

# Welcome to the WebEx. The presentation on the Project Safety Assessment Tool will begin shortly.

- We will take questions after the presentation, however, you may enter questions at any time during this meeting via the WebEx Chat Function. We will address all questions at the end of the presentation.
- Please mute your phone before and during the presentation.
- The presentation will be recorded and posted online.



#EndTheStreakTX



# Project Safety Assessment Tool

Webinar



- Background
- Council on System Safety
- Texas Transportation Commission adopted formal goal May 2019
  - Reduce number of deaths by half by 2035
  - Reduce number of deaths to zero by 2050
- Approved additional \$600M of Road to Zero funding
- Specific Topic of Safety Scoring Tool

Policy and Standards

Plans

Programs

Planning and Design

Construction

Maintenance

Plan and Process Reviews

Roadside Safety Hardware

Supporting Data

Communication/Outreach

Research

# TTI Project Safety Scoring Team:



- Raul Avelar
- Karen Dixon
- Robert Wunderlich



**Approach**

**Tool Overview**

**Tool Demonstration**



- PURPOSE:

*Assist in making safety-driven decisions in the project design process*

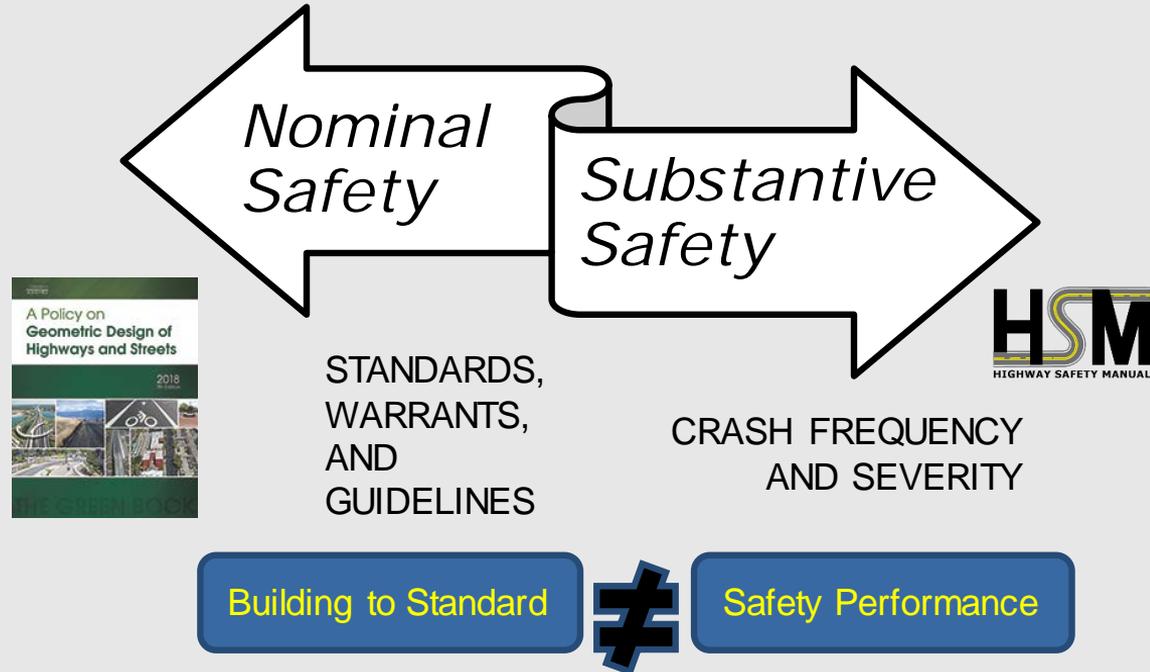


Help to:

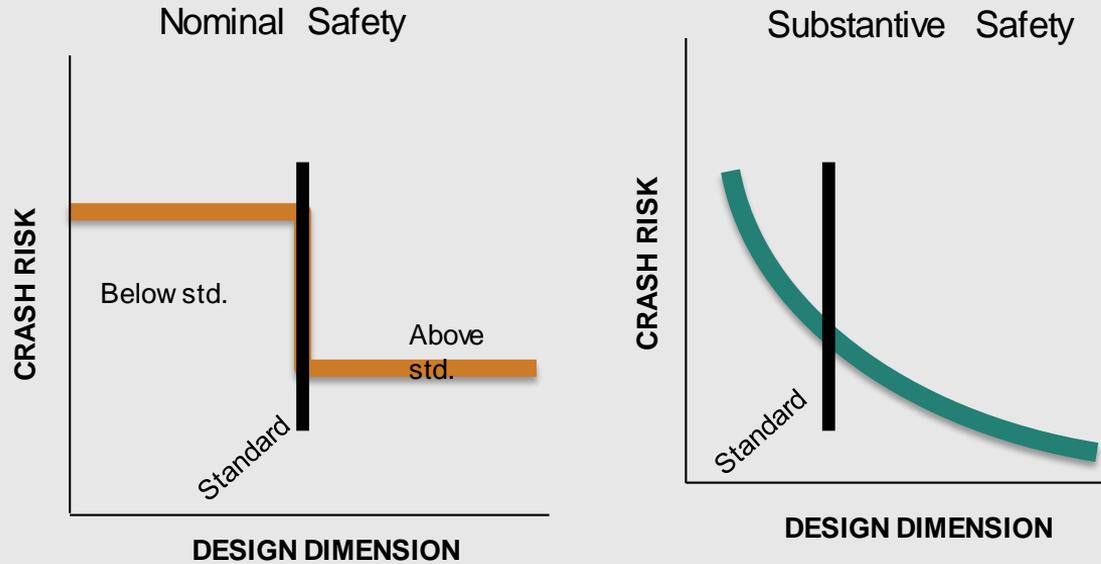
optimize safety before the project is constructed

understand safety effects of design elements

# Objective Safety: Nominal vs. Substantive Design

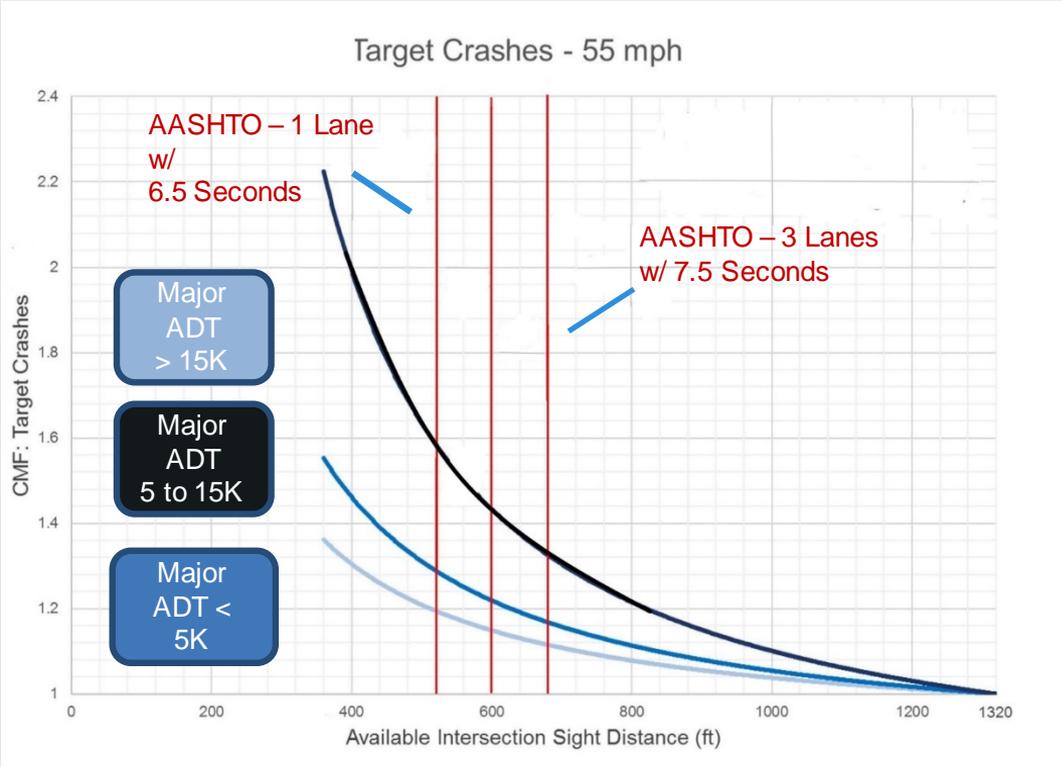


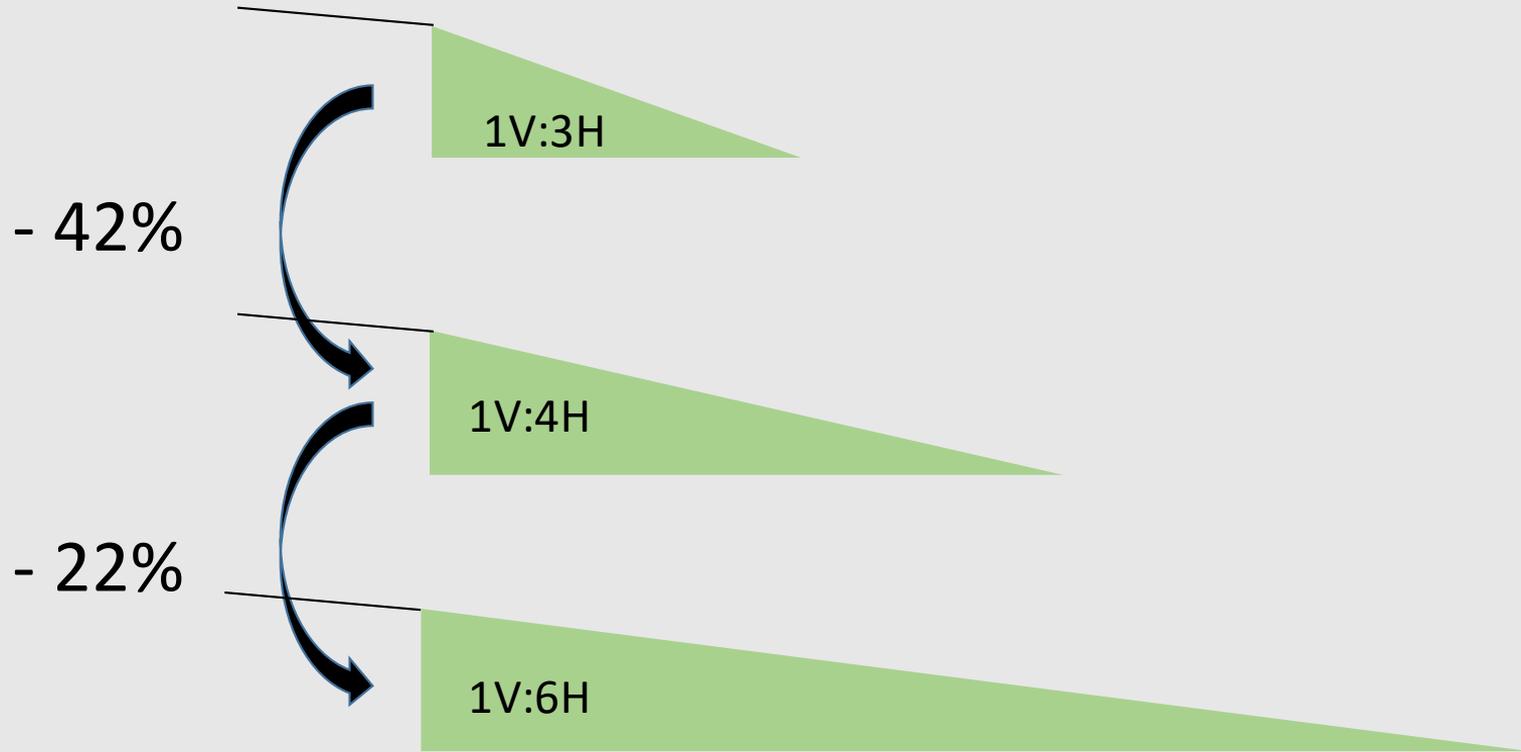
# Safety is a Continuum



Lane Width, Radius of Curve, Sight Distance,  
etc.

# Nominal vs Substantive Sight Distance







Assign design elements to categories

Define standard and optimal values for each element

Calculate individual element scores & combine into category scores to determine score



Roadway Elements were classified into the following categories:

## Geometric

e.g.,

Shoulder and Lane Width  
Curvature  
Turn Lanes  
Passing Lanes

**Baseline for Safety  
(e.g., sharp vs. flat  
curve)**

## Traffic

e.g.,

Markings  
Signs  
Rumble Strips  
Access Management

**Improves Safety by  
helping drivers stay  
on the road**

## Roadside

e.g.,

Sideslope  
Lateral Clearance  
Barriers  
Safety Edge

**Mitigate  
consequences of  
departing the road**



Researched and quantified

Documented as Crash Modification Factors (CMFs)

Form the basis of comparing design alternatives

Examples can be found at: [www.cmfclearinghouse.com](http://www.cmfclearinghouse.com)



Traditional  
Approach



Existing  
Conditions

Project  
Designed  
to  
Standards



No need to  
go further



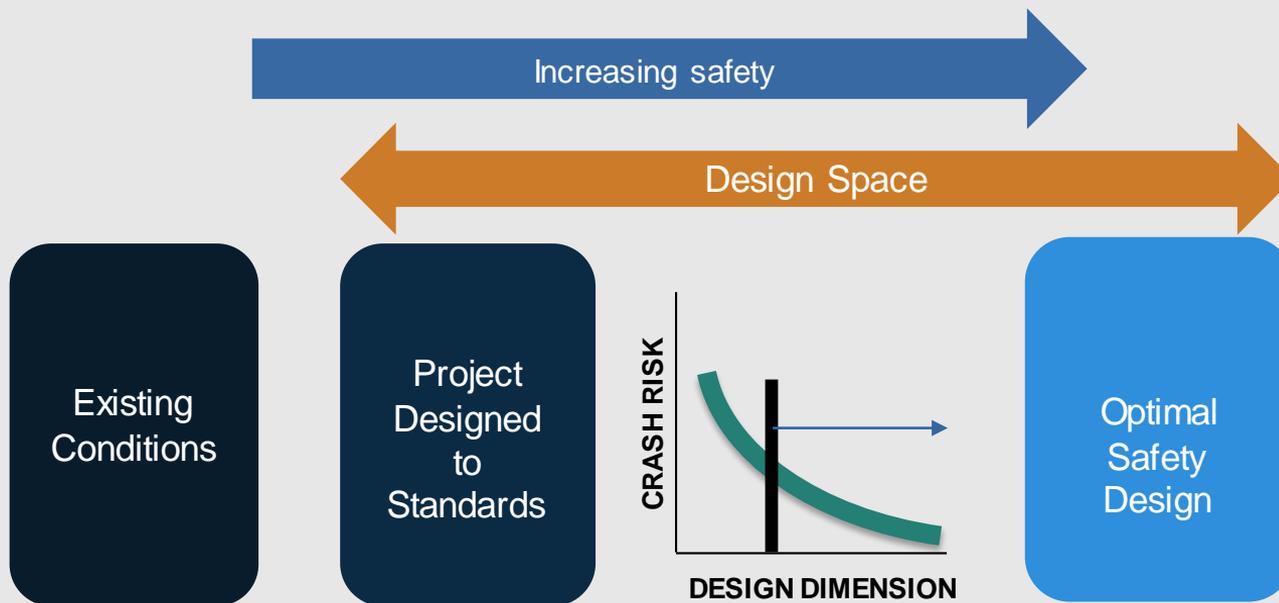
Define maximum practical value for each design parameter

Combination establishes optimal design





The Optimal Design creates space to improve safety beyond the “standard.”





The tool uses the Optimal Safety Design as the basis for comparing alternatives



# Weighting for Roadway Element Categories



Geometric and Roadside elements are weighted more heavily because they are likely to be in place the longest. Traffic devices may be improved during the life of the project and are less permanent.

## Geometric 40 points

e.g.,  
Shoulder and Lane  
Width  
Curvature

**Baseline for Safety**  
(e.g., sharp vs. flat  
curve)

## Traffic 20 points

e.g.,  
Markings  
Signs  
Access Management

**Improves Safety by**  
helping drivers stay  
on the road

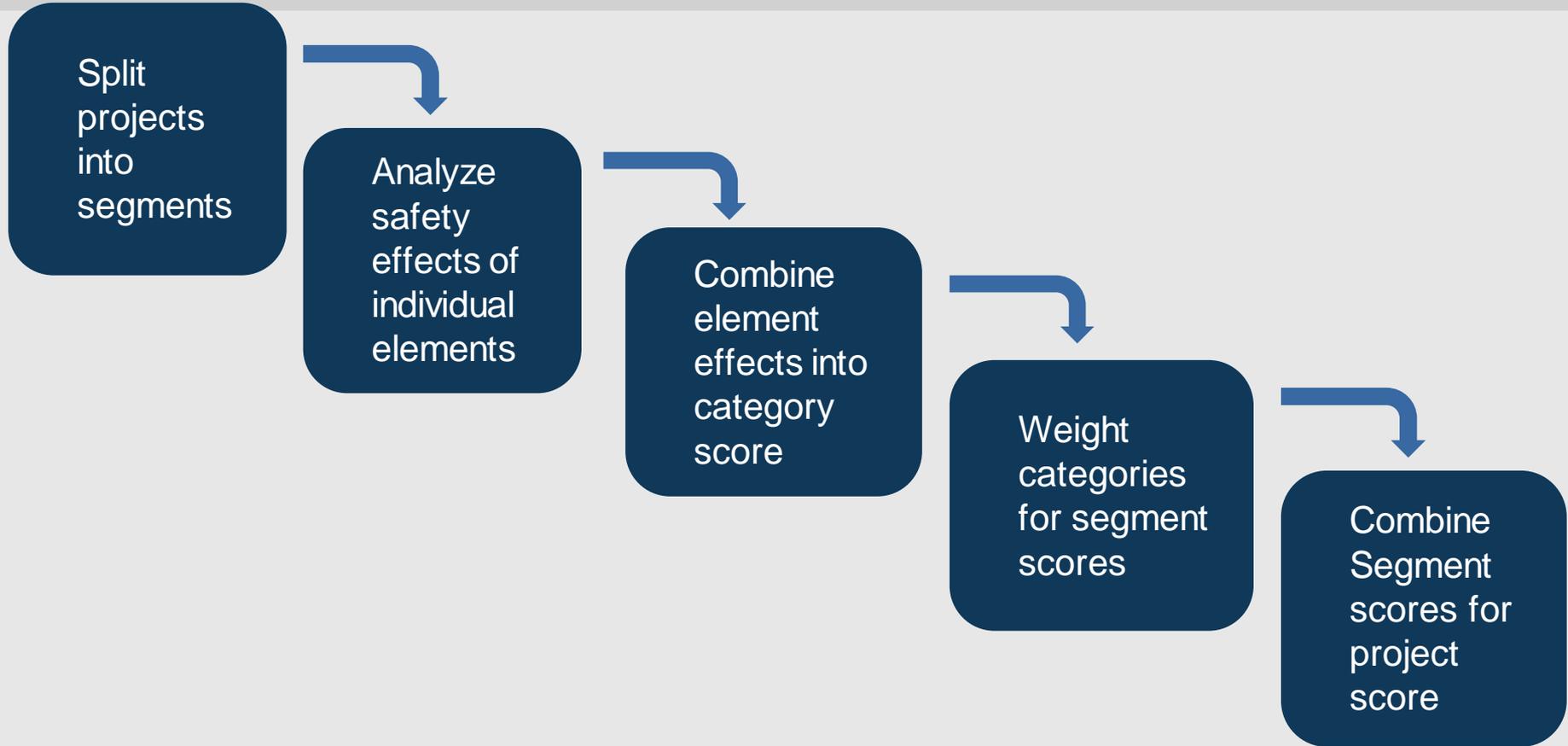
## Roadside 40 points

e.g.,  
Clear Zone  
Sideslope  
Barriers

**Mitigate**  
consequences of  
departing the road

Based on a maximum total score of 100

# Summary of Scoring Procedure





***Purpose: Develop a tool to assist in making safety-driven decisions in the project development and design process***

## What *IS* intended

- Increase awareness of how design changes can affect safety
- Identify and evaluate design component effect of safety
- Simple and straight-forward decision aid

## What is *NOT* intended

- A final decision-making tool
- Requirement for project approval
- Substitute for engineering judgement
- Mandate for over-design
- Intended to compare Districts

# Tool Overview



## Rural Two-Lane Road Segment -- Safety Score Input

INPUT INSTRUCTIONS	
Blue Boxes -- Select from pulldown options	Select from Pulldown
Yellow Boxes -- Type input information into box	Type Input Value
<b>General Information</b>	
Analyst:	S. Houston
Agency or Company:	TxDOT
Date:	8/21/2019
<b>Segment Limits (Limit up to 15 miles in length):</b>	
Road Name:	FM1776
Category (4R, 3R) -- Future Enhancement	4R
Segment Beginning Mile Point (BMP):	2.10
Segment Ending Mile Point (EMP):	14.30
<b>Calculated Total Segment Length (miles):</b>	12.20

Segment Number	Boundary Conditions			Applicable Worksheet (similar segment can use same worksheet)	Segment Safety Score						
	BMP	EMP	Length		Existing	Standard	Design 1	Design 2	Optimal		
1	2.10	3.10	1.00	Configuration 1	74	69	86	90	100		
2	3.10	4.10	1.00	Configuration 2	62	69	86	90	100		
3	4.10	5.10	1.00	Configuration 1	74	69	86	90	100		
4	5.10	6.10	1.00	Configuration 1	74	69	86	90	100		
5	6.10	7.10	1.00	Configuration 1	74	69	86	90	100		
6	7.10	8.10	1.00	Configuration 1	74	69	86	90	100		
7	8.10	9.10	1.00	Configuration 1	74	69	86	90	100		
8	9.10	10.10	1.00	Configuration 1	74	69	86	90	100		
9	10.10	11.10	1.00	Configuration 1	74	69	86	90	100		
10	11.10	12.10	1.00	Configuration 1	74	69	86	90	100		
11	12.10	13.10	1.00	Configuration 1	74	69	86	90	100		
12	13.10	14.10	1.00	Configuration 1	74	69	86	90	100		
13	14.10	14.30	0.20	Configuration 1	74	69	86	90	100		
Total Study Length											
					12.20	<b>Weighted Total Score:</b>	<b>73.0</b>	<b>69.0</b>	<b>86.0</b>	<b>90.0</b>	<b>100.0</b>



## Rural Two-Lane Road Segment -- Safety Score Input

INPUT INSTRUCTIONS	
Blue Boxes -- Select from pulldown options	Select from Pulldown
Yellow Boxes -- Type input information into box	Type Input Value
<b>General Information</b>	
Analyst:	A. Einstein
Agency or Company:	TxDOT
Date:	03/06/19
<b>Segment Limits (Limit up to 5 miles in length):</b>	
Road Name:	SH 222
Category (4R, 3R, 2R) -- Future Enhancement	3R
Segment Beginning Mile Point (BMP):	5.00
Segment Ending Mile Point (EMP):	8.40
<b>Calculated Total Segment Length (miles):</b>	3.40

# Worksheet Analysis Section Assignment



Segment Number	Boundary Conditions			Applicable Worksheet (similar segment can use same worksheet)	Segment Safety Score				
	BMP	EMP	Length		Existing	Standard	Design 1	Design 2	Optimal
1	2.10	3.10	1.00	Configuration 1	74	69	86	90	100
2	3.10	4.10	1.00	Configuration 2	62	69	86	90	100
3	4.10	5.10	1.00	Configuration 1	74	69	86	90	100
4	5.10	6.10	1.00	Configuration 1	74	69	86	90	100
5	6.10	7.10	1.00	Configuration 1	74	69	86	90	100
6	7.10	8.10	1.00	Configuration 1	74	69	86	90	100
7	8.10	9.10	1.00	Configuration 1	74	69	86	90	100
8	9.10	10.10	1.00	Configuration 1	74	69	86	90	100
9	10.10	11.10	1.00	Configuration 1	74	69	86	90	100
10	11.10	12.10	1.00	Configuration 1	74	69	86	90	100
11	12.10	13.10	1.00	Configuration 1	74	69	86	90	100
12	13.10	14.10	1.00	Configuration 1	74	69	86	90	100
13	14.10	14.30	0.20	Configuration 1	74	69	86	90	100
Total Study Length			12.20	<b>Weighted Total Score:</b>	<b>73.0</b>	<b>69.0</b>	<b>86.0</b>	<b>90.0</b>	<b>100.0</b>





Safety Score based on higher of the two

General Site Features	
Location	Rural (no town)
Beginning Milepoint	0.00
Ending Milepoint	1.00
Segment Length	1.00 mi
Design Year AADT (vehicles per day)	< 400 vpd
Distance from Centerline to Left R.O.W.	60.00 ft
Distance from Centerline to Right R.O.W.	60.00 ft
E max	5.0%
Design Speed	65 mph
Posted Speed	75 mph
Segment with Horizontal Curve?	Yes

Posted speed exceeds design speed. Optimal safety will only be achieved if design speed exceeds posted speed. The Safety Assessment Score is based on the higher of the two speed values.

# General Study Segment Data

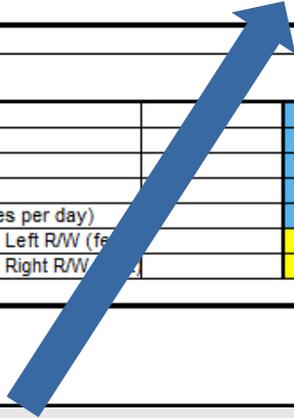


**CHARACTERISTICS TO CONSIDER FOR ANALYSIS**

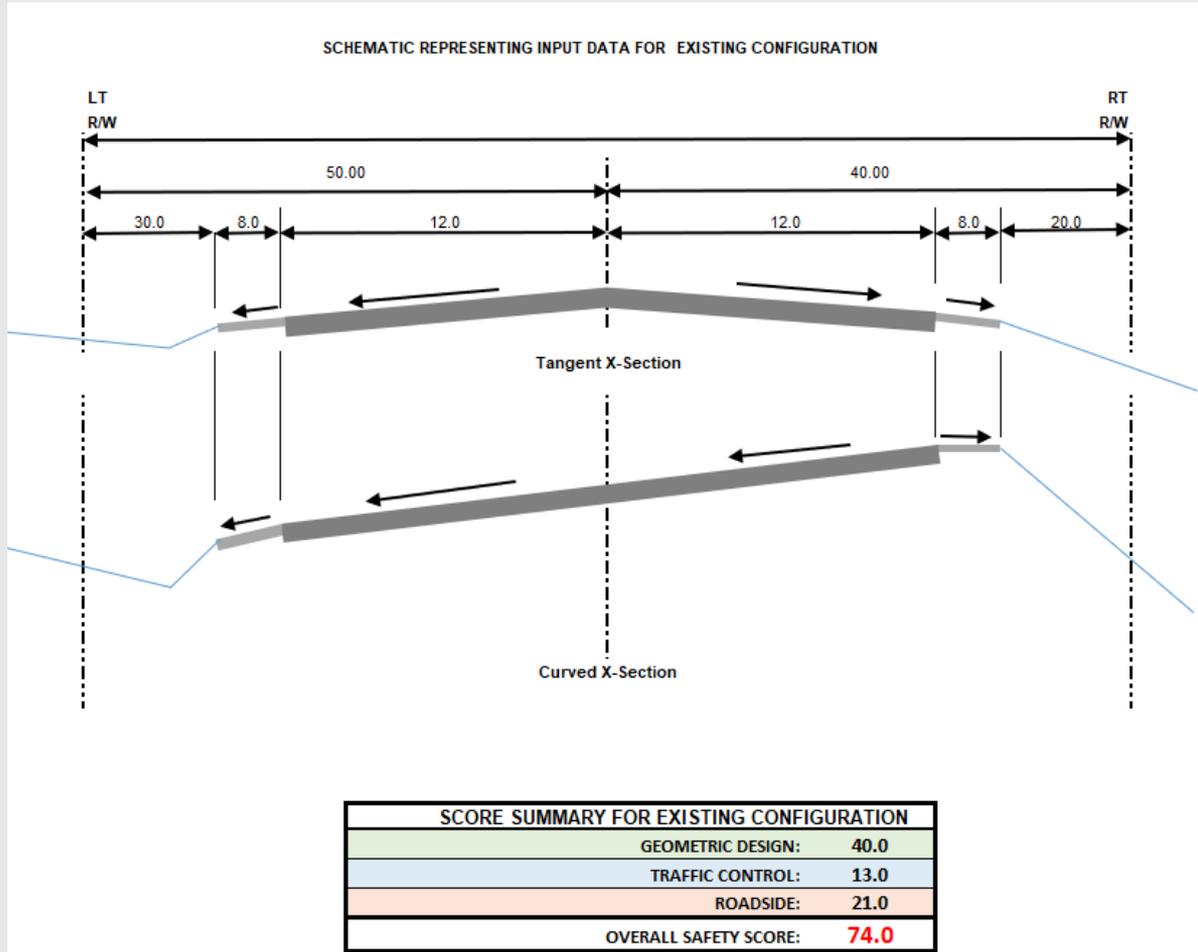
INPUT INSTRUCTIONS		Preferred Schematic View to Display
Blue Boxes -- Select from pulldown options	Select from Pulldown	Existing
Yellow Boxes -- Type input information into box	Type Input Value	
<b>Rural Two-Lane Road Segment -- Safety Score Input</b>		
<b>General Information:</b>		<b>General Site Features</b>
Analyst:	S. Houston	Location: Rural (no town)
Agency or Company:	TxDOT	Design Speed (mph): 65
Date:	8/21/2019	Posted Speed (mph): 55
Description:		E max (%): 8
Example to demonstrate tool functionality		Design Year AADT (vehicles per day): 400 to 2,000 vpd
		Distance from Centerline to Left R/W (feet): 50.00
		Distance from Centerline to Right R/W (feet): 40.00
<b>Warning:</b>		
No warnings identified		

Preferred Schematic View to Display	Existing
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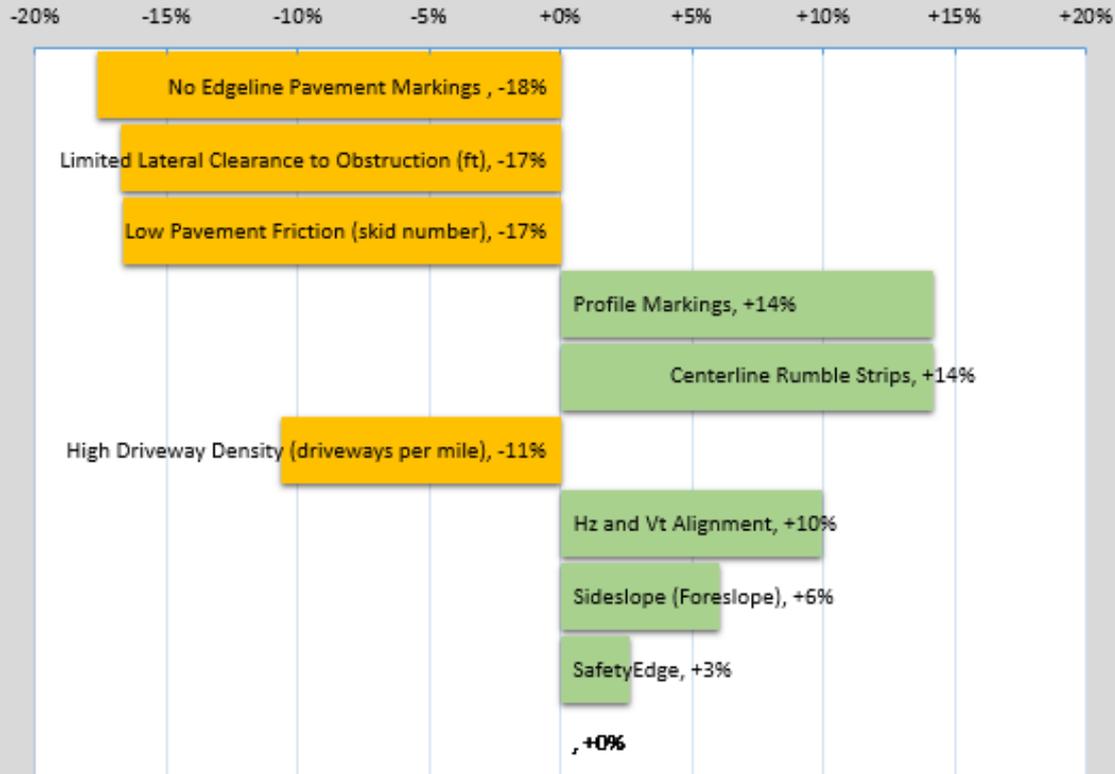


# Site Schematics – Existing Configuration on Tangent Example



# Vortex of Safety

## Unadjusted Marginal Safety in Existing relative to Standard



# Design Elements – Horizontal and Vertical Curvature Present



## 40 Total Available Points

Geometric Design Elements	
Lane Width (feet)	
Shoulder Width (feet)	
Cross-slope or Superelevation (%)	
Yes Horizontal Curve Present?	
<i>Horizontal Curve Data for Controlling Element:</i>	
Radius (feet)	
Length of Horizontal Curve (feet)	
Yes Vertical Curve Present?	
<i>Vertical Curve Data for Controlling Element:</i>	
Approach (Entry) Grade, G1 (%)	
Departure (Exit) Grade, G2 (%)	
Length (feet)	
Calculated Rate of Change, K (ft/ft)	
Calculated Sag or Crest?	
TWLTL (two-way left-turn lane)	
Passing or Climbing Lane in One Direction	

Geometric Design Element (Partial Score)  
Total Safety Score

## 40 Total Available Points

Geometric Design Elements		Marginal Safety for Design 2 (compared to standard)	Optimal
Lane Width (feet)		-1%	12.0
Shoulder Width (feet)		+0%	10.0
Cross-slope or Superelevation (%)			8.0
Horizontal Curve Present?			--
Cross-slope or Superelevation (%)			--
Yes Horizontal Curve Present?		+12%	4000.00
			1000.00
<i>Horizontal Curve Data for Controlling Element:</i>			--
Radius (feet)			--
			-1.00
Length of Horizontal Curve (feet)			3.00
			1560.0
Yes Vertical Curve Present?			390.0
			Sag
<i>Vertical Curve Data for Controlling Element:</i>		+29%	No
Approach (Entry) Grade, G1 (%)		+0%	No
Departure (Exit) Grade, G2 (%)			40
Length (feet)			100
Calculated Rate of Change, K (ft/ft)			
Calculated Sag or Crest?			
TWLTL (two-way left-turn lane)			
Passing or Climbing Lane in One Direction			

# Design Elements – No Horizontal and Vertical Curvature Present

40 Total Available Points

## Geometric Design

Lane Width (feet)
Shoulder Width (feet)
Cross-slope or Superelevation
<input type="checkbox"/> No Horizontal Curve Present?
<i>Horizontal Curve Data for Controlling Element:</i>
Radius (feet)
Length of Horizontal Curve (feet)
<input type="checkbox"/> No Vertical Curve Present?
<i>Vertical Curve Data for Controlling Element:</i>
Approach (Entry) Grade (%)
Departure (Exit) Grade (%)
Length (feet)
Calculated Rate of Change, K (ft/ft)
Calculated Sag or Crest?
TWTL (two-way left-turn lane)
Passing or Climbing Lane in One Direction

40 Total Available Points

## Geometric Design Elements

Lane Width (feet)
Shoulder Width (feet)
Cross-slope or Superelevation (%)
<input type="checkbox"/> No Horizontal Curve Present?
<i>Horizontal Curve Data for Controlling Element:</i>
Radius (feet)
Length of Horizontal Curve (feet)
<input type="checkbox"/> No Vertical Curve Present?
<i>Vertical Curve Data for Controlling Element:</i>
Approach (Entry) Grade, G1 (%)
Departure (Exit) Grade, G2 (%)
Length (feet)
Calculated Rate of Change, K (ft/ft)
Calculated Sag or Crest?
TWTL (two-way left-turn lane)
Passing or Climbing Lane in One Direction

Design 1	Design 2	Marginal Safety for Design 2 (compared to standard)	Optimal
12.0	11.5	-1%	12.0
10.0	8.0	+0%	10.0
5.0	5.0		8.0
--	--		--
--	--		--
		+0%	
--	--		--
--	--		--
-1.00	-1.00		-1.00
--	--		--
--	--		--
No	Yes	+29%	No
No	No	+0%	No
40	40		40
86	90		100

# Traffic Elements



20 Total Available Points

Traffic Elements
Advance Static Curve W
Chevron Signs on Horizo
Post-Mounted Delineator
Edgeline Pavement Marki
Profile Markings
Shoulder Rumble Strips
Centerline Rumble Strips
Driveway Density (drive
Lighting
Pavement Friction (skid n

Traffic Control Elements

20 Total Available Points

Traffic Elements
Advance Static Curve Warning Signs
Chevron Signs on Horizontal Curves
Post-Mounted Delineators
Edgeline Pavement Markings
Profile Markings
Shoulder Rumble Strips
Centerline Rumble Strips
Driveway Density (driveways per mile)
Lighting
Pavement Friction (skid number)

	Design 2	Marginal Safety for Design 2 (compared to standard)	Optimal
	No	+0%	Yes
	No	+0%	Yes
	No	+0%	Yes
	Yes	+0%	Yes
	No	+0%	Yes
	Yes	+0%	Yes
	No	+0%	Yes
	15 Dwy / Mi	-11%	0 Dwy / Mi
	Yes	+2%	Yes
	20.0	-28%	56.0
	12		20
	90		100



## 40 Total Available Points

# Roadside Elements

Sideslope (Foreslope)
Distance to Slope Toe from Shoulder (ft)
Backslope
SafetyEdge
Lateral Clearance to Obstruction (ft)
Fixed Object Type

## 40 Total Available Points

Roadside Element
Sideslope (Foreslope)
Distance to Slope Toe from Shoulder (ft)
Backslope
SafetyEdge
Lateral Clearance to Obstruction (ft)
Fixed Object Type

Roadside Element (Pair)  
Total Safety Points

### ADDITIONAL SIDESLOPE INFORMATION

Minimum foreslope feasible within current R/W
Additional R/W needed on left side
Additional R/W needed on right side

Marginal Safety for Design 2 (Compared to Standard)	Optimal
+6%	1V:6H
	30.0
+0%	1V:4H
+0%	Yes
+0%	40.0
+0%	None/Removed
	40
	100

	1V:5H
	0.00 ft
	4.50 ft



40 Total Available Points

Roadside Element
Sideslope (Foreslope)
Backslope
SafetyEdge
Lateral Clearance to obstruction
Obstruction Type
<b>Roadside Element Total</b>

40 Total Available Points

Roadside Elements
Sideslope (Foreslope)
Backslope
SafetyEdge
Lateral Clearance to obstruction (ft)
Obstruction Type

2	Marginal Safety for Existing (compared to standard)	Optimal
	+0%	1V:6H
	+0%	1V:4H
	+3%	Yes
	-13%	40.0
Object	+0%	None
		<b>40</b>
		<b>100</b>

ADDITIONAL SIDESLOPE INFORMATION

Distance to Slope Toe from Shoulder (ft)	20.0	20.0	20.0	20.0	20.0
Minimum foreslope feasible within current ROW		1V:5H	1V:5H	1V:5H	1V:4H
Additional R/W needed on left side		0.00 ft	7.00 ft	7.00 ft	12.00 ft
Additional R/W needed on right side		0.00 ft	0.00 ft	0.00 ft	2.00 ft

# Summary of Results



SCORE SUMMARY FOR EXISTING CONFIGURATION	
GEOMETRIC DESIGN:	47.0
TRAFFIC CONTROL:	10.0
ROADSIDE:	7.0
OVERALL SAFETY SCORE:	64.0

Analysis Group	Existing	Standard	Design 1	Design 2	Optimal
Geometric Design	47.0	42.0	59.0	58.0	60.0
Traffic Control	10.0	18.0	23.0	21.0	25.0
Roadside	7.0	10.0	15.0	15.0	15.0
<b>Total Score</b>	<b>64.0</b>	<b>70.0</b>	<b>97.0</b>	<b>94.0</b>	<b>100.0</b>

# Multilane Tool Demonstration

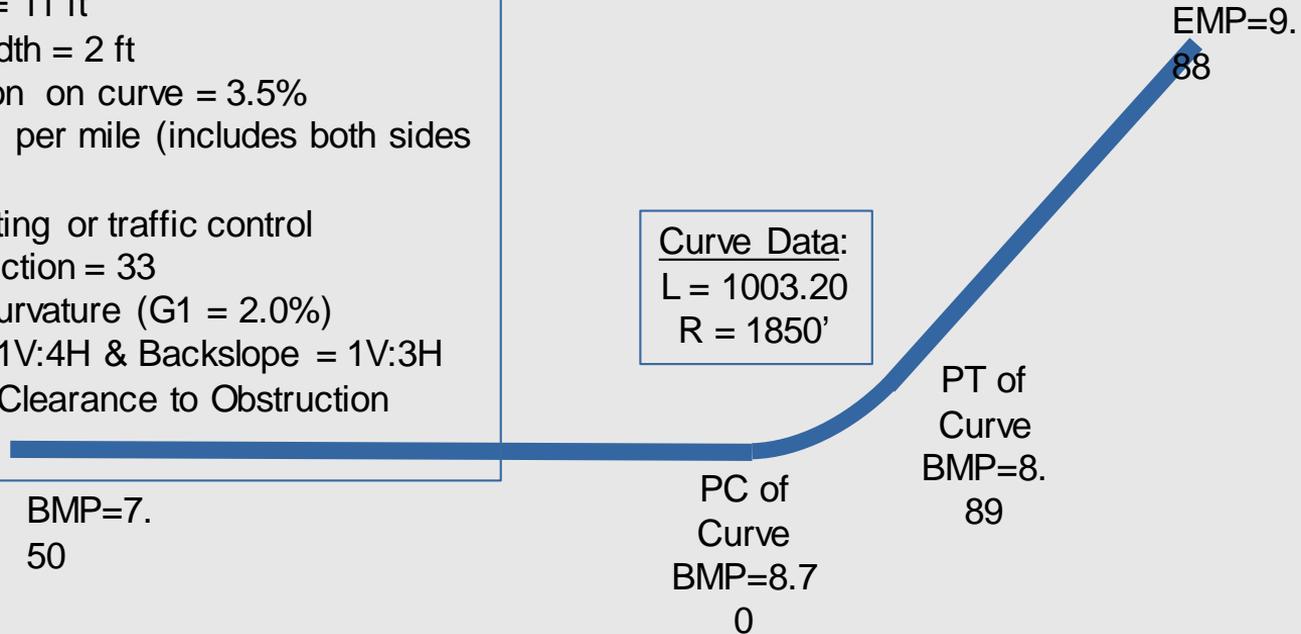


# Rural Multi-Lane Highway Example (No passing, climbing, or turning lanes)



## Existing Conditions:

- Design Speed = 65 mph & Speed Limit = 55 mph
- 4 lanes undivided
- Lane Width = 11 ft
- Shoulder Width = 2 ft
- Superelevation on curve = 3.5%
- 12 driveways per mile (includes both sides of road)
- No extra lighting or traffic control
- Pavement friction = 33
- No vertical curvature ( $G1 = 2.0\%$ )
- Sideslope = 1V:4H & Backslope = 1V:3H
- 25 ft Lateral Clearance to Obstruction (Trees)





- [Materials can be found on the Design Division Web Page under Key Initiatives](#)
- Begin using the tool on all Two-Lane and Multi-Lane Rural projects
- Continue to provide feedback on the scoring tools/process to DES
- Starting with the April 2020 Letting, submit initial and final safety scores with Final PS&E
  - DES will update the Form 1002
- DES/Council on System Safety will continue developing tools and guidance for intersections and urban contexts



# Questions?

(Please use WebEx chat function)