Bicycle and Pedestrian Safety Action Plan Update Analysis

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Lee County Metropolitan Planning Organization

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Acronyms and Abbreviations

BPSAP	Bicycle and Pedestrian Safety Action Plan
BOCC	Board of County Commissioners
CMF	Crash Modification Factor
County	Lee County
FDM	FDOT Design Manual
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
GIS	geographic information system
HSIP	Highway Safety Improvement Program
Jacobs	Jacobs Engineering Group Inc.
KABCO	Killed, Awful, Bloody, Complaint, Property Damage Only (severity scale)
LPI	Leading Pedestrian Interval
mph	mile(s) per hour
MPO	Metropolitan Planning Organization

1. Introduction

To support the Lee County Metropolitan Planning Organization's (Lee MPO) efforts to choose the most effective transportation projects to pursue and ultimately implement, Jacobs Engineering Group Inc. (Jacobs) conducted a detailed risk-based analysis to update the 2013 Bicycle and Pedestrian Safety Action Plan (BPSAP). The purpose of this report is to provide a roadmap that summarizes the process used to analyze crash data in Lee County and the resulting prioritization and countermeasure selections. To that end, this report includes:

- Identified at-risk corridors and intersections.
- Overrepresentations in the pedestrian and bicycle crash data, which are the locations with the highest crash densities and are the best candidates for safety investment.
- Methodologies to prioritize a segment and intersection study network and the selection process of proven effective countermeasures to be recommended at the prioritized locations.
- An overview of how countermeasures were selected.
- Assigned countermeasures for site-specific locations that will have a positive effect on the performance of pedestrian and bicycle safety through project development.

This report is delineated into eight sections that detail the key drivers for Jacobs' analytical process.

1. Introduction
2. Crash Review and Disaggregation
3. Network and Data Collection
4. Segment and Intersection Crash Analysis
5. Risk Factor Identification
6. Location Prioritization and Countermeasure Selection
7. Project Development
8. References

In addition, the supplemental supporting information included in Appendices A, B and C, provide prioritized lists, project development methodologies and summaries and cost estimate information to guide the MPO in their next steps for project planning and implementation.

2. Crash Review and Disaggregation

The Lee County crash data were collected between 2012 and 2016, and the priority crash type reviewed was pedestrian- and bicycle-related. Only crashes that occurred on public roads were considered. Jacobs found there were 1,008 pedestrian and bicycle-related crashes, representing 3 percent of countywide crashes (38,666 total countywide crashes).

Of the 1,008 pedestrian and bicycle crashes, 284 were categorized as severe. These crashes represent 13 percent of severe countywide crashes (2,241 severe countywide crashes). Severe crashes are those with fatal or incapacitating injuries and are the priority crash types used in decision making.

3. Network and Data Collection

3.1 Study Area: Segments

There are a total of 4,560 miles of public roads in the county. Jacobs analyzed 989 miles (22 percent) of those public road miles. This subset of segments include arterial and collector roadways in the county, acquired from a . Geographic Information System (GIS) Data Hub managed by the Lee County Board of County Commissioners (BOCC). Figure 3-1 provides a map of the road segment study network.

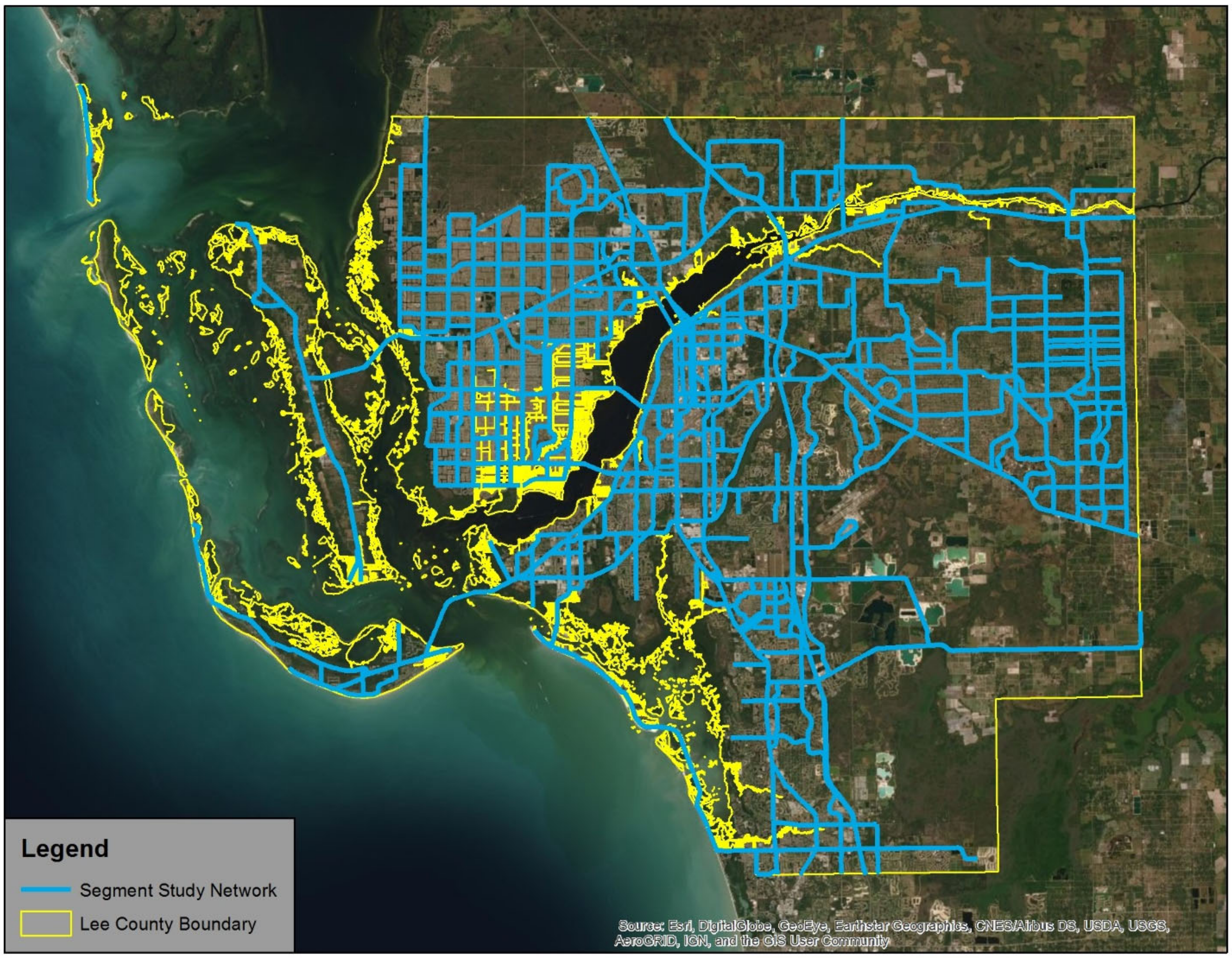

Figure 3-1. Road Segment Study Network Map

3.2 Study Area: Intersections

Based on the previous identification of roadway segments, a subset of intersections were identified within the county. Intersections were chosen based on where the roadways identified in the Segment Study Network crossed, and were used as a starting point for a more detailed analysis of crash data. A total of 580 intersections were analyzed. Figure 3-2 provides a map of intersections identified for study.

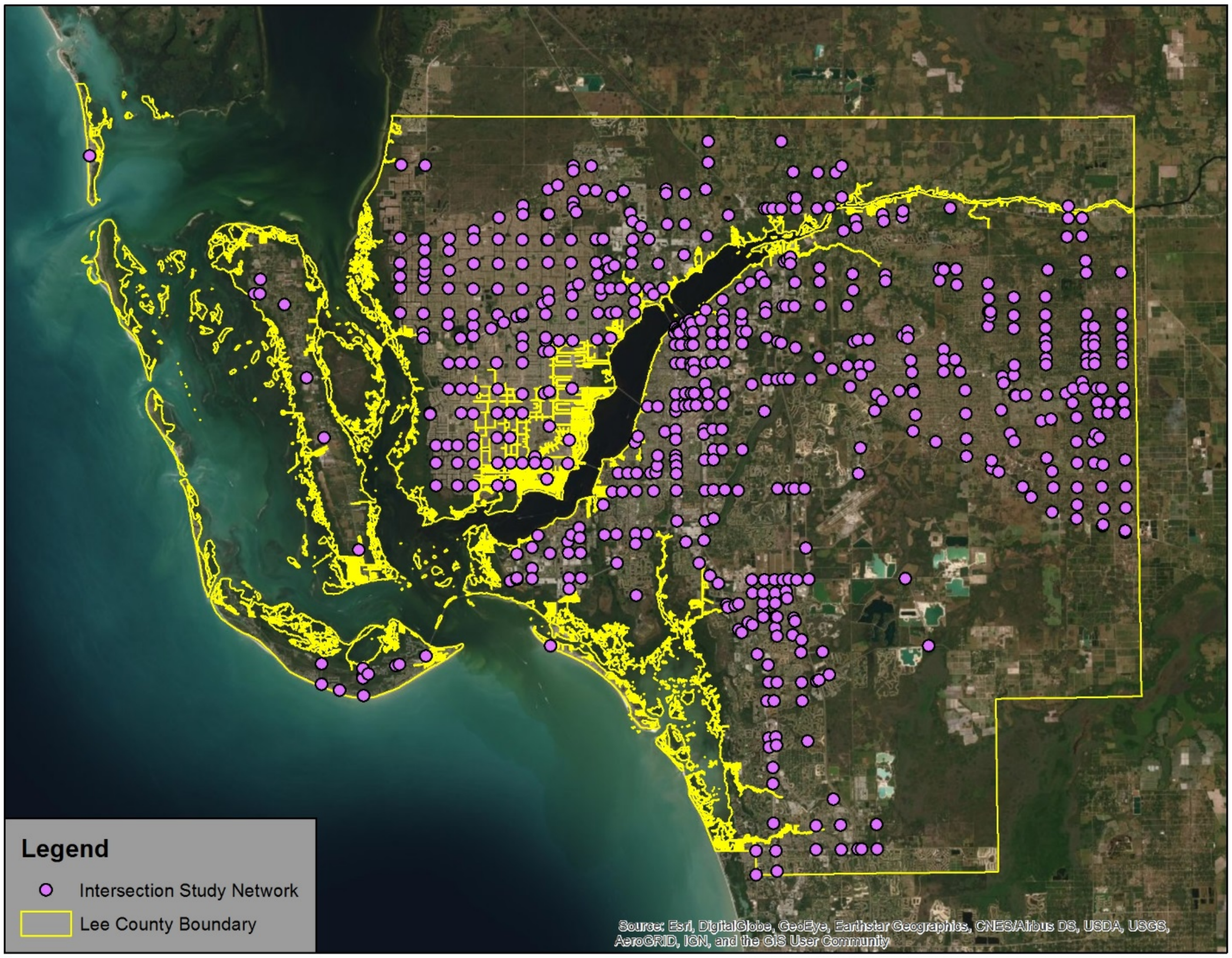

Figure 3-2. Intersection Study Network Map

4. Segment and Intersection Crash Analysis

4.1 Intersection Crash Analysis

During the analysis, Jacobs found that 143 intersections (25 percent) had 1 or more recorded crashes; 63 intersections (11 percent) had 1 or more severe crashes. Each intersection was assigned a 350-foot area of influence. Using this area of influence, a total of 244 intersection-related crashes (24 percent of total) and 74 severe intersection-related crashes (26 percent of severe) were identified. Figure 4-1 identifies a sample intersection influence area used to determine intersection-related crashes.

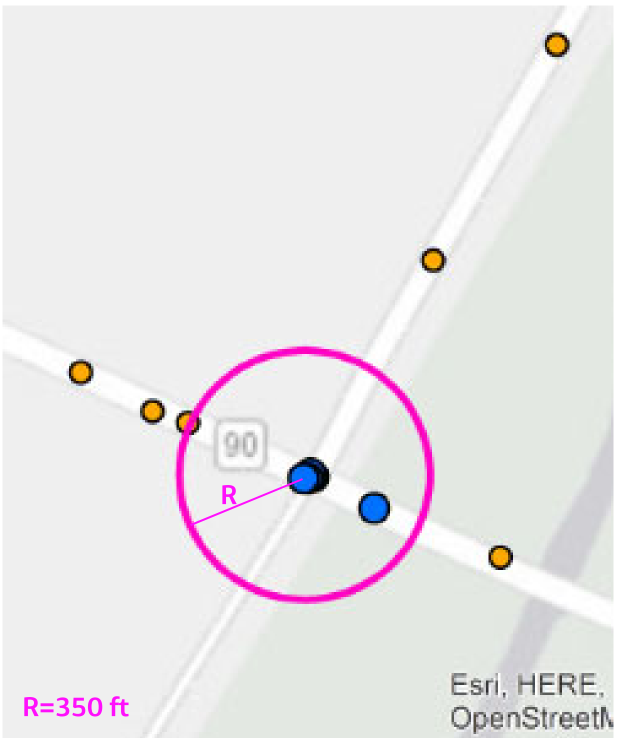

Figure 4-1. Sample Intersection Crash Data Map

4.2 Segment Analysis

After completing the intersection-related crash analysis, Jacobs identified segment-related crashes based on a 50-foot influence area from the centerline of the roadway. Only 278 miles (28 percent of network) had 1 or more crashes recorded, and 127 miles (13 percent) had 1 or more severe crashes recorded. There were a total of 572 segment-related crashes (57 percent of total) and 175 severe segment-related crashes (62 percent of severe). Figure 4-2 identifies a sample segment influence area used to identify segment-related crashes.

Jacobs confirmed that the crashes are unique and there are no overlapping crashes between intersections and road segments. These data equate to low crash density and illustrate one challenge of mitigating pedestrian and bicycle crashes; finding and treating safety issues using a small sample set.

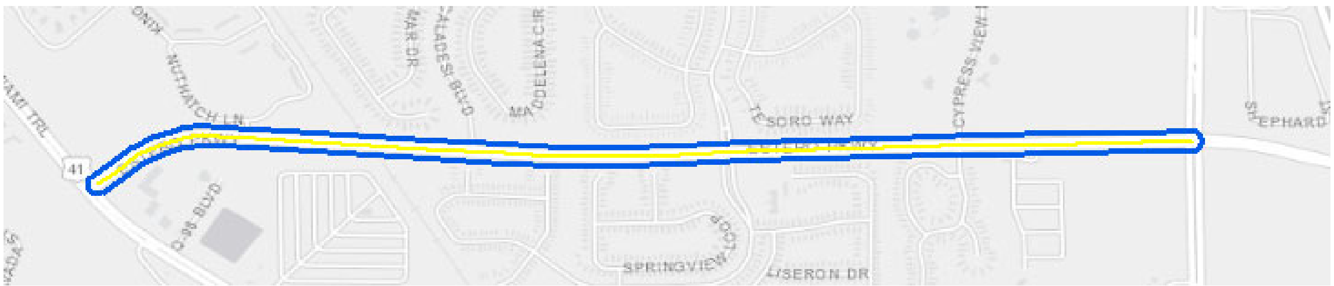

Figure 4-2. Sample Segment Crash Data Map

4.3 Majority of Crashes on a Minority of the System

Of the 284 pedestrian- and bicycle-related severe crashes in Lee County, 249 occurred at the studied intersections and road segments. Therefore, 88 percent of severe pedestrian-related and bicycle-related crashes occur on only 22 percent of countywide roadway miles. These locations with higher crash densities are stronger candidates for safety investment than those with lower crash densities.

5. Risk Factor Identification

Jacobs developed a series of graphs outlining and summarizing the analyzed crash data. The bars on the graphs represent various crash severities shown as percentages. All bars from a single series will equal 100 percent when added together. The lines represent the proportion of the system (in miles or intersection count) that falls within the specified categorical bins. Bars above the lines indicate overrepresented crashes, while bars below the lines represent underrepresented crashes. When the bars are approximately the same percentage as the lines, the crashes are representative compared to the network.

Risk factors were determined based on the greatest percentage difference between overrepresented severe crashes and the roadway system for intersections and segments. The following risk factors were identified for intersections and road segments.

Risk factors for intersections are:

- Control type (signalized)
- Number of approaches (four)
- Florida Department of Transportation (FDOT) context classification (C3C)
- Presence of sidewalk or trail

Risk factors for road segments are:

- Speed limit (45 miles per hour [mph])
- Segment length (0.75 to 1 mile)
- FDOT context classification (C3C)
- Functional classification (arterial)

5.1 KABCO Severity Scale

Developed by the National Safety Council, the KABCO Severity Scale is frequently used by law enforcement agencies to classify crash-related injuries. Jacobs used KABCO to determine the severity of analyzed crashes. The KABCO acronym stands for:

- Killed = Fatal Injury: An injury received in a traffic accident that results in death within 30 days of the crash.
- Awful = Incapacitating Injury: An injury, other than fatal, that prevents walking, driving, or performing other activities that were performed before the crash.
- Bloody = Non-incapacitating Injury (Minor Injury): An injury, other than fatal or incapacitating, that is evident at the scene. Evidence includes known symptoms.
- Complaint = Possible Injury: Any injury that is not evident at the scene but that is claimed by the individual or suspected by law enforcement.
- Property Damage Only = A crash that involves a motor vehicle in transport or on a public traffic-way and results in at least $1,000.00 in property damage.

5.2 Intersection Risk Factors

Figure 5-1 provides data for the control type intersection risk factor. Intersection control type data were collected manually. Signalized intersections account for 82 percent of severe crashes while occurring at 43 percent of the analyzed network.

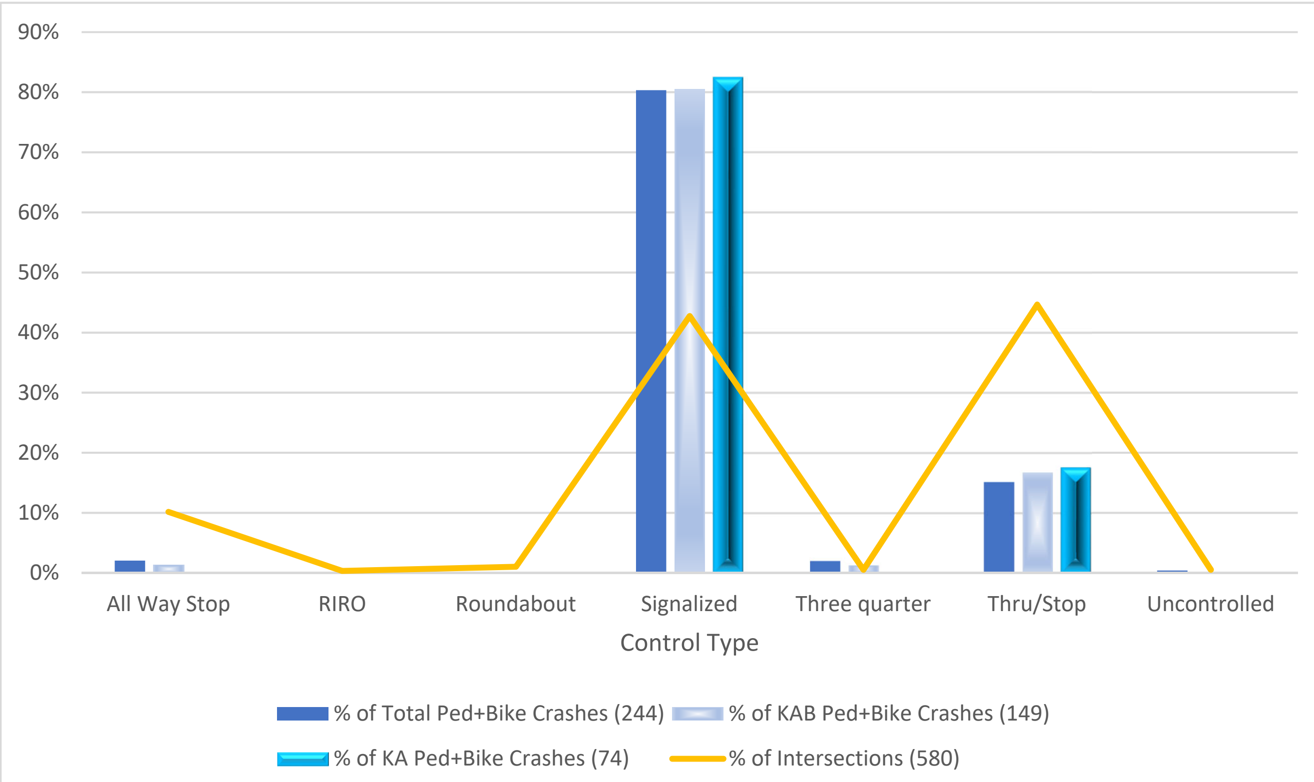

Figure 5-1. Intersection Risk Factor: Control Type

Figure 5-2 provides data for the number of approaches intersection risk factor. Intersection approach data were collected manually. Intersections with four approaches account for 89 percent of severe crashes while occurring at 67 percent of the analyzed network.

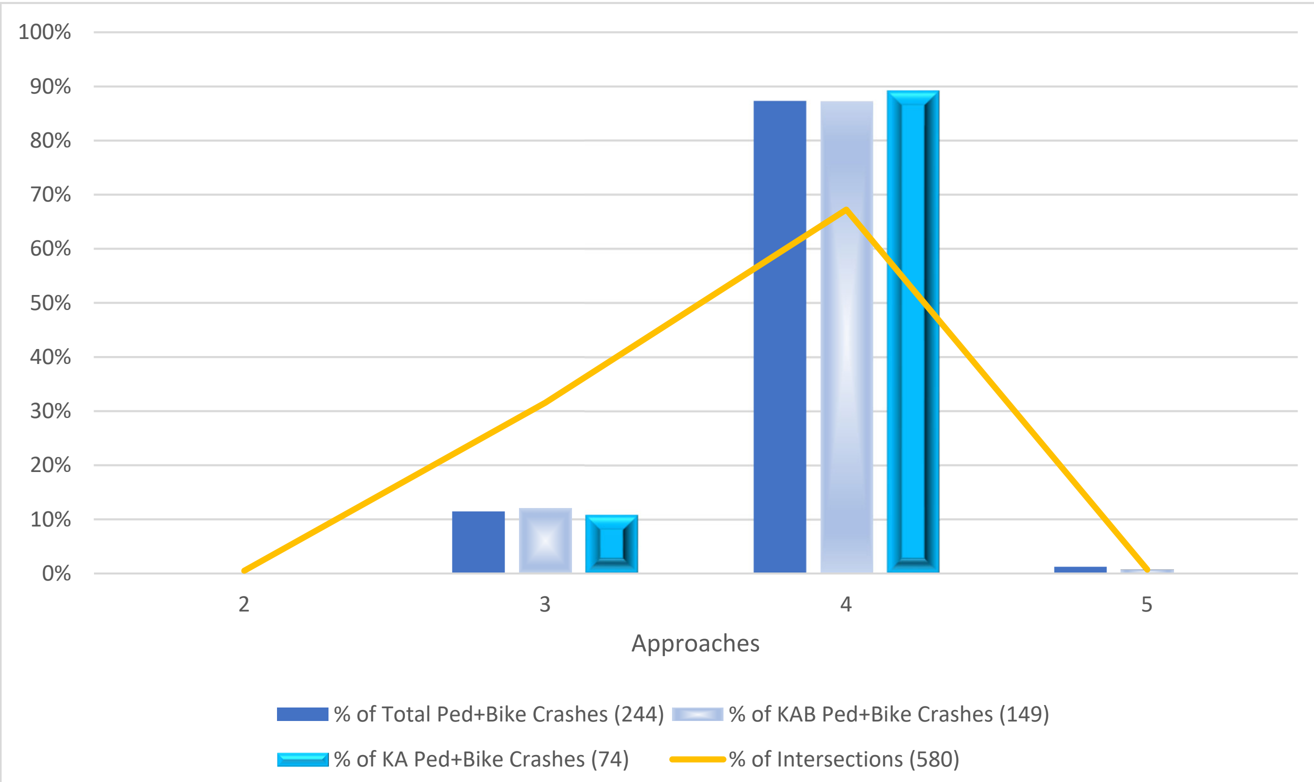

Figure 5-2. Intersection Risk Factor: Number of Approaches

Figure 5-3 provides data for the context classification intersection risk factor. The context classifications, from rural to urban, are:

- C1 – Natural
- C2 – Rural
- C2T – Rural Town
- C3C – Suburban Commercial
- C3R – Suburban Residential
- C4 – Urban General
- C5 – Urban Center
- C6 – Urban Core

Intersections with Suburban Commercial classification account for 34 percent of severe crashes while occurring at 18 percent of the analyzed intersections.

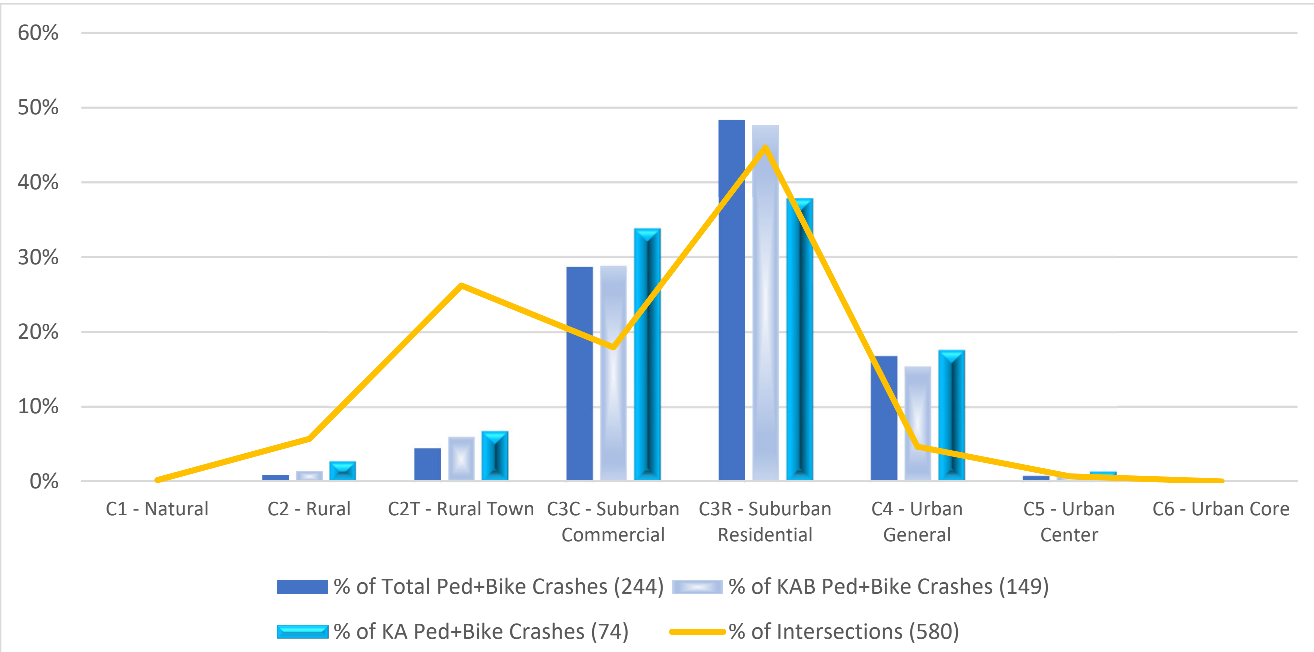

Figure 5-3. Intersection Risk Factor: Context Classification

Figure 5-4 provides the distribution of crashes at intersections with the Presence of Sidewalk/Trail. This information was collected manually and shows that the presence of a sidewalk or trail near an intersection accounts for 91 percent of the severe crashes. However, sidewalks or trails near an intersection only occurs at 63 percent of the analyzed intersections.

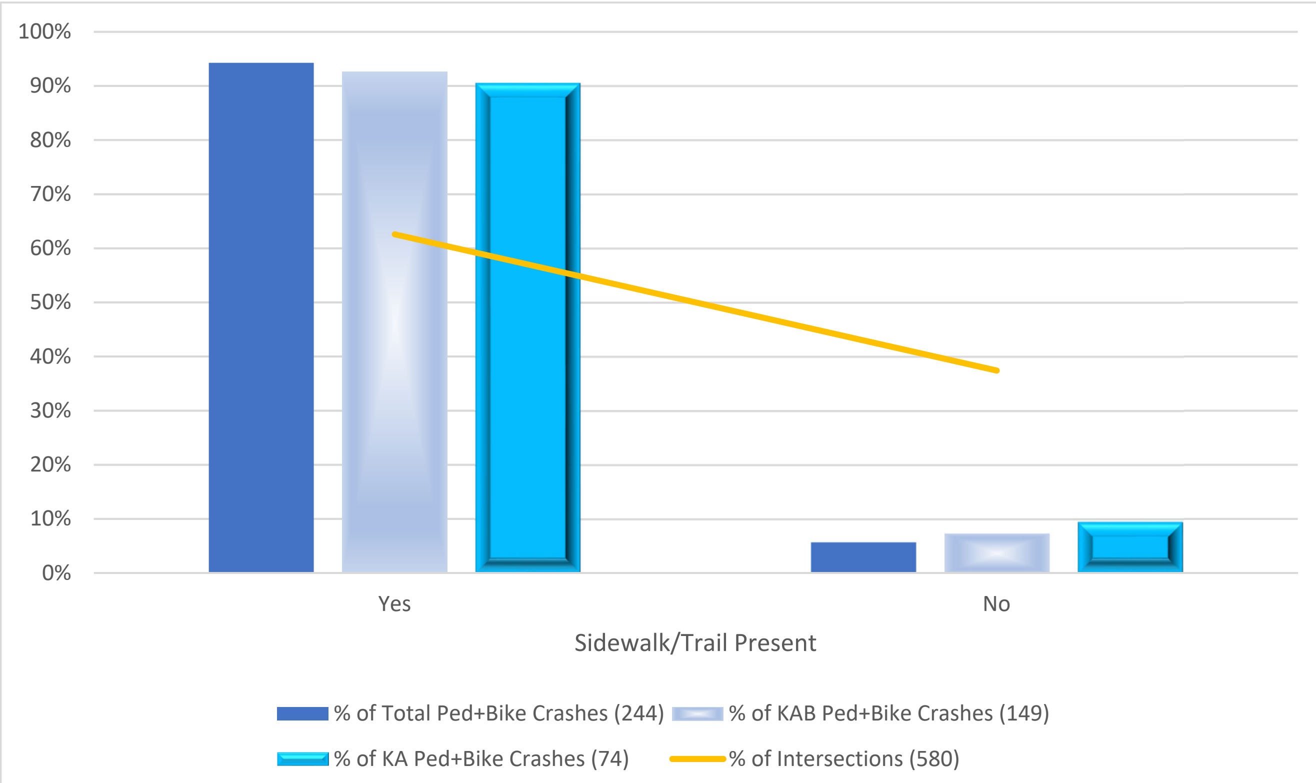

Figure 5-4. Intersection Risk Factor: Presence of Sidewalk/Trail

Figure 5-5 provides a summary graph of intersection risk factors. Intersections that have accumulated 3 or more risk factors account for 82 percent of the severe pedestrian and bicycle crashes while only occurring at 38 percent of the analyzed network. The graph shows that crashes are overrepresented at locations with three or more risk factors and are considered at-risk for future severe crashes. These locations are the best candidates for safety investment.

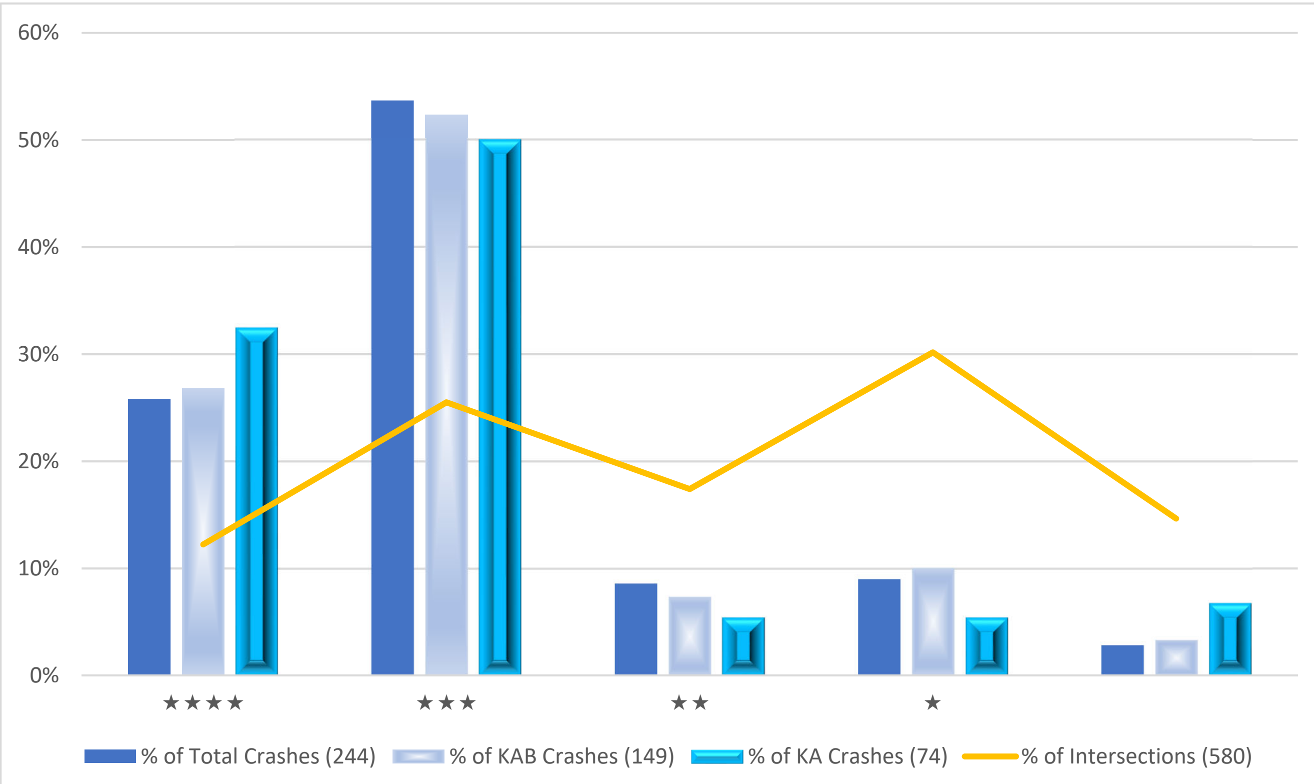

Figure 5-5. Intersection Risk Factor Summary

Figure 5-6 shows the distribution of crash densities (crashes per intersection per year) based on the accumulation of risk factors at the analyzed intersections. Intersection crash densities are approximately 14 times greater where there are 4 risk factors compared to intersections with only 1 risk factor. This further illustrates why three and four risk factor intersections are the best candidates for safety investment.

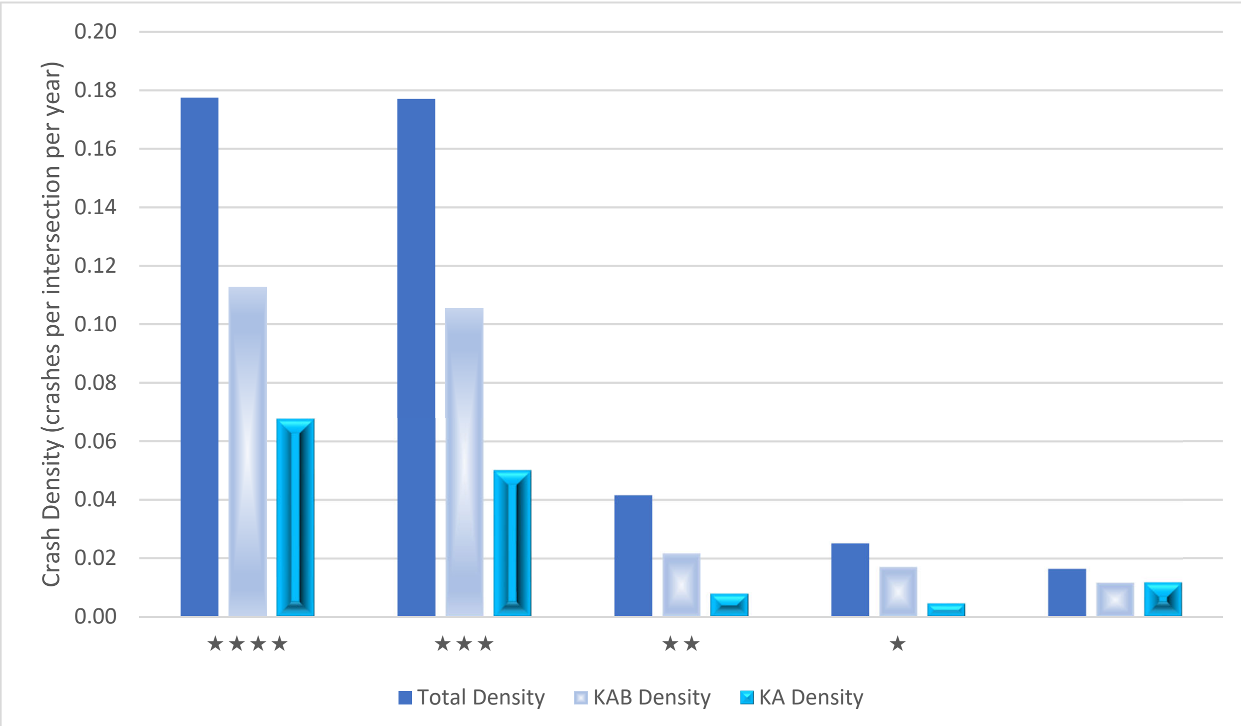

Figure 5-6. Intersection Crash Density

Figure 5-7 provides a map of an example intersection with four risk factors.

Figure 5-7. Intersection Example: Risk Factors

5.3 Segment Risk Factors

Figure 5-8 provides data for the posted speed limit segment risk factor. Posted speed limit information was included as an attribute in the shapefile acquired from the Lee County BOCC managed GIS Data Hub. Segments with a posted speed limit of 45 mph account for 48 percent of the severe crashes while only occurring along 35 percent of the analyzed miles.

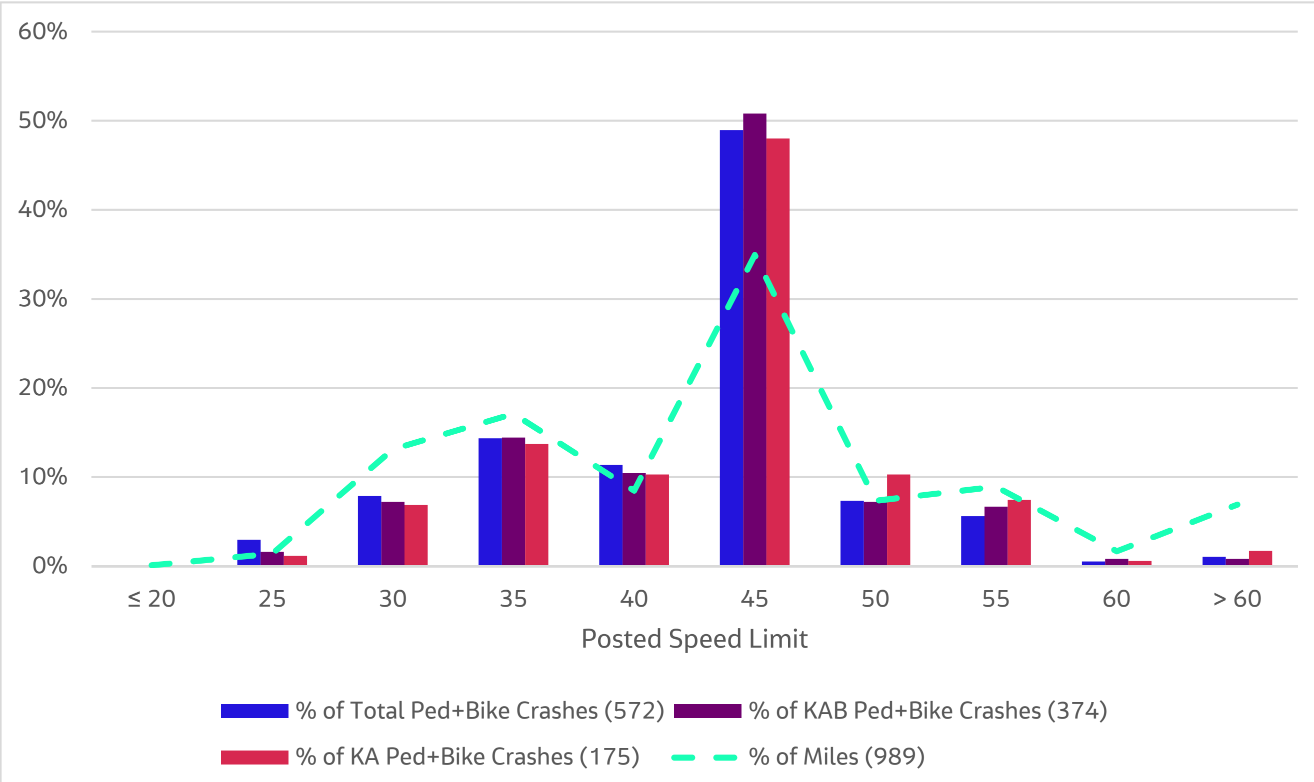

Figure 5-8. Segment Risk Factor: Speed Limit

Figure 5-9 provides data for the segment length risk factor. An increase in distance may be correlated to an increase in midblock crossings. Too long of a distance may be indicative of a rural corridor with less pedestrian and bicycle exposure. However, segments that are between 0.75 and 1.00 miles long are more at-risk for future severe crashes. These locations account for 24 percent of the severe crashes while occurring along 15 percent of the analyzed miles.

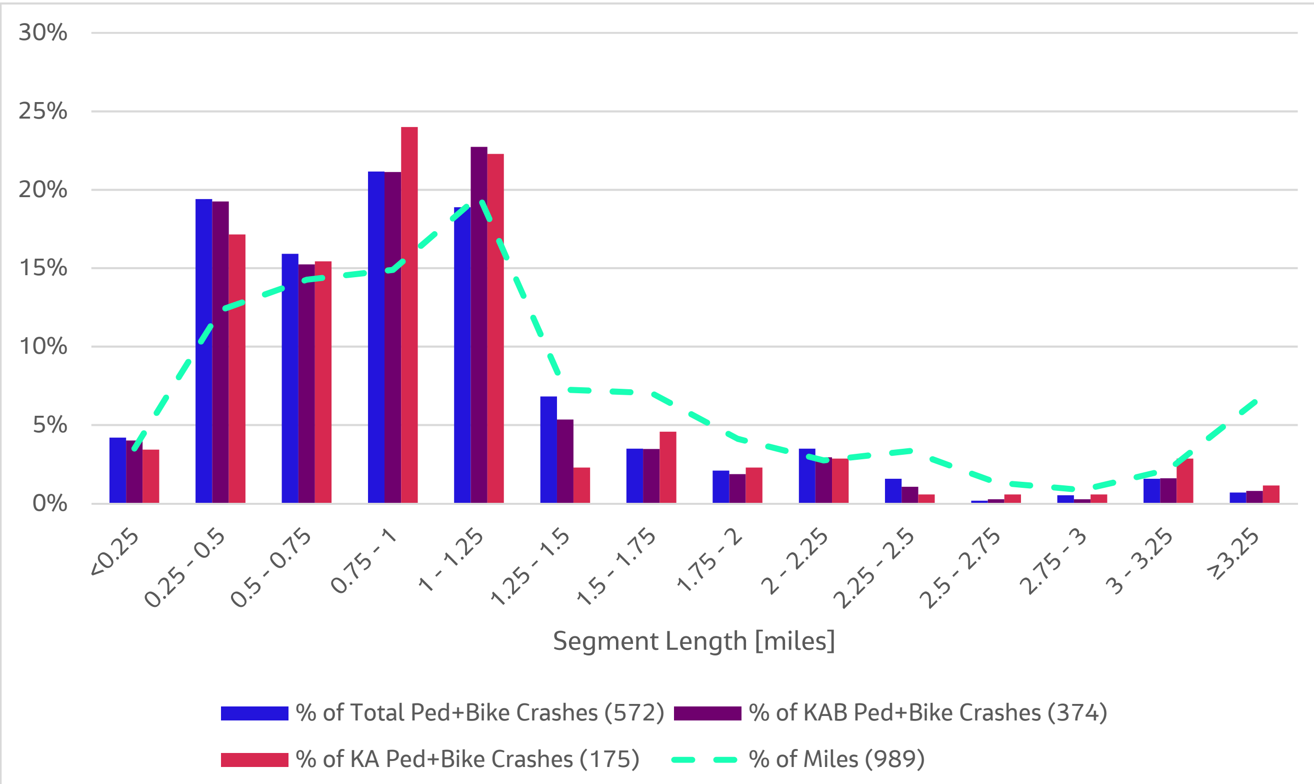

Figure 5-9. Segment Risk Factor: Segment Length

Figure 5-10 provides data for the context classification segment risk factor. The context classifications, from rural to urban, are:

- C1 – Natural
- C2 – Rural
- C2T – Rural Town
- C3C – Suburban Commercial
- C3R – Suburban Residential
- C4 – Urban General
- C5 – Urban Center
- C6 – Urban Core
- LA – Limited Access (Freeway/Interstate)

Segments with Suburban Commercial classification are the selected risk factor since these locations account for 42 percent of the severe crashes while occurring along 17 percent of the analyzed miles.

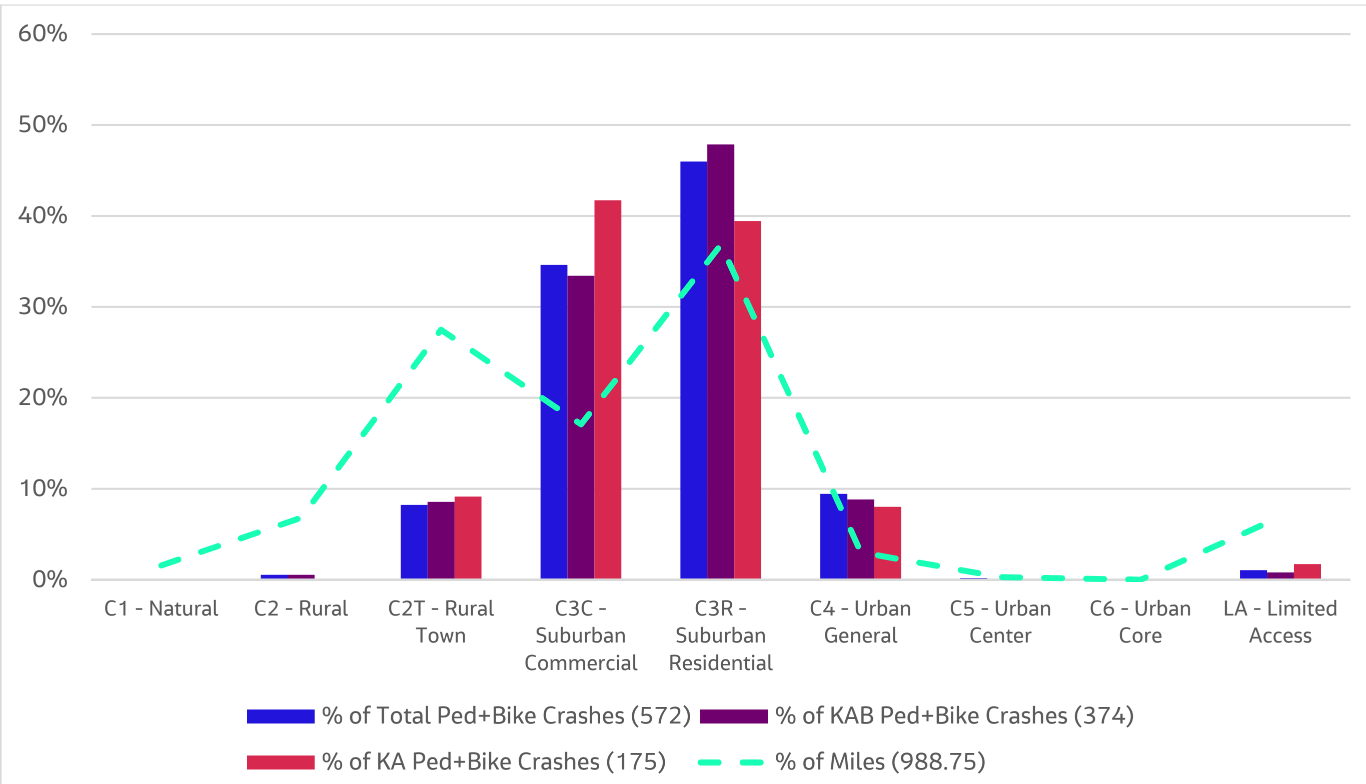

Figure 5-10. Segment Risk Factor: Context Classification

Figure 5-11 provides data for the functional classification segment risk factor. Functional classification information was included as an attribute in the. shapefile from the Lee County BOCC managed GIS Data Hub. Segments with an Arterial functional classification are the selected risk factor due to the overrepresentation of crashes. Approximately 83 percent of severe crashes occurred along 53 percent of the analyzed miles.

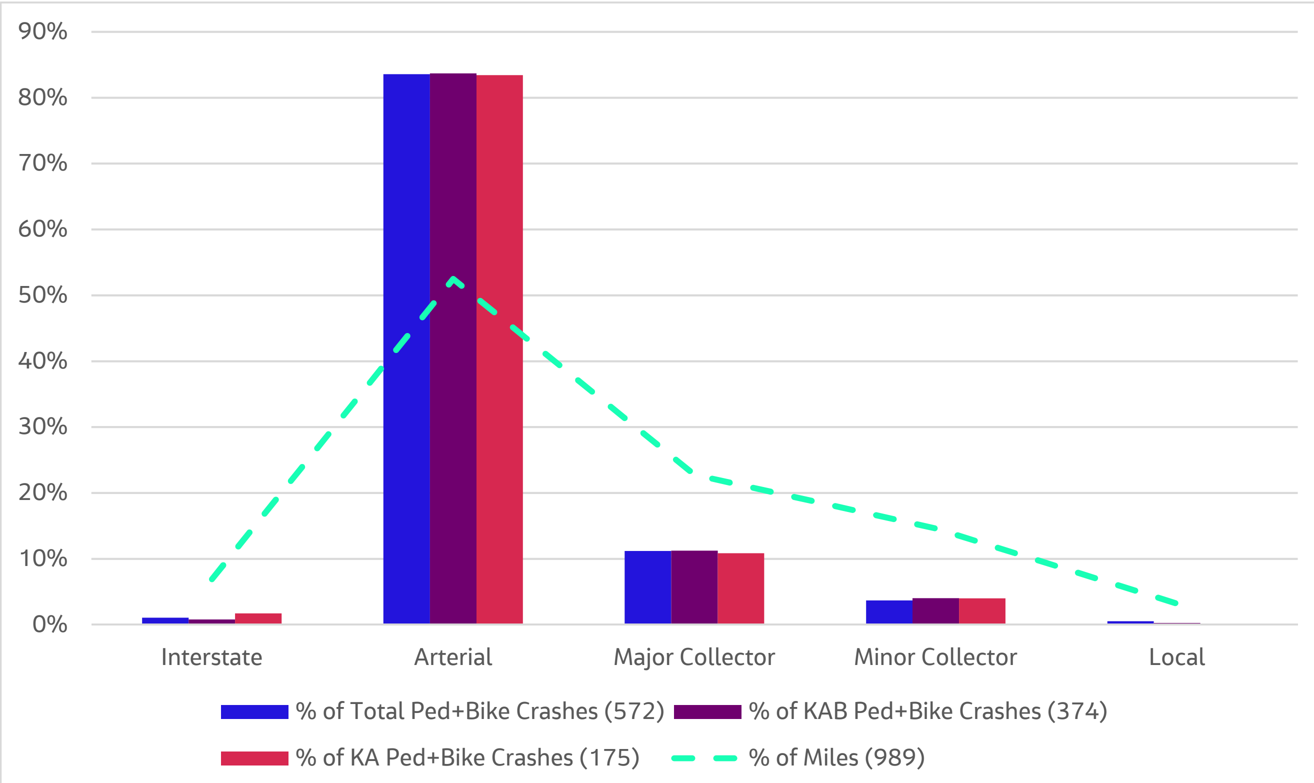

Figure 5-11. Segment Risk Factor: Functional Classification

Figure 5-12 provides a summary graph of segment risk factors. Segments that have accumulated two or more risk factors were identified to be at-risk for the potential of future severe crashes occurring. These segments account for 73 percent of the severe crashes occurring along 37 percent of the analyzed miles.

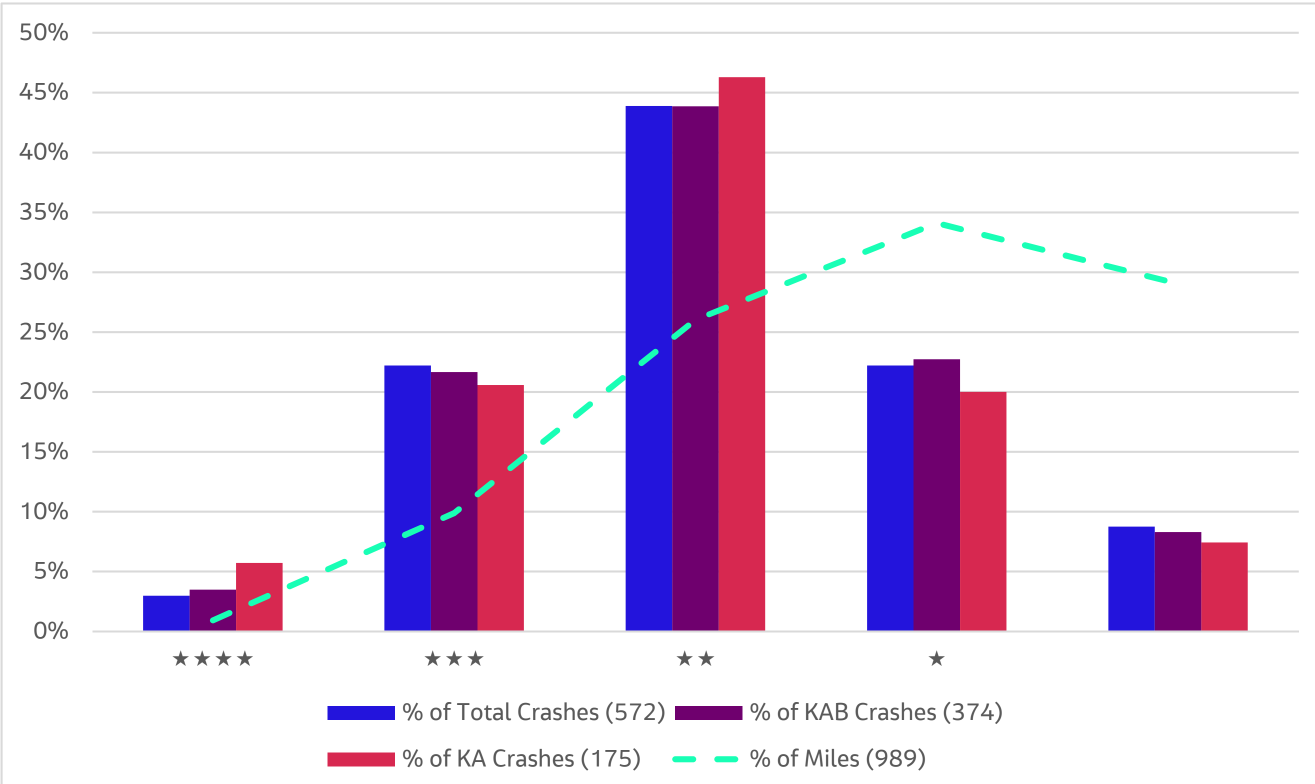

Figure 5-12. Segment Risk Factor Summary

Figure 5-13 shows the distribution of crash densities (crashes per mile per year) based on the accumulation of risk factors for the analyzed segments. Segment crash densities, measured as crashes per mile per year, are more than 11 times with 4 risk factors compared to segment crash densities with only 1 risk factor. This further illustrates why locations with two or more risk factors are the best candidates for safety investment.

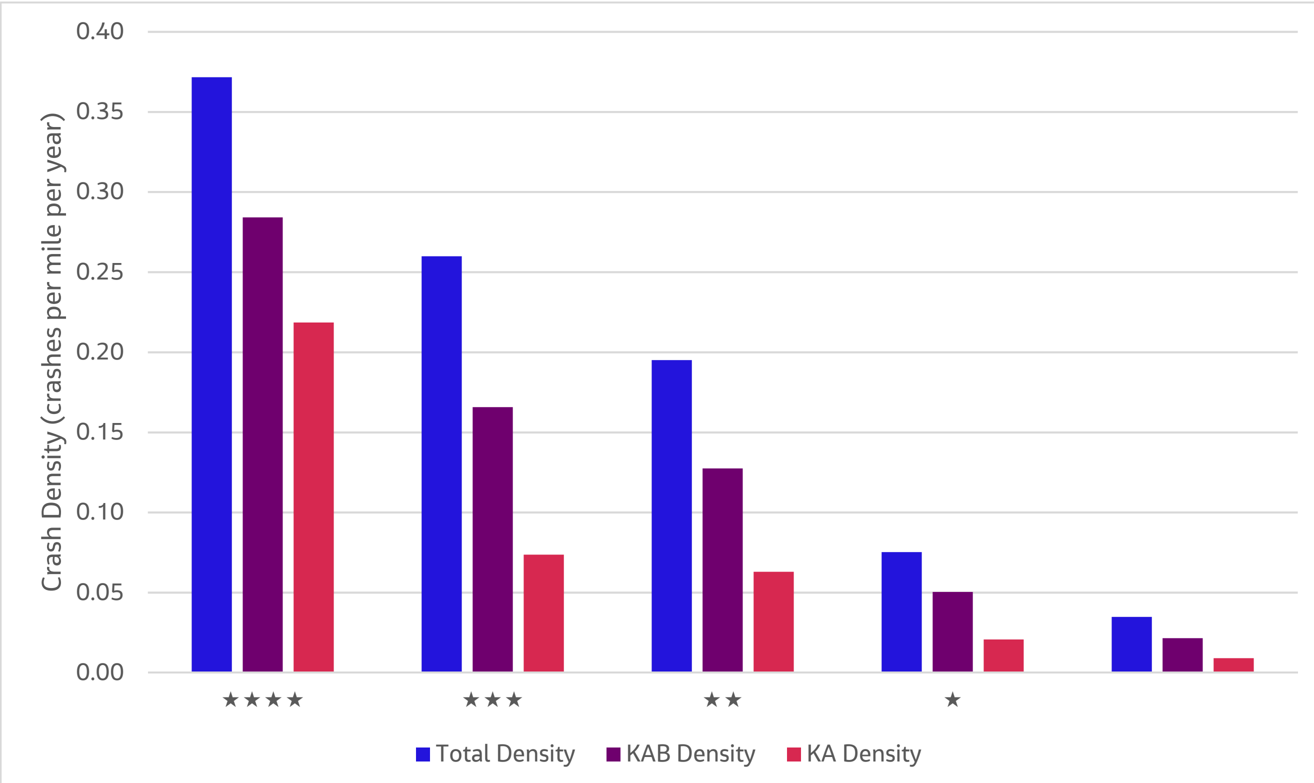

Figure 5-13. Segment Crash Density

6. Location Prioritization Methodology and Countermeasure Selection

This section describes the methodologies used to prioritize the roadway network and the selection process of proven effective countermeasures to be recommended at the prioritized locations.

6.1 Reactive Methodology

Traditional safety analyses prioritize candidate locations for safety investment by the accumulation of total crashes. High-crash locations are intersections or segments that experience a higher-than-average number of crashes compared to similar locations. Since pedestrian and bicycle crash types are much less frequent than vehicular crashes (and to align with FDOT performance measures and the Florida Strategic Highway Safety Plan Emphasis Areas) the segments and intersections were prioritized based on the accumulation of multiple severe pedestrian- and bicycle-related crashes.

6.1.1 Multi-crash Segments

There were 24 segments (approximately 26 miles) with 2 or more severe crashes. These segments accumulate 70 severe segment-related crashes, which accounts for 40 percent of the crashes; 54 percent (13 of 24) of the segments had exactly 2 severe crashes and only 3 segments averaged 1 or more severe crashes per year. There was one 0.75-mile segment along State Route 80 between New York Drive and Ortiz Avenue that had 7 severe crashes in a 5-year period.

Figure 6-1 shows the distribution of multi-crash segments.

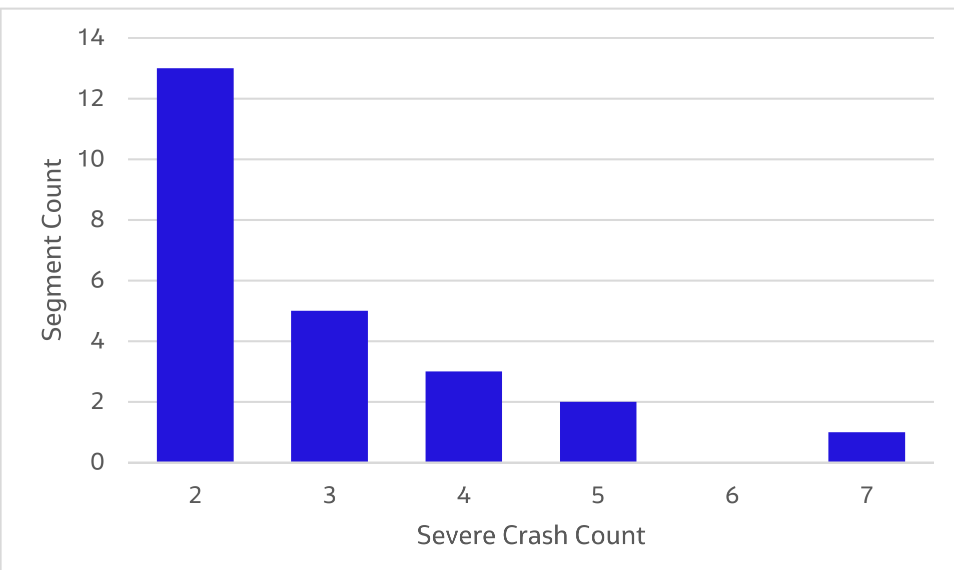

Figure 6-1. Multi-Crash Segment Distribution

6.1.2 Multi-crash Intersections

Less than 2 percent (11) of intersections have multiple severe intersection-related crashes. Each location had signalized control and had recorded exactly two severe crashes. The 22 severe crashes account for 30 percent of the severe intersection-related crashes for the analyzed network. Figure 6-2 provides a map of the multi-crash locations.

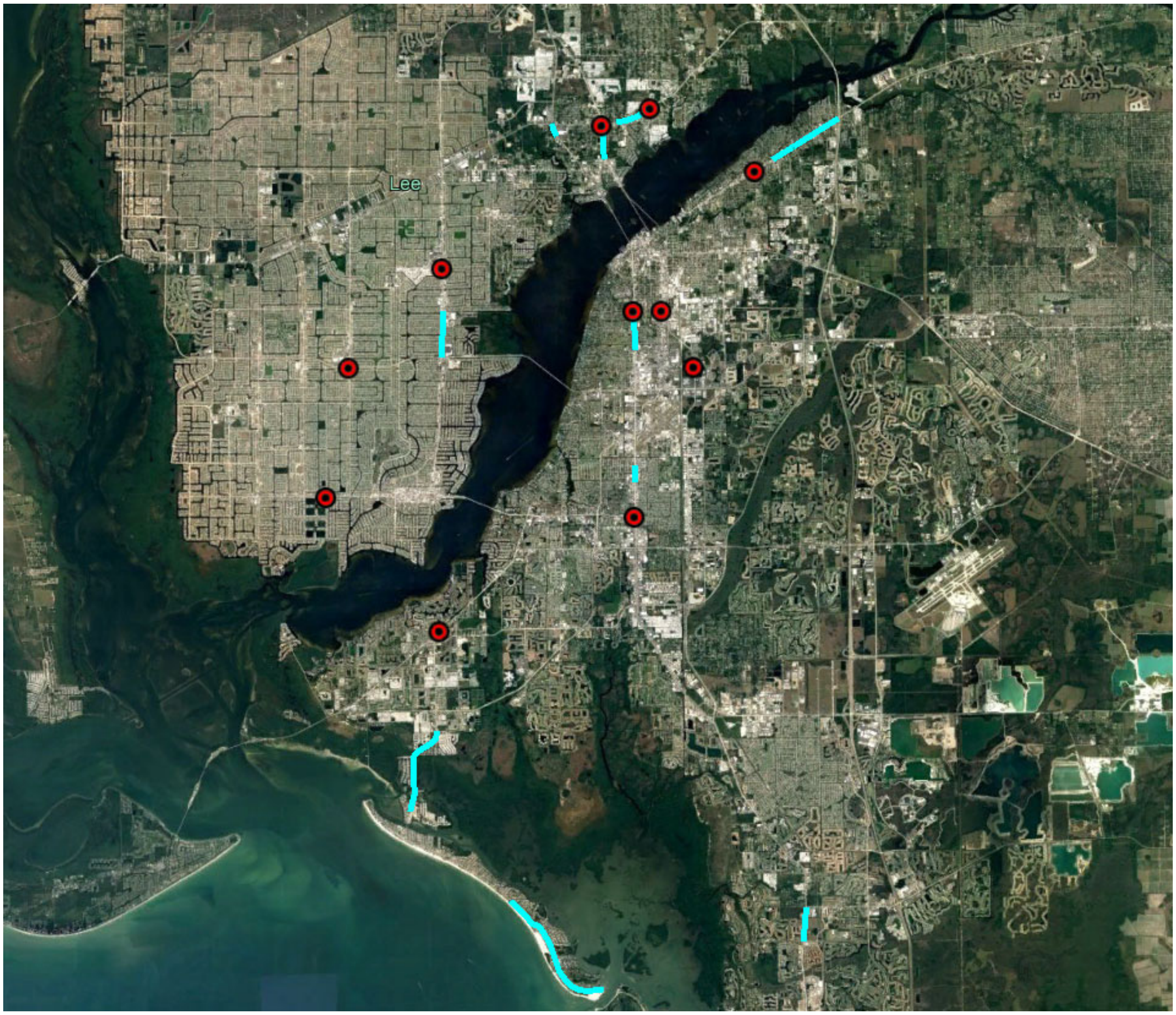

Figure 6-2. Multi-Crash Locations

6.2 Proactive Methodology

The analyzed intersection and segment networks were similarly prioritized after risk factors were determined. The highest risk-based ranking was determined based on two sequential sorting criteria – 1) accumulation of risk factors; 2) crash cost. Crash costs were determined from FDOT Design Manual (FDM) Table 122.6.2 *FDOT KABCO Crash Costs*.

6.2.1 At-Risk Prioritized Intersections

Based on the risk factor analysis, intersections with three or more risk factors are considered at-risk. Higher emphasis should be placed on the 72 (12 percent) intersections that have all 4 risk factors compared to the 144 (25 percent) intersections that have three risk factors. Table 6-1 shows the distribution of prioritized intersections. Intersection listing and prioritization summary tables can be found in Appendix A.

Table 6-1. Intersection Prioritization Summary Table

Stars	Intersection Count	Percent of Intersections	Severe Crash Count	Percent of Severe Crashes	Relative Priority
★★★★	72	12%	24	32%	High
★★★	144	25%	37	50%	At-Risk
★★	104	18%	4	5%	Low
★	175	30%	4	5%	
	85	15%	5	7%	
Total	**580**	**100%**	**74**	**100%**	

6.2.2 At-Risk Prioritized Segments

Based on the risk factor analysis, segments that had two or more risk factors are considered to be at-risk. Higher emphasis should be placed on the 107 (11 percent) miles that have 3 or more risk factors compared to the 257 (26 percent) miles that have 2 risk factors. Table 6-2 shows the distribution of prioritized segments. Segment listing and prioritization summary tables can be found in Appendix A.

Table 6-2. Segment Prioritization Summary Table

Stars	Segment Count	Percent of Segments	Sum of Miles	Percent of Miles	Severe Crash Count	Percent of Severe Crashes	Relative Priority
★★★★	10	1%	8	1%	10	6%	High
★★★	148	11%	99	10%	36	21%	
★★	373	27%	257	26%	81	46%	At-Risk
★	431	31%	337	34%	35	20%	Low
	420	30%	287	29%	13	7%	
Total	**1,382**	**100%**	**989**	**100%**	**175**	**100%**	

6.3 Countermeasure Selection

Figure 6-3 shows the initial steps taken to identify and research countermeasures from FHWA's Crash Modification Factor (CMF) Clearinghouse. Jacobs staff targeted safety improvements with CMF values between zero and one, which helps calculate the predicted number of crashes after the countermeasures has been implemented. The majority of the pedestrian and bicycle specific countermeasures shown in Figure 6-3 have a CMF range indicating that depending on which report is being referenced, the actual CMF can vary depending on existing roadway and traffic characteristics and conditions. The final list of countermeasures was reviewed and approved by Lee MPO staff and are ultimately responsible to work with the implementing agency to determine constructability. The CMF would expect a fewer number of crashes after implementation.

Crash Modification Factor Strategies Table

Focus Area	Site Location	Area Type	Control	Countermeasure	Crash Severity*	CMF Value Range	Star Rating Range	State(s) Observed	Publication Date	Prior Condition
Pedestrian	Intersection	Not Specified	Signalized	Permit Right Turn on Red	All	1.07 - 1.69	5	SC, AL	1983, 2010	A signalized intersection with prohibited right-turn-on-red operation
				Street Lighting	K	0.19	3	N/A	2004	N/A
					ABC	0.41 - 0.58	4	N/A	2004	N/A
		Urban		Leading Pedestrian Interval (LPI)	All	0.413 - 1.136	3 - 5	PA, IL, NY, NC, Toronto	2009, 2018	Signal phasing without leading pedestrian interval
					KABC	0.72 - 1.09	3 - 5	IL, NY, NC, Toronto	2018	Signal phasing without leading pedestrian interval
				Countdown Timer	All	0.3 - 0.954	3 - 4	MI, FL	2012, 2016, 2017	Intersections without pedestrian countdown signals.
					KABC	0.48 - 0.952	3 - 4	MI, FL	2016, 2017	Intersections without pedestrian countdown signals.
				All Pedestrian Phase	All	0.49 - 1.1	2	NY	2012	All pedestrian phase not present
		Rural	Thru/STOP	LED STOP Sign	All	0.585 - 0.59	3	MN	2012, 2014	Standard stop sign without LED flashers. Intersection with standard stop signs
				Street Lighting	All	0.56	3	GA	2008	Rural 2-lane intersection with no lighting
				Roundabout	All	0.17 - 4.66	3, 4	KS,MD,MN,OR, WA,WI	2012	Stop controlled intersection (3 or 4 leg). 4 leg intersection. 3 leg intersection.
	Segment	Urban	Free	Rectangular Rapid Flashing Beacon	All	0.93	3	OR	2017	Previously unmarked or at a location with prior high-visibility markings.
				Pedestrian Hybrid Beacon	All	0.30 - 0.876	3 - 5	AZ,FL,IL,MA,NY NC,OR,VA,WI	2010, 2017	No PHB or advanced yield or stop markings and signs
					KABC	0.849	3-Jan	AZ	2010	No PHB or advanced yield or stop markings and signs
				Sidewalks	All	1.78 - 1.87	3	FL	2017	No sidewalk present
Bicyclist	Intersection	All	N/A	Street Lighting	All	0.881 - 1.05	3	MN	2010, 2012	No lighting
	Segment	Not Specified	Free	Protected Bike Lane	All	0.00 - 6.667	1-2	CA,DC,FL,IL,MT, NY,OR,TX	2016	No separate bicycle lane
		Urban		Bike Lane	All	0.44 - 1.509	3	NY, FL	2012, 2016, 2017	No bicycle lane along the roadway segment. Roadway with narrower bike lane width. No bicycle lane.
					KABC	0.946 - 1.07	3	NY, FL	2012, 2016	Install bicycle lanes. Increase bike lane width.
				Shared Use Path	All	0.75	3	FL	2017	Install shared path
	Intersection		N/A	Street Lighting	All	0.648 - 1.158	3	OR, MN, FL	2008, 2012, 2016, 2017	Full lighting. Full interchange lighting. Full lineal lighting. Partial plus interchange lighting. No lighting. Illuminance ≥ 0.2 fc and < 1.1 fc.
					ABC	0.6 - 0.913	3 - 4	OR	2008	Full interchange lighting. Full lineal lighting. Partial plus interchange lighting.
		Rural		Street Lighting	All	1.07 - 1.09	3	MN	2012	No lighting
	Segment		Free	Bike Boulevard	All	0.37	3	CA	2011	No bicycle boulevards, but many traffic calming devices were preexisting.

*Crash Severity Definitions: K = Fatal Injury Related Crash, A = Incapacitating Injury Related Crash, B = Minor Injury Related Crash, C = Possible Injury Related Crash, O = Property Damage Only, All = All Severities Included

Figure 6-3. Crash Modification Factor Strategies Table

6.3.1 Intersection Countermeasures

Based on CMF Clearinghouse research and guidance provided by the Lee MPO, the following list of intersection-related countermeasures were selected for project development:

- Upgrade signal heads to include backplate with retroreflective sheeting
- Upgrade to special emphasis style crosswalk markings
- Leading Pedestrian Intervals (at signals only)
- Prohibiting Right Turn on Red by installation of Blank Out Signs (at signals only)
- Installation of R10-15 Turning Vehicles Yield to Pedestrian sign (at signals only)

6.3.2 Segment Countermeasures

Based on CMF Clearinghouse research and guidance provided by the Lee MPO, the following list of segment-related countermeasures were selected for project development:

- Upgrade Roadway Pavement Markings
- Upgrade Bike Lane Markings
- Street Lighting
- Access Management
- Rectangular Rapid Flashing Beacons (midblock treatment)
- Pedestrian Hybrid Beacons (midblock treatment)
- Pedestrian Refuge Islands (midblock or segment terminal treatment)
- Dynamic Speed Feedback Sign

7. Project Development

The following section provides an overview of the project development process. One objective throughout this effort was to focus on implementing relatively low-cost strategies that are proven to improve safety performance. High-level planning cost estimates were also developed using a combination of the Lee MPO's Long Range Cost Estimating Tool and FDOT's Basis of Estimates Manual and average historical costs.

7.1 Project Development Methodology

Two primary methodologies were used to determine countermeasures at site-specific locations. One approach used a manual site review with Google Earth and a second approach used Excel formulas and Boolean logic from criteria based on existing and supplemental data. Both methodologies were used to determine segment and intersection countermeasures at site-specific locations.

7.2 Intersection Project Development

Based on the prioritization effort, at-risk intersections (intersections that received three or four risk factors) were selected as candidate locations for safety investment. The countermeasure research and discussions with the Lee MPO staff about traffic crash report reviews and public comments received from users resulted in focusing on five intersection-related safety improvements:

- Upgrade to Special Emphasis Crosswalk Markings
- Upgrade Signal Heads with Retroreflective Backplates
- Leading Pedestrian Interval (LPI)
- Prohibit Right Turn on Red Blank Out Sign
- Turning Vehicles Yield to Pedestrian Sign (R10-15)

Identification of crosswalk markings and signal head backplate improvements required site specific review with Google Earth. The special emphasis crosswalk markings were identified based on the measured distance of existing crosswalks in Google Earth. No new crosswalks were suggested; only existing crosswalks were selected to be upgraded. For the signal hardware upgrades, the number of individual signal heads were tabulated that did not have backplates or the retroreflective sheeting, for all approaches. 144 unique intersections were identified for signal head improvements and 196 unique intersections were identified to upgrade the existing crosswalks to special emphasis styles (Table 7-1).

LPIs, blank out signs and R10-15 signs project development process underwent a more thorough review per the guidance of the Lee MPO staff. This additional review process assessed key components and recommendations from the Center for Urban Transportation Research 2017 Research Report BDV25-977-22 *Development of Statewide Guidelines for Implementing Leading Pedestrian Intervals in Florida*. The results of the additional screening process resulted in a Lee County-specific criteria for recommending LPIs and supplemental signs at signalized intersections. Of the 210 signalized intersections that were evaluated, 101 (48 percent) signalized intersections received an LPI recommendation. 51 of those signals also received a supplemental blank out sign and another 50 signals received the supplemental R10-15 sign. Additionally, another 93 intersections received only the R10-15 signs. Even though leading pedestrian intervals have been identified at a number of locations, there still needs to be a corresponding engineering review.

Of the 216 at-risk intersections, 215 locations received at least one project. The one intersection that did not receive a project was unsignalized and the surrounding area appears to be under construction. Therefore, additional review is recommended post-construction as a candidate for safety investment. The estimated costs for implementation of the five intersection countermeasures are described in Table 7-1. Intersection project summary tables and locations maps can be found in Appendix B

The research materials, established assumptions, guiding criteria and cost estimation processes for the development of intersection safety improvements can be found in Appendix C which provides more in-depth documentation.

Table 7-1. Intersection Countermeasure Summary

Countermeasure	Number of Intersections	Estimated Total Cost
Signal Head Retroreflective Backplate	144	$723,698
Special Emphasis Crosswalk Markings	196	$6,232,057
Leading Pedestrian Interval	101	Varies
No Right Turn on Red Blank Out Sign	51	$494,343
R10-15 Yield to Pedestrian Sign	143	$187,616
Total	**215[a]**	**$7,637,714**

[a] Unique Intersections receiving at least one project

7.3 Segment Project Development

Segments with two or more risk factors are considered to be at-risk of future severe crashes occurring. The segment project development process only assessed high-priority segments which are segments with three or more risk factors present. Approximately 107 miles were analyzed using various criteria based on readily available data to determine countermeasures at these locations. Appendix C provides additional in-depth details about specific data that was used to develop the criteria thresholds and Excel formulas needed to assign the following eight segment-related countermeasures to the high-priority network:

- Upgrade Pavement Markings (per mile)
- Upgrade Bike Lane Markings (per mile)
- Street Lighting (per mile)
- Access Management (per mile)
- Rectangular Rapid Flashing Beacon enhanced crosswalk (spot improvement)
- Pedestrian Hybrid Beacon (spot improvement)
- Dynamic Speed Feedback Signs (spot improvement)
- Pedestrian Refuge Islands (spot improvement)

While the initial intent was to focus on lower cost strategies, street lighting is the one exception that was made for segment related improvements due to the added safety benefits for pedestrian and bicyclists and the public comments received that rate this a high priority need. Decision criteria and supplemental data were reviewed and discussed with Lee MPO staff input. The cost estimates and Lee County-specific criteria for recommending safety improvements can also be found in Appendix C.

Approximately 21 percent (23 miles) of the high-priority miles did not receive a project. Further review at these locations may be needed to justify safety investment. Table 7-2 provides an overview of the countermeasures that were identified. Segment project summary tables and locations maps can be found in Appendix B.

Table 7-2. Segment Countermeasure Summary

Countermeasure	Number of Locations	Number of Miles	Estimated Cost
Upgrade Pavement Markings	N/A	33.8	$65,157
Upgraded Bike Lane Markings	N/A	52.62	$105,648
Rectangular Rapid Flash Beacon	34	N/A	$830,144
Pedestrian Refuge Islands	14	N/A	$162,946
Dynamic Speed Feedback Sign	19	N/A	$481,650
Pedestrian Hybrid Beacon	21	N/A	$3,957,702
Street Lighting	N/A	69.7	$30,462,594
Access Management	N/A	10.6	Varies
Total	**124**[a]	**83.92**[a]	**$36,065,841**

[a] Unique Segments/Miles receiving at least one project

7.4 Project Summary

The project development process identified 339 site-specific improvements and more than 160 miles of roadway improvements that can help mitigate severe pedestrian- and bicycle-related crashes. The total estimated implementation cost is nearly $44 million. Table 7-3 provides a summary of the project development effort.

The projects identified through this proactive process are suggestions for the Lee MPO to consider when coordinating safety improvements to stakeholder groups, standing committees or elected officials. Additionally, these projects may be eligible to compete for Highway Safety Improvement Program (HSIP) funding though District 1’s HSIP application process if the Lee MPO decides to seek additional funding opportunities.

Table 7-3. Project Summary

Countermeasure Type	Project Locations	Project Miles	Estimated Cost
Segment	124	166.7	$36,065,841
Intersection	215	N/A	$7,637,714
Total	**339**	**166.7**	**$43,703,555**

8. References

Center for Urban Transportation Research (CUTR). 2017. *BDV25-977-22 Development of Statewide Guidelines for Implementing Leading Pedestrian Intervals in Florida*. December.

Florida Department of Transportation (FDOT). *FDOT KABCO Crash Costs*. FDM Table 122.6.2. April.

Federal Highway Administration (FHWA). N.D. *Crash Modification Factors Clearinghouse*. http://www.cmfclearinghouse.org/.