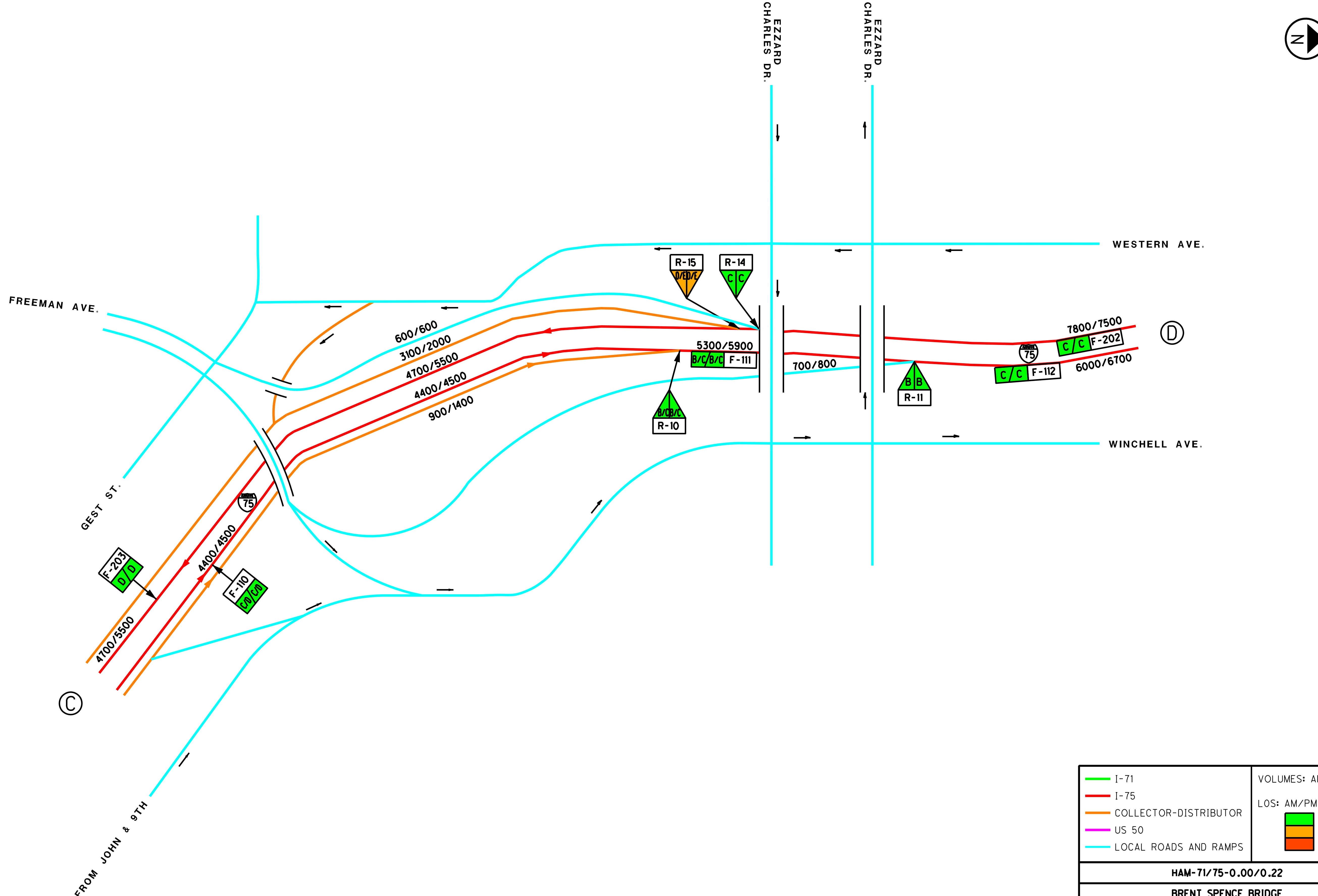


N
DIXIE HWY
KYLE'S LANE
5700/8400
B/B F-211
C/C F-104
7600/7000
R-22 B B
C C R-04
300/400
210/240
350/800
140/190
960/710
1100/900
5400/8000
C/C F-210
90/160
740/660
B B R-21
200/300
300/300
1120/1220
190/290
230/130
70/170
1000/1200
1600/690
810/910
7000/6300
D/D F-105
B/B F-209
5200/7700
75
71
B/B F-208
5200/7700
7000/6300
D/D F-106
300/400
300/400
200/300
70/130
1000/910
220/310
580/790
130/170
940/840
800/1100
1900/2000
C C R-05
1400/1250
180/450
160/150
140/250
910/860
1220/850
1400/1300
C C R-06
R-20 B B
7100/9700
B/C B/C F-207
9400/8800
C/C F-107
A
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT W (AM/PM TOLL-FREE)
PLATE 1 OF 5 (KY)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB


CRESCENT AVE.
W. 5TH
W. 4TH
BULLOCK ST.
JILLIANS WAY
PHILADELPHIA ST.
MAIN ST.
PIKE ST.
9TH ST.
12TH ST.
W. 5TH ST.
W. 4TH ST.
IR-71/IR-75 SB LOWER LEVEL 5700/6900
IR-71/IR-75 NB UPPER LEVEL 6500/6300
LOCAL SB UPPER LEVEL 2600/4000
LOCAL NB UPPER LEVEL 4100/3300
F-205 C C
F-108 C C
F-206 B/C B/C
F-207 B/C B/C
F-107 C C
R-18 B B
R-19 B B
R-07 C/D C/D
I-01
I-02
I-03
I-04
I-05
I-06
A
B
6400/8300
6500/6300
7100/9700
9400/8800
2900/2500
500/700
700/1400
1000/1400
700/1400
1700/2800
900/1200
2700/1800
1400/1500
1500/1000
900/800
1200/800
2400/1800
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT W (AM/PM TOLL-FREE)
PLATE 2 OF 5 (KY)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB

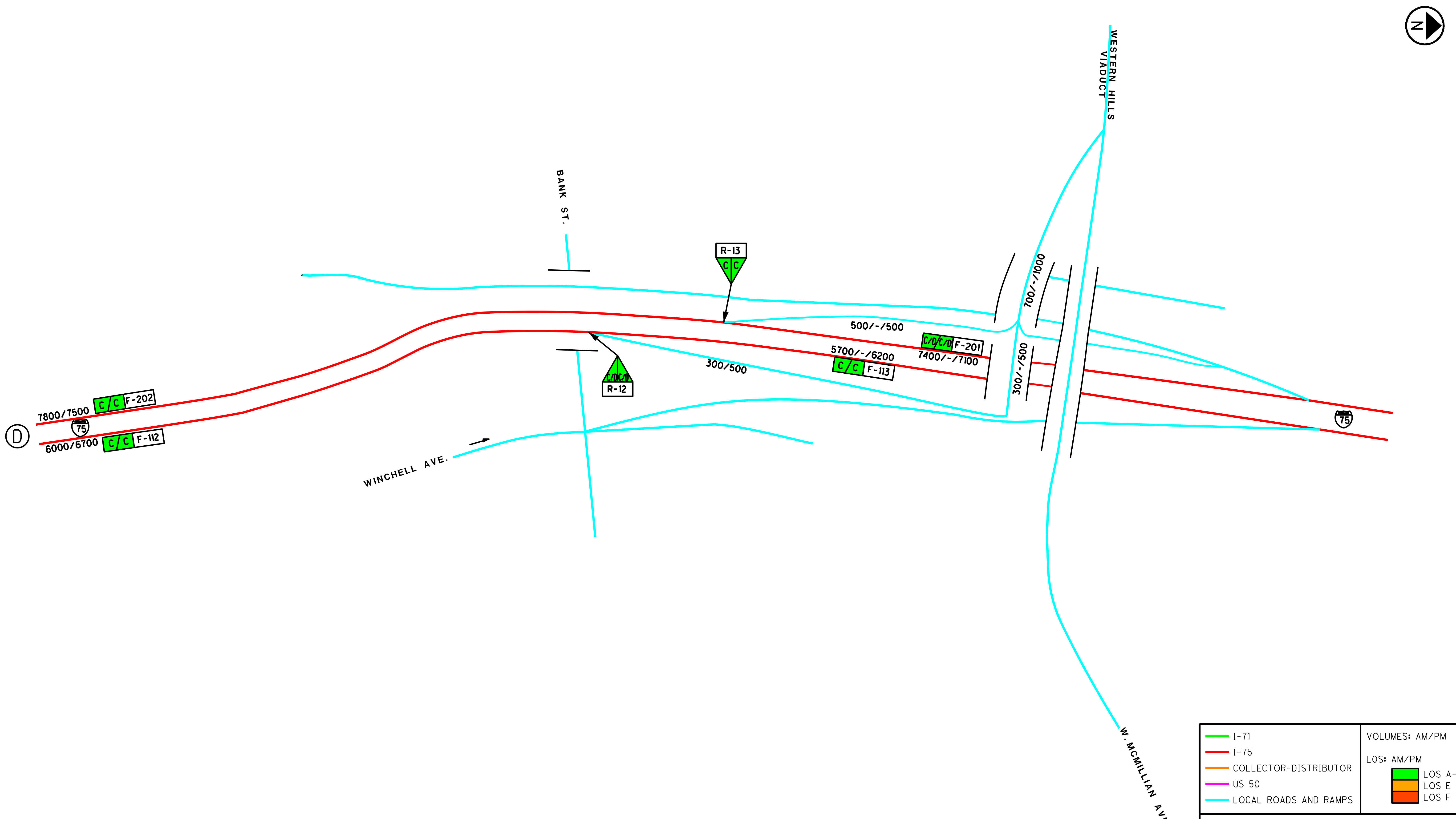


107'
89'
I-75 NB
I-71 NB
12'
UPPER DECK
5 LANES
CABLES
I-75 SB
I-71 SB
LOWER DECK
5 LANES
51'
46'
SB LOCAL
11'
UPPER DECK
3 LANES
NB LOCAL
LOWER DECK
3 LANES
B
C
IR-71/IR-75 SB LOWER LEVEL
5700/6900
IR-71/IR-75 NB UPPER LEVEL
6500/6300
LOCAL SB UPPER LEVEL
2600/4000
LOCAL NB LOWER LEVEL
4100/3300
R-17
F-205
F-108
R-08
F-204
F-109
F-109a
R-09
R-16
R-8a
R-8b
C/C
C/D/C/D
3200/3900
2500/3000
3900/3600
2600/2700
1900/1900
2200/1400
2800/2700
1400/700
800/700
6200/6100
3RD ST.
CW BAILEY BRIDGE
TO KY
TO 2ND ST.
TO 5TH
TO 5TH ST
TO 2ND
TO US 50
4TH ST.
5TH ST.
2ND ST.
6TH ST.
7TH ST.
9TH ST.
8TH ST. W
GEST ST
TO KY & 2ND
TO 5TH & 7TH
TO WINCHELL
W 6TH ST EXPY
TO 2ND & IR71 EB
TO KY
TO 2ND ST
TO 5TH ST
TO IR71
50
75
71
LOWER DECK
UPPER DECK
LOCAL NB
LOCAL SB
OHIO RIVER
3200/3900
2500/3000
4100/3300
3900/3600
2600/2700
2600/4000
I-71
I-75
COLLECTOR-DISTRIBUTOR
US 50
LOCAL ROADS AND RAMPS
VOLUMES: AM/PM
LOS: AM/PM
LOS A-D
LOS E
LOS F
HAM-71/75-0.00/0.22
BRENT SPENCE BRIDGE
CONCEPT W (AM/PM TOLL-FREE)
PLATE 3 OF 5 (OH)
2040 BUILD
MARCH 2020
NOT TO SCALE
HNTB



I-71 I-75 COLLECTOR-DISTRIBUTOR US 50 LOCAL ROADS AND RAMPS	VOLUMES: AM/PM LOS: AM/PM LOS A-D LOS E LOS F

HAM-71/75-0.00/0.22	
BRENT SPENCE BRIDGE	
CONCEPT W (AM/PM TOLL-FREE)	
PLATE 4 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE
HNTB	



HAM-71/75-0.00/0.22

BRENT SPENCE BRIDGE

CONCEPT W (AM/PM TOLL-FREE)

PLATE 5 OF 5 (OH)	2040 BUILD
MARCH 2020	NOT TO SCALE

HNTB