KY 121 – Safe System Approach at Early Alignments

Item No 1-80202.00

September 4, 2024

BURGESS & NIPLE

KYTC District 1

Patsy Rawlins, PE
Project Manager
patsy.rawlins@ky.gov

Burgess & Niple

Diana Mitchen, PE
Project Manager
diana.mitchen@burgessniple.com

Kevin McKeel, PE, PTOE, RSP1
Safety & Traffic Lead
kevin.mckeel@burgessniple.com

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Project Area

Urban Principal Arterial

55 MPH Posted Speed Limit

Partially Controlled Access Highway

- 3 Signalized Intersections
- 5 Non-signalized Intersections
- Railroad Crossing
- 8 Full Access Entrances

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Project Context

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2022 Highway Plan

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Graves **KY-121** From MP 5.499 To 8.938 **On NHS**

Description: Upgrade/Widen KY 121 bypass in Mayfield to four lanes. (2022CCN)

Type of Work: MAJOR WIDENING(O)

Item#: 1-80202.00 **Parent#:** 1-80202.00 **Length**

Plan Year: 2022 **Parent Year:** 2022 3.439

FUND	PH	2022	2023	2024	2025	2026	2027	2028	Phase Total
SPP	D	$500,000	$0	$0	$0	$0	$0	$0	**$500,000**
SPP	R	$0	$250,000	$0	$0	$0	$0	$0	**$250,000**
SPP	U	$0	$0	$500,000	$0	$0	$0	$0	**$500,000**
SPP	C	$0	$0	$0	$10,000,000	$0	$0	$0	**$10,000,000**
		$500,000	**$250,000**	**$500,000**	**$10,000,000**	**$0**	**$0**	**$0**	**$11,250,000**

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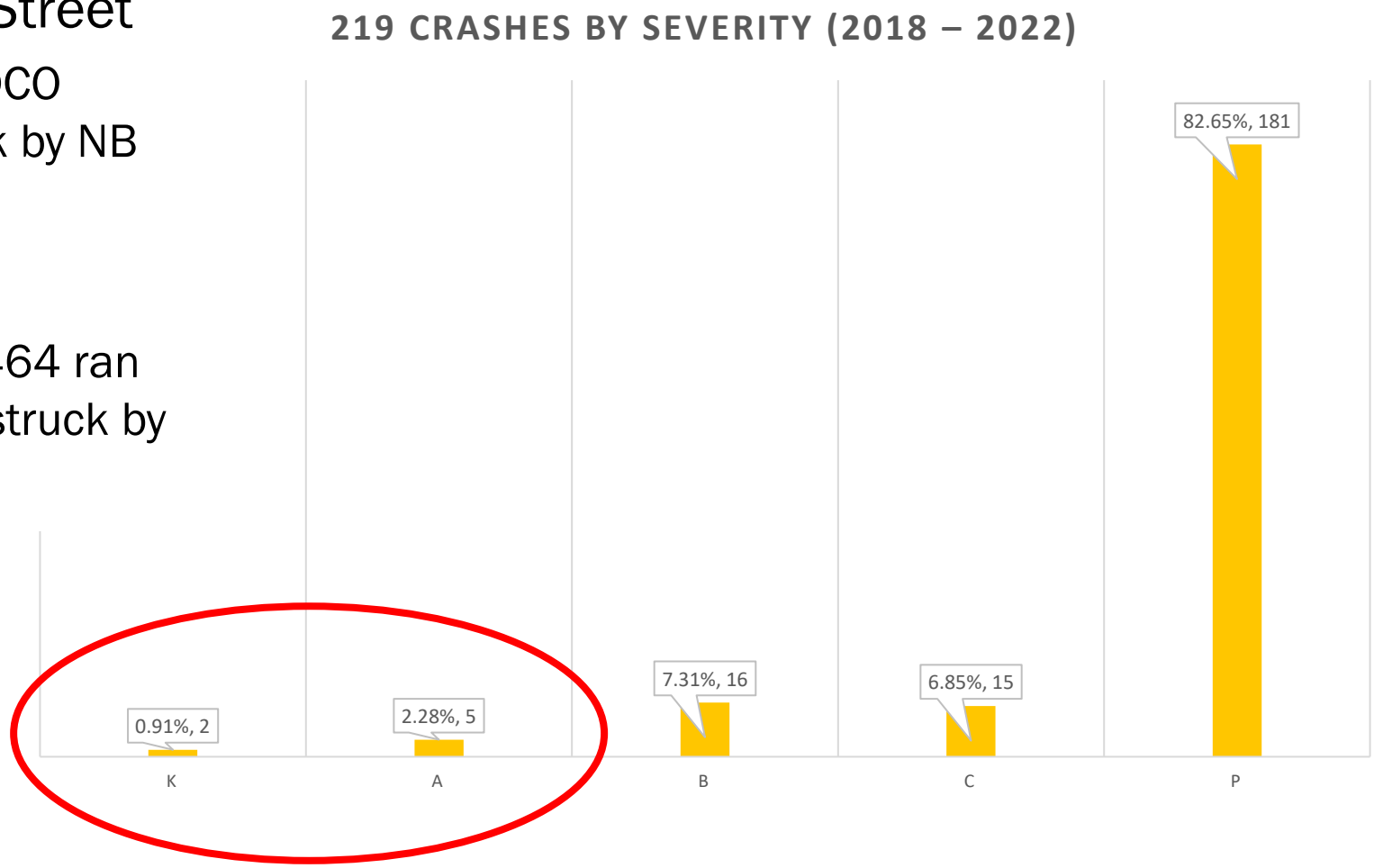
Safety - Severity

- Fatality at Douthitt Street
  - Vehicle leaving MIDCO entrance WB struck by NB vehicle
- Fatality at KY 464
  - Vehicle WB on KY 464 ran stop sign and was struck by NB vehicle



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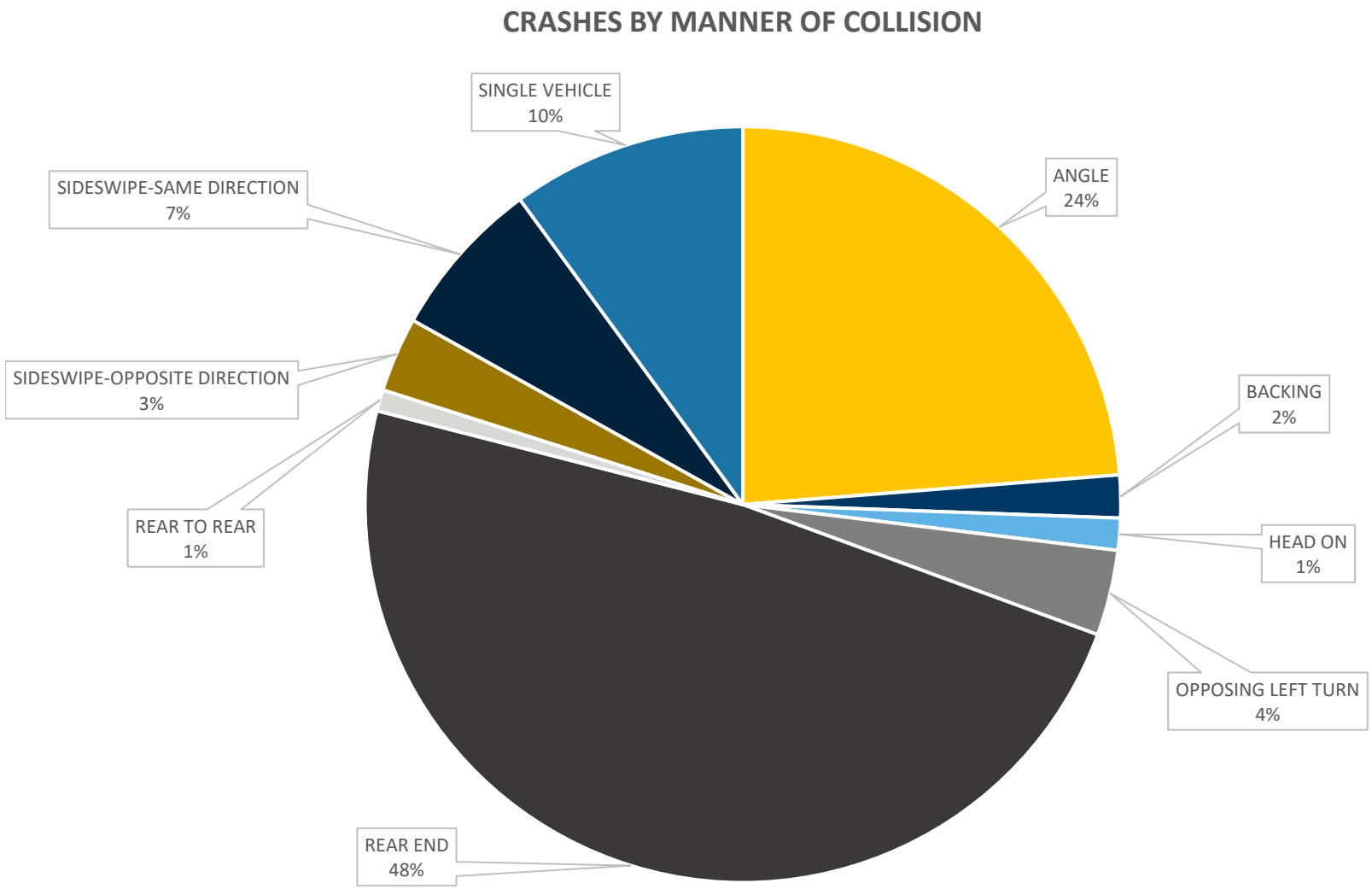
Safety – Crash Analysis

Takeaways –

- Nearly half of crashes are rear ends
- Angle & Left Turn combine for more than 25%
- 40% of SV were animals



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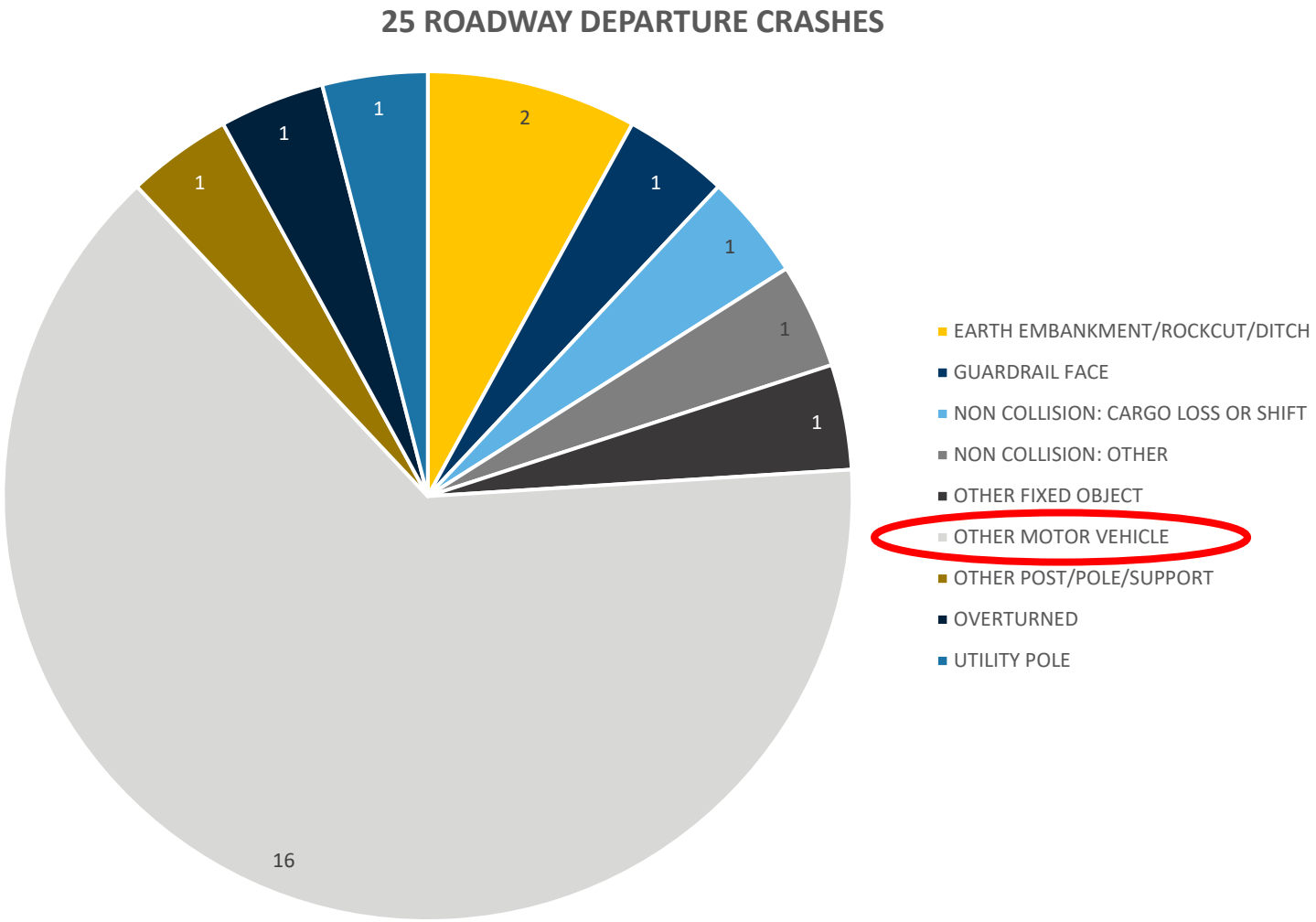
Safety – Roadway Departure



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Safety – Influence Area

Takeaways –

- 3.4 miles
- 8 intersections
- Unexpected change in context

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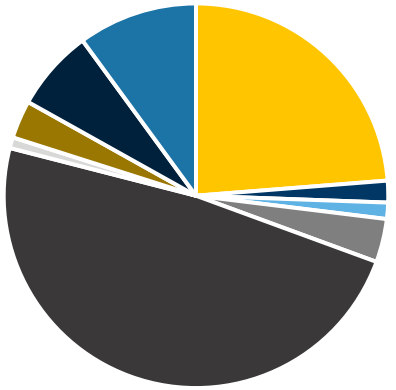
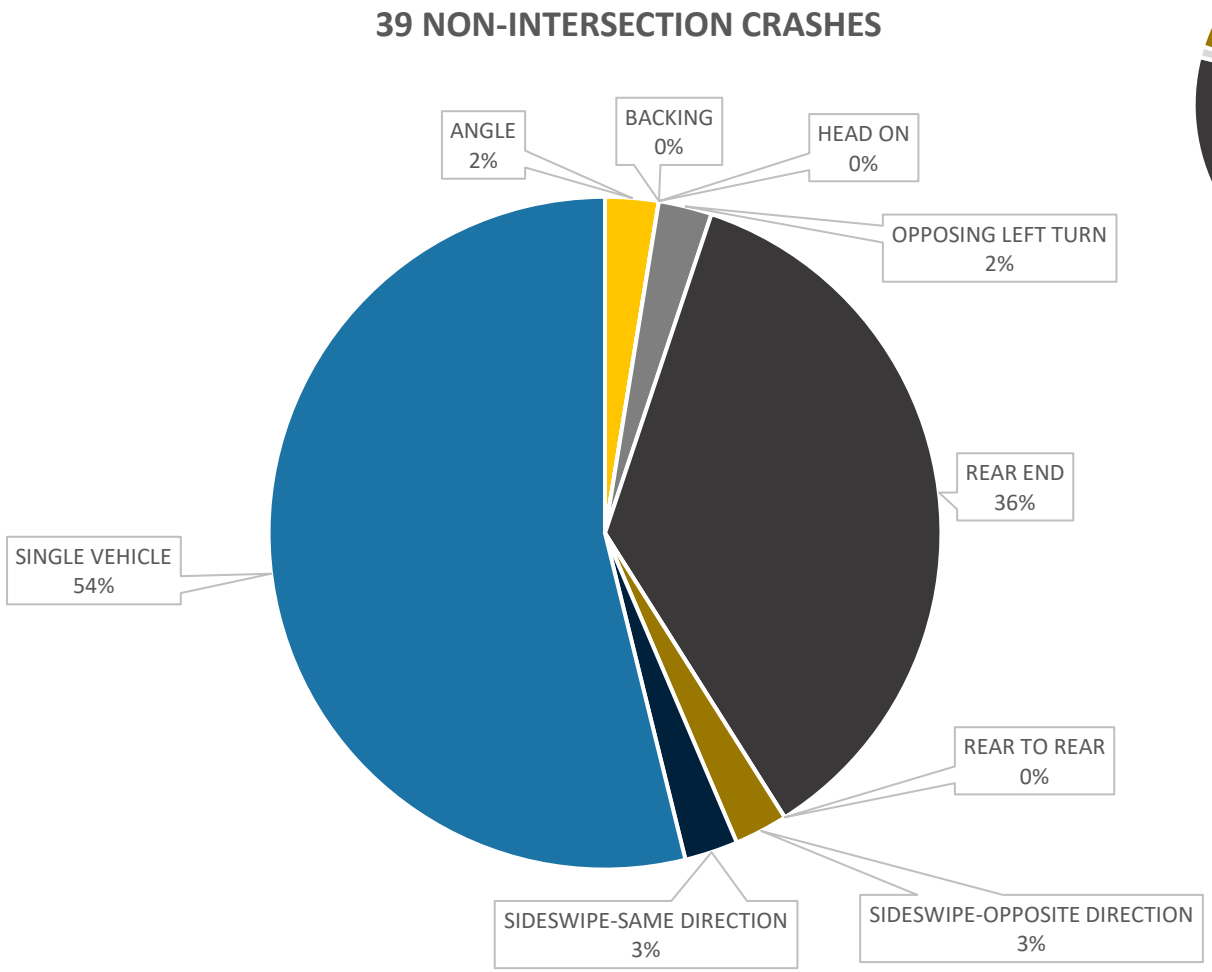
Safety – Non-Intersection

Takeaways –

- More likely to be SV
- 90% of all non-intersection are PDO
- Rear ends at RR crossing, inattention, animals, construction





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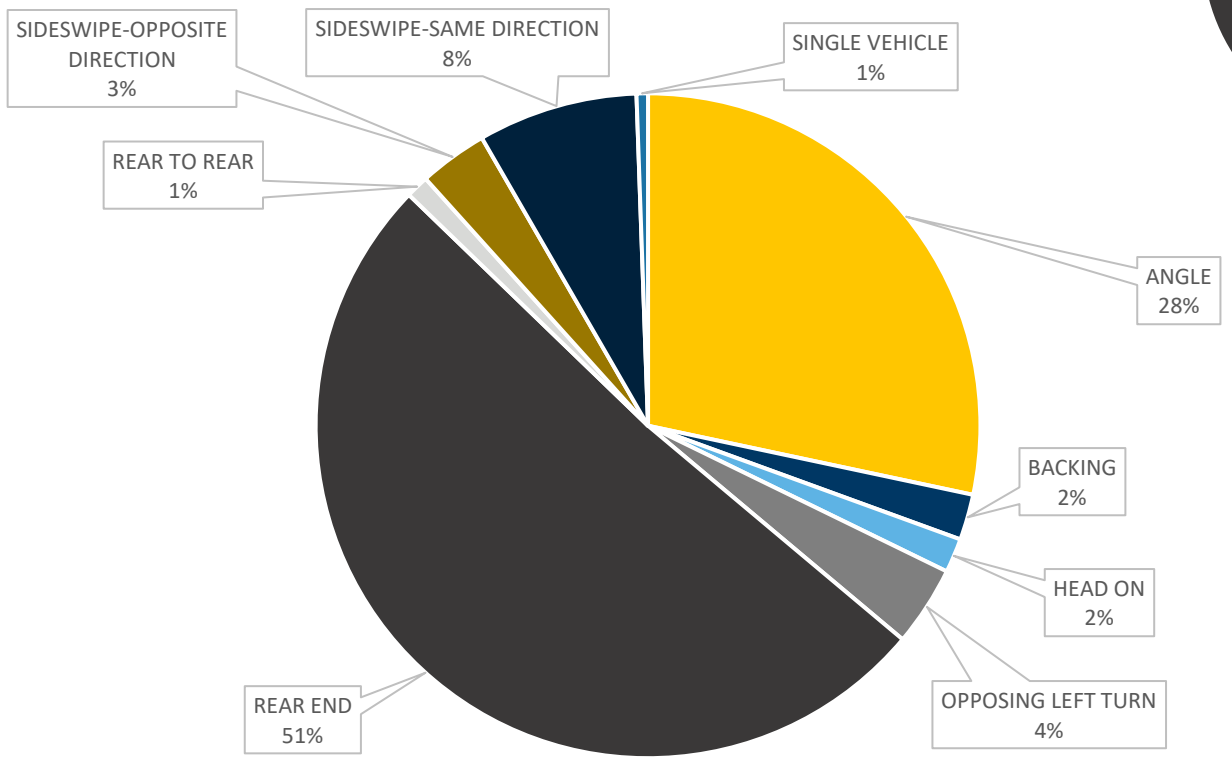
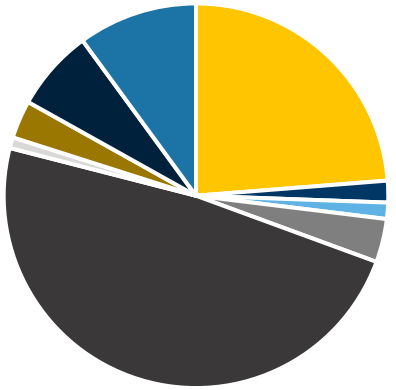
Safety – Intersections

Takeaways –

- 51 Angle
  - 23% of crashes, 47% of injury
- 90 Rear End
  - 41% of crashes, 14% of injury





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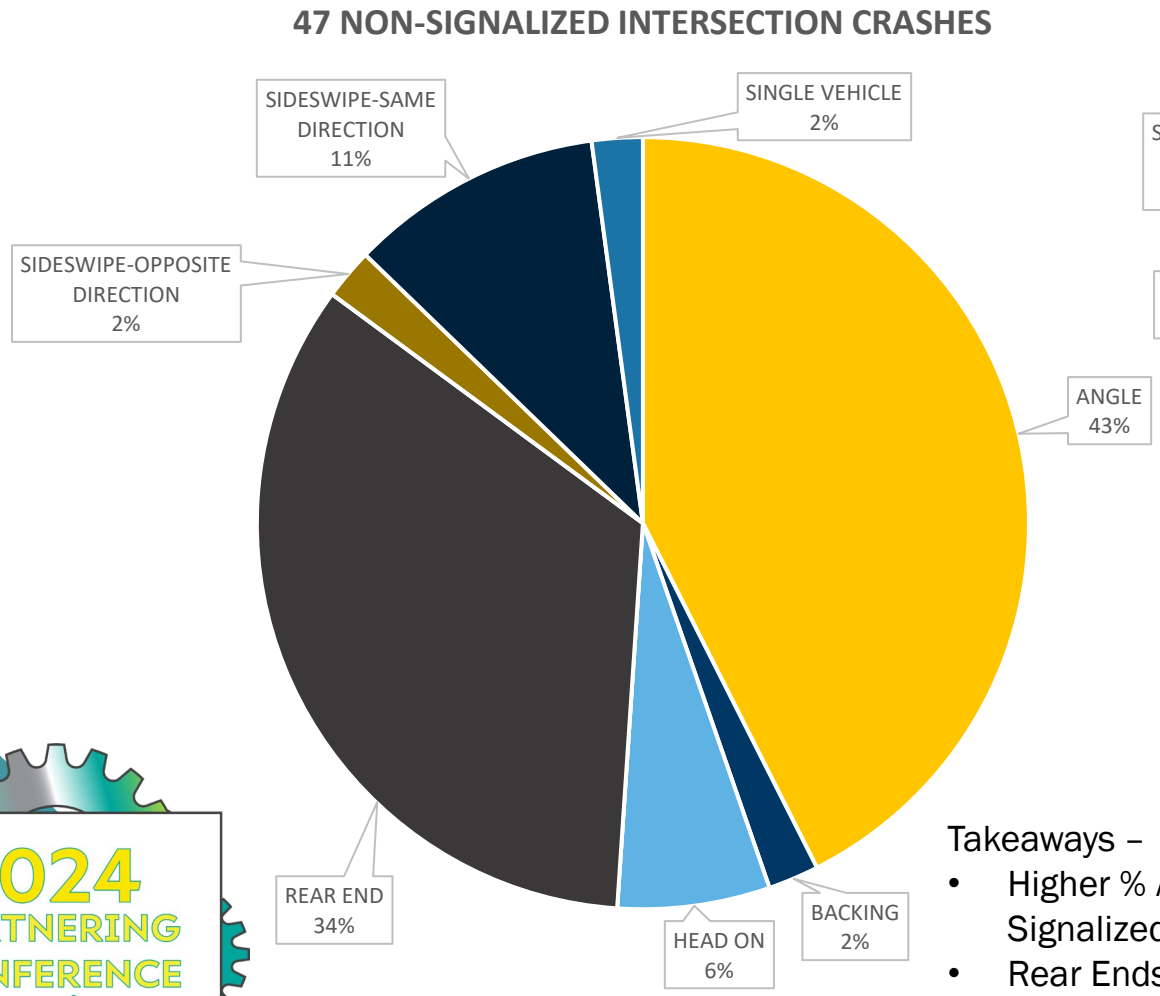
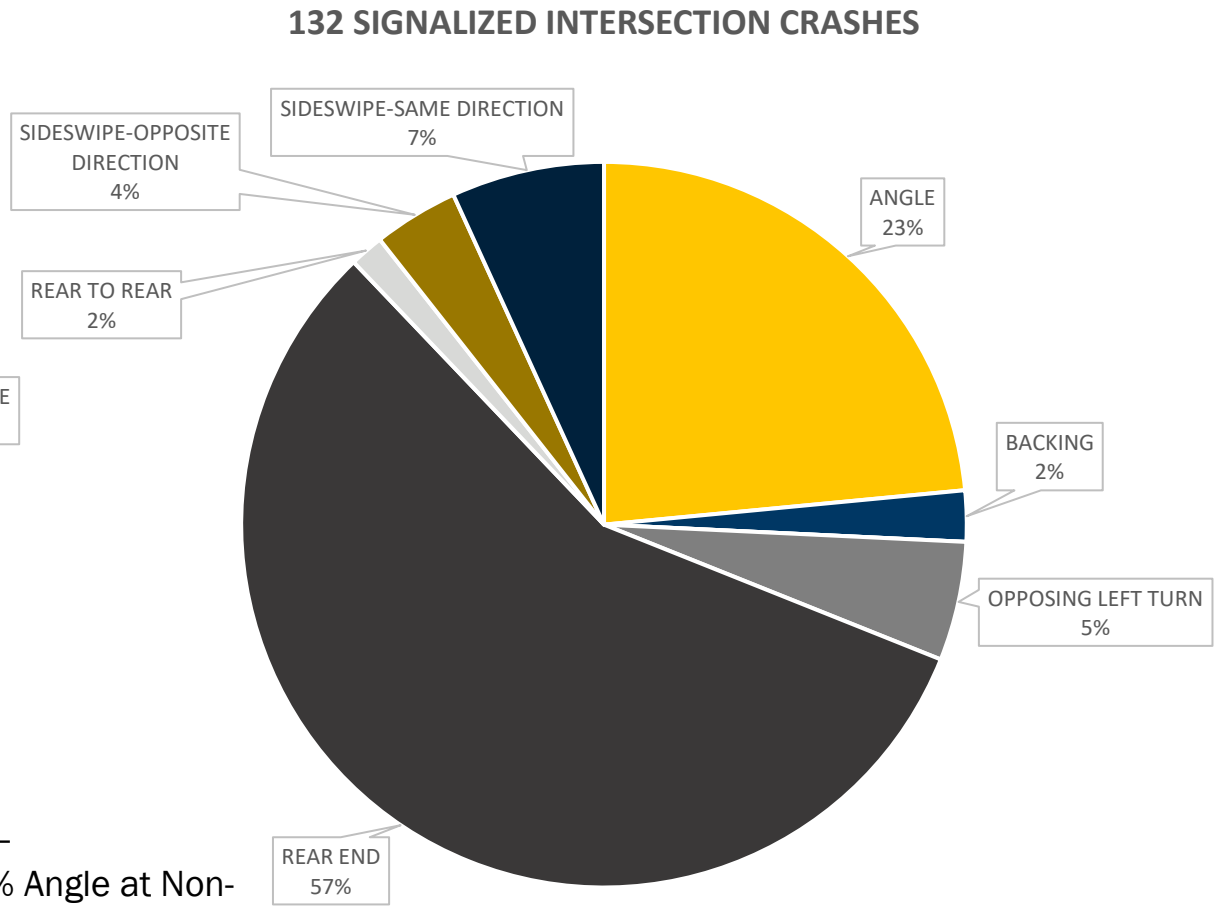
Safety – Intersection Control





Takeaways –

- Higher % Angle at Non-Signalized
- Rear Ends at both
- Both Fatal at Non-Signalized
- Rear Ends – 27% of injuries at non-signalized, 10% at signalized

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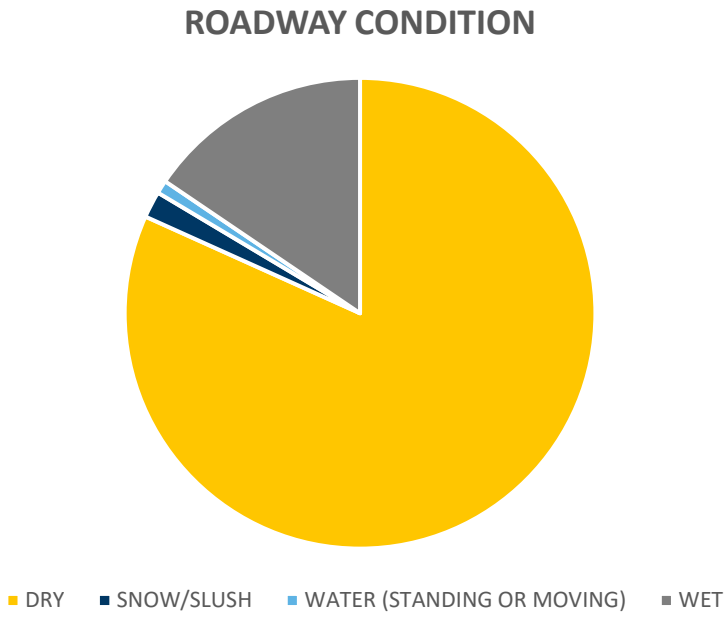
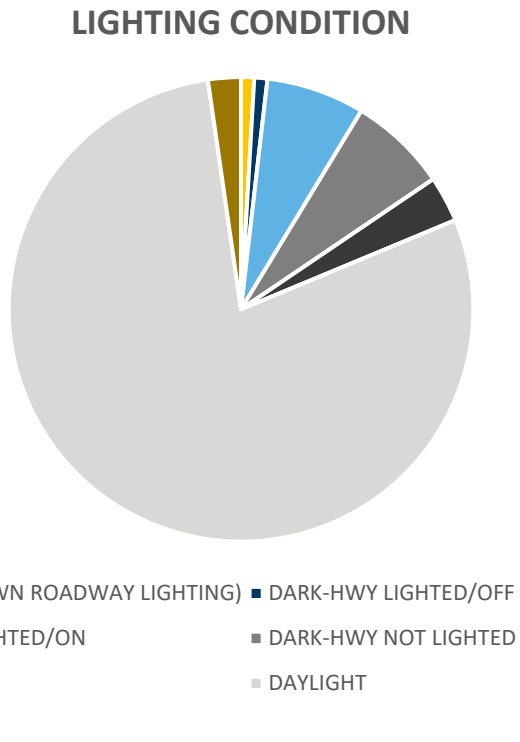
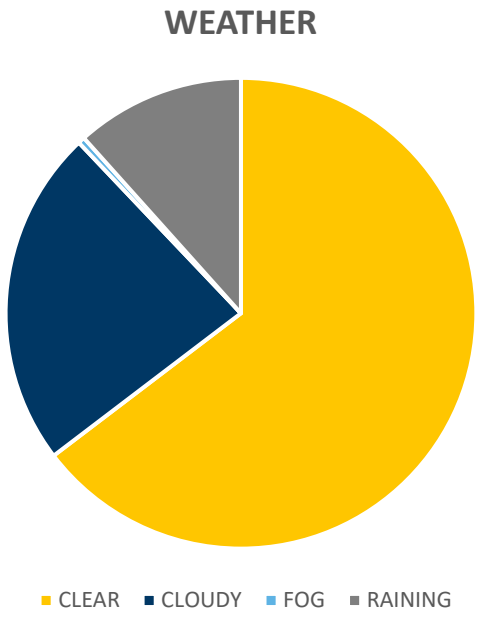
Safety – Environmental Factors







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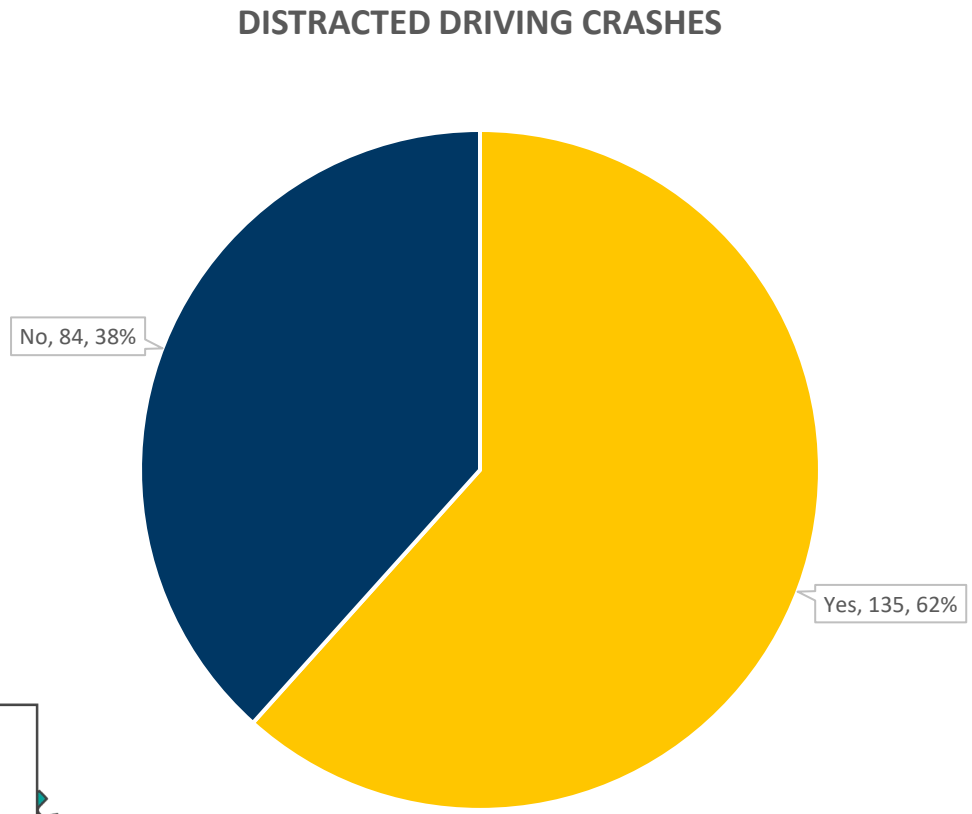
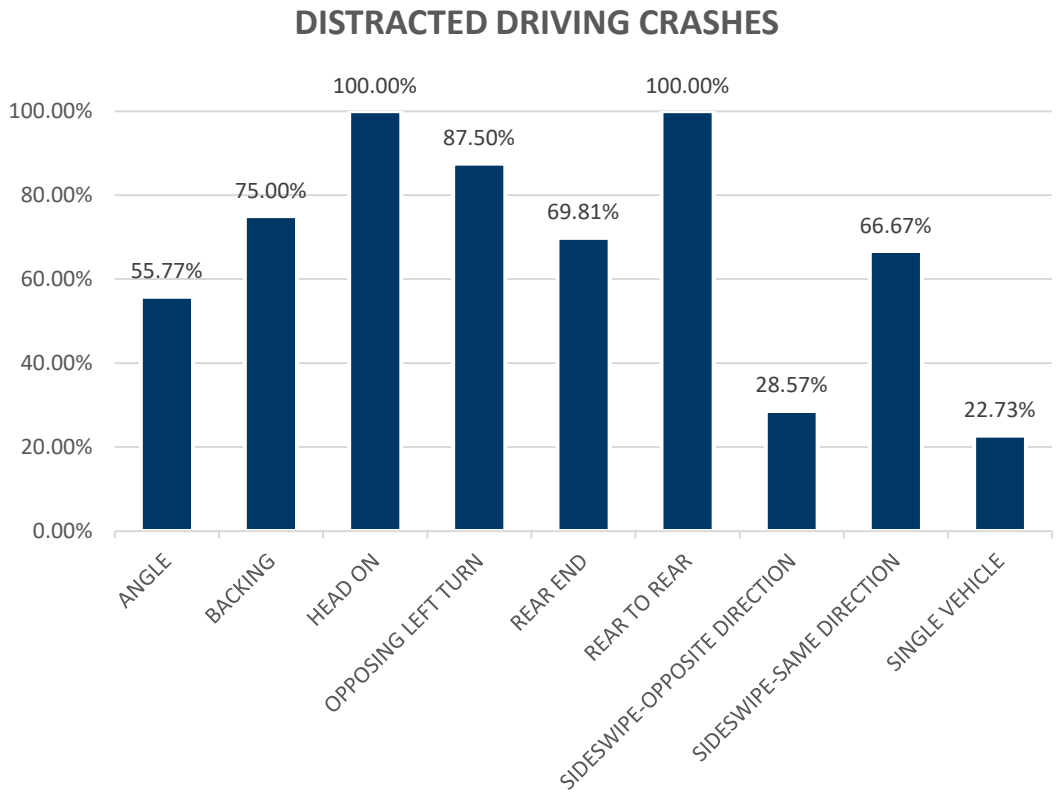
Safety – Human Factors





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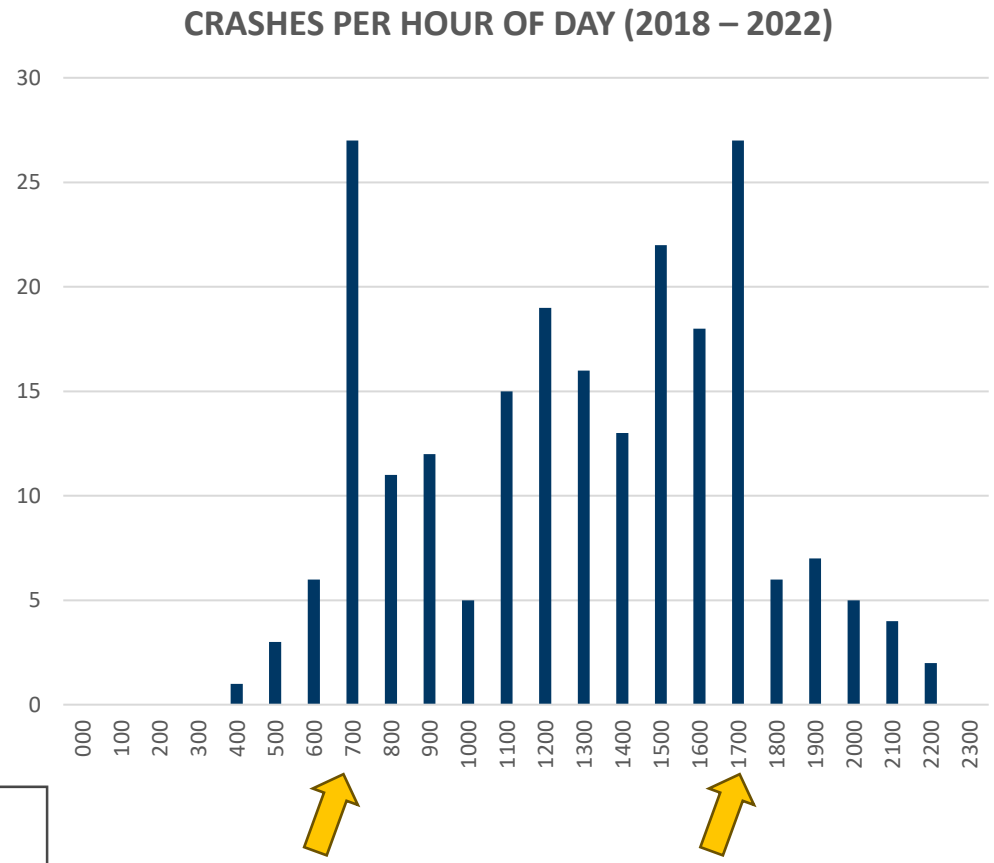
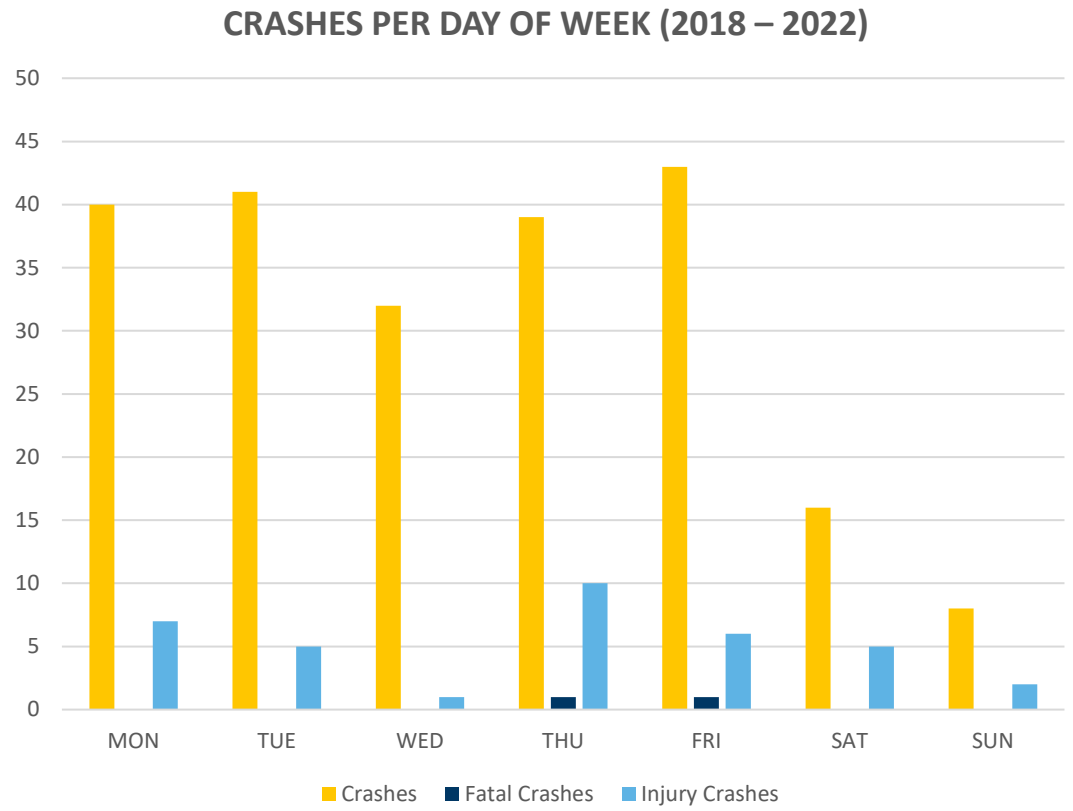
Safety – Time





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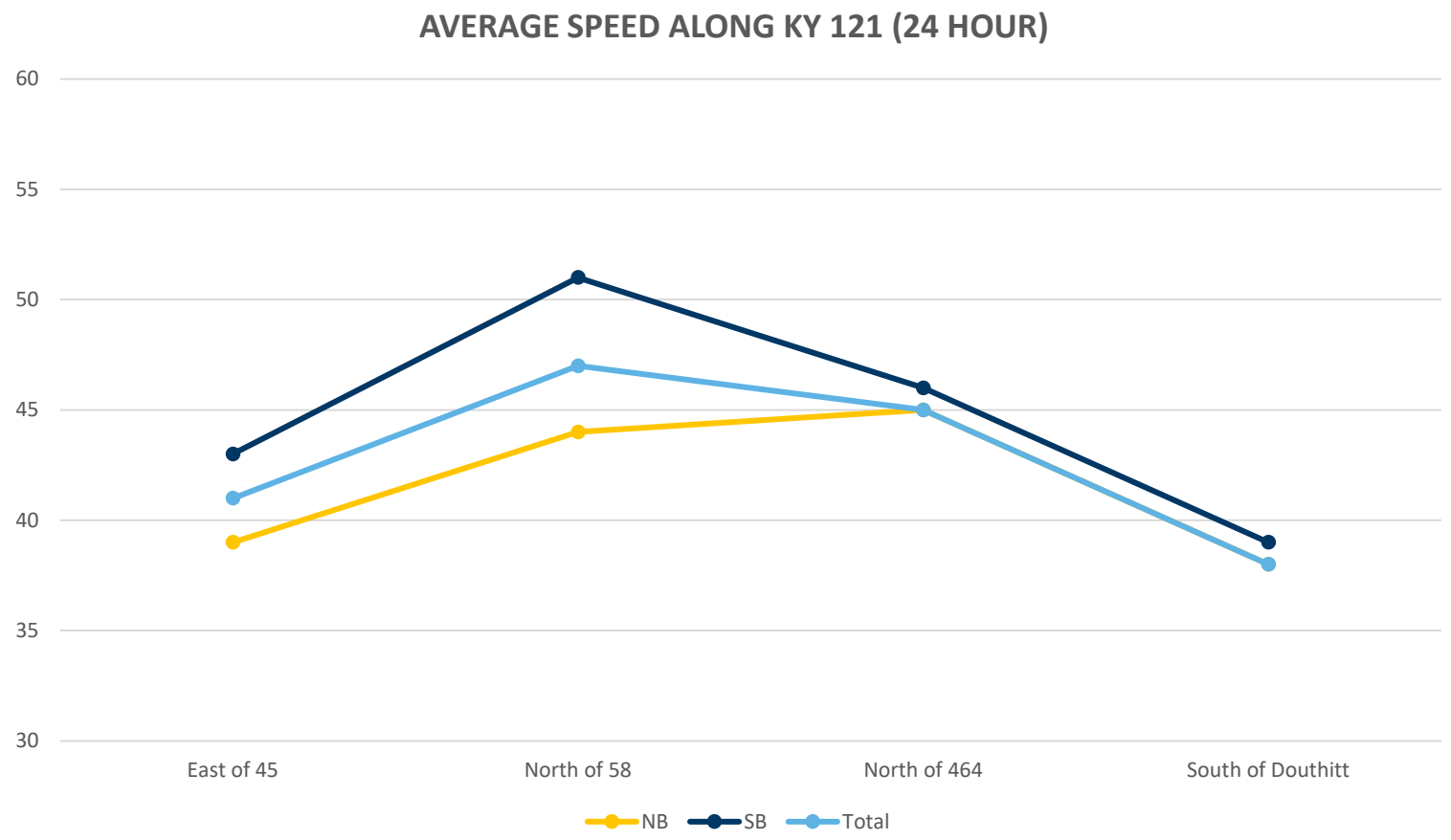
Speed Data

- Collected Speed Data over 24 hours

Percentage of Vehicles at Speeds			
	SB	NB	Total
> 45	42%	28%	34%
> 55	8%	2%	5%

- Highest concentration of high-speed vehicles occurred for SB, north of KY 58
- Very little speeding south of Douthitt
- Generally, SB quicker than NB

Speed Data



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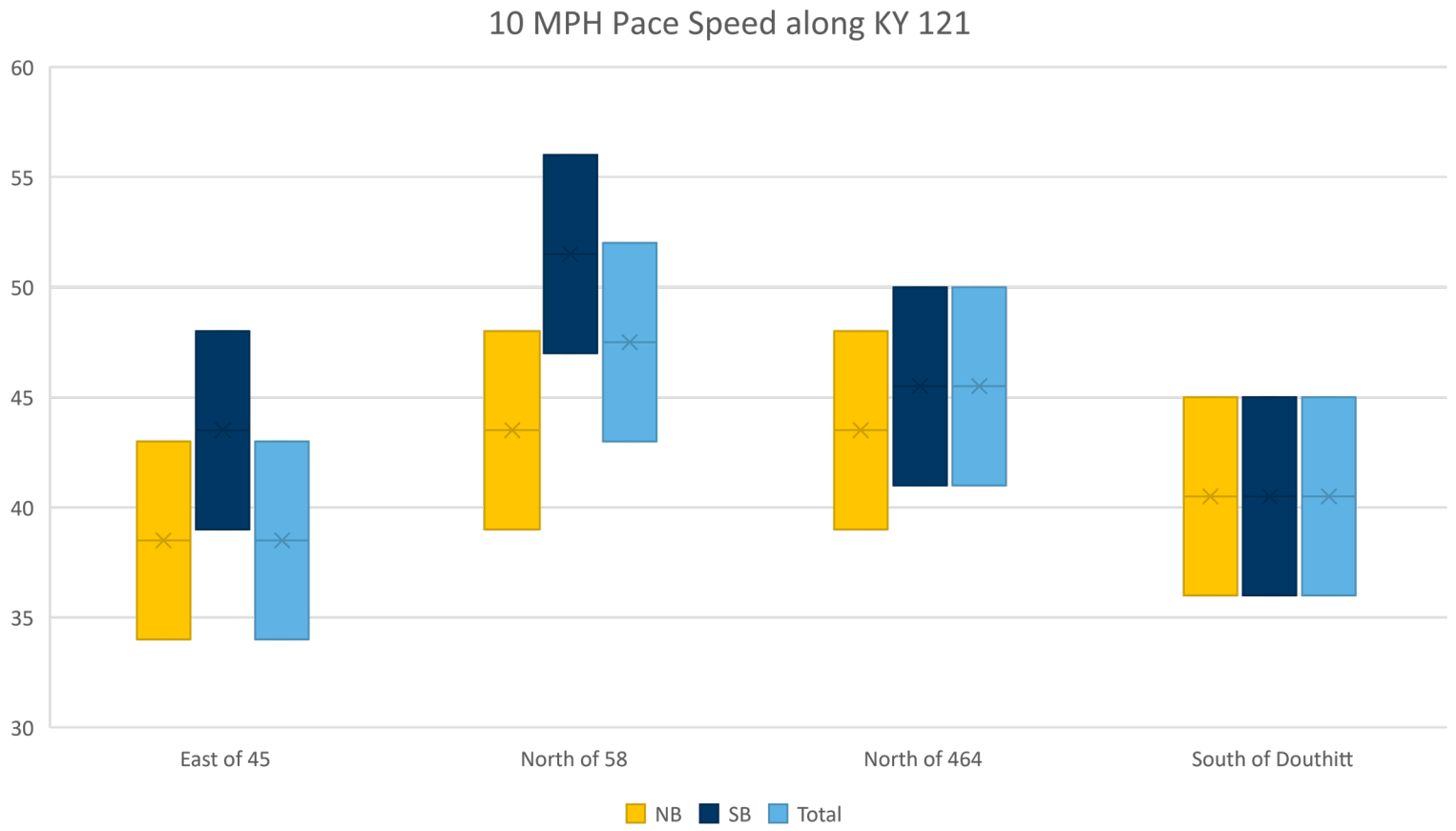
Speed Data



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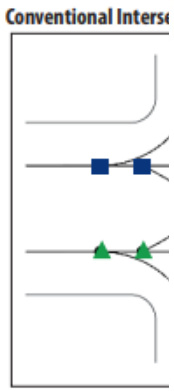
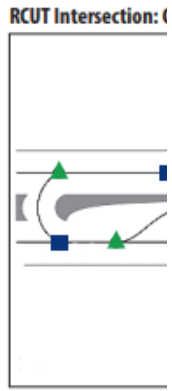
Safety – Safety Recommendations





Center Line Buffer (Narrow Painted Medians)

Facility Type	Buffer Width	Head-on RwD Crash Reduction*
2-Lane	2 feet	35%
2-Lane	4 feet	64%
2-Lane	10 feet	90%
4-Lane	Not significant	

Source: NCHRP Report 995

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Safety – HSM Analysis

Roundabouts			
Location	Predicted Crash Prevention		
	Total	FI	PDO
Charles Drive	25.01	25.57	-0.56
Douthitt Street	83.00	54.63	28.36
KY 464	20.46	28.42	-7.96
KY 58	73.67	41.23	32.43
E Housman Street	-0.33	18.27	-18.60

RCUTs			
Location	Predicted Crash Prevention		
	Total	FI	PDO
Douthitt Street	20.89	9.01	11.89
KY 464	36.41	15.7	20.72
KY 58	21.2	7.21	13.99

Traffic – Existing 2023 to Future 2048

- ADT Volumes (Existing)
  - KY 121: 9,000 – 15,000 – 12,000
  - KY 97: 4,500
  - KY 80: 8,500 – 11,000
  - Charles Drive: 3,500
  - Douthitt Street: 4,000
  - KY 464: 1,500 – 1,000
  - KY 58: 4,000 – 6,500
  - US 45: 9,000 – 16,000

- ADT Volumes (Future)
  - KY 121: 10,000 – 20,000 – 15,500
  - KY 97: 5,000
  - KY 80: 12,000 – 13,000
  - Charles Drive: 4,000
  - Douthitt Street: 4,500
  - KY 464: 1,500 – 1,000
  - KY 58: 4,000 – 7,000
  - US 45: 9,000 – 18,500

Traffic – Segments

	Segment #	Description	AM Peak			PM Peak		
			LOS	Follower Density (followers/mi/ln)	d/c	LOS	Follower Density (followers/mi/ln)	d/c
Existing 2023	1	KY 80 - Douthitt	D	8.6	0.46	C	6.1	0.37
	2	Douthitt - KY 464	D	9.1	0.46	D	8.4	0.44
	3	KY 464 - KY 58	D	8.5	0.44	D	8.4	0.44
	4	KY 58 - US 45	D	9.5	0.49	C	6.7	0.39

	Segment #	Description	AM Peak			PM Peak		
			LOS	Follower Density (followers/mi/ln)	d/c	LOS	Follower Density (followers/mi/ln)	d/c
Future 2048	1	KY 80 - Douthitt	E	12	0.58	D	8.7	0.46
	2	Douthitt - KY 464	E	12.7	0.58	D	11.3	0.54
	3	KY 464 - KY 58	E	12.1	0.57	E	12.5	0.58
	4	KY 58 - US 45	D	11.1	0.54	D	11.5	0.56

LOS	Follower Density (followers / mi / ln)
A	≤ 2.0
B	> 2.0 – 4.0
C	> 4.0 – 8.0
D	> 8.0 – 12.0
E	> 12.0
F	Demand > Capacity

Traffic – Intersections 2023

Intersection #	Intersection Name	Control	AM Peak Hour						PM Peak Hour					
			LOS					Delay (s/veh)	LOS					Delay (s/veh)
			EB	WB	NB	SB	Intersection		EB	WB	NB	SB	Intersection	
1	KY 121 at KY 80 / KY 97	Signal	B	B	D	C	C	22.8	B	B	D	C	C	22.1
2	KY 121 at Charles Drive	TWSC	C	-	A	A	-	21.6	C	-	A	A	-	18.7
3	KY 121 at Douthitt Street	TWSC	E	-	A	A	-	36.3	E	C	A	A	-	40.3
4	KY 121 at KY 464	TWSC	D	C	A	A	-	30.1	D	C	A	A	-	31.2
5	KY 121 at KY 58	Signal	C	D	B	B	B	18.6	C	C	B	B	B	19.6
6	KY 121 at E Housman Street	TWSC	-	B	A	A	-	11.4	-	C	A	A	-	18.7
7	KY 121 at Andrea Drive	TWSC												
8	KY 121 at US 45	Signal	B	B	D	D	C	29.1	B	B	D	D	C	33.2

Traffic – Intersections 2048 No Build

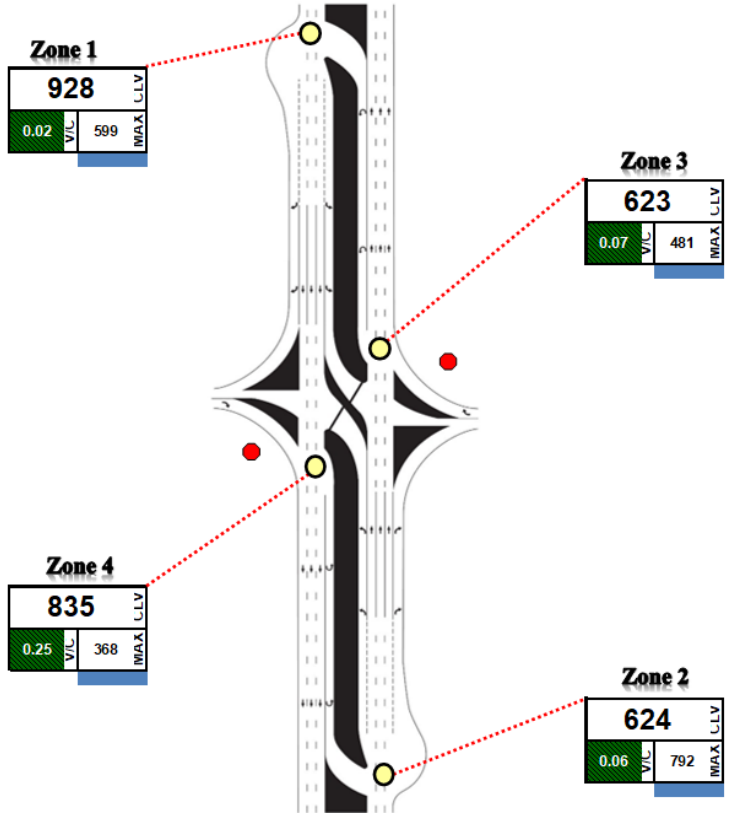
Intersection #	Intersection Name	Control	AM Peak Hour						PM Peak Hour					
			LOS					Delay (s/veh)	LOS					Delay (s/veh)
			EB	WB	NB	SB	Intersection		EB	WB	NB	SB	Intersection	
1	KY 121 at KY 80 / KY 97	Signal	B	B	D	C	C	22.2	B	B	D	C	C	21.7
2	KY 121 at Charles Drive	TWSC	E	-	A	A	-	42.1	F	-	A	A	-	40.3
3	KY 121 at Douthitt Street	TWSC	F	-	A	A		103.3	F	C	A	A	-	164.3
4	KY 121 at KY 464	TWSC	F	D	A	A	-	99.7	F	E	A	A	-	161
5	KY 121 at KY 58	Signal	D	D	C	B	C	24.7	D	C	C	C	C	25
6	KY 121 at E Housman Street	TWSC	-	B	A	A	-	11.8	-	D	A	A	-	32.6
7	KY 121 at Andrea Drive	TWSC												
8	KY 121 at US 45	Signal	B	C	D	D	C	35	C	C	D	C	C	32.8

Traffic – Intersections 2048 Roundabouts

Intersection #	Intersection Name	Control	AM Peak Hour						PM Peak Hour					
			LOS					Delay (s/veh)	LOS					Delay (s/veh)
			EB	WB	NB	SB	Intersection		EB	WB	NB	SB	Intersection	
2	KY 121 at Charles Drive	1x Roundabout	A	-	B	A	B	11.3	A	-	A	A	A	8.3
3	KY 121 at Douthitt Street	1x Roundabout	A	-	C	A	C	16.1	A	A	A	B	B	10.9
4	KY 121 at KY 464	1x Roundabout	A	A	C	B	B	12.6	A	A	A	C	B	12.6
5	KY 121 at KY 58	1x Roundabout	A	C	C	B	C	16.9	B	A	B	C	C	15.8
6	KY 121 at E Housman Street	1x Roundabout	-	A	A	B	B	10.1	-	A	A	A	A	7.3

Traffic – Intersections 2048 RCUTs

- HCM methods cover 2-lane RCUTs
- Synchro Microsimulation required for 1-lane
- CAP-X results show low delay. Verified with Synchro of one intersection



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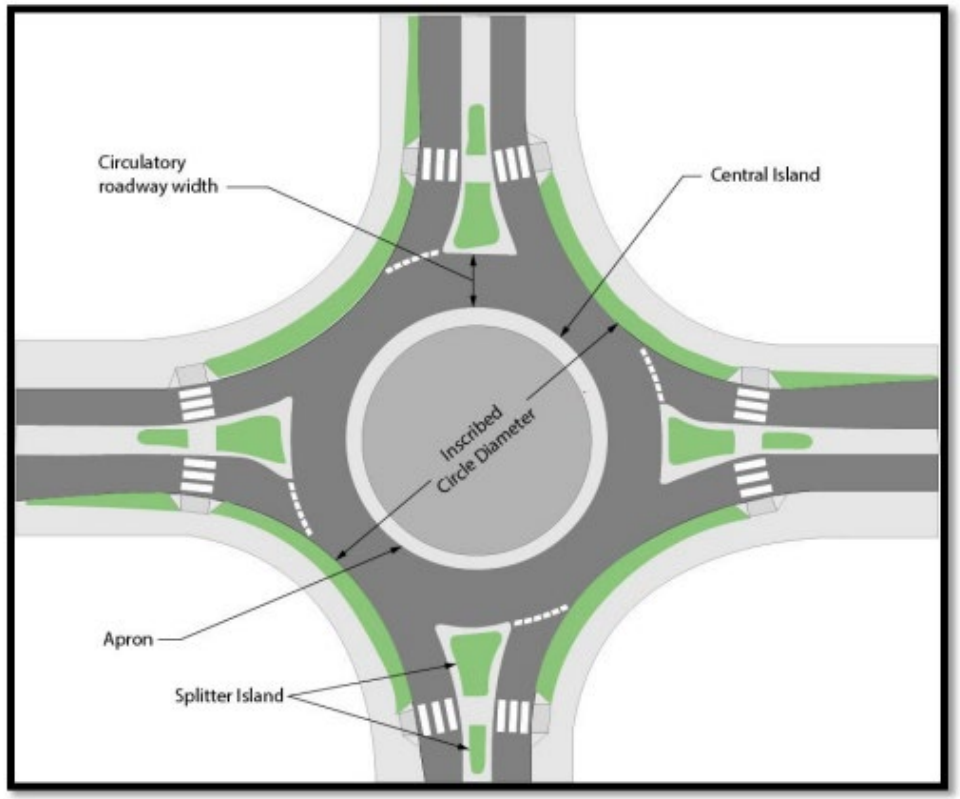
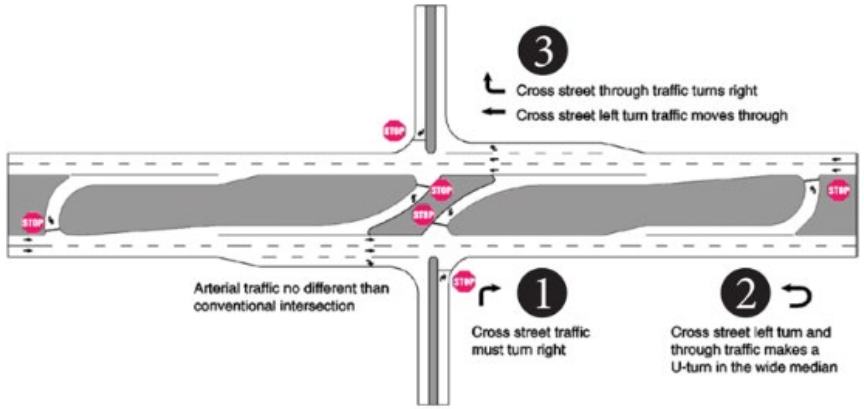
Conclusions

- Non-intersection capacity is not an issue
- Utilize Roundabouts or RCUTs at intersections to reduce conflict points, angle of collision, and speeds
- Separate travel directions to prevent crashes involving transfer of high kinetic energy
- Introduce speed management techniques north of KY 58 through sweeping curve, emphasis on SB movement
- Increase driver awareness of intersections due to high-speed rural context

Concept Evaluation

- 2+1 Highway
- Multilane Highway
- Complete Streets
- Roundabouts
- Restricted Crossing U-Turns





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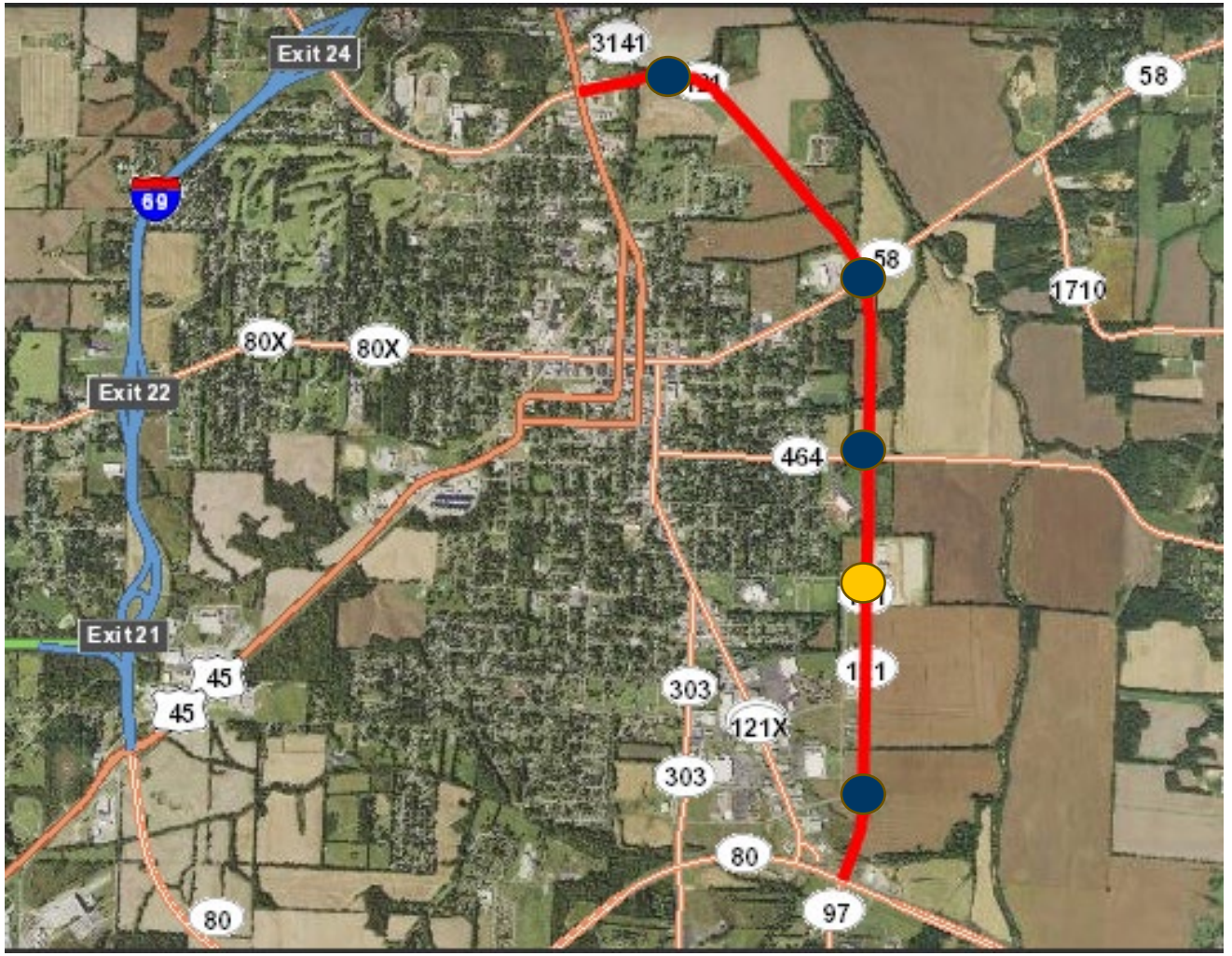
Recommended Alternative

Flush Centerline Buffer

Curb and Gutter

1 RCUT



4 Roundabouts

RIRO Entrances

45 MPH Design Speed

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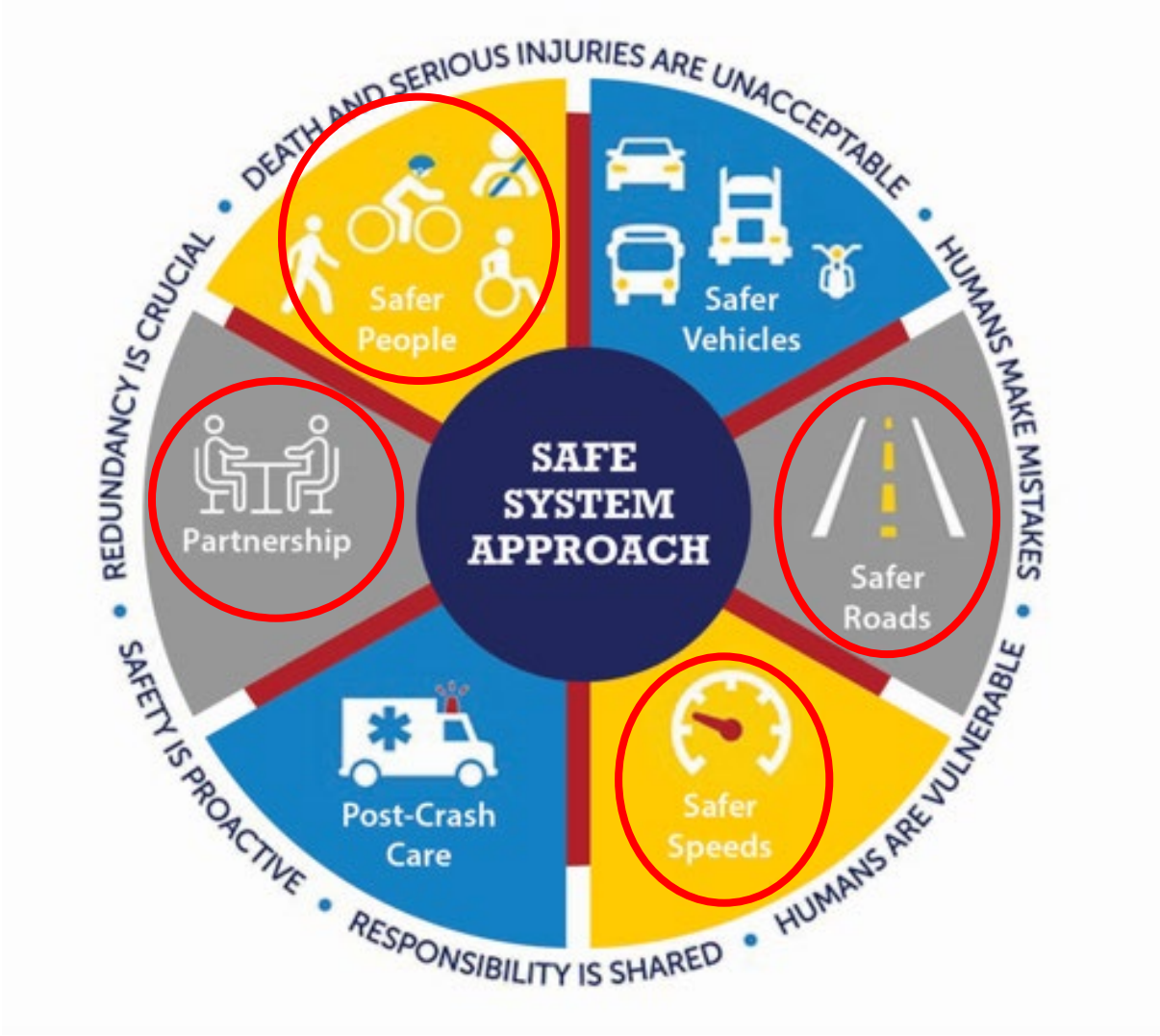
Alignment with Safe System Approach



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Safety Culture

Figure 2. The relationship between TSC and Safe System (National Safety Council 2023).

- *... the implementation of the Safe System Approach is not possible without a safety culture aligned with the goals of a Safe System (Ward and Otto 2019).*

So, What Now?

Traditional		Safe System
Prevent crashes	→	Prevent deaths and serious injuries
Improve human behavior	→	Design for human mistakes/limitations
Control speeding	→	Reduce system kinetic energy
Individuals are responsible	→	Share responsibility
React based on crash history	→	Proactively identify and address risks

- Every project should consider safety!
- Are you following where data leads?
- Are you willing to challenge the norm?
- Are you willing to take risks to develop a better project?

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For PDHs:

Safe System Approach at Early Alignments 10:00am