

June, 2020

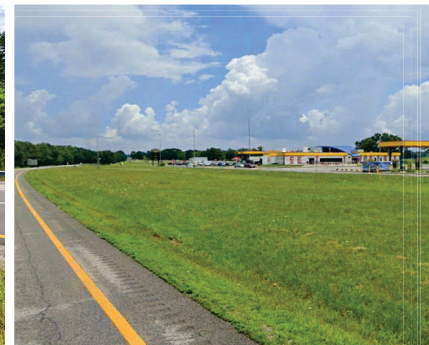
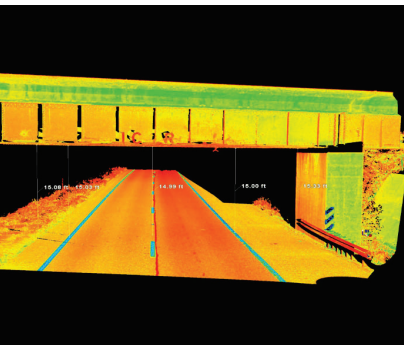
Western Kentucky Parkway Upgrade Study Executive Summary



Hopkins, Muhlenberg, and
Ohio Counties, KY



HMB Professional Engineers, Inc.



Introduction

The Western Kentucky Parkway Upgrade Study was initiated by the Kentucky Transportation Cabinet (KYTC) to identify and evaluate potential improvement options to upgrade a portion of the parkway to interstate standards for inclusion into the interstate system. The portion under consideration for this study is between I-69 / Edward T. Breathitt Pennyriple Parkway (EBP) in Hopkins County (MP 38.326) and I-165 (formerly William H. Natcher Green River Parkway [WNP]) in Ohio County (MP 77.143). This includes interchanges with KY 175 (Exit 48), KY 181 (Exit 53), US 431 (Exit 58), and US 231 (Exit 75). Though not numbered as exits, the ramps associated with the Kentucky State Police (KSP) Post No. 2 and the Beaver Dam Rest Area (Huck's) are included as part of the study considerations. The system interchanges with I-69 and I-165 are not included as part of the evaluation area. KYTC and the Federal Highway Administration (FHWA) concurred at the Western Kentucky Parkway Upgrade Scoping Meeting, held April 23, 2019, that both system interchanges were felt to be appropriate as configured and did not require additional consideration at this time. **Figure ES-1** depicts the study area location for reference.

Study Objective and Goals

Objective

The *Objective* of the Western Kentucky Parkway (WKP) Upgrade Study is to identify and evaluate potential improvement options to upgrade a portion of the WKP to interstate standards between I-69 in Hopkins County (MP 38.326) and I-165 in Ohio County (MP 77.143) for inclusion into the interstate system.

Study Goals

To achieve the desired outcomes noted above, the following goals were identified:

- Consider system linkage – connectivity between I-69 and I-165
- Evaluate safety
- Identify roadway deficiencies – relative to interstate standards
- Prepare upgrade options and planning-level cost estimates

Study Design Considerations

According to the FHWA memorandum “Revisions to the Controlling Criteria for Design and Documentation for Design Exceptions” dated May 5, 2016, there are ten (10) criteria considered controlling for the design features that define the operational and safety performance of a highway. These include:

- | | |
|----------------------------|--|
| 1. Design Speed | 6. Stopping Sight Distance |
| 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 |

In this study, these design features for the WKP were evaluated for compliance with AASHTO and KYTC design criteria for an interstate facility. **Table ES-1** summarizes the design standards and notes the guidelines for each of the identified design features noted above.

Figure ES-1. Study Area

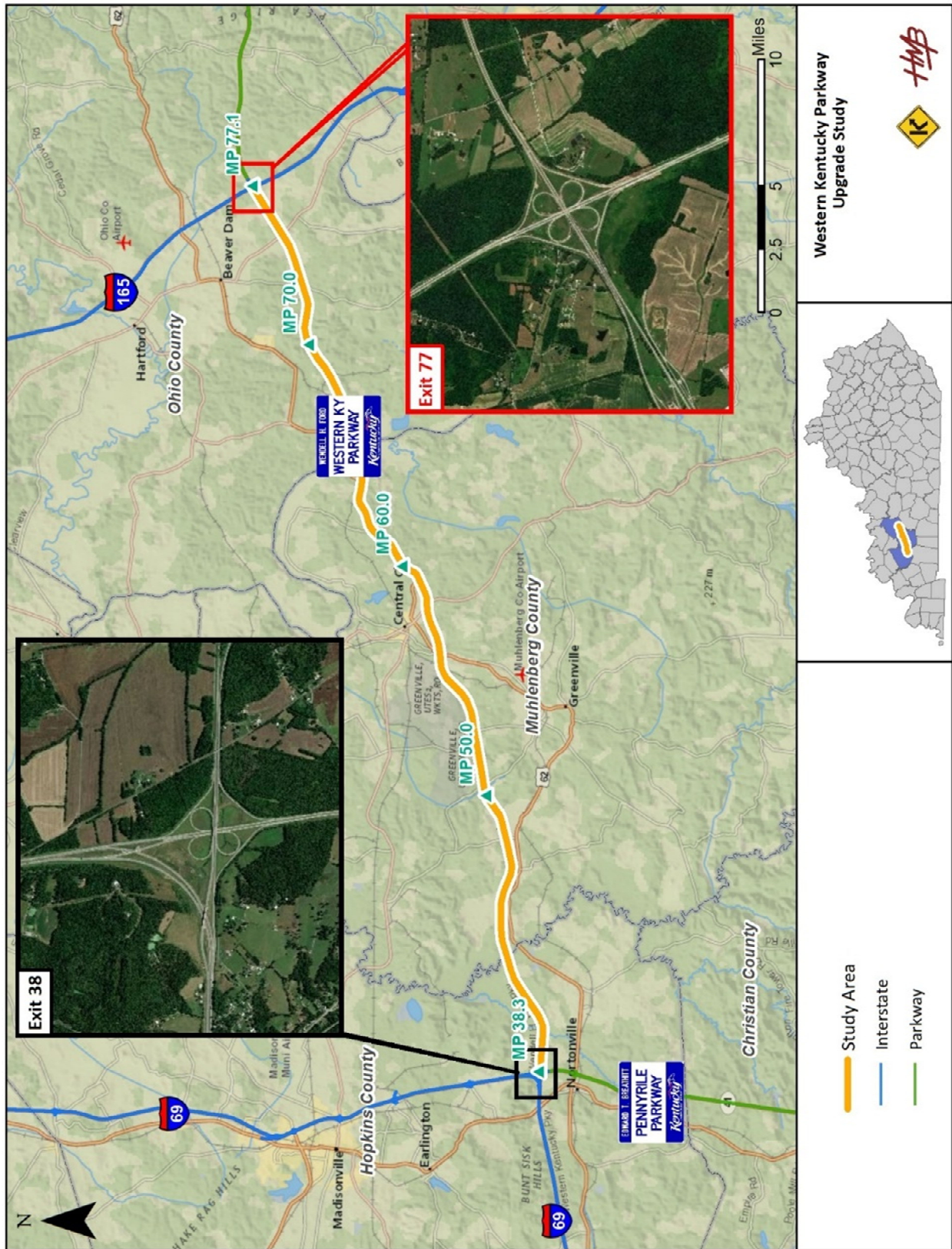


Table ES-1. Design Criteria for Rural, 4-Lane Interstate Facilities

Design Element	Governing Agency	Reference	Mainline	Ramps	Loops	Design Exception	Design Variance	Other Considerations
Design Speed	AASHTO	2018 Green Book	70 mph	35 mph	20 mph	✓		
Lane Width	AASHTO	2018 Green Book	12'	14'	15'	✓		
Inside Shoulder	AASHTO	2018 Green Book	4'	2'-4'		✓		
Outside Shoulder								
Tuck DDHV <= 250	AASHTO	2018 Green Book	10'		8'-10'	✓		
Truck DDHV > 250	AASHTO	2018 Green Book	12'			✓		
Median Width	AASHTO	Roadside Design Guide	30'-60'	N/A			✓	
Median Turnarounds	AASHTO	2018 Green Book	May be spaced at 3 to 4 mile intervals or as needed					✓
Clear Zone	AASHTO	Roadside Design Guide	30'-46'		10'-14'		✓	
Guardrail Height	KYTC	KYTC Standard Drawings		31"			✓	
Horizontal Alignment								
Superelevation	AASHTO	2018 Green Book		8% Max				
Minimum Radius	AASHTO	2018 Green Book	1810'	314'	134'	✓		
Cross Slopes	AASHTO	A Policy on Design Standards - Interstate System		Greater than 1.5%		✓		
Vertical Alignment								
Vertical Grade	AASHTO	A Policy on Design Standards - Interstate System/2018 Green Book	4%		4% - 8%	✓		
Crest Vertical Curves - Stopping Sight Distance	AASHTO	2018 Green Book	730'	250'	76'	✓		
Sag Vertical Curves - Head Light Sight Distance	AASHTO	2018 Green Book				✓		
Bridges and Overpasses								
Bridge Width <= 200 feet	AASHTO	A Policy on Design Standards - Interstate System	37.5'		N/A	✓		
Bridge Width > 200 feet	AASHTO	A Policy on Design Standards - Interstate System	31'		N/A	✓		
Overpass Vertical Clearance	AASHTO	A Policy on Design Standards - Interstate System	16'		N/A	✓		
Overhead Sign Vertical Clearance	AASHTO	2009 MUTCD		17'		✓		
Divergence Angle	AASHTO	2018 Green Book		2 to 5 degrees			✓	
Speed Change Lanes	AASHTO	2018 Green Book	Varies depending on the design speed of the entering or exiting curve				✓	
Interchange Spacing	AASHTO	2018 Green Book		2 miles			✓	
Interchange Control of Access	AASHTO	A Policy on Design Standards - Interstate System		300'			✓	

Study Information

A range of data was collected to inform the study process. The data and findings include the following:

Committed and Identified Projects

A summary of study area projects was compiled based on reviews of Kentucky's FY 2018 – FY 2024 and FY 2020 – FY 2026 Highway Plans and KYTC's Continuous Highway Analysis Framework (CHAF) database. No other phases of this project are identified in Kentucky's Fiscal Year (FY) 2020 – 2026 Highway Plan. There are other projects that are within the study area that would affect the study. These include multiple projects to address pavement condition of the WKP and interchange modifications at US 431, US 231, KY 1245, and at I-165. These are upcoming opportunities to address certain deficiencies that are already programmed.

Traffic Volumes and Analysis

According to functional classification criteria, the WKP is currently identified as an Expressway. Current year (2019) average annual daily traffic (AADT) volumes range from 10,000 – 11,200. Future year (2045) AADT volumes range from 13,000 – 14,500. The level of service evaluation that assesses roadway operation was found to be acceptable in both years at LOS A.

Crash Analysis

As part of this study, historical crash data was analyzed to identify high crash locations. Historical crash records were extracted from the Kentucky State Police's (KSP) *Collision Database* for a five-year period (January 1, 2014 – December 31, 2018). Seventy (70) high crash spots were identified using the Critical Crash Rate methodology defined in *Analysis of Crash Data in Kentucky (2014-2018)*. This means that there are 70 identified locations where the critical crash rate is greater statistically than the average crash rate (greater than 1.0) for similar roadways and represents a rate above which crashes may be occurring in a non-random fashion. An evolving analysis method was also used to evaluate crash patterns that is based on the Highway Safety Manual (HSM). Excess Expected Crashes (EEC) is a measure used to predict crash amounts. Positive EEC values indicate more crashes have occurred than expected in the segment. If the EEC is negative, it indicates that there are less crashes than expected. There was a total of 246.66 EEC per mile along the mainline of the WKP. This means more crashes occurred than what was predicted for that roadway type. Reviewing the type and severity of crashes, most of the crashes were single vehicle collisions, with almost one-third of those involving an animal. Looking at the detailed crash reports, there appeared to be a number of crashes that occurred during inclement weather with water pooling or snow / ice on the road.

Study Meetings

The project team consisting of KYTC, the Green River Area Development District (GRADD), the Pennyrite Area Development District (PADD), and the consultant met twice to discuss progress and next steps. Also, during the study, local officials and stakeholders were engaged to obtain their input and keep them informed of the process. At the first meeting, the project team presented the study purpose, project background, crash and traffic analysis, existing conditions, and next steps. Feedback was requested through comment forms. All respondents noted their support of the project. At the second (and final) meeting, the project team presented the study objectives and goals, study background, crash and traffic analysis update, the work item summary, and next steps. Attendees were given the opportunity to ask questions and provide input on the study findings.

Summary of Key Findings

Mainline Geometry / Typical Section

<i>Design Speed/ Superelevation</i>	26 horizontal curves do not meet a 70 mph design speed based on the relationship between each curve's radius and its superelevation rate. The maximum allowable side friction factor (0.10) for 70 mph was not exceeded.
<i>Lane Width</i>	Lane widths are 12 feet which meets minimum guidelines for an interstate facility.
<i>Shoulder Width</i>	Left shoulder widths are 4-foot and right shoulder widths are 10-foot which meets minimum guidelines for an interstate facility.
<i>Median Width</i>	Median is a 30-foot depressed median which does not meet minimum guidelines according to one set of criteria. However, another set of criteria based on AADT, states a median barrier is optional.
<i>Clear Zones</i>	113 locations do not meet minimum clear zone requirements for an interstate facility.
<i>Guardrail Placement and Condition</i>	All guardrail end treatments are adequate for an interstate facility. All field measurements of guardrail heights were below the KYTC standard of 31 inches.
<i>Horizontal Alignment</i>	All mainline horizontal curves meet minimum guidelines for an interstate facility.
<i>Cross Slopes</i>	Seven measured locations have a cross slope less than the standard for an interstate facility.
<i>Vertical Grade</i>	Grade meets design criteria for rural sections in rolling terrain.
<i>Vertical Curves</i>	Four sag vertical curves do not meet headlight sight distance criteria.

Bridges and Overpasses

<i>Bridges Less Than or Equal to 200 Feet</i>	Nine mainline bridges do not meet minimum width of 37.5 feet for an interstate facility.
<i>Bridges Greater Than 200 Feet</i>	Four mainline bridges do not meet minimum width of 31.0 feet for an interstate facility.
<i>Structures with Curbs</i>	Four bridges have railings / barriers that will need to be modified to meet guidelines for an interstate facility.
<i>Vertical Clearance of Overpasses</i>	Nine locations where overpass structures do not meet a minimum vertical clearance of 16 feet for an interstate facility.
<i>Bridge Conditions</i>	All WKP mainline and overpass bridges have NBI ratings per KYTC Bridge Inspection Reports that result in a bridge condition of "Fair" except for the abandoned railroad crossing at MP 68.570.
<i>Overhead Signs and Trusses</i>	All meet the minimum 17-foot vertical clearance for an interstate facility with the exception of the bridge mounted sign for Exit 58 Central City / Drakesboro, over the westbound lanes (16.83 feet).

Interchanges and Ramps

Design Speed	All interchange ramps meet the minimum criteria for design speed, except for the westbound on-ramp at Exit 58.
Lane Width	Interchange ramp lane widths range from 15 to 18 feet and meet guidelines for an interstate facility.
Shoulder Width	All ramps at interchanges meet shoulder width requirements for an interstate facility, with the exception of the ramps at Huck's.
Horizontal Alignment	All ramps meet minimum criteria for an interstate facility.
Vertical Grade	All ramps meet minimum criteria for an interstate facility.
Vertical Curves	All crest vertical curves on ramps at interchanges meet minimum requirements for stopping sight distance; however, two sag vertical curves do not meet minimum requirements for headlight sight distance.
Speed Change Lanes	12 ramps do not meet acceleration and deceleration lengths for an interstate facility.
Weaving Characteristics	The interchange between the WKP and US 431 (Exit 58) has less than minimum weaving distance for an interstate facility.
Interchange Configuration	The crash data did not show the interchange configuration for the following locations to be an issue: KSP Post No. 2, KY 175, KY 181, and Huck's. The interchange at US 431 is in a high crash rate spot (CRF = 5.70 and EEC = 8.73).
Interchange Spacing	Two segments do not meet the minimum spacing guidelines for interstate facilities in rural areas of 3 miles: I-69 (Exit 38) to KSP Post No. 2 (1.35 miles), and US 231 (Exit 75) to Huck's (1.01 miles).
Interchange Control of Access	Minimum criteria for interchange control of access was not met at the following locations due to less than required spacing between the ramp and access point: KY 175, KY 181, US 431, and US 231.

Summary of Improvement Options

In order to upgrade the WKP to interstate standards, a range of potential work items were investigated to address the deficiencies identified in this study. These were eventually grouped into the following Improvement Options:

- **No-Build:** The WKP would remain as it currently is (excluding committed projects identified in the Highway Plan) and would not be signed as I-569.
- **Necessary Upgrades and Spot Safety Improvements - \$29,109,400:** The WKP would be upgraded to meet some, but not all, current interstate design criteria. Design exceptions and design variances would be required for design features that are not upgraded. Further investigation would be needed to determine if those design exceptions and design variances are acceptable to KYTC and FHWA.

All upgraded items that were included in recent programmatic agreements between KYTC and FHWA on the Edward T. Breathitt Parkway (EBP) and the William H. Natcher Green River Parkway (WNP) are included in this option. For those conversion agreements, mainline bridges that did not meet minimum width were not widened, which is also assumed for this option. The interchange reconfiguration at US 431 (Exit 58) that was investigated as a part of this study is included. Other items excluded from this option include:

- Work addressing horizontal and vertical curves
- Guardrail and guardrail end treatments that fall within the three scheduled pavement rehabilitation projects.
- Work related to achieving minimum clear zone.
- Median barrier installation due to the low volume of traffic and low frequency of cross-over crashes.
- All additional operational and safety considerations with the exception of the interchange reconfiguration at US 431 (Exit 58).
- **Fully Compliant Reconstruction – \$79,988,600:** This improvement option addresses all deficiencies identified through this study that would be considered design exceptions and design variances based on interstate design criteria. Similar to the Necessary Upgrades and Spot Safety Improvements option, all additional operational and safety considerations with the exception of the interchange reconfiguration at US 431 (Exit 58) are excluded.

While not necessarily required to upgrade the WKP to interstate standards, several locations and improvement concepts were identified as a result of this study. These additional operational and safety considerations include work items to address inside shoulder widening at Huck’s, improvements to the Green River Bridge to address safety issues, and potential issues identified with the configuration of KSP Post No. 2’s access ramps.

A detailed summary of the work items and costs are included in the following tables (**Table ES-2 and ES-3**) and figure (**Figure ES-2**). For the Fully Compliant Reconstruction, the highest cost method was assumed to address each design exception or design variance and was included in the estimated total of this improvement option. Further investigation is needed to determine if lower cost fully compliant construction options are feasible.

Table ES-2. Operational and Safety Considerations Work Item Summary



















Map Symbol	Upgrade/Improvement Categories and Options	No. Locations or Milepoints	Work Item Cost	Design Exception	Design Variance	Other Considerations
	Inside Shoulder Widening - Huck's Gas Station	75.08 - 76.42	\$ 1,096,000			✓
	Green River Bridge					
	Lighting		\$ 375,900			✓
	KSP Post No. 2	1				
	Collector Distributor Road (Option 1)		\$ 1,387,100			✓
	Relocate KYTC Maintenance Facility (Option 2)		\$ 1,273,500			✓
Subtotal			\$ 2,745,400 - \$ 2,859,000			
Estimated Design and Environmental (15%)			\$ 411,900 - \$ 428,900			
Miscellaneous (15%)			\$ 411,900 - \$ 428,900			
TOTAL			\$ 3,569,200 - \$ 3,716,800			
PROGRAMMATIC AGREEMENT WITH KYTC AND FHWA MAY NOT ENCOMPASS ALL WORK ITEMS (ALL COSTS IN 2019 DOLLARS)						

Table ES-3. Western Kentucky Parkway Work Items Summary

Map Symbol	Upgrade/Improvement Categories and Options	No. Locations or Milepoints	Work Item Cost	Design Exception	Design Variance	Other Considerations
MAINLINE						
	Horizontal Curves					
	In high crash locations	18	\$ 5,678,000	✓		
	Not in high crash locations	8	\$ 2,704,400	✓		
	Vertical Curves	1	\$ 476,800		✓	
	Cross Slopes (Flatter than 1.5%)	N/A	N/A	✓		
	Guardrail and Guardrail End Treatments (100%)					
		38.33 - 42.81	\$ 670,000		✓	
	(Future Pavement Rehab Location)	42.81 - 45.95	\$ 441,800		✓	
		45.95 - 65.68	\$ 2,409,600		✓	
	(Future Pavement Rehab Location)	65.68 - 77.14	\$ 1,408,300		✓	
	Clear Zones (Less than 30')	113				
	Re-grading (Option 1)		\$ 8,922,100		✓	
	Guardrail (Option 2)		\$ 2,766,700		✓	
	Median Width (Barrier Installation)	38.326 - 77.143				
	Cable Barrier (Option 1)		\$ 5,621,800		✓	
	Double Face Guardrail (Option 2)		\$ 5,661,400		✓	
	Median Turn Arouds	23	\$ 124,000			✓
STRUCTURES						
	Bridge Barrier/Width Compliance					
	Length <= 200' Overlay and Widening (Option 1)	11	\$ 3,891,900	✓		
	Length <= 200' Superstructure Replacement (Option 2)	11	\$ 5,457,700	✓		
	Length > 200' Overlay and Widening	4	\$ 5,526,400	✓		
	Bridge Barrier Retrofit (Lewis Creek & Green River)	2	\$ 483,300	✓		
	Vertical Clearances	9				
	Taper at 1" - 100' (Option 1)		\$ 5,058,900	✓		
	Taper at 1" - 50' (Option 2)		\$ 2,559,800	✓		
	Bridge Jacking (Option 3)		\$ 5,904,000	✓		
	Abandoned Railroad Bridge	68.57	\$ 150,000	✓		
INTERCHANGES						
	Acceleration / Deceleration Lanes	12	\$ 2,283,500		✓	
	Control of Access	4	\$ 3,165,000		✓	
	Exit 58 - Interchange Reconfiguration	1	\$ 10,546,600			✓
Subtotal			\$ 22,391,800 - \$ 61,529,600			
Estimated Design and Environmental (15%)			\$ 3,358,800 - \$ 9,229,500			
Miscellaneous (15%)			\$ 3,358,800 - \$ 9,229,500			
TOTAL			\$ 29,109,400 - \$ 79,988,600			
PROGRAMMATIC AGREEMENT WITH KYTC AND FHWA MAY NOT ENCOMPASS ALL WORK ITEMS						

Design Exception – deficiency that falls within FHWA’s 10 controlling design criteria

Design Variance – deficiency that does not fall within the 10 controlling criteria but does not adhere to minimum AASHTO or KYTC guidelines

Figure ES-2. Work Items Summary Map

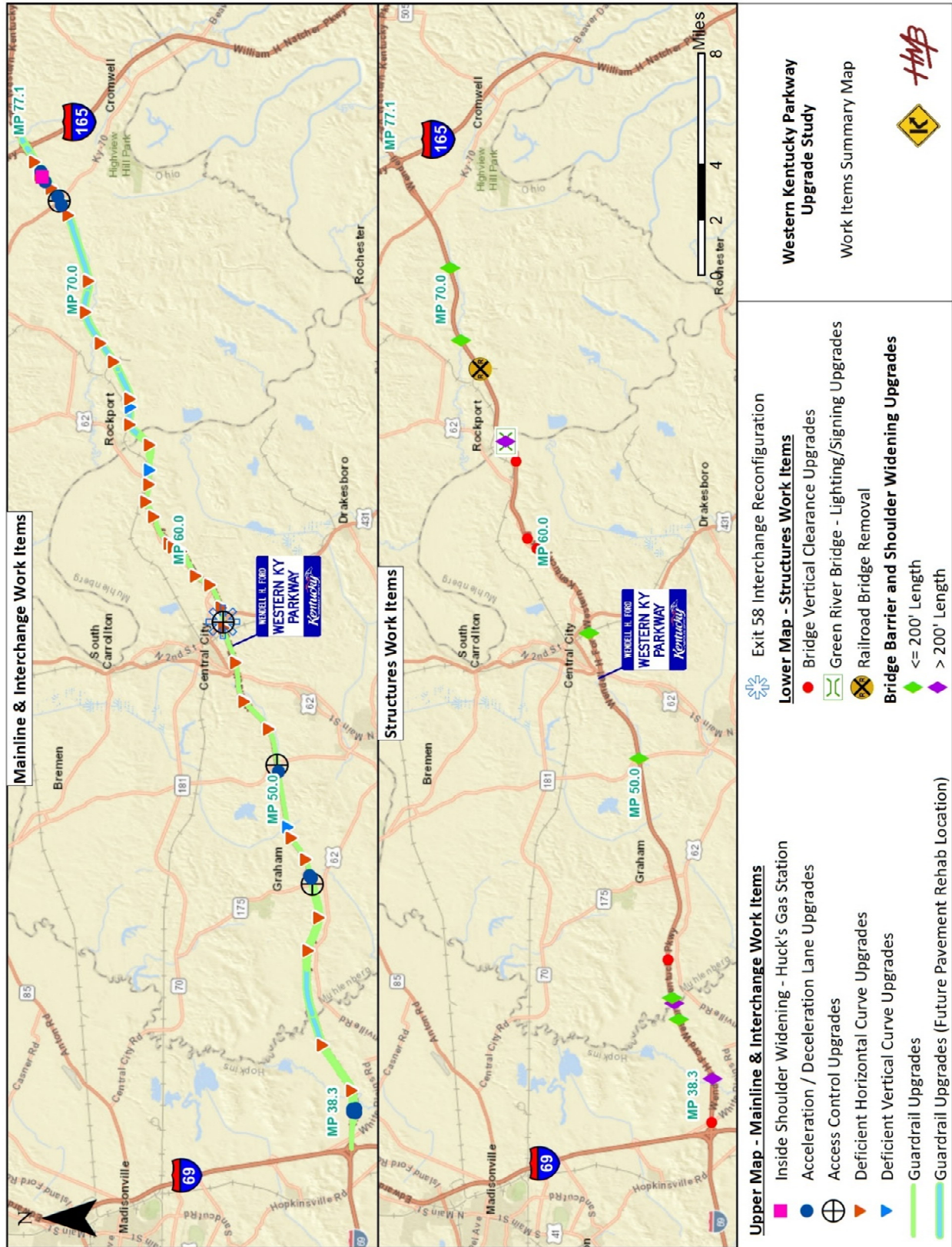


Figure ES-3. US 431 (Exit 58) Interchange Reconfiguration

