SYSTEMIC APPROACH TO SAFETY

August 15, 2018

JACOBS®

INTRODUCTIONS

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AGENDA

- Introduction
- Florida Crash Data Overview
- Systemic Process Workflow
  - Disaggregating Crashes
  - Identification of Risk Factors
  - Identification of Safety Strategies
  - Identification of Candidate Locations
  - Results & Acknowledgement
- Local Application
- Questions?

Introduction

If you always do,

what you've always done,

you will always get,

what you always got.

Henry Ford

GOALS

1. Raise awareness of the systemic approach and how it can be integrated into a comprehensive safety program
2. Make you think

WHAT IS THE SYSTEMIC APPROACH?

> A systemic approach to safety involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The approach provides a more comprehensive method for safety planning and implementation that supplements and compliments traditional site analysis.

Data-driven process that identifies safety performance candidates based on **risk**

Source | https://safety.fhwa.dot.gov/systemic/

JACOBS EXPERIENCE

- Pioneered the process
- Have analyzed more networks than any other consultant
  - 65,000+ centerline miles of roadway
  - 29,000+ intersections
  - 27,000+ horizontal curves
- Developed FHWA Systemic Toolbox
- Developed Case Study for Bike/Ped Systemic

UNIQUE BENEFITS TO THIS APPROACH

- Proactive
- Defensible list of projects
- Increased success in applying for HSIP funding

TERMINOLOGY

- Systemic Approach/Systemic Safety/Systemic Process
- Local Road Safety Plan
- County Road Safety Plan

WHERE CAN SYSTEMIC APPROACH BE APPLIED?

State

County

City

WHERE HAS THE SYSTEMIC APPROACH BEEN APPLIED?

Vehicles
(Rural, urban, etc.)

Pedestrians/ Bicycles

Railroad Crossings

FDOT
(Lane departure & intersections)

CHALLENGE

LOW CRASH DENSITY

- Fatalities per mile per year: 0.015 (MN State System) & 0.003 (MN County)
- Majority of roadway system has ZERO recent severe crash history
- Prior crash history is NOT a good predictor of future severe crashes

☒ Too many miles to address
☒ Not enough $$$

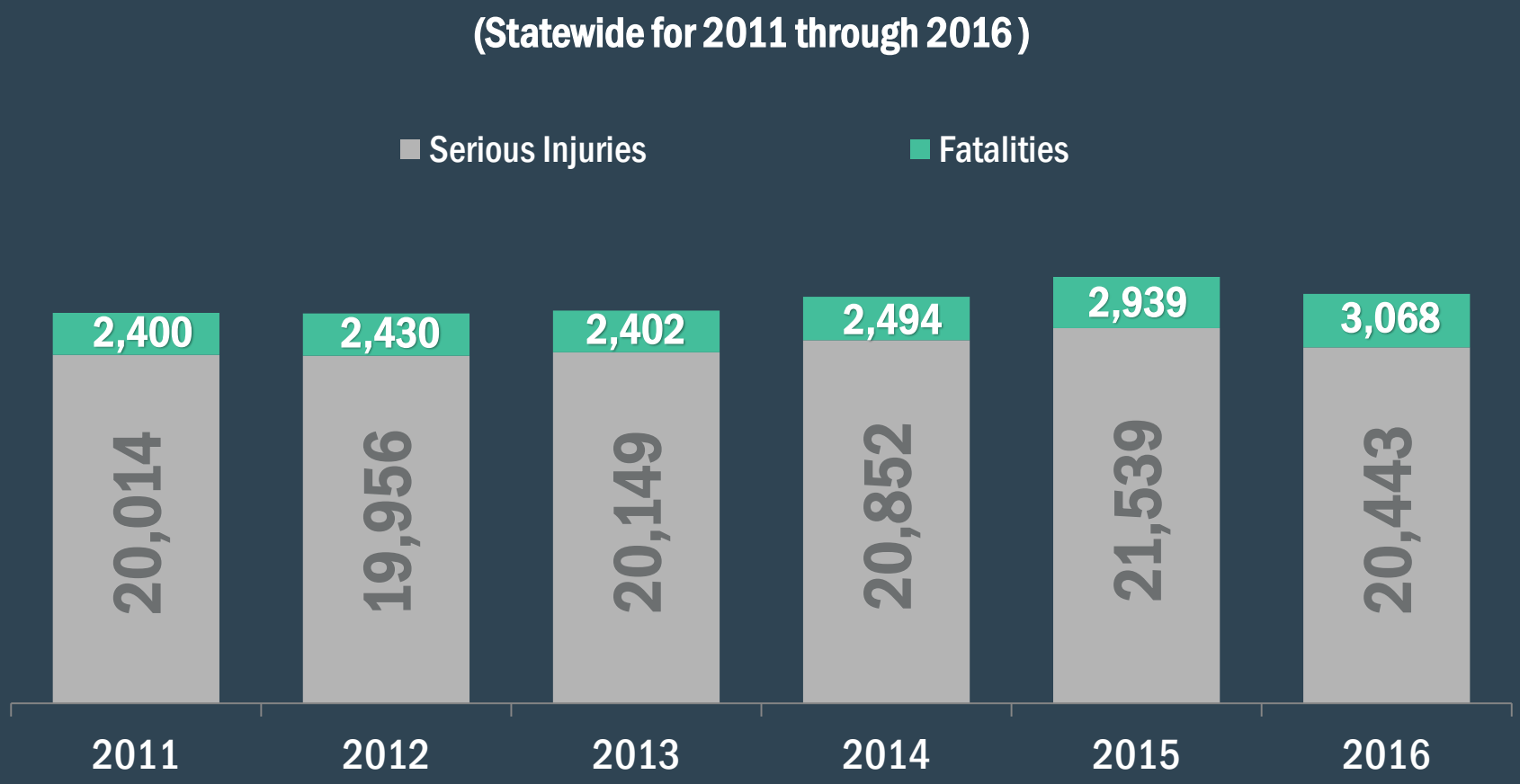
SOLUTION

Systemic Approach

- Ability to identify at-risk locations based on the presence of characteristics affiliated with severe crashes

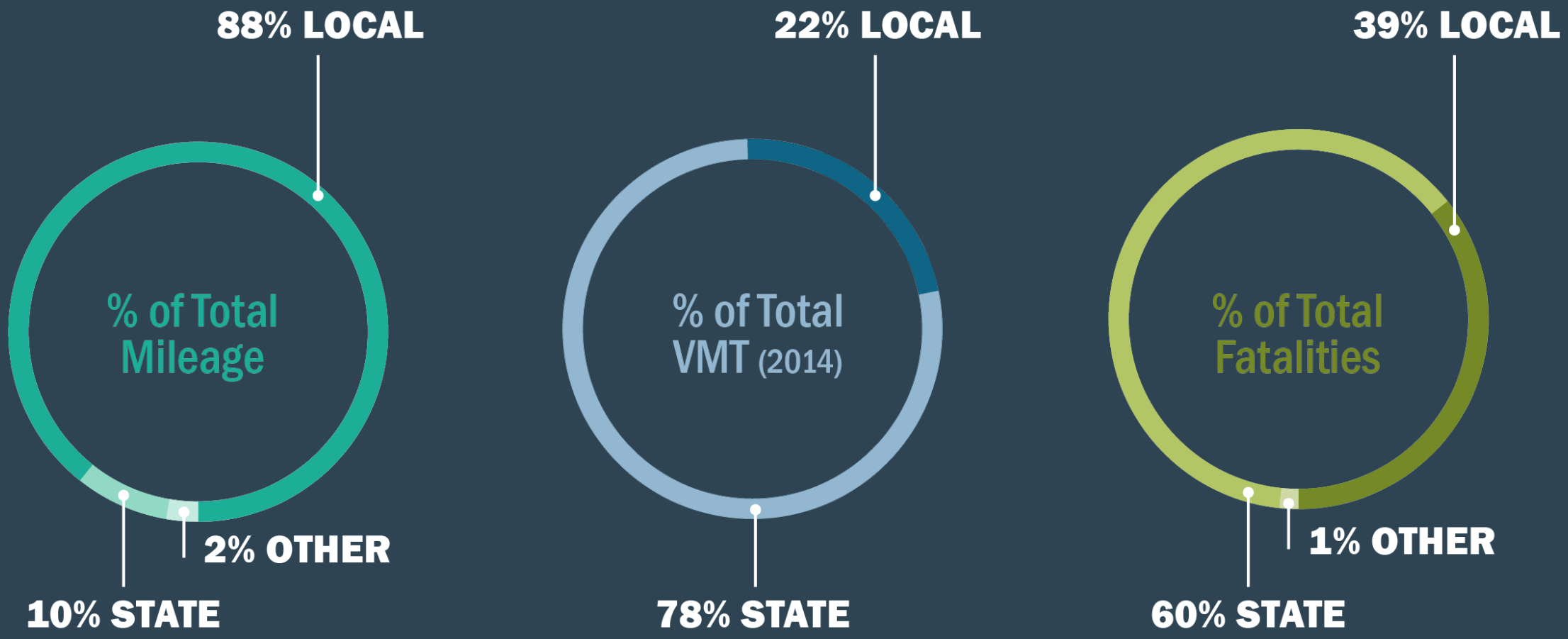
Florida Crash Data Overview

FLORIDA CRASH TRENDS | Annual Serious Injuries & Fatalities



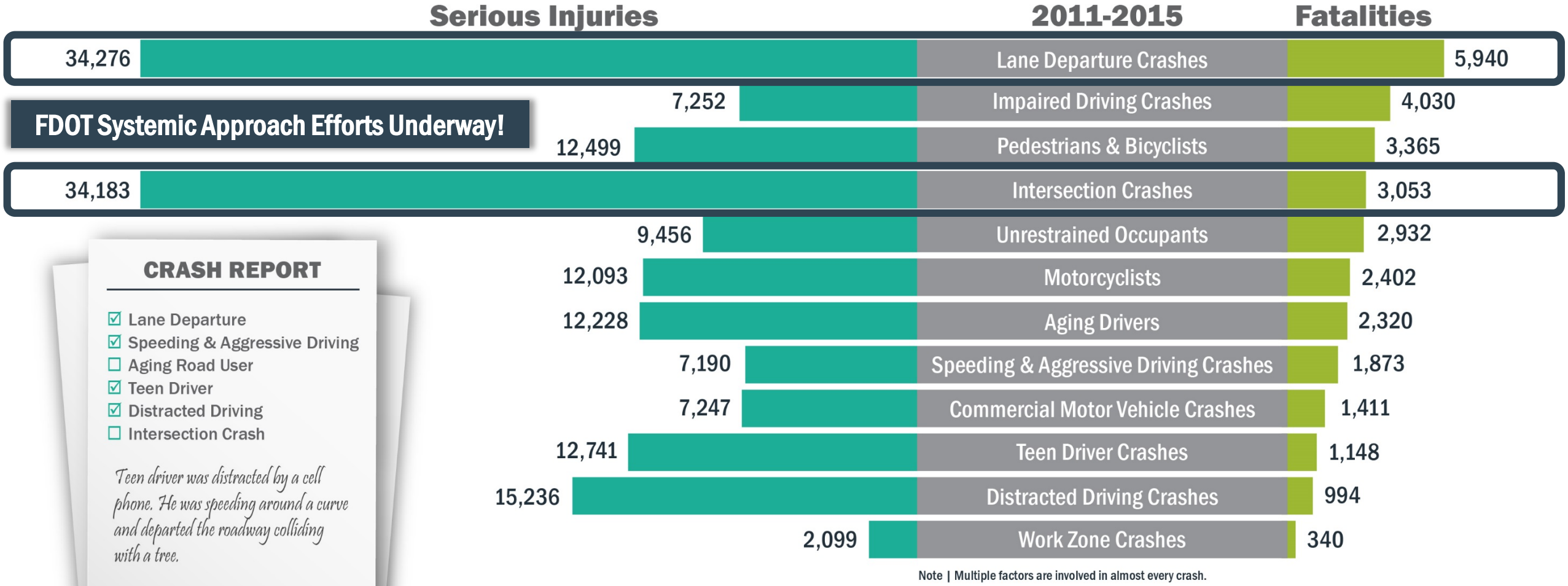
Source | FDOT Strategic Highway Safety Plan
Notes: 1) Counts from FDOT State Safety Office Crash Analysis and Reporting (CAR) system. 2) 2016 Counts are preliminary

FLORIDA CRASH TRENDS | State vs. Local Roadway



Source | FDOT 2016 Strategic Highway Safety Plan

FLORIDA CRASH TRENDS | Severe Crashes by Crash Type



FDOT Systemic Approach Efforts Underway!

Note | Multiple factors are involved in almost every crash.

CRASH REPORT

- ☑ Lane Departure
- ☑ Speeding & Aggressive Driving
- ☐ Aging Road User
- ☑ Teen Driver
- ☑ Distracted Driving
- ☐ Intersection Crash

Teen driver was distracted by a cell phone. He was speeding around a curve and departed the roadway colliding with a tree.

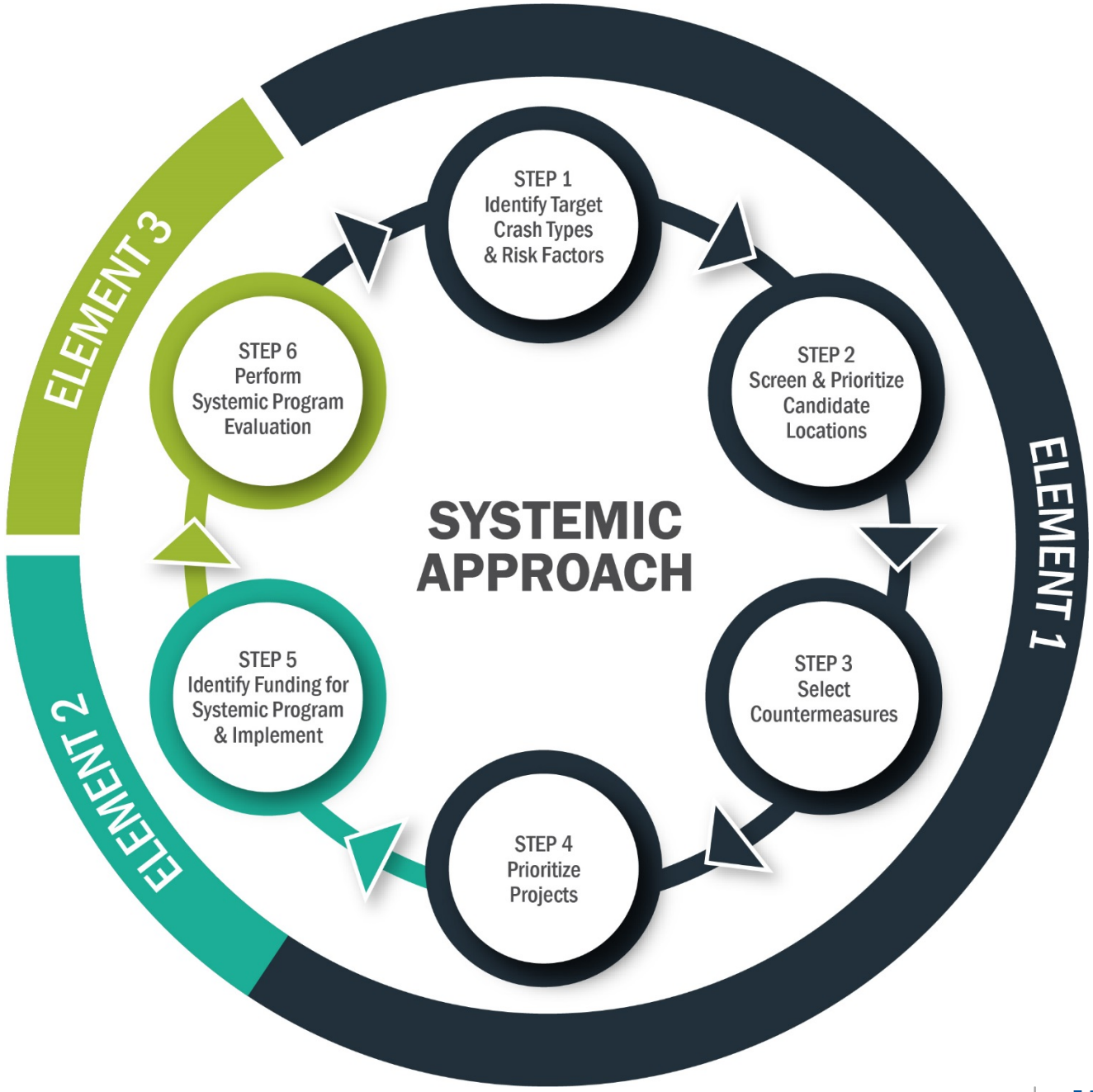
Source | FDOT Strategic Highway Safety Plan

Systemic Process Workflow

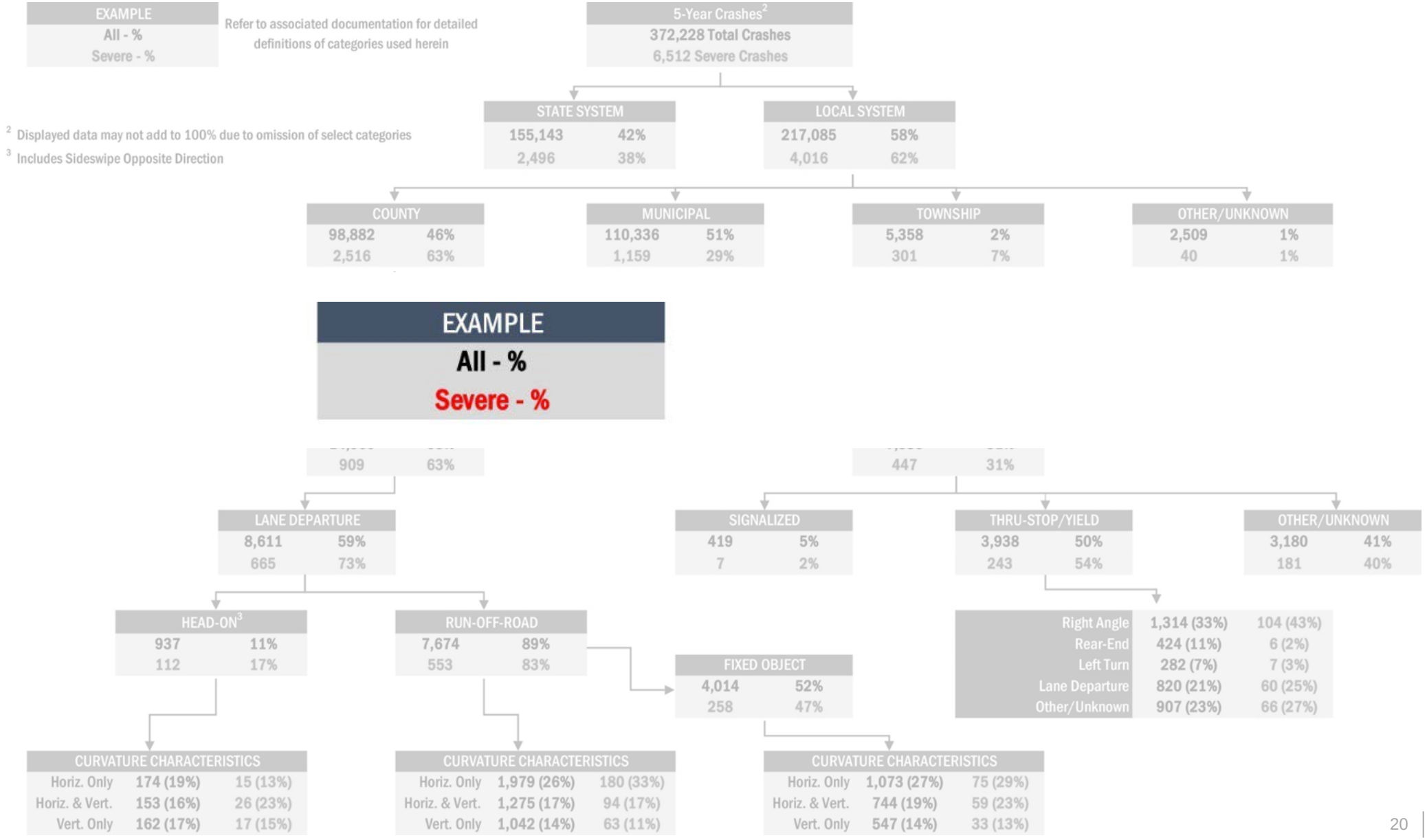
DATA DRIVEN PROCESS

Systemic Approach

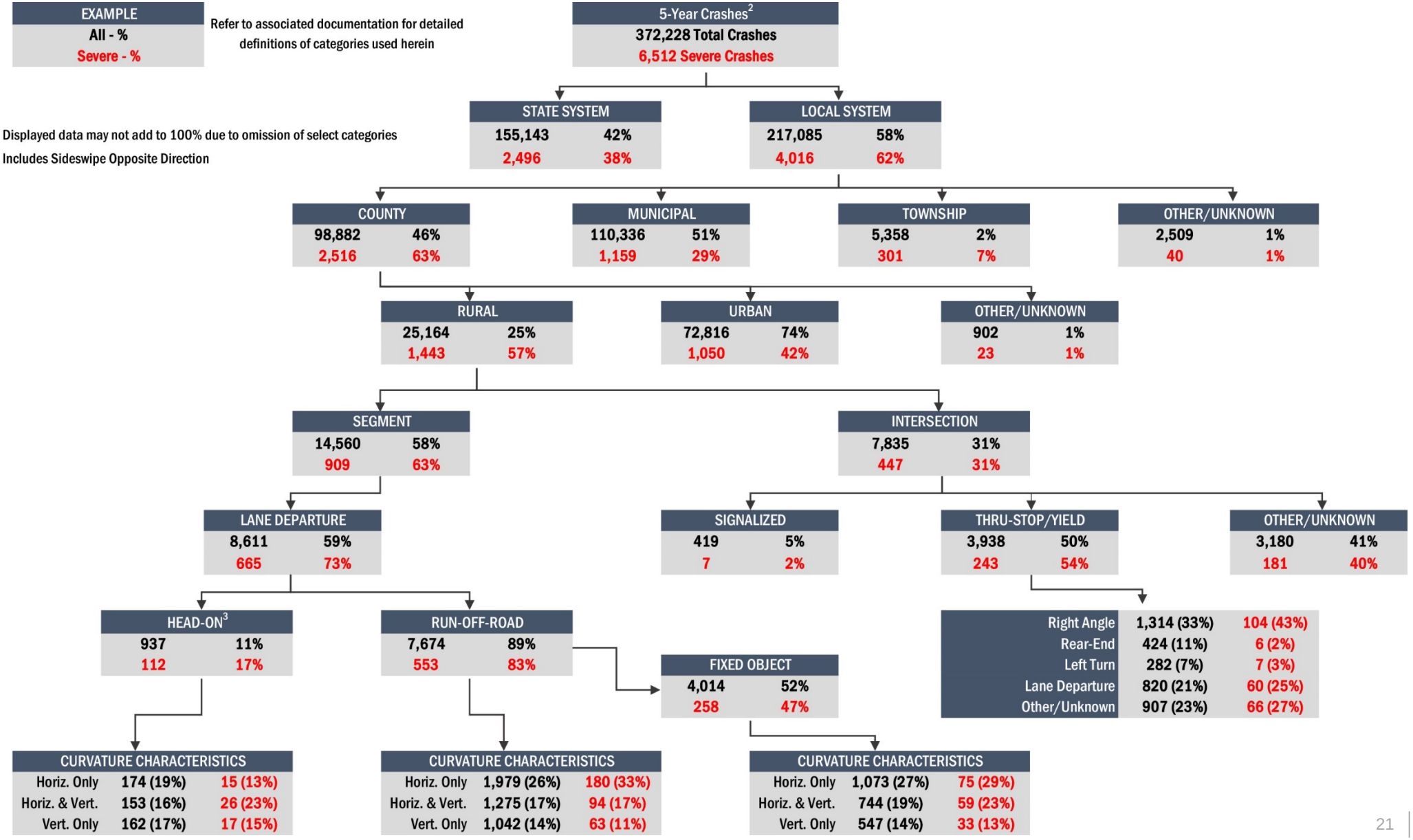
Deploy countermeasures at locations with greatest risk



CRASH TREE | County Rural System



CRASH TREE | County Rural System



[2] Displayed data may not add to 100% due to omission of select categories

[3] Includes Sideswipe Opposite Direction

CRASH TREE | County Rural System

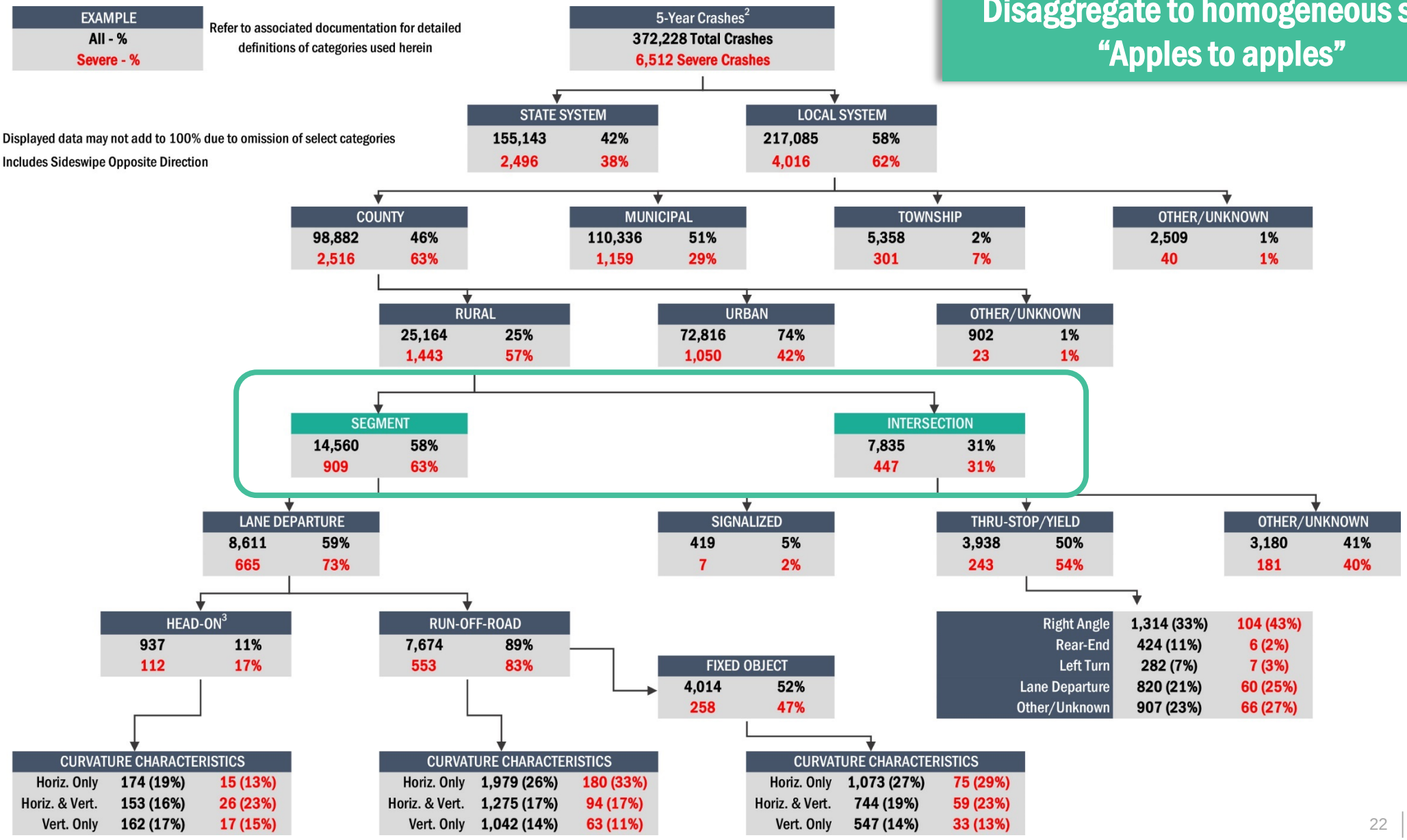
EXAMPLE
All - %
Severe - %

Refer to associated documentation for detailed definitions of categories used herein

Disaggregate to homogeneous sites
"Apples to apples"

[2] Displayed data may not add to 100% due to omission of select categories

[3] Includes Sideswipe Opposite Direction



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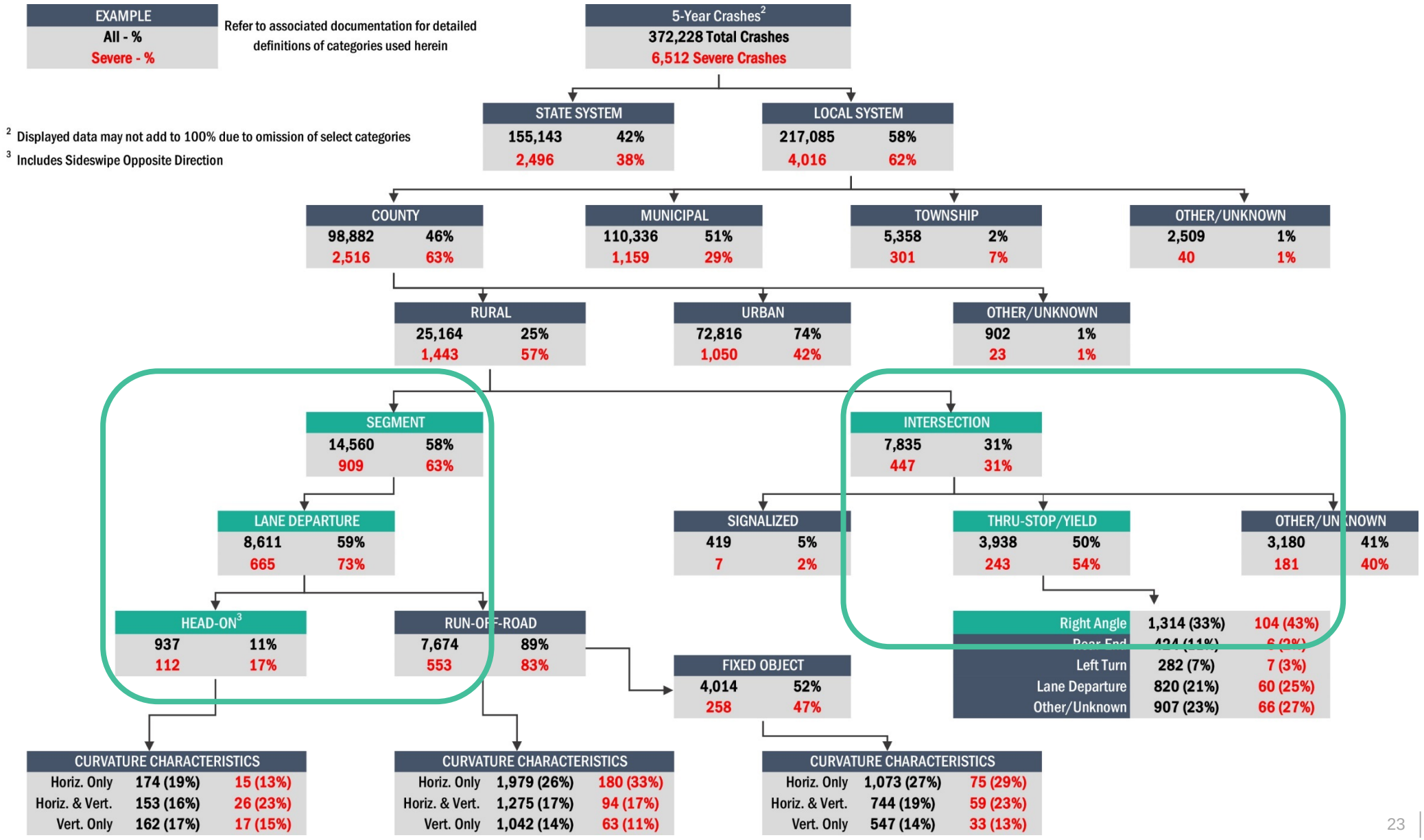

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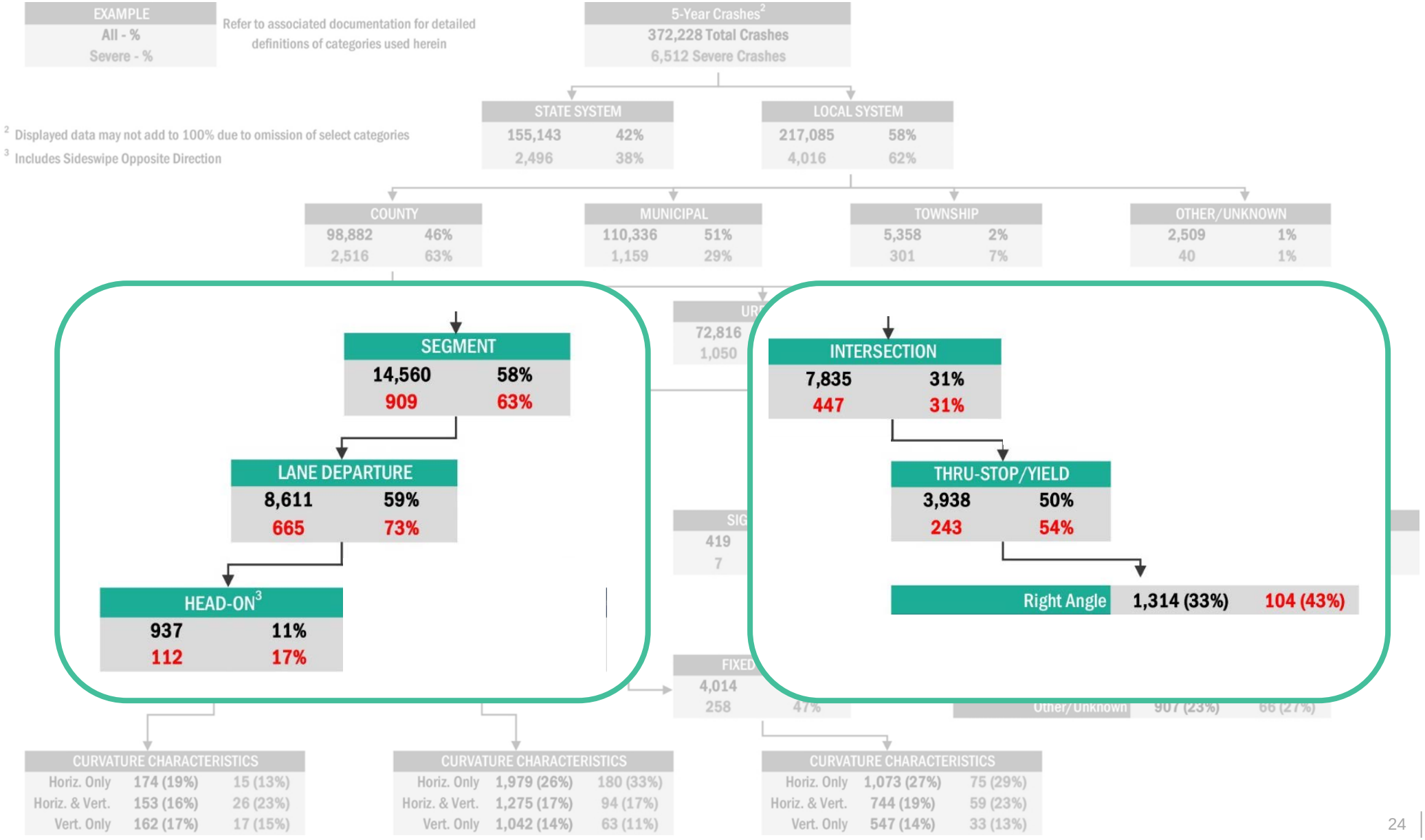

RISK EXAMPLE | Infrastructure

- 2-lane undivided
- Rural typical section
- Design speed = 50

Design Criteria -> Radius = 716’

Superelevation (e) = 10%

CURVE #1	CURVE #2
Radius = 500’ Superelevation (e) = 8.0%	Radius = 550’ Superelevation (e) = 8.5%

Is one safer than the other?

RISK EXAMPLE | Infrastructure (CONTINUED)

CURVE #1

Radius = 500’
Superelevation (e) = 8.0%

- 5-Year Crash History
- 0 fatalities
- 1 incapacitating

CURVE #2

Radius = 550’
Superelevation (e) = 8.5%

- 5-Year Crash History
- 3 fatalities
- 2 incapacitating

Is one safer than the other?

Which has more risk?

RURAL INTERSECTIONS | Risk Factors Analyzed

- ★ Adjacent Curve
- ★ Adjacent Development
- ★ Alignment Skew
- ★ Area Type
- ★ Bike Facility
- ★ Context Zone
- ★ Design Type
- ★ Flashers
- ★ Flashing Yellow Arrow
- ★ Intersection Type
- ★ Left Turn Phasing Maj
- ★ Left Turn Phasing Min
- ★ Leg Configuration
- ★ Lighting Present
- ★ Major1 ADT
- ★ Major1 Lane Config
- ★ Major2 ADT
- ★ Major2 Lane Config
- ★ Major Division Configuration
- ★ Major Speed Limit
- ★ Major Surface Type
- ★ Max Lanes Cross
- ★ Minor1 ADT
- ★ Minor1 Lane Config
- ★ Minor2 ADT
- ★ Minor2 Lane Config
- ★ Minor3 ADT
- ★ Minor3 Lane Config
- ★ Volume Cross Product
- ★ Minor Division Configuration
- ★ Minor Speed Limit
- ★ Minor Surface Type
- ★ Overhead Signal
- ★ Ped Indicator
- ★ PedBike Other1
- ★ PedBike Other2
- ★ Previous Stop
- ★ Railroad Crossing
- ★ Refuge Island
- ★ Right Turn On Red
- ★ School Crosswalk
- ★ Sidewalk
- ★ Transit Adjacent
- ★ School Crosswalk
- ★ Crash History

INTERSECTIONS

RURAL INTERSECTIONS | Risk Factors Analyzed

- ★ Adjacent Curve
- ★ Adjacent Development
- ★ Alignment Skew
- ~~★ Area Type~~
- ~~★ Bike Facility~~
- ~~★ Context Zone~~
- ~~★ Design Type~~
- ~~★ Flashers~~
- ~~★ Flashing Yellow Arrow~~
- ~~★ Intersection Type~~
- ~~★ Left Turn Phasing Maj~~
- ~~★ Left Turn Phasing Min~~
- ~~★ Leg Configuration~~
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- ~~★ Minor2 Lane Config~~
- ~~★ Minor3 ADT~~
- ~~★ Minor3 Lane Config~~
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- ~~★ Railroad Crossing~~
- ~~★ Refuge Island~~
- ~~★ Right Turn On Red~~
- ~~★ School Crosswalk~~
- ~~★ Sidewalk~~
- ~~★ Transit Adjacent~~
- ~~★ School Crosswalk~~
- ★ Crash History

INTERSECTIONS

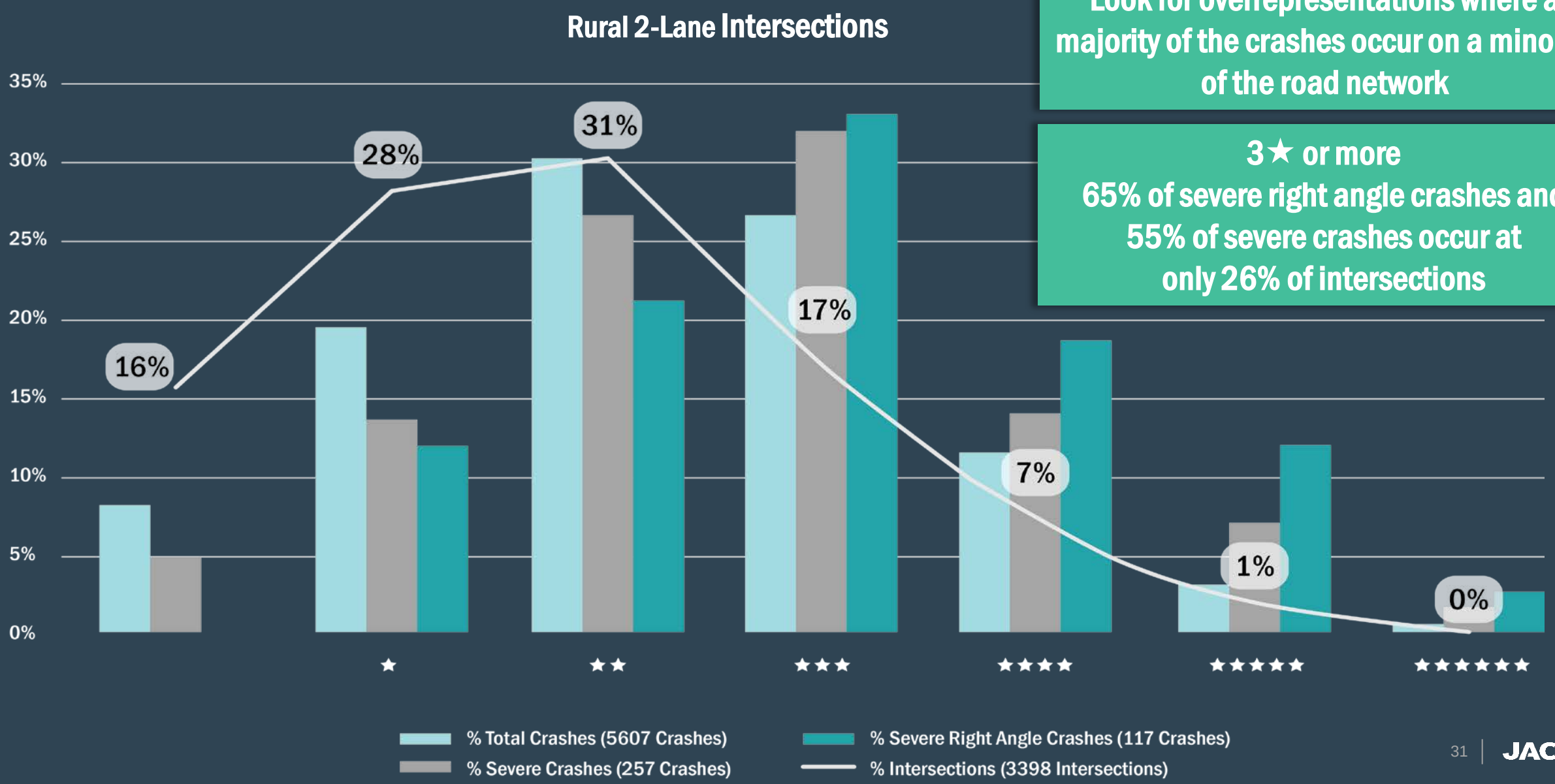
RESULTS FROM RISK FACTOR ANALYSIS | Identifying Thresholds

Rural Intersections	Min	Max
Skew	10˚	Unlimited
On/Near Curve	Present	
Adjacent Development	Present	
Previous Stop > 5 Miles	Present	
Volume Cross Product	400,000	Unlimited
Severe Right Angle Density	State Avg	Unlimited

STAKEHOLDER ENGAGEMENT

- Focus on 4 E's
- 1 day workshop
- Stakeholder input and buy-in

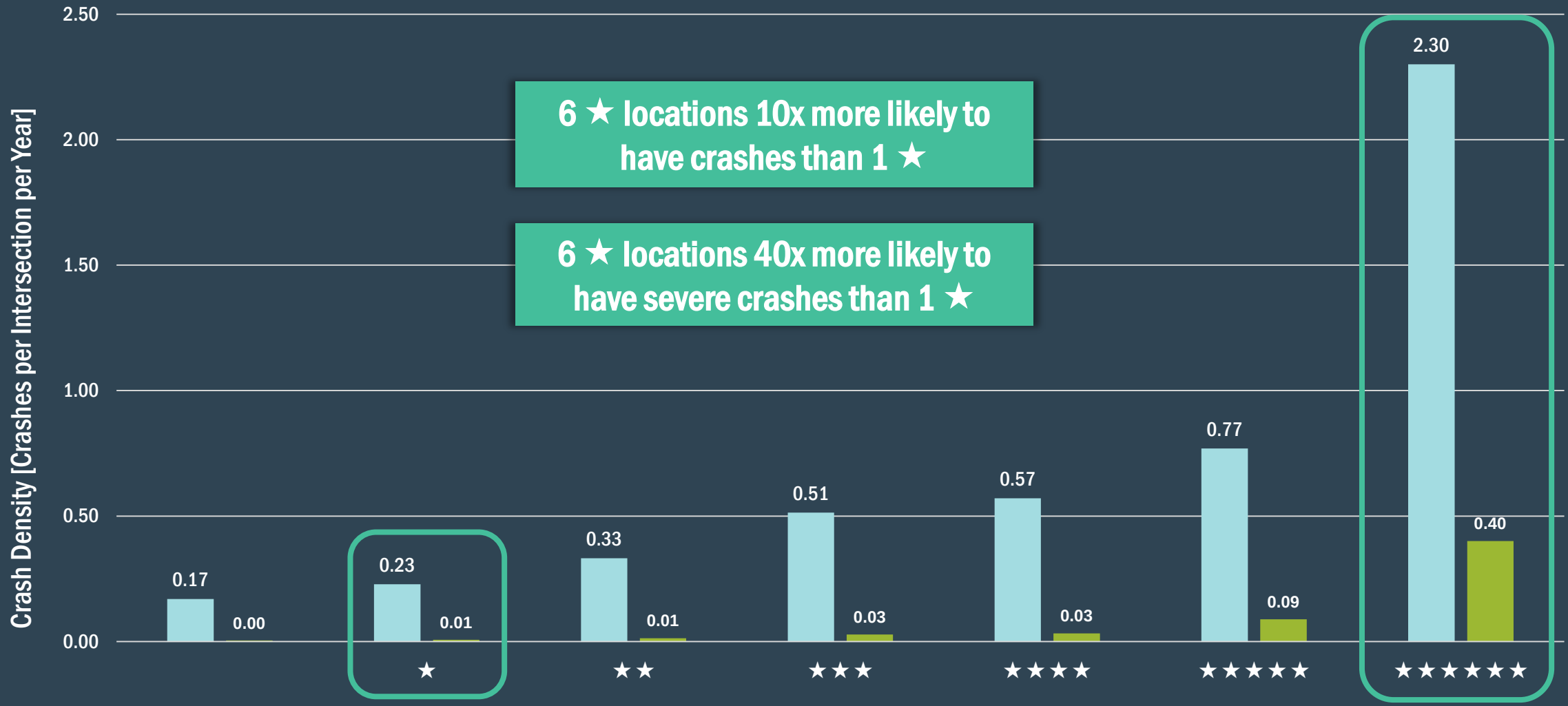
VALIDATION EXAMPLE #1 | Intersection Distribution Vs. Combined Risk Rating



Look for overrepresentations where a majority of the crashes occur on a minority of the road network

3★ or more
65% of severe right angle crashes and 55% of severe crashes occur at only 26% of intersections

VALIDATION EXAMPLE #2 | Risk Rating – Rural 2-lane Intersections



IMPLEMENTATION PRIORITY LIST

Rural 2-Lane Paved Segment Priority

						Risk Factors							Tiebreaker
#	Unique Segment ID	Reservation	Road Name	Start	End	Length [miles]	Surface Type	BIS Functional Classification	ADT Range	Shoulder Width	Access Density	Total Crash History	Total Stars	Lane Departure Crash History
1	BR.17.01	Brighton	RESERVATION RD	N/A (S)	N/A (N)	8.1	★	★	★		★	★	★★★★★	6
2	BC.10.03	Big Cypress	JOSIE BILLIE HWY	W BOUNDARY RD	N Reservation Boundary	1.5	★	★	★		★	★	★★★★★	2
3	BC.10.01	Big Cypress	JOSIE BILLIE HWY	SE Reservation Boundary	S BOUNDARY RD	10.4	★	★		★		★	★★★★	3
4	BC.1.02	Big Cypress	W BOUNDARY RD	W BOUNDARY RD (Pavement Change)	JOSIE BILLIE HWY	4.3	★	★		★		★	★★★★	0
5	BR.8.02	Brighton	RED BARN RD	HARNEY CANAL RD	FRANK SHORE RD	0.8	★	★		★	★		★★★★	0
6	IM.8.01	Immokalee	S 1ST ST	EUSTIS AVE E	STOCKADE RD	1.0	★	★	★		★		★★★★	0
7	BR.4.02	Brighton	E HARNEY POND RD	FRANK SHORE RD	FLOWING WELL RD	1.5	★	★		★			★★★	0
8	IM.6.02	Immokalee	SEMINOLE CROSSING TRL	KOOWACHOBEE TRL	SR 29	0.7	★			★		★	★★★	0
9	IM.13.01	Immokalee	KOOWACHOBEE TRL	STOCKADE RD	SEMINOLE CROSSING TRL	0.8	★			★	★		★★★	0
10	BC.15.01	Big Cypress	ROUTE 1512	JOSIE BILLIE HWY	ROUTE 1512 (Pavement Change)	0.6	★			★			★★	0
11	BC.19.01	Big Cypress	GATOR TAIL TRL	W BOUNDARY RD	Dead End	0.5	★			★			★★	0
12	BC.37.01	Big Cypress	HUDSON TRL	NE CANAL ST	Dead End	0.4	★			★			★★	0
13	BR.6.01	Brighton	S TUCKER RIDGE RD	RESERVATION RD	ROCK QUARRY DR	2.0	★			★			★★	0
14	BR.6.03	Brighton	N TUCKER RIDGE RD	DEAN YOUNGBLOOD ACCESS DR	RESERVATION RD	1.9	★			★			★★	0
15	BR.10.03	Brighton	FLOWING WELL RD	BIRD NEST RD (S)	E HARNEY POND RD	1.3	★			★			★★	0
16	BR.16.01	Brighton	HAWKSPUR LN	EAGLE RD	Dead End	0.3	★			★			★★	0
17	BR.16.02	Brighton	EAGLE RD	Dead End	RESERVATION RD	0.3	★			★			★★	0
18	BR.18.01	Brighton	JONES RD	RESERVATION RD (S)	RESERVATION RD (N)	0.8	★			★			★★	0
19	FP.1.01	Fort Pierce	SALLY CHUPCO TOMMIE WAY	SR 70	SALLY CHUPCO TOMMIE WAY	0.8	★			★			★★	0
20	FP.2.01	Fort Pierce	HOPE TOMMIE WILCOX RD	SALLY CHUPCO TOMMIE WAY	MINNIE TOMMIE HOWARD CIR	0.0	★			★			★★	0
21	FP.2.02	Fort Pierce	MINNIE TOMMIE HOWARD CIR	Dead End (S)	Dead End (N)	0.1	★			★			★★	0
22	IM.6.01	Immokalee	SEMINOLE CROSSING TRL	S 1ST ST	KOOWACHOBEE TRL	0.3	★			★			★★	0
23	IM.13.02	Immokalee	KOOWACHOBEE TRL	SEMINOLE CROSSING TRL	EUSTIS AVE E	0.2	★			★			★★	0
24	BC.36.01	Big Cypress	S BOUNDARY RD	JOSIE BILLIE HWY	MOLLY PRITCHARD RD	3.2				★			★	0
25	BR.12.01	Brighton	FRANK HUFF RD	RESERVATION RD	Dead End	0.9				★			★	0
						Total Stars	23	7	3	22	5	5		

Stars	Count	Percent	Mileage	Percent
★★★★★★	0	0%	0.0	0%
★★★★★	2	8%	9.5	22%
★★★★	4	16%	16.5	38%
★★★	3	12%	3.1	7%
★★	14	56%	9.8	23%
★	2	8%	4.1	9%
	0	0%	0.0	0%
Total	**25**	**100%**	**43.0**	**100%**

Stars	Big Cypress		Brighton		Fort Pierce		Immokalee	
★★★★★★	0	0%	0	0%	0	0%	0	0%
★★★★★	1	14%	1	10%	0	0%	0	0%
★★★★	2	29%	1	10%	0	0%	1	20%
★★★	0	0%	1	10%	0	0%	2	40%
★★	3	43%	6	60%	3	100%	2	40%
★	1	14%	1	10%	0	0%	0	0%
	0	0%	0	0%	0	0%	0	0%
Totals	**7**	**100%**	**10**	**100%**	**3**	**100%**	**5**	**100%**

IMPLEMENTATION PRIORITY LIST

Rural 2-Lane Paved Segment Priority

#	Unique Segment ID	Reservation	Road Name	Start	End	Risk Factors: Length [miles]	Surface Type	BIS Functional Classification	ADT Range	Shoulder Width	Access Density	Total Crash History	Total Stars	Tiebreaker: Lane Departure Crash History
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4	BC.1.02	Big Cypress	W BOUNDARY RD	W BOUNDARY RD (Pavement Change)	JOSIE BILLIE HWY	4.3	★	★		★		★	★★★★	0
5	BR.8.02	Brighto											★★★★	0
6	IM.8.01	Imm											★★★★	0
7	BR.4.02	B											★★★	0
8	IM.6.02	In											★★★	0
9	IM.13.01	In											★★★	0
10	BC.15.01	Bi											★★	0
11	BC.19.01	Bi											★★	0
12	BC.37.01	Bi											★★	0
13	BR.6.01												★★	0
14	BR.6.03												★★	0
15	BR.10.03												★★	0
16	BR.16.01												★★	0
17	BR.16.02												★★	0
18	BR.18.01												★★	0
19	FP.1.01	Fo											★★	0
20	FP.2.01	Fo											★★	0
21	FP.2.02	Fo											★★	0
22	IM.6.01	In											★★	0
23	IM.13.02	In											★★	0
24	BC.36.01	Bi											★	0
25	BR.12.01	B											★	0

Risk Factors

#	Length [miles]	Surface Type	BIS Functional Classification	ADT Range	Shoulder Width	Access Density	Total Crash History	Total Stars
1	8.1	★	★	★		★	★	★★★★★
2	1.5	★	★	★		★	★	★★★★★
3	10.4	★	★		★		★	★★★★

Stars	Count	Percent	Mileage	Percent
★★★★★★	0	0%	0.0	0%
★★★★★	2	8%	9.5	22%
★★★★	4	16%	16.5	38%
★★★	3	12%	3.1	7%
★★	14	56%	9.8	23%
★	2	8%	4.1	9%
	0	0%	0.0	0%
Total	25	100%	43.0	100%

Stars	Big Cypress		Brighton		Fort Pierce		Immokalee	
★★★★★★	0	0%	0	0%	0	0%	0	0%
★★★★★	1	14%	1	10%	0	0%	0	0%
★★★★	2	29%	1	10%	0	0%	1	20%
★★★	0	0%	1	10%	0	0%	2	40%
★★	3	43%	6	60%	3	100%	2	40%
★	1	14%	1	10%	0	0%	0	0%
	0	0%	0	0%	0	0%	0	0%
Totals	7	100%	10	100%	3	100%	5	100%

DEVELOP COUNTERMEASURES

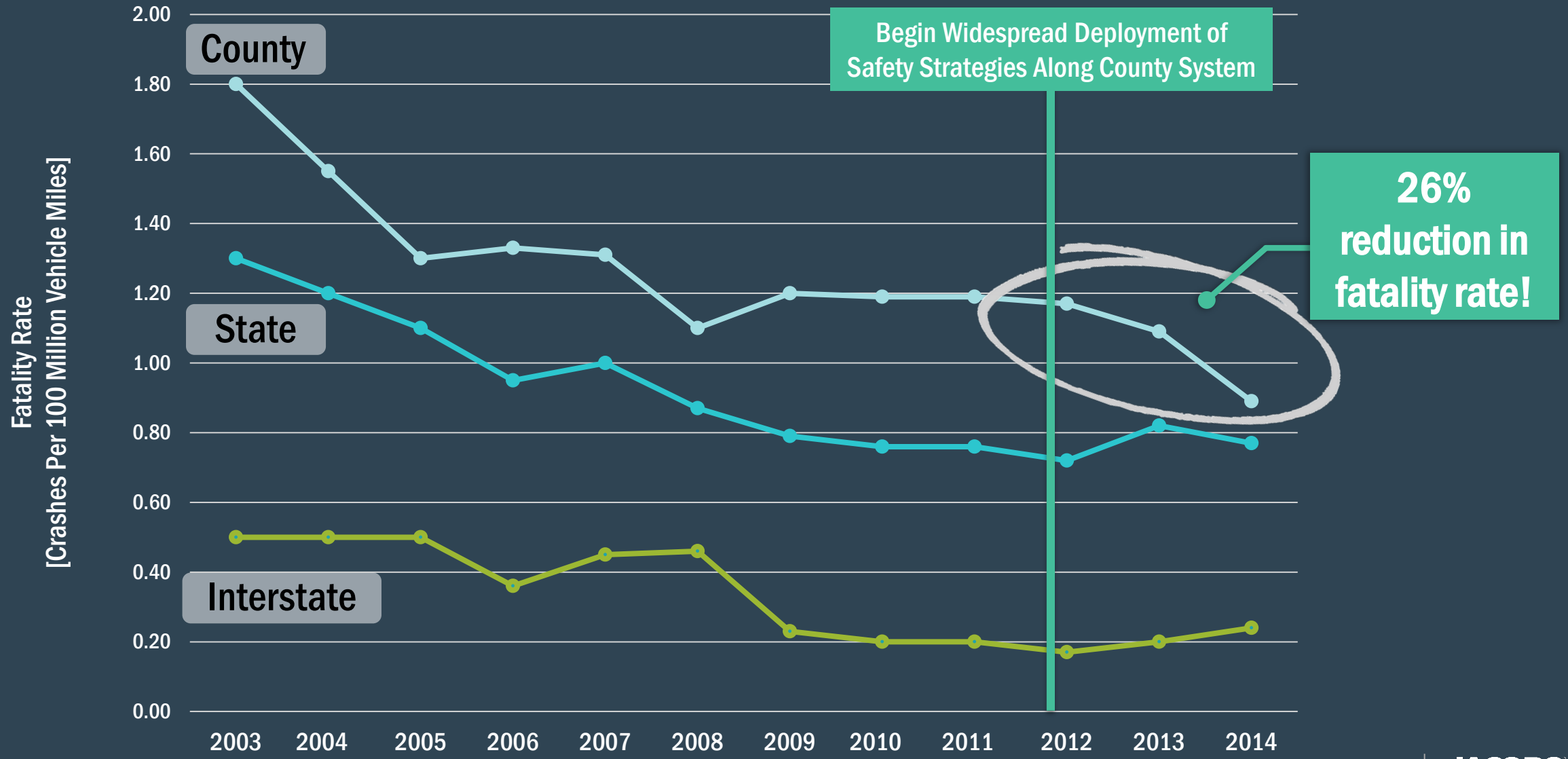
- Predominantly low-cost countermeasures that can be applied to the at-risk system
- Include cost and effectiveness to inform decision-making
- Provides opportunity to proactively address severe crashes

Adopted Safety Strategies/Countermeasures, Crash Reduction Factors, and Typical Cost Estimates

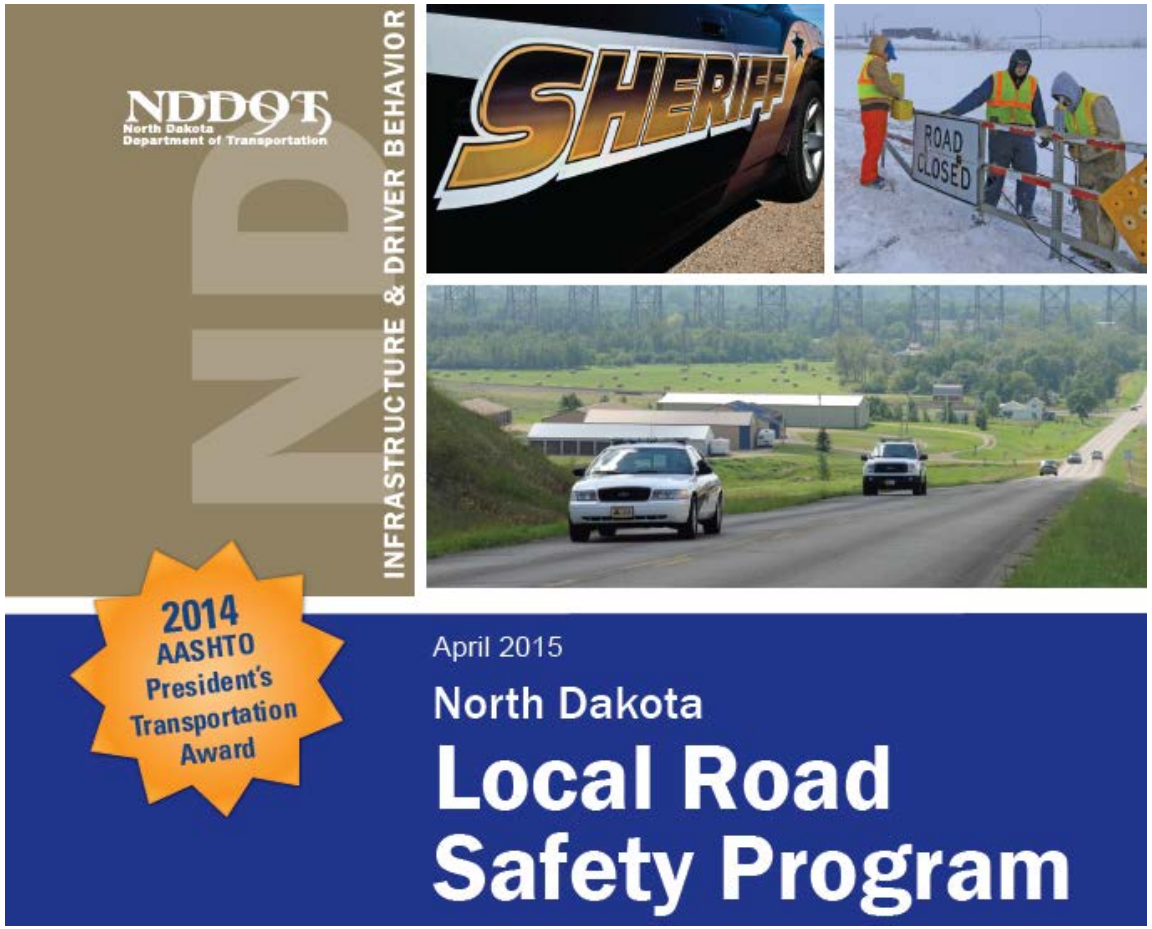
Rural Segments

STRATEGY	CRASH REDUCTION FACTOR	TYPICAL INSTALLATION COSTS
Centerline rumble strip	40% head-on/sideswipe crashes	$3,600 per mile
Shoulder/Edgeline rumble strip	20% run off road crashes	$5, 850 per mile
Raised pavement markers		
Enhanced edgeline (6” & 8”)	10% to 45% all rural serious crashes (6”)	$1, 980 per mile
Shoulder paving (2’, 4’, 6’)	20% to 30% run-off-the-road crashes (with shoulder rumble) (2’ only)	$54,000 per mile, plus $5, 850 per mile (for edge rumble)

RESULTS OF COUNTY ROAD SAFETY PLANS



INDUSTRY ACKNOWLEDGMENT



Source | AASHTO & North Dakota Department of Transportation. Used with permission.

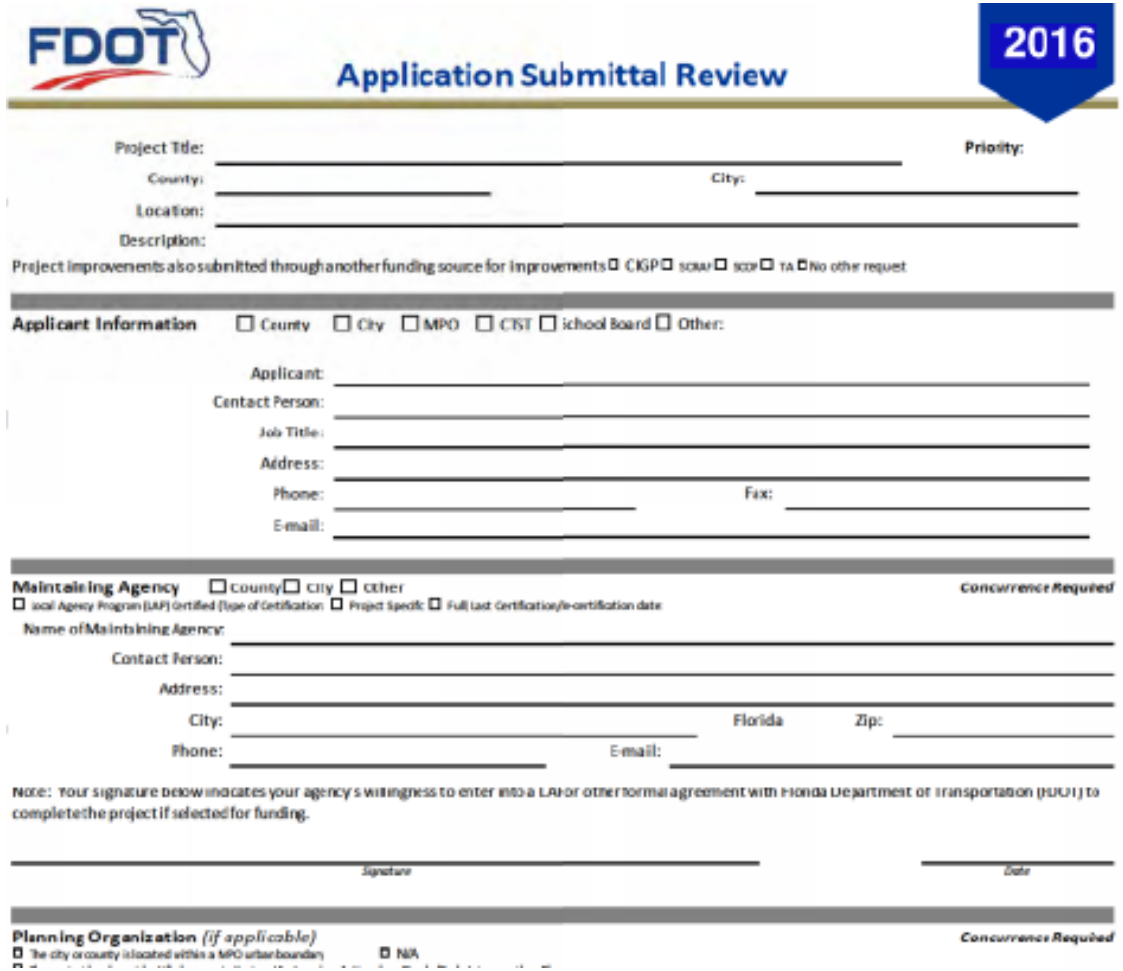
- Systemic Approach will be included in the 2nd version of the HSM
- Local Road Safety Plan is a proven safety countermeasure by FHWA Safety Office

Local Application

HIGHWAY SAFETY IMPROVEMENT PROGRAM (HSIP) FUNDING

- Work with agencies to create compliant HSIP applications
- Develop HSIP applications for all projects on prioritized lists

Cost of systemic approach frequently "pays for itself" through increased success in HSIP applications!



FDOT

Application Submittal Review

2016

Project Title: _____ Priority:

County: _____ City: _____

Location: _____

Description: _____

Project improvements also submitted through another funding source for improvements ☐ CIGP ☐ SCRAP ☐ SCOP ☐ TA ☐ No other request

Applicant Information ☐ County ☐ City ☐ MPO ☐ CTST ☐ School Board ☐ Other:

Applicant: _____

Contact Person: _____

Job Title: _____

Address: _____

Phone: _____ Fax: _____

E-mail: _____

Maintaining Agency ☐ County ☐ City ☐ Other *Concurrence Required*

☐ Local Agency Program (LAP) Certified (Type of Certification ☐ Project Specific ☐ Full Last Certification/Re-certification date

Name of Maintaining Agency: _____

Contact Person: _____

Address: _____

City: _____ Florida Zip: _____

Phone: _____ E-mail: _____

Note: Your signature below indicates your agency's willingness to enter into a LAP or other formal agreement with Florida Department of Transportation (FDOT) to complete the project if selected for funding.

_____ _____

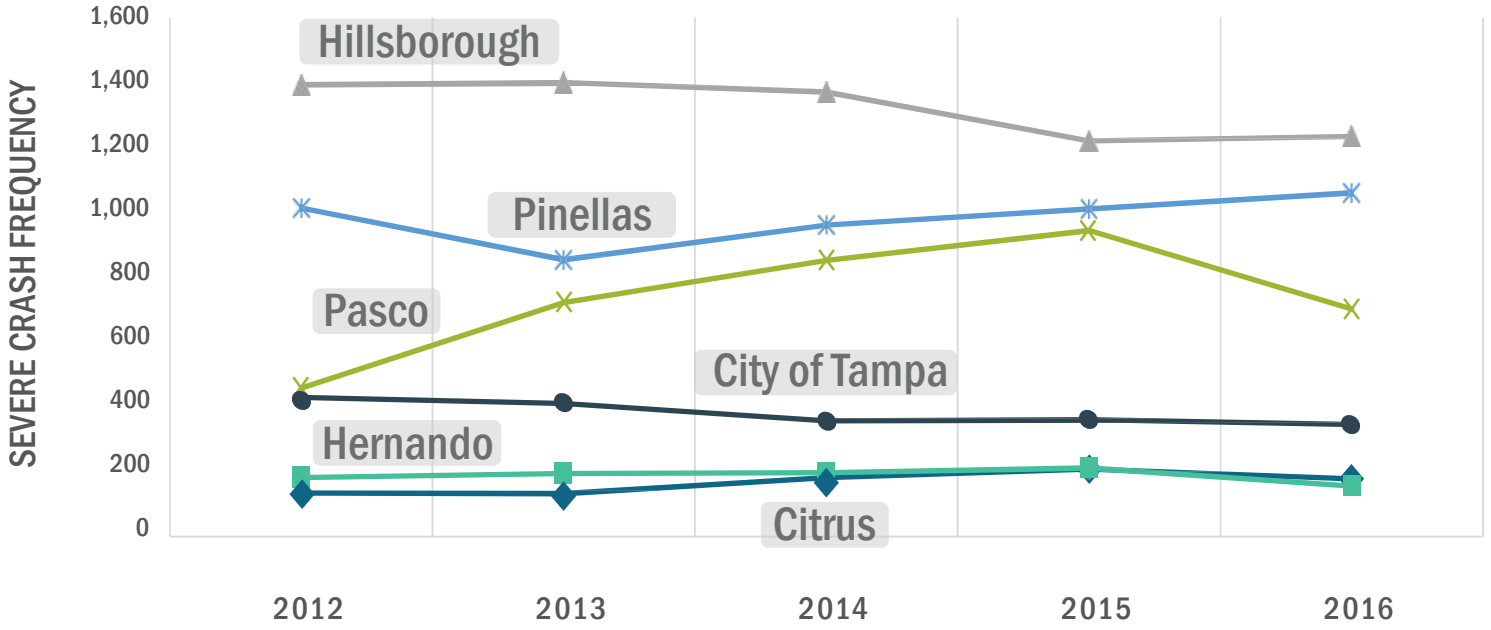
Signature *Date*

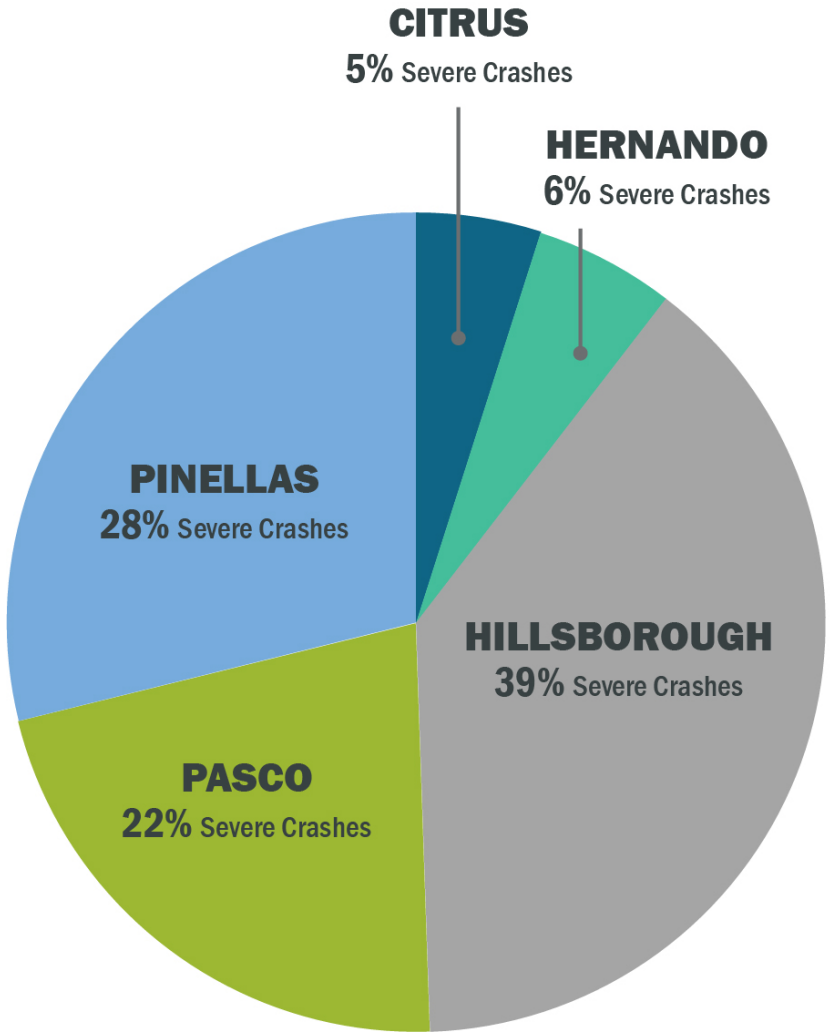
Planning Organization *(if applicable)* *Concurrence Required*

☐ The city or county is located within a MPO urban boundary ☐ N/A

Source | FDOT 2016 Strategic Highway Safety Plan p. 7 - http://www.fdot.gov/safety/SHSP2016/FDOT_2016SHSP_Final.pdf

FDOT DISTRICT 7 SEVERE CRASHES (2012 – 2016)





FDOT District 7 (16,955 Severe Crashes)

FDOT DISTRICT 7 SEVERE CRASHES

DISTRICT 7 TOTAL		
Traffic Homicide	1,809	11%
Incapacitating Injury	15,146	89%
Sum	**16,955**	**100%**

Citrus	
107	6%
726	5%
833	**5%**

Relation to Intersection		
Intersection	378	45%
Non-Intersection	417	50%
Other	38	5%

Hernando	
115	6%
823	5%
938	**6%**

Relation to Intersection		
Intersection	387	41%
Non-Intersection	499	53%
Other	52	6%

Hillsborough	
803	44%
5,813	38%
6,616	**39%**

Relation to Intersection		
Intersection	3,108	47%
Non-Intersection	2,957	45%
Other	551	8%

Pasco	
302	17%
3,373	22%
3,675	**22%**

Relation to Intersection		
Intersection	1,974	54%
Non-Intersection	1,529	42%
Other	172	5%

Pinellas	
482	27%
4,411	29%
4,893	**29%**

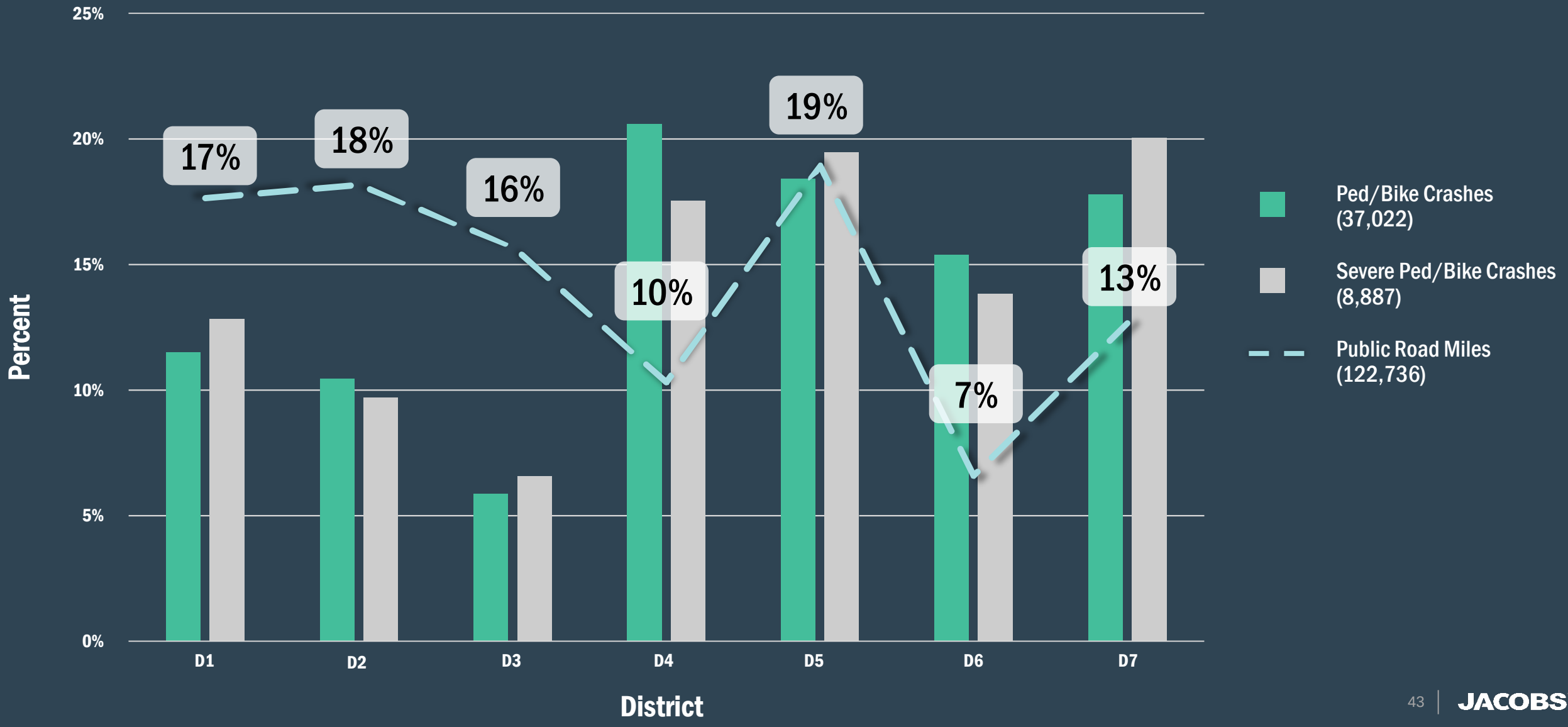
Relation to Intersection		
Intersection	2,750	56%
Non-Intersection	1,770	36%
Other	373	8%

FDOT DISTRICT 7 SEVERE CRASHES

Pinellas	
482	27%
4,411	29%
4,893	**29%**

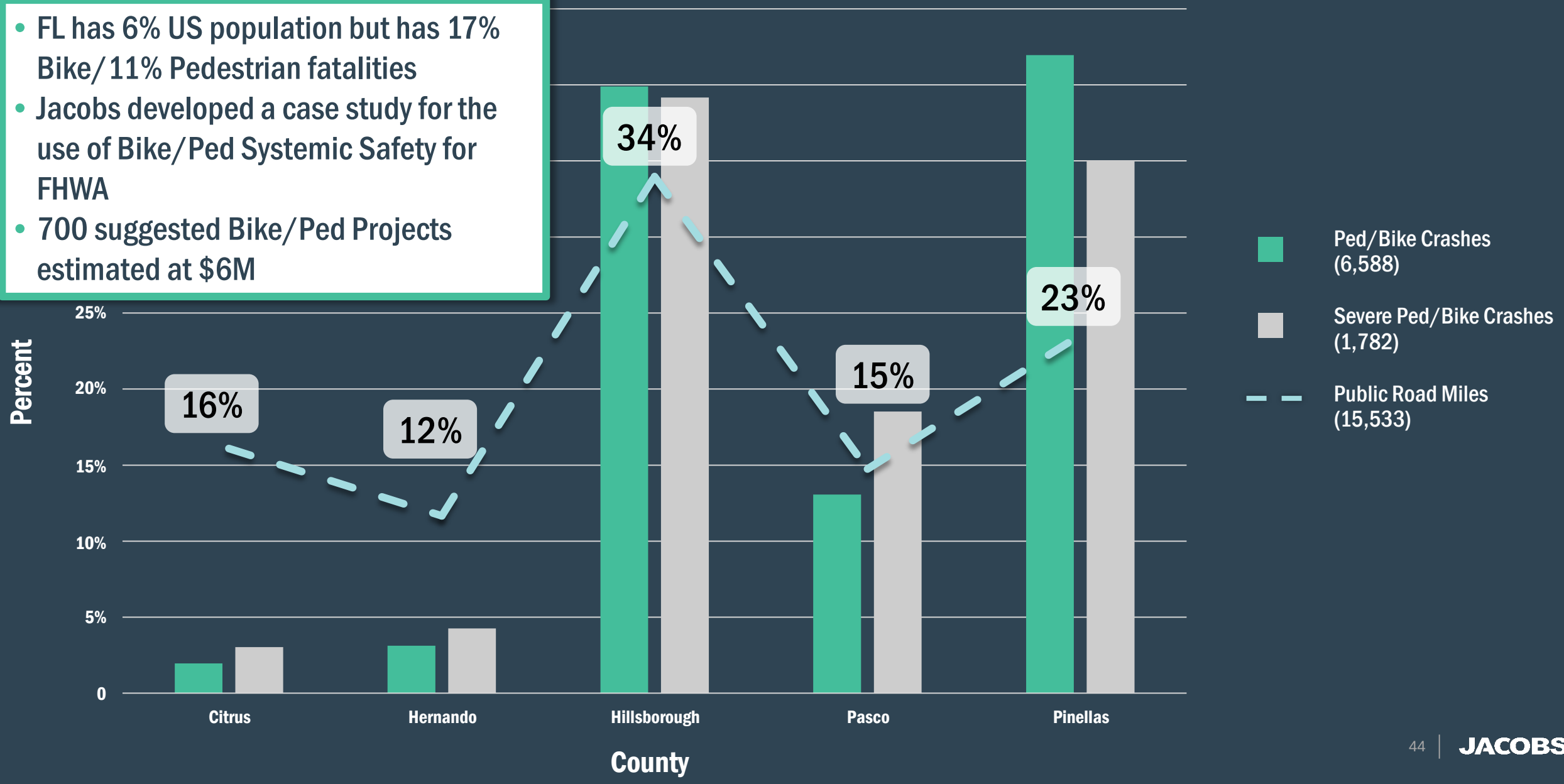
Relation to Intersection		
Intersection	2,750	56%
Non-Intersection	1,770	36%
Other	373	8%

PERCENTAGE OF BIKE/PED CRASHES (2012 – 2015) & PUBLIC ROAD MILEAGE



PERCENTAGE OF BIKE/PED CRASHES (D7, 2012 – 2015) & PUBLIC ROAD MILEAGE

- FL has 6% US population but has 17% Bike/11% Pedestrian fatalities
- Jacobs developed a case study for the use of Bike/Ped Systemic Safety for FHWA
- 700 suggested Bike/Ped Projects estimated at $6M



SYSTEMIC RESULTS

- 65,000+ centerline miles of roadway
- 29,000+ intersections
- 27,000+ horizontal curves
- $720M in countermeasures suggested

DELIVERABLES/BENEFITS FROM SYSTEMIC APPROACH PLANNING

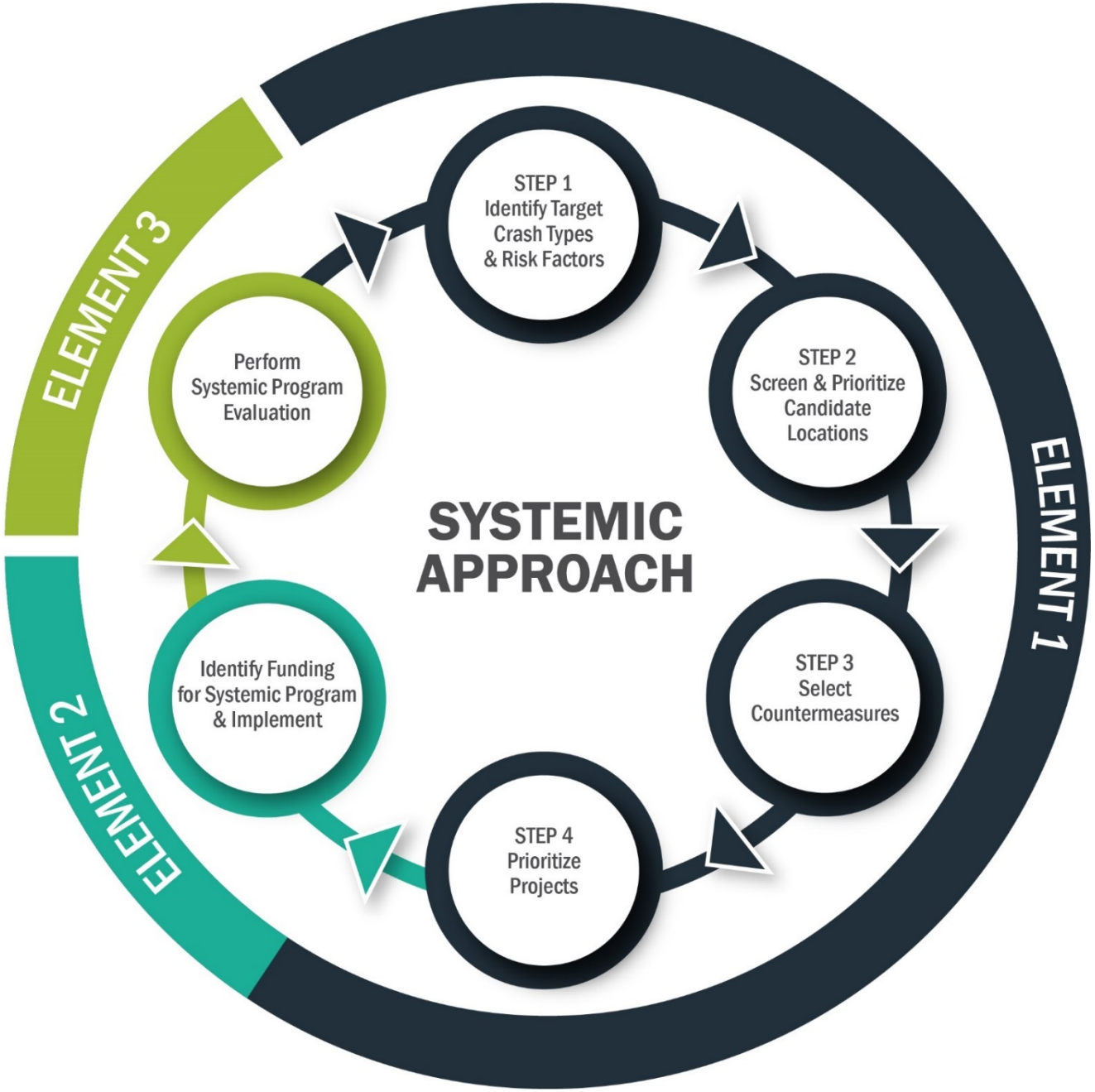
- Agency specific safety plans
- Increased success in applying for HSIP funding
- Location prioritization and countermeasure recommendations
- Defensible Project List
- Stakeholder engagement

“Failure is not fatal,

but failure to change might be.”

John Wooden

QUESTIONS?


ELEMENT 3
ELEMENT 1
ELEMENT 2
STEP 1
Identify Target
Crash Types
& Risk Factors
STEP 2
Screen & Prioritize
Candidate
Locations
STEP 3
Select
Countermeasures
STEP 4
Prioritize
Projects
Identify Funding
for Systemic Program
& Implement
Perform
Systemic Program
Evaluation
SYSTEMIC
APPROACH