



KENTUCKY TRANSPORTATION CABINET

# Western Kentucky Parkway Upgrade Study

Executive Summary • May 2022



# Executive Summary

The Kentucky Transportation Cabinet (KYTC) initiated this planning study to identify and evaluate potential improvements that would be necessary to upgrade the Wendell H. Ford Western Kentucky Parkway (WKP) to meet current Interstate design standards. The study area, shown in **Figure ES1**, extends from Interstate 165 (I-165) in Ohio County (MP 76.758) through Grayson and Butler counties to continues to I-65 in Hardin County (MP 136.443)

State and local officials have expressed interest in redesignating this eastern portion of the WKP as an Interstate. Converting this portion of the highway would link two Interstates (I-65 and I-165) and would provide a signed east to west Interstate connection between Central and Western Kentucky. This study outlines what may be required to accomplish the redesignation for the WKP. It will identify and evaluate short-term and long-term improvement strategies to upgrade the WKP to current (2021) Interstate design standards. The study also identifies improvement strategies to address specific traffic operations and safety issues identified during the process. 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 technical evaluation and KYTC and FHWA input

## Interstate Design Standards

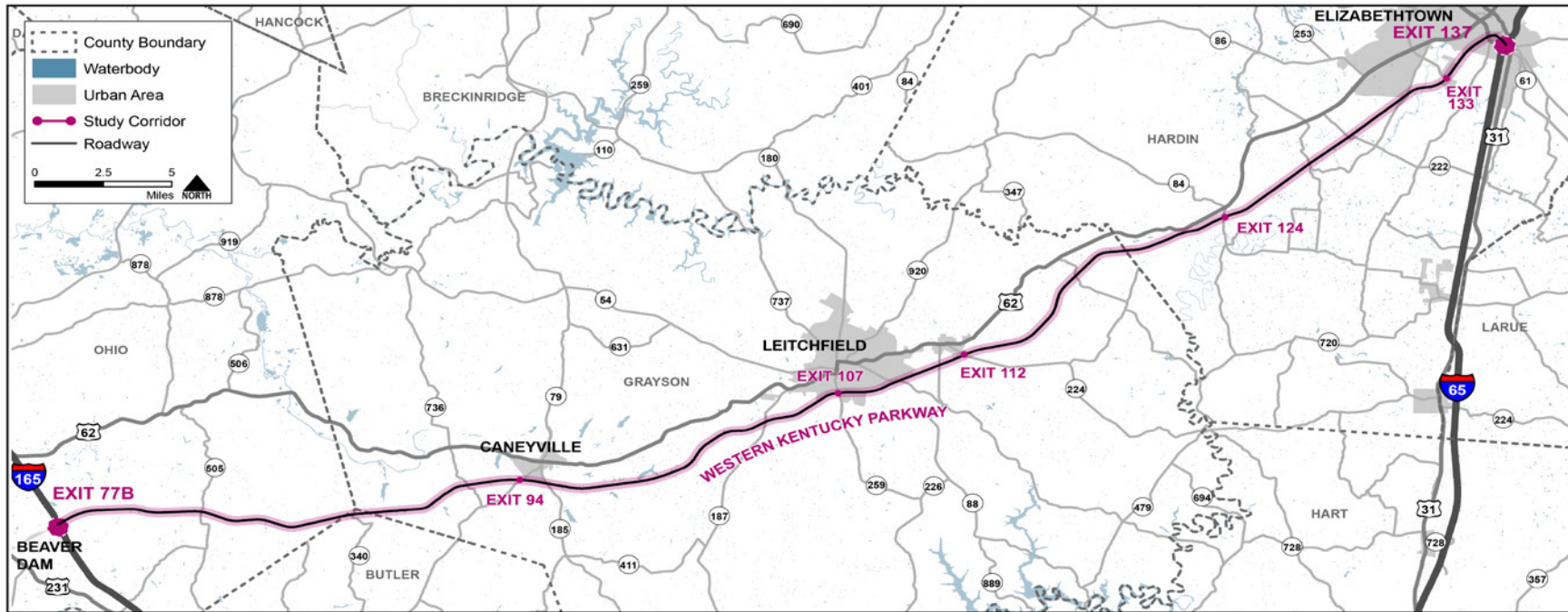
FHWA identifies ten controlling design criteria that define the operational and safety performance of an Interstate. A Design Exception (DE) can be requested when design features do not meet those standards if there is not an associated safety issue. The ten controlling criteria apply to high speed (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

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

This study evaluates the design features of the WKP for compliance with FHWA's ten controlling criteria as well as the American Association of State Highway Transportation Officials (AASHTO) and KYTC design guidelines 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 FHWA's ten controlling criteria whereas those without an asterisk are KYTC standards. A Design Variance (DV) can be requested for design features that do not meet the KYTC or AASHTO guidelines 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 with respect to the listed official reference. A technical analysis was conducted to determine study recommendations.

<sup>1</sup> 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 seven pavement rehabilitation projects in the study area included in *Kentucky's Fiscal Year (FY) 2020 – FY 2026 Highway Plan*, and six projects in the vicinity of the study area in the KYTC Continuous Highway Analysis Framework (CHAF) database, listed below. Item No. 4-20016.00 was let for construction in October 2021 and Item No. 4-20001.00 was combined with 4-20002.00 and 4-20003.00 and was let in April 2022.

### Kentucky FY 2020 – FY 2026 Highway Plan Projects

- ▶ 2-80201.00 - Western Kentucky Parkway - Reconstruct interchange at US 431 at Central City
- ▶ 4-20001.00 – Address pavement deficiencies from MP 111.25 – 112.4
- ▶ 4-20002.00 – Address pavement condition from MP 112.4 – 114.8
- ▶ 4-20003.00 – Address pavement condition from MP 114.8 – 116.95
- ▶ 4-20016.00 – Address pavement condition from MP 120.93 – 132.4 – ESTIMATED COMPLETION END OF 2022

### CHAFs

- ▶ IP20130047 – Address need for new interchange access to the WKP at KY-505.
- ▶ IP20100007 – Construct a truck parking facility for overnight parking of semi tractor trailers (location to be determined)
- ▶ IP20060115 – Improve safety and mobility of the WKP (WK9001) and the William Natcher Parkway (WN9007) interchange to address interstate standards.
- ▶ IP20070103 – Address safety and service concerns of the WK-9001 and US 231 interchange near Beaver Dam.
- ▶ IP20060114 – Address need for additional parkway access at KY 1245 near Rockport on the WKP.

Some of the recommendations from this study could possibly be included in future resurfacing, restoration, and rehabilitation (3R) projects, as well as any other future projects within the study boundaries.

## Traffic Volumes and Operations

According to functional classification criteria, the WKP is currently identified as a Rural Freeway Expressway. Current year (2020) Average Annual Daily Traffic (AADT) volumes range from 9,080 – 34,600 vehicles per day (vpd). Future year (2045) AADT volumes range from 11,640 – 44,380 vpd. A screening process was used to evaluate level of service (LOS) along the corridor. Based on this screening analysis, the WKP currently operates at an acceptable level of service and is operating below capacity. In the future year of 2045, the majority of the WKP is expected to operate at an acceptable LOS, with the exception of two segments between the I-65 and US 31W Bypass interchange in Elizabethtown, which will operate at LOS D.

## 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, 919 crashes were reported in the study area. Of the total crashes, 816 (89%) occurred on the mainline and 103 (11%) occurred on interchange ramps. There were 12 fatal crashes and 23 serious injury crashes (3.8% combined) over the five-year period. The severity type involving the most crashes (728, 79.4%) were property damage only crashes. A majority of crashes in the study area (635, 69.1%) were single-vehicle crashes. This is consistent with the low volume rural nature of the majority of the roadway. Rear-end crashes and sideswipe crashes were the other two major crash categories. The angle crashes had the highest average severity of all the categories with ten of the 38 involving a fatality or injury (3 fatal, 2 severe injury, and 5 minor injury). It was also noted that commercial vehicles were involved in 11% of all reported crashes, which is a lower percent than the total truck percentage of traffic volume on the WKP.

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. The WKP within each county experiences a mixture of positive and negative EEC values. The area of western Hardin County and eastern Grayson County is more concentrated with fatal and injury crashes compared to other segments of the WKP within the study area. 211 crashes occurred in this area including five fatal crashes and five serious injury crashes. The overall EEC for the study area was a negative value of -9.82 crashes per year. The EEC for KAB (fatal, serious injury, minor injury) crashes total +3.02 crashes per year and the EEC for CO (possible injury, property damage only) crashes total -12.84 crashes per year. These results indicate that overall, the WKP is operating better than would be predicted for a rural freeway / parkway with similar traffic volumes, but it is experiencing more injury and fatal crashes. One caveat to the EEC data is that there are some segments of the corridor in western Grayson County that do not have calculated EEC values.

## Study Recommendations

Existing conditions along the WKP were evaluated with regards to three areas: mainline, structures, and interchanges and ramps. The conditions along the WKP 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 DE or 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% is 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 \$)	Low	High
Total Initial Conversion Cost (2021 \$)	\$56,520,299	\$64,164,689
Total Initial Conversion Construction Cost	\$43,477,153	\$49,357,453
Design + Environmental (15%)	\$6,521,573	\$7,403,618
Miscellaneous (15%)	\$6,521,573	\$7,403,618

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

Total Full Compliance Cost (2021 \$)	Low	High
Total Full Compliance Cost (2021 \$)	\$102,591,683	\$127,136,073
Total Full Compliance Construction Cost	\$78,916,679	\$97,796,979
Design + Environmental (15%)	\$11,837,502	\$14,669,547
Miscellaneous (15%)	\$11,837,502	\$14,669,547

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

Mainline								
Category	Subcategory	Miles	Cost (2021\$)	Initial Conversion	Full Compliance	Requires DE	Requires DV	Safety Issue
Shoulders	Widen inside shoulder to consistent 4 foot minimum	17.147	\$2,546,000	✓				Yes
Superelevation	Increase superelevation (locations with safety issues)	7.32	\$10,309,000	✓				Yes
	Increase superelevation (locations without safety issues)	1.86	\$1,208,000		✓	✓		No
Headlight Sight Distance	Increase curve length	0.552	\$1,608,000		✓		✓	No
Guardrail	Replace damaged guardrail	13.8	\$2,565,240	✓				No
	Regrade crash cushions	-	\$10,000	✓				No
	Raise guardrail height to 31 inches at areas with safety issues	4.986	\$1,401,413	✓				Yes
	Replace all guardrail less than 31 inches	25.7	\$4,949,360		✓			No
Clear Zone	Add guardrail where clear zone is not met	12.818	\$2,443,766		✓		✓	Yes
Interchanges								
Ramps - Accel/ Decel	Exit 94 (KY 79) Increase WB accel length to 580'	1	\$184,000	✓				No
	Exit 107 (KY 259) Increase EB decel length to 390'	1	\$52,000	✓				Yes
	Exit 124 (KY 84) Increase WB accel length to 580'	1	\$187,000	✓				No
Lane Width	Exit 137 (I-65) Increase EB cloverleaf off ramp lane width to 15 feet	1	\$148,000	✓				No
Superelevation	Add auxiliary speed signs	6	\$30,000	✓				Yes
Control of Access	Increase control of access to 300 feet (rural) or 100 feet (urban)	5	\$5,370,000	✓				Yes
Interchange Spacing / Reconfiguration	Exit 137 (I-65) Phase 1: Add auxiliary lanes and increase superelevation / bridge clearances	N/A	\$11,000,000	✓				Yes
	Exit 137 (I-65) Phase 2: Provide direct connection from I-65 SB to US 31W Bypass	N/A	\$5,500,000		✓			Yes
	Exit 137 (I-65) Phase 3A: Provide direct connection from I-65 NB and Lincoln Parkway to US 31W	N/A	\$31,000,000		✓			Yes
	Exit 137 (I-65) Phase 3B: Braid movements from I-65 NB, SB, and Lincoln Pkwy to provide direct connection to US 31W	N/A	\$18,000,000		✓			Yes

DE = Design Exception, DV = Design Variance

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

Bridges								
Category	Subcategory	Miles	Cost (2021\$)	Initial Conversion	Full Compliance	Requires DE	Requires DV	Safety Issue
Bridge Railing	Replace metal railing	6	\$526,000	✓	✓			Yes
Bridge Width	If Bridge Length <=200ft widen 1.0 foot If Bridge Length >200ft widen 7.5 feet	6	\$2,169,600	✓	✓			Yes
Bridge Vertical Clearance	Replace bridge or lower pavement to achieve minimum vertical clearance	7	\$8,719,300	✓				Yes
	Replace bridge to achieve minimum vertical clearance	7	\$14,599,600	✓				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**

Description	Cost
Total Operational and Safety Improvement Cost (2021 \$)	\$10,393,318
Total Operational and Safety Improvement Construction Cost	\$7,994,860
Design + Environmental (15%)	\$1,199,229
Miscellaneous (15%)	\$1,199,229

**Table ES6: Summary of Recommended Additional Safety and Operation Improvements**

Additional Safety and Operational Improvements				
Category	Subcategory	Length	Cost	Possible Design Related Safety Issue
Shoulders and Cable Median Barrier	Widen outside shoulders to 12 feet	3.326	\$894,526	Yes
	Add cable median barrier	54.094	\$6,750,000	Yes
Median Turnarounds	Remove median turnarounds	N/A	\$132,000	No
	Pave median turnaround	N/A	\$10,000	No
Interchange Ramp Improvements	Improve ramp terminal at Exit 107 (KY 259) WB ramp	N/A	\$10,000	Yes
	US31 Bypass SB to EB Loop Ramp - Add High Friction Surface Treatment	0.32	\$198,333	Yes



