KENTUCKY TRANSPORTATION CABINET

Cumberland Expressway Upgrade Study

Executive Summary • March 2022

WSP

HDR

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Executive Summary

The Kentucky Transportation Cabinet (KYTC) initiated this planning study to identify and evaluate potential improvements that would be necessary to upgrade the Louie B. Nunn Cumberland Expressway to meet Interstate design standards. The study area, shown in **Figure ES1**, encompasses the entire length of the Cumberland Expressway, including interchanges, from Interstate 65 (I-65) in Barren County (MP 0.0) through Metcalfe, Adair, and Russell counties to U.S. Highway (US) 27 in Pulaski County (MP 88.376).

The Cumberland Expressway was legislatively redesignated from a parkway to an expressway as part of Kentucky Senate Bill 215 in April 2021. The Federal 2021 Infrastructure Investment and Jobs Act (IIJA) also added it to the list of High Priority Corridors on the National Highway System to prioritize funding for the corridor. The IIJA also specifically stated that it will "be designated as a spur of Interstate Route 65". This study will identify and evaluate short-term and long-term improvement strategies to upgrade the Cumberland Expressway to current (2021) Interstate design standards. The goals of this study are to:

- Evaluate existing mainline, interchange, ramp, and bridge conditions to identify deficiencies with respect to Interstate design standards
- Evaluate existing traffic and safety conditions
- Develop a list of proposed improvements needed to meet Interstate design standards
- Evaluate proposed improvements with respect to traffic, safety, environment, and cost
- Develop a list of prioritized recommended improvements based on the technical evaluation and input from KYTC and the Federal Highway Administration (FHWA).

Interstate Design Standards

FHWA identifies ten controlling design criteria that define the operational and safety performance of an Interstate. A Design Exception (DE) can be requested when design features do not meet those standards if there is not an associated safety issue. The ten controlling criteria apply to high speed (≥50 mph) National Highway System routes and include:

1. Design Speed
2. Lane Width
3. Shoulder Width
4. Horizontal Curve Radius
5. Superelevation Rate
6. Stopping Sight Distance[1]
7. Maximum Grade
8. Cross Slope
9. Vertical Clearance
10. Design Loading Structural Capacity

This study evaluates the design features of the Cumberland Expressway for compliance with FHWA's ten controlling criteria as well as the American Association of State Highway and Transportation Officials (AASHTO) and KYTC design criteria for non-controlling criteria. **Table ES1** summarizes the guidelines used for the design standards for each mainline, structure, ramp, or loop feature. Items with an asterisk are part of the ten controlling criteria whereas those without an asterisk are KYTC standards. A Design Variance (DV) can be requested for standards that are not met if they are not one of the ten controlling criteria and if there are no safety issues present. The project team evaluated each design feature shown, compared against the listed official reference. A technical analysis was conducted by the project team to determine which deficient features would be recommended for improvement prior to Interstate conversion and which features would be recommended for DE or DV requests and only required for full compliance with Interstate standards.

1 Applies to the horizontal and vertical alignment except in the case of vertical sag curves.

Figure ES1: Study Area

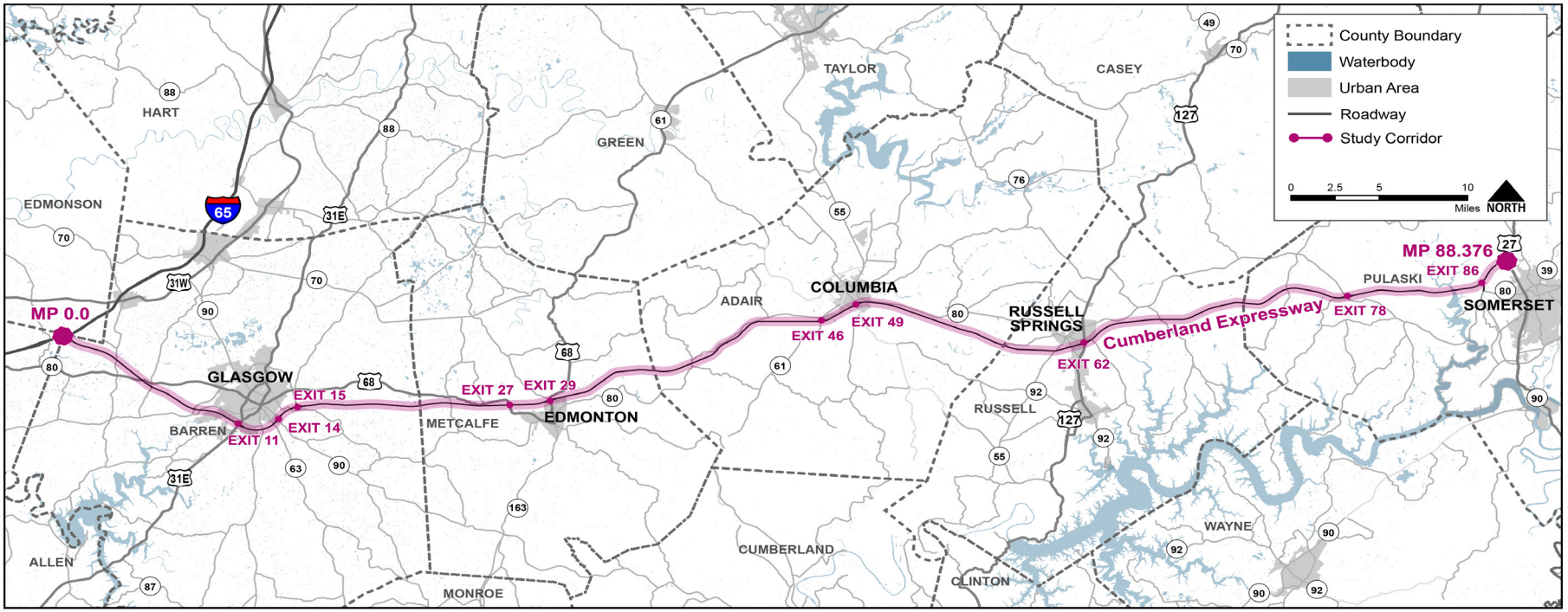

Table ES1: Interstate Design Criteria for Rural, 4-Lane Interstate Facilities

Design Element	Governing Agency	Reference	Mainline	Ramps	Loops
Design Speed*	AASHTO	A Policy on Geometric Design of Highways & Streets (Green Book), 2018	70 mph	35 mph	20 mph
Lane Width*	AASHTO	Green Book, 2018	12’	14’	15’
Inside Shoulder*	AASHTO	Green Book, 2018	4’	2’-4’	
Outside Shoulder*					
Truck DDHV ≤ 250	AASHTO	Green Book, 2018	10’	6’-10’	
Truck DDHV > 250	AASHTO	Green Book, 2018	12’		
Median Width	AASHTO	Roadside Design Guide, 2011 / A Policy on Design Standards - Interstate System (Interstate Design Guide), 2016	30’ (Roadside Design Guide)/50’ (Interstate Design Guide)	N/A	
Median Turnarounds	AASHTO	Green Book, 2018	May be spaced at 3 to 4-mile intervals or as needed		
Clear Zone	AASHTO	Roadside Design Guide, 2011	30’-46’	10’-18’	
Guardrail Height	KYTC	KYTC Standard Drawings	31”		
Horizontal Alignment					
Superelevation*	AASHTO	Green Book, 2018	8% Max		
Minimum Radius*	AASHTO	Green Book, 2018	1810’	314’	134’
Cross Slopes*	AASHTO	2016 Interstate Design Guide	Greater than 1.5%		
Vertical Alignment					
Maximum Vertical Grade*	AASHTO	2016 Interstate Design Guide/2018 Green Book	4%	4%-6%	6%-8%
Crest Vertical Curves – Minimum Stopping Sight Distance*	AASHTO	Green Book, 2018	730’	250’	115’
Sag Vertical Curves - Minimum Head Light Sight Distance	AASHTO	Green Book, 2018			
Bridges and Overpasses					
Bridge Width ≤ 200 feet	AASHTO	2016 Interstate Design Guide	37.5’	N/A	
Bridge Width > 200 feet	AASHTO	2016 Interstate Design Guide	31’	N/A	
Minimum Overpass Vertical Clearance*	AASHTO	2016 Interstate Design Guide/KYTC Highway Design Manual	16’ (Interstate Design Guide)/16.5’ (KYTC Highway Design Manual)	N/A	
Minimum Overhead Sign Vertical Clearance*	AASHTO	Manual on Uniform Traffic Control Devices (MUTCD), 2009	17’		
Divergence Angle	AASHTO	Green Book, 2018	2 to 5 degrees		
Speed Change Lanes	AASHTO	Green Book, 2018	Varies depending on the design speed of the entering or exiting curves		
Interchange Spacing	AASHTO	Green Book, 2018	1 mile (Urban); 2 miles (Rural)		
Interchange Control of Access	AASHTO	A Policy on Design Standards - Interstate System, 2016	300’		

*FHWA Design Controlling Criteria**

Committed Projects

There are five projects in the study area included in *Kentucky's Fiscal Year (FY) 2020 – FY 2026 Highway Plan*, and two projects in the KYTC Continuous Highway Analysis Framework (CHAF) database, listed below.

KENTUCKY FY 2020 – FY 2026 HIGHWAY PLAN PROJECTS

- 3-20004.00 – Address pavement condition from MP 20.1 to 22.357
- 3-20005.00 – Address pavement condition from MP 9.375 to 14.85
- 3-20013.00 – Address pavement condition from MP 22.357 to 36.16
- 3-80002.00- New Interchange on the Louie Nunn Cumberland Expressway at KY 249 in Glasgow
- 8-20007.00 – Address pavement conditions from Mile Post (MP) 62.544 to 72.087

CHAFS

- IP20020006- Modernize the Louie B. Nunn parkway for possible utilization as a portion of I 66
- IP20140050- Improve safety and address geometric deficiencies on the Louie B. Nunn Parkway at the Exit 27 interchange

Resurfacing, Restoration, and Rehabilitation (3R) projects like those listed above, as well as future projects, can possibly be used to construct some of the recommendations from this study.

Traffic Volumes and Operations

According to functional classification criteria, the Cumberland Expressway is currently identified as an Expressway. Current year (2020) Average Annual Daily Traffic (AADT) volumes range from 4,600 – 12,900 vehicles per day (vpd). Future year (2045) AADT volumes range from 6,700 – 18,700 vpd. Levels of service (LOS) were determined for the corridor, and found to be in the acceptable range, LOS A-C, for the entire corridor.

Safety

A historical crash analysis was performed to examine traffic safety trends and to identify potential safety issues. Five years of data (2015 to 2019) was used. 2020 crash data was not used due to changes in driver behavior and traffic volumes during the COVID-19 pandemic. Within the five-year period, 835 crashes were reported in the study area. Of the total crashes, 758 (91%) occurred on the mainline and 77 (9%) occurred on interchange ramps. There were 12 fatal crashes and 19 serious injury crashes (3.7% combined) over the five years. Most crashes (692, 82.9%) were property damage only crashes. The majority of crashes (621, 74.4%) were also single-vehicle crashes. This is consistent with the low volume rural nature of the roadway. Rear-end and sideswipe crashes were the other two major crash categories.

KYTC uses a performance metric called Excess Expected Crashes (EEC) to evaluate the need for safety improvements on state highways. EEC compares the number of observed crashes on a highway to the number of expected crashes using a crash prediction model for that highway type. A positive EEC indicates that more crashes are occurring than the model would have predicted, meaning that improvements may be warranted. A negative EEC indicates that fewer crashes are occurring than expected. Much of the Cumberland Expressway has a negative EEC. The overall EEC for the study area was -37.9 crashes per year and the EEC for fatal, serious & minor injury (KAB) crashes was -0.66 crashes per year. These results indicate that the Cumberland Expressway is operating better than predicted for a rural freeway/parkway facility with similar traffic volumes. While the highway operates well overall, there are some specific locations that could warrant safety related improvements. These locations were investigated further as part of the review of specific design standard topics.

Study Recommendations

Existing conditions along the Cumberland Expressway were evaluated with regards to three areas: mainline, structures, and interchanges and ramps. The conditions along the Cumberland Expressway were compared to Interstate standards and a list of potential improvement concepts was developed. An iterative process was used, in which the initial list of potential improvement concepts was shared with the project team to obtain feedback. Based on that feedback, the consultant team investigated certain locations further with respect to crashes, record plans, or other available data to determine which improvement concepts would need to be constructed before Interstate conversion (initial conversion), and which could possibly be granted a Design Exception (DE) or Design Variance (DV) but would be necessary for full interstate compliance. DEs and DVs can be granted when the element

that does not meet Interstate standards does not contribute to a safety issue at that location. Planning level construction cost estimates were developed for the refined list of improvement concepts, which was presented and discussed in the final project team meeting. Based on feedback, a finalized list of recommended improvement concepts was developed. **Tables ES2** and **ES3** show the total costs (in 2021 dollars) for initial conversion and full compliance. An additional 15% was added to the construction cost to account for design and environmental related costs, and another 15% is added to the construction cost to account for any miscellaneous construction costs. **Table ES4** gives a summary of the improvement concepts recommended as part of this study. The table includes the construction cost in 2021 dollars, and whether the improvement would likely be needed prior to Interstate conversion, or for full compliance to Interstate standards.

Table ES2: Cost Estimates for Initial Conversion to Interstate Design Standards

Total Initial Conversion Cost (2021 $)	$26,351,243
Total Initial Conversion Construction Cost	$20,270,187
Design + Environmental (15%)	$3,040,528
Miscellaneous (15%)	$3,040,528

Table ES3: Cost Estimates for Full Compliance with Interstate Design Standards

Total Full Compliance Cost (2021 $)	$41,548,347
Total Full Compliance Construction Cost	$31,960,267
Design + Environmental (15%)	$4,794,040
Miscellaneous (15%)	$4,794,040

Table ES4: Summary of Recommended Improvements to Upgrade the Cumberland Expressway to Interstate Standards

Mainline								
Category	Subcategory	Miles	Cost (2021 $)	Initial Conver-sion	Full Compli-ance	Requires Design Exception	Requires Design Variance	Safety Concerns
Shoulders	Widen inside shoulder from 3' to 4'	15.086	$2,240,000		✓	✓		YES
Superelevation	Increase superelevation (locations with safety issues)	1.215	$623,000	✓				YES
	Increase superelevation (locations without safety issues)	0.104	$55,000		✓	✓		
Headlight Sight Distance	Increase curve length	0.112	$459,000		✓		✓	
Guardrail	Replace damaged guardrail	5	$807,000	✓				YES
	Add new guardrail to address safety issues	2.433	505,387	✓				
	Add new guardrail to address clear zone issues	2.5	$662,000	✓	✓		✓	
	Replace all guardrail less than 31"	29.2	$4,640,280		✓		✓	
Interchanges and Ramps								
Ramps - Accel/Decel	Exit 14 (KY 90) Increase EB accel length to 580'	N/A	$163,000	✓				
	Exit 78 (KY 80) Increase WB accel length to 580'	N/A	$138,000	✓				
Lane Width	Exit 88 (US 27) Increase cloverleaf lane width to 15'	N/A	$182,000	✓				
Interchange Rebuild	Exit 27 (US 68, Glasgow Road) Reconfigure to standard diamond	1.667	$15,000,000	✓				
Bridges								
Bridge Railing	Replace metal railing (locations with safety issues)	9	$1,179,800	✓				YES
	Replace metal railing (locations without safety issues)	11	$1,170,000		✓		✓	
Bridge Width	Widen bridge 7.5 ft	2	$1,042,800		✓		✓	
Bridge over Fishing Creek	100B00074L/100B00074R - Bridge over Fishing Creek - Replace bridge railing + widen 1 ft	1	$2,083,000		✓	✓		YES
	100B00074L/100B00074R - Bridge over Fishing Creek - Replace bridge railing + HFST	1	$1,010,000	✓				YES

Additional Safety and Operational Improvement Recommendations

A list of additional safety and operational improvements was developed to recommend improvements for locations that meet the design criteria but have a noted safety or operational deficiency that should be addressed.

Table ES5 shows the total cost (in 2021 dollars) of these improvements with an additional 15% added for design and environmental related costs, and another 15% for miscellaneous construction costs. **Table ES6** shows a summary of these recommendations.

Table ES5: Cost Estimates for Additional Safety and Operational Improvements

Total Operational and Safety Improvement Cost (2021 $)	$4,724,850
Total Operational and Safety Improvement Construction Cost	$3,634,500
Design + Environmental (15%)	$545,175
Miscellaneous (15%)	$545,175

Table ES6: Summary of Recommended Additional Safety and Operation Improvements

Category	Subcategory	Count	Cost (2021 $)	Safety Concern
Upgrade Ramp Terminal Design	Remove or modify channelization and modify right turn radius @ Exit 14 (KY 90) EB ramp	1	$30,000	YES
Add Traffic Signal at Interchange Ramps	Signalize the Exit 11 (US 31E) WB Ramp Terminal	1	$250,000	YES
Safety Improvements at KY 914	Continue High Friction Surface Treatment	1	$68,000	YES
Median Turnarounds	Remove median turnarounds	5	$60,000	NO
	Remove median turnarounds and install delineation bollards	5	$67,500	NO
	Pave gravel median turnarounds	7	$70,000	NO
	Install new median turnaround	1	$20,000	NO
Safety Improvements at WB On Ramp to I-65	Add signing, striping, and rumble strips	1	$10,000	YES
Cable Median Barrier	Add cable median barrier to prevent crossover crashes	16.1 (mi)	$3,059,000	YES

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