

# Appendix F

Mainline Improvement Concepts

Mainline														
Category	Subcategory	Measured Value	Design Standard	Deficiency	Direction	Length	Begin MP	End MP	Cost	Initial Conversion	Full Compliance	Requires Design Exception	Requires Design Variance	Possible Design Related Safety Issue
Shoulders	Widen inside shoulder from 3' to 4'	3	4	1	Both	12.20	72.09	84.29	\$1,811,000		✓			YES
	Widen inside shoulder from 3' to 4' (Currently varies from 3' to 4')	3	4	1	Both	2.89	85.49	88.38	\$429,000		✓	✓		-
Superelevation	Adjust superelevation	3.9	4.2	0.30	Both	0.043	39.541	39.584	\$23,000		✓	✓		-
	Adjust superelevation	3.9	4.4	0.50	Both	0.061	39.913	39.974	\$32,000		✓	✓		
	Adjust superelevation	3.9	4.2	0.30	Both	0.029	40.301	40.330	\$15,000	✓				YES
	Adjust Superelevation *	2.9	3.6	5.18	Both	0.210	62.332	62.542	\$108,000	✓				YES
	Adjust Superelevation *	3.4	3.6	5.18	Both	0.976	85.426	86.402	\$500,000	✓				YES
Headlight Sight Distance	Increase HLSD of the curve by 51 feet	679	730	51	EB	0.112	41.929	42.041	\$459,000		✓	✓		-
Guardrail	Replace damaged guardrail				Both	5			\$807,000	✓				N/A
	Add new guardrail to address clear zone issues				EB	0.052	72.107	72.159	\$23,237	✓				YES
					EB	0.395	73.01	73.405	\$77,568	✓				YES
					EB	0.515	83.851	84.366	\$96,576	✓				YES
					WB	0.126	56.096	56.222	\$34,958	✓				YES
					WB	0.169	56.271	56.44	\$41,770	✓				YES
					WB	0.235	60.274	60.509	\$52,224	✓				YES
					WB	0.396	76.787	77.183	\$77,726	✓				YES
				WB	0.545	83.821	84.366	\$101,328	✓				YES	
Add new guardrail to address clear zone issues				Both	2.5			\$662,000	✓				YES	
Replace all guardrail less than 31"				Both	29.2			\$4,640,280		✓		✓		

\* Indicates discrepancy between HIS data/record plans and field review, may be removed following detailed field survey

Bridges and Interchange Ramp Improvement Concepts

Bridges														
Category	Subcategory	Measured Value	Design Standard	Requirement	Direction	Length	Begin MP	End MP	Cost	Initial Conversion	Full Compliance	Requires Design Exception	Requires Design Variance	Possible Design Related Safety Issue
Bridge Railing	005B00067L - Bridge over I-65 - Replace bridge railing	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.052	0.031	0.083	133,600	✓				YES
	005B00067R - Bridge over I-65 - Replace bridge railing	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.052	0.031	0.083	133,600		✓		✓	-
	005B00068L - Bridge over Beaver Creek - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.053	8.199	8.252	135,700	✓				YES
	005B00068R - Bridge over Beaver Creek - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.053	8.188	8.241	135,700	✓				YES
	005B00071L - Bridge over US 31E - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.038	11.498	11.536	103,300		✓		✓	-
	005B00071R - Bridge over US 31E - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.038	11.467	11.505	103,300		✓		✓	-
	005B00075L - Bridge over Mt. Pisgan Rd. - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.040	18.260	18.300	107,400		✓		✓	-
	005B00075R - Bridge over Mt. Pishan Rd. - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.040	18.259	18.299	107,400		✓		✓	-
	085B00040L - Bridge over KY 640 - Replace bridge railing	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.024	24.132	24.156	72,500		✓		✓	-
	085B00040R - Bridge over KY 640 - Replace bridge railing	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.024	24.135	24.159	72,500		✓		✓	-
	085B00042L - Bridge over S. Fork Little Barren River - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.056	28.114	28.170	142,300	✓				YES
	085B00042R - Bridge over S. Fork Little Barren River - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.056	28.125	28.181	142,300	✓				YES
	085B00043L - Bridge over E. Fork Little Barren River - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.040	34.227	34.267	106,100			✓		-
	085B00043R - Bridge over E. Fork Little Barren River - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.040	34.226	34.266	106,100			✓		-
	001B00062L - Bridge over Pettys Fork - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.040	48.136	48.176	105,600	✓				YES
	001B00062R - Bridge over Pettys Fork - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.040	48.131	48.171	105,600	✓				YES
	001B00063L - Bridge over Russell Creek - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.055	50.103	50.158	139,500	✓				YES
	001B00063R - Bridge over Russell Creek - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.055	50.069	50.124	139,500	✓				YES
	001B00069L - Bridge over Russell Creek - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.050	56.249	56.299	128,900			✓		-
	001B00069R - Bridge over Russell Creek - Replace bridge railing*	Substandard	MASH TL-4	Replace with Standard Drawing BHS-010	EB and WB	0.050	56.243	56.293	128,900			✓		-
Bridge Widening	005B00072L - Bridge over S. Fork Beaver Creek - Widen bridge 7.5 ft**	30	37.5	7.5	EB and WB	0.036	11.576	11.612	521,400		✓		✓	-
	005B00072R - Bridge over S. Fork Beaver Creek - Widen bridge 7.5 ft**	30	37.5	7.5	EB and WB	0.036	11.541	11.577	521,400		✓		✓	-
Bridge over Fishing Creek	100B00074L/100B00074R - Bridge over Fishing Creek - Replace bridge railing + widen 1 ft	30	31	1	EB and WB	0.331	84.466	84.797	2,083,000		✓	✓		YES
	100B00074L/100B00074R - Bridge over Fishing Creek - Replace bridge railing + HFST	30	31	1	EB and WB	0.331	84.466	84.797	1,010,000	✓		✓		YES

\* = Bridge also does not meet clear width minimum. \*\* = Bridge also does not meet bridge railing standard.

Interchanges														
Category	Subcategory	Measured Value	Design Standard	Deficiency	Direction	Length	Begin MP	End MP	Cost	Initial Conversion	Full Compliance	Requires Design Exception	Requires Design Variance	Possible Design Related Safety Issue
Ramps - Accel/Decel	Exit 14 - Burkesville Rd - Increase EB accel length to 580'	500	580	80	EB				\$163,000	✓				-
	Exit 78 - KY 80 - Increase WB accel length to 580'	450	580	130	WB				\$138,000	✓				-
Lane Width	Exit 88 - US 27 - Increase cloverleaf lane width to 15'	14	15	1	WB				\$182,000	✓				-
Interchange Rebuild	Exit 27 - Glasgow Road - Reconfigure to standard diamond	-	-	-	-	1.667	27.419	29.086	\$15,000,000	✓				YES

## Additional Safety and Operational Improvement Concepts

Additional Safety and Operational Improvements				
Category	Subcategory	Direction	Cost	Possible Design Related Safety Issue
<i>Upgrade Ramp Terminal Design</i>	Remove or modify channelization and modify right turn radius @ Exit 14 (KY 90) EB ramp	EB	\$30,000	YES
<i>Add Traffic Signal at Interchange Ramps</i>	Signalize the Exit 11 (US 31E) WB Ramp Terminal	WB	\$250,000	YES
<i>Safety Improvements at KY 914</i>	Continue High Friction Surface Treatment	-	\$68,000	YES
<i>Safety Improvements at WB On Ramp to I-65</i>	Add signing, striping and rumble strips	WB	\$10,000	YES
<i>Cable Median Barrier</i>	Add cable median barrier to prevent crossover crashes	-	\$3,059,000	YES

Category	Improvement	Median Mile point	Median Turnaround Needed?	Condition	Cost
<i>Median Turnarounds</i>	Remove median turnaround	37.715	NO	Not required by district	\$12,000
		55.102	NO	Not required by district	\$12,000
		59.646	NO	Not required by district	\$12,000
		73.854	NO	Not required by district	\$12,000
		74.9	NO	Not required by district	\$12,000
	Remove median turnaround and Install delineation ballards	38.42	NO	Crash Cushion Transition	\$13,500
		42.65	NO	Crash Cushion Transition	\$13,500
		51	NO	Crash Cushion Transition	\$13,500
		65.333	NO	Crash Cushion Transition	\$13,500
		67.1	NO	Crash Cushion Transition	\$13,500
	Pave median turnaround	3.216	YES	Unpaved	\$10,000
		46.251	YES	Unpaved	\$10,000
		48.537	YES	Unpaved	\$10,000
		61.66	YES	Unpaved	\$10,000
		69.5	YES	Unpaved	\$10,000
		79.852	YES	Unpaved	\$10,000
	Install new median turnaround	82.718	YES	Unpaved	\$10,000
	87.88	YES	Unpaved	\$20,000	

## Cost Estimates for Improvement Concepts

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

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

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

**Purpose:** Remove or modify channelization and modify right turn radius at the Exit 14 (KY 90) eastbound ramp.

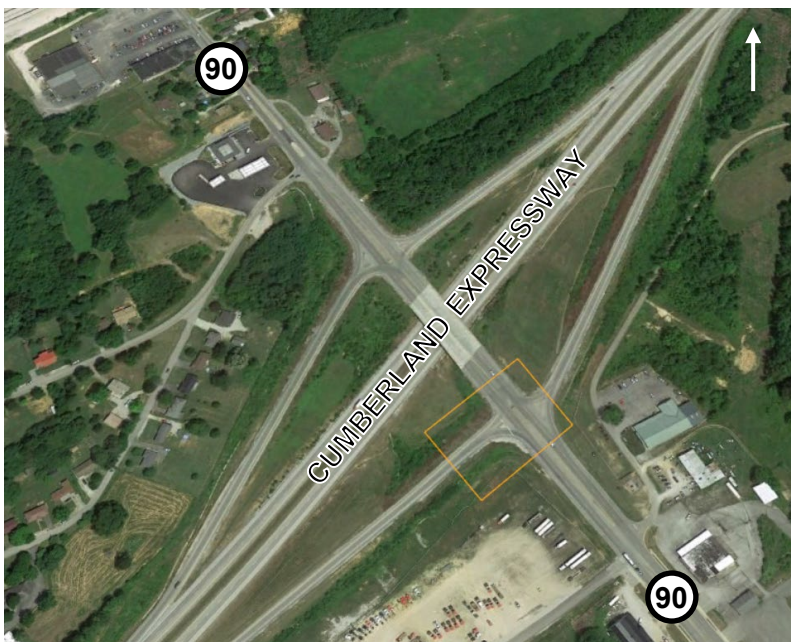
## Identified Needs:

### Safety

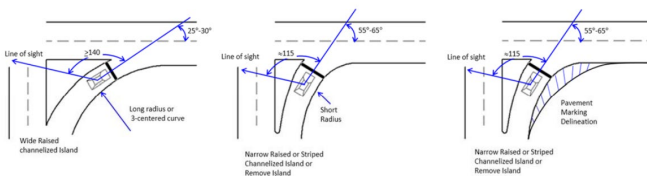
- There were 12 crashes over 5 years that appeared to be related to the right turn movement from the eastbound off-ramp at KY-90 (Burkesville Road).

### Economic Growth

- The interchange serves local employers and retail businesses. KY-90 is also an important thoroughfare for the City of Glasgow and nearby communities.
- The area surrounding the interchange has the potential for economic growth.



Area of new ramp modification (left) and crash locations (above).



**Improvement Strategy:** A potential improvement that could be considered for this location is to convert the channelized right turn into a “Smart Right Turn”. This design approach would maintain the channelization but increase the cone of vision for right turning drivers. It would also decrease the corner radius. Pavement marking delineation could be used to better accommodate trucks.

## Return on Investment:

- This design approach could result in a right turn crash reduction of 44% based on recent research (<http://cmfclearinghouse.org/detail.cfm?facid=8428>). This is a reduction of approximately one crash per year based on the historical data.
- The observed crashes were all property damage crashes. Using an approximate cost per crash of \$10,000 results in a savings of \$100,000 over 10 years (undiscounted). The benefit/cost ratio for the project is expected to be over 1.0.

**Construction Cost Estimate:**

**Total: \$30,000**

**Purpose:** Signalize the Exit 11 (US 31E) westbound ramp terminal.

## Identified Needs:

### Safety

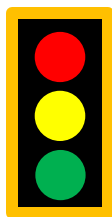
- The westbound ramp terminal at Exit 11 (US 31E) currently experiences significant delays and queueing during the AM peak.

### Economic Growth

- The interchange serves a considerable volume of local and regional traffic. It provides access to major employers, educational institutions, commercial establishments, and residential areas. US 31W is also a major regional thoroughfare for the City of Glasgow and nearby communities.
- The area surrounding the interchange has the potential for continued economic growth.



Location of new traffic signal at ramp terminal (left).



**Improvement Strategy:** Installing a traffic signal at the US 31W westbound ramp terminal and coordinating it with the signals immediately adjacent could help alleviate queueing and prevent traffic from backing up onto the Expressway. A traffic signal warrant analysis should be performed to document the need for the new signal.

### Return on Investment:

- According to the Highway Safety Manual, the installation of a traffic signal on a 40mph or higher roadway in an urbanized area can reduce crashes by approximately 5%. (<http://cmfclearinghouse.org/detail.cfm?facid=322>) With the addition of a traffic signal, some types of crashes will decrease, and others will increase. Certain types of right-angle crashes could be expected to be reduced, while rear-end crashes could increase. The reduction of queueing during peak periods should also benefit safety.
- A well-timed signal in this location could reduce delays and queues during peak periods. It may increase delays somewhat during off-peak periods.

### Construction Cost Estimate:

**Total: \$250,000**

**Total: \$250,000**

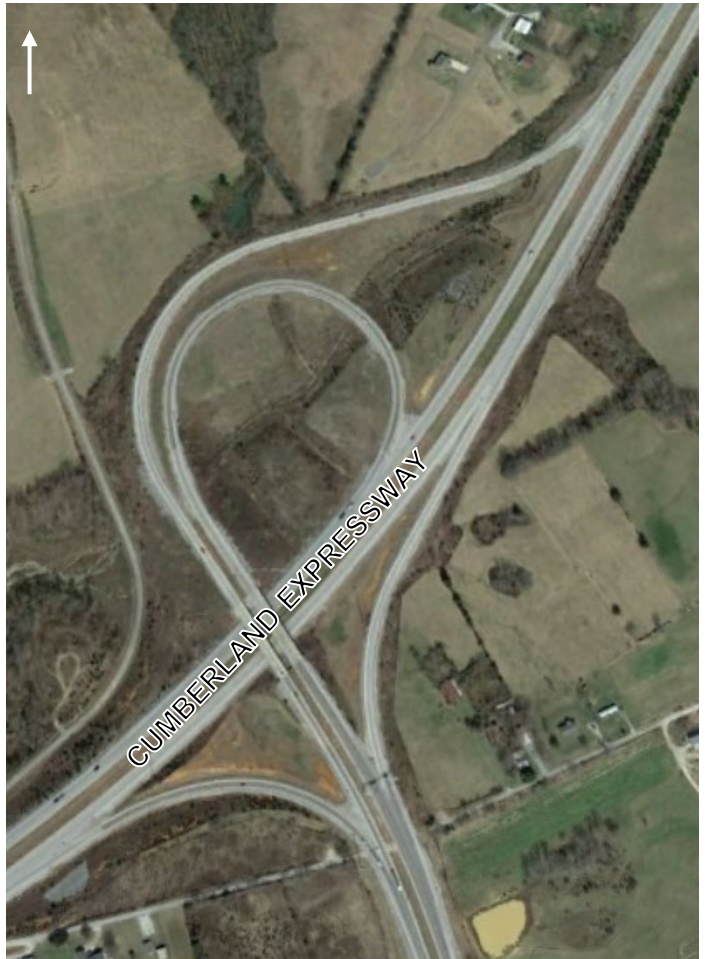
**Purpose:** Continue high friction surface treatment at the Kentucky 914 interchange.

**Identified Needs:**

**Safety**

- The eastbound off-ramp to KY 914 was flagged during project team discussions as a ramp where there were several truck rollover crashes in the past. In response to the truck rollover crashes, KYTC added a HFST to the ramp in 2014/15. After that application, the number of crashes on the ramp decreased. However, a smaller number of crashes have continued to occur. Contributing factors are likely speed, ramp radius, and driver expectations.
- A review of the 2015 to 2019 crash data showed six crashes on the ramp:
  - K - 0
  - A - 1
  - B - 1
  - C - 1
  - O - 3
- The severe injury crash involved a tractor trailer overturning in 2018. The minor injury crash involved a pick-up truck running off the road during wet weather conditions.

*Continue high friction surface treatment on eastbound to southbound ramp (right).*



*Example of high friction surface treatment (left) [FHWA].*

**Improvement Strategy:** Run off road crashes can be prevented with high friction surface treatment for vehicles at high speeds under normal conditions or vehicles driving too fast for weather conditions.

**Return on Investment:**

- High Friction Surface Treatments (HFST) on ramps have been shown to reduce crashes by 34.7%. (<http://www.cmfclearinghouse.org/detail.cfm?facid=7898>) The benefits are even greater during wet weather events.
- HFST was implemented on this ramp around 2014/2015. Given that there continue to be crashes on the ramp, this treatment should be maintained in good condition to continue to experience the benefits of the deployment.

**Construction Cost Estimate:**

**Estimate:**

**Total: \$68,000**