Safety Improvements Design-Build Project

St. Charles and Franklin Counties, MO

2018 TEAM Conference – Branson, MO -- March 8, 2018

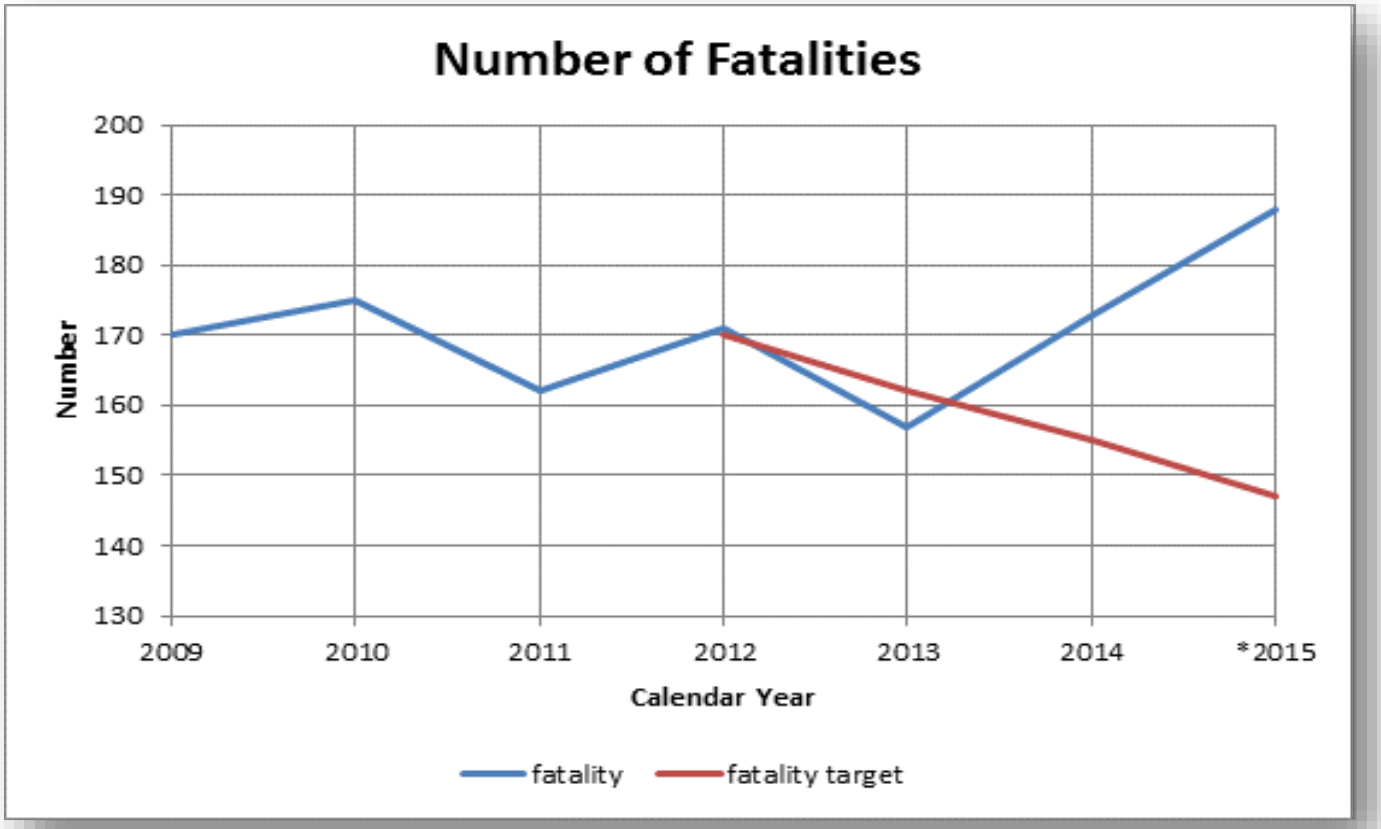
David Simmons, *MoDOT St. Louis District*
Stephen Georges, *MoDOT St. Louis District*
Dawn Perkins, *FHWA MO Division*
James Ritter, *Jacobs (CH2M)*
Jarrett Jasper, *Horner & Shifrin*

David J. Simmons P.E.
Missouri Department of Transportation

PROJECT INCEPTION

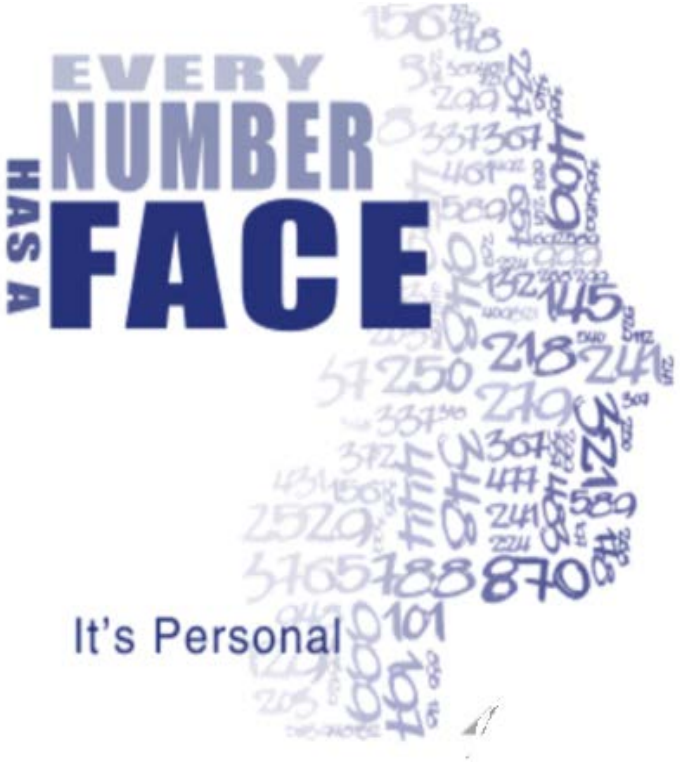
No. 1 Tangible Result

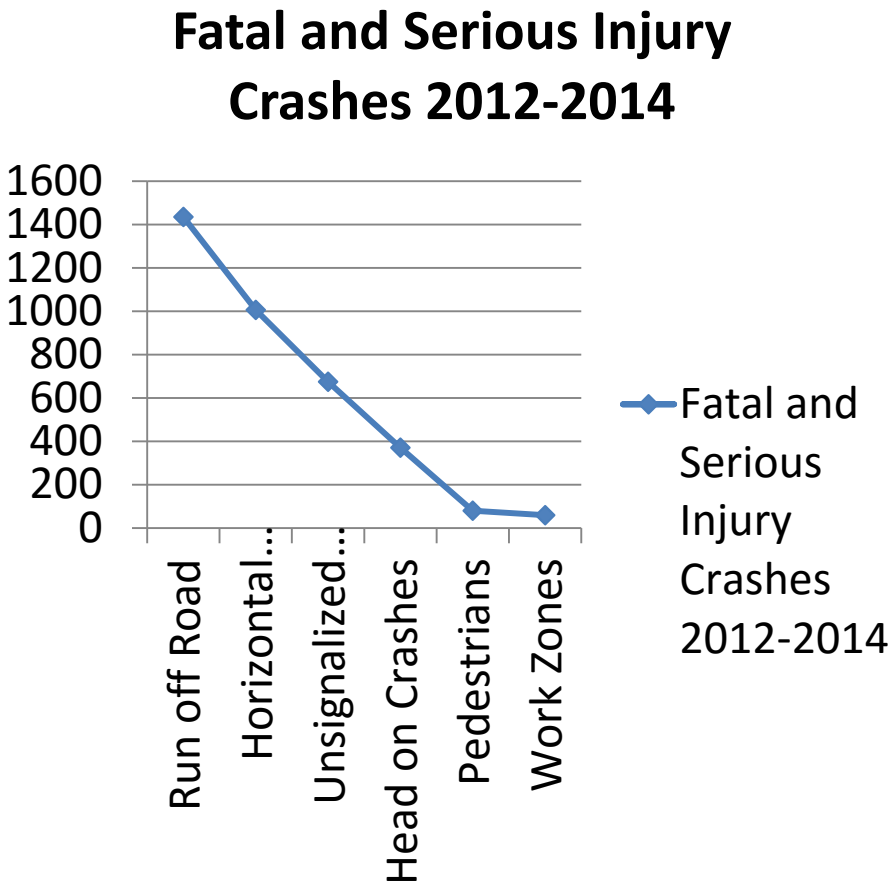
Keep Customers and Ourselves Safe



Road to Saving Lives

Missouri Blueprint
October 2016





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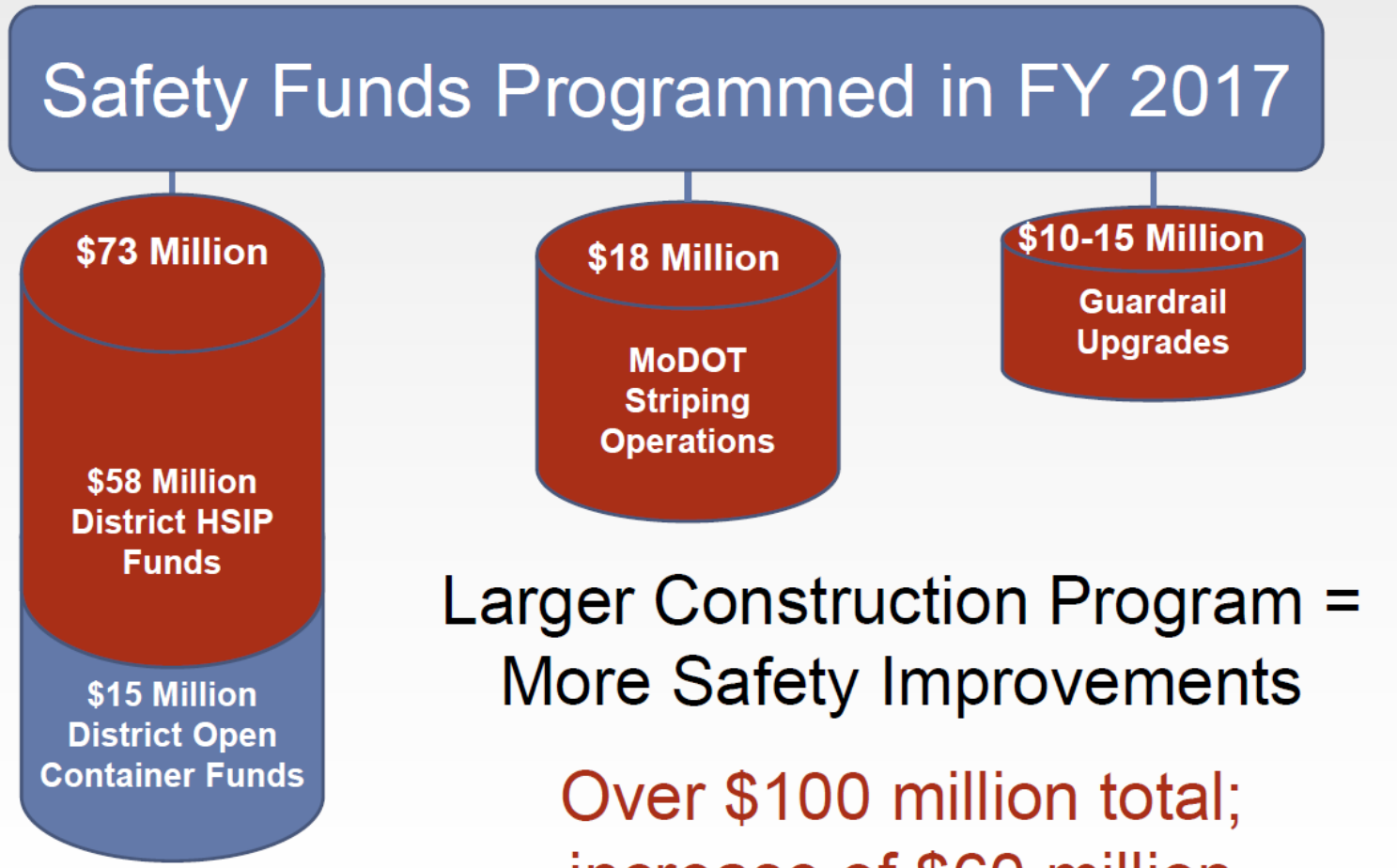
Funding Safety



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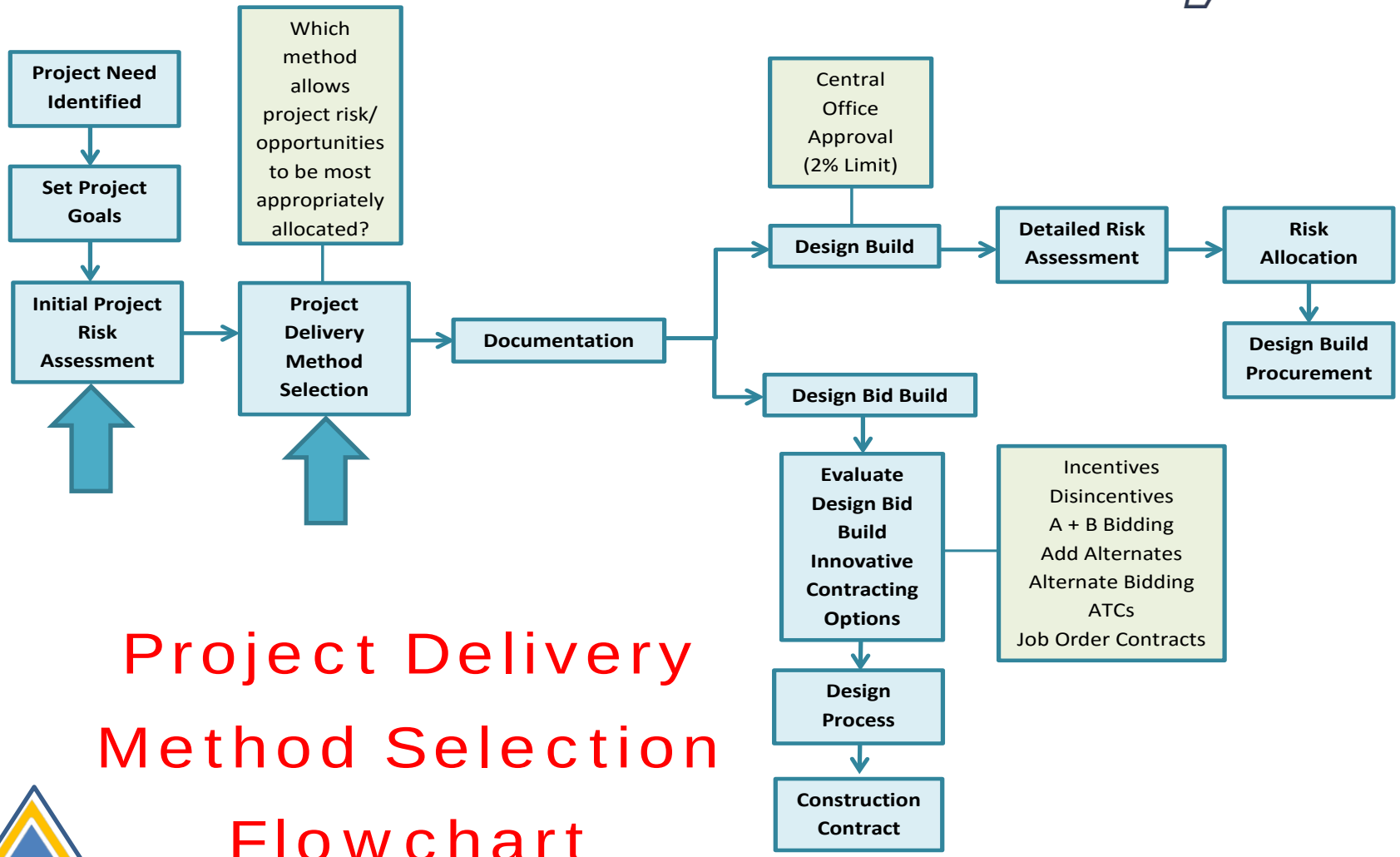
Project Delivery Method Selection

How does MoDOT select projects for Design-Build?



Project Delivery Method Selection Flowchart

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Project Delivery Method Selection

How does MoDOT select projects for Design-Build?

Typical Characteristics

1. Complexity of the Project
2. Opportunity for Innovation
3. Schedule/Speed Component
4. Manageable Risks
   - Utilities
   - ROW
   - Environmental
   - Community Relations
5. Staff Availability and Market Conditions

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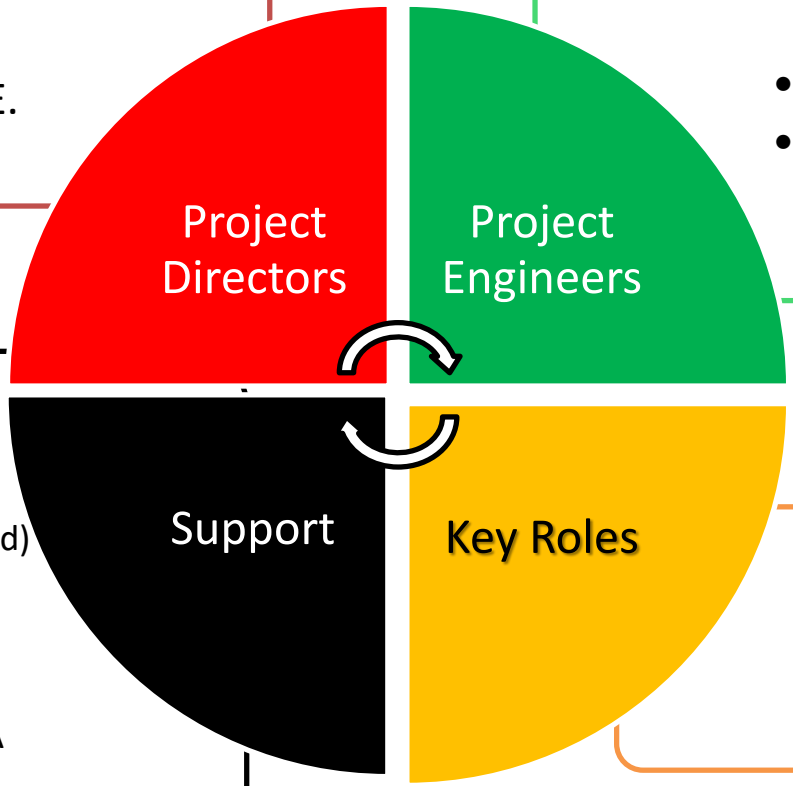
Project History

- Goal: Maximize Safety Benefit, Save Lives
  - Less political, more data driven
- Funding: $ 21M Budget
- Faster Implementation
- Goal Driven Design-Build Chosen

Road to Saving Lives

Project Team

- Vince Kaimann, P.E.
- Bill Schnell, P.E.
- Jim Gremaud, P.E. (retired)



- Heather Copeland, P.E. Deputy Director
- Stephen Georges, P.E.
- Tao Liao, P.E.

- Jon Nelson, P.E.
- Ray Shank, P.E
- Jim Smith, P.E. (retired)
- CH2M Staff
- Bryce Gamblin, Attorney
- Dawn Perkins, FHWA
- Jessica Hochlan
- St. Louis and CO Staff

- Teresa Krenning, P.E.
- Eddie Watkins
- David Simmons, P.E.
- Stacey Smith, P.E.

Road to Saving Lives

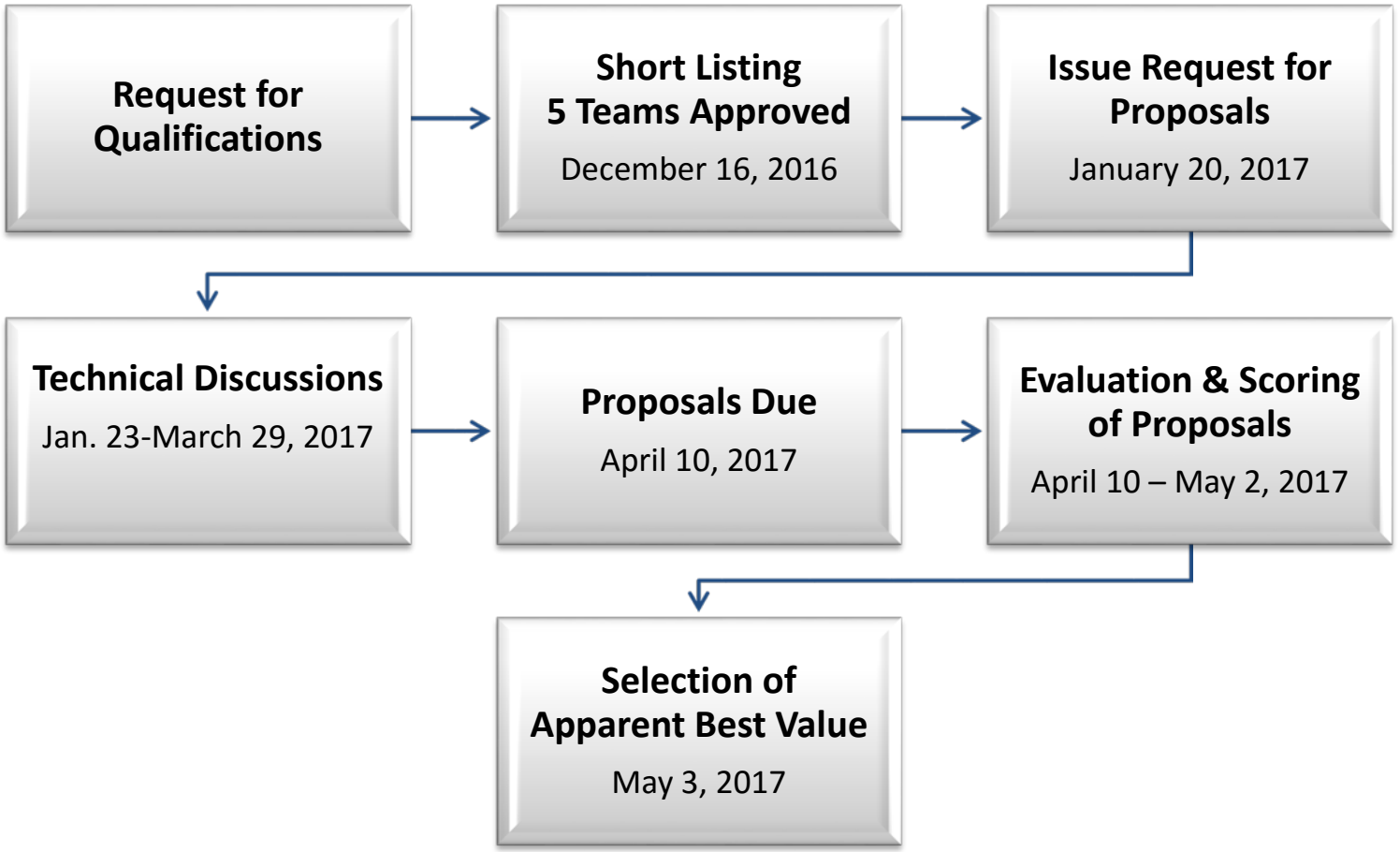
Stephen Georges, P.E.
Missouri Department of Transportation

PROJECT GOALS & PROCUREMENT

Project Goals

1. Deliver the project within the budget of $24.11 million
2. Reduce fatal and serious injury crashes by maximizing safety improvements
3. Deliver all improvements with a reasonable service life and low maintenance cost
4. Minimize impacts to the public during and after construction
5. Complete construction on the project by October 1, 2019

Project Schedule



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Highest Crash Severity Locations Identified

Horizontal Curve Analysis

Wet Crash Analysis

Shoulder Analysis

Crossed Centerline Analysis

Expressway Intersection Analysis

High Severity Analysis

- Data-Driven Selection
- 2013-2015 MSHP Records
- Fatal and Serious Injury Crash History
- High Severity & Target Crash Types
- Top 31 Locations

Traffic Safety List

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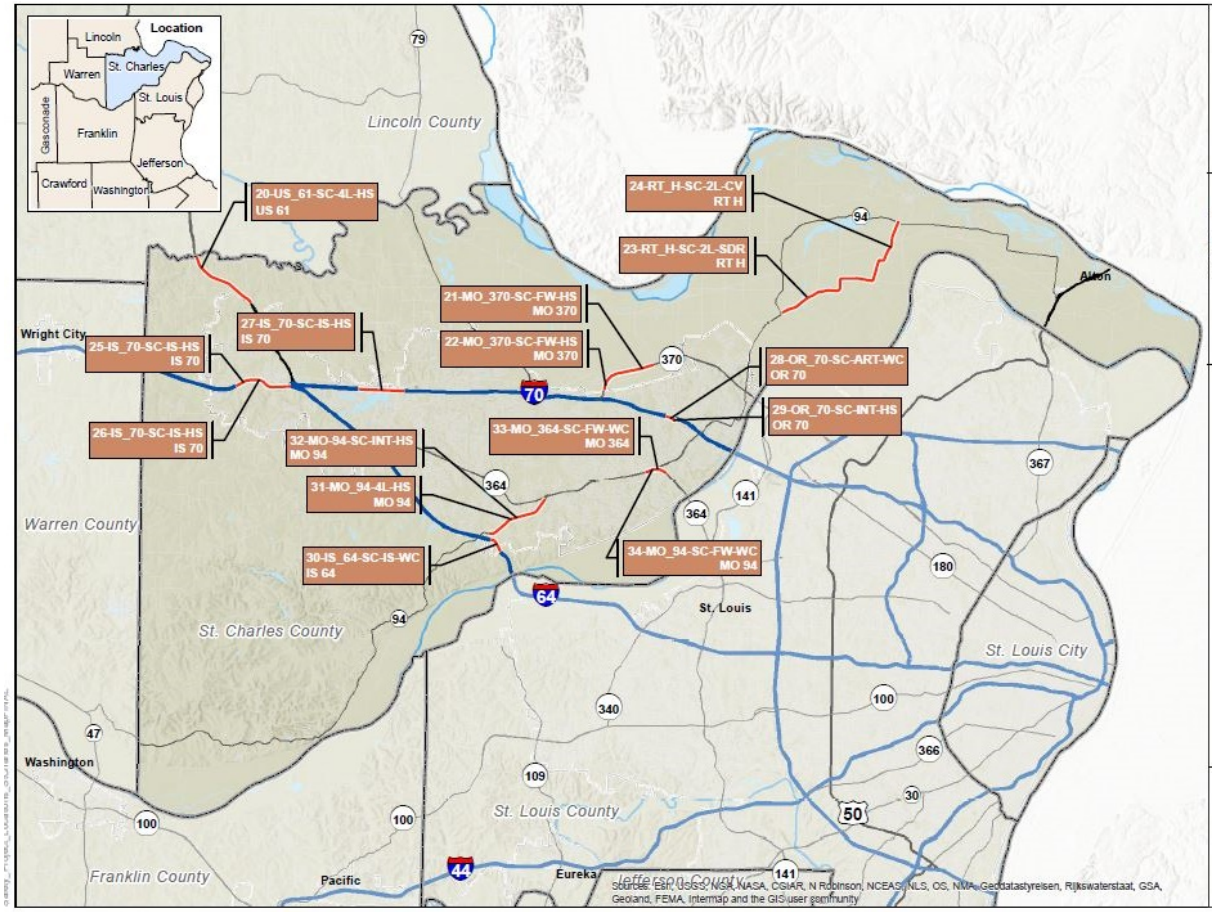
St. Charles County

15 High Severity Locations



Routes Include:

- I-70
- I-64
- U.S. 61
- Route H
- MO 94
- MO 364
- MO 370
- Outer Road 70

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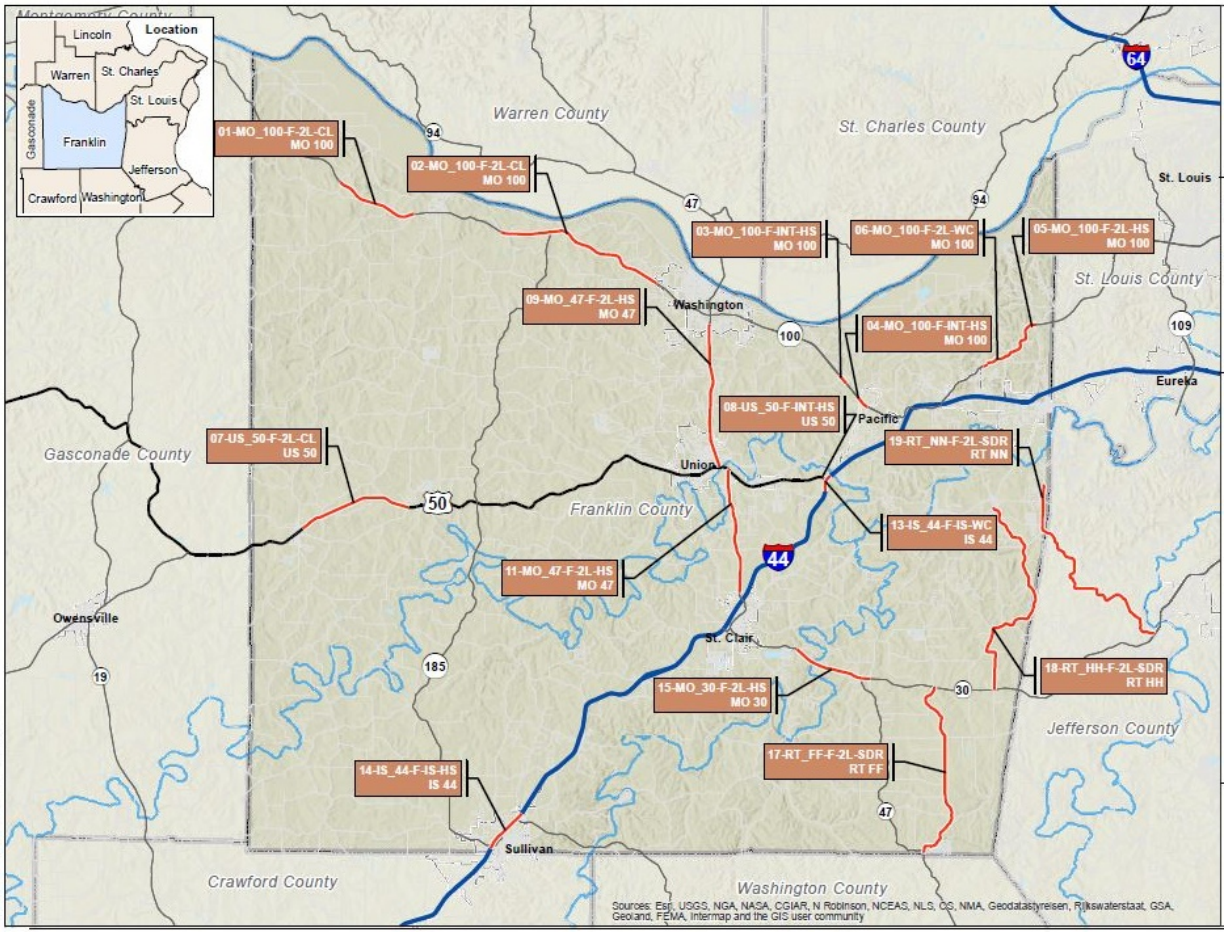
Franklin County

16 High Severity Locations



Routes Include:

- I-44
- U.S. 50
- MO 100
- MO 47
- MO 30
- Route FF
- Route HH
- Route NN

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The RFP Conundrum

- 5 Prequalified Teams
- No other state has ever tried packaging multiple safety improvements into a Design-Build contract
- Use data-driven method as the main scoring criteria
- Didn't know what the solution was going to be!

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Opportunities for Innovation

Additional Applicable Standards (AAS)

- Additional Applicable Standards
- Products, Designs, Specifications not currently utilized by MoDOT
- Had to be submitted and approved by MoDOT and FHWA

Crash Modification Factors (CMF)

- Statistically determines how an improvement reduces crashes
- MoDOT included pre-approved CMFs in contract
- Teams encouraged to propose others for review and approval

Scoring Criteria

- **Safety Improvements** 45 Points
  - Based on Data-Driven Analysis
- **Maintenance and Durability of Improvements** 30 Points
  - 5 Year minimum design life
- **Maintenance of Traffic** 15 Points
  - Mobility during and after construction
- **Completion Schedule** 10 Points
  - Early Completion Encouraged

100 Points Possible

One-on-One Meetings

- Improve Proposer understanding of Project Goals
- Feedback on whether the technical concepts achieve or exceed the Project goals
- Feedback on Highway Safety Manual Analysis, AAS, CMF, technical requirements, etc…
- Request for Clarification (RFC) of the Request for Proposal (RFP)

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Dawn Perkins, P.E.
FHWA MO Division

FHWA PERSPECTIVE

James Ritter, P.E.
CH2M (is now Jacobs)

EVALUATION & ADVISOR TEAM PERSPECTIVE

“Nerd Christmas”

For Traffic Safety Engineers

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Analysis Tools

- HSM Spreadsheets (NCHRP 17-38)
  - Rural two-lane
  - Rural multi-lane
  - Urban arterial
  - Modified for Fatal Serious Injury, CMFs, Input & Output Summaries
- ISATe Spreadsheets
  - Freeways, Interstates
  - Unmodified
  - Supplemented w/ CMF post-processing worksheet

Modified HSM Spreadsheet

Project Specific Instructions

Safety Improvements (MoDOT J6P3194) - Instructions to Users for the Customized Highway Safety Manual Spreadsheet Tool

This spreadsheet tool is customized using the HSM spreadsheets developed as part of the NCHRP 17-38. Exhibit 1 at the bottom of this worksheet provides the original instructions that were provided as part of the source spreadsheets that are available for download at www.highwaysafetymanual.org. Instructions are provided below for use by the HSM users for MoDOT St. Louis District Safety Design Build Project (J6P3194). Please contact the project director, James Gremaud, with any questions or requests for clarifications.

James R. Gremaud
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Project Director – SL Safety
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Project Specific Instructions for HSM Spreadsheet Users

HSM Spreadsheet modifications for the proposed conditions

HSM analyses for the proposed condition is shall be conducted using the "Proposer" copies of the No-Build condition spreadsheets. This section outlines the various steps in the process of quantifying the safety benefits of the proposed improvements.

In addition to the CMFs built into the standard HSM tool, there is a provision to apply up to three additional non-HSM incorporated CMFs into the spreadsheets. However, it should be noted that there are specific criteria and requirements for the application of non-HSM CMFs that can be used in these spreadsheets. The user should refer to the ITP and contact the MoDOT project director with any questions or requests for clarification.

Guidance in the selection of non-HSM CMFs is provided by the following FAQ from cmfclearinghouse.org:

How can I apply multiple CMFs?
If multiple countermeasures are implemented at one location, then common practice is to multiply the CMFs to estimate the combined effect of the countermeasures.

Modified HSM Spreadsheet

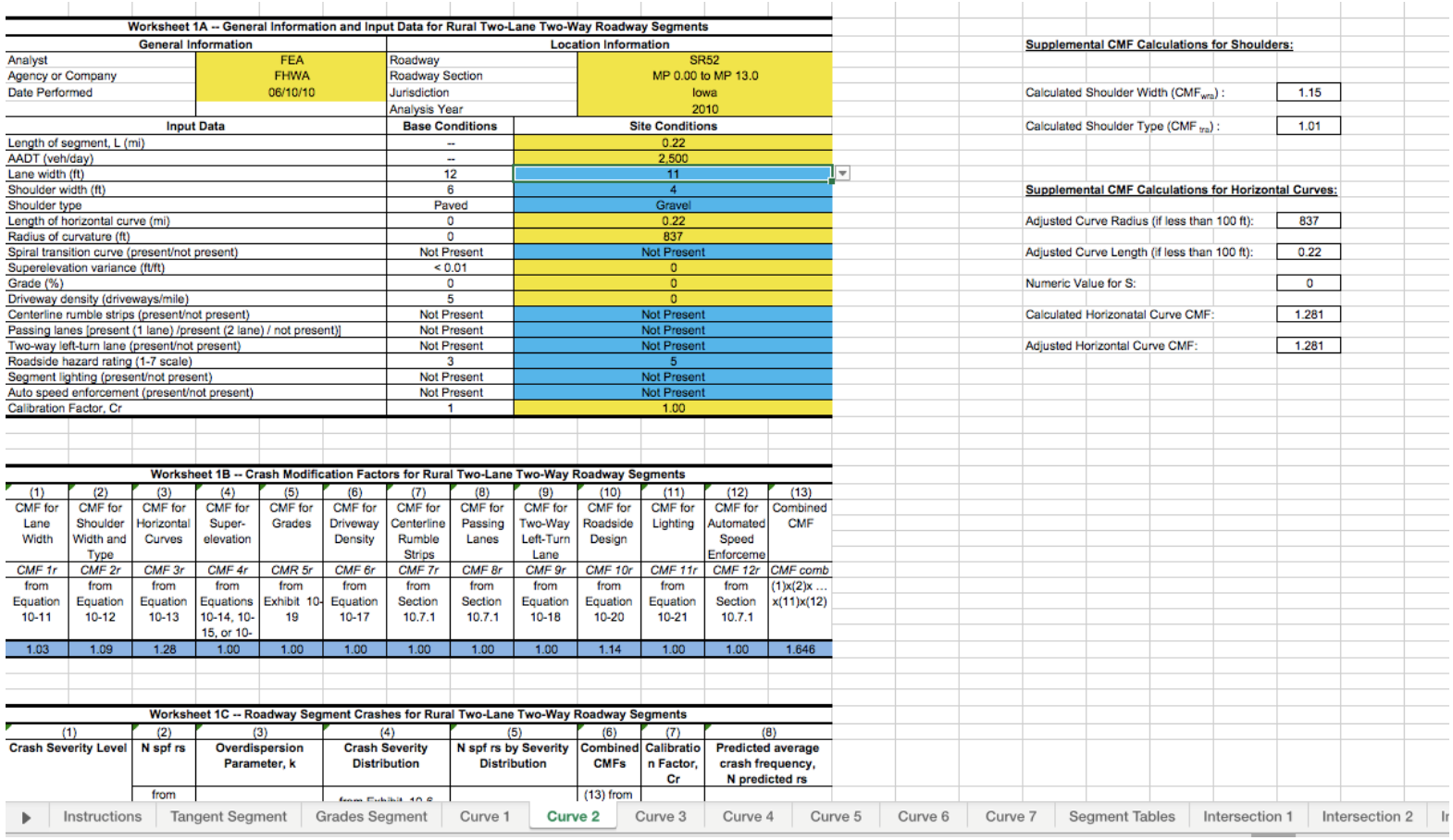
CMF Input Tab

Table 1 CMF for Rural Two-lane Roads (Segment)

CMF Source	Number	Abbreviated Improvement Name (For Input Summary Tab)	Improvement Name (From CMF Clearinghouse, if applicable)	CMF Value			
				K	A	BC	PDO
MoDOT CMF Table	1	HFST	Improve pavement friction using High-friction surface treatment (HFST)	0.380	0.380	0.380	0.380
MoDOT CMF Table	2	Open graded friction course	Open graded friction course	0.959	0.959	0.959	0.959
MoDOT CMF Table	3	Ultra thin bonded wearing course	Ultra thin bonded wearing course	0.956	0.956	0.956	0.956
MoDOT CMF Table	4	Centerline and shoulder rumble strips	Install centerline and shoulder rumble strips	0.770	0.770	0.770	0.770
MoDOT CMF Table	5	Rumble, 2-ft shoulder, resurfacing	Install shoulder rumble stripe, widen shoulder from 0 to 2 feet, and pavement resurfacing	0.822	0.822	0.822	0.822
MoDOT CMF Table	6	Centerline rumble strips	Install centerline rumble strips	0.880	0.880	0.880	0.880
MoDOT CMF Table	7	Shoulder rumble strips	Install shoulder (or edgeline) rumble strips	0.940	0.940	0.940	0.940
MoDOT CMF Table	8	Safety edge treatment	Installation of safety edge treatment	0.983	0.983	0.983	0.983
MoDOT CMF Table	9	TWLTL	Install TWLTL (two-way left turn lane) on two lane road	0.739	0.739	0.739	0.739
<<Placeholder>>	10	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	11	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	12	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	13	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	14	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	15	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	16	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	17	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	18	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000
<<Placeholder>>	19	<<User Input per CMF Request Form>>	<<User Input per CMF Request Form>>	1.000	1.000	1.000	1.000

Modified HSM Spreadsheet

Individual Segment Input Tab



Worksheet 1A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Segments

General Information		Location Information	
Analyst	FEA	Roadway	SR52
Agency or Company	FHWA	Roadway Section	MP 0.00 to MP 13.0
Date Performed	06/10/10	Jurisdiction	Iowa
		Analysis Year	2010

Input Data	Base Conditions	Site Conditions
Length of segment, L (mi)	--	0.22
AADT (veh/day)	--	2,500
Lane width (ft)	12	11
Shoulder width (ft)	6	4
Shoulder type	Paved	Gravel
Length of horizontal curve (mi)	0	0.22
Radius of curvature (ft)	0	837
Spiral transition curve (present/not present)	Not Present	Not Present
Superelevation variance (ft/ft)	< 0.01	0
Grade (%)	0	0
Driveway density (driveways/mile)	5	0
Centerline rumble strips (present/not present)	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present
Calibration Factor, Cr	1	1.00

Supplemental CMF Calculations for Shoulders:

Calculated Shoulder Width (CMF_{wra}) :	1.15
Calculated Shoulder Type (CMF_{tra}) :	1.01

Supplemental CMF Calculations for Horizontal Curves:

Adjusted Curve Radius (if less than 100 ft):	837
Adjusted Curve Length (if less than 100 ft):	0.22
Numeric Value for S:	0
Calculated Horizonatal Curve CMF:	1.281
Adjusted Horizontal Curve CMF:	1.281

Worksheet 1B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
CMF for Lane Width	CMF for Shoulder Width and Type	CMF for Horizontal Curves	CMF for Super-elevation	CMF for Grades	CMF for Driveway Density	CMF for Centerline Rumble Strips	CMF for Passing Lanes	CMF for Two-Way Left-Turn Lane	CMF for Roadside Design	CMF for Lighting	CMF for Automated Speed Enforceme	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMR 5r*	*CMF 6r*	*CMF 7r*	*CMF 8r*	*CMF 9r*	*CMF 10r*	*CMF 11r*	*CMF 12r*	*CMF comb*
from Equation 10-11	from Equation 10-12	from Equation 10-13	from Equations 10-14, 10-15, or 10-	from Exhibit 10-19	from Equation 10-17	from Section 10.7.1	from Section 10.7.1	from Equation 10-18	from Equation 10-20	from Equation 10-21	from Section 10.7.1	(1)x(2)x … x(11)x(12)
1.03	1.09	1.28	1.00	1.00	1.00	1.00	1.00	1.00	1.14	1.00	1.00	1.646

Worksheet 1C -- Roadway Segment Crashes for Rural Two-Lane Two-Way Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**N spf rs**	**Overdispersion Parameter, k**	**Crash Severity Distribution**	**N spf rs by Severity Distribution**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted average crash frequency, N predicted rs**
	from				(13) from		

Instructions | Tangent Segment | Grades Segment | Curve 1 | Curve 2 | Curve 3 | Curve 4 | Curve 5 | Curve 6 | Curve 7 | Segment Tables | Intersection 1 | Intersection 2

Road to Saving Lives

Modified HSM Spreadsheet

Consolidated Input Summary Tab

General Information			
Project Description	No Build		
Project Location ID	01-MO_100-F-2L-CL		
Analyst	MM/STL	Date:	2/27/2017

Segment Input Summary Table

Input Item/Segment Number	1	2	3	4	5	6	7	8
Analyst	MM/STL	MM/STL	MM/STL	MM/STL	MM/STL	MM/STL	MM/STL	MM/STL
Agency or Company	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M	CH2M
Date Performed	2/27/2017	2/27/2017	2/27/2017	2/27/2017	2/27/2017	2/27/2017	2/27/2017	2/27/2017
Roadway	MO 100	MO 100	MO 100	MO 100	MO 100	MO 100	MO 100	MO 100
Roadway Section	LM 52.588 to LM 53.09	LM 53.09 to LM 53.3	LM 53.3 to LM 53.41	LM 53.41 to LM 53.91	LM 53.91 to LM 54.68	LM 54.68 to LM 54.88	LM 54.88 to LM 55.4	LM 55.4 to LM 55.93
Jurisdiction	Franklin, MO	Franklin, MO	Franklin, MO	Franklin, MO	Franklin, MO	Franklin, MO	Franklin, MO	Franklin, MO
Analysis Year	2015	2015	2015	2015	2015	2015	2015	2015
Length of segment, L (mi)	0.502	0.210	0.110	0.500	0.770	0.200	0.520	0.530
AADT (veh/day) (max - 17,800)	4210	4210	4210	4210	4210	4210	4210	4210
Lane width (ft)	11	11	11	11	11	11	11	11
Shoulder width (ft)								
Right	2	2	2	2	2	2	2	2
Left	2	2	2	2	2	2	2	2
Shoulder type								
Right	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
Left	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
Length of horizontal curve (mi)	0	0.21	0	0.5	0	0.2	0	0.53
Radius of curvature (ft)	0	2286	0	3747	0	3231	0	2854
Spiral transition curve (present/not present)	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present
Superelevation variance (ft/ft)	0	0	0	0	0	0	0	0
Grade (%)	0	0	0	0	0	0	0	0
Driveway density (driveways/mile)	7.97	9.52	0.00	4.00	14.29	20.00	15.38	18.87
Centerline rumble strips (present/not present)	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present
Passing lanes (present (1 lane) /present (2 lane) / not present)	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present
Roadside hazard rating (1-7 scale)	2	2	2	2	2	2	2	2
Segment lighting (present/not present)	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present
Additional Safety Treatment 1								
Additional Safety Treatment 2								
Additional Safety Treatment 3								
Observed crashes	0.8	0.4	0	0.8	0.6	0.6	0.4	0.6

Intersection Input Summary Table

Input Item/Intersection Number	1	2	3	4	5
Analyst	MM/STL	MM/STL	MM/STL		
Agency or Company	CH2M	CH2M	CH2M		
Date Performed	2/27/2017	2/27/2017	2/27/2017		
Roadway	MO 100	MO 100	MO 100		
Intersection	Highway E	Olive Street	Olive Rd		
Jurisdiction	Franklin, MO	Franklin, MO	Franklin, MO		
Analysis Year	2015	2015	2015	2015	2015

Modified HSM Spreadsheet

Output Summary Tab

Safety Performance - Output Summary

General Information			
Project Description:	No Build		
Project Location ID:	01-MO_100-F-2L-CL		
Analyst	MM/STL	Date:	2/27/2017

Project Description		Expected Number of Crashes	
Segment ID	Log Mile	K	A
ROADWAY SEGMENTS			
Segment 1	LM 52.588 to LM 53.09	0.012	0.046
Segment 2	LM 53.09 to LM 53.3	0.006	0.022
Segment 3	LM 53.3 to LM 53.41	0.002	0.007
Segment 4	LM 53.41 to LM 53.91	0.011	0.044
Segment 5	LM 53.91 to LM 54.68	0.017	0.066
Segment 6	LM 54.68 to LM 54.88	0.007	0.028
Segment 7	LM 54.88 to LM 55.4	0.012	0.045
Segment 8	LM 55.4 to LM 55.93	0.014	0.053
Segment 9	LM 55.93 to LM 56.14	0.005	0.020
Segment 10	LM 56.14 to LM 56.212	0.001	0.005
Segment 11		0.000	0.000
Segment 12		0.000	0.000
Segment 13		0.000	0.000
Segment 14		0.000	0.000
Segment 15		0.000	0.000
Segment 16		0.000	0.000
Segment 17		0.000	0.000
Segment 18		0.000	0.000
Segment 19		0.000	0.000
Segment 20		0.000	0.000
INTERSECTIONS			
Intersection 1	3ST	0.006	0.067
Intersection 2	4ST	0.010	0.038
Intersection 3	3ST	0.003	0.036
Intersection 4		0.000	0.000
Intersection 5		0.000	0.000
Estimated Number of Crashes by Year		0.107	0.478

ISATe Spreadsheet

Unmodified

Input Worksheet for Freeway Segments

Clear | Echo Input Values (View results in Column AV) | Check Input Values (View results in Advisory Messages)

		Segment 1		Segment 2		Segment 3		Segment 4		Segment 5		Segment 6		Segment 7		Segment 8	
		Crash Period	Study Period	Crash Period	Study Period	Crash Period	Study Period	Crash Period	Study Period	Crash Period	Study Period	Crash Period	Study Period	Crash Period	Study Period	Crash Period	S P
Basic Roadway Data																	
Number of through lanes (n):		4	4	4	4	4	4	4	4	4	4	4	4	4	4		
Freeway segment description:		WB01	WB01	WB02	WB02	WB03	WB03	WB04	WB04	WB05	WB05	WB06	WB06	WB07	WB07		
Segment length (L), mi:		0.115411	0.115411	0.040748	0.040748	0.090445	0.090445	0.033756	0.033756	0.074782	0.074782	0.102593	0.102593	0.182494	0.182494		
Alignment Data																	
Horizontal Curve Data	See note																
1	Horizontal curve in segment?:	No	No	Both Dir.	Both Dir.	Both Dir.	Both Dir.	Both Dir.	Both Dir.	Both Dir.	Both Dir.	Both Dir.	Both Dir.	No	No		
	Curve radius (R_1), ft:			2088	2088	1533	1533	3584	3584	2296	2296	2296	2296				
	Length of curve (L_{c1}), mi:			0.040748	0.040748	0.090445	0.090445	0.033756	0.033756	0.177375	0.177375	0.177375	0.177375				
	Length of curve in segment ($L_{c1,seg}$), mi:			0.040748	0.040748	0.090445	0.090445	0.033756	0.033756	0.074782	0.074782	0.102593	0.102593				
2	Horizontal curve in segment?:			No	No	No	No	No	No	No	No	No	No				
	Curve radius (R_2), ft:																
	Length of curve (L_{c2}), mi:																
	Length of curve in segment ($L_{c2,seg}$), mi:																
3	Horizontal curve in segment?:																
	Curve radius (R_3), ft:																
	Length of curve (L_{c3}), mi:																
	Length of curve in segment ($L_{c3,seg}$), mi:																
Cross Section Data																	
Lane width (W_l), ft:		12	12	12	12	12	12	12	12	12	12	12	12	12	12		
Outside shoulder width (W_s), ft:		10	10	10	10	10	10	10	10	10	10	10	10	10	10		
Inside shoulder width (W_{is}), ft:		6	6	12	12	12	12	12	12	6	6	10	10	5.5	5.5		
Median width (W_m), ft:		40	40	52	52	60	60	56	56	43	43	28	28	14	14		
Rumble strips on outside shoulders?:		Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes		
	Length of rumble strips for travel in increasing milepost direction, mi:	0.013447	0.013447					0.024905	0.024905	0.050568	0.050568			0.182494	0.182494		
	Length of rumble strips for travel in decreasing milepost direction, mi:	0.013447	0.013447					0.024905	0.024905	0.050568	0.050568			0.182494	0.182494		
Rumble strips on inside shoulders?:		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
	Length of rumble strips for travel in increasing milepost direction, mi:	0.115411	0.115411	0.040748	0.040748	0.040341	0.040341	0.024527	0.024527	0.074782	0.074782	0.102593	0.102593	0.182494	0.182494		
	Length of rumble strips for travel in decreasing milepost direction, mi:	0.115411	0.115411	0.040748	0.040748	0.040341	0.040341	0.024527	0.024527	0.074782	0.074782	0.102593	0.102593	0.182494	0.182494		
Presence of barrier in median:		Some	Some	Some	Some	Some	Some	Some	Some	Some	Some	Some	Some	Center	Center		
1	Length of barrier ($L_{ib,1}$), mi:	0.115411	0.115411	0.004167	0.004167	0.083712	0.083712	0.033756	0.033756	0.074782	0.074782	0.102593	0.102593		0		
	Distance from edge of traveled way to barrier face ($W_{off,in,1}$), ft:	34	34	38	38	16	16	44	44	35	35	18	18		0		
2	Length of barrier ($L_{ib,2}$), mi:	0.115411	0.115411	0.004167	0.004167	0.083712	0.083712	0.033756	0.033756	0.074782	0.074782	0.102593	0.102593		0		
	Distance from edge of traveled way to barrier face ($W_{off,in,2}$), ft:	34	34	38	38	16	16	44	44	35	35	18	18		0		
3	Length of barrier ($L_{ib,3}$), mi:		0	0.036553	0.036553	0.005871	0.005871		0		0		0		0		

... | Main | Input Freeway Segments | Input Ramp Segments | Input Ramp Terminals | Output Summary | Output Freeway Segments | Output Ramp Segments | Output Ramp Terminals | Calibration Factors

Road to Saving Lives

ISATe Spreadsheet

Separate Post-Processing to CMFs

Highway Safety Manual (ISATe) Output Processing and Additional CMFs

for Freeway / Interstate Project Locations

General Information *(Proposer should input this data)*					
Project Description:					
Project Location ID: *(select from list)*					
Proposer Analyst / Point of Contact			Date:		

Estimated Crash Statistics - Output from ISATe *(Proposer should copy output for Fatal (K) and Serious Injury (A) crashes directly from ISATe file that has been modified based on proposed improvements)*		
Crashes for Entire Facility by Year	**K**	**A**
Estimated number of crashes by year		

Modified Output for Project - Adjustment for Single Direction of the Freeway / Interstate *(Calculated by formula based on above inputs)*		
Estimated Crash Statistics		
Crashes for Analysis Direction by Year	**K**	**A**
Estimated number of crashes by year	0.000	0.000

Application of Non-ISATe CMFs *(Proposer is required to consult with MoDOT to determine permissibility and applicability of all CMFs not included in the ISATe spreadsheet tool)*

From Project CMF Table (or as determined in consultation with MoDOT)				Application of CMF by Severity *(see comment)*				
CMF Name	**Clearing-house ID**	**Crash Type**	**Crash Severity**	**CMF_K**	**CMF_A**		**$Weight_K$**	**$Weight_A$**
						CMF #1 - Weighted CMF Value -->	1.000	1.000
<<CMF 2>>								
						CMF #2 - Weighted CMF Value -->	1.000	1.000
<<CMF 3>>								
						CMF #3 - Weighted CMF Value -->	1.000	1.000
Combined Non-ISATe CMFs by Severity							1.000	1.000

Project Summary - Additional CMFs Applied *(Calculated by formula based on above inputs)*		
Estimated Crash Statistics		
Crashes for Analysis Direction by Year (with Additional CMFs)	**K**	**A**
Estimated number of crashes by year	0.000	0.000

Road to Saving Lives

Analysis Constraints

Predicted Crash Frequency Equation

Calibration Factor for Missouri

$$N_{predicted\ ru} = N_{spf\ ru} (CMF_1 \times CMF_2 \times ....) C_r$$

Proposers Limited to 3 CMFs for Safety Improvements not included in HSM/ISATe Models

Expected Crash Frequency

→ **Observed crash data was input into spreadsheet tools**

Reduction in Expected Crash Frequency

→ **Scored on difference between Existing/No-Build and Proposed**

Safety Improvements
Evaluating & Scoring Proposals

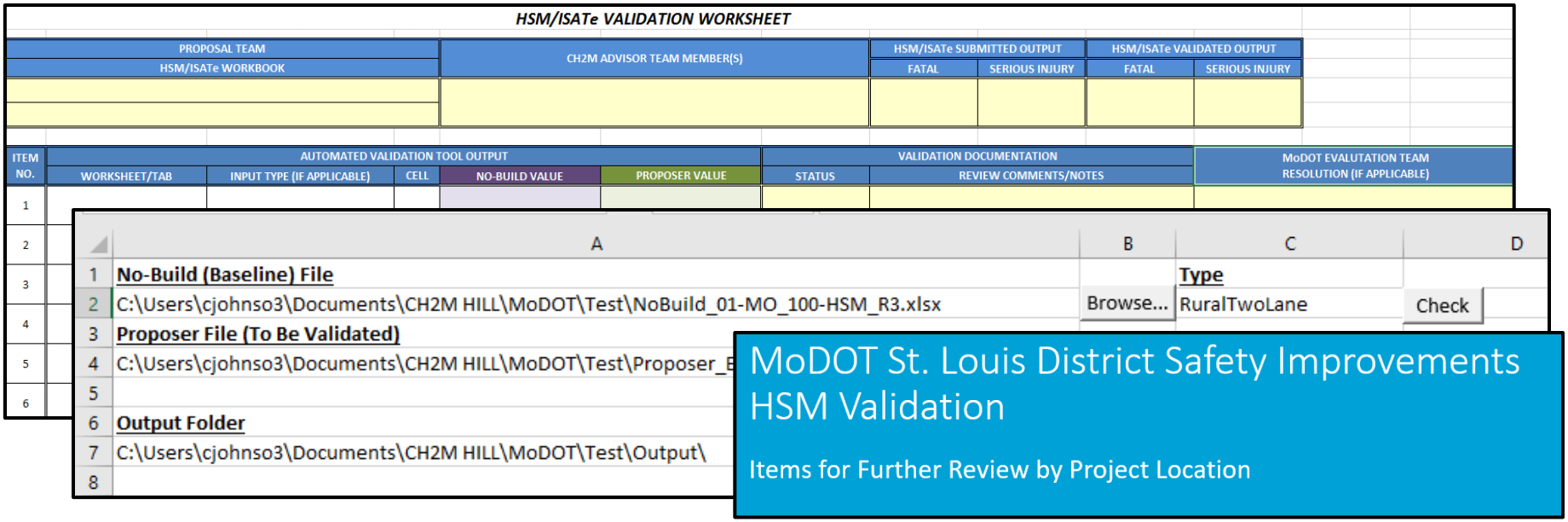
1. Proposer submits their Data Driven Analysis
   - List of Proposed Safety Improvements
   - Depiction of Safety Improvements
   - Highway Safety Manual Spreadsheets
   - Crash Modification Factors (CMF)

Safety Improvements
Evaluating & Scoring Proposals

2. Analysis verified by MoDOT and their consultant
   - Excel VBA/macro-based tool
   - Identify changes to HSM, ISATe spreadsheets
   - Validate each change is consistent with proposal
   - Resolved apparent inconsistencies
   - Validate Expected Crash Reduction

Safety Improvements

Evaluating & Scoring Proposals



HSM/ISATe VALIDATION WORKSHEET

PROPOSAL TEAM HSM/ISATe WORKBOOK	CH2M ADVISOR TEAM MEMBER(S)	HSM/ISATe SUBMITTED OUTPUT		HSM/ISATe VALIDATED OUTPUT	
		FATAL	SERIOUS INJURY	FATAL	SERIOUS INJURY

ITEM NO.	AUTOMATED VALIDATION TOOL OUTPUT					VALIDATION DOCUMENTATION		MoDOT EVALUTATION TEAM RESOLUTION (IF APPLICABLE)
	WORKSHEET/TAB	INPUT TYPE (IF APPLICABLE)	CELL	NO-BUILD VALUE	PROPOSER VALUE	STATUS	REVIEW COMMENTS/NOTES	
1								

	A	B	C	D
1	**No-Build (Baseline) File**		**Type**	
2	C:\Users\cjohnso3\Documents\CH2M HILL\MoDOT\Test\NoBuild_01-MO_100-HSM_R3.xlsx	Browse...	RuralTwoLane	Check
3	**Proposer File (To Be Validated)**			
4	C:\Users\cjohnso3\Documents\CH2M HILL\MoDOT\Test\Proposer_E			
5				
6	**Output Folder**			
7	C:\Users\cjohnso3\Documents\CH2M HILL\MoDOT\Test\Output\			
8				

MoDOT St. Louis District Safety Improvements
HSM Validation

Items for Further Review by Project Location

3. Proposal with greatest Reduction in Fatal and Serious Injury Crashes receives **all 45 points**
   - All other Proposals Pro-Rated based on high score

Road to Saving Lives

Best Value Proposal – NB West

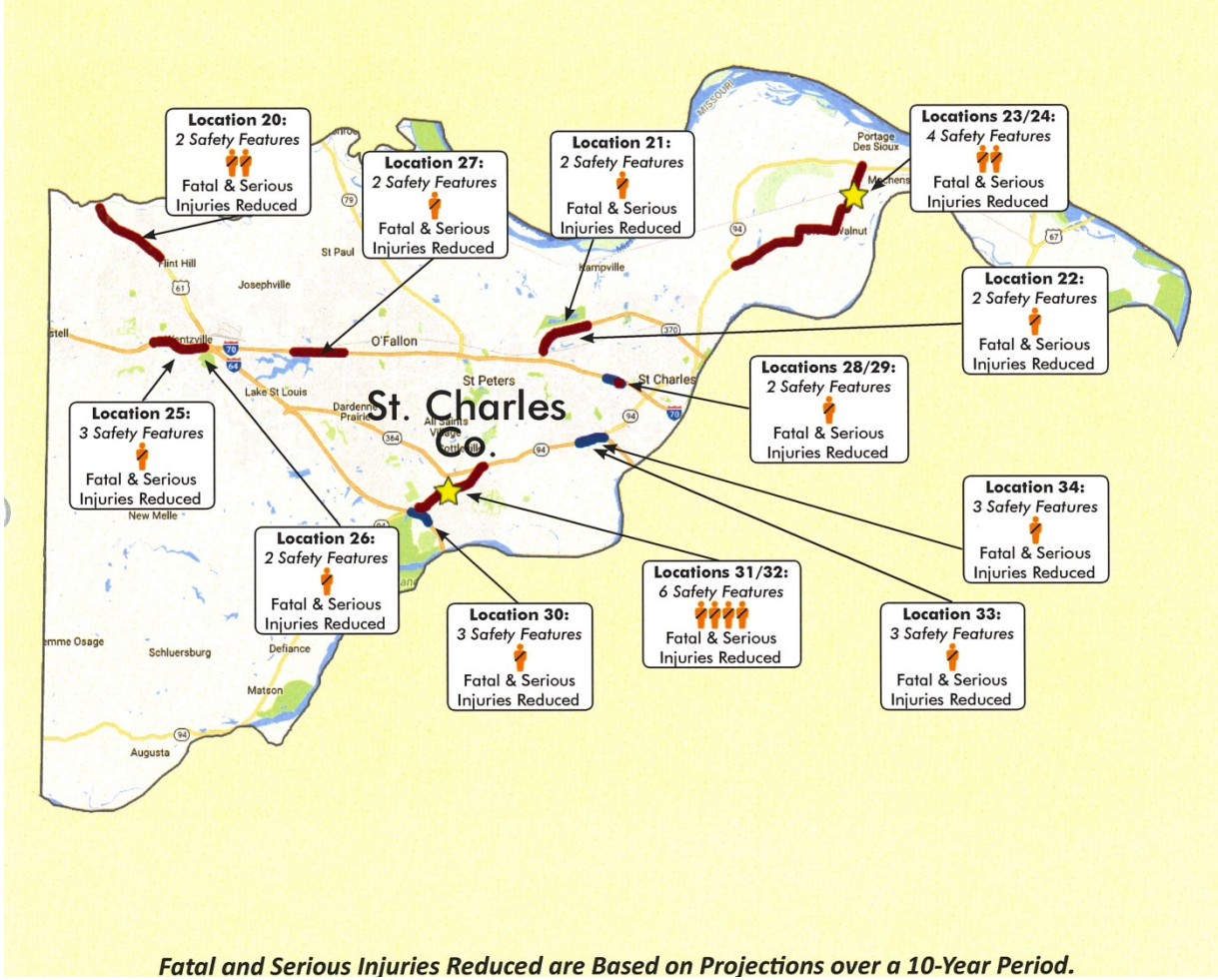
St. Charles County Improvements

WEST Contracting

HORNER SHIFRIN

LOCHMUELLER GROUP

EDSI
ENGINEERING DESIGN SOURCE, INC.

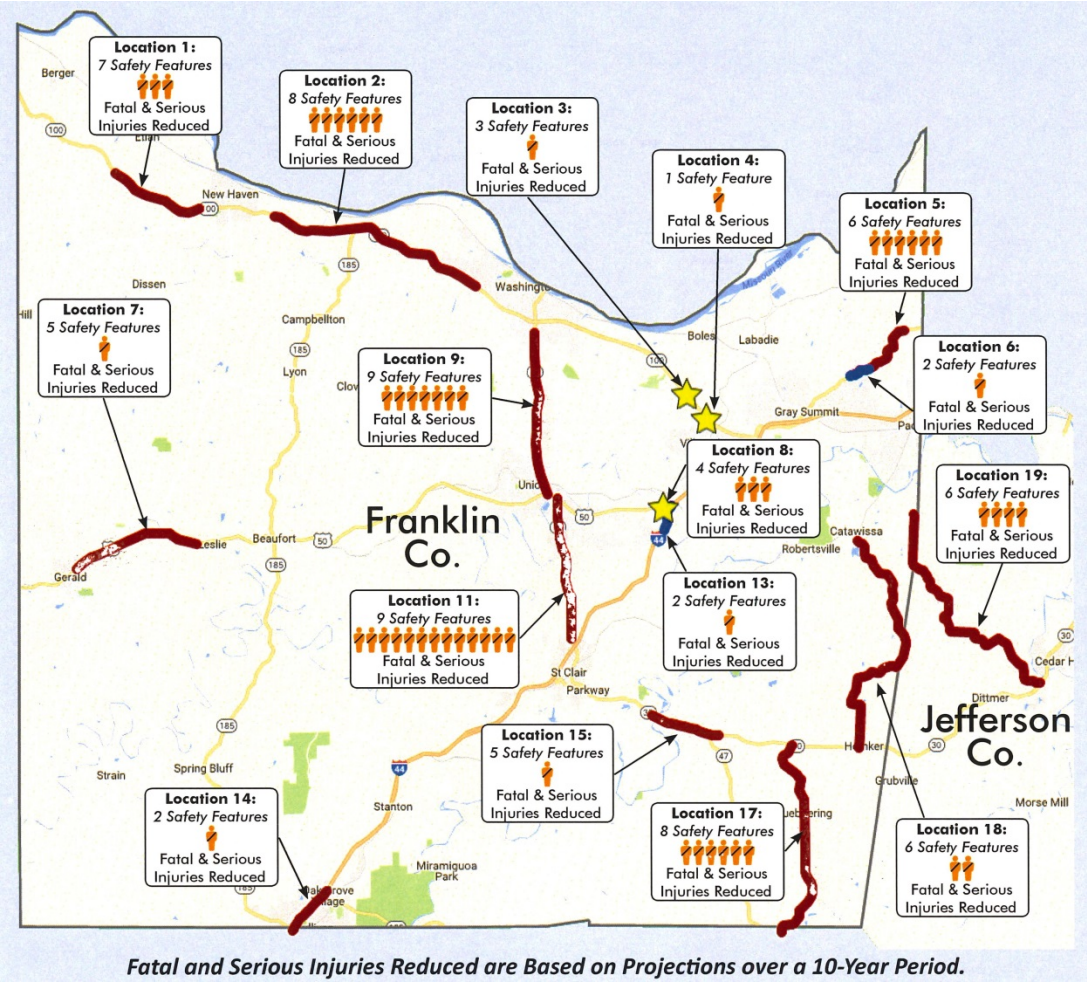


Fatal and Serious Injuries Reduced are Based on Projections over a 10-Year Period.

Road to Saving Lives

Best Value Proposal – NB West

Franklin County Improvements



Fatal and Serious Injuries Reduced are Based on Projections over a 10-Year Period.

Road to Saving Lives

Best Value Proposal – NB West
Summary of Improvements

Improvement Description	Quantity Proposed
Guardrail Replacement (upgrading to MASH)	26,400+ LF
Crashworthy End Terminals (upgrading to MASH)	90+ each
High Friction Surface Treatment	72 curves, 2 intersections
Transverse Rumbles	11 locations
Centerline Rumbles	43.5 miles
Edgeline Rumbles	30.8 miles
Roundabout	MO 100 @ Bluff Rd
Improve channelized right turn lane	8 locations
Fluorescent Curve Signs	192 curves
Inlaid pavement markers	22.8 miles
Wet reflective pavement markings	11.2 miles
Intersection Conflict Warning System	6 locations
Flashing Beacons	10 locations
1” Asphalt Overlay (BP-1)	17.0 miles

Jarrett Jasper, P.E.
Horner & Shifrin

PROPOSING TEAM'S PERSPECTIVE

Team Development

- RFQ Release
  - Industry reaction
- NB West and H&S Partnership
- Design Partners:
  - Lochmueller Group
  - EDSI
  - Kivindyo Engineering Services
- Design-Build Experience
- RFP Release

Scoring Criteria

- **Safety Improvements** (45 Points)
  - Data-Driven Analysis & Scoring
- **Maintenance and Durability of Improvements** (30 Points)
  - 5 Year Service Life Minimum
  - Overlay of Existing Roadways, Upgrade Guardrail
- **Maintenance of Traffic** (15 Points)
  - Low Impacts to Traffic
- **Completion Schedule** (10 Points)
  - Coordination with Other Projects
  - Complete by November 30, 2018 (max points)

NB West Contracting

Proposed Safety Improvements

# of Safety Locations Improved	# of Distinct Safety Improvements	# of Approved Crash Modification Factors (CMF)	# of Additional Applicable Standards (AAS)	# Serious Injuries Reduced Annually	# Fatal Crashes Reduced Annually
31 of 31	25	45	13	5.0	1.2

Road to Saving Lives

Design Coordination

- 31 Locations Throughout 2 Counties
- Design Team Responsibilities
- Weekly Meetings with MoDOT and Design Team
- Co-Location
- Separate Approvals for Each Location
- Coordination with Other Projects
- SharePoint & ProjectWise

Road to Saving Lives

Stephen Georges, P.E.
Missouri Department of Transportation

CONSTRUCTION UPDATE & PROJECT RESULTS

Under Construction Now

Notice To Proceed #2

- Construction Started Mid-July 2017
  - Started locations in groups of 4 and expected to have up to 14 locations happening simultaneously.
  - 90 days allotted for each location
  - Critical Path – High Friction Surface Treatment
  - Completion November 30, 2018

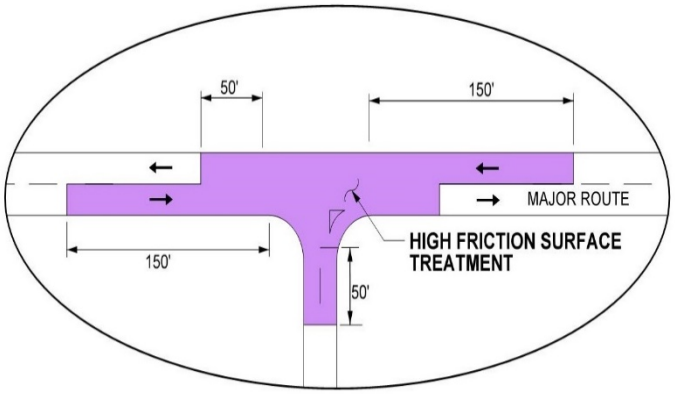
Rapid Implementation of Safety Improvements

Improvement Description	Quantity
High Friction Surface Treatment	101 curves, 26 tangents, 13 intersections
Improve channelized right turn lane	9 locations
Flashing Beacons	10 locations
Transverse Rumbles	11 locations
Centerline Rumbles	43.5 miles
Edgeline Rumbles	30.8 miles
Fluorescent Curve Signs	192 curves
Intersection Conflict Warning System	6 locations
Crashworthy End Terminals (upgrading to MASH)	90+ each
Guardrail Replacement (upgrading to MASH)	26,400+ LF
Wet reflective pavement markings	11.2 miles
Inlaid pavement markers	22.8 miles
1” Asphalt Overlay (BP-1)	17.0 miles

High Friction Surface Treatment (HFST)

Improve Friction

- **Biggest safety improvement for project**
- **Aggregates**
  - Chinese Bauxite – required for interstates
  - Phonolite – approved for all other routes
- **Contract Quantity**
  - 101 curves, 26 tangents, 13 intersections
  - 265,000 square yards (40 lane miles)
- **Completed**
  - 27 curves, 14 tangents, 4 intersections (10 lane miles)



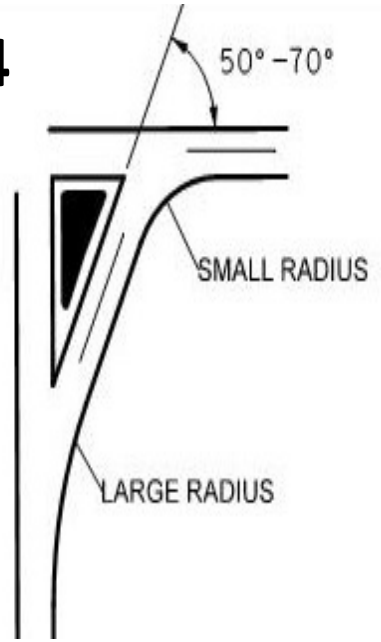
Road to Saving Lives

Improved Channelized Right Turn Lane

Straighter angle to improve sight distance

Encourages drivers to stop

- **11 out of 24 complete**
- **CMF: 0.564**



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Flashing Beacons

Flashing beacons added to stop signs

Increases visibility of approaching intersection

- **8 out of 16 complete**
- **CMF: 0.900**

Road to Saving Lives

Rumbles

Centerline & Edgeline

Provide feedback to driver (sound & feel) for lane departures

- **Centerline Rumbles**
  - 7 out of 42 miles complete
  - CMF: 0.88
- **Edgeline Rumbles**
  - 14 out of 38 miles complete
  - CMF: 0.94

Road to Saving Lives

Transverse Rumbles

Provide feedback to driver (sound & feel) to alert driver of approaching intersection

- 9 out of 23 complete
- CMF: 0.90

Road to Saving Lives

Intersection Conflict Warning System

Detection of vehicle on minor crossing route to notify drivers on major highway that vehicle is approaching intersection

- 3 locations out of 6 complete

2-lane highway

- CMF: 0.450

4-lane highway

- CMF: 0.734

Road to Saving Lives

2018 Construction Season

Additional Safety Improvements to Come

- Dynamic Signal Warning Flashers
  - Rte. 94/ Hwy. 47
- Inlaid Pavement Markers
  - 61, 94, 364, I-70, I-44, 370
- Wet Reflective Pavement Markings
- Cable Barrier
  - Hwy. 61

Road to Saving Lives

Results & Findings

- **Data supported smaller improvements spread system wide to deliver maximum safety results**
  - *High Friction Surface Treatments* delivered most safety benefits per dollar
  - All teams had extensive rumbles, striping, guard cable, guard rail, and pavement treatments to increase friction
  - No team proposed shoulder widening
- **THINK BIG!**

National Roadway Safety Award

Jointly Sponsored by FHWA and the Roadway Safety Foundation

- 2017 Award for Program Planning, Development, & Evaluation

Road to Saving Lives

Project Website

For More Information

http://contribute.modot.mo.gov/stlouis/major_projects/SLSafetyDBProject/

Road to Saving Lives

Questions & Answers
Time Permitting

Safety Improvements Design-Build Project

David Simmons, *MoDOT St. Louis District*
Stephen Georges, *MoDOT St. Louis District*
Dawn Perkins, *FHWA MO Division*
James Ritter, *Jacobs (CH2M)*
Jarrett Jasper, *Horner & Shifrin*