Bike and Pedestrian Safety Recommendations Technical Memorandum

April 27, 2023

CITY OF ORLANDO

SOUTHWEST BIKE AND PEDESTRIAN STUDY

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FIGURES

TABLES

1.0 Introduction

The purpose of the Southwest Orlando Bike and Pedestrian Study is to identify and develop recommendations and concepts to improve conditions and the environment for people currently or desiring to walk or ride a bike safely and connect to key destinations in southwest Orlando within the city limits but generally bounded by SR 408, John Young Parkway, Sand Lake Road and Hiawassee Road. This study will build on recent planning efforts such as the Orlando Bike Plan and Vision Zero Action Plan, as well as the recently completed pedestrian and bicycle infrastructure projects. The study area has a strong economic base containing Universal Studios and the International Drive Tourist District, which rely heavily on service and entertainment workers. The area also contains Valencia College West Campus and industrial parks that use different aspects of the city's transportation network. The transportation network within the study area is served by large arterial roadways with limited transit service and an insufficient amount of bicycle and pedestrian infrastructure.

This study will address the challenges identified for bicyclists and pedestrians to establish a more comfortable environment for all modes along heavily traveled streets, as well as providing enhanced street crossing opportunities. The overall study will combine five separate, but interrelated tasks to analyze and recommend improvements that will connect people in this area of the city to jobs, schools, and entertainment uses. The five tasks are related to the following:

1. Arterial roadway crash analysis / Safety analysis
2. Valencia College West Campus bicycle and pedestrian study
3. Pedestrian and bicycle overpass locations feasibility analysis
4. Off-street trail concepts and connectivity study
5. Pedestrian walking conditions analysis / recommendations

This technical memorandum is focused on the first task listed above to address existing safety concerns to establish a more comfortable environment for bicyclists and pedestrians in the southwest Orlando area. This study builds on the recent City of Orlando Vision Zero Plan Action (VZAP) which provides a systemic approach to eliminate traffic fatalities and serious injuries within the city by 2040. The High Injury Network (HIN) in the VZAP consists of corridors and intersections where crashes are more prevalent and severe, or even result in multiple serious injuries or fatalities.

The safety analysis completed as part of this study focused on two high priority roadway segments and two high priority intersections from the HIN. Safety audits were completed to incorporate firsthand observations about challenges for bicyclists and pedestrians and help identify location-specific countermeasures and treatments. The analysis of factors such as crash type, alcohol involvement, weather and lighting conditions, crash severity, and bicyclist direction and position allowed the identification of trends and potential areas of improvement, and ultimately the recommendation of potential treatment solutions to improve the safety for bicyclists and pedestrians at the reviewed high priority locations. Treatments recommended for application at specific high priority locations should also be considered proactively at other locations across the city with similar context environments and physical configurations.

2.0 Initial Crash Location Screening

2.1 Screening and Scoring Criteria

To determine the locations for the safety audit, an initial screening of crash data from the bicycle and pedestrian focused locations in the HIN within the study area was completed. The screening criteria are shown in **Table 1** and include the total number of bicycle and pedestrian crashes in the VZAP analysis period (2012-2017), number of bicycle and pedestrian fatalities, location in a community of concern (composite equity score, taken from the Orlando Bicycle Plan Update 2020), proximity to schools (within 0.25 mile), and annual average daily traffic (AADT) volume. The scoring criteria were applied to bicycle and pedestrian focused HIN segments and intersections in **Table 2** and **Table 3**, respectively. Two high priority roadway segments and two high priority intersections from the HIN were selected to complete a more detailed assessment of the pedestrian and bicycle crash data and develop a thorough understanding of where, how, and why crashes happened. The high priority intersections and segments are shown in **Figure 1**. The selected road segments include Kirkman Road from LB McLeod Road to Conroy Road, and Ivey Lane from Malibu Street to Gore Street (also inclusive of Malibu Street from Danton Avenue to Ivey Lane). The Ivey Lane segment had a moderate score compared to other segments, but it was selected based on the crash history and the close location of communities of concern. The highest scored intersection is Kirkman Road at Conroy Road; however, this intersection is included as part of the selected Kirkman Road segment. Therefore, the selected intersections for the safety analysis include Columbia Street at Bruton Boulevard, and Conroy Road at Vineland Road.

Table 1 | High Priority Crash Location Preliminary Screening Criteria

Criteria	Value	Score
Total Number of Bike/Ped Crashes (2012-2017)	≥ 15	5
	10 to 14	4
	5 to 9	3
	2 to 4	2
	1	1
Total Number of Bike/Ped Fatalities (2012-2017)	≥ 1	5
	0	0
Composite Equity Score	≥ 4	5
	< 4	1
Within 0.25 mile of a School	Yes	5
	No	0
Average Annual Daily Traffic (AADT)	≥ 40,000	5
	25,000 to 39,999	3
	< 25,000	2

Figure 1 | Study Area & Vision Zero Bicycle and Pedestrian Focused High Injury Network

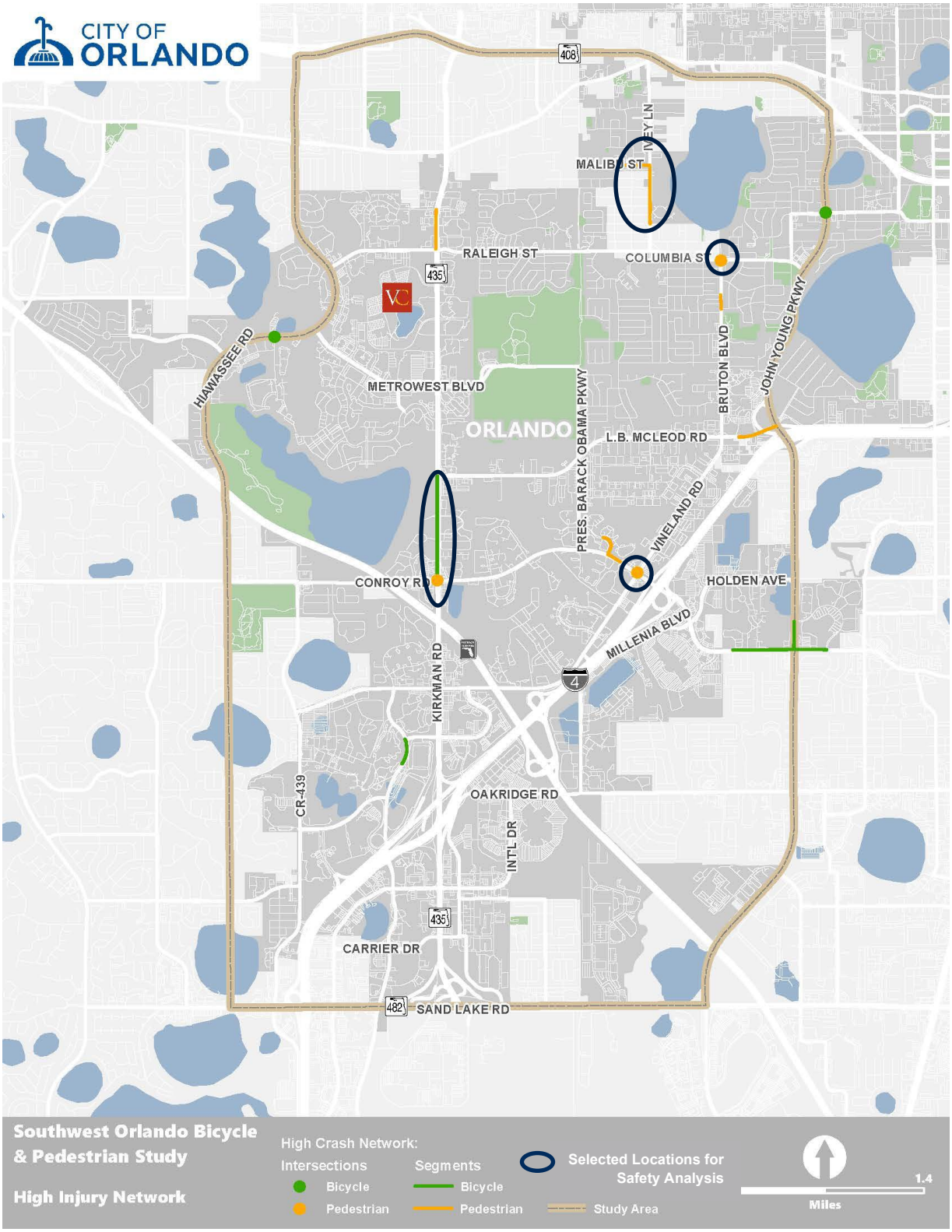


Table 2 | High Priority HIN Road Segments Initial Screening

Road	From	To	# of Ped/Bike Crashes	# of Ped/Bike Fatalities	Equity Score	Nearby School	Traffic Volume	Priority Score
Kirkman Rd	LB McLeod Rd	Conroy Rd	5	5	5	0	5	**20**
Kirkman Rd	Westgate Dr	Raleigh St	4	0	5	0	5	**14**
Conroy Rd / Cason Cove Dr	Apt. Complex Ent	Emerald Forest Way	2	0	5	0	5	**12**
LB McLeod Rd	E. of Bruton Blvd	John Young Pkwy	3	0	5	0	3	**11**
Ivey Ln / Malibu St	Danton Ave	Gore St	4	0	5	0	2	**11**
Conroy Rd / Americana Blvd	Moonglow Blvd	Grand Central Pkwy	4	0	1	0	5	**10**
John Young Pkwy	Grand Central Pkwy	Conroy Rd / Americana Blvd	3	0	1	0	5	**9**
Bruton Blvd	Cepeda St	Wells St	2	0	5	0	2	**9**
Universal Blvd	Major Blvd	Universal Valet Parking	2	0	1	0	3	**6**

High Low

Table 3 | High Priority HIN Intersections Initial Screening

Intersection	# of Ped/Bike Crashes	# of Ped/Bike Fatalities	Equity Score	Nearby School	Traffic Volume	Priority Score
Kirkman Rd at Conroy Rd	5	5	5	0	5	**20**
Columbia St at Bruton Blvd	3	0	5	5	3	**16**
Conroy Rd at Vineland Rd	3	0	5	0	5	**13**
John Young Pkwy at Orange Center Blvd	2	0	5	0	5	**12**
Hiawassee Rd at Lake Debra Dr	2	0	5	0	3	**10**

High Low

3.0 High Priority Location Characteristics

3.1 High Priority Road Segment Characteristics

Table 4 summarizes key physical and traffic operating characteristics for the selected high priority road segments. The Kirkman Road segment from LB McLeod Road to Conroy Road is a six-lane roadway with a grass planted median that transitions to a concrete median at the intersection with Conroy Road at the south end of the segment. This section of Kirkman Road has buffered bike lanes on each side of the roadway, and there is a multi-use path on the east side of the road just beyond the limits of this section, with a southern terminus at LB McLeod Road.

The Ivey Lane segment from Malibu Street to Gore Street is a four-lane roadway with center turn lane. The short section of Malibu Street that was included with Ivey Lane is a local, 25 miles per hour (mph), two-lane street with existing speed humps and sidewalks on both sides. There is only one signalized intersection along Ivey Lane at Cypress Street. Ivey Lane has sidewalks as well as conventional bike lanes on both sides of the street.

Table 4 | High Priority Road Segment Characteristics

Road Segment	Length (miles)	Number of Signals	Number of Through Lanes	Median	Traffic Volume (AADT)	Posted Speed	Sidewalks	Bicycle Facility
Kirkman Rd	0.74	2	6	Yes	55,000	50 mph	Yes	Yes
Ivey Ln / Malibu St	0.44 / 0.16	1 / 0	4 / 2	No / No	16,900 / N/A	35 mph / 25 mph	Yes / Yes	Yes / No

3.2 High Priority Intersection Characteristics

Table 5 summarizes important physical and traffic operating characteristics for the high priority intersections. At the Columbia Street and Bruton Boulevard intersection, there are six lanes to cross Columbia Street and five lanes to cross Bruton Boulevard, including turn lanes. There are sidewalks at all four approaches of the intersection and there is a dedicated bike lane along eastbound Columbia Street, west of Bruton Boulevard, although it ends prior to the eastbound right turn lane.

At the intersection of Conroy Road and Vineland Road, there are eight lanes to cross Conroy Road and there are six lanes to cross Vineland Road. In addition, each of the four corners have channelized right turn lanes with uncontrolled pedestrian crossings to a refuge island. Three of the four channelized right turn lanes operate with yield control at the intersecting street; however, the northbound right turn from Vineland Road to Conroy Road is free flow. This intersection provides sidewalks at all approaches and there is a bike lane on the north and south approaches on Vineland Road and the west approach on Conroy Road although there is no receiving bike lane on the east side of the intersection on Conroy Road.

Table 5 | High Priority Intersection Characteristics

Road Segment	Number of Lanes to Cross*	Median	Posted Speed*	Traffic Volume (AADT)*	Sidewalks	Bicycle Facility
Columbia St at Bruton Blvd	6-lanes / 5-lanes	Yes (west and south leg)	30 mph / 35 mph	18,800/ 13,200	Yes	Eastbound Columbia St (west of Bruton Blvd)
Conroy Rd at Vineland Rd	8-lanes / 6-lanes	Yes (all approaches)	35 mph / 45 mph	40,000/ 26,000	Yes	Yes

*Intersection major street/ minor street

4.0 High Priority Location Crash Analysis and Summary

4.1 Crashes and Severity

Within the selected analysis areas there were a total of 84 crashes involving bicyclists and pedestrians between 2012 and 2021. The majority of the reported crashes (nearly 60%) involved a pedestrian. The Kirkman Road segment had significantly higher reports of bicycle crashes when compared to other analysis areas as seen in **Figure 2**.

Figure 2 | Total Bicycle and Pedestrian Crashes by Location

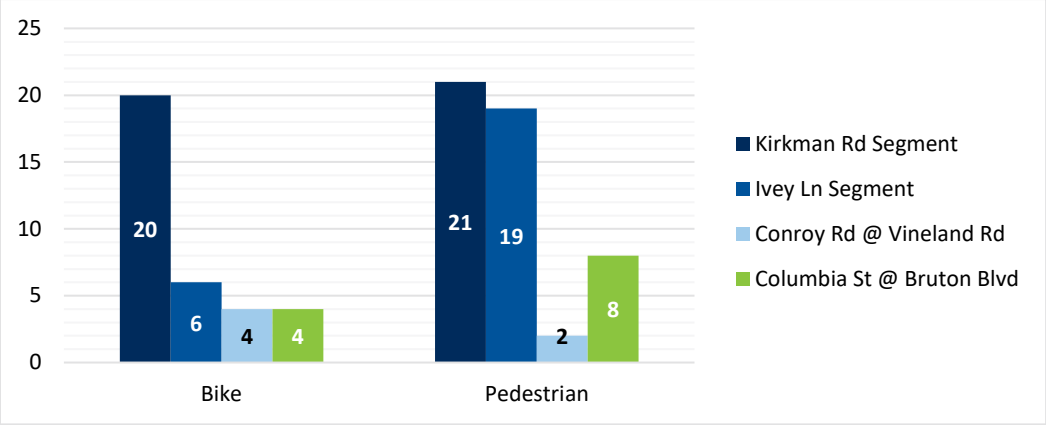
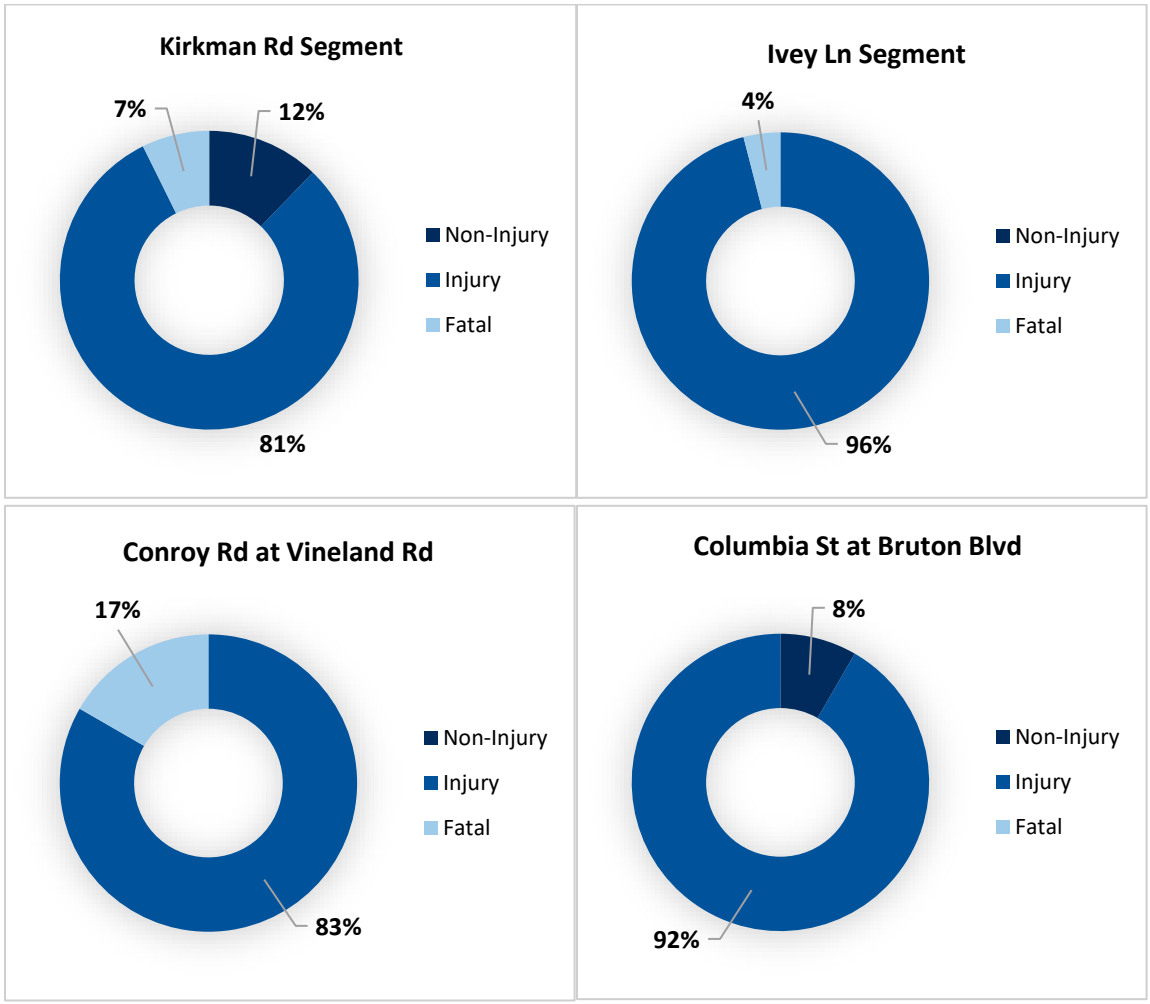


Figure 3 and **Table 6** show the distribution of crash severity by location. It should be noted that "non-injury" crashes were also classified as "property damage only". The Kirkman Road segment had the highest number of reported crashes with 33 involving injuries and three resulting in fatalities. There were 21 crashes involving pedestrians along the Kirkman Road segment, 18 of which involved injuries while two involved fatalities. There were 20 bicycle crashes with 15 involving injuries and one involving a fatality. It should be noted that the Kirkman Road segment also reported the highest number of fatalities (including both bikes and pedestrians).

Along the Ivey Lane segment there were 24 crashes involving injuries and one resulting in a fatality. Of the total crashes along this road segment, 19 involved a pedestrian with 18 of those involving injuries with one fatality. The remaining six crashes involved a bicyclist and all of them resulted in injuries.

Figure 3 | Bicycle and Pedestrian Crash Severity by Location



The intersection of Conroy Road and Vineland Road had the lowest total number of reported crashes with two involving a pedestrian and four involving a bicyclist. The one reported fatality at this intersection was a crash involving a bicyclist.

At the Columbia Street and Bruton Boulevard intersection, there were 12 crashes, eight of which involved a pedestrian and four involved a bicyclist. Seven of the pedestrian crashes and all four of the bicycle crashes included injuries. There were no reported fatalities at this location during the assessed time frame.

Table 6 also shows the crash severity distribution further broken down by type and year. The year 2013 had the highest number of total bike and pedestrian involved crashes. 2015 had the highest number of reported pedestrian crashes and 2013 had the highest number of reported bicycle crashes.

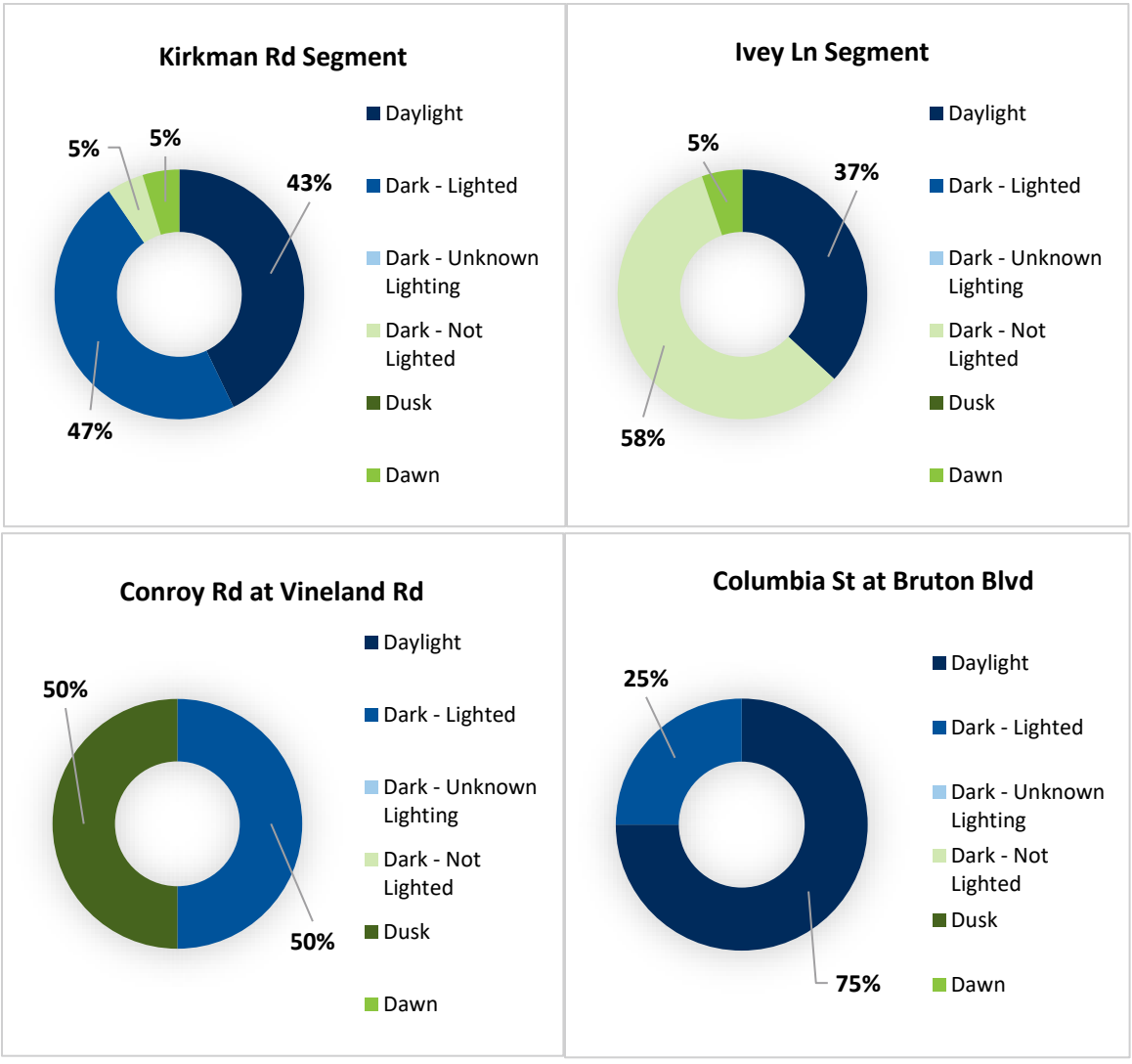
Table 6 | Crash Severity by Location Per Year

Bike/Pedestrian Crash Severity by Location Per Year													
Year	Kirkman Road Segment			Ivey Ln Road Segment			Conroy Rd at Vineland Rd Intersection			Columbia St at Bruton Blvd Intersection			Total
	Non-Injury	Injury	Fatal	Non-Injury	Injury	Fatal	Non-Injury	Injury	Fatal	Non-Injury	Injury	Fatal	
Pedestrian Crashes													
2012	-	-	-	-	4	-	-	-	-	-	1	-	**5**
2013	-	3	1	-	2	-	-	2	-	-	1	-	**9**
2014	-	4	-	-	-	-	-	-	-	1	1	-	**6**
2015	-	3	-	-	6	-	-	-	-	-	2	-	**11**
2016	-	-	-	-	2	-	-	-	-	-	-	-	**2**
2017	1	-	-	-	-	-	-	-	-	-	-	-	**1**
2018	-	1	-	-	1	-	-	-	-	-	1	-	**3**
2019	-	3	-	-	1	1	-	-	-	-	-	-	**5**
2020	-	2	1	-	1	-	-	-	-	-	1	-	**5**
2021	-	2	-	-	1	-	-	-	-	-	-	-	**3**
Total	**1**	**18**	**2**	**0**	**18**	**1**	**0**	**2**	**0**	**1**	**7**	**0**	**50**
Bike Crashes													
2012	-	1	-	-	-	-	-	-	-	-	-	-	**1**
2013	1	4	1	-	1	-	-	-	-	-	1	-	**8**
2014	-	4	-	-	1	-	-	-	-	-	-	-	**5**
2015	-	-	-	-	-	-	-	-	-	-	-	-	**0**
2016	-	1	-	-	-	-	-	1	-	-	1	-	**3**
2017	1	1	-	-	-	-	-	-	-	-	-	-	**2**
2018	-	1	-	-	2	-	-	-	-	-	1	-	**4**
2019	1	1	-	-	1	-	-	2	-	-	-	-	**5**
2020	-	1	-	-	-	-	-	-	-	-	1	-	**2**
2021	1	1	-	-	1	-	-	-	1	-	-	-	**4**
Total	**4**	**15**	**1**	**0**	**6**	**0**	**0**	**3**	**1**	**0**	**4**	**0**	**34**
Total Pedestrian & Bike Crashes													
2012	-	1	-	-	4	-	-	-	-	-	1	-	**6**
2013	1	7	2	-	3	-	-	2	-	-	2	-	**17**
2014	-	8	-	-	1	-	-	-	-	1	1	-	**11**
2015	-	3	-	-	6	-	-	-	-	-	2	-	**11**
2016	-	1	-	-	2	-	-	1	-	-	1	-	**5**
2017	2	1	-	-	-	-	-	-	-	-	-	-	**3**
2018	-	2	-	-	3	-	-	-	-	-	2	-	**7**
2019	1	4	-	-	2	1	-	2	-	-	-	-	**10**
2020	-	3	1	-	1	-	-	-	-	-	2	-	**7**
2021	1	3	-	-	2	-	-	-	1	-	-	-	**7**
Total	**5**	**33**	**3**	**0**	**24**	**1**	**0**	**5**	**1**	**1**	**11**	**0**	**84**

4.2 Contributing Causes

When analyzing crash data, it is important to look at contributing causes such as light conditions, weather conditions, and alcohol involvement. Knowing the factors that were present at the time of the crash can help to identify potential treatments later that could help minimize these factors influence on crashes in the area. Lighting conditions can impact the visibility of the bicyclist or pedestrian by a motor vehicle operator during the time of the crash. **Figure 4** shows the distribution of lighting conditions by location. The Kirkman Road segment had nearly equal reports of bicycle and pedestrian crashes that occurred during daylight (43%) and dark – lighted (47%) conditions. Along the Ivey Lane segment 58% of reported bicycle and pedestrian crashes occurred under dark – not lighted conditions which strongly indicates the need for additional lighting at this location. The Conroy Road at Vineland Road intersection had an equal distribution of crashes occurring during dark-lighted and dusk conditions while the intersection of Columbia Street and Bruton Boulevard had most crashes reported during daylight conditions.

Figure 4 | Lighting Conditions by Location



As shown in **Table 7**, weather conditions and alcohol involvement do not appear to be a major factor in the crashes reported for the analysis period. Most crashes were reported under clear conditions, while only 14% were reported under cloudy conditions and 6% were reported during rain. Alcohol also does not seem to have played a large role in the crashes with 10% of the total crashes involving alcohol. It should be noted that the Kirkman Road segment and Ivey Lane segment had the highest number of alcohol-involved crashes. Nearly 88% of all crashes involving alcohol occurred along these two road segments of the four study locations.

Table 7 | Weather Conditions and Alcohol Involvement by Location

Bike/Pedestrian Crash Type by Location Per Year					
	Kirkman Road Segment	**Ivey Ln Road Segment**	**Conroy Rd at Vineland Rd Intersection**	**Columbia St at Bruton Blvd Intersection**	**Total**
Weather Conditions					
Clear	33	19	4	11	**67**
Cloudy	5	4	2	1	**12**
Rain	3	2	-	-	**5**
Alcohol Involvement					
Alcohol Involved	4	3	-	1	**8**
Alcohol Not Involved	37	22	6	11	**76**

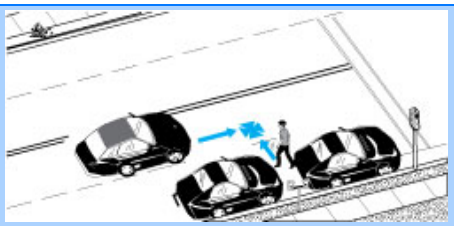
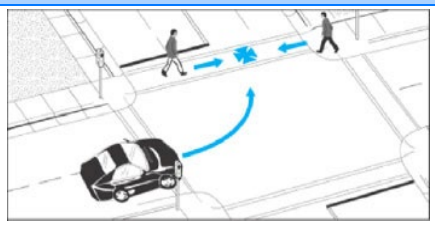
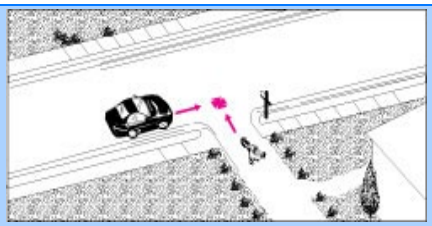
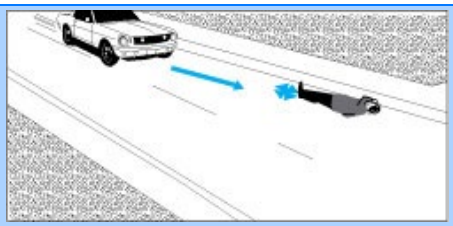
4.3 Pedestrian and Bicycle Crash Type Groups

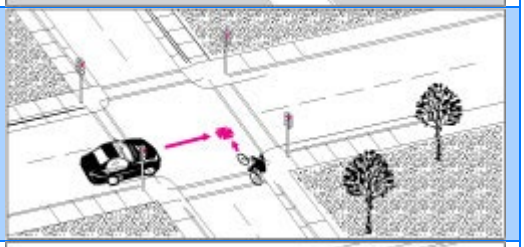
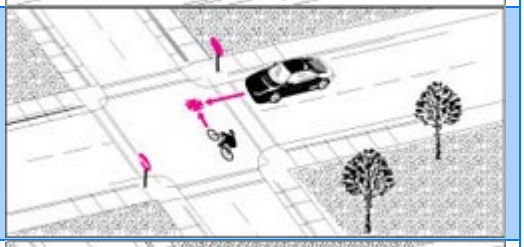
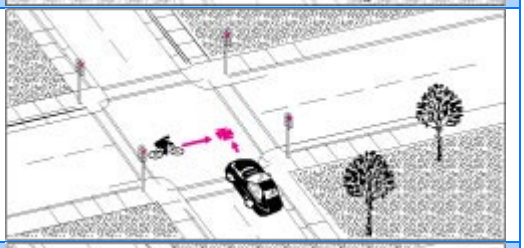
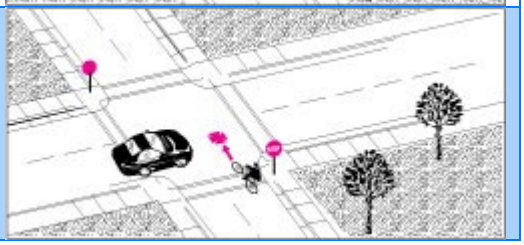
Table 8 summarizes the most common pedestrian and bicycle crash type groups at the four study locations with a breakdown of the number of pedestrian and bicycle crashes for the roadway segments and intersection. Specific countermeasures apply to each crash type or crash type group which can help mitigate that specific crash type or crash type group. Countermeasures can be found on the PEDSAFE or BIKESAFE applications/websites.

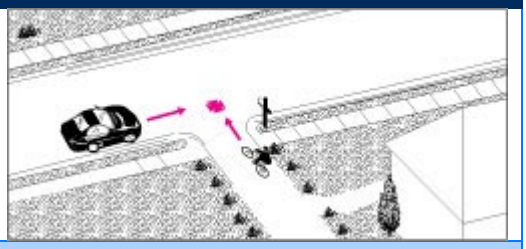
The analysis scope was to show the top five crash type groups of the pedestrian crashes and of the bicycle crashes. However, there were two pedestrian crash type groups that tied at the fifth spot with three crashes each, so the top six pedestrian type groups are presented. Those six crash type groups comprise 93% of the pedestrian crashes on the roadway segments, 70% of the pedestrian crashes at the intersections, and 88% of all pedestrian crashes. Two pedestrian crash type groups stand out with “Crossing Roadway – Vehicle not Turning” representing 35% of the pedestrian roadway segment crashes and 30% of the pedestrian intersection crashes, and “Dash/Dart-out” representing 25% of the pedestrian roadway segment crashes and 30% of the pedestrian intersection crashes.

Similarly, there were five bicycle crash type groups that tied for the third spot with three crashes each, so the top seven bicycle crash type groups are presented. Those seven crash type groups comprise 81% of the bicycle crashes on roadway segments and 75% of the bicycle crashes at intersections. The most prevalent type of bicycle crash on roadway segments was “Motorist Failed to Yield – Midblock” (31%) and the two most prevalent type of bicycle crash at intersections were “Bicyclist Failed to Yield – Signalized Intersection” (38%) and “Motorist Failed to Yield – Signalized Intersection” (25%).

Table 8 | Most Common Pedestrian and Bicycle Crash Type Groups by Location

Crash Type Group	Road Segment Crashes		Intersection Crashes		All Crashes		Illustration
Pedestrian Crashes							
Crossing Roadway – Vehicle Not Turning	14	35%	3	30%	17	34%	
Dash/ Dart-Out	10	25%	2	20%	12	24%	
Crossing Roadway – Vehicle Turning	5	13%	0	0%	5	10%	
Unusual Circumstances	3	8%	1	10%	4	8%	
Off Roadway	3	8%	0	0%	3	6%	
Pedestrian in Roadway – Circumstances Unknown	2	5%	1	10%	3	6%	
Top Six Pedestrian Crash Type Groups	**37**	**93%**	**7**	**70%**	**44**	**88%**	

Crash Type Group	Road Segment Crashes		Intersection Crashes		All Crashes		Illustration
Bike Crashes							
Motorist Failed to Yield – Midblock	8	31%	0	0%	8	24%	
Bicyclist Failed to Yield – Signalized Intersection	1	4%	3	38%	4	12%	
Motorist Overtaking Bicyclist	3	12%	0	0%	3	9%	
Motorist Failed to Yield – Sign Controlled Intersection	3	12%	0	0%	3	9%	
Motorist Failed to Yield – Signalized Intersection	1	4%	2	25%	3	9%	
Bicyclist Failed to Yield – Sign Controlled Intersection	3	12%	0	0%	3	9%	

Crash Type Group	Road Segment Crashes		Intersection Crashes		All Crashes		Illustration
Bicyclist Failed to Yield – Midblock	2	8%	1	13%	3	9%	
Top Seven Bicycle Crash Type Groups	**21**	**81%**	6	**75%**	**27**	**79%**	

Source: Signal Four Analytics

4.3.1 Pedestrian Crashes

Figure 5 shows all pedestrian crash type groups reported for crashes that occurred for the four study locations. Crashes have been grouped with similar crash types. As shown, the vast majority of pedestrian crashes (74%) involve roadway crossings of some form.

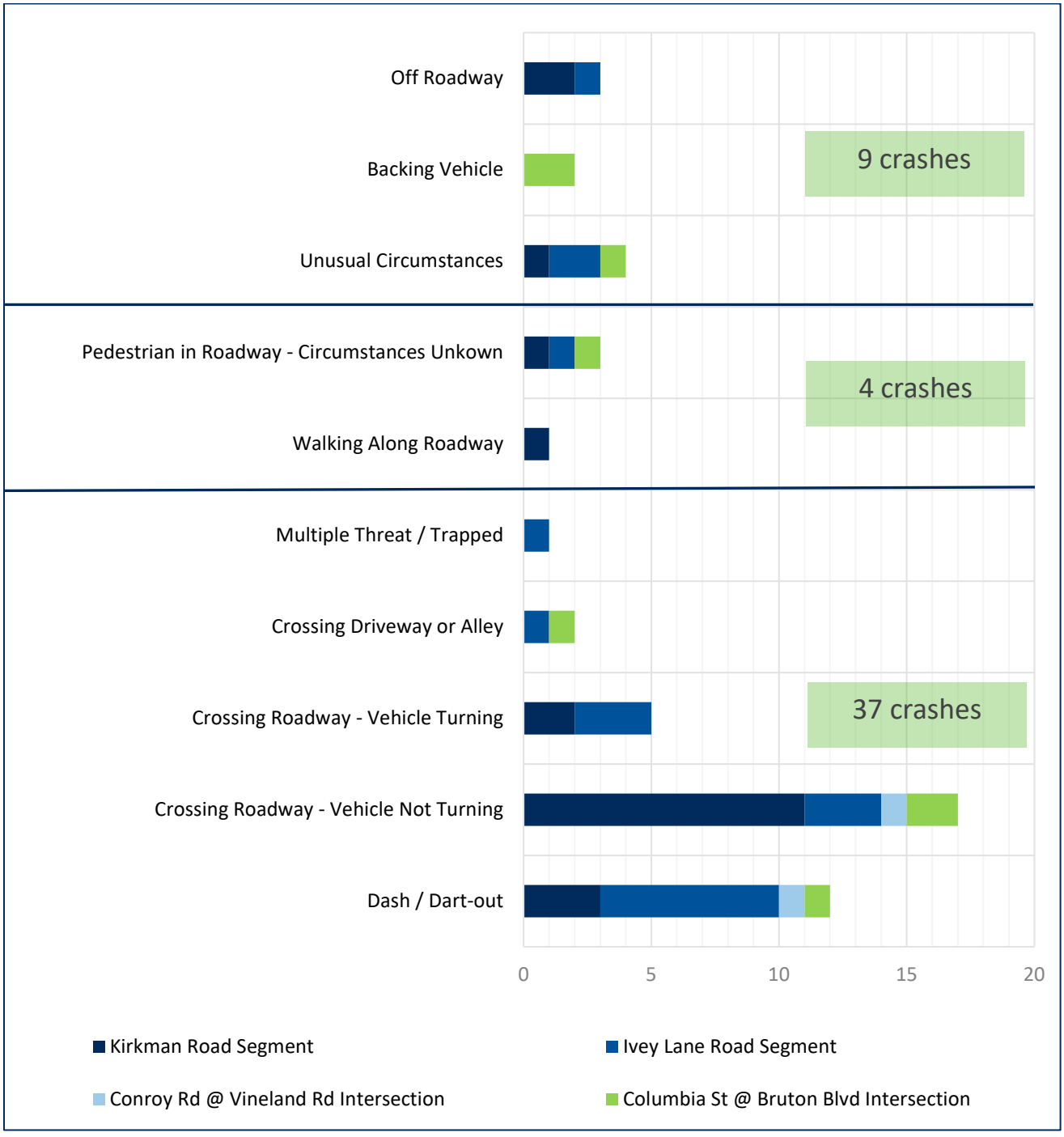
Along the Kirkman Road segment, "Crossing Roadway – Vehicle Not Turning" was the most reported crash type group at 11 out of 21 total crashes, or 52%, followed by "Dash/Dart-Out" which was reported in three of the 21, or 14%, of the pedestrian crashes on this segment.

Along the Ivey Lane segment, "Dash/Dart-Out" was the most reported crash type group at seven out of 19, or 37%, of the reported pedestrian crashes. The second most common crash type group was "Crossing Roadway – Vehicle Not Turning," and "Crossing Roadway – Vehicle Turning" each being reported three times, or 16% each, of the pedestrian crash types along this segment.

At the intersection of Conroy Road and Vineland Road, there were only two reported pedestrian-involved crashes. One crash each was reported as "Dash/Dart-Out" and "Crossing Roadway – Vehicle Not Turning."

Pedestrian-involved crashes at the intersection of Columbia Street and Bruton Boulevard were relatively evenly spread with respect to crash type groups. "Crossing Roadway – Vehicle Not Turning" and "Backing Vehicle" were the most reported at two times each of the eight pedestrian crashes at this location (25%).

Figure 5 | Pedestrian Crash Type Group



4.3.2 Bicycle Crashes

Figure 6 shows all bicycle crash type groups reported for crashes that occurred for the four study locations. As shown, 19 of the bicycle crashes (56%) were related to motorist actions, 10 (29%) were related to bicycle actions, and five (15%) were related to other circumstances.

With respect to bicycle crashes along the Kirkman Road segment, eight (40%) were "Motorist Failed to Yield - Midblock." "Bicyclist Failed to Yield – Sign Controlled Intersection" was the second most reported crash type group, making up three, or 15% of the reported bicycle crashes on this segment. Along the Ivey Lane segment, "Motorist Overtaking Bicyclist," "Motorist Failed to Yield – Sign Controlled Intersection," and "Bicyclist Failed to Yield – Midblock" were each reported two times (33%). The intersection of Conroy Road and Vineland Road had an equal distribution of bicycle crash type groups. "Crossing Paths – Other Circumstances," "Loss of Control/Turning Error," "Motorist Failed to Yield – Signalized Intersection," and "Bicyclist Failed to Yield – Signalized Intersection" were each reported once or 25% of the time. Finally, at the intersection of Columbia Street and Bruton Boulevard, the most reported crash type group was "Bicyclist Failed to Yield – Signalized Intersection" being reported in two, or 50% of the bicycle-involved crashes.

Figure 7, Figure 8, Figure 9, and Figure 10 show pedestrian and bicycle crashes by location and are color coded to represent the type of the crash. Along the Kirkman Road segment, there is a cluster of pedestrian crashes near the Pine Shadows Condominiums all with the crash type of "Dash/Dart-Out." Along the Ivey Lane segment, there is a high concentration of pedestrian crashes near the Liquor Master Liquor Store, the majority of which have a reported crash type of "Dash/Dart-Out." Looking at the two pedestrian crashes at the intersection of Conroy Road and Vineland Road, one crash occurred in the crosswalk on the western side of the intersection and the other occurred at the exit to the parking lot of the gas station. Most the pedestrian-involved crashes at the intersection of Columbia Street and Bruton Boulevard occurred within a crosswalk, with the remaining being concentrated to the parking lot of the plaza in the northwest corner of the intersection.

This crash type information was used as a reference by the multimodal safety audit team prior to and during the field audits. Many of the recommendations identified in Section 5 of this report are intended to address prominent crash types at the respective locations.

Figure 6 | Bicycle Crash Type Group

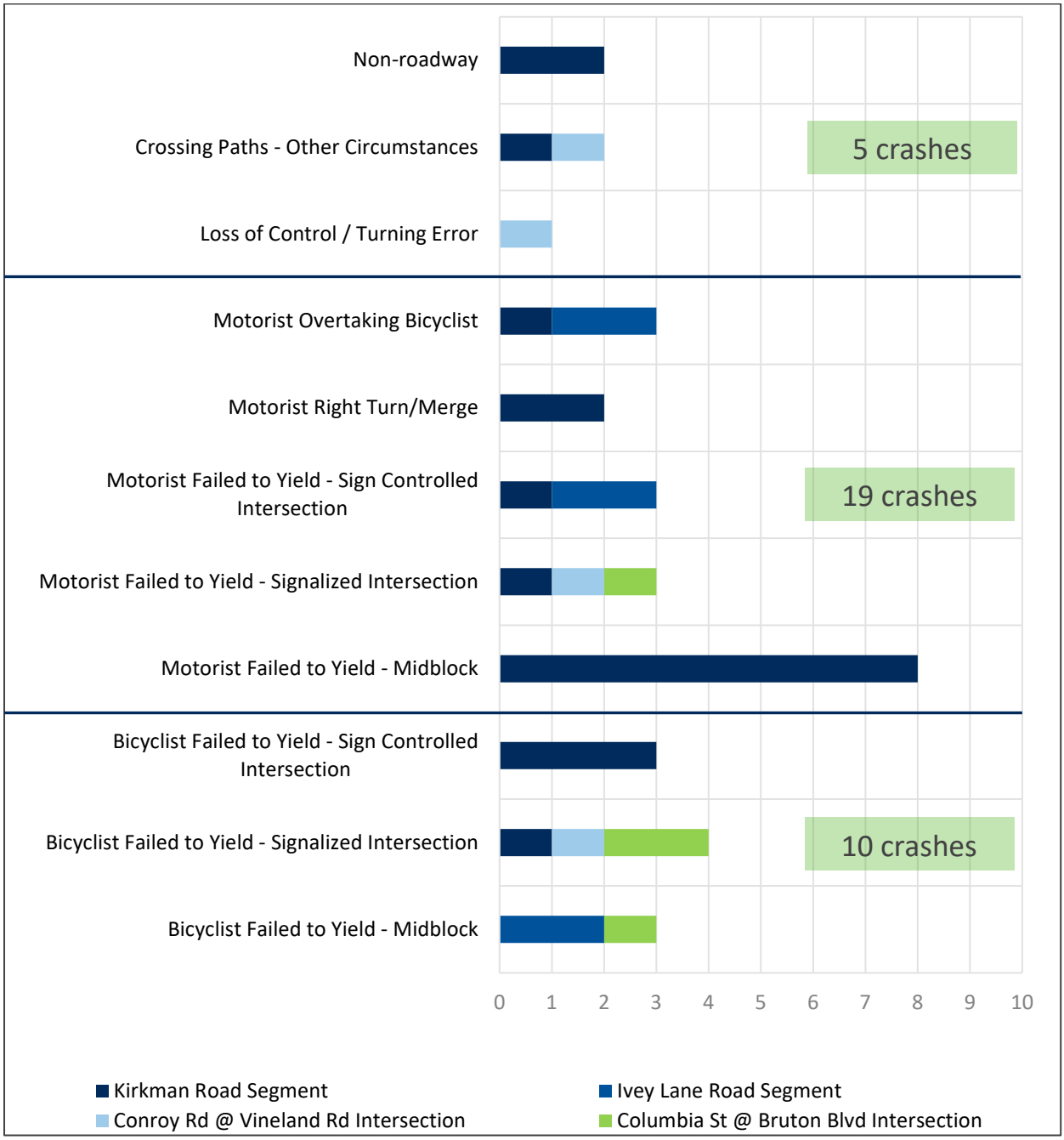


Figure 7 | Bicycle and Pedestrian Crashes along Kirkman Road from LB McLeod Road to Conroy Road (2012-2021)

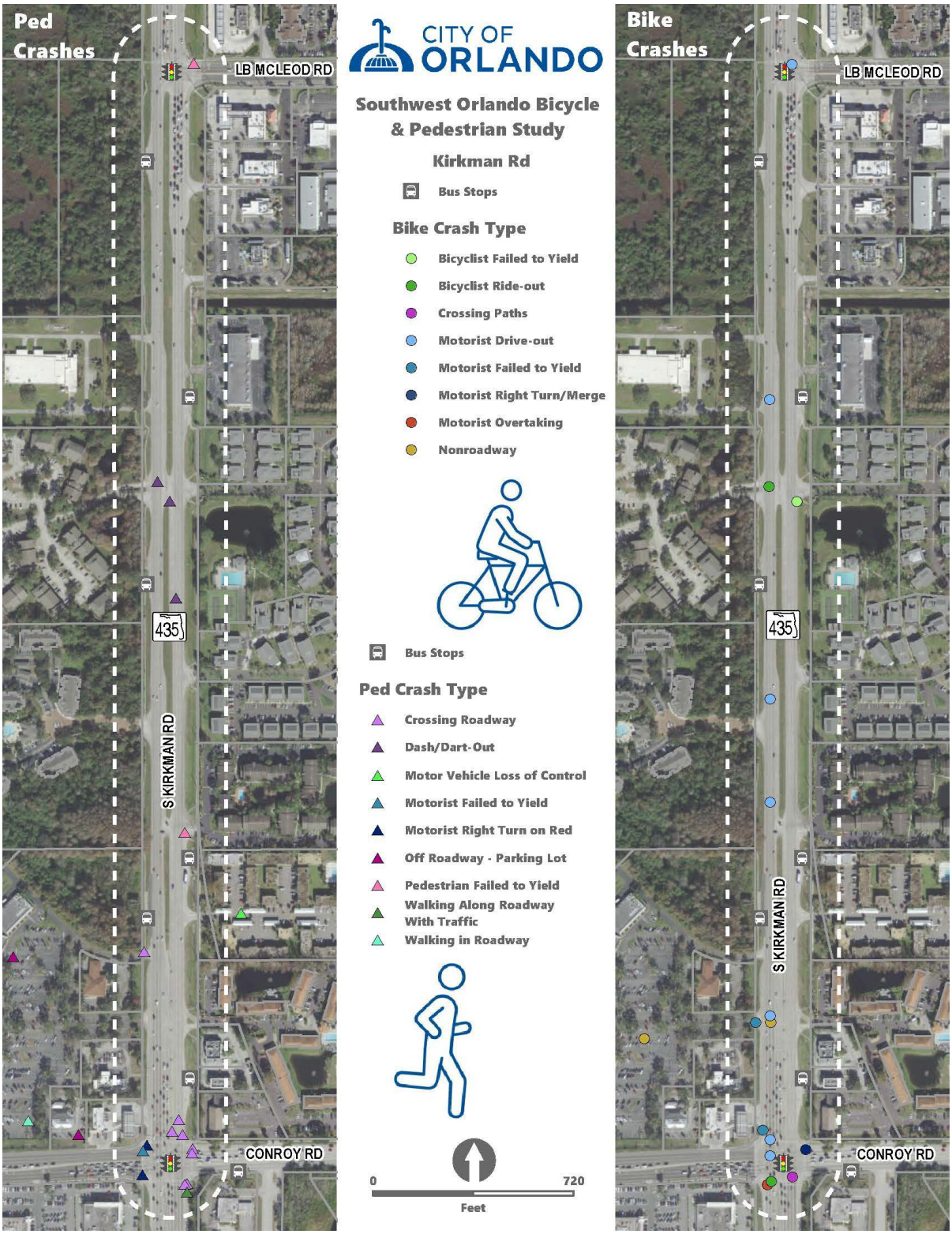


Figure 8 | Bicycle and Pedestrian Crashes Along Ivey Lane/Malibu Street from Danton Avenue to Gore Street (2012-2021)

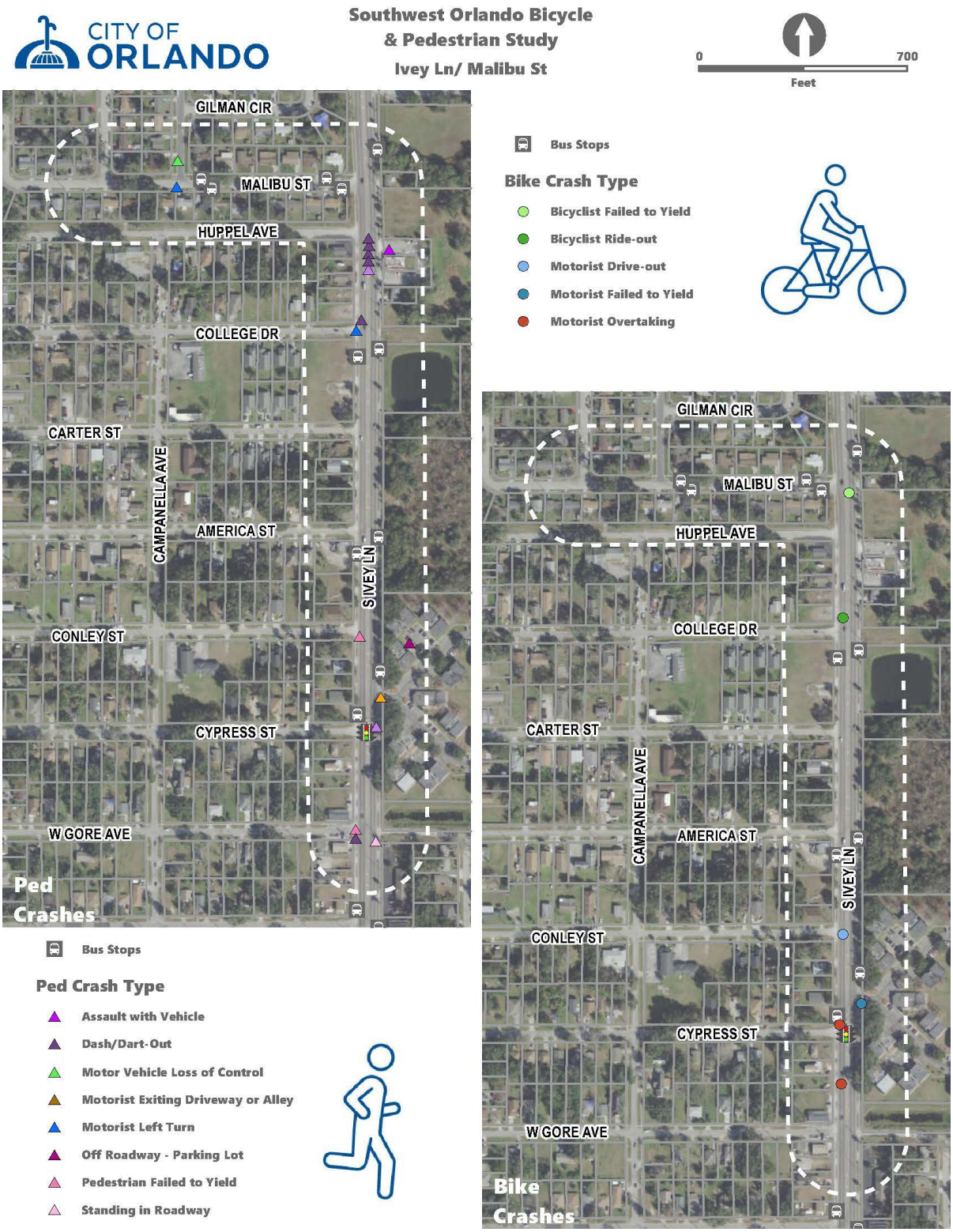


Figure 9 | Bicycle and Pedestrian Crashes at the Intersection of Conroy Road and Vineland Road (2012-2021)

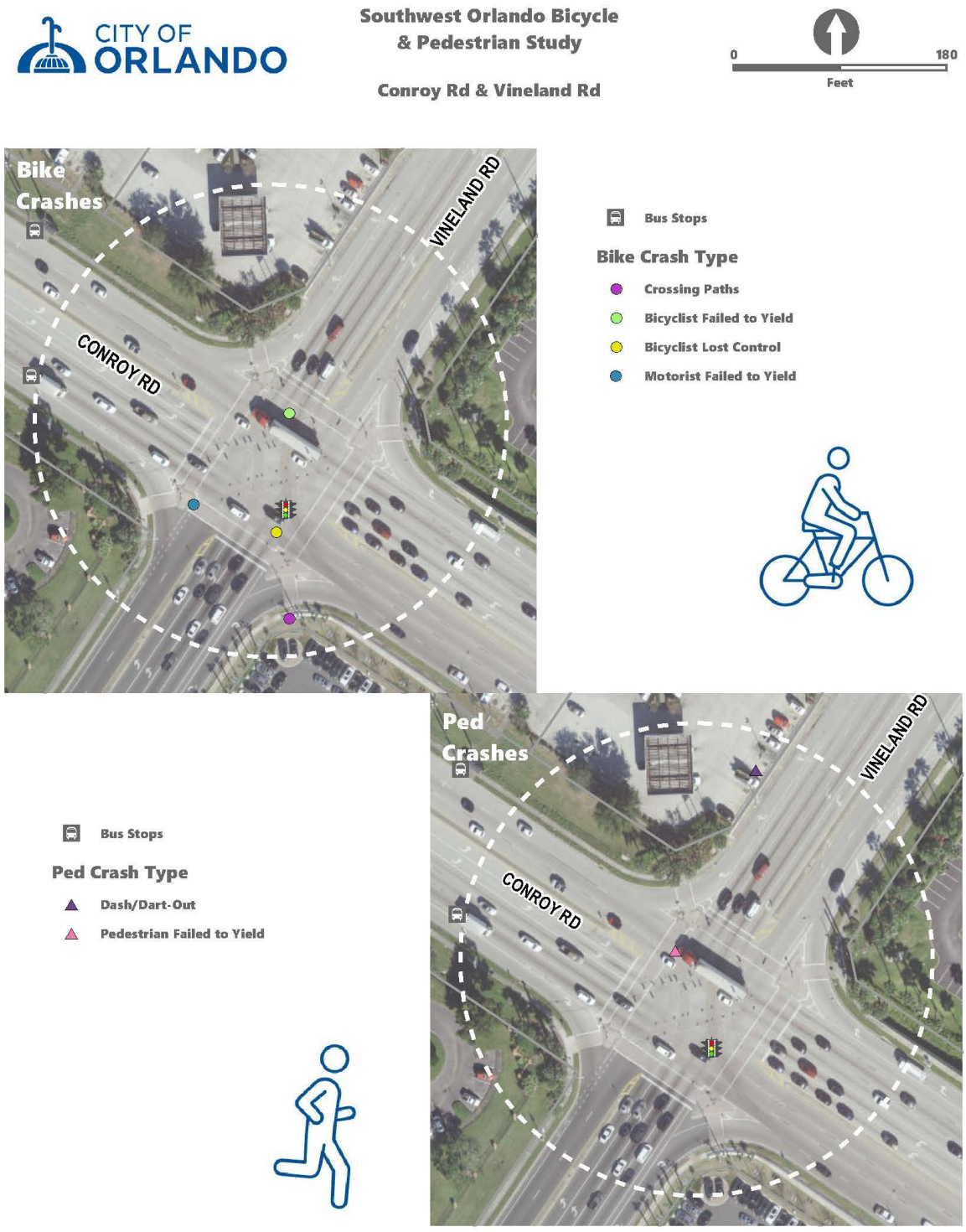
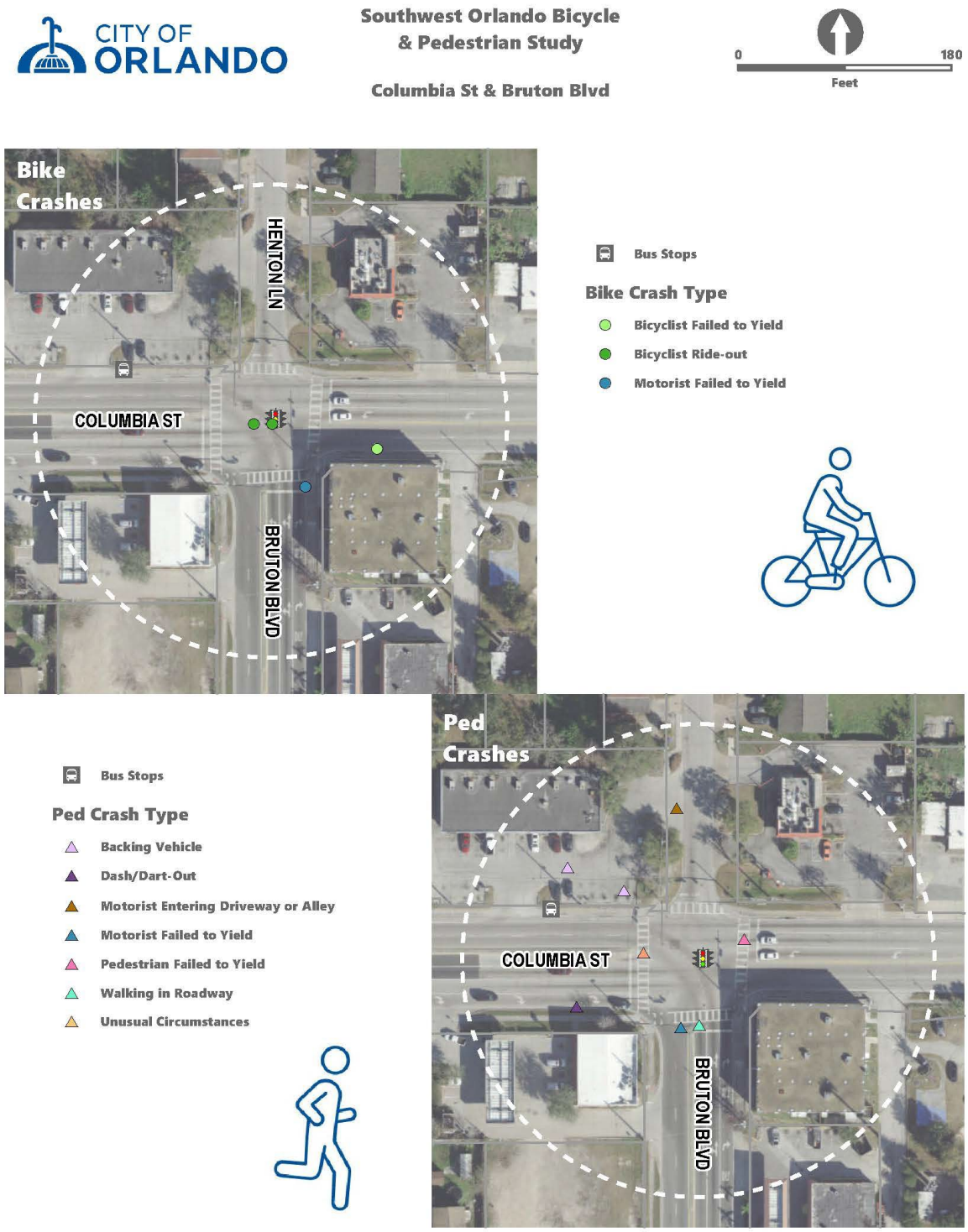


Figure 10 | Bicycle and Pedestrian Crashes at the Intersection of Columbia Street and Bruton Boulevard (2012-2021)



4.4 Bicycle Position and Direction

Bicycle position refers to the location of the bicycle at the time of the crash. The analysis of crash data indicates that bike crashes occurred in one of three locations: (1) on a roadway in a bicycle lane or on a paved shoulder, (2) on a roadway in a shared travel lane or, (3) on a sidewalk, crosswalk, or driveway crossing. It should be noted that there is also a fourth category included in **Figure 11** which shows the bicyclist position at the time of the crash, called "Unidentified/Unknown." This is due to the fact that portions of the data were missing in the crash reports. Any crash in which the bicycle position was not identified is represented by this category.

The Kirkman Road segment had 14 bicycle crashes with a known bicycle position. Nine of these crashes occurred with the bicyclist on a sidewalk, crosswalk, or driveway crossing; four occurred with the bicyclist on the roadway in a shared travel lane; and one occurred with the bicyclist on the roadway, in a bicycle lane or on a paved shoulder. Six crashes along this road segment had an "Unidentified/ Unknown" bicycle crash position. Only two of the six bicycle crashes on the Ivey Lane segment had a reported bicycle position at the time of the crash. Both were reported to have the bicyclist travelling on a roadway in a shared travel lane.

At the intersection of Conroy Road and Vineland Road only one crash involving a bicycle was reported with a known position (on a sidewalk, crosswalk, or driveway crossing). Similarly, only two of the four crashes at the intersection of Columbia Street and Bruton Boulevard had a reported bicycle position. Both of these crashes had a reported bicycle position of on a sidewalk, crosswalk, or driveway alley.

Bicycle direction indicates the direction of travel of the bicyclist at the time of the crash. "Facing Traffic" indicates that the bicyclist was traveling in the direction opposite of adjacent motor vehicle traffic. "With Traffic" indicates that the bicyclist was travelling in the same direction as the adjacent motor vehicle traffic. As mentioned above, portions of the data collected were incomplete for this section of the analysis. As such, an additional category of "Unidentified/Unknown" was created to capture these bicycle crashes.

Figure 12 shows the breakdown of bicyclist direction at the time of crash. The Kirkman Road segment had seven of the reported 20 crashes with the bicyclist facing traffic, and five with the bicycling travelling with traffic. The one crash along the Ivey Lane segment with a known direction was travelling with traffic. For both intersection locations, the crashes with known bicyclist direction were facing traffic. Looking at the reported bicyclist position for all crashes in the study area, in 10, or nearly 30%, the bicyclist was travelling facing traffic.

Figure 11 | Bicycle Position by Location

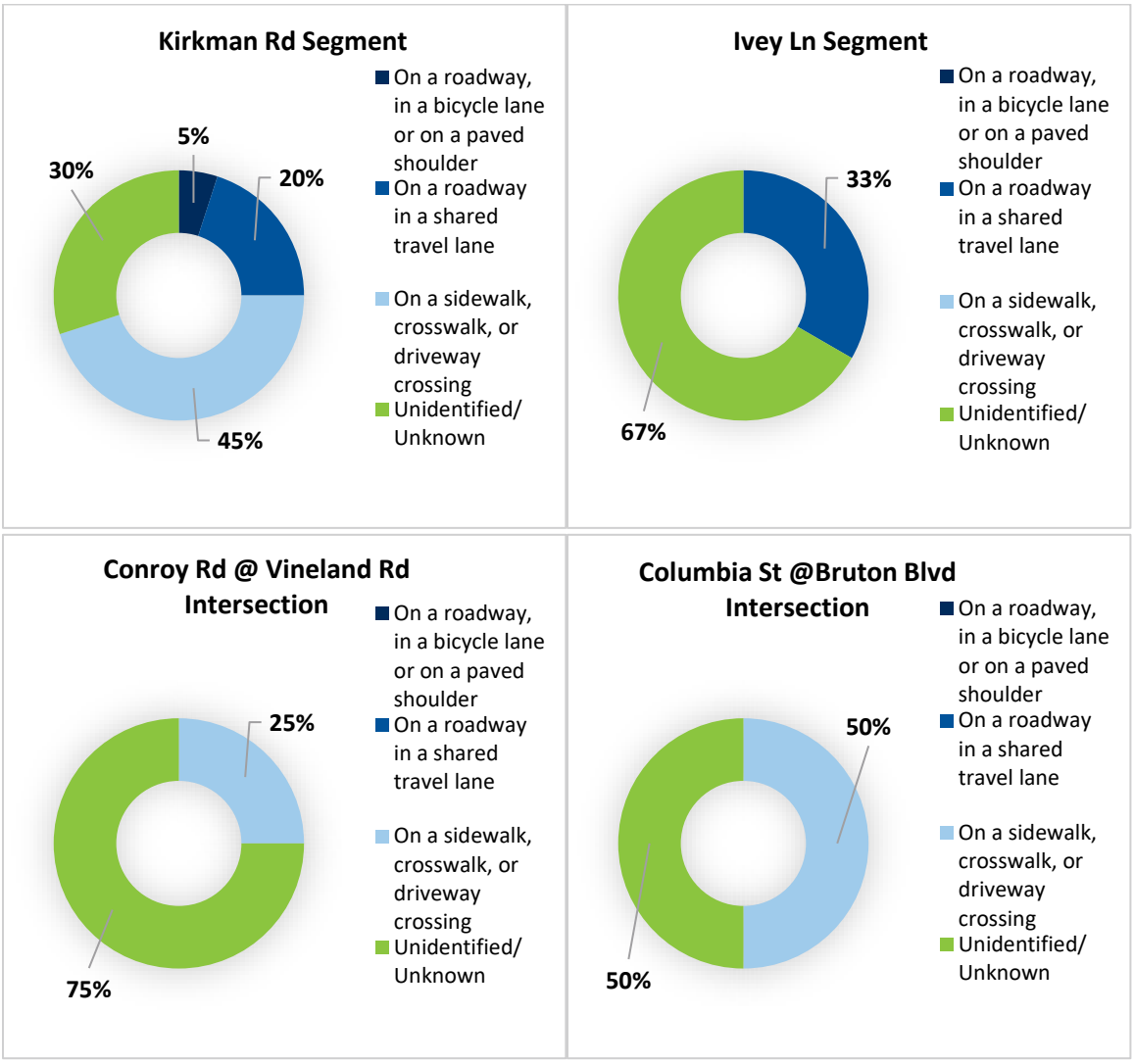
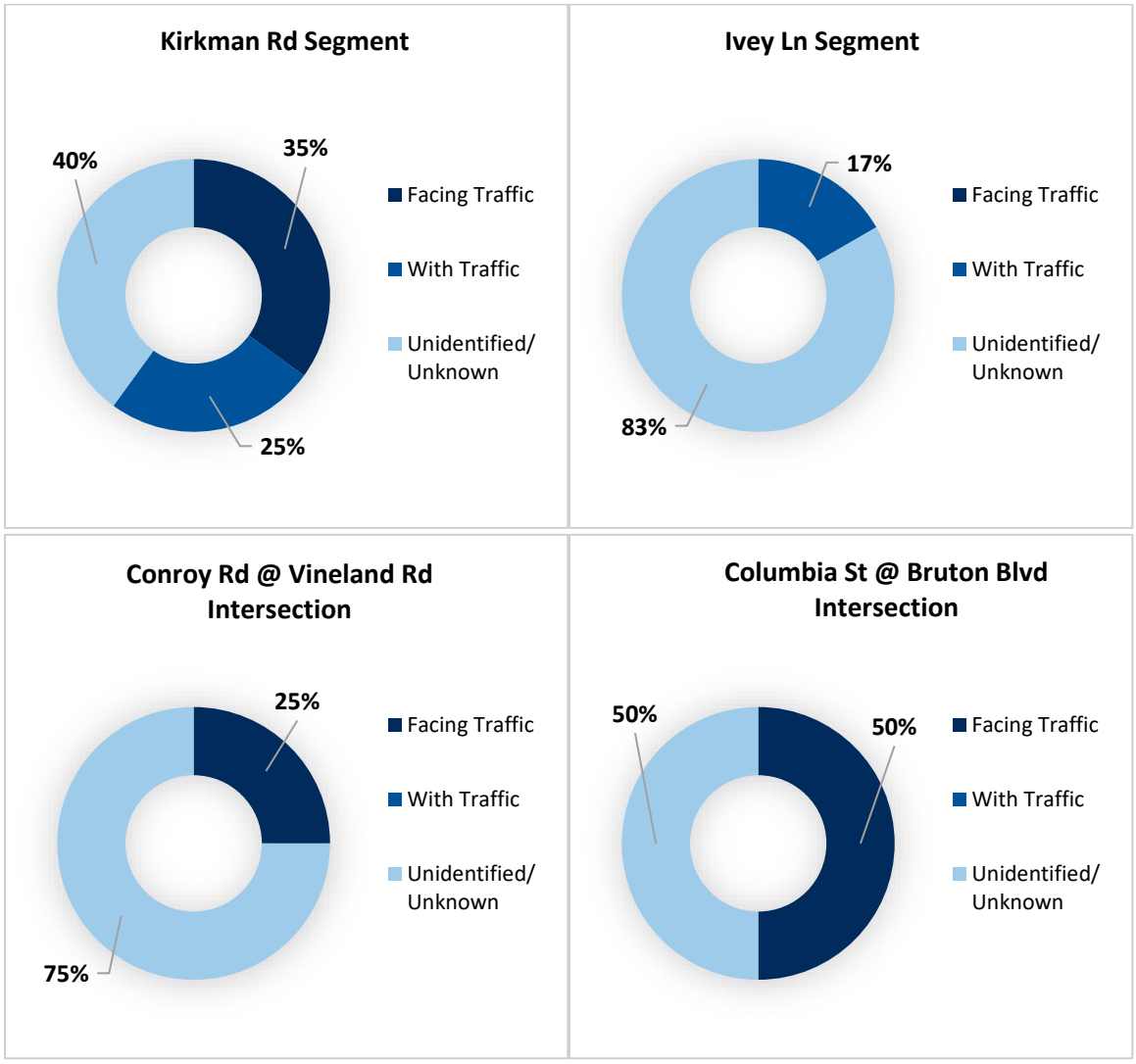


Figure 12 | Bicycle Direction by Location



5.0 Multimodal Safety Audits and Proposed Recommendations

The safety analysis culminated in field-based multimodal safety audits conducted for the identified high-priority roadway segments and intersections. These audits were conducted in January 2022 over the course of two days. Participants included staff from the City of Orlando and regional transportation agency partners, community representatives, and members of the project consulting team. The range of participants, identified in the list below, allowed for a diverse set of perspectives and experiences with the audit locations.

Laura Hardwicke, City of Orlando
Jenn Rhodes, City of Orlando
Yaminel Reyes-Albino, City of Orlando
Vishal Patel, City of Orlando
Officer Jason Stewart, Orlando Police Department (OPD)
Cody Johnson, LYNX
Paul Schoelzel, Florida Department of Transportation (FDOT) District Five
Mighk Wilson, MetroPlan Orlando
Ric DyLiacco, Orlando Utilities Commission (OUC)
Sarah Riseden, OUC
Cynthia Harris, citizen
Mary Maxwell, citizen
Meyette Chenault, citizen
Barbara Frazier, citizen
Jamie Krzeminski, HDR
Austin Britt, HDR
Peyton McLeod, PGA
Jonathan Jones, PGA

Safety Audit team members meeting prior conducting the safety audit of Ivey Lane.

The safety audit process identified numerous barriers to safe and comfortable walking, bicycling, and access to transit, along with associated recommendations to improve those conditions. These recommendations are described in the following sections for each of the four audit locations. While accessibility for all users was considered and some related recommendations have been identified, these audits do not constitute a formal Americans with Disabilities Act (ADA) assessment.

5.1 Ivey Lane/Malibu Street (Gore Street to Danton Avenue)

Ivey Lane between Gore Street and Malibu Street has a five-lane typical section including a continuous two-way left turn lane. Multimodal facilities consist of four-foot bike lanes and five-foot sidewalks separated from the roadway by a four-foot buffer. Malibu Street is a two-lane residential roadway with buffered sidewalks and no designated bicycle facilities. Ivey Lane's configuration and general operating characteristics (straight, wide, low signal density, and abundant roadway capacity) are conducive to creating an environment in which motorists drive well above the posted speed limit

of 35 mph – handheld radar observations during the audit indicated a typical speed range of 40-50 mph. Combined with abundant walking and bicycling activity and limited controlled crossing opportunities, this context creates a setting consistent with the observed high crash frequency. Many of the audit findings and recommendations relate to these conditions and opportunities to make modifications that mitigate common crash types.

5.1.1 Lane Repurposing

The AADT along this segment of Ivey Lane is 18,500 according to 2021 data from Florida Traffic Online, although Orange County reports a lower volume of 14,745 in 2022. Based on existing traffic volumes, low density of traffic signals, nominal side street traffic, and concerns about vehicle speeds and safety, Ivey Lane is a strong candidate for lane repurposing, which involves a redistribution of the existing space on a roadway to better meet the needs of a community. It is recommended that the City conduct a design project for the corridor to reduce the number of through lanes to one in each direction with center turn lane / median. While neither community opposition nor roadway operational issues are anticipated with such a modification, the design phase should incorporate community engagement and capacity analysis as early components of the project. With the opportunity for reallocating the existing pavement space, the following components should be considered during the design:

- Install a raised median that provides a pedestrian crossing refuge
- Add street trees in the new median or along the roadside to provide shade, create a sense of enclosure that slows traffic speeds, and generally provide a more aesthetically pleasing environment
- Install curb extensions, mini-traffic circles, or roundabouts at select intersections to calm traffic
- Create wider buffered or separated bike lanes that offer additional separation from motor vehicle traffic

5.1.2 Identify Locations for Enhanced Crossings

Rectangular Rapid Flashing Beacons (RRFBs) are increasingly common treatment for mid-block and unsignalized intersection roadway crossings. They are user-activated traffic devices placed on both sides of the roadway that alert motorists to an active crossing. RRFBs typically significantly improve motorist yielding rates, in some cases to above 90 percent. The FDOT *Traffic Engineering Manual* indicates that RRFBs would be appropriate on a 35 mph, five-lane roadway as long as a raised median or refuge island is provided.

The City of Orlando has already identified two locations along Ivey Lane for installation of RRFBs and developed design plans that also include raised pedestrian refuges: south of Gore Street (just outside the audit study limits) and south of College Drive. The City should move forward with these installations and consider additional locations for similar treatments.

Pedestrian Hybrid Beacons (PHBs) are specialized overhead signal and signs that are used to warn and control traffic at unsignalized locations and to assist bicyclists crossing a street or highway at a marked crosswalk. The *Manual on Uniform Traffic Control Devices* includes guidance for traffic and

pedestrian volumes that warrant installation of PHBs. The City should consider conducting a more detailed crossing study to identify locations where PHBs may be warranted.

5.1.3 Lighting Improvements

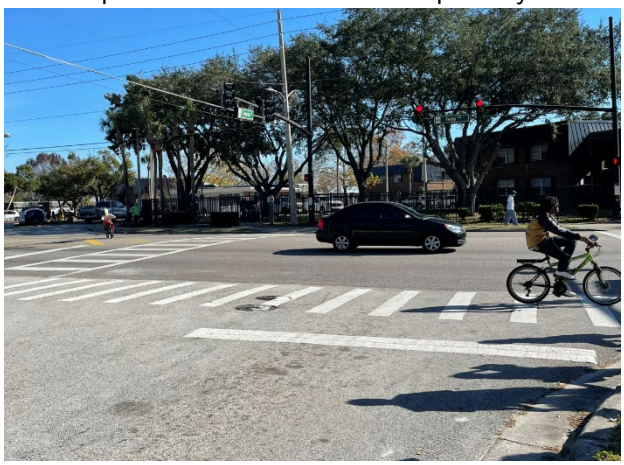
Multiple opportunities for enhanced lighting along the corridor were noted by audit participants. Following the audits, and based on initial field observations, OUC performed a photometric study and developed a detailed set of lighting-related recommendations. These recommendations include improvements at every intersection between Gore Street and Huppel Avenue and consist of installing new LED fixtures, poles, and cables. The recommendations from the study can be found in the graphics provided in Appendix A and are summarized below:

- Replace seven existing 250-watt light fixtures with 400-watt fixtures adjacent to Ivey Lane northbound
- Install one 250-watt light fixture adjacent to Ivey Lane northbound
- Install seven 250-watt light fixtures adjacent to Ivey Lane southbound
- Install one 100-watt light fixture along Malibu Street westbound

5.1.4 Cypress Street Signalized Intersection Improvements and Potential Relocation

The intersection of Ivey Lane and Cypress Street is the only signalized intersection along the corridor. The audit team identified several short-term improvements to this intersection that would enhance conditions for nonmotorized users:

- The pedestrian pushbutton at the southwest corner of the intersection is located too far from the intersection corner. This discourages use of the pushbutton and should be addressed. This improvement would be especially useful given the observed signal timing that almost immediately grants the WALK phase for those crossing Ivey Lane who instead must wait through a lengthy signal cycle if the pushbutton is not used.
- Currently, the WALK phase is only activated when the pushbutton is activated. Especially considering the crossing volumes at the intersection, the WALK phase should be placed on automatic recall such that it is activated during every signal cycle.
- Orientation signs associated with pedestrian pushbuttons are mislabeled and should be corrected.
- Installing a raised intersection would calm traffic and create a safer, slower-speed environment for those crossing.
- The side street (Cypress Street) green phase was observed to occur only when a motorist approaches Ivey Lane from the west. Given the very low side street volumes observed, this leads to long cycles which



Pedestrian crossing against traffic at intersection of Cypress Street and Ivey Lane.

can be problematic for pedestrians and bicyclists. To ensure that bicyclists crossing Ivey Lane receive a green phase, bicycle detection should be added, via either signal-mounted video detection or pavement loops geared toward detecting bicyclists, along with signing indicating where bicyclists should position themselves to be detected.
- Existing curb ramps are not ADA-compliant and should be updated.

While the presence of this signalized intersection creates a rare opportunity for controlled crossings of Ivey Lane, multiple considerations indicate that there may be a more appropriate alternative location along the corridor for a traffic signal.

First, the existing signal is offset from the Ivey on the Lake Apartment Homes driveway. These apartments generate significant pedestrian and bicycle activity, but most residents were observed to cross either perpendicular to the driveway or diagonally, not making use of the intersection crosswalks. The close intersection-driveway proximity also creates potentially unsafe motor vehicle turning movements for motorists as turns occur within the functional area of the intersection.

Secondly, observed traffic volumes on Cypress Street are very low, even relative to other side streets along the corridor. As a mid-term recommendation, the City should consider relocating this signal to a different side street farther north that has a higher volume, avoids the apartment complex driveway issues, and would be more evenly spaced between the next signals to the north and south (Old Winter Garden Road and Raleigh Street/Columbia Street, respectively). Analysis provided by MetroPlan Orlando based on StreetLight Data metrics indicates that a signal at either Carter Street or Malibu Street would serve approximately twice as many side street motorists as the existing Cypress Street signal. This potential improvement should be coordinated with the previously recommended study of potential locations for RRFBs and/or PHBs. If the signal is relocated, crossing features, such as a pedestrian refuge island and RRFBs, should be considered on the north leg of the Cypress Street intersection to help people cross to and from the adjacent LYNX bus stops.

5.1.5 Miscellaneous Recommendations

The audit team also identified several miscellaneous recommendations for the corridor. These are summarized below:

- Consider narrowing or eliminating the grass buffer between the roadway and the sidewalk to create sidewalk widths similar to those found in the MetroWest development (typically seven feet)
- Refresh pavement markings, particularly bike lane symbols
- Consider green pavement markings for bike lanes at key motorist-bicyclist conflict points
- Trim overgrown vegetation and repair broken sidewalks along the Malibu Street portion of the corridor

Cracked and separated sidewalk along Ivey Lane.

- Install curb ramps at the Malibu Street intersections with Danton Avenue and Fanfair Avenue

5.2 Kirkman Road (Conroy Road to L B McLeod Road)

Kirkman Road between Conroy Road and L B McLeod Road is a six-lane principal arterial with buffered bike lanes and widely separated (up to 60 feet) sidewalks. The posted speed limit is 50 mph and the FDOT context classification is C3C (Suburban Commercial). With 2020 daily traffic volumes above 70,000, this segment of Kirkman Road is the most heavily traveled road in this study's roadway network. While basic pedestrian and bicycle facility accommodation is provided along this FDOT-maintained roadway in the form of sidewalks and recently striped buffered bike lanes, the volume and speed of motor vehicles create an uncomfortable environment for bicyclists and pedestrians, as shown in the study's Pedestrian Level of Service evaluation. Audit participants noted a general impression of an auto-focused corridor in which other users are made to feel de-emphasized and like an afterthought. The recommendations below are intended to help achieve a better modal equity and to enhance the dignity of those traveling by bike or on foot.

5.2.1 Shared Use Path Extension

In 2020, a 10-foot-wide shared use path was constructed along the east side of Kirkman Road immediately north of this segment, extending approximately 1.6 miles from L B McLeod Road to Raleigh Street and connecting to the Shingle Creek Trail network. The typical roadway section and drainage features in the area of the newly constructed path are very similar to those found south of L B McLeod Road. Many people will not feel comfortable biking in the buffered bike lane. Extending the shared use path to the south would provide an alternative option for those users.

5.2.2 Identify Locations for Enhanced Crossings

Opportunities for controlled crossings of Kirkman Road are very limited, with no such crossings present between the segment's two boundary intersections. People frequently cross midblock or at unmarked, uncontrolled intersections along this section of Kirkman Road, and several crashes associated with these types of movements have occurred. Because RRFBs are inappropriate for a high-speed, six-lane roadway, options for enhanced crossings are limited to PHBs and full signalization. Most observed mid-block crossings are generated by the multi-family residential developments on both sides of Kirkman Road. This fact suggests that any controlled crossing would be most beneficial at driveways, which further eliminates PHBs as an alternative in accordance with the FDOT *Traffic Engineering Manual* and concerns related to PHBs controlling side street turning movements.

Pedestrians crossing midblock, against traffic.

While analysis provided by MetroPlan Orlando based on StreetLight Data metrics indicates somewhat higher pedestrian activity levels near the southern end of the corridor, several considerations led the audit team to identify the four-way intersection of Kirkman Road with the northern driveway of the Pine Shadows (east side) and Hidden Lake (west side) properties as the most likely candidate for a potential signal: 1) the greatest number of observed crossing-related pedestrian and bicycle crashes along the corridor, 2) location near the midpoint between the signals at Conroy Road and L B McLeod Road, 3) status as the only four-leg intersection among the two existing median openings, and 4) the potential to also mitigate significant observed motor vehicle crashes. Though this intersection would not be expected to meet traditional signal warrants based on traffic volumes, the potential safety benefits of signalization suggest that a signalization study be performed.

5.2.3 Transit Stop Amenities

There are six bus stops within the corridor serving four LYNX bus routes, including two routes that operate with 30-minute headways. Until 2020, all six stops included benches and trash receptacles, and three also had covered shelters. As part of recent roadway improvements that included lengthening bus boarding and alighting areas, all bus stop amenities were removed except for one shelter. During the safety audit, numerous passengers were observed either standing or using makeshift items such as an overturned newspaper stand to create a place to sit. At a minimum, previously existing amenities should be restored, and additional amenities (e.g., shelters, bike racks, and system information signing) should be considered.

LYNX riders using an overturned newspaper stand for seating at bus stop on Kirkman Road.

5.2.4 Conroy Road Signalized Intersection Improvements

The intersection of Kirkman Road and Conroy Road is a major signalized intersection at the south end of the corridor with crossing widths ranging from seven to nine lanes of traffic. Several recommendations were identified to enhance crossing safety and comfort:

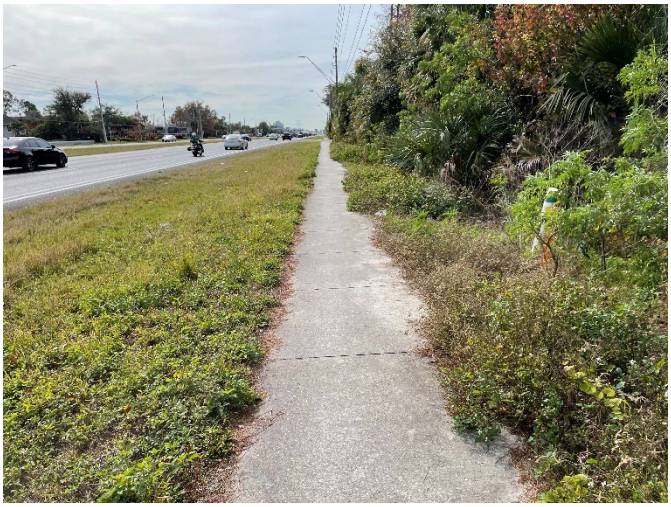
- The turning radii at all four intersection corners are large, which encourages high-speed right turns and lengthens crossing distances. Tightening these radii would mitigate both of these considerations. The use of mountable truck aprons can be considered if smaller corners would affect the operating needs of larger design vehicles.
- Observed signal cycle lengths exceed four minutes, even in off-peak periods. This can lead to exceedingly long delays for pedestrians and discourages pedestrian signal compliance. Opportunities to shorten the cycle length should be explored.
- Within the existing signal timing plan, which includes long green phases for north-south traffic, pedestrian WALK intervals should be maximized. Currently, the pedestrian clearance interval for north-south crossings begins approximately 15 seconds earlier than needed,

which unnecessarily increases the likelihood that pedestrians will encounter delay at the intersection.

- The "Turning Vehicles Yield to Pedestrians" sign at the southwest corner is located directly behind a utility pole. This sign should be relocated for improved visibility.
- OUC discovered opportunities for additional lighting on all four intersection corners and will be making associated upgrades.

5.2.5 Miscellaneous Recommendations

The audit team also identified several miscellaneous recommendations within the corridor. These are summarized below:



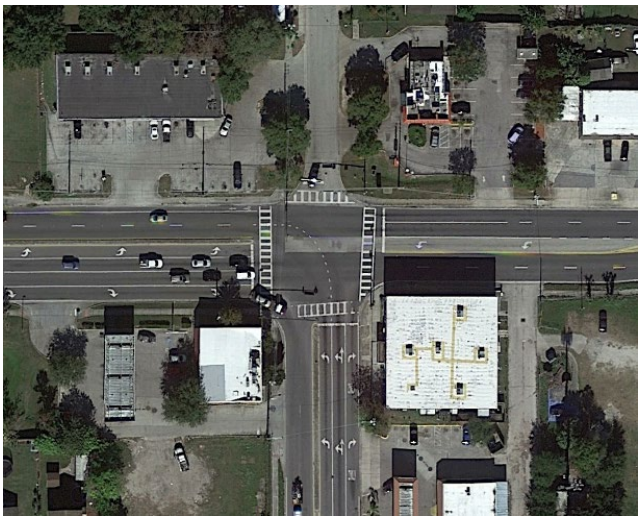
Narrow overgrown sidewalk on west side of Kirkman Road.

- The west side sidewalk is overgrown by vegetation in many places. This vegetation should be trimmed and potential modifications to the maintenance schedule should be considered.
- To improve corridor aesthetics and to provide more visual and physical separation between the roadway and the sidewalk, adding vegetation to the buffer should be considered, potentially in the form of a bioswale.
- The segment's buffered bike lanes were field measured at as narrow as 5-5.5 feet, which is below the standards identified in the *FDOT Design Manual*. Investigate opportunities to either narrow vehicular travel lanes or add pavement to widen buffered bike lanes to seven feet (five-foot lane with two-foot buffer).
- Detectable warning surfaces at several newer driveways along the corridor are oriented diagonally, which could direct vision-impaired pedestrians toward the roadway. These detectable warnings should be reconfigured.
- The signal phasing at the intersection with L B McLeod Road includes right turn overlap phases during which right turns and U-turns operate concurrently. Signing indicating the U-turns must yield to right turns should be added to mitigate this potential conflict.

Improperly installed blister strips detectable warnings for the visually impaired on sidewalk.

5.3 Columbia Street at Bruton Boulevard/Henton Lane Intersection

This location is an important community point at the intersection of the Richmond Heights, Washington Shores, and Johnson Village neighborhoods. The multimodal safety audit of this intersection yielded several recommendations.



Aerial of Columbia Street and Bruton Boulevard/Henton Lane intersection.

- The southern leg of the intersection has two receiving lanes for southbound traffic. Given the single lane configurations for the eastbound right, westbound left, and southbound through movements, two receiving lanes may not be necessary. Eliminating the outside receiving lane would allow for the construction of a curb extension. Such a feature would slow right turn speeds and shorten the crossing distance, thereby reducing pedestrian exposure and shortening the necessary pedestrian clearance interval.
- This intersection appears to be a good candidate for installation of a Leading Pedestrian Interval (LPI). LPIs activate the WALK symbol three to seven seconds before the parallel green for motorized traffic, thereby giving pedestrians a chance to establish themselves in the crosswalk before any turning movements occur.
- The median nose at the south leg could be extended to slow turning speeds.
- Orientation signs associated with pedestrian pushbuttons are mislabeled and should be corrected.
- To eliminate predominant turning conflicts, No Right Turn on Red blank-out signs for the eastbound and northbound approaches that illuminate when the pedestrian button is pushed should be considered. Similar pedestrian-activated Yield to Peds in Crosswalk blank out signs could also be considered for the intersection's left turn movements to alert motorists to the presence of pedestrians.
- In accordance with ADA best practices, separate curb ramps should be created for each directional crossing. At a minimum, detectable warning surfaces should be added to the ramps on the north side of the

Unclear, unseparated curb ramps.

intersection and the existing detectable warnings on the south side should be reoriented for parallel crossings.

- The eastbound bike lane on Columbia Street terminates on the approach to this intersection. Ideally, as a longer-term solution, this bike lane should be extended through the intersection and east on Columbia Street. In the meantime, adding a Bike Lane Ends sign would alert unexpecting bicyclists to this condition.
- In accordance with findings from the OUC photometric study, replace the existing light fixtures on all four intersection corners with LED fixtures.
- As a low-cost safety countermeasure, retroreflective backplates can improve safety for all users by reducing crashes caused by driver inattentiveness and lighting- or weather-related impacts on signal visibility. Such backplates should be considered for installation at this intersection.

5.4 Conroy Road at Vineland Road Intersection

Aerial view of Conroy Road and Vineland Road intersection.

Conroy Road and Vineland Road are both principal arterial roadways and the intersection is located approximately 600 feet from the I-4 / Conroy Road interchange, making it an important intersection for efficient traffic flow. While the immediately surrounding land uses generate limited bicycle and pedestrian trips, nonmotorized activity is still prevalent for longer trips and there are several opportunities to make this large auto-oriented intersection more accommodating of those users.

The following potential improvements are listed in priority order, generally from quick, easy, low-cost improvements to more complicated and higher cost:

- There are numerous issues with the push button orientation signs that need to be addressed:
  - Signs that are mismatched with their associated buttons
  - Signs that refer to the incorrect roadway being crossed
  - Signs missing orientation arrows under the street name
  - One missing sign at the northeast corner
- Similar to a recommendation for the Kirkman Road/Conroy Road intersection described above, pedestrian WALK intervals for all crossings should be maximized. Currently, the pedestrian clearance interval for the east-west crossing at the south leg if the intersection begins approximately 50 seconds earlier than needed based on the parallel green phase, which unnecessarily increases the likelihood that pedestrians will encounter delay at the intersection.

- As with the Columbia Street at Bruton Boulevard/Henton Lane intersection, retroreflective signal backplates should be considered to improve signal conspicuity, which can improve safety for all users by reducing crashes caused by driver inattentiveness and lighting- or weather-related impacts on signal visibility.
- Consideration should be given to reducing the width of the channelized right turn lanes at all four corners. The width of these lanes is 23 feet, which encourages high entry and exit speeds. Pending analysis of potential design vehicle-related considerations, these lanes should be narrowed.
- Another opportunity to slow right turn speeds is to redesign the channelized right turn lanes to flatten the approach angles. By bringing these turns much closer to a right-angle entry, motorists are forced to slow down to execute the turn and are more likely to focus their attention on locations where pedestrians may be present.
- Significant conflicts were observed between northbound right turning motorists and southbound left turning motorists interested in occupying the free-flow right turn receiving lane which becomes a drop lane at the I-4 westbound on-ramp only 350 feet downstream. Eliminating the northbound free-flow right turn lane and forcing the movement to stop on red would eliminate this common conflict. While doing so would increase both delay and the needed storage length for the northbound right turn, other operational and safety benefits may be achieved, and this potential modification should be studied for feasibility.

Mislabeled pedestrian crossing push-button signage.

- Consideration could be given for modifying the existing bike lanes on Vineland Road to buffered or separated bike lanes (at minimum on the immediate approaches to the intersection) and improving the intersection to incorporate protected intersection features including corner islands and recessed bike crossing areas. Since this would require significant modifications to the intersection, the overall value of this type of improvement should be considered compared to other potentially higher bicycle use areas of the City.

Consideration should be given to grouping these improvements together as a single project for advancement.

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