Brent Spence Strategic Corridor Study

KYTC Item No. 6-431

Final Report

Prepared for:
Kentucky Transportation Cabinet

Prepared by:
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Overview

The following summarizes the purpose, methodologies, and findings of the *Brent Spence Strategic Corridor Study* which included:

1) A review and update of elements of the *Brent Spence Bridge Replacement/ Rehabilitation Project* (KYTC Item 6-17)[1],

2) Evaluation of the I-71/I-75 corridor in Cincinnati/Northern Kentucky beyond what was completed for KYTC Item 6-17, and

3) Development and evaluation of Brent Spence Bridge bypass alternatives, including the proposed Cincy Eastern Bypass (CEB) shown in **Figure 1**.

History

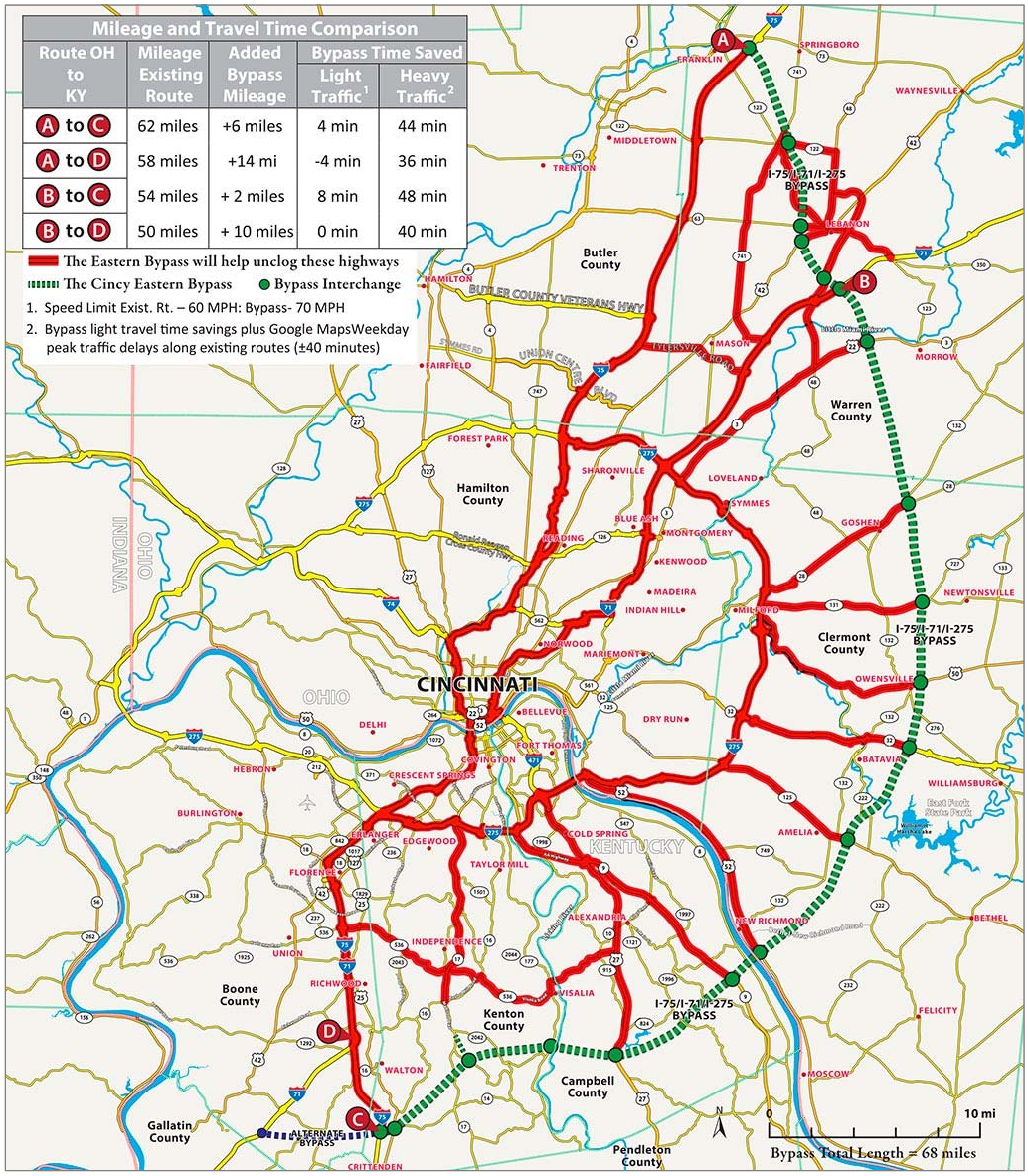
For over two decades, the northern Kentucky community served by the I-71/I-75 corridor has faced increasing traffic demands on aging infrastructure. The Brent Spence Bridge was constructed in 1963. For much of its history, the bridge has carried more traffic than it was designed to accommodate (80,000 vehicles per day). Now, average daily traffic (ADT) volumes are approximately 170,000[2]. Levels of service (a measure of the quality of traffic flow) will continue to worsen and peak periods will grow longer if nothing is done. Any delay in project implementation will result in higher construction costs, increased travel delay, and higher vehicular emissions.

An environmental document (Finding of No Significant Impact or FONSI), prepared by the partnership between the Ohio Department of Transportation and the Kentucky Transportation Cabinet, was approved in 2012 by the Federal Highway Administration for the *Brent Spence Bridge Replacement/ Rehabilitation Project* (KYTC Item 6-17). Multiple alternatives were evaluated during the earlier Preliminary Engineering and Environmental phase, but the Replacement/Rehabilitation option was selected as the Preferred Alternative. Despite the project name, the preferred alternative does not include replacing the Brent Spence Bridge. Instead, it is proposed that the Brent Spence Bridge and a new bridge would both serve cross-river traffic.

The Brent Spence Bridge Replacement/ Rehabilitation Project lasted several years and generated numerous reports and other documents. A number of those were consulted as they provided a baseline of information for this project. Those documents are referenced in **Appendix A** and copies of the documents are included with the DVD version of the appendices.

[1] http://www.brentspencebridgecorridor.com/documents/

[2] Based on a March 2017 traffic count conducted for this study. There is considerable variation in traffic day to day, month to month. These variances would not alter the findings of this study.



Source: Citizens for the Cincy Eastern Bypass (CCEB)

Figure 1. Proposed Cincy Eastern Bypass (CEB)

Study Tasks

The Kentucky Transportation Cabinet contracted in September 2016 with the consultant team led by Stantec Consulting Services Inc. to conduct a 12-month study that included the following tasks:

- Obtain all available traffic count, classification and travel data for the I-71/I-75 study section from KY 236 Donaldson Road in Kentucky to the Western Hills Viaduct in Cincinnati
- Update of the *Brent Spence Bridge Replacement/ Rehabilitation Project* (KYTC Item 6-17) traffic analyses and cost estimates

- Evaluate additional I-71/I75 corridor improvements beyond what was completed for KYTC Item 6-17, including future capacity needs and Active Traffic and Demand Management (ATDM) strategies
- Obtain new traffic count and traveler origin-destination information
- Develop and evaluate multiple bypass options, including the proposed CEB, to ascertain the following:
    - Diversion of traffic from the I-71/I-75 corridor and other regional interstate facilities
    - Estimate of probable cost
    - Potential environmental impacts at a planning level
    - Utility and right-of-way impacts at a high planning level
    - Estimate of induced traffic from new development

Project Team and Stakeholder Meetings

This study involved considerable project team and stakeholder involvement and coordination. The Project Team included representatives from:

- Kentucky Transportation Cabinet
    - Office of the Secretary
    - State Highway Engineer's Office
    - Division of Planning
    - Division of Environmental Analysis
    - Highway District 6
    - Division of Program Management
- Consultant Team
    - Stantec
    - AECOM
    - H.W. Lochner
    - O.R. Colan

Seven formal project team meetings were held during the study and are itemized in **Table 1**.

Table 1. Project Team Meetings

No.	Date	Objective(s)
1	October 19, 2016	Project kickoff
2	November 22, 2016	Deliverables, data collection, project goals, eastern bypass concepts
3	December 9, 2016	Modeling framework, Level 1 evaluation, traffic counts, origin-destination data, TN 840
4	January 17, 2017	Project status, stakeholder meetings, TN 840
5	April 24, 2017	Deliverables, status, ATDM strategy evaluation, economic analysis, Concept 1 design, stakeholder meetings
6	May 31, 2017	Traffic analyses, estimation of regional through traffic, ATDM strategy evaluation
7	June 26, 2017	Level 2 analyses, traffic forecasts, ATDM strategy evaluation

Three formal stakeholder meetings were held with representatives from the Citizens for the Cincy Eastern Bypass (CCEB):

- January 30, 2017
- March 17, 2017
- August 31, 2017

Study Methodology and Results

This study consisted of and the report is organized in two main parts, as follows:

- Section I: I-71/I-75 corridor analysis, which included an update to KYTC Item 6-17 and further evaluation of the I-71/I-75 corridor from the I-71/I-75 split in Walton to the Ohio River; and
- Section II: Development and evaluation of bypass alternatives, including the proposed CEB.

I. I-71/I-75 Corridor Analysis

KYTC ITEM 6-17 UPDATE

Several years have passed since the traffic analyses supporting the original *Brent Spence Bridge Replacement/ Rehabilitation Project* were performed. Traffic analyses of conceptual alternatives were performed using methods prescribed in the 2000 Highway Capacity Manual ("HCM 2000"), which represented the state of the practice at that time. The analyses were performed for a Base Year 2005 and Forecast Year 2035.

A portion of this corridor study involved updating the KYTC Item 6-17 analyses to a current base year and new forecast year (2040). Extensive data collection within the I-71/I-75 corridor was performed to support the revised analyses. This included collection of current traffic counts – 24-hour directional classification counts and 12-hour intersection turning movement counts – at over 70 locations. A map of those count locations is shown in **Figure 2**. Other data collected included origin-destination data (which is further described as part of the Development and Evaluation of Bypass Alternatives) and travel time data, obtained from the Kentucky Transportation Cabinet and the Ohio Department of Transportation, which was used to calibrate analytical tools used in the study. The traffic count data obtained for this study are located in **Appendix B**.

Traffic analyses were updated for weekday A.M. and P.M. peak periods for:

- Existing (Year 2017) conditions
- Future Year 2040 No Build
- Future Year 2040 Preferred Alternative

Traffic analyses were conducted based on methods prescribed in the Highway Capacity Manual, as with the previous KYTC Item 6-17 work. However, beginning with the 2010 HCM and now in the new HCM 6th Edition (published in 2016), the Freeway Facilities method represents the state of the practice. The method combines the procedures for individual freeway components

– basic segments, ramp merge and diverge segments, and weaving segments – into a single approach that evaluates a freeway as a system. The advantage to the Freeway Facilities method is its capability to quantify the effects of bottlenecks over time and space on both upstream and downstream flows. Evaluation methods for the individual freeway components - those used for KYTC Item 6-17 – are insensitive to the impacts of one freeway segment on adjacent segments.

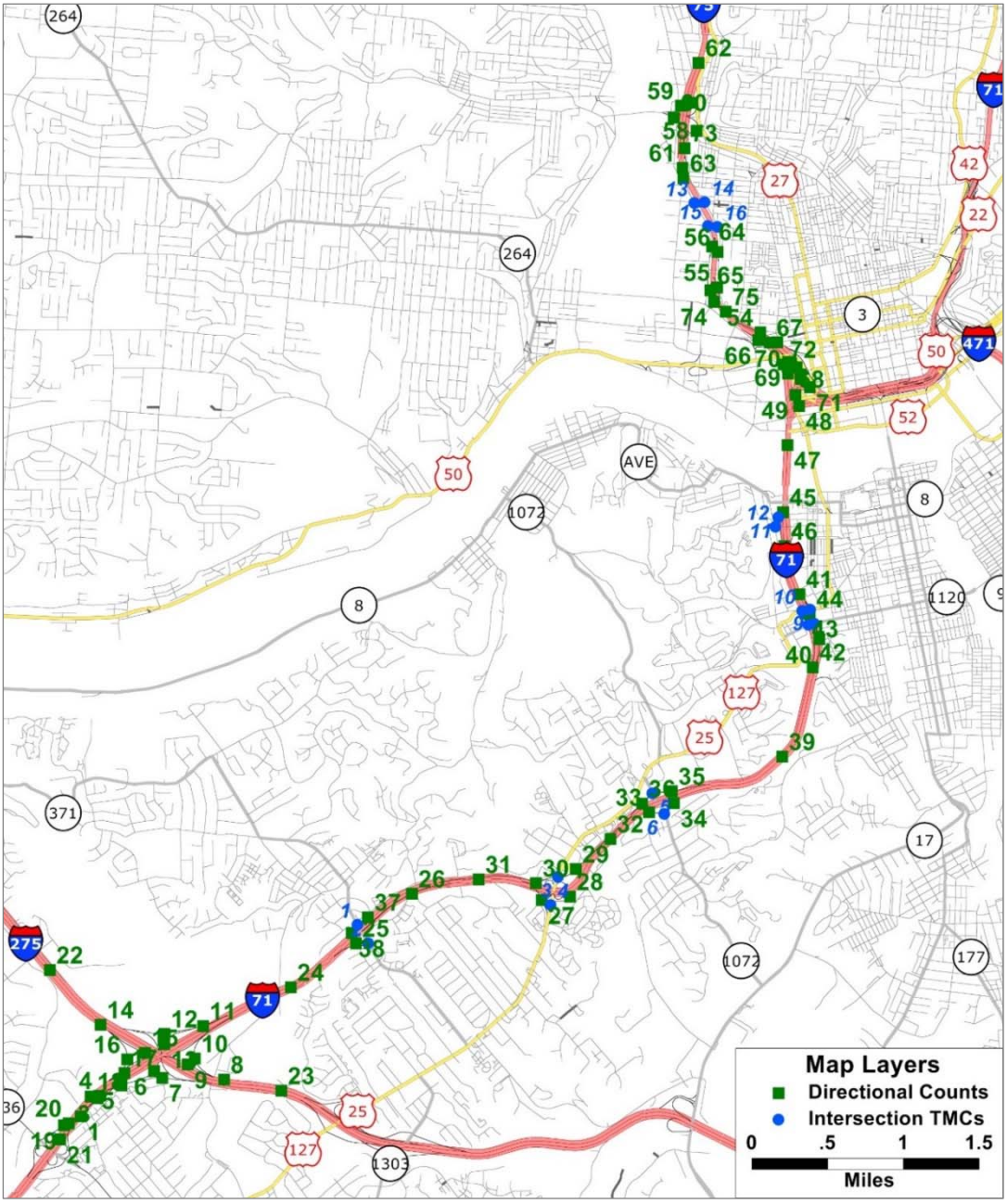


Figure 2. Traffic Count Locations

The area from the I-275 interchange in Kenton County to the Western Hills Viaduct (Harrison Avenue exit) north of downtown Cincinnati, about 11 miles, was the focus of the analysis for the Brent Spence Strategic Corridor Study. The analyses were performed using FREEVAL, one of the

computational software packages that implements the HCM Freeway Facilities method. The analyses were performed for a typical weekday A.M. peak (6:00 – 10:00) and P.M. peak (2:00 – 6:00). The traffic counts collected to support these analyses were used to affirm these timeframes as the A.M. and P.M. peak periods. Traffic counts were summed in 15-minute intervals, which allows for analyses that are more sensitive to fluctuations in traffic demand (compared with traffic demands on an hourly basis). In addition to the traffic count data, travel time and speed data were obtained for use in development and calibration of evaluation tools, including the FREEVAL models. Kentucky travel time data for I-71/I-75 were obtained from the National Performance Measure Research Data Set (NPMRDS) through the vendor HERE. These data were provided by the Kentucky Transportation Cabinet. In Ohio, travel time and speed data were obtained through the vendor INRIX and were provided by the Ohio Department of Transportation. The speed data are included in **Appendix C**.

The HCM Freeway Facilities method computes performance measures for each segment of the study section in the direction of travel. Key performance measures included:

- Average travel speed
- Delay (in vehicle-hours, per 15-minute period)
- Density
- Level of Service (based on density)
- Demand-to-capacity ratio

Segment levels of service are shown in **Figure 3** for the existing A.M. peak and in **Figure 4** for the existing P.M. peak. The "heat map" illustrates how the northbound direction begins backing up in downtown Cincinnati, extends across the Brent Spence, and backs up all the way to Buttermilk Pike during the middle of the morning peak. During the afternoon peak, slowdowns are observed in the southbound direction in the downtown Cincinnati area and on the Brent Spence Bridge, as well as on the uphill grade approaching Kyles Lane. Slowdowns are present in the northbound direction as well, from I-275 all the way to the Brent Spence Bridge.

Segment-by-segment performance measures from the Freeway Facilities analyses, including vehicle-hours of travel (VHT), vehicle-hours of delay (VHD), average speed, average density, maximum demand-to-capacity (D/C) ratio, and level of service are summarized for the existing A.M. peak period in **Table 2** (northbound) and **Table 3** (southbound) and for the P.M. peak period in **Table 4** (northbound) and **Table 5** (southbound).

Year 2040 A.M. and P.M. peak traffic volumes were estimated by computing annual growth rates from the OKI Regional Travel Demand Model (RTDM) and applying them to the counts collected for this study. **Figure 5** (2040 A.M. peak) and **Figure 6** (2040 P.M. peak) illustrate how conditions will worsen if no improvements are made to the Brent Spence Bridge (i.e. if KYTC Item 6-17 is not built). In the southbound direction during the P.M. peak, the results imply conditions overall are slightly below capacity today, but predicted future growth will result in extensive congestion beginning at the I-275 interchange and extending to the Brent Spence Bridge.

Segment summaries for northbound and southbound year 2040 A.M. peak periods (No Build) are provided in **Table 6** and **Table 7**, respectively. Summaries for northbound and southbound year 2040 P.M. peak periods (No Build) are provided in **Table 8** and **Table 9**, respectively.

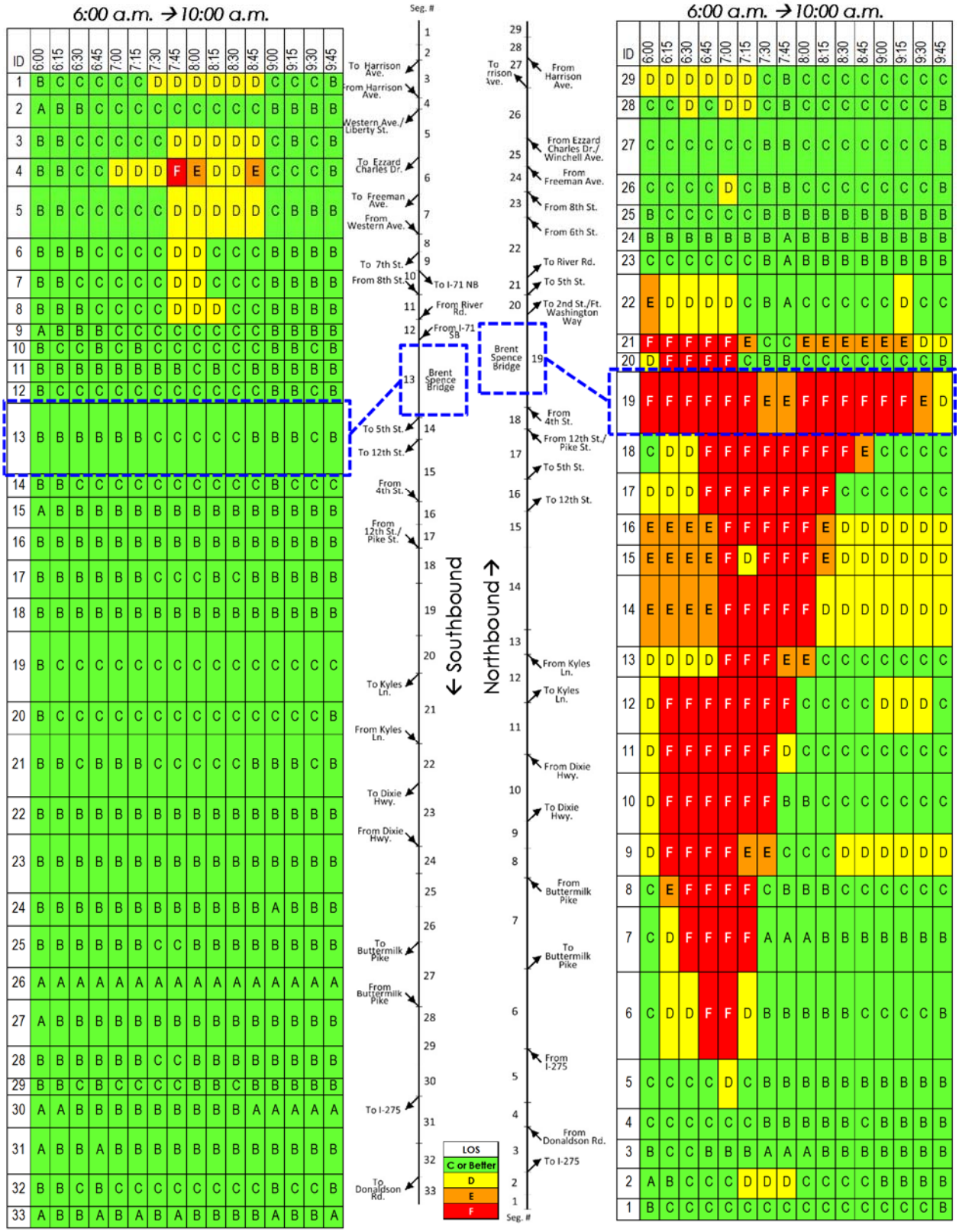


Figure 3. I-71/I-75 Existing A.M. Peak Levels of Service

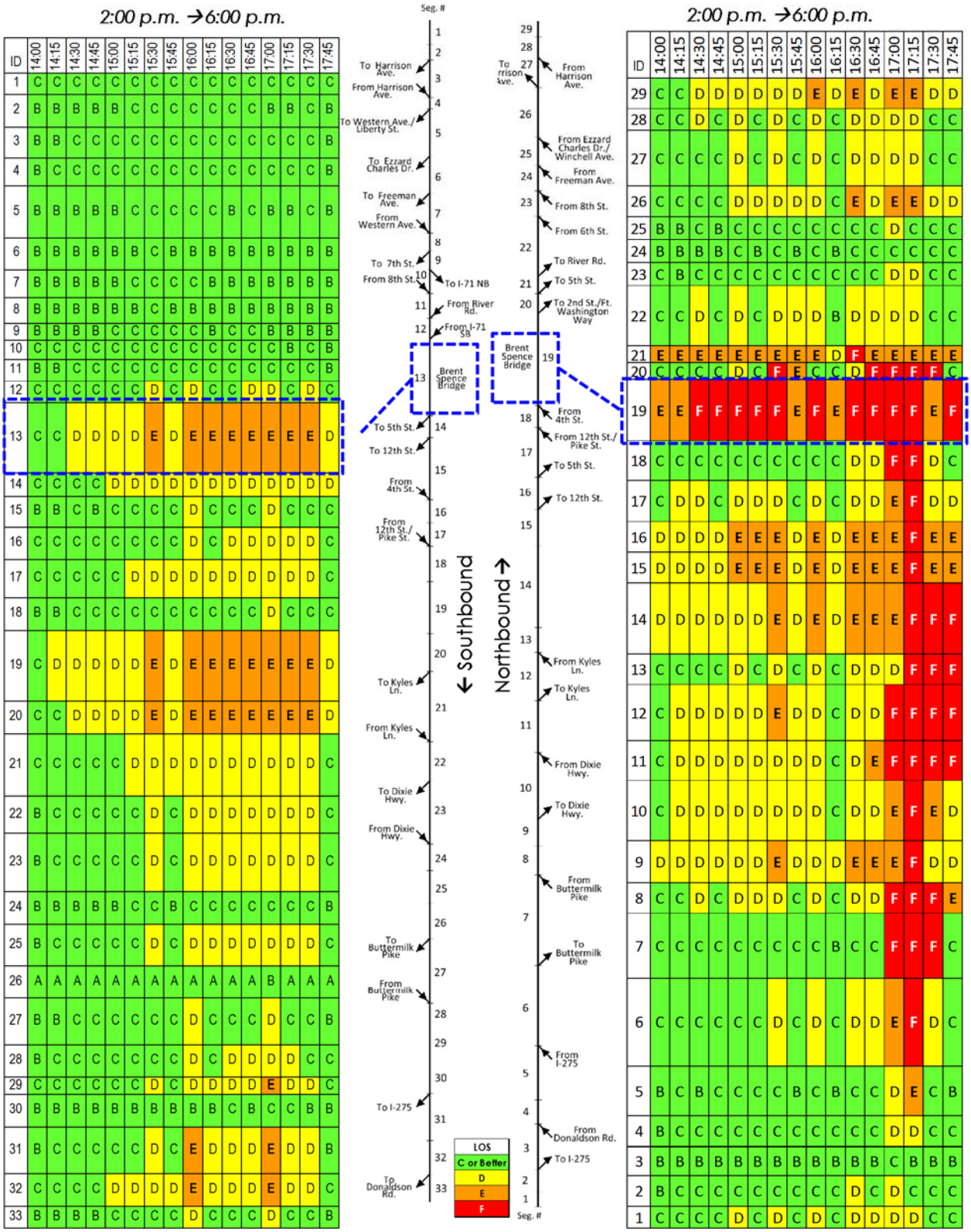


Figure 4. I-71/I-75 Existing P.M. Peak Levels of Service

Table 2. Existing A.M. Peak Northbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	KY 236 Donaldson Rd.	1,500' south of exit to I-275	Basic	0.095	29	0	64.8	21.5	0.69	C
2	1,500' south of Exit to I-275	Exit to I-275	Off Ramp	0.321	113	17	55.4	22.7	0.73	C
3	Exit to I-275	Entrance from KY 236 Donaldson Rd.	Basic	0.338	45	0	64.3	13.7	0.53	B
4	Entrance from KY 236 Donaldson Rd.	1,500' downstream of entrance ramp	On Ramp	0.284	54	5	58.6	21.3	0.65	C
5	1,500' downstream of entrance ramp	Entrance from I-275	Basic	0.429	79	5	60.3	18.9	0.65	C
6	Entrance from I-275	Exit to KY 371 Buttermilk Pike	Weaving	0.925	338	193	40.9	28.0	0.69	D
7	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.694	229	116	36.4	35.0	0.81	E
8	Entrance from KY 371 Buttermilk Pike	1,500' downstream of Buttermilk Pk. entrance ramp	On Ramp	0.264	102	97	39.7	39.9	0.93	E
9	1,500' upstream of Dixie Hwy. exit ramp	Exit to US 25 Dixie Highway	Off Ramp	0.264	97	35	41.7	40.7	0.95	E
10	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.482	190	74	36.7	40.7	0.97	E
11	Entrance from US 25 Dixie Highway	Exit to KY 1072 Kyles Lane	Weaving	0.583	412	337	23.9	53.3	0.82	F
12	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.373	187	86	32.5	50.7	1.03	F
13	Entrance from KY 1072 Kyles Lane	1,500' downstream of Kyles Ln. entrance ramp	On Ramp	0.284	114	63	48.1	34.3	1.14	F
14	1,500' downstream of Kyles Ln. entrance ramp	1,500' upstream of 12th Street exit ramp	Basic	0.748	301	61	47.9	39.9	1.14	F
15	1,500' upstream of 12th Street exit ramp	Exit ramp to 12th Street	Off Ramp	0.284	119	28	46.0	42.1	1.14	F
16	Exit ramp to 12th Street	Exit ramp to 5th Street	Off Ramp	0.304	134	41	41.7	45.8	1.11	F
17	Exit ramp to 5th Street	Entrance ramp from 12th/Pike Streets	Basic	0.353	192	101	30.5	55.1	1.03	F
18	Entrance ramp from 12th/Pike Streets	Entrance Ramp from 4th Street	On Ramp	0.318	174	277	36.4	50.7	1.11	F
19	Entrance ramp from 4th Street	Exit ramp to 2nd Street/Ft. Washington Way	Weaving	0.820	553	1,364	34.4	48.6	1.06	F
20	Exit ramp to 2nd Street/Ft. Washington Way	Exit ramp to 5th Street	Off Ramp	0.147	58	26	33.0	23.8	0.83	C
21	Exit ramp to 5th Street	Exit ramp to River Rd.	Off Ramp	0.156	35	5	51.5	38.3	1.16	F
22	Exit ramp to River Rd.	Entrance ramp from 6th Street	Basic	0.583	94	2	58.9	24.8	1.06	F
23	Entrance ramp from 6th Street	Entrance ramp from 8th Street	On Ramp	0.177	43	0	60.0	21.0	0.65	C
24	Entrance ramp from 8th Street	Entrance ramp from Freeman Ave.	On Ramp	0.242	66	4	56.2	15.0	0.69	B
25	Entrance ramp from Freeman Ave.	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	On Ramp	0.238	73	5	55.8	18.6	0.76	C
26	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	Exit ramp to Harrison Ave.	Weaving	0.849	249	0	60.0	21.7	0.77	C
27	Exit ramp to Harrison Ave.	Entrance ramp from Harrison Ave.	Basic	0.108	29	0	60.0	20.3	0.73	C
28	Entrance ramp from Harrison Ave.	1,500' downstream of Harrison Ave. entrance ramp	On Ramp	0.284	102	9	54.9	25.0	0.88	C
29	1,500' downstream of Harrison Ave. entrance ramp	Marshall Ave. overpass	Basic	0.379	126	1	59.5	25.5	0.88	C
			Facility	11.323	4,336	2,950	42.4	33.2	1.16	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 3. Existing A.M. Peak Southbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	Marshall Ave. overpass	1,500' north of exit to Harrison Ave.	Basic	0.284	102	1	59.6	24.6	0.83	C
2	1,500' north of exit to Harrison Ave.	Exit to Harrison Ave.	Off Ramp	0.284	101	0	60.0	0.0	0.66	A
3	Exit to Harrison Ave.	Entrance from Harrison Ave.	Basic	0.157	53	0	59.8	23.3	0.80	C
4	Entrance from Harrison Ave.	Exit to Western Ave./Liberty St.	Weaving	0.376	200	53	44.0	29.0	0.85	D
5	Exit to Western Ave./Liberty St.	Exit to Ezzard Charles Dr.	Off Ramp	0.357	132	4	58.3	24.5	0.86	C
6	Exit to Ezzard Charles Dr.	Exit ramp to Freeman Ave.	Off Ramp	0.308	107	3	58.4	21.6	0.81	C
7	Exit to Freeman Ave.	Entrance from Western Ave.	Basic	0.169	53	0	59.8	20.9	0.74	C
8	Entrance from Western Ave.	Exit to 7th St.	Weaving	0.439	183	40	46.7	22.4	0.70	C
9	Exit to 7th St.	Exit to I-71 NB	Off Ramp	0.057	16	0	42.7	29.9	0.62	D
10	Exit to I-71 NB	Entrance from 8th Street	Basic	0.152	20	0	55.0	19.0	0.55	C
11	Entrance from 8th Street	Entrance from River Rd.	On Ramp	0.236	36	2	51.2	18.1	0.58	C
12	Entrance from River Rd.	Entrance from I-71 SB	On Ramp	0.153	29	2	50.5	23.3	0.69	C
13	Entrance from I-71 SB	Exit to 5th Street	Weaving	0.923	260	23	54.4	19.8	0.57	C
14	Exit to 5th Street	Exit to 12th Street	Off Ramp	0.101	23	0	59.2	21.9	0.49	C
15	Exit to 12th Street	Entrance from 4th Street	Basic	0.573	119	0	59.9	14.7	0.45	B
16	Entrance from 4th Street	1,500' downstream of 4th Street ramp	On Ramp	0.284	69	4	56.2	16.4	0.52	B
17	1,500' downstream of 4th Street ramp	Entrance from 12th/Pike streets	Basic	0.095	22	0	59.2	17.0	0.52	B
18	Entrance from 12th/Pike streets	1,500' downstream of 12th/Pike streets entrance	On Ramp	0.284	75	5	56.0	16.3	0.57	B
19	1,500' downstream of 12th/Pike streets entrance	1,500' feet upstream of KY 1072 Kyles Lane	Basic	0.664	197	0	50.0	22.0	0.60	C
20	1,500' feet upstream of KY 1072 Kyles Lane	Exit to KY 1072 Kyles Lane	Off Ramp	0.284	84	0	50.1	23.1	0.60	C
21	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.494	119	0	54.8	17.9	0.51	B
22	Entrance from KY 1072 Kyles Lane	Exit to US 25 Dixie Highway	Weaving	0.376	95	12	56.4	15.0	0.46	B
23	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.411	86	0	64.5	15.6	0.49	B
24	Entrance from US 25 Dixie Highway	1,500' downstream from Dixie Hwy. entrance ramp	On Ramp	0.284	70	4	58.4	12.9	0.52	B
25	1,500' downstream from Dixie Hwy. entrance ramp	1,500' upstream from exit to KY 371 Buttermilk Pike	Basic	0.322	75	0	61.7	16.3	0.52	B
26	1,500' upstream from exit to KY 371 Buttermilk Pike	Exit to KY 371 Buttermilk Pike	Off Ramp	0.417	98	0	54.6	20.9	0.52	C
27	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.465	96	0	62.0	14.6	0.46	B
28	Entrance from KY 371 Buttermilk Pike	1,500' downstream from KY 371 Buttermilk Pike ent.	On Ramp	0.284	75	5	57.9	17.5	0.56	B
29	1,500' downstream from KY 371 Buttermilk Pike ent.	1,500' feet upstream of exit to I-275	Basic	0.283	70	0	61.6	17.3	0.56	B
30	1,500' feet upstream of exit to I-275	Exit to I-275	Off Ramp	0.284	75	4	58.4	11.6	0.56	B
31	Exit to I-275	1,500' downstream from I-275 exit	Basic	0.438	64	0	61.8	14.1	0.46	B
32	1,500' downstream from I-275 exit	Exit to KY 236 Donaldson Rd.	Off Ramp	0.284	44	3	58.0	20.9	0.46	C
33	Exit to KY 236 Donaldson Rd.	Exit KY 1071 Turfway Rd.	Basic	0.448	52	0	61.8	11.7	0.38	B
			Facility	10.971	2,899	169	55.9	17.2	0.86	B

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 4. Existing P.M. Peak Northbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	KY 236 Donaldson Rd.	1,500' south of exit to I-275	Basic	0.095	33	0	60.1	26.2	0.80	D
2	1,500' south of Exit to I-275	Exit to I-275	Off Ramp	0.321	119	17	55.9	25.5	0.78	C
3	Exit to I-275	Entrance from KY 236 Donaldson Rd.	Basic	0.338	51	0	59.9	15.9	0.54	B
4	Entrance from KY 236 Donaldson Rd.	1,500' downstream of entrance ramp	On Ramp	0.284	64	8	57.3	24.4	0.73	C
5	1,500' downstream of entrance ramp	Entrance from I-275	Basic	0.429	90	5	61.0	21.2	0.73	C
6	Entrance from I-275	Exit to KY 371 Buttermilk Pike	Weaving	0.925	373	257	46.0	29.9	0.83	D
7	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.694	208	63	51.7	30.3	0.82	D
8	Entrance from KY 371 Buttermilk Pike	1,500' downstream of Buttermilk Pk. entrance ramp	On Ramp	0.264	103	77	49.1	38.0	1.01	F
9	1,500' upstream of Dixie Hwy. exit ramp	Exit to US 25 Dixie Highway	Off Ramp	0.264	95	11	53.5	36.0	1.05	F
10	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.482	160	15	54.4	33.1	1.01	F
11	Entrance from US 25 Dixie Highway	Exit to KY 1072 Kyles Lane	Weaving	0.583	323	132	36.5	40.7	0.90	E
12	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.373	157	42	44.1	41.6	1.04	F
13	Entrance from KY 1072 Kyles Lane	1,500' downstream of Kyles Ln. entrance ramp	On Ramp	0.284	121	25	47.7	34.2	1.14	F
14	1,500' downstream of Kyles Ln. entrance ramp	1,500' upstream of 12th Street exit ramp	Basic	0.748	304	52	49.7	39.9	1.14	F
15	1,500' upstream of 12th Street exit ramp	Exit ramp to 12th Street	Off Ramp	0.284	107	11	53.7	37.2	1.14	F
16	Exit ramp to 12th Street	Exit ramp to 5th Street	Off Ramp	0.304	104	10	54.0	37.1	1.09	F
17	Exit ramp to 5th Street	Entrance ramp from 12th/Pike Streets	Basic	0.353	109	10	54.6	30.9	1.03	F
18	Entrance ramp from 12th/Pike Streets	Entrance Ramp from 4th Street	On Ramp	0.318	122	16	48.0	29.6	1.12	F
19	Entrance ramp from 4th Street	Exit ramp to 2nd Street/Ft. Washington Way	Weaving	0.820	566	376	31.1	50.5	1.02	F
20	Exit ramp to 2nd Street/Ft. Washington Way	Exit ramp to 5th Street	Off Ramp	0.147	70	33	29.4	31.7	0.91	D
21	Exit ramp to 5th Street	Exit ramp to River Rd.	Off Ramp	0.156	43	5	48.1	39.9	1.31	F
22	Exit ramp to River Rd.	Entrance ramp from 6th Street	Basic	0.583	105	1	59.4	26.9	1.10	F
23	Entrance ramp from 6th Street	Entrance ramp from 8th Street	On Ramp	0.177	57	0	60.0	24.4	0.86	C
24	Entrance ramp from 8th Street	Entrance ramp from Freeman Ave.	On Ramp	0.242	95	8	55.1	21.9	0.99	C
25	Entrance ramp from Freeman Ave.	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	On Ramp	0.238	103	9	54.5	23.7	1.06	F
26	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	Exit ramp to Harrison Ave.	Weaving	0.849	356	9	58.4	29.7	1.09	F
27	Exit ramp to Harrison Ave.	Entrance ramp from Harrison Ave.	Basic	0.108	39	0	59.5	26.2	0.99	D
28	Entrance ramp from Harrison Ave.	1,500' downstream of Harrison Ave. entrance ramp	On Ramp	0.284	135	14	53.6	29.2	1.11	F
29	1,500' downstream of Harrison Ave. entrance ramp	Marshall Ave. overpass	Basic	0.379	167	7	57.7	31.8	1.11	F
			Facility	11.323	4,381	1,213	48.6	32.3	1.31	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 5. Existing P.M. Peak Southbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	Marshall Ave. overpass	1,500' north of exit to Harrison Ave.	Basic	0.284	95	0	60.0	22.9	0.68	C
2	1,500' north of exit to Harrison Ave.	Exit to Harrison Ave.	Off Ramp	0.284	95	0	57.0	26.2	0.54	D
3	Exit to Harrison Ave.	Entrance from Harrison Ave.	Basic	0.157	46	0	60.0	20.2	0.61	C
4	Entrance from Harrison Ave.	Exit to Western Ave./Liberty St.	Weaving	0.376	154	31	47.8	22.4	0.59	C
5	Exit to Western Ave./Liberty St.	Exit to Ezzard Charles Dr.	Off Ramp	0.357	107	2	59.2	20.0	0.61	C
6	Exit to Ezzard Charles Dr.	Exit ramp to Freeman Ave.	Off Ramp	0.308	89	1	59.0	17.7	0.58	B
7	Exit to Freeman Ave.	Entrance from Western Ave.	Basic	0.169	44	0	59.9	17.5	0.52	B
8	Entrance from Western Ave.	Exit to 7th St.	Weaving	0.439	142	20	51.5	17.5	0.49	B
9	Exit to 7th St.	Exit to I-71 NB	Off Ramp	0.057	15	0	52.8	22.5	0.55	C
10	Exit to I-71 NB	Entrance from 8th Street	Basic	0.152	22	0	55.0	20.7	0.65	C
11	Entrance from 8th Street	Entrance from River Rd.	On Ramp	0.236	45	3	50.8	22.2	0.73	C
12	Entrance from River Rd.	Entrance from I-71 SB	On Ramp	0.153	35	3	49.9	27.7	0.85	D
13	Entrance from I-71 SB	Exit to 5th Street	Weaving	0.923	481	72	44.2	35.9	0.88	E
14	Exit to 5th Street	Exit to 12th Street	Off Ramp	0.101	39	1	54.0	30.7	0.76	D
15	Exit to 12th Street	Entrance from 4th Street	Basic	0.573	186	1	57.8	22.6	0.69	C
16	Entrance from 4th Street	1,500' downstream of 4th Street ramp	On Ramp	0.284	118	10	53.0	26.0	0.83	D
17	1,500' downstream of 4th Street ramp	Entrance from 12th/Pike streets	Basic	0.095	37	1	57.0	27.7	0.83	D
18	Entrance from 12th/Pike streets	1,500' downstream of 12th/Pike streets entrance	On Ramp	0.284	136	12	50.0	25.1	0.91	C
19	1,500' downstream of 12th/Pike streets entrance	1,500' feet upstream of KY 1072 Kyles Lane	Basic	0.664	318	0	50.0	34.5	0.93	D
20	1,500' feet upstream of KY 1072 Kyles Lane	Exit to KY 1072 Kyles Lane	Off Ramp	0.284	131	3	51.9	33.4	0.92	D
21	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.494	194	0	54.9	27.3	0.81	D
22	Entrance from KY 1072 Kyles Lane	Exit to US 25 Dixie Highway	Weaving	0.376	186	41	46.9	27.3	0.74	D
23	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.411	148	1	59.4	26.0	0.83	D
24	Entrance from US 25 Dixie Highway	1,500' downstream from Dixie Hwy. entrance ramp	On Ramp	0.284	115	10	56.5	21.0	0.85	C
25	1,500' downstream from Dixie Hwy. entrance ramp	1,500' upstream from exit to KY 371 Buttermilk Pike	Basic	0.322	121	2	61.1	25.9	0.85	C
26	1,500' upstream from exit to KY 371 Buttermilk Pike	Exit to KY 371 Buttermilk Pike	Off Ramp	0.417	160	5	60.0	6.2	0.85	A
27	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.465	152	0	61.8	22.8	0.76	C
28	Entrance from KY 371 Buttermilk Pike	1,500' downstream from KY 371 Buttermilk Pike ent.	On Ramp	0.284	121	12	56.0	25.8	0.89	C
29	1,500' downstream from KY 371 Buttermilk Pike ent.	1,500' feet upstream of exit to I-275	Basic	0.283	112	3	60.5	27.0	0.89	D
30	1,500' feet upstream of exit to I-275	Exit to I-275	Off Ramp	0.284	116	7	58.3	17.6	0.89	B
31	Exit to I-275	1,500' downstream from I-275 exit	Basic	0.438	122	3	60.6	25.9	0.90	C
32	1,500' downstream from I-275 exit	Exit to KY 236 Donaldson Rd.	Off Ramp	0.284	83	6	57.9	31.0	0.90	D
33	Exit to KY 236 Donaldson Rd.	Exit KY 1071 Turfway Rd.	Basic	0.448	107	1	61.5	22.4	0.81	C
				10.971	4,072	251	54.3	23.9	0.93	C

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

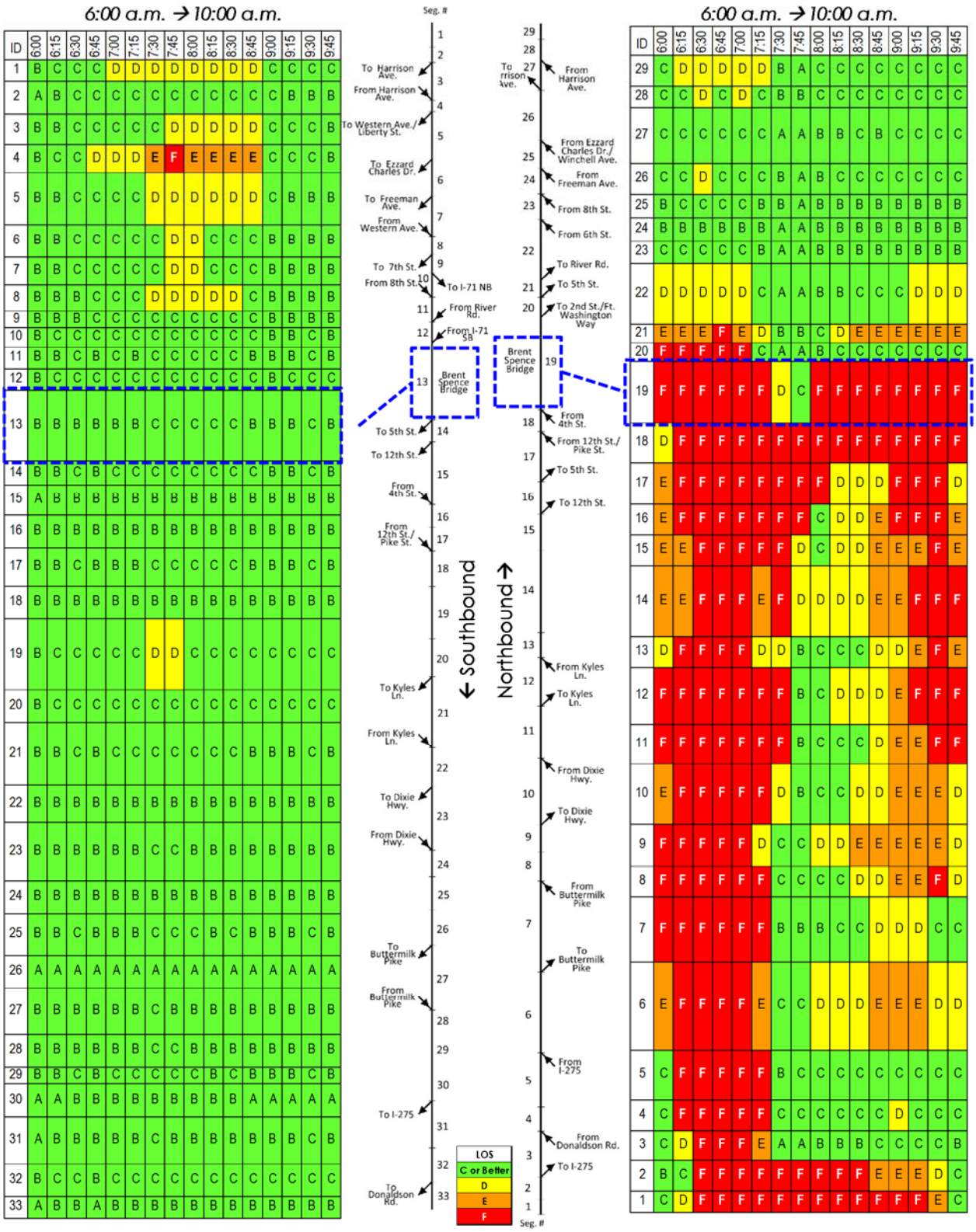


Figure 5. I-71/I-75 2040 No Build A.M. Peak Levels of Service

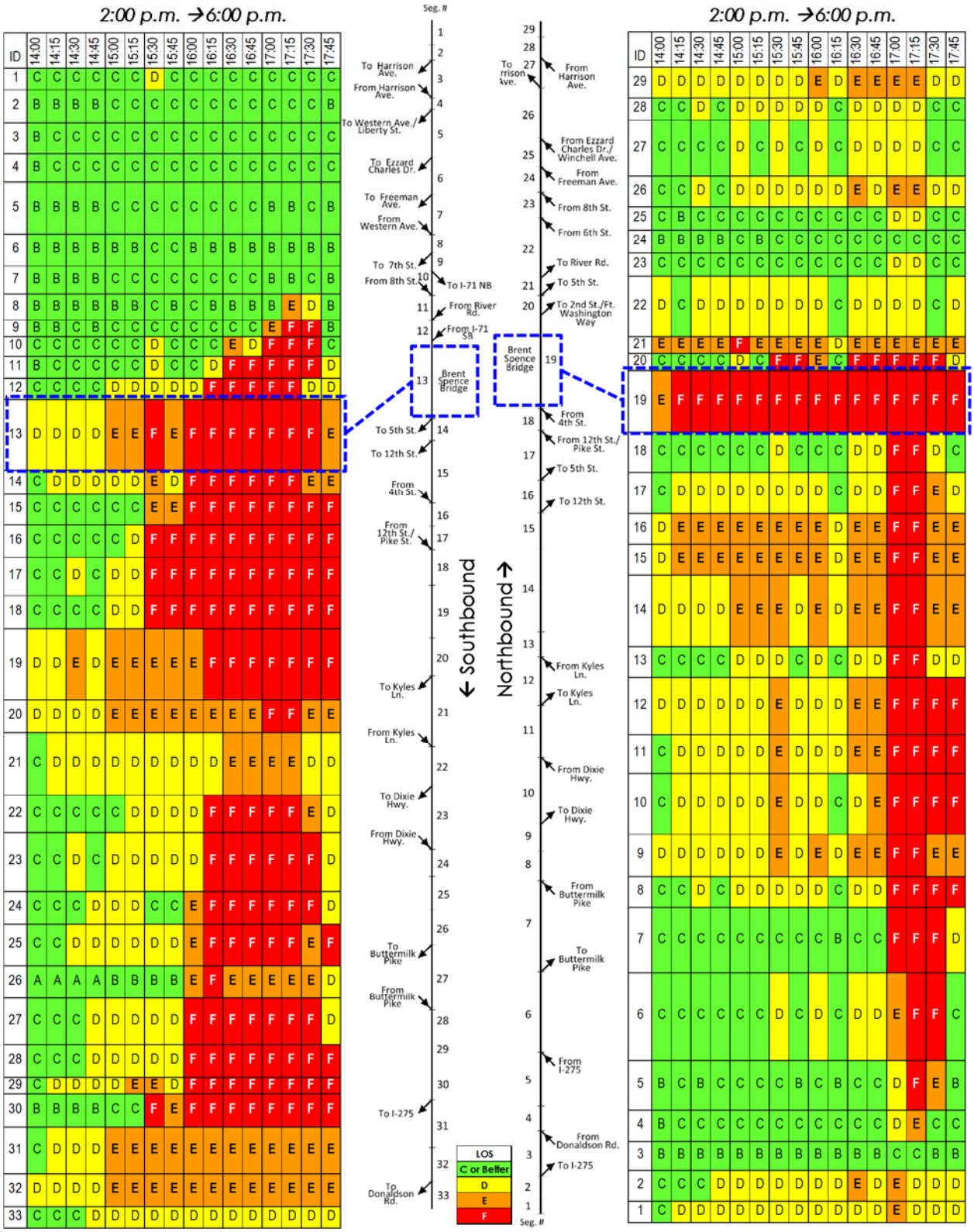


Figure 6. I-71/I-75 2040 No Build P.M. Peak Levels of Service

Table 6. Year 2040 No Build A.M. Peak Northbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	KY 236 Donaldson Rd.	1,500' south of exit to I-275	Basic	0.095	92	12,861	26.6	69.0	0.91	F
2	1,500' south of Exit to I-275	Exit to I-275	Off Ramp	0.321	205	77	40.4	46.6	0.96	F
3	Exit to I-275	Entrance from KY 236 Donaldson Rd.	Basic	0.338	135	80	26.3	41.5	0.69	E
4	Entrance from KY 236 Donaldson Rd.	1,500' downstream of entrance ramp	On Ramp	0.284	131	342	30.1	48.2	0.83	F
5	1,500' downstream of entrance ramp	Entrance from I-275	Basic	0.429	172	80	34.5	41.3	0.83	E
6	Entrance from I-275	Exit to KY 371 Buttermilk Pike	Weaving	0.925	589	3,452	30.1	48.8	0.93	F
7	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.694	287	150	35.4	43.6	1.07	F
8	Entrance from KY 371 Buttermilk Pike	1,500' downstream of Buttermilk Pk. entrance ramp	On Ramp	0.264	131	228	36.5	50.2	1.20	F
9	1,500' upstream of Dixie Hwy. exit ramp	Exit to US 25 Dixie Highway	Off Ramp	0.264	118	45	40.4	46.1	1.23	F
10	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.482	190	59	41.3	40.5	1.23	F
11	Entrance from US 25 Dixie Highway	Exit to KY 1072 Kyles Lane	Weaving	0.583	463	308	23.0	59.6	1.01	F
12	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.373	215	107	30.1	58.1	1.28	F
13	Entrance from KY 1072 Kyles Lane	1,500' downstream of Kyles Ln. entrance ramp	On Ramp	0.284	120	28	46.7	37.6	1.36	F
14	1,500' downstream of Kyles Ln. entrance ramp	1,500' upstream of 12th Street exit ramp	Basic	0.748	328	83	44.9	43.4	1.36	F
15	1,500' upstream of 12th Street exit ramp	Exit ramp to 12th Street	Off Ramp	0.284	125	32	44.7	43.3	1.36	F
16	Exit ramp to 12th Street	Exit ramp to 5th Street	Off Ramp	0.304	143	48	39.7	47.5	1.32	F
17	Exit ramp to 5th Street	Entrance ramp from 12th/Pike Streets	Basic	0.353	246	154	24.1	70.4	1.24	F
18	Entrance ramp from 12th/Pike Streets	Entrance Ramp from 4th Street	On Ramp	0.318	225	735	28.8	68.7	1.30	F
19	Entrance ramp from 4th Street	Exit ramp to 2nd Street/Ft. Washington Way	Weaving	0.820	616	2,037	30.7	54.2	1.15	F
20	Exit ramp to 2nd Street/Ft. Washington Way	Exit ramp to 5th Street	Off Ramp	0.147	66	34	28.4	31.1	1.02	F
21	Exit ramp to 5th Street	Exit ramp to River Rd.	Off Ramp	0.156	33	5	50.7	36.3	1.42	F
22	Exit ramp to River Rd.	Entrance ramp from 6th Street	Basic	0.583	85	1	59.1	22.3	1.31	F
23	Entrance ramp from 6th Street	Entrance ramp from 8th Street	On Ramp	0.177	41	0	59.9	19.6	0.76	C
24	Entrance ramp from 8th Street	Entrance ramp from Freeman Ave.	On Ramp	0.242	62	4	56.2	14.3	0.80	B
25	Entrance ramp from Freeman Ave.	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	On Ramp	0.238	70	5	55.8	18.0	0.86	C
26	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	Exit ramp to Harrison Ave.	Weaving	0.849	238	0	60.0	20.8	0.87	C
27	Exit ramp to Harrison Ave.	Entrance ramp from Harrison Ave.	Basic	0.108	28	0	60.0	19.4	0.84	C
28	Entrance ramp from Harrison Ave.	1,500' downstream of Harrison Ave. entrance ramp	On Ramp	0.284	98	8	54.9	24.3	0.97	C
29	1,500' downstream of Harrison Ave. entrance ramp	Marshall Ave. overpass	Basic	0.379	121	1	59.6	24.5	0.97	C
			Facility	11.323	5,372	20,966	36.6	41.4	1.42	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 7. Year 2040 No Build A.M. Peak Southbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	Marshall Ave. overpass	1,500' north of exit to Harrison Ave.	Basic	0.284	105	1	59.4	25.4	0.86	C
2	1,500' north of exit to Harrison Ave.	Exit to Harrison Ave.	Off Ramp	0.284	104	0	60.0	24.8	0.68	C
3	Exit to Harrison Ave.	Entrance from Harrison Ave.	Basic	0.157	55	0	59.7	24.2	0.83	C
4	Entrance from Harrison Ave.	Exit to Western Ave./Liberty St.	Weaving	0.376	205	55	44.0	29.8	0.87	D
5	Exit to Western Ave./Liberty St.	Exit to Ezzard Charles Dr.	Off Ramp	0.357	136	4	58.2	25.1	0.88	C
6	Exit to Ezzard Charles Dr.	Exit ramp to Freeman Ave.	Off Ramp	0.308	110	3	58.4	22.2	0.83	C
7	Exit to Freeman Ave.	Entrance from Western Ave.	Basic	0.169	55	0	59.8	21.6	0.76	C
8	Entrance from Western Ave.	Exit to 7th St.	Weaving	0.439	188	42	46.6	23.0	0.71	C
9	Exit to 7th St.	Exit to I-71 NB	Off Ramp	0.057	16	0	58.4	22.0	0.63	C
10	Exit to I-71 NB	Entrance from 8th Street	Basic	0.152	22	0	55.0	21.0	0.61	C
11	Entrance from 8th Street	Entrance from River Rd.	On Ramp	0.236	39	3	51.1	19.7	0.63	C
12	Entrance from River Rd.	Entrance from I-71 SB	On Ramp	0.153	30	2	50.4	24.3	0.73	C
13	Entrance from I-71 SB	Exit to 5th Street	Weaving	0.923	262	23	54.3	19.9	0.58	C
14	Exit to 5th Street	Exit to 12th Street	Off Ramp	0.101	23	0	59.4	21.3	0.49	C
15	Exit to 12th Street	Entrance from 4th Street	Basic	0.573	125	0	59.9	15.5	0.47	B
16	Entrance from 4th Street	1,500' downstream of 4th Street ramp	On Ramp	0.284	72	5	56.1	16.8	0.54	B
17	1,500' downstream of 4th Street ramp	Entrance from 12th/Pike streets	Basic	0.095	23	0	59.2	17.7	0.54	B
18	Entrance from 12th/Pike streets	1,500' downstream of 12th/Pike streets entrance	On Ramp	0.284	78	5	55.9	16.9	0.59	B
19	1,500' downstream of 12th/Pike streets entrance	1,500' feet upstream of KY 1072 Kyles Lane	Basic	0.664	205	0	50.0	22.8	0.62	C
20	1,500' feet upstream of KY 1072 Kyles Lane	Exit to KY 1072 Kyles Lane	Off Ramp	0.284	87	0	50.1	23.5	0.62	C
21	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.494	125	0	54.8	19.0	0.53	C
22	Entrance from KY 1072 Kyles Lane	Exit to US 25 Dixie Highway	Weaving	0.376	100	13	56.5	15.8	0.48	B
23	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.411	92	0	64.5	16.6	0.53	B
24	Entrance from US 25 Dixie Highway	1,500' downstream from Dixie Hwy. entrance ramp	On Ramp	0.284	75	5	58.2	13.7	0.55	B
25	1,500' downstream from Dixie Hwy. entrance ramp	1,500' upstream from exit to KY 371 Buttermilk Pike	Basic	0.322	80	0	61.7	17.3	0.55	B
26	1,500' upstream from exit to KY 371 Buttermilk Pike	Exit to KY 371 Buttermilk Pike	Off Ramp	0.417	104	1	61.6	16.6	0.55	B
27	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.465	104	0	62.0	15.9	0.50	B
28	Entrance from KY 371 Buttermilk Pike	1,500' downstream from KY 371 Buttermilk Pike ent.	On Ramp	0.284	79	5	57.9	17.4	0.58	B
29	1,500' downstream from KY 371 Buttermilk Pike ent.	1,500' feet upstream of exit to I-275	Basic	0.283	73	0	61.6	18.0	0.58	B
30	1,500' feet upstream of exit to I-275	Exit to I-275	Off Ramp	0.284	77	4	59.0	11.2	0.58	B
31	Exit to I-275	1,500' downstream from I-275 exit	Basic	0.438	72	0	61.9	15.8	0.50	B
32	1,500' downstream from I-275 exit	Exit to KY 236 Donaldson Rd.	Off Ramp	0.284	49	3	58.4	22.3	0.50	C
33	Exit to KY 236 Donaldson Rd.	Exit KY 1071 Turfway Rd.	Basic	0.448	63	0	61.8	14.1	0.45	B
				10.971	3,033	176	55.9	17.9	0.88	B

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 8. Year 2040 No Build P.M. Peak Northbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	KY 236 Donaldson Rd.	1,500' south of exit to I-275	Basic	0.095	37	1	59.3	29.7	0.89	D
2	1,500' south of Exit to I-275	Exit to I-275	Off Ramp	0.321	138	23	54.0	31.9	0.87	D
3	Exit to I-275	Entrance from KY 236 Donaldson Rd.	Basic	0.338	52	1	59.4	16.1	0.55	B
4	Entrance from KY 236 Donaldson Rd.	1,500' downstream of entrance ramp	On Ramp	0.284	66	14	55.2	25.4	0.74	C
5	1,500' downstream of entrance ramp	Entrance from I-275	Basic	0.429	99	14	55.8	23.3	0.74	C
6	Entrance from I-275	Exit to KY 371 Buttermilk Pike	Weaving	0.925	401	403	42.6	32.1	0.84	D
7	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.694	237	92	45.3	34.6	0.84	D
8	Entrance from KY 371 Buttermilk Pike	1,500' downstream of Buttermilk Pk. entrance ramp	On Ramp	0.264	113	131	44.5	41.8	1.03	F
9	1,500' upstream of Dixie Hwy. exit ramp	Exit to US 25 Dixie Highway	Off Ramp	0.264	103	19	49.1	39.4	1.07	F
10	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.482	182	35	48.6	37.5	1.05	F
11	Entrance from US 25 Dixie Highway	Exit to KY 1072 Kyles Lane	Weaving	0.583	367	185	32.4	46.1	0.92	F
12	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.373	167	50	42.1	44.3	1.09	F
13	Entrance from KY 1072 Kyles Lane	1,500' downstream of Kyles Ln. entrance ramp	On Ramp	0.284	119	22	49.0	32.5	1.19	F
14	1,500' downstream of Kyles Ln. entrance ramp	1,500' upstream of 12th Street exit ramp	Basic	0.748	293	37	52.5	38.4	1.19	F
15	1,500' upstream of 12th Street exit ramp	Exit ramp to 12th Street	Off Ramp	0.284	114	17	51.2	39.1	1.19	F
16	Exit ramp to 12th Street	Exit ramp to 5th Street	Off Ramp	0.304	111	16	51.6	39.0	1.13	F
17	Exit ramp to 5th Street	Entrance ramp from 12th/Pike Streets	Basic	0.353	120	19	50.7	34.0	1.07	F
18	Entrance ramp from 12th/Pike Streets	Entrance Ramp from 4th Street	On Ramp	0.318	129	20	46.7	31.2	1.16	F
19	Entrance ramp from 4th Street	Exit ramp to 2nd Street/Ft. Washington Way	Weaving	0.820	613	581	29.3	54.7	1.06	F
20	Exit ramp to 2nd Street/Ft. Washington Way	Exit ramp to 5th Street	Off Ramp	0.147	82	43	26.0	43.3	0.96	E
21	Exit ramp to 5th Street	Exit ramp to River Rd.	Off Ramp	0.156	44	6	47.6	40.9	1.37	F
22	Exit ramp to River Rd.	Entrance ramp from 6th Street	Basic	0.583	110	1	59.4	28.2	1.16	F
23	Entrance ramp from 6th Street	Entrance ramp from 8th Street	On Ramp	0.177	59	0	60.0	25.2	0.90	C
24	Entrance ramp from 8th Street	Entrance ramp from Freeman Ave.	On Ramp	0.242	97	8	55.0	22.2	1.02	F
25	Entrance ramp from Freeman Ave.	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	On Ramp	0.238	106	10	54.4	24.4	1.09	F
26	Entrance ramp from Ezzard Charles Dr./Winchell Ave.	Exit ramp to Harrison Ave.	Weaving	0.849	368	11	58.2	30.7	1.13	F
27	Exit ramp to Harrison Ave.	Entrance ramp from Harrison Ave.	Basic	0.108	41	0	59.4	27.1	1.03	F
28	Entrance ramp from Harrison Ave.	1,500' downstream of Harrison Ave. entrance ramp	On Ramp	0.284	139	15	53.4	29.8	1.15	F
29	1,500' downstream of Harrison Ave. entrance ramp	Marshall Ave. overpass	Basic	0.379	173	8	57.3	32.9	1.15	F
			Facility	11.323	4,681	1,780	46.4	34.6	1.37	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 9. Year 2040 No Build P.M. Peak Southbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	Marshall Ave. overpass	1,500' north of exit to Harrison Ave.	Basic	0.284	99	0	60.0	23.9	0.70	C
2	1,500' north of exit to Harrison Ave.	Exit to Harrison Ave.	Off Ramp	0.284	99	0	60.0	22.5	0.56	C
3	Exit to Harrison Ave.	Entrance from Harrison Ave.	Basic	0.157	48	0	60.0	21.1	0.63	C
4	Entrance from Harrison Ave.	Exit to Western Ave./Liberty St.	Weaving	0.376	161	34	47.5	23.5	0.61	C
5	Exit to Western Ave./Liberty St.	Exit to Ezzard Charles Dr.	Off Ramp	0.357	112	2	59.1	20.8	0.63	C
6	Exit to Ezzard Charles Dr.	Exit ramp to Freeman Ave.	Off Ramp	0.308	93	2	59.0	18.4	0.61	C
7	Exit to Freeman Ave.	Entrance from Western Ave.	Basic	0.169	46	0	59.9	18.4	0.55	C
8	Entrance from Western Ave.	Exit to 7th St.	Weaving	0.439	171	42	45.4	21.0	0.52	C
9	Exit to 7th St.	Exit to I-71 NB	Off Ramp	0.057	28	12	34.4	21.0	0.58	C
10	Exit to I-71 NB	Entrance from 8th Street	Basic	0.152	45	21	28.6	42.9	0.69	E
11	Entrance from 8th Street	Entrance from River Rd.	On Ramp	0.236	80	39	30.6	45.0	0.79	E
12	Entrance from River Rd.	Entrance from I-71 SB	On Ramp	0.153	44	10	44.5	36.3	0.93	E
13	Entrance from I-71 SB	Exit to 5th Street	Weaving	0.923	555	1,313	40.9	41.4	0.98	E
14	Exit to 5th Street	Exit to 12th Street	Off Ramp	0.101	59	18	38.5	42.4	0.86	E
15	Exit to 12th Street	Entrance from 4th Street	Basic	0.573	403	205	28.5	49.0	0.77	F
16	Entrance from 4th Street	1,500' downstream of 4th Street ramp	On Ramp	0.284	241	1,125	28.0	60.4	0.97	F
17	1,500' downstream of 4th Street ramp	Entrance from 12th/Pike streets	Basic	0.095	81	42	27.7	61.9	0.97	F
18	Entrance from 12th/Pike streets	1,500' downstream of 12th/Pike streets entrance	On Ramp	0.284	209	71	36.7	49.6	1.09	F
19	1,500' downstream of 12th/Pike streets entrance	1,500' feet upstream of KY 1072 Kyles Lane	Basic	0.664	421	63	42.5	45.5	1.12	F
20	1,500' feet upstream of KY 1072 Kyles Lane	Exit to KY 1072 Kyles Lane	Off Ramp	0.284	154	10	49.6	38.4	1.10	F
21	Exit to KY 1072 Kyles Lane	Entrance from KY 1072 Kyles Lane	Basic	0.494	236	14	51.7	33.1	0.98	D
22	Entrance from KY 1072 Kyles Lane	Exit to US 25 Dixie Highway	Weaving	0.376	278	118	34.6	40.8	0.85	E
23	Exit to US 25 Dixie Highway	Entrance from US 25 Dixie Highway	Basic	0.411	239	77	40.7	42.2	0.98	E
24	Entrance from US 25 Dixie Highway	1,500' downstream from Dixie Hwy. entrance ramp	On Ramp	0.284	164	478	48.2	36.5	1.08	F
25	1,500' downstream from Dixie Hwy. entrance ramp	1,500' upstream from exit to KY 371 Buttermilk Pike	Basic	0.322	185	41	48.2	39.7	1.08	F
26	1,500' upstream from exit to KY 371 Buttermilk Pike	Exit to KY 371 Buttermilk Pike	Off Ramp	0.417	215	28	53.9	24.6	1.08	F
27	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.465	298	112	38.8	44.6	0.99	E
28	Entrance from KY 371 Buttermilk Pike	1,500' downstream from KY 371 Buttermilk Pike ent.	On Ramp	0.284	179	487	46.2	40.7	1.15	F
29	1,500' downstream from KY 371 Buttermilk Pike ent.	1,500' feet upstream of exit to I-275	Basic	0.283	184	51	44.7	44.6	1.15	F
30	1,500' feet upstream of exit to I-275	Exit to I-275	Off Ramp	0.284	204	71	40.4	44.6	1.15	F
31	Exit to I-275	1,500' downstream from I-275 exit	Basic	0.438	170	15	56.6	36.1	1.22	F
32	1,500' downstream from I-275 exit	Exit to KY 236 Donaldson Rd.	Off Ramp	0.284	111	11	56.1	37.0	1.22	F
33	Exit to KY 236 Donaldson Rd.	Exit KY 1071 Turfway Rd.	Basic	0.448	148	6	59.4	31.3	1.11	F
				10.971	5,755	4,516	43.6	35.7	1.22	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Projected Year 2040 A.M. and P.M. peak traffic conditions with the construction of KYTC Item 6-17 are shown in **Figure 7** and **Figure 8**, respectively. Performance measures are summarized for northbound and southbound year 2040 A.M. peak periods with KYTC Item 6-17 in **Table 10** and **Table 11**, respectively. For northbound and southbound year 2040 P.M. peak periods with KYTC Item 6-17, performance measures are summarized in **Table 12** and **Table 13**, respectively.

A summary and comparison of directional performance measures for existing conditions, Year 2040 No Build, and Year 2040 Build (i.e. with Item 6-17) scenarios is shown in **Table 14**.

The figures illustrate two important points:

- The Brent Spence Bridge project is needed. Without it, congestion will worsen considerably. Peak periods will be extended beyond the current timeframes and congestion will be extended throughout the corridor.
- The Brent Spence Bridge project will not completely eliminate congestion in the I-71/I-75 corridor, particularly in the downtown Cincinnati area and near the I-275 interchange in Kentucky. The Ohio Department of Transportation has other planned projects beyond the Brent Spence Bridge Replacement/Rehabilitation Project that will improve congestion on the Cincinnati side of the bridge. These results point to the additional need for capacity improvements of the I-275 interchange with I-71/I-75. For maximum benefit, the needed improvements should be scheduled as closely as possible to the Brent Spence Bridge Replacement/Rehabilitation Project. The I-275 interchange reconstruction would include widening of I-71/I-75 from Turfway Road north through the I-275 interchange to KYTC Item 6-17.

With respect to the Kentucky portion of I-71/I-75, peak travel directions and times are in the northbound direction during the morning peak and southbound during the afternoon peak.

Several conclusions can be drawn from the analyses:

- Traffic congestion and the metrics used to quantify it – speed, density, delay, demand-to-capacity (D/C) ratio – will worsen due to traffic growth in the corridor if no improvements are made.
- The *Brent Spence Bridge Replacement/ Rehabilitation Project* will provide a significant improvement to future traffic congestion when compared with a No Build scenario.
- KYTC Item 6-17 will not resolve all congestion issues in the corridor; there will remain segments where travel demand exceeds capacity (i.e. D/C is greater than 1.0). In Kentucky, this is in the vicinity of the I-275 interchange.
- From the system-wide results, there is the appearance that KYTC Item 6-17 reduces vehicle-miles traveled (VMT) in the northbound direction. This is not the case. Whereas I-71 and I-75 run concurrently across the Brent Spence Bridge today, KYTC Item 6-17 separates I-71 and I-75 onto separate bridges. The HCM analysis was conducted for the I-75 corridor, including the sections where it runs concurrent with I-71. The "2040 with 6-17" analysis involves less lane mileage than do the "Existing" and "2040 No Build" analyses due to the separation of I-71 and I-75, thus the VMT metric is less.

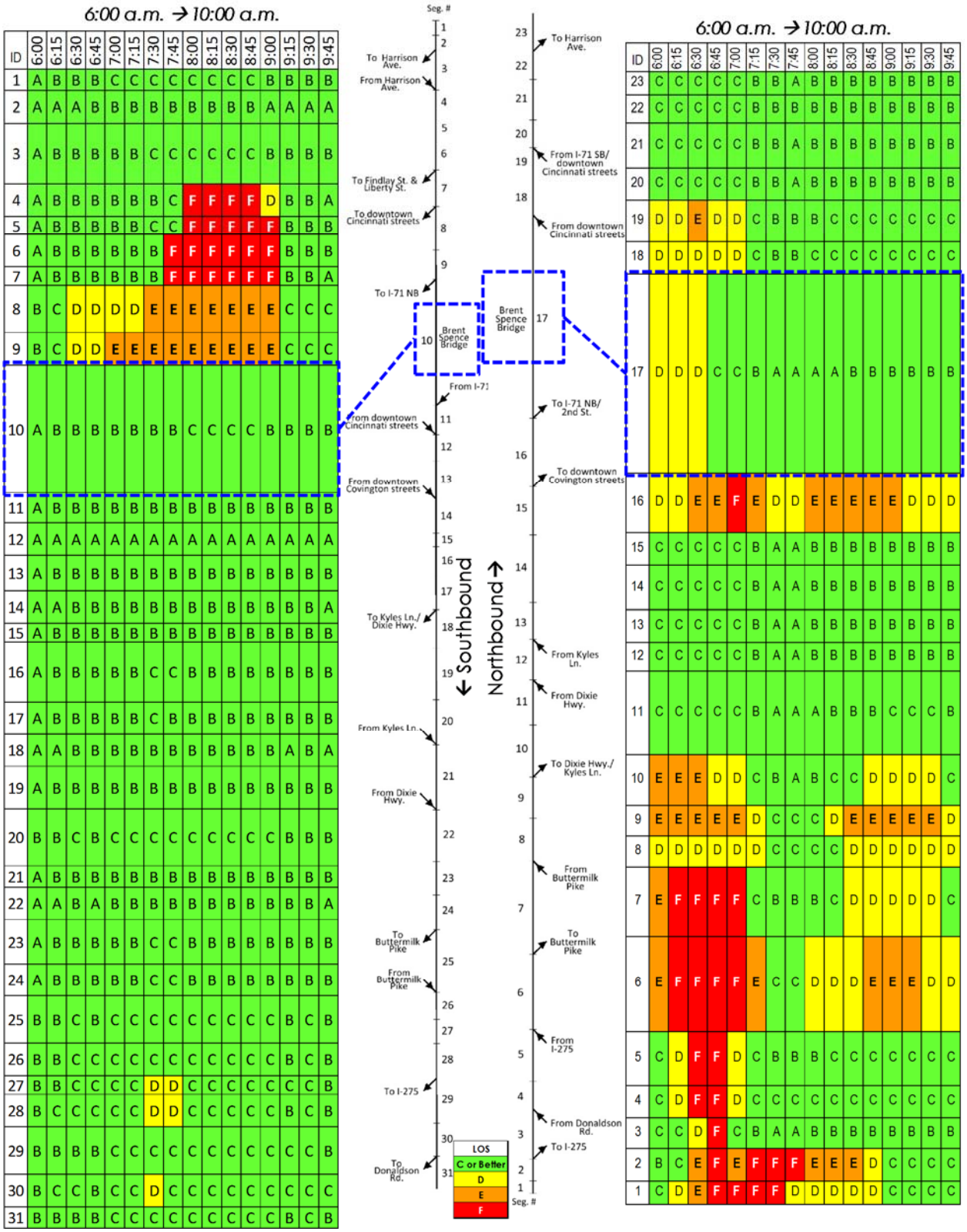


Figure 7. I-71/I-75 2040 with 6-17 A.M. Peak Levels of Service

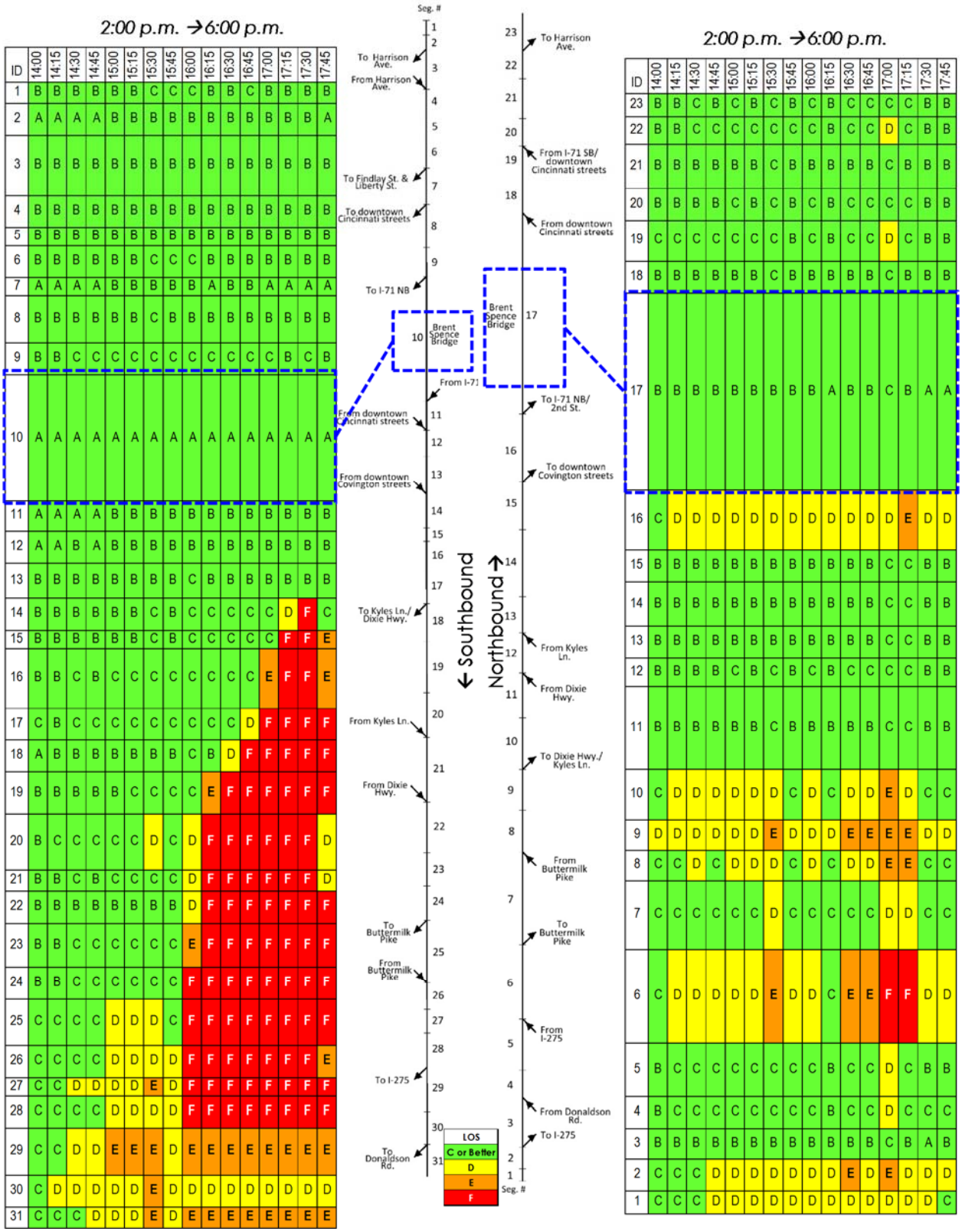


Figure 8. I-71/I-75 2040 with 6-17 P.M. Peak Levels of Service

Table 10. Year 2040 with 6-17 A.M. Peak Northbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	KY 236 Donaldson Rd.	1,500' south of exit to I-275	Basic	0.095	51	421	47.7	38.5	0.91	E
2	1,500' south of Exit to I-275	Exit to I-275	Off Ramp	0.321	159	32	52.0	35.5	0.96	E
3	Exit to I-275	Entrance from KY 236 Donaldson Rd.	Basic	0.338	62	7	57.4	18.9	0.69	C
4	Entrance from KY 236 Donaldson Rd.	1,500' downstream of entrance ramp	On Ramp	0.284	75	17	52.1	28.6	0.83	D
5	1,500' downstream of entrance ramp	Entrance from I-275	Basic	0.429	109	17	54.6	26.0	0.83	C
6	Entrance from I-275	Exit to KY 371 Buttermilk Pike	Weaving	0.925	528	1,463	34.4	43.8	0.96	E
7	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.694	265	104	39.5	40.2	1.10	F
8	Entrance from KY 371 Buttermilk Pike	1,500' downstream of entrance ramp	On Ramp	0.264	89	22	55.0	30.7	1.23	F
9	1,500' upstream of exit ramp	Exit to US 25 Dixie Hwy. & KY 1072 Kyles Ln.	Off Ramp	0.264	85	9	57.8	34.6	1.23	F
10	Exit to US 25 Dixie Hwy. & KY 1072 Kyles Ln.	Lane addition	Basic	0.455	119	7	61.1	27.1	1.19	F
11	Lane addition	Entrance from US 25 Dixie Highway	Basic	0.795	196	0	64.9	17.9	0.84	B
12	Entrance from US 25 Dixie Highway	Entrance from KY 1072 Kyles Lane	On Ramp	0.152	43	0	65.0	16.7	0.76	B
13	Entrance from KY 1072 Kyles Lane	1,500' downstream of entrance ramp	On Ramp	0.284	94	0	65.0	16.7	0.68	B
14	1,500' downstream of entrance ramp	1,500' upstream of exit to downtown Covington	Basic	0.758	251	0	65.0	15.5	0.65	B
15	1,500' upstream of exit to downtown Covington	Exit to downtown Covington streets	Off Ramp	0.284	94	0	65.0	25.8	0.68	C
16	Exit to downtown Covington streets	Exit to I-71 NB/FWW and 2nd Street	Off Ramp	0.304	97	9	58.9	36.1	0.96	E
17	Exit to I-71 NB/FWW and 2nd Street	Entrance from downtown Cincinnati streets	Basic	2.375	340	5	64.1	16.1	0.95	B
18	Entrance from downtown Cincinnati streets	1,500' downstream of entrance from downtown Covington streets	On Ramp	0.284	71	10	57.2	25.2	0.99	C
19	1,500' downstream of entrance from downtown Covington streets	Entrance from I-71 SB and downtown Cincinnati streets	Basic	0.575	132	5	62.6	23.3	1.04	F
20	Entrance from I-71 SB and downtown Cincinnati streets	1,500' downstream of entrance ramp from 12th/Pike Streets	On Ramp	0.284	86	0	64.9	19.5	0.71	C
21	1,500' downstream of entrance ramp from 12th/Pike Streets	1,500'upstream of exit ramp to Harrison Ave.	Basic	0.565	159	1	69.7	15.8	0.69	B
22	1,500'upstream of exit ramp to Harrison Ave.	Exit ramp to Harrison Ave.	Off Ramp	0.284	86	0	64.7	18.3	0.74	C
23	Exit ramp to Harrison Ave.	Marshall Ave. overpass	Basic	0.379	107	0	65.0	16.6	0.72	B
			Facility	11.391	3,297	2,131	55.4	21.0	1.23	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 11. Year 2040 with 6-17 A.M. Peak Southbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	Marshall Ave. overpass	1,500' north of exit to Harrison Ave.	Basic	0.284	92	0	65.0	17.9	0.64	B
2	1,500' north of exit to Harrison Ave.	Exit to Harrison Ave.	Off Ramp	0.284	93	0	64.7	9.6	0.64	A
3	Exit to Harrison Ave.	Entrance from Harrison Ave.	Basic	0.701	219	2	64.3	17.2	0.62	B
4	Entrance from Harrison Ave.	1,500 downstream from Harrison Ave. on ramp	On Ramp	0.284	242	143	27.2	37.4	0.61	E
5	1,500' downstream from Harrison Ave. on ramp	1,500' upstream of exit to Findlay & Liberty streets	Basic	0.066	63	40	24.3	43.2	0.61	E
6	1,500' upstream of exit to Findlay & Liberty streets	Exit to Findlay & Liberty streets	Off Ramp	0.284	298	197	22.1	47.8	0.61	F
7	Exit to Findlay & Liberty streets	Exit to downtown Cincinnati streets	Off Ramp	0.152	182	131	18.3	45.9	0.57	F
8	Exit to downtown Cincinnati streets	1,500' upstream of exit to I-71 NB	Basic	0.492	169	15	59.4	31.2	1.07	F
9	1,500' upstream of exit to I-71 NB	Exit to I-71 NB	Off Ramp	0.284	100	11	58.1	33.9	1.07	F
10	Exit to I-71 NB	Entrance from I-71 SB	Basic	0.966	175	0	65.0	16.7	0.59	B
11	Entrance from I-71 SB	Entrance from downtown Cincinnati streets	On Ramp	0.218	57	0	65.0	11.7	0.49	B
12	Entrance from downtown Cincinnati streets	1,500' downstream of entrance from downtown Cincinnati streets	On Ramp	0.284	88	4	62.4	6.8	0.47	A
13	1,500' downstream of entrance from downtown Cincinnati streets	Entrance from downtown Covington streets	Basic	0.398	119	0	64.9	14.0	0.48	B
14	Entrance from downtown Covington streets	1,500' downstream of entrance from downtown Covington streets	On Ramp	0.284	93	0	65.0	13.9	0.46	B
15	1,500' downstream of entrance from downtown Covington streets	Lane drop	Basic	0.142	51	0	60.0	13.8	0.45	B
16	Lane drop	1,500' upstream of exit to Kyles Lane & Dixie Hwy.	Basic	0.587	209	0	60.0	16.0	0.52	B
17	1,500' upstream of exit to Kyles Lane & Dixie Hwy.	Exit to Kyles Lane & Dixie Hwy.	Off Ramp	0.284	94	0	64.8	15.9	0.53	B
18	Exit to Kyles Lane & Dixie Hwy.	Lane drop	Basic	0.256	71	1	69.5	12.5	0.45	B
19	Lane drop	Lane drop	Basic	0.445	123	0	70.0	15.0	0.54	B
20	Lane drop	Entrance from KY 1972 Kyles Ln.	Basic	0.549	152	1	69.6	18.8	0.67	C
21	Entrance from KY 1972 Kyles Ln.	Entrance from US 25 Dixie Hwy.	On Ramp	0.199	58	0	70.0	15.2	0.57	B
22	Entrance from US 25 Dixie Hwy.	1,500' downstream of entrance from US 25 Dixie Hwy.	On Ramp	0.284	93	6	65.3	11.6	0.60	B
23	1,500' downstream of entrance from US 25 Dixie Hwy.	1,500' upstream of exit to KY 371 Buttermilk Pike	Basic	0.189	58	1	69.4	16.4	0.60	B
24	1,500' upstream of exit to KY 371 Buttermilk Pike	Exit to KY 371 Buttermilk Pike	Off Ramp	0.284	86	0	69.9	17.8	0.60	B
25	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.464	131	1	69.5	19.1	0.68	C
26	Entrance from KY 371 Buttermilk Pike	1,500' downstream from entrance from KY 371 Buttermilk Pike	On Ramp	0.284	99	9	63.4	22.5	0.78	C
27	1,500' downstream from entrance from KY 371 Buttermilk Pike	1,500' upstream of exit to I-275	Basic	0.284	92	2	68.3	21.9	0.78	C
28	1,500' upstream of exit to I-275	Exit to I-275	Off Ramp	0.284	97	7	65.2	24.0	0.78	C
29	Exit to I-275	1,500' downstream of exit to KY 236 Donaldson Rd.	Basic	0.436	101	2	68.6	20.9	0.73	C
30	1,500' downstream of exit to KY 236 Donaldson Rd.	Exit to KY 236 Donaldson Rd.	Off Ramp	0.284	70	5	64.5	24.6	0.73	C
31	Exit to KY 236 Donaldson Rd.	Exit to KY 1017 Turfway Rd.	Basic	0.445	91	1	69.2	19.3	0.69	C
			Facility	10.682	3,665	579	56.2	17.9	1.07	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 12. Year 2040 with 6-17 P.M. Peak Northbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	KY 236 Donaldson Rd.	1,500' south of exit to I-275	Basic	0.095	35	1	62.7	28.1	0.87	D
2	1,500' south of Exit to I-275	Exit to I-275	Off Ramp	0.321	141	22	53.1	31.9	0.88	D
3	Exit to I-275	Entrance from KY 236 Donaldson Rd.	Basic	0.338	50	0	62.4	15.2	0.55	B
4	Entrance from KY 236 Donaldson Rd.	1,500' downstream of entrance ramp	On Ramp	0.284	64	6	54.8	23.3	0.72	C
5	1,500' downstream of entrance ramp	Entrance from I-275	Basic	0.429	88	0	59.8	20.8	0.72	C
6	Entrance from I-275	Exit to KY 371 Buttermilk Pike	Weaving	0.925	425	142	39.9	34.0	0.86	D
7	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.694	165	2	64.1	24.1	0.83	C
8	Entrance from KY 371 Buttermilk Pike	1,500' downstream of entrance ramp	On Ramp	0.264	89	17	55.9	29.5	1.02	F
9	1,500' upstream of exit ramp	Exit to US 25 Dixie Hwy. & KY 1072 Kyles Ln.	Off Ramp	0.264	85	8	59.1	34.9	1.02	F
10	Exit to US 25 Dixie Hwy. & KY 1072 Kyles Ln.	Lane addition	Basic	0.455	128	2	59.1	28.4	0.96	D
11	Lane addition	Entrance from US 25 Dixie Highway	Basic	0.795	190	0	69.8	17.0	0.65	B
12	Entrance from US 25 Dixie Highway	Entrance from KY 1072 Kyles Lane	On Ramp	0.152	47	0	60.0	16.8	0.63	B
13	Entrance from KY 1072 Kyles Lane	1,500' downstream of entrance ramp	On Ramp	0.284	96	0	60.0	16.8	0.57	B
14	1,500' downstream of entrance ramp	1,500' upstream of exit to downtown Covington	Basic	0.758	256	0	60.0	16.6	0.57	B
15	1,500' upstream of exit to downtown Covington	Exit to downtown Covington streets	Off Ramp	0.284	96	0	60.0	24.0	0.57	C
16	Exit to downtown Covington streets	Exit to I-71 NB/FWW and 2nd Street	Off Ramp	0.304	73	4	56.5	31.4	0.65	D
17	Exit to I-71 NB/FWW and 2nd Street	Entrance from downtown Cincinnati streets	Basic	2.375	264	0	58.0	12.1	0.57	B
18	Entrance from downtown Cincinnati streets	1,500' downstream of entrance from downtown Covington streets	On Ramp	0.284	53	3	52.0	15.8	0.71	B
19	1,500' downstream of entrance from downtown Covington streets	Entrance from I-71 SB and downtown Cincinnati streets	Basic	0.575	101	0	54.9	17.8	0.71	B
20	Entrance from I-71 SB and downtown Cincinnati streets	1,500' downstream of entrance ramp from 12th/Pike Streets	On Ramp	0.284	86	2,066	55.0	16.9	0.72	B
21	1,500' downstream of entrance ramp from 12th/Pike Streets	1,500'upstream of exit ramp to Harrison Ave.	Basic	0.565	158	0	59.9	16.0	0.70	B
22	1,500'upstream of exit ramp to Harrison Ave.	Exit ramp to Harrison Ave.	Off Ramp	0.284	81	2	58.5	21.1	0.88	C
23	Exit ramp to Harrison Ave.	Marshall Ave. overpass	Basic	0.379	90	0	59.9	17.3	0.77	B
			Facility	11.391	2,861	2,277	56.5	17.9	1.02	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 13. Year 2040 with 6-17 P.M. Peak Southbound Performance Measures

Segment No.	From	To	Segment Type	Length (miles)	① VHT/Int. (hrs)	② VHD/Int. (hrs)	③ Speed (mph)	Density (pc/mi/ln)	④ Max D/C	LOS
1	Marshall Ave. overpass	1,500' north of exit to Harrison Ave.	Basic	0.284	91	0	65.0	17.6	0.55	B
2	1,500' north of exit to Harrison Ave.	Exit to Harrison Ave.	Off Ramp	0.284	92	1	64.0	11.8	0.55	B
3	Exit to Harrison Ave.	Entrance from Harrison Ave.	Basic	0.701	197	0	65.0	15.5	0.49	B
4	Entrance from Harrison Ave.	1,500 downstream from Harrison Ave. on ramp	On Ramp	0.284	93	5	61.8	12.0	0.45	B
5	1,500' downstream from Harrison Ave. on ramp	1,500' upstream of exit to Findlay & Liberty streets	Basic	0.066	21	0	64.3	14.2	0.45	B
6	1,500' upstream of exit to Findlay & Liberty streets	Exit to Findlay & Liberty streets	Off Ramp	0.284	91	2	63.7	19.5	0.45	C
7	Exit to Findlay & Liberty streets	Exit to downtown Cincinnati streets	Off Ramp	0.152	38	0	64.8	17.3	0.36	B
8	Exit to downtown Cincinnati streets	1,500' upstream of exit to I-71 NB	Basic	0.492	81	0	65.0	15.2	0.53	B
9	1,500' upstream of exit to I-71 NB	Exit to I-71 NB	Off Ramp	0.284	55	9	54.6	22.9	0.53	C
10	Exit to I-71 NB	Entrance from I-71 SB	Basic	0.966	35	0	65.0	4.3	0.21	A
11	Entrance from I-71 SB	Entrance from downtown Cincinnati streets	On Ramp	0.218	51	271	65.0	8.8	0.45	A
12	Entrance from downtown Cincinnati streets	1,500' downstream of entrance from downtown Cincinnati streets	On Ramp	0.284	96	5	61.9	13.3	0.50	B
13	1,500' downstream of entrance from downtown Cincinnati streets	Entrance from downtown Covington streets	Basic	0.398	128	1	64.6	15.8	0.53	B
14	Entrance from downtown Covington streets	1,500' downstream of entrance from downtown Covington streets	On Ramp	0.284	141	1,302	55.7	6.3	0.60	A
15	1,500' downstream of entrance from downtown Covington streets	Lane drop	Basic	0.142	102	37	38.4	28.3	0.59	D
16	Lane drop	1,500' upstream of exit to Kyles Lane & Dixie Hwy.	Basic	0.587	396	126	40.9	31.0	0.69	D
17	1,500' upstream of exit to Kyles Lane & Dixie Hwy.	Exit to Kyles Lane & Dixie Hwy.	Off Ramp	0.284	210	89	37.4	37.8	0.70	E
18	Exit to Kyles Lane & Dixie Hwy.	Lane drop	Basic	0.256	236	150	25.4	43.0	0.58	E
19	Lane drop	Lane drop	Basic	0.445	383	234	27.2	48.3	0.70	F
20	Lane drop	Entrance from KY 1972 Kyles Ln.	Basic	0.549	292	108	44.1	37.3	0.88	E
21	Entrance from KY 1972 Kyles Ln.	Entrance from US 25 Dixie Hwy.	On Ramp	0.199	153	103	33.8	33.2	0.78	D
22	Entrance from US 25 Dixie Hwy.	1,500' downstream of entrance from US 25 Dixie Hwy.	On Ramp	0.284	222	112	36.4	40.1	0.85	E
23	1,500' downstream of entrance from US 25 Dixie Hwy.	1,500' upstream of exit to KY 371 Buttermilk Pike	Basic	0.189	149	72	36.3	43.4	0.85	E
24	1,500' upstream of exit to KY 371 Buttermilk Pike	Exit to KY 371 Buttermilk Pike	Off Ramp	0.284	250	135	32.2	38.2	0.85	E
25	Exit to KY 371 Buttermilk Pike	Entrance from KY 371 Buttermilk Pike	Basic	0.464	316	147	37.4	47.6	0.97	F
26	Entrance from KY 371 Buttermilk Pike	1,500' downstream from entrance from KY 371 Buttermilk Pike	On Ramp	0.284	171	489	49.0	40.6	1.13	F
27	1,500' downstream from entrance from KY 371 Buttermilk Pike	1,500' upstream of exit to I-275	Basic	0.284	178	58	47.2	43.1	1.13	F
28	1,500' upstream of exit to I-275	Exit to I-275	Off Ramp	0.284	194	74	43.2	46.2	1.13	F
29	Exit to I-275	1,500' downstream of exit to KY 236 Donaldson Rd.	Basic	0.436	163	24	59.5	35.1	1.20	F
30	1,500' downstream of exit to KY 236 Donaldson Rd.	Exit to KY 236 Donaldson Rd.	Off Ramp	0.284	107	17	59.2	33.0	1.20	F
31	Exit to KY 236 Donaldson Rd.	Exit to KY 1017 Turfway Rd.	Basic	0.445	146	19	61.0	33.0	1.15	F
			Facility	10.682	4,879	3,588	45.5	26.0	1.20	F

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C >1.00

① Average Vehicle-Hours of Travel per 15-minute interval
② Average Vehicle-Hours of Delay per 15-minute interval
③ Space Mean Speed (mph)
④ Maximum Demand Volume-to-Capacity ratio

Table 14. I-71/I-75 Study Section System-wide Performance Comparison

	SOUTHBOUND			NORTHBOUND		
A.M. Peak	Existing	2040 No Build	2040 with 6-17	Existing	2040 No Build	2040 with 6-17
Average Speed (mph)	55.9	55.9	56.1	42.4	36.6	55.4
Average Density (pc/mi/ln)	17.2	17.9	17.9	33.2	41.4	21.1
Vehicle-Miles Traveled (VMTV) per Interval*	162,045	169,695	205,906	183,627	196,404	182,803
Vehicle-Hours Delay (VHD) per Interval*	169	176	581	2,950	20,966	2,170
Max Demand-to-Capacity (D/C)	0.86	0.88	1.07	1.16	1.42	1.23
Max Volume-to-Capacity (V/C)	0.86	0.88	1.00	0.99	1.00	1.00
P.M. Peak	Existing	2040 No Build	2040 with 6-17	Existing	2040 No Build	2040 with 6-17
Average Speed (mph)	54.3	43.6	45.5	48.6	46.4	56.5
Average Density (pc/mi/ln)	23.9	35.7	26.0	32.3	34.6	18.4
Vehicle-Miles Traveled (VMTV) per Interval*	221,294	250,982	221,898	212,702	217,037	161,205
Vehicle-Hours Delay (VHD) per Interval*	251	4,516	3,588	1,213	1,780	2,758
Max D/C	0.93	1.22	1.20	1.31	1.37	1.02
Max V/C	0.93	1.00	1.00	0.99	1.00	1.00

* The A.M. (06:00 - 10:00) and P.M. (2:00 - 6:00) peaks were evaluated at 15-minute intervals. These statistics were computed as the peak period average per 15-minute interval.

In **Table 14**, the significant increase in vehicle-hours of delay (VHD) in the northbound direction for the 2040 No Build scenario underscores what can be expected if KYTC Item 6-17 is not built. For northbound traffic approaching downtown Cincinnati in the A.M. peak, the Brent Spence Bridge is a bottleneck. As traffic demand increases, resulting congestion also increases, but it does so exponentially and not proportionally. The Year 2040 A.M. Peak analysis, for which traffic forecasts were derived from the OKI RTDM, quantifies this increase. Graphically, this can be seen in **Figure 5**.

For the southbound direction, **Table 14** suggests that KYTC Item 6-17 would increase VHD during the A.M. peak. That may be true, but the increase would be as a result of consolidating the southbound exits into downtown Cincinnati into just a couple instead of having them spread out over four or five. For the study section, the A.M. VHD in the southbound direction is much less than in the northbound direction, even the increased VHD that might occur in conjunction with constructing KYTC Item 6-17.

Regarding cost, it was determined that no change should be made from the phases costs presented in the KYTC Item 6-17 Initial Financial Plan (2013). The total estimated cost for the 6-17 project is $2.3 Billion in current year dollars and $2.6 Billion in year of expenditure dollars, assuming the project would be open to traffic in 2024. With the addition of the I-275 interchange, the cost estimate rises to $3.0 Billion in year of expenditure dollars. Kentucky's share would be approximately $1.6 Billion.

EVALUATION OF ATDM STRATEGIES

As defined by the Federal Highway Administration, Active Traffic and Demand Management (ATDM) is the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities. This is accomplished through the use of available tools and assets to manage traffic flow and influence traveler behavior to achieve operational

objectives such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency.

As part of this Brent Spence Strategic Corridor Study, potential ATDM strategies were examined to identify any potential solutions that would provide incremental relief or mitigation of current congestion.

A list of commonly applied ATDM strategies and their applicability to the I-71/I-75 corridor is provided in **Table 15**.

Table 15. Potential Active Traffic and Demand Management (ATDM) Strategies

Strategy	Applicability to This Study (Item 6-431)
Roadway Metering	
Freeway On-Ramp Metering	Should be considered. ODOT has implemented along I-74.
Freeway-to-Freeway Ramp Metering	I-71/I-75/I-275 is the only freeway-to-freeway system interchange in the study area. Improving traffic operations at this location is not the focus of this study.
Freeway Mainline Metering	Not applicable
Peak Period Freeway Ramp Closures	Not applicable
Arterial Signal Metering	Not being considered at this time, as there are no interchanges with major arterials in the study corridor where this strategy may offer potential benefits.
Managed Lanes	
Reversible (Express) Lanes	Reversible, barrier-separated facility. Express lanes would run between I-275 and the Brent Spence Bridge, bypassing interchanges at Buttermilk Pike, Dixie Highway, Kyles Lane, 12th Street/Martin Luther King, and 4th/5th streets.
High-Occupancy Vehicle (HOV) Lanes	It is not believed this would have a significant impact.
Truck Lanes	There are *de facto* truck lanes in the southbound direction between Martin Luther King and Kyles Lane (i.e. on the hill). Exclusive truck lanes for the entire study section aren't feasible.
Bus Lanes	Not feasible. There is not enough bus ridership in the corridor to consider further.
Speed Harmonization	Implemented through changeable speed limit or advisory speed signs. Should be considered for 6-431, if no legal barriers.
Temporary Shoulder Use	Would be various combinations of outside shoulder and median shoulder uses. Would require full-depth shoulder reconstruction. Should be considered for 6-431
Traveler Information Systems	
ARTIMIS	System already in use. Enhancements unlikely to provide significant be
Smart Phone Apps	Already in use (KYTC partnership with WAZE)
Specialized Applications	
Incident Management	Increased freeway patrols. Primary benefits related to non-recurring congestion. KYTC already employs the Safety Assistance for Freeway Emergencies (SAFE) Patrol in this corridor.
Work Zone Management	Primary benefits related to non-recurring congestion. Not applicable.

After initial assessment, strategies identified for further evaluation included:

- On-Ramp Metering – using assumed locations where ramp meters could be deployed and using assumed metering rates.
- Temporary Shoulder Use – using the inside (left) shoulder as a general-purpose lane during peak periods, which would require reconstruction of shoulders to full-depth pavement and adequate cross-section width.
- Speed Harmonization through Variable Speed Limits/Advisory Speeds – reduction of posted speed limits during peak periods to help "dampen" or reduce shock waves when congestion-induced bottlenecks begin to grow.

The first two strategies were evaluated using the HCM Freeway Facilities method as implemented in the FREEVAL tool. Variable speed limits were evaluated using the microscopic traffic simulation model developed for the corridor, as the HCM methodology lacks the sensitivity to perform this type of evaluation. The system-wide results are summarized in **Table 16**.

Table 16. Summary of ATDM Strategy Evaluation

	SOUTHBOUND				*NORTHBOUND*			
A.M. Peak								
Performance Measure	**Existing**	**Ramp Metering**	**Temporary Shoulder Use**	**Express Lane**	**Existing**	**Ramp Metering**	**Temporary Shoulder Use**	**Express Lane**
Average Travel Time (min)	11.7	12.0	12.0	11.7	15.8	16.57	17.2	11.9
VHT (travel / interval (hrs))	2,899	2,967	2,966	2,957	4,336	4,566	4,700	2,966
VHD (delay / interval (hrs))	169	221	179	198	2,950	4,431	4,943	304
Average Speed (mph)	55.9	54.6	54.6	55.5	42.4	40.1	38.8	55.5
Reported Density (pc/mi/ln)	17.2	17.6	17.2	15.1	33.2	34.8	36.4	16.8
Max D/C	0.86	0.86	0.86	0.86	1.16	1.18	1.22	0.93
Max V/C	0.86	0.86	0.86	0.86	0.99	1.00	0.98	0.93
P.M. Peak								
Performance Measure	**Existing**	**Ramp Metering**	**Temporary Shoulder Use**	**Express Lane**	**Existing**	**Ramp Metering**	**Temporary Shoulder Use**	**Express Lane**
Average Travel Time (min)	12.1	12.1	12.1	12.2	13.9	14.29	14.2	13.7
VHT (travel / interval (hrs))	4,072	4,082	4,083	4,213	4,381	4,495	4,471	3,919
VHD (delay / interval (hrs))	251	418	262	339	1,213	1,984	1,243	916
Average Speed (mph)	54.3	54.2	54.2	53.5	48.6	47.2	47.5	49.5
Reported Density (pc/mi/ln)	23.9	24.1	23.8	20.5	32.3	33.4	32.7	22.3
Max D/C	0.93	0.93	0.97	0.90	1.31	1.31	1.31	1.34
Max V/C	0.93	0.93	0.97	0.90	0.99	1.00	1.00	0.94

The microscopic traffic simulation model of the I-71/I-75 corridor was used to test the potential effectiveness of variable speed limits (VSLs) during peak traffic periods. The principle behind VSLs is that lowering the speed limit during periods of peak flow results in more uniform speeds, especially in those areas where "shock waves" are present. A shock wave occurs when faster moving traffic catches up with slower moving traffic, resulting in a greater speed differential represented by localized "turbulence." Shock waves are not only inconvenient to drivers, they are also more likely to produce crashes associated with congestion – rear-end crashes and sideswipe crashes caused by sudden lane changes.

Three alternative scenarios were evaluated for existing A.M. and P.M. peak period traffic demand. In the first scenario, the existing 55 mph posted speed limit was used. The speed limit

was changed to 50 mph and 45 mph for the second and third scenarios. For each freeway segment, statistics were obtained for:

- Average (mean) speed
- Standard deviation of speed
- Number of observations (four-hour simulation period directional volume)

An analysis of variance (ANOVA) was performed to compare the mean speeds and their standard deviations for the three speed limit scenarios (55 mph, 50 mph, and 45 mph). An ANOVA compares the two types of variability between and within the scenarios – variability of observations about the mean within the scenario (i.e. for each speed limit scenario) and variability of the average speeds in the different scenarios about the overall average.

For this statistical evaluation of simulation model results, the null hypothesis (i.e. the hypothesis to be nullified) is the average or mean speed for the 55 mph, 50 mph, and 45 mph posted speed limit scenarios does not produce statistically different results. Mathematically, it is stated:

$$\text{Null Hypothesis } H_O: \bar{V}_{55} = \bar{V}_{50} = \bar{V}_{45}$$

where $\overline{V}_{xx}$ is the computed mean speed for the scenario.

Rejecting the null hypothesis means that the mean speeds and resulting speed variances for the different speed limit scenarios *are* statistically different; if the standard deviation is smaller when compared to the existing 55 mph posted speed limit, it can be concluded that lowering the speed limit during peak periods would produce a lower speed differential for that segment.

The ANOVA uses the F test statistic to compare the variation between the scenarios to the variation within each scenario. When the null hypothesis tends to be false, the F test statistic tends to be considerably larger than 1.0. Another important parameter is the P-value, which is the probability that the F test statistic is at least as large of the observed F value; that is, the right-hand tail probability of the normal distribution curve. The larger the F test statistic, the smaller the P-value. In this case, the mean speed for each scenario is the test statistic.

Table 17 presents the results of the ANOVA for the individual I-75 segments, based on the simulation model runs. For those segments where F is significantly greater than 1.0 and the P-value is less than 0.05 (corresponding to a 95 percent level of confidence), the null hypothesis can be rejected; that is, there is a statistically significant difference in the speed variance for 55 mph, 50 mph, and 45 mph. Also, it can be concluded that the standard deviations generally are lowest for a posted speed limit of 50 mph compared to 55 mph and 45 mph; thus, if variable speed limits were to be employed, 50 mph would provide the smallest speed variance.

Table 17. Variable Speed Limit Statistical Analysis Results

Mainline Segments: Existing AM Peak Period (06:00 - 10:00)

Model Segment ID	Model Link ID	Segment Length (Miles)	Segment Location	55 mph Volume (Total Vehicles)	55 mph Ave. Speed (mph)	55 mph Model Std. Dev.(mi/hr)^2	50 mph Volume (Total Vehicles)	50 mph Ave. Speed (mph)	50 mph Model Std. Dev.(mi/hr)^2	45 mph Volume (Total Vehicles)	45 mph Ave. Speed (mph)	45 mph Model Std. Dev.(mi/hr)^2	Statistical Analysis F	Statistical Analysis Prob. > F (P-value)
I-75 Southbound (Ohio, Harrison Avenue to Kentucky, Donaldson Road)														
411950905	411950848	0.44	OH: Harrison Ave. - Western Ave./Liberty St.	21,971	53.1	6.8	22,012	52.8	6.8	22,397	54.0	6.2	198.9900	0.0000
411950898	411950846	0.16	OH: Western Ave./Liberty St. - Ezzard Charles St.	20,798	53.3	7.5	20,854	53.4	7.3	21,198	52.6	6.8	77.1583	0.0000
411950892	411950841	0.23	OH: Ezzard Charles St. - Freeman Ave.	19,447	43.5	15.2	19,484	42.6	15.6	19,799	41.3	16.1	98.2269	0.0000
411950884	411950830	0.08	OH: Freeman Ave. - 7th St.	17,295	42.1	11.4	17,140	42.5	11.2	17,448	42.1	11.4	7.1475	0.0008
413415	411950810	0.12	OH: 7th St. - I-71 (FWW) /5th St./2nd St.	10,365	37.6	10.5	10,215	38.7	10.5	10,331	38.3	10.6	28.7876	0.0000
411950875	413416	0.62	[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	16,569	51.3	7.6	16,543	51.5	7.3	16,542	51.4	7.5	2.9679	0.0514
224011	224011	0.55	KY: 5th St./4th St. - 12th St./Pike St.	13,270	46.9	8.9	13,282	47.0	8.7	13,306	47.3	8.7	7.4945	0.0006
411950816	411950789	0.18	KY: 12th St./Pike St. - Kyles Ln.	16,118	44.4	8.8	16,071	44.4	8.7	16,140	44.3	8.7	0.7047	0.4943
224005	224005	0.30	KY: Kyles Ln. - Dixie Hwy.	16,006	52.9	7.4	15,940	53.2	7.2	16,053	53.0	7.5	6.8630	0.0010
411950801	411940817	0.35	KY: Dixie Hwy. - Buttermilk Pk.	16,487	51.5	6.9	16,527	51.8	6.8	16,535	52.0	6.6	22.8268	0.0000
411950792	223995	0.69	KY: Buttermillk Pk. - I-275	18,037	53.4	7.3	18,005	53.5	7.3	18,094	53.3	7.3	3.3870	0.0338
411950789	223989	0.28	KY: I-275 - Donaldson Rd.	11,942	55.7	6.3	11,994	55.6	6.3	12,000	55.0	6.2	43.7417	0.0000
I-75 Northbound (Kentucky, Donaldson Road to Ohio, Harrison Avenue)														
223955	223955	0.18	KY: I-275 - Donaldson Rd.	17,932	50.7	10.2	17,916	51.5	9.7	17,888	50.9	10.3	30.6304	0.0000
411950967	223962	0.57	KY: Buttermillk Pk. - I-275	15,806	55.2	7.1	15,607	55.3	6.9	15,543	55.3	6.8	1.0900	0.3362
411950800	223967	0.33	KY: Dixie Hwy. - Buttermilk Pk.	14,395	52.9	5.7	14,269	52.9	5.8	14,134	53.2	5.8	12.8102	0.0000
223973	223973	0.36	KY: Kyles Ln. - Dixie Hwy.	16,111	54.2	5.9	15,807	54.3	5.8	15,756	54.3	5.9	1.5494	0.2124
411950815	411940831	1.11	KY: 12th St./Pike St. - Kyles Ln.	18,498	46.9	7.4	18,237	48.1	4.9	18,216	48.5	4.8	374.6424	0.0000
223978	223978	0.44	KY: 5th St./4th St. - 12th St./Pike St.	15,705	26.2	17.5	15,426	35.1	17.4	15,462	30.2	18.1	990.0602	0.0000
402467	223982	0.53	[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	22,399	48.6	8.4	22,184	48.7	8.4	22,205	48.4	8.5	7.2838	0.0007
411950872	411950819	0.11	OH: 7th St. - I-71 (FWW) /5th St./2nd St.	10,482	53.0	6.4	10,265	53.0	6.3	10,270	53.3	6.2	7.7856	0.0004
411950873	411950821	0.60	OH: Freeman Ave. - 7th St.	8,887	55.8	5.9	8,659	55.6	5.9	8,657	55.7	5.7	2.5767	0.0760
411950893	411950838	0.20	OH: Ezzard Charles St. - Freeman Ave.	14,315	56.9	6.7	14,123	56.8	6.3	14,113	56.7	5.9	3.5694	0.0282
411950901	411950844	0.04	OH: Western Ave./Liberty St. - Ezzard Charles St.	16,292	56.3	6.8	16,206	56.6	7.2	16,197	56.5	7.1	7.6646	0.0005
411950911	411950844	0.63	OH: Harrison Ave. - Western Ave./Liberty St.	16,264	55.5	6.3	16,172	55.4	6.1	16,162	55.4	6.0	1.4375	0.2375

Mainline Segments: Existing PM Peak Period (14:00 - 18:00)

Model Segment ID	Model Link ID	Segment Length (Miles)	Segment Location	55 mph Volume (Total Vehicles)	55 mph Ave. Speed (mph)	55 mph Model Std. Dev.(mi/hr)^2	50 mph Volume (Total Vehicles)	50 mph Ave. Speed (mph)	50 mph Model Std. Dev.(mi/hr)^2	45 mph Volume (Total Vehicles)	45 mph Ave. Speed (mph)	45 mph Model Std. Dev.(mi/hr)^2	Statistical Analysis F	Statistical Analysis Prob. > F (P-value)
I-75 Southbound (Ohio, Harrison Avenue to Kentucky, Donaldson Road)														
411950905	411950848	0.44	OH: Harrison Ave. - Western Ave./Liberty St.	18,558	54.6	6.5	18,624	54.3	6.7	18,494	55.5	5.8	178.0956	0.0000
411950898	411950846	0.16	OH: Western Ave./Liberty St. - Ezzard Charles St.	17,847	55.0	7.3	17,914	54.5	7.3	17,851	54.0	6.8	87.5937	0.0000
411950892	411950841	0.23	OH: Ezzard Charles St. - Freeman Ave.	16,407	53.4	6.5	16,464	53.3	6.6	16,496	53.4	6.7	1.2593	0.2839
411950884	411950830	0.08	OH: Freeman Ave. - 7th St.	16,943	48.1	8.2	16,970	48.2	8.2	16,981	48.2	8.4	0.8268	0.4374
413415	411950810	0.12	OH: 7th St. - I-71 (FWW) /5th St./2nd St.	12,062	30.7	10.1	12,151	33.1	10.2	11,977	32.9	9.6	215.2680	0.0000
411950875	413416	0.62	[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	23,976	49.2	7.2	23,937	49.2	7.0	23,876	49.3	7.0	0.0944	0.9099
224011	224011	0.55	KY: 5th St./4th St. - 12th St./Pike St.	19,905	42.1	7.8	19,833	42.4	7.9	19,835	42.8	7.8	39.9298	0.0000
411950816	411950789	0.18	KY: 12th St./Pike St. - Kyles Ln.	24,664	37.2	6.9	24,493	38.2	6.7	24,510	38.5	6.9	244.1031	0.0000
224005	224005	0.30	KY: Kyles Ln. - Dixie Hwy.	24,069	50.6	7.2	24,021	50.6	7.0	23,803	50.9	6.8	14.6113	0.0000
411950801	411940817	0.35	KY: Dixie Hwy. - Buttermilk Pk.	23,793	49.0	6.3	23,507	49.4	6.4	23,353	49.5	6.4	40.8362	0.0000
411950792	223995	0.69	KY: Buttermillk Pk. - I-275	25,338	45.5	9.7	24,909	47.9	8.7	24,827	47.9	8.5	598.5994	0.0000
411950789	223989	0.28	KY: I-275 - Donaldson Rd.	18,270	53.2	5.2	17,998	53.2	5.2	18,039	53.2	5.0	0.0000	1.0000
I-75 Northbound (Kentucky, Donaldson Road to Ohio, Harrison Avenue)														
223955	223955	0.18	KY: I-275 - Donaldson Rd.	21,210	27.5	16.3	20,887	33.2	16.4	21,386	28.3	15.4	778.2200	0.0000
411950967	223962	0.57	KY: Buttermillk Pk. - I-275	16,914	54.9	6.6	16,765	55.1	6.7	17,180	55.0	6.5	3.8661	0.0209
411950800	223967	0.33	KY: Dixie Hwy. - Buttermilk Pk.	16,059	52.0	5.8	15,984	52.4	5.8	16,331	52.3	5.4	21.6466	0.0000
223973	223973	0.36	KY: Kyles Ln. - Dixie Hwy.	17,141	53.9	6.1	17,006	54.6	5.8	17,315	54.3	5.7	61.1645	0.0000
411950815	411940831	1.11	KY: 12th St./Pike St. - Kyles Ln.	17,288	48.2	5.2	17,127	48.6	5.3	17,428	48.6	5.2	33.6599	0.0000
223978	223978	0.44	KY: 5th St./4th St. - 12th St./Pike St.	13,472	50.7	6.4	13,340	50.9	6.3	13,695	51.1	6.1	13.8340	0.0000
402467	223982	0.53	[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	18,395	52.1	6.2	18,259	52.4	6.0	18,661	52.3	6.2	11.3766	0.0000
411950872	411950819	0.11	OH: 7th St. - I-71 (FWW) /5th St./2nd St.	10,518	52.3	6.7	10,413	52.6	7.1	10,610	52.2	6.4	10.1964	0.0000
411950873	411950821	0.60	OH: Freeman Ave. - 7th St.	8,629	55.1	6.2	8,561	55.3	6.5	8,755	55.1	6.1	2.9205	0.0539
411950893	411950838	0.20	OH: Ezzard Charles St. - Freeman Ave.	19,450	54.5	6.7	19,481	54.3	6.6	19,637	53.6	7.2	93.4370	0.0000
411950901	411950844	0.04	OH: Western Ave./Liberty St. - Ezzard Charles St.	22,583	52.4	8.1	22,465	52.6	7.5	22,667	53.0	7.5	35.5750	0.0000
411950911	411950844	0.63	OH: Harrison Ave. - Western Ave./Liberty St.	22,540	52.8	6.0	22,457	53.2	6.0	22,638	53.2	5.8	34.1455	0.0000

Note: F-statistic and p-value numbers shown in red suggest rejection of the Null Hypothesis that the mean speeds are equal; i.e. the reduction is speed variance is likely due to the lower speed limit.

I-71/I-75 FURTHER ANALYSIS AND FUTURE CAPACITY NEEDS

The project team studied additional infrastructure improvements that could be considered in the short-term, including each interchange from I-275 in Boone County to the Western Hills Viaduct in Cincinnati. Such items to be considered were:

- Increasing storage on exit ramps to reduce queue spillback onto I-71/I-75;
- Lengthening entrance ramps to increase transition space and weaving opportunities on mainline I-71/I-75;
- Implementing access management along cross-streets to improve capacity at service interchanges;
- Reconfiguring interchanges to improve capacity;
- Reducing shoulder widths to accommodate additional through-lanes on I-71/I-75; and
- Closing, reconfiguring, or relocating ramps.

The simulation models developed for this study were used to evaluate potential improvements on the Kentucky side of the Ohio River. Improvements worthy of consideration include:

1. Adding a second left-turn lane on westbound Buttermilk Pike to southbound I-71/I-75, which will reduce queuing on Buttermilk Pike across the I-71/I-75 bridge (see **Figure 9**);

2. Providing an additional southbound lane (making a total of five) from Dixie Highway to Buttermilk Pike (see **Figure 10**);

3. Optimizing signal timing of ramp junction intersections at Buttermilk Pike (A.M. and P.M.) and Kyles Lane (P.M.).

Adding an additional southbound lane from Dixie Highway to Buttermilk Pike would provide a modest short-term improvement to peak period traffic flow, as indicated in **Table 18**.

Table 18. Added Lane Improvement - Southbound I-71/I-75

	A.M. Peak Period			P.M. Peak Period		
Model Scenario	Average Speed (mph)	Average Density (pc/hr/ln)	Level of Service	Average Speed (mph)	Average Density (pc/hr/ln)	Level of Service
Existing	52	26	D	49	38	E
Add SB Lane	53	22	C	50	32	D

Note: Average speed and density performance measures obtained from traffic simulation model.

On the north side of the Ohio River, no short-term or interim improvement projects were identified. Given the complexity of the existing freeway system and the improvements developed as part of KYTC Item 6-17, it was determined that no feasible interim improvement opportunities existed.

Figure 9. Left Turn Lane Backups from Buttermilk Pike to Southbound I-71/I-75

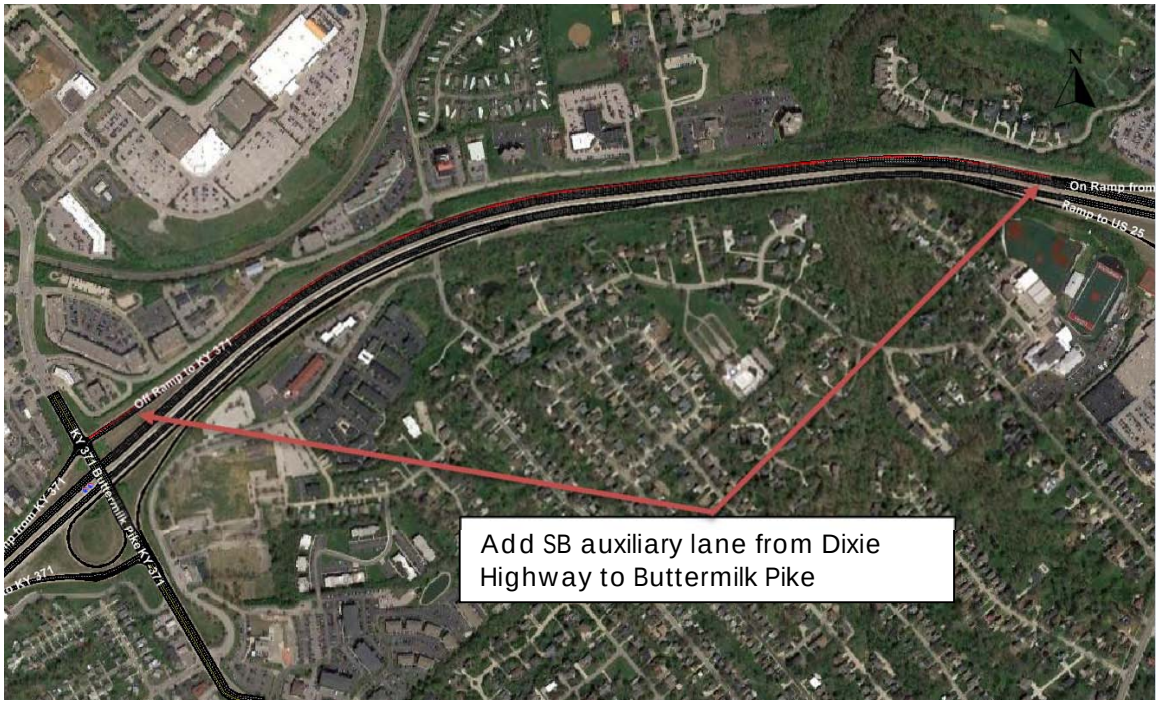


Figure 10. Add Southbound Auxiliary Lane

Two locations were selected by the project team for intensive study. Those were the I-275 interchange and relocation of the 4th Street entrance ramp to the Brent Spence Bridge in Covington.

I-275 Interchange

Improvement to the I-275 interchange with I-71/I-75 has been identified as a high priority within the SHIFT (Strategic Highway Investment Formula for Tomorrow) program of the Kentucky Transportation Cabinet. Additionally, the HCM Freeway Facilities analysis discussed previously identified this location as a major source of congestion and would need to be improved along with KYTC Item 6-17 to ensure LOS of D or greater throughout the corridor. The project team developed a concept to improve current and projected future congestion at the I-275 interchange.

Operational issues affecting the I-275 interchange are primarily related to the merge and diverge movements for the exit and entrance ramps south of I-275. As shown in **Figure 11**, the merge distance for the eastbound I-275 to southbound I-75 ramp is very short (actual distance is difficult to estimate based on pavement markings), which affects operations on the I-275 exit ramp as well as the collector-distributor (C-D) between I-275 and Donaldson Pike. In the northbound direction, traffic entering from Donaldson Pike and wishing to travel westbound on I-275 must weave across the I-75 exit ramp in less than 1,100 feet.

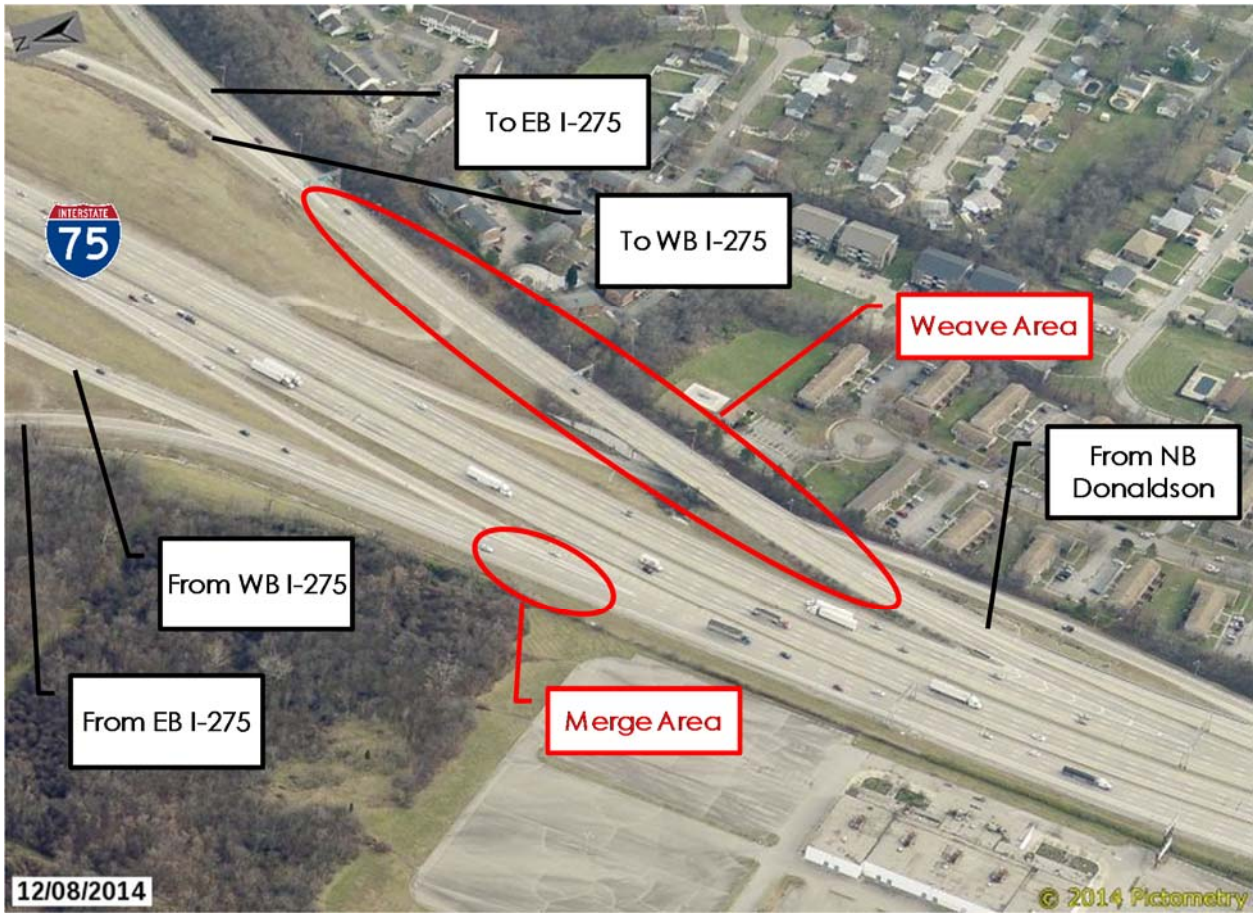


Figure 11. I-71/I-75 South of I-275

The project team considered more modest "spot" improvements that could address locations such as those outlined in **Figure 11**. However, as a long-term solution to improve mobility in the I-75 corridor, a more robust solution was developed. **Figures 12** through **14** show the limits of a

proposed C-D system that would extend the improvements from KYTC Item 6-17 south of Dixie Highway to south of Turfway Road. **Figure 12** shows the southern section of this project from Turfway Road to Donaldson Road. The middle section, from Turfway Road through the I-275 interchange to Buttermilk Pike, is shown in **Figure 13**. The northern segment from Buttermilk Pike to Kyles Lane is shown in **Figure 14**. A two-lane C-D system with auxiliary lanes where appropriate would separate local and I-275 traffic from mainline I-75 traffic, thereby increasing efficiency and improving safety. The proposed improvement is scalable and could be partially constructed in segments as funding allows. The total cost of these improvements is estimated at $289.2 Million in current year dollars.

Relocation of the 4th Street Ramp, Covington

This improvement has been discussed for several years. In KYTC Item 6-17, the ramp is included as it currently exists, but the flow remains on the existing bridge and does not directly merge into I-75 traffic. It creates a problem now because the ramp volumes in the peak hours are over 1,000 vehicles per hour. The vehicles enter the traffic stream on the upstream side of the Brent Spence Bridge. For those drivers wanting to proceed north on I-75, a short, highly congested weave is required to move over to the lanes accessing I-75. Relocation of these vehicles to Pike Street, which would allow a longer weave, is the philosophy behind the improvement. This project and related improvements were also recommended for study by the Citizens for the Cincy Eastern Bypass (CCEB).

The project team evaluated the relocation of this ramp to Pike Street and reached the following conclusions:

- The OKI Regional Travel Demand Model shows a 15-20 percent increase in traffic at the Pike Street on-ramp with the ramp at 4th street closed.
- The conclusion is that most of the traffic now using 4th Street will divert to other crossings such as Clay Wade Bailey, Roebling, or Taylor-Southgate, rather than drive to Pike Street.
- It will be necessary to provide a 'free-flow' movement from southbound to northbound at Pike Street for traffic to avoid going through the signals at Pike Street (for which this concept is illustrated in **Figure 15**).

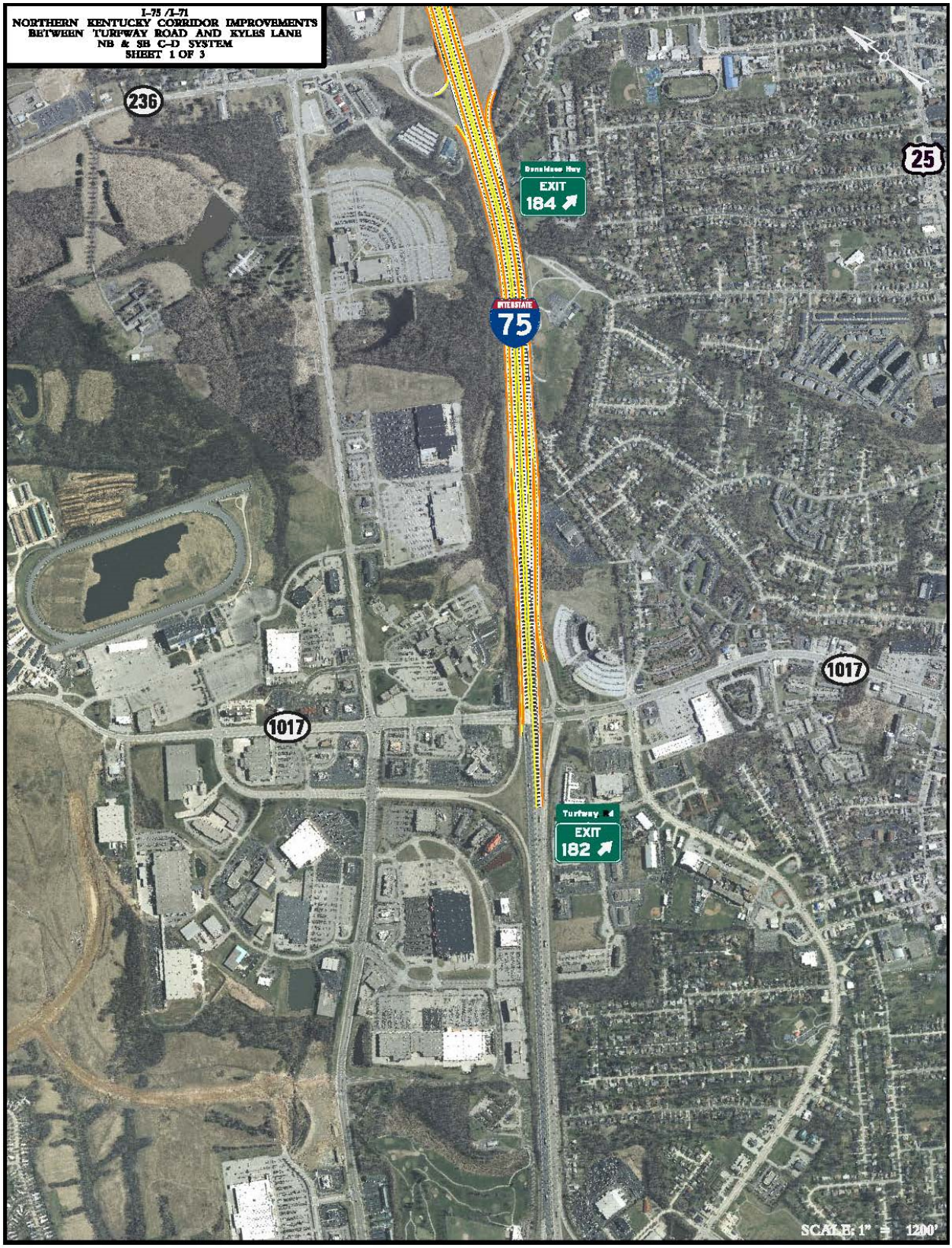


Figure 12. I-71/I-75 Collector-Distributor System – Turfway Road to Donaldson Road

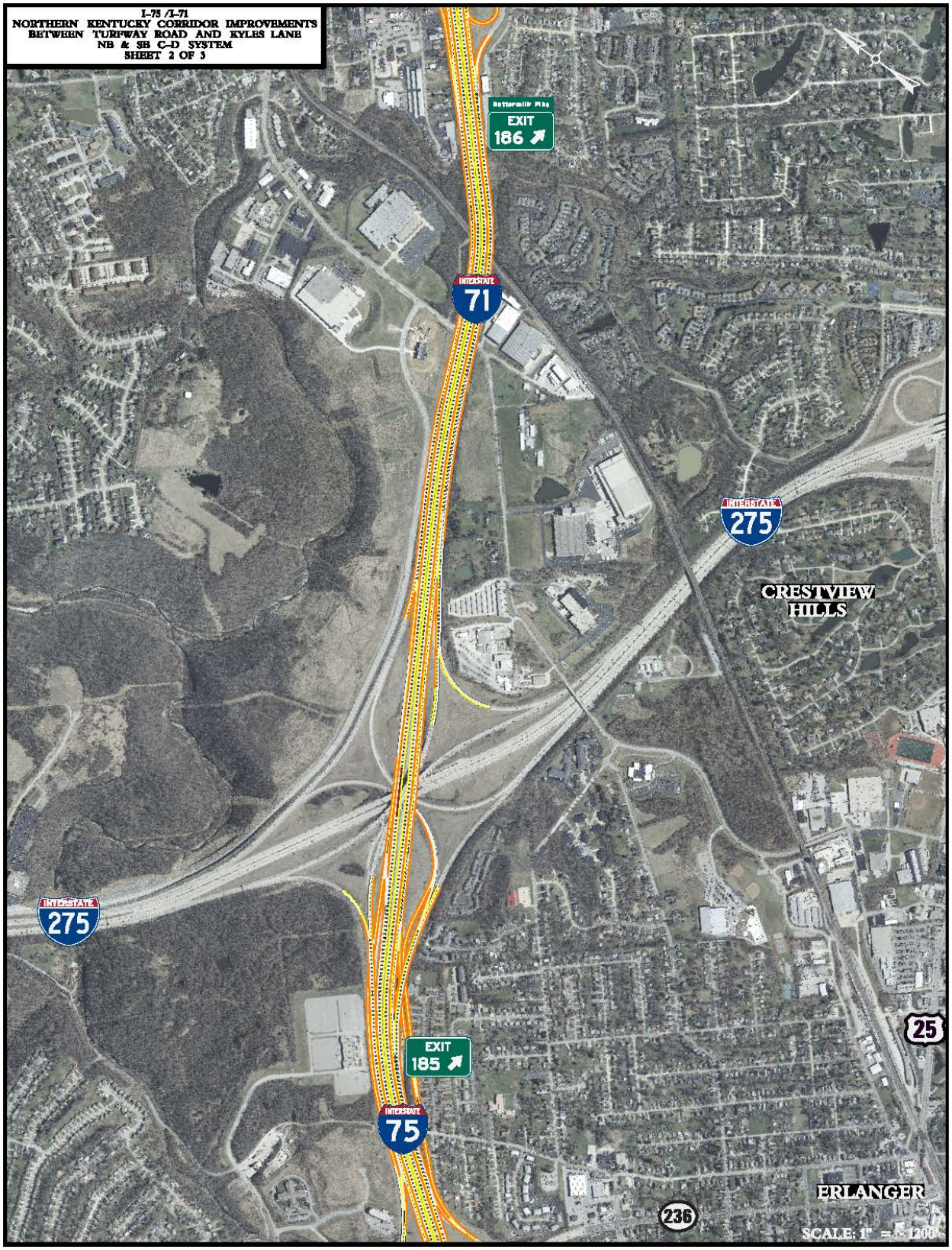


Figure 13. I-71/I-75 Collector-Distributor System – Donaldson Road to Buttermilk Pike

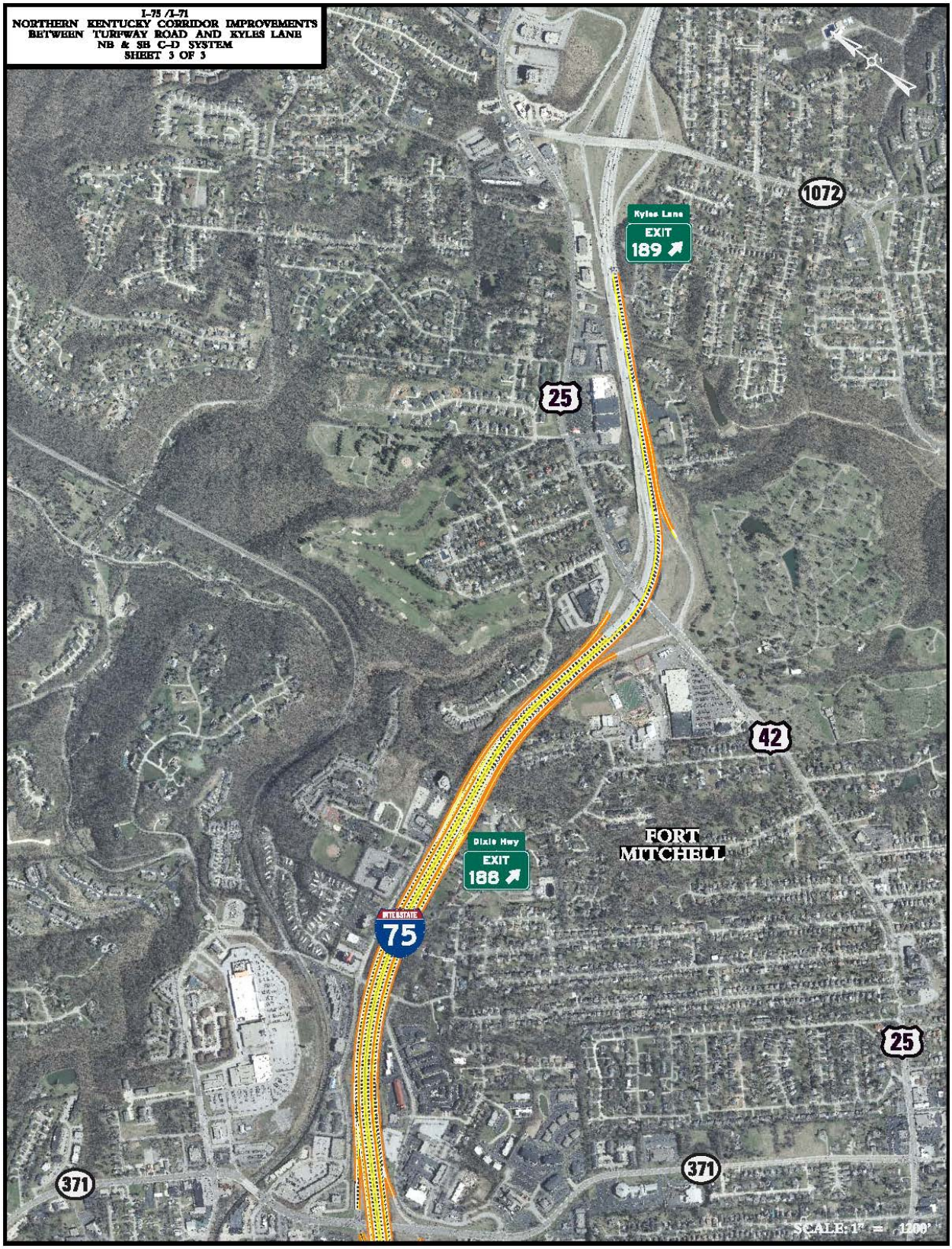


Figure 14. I-71/I-75 Collector-Distributor System – Buttermilk Pike to Kyles Lane

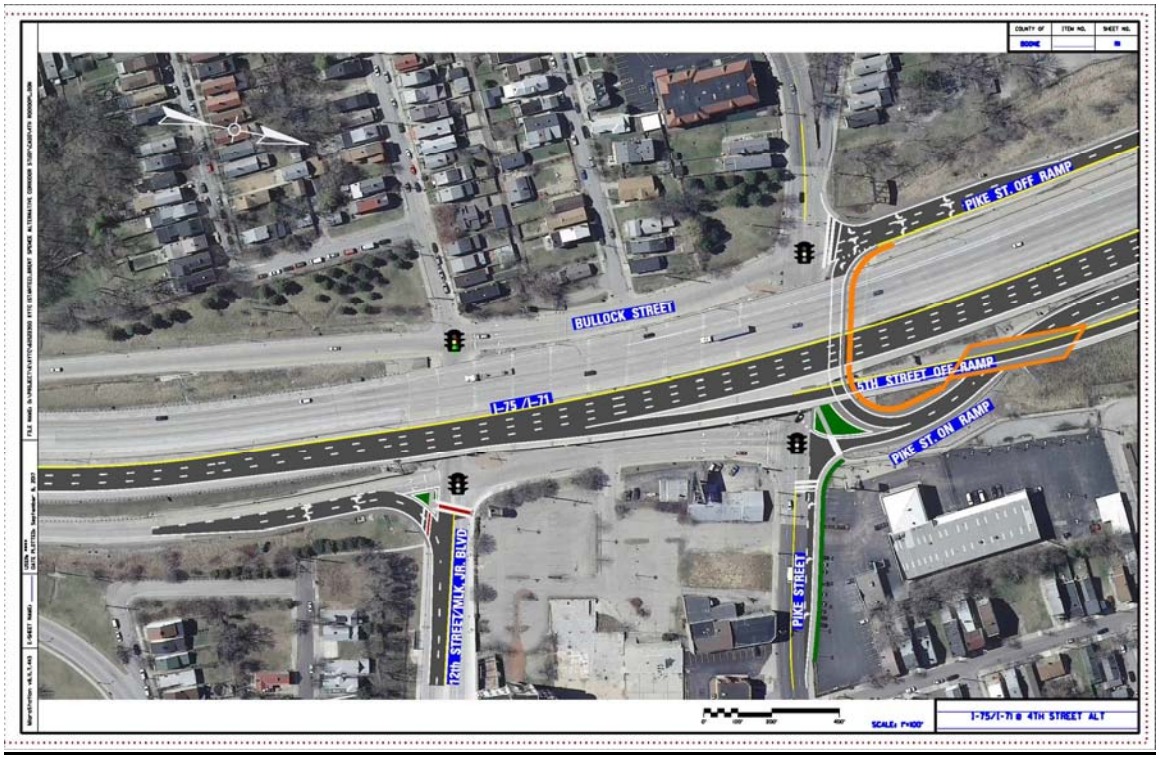


Figure 15. Relocation of I-71/I-75 Northbound Entrance Ramp from 4th Street

Relocation of the 4th Street entrance ramp would require the following improvements:

- 12th Street/MLK, Jr. Boulevard
  - Install new traffic signals
  - Add a right turn lane on the northbound off ramp
- Pike Street
  - Add right turn lane westbound on Pike Street
  - Add right turn lane southbound on Bullock at Pike Street
- Northbound Entrance Ramp
  - Widen and reconstruct the 5th Street overpass
- I-71/I-75 Mainline
  - Evaluate the best location for ramp, i.e., between piers and north abutment or south of the piers

If the 4th Street ramp is relocated to Pike Street, the mainline corridor could be restriped to accommodate four lanes from there to the bridge by utilizing existing shoulder and constricting lane width. This is illustrated in **Figure 16**.

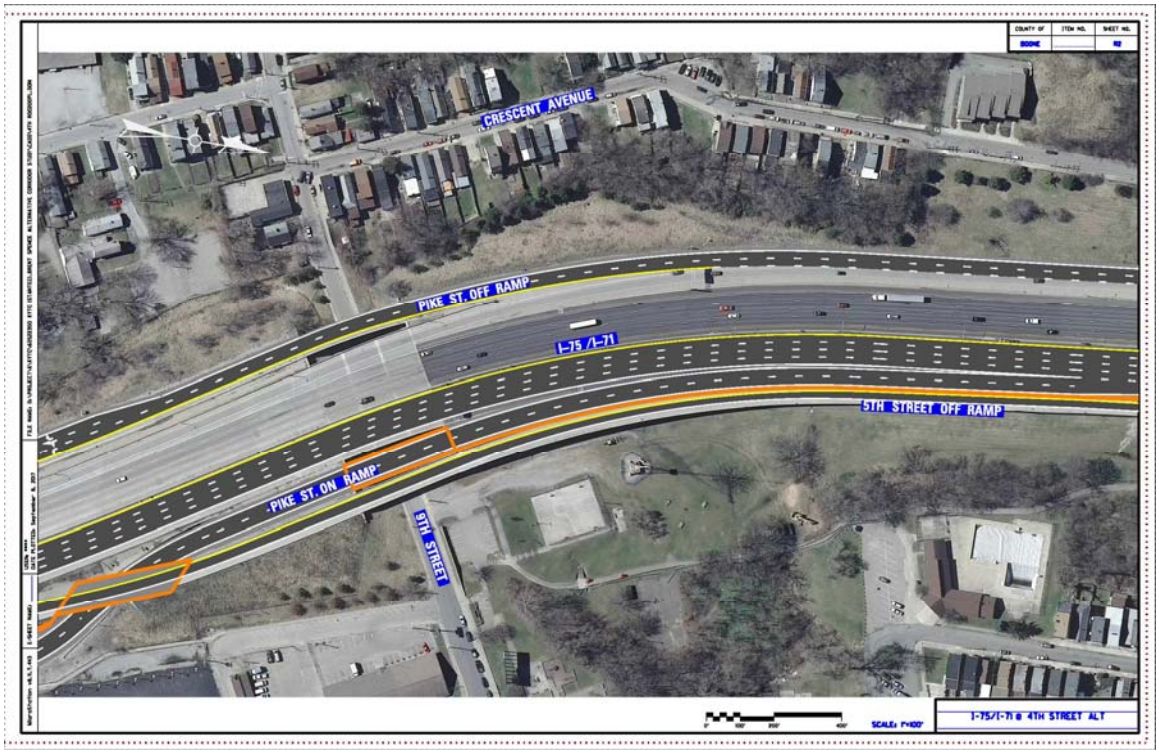


Figure 16. I-71/I-75 Northbound Restriping

It may be necessary to widen the structure over 9th Street if the Pike Street entrance ramp requires two lanes. **Figure 17** illustrates the removal and relocation of the existing 4th Street northbound entrance ramp. The restriping of the main line to four lanes is also shown.

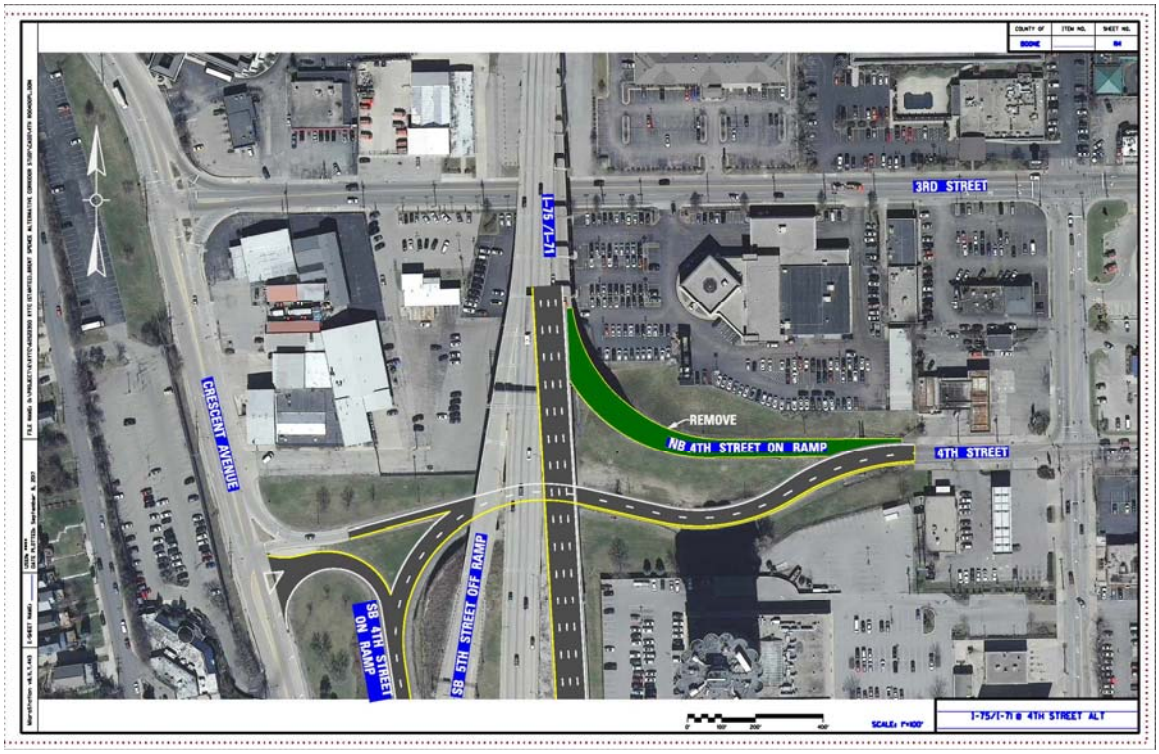


Figure 17. Removal of Fourth Street Entrance Ramp

In summary, the relocation of this northbound entrance ramp at 4th Street could provide some congestion relief in the A.M. Peak at a relatively low cost, somewhat due to traffic diverting to other local bridges. The other improvements to be anticipated include:

- Routing of traffic allows for dedicated through lane across the Brent Spence bridge
- Eliminating the merge at the Brent Spence bridge would reduce crashes
- Relieves congestion by relocating merge and weaving maneuvers
- Enhances connectivity while using existing mainline infrastructure
- Reduces conflicts and improves driver expectancy before the decisions points prior to and after the Brent Spence Bridge
- Improves level of service by adding capacity, shortening travel times, and reducing queuing
- May Increase travel speeds

This interim improvement warrants additional consideration.

CCEB RECOMMENDATIONS

The project team performed a preliminary look at recommendations from the Citizens for Cincy Eastern Bypass, as outlined here:

Recommendation: Create a Northern Kentucky I-71/I-75 Master Plan.

This plan would perform a 50-year economic growth value and transportation value analysis of the 19-mile corridor from the I-71/I-75 split through the Brent Spence Bridge. The objective would be to determine the Commonwealth's highest net present value solution to maintain a high level of transportation service and the potential for economic growth throughout the corridor. Essentially, the plan would evaluate two alternatives, one of which is the 6-17 project for the full 19 miles of the corridor and the Cincy Eastern Bypass with associated 'improvements' along the corridor and elsewhere in the vicinity.

Comments: The project team chose 2040 as the horizon year for the 6-431 study due to available tools and data. An economic analysis was performed to forecast additional traffic to the bypass options due to induced development.

The Master Plan recommendation included two alternatives. A description and comments for each element is as follows:

Alternative #1 of the Master Plan

This alternative was to evaluate the existing 6-17 project plus the additional length of corridor from the end of 6-17 to include the I-71/I-75 interchange in Kenton County. The objective was to evaluate necessary 'other improvements' to maintain 50 years of high level transportation service.

Comments: The team evaluated this corridor for several scenarios to include:

- Current year
- 2040 No Build

- 2040 with 6-17
- 2040 No Build with the Concept 1(CEB)
- 2040 No Build with Concept 3

All scenarios above were evaluated using a 2040 horizon year for the forecasts. 'Other improvements' south of the I-275 interchange included mainline reconstruction ending at Turfway Road. This reconstruction was a part of the evaluation of improving the I-275 interchange. South of Turfway Road, additional lanes were studied to provide an acceptable level of service. It was determined that the additional lanes could be postponed for the near future.

Alternative #2 of the Master Plan

There are several parts to this alternative.

a. Construct the Cincy Eastern Bypass (CEB)

Comments: The CEB was evaluated in-depth by building a digital model of the alignment provided by the CCEB and producing cost estimates based on calculated quantities and regional unit bid prices. Traffic projections and diversion from the I-71/I-75 corridor were studied. Detailed results are shown elsewhere in this report under Level 2 evaluation.

b. Make improvements to traffic flow and safety on the BSB and entrances and exits to the BSB as follows:

   1. Close and re-route the 4th Street on-ramp NB to I-71/I-75

      Comment: This was studied in detail as shown earlier in this section of the report.

   2. Add a dedicated new lane parallel to Pike Street under the I-75 bridge over Pike Street moving the 4th Street northbound traffic onto the Pike Street northbound on-ramp

      Comment: This was studied in detail as shown earlier in this section of the report.

   3. Restripe I-71/I-75 from three lanes to four between Pike Street and the Brent Spence Bridge

      Comment: This could be done if items 1 and 2 are accomplished.

   4. Add a southbound 4th Street exit ramp to Covington on the east side of the Brent Spence Bridge

      Comments: This appears unconstructible due to geometric issues. The ramp would be a left-hand exit from the upper deck of the Brent Spence Bridge. The concept in the sketches that were provided show the new ramp using the old on-ramp location. This would require the new ramp to be built on structure to ground level at a very steep grade. In addition, 4th Street is one-way westbound at this location and would require reconstruction to accommodate two-way traffic for that block.

Recommendation: Widen I-75 northbound from two lanes to three lanes between 5th Street in Cincinnati and the Fort Washington Way northbound merger with I-75.

Comments: This concept would require the following construction activities:

a. Widen I-75/I-71 northbound from 2 lanes to 3 lanes.
b. Re stripe 2nd street off ramp to accommodate extra lane
c. Optimize 5th street/Central Avenue signal
d. Re striping from 2nd Street to northbound 6th street off ramp

There are some improvements that can be realized from this concept, but also some serious issues, as listed below:

Improvements	Issues
Improved travel times	Decreased lane widths
Improved flow	Decreased shoulder widths
Reduced delay	Driver expectancy/behavior/comfort
Reduced congestion	Potential horizontal and vertical clearance issues
Increased travel speed	Utility Impacts
Increased capacity	Maintenance of traffic during construction
Improved segment level of service	
Reduced peak period queues	

During evaluation, the project limits of the addition of the extra lanes were expanded. In **Figure 18**, the widening is shown occurring at the I-71/I-75/Fort Washington Way split, rather than at 5th Street as proposed by the CCEB. The project team also looked at extending the widening to the Western Hills Viaduct. **Figure 19** illustrates that the section from 5th to 7th streets can be done without alteration of overpasses.

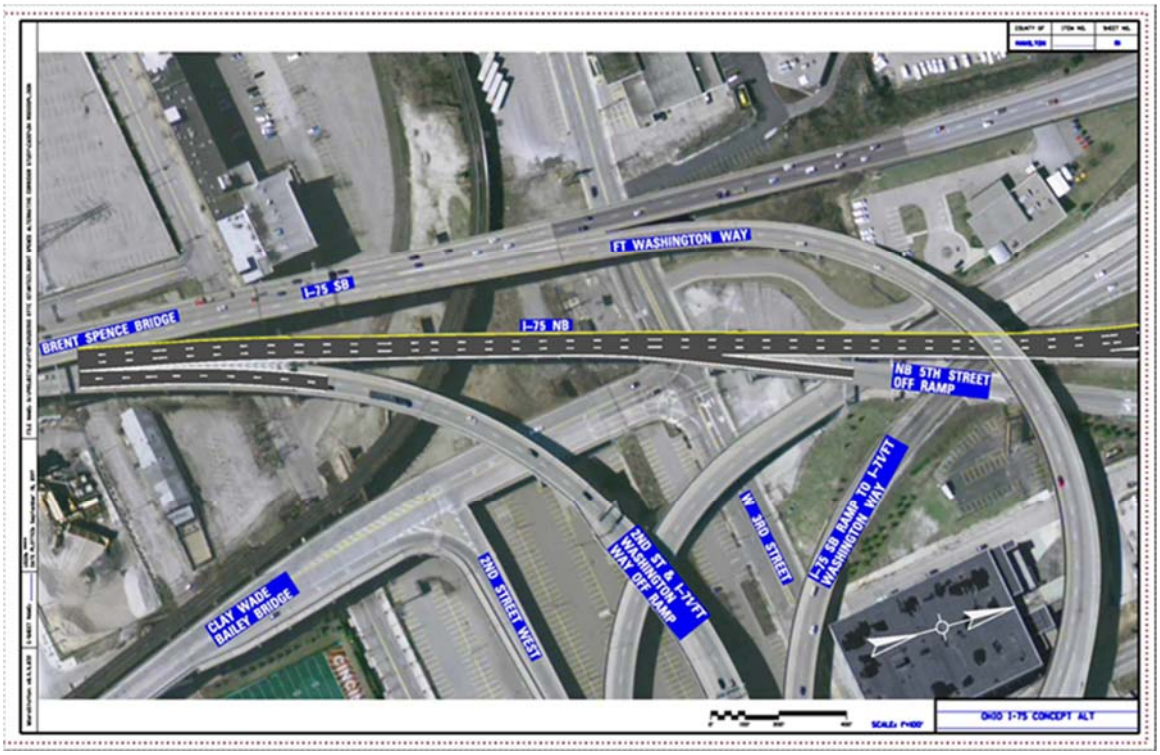


Figure 18. I-75 Northbound Widening at Fort Washington Way

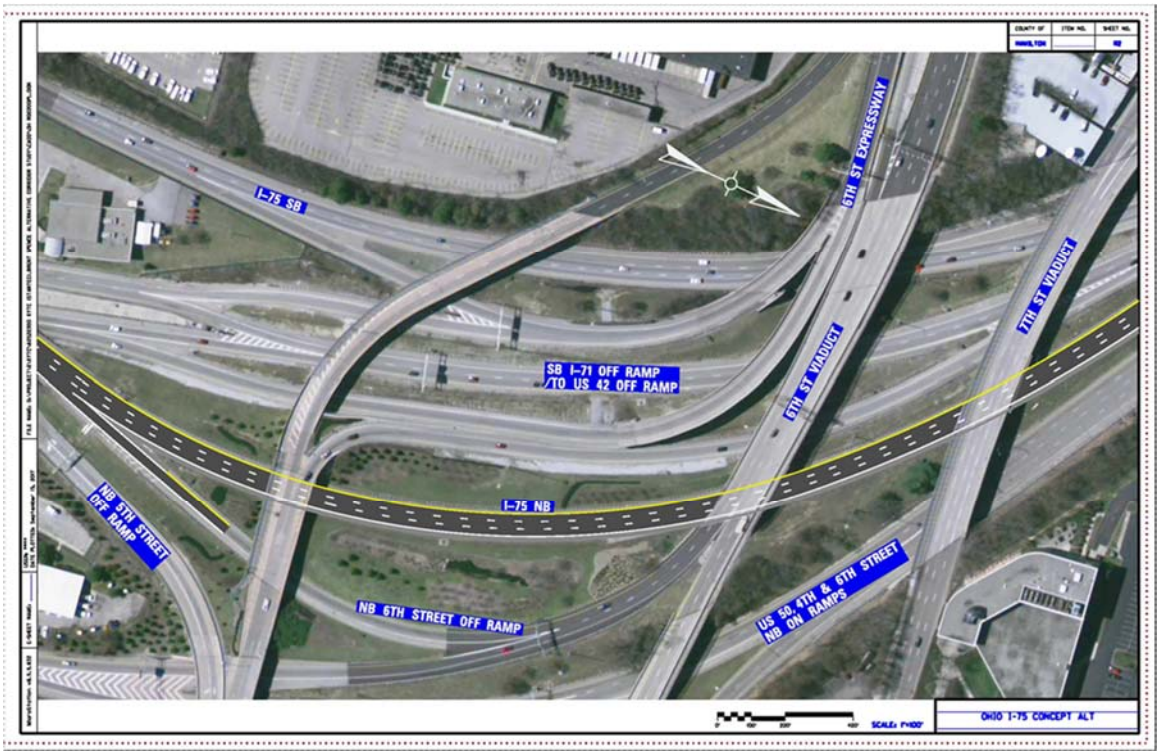


Figure 19. Northbound I-75 Widening between 5th Street and 7th Street

Continuing northbound, the impacts become more evident. **Figure 20** illustrates the reconstruction of the 8th Street viaduct that would have to happen due to horizontal clearance issues on I-75. **Figure 21** illustrates the required reconstruction of the Linn Street and Freeman

Avenue overpasses due to inadequate horizontal clearances on I-75 to accommodate the extra lane. Two existing on-ramps are shown as being eliminated but this would require further study and coordination.

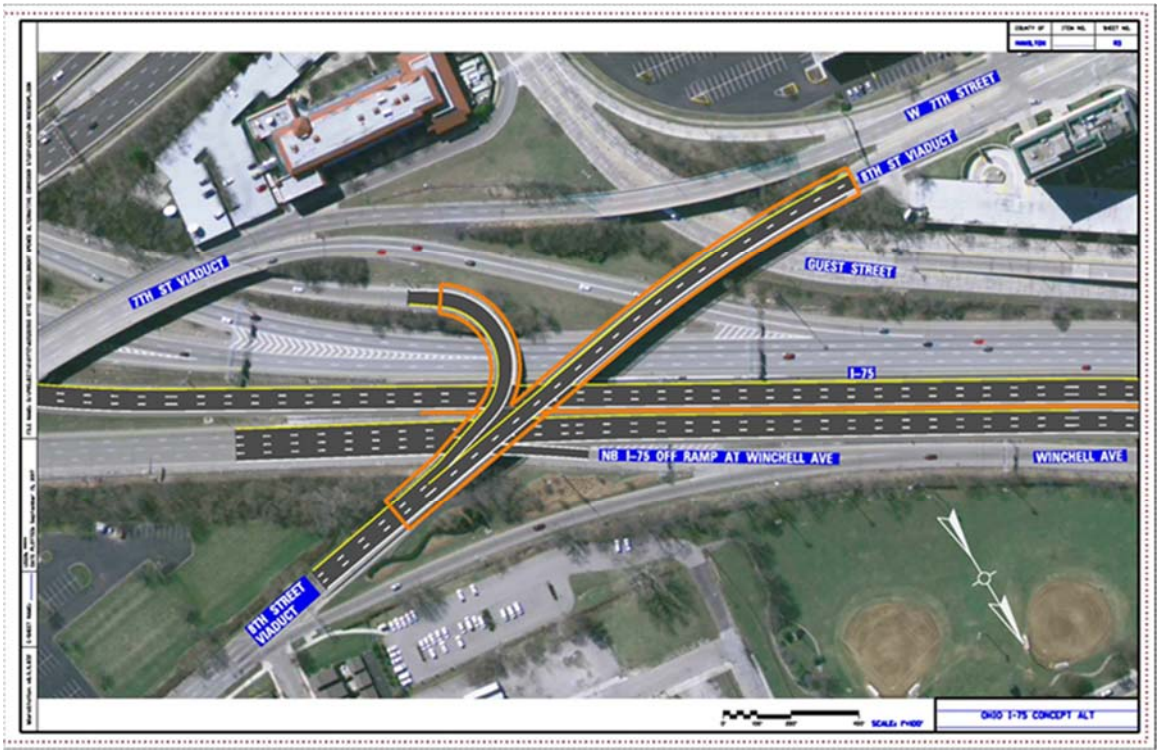


Figure 20. 8th Street Viaduct Reconstruction

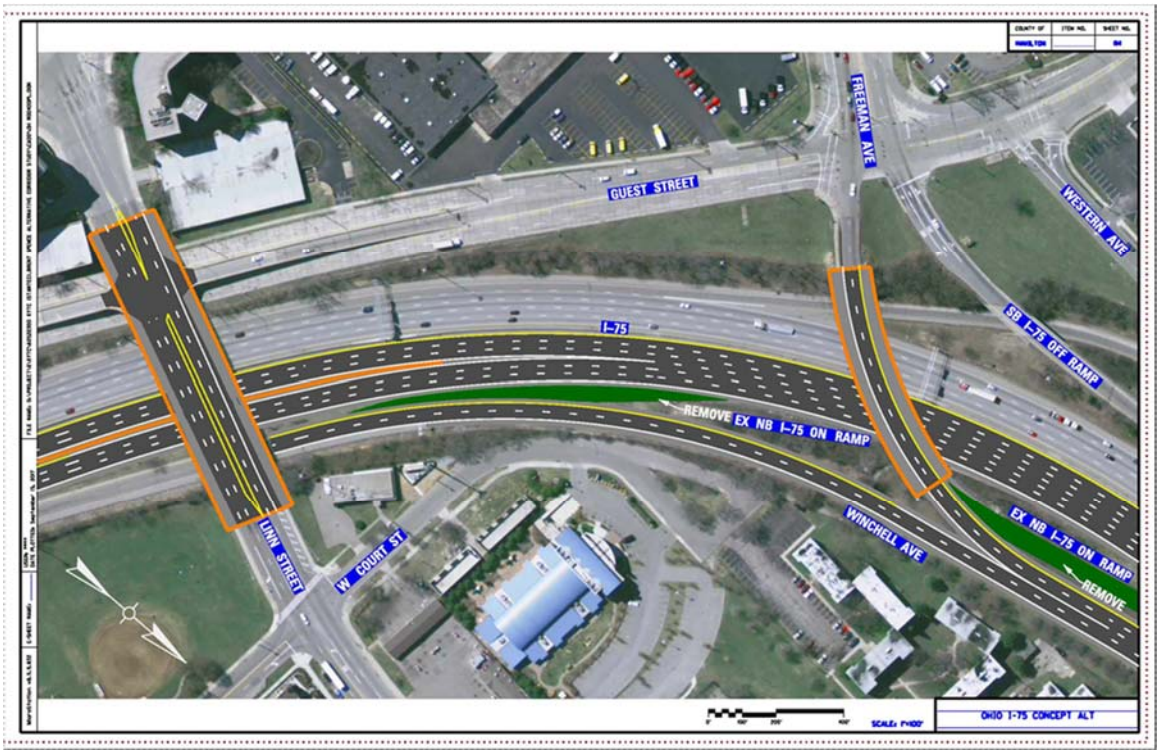


Figure 21. Reconstruction of Linn Street and Freeman Overpass Structures

Considering that this recommendation would require considerable reconstruction to widen the mainline and overpass structures, the project team compared it to the reconstruction planned in KYTC Item 6-17 with the thought that this might be an interim step. As can be seen in **Figure 22** below, this work would NOT be an interim construction step for KYTC Item 6-17.

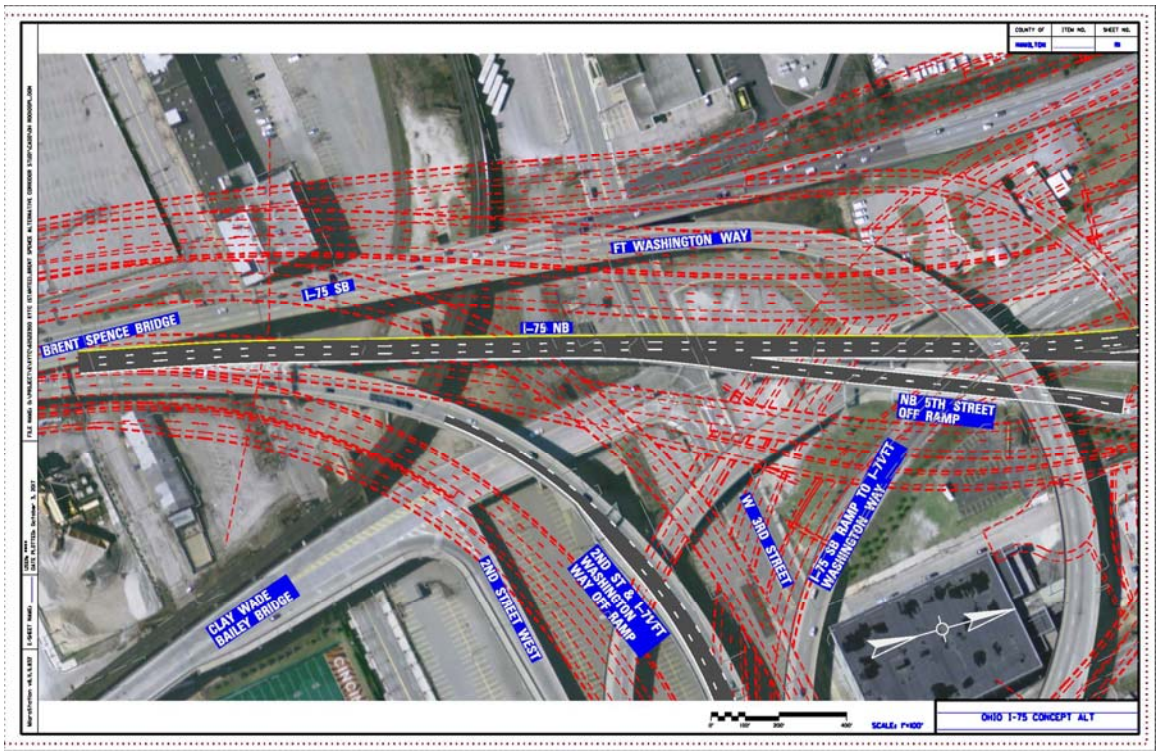


Figure 22. Comparison of I-75 Widening and KYTC Item 6-17 Improvements

In summary:

- The addition of the extra lane cannot be done as an interim step to KYTC Item 6-17.
- The work would be extremely expensive ($30 million - $50 million) as it would require the following changes:

    1. 8th Street Viaduct bridges would need to be reconstructed to allow for width of extra lanes and shoulders.
    2. Add one lane on I-75 northbound
    3. Reconstruct the Linn Street Bridge
    4. Remove I-75 northbound on-ramp just north of Linn Street
    5. Reconstruct the Freeman Avenue overpass to Winchell Avenue
    6. Remove the I-75 northbound on-ramp just north of Freeman Avenue
    7. Add one lane to the northbound on-ramp just north of Ezzard Charles Drive

Recommendation: Substantially improve lighting and signage leading to and on the Brent Spence Bridge.

Comment: While significant congestion relief would not be expected from these improvements, improved lighting and signage always warrant consideration.

Recommendation: Improve utilization of other downtown Ohio River Bridges, thus reducing traffic on the Brent Spence Bridge.

Comment: There are multiple components associated with this recommendation and would require a separate study to evaluate. Given that I-471 is also over capacity, this is not expected to make a significant difference to conditions at and around the Brent Spence Bridge.

Recommendation: Improve northbound I-71/I-75 traffic flow from Kyles Lane to 12th Street by adding a fourth lane. Use right shoulder as an exit lane in A.M. peak.

Comment: This recommendation was tested using the traffic simulation model that was developed for the study. For existing traffic conditions, adding a lane would change the A.M. peak period level of service from LOS E to LOS D and average speed would increase from 47 mph to 49 mph. However, because of projected traffic growth, there would be virtually no difference in year 2040 A.M. peak speeds and levels of service.

Recommendation: Restripe the I-71/I-75 corridor NB from Pike Street to the Brent Spence Bridge.

Comment: Restriping is feasible if the 4th Street ramp is relocated to Pike Street. See previous comments in the section entitled "4th Street Ramp Relocation."

Recommendation: Using 10-year intervals of the 50-year planning cycle, determine if, when, and what kind of additional improvements will be necessary to maintain an adequate level of transportation service along the 19-mile corridor of I-71/I-75.

Comments: The project team chose 2040 as the horizon year for the 6-431 study due to available tools and data. Using the current planning tools with the Forecast Year 2040, multiple scenarios were examined to include the No Build on the corridor with Concept 1 and Concept 3 bypass scenarios, No Build, and No Build with a potential 20 percent reduction in traffic from an unknown solution. The only scenario that significantly reduces congestion in the horizon year is to construct KYTC Item 6-17 along with reconstruction of the I-275 interchange. Currently there are already three projects south of I-275 that are in development, as shown in **Figure 23**.

Addition of extra lanes along the corridor, south of Turfway Road, is not needed currently, but will be needed sometime after 2030 and by 2040. Construction of the planned projects south of I-275, shown in **Figure 23,** will reduce the amount of widening necessary.

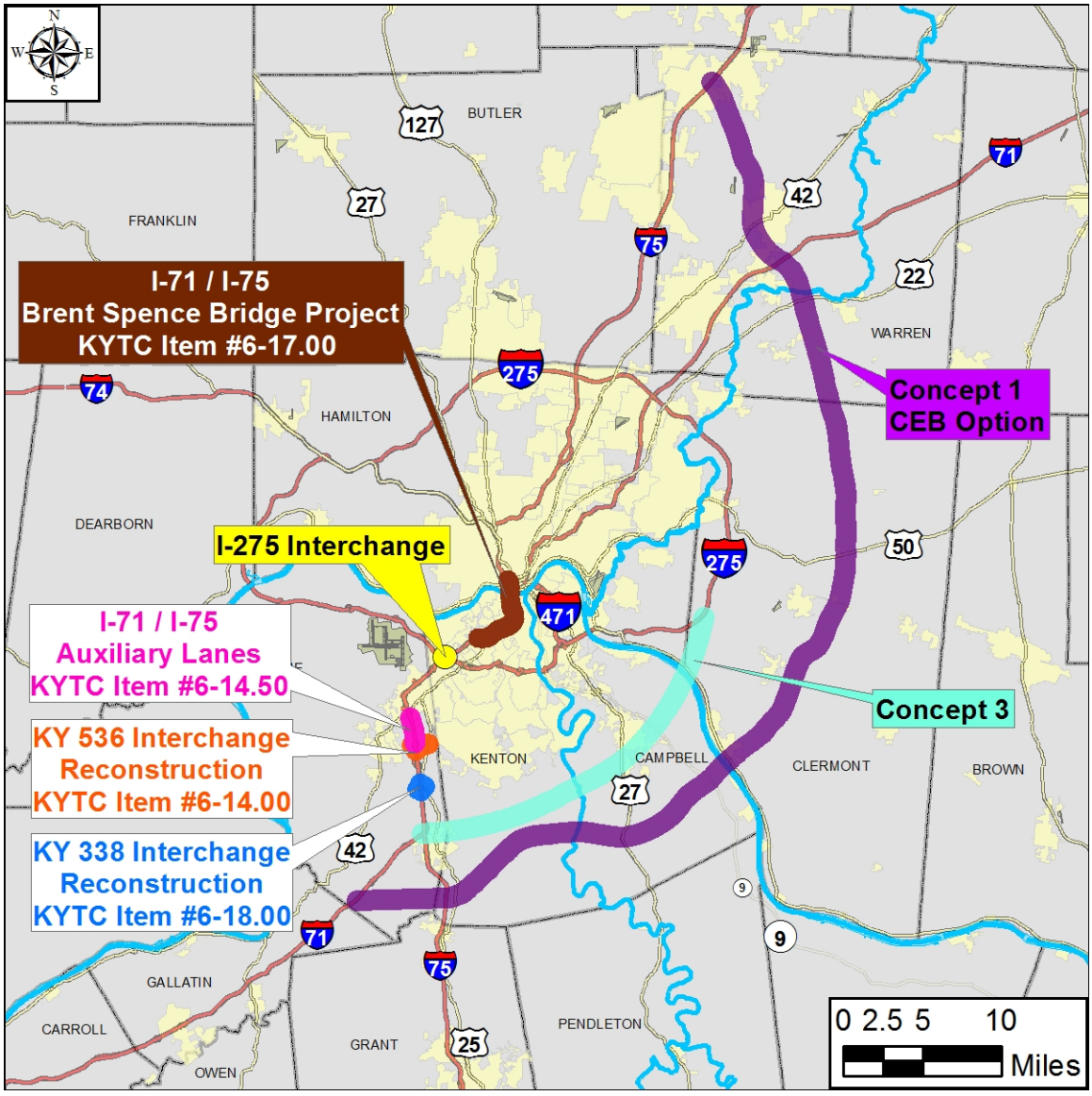


Figure 23. Current I-71/I-75 Improvement Projects

Recommendation: The construction of the Cincy Eastern Bypass will significantly improve traffic flow on I-275 and many other congested regional highways by traffic diversion to the Bypass. This positive impact should be estimated and considered in the decision making.

Comment: Traffic diversion relative to the CEB was analyzed in the Project 6-431 study and found that diversion would occur from all the existing Ohio River crossings. It was also found that cross-river trips would increase due to the addition of a new Ohio River bridge. Diversion was not enough (7 - 10 percent) to improve the I-71/I-75 corridor as significantly as would KYTC Item 6-17. It does, however, increase the total number of trips crossing the Ohio River. **Figure 24** was derived from application of the OKI Regional Travel Demand Model and shows the composition of year 2040 average daily traffic that would be expected to use a new Ohio River bridge constructed as part of the CEB.

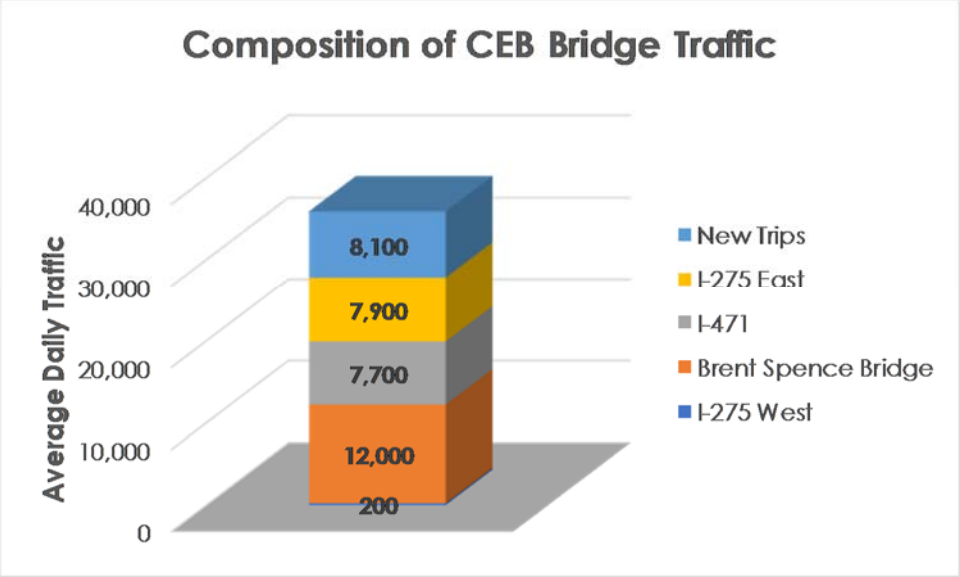


Figure 24. Composition of Year 2040 Traffic Using a New CEB Ohio River Bridge

I-71/I-75 ADDITIONAL FUTURE CAPACITY NEEDS

A "high level" analysis of the corridor also was performed to assess future capacity needs that might need to be addressed beyond the construction of KYTC Item 6-17. The "high level" analysis extends the KYTC Item 6-17 section from I-275 to the I-71/I-75 split in Boone County and was performed at a coarser level of detail. The intent of the analyses was to answer a fundamental question, "Will there be additional need for future through-lane capacity after KYTC Item 6-17 is constructed?"

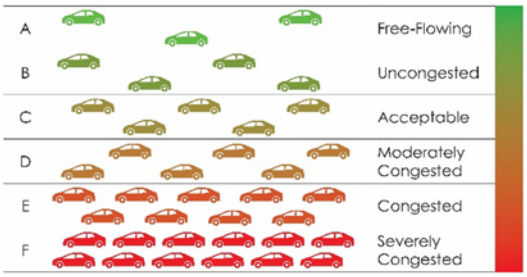
The analysis was performed by developing service volume tables (SVTs) using the Basic Freeway Segments method of the Highway Capacity Manual. Generalized service volume tables are look-up tables that estimate the maximum daily (or hourly) traffic volume for a given Level of Service (LOS) under a specific combination of conditions. In developing SVTs, for ease of use, average or representative input values are used. It is unlikely that any given roadway section's characteristics will exactly match all the values used in creating the table, thus, conclusions drawn for using SVTs should be considered as rough approximations. Within the context of this analysis, SVTs were deemed to be an appropriate first step in determining future capacity needs beyond construction of KYTC Item 6-17.

The HCM uses density as the performance measure to define LOS for basic freeway sections. Density, expressed in equivalent passenger cars per mile per lane, is a measure of congestion that also is correlated with speed and flow (i.e. volume). The service volume lookup table created for this analysis is shown in **Table 19.**

Table 19. I-71/I-75 Service Volumes

Total No. Lanes	LOS Thresholds - Average Daily Traffic			
	B	C	D	E
4	22,000	36,000	50,000	69,500
6	32,900	54,100	75,000	104,100
7	38,600	63,100	87,500	121,600
8	44,200	72,100	100,000	139,000
9	49,600	81,000	112,500	156,400
10	54,900	89,800	125,000	173,800
11	60,400	99,100	137,600	191,000
12	65,800	108,300	150,100	208,100
14	77,000	126,100	174,700	242,700
16	88,200	144,000	244,400	277,900

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11 - 18
C	> 18 - 26
D	> 26 - 35
E	> 35 - 45
F	> 45 or D/C > 1.0



Source: HCM 6th Edition

"Total No. Lanes" refers to both directions. Along some segments of I-71/I-75, there is an additional lane in one direction compared to the other (just south of the Brent Spence Bridge, for example, where there are three lanes northbound but four lanes southbound). Maximum service volumes for these "odd lane" rows in the table were computed by interpolating between the adjacent "even lane" rows.

A comparison of Existing, 2040 No Build, and 2040 with KYTC Item 6-17 scenarios is provided in **Table 20**. Average daily traffic projections were obtained from the OKI RTDM. The results indicate KYTC Item 6-17 will provide sufficient capacity for the length of the project when compared with the No Build scenario. For the one section in Ohio where it appears that KYTC Item 6-17 makes conditions worse (LOS F vs. LOS E), this should be investigated at a more detailed level of analysis. As KYTC Item 6-17 would improve the current bottleneck through the downtown Cincinnati area, this improvement would make the Brent Spence Corridor more "attractive" to travelers, thus resulting in a higher traffic volume (compared with the 2040 No Build) that is greater than the LOS E/F threshold.

Table 20. Freeway Segment ADT and Levels of Service

I-71/I-75 Segment	Begin MP - End MP	Existing Lanes Total (Mainline)**	Existing Daily Traffic (OKI Model)	Existing LOS	2040 No Build Daily Traffic (OKI Model)	2040 No Build LOS	2040 with 6-17 No. Lanes Total (Mainline)**	2040 with 6-17 Daily Traffic (OKI Model)	2040 with 6-17 LOS
OH: Harrison Ave. - Western Ave./Liberty St.	2.5-2.1	9(8)	139,800	E	143,500	E	9(8)	149,500	E
OH: Western Ave./Liberty St. - Ezzard Charles St.	2.1-1.8	8	131,600	E	135,500	E	8	144,100	F
OH: Ezzard Charles St. - Freeman Ave.	1.8-1.6	8	116,000	E	120,800	E	8	127,300	E
OH: Freeman Ave. - 7th St.	1.6-0.9	9(8)	112,900	D/E	117,900	E	8	122,800	E
OH: 7th St. - I-71 (FWW) /5th St./2nd St.	0.9-0.5	4	95,800	F	113,500	F	4	115,900	E
[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	KY (191.2-191.777) OH (0.0-0.5)	8	159,300	F	174,400	F	16	174,200	D
KY: 5th St./4th St. - 12th St./Pike St.	190.5-191.2	7	132,000	F	134,300	F	10	151,500	E
KY: 12thSt./Pike St. - Kyles Ln.	188.6-190.5	7	131,000	F	152,100	F	10	151,900	E
KY: Kyles Ln. - Dixie Hwy.	187.7-188.6	9(7)	115,400	E	136,300	E	9(7)	135,300	E
KY: Dixie Hwy. - Buttermilk Pk.	186.3-187.7	7	99,500	E	121,872	E/F	7	121,000	E/F
KY: Buttermillk Pk. - I-275	184.7-186.3	8(7)	102,900	E	127,900	E	8(7)	127,900	E
KY: I-275 - Donaldson Rd.	183.7-184.7	6	93,000	E	99,100	E	6	118,300	F
KY: Donaldson Rd. - Turfway Rd.	182.4-183.7	10 (8)	125,500	D/E	167,900	E	10(8)	166,000	E
KY: Turfway Rd. - Burlington Pk. (KY 18)	181.2-182.4	10 (8)	123,200	D/E	171,600	E	10(8)	169,100	E
KY: Burlington Pk. (KY 18) - Mall Rd. Ramps	180.8-181.2	8	100,900	D/E	147,700	F	8	144,500	F
KY: Mall Rd. Ramps - US 42	180.0-180.8	8	108,400	E	146,900	F	8	146,300	F
KY: US 42 - Mt. Zion Rd. (KY 536)	178.0-180.0	8	103,700	E	140,900	E/F	8	148,100	F
KY: Mt. Zion Rd. (KY 536) - Richwood Rd. (KY 338)	175.4-178.0	8	94,300	D	135,000	E	8	137,000	E
KY: Richwood Rd. (KY 338) - I-71/I-75 Split	172.9-175.4	8	90,300	D	123,200	E	8	124,400	E

*** Total lanes includes mainline lanes plus auxiliary lanes*

In Kentucky, the analysis indicates that additional through-lane capacity – one lane in each direction - will be needed south of the KYTC Item 6-17 terminus, from Kyles Lane all the way to the I-71/I-75 split. The widening is not needed immediately but will likely be needed sometime after 2030 and by 2040 if the objective is to provide an acceptable LOS for this section. This widening need would be in addition to the construction of three projects currently in design:

- I-71/I-75 interchange reconstruction at KY 338 (KYTC Item 6-18.00)
- I-71/I-75 interchange reconstruction at KY 536 (KYTC Item 6-14.00)
- I-71/I-75 auxiliary lanes between KY 536 and US 42 (KYTC Item 6-14.50)

II. Development and Evaluation of Bypass Alternatives

LEVEL 1 EVALUATION

Development of Concepts

Five alternative bypass concepts were developed, as shown in **Figure 25**.

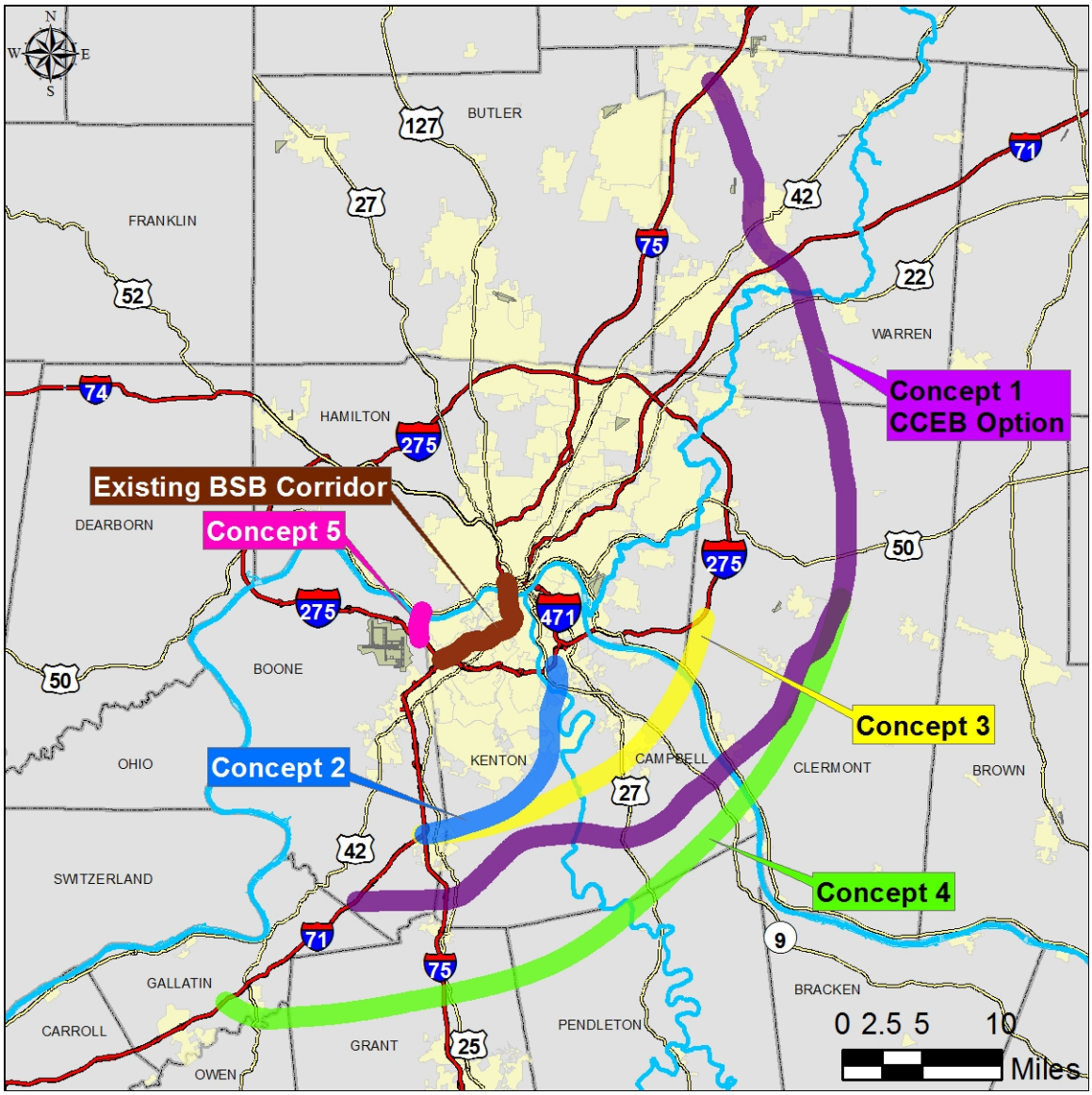


Figure 25. Level 1 Bypass Concepts

The alternative concepts are described below:

Concept 1 (CCEB Option)

- It starts at approximate Milepoint (MP) 72 near Verona, KY on I-71 and ends at I-75 at approximate MP 37 near Franklin, OH.
- The length is approximately 75 miles, with new bridges over the Licking River, Ohio River, East Fork of the Little Miami River, and the Little Miami River.
- It contains four system interchanges at I-71 (KY), I-75 (KY), I-71 (OH), and I-75 (OH), with 16 service interchanges specified from the preliminary engineering analysis performed by the CCEB and provided to the project team.

Concept 2 (I-71/I-75 Connector to I-471)

- It starts at approximate MP 175 on I-75 near Walton, KY and ends at approximate MP 1 on I-471 near Wilder, KY.
- The length is approximately 17.5 miles with a new bridge over the Licking River.
- In includes two system interchanges at I-71/I75 (KY), and I-471 (KY) with four service interchanges.

Concept 3 (I-71/I-75 to I-275 Connector Extended)

- It starts at approximate MP 175 on I-75 (running concurrently with I-71) near Walton, KY and ends at approximate MP 67 on I-275 near 8 Mile Road in OH.
- The length is approximately 23 miles with new bridges over the Licking River and the Ohio River.
- It includes two system interchanges at I-71/I-75 (KY) and I-275 (OH) with three service interchanges.

Concept 4 (I-71 diversion near Sparta eastward to connections with I-71 and I-75 north of Cincinnati)

- It starts at approximate MP 55 on I-71near Sparta, KY and ends at approximate MP 37 on I-75 near Franklin, OH.
- The length is approximately 93 miles with new bridges over Eagle Creek, Licking River, Ohio River, East Fork Little Miami River and Little Miami River.
- It includes four system interchanges at I-71 (KY), I-75 (KY), I-71 (OH), and I-75 (OH) and 10 service interchanges.

Concept 5 (A western corridor to cross the Ohio River near or at the Anderson Ferry location)

- It starts at approximate MP 2 on I-275 near the Cincinnati/Northern KY International Airport in KY and ends at US 50 in Ohio just across the Ohio River.

- The length is approximately 2-3 miles with a new bridge over the Ohio River.
- It includes one system interchange at I-275 (KY) and one service interchange with US 50 (OH).

Evaluation Tools

Objectives of the Level 1 analysis were to develop summary metrics associated with each of the alternative concepts and then use those metrics to select two concepts for more detailed analysis (Level 2). With respect to traffic, the estimated percent reduction in projected Year 2040 average daily traffic on the Brent Spence Bridge was the primary metric. The OKI Regional Travel Demand Model (RTDM) was used to estimate 2040 ADT on Concepts 1, 2, 3, and 5, and to estimate the reduction in corresponding Brent Spence Bridge ADT if each concept was built. Concept 4 extends in Pendleton, Grant, Owen and Gallatin counties in Kentucky, which lie beyond the limits of the OKI model. The Kentucky Statewide Traffic Model (KYSTM) was used to make these projections for Concept 4. While the KYSTM is "coarser" than the OKI RTDM, it does include neighboring Ohio counties plus the Brent Spence Bridge and was deemed sufficient to evaluate Concept 4 as part of the Level 1 analysis.

Planning-level unit costs were used to develop preliminary opinions of probable cost for each of the concepts. Level 1 unit cost assumptions, which were vetted internally and within the KYTC project team, are shown **Table 21**.

Table 21. Level 1 Unit Costs

Item	Cost	Unit
Roadway Elements		
Pavement	$ 90	square yard
System Interchange	$ 30,000,000	each
Service Interchange	$ 10,000,000	each
Traffic Signal	$ 100,000	each
Earthwork	$ 1,000,000	mile
Maintenance of Traffic (MOT)	$ 100,000	mile
ITS	$ 100,000	mile
Structures		
Ohio River Bridge	$ 415	square foot
Other Major Structures	$ 300	square foot
Typical Structure	$ 150	square foot

Environmental data were obtained from available GIS layers, from which analyses were performed to quantify environmental resources such as land cover (development, forests, and pasture), stream encroachment, floodplain, wetlands, parks, historic sites, cemeteries, churches and schools. These were identified for environmental resources falling within a 1,000-foot-wide corridor representing each alternative concept.

Evaluation Summary

The Level 1 evaluation summary for the alternative concepts is presented in **Table 22**.

Table 22. Level 1 Evaluation Summary Results

Concept/Description	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5
	CCEB Option	I-275 / I-471 Connector	I-275 Ohio Connector	Sparta Connector	Anderson Ferry Connector
Engineering Characteristics Based on preliminary concepts developed for Level 1 Analysis.					
Length (miles)	75	17.5	23	93	3
System Interchanges	4	2	2	4	1
Service Interchanges	11	4	3	10	1
Est. Construction Cost (2016 $Millions)	$3,225	$810	$1,853	$3,393	$716
Traffic Characteristics Based on 2040 output from the OKI RTDM or KY Statewide Traffic Model (Concept 4 only).					
Net increase in Daily Interstate Ohio River Crossings	2.3%	0.5%	3.7%	0.8%	5.1%
Daily impact - I-71/I-75 Bridge traffic	**-6.9%**	-5.4%	-3.8%	**-5.8%**	**-0.9%**
Daily impact - I-471 Bridge traffic	**-6.1%**	**7.6%**	**-5.5%**	0.1%	0.3%
Daily impact - I-275 (east) Bridge traffic	**-13.4%**	**2.4%**	**-15.5%**	-2.0%	-0.1%
Environmental Considerations Resources falling within a 1,000'-wide corridor representing each concept.					
Total Acres	10,051	2,659	3,001	12,559	235
Developed, High Intensity	34.4	19.8	9.0	22.6	11.3
Developed, Low Intensity	423.4	195.9	112.4	447.1	24.5
Developed, Medium Intensity	189.3	100.4	48.7	195.5	31.3
Deciduous forest	4,059.0	1,002.2	1,491.9	5,327.2	84.4
Evergreen forest	216.6	17.0	124.3	452.3	0.5
Pasture, hay	2,809.0	877.6	785.8	3,666.1	16.3
Stream encroachment (miles)	20.5	3.7	5.6	22.4	0.5
Floodplain (acres)	591.6	34.3	190.3	701.9	107
Wetlands (acres)	394.7	102.6	185.6	402.8	82.4
Parks (acres)	155.8	0.9	75.5	86.4	0
Known historic sites	1	0	4	0	2
Cemeteries	3	1	1	1	0
Churches	0	2	0	0	1
Schools	6	0	0	3	0
Potentially Affected Parcels	2,769	1,404	401	2,654	103

Biggest impact in reducing Brent Spence Bridge traffic

Least impact in reducing Brent Spence Bridge traffic

Selection of Concepts for Level 2 Evaluation

Concepts 1 and 4 have the highest cost, due to their length and anticipated number of interchanges. Three concepts (1, 3 and 5) suggest significant increases in the total number of daily Ohio River crossings (considering all bridges in the region). When considering possible reduction to I-71/I-75 Brent Spence Bridge traffic, Concepts 1 and 4 suggest the biggest benefits. Concepts 1 and 3 would provide the biggest reductions to traffic on the I-471 (Daniel Carter Beard) and I-275 East (Combs Hehl) bridges.

Concepts 1 and 4 present the greatest number of environmental considerations that must be addressed, primarily because they are the longest and therefore are exposed to the greatest number of environmental resources. Due to the similarity of Concepts 1 and 4, it was determined to evaluate only one of these in the Level 2 analysis.

Considering all factors, Concepts 1 and 3 were selected for further, more detailed evaluation.

LEVEL 2 EVALUATION

The Level 1 evaluation served as a screening process to consider all potentially feasible alternatives and identify those most likely to provide regional transportation benefits. The Level 2 evaluation involved performing preliminary design for Concepts 1 and 3, which included development/refinement of roadway alignments (horizontal and vertical), estimation of construction quantities, estimation of construction timeframe, and developing an opinion of probable cost. The Level 2 evaluation also included development of refined traffic forecasts for Concepts 1 and 3, along with a re-examination of the impacts they would have on the I-71/I-75 corridor and the need for KYTC Item 6-17.

Development of Level 2 Concepts

Concepts 1 and 3 are shown in **Figure 26**.

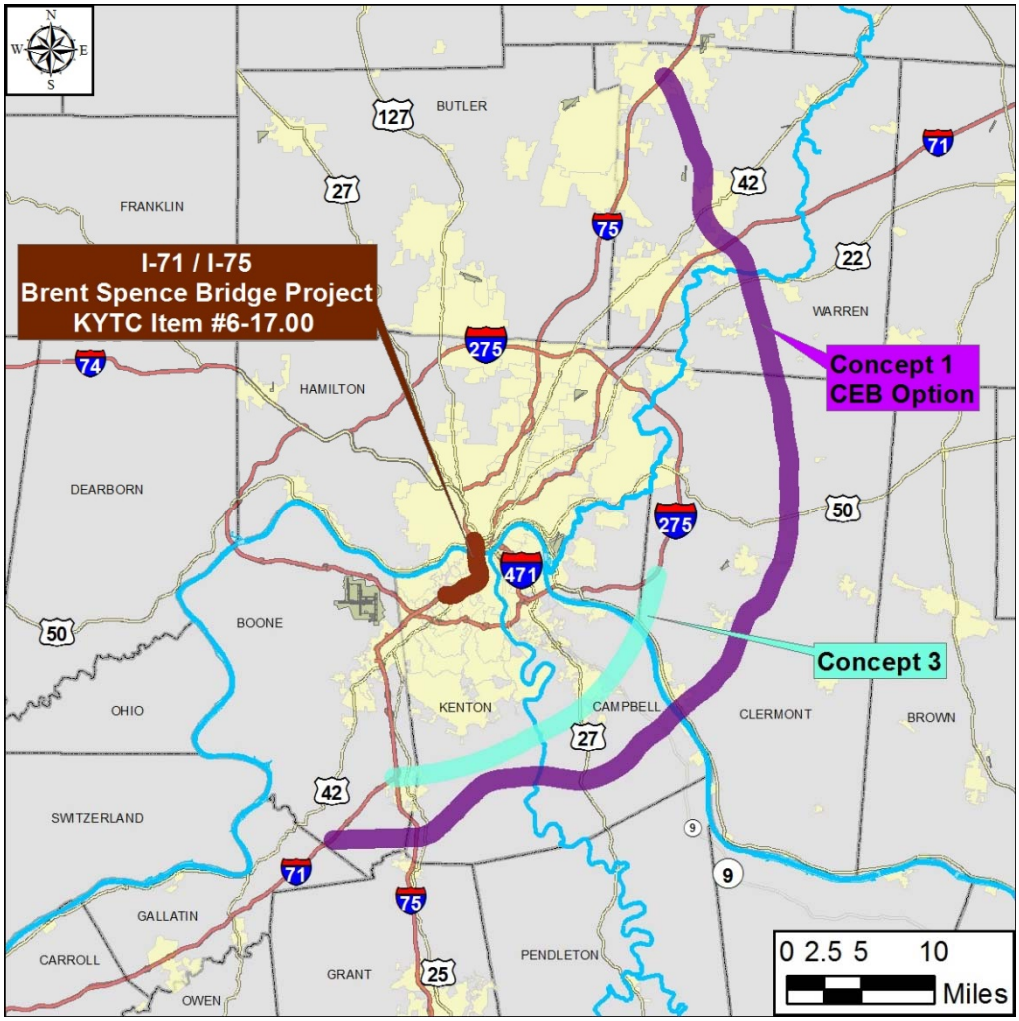


Figure 26. Level 2 Evaluation of Concepts 1 and 3

Concept 1

Concept 1, proposed by the Citizens for the Cincy Eastern Bypass (CCEB), is approximately 75 miles long and extends from I-71 in Boone County, Kentucky to I-75 just south of Lebanon, Ohio. The project team was provided design files from the CCEB which were used to develop a digital model of the alignment. It was decided to use the horizontal alignment as provided, but the vertical geometry was modified to provide adequate vertical clearance in many locations. The project team performed detailed preliminary engineering on Concepts 1 and 3 in part to better determine probable cost. The team developed the digital model using the same software tools the KYTC requires for all design projects (MicroStation and InRoads). Once the digital model was finished, the tools were used to produce actual construction quantities. Once all major bid quantities for over 60 bid items were identified, the project team then used the KYTC Estimator Program that assigns bid prices for each item. The KYTC Estimator Program is used by the KYTC and its agents to develop cost estimates for roadway construction projects. This program assigns unit bid prices for each construction item based on historic prices specific to the region of the state where the project is located. Once current-year prices were established, the project team escalated the prices to the assumed year of expenditure. The project was broken into the five phases of project development and construction: 1) engineering/environmental, 2) right-of-way

acquisition, 3) utilities, 4) construction, and 5) engineering during construction. A summary of the opinion of probable costs for each phase, for both the current year and anticipated year of expenditure, is provided in **Table 23.**

Table 23. Opinion of Probable Cost - Concept 1 (CEB)

Project Development Phase	Estimated Timeframe	Assumed Midpoint (for Inflation)	Concept 1	
			Current Year	Year of Expenditure*
Engineering/Environmental	2018 - 2021	N/A	$269,210,000	$269,210,000
Right-of-Way	2022 - 2025	1/1/2024	$106,570,000	$134,430,000
Utilities	2026 - 2028	6/30/2027	$83,590,000	$117,730,000
Construction	2029 - 2032	1/1/2031	$2,924,490,000	$4,421,820,000
Engineering During Construction	2029 - 2032	1/1/2031	$244,730,000	$370,030,000
		SUBTOTAL	**$3,628,590,000**	**$5,313,220,000**

* Source: ODOT CY 2017-2021 Business Plan Inflation Calculator

As with any major corridor project of this type, there are issues with Concept 1 that would need to be resolved in a future design phase. This includes proposed interchanges that violate federal spacing requirements, avoidance of impacts to Section 4f properties such as A.J. Jolly State Park, and KYTC/ODOT decisions on whether or not to dead-end some county roads that would be severed by the new route. Another key environmental concern is the process to gain approvals necessary to build over the Little Miami River, which may require elimination of an existing crossing before a new crossing is allowed.

Concept 3

Concept 3 was developed by the project team as part of the Level 1 analysis. The evaluation process was similar in most ways to that used for Concept 1. The two big differences were that the digital model was developed without benefit of previous design drawings and that efforts were made to avoid environmental and other design issues inherent in the Concept 1 plans. This concept has the benefit of utilizing the existing I-275 alignment in Ohio, greatly reducing cost and coordination efforts between the two states. The costs are broken down by phase and by year of expenditure as provided in **Table 24**.

Table 24. Opinion of Probable Cost - Concept 3

Project Development Phase	Estimated Timeframe	Assumed Midpoint (for Inflation)	Concept 3	
			Current Year	Year of Expenditure*
Engineering/Environmental	2018 - 2021	N/A	$106,892,300	$106,892,300
Right-of-Way	2022 - 2025	1/1/2024	$68,245,363	$86,085,502
Utilities	2026 - 2028	6/30/2027	$38,624,503	$54,399,622
Construction	2029 - 2032	1/1/2031	$1,161,237,900	$1,755,785,492
Engineering During Construction	2029 - 2032	1/1/2031	$97,174,800	$146,927,778
		SUBTOTAL	**$1,472,174,866**	**$2,150,090,694**

* Source: ODOT CY 2017-2021 Business Plan Inflation Calculator

Design files and detailed estimates of probable costs for Concepts 1 and 3 are located in **Appendix D**.

Additional studies were conducted to support the development of Concepts 1 and 3. Those are:

- Environmental overview and red flag summary (**Appendix E**)
- Socioeconomic study (**Appendix F**)
- Right-of-way estimates
- Utility impacts report
- Economic analysis to determine induced traffic

Development of Traffic Forecasts

The OKI RTDM was used to develop future traffic forecasts for Concepts 1 and 3. The model horizon year 2040 was used for the forecasts as a conservative estimate of predicted travel demand should either concept be constructed.

Construction of either Concept 1 or 3 likely would be a catalyst for land use change and development within their respective corridors. Acknowledging this, adjustments were made to the OKI RTDM to incorporate this possible growth in the traffic forecasts.

Geographically, the OKI RTDM is organized in traffic analysis zones (TAZs), which are generally aligned with U.S. Census block boundaries. Within each TAZ, demographic and other data are quantified – population, number of households, employment, median income, etc. Those data variables upon which travel demand projections are based – namely population, number of households, and employment – were modified for those TAZs within the Concept 1 and 3 corridors to reflect possible land use changes that might be expected if either of those alternatives were built. The "corridor" was defined as those TAZs that fell within or touched a three-mile band on either side of the alignment. An illustration of a section of the Concept 3 corridor and related TAZs is shown in **Figure 27**.

Within the OKI RTDM context, anticipated growth in the region is reflected in population and employment increases between the base year 2010 and the horizon year 2040. For the eight-county OKI region, Year 2010 and 2040 population and employment totals are shown in **Figure 28**. For the OKI region, the changes in totals reflect an eleven percent increase in total population and a five percent increase in total employment.

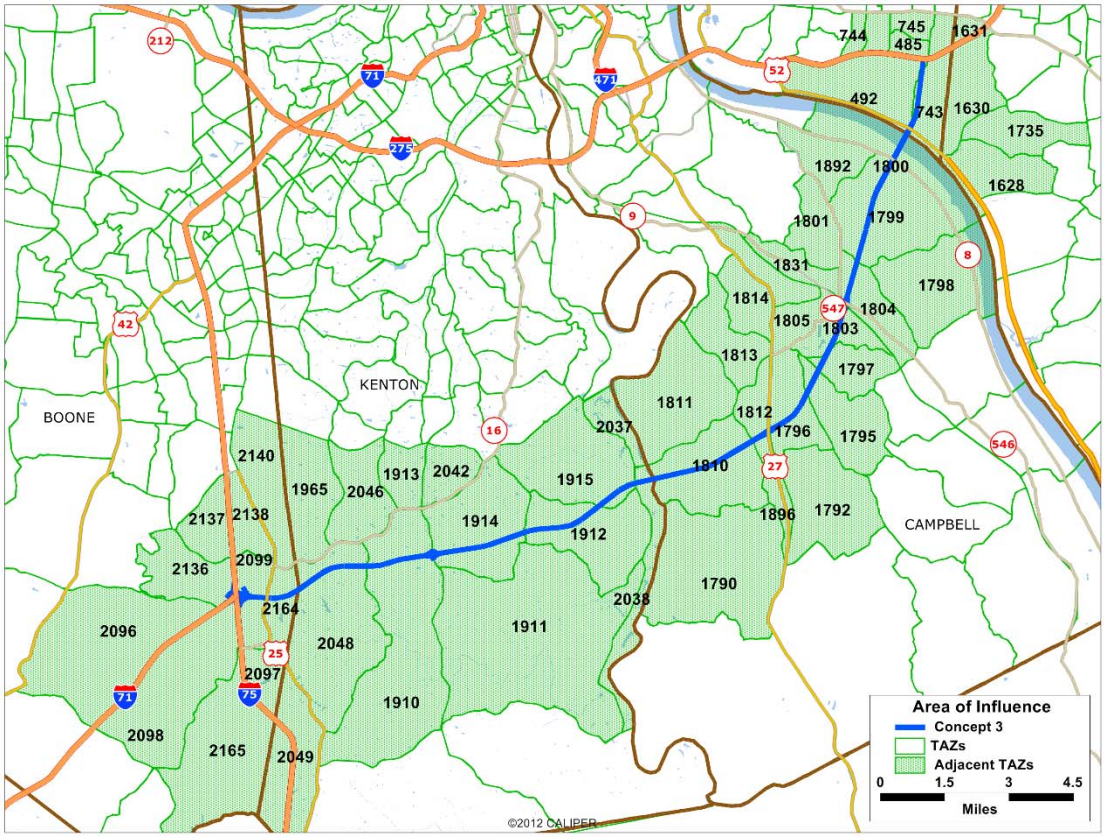
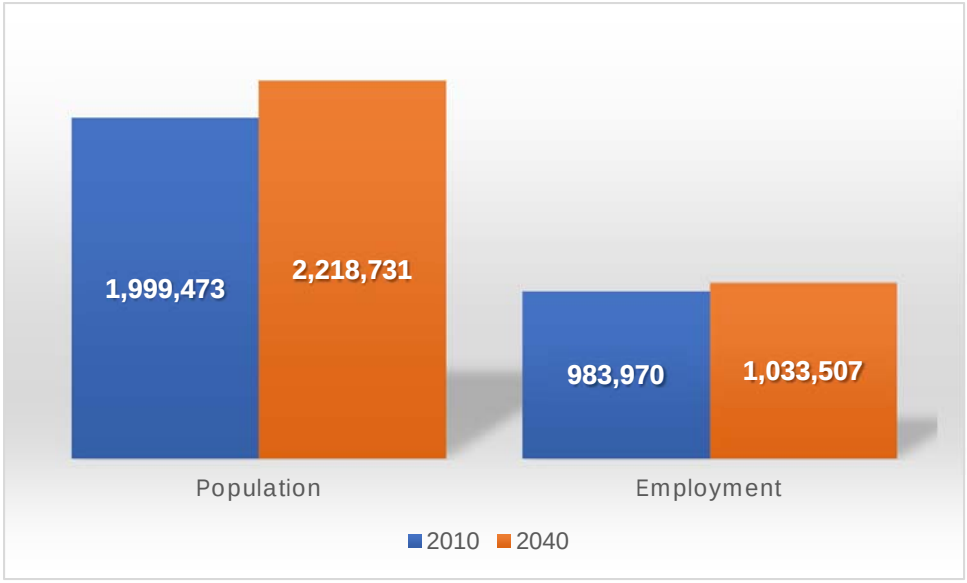


Figure 27. Concept 3 Alignment and TAZs with Potential for New Development



Source: OKI Regional Travel Demand Model

Figure 28. OKI Region Population and Employment Growth 2010 – 2040

Traffic Diversion Estimation

This study generated much discussion about traffic traveling through the region on I-71 or I-75 and how much of that traffic might be diverted away from the Brent Spence Bridge should either Concept 1 or Concept 3 be constructed. To help answer this question, origin-destination (O-D) data were collected from two independent commercial sources. This information, along with the OKI RTDM, were used to develop an estimate of regional through traffic currently traveling across the Brent Spence Bridge that might divert to an alternative route. This leads to the question: If this diversion were to happen, would it affect or change the need for KYTC Item 6-17?

One commercial source for O-D data was StreetLight Data, Inc. The StreetLight data comes from two sources: Location-Based Services Data (i.e. smartphone apps that track devices' locations) and Navigation-GPS data (devices that help people navigate, such as connected cars and trucks, turn-by-turn route guidance apps, and commercial fleet management systems). Based upon defined locations for obtaining the O-D data, StreetLight estimates a 5 – 7 percent sampling rate from which its results are generated. Origin-destination data for the Level 2 analyses were obtained for locations along major routes leading into and out of the Greater Cincinnati area – I-71, I-74, I-75, US 50, Ohio SR 32, and KY 9 (AA Highway). The data were obtained for weekdays during July 2015 (before construction on I-71/I-75 began). On a daily basis, the StreetLight data estimated up to 25 percent of the traffic on the Brent Spence Bridge could be regional through traffic.

A second commercial source was used to obtain O-D data. From the vendor TrafficCast, BlueTOAD technology was used to collect the data. The technology is based on roadside equipment reading MAC addresses (i.e. media access control unique identifiers) of Wi-Fi enabled devices (smart phones, tablets, etc.) in passing vehicles. TrafficCast estimates its penetration rate at around 7 percent. At designated locations along major regional through routes, the equipment was deployed and O-D data were collected. From the TrafficCast data, it is estimated up to 14 percent of the traffic on the Brent Spence Bridge might be regional through traffic.

The OKI RTDM also was used to estimate regional through traffic crossing the Brent Spence Bridge. Included in the area-wide calibration of the 2010 base year model were external travel data collected from a survey in 1996 for major bridges crossing the Ohio River. Results from that survey indicated that 12 percent of the Brent Spence Bridge traffic was regional through traffic. A select link analysis also was performed using the OKI RTDM and the results suggest that 15-16 percent of the bridge's daily traffic is regional through traffic.

From the Level 1 evaluation, the OKI RTDM showed a 7 percent reduction in projected year 2040 daily traffic on the Brent Spence Bridge if Concept 1 were constructed. For Concept 3, this reduction was about 4 percent. Select link analyses of the model runs showed most of this traffic volume reduction to be diverted to a new bridge (either Concept 1 or Concept 3). However, the analyses highlighted another important point – not all regional through traffic would divert to a new bypass; some of the through traffic would be expected to remain on the Brent Spence Bridge, according to the data, tools and methods used in this analysis.

Considering all these data and results, it was estimated that regional through traffic crossing the Brent Spence Bridge is in the range of 12 – 20 percent for a typical weekday, but not all of that traffic necessarily would divert to a new eastern bypass. Other factors to consider: 1) regional through traffic percentages were lower during peak commuting traffic periods than during off-peak periods, weekends and holidays; and 2) trucks traveling through the area would be less likely to divert during off-peak periods than during peak periods as travel times through downtown Cincinnati would be lower during off-peak periods than longer trips using the bypass during those same periods.

The origin-destination data from StreetLight and TrafficCast are located in **Appendix G**.

Traffic Forecasts and Impacts on the I-71/I-75 Corridor

Year 2040 traffic forecasts for Concepts 1 and 3 were developed using the OKI RTDM. Projected average daily traffic volumes for Concept 1 ranged from about 25,000 in Kentucky to 46,000 in Ohio near I-71 and I-75. Traffic crossing a new Ohio River Bridge was estimated to be about 36,000 vehicles per day. For Concept 3, 2040 ADT projections were about 22,000 at the southern terminus in Kentucky and about 36,000 across a new Ohio River bridge, near its northern terminus with I-275. A four-lane median-divided cross-section would provide an acceptable level of service for either alternative.

The Level 2 analysis addressed the question: *What would be the impact on the need for the Brent Spence Bridge Replacement/ Rehabilitation Project if the Cincinnati Eastern Bypass were built instead?* For both the Concept 1 and Concept 3 scenarios, projected year 2040 traffic volumes were obtained using the OKI RTDM. The service volume tables used in the Level 1 analyses were used again here. A comparison of I-71/I-75 Year 2040 average daily traffic volumes and levels of service with and without Concept 1 is shown in **Table 25**. The tables show that significant congestion and poor levels of service will remain between Kyles Lane and downtown Cincinnati, even if Concept 1 is built. Similarly, a comparison of I-71/I-75 Year 2040 average daily traffic volumes and levels of service with and without Concept 3 is shown in **Table 26**. The results are the same – Concept 3 would do nothing to solve the congestion issues within the KYTC Item 6-17 area. Finally, the Concept 1 scenario was re-examined for the case where a theoretical bypass would result in a 20 percent diversion of traffic away from the I-71/I-75 corridor. Twenty percent represents the high end of the range of estimated regional through traffic on the Brent Spence Bridge and the assumption is that all of the regional through traffic would be diverted. Those results are shown in **Table 27**. While diverting 20 percent of the traffic away from I-71/I-75 would have a significant impact, it would not completely solve congestion issues in the corridor.

Table 25. I-71/I-75 Year 2040 ADT and LOS With and Without Concept 1

I-71/I-75 Segment	Total Lanes (Mainline Lanes)	2040 No Build		2040 w/CEB (Concept 1)	
		Daily Traffic*	Level of Service (LOS)	Daily Traffic*	Level of Service (LOS)
OH: Harrison Ave. - Western Ave./Liberty St.	9(8)	143,500	E	134,600	E
OH: Western Ave./Liberty St. - Ezzard Charles St.	8	135,500	E	120,000	E
OH: Ezzard Charles St. - Freeman Ave.	8	120,800	E	108,100	E
OH: Freeman Ave. - 7th St.	9(8)	117,900	E	107,100	D
OH: 7th St. - I-71 (FWW) /5th St./2nd St.	4	113,500	F	107,100	F
[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	8	174,400	F	164,700	F
KY: 5th St./4th St. - 12th St./Pike St.	7	134,300	F	139,000	F
KY: 12thSt./Pike St. - Kyles Ln.	7	152,100	F	141,700	F
KY: Kyles Ln. - Dixie Hwy.	9(7)	136,300	E	125,900	E
KY: Dixie Hwy. - Buttermilk Pk.	7	121,872	E/F	110,400	E
KY: Buttermillk Pk. - I-275	8(7)	127,900	E	116,000	E
KY: I-275 - Donaldson Rd.	6	99,100	E	104,000	E/F
KY: Donaldson Rd. - Turfway Rd.	10(8)	167,900	E	150,100	E
KY: Turfway Rd. - Burlington Pk. (KY 18)	10(8)	171,600	E	154,000	E
KY: Burlington Pk. (KY 18) - Mall Rd. Ramps	8	147,700	F	128,900	E
KY: Mall Rd. Ramps - US 42	8	146,900	F	132,000	E
KY: US 42 - Mt. Zion Rd. (KY 536)	8	140,900	E/F	122,300	E
KY: Mt. Zion Rd. (KY 536) - Richwood Rd. (KY 338)	8	135,000	E	116,600	E
KY: Richwood Rd. (KY 338) - I-71/I-75 Split	8	123,200	E	105,600	E

* Source: OKI Regional Travel Demand Model

Table 26. I-71/I-75 Year 2040 ADT and LOS With and Without Concept 3

I-71/I-75 Segment	Total Lanes (Mainline Lanes)	2040 No Build		2040 w/Concept 3	
		Daily Traffic*	Level of Service (LOS)	Total Daily Traffic	Level of Service (LOS)
OH: Harrison Ave. - Western Ave./Liberty St.	9(8)	143,500	E	138,300	E
OH: Western Ave./Liberty St. - Ezzard Charles St.	8	135,500	E	123,900	E
OH: Ezzard Charles St. - Freeman Ave.	8	120,800	E	115,000	E
OH: Freeman Ave. - 7th St.	9(8)	117,900	E	112,200	D/E
OH: 7th St. - I-71 (FWW) /5th St./2nd St.	4	113,500	F	111,100	F
[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	8	174,400	F	167,800	F
KY: 5th St./4th St. - 12th St./Pike St.	7	134,300	F	142,500	F
KY: 12thSt./Pike St. - Kyles Ln.	7	152,100	F	145,300	F
KY: Kyles Ln. - Dixie Hwy.	9(7)	136,300	E	129,200	E
KY: Dixie Hwy. - Buttermilk Pk.	7	121,872	E/F	114,100	E
KY: Buttermillk Pk. - I-275	8(7)	127,900	E	119,600	E
KY: I-275 - Donaldson Rd.	6	99,100	E	107,800	F
KY: Donaldson Rd. - Turfway Rd.	10(8)	167,900	E	152,800	E
KY: Turfway Rd. - Burlington Pk. (KY 18)	10(8)	171,600	E	156,500	E
KY: Burlington Pk. (KY 18) - Mall Rd. Ramps	8	147,700	F	121,800	E
KY: Mall Rd. Ramps - US 42	8	146,900	F	134,300	E
KY: US 42 - Mt. Zion Rd. (KY 536)	8	140,900	E/F	124,500	E
KY: Mt. Zion Rd. (KY 536) - Richwood Rd. (KY 338)	8	135,000	E	118,900	E
KY: Richwood Rd. (KY 338) - I-71/I-75 Split	8	123,200	E	114,900	E

* Source: OKI Regional Travel Demand Model

Table 27. I-71/I-75 Year 2040 ADT and LOS With 20 Percent Diversion

I-71/I-75 Segment	Total Lanes (Mainline Lanes)	2040 No Build		2040 No Build with 20% Less Traffic on I-75	
		Daily Traffic*	Level of Service (LOS)	Daily Traffic*	Level of Service (LOS)
OH: Harrison Ave. - Western Ave./Liberty St.	9(8)	143,500	E	114,800	E
OH: Western Ave./Liberty St. - Ezzard Charles St.	8	135,500	E	108,400	E
OH: Ezzard Charles St. - Freeman Ave.	8	120,800	E	96,600	D
OH: Freeman Ave. - 7th St.	9(8)	117,900	E	94,300	D
OH: 7th St. - I-71 (FWW) /5th St./2nd St.	4	113,500	F	90,800	F
[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	8	174,400	F	139,500	E/F
KY: 5th St./4th St. - 12th St./Pike St.	7	134,300	F	107,400	E
KY: 12thSt./Pike St. - Kyles Ln.	7	152,100	F	121,700	E/F
KY: Kyles Ln. - Dixie Hwy.	9(7)	136,300	E	109,000	D
KY: Dixie Hwy. - Buttermilk Pk.	7	121,872	E/F	97,500	E
KY: Buttermillk Pk. - I-275	8(7)	127,900	E	102,300	E
KY: I-275 - Donaldson Rd.	6	99,100	E	79,300	E
KY: Donaldson Rd. - Turfway Rd.	10(8)	167,900	E	134,300	E
KY: Turfway Rd. - Burlington Pk. (KY 18)	10(8)	171,600	E	137,300	E
KY: Burlington Pk. (KY 18) - Mall Rd. Ramps	8	147,700	F	118,200	E
KY: Mall Rd. Ramps - US 42	8	146,900	F	117,500	E
KY: US 42 - Mt. Zion Rd. (KY 536)	8	140,900	E/F	112,700	E
KY: Mt. Zion Rd. (KY 536) - Richwood Rd. (KY 338)	8	135,000	E	108,000	E
KY: Richwood Rd. (KY 338) - I-71/I-75 Split	8	123,200	E	98,600	D

* Source: OKI Regional Travel Demand Model

Tables 25 through 27 illustrate the need for KYTC Item 6-17. Even if an eastern bypass was constructed, there would not be enough traffic diversion to eliminate the need for KYTC Item 6-17, based on current and projected future travel demand. An eastern bypass would have to divert 40,000 – 50,000 vehicles per day or more away from the I-71/I-75 corridor simply to keep sections of that corridor at the LOS E/F threshold. Construction of either bypass option studied along with short-term improvement strategies studied would not result in this level of diversion.

Level 2 Evaluation Summary

A Level 2 evaluation summary is shown in **Table 28**. It illustrates each identified segment of the project from the Western Hills Viaduct in Ohio to the I-71/I-75 split in Kentucky. Daily traffic volumes and levels of service were derived from OKI's RTDM for the following scenarios:

- Existing
- Year 2040 No-Build
- Year 2040 with 6-17
- Year 2040 with Concept 1 (induced traffic added)
- Year 2040 with Concept 3 (induced traffic added)

"Induced traffic" represents the additional traffic anticipated to be generated by new development in the corridor should either Concept 1 or Concept 3 be constructed. An economic analysis was performed to estimate the induced traffic. The economic analysis showed that a new bypass and bridge would promote economic development in the affected counties. Also included in the summary are changes in traffic demand on major bridges in the region with the construction of Concepts 1 and 3. For comparison, costs are shown for: 1) KYTC Item 6-17; 2) for adding one lane in each direction on I-71/I-75 in two separate sections (Brent Spence Bridge to I-275, I-275 to I-71/I-75 split); 3) for Concept 1; 4) and for Concept 3. Each cost is broken down by phase in current year dollars and year of expenditure. Kentucky's share of each also is shown in current dollars and year of expenditure.

Table 28. Level 2 Evaluation Summary

I-71/I-75 Segment	Begin MP - End MP	Existing Lanes Total (Mainline)**	Existing		2040 No Build		2040 with 6-17			2040 w/Concept 1*		2040 w/Concept 3*		2040 No Build with 20% Less Traffic on I-75	
			Daily Traffic (OKI RTDM)***	LOS	Daily Traffic (OKI RTDM)***	LOS	No. Lanes Total (Mainline)**	Daily Traffic (OKI RTDM)***	LOS	Daily Traffic (OKI RTDM)***	LOS	Daily Traffic (OKI RTDM)***	LOS	Daily Traffic (OKI RTDM)***	LOS
OH: Harrison Ave. - Western Ave./Liberty St.	2.5-2.1	9(8)	139,800	E	143,500	E	9(8)	149,500	E	134,600	E	138,300	E	114,800	E
OH: Western Ave./Liberty St. - Ezzard Charles St.	2.1-1.8	8	131,600	E	135,500	E	8	144,100	F	120,000	E	123,900	E	108,400	E
OH: Ezzard Charles St. - Freeman Ave.	1.8-1.6	8	116,000	E	120,800	E	8	127,300	E	108,100	E	115,000	E	96,600	D
OH: Freeman Ave. - 7th St.	1.6-0.9	9(8)	112,900	D/E	117,900	E	8	122,800	E	107,100	D	112,200	D/E	94,300	D
OH: 7th St. - I-71 (FWW) /5th St./2nd St.	0.9-0.5	4	95,800	F	113,500	F	4	115,900	E	107,100	F	111,100	F	90,800	F
[OH] I-71 (FWW) /5th St./2nd St. - [KY] 5th St./4th St.	KY (191.2-191.777) OH (0.0-0.5)	8	159,300	F	174,400	F	16	174,200	D	164,700	F	167,800	F	139,500	E/F
KY: 5th St./4th St. - 12th St./Pike St.	190.5-191.2	7	132,000	F	134,300	F	10	151,500	E	139,000	F	142,500	F	107,400	E
KY: 12thSt./Pike St. - Kyles Ln.	188.6-190.5	7	131,000	F	152,100	F	10	151,900	E	141,700	F	145,300	F	121,700	E/F
KY: Kyles Ln. - Dixie Hwy.	187.7-188.6	9(7)	115,400	E	136,300	E	9(7)	135,300	E	125,900	E	129,200	E	109,000	D
KY: Dixie Hwy. - Buttermilk Pk.	186.3-187.7	7	99,500	E	121,872	E/F	7	121,000	E/F	110,400	E	114,100	E	97,500	E
KY: Buttermillk Pk. - I-275	184.7-186.3	8(7)	102,900	E	127,900	E	8(7)	127,900	E	116,000	E	119,600	E	102,300	E
KY: I-275 - Donaldson Rd.	183.7-184.7	6	93,000	E	99,100	E	6	118,300	F	104,000	E/F	107,800	F	79,300	E
KY: Donaldson Rd. - Turfway Rd.	182.4-183.7	10 (8)	125,500	D/E	167,900	E	10(8)	166,000	E	150,100	E	152,800	E	134,300	E
KY: Turfway Rd. - Burlington Pk. (KY 18)	181.2-182.4	10 (8)	123,200	D/E	171,600	E	10(8)	169,100	E	154,000	E	156,500	E	137,300	E
KY: Burlington Pk. (KY 18) - Mall Rd. Ramps	180.8-181.2	8	100,900	D/E	147,700	F	8	144,500	F	128,900	E	121,800	E	118,200	E
KY: Mall Rd. Ramps - US 42	180.0-180.8	8	108,400	E	146,900	F	8	146,300	F	132,000	E	134,300	E	117,500	E
KY: US 42 - Mt. Zion Rd. (KY 536)	178.0-180.0	8	103,700	E	140,900	E/F	8	148,100	F	122,300	E	124,500	E	112,700	E
KY: Mt. Zion Rd. (KY 536) - Richwood Rd. (KY 338)	175.4-178.0	8	94,300	D	135,000	E	8	137,000	E	116,600	E	118,900	E	108,000	E
KY: Richwood Rd. (KY 338) - I-71/I-75 Split	172.9-175.4	8	90,300	D	123,200	E	8	124,400	E	105,600	E	114,900	E	98,600	D

** Traffic forecasts include induced traffic from new development in the corridor*
*** Total lanes includes mainline lanes plus auxiliary lanes*
**** Traffic volumes shown are based on OKI Regional Travel Demand Model (RTDM) Assignments*

Estimated Traffic Impact to Ohio River Crossings

Ohio River Crossing	Bridge Name	Existing Daily Traffic (OKI RTDM)	2040 No Build Daily Traffic (OKI RTDM)	2040 with 6-17 Daily Traffic (OKI RTDM)	2040 with 6-17 % Change**	2040 w/Concept 1* Daily Traffic (OKI RTDM)	2040 w/Concept 1* % Change**	2040 w/Concept 3* Daily Traffic (OKI RTDM)	2040 w/Concept 3* % Change**
I-71/I-75	Brent Spence	159,300	174,400	174,200	-0.1%	164,700	-5.6%***	167,800	-3.8%
I-471	Daniel Carter Beard	123,389	126,000	127,000	0.8%	118,300	-6.1%	119,600	-5.1%
I-275 East	Combs Hehl	56,698	58,700	58,500	-0.3%	50,800	-13.5%	49,900	-15.0%
I-275 West	Carol Cropper	32,907	40,200	38,800	-3.5%	40,000	-0.5%	40,700	1.2%
New Crossing	N/A	N/A	N/A	N/A	N/A	35,900	N/A	36,200	N/A
Daily Crossings of 4 Major Bridges		*372,294*	*399,300*	*398,500*	*-0.2%*	*409,700*	*2.6%*	*414,200*	*3.7%*

** Traffic forecasts include induced traffic from new development in the corridor*
*** Percent change as compared to 2040 No Build*
***** Applying the OKI model results in a range of diverson from 5.6% to 6.9%

Opinion of Probable Cost

Project	Year Open to Traffic	Cost (2017 Dollars)							Kentucky's share of cost (2017 Dollars)	Estimated Total Cost based on Year of Expenditure (YOE)	Kentucky's Share of Estimated Total Cost (YOE Dollars)
		Preliminary Engineering & Environmental	Design	Right-of-Way	Utilties	Construction	CEI	Total Cost			
KYTC Item 6-17 [1]	2024	--	$106,900,000	$76,000,000	$149,700,000	$1,793,000,000	$163,700,000	$2,289,300,000	$1,018,800,000	$2,612,000,000	$1,162,500,000
Reconstruction of I-275 Interchange	2030 [3]	$2,000,000	$21,200,000	$25,000,000	$12,000,000	$212,000,000	$17,000,000	$289,200,000	$289,200,000	$398,830,000	$398,830,000
KYTC Item 6-17 + Reconstruction of I-275 Interchange	2030	$2,000,000	$128,100,000	$101,000,000	$161,700,000	$2,005,000,000	$180,700,000	$2,578,500,000	$1,308,000,000	$3,010,830,000	$1,561,330,000
I-75 additional lane from I-275 to I-71/75 Split [2]	2040	$15,120,000	$40,320,000	$12,600,000	$100,800,000	$504,000,000	$50,400,000	$723,240,000	$723,240,000	$1,236,070,000	$1,236,070,000
Concept 1 (CEB)	2032	$73,420,000	$195,790,000	$106,570,000	$83,590,000	$2,924,490,000	$244,730,000	$3,628,590,000	$1,490,349,000	$5,313,200,000	$2,182,300,000
Concept 3	2032	$29,160,000	$77,740,000	$68,250,000	$38,630,000	$1,161,240,000	$97,180,000	$1,472,200,000	$1,345,165,000	$2,150,090,000	$1,964,600,000

[1] Source: 2013 Brent Spence Bridge Initial Financial Plan
[2] High-level construction estimate of $42 million per mile was used
[3] The I-275 Interchange should be completed as near as possible to the completion of KYTC Item 6-17

Study Conclusions

The following conclusions were drawn as a result of the Brent Spence Strategic Corridor Study:

- The study confirmed that the *Brent Spence Bridge Replacement/* Rehabilitation Project (KYTC Item 6-17) is needed. Along with reconstruction of the I-275 interchange, this project clearly demonstrates travel congestion relief in the corridor through the year 2040 with acceptable levels of service.

- The I-275 interchange reconstruction should be accomplished concurrently, or nearly concurrently, with KYTC Item 6-17. This would include widening of I-71/I-75 from Turfway Road north to KYTC Item 6-17. Widening further south of Turfway Road to the I-71/I-75 split is not needed currently but should be evaluated periodically as traffic volumes increase. The study indicates that widening in this area would be needed between 2030 and 2040 if the objective is to provide an acceptable level of service in this section.

- Regional through traffic on the Brent Spence Bridge is estimated to be 12 to 20 percent of the average daily traffic. If the CEB were constructed, it is estimated that traffic volume on the Brent Spence Bridge would be reduced by 7 to 10 percent in Year 2040 (compared to 2040 traffic volume on the Brent Spence Bridge) and that most of the reduction would be regional through traffic. If Concept 3 were constructed, the reduction would be approximately 4 percent. In either case, significant congestion and poor levels of service would remain between Kyles Lane and downtown Cincinnati.

- No short-term improvement strategies studied would provide adequate traffic operations improvements to eliminate or defer the need for *the Brent Spence Bridge Replacement/* Rehabilitation Project (KYTC Item 6-17). Nor would the combination of short-term improvement strategies with either Concept 1 (CEB) or Concept 3 eliminate or defer the need for KYTC Item 6-17.

- Costs are estimated as follows (each assumes funding is in place):

    - **KYTC Item 6-17** - $2.3 Billion in current year dollars and $2.6 Billion in year of expenditure (YOE) dollars, assuming the project would be open to traffic in 2024. Kentucky's share is estimated at $1.0 Billion in current year dollars and $1.2 Billion in YOE dollars. With the addition of the I-275 interchange, the cost estimate rises to $2.6 Billion in current year dollars and $3.0 Billion in YOE dollars. Kentucky's share is estimated at $1.3 Billion in current year dollars and $1.6 Billion in YOE dollars.

    - **Concept 1 (CEB)** - $3.6 Billion in current year dollars and $5.3 Billion in YOE dollars, assuming construction beginning in 2029 and the project being open to traffic in 2032. Kentucky's share is about $2.2 Billion in YOE dollars.

    - **Concept 3** - $1.5 Billion in current year dollars and $2.2 Billion in YOE dollars, assuming construction beginning in 2029 and the project being open to traffic in 2032. Kentucky's share is about $2.0 Billion in YOE dollars.

- By 2040, the CEB is estimated to carry 25,000 to 46,000 vehicles per day, with approximately 36,000 vehicles per day at the new Ohio River Crossing. The bypass would enhance economic development and cross-river capacity. While it does not defer the need for the *Brent Spence Bridge Replacement/ Rehabilitation Project,* this concept is worthy of further exploration.

Appendices

APPENDIX A. RELATED DOCUMENTS FROM THE BRENT SPENCE BRIDGE REPLACEMENT/ REHABILITATION PROJECT

APPENDIX B. TRAFFIC COUNTS

APPENDIX C. I-71/I-75 SPEED/TRAVEL TIME DATA

APPENDIX D. LEVEL 2 CONCEPT SCHEMATICS AND OPINIONS OF PROBABLE COST

APPENDIX E. ENVIRONMENTAL OVERVIEW/RED FLAG SUMMARY

APPENDIX F. SOCIOECONOMIC STUDY

APPENDIX G. ORIGIN-DESTINATION DATA